Massey Ferguson
135 148 Workshop Service Manual

Publication No 1856 027 M1 1856 002 M1

INTRODUCTION

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This Workshop Manual which is in loose leaf form for easy amendment, has been compiled to assist Massey-Ferguson Distributor and Dealer personnel to undertake routine maintenance and servicing, minor and major repairs, replacements, adjustments and out of season storage efficiently by the most straight forward method.

With this aim in mind, the Manual is divided into parts and sections, and each page bears the part and section number. This will make the required subject easier to find and the numbered operations will simplify cross reference.

REPAIRS AND REPLACEMENTS

When service parts are required it is essential that only genuine Massey-Ferguson replacements are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories.

Safety features embodied in the tractor may be impaired if other than genuine parts are fitted.

In certain territories, legislation prohibits the fitting of parts not to the tractor manufacturers specification.

Torque wrench setting figures given in the Workshop Manual must be strictly adhered to. Locking devices, where specified must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

The tractor warranty may be invalidated by the fitting of other than genuine Massey-Ferguson parts.

All Massey-Ferguson replacements have the full backing of the factory warranty.

Massey-Ferguson Distributors and Dealers are obliged to supply only genuine service parts.

Special Tools
The use of special tools mentioned in the text contributes to an efficient and profitable repair. Some operations are, in fact, impracticable without their use, particularly those, for example, which deal with the assembly of the differential unit. Distributors are therefore urged to check their tools against the list provided and order those necessary from: V. L. Churchill & Co. Ltd., London Road, Daventry, England.

Schedule of Repair Operations
The operations listed in the Repair Time Schedule refer to those described in this manual. The time set against each operation in the schedule is evolved by performing the actual operations on a standard tractor using special tools where stated. The Repair Time Schedule for use with this manual, is issued as a separate publication.

NOTE – SERVICE INFORMATION SHEETS AMENDMENT SHEETS AND REPAIR TIME SCHEDULES ARE ISSUED TO THE MASSEY-FERGUSON DISTRIBUTORS AND DEALERS ONLY AND ARE NOT FOR GENERAL PUBLICATION

Service Tools and Equipment
Where the use of a Service Tool is specified in an operation the tool number will be shown under the operation heading and also following the instruction requiring its use.

AMENDMENTS

To assist in identifying amendments on revised pages, two asterisks (**) or stars will be inserted at the beginning and the end of the amended paragraph, section, instruction or illustration.

To ensure that a record of amendments to this manual is available, this page will be re-issued with each set of revised pages. The amendment number, date of issue, appropriate instructions and revised page numbers will be quoted.

Revised pages must be inserted in place of existing pages carrying the same number and the old page discarded.

Additional pages or complete major assembly groups may be issued. In such cases the new pages must be inserted immediately following the existing pages carrying the next lowest number. Where the new pages are to be inter-leaved with existing pages, the new page numbers will carry a suffix letter, and these pages must be inserted as indicated by their numbers and suffixes.

Amendment No.	Date	Pages Issued

MF 135 AND MF 148 TRACTORS

Publication Numbers 1856 027 M1 and 1856 002 M1

The following amendment should be applied by hand to the pages indicated.

Page No.	Operation No.	Issue	Amendment
4B-06	4B-05-06	1	Delete from Item 3, Removal "centre thrust washer (53)". Delete from Item 4, Refitment "and thrust washer (53)".
4B-08	Fig. 14	1	Delete the thrust washer and the reference '53'.
4B-13	4B-11-10	1	Delete from Item 38, Disassembly "centre thrust washer (53)".
4B-14	4B-11-10	1	Delete from Item 21, Refitment "and thrust washer (53)".
7B-26	7B-13-26	1	Amend the torque figures in Item 5 to read "3,5 kg m (25 lb ft)".

The following additional information should be attached to page 4B-10.

MULTI-POWER REGULATOR VALVE
(From Serial Numbers – MF 135 – 404918
MF 148 – 600004)

Servicing

Special Tools Required – See operation 4B-03-05.

Disassembly

1. Remove the p.t.o. input housing as stated in operation 4B-03-05.
2. After removing the regulator from the input housing, remove the plug, adjacent to the feed pipe adapter, spring and ball.
3. Withdraw the large spool.
4. Remove the other plug washer, spring and spool.

Reassembly

1. Fit a new 'O' ring to the large spool.
2. Slide the spool into the spool block, then refit the ball, spring and plug.
3. Refit the small spool, spring, new washer and plug.
4. Tighten the plug to 2,75 kg m (20 lb ft).
5. Refit the p.t.o. input housing and p.t.o. input shaft as stated in operation 4B-03-05.

MF 135/148 TRACTOR

WORKSHOP SERVICE MANUAL

PART 4

Publication No. 1856 002 M2

AMENDMENT

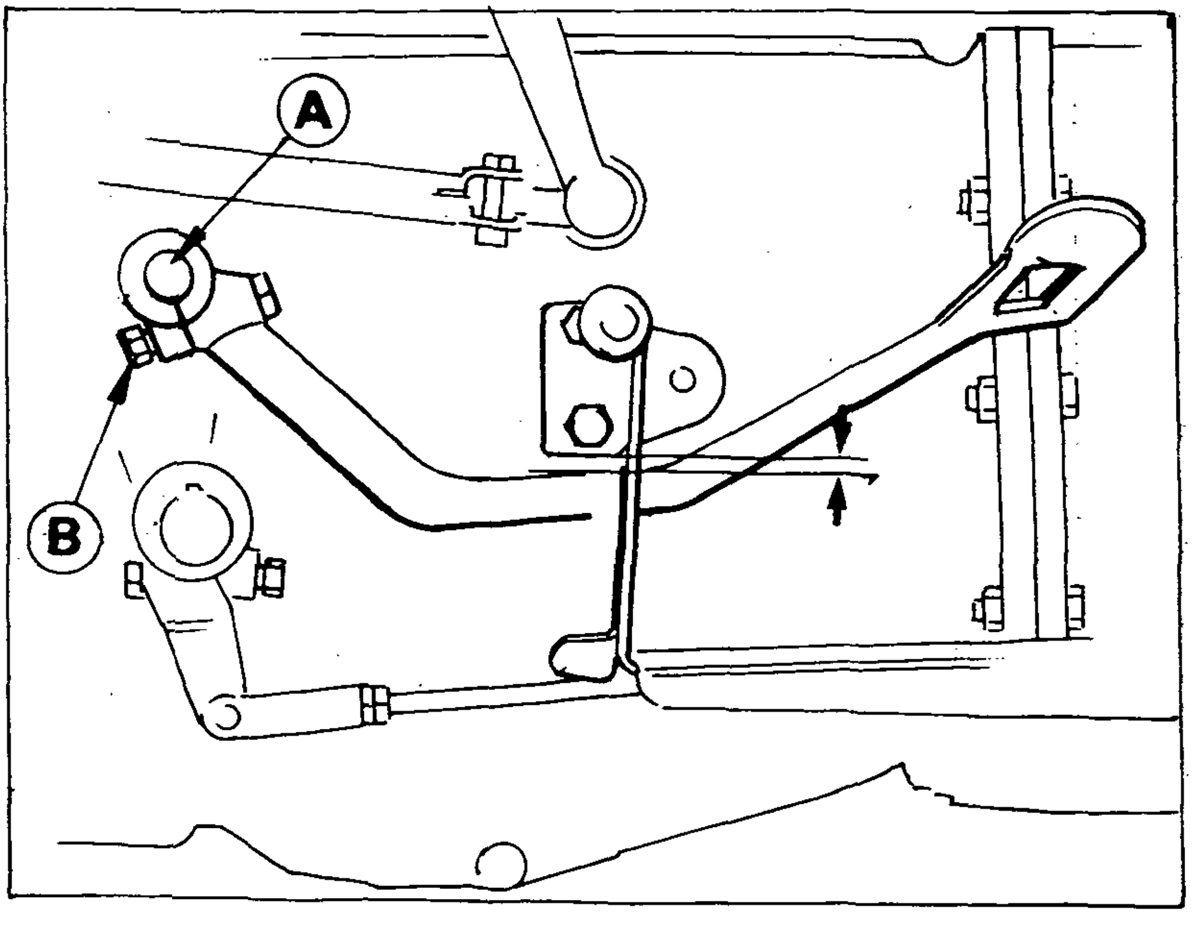
Page 4A–02 MAIN FRICTION DISC OR CLUTCH ASSEMBLY

Item 9. Fig. 9	Depress the clutch pedal until the distance between the arm and the transmission case is 3.2 mm (1/8 in). Retain the arm in this position and tighten the clamping bolt (B). Recheck the adjustment.

SHOULD READ:

Depress the clutch pedal until the distance between the arm and the transmission case is 11,11 mm (7/16 in). Retain the arm in this position and tighten the clamp bolt (B). Recheck the adjustment.

Illustration 9, Page 4A–06 should be replaced with the illustration below:



MF 148 TRACTOR

Publication No. 1856 002 M1

ADDENDUM

The following pages are amendments which should be applied by hand to the pages indicated

Page No.	Operation No.	Issue	Amendment
4B-05	4B-04-05	1	Add to Special Tools Required "MF 218A-2 Adapter".
4B-06	4B-04-05	1	Add to Item 3, Refitment "and adapter MF 218A-2".
4B-10	4B-11-10	1	Add to Special Tools Required "MF 218A-2 Adapter".
4B-17	4B-11-10	1	Add to Item 30, Refitment, "and adapter MF 218A-2".
4C-07	4C-04-07	1	Special Tools Required, amend "MF 265A" to read "MF 331".
			Item 4, Refitment, amend "MF 256A" to read "MF 331".
4C-08	4C-05-08	1	Add to Special Tools Required "MF 281A-2 Adapter". Add to Item 3, Refitment "and adapter MF 218A-2".
4C-08	4C-06-08	1	Add to Special Tools Required "MF 218A-2 Adapter". Add to Item 3, Refitment "and adapter. MF 218A-2".
4C-10	4C-11-10	1	Add to Special Tools Required "MF 218A-2 Adapter". Special Tools Required, amend "MF 256A" to read "MF 331".
4C-13	4C-11-10	1	Item 3, Reassembly, amend "MF 256A" to read "MF 331". Add to Item 25, Reassembly "and adapter MF 281-2".
5B-01	GENERAL	1	Amend "Figures" to read "1 and 2".
5B-11		1	Amend "Part 5 Section C" to read "Part 5 Section B".
5B-15	5B-12-15	1	Item 4, Disassembly, amend to read "Withdraw the selector shaft from the side cover".
			Item 1, Reassembly, delete all text and amend Item "2" to read Item "1" and so on.
7A-11		1	Pressure Control, line 3, amend "211" to read "179" and "3000" to read "2550".
7A-27	7A-12-27	1	Draft Control Rod, Item 3, amend "MF 333" to read "MF 271".
7A-32	7A-15-31	1	Item 8, Refitment, amend " 'O' rings" to read "gaskets".
7A-32	7A-15-32	1	Add between Items 2 and 3. Disassembly "2a. Remove the split pin securing the coupler (if fitted) to the camshaft and remove the coupler".
			Add between Items 10 and 11 Reassembly "10a. Refit the coupler (if fitted) to the camshaft and secure with a new split pin".

Page No.	Operation No.	Issue	Amendment
7B-02	GENERAL	1	Line 16, amend "28,6" to read "31,8" and "6.3" to read "7.0". Line 18, amend "14,1" to read "15,0" and "3.1" to read "3.3". Line 19, amend "42,7" to read "46,7" and "9.4" to read "10.3". Line 31, amend "211" to read "179" and "3000" to read "2550".
7B-02	7B-01-02	1	Removal, transpose Items 2 and 3. Refitment, transpose Items 2 and 3.
7B-17	CIRCUIT FLOWS	1	Lines 13 and 14, amend "211" to read "179" and "3000" to read "2550".
7B-31	HYDRAULIC TESTS	1	Below first paragraph add "Low Capacity Pump 7B-15-31". Relief Valve, Item 4 amend "500 to 550" to read "725 to 775". "46" to read "49". "650" to read "700". "2000" to read "2250". "53" to read "70" and "750" to read "1000". Multi-Power Operating Pressure, Item 4, amend "2000" to read "2550".
7B-31	7B-16-31	1	Multi-Power Relief Valve, Item 2, amend "500 to 550" to read "725 to 775". "46" to read "49". "650" to read "700". "2000" to read "2250". "53" to read "70" and "750" to read "1000". Multi-Power Flow Test, Item 5 amend "500 to 550" to read "725 to 775".
7B-32	7B-16-31	1	Filter By-Pass Valve, Item 4, amend "500 to 550" to read "725 to 775". Multi-Power Operating Pressure, Item 2, amend "2000" to read "2250". Flow Check, Item 3, amend "2000" to read "2250".

GENERAL INSTRUCTIONS

These instructions will be helpful in following the information in the Service Manual. In analysing a system malfunction, use this systematic procedure to locate and correct the problem.

1. Determine problem.
2. List possible causes.
3. Devise checks.
4. Conduct checks in logical order to determine cause.
5. Consider remaining service life against cost of parts and labour.
6. Make necessary repair.
7. Recheck.

SAFETY

Your safety and that of others is always the first consideration when working around machines. Safety is a matter of thoroughly understanding the job to be done and the application of good common sense. It is not just a matter of "do's" and don'ts".

CLEANLINESS

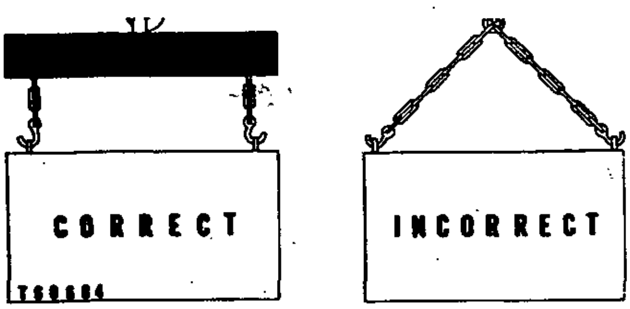
The most important single item in preserving the long life of the machine is to keep dirt out of vital working parts. Precautions have been taken to safeguard against this. Enclosed compartments, seals and filters have been provided to keep the supply of air, fuel and lubricants clean. These safeguards must be maintained. be maintained.

Whenever hydraulic, fuel, lubricating oil or air lines are disconnected, clean the point of disconnection as well as the adjacent area. As soon as the disconnection is made, cap, plug or tape the line or opening to prevent entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.

Clean and inspect all parts. Be sure all passages and holes are open. Cover all parts to keep them clean. Be sure parts are clean when they are installed. Leave new parts in their containers until ready for assembly.

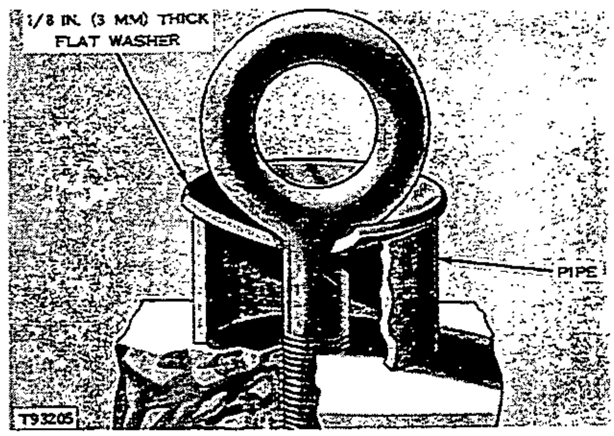
REMOVAL AND INSTALLATION

Unless otherwise specified, all removals should be accomplished using an adjustable lifting beam. All supporting members (chains and cables) should be parallel to each other and as near perpendicular as possible to the top of the object being lifted.



Correct and incorrect method of lifting a component

When removing a component on an angle, remember that the capacity of an eyebolt diminishes as the angle between the supporting members and the object becomes less than 90°. Eyebolts and brackets should never be bent and should only have stress in tension. A length of pipe and a washer can be used, as shown, to help relieve these stresses on eyebolts.



Forged eyebolt support

Some removals require the use of lifting fixtures to obtain proper balance and to provide safe handling.

Use a hoist to remove heavy parts.

If a part resists removal, check to be certain all nuts and bolts have been removed and that an adjacent part is not interfering.

DISASSEMBLY AND REASSEMBLY

When reassembling a machine, complete each step in turn. Do not partially assemble one part and start assembling some other part. Make all adjustments as recommended. Always check the job after it is completed to see nothing has been overlooked.

Recheck the various adjustments before returning the machine to the job.

PRESSING PARTS

When one part is pressed into another lubricate the mating surfaces.

Assemble tapered parts dry. Before assembling, be sure the tapers are clean, dry and free from burrs.

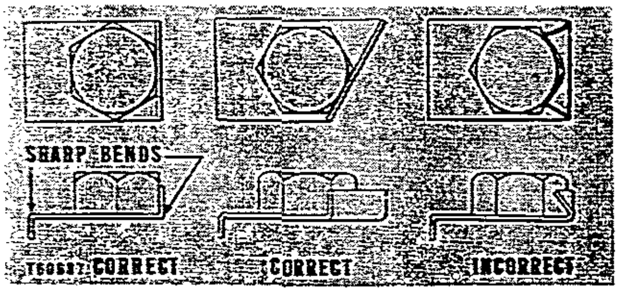
BOLTS AND BOLT TORQUE

Use bolts of the correct length. A bolt which is too long may "bottom" before the head is tight against *the part it is to hold. The threads can be damaged* when a "long" bolt is removed.

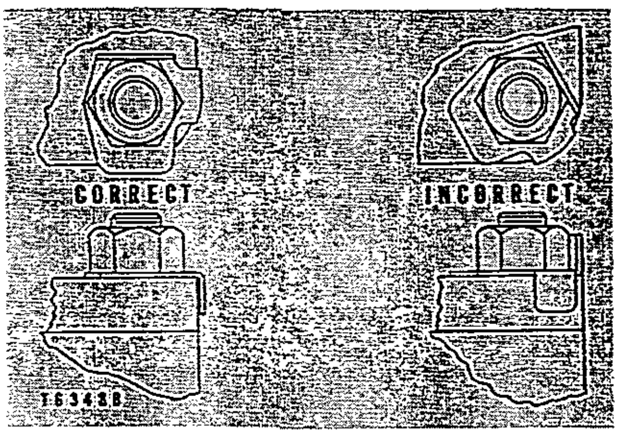
If a bolt is too short, there may not be enough threads engaged to hold the part securely.

Apply proper torque values to all bolts and nuts when re-assembling equipment. When a specific torque value is required, the value is listed in the text. Tighten all other bolts and nuts for general usage or taperlock studs to the torque values given in the charts at the front of the SPECIFICATION.

LOCKS



Correct and incorrect methods of installing flat metal locks.



Correct and incorrect method for lock positioning and bending.

Lockwashers, flat metal lock or cotter pins are used to lock nuts and bolts.

Flat metal locks must be installed properly to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head.

Always install new locks in compartments which house moving parts.

When installing lockwashers on housings made of aluminium, use a flat washer between the lockwasher and the housing.

CABLES AND WIRES

When removing or disconnecting a group of cables or wires, tag each one to assure proper assembly.

LUBRICATION

Where applicable, fill the compartments of the components serviced with the amount, type and grade of lubricant recommended in the Regular Maintenance Section (1B) of this Manual.

RUST PREVENTITIVE COMPOUND

Clean the rust preventitive compound from all machined surfaces of new parts before installing them.

SHIMS

When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are reinstalled.

BEARING BUSHES

Do not install bearing bushes with a hammer. Use a press if possible and be sure to apply the pressure directly in line with the bore. If necessary, drive on a bearing using a bearing driver or a bar with a smooth flat end. If a sleeve bearing has an oil hole, align it with the oil hole in the mating part.

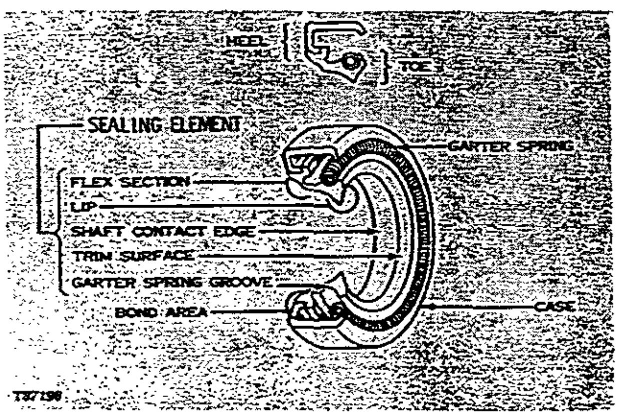
GASKETS

Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If gaskets are to be made, select material of the proper type and thickness. Be sure to cut holes in the right places. Blank gaskets can cause serious damage.

LIP-TYPE RUBBER SEALS

Lubricate the lips of lip-type rubber seals before installation. Use petroleum jelly. Do not use grease on any seal except a grease seal.

The main parts of a lip-type seal are the case, sealing element, and garter spring. The picture below illustrates the construction of a simple lip-type seal. The cross section at the top shows the terms "heel" and "toe" used to identify the sides of a single element seal. With few exceptions, the toe of an oil seal with one lip is next to the lubricant that is sealed. Some seals have a second auxiliary lip, which does not carry a garter spring.



Lip-type seal construction.

If, during installation, the seal lip must pass over a shaft that has splines, a keyway, rough surface or a sharp edge, the lip can be easily damaged. Always use a seal protector, when one is provided.

CONVERSION TABLES

INCHES	DECIMALS	MILLIMETRES
1/64	.015625	.3969
1/32	.03125	.7937
3/64	.046875	1.1906
1/16	.0625	1.5875
5/64	.078125	1.9844
3/32	.09375	2.3812
7/64	.109375	2.7781
1/8	.125	3.1750
9/64	.140625	3.5719
5/32	.15625	3.9687
11/64	.171875	4.3656
3/16	.1875	4.7625
13/64	.203125	5.1594
7/32	.21875	5.5562
15/64	.234375	5.9531
1/4	.25	6.3500
17/64	.265625	6.7469
9/32	.28125	7.1437
19/64	.296875	7.5406
5/16	.3125	7.9375
21/64	.328125	8.3344
11/32	.34375	8.7312
23/64	.359375	9.1281
3/8	.375	9.5250
25/64	.390625	9.9219
13/32	.40625	10.3187
27/64	.421875	10.7156
7/16	.4375	11.1125
29/64	.453125	11.5094
15/32	.46875	11.9062
31/64	.484375	12.3031
1/2	.5	12.7000
33/64	.515625	13.0969
17/32	.53125	13.4937
35/64	.546875	13.8906
9/16	.5625	14.2875
37/64	.578125	14.6844
19/32	.59375	15.0812
39/64	.609375	15.4781
5/8	.625	15.8750
41/64	.640625	16.2719
21/32	.65625	16.6687
43/64	.671875	17.0656
11/16	.6875	17.4625
45/64	.703125	17.8594
23/32	.71875	18.2562
47/64	.734375	18.6531
3/4	.75	19.0500
49/64	.765625	19.4469
25/32	.78125	19.8437
51/64	.796875	20.2406
13/16	.8125	20.6375
53/64	.828125	21.0344
27/32	.84375	21.4312
55/64	.859375	21.8281
7/8	.875	22.2250
57/64	.890625	22.6219
29/32	.90625	23.0187
59/64	.921875	23.4156
15/16	.9375	23.8125
61/64	.953125	24.2094
31/32	.96875	24.4062
63/64	.984375	25.0031

INCHES TO MILLIMETRES

Inches	Millimetres
.0001	.00254
.0002	.00508
.0003	.00762
.0004	.01016
.0005	.01270
.0006	.01524
.0007	.01778
.0008	.02032
.0009	.02286
.001	.0254
.002	.0508
.003	.0762
.004	.1016
.005	.1270
.006	.1524
.007	.1778
.008	.2032
.009	.2286
.01	.254
.02	.508
.03	.762
.04	1.016
.05	1.270
.06	1.524
.07	1.778
.08	2.032
.09	2.286
.1	2.54
.2	5.08
.3	7.62
.4	10.16
.5	12.70
.6	15.24
.7	17.78
.8	20.32
.9	22.86
1	25.4
2	50.8
3	76.2
4	101.6
5	127.0
6	152.4
7	177.8
8	203.2
9	228.6
10	254.0
11	279.4
12	304.8
13	330.2
14	355.6
15	381.0
16	406.4
17	431.8
18	457.2
19	482.6
20	508.0
21	533.4
22	550.8
23	584.2
24	609.6
25	635.0
26	660.4

MILLIMETRES TO INCHES

mm	inches
0.001	.000039
0.002	.000079
0.003	.000118
0.004	.000157
0.005	.000197
0.006	.000236
0.007	.000276
0.008	.000315
0.009	.000354
0.01	.00039
0.02	.00079
0.03	.00118
0.04	.00157
0.05	.00197
0.06	.00236
0.07	.00276
0.08	.00315
0.09	.00354
0.1	.00394
0.2	.00787
0.3	.01181
0.4	.01575
0.5	.01969
0.6	.02362
0.7	.02756
0.8	.03150
0.9	.03543
1	.03937
2	.07874
3	.11811
4	.15748
5	.19685
6	.23622
7	.27559
8	.31496
9	.35433
10	.39370
11	.43307
12	.47244
13	.51181
14	.55118
15	.59055
16	.62992
17	.66929
18	.70866
19	.74803
20	.78740
21	.82677
22	.86614
23	.90551
24	.94480
25	.98425
26	1.02362
27	1.06299
28	1.10236
29	1.14173
30	1.18110
31	1.22047
32	1.25984
33	1.29921
34	1.33858
35	1.37795
36	1.41732
37	1.45669
38	1.49606
39	1.53543
40	1.57480

FAHRENHEIT & CENTIGRADE

°F	°C	°C	°F
−20	−28.9	−30	−22
−15	−26.1	−28	−18.4
−10	−23.3	−26	−14.8
− 5	−20.6	−24	−11.2
0	−17.8	−22	− 7.6
1	−17.2	−20	− 4
2	−16.7	−18	− 0.4
3	−16.1	−16	3.2
4	−15.6	−14	6.8
5	−15.0	−12	10.4
10	−12.2	−10	14
15	− 9.4	− 8	17.6
20	− 6.7	− 6	21.2
25	− 3.9	− 4	24.8
30	− 1.1	− 2	28.4
35	1.7	0	32
40	4.4	2	35.6
45	7.2	4	39.2
50	10.0	6	42.8
55	12.8	8	46.4
60	15.6	10	50
65	18.3	12	53.6
70	21.1	14	57.2
75	23.9	16	60.8
80	26.7	18	64.4
85	29.4	20	68
90	32.2	22	71.6
95	35.0	24	75.2
100	37.8	26	78.8
105	40.6	28	82.4
110	43.3	30	86
115	46.1	32	89.6
120	48.9	34	93.2
125	51.7	36	96.8
130	54.4	38	100.4
135	57.2	40	104
140	60.0	42	107.6
145	62.8	44	112.2
150	65.6	46	114.8
155	68.3	48	118.4
160	71.1	50	122
165	73.9	52	125.6
170	76.7	54	129.2
175	79.4	56	132.8
180	82.2	58	136.4
185	85.0	60	140
190	87.8	62	143.6
195	90.6	64	147.2
200	93.3	66	150.8
205	96.1	68	154.4
210	98.9	70	158
212	100.0	75	167
215	101.7	80	176
220	104.4	85	185
225	107.2	90	194
230	110.0	95	203
235	112.8	100	212
240	115.6	105	221
245	118.3	110	230
250	121.1	115	239

INCHES TO CENTIMETERS

	0	1	2	3	4	5	6	7	8	9	
–	–	2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86	–
10	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26	10
20	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66	20
30	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06	30
40	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46	40
50	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86	50
60	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26	60
70	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66	70
80	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06	80
90	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46	90

FEET TO METRES

	0	1	2	3	4	5	6	7	8	9	
-	–	0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	–
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6,096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90

SQUARE INCHES TO SQUARE CENTIMETRES

	0	1	2	3	4	5	6	7	8	9	
-	–	6.452	12.903	19.355	25.807	32.258	38.710	45.161	51.613	58.065	–
10	64.516	70.968	77.420	83.871	90.323	96.774	103.226	109.678	116.129	122.581	10
20	129.033	135.484	141.936	148.387	154.839	161.291	167.742	174.194	180.646	187.097	20
30	193.549	200.000	206.452	212.904	219.355	225.807	232.259	238.710	245.162	251.613	30
40	258.065	264.517	270.968	277.420	283.871	290.323	296.775	303.226	309.678	316.130	40
50	322.581	329.033	335.485	341.936	348.388	354.839	361.291	367.743	374.194	380.646	50
60	387.098	393.549	400.001	406.452	412.904	419.356	425.807	432.259	438.711	445.162	60
70	451.614	458.065	464.517	470.969	477.420	483.872	490.324	496.775	503.227	509.678	70
80	516.130	522.582	529.033	535.485	541.937	548.388	554.840	561.291	567.743	574.195	80
90	580.646	587.098	593.550	600.001	606.453	612.904	619.356	625.808	632.259	638.711	90

CUBIC INCHES TO CUBIC CENTIMETERS

	0	1	2	3	4	5	6	7	8	9	
-	–	16.387	32.774	49.162	65.549	81.936	98.323	114.710	131.097	147.484	–
10	163.872	180.259	196.646	213.033	229.420	245.808	262.195	278.582	294.969	311.356	10
20	327.743	344.130	360.518	376.905	393.292	409.679	426.066	442.453	458.841	475.228	20
30	491.615	508.002	524.389	540.776	557.164	573.551	589.938	606.325	622.712	639.099	30
40	655.486	671.874	688.261	704.648	721.035	737.422	753.809	770.197	786.584	802.971	40
50	819.358	835.745	852.132	868.520	884.907	901.294	917.681	934.068	950.455	966.843	50
60	983.230	999.617	1016.004	1032.391	1048.778	1065.166	1081.553	1097.940	1114.327	1130.714	60
70	1147.101	1163.489	1179.876	1196.263	1212.650	1229.037	1245.424	1261.811	1278.199	1294.586	70
80	1310.973	1327.360	1343.747	1360.134	1376.522	1392.909	1409.296	1425.683	1442.070	1458.457	80
90	1474.845	1491.232	1507.619	1524.006	1540.393	1556.780	1573.168	1589.555	1605.942	1622.329	90

CONVERSION TABLES

CENTIMETRES TO INCHES

	0	1	2	3	4	5	6	7	8	9	
	–	0.3937	0.7874	1.1811	1.5748	1.9685	2.3622	2.7559	3.1496	3.5433	–
10	3.9370	4.3307	4.7244	5.1181	5.5118	5.9055	6.2992	6.6929	7.0866	7.4803	10
20	7.8740	8.2677	8.6614	9.0551	9.4488	9.8425	10.2362	10.6299	11.0236	11.4173	20
30	11.8110	12.2047	12.5984	12.9921	13.3858	13.7795	14.1732	14.5669	14.9606	15.3543	30
40	15.7480	16.1417	16.5354	16.9291	17.3228	17.7165	18.1102	18.5039	18.8976	19.2913	40
50	19.6850	20.0787	20.4724	20.8661	21.2598	21.6535	22.0472	22.4409	22.8346	23.2283	50
60	23.6220	24.0157	24.4094	24.8031	25.1968	25.5905	25.9842	26.3779	26.7716	27.1653	60
70	27.5590	27.9527	28.3464	28.7401	29.1338	29.5275	29.9212	30.3149	30.7086	31.1023	70
80	31.4960	31.8897	32.2834	32.6771	33.0708	33.4645	33.8582	34.2519	34.6456	35.0393	80
90	35.4330	35.8267	36.2204	36.6141	37.0078	37.4015	37.7952	38.1889	38.5826	38.9763	90

METRES TO FEET

	0	1	2	3	4	5	6	7	8	9	
—	–	3.2808	6.5617	9.8425	13.1233	16.4042	19.6850	22.9658	26.2467	29.5275	–
10	32.8083	36.0892	39.3700	42.6508	45.9317	49.2125	52.4933	55.7742	59.0550	62.3358	10
20	65.6167	68.8975	72.1783	75.4592	78.7400	82.0208	85.3017	88.5825	91.8633	95.1442	20
30	98.4250	101.7058	104.9867	108.2675	111.5483	114.8292	118.1100	121.3908	124.6717	127.9525	30
40	131.2333	134.5142	137.7950	141.0758	144.3567	146.6375	150.9183	154.1992	157.4800	160.7608	40
50	164.0417	167.3225	170.6033	173.8841	177.1650	180.4458	183.7266	187.0075	190.2883	193.5691	50
60	196.8500	200.1308	203.4116	206.6925	209.9733	213.2541	216.5350	219.8158	223.0966	226.3775	60
70	229.6583	232.9391	236.2200	239.5008	242.7816	246.0625	249.3433	252.6241	255.9050	259.1858	70
80	262.4666	265.7475	269.0283	272.3091	275.5900	278.8708	282.1516	285.4325	288.7133	281.9941	80
90	295.2750	298.5558	301.8366	305.1175	308.3983	311.6791	314.9600	318.2408	321.5216	324.8025	90

SQUARE CENTIMETRES TO SQUARE INCHES

	0	1	2	3	4	5	6	7	8	9	
–	–	0.1550	0.3100	0.4650	0.6200	0.7750	0.9300	1.0850	1.2400	1.3950	–
10	1.5500	1.7050	1.8600	2.0150	2.1700	2.3250	2.4800	2.6350	2.7900	2.9450	10
20	3.1000	3.2550	3.4100	3.5650	3.7200	3.8750	4.0300	4.1850	4.3400	4.4950	20
30	4.6500	4.8050	4.9600	5.1150	5.2700	5.4250	5.5800	5.7350	5.8900	6.0450	30
40	6.2000	6.3550	6.5100	5.6650	6.8200	6.9750	7.1300	7.2850	7.4400	7.5950	40
50	7.7500	7.9050	8.0600	8.2150	8.3700	8.5250	8.6800	8.8350	8.9900	9.1450	50
60	9.3000	9.4550	9.6100	9.7650	9.9200	10.0750	10.2300	10.3850	10.5400	10.6950	60
70	10.8500	11.0050	11.1600	11.3150	11.4700	11.6250	11.7800	11.9350	12.0900	12.2450	70
80	12.4000	12.5550	12.7100	12.8650	13.0200	13.1750	13.3300	13.4850	13.6400	13.7950	80
90	13.9500	14.1050	14.2600	14.4150	14.5700	14.7250	14.8800	15.0350	15.1900	15.3450	90

CUBIC CENTIMETRES TO CUBIC INCHES

	0	1	2	3	4	5	6	7	8	9	
—	–	0.0610	0.1220	0.1831	0.2441	0.3051	0.3661	0.4272	0.4882	0.5492	–
10	0.6102	0.6713	0.7323	0.7933	0.8543	0.9154	0.9764	1.0374	1.0984	1.1594	10
20	1.2205	1.2815	1.3425	1.4035	1.4646	1.5256	1.5866	1.6476	1.7086	1.7697	20
30	1.8307	1.8917	1.9527	2.0138	2.0748	2.1358	2.1968	2.2579	2.3189	2.3799	30
40	2.4409	2.5020	2.5630	2.6240	2.6850	2.7461	2.8071	2.8681	2.9291	2.9901	40
50	3.0512	3.1122	3.1732	3.2342	3.2953	3.3563	3.4173	3.4783	3.5394	3.6004	50
60	3.6614	3.7224	3.7834	3.8445	3.9055	3.9665	4.0275	4.0886	4.1496	4.2106	60
70	4.2716	4.3327	4.3937	4.4547	4.5157	4.5768	4.6378	4.6988	4.7598	4.8208	70
80	4.8819	4.9429	5.0039	5.0649	5.1260	5.1870	5.2480	5.3090	5.3701	5.4311	80
90	5.4921	5.5531	5.6142	5.6752	5.7362	5.7972	5.8582	5.9193	5.9803	6.0413	90

POUNDS TO KILOGRAMS

	0	1	2	3	4	5	6	7	8	9	
–	–	0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	–
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.968	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38.855	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.731	42.184	42.638	43.091	43.545	43.998	44.452	44.906	90

LBS PER SQUARE INCHES TO KGS. PER SQUARE CENTIMETRE

	0	1	2	3	4	5	6	7	8	9	
–	–	0.070	0.141	0.211	0.281	0.352	0.422	0.492	0.562	0.633	–
10	0.703	0.773	0.844	0.914	0.984	1.055	1.125	1.195	1.266	1.336	10
20	1.406	1.476	1.547	1.617	1.687	1.758	1.828	1.898	1.969	2.039	20
30	2.109	2.179	2.250	2.320	2.390	2.461	2.531	2.601	2.672	2.742	30
40	2.812	2.883	2.953	3.023	3.093	3.164	3.234	3.304	3.375	3.445	40
50	3.515	3.586	3.656	3.726	3.797	3.867	3.937	4.007	4.078	4.148	50
60	4.218	4.289	4.359	4.429	4.500	4.570	4.640	4.711	4.781	4.851	60
70	4.921	4.992	5.062	5.132	5.203	5.273	5.343	5.414	5.484	5.554	70
80	5.624	5.695	5.765	5.835	5.906	5.976	6.046	6.117	6.187	6.257	80
90	6.328	6.398	6.468	6.538	6.609	6.679	6.749	6.820	6.890	6.960	90

FOOT LBS. TO KILOGRAM METRES

	0	1	2	3	4	5	6	7	8	9	
–	–	0.138	0.277	0.415	0.553	0.691	0.830	0.968	1.106	1.244	–
10	1.383	1.521	1.659	1.797	1.936	2.074	2.212	2.350	2.489	2.627	10
20	2.765	2.903	3.042	3.180	3.318	3.456	3.595	3.733	3.871	4.009	20
30	4.148	4.286	4.424	4.562	4.701	4.839	4.977	5.116	5.254	5.392	30
40	5.530	5.668	5.807	5.945	6.083	6.221	6.360	6.498	6.636	6.774	40
50	6.913	7.051	7.189	7.328	7.466	7.604	7.742	7.881	8.019	8.157	50
60	8.295	8.434	8.572	8.710	8.848	8.987	9.125	9.263	9.401	9.540	60
70	9.678	9.816	9.954	10.093	10.231	10.369	10.507	10.646	10.784	10.922	70
80	11.060	11.199	11.337	11.475	11.613	11.752	11.890	12.028	12.166	12.305	80
90	12.443	12.581	12.719	12.858	12.996	13.134	13.272	13.411	13.549	13.687	90

KILOGRAMS TO POUNDS

	0	1	2	3	4	5	6	7	8	9	
–	–	2.2046	4.4092	6.6139	8.8185	11.0231	13.2277	15.4324	17.6370	19.8416	–
10	22.0462	24.2508	26.4555	28.6601	30.8647	33.0693	35.2740	37.4786	39.6832	41.8878	10
20	44.0924	46.2971	48.5017	50.7063	52.9109	55.1156	57.3202	59.5248	61.7294	63.9340	20
30	66.1387	68.3433	70.5479	72.7525	74.9572	77.1618	79.3664	81.5710	83.7756	85.9803	30
40	88.1849	90.3895	92.5941	94.7988	97.0034	99.2080	101.4126	103.6172	105.8219	108.0265	40
50	110.2311	112.4357	114.6404	116.8450	119.0496	121.2542	123.4589	125.6635	127.8681	130.0727	50
60	132.2773	134.4820	136.6866	138.8912	141.0958	143.3005	145.5051	147.7097	149.9143	152.1189	60
70	154.3236	156.5282	158.7328	160.9374	163.1421	165.3467	167.5513	169.7559	171.9605	174.1652	70
80	176.3698	178.5744	180.7790	182.9837	185.1883	187.3929	189.5975	191.8021	194.0068	196.2114	80
90	198.4160	200.6206	202.8253	205.0299	207.2345	209.4391	211.6437	213.8484	216.0530	218.2576	90

KILOGRAMS PER SQUARE CENTIMETRE TO POUNDS PER SQUARE INCH

	0	1	2	3	4	5	6	7	8	9	
–	–	14.2235	28.4471	42.6706	56.8941	71.1177	85.3412	99.5647	113.7883	128.0118	–
10	142.2353	156.4589	170.6824	184.9059	199.1295	213.3530	227.5765	241.8001	256.0236	270.2471	10
20	284.4707	298.6942	312.9177	327.1413	341.3648	355.5883	369.8119	384.0354	398.2589	412.4825	20
30	426.7060	440.9295	455.1531	469.3766	483.6001	497.8237	512.0472	526.2707	540.4943	554.7178	30
40	568.9413	583.1649	597.3884	611.6119	625.8355	640.0590	654.2825	668.5061	682.7296	696.9531	40
50	711.1767	725.4002	739.6237	753.8472	768.0708	782.2943	796.5178	810.7414	824.9649	839.1884	50
60	853.4120	867.6355	881.8590	896.0826	910.3061	924.5296	938.7532	952.9767	967.2002	981.4238	60
70	995.6473	1009.8708	1024.0944	1038 3180	1052.5414	1066.7650	1080.9885	1095.2120	1109.4356	1123.6591	70
80	1137.8826	1152.1062	1166.3297	1180.5532	1194.7768	1209.0003	1223.2238	1237.4474	1251.6709	1265.8944	80
90	1280.1180	1294.3415	1308.5650	1322.7886	1337.0121	1351.2356	1365.4592	1379.6827	1393.0962	1408.1298	90

KILOGRAM METRE TO FOOT POUNDS

	0	1	2	3	4	5	6	7	8	9	
–	–	7.2330	14.4660	21.6990	28.9320	36.1651	43.3981	50.6311	57.8641	65.0971	–
10	72.3301	79.5631	86.7961	94.0291	101.2622	108.4952	115.7282	122.9612	130.1942	137.4272	10
20	144.6602	151.8932	159.1262	166.3593	173.5923	180.8253	188.0583	195.2913	202.5243	209.7573	20
30	216.9903	224.2233	231.4564	238.6894	245.9224	253.1554	260.3884	267.6214	274.8544	282.0874	30
40	289.3204	296.5535	303.7865	311.0195	318.2525	325.4855	332.7185	339.9515	347.1845	354.4175	40
50	361.6506	368.8836	376.1166	383.3496	390.5825	397.8156	405.0486	412.2816	419.5146	426.7476	50
60	433.9807	441.2137	448.4467	455.6797	462.9127	470.1457	477.3787	484.6117	491.8447	499.9778	60
70	506.3108	513.5438	520.7768	528.0098	535.2428	542.4758	549.7088	556.9418	564.1749	571.4079	70
80	578.6409	585.8739	593.1069	600.3399	607.5729	614.8059	622.0389	629.2720	636.5050	643.7380	80
90	650.9710	658.2040	665.4370	672.6700	679.9030	687.1360	694.3691	701.6021	708.8351	716.0681	90

LITRES TO GALLONS (IMPERIAL)

	0	1	2	3	4	5	6	7	8	9	
–	–	0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5399	1.7598	1.9798	–
10	2.1998	2.4198	2.6398	2.8597	3.0797	3.2997	3.5197	3.7397	3.9596	4.1796	10
20	4.3996	4.6196	4.8396	5.0595	5.2795	5.4995	5.7195	5.9395	6.1594	6.3794	20
30	6.5994	6.8194	7.0394	7.2593	7.4793	7.6993	7.9193	8.1393	8.3592	8.5792	30
40	8.7992	9.0192	9.2392	9.4591	9.6791	9.8991	10.1191	10.3391	10.5590	10.7790	40
50	10.9990	11.2190	11.4390	11.6589	11.8789	12.0989	12.3189	12.5389	12.7588	12.9788	50
60	13.1988	13.4188	13.6388	13.8587	14.0787	14.2987	14.5187	14.7387	14.9586	15.1786	60
70	15.3986	15.6186	15.8386	16.0595	16.2785	16.4985	16.7185	16.9385	17.1584	17.3784	70
80	17.5984	17.8184	18.0384	18.2583	18.4783	18.6983	18.9183	19.1383	19.3582	19.5782	80
90	19.7982	20.0182	20.2382	20.4581	20.6781	20.8981	21.1181	21.3381	21.5580	21.7780	90

LITRES PER 100 KILOMETRES TO MILES PER GALLON (IMPERIAL)

4	70.62	6	47.08	8	35.31	10	28.25	12	23.54	14	20.18	17.5	16.14	22.5	12.55	27.5	10.27	32.5	8.69
4.2	67.26	6.2	45.56	8.2	34.45	10.2	27.69	12.2	23.15	14.2	19.89	18	15.69	23	12.28	28	10.09	33	8.56
4.4	64.20	6.4	44.14	8.4	33.63	10.4	27.16	12.4	22.78	14.4	19.62	18.5	15.27	23.5	12.02	28.5	9.91	33.5	8.43
4.6	61.41	6.6	42.80	8.6	32.85	10.6	26.65	12.6	22.42	14.6	19.35	19	14.87	24	11.77	29	9.74	34	8.31
4.8	58.85	6.8	41.54	8.8	32.10	10.8	26.15	12.8	22.07	14.8	19.09	19.5	14.49	24.5	11.53	29.5	9.58	34.5	8.19
5	56.49	7	40.35	9	31.39	11	25.68	13	21.73	15	18.83	20	14.12	25	11.30	30	9.42	35	8.07
5.2	54.32	7.2	39.23	9.2	30.70	11.2	25.22	13.2	21.40	15.5	18.22	20.5	13.78	25.5	11.08	30.5	9.26	35.5	7.96
5.4	52.31	7.4	38.17	9.4	30.05	11.4	24.78	13.4	21.08	16	17.65	21	13.45	26	10.86	31	9.11	36	7.85
5.6	50.44	7.6	37.17	9.6	29.42	11.6	24.35	13.6	20.77	16.5	17.12	21.5	13.14	26.5	10.66	31.5	8.97	36.5	7.74
5.8	48.70	7.8	36.21	9.8	28.82	11.8	23.94	13.8	20.47	17	16.62	22	12.84	27	10.46	32	8.83	37	7.63

GALLONS (IMP.) TO LITRES

	0	1	2	3	4	5	6	7	8	9	
–	–	4.546	9.092	13.638	18.184	22.730	27.276	31.822	36.368	40.914	–
10	45.460	50.005	54.551	59.097	63.643	68.189	72.735	77.281	81.827	86.373	10
20	90.919	95.465	100.011	104.557	109.103	113.649	118.195	122.741	127.287	131.833	20
30	136.379	140.924	145.470	150.016	154.562	159.108	163.654	168.200	172.746	177.292	30
40	181.838	186.384	190.930	195.476	200.022	204.568	209.114	213.660	218.206	222.752	40
50	227.298	231.843	236.389	240.935	245.481	250.027	254.573	259.119	263.665	268.211	50
60	272.757	277.303	281.849	286.395	290.941	295.487	300.033	304.579	309.125	313.671	60
70	318.217	322.762	327.308	331.854	336.400	340.946	345.492	350.038	354.584	359.130	70
80	363.676	368.222	372.768	377.314	381.860	386.405	390.952	395.498	400.044	404.590	80
90	409.136	413.681	418.227	422.773	427.319	431.865	436.411	440.957	445.503	450.049	90

MILES PER GALLON (IMP.) TO LITRES PER 100 KILOMETRES

10	28.25	15	18.83	20	14.12	25	11.30	30	9.42	35	8.07	40	7.06	50	5.65	60	4.71	70	4.04
10½	26.90	15½	18.22	20½	13.78	25½	11.08	30½	9.26	35½	7.96	41	6.89	51	5.54	61	4.63	71	3.98
11	25.68	16	17.66	21	13.45	26	10.87	31	9.11	36	7.85	42	6.73	52	5.43	62	4.55	72	3.92
11½	24.56	16½	17.12	21½	13.14	26½	10.66	31½	8.97	36½	7.74	43	6.57	53	5.33	63	4.48	73	3.87
12	23.54	17	16.61	22	12.84	27	10.46	32	8.83	37	7.63	44	6.42	54	5.23	64	4.41	74	3.82
12½	22.60	17½	16.14	22½	12.55	27½	10.27	32½	8.69	37½	7.53	45	6.28	55	5.13	65	4.35	75	3.77
13	21.73	18	15.69	23	12.28	28	10.09	33	8.56	38	7.43	46	6.14	56	5.04	66	4.28	76	3.72
13½	20.92	18½	15.27	23½	12.02	28½	9.91	33½	8.43	38½	7.34	47	6.01	57	4.96	67	4.22	77	3.67
14	20.18	19	14.87	24	11.77	29	9.74	34	8.31	39	7.24	48	5.89	58	4.87	68	4.16	78	3.62
14½	19.48	19½	14.49	24½	11.53	29½	9.58	34½	8.19	39½	7.15	49	5.77	59	4.79	69	4.10	79	3.57

SCREW THREADS

BSW
(British Std. Whitworth)

Size	Threads per Inch	Tapping Drill
3/16	24	9/64
1/4	20	3/16
5/16	18	1/4
3/8	16	19/64
7/16	14	23.64
1/2	12	25/64
9/16	12	29/64
5/8	11	1/2
11/16	11	37/64
3/4	10	5/8

BSP
(British Std. Pipe) (Gas)

Size	Diameter	Threads per Inch	Tapping Drill
1/8	.383	28	11/32
1/4	.518	19	15/32
3/8	.656	19	19/32
1/2	.825	14	3/4
5/8	.902	14	53/64
3/4	1.041	14	31/32
7/8	1.189	14	1–7/64
1	1.309	11	1–13/64

BSF
(British Std. Fine)

Size	Threads per Inch	Tapping Drill
7/32	28	11/64
1/4	26	13/64
9/32	26	15/64
5/16	22	1/4
3/8	20	5/16
7/16	18	23/64
1/2	16	27/64
9/16	16	31/64
5/8	14	17/32
11/16	14	19/32
3/4	12	41/64

BA
(British Association)

Size	Diameter	Threads per Inch	Tapping Drill
0	.236	25.4	7
1	.209	28.2	16
2	.185	31.4	22
3	.161	34.8	29
4	.142	38.5	31
5	.126	43.1	36
6	.110	47.9	42
7	.098	52.9	45
8	.087	59.2	49
9	.075	64.9	52
10	.067	72.5	54

CONVERSION TABLES

UNC
(Unified Coarse)

Size	Diameter	Threads per Inch	Tapping Drill
(No. 4)	.1120	40	42 or 44
(No. 6)	.1380	32	7.64
(No. 8)	.1640	32	29
(No. 10)	.1900	24	24 or 26
	1/4	20	13/64
	5/16	18	17/64
	3/8	16	5/16
	7/16	14	U
	1/2	13	27/64

UNF
(Unified Fine)

Size	Diameter	Threads per Inch	Tapping Drill
(No. 10)	190	32	5/32
	1/4	28	3
	5/16	24	1
	3/8	24	21/64
	7/16	20	25/64
	1/2	20	29/64
	9/16	18	13 mm (.5118 in)
	5/8	18	14.5 mm (.5709 in)
	3/4	16	11/16

SELF TAPPING SCREWS

Size		Tapping Drill
No. 2	FOR 20 SWG SHEET	49
No. 4		39
No. 6		35
No. 8		31
No. 10		27
No. 12		19
No. 14		11

Spanner Sizes for unified Nuts and Bolts
Measured across the Flats (A/F)

Bolt diameter		¼	5/16	3/8	7/16
Spanner Sizes	Nuts	7/16	½	9/16	11/16*
	Bolts	7/16	½	9/16	5/8
Bolt diameter		½	9/16*	5/8	¾
Spanner Sizes	Nuts	¾	7/8	13/16	1 1/8
	Bolts	¾	13/16	13/16	1 1/8

**Note variation in Nut and Bolt Head sizes.*

RECOMMENDED SPECIAL TOOLS

Tool No.	Description
ENGINE	
PD.1C	Valve Guide Remover & Replacer (Main Tool)
PD.1C-1	Adaptor for PD.1C
PD.1C-4	Adaptor for PD.1C
4RL	Tension Wrench
No. 13	Tension Wrench
PD.41B	Piston Height & Valve Depth Gauge
PD.137	Valve Guide Reamer .015" O/size
PD.138	Valve Guide Reamer .030" O/size
PD.150	Cylinder Liner Remover & Replacer (Main Tool)
PD.150-1A	Adaptors for PD.150
PD.150-7	Adaptors for PD.150
PD.155A	Basic Puller
PD.155-1	Adaptor for PD.155A
335	Con Rod Jig & Master Arbor
PD.336-6	Arbor Adaptor 2.6459" dia.
6000C	Diesel Compression Tester
6000C-3	Adaptor for 6000C
6000C-4A	Adaptor for 6000C
6118B	Valve Spring Compressor
PD.6118-3	Adaptor for 6118B
7066	Circlip Pliers
FC. 9900	Injector Tester
MF.200-26	Water Pump Overhaul Kit
6200C	Small End Reaming Fixture
316X	Valve Seat Cutter Handle
316-10	Pilot ($\frac{5}{16}$" dia. Valve Guide)
316-12	Pilot ($\frac{3}{8}$"dia. Valve Guide)
316-13	Pilot
316-125	Pilot (.015" O/size on $\frac{3}{8}$" Guide)
PD.317-22	Valve Seat Cutter
PD.317-23	Valve Seat Cutter
317-30	Valve Seat Cutter
317G-19	Valve Seat Glazebreaker
317G-25	Valve Seat Glazebreaker
317G-30	Valve Seat Glazebreaker
FRONT AXLE & STEERING	
MF.148-7	Power Steering Adaptor
MF.195-4	Front Axle Pivot Pin Bush Remover/Replacer & P.T.O. Bush Remover/Replacer
MF.263	Front Axle & Steering Bush Remover (Main Tool)

Tool No.	Description
MF.263-2	Front Axle & Steering Bush Remover/Replacer Adaptors ($1\frac{1}{2}$")
MF.263-3	Front Axle & Steering Bush Remover/Replacer Adaptors ($1\frac{7}{8}$")
MF.264	Front Axle & Steering Bush Reamer (Main Tool)
MF.264-1	Reamer & Pilot
MF.264-2	Reamer & Pilot
MF.268	Steering Wheel Remover
MF.332	Power Steering Pump Oil Seal Protector
6312A	Steering Drop Arm Remover
MF.334	Steering Pivot Pin Remover
REAR AXLE	
MF.9A MF.10	Differential Housing Holder and Bench Plate
MF.197	Wheel Axle Outer Bearing Cone & Differential Cone Replacer (Main Tool)
MF.197-2	Differential Carrier Plate Bearing Cone Replacer Adaptor
MF.200-2	Drive Cover Assembly & Bearing Remover
MF.200-3	Differential Carrier Plate Bearing Cone Remover Adaptor
MF.200-23	Driving Pinion Bearing & Pilot Bearing Remover/Replacer Adaptor
MF.200-24	Epicyclic Hub Inner Bearing Cone Remover Adaptor
MF.202A	Rear Drive Shaft Needle Bearing Remover
MF.203A	Rear Drive Shaft Needle Bearing Replacer & P.T.O. Remover/Replacer
MF.224	Differential Lock Shaft Circlip Remover/Replacer
MF.245D	Rear Axle Preload Gauge
MF.245D-1	Straight Edge
MF.257	Differential Bearing Cone Replacer
MF.258	Differential Housing Holder
MF.265	Planetary Carrier Assembly Remover
MF.266B	Planetary Carrier Bush Inner Coil Seal Bearing Cone & Unit Replacer
MF.267A	Epicyclic Hub Pre-load Gauge

RECOMMENDED SPECIAL TOOLS

Tool No.	Description
MF.555-2A	Differential Coupling Bearing Cone Remover
MF.278	Dial Indicator with Magnetic Base (Baty No. D.1)
MF.1105-2A	Differential Bearing Cup Remover/Replacer
MF.1105-6	Differential Carrier Plate Oil Seal Remover/Replacer Adaptor
MF.1105-7A	Differential Bearing Cup Remover/Replacer Adaptor
MF.1105-8	Epicyclic Hub Inner Bearing Cup Remover/Replacer Adaptor
MF.1105-11	Rear Axle Shaft Oil Seal Remover and Replacer

CLUTCH & TRANSMISSION

Tool No.	Description
MF.159A	Single & Dual Clutch Centraliser
MF.177	Transmission Main Drive Shaft Oil Seal Pilot
MF.178	P.T.O. Main Drive Shaft Pilot
MF.179	Transmission & P.T.O. Pinion Oil Seal Replacer
MF.200-25	Multi-purpose Bearing Remover
MF.215	Secondary Clutch Setting Gauge
MF.218A	Front P.T.O. Housing Replacer (Main Tool)
MF.218A-2	Front P.T.O. Housing Replacer Adaptor
MF.220	Lever Fulcrum Height Setting Gauge
MF.255A	Multi-Power Pinion Oil Seal Replacer & Assembly Sleeve
MF256A	Multi-Power Pinion Assembly Inner Oil Seal Replacer
MF.314	Lever Fulcrum Height Setting Gauge
MF.315	Main Drive Shaft Retainer Needle Bearing & Seal Remover Replacer
MF.331	Transmission Input Shaft Oil Seal Replacer
7600B	Flywheel Spigot Bearing Remover (Main Tool)
MF.7600-1	Flywheel Spigot Bearing Remover Adaptor

P.T.O. & HYDRAULICS

Tool No.	Description
MF.163	Spring Retainer Nut Wrench
MF.166	Hydraulic Adaptor for Lift Cover
MF.167	P.T.O. Oil Seal Pilot
MF.168	P.T.O. Shaft Oil Seal Remover/Replacer
MF.195-5	P.T.O. Needle Bearing Bush Remover/Replacer Adaptor
MF.196B	Hydraulic Pump Valve Seat Chamber Cutter & Glaze Breaker
MF.226A	Hydraulic Lift Cover Remover/Replacer
MF.260-1	Multi-Power Hydraulic Test Adaptor
MF.260-3	Multi-Power Hydraulic Adaptor
MF.260-4	Multi-Power Pressure Test Adaptor
MF.260-5	Multi-Power Pump Flow Adaptor
MF.269	Response Plunger Adjusting Wrench
MF.270B	Dashpot Piston Wedge
MF.271	Roller Assembly Tool & Draft Control Rod Gauge
MF.272	Ram Arm Gauge Fixture
MF.273	Hydraulic Control Lever Setting Fixture
MF.333	Draft Control Rod Gauge (Increased Tension Range)
810	Hydraulic Pressure & Flow Test Fixture (Main Tool)
MF.810-1	Adaptor
MF.810-4	Multi-Power Pump Flow Adaptor

MULTI-PURPOSE & MISCELLANEOUS TOOLS

Tool No.	Description
13A	Tension Wrench
MF.148A	Hydraulic Pressure Test Equipment (Main Tool)
MF.195	Bearing Cups Remover/Replacer (Main Tool)
MF.200	Hand Press (Main Tool)
MF.260	Low Pressure Hydraulic Test Set (Main Tool)
270	Tractor Splitting Kit
550	Driver Handle (Main Tool)
555	Three Leg Adjustable Puller (Main Tool)
MF.1105	Bearing Remover (Main Tool)
7065M	Heavy Duty Circlip Pliers
7066	Circlip Pliers
HD.3	Circlip Plier Points

TORQUE DATA

The following information gives standard torquing requirements for MF standard bolts, nuts and cap screws for use where the torque requirements are not otherwise specified.

NOMINAL SIZE (diameter)	WRENCH TORQUE kg–m (lb-ft) A	WRENCH TORQUE kg–m (lb-ft) B
¼ in	0,69 to 0,83 (5 to 6)	1,1 to 1,4 (8 to 10)
5/16 in	1,4 to 1,6 (10 to 12)	2,1 to 2,5 (15 to 18)
⅜ in	2,6 to 3,0 (19 to 22)	4,1 to 4,8 (30 to 35)
7/16 in	4,5 to 5,3 (33 to 38)	6,9 to 7,6 (50 to 55)
½ in	6,5 to 7,3 (47 to 53)	10,5 to 11,7 (76 to 85)
9/16 in	8,9 to 10,0 (65 to 73)	15,9 to 17,3 (115 to 125)
⅝ in	13,8 to 17,3 (100 to 125)	21,4 to 23,5 (155 to 170)
¾ in	24,2 to 27,6 (175 to 200)	37,3 to 41,5 (270 to 300)

COLUMN A

NON-RIGID JOINTS

Column "A" specifies the spanner torques to be used with non-rigid joints where extrusion, deformity or other damage would result when higher clamping forces are used.

LIMITED STRENGTH NUTS

The torque values in column "A" are also the maximum recommended for weld nuts, slotted nuts or other limited strength nuts.

STANDARD NUTS WITH LOCK WASHERS

When lock washers are used under the nut, the torque values in column "A" should be applied. Laboratory tests indicate that lock washers substantially reduce the friction under the nut. This is especially true if the bolt, nut and lock washer are oiled. Due to this reduction in friction, proper bolt elongation is obtained by use of the torque in column "A". Column "B" torques may cause failure of the nut or bolt during assembly.

COLUMN B

Column "B" is the wrench torque to be used for assembly of rigid joints where extrusion, deformity or other damage will not result, and it is desirable to obtain more elastic elongation of the bolt or stud to ensure that it remains tight.

GENERAL SPECIFICATION

Part 1 Section A

Table of Contents

GENERAL

This section of the manual gives details of all general information related to this tractor. The section has been divided into sub-section related to the various parts of this Manual, i.e. the seventh sub-section is related to Part 7 – Hydraulics.

GENERAL SPECIFICATION

Recommended Antifreeze Solutions
Smith's Super Bluecol
Duckham's Antifreeze
Mobil Permazone

Prestone Two-phase
Esso Antifreeze
Union Carbide P3B

NOTE – ONLY THE ANTIFREEZE SOLUTIONS LISTED HERE MEET MASSEY-FERGUSON TEST SPECIFICATIONS. THE USE OF INFERIOR GRADES OF ANTIFREEZE (INCLUDING SOME SOLUTIONS CONFORMING TO BS.3151) CAN CAUSE SEVERE DAMAGE TO THE COOLING SYSTEM.

RECOMMENDED LUBRICATION BRITISH ISLES ALL SEASONS

UNIT		*CAPACITY*	*B.P.*	*Castrol*	*Duckham's*	*Esso*	*Mobil*	*Shell*
ENGINE including FILTER	Dipstick Full	6.8 litres (12 pints)	Tractor Oil Universal	Agricastrol Multi-use	Farmadcol Multigrade	Tractorlube (Universal)	Mobiland Universal	Tractor Oil Universal
STEERING BOX		0.85 litres (1½ pints)						
TRANSMISSION See note 2	Standard Multi-power	28.4 litres (50 pints) 27.27 litres (48 pints)	Hydraulic TF8 or Tractran	Agricastrol AS (BB11)	Hydrolube	IL 1941	Mobilfluid 422	S 7884
POWER STEERING		0.47 litres (0·84 pints)	Autran DX	Deusol TFA Dexron	Fleetmatic D D-matic	Esso Automatic Transmission Fluid (Dexron)	Mobil A.T.F. 200 or Mobil A.T.F. 220	A.T.F. Dexron
LIFT SHAFT (2 nipples)			Tractor Gear Oil SAE 90EP	Agricastrol Gear EP90/140	Farm Mesh EP 90	Tractorlube Gear Oil GP90/140	Mobilube GX 90	Tractor Gear Oil
GREASE GUN			Energrease Universal	Agricastrol Multi-use Grease	Duckham's Admax L2	Esso Multi-purpose Grease H	Mobilgrease Special	Farm Grease Universal

NOTES:

1. Provided the oil change periods recommended in the Maintenance Section have been followed, discolouration of the engine oil with use is normal and of no significance.
2. If the tractor is to work on slopes and inclines, the transmission should be filled to the 'H' mark on the dipstick.

RECOMMENDED LUBRICANTS—OVERSEAS

UNIT	*CAPACITY*	*Temperature* °F	°C	*B.P.*	*Castrol*	*Duckham's*	*Esso*	*Mobil*	*Shell*
ENGINE Including FILTER	6,8 litres (12 pints)	Below 30	Below −1	B.P. Vanellus SAE 10W	Castrol Deusol CRB 10	Duckham's Fleetol HDX 10	Essolube HDX 10	Delvac 1110	Rotella 'T' Oil 10W
STEERING BOX	0.85 litres (1½ pints)	30 to 80	−1 to 27	B.P. Vanellus SAE 20W	Castrol Deusol CRB 20	Duckham's Fleetol HDX 20	Essolube HDX 20W	Delvac 1120	Rotella 'T' Oil 20/20W
		Above 80	Above 27	B.P. Vanellus SAE 30	Castrol Deusol CRB 30	Duckham's Fleetol HDX 30	Essolube HDX 30	Delvac 1130	Rotella 'T' Oil 30
TRANSMISSION See Notes 3 and 4 Standard	28,4 litres (50 pints)	Below 0	Below −17	B.P. TF-7	Agricastrol M.D.	Hydrol 303	Torque Fluid 56	—	S.6332
Multi-Power	27,7 litres (48 pints)	0 to 80	−17 to 27	Hydraulic TF-8	Agricastrol AS BB 11	Hydrolube	IL 1941	Mobilfluid 422	S 7884
POWER STEERING	0.47 litres (0·84 pints)	All Temps.		Autran DX	Castrol TQ Dexron R	D-matic	Esso Automatic Transmission Fluid (Dexron)	Mobilfluid ATF 220	ATF Dexron
LIFT SHAFT (2 nipples)		All Temps.		Gear Oil SAE 90EP	Castrol Hypoy EP90	Duckham's Farm Mesh	Esso Gear Oil GP 90	Mobilube GX 90	Spirax 90EP
GREASE GUN		All Temps.		Energrease L2	Castrol LM Grease	Duckham's Admax L2	Esso Multi-purpose Grease	Mobil-grease Special	Retinax A

NOTES:

1. Provided the oil change periods recommended in the Maintenance Section have been followed, discolouration of the engine oil with use is normal and of no significance.
2. The multi-purpose oils listed as recommended for U.K. can be used in other territories where available in the temperature range 30° to 80°F (-1°C to 27°C) only. Where it is desired to use such lubricants in temperature ranges other than this, the MF Distributor/Dealer should be consulted.
3. If the tractor is to work on slopes and inclines the transmission should be filled to the 'H' mark on the dipstick.
4. The transmission oils listed for −17°C (0°F) and below are intended for use only in very severe conditions.

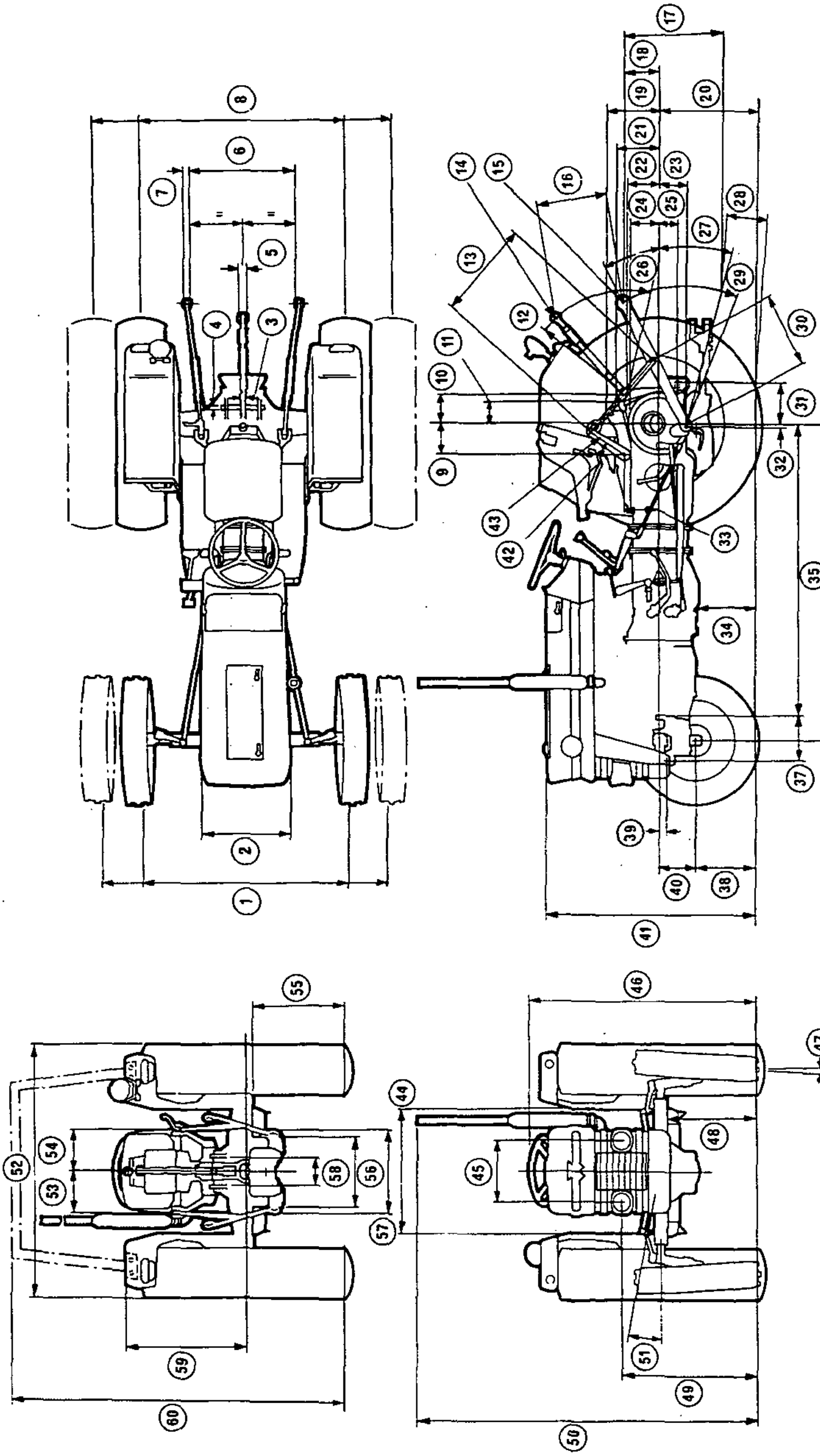

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FIG. 1

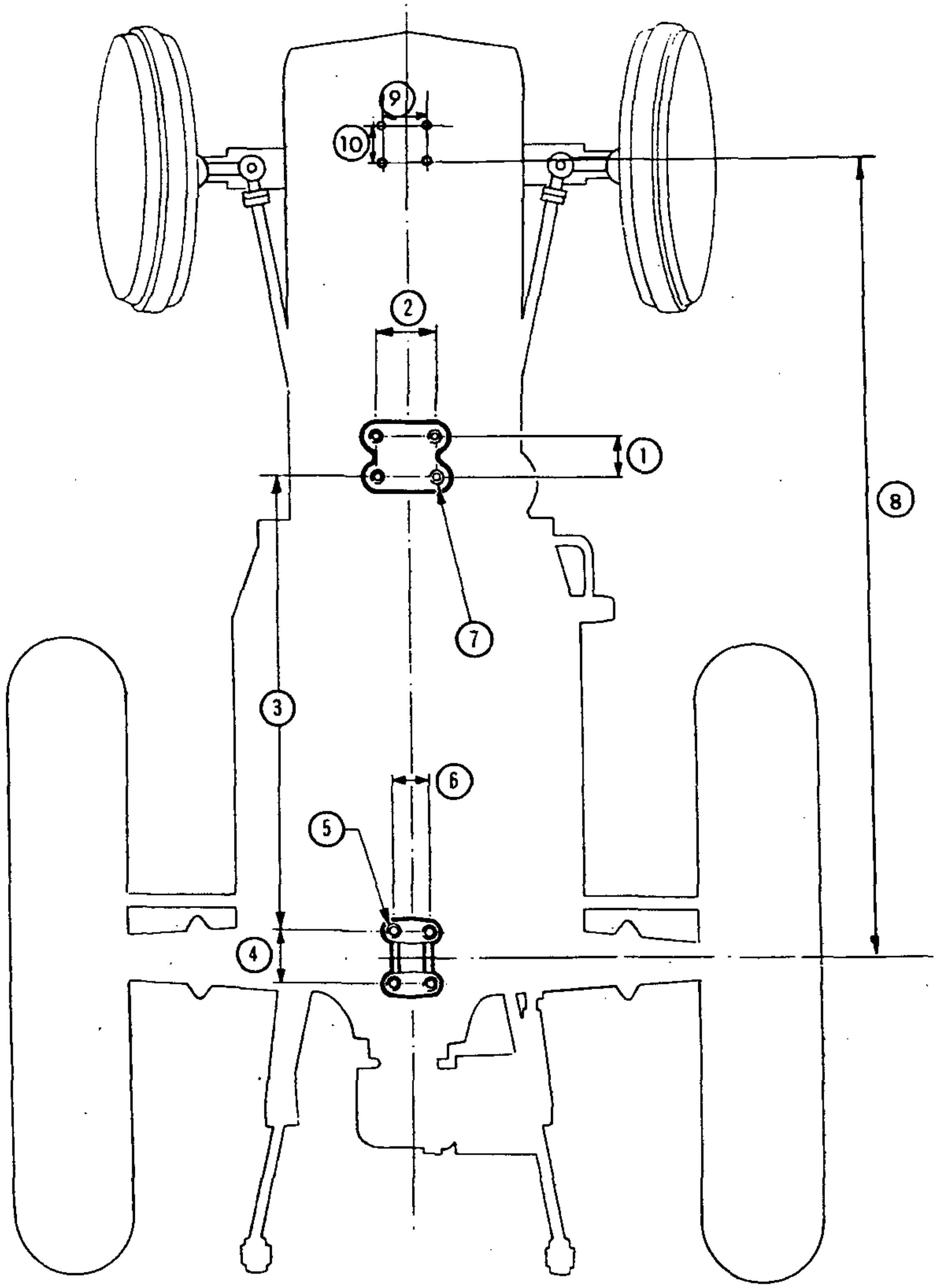


FIG. 2

GENERAL INFORMATION

Main Dimensions
The following overall dimensions relate to the MF 148 tractor fitted with 6.00–19 front tyres and 11–32 rear tyres.

Key to Figure 1.
1. Manual Steering – 1212 to 1829 mm (48 to 72 in) in 102 mm (4 in) steps.
   Power Steering – 1321 to 1829 mm (52 to 72 in) in 102 mm (4 in) steps.
2. 565 mm (22¼ in)
3. 29 mm (1⅛ in)
4. 19 mm (¾ in) dia.

	CAT. 1	CAT. 2
5.	43,6 to 43,9 mm (1.72 to 1.73 in)	50,5 to 51,0 mm (1.99 to 2.01 in)
6.	683 mm (26⅞ in)	824 mm (32 7/16 in)
7.	34,8 to 35,1 mm (1.37 to 1.38 in)	44,4 to 44,7 mm (1.75 to 1.76 in)

8. 1321 to 1930 mm (52 to 76 in) in 102 (4 in) steps.
9. 196 mm (7.7 in)
10. 184 mm (7¼ in)
11. 133 mm (5¼ in)

	CAT. 1	CAT. 2
12.	692 mm radius (27¼ in)	683 radius (26⅞ in)
13.	610 mm (24 in)	606 mm (23⅞ in)
14.	19,3 to 19,6 mm dia. (0.76 to 0.77 in)	25,6 to 25,9 mm dia. (1.01 to 1.02 in)
15.	22,4 to 22,7 mm dia. (0.885 to 0.895 in)	28.8 to 29,1 mm dia. (1.135 to 1.145 in)
16.	457 mm (18 in)	457 mm (18 in)
17.	625 mm (24⅝ in)	625 mm (24⅝ in)
18.	232 mm (9⅛ in)	229 mm (9 in)

19. 338 mm (13.3 in)
20. 630 mm (24.8 in)
21. 274 mm (10.8 in)
22. 206 mm (8⅛ in)
23. 184 mm (7¼ in)
24. 191 mm (7.5 in)
25. 127 mm (5 in)

	CAT. 1	CAT. 2
26.	28° 30'	28° 30'
27.	13° 30'	14°
28.	248 mm (9¾ in)	245 mm (9⅝ in)
29	883 mm (34¾ in)	870 mm (34¼ in)
30	454 mm (17⅞ in)	448 mm (7⅝ in)

31. 261 mm (10 9/32 in)
32. 9 mm (11/32 in)
33. 233 mm (9.165 in)
34. 356 mm (14 in)
35. 1891 mm (74.45 in)
36. 2048 mm (80⅝ in)
37. 285 to 286 mm (11.21 to 11.25 in)
38. 381 mm (15 in)
39. 42 mm (1.66 in)
40. 229 mm (9 in)
41. 1343 mm (52⅞ in)
42. 33°
43. 64°
44. 813 mm (32 in) approx.
45. 392 mm (15 7/16 in)
46. 1445 mm (56⅞ in)
47. 3° 30' Camber
48. 546 mm (21½ in)
49. 851 mm (33½ in)
50 2210 mm (87 in)
51. 11° maximum swing
52. 1626 mm (64 in) at 1321 mm (52 in) track
53. 267 mm (10½ in)
54. 267 mm (10½ in)
55. 589 mm (23.2 in)
56. 474 mm (18⅝ in)
57. 562 mm (22⅛ in)
58. 182 mm (7.16 in)
59. 778 mm (30⅝ in)
60. 2241 mm (88¼ in)

Mounting Points
These mounting points can be used for the attachment of some implements.

Key to Figure 2.
1. 101,6 mm (4 in)
2. 184 mm (7¼ in)
3. 1168 mm (46 in)
4. 152,4 mm (6 in)
5. 4 holes tap ¾ in 10 UNC 3B x 28,6 mm (1⅛ in) deep (blind).
6. 85,7 mm (3⅜ in)
7. 8 holes tap ⅝ in 11 UNC 3B x 31,7 mm (1¼ in) deep (blind).
8. 1982 mm (77⅛ in)
9. 152,4 mm (6 in).
10. 114,3 mm (4½ in)

ENGINE

A comprehensive specification for the AD3.152 engine is provided in the Perkins Workshop Service Manual.
For all data, consult the Perkins AD3.152 Manual.

COOLING SYSTEM

The cooling system comprises a fan and centrifugal type pump, driven by a belt, from the crankshaft, coolant flow being controlled by a wax type thermostat. The radiator is of a conventional fin and tube type, with a header tank.

System capacity – 10,2 litres (18 Imp pints)
Pump Impeller Clearance – 0,25 to 0.51 mm (0.010 to 0.020 in)
Thermostat Opening Temperature – 76 to 80°C (169 to 176°F)
Thermostat Valve fully open – 88 to 90,6°C (190 to 195°F)
Thermostat Valve Lift – 7,9 to 11,9 mm (5/16 to 15/32 in)
Antifreeze solutions should be used where there is a risk of freezing.

FUEL SYSTEM

Air Cleaner
A two stage dry air cleaner is fitted, this air cleaner has a washable, pleated main element, and inner safety element and a self acting unloader valve.

Fuel Tank
The 47,73 litres (10.5 Imp gal) fuel tank is situated above the engine and has a thermostart reservoir and a fuel tap at the rear end.

Thermostart
C.A.V. Thermostart Mk IIIC is fitted to this tractor. Full details and data are provided in the Perkins AD3.152 Manual.

Fuel Injection Equipment
A C.A.V. D.P.A. type fuel pump with C.A.V. injector holders and nozzles are fitted. For full details, consult the Perkins AD3.152 Manual.

Fuel Filters
C.A.V. primary and secondary fuel filters with replaceable cartridge type elements are fitted. A sediment bowl is incorporated in the primary fuel filter.

Throttle Controls
A hand throttle and foot throttle are fitted as standard equipment. The action of the foot throttle overrides the hand throttle. The throttle controls are of the rod type, adjustable for length to permit setting of maximum engine speed.

TRANSMISSION

Clutch
The dual clutch is of the Auburn ventilated type, with a 305 mm (12 in) diameter main drive disc and a 254 mm (10 in) p.t.o. disc. The main drive clutch is coil spring operated and the p.t.o. clutch is Belleville spring operated.

Colour Code
Clutch Cover Assembly – White
Coil Spring – Brown
Free length 65,40 mm (2.575 in)
Compressed Length 33,59 mm (1.283 in)
Working Length 34,16 mm (1.345 in)
Test Load 32,66 to 35,38 kg (72 to 78 lb)
Total Load Rating (12 springs) 408 kg (900 lb)
Belleville Spring – Dark Blue
Free Height 5,9 to 6,2 mm (0.235 to 0.245 in)
Thickness 2,89 mm (0.114 in)
Total Load Rating 566,9 kg (1250 lb)

Toggle Lever Height Setting
79,24 to 83,3 mm (3.12 to 3.28 in)
Use Special Tool MF 314 to adjust toggle lever height.

P.T.O. Clutch Setting
2,03 mm (0.080 in)
Use Special Tool MF 215 to adjust
Pedal free travel, measured between the pedal and the shoulder on the transmission case – 11,11 mm (7/16 in).

Eight Speed Transmission
The eight speed transmission provides four forward and one reverse gear, compounded by a planetary reduction gearset on the output end of the mainshaft to give eight forward and two reverse gears.

	No of teeth
Main Input Shaft Constant Mesh Gear	17
P.t.o. Input Shaft Constant Mesh Gear	17
Main Input Layshaft Constant Mesh Gear	52
P.t.o. Input Layshaft Constant Mesh Gear	53
Mainshaft 1st	44
Mainshaft 2nd	46
Mainshaft 3rd	41
Mainshaft 4th	36
Layshaft 1st	15
Layshaft 2nd	23
Layshaft 3rd	28
Layshaft 4th	33
Reverse Gear Cluster	13/21
Planetary Reduction Unit Sun Gear	18
Planetary Reduction Unit Planet Gear	18
Planetary Reduction Unit Ring Gear	54
Transmission Ratios: 1st	2.933 : 1
2nd	2 : 1
3rd	1.464 : 1
4th	1.09 : 1
Reverse	2.156 : 1
Constant Mesh Ratios: Main	3.059 : 1
P.t.o.	3.12 : 1
Planetary Reduction in Unit Ratios – Low Range	4 : 1
Planetary Reduction in Unit Ratios – High Range	1 : 1

11-32 Tyres–716,3 mm (25.2 in) Dynamic rolling radius

Planetary Range	Gear	Total Ratio	Road speeds			
			1 500 e.r.p.m.		2 250 e.r.p.m.	
			m.p.h.	*k.p.h.*	*m.p.h.*	*k.p.h.*
LOW	1st	221.4	1.02	1.64	1.53	2.46
	2nd	150.98	1.49	2.39	2.23	3.59
	3rd	110.52	2.03	3.27	3.04	4.90
	4th	82.28	2.73	4.39	4.09	6.59
	Rev.	162.76	1.38	2.22	2.07	3.33
HIGH	5th	55.35	4.08	6.56	6.12	9.84
	6th	37.74	5.96	9.59	8.94	14.38
	7th	27.63	8.14	13.09	12.21	19.64
	8th	20.57	10.92	17.56	16.36	26.36
	Rev.	40.69	5.52	8.88	8.28	13.32

Multi-Power Transmission

The Multi-Power transmission has three forward and one reverse gear, compounded by a planetary reduction gearset to give six forward and two reverse gears which are further compounded by a hydraulically actuated two-speed input gearset to give twelve forward and four reverse gears.

	No of teeth
Main Input Shaft Constant Mesh Gear High Range	15
Main Input Shaft Constant Mesh Gear Low Range	18
P.t.o. Input Shaft Constant Mesh Gear	17
Main Input Layshaft Constant Mesh Gear High Range	45
Main Input Layshaft Constant Mesh Gear Low Range	42
P.t.o. Input Layshaft Constant Mesh Gear	53
Mainshaft 1st	44
Mainshaft 2nd	46
Mainshaft 3rd	36
Layshaft 1st	15
Layshaft 2nd	23
Layshaft 3rd	33
Reverse Gear Cluster	13/21
Planetary Reduction Unit Sun Gear	18
Planetary Reduction Unit Planet Gear	18
Planetary Reduction Unit Ring Gear	54
Transmission Ratios: 1st	2.933 : 1
2nd	2 : 1
3rd	1.09 : 1
Reverse	2.156 : 1
Constant Mesh Ratios Main (High)	2.33 : 1
Constant Mesh Ratios Main (Low)	3 : 1
Constant Mesh Ratios P.t.o.	3.12 : 1
Planetary Reduction Unit Ratio – Low Range	4 : 1
Planetary Reduction Unit Ratio – High Range	1 : 1

11-32 Tyres–716,3 mm (25.2 in) Dynamic rolling radius

Planetary Range	Gear	Total Ratio	Road Speeds					
			1 500 r.p.m.		1 700 r.p.m.		2 250 r.p.m.	
			m.p.h.	*k.p.h.*	*m.p.h.*	*k.p.h.*	*m.p.h.*	*k.p.h.*
LOW	1st Low	217.05	1.04	1.67	1.17	1.89	1.56	2.50
	1st High	168.66	1.38	2.14	1.51	2.42	2.00	3.21
	2nd Low	148.00	1.52	2.44	1.72	2.76	2.28	3.66
	2nd High	114.96	1.96	3.15	2.22	3.57	2.94	4.72
	3rd Low	80.66	2.79	4.49	3.16	5.09	4.19	6.73
	3rd High	62.66	3.59	5.78	4.07	6.55	5.38	8.67
	Rev. Low	160.00	1.40	2.92	1.59	2.56	2.11	3.39
	Rev. High	123.90	1.81	3.25	2.05	3.31	2.71	4.38
HIGH	4th Low	54.26	4.16	6.69	4.68	7.56	6.20	10.00
	4th High	42.16	5.32	8.56	6.03	9.68	7.98	12.84
	5th Low	37.00	6.08	9.76	6.83	11.04	9.12	14.64
	5th High	28.74	7.84	12.60	8.88	14.28	11.76	18.88
	6th Low	20.17	11.16	17.96	12.64	20.36	16.76	26.92
	6th High	15.67	14.36	23.10	16.28	26.20	21.52	34.68
	Rev. Low	40.00	5.60	9.01	6.36	10.24	8.44	13.58
	Rev. High	30.98	7.24	11.68	8.20	13.24	10.84	17.52

REAR AXLE AND BRAKES

Spiral bevel rear axle with lockable differential unit is fitted.

	No of teeth
Crownwheel	37
Pinion	6
Crownwheel and Pinion Ratio	6.17 : 1

Brakes
Girling 355,6 x 50,8 mm (14 x 2 in), two shoes, internal expanding full servo drum brakes, operated together or independently to assist steering. The brake pedals can be locked together for use on the road. The parking brake (where fitted) operates on both rear wheels simultaneously.

Power Take-Off
Live p.t.o. is driven from the clutch through constant mesh gears in the transmission case to the hydraulic pump and then to the p.t.o. drive shaft. Engagement by a *lever on L.H. side of centre housing.*

Independent p.t.o. is driven from the clutch through constant mesh gears in the transmission case to the hydraulic pump and the i.p.t.o. multi-plate wet clutch and then to the p.t.o. drive shaft. Engagement by a lever on L.H. side of centre housing.

Reduction Ratio – 3.12 : 1
Speeds: 540 p.t.o. rev/min at 1684 eng. rev/min
721 p.t.o. rev/min at 2250 eng. rev/min

P.t.o. Shaft Dimension

Number of Splines	6
Major Diameter of Splines	34,82 to 34,87 mm (1.371 to 1.373 in)
Minor Diameter of Splines	27,89 to 28,14 mm (1.098 to 1.108 in)
Spline Width	8,58 to 8,63 mm (0.338 to 0.340 in)
Length suitable for Drive Attachment	73,03 mm (2.875 in)
Hole Diameter	8,28 to 8,53 mm (0.326 to 0.336 in)
Distance of Hole Centre From Shaft End	15,875 mm (0.625 in)
Groove Diameter	29,34 to 29,46 mm (1.155 to 1.160 in)
Groove Radius	6,53 mm (0.265 in)
Distance of Groove Centre from Shaft End	28,575 mm (1.125 in)
Ground Speed Ratio (Live p.t.o. or Side i.p.t.o. only)	Approx 549 mm (21 in) of forward travel for each revolution of the p.t.o. shaft. When ground speed p.t.o. is engaged the shaft revolves clockwise when the tractor moves forwards or, anti-clockwise when the tractor reverses.

FRONT AXLE AND STEERING

A three section front axle, adjustable for track width is fitted. Outer arms are secured to the centre beam by two bolts and nuts.

Castor Angle	4° 56'
Camber Angle	3° 30' Positive
King-pin inclination	9° 30'
Toe-in	3,17 mm (⅛ in)
King-pin diameter	31,62 to 31,64 mm (1.245 to 1.246 in)
King-pin Bush diameter	31,73 to 31,75 mm (1.249 to 1.250 in)
Pivot Pin diameter	41,96 to 41,99 mm (1.652 to 1.653 in)
Pivot Pin Bush diameter	42,04 to 42,19 mm (1.655 to 1.661 in)
Track Adjustments	
Manual Steering	1219 to 1829 mm (48 *to* 72 *in)*
Power Steering	1321 to 1829 mm (52 to 72 in)

Recirculating ball worm and nut type steering is fitted. Power assisted steering is available as an optional extra.

Steering Ratio	13 : 1
Power Steering Pump	Output @ 56 kg/cm^2 (800 lb/in^2) 16,95 lit/min (3.73 Imp gal/min)
Maximum Pressure	98,43 kg/cm^2 (1400 lb/in^2)
Power Steering System Capacity	0,47 litre (0.84 pints)

WHEELS AND TYRES

This tractor is available with W10 x 32 pressed steel, single disc rear wheels, fitted with 11-32 tyres. The maximum pressures and weights are as follows:

Tyre Size	Max. Pressure		Max. Load	
	kg/cm^2	lb/in^2	kg	lb
11-32 (4 ply)	0,98	14	1016	2240
11-32 (6 ply)	1,55	22	1297	2860

The front wheels available are 4.50 x 19 rims and pressed steel centres, fitted with 6.00-19 tyres.

Tyre Size	Weight on the tractor front wheels		Maximum permissible front end weight		Normal tyre pressures		Maximum tyre pressures	
	lb	kg	lb	kg	lb/in^2	kg/cm^2	lb/in^2	kg/cm^2
6.00-19 (4 ply)	1404	637	2370	1075	26	1.82	32	2,25
6.00-19 (6 ply)	1404	637	3000	1360	28	1.96	48	3,37

Wheel Weight Data
Rear Wheels

The Adapter weight weighs	31,8 kg (70 lb) (two halves)
The second weight weighs	50,8 kg (112 lb).

The maximum number which can be attached is determined by the ply rating and pressure of the tyres fitted.
Front Wheels

Two peice weights per wheel	68 kg (150 lb)

HYDRAULICS

The four cylinder, Scotch Yoke pump is driven from the p.t.o. driveshaft and supplies oil, under pressure, to the ram cylinder and four external tapping points. The Pressure Control System operated from 10,6 to 179 kg/cm^2 (150 to 2550 lb/in^2).
The auxiliary hydraulic system can be used to operate external services and can be used to operate independently, or combined with the output of the linkage pump.

Lift Pump

Output @ 2250 eng. rev/min	15,0 litres/min (3.3 Imp. gal/min)
Hydraulic h.p. @ 2250 eng. rev/min and 140,6 kg/cm^2 (2000 lb/in^2)	4.4 h.p.
Maximum Pressure	179 kg/cm^2 (2550 lb/in^2)
Piston Diameter	25,04 to 25,06 mm (0.986 to 0.9865 in)
Piston Bore	25,08 to 25.11 mm (0.9875 to 0.9885 in)
Stroke	15,24 mm (0.06 in)
Piston Area	4,95 cm^2 (0.767 in^2)

Auxiliary Pump (High Capacity)

Output @ 2250 eng. rev/min	31,8 litres/min (7 Imp gal/min)
Hydraulic h.p. @ 2250 eng. rev/min and 140,6 kg/cm^2 (2000 lb/in^2)	9.8 h.p.
Multi-Power Circuit Flow @ 2250 eng. rev/min	15,9 litres/min (3.5 Imp gal/min)
Maximum Pressure	169 kg/cm^2 (2400 lb/in^2)
Multi-Power Relief Valve Pressure	49,2 to 70,3 kg/cm^2 (700 to 1000 lb/in^2)

Multi-Power Pump (Low Capacity)

Output @ 2250 eng. rev/min	17,5 litres/min (3.8 Imp gal/min)
Relief Valve Pressure	49,2 to 70,3 kg/cm^2 (700 to 1000 lb/in^2)

Hydraulic Tapping Points

From lift pump	Two tapping points on sides of the lift cover – ⅜ – 18 N.P.T.F (Dry Seal) taper plug. On top of the lift cover to the left of the transfer cap – ⅜ N.P.S.M. x 19 mm (¾ in) deep. On the transfer cap – ⅜ - 27 N.P.T.F. (Dry Seal).
From Auxiliary Pump	With Spool Valve fitted, 'Pioneer' self sealing, quick release couplings. The hoses adjacent to the quick release couplings have identification tags for flow and return:

L.H. Couplers; Flow – White, Return – Yellow
R.H. Couplers; Flow – Red, Return – Blue

LINKAGE

Three point linkage is fitted, the lower links being of the interchangable ball type and the top link of the barrel and turnbuckle type.

Lower Link – between centres	879 mm (34 ⅝ in)
Width and Thickness	76 x 17,8 mm (3 x ¹¹⁄₁₆ in)
Lift Rod – Nominal Length	612 mm (24 ⅛ in)
Top Link – Nominal Length	685,8 mm (27 in)
Adjustment	609,6 to 702 mm (24 to 30 in)
Barrel Length	476,3 mm (18¾ in)

Swinging Drawbar

Settings and Load Capacity (Static)	254 mm (10 in) – 990 kg (2200 lb) 356 mm (14 in) – 765 kg (1700 lb)
Offset – three positions per side	1. 60 mm (2⅜ in) 2. 130 mm (5⅛ in) 3. 233 mm (9³⁄₁₆ in)

ELECTRICAL SYSTEM

Voltage	12 volt NEGATIVE EARTH
Battery	17 plate, 96 amp (temperate) or 125 amp (cold climate)
Starter Motor	Lucas M50G or M45G with solenoid engaged pinion. Starter circuit protected by neutral safety start switch incorporated in the trans mission.
Dynamo	Lucas C40A
Voltage Control Box	Lucas RB 108
Lamp Bulb Sizes:	
Headlamp	12V 36/36 watt
Plough Lamp	12V 36 watt
Side Lamp	12V 6 watt
Tail Lamp	12V 6 watt
Number Plate Lamp	12V 6 watt
Panel Light	12V 2.2 watt
Fuses – Tractor	25 amp
Safety Cab Wiper (if fitted)	35 amp

ACCESSORIES

Front Weights	each weight weighs 27 kg (60 lb)
Auto-Hitch	Lift capacity 1814 kg (4000 lb)
Belt Pulley	
Pulley Diameter	228,6 mm (9 in)
Pulley Width	165 mm (6½ in)
Gear ratio to p.t.o. shaft	1.824 : 1
Pulley Oil Capacity	0,85 litres (1½ Imp pints)

Speeds

Engine rev/min	P.T.O. rev/min	Pulley rev/min	Belt Speed m/min	Belt Speed ft/min
1685	540	985	708,6	2325
2250	721	1315	946	3105

Linkage Drawbar

Drawbars to fit Category 2 link ends are available.

Length of Drawbar, over flat section	660 mm (26 in)
Number of securing holes	9
Diameter of securing holes	19,8 mm (0.781 in)
Stay Length – from the right hand corner of the cranked section to the straight end – Upper	765 mm (30 ⅛ in)
– Lower	768 mm (30¼ in)

Selector Valve

Port thread sizes Ext 1	$\frac{9}{16}$ 18 UNF
Ext 2	$\frac{9}{16}$ 18 UNF
Port 'R'	¾ 16 UNF
Relief Valve Setting	260 kg/cm^2 (3700 lb/in^2)

GENERAL SPECIFICATION

Part 1 Section A

Table of Contents

GENERAL

This section of the manual gives details of all general information related to this tractor. The section has been divided into sub-section related to the various parts of this Manual, i.e. the seventh sub-section is related to Part 7 – Hydraulics.

GENERAL SPECIFICATION

Recommended Antifreeze Solutions
Smith's Super Bluecol
Duckham's Antifreeze
Mobil Permazone

Prestone Two-phase
Esso Antifreeze
Union Carbide P3B

NOTE – ONLY THE ANTIFREEZE SOLUTIONS LISTED HERE MEET MASSEY-FERGUSON TEST SPECIFICATIONS. THE USE OF INFERIOR GRADES OF ANTIFREEZE (INCLUDING SOME SOLUTIONS CONFORMING TO BS.3151) CAN CAUSE SEVERE DAMAGE TO THE COOLING SYSTEM.

RECOMMENDED LUBRICATION BRITISH ISLES ALL SEASONS

UNIT		*CAPACITY*	*B.P.*	*Castrol*	*Duckham's*	*Esso*	*Mobil*	*Shell*
ENGINE including FILTER	Dipstick Full	6,8 litres (12 pints)	Tractor Oil Universal	Agricastrol Multi-use	Farmadcol Multigrade	Tractorlube (Universal)	Mobiland Universal	Tractor Oil Universal
STEERING BOX		0,85 litres (1½ pints)						
TRANSMISSION See note 2.	Standard Multi-power	25 litres (44 pints) 23,5 litres (42 pints)	Hydraulic TF8 or Tractran	Agricastrol AS (BB11)	Hydrolube	IL 1941	Mobilfluid 422	S 7884
POWER STEERING		0,47 litres (0·84 pints)	Autran DX	Deusol TFA Dexron	Fleetmatic D D-matic	Esso Automatic Transmission Fluid (Dexron)	Mobil A.F.T. 200 or Mobil A.T.F. 220	A.T.F. Dexron
LIFT SHAFT (2 nipples)			Tractor Gear Oil SAE 90EP	Agricastrol Gear EP90/140	Farm Mesh EP 90	Tractorlube Gear Oil GP90/140	Mobilube GX 90	Tractor Gear Oil
GREASE GUN			Energrease Universal	Agricastrol Multi-use Grease	Duckham's Admax L2	Esso Multi-purpose Grease H	Mobilgrease Special	Farm Grease Universal

NOTES:

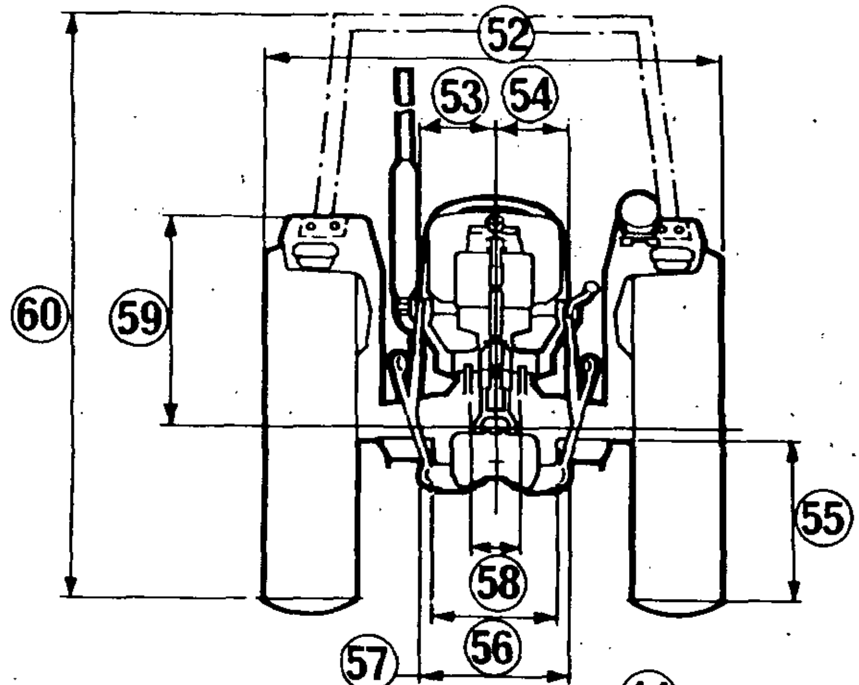
1. Provided the oil change periods recommended in the Maintenance Section have been followed, discolouration of the engine oil with use is normal and of no significance.
2. If the tractor is to work on slopes and inclines, the transmission should be filled to the 'H' mark on the dipstick.

RECOMMENDED LUBRICANTS—OVERSEAS

UNIT	*CAPACITY*	*Temperature* °F °C	*B.P.*	*Castrol*	*Duckham's*	*Esso*	*Mobil*	*Shell*
ENGINE including FILTER	6,8 litres (12 pints)	Below 30 Below −1	B.P. Vanellus SAE 10W	Castrol Deusol CRB 10	Duckham's Fleetol HDX 10	Essolube HDX 10	Delvac 1110	Rotella 'T' Oil 10 W
STEERING BOX	0,85 litres (1½ pints)	30 to 80 −1 to 27	B.P. Vanellus SAE 20W	Castrol Deusol CRB 20	Duckham's Fleetol HDX 20	Essolube HDX 20W	Delvac 1120	Rotella 'T' Oil 20/20 W
		Above 80 Above 27	B.P. Vanellus SAE 30	Castrol Deusol CRB 30	Duckham's Fleetol HDX 30	Essolube HDX 30	Delvac 1130	Rotella 'T' Oil 30
TRANSMISSION See Notes 3 and 4 Standard	25 litres (44 pints)	Below 0 Below −17	B.P. TF-7	Agricastrol M.D.	Hydrol 303	Torque Fluid 56	—	S.6332
Multi-Power	23,5 litres (42 pints)	0 to 80 −17 to 27	Hydraulic TF-8	Agricastrol AS BB 11	Hydrolube	IL 1941	Mobilfluid 422	S 7884
POWER STEERING	0,47 litres (0·84 pints)	All Temps	Autran DX	Castrol TQ Dexron R	D-matic	Esso Automatic Transmission Fluid (Dexron)	Mobilfluid ATF 220	ATF Dexron
LIFT SHAFT (2 nipples)		All Temps.	Gear Oil SAE 90EP	Castrol Hypoy EP90	Duckham's Farm Mesh	Esso Gear Oil GP 90	Mobilube GX 90	Spirax 90 EP
GREASE GUN		All Temps.	Energrease L2	Castrol LM Grease	Duckham's Admax L2	Esso Multi-purpose Grease	Mobil-grease Special	Retinax A

NOTES:

1. Provided the oil change periods recommended in the Maintenance Section have been followed, discolouration of the engine oil with use is normal and of no significance.
2. The multi-purpose oils listed as recommended for U.K. can be used in other territories where available in the temperature range 30° to 80°F (−1°C to 27°C) only. Where it is desired to use such lubricants in temperature ranges other than this, the MF Distributor/Dealer should be consulted.
3. If the tractor is to work on slopes and inclines the transmission should be filled to the 'H' mark on the dipstick.
4. The transmission oils listed for −17°C (0°F) and below are intended for use only in very severe conditions.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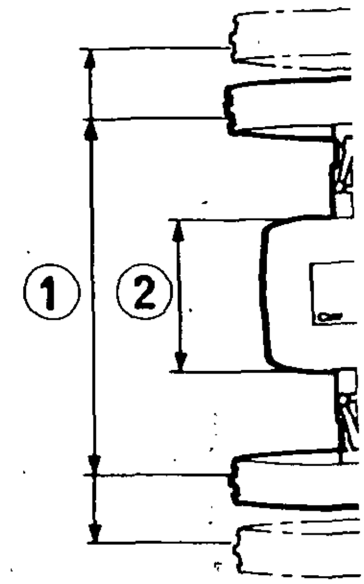
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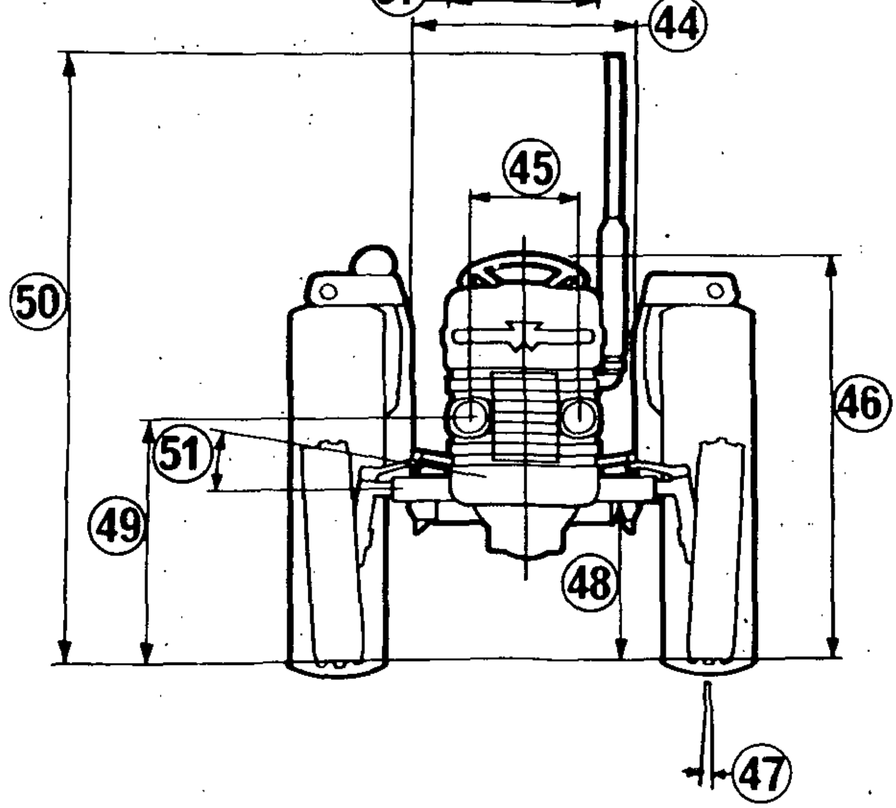
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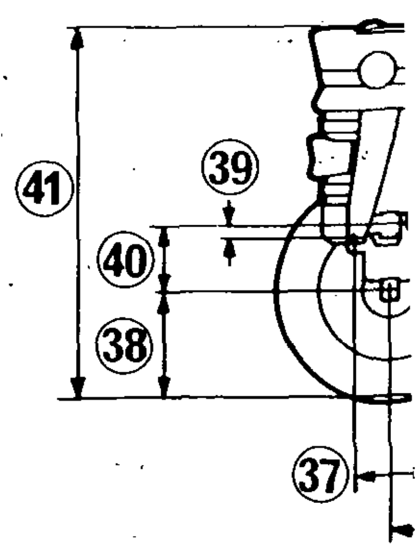
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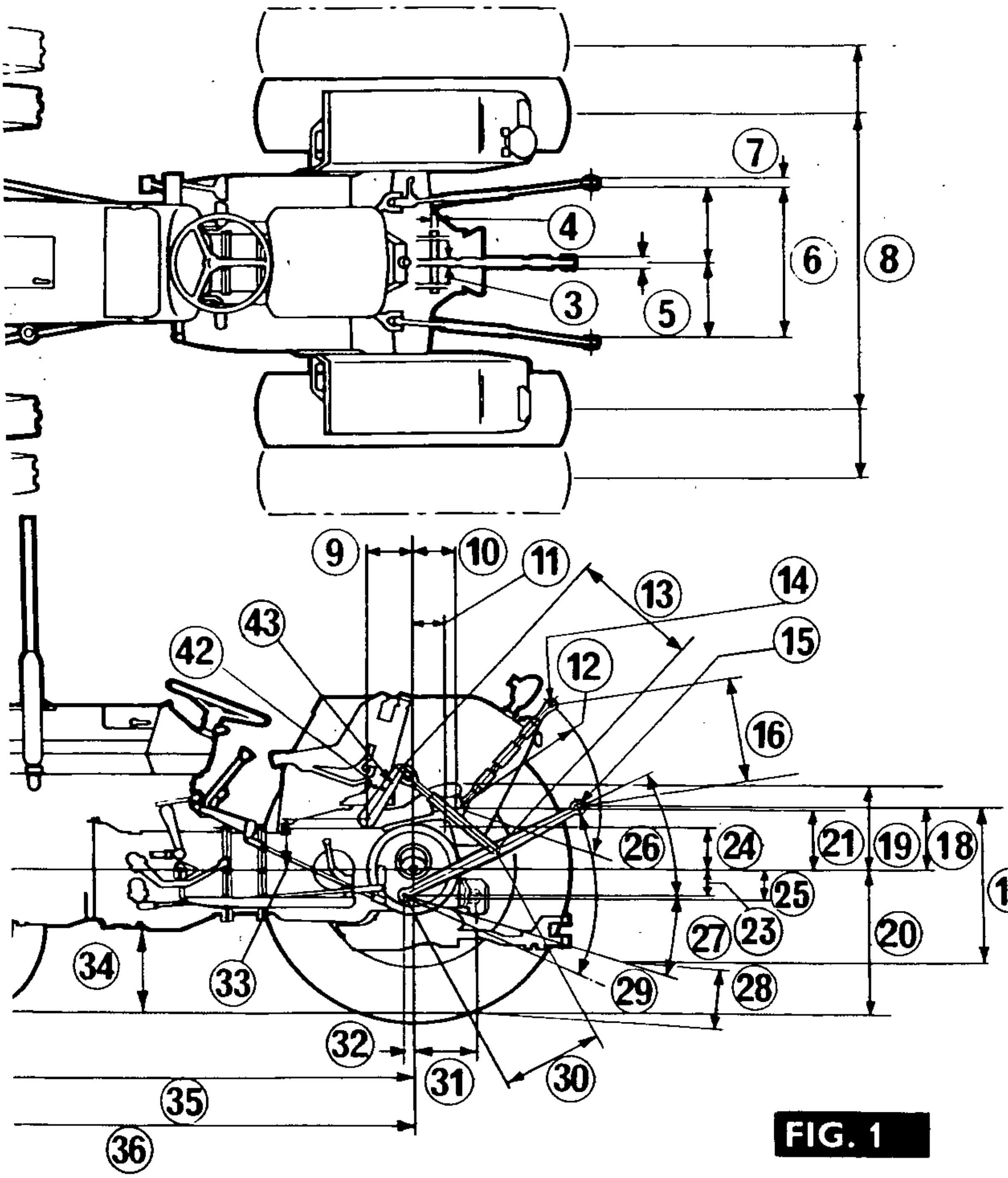
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FIG. 1

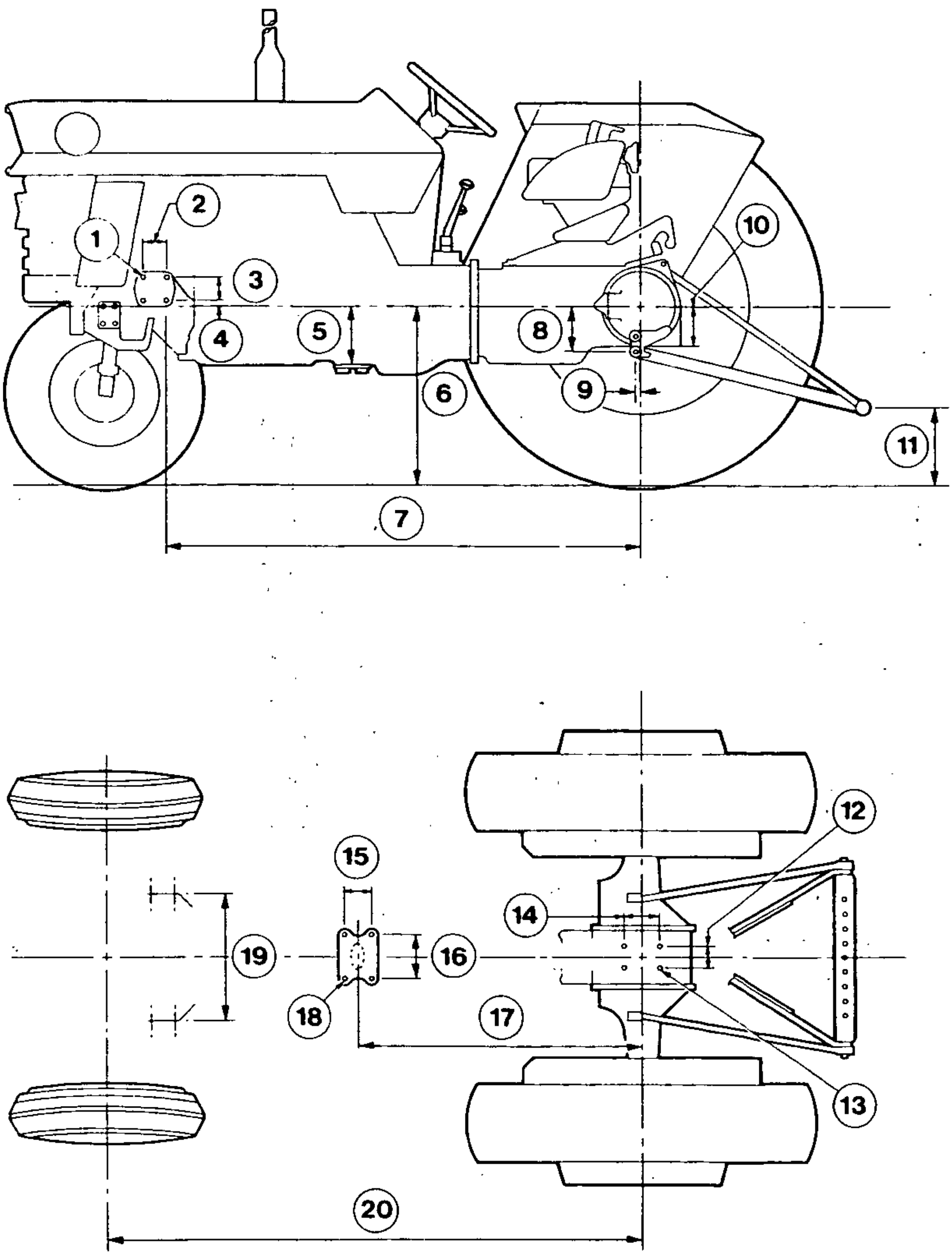

FIG. 2

GENERAL INFORMATION

Main Dimensions

The following overall dimensions relate to the MF 135 tractor fitted with 6.00–16 front tyres and 11–28 rear tyres.

Key to Figure 1

1. Manual Steering – 1212 to 1829 mm (48 to 72 in) in 102 mm (4 in) steps.
   Power Steering – 1321 to 1829 mm (52 to 72 in) in 102 mm (4 in) steps.
2. 565 mm (22¼ in)
3. 29 mm (1⅛ in)
4. 19 mm (¾ in) dia.

	CAT. 1	CAT. 2
5.	43,6 to 43,9 mm (1.72 to 1.73 in)	50,5 to 51,0 mm (1.99 to 2.01 in)
6.	683 mm (26⅞ in)	824 mm (32 7/16 in)
7.	34,8 to 35,1 mm (1.37 to 1.38 in)	44,4 to 44,7 mm (1.75 to 1.76 in)

8. 1321 to 1930 mm (52 to 76 in) in 102 (4 in) steps.
9. 196 mm (7.7 in)
10. 133 mm (5¼ in)
11. 102 mm (4 in)

	CAT. 1	CAT. 2
12.	635 mm radius (25 in)	622 mm radius (24½ in)
13.	513 mm (20.2 in)	509 mm (20 in)
14.	19,3 to 19,6 mm dia. (0.76 to 0.77 in)	25,6 to 25,9 mm dia. (1.01 to 1.02 in)
15.	22,4 to 22,7 mm dia. (0.885 to 0.895 in)	28,8 to 29,1 mm dia. (1.135 to 1.145 in)
16.	457 mm (18 in)	457 mm (18 in)
17.	645 mm (25⅜ in)	641 mm (25¼ in)
18.	284 mm (11 3/16 in)	281 mm (11 1/16 in)

19. 369 mm (14 17/32 in)
20. 579 mm (22.8 in)
21. 274 mm (10.8 in)
*22. Not applicable.
23. 114 mm (4½ in)
24. 191 mm (7.5 in)
25. 127 mm (5 in)

	CAT. 1	CAT.2
26.	29°	30°
*27.	18°	18°
28.	219 mm (8⅝ in)	219 mm (8⅝ in)
29.	802 mm (31 9/16 in)	787 mm (31 in)
30.	401 mm (15 25/32 in)	394 mm (15½ in)

*31. 261 mm (10 9/32 in)
32. 45 mm (1¾ in)
33. 233 mm (9.165 in)
34. 311 mm (12¼ in)
35. 1741 mm (68½ in)
36. 1896 (74⅝ in)
37. 285 to 286 mm (11.21 to 11.25 in)
38. 342 mm (13.45 in)
39. 42 mm (1.66 in)
40. 229 mm (9 in)
41. 1305 mm (51⅜ in)
42. 33°
43. 64°
44. 813 mm (32 in) approx.
45. 392 mm (15 7/16 in)
46. 1400 mm (55⅛ in)
47. 3° 30′ Camber
48. 508 mm (20 in)
49. 813 mm (32 in)
50. 2165 mm (85¼ in)
51. 11° maximum swing
52. 1626 mm (64 in) at 1321 mm (52 in) track
53. 267 mm (10½ in)
54. 267 mm (10½ in)
55. 539 mm (21.2 in)
56. 450 mm (17¾ in)
57. 520 mm (20½ in)
58. 182 mm (7.16 in)
59. 778 mm (30⅝ in)
60. 2196 mm (87¼ in)

Mounting Points

These mounting points can be used for the attachment of some implements.

Key to Figure 2.

1. 101,6 mm (4 in)
2. 184 mm (7¼ in)
3. 1018 mm (40 1/16 in)
4. 152,4 mm (6 in)
5. 4 holes tap ¾ in 10 UNC 3B x 28,6 mm (1⅛ in) deep (blind).
6. 85,7 mm (3⅜ in)
7. 8 holes tap ⅝ in 11 UNC 3B x 31,7 mm (1¼ in) deep (blind).
8. 1832 mm (72⅛ in)
9. 152,4 mm (6 in)
10. 114,3 mm (4½ in)

ENGINE

A comprehensive specification for the AD3.152 engine is provided in the Perkins Workshop Service Manual.
For all data, consult the Perkins AD3.152 Manual.

COOLING SYSTEM

The cooling system comprises a fan and centrifugal type pump, driven by a belt, from the crankshaft, coolant flow being controlled by a wax type thermostat. The radiator is of a conventional fin and tube type, with a header tank.

System capacity – 10,2 litres (18 Imp pints).

Pump Impeller Clearance – 0,25 to 0,51 mm (0.010 to 0.020 in).

Thermostat Opening Temperature – 76 to 80°C (169 to 176°F).

Thermostat Valve fully open – 88 to 90,6°C (190 to 195°F).

Thermostat Valve Lift – 7,9 to 11,9 mm (5/16 to 15/32 in).

Antifreeze solutions should be used where there is a risk of freezing.

GENERAL SPECIFICATION

FUEL SYSTEM

Air Cleaner
A two stage dry air cleaner is fitted, this air cleaner has a washable, pleated main element, and inner safety element and a self acting unloader valve.

Fuel Tank
The 47,73 litres (10.5 Imp gal) fuel tank is situated above the engine and has a thermostart reservoir and a fuel tap at the rear end.

Thermostart
C.A.V. Thermostart Mk IIIC is fitted to this tractor. Full details and data are provided in the Perkins AD3.152 Manual.

Fuel Injection Equipment
A C.A.V. D.P.A. type fuel pump with C.A.V. injector holders and nozzles are fitted. For full details, consult the Perkins AD3.152 Manual.

Fuel Filters
C.A.V. primary and secondary fuel filters with replaceable cartridge type elements are fitted. A sediment bowl is incorporated in the primary fuel filter.

Throttle Controls
A hand throttle and foot throttle are fitted as standard equipment. The action of the foot throttle overrides the hand throttle. The throttle controls are of the rod type, adjustable for length to permit setting of maximum engine speed.

TRANSMISSION

Clutch
The dual clutch is of the Auburn ventilated type, with a 305 mm (12 in) diameter main drive disc and a 254 mm (10 in) p.t.o. disc. The main drive clutch is coil spring operated and the p.t.o. clutch is Belleville spring operated.

Colour Code
Clutch Cover Assembly – White

Coil Spring Brown
- Free length 65,40 mm (2.575 in)
- Compressed Length 33,59 mm (1.283 in)
- Working Length 34,16 mm (1.345 in)
- Test Load 32,66 to 35,38 kg (72 to 78 lb)
- *Total Load Rating (12 springs)* 408 kg (900 lb)

Belleville Spring – Dark Blue
- Free Height 5,9 to 6,2 mm (0,235 to 0,245 in)
- Thickness 2,89 mm (0.114 in)
- Total Load Rating 566,9 kg (1250 lb)

Toggle Lever Height Setting
79,24 to 83,3 mm (3.12 to 3.28 in)
Use Special Tool MF 314 to adjust toggle lever height.

P.T.O. Clutch Setting
2,03 mm (0.080 in).

Use Special Tool MF 215 to adjust.

Pedal free travel, measured between the pedal and the shoulder on the transmission case – 11,11 mm (7/16 in).

Six Speed Transmission
The six speed transmission provides three forward and one reverse gear, compounded by a planetary reduction gearset on the output end of the mainshaft to give six forward and two reverse gears.

		No of teeth
Main Input Shaft Constant Mesh Gear		18
P.t.o. Input Shaft Constant Mesh Gear		17
Main Input Shaft Constant Mesh Gear		50
P.t.o. Input Layshaft Constant Mesh Gear		53
Mainshaft 1st		44
Mainshaft 2nd		46
Mainshaft 3rd		36
Layshaft 1st		15
Layshaft 2nd		23
Layshaft 3rd		33
Reverse Gear Cluster		13/21
Planetary Reduction Unit Sun Gear		18
Planetary Reduction Unit Planet Gear		18
Planetary Reduction Unit Ring Gear		54
Transmission Ratios:	1st	2.933:1
	2nd	2:1
	3rd	1.09:1
	Reverse	2.2:1
Constant Mesh Ratios:	Main	2.78:1
	P.t.o.	3:12:1
Planetary Reduction in Unit Ratios— Low Range		4:1
Planetary Reduction in Unit Ratios— High Range		1:1

Eight Speed Transmission
The eight speed transmission provides four forward and one reverse gear, compounded by a planetary reduction gearset on the output end of the mainshaft to give eight forward and two reverse gears.

		No of teeth
Main Input Shaft Constant Mesh Gear		18
P.t.o. Input Shaft Constant Mesh Gear		17
Main Input Layshaft Constant Mesh Gear		50
P.t.o. Input Layshaft Constant Mesh Gear		53
Mainshaft 1st		46
Mainshaft 2nd		46
Mainshaft 3rd		41
Mainshaft 4th		36
Layshaft 1st		15
Layshaft 2nd		23
Layshaft 3rd		28
Layshaft 4th		33
Reverse Gear Cluster		13/21
Planetary Reduction Unit Sun Gear		18
Planetary Reduction Unit Planet Gear		18
Planetary Reduction Unit Ring Gear		54
Transmission Ratios:	1st	2.933:1
	2nd	2:1
	3rd	1.464:1
	4th	1.09:1
	Reverse	2.156:1
Constant Mesh Ratios:	Main	2.78:1
	P.t.o.	3.12:1
Planetary Reduction in Unit Ratios— Low Range		4:1
Planetary Reduction in Unit Ratios— High Range		1:1

Multi-Power Transmission

The Multi-Power transmission has three forward and one reverse gear, compounded by a planetary reduction gearset to give six forward and two reverse gears which are further compounded by a hydraulically actuated two-speed input gearset to give twelve forward and four reverse gears.

		No. of teeth
Main Input Shaft Constant Mesh Gear High Range		19
Main Input Shaft Constant Mesh Gear Low Range		16
P.t.o. Input Shaft Constant Mesh Gear		18
Main Input Layshaft Constant Mesh Gear High Range		40
Main Input Layshaft Constant Mesh Gear Low Range		44
P.t.o. Input Layshaft Constant Mesh Gear		50
Mainshaft 1st		44
Mainshaft 2nd		46
Mainshaft 3rd		36
Layshaft 1st		15
Layshaft 2nd		23
Layshaft 3rd		33
Reverse Gear Cluster		13/21
Planetary Reduction Unit Sun Gear		18
Planetary Reduction Unit Planet Gear		18
Planetary Reduction Unit Ring Gear		54
Transmission Ratios:	1st	2.933:1
	2nd	2:1
	3rd	1.09:1
	Reverse	2.156:1
Constant Mesh Ratios Main (High)		2.105:1
Constant Mesh Ratios Main (Low)		2.75:1
Constant Mesh Ratios P.t.o.		3.12:1
Planetary Reduction Unit Ratio— Low Range		4:1
Planetary Reduction Unit Ratio— High Range		1:1

REAR AXLE AND BRAKES

Spiral bevel rear axle with lockable differential unit is fitted.

	No of teeth
Crownwheel	37
Pinion	6
Crownwheel and Pinion Ratio	6.17:1

Brakes

Girling 355,6 x 50,8 mm (14 x 2 in), two shoes, internal expanding full servo drum brakes, operated together or independently to assist steering. The brake pedals can be locked together for use on the road. The parking brake (where fitted) operates on both rear wheels simultaneously.

Power Take-Off

Live p.t.o. is driven from the clutch through constant mesh gears in the transmission case to the hydraulic pump and then to the p.t.o. drive shaft. Engagement by a lever on L.H. side of centre housing.

Independent p.t.o. is driven from the clutch through constant mesh gears in the transmission case to the hydraulic pump and the i.p.t.o. multi-plate wet clutch and then to the p.t.o. drive shaft. Engagement by a lever on L.H. side of centre housing.

Reduction Ratio – 3.12:1

Speeds: 540 p.t.o. rev/min at 1684 eng. rev/min
721 p.t.o. rev/min at 2250 eng. rev/min

P.t.o. Shaft Dimension

Number of Splines	6
Major Diameter of Splines	34,82 to 34,87 mm (1.371 to 1.373 in)
Minor Diameter of Splines	27,89 to 28,14 mm (1.098 to 1.108 in)
Spline Width	8,58 to 8,63 mm (0.338 to 0.340 in)
Length suitable for Drive Attachment	73,03 mm (2.875 in)
Hole Diameter	8,28 to 8,53 mm (0.326 to 0.336 in)
Distance of Hole Centre From Shaft End	15,875 mm (0.625 in)
Groove Diameter	29,34 to 29,46 mm (1.155 to 1.160 in)
Groove Radius	6,53 mm (0.265 in)
Distance of Groove Centre From Shaft End	28,575 mm (1.125 in)
Ground Speed Ratio (Live p.t.o. or Side i.p.t.o. only)	Approx 477 mm (18.8 in) of forward travel for each revolution of the p.t.o. shaft. (10–28 tyres). When ground speed p.t.o. is engaged the shaft revolves clockwise when the tractor moves forwards or, anti-clockwise when the tractor reverses.

GENERAL SPECIFICATION

10–28 TYRES – 566 mm (22.3 in) DYNAMIC ROLLING RADIUS

6 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds 1500 E.R.P.M. m.p.h.	1500 E.R.P.M. k.p.h.	1700 E.R.P.M. m.p.h.	1700 E.R.P.M. k.p.h.	2250 E.R.P.M. m.p.h.	2250 E.R.P.M. k.p.h.
LOW	1st	201.24	.99	1.59	1.12	1.80	1.48	2.38
	2nd	137.1	1.47	2.33	1.64	2.64	2.18	3.51
	3rd	74.7	2.67	4.29	3.02	4.86	4.00	6.45
	Rev.	147.77	1.35	2.17	1.53	2.46	2.92	3.25
HIGH	4th	50.31	3.95	6.35	4.48	7.21	5.93	9.54
	5th	34.2	5.81	9.38	6.59	10.61	8.73	14.05
	6th	18.7	10.64	17.12	12.06	19.88	15.96	25.70
	Rev.	36.94	5.39	8.67	6.11	9.83	8.08	13.00

8 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds 1500 E.R.P.M. m.p.h.	1500 E.R.P.M. k.p.h.	2250 E.R.P.M. m.p.h.	2250 E.R.P.M. k.p.h.
LOW	1st	201.24	0.99	1.59	1.48	2.38
	2nd	137.04	1.45	2.34	2.18	3.51
	3rd	100.33	1.98	3.19	2.98	4.79
	4th	74.74	2.66	4.28	3.99	6.43
	Rev.	147.77	1.35	2.17	2.02	3.25
HIGH	5th	50.31	3.95	6.35	5.95	9.54
	6th	34.28	5.81	9.35	8.71	14.01
	7th	25.08	7.94	14.38	11.90	19.15
	8th	18.69	10.65	13.13	15.97	25.70
	Rev.	36.94	5.39	8.67	8.08	13.00

Multi-Power Transmission

Planetary Range	Gear	Total Ratio	Road Speeds 1500 E.R.P.M. m.p.h.	1500 E.R.P.M. k.p.h.	1700 E.R.P.M. m.p.h.	1700 E.R.P.M. k.p.h.	2250 E.R.P.M. m.p.h.	2250 E.R.P.M. k.p.h.
LOW	1st Low	198.96	1.00	1.61	1.13	1.82	1.50	2.41
	1st High	152.28	1.31	2.10	1.48	2.38	1.96	3.15
	2nd Low	135.52	1.47	2.36	1.66	2.68	2.20	3.54
	2nd High	103.73	1.92	3.08	2.17	3.50	2.88	4.63
	3rd Low	73.86	2.52	4.06	2.85	4.92	4.03	6.49
	3rd High	56.53	3.51	5.67	3.97	6.39	5.28	8.49
	Rev. Low	144.12	1.36	2.19	1.54	2.48	2.04	3.29
	Rev. High	111.84	1.78	2.86	2.02	3.24	2.67	4.29
HIGH	4th Low	49.74	4.00	6.44	4.53	7.29	6.00	9.66
	4th High	38.07	5.23	8.41	5.93	9.54	7.84	12.62
	5th Low	33.93	5.87	9.45	6.63	10.67	8.81	14.18
	5th High	25.93	7.67	12.36	8.67	13.96	11.51	18.54
	6th Low	18.46	10.78	17.36	12.18	19.61	16.18	26.05
	6th High	14.13	14.09	22.68	15.91	25.52	21.13	34.03
	Rev. Low	36.53	5.45	8.77	6.18	9.94	8.17	13.15
	Rev. High	27.96	7.12	11.45	8.07	12.98	10.68	17.18

11–28 TYRES – 589 mm (23.2 in) DYNAMIC ROLLING RADIUS

6 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds					
			1500 E.R.P.M.		1700 E.R.P.M.		2250 E.R.P.M.	
			m.p.h.	k.p.h.	m.p.h.	k.p.h.	m.p.h.	k.p.h.
LOW	1st	201.24	1.03	1.66	1.16	1.87	1.54	2.48
	2nd	137.1	1.51	2.44	1.71	2.75	2.28	3.67
	3rd	74.7	2.79	4.47	3.15	5.07	4.18	6.75
	Rev.	147.77	1.40	2.26	1.59	2.55	2.10	3.38
HIGH	4th	50.31	4.12	6.63	4.66	7.49	6.17	9.93
	5th	34.2	6.07	9.77	6.86	8.83	9.11	14.67
	6th	18.7	11.14	17.92	12.58	20.26	16.71	26.89
	Rev.	36.94	5.61	9.03	6.35	10.22	8.41	13.53

8 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds			
			1500 E.R.P.M.		2250 E.R.P.M.	
			m.p.h.	k.p.h.	m.p.h.	k.p.h.
LOW	1st	201.24	1.03	1.66	1.54	2.48
	2nd	137.04	1.51	2.43	2.27	3.65
	3rd	100.33	2.06	3.32	3.10	4.42
	4th	74.74	2.77	4.48	4.16	6.69
	Rev.	147.77	1.40	2.26	2.10	3.38
HIGH	5th	50.31	4.12	6.63	6.17	9.93
	6th	34.28	6.04	9.72	9.07	14.59
	7th	25.08	8.26	13.28	12.38	19.93
	8th	18.69	11.08	17.83	16.62	26.74
	Rev.	36.94	5.61	9.03	8.41	13.53

Multi-Power Transmission

Planetary Range	Gear	Total Ratio	Road Speeds					
			1500 E.R.P.M.		1700 E.R.P.M.		2250 E.R.P.M.	
			m.p.h.	k.p.h.	m.p.h.	k.p.h.	m.p.h.	k.p.h.
LOW	1st Low	198.96	1.04	1.67	1.18	1.90	1.56	2.51
	1st High	152.28	1.36	2.19	1.54	2.48	2.04	3.28
	2nd Low	135.52	1.52	2.46	1.73	2.79	2.29	3.68
	2nd High	103.75	1.99	3.21	2.26	3.63	2.99	4.81
	3rd Low	73.86	2.80	4.51	3.17	5.10	4.20	6.76
	3rd High	56.53	3.66	5.90	4.15	6.68	5.49	8.84
	Rev Low	144.12	1.42	2.28	1.69	2.58	2.12	3.42
	Rev High	111.84	1.85	2.98	2.10	3.38	2.78	4.47
HIGH	4th Low	49.74	4.16	6.70	4.72	7.59	6.24	10.05
	4th High	38.07	5.43	8.75	6.16	9.92	8.16	13.13
	5th Low	33.93	6.10	9.82	6.91	11.14	9.15	14.74
	5th High	25.93	7.98	12.85	9.05	14.54	11.98	19.27
	6th Low	18.46	11.12	18.06	12.78	20.58	16.82	27.08
	6th High	14.13	14.65	23.59	16.61	26.74	21.98	35.38
	Rev Low	36.53	5.67	9.12	6.42	10.34	8.50	13.68
	Rev High	27.96	7.41	11.92	8.39	13.51	11.11	17.87

GENERAL SPECIFICATION

13–24 TYRES – 584 mm (23 in) DYNAMIC ROLLING RADIUS

6 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds 1500 E.R.P.M. m.p.h.	k.p.h.	1700 E.R.P.M. m.p.h.	k.p.h.	2250 E.R.P.M. m.p.h.	k.p.h.
LOW	1st	201.24	1.02	1.64	1.16	1.87	1.53	2.46
	2nd	137.1	1.49	2.42	1.69	2.72	2.26	3.64
	3rd	74.7	2.76	4.43	3.12	5.02	4.14	6.67
	Rev.	147.77	1.39	2.24	1.57	2.53	2.08	3.35
HIGH	4th	50.31	4.08	6.56	4.62	7.43	6.12	9.85
	5th	34.2	6.01	9.68	6.79	10.93	9.03	14.54
	6th	18.7	11.04	17.76	12.47	20.08	16.56	26.65
	Rev.	36.94	5.56	8.95	6.30	10.14	8.34	13.41

8 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds 1500 E.R.P.M. m.p.h.	k.p.h.	2250 E.R.P.M. m.p.h.	k.p.h.
LOW	1st	201.24	1.02	1.64	1.53	2.46
	2nd	137.04	1.50	2.41	2.25	3.62
	3rd	100.33	2.05	3.29	3.07	4.94
	4th	74.74	2.74	4.42	4.12	6.63
	Rev.	147.77	1.39	2.24	2.08	3.35
HIGH	5th	50.31	4.08	6.56	6.12	9.84
	6th	34.28	5.99	9.64	8.99	14.48
	7th	25.08	8.18	13.17	12.28	19.75
	8th	18.69	10.78	17.69	16.47	26.51
	Rev.	36.94	5.56	8.95	8.34	13.41

Multi-Power Transmission

Planetary Range	Gear	Total Ratio	Road Speeds 1500 E.R.P.M. m.p.h.	k.p.h.	1700 E.R.P.M. m.p.h.	k.p.h.	2250 E.R.P.M. m.p.h.	k.p.h.
LOW	1st Low	198.96	1.03	1.66	1.17	1.88	1.55	2.49
	1st High	152.28	1.35	2.17	1.53	2.46	2.02	3.25
	2nd Low	135.52	1.51	2.43	1.71	2.75	2.27	3.65
	2nd High	103.73	1.97	3.17	2.24	3.60	2.96	4.76
	3rd Low	73.86	2.57	4.14	3.14	5.05	4.16	6.69
	3rd High	56.53	3.63	5.84	4.11	6.63	5.44	8.76
	Rev. Low	144.12	1.41	2.26	1.59	2.56	2.11	3.39
	Rev. High	111.84	1.83	2.95	2.08	3.35	2.75	4.43
HIGH	4th Low	49.74	4.13	6.64	4.68	7.53	6.19	9.96
	4th High	38.07	5.39	8.68	6.11	9.83	8.09	13.01
	5th Low	33.95	6.04	9.72	6.85	11.03	9.06	14.59
	5th High	25.93	7.91	12.73	8.97	14.44	11.87	19.11
	6th Low	18.46	11.02	17.74	12.66	20.38	16.67	26.84
	6th High	14.13	15.53	25.00	14.64	26.50	21.78	35.06
	Rev. Low	36.53	5.62	9.04	6.37	10.25	8.43	13.56
	Rev. High	27.96	7.34	11.81	8.32	13.39	11.01	17.72

11–32 TYRES – 640 mm (25.2 in) DYNAMIC ROLLING RADIUS

6 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds					
			1500 E.R.P.M.		1700 E.R.P.M.		2250 E.R.P.M.	
			m.p.h.	*k.p.h.*	*m.p.h.*	*k.p.h.*	*m.p.h.*	*k.p.h.*
LOW	1st	201.24	1.12	1.80	1.27	2.04	1.68	2.70
	2nd	137.1	1.64	2.64	1.86	2.99	2.46	3.96
	3rd	74.7	3.01	4.85	3.41	5.48	4.52	7.26
	Rev.	147.77	1.52	2.45	1.72	2.77	2.28	3.67
HIGH	4th	50.31	4.47	7.19	5.07	8.15	6.71	10.80
	5th	34.2	6.57	10.60	7.44	11.98	9.86	15.86
	6th	18.7	12.05	19.30	13.60	21.90	18.01	29.00
	Rev.	36.94	6.08	9.78	6.90	11.10	9.13	14.69

8 Speed Transmission

Planetary Range	Gear	Total Ratio	Road Speeds			
			1500 E.R.P.M.		2250 E.R.P.M.	
			m.p.h.	*k.p.h.*	*m.p.h.*	*k.p.h.*
LOW	1st	201.24	1.12	1.80	1.68	2.70
	2nd	137.04	1.64	2.63	2.46	3.96
	3rd	100.33	2.23	3.59	3.36	5.41
	4th	74.74	3.00	4.83	4.51	7.26
	Rev.	147.77	1.52	2.45	2.28	3.67
HIGH	5th	50.31	4.47	7.19	6.71	10.80
	6th	34.28	6.54	10.82	9.85	15.84
	7th	25.08	8.94	14.38	13.45	21.64
	8th	18.68	11.99	19.29	18.05	29.04
	Rev.	36.94	6.08	9.78	8.94	14.39

Multi-Power Transmission

Planetary Range	Gear	Total Ratio	Road Speeds					
			1500 E.R.P.M.		1700 E.R.P.M.		2250 E.R.P.M.	
			m.p.h.	*k.p.h.*	*m.p.h.*	*k.p.h.*	*m.p.h.*	*k.p.h.*
LOW	1st Low	198.96	1.13	1.81	1.28	2.06	1.69	2.73
	1st High	152.28	1.48	2.38	1.67	2.69	2.21	3.56
	2nd Low	135.52	1.65	2.65	1.87	3.01	2.48	3.99
	2nd High	103.73	2.19	3.53	2.46	3.96	3.26	5.25
	3rd Low	73.86	3.03	4.86	3.44	5.53	4.55	7.33
	3rd High	56.53	3.96	6.36	4.50	7.25	5.96	9.60
	Rev. Low	144.12	1.54	2.48	1.74	2.81	2.31	3.72
	Rev. High	111.84	2.01	3.01	2.28	3.67	3.02	4.85
HIGH	4th Low	49.74	4.52	7.27	5.12	8.25	6.78	10.91
	4th High	38.07	5.91	9.51	6.69	10.77	8.86	14.26
	5th Low	33.93	6.62	10.65	7.51	12.09	9.95	16.02
	5th High	25.93	8.66	15.92	9.81	15.80	13.00	20.93
	6th Low	18.46	12.20	19.60	13.81	22.23	18.30	29.45
	6th High	14.13	15.90	25.60	18.01	29.00	23.85	38.40
	Rev. Low	36.53	6.16	9.91	6.98	11.23	9.24	14.87
	Rev. High	27.96	8.04	12.94	9.12	14.67	12.07	19.42

GENERAL SPECIFICATION

FRONT AXLE AND STEERING

A three section front axle, adjustable for track width is fitted. Outer arms are secured to the centre beam by two bolts and nuts.

Castor Angle	4° 56′
Camber Angle	3° 30′ Positive
King-pin inclination	9° 30′
Toe-in	3.17 mm (⅛ in)
King-pin diameter	31,62 to 31,64 mm (1.245 to 1.246 in)
King-pin Bush diameter	31,73 to 31,75 mm (1.249 to 1.250 in)
Pivot Pin diameter	41,96 to 41,99 mm (1.652 to 1.653 in)
Pivot Pin Bush diameter	42,04 to 42,19 mm (1.655 to 1.661 in)
Track Adjustments	
Manual Steering	1219 to 1829 mm (48 to 72 in)
Power Steering	1321 to 1829 mm (52 to 72 in)

Recirculating ball worm and nut type steering is fitted. Power assisted steering is available as an optional extra.

Steering Ratio	13:1
Power Steering Pump	Output @ 56 kg/cm² (800 lb/in²) 16,95 lit/min (3.73 Imp gal/min)
Maximum Pressure	98,43 kg/cm² (1400 lb/in²)
Power Steering System Capacity	0,47 litre (0.84 pints)

WHEELS AND TYRES

The following rim sizes are available. W9 x 28 pressed steel, single disc rear wheels, fitted with 10–28 or 11–28 tyres. W12 x 24 pressed steel, single disc rear wheels. Fitted with 13 - 24 tyres.

W9 x 28 P.A.V.T. rear wheels with pressed steel rims. Fitted with 11–28 tyres. W10 x 32 pressed steel, single disc rear wheels. Fitted with 11–32 tyres (not available in U.K.).

Maximum Pressures and Weights

Tyre Size	Ply-Rating	Maximum Pressure lb/in²	kg/cm²	Maximum Load lb	kg
10–28	4	16	1,1	1860	844
10–28	6	26	1,8	2475	1123
11–28	4	14	0,9	2070	939
11–28	6	22	1,5	2685	1218
11–32	4	14	0,9	2200	998
11–32	6	22	1,5	2860	1297
13–24	6	18	1,2	3125	1417

FRONT WHEELS

The following front wheels are available. W3 x 19 fitted with 4.00–19 tyres.
W4.50 x 16 rims fitted with 6.00–16 tyres.

Maximum Pressures and Weights

Tyre Size	Weight on the tractor front wheels		Maximum permissible front end weight		Normal tyre pressures		Maximum tyre pressures	
	lb	kg	lb	kg	lb/in²	kg/cm²	lb/in²	kg/cm²
4.00–19 (4 ply)	1362	618	1500	680	38	2,6	44	3,0
6.00–16 (4 ply)	1362	618	1980	898	26	1,8	32	2,2
6.00–16 (6 ply)	1362	618	2520	1143	26	1,8	48	3,4

WHEEL WEIGHT DATA

Pressed Steel Rear Wheels
10–28 and 11–28 tyres: Two weights per wheel, each weight weighs 49 kg (108 lb).

11–32 tyres: Adapter weight weighs 31,8 kg (70 lb) (two halves). Second weight weighs 50,8 kg (112 lb). The maximum number which can be attached is determined by the ply rating and pressure of the tyres.

Front Wheels
16 in wheels – 2 weights per wheel 42 kg (94 lb).
19 in wheels – 1 weight per wheel 45 kg (100 lb).

HYDRAULICS

The four cylinder, Scotch Yoke pump is driven from the p.t.o. driveshaft and supplies oil, under pressure, to the ram cylinder and four external tapping points. *The Pressure Control System operated from 10,6 to* 179 kg/cm² (150 to 2550 lb/in²).

The auxiliary hydraulic system can be used to operate external services and can be used to operate independently, or combined with the output of the linkage pump.

Lift Pump

Output @ 2250 eng. rev/min	15.0 litres/min (3.3 Imp. gal/min)
Hydraulic h.p. @ 2250 eng. rev/min and 140,6 kg/cm² (2000 lb/in²)	4.4 h.p.
Maximum pressure	179 kg/cm² (2250 lb/in²)
Piston Diameter	25,04 to 25,06 mm (0.986 to 0.9865 in)
Piston bore	25,08 to 25.11 mm (0.9875 to 0.9885 in)
Stroke	15,24 mm (0.06 in)
Piston Area	4,95 cm² (0.767 in²)

Auxiliary Pump (High Capacity)

Output @ 2250 eng. rev/min	31,8 litres/min (7 Imp gal/min)
Hydraulic h.p. @ 2250 eng. rev/min and 140,6 kg/cm² (2000 lb/in²)	9.8 h.p.
Multi-Power Circuit Flow @ 2250 eng. rev/min	15,9 litres/min (3.5 Imp gal/min)
Maximum Pressure	169 kg/cm² (2400 lb/in²)

Multi-Power Relief Valve Pressure

Before Serial No. 405916	42,2 to 56,2 kg/cm² (600 to 800 lb/in²)
After Serial No. 405916	49,2 to 70,3 kg/cm² (700 to 1000 lb/in²)

Multi-Power Pump (Low Capacity)

Output @ 2250 eng. rev/min	17,5 litres/min (3.8 Imp gal/min)
Relief Valve Pressure	
Before Serial No. 405916	42,2 to 56,2 kg/cm² (600 to 800 lb/in²)
After Serial No. 405916	49,2 to 70,3 kg/cm² (700 to 1000 lb/in²)

Hydraulic Tapping Points

From lift pump	Two tapping points on sides of the lift cover – ⅜ – 18 N.P.T.F. (Dry Seal) taper plug. On top of the lift cover to the left of the transfer cap – ⅜ N.P.S.M. x 19 mm (¾ in deep. On the transfer cap – ⅜ - 27 N.P.T.F. (Dry Seal).
From Auxiliary Pump	With Spool Valve fitted, 'Pioneer' self sealing quick release couplings. The hoses adjacent to the quick release couplings have identification tags for flow and return:

L.H. Couplers: Flow – White, Return – Yellow.
R.H. Couplers: Flow – Red, Return – Blue

LINKAGE

Three point linkage is fitted, the lower links being of the interchangeable ball type and the top link of the barrel and turnbuckle type.

Lower Link – between Centres	800 mm (31½ in) (880 mm (34⅝ in) 11–32 tyres)
Width and Thickness	76 x 17,8 mm (3x¹¹⁄₁₆in)
Lift Rod – Nominal Length	515 mm (20¼ in) (556 mm (21¾ in) 11–32 tyres)
Top Link – Nominal Length	647 mm (25½ in) (686 mm (27 in) 11–32 tyres)
Adjustment	584 to 725 mm (23 to 28½ in) (610 to 762 mm (24 to 30 in) 11–32 tyres)
Barrel Length	440 mm (17¼ in) (476 mm (18¾ in) 11–32 tyres)

Swinging Drawbar

Settings and Load Capacity (static)	254 mm (10 in) 990 kg (2200 lb) 356 mm (14 in) 765 kg (1700 lb)
Offset – three positions per side	1. 60 mm (2⅜ in) 2. 130 mm (5⅛ in) 3. 233 mm (9³⁄₁₆in)

GENERAL SPECIFICATION

ELECTRICAL SYSTEM

Voltage	12 volt NEGATIVE EARTH
Battery	17 plate, 96 amp (temperate) or 125 amp (cold climate).
Starter Motor	Lucas M50G or M45G with solenoid engaged pinion. Starter circuit protected by neutral *safety start switch* incorporated in the trans mission.
Dynamo	Lucas C40A
Voltage Control Box	Lucas RB 108
Lamp Bulb Sizes:	
Headlamp	12V 36/36 watt
Plough Lamp	12V 36 watt
Side Lamp	*12V 6 watt*
Tail Lamp	12V 6 watt
Number Plate Lamp	12V 6 watt
Panel Light	12V 2.2 watt
Fuses – Tractor	25 amp
Safety Cab Wiper (if fitted)	35 amp

ACCESSORIES

Front Weights	each weight weighs 27 kg (60 lb)
Auto-Hitch	Lift capacity 1814 kg (4000 lb).

Belt Pulley

Pulley Diameter	228,6 mm (9 in)
Pulley Width	165 mm (6½ in)
Gear ratio to p.t.o. shaft	1.824 : 1
Pulley Oil Capacity	0,85 litres (1½ Imp pints)

Speeds

Engine rev/min	P.T.O. rev/min	Pulley rev/min	Belt Speed m/min	Belt Speed ft/min
1685	540	985	708,6	2325
2250	721	1315	946	3105

Linkage Drawbar

Drawbars to fit Category 1 link ends are available.

Length of Drawbar, over flat section	660 mm (26 in)
Number of securing holes	9
Diameter of securing holes	19,8 mm (0.781 in)
Stay Length – from the right hand corner of the cranked section to the straight end – Upper	686 mm (27 in) (765 mm (30⅛ in) 11–32 tyres)
Lower	740 mm (29½ in) (768 mm (30¼ in) 11–32 tyres)

Selector Valve

Port thread sizes Ext 1	9/16 18 UNF
Ext 2	9/16 18 UNF
Port 'R'	¾ 16 UNF
Relief Valve Setting	260 kg/cm^2 (3700 lb/in^2)

REGULAR MAINTENANCE

Part 1 Section B

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GENERAL

This section has been compiled to enable the Manual user to ascertain quickly what action is necessary in any servicing period. The section also lists the obligatory tasks specified for FREE SERVICE VOUCHERS.

In addition to the above, operations to be executed on new tractors during the running-in period are listed as follows:

Stipulate that the tractor should be kept on light work for the first 25 hours and, that all nuts and bolts should be examined for tightness.

At 25 hours change the engine oil.

At 100 hours change the transmission oil, clean the hydraulic pump oil strainer and change the Multi-Power filter element.

IMPORTANT – THE TRANSMISSION OIL IN A NEW TRACTOR MUST NOT BE USED FOR MORE THAN THE FIRST 100 HOURS.

1. In addition to the oils listed in the tables in Part 1, Section A; details of alternative products of the companies listed are available.
2. Provided the oil change periods recommended in the Maintenance Section have been followed, discolouration of the engine oil with use is normal and of no significance.
3. The multi-purpose oils listed as recommended for U.K. can be used in other territories where available in the temperature range -1°C to 27°C (30°F to 80°F) only. Where it is desired to use such lubricants in temperature range other than this, Distributor/Dealer should provide the information.

10 HOURS OR DAILY

Check the oil level in the sump (ensure that the tractor is on level ground). Fill, if necessary.

Check the dry air cleaner hoses and unloader valve.

Inspect the primary fuel filter glass bowl and drain off any water.

Check the water level in the radiator and top up, if required, to within 37 mm (1½ in) from the top of the radiator.

Check the belt pulley oil level, when in service. Refill if necessary to the plug level with a recommended transmission oil.

Grease the front axle spindles and front hubs.

Grease the front axle pivot pin (two nipples).

Grease the levelling box and lift rods.

Grease the brake pedal bearing assembly.

Check tyre pressures.

IMPORTANT – THE SIGNIFICANCE OF DAILY GREASING IS THE FLUSHING ACTION APPLIED TO GREASE POINTS, WHICH DISPEL DIRT AND MOISTURE FROM THE BEARING SURFACES. ALL EXCESSIVE GREASE WHICH COULD ACCUMULATE DUST SHOULD BE WIPED OFF.

100 HOURS

Carry out 10 hour service.

Check the fan belt tension and adjust if necessary, deflection should be no more than 19 mm (¾ in).

Check the oil level in the power steering reservoir and top up if necessary.

Check the transmission oil level and top up if necessary. Allow time for the oil to reach the dipstick.

Check the front and rear wheel nuts for tightness.

Front	8,3 kg-m (60 lb-ft)
Rear	27,5 kg-m (200 lb-ft)

Check the clutch pedal free travel and adjust if necessary.

Examine and top up the battery with distilled water as necessary. Do not overfill.

FREE SERVICE VOUCHER

100 hours (Initial Service)

Engine

Check fan belt tension.

Clean fuel sediment bowl and gauze filters.

Renew fuel filter element (primary).

Ensure engine oil has been renewed at 25 hour period.

Renew oil filter element.

Tighten manifold nuts.

Clutch and Brakes

Check clutch operation and pedal clearance.

Check/adjust secondary clutch (if tractor performing heavy p.t.o. work).

Adjust brakes (foot and parking) as necessary, and test.

Hydraulic System and Transmission

Renew transmission oil.

Clean hydraulic pump oil strainer.

Tighten the four nuts securing hydraulic cylinder to lift cover.

Renew Multi-Power filter element.

Check operation of Multi-Power.

Check operation of Auxiliary Hydraulics.

Front Axle and Steering

Grease front hubs to flush out dust.

Adjust front hub bearings if necessary.

Check oil level in steering box.

Check power steering oil level, check operation of steering and adjust as necessary.

Grease front axle pivot pin.

Safety Frame (if fitted)

Check all safety frame bolts for correct torque tightness.

Electrical

Top up battery and clean terminals.

Lubricate dynamo rear bearing.

Check tightness of terminals and cable clips.

Check all electrical wiring and examine for chafing.

Check operation of starter safety switch.

Check operation of all lamps.

General

Lubricate all points and oil where necessary.

Examine for external leaks, generally check all bolts, nuts, clips for tightness, notably air intake connections.

Check all pipes for chafing.

Carry out any other maintenance as detailed for 100 hours.

Check tyre pressures and tightness of wheel nuts.

Check tractor for satisfactory operation of hydraulics, engine, instruments, etc., and field test.

200 HOURS

Carry out 100 hour service.

Clean the radiator fins.

Wipe the battery with a clean dry cloth and grease terminals with petroleum jelly to prevent corrosion.

Check the front axle hub nuts for tightness and adjust if necessary.

Check the brakes and adjust them if necessary.

Change the engine oil every 200 hours if conditions are dusty, or involve extensive light or heavy running. In normal conditions, using recommended oil and fuels, change the oil every 300 hours (maximum).

Lubricate the dynamo rear bearing.

Lubricate the hydraulic lift shafts.

Grease the upper steering column bush.

Grease the pressure control coupler boom pivot.

300 HOURS

The oil change period at 300 hours assumes that maintenance of the engine assemblies, i.e. air cleaner and engine lubricating oil filter has been efficiently fulfilled and that oils and fuels are within recommended specifications. If inadequate maintenance and inferior oils or fuels are used, engine oil changes must be more frequent.

Carry out 100 hour service.

Change the engine oil.

Change the lubricating oil filter element.

Change the Multi-Power filter element.

500 HOURS

Carry out 100 hour service.

Renew the primary fuel filter element.

Drain, clean, flush and refill the radiator.

Check the steering box oil level, and top up as necessary.

Renew the power steering filter element.

Change the transmission oil. Both control levers should be in the 'down' position to drain the ram cylinder.

The following operation should be carried out by the Distributor/Dealer.

Injectors serviced.

Examine valve springs and check valve clearances.

Clean engine breather pipe.

FREE SERVICE VOUCHER

600 hours (Initial Service)

Engine
Check fan belt tension.

Clean fuel sediment bowl and gauze filters.

Renew primary fuel filter element.

Drain engine oil and renew.

Renew oil filter element.

Service injectors.

Examine valve springs and check valve clearances.

Clean the engine breather pipe.

Clutch and Brakes
Check clutch operation and pedal clearance.

Adjust brakes (foot and parking) as necessary and test.

Hydraulic System and Transmission
Check transmission oil level.

Clean hydraulic pump oil strainer.

Tighten the four nuts securing hydraulic cylinder to lift cover.

Renew the Multi-Power filter element.

Check operation of Multi-Power.

Check operation of Auxiliary Hydraulics.

Front Axle and Steering
Grease front hubs to flush out dust and adjust if necessary.

Check oil level in steering box.

Check power steering oil level, check operation of steering and adjust if necessary.

Grease the front axle pivot pin.

Electrical
Top up battery and clean terminals.

Lubricate dynamo rear bearing.

Check tightness of terminals and cable clips.

Check all electrical wiring.

Check operation of starter safety switch.

Check operation of all lamps.

General
Lubricate all points and oil where necessary.

Check tyre pressures and tightness of wheel nuts.

Examine for external leaks; generally check all bolts, nuts, clips, and unions for tightness, notably air intake connections.

Check all pipes for chafing.

Check tractor for satisfactory operation of hydraulics, engine, instruments, etc., and field test.

Carry out any other maintenance detailed for 10, 100 and 200 hours.

1000 HOURS

Carry out 200 and 500 hour services.

Replace the dry air cleaner elements. The elements must be renewed at 1000 hours or after a maximum of ten washings of the main element.

The following operations should be carried out by the Distributor/Dealer.

Renew the secondary fuel filter element.

Drain, clean and refill fuel tank.

Examine the dynamo commutator and brushes.

Clean the hydraulic pump oil strainer.

Check the rubber protective sleeves on the gear levers to ensure that they are free from the ingress of water or dirt.

PRE DELIVERY AND INSTALLATION

Part 1 Section C

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GENERAL

To ensure regular maintenance of the tractor during the 12 months Warranty period, two free services must be carried out. The two Service Vouchers, detailing the work to be undertaken, cover the first 100 and 600 hours running of the tractor. The intervals between the free Service Vouchers are calculated to provide maximum benefit throughout the tractor Warranty period.

Pre-Delivery Check

The following items must be checked by the Distributor before disposal and by the Dealer before sale of the tractor.

1. Check the battery electrolyte level and terminals. Charge the battery as necessary.
2. Check all electrical connections, lights and cable clips.
3. Check the oil level in the following:

   Power Steering Reservoir
   Engine Sump
   Steering Box
   Transmission
   Belt Pulley
4. Apply grease to all greasing points.
5. Check the fan belt adjustment, which must be 19 mm (¾ in) deflection, measured midway between the water pump pulley and the crankshaft pulley.
6. Flush the radiator and fill with rain water, except where anti-freeze solution is provided.
7. Remove the clutch pedal keeper and check the clutch adjustment.
8. Check that the correct fuel is in the tank.
9. De-aerate the fuel system, check the injectors, and tighten all fuel pipe connections.
10. Check the tightness of the clips securing the hose connecting the air cleaner to engine manifold.
11. Start the engine.
12. Check the engine oil pressure.
13. Check the dynamo, ammeter and fuel gauge.
14. Check the water temperature gauge.
15. Check the engine governor with the hand and foot throttle and the tractormeter.
16. Fit the lower links and free the linkage joints. Check that the correct top link barrel is fitted.
17. Mount an implement and check the operation of the tractor hydraulics.
18. Check the tyre pressures which should be:
    front 1,83 kg/cm^2 (26 lb/in^2)
    rear 0,84 kg/cm^2 (12 lb/in^2)
19. Check all nuts, bolts, plugs, unions and clips for tightness.
20. Road test the tractor. Check the brakes, Multi-Power and tractormeter.
21. Check the oil cooler hoses for leaks and chafing.
22. Check the headlamp adjustment.
23. Fit the cigarette lighter and mirror.

Customer Installation

Instructions must be given to the Owner or Operator on the following items, appropriate to his tractor model. When the instructions have been given to the Owner or Operator, the installation Certificate must be signed by the Distributor and returned to Service Department, Coventry, also the Marketing Economic Card should be returned to the appropriate Department.

1. Use of the tractor instruction book.
2. Location and significance of the tractor and engine numbers. Importance of quoting these numbers in any communication. (It is the Distributor's responsibility *physically* to verify all serial numbers).
3. Instruments and controls.
4. Starting and stopping procedure. Position of dual range selector lever for starting.
5. Uses of Multi-Power.
6. Coasting and towing. Multi-Power tractors cannot be started by towing.
7. Gear selection. Danger of changing gear when the tractor is moving.
8. Use and adjustment of brakes. Interlock latch.
9. Use of the differential lock.
10. Running in.
11. Tyre Pressures.
12. Operation of hydraulic system.
13. Attaching and detaching implements. Danger of towing from top link.
14. Using power take-off. Danger of reversing the tractor when ground speed p.t.o. is being used.
15. Use of dual clutch. Consequences of continually resting the foot on the clutch pedal.
16. Wheel track width adjustments.
17. Accessories, Belt pulley, drawbars, hitches.
18. Lubrication and grease points. Daily attention.
19. Changing factory fill oils.
20. Engine and hydraulic oil filter replacements.
21. Operation of fuel system. De-aeration. Cold starting. Air Cleaner.
22. Fuel handling and storage. Fuel cleanliness.
23. Cooling system. Frost precautions. Fan belt adjustment.
24. Engine speed adjustments.
25. Maintenance of electrical equipment. Negative earth system.
26. Power steering. Procedure for topping up reservoir oil level.
27. Tightness of all nuts, bolts, plugs, unions and clips.
28. Use of auxiliary hydraulics.

TRACTOR STORAGE

General

When preparing a tractor for storage, comply with the following recommendations to ensure that the tractor is in good condition when required for service again. Clean the tractor thoroughly, paying special attention to greasing points and oil filler plugs.

Select a dry protected area where the tractor is not exposed to weather or livestock. If the tractor has to be stored outside, park it in the shelter of a building or wall, and cover it completely with a good tarpaulin or cover.

Tyres

If water ballasted tyres are not filled with calcium chloride it is necessary to empty and inflate with air. All tyres should be inflated slightly above normal pressures, and protected from direct sunlight.

Hydraulics

Check the oil level in the centre housing, if it is low, top-up to the high mark on the dipstick.

Using the hydraulics, raise and lower the linkage several times with the p.t.o. engaged to circulate the oil around the inside of the housing. Raise the rear linkage to its transport position. Use a piece of wood as a prop. between the top of the L.H. rear axle casing and the "crook" formed by the lift arm and the lift rod, to hold the linkage in this position. Leave the control quadrant levers at transport, i.e. outer lever placed in the fully "UP" position and the inner lever against "TRANSPORT". DO NOT move the levers from this position. The response lever should be left in the "FAST" position.

Power Steering
Remove the filler plug from the reservoir, and add oil to the filler oil level. Replace the plug.

Engine and Fuel System
Clean all the fuel filters (see Operator Instruction Book) and drain the fuel tank of diesel fuel.

Completely refill the tank and add rust inhibitor, (see chart on page 1C–04) then bleed the fuel system as stated in the Operator Instruction Book.

Start the engine and run it for 15 minutes at half MAXIMUM speed, the oil will have then thoroughly circulated through the pump and fuel lines, then refil the tank with fuel.

The following points must be observed when using fuel system protectors.

1. When using Duckham's Adcoid additive, a winter grade fuel must be used.
2. With Mobilkote 203, the following procedure is recommended:
   (a) Drain the diesel fuel tank.
   (b) Pour 2.25 litres (½ gal.) of Mobilkote 203 into the fuel tank.
   (c) Start the engine and run it until the Mobilkote has completely filled the fuel pump, pipes and injectors.
   (d) Stop the engine and fill the fuel tank with winter grade diesel fuel.

NOTE – THE FUEL TANK SHOULD BE FILLED AS FULLY AS POSSIBLE, TO PREVENT CONDENSATION FORMING ON THE UNFILLED PORTION OF THE TANK, THUS CAUSING RUSTING. RUST, IF ALLOWED TO FORM IN LARGE QUANTITIES CAN CAUSE FILTER BLOCKAGE.

Drain the radiator and block while the engine is still warm and leave the taps in the open position after all the water has drained out.

Ensure that the tractor is on level ground and drain the engine sump oil. Change the filter element.

Refill engine with a recommended grade of oil.

Remove atomisers and spray into the cylinder bores approximately 72 cc (⅛ pt.) of engine oil, divided between all the cylinders. Replace the atomisers (using new joint washers) and slowly rotate the crankshaft through one complete revolution.

Seal the fuel tank cap air intake, crankcase breather pipe and exhaust pipe with adhesive tape or polythene bags.

Lubricate throttle control linkage joints.

Clean the dry air cleaner main element.

Battery
Remove the battery from the tractor.

Check the electrolyte level, if it is low, top it up with distilled water so that the top of the separator plates are just covered. Fully charge the battery i.e. to a state of free gassing, from a separate source of supply.

Repeat this charging process every month of storage. A smear of petroleum jelly or a non-acid grease, on the terminals will prevent corrosion.

The battery should be stored in a cool dry dust-free place where there is no chance of freezing. DO NOT store batteries directly on metal or concrete surfaces.

Clutch
In order to prevent the clutch lining bonding itself to the flywheel when stored for long periods, the following procedures should be used:

Depress the clutch pedal fully (onto the step board) then slip a wedge of hardwood, or similar material in between the clutch release shaft arm and the bottom of the footrest bracket.

General
Lubricate all grease fittings with a recommended grease.

Smear starter motor and generator terminals with petroleum jelly.

Remove the seat and backrest and store them in a cool dry place where vermin cannot reach them.

Sheet Metal, Exposed Castings and Bright Metal Components
Any rusty, scratched or bare patches of sheet metal or castings should be cleaned with an abrasive paper and re-painted in the appropriate colour. Matching shades are available for all MF Tractors from MF Distributors.

The bright metal protective (see chart) can be applied either by spraying or with a brush.

Final Preparation
1. Jack up the tractor and place substantial blocks under the axles to relieve the tyres of weight.
2. Ensure that water ballast has been drained from the tyres and that any wheel weights have been removed.

Manufacturer	Diesel Fuel System	Bright Metal Surfaces
Duckham's	7% Adcoid Fuel Additive	Hydropel 400
Esso	IL 1047A	Rust-Ban 392
Shell	Shell Calibration Fluid "C" (U.K. only) Shell Calibration Fluid "B" (Overseas)	Ensis 256
B.P.	Energol LM	Energol CPD 32
Castrol	Castrol Iso	Surecoat
Mobil	Mobilkote 203	Mobilkote 236

PREPARING THE TRACTOR PRIOR TO RE-ENTERING SERVICE

1. Remove all the covering from the exhaust pipe, air intake, crankcase breather pipe and fuel tank filler cap.
2. Close all taps on the cylinder block and radiator. Re-fill the system with either clean rain water or soft water. In winter, re-fill with an anti-freeze solution. Check for leaks.
3. Check that the battery is fully charged and that the electrolyte is to the correct level. After checking the specific gravity of the electrolyte (see section 8A), refit the battery into the tractor.
4. Wipe the petroleum jelly from the dynamo and starter motor terminals.
5. On diesel engine tractors, the fuel level should be high, but some topping up may be necessary. Bleed the system.
6. Grease all nipples as recommended in the Regular Maintenance Section of the Operator Instruction Book.
7. Check the oil level in the engine sump and the transmission. Top up if necessary.
8. Remove the wooden blocks from the clutch pedal and hydraulic linkage.
9. Remove the jacking blocks from under the axles.
10. Check tyre pressures and adjust if necessary.
11. Start the engine and run on light load for 10-15 minutes.
    Check the instruments to ensure that all services are working correctly, especially the oil pressure gauge and ammeter.

IF ANY INSTRUMENT INDICATES A MALFUNCTION IN ITS SYSTEM, SWITCH OFF THE ENGINE IMMEDIATELY AND RECTIFY THE FAULT BEFORE RESTARTING.

Drive the tractor for a short time under light load, constantly checking all instruments and making use of all systems to check for correct functioning.

TRACTOR WATERPROOFING

General

Before working in Paddy Fields certain essential modifications must be made to prevent water entering the major components and electrical equipment of the tractor. Complete sealing is not possible if the depth of the water exceeds 60 cm (24 in). Ideally, only tractors with sealed type disc brakes should be used in such conditions, as little can be done to ensure braking efficiency with drum brakes.

MODIFICATIONS

Clutch Housing Drain Hole

1. Remove the split pin from the drain hole under the clutch housing.
2. Enlarge the hole, tap and fit a screwed plug.

Clutch Housing Cover Plate

Ensure that a gasket (180 481 M1) is fitted between the clutch housing and the cover plate (180 482 M1).

Engine Breather Pipe

1. Shorten the existing breather pipe by approximately 20 cm (8 in).
2. Attach a suitable length of rubber hose, 23 cm (9 in) long to the shortened breather pipe.
3. Route the hose to the front of the engine and secure it to one of the timing case bolts with a suitable clip.

NOTE – THE BREATHER PIPE IN AN UNMODIFIED CONDITION IS OF A CRITICAL LENGTH. AFTER MODIFICATION, THE PIPE MAY BE LENGTHENED, BUT NEVER SHORTENED AND MUST POINT IN A GENERALLY DOWNWARD DIRECTION, WITHOUT ANY RESTRICTION, OR A 'U' BEND WHICH COULD TRAP LIQUID OR DIRT.

Engine and Transmission Dipsticks

Remove the dipsticks and replace them with seal fit tapered rubber plugs. The dipsticks can be stored in the tractor toolbox.

Brake and Clutch Pedal Cross – Shafts

The bosses from which the brake and clutch pedal cross-shafts protrude should be drilled, tapped and fitted with grease nipples. Charge the nipples with a recommended grease until grease exudes from the bearings, thus building up a wall of grease and preventing the ingress of water. Do not over-grease.

Brakes

Enlarge each sealed brake housing drain hole, tap and fit a screwed plug.

P.T.O. Shaft

Grease the thread of the p.t.o. cap and screw it fully home.

ELECTRICAL SYSTEM

Starter Motor and Solenoid

1. Remove the starter motor complete. Thoroughly clean the starter motor and solenoid.
2. Carefully fill any slots, or gaps, where water could enter with 'VYPATCH' putty, available from:
   Plastic Coating Ltd.,
   Products Division,
   Trading Estate,
   Farnham, Surrey,
   England.
3. Spray the starter motor and solenoid with 'VYCOAT' plastic coating (also available form the same address).
4. Leave the 'VYCOAT' coating to harden for at least 10 minutes, then give a second liberal coat of 'VYCOAT'.
5. Leave the 'VYCOAT' to finally dry, then clean off all terminals to ensure a good contact when reconnecting the wiring.
6. Refit the starter motor.

Dynamo

Only the Lucas type C40A dynamo, should be used. The dynamo must be fitted with a breather pipe, as, unlike the starter motor, continuous air circulation is necessary.

1. Remove the dynamo from the tractor.
2. Disassemble the dynamo and thoroughly clean all components.
3. Strip the paint from the dynamo outer case.
4. Drill and tap the top of the dynamo outer case ¼ UNC to accept a breather pipe.
5. Using a piece of tubing approximately 25 cm (10 in) long tap the inside diameter at one end ⅛ in x 27 PTF and fit a one-way breather (182 099 M91) is suitable).
6. Die the opposite end of the tube ¼ UNC and screw the tube into the tapped hole in the top of the dynamo case.
7. Apply a thick layer of grease to the commutator, the bearing shafts and the outside diameter of the armature.
8. Spray a thick coating of 'VYCOAT' on to the armature field coils.
9. Remove the grease from the armature, bearing shafts and commutator.
10. Re-assemble the dynamo.
11. Seal all openings with 'VYPATCH' putty, then spray the entire exterior of the dynamo with 'VYCOAT'.
12. Leave for at least 10 minutes, then liberally re-coat the dynamo with 'VYCOAT'. Allow the 'VYCOAT' to finally harden, then clean the terminals thoroughly.
13. Refit the dynamo and reconnect the wiring harness.

Voltage Control Box

Ensure that the rubber gasket fits correctly; also, if necessary, seal with 'VYCOAT'.

Batteries

Keep the battery terminals clean and well smeared with petroleum jelly.

Special Extra Maintenance

Every 10 hours or daily.

1. Charge all grease points with a recommended grease until grease exudes from the seals.
2. Remove the dynamo drain plug and allow any water to drain away. Replace the plug.

Every 50 hours or weekly.

1. Remove the special drain plugs from the clutch housing and sealed brake housings and allow any oil which may have accumulated to drain away.
2. Ensure that the engine breather pipe is clear of foreign matter.

DE-LUXE SEAT

Figure 1

This seat is a pan type unsprung seat with a detachable foam rubber cushion covered in waterproof leathercloth.

The cushion is secured to the seat pan by webbing straps. A backrest, similarly upholstered, is secured to the seat pan by bolts and nuts.

The seat pan is connected to the tractor by a double hinged link which in turn is attached to a mounting bracket secured to a seat riser. The seat riser is fitted to the tractor hydraulic lift cover by studs and nuts.

The double hinged link allows the seat to be tilted backwards, enabling the driver to operate the tractor from a standing position.

ADJUSTMENTS

The seat riser has two 50,0 mm ($1\frac{31}{32}$ in) long slots in the base allowing fore and aft adjustment on the mounting studs in the hydraulic lift cover. In addition a 246,8 mm ($9\frac{23}{32}$ in) long slot is machined to the inclined face of the riser to allow variable height adjustment of the seat.

SPRING SUSPENSION SEAT

Figures 2, 3, 4 & 5

This seat has a pressed steel pan to which is attached a foam rubber insert, with a formed leathercloth cover bonded to the pan. A plastic sealing strip is attached around the edge of the cover and pan, thus making the upholstery waterproof.

The seat cover incorporates a waterproof air valve, which allows the foam rubber insert to "breathe". The seat pan has water drain holes and can be inverted when the tractor is parked, giving additional weather protection to the upholstery.

The seat pan is mounted on nylon bearings to the front of a tubular swing arm (1, Figure 2), the swing arm in turn, is mounted on nylon bushes and bolted to the seat pillar (2). A bracket (16, Figure 3) bolted to the seat backrest, locates on runners (17) with nylon inserts, welded to a channel section plate (18) on the seat pillar. The channel section plate, is mounted at the top on nylon rollers (3, Figure 2) which travel through a vertical plate on tracks (4) welded to the seat pillar.

The suspension is governed by two coil springs (5) which are mounted vertically with the seat pillar. The springs are attached at one end to a threaded spring adjuster (6), secured to the top of the seat pillar by a control knob (7), the other end of the springs are mounted on a pin (8) fitted to the base of the channel section plate. Nylon spacers (9) are postioned between the spring end loops on the plate pin to maintain the springs in a vertical position.

The spring adjuster is threaded into the control knob and rotation of the knob causes the spring adjuster to rise or fall, depending on the direction of rotation, thereby altering the tension in the springs to suit the driver's weight.

A hydraulic damper (10), is located between the fixed seat pillar and sliding channel section plate, to compensate for seat oscillations when travelling over rough ground.

The seat assembly is mounted on runners, with nylon inserts, to a seat riser (11) secured by studs and nuts to the tractor hydraulic lift cover.

ADJUSTMENTS

A control lever (20, Figure 3) situated on the bottom of the seat frame allows the seat to be locked in any position on the seat riser. With the lever in the central position, the seat can be moved on its runners, along the riser, giving fore, aft and height adjustment. The seat is locked in the selected position by moving the lever to the right.

To adjust the rake of the seat, loosen the four nuts (14, Figure 2) securing the bearings and housings (12) to the seat pan and tubular swing arm. The bearing housings are slotted and sliding the bearing housings fully rearwards will increase the rake by 25 mm (1 in). Conversely sliding the housings fully forwards will reduce the rake by 25 mm (1 in). Re-tighten the nuts when the desired inclination is reached.

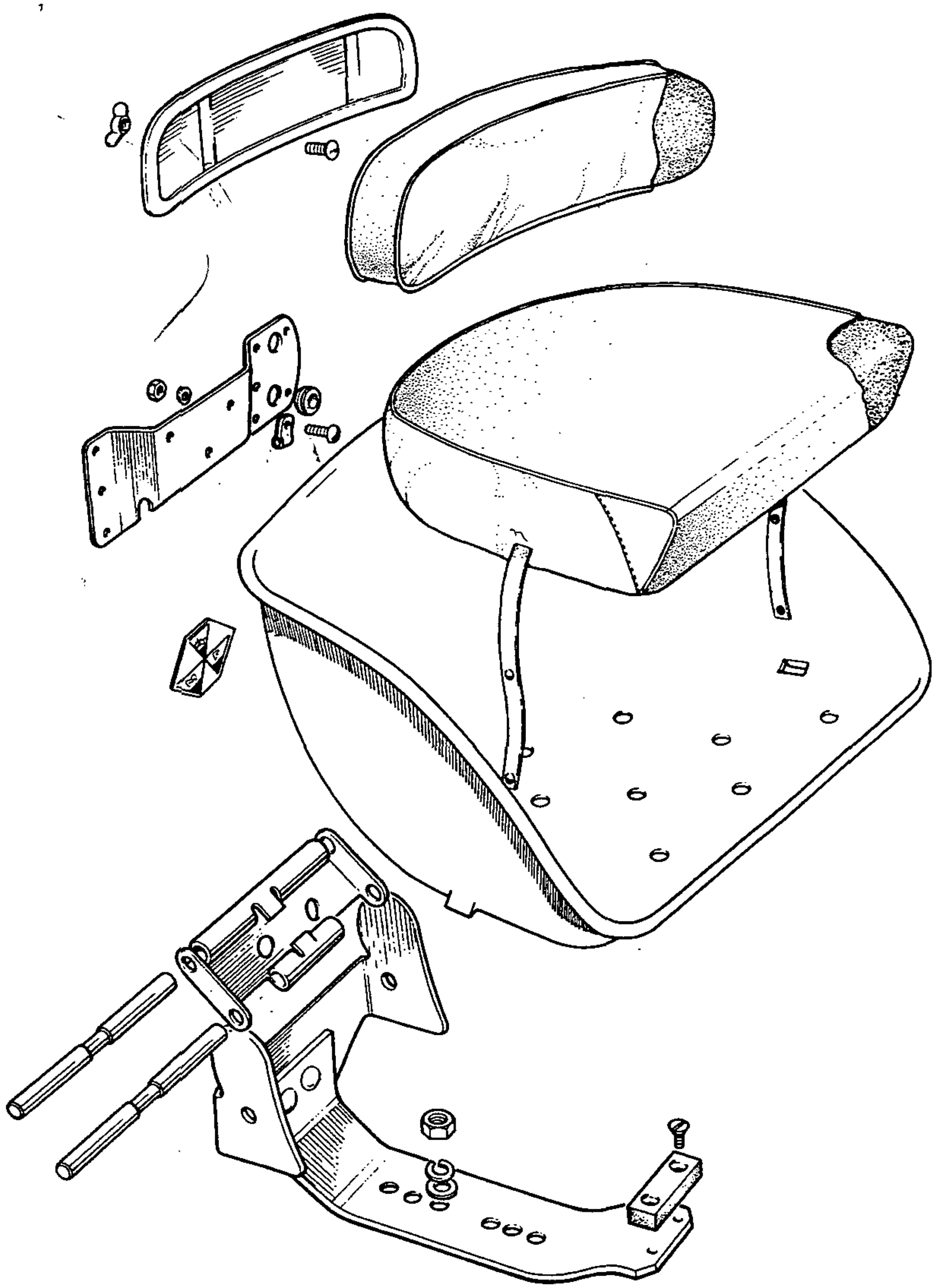


FIG. 1

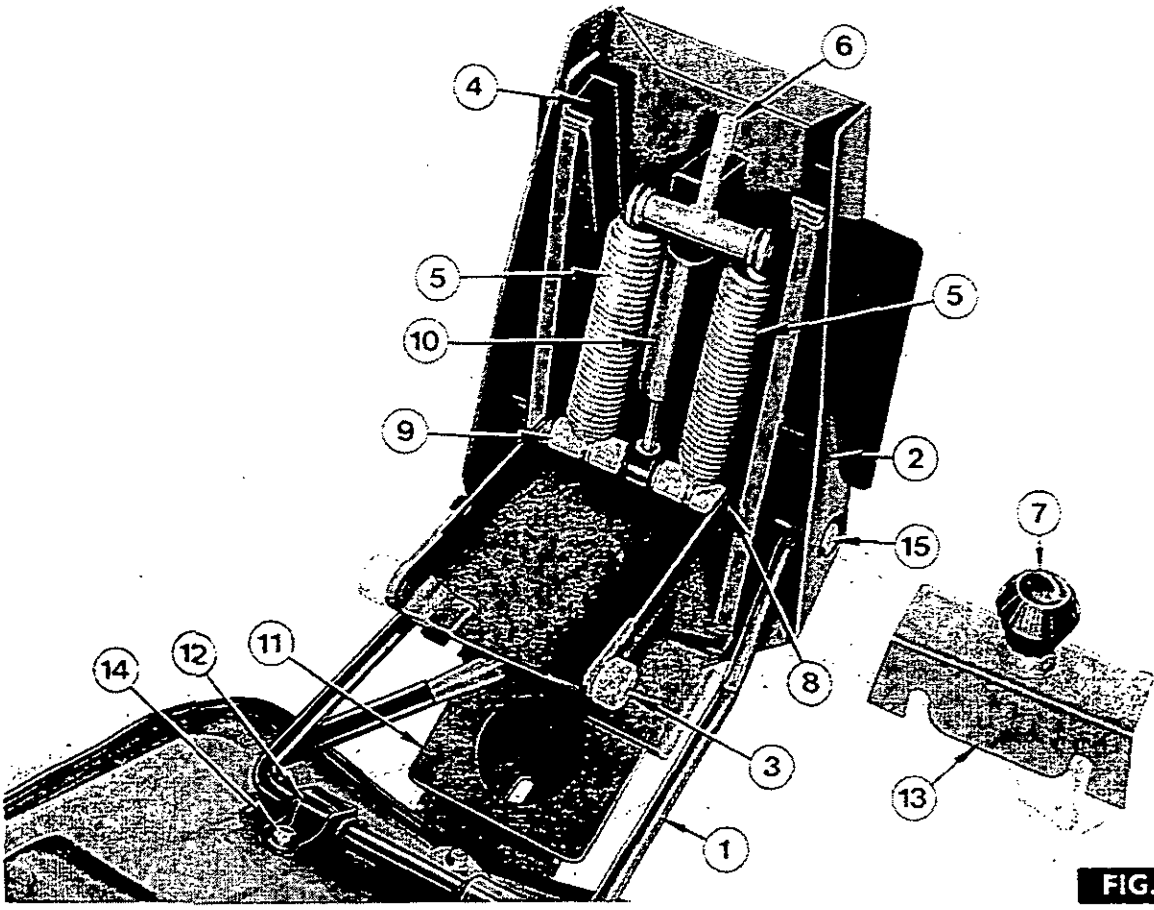


FIG. 2

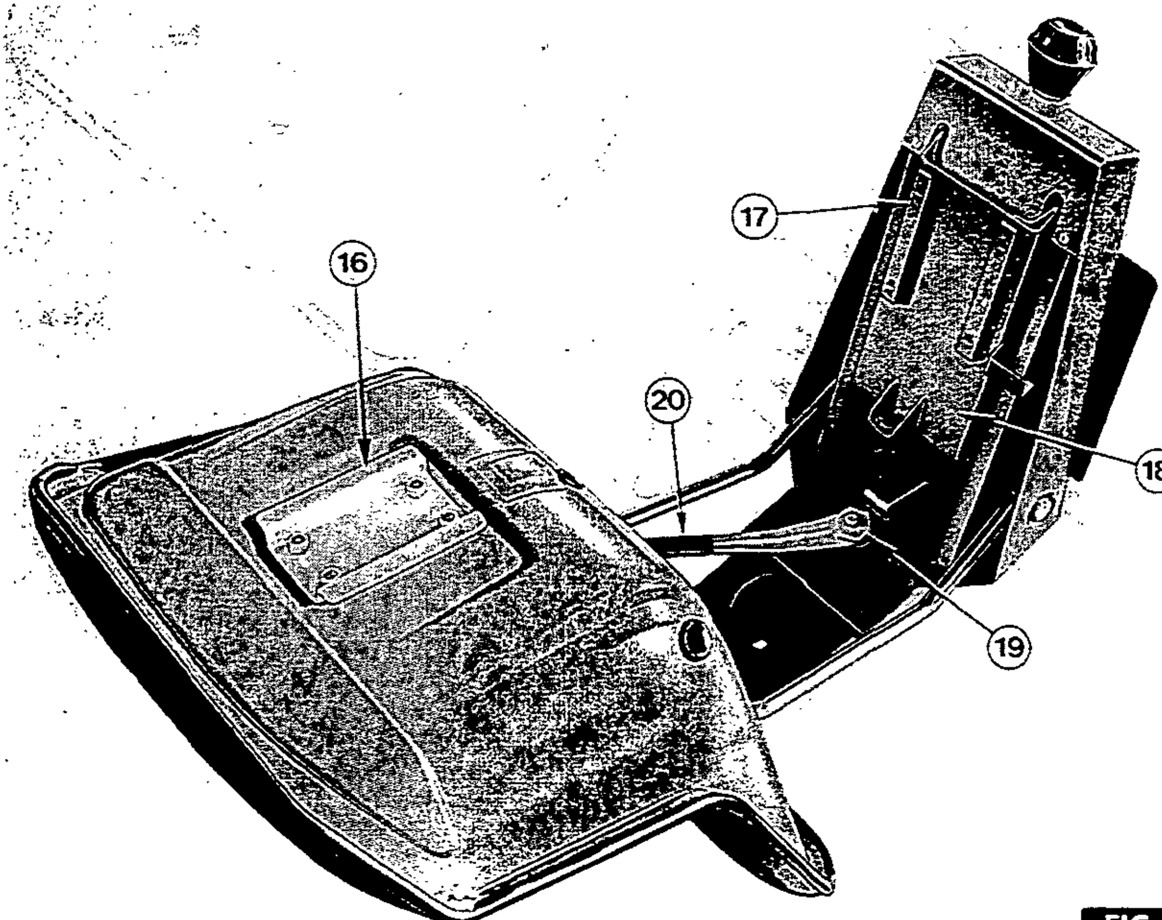


FIG. 3

SPRING SUSPENSION SEAT

Disassembly and Reassembly 2A-01-05

Figures 2, 3, 4 & 5

1. Rotate the control knob (7, Figure 2), in an anti-clockwise direction to remove the tension from the suspension springs, and to release the control knob from spring adjuster.
2. Lift the back of the seat pan to disconnect it from its runners (17) on the channel section plate (18) in the seat pillar (2).
3. Remove the four nuts and washers (14), bearing caps (12), and nylon bearings securing the seat pan to the tubular swing arm (1) and lift off the seat pan.
4. Remove the seat suspension assembly from the studs in the tractor hydraulic lift cover.
5. Unscrew the self tapping screws retaining the top cover (13) and control knob to the seat pillar and lift off the cover complete with control knob. Remove the retaining circlip beneath the top cover, to detach the knob.
6. Lift the base of the channel section plate as shown in Figure 4, to free the nylon rollers (3, Figure 2) from their tracks (4) on the seat pillar.
7. Remove the snap rings and washers retaining the spring loops to the spring adjuster (6) and remove the adjuster.
8. Remove the snap rings retaining the pin (8) to the bottom of the channel section plate and withdraw the pin. The nylon spacers (9) and piston end of shock absorber (10) can now be removed.
9. Remove the snap ring and pin securing the barrel end of the shock absorber.
10. Remove the bolts (15) securing the tubular swing arm and nylon bushes to the seat pillar.
11. Remove the bolt (19, Figure 3) securing the seat locking lever (20) to the seat and lift off the lever. The large bolt beneath the locking lever can now be removed to release the locking plate, situated beneath the top face of the seat riser.
12. Slide the seat frame backwards to detach from the riser.
13. Reassembly is a reversal of the disassembly procedure.

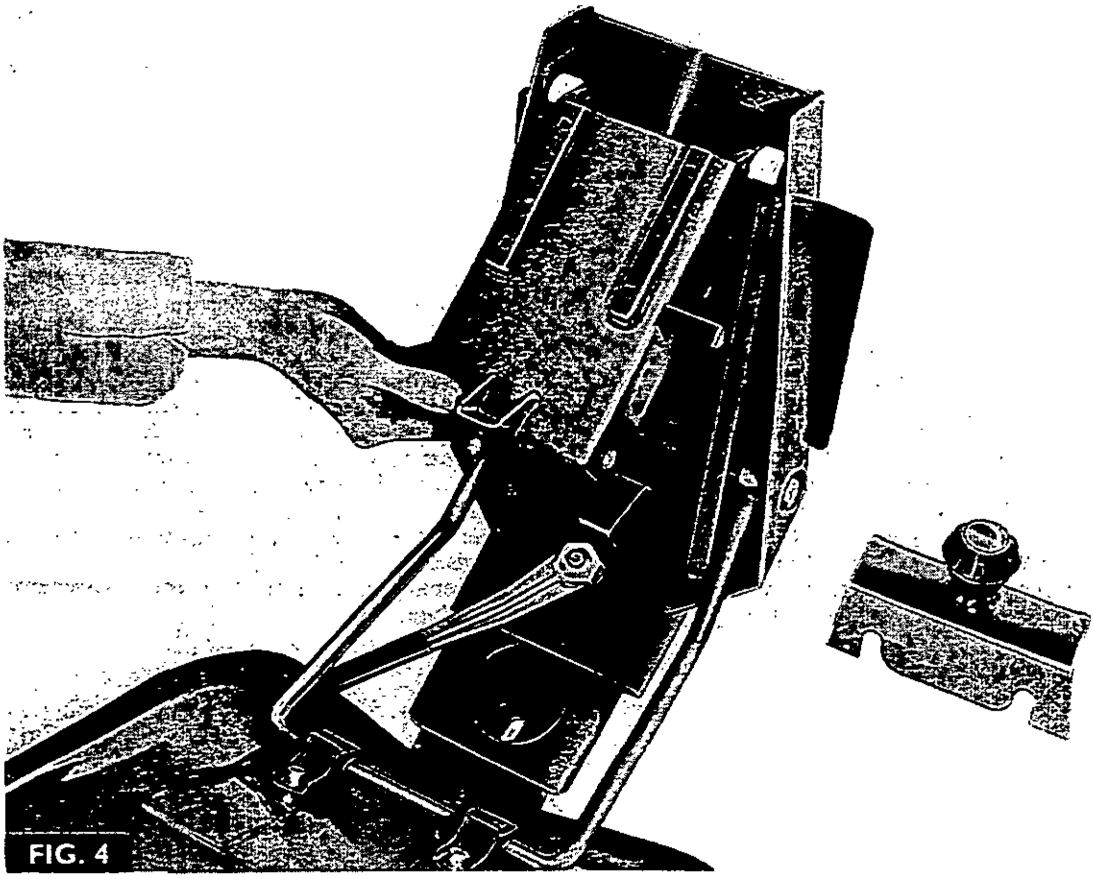


FIG. 4

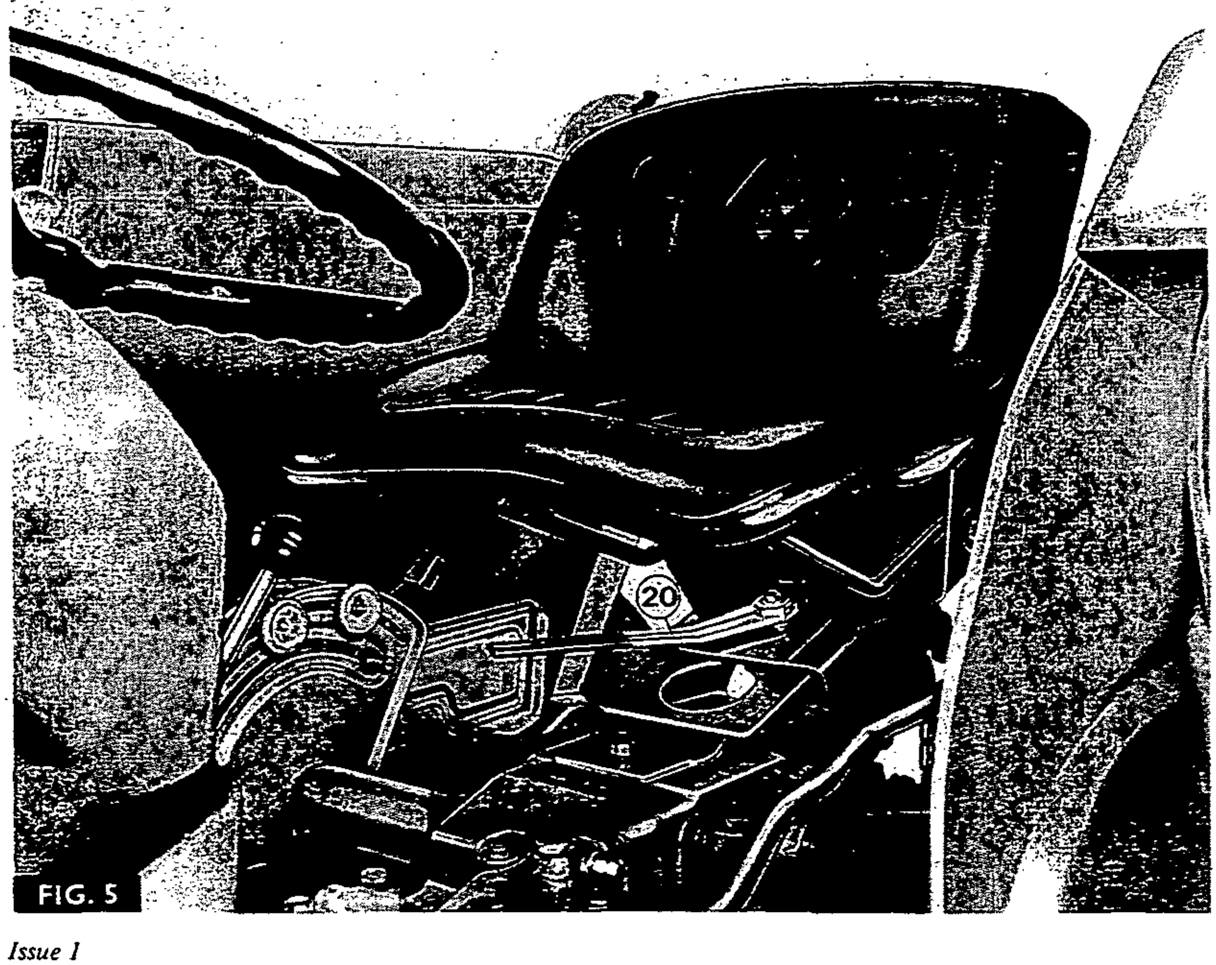


FIG. 5

SHEET METAL AND FENDERS

Part 2 Section B

Table of Contents

GENERAL

Fig. 1. The hood (1), grille (2), fender (5) and footplate (3) assemblies are shown. There is also a lower instrument panel (4) which gives access to the underside of the instrument panel. The battery is inspected by removing the access panel (6).

Each of the fenders (5) incorporate a toolbox with a hinged lid.

All sheet metal is readily removed and refitted and gives protection to the tractor and the operator. The tractor must not be operated with any of these panels removed, except for the p.t.o. guard which has to be removed when certain implements are used.

Always keep the sheet metal clean and respray, as soon as possible, any parts which become chipped, to prevent corrosion.

HOOD AND GRILLE ASSEMBLY

Removal and Refitment 2B-01-02

Removal
1. Remove the six bolts and washers securing the hood to the instrument panel.
2. Slacken the two bolts and washers securing the grille to the front axle support.
3. Disconnect the two oil cooler pipes (if fitted) at the couplings adjacent to the grille front panel.
4. Remove the battery access panel.
5. Disconnect the headlight wiring at the light switch.
6. Fig. 2. Lift the hood and grille assembly clear of the tractor as shown.

Refitment
1. Place the hood and grille assembly over the tractor, locating the grille on the bolts at the front axle support.
2. Secure the hood to the instrument panel with the six bolts and washers and tighten the bolts at the front axle support.
3. Reconnect the oil cooler pipes (if fitted).
4. Reconnect the headlight wiring at the light switch and refit the battery access panel.

GRILLE AND SIDE PANELS ASSEMBLY

Removal and Refitment 2B-02-02

Removal
1. Remove the hood and grille assembly as stated in operation 2B-01-02.
2. If necessary, remove the oil cooler (if fitted) as stated in operation 7B-01-02 and then withdraw the two oil cooler pipes from the grille.
3. Release the headlight wiring from the hood.
4. Remove the five bolts and washers securing the grille to the hood, and the two bolts and washers each side, securing the side panels to the hood.
5. Remove the grille and side panels assembly from the hood.

Refitment
1. Place the grille and side panels assembly in position on the hood and secure the grille with the five bolts and washers and the side panels with two bolts and washers each side.
2. If necessary, refit the oil cooler pipes (if fitted) and the oil cooler.
3. Secure the headlight wiring to the hood with the clips.
4. Refit the hood and grille assembly as stated in operation 2B-01-02.

SEALS REMOVAL AND REPLACEMENT 2B-03-02

Removal
1. Remove the hood and grille assembly as stated in operation 2B-01-02.
2. If necessary remove the oil cooler as stated in operation 7B-01-02 and withdraw the oil cooler pipes.
3. Fig. 3. Release the required panel by removing the two bolts and washers.

NOTE – IF THE BOTTOM PANEL IS TO BE REMOVED THE TWO SIDE PANELS MUST BE REMOVED FIRST.

4. Remove all traces of the old seal and adhesive from the panel.

Replacement
1. Pre-coat the neoprene material on the contact surface of the new seal with an approved adhesive (i.e. Bostik 19A 186) and allow to dry completely.
2. Apply a coat of the adhesive to the metal surface and allow it to become tacky.
3. Place the seal in position, applying pressure evenly to exclude air bubbles.
4. Refit the panel and secure with the two bolts and washers.
5. If necessary, refit the oil cooler pipes and the oil cooler.
6. Refit the hood and grille assembly as stated in operation 2B-01-02.

LOWER INSTRUMENT PANEL

Removal and Refitment 2B-04-02

Removal
1. Remove the battery access panel.
2. Disconnect the tube from the air cleaner service indicator.
3. Fig. 4. Remove the two bolts and washers securing the lower instrument panel and release the panel from the instrument panel as shown.
4. If necessary, remove the air cleaner service indicator, by removing the screw, nut and washers securing the mounting bracket to the lower panel.

Refitment
1. If necessary, refit the air cleaner service indicator and secure it to the lower panel with the screw, nut and washers.
2. Fig. 4. Refit the lower panel and secure with the two bolts and washers.
3. Reconnect the tube to the air cleaner service indicator and refit the battery access panel.

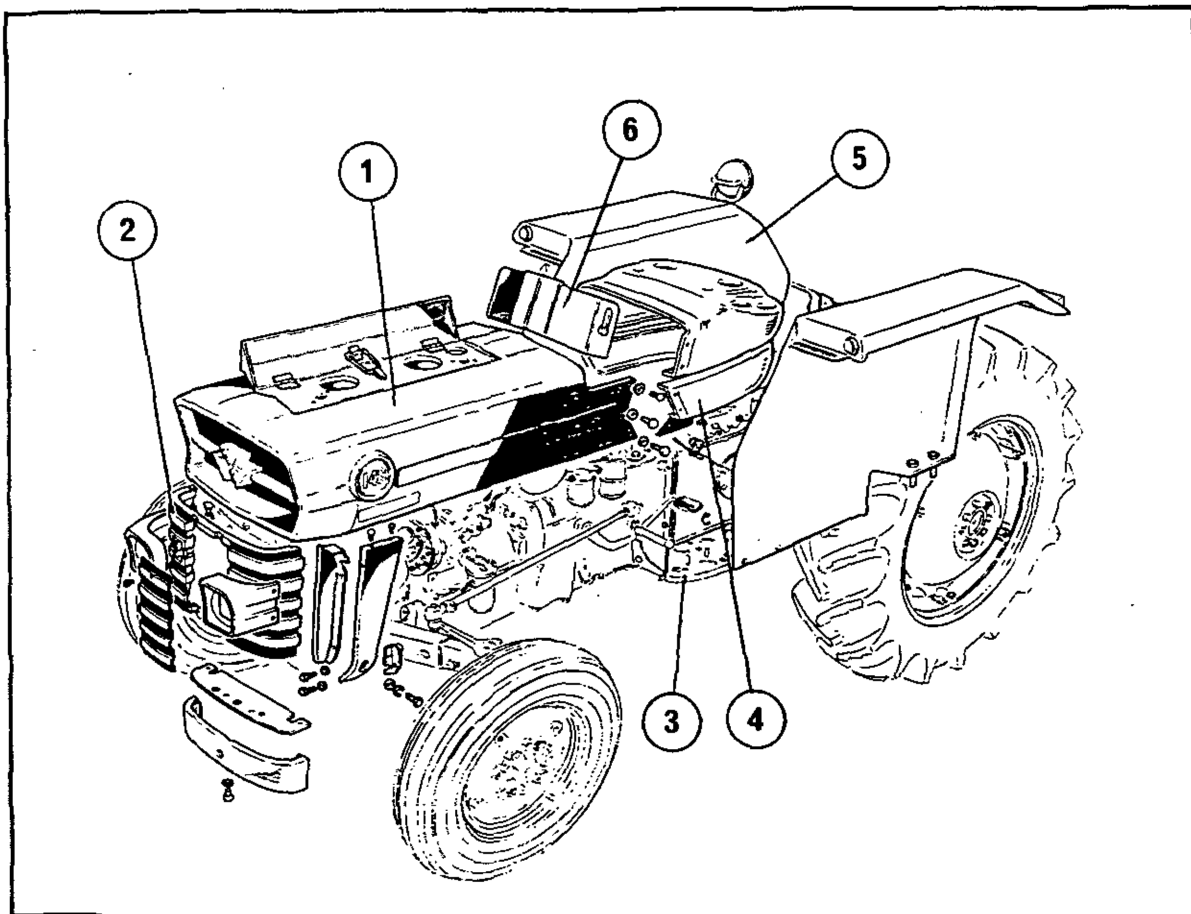


FIG. 1

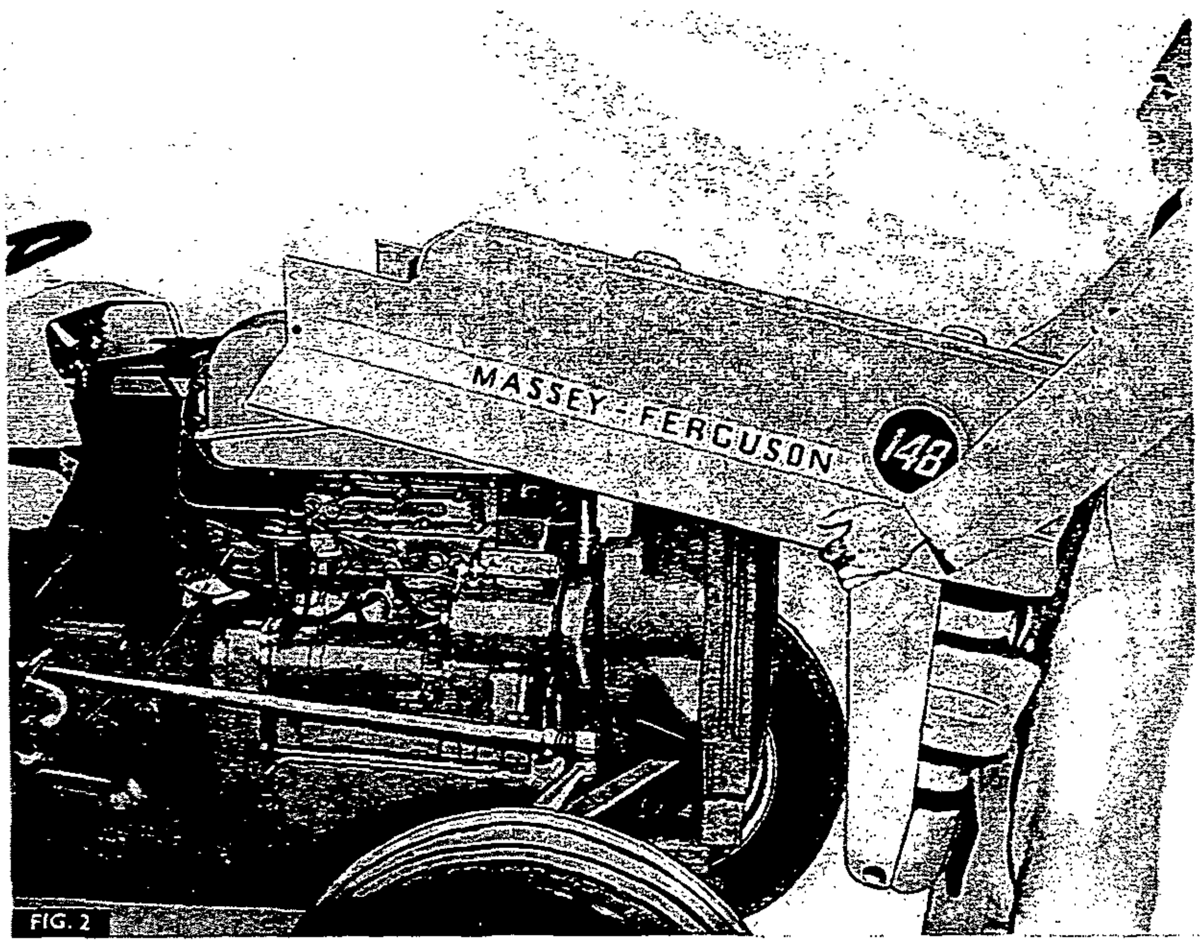


FIG. 2

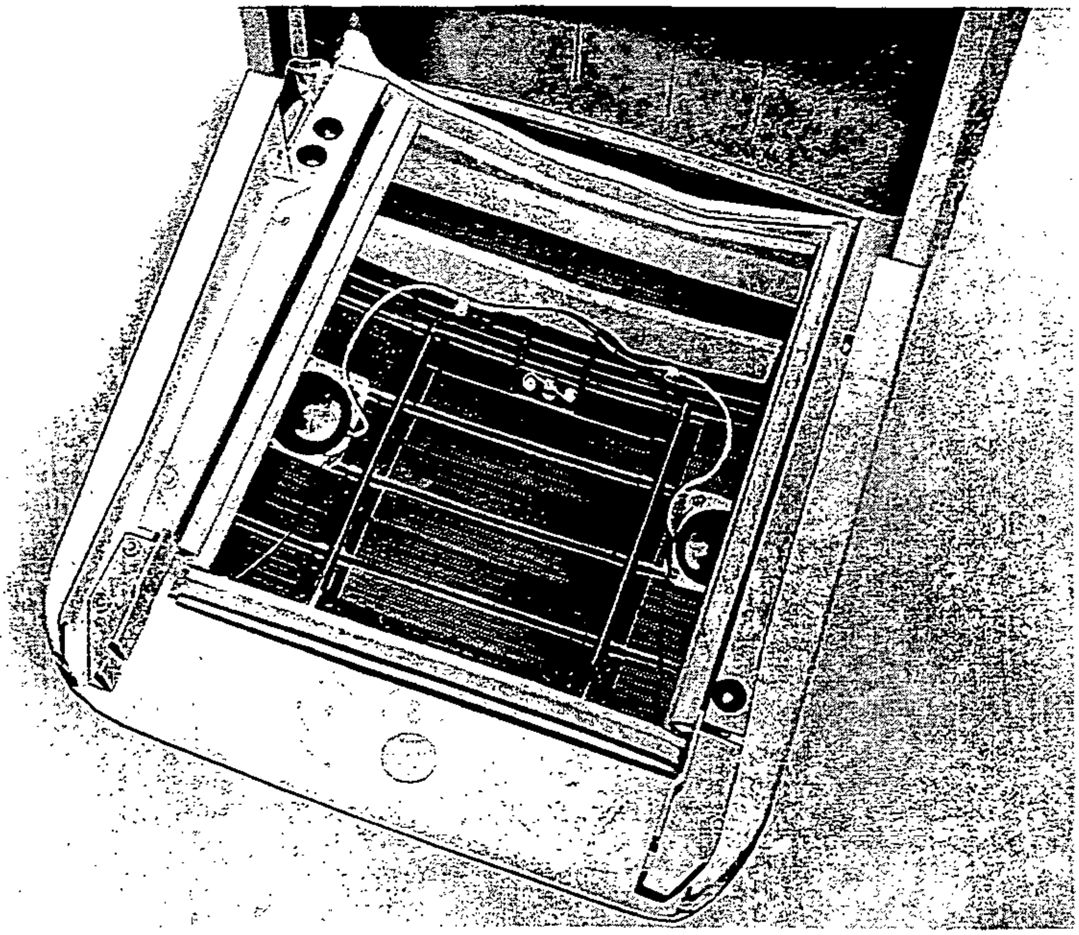


FIG. 3

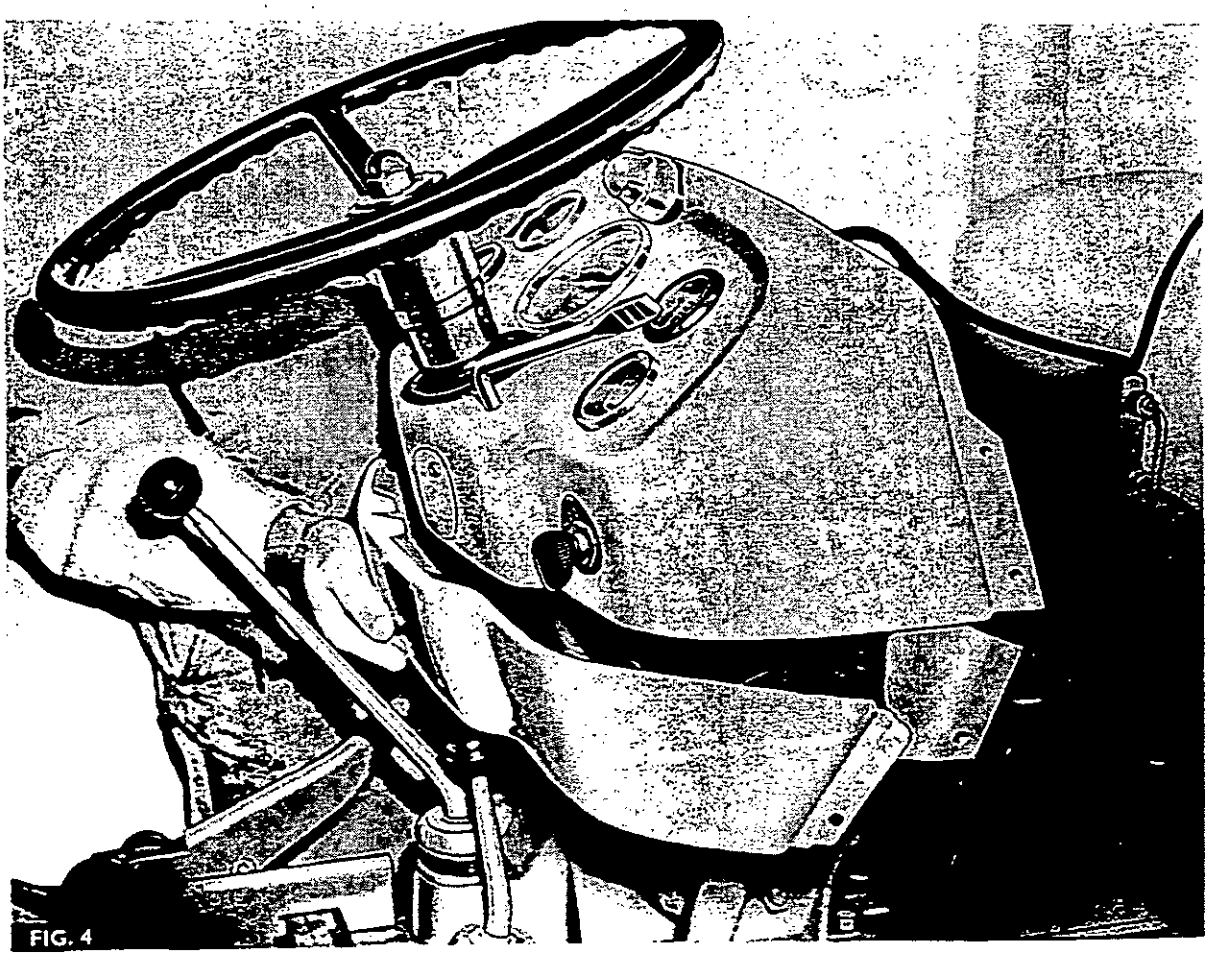


FIG. 4

FENDER

Removal and Refitment 2B-05-05

Removal

1. Disconnect the rear light wiring (if fitted) at the fender.
2. Remove the three bolts, nuts and washers securing the fender to the footplate.

 NOTE – IF A SAFETY FRAME IS FITTED, THE UNDER FENDER SUPPORT MUST BE REMOVED.

3. Remove the two nuts, spring washer, flat washers and plate securing the fender to the trumpet housing.
4. Lift the fender slightly and remove the two bolts from inside the tool box.
5. Lift the fender clear of the tractor.

Refitment

1. Locate the fender on the trumpet housing and refit the two bolts through the base of the tool box.
2. Secure the fender with the two nuts, spring washers, flat washers and plate, then tighten the nuts to 17 kg-m (125 lb-ft).
3. If necessary, refit the under fender support.
4. Secure the fender to the footplate with the three bolts, nuts and washers.
5. Reconnect the rear light wiring (if fitted) at the fender.

FOOTPLATE

Removal and Refitment 2B-06-05

Removal

1. Remove the three bolts, nuts and washers securing the fender to the footplate.
2. Remove the four bolts, nuts and washers securing the footplate to the front and rear mounting brackets and remove the footplate.

Refitment

1. Locate the footplate on the mounting brackets and secure with the four bolts, nuts and washers.
2. Secure the fender to the footplate with the three bolts, nuts and washers.

SAFETY FRAME AND CABS

Part 2 Section C

Operation No.	Table of Contents	Page No.

GENERAL

This section details fitment and rigid safety cabs.

For full details of the Government Statutory Instrument 1967 No. 1072, or any queries related to safety cabs, apply to:

Ministry of Agriculture, Fisheries and Food,
Safety Branch
Great Westminster House
Horseferry Road,
London S.W.1.

A comprehensive statement regarding Distributor's and Dealer's responsibilities related to cab fitment and Massey-Ferguson policy concerning safety cabs is contained in Service Information TRAC 233, 8th October, 1970, which was circulated to all Massey-Ferguson Distributors and Dealers in Great Britain.

Before beginning any assembly, always check the contents of the kits and prepare the components for assembly, as described.

SAFETY FRAME KIT

Fitment 2C-01-02

Before Fitment
The following important points must be noted before attempting assembly:

ALWAYS:–

Remove any surface irregularities (paint lumps, burrs, swarf and dirt) from mating faces, this will ensure firm contact when torque loading is applied.

Assemble the complete safety frame with all bolts *finger tight, then fully tighten all bolts, progressively* and evenly.

Torque values must be strictly obeyed.

ALL bolts which project into the inside edges and faces of the frame or cab, must be fitted from the inside, facing outwards, i.e. the threaded portion of the bolt and the nut must be outside the frame to reduce the number of sharp corners and projections to a minimum.

During assembly use only the bolts and other hardware supplied in the kit. these bolts are manufactured from high tensile steel; the use of substitute mild steel nuts and bolts automatically invalidates regulation approval and could be extremely dangerous. All slotted holes must be covered by a flat washer and all nuts must be secured with a lock washer, except where self locking nuts are provided. Before assembly, identify all of the safety cab components.

If the frame is to be removed for tractor servicing, refitting must follow the initial procedure exactly and all bolts must be re-tightened to the correct torque values.

ILLEGAL PRACTICES

Never drill the frame to accept equipment such as extra mirrors or flashing indicators as this could dangerously weaken the frame structure.

Never weld anything to the frame.

Never straighten a bent frame.

Never interchange components with other safety frames even of identical type, or modify the frame in any way whatsoever without prior approval by Massey-Ferguson.

OTHER IMPLEMENTS

It is an offence to attach other implements or fittings to the tractors by means of the safety frame or its attachment points unless such attachments are approved by Massey-Ferguson.

New Tractors Fig. 1
New tractors are despatched from the factory with the rear lower struts fitted (6, 7, 8, 9, 10 and 11) except where an MF approved conversion is to be fitted.

Assembly Method (Figs. 1 and 2)

1. Remove the bolt and nut securing the rear lower strut to the fender top. Discard the nut but retain the bolt.
2. Slacken the fender mounting bolts and the rear lower strut mounting bolts.
3. Attach the rear upper struts (3 & 5) to the top of the fender using two ⅝ UNF x 50,8 mm (2 in) bolts and ⅝ lockwashers.

   NOTE – ENSURE THAT THE UPPER STRUTS ARE FITTED WITH THE OPEN THREADED HOLES ON THE INSIDE OF THE MEMBER.

4. Attach each front strut (2 & 4 Fig. 1) to the transmission housing using three ⅝ UNC x 44,5 mm (1¾ in) bolts and ⅝ lockwashers.
5. Inspect the roof frame for obstructions in strut location points (extraneous paint, packing or weld). Raise the roof frame and locate it on the four struts.

   NOTE – THE FRAME SERIAL NUMBER PLATE MUST BE LOCATED IN THE FRONT L.H. CORNER OF THE ROOF FRAME.

6. Secure the roof frame with two ½ UNF x 89,0 mm (3½ in) bolts, plain washers, lock-washers and nuts per strut.

   IMPORTANT – THE ROOF FRAME BOLTS MUST BE FITTED FROM THE INSIDE, I.E. NUTS AND ALL WASHERS ON THE OUTSIDE.

7. Tighten all bolts and nuts progressively in the following order and to the torque values stated:

	kgm	lb-ft
Rear fender to rear axle Rear lower strut to attachment bracket Rear lower strut to rear upper strut Front strut to transmission case	17,0	125
Roof Frame	8,7	50

8. Attach the plough lamp to the R.H. rear upper strut approximately 300 mm (12 in) above the fender top. Route the wire down the front side of the strut, secure it with the two plastic straps, then feed the wire through the grommet on the fender top. Attach the spade end connector to the spare terminal in the rear lamp, and attach the eyelet terminal to one of the rear lamp securing screws.

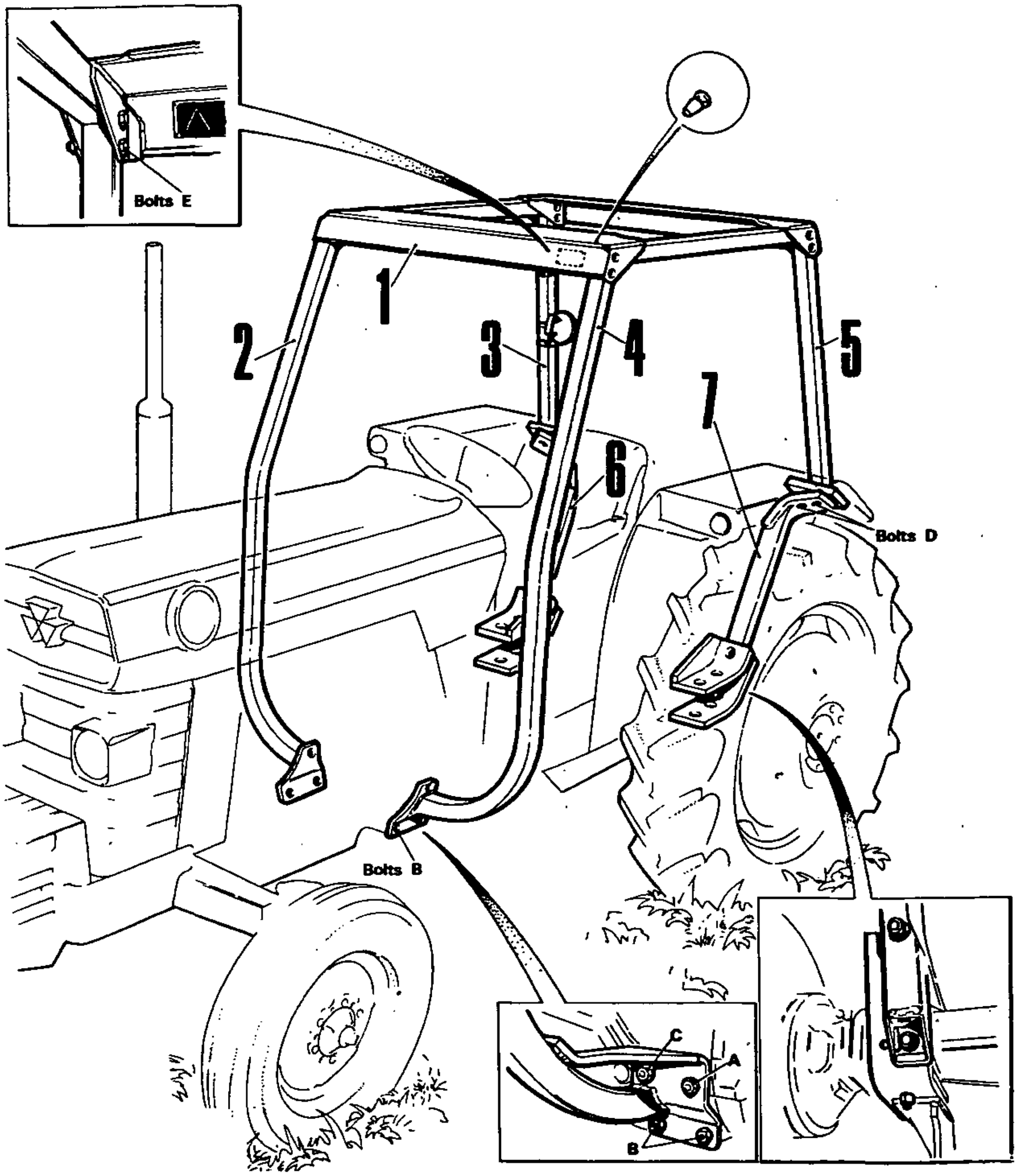


FIG. 1

FIG. 2

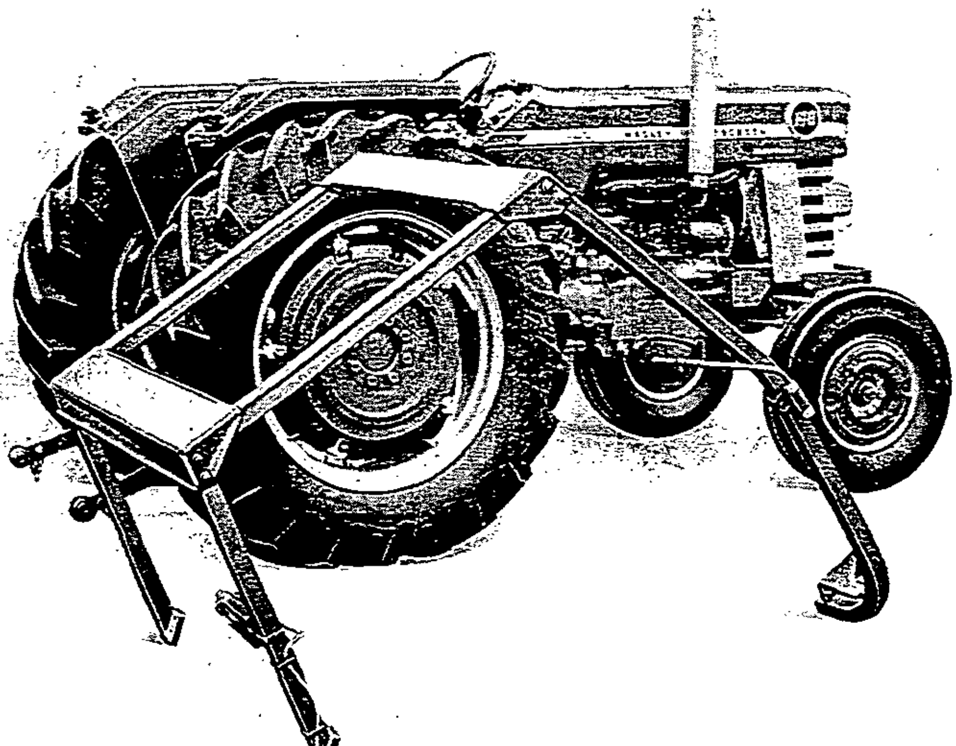


FIG. 3

SAFETY FRAME

Removal and Refitment 2C-02-05

Removal

1. Remove the cladding as stated in either operation 2C-04-06 or 2C-06-09, for flexible or rigid cladding respectively.
2. Disconnect the plough lamp wiring.
3A. If a crane is available: Remove the L.H. front strut as shown in Fig. 2, then, using a crane support the frame by slinging from the roof member. Remove the remaining bolts securing the other three legs to the tractor, then lift the complete assembly off the tractor as shown in Fig. 3.
3B. If no crane is available: Remove the bolts securing the roof member, then lift off the roof member. Remove the bolts securing the front and rear struts.
4. Store the bolts, nuts and washers carefully, as they must all be refitted to comply with the safety regulations.
   Except in exceptional circumstances, there is no necessity to remove the under fender supports.
5. If the under fender supports are to be removed, remove the fender mounting bolts and the bolts securing the brackets to the fender.

Refitment

1. If necessary refit the under fender supports and their brackets, then refit the fender mounting bolts.
2A. If a crane is available: Refit the L.H. front leg securing it with three ⅝ UNC x 44,5 mm (1¾ in) bolts and ⅝ lockwashers. Using the crane, lift the roof assembly back onto the tractor and refit the remaining bolts; two ⅝ UNF x 50,8 mm (2 in) bolts and ⅝ lockwashers for each rear strut, two ½ UNF x 89,0 mm (3½ in) bolts, plain washers and lockwashers to the roof and three ⅝ UNC x 44,5 mm (1¾ in) bolts and ⅝ lockwashers to the front R.H. strut.
2B. If no crane is available: Refit the two rear struts using two ⅝ UNF x 50,8 mm (2 in) bolts and ⅝ lockwashers for each, then refit the two front struts, securing them with three ⅝ UNC x 44,5 mm (1¾ in) bolts and lockwashers. Refit the roof member and refit the two ½ UNF x 89,0 mm (3½ in) bolts to each corner from the INSIDE, facing OUTWARDS. Refit the flat washers, lockwashers and nuts.
3. Tighten all bolts and nuts progressively in the following order and to the torque values stated:

	kg-m	lb-ft
Rear fender to rear axle Rear lower strut to attachment bracket Rear lower strut to rear upper strut Front strut to transmission case	17,0	125
Roof Frame	8,7	50

4. Reconnect the plough lamp wiring.
5. Refit the cladding, as stated in operation 2C-04-06 or 2C-06-09 for flexible or rigid cladding respectively.

FLEXIBLE CLADDING KIT

Fitment 2C-03-05

1. Assemble the safety frame as stated in operation 2C-01-02.
2. Place the windscreen on the front of the safety frame. Locate the channel on the screen top edge over the lip on the roof frame front edge.

NOTE – TO OVERCOME TIGHTNESS BETWEEN THE SAFETY FRAME AND THE HINGE BRACKETS, RAISE THE WINDSCREEN APPROXIMATELY 150 MM (6 IN) THEN LOWER IT INTO THE CORRECT POSITION.

3. Loosely assemble the four windscreen attachment bolts using two 'U' bolts at the top and two 'L' bolts at the bottom.
4. Attach the top edge of each lower screen behind the bottom edge of the windscreen using two bolts, plain washers and locknuts each side.

NOTE – FLAT WASHERS SHOULD BE PLACED UNDER THE BOLT HEADS AND UNDER THE LOCKNUTS.

5. Loosely assemble the 'S' brackets to the lower panels, using a bolt, plain washers and locknut each side.
6. Fully tighten the front screen bolts, starting at the top and working downwards. Before tightening the bolts securing the lower front screen, hold each lower screen firmly against the safety frame strut. Do not tighten the two inner bolts.
7. Remove the bottom bolts, securing the sump to the clutch housing on each side, and fit the heat duct retaining tabs, securing them with the bolts.
8. Place the inverted 'U' frame of the engine shroud over the bonnet, just forward of the steering wheel, but behind the windscreen, locating the end of the 'U' frame on the pegs attached to the lower screens, Draw the side covers through the gaps between the engine and the front screens.
9. Engage the heat duct retaining hooks on the lips under the bonnet, adjacent to the battery compartment and at the tabs on the sump. Adjust the strap at the sump until the duct is a tight fit around the bonnet.
10. Fasten the side covers at the front end of the tractor with the rubber straps. Place the two wire hooks through the drain slots in the footplates and fasten the clips around the tie rods.
11. Fit the two 'Z' clips to the inner bolts securing the lower screen to the windscreen to secure the top edge of the heat shield.
12. Place the heat shield exhaust frame in the side duct (if necessary).
13. Remove the protective sleeve from the wiper motor shaft. Position the wiper mechanism in place (R.H. top corner of the windscreen) taking care not to dislodge the rubber grommet with the wiper motor shaft, and secure the wiper mechanism with three screws, plain washers and locking nuts.

14. Connect the wiring to the starter motor solenoid and clip the wire to the R.H. safety frame leg with the strap provided.
15. Fit the windscreen wiper blade and arm. Pull back the arm until the ⅛ in A/F Allen screw can be tightened. Before fully tightening the screw, adjust the sweep of the arm.
16. Insert a plastic plug into each top outer corner of the safety frame.
17. Slacken off the adjusters on the roof canopy and position the roof canopy on top of the safety frame.
18. Secure the rear corners of the roof canopy to the safety frame rear struts using a 'U' bolt, plate, plain washers and locking nut each side. Do not fully tighten the bolts at this stage.
19. Secure the front corners using the over-centre catches. Make sure by use of the adjusters that the gap between the safety frame and the roof frame is the same both sides.
20. Fit the top half of each door.
21. Position the centre post and spacer on top of the fender, approximately 58 mm (2¼ in) inwards from a line taken from the inside edge of the side light. Whilst ensuring that the rear edge of the door and the door catch locate correctly on the centre post, drill the fender through the hole in the centre post and spacer. Remove the burrs and retouch the paintwork.
22. Secure the centre post and spacer to the fender with a bolt, flat washer and locknut.
23. Repeat operations 20 and 21 for the other side.
24. Position the front edge of a side screen in place at the centre post, by locating the rod in the side screen, first at the top and then at the bottom of the centre post.
25. Make sure the stay in the rear of the side screen is located in the side screen correctly, then secure the stay to the plate at the top of the safety frame leg, with a bolt, plain washers and locknut.
26. With the stay vertical (nearly touching the reflector) drill the fender through the bottom hole in the stay, secure the stay with a bolt, flat washer and locknut.
27. Drill a hole in the front end of the fender to take the side screen front retaining hook, and locate the hook.
28. Locate the side screen rear retaining hook in the upper hole in the stay, taking care that both the side screen bottom sealing edges face outwards.
29. Fully tighten the 'U' bolt on the rear leg of the safety frame.
30. Secure the top rear corner of the side screen by engaging the rubber ring with the angled hook suspended from the underside of the roof canopy.
31. Repeat operation 23 to 29 for the other side.
32. If the rear screen is to be fitted, unroll the screen and hook the metal cross-bar on to the vertical hooks suspended from the roof canopy. With the stowing strap on the inside, engage the rubber loop on the bottom corners of the rear screen to the upper hole in the side screen stays.
33. Ensure that the roof edging pelmet hangs freely to cover the roof to side screen joint.
34. Place the fender extension in position on the outside of each fender and secure them to the footplates using a new bolt, plain washer and locknut, and the existing bolt, flatwasher, spring washer and nut each side, then drill the fenders through the holes in the fender extensions and secure the extensions with two bolts, flat washers and locknuts each side.
35. Fit the bottom half of each door; engage the hinge pin in the hinge bracket, push the door upwards and forwards to locate the frame into the inverted 'U' bracket, and locate the front pin through the hole in the door top half. Insert a hairpin through the top front pin.
36. Close each door and draw the flaps inside the fender. Pull the rubber loops onto the inner face of the fenders at right angles to the edge of the door flaps.
37. Stretch the loops approximately 20 mm (¾ in) and mark the position on the fenders. Drill a hole and fit a nylon thimble with a bolt, plain washer and locknut each side.
38. Bolt the rear view mirror to the R.H. side of the windscreen.
39. Lubricate the door hinges with oil.
40. If a loader is fitted, the clear plastic in the R.H. front lower screen must be removed and a suitable aperture cut out to enable the loader trip mechanism to be used.

FLEXIBLE CLADDING

Removal and Refitment 2C-04-06

Removal

1. Remove the hairpins securing the lower doors to the upper doors, then remove the lower doors.
2. Lift off the upper doors.
3. Release the heat shield retaining straps from; the front of the bonnet; the retaining tabs at the sump; the bonnet, adjacent to the battery compartment; the footplates and the tie rods; then remove the two 'Z' clips securing the heat shield to the lower edge of the windscreen, and lift off the heat shield.
4. Remove the rear screen by releasing the two rubber loops at the bottom of the screen and unhooking the screen from the roof canopy.
5. Disengage the sidescreen hooks from the front and rear of the fenders and release the rubber loops from each side screen upper edge.
6. Remove the two bolts, washers and nuts, securing each side screen rod to the fender and to the plate attached to the safety frame strut, then push each side screen up at the front until it becomes free from the retaining rod and then pull down and release it from the top and lift clear of the tractor.
7. Release the over-centre catches securing the front edge of the roof.
8. Remove the two bolts, washers and nuts securing the rear edge of the roof to the plates attached to the safety frame struts.
9. Remove the bolt, washer and nut securing the centre post to each fender and lift the roof assembly clear of the tractor.
   DO NOT lose the two spacers.
10. Disconnect the wiper motor wiring to allow the lower panels and windscreen to be removed.

11. Remove the 'S' brackets securing the two front lower panels to the safety frame, then remove the remaining bolts and washers securing the panels to the windscreen and remove the panels.
12. Remove the wiper arm, then remove the three screws, washers and nuts securing the wiper motor to the windscreen and remove the wiper motor
13. Remove the nuts and washers securing the 'U' bolts and 'L' bolts at the top and bottom of the windscreen and lift off the windscreen.

Refitment
Refitment procedure is similar to that for assembling the kit (operation 2C-03-05) except that certain operations (e.g. operation 21) will already have been completed.

RIGID CLADDING KIT

Fitment 2C-05-07
Special Tools Required: 5⁄16 A/F Socket Screwdriver
No. 10 UNC Taps
¼ UNC Taps

Before Assembly
Check the markings on cladding pack for tractor compatibility. Open the pack and check its contents against the list provided. The list is protected in a polythene bag attached to the inside of the crate. Count and group all hardware to ascertain correct quantities of nuts, bolts, washers, brackets, etc.

Before commencing assembly, use the appropriate tap to clean all threads in welded nuts, and lightly oil all tapped threads.

Assembly Method
1. Assemble the safety frame, as stated in operation 2C-01-02.
2. Fig. 4. Position the roof rail (1) on the top of the safety frame, ensure that the narrow groove is on the underside and that weld nuts are situated to the front and rear. Assemble four 'Z' retainers (2) to secure the roof rail to the safety frame. Use four ¼ UNC x ⅝ in bolts and nuts, together with plain washers and spring washers. Assemble with nuts at the top and both washers under each nut.

   NOTE – LEAVE ALL ASSEMBLED BOLTS SLACK UNTIL BOLT TIGHTENING IS SPECIFIED.

3. Fit sealing strip (19) to the lower centre edge of the windscreen panel using angle bar as shown. This bar incorporates four weld nuts and is used to sandwich the sealing strip to the inside bottom edge of the windscreen panel. Use four No. 10 x ½ in bolts, spring washers and plain washers.
4. Position the windscreen assembly (3) against the safety frame front members and attach it to the roof rail (1) using three ¼ UNC x ⅝ in bolts screwed into weld nuts. Use a spring and a plain washer under each bolt head.
5. Before fitting lower front panels, disconnect the throttle control rod from the throttle pedal. Position the lower front panels (5). On the R.H. panel, feed the throttle control rod through the hole in the skirt, then reconnect the throttle control rod. Attach the top edge of lower front panels (5) to the bottom edge of windscreen assembly (3) using eight (4 per side) No. 10 UNC x ½ in bolts, spring washers and plain washers. First assemble the outer bolt on each lower panel, then assemble the remaining bolts with heads and washers on the inside. Unless a loader is to be fitted, fit blanking plate (22) using two of the above No. 10 bolts. Fit skirts (21) to existing bolts as shown, omit washers, and fit retaining bracket (23) to secure firmly against panel form.
6. Attach the windscreen assembly to the safety frame front members using 4 retainers (7) and two No. 10 UNC x ½ in bolts, spring washers and plain washers per retainer.
7. Attach both lower front panels to the safety frame using the retainers shown, and two No. 10 UNC x ½ in bolts, spring washers and plain washers per retainer. The upper retainer (6) is designed to secure the inner end of the door check strap.
8. Secure the rear view mirror arm (8) to the top outer corner of the lower front panel 'R.H.' Use two ¼ in UNC x ½ in bolts, spring washers and plain washers.
9. The top inner corner of each side panel sealing skirt is to be laced to the cross bar securing the central sealing strip.
10. Fit the rear curtain (15) to the roof rail (1). Use three ¼ in UNC x ⅝ in bolts and plain washers. (Turn buttons to face rearwards).
11. Attach side panel assemblies (12) by pushing the top edge of each panel fully into the groove in the underside of the roof rail. Locate the rear curtain (15) and the bottom rear corner of the side panel against the safety frame rear member. Insert and secure the three turn buttons on each side of the rear curtain. Ensure that the 'side panel to fender' sealing rubber remains in its true location. Secure the rear of each panel with a retainer (13) and two No. 10 UNC x ½ in bolts, spring washers and plain washers.

    The top front of each panel must be secured to the safety frame roof member using a slotted bracket (14) and two ¼ in UNC x ⅝ in bolts, spring washers and plain washers.
12. Assemble clamp brackets to slotted holes in fender extensions (9) using three ¼ in UNC x ⅝ in bolts, spring washers and plain washers per assembly. Slacken the front bolt attaching the fender support bracket (10). When attaching the extension (9) slide the bottom rear edge between the fender and the support bracket. Position the clamps over the fender rim. Insert a ¼ in UNC x 2½ in bolt, nut spring washer and plain washer to secure the bottom front corner of the side panels to the attachment block on the fender extensions.
13. Attach each footstep extension (11) to the appropriate fender extension (9) and to the lower front panel (5). Use four ¼ in UNC x ⅝ in bolts, plain washers and spring washers. Insert two bolts through panel (5). Ensure that bolts securing the fender extension (9) to the fender front edge are slack, push the extension (9) forward until the lower edge locates against the rear edge of footplate extension (11). Insert two bolts through extension (9) in the rear edge of footplate (11). Secure the front inner corner of each footplate extension to the safety frame using the brackets (24 and 26) as illustrated.

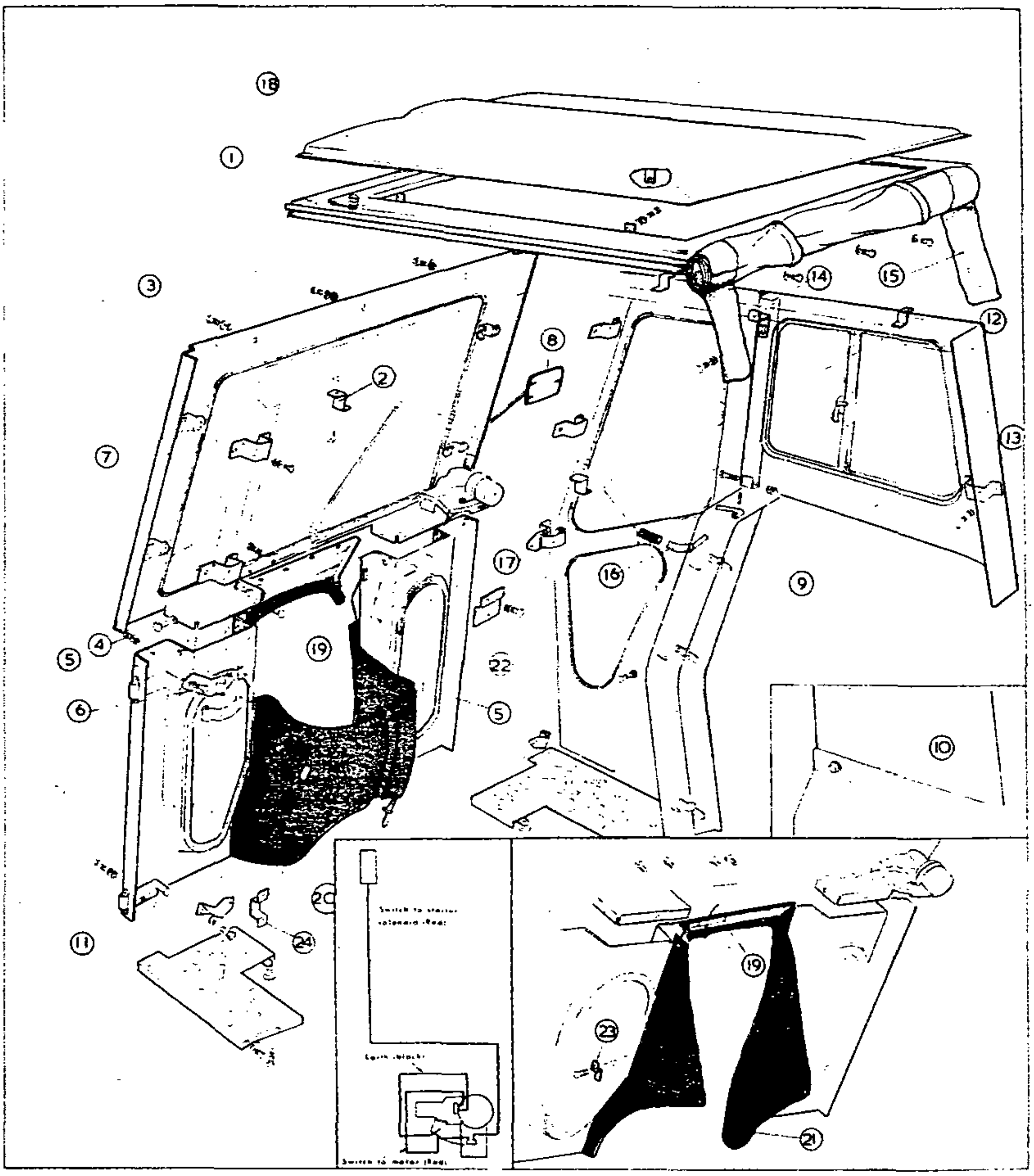


FIG. 4

Use two ¼ in bolts, plain washers and spring washers.

14. Connect wiper motor wiring (see inset). Tighten the nuts securing the plate behind the wiper pivot. Use one spring clip to secure the supply wire to the lower front panel as shown, cross the wire under the hood behind the engine, and use the remaining two clips to route the wire along the underlip of the hood to the starter motor. Ensure that there is a metal-to-metal contact at the earth eyelet attachment on the wiper motor mounting. Check operation of wiper mechanism and inclusion of correct fuse (35A). Fit and adjust wiper arm and blade.
15. Lubricate the hinge pins on both doors, ensure that the female portion of the hinge is fully tightened, and hang the doors. Slide a black plastic cover on to each inner door handle (16) and fit each handle into the release mechanism. Assemble a fibre washer on to the outer end of the stem and fit the outer door handles using a roll pin in each handle. Gently close the doors to ascertain what adjustment is necessary for a satisfactory fit. Use available manoeuvrability of fender extensions and door hinge brackets to obtain a secure engagement of door catch and adequate sealing around the door. The outer angle of the door sealing rubber, at the front, should seal against the rearward facing sharp edge of the front panel. If there are any gaps under the door seal after all adjustments have been made, set the door by hand to eliminate the gaps. Fit check strap (17) using pins provided.
    If difficulty is still experienced with door fitting, the following procedure should be adopted: Remove the floor extension plate. Slacken off all of the fender and safety frame mounting bolts, then attach a piece of rope to the fender hand grip. Pass the rope round the *front leg of the safety frame, diagonally* opposite the fender being worked on. Pull the cord tight to "toe-in" the fender, then fully tighten all of the fender and safety frame bolts, using the specified torques, where necessary. Remove the rope and check the door for fit. Refit the floor extension plate.
16. Tighten all remaining bolts, re-check bolts previously tightened and ensure that cab doors close satisfactorily.
17. Fit roof panel (18) and secure it with four ¼ in UNC x ⅝ in bolts, plain washers and spring washers.
18. Clean the cab windows; touch up paintwork where necessary; check zips on rear curtain and remove protective tissue from transparent portion. Lubricate the door hinges with oil.
19. Check that throttle control is free of restrictions. If the sealing skirt rubs the control rod, enlarge the hole in the skirt with a knife or coarse file.
20. If necessary remove a small portion of the sealing skirt top edge to clear the air cleaner indicator.

RIGID CLADDING

Removal and Refitment 2C-06-09
Special Tools Required: 5/16 A/F Socket Screwdriver

Removal

1. Slacken the four roof bracket securing bolts, then lift off the roof.
2. Remove the screws securing each side panel to the safety frame and fender extension, then release the rear curtain turn buttons and lift off the side panels.
3. Remove the rear curtain.
4. Release the door check straps then lift off the doors.
5. Remove the bolts securing the skirt to the tractor hood.
6. Release the throttle rod.
7. Remove the bolts securing the lower front panels and lift off the panels, sliding the throttle rod out of the hole in the skirt.
8. Remove the windscreen assembly by releasing the clamps and wiper wire, then removing the bolts securing the windscreen to the roof rail.
9. Remove the four 'Z' clamps securing the roof *rail and lift off the roof rail.*
10. Reconnect the throttle rod.
    The floor extension plates and fender extensions need not normally be removed.

Refitment

Refitment procedure is generally similar to that for kit fitment (operation 2C-05-07) except that items such as sealing strip fitment or skirt attachment will be unnecessary.

ENGINE REMOVAL

Part 3 Section A

Table of Contents

GENERAL

This section gives details on procedure for splitting the tractor into five major assemblies and will be referred to whenever major splitting operations are required.

This section also includes information on the spacer housing fitted between the transmission and the centre housing.

ENGINE REMOVAL

SPLITTING THE TRACTOR BETWEEN THE ENGINE AND THE TRANSMISSION

3A-01-02

Special Tools Required: 270 Rail Trolley
MF27G Support Stand

Disassembly

1. Remove the fuel tank as stated in Part 3C.
2. Place wedges between the front axle beam and the engine support casting.
3. Release the drag links from the steering box drop arms.
4. Position the tractor dismantling stand No. 270 under the tractor and support the transmission housing on a rail trolley and the engine on a fixed stand.
5. Disconnect the battery leads.
6. Disconnect the wiring from the starter motor, dynamo, thermostart, and horn (if fitted).
7. Disconnect the Multi-Power oil cooler pipes (if fitted) at the transmission housing.
8. Remove the temperature gauge bulb from the thermostat housing and release the tube back to the battery carrier.
9. Disconnect the oil pressure gauge pipe and the tractormeter drive cable at the engine.
10. Disconnect the fuel cut-off control rod from the injector pump and remove the rod from the tractor.
11. Disconnect the L.H. throttle control rod at the cross shaft.
12. Disconnect the air cleaner hose at the air cleaner.
13. Disconnect the four power steering ram hoses (two each side) at the metal pipes (if fitted).
14. Disconnect the two power steering pump pipes (if fitted) adjacent to the starter motor.
15. Disconnect the following fuel pipes:
    Both pipes from the secondary fuel filter to the injector pump at the filter.
    Injector leak off pipe to the secondary fuel filter at the leak off pipe.
    Fuel pump to the primary fuel filter at the fuel pump.
16. If the tractor is fitted with a horizontal exhaust system; remove the bolt, nut, washer and clip securing the silencer to the exhaust down-pipe, then release the down-pipe from the silencer.
17. Remove the two bolts and spring washer securing the battery carrier to the engine.
18. Remove the bolts securing the engine to the transmission.
19. Roll the rear half of the tractor on the trolley, clear of the engine.
20. Fit the support stand MF 27G on the front of te transmission housing and secure it with two bolts each side.

Reassembly

1. Support the transmission on a rail trolley No. 270 and remove the support stand MF 27G from the front of the transmission housing.
2. Align the transmission with the engine, the use of a slave bolt in each side of the transmission will facilitate alignment.
3. Push the rear half of the tractor towards the engine, simultaneously rotating the flywheel to engage the transmission input shaft spline with the splines of the clutch friction disc. To engage the p.t.o. input shaft splines with the splines of the clutch friction disc. remove the $\frac{9}{16}$ A/F Allan plug from the left-hand side of the clutch housing, and using a suitable lever, rotate the flywheel.
4. Bolt the engine to the transmission. Tighten the nuts and bolts to a torque of 7,5 kg-m (55 lbs-ft).

   NOTE –DO NOT FORGET TO REFIT THE POWER STEERING CLAMP BRACKET (IF FITTED) TO THE L.H. SIDE OF THE ENGINE.

5. Refit the two bolts and washers securing the battery carrier to the engine.
6. If the tractor is fitted with a horizontal exhaust system, refit the down-pipe into the silencer, and secure the silencer with a clip, bolt, nut and washers.
7. Reconnect the fuel pipes.
8. Refit the fuel cut off control rod and connect it to the injector pump.
9. Reconnect the throttle rod to the injector pump.
10. Refit the temperature gauge bulb to the thermostat housing.
11. Reconnect the oil pressure gauge pipe and the tractormeter drive cable to the engine.
12. Reconnect the air cleaner hose to the air cleaner.
13. Reconnect the Multi-Power oil cooler pipes (if fitted) at the transmission housing.
14. Connect the wiring to the starter motor, dynamo, thermostart, and horn (if fitted).
15. Refit the fuel tank as stated in Part 3C.
16. Refit the drag links to the steering box drop arms.
17. Remove the wedges from the front axle beam and remove the tractor stand from beneath the tractor.
18. Reconnect the power steering pipes and hoses (if fitted) and top up the reservoir with a recommended fluid.
19. Reconnect the battery leads and bleed the fuel system as stated in Part 3C, then refill the power steering reservoir (if fitted) as stated in Part 6C.

FRONT AXLE ASSEMBLY

Removal and Refitment 3A-02-02

Removal

1. Remove the hood and grille assembly as stated in Part 2B.
2. Drain the coolant from the engine and the radiator.
3. Release the top and bottom radiator hoses.
4. Disconnect the hoses from the power steering rams (if fitted).
5. Disconnect the radiator support stay from the fan shroud.
6. Release the drag links from the steering box drop arms.
7. Jack up the tractor under the transmission housing.
8. Remove the nuts and bolts securing the engine support to the engine and manoeuvre the front axle assembly complete with drag links and radiator clear of the tractor.

Refitment

1. Manoeuvre the front axle assembly in line with the engine and secure it with the nuts and bolts.

NOTE – DO NOT FORGET TO REFIT THE TWO POWER STEERING HOSE RETAINING CHAINS (IF FITTED) TO THE SUPPORT CASTING BOLTS.

2. Reconnect the drag links to the steering box drop arms.
3. Reconnect the radiator hoses and the radiator support stay.
4. Refill the engine and radiator with coolant.
5. Refit the hood and grille assembly as stated in Part 2B.
6. Reconnect the power steering hoses (if fitted) to the rams, and refill the reservoir as stated in Part 6C.

ENGINE UNIT

Removal and Refitment 3A-03-03

Special Tools Required: 270 Rail Trolley
MF 27G Support Stand

Removal

1. Remove the exhaust pipe.
2. Split the tractor between the engine and the transmission as stated in operation 3A-01-02.
3. Remove the front axle assembly as stated in operation 3A-02-02.

Refitment

1. Refit the front axle assembly as stated in operation 3A-02-02.
2. Reassemble the rear half of the tractor to the engine as stated in operation 3A-01-02.
3. Refit the exhaust pipe.

STEERING BOX UNIT

Removal and Refitment 3A-04-03

Removal

1. Remove the fuel tank as stated in Part 3C.
2. Disconnect the battery leads then lift the battery clear of the tractor.
3. Disconnect the wiring from the starter motor, dynamo, safety start switch, thermostart and the horn (if fitted) then, feed the main wiring harness back through the battery carrier.
4. Disconnect the rear light wire (if fitted) from the switch and then release the wire from the clip on the steering column.
5. Disconnect the oil pressure gauge pipe at the engine and the gauge and remove it.
6. Remove the temperature gauge bulb from the thermostat housing and release the tube back to the battery carrier.
7. Disconnect the tractormeter drive cable from the engine.
8. Disconnect the fuel cut-off control rod from the injector pump and remove the rod from the tractor.
9. Release the L.H. and the foot throttle control rods from the cross shaft.
10. Disconnect the air cleaner hose at the air cleaner.
11. Release the drag links from the steering box drop arms.
12. Disconnect the following fuel pipes:–
    Both pipes from the secondary fuel filter to the injector pump at the filter.
    Injector leak-off pipe to the secondary fuel filter at the leak-off pipe.
    Fuel pump to the primary fuel filter at the filter.
13. Disconnect the Multi-Power shift lever at the transmission housing (Multi-Power tractors only).
14. Disconnect the two power steering pump pipes (if fitted) adjacent to the starter motor.
15. Disconnect the four power steering ram hoses (two each side) at the metal pipes (if fitted) and then release the two pipes from the clamp bracket on the R.H. side of the tractor.
16. Remove the two bolts and washers securing the front of the battery carrier to the engine.
17. Remove the eight bolts and spring washers securing the steering box to the transmission.
18. Lift and manoeuvre the steering box unit clear of the tractor and place on a suitable surface taking care not to damage the filters or the gear selector levers.

Refitment

1. Ensuring that all the gears and levers are in the neutral position, place the steering box unit onto the transmission housing and secure with the eight bolts and spring washers.

   NOTE – DO NOT FORGET TO REFIT THE WIRING CLIP (IF FITTED) TO THE BOLT ADJACENT TO THE HIGH/LOW GEAR LEVER.

2. Secure the front of the battery carrier to the engine with the two bolts and spring washers.
3. Reconnect the power steering pipes and hoses (if fitted) and secure the R.H. pipes with the clamp bracket, and then top up the reservoir with a recommended fluid.
4. Reconnect the Multi-Power shift lever. (Multi-Power tractors only).
5. Reconnect the fuel pipes.
6. Reconnect the drag links to the steering box drop arms.
7. Reconnect the air cleaner hose to the air cleaner.
8. Reconnect the L.H. and the foot throttle control rods to the cross shaft.
9. Refit the fuel cut-off control rod and connect it to the injector pump.
10. Reconnect the tractormeter drive cable to the engine.
11. Refit the oil pressure gauge pipe to the engine and the gauge.
12. Refit the temperature gauge bulb to the thermostat housing.
13. Refit the rear light wire (if fitted) to the switch and secure the wire to the steering column with the clip.
14. Feed the main wiring harness through the battery carrier and connect the wiring to the starter motor, dynamo, safety start switch, thermostart and the horn (if fitted).
15. Refit the battery.
16. Refit the fuel tank as stated in Part 3C.
17. Reconnect the battery leads and bleed the fuel system as stated in Part 3C, then refill the power steering reservoir (if fitted) as stated in Part 6C.

SPLITTING THE TRACTOR BETWEEN THE TRANSMISSION AND THE SPACER HOUSING OR BETWEEN THE SPACER HOUSING AND THE CENTRE HOUSING

3A-05-04

Special Tools Required: See operation 7A-03-16 (Multi-Power tractors only) and
270 Rail Trolley
MF 27T Support Stand

Disassembly

1. Drain the oil from the transmission and the centre housing.
2. Release the footbrake operating rods from the brake cross shaft levers.
3. Remove the two bolts, nuts and washers each side, securing the footplates to their front mounting brackets.
4. Disconnect the rear light wire from the switch and then release the wire from two clips, one underneath the instrument panel on the steering column and the other adjacent to the High/Low gear lever.
5. If the tractor is fitted with a horizontal exhaust system, remove the bolt, nut, washer and clip securing the silencer to the exhaust down-pipe, then release the down-pipe from the silencer.
6. Place wedges between the front axle beam and engine support casting.
7. Position the tractor dismantling stand No. 270 under the tractor and support the transmission housing and centre housing on trolleys.
8. Remove the hydraulic lift cover as stated in operation 7A-03-16 and then disconnect the hose to the Multi-Power spool valve at the Multi-Power pump (Multi-Power tractors only).
9. Release the operating rods from the parking brake cross shaft and lever (Splitting between spacer housing and centre housing only).
10. Remove the bolts securing the transmission or the centre housing to the spacer housing.
11. Push the rear part of the tractor out of engagement with the transmission or the spacer housing.
12. Fit support stands 27T to the transmission housing, centre housing or spacer housing and secure with one bolt each side.

Reassembly

1. Support the transmission housing and centre housing on rail trolleys and then remove the support stands MF 27T.
2. Fit the rear drive shaft to the transmission, then fit the shear tube to the rear drive shaft.
3. Remove the p.t.o. side cover from the centre housing (8 speed transmission tractors only).
4. Fit a new gasket to the spacer housing.

5A. **Tractor split between transmission and spacer housing.**
Push the rear half of the tractor into engagement with the transmission, simultaneously aligning the shear tube splines into the rear axle pinion splines and the transmission front p.t.o. drive shaft into the intermediate shaft coupler splines.

5B. **Tractor split between spacer housing and centre housing.**
Push the rear half of the tractor into engagement with the spacer housing, simultaneously aligning the shear tube splines onto the rear axle pinion splines and the intermediate shaft into the hydraulic pump camshaft coupler splines or the plated drive unit (Multi-Power tractors only).

NOTE – ALIGNMENT OF THE SHEAR TUBE CAN BE EFFECTED THROUGH THE P.T.O. SIDE COVER APERTURE IN THE CENTRE HOUSING (8 SPEED TRANSMISSION TRACTORS ONLY).

Alignment of the hydraulic pump drive is facilitated by rotating the flywheel, this is effected by removing the 9/16 Allan plug in the L.H. side of the clutch housing and using a suitable lever.

6. End float between the rear drive shaft and the main shaft must be governed to 0,4 to 2,5 mm (0.015 to 0.100 in), by fitting the split pin to the appropriate hole in the shear tube.
7. Bolt the transmission or the centre housing to the spacer housing.
8. Replace the p.t.o. cover (8 speed transmission tractors only).
9. Reconnect the Multi-Power spool valve hose to the Multi-Power pump and refit the lift cover as stated in operation 7A-03-16. (Multi-Power tractors only)
10. Remove the wedges from the front axle beam and remove the tractor stand from beneath the tractor.
11. If the tractor is fitted with a horizontal exhaust system, refit the exhaust down-pipe into the silencer and secure with clip, bolt, nut and washer.
12. Reconnect the rear light wiring to the light switch and secure the wire with the two clips.
13. Secure the footplates.
14. Reconnect the footbrake and parking brake (if removed) operating rods.
15. Refill the transmission with recommended oil.

SPACER HOUSING

Removal and Refitment 3A-06-04

Special Tools Required: See operation 7A-03-16 (Multi-Power tractors only) and
270 Rail Trolley
MF 27T Support Stand

Removal

1. Split the tractor between the spacer housing and the centre housing as stated in operation 3A-05-04.
2. Remove the two bolts securing the parking brake to the spacer housing and remove the parking brake.
3. Supporting the spacer housing remove the securing bolts and then move the spacer housing out of engagement with the transmission.

Refitment

1. Using a new gasket, position the spacer housing on the transmission housing simultaneously aligning the transmission front p.t.o. drive shaft into the intermediate shaft coupler splines and then secure the spacer housing to the transmission housing with the nuts and bolts.
2. Refit the parking brake and secure with the two bolts.
3. Refit the rear half of the tractor to the spacer housing as stated in operation 3A-05-04.

SPACER HOUSING

Servicing 3A-07-05

Special Tools Required: See operation 7A-03-16 (Multi-Power tractors only) and
270 Rail Trolley
MF 27T Support Stand

Disassembly

1. Remove the spacer housing as stated in operation 3A-06-04.
2. Remove the split pin securing the coupler to the intermediate shaft and then remove the coupler and withdraw the shaft from the spacer housing.
3. Using a suitable drift, carefully drive out the needle bearing.
4. If necessary, remove the stop bolt from the spacer housing.

Reassembly

1. If necessary, degrease the stop bolt and spacer housing threads with trichlorethylene, then apply a few drops of either Casco ML 15 or Loctite grade AAV to the stop bolt threads and refit the bolt and tighten to a torque of 4,8 kg-m (35 lb-ft)
2. Tap a new needle bearing into the spacer housing until the bearing is 2,54 mm (0.1 in) below the surface of the spacer housing.
3. Slide the intermediate shaft into the needle bearing and then refit the coupler to the shaft and secure with a new split pin.
4. Refit the spacer housing as stated in operation 3A-06-04.

ENGINE REMOVAL

Part 3 Section A

GENERAL

This section gives details on procedure for splitting the tractor into five major assemblies and will be referred to whenever major splitting operations are required.

ENGINE REMOVAL

SPLITTING THE TRACTOR BETWEEN THE ENGINE AND THE TRANSMISSION

3A-01

Special Tools Required: 270 Rail Trolley
MF27G Support Stand

Disassembly

1. Remove the fuel tank as stated in Part 3C-03-05
2. Place wedges between the front axle beam and the engine support casting.
3. Release the drag links from the steering box drop arms.
4. Position the tractor dismantling stand No. 270 under the tractor and support the transmission housing on a rail trolley and the engine on a fixed stand.
5. Disconnect the battery leads.
6. Disconnect the wiring from the starter motor, dynamo, thermostart, and horn (if fitted).
7. Disconnect the Multi-Power oil cooler pipes (if fitted) at the transmission housing.
8. Remove the temperature gauge bulb from the thermostat housing and release the tube back to the battery carrier.
9. Disconnect the oil pressure gauge pipe and the tractormeter drive cable at the engine.
10. Disconnect the fuel cut-off control rod from the injector pump and remove the rod from the tractor.
11. Disconnect the L.H. throttle control rod at the cross shaft.
12. Disconnect the air cleaner hose at the air cleaner.
13. Disconnect the four power steering ram hoses (two each side) at the metal pipes (if fitted).
14. Disconnect the two power steering pump pipes (if fitted) adjacent to the starter motor.
15. Disconnect the following fuel pipes:
    Both pipes from the secondary fuel filter to the injector pump at the filter.
    Injector leak off pipe to the secondary fuel filter at the leak off pipe.
    Fuel pump to the primary fuel filter at the fuel pump.
16. If the tractor is fitted with a horizontal exhaust system; remove the bolt, nut, washer and clip securing the silencer to the exhaust down-pipe, then release the down-pipe from the silencer.
17. Remove the two bolts and spring washer securing the battery carrier to the engine.
18. Remove the bolts securing the engine to the transmission.
19. Roll the rear half of the tractor on the trolley, clear of the engine.
20. Fit the support stand MF 27G on the front of the transmission housing and secure it with two bolts each side.

Reassembly

1. Support the transmission on a rail trolley No. 270 and remove the support stand MF 27G from the front of the transmission housing.
2. Align the transmission with the engine, the use of a slave bolt in each side of the transmission will facilitate alignment.
3. Push the rear half of the tractor towards the engine, simultaneously rotating the flywheel to engage the transmission input shaft spline with the splines of the clutch friction disc. To engage the p.t.o. input shaft splines with the splines of the clutch friction disc, remove the 9/16 A/F Allan plug from the left-hand side of the clutch housing, and using a suitable lever, rotate the flywheel.
4. Bolt the engine to the transmission. Tighten the nuts and bolts to a torque of 7,5 kg-m (55 lbs-ft).

NOTE – DO NOT FORGET TO REFIT THE POWER STEERING CLAMP BRACKET (IF FITTED) TO THE L.H. SIDE OF THE ENGINE.

5. Refit the two bolts and washers securing the battery carrier to the engine.
6. If the tractor is fitted with a horizontal exhaust system, refit the down-pipe into the silencer, and secure the silencer with a clip, bolt, nut and washers.
7. Reconnect the fuel pipes.
8. Refit the fuel cut off control rod and connect it to the injector pump.
9. Reconnect the throttle rod to the injector pump.
10. Refit the temperature gauge bulb to the thermostat housing.
11. Reconnect the oil pressure gauge pipe and the tractormeter drive cable to the engine.
12. Reconnect the air cleaner hose to the air cleaner.
13. Reconnect the Multi-Power oil cooler pipes (if fitted) at the transmission housing.
14. Connect the wiring to the starter motor, dynamo, thermostart, and horn (if fitted).
15. Refit the fuel tank as stated in Part 3C-03-05.
16. Refit the drag links to the steering box drop arms.
17. Remove the wedges from the front axle beam and remove the tractor stand from beneath the tractor.
18. Reconnect the power steering pipes and hoses (if fitted) and top up the reservior with a recommended fluid.
19. Reconnect the battery leads and bleed the fuel system as stated in Part 3C, then refill the power steering reservior (if fitted) as stated in Part 6C-03-05

FRONT AXLE ASSEMBLY

Removal and Refitment 3A-02

Removal

1. Remove the hood and grille assembly as stated in Part 2B-01-02.
2. Drain the coolant from the engine and the radiator.
3. Release the top and bottom radiator hoses.
4. Disconnect the hoses from the power steering rams (if fitted).
5. Disconnect the radiator support stay from the fan shroud.
6. Release the drag links from the steering box drop arms.
7. Jack up the tractor under the transmission housing.
8. Remove the nuts and bolts securing the engine support to the engine and manoeuvre the front axle assembly complete with drag links and radiator clear of the tractor.

Refitment

1. Manoeuvre the front axle assembly in line with the engine and secure it with the nuts and bolts.

NOTE – DO NOT FORGET TO REFIT THE TWO POWER STEERING HOSE RETAINING CHAINS (IF FITTED) TO THE SUPPORT CASTING BOLTS.

2. Reconnect the drag links to the steering box drop arms.
3. Reconnect the radiator hoses and the radiator support stay.
4. Refill the engine and radiator with coolant.
5. Refit the hood and grille assembly as stated in Part 2B-01-02.
6. Reconnect the power steering hoses (if fitted) to the rams, and refill the reservior as stated in Part 6C-08-10

ENGINE UNIT

Removal and Refitment 3A-03

Special Tools Required: 270 Rail Trolley
MF 27G Support Stand

Removal

1. Remove the exhaust pipe.
2. Split the tractor between the engine and the Transmission as stated in operation 3A-01
3. Remove the front axle assembly as stated in operation 3A-02

Refitment

1. Refit the front axle assembly as stated in operation 3A-02
2. Reassemble the rear half of the tractor to the engine as stated in operation 3A-01
3. Refit the exhaust pipe.

STEERING BOX UNIT

Removal and Refitment 3A-04

Removal

1. Remove the fuel tank as stated in Part 3C-03-05
2. Disconnect the battery leads then lift the battery clear of the tractor.
3. Disconnect the wiring from the starter motor, dynamo, safety start switch, thermostart and the horn (if fitted) then, feed the main wiring harness back through the battery carrier.
4. Disconnect the rear light wire (if fitted) from the switch and then release the wire from the clip on the steering column.
5. Disconnect the oil pressure gauge pipe at the engine and the gauge and remove it.
6. Remove the temperature gauge bulb from the thermostat housing and release the tube back to the battery carrier.
7. Disconnect the tractormeter drive cable from the engine.
8. Disconnect the fuel cut-off control rod from the injector pump and remove the rod from the tractor.
9. Release the L.H. and the foot throttle control rods from the cross shaft.
10. Disconnect the air cleaner hose at the air cleaner.
11. Release the drag links from the steering box drop arms.
12. Disconnect the following fuel pipes:–
    Both pipes from the secondary fuel filter to the injector pump at the filter.
    Injector leak-off pipe to the secondary fuel filter at the leak-off pipe.
    Fuel pump to the primary fuel filter at the filter.
13. Disconnect the Multi-Power shift lever at the transmission housing (Multi-Power tractors only).
14. Disconnect the two power steering pump pipes (if fitted) adjacent to the starter motor.
15. Disconnect the four power steering ram hoses (two each side) at the metal pipes (if fitted) and then release the two pipes from the clamp bracket on the R.H. side of the tractor.
16. Remove the two bolts and washers securing the front of the battery carrier to the engine.
17. Remove the eight bolts and spring washers securing the steering box to the transmission.
18. Lift and manoeuvre the steering box unit clear of the tractor and place on a suitable surface taking care not to damage the filters or the gear selector levers.

Refitment

1. Ensuring that all the gears and levers are in the neutral position, place the steering box unit onto the transmission housing and secure with the eight bolts and spring washers.

NOTE – DO NOT FORGET TO REFIT THE WIRING CLIP (IF FITTED) TO THE BOLT ADJACENT TO THE HIGH/LOW GEAR LEVER.

2. Secure the front of the battery carrier to the engine with the two bolts and spring washers.
3. Reconnect the power steering pipes and hoses (if fitted) and secure the R.H. pipes with the clamp bracket, and then top up the reservior with a recommended fluid.
4. Reconnect the Multi-Power shift lever. (Multi-Power tractors only).
5. Reconnect the fuel pipes.
6. Reconnect the drag links to the steering box drop arms.
7. Reconnect the air cleaner hose to the air cleaner.
8. Reconnect the L.H. and the foot throttle control rods to the cross shaft.
9. Refit the fuel cut-off control rod and connect it to the injector pump.
10. Reconnect the tractormeter drive cable to the engine.
11. Refit the oil pressure gauge pipe to the engine and the gauge.
12. Refit the temperature gauge bulb to the thermostat housing.
13. Refit the rear light wire (if fitted) to the switch and secure the wire to the steering column with the clip.
14. Feed the main wiring harness through the battery carrier and connect the wiring to the starter motor, dynamo, safety start switch, thermostart and the horn (if fitted).
15. Refit the battery.
16. Refit the fuel tank as stated in Part 3C-03-05.
17. Reconnect the battery leads and bleed the fuel system as stated in Part 3C, then refill the power steering reservior (if fitted) as stated in Part 6C-08-10.

SPLITTING THE TRACTOR BETWEEN THE TRANSMISSION AND THE CENTRE HOUSING

3A-05

Special Tools Required: See operation 7A-03-16 (Multi-Power tractors only) and 270 Rail Trolley MF 27T Support Stand

Disassembly

1. Drain the oil from the transmission and the centre housing.
2. Release the footbrake operating rods from the brake cross shaft levers.
3. Remove the two bolts, nuts and washers each side, securing the footplates to their front mounting brackets.
4. Disconnect the rear light wire from the switch and then release the wire from two clips, one underneath the instrument panel on the steering column and the other adjacent to the High/Low gear lever.
5. If the tractor is fitted with a horizontal exhaust system, remove the bolt, nut, washer and clip securing the silencer to the exhaust down-pipe, then release the down-pipe from the silencer.
6. Place wedges between the front axle beam and engine support casting.
7. Position the tractor dismantling stand No. 270 under the tractor and support the transmission housing and centre housing on trolleys.
8. Remove the hydraulic lift cover as stated in operation 7A-03-16 and then disconnect the hose to the Multi-Power spool valve at the Multi-Power pump (Multi-Power tractors only).
9. Remove the bolts securing the transmission to the centre housing.
10. Push the rear part of the tractor out of engagement with the transmission.
11. Fit support stands 27T to the transmission housing and the centre housing. Secure each stand with one bolt each side.

Reassembly

1. Support the transmission housing and centre housing on rail trolleys and then remove the support stands MF 27T.
2. Fit the rear drive shaft to the transmission, then fit the shear tube to the rear drive shaft.
3. Remove the p.t.o. side cover from the centre housing (6 and 8 speed transmission tractors only).
4. Fit a new gasket to the centre housing.
5. Push the rear half of the tractor into engagement with the transmission, simultaneously aligning the shear tube splines onto the rear axle pinion splines and the transmission front p.t.o. drive shaft into the camshaft coupler splines or the plated drive unit (Multi-Power tractors only).

NOTE – ALIGNMENT OF THE SHEAR TUBE CAN BE EFFECTED THROUGH THE P.T.O. SIDE COVER APERTURE IN THE CENTRE HOUSING (6 and 8 SPEED TRANSMISSION TRACTORS ONLY).

Alignment of the hydraulic pump drive is facilitated by rotating the flywheel, this is effected by removing the 9/16 Allan plug in the L.H. side of the clutch housing and using a suitable lever.

6. End float between the rear drive shaft and the main shaft must be governed to 0,4 to 2,5 mm (0.015 to 0.100 in), by fitting the split pin to the appropriate hole in the shear tube.
7. Bolt the transmission to the centre housing.
8. Replace the p.t.o. cover (6 and 8 speed transmission tractors only).
9. Reconnect the Multi-Power spool valve hose to the Multi-Power pump and refit the lift cover as stated in operation 7A-03-16. (Multi-Power tractors only).
10. Remove the wedges from the front axle beam and remove the tractor stand from beneath the tractor.
11. If the tractor is fitted with a horizontal exhaust system, refit the exhaust down-pipe into the silencer and secure with clip, bolt, nut and washer.
12. Reconnect the rear light wiring to the light switch and secure the wire with the two clips.
13. Secure the footplates.
14. Refill the transmission with recommended oil.

COOLING SYSTEM

Part 3 Section B

GENERAL

The coolant is circulated by thermo-syphon action and a centrifugal type pump driven by a belt from the crankshaft. The system incorporates a thermostat, which prevents the coolant flowing to the radiator unit the working temperature is reached. Cooling is aided by the action of the fan drawing air through the radiator and the fan shroud.

The only maintenance required on the cooling system is to ensure that there is no obstruction to the flow of air to the radiator, and that the fan belt is kept to the correct tension.

This section of the Workshop Manual gives only partial details of the cooling system components. For more comprehensive details, particularly related to servicing, see the Perkins Workshop Manual.

RADIATOR

Removal and Refitment 3B-01-02

Removal
1. Remove the radiator cap and drain the coolant from the radiator and engine.
2. Remove the hood and grille assembly as stated in Part 2B.
3. Remove the top and bottom radiator hoses.
4. Remove the two bolts, plain washers and lockwashers securing the radiator to the front axle support.
5. Remove the bolt securing the radiator tie rod to the shroud.
6. Remove the radiator and shroud assembly from the tractor.
7. If necessary remove the 11 screws securing the shroud and the two plates to the radiator.

Refitment
1. If necessary refit the shroud and the two plates to the radiator and secure them with the 11 screws.
2. Locate the radiator and shroud assembly on the front axle support and secure with the two bolts, plain washers and lockwashers.
3. Refit the radiator tie rod securing bolt.
4. Refit the top and bottom hoses.
5. Refit the hood and grille assembly as stated in Part 2B.
6. Close the radiator and engine drain taps and refill the radiator and engine with coolant.
7. Refit the radiator filler cap.

WATER PUMP

Removal and Refitment 3B-02-02

Removal
1. Remove the radiator as stated in Operation 3B-01-02.
2. Remove the water pump as stated in the Perkins Workshop Manual.

Refitment
1. Refit the water pump as stated in the Perkins Workshop Manual.
2. Refit the radiator as stated in operation 3B-01-02.

WATER PUMP

Servicing 3B-03-02

1. Remove the water pump as stated in operation 3B-02-02
2. For servicing details see the Perkins Workshop Manual.
3. Refit the water pump as stated in operation 3B-02-02.

THERMOSTAT

Removal and Refitment 3B-04-02

Removal
1. Remove the fuel tank as stated in operation 3C-03-02.
2. Remove the thermostat as stated in the Perkins Workshop Manual.

Refitment
1. Refit the thermostat as stated in the Perkins Workshop Manual.
2. Refit the fuel tank as stated in operation 3C-03-02.

THERMOSTAT

Testing Procedure 3B-05-02

1. Remove the thermostat as stated in operation 3B-04-02.
2. Test the thermostat as stated in the Perkins Workshop Manual.
3. Refit or replace the thermostat as necessary, as stated in operation 3B-04-02.

FROST PRECAUTIONS

For obvious reasons precautions must be taken against the ravages of frost. There are three methods whereby protection may be afforded. These are listed below.

Draining the Cooling System after each day's work
This method offers economy, but can be inconvenient and leaves the cooling system unprotected during idle periods. In extremely unfavourable conditions the cooling system can freeze while the engine is running.

Under conditions where hard water conditions exist, silt formation and impeller erosion will be accelerated by the frequent draining and refilling of the cooling system.

Under these conditions the saving is debatable..

The use of Heated Premises, Engine or sump Heaters
Possesses disadvantages similar to the above method, i.e. during the working day no protection is afforded if the tractor is standing idle.

The use of Anti-Freeze
Probably the most universally accepted method of frost protection. Anti-freeze solutions, by their very nature, are capable of power of penetration not possessed by water. A cooling system which is normally sound may well exude leaks and drips when anti-freeze is employed. Even if no leaks are apparent in the initial filling, they may subsequently develop within a very short time. It is precisely for this reason that all cooling system hoses, joints, etc., must be in sound condition if expensive loss is to be avoided. A leaky cooling system and frequent topping up will reduce the protection afforded to dangerous limits.

NOTE – ONLY THE ANTI-FREEZE SOLUTIONS LISTED IN THE SPECIFICATION SECTION MEET MASSEY-FERGUSON TEST SPECIFICATIONS. THE USE OF INFERIOR GRADES OF ANTI-FREEZE (INCLUDING SOME SOLUTIONS CONFORMING B.S. 3151) CAN CAUSE SEVERE DAMAGE TO THE COOLING SYSTEM.

Recommended Anti-Freeze solutions are given in the Specification section.

The cooling system must be drained and flushed when the risk of frost has passed.

FAULT DIAGNOSIS

The diagnosis of faults contributing to overheating of the engine must be undertaken carefully, and all external causes thoroughly investigated. An apparent cooling system defect may, for example, be cured by adjusting the injection setting, or by tightening the fan belt. It is not intended to cover in this section the engine defects which may contribute towards overheating. The faults listed below are cooling system faults which, of course, can be accentuated by engine deficiencies, conditions, and the handling of the tractor.

Symptom	Possible Causes	Remedy
Coolant Boils	Insufficient water in radiator	Top up radiator
	Leaking radiator filler cap	Rectify
	Leaking hoses or joints	Rectify
	Leaking water pump seal	Rectify
	Weak or broken spring *Defective valve seat in* radiator filler cap	*Renew filler cap*
	Fan blades incorrectly fitted	Rectify
	Slack or worn fan belt	Adjust or renew belt
	Incorrect gear selection (Engine slogging or racing)	Select correct gear to suit operation requirements
	Faulty thermostat (remaining closed or not opening sufficiently)	Renew thermostat
	Perished cooling system hoses	Renew hoses
	Choked radiator core or restricted water passages	Flush out cooling (reversed flusing advised) or fit replacement radiator
	Damaged or corroded water pump impeller	Fit new impeller
	Radiator choked with mud or chaff	Clean radiator and grille
Engines runs too cool	Faulty thermostat (remaining open or not closing sufficiently)	Renew thermostat
	Operating conditions (cold head winds, etc.)	Blank off portion of the radiator

FUEL SYSTEM AND AIR CLEANER

Part 3 Section C

FUEL SYSTEM AND AIR CLEANER

GENERAL

The components and layout of the fuel and air systems are shown in Fig. 1. Cleanliness must always be observed when servicing any components of the fuel system. Suitable caps or masking tape should be available for blanking off open fuel connections as soon as a union has been removed. Do not use cotton waste or fluffy rags to clean out any part of the fuel system. When working with Diesel equipment, mechanics should always protect their hands with a protective cream. Servicing of fuel and air system components should be limited to the recommendations given in the following pages.

This section of the Workshop Manual gives only partial details of the fuel systems components. For more comprehensive details of the fuel system components, particularly related to servicing, see the Perkins Workshop Manual.

TWO STAGE DRY AIR CLEANER

The two stage dry air cleaner is situated alongside the battery on the R.H. side of the tractor. A section through the air cleaner is shown in Fig. 2. Air entering the cleaner is swirled so that particles of grit and dust are spun off and expelled through the unloader valve (4).

When the service indicator (on the instrument panel) shows red the air cleaner requires attention, after cleaning the air cleaner the indicator should be reset by pressing the button on top of the indicator.

TWO STAGE DRY AIR CLEANER

Servicing 3C-01-02

The air cleaner only needs servicing when the service indicator shows red. If, after servicing, the indicator shows red, the main element (3) is unfit for service and must be replaced. However, if, after replacement of the main element, the indicator continues to show red, the SAFETY element (2) must also be replaced.

NOTE – DO NOT CLEAN THE SAFETY ELEMENT.

The procedure is as follows:–

1. Remove the wing nut (1) and carefully slide out the main element (3).
2. Either – (a) Carefully tap the element on a CLEAN, DRY tyre. Rotate the element and continue tapping until all loose dust is removed. Alternatively – Blow the element clean, FROM THE INSIDE, with compressed air at not more than 7 kg-cm^2 (100 lb/in^2), and keeping the air line at a reasonable distance from the element at all times.

   THESE PRACTICES WILL ONLY WORK SATISFACTORILY IN DRY CONDITIONS.

   WARNING – DO NOT ATTEMPT TO BLOW THE MAIN ELEMENT CLEAN USING THE TRACTOR EXHAUST GASES.

   (b) If the element is oily, soot laden or contains damp foreign matter, the element should be washed as follows. Seal the open end of the element with either a suitable plug, or waterproof adhesive tape, then immerse the element in a vessel containing a solution of warm water (not more than 38°C (100°F – BLOOD HEAT) and a non-foaming automatic washing machine detergent (e.g. 'Pat Low Lather or Persil Automatic'). Leave the element to stand for approximately 10 minutes, then roll the element around in the liquid to clean off the dirt. Thoroughly rinse the element in CLEAN water, then remove the bung and flush out the element from the inside until the water comes through clear.

   NOTE – NEVER USE PETROL (GASOLENE) PARAFFIN OR CLEANING SOLVENTS TO CLEAN THE ELEMENT.

   Shake off the excess water and leave the element to dry naturally (this will take at least 12 hours in humid conditions). After drying out the element, check its condition for damage, or deterioration – particularly the sealing washer. A small light shone inside the element will reveal any holes or 'thin' areas. If the element is in any way damaged, it must be discarded.
3. Before refitting the element, wipe out the cleaner body with a damp cloth to remove any loose dust.
4. Squeeze the unloader valve (4) to release any loose dust.
5. Check the filter housing and hose for damage and ensure that all hose connections are tight.
6. Slide the cleaned element back into place and refit the wing nut (1).

TWO STAGE DRY AIR CLEANER

Removal and Refitment 3C-02-02

Removal

1. Disconnect the induction manifold hose at the air cleaner.
2. Disconnect the service indicator tube at the air cleaner.
3. Open the battery access panel, remove the two bolts securing the air cleaner to the battery platform and remove the air cleaner.
4. Assemble in reverse sequence.

Key to Fig. 1

1. Start-Aid Tank.
2. Two Stage Dry Air Cleaner.
3. Primary Fuel Filter.
4. Secondary Fuel Filter.
5. Injection Pump.
6. Fuel Lift Pump.
7. Injectors.
8. Fuel Tap.

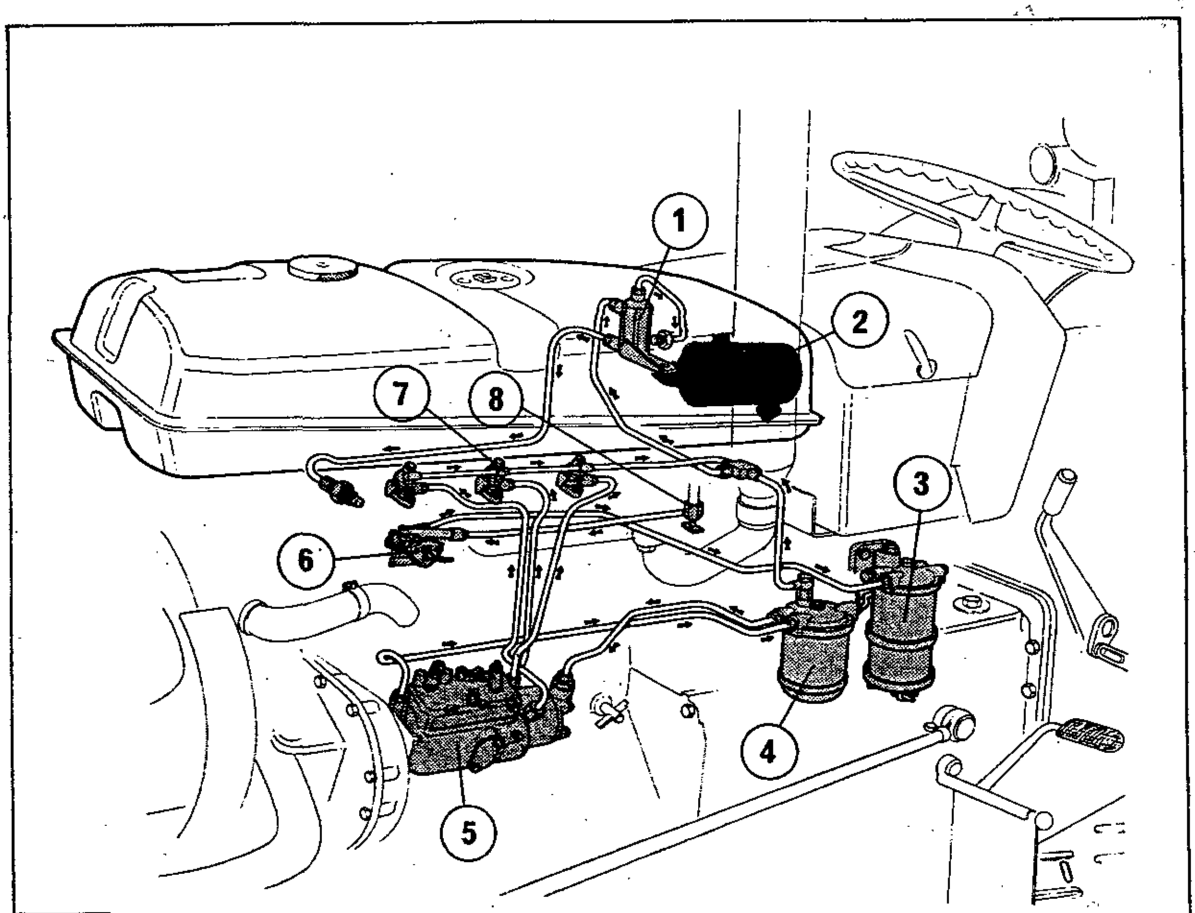
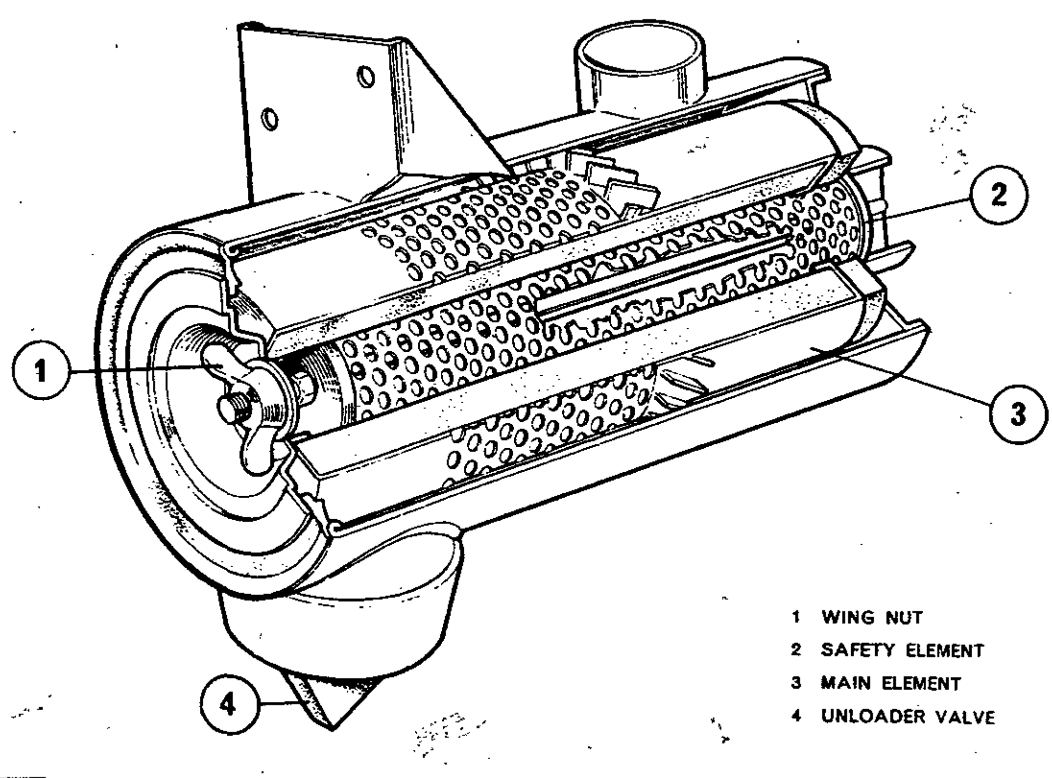


FIG. 1



1 WING NUT
2 SAFETY ELEMENT
3 MAIN ELEMENT
4 UNLOADER VALVE

FIG. 2

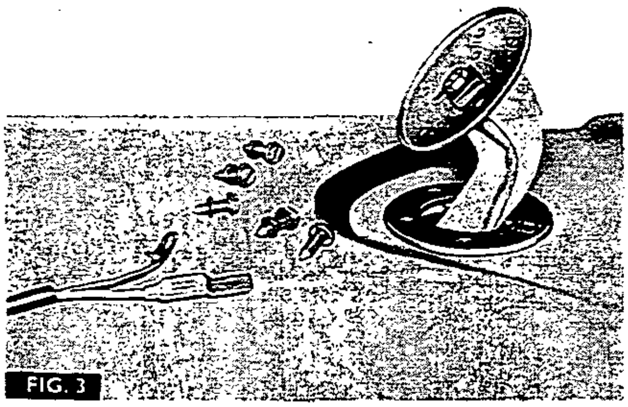


FIG. 3

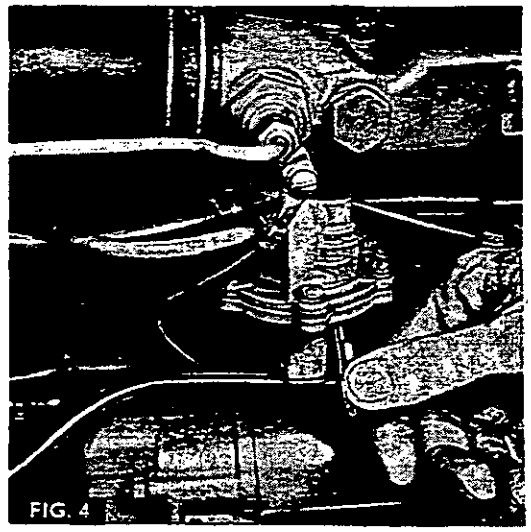


FIG. 4

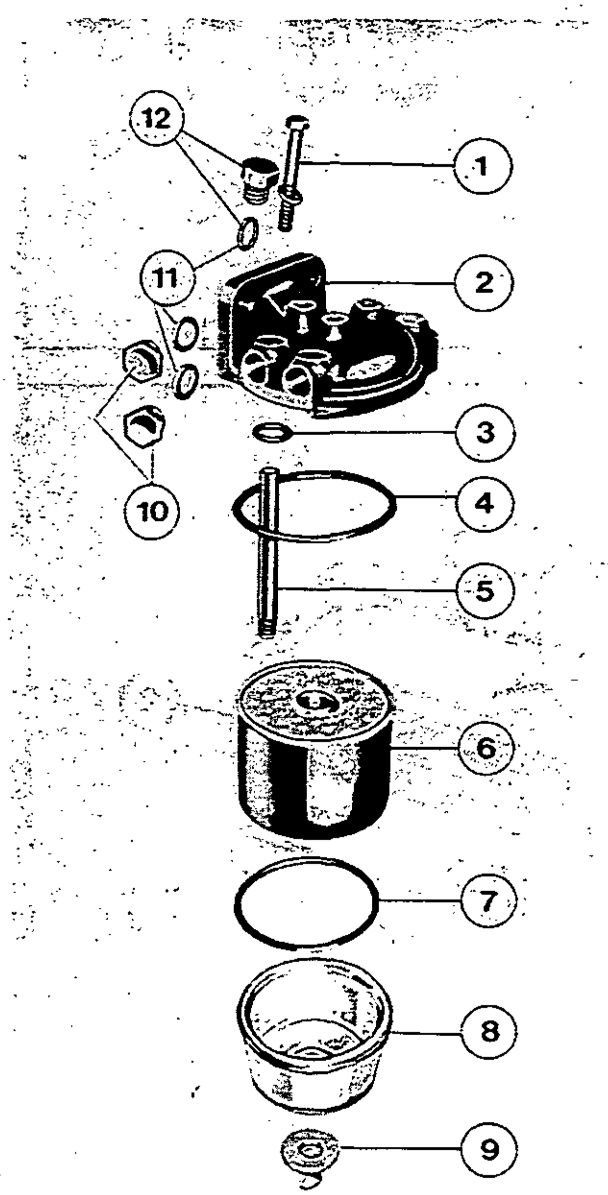


FIG. 5

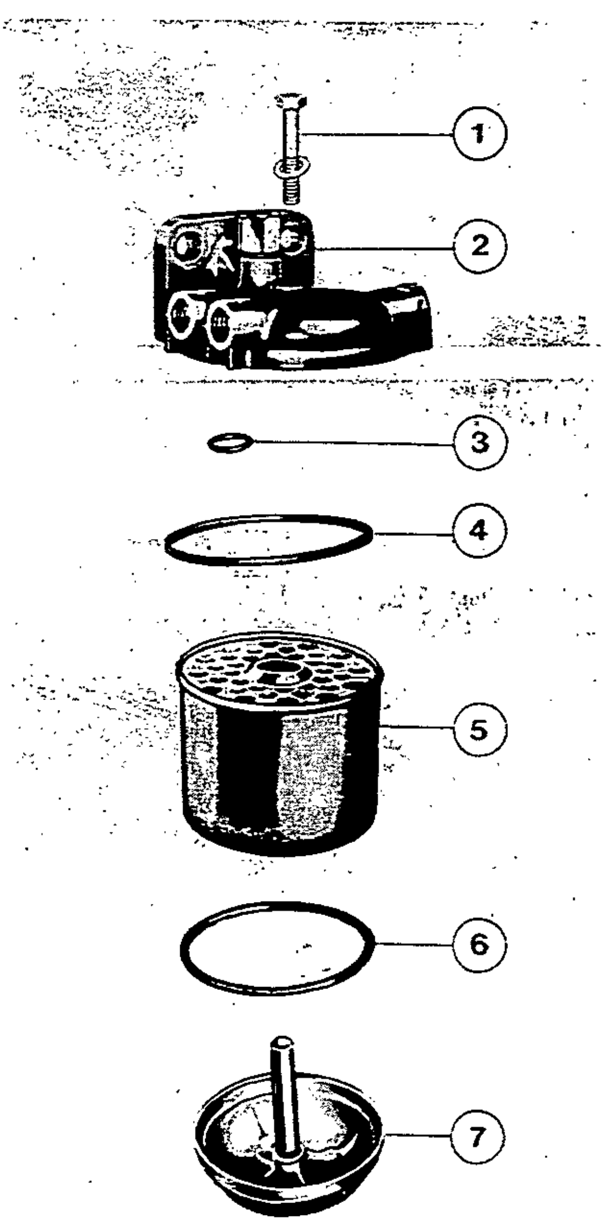


FIG. 6

FUEL TANK

The fuel tank has a capacity of 47,7 litres (10.5 Imp. gal.) and is rubber mounted above the engine. A fuel tap is fitted to the rear of the tank which enables the fuel to be turned off when required. The fuel tap incorporates a gauze filter, which extends inside the fuel tank. A fuel gauge sender unit is located in the top of the tank.

FUEL TANK

Removal and Refitment 3C-03-05

Removal

1. Remove the hood as stated in Part 2B.
2. Disconnect the battery cables and the battery securing hooks.
3. Disconnect the fuel gauge sender unit wires.
4. Disconnect the start-aid tank pipes.
5. Turn off the fuel and disconnect the pipe at the fuel tap.
6. Release the tabwashers, and remove the two bolts, metal plates and rubber pads securing the battery hook bracket, start-aid tank and the fuel tank to the mounting bracket and then lift off the start-aid tank and the battery hook bracket.
7. Remove the two self locking nuts, washers and springs securing the front of the fuel tank to the engine.
8. Move the fuel tank rearwards until the front securing bolts can be released from the fuel tank and then lift the fuel tank clear of the tractor.
9. Remove the two fuel tank securing bolts, rubber pads and washers from the thermostat housing..

Refitment

1. Refit the two fuel tank securing bolts, rubber pads and washers to the thermostat housing.
2. Place the fuel tank over the engine and locate the two front securing bolts in place and secure with the two springs, washers and lock nuts.
3. Refit the battery hook bracket, start-aid tank, rubber pads and metal plates to the rear of the fuel tank and secure with the two bolts and tabwasher.

NOTE – THE RUBBER PADS MUST BE PLACED BETWEEN THE FUEL TANK AND THE MOUNTING BRACKET AND ABOVE THE BATTERY HOOK BRACKET.

4. Reconnect the start-aid tank pipes and the pipe to the fuel tap.
5. Reconnect the fuel gauge sender unit wires.
6. Reconnect the battery cables and refit the battery securing hooks.
7. Refit the hood as stated in Part 2B.
8. Turn the fuel tap on and bleed the fuel system as stated in operation 3C-10-09.

FUEL GAUGE SENDER UNIT

Removal and Replacement 3C-04-05

1. Open the hood panel and disconnect the wires from the sender unit.
2. Remove the five screws and washers.
3. Fig. 3. Manoeuvre the sender unit out through the aperture in the tank.
4. Remove the cork seal.
5. When replacing, attach the wire to the centre terminal before placing the sender unit in the fuel tank.

START-AID TANK

The start-aid tank is a small container situated between the fuel tank and the battery. This tank serves as a reservoir for the engine thermostart and a junction for the primary fuel filter, fuel injection pump and injector leak-off pipes. It contains no valves and requires no maintenance other than ensuring that *there are no leaks at the unions.*

START-AID TANK

Removal and Refitment 3C-05-05

1. Remove the hood as stated in Part 2B.
2. Disconnect and blank off pipes:
   (a) Injectors to start-aid tank.
   (b) Start-aid tank to thermostart.
   (c) Fuel tank to start-aid tank, at the start-aid tank.
3. Release the tabwasher and remove the R.H. fuel tank securing bolt and lift off the start-aid tank.
4. Replace in reverse order.

NOTE – PRIME START-AID TANK BEFORE ATTEMPTING TO USE THERMOSTART.

THERMOSTART

To facilitate starting under cold weather conditions, a thermostart is fitted to the engine induction manifold and provides pre-heating and priming of the inlet manifold and combustion chambers. The first movement anti-clockwise, of the starter switch operates the thermostart heater, so causing the heater coil to expand and allowing the ball valve to lift and, at the same time, a small quantity of fuel flows from the reservoir tank through the heater, wherein it is vapourised and then ignited by the heater coil. A second anti-clockwise movement of the starter switch operates the starter motor and the ignited fuel is drawn into the engine. Before operating the thermostart, ensure fuel is present in the start-aid tank.

NOTE – SEE PERKINS WORKSHOP MANUAL FOR SERVICING DETAILS.

FUEL LIFT PUMP

Fig. 4.
A mechanical diaphragm type fuel lift pump operated by the engine camshaft and incorporating a hand primer is fitted to the R.H. side of the engine. The pump is installed between the induction manifold and the starter motor solenoid.

NOTE – SEE PERKINS WORKSHOP MANUAL FOR SERVICING DETAILS.

FUEL INJECTORS

The fuel injectors deliver to the engine combustion chambers the quantity of atomised fuel determined by the engine throttle load.

Injection operation pressure is 170 atmospheres. The servicing of injectors must not be attempted unless proper facilities and equipment are available.

Servicing is advised at least every 500 hours. Attention will be required more frequently if the fuel cleanliness, or the engine cooling system is neglected.

NOTE – SEE PERKINS WORKSHOP MANUAL FOR SERVICING DETAILS.

FUEL INJECTION PUMP

The C.A.V. distributor type fuel injection pump is a robust precision built unit incorporating a mechanical governor, and is gear driven from the engine timing case. Provided clean fuel of correct grade is used, and regular attention is paid to the fuel filters, very little trouble should be experienced with the injection pump. Servicing of the injection pump should be limited to recommendations given in the Perkins Workshop Manual.

FUEL FILTER

Two fuel filters, a primary and secondary, are fitted beneath the battery on the L.H. side of the tractor.

These filters are fitted, not to compensate for careless filling, but to protect the finely machined components of the fuel injection equipment from the ravages of dirt and foreign bodies which may be present in the fuel oil. Careless filling can over-burden these filters and defeat their purpose. Before attempting to dismantle the fuel filters, thoroughly clean the exterior of the filter bodies.

PRIMARY FUEL FILTER

Fig. 5.
The filter consists of the filter head (2), element (6), glass bowl filter base (8) and drain tap (9). Any water which accumulates in the bottom of the glass bowl can be drained off, by turning the tap in the base of the filter, anti-clockwise.

An expendable cartridge type filter element is employed and this should be discarded and replaced by a new one every 500 hours. No attempt must be made to clean or in any way reclaim the old element.

PRIMARY FILTER ASSEMBLY

Removal and Refitment 3C-06-06

1. Disconnect and blank off pipes.
   (a) Primary to secondary filter.
   (b) Fuel lift pump to primary filter, at primary filter.
2. Remove two securing bolts and withdraw filter complete.
3. Replace in the reverse order and bleed the fuel system as stated in operation 3C-10-09

PRIMARY FUEL FILTER ELEMENT

Replacement 3C-07-06

1. Remove drain plug (9) and run off fuel. The bleed screw (12) may need slackening to permit fuel to drain off.
2. Remove the 7/16 in AF bolt (1) from the filter head (2).
3. Remove the sediment filter bowl (8) complete with the filter element.
4. Discard the filter element. Reclamation must not be attempted.
5. Flush out the filter sediment bowl in clean fuel or paraffin. Do not use rags.
6. Fit new 'O' rings (3, 4 and 7).
7. Insert a new filter element and assemble bowl.
8. Bleed the fuel system as stated in operation 3C-10-09, before attempting to start the engine.

NOTE – RENEW ELEMENT EVERY 500 HOURS.

SECONDARY FUEL FILTER

Fig. 6.
The filter consists of a filter head (2), element (5) and base (7). Again an expendable cartridge type element is employed, and this should be changed every 1000 hours. No attempt must be made to clean or reclaim the element.

SECONDARY FUEL FILTER ASSEMBLY

Removal and Refitment 3C-08-06

1. Disconnect and blank off pipes:
   (a) From secondary to primary filter.
   (b) From secondary filter to fuel injection pump (2 pipes).
   (c) From secondary filter to start-aid tank, at the secondary filter.
2. Remove the two securing bolts and washers and remove filter.
3. Replace in the reverse order. Bleed the fuel system as stated in operation 3C-10-09.

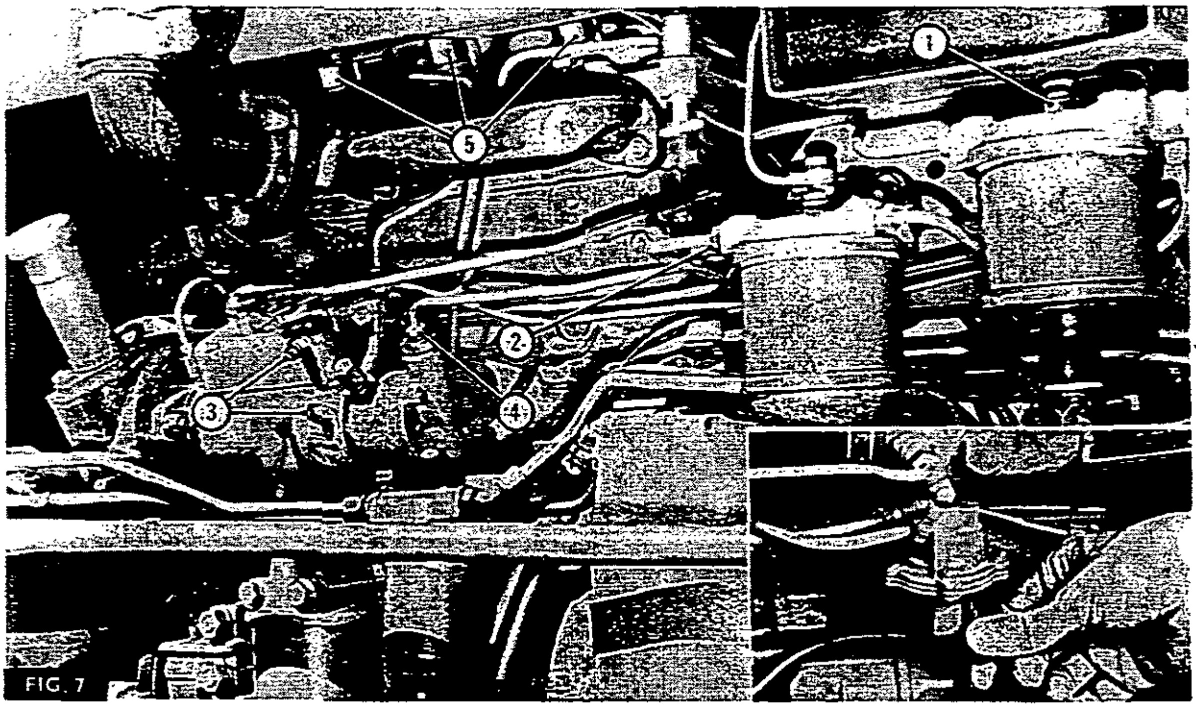


FIG. 7

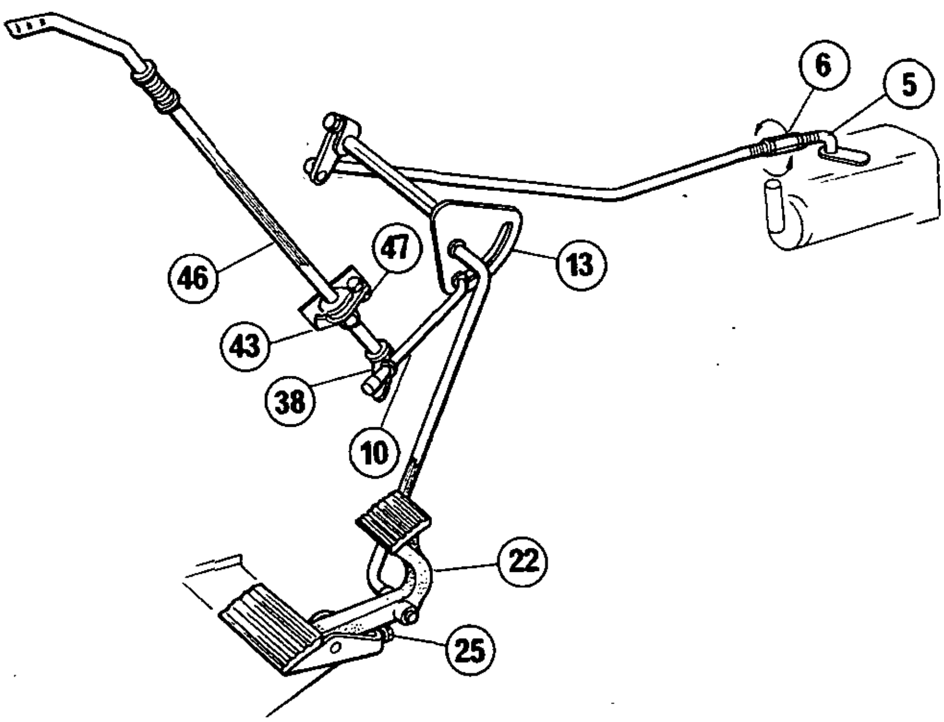


FIG. 8

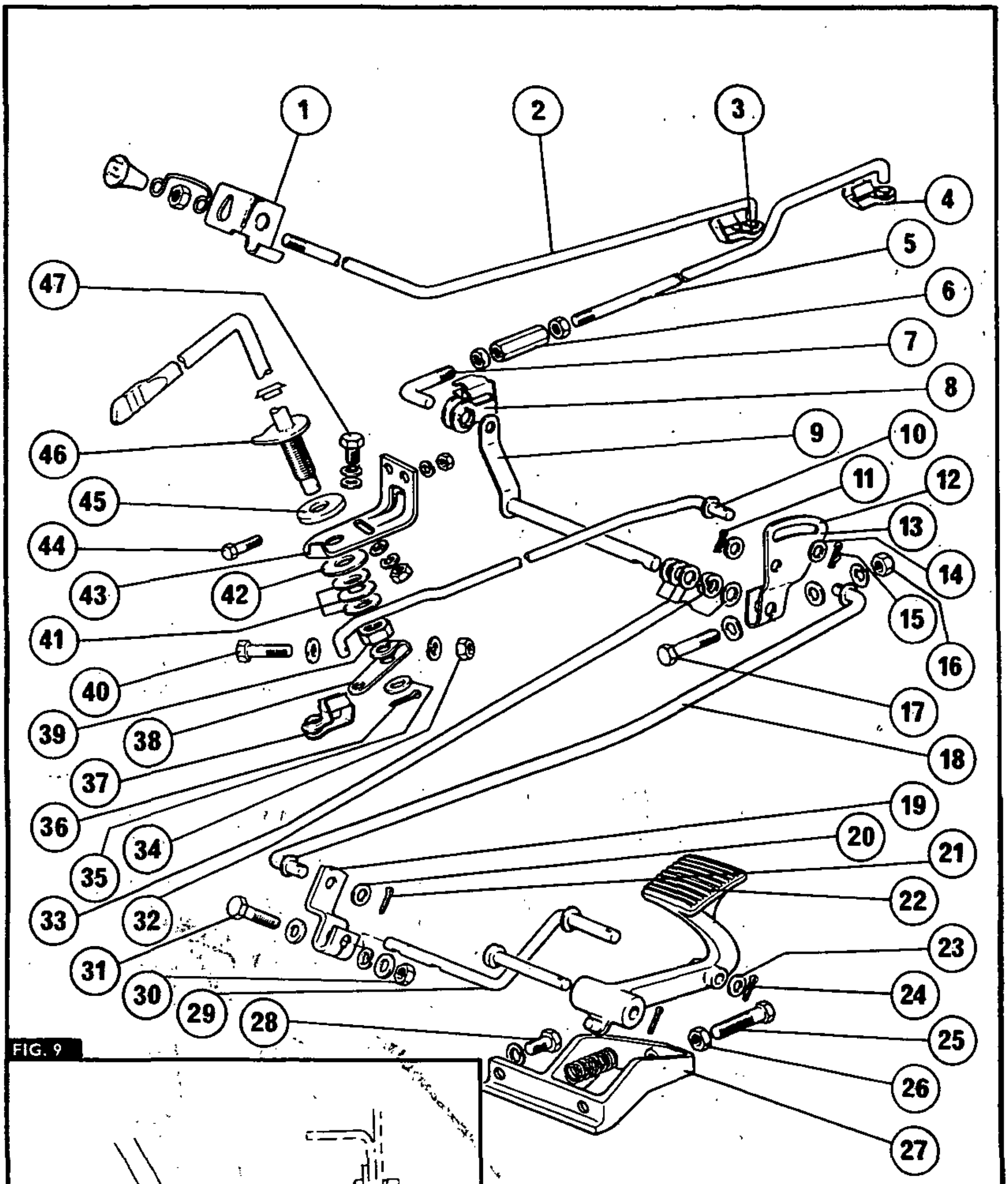

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FIG. 9

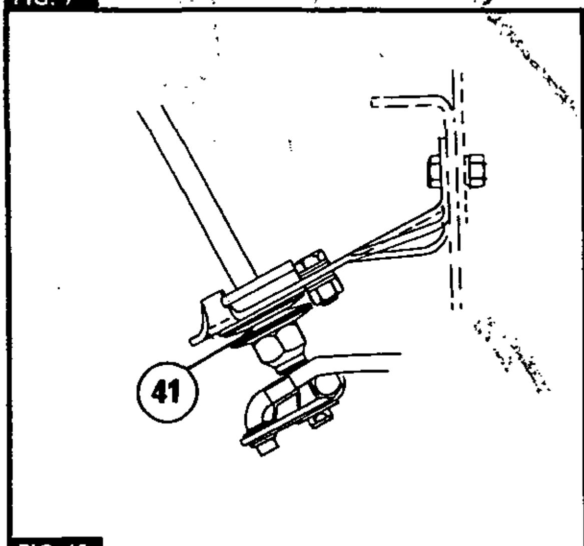
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FIG. 10

SECONDARY FUEL FILTER ELEMENT

Replacement 3C-09-09

1. Remove $\frac{7}{16}$ in AF centre bolt (1) from the filter head (2).
2. Ease base (7) and element (5) from the filter head.
3. Fit new 'O' rings (3, 4 and 6).
4. Change element (5) and replace in reverse order. Bleed the fuel system as stated in operation 3C-10-09

NOTE – ELEMENT RENEWAL SHOULD BE CARRIED OUT EVERY 1000 HOURS. NO ATTEMPT SHOULD BE MADE TO CLEAN OR RECLAIM THE FILTER ELEMENT.

DE-AERATION OF FUEL SYSTEM 3C-10-09

Should air enter the system, due to unexpected emptying of the fuel tank, dismantling of the fuel filter, sediment bowl or feed pump for cleaning or for any other reason, the fuel system must be de-aerated before any attempt is made to start the engine.

Procedure as follows:

1. Fig. 7. Check all fuel line connections for tightness, except those which will be slackened during the process of bleeding.
2. Slacken the vent plug on top of the primary fuel filter (1). Operate the hand priming lever (Inset Fig. 7) on the fuel lift pump until fuel free of air bubbles issues from vent plug. Tighten the vent plug.
3. Slacken the secondary fuel filter outlet union (2) and operate the hand priming lever until fuel free of air bubbles issues from the union.
4. Slacken off the two vent plugs (3), on the fuel injection pump body, and operate the hand priming lever until both vent plugs cease to exude air. Still operating the hand primer, tighten the lower and then upper vent plugs.
5. Slacken the bleed screw on the inlet pipe union (4) on the pump inlet; operate the priming lever and re-tighten when fuel free from air bubbles issues from around the threads.
6. Slacken the unions at the atomiser ends of all three pipes (5).
7. Set the throttle control at the fully open position and ensure that the "stop" control is pushed fully in.
8. Operate the starter to crank the engine, until fuel oil free from air bubbles issues from the high pressure pipes.
9. Tighten the unions on the high pressure pipes, and the engine is ready for starting.
10. Finally, ensure that all fuel lines are free from leaks.

FUEL CONTROL LINKAGE

Adjustments 3C-11-09

1. Fig. 8. With the rod (5) disconnected from the injector pump, and the lever (38) slack on lever (46), fully depress the foot pedal (22).
2. With the foot pedal fully depressed, adjust the rod (5) until it freely assembles into the injector pump lever at 'full throttle' setting. Tension the linkage by giving half a turn to the connector (6) in the direction indicated. Tighten the locknuts on the rod (5).
3. Release the foot pedal (22) and with the bolt (47) slack, adjust the bolt (25) so that the engine idling speed is obtained. Without further movement of the bolt (25) tighten the locknut.
4. With the foot pedal (22) fully depressed, open the hand throttle (46) against the stop on the bracket (43). Adjust the lever (38) so that the link (10) just contacts the rear of the slot on the quadrant (13). Lock the lever (38) in this position.
5. Release the foot pedal (22) and fully close the hand throttle (46). Move the hand throttle (46) slowly towards the open throttle setting until the idling rev/min is just at the point of increase. At this position, adjust the bolt (47) to provide the hand throttle idling stop.

FUEL CUT-OFF CONTROL

Removal and Refitment 3C-12-09

1. Fig. 9. Remove the rod (2) from the clip (3) at the fuel injection pump.
2. Withdraw the complete assembly through the bracket (1).
3. Reassemble in the reverse order.

HAND THROTTLE LINKAGE

Removal and Refitment 3C-13-09

1. Fig. 9. Remove the rod (5) from the clip (4) at the injection pump.
2. Disconnect the rod (7) from the clip (8) at the shaft (9).
3. Remove the clip (15) and washer (14) from the rod (10) and then remove the rod from the clip (37) at the lever (38).
4. Remove the nut (16), spring washer, flat washers and bolt (17) from the quadrant (13), then remove the quadrant, spring (32) and washers (33) from the shaft (9).
5. Withdraw the shaft (9).
6. Remove the lower instrument panel as stated in Part 2B.
7. Disconnect the battery cables and remove the battery securing brackets.
8. Move the battery as far forward as possible and remove the bolts (44) securing the throttle lever bracket (43) and then manoeuvre the complete lever from beneath the instrument panel.

9. To overhaul the lever, remove the pin (36) and washer (35), then remove the nut (34), spring washer, flat washers and bolt (40); remove the lever (38), nut (39), belleville washers (41), flat washer (42), bracket (43) and friction disc (45).
10. Assemble in reverse order and adjust the linkage as stated in operation 3C-11-09.

NOTE – THE BELLEVILLE WASHERS MUST BE FITTED AS SHOWN IN FIG. 10.

FOOT THROTTLE LINKAGE

Removal and Refitment 3C-14-10

1. Fig. 9. Carry out operations 1 and 2 of operation 3C-13-09
2. Remove the clip (15) and washer (14) from the rod (10) and release the rod.
3. Remove the pin (21) and washer (20), and release the rod (18) from the lever (19).
4. Remove the nut (16), spring washers, flat washers and bolt (17) from the quadrant (13), then remove the quadrant complete with the rod (18) from the shaft (9). If necessary, remove the clip (11) and washer (12) to release the rod (18).
5. Remove the spring (32) and washers (33) from the shaft (9) and withdraw the shaft.
6. Remove the pin (24) and washer (23) from the shaft (29).
7. Remove the two bolts (28) and spring washers securing the pedal bracket (27) to the footrest, then remove the pedal (22) complete with the bracket.
8. Remove the bolt (31), flat washers, spring washer and nut (30) and then remove the lever (19) from the rod (29) and withdraw the rod from the footrest.
9. Assemble in reverse order and adjust the linkage as stated in operation 3C-11-09.

DUAL CLUTCH

Part 4 Section A

GENERAL

The Dual Clutch Assembly enables the main transmission drive to be disconnected without interrupting the drive to the pump and p.t.o. shaft. When the main transmission drive is stopped, with the first movement of the pedal, p.t.o. driven implements can still be operated and raised and lowered by the hydraulic system. Further movement of the pedal will stop p.t.o. driven implements and the hydraulic pump.

DESCRIPTION AND PRINCIPLE OF OPERATION.

Figures 1 and 2.
The Dual Clutch Assembly consists of a main 305 mm (12 in) friction disc (16), driving the transmission main input shaft, and a p.t.o. 254 mm (10 in) friction disc (12) driving the p.t.o. input shaft. The main friction disc (16) is operated by the main pressure plate (15), against the engine flywheel. The p.t.o. friction disc (12) is operated by the p.t.o. pressure plate (11) against a false flywheel (13). Pressure plate movement is obtained by three release levers (7), pivoted on the clutch cover plate (9). Initial release lever movement operating against the 12 coil springs (18), moves the main pressure plate (15), rearwards and so releases the main friction disc (16). Further movement of the main pressure plate (15), by the release levers, forces the setscrews (5) on the main pressure plate against the p.t.o. pressure plate (11). This moves the p.t.o. pressure plate (11) against its belleville spring (10), and releases the p.t.o. friction disc (12). The clutch release levers (7) are operated by a release bearing (3) which is moved by the clutch pedal.

DUAL CLUTCH

MAIN FRICTION DISC OR CLUTCH ASSEMBLY

Removal and Refitment. 4A-01-02

Special Tools Required: MF 159A Clutch Centraliser
MF 215 P.T.O. Clutch Setting Gauge
MF 314 Lever Height Setting Gauge

WARNING : SPRING PRESSURE WILL CAUSE THE CLUTCH COVER TO FLY APART IF PRESSURE IS NOT RELEASED SLOWLY AND EVENLY. THE GIVEN SEQUENCE OF INSTRUCTIONS MUST BE CAREFULLY FOLLOWED.

Removal

1. Split the tractor between the engine and transmission as stated in Part 3.
2. Fig 3. Fit three slave bolts, ¼ in UNC x 54 mm (2⅛n) to the three equi-spaced holes in the clutch cover.
3. Fig. 4. Progressively slacken and remove the six bolts securing the clutch assembly to the flywheel. Detach the complete clutch assembly from the flywheel. The main friction disc will remain seperate from the clutch assembly.

Refitment.

1. Fit the main friction disc (16) to the flywheel, with the splined boss facing away from the flywheel. A very slight smear of Mobilgrease Super should be applied to the splines.
2. Fig 5. Position the clutch assembly on the flywheel and centralise the clutch assembly and main friction disc with special tool MF159A
3. Fig 4. Refit the six bolts and washers securing the clutch to the flywheel and progressively tighten the bolts.
4. Remove the three ¼ in UNC x 54 mm (2⅛ in) slave bolts and then the centraliser tool.
5. Fig 6. Using gauge MF 215, check the clearance between the p.t.o. clutch adjusting setscrews and the p.t.o. pressure plate. Slacken each adjusting screw locknut, and adjust the setscrews as required. Tighten the locknuts after adjustment.
6. Figs 7 & 8. Fit the guage MF 314 and check the adjustment of each release lever. The domed end of the release lever setscrew must be touching the gauge. Slacken the release lever setscrew locknut, then adjust the setscrew as required. Tighten the locknut after adjustment.
7. Connect the rear half of the tractor to the engine as stated in Part 3.
8. Fig. 9. To adjust the clutch pedal to the correct clearance, fit a suitable lever to the hole (A) in the end of the clutch release shaft.
9. Fig. 9. Depress the clutch pedal until the distance between the arm and the transmission case is 3,2 mm (⅛ in). Retain the arm in this position and tighten the clamping bolt (B). Re-check the adjustment.

NOTE – THE ROD ASSEMBLY MUST BE FITTED TO THE FRONT HOLE IN THE ARM. THE CORRECT ADJUSTMENT OF THE ROD ASSEMBLY IS 646 mm (25⅜in) MEASURED BETWEEN THE HOLE CENTRES IN THE FORK ENDS.

CLUTCH COVER ASSEMBLY SERVICING.4A-02-02

Special Tools Required: Hydraulic Press.

Disassembly.

1. Remove the clutch assembly, as stated in operation 4A-01-02.
2. Mark the following components to permit their refitment in the same relative positions:
   Cover Plate (9)
   P.t.o. Pressure Plate (11)
   False Flywheel (13)
   Main Pressure Plate (15)
3. Fig 10. Place the cover assembly on the hydraulic press and locate a suitable bar, as shown.
4. Apply the press pressure until the three ¼ UNC slave bolts can be easily removed.
   Remove the retaining clips (6), then drive the lever pivot pins (8) out of the cover.
6. Remove the springs (4) from the release levers (7).
7. Release the pressure from the press. The springs (18) will fully expand, raising the cover.
8. Lift off the cover plate (9) Belleville spring (10) p.t.o. pressure plate (11) p.t.o. friction disc (12) and false flywheel (13).
9. Remove the twelve springs (18) and the fibre washers (17).
10. If necessary remove the links (7 and 14).

Examination

Check all components for signs of wear, scoring, overheating or other damage.
Always check the coil springs and Belleville springs for correct loading and pressures, as stated in the Specification section.
Always fit a new pair of friction discs (12 and 16) and new fibre washers (17).
If the tractor flywheel is scored, it can be skimmed to remove scoring in 0,254 mm (0.010 in) increments up to a maximum of 1,00 mm (0.040 in).
The ledge to which the clutch cover is bolted, must also be skimmed by the same amount to maintain the distance from the clutch face to 39,75 to 39,62 mm (1.565 to 1.560 in).

WARNING: – NEVER, UNDER ANY CIRCUMSTANCES, ATTEMPT TO SKIM EITHER THE FALSE FLYWHEEL, OR THE PRESSURE PLATES, AS THIS WILL SEVERELY IMPAIR THEIR HEAT DISSIPATION CHARACTERISTICS.

KEY TO FIG 1 & 2

1	Spring
2	Carrier
3	Bearing
4	Spring
5	Setscrews
6	Clip
7	Release Lever
8	Pin
9	Cover Plate
10	Belleville Spring
11	P.T.O. Pressure Plate
12	P.T.O. Friction Disc
13	False Flywheel
14	Link
15	Main Pressure Plate
16	Main Friction Disc
17	Washer
18	Coil Spring

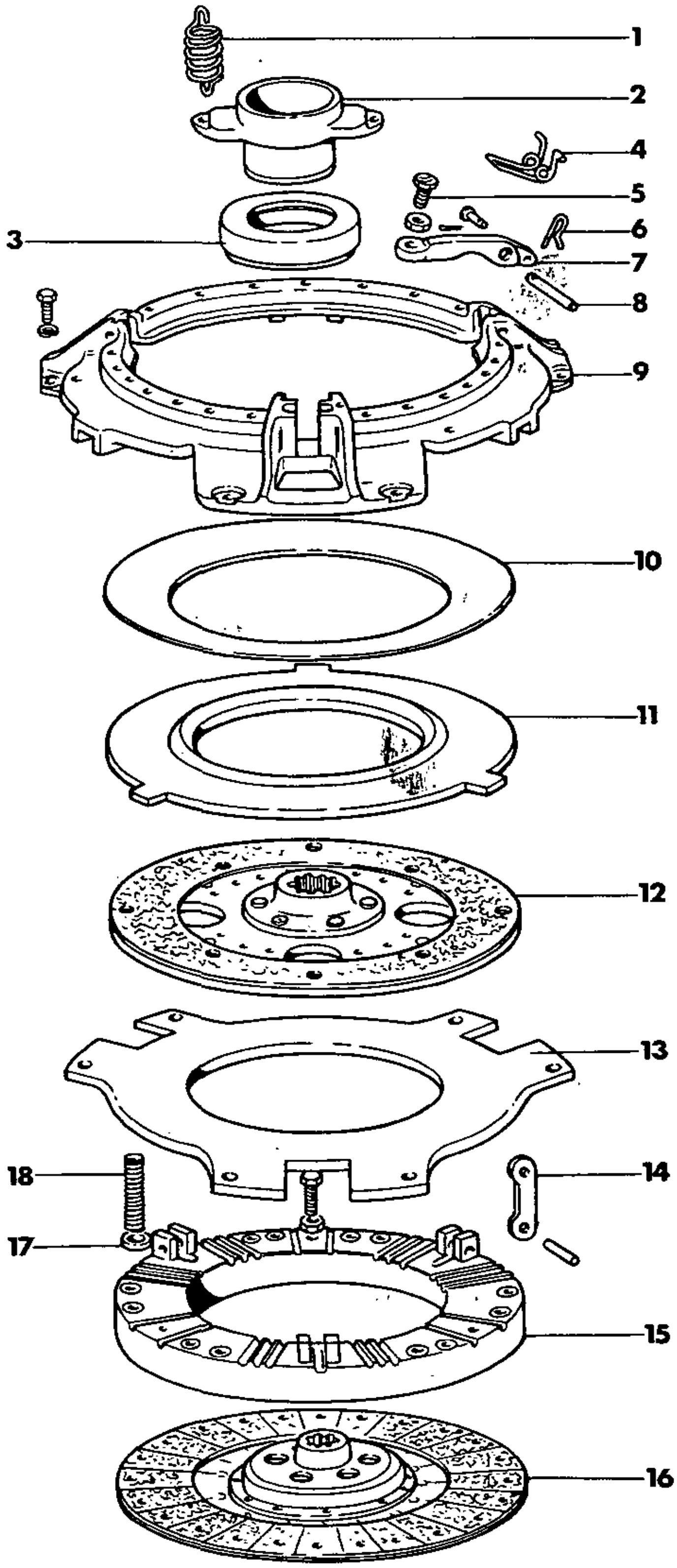


FIG. 1

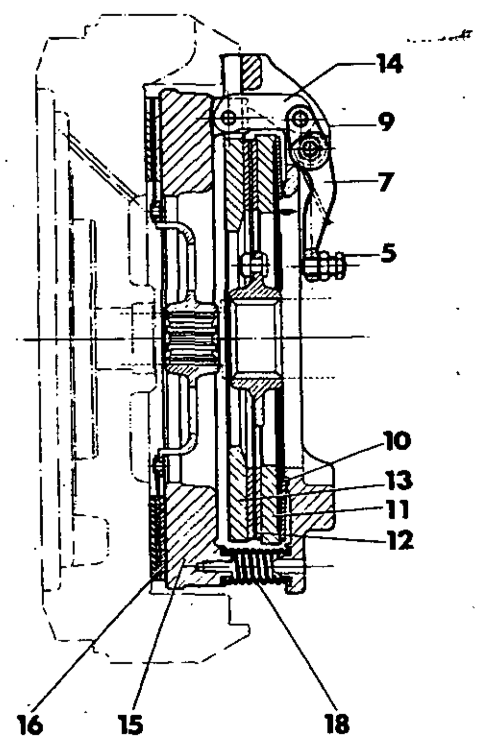


FIG. 2

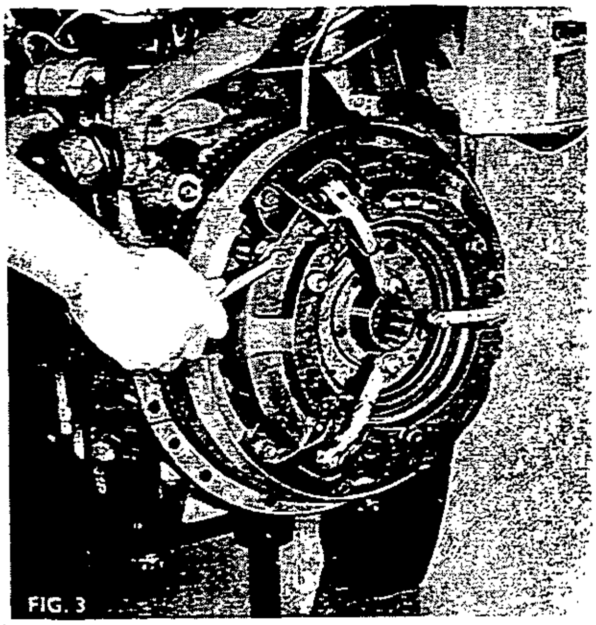
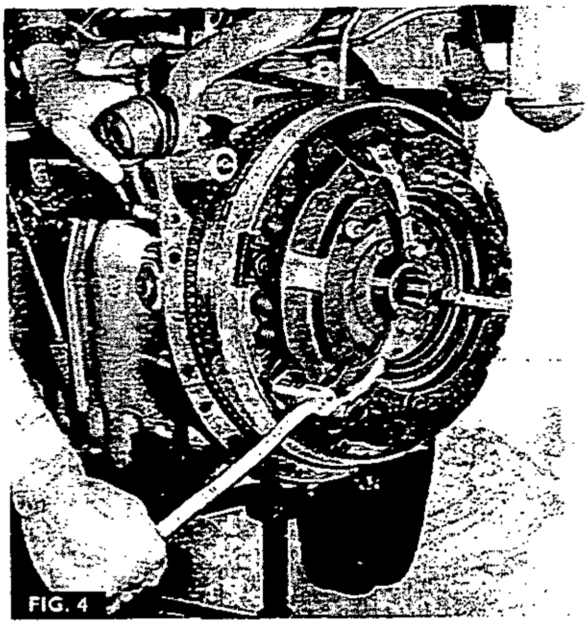


FIG. 3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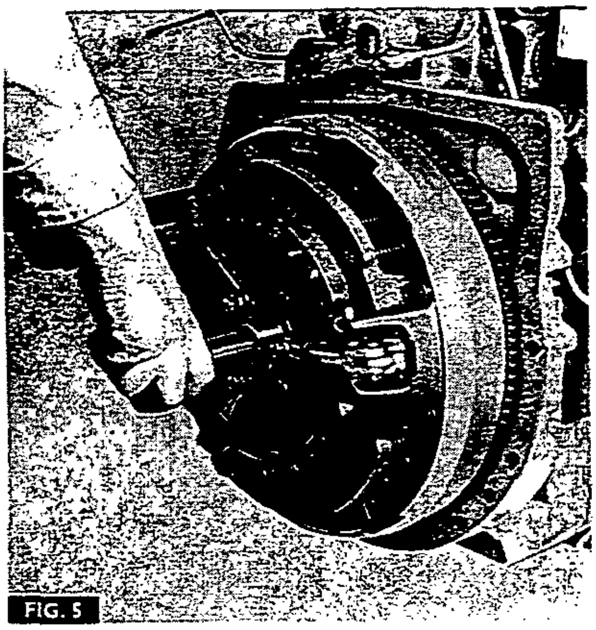
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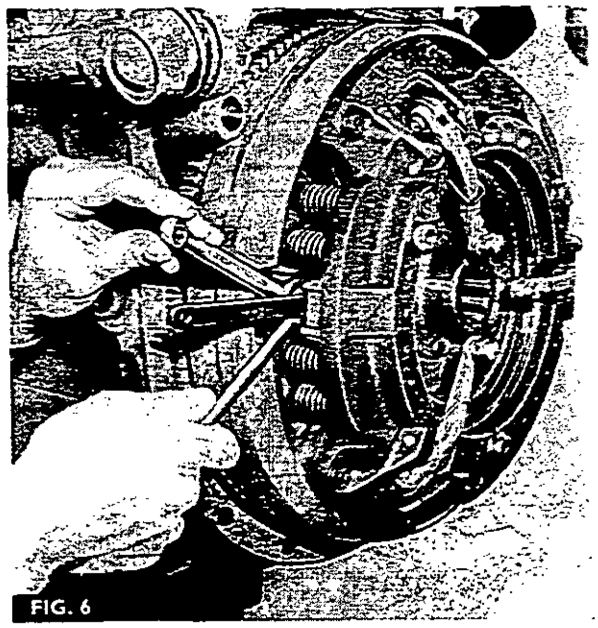
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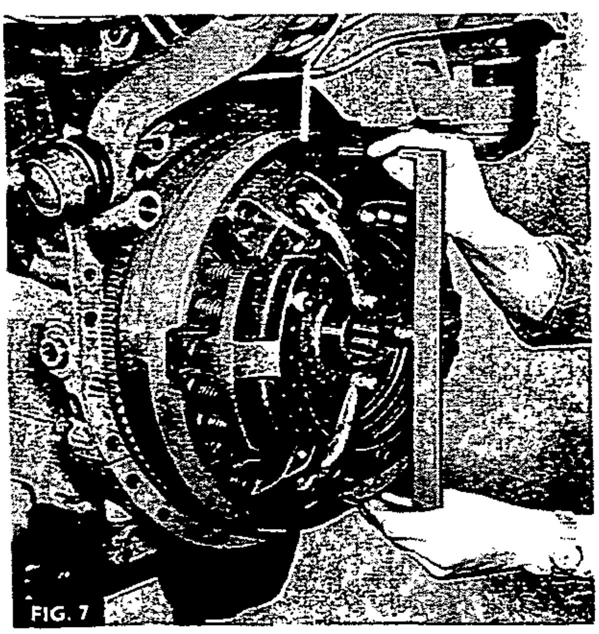
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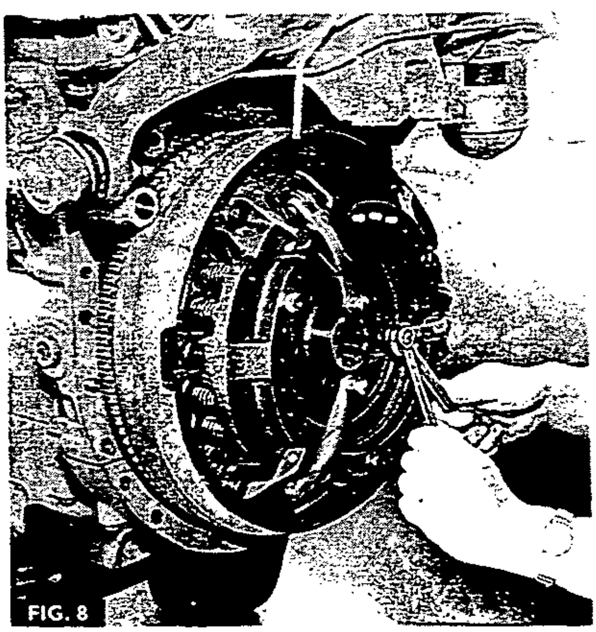
FIG. 8

Reassembly.

1. If necessary, refit the links (7 and 14) to the main pressure plate (15).
2. Aligning the marks, refit the false flywheel (13), new p.t.o. friction disc (12) p.t.o. pressure plate (11) and Belleville spring (10).
3. Fit twelve new fibre washers (17) then fit the springs (18) and finally the cover plate (9) locating the links (7) through the slots in the cover plate.
4. Fig 10. Place the cover assembly on the press, refit the bar and compress the springs until the springs (4) and pins (8) can be refitted. Secure the pins (8) with the retaining clips (6).
5. Compress the springs fully and refit the three ¼ UNC slave bolts.
6. Remove the cover assembly from the press then refit the cover assembly to the tractor, as stated in operation 4A-01-02, using a new friction disc (16).

RELEASE BEARING, CARRIER, FORK AND SHAFT

Removal and Refitment 4A-03-05

Removal

1. Split the tractor between the engine and transmission as stated in Part 3.
2. Release the two springs securing the release bearing carrier, and slide the carrier and bearing assembly off the input shaft retainer.
3. Drive out the carrier from the release bearing, only if either is being replaced.
4. Release the locking wire and remove the two locking setscrews from the release fork.
5. Slacken off the clamp bolt on the clutch pedal lever and remove the fork and shaft.

Examine the bearing, carrier, shaft and fork for wear or damage and replace if necessary.

Refitment.

1. Refit the shaft and fork, secure with the two locking setscrews and lockwire.
2. Lubricate the release bearing, carrier and input housing with Mobilgrease Super.
3. Press the release bearing onto the carrier, slide the carrier on to the input shaft retainer and secure with the two springs.
4. Connect the rear half of the tractor to the engine as stated in Part 3.
5. Adjust the clutch pedal clearance, as stated in item 8 and 9 of refitment, operation 4A-01-02.

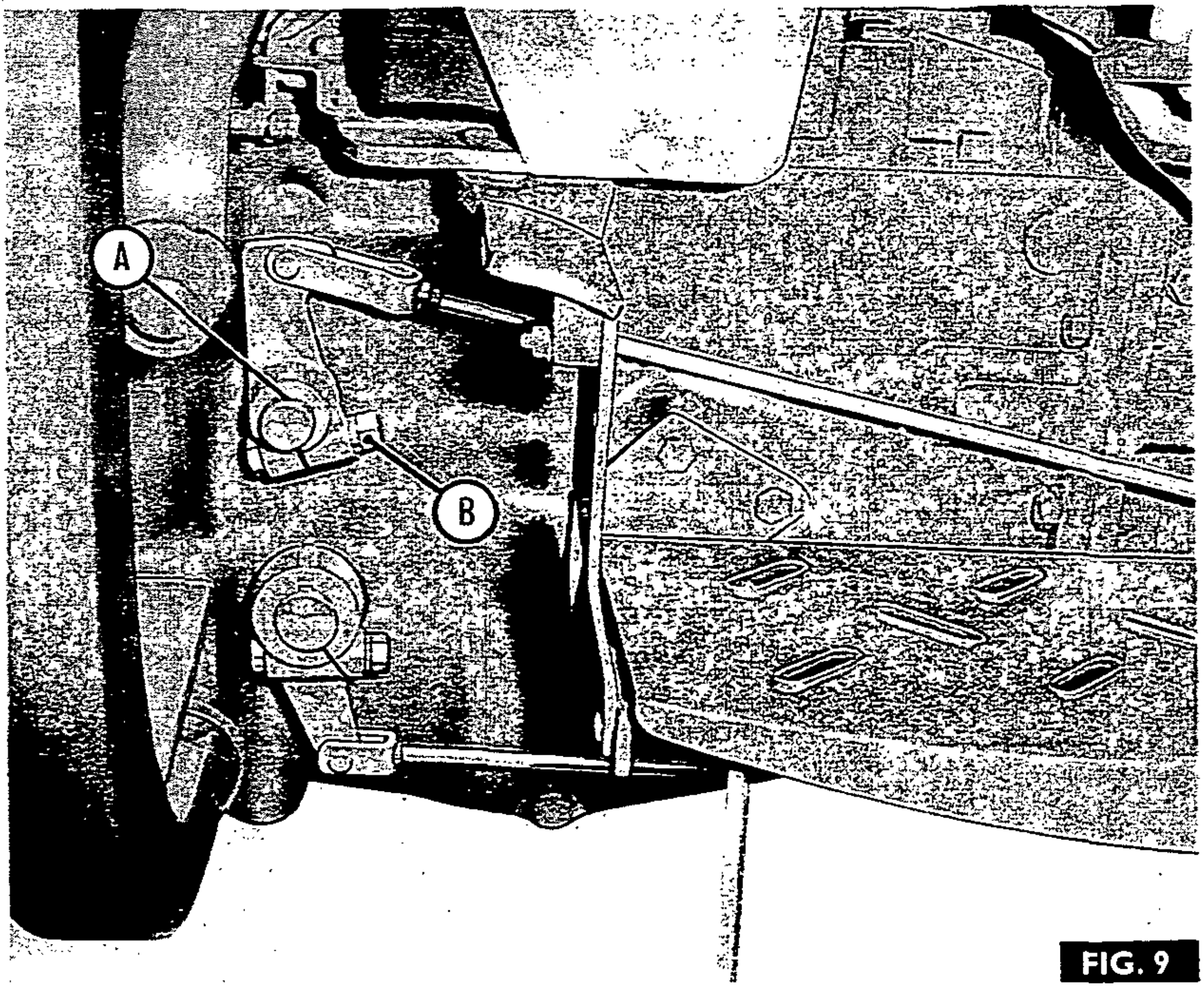

FIG. 9

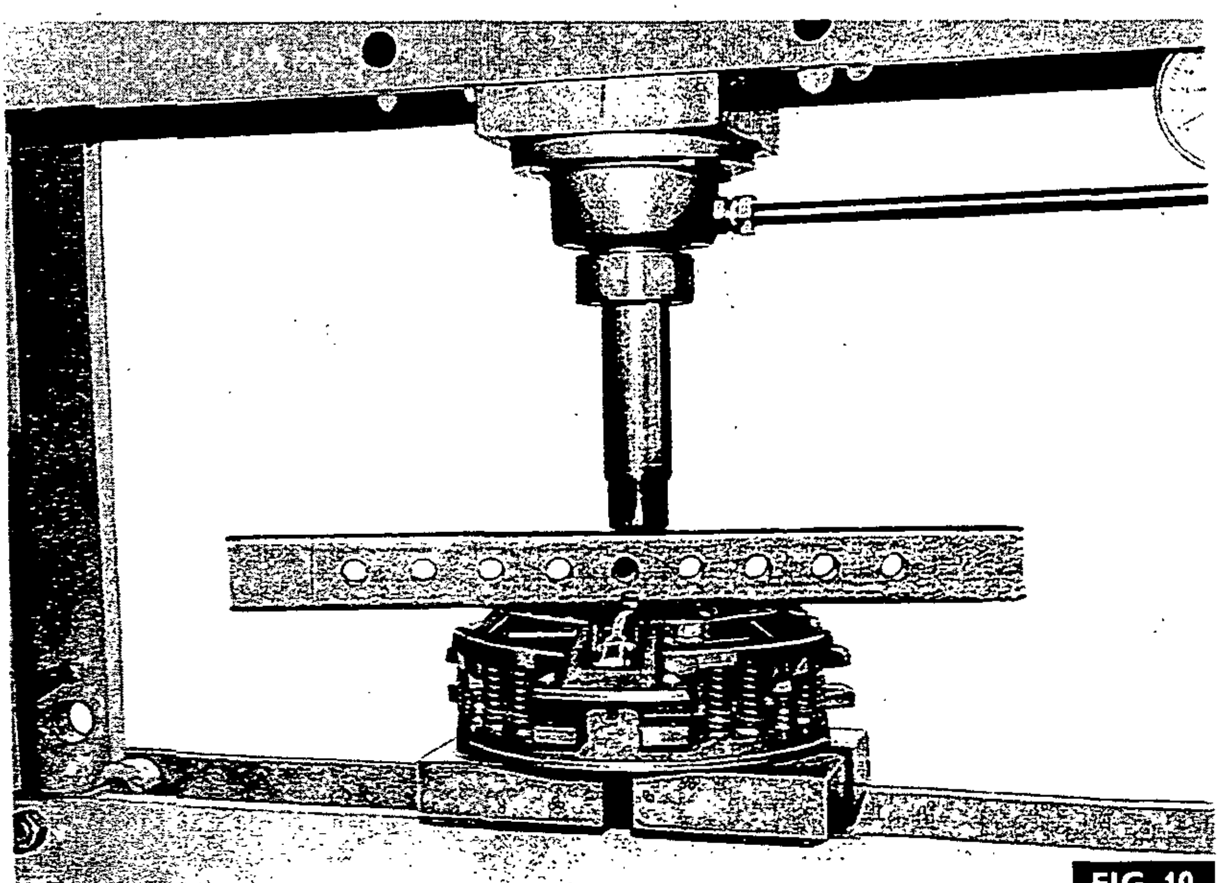
FIG. 10

MULTI-POWER TRANSMISSION

Part 4 Section B

GENERAL

Figures 1 and 2.
Multi-Power transmission provides twelve forward gears and four reverse gears. This is achieved by combining with the standard transmission, low driving (57) and driven (95) constant mesh gears, operated by a free-wheel coupler (94), and high driving (52), and driven (92) constant mesh gears operated by a multi-plate hydraulic clutch (43). By driving the countershaft (98) with either of these two pairs of gears, an alternative speed for each gear becomes available.

To provide Multi-Power, the following components are added to the standard transmission; a pair of constant mesh gears, free-wheel unit (94), multi-plate clutch (43), oil pump, oil control valve and shift mechanism (30).

The high driving gear (52), runs on a bush on the main input shaft (57), next to the low driving gear (54). The front end of the high driving gear (52) is splined to engage the clutch disc splines. The three clutch discs, plates, piston and return springs are held into the clutch housing (43) by a retainer plate and snap ring. The three clutch plates are splined into the clutch housing, and the housing (43) is splined to the main input shaft (54).

The high driven gear (92) is splined to the countershaft (98) and is retained by a snap ring. The low driven gear (95) runs on a bush on the countershaft, next to the high driven gear (92). A spring loaded coupler (94) is fitted between the driven gears and operates on a helical spline on the countershaft (98). The coupler is spring loaded towards the low driven gear (95), and the teeth on the rear face of the coupler engage similar teeth on the front face of the low driven gear (95).

The oil pump supplies oil to the control valve for operation of the clutch (43). The control valve is fitted to the main drive retainer (34) and directs oil to the clutch or returns oil into the transmission housing. When the shift lever is in the high position, oil is directed from the control valve through drillings in the retainer (34), input shafts and clutch housing to the clutch piston. When the shift lever is in the low position, oil is returned from the control valve into the transmission housing. The Multi-Power shift lever is fitted to the instrument panel and mechanical linkage connects the shift lever to the oil control valve. Multi-Power high or low can be selected whilst the tractor is moving and in any gear. The gear levers and reduction unit are identical to those used for the eight speed transmission.

OPERATION

Shift Lever in Low
Oil is pumped through the control valve and back into the transmission housing. The drive is transmitted to the countershaft (98) through the low constant mesh gears (57, 95), and the free wheel coupler (94). The coupler is forced into engagement with the low driven gear (95) by its spring and the thrust exerted by the helical splines. When the coupler is in this engaged (low) position, no engine braking is available. If engine braking is required, move the Multi-Power shift lever to high.

Shift Lever in High
Oil is pumped to the control valve and is then directed through drillings to the clutch (43) which engages the high driving gear (52). The higher ratio of the high gears increases the speed of the countershaft (98). This speed increase exerts an opposite thrust on the helical splines of the coupler (94), which overcomes spring pressure and disengages the coupler from the low driven gear (95), so allowing the low driven gear to free-wheel.

SHIFTER RAIL MECHANISM

Removal and Refitment 4B-01-02
Special Tools Required: 270 Rail Trolley.

Removal

1. Split the tractor between the gearbox and centre housing as stated in Part 3.
2. Remove the gearbox top cover, in unit with the instrument panel, as stated in Part 3.
3. Fig 3. Release the locking wire from the 1st/rev. and 2nd/3rd shift rails (8, 10), and from the rear end of the HIGH/LOW shift rail (5).
4. Fig 4. Remove the locking peg (3) from the HIGH/LOW shift fork (6), detach the fork and coupler (77).
5. Remove the gear lever stop plate (11) and interlock pin (14), secured by two bolts (13) and spring washers (12).
6. Lift out the three shift rail springs (1), and plungers (2).
7. Remove the locking pegs (3) from the 1st/rev. and 2nd/3rd shift forks (7, 9).
8. Slide the 1st/rev. and 2nd/3rd shift rails (8, 10), rearwards out of the transmission housing. Lift out the 1st/rev. and 2nd/3rd shift forks (7, 9).
9. Release the locking wire and remove the locking peg (3) from the HIGH/LOW shift selector (4).
10. Slide the HIGH/LOW shift rail (5), rearwards out of the transmission housing. Lift out the HIGH/LOW shift selector (4).

Refitment

1. Fit the HIGH/LOW shift rail (5), sliding the HIGH/LOW shift selector (4), onto the rail and secure to the rail with locking peg (3). Wire lock the peg to the rail.
2. Locate the 1st/rev. and 2nd/3rd shift forks (7, 9), to their respective grooves in the mainshaft gears. The two forks are identical.
3. Assemble the 1st/rev. and 2nd/3rd shift rails (8, 10), with interlock pin grooves facing each other, to the forks, and secure each fork with a locking peg (3). Wire lock the pegs to the rails. The shorter, 2nd/3rd shift rail (8) is fitted to the L.H. side.
4. Locate the HIGH/LOW shift fork (6), to the groove in the coupler (77). Assemble the coupler into the planet pinion carrier assembly (69), simultaneously sliding the fork (6), onto the HIGH/LOW shift rail (5).
5. Secure the HIGH/LOW shift fork (6), to its rail withthe locking peg (3).
6. Wire lock the peg to the rail.
7. Fit the interlock pin (14), to the stop plate (11), and secure the stop plate with two bolts (13), and spring washers (12).
8. Fit the three plungers (2), pointed end downwards, and the three springs (1).
9. Refit the gearbox top cover and instrument panel assembly as stated in Part 3.

NOTE – BOTH GEAR LEVERS AND THE GEAR SELECTOR DOGS MUST BE PLACED IN NEUTRAL.

10 Reconnect the transmission to the centre housing, as stated in Part 3.

TRANSMISSION EPICYCLIC

Removal and Refitment 4B-02-02

Figure 4
Special Tools Required: 270 Rail Trolley

Removal

1. Split the tractor between the transmission and the centre housing.
2. Remove the locking wire and peg from the HIGH/LOW shifter fork, then remove the fork and coupler.

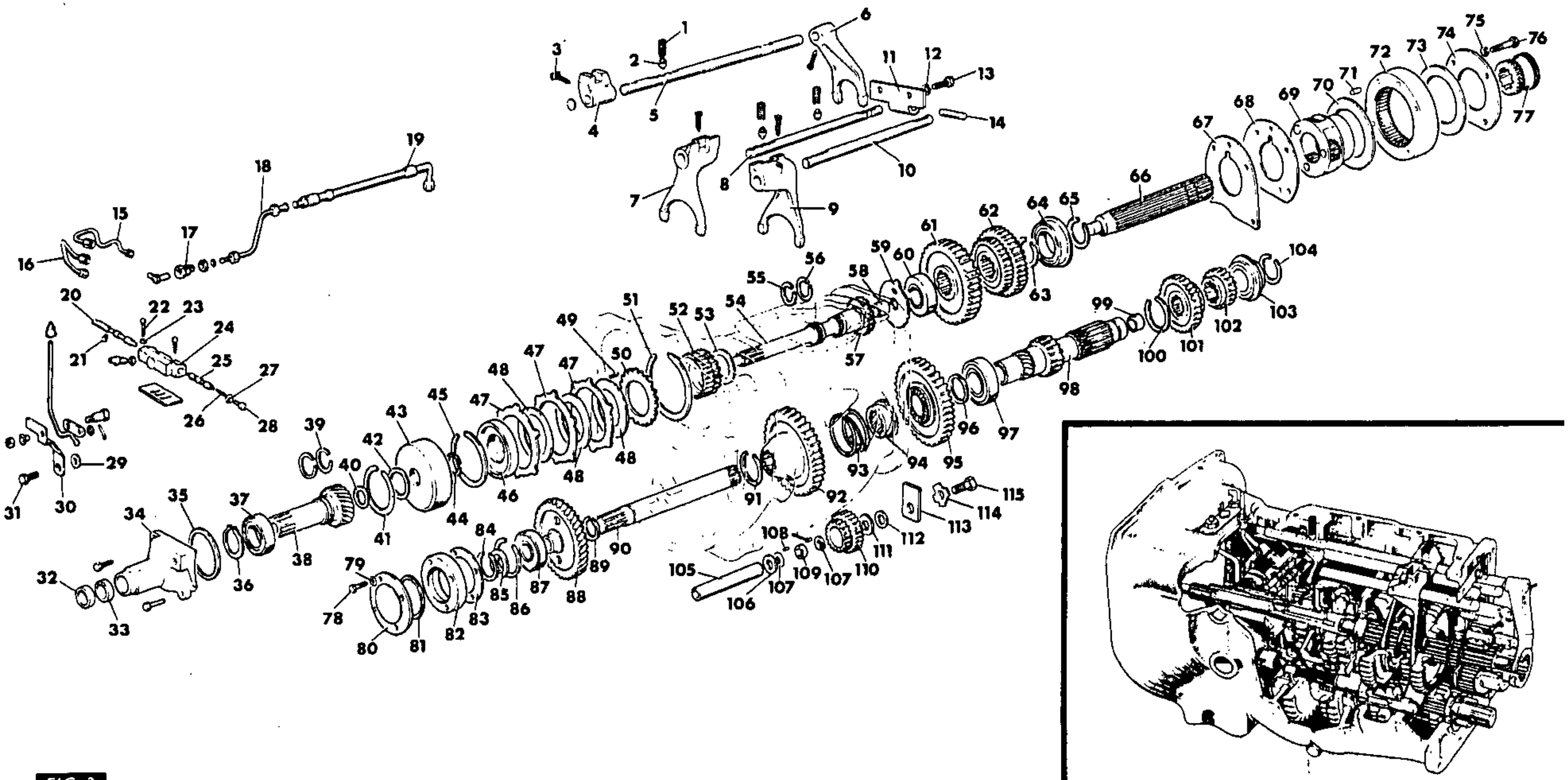
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FIG. 2

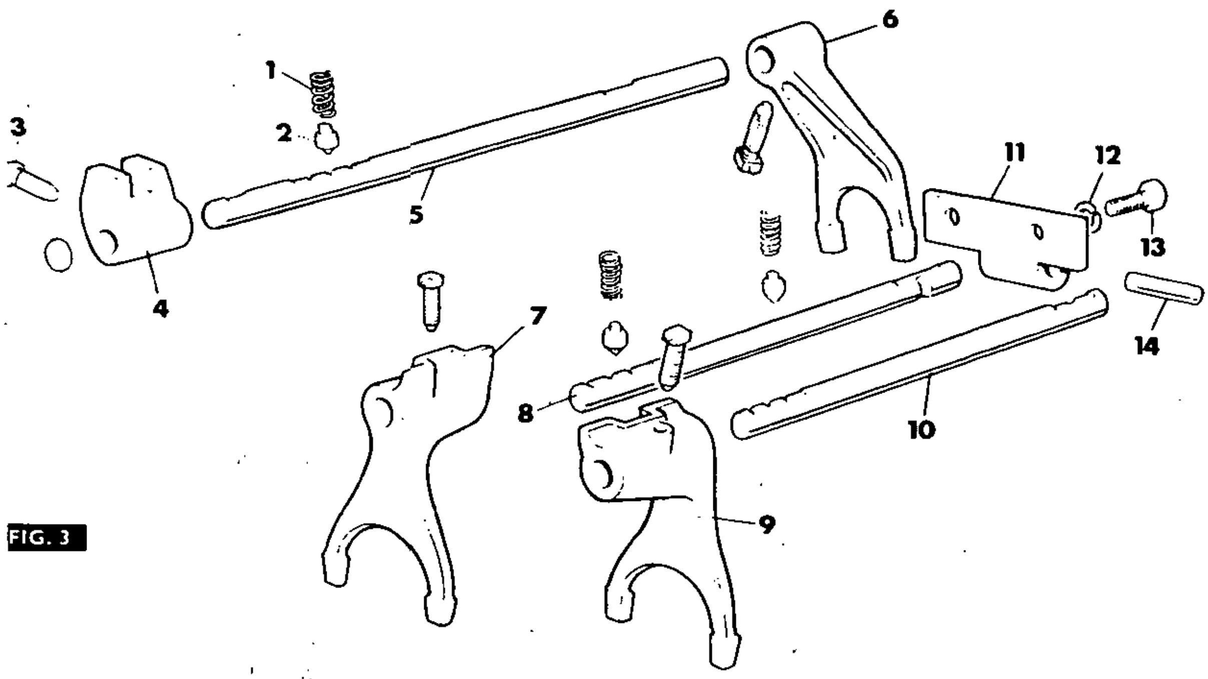
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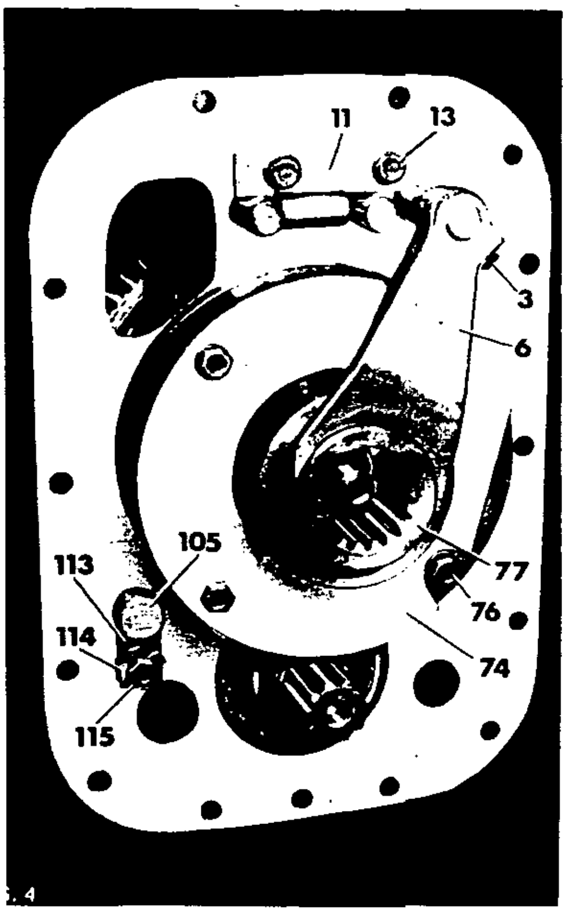
FIG. 3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. 4

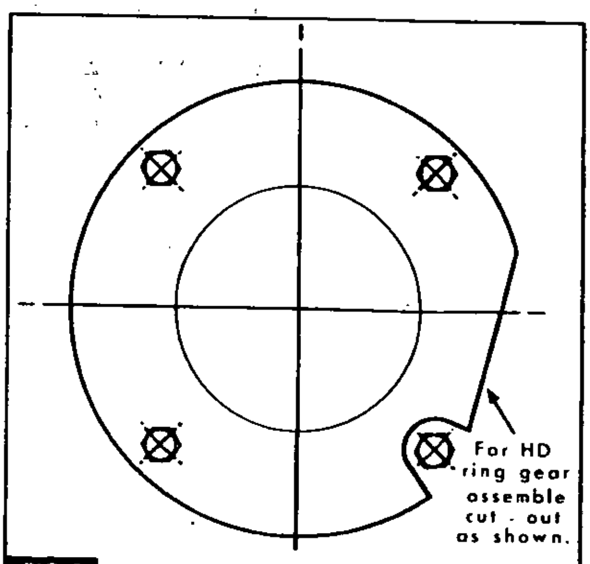
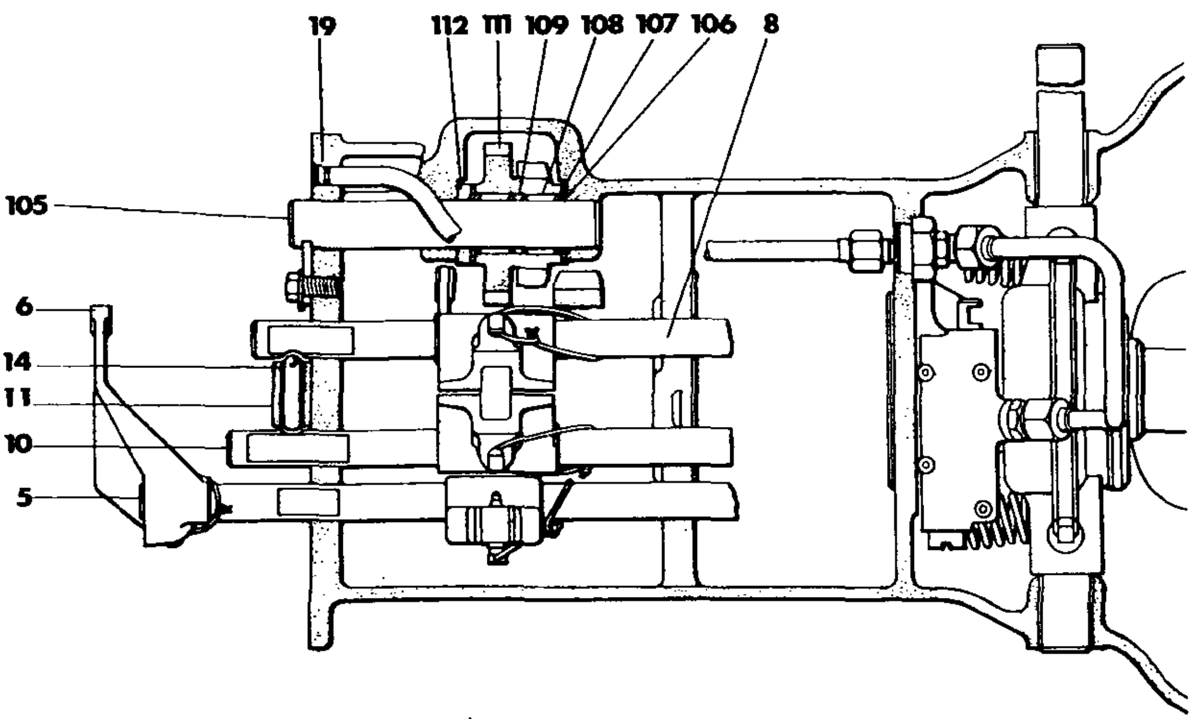

For HD
ring gear
assemble
cut - out
as shown.

FIG. 5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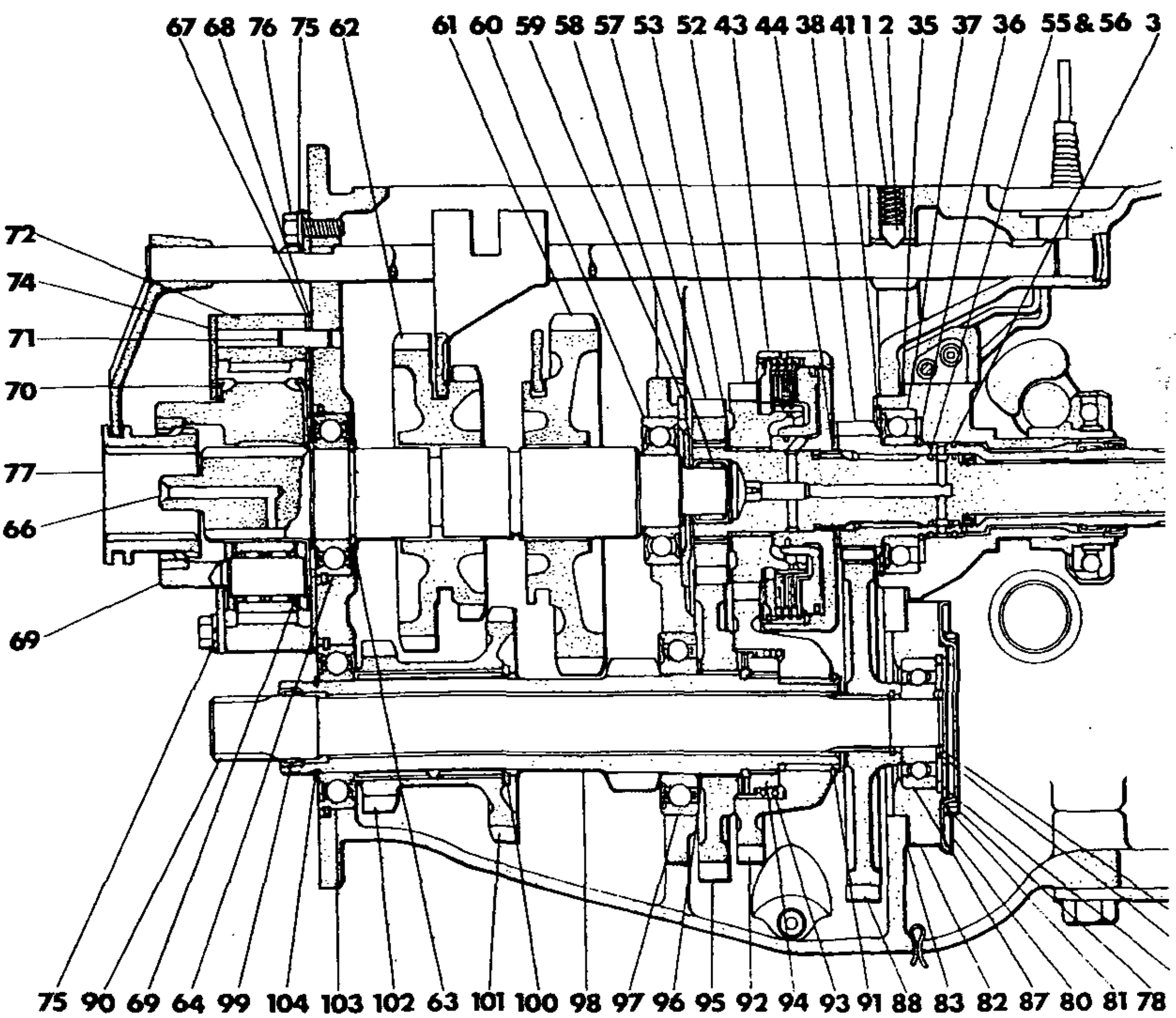
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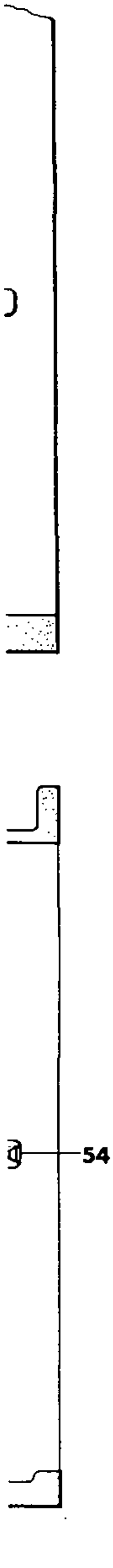

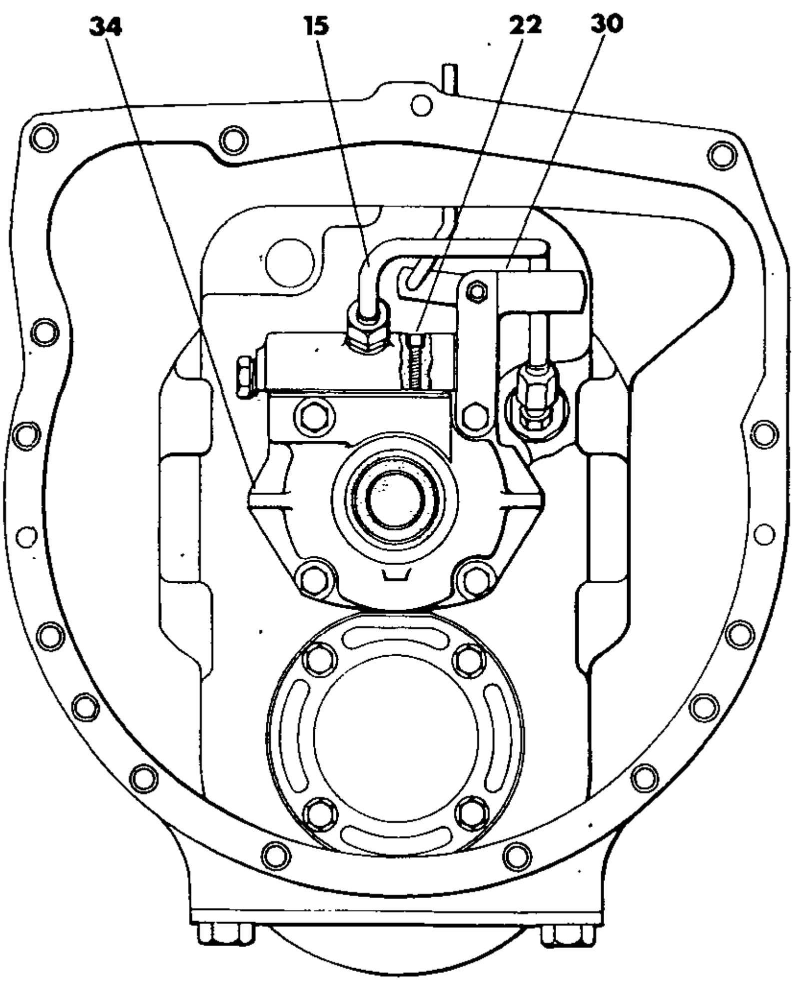

FIG. 1

3. Figure 4. Remove the four bolts (76) securing the transmission epicyclic unit, then remove the complete assembly.

Refitment

1. Figure 4. Refit the backplate (67) and the *shims (68) to the dowels (71) on the ring gear* (72), then locate the dowels in the holes in the transmission case. Fit the thrust washers (70 and 73) to the planetary pinion carrier (69) and locate the carrier in the ring gear. Refit the cover plate (74), as shown in Fig 5. Fit the four bolts (76) and tighten them progressively and evenly to a torque of 4,9 kg-m (35 lb ft).

NOTE – OMIT LOCKWASHER FROM LOWER LEFT HAND BOLT.

2. Refit the coupler and HIGH/LOW shifter fork, then refit the locking peg and locking wire.
3. Reconnect the transmission to the centre housing.

INPUT SHAFT HOUSING AND P.T.O. INPUT SHAFT

Removal and Refitment 4B-03-05

Special Tools Required: 270 Rail Trolley
MF 177 Seal Protector
MF 255B Oil Seal Replacer
MF 256A Oil Seal Replacer
MF 315 Needle Roller Bearing Removal and Refitting Tool.

Removal.

1. Remove the clutch release mechanism, as stated in operation 4A-03-05.
2. Fig 6. Remove the R.H. upper bolt (31) securing the Multi-Power shift linkage bracket (30) to the input housing, then remove the linkage by pulling the shifter rod downwards through the rubber bung in the top of the transmission case.
3. Disconnect the pipe (15) from the spool valve.

NOTE – IF THE TRACTOR IS FITTED WITH A LOW CAPACITY PUMP, THE COMPLETE PIPE MUST BE REMOVED (15 AND 16, FIG 6).

4. Remove the three remaining bolts (31) securing the input housing to the transmission case.
5. Fig 7. Withdraw the input housing (34), complete with the p.t.o. input shaft (38) from the transmission case.
6. Remove the four Allen screws (22) securing the spool valve (24) to the input housing.
7. Fig 8. Remove the large internal circlip (41) from the rear end of the input housing, then push the p.t.o. input shaft (38) out of the housing, complete with its bearing (37).
8. Lever the inner seal (40) out of the input shaft.
9. Carefully lever the front oil seal (32) from the front of the input housing with a screwdriver.
10. Fig 9A. Drive the needle roller bearing (33) out of the housing using special tool MF 315, as shown.
11. If the rear bearing (37) needs servicing remove the two rings (39) and the circlip (36) then press off the bearing.
12. Remove the 'O' ring (35) from the input housing.

Examine the bearings (33 and 37), the rings (39) and the input shaft gear teeth for signs of wear or damage and replace any defective components.

Always fit new seals (32 and 40) a new 'O' ring (35); also if possible, fit new circlip and snap ring (36 and 41).

Refitment

1. If necessary, press the bearing (37) on to the input shaft (38) (with the shield towards the gear teeth) and secure it with the circlip (36).
2. Fig 9B. Using special tool MF 315 drive the needle roller bearing (33) into the input housing.
3. Fig 10. Fit the new inner oil seal (40) to special tool MF 256A, then drive the seal fully into place.
4. Fig 11. Assemble special tool MF 255B, then slide the oil seal (32) (metal face first) on to the tool.
5. Remove the cone from the front of tool MF 255B.
6. Refit the two rings (39) to the input shaft (38), ensuring that the interlocking ends of the rings are properly engaged.
7. Slide the p.t.o. input shaft (38) into the housing, securing it with the large snap ring (41).
8. Carefully slide the special tool MF 255B on to the p.t.o. input shaft, then drive the seal (32) fully into place.
9. Refit the spool valve (24) to the input housing with the four Allen screws (22) and lockwashers.
10. Fit a new 'O' ring (35) to the rear spigot of the input housing.
11. Fit the seal protector MF 177 on the fron of the main input shaft (54), then carefully slide the input housing assembly into place.
12. Fig 6. Refit three bolts (31), but not the R.H. upper bolt.

NOTE – THE BOLT THREADS MUST BE COATED WITH HYLOMAR SQ32M SEALING COMPOUND.

13. Reconnect the pipe (15) to the spool value; OR, if the tractor is fitted with a low capacity pump, refit the complete pipe (15 and 16).
14. Push the Multi-Power shifter rod upwards through the rubber boot in the top of the transmission case, then locate and secure the shift linkage bracket (30) to the input housing, with the R.H. upper bolt.

NOTE – COAT THE BOLT THREAD WITH HYLOMAR SQ32M SEALING COMPOUND.

15. Refit the clutch release mechanism, as stated in operation 4A-03-05.

P.T.O. DRIVESHAFT FRONT BEARING

Removal and Refitment 4B-04-05

Special Tools Required:

270 Rail Trolley
MF 218A P.t.o. Driveshaft puller
Two ⅜ UNC x 75 mm (3 in) Bolts

Removal

1. Split the tractor between the engine and gearbox.
2. Figure 12. Remove the bolt, nut and lockwasher (A) securing the left brake cross shaft lever. Remove the lever and key (B) from the shaft.
3. Withdraw the shaft, complete with pedals from the right hand side of the transmission housing.
4. Remove the four bolts (78) securing the cover plate (80).
5. Figure 13. Remove the circlip (84) and the thrust washer (85).
6. Screw two ⅜ UNC x 75 mm (3 in) bolts into the tapped holes in the bearing housing (82). Progressively and evenly tighten the bolts until the housing is extracted.
7. Remove the 'O' ring (81) from the bearing housing.
8. If the bearing (87) needs servicing, remove the circlip (86) and press out the bearing (87).

When refitting, always fit a new 'O' ring (81) and gasket (83), also fitting new circlips (84 and 86), if possible.

Refitment

1. Refit the p.t.o. driveshaft front bearing (87) to its housing (82) and secure it with the circlip (86).
2. Refit the housing (82) together with a new gasket (83) into the transmission case.
3. Pull the p.t.o. driveshaft (90) into its bearing (87) by using special tool MF 218A.
4. Figure 13. Secure the p.t.o. driveshaft with the thrust washer (84) and the circlip (85).
5. Using a new 'O' ring (81) refit the front cover plate (80).

NOTE – WHEN REFITTING THE COVER PLATE AND THE BOLTS (78) USE SEALING COMPOUND 'HYLOMAR COMPOUND SQ 32M' TO SEAL THE PLATE AND BOLT THREADS.

6. Refit the brake pedal and cross shaft assembly to the transmission case, from the right hand side.
7. Figure 12. Refit the lever and key to the brake cross shaft, then re-tighten the nut and bolt.
8. Reconnect the gearbox.

MAIN INPUT SHAFT

Removal and Refitment 4B-05-06

Removal

1. Remove the mainshaft, as stated in operation 4B-06-06.
2. Fig 14. Remove the tab located spacer (59), from the rear of the main input shaft.
3. Drive the main input shaft (54) rearwards out of the gearbox, removing the thrust washer (42) Multi-Power clutch (43) centre thrust washer (53) and the main drive pinion (57) as the shaft is withdrawn through them.
4. Remove the input overdrive pinion (52) from the Multi-Power clutch.
5. Remove the two rings (55 and 56) from the main input shaft.
6. If necessary, remove the needle roller bearing (58) from the rear end of the main input shaft.

Examination.

Check the condition of all components for wear, scoring, chipping, or any other damage. Any defective components must be replaced.
On reassembly, always fit new thrust washers (42 and 53) and new sealing rings (55 and 56).

Reassembly.

1. Fig 14. If necessary, fit a new needle roller bearing (58) to the rear of the main input shaft.
2. Fit the two new sealing rings (55 and 56) to their grooves in the main input shaft.
3. Refit the input overdrive gear (52) to the Multi-Power clutch.
4. Fit the main input shaft (54) into the gearbox from the rear, locating the main input gear (57) and thrust washer (53), then the clutch and overdrive assembly, locating the main input gear and the clutch on their relevant splines.
5. Refit the front thrust washer (42) on the splines, with the steel face towards the clutch.
6. Refit the tab located spacer (59) with its convex face towards the main input shaft and locating the tab in the centre web of the gear box.
7. Refit the mainshaft, as stated in operation 4B-06-06.

FIRST/REVERSE GEAR, SECOND/THIRD GEAR AND MAINSHAFT

Removal and Refitment 4B-06-06

Special Tools Required: MF200 Hand Press
MF200-25 Adapter.

Removal.

1. Remove the shifter rail mechanism, as stated in operation 4B-01-02.
2. Remove the transmission epicylic unit, as stated in operation 4B-02-02.
3. Fig 15. Pull the mainshaft (66) rearwards to release the mainshaft fron bearing (60) from the centre web in the gearbox.
4. Tilt the mainshaft upwards and drive off the bearing.
5. Withdraw the mainshaft rearwards and slide off the first/reverse gear (61) and the second/third gear (62).
6. Fig 16. Remove the circlip (63) from the mainshaft, then press off the bearing (64) using hand press MF 200 with the MF 200-25 adapter. Remove the rear circlip (65).

WARNING – DO NOT ATTEMPT TO PRESS THE BEARING OFF THE REAR END OF THE MAINSHAFT. AS THE GEAR TEETH ARE OF A LARGER DIAMETER THAN THE SHAFT SPLINES.

Refitment.

1. Refit the rear snap ring (65) to the mainshaft (66), then press on the bearing (64) using Hand Press MF 200 and adapter MF 200-25. Refit the second snap ring (63).
2. Refit the mainshaft front bearing (60) to its web in the gearbox.
3. Slide the mainshaft into the gearbox from the rear, locating the second/third gear (62) and the first/reverse gear (61) on the splines.

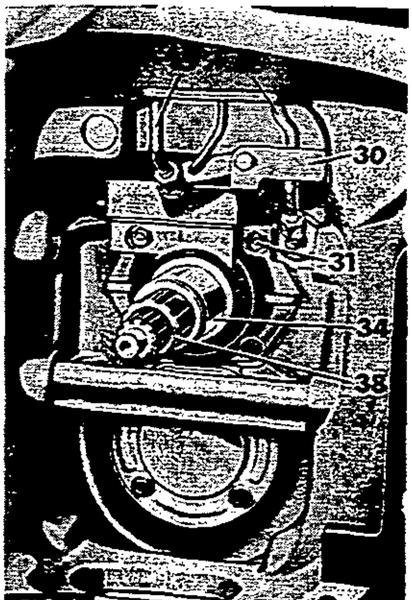

FIG. 6

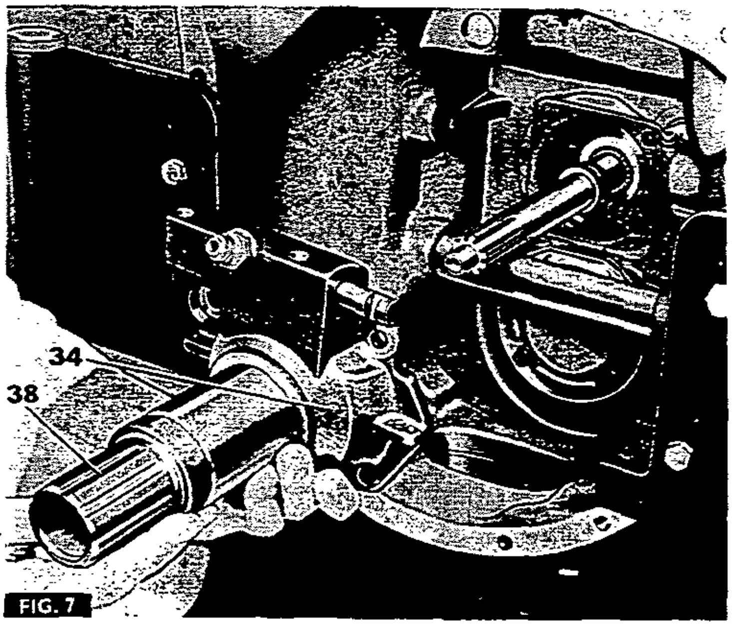

FIG. 7

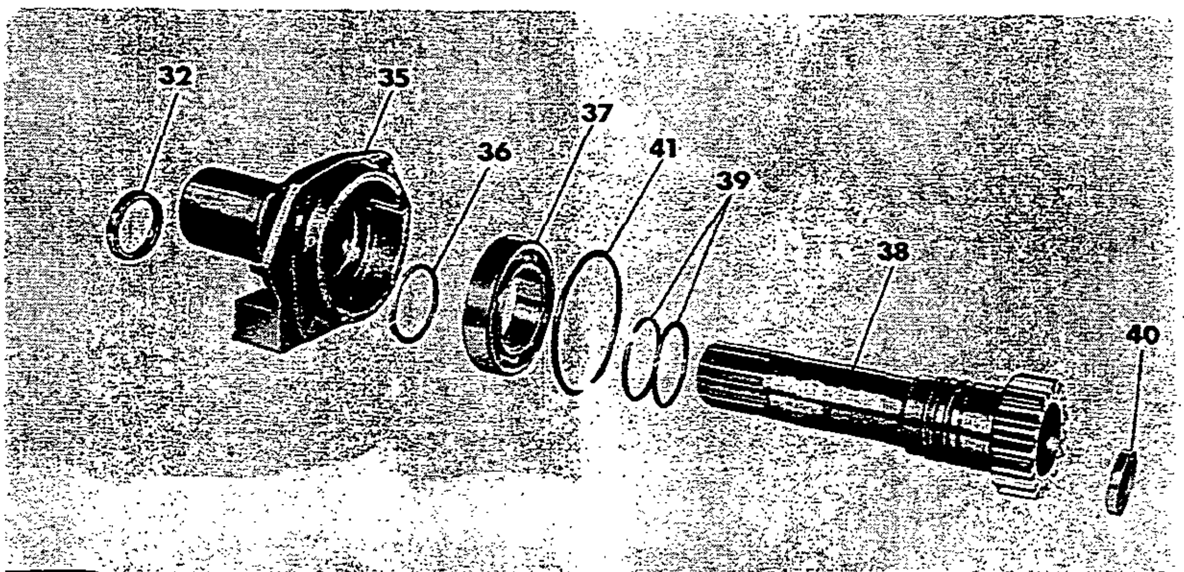

FIG. 8

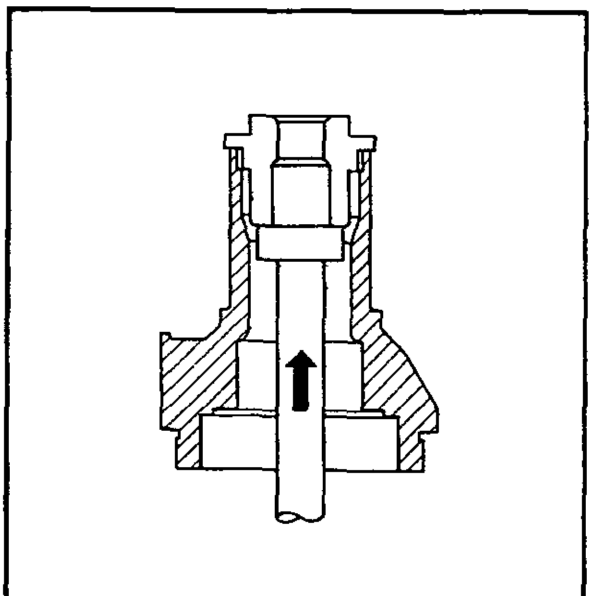
FIG. 9a

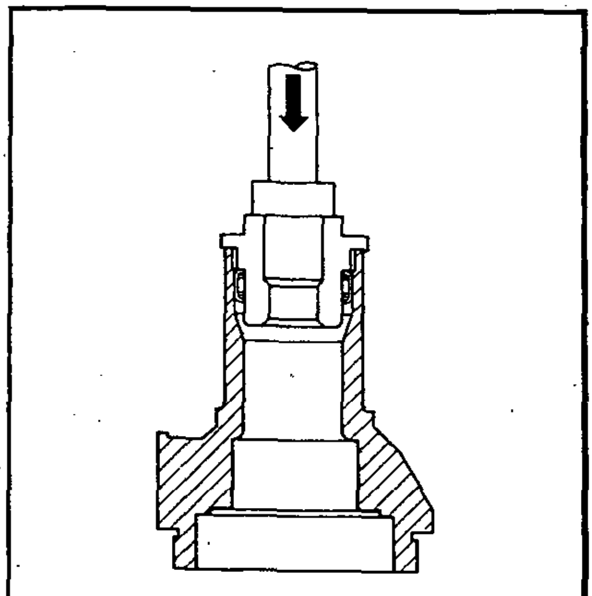
FIG. 9b

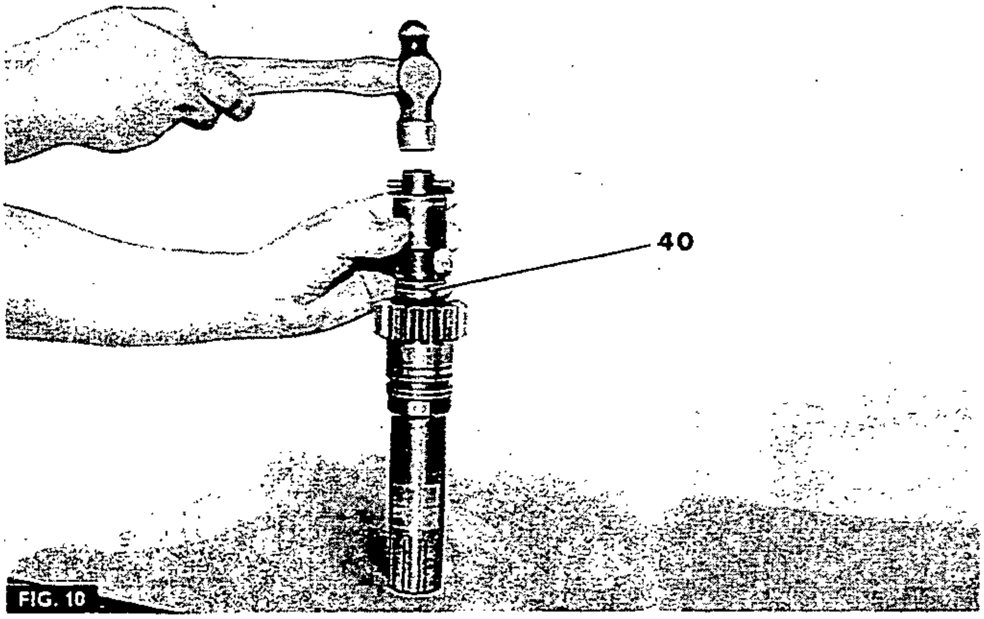

FIG. 10

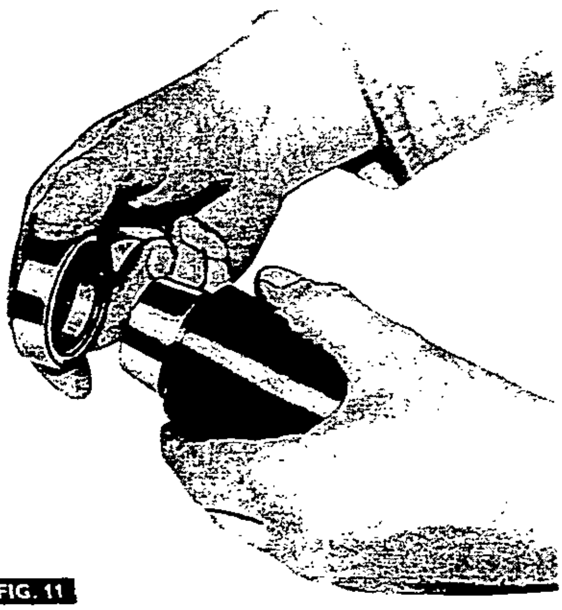
FIG. 11

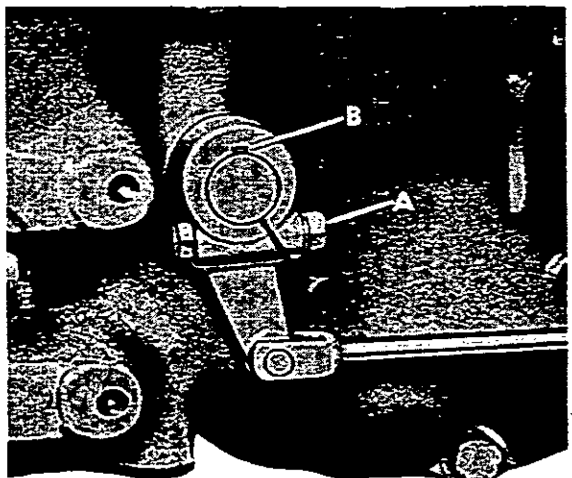

FIG. 12

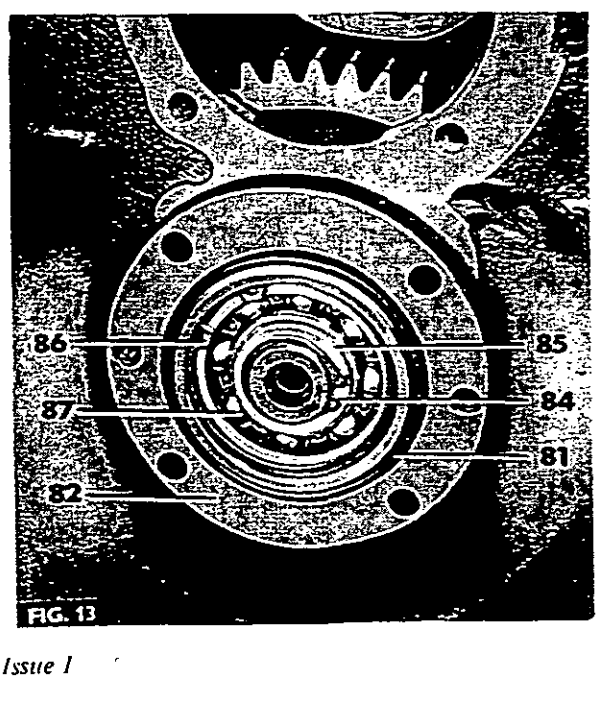

FIG. 13

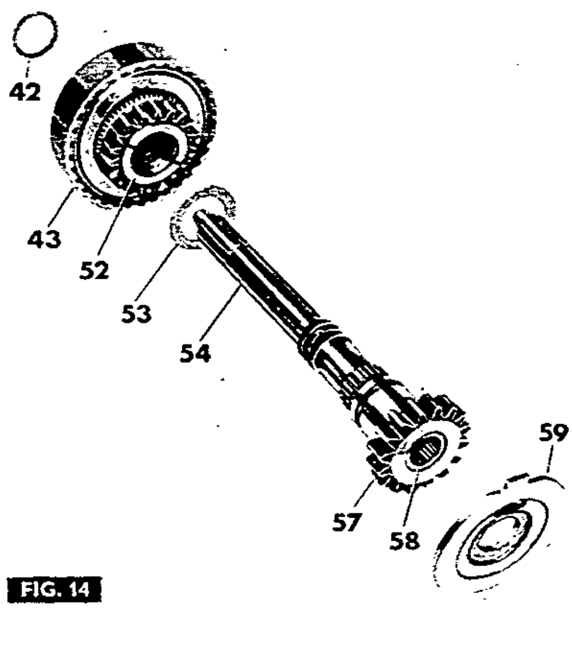

FIG. 14

4. Drive the mainshaft forwards, fully locating it in the front bearing (60) and the needle roller bearing in the rear end of the main input shaft.
5. Refit the transmission epicyclic unit, as stated in operation 4B-02-02.
6. Refit the shifter rail mechanism, as stated in operation 4B-01-02.

LAYSHAFT AND LAYSHAFT GEAR

Removal and Refitment. 4B-07-09

Removal.

1. Remove the main input shaft, as stated in operation 4B-05-06
2. Remove the p.t.o. driveshaft front bearing, as stated in operation 4B-04-05.
3. Remove the p.t.o. Driveshaft (90) by withdrawing it rearwards, then lift out the p.t.o. constant mesh gear (88).
4. Remove the rear snap ring (104) from the rear end of the layshaft.
5. Fig 17. Drive the layshaft forwards, as shown, then move the snap ring (100) on to the unsplined portion of the layshaft.
6. Remove the snap ring (91) from the front end of the layshaft.
7. Fig 18. Drive the layshaft forwards, removing the overdrive layshaft gear (92), spring (93) coupler (94) main drive layshaft gear (95) and thrust washer (96).
8. Locating the layshaft rear bearing (103) in the gearbox, drive the layshaft forwards out of the gearbox, complete with the centre bearing (97).
9. Remove the second (102) and third speed (101) layshaft fears from the transmission case.
10. If necessary, remove the circlip (100) from the layshaft, press off the bearing (97), using Hand *Press MF 200* and adapter *MF 200-25*, and remove the layshaft rear bearing (103) from the gearbox case.

Examination.

Check the condition of all components for wear, scoring, chipping or other damage, particularly the following:

All gear teeth

The coupler splines and teeth

The main input gear coupler teeth.

The coupler spring.

The coupler spring should have a free length of 47,5 mm (1.87 in), a compressed length of 16,5 mm (0.65 in) and a maximum load of 10,2 kg (22.5 lb) when compressed. Any defective components must be replaced. When reassembling, if possible, always use new snap rings (91, 100 and 104) and a new thrust washer (96).

Refitment

1. Fig 18. If necessary, press the centre bearing (97) on to the layshaft.
2. Fit a new snap ring (100) on to the layshaft, temporarily placing it on the unsplined portion of the shaft, adjacent to the first gear teeth.
3. Slide the layshaft into the gearbox from the front, locating the third (101) and second speed (102) gears on the splines.
4. Push the layshaft rearwards sufficiently far to permit fitment of the new thrust washer (96) the main input gear (95), the coupler (94), spring (93) and overdrive gear (92), then refit the front snap ring (91).
5. Pull the layshaft forwards to permit fitment of the snap ring (100) in the groove adjacent to the third speed gear (101).
6. Refit the layshaft rear bearing (103) then drive the layshaft fully rearwards and refit the rear snap ring (104). Ensure that the rear bearing is fully located. The layshaft is shown fully assembled in Fig 19.
7. Refit the p.t.o. constant mesh gear (88) into the transmission case, then refit the p.t.o. driveshaft (90).
8. Refit the p.t.o. driveshaft front bearing, as stated in operation 4B-04-05.
9. Refit the main input shaft as stated in operation 4B-05-06.

REVERSE GEAR

Removal and Refitment. 4B-08-09

Removal

1. Remove the mainshaft as stated in operation 4B-06-06.
2. Figure 4 Release the tabwasher (114), then remove the bolt (115) and plate (113).
3. Using a dummy shaft to prevent the needle rollers from falling into the transmission case remove the reverse gear cluster (110) thrust washers (106 and 111) and distance piece (112).

Refitment

1. Using petroleum jelly refit the two sets of needle rollers 108) with a spacer (109) between the rows and a retaining ring (107) at each end. A *smear of petroleum jelly can be used to make* the thrust washers (106 and 111) and the distance piece (112) adhere to the end face of the gear cluster.
2. Insert the dummy shaft to the reverse gear cluster.
3. Figure 19. Refit the gear cluster assembly to the transmission case, then insert the shaft (105) from the rear and push out the dummy shaft.
4. Figure 4. Refit the plate (113) a new tabwasher (114) and the bolt (115) Bend up the tabwasher. The assembled dear cluster is shown in Fig 19.
5. Refit main shaft as stated in operation 4B-06-06.

MULTI-POWER CLUTCH UNIT SERVICING.

Removal. 4B-09-09

1. Remove the clutch unit, by removing the main input shaft, as stated in operation 4B-05-06.
2. Fig 20. Place the clutch assembly on a flat surface, push down the retainer plate (50) and remove the snap ring (51).
3. Remove the retainer plate (50), three friction discs (48), three interplates (47) and the six return springs (49).
4. Slide the piston (46) out of the clutch housing (43).
5. If necessary, remove the piston ring (45) from the piston.

Examination.
Check the condition of all components for signs of wear, scoring, damage, distortion or overheating. Check the friction plates (48) for the following dimensional tolerances:

Thickness 2,41 to 2,59 mm (0.095 to 0.102 in)
Maximum Height (permissible distortion) 2,92 mm (0.115 in)
Groove Depth 0,38, to 0,63 mm (0.015 to 0.025 in)

Check the interplates (47) as follows:

Thickness 1,67 to 1,75 mm (0.66 to 0.69 in)
Maximum Dish 0,25 mm (0.010 in)

Maximum Height (permissible distortion) 2,21 mm (0.0875 in)
Check the six coil springs (49) as follows:

Free Length 17,8 mm (0.70 in)
Working Length 12,7 mm (0.50 in)

Load at Working Length 2,98 to 3,64 kg (6.57 to 8.03 lb).

Replace any worn or damaged components, as required.

Reassembly.
1. If necessary, refit the piston ring (45) to the piston.
2. Fig 21. Compressing the piston rings, as shown, refit the piston to the housing
3. Fig 22. Fit one interplate (47) to the clutch housing, with the lugs on the interplate located in the housing splines immediately to the right of the six holes in the housing.
4. Fig 22. Fit the six springs (49) as shown, placing them on the interplate lugs.
5. Fig 23. Refit the three friction plates and the remaining two interplates alternately, locating the lugs on each interplate one spline further to the right of one previously fitted.

NOTE: – THE SPRINGS MUST ONLY CONTACT THE FIRST INTERPLATE.

6. Fig 24. Refit the retainer plate (50) and the snap ring (51).
7. Refit the Multi-Power clutch and refit the main input shaft, as stated in operation 4B-05-06.
8. Test the assembled Multi-Power system, as stated in Part 7B.

MULTI-POWER SPOOL VALVE SERVICING.

Removal. 4B-10-10
1. Remove the input housing and p.t.o. input shaft, as stated in items 1 to 6 of operation 4B-03-05.
2. Remove the four Allen screws (22) securing the spool valve (24) to the input housing.
3. Remove the old gasket from the top face of the input housing, or the underside of the spool valve block.
4. Fig 25. Withdraw the actuating spool (20) from the spool block (24).
5. Remove the screw (28) from the end of the spool block, then withdraw the spring (26) and the spool (25).

Examine the spools (20 and 25) and the spool block (24) for scoring, pitting and wear and replace if necessary.

Refitment.
1. Place the spool (25) into the spool block (24), then the spring (26) and secure with a new washer (27) and screw (28).
2. Place the adjusting spool (20) with a new seal (21) into the spool block.
3. Fit a new gasket into position on the spool block and refit the block to the input housing.
4. Secure the spool block with the four Allen screws (22).
5. Refit the input housing as stated in operation 4B-03-05.

TRANSMISSION CASE.

Removal and Refitment
or Complete Gearbox Overhaul 4B-11-10
Special Tools Required:

MF 177 Seal Protector
MF 200 Hand Press
MF 200-25 Adapter
MF 218A P.t.o. Driveshaft Puller
MF 255B Oil Seal Protector
No. 270 Rail Trolley
2 ⅜ UNC x 75 mm (3 in) Bolts

Disassembly
1. Remove the clutch release mechanism, as stated in operation 4A-03-05.
2. Split the tractor between the gearbox and centre housing as stated in Part 3.
3. Remove the gearbox top cover, in unit with the instrument panel, as stated in Part 3.
4. Fig 3. Release the locking wire from the 1st/rev. and 2nd/3rd shift rails (8, 10), and from the rear end of the HIGH/LOW shift rail (5).
5. Fig 4. Remove the locking peg (3) from the HIGH/LOW shift fork (6), detach the fork (6) and coupler (77).
6. Remove the gear lever stop plate (11) and interlock pin (14), secured by two bolts (13) and spring washers (12).
7. Lift out the three shift rail springs (1), and plungers (2).
8. Remove the locking pegs (3) from the 1st/rev. and 2nd/3rd shift forks (8, 10).
9. Slide the 1st/rev. and 2nd/3rd shift rails (8, 10), rearwards out of the transmission housing. Lift Lift out the 1st/rev. and 2nd/3rd shift forks (7, 9).
11. Release the locking wire and remove the locking peg (3) from the HIGH/LOW shift selector (4).
12. Slide the HIGH/LOW shift rail (5), rearwards out of the transmission housing. Lift out the HIGH/LOW SHIFT SELECTOR (4).

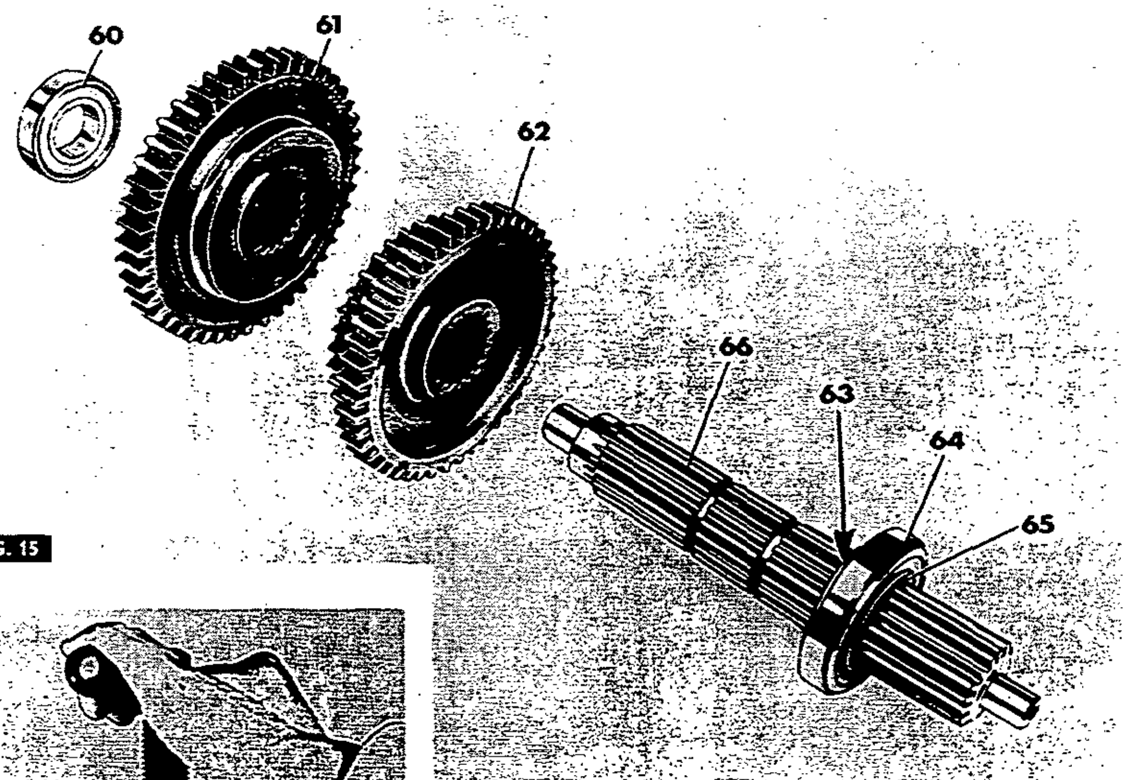

FIG. 15

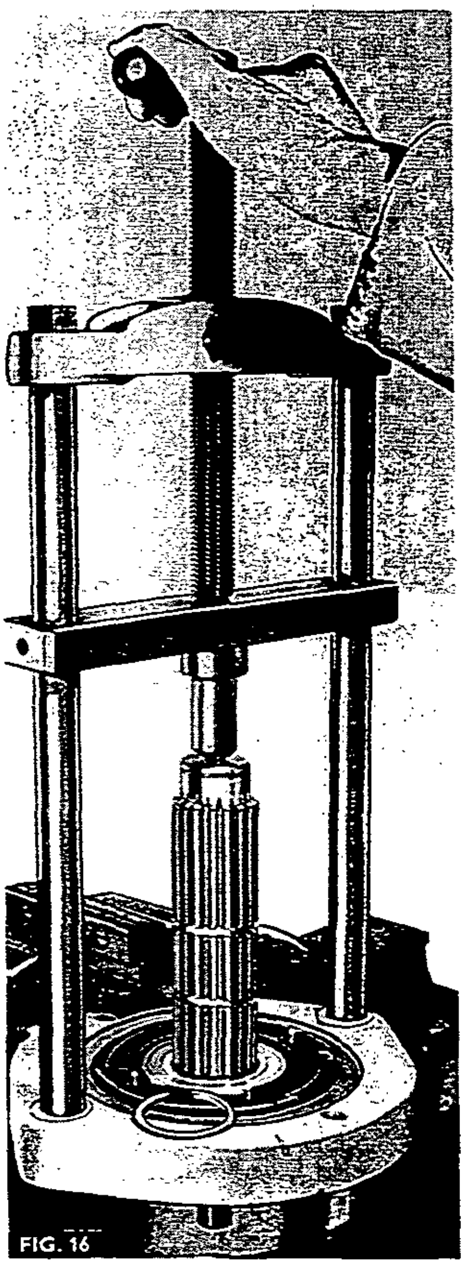

FIG. 16

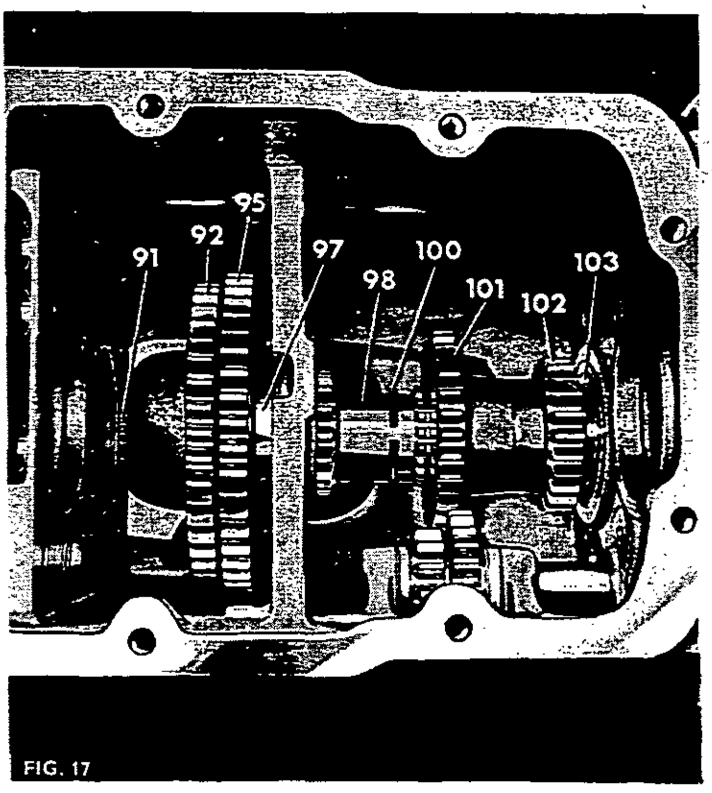

FIG. 17

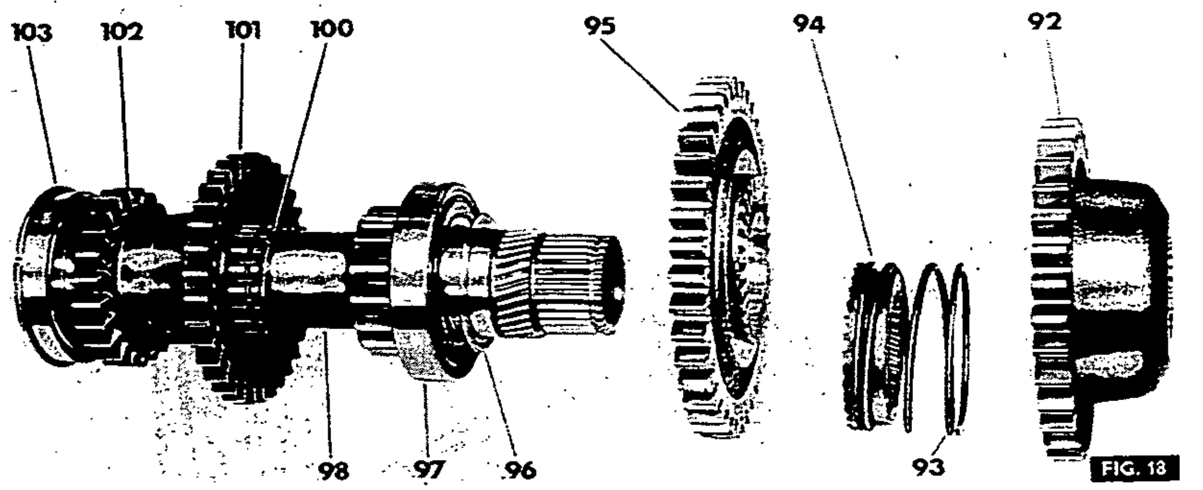

FIG. 18

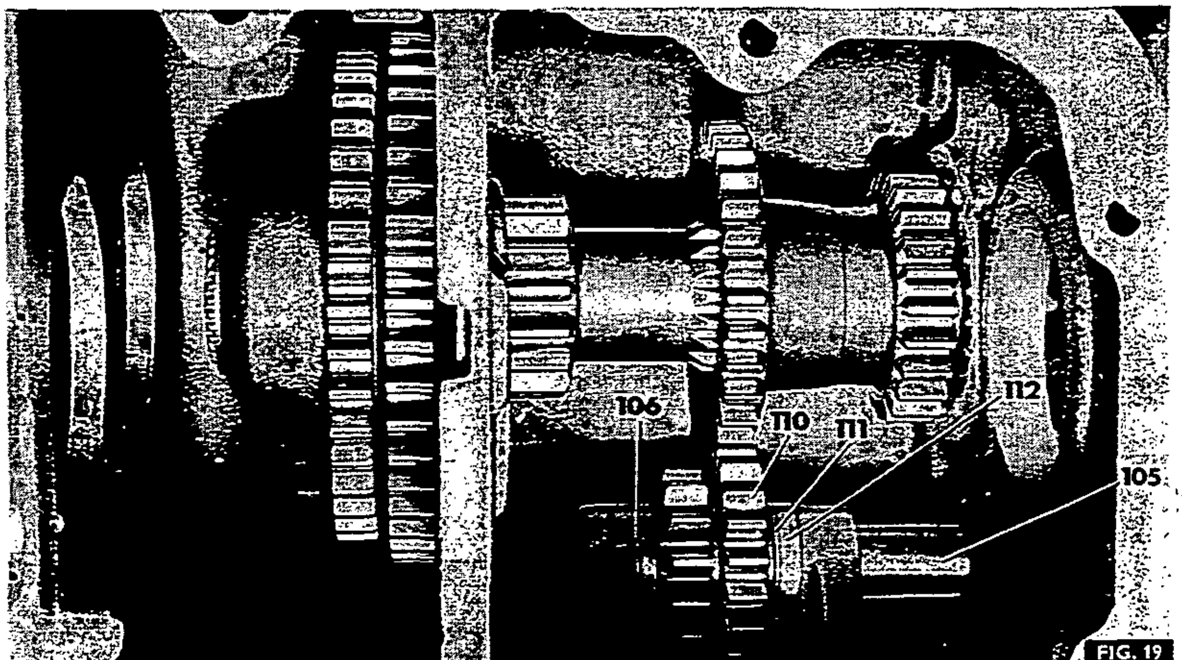

FIG. 19

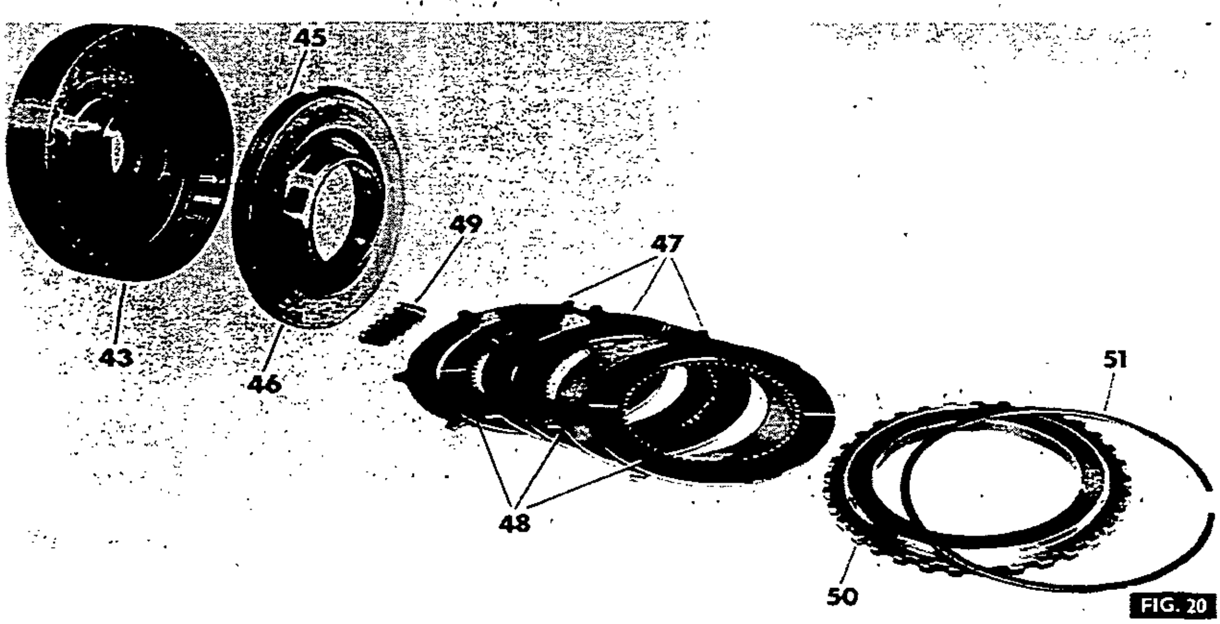

FIG. 20

13. Figure 4. Remove the four bolts (76) securing the transmission epicyclic unit, then remove the complete assembly.
14. Fig 6. Remove the R.H. upper bolt (31) securing the Multi-Power shift linkage bracket (30) to the input housing, then remove the linkage by pulling the shifter rod downwards through the rubber bung in the top of the transmission case.
15. Disconnect the pipe (15) from the spool valve.

NOTE – IF THE TRACTOR IS FITTED WITH A LOW CAPACITY PUMP, THE COMPLETE PIPE MUST BE REMOVED (15 AND 16, FIG 6).

16. Remove the three remaining bolts (31) securing the input housing to the transmission case.
17. Fig 7. Withdraw the input housing (34), complete with the p.t.o. input shaft (38) from the transmission case.
18. Remove the four Allen screws (22) securing the spool valve (24) to the input housing.
19. Fig 8. Remove the large internal circlip (41) from the rear end of the input housing, then push the p.t.o. input shaft (38) out of the housing, complete with its bearing (37).
20. Lever the inner seal (40) out of the input shaft.
21. Carefully lever the front oil seal (32) from the front of the input housing with a screwdriver.
22. Fig 9A. Drive the needle roller bearing (33) out of the housing using special tool MF 315, as shown.
23. If the rear bearing (37) needs servicing remove the two rings (39) and the circlip (36) then press off the bearing.
24. Remove the 'O' ring (35) from the input housing.
25. Figure 12. Remove the bolt, nut and lockwasher (A) securing the left brake cross shaft lever. Remove the lever and key (B) from the shaft.
26. Withdraw the shaft, complete with pedals from the right hand side of the transmission housing.
27. Remove the four bolts (78) securing the cover plate (80).
28. Figure 13. Remove the circlip (84) and the thrust washer (85).
29. Screw two ⅜ UNC x 75 mm (3 in) bolts into the tapped holes in the bearing housing (82).
30. Progressively and evenly tighten the bolts until the housing is extracted.
31. Remove the 'O' ring (81) from the bearing housing.
32. If the bearing (87) needs servicing, remove the circlip (86) and press out the bearing (87).
33. Fig 15. Pull the mainshaft (66) rearwards to release the mainshaft front bearing (60) from the centre web in the gearbox.
34. Tilt the mainshaft upwards and drive off the bearing.
35. Withdraw the mainshaft rearwards and slide off the first/reverse gear (61) and the second/third gear (62).
36. Fig 16. Remove the circlip (63) from the mainshaft, then press off the bearing (64) using hand press MF 200 with the MF 200-25 adapter. Remove the rear circlip (65).

WARNING – DO NOT ATTEMPT TO PRESS THE BEARING OFF THE REAR END OF THE MAINSHAFT. AS THE GEAR TEETH ARE OF A LARGER DIAMETER THAN THE SHAFT SPLINES.

37. Fig 14. Remove the tab located spacer (59), from the rear of the main input shaft.
38. Drive the main input shaft (54) rearwards out of the gearbox, removing the thrust washer (42) Multi-Power clutch (43) centre thrust washer (53) and the main drive pinion (57) as the shaft is withdrawn through them.
39. Remove the input overdrive pinion (52) from the Multi-Power clutch.
40. Remove the two rings (55 and 56) from the main input shaft.
41. If necessary, remove the needle roller bearing (58) from the rear end of the main input shaft.
42. Remove the p.t.o. Driveshaft (90) by withdrawing it rearwards, then lift out the p.t.o. constant mesh gear (88).
43. Remove the rear snap ring (104) from the rear end of the layshaft.
44. Fig 17. Drive the layshaft forwards, as shown, then move the snap ring (100) on to the unsplined portion of the layshaft.
45. Remove the snap ring (91) from the front end of the layshaft.
46. Fig 18. Drive the layshaft forwards, removing the overdrive layshaft gear (92), spring (93) coupler (94) main drive layshaft gear (95) and thrust washer (96).
47. Locating the layshaft rear bearing (103) in the gearbox, drive the layshaft forwards out of the gearbox, complete with the centre bearing (97).
48. Remove the second (102) and third speed (101) layshaft fears from the transmission case.
49. If necessary, remove the circlip (100) from the layshaft, press off the bearing (97), using Hand Press MF 200 and adapter MF 200-25, and remove the layshaft rear bearing (103) from the gearbox case.
50. Fig 20. Place the clutch assembly on a flat surface, push down the retainer plate (50) and remove the snap ring (51).
51. Remove the retainer plate (50), three friction discs (48), three interplates (47) and the six return springs (49).
52. Slide the piston (46) out of the clutch housing (43).
53. If necessary, remove the piston ring (45) from the piston.
54. Figure 4 Release the tabwasher (114), then remove the bolt (115) and plate (113).
55. Using a dummy shaft to prevent the needle rollers from falling into the transmission case, remove the reverse gear cluster (110) thrust washers (106 and 111) and distance piece (73).
56. Remove the old gasket from the top face of the input housing, or the underside of the spool valve block.
57. Fig 25. Withdraw the actuating spool (20) from the spool block (24).
58. Remove the screw (28) from the end of the spool block, then withdraw the spring (26) and the spool (25).

Examination.
Check the condition of all components for signs of wear, scoring, damage, distortion or overheating.

The coupler spring should have a free length of 47,5 mm (1.87 in), a compressed length of 16,5 mm (0.65 in) and a maximum load of 10,2 kg (22.5 lb) when compressed. Any defective components must be replaced. When reassembling, if possible, always use new snap rings (91, 100 and 104) and a new thrust washer (96).

Check the friction plates (48) for the following dimensional tolerances:

Thickness 2,41 to 2,59 mm (0.095 to 0.102 in)
Maximum Height (permissible distortion) 2,92 mm (0.115 in)
Groove Depth 0,38, to 0,63 mm (0.015 to 0.025 in)

Check the interplates (47) as follows:

Thickness 1,67 to 1,75 mm (0.66 to 0.69 in)
Maximum Dish 0,25 mm (0.010 in)

Maximum Height (permissible distortion) 2,21 mm (0.0875 in)

Check the six coil springs (49) as follows:

Free Length 17,8 mm (0.70 in)
Working Length 12,7 mm (0.50 in)

Load at Working Length 2,98 to 3,64 kg (6.57 to 8.03 lb).

Replace any worn or damaged components, as required.

On reassembly, always fit new thrust washers (42 and 53) and new sealing rings (55 and 56).

Examine the bearings (33 and 37), the rings (39) and the input shaft gear teeth for signs of wear or damage and replace any defective components.

Always fit new seals (32 and 40) a new 'O' ring (35); also if possible, fit new circlip and snap ring (36 and 41).

Before fitting, lubricate all seals with petroleum jelly.

When refitting, always fit a new 'O' ring (81) and gasket (83), also fitting new circlips (84 and 86), if possible.

Examine the spools (20 and 25) and the spool block (24) for scoring, pitting and wear and replace if necessary.

Refitment

1. Using petroleum jelly refit the two sets of needle rollers 108) with a spacer (109) between the rows and a retaining ring (107) at each end. A smear of petroleum jelly can be used to make the thrust washers (106 and 111) and the distance piece (112) adhere to the end face of the gear cluster (110).
2. Insert the dummy shaft in the reverse gear cluster.
3. Figure 19. Refit the gear cluster assembly to the transmission case, then insert the shaft (105) from the rear and push out the dummy shaft.
4. Figure 4. Refit the plate (113) a new tabwasher (114) and the bolt (115). Bend up the tabwasher. The assembled gear cluster is shown in Fig 19.
5. Fig 18. If necessary, press the centre bearing (97) on to the layshaft (98).
6. Fit a new snap ring (100) on to the layshaft, temporarily placing it on the unsplined portion of the shaft, adjacent to the first gear teeth.
7. Slide the layshaft into the gearbox from the front, locating the third (101) and second speed (102) gears on the splines.
8. Push the layshaft rearwards sufficiently far to permit fitment of the new thrust washer (96) the main input gear (95), the coupler (94), spring (93) and overdrive gear (92), then refit the front snap ring (91).
9. Pull the layshaft forwards to permit fitment of the snap ring (100) in the groove adjacent to the third speed gear (101).
10. Refit the layshaft rear bearing (103) then drive the layshaft fully rearwards and refit the rear snap ring (104). Ensure that the rear bearing is fully located. The layshaft is shown fully assembled in Fig 19.
11. Refit the p.t.o. constant mesh gear (88) into the transmission case, then refit the p.t.o. driveshaft (90).
12. If necessary, refit the piston ring (45) to the piston (46).
13. Fig 21. Compressing the piston rings, as shown, refit the piston to the housing (43).
14. Fig 22. Fit one interplate (47) to the clutch housing, with the lugs on the interplate located in the housing splines immediately to the right of the six holes in the housing.
15. Fig 22. Fit the six springs (49) as shown, placing them on the interplate lugs.
16. Fig. 23. Refit the three friction plates (48) and the remaining two interplates alternately, locating the lugs on each interplate one spline further to the right of one previously fitted.

NOTE: – THE SPRINGS MUST ONLY CONTACT THE FIRST INTERPLATE.

17. Fig 24. Refit the retainer plate (50) and the snap ring (51).
18. Fig 14. If necessary, fit a new needle roller bearing (58) to the rear the main input shaft.
19. Fit the two new sealing rings (55 and 56) to their grooves in the main input shaft (54).
20. Refit the input overdrive gear (52) to the Multi-Power clutch.
21. Fit the main input shaft (54) into the gearbox from the rear, locating the main input gear (57) and thrust washer (53), then the clutch and overdrive assembly, locating the main input gear and the clutch on their relevant splines.
22. Refit the front thrust washer (42) on the splines, with the steel face towards the clutch.
23. Refit the tab located spacer (59) with its convex face towards the main input shaft and locating the tab in the centre web of the gear box.
24. Refit the rear snap ring (65) to the mainshaft (66), then press on the bearing (64) using Hand Press MF 200 and adapter MF 200-25. Refit the second snap ring (63).
25. Refit the mainshaft front bearing (60) to its web in the gearbox.

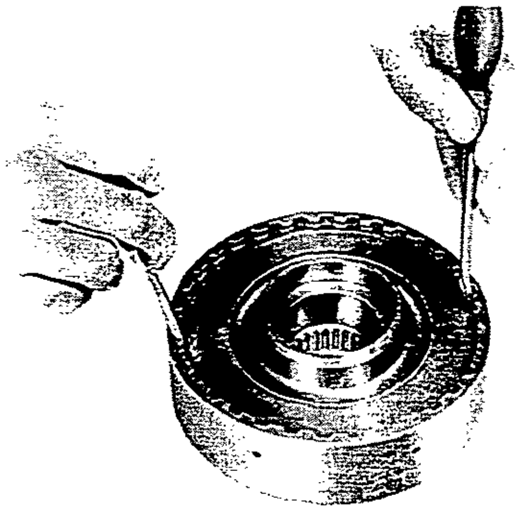

FIG. 21

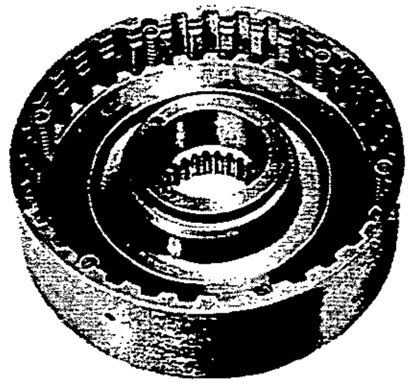

FIG. 22

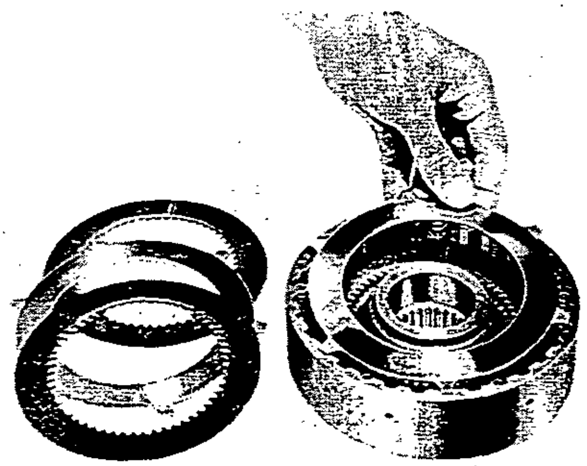

FIG. 23

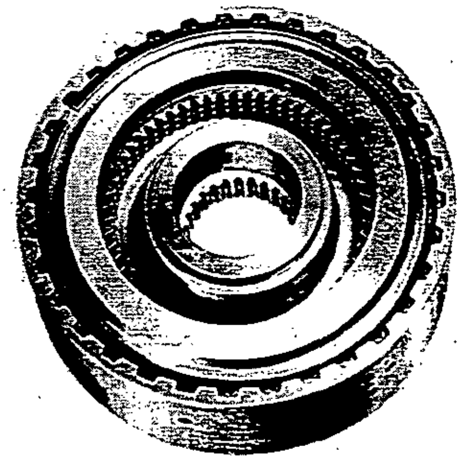

FIG. 24

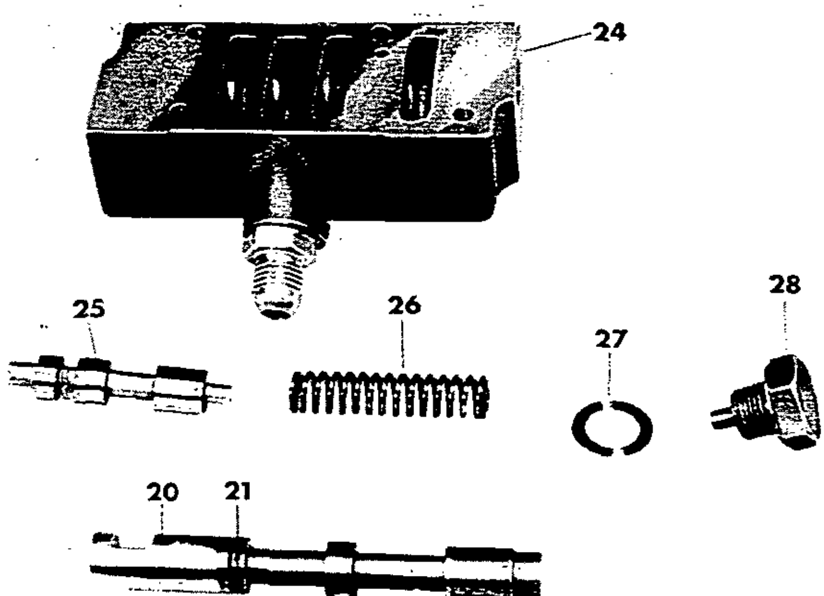

FIG. 25

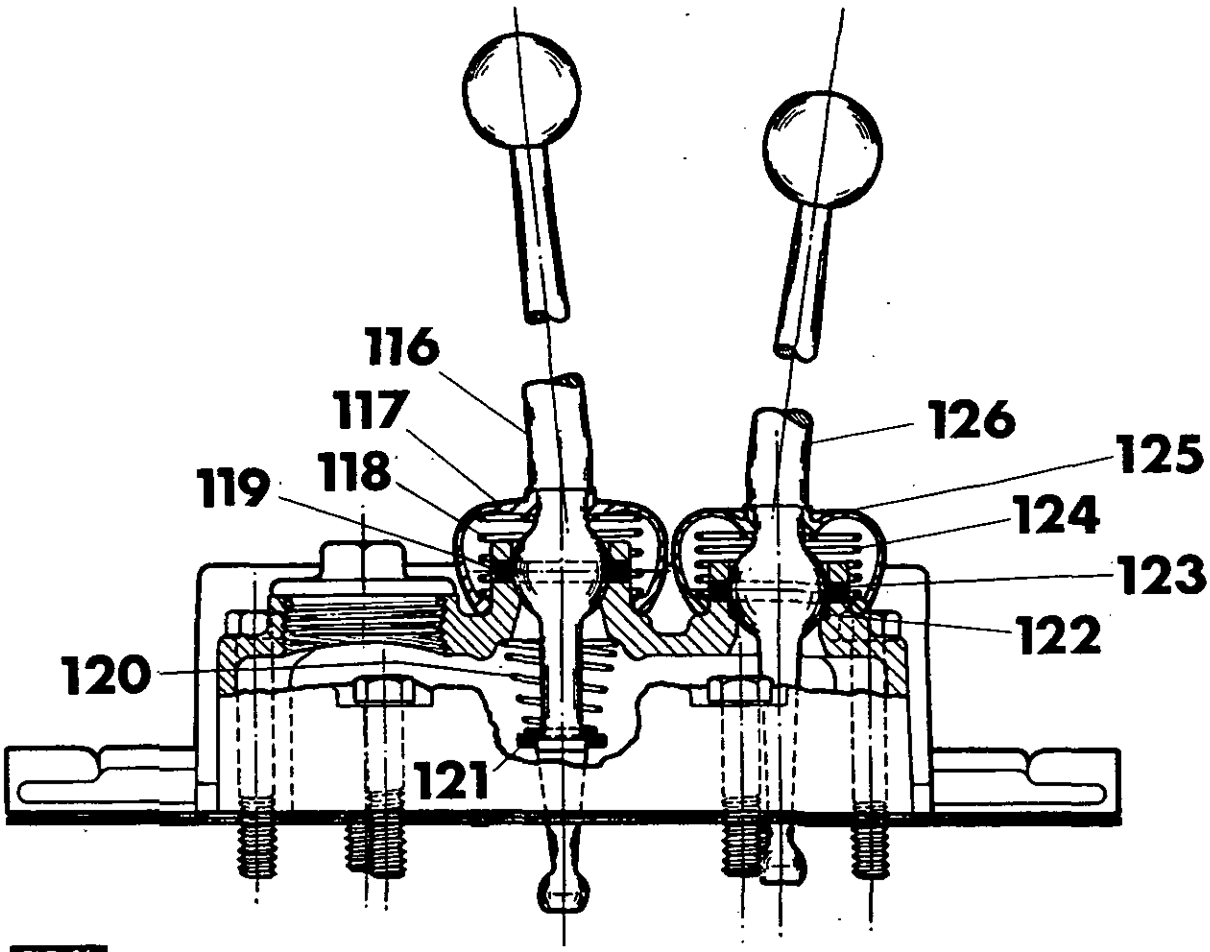

FIG. 26

26. Slide the mainshaft into the gearbox from the rear, locating the second/third gear (62) and the first/reverse gear (61) on the splines.
27. Drive the mainshaft forwards, fully locating it in the front bearing (60) and the needle roller bearing in the rear end of the main input shaft.
28. Refit the p.t.o. driveshaft front bearing (87) to its housing (82) and secure it with the circlip (86).
29. Refit the housing (82) together with a new gasket (83) into the transmission case.
30. Pull the p.t.o. driveshaft (90) into its bearing (87) by using special tool MF 218A.
31. Figure 13. Secure the p.t.o. driveshaft with the thrust washer (84) and the circlip (85).
32. Using a new 'O' ring (81) refit the front cover plate (80).

NOTE – WHEN REFITTING THE COVER PLATE AND THE BOLTS (78) USE SEALING COMPOUND 'HYLOMAR COMPOUND SQ 32M' TO SEAL THE PLATE AND BOLT THREADS.

33. Refit the brake pedal and cross shaft assembly to the transmission case, from the right hand side.
34. Figure 12. Refit the lever and key to the brake cross shaft, then re-tighten the nut and bolt.
35. Place the spool (25) in the spool block (24), then the spring (26) and secure with a new washer (27) and screw (28).
36. Place the adjusting spool (20) with a new seal (21) into the spool block.
37. Fit a new gasket into position on the spool block and refit the block to the input housing.
38. Secure the spool block with the four Allen screws (22) and spring washers (23).
39. If necessary, press the bearing (37) on to the input shaft (38) (with the shield towards the gear teeth) and secure it with the circlip (36).
40. Fig 9B. Using special tool MF 315 drive the needle roller bearing (33) into the input housing.
41. Fig 10. Fit the new inner oil seal (40) to special tool MF 256A, then drive the seal fully into place.
42. Fig 11. Assemble special tool MF 255B, then slide the oil seal (32) (metal face first) on to the tool.
43. Remove the cone from the front of tool MF 255B.
44. Refit the two rings (39) to the input shaft (38), ensuring that the interlocking ends of the rings are properly engaged.
45. Slide the p.t.o. input shaft (38) into the housing, securing it with the large snap ring (41).
46. Carefully slide the special tool MF 255B on to the p.t.o. input shaft, then drive the seal (32) fully into place.
47. Fit a new 'O' ring (35) to the rear spigot of the input housing.
48. Fit the seal protector MF 177 on the front of the main input shaft (54), then carefully slide the input housing assembly into place.
49. Fig 6. Refit three bolts (31), but not the R.H. upper bolt.

NOTE – THE BOLT THREADS MUST BE COATED WITH HYLOMAR SQ32M SEALING COMPOUND.

50. Reconnect the pipe (15) to the spool value; OR, if the tractor is fitted with a low capacity pump, refit the complete pipe (15 and 16).
51. Push the Multi-Power shifter rod upwards through the rubber boot in the top of the transmission case, then locate and secure the shift linkage bracket (30) to the input housing, with the R.H. upper bolt.

NOTE – COAT THE BOLT THREAD WITH HYLOMAR SQ32M SEALING COMPOUND.

52. Figure 4. Refit the backplate (67) and the shims (68) to the dowels (71) on the ring gear (72), then locate the dowels in the holes in the transmission case. Fit the thrust washers (70 and 73) to the planetary pinion carrier (69) and locate the carrier in the ring gear. Refit the cover plate (74), as shown in Fig 5. Fit the four bolts (76) and tighten them progressively and evenly to a torque of 4,9 kg-m (35 lb ft).

NOTE – OMIT LOCKWASHER (75) FROM LOWER LEFT HAND BOLT.

53. Fit the HIGH/LOW shift rail (5), sliding the HIGH/LOW shift selector (4), onto the rail and secure to the rail with locking peg (3). Wire lock the peg to the rail.
54. Locate the 1st/rev. and 2nd/3rd shift forks (7, 9), to their respective grooves in the mainshaft gears. The two forks are identical.
55. Assemble the 1st/rev. and 2nd/3rd shift rails (8, 10), with interlock pin grooves facing each other, to the forks, and secure each fork with a locking peg (3). Wire lock the pegs to the rails. The shorter, 2nd/3rd shift rail (10) is fitted to the L.H. side.
56. Locate the HIGH/LOW shift fork (6), to the groove in the coupler (77). Assemble the coupler into the planet pinion carrier assembly (69), simultaneously sliding the fork (6), onto the HIGH/LOW shift rail (5).
57. Secure the HIGH/LOW shift fork (6), to its rail withthe locking peg (3).
58. Wire lock the peg to the rail.
59. Fit the interlock pin (14), to the stop plate (11) and secure the stop plate with two bolts (13), and spring washers (12).
60. Fit the three plungers (2), pointed end downwards, and the three springs (1).
61. Refit the gearbox top cover and instrument panel assembly as stated in Part 3.

NOTE – BOTH GEAR LEVERS AND THE GEAR SELECTOR DOGS MUST BE PLACED IN NEUTRAL.

62. Reconnect the transmission to the centre housing, as stated in Part 3.

GEAR SHIFT LEVER

Removal and Refitment 4B-12-18

Figure 26.

1. Remove the steering box.
2. Remove the eight bolts securing the shift lever support and battery platform to the transmission housing. Lift the support and platform up off the transmission housing.
3. Release the spring retaining seat (120) from the lower end of the gear lever (116), and detach the seat and spring (120).
4. Remove the gear lever rubber cover (117) and spring (118) fitted under the cover.
5. Drive out the pin (119) securing the gear lever (116) to its housing.
6. Lift out the gear lever (116).
7. Refitment is a reversal of the removing procedure.

HIGH/LOW SHIFT LEVER

Removal and Refitment 4B-13-18

Figure 26

1. Remove the rubber cover (125) and spring (124), fitted under the cover.
2. Drive out the pin (123) securing the lever (126) to its housing.
3. Lift out the lever (126) and 'O' ring (122).
4. Refitment is a reversal of the removing procedure.

8 SPEED TRANSMISSION

Part 4 Section C

GENERAL

The transmission has four forward gears and one reverse gear which are doubled by a planetary reduction unit to give eight forward and two reverse gears.

All gear teeth are of involute, straight cut spur type. Where movement of the gears is required, to change ratio, the gears slide on a splined shaft.

PRINCIPLE OF OPERATION

Figure 1 and 2

The Gearbox
The tractor engine drives a clutch with divided drive. Each plate is splined on to a separate gearbox shaft. Drive is transmitted to:

(a) The p.t.o. input shaft (15), which is hollow and has gear teeth on its rear end.

(b) The main drive input shaft (18) which runs inside the p.t.o input shaft has gear teeth on its rear end and is spigot located in the front end of the mainshaft (25).

Layshaft and P.T.O. Shaft
Rotation of the p.t.o. input shaft (15), drives the p.t.o. constant mesh gear (52) which is splined on to the p.t.o. drive shaft (53). When the main input shaft (18) rotates, the drive is transmitted to the constant mesh gear (55) which is splined on to the layshaft (58). The layshaft, which is hollow and externally splined, has 15 gear teeth machined on its outside diameter to provide the first gear layshaft pinion. It is supported on two ball races located in the centre web and rear wall of the transmission case. Mounted on the layshaft are three other gears, (56, 61 and 62) with 28, 33 and 23 teeth, which are third, fourth and second gears respectively. None of the layshaft gears are free to move along the shaft, being retained, either by abutment with other gears, bearings or snap rings.

Mainshaft
The mainshaft (25) is externally splined, has gear teeth at its rear end and has a bore at its front end to accept the spigot on the main input shaft and its needle roller bearing (24). Mounted on the mainshaft are three gears (one being a compound gear having two sets of teeth): When viewed from the front of the gearbox, these gears have 41 teeth (20); 45 teeth (26) and 36/46 teeth (27) to mesh with the layshaft gears and give third, first, fourth and second gears respectively. The mainshaft gears are moved into and out of mesh by selector forks (86, 88 and 92), the gears sliding on the mainshaft splines.

The engine speed is reduced by the selected gear ratio (variable reduction) and by the input constant mesh gears (fixed reduction).

Reverse Gear Cluster
Reverse gear is achieved by the engagement of a compound gear cluster (71) with 13/21 teeth. The 21 tooth half of the gear is in constant mesh with the fourth gear pinion (33 teeth) on the layshaft. The 45 tooth first gear pinion on the mainshaft is moved into, or out of mesh with the 13 tooth portion of the reverse gear cluster.

The reverse gear, by acting as an idler gear between the layshaft and the mainshaft drive, reverses the rotation of the mainshaft, epicyclic unit and the final drive.

Epicyclic Unit
The basic four forward and one reverse gears are doubled by the epicyclic unit mounted on the rear end of the transmission case. The epicyclic unit comprises a ring gear (34), inside which run three planetary pinions mounted in a carrier (36). The planetary pinions are driven by gear teeth on the end of the mainshaft (25) which acts as the sun gear. When the mainshaft rotates, the planetary pinions also rotate, but being meshed with the teeth on the inside of the ring gear the rotational speed of the carrier is reduced by a ratio of 4 : 1.

To transmit the drive from the epicyclic unit to the rear axle, a driveshaft is connected by the coupler (39), either directly to the gearbox mainshaft (HIGH range), or to the planetary pinion carrier (36) (LOW range).

Movement of the dual range selector lever actuates the rod attached to the selector fork (95) which moves the coupler (39) into, or out of mesh with either the end of the mainshaft (25) or the planetary pinion carrier (36). Between the two engaged (HIGH or LOW range) positions, there is a neutral position, where the coupler splines are disengaged from both the mainshaft and the planetary pinion carrier.

SHIFTER RAIL MECHANISM

Removal and Refitment 4C-01-02

Figure 3

Special Tools Required: 270 Rail Trolley

Removal

1. Split the tractor between the gearbox and the centre housing.
2. Remove the gearbox top cover, in unit with the instrument panel.
3. Figure 5. Remove the two bolts (78) securing the interlock mechanism. Lift off the locking ball carrier (80) and the two plates (83 and 84). Store the balls carefully.
4. Cut the locking wire and remove the shifter rails.

Refitment

1. Refit the third speed selector rod (89), fitting first the engagement dog (90), then the selector fork (88), engaging the selector fork in the third speed sliding gear (20).
2. Rotate the rod until the engagement dog locking pin can be fitted. Tighten the locking pin and secure it with locking wire.
3. Rotate the rod to bring the engagement dog to the top, then fit the locking pin and locking wire to the selector fork (88).
4. Slide the interlock cross peg (81) into the third speed selector rod.
5. Refit the first/reverse and the second/fourth gear selector rods and forks (86, 87, 91 and 92), engaging the forks in the gears. Refit the locking pegs (85) and the locking wires.
6. Figure 4. Refit the HIGH/LOW selector rod assembly (92 and 95) engaging the selector fork (95) in the coupler (39) and locating the coupler in the end of the planetary pinion carrier (36).
7. Figure 3. Refit the locking peg and locking wire to the HIGH/LOW engagement dog (94).
8. Refit the stop plate (84), the plain plate (83), the locking ball carrier (80) and the locking balls (82), securing them with the two bolts and spring washers (78 and 79), tightened to a torque of 4.9 kg/m (35 lb ft).

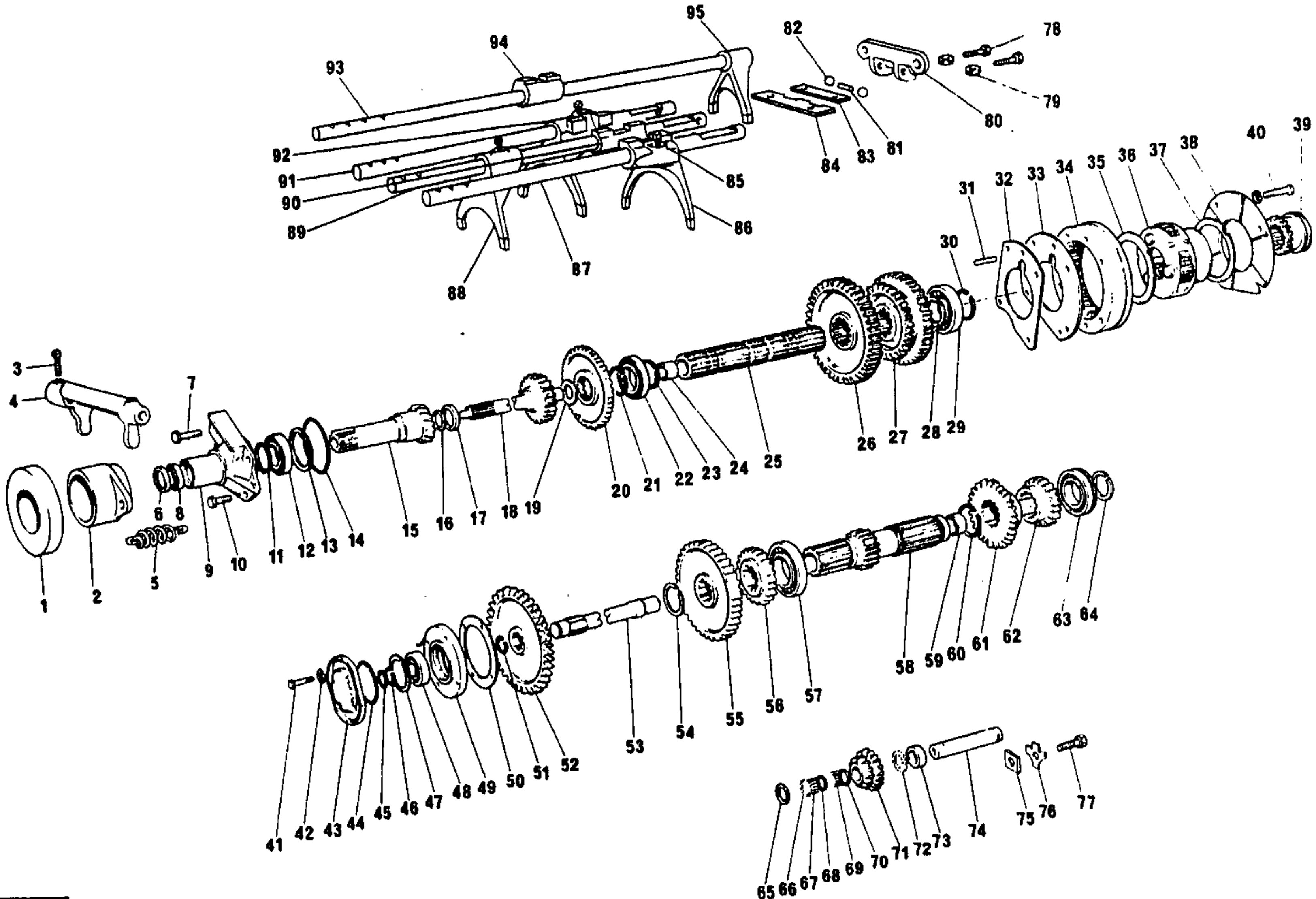
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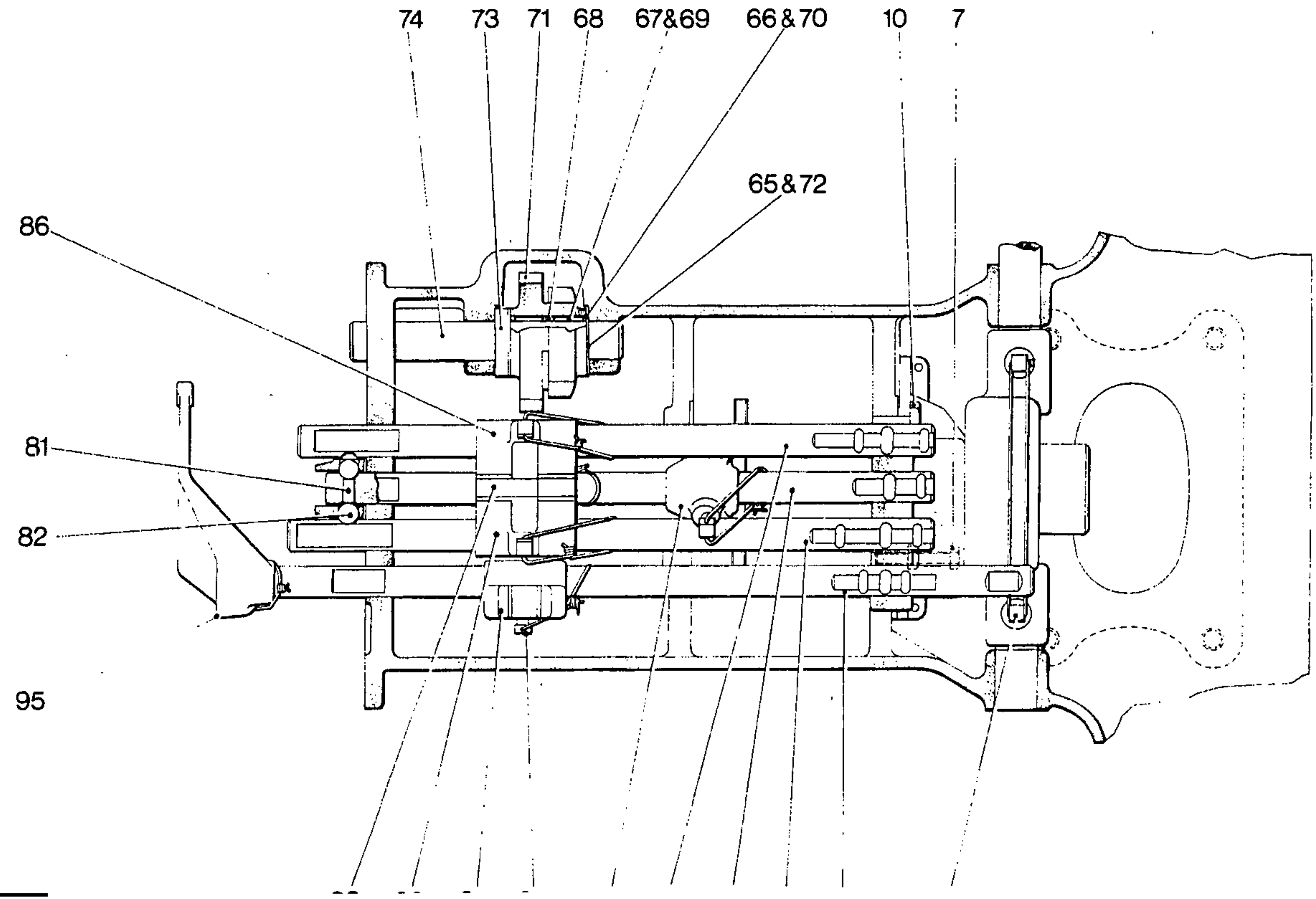
FIG. 2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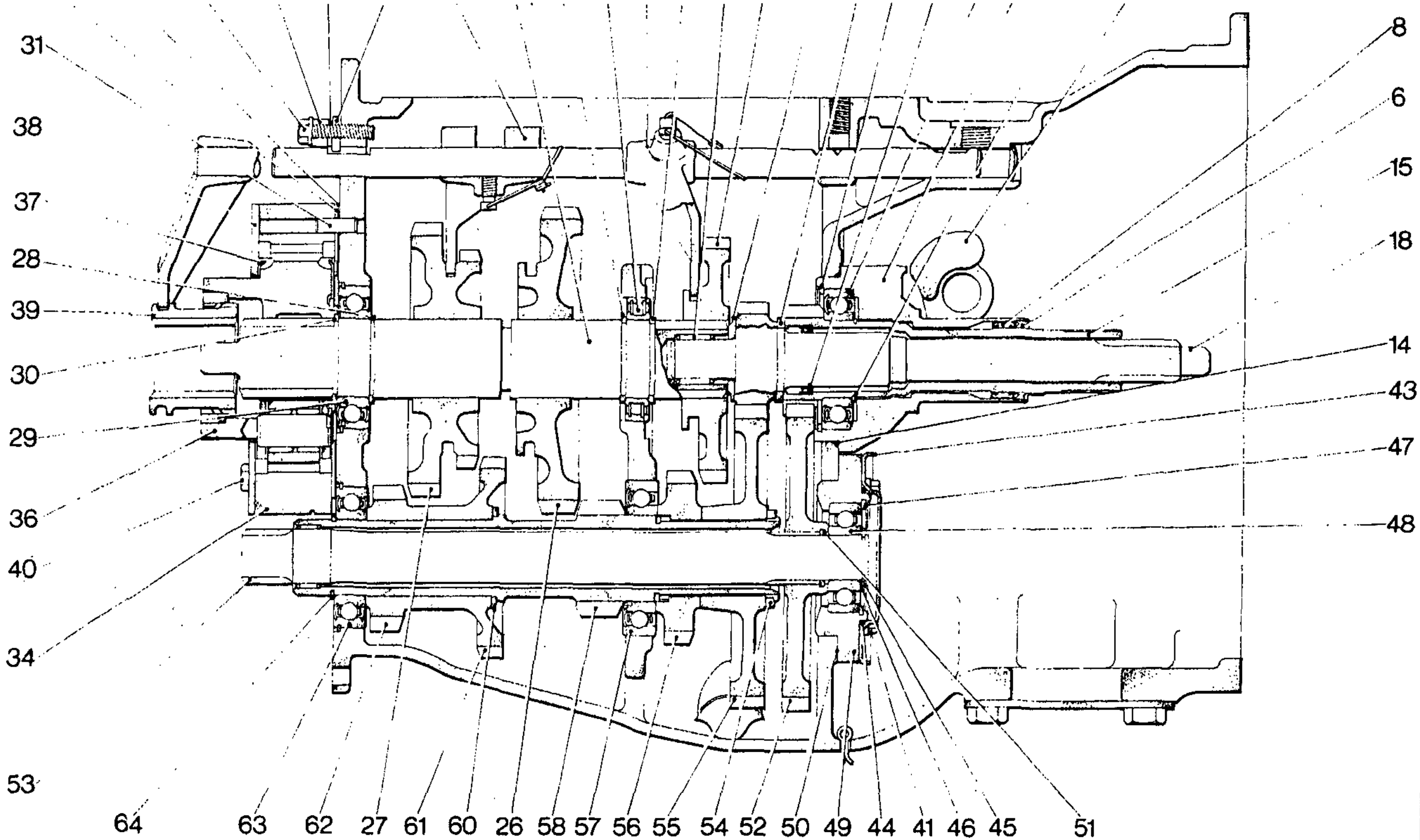
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FIG. 1

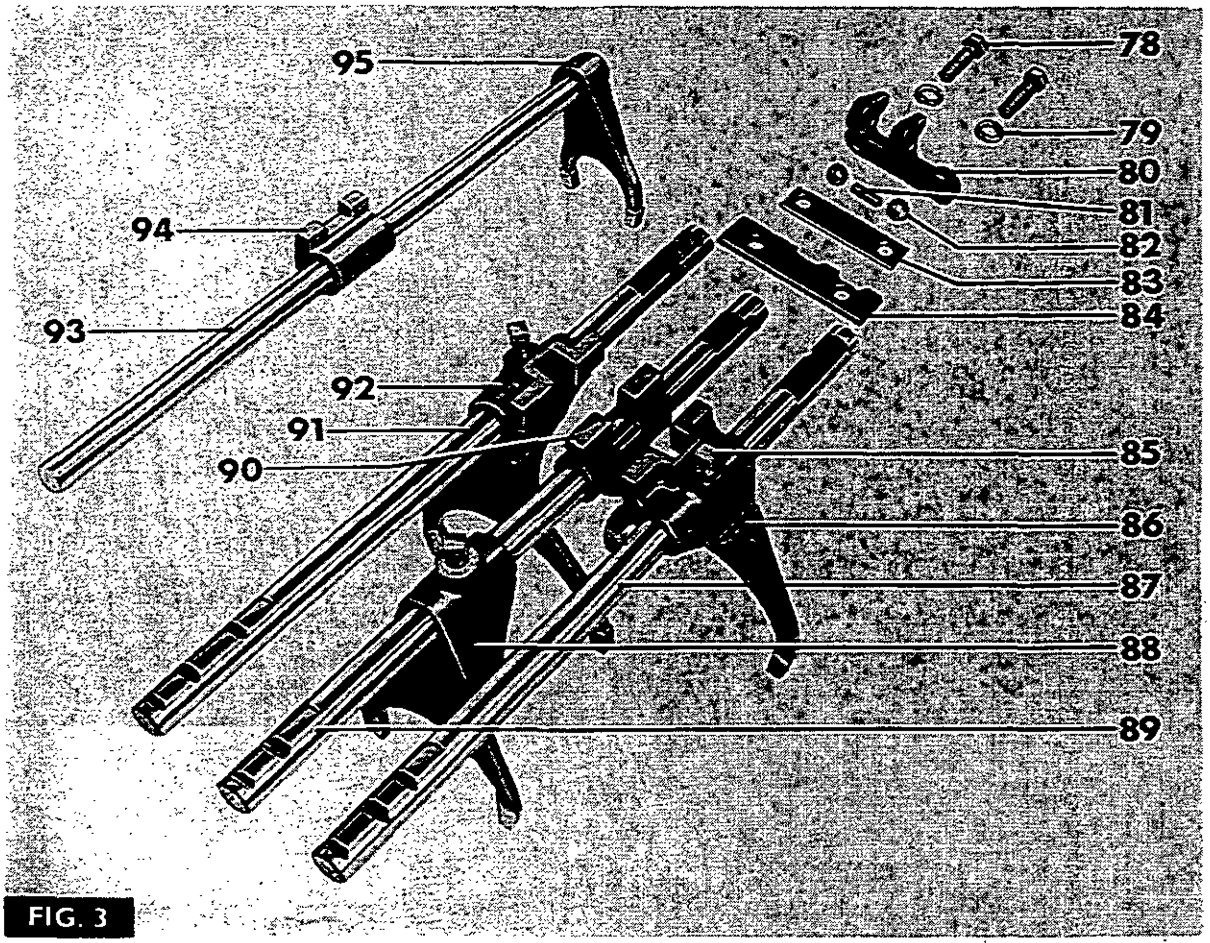

FIG. 3

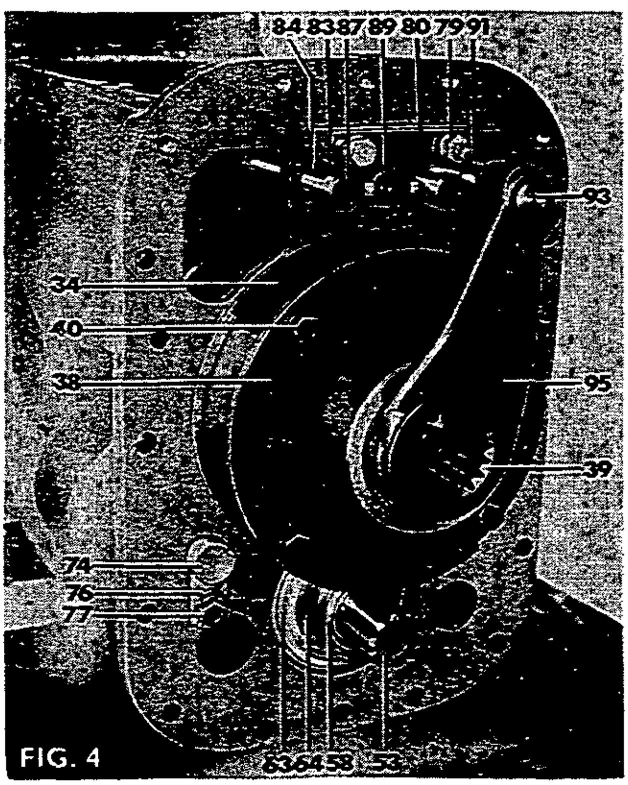

FIG. 4

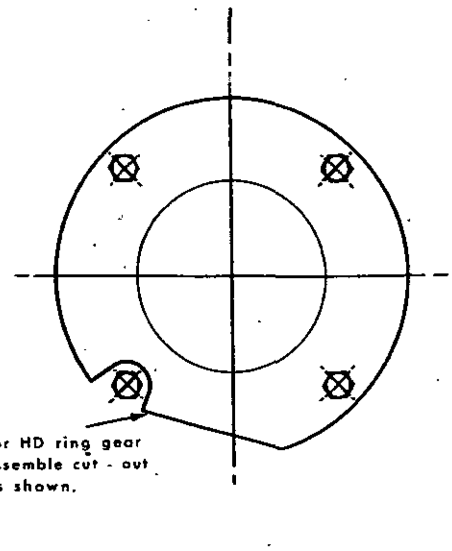

FIG. 5

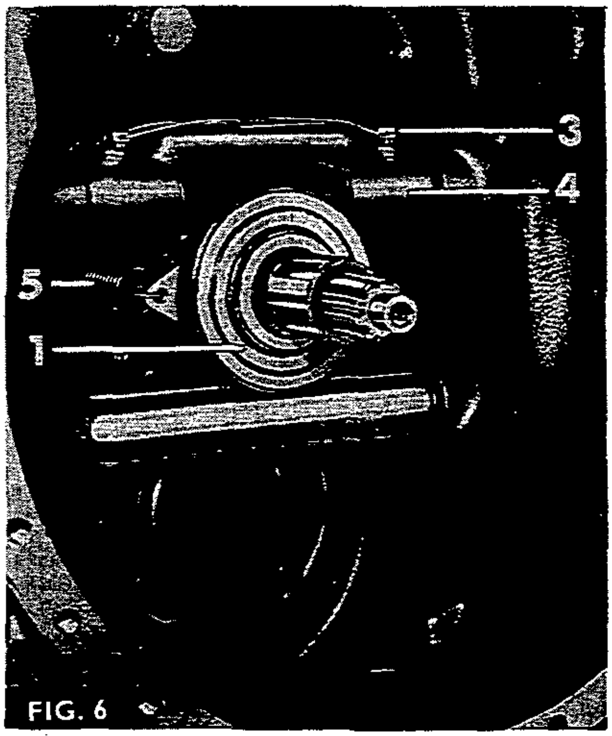

FIG. 6

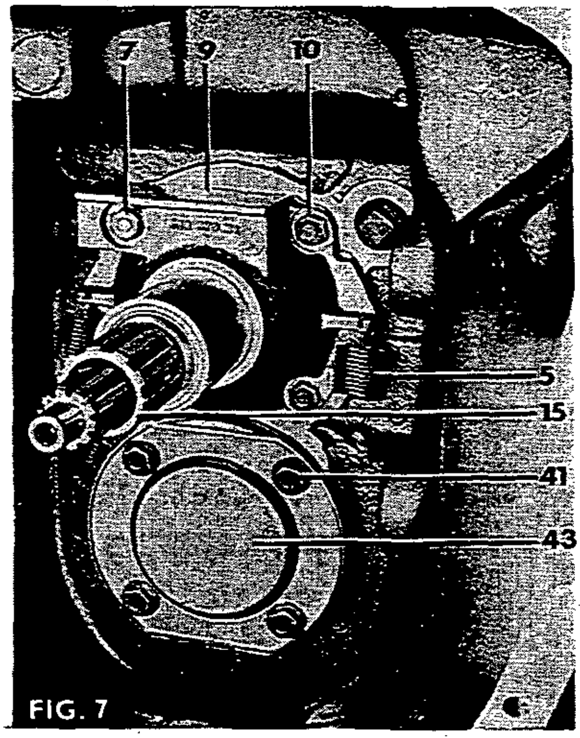

FIG. 7

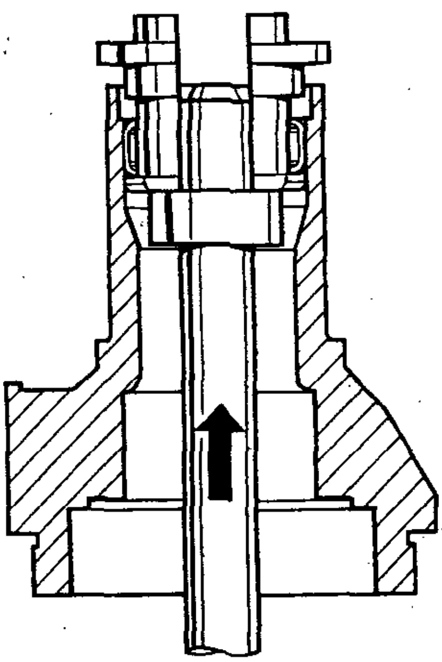
FIG. 8a

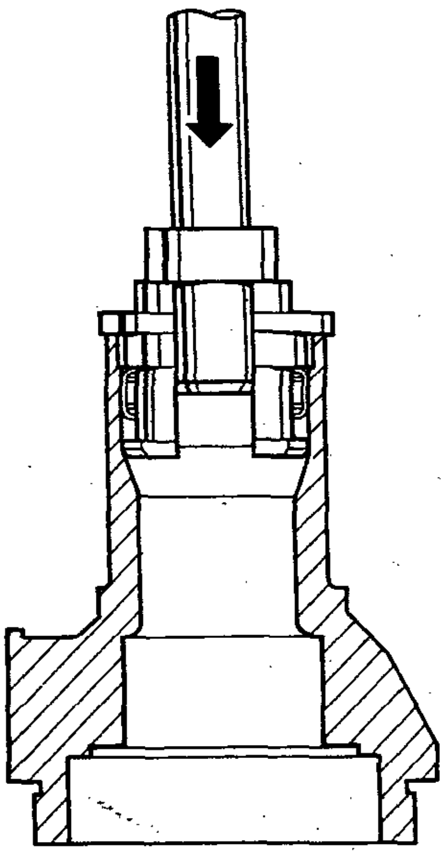
FIG. 8b

9. Refit the gearbox top cover and instrument panel assembly.

NOTE – BOTH GEAR LEVERS, AND THE GEAR SELECTOR DOGS SHOULD BE PLACED IN NEUTRAL.

10. Reconnect the centre housing to the gearbox.

TRANSMISSION EPICYCLIC

Removal and Refitment 4C-02-07

Figure 4

Special Tools Required: 270 Rail Trolley

Removal

1. Split the tractor between the transmission and the centre housing.
2. Remove the locking wire and peg from the HIGH/LOW shifter fork, then remove the fork and coupler.
3. Figure 4. Remove the four bolts (40) securing the transmission epicyclic unit, then remove the complete assembly.

Refitment

1. Figure 4. Refit the backplate (33) and the shims (32) to the dowels (31) on the ring gear (34), then locate the dowels in the holes in the transmission case. Fit the thrust washers (35 and 37) to the planetary pinion carrier (36) and locate the carrier in the ring gear. Refit the cover plate (38), as shown in Fig. 5. Fit the four bolts (40) and tighten them progressively and evenly to a torque of 4.9 kg/m (35 lb ft).

NOTE – OMIT LOCKWASHER FROM LOWER LEFT HAND BOLT.

2. Refit the coupler and HIGH/LOW shifter fork, then refit the locking peg and locking wire.
3. Reconnect the transmission to the centre housing.

CLUTCH RELEASE MECHANISM

Removal and Refitment 4C-03-07

Figure 6

Special Tools Required: 270 Rail Trolley

Removal

1. Split the tractor between the engine and transmission.
2. Figure 6. Remove the two springs (5) securing the release bearing carrier, then slide the carrier and release bearing (1) off the input shaft retainer housing.
3. Cut the locking wire and remove the two locking pegs (3) from the clutch release fork (4). Remove the clutch release shafts and fork.

Refitment

1. Figure 3. Refit the clutch release shafts and the clutch release fork (4) refitting the locking pegs (3) and the locking wire.
2. Lubricate the splines of the input shafts and the clutch release bearing carrier bore with special grease Mobilgrease Super.
3. Slide the clutch release bearing (1) and carrier (2) on to the input housing, and refit the two return springs (5).
4. Ensure that all gears are in neutral, then reconnect the engine to the transmission.

INPUT SHAFT AND P.T.O. INPUT SHAFT

Removal and Refitment 4C-04-07

Figures 7, 8A & 8B

Special Tools Required: 270 Rail Trolley
MF 177 Seal Protector
MF 255B Oil Seal Replacer
MF 256A Oil Seal Replacer
MF 315 Needle Roller Bearing Removal and Refitting Tool

Removal

1. Remove the clutch release mechanism as stated in operation 4C-03-07
2. Figure 7. Remove the four bolts (7 and 10) and withdraw the input shaft retainer housing (9), complete with the p.t.o. input shaft (15).
3. Remove the large internal circlip (13) from the rear end of the input housing (9), then push the p.t.o. input housing (15) out of the housing, complete with its bearing (12).
4. Lever the inner seal (16) from the input shaft.
5. Carefully lever the front oil seal (6) from the front of the input housing (9) with a screwdriver.
6. Figure 8A. Using special tool MF 315, drive the needle roller bearing (8) out of the input housing.
7. If the bearing needs servicing, remove the external circlip (11) from the input shaft, then press off the bearing (12).

Refitment

1. If necessary, press the bearing (12) on to the front of the p.t.o. input shaft (15) and secure it with the circlip (11).
2. Figure 8B. Refit the needle roller bearing (8) to the input housing (9) using special tool MF 315 as shown.
3. Fit a new front oil seal (6) to the input housing, using special tool MF 255B. Lubricate the oil seal and the needle roller bearing with petroleum jelly.
4. Fit a new oil seal (16) to the p.t.o. input shaft (15), using special tool MF 256A. Lubricate the seal with petroleum jelly.
5. Carefully insert the p.t.o. input shaft (15) into the housing (9). Push the bearing (12) fully into place and secure it with the large internal circlip (13).
6. Place the seal protector MF 177 on the front of the main input shaft (18).
7. Fit a new 'O' ring (14) on to the rear spigot of the input retainer housing (9), then carefully feed the input housing (9) over the seal protector and locate the input housing in the front of the transmission case.
8. Figure 7. Refit the four bolts (7 and 10) using 'Hylomar Compound SQ 32M' to seal the threads.

P.T.O. DRIVESHAFT FRONT BEARING

Removal and Refitment 4C-05-08

Special Tools Required: 270 Rail Trolley
Two ⅜ UNC x 75 mm (3 in) Bolts.
MF 218A P.t.o. Drive shaft Puller.

Removal
1. Split the tractor between the engine and gearbox.
2. Figure 9. Remove the bolt, nut and lockwasher (A) securing the left brake cross shaft lever. *Remove the lever and key (B) from the shaft.*
3. Withdraw the shaft, complete with pedals from the right hand side of the transmission housing.
4. Remove the four bolts (41) securing the cover plate (43).

NOTE – IF THE 'O' RING (44) IS CAUSING LEAKAGE, PROCEDE NO FURTHER.

5. Figure 10. Remove the circlip (45) and the thrust washer (46).
6. Screw two ⅜ UNC x 75 mm (3 in) bolts into the tapped holes in the bearing housing (49). Progressively and evenly tighten the bolts until the housing is extracted.
7. Remove the 'O' ring (44) from the bearing housing.
8. If the bearing (48) needs servicing, remove the circlip (47) and press out the bearing (48).

Refitment
1. Refit the p.t.o. driveshaft front bearing (48) to its housing (49) and secure it with the circlip (47).
2. Figure 10. Refit the housing (49) together with a new gasket (50) into the transmission case as shown.
3. Pull the p.t.o. driveshaft into its bearing (48) by using special tool MF 218A.
4. Figure 10. Secure the p.t.o. driveshaft with the thrust washer (46) and the circlip (45).
5. Using a new 'O' ring (44), refit the front cover plate (43) as shown in Fig. 7.

NOTE – WHEN REFITTING THE COVER PLATE AND THE BOLTS (41) USE SEALING COMPOUND 'HYLOMAR COMPOUND SQ 32M' TO SEAL THE PLATE AND BOLT THREADS.

6. Refit the brake pedal and cross shaft assembly to the transmission case, from the right hand side.
7. Figure 9. Refit the lever and key to the brake cross shaft, then re-tighten the nut and bolt.
8. Reconnect the gearbox.

MAIN INPUT SHAFT

Removal and Refitment 4C-06-08

Special Tools Required: MF 218A P.t.o. Driveshaft Puller

Removal
1. Remove the clutch release mechanism as stated in operation 4C-03-07
2. Remove the input housing and p.t.o. input shaft as stated in operation 4C-04-07
3. Remove the shifter rail mechanism as stated in operation 4C-01-02
4. Remove the p.t.o. driveshaft front bearing cover (43) as stated in operations 1 to 4 of operation 4C-05-08
5. Figure 4. Withdraw the p.t.o. drive shaft (53) from the rear end of the layshaft, thus allowing the p.t.o. constant mesh gear to drop into the transmission case.
6. Remove the main input shaft (18) complete with the thrust washers (17 and 19) and lift the p.t.o. constant mesh gear (52) from the transmission case. Remove the lockring (51) from the constant mesh gear only if necessary.

Refitment
1. Lower the p.t.o. constant mesh gear (52) into the transmission case but do not yet fit the p.t.o. driveshaft (53).
2. Insert the main input shaft (18), complete with its thrust washers (17 and 19) into the transmission case, locating the shaft spigot in the needle roller bearing (24) located in the end of the mainshaft. Engage the input shaft gear teeth with those of the constant mesh gear (55).
3. Refit the p.t.o. driveshaft (53) from the rear, locating the p.t.o. constant mesh gear on the splines and then pull the end of the shaft through the bearing (48) using special tool M F 218A.
4. *Figure 4. Secure the p.t.o. driveshaft with the* thrust washer (46) and the circlip (45).
5. Using a new 'O' ring (44), refit the front cover plate (43) as shown in Fig. 10.

NOTE – WHEN REFITTING THE COVER PLATE AND THE BOLTS (41) USE SEALING COMPOUND 'HYLOMAR COMPOUND SQ 32M' TO SEAL THE PLATE AND THE BOLT THREADS.

6. Refit the brake pedal and cross shaft assembly to the transmission case, from the right-hand side.
7. Figure 4. Refit the lever and key to the brake cross shaft, then re-tighten the nut and bolt.
8. Refit the shifter rail mechanism as stated in operation 4C-01-02
9. Refit the input housing and p.t.o. input shaft assembly as stated in operation 4C-04-07
10. Refit the clutch release mechanism as stated in operation 4C-03-07

THIRD GEAR (MAINSHAFT)

Removal and Refitment 4C-07-08

Removal
1. Remove the shifter rail mechanism as stated in operation 4C-01-02
2. Remove the transmission epicyclic unit as stated in operation 4C-02-07
3. Remove the clutch release mechanism as stated in operation 4C-03-07
4. Remove the input housing as stated in operation 4C-04-07
5. Remove the main input shaft as stated in operation 4C-06-08
6. Using a soft faced drift, drive the mainshaft (25) rearwards to permit removal of the third gear pinion (20).

Refitment
1. Drive the mainshaft forwards through the centre bearing, locating the third gear pinion (20) on the splines as the shaft emerges.
2. Refit the main input shaft as stated in operation 4C-06-08
3. Refit the input housing as stated in operation 4C-04-07
4. Refit the clutch release mechanism as stated in operation 4C-03-07
5. Refit the transmission epicyclic unit as stated in operation 4C-02-07
6. Refit the clutch release mechanism as stated in operation 4C-01-02

FIRST, SECOND OR FOURTH GEAR OR MAINSHAFT

Removal and Refitment 4C-08-09

Special Tools Required: MF 200 Hand Press
MF 200-25 Adapter

Removal
1. Remove the third gear pinion as stated in operation 4C-07-08
2. Remove the snap ring (21), then drive the mainshaft through the centre bearing (22).
3. Remove the snap ring (23) and withdraw the main shaft rearwards, progressively removing the first/reverse pinion (26) and the second/fourth pinion (27).
4. Figure 11. Remove the circlip (28) from the mainshaft, then press off the bearing (29) using hand press MF 200 with the MF 200-25 adapter, then remove the circlip (30).

WARNING – DO NOT ATTEMPT TO PRESS THE BEARING OFF THE REAR END OF THE MAINSHAFT, AS THE GEAR TEETH ARE OF A LARGER DIAMETER THAN THE SHAFT SPLINES.

Refitment
1. Refit the mainshaft rear snap ring (30) from the front end, then press the bearing (29) on to the mainshaft (25) using press MF 200 (see figure 9). Refit the second snap ring (28).
2. Refit the mainshaft centre bearing (22) to the web in the transmission case.
3. Figure 12. Feed the mainshaft into the transmission case from the rear, progressively fitting the fourth/second compound sliding gear (27), the first/reverse sliding gear (26) and the snap ring (23). Insert the mainshaft through the centre bearing.
4. Refit the third gear pinion as stated in operation 4C-07-08

LAYSHAFT AND LAYSHAFT GEAR

Removal and Refitment 4C-09-09

Special Tools Required: MF 200 Hand Press
MF 200-25 Adapter

Removal
1. Remove the mainshaft and gears as stated in operation 4C-07-08
2. Figure 4. Remove the snap ring (64) from the rear of the layshaft.
3. Figure 13. Tap the layshaft forwards to expose the snap ring (60), forward of the fourth gear pinion (61). Move the snap ring (60) forwards on to the unsplined portion of the layshaft.
4. Remove the snap ring (54) from the front of the layshaft, then tap the layshaft backwards until the constant mesh gear (55) and the third speed gear (56) can be removed.
5. Drive the layshaft forward out of the case, progressively removing the second and fourth gear pinions (62 and 61) from the transmission case.
6. Using the hand press MF 200 and the adapter MF 200-25, press the centre bearing (57) from the layshaft (58).

Refitment
1. Press the layshaft centre bearing (57) on to the layshaft (58) using MF 200 and MF 200-25.
2. Refit the snap ring (60) on to the layshaft (58) placing it temporarily on the unsplined portion of the shaft to the rear of the first gear teeth.
3. Feed the layshaft into the transmission case, from the front, progressively fitting the fourth gear pinion (61) and the second gear pinion (62). Push the layshaft rearwards to permit fitment of the third gear pinion (56) and the constant mesh gear (55).
4. Refit the snap ring (54) to secure the constant mesh gear (55) the third gear pinion (56) and the bearing (57).
5. Tap the layshaft forwards slightly to allow the snap ring (60) to be fitted to its groove adjacent to the second gear pinion (61).
6. Carefully drive the layshaft rearwards and fit the rear snap ring (64).
7. Refit the mainshaft as stated in operation 4C-07-08

REVERSE GEAR CLUSTER

Removal and Refitment 4C-10-09

Removal
1. Remove the mainshaft as stated in operation 4C-07-08
2. Figure 4. Release the tabwasher (76), then remove the bolt (77).
3. Using a dummy shaft to prevent the needle rollers from falling into the transmission case, remove the reverse gear cluster (71) thrust washers (65 and 72) and distance piece (73).

Refitment
1. Using petroleum jelly refit the two sets of needle rollers (67 and 69), with a spacer (68) between the rows and a retaining ring (66 and 70) at each end. A smear of petroleum jelly can be used to make the thrust washers (65 and 72) and the distance piece (73) adhere to the end face of the gear cluster.
2. Insert the dummy shaft to the reverse gear cluster.
3. Figure 12. Refit the gear cluster assembly to the transmission case, then insert the shaft (74) from the rear and push out the dummy shaft.
4. Figure 4. Refit the plate (75), a new tabwasher (76) and the bolt (77). Bend up the tabwasher. The assembled gear cluster is shown in Fig. 13.

TRANSMISSION CASE REMOVAL AND REFITMENT OR COMPLETE GEARBOX OVERHAUL

Removal and Refitment 4C-11-10

Special Tools Required: MF 177 Seal Protector
MF 200 Hand Press
MF 200-25 Adapter
MF 218A P.T.O. Shaft Puller
MF 255B Oil Seal Replacer
MF 256A Oil Seal Replacer
MF 315 Needle Roller Bearing Remover/Refitting Tool V.L. Churchill 50 ton Hydraulic Press.
(Alternative to MF 200)

Disassembly

1. Drain the transmission oil.
2. Split the tractor at the engine.
3. Remove the steering box and instrument panel as an assembly.
4. Split the tractor at the centre housing.
5. Figure 6. Remove the two springs (5) securing the release bearing carrier, then slide the carrier and release bearing (1) off the input shaft retainer housing.
6. Cut the locking wire and remove the two locking pegs (3) from the clutch release fork (4). Remove the clutch release shafts and fork.
7. Figure 8. Remove the bolt, nut and lockwasher (A) securing the left brake cross shaft lever. Remove the lever and key (B) from the shaft.
8. Withdraw the shaft, complete with pedals from the right hand side of the transmission housing.
9. Figure 4. Remove the two bolts (78) securing the interlock mechanism. Lift off the locking ball carrier (80) and the two plates (83 and 84). Store the balls carefully.
10. Cut the locking wire and remove the shifter rails.
11. Figure 4. Remove the four bolts (40) securing the transmission epicyclic unit, then remove the complete assembly.
12. Figure 7. Remove the four bolts (7 and 10) and withdraw the input shaft retainer housing (9), complete with the p.t.o. input shaft (15).
13. Remove the four bolts (41) securing the cover plate (43).
14. Figure 9. Remove the circlip (45) and the thrust washer (46).
15. Screw two ⅜ UNC x 75 mm (3 in) bolts into the tapered holes in the bearing housing (49). Progressively and evenly tighten the bolts until the housing is extracted.
16. Remove the 'O' ring (44) from the bearing housing then remove the circlip (47) and press out the bearing (48).
17. Figure 4. Withdraw the p.t.o. drive shaft (53) from the rear end of the layshaft, thus allowing the p.t.o. constant mesh gear to drop into the transmission case.
18. Remove the main input shaft (18) complete with the thrust washers (17 and 19) and lift the p.t.o. constant mesh gear (52) from the transmission case. Remove the lockring (51) from the constant mesh gear.
19. Using a soft faced drift, drive the mainshaft (25) rearwards to permit removal of the third gear pinion (20).
20. Remove the snap ring (21), then drive the mainshaft through the centre bearing (22).
21. Remove the snap ring (23) and withdraw the main shaft rearwards, progressively removing the first/reverse pinion (26) and the second/fourth pinion (27).
22. Figure 4. Remove the snap ring (64) from the rear of the layshaft.
23. Figure 12. Tap the layshaft forwards to expose the snap ring (60), forward of the fourth gear pinion (61). Move the snap ring (60) forwards on to the unsplined portion of the layshaft.
24. Remove the snap ring (54) from the front of the layshaft, then tap the layshaft backwards until the constant mesh gear (55) and the third speed gear (56) can be removed.
25. Drive the layshaft forward out of the case, progressively removing the second and fourth gear pinions (62 and 61) from the transmission case.
26. Figure 4. Release the tabwasher (76), then remove the bolt (77).
27. Using a dummy shaft to prevent the needle rollers from falling into the transmission case, remove the reverse gear cluster, (71), thrust washers, (65 and 72) and distance piece (73).
28. Figure 10. Remove the circlip (28) from the mainshaft, then press off the bearing (29) using hand press MF 200 with the MF 200-25 adapter, then remove the circlip (30).

WARNING – DO NOT ATTEMPT TO PRESS THE BEARING OFF THE REAR END OF THE MAINSHAFT, AS THE GEAR TEETH ARE OF A LARGER DIAMETER THAN THE SHAFT SPLINES.

29. Using the hand press MF 200 and the adapter MF 200-25, press the centre bearing (57) from the layshaft (58).
30. Remove the large internal circlip (13) from the rear end of the input housing (9), then push the p.t.o. input housing (15) out of the housing, complete with its bearing (12).
31. Remove the external circlip (11) from the input shaft, then press off the bearing (12).
32. Lever the inner seal (16) from the input shaft.
33. Carefully lever the front oil seal (6) from the front of the input housing (9) with a screwdriver.
34. Figure 7A. Using special tool MF 315, drive the needle roller bearing (8) out of the input housing.
35. Tap the bearing (63) rearwards from the transmission case.

Examination

After disassembly of the transmission, examine all the components for scoring, wear or chipping. Pay particular attention to the gear teeth, bearings needle rollers, gear selector forks, also shaft splines which are subject to wear from the sliding action of the gears.

All bearings should be washed in clean paraffin, blown dry, inspected for wear or scoring on the outer circumference and measured for fit in transmission case webbs. Maximum acceptable clearance is 0,033 mm (0.0013 in). Where clearance between bearing and bore exceeds this figure, Loctite Grade A or grade AV may be used to refit bearings into transmission case. After inspection, lubricate bearings with transmission oil.

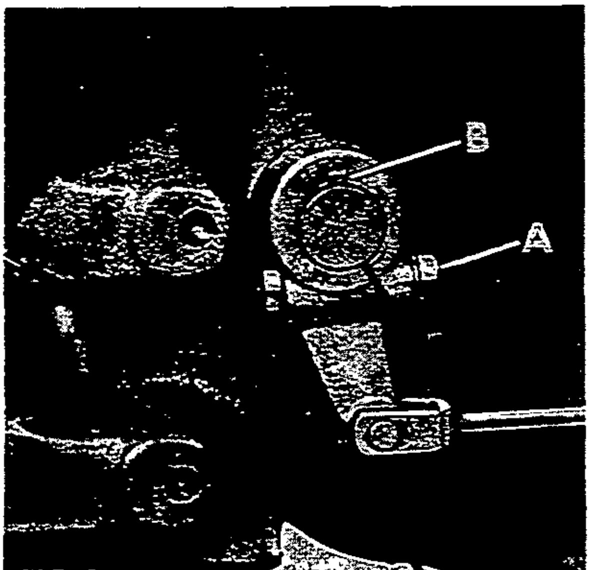

FIG. 9

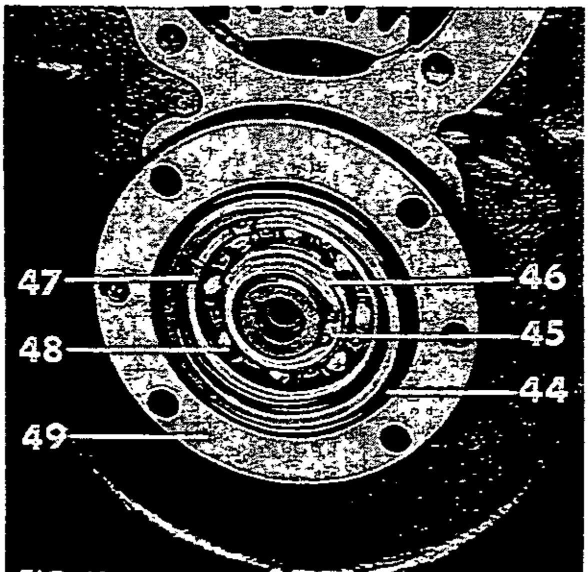

FIG. 10

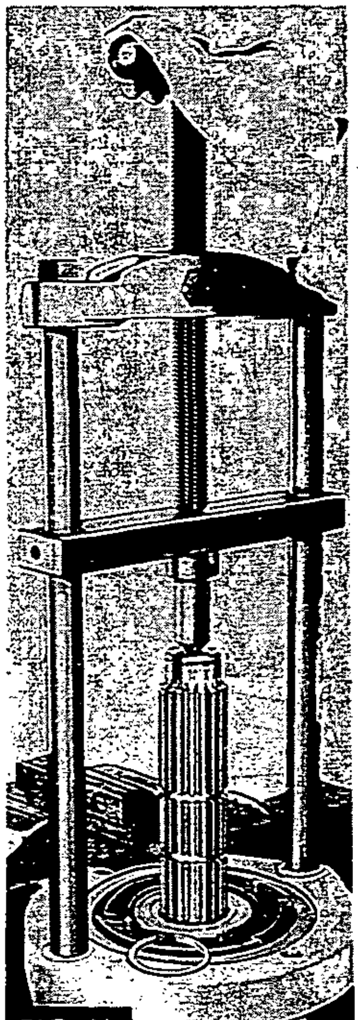
FIG. 11

FIG. 12

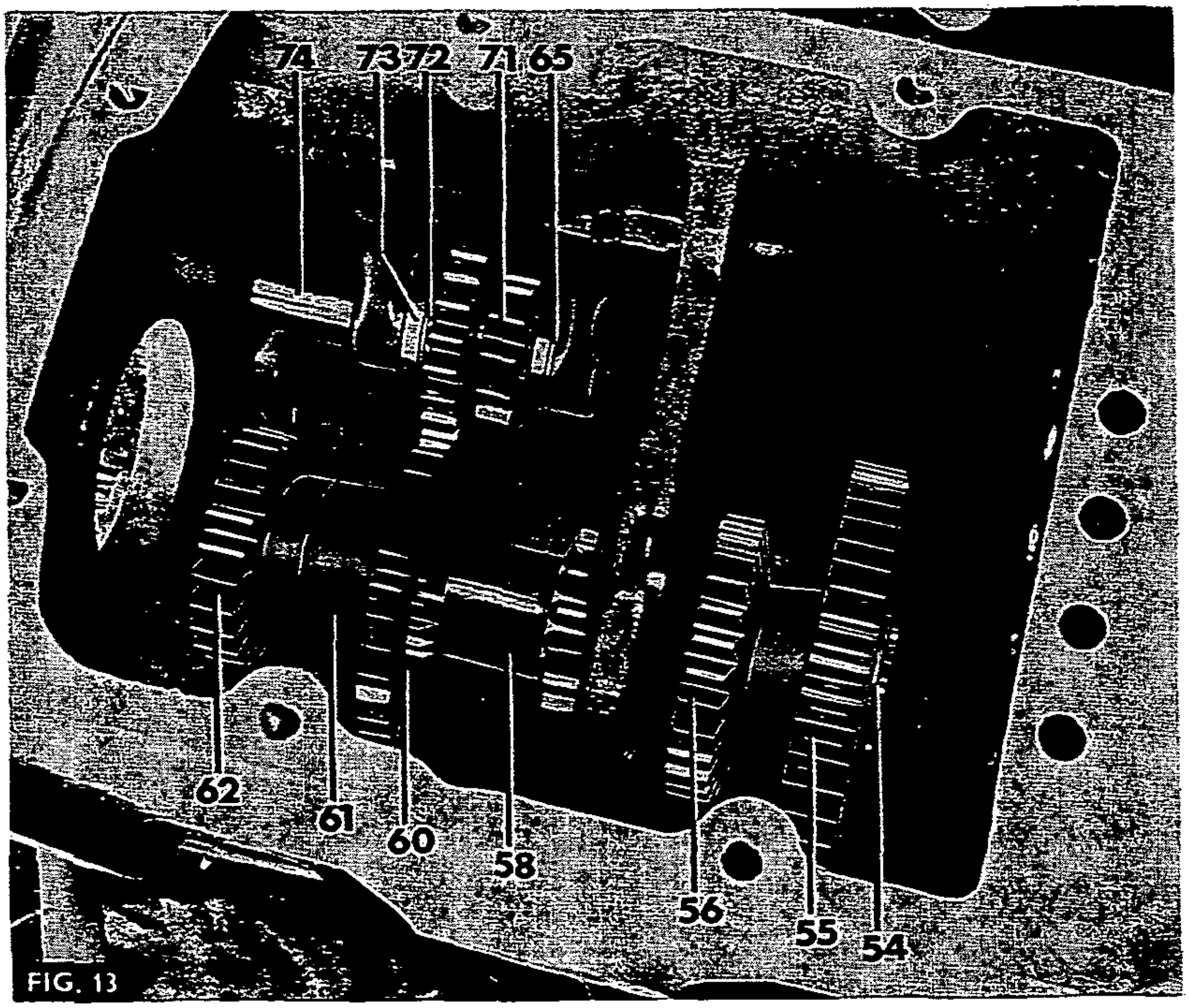
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FIG. 13

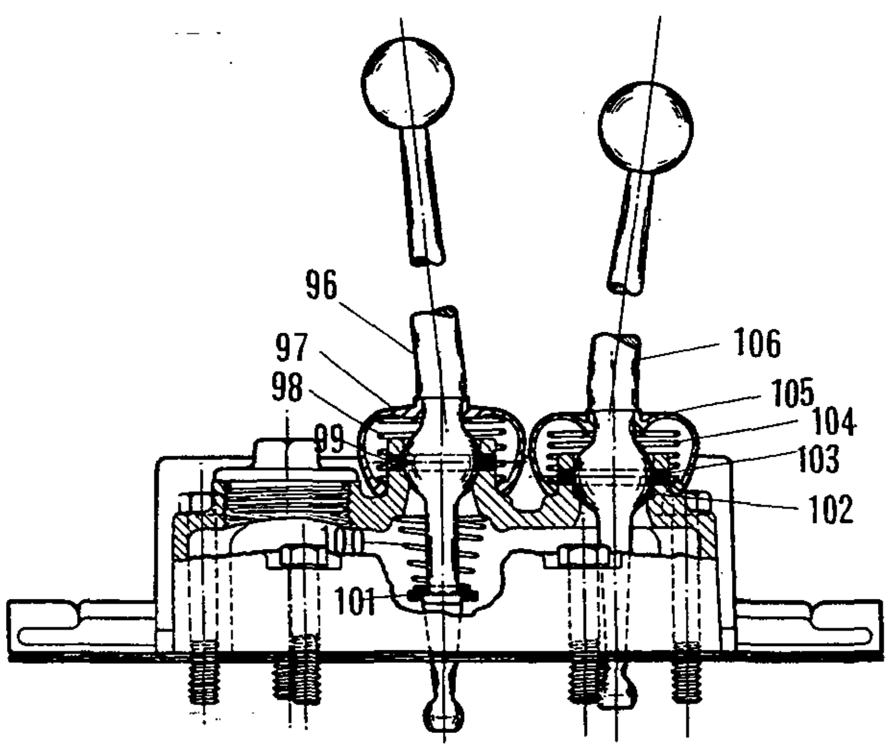
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FIG. 14

Any worn or damaged components should be replaced; also, a complete set of new gaskets, 'O' rings and a new tabwasher should be fitted.

Reassembly
NOTE – USE ONLY PETROLEUM JELLY FOR REASSEMBLY PURPOSES – NEVER GREASE.

1. Figure 7B. Refit the needle roller bearing (8) to the input housing (9) using special tool MF 315 as shown.
2. Fit a new front oil seal (6) to the input housing, using special tool MF 255B. Lubricate the oil seal and the needle roller bearing with petroleum jelly.
3. Fit a new oil seal (16) to the p.t.o input shaft (15), using special tool MF 256A. Lubricate the seal with petroleum jelly.
4. Press the bearing (12) on to the front of the p.t.o. input shaft (15) and secure it with the circlip (11).
5. Carefully insert the p.t.o. input shaft (15) into the housing (9). Push the bearing (12) fully into place and secure it with the large internal circlip (13).
6. Reassemble the reverse gear cluster as follows: Using petroleum jelly refit the two sets of needle rollers (67 and 69), with a spacer (68) between the rows and a retaining ring (66 and 70) at each end. A smear of petroleum jelly can be used to make the thrust washers (65 and 72) and the distance piece (73) adhere to the end face of the gear cluster.
7. Insert the dummy shaft to the reverse gear cluster.
8. Figure 12. Refit the gear cluster assembly to the transmission case, then insert the shaft (74) from the rear and push out the dummy shaft.
9. Figure 4. Refit the plate (75), a new tabwasher (76) and the bolt (77). Bend up the tabwasher. The assembled gear cluster is shown in Fig. 12.
10. Refit the layshaft rear bearing (63) to the transmission case.
11. Press the layshaft centre bearing (57) on to the layshaft (58) using MF 200 and MF 200-25.
12. Refit the snap ring (60) on to the layshaft (58) placing it temporarily on the unsplined portion of the shaft to the rear of the first gear teeth.
13. Feed the layshaft into the transmission case, from the front, progressively fitting the fourth gear pinion (61) and the second gear pinion (62). Push the layshaft rearwards to permit fitment of the third gear pinion (56) and the constant mesh gear (55).
14. Refit the snap ring (54) to secure the constant mesh gear (55) the third gear pinion (56) and the bearing (57).
15. Tap the layshaft forwards slightly to allow the snap ring (60) to be fitted to its groove adjacent to the second gear pinion (61).
16. Carefully drive the layshaft rearwards and fit the rear snap ring (64).
17. Refit the p.t.o. driveshaft front bearing (48) to its housing (49) and secure it with the circlip (47).
18. Figure 9. Refit the housing (49) together with a new gasket (50) into the transmission case as shown.
19. Refit the mainshaft rear snap ring (30) from the front end, then press the bearing (29) on to the mainshaft (25) using press MF 200 (see figure 10). Refit the second snap ring (28).
20. Refit the mainshaft centre bearing (22) to the web in the transmission case.
21. Figure 11. Feed the mainshaft into the transmission case from the rear, progressively fitting the fourth/second compound sliding gear (27), the first/reverse sliding gear (26) and the snap ring (23). Insert the mainshaft through the centre bearing.
22. As the mainshaft emerges through the bearing, refit the snap ring (21) and the third speed sliding gear (20).

NOTE – ENSURE THAT THE SNAP RINGS (21 AND 23) ARE CORRECTLY LOCATED IN THEIR GROOVES.

23. Lower the p.t.o. constant mesh gear (52) into the transmission case but do not yet fit the p.t.o. driveshaft (53).
24. Insert the main input shaft (18), complete with its thrust washers (17 and 19) into the transmission case, locating the shaft spigot in the needle roller bearing (24) located in the end of the mainshaft. Engage the input shaft gear teeth with those of the constant mesh gear (55).
25. Refit the p.t.o. driveshaft (53) from the rear, locating the p.t.o. constant mesh gear on the splines and then pull the end of the shaft through the bearing (48) using special tool MF 218A.
26. Figure 9. Secure the p.t.o. driveshaft with the thrust washer (46) and the circlip (45).
27. Using a new 'O' ring (44), refit the front cover plate (43) as shown in Fig. 7.

NOTE – WHEN REFITTING THE COVER PLATE AND THE BOLTS (41) USE SEALING COMPOUND 'HYLOMAR COMPOUND SQ 32M' TO SEAL THE PLATE AND THE BOLT THREADS.

28. Place the seal protector MF 177 on the front of the main input shaft (18).
29. Fit a new 'O' ring (14) on to the rear spigot of the input retainer housing (9), then carefully feed the input housing (9) over the seal protector and locate the input housing in the front of the transmission case.
30. Figure 7. Refit the four bolts (7 and 10) using 'Hylomar Compound SQ 32M' to seal the threads.
31. Figure 4. Refit the transmission epicyclic unit as follows:
Refit the backplate (33) and the shims (32) to the dowels (31) on the ring gear (34), then locate the dowels in the holes in the transmission case. Fit the thrust washers (35 and 37) to the planetary pinion carrier (36) and locate the carrier in the ring gear. Refit the cover plate (38), as shown in figure 5A. Fit the four bolts (40) and tighten them progressively and evenly to a torque of 4.9 kg.m (35 lb ft).

NOTE – OMIT LOCKWASHER FROM LOWER LEFT HAND BOLT IRRESPECTIVE OF ITS ALIGNMENT WITH THE CUT–OUT IN COVER PLATE.

32. Figure 3. Refit the third speed selector rod (89), fitting first the engagement dog (90), then the selector fork (88), engaging the selector fork in the third speed sliding gear (20).
33. Rotate the rod until the engagement dog locking pin can be fitted. Tighten the locking pin and secure it with locking wire.
34. Rotate the rod to bring the engagement dog to the top, then fit the locking pin and locking wire to the selector fork (88).
35. Slide the interlock cross peg (81) into the third speed selector rod.
36. Refit the first/reverse and the second/fourth gear selector rods and forks (86, 87, 91 and 92), engaging the forks in the gears. Refit the locking pegs (85) and the locking wires.
37. Figure 4. Refit the HIGH/LOW selector rod assembly (93 and 95) engaging the selector fork (95) in the coupler (39) and locating the coupler in the end of the planetary pinion carrier (36).
38. Figure 3. Refit the locking peg and locking wire to the HIGH/LOW engagement dog (94).
39. Refit the stop plate (84), the plain plate (83), the locking ball carrier (80) and the locking balls (82), securing them with the two bolts and spring washers (78 and 79), tightened to a torque of 4.9 kg/m (35 lb ft).
40. Refit the brake pedal and cross shaft assembly to the transmission case, from the right-hand side.
41. Figure 8. Refit the lever and key to the brake cross shaft, then re-tighten the nut and bolt.
42. Figure 6. Refit the clutch release shafts and the clutch release fork (4) refitting the locking pegs (3) and the locking wire.
43. Lubricate the splines of the input shafts and the clutch release bearing carrier bore with special grease Mobilgrease Super. Slide the clutch release bearing (1) and carrier (2) on to the input housing, and refit the two return springs (5).
44. Reconnect the transmission to the centre housing.
45. Ensure that all gears are in neutral, then reconnect the engine to the transmission.
46. Refill the transmission with a recommended oil to the correct level.
47. Test run the tractor in all gears, checking for quiet operation and ease of selection.

GEAR SHIFT LEVER

Removal and Refitment 4C-12-14

Figure 14

1. Remove the steering box.
2. Remove the eight bolts securing the shift lever support and battery platform to the transmission housing. Lift the support and platform up off the transmission housing.
3. Release the spring retaining seat (101) from the lower end of the gear lever (96), and detach the seat and spring (100).
4. Remove the gear lever rubber cover (97) and spring (98) fitted under the cover.
5. Drive out the pin (99) securing the gear lever (96) to its housing.
6. Lift out the gear lever (96).
7. Refitment is a reversal of the removing procedure.

HIGH/LOW SHIFT LEVER

Removal and Refitment 4C-13-14

Figure 14

1. Remove the rubber cover (105) and spring (104), fitted under the cover.
2. Drive out the pin (103) securing the lever (106) to its housing.
3. Lift out the lever (106) and 'O' ring (102).
4. Refitment is a reversal of the removing procedure.

6 SPEED TRANSMISSION

Part 4 Section D

GENERAL

The transmission has three forward gears and one reverse gear which are doubled by a planetary reduction unit to give six forward and two reverse gears.

All gear teeth except those of the main constant mesh gears are of involute, straight cut spur type. Where movement of the gears is required, to change ratio, the gears slide on a splined shaft.

PRINCIPLE OF OPERATION

Figure 1

The Gearbox

The tractor engine drives a clutch with divided drive. Each plate is splined on to a separate gearbox shaft. *Drive is transmitted to:*

a) The p.t.o. input shaft (24), which is hollow and has gear teeth on its rear end.

b) The main drive input shaft (31) which runs inside the p.t.o. input shaft has gear teeth on its rear end and abuts against the front end of the mainshaft (39).

Layshaft and P.t.o. Shaft

Rotation of the p.t.o. input shaft (24), drives the p.t.o. constant mesh gear (63) which is splined on to the p.t.o. drive shaft (65). When the main input shaft (31) rotates, the drive is transmitted to the constant mesh gear (67) which splined on the layshaft (70). The layshaft, which is hollow and externally splined, has 15 gear teeth machined on its outside diameter to provide the first gear layshaft pinion. It is supported on two ball races located in the centre web and rear wall of the transmission case. Mounted on the layshaft are other gears, (73 and 74) with 33 and 23 teeth which are third, and second gears respectively. None of the layshaft gears are free to move along the shaft, being retained, either by abutment with other gears, bearings or snap rings.

Mainshaft

The mainshaft (39) is externally splined, and has gear teeth at its rear end. Mounted on the mainshaft are two gears (one being a compound gear having two sets of teeth): When viewed from the front of the gearbox, these gears have 45 teeth (34) and 36/46 teeth (35) to mesh with the layshaft gears and give first, third and second gears respectively. The mainshaft gears are moved into and out of mesh by selector forks (10 and 13), the gears sliding on the mainshaft splines.

The engine speed is reduced by the selected gear ratio (variable reduction) and by the input constant mesh gears (fixed reduction).

Reverse Gear Cluster

Reverse gear is achieved by the engagement of a compound gear cluster (83) with 13/21 teeth. The 21 tooth half of the gear is in constant mesh with the third gear pinion (33 teeth) on the layshaft. The 45 tooth first gear pinion on the mainshaft is moved into, or out of mesh with the 13 tooth portion of the reverse gear cluster.

The reverse gear, by acting as an idler gear between the layshaft and the mainshaft drive, reverses the rotation of the mainshaft, epicyclic unit and the final drive.

Epicyclic Unit

The basic three forward and one reverse gears are doubled by the epicyclic unit mounted on the rear end of the transmission case. The epicyclic unit comprises a ring gear (43), inside which run three planetary pinions mounted in a carrier (45). The planetary pinions are driven by gear teeth on the end of the mainshaft (39) which acts as the sun gear. When the mainshaft rotates, the planetary pinions also rotate, but being meshed with the teeth on the inside of the ring gear the rotational speed of the carrier is reduced by a ratio of 4:1.

To transmit the drive from the epicyclic unit to the rear axle, a driveshaft is connected by the coupler (50), either directly to the gearbox mainshaft (HIGH range), or to the planetary pinion carrier (45) (LOW range).

Movement of the dual range selector lever actuates the rod attached to the selector fork (7) which moves the coupler (50) into, or out of mesh with either the end of the mainshaft (39) or the planetary pinion carrier (45). Between the two engaged (HIGH or LOW range) positions, there is a neutral position, where the coupler splines are disengaged from both the mainshaft and the planetary pinion carrier.

SHIFTER RAIL MECHANISM

Removal and Refitment 4D-01-02

Special Tools Required: 270 Rail Trolley.

Removal

1. Split the tractor between the gearbox and centre housing as stated in Part 3.
2. Remove the gearbox top cover, in unit with the instrument panel, as stated in Part 3.
3. Fig 2. Release the locking wire from the 1st/rev. and 2nd/3rd shift forks (10,13), and from the rear end of the HIGH/LOW shift rail (6).
4. Fig 3. Remove the locking peg (8) from the HIGH/LOW shift fork (7), detach the fork and coupler (50).
5. Remove the gear lever stop plate (15) and interlock pin (18), secured by two bolts (17) and spring washers (16).
6. Lift out the three shift rail springs (1), and plungers (2).
7. Remove the locking pegs (9 and 12) from the 1st/rev. and 2nd/3rd shift forks (10 and 13).
8. Slide the 1st/rev. and 2nd/3rd shift rails (11 and 14), rearwards out of the transmission housing. Lift out the 1st/rev. and 2nd/3rd shift forks (10 and 13).
9. Release the locking wire and remove the locking peg (3) from the HIGH/LOW shift selector (5).
10. Slide the HIGH/LOW shift rail (6), rearwards out of the transmission housing. Lift out the HIGH/LOW shift selector (5).

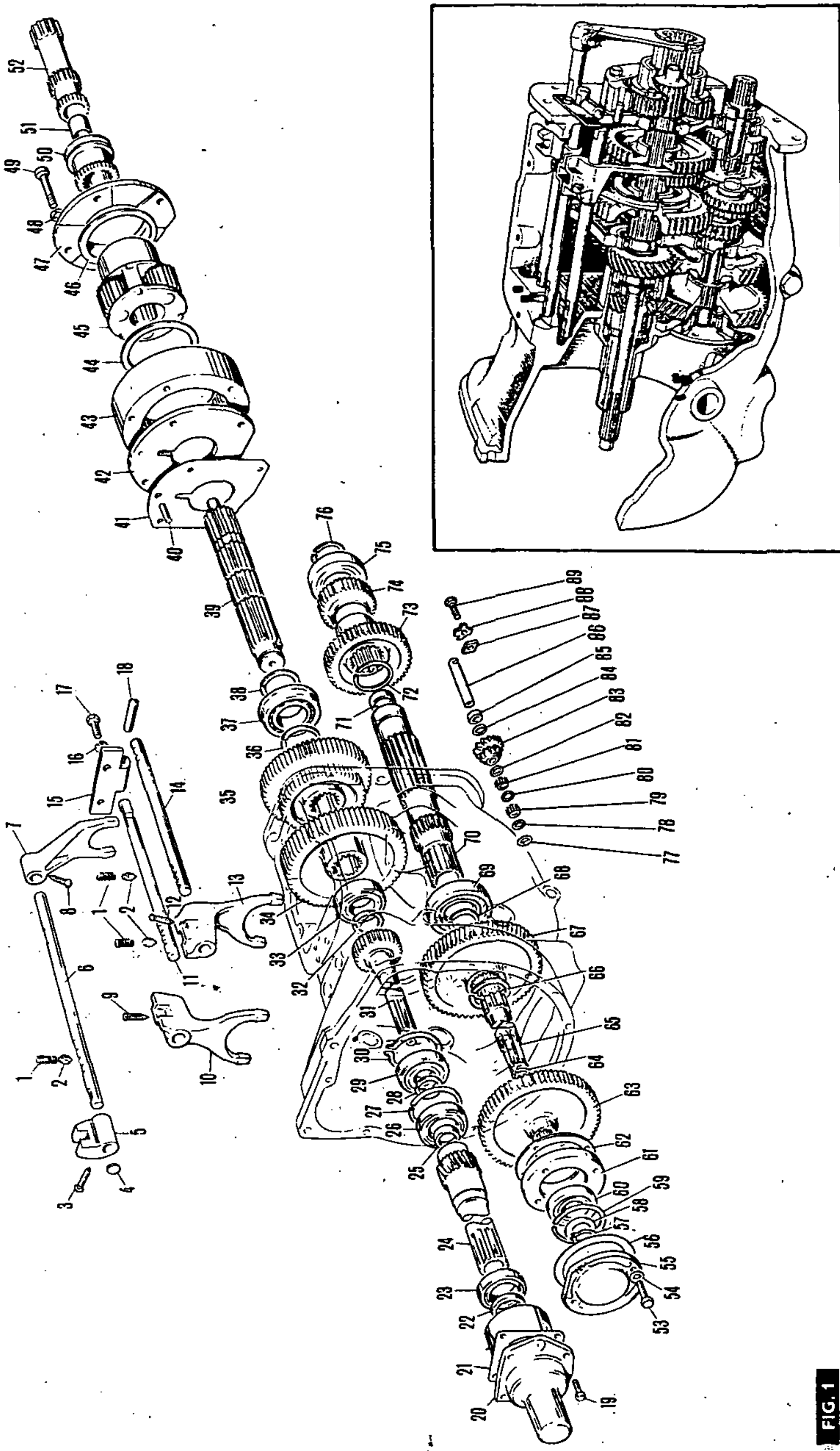

FIG. 1

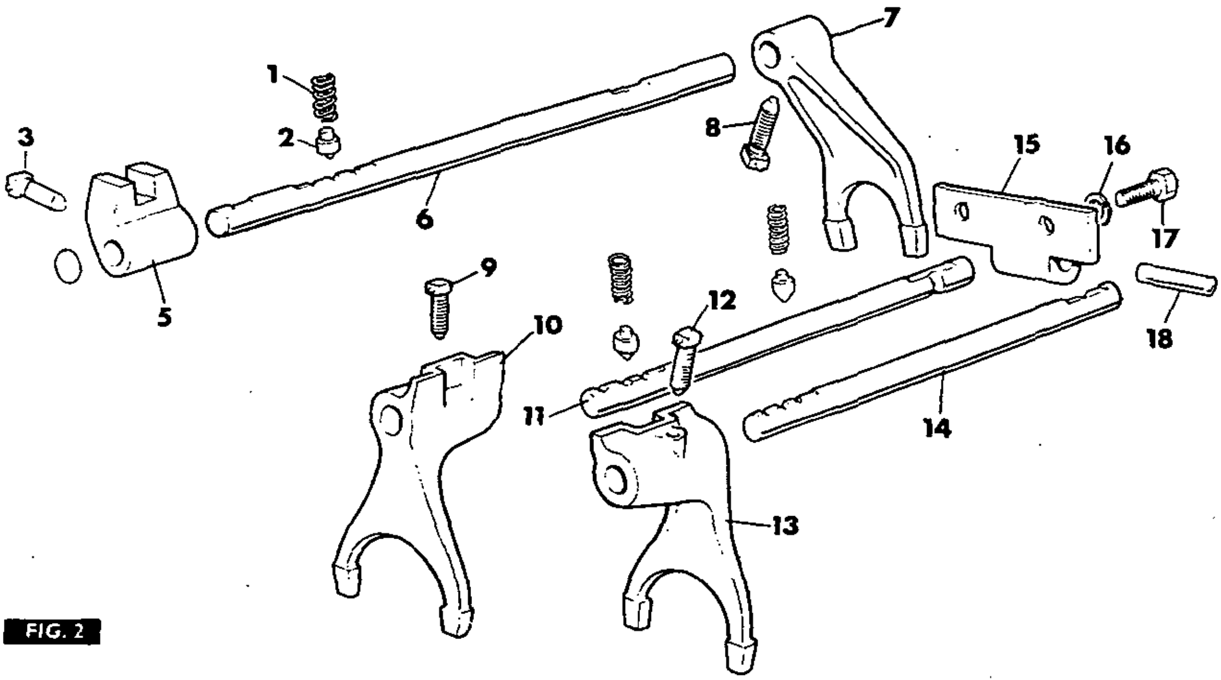

FIG. 2

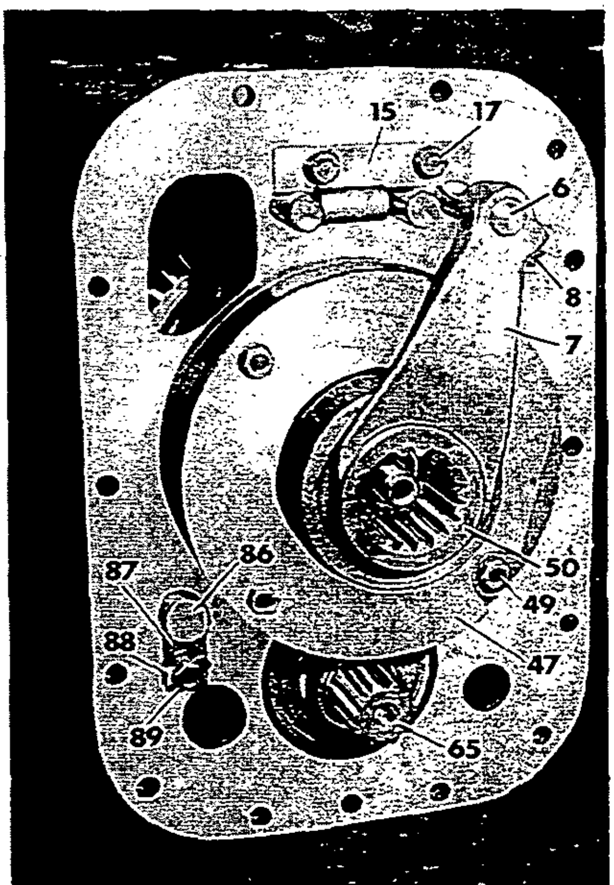

FIG. 3

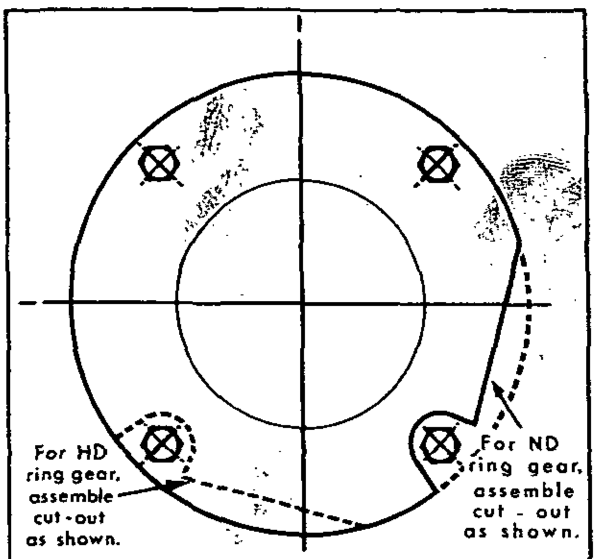

FIG. 4

Refitment

1. Fit the HIGH/LOW shift rail (6), sliding the HIGH/LOW shift selector (5), onto the rail and secure to the rail with a locking peg (3). Wire lock the peg to the rail.
2. Locate the 1st/rev. and 2nd/3rd shift forks (10 and 13), to their respective grooves in the mainshaft gears. The two forks are identical.
3. Assemble the 1st/rev. and 2nd/3rd shift rails (11 and 14), with the interlock pin grooves facing each other, to the forks, and secure each fork with a locking peg (9 and 12). Wire lock the pegs to the rails. The shorter, 2nd/3rd shift rail (14) is fitted to the L.H. side.
4. Locate the HIGH/LOW shift fork (7), to the groove in the coupler (50). Assemble the coupler into the planet pinion carrier assembly (45), simultaneously sliding the fork (7), onto the HIGH/LOW shift rail (6).
5. Secure the HIGH/LOW shift fork (7), to its rail with the locking peg(8).
6. Wire lock the peg to the rail.
7. Fit the interlock pin (18), to the stop plate (15), and secure the stop plate with two bolts (17), and spring washers (16).
8. Fit the three plungers (2), pointed end downwards, and the three springs (1).
9. Refit the gearbox top cover and instrument panel assembly as stated in Part 3.

NOTE – BOTH GEAR LEVERS AND THE GEAR SELECTOR DOGS MUST BE PLACED IN NEUTRAL.

10. Reconnect the transmission to the centre housing, as stated in Part 3.

TRANSMISSION EPICYCLIC

Removal and Refitment 4D-02-05

Figure 3

Special Tools Required: 270 Rail Trolley.

Removal

1. Split the tractor between the transmission and the centre housing.
2. Remove the locking wire and peg (8) from the HIGH/LOW shifter fork (7) then remove the fork and coupler (50).
3. Figure 3. Remove the four bolts (49) securing the transmission epicyclic unit, then remove the complete assembly.

Refitment

1. Refit the backplate (42) and the shims (41) to the dowels (40) on the ring gear (43), then locate the dowels in the holes in the transmission case. Fit the thrust washers (44 and 46) to the planetary pinion carrier (45) and locate the carrier in the ring gear. Refit the cover plate (47), as shown in Fig 4. Fit the four bolts (49), and tighten them progressively and evenly to a torque of 4,9 kg-m (35 lb-ft).

NOTE – OMIT LOCKWASHER FROM LOWER LEFT HAND BOLT.

2. Refit the coupler (50) and HIGH/LOW shifter fork (7), then refit the locking peg (8) and locking wire.
3. Reconnect the transmission to the centre housing.

P.T.O. DRIVESHAFT FRONT BEARING

Removal and Refitment 4D-03-05

Special Tools Required: 270 Rail Trolley
MF 218A P.t.o. Driveshaft puller
MF 218A-2 Adapter

Removal

1. Split the tractor between the engine and gearbox.
2. Fig 5. Remove the bolt, nut and lockwasher (A) securing the left brake cross shaft lever. Remove the lever and key (B) from the shaft.
3. Withdraw the shaft, complete with pedals from the right hand side of the transmission housing.
4. Remove the four bolts (53) securing the cover plate (55).

NOTE – IF THE 'O' RING (56) IS CAUSING LEAKAGE, PROCEDE NO FURTHER.

5. Figure 6. Remove the circlip (57) and the thrust washer (58).
6. Screw two 3/8 UNC x 75 mm (3 in) bolts into the tapped holes in the bearing housing (61). Progressively and evenly tighten the bolts until the housing is extracted.
7. Remove the 'O' ring (56) from the bearing housing.
8. If the bearing (60) needs servicing, remove the circlip (59) and press out the bearing (60).

When refitting, always fit a new 'O' ring (56) and gasket (62), also fitting new circlips (57 and 59), if possible.

Refitment

1. Refit the p.t.o. driveshaft front bearing (60) to its housing (61) and secure it with the circlip (59).
2. Refit the housing (61) together with a new gasket (62) into the transmission case.
3. Fig. 7. Pull the p.t.o. driveshaft (65) into its bearing (60) by using special tool MF 218A and adapter MF218-2.
4. Figure 6. Secure the p.t.o. driveshaft with the thrust washer (58) and the circlip (57).
5. Using a new 'O' ring (56) refit the front cover plate (55).

NOTE – WHEN REFITTING THE COVER PLATE AND THE BOLTS (53) USE SEALING COMPOUND 'HYLOMAR COMPOUND SQ 32M' TO SEAL THE PLATE AND BOLT THREADS.

6. Refit the brake pedal and cross shaft assembly to the transmission case, from the right hand side.
7. Figure 5. Refit the lever and key to the brake cross shaft, then re-tighten the nut and bolt.
8. Reconnect the gearbox.

INPUT SHAFT HOUSING AND INPUT SHAFTS

Removal and Refitment. 4D-04-06

Special Tools Required: 270 Rail Trolley
MF 177 Seal Protector
MF 178 Seal Protector
MF 179 Oil Seal Replacer
MF 200 Hand Press
MF 200-25 Adapter
550 Universal Handle

Removal

1. Remove the p.t.o. driveshaft front bearing, as stated in operation 4D-03-05.
2. Split the tractor between the gearbox and centre housing, as stated in Part 3A.
3. Remove the clutch release mechanism and stated in operation 4A-03-05.
4. Withdraw the p.t.o. driveshaft (65) rearwards to permit the p.t.o. constant mesh gear (63) to drop into the transmission case.
5. Remove the four bolts (19) securing the input shaft housing (20) to the gearbox, then withdraw the housing, complete with the shafts and gasket.
6. Fig 8. Compress the snap ring (30) then, drive the main input shaft (31) out of the housing (20).
7. Remove the snap ring (27), then drive the p.t.o. input shaft (24), complete with its bearings (23 and 26) and oil seal (25) out of the housing.
8. Carefully remove the oil seals (22 and 25) from the housing (20) and the p.t.o. input shaft (24).
9. If necessary, remove the snap ring (28), then press the main input shaft and p.t.o. input shaft bearings (29, 23 and 26) off their respective shafts using the hand press MF 200 and adapter MF 200-25.

Refitment

1. If necessary, press the p.t.o. input shaft and main input shaft bearings (23, 26 and 29) on to their respective shafts securing the main input shaft bearing (29) with a new snap ring(28).
2. Fig 9. Assemble the oil seal replacer MF 179 to the 550 handle, then slide the new oil seal (22), with its metal face towards the housing on to MF 179.
3. Drive the seal into the input housing (20).
4. Fig 10. Fit a new oil seal (25) on to MF 179, then drive the seal into the p.t.o. input shaft.
5. Fig 10. Fit the oil seal protector, MF 178 to the p.t.o. input shaft, then slide the p.t.o. input shaft into the housing (20).
6. Secure the p.t.o. input shaft with a new snap ring (27), then remove the oil seal proctector MF 178..
7. Thoroughly clean and degrease the outside diameter of the main input shaft bearing (29), using triclorethylene or a similar degreasing solvent.
8. Fig 12. Fit the seal protector MF 177 to the main input shaft.
9. Apply four drops of either 'Loctite Grade 'AV' (Red), or Casco Metalok LF5 to the outside diameter of the bearing (29), then press the bearing into the main input shaft until the bearing contacts the inner snap ring (27). Fit a new outer snap ring (30). Remove the seal protector.
10. Slide the input housing and shaft assembly into the transmission case, using a new gasket (21) and secure it with the four bolts (19).

NOTE – TO SEAL THE BOLT THREADS AND THE GASKET FACE, USE SEALING COMPOUND 'HYLOMAR SQ32M'.

11. Slide the p.t.o. driveshaft (65) into the layshaft from the rear engaging the constant mesh gear (63).
12. Refit the p.t.o. driveshaft front bearing, as stated in operation 4D-03-05.
13. Reconnect the gearbox to the centre housing, as stated in Part 3A.
14. Refit the clutch release mechanism, as stated in operation 4A-03-05.

FIRST, SECOND OR THIRD GEAR OR MAINSHAFT

Removal and Refitment 4D-05-06

Special Tools Required: MF 200 Hand Press
MF 200-25 Adapter

Removal

1. Remove the shifter rail mechanism, as stated in operation 4D-01-02.
2. Remove the transmission epicyclic unit, as stated in operation 4D-02-05.
3. Remove the input housing and input shafts as stated in operation 4D-04-06.
4. Fig 13. Remove the snap ring (32) from the front end of the mainshaft (39).
5. Drive the mainshaft rearwards to release the front bearing (33) from its web in the gearbox, then drive the bearing off the mainshaft.
6. The mainshaft can then be withdrawn rearwards, removing the 1st/rev. gear (34) and the 2nd/3rd gear (35).
7. Fig 14. If necessary, remove the snap ring (36) and press off the bearing (37), using the MF 200 hand press and the MF 200-25 adapter, then remove the snap ring (38).

WARNING – DO NOT ATTEMPT TO PRESS THE BEARING OFF THE REAR END OF THE MAINSHAFT, AS THE GEAR TEETH ARE OF A LARGER DIAMETER THAN THE SHAFT SPLINES.

Refitment

1. Fig 14. Refit the mainshaft rear snap ring (38) from the front end, then press the bearing (37) on to the mainshaft (39) using press MF 200 and adapter MF 200-25. Refit the second snap ring (36).
2. Refit the mainshaft centre bearing (33) to the web in the transmission case.

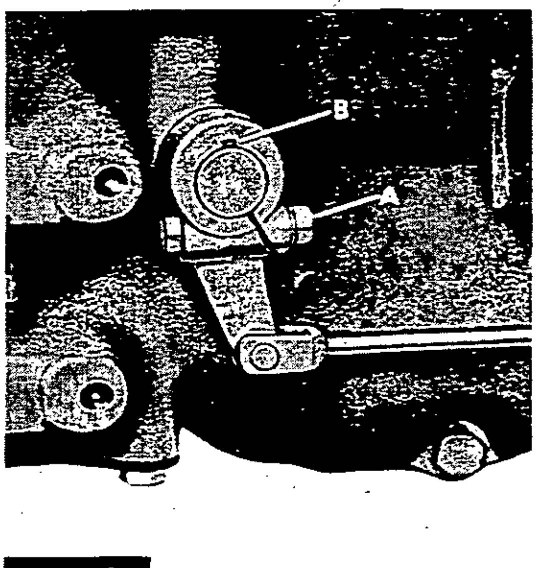

FIG. 5

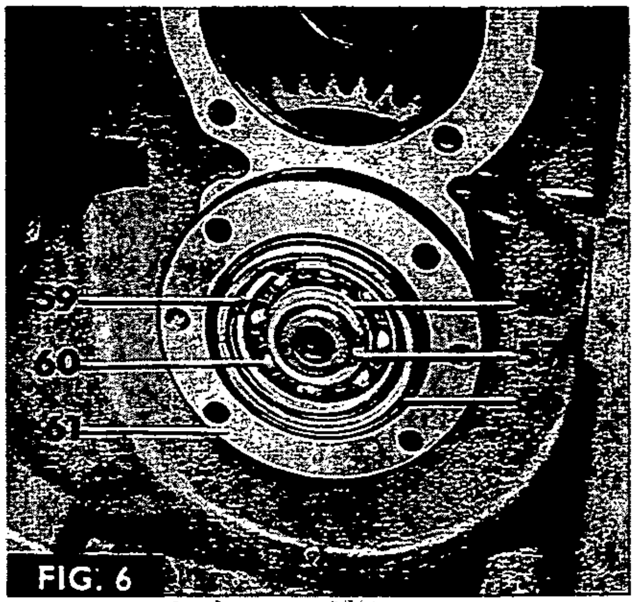

FIG. 6

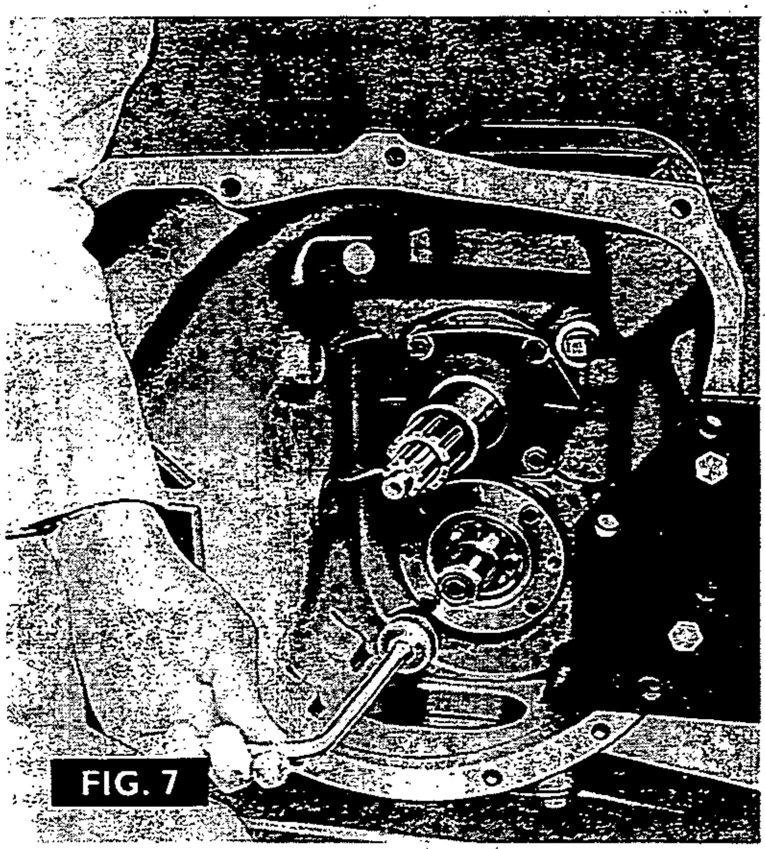

FIG. 7

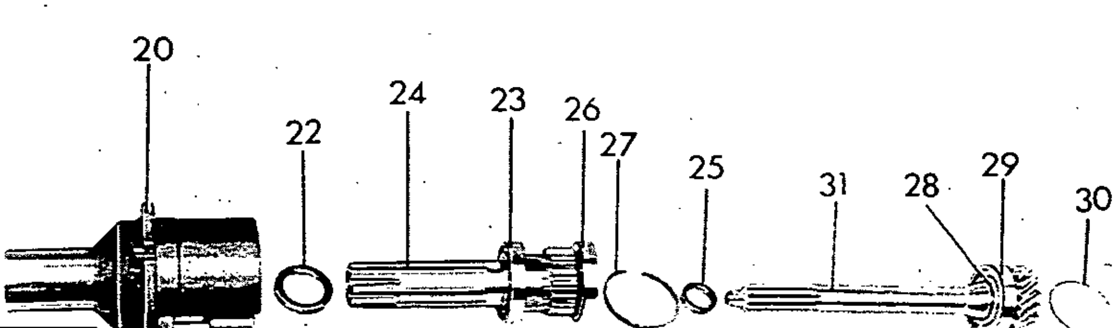

FIG. 8

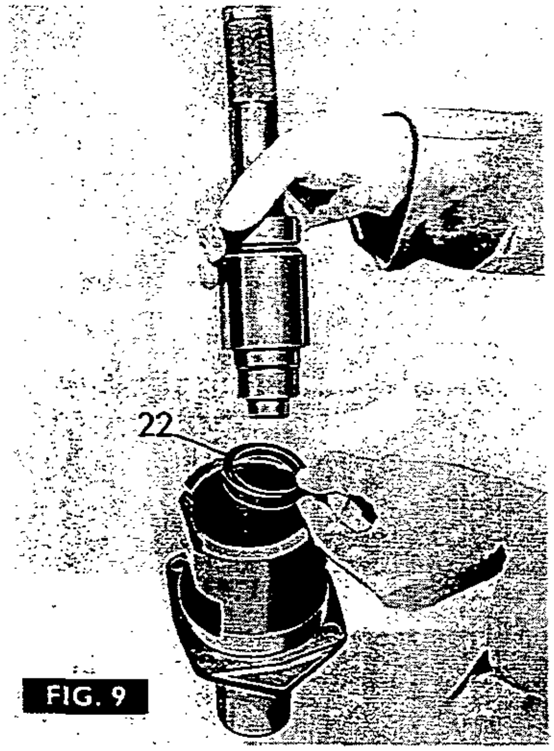

FIG. 9

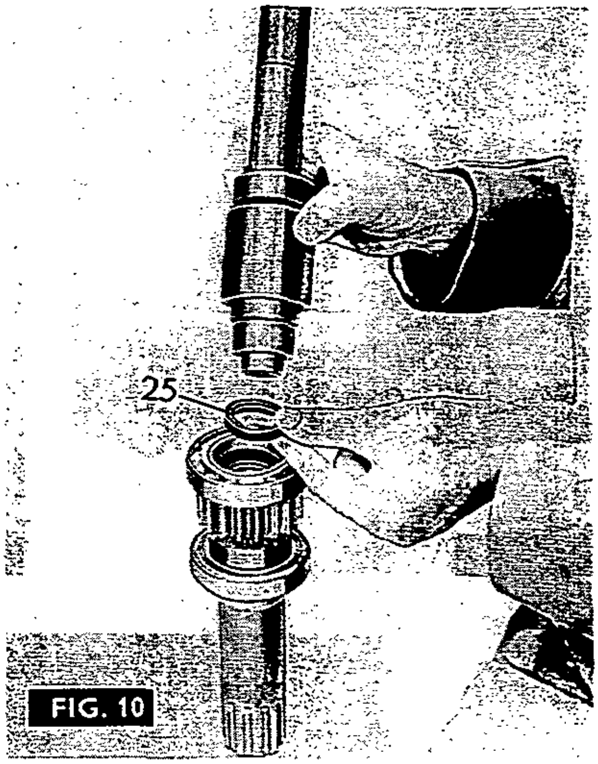

FIG. 10


FIG. 11


FIG. 12

3. Figure 13. Feed the mainshaft into the transmission case from the rear, progressively fitting the third/second compound sliding gear (35) and the first reverse sliding gear (34). Insert the mainshaft through the centre bearing.
4. Drive the mainshaft forwards into the front bearing then fit the snap ring (32).
5. Refit the input housing and input shafts, as stated in operation 4D-04-06.
6. Refit the transmission epicyclic unit, as stated in operation 4D-02-05.
7. Refit the shifter rail mechanism, as stated in operation 4D-01-02.

LAYSHAFT AND LAYSHAFT GEARS

Removal and Refitment 4D-06-09

Special Tools Required: MF 200 Hand Press
MF 200-25 Adapter

Removal

1. Remove the mainshaft and gears as stated in operation 4D-05-06.
2. Figure 15. Remove the snap ring (76) from the rear of the layshaft.
3. *Figure 16. Tap the layshaft forwards to expose* the snap ring (72), forward of the third gear pinion (73). Move the snap ring (72) forwards on to the unsplined portion of the layshaft.
4. Remove the snap ring (66) from the front of the layshaft, then tap the layshaft backwards until the constant mesh gear (67) can be removed.
5. Drive the layshaft forward out of the case, progressively removing the second and third gear pinions (74 and 73) from the transmission case.
6. Using the hand press MF 200 and the adaptor MF 200-25, press the centre bearing (69) from the layshaft (70).

Refitment

1. Fig 16. Press the layshaft centre bearing (69) on to the layshaft (70) using MF200 and MF200-25.
2. Refit the snap ring (72) on to the layshaft (70) placing it temporarily on the unsplined portion of the shaft to the rear of the first gear teeth.
3. Feed the layshaft into the transmission case, from the front, progressively fitting the third gear pinion (74) and the second gear pinion (74). Push the layshaft rearwards to permit fitment of the constant mesh gear (67).
4. Refit the snap ring (66) to secure the constant mesh gear (67) and the bearing (69).
5. Tap the layshaft forwards slightly to allow the snap ring (72) to be fitted to its groove adjacent to the third gear pinion (73).
6. Fig 15. Carefully drive the layshaft rearwards and fit the rear snap ring (76).
7. Refit the mainshaft as stated in operation 4D-05-06.

REVERSE GEAR CLUSTER

Removal and Refitment 4D-07-09

Removal

1. Remove the mainshaft as stated in operation 4D-05-06.
2. Figure 3. Release the tabwasher (88), then remove the bolt (89)
3. Fig 17. Using a dummy shaft to prevent the needle rollers from falling into the transmission case, remove the reverse gear cluster (83) thrust washers (77 and 84) and distance piece (85).

Refitment

1. Fig 17. Using petroleum jelly refit the two sets of needle rollers (79 and 81), with a spacer (80) between the rows and a retaining ring (78 and 82) at each end. A smear of petroleum jelly can be used to make the thrust washers (77 and 84) and the distance piece (85) adhere to the end face of the gear cluster.
2. Insert the dummy shaft to the reverse gear cluster.
3. Refit the gear cluster assembly to the transmission case, then insert the shaft (86) from the rear and push out the dummy shaft.
4. *Figure 3. Refit the plate (87), a new tabwasher* (88) and the bolt (89). Bend up the tabwasher.

TRANSMISSION CASE REMOVAL AND REPLACEMENT OR COMPLETE TRANSMISSION OVERHAUL

4D-08-09

Special Tools Required: MF 177 Seal Protector
MF 178 Seal Protector
MF 179 Oil Seal Replacer
MF 200 Hand Press
MF 200-25 Adapter
MF 218A P.t.o. Driveshaft Puller
MF 218A-2 Adapter
270 Rail Trolley
550 Universal Handle

Disassembly

1. Remove the clutch release mechanism, as stated in operation 4A-03-05
2. Split the tractor between the gearbox and centre housing as stated in Part 3
3. Remove the gearbox top cover, in unit with the instrument panel, as stated in Part 3.
4. Fig 2. Release the locking wire from the 1st/rev. and 2nd/3rd shift rails (11, 14), and from the rear end of the HIGH/LOW shift rail (6).
5. Fig 3. Remove the locking peg (8) from the HIGH/LOW shift fork (7), detach the fork (7) and coupler (50)
6. Remove the gear lever stop plate (15) and interlock pin (18), secured by two bolts (17) and spring washers (16)
7. Fig 2. Lift out the three shift rail springs (1), and plungers (2).
8. Remove the locking pegs (9 and 12) from the 1st/rev. and 2nd/3rd shift forks (10, 13)

9. Slide the 1st/rev. and 2nd/3rd shift rails (11, 14), rearwards out of the transmission housing. Lift out the 1st/rev. and 2nd/3rd shift forks (10, 13).
10. Release the locking wire and remove the locking peg (3) from the HIGH/LOW shift selector (5)
11. Slide the HIGH/LOW shift rail (6), rearwards out of the transmission housing. Lift out the HIGH/LOW shift selector (5).
12. Figure 3. Remove the four bolts (49) securing the transmission epicyclic unit, then remove the complete assembly.
13. Remove the four bolts (53) securing the cover plate (55).
14. Figure 6. Remove the circlip (57) and the thrust washer (58).
15. Screw two 3/8 UNC x 75 mm (3 in) bolts into the tapped holes in the bearing housing (61). Progressively and evenly tighten the bolts until the housing is extracted.
16. Remove the 'O' ring (56) from the bearing housing then remove the circlip (59) and press out the bearing (60).
17. Figure 3. Withdraw the p.t.o. drive shaft (65) from the rear end of the layshaft, thus allowing the p.t.o. constant mesh gear (63), to drop into the transmission case.
18. Remove the four bolts (19) and withdraw the input shaft retainer housing (20) complete with the input shafts.
19. Fig 8. Compress the snap ring (30) then, drive the main input shaft (31) out of the housing (20).
20. Remove the snap ring (27), then drive the p.t.o. input shaft (24), complete with its bearings (23 and 26) and oil seal (25) out of the housing.
21. Carefully remove the oil seals (22 and 25) from the housing (20) and the p.t.o. input shaft (24).
22. Remove the snap ring (28), then press the main input shaft and p.t.o. input shaft bearings (29, 23 and 26) off their respective shafts using the hand press MF200 and adapter MF 200-25.
23. Fig 13. Remove the snap ring (32) from the front end of the mainshaft (39).
24. Drive the mainshaft rearwards to release the front bearing (33) from its web in the gearbox, then drive the bearing off the mainshaft.
25. The mainshaft can then be withdrawn rearwards, removing the 1st/rev. gear (34) and the 2nd/3rd gear (35).
26. Fig 14. Remove the snap ring (36) and press off the bearing (37), using the MF200 hand press and the MF200-25 adapter, then remove the snap ring (38)

WARNING – DO NOT ATTEMPT TO PRESS THE BEARING OFF THE REAR END OF THE MAINSHAFT, AS THE GEAR TEETH ARE OF A LARGER DIAMETER THAN THE SHAFT SPLINES.

27. Figure 15. Remove the snap ring (76) from the rear of the layshaft.
28. *Figure 16. Tap the layshaft forwards to expose* the snap ring (72), forward of the third gear pinion (73). Move the snap ring (72) forwards on to the unsplined portion of the layshaft.
29. Remove the snap ring (66) from the front of the layshaft, then tap the layshaft backwards until the constant mesh gear (67) can be removed.
30. Drive the layshaft forward out of the case, progressively removing the second and third gear pinions (74 and 73) from the transmission case.
31. Using the hand press MF 200 and the adapter MF 200-25, press the centre bearing (69) from the layshaft (70).
32. Figure 3. Release the tabwasher (88), then remove the bolt (89).
33. Using a dummy shaft to prevent the needle rollers from falling into the transmission case, remove the reverse gear cluster (83) thrust washers (77 and 84) and distance piece (85).

Examination

After disassembly of the transmission, examine all the components for scoring, wear or chipping. Pay particular attention to the gear teeth, bearings needle rollers, gear selector forks, also shaft splines which are subject to wear from the sliding action of the gears. All bearings should be washed in clean paraffin, blown dry, inspected for wear or scoring on the outer circumference and measured for fit in transmission case webbs. Maximum acceptable clearance is 0,33 mm (0.0013 in). Where clearance between bearing and bore exceeds this figure, Loctite Grade 'Bearing Fit' (Yellow) may be used to refit bearings into transmission case. After inspection, lubricate bearings with transmission oil.

Any worn or damaged components should be replaced; also, a complete set of new gaskets, 'O' rings and a new tabwasher should be fitted.

Reassembly

1. Fig 17. Using petroleum jelly refit the two sets of needle rollers (79 and 81), with a spacer (80 between the rows and a retaining ring (78 and 82) at each end. A smear of petroleum jelly can be used to make the thrust washers (77 and 84) and the distance piece (85) adhere to the end face of the gear cluster.
2. Insert the dummy shaft to the reverse gear cluster.
3. Refit the gear cluster assembly to the transmission case, then insert the shaft (86) *from the rear and push out the dummy shaft.*
4. Fig 3. Refit the plate (87), a new tabwasher (88) and the bolt (89). Bend up the tabwasher.
5. Fig 16. Press the layshaft centre bearing (69) on to the layshaft (70) using MF200 and MF200-25.
6. Refit the snap ring (72) on to the layshaft (70) placing it temporarily on the unsplined portion of the shaft to the rear of the first gear teeth.
7. Feed the layshaft into the transmission case, from the front, progressively fitting the third gear pinion (73) and the second gear pinion (74). Push the layshaft rearwards to permit fitment of the constant mesh gear (67).
8. Refit the snap ring (66) to secure the constant, mesh gear (67) and the bearing (69).
9. Tap the layshaft forwards slightly to allow the snap ring (72) to be fitted to its groove adjacent to the gear pinion (73).
10. Fig 15. Carefully drive the layshaft rearwards and fit the rear snap ring (76).

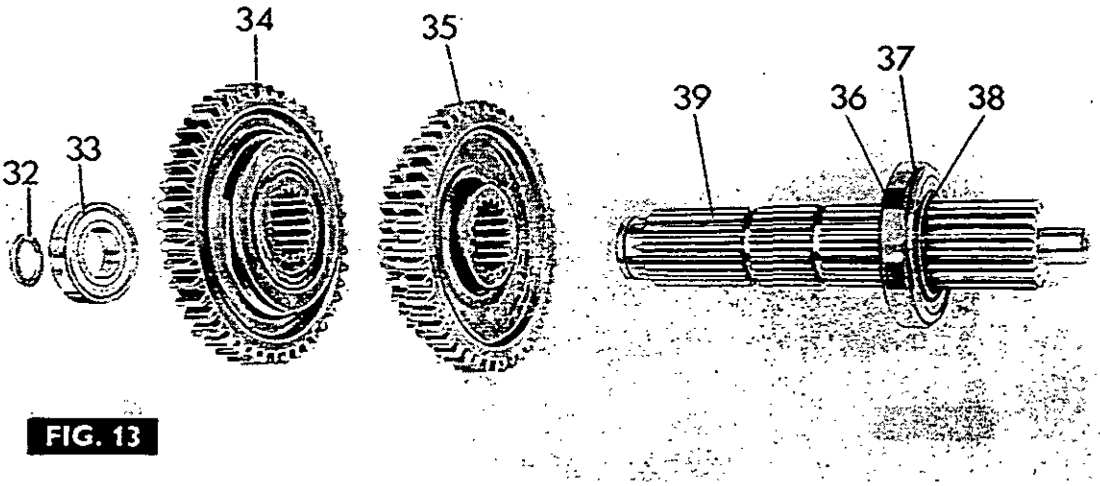

FIG. 13

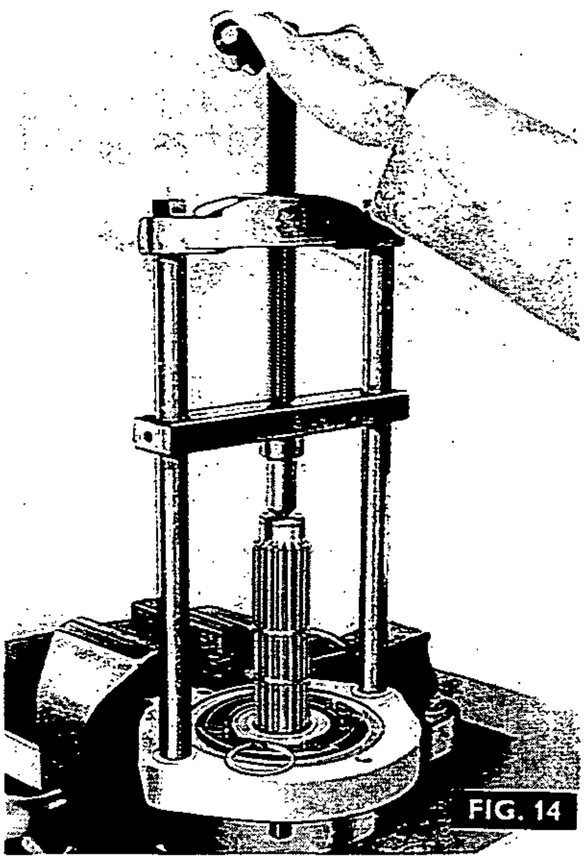

FIG. 14

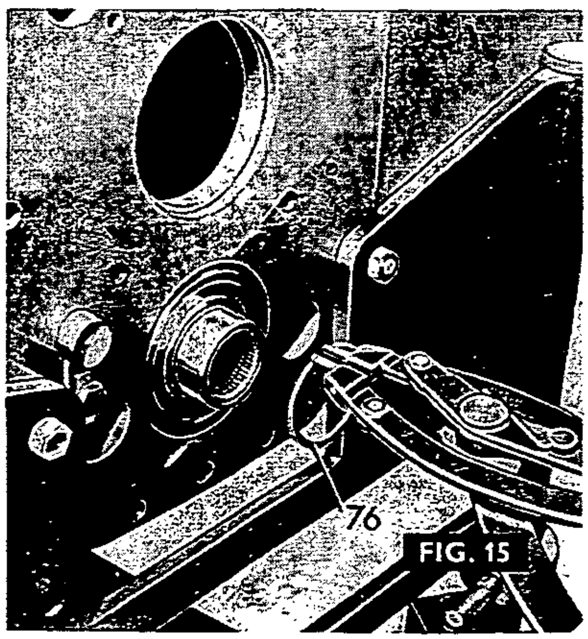

FIG. 15

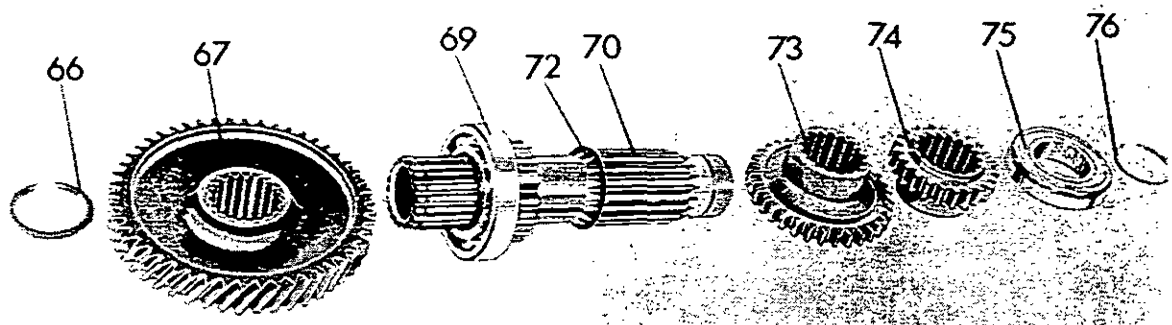

FIG. 16

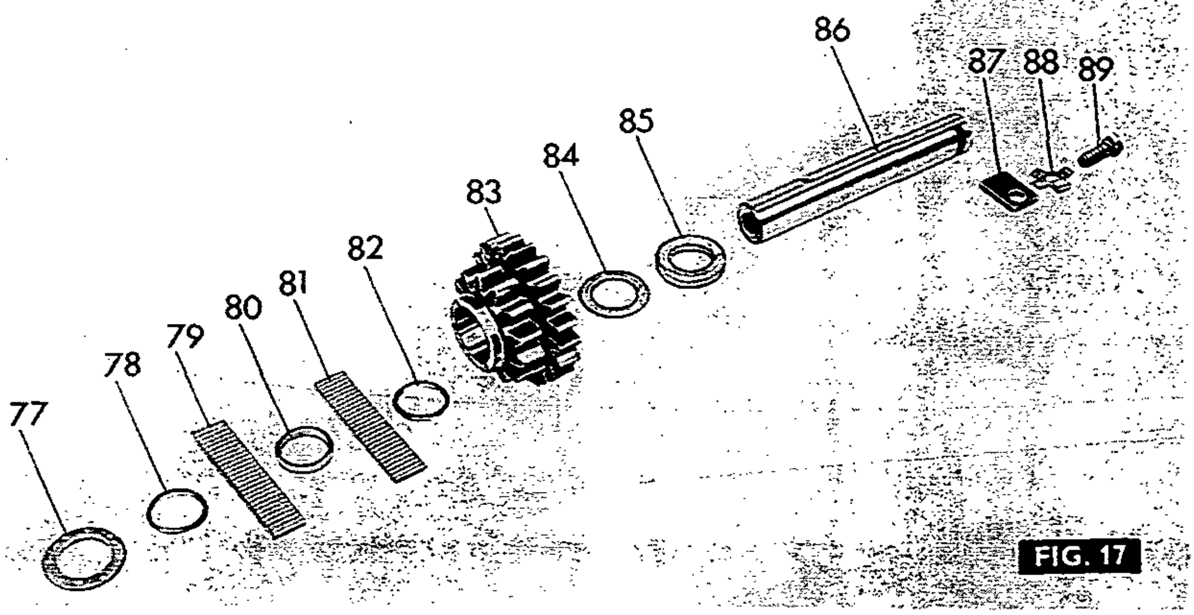

FIG. 17

11. Fig 14. Refit the mainshaft rear snap ring (38) from the front end, then press the bearing (37) on to the mainshaft (39) using press MF200 and adapter MF200-25. Refit the second snap ring (36).
12. Refit the mainshaft centre bearing (33) to the web in the transmission case.
13. Fig 13. Feed the mainshaft into the transmission case from the rear, progressively fitting the third/second compound sliding gear (35) and the first/reverse sliding gear (34). Insert the mainshaft through the front bearing.
14. Drive the mainshaft forwards into the front bearing then fit the snap ring (32).
15. Fig 8. Press the p.t.o. input shaft and main input shaft bearings (23, 26 and 29) on to their respective shafts securing the main input shaft bearing (29) with a new snap ring (28).
16. Fig 9. Assemble the oil seal replacer MF179 to the 550 handle, then slide the new oil seal (22), with its metal face towards the housing on to MF179.
17. Drive the seal into the input housing (20).
18. Fig 10. Fit a new oil seal (25) on to MF 179, then drive the seal into the p.t.o. input shaft.
19. Fig 11. Fit the oil seal protector, MF 178 to the p.t.o. input shaft, then slide the p.t.o. input shaft into the housing(20).
20. Secure the p.t.o. input shaft with a new snap ring (27), then remove the oil seal protector MF178.
21. Fig 8. Thoroughly clean and degrease the outside diameter of the main input shaft bearing (29), using triclorethylene or a similar degreasing solvent.
22. Fig 12. Fit the seal protector MF177 to the main input shaft.
23. Apply four drops of either 'Loctite Grade 'AV' (Red), or Casco Metalok LF5 to the outside diameter of the bearing (29), then press the bearing into the main input shaft until the bearing contacts the inner snap ring (27). Fit a new outer snap ring (30). Remove the seal protector.
24. Slide the input housing and shaft assembly into the transmission case, using a new gasket (21) and secure it with the four bolts (19).

NOTE – TO SEAL THE BOLT THREADS AND THE GASKET FACE, USE SEALING COMPOUND 'HYLOMAR SQ32M'.

25. Slide the p.t.o. driveshaft (65) into the layshaft from the rear, engaging the constant mesh gear (63).
26. Fig 6. Refit the p.t.o. driveshaft front bearing (60) *to its housing (61) and secure it with the* circlip (59).
27. Refit the housing (61) together with a new gasket (62) into the transmission case.
28. Fig 7. Pull the p.t.o. driveshaft (65) into its bearing (60) by using special tool MF218A and adapter MF218-2.
29. Fig 6. Secure the p.t.o. driveshaft with the thrust washer (58) and the circlip (57).
30. Using a new 'O' ring (56) refit the front cover plate (55).

NOTE – WHEN REFITTING THE COVER PLATE AND THE BOLTS (53) USE SEALING COMPOUND 'HYLOMAR COMPOUND SQ 32M' TO SEAL THE PLATE AND BOLT THREADS.

31. Refit the brake pedal and cross shaft assembly to the transmission case, from the right hand side.
32. Fig 5. Refit the lever and key to the brake cross shaft, then re-tighten the nut and bolt.
33. Refit the backplate (42) and the shims (41) to the dowels (40) on the ring gear (43), then locate the dowels in the holes in the transmission case. Fit the thrust washers (44 and 46) to the planetary pinion carrier (45) and locate the carrier in the ring gear. Refit the cover plate (47), as shown in Fig 4. Fit the four bolts (49) and tighten them progressively and evenly to a torque of 4,9 kg-m (35 lb-ft).

NOTE – OMIT LOCKWASHER FROM LOWER LEFT HAND BOLT

34. Fig 2. Fit the HIGH/LOW shift rail (6), sliding the HIGH/LOW shift selector (5), onto the rail and secure it to the rail with a locking peg (3). Wire lock the peg to the rail.
35. Locate the 1st/rev. and 2nd/3rd shift forks (10 and 13) to their respective grooves in the mainshaft gears. The two forks are identical.
36. Assemble the 1st/rev. and 2nd/3rd shift rails (11 and 14), with the interlock pin grooves facing each other, to the forks, and secure each fork with a locking peg (9 and 12). Wire lock the pegs to the rails. The shorter, 2nd/3rd shift rail (14) is fitted to the L.H. side.
37. Fig 3. Locate the HIGH/LOW shift fork (7), to the groove in the coupler (50). Assemble the coupler into the planet pinion carrier assembly (45), simultaneously sliding the fork (7), onto the HIGH/LOW shift rail (6).
38. Secure the HIGH/LOW shift fork (7), to its rail with the locking peg (8).
39. Wire lock the peg to the rail.
40. Fig 2. Fit the interlock pin (18), to the stop plate (15), and secure the stop plate with two bolts (17) and spring washers (16).
41. Fit the three plungers (2), pointed end downwards, and the three spings (1).
42. Refit the gearbox top cover and instrument panel assembly as stated in Part 3.

NOTE – BOTH GEAR LEVERS AND THE GEAR SELECTOR DOGS MUST BE PLACED IN NEUTRAL.

43. Reconnect the transmission to the centre housing, as stated in Part 3.
44. Refit the clutch release mechanism, as stated in operation 4A-03-05

GEAR SHIFT LEVER

(MF 135 tractor only)

Removal and Refitment 4D-09-14

1. Remove the steering box as stated in Part 6A.
2. Fig 18. Release the spring retaining seat (96) from the gear lever (90) and detach the seat (96) and spring (95).
3. Remove the gear lever rubber cover (91).
4. Unscrew the locking ring (93) securing the gear lever cup (94).
5. Drive out the pin (92) securing the gear lever (90) to the cup (94).
6. Lift out the gear lever (90).
7. Drive the cup (94) downwards out of the housing.
8. Refitment to a reversal of the removing procedure

HIGH/LOW SHIFT LEVER

(MF 135 tractor only)

Removal and Refitment 4D-10-14

1. Remove the steering box as stated in Part 6A.
2. Fig 18. Remove the rubber cover (100).
3. Unscrew the locking (98) securing the lever cup (97).
4. Turn the lever (101) and cup (97) until the pin (99), securing the lever to the cup, can be removed.
5. Lift out the lever (101).
6. Drive the cup (97) downwards out of the housing.
7. Refitment is a reversal of the removing procedure.

GEAR SHIFT LEVER

(MF 165 tractor only)

Removal and Refitment 4D-09-14

1. Remove the steering box as stated in Part 6A.
2. Fig 19. Remove the bolts securing the shift lever support and battery platform to the transmission housing. Lift the support and platform up off the transmission housing.
3. Release the spring retaining seat (107) from the lower end of the gear lever (102) and detach the seat and spring (106).
4. Remove the gear lever rubber cover (103) and spring (104) fitted under the cover.
5. Drive out the pin (105) securing the gear lever (102) to its housing.
6. Lift out the gear lever (102).
7. Refitment is a reversal of the removing procedure.

HIGH/LOW SHIFT LEVER

(MF 165 tractor only)

Removal and Refitment 4D-10-14

1. Fig 19. Remove the rubber cover (111) and spring (110) fitted under the cover.
2. Drive out the pin (109) securing the lever (112) to its housing.
3. Lift out the lever (112) and 'O' ring (108).
4. Refitment is a reversal of the removing procedure.

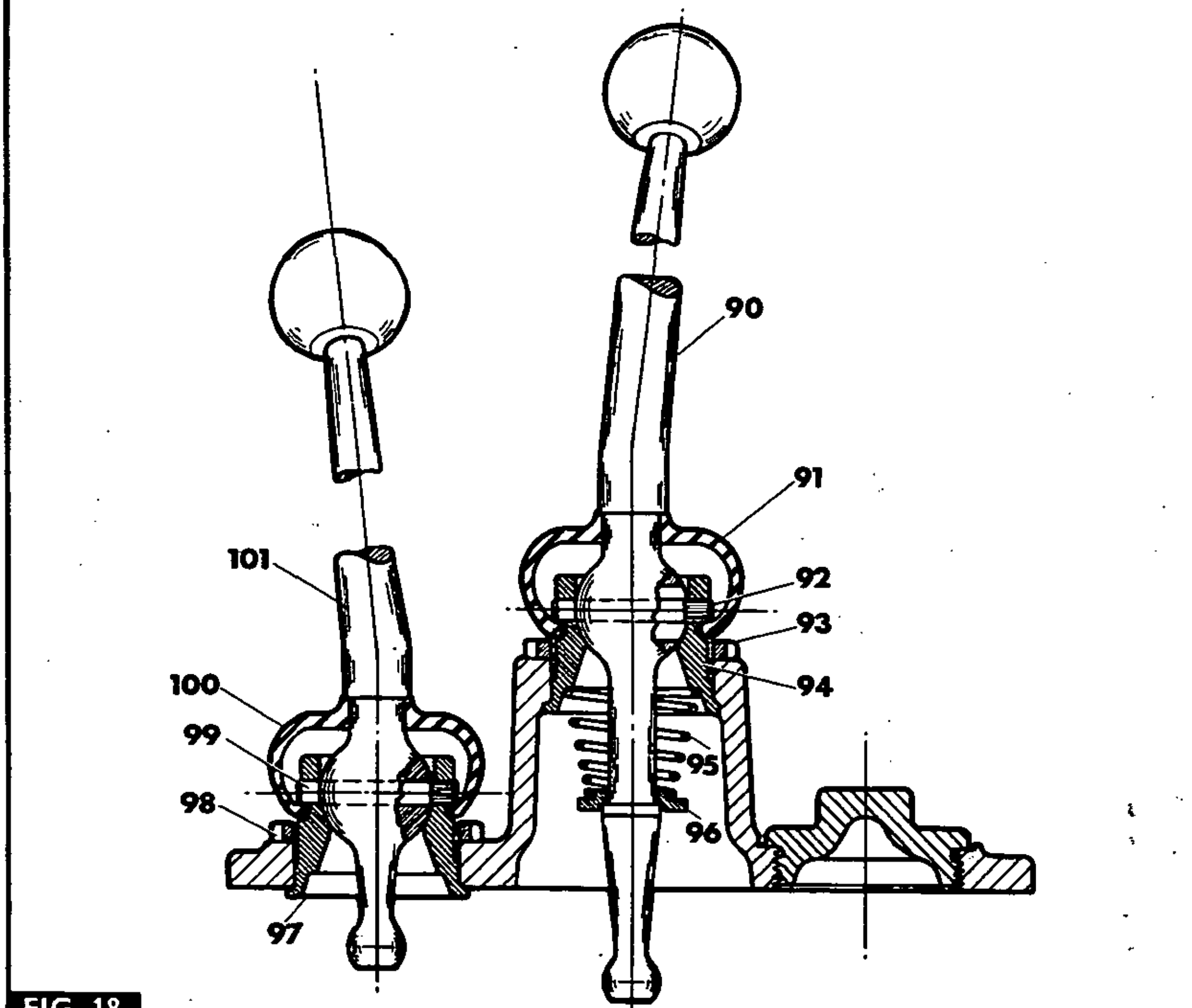
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FIG. 18

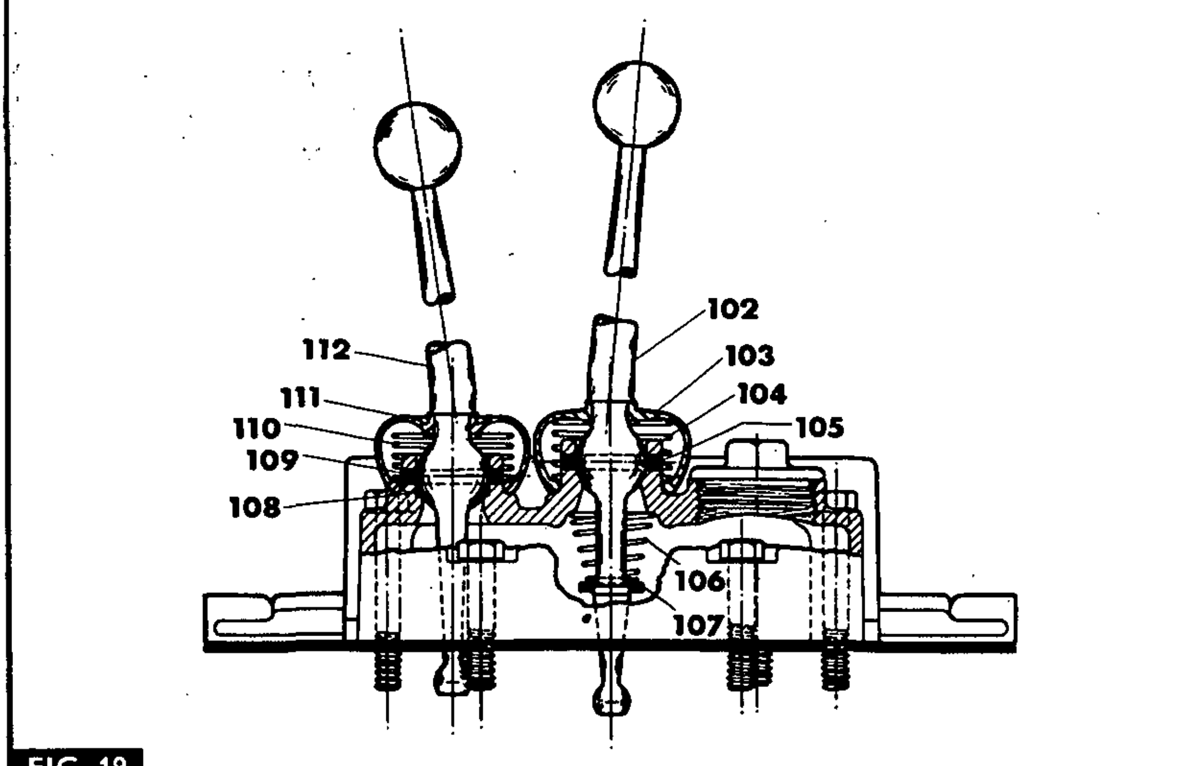
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FIG. 19

REAR AXLE AND BRAKES

Part 5 Section A

GENERAL

The drive from the transmission mainshaft is transmitted through the rear drive shaft and shear tube to a spiral bevel driving pinion and crown wheel, then through the axle shafts to the rear wheels.

The driving pinion is supported in the centre housing by a straight roller pilot bearing and a pre-loaded housing assembly carrying two tapered roller bearings.

The crown wheel is attached to the split differential case, which is supported each side by a tapered roller bearing. The differential pinions run on a cross joint and thrust is taken by thrust washers behind the pinions.

The axle shaft inner ends are splined into the differential gears, and the outer ends run on tapered roller bearings in the hubs. The hub bearings are retained by collars shrunk onto the axle shafts.

A differential lock is fitted to the R.H. axle housing. When the spring loaded pedal is depressed, a cam engages a coupler with a coupling cap on the differential case, and locks the differential.

This tractor is fitted with Girling double acting, floating cam type brakes which operate on the rear wheels only. They are internally expanding 356 mm x 51 mm (14 in x 2 in) drum brakes fitted with bonded linings in production but the shoes are drilled to receive riveted linings in service.

Each brake consists of a backplate on which is mounted the double anchor pin assembly securing one end of each shoe. The other end of each shoe fits into slots in the adjuster assembly and is held in position by a spring.

Between the shoe webs at the anchor pin end is the operating camshaft which is connected by linkage to the pedal. A shoe to anchor pin spring is connected between the anchor pin and shoe web of each shoe. The shoes are kept square in relation to the backplate by steady posts and shoe hold down pins. The backplate is secured to the rear axle housing and is enclosed within a drum which is fitted to the rear axle shaft assembly.

The brakes are operated by two independent brake pedals situated on the right hand side of the transmission case. Each pedal can be operated independently to assist turning during field work or locked together by means of the combining brake lock pivoting on the right hand pedal.

REAR WHEEL STUD

Removal and Replacement 5A-01-02

Removal

1. Jack up the tractor under the trumpet housing adjacent to the wheel being serviced.
2. Remove the rear wheel.
3. Remove the two screws (3) securing the brake drum (2) to the axle shaft (4) and remove the drum.
4. Drive out the stud (5) to be replaced, using a suitable drift and hammer.

Replacement

1. Fit a new stud to the hole in the axle and tap the stud gently to locate the splines.
2. Fit a new wheel nut, with the flat side against the axle, to the stud and pull the stud through the axle to its correct position. Remove the nut.
3. Refit the brake drum (2) and secure it with the two screws (3).
4. Refit the rear wheel and nuts, then torque the nuts progressively and evenly to 27,5 kg-m (200 lb-ft).
5. Adjust the brakes as stated in operation 5A-07-06.

AXLE SHAFT ASSEMBLY

Removal and Refitment 5A-02-02

Special Tools Required: MF 278 Dial Indicator

Removal

1. Jack up the tractor under the trumpet housing to be serviced.
2. Drain the transmission oil.
3. Remove the rear wheel.
4. Remove the two screws (3) securing the brake drum (2) to the axle shaft (4) and remove the drum.
5. Release the brake pull rods from the brake camshaft lever.
6. Remove the 12 nuts (11) and spring washers securing the hub (7) to the trumpet housing (12).
7. Withdraw the axle shaft (4), complete with shims (10), hub and bearing assembly (7) and brake assembly (1) from the trumpet housing, then remove the shims and the brake assembly from the shaft.

Refitment

1. Place the brake assembly (1) and more shims (10) than will be necessary on the axle shaft, then taking care not to damage the oil seal (9), place the axle shaft in the trumpet housing, simultaneously locating the brake camshaft, and secure with three of the nuts (11) and spring washers, equi-spaced and tightened to a torque of 7,0 kg-m (55 lb-ft).
2. Fig. 2. Check the axle shaft end float, using the dial indicator MF 278 as shown. Remove shims as necessary to give an end float of 0,05 to 0,2 mm (0.002 to 0.008 in).
3. Refit the remaining nuts (11) and spring washers and tighten to a torque of 7,0 kg-m (55 lb-ft)
4. Reconnect the brake pull rods to the brake camshaft lever.
5. Refit the brake drum (2) and secure it with the two screws (3).
6. Refit the rear wheel and nuts, then torque the nuts progressively and evenly to 27,5 kg-m (200 lb-ft).
7. Refill the transmission with a recommended oil to the correct level.
8. Adjust the brakes as stated in operation 5A-07-06.

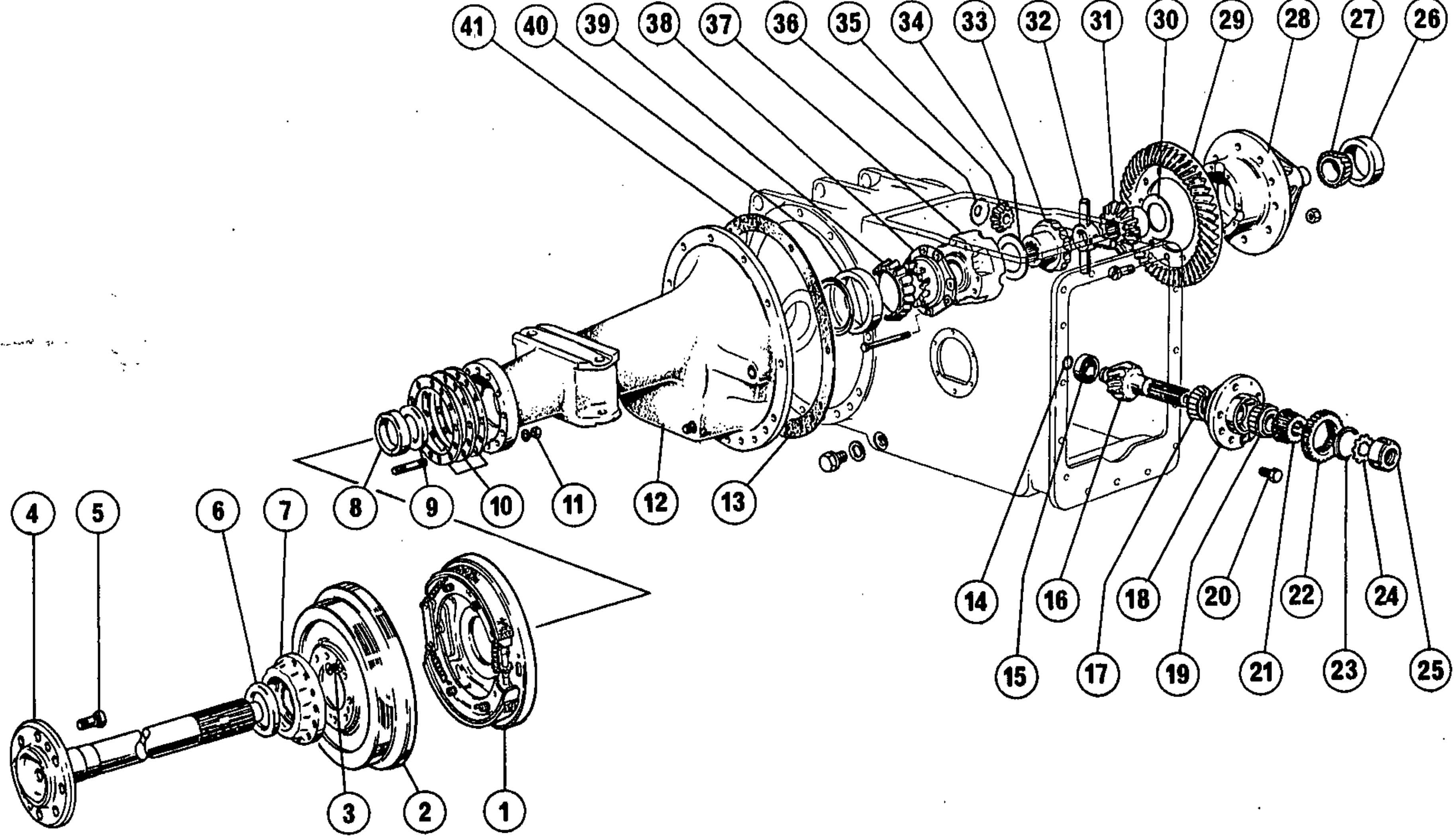
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FIG. 1

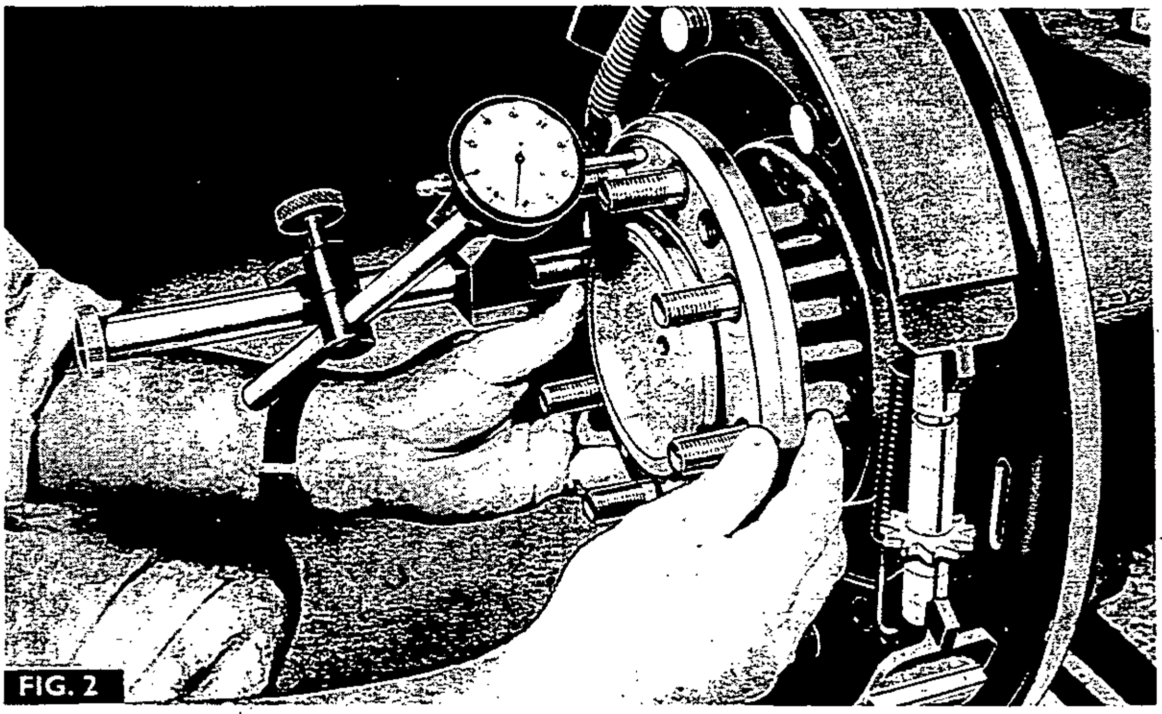

FIG. 2

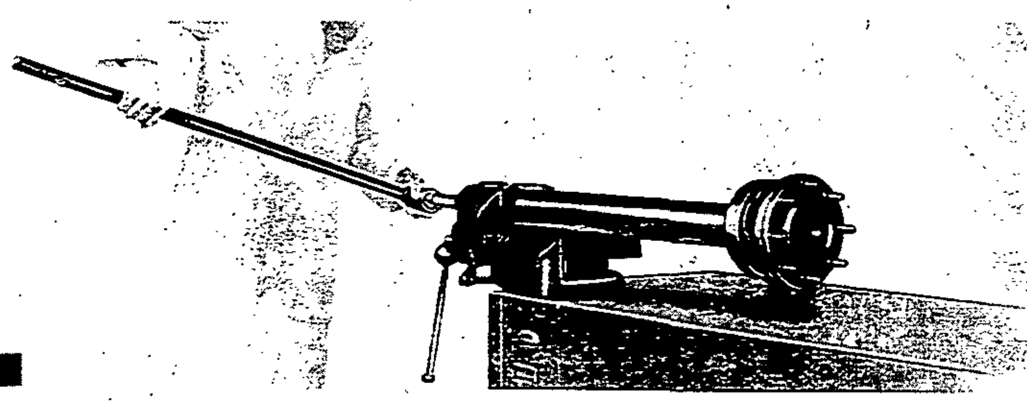

FIG. 3

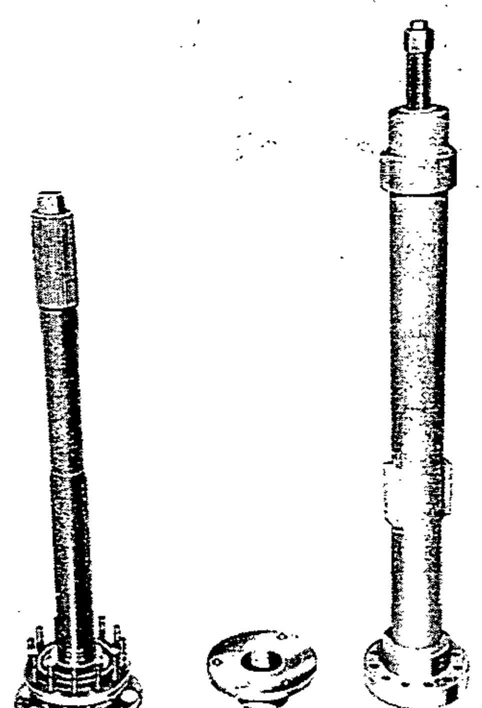

FIG. 4

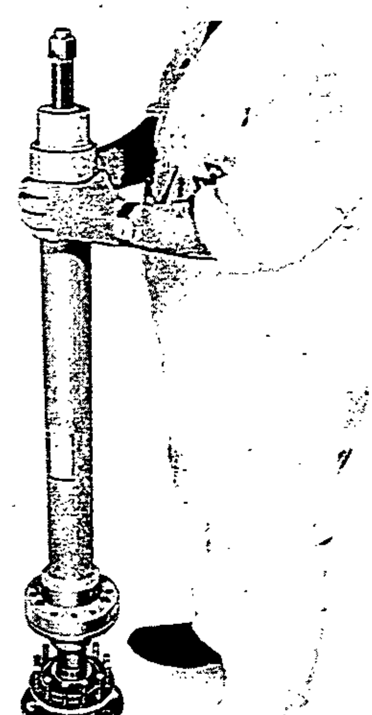

FIG. 5

AXLE SHAFT ASSEMBLY

Servicing 5A-03-05

Special Tools Required: MF 26A Wrench
MF 26B Bearing Remover
MF 26B-1 Adapter
MF 278 Dial Indicator

Disassembly

1. Remove the axle shaft assembly as stated in operation 5A-02-02
2. Drill into the side of the bearing retaining collar (8).
3. Fig. 3. Assemble the bearing remover tool MF 26B over the axle shaft and secure the tool to the hub studs. Using the MF 26A Wrench force the axle shaft out of the hub and bearing assembly (7) and collar (8) as shown.
4. Remove the special tools MF 26A and MF 26B, then remove the collar, hub and bearing assembly, and oil seal (6) from the axle shaft.

Reassembly

1. Figs. 4 and 5. Fit a new oil seal (6) to the hub and bearing assembly (7) and postion the hub and bearing assembly, new collar (8) and adapter MF 26B-1 onto the axle shaft, and then using the MF 26B tool as shown, drive the hub and bearing assembly and collar onto the axle shaft.
2. Refit the axle shaft assembly as stated in operation 5A-02-02.

BRAKE ASSEMBLY

Brake Shoes

Removal and Replacement 5A-04-05

Removal

1. Jack up the tractor.
2. Remove the rear wheel.
3. Fig. 6. Remove the two screws (3) securing the brake drum (2) to the axle shaft and remove the drum.
4. Release the brake pull rods from the brake camshaft lever.
5. Remove the brake shoes hold down springs (43) by gripping each pin (53) in turn with pliers and pressing and turning the dished washer (42) until released.
6. Remove the four sets of washers (42), springs (43), washers (44) and pins (53).
7. Force apart the brake shoes (47) at the adjuster end to allow the adjuster (59) to drop out of position, then remove the spring (60).
8. Remove the two springs (46), by levering, with a screwdriver, between the springs and the anchor pin plate (45).
9. Remove the plate (45), then lift off the two brake shoes (47) and the two spacer washers (49).

Replacement

1. Lightly smear both ends of the new brake shoes and the flat end of the camshaft with Girling White Brake Grease.
2. Refit the two spacer washers (49) to the anchor pins (60), then place the new brake shoes (47) into position over the pins (60).
3. Refit the anchor pin plate (45), then the two springs (46).

NOTE – TO FACILITATE THE FITMENT OF THE SPRINGS, USE A LENGTH OF WIRE LOOPED AROUND THE HOOK OF THE SPRING AND PULL THE SPRING OVER THE ANCHOR PIN.

4. Refit the spring (60), then pull the brake shoes apart and refit the adjuster (59).

NOTE – ENSURE THAT THE ADJUSTER IS FITTED WITH THE STAR WHEEL ADJACENT TO THE ADJUSTING HOLE IN THE BACK PLATE (51).

5. Refit the four pins (53), washers (44), springs (43), and dished washers (42), by gripping each pin (53) in turn with pliers and pressing and turning the dished washer (42) until secured.
6. Slacken the steady post nuts (57) and screw the steady posts (58) well back into the back plate (51).
7. Turn the adjuster (59) to the fully OFF position, then refit the drum (2) and secure it with the two screws (3).
8. Slacken the anchor pin nuts (52).
9. Using the adjuster, expand the brake shoes in the drum, then tap the anchor pin nuts (52), with a soft faced hammer, to ensure that the brake shoes are seated correctly.
10. Repeat the tightening and tapping procedure until the adjuster can not be tightened any more, then torque the anchor pin nuts (52) to 20 kg-m (150 lb-ft).
11. Remove the two screws (3) securing the brake drum to the axle shaft, then slacken off the brake shoes until the drum can be removed.
12. Screw in the steady posts (58) until they are in contact with the brake shoe webs, then secure the posts (58) with the nuts (57).
13. Refit the brake drum and secure it with the two screws (3).
14. Reconnect the brake pull rods to the brake camshaft lever.
15. Refit the rear wheel and nuts, then torque the nuts progressively and evenly to 27,5 kg-m (200 lb-ft).
16. Adjust the brakes as stated in operation 5A-07-06.

BRAKE ASSEMBLY

Brake Shoes Re-lining 5A-05-05

Special Tools Required: Brake Re-lining Equipment
or
Brake Riveting Anvil, Clamps and Punch.

It is permissible to reline brake shoes when genuine reconditioned shoes are not available, but it must be stressed that it is advisable to use factory reconditioned brake shoes where ever possible.

Disassembly

1. Remove the brake shoes as stated in operation 5A-04-05.
2. Place the brake shoes in an oven and heat to 700°C (1300°F) until the lining material turns white.
3. Remove the brake shoes from the oven and peel off the old lining.

NOTE – IF NO OVEN IS AVAILABLE PLACE THE BRAKE SHOES IN BOILING WATER UNTIL THE LINING CAN BE PEELED OFF.

4. Thoroughly clean the brake shoes, paying particular attention to the lining contact surface. Ensure that all the drillings are clear.

Reassembly

1. Offer up the lining to the brake shoe and align the holes.
2. Locate the lining to the brake shoes by inserting two rivets at the centre of the lining.
3. Place clamps in position and tighten securely.
4. Using brake riveting anvil and the appropriate punch or brake re-lining equipment, secure the centre rivets in position.
5. Working alternately from the centre of the brake shoe, move the clamps, insert rivets and secure in position.

NOTE – THE GAP BETWEEN THE BRAKE SHOE AND THE LINING MUST NOT EXCEED 0,1 mm (0.004 in).

6. Refit the brake shoes as stated in operation 5A-04-05.

BRAKE ASSEMBLY

Servicing 5A-06-06

Special Tools Required: MF 278 Dial Indicator

Disassembly

1. Remove the brake shoes as stated in operation 5A-04-05.
2. Fig. 6. Remove the steady posts (58) and nuts (57).
3. Remove the anchor pins (50), spring washers and nuts (52).
4. Release the wiring cable and clips from the camshaft.
5. Remove the setscrew securing the brake lever to the camshaft (48) and remove the camshaft, spring (54) and washer (55) from the back plate (51).
6. Fig. 1. Remove the 12 nuts (11) and spring washers securing the hub (7) to the trumpet housing.
7. Withdraw the axle shaft (4) complete with shims (10), hub and bearing assembly (7) and the back plate (51) from the trumpet housing, then remove the shims and back plate.

Examination

Check all components for signs of wear or damage and replace if necessary.

Reassembly

1. Place the back plate and more shims (10) than will be necessary on the axle shaft, then taking care not to damage the oil seal (9) place the axle shaft in the trumpet housing and secure with three of the nuts (11) and spring washers, equi-spaced and tightened to a torque of 7,0 kg-m (55 lb-ft).
2. Fig. 2. Check the axle shaft end float, using the dial indicator MF 278 as shown. Remove shims as necessary to give an end float of 0,05 to 0,2 mm (0.002 to 0.008 in).
3. Refit the remaining nuts (11) and spring washers and tighten to a torque of 7,0 kg-m (55 lb-ft).
4. Fig. 6. Place the camshaft (48) through the back plate (51) and refit the washer (55) and spring (54), then refit the brake lever, with a new key, and secure it to the camshaft with a new setscrew.
5. Locate the camshaft in the trumpet housing and drive the spring (54), until it is half compressed, against the back plate to load the camshaft.
6. Refit the wiring cable and clips onto the camshaft.
7. Refit the anchor pins (50), spring washers and nuts (52), but do not fully tighten the nuts at this stage.
8. Refit the steady posts (58) and nuts (57), but do not fully tighten the steady posts or nuts at this stage.
9. Refit the brake shoes as stated in operation 5A-04-05.

BRAKE ADJUSTMENT AND BALANCING

5A-07-06.

Procedure is as follows:

1. Jack up the tractor until both rear wheels are clear of the ground.
2. Ensure that all shafts and pins work freely and that the brake pedals and parking brake are against their stops when the brakes are OFF.
3. Figs 7A and 7B. Move the cover plate (56) to one side and lever the star wheel adjuster (59) clockwise until the wheel is locked. Tap the drum lightly with a soft faced hammer and again attempt to tighten the brake shoes.
4. Slacken off the adjuster (59) six to eight clicks and check that the wheel is free to rotate.
5. Remove the jack, then road test the tractor, with the pedals locked together, checking for binding or pulling to one side. Any tendency to pull to one side should be counteracted by slackening off the adjuster on the side which the pulling takes place.

TRUMPET HOUSING

Removal and Refitment 5A-08-06

Special Tools Required: 270 Rail Trolley

Removal

1. Drain the transmission oil.
2. Fig. 8. Remove the two bolts (61) securing the lower link adapter bracket (62) to the swinging drawbar, then remove the split pin, nut (63) and washer securing the bracket (62) to the trumpet housing pin, and release the bracket.
3. Jack up the tractor under the trumpet housing being serviced.
4. Remove the rear wheel.
5. Support the tractor on the 270 rail trolley.
6. Release the brake pull rods from the brake camshaft lever.
7. Remove the three nuts, bolts and spring washers securing the fender to the footplate.
8. Release the fender light wiring from the camshaft and at the fender.
9. Place a trolley jack under the centre of the trumpet housing being serviced, just supporting the housing.
10. Remove all of the nuts and bolts securing the trumpet housing to the centre housing.
11. Withdraw the trumpet housing on the trolley jack, complete with the fender.

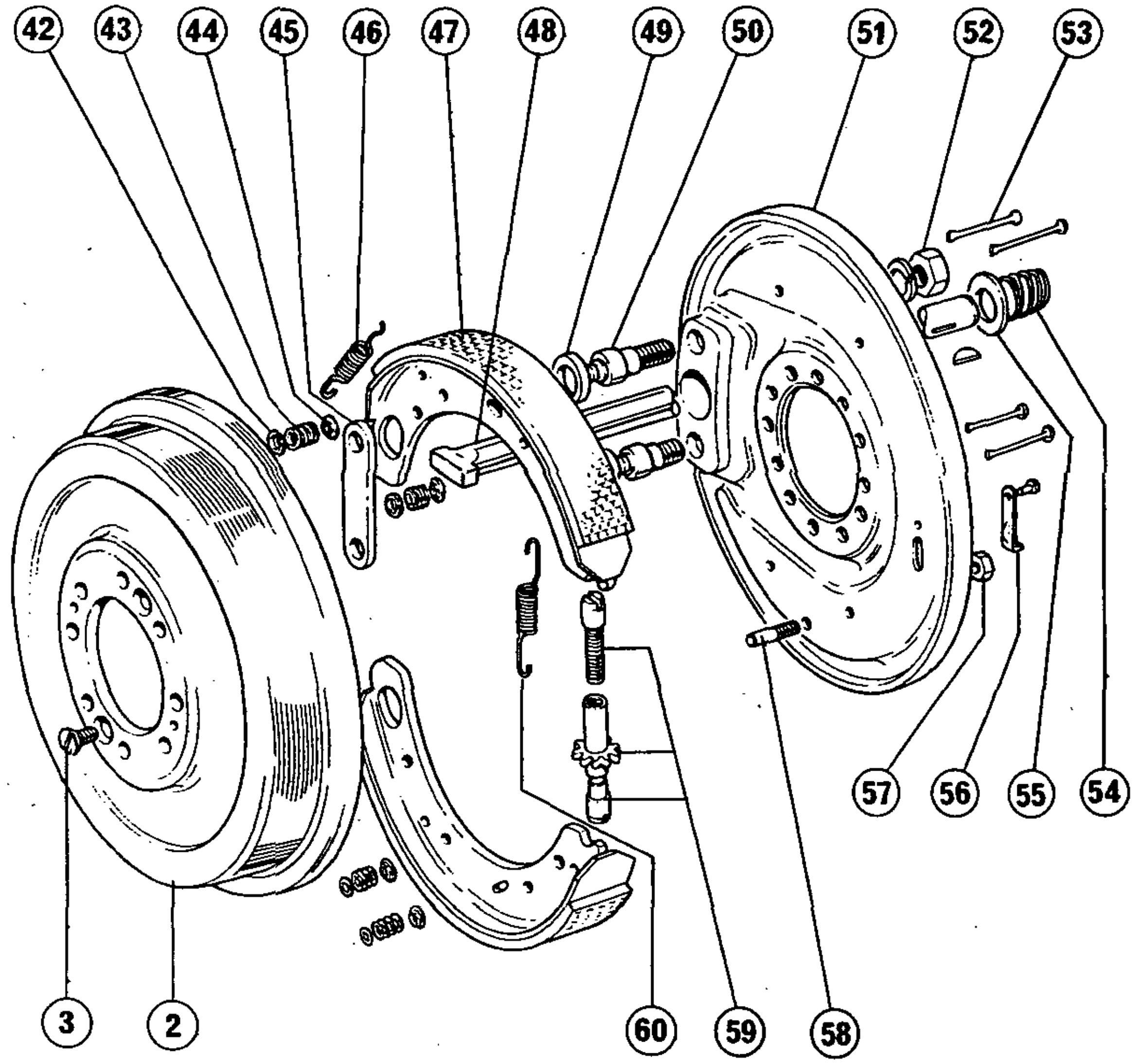

FIG. 6

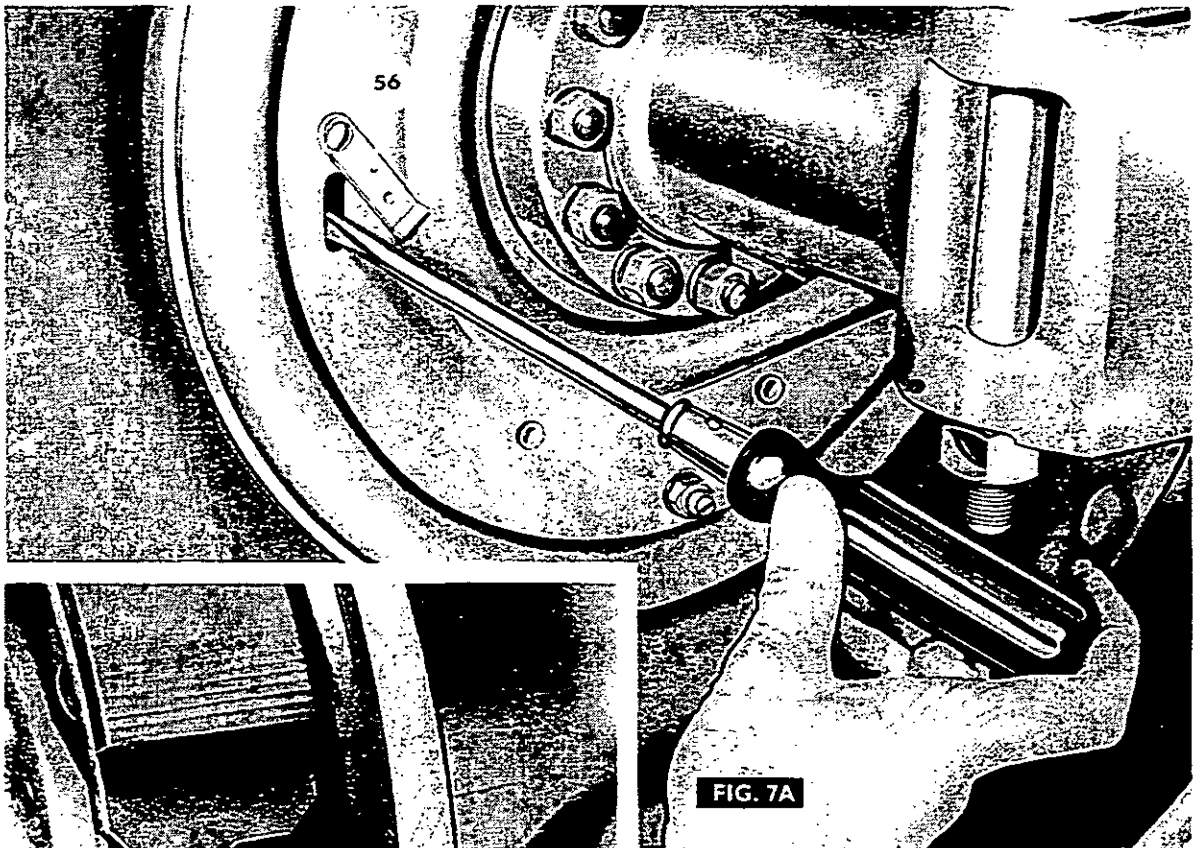

FIG. 7A

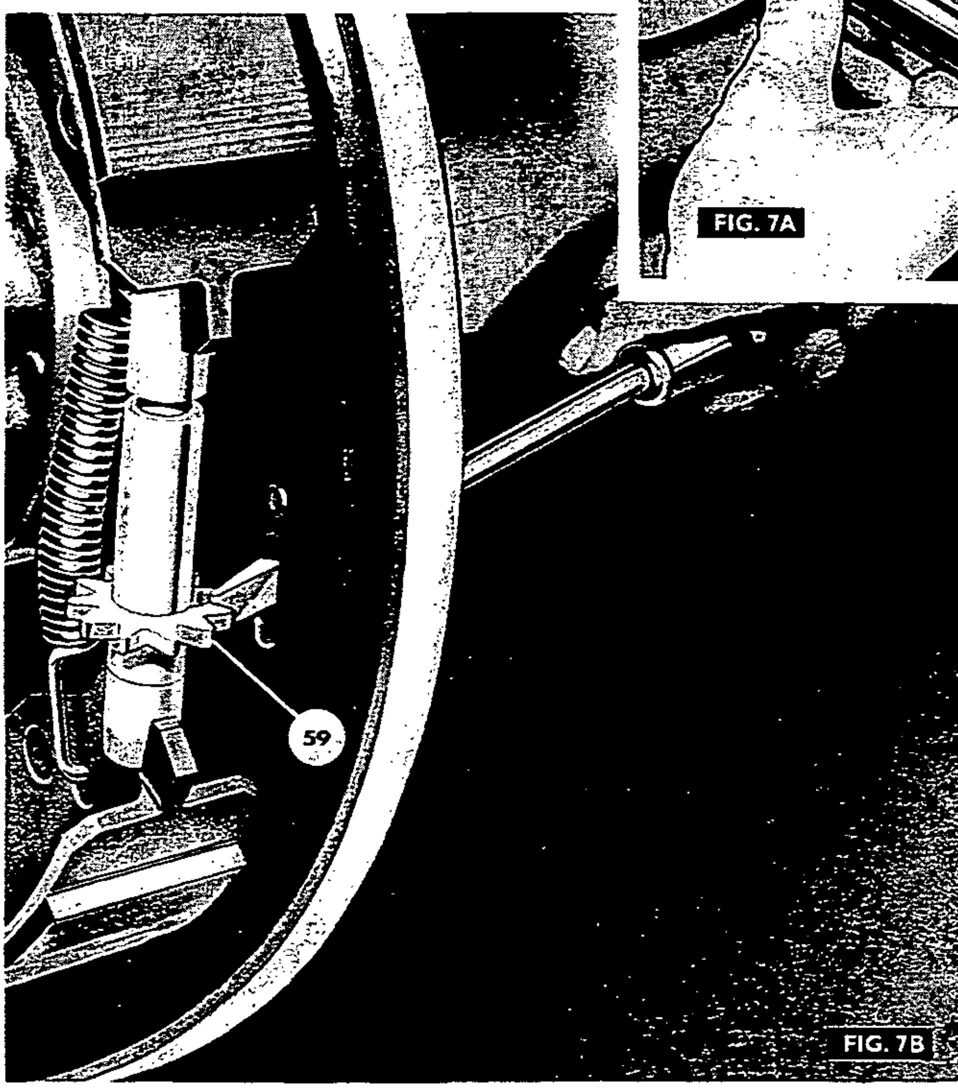

FIG. 7B

NOTE – WHEN REMOVING THE L.H. TRUMPET HOUSING THE DIFFERENTIAL UNIT MUST BE SUPPORTED.

12. Remove the gasket (13) from the centre housing or trumpet housing.

Refitment

1. Fit a new gasket (13) to the centre housing using petroleum jelly.
2. Supporting the trumpet housing and fender on the trolley jack, manoeuvre the trumpet housing into position, locating the axle shaft splines in the differential unit and the studs through their holes in the trumpet housing.
3. Refit the nuts and bolts securing the trumpet housing to the centre housing.

NOTE – WHEN REFITTING THE R.H. TRUMPET HOUSING DO NOT FORGET TO REFIT THE DIFFERENTIAL LOCK RETURN SPRING AND ATTACHMENT PLATE.

4. Remove the 270 rail trolley.
5. Refit the three bolts, nuts and spring washers securing the fender to the footplate.
6. Refit the wiring to the brake camshaft and the fender.
7. Reconnect the brake pull rods to the brake camshaft lever.
8. Refit the rear wheel and nuts, then torque the nuts progressively and evenly to 27,5 kg-m (200 lb-ft).
9. Remove the trolley jack.
10. Fig. 8. Refit the lower link adapter bracket (62) to the trumpet housing pin, and secure with the washer, nuts (63) and a new split pin, then refit the two bolts (61) securing the bracket to the swinging drawbar.
11. Refill the transmission with a recommended oil.

LOWER LINK ADAPTER BRACKET PIN

Removal and Replacement 5A-09-09

Special Tools Required: 270 Rail Trolley

Removal

1. Remove the trumpet housing as stated in operation 5A-08-06.
2. Remove the nut and washer securing the pin and remove the pin.

Replacement

1. Place a new pin in the trumpet housing and refit the washer and nut.
2. Tighten the nut to a torque of 16,5 kg-m (120 lb-ft).
3. Refit the trumpet housing as stated in operation 5A-08-06.

DIFFERENTIAL LOCK MECHANISM

Removal and Refitment 5A-10-09

Special Tools Required: 270 Rail Trolley
MF 259A Bush and Oil Seal Remover/Replacer.

Removal

1. Remove the R.H. trumpet housing as stated in operation 5A-08-06.
2. Fig. 9. Remove the bolt (64), nut and spring washer securing the arm (65) to the actuating shaft (67).
3. Fig. 10. Withdraw the cam (71) and shaft (67) as shown.
4. Remove the two bolts (72) securing the shifter fork (68) to the trumpet housing.
5. Manoeuvre the shifter fork, with the two guide shoes (70) out of the trumpet housing.
6. Slide the coupler (69) off the axle shaft splines.
7. Remove the seal (73) from the trumpet housing.

Refitment

1. Fig. 11. Fit a new oil seal (73) into the trumpet housing using tool MF 259A as shown.
2. Clean and degrease the threads of the shifter fork securing bolts (72) and their locating holes in the trumpet housing.
3. Fig. 10. Slide the coupler (69) on to the axle shaft splines, with the teeth facing outwards as shown.
4. Position the shifter fork (68) together with the two guide shoes (70) in the trumpet housing, making sure the guide shoes locate properly on the coupler.
5. Apply a small quantity of either Loctite grade A.V. or Casco LF5 to the threads of the bolts (72) and secure the shifter fork to the trumpet housing, then torque the bolts to 5,5 kg-m (40 lb-ft).
6. Fig. 10. Taking care not to damage the oil seal, slide the cam (71) and shaft (67) into the trumpet housing simultaneously refitting the arm (65) to the shaft (67), and locating the dowel on the shifter fork (68) in the cam (71).
7. Fig. 9. Secure the arm (65) to the shaft (67) with the bolt (64), spring washer and nut.
8. Refit the R.H. trumpet housing as stated in operation 5A-08-06.
9. Adjust the differential lock pedal as stated in operation 5A-12-10.

DIFFERENTIAL LOCK SHAFT BUSH

Removal and Replacement 5A-11-09

Special Tools Required: 270 Rail Trolley
MF 259A Bush and Oil Seal Remover/Replacer
MF 278 Dial Indicator.

Removal

1. Remove the differential lock mechanism as stated in operation 5A-10-09.
2. Fig. 1. Remove the 12 nuts (11) and spring washers securing the hub (7) to the trumpet housing. (12).
3. Withdraw the axle shaft (4), complete with shims (10), hub and bearing assembly (7) and brake assembly (1) from the trumpet housing.
4. Fig. 12. Using tool MF 259A, cut a thread into the bush (74), then drive out the tool and bush as shown.

Replacement
1. Fig. 13. Fit a new bush, using tool MF 259A as shown.
2. Place the axle shaft, brake assembly and more shims than will be necessary in the trumpet housing, simultaneously locating the brake camshaft, and secure with three of the nuts (11) and spring washers, equi-spaced and tightened to a torque of 7,0 kg-m (55 lb-ft).
3. Replace the differential lock mechanism as stated in operation 5A-10-09, but do not refit the wheel at this point.
4. Remove the two screws (3) securing the brake drum (2) to the axle shaft (4) and remove the drum.
5. Fig. 2. Check the axle end float, using the dial indicator MF 278 as shown. Remove shims as necessary to give an end float of 0,05 to 0,2 mm (0.002 to 0.008 in).
6. Refit the brake drum and secure with the two screws (3).
7. Refit the rear wheels and nuts, then torque the nuts progressively and evenly to 27,5 kg-m (200 lb-ft).
8. Remove the jack.
9. Fig. 8. Refit the lower link adapter bracket (62) to the trumpet housing pin, and secure with the washer, nut (63), and a new split pin, then refit the two bolts (61), securing the bracket to the swinging drawbar.
10. Refill the transmission with a recommended oil.
11. Adjust the brakes as stated in operation 5A-07-06.
12. Adjust the differential lock as stated in operation 5A-12-10.

DIFFERENTIAL LOCK ADJUSTMENT 5A-12-10

Procedure is as follows:
1. Engage the differential lock.
2. Fig. 14. Slacken the nut (A) and adjust the pedal so that the clearance between the pedal and footplate is 6,5 to 12,5 mm (¼ to ½ in).
3. Tighten the nut to a torque of 11,7 kg-m (85 lb-ft) and check the clearance.

DIFFERENTIAL LOCK COUPLER CAP

Removal and Replacement 5A-13-10
Special Tools Required: 555 Universal Puller
MF 555-2A/1 Puller Adapter.
MF 257 Bearing Driver.

Removal
1. Remove the R.H. trumpet housing as stated in operation 5A-08-06.
2. Fig. 15. Fit puller 555 and adapter MF 555-2A/1 to the differential bearing cone (39) then pull off the case.
3. Remove the eight bolts securing the cap (38) to the differential case (37) then carefully prise the cap off the case, taking care not to release the case which will allow the differential components to fall out of the case.

Refitment
1. Fit the new differential coupler cap (38) in place then refit the eight bolts loosely.
2. Progressively and evenly tighten the bolts, using diagonal selection to a final torque of 11,5 kg-m (80 lb-ft).
3. Drive the bearing cone (39) on to the coupler cap using special tool MF 257.
4. Refit the trumpet housing as stated in operation 5A-08-06.

DIFFERENTIAL

Pre-Load Checking and Adjustment 5A-14-10
Special Tools Required: 270 Rail Trolley
MF 254D Pre-Load Gauge
MF 254D-1 Straight Edge
MF 1105 Bearing Remover/Replacer
MF 1105-7A/1 and 2 Adapters.
550 Driver Handle
MF 278 Dial Indicator.

NOTE – THIS CHECK MUST BE CARRIED OUT WHENEVER THE DIFFERENTIAL UNIT IS DISASSEMBLED, OR IF THE BEARINGS HAVE BEEN REPLACED.

Procedure is as follows:
1. Remove the R.H. trumpet housing as stated in operation 5A-08-06.
2. Remove the axle shaft assembly as stated in operation 5A-02-02.
3. Remove the differential lock mechanism as stated in operation 5A-10-09.
4. Remove the bearing cup (40) from the trumpet housing using special tool MF 1105 and adapters MF 1105-7A/1 and MF 1105-7A/2, then remove the chip shield (41).
5. Fig. 16. Screw the two setting blocks (A) on to two centre housing studs as shown. Remove one stud from an adjacent location to permit fitment of the upper block.
6. Remove another stud from the centre housing and refit it in the tapped hole adjacent to the long pin.
7. Place the bearing cup on the bearing cone, fit the centralisers (B) and then place the clamp bar (C) in position, securing it with the two tube nuts (D).
8. Torque the clamp bar nut (E) to 2,7 kg-m (20 lb-ft) turning the differential unit, by use of a lever, but keeping the bearing cup and cone stationary, to fully centralise the end seat of both bearings.
9. Fig. 17. Place the straight edge in position as shown, then measure the gap between the straight edge and the end of the centraliser pin, using feeler gauges to determine the thickness of chip shield required. The gap measured, directly indicates the required shield which should be selected from the table shown below:

FEELER GAP (Equals Shield Thickness)		MEANS OF IDENTIFICATION	PART No.
mm	ins		
0,74 to 0,79	0.29 to 0.31	No Dots	187 689 M1
0,86 to 0,91	0.34 to 0.36	One Dot	892 173 M1
0,99 to 1,04	0.39 to 0.41	Two Dots	892 172 M1
1,12 to 1,17	0.44 to 0.46	Three Dots	892 171 M1
1,25 to 1,30	0.49 to 0.51	Four Dots	892 170 M1
1,37 to 1,42	0.54 to 0.56	No Dots	191 124 M1

10. Remove the tube nuts (D), clamp bar (C), centraliser (B) and the setting blocks (A), then refit the two studs to their original holes.
11. Place the new chip shield (41) in the trumpet housing, with the 'dished' face towards the differential, then refit the bearing cup (40) using tool MF 1105-7A/1 and the 550 handle.
12. Refit the differential lock mechanism as stated in operation 5A-10-09.
13. Refit the trumpet housing as stated in operation 5A-08-06.
14. Refit the axle shaft assembly as stated in operation 5A-02-02.

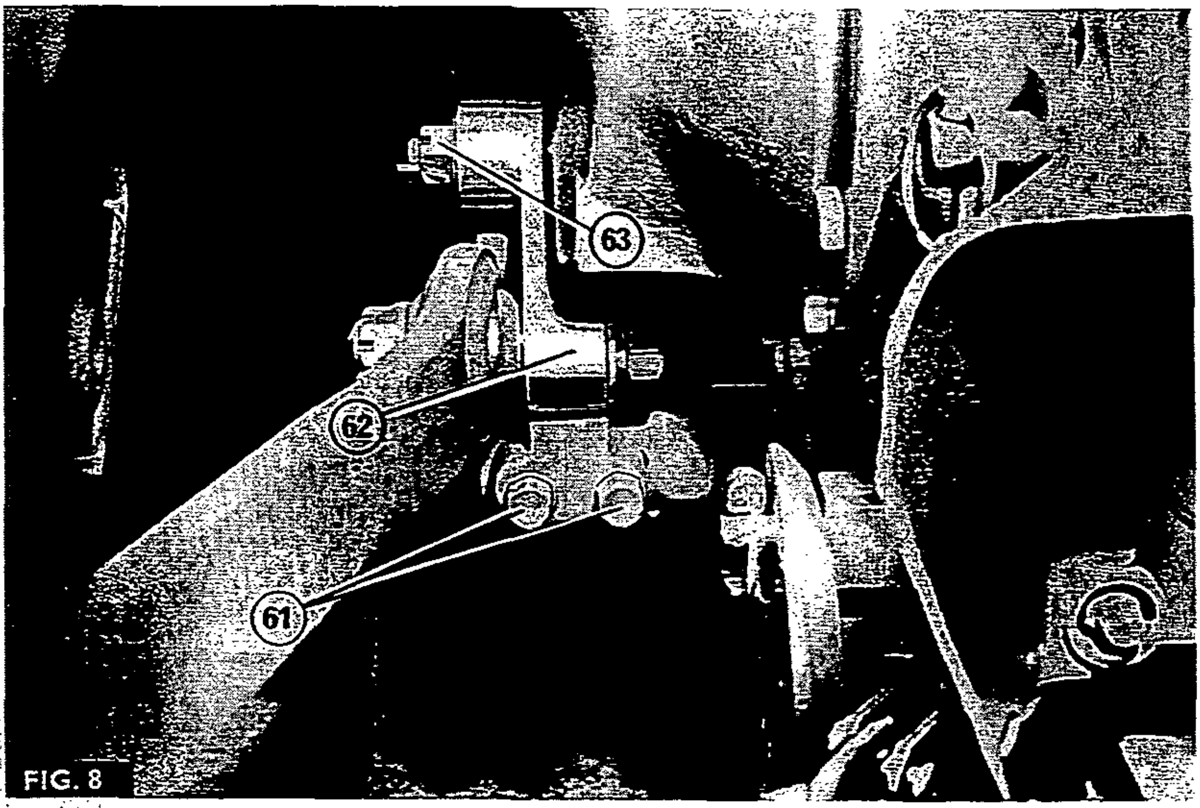

FIG. 8

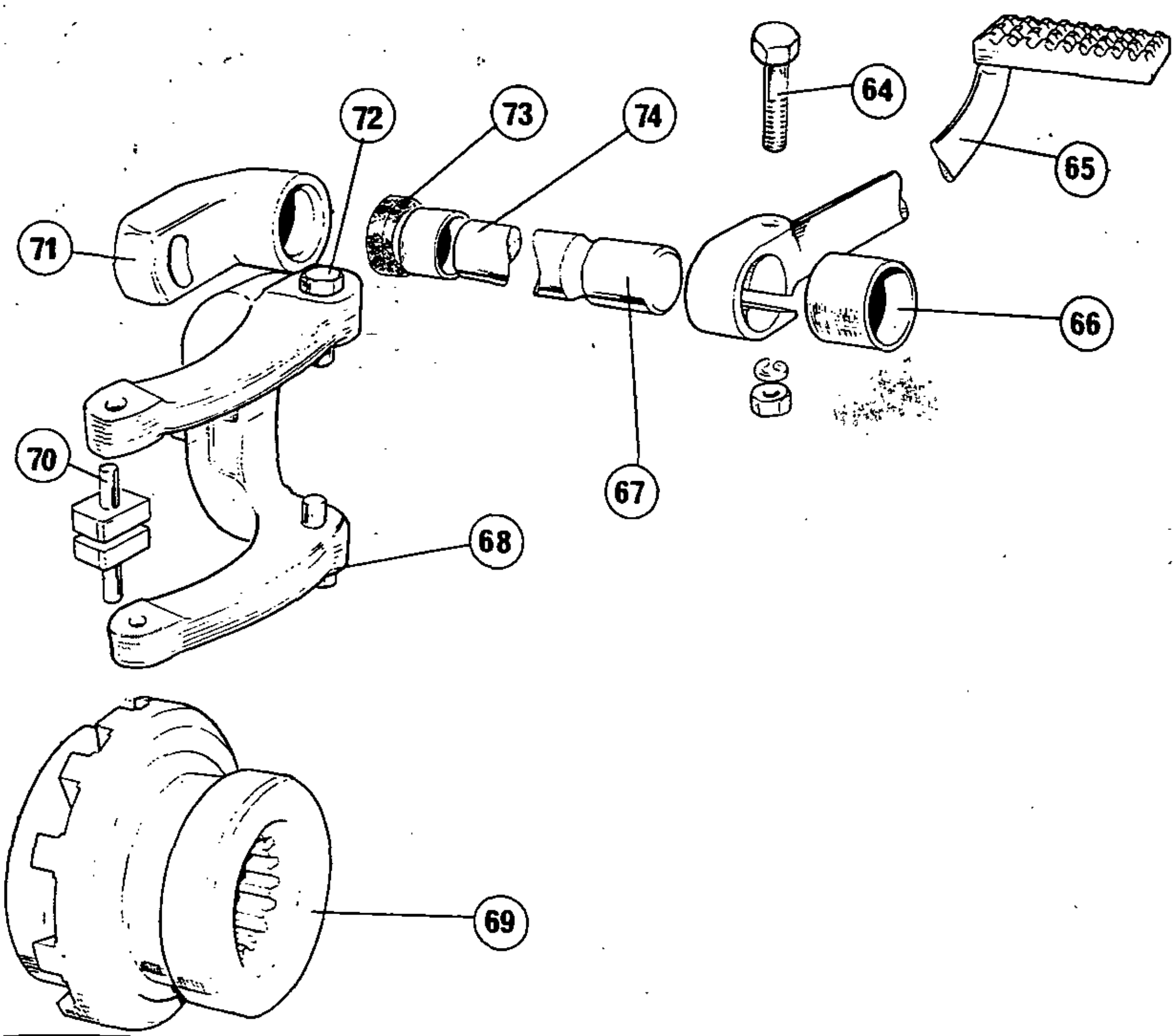

FIG. 9

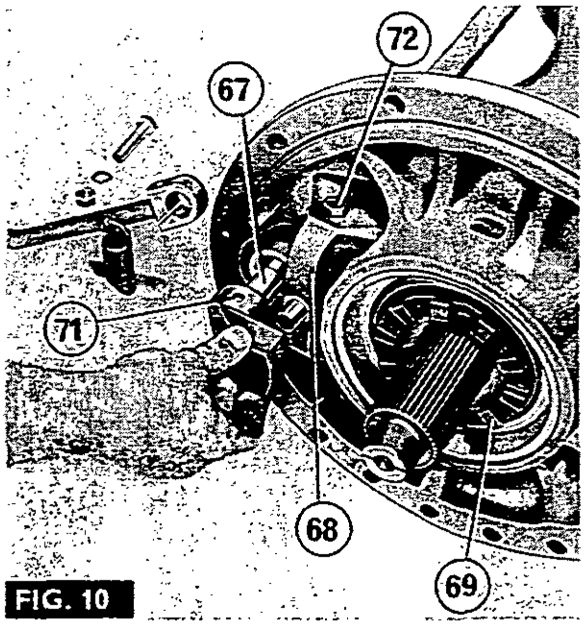

FIG. 10

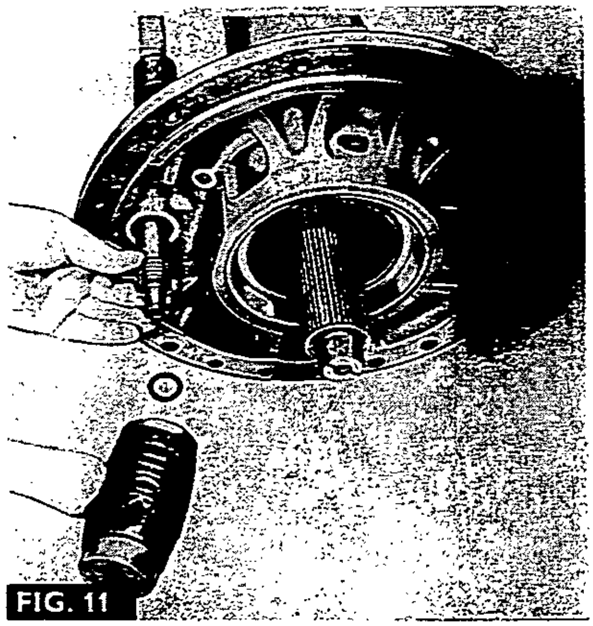

FIG. 11

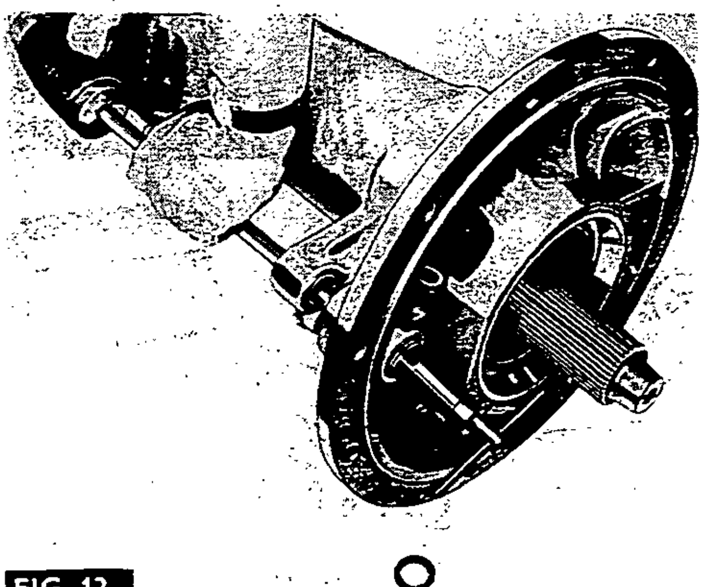

FIG. 12

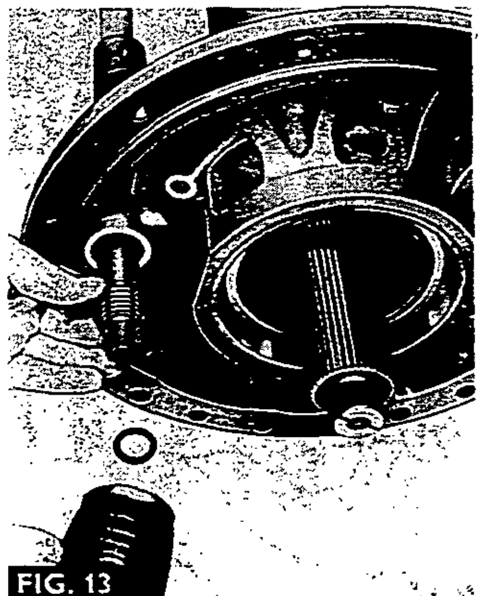

FIG. 13

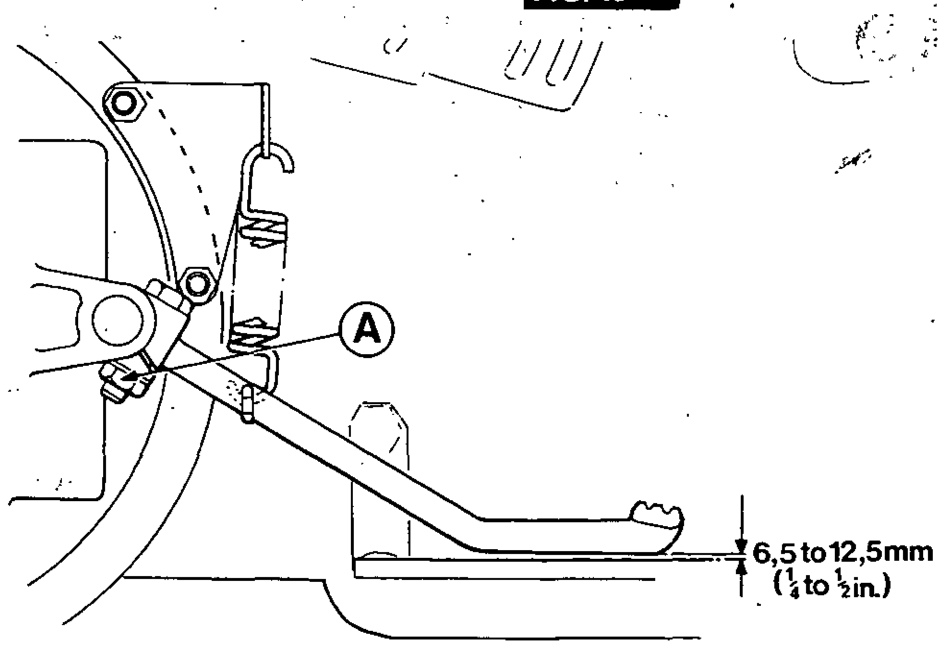

FIG. 14

FIG. 15

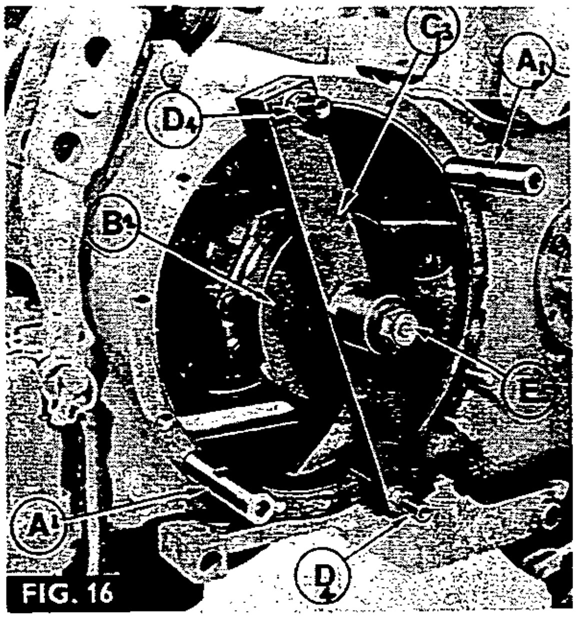

FIG. 16

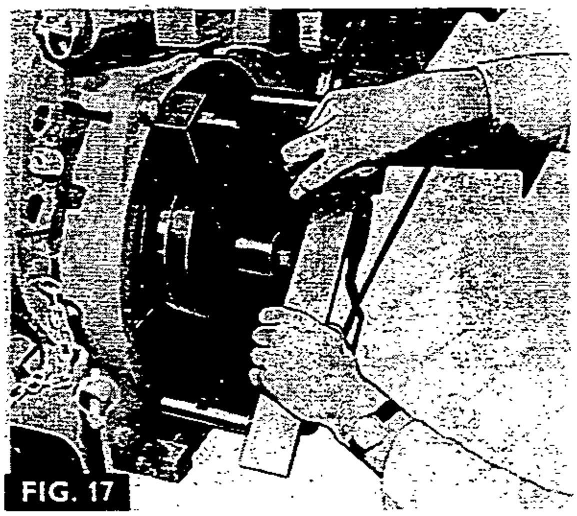

FIG. 17

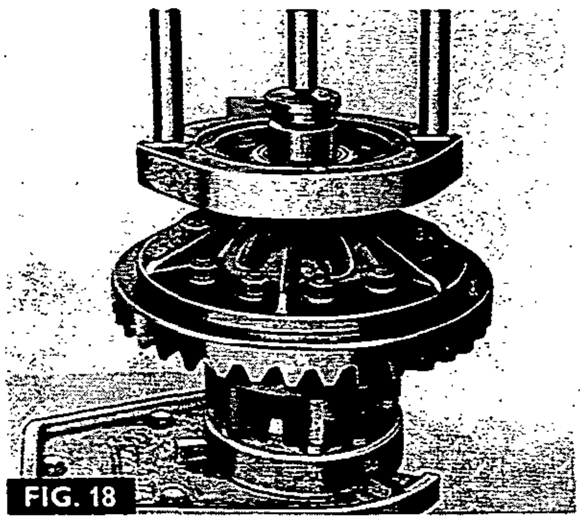

FIG. 18

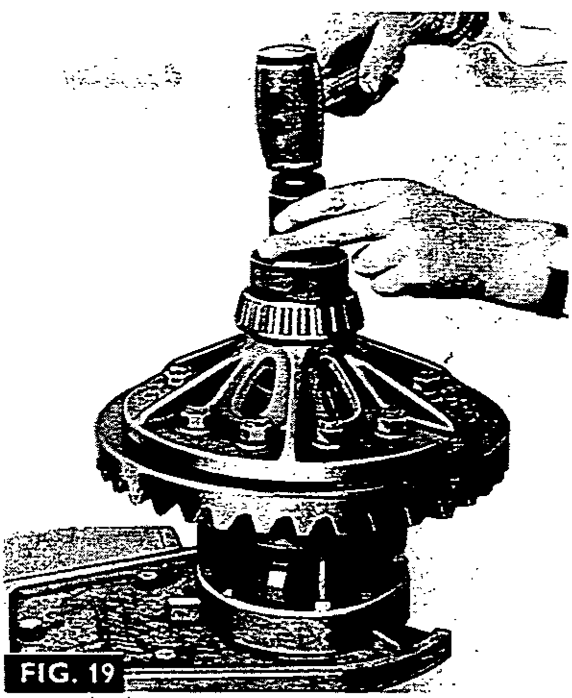

FIG. 19

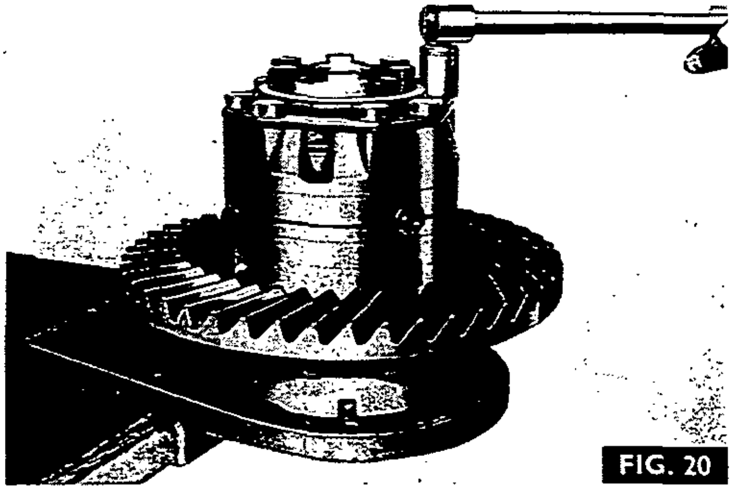

FIG. 20

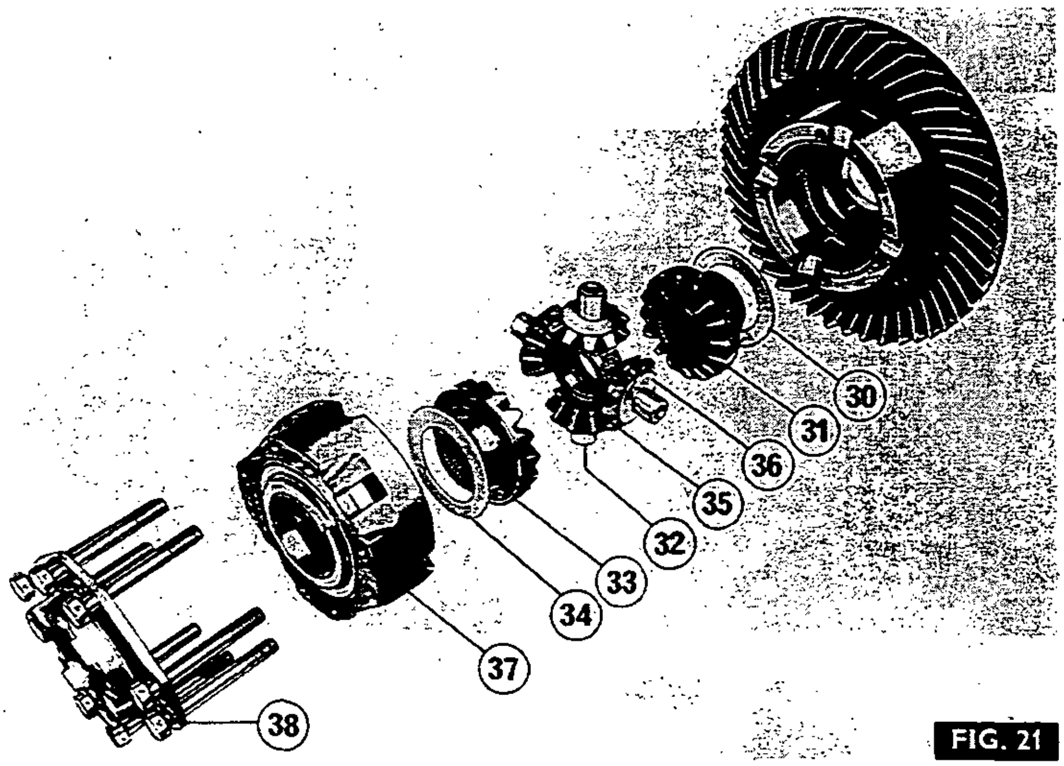

FIG. 21

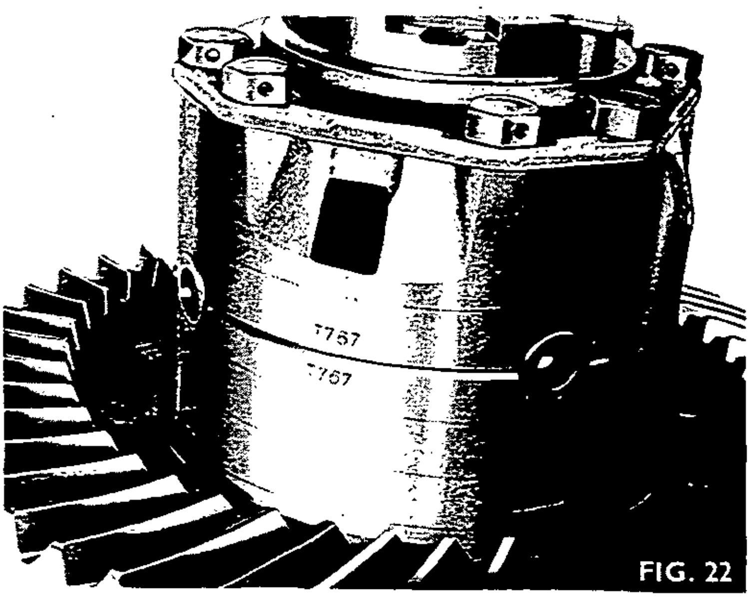

FIG. 22

R.H. DIFFERENTIAL

Bearing Removal and Replacement 5A-15-15

Special Tools Required: See operation 5A-14-10 and
555 Universal Puller
MF 555-2A/1 Puller Adapter
MF 257 Bearing Driver.

Removal

1. Remove the R.H. trumpet housing as stated in operation 5A-08-06.
2. Fig. 15. Fit puller 555 and adapter MF 555-2A/1 to the differential as shown, then pull off the bearing cone (39).
3. Remove the axle shaft assembly as stated in operation 5A-02-02.
4. Remove the differential lock mechanism as stated in operation 5A-10-09.
5. Remove the bearing cup (40) from the trumpet housing using tool MF 1105 and adapters MF 1105-7A/1 and MF 1105-7A/2, then remove the chip shield.

Replacement

1. Drive a new bearing cone (39) on to the differential lock cap (38) using tool MF 257.
2. Check the bearing pre-load as stated in items 5 to 14 of operation 5A-14-10.

DIFFERENTIAL UNIT

Removal and Refitment 5A-16-15

Special Tools Required: 270 Rail Trolley

Removal

1. Remove the L.H. trumpet housing as stated in operation 5A-08-06
2. Insert a suitable bar into the differential case assembly, then manoeuvre the differential assembly out of the centre housing.

Warning

The differential unit is heavy and awkward to handle. Take care when both removing and refitting.

Refitment

1. Manoeuvre the differential assembly back into the centre housing, engaging the splines of the differential unit in those of the R.H. axle shaft.
2. Refit the L.H. trumpet housing as stated in operation 5A-08-06.
3. If for any reason, any of the components of the differential unit have been replaced, check the differential pre-load, as stated in operation 5A-14-10.

L.H. DIFFERENTIAL BEARING

Removal and Replacement 5A-17-15

Special Tools Required: See operation 5A-14-10 and
MF 200 Hand Press
MF 200-22 Adapter
MF 10 Bench Adapter
MF 258 Holder
MF 257 Bearing Driver
MF 1105-2A Adapter

Removal

1. Remove the differential assembly as stated in operation 5A-16-15.
2. Fig. 18. Fit the bench adapter MF 10 to the bench, then fit the holder MF 258 to the bench adapter.
3. Place the differential on the adapter, then assemble the hand press MF 200 with the MF 200-22 adapter as shown, then pull off the bearing cone (27).
4. Remove the axle shaft assembly as stated in operation 5A-02-02.
5. Remove the bearing cup (26) from the trumpet housing, using puller MF 1105 and adapter MF 1105-2A.

Replacement

1. Fig. 19. Drive the new bearing cone (27) on to the differential using tool MF 257 as shown.
2. Fit the new bearing cup (26) in the trumpet housing using a suitable punch and hammer.
3. Refit the differential assembly as stated in operation 5A-16-15.
4. Refit the axle shaft assembly as stated in operation 5A-02-02.
5. Check the differential pre-load as stated in operation 5A-14-10.

DIFFERENTIAL UNIT

Servicing 5A-18-15

Special Tools Required: See operation 5A-14-10 and
MF 10 Bench Adapter
MF 258 Holder
MF 257 Bearing Driver
555 Universal Puller
MF 555-2A/1 Adapter

Disassembly

1. Remove the differential unit, as stated in operation 5A-16-15.
2. Fit puller 555 and adapter MF 555-2A/1 to the differential bearing cone (39) then pull off the cone.
3. Fit the bench adapter MF 10 to the bench, then fit the holder MF 258 to the bench adapter.
4. Fig. 20. Place the differential on the adapter as shown, then remove the eight bolts securing the R.H. case (37) and the differential lock coupler cap (38).
5. Remove the coupler cap from the R.H. case, and remove the case.
6. Fig. 21. Lift out the R.H. differential gear (33) with its thrust washer (34), cross joint (32) and gears (35) with their thrust washers (36), then finally remove the remaining differential gear (31) and thrust washer (30).

Examination

Examine all differential components, particularly gears, thrust washers and shafts, for scoring, chipping or wear. Any component showing signs of wear should be renewed.

NOTE – IF ANY OF THE SPRIDER GEARS IS WORN, A FULL SET OF FOUR NEW GEARS SHOULD BE FITTED. IN SUCH CIRCUMSTANCES, DIFFERENTIAL GEARS MAY ALSO NEED REPLACING.

Reassembly
1. Fig. 21. Refit the L.H. differential gear (31) and thrust washer (30) into the differential case followed by the cross joint (32) and pinion assembly (35) with thrust washers (36), then finally the remaining differential gear (33) and thrust washer (34).
2. Fig. 22. Refit the R.H. differential case (37) with the markings aligned, as shown, then fit the differential lock coupler (38).
3. Refit the eight bolts and torque them to 11,5 kg-m (80 lb-ft).
4. Drive the bearing cone (39) on to the coupler cap using special tool MF 257.
5. Refit the differential unit as stated in operation 5A-16-15.

CROWNWHEEL

Removal and Replacement 5A-19-16
Special Tools Required: See operation 5A-14-10 and 5A-18-15 and Epoxy Resin Bonding Kit 1852 913M91.

Removal
1. Remove the differential gears as stated in operation 5A-18-15
2. Place the differential unit on the bench with teeth facing downwards, then carefully centre punch the head of each rivet centrally.
3. Using a 13 mm (½ in) diameter drill, very carefully drill through each rivet head until the rivet heads become detached from the shanks.
4. Drive the rivets out of the differential case and the crownwheel, then drive off the crownwheel.

NOTE – IF THE CROWNWHEEL IS DAMAGED, THE PINION MUST ALSO BE REPLACED AS THESE ARE ONLY SUPPLIED IN MATCHED SETS.

Replacement
1. Inspect the mating faces of the differential case and the new crownwheel, ensuring that they are perfectly flat.
2. Place the L.H. differential case on the MF 258 holder, with the crownwheel mating faces upwards.
3. Thoroughly degrease the crownwheel, L.H. differential case, differential bolts and nuts with trichlorethylene, before attempting assembly.
4. Before attempting assembly, have all the bolts and nuts, a torque wrench, a correct size socket and either Loctite Grade AV or Casco ML15 ready for use immediately the crownwheel and differential case are joined..
5. Open the epoxy resin kit 1852 913 M91. Its contents are:
   One jar containing 10 ml of resin. This jar is also used as a mixing vessel.
   One jar containing 5 ml of hardener.
   One glass stirring rod.
   One brush.
6. Pour the hardener into the resin jar then mix the two elements thoroughly with the glass rod.
7. Apply an even coating of adhesive to both mating faces.
8. Carefully fit the crownwheel to the differential case.

NOTE – THESE TWO COMPONENTS ARE AN INTERFERENCE FIT AND MUST, THEREFORE, HAVE THEIR BOLT HOLES ACCURATELY ALIGNED BEFORE FITTING THE TWO COMPONENTS.

9. Fit the twelve bolts with their heads nearest the crownwheel teeth, then apply two drops of either Loctite Grade AV or Casco ML15 to the first thread of each bolt.
10. Fit the nuts and torque them progressively and evenly to 15,5 kg-m (120 lb-ft).

NOTE– OPERATION 7 TO 10 MUST BE COMPLETED WITHIN 30 MINUTES OF MIXING THE RESIN AND HARDENER.

11. Finally cure the resin bonding by subjecting the crownwheel and differential case to uniform heating at one of the temperatures listed below, for the required length of time:
    120°C (245°F) for a minimum of 1 hour
    40°C (105°F) for a minimum of 12 hours
    30°C (85°F) for a minimum of 16 hours
    20°C (68°F) for a minimum of 24 hours
12. Refit the differential components as stated in operation 5A-18-15.

PINION ASSEMBLY

Removal and Refitment 5A-20-16
Special Tools Required: See operation 7A-14-31.

Removal
1. Remove the hydraulic lift cover and the hydraulic pump(s), as stated in operation 7A-14-31.
2. Fig. 23. Release the snap ring (23), securing the ground speed gear (22) to the splined hub, then slide off the gear.
3. Remove the six bolts (20) and spring washers securing the pinion housing (18).
4. Screw two of the bolts into the two tapped holes in the housing, then extract the pinion assembly.

Refitment
1. Fit the pinion assembly into the centre housing, aligning the locating pin, before pressing the housing in place.
2. Secure the housing with the six bolts and spring washers tightened to a torque of 11 kg-m (80 lb-ft).
3. Locate the ground speed gear (22), with the boss at the rear, then fit a new snap ring (23).
4. Refit the ground speed gear to the front of the p.t.o. shaft.
5. Refit the hydraulic pump(s) and the hydraulic lift cover as stated in operation 7A-14-31.

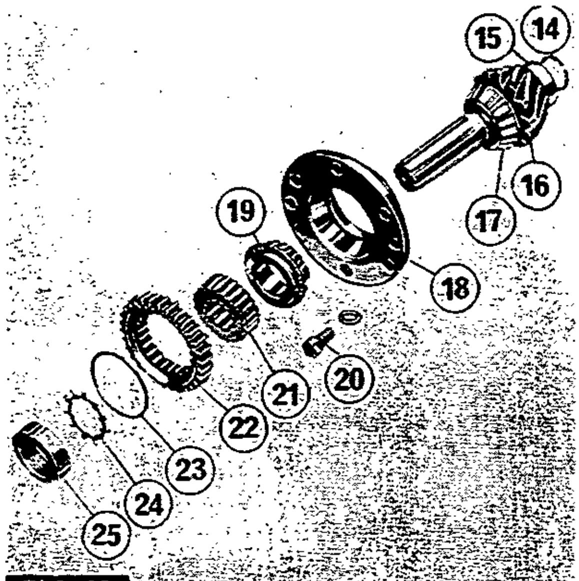

FIG. 23

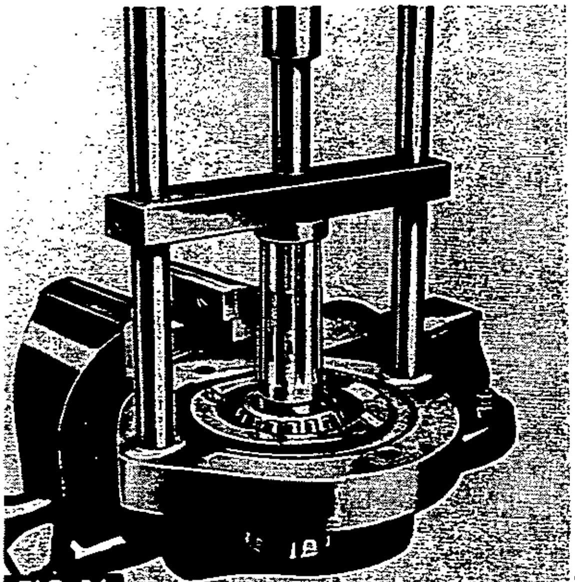
FIG. 24

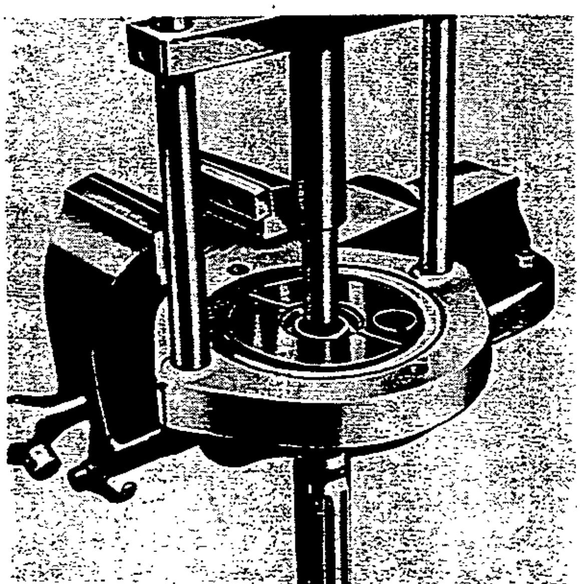
FIG. 25

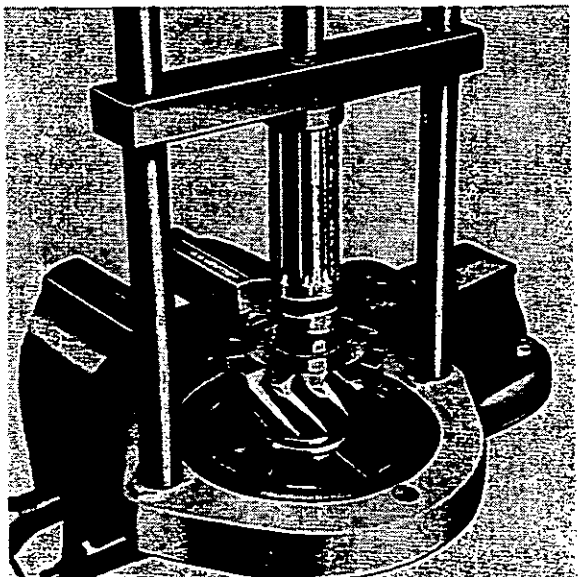
FIG. 26

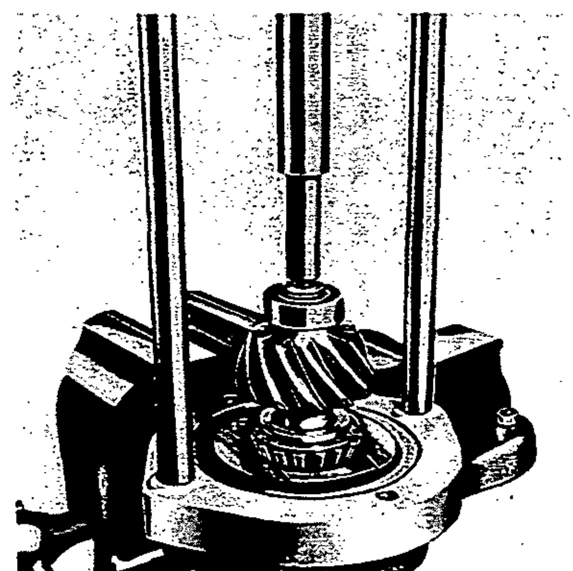
FIG. 27

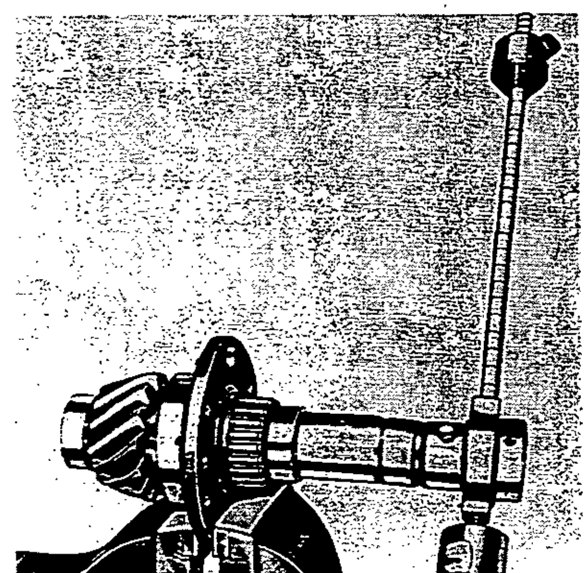
FIG. 28

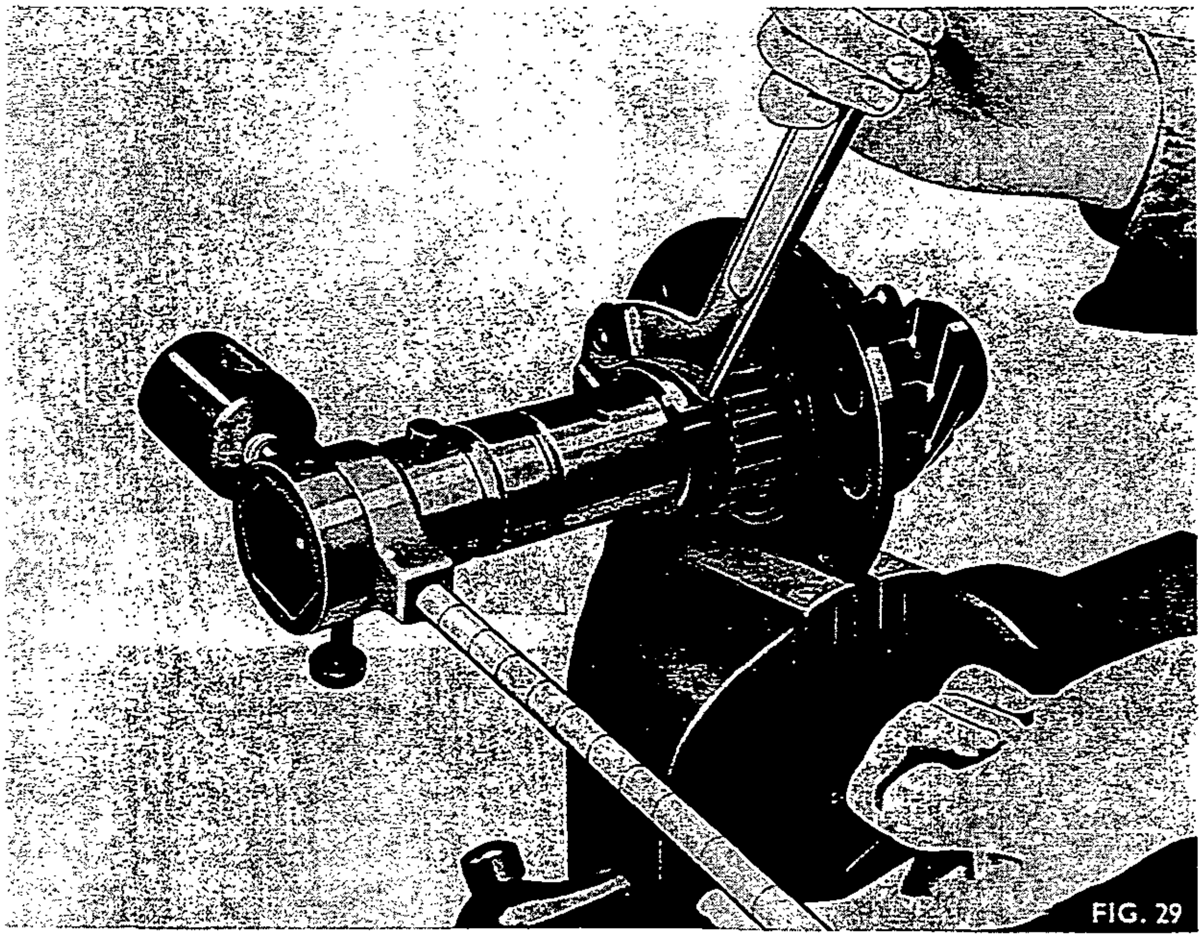

FIG. 29

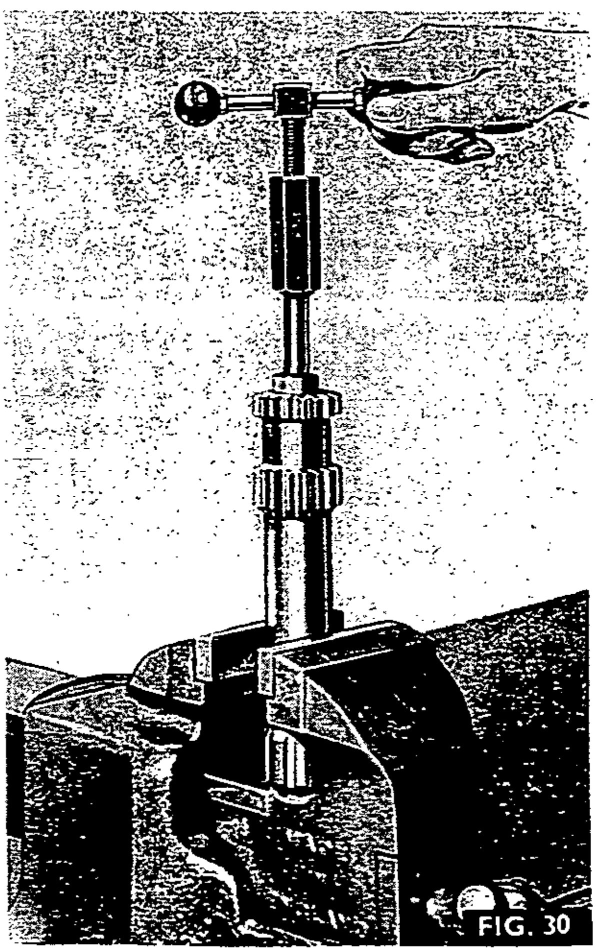

FIG. 30

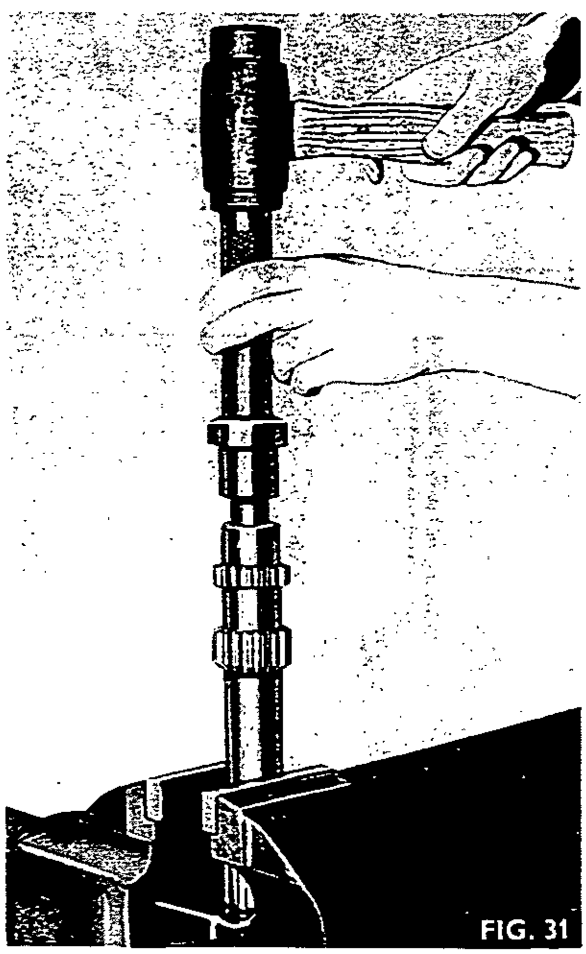

FIG. 31

PINION ASSEMBLY

Servicing 5A-21-19

Special Tools Required: See operation 7A-14-31 and
3150 'C' Spanner
CP 4030 Pre-Load Gauge
MF 200 Hand Press
MF 200-23 Adapter
MF 200-25 Adapter

Disassembly

1. Remove the pinion assembly as stated in operation 5A-20-16.
2. Fig. 23. Hold the pinion in a soft faced vice, release the tab washer (24), then unscrew the locking ring (25) using the 3150 'C' spanner. Remove the splined hub (21) and pull off the housing (18) complete with the front bearing cone (19).
3. Fig. 24. Fit the pinion to the MF 200 hand press with adapters MF 200-23 and MF 200-25 as shown, then press off the bearing (17).
4. Remove the snap ring (14) securing the pilot bearing (15) to the pinion.
5. Fig. 25. Fit the pinion to the MF 200 hand press, using adapter MF 200-23 as shown, then press off the pilot bearing (15).

Examination

Examine the following:
Pinion teeth and splines
All bearings and cones
Gear teeth

All of the above components must be checked for wearing, chipping or scoring.

Any component which shows signs of wear must be replaced (*i.e. both the cup and cone for taper roller* bearings).

NOTE

1. IF THE PINION IS DAMAGED, THE CROWN-WHEEL MUST ALSO BE REPLACED AS THESE ARE ONLY SUPPLIED IN MATCHED SETS.
2. THE TAPER ROLLER BEARINGS (17 AND 19) ARE SERVICED AS A PAIR, ASSEMBLED WITH THE HOUSING (18). NEW SNAP RINGS AND A NEW TAB WASHER SHOULD ALWAYS BE FITTED.

Reassembly

1. Fig. 26. Using the MF 200 hand press and adapter MF 200-23 as shown, press the pilot bearing (16) on to the pinion.
2. Secure the pilot bearing with a new snap ring (14).
3. Fig. 27. Using the MF 200 hand press and adapters MF 200-23 and MF 200-25, press the bearing (17) on to the pinion.
4. Locate the pinion in its housing (18), then fit the front bearing cone (19), the splined hub (21), a new tab washer (24) and the locking ring (25).
5. *Fig. 28. Hold the housing in a soft faced vice,* then assemble the CP 4030 pre-load gauge as shown. Adjust the pre-load gauge to 0,23 kg-m (1.67 lb-ft, 20 lb-in).
6. Fig. 29. Tighten the locking ring (25) using the 3150 'C' spanner, simultaneously tapping the pinion to centralise the bearing. When the pre-load is correctly set, the weight on the gauge should just fall freely under its own weight.
7. Secure the locking ring with the tab washer (24).
8. Refit the pinion assembly as stated in operation 5A-20-16.

REAR DRIVE SHAFT

Servicing 5A-22-19

Special Tools Required: See operation 7A-03-16 and
MF 202A Bearing Puller
MF 203A Bearing Driver
550 Universal Handle

Disassembly

1. Remove the lift cover as stated *in* operation 7A-03-16.
2. Remove the split pin from the shear tube, then remove the shear tube.
3. Remove the rear drive shaft.
4. *Fig. 30. Locate the end of the bearing remover* tool MF 202A underneath the bearing cage, inside the bore of the rear drive shaft as shown, then extract the bearing.

Examine the rear drive shaft for wear or damage and fit a new needle roller bearing.

Reassembly

1. Fig. 31. Position the new needle roller bearing squarely over its bore in the rear drive shaft.
2. Place the bearing depth control collar (part of MF 203A) on the end of the driveshaft, over the bearing.
3. Drive in the needle roller bearing using MF 203A and the 550 handle, as shown, until the tool contacts the depth control collar.
4. Refit the rear drive shaft.
5. Refit the shear tube, then fit a new split pin to give 0,40 to 2,50 mm (0.015 to 0.100 in) end float.
6. Refit the lift cover as stated in operation 7A-03-16.

FOOTBRAKE LINKAGE AND PEDALS

Removal and Refitment 5A-23-19

Removal

1. Fig. 32. Remove the split pin (77) and the clevis pin (76) securing the brake rod to the R.H. pedal (83).
2. Remove the split pin and clevis pin securing the L.H. brake rod to the cross shaft arm (91).
3. Remove the split pin (81) and the clevis pin (82) securing the brake rod (90) to the R.H. brake camshaft lever.
4. Repeat item 3 for the L.H. brake camshaft lever pull rod.
5. Remove the snap ring (94), and the washer (93), then slide the R.H. brake pedal off the cross shaft (95).
6. *Slacken the pinch bolt (92) securing the L.H.* cross shaft arm (91), then pull off the arm.
7. Remove the Woodruff Key from the cross shaft, then push the cross shaft through the centre housing and remove it, complete with the L.H. brake pedal.
8. Remove the pinch bolt (97), nut and spring washer, securing the L.H. brake pedal (85) then slide the pedal off the shaft. Remove the Woodruff Key.
9. To remove the locking latch (99), remove the screw (100) and lift off the latch (99) and plate (98). To service the parking latch see operation 5A-24-20.

Examine the cross shaft (95), and the R.H. pedal bush (75) for wear and replace if necessary.
When reassembling, fit new Woodruff Keys, a new snap ring (94) and new split pins (77 and 81).

Refitment

1. If necessary, press a new bush (75) into the R.H. brake pedal (83).
2. Fit a new Woodruff Key to the R.H. end of the cross shaft (95), then refit the L.H. brake pedal (85) and secure with the pinch bolt (97), nut and spring washer.
3. Slide the cross shaft through the transmission case. Fit a new Woodruff Key, then refit the cross shaft arm (91) and secure it with the pinch bolt (92), nut and spring washer.
4. Re-assemble the locking latch (99) and plate (98) to the R.H. brake pedal (83), refitting the screw (100) and a new self-locking nut.
5. Slide the R.H. brake pedal on to the cross shaft, refit the washer (93) and secure the pedal with a new snap ring (94).
6. Refit the L.H. brake rod and secure it to the brake cross shaft lever (91) and the brake camshaft lever with the clevis pins (76 and 81) and new split pins (77 and 81).
7. With the brake shoes fully extended in the drums, adjust the L.H. brake rod until the pedal is depressed three or four teeth on the parking brake sector.
8. Refit the R.H. brake rod and secure it with the clevis pins and new split pins, then adjust the rod until the locking latch can be engaged freely.
9. Adjust and balance the brakes as stated in operation 5A-07-06.

PARKING LATCH

Servicing 5A-24-20

Fig. 32. The parking latch is secured to the L.H. brake pedal by a clevis pin (84) and split pin (87). To disassemble the latch, remove the split pin and clevis pin. This then frees the latch (89), pawl (88) and spring (86). The sector (90) is secured to the transmission case by three bolts.

Examine the pawl, pin and sector teeth for wear and replace as necessary.
When reassembling the latch, retension the spring and fit a new split pin (87).

PARKING BRAKE AND LINKAGE

Removal and Refitment 5A-25-20

Removal

1. Fig. 33. Remove the split pin (101), washer and clevis pin (117) securing the brake rod clevis (103) to the lever (110), then remove the split pin (105), washer and clevis pin (106) securing the brake rod (104) to the brake camshaft lever and lift off the rod and clevis assembly.
2. Repeat item one for the other side of the tractor, if necessary.
3. Remove the two bolts (107) securing the lever assembly to the tractor.
4. To disassemble the lever assembly, withdraw the taper pin (109), then pull the cross shaft (118) and lift off the lever (110).
5. To remove the pawl (112), remove the split pin (116), washer and clevis pin (111), then disengage the pawl from the actuator (113).
6. Pull the actuator (113), spring (114) and stop (115) from the lever.

Examine the pawl and teeth for wear and replace if necessary. Replace any worn clevis pins and always fit new split pins and a new taper pin (109) on assembly.

Refitment

1. Fit the spring (114) and stop (115) to the actuator (113), then feed the actuator into the lever (110) from the top.
2. Engage the pawl (112) in the end of the actuator rod, then refit the clevis pin (111), washer and a new split pin (116).
3. Slide the cross shaft (118) into the bracket (108), then fit the lever assembly and secure them with a new taper pin (109).
4. Refit the bracket assembly to the tractor and secure it with the two bolts (107).
5. Adjust the footbrakes as stated in operation 5A-07-06.
6. Refit the brake rod and clevis assembly to the brake camshaft lever securing it with the clevis pin (106), washer and a new split pin (105).
7. With the parking brake lever in the fully lowered position, adjust the clevis adapter (103) until the clevis pin (117) can be just fitted without movement of the brake lever, then secure the clevis pin with a washer and new split pin (101).
8. Repeat items six and seven for the opposite side of the tractor.

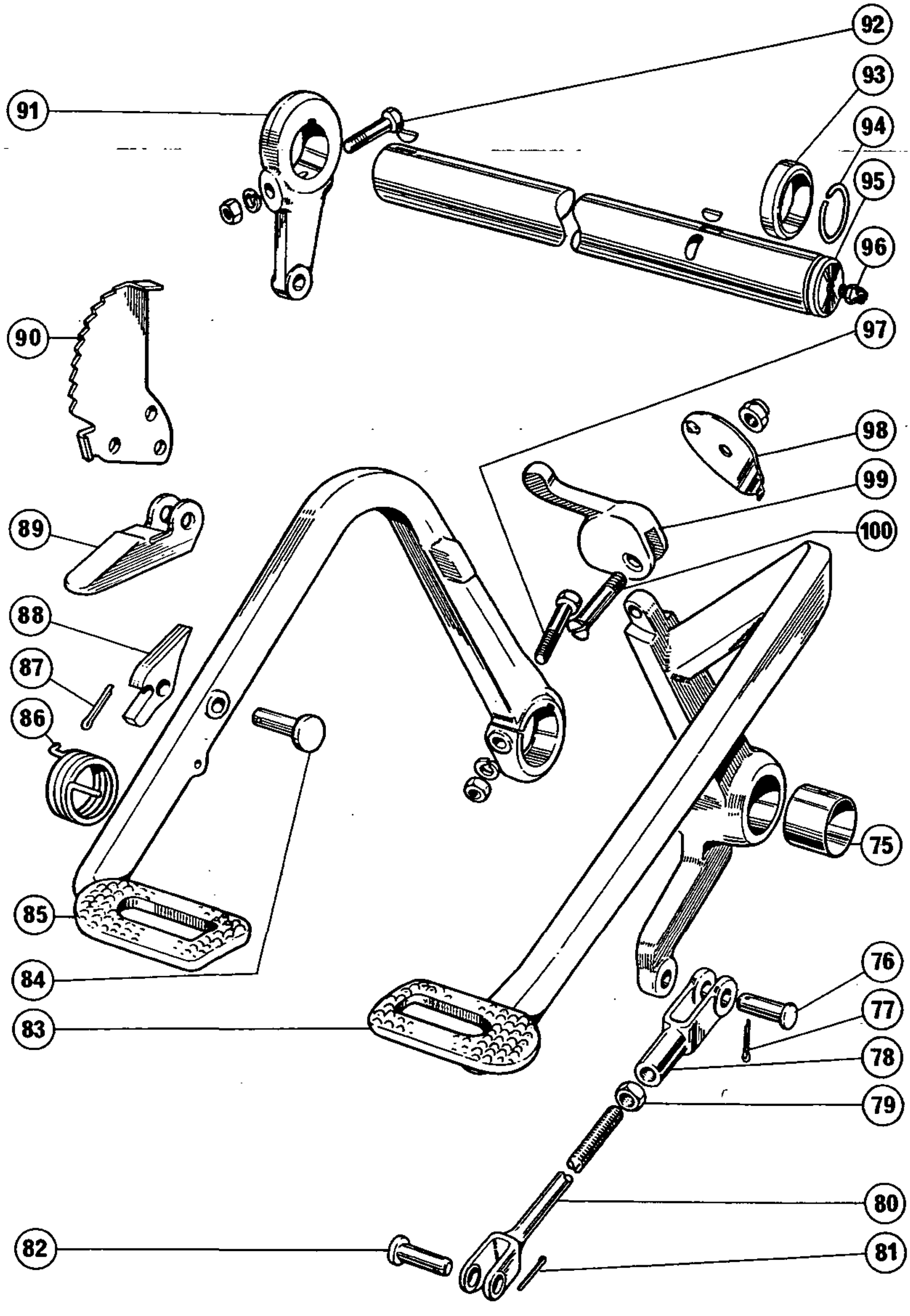
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FIG. 32

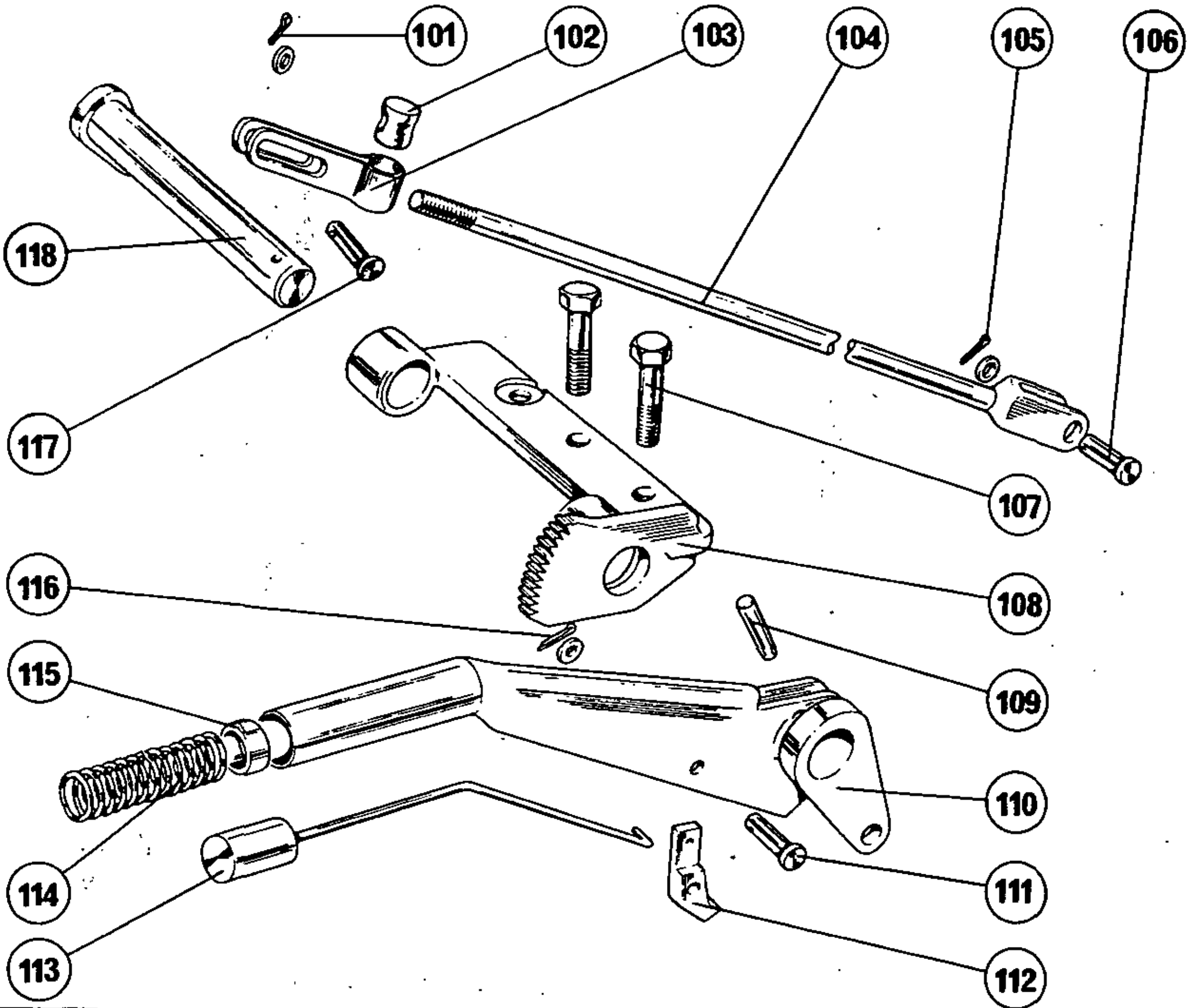
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FIG. 33

POWER TAKE–OFF

Part 5 Section B

GENERAL

Figures 1, 2, 3, 4, 5 & 6

The power take-off shaft projects from the rear of the tractor centre housing and has a 34.9 mm (1 ⅜ in) (British Standard) spline with an annular groove for positive fixing of implement couplings.

A removable cap (16) protects the splines when the shaft (9) is not in use. The shaft itself is supported at the rear by a ball race (10) and at the front by a needle roller bearing (8). Double seals (12 & 14) exclude dirt from the bearing and retain lubricant in the centre housing. The power take-off is engaged by a lever (1) located on the Left Hand side of the centre housing, which selects either proportional engine speed or proportional ground speed.

Placing the lever in the neutral position (A, Figure 2), disconnects the p.t.o. drive. Proportional engine speed (B. Figure 2) is selected by pulling the lever rearwards to engage the internal splines of the ground speed p.t.o. driven gear with the splines on the rear end of the hydraulic pump drive shaft. The p.t.o. shaft is then driven at 17/53 of the engine speed. The p.t.o. shaft is coupled behind the hydraulic pump shaft; the pump is therefore constant running and continues to operate even when the p.t.o. is disengaged. Proportional ground speed (C, Figure 2) is engaged by pushing the p.t.o. lever forwards towards the ground – thereby shifting the ground speed p.t.o. driven gear into mesh with the gear splined onto the rear axle driving pinion. The p.t.o. shaft speed is then directly related to the ground speed of the tractor, and the shaft revolves once for approximately every 483 mm (19 in) of travel by the rear wheels. If the tractor is reversed, the direction of rotation will also be reversed, and this must be remembered as the implement mechanism may be damaged if driven in reverse.

Key to Fig. 1

1. Roll Pin
2. Oil Seal
3. Shift Lever
4. Side Cover
5. Spring
6. Detent
7. Selector
8. Ground Speed Gear
9. Bush
10. Needle Roller Bearing
11. P.T.O. Shaft
12. Ball Race
13. Circlip
14. Seal
15. Housing
16. 'O' Ring
17. Cover
18. Cap
19. P.T.O. Shield

P.T.O. SHAFT OIL SEAL

Removal and Replacement 5B-01-01

Special Tools Required: MF 167 Seal Protector
MF 168 Seal Remover/Replacer
550 Universal Handle

Removal

1. Drain the centre housing of oil.
2. Remove the p.t.o. shield, cap, check chain mounting bracket and oil seal housing retainer plate.
3. Slide the oil seal and housing assembly off the p.t.o. shaft.
4. Remove the oil seal using tool MF 168 and 550 handle as shown in Figure 3.

Replacement

1. Replace the oil seal using tool MF 168 and 550 handle as shown in Figure 4.
2. Fit oil seal protector MF 167 over the rear end of the p.t.o. shaft and slide the oil seal assembly onto the shaft as shown in Figure 5. Remove the oil seal protector.
3. Replace the oil seal housing retainer plate (with cut-out facing downwards) and locate onto the two flats on the oil seal housing. Secure the plate.
4. Refit the check chain mounting bracket, p.t.o. cap and shield.
5. Refill the centre housing with recommended oil.

P.T.O. SHAFT

Removal and Refitment 5B-02-02

Special Tools Required: MF 167 Seal Protector

Removal

1. Drain the centre housing of oil.
2. Remove the p.t.o. shield secured by one bolt and spring washer.
3. Remove the p.t.o. cap.
4. Remove four nuts and spring washers securing the check chain mounting bracket, and release the bracket from the centre housing.
5. Remove the p.t.o. shaft oil seal housing retainer plate, secured by two screws.
6. Withdraw the p.t.o. shaft from the centre housing, complete with oil seal assembly and bearing.

Refitment

1. Fit a new seal to the housing before reassembly.
2. Enter the p.t.o. shaft with its bearing into the centre housing and align the splines on the front end of the shaft into the ground speed p.t.o. driven gear.
3. Fit oil seal protector MF 167 over the rear end of the p.t.o. shaft and slide the oil seal assembly onto the shaft as shown in Figure 5. Remove the oil seal protector.
4. Replace the oil seal housing retainer plate (with cut-out facing downwards) and locate onto the two flats on the oil seal housing. Secure the plate with two screws.
5. Replace the check chain mounting bracket, p.t.o. cap and shield.
6. Refill the centre housing with recommended oil.

P.T.O. SHAFT REAR BEARING

Removal and Replacement 5B-03-02

Special Tools Required: MF 167 Seal Protector
MF 200 Hand Press
MF 200-25 Adaptor

Removal

1. Remove the p.t.o. shaft as stated in operation 5B-02-02
2. Slide the oil seal assembly off the p.t.o. shaft.
3. Remove the bearing retaining snap ring from the collar on the p.t.o. shaft.
4. Press off the bearing using multi-purpose bearing remover MF 200-25 as shown in Figure 6.
5. Examine the bearing and replace it if necessary.

Replacement

1. Press the bearing onto the p.t.o. shaft.
2. Refit the snap ring.
3. Refit the p.t.o. shaft and seal, as stated in operations 5B-01-02 and 5B-02-02, not forgetting to fit a new 'O' ring.

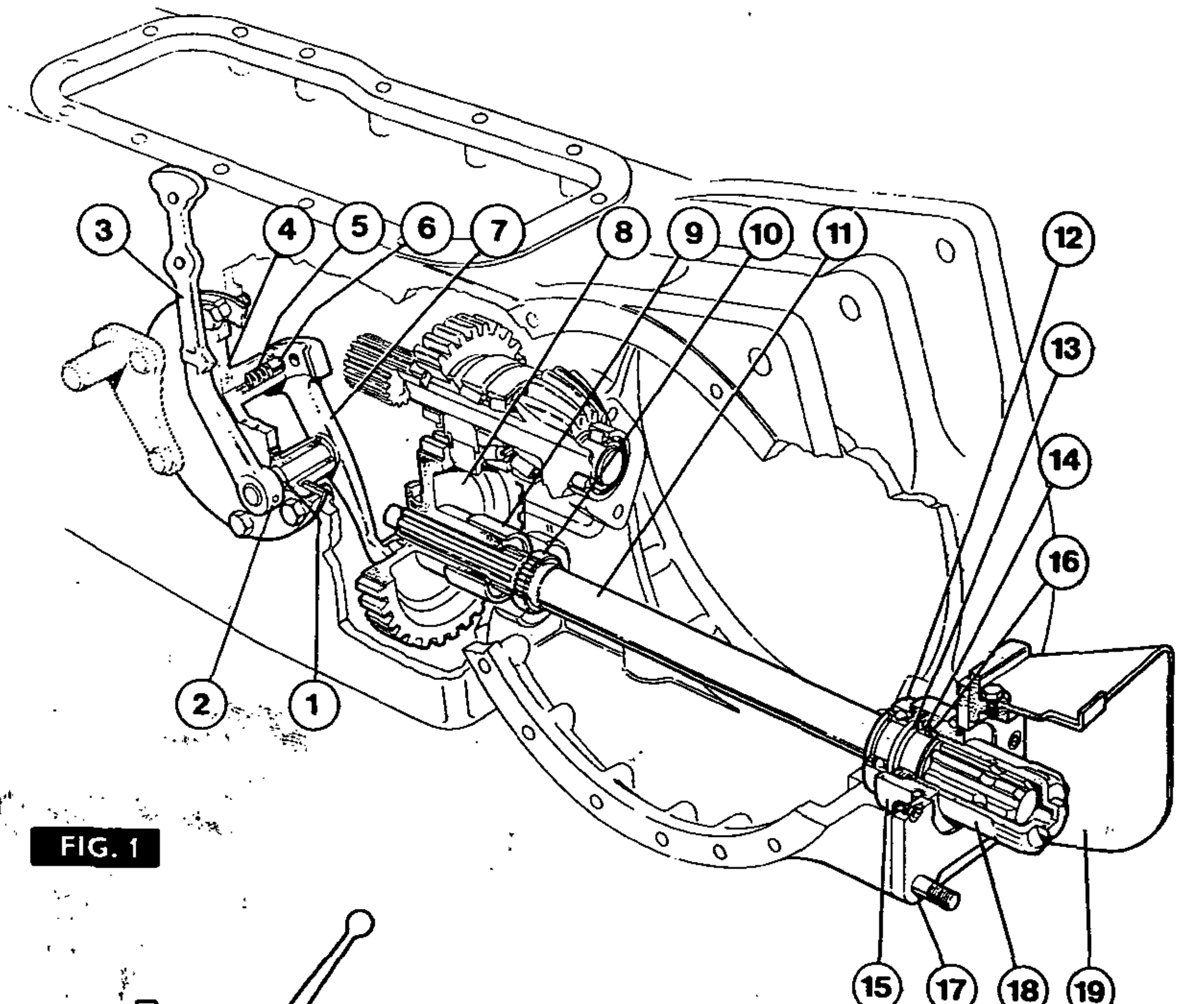


FIG. 1

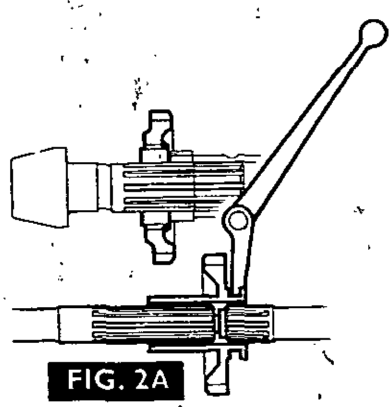


FIG. 2A

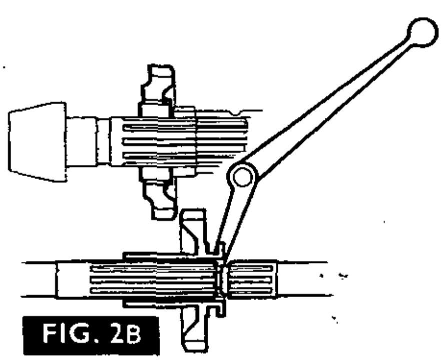


FIG. 2B

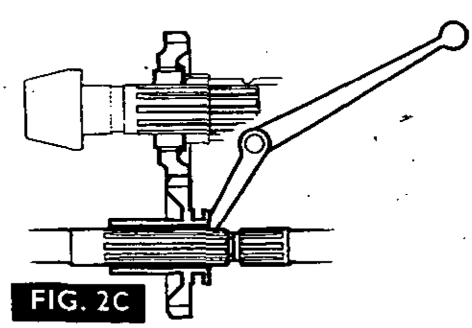


FIG. 2C

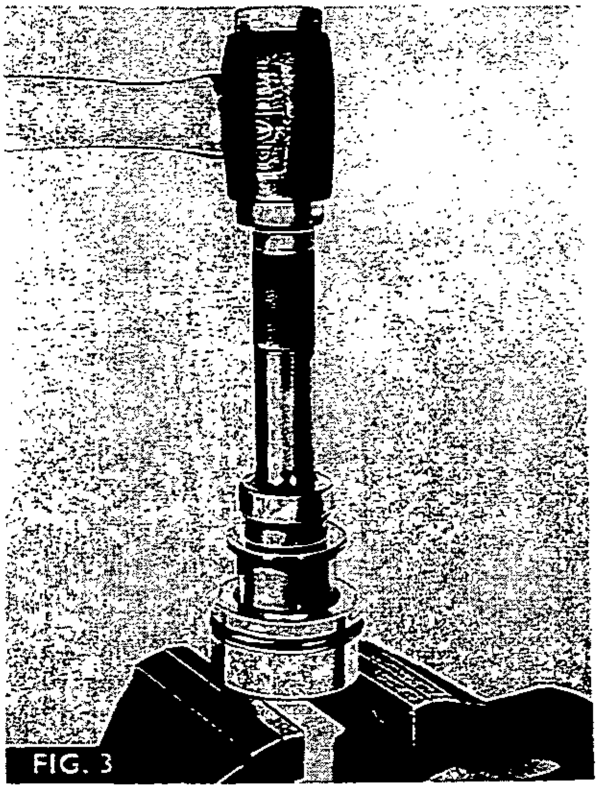


FIG. 3

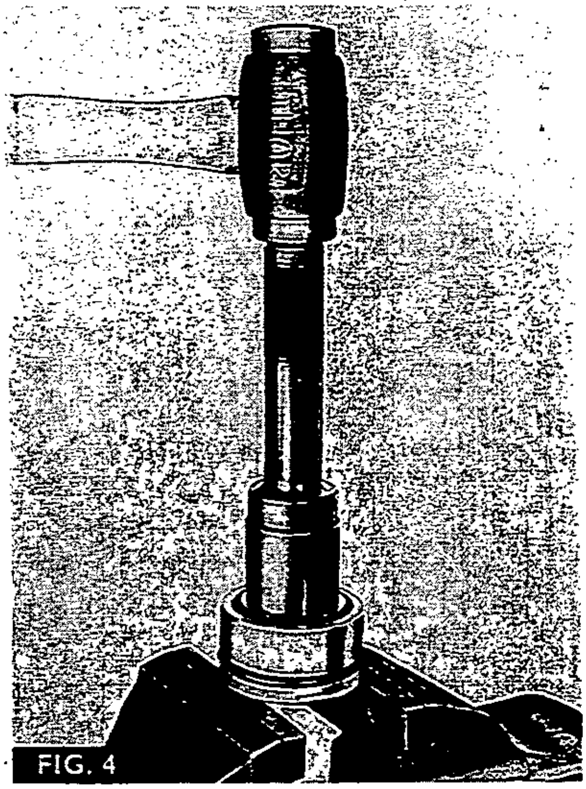


FIG. 4

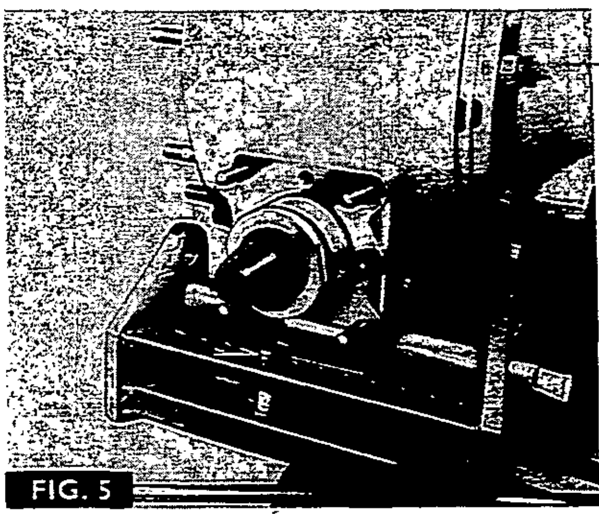


FIG. 5

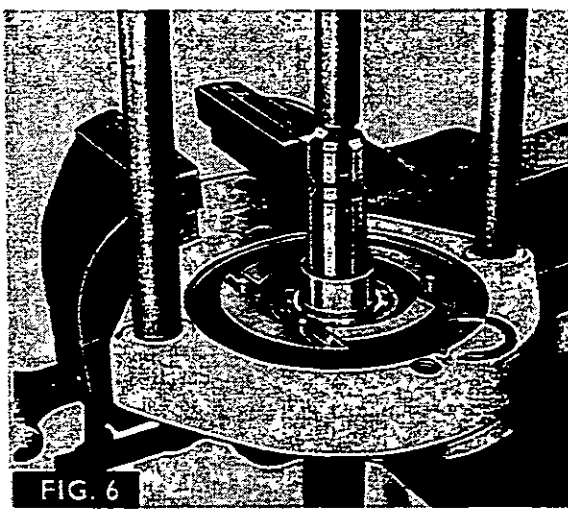


FIG. 6

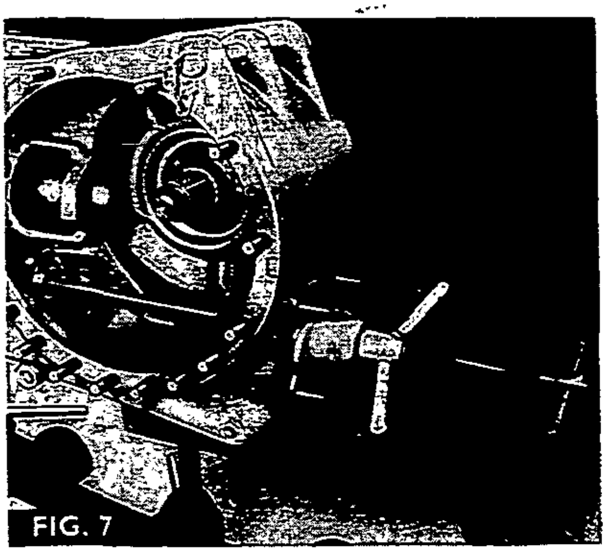


FIG. 7

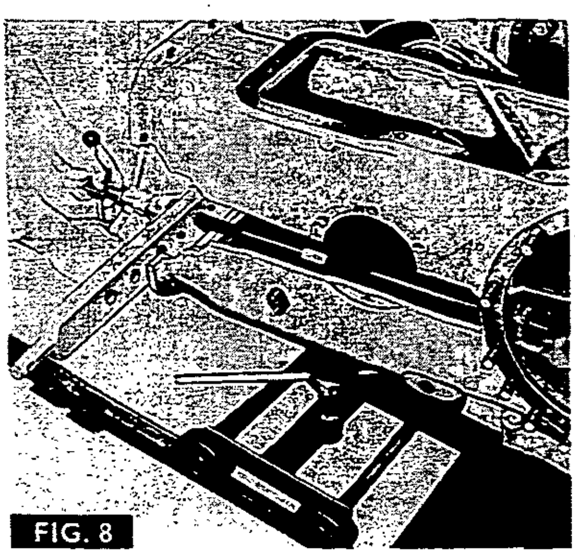


FIG. 8

P.T.O. NEEDLE ROLLER BEARING

Removal and Replacement 5B-04-05

Special Tools Required: MF 195-5/1 Adapters
MF 195-5/2 Bar
MF 195 Puller

Removal

1. Drain the centre housing of oil.
2. Remove the hydraulic lift cover as stated in Part 7, Section A.
3. *Split the tractor at the centre housing.*
4. Remove the hydraulic pumps as stated in Part 7, Section A.
5. Remove the p.t.o. side cover, then the ground speed p.t.o. driven gear.
6. Remove the Left Hand axle shaft housing assembly and the differential assembly.
7. Remove the p.t.o. shaft as stated in operation 5B-02-02
8. Assemble tool MF 195-5/1 to the needle roller bearing from the front. Fit tool MF 195 and bar MF 195-5/2 to the centre housing as shown in Figure 7, screw the bar into tool MF 195-5/1 and remove the bearing.
9. Examine the bearing and replace it if necessary.

Replacement

1. Position the new bearing squarely over its bore in the centre housing from the rear. Fit tool MF 195-5/1 into the bearing from the rear. Screw the bar tool MF 195-5/2 into tool MF 195-5/1 from the front and, using a suitable support for main tool MF 195, pull the bearing into its bore in the centre housing as shown in Figure 8.
2. Refit the p.t.o. shaft as stated in operation 5B-02-02
3. Refit the differential case assembly, and Left Hand axle shaft housing assembly.
4. Refit the ground speed p.t.o. driven gear and the p.t.o. cover plate and lever, locating the lever into its groove in the gear.
5. Refit the hydraulic pumps.
6. Refit the centre housing to the transmission.
7. Refit the hydraulic lift cover.
8. Refill the centre housing with recommended oil.

GROUND SPEED GEAR BUSH

Removal and Replacement 5B-05-05

Special Tools Required: MF 195-4/1 Adapter
MF 195-5/2 Bar
MF 195 Puller

Removal

1. Drain the oil from the centre housing.
2. Remove the hydraulic lift cover as stated in Part 7. Section A.
3. Split the tractor at the centre housing.
4. Remove the hydraulic pump(s) as stated in Part 7. Section A.
5. Remove the p.t.o. side cover and lever, then remove the ground speed p.t.o. driven gear.
6. Remove the Left Hand axle shaft housing assembly and the differential assembly.
7. Remove the p.t.o. shaft, as stated in operation 5B-02-02
8. Assemble the two adapters MF 195-4/1 into the bush.
9. Screw the tool bar portion MF 195-5/2 into the adapter MF 195-4/1 then, using a suitable support bar for MF 195, pull the bush out of the centre housing, as shown in Figure 9.

Replacement

1. Position the new bush squarely over its bore in the centre housing.
2. Assemble the adapter MF195-4/1 into the bush.
3. Screw the tool bar portion MF 195-5/2 into the adapter MF 195-4/1 from the rear and pull the bush into the centre housing using puller MF 195 as shown in Fig. 10.
4. Refit the p.t.o. shaft, as stated in operation 5B-02-02.
5. Refit the differential assembly and the Left Hand axle housing.
6. Refit the ground speed p.t.o. driven gear and the p.t.o. side cover assembly, locating the lever in its groove in the gear.
7. Refit the hydraulic pumps.
8. Re-attach the centre housing to the transmission.
9. Refit the hydraulic lift cover.
10. Refill the centre housing with a recommended oil.

P.T.O. SIDE COVER

Removal and Refitment 5B-06-05

Special Tools Required: Torque Wrench

Removal

1. Drain about 9 litres (2 gallons) of oil from the centre housing.
2. Disconnect the two hoses from the side cover to the spool valve manifold at the two unions on the side cover (Multi-Power auxiliary hydraulic tractors only).
3. Remove the three socket head screws securing the internal manifold to the side cover (Multi-Power auxiliary hydraulic tractors only).
4. Remove the six bolts securing the side cover to the centre housing.
5. Manoeuvre the side cover, complete with its lever and selector out of the centre housing.

Refitment

1. Fit the side cover assembly into the centre housing, locating the selector in the groove in the ground speed driven gear.
2. Fit the six side cover securing bolts loosely, to permit alignment with the internal manifold (Multi-Power auxiliary hydraulic tractors only).
3. Fit the three socket head screws and secure the internal manifold (Multi-Power auxiliary hydraulic tractors only).
4. Tighten the six side cover bolts to a torque of 7,6 kg/m (55 lb ft).
5. Reconnect the hose from the tee-piece union on the spool valve to the rear union on the side cover (Multi-Power tractors only).
6. Reconnect the hose from right-angle union on the spool valve union to the front union on the side cover (Multi-Power auxiliary hydraulic tractors only).
7. Replenish the transmission with oil.

NOTE – THE ABOVE PROCEDURE ASSUMES THAT FOR MULTI–POWER TRACTORS THE LIFT COVER WILL HAVE BEEN REMOVED FOR OTHER WORK TO BE CARRIED OUT, AS THE INTERNAL MANIFOLD CANNOT EASILY BE ALIGNED WITH THE SIDE COVER, EVEN WHEN THE BOLTS ARE LEFT SLACK.

P.T.O. SIDE COVER UNIT

Disassembly and Reassembly 5B-07-06

Figure 11

Disassembly

1. Remove the p.t.o. side cover unit as stated in operation 5B-06-05
2. Drive out the roll pin (2) securing the shift lever (3) to the selector shaft (7).
3. Withdraw the selector shaft from the side cover (4) and remove the detent (6) and spring (5).
4. Remove the oil seal (1) from the side cover (4).

Reassembly

1. Fit a new oil seal (1) to the side cover (4).
2. Examine the detent spring (5) and replace it if necessary, then fit the spring and the detent (6) to the side cover.
3. Refit the selector shaft to the side cover taking care not to damage the oil seal.
4. Refit the flat washer, then the shift lever and secure the lever with a new roll pin.
5. Refit the side cover unit as stated in operation 5B-06-05

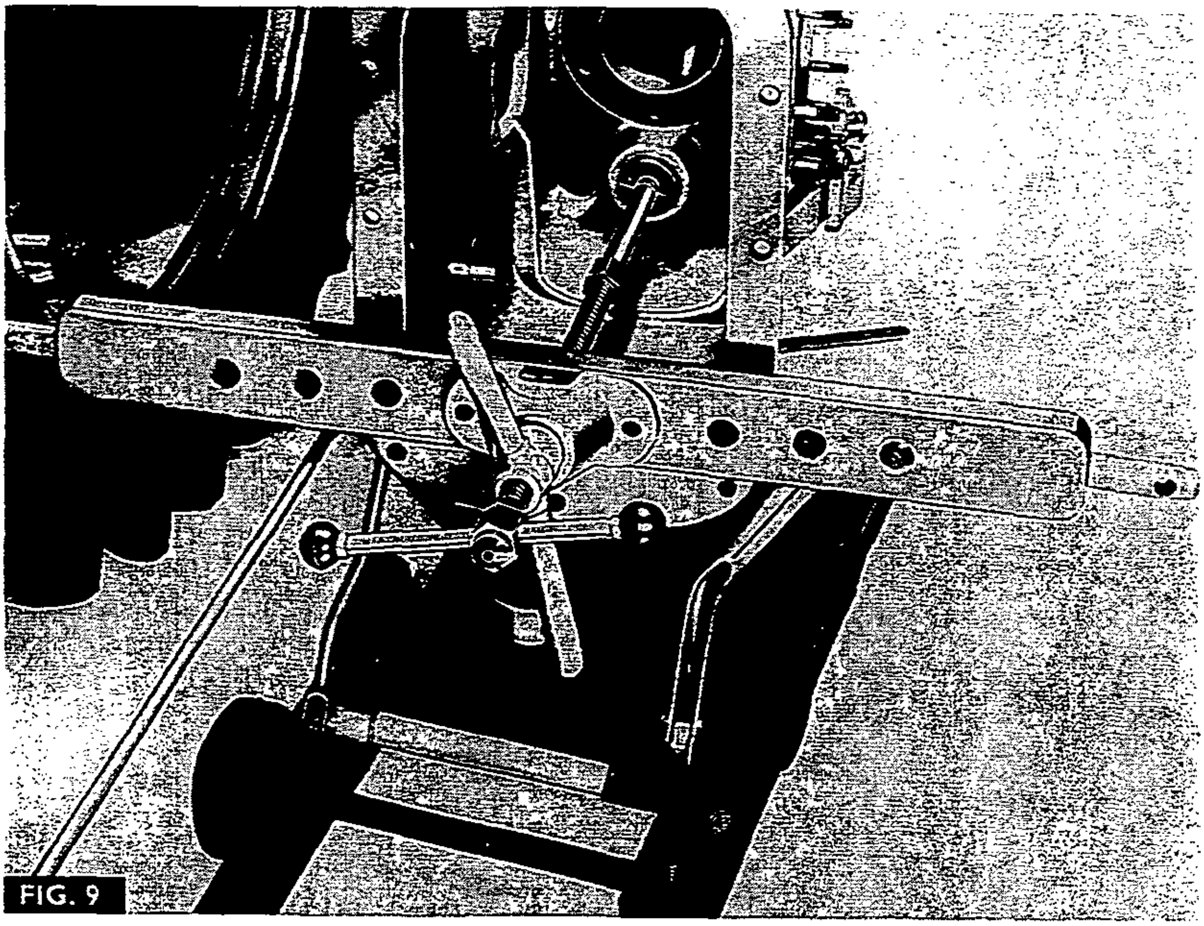


FIG. 9

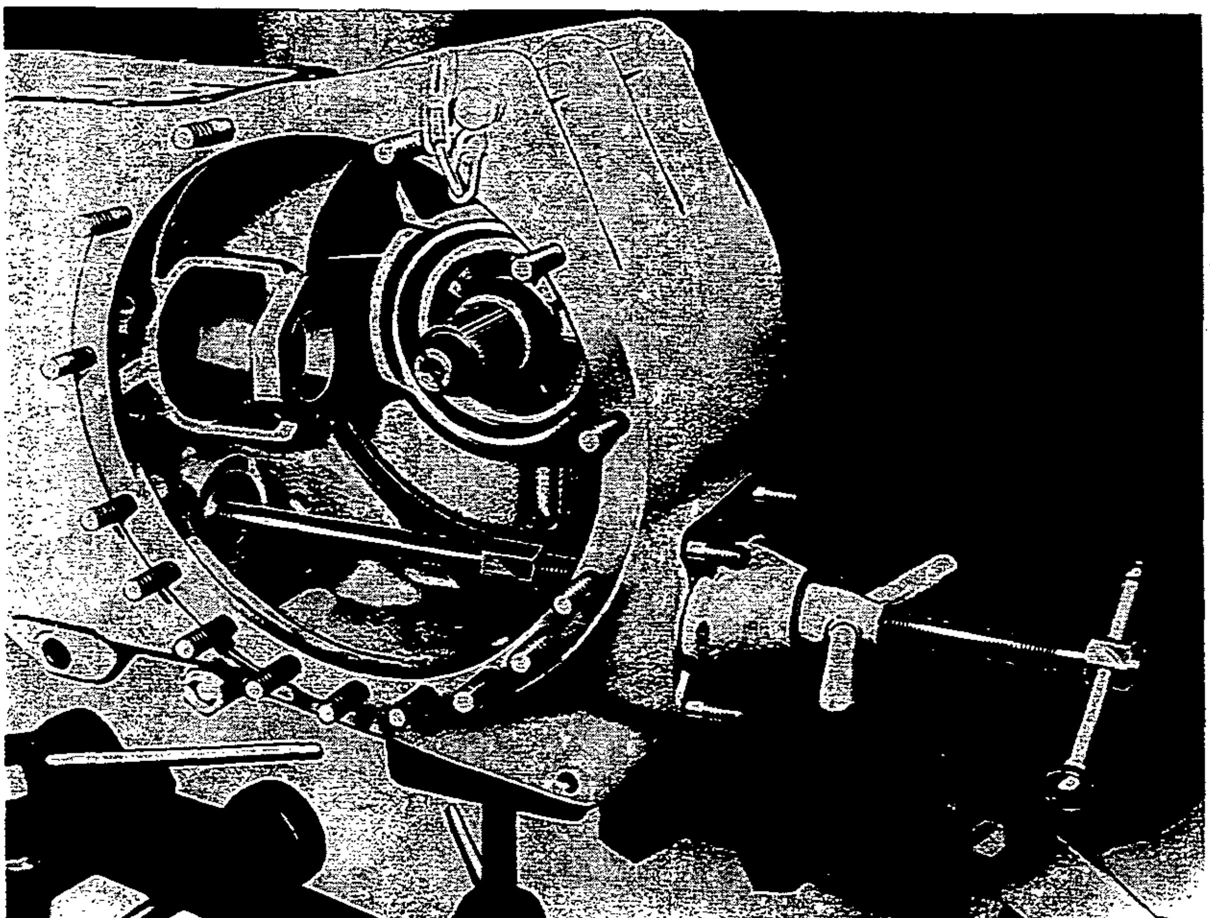


FIG. 10

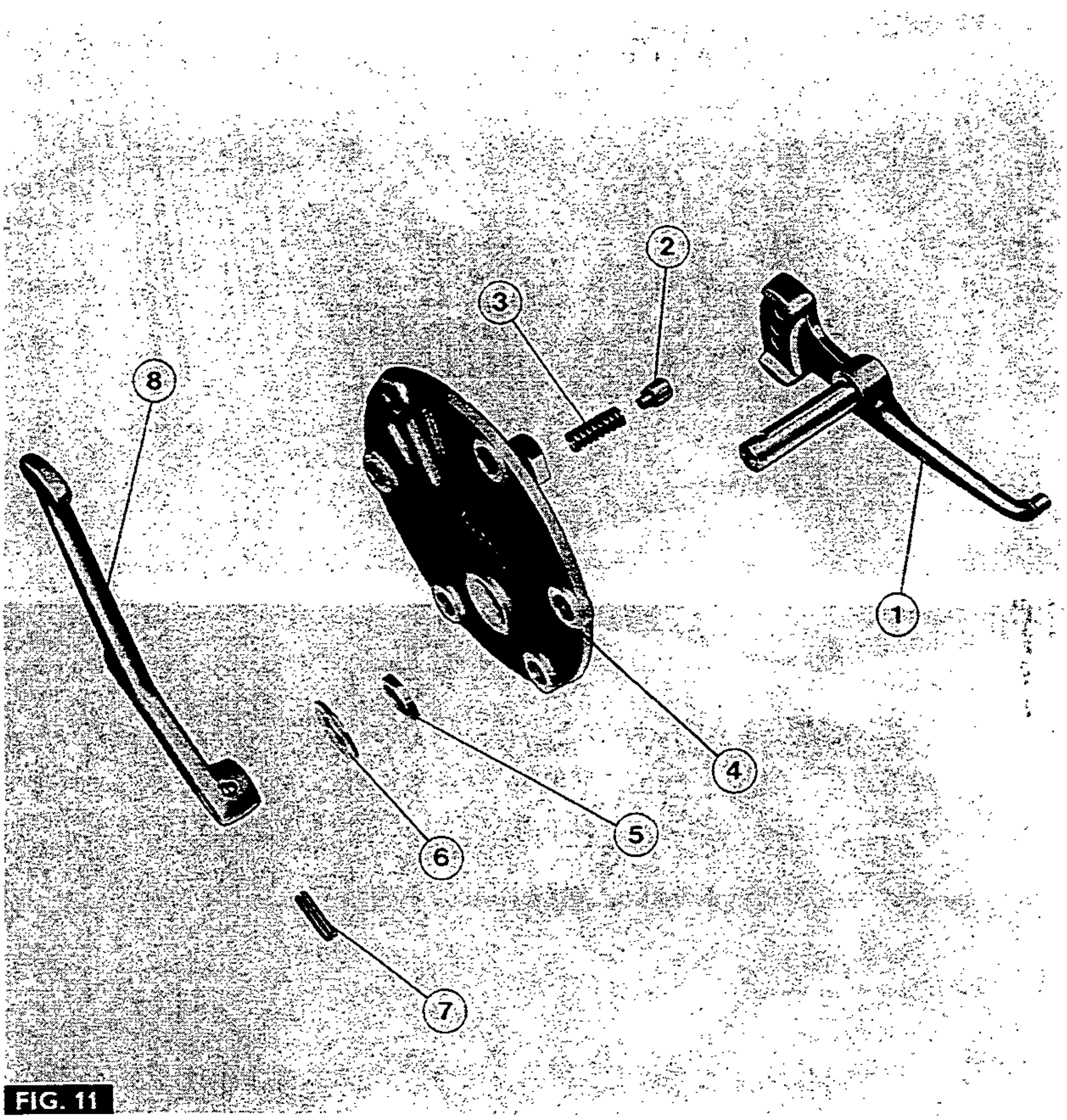


FIG. 11

INDEPENDENT POWER TAKE-OFF

Part 5 Section C

GENERAL

The independent power take off system consists of a hydraulically actuated clutch whose engagement, or disengagement is controlled by a three position spool valve. The clutch drum is splined on to the rear end of the hydraulic lift pump camshaft and the friction plate hub is splined on to the front end of the p.t.o. shaft.

Hydraulic pressure is supplied by one of the low pressure outlet ports on the Multi-Power or Auxiliary pump at a minimum of 17,5 Kg/cm^2 (250 lb/in^2). To maintain this minimum pressure, a special valve is incorporated in the outlet flow pipe in the Multi-Power circuit.

The clutch valve is operated by a hand lever on the left side of the centre housing.

I.P.T.O. UNIT

Removal and Refitment 5B-08-12
Special Tools Required: See operation 7A-03-16 and 3A-05-03

Removal

1. Drain the transmission oil to the low mark on the dipstick.
2. Disconnect the two hoses (if fitted), from the unions on the side cover to the spool valve manifold, at the side cover.
3. Remove the lift cover as stated in operation 7A-03-16.
4. Split the tractor between the centre housing and the transmission as stated in operation 3A-05-03.
5. Remove the two banjo bolts and manifold (auxiliary hydraulic tractors without spool valves) or the two unions and nuts (auxiliary hydraulic tractors with spool valves) from the side cover.
6. Fig.12. Remove the pipe (1) (auxiliary hydraulic tractors only) by removing the snap ring securing the pipe to the side cover (6) and releasing the pipe at the auxiliary pump.
7. Remove the pipe (2) from the auxiliary pump and the i.p.t.o. spool valve (5).
8. Remove the return pipe (3) (auxiliary hydraulic tractors only) by removing the snap ring securing the pipe to the side cover.
9. Disconnect the pressure test pipe (4) at the spool valve (5).
10. Remove the six bolts securing the side cover to the centre housing.
11. Manoeuvre the side cover, complete with the lever (7), selector (8) and pipe (4) out of the centre housing.
12. Move the auxiliary pump, hydraulic pump and the i.p.t.o. unit forwards.
13. Withdraw the auxiliary pump and hydraulic pump as a complete assembly, then remove the i.p.t.o. unit.

Refitment

1. Place the i.p.t.o. unit in the centre housing and locate it on the p.t.o. shaft splines.
2. Position the auxiliary pump and hydraulic pump in the centre housing, locating the camshaft splines in the i.p.t.o. unit.
3. Refit the hydraulic pump securing dowels, with new 'O' rings, then locate the dowels in the hydraulic pump and secure with two nuts each side.
4. Position the side cover, with a new gasket, on the centre housing, locating the selector (8) in the spool (9) and the dowel pin in the spool valve (5).
5. Secure the side cover, rear footplate bracket and clutch pedal (if removed) with six bolts, tightened to a torque of 7,6 Kg-m (55 lb-ft).
6. Reconnect the pressure test pipe (4) to the spool valve (5).
7. Refit the return pipe (3) (auxiliary hydraulic tractors only), with a new sealing ring, to the side cover and secure with a new snap ring.
8. Refit the pipe (2) to the auxiliary pump and the i.p.t.o. spool valve (5).
9. Refit the pipe (1) (auxiliary hydraulic tractors only), with a new sealing ring, to the side cover and secure with a new snap ring, then fit the pipe to the auxiliary pump.
10. Refit the manifold (auxiliary hydraulic tractors without spool valves), with a new gasket, and secure with the two banjo bolts and new sealing rings. Tighten the banjo bolts to a torque of 5,5 kg-m (40 lb-ft).
11. Refit the two nuts and unions (auxiliary hydraulic tractors with spool valves) to the side cover. The right angle union must be fitted to the rear hole in the side cover.
12. Reconnect the centre housing to the transmission as stated in operation 3A-05-03.
13. Refit the lift cover as stated in operation 7A-03-16.
14. Reconnect the hose (if fitted), from the tee-piece union on the spool valve manifold, to the rear union on the side cover.
15. Reconnect the hose (if fitted), from the right angle union on the spool valve manifold, to the front union on the side cover.

Clutch Assembly Servicing 5B-09-12
Special Tools Required: See operations 7A-03-16 and 3A-05-03

Disassembly

1. Remove the i.p.t.o. unit as stated in operation 5B-08-12
2. Fig. 13. Remove the snap ring (10), thrust washer (11) and then the spool valve (5) from the clutch assembly.
3. Fig.14. Remove the snap ring (19) and then lift out the clutch cover plate (18).
4. Remove the centre hub (13).
5. Remove the seven friction discs (17), springs (16) and pressure plates (15).
6. Invert the housing (12) and tap out the piston (14). If necessary remove the piston ring.

Examine all parts for scoring, wear or damage and replace if necessary. Always fit new snap rings.

Reassembly

1. If necessary, fit a new piston ring to the piston (14), then place the piston, boss uppermost, in the clutch housing (12).
2. Refit the centre hub (13) in the housing.
3. Fig.15. Alternately assemble the seven pressure plates (15), friction discs (17) and springs (16) in the housing. To facilitate the refitting of all the discs, place suitable pins to compress the springs as shown.
4. Refit the cover plate (18) and secure with a new snap ring (19).
5. Remove the spring compressing pins.
6. Fig.13. Refit the spool valve (5) to the clutch, then the thrustwasher (11) and secure with a new snap ring (10).
7. Refit the i.p.t.o. unit as stated in operation 5B-08-12.

Spool Valve Servicing 5B-10-12
Special Tools Required: See operations 7A-03-16 and 3A-05-03

Disassembly

1. Remove the i.p.t.o. unit as stated in operation 5B-08-12.

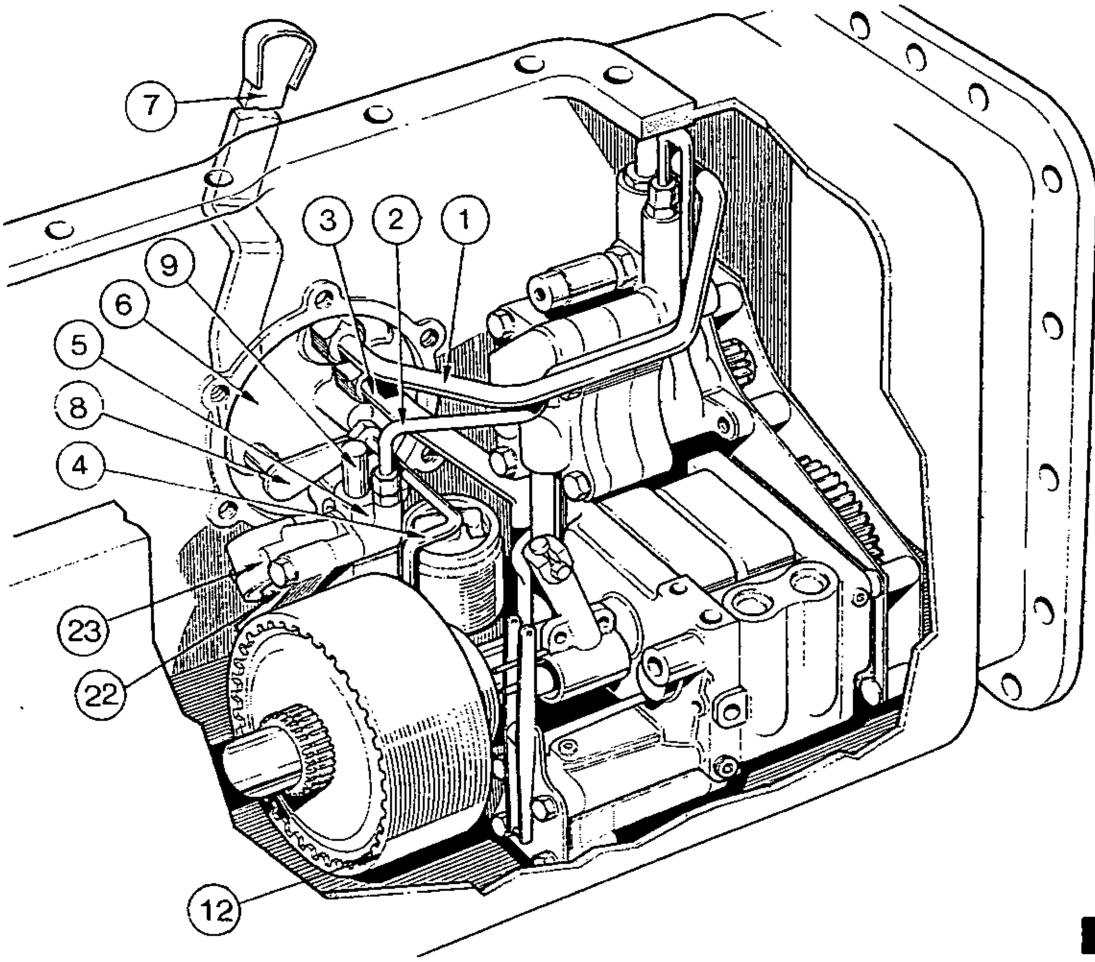


FIG. 12

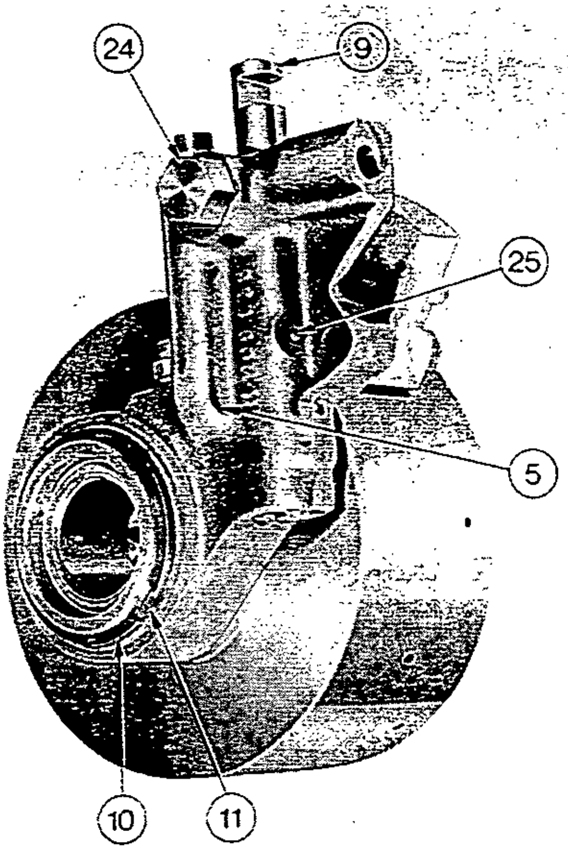


FIG. 13

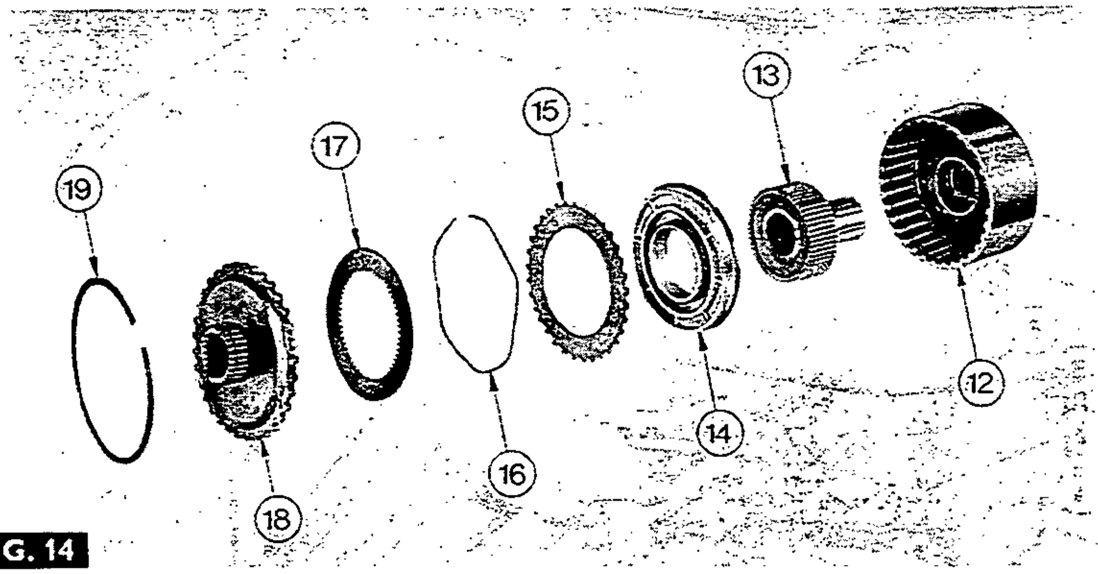


FIG. 14

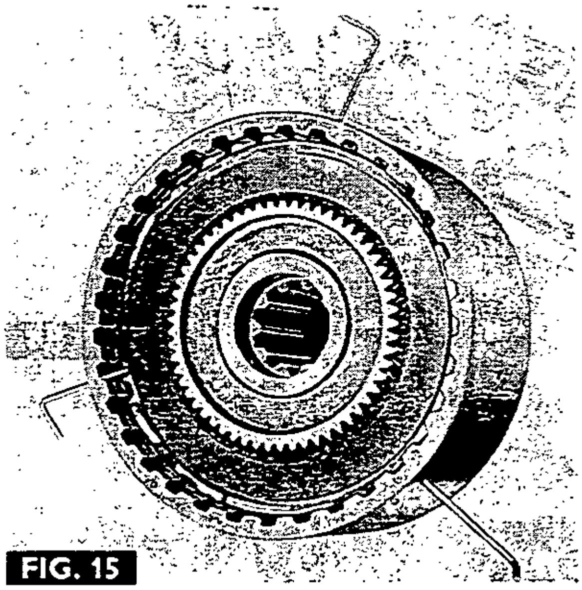


FIG. 15

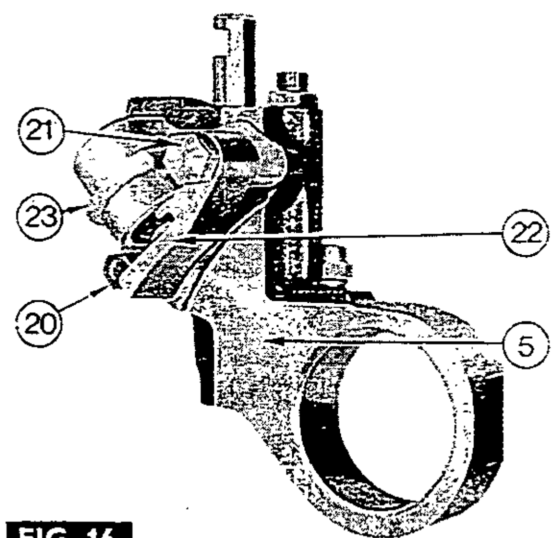


FIG. 16

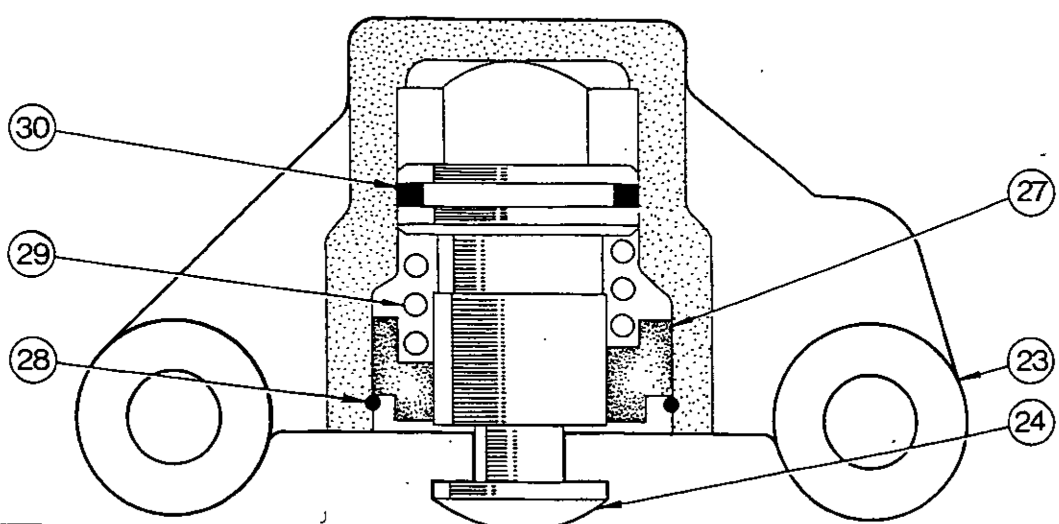


FIG. 17

2. Fig.13. Remove the snap ring (10), thrust washer (11) and then the spool valve (5) from the clutch housing.
3. Fig.16. Remove the two bolts (20 and 21) securing the brake (22) and the brake housing (23) to the spool valve (5).
4. Fig.13. Remove the plug (24), spring and ball, then drive out the securing pin (25) and withdraw the spool (9) from the spool valve (5).
5. Fig.17. To service the brake assembly, remove the snap ring (28), guide (26), spring (29) and piston (27). Remove the 'O' ring (30) from the piston.

Examine all parts for scoring, wear or damage and replace if necessary. Always fit new 'O' rings and snap rings.

Reassembly

1. Fig.17. To reassemble the brake assembly, fit a new 'O' ring (30) on the piston (27) then refit the piston, spring (29), and guide (26) in the brake housing (23) and secure with a new snap ring (28).
2. Fig.13. Slide the spool (9) into the valve (5), then align the flat on the spool with the hole in the valve and fit a new securing pin (25).
3. Refit the ball, spring and plug (24).
4. Fig.16. Engage the brake (22) into the slot at the end of the piston (27 Fig. 6) then refit the brake and the brake housing (23) to the spool valve and secure with the two bolts (20 and 21).

   NOTE – BEFORE FULLY TIGHTENING THE BOLTS (20 and 21) ENSURE THAT THE BRAKE (22) IS FLUSH AGAINST THE BRAKE HOUSING (23).

5. Fig.13. Refit the spool valve (5) to the clutch, then the thrust washer (11) and secure with a new snap ring (10).
6. Refit the i.p.t.o. unit as stated in operation 5B-08-12.

P.T.O. SIDE COVER

Removal and Refitment 5B-11-15
Special Tools Required: See operation 7A-03-16

Removal

1. Drain the transmission oil to the low mark on the dipstick.
2. Disconnect the two hoses (if fitted), from the unions on the side cover to the spool valve manifold, at the side cover.
3. Remove the lift cover as stated in operation 7A-03-16.
4. Remove the two banjo bolts and manifold (auxiliary hydraulic tractors without spool valves) or the two unions and nuts (auxiliary hydraulics with spool valves) from the side cover.
5. Fig.12. Remove the two snap rings securing the two pipes (1 and 3) (auxiliary hydraulic tractors only) to the side cover and lift out the return pipe (3).
6. Disconnect the pressure test pipe (4) at the spool valve (5).
7. Remove the six bolts securing the side cover to the centre housing.
8. Manoeuvre the side cover, complete with the lever (7), selector (8) and pipe (4) out of the centre housing.

Refitment

1. Position the side cover, with a new gasket, on the centre housing, locating the selector (8) in the spool (9) and the dowel pin in the spool valve (5).
2. Secure the side cover, rear footplate bracket and clutch pedal (if removed) with six bolts, tightened to a torque of 7,6 Kg-m (55 lb-ft).
3. Reconnect the pressure test pipe (4) to the spool valve.
4. Refit the return pipe (3), then the delivery pipe (1) (auxiliary hydraulic tractors only), with new sealing rings, to the side cover and secure them with new snap rings.
5. Refit the manifold (auxiliary hydraulic tractors without spool valves), with a new gasket, and secure with two banjo bolts and new sealing rings. Tighten the banjo bolts to a torque of 5,5 Kg-m (40 lb-ft).
6. Refit the two nuts and unions (auxiliary hydraulic tractors with spool valves) to the side cover. The right angle union must be fitted to the rear hole in the side cover.
7. Refit the lift cover as stated in operation 7A-03-16.
8. Reconnect the hose (if fitted), from the tee-piece union on the spool valve manifold, to the rear union on the side cover.
9. Reconnect the hose (if fitted), from the right angle union on the spool valve manifold, to the front union on the side cover.

Servicing | 5B-12-15
Special Tools Required: See operation 7A-03-16

Disassembly

1. Remove the p.t.o. side cover as stated in operation 5B-11-15.
2. Remove the nut securing the pressure test pipe and remove the pipe.
3. Drive out the roll pin securing the lever to the selector shaft.
4. Withdraw the selector shaft from the side cover and remove the detent and spring.
5. Remove the sealing ring from the selector shaft.

Reassembly

1. Examine the detent and spring and replace if necessary, then fit the spring and detent to the side cover.
2. Refit the selector shaft to the side cover, then fit a new sealing ring to the shaft.
3. Refit the lever and secure with a new roll pin.
4. Refit the pressure test pipe, with new sealing ring, to the side cover and secure with the nut.
5. Refit the p.t.o. side cover as stated in operation 5B-11-15.

P.T.O. SHAFT

Oil Seal
Removal and Replacement 5B-13-16

Special Tools Required: MF 167 Seal Protector
MF 168 Seal Remover/Replacer
550 Universal Handle

Removal
1. Drain the centre housing of oil.
2. Remove the pin from the control beam lower pivot.
3. Remove the p.t.o. shield, cap, check chain mounting bracket and oil seal housing retainer plate.
4. Slide the oil seal and housing assembly off the p.t.o. shaft.
5. Fig. 3. Remove the oil seal using tool MF 168 and 550 handle as shown.

Replacement
1. Fig. 4. Replace the oil seal using tool MF168 and 550 handle as shown.
2. Fig. 5. Fit oil seal protector MF 167 over the rear end of the p.t.o. shaft and slide the oil seal assembly onto the shaft as shown. Remove the oil seal protector.
3. Replace the oil seal housing retainer plate (with cut-out facing downwards) and locate onto the two flats on the oil seal housing.
4. Refit the check chain mounting bracket, p.t.o. cap, shield and control beam pin.
5. Refill the centre housing with recommended oil.

Shaft Removal and Refitment 5B-14-16

Special Tools Required: MF 167 Seal Protector
MF 168 Seal Remover/Replacer
550 Universal Handle

Removal
1. Drain the centre housing of oil.
2. Remove the pin from the control beam lower pivot.
3. Remove the p.t.o. shield secured by one bolt and spring washer.
4. Remove the p.t.o. cap.
5. Remove the four nuts, four spring washers, two spacers and two bolts securing the check chain mounting bracket, and remove the bracket from the centre housing.
6. Remove the p.t.o. shaft oil seal housing retainer plate.
7. Withdraw the p.t.o. shaft from the centre housing, complete with oil seal assembly and bearing.
8. Remove the oil as stated in operation 5B-13-16.

Refitment
1. Fit a new seal to the housing before reassembly as stated in operation 5B-13-16.
2. Enter the p.t.o. shaft with its bearing into the centre housing and align the splines on the front end of the shaft into the i.p.t.o. unit.
3. Fig. 5. Fit oil seal protector MF 167 over the rear end of the p.t.o. shaft and slide the oil seal assembly onto the shaft as shown. Remove the oil seal protector.
4. Replace the oil seal housing retainer plate (with cut-out facing downwards) and locate onto the two flats on the oil seal housing.
5. Replace the check chain mounting bracket, p.t.o. cap, shield and the control beam pin.
6. Refill the centre housing with recommended oil.

Rear Bearing
Removal and Replacement 5B-15-16

Special Tools Required: MF 167 Seal Protector
MF 200 Hand Press
MF 200-25 Adapter

Removal
1. Remove the p.t.o. shaft as stated in operation 5B-14-16
2. Slide the oil seal assembly off the p.t.o. shaft.
3. Remove the bearing retaining snap ring from the collar on the p.t.o. shaft.
4. Fig. 6. Press off the bearing using multi-purpose bearing remover MF 200-25 as shown.
5. Examine the bearing and replace if necessary.

Replacement
1. Press the bearing onto the p.t.o. shaft.
2. Refit the snap ring.
3. Refit the p.t.o. shaft and seal, as stated in operations 5B-13-16 and 5B-14-16 not forgetting to fit a new 'O' ring.

Needle Roller Bearing
Removal and Replacement 5B-16-16

Special Tools Required: See operations 7A-03-16 and 3A-05-03
MF 195 Puller
MF 195-5 Adapters

Removal
1. Remove the i.p.t.o. unit as stated in operation 5B-08-12.
2. Remove the Left Hand axle shaft housing assembly and the differential assembly, as stated in operation 5A-20-17.
3. Remove the p.t.o. shaft as stated in operation 5B-14-16.
4. Fig. 7. Assemble tool MF 195-5/1 to the needle roller bearing from the front. Fit tool MF 195 and bar MF 195-5/2 to the centre housing as shown, screw the bar into tool MF 195-5/1 and remove the bearing.
5. Examine the bearing and replace it if necessary.

Replacement
1. Fig. 8. Position the new bearing squarely over its bore in the centre housing from the rear. Fit tool MF 195-5/1 into the bearing from the rear. Screw the bar tool MF 195-5/2 into tool MF 195-5/1 from the front and, using a suitable support for main tool MF 195, pull the bearing into its bore in the centre housing as shown.
2. Refit the p.t.o. shaft as stated in operation 5B-14-16.
3. Refit the differential case assembly, and Left Hand axle shaft housing assembly, as stated in operation 5A-20-17.
4. Refit the i.p.t.o. unit as stated in operation 5B-08-12.

HYDRAULIC TEST

When carrying out hydraulic tests, clean fresh oil, of the recommended grade must be used an should be warmed to a temperature of 50°C (120°F) by running under load, before testing. The use of either excessively hot, or cold oil can seriously affect the instrument readings.

I.P.T.O. Pressure Test 5B-17-17
Special Tools Required: MF 810 Gauge
MF 810-6 Adapter.

1. Fig. 18. Remove the plug on the side cover and fit the adapter MF 810-6 and the MF 810 Gauge as shown.
2. Start the engine and select Multi-Power 'HIGH' and engage 'ENGINE P.T.O.' With the oil at the correct temperature the gauge should indicate the following minimum pressures,

550 engine rev/min	17,5 Kg/cm^2 (250 lb/in^2)
2000 engine rev/min	25,3 Kg/cm^2 (360 lb/in^2)

3. Disengage p.t.o. and stop engine, remove the gauge and adapter and refit the plug in the side cover.

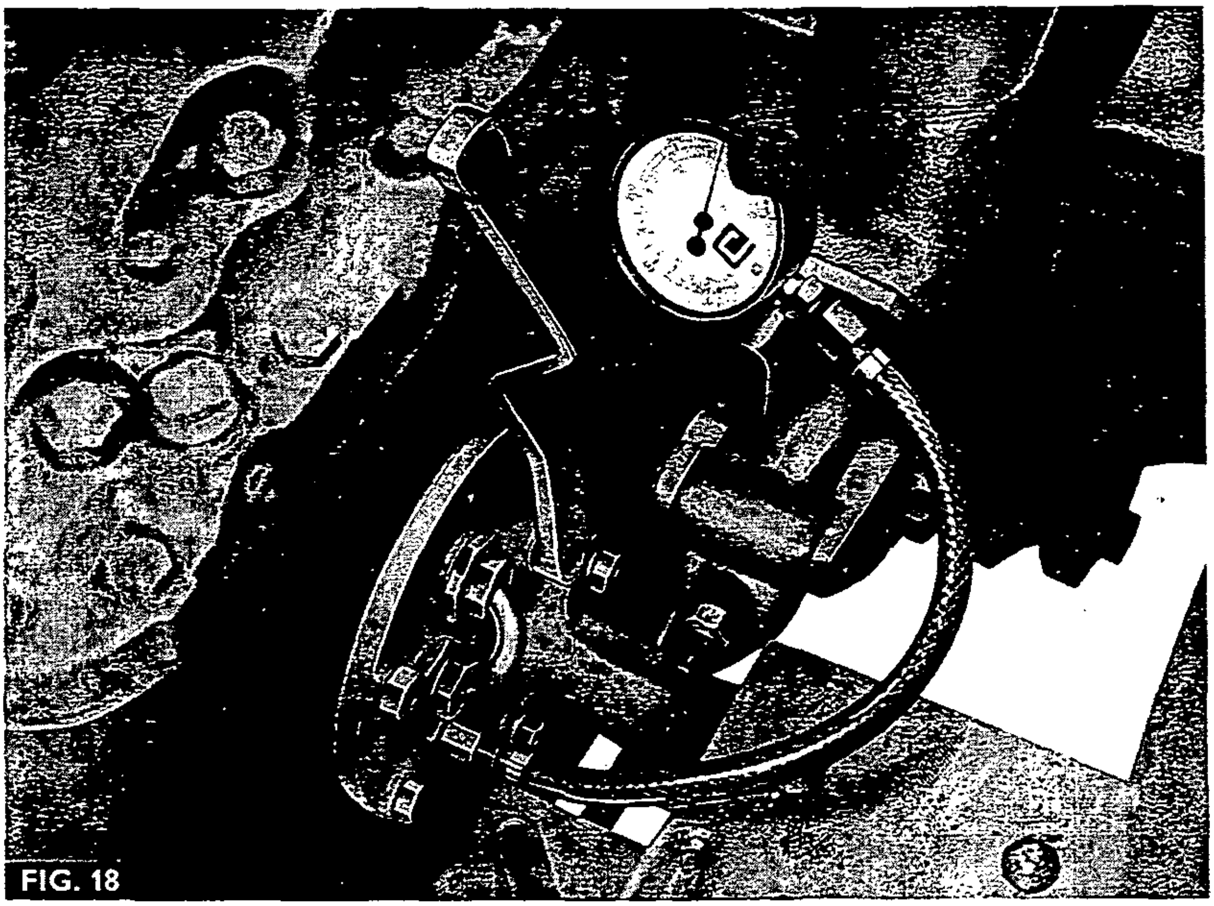


FIG. 18

FRONT AXLE

Part 6 Section A

GENERAL

The front axle assembly consists of a centre beam and two outer axles. The centre beam pivots on a pin, which is located in bushes in the axle support. The pin is secured to the centre beam by a peg bolt and locknut. The outer axles can be bolted to the centre beam in alternative positions to provide front wheel track adjustment.

FRONT TRACK ADJUSTMENT 6A-01-02

The front track is adjustable in 102 mm (4 in) steps from *1219 to 2032* mm (48 to *80 in*) (*1320* to 2032 mm (52 to 80 in) for power steering tractors). For settings above 1625 mm (64 in) the foot throttle (if fitted) must be repositioned.

The settings from 1219 to 1828 mm (48 to 72 in) are obtainable as follows:–

1. Jack up the front of the tractor.
2. Fig. 1. Remove the two bolts (1), nuts and washers securing each outer axle arm to the centre beam.
3. Remove the bolt (2), nut and washer securing each power steering ram bracket to the centre beam (power steering tractors only)

   NOTE – DO NOT REMOVE THE BOLT (5) SECURING EACH RAM BRACKET TO THE OUTER AXLE ARMS.

4. Loosen the locknut (4) and bolt (3) securing each telescopic ball end to the front of each drag link.
5. Fig. 2. Adjust the outer axle arms and the ball ends to the required track setting.
6. Refit the bolts (1), nuts and washers, ensuring that the bolt heads are correctly located in the triangular holes in the centre beam, and tighten the bolts to 22 kg-m (160 lb-ft).
7. Refit the bolts (2), nuts and washers and tighten to 7 kg-m (50 lb-ft) (power steering tractors only).

   NOTE – THESE BOLTS ARE NOT USED FOR SETTINGS ABOVE 1422 MM (56 IN) BUT SHOULD BE RETAINED IN THE CENTRE BEAM FOR USE WHEN REVERTING BACK TO SETTINGS OF 1422 MM (56 IN) OR LESS.

8. Tighten the bolts (3) to 5 Kg-m (35 lb-ft) and then tighten the locknuts (4).

For track settings of 1930 mm (76 in) and 2032 mm (80 in), reverse the front wheels and set the outer axles to 1727 mm (68 in) and 1828 mm (72 in) respectively.

NOTE – THE 1930 MM (76 IN) AND 2032 MM (80 IN) SETTINGS SHOULD ONLY BE USED WHEN ABSOLUTELY NECESSARY AND NEVER WITH FRONT MOUNTED EQUIPMENT.

Foot Throttle Adjustment

If a front wheel track setting of 1625 mm (64 in) or over is required, reposition the foot throttle as follows:–

1. Fig. 3. Remove the bolt (6) securing the relay lever to the relay shaft.
2. Remove the two bolts (8) securing the pedal support bracket to the footrest mounting bracket.
3. Position the pedal support bracket to the two outer holes in the footrest mounting bracket and secure with the two bolts (8).
4. Position the relay lever (7) to the inner groove on the relay shaft and secure with the bolt (6).

Toe-in Adjustment 6A-02-02

Special Tool Required: Track Gauge

1. Locate the tractor on firm level ground and place the front wheels in a straight ahead position.
2. Using a suitable track gauge, check the toe-in, which should be 3,2 mm (⅛ in).
3. If adjustment is required, slacken the bolt securing the drag link rear ball end, and rotate the ball end clockwise or anti-clockwise to increase or decrease the toe-in as required.
4. Reitighten the drag link bolt, ensuring that it runs directly across the slot in the drag link.

   NOTE – ADJUSTMENT SHOULD BE MADE EQUALLY TO BOTH DRAG LINK REAR BALL ENDS.

FRONT HUB SERVICING 6A-03-02

Disassembly

1. Jack up the tractor and remove the wheel.
2. Fig. 4. Remove the hub cap (17) and gasket (16).
3. Straighten out and remove the split pin (15).
4. Remove the slotted nut (14) and tab located washer (13).
5. Lift the hub (11) complete with bearings (10 and 12) and seal (9) from the axle spindle.
6. Remove the outer bearing cone (12) from the hub.
7. Drive out the inner bearing cone (10) from the hub, this will also remove the seal (9).
8. Drive out the bearing cups from the hub.

Examination

Thoroughly wash out the old grease or dirt from the hub components, using CLEAN paraffin.
Check the condition of the hub, spindle and roller bearings.
Any worn or damaged components should be replaced. Always fit a new seal (9), split pin (15) and gasket (16).

Reassembly

1. Refit the bearing cups into the hub.
2. Refit the inner bearing cone (10).
3. Fit a new seal (9), with the flat face towards the centre of the hub, and tap the seal right into the recess in the hub.
4. Pack the hub ⅓ full with grease and position the hub on the axle spindle.
5. Refit the outer bearing cone (12), the tab located washer (13) and the slotted nut (14).
6. Rotate the hub and tighten the slotted nut to 8,3 kg-m (60 lb-ft), then slacken off the nut two to three flats to give hub end float.
7. Fit a new split pin (15).
8. Refit the hub cam (17) with a new gasket (16).
9. Grease the hub until grease exudes past the seal.
10. Refit the wheel and tighten the bolts to 8,3 kg-m (60 lb-ft), then remove the jack.

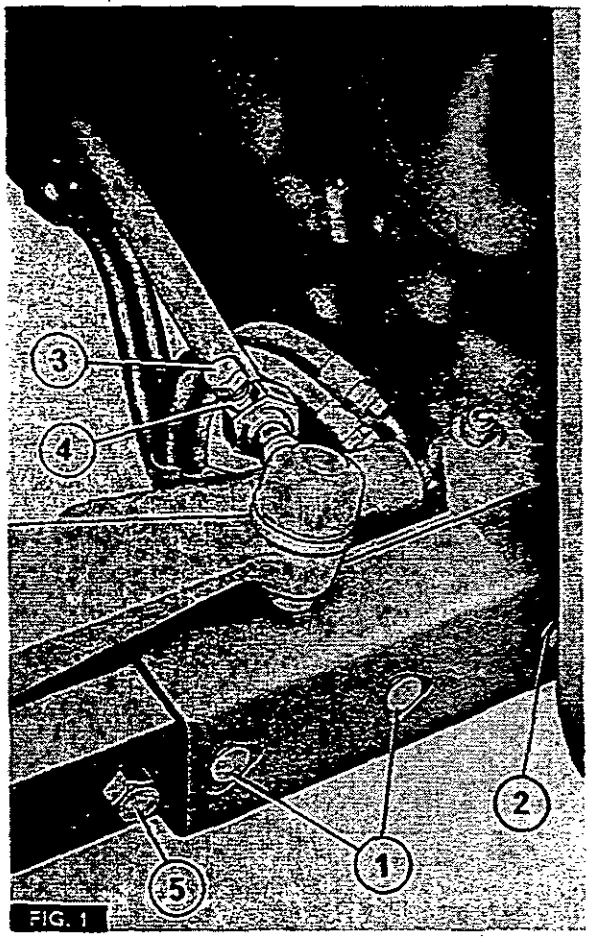


FIG. 1

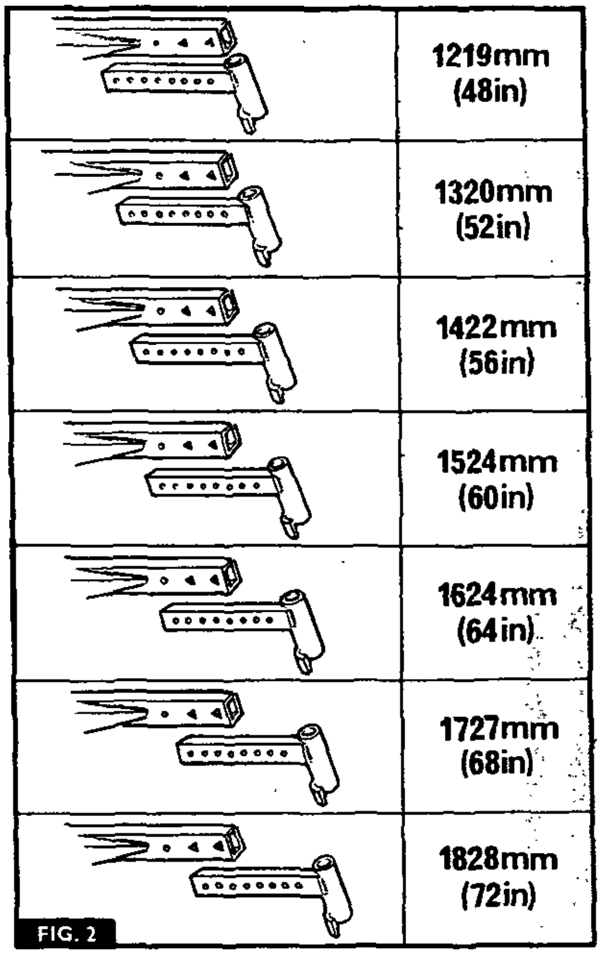


FIG. 2

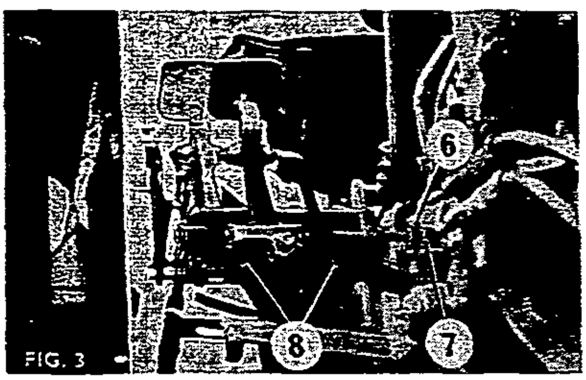


FIG. 3

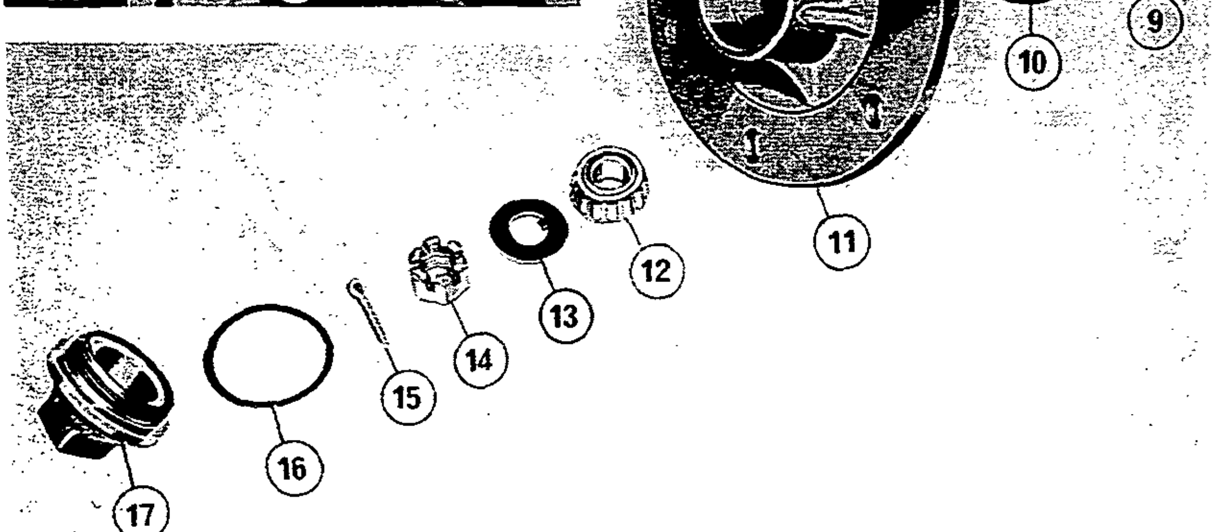


FIG. 4

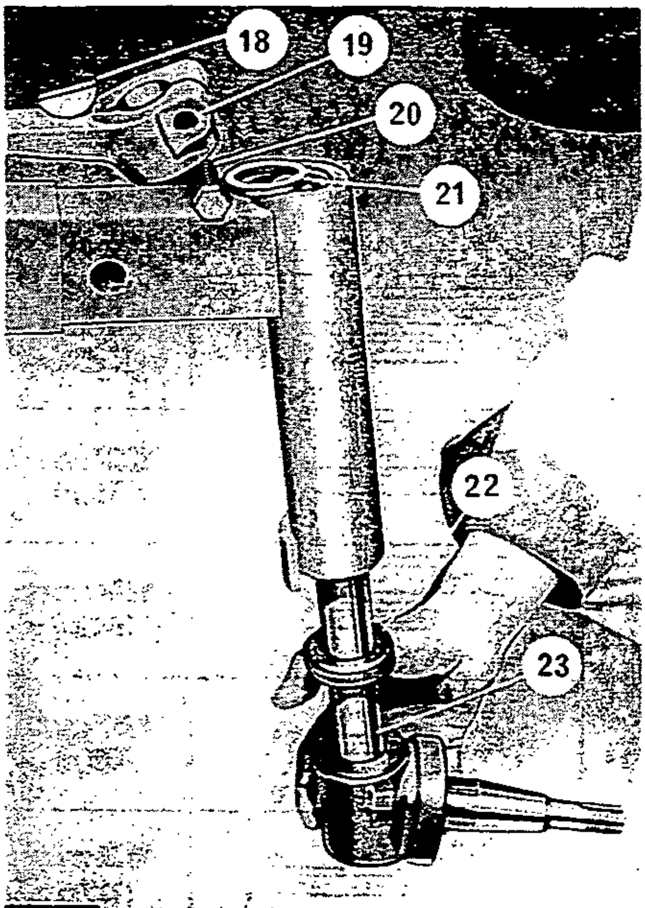


FIG. 5

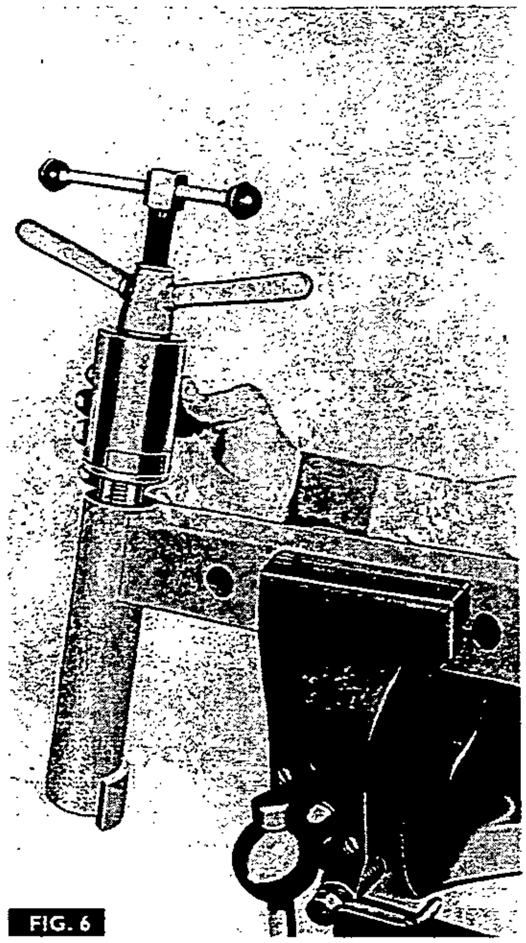


FIG. 6

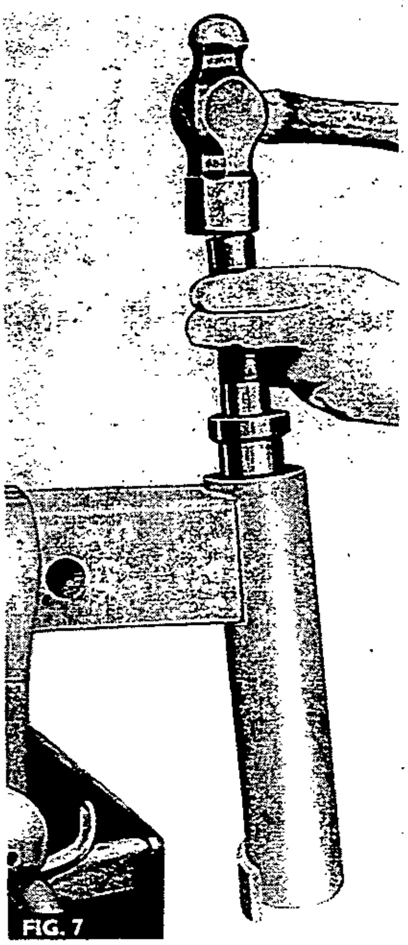


FIG. 7

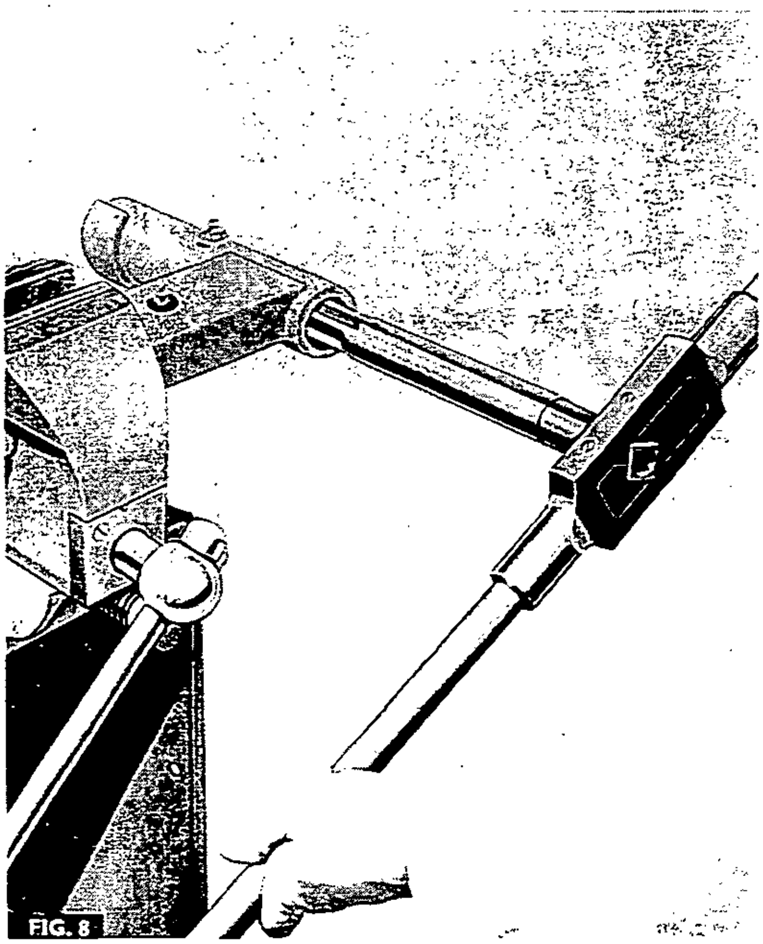


FIG. 8

SPINDLE SHAFT

Removal and Refitment 6A-04-05

Removal
1. Jack up the tractor and remove the hub as stated in operation 6A-03-02.
2. Fig. 5. Remove the bolt (20), nut and washer securing the spindle arm (19) and detach the arm from the spindle shaft (23).
3. Remove the key (18) and the seal (21) from the spindle shaft.
4. Lower the spindle shaft (23) and bearing (22) out of the housing.

Examination
Examine the spindle shaft (23) and the thrust bearing (22) for wear or damage. When reassembling use a new seal (21), key (18) and replace the thrust bearing (22) if necessary.

Refitment
1. Fit the bearing (22) to the spindle (23) with the thrust face downwards.
2. Refit the spindle to the housing, then fit a new seal (21) and key (18).
3. Refit the arm (19), securing it with the bolt (20), washer and nut and tighten the bolt to 7 kg-m (50 lb-ft).
4. Grease the spindle, through the nipple on the housing, with a recommended grease.
5. Refit the hub as stated in operation 6A-03-02.

OUTER AXLE ARM

Removal and Refitment 6A-05-05

Removal
1. Jack up the tractor and remove the front wheel.
2. Remove the spindle and hub assembly as stated in items 2 to 4 of operation 6A-04-00.
3. Fig. 1. Remove the two bolts (1) nuts and washers securing the outer axle arm to the centre beam.
4. Remove the bolt (2) nut and washers securing the power steering ram bracket to the centre beam (power steering tractors only).
5. Remove the bolt (5) nut and washer securing the power steering ram bracket to the outer axle arm (power steering tractors only).
6. Withdraw the outer axle arm from the centre beam.

Refitment
1. Refit the outer axle arm in the centre beam.
2. Secure the power steering ram bracket to the outer axle arm with the bolt (5) nut and washer and tighten the bolt to 22 kg-m (160 lb-ft) (power steering tractors only).
3. Refit the bolts (1) nuts and washers, ensuring that the bolt heads are correctly located in the triangular holes in the centre beam and tighten the bolts to 22 kg-m (160 lb-ft).
4. Refit the bolt (2) nut and washers and tighten to 7 kg-m (50 lb-ft) (power steering tractors only).
5. Refit the spindle and hub assembly as stated in items 1 to 4 of operation 6A-04-00.
6. Refit the wheel and tighten the bolts to 8,3 kg-m (60 lb-ft), then remove the jack.

Spindle Housing Servicing 6A-06-05

Special Tools Required: MF 263 Bush Remover
MF 263-1 Adapter
MF 19A Reamer
550 Universal Handle

Procedure
1. Remove the outer axle arm as stated in operation 6A-05-00.
2. Fig. 6. Assemble the bush remover MF 263 and adapter MF 263-1 as shown.
3. Enter the adapter into the bush by turning the upper handle, then extract the bush by rotating the lower handle.
4. Invert the outer axle arm and similarly extract the other bush.
5. Fig. 7. Position the new bush squarely over the bore, as shown, then drive in the new bush using the 550 handle and the adapter MF 263-1.
6. Invert the outer axle arm and similarly drive in the other new bush.
7. Fig. 8. Using the tool MF 19A, as shown, ream the two bushes.
8. Remove all swarf from the housing by washing the housing in clean paraffin and ensure that the grease nipple hole is clear.
9. Refit the outer axle arm as stated in operation 6A-05-00.

CENTRE BEAM ASSEMBLY

Removal and Refitment 6A-07-05

Removal
1. Remove the radiator as stated in Part 3B.
2. Jack up the tractor under the sump.
3. Remove the nuts securing each drag link ball end to the spindle arms and release the ball ends.
4. Fig. 1. Remove the two bolts (1) nut and washers securing each outer axle arm to the centre beam.
5. Remove the bolt (2) nut and washers securing each power steering ram bracket to the centre beam (power steering tractors only).

NOTE – DO NOT REMOVE THE BOLT (5) SECURING EACH RAM BRACKET TO THE OUTER AXLE ARMS.

6. Withdraw each outer axle arm from the centre beam complete with their wheels.
7. Fig. 9. Remove the circlip (24), peg bolt (28), nut (27) and washer (26) securing the pivot pin (30).
8. Fit a 7/16 UNC bolt into the front of the pivot pin (30).
9. With one operator each side supporting the centre beam (25), withdraw the pivot pin (30).
10. Lift the centre beam clear of the axle support (29) and remove the shims (31).

Examination
Check the end faces of the centre beam journals and the pivot pin for wear. Examine all bores and threads for wear or damage.
In the event of accident damage, check the centre beam for bending or twisting. If the centre beam has been in any way deformed, it must be replaced, as steering characteristics and tyre wear can be severely affected. Also the centre beam may have been dangerously weakened due to straining of the welded seams.

Refitment

1. Place the centre beam into position on the axle support.
2. With one operator each side supporting the centre beam, align the bore of the centre beam and the support casting, then push the pivot pin, with the circlip groove towards the rear of the tractor, into position.
   Do not yet fit the peg bolt (28) or circlip (24). (24).
3. Push the centre beam fully rearwards, then measure the end float using feeler gauges.
4. From the following tables, select shims to give the correct end float.

Tractors prior to Serial No. 600465

End Float: 0,07 to 0.17 mm (0.003 to 0.007 in)

Part No.	Shim Thickness mm.	in.
888 361 M1	0,127	0.005
888 362 M1	0,254	0.010
888 366 M1	0,508	0.020

Tractors after Serial No. 600465

End Float: 0,05 to 0,25 mm (0.002 to 0.010 in)

Part No.	Shim Thickness mm.	in.
1863 312 M1	0,89	0.035
1863 313 M1	1,02	0.040
1863 314 M1	1,15	0.045

5. Supporting the centre beam, withdraw the pivot pin (30), then fit the new shims (31) at the front of the centre beam, then refit the pivot pin, securing it with a new circlip (24).
6. Thoroughly degrease the tapped hole in the centre beam, the peg bolt (28) and the locknut (27).
7. Rotate the pivot pin until the peg bolt hole is aligned with the hole in the centre beam.
8. Apply a few drops of either Locktite Grade AV or Casco Metalock LF5 to the peg bolt, then fit the washer (26) and the peg bolt and nut (27 and 28). Tighten the peg bolt to 7,5 kg-m (55 lb-ft), then tighten the lock nut to 5,5 kg-m (40 lb-ft).
9. Remove the 7⁄16 UNC bolt from the pivot pin.
10. Refit the outer axle arms to the centre beam.
11. Fig. 1. Refit the bolts (2) nuts and washers and tighten to 7 kg-m (50 lb-ft) (power steering tractors only)
12. Refit the bolts (1), nuts and washers, ensuring that the bolt heads are correctly located in the triangular holes in the centre beam, and tighten the bolts to 22 kg-m (160 lb-ft).
13. Refit the drag link ball ends to the spindle arms and tighten the nuts to 12,5 kg-m (90 lb-ft).
14. Refit the radiator as stated in Part 3B and remove the jack.

FRONT AXLE SUPPORT

Bush Removal and Replacement 6A-08-06

Special Tools Required: MF 322 Bush Remover and Replacer
550 Universal Handle

Removal

1. Remove the centre beam as stated in operation 6A-07-00.
2. Fig. 10. Drive out the two bushes from the axle support using the bush remover MF 322 and the 550 handle.

Refitment

1. Using the 550 handle and the bush replacer MF 322 drive the new bushes into the axle support, as shown.

   NOTE – THE BUSHES MUST BE 0,508 MM (0.020 IN) BELOW THE FACES IN THE SUPPORT ADJACENT TO THE CENTRE BEAM.

2. Refit the centre beams as stated in operation 6A-07-00.

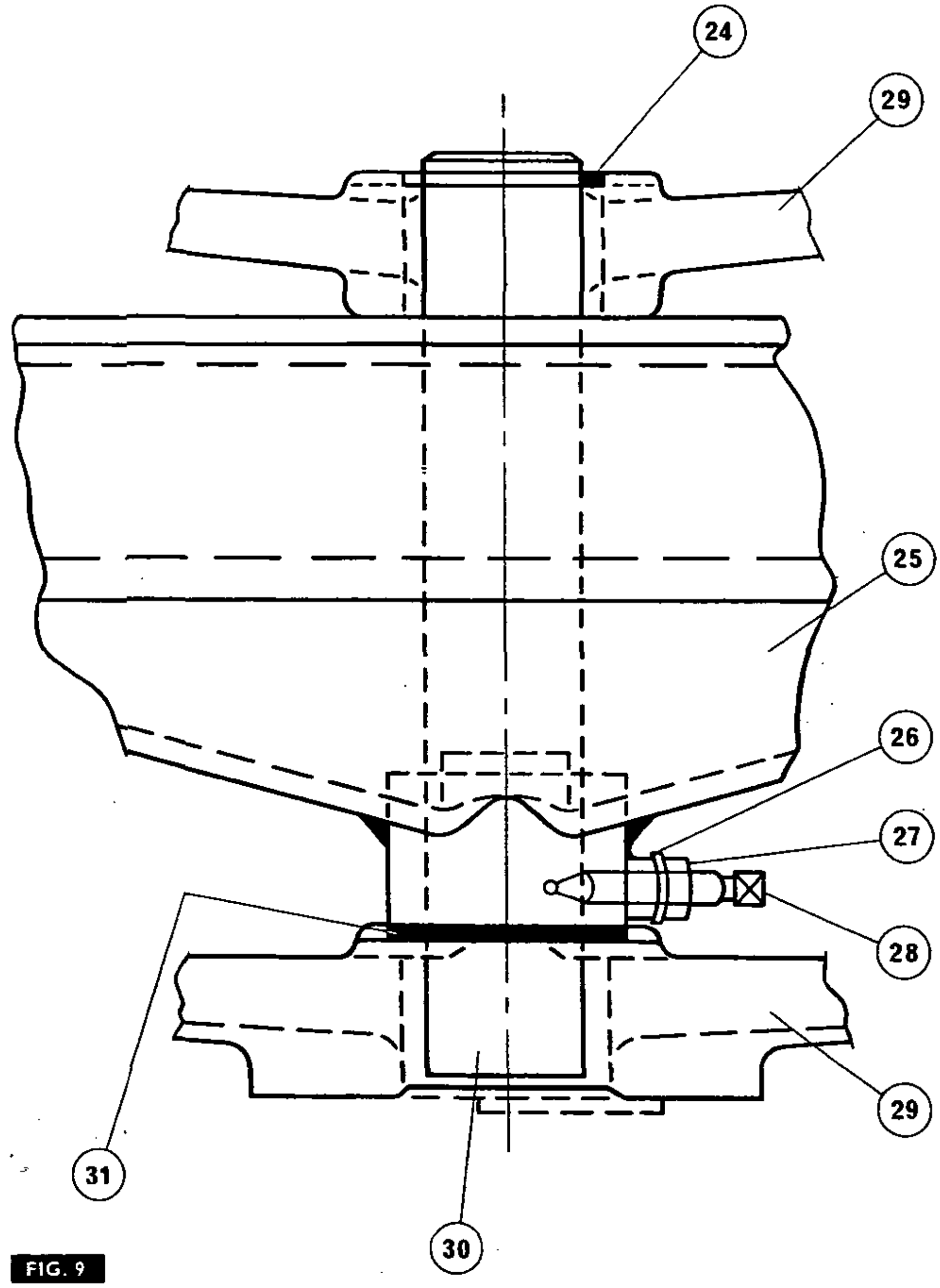


FIG. 9

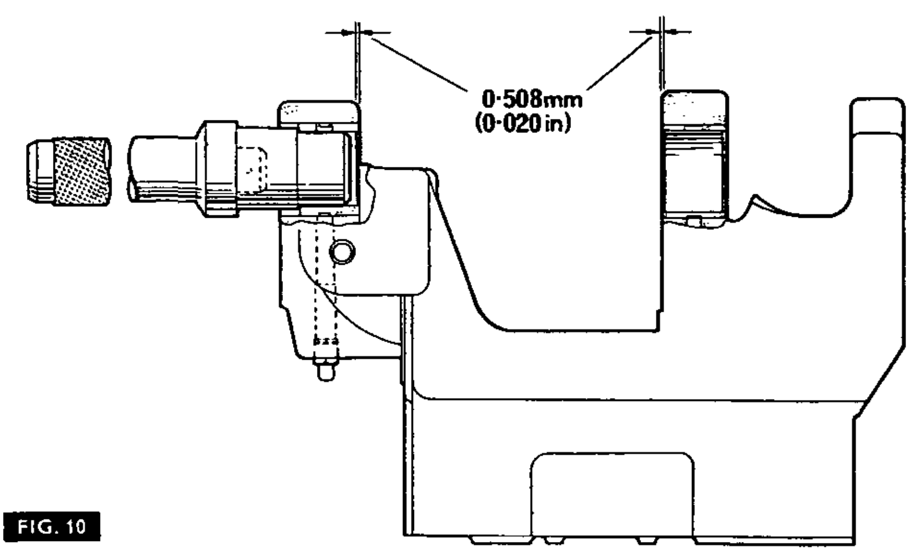


FIG. 10

WHEELS AND TYRES

Part 6 Section B

WHEELS AND TYRES

REAR TYRES

General
The tyres fitted to MF Farm Machinery tractors can be divided fairly easily into three separate categories:

1. Field (Dunlop RT40, Goodyear Traction Sure Grip or Firestons F151).
2. Universal Field and Road (Goodyear Sure Grip All Service, Firestone F151 or Dunlop RT35).
3. Grassland, Sand or Hard Surfaces (Firestone A.N.S. or Goodyear All Weather).

Each of the above types of tyre has been designed especially to give the best grip and wear characteristics obtainable in the specified conditions. On grassland, such as parks and golf courses, worn field or universal type tyres can also be used successfully.

Traction
Very few tractors are used to their fullest capacity, mainly due to inability of the driver to control excessive wheelspin.

If a tractor (or any other wheel driven machine) is being driven along a smooth flat surface, the tyre tread will grip the road provided that the torque applied to the wheel is not in excess of the coefficient of friction between the tyre and the road. When the tyre grips the road without slipping, the condition is one of 100% traction.

Unfortunately, due to tread design and other factors, the maximum rate of traction normally obtainable in the most favourable conditions (i.e. smooth concrete) is approximately 90%, i.e. the tractor will pull a load of 90% of the weight acting on its rear wheels, e.g. a tractor working on smooth dry concrete, with a weight of 5000 kg acting on its rear wheels. Allowing for a coefficient of traction of 90%, the tractor will be capable of pulling a load of approximately:

$$\frac{5000}{1} \times \frac{90}{100} = 4500 \text{ kg}$$

When ploughing or performing similar operations in the field, the coefficient of traction is reduced to around of 45 to 50%. This is the reason for ballasting the rear end of the tractor, thereby increasing the weight acting on the rear axle and thus increasing the tractive effort of the tractor.

The coefficients of traction mentioned can only be achieved by ensuring that all of the factors which affect the tractor performance are adjusted to suit the ground condition.

Some of the factors are:

1. Tyre Pressures – must be set at the lowest pressure for the load being carried and the size and the ply-rating of tyre being used.
2. Tyre Tread – the tyre tread should not be more than ⅓ to ½ worn for efficient ploughing. The lug-bars must face in the correct direction (most tyres have arrows on the sidewalls to indicate the correct direction of rotation).
3. The correct section and size of tyre should be used for certain ground conditions. Some examples are:

   a. Clay – Large diameter, narrow section tyres. These tyres have a small contact area and will concentrate a larger amount of weight on the on the contact area than would a wide section tyre, thus helping the lug-bars to 'bite' into the soil and give traction.
   b. Very light sandy soil – or peat. Any wide section tyre will allow the weight acting on the rear end of the tractor to be spread over a large area than with a narrow tyre, thus preventing sinkage and crushing of the furrow.
   c. Stony Ground – Large diameter, wide section tyres will spread the wear out over a large area of tread and give good flotation.
   d. Sand – Sand requires an entirely different type of tyre, for if ordinary lug-bar type tyres are used, they will greatly disturb the surface of the sand and rapidly dig themselves into an ever increasing depth. In these conditions, a smooth tread pattern, on as wide a tyre as possible is required, to disturb the surface as little as possible and give good flotation.

CORRECT TYRE USAGE FOR ECONOMICAL LIFE

Pressures
Tyre pressure must be maintained at the manufacturers' recommended minimum to give the best possible performance. This minimum is determined by the weight acting on the rear end of the tractor and can be calculated from the table given in the Specification Seciton.

Incorrect inflation of tyres has the following effects.

Over-Inflation
Excessive tyre pressure deprives the tyre of its self-cleaning properties. This causes wheelspin, which in turn causes sinkage, thus increasing the rolling resistance of the tyre and lowering the power available for traction.

Frequent and prolonged bouts of wheelspin cause rapid tyre wear. Another effect of over-inflation is that the casing of the tyre is very susceptible to damage from sharp rocks or similar objects due to the inability of the casing to 'give' on contact.

Under-Inflation
If a tyre has insufficient pressure to support the casing, this may be deflected to such an extent that the plies may become separated. Such damage is irrepairable and the tyre must be replaced. Excessive deflection allied to a high drawbar pull can cause wrinkling of the tyre sidewalls which, if allowed to occur continually can cause the tyre to 'creep' on the rim and tear out the valve.

A visible warning of under-inflation is uneven wear of the lug-bars, indicated by 'gouging' of the centre of the bars.

Cleanliness
Certain liquids can cause considerable harm to tyres, if they are not quickly removed. Some of the worst offenders are oil, grease and some crop sprays which can contain considerable quantities of acid or alkali. If any of the above penetrate into the plies through small holes or splits, rapid deterioration will result.

Effective Tyre Pressures
Details of the maximum pressures usable with the various sizes and ply-ratings of tyres fitted are given in the Specification Section. These maxima are only used when very heavy loading of the tractor is required.

Under normal conditions the following pressures can be used, but must be increased if extra loading is involved.

Ploughing: 0,84 kg/cm^2 (12 lb/in^2)

If bolt-on ballast weights are used, the pressure must be raised accordingly. When working on a hillside pressure should be raised by 0,14 kg/cm^2 (2 lb/in^2) in both tyres, because as each tyre alternately takes most of the load when it is on the side of the tractor nearest the bottom of the slope, the pressure must be raised accordingly to cope.

When using a non-reversible plough the pressure of the landside tyre may be reduced by 0,14 kg/cm^2 (2 lb/in^2) although the differential lock should be used to compensate for wheelspin by one wheel only.

Road Work
When driving a tractor on the road, higher speeds can be used than in the field. In such conditions the pressure can be raised by 0,28 kg/cm^2 (4 lb/in^2) (not Firestone F151) to prevent squirming and gouging of the lug-bars.

If a two wheel trailer, or manure spreader is used, the weight exerted on the tractor drawbar should be determined and the pressure adjusted to suit.

Using a Front End Loader
If a loader is fitted to the tractor, a counter-weight is frequently fitted to the tractor rear linkage as a safety precaution. If a counter-weight is to be fitted the tyre pressure should be raised to compensate.

INNER TUBE

Removal and Refitment 6B-01-03

Special Tools required: 'Bead-breaking' tool
3 lb. Hammer
Tyre levers

Removal
1. Lay the wheel on the ground with the valve uppermost.
2. Deflate the tyre by removing the valve core. Remove the valve retaining nut.
3. Fig. 1. Drive the 'bead-breaking' tool between the tyre and rim, taking care not to damage the rim or the tyre.
4. After the bead has been released from the rim, invert the wheel and repeat Item 3.
5. Fig. 2. Lubricate the rim, tyre and base of the tube with a solution of soap and water or similar rubber lubricant.

NOTE – NEVER USE PETROLEUM OR SILICONE BASE GREASES.

6. Fig. 3. Starting at the valve location, pry the tyre off the rim, taking small bites with tyre levers, and ensuring that the bead on the opposite side is fully located in the mounting well.
7. Fig. 4. With the wheel in a vertical position, pull the tyre forwards and remove the tube.

Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for foreign matter or damage.

Refitment
1. Fig. 5. Inflate the tube until 'rounded out'. Place the tube in the tyre with the valve located in the valve hole. Refit the valve retaining nut finger tight.
2. Fig. 6. Refit the tyre, starting opposite the valve location taking small bites with long tyre levers and keeping the fixed part of the bead fully located in the well.

A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help fitment.

NOTE – CARE MUST BE TAKEN NOT TO PINCH THE TUBE WHEN FITTING.

3. Fig. 7. Centre the tyre on the rim and inflate to approx. 2,5 kg/cm^2 (35 lb/in^2).

NOTE – NEVER STAND OVER THE ASSEMBLY WHEN INFLATING, REMOTE CONTROL INFLATION EQUIPMENT SHOULD BE USED.

4. Remove the valve core and completely deflate the tyre.
5. Refit the valve core and inflate to recommended pressure.

NOTE – IF BEADS FAIL TO SEAT AT 2,5 KG/CM^2 (35 LB/IN^2) THE TUBE MAY BE PINCHED, DO NOT INCREASE THE PRESSURE BUT REMOVE THE VALVE CORE AND RELEASE TYRE FROM RIM. LUBRICATE TYRE, BEAD AND RIM AND RE-INFLATE TO 2,5 KG/CM^2 (35 LB/IN^2). REPEAT PROCESS UNTIL BOTH BEADS ARE PROPERLY SEATED.

TYRE

Removal and Refitment 6B-02-04

Special Tools Required: 'Bead-breaking' tool
3 lb Hammer
Tyre levers

Removal

1. Remove inner tube as stated in operation 6B-01-03.
2. Figs. 8 & 9. With the wheel in a vertical position pry off the tyre taking small bites with the tyre levers. The use of rubber lubricant will help removal.

Refitment

1. Place the rim on the ground, lubricate the bead and rim and place the tyre on rim.
2. Fig. 10. Refit the tyre to rim, using long tyre levers.
3. Refit the inner tube as stated in operation 6B-01-03.

REAR WHEELS

General (Fig. 11)
This tractor is available with W10 x 32 pressed steel, single disc wheels fitted with 11–32 tyres.

TRACK SETTINGS

Fig. 12. Track settings between 1321 mm (52 in) and 1542 mm (60 in) are available with wheels set normally and from 1625 mm (64 in) to 1930 mm (76 in) with the wheels reversed.

TRACK ADJUSTMENT PROCEDURE

1. Select the required track setting.
2. Slightly slacken either the wheel to axle, or rim to disc nuts, or both, according to requirements.
3. Using a jack capable of lifting 3000 kg (3 tons) raise the rear wheels just clear of the ground.
4. Remove the rim from the disc, or the complete wheel, or both, and re-assemble them with the rim and disc in their new position. Tighten the nuts to a torque of 14 kg-m (100 lb-ft).
   If the wheels are to be reversed, they have to be transferred to the opposite side of the tractor.
5. Re-fit the wheel and tighten the wheel nuts progressively and evenly to a torque of 27,5 kg-m (200 lb-ft).
6. Lower the tractor to the ground and remove the jack.

BALLASTING

General
To impart extra weight on the rear wheels of a tractor, several methods may be employed:

1. Pressure Control or Draft Control
2. Liquid Ballast
3. Bolt-on Weights

Each of these methods has advantages and disadvantages, but all work well in practice and any two, or even all three may be combined for absolute efficiency.

PRESSURE CONTROL AND DRAFT CONTROL

This feature, exclusive to Massey-Ferguson tractors, is described in detail in Part 7A of this Manual.

LIQUID BALLAST

Liquid filling of the tyres is a well known and widely used method of weighting the rear of a tractor. To prevent damage by frost, calcium chloride should be dissolved in the water used to fill the tyres, thus forming an anti-freeze solution. The calcium chloride used should be 'Commercial Grade 70 to 72% $CaCl_2$'.

The following table and actual filling method is based on data supplied by the Dunlop, Goodyear and Firestone Tyre Companies. This table is, of necessity, a compromise, because tyres of the same nominal size manufactured by different companies differ slightly in internal dimensions, which may alter the degree of filling by a small percentage, but this will not affect the actual performance of the tyre.

MIXING THE CALCIUM CHLORIDE WATER SOLUTION

WARNING – NEVER POUR THE WATER ON TO CALCIUM CHLORIDE. ALWAYS ADD CALCIUM CHLORIDE TO WATER.

Procedure is as follows:

1. Consult the chart and weigh out the correct quantity of calcium (column 1) but do not put it in the mixing tank.
2. Measure the volume of water shown in column two and put it into the tank.
3. Add the calcium chloride to the water slowly.

NOTE – WHEN CALCIUM CHLORIDE AND WATER ARE MIXED A CHEMICAL REACTION CAUSES GREAT QUANTITIES OF HEAT TO BE PRODUCED. THE HOT SOLUTION MUST NOT BE USED – WAIT UNTIL IT HAS COOLED.

4. Add the remaining volume of water indicated in column 3 to the solution.

TYRES FILLED WITH WATER

If a tyre has been previously filled with water and calcium chloride anti-freeze is to be added, drain off the amount indicated in column 5 of the table.

Mix a solution from the quantities shown in columns 1 and 2 and allow to cool.

Re-fill the tyre with this solution to make up the correct filling.

WARNING – NEVER ATTEMPT TO ADD PURE CALCIUM CHLORIDE TO A TYRE FILLED WITH WATER, AS THE RESULTANT HEAT AND EXPANSION CAN CAUSE TYRE DAMAGE.

Ballasting Procedure
There are two methods of liquid ballasting tractor tyres, 75% filling and 100% filling. The 75% filling method is the most common, and is easier to achieve than 100% filling,not requiring a motorised pump.

The 100% filling increases casing vulnerability to impact damage and accordingly 75% filling is recommended by Tyre Manufacturers.

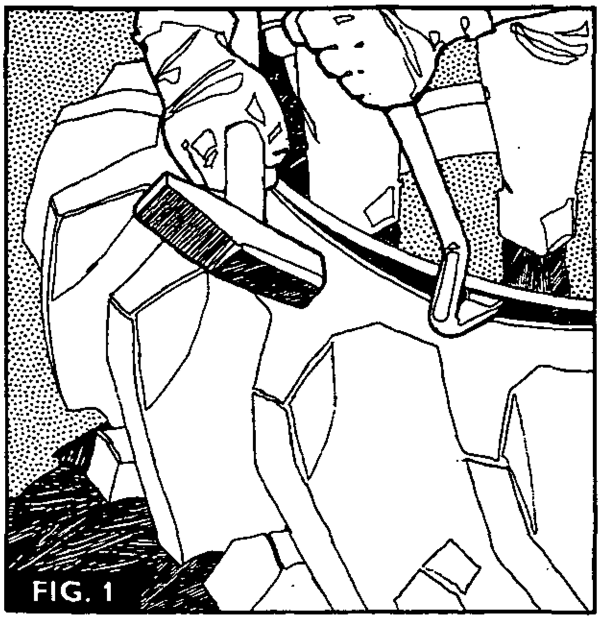
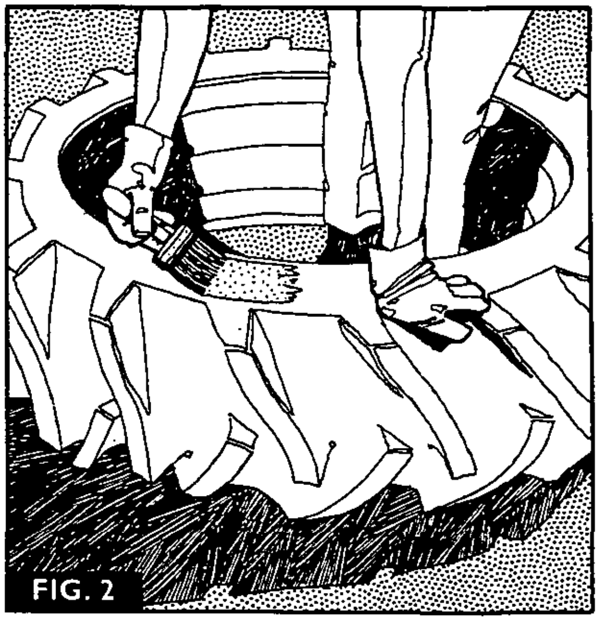


FIG. 1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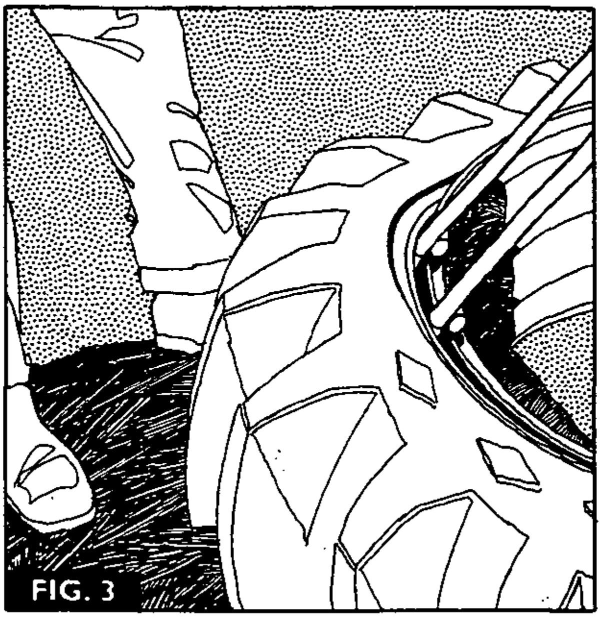
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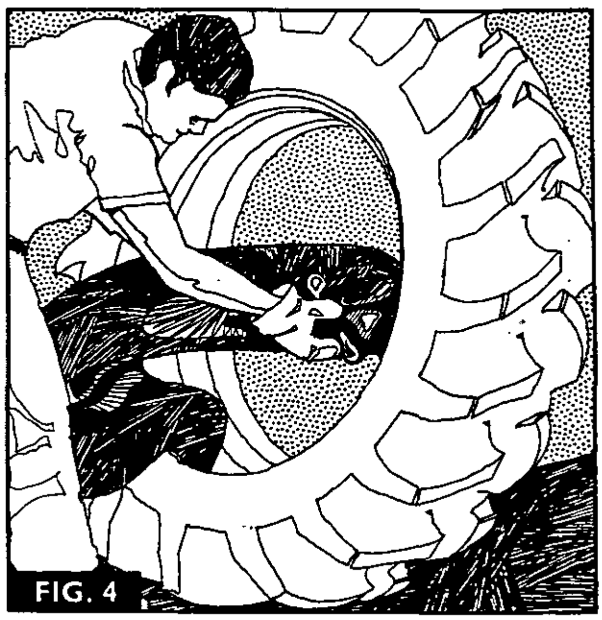
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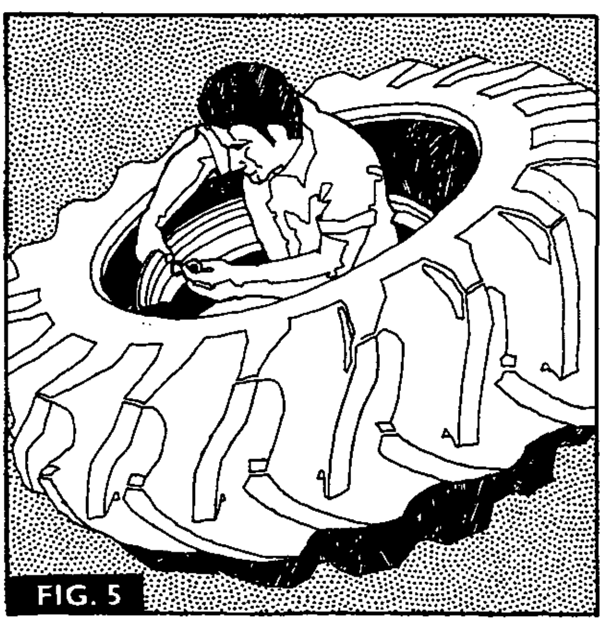
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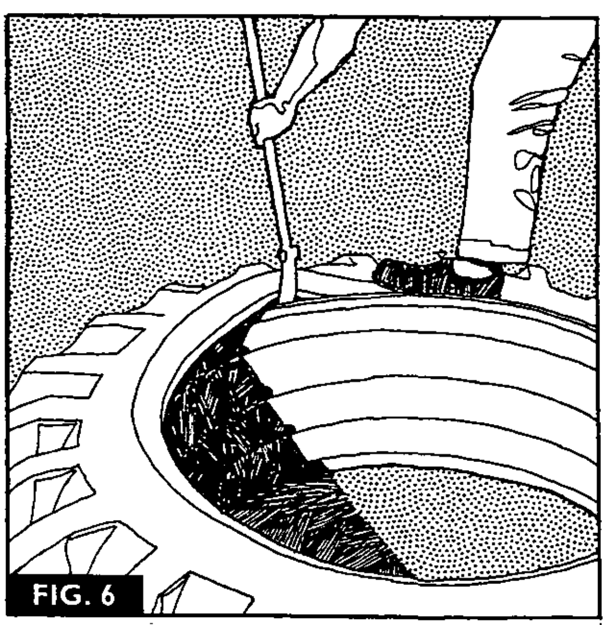
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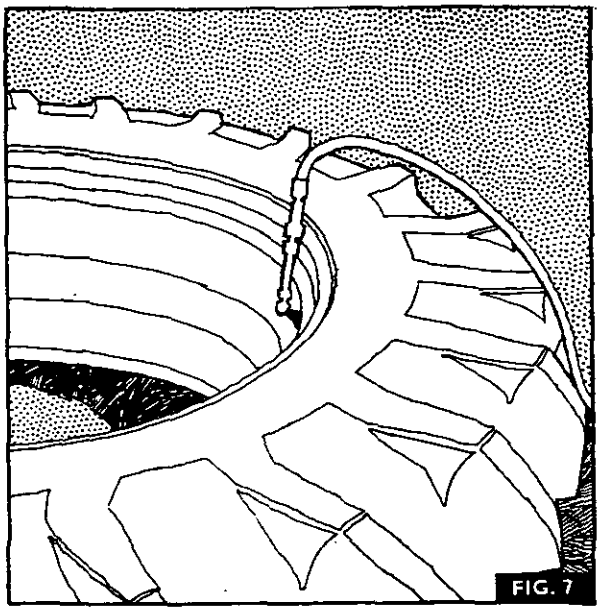

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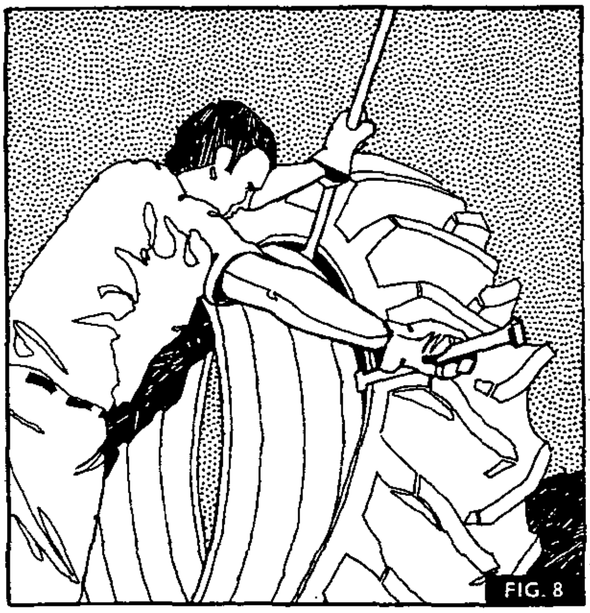

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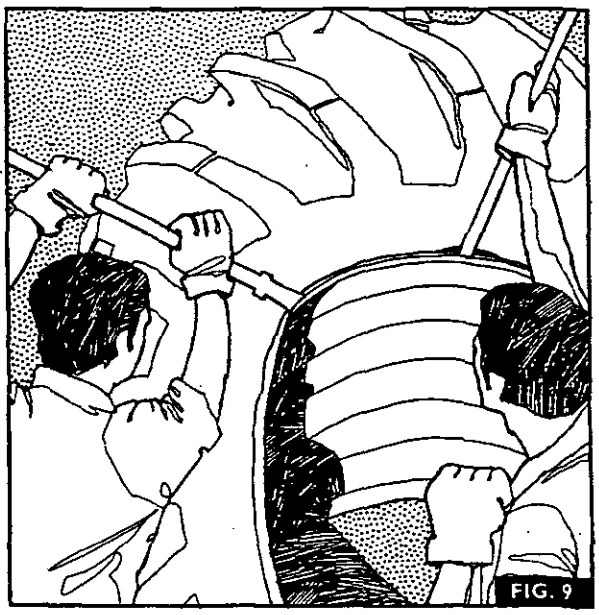


FIG. 9

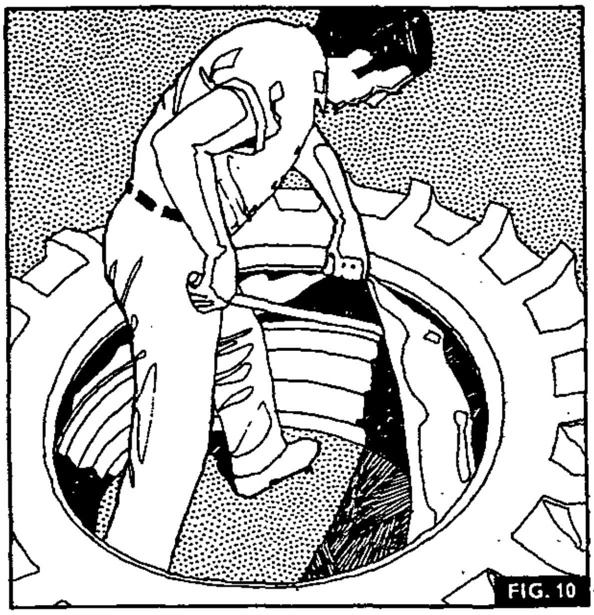


FIG. 10

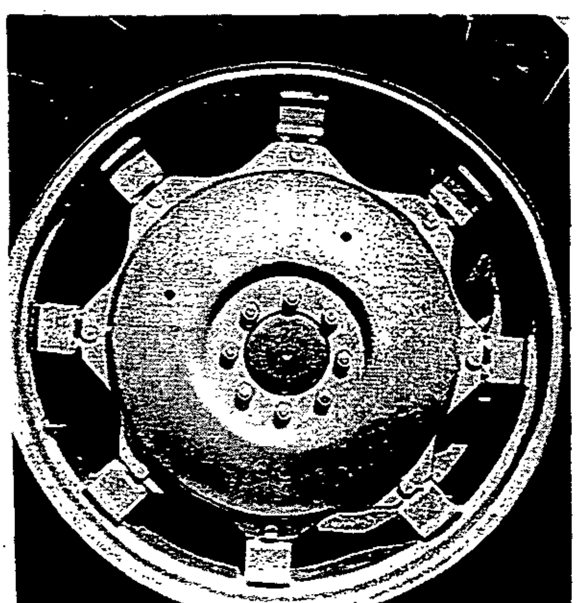


FIG. 11

75% Filling

1. Using a jack capable of lifting 3000 kg (3 tons) raise the rear wheels just clear of the ground.
2. Ensure that the tyre valve is secured to the rim, either by a mounting cone or valve nut. If so deflate the tyre.
3. Check that an air-water type valve core is fitted to the valve.
4. Position the valve by turning the wheel until the valve is at '12 o'clock' (i.e. vertical at the top).
5. Connect the water adapter to the valve and place the solution suction tube in the tank of solution.
6. Pump the solution into the tyre until a steady stream of solution pours from the breather hole. This indicates that the tyre has been filled up to the level of the valve, which is approximately 75% of the tyre's capacity.
7. Disconnect the water adapter.
8. Using a special air-water gauge, adjust the air pressure in the tyre to that recommended for the load being carried by the rear of the tractor.

Essential Facts when Liquid Ballasting

Always use a proper air-water pressure gauge, as a normal air type gauge will be rapidly corroded by calcium chloride solution.

Never attempt to inflate the tyre with the wheel resting on the ground.

Always use an open topped container when mixing calcium chloride solution.

Never pour water on calcium chloride.

LIQUID BALLAST TABLE 75% FILLING

		1		2		3		4		5	
Tyre Size	Rim Size	Weight of Calcium Chloride Required		Volume of Water to Mix with Calcium Chloride		Volume of Water Required to Finally Fill the Tyre		Actual Weight Added to Tyre		Volume of Plain Water Which must be Drained from Tyre if Anti-Freeze is to be added	
		kg.	lb.	Lit.	Gal.	Lit.	Gal.	kg.	lb.	Lit.	Gal.
11 – 32	W10 x 32	13,8	30.5	17,0	3.75	112,6	24.75	143	315	25,5	5.75

BOLT-ON BALLAST WEIGHTS

The main advantage of bolt-on weights is that they can be removed easily when not required; thus relieving the tractor of unnecessary weight. This should, over a long period, give the tractor better fuel consumption than a tractor with liquid ballast, which cannot easily be removed.

These are cast iron weights, having various tapped and plain holes which are necessary for attaching the weight to the wheel and subsequent weights.

FITTING WHEEL WEIGHTS

Two separate types of weight are used on this tractor, i.e. an inner adapter weight and a second weight.

The adapter weights are fitted first, with the slot in the weight aligned with the tyre valve, thus rendering it accessible.

The second weight has semi-circular cut-outs, which must align with the tyre valve, to allow the valve to be still accessible.

Fitting procedure is as follows:

1. Position the tractor on level ground with the tyre valve in the '12 o'clock' position.
2. Ensure the tractor is in gear with the parking brake engaged.
3. Place the adapter weight in position with the cut-outs aligned with the tyre valve.
4. Fig. 13. Fit the four bolts, spring washers and nuts.
5. Fig. 14. Fit second and subsequent weights with four bolts and spring washers for each weight.

NOTE – NOT MORE THAN FOUR WEIGHTS CAN BE FITTED TO EACH WHEEL.

NOTE – IN ALL CASES AN EQUAL AMOUNT OF WEIGHT MUST BE FITTED TO BOTH SIDES OF THE TRACTOR. TYRE PRESSURES MUST BE RAISED TO SUIT THE AMOUNT OF WEIGHT ACTING ON THE TYRES.

TRACTION AIDS

Cage Wheels (Fig. 15)

Cage Wheels are circular frames which attach to the sides of the existing tractor wheels to increase flotation and traction. There are numerous types available with either straight, angled or chevron type tread bars.

Due to the large number of differing designs available, pedantic instructions for fitting and removal cannot be given.

Girdles (Fig. 16)

These are chains made of steel strip which are fitted around the periphery of the wheel to give better traction when hauling timber and in similar conditions.

Half-Tracks (Fig. 17)

Half-Tracks are ideal for work in deep snow where as much flotation as possible is required.

Strakes (Fig. 18)

Strakes are retractable, radially mounted metal bars, with spade lug-ends which can give increased traction in heavy clay and similar soils.

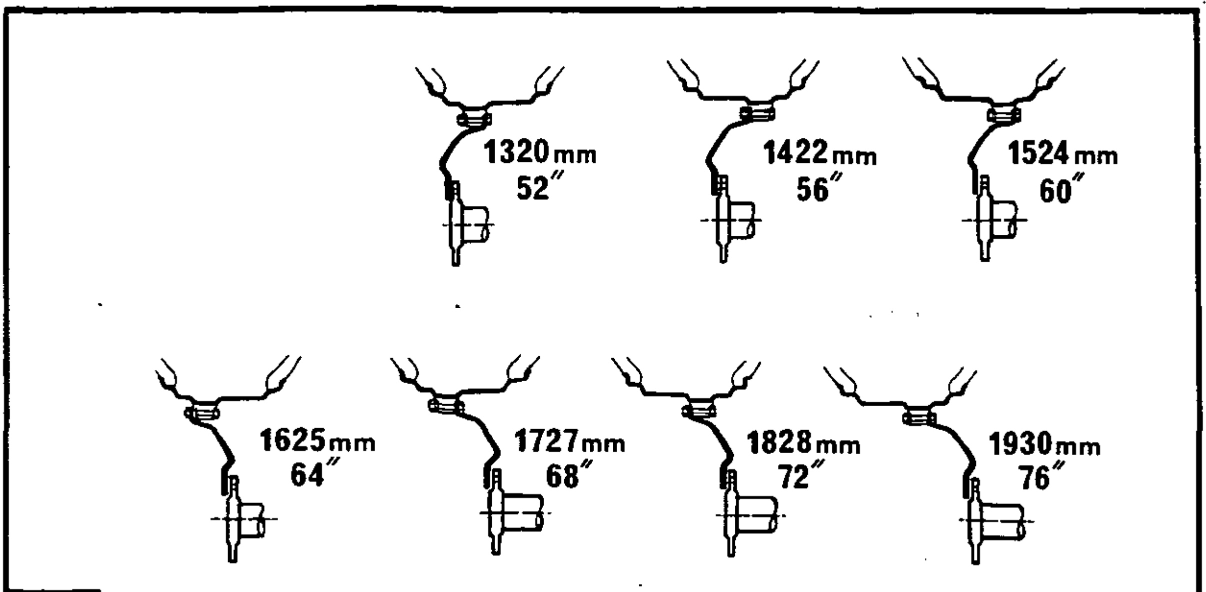


FIG. 12

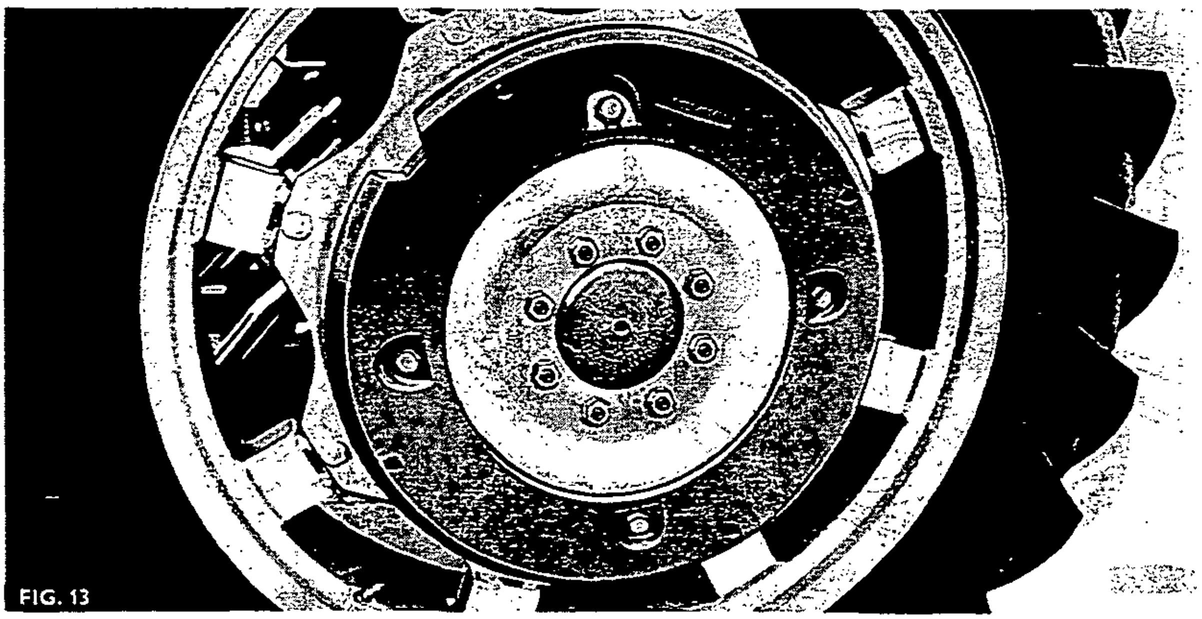


FIG. 13

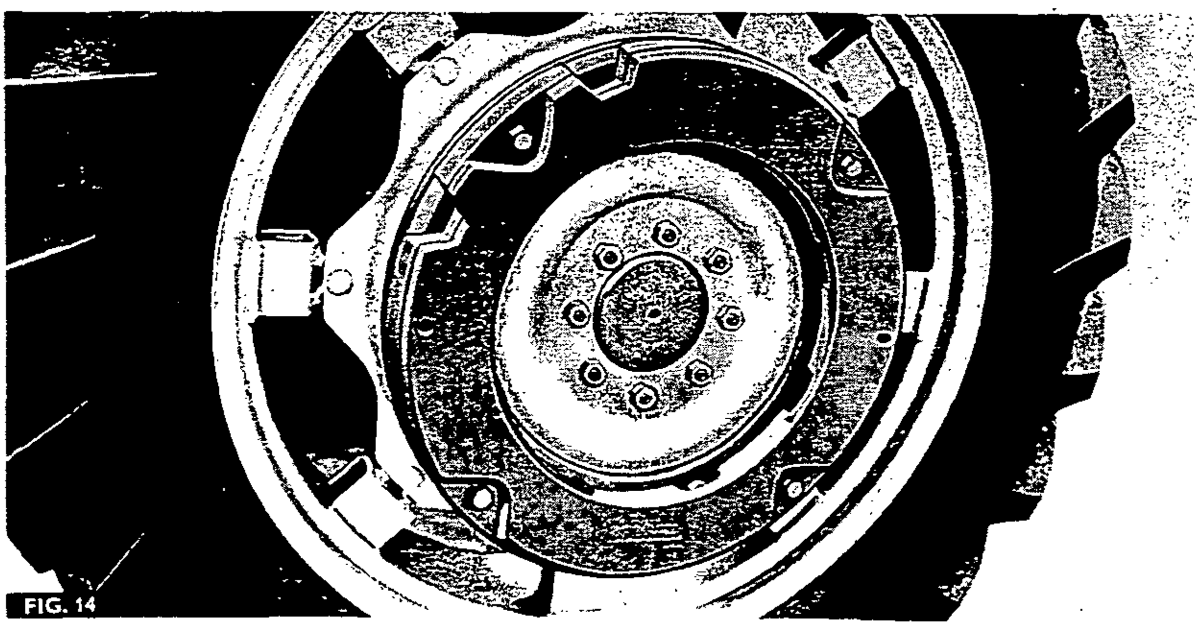


FIG. 14

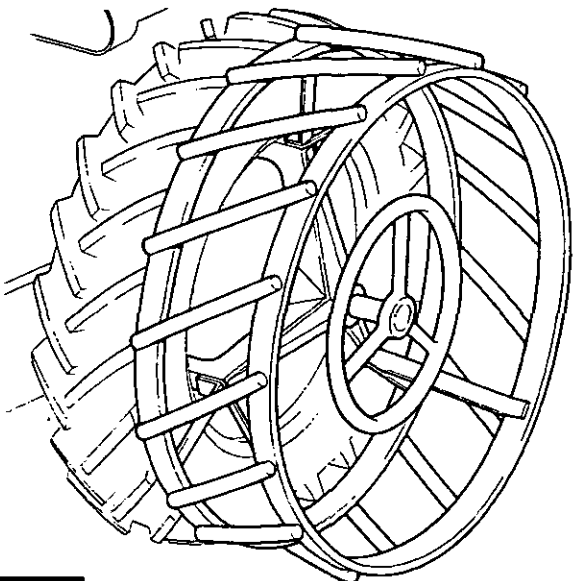


FIG. 15

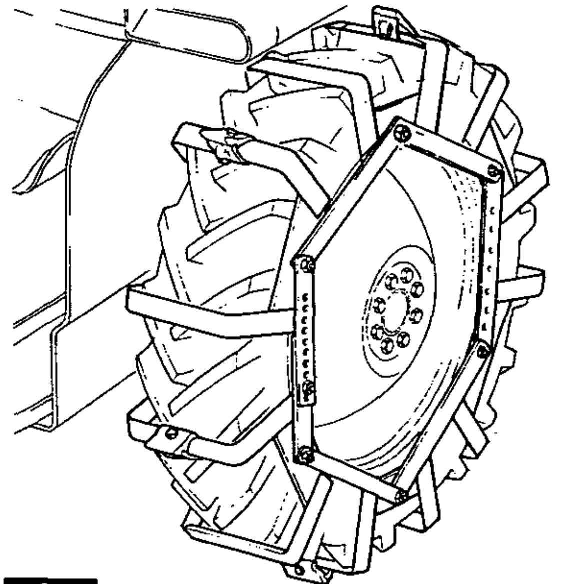


FIG. 16

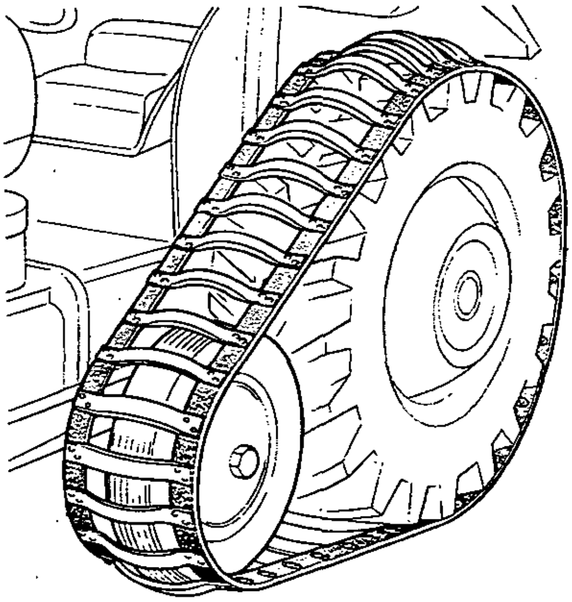


FIG. 17

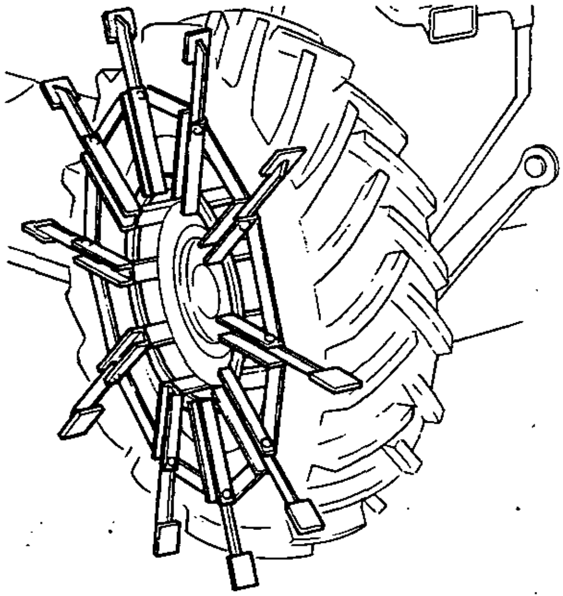


FIG. 18


FIG. 19

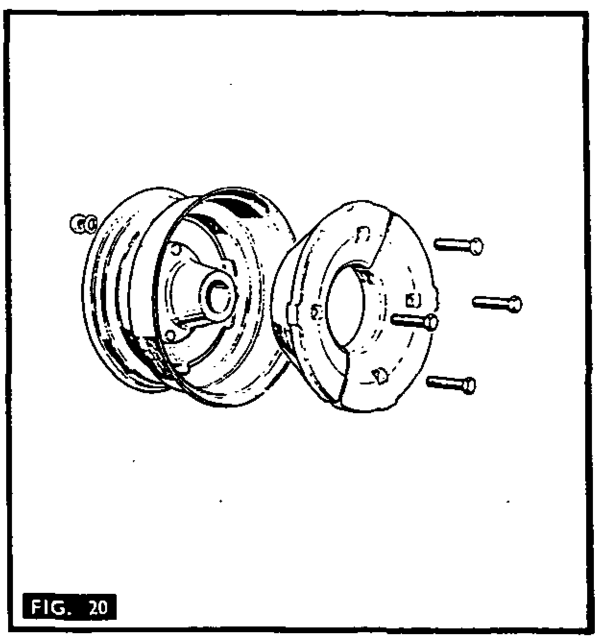


FIG. 20

TYRE FAULT FINDING CHART

Symptom	Possible Cause	Suggested Cure
Wheelspin	Too low gear	Use the highest gear that the tractor will pull without labouring
Wheelspin due to tyres loading with soil	Tyre pressures excessive	Adjust the pressures to the manufacturer's recommended minimum
	Inadequate tyre pressures	Raise the tyre pressures to that correct for the load on the rear end of the tractor
	Insufficient weight acting of the rear end of the tractor	1) Fit wheel weights 2) Water ballast tyres 3) Increase 'Pressure Control' pressure if fitted. 4) Try narrower section tyres
Wheelspin The tyre retains its self-cleaning action and sinks into the ground	Inadequate weight on the front end of the tractor	Fit weight frame and front-end weights
	Too narrow section tyre for the weight being carried by the rear end of the tractor	1) Fit wider section tyres 2) Reduce the weight on the rear end of the tractor
	Lug-bar type tyres being used in sand	Use either grassland/sand type tyres, or heavily worn lug-bar type tyres
Tractor slews from side to side when being driven on hard ground (e.g. road)	Tyre squirms due to excessively low pressures	Raise the tyre pressures. This complaint can cause rapid tyre wall wear and consequent failure
Tyre tread worn unevenly when used for long periods on the road	1) Too low pressure 2) Overloading	Raise pressure – This complaint is indicated by wear on the leading and trailing edges of the lug-bar
Uneven tread wear	Over inflation	Adjust pressures to those recommended by tyre manufacturers. This problem is indicated by wear to the centre of the tread only
	Wheels running out of true	1) Jack up axle to relieve wheel of weight slacken and re-tighten wheel nuts. 2) Check that the tyre is located accurately on the rim.
Tyre creep	Too low tyre pressure	1) Increase tyre pressure 2) Check the condition of both the rim and bead and replace as necessary Certain sizes of wheel are available with knurled rims.
Split sidewall	Under-inflated tyre striking a sharp object	Minor splits are repairable. In cases of severe damage the tyre must be replaced.

FRONT WHEELS AND TYRES

General (Fig. 19)
One type of front wheel is fitted to this tractor. This is a W4.50 x 19 Pressed Steel Rim and Disc fitted with a 6.00–19 tyre.

Tyre Pressures
The tyre pressure are shown in the Specification Section. However, if a very heavy front end weight is fitted, such as a loader, the pressure should be raised to 2,81 to 3,09 kg/cm^2 (40 – 44 lb/in^2).

Liquid Ballast
Liquid ballasting is not normal procedure, but it can be used if required. The procedure is similar to that used for rear tyres. Ensure the correct type of valve is fitted to the tyre.

Bolt-On Ballast Weights (Fig. 20)
Two piece inner wheel weights can be fitted to this tractor. The weights are attached by four bolts per wheel.

Fitting procedure as follows:

1. Position the tractor on level ground.
2. Ensure that the tractor is in gear with the parking brake engaged.
3. Using a jack, raise the front wheels just clear of the ground.
4. Remove the wheel.
5. Place the two pieces of the weight on the inside of the wheel and secure with the four bolts, nuts and spring washers.
6. Refit the wheel to the tractor and secure it with the wheel nuts tightened to a torque of 8,3 kg-m (60 lb-ft).
7. Lower the tractor to the ground and remove the jack.
8. Repeat this procedure for the other side.

NOTE – NEVER OPERATE THE TRACTOR WITH UNEVEN WEIGHTS (E.G. L.H. WHEEL WEIGHTED, R.H. WHEEL WITHOUT WEIGHTS).

Inner Tube Removal and Refitment 6B-03-12
See operation 6B-01-03

Tyre Removal and Refitment 6B-04-12
See operation 6B-02-04

WHEELS AND TYRES

Part 6 Section B

REAR TYRES

General

The tyres fitted to M.F. Farm Machinery tractors can be divided fairly easily into three separate categories:

1. Field (Dunlop RT40, Goodyear Traction Sure Grip or Firestone F151).
2. Universal Field and Road (Goodyear Sure Grip All Service, Firestone F151 or Dunlop RT35).
3. Grassland, Sand or Hard Surfaces (Firestone A.N.S. or Goodyear All Weather).

Each of the above types of tyre has been designed especially to give the best grip and wear characteristics obtainable in the specified conditions. On grassland, such as parks and golf courses, worn field or universal type tyres can also be used successfully.

Traction

Very few tractors are used to their fullest capacity, mainly due to inability of the driver to control excessive wheelspin.

If a tractor (or any other wheel driven machine) is being driven along a smooth flat surface, the tyre tread will grip the road provided that the torque applied to the wheel is not in excess of the coefficient of friction between the tyre and the road. When the tyre grips the road without slipping, the condition is one of 100% traction.

Unfortunately, due to tread design and other factors, the maximum rate of traction normally obtainable in the most favourable conditions (i.e. smooth concrete) is approximately 90%, i.e. the tractor will pull a load of 90% of the weight acting on its rear wheels, e.g. a tractor working on smooth dry concrete, with a weight of 5000kg acting on its rear wheels. Allowing for a coefficient of traction of 90%, the tractor will be capable of pulling a load of approximately:

$$\frac{5000}{1} \times \frac{90}{100} = 4500 \text{ kg}$$

When ploughing or performing similar operations in the field, the coefficient of traction is reduced to around 45 to 50%. This is the reason for ballasting the rear end of the tractor, thereby increasing the weight acting on the rear axle and thus increasing the tractive effort of the tractor.

The coefficients of traction mentioned can only be achieved by ensuring that all of the factors which affect the tractor performance are adjusted to suit the ground condition.

Some of the factors are:

1. Tyre Pressures – must be set at the lowest pressure permissible for the load being carried and the size and the ply-rating of tyre being used.
2. Tyre Tread – the tyre tread should not be more than 1/3 to ½ worn for efficient ploughing. The lug-bars must face in the correct direction (most tyres have arrows on the sidewalls to indicate the correct direction of rotation).
3. The correct section and size of tyre should be used for certain ground conditions. Some examples are:

   a. Clay – Large diameter, narrow section tyres. These tyres have a small contact area and will concentrate a larger amount of weight on the contact area than would a wide section tyre, thus helping the lug-bars to 'bite' into the soil and give traction.
   b. Very light sandy soil – or peat. Any wide section tyre will allow the weight acting on the rear end of the tractor to be spread over a larger area than with a narrow tyre, thus preventing sinkage and crushing of the furrow.
   c. Stony Ground – Large diameter, wide section tyres will spread the wear out over a large area of tread and give good flotation.
   d. Sand – Sand requires an entirely different type of tyre, for if ordinary lug-bar type tyres are used, they will greatly disturb the surface of the sand and rapidly dig themselves into an ever increasing depth. In these conditions, a smooth tread pattern on as wide a tyres as possible is required, to disturb the surface as little as possible and give good flotation.

CORRECT TYRE USAGE FOR ECONOMICAL LIFE

Pressures

Tyre pressure must be maintained at the manufacturers' recommended minimum to give the best possible performance. This minimum is determined by the weight acting on the rear end of the tractor and can be calculated from the table given in the Specification Section.

Incorrect inflation of tyres has the following effects:

Over-Inflation

Excessive tyre pressure deprives the tyre of its self-cleaning properties. This causes wheelspin, which in turn causes sinkage, thus increasing the rolling resistance of the tyre and lowering the power available for traction.

Frequent and prolonged bouts of wheelspin cause rapid tyre wear. Another effect of over-inflation is that the casing of the tyre is very susceptible to damage from sharp rocks or similar objects due to the inability of the casing to 'give' on contact.

Under-Inflation

If a tyre has insufficient pressure to support the casing, this may be deflected to such an extent that the plies may become separated. Such damage is irrepairable and the tyre must be replaced. Excessive deflection allied to a high drawbar pull can cause wrinkling of the tyre sidewalls which, if allowed to occur continually can cause the tyre to 'creep' on the rim and tear out the valve.

A visible warning of under-inflation is uneven wear of the lug-bars, indicated by 'gouging' of the centre of the bars.

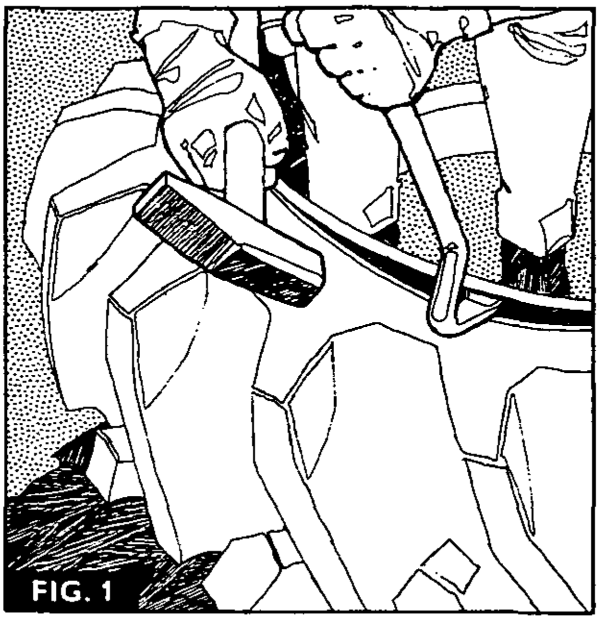
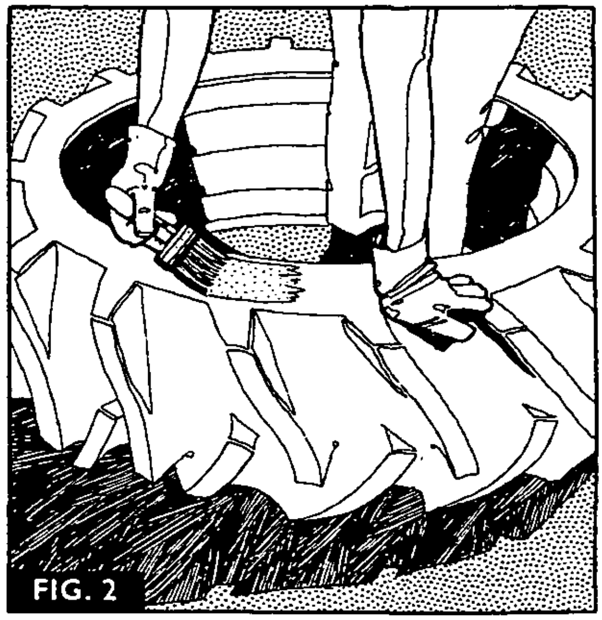


FIG. 1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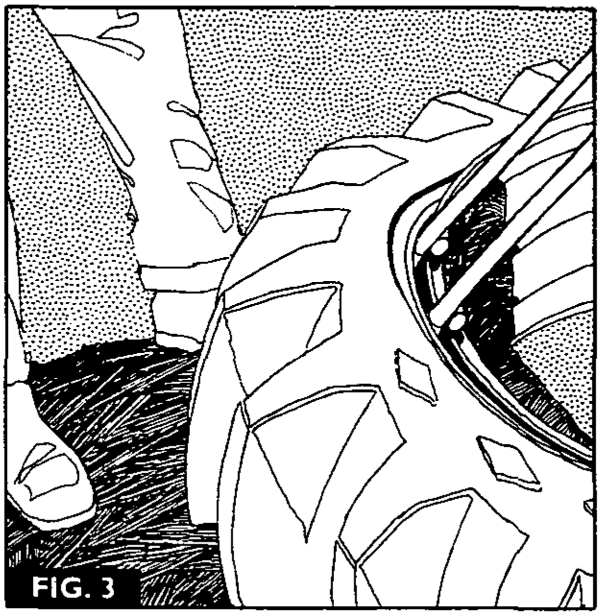
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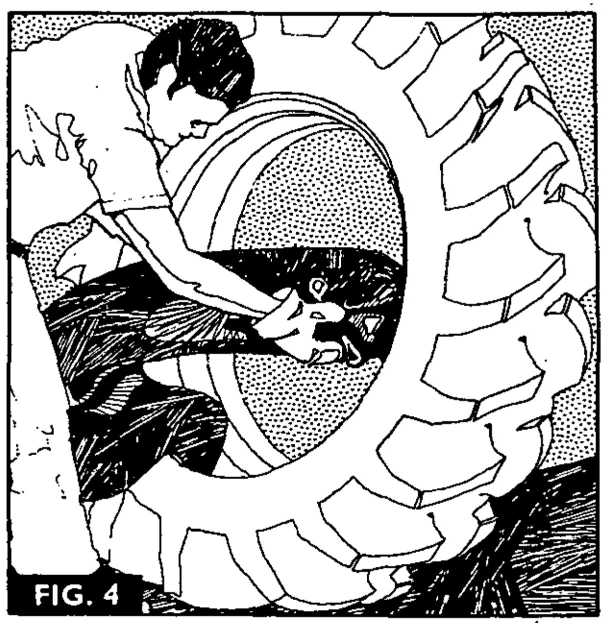
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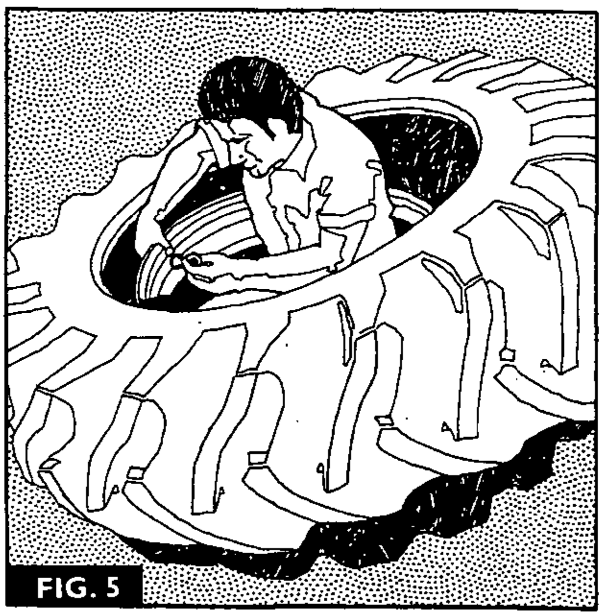
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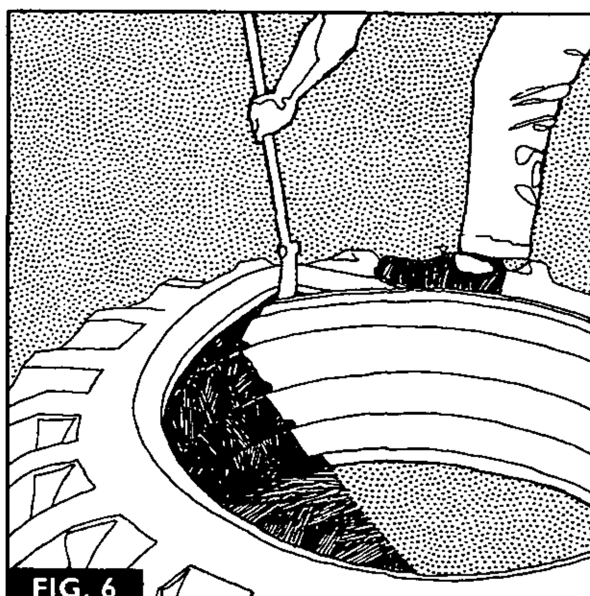
FIG. 6

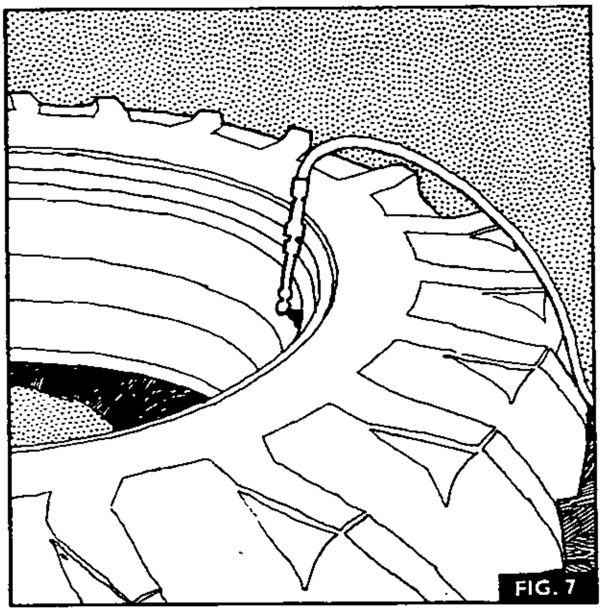

FIG. 7

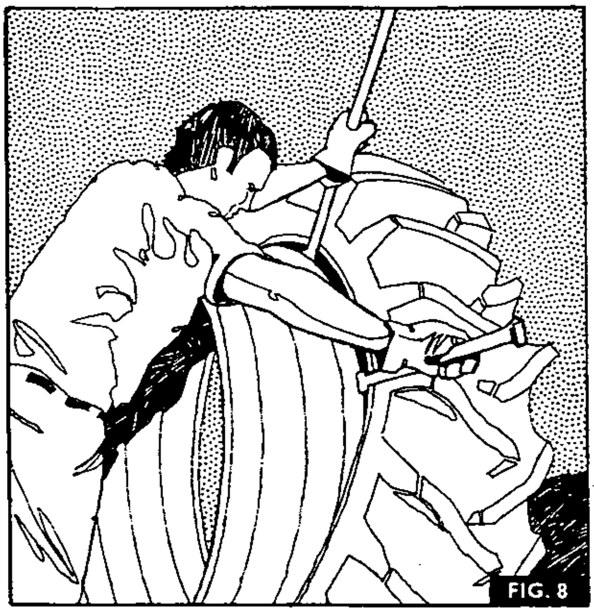

FIG. 8

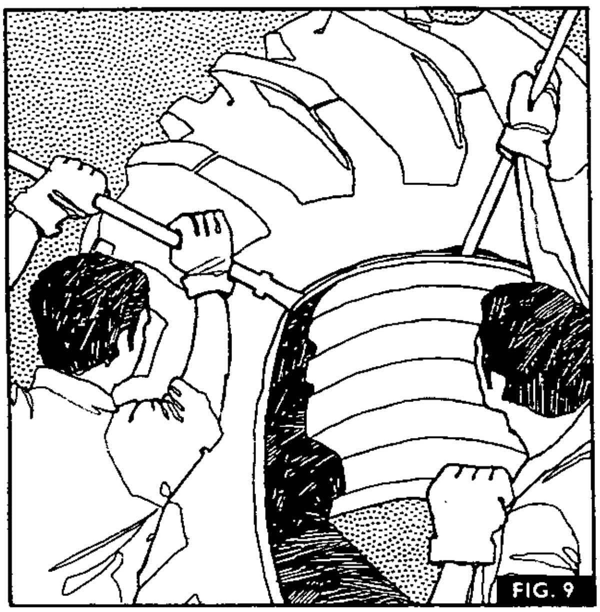

FIG. 9

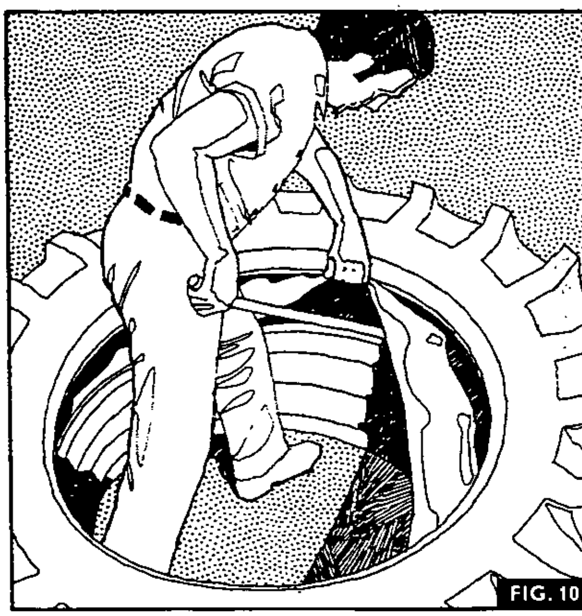

FIG. 10

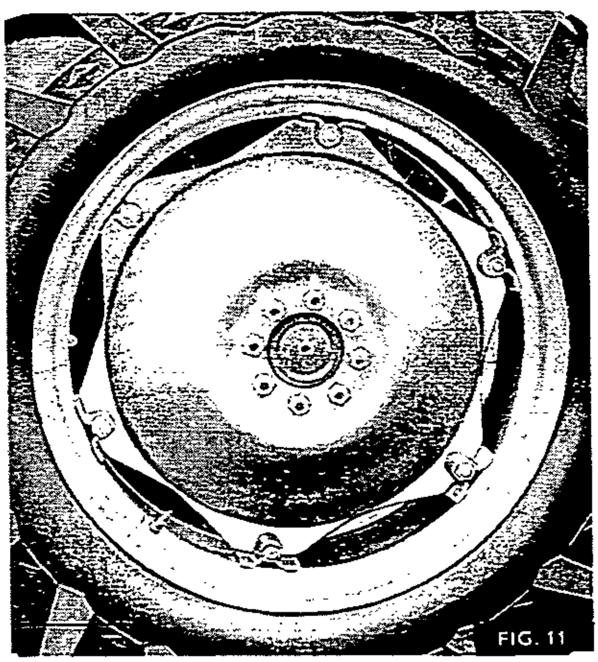

FIG. 11

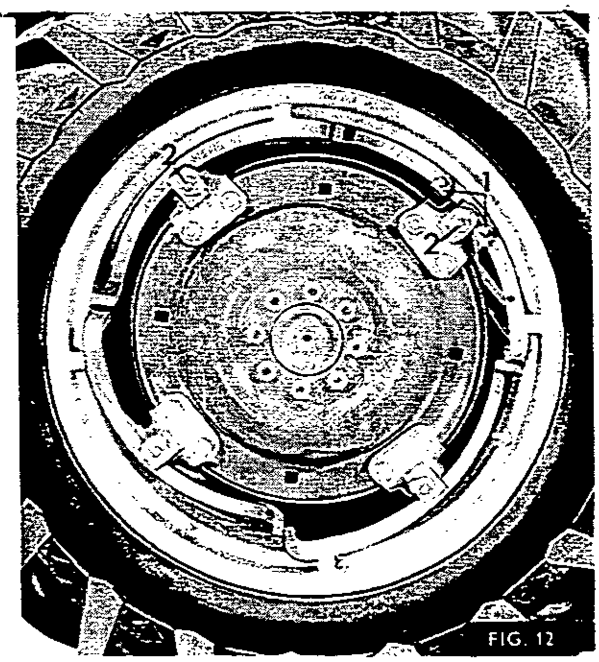

FIG. 12

Cleanliness
Certain liquids can cause considerable harm to tyres, if they are not quickly removed. Some of the worst offenders are oil, grease and some crop sprays which can contain considerable quantities of acid or alkali. If any of the above penetrate into the plies through small holes or splits, rapid deterioration will result.

Effective Tyre Pressures
Details of the maximum pressures usable with the various sizes and ply-ratings of tyres fitted are given in the Specification Section. These maxima are only used when very heavy loading of the tractor is required.
Under normal conditions the following pressures can be used, but must be increased if extra loading is involved.

Ploughing: 0,84 kg/cm² (12 lb/in²)

If bolt-on ballast weights are used, the pressure must be raised accordingly. When working on a hillside pressure should be raised by 0,14 kg/cm² (2 lb/in²) in both tyres, because as each tyre alternately takes most of the load when it is on the side of the tractor nearest the bottom of the slope, the pressure must be raised accordingly to cope.
When using a non-reversible plough the pressure of the landside tyre may be reduced by 0,14kg/cm² (2lb/in²) although the differential lock should be used to compensate for wheelspin by one wheel only.

Road Work
When driving a tractor on the road, higher speeds can be used than in the field. In such conditions the pressure can be raised by 0,28kg/cm² (4lb/in²) (not Firestone F151) to prevent squirming and gouging of the lug-bars.
If a two wheel trailer, or manure spreader is used, the weight exerted on the tractor drawbar should be determined and the pressure adjusted to suit.

Using a Front End Loader
If a loader is fitted to the tractor, a counter-weight is frequently fitted to the tractor rear linkage as a safety precaution. If a counter-weight is to be fitted the tyre pressure should be raised to compensate.

INNER TUBE

Removal and Refitment *6B-01*

Special tools required:	'Bead-breaking' tool
	3lb. Hammer
	Tyre levers

Removal
1. Lay the wheel on the ground with the valve uppermost.
2. Deflate the tyre by removing the valve core. Remove the valve retaining nut.
3. Fig 1. Drive the 'bead-breaking' tool between the tyre and rim, taking care not to damage the rim or the tyre.
4. After the bead has been released from the rim, invert the wheel and repeat Item 3.
5. Fig 2. Lubricate the rim, tyre and base of the tube with a solution of soap and water or similar rubber lubricant.

NOTE – NEVER USE PETROLEUM OR SILICONE BASE GREASES.

6. Fig 3. Starting at the valve location, pry the tyre off the rim, taking small bites with tyre levers, and ensuring that the bead on the opposite side is fully located in the mounting well.
7. Fig 4. With the wheel in a vertical position, pull the tyre forwards and remove the tube.

Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for foreign matter or damage.

Refitment
1. Fig 5. Inflate the tube until 'rounded out'. Place the tube in the tyre with the valve located in the valve hole. Refit the valve retaining nut finger tight.
2. Fig 6. Refit the tyre, starting opposite the valve location taking small bites with long tyre levers and keeping the fixed part of the bead fully located in the well.

A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help fitment.

NOTE – CARE MUST BE TAKEN NOT TO PINCH THE TUBE WHEN FITTING.

3. Fig 7. Centre the tyre on the rim and inflate to approx. 2,5kg/cm² (35lb/in²).

NOTE – NEVER STAND OVER THE ASSEMBLY WHEN INFLATING, REMOTE CONTROL INFLATION EQUIPMENT SHOULD BE USED.

4. Remove the valve core and completely deflate the tyre.
5. Refit the valve core and inflate to recommended pressure.

NOTE – IF BEADS FAIL TO SEAT AT 2,5kg/cm² (35lb/in²) THE TUBE MAY BE PINCHED, DO NOT INCREASE THE PRESSURE BUT REMOVE THE VALVE CORE AND RELEASE TYRE FROM RIM. LUBRICATE TYRE, BEAD AND RIM AND REINFLATE TO 2,5kg/cm² (35lb/in²). REPEAT PROCESS UNTIL BOTH BEADS ARE PROPERLY SEATED.

TYRE

Removal and Refitment 6B-02

Special tools required: 'Bead-breaking' tool
3lb Hammer
Tyre levers

Removal

1. Remove inner tube as stated in operation 6B-01
2. Figs 8 & 9. With the wheel in a vertical position pry off the tyre taking small bites with the tyre levers. The use of rubber lubricant will help removal.

Refitment

1. Place the rim on the ground, lubricate the bead and rim and place the tyre on rim.
2. Fig 10. Refit the tyre to rim, using long tyre levers.
3. Refit the inner tube as stated in operation 6B-01

REAR WHEELS

General

The following types of wheels are available for MF 135 Tractors:

Pressed Steel Single Disc Wheels (Fig 1).
Pressed Steel Power Adjusted Variable Track (P.A.V.T.) wheels (Fig 12).

Both types of wheel can be reversed to give extra wide track settings, except when fitted to tractors with sealed brakes.
A general rule governing rim size in relation to tyre size is that the rim will be 25,4 mm (1 inch) narrower than the tyre fitted to it: e.g.

W12 x 24 rims are fitted with 13-24 tyres.

However, this rule does not always apply and in certain instances the rim may be 50,8 mm (2ins) narrower, or the same nominal width as the tyre: e.g.

W9 x 28 rims fitted with 11-28 tyres.
W14 x 30 rims fitted with 14-30 tyres.

Any tractor fitted with dual brakes will have track settings wider than standard.
The following wheel sizes are standard equipment on current MF 135 tractors.

TRACK SETTINGS

W9 x 28 and W10 x 32 Wheels

Track settings can be varied from 1219 to 1524 mm (48 to 60 in) in 101,6 mm (4 in) increments with the wheels set normally on tractors fitted with shell type safety fenders, and from 1320 to 1524 mm (52 to 60 in) in 101,6 mm (4 in) increments on tractors fitted with flat-top fenders.
The rims and discs can be reversed to give track settings from 1625 to 1930 mm (64 to 76 in). See figure 13.

W12 x 24 Wheels

The minimum track setting for these wheels is 1422 mm (56 in) because if a narrower setting is attempted, the wheels and tyres will foul the tool box and strengthening ribs on the fenders. All other track settings are as for W9 x 28 and W10 x 32 rims. (Fig 13).

W9 x 28 P.A.V.T. Wheels

P.A.V.T. wheels have a range of track settings from 1333 mm (52. 1/2 in) to 1524 mm (60 in) with the wheels set normally and from 1625 mm (64 in) to 1929 mm (76 in) with the wheels reversed.

Tractor with Sealed Brakes (Export Only)

MF 135 tractors fitted with sealed brakes have their track increased by 172,45 mm (6¾ in) from the normal setting. Sealed brake tractors are fitted either with W9 x 28 or W12 x 24 pressed steel wheels. The discs cannot be reversed.

TRACK ADJUSTMENT PROCEDURE

Tractors with Pressed Steel Wheels

1. Select the required track setting.
2. Slightly slacken either the wheel to axle, or rim to disc nuts, or both, according to requirements.
3. Using a jack capable of lifting 3000 kg (3 tons) raise the rear wheels just clear of the ground.
4. Remove the rim from the disc, or the complete wheel, or both, and re-assemble them with the rim and disc in their new position. Tighten the nuts to a torque of 14 kg-m (100 lb-ft).

If the wheels are to be reversed, they have to be transferred to the opposite side of the tractor.

5. Refit the wheel and tighten the wheel nuts progressively to a torque of 27,5 kg-m (200 lb-ft).
6. Lower the tractor to the ground and remove the jack.

P.A.V.T. Wheel Track Adjustment **Fig 12.**

1) Remove the two rim stop pins (1) from the rim stops which position each wheel disc to the rim and remove the stops.
2) Replace one stop on each rim rail at the track limiting position and secure each with a rim stop pin.
3) Loosen the four eccentric pins (2) on each wheel disc lug.
4) Drive the tractor either forwards or backwards to helically rotate the discs in relation to the rails on the rims until the wheel disc lugs engage the stops on the rails.
5) Secure the position of the discs in relation to the rims by fitting the remaining stops and pins to the holes immediately adjacent to the disc lugs.
6) Re-tighten the four eccentric stop pins (2).

Dual Rear Wheels

Conversion kits which allow the fitting of an extra pair of rear wheels are available for MF 135 tractors. These extra wheels can be fitted to all types of wheel except the P.A.V.T. type.

Note

The supplementary wheels must be of exactly the same type and size as those already fitted.

Fitting Procedure Fig 14.

1) Adjust the track of the existing wheels to the narrowest available.
2) Remove one wheel nut at a time and replace it with one of the special adapter studs (3). Secure the studs.
3) Fit the location ring (4) over the studs.
4) Locate the wheel on the studs and refit the wheel nuts. Tighten the nuts to 27,7 kg-m (200 lb-ft).

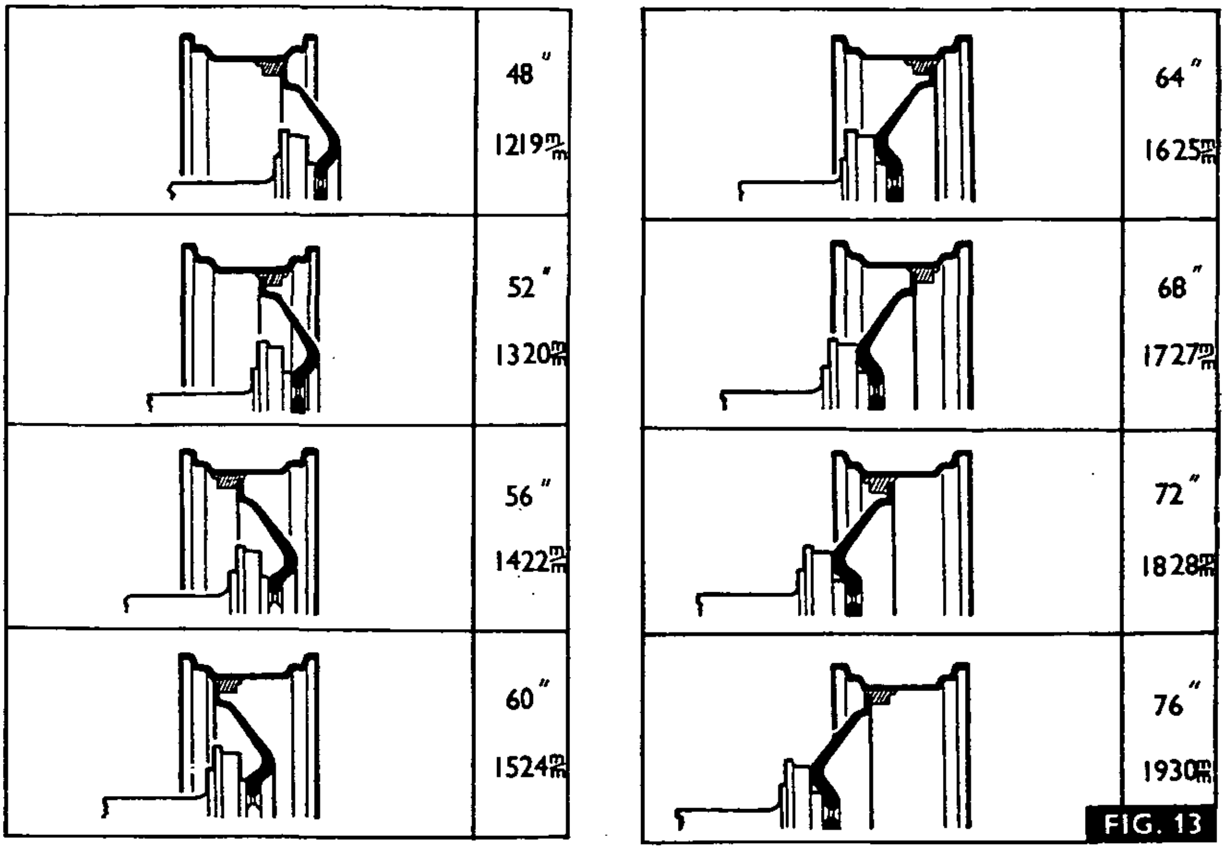
48″
1219 m/m
52″
1320 m/m
56″
1422 m/m
60″
1524 m/m
64″
1625 m/m
68″
1727 m/m
72″
1828 m/m
76″
1930 m/m

FIG. 13

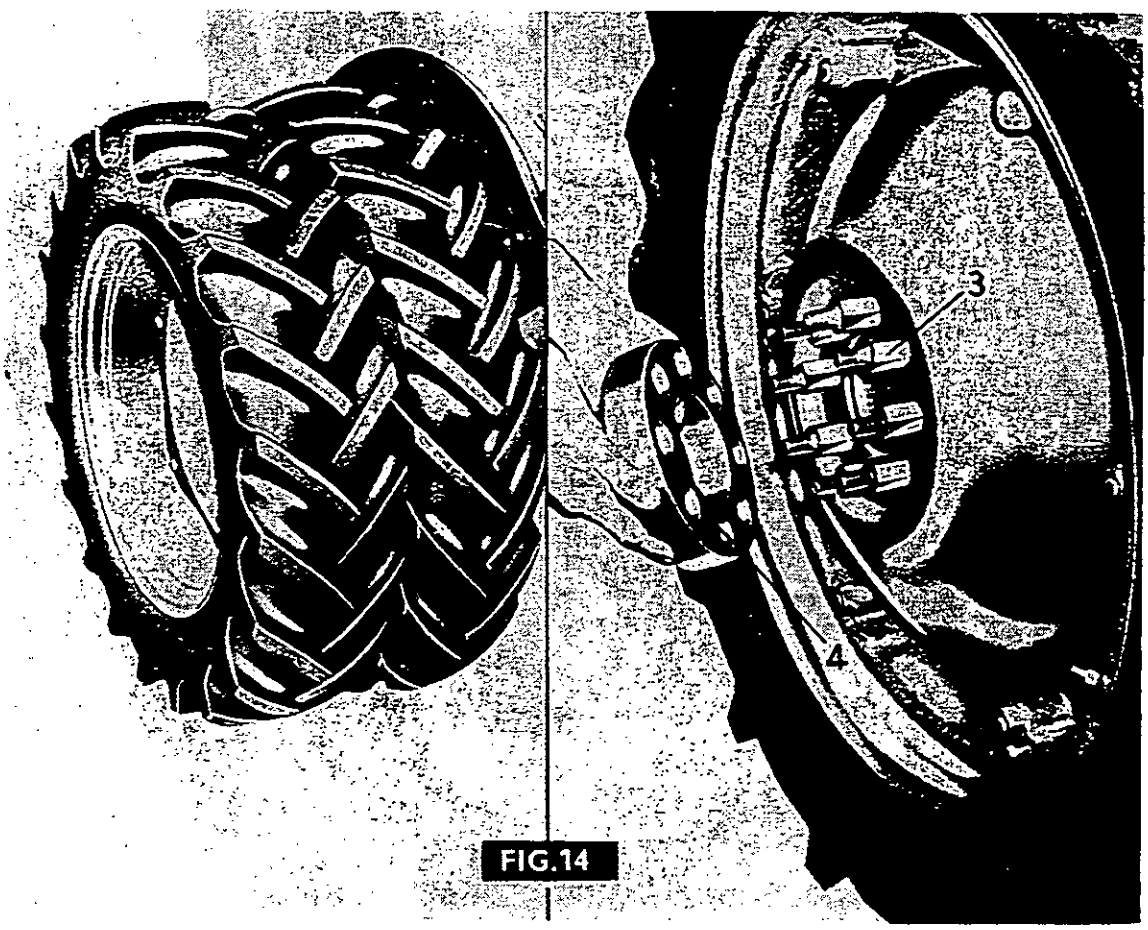
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FIG.14

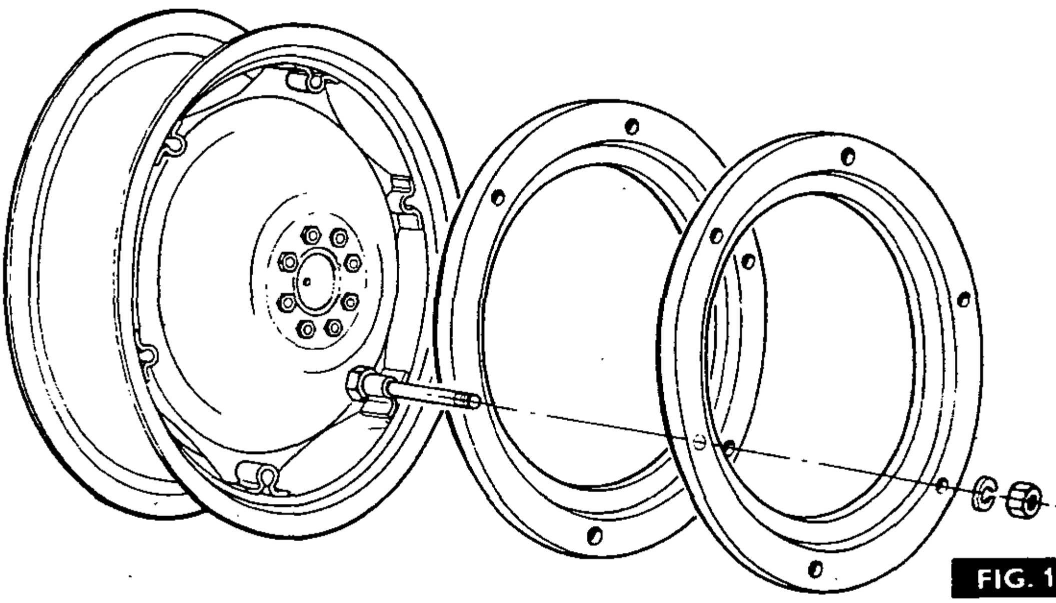

FIG. 15

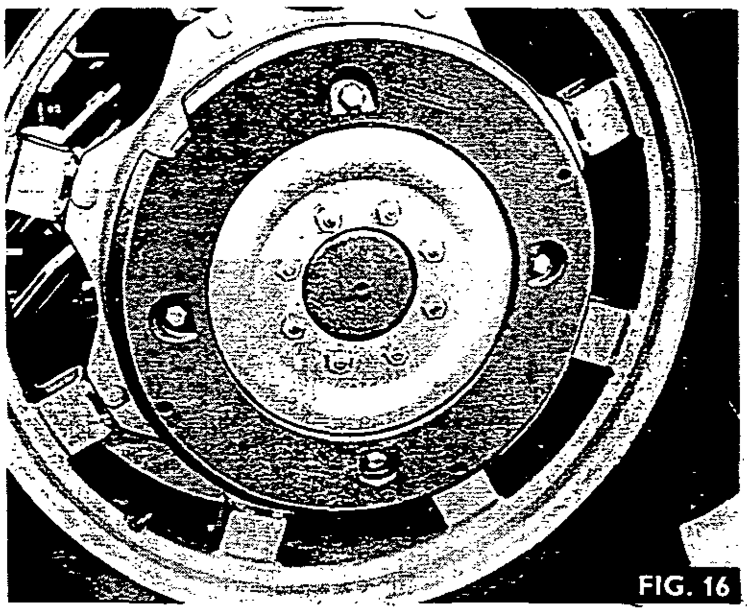

FIG. 16

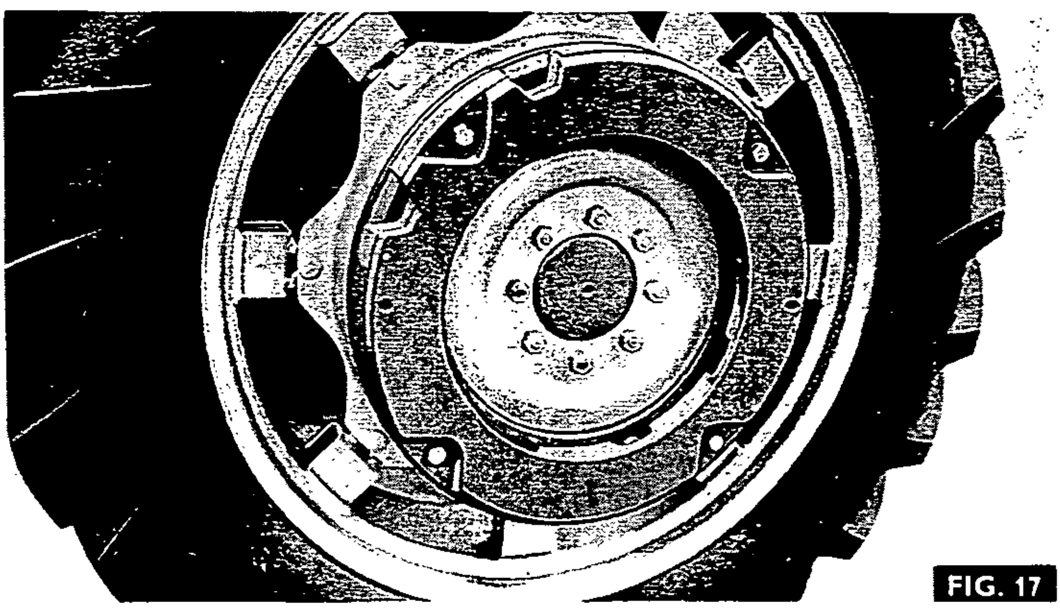

FIG. 17

BALLASTING

General

To impart extra weight on the rear wheels of a tractor, several methods may be employed:

1. Pressure Control or Draft Control
2. Liquid Ballast
3. Bolt-on Weights

Each of these methods has advantages and disadvantages, but all work well in practice and any two, or even all three may be combined for absolute efficiency.

PRESSURE CONTROL AND DRAFT CONTROL

This feature, exclusive to Massey-Ferguson tractors, is described in detail in Part 7A of this Manual.

LIQUID BALLAST

Liquid filling of the tyres is a well known and widely used method of weighting the rear of a tractor. To prevent damage by frost, calcium chloride should be dissolved in the water used to fill the tyres, thus forming an anti-freeze solution. The calcium chloride used should be 'Commercial Grade 70 to 72% $CaCl_2$'.

The following table and actual filling method is based on data supplied by the Dunlop, Goodyear and Firestone Tyre Companies. This table is, of necessity, a compromise, because tyres of the same nominal size manufactured by different companies differ slightly in internal dimensions, which may alter the degree of filling by a small percentage, but this will not affect the actual performance of the tyre.

MIXING THE CALCIUM CHLORIDE WATER SOLUTION

WARNING – NEVER POUR THE WATER ON TO CALCIUM CHLORIDE. ALWAYS ADD CALCIUM CHLORIDE TO WATER.

Procedure is as follows:

1. Consult the chart and locate the size of tyre to be filled.
2. Weigh out the correct quantity of calcium chloride (column 1), but do not put it in the mixing tank.
3. Measure the volume of water shown in column 2 and put it into the tank.
4. Add the calcium chloride to the water slowly.

NOTE – WHEN CALCIUM CHLORIDE AND WATER ARE MIXED A CHEMICAL REACTION CAUSES GREAT QUANTITIES OF HEAT TO BE PRODUCED. THE HOT SOLUTION MUST NOT BE USED – WAIT UNTIL IT HAS COOLED.

5. Add the remaining volume of water indicated in column 3 to the solution.

TYRES FILLED WITH WATER

If a tyre has been previously filled with water and calcium chloride anti-freeze is to be added, drain off the amount indicated in column 5 of the table.

Mix a solution from the quantities shown in columns 1 and 2 and allow to cool.

Re-fill the tyre with this solution to make up the correct filling.

WARNING – NEVER ATTEMPT TO ADD PURE CALCIUM CHLORIDE TO A TYRE FILLED WITH WATER, AS THE RESULTANT HEAT AND EXPANSION CAN CAUSE TYRE DAMAGE.

Ballasting Procedure

There are two methods of liquid ballasting tractor tyres, 75% filling and 100% filling. The 75% filling method is the most common, and is easier to achieve than 100% filling, not requiring a motorised pump.

The 100% filling increases casing vulnerability to impact damage and accordingly 75% filling is recommended by Tyre Manufacturers.

LIQUID BALLAST TABLE 75% FILLING

		1		2		3		4		5	
Tyre Size	Rim Size	Weight of Calcium Chloride Required		Volume of Water to Mix with Calcium Chloride		Volume of Water Required for Final Filling of Tyre		Actual Weight Added to Tyre		Volume of Plain Water which must be Drained from Tyre if Anti-Freeze is to be added	
		lb.	kg.	Gal.	Lit.	Gal.	Lit.	lb.	kg.	Gal.	Lit.
10 – 28	W9 x 28	20.0	9,07	2.5	11,36	16.25	73,85	207.5	94,12	3.75	17,05
11 – 28	W9 x 28	27.5	12,47	3.5	15,92	22.25	101,2	285.0	192,28	5.25	23,92
11 – 32	W10 x 32	30.5	13,83	3.75	17,05	24.75	112,6	315.5	143,09	5.75	25,55
13 – 24	W12 x 24	38.5	17,46	5.0	22,74	31.0	140,9	398.5	180,76	7.5	34,1

75% Ballasting

1. Using a jack capable of lifting 5000 kg. (5 tons) raise the rear wheels just clear of the ground.
2. Ensure that the tyre valve is secured to the rim, either by a mounting cone or valve nut. If so, deflate the tyre.
3. Check that an air-water type valve core is fitted to the valve.
4. Position the valve by turning the wheel until the valve is at '12 o'clock' (i.e. vertical and at the top).
5. Connect the water adapter to the valve and place the solution suction tube in the tank of solution.
6. Pump the solution into the tyre until a steady stream of solution pours from the breather hole. This indicates that the tyre has been filled up to the level of the valve, which is approximately 75% of the tyre's capacity.
7. Disconnect the water adapter.
8. Using a special air-water gauge, adjust the air pressure in the tyre to that recommended for the load being carried by the rear of the tractor.

Essential Facts when Liquid Ballasting

Always use a proper air-water pressure gauge, as a normal air type gauge will be rapidly corroded by calcium chloride solution.
Never attempt to inflate the tyre with the wheel resting on the ground.
Always use an open topped container when mixing calcium chloride solution.
Never pour water on calcium chloride.

BOLT-ON BALLAST WEIGHTS

The main advantage of bolt-on weights is that they can be removed easily when not required; thus relieving the tractor of unnecessary weight. This should, over a long period, give the tractor better fuel consumption than a tractor with liquid ballast, which cannot easily be removed.
These are cast iron weights, having various tapped and plain holes which are necessary for attaching the weight to the wheel and subsequent weights.

FITTING WHEEL WEIGHTS

Wheel weights for MF 135 tractors are secured to the rim lugs by extension bolts which replace the standard bolts, as shown in Figure 15.

Procedure is as follows:

1) Jack up the rear of the tractor to relieve the rear wheels of weight.
2) Remove the six rim to disc securing bolts from one wheel.
3) Fit the extension bolts, as shown in Figure 15.
4) Secure the weight(s) with six nuts and spring washers.
5) Repeat the above procedure for the opposite wheel.

Removal is the reverse of fitting procedure.

Tractor with 11-32 Wheels

Two separate types of weight are used on this tractor, i.e. an inner adapter weight and a second weight.
The adapter weights are fitted first, with the slot in the weight aligned with the tyre valve, thus rendering it accessible.
The second weight has semi-circular cut-outs which must align with the tyre valve, to allow the valve to be still accessible.
Fitting procedure is as follows:

1. Position the tractor on level ground with the tyre valve in the '12 o'clock' position.
2. Ensure the tractor is in gear with the parking brake engaged.
3. Place the adapter weight in position with the cut-outs aligned with the tyre valve.
4. Fig. 16. Fit the four bolts, spring washers and nuts.
5. Fig. 17. Fit second and subsequent weights with four bolts and spring washers for each weight.

NOTE – NOT MORE THAN FOUR WEIGHTS CAN BE FITTED TO EACH WHEEL.

NOTE – IN ALL CASES AN EQUAL AMOUNT OF WEIGHT MUST BE FITTED TO BOTH SIDES OF THE TRACTOR. TYRE PRESSURES MUST BE RAISED TO SUIT THE AMOUNT OF WEIGHT ACTING ON THE TYRES.

Tractors fitted with P.A.V.T. Wheels

Wheel weights are not available for P.A.V.T. wheels.

TRACTION AIDS

Cage Wheels (Fig. 18)

Cage Wheels are circular frames which attach to the sides of the existing tractor wheels to increase flotation and traction. There are numerous types available with either straight, angled or chevron type tread bars.
Due to the large number of differing designs available, pedantic instructions for fitting and removal cannot be given.

Girdles (Fig. 19)

These are chains made of steel strip which are fitted around the periphery of the wheel to give better traction when hauling timber and in similar conditions.

Half-Tracks (Fig. 20)

Half-Tracks are ideal for work in deep snow where as much flotation as possible is required.

Strakes (Fig 21)

Strakes are retractable, radially mounted metal bars, with spade lug-ends which can give increased traction in heavy clay and similar soils.

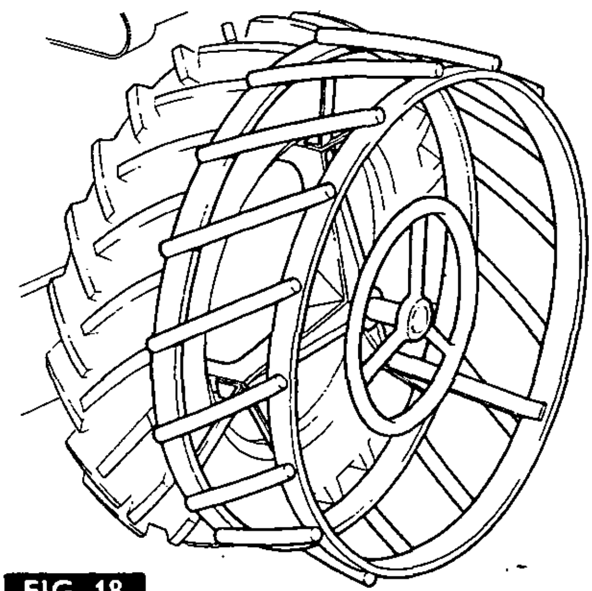

FIG. 18

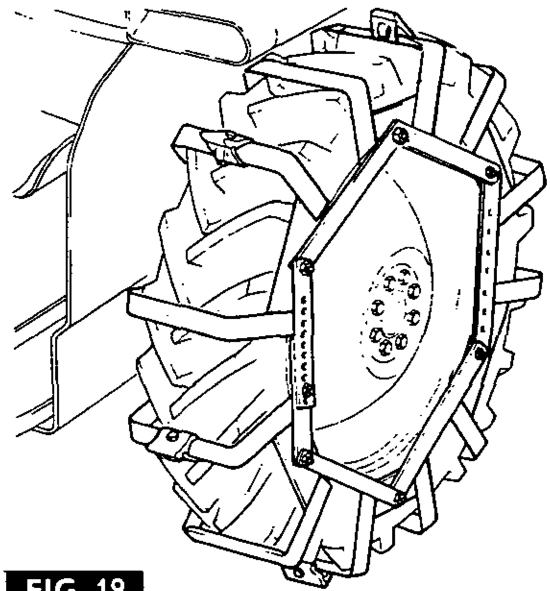

FIG. 19

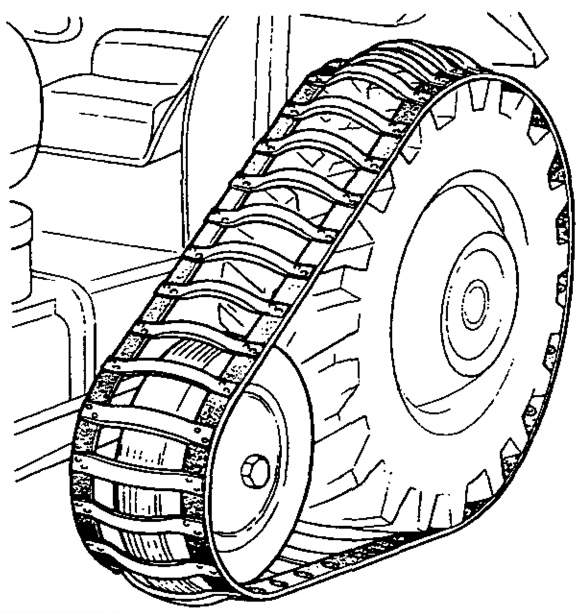

FIG. 20

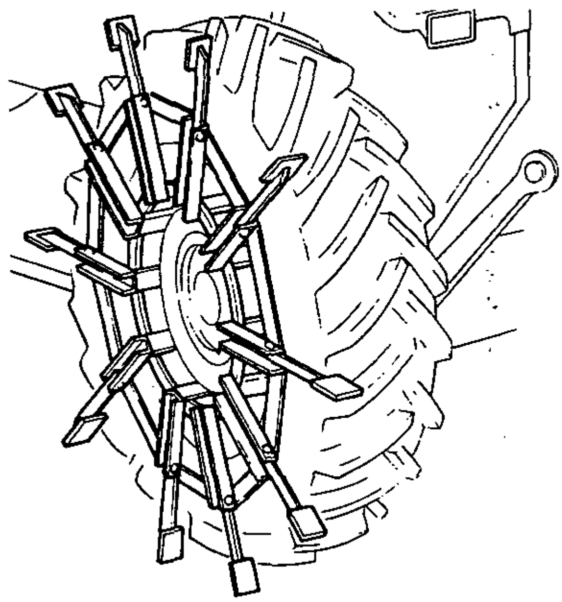

FIG. 21

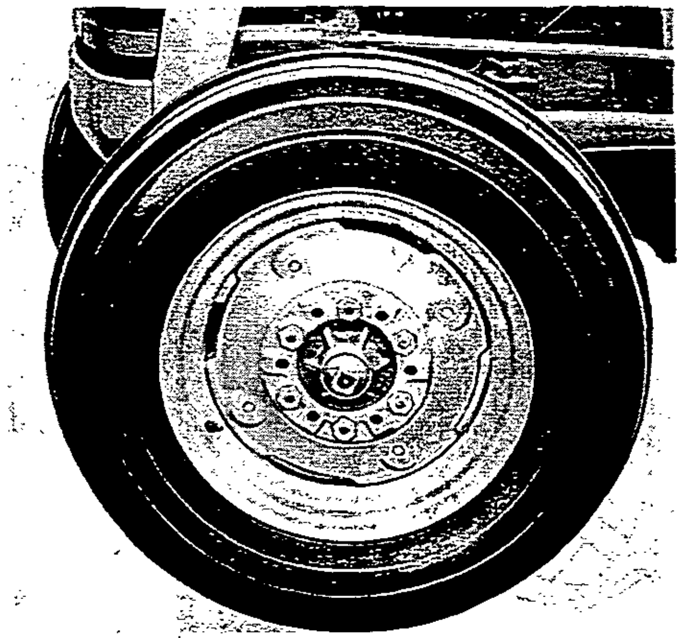

FIG. 22

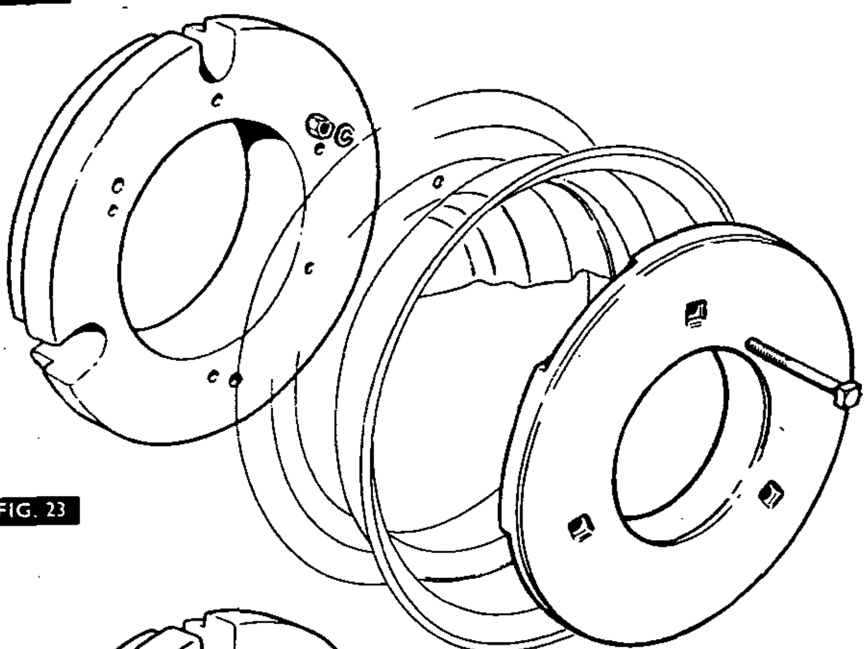

FIG. 23

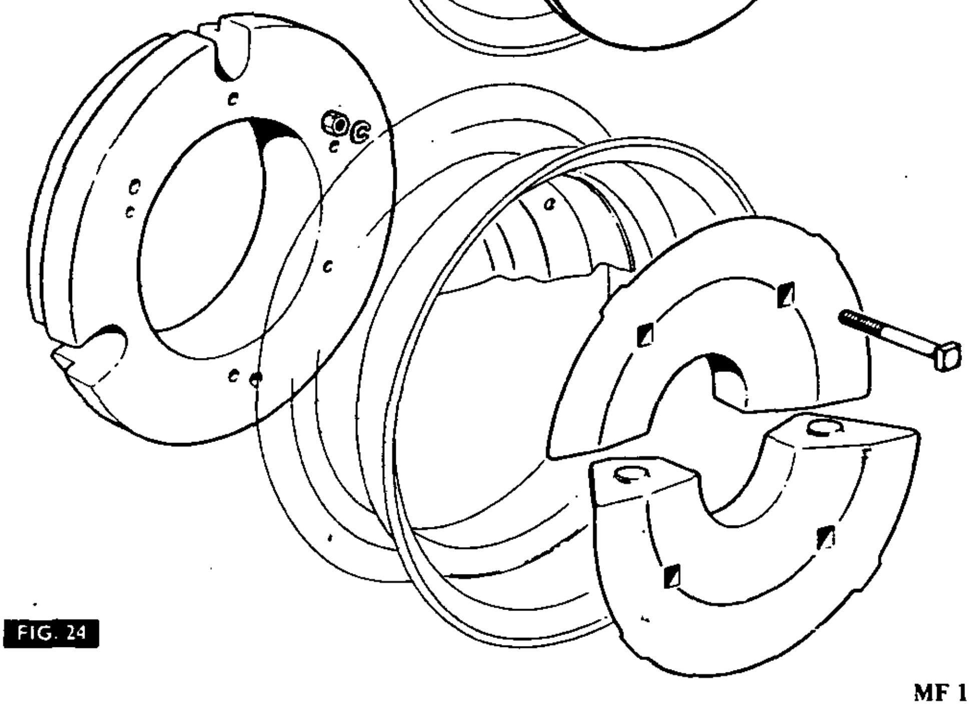

FIG. 24

TYRE FAULT FINDING CHART

Symptom	Possible Cause	Suggested Cure
Wheelspin	Too low gear	Use the highest gear that the tractor will pull without labouring
Wheelspin due to tyres loading with soil	Tyre pressures excessive	Adjust the pressures to the manufacturer's recommended minimum
	Inadequate tyre pressures	Raise the tyre pressures to that correct for the load on the rear end of the tractor
	Insufficient weight on the rear end of tractor	1) Fit wheel weights 2) Water ballast tyres 3) Increase 'Pressure Control' pressure if fitted 4) Try narrower section tyres
	Inadequate weight on the front end of tractor	Fit weight frame and front-end weights
Wheelspin The tyre retains its self-cleaning action and sinks into the ground	Too narrow section tyre for the weights being carried by the rear end of the tractor	1) Fit wider section tyres 2) Reduce the weight on the rear end of the tractor
	Lug-bar type tyres being used in sand	Use either grassland/sand type tyres, or heavily worn lug-bar type tyres
Tractor slews from side to side when being driven on hard ground (e.g. road)	Tyre squirms due to excessively low pressures	Raise the tyre pressures. This complaint can cause rapid tyre wall wear and consequent failure
Tyre tread worn unevenly when used for long periods on the road	1) Too low pressure 2) Overloading	Raise pressure – This complaint is indicated by wear on the leading and trailing edges of the lug-bar
Uneven tread wear	Over-inflation	Adjust pressures to those recommended by tyre manufacturers. This porblem is indicated by wear to the centre of the tread only
	Wheels running out of true (especially P.A.V.T. type)	1) Jack up axle to relieve wheel of weight slacken and re-tighten wheel nuts. 2) Check that the tyre is located accurately on the rim.
Tyre creep	Too low tyre pressure	1) Increase tyre pressure 2) Check the condition of both the rim and bead and replace as necessary Certain sizes of wheel are available with knurled rims.
Split sidewall	Under-inflated tyre striking a sharp object	Minor splits are repairable. In cases of severe damage the tyre must be replaced.

FRONT WHEELS AND TYRES

GENERAL

MF 135 tractors have all pressed steel rims and discs (Figure 22) of three sizes:

W3 x 19 rims fitted with 4.00-19, four-ply rating tyres.

W4.50 x 16 rims, fitted with 6.00-16 four or six-ply tyres.

W4.50 x 19 rims fitted with 6.00-19 four or six-ply tyres.

The tyres can be of the triple rib or multi-rib type.

Tyre Pressures

The tyre pressures are shown in the Specification Section. However, if a very heavy front end weight is fitted, such as a loader, the pressure should be raised to 2,81 to 3,09 kg/cm² (40 – 44 lb/in²).

Liquid Ballast

Liquid ballasting is not normal procedure, but it can be used if required. The procedure is similar to that used for rear tyres. Ensure the correct type of valve is fitted to the tyre.

Bolt-On Ballast Weights (Fig. 23 and 24)

Two types of weight can be fitted to this tractor; an inner weight and an outer weight.

The inner weight is fitted first and is secured by four bolts, nuts and spring washers.

The outer weight (optional extra) has semi-circular cut-outs which must align with the tyre valve, to render the valve accessible.

Fitting procedure as follows:

1. Position the tractor on level ground.
2. Ensure that tractor is in gear with the parking brake engaged.
3. Using a jack, raise the front wheels just clear of the ground.
4. Remove the wheel.
5. Place the inner weight on the inside of the wheel and secure with the four bolts, nuts and spring washers, making sure the head of the bolts faces inwards.
6. Refit the wheel to tractor and secure it with the wheel nuts tightened to a torque of 8,3 kg-m (60 lb-ft).
7. Place the outer weight over the protruding bolts making sure the semi-circular cut-outs align with the valve. Secure the weight with four nuts and spring washers.
8. Lower tractor to ground and remove the jack.
9. Repeat this procedure for the other side.

NOTE – NEVER OPERATE THE TRACTOR WITH ENEVEN WEIGHTS (E.G. LH WHEEL WEIGHTED, RH WHEEL WITHOUT WEIGHTS).

Inner Tube Removal and Refitment 6B-03

See operation 6B-01

Tyre Removal and Refitment 6B-04

See operation 6B-02

STEERING SYSTEM

Part 6 Section C

GENERAL (Figs. 1 and 2)

The steering box is a screw and recirculating ball type unit, mounted above the transmission casing. Drop arms, splined to the outer ends of two rocker shafts, control the front wheels by means of drag links.

The power assisted steering system comprises of a gear pump attached to the rear of the timing case, having a spur gear driven by the timing idler gear. The pump has a integral oil reservoir and supplies oil under pressure to a spool valve mounted on the outer tube of the steering column. A control link, attached to the spool valve, is actuated upon initial movement of the steering wheel, causing relative movement of the spool, which allows oil under pressure to flow through hoses to two double acting rams.

Each ram cylinder is mounted on a reaction bracket bolted to the centre axle beam and each ram piston rod is attached to a bell crank lever, keyed to the top of each front axle spindle.

Rotation of the steering wheel causes movement of the spool to allow oil to flow under pressure to the appropriate side of each ram piston. Oil from the opposite side is exhausted through the spool valve back to the pump reservoir. A filter element is located within the reservoir.

When the wheels have pivoted sufficiently around the axle spindle housings and effort is removed from the steering wheel, a return spring within the spool valve unit, returns the spool to the neutral position.

A by-pass valve is incorporated in the spool valve unit to allow the tractor to be steered with the engine stopped. The by-pass valve permits desplaced oil to flow from the exhaust side of the ram piston back to the pump reservoir.

STEERING BOX

Removal and Refitment 6C-01-02

Special Tools Required: MF 268 Steering Wheel Remover
P1007C Steering Drop Arm Remover

Removal

1. Fig. 3. Remove the nut and washer securing the steering wheel and pull off the wheel using the special tool MF 268 as shown. Remove the key.
2. Remove the instrument panel as stated in Part 8B.
3. Fig. 5. Remove the nuts (14) and washers securing the drop arms (15) to the rocker shafts, then using the puller P1007C remove each drop arm and felt-seal (16) from the rocker shafts.
4. Remove the bolt and washer securing the fuel cut-off rod mounting bracket to the steering box.
5. Remove one bolt and washer each side securing the steering box to the battery carrier.
6. Disconnect the power steering pipes from the control valve on the steering column (Power Steering Tractors only).
7. Remove the bolt and washer securing the rear light wiring clip to the steering column (if fitted).
8. Remove the eight bolts and washers securing the steering box to the transmission housing.
9. Fig. 4. Lift and manoeuvre the steering box complete with gear levers clear of the tractor and place on a suitable surface taking care not to damage the gear selector levers.
10. Remove the gasket from the transmission housing.

Refitment

1. Ensuring that all the gears and levers are in the neutral position, place the steering box with a new gasket onto the transmission housing and secure with the eight bolts and washers.

   NOTE – DO NOT FORGET TO REFIT THE WIRING CLIP (IF FITTED) TO THE BOLT ADJACENT TO THE HIGH/LOW GEAR LEVER.

2. Reconnect the power steering pipes to the control valve on the steering column (Power Steering Tractors only).
3. Refit the bolt, washer and wiring clip to the steering column (if fitted).
4. Refit the bolt and washer securing the Multi-Power pivot (if fitted) and the steering box to the battery carrier and the bolt and washer securing the oil pressure gauge pipe clip and the steering box to the other side of the battery carrier.
5. Refit the bolt and washer securing the fuel cut-off rod mounting bracket to the steering column.
6. Fig. 5. Fit a new felt washer (16) to each rocker shaft, then refit the drop arms (15) aligning the master splines, and secure the drop arms with the two nuts (14) and washers tightened to a torque of 34,5 kg-m (250 lb-ft).
7. Refit the instrument panel as stated in Part 8B.
8. Refit the steering wheel with a new key and secure the wheel with the nut and washer tightened to a torque of 4,8 kg-m (35 lb-ft)
9. Refill the power steering reservoir (if fitted) as stated in operation 6C-08-10.

Servicing 6C-02-02

Special Tools Required: MF 268 Steering Wheel Remover
P1007C Steering Drop Arm Remover
MF 263 Bush Remover
MF 263-1 Adapter
550 Handle
MF 19A Bush Reamer
7066 Circlip Pliers (Power Steering Tractors only).

Disassembly

1. Remove the steering box as stated in operation 6C-01-02.

Power Steering Tractors only

2a. Fig. 16. Remove the hairpin (64) and washer (65) securing the valve linkage (67) and release the linkage from the pin (66).
2b. Remove the three bolts and washers securing the control valve to the steering column and remove the valve.
2c. Remove the two 'O' rings from the steering column valve face.
2d. Fig. 5. Remove the screw (36) and washer securing the retainer (35) to the outer ball race (39) and slide the retainer and the felt seal (37) on to the tube (10).
2e. Using the circlip pliers 7066 remove the circlip (38) from the outer ball race (39).

3. Fig. 5. Remove the plug (12) and drain off the oil.

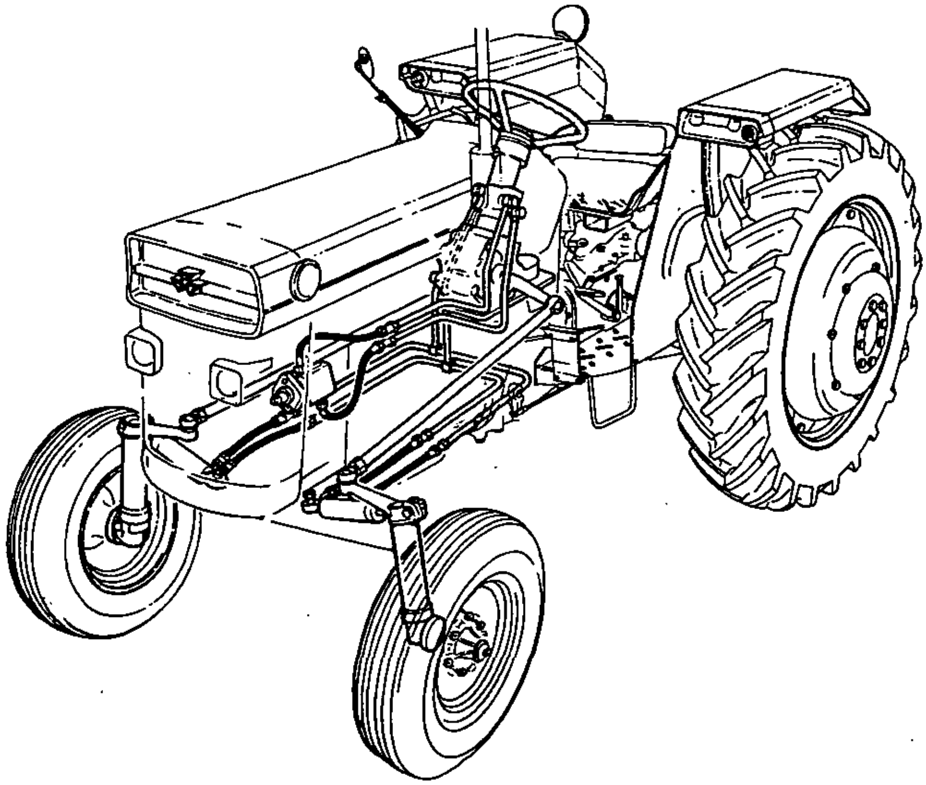

FIG. 1

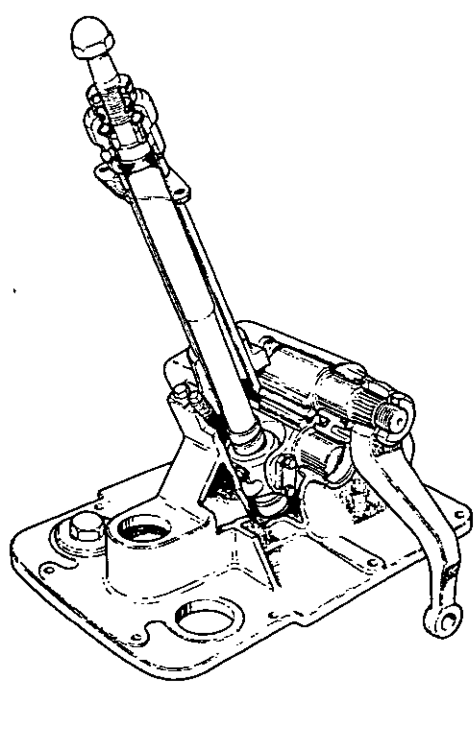

FIG. 2

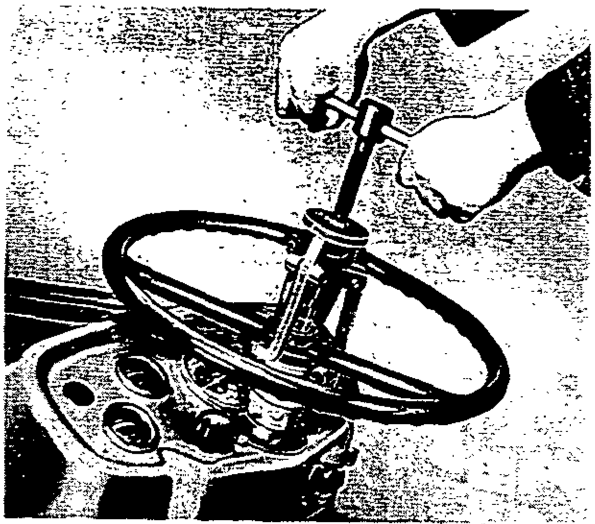

FIG. 3

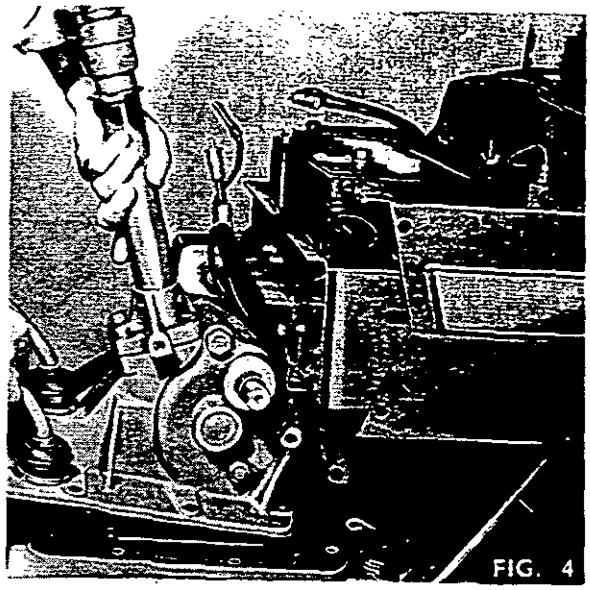

FIG. 4

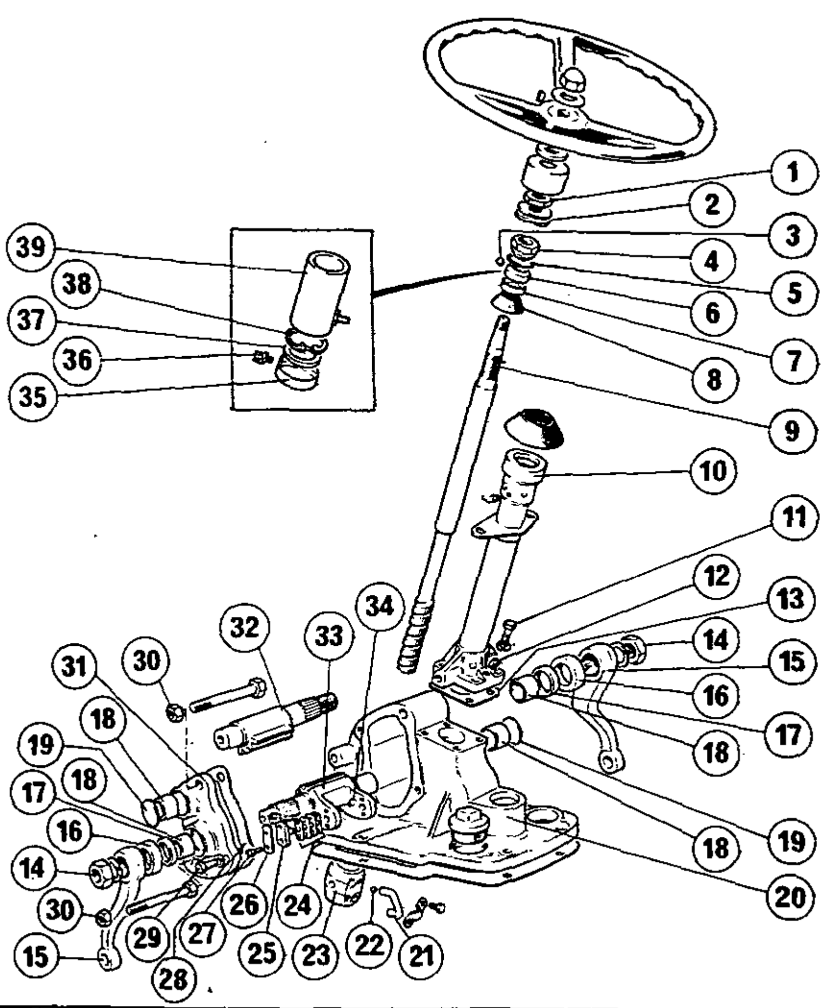

FIG. 5

4. Remove the two bolts (29) and washers and the two nuts (30) securing the cover plate (31) and remove the cover plate with its gasket (28).
5. Remove the secondary rocker shaft (32) from the steering box.
6. Release the tabwasher (26) locking the ball peg securing bolts (27), then remove the bolts, tabwasher, ball peg (25) and shims (24).
7. Remove the four bolts (11) and washers securing the steering column tube (10) to the steering box (20), then remove the tube, gasket (13) and the steering column (9) complete with main nut (23) and steel balls (22).
8. Remove the primary rocker shaft (33) and the steel ball (34) from the steering box (20).
9. Unscrew the main nut (23) off the column and collect 28 steel balls (22).
10. Release the tabwasher (2), then remove the locknut (1), tabwasher, adjustable race (4) and seal (5) from the column (9).

Manual Steering Tractors only

11a. Withdraw the column (9) out of the tube (10), then remove the ball race (6), ball ring (7) and seal (8) from the column.
11b. Remove the 12 steel balls (3) from the tube (10).

Power Steering Tractors only

12a. Carefully lift the outer ball race (39) off the tube (10) and collect the 12 steel balls (3).
12b. Withdraw the column (9) out of the tube (10), then remove the ball race (6), ball ring (7) and seal (8) from the column.
12c. Remove the circlip (38), felt seal (37) and the retainer (35) from the tube (10).

13. Remove the two dished washers (19) and the two oil seals (17) from the steering box and the cover plate.
14. Fig. 6. Using special tool MF 263 and adapter MF 263-1, as shown, cut a thread into a bush (18) by turning the outer handle, then pull out the bush by rotating the inner handle.
15. Repeat operation 14 for the retaining three bushes.

Examination

Check the condition of all components for wear or damage and replace any parts which are unfit for further service. Thoroughly clean all components of the steering box, removing any pieces of old gasket from the joint faces of the steering box and cover plate.

Reassembly

1. Fig. 7. Position a bush (18) squarely over its hole and drive in the bush using the adapter MF 263-1 and the 550 handle, as shown.
2. Repeat operation 1 for the remaining three bushes.
3. Secure the cover plate (31) to the steering box and ream through each pair of bushes using the reamer MF 19A.
4. Remove the cover plate and thoroughly clean out all the swarf from the steering box (20).
5. Fig. 5. Fit a new seal (8), ball ring (7) and ball race (6) onto the column (9).

Manual Steering Tractors only

6. Position the 12 balls (3) in the tube (10), using grease to retain them, then lower the tube onto the column, taking care not to dislodge any of the balls.

Power Steering Tractors only

7a. Place on the tube (10) the retainer (35), a new felt seal (37) and a new circlip (38).
7b. Lower the tube (10) onto the column, then position the 12 balls (3) in the outer ball race (39), using grease to retain them, and slide the outer ball race over the column, taking care not to dislodge any of the balls and locate the ball race on the tube.

8. Fit a new seal (5) to the adjustable race (4) then fit the adjustable race to the column. Tighten the adjustable race to 1,4 kg-m (10 lb-ft), then slacken off one flat to bring a flat adjacent to the tabwasher keyway.

NOTE – ACCURATE ADJUSTMENT OF THE ADJUSTABLE RACE IS ESSENTIAL. IF THE ADJUSTMENT IS INCORRECT, THE SHAFT MAY BE PREVENTED FROM OSCILLATING, RESULTING IN BENDING STRESSES AND FAILURE OCCURING, WITH DANGEROUS CONSEQUENSES.

9. Fit a new tabwasher (2) and the locknut (1) and secure the adjustable race (4) and the locknut with the tabwasher.
10. Place the main nut (23) onto the column and assemble the 28 balls (22) into the main nut channel. Turn the main nut to house the balls as they are assembled.
11. Fit new oil seals (17) and dished washers (19) to the steering box (20) and cover plate (31).
12. Slide the primary rocker shaft (33) into its bore in the steering box (20), then refit the ball (34) to the shaft, using grease to retain it.
13. Screw the main nut (23) to the top of its thread on the column, then locate a new gasket (13) onto the steering box (20) and enter the column assembly into the box, still retaining the main nut at the top of its thread.
14. As the column is lowered into the box, turn the primary rocker shaft (33) until the ball (34) locates in its seating in the main nut (23).

NOTE – THE BALL TRANSFER TUBE (21) ON THE MAIN NUT MUST BE FACING AWAY FROM THE ROCKER SHAFT (33).

Hold the assembly in this position and secure the tube (10) to the steering box (20) with the four bolts (11) and washers.

15. Refit the ball peg (25) and more shims (24) then will be necessary and temporarily secure them with the two bolts (27).
16. Turn the column until the main nut is half way along its thread on the column, then remove shims until there is no end float with the main nut rotating freely. When correctly adjusted, secure the ball peg (25) and shims (24) with the two bolts (27) and tabwasher (26).
17. Taking care not to damage the oil seal (17), refit the secondary rocker shaft (32) so that the two centre teeth of each rocker shaft are in mesh.
18. Refit the cover plate (31) with a new gasket (28) taking care not to damage the oil seal (17) and secure the cover plate with the two bolts (29) and washers and the two nuts (30).
19. Fill the steering box with recommended oil to the plug level and refit the plug (12).

Power Steering Tractors only

20a. Refit the circlip (38) to the outer ball race (39) using the 7066 circlip pliers.

20b. Fit the new felt seal (37) against the circlip (38) and secure the retainers (35) to the outer ball race (39) with the screw (36) and washer.

20c. Fit two new 'O' rings to the steering column valve face and refit the valve, securing it to the steering column with the three bolts and washers.

20d. Fig. 16. Refit the linkage (67) to the pin (66) and secure it with the washer (65) and hairpin (64).

21. Refit the steering box as stated in operation 6C-01-01 and adjust the control valve as stated in operation 6C-11-13.

Steering Box Gasket Removal and Replacement 6C-03-06

Special Tools Required: P1007C Steering Drop Arm Remover

Removal

1. Remove the bolt securing the oil pressure pipe clip and the L.H. side of the battery carrier to the steering box.
2. Fig. 5. Remove the nut (14) and washer securing the L.H. drop arm (15) to its rocker shaft (33), then using the puller P1007C remove the drop arm, and the felt seal (16).
3. Remove the bolt and washer securing the fuel cut-off rod mounting bracket to the steering box.
4. Remove the lower instrument panel and disconnect the two power steering pipes from the valve (Power Steering Tractors only).
5. Place a suitable container beneath the cover plate (31) and remove the two bolts (29) and washers and the two nuts (30) securing the cover plate to the steering box.
6. Remove the cover plate and the gasket (28) from the steering box, taking care not to damage the oil seal (17).

Examine the joint faces on the steering box and the cover plate for damage and distortion. Clean both faces, removing any pieces of old gasket. Always fit a new gasket.

Replacement

1. Fit a new gasket (28) to the steering box, and taking care not to damage the oil seal (17) refit the cover plate to the steering box and secure it with the two nuts (30) and the two bolts (29) and washers.
2. Fit a new felt seal (16) to the rocker shaft (33), then refit the drop arm (15) aligning the master splines, and secure with the nut (14) and washer tightened to a torque of 34,5 kg-m (250 lb-ft)
3. Reconnect the two power steering pipes to the valve and refit the lower instrument panel. (Power Steering Tractors only).
4. Refit the bolt and washer securing the fuel cut-off rod mounting bracket to the steering box.
5. Refit the bolt securing the oil pressure pipe clip and the L.H. side of the battery carrier to the steering box.
6. Remove the filler plug (12) and refill the steering box with recommended oil to the plug level and refit the plug (12).
7. Refill the power steering reservoir (if fitted) as stated in operation 6C-08-10

DRAG LINK

Removal and Refitment 6C-04-06

Removal

1. Remove the nuts securing the drag link balls ends to the drop arm and the spindle arm.
2. Release the ball ends by hitting the side of the spindle arm or drop arm smartly whilst supporting the other side of the spindle arm or drop arm with a block of metal.
3. Fig. 8. If necessary slacken the bolt (42) and locknut (43) securing the front ball end (41) and withdraw the ball end.

NOTE – DO NOT SLACKEN THE PINCH BOLT (44) OR UNSCREW THE BALL END (40) UNLESS THE BALL END IS TO BE REPLACED.

Check the ball ends (40 and 41) for wear, replacing any defective components and fitting new rubber boots and garter springs.

Refitment

1. If necessary, refit the front ball end (41) into the drag link and secure with the bolt (42) and locknut (43). Ensure that the bolt is located in the seating groove in the ball end.
2. If necessary, screw the ball end (40) into the drag link. Screw the end in or out until the length of the drag link (at 1320 mm (52 in) track setting) is 1052,6 mm (41,44 in) from the centres of the ball ends. Retighten the pinch bolt (44) to a torque of 4,8 kg-m (35 lb-ft).

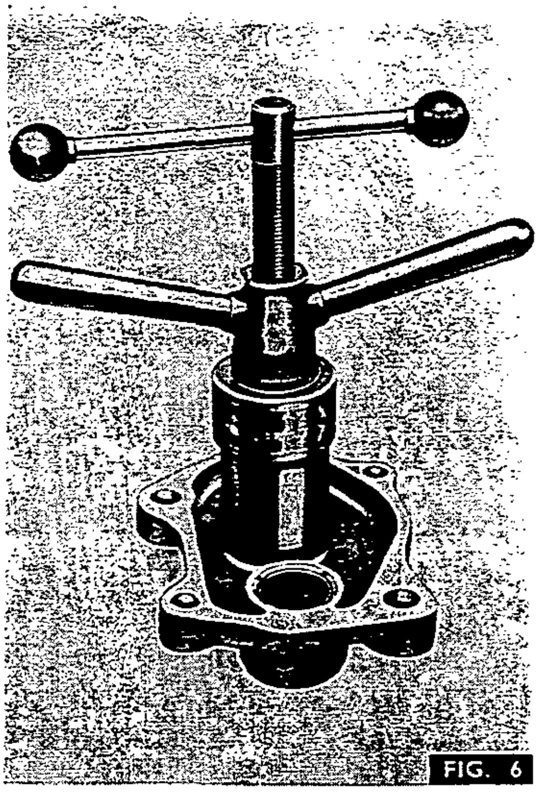

FIG. 6

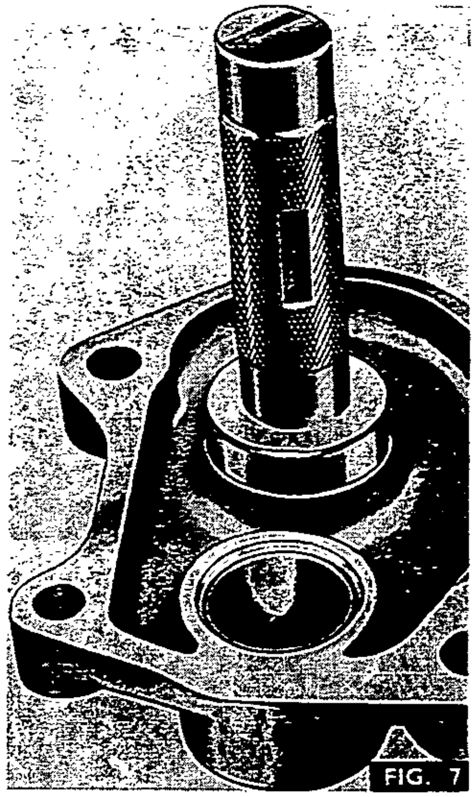

FIG. 7

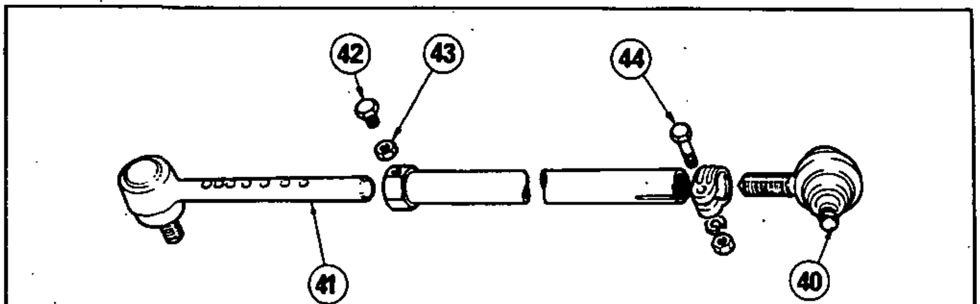

FIG. 8

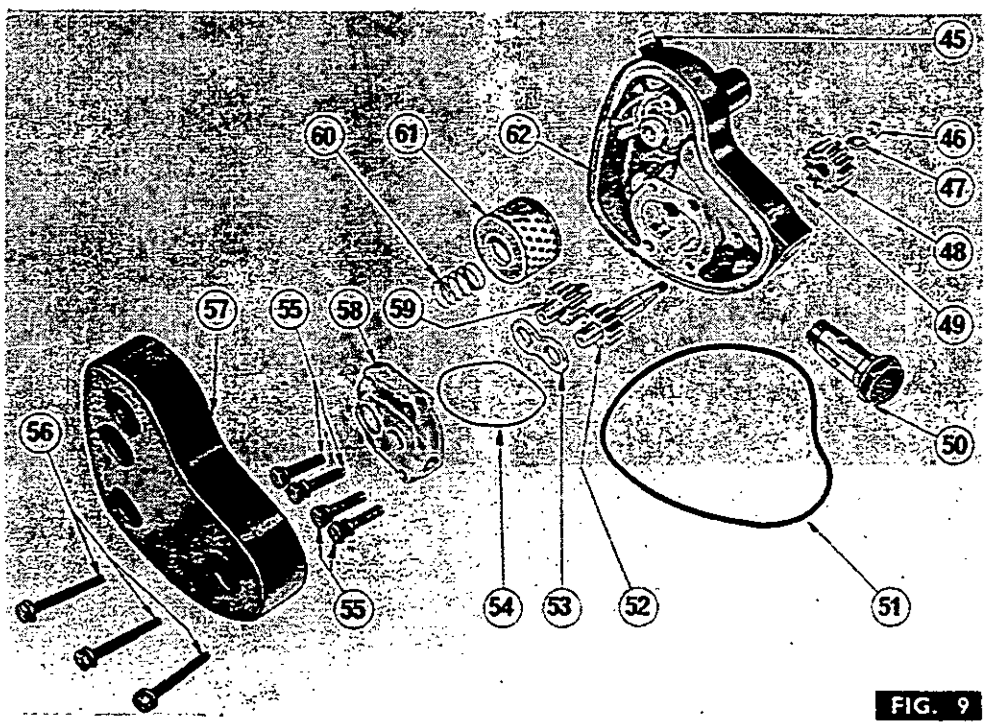

FIG. 9

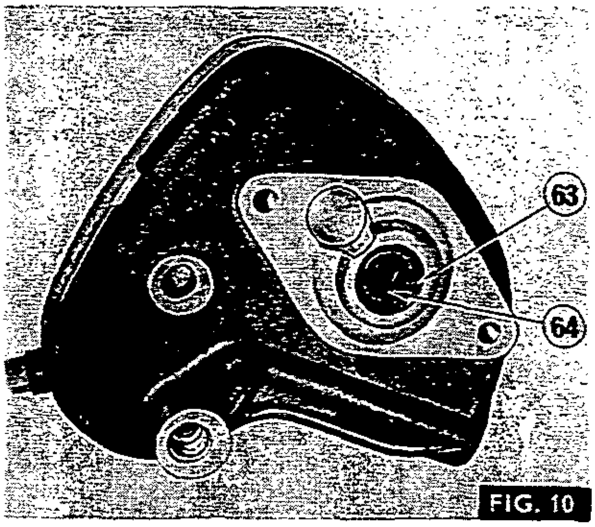

FIG. 10

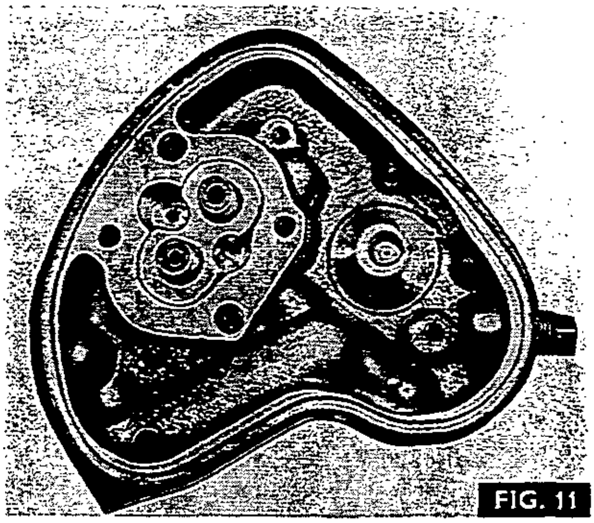
FIG. 11

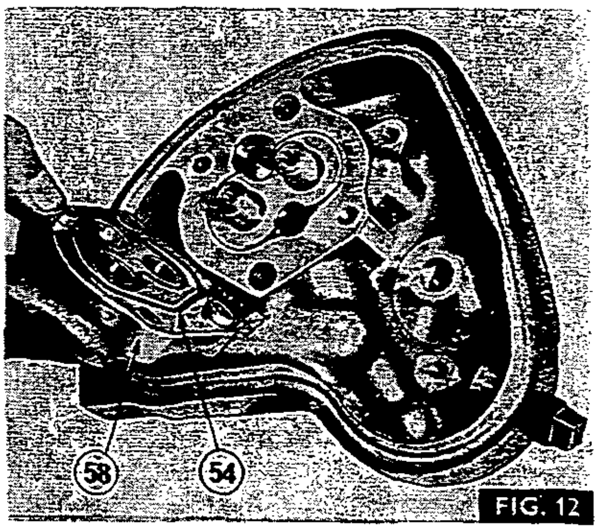

FIG. 12

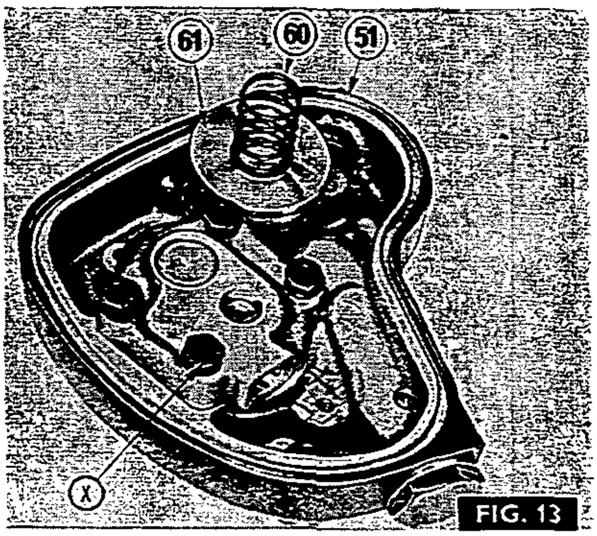

FIG. 13

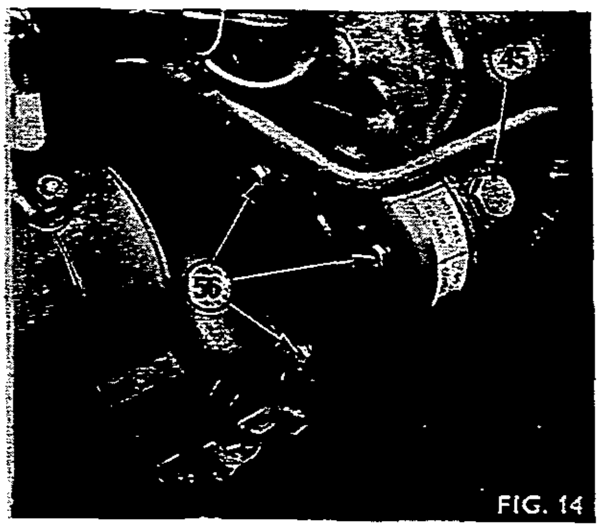

FIG. 14

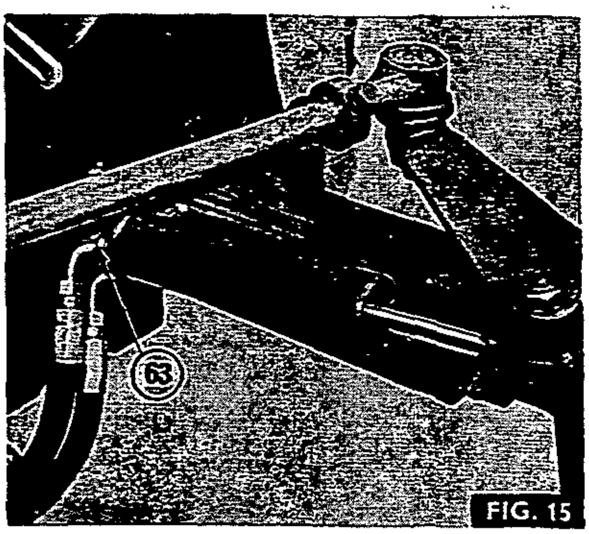

FIG. 15

NOTE – BEFORE RETIGHTENING THE BOLT (44) ENSURE THAT THE BOLT RUNS DIRECTLY ACROSS THE SLOT IN THE DRAG LINK.

3. Refit the drag link to the spindle arm and the drop arm and secure with the two nuts tightened to a torque of 12,5 kg-m (90 lb-ft).
4. Check the front wheel toe-in as stated in Part 6A.

POWER STEERING PUMP

Removal and Refitment 6C-05-09

Removal

1. Disconnect the two pipes from the power steering pump.
2. Remove the two bolts and washers securing the pump to the engine timing case and remove the pump.

Refitment

1. Position the pump in place on the timing cover and secure it with the two bolts and washers.
2. Reconnect the two pipes and refill the reservoir as stated in operation 6C-08-10

Servicing 6C-06-09

Special Tools Required: 7066 Circlip Pliers

Disassembly

1. Remove the pump as stated in operation 6C-05-09.
2. Fig. 9. Remove the reservoir filler plug (45) and drain the pump of oil.
3. Release the tabwasher (47) and remove the nut (46) and tabwasher securing the gear to the spindle.
4. Remove the gear (48) and the key (49) from the spindle.
5. Remove the three bolts (56) and washers securing the reservoir cover (57) to the pump body (62), then remove the cover, together with the filter element (61) and the spring (60).
6. Remove the four bolts (55) and washers securing the gear cover (58) to the pump body, then remove the cover and the sealing ring (54).
7. Remove the pressure plate (53) and withdraw the drive gear (52) and the driven gear (59) from the pump body.
8. Remove the reservoir sealing ring (51) from the pump body.
9. Fig. 10. Using the circlip pliers 7066 remove the circlip (63) and then the seal (64) from the front of the pump body.
10. Fig. 9. If necessary, remove the relief valve (50) and washer.

Examination

Examine all parts for wear, scoring or damage and replace any defective components. Always fit new 'O' rings and seals.

Reassembly

1. If necessary, fit the relief valve (50) with a new washer and tighten it to a torque of 5,5 kg-m (40 lb-ft).
2. Fig. 10. Fit a new seal (64) into position in the pump body and secure it with a new circlip (63) using the circlip pliers 7066. Pack the cavity between the seal and the pump body with petroleum jelly.
3. Fig. 9. Fit the drive gear (52) into the pump body taking care not to damage the seal.
4. Fit a new key (49) and the gear (48) to the spindle (52) and secure the gear with a new tabwasher (47) and nut (46).
5. Fit the driven gear (59), with the shorter spindle in the bush in the pump body.
6. Fig. 11. Fit the pressure plate (53) on top of the gears, with the oil recesses against the gears and the relieved radii to the outlet side of the pump, as shown.
7. Fig. 12. Fit a new sealing ring (54) to the gear cover (58) and place the cover into position. Secure the cover with the four bolts (55, Fig. 9) and washers tightened to a torque of 2,0 kg-m (15 lb-ft).

   NOTE – THE LONGER BOLT IS FITTED AT "X" AS SHOWN IN FIG. 13.

8. Fig. 13. Lightly coat the outside edge of a new sealing ring (51) with petroleum jelly, then fit the ring into the recess around the outer edge of the pump body.
9. Fit a new filter element (61) with the oil inlet over the boss in the inlet port in the pump body.
10. Locate the filter element spring (60) in the recess on top of the element.
11. Fig. 9. Fit the reservoir cover (57), then, compressing the spring (60) tighten the securing bolts (56) and washers until the cover is maintained in contact with the sealing ring, then tighten the bolts a further complete turn.
12. Refit the pump to the timing cover as stated in operation 6C-05-09

Filter Removal and Replacement 6C-07-09

Removal

1. Fig. 14. Place a suitable container beneath the pump body and remove the three bolts (56) and washers securing the reservoir cover to the pump body.
2. Remove the reservoir cover complete with the filter element and spring.
3. Remove the sealing ring from the pump body.

Replacement

1. Fig. 13. Lightly coat the outside edge of a new sealing ring (51) with petroleum jelly, then fit the ring into the recess around the outer edge of the pump body.
2. Fit the new filter element (61) with the oil inlet over the boss on the inlet port in the pump body.
3. Locate the filter element spring (60) in the recess on top of the element.
4. Fig. 14. Fit the reservoir cover, then, compressing the spring tighten the securing bolts (56)and washers until the cover is maintained in contact with the sealing ring, then tighten the bolts a further complete turn.
5. Refill the reservoir as stated in operation 6C-08-10

Filling the Reservoir 6C-08-10.

Procedure is as follows

1. Fig. 14. Remove the filter plug (45) and fill the reservoir with a recommended fluid.
2. With the engine STOP control fully out, operate the engine starter motor to actuate the pump. Fluid will be pumped to the control valve, emptying the reservoir.
3. Immediately, refill the reservoir to avoid damage to the pump.
4. Fig. 15. Refit the filler plug, then loosen the steel pipe (63) connected to a steering ram hose.
5. Start the engine and run at idling speed. Turn the steering wheel from lock to lock several times to expel air from the system.
6. Remove the filler plug and when fluid can be seen through the filler hole, to be returning to the reservoir free of air bubbles, retighten the steel pipe (63).
7. Stop the engine, top up the reservoir and refit the filler plug.

NOTE – NEVER RUN THE ENGINE UNLESS THERE IS SUFFICIENT FLUID IN THE PUMP RESERVOIR.

CONTROL VALVE

Removal and Refitment 6C-09-10

Removal

1. Remove the lower instrument panel and the battery access panel.
2. Disconnect the feed and return pipes from the control valve.
3. Fig. 16. Remove the split pins (70) securing the valve pin (71) and remove the pin.
4. Remove the three bolts and washers securing the control valve to the steering column and remove the valve.
5. Remove the two 'O' rings from the steering column valve face.

Refitment

1. Fit two new 'O' rings to the steering column valve face, then refit the valve to the steering column and secure it with the three bolts and washers.
2. Reconnect the feed and return pipes to the valve.
3. Adjust the linkage as stated in items 3 to 8 of operation 6C-11-13

Servicing 6C-10-10

Special Tools Required: 7066 Circlip Pliers

Disassembly

1. Remove the control valve as stated in operation 6C-09-10.
2. Throroughly clean the valve housing.
3. Fig. 17. Using the 7066 Circlip Pliers remove the circlip (91) at the end of the valve, then remove the two washers (89) and the felt seal (90).
4. Remove the two bolts (73) and washers securing the end cover (74) and withdraw the spool complete with yoke, end cover, springs, washers and seals.
5. Detach the yoke (72) from the spool, then remove the end cover (74), reaction ring (76), springs (78 and 79) and washer (80) from the spool.
6. Remove the 'O' rings (75 and 77) from the reaction ring (76).
7. Remove the 'O' ring (88) from the valve body (87).
8. Invert the valve body and tap out the plug (83), ball (85) and spring (86).
9. Remove the 'O' rings (82 and 84) from the plug (83).
10. If necessary, remove the relief valve plug (95), washer (94), ball (92) and spring (93).

Examination

Thoroughly clean all components and check for wear or damage, replace any parts which are defective. Always fit new 'O' rings and seals.

NOTE – IF THE SPOOL OR BODY IS DAMAGED, BOTH PARTS MUST BE REPLACED AS THEY ARE ONLY SUPPLIED IN MATCHED SETS.

Reassembly

1. If necessary, refit the ball (92), spring (93), washer (94) and the relief valve plug (95).
2. Fit a new 'O' ring (88) to the valve body (87).
3. Fit new 'O' rings (82 and 84) to the plug (83), then fit the spring (86), ball (85) and plug (83) to the valve.
4. Fit new 'O' rings (75 and 77) to the reaction ring (76), then fit the washer (80), two springs (78 and 79), reaction ring (76) and the end cover (74) to the spool (81) and secure with the yoke (72).
5. Lubricate the spool and body with clean hydraulic fluid and slide the spool into the valve and secure the end cover (74) with the two bolts (73) and washers.
6. Fit a new felt seal (90) and the two washers (89) to the valve body and secure with a new circlip (91) using the circlip pliers 7066.
7. Refit the valve to the steering column as stated in operation 6C-09-10

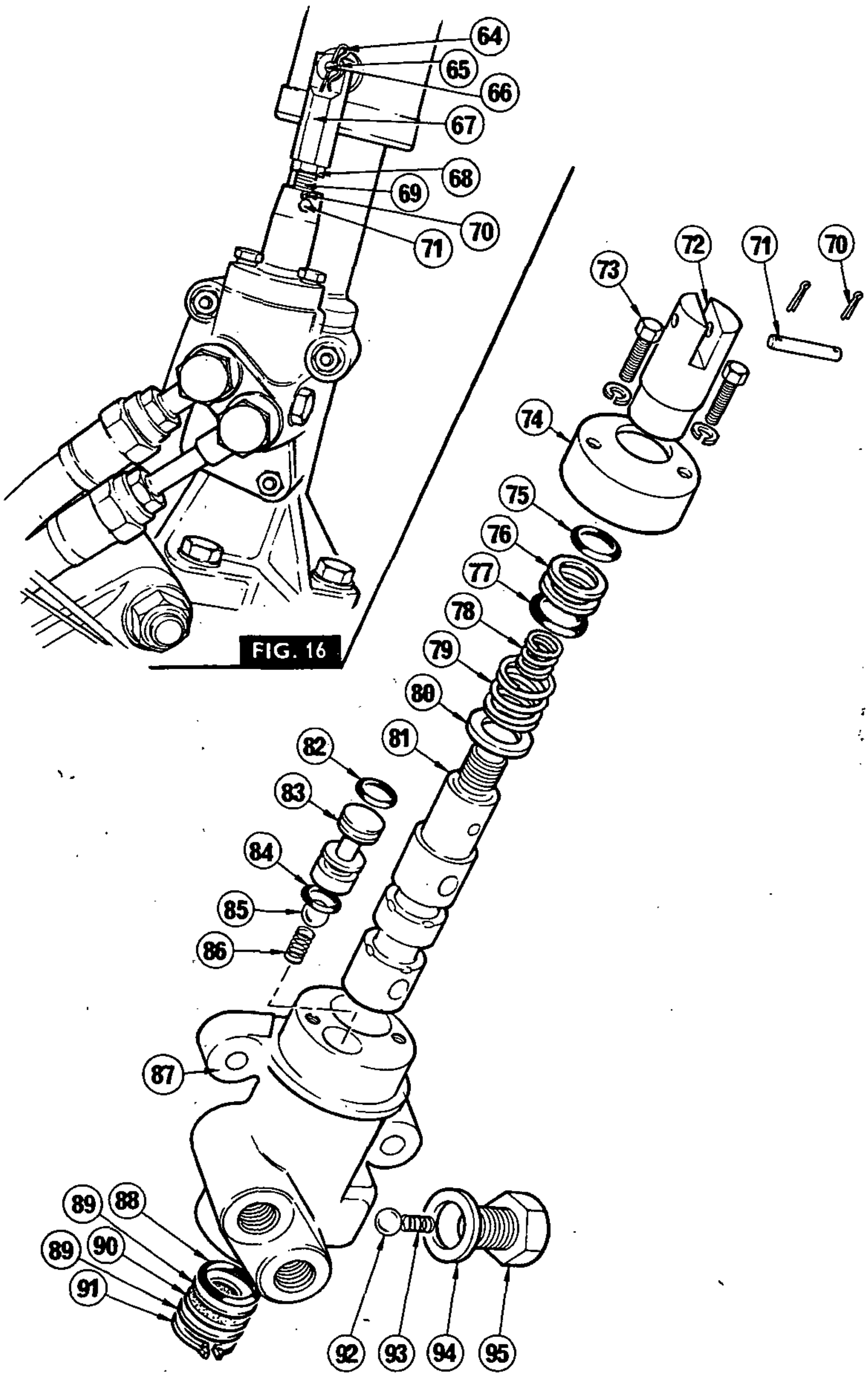
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FIG. 16

FIG. 17

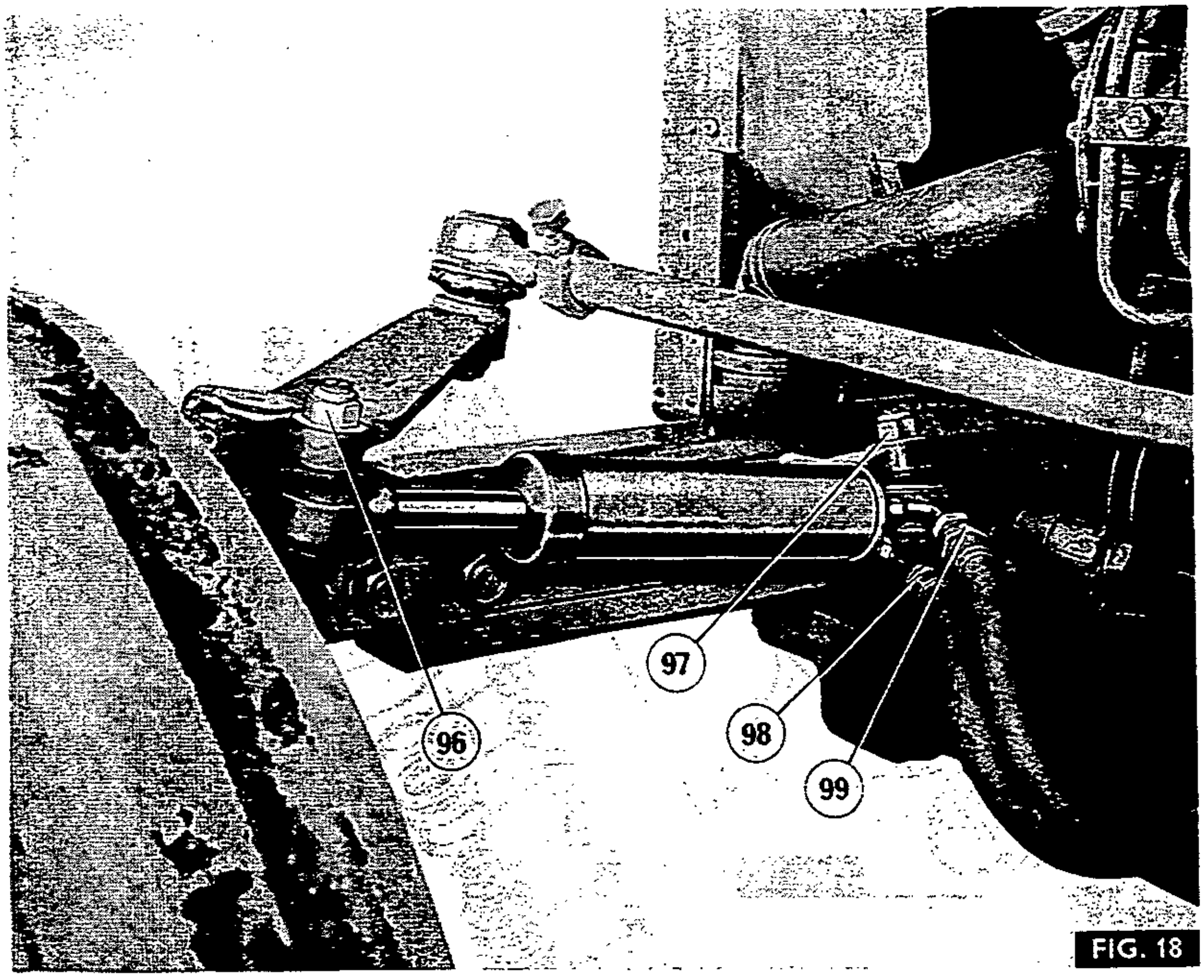

FIG. 18

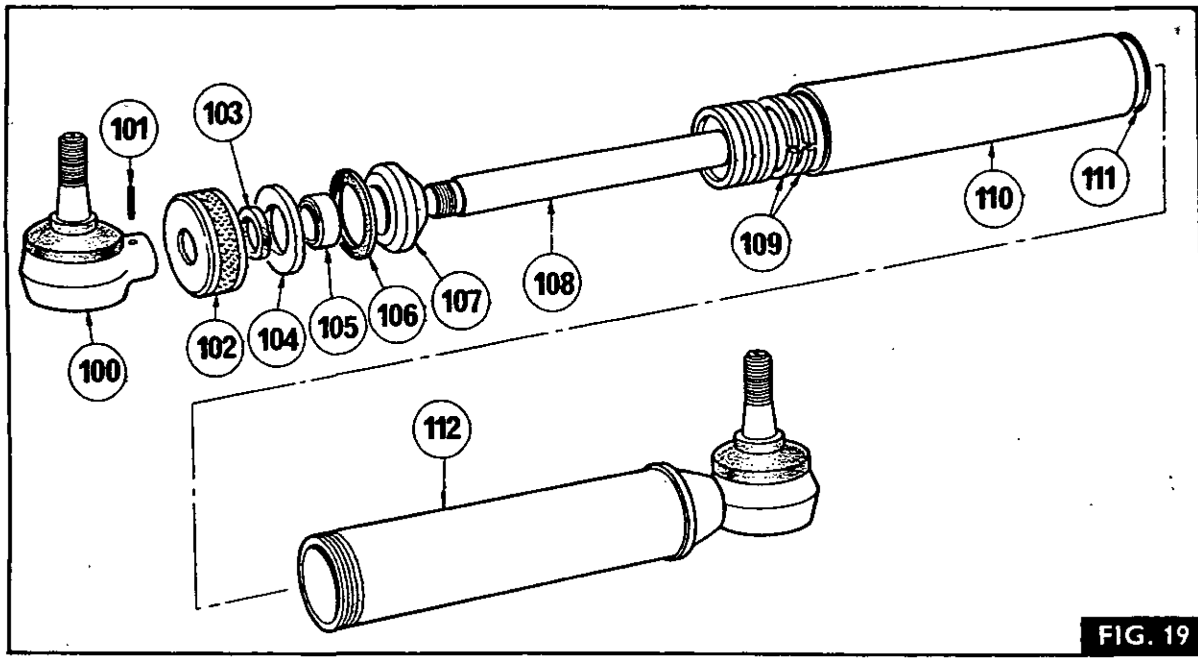

FIG. 19

Adjustment 6C-11-13

1. Remove the battery access panel and the lower instrument panel.
2. Fig. 16. Remove the split pins (70) securing the valve pin (71) and remove the pin.
3. Set the wheels in the straight ahead position.
4. Turn the steering wheel to the right until all free travel is taken up.
5. With the steering wheel in this position, adjust the linkage to enable the valve pin (71) to be fitted. The control valve yoke may be turned to facilitate fitment.
6. Remove the valve pin (71), then increase the length of the linkage 1,4 mm (0.055 in) by screwing out the link end (69) one complete turn, then secure with the locknut (68).
7. Turn the steering wheel to the left until the valve pin (71) can be refitted. Secure the pin with two new split pins (70).

   NOTE – DO NOT CHANGE THE POSITION OF THE CONTROL VALVE YOKE WHEN REFITTING THE LINKAGE.

8. Refit the battery access panel and the lower instrument panel.

STEERING RAM

Removal and Refitment 6C-12-13

Removal

1. Fig. 18. Disconnect the two hoses (98 and 99) from the ram assembly.
2. Remove the nut (96) securing the ram piston to the spindle arm and the other nut (97) securing the ram cylinder to the bracket.
3. Release the two ball ends and remove the ram assembly.

Refitment

1. Refit the ram assembly, as shown, and secure it with the two nuts (96 and 97).
2. Reconnect the two hoses (98 and 99) to the ram cylinder and refill the reservoir as stated in operation 6C-08-10

Servicing 6C-13-13

Disassembly

1. Remove the steering ram as stated in operation 6C-12-13.
2. Thoroughly clean the outside of the steering ram.
3. Fig. 19. Unscrew the gland nut (102) and withdraw the piston assembly (108) together with the inner tube (110) from the cylinder assembly (112).
4. Remove the copper washer (111) from the cylinder assembly (112).
5. Withdraw the piston assembly (108) from the inner tube (110).
6. Remove the roll pin (101) and unscrew the ball end (100) from the piston assembly (108).
7. Remove the gland nut (102), seal (103), washer (104), 'O' ring (106), seal (105) and rod guide (107) from the piston (108).
8. If necessary, remove the piston rings (109) from the piston.

Examination

Examine all components for signs of wear, scoring or damage and replace any defective parts. When reassembling always fit new seals, 'O' rings and a new roll pin.

Reassembly

1. If necessary, fit new piston rings (109) to the piston.
2. Fit the rod guide (107), a new seal (105), 'O' ring (106) washer (104), seal (103), and the gland nut (102) to the piston assembly.
3. Screw the ball end (100) on to the piston assembly (108) and secure with a new roll pin (101).
4. Slide the piston assembly into the inner tube (110).
5. Place a new copper washer (111) in the cylinder assembly, then slide the inner tube and piston assembly into the cylinder assembly and secure with the gland nut (102).
6. Refit the steering ram as stated in operation 6C-12-13

HYDRAULIC SYSTEM

Part 7 Section A

Table of Contents

GENERAL

Fig. 1. The hydraulic lift system comprises of a four cylinder pump (2), which delivers oil through a vertical pipe (1), to the cylinder (3).

A connecting rod (4), from the cylinder piston engages the ram arm (5) on the lift shaft, which projects from the lift cover. Lift arms (6) are splined to each end of the lift shaft.

When oil, under pressure from the pump, is delivered to the closed end of the cylinder, the piston inside the cylinder is forced rearwards and pushes the ram arm upwards, causing the lift shaft to rotate and raise the lift arms.

Conversely, when the oil is allowed to drain back from the system, the piston moves back along its cylinder under the load of the lift arms.

Hydraulic Pump

The pump is driven by the front p.t.o. drive shaft. Dowel pins, fitted through each side of the centre housing, prevent the pump from rotating.

Fig. 2. The pump consists of two piston yokes which ride on cam blocks over eccentrics on a camshaft. The pistons, two on each yoke, reciprocate in two opposed valve chambers, each chamber housing two inlet and outlet valves, and springs. A sealing plug and snap ring close the valve bores in the valve chambers. Front and rear castings incorporate the oil galleries connecting the two valve chambers, and house the control valve at the rear, and support the oscillator body and oil strainer.

As each of the pump pistons moves down its cylinder it creates suction which lifts the inlet valve from its seat and draws in oil past the control valve – if open – along the intake gallery into the cylinder. During this inlet stroke the outlet valve is held closed by the spring acting upon it. When the piston reaches the end of its inlet stroke, the suction ceases and the inlet valve is closed by the inlet valve spring. As the piston returns into the cylinder, the resultant pressure in the oil keeps the inlet valve closed and lifts the outlet valve. This pressure forces the oil past the outlet valve into the discharge passage.

Control Valve

Fig. 3 The control valve slides inside the lower part of the pump rear casting on three hardened steel washers, which are separated by spacing sleeves, dividing the bore inside the casting into two compartments.

These two compartments provide inlet and outlet chambers for the pump which are opened and closed by the inlet and outlet slots at opposite ends of the control valve. The suction side of the pump or intake passage connects with the rear or outer compartment, and similarly the inner compartment lies at the bottom of the high pressure side of the system. The outer ends of the high pressure chamber are sealed by 'O' rings and the assembly is held in place by a cover plate bolted to the rear casting.

Intake Position

When the valve slides forward, its inlet slots pass within the suction chamber so that the constant running pump may draw on the oil supply and deliver it to the lift cylinder to raise the lower links. In this position the valve keeps the discharge chamber closed so that oil cannot escape back to the sump.

Neutral Position

With the valve positioned centrally, both the inlet and outlet slots are outside their respective chambers, the oil is therefore locked in the system and the lift piston and lower links remain stationary.

Discharge Position

When the valve slides rearwards, the suction chamber remains closed, but the outlet slots are brought within the discharge chamber, permitting oil to drain into the sump from the lift cylinder, and the lower links fall.

The rate at which the oil drains away is, of course, proportional to the area of the slot within the chamber, which is dependant on the amount the valve is withdrawn.

OPERATION

Draft Control – Implement Lowering (Fig. 4)

The position control lever must be in the transport position when operating the draft control.

To lower the implement, move the draft control lever downwards through the quadrant. This action presses the eccentric roller. (7), on the end of the draft control lever shaft, down onto the upper cam face of the draft control cam (8), causing the lower face of cam (8) to be forced downwards into contact with roller (9) on the draft control linkage. Cam (8) is then moved rearwards causing the vertical lever (10) to pivot about its fulcrum and move the pump control valve lever (11) into the discharge position against the influence of the pump control valve spring. The draft control linkage will move because the force from the pump control valve is less than the breakout spring force from (12).

Draft Control – Compression Force in Top Link (Fig. 5)

When the vertical lever (10) has moved the control valve to full discharge, the lever (10) will also have forced the dashpot piston to the end of its stroke. Therefore, with further downward movement of the draft control lever, the eccentric roller (7) acting on the upper cam face of the draft control cam (8), forces the lower cam face of the draft control cam (8) to move roller (9) forwards. Forward movement of the roller (9) leaves a gap between the draft control rod (15) and the draft control spring plunger (14), and simultaneously compresses the spring on the guide rod (12).

Forward movement of the tractor will cause an implement to gain depth (as the control valve is in the discharge position), until the resultant implement draft reaction compression forces applied through the top link deflect the control spring and cause the draft control spring plunger (14) to contact, the draft control rod (15), and move the draft control linkage forwards. This permits the draft control cam (8) to move forward, acting under the influence of the pump control valve spring and limited by the position of roller (9), until the control valve reaches the neutral position.

Draft Control – Tension Force in Top Link (Fig. 6)

Variations in ground conditions will cause fluctuation in the draft force in the top link. If the draft force decreases, the compression force in the control spring decreases.

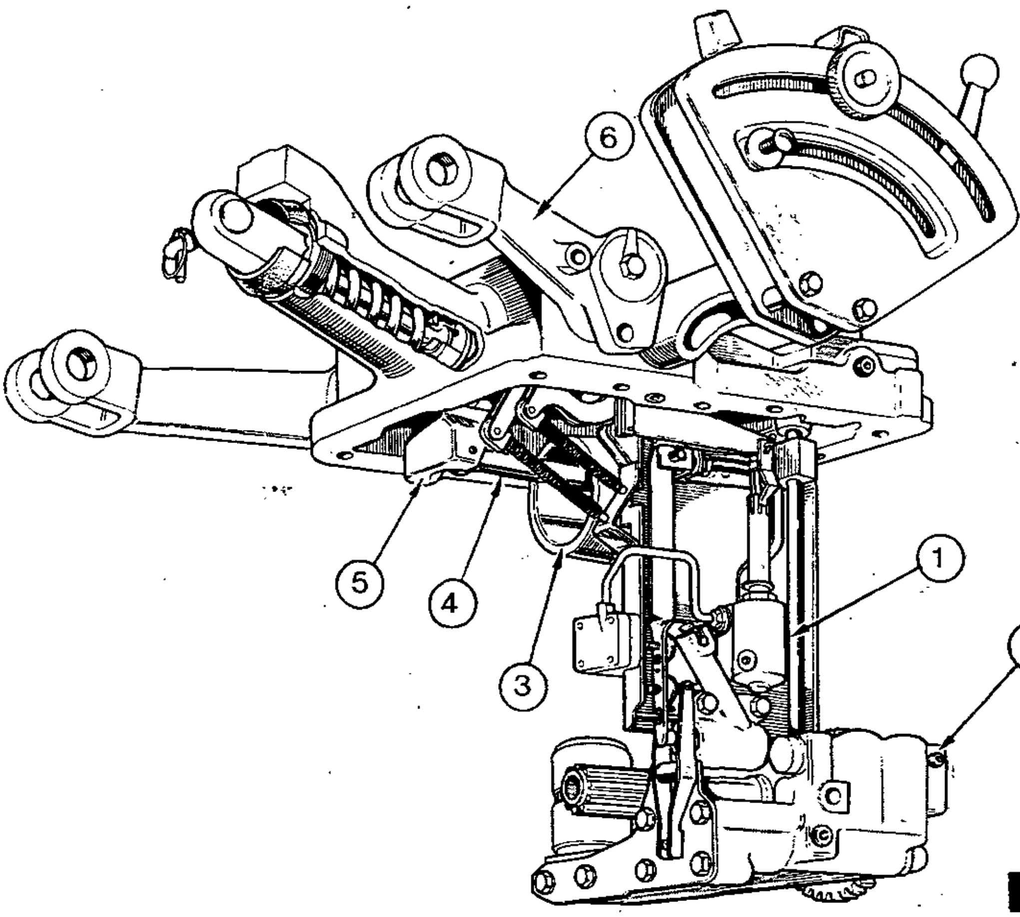

FIG. 1

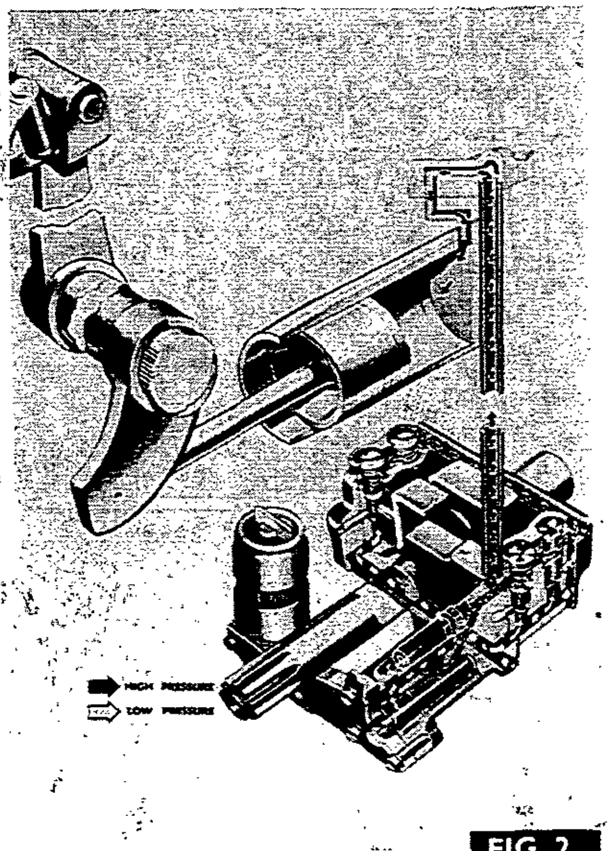

FIG. 2

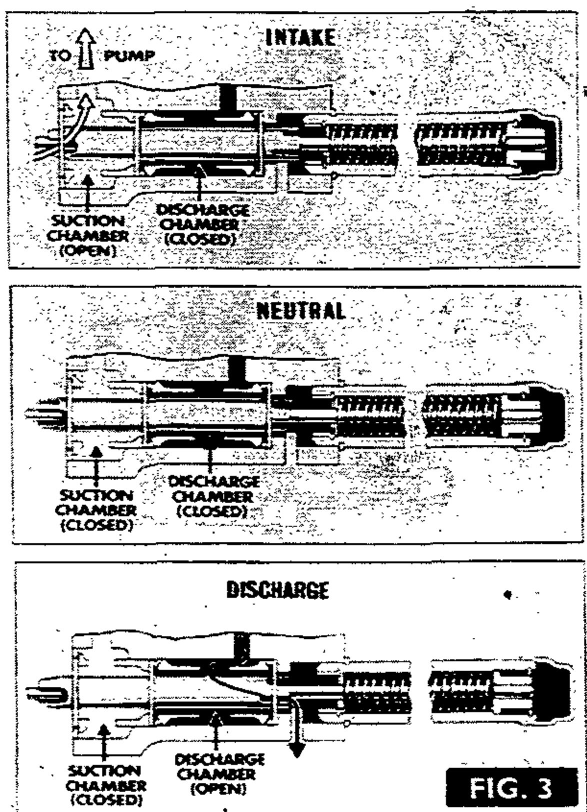

FIG. 3

DRAFT CONTROL — IMPLEMENT LOWERING

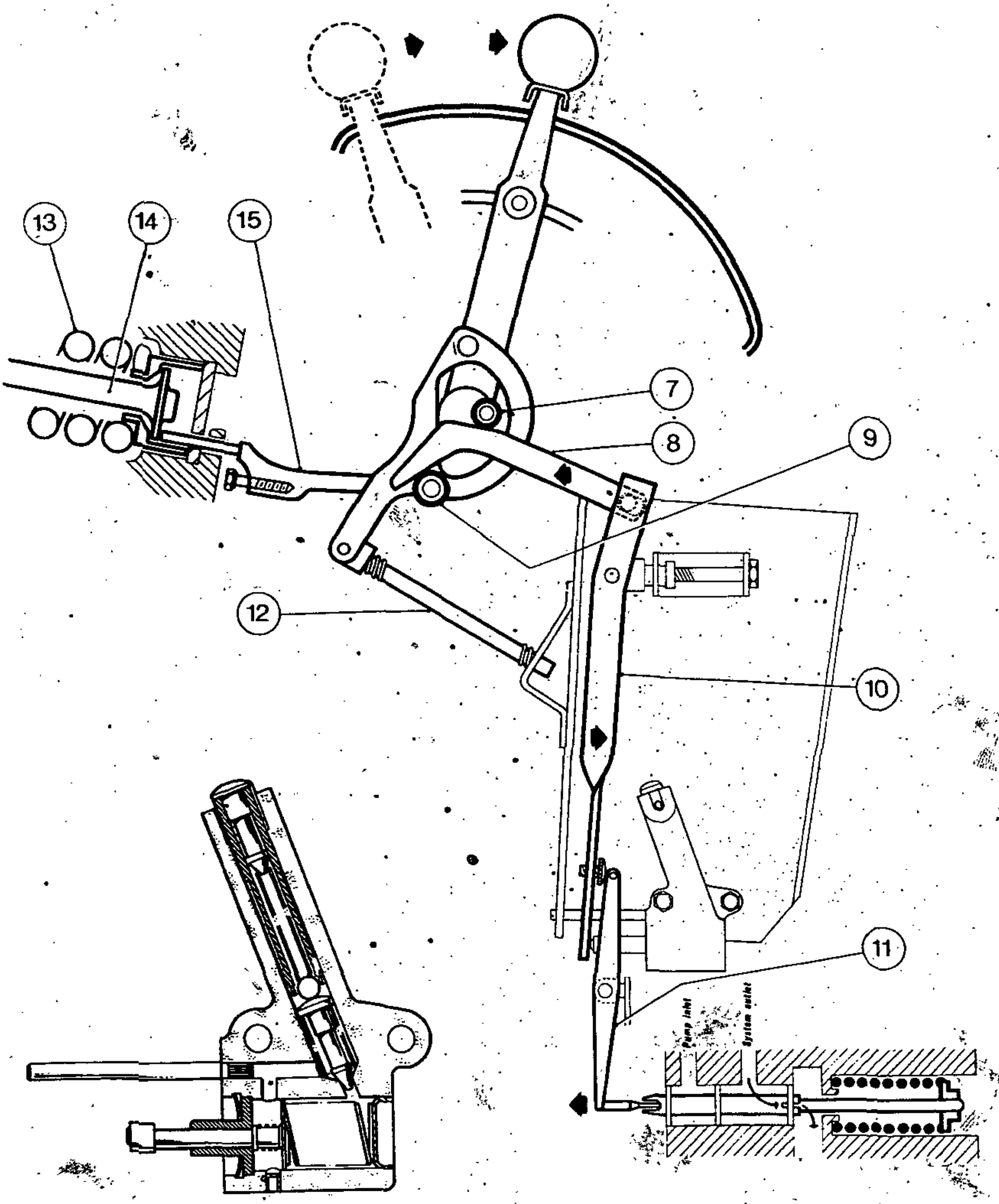

FIG. 4

DRAFT CONTROL – COMPRESSION FORCE IN TOP LINK

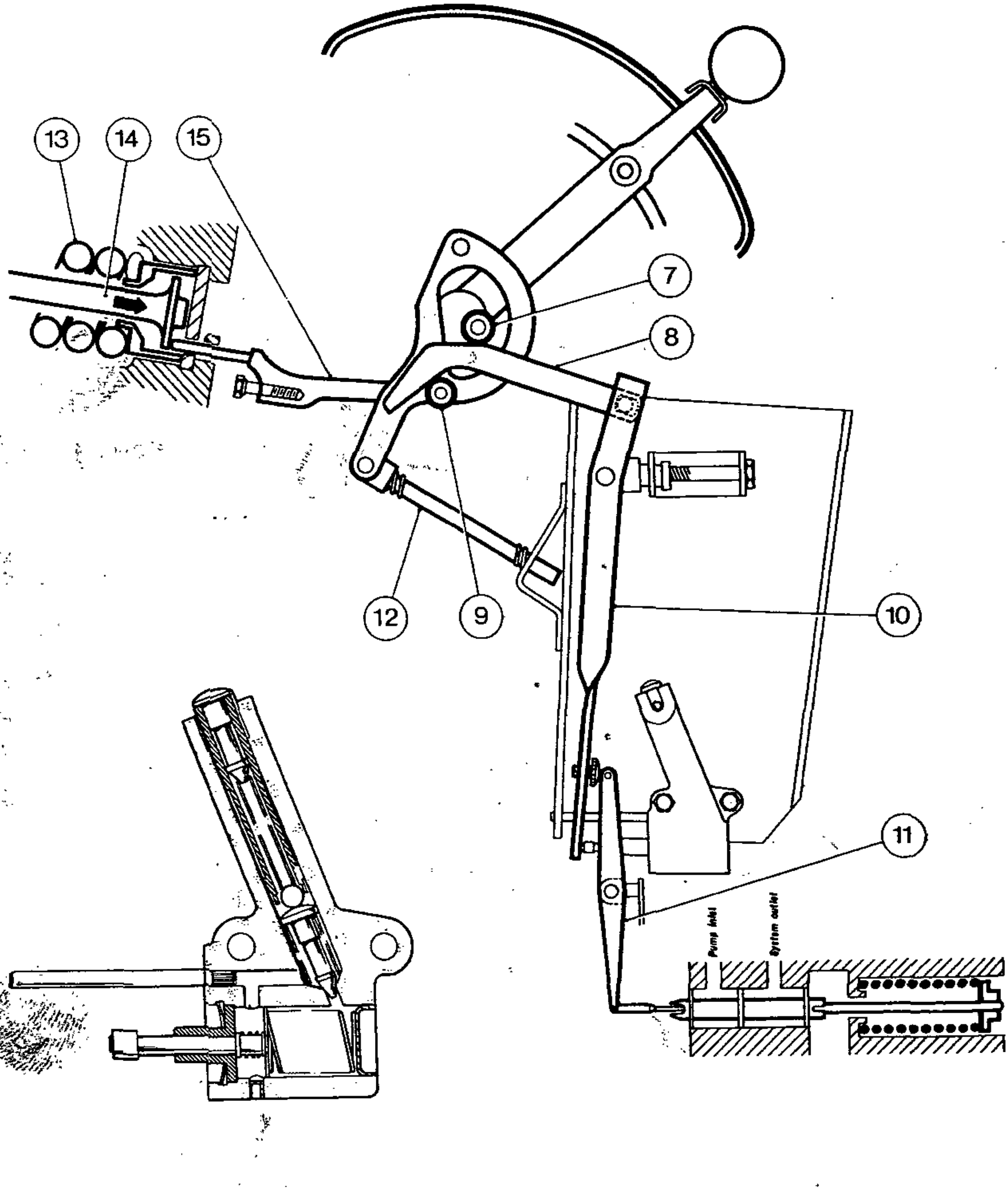

FIG. 5

DRAFT CONTROL – TENSION FORCE IN TOP LINK

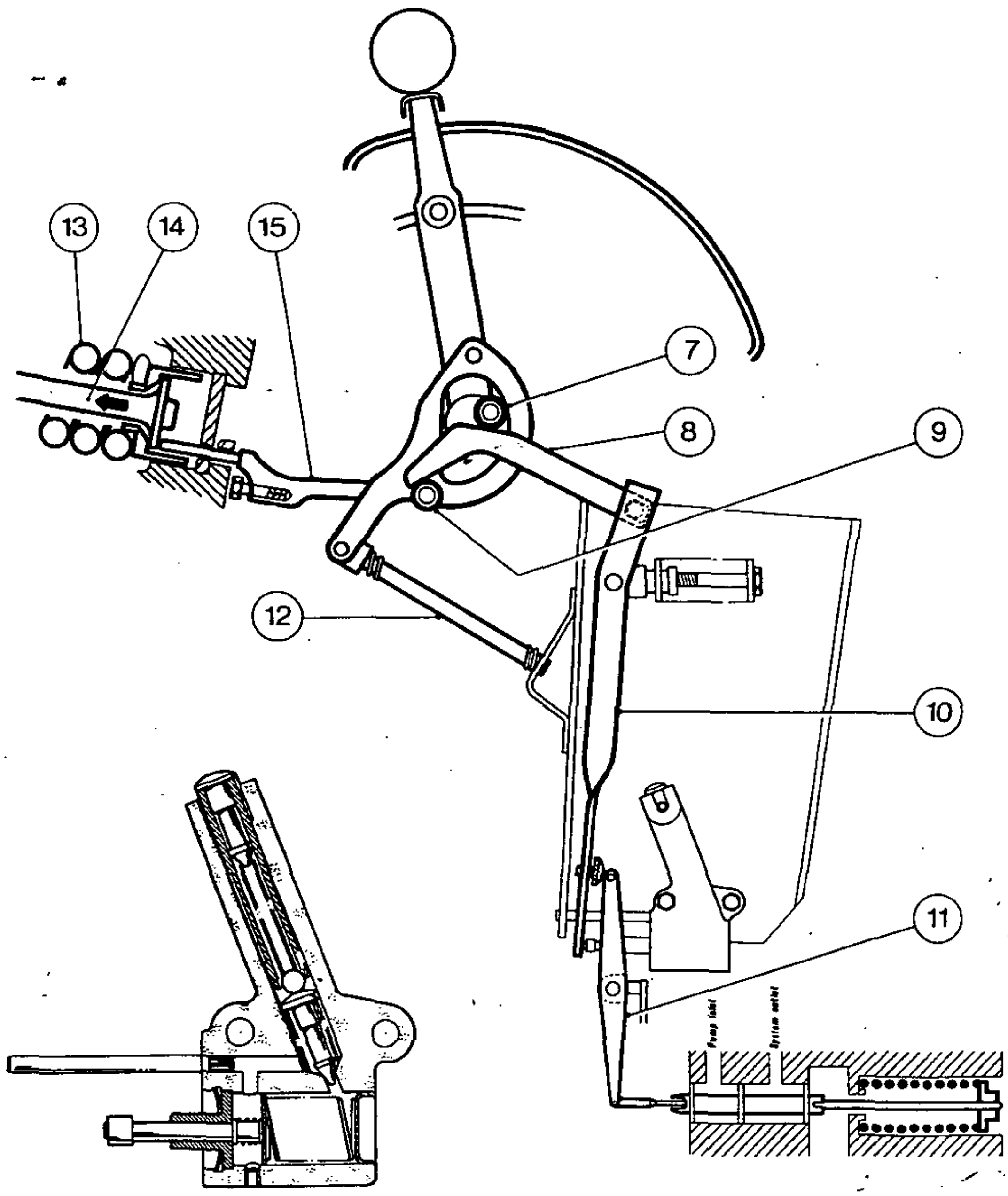

FIG. 6

POSITION CONTROL – TRANSPORT POSITION

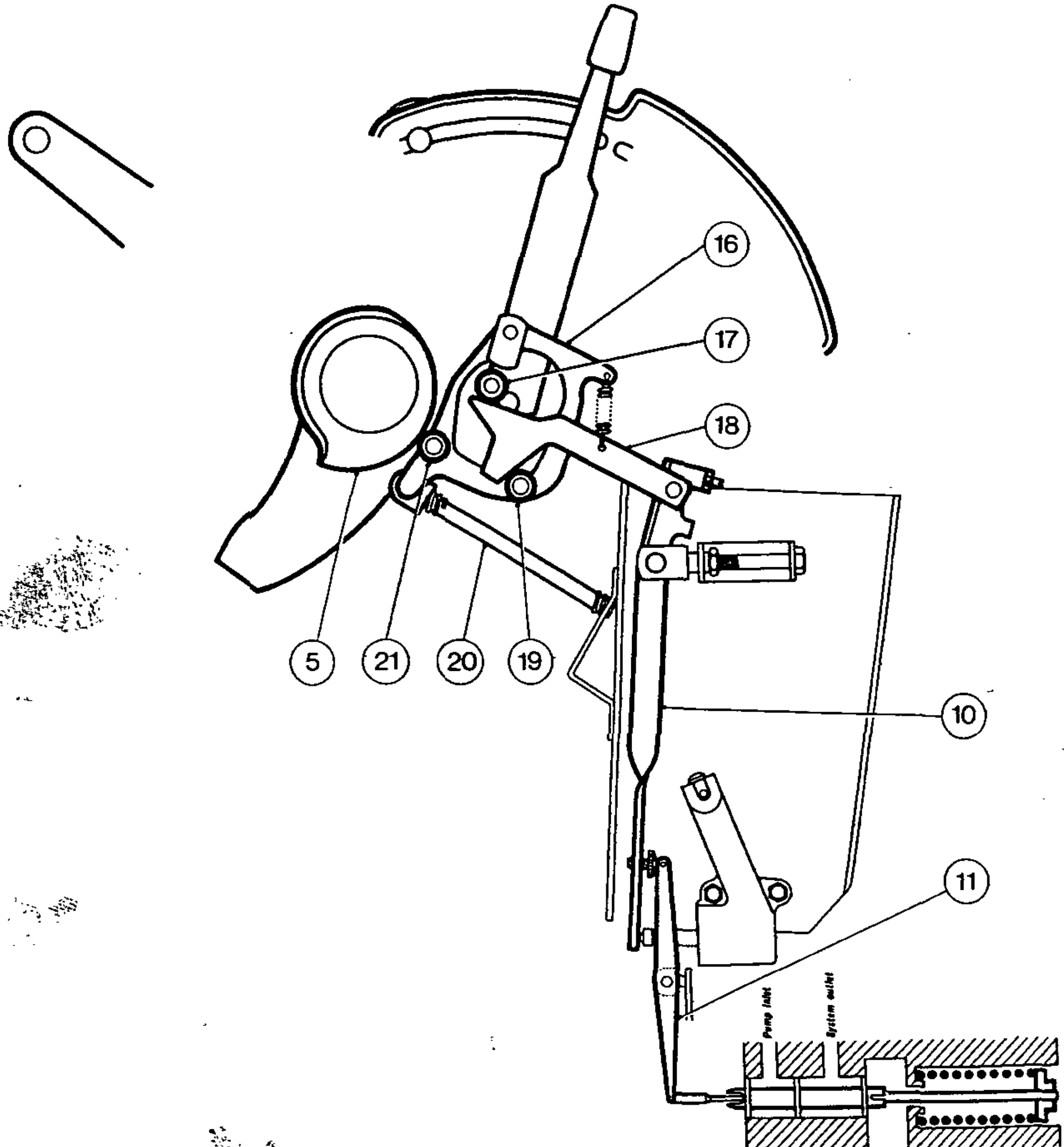

FIG. 7

POSITION CONTROL – IMPLEMENT LOWERING

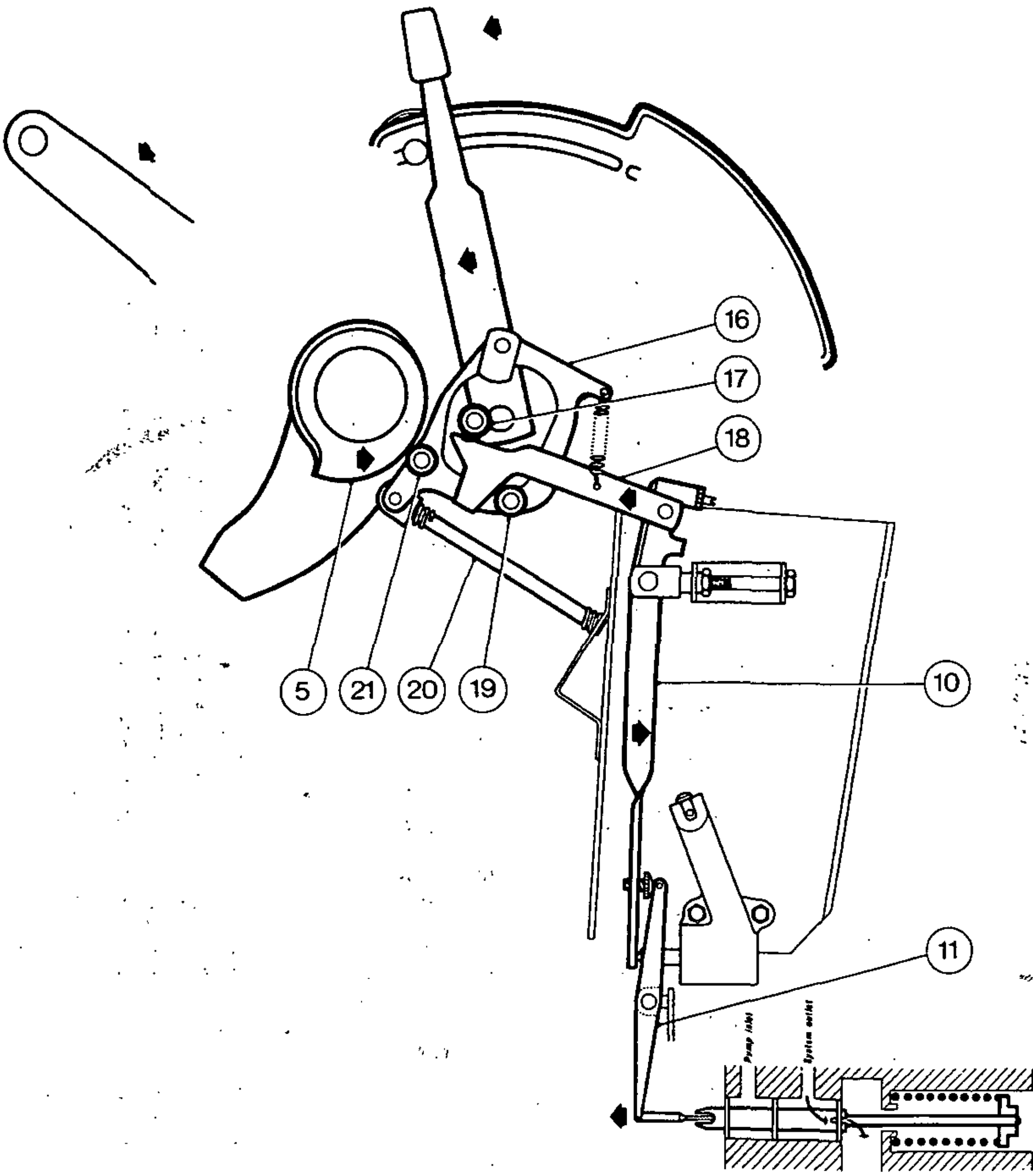

FIG. 8

POSITION CONTROL – IMPLEMENT RAISING

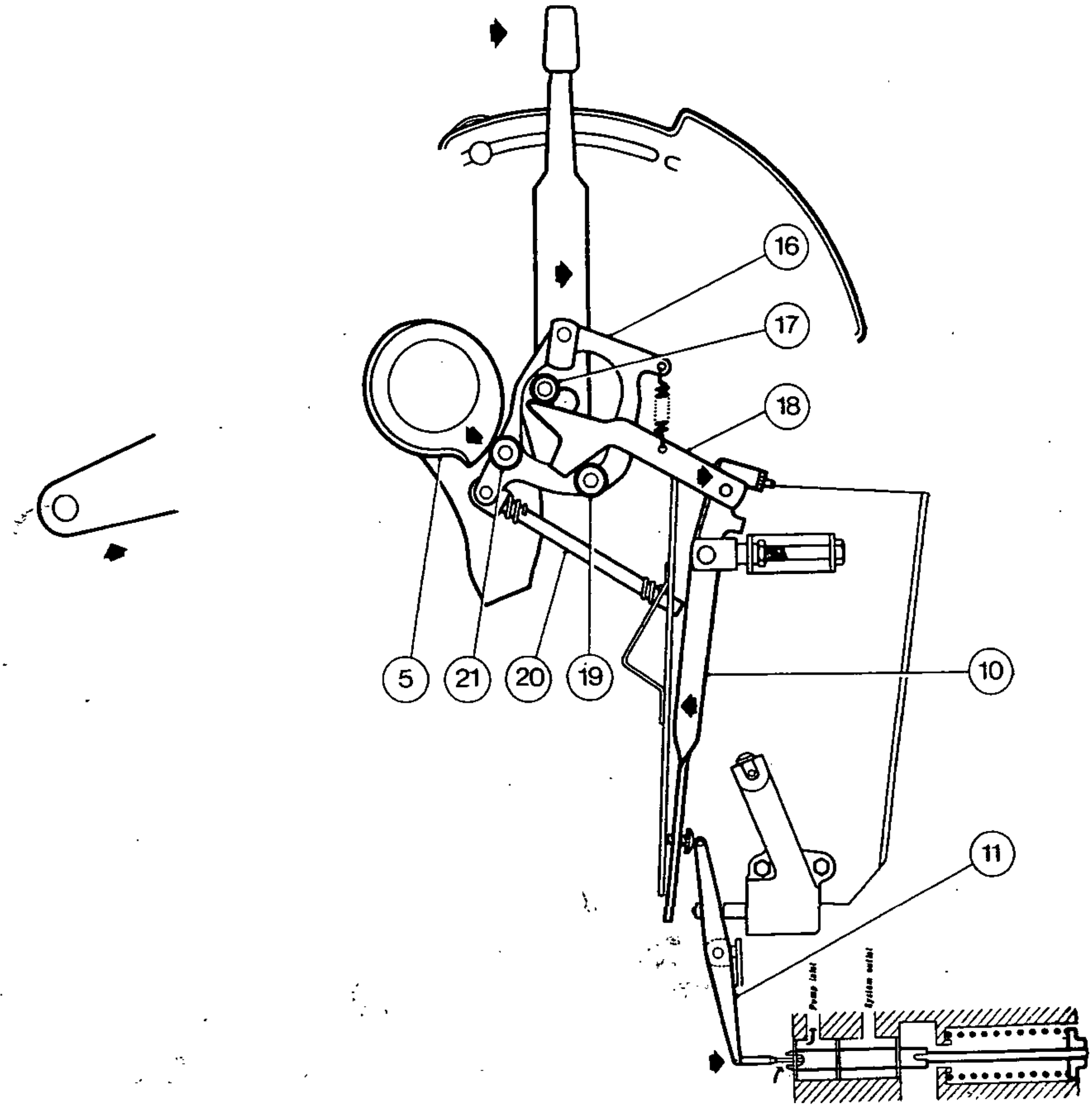

FIG. 9

PRESSURE CONTROL

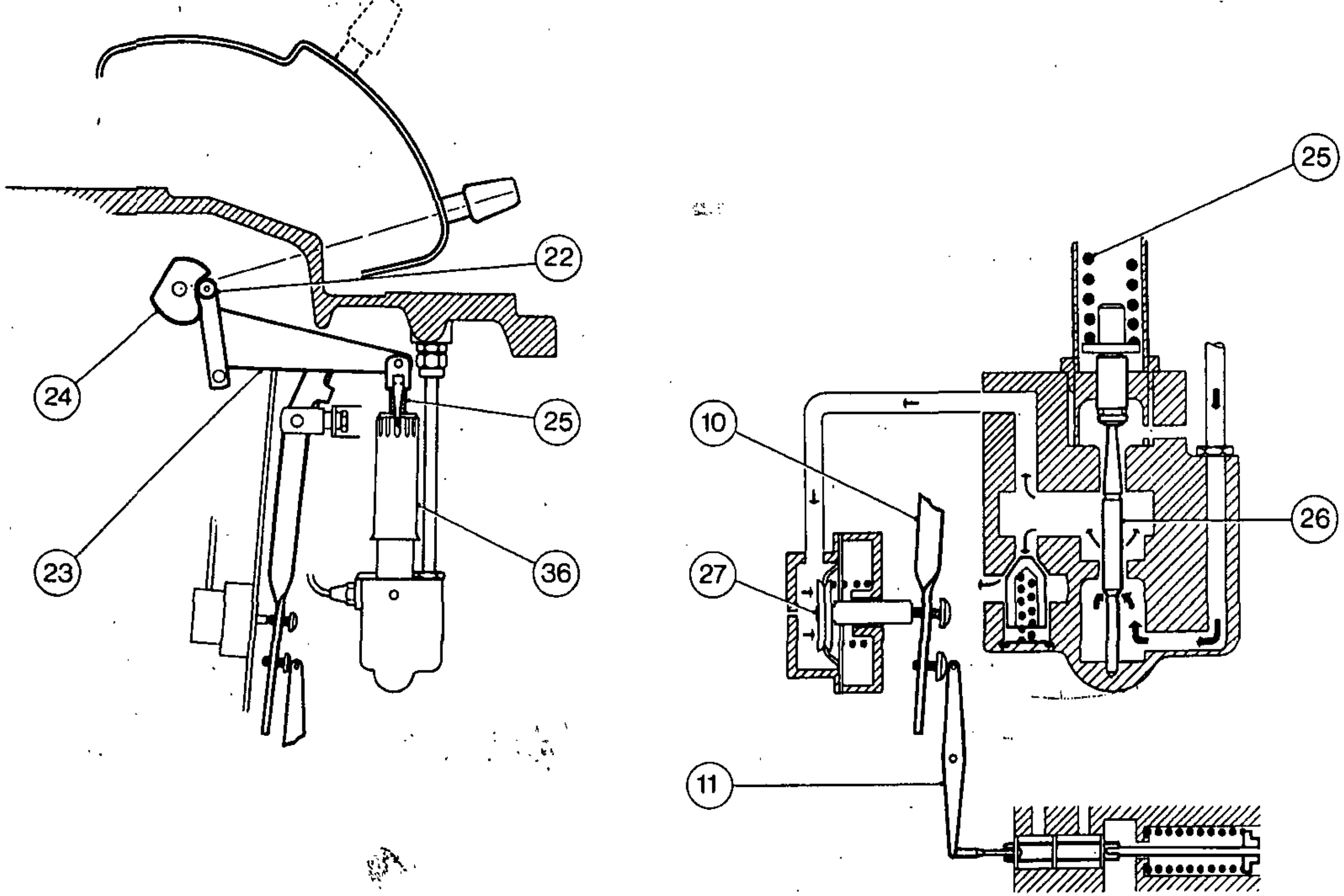

FIG. 10

The draft control linkage follows the control spring plunger (14) under the influence of the spring on guide rod (12), and moves the draft control link rearwards. Lever (10) again pivots and causes the pump control valve lever (11) to push the pump control valve towards discharge. When correct depth is gained, the valve is restored to neutral. An increase of draft force in the top link will have an opposite effect.

Position Control – Transport Position (Fig. 7)
The position control lever shaft carries an eccentric roller (17) which contacts the upper cam face of the position control cam (18). The position control link (16) is pivoted at the top and carries two rollers (19) and (21). The front roller (19) contacts the lower cam face of the position control cam (18). The rear roller (21) is held in contact with the cam on the ram arm (5) by the spring on the guide rod (20). The front end of the position control cam (18) is connected to the vertical lever (10), which is in contact with the control valve lever (11).

Position Control – Implement Lowering (Fig. 8)
Downward movement of the position control lever causes the eccentric roller (17) to force the cam (18) downwards. The breakout spring pushes the position control link (16) to maintain contact between the roller (21) and the ram arm (5), and the front roller (19) moves the cam (18) rearwards, thus moving the pump control valve into discharge.

Position Control – Implement Raising (Fig. 9)
Release of oil from the ram cylinder allows the ram arm (5) to rotate and force the rear roller (21), mounted on position control link (16), forward. This action allows the pump control valve spring to move the position control cam (18), which is in contact with the front roller (19), forward, until the control valve reaches the neutral position, which has been determined by the position control lever.

Response Control
Response control governs the rate of movement of the pump control valve towards discharge, in the discharge range. In this way, the rate of drop of implements is controlled, thus ensuring smooth draft control operation.

The response control unit is bolted to the base of the lever support bracket. The unit is submerged in oil and is self-priming, and comprises a horizontal dashpot to which is fitted a spring loaded plunger with a spring loaded piston, and a vertical plunger with a spring loaded needle valve. Holes in the dashpot housing enable oil to enter either side of the piston.

The dashpot is only effective when the vertical lever moves forwards from the neutral position, i.e. control valve moving towards discharge. This action pushes the plunger and the piston forwards along the dashpot bore, oil is then forced past the needle valve to the other side of the piston and to the sump. Rearward movement of the vertical lever, i.e. control valve moving towards inlet, allows the plunger spring to lift the plunger clear of the piston, exposing a hole in the piston centre. Oil pressure then equalises on either side of piston as it is forced rearwards by the return spring.

Rate of oil escape from the dashpot is controlled by the size of the orifice between the needle valve and its seat. Movement of the response control lever (situated on the R.H. centre housing inspection cover, will adjust the orifice size due to the cam on the end of the lever acting against the needle valve plunger. The spring holding the needle valve clear of its seat also holds the valve and plunger up against the cam.

Movement of the response control lever rearwards, i.e. towards SLOW Response causes the cam to force the plunger and needle valve closer to the seat against spring pressure. This reduces the orifice size, so restricting oil flow past the valve. The damping action of the dashpot is thereby increased, thus slowing the vertical lever and pump control valve movement.

Conversely, movement of the response control lever forwards, i.e. towards FAST Response, rotates its cam, permitting the plunger and needle valve to lift away from the valve seat. The size of the orifice and oil flow past the valve thus increases. Damping effect of the plunger is reduced and faster movement of the vertical lever and pump control is allowed.

Pressure Control (Fig. 10)
The pressure control system enables the pressure in the ram cylinder to be regulated from 10.5 to 211 kg/cm^2 (150 to 3000 lb/in^2). One of the uses for this system is with semi-trailed implements fitted with depth control wheels. By suitable adjustment of the pressure control lever, part of the weight of the implement is supported by the tractor linkage, thus obtaining weight transfer to the tractor rear wheels and increasing traction.

The cam (24), fixed to the pressure control shaft, contacts the roller (22), mounted on the pressure control lever (23). This lever pivots at its rear lower end on the support bracket assembly.

The front end of the pressure control lever (23), carries an adjustable rod assembly which screws into an adjustment tube fitted to the control valve assembly. The control spring (25), fitted inside the adjustment tube locates at its lower end onto a guide, this guide contacts the servo valve plunger which in turn contacts the servo valve piston (26). A pin, fitted into the control valve body below and in line with the piston, controls maximum piston travel.

The piston runs in a sleeve assembly which embodies three compartments, the lower (pressure) compartment, central compartment and exhaust compartment. The central compartment is connected, by drillings in the sleeve and the valve body, and a pipe, to a diaphragm assembly (27). The diaphragm plunger acts on vertical lever (10).

When the pressure control lever is moved to its lowest position on the quadrant, the roller (22) on the internal pressure control lever (23) moves to the lowest position on the cam (24), allowing the lever (23), to exert minimum compression force on the control spring.

Oil entering the lower compartment, exerts pressure on the lower face of the piston and moves it against spring pressure. This allows the slot in the piston to pass through the lower sleeve and form a passage between the pressure and central compartments. Oil then flows into the diaphragm unit (27), which causes the plunger to move the vertical lever (10), and the pump control valve lever (11), and the pump control valve towards neutral. Maintaining system pressure at a selected value, slight oil flow past the piston slot maintains pressure at the diaphragm face, under the influence of a 1.6 kg/cm^2 (23 lb/in^2) valve which allows flow back to the sump. A small hole in the rear diaphragm housing allows a continuous oil leakage.

As the quadrant lever is moved rearwards towards the high pressure position, the load on the control spring increases, so that a greater system pressure will be required to move the piston and allow oil through to the central compartment to extend the diaphragm plunger.

When the spring force on the piston exceeds the opposing pressure force, the piston will move down to the stop pin, cutting off oil supply to the central compartment and so to the diaphragm, thus allowing oil to exhaust from the diaphragm unit past the taper on the upper half of the piston. The diaphragm plunger is thus allowed to move rearwards, allowing the pump control valve under the influence of its spring to move into the lift position.

CONTROLS

The Hydraulic Control Quadrants are located on the right hand side of the seat within easy reach of the operator. The two control levers, Draft (outer) and Position (inner), operate as follows:–

Draft Control Lever (Fig. 11)
The Draft Control Lever is the outer lever, and operates on the Draft (Yellow) range of the quadrant. A knurled nut locks the adjustable stop in place to indicate when the desired working depth is reached. The further the lever is moved towards the 'Down' position, the deeper the implement will tend to penetrate the ground, and conversely the nearer the lever is to the 'Up' mark, the shallower the implement will tend to work.

Position Control Lever (Fig. 11)
The Position Control Lever is the inner lever and operates on the Pressure (Black), Constant Pumping (Blue), and Position (Red) ranges of the quadrant. There are two knurled nuts which enable the adjustable stops to be locked in the required position. In the Position (Red) sector of the quadrant, the lever is used for lifting and lowering the tractor linkage, and carrying an implement at varying fixed heights above the ground. When the lever is in the Constant Pumping (Blue) sector, the tractor's hydraulic power is transmitted to external control rams or hydraulic motors. With the lever in the Pressure (Black) sector of the quadrant, a variable pressure in the system can be obtained which is determined by the position of the lever. The pressure can vary from 10,5 kg/cm^2 (150 lb/in^2) with the lever in 'Low', to 211 kg/cm^2 (3000 lb/in^2) with the lever in 'High', and enables part of the weight of a trailed implement (with pressure control coupler), or semi-mounted implement to be transferred to the tractor rear wheels for adhesion. The lower the lever in the quadrant the less weight is transferred, and conversely, the higher the lever in the quadrant the more weight is transferred.

Response Control Quadrant (Fig. 12)
The response quadrant is positioned on the right-hand side cover of the centre housing, which incorporates the transmission oil level dipstick. The quadrant is marked FAST and SLOW with an arrow on the lever knob to indicate the position. When the arrow is in the FAST position, an implement will drop in work fast, and conversely in the SLOW position, will drop in work slowly. Therefore, when ploughing, for example, over undulating ground, the plough will re-enter and follow the ground contours more accurately with the response lever towards the FAST position. The normal working position for the response lever should be just on the SLOW side of the centre position.

EXAMPLES OF CONTROL LEVER SETTINGS

Draft Control (Fig. 13)

Type of Work:	Ploughing, subsoiling and heavy cultivation. For Draft Control, use the outer lever (yellow quadrant).
Transport Position:	Lever fully back (A).
Entering Work:	Push the lever forward until the implement reaches the required depth (B). Set the adjustable stop in line with the lever. Set the Response Control lever as shown.
Working:	The Draft Control lever can be moved slightly to suit varying soil conditions. If an even depth cannot be maintained on undulating ground, move the Response lever towards FAST. If the implement 'bobs', move the Response lever towards 'SLOW'.
Leaving Work:	Pull the Draft lever back to position 'A'.

Position Control (Fig. 14)

Type of Work:	Mowing, grading, harrowing and broadcasting. For Position Control, use the inner lever in the rear sector (red quadrant).
Transport:	Push the lever to line up with the 'TRANSPORT' mark (A).
Entering Work:	Move the lever rearwards until the required implement position is obtained (B). Set the adjustable stop in line with the lever. Set the Response Control lever centrally as shown.
Working:	No further adjusting is necessary.

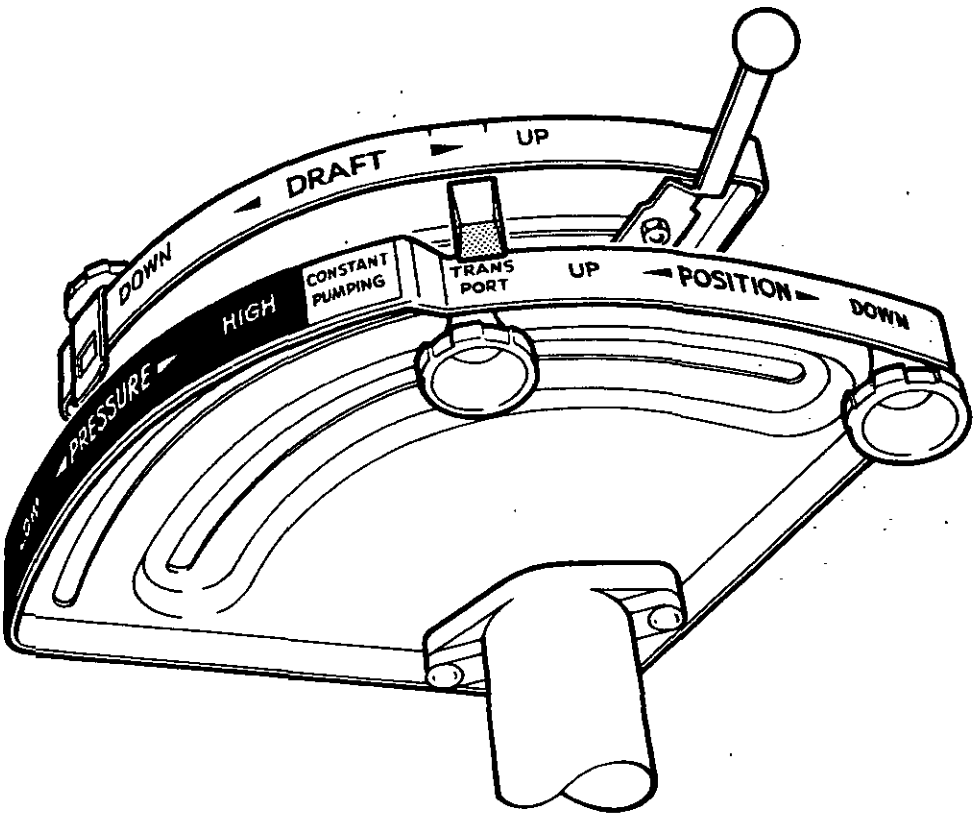
DRAFT
UP
DOWN
CONSTANT PUMPING
TRANS PORT
UP
POSITION
DOWN
HIGH
PRESSURE

FIG. 11

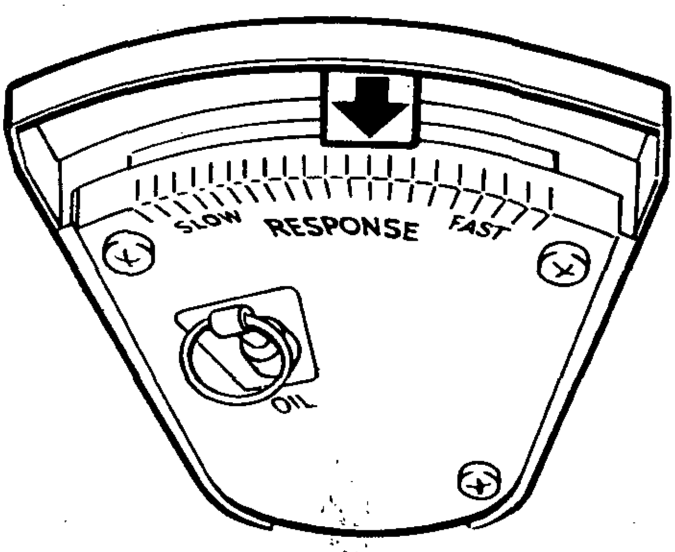
SLOW
RESPONSE
FAST
OIL

FIG. 12

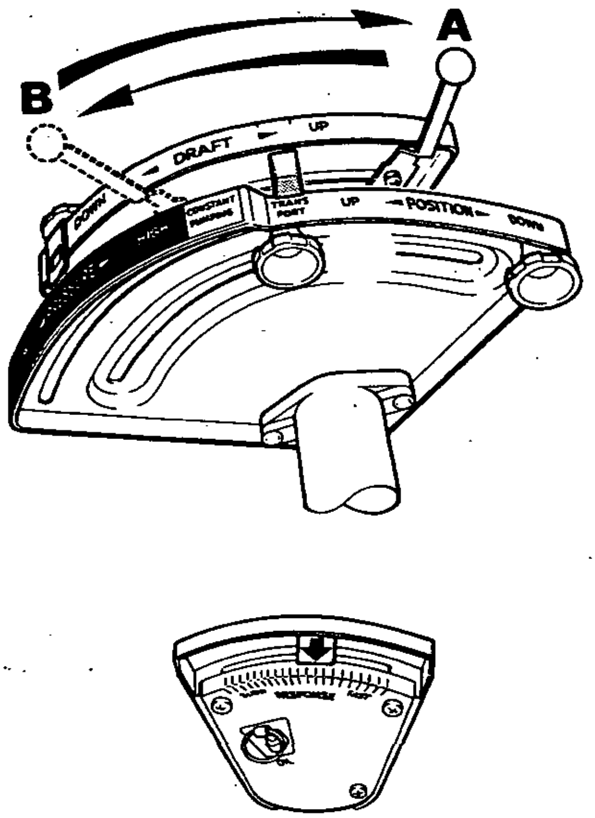

FIG. 13

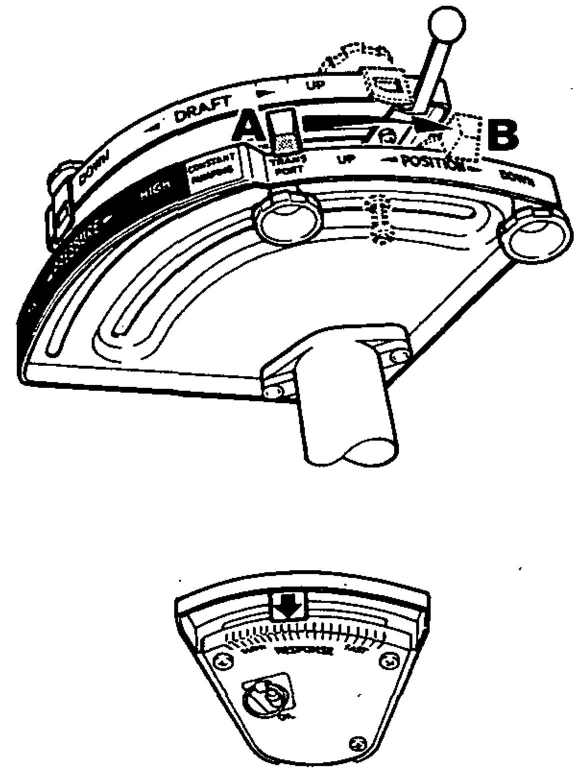

FIG. 14

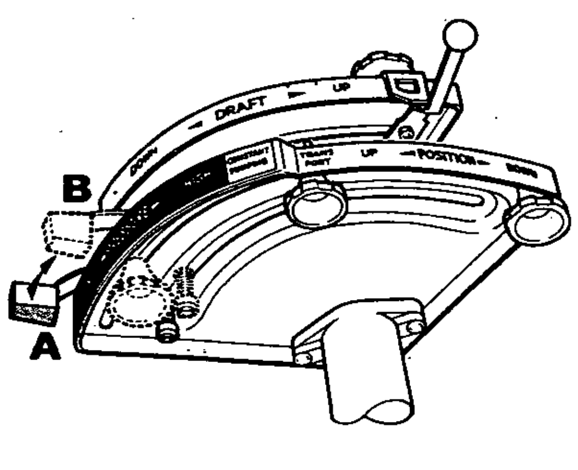

FIG. 15

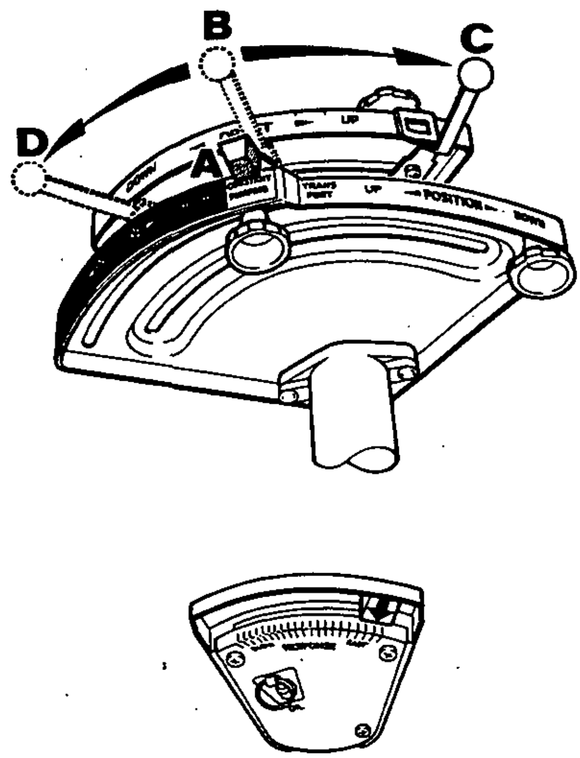

FIG. 16

Leaving Work: Move the lever forward to the 'TRANSPORT' position.

Pressure Control (Fig. 15)

Type of Work: Towing four-wheel trailers, disc harrows, seed drills, balers or manure spreaders.
Pressure control can only be used with the additional coupler.
For Pressure Control, use the inner lever in the front sector (black quadrant).

Operating: If wheelspin occurs, pull the lever rearwards from 'A' until *traction is obtained* (B).
Set the adjustable stop in line with the lever.

NOTE – USE OF EXTREME PRESSURE (IN EXCESS OF NORMAL REQUIREMENTS) CAN CAUSE FRONT END INSTABILITY.

When operating, the pressure may need to be increased slightly to improve traction, but the lever should be returned to position 'B' as soon as possible.

Control of Hydraulic Equipment (Fig. 16)

Type of Work: Single-acting hydraulic ram and low input hydraulic motors.

Rams: Move the inner lever to 'CONSTANT PUMPING' ('A', blue sector), then move the outer lever to approx. position 'B' to establish the point at which the ram neither extends, nor retracts.
Set the adjustable stop in line with the outer lever.
Set the Response Control lever to FAST.

Operation: To extend the ram, move the lever to 'C'.
To retract the ram, move the lever to 'D'.

IMPORTANT – WHEN THE RAM IS FULLY EXTENDED, RETURN THE LEVER TO 'B' TO PREVENT THE INTERNAL PRESSURE RELIEF VALVE FROM DISCHARGING CONTINUOUSLY.

Hydraulic Motors: Move the inner lever to 'CONSTANT PUMPING' ('A'). Move the outer lever to 'D'.

Operation: Move the outer lever to 'C' to engage the hydraulic drive and to 'D' to disengage the drive.
Response Control is not used.

OPERATION OF EXTERNAL HYDRAULIC EQUIPMENT

There are four external tapping points (Fig. 17) in the left cover for use with implements which incorporate remote pressure operated hydraulic systems, such as loaders and tipping trailers. Various spool valves and hydraulic pipes can be fitted to this tractor.

For tapping points data see the Specification Section.

NOTE – IF A QUANTITY OF OIL IN EXCESS OF 7 LIT. (1½ IMP. GAL) IS REQUIRED FOR EXTERNAL USE, ADDITIONAL OIL CAN BE ADDED TO THE "HIGH" MARK ON THE DIPSTICK.

CONTROL SPRING

Removal and Refitment 7A-01-15

Special Tools Required: MF 163 Wrench
Torque Wrench

Removal

1. Remove the control beam assembly.
2. Fig. 18. Slacken the socket screw (28).
3. Pull back the rubber boot (29).
4. Using tool MF 163, unscrew the retainer (30) out of the lift cover.
5. Fig. 19. Withdraw the control spring.

Refitment

1. Fig. 19. Refit the control spring assembly into the lift cover.
2. Place the draft control lever in the fully lowered position.
3. Fig. 18. Tighten the retainer (30) using tool MF 163 until all the end float is eliminated. Do not overtighten or end float will re-occur.
4. Refit the rubber boot (29).
5. Fit a new nylon locking plug then tighten the socket screw (28), to a torque of 0,70 kg-m (5 lb-ft).
6. Refit the control beam assembly.

CONTROL SPRING ASSEMBLY SERVICING

7A-02-15

Special Tools Required: MF 163 Wrench
Torque Wrench

Disassembly

1. Remove the control spring assembly as stated in operation 7A-01-15.
2. Fig. 20. Drive out the pin (33) and detach the head (31).
3. Remove the retainer (30), control spring (13) and spring seat (32) from the plunger (14).

Reassembly

1. Fig. 20. Refit the spring seat (32), spring (13) and retainer (30) to the plunger (14).
2. *Screw the plunger into the head (31), until all* the end float is eliminated and the spring is tight to turn by hand.
3. *Fit a new securing pin (33).*
4. Refit the control spring assembly as stated in operation 7A-01-15.

HYDRAULIC LIFT COVER

Removal and Refitment 7A-03-16

Special Tools Required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3. Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 kg (3 lb) weight
Torque Wrench
Feeler Gauge
Rule

Removal

1. Remove the seat.
2. Disconnect the wiring to the number plate light at the connection box attached to the lift cover.
3. Remove the split pins and pivot pins securing the lift rods to the lift arms.
4. Remove the control beam assembly.
5. Disconnect the Auto-Hitch (if fitted) at the lift arms.
6. Fig. 21. Remove the two bolts and spring washers securing the stand pipe cap (34) to the lift cover and remove the cap.
7. Disconnect the stand pipe (1) from the hydraulic pump by lifting the stand pipe slightly.
8. Remove the R.H. footplate, and drain the oil to the low mark on the dipstick.
9. Fig. 22. Remove the four screws (63) securing the response control cover plate (64), and remove the plate.
10. Remove the five bolts (61) and the screw (59) securing the inspection cover (60) to the centre housing and remove the cover.
11. Fig. 23. Remove the valve actuating roller using tool MF 271 as shown.
12. Fig. 22. Suitably retain the dashpot plunger (49) to prevent it from dropping out when the lift cover is removed.
13. Remove the 14 bolts securing the lift cover to the centre housing.
14. Place the parking brake clear of the lift cover.
15. Fig. 24. Fit tool MF 226A and adapter MF226A-3 to the lift cover as shown.
16. Fig. 25. Taking care not to damage the control valve vertical lever (10, Fig. 10), detach the lift cover from the centre housing as shown, and place the support leg on the ground.

Refitment

NOTE – BEFORE REFITMENT OF THE LIFT COVER THE EXTERNAL ADJUSTMENTS AS STATED IN OPERATION 7A-12-27 MUST BE CARRIED OUT.

1. Fig. 26. Fit the two special studs to the centre housing as shown.
2. Fit a new lift cover gasket.
3. Place the lift arms in the down position.
4. Set the shear tube split pin in the vertical position.
5. Fig. 25. Taking care not to damage any parts, manoeuvre the lift cover assembly into position, over the two special studs onto the centre housing.
6. Remove the two special studs, tool MF 226A and adapter MF 226A-3.
7. Fig. 23. Refit the valve actuating roller using tool MF 271 as shown.
8. Fig. 21. Centralise and locate the stand pipe (1) in the pump assembly.
9. Secure the lift cover and parking brake to the centre housing and tighten the bolts to a torque of 8,5 kg-m (65 lb-ft).
10. Fig. 21. Refit the stand pipe cap (34) with a new 'O' ring and secure with the two bolts and spring washers.
11. Refit the control beam assembly.
12. Secure the lift rods to the lift arms.
13. Reconnect the number plate light wiring at the connection box.
14. Refit the Auto-Hitch at the lift arms.
15. Carry out the internal adjustments as stated in operation 7A-12-27.
16. Refit the seat.

HYDRAULIC LIFT COVER SERVICING 7A-04-16

Special Tools Required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 kg (3 lb) Hide Hammer
1,36 kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

Disassembly

1. Remove the lift cover as stated in operation 7A-03-16.
2. Fig. 10. Place the position and pressure control lever in the constant pumping position, remove the split pin retaining the pressure control linkage (23) to the support bracket (35, Fig. 27) then place the lever into the low range on the quadrant and remove the linkage complete with the adjustment tube (36), and spring (25) and spring guide.
3. Fig. 27. Remove the position control spring (37) as shown.
4. Disconnect the diaphragm pipe (38) at the pressure control valve (39).

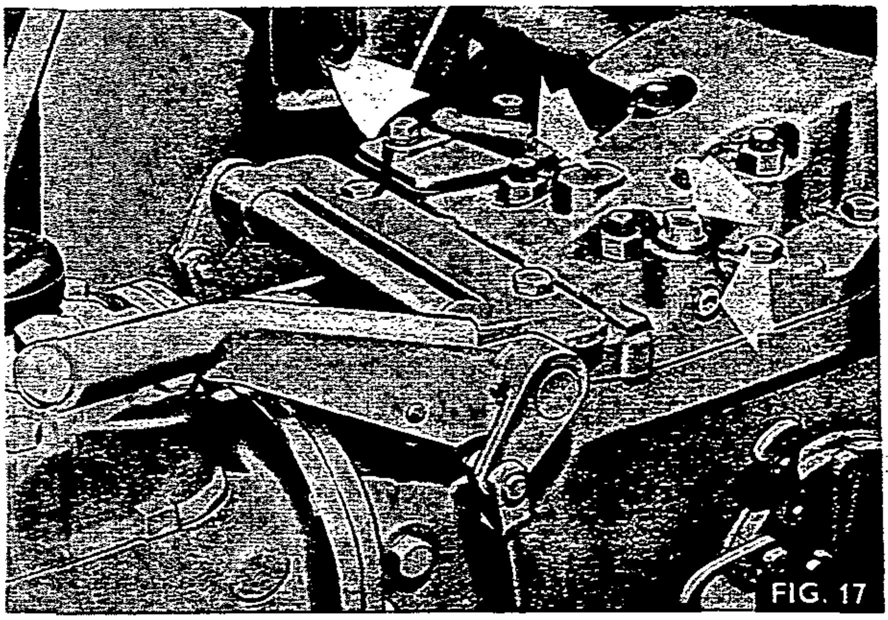

FIG. 17

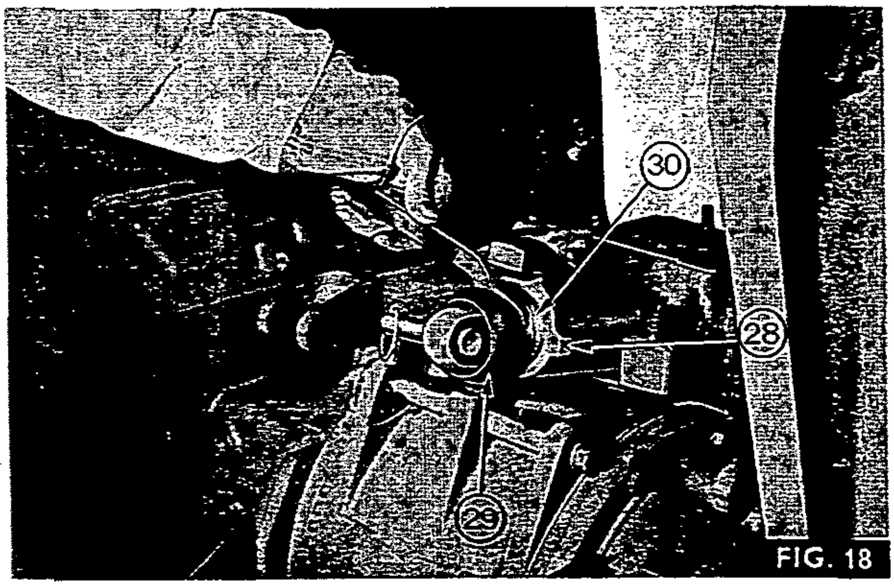

FIG. 18

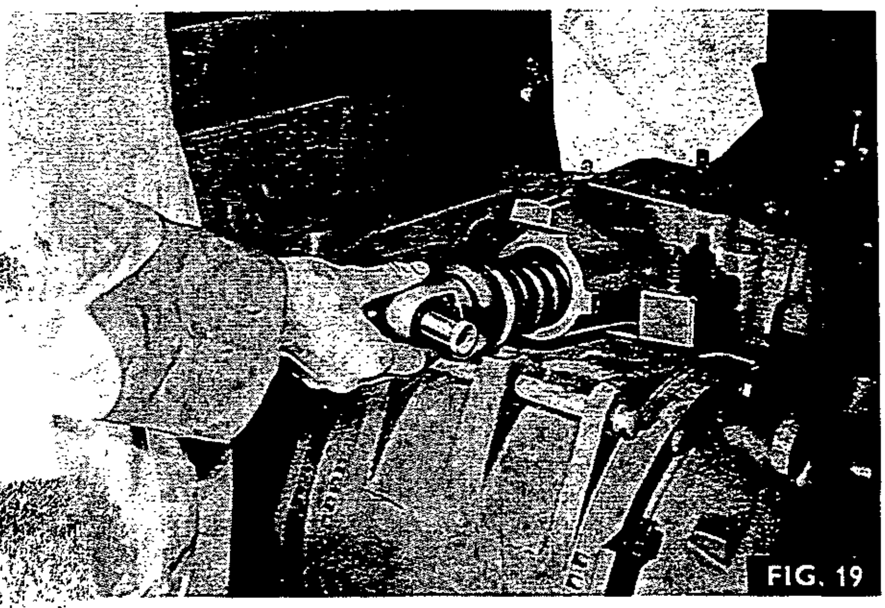

FIG. 19

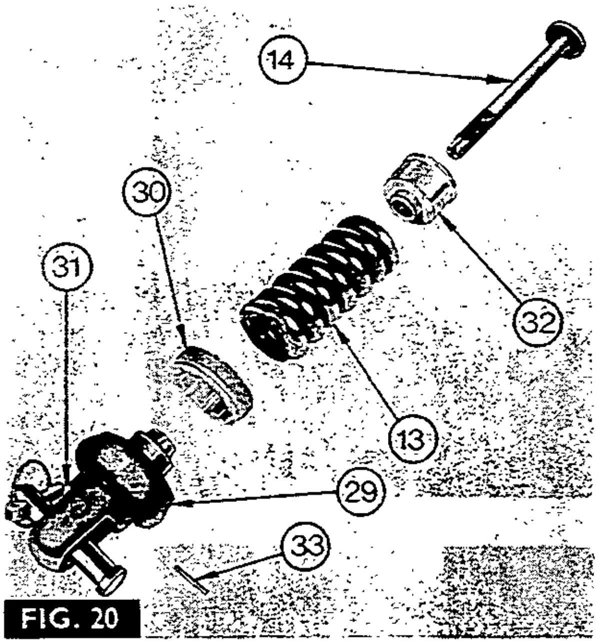

FIG. 20

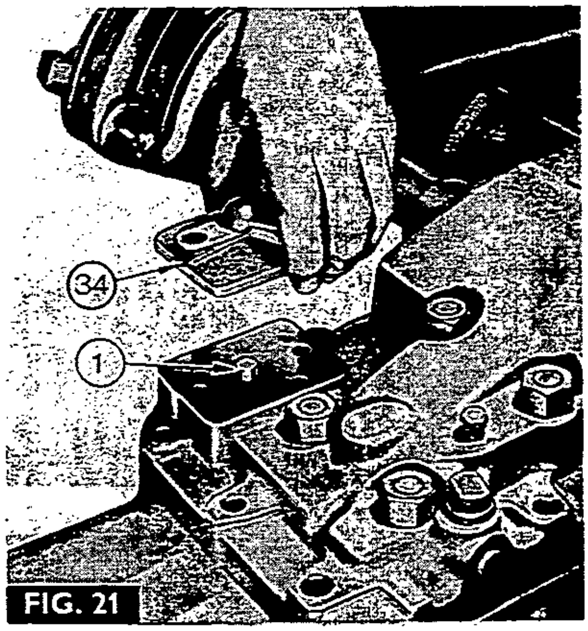

FIG. 21

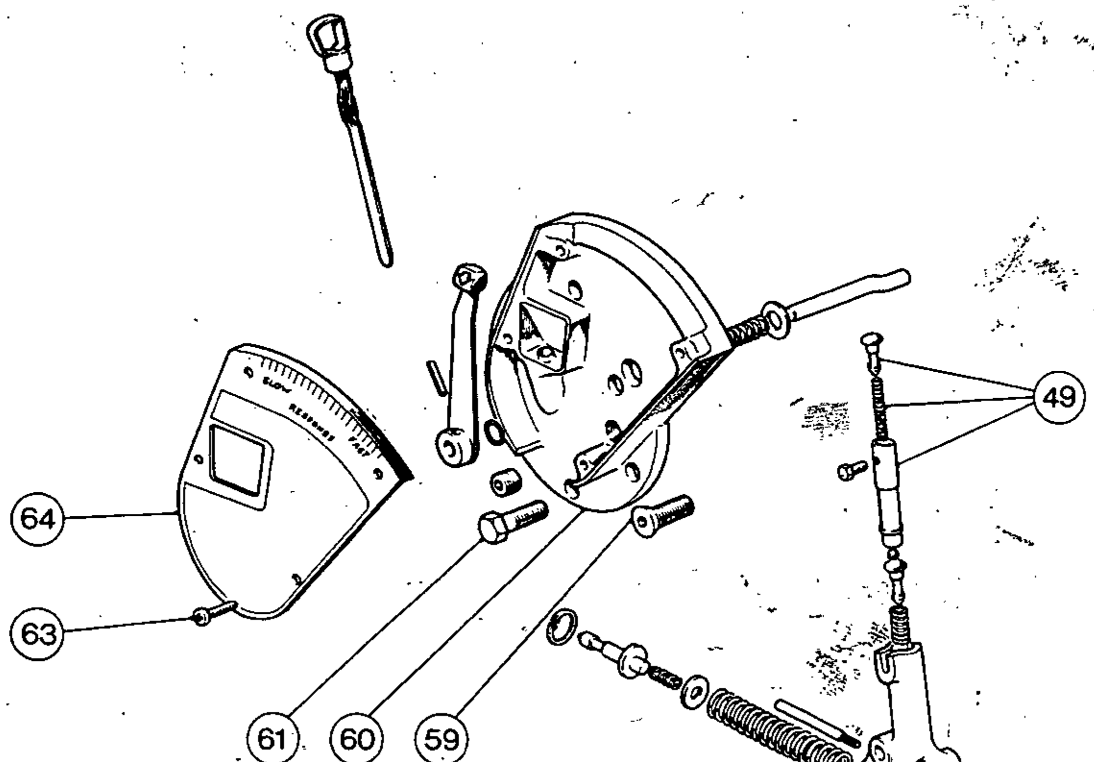

FIG. 22

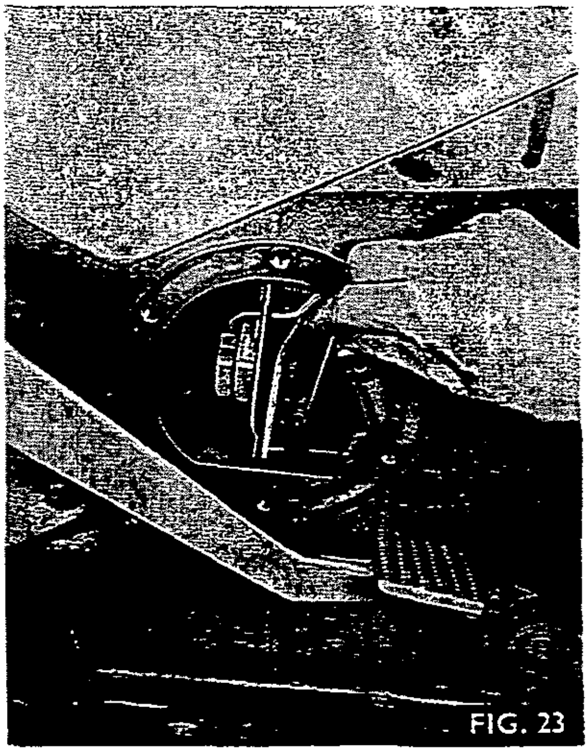

FIG. 23

FIG. 24

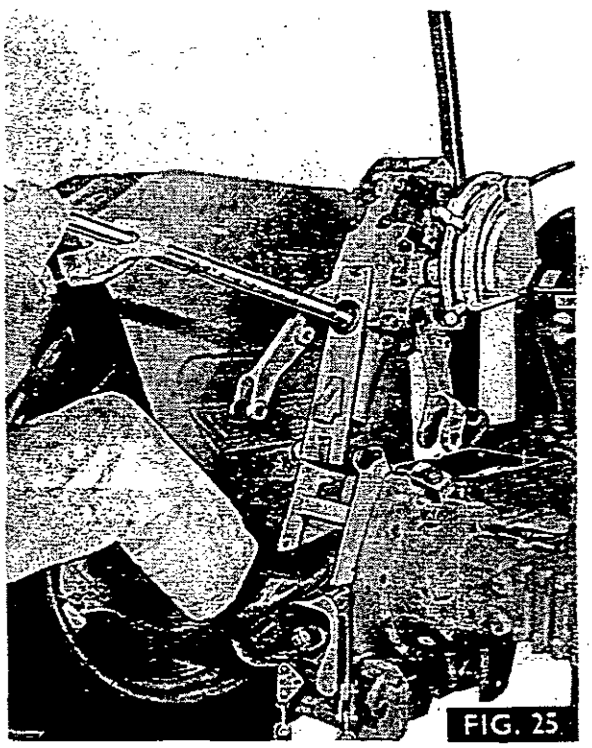

FIG. 25

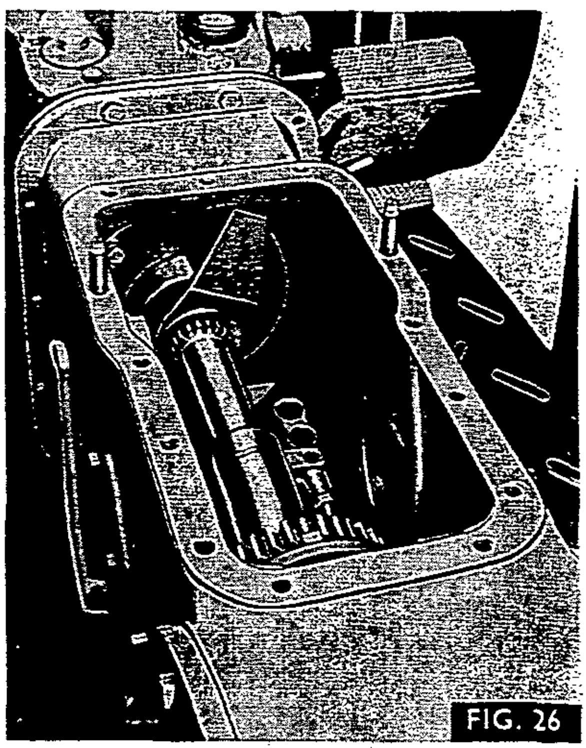

FIG. 26

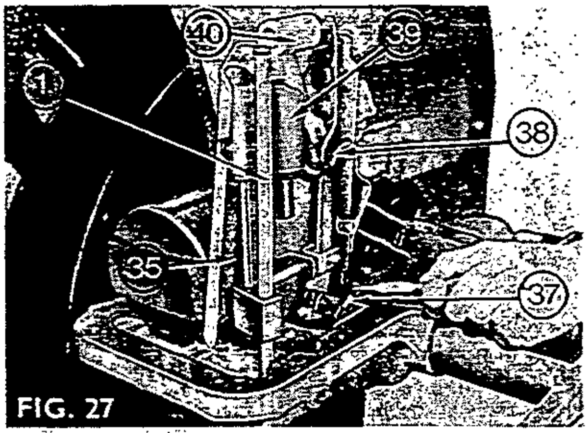

FIG. 27

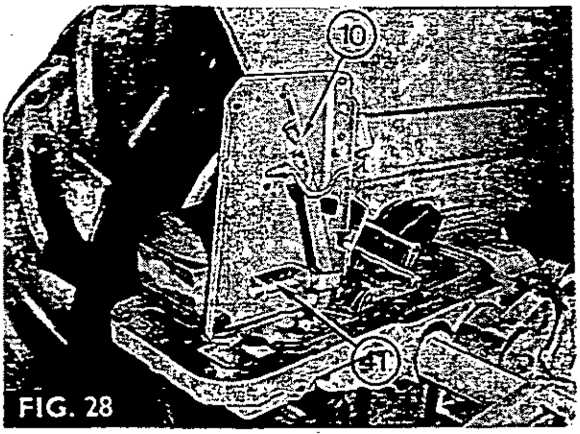

FIG. 28

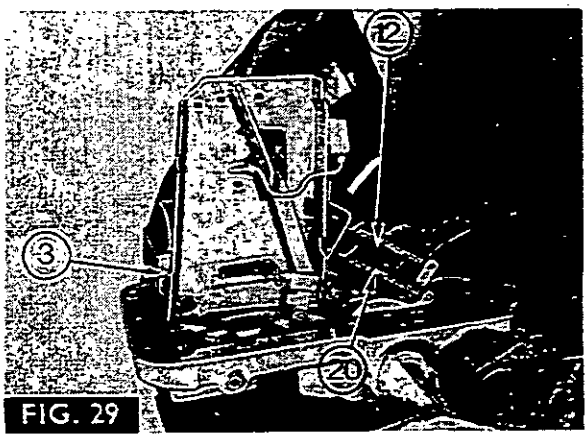

FIG. 29

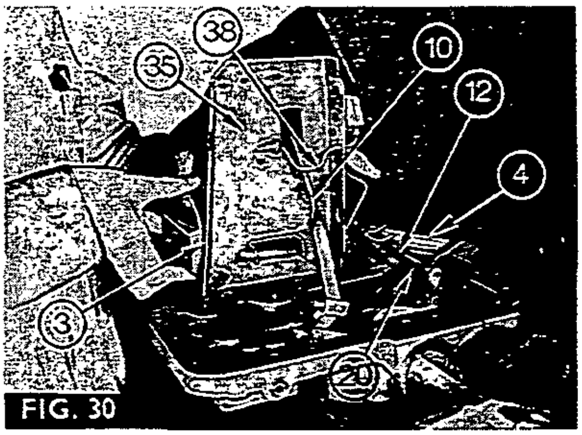

FIG. 30

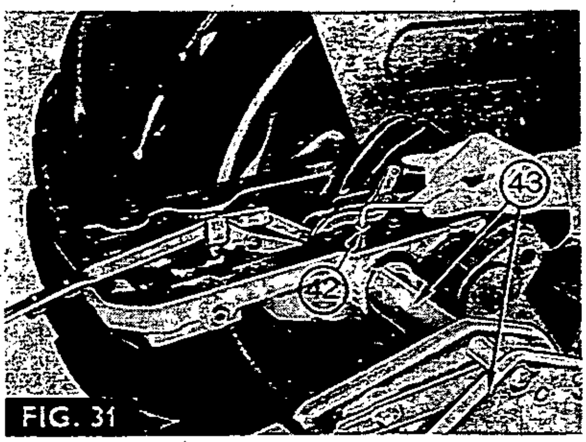

FIG. 31

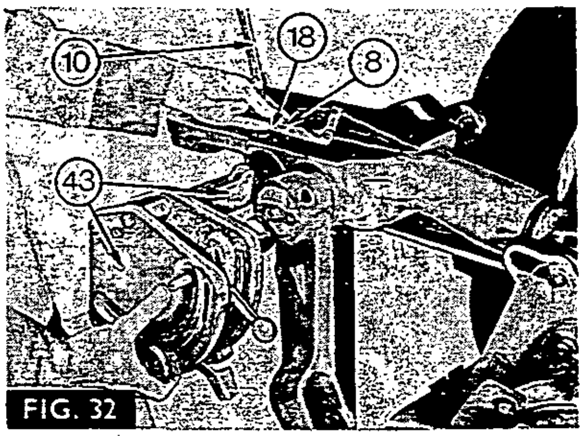

FIG. 32

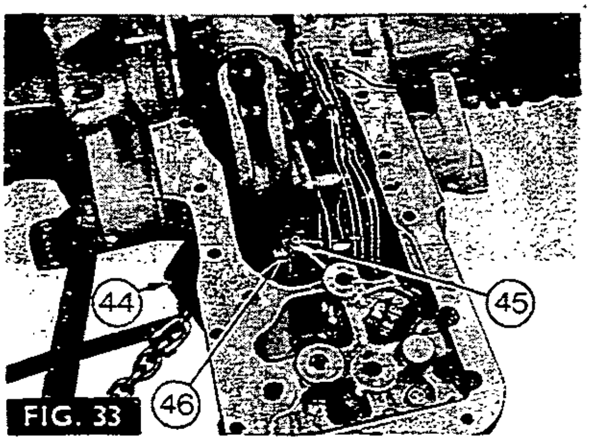

FIG. 33

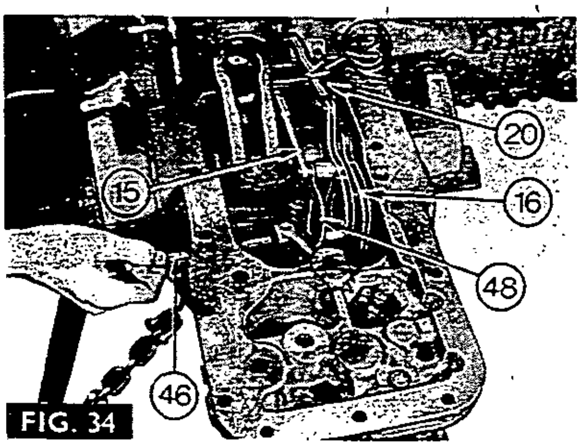

FIG. 34

5. Remove the two bolts and washers securing the pressure control valve to the support bracket and remove the valve (39) complete with the stand pipe (1).
6. Remove the two bolts and washers securing the response control dashpot (40) to the support bracket (35) and remove the response control dashpot.
7. Fig. 28. Loosen the locknut on the fulcrum bolt (41) and release the vertical lever (10).
8. Fig. 29. Fit a suitable retaining pin to the lower guide rod (20) to prevent the spring from being ejected.
9. Remove the four nuts securing the ram cylinder (3) to the lift cover.
10. Lift the cylinder slightly and fit a suitable retaining pin to the upper guide rod (12) to prevent the spring from being ejected.
11. Fig. 30. Lift the cylinder (3) and support bracket (35) clear of the lift cover, taking care not to damage the vertical lever (10) or the diaphragm pipe (38).
12. Remove the connecting rod (4).
13. Fig. 31. Remove the Allen screw (42) retaining the quadrant (43) in the lift cover.
14. Fig. 32. Withdraw the quadrant (43) from the lift cover simultaneously removing the vertical lever (10) and cams (8 and 18).
15. Fig. 33. Remove the plug (44) on the L.H. side of the lift cover to enable the linkage pivot shaft (46) to be removed.
16. Remove the Allen Screw (45).
17. Fig. 34. Withdraw the linkage pivot shaft (46) as shown and remove the remaining links (12, 15 and 48, then 20 and 16).
18. Release the tab washer and remove the bolt and washer securing the R.H. lift arm (6, Fig. 1) to the lift shaft (47) and remove the arm.
19. Fig. 35. Drive the remaining lift arm and shaft (47) out of the lift cover and remove the ram arm (5).

Reassembly

1. Fig. 35. Position the ram arm (5) in the lift cover.
2. Slide the lift arm and shaft (47), with a new 'O' ring into the lift cover and ram arm (5), aligning the master spines on the shaft and ram arm.
3. Refit the remaining lift arm, with a new 'O' ring. aligning the master splines.
4. Release the tabwasher on the L.H. lift arm and slacken the securing bolt.
5. Refit the washer and securing bolt to the R.H. lift arm and fully tighten, then secure it with new tabwasher.
6. Tighten the L.H. bolt so that the lift arms just move freely through their travel with no lift shaft (47) end float, and secure it with a new tabwasher.
7. Fig. 34. Refit the position control linkage (16 and 20), the draft control linkage (48, 15 and 12) then refit the linkage pivot shaft (46) as shown.
8. Fig. 32. Refit the vertical lever (10) and cams (8 and 18) simultaneously refitting the quadrant (43) into the lift cover.
9. Fig. 31. Secure the quadrant in the lift cover with the Allen Screw (42).
10. Fig. 33. Making sure that the linkage pivot pin (46) is hard against the lift cover, secure the pin (46) with the Allen screw (45).
11. Refit the plug in the L.H. side of the lift cover.
12. Refit the connecting rod (4) into the ram arm (5). Apply Loctite Grade 'AV' or Casco 'Metalok ML15' to the Allen Screw. Fit the screw, screw it in fully, then back off ¼ turn.

NOTE – THOROUGHLY DEGREASE THE RAM ARM THREADS.

13. Fig. 30. Place the cylinder (3) and support bracket (35) assembly on the lift cover using new 'O' rings simultaneously locating the two guide rods (12 and 20) into their holes, the vertical link (10) upright as shown and relocate the connecting rod (4).
14. Fig. 29. Remove the upper guide rod (12) spring retaining pin.
15. Secure the cylinder assembly (3) to the lift cover with the four nuts tightened to a torque of 16,0 kg-m (120 lb-ft).
16. Remove the lower guide rod (20) spring retaining pin.
17. Fig. 27. Refit the response control dashpot (40) and secure it with the two bolts and washers.
18. Refit the pressure control valve assembly (39) complete with the stand pipe (1) using new 'O' rings and washer and secure the valve with the two bolts and washers.
19. Reconnect the diaphragm pipe (38) to the pressure control valve (39).
20. Refit the position control spring (37).
21. Refit the lift cover as stated in operation 7A-03-16

RESPONSE CONTROL DASHPOT

Removal and Refitment 7A-05-21

Special Tools Required:
- MF 163 Wrench
- MF 271 Draft Control Rod Gauge
- MF 148A Pressure Test Kit
- MF 166 Adapter
- MF 226A Lift Cover Remover and Replacer
- MF 226A-3 Lift Cover Adapter
- MF 269 Wrench
- MF 270B Dashpot Piston Wedge
- MF 271 Roller Tool
- MF 272 Ram Arm Fixture
- MF 273 Hydraulic Setting Fixture
- 1,36 kg (3 lb) Weight
- Torque Wrench
- Feeler Gauge
- Rule

Removal

1. Remove the lift cover as stated in operation 7A-03-16.
2. Fig. 27. Remove the two bolts and washers securing the response control dashpot (40) to the support bracket (35) and remove the dashpot (40)

Refitment

1. Refit the response control dashpot (40) to the support bracket and secure with the two bolts and washers.
2. Refit the lift cover as stated in operation 7A-03-16.

RESPONSE CONTROL DASHPOT SERVICING

7A-06-22

Special Tools Required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit.
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

Disassembly

1. Remove the responce control dashpot as stated in operation 7A-05-21.
2. Fig. 36. Slacken the setscrew (50) and remove the plunger assembly (49), needle valve (51) and spring (52).
3. Remove the retaining ring (58), rod (57), guide (56), spring (55), piston (54) and spring (53).

Examine all the components for signs of wear, damage, scoring or pitting and replace if necessary.

Reassembly

1. Refit the spring (53), piston (54), spring (55), guide (56), rod (57), and secure with new retaining ring (58).
2. Refit the spring (52), needle valve (57) and plunger assembly (49) and secure with the setscrew (50).
3. Refit the response control dashpot as stated in operation 7A-05-21.

PRESSURE CONTROL VALVE

Removal and Refitment 7A-07-22

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

Removal

1. Remove the lift cover as stated in operation 7A-03-16.
2. Fig. 10. Place the position control lever in the 'Constant Pumping' position remove the split pin, retaining the pressure control linkage (23) to the support bracket then place the lever in the low range on the quadrant and remove the linkage complete with the adjustment tube (36), spring (25), and spring guide.
3. Fig. 27. Disconnect the diaphragm pipe (38) at the pressure control valve.
4. Remove the two bolts and washers securing the pressure control valve (39) to the support bracket (35) and remove the valve complete with the stand pipe (1).
5. Remove the stand pipe (1) from the valve (39) at the stand pipe block.

Refitment

1. Refit the stand pipe (1), with a new 'O' ring, to the valve (39).
2. Refit the valve, complete with the stand pipe, to the support bracket and secure with the two bolts and washers.
3. Reconnect the diaphragm pipe (38) to the valve (39).
4. Refit the lift cover as stated in operation 7A-03-16

PRESSURE CONTROL VALVE SERVICING

7A-08-22

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

Disassembly

1. Remove the pressure control valve as stated in operation 7A-07-22.
2. Fig. 37. Remove the pilot assembly (65), and withdraw the plunger (67).
3. Withdraw the sleeve assembly (68), piston (26) and pin (69).
4. Remove the retaining ring (73), washer (72), spring (71) and relief valve (70).

Examine all the components for signs of wear, damage, scoring or pitting and replace if necessary.

Reassembly

1. Refit the relief valve (70), spring (71), washer (72), and secure with a new retaining ring (73).
2. Fit two new 'O' rings (74), and one washer (75) to the sleeve assembly (68).

3. Check that the diametral clearance between the piston (26) and the insert inside the sleeve is 0,0051 to 0,0102 mm (0.0002 to 0.0004 in).
4. Locate the pin (69) into the valve body (39) and refit the sleeve assembly (68) and piston (26).
5. Locate the plunger (67) into the pilot assembly (65) and secure the pilot assembly (65) to the valve body (39) tightening to a torque of 3,5 kg-m (25 lb-ft).
6. Refit the pressure control as stated in operation 7A-07-22

DIAPHRAGM

Removal and Replacement 7A-09-23

Special Tools required:
MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit.
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

Removal

1. Remove the pressure control valve as stated in operation 7A-07-22.
2. Remove the response control dashpot as stated in operation 7A-05-21.
3. Fig. 28. Loosen the locknut on the fulcrum bolt (41) and release the vertical lever (10).
4. Fig. 37. Remove the two screws (76) securing the diaphram assembly to the support bracket.
5. Disconnect the diaphragm pipe (38) from the diaphragm assembly and remove the pipe and the diaphragm assembly from the support bracket.
6. Disassemble the diaphragm assembly by removing the remaining two screws (76), rear housing (79), diaphragm (27), spring (78), and front housing (77).

Examine the diaphragm (27) for wear or damage and replace if necessary.

Replacement

1. Reassemble the spring (78), and the diaphragm (27) to the front housing (77) and secure the rear housing (79) to the front housing (77) with the two short screws (76).
2. Fig. 28. Position the diaphragm assembly in place on the support bracket and refit the diaphragm pipe (38) with a new 'O' ring, and secure the diaphragm assembly with the two screws as shown.
3. Refit the response control dashpot as stated in operation 7A-05-21.
4. Refit the pressure control valve as stated in operation 7A-07-22.

CYLINDER, PISTON AND RAM ARM

Removal and Refitment 7A-10-23

Special Tools required:
MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
MF 283 Ram Piston Assembly Ring
1,36 kg (3 lb) Hide Hammer
1,36 kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

Removal

1. Remove the lift cover as stated in operation 7A-03-16.
2. Remove the response control dashpot as stated in operation 7A-05-21.
3. Remove the pressure control valve as stated in operation 7A-07-22.
4. Fig. 27. Remove the position control spring (37) as shown.
5. Loosen the locknut on the vertical lever and release the lever.
6. Fig. 29. Fit a suitable retaining pin to the lower guide rod (20) to prevent the spring from being ejected
7. Remove the four nuts securing the ram cylinder (3) to the lift cover.
8. Lift the cylinder slightly and fit a suitable retaining pin to the upper guide rod (12) to prevent the spring from being ejected.
9. Fig. 30. Lift the cylinder (3) and support bracket (35) clear of the lift cover, taking care not to damage the vertical lever (10) or the diaphragm pipe (38).
10. Remove the connecting rod (4).
11. Fig. 34. Remove the retaining spring clip on the draft rod (15) pivot pin and remove the rod.
12. Release the tabwasher and remove the bolt and washer securing the R.H. lift arm (6, Fig. 1) to the lift shaft (47)and remove the arm.
13. Fig. 35. Drive the remaining lift arm and shaft (47) out of the lift cover and remove the ram arm (5).
14. Remove the two bolts and washers securing the support bracket to the cylinder.
15. Withdraw the piston, from the cylinder.

Refitment

1. If necessary replace the piston rings then reassemble the piston into the cylinder using tool MF 283.
2. Position the support bracket in place on the cylinder and secure it with the two bolts and washers.
3. Fig. 35. Position the ram arm (5) in the lift cover, apply Locktite Type AV or Casco Metalock ML15 to the threads, and screw the setscrew into the ram arm until engagement is made with the connecting rod, then slacken off the setscrew ¼ of a turn.
4. Slide the lift arm and shaft (47) with a new 'O' ring into the lift cover and ram arm (5), aligning the master spines on the shaft and ram arm.
5. Refit the remaining lift arm, with a new 'O' ring. aligning the master spline.
6. Release the tabwasher on the L.H. lift arm and slacken the securing bolt.
7. Refit the washer and securing bolt to the R.H. lift arm and fully tighten it, secure with a new tabwasher.
8. Tighten the L.H. bolt so that the lift arms just move freely through their travel with no lift shaft (47) end float, and secure with a new tabwasher.
9. Fig. 34. Refit the draft rod (15) securing it with a new spring retaining clip.
10. Fig. 30. Place the cylinder (3) and support bracket (35) assembly on the lift cover simultaneously locating the two guide rods (12 and 20) into their holes, the vertical link (10) upright as shown and relocate the connecting rod (4).
11. Fig. 29. Remove the upper guide rod (12) spring retaining pin.
12. Secure the cylinder assembly (3) to the lift cover with the four nuts tightened to a torque of 16,0 kg-m (120 lb-ft).
13. Remove the lower guide rod (20) spring retaining pin
14. Refit the pressure control valve as stated in operation 7A-07-22.
15. Refit the response control dashpot as stated in operation 7A-05-21.
16. Fig. 27. Refit the position control spring (37).
17. Refit the lift cover as stated in operation 7A-03-16.

LINKAGE

Removal and Refitment 7A-11-24

Special Tools required:
- MF 163 Wrench
- MF 271 Draft Control Rod Gauge
- MF 148A Pressure Test Kit
- MF 166 Adapter
- MF 226A Lift Cover Remover and Replacer
- MF 226A-3 Lift Cover Adapter
- MF 269 Wrench
- MF 270B Dashpot Piston Wedge
- MF 271 Roller Tool
- MF 272 Ram Arm Fixture
- MF 273 Hydraulic Setting Fixture
- 1,36 Kg (3 lb) Weight
- Torque Wrench
- Feeler Gauge
- Rule

Removal.

1. Remove the lift cover as stated in operation 7A-03-16
2. Remove the pressure control valve as stated in operation 7A-07-22
3. Remove the response control valve as stated in operation 7A-05-21
4. Fig 27 Remove the position control spring (37) as shown.
5. Fig 29 Fit a suitable retaining pin to the lower guide rod (20) to prevent the spring from being ejected.
6. Remove the four nuts securing the ram cylinder (3) to the lift cover
7. Lift the cylinder slightly and fit a suitable retaining pin to the upper guide rod (12) to prevent the spring from being ejected.
8. Fig 30. Lift the cylinder (3) and support bracket (35) clear of the lift cover, taking care not to damage the vertical lever (10) or the diaphrapm pipe (38).
9. Fig 31. Remove the Allen screw (42) retaining the quadrant (43) in the lift cover.
10. Fig 32. Withdraw the quadrant (43) from the lift cover simultaneously removing the vertical lever (10) and cams (8 and 18).
11. Fig. 33 Remove the plug (44) in the L.H. side of the lift cover to enable the linkage pivot shaft (46) to be removed.
12. Remove the Allen screw (45).
13. Fig 34. Withdraw the linkage pivot shaft (46) as shown and remove the remaining links (12, 15 and 18, then 20 and 16).

Refitment

1. Refit the position control linkage (16 and 20), the draft control linkage (48, 15 and 12), then refit the linkage pivot shaft (46) as shown.
2. Fig 32. Refit the vertical lever (10) and cams (8 and 18) simultaneously refitting the quadrant (43) into the lift cover.
3. Fig 31. Secure the quadrant in the lift cover with the Allen Screw (42).
4. Fig 33. Making sure that the linkage pivot pin (46) is hard against the lift cover, secure the pin (46) with the Allen screw (45).
5. Refit the plug in the L.H. side of the lift cover.
6. Fig 30. Place the cylinder (3) and support bracket (35) assembly on the lift cover simultaneously locating, the two guide rods (12 & 20) into their holes, the vertical link (10) upright as shown and relocate the connecting rod (4).

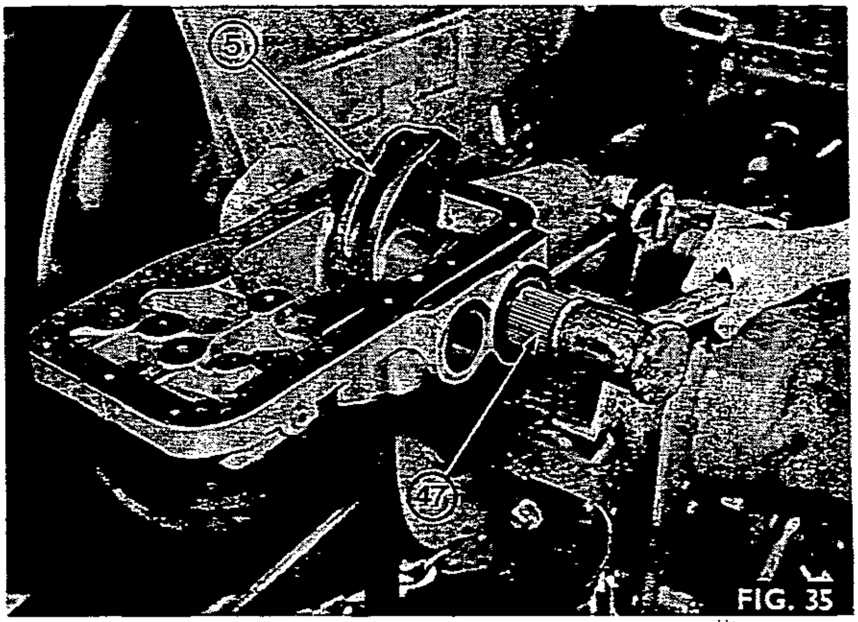
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FIG. 35

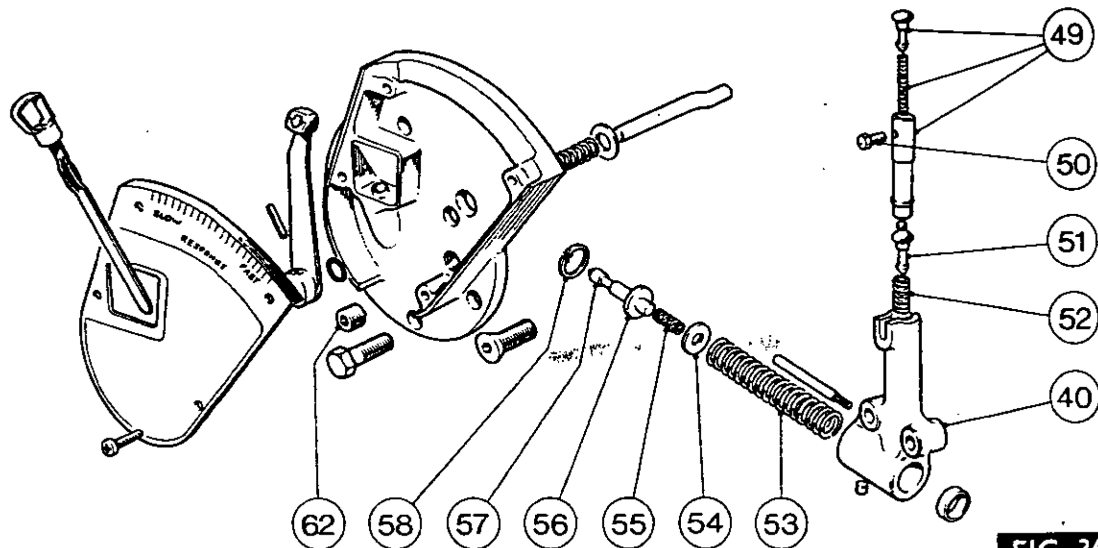
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FIG. 36

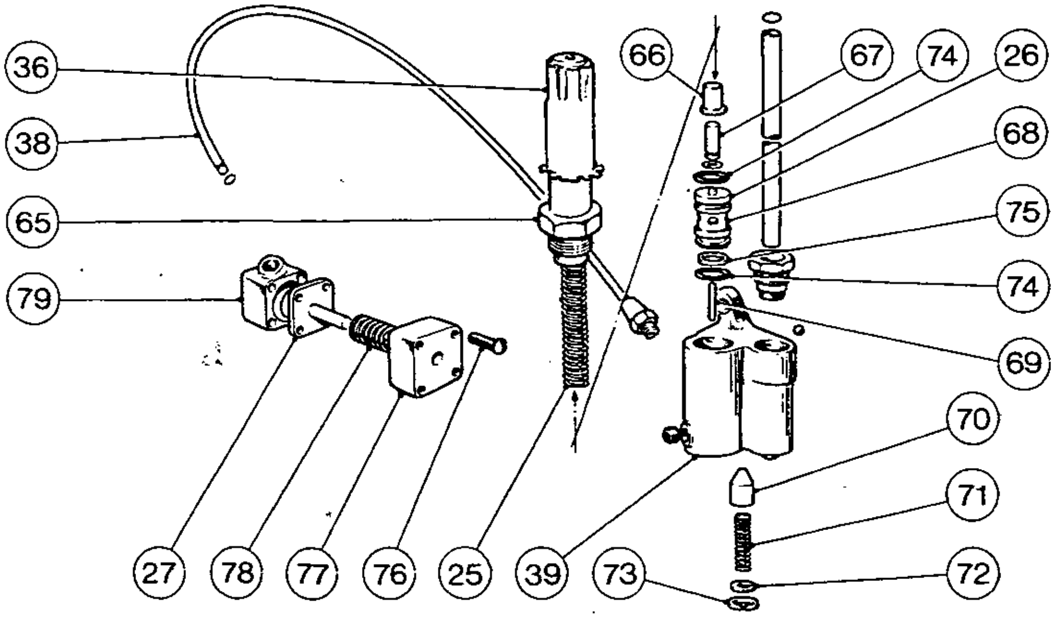
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FIG. 37

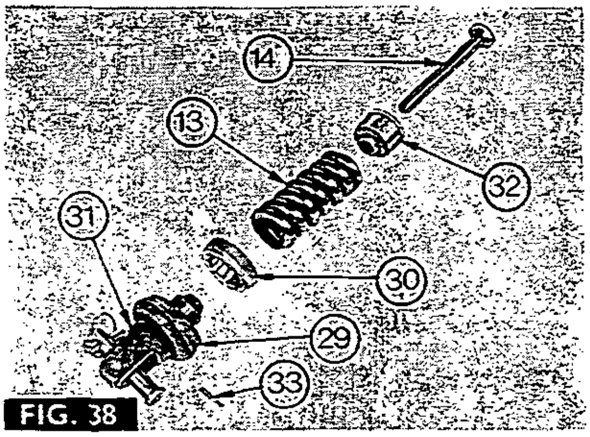

FIG. 38

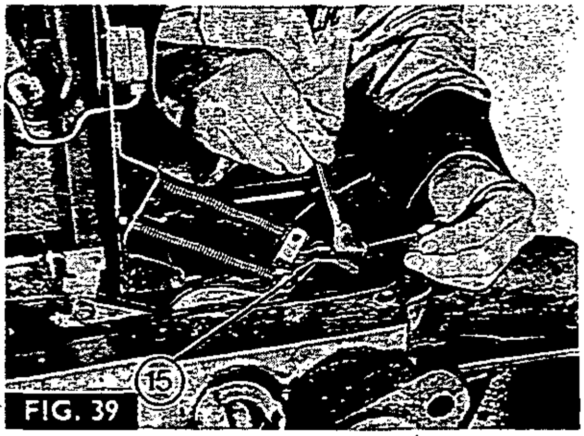

FIG. 39

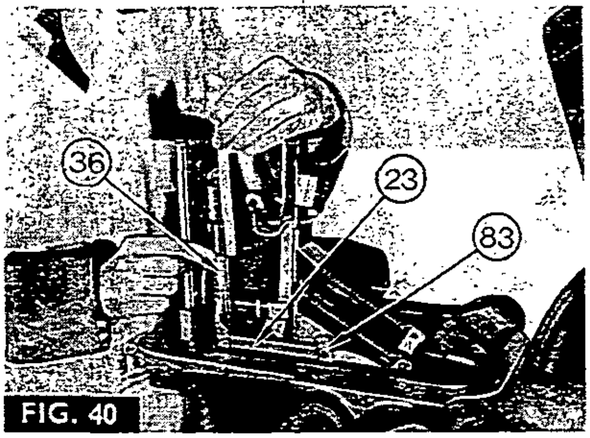

FIG. 40

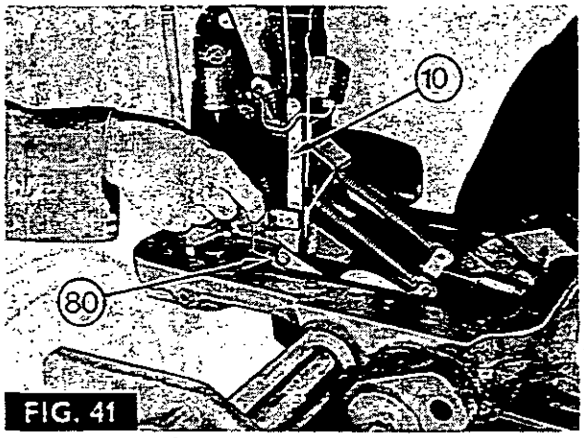

FIG. 41

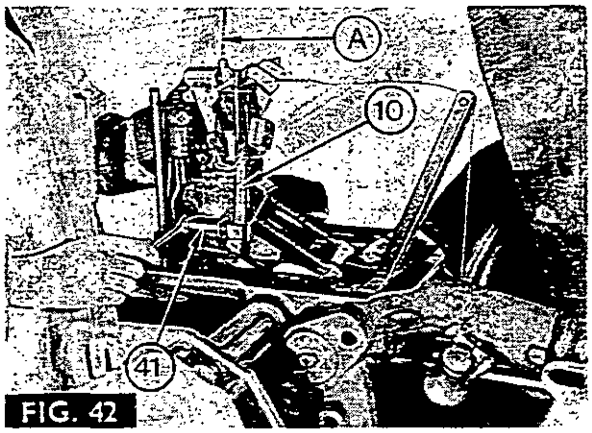

FIG. 42

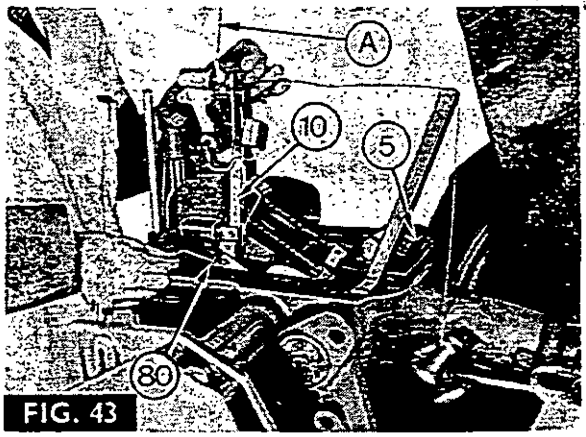

FIG. 43

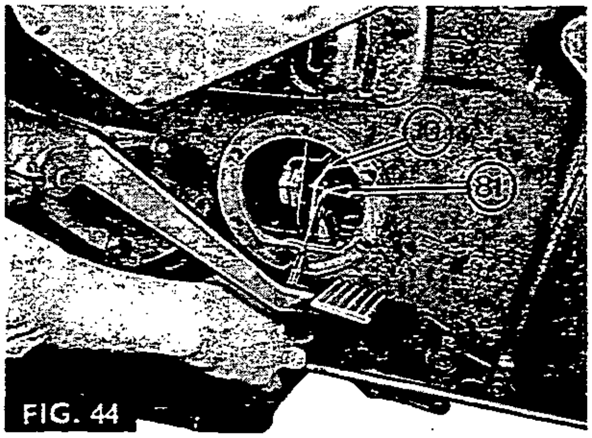

FIG. 44

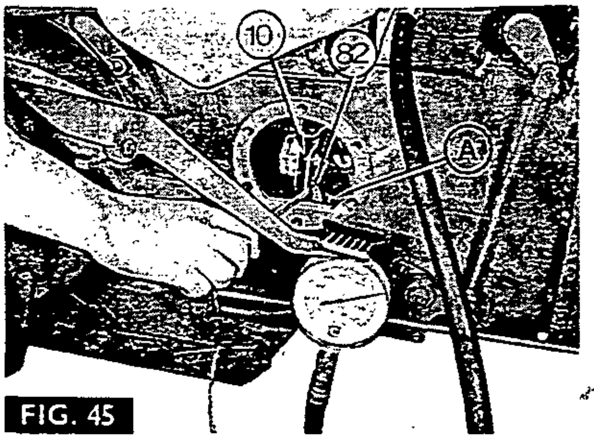

FIG. 45

7. Fig 29. Remove the upper guide rod (12) spring retaining pin.
8. Secure the cylinder assembly (3) to the lift cover with the four nuts tightened to a torque of 16,0 kg-m. (120 lb-ft).
9. Remove the lower guide rod (20) spring retaining pin.
10. Refit the response control dashpot as stated in operation 7A-05-21.
11. Refit the pressure control valve as stated in operation 7A-07-22.
12. Fig 27. Refit the position control spring (37) as shown.
13. Refit the lift cover as stated in operation 7A-03-16

HYDRAULIC ADJUSTMENTS

External and Internal 7A-12-27

Special Tools required:
- MF 163 Wrench
- MF 271 Draft Control Rod Gauge
- MF 148A Pressure Test Kit
- MF 166 Adapter
- MF 226A Lift Cover Remover and Replacer
- MF 226A-3 Lift Cover Adapter
- MF 269 Wrench
- MF 270B Dashpot Piston Wedge
- MF 271 Roller Tool
- MF 272 Ram Arm Fixture
- MF 273 Hydraulic Setting Fixture
- 1,36 Kg (3 lb) Weight
- Torque Wrench
- Feeler Gauge
- Rule

External Adjustments

Control Spring Internal and External End Float

1 Remove the control spring as stated in operation 7A-01-15.
2 Fig 38. Drive out the pin (33) and screw the plunger (14) into the head (31) until all the end float is eliminated and the spring (13) is tight to turn by hand.
3. Fit new securing pin (33), and refit the Control Spring Assembly as stated in operatin 7A-01-15.

Lift Arm End Float.

1. Release the L.H. lift arm tabwasher and slacken the retaining bolt.
2. Fully tighten the R.H. lift arm retaining bolt and secure with a new tabwasher.
3. Tighten the L.H. retaining bolt, so that the lift arms just move freely through their travel with no lift shaft end float, and secure with a new tabwasher.

Quadrant Location.

1. Slacken the two bolts securing the quadrant to the support.
2. Turn the position and pressure control quadrant to the central position of the bolt holes and retighten the two bolts.

Draft Control Rod.

1. Remove the lift cover as stated in operation 7A-03-16.
2. Place the draft control lever in the fully raised position.
3. Fig 39. With the draft control rod held against the control spring plunger by the linkage retain spring, adjust the setscrew on the draft control rod assembly (15), using tool MF 333 as shown, so that the clearance between the setscrew head and the lift cover casting is 5,8 mm (0.230 in).

Draft Control

1. Place the position control lever in the fully lowered position.
2. Figs. 37 and 40. Remove the split pin (83) retaining the pressure control linkage (23) to the support bracket, and remove the linkage complete with adjustment tube (36) spring (25) and spring guide (66).
3. Fig 41. Slacken the locknut and unscrew the socket screw (80) on the vertical link (10) to the end of its thread as shown.
4. Place the draft control lever between the two sector marks on the quadrant.
5. Place the position control lever in the Transport position, making sure the stop is at the end of its travel.
6. Fig 42. Fit wedge tool MF270B (A) to the dashpot piston rod.
7. Position the weight frame tool MF 273 and apply a load of 1,36 Kg (3 lb) to the end of the vertical lever (10) as shown.
8. Adjust the lever fulcrum clevis bolt (41) until the gap between the end of the lever (10) and the dashpot piston rod is 0,051 to 0,102 mm (0.002 to 0.004 in).
9. Tighten the clevis bolt locknut and check the gap.

Position Control

1. Place the draft control lever in the fully raised position.
2. Place the position and pressure control lever in the Transport position.
3. Fig 43. Fit wedge tool MF270B (A) to the dashpot piston rod.
4. Position tool MF 272 into the lift cover as shown, then locate the ram arm (5) onto the tool.
5. Position weight frame tool MF 273 and apply a load of 1,36 kg (3 lb) to the end of the vertical lever (10) as shown.
6. Adjust the socket screw (80) on the vertical lever (10) until the gap between the lever and the dashpot piston rod is 0,051 to 0,102 mm (0.002 to 0.004 in).
7. Tighten the locknut and check the gap.

Pressure Control Spring.

1. Fig 37. Refit the pressure control linkage complete with adjustment tube (36), spring (25) and spring guide (66) and secure with a new split pin (83 Fig 40).
2. Place the draft control lever in the fully raised position
3. Place the position and pressure control lever right down to the forward (low) end of the pressure range on the quadrant.
4. Fig 40. Hold the adjustment tube and pressure control lever assembly against the cam to remove end play, then turn the adjustment tube (36) until the distance between the bottom of the tube and the control valve body is 33,4 mm ($1\frac{5}{16}$ in).

Internal Adjustments.

1. Refit the lift cover as stated in operation 7A-03-16.
2. Fill the transmission with recommended oil to the level of the inspection aperure in the centre housing.
3. Attach a weight of 400 kg (900lb) to the lower links.
4. Fig 44. Slacken the upper knurled adjusting screw (81), on the vertical lever (10), right out of contact with the diaphragm plunger.
5. Place the draft control lever in the fully raised position.
6. Set the engine at 400-600 rpm and operate the position control lever through the quadrant range to expel all the air from the system.

Valve Blow off Position and Drop Rate.

1. Place the position and pressure control lever in the transport position.
2. Fig 45. Fit Wedge tool MF 270B (A) over the dashpot piston rod through the R.H. inspection aperture in the centre housing.

NOTE: – THE WEDGE TOOL MUST BE HELD FIRMLY IN POSITION WHEN MAKING ADJUSTMENTS.

3. Place the draft control lever in the fully lowered position.
4. Connect the pressure gauge MF 148A and adapter MF 166 to the tapped port.
5. Start the engine and set the engine speed at 400 to 600 rpm.
6. Screw in the lower knurled adjustment screw (82) on the vertical lever (10) as shown, until the weighted lower links have risen fully and pressure control valve starts to blow off and a gauge reading of approximately 208 to 218 kg/cm^2 (2950 to 3100 lb/in^2) is obtained.
7. Fig 46. Scribe a line (A) on the lift cover and lift arm, to indicate the start of valve blow off.
8. Scribe two more lines (B) on the lift cover 3,2 mm (in) apart, and about 12,7 mm (½ in) back from the line (A) as shown.
9. Turn the lower adjustment screw (82) out until the time taken for the scribe line (A) on the lift arm to pass between the two scribe lines (B) on the lift cover is five seconds. (This is equivalent to a rate of drop of 25,4 mm (1 in) per five seconds at the ends of the lower links).
10. Fully raise the draft control lever and remove the wedge tool MF 270B (A).

Transport Limit Stop.

1. Place the transport limit stop on the quadrant at the end of its travel.
2. Move the position and pressure control lever up against the stop.
3. Slacken the two bolts securing the quadrant to the support.
4. Turn the position and pressure control quadrant, NOT the draft control quadrant, until the lines (A) are 1,6 to 3,2 mm(1/16 to 1/8 in) apart.
5. Retighten the quadrant bolts.

Pressure Control Final Adjustments.

1. Place the position and pressure control lever in the Constant pump position.
2. Fig 47. Screw in the upper knurled adjustment screw (81) on the vertical lever (10) as shown, until the lever (10) moves rapidly from side to side and the needle on the gauge MF 148A begins to fluctuate excessively.
3. *Turn out the screw (81) until, the lever (10)* is steady, the least amount of fluctuation is shown by the gauge needle, and as little oil as possible comes from the pressure control valve.
4. If the pressure reading on the guage is not within 208 to 218 kg/cm^2 (2950 to 3100 lb/in^2); *place the position and pressure control* lever in the low end of the pressure range on the quadrant.
5. Adjust the pressure control spring tube (up to decrease and down to increase the pressure), until the correct gauge reading is obtained in constant pumping.
6. Recheck the vertical lever (10). See items 2 and 3.
7. Remove the gauge MF 148A and adapter MF 166 and refit the plug.

Response Control

1. Fig 48. Compress the cap into the plunger and using tool MF 269 tighten the setscrew to a torque of 0,28 to 0,42 kg m (2 to 3 lb-ft) as shown.
2. Fig 49. Refit the response control plate (60) with a new gasket and secure with the five bolts (61) and one screw (59).
3. Remove the plug (62) from the plate as shown.
4. Fig 50. Using tool MF 269 as shown, slaken the setscrew to allow the spring to force the plunger head upwards.
5. Place the response lever 6 mm (¼in) from the 'slow' position and retighten the setscrew to a torque of 0,28 to 0,42 kg m (2 to 3 lb-ft).
6. Refit the plug and the response cover plate.
7. Refit the R.H. footplate.
8. Add oil to the transmission until the required level is reached
9. Carry out Hydraulic Test Procedure as stated in operation 7A-13-28.

HYDRAULIC TEST PROCEDURE 7A-13-28

The following test procedure is used for checking the accuracy of the adjustments previously carried out in operation 7A-12-27, with the tractor completely assembled.

Special Tools required: MF 148A Pressure Test Kit
MF 166 Adapter.
Rule.

1. Attach a weight of 400kg (900lb) to the lower links.
2. Connect the pressure gauge MF 148A and adapter MF 166 to one of the tapped ports on the lift cover.
3. Start the engine and set the engine speed at 400 to 600 rpm.
4. Place the response control lever in the FAST position.
5. Place the draft control lever in the fully raised position.
6. Place the position control lever in the transport position.
7. Rapidly raise and lower the weight several times using the position control lever, to expel air from the system.

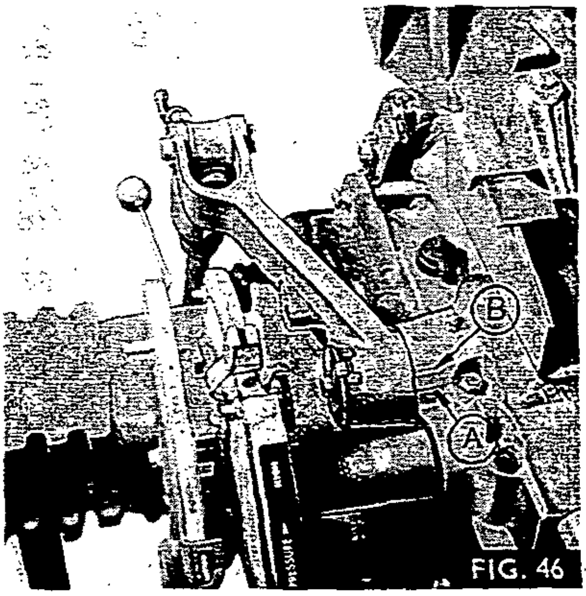

FIG. 46

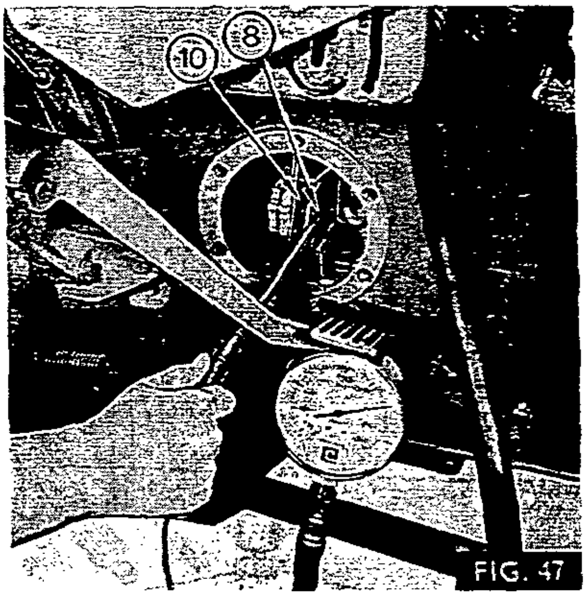

FIG. 47


FIG. 48

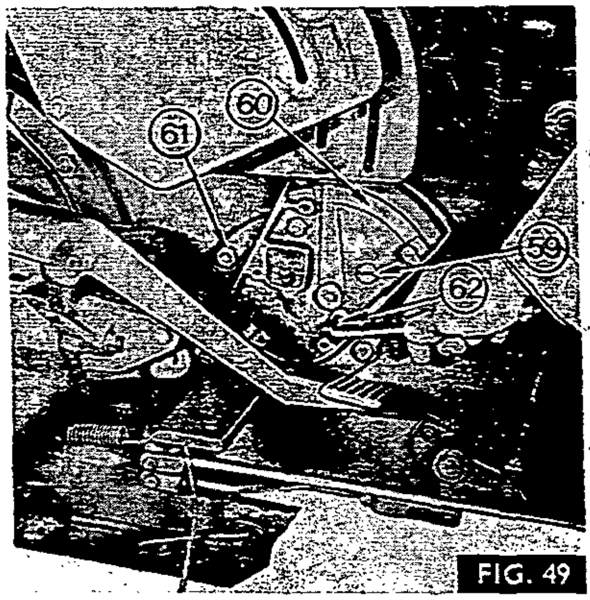

FIG. 49

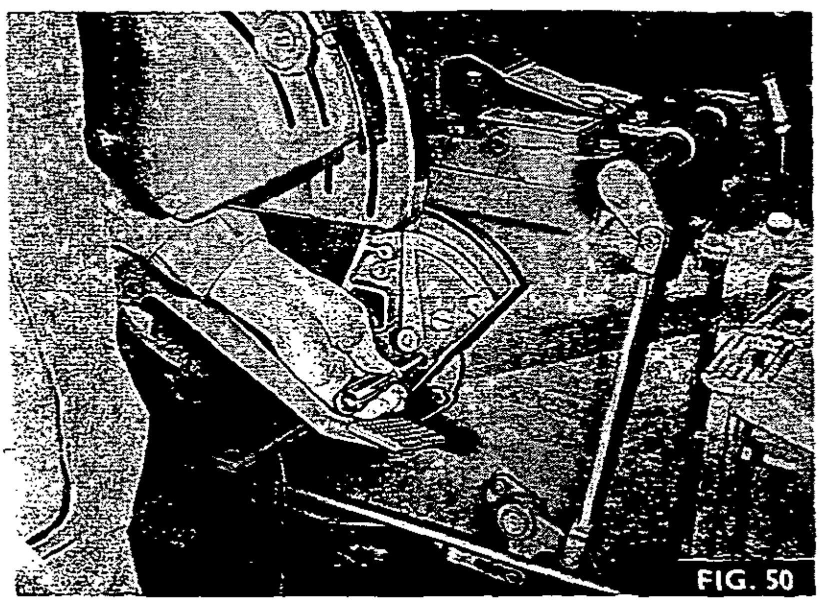
FIG. 50

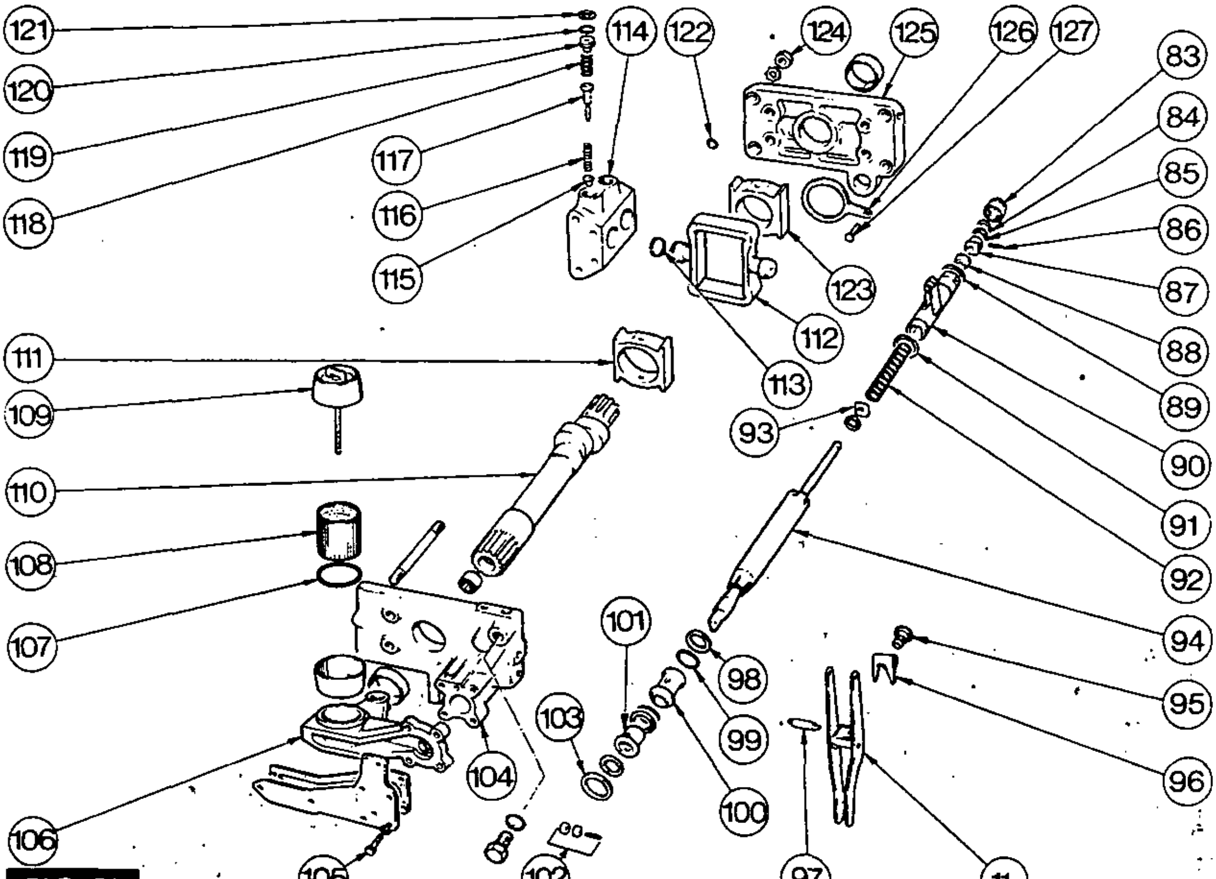

FIG. 51

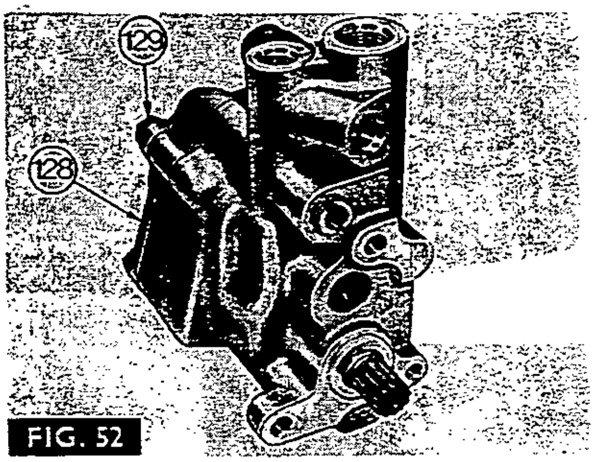

FIG. 52

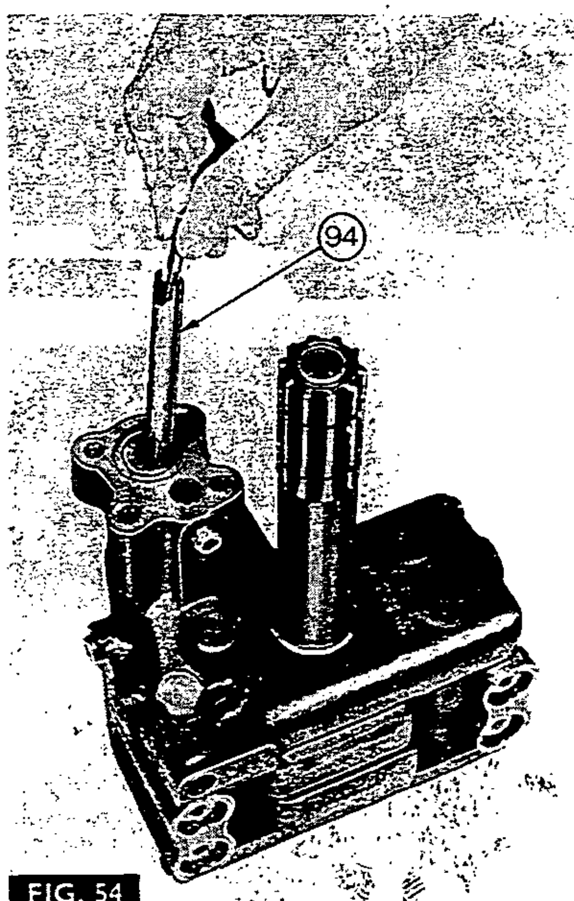

FIG. 54

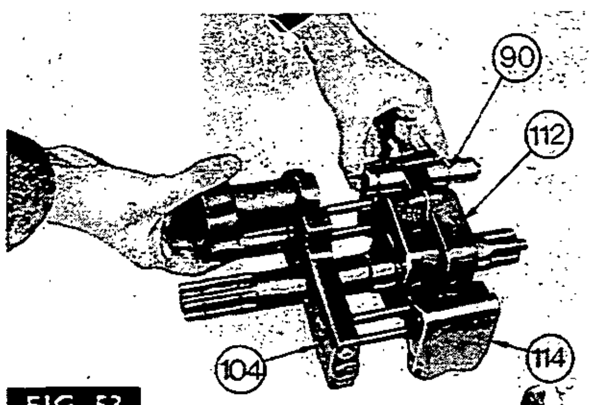

FIG. 53

Position Control Test.

1. Move the position and pressure control lever into the constant pumping sector on the quadrant, a gauge reading of 208 to 218 kg/cm² (2950 to 3100 lb/in²) should be obtained.
2. Move the lever past the transport position to lower the weight, then return the lever to the transport position against the stop, the scribe lines (A) (Fig. 46) should be 1,6 to 3,2 mm (1/16 to 1/8 in) apart.
3. With the response control lever at FAST and then at SLOW, it must be possible, using the position control lever, to raise, lower and hold the weight at any pre-selected height throughout the full range of lower link travel. Any tendency to creep beyond a pre-selected height indicates internal friction or a sticking control valve.
4. Place the response control lever at 'SLOW'.
5. Place the position control lever in transport.
6. Check that the lower links rise to the correct height, scribe lines separated 1,6 to 3,2 mm (1/16 to 1/8 in). Any tendency to creep up beyond this point indicates that the dashpot is preventing the pump from shutting off and the vertical lever assembly is mis-adjusted.

Draft Control Test.

1. Place the position control lever in transport.
2. Check that the weight can be raised and lowered with the draft control lever.
3. Place the response control lever at SLOW, then fully raise the draft control lever.
4. Check that the lower links rise to the correct height, scribe lines separated 1,6 to 3,2 mm (1/16 to 1/8 in), without creeping up beyond this point.
5. With the weight fully supported on the lower links, move the draft control lever and find the position at which the lower links neither raise nor lower. At this point, the draft control lever must be between the sector marks in the quadrant within 6,4 mm (1/4 in).

Response Control Test

1. Place the response control lever at 'SLOW'
2. Place the draft control lever in the fully raised position.
3. Rapidly lower the draft control lever and note the time taken for the weighted lower links to fall from the fully raised position to the horizontal position. The drop times must be:

Oil Temperature	Minimum Drop Time In Seconds
16°C (60°F)	6
27°C (80°F)	4
38°C (100°F)	3
49°C (120°F)	2,5

4. Moving the response control lever progressively from SLOW to FAST, should result in a corresponding increase in the drop rate of the weighted lever links when the draft control lever is rapidly lowered. With the response control lever at FAST, the maximum drop time should be one second at an oil temperature of 49°C (120°F).

Linkage Radial Drop Test.

1. Fully raise the weighted lower links by placing the position control lever at transport.
2. Stop the engine.
3. Check that the lift arms continue to support the weight, and that after three minutes the lift arms do not fall more than 8 mm (5/16 in), measured between the scribe times (A Fig 46) using recommended oil at 38°C (100°F) minimum.

HYDRAULIC PUMP

Removal and Refitment 7A-14-31

Special Tools required:
- MF 163 Wrench
- MF 271 Draft Control Rod Gauge
- MF 148A Pressure Test Kit
- MF 166 Adapter
- MF 226A Lift Cover Remover and Replacer
- MF 226A-3 Lift Cover Adapter
- MF 269 Wrench
- MF 270B Dashpot Piston Wedge
- MF 271 Roller Tool
- MF 272 Ram Arm Fixture
- MF 273 Hydraulic Setting Fixture
- 1,36 Kg (3 lb) Weight
- Torque Wrench
- Feeler Gauge
- Rule

Removal

1. Remove the lift cover as stated in operation 7A-03-16.
2. Remove the p.t.o. shaft as stated in Part 5.
3. Remove the L.H. footplate.
4. Remove the L.H. side cover plate as stated in Part 5.
5. Fig 51. Release the locking wire on the stainer head (109) and remove the head, filter (108) and sealing ring (107).
6. Remove the split pin from the shear tube, remove the tube and the rear drive shaft.
7. Disconnect the L.H. and R.H. brake rods at the front clevis pins.
8. Disconnect the L.H. and R.H parking brake rods at the cross shaft
9. Remove the two nuts each side securing the two dowel pins and remove the pins
10. Fig 52. Remove the four bolts (129) and spring washers securing the end plate (128) to the auxilary pump (if fitted).
11. Remove the end plate (128) and then the feed pipe.

NOTE: – DO NOT USE A SCREWDRIVER OR ANY SHARP OBJECT TO PRISE THE END PLATE OFF THE PUMP AS DAMAGE WILL OCCUR.

12. Disconnect the multi-power feed pipe at the auxiliary pump (if fitted).
13. Move the hydraulic pump rearwards and manoeuvre the auxiliary pump (if fitted) complete with the plated drive out of the housing.
14. Manoeuvre the hydraulic pump, tailshaft first, out of the housing.

Refitment

1. Place the hydraulic pump in the rear of the centre housing

NOTE: – BEFORE REFITTING THE AUXILIARY PUMP (IF FITTED) AND END PLATE ENSURE THAT THE END PLATE IS NOT SCORED OR DAMAGED, AND REPLACE IF NECESSARY.

2. Place the auxiliary pump (if fitted) into the centre housing and position it in place on the hydraulic pump.
3. Refit the feed pipe, with a new 'O' ring
4. Fig 52. Refit the end plate (128), with a new seal, and secure with the four bolts (129) and spring washers.
5. Slide both pumps rearwards to enable the end plate securing bolts to be tightened to a torque of 5,5 kg m (40 lb-ft).
6. Refit both pumps into position.
7. Place the p.t.o. gear into position and refit the p.t.o. shaft as stated in Part 5.
8. Refit the two dowel pins with new 'O' rings and secure with the two nuts each side.
9. Refit the parking brake rods and secure with the clevis pins and new split pins.
10. Refit the L.H. and R.H. brake rods and secure with the clevis pins and new split pin.
11. Fig 51. Fit a new sealing ring (107) and filter (108) and refit the strainer head (109), securing it with locking wire.
12. Refit the p.t.o. side cover as stated in Part 5, also refit the clutch pedal and the L.H. footplate to the side cover.
13. Reconnect the multi-power feed pipe to the auxiliary pump (if fitted).
14. Refit the rear drive shaft and shear tube and locate the split pin to give 0,38 to 2,54 mm (0.015 to 0.100 in) end float.
15. Refit the lift cover as stated in operation 7A-03-16.

HYDRAULIC PUMP SERVICING 7A-15-32

Special Tools required:
- MF 163 Wrench
- MF 271 Draft Control Rod Gauge
- MF 148A Pressure Test Kit
- MF 166 Adapter
- MF 226A Lift Cover Remover and Replacer
- MF 226A-3 Lift Cover Adapter
- MF 196B Valve Seat Cutter Tool
- MF 269 Wrench
- MF 270B Dashpot Piston Wedge
- MF 271 Roller Tool
- MF 272 Ram Arm Fixture
- MF 273 Hydraulic Setting Fixture
- 1,36 Kg (3 lb) Weight
- Torque Wrench
- Feeler Gauge
- Rule

Disassembly.

1. Remove the hydraulic pump as stated in operation 7A-14-31.
2. Remove the control valve as stated in operation 7A-16-33.
3. Fig 51. Remove the four nuts (124) and washers and detach the front body assembly (125).
4. Fig 53. Withdraw the two valve chambers (114), from the rear body assembly (104), complete with the front cam block (123), pistons (112), cam follower (126) and oscillator assembly (90) and rear cam block (111) as shown.
5. Fig 51. Separate the valve chabers (114) from the pistons (112) and remove the cam blocks (111 and 123) from the pistons.
6. Withdraw the camshaft (110) from the rear body assembly (104).
7. Dismantle the oscillator assembly (90) by removing the snap ring (84), collar (87), guide (88), spring (92), and retainer disc (93).
8. If necessary remove the split pin and clevis pin (127) retaining the cam follower (126) to the oscillator assembly.
9. Dismantle each valve chamber by removing the retaining ring (121) 'O' ring (120) plug (119), outlet valve spring (118) outlet valve (117) inlet valve spring (116) and inlet valve (115).

Examine all parts for wear; damage, scoring or pitting and replace if necessary.

Reassembly.

1. Recut the valve seats in the valve chambers (114) if necessary, using tool MF 196B.
2. Refit the inlet valve (115), inlet valve spring (116), outlet valve (117), outlet valve spring (118), plug (119), 'O' ring (120) and secure with a new retaining ring (121).
3. Refit the retainer disc (93), spring (92), guide (88) and roller (87) with the oscillator and secure with a new snap ring (84).
4. Secure the cam follower to the oscillator with the clevis pin (127) and a new split pin.
5. Fit new 'O' rings (122) into place on the front and rear bodies (104 and 125)
6. Refit the valve chambers (114) onto the pistons, with new piston rings (113) if necessary.
7. Place the cam follower (126) between the pistons.
8. Place the camshaft (110), with the front and rear cam blocks (111 and 123) into the pistons.
9. Refit the rear body (104) making sure the oscilator housing aligns with the aperature in the rear body.
10. Refit the front body (125) and secure it with the four nuts (124) and washers, tightened to a torque of 4,8 kg m (35 lb-ft).
11. Refit the control valve as stated in operation 7A-16-33.
12. Refit the hydraulic pump as stated in operation 7A-14-31.

CONTROL VALVE

Removal and Refitment 7A-16-33

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

Removal.

1. Remove the hydraulic pump as stated in operation 7A-14-31.
2. Fig 51. Remove the clip (96) and stud (95), lever (11) and the two rollers and pin (102).
3. Remove the four bolts (105) and washer securing the oil strainer housing (106) to the pump, and detach the housing.
4. Remove the oscillator body cap (83) and retaining ring (85).
5. Extract the pin (86) from the collar (87) and the oscillator drive rod in the control valve (94).
6. Fig. 54. Withdraw the control valve (94) from the pump as shown.
7. Fig. 51. Remove the spacer washer (103), washer (98), intake chamber (101), washer (98), 'O' ring (99), discharge chamber (100), 'O' ring (99) and washer (98) from the pump.

Examination

Fit the three washers (98) to the control valve (94) and check that the diametral clearance between each washer and the valve is 0,0051 to 0,0102 mm (0.0002 to 0.0004 in), then remove the washers from the valve.

NOTE – ANY PARTS WHICH SHOW SIGNS OF WEAR, SCORING OR PITTING MUST BE REPLACED.

Refitment.

1. Refit the following parts into the rear body of the pump in this order. Washer (98), 'O' ring (99), discharge chamber (100), 'O' ring (99), washer (98), intake chamber (101), washer (98), spacer washer (103).
2. Insert the valve assembly (94) into the pump, centralising the valve into the three washers (98). Operate the valve to ensure centralisation.
3. Refit the pin (86) to the collar (87) and oscillator drive rod in the control valve.
4. Secure the pin (86) with the retaining ring (85) fitted to the groove in the collar (87).
5. Refit the oscillator body cap (83).
6. Refit the oil strainer housing (106) to the pump and secure with the four bolts (105) and washers.
7. Refit the lever (11) and secure it to the control valve with the two rollers and pin (102).
8. Refit the stud (95) and clip (96).
9. Fit a new sealing ring (107) and filter (108), refit the strainer head (109) and secure with locking wire.
10. Refit the hydraulic pump as stated in operation 7A-14-31.

HYDRAULIC SYSTEM (MARK III PUMP)

PART 7 SECTION A

GENERAL

The Ferguson hydraulic system comprises a four cylinder scotch yoke type pump (1) which delivers oil, through a vertical pipe (2) to the cylinder (3).

A connecting rod (4) from the cylinder piston (5) engages in the ram arm (6) which is splined on to the lift shaft (7) which carries the linkage lift arms.

When oil, under pressure from the pump, is delivered to the ram cylinder (3), the piston is forced rearwards and pushes the ram arm upwards, causing the lift shaft to rotate and raise the lift arms.

The hydraulic pump is driven by the p.t.o. drive from the p.t.o. clutch plate, via the gearbox constant mesh gears and the p.t.o. drive shaft whose splines engage in the front end of the pump.

Dowel pegs, fitted through each side of the centre housing, prevent the pump from rotating.

Mounted on the right hand rear end of the pump is a control valve (9), which meters the quantity of oil being fed to the pump pistons and also allows oil to return from the ram cylinder. An oscillator, attached to the pump camshaft partially rotates the control valve to prevent it from sticking in its sleeve.

When using Draft Control, movement of the lever down the quadrant actuates the internal linkage which moves the control valve to the discharge position. As the implement enters the ground a force down the top link actuates the internal linkage which moves the control valve to the neutral position. Any variation in the force down the top link moves the control valve to the intake and the discharge positions, maintaining the implement at the pre-set depth. When the lever is fully raised the control valve moves to the full intake position, and when the lift arms reach their transport position, the Position Control linkage moves the valve to the neutral position.

When using Position Control, movement of the lever down the quadrant actuates the internal linkage which moves the control valve to the discharge position. As the lift arms lower, the cam on the ram arm actuates the internal linkage which moves the control valve to the neutral position. When the TRANSPORT position is selected the control valve moves to the full intake position, and when the lift arms reach their transport position, the cam actuates the internal linkage which moves the control valve to the neutral position.

Response Control, incorporated in the pump, regulates the speed that the control valve moves to the discharge position, and therefore can control the initial rate of flow from the ram cylinder and the speed of drop of an implement. Movement of the Response Control lever actuates an internal slide valve (11), which varies the size of an orifice in the intake gallery, from which oil can escape. When the control valve moves to the discharge position, oil has to be displaced from the intake gallery. The oil is prevented from returning through the strainer by a non-return valve (8), therefore it must pass through the inlet gallery orifice. The slide valve (11) controls the size of the orifice and therefore the speed of movement of the control valve.

The Pressure Control system enables the pressure in the ram cylinder to be regulated from 7 to 179 kg/cm² (100 to 2550 lb/ft²)—MF 148 Tractor and 7 to 211 kg/cm² (100 to 3000 lb/in²)—MF 165, 168, 185 and 188 Tractors. One of the uses for this system is with semi-trailed implements fitted with depth control wheels. By suitable adjustment of the Pressure Control lever, part of the weight of the implement is supported by the tractor linkage, thus obtaining weight transfer to the tractor rear wheels and increasing traction.

The Pressure Control valve (12) consists of a ball valve, held on a seat by a spring, a secondary relief valve and a diaphragm.

Setting the Pressure Control lever in the LOW position moves the control valve, under the influence of its spring, to the intake position. The pump supplies oil to the ram cylinder, and the lower links rise until the Pressure Control Coupler chain becomes tight. As the chain prevents the lower links from lifting any higher a pressure is created in the system, which moves the control valve towards neutral to reduce the flow. The excess oil escapes through the secondary relief valve.

Moving the Pressure Control lever towards the HIGH position, for more weight transfer, increases the pressure on the spring which seats the ball. Oil in the diaphragm escapes through the secondary relief valve and the diaphragm allows the control valve to move to the full intake position. The pump provides the increase in pressure until the ball valve is lifted. When the desired increase in pressure is achieved, oil enters the diaphragm which moves the control valve to a reduced flow situation.

As the tractor travels over undulations the lower links will rise and fall. When the lower links are pulled down, the excess oil is expelled through the secondary relief valve. When the Pressure Control Coupler Chain goes slack, the pressure in the system drops. Oil escapes from the diaphragm through the secondary relief valve and the control valve moves to the intake position. The lower links quickly rise and re-tension the chain, which again builds up the pressure and lifts the ball valve, and the diaphragm moves the control valve to reduce the flow.

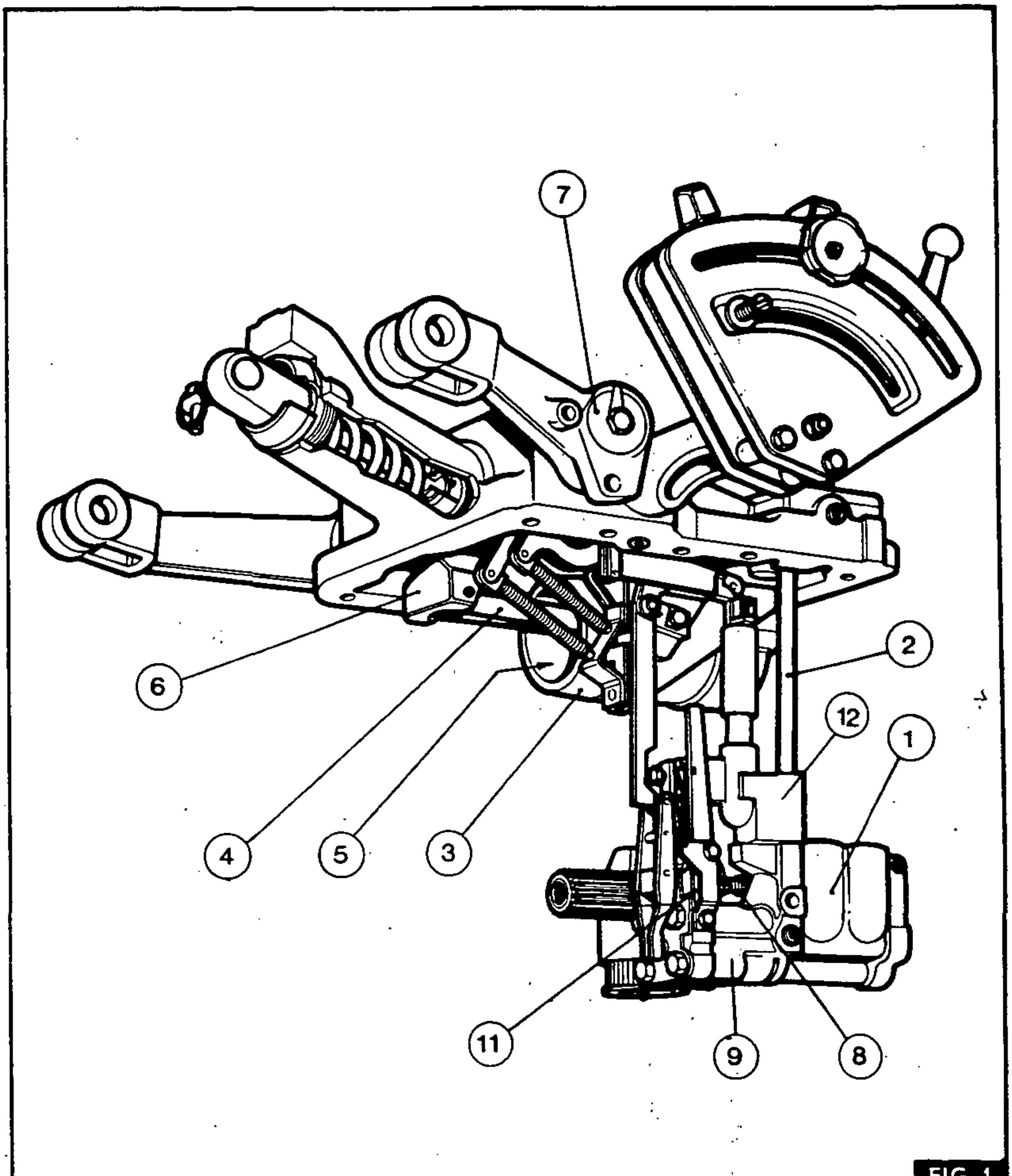

FIG. 1

CONTROL SPRING ASSEMBLY

Removal and Refitment 7A—01—38

Special tools required:— MF 163 Wrench.
Torque Wrench.

Figs. 2 and 3
Removal

1. Remove the control beam.
2. Fig. 2. Remove the Allen screw (14).
3. Pull back the rubber boot (15).
4. Using MF 163, unscrew the retainer (13) from the lift cover.
5. Fig. 3. Withdraw the control spring assembly from the lift cover, as shown.
6. Remove the nylon plug.

Refitment

1. Fig. 3. Slide the control spring assembly into the lift cover.
2. Place the Draft Control lever in the fully DOWN position.
3. Fig. 2. Tighten the retainer (13), using MF 163, until all the end float is eliminated. *Do not overtighten the retainer, otherwise the end float will reappear.*
4. Refit the rubber boot (15).
5. Fit a new nylon plug, then refit and tighten the Allen screw (14) to a torque of 0,7 kg m (5 lbf ft).
6. Refit the control beam.

CONTROL SPRING ASSEMBLY

Servicing 7A—02—38

Special tools required:— MF 163 Wrench.
Torque Wrench.

Figs. 4 and 5
Disassembly

1. Remove the control spring assembly as stated in operation 7A—01—38.
2. Fig. 4. Drive out the pin (17) and detach the head (18).
3. Remove the retainer (13), control spring (10) and spring seat (19) from the plunger (16).

Reassembly

1. Fig. 4. Refit the spring seat (19), spring (10) and retainer (13) to the plunger (16).
2. Fig. 5. Screw the plunger into the head, until all the end float is eliminated and the spring is tight to turn, by hand.
3. Fig. 4. Fit a new securing pin (17).
4. Refit the control spring assembly as stated in operation 7A—01—38.

HYDRAULIC LIFT COVER

Removal and Refitment 7A—03—38

Special tools required:— MF 163 Wrench.
MF 148A Pressure Test Kit.
MF 166 Adapter.
MF 226A Lift Cover Remover and Replacer.
MF 226A-3 Lift Cover Adapter.
MF 272 Ram Arm Fixture.
MF 273 Hydraulic Setting Fixture.
MF 333 Draft Control Rod Gauge.
MF 356 Position and Draft Control Setting Gauge.
MF 357 Screwdriver Adjuster.
MF 359 Pressure Control Bleed Pipe.
1,4 kg (3 lb) weight.
Torque Wrench.
Rule.

Figs. 6 to 11
Removal

1. Remove the seat.
2. Disconnect the lift rods from the lift arms.
3. Remove the control beam.
4. Disconnect the Auto-Hitch (if fitted) at the lift arms.
5. Fig. 6. Fully lower the links, then remove the two bolts and spring washers securing the standpipe cap (20), then remove the cap, withdrawing the standpipe (2).
6. Remove the bolts securing the lift cover to the centre housing.
7. Place the parking brake clear of the lift cover ('5' line tractors only).
8. Fig. 7. Fit MF 226A and MF 226A—3 to the lift cover, as shown.
9. Place the Draft Control lever in the fully UP position and the Position Control lever in the TRANSPORT position.
10. Fig. 8. Taking care not to damage any parts, detach the lift cover from the centre housing as shown, and place the support leg on the ground.
11. Drain the oil to the LOW mark on the dipstick.
12. Fig. 9. Remove the four screws (24) securing the Response Control cover plate (25) and remove the plate.
13. Remove the five bolts (23) and the screw (22) securing the side cover (21) to the centre housing, then remove the cover. (To facilitate side cover removal, it may be necessary to remove the rear footstep bracket).

Refitment

NOTE—BEFORE REFITTING THE LIFT COVER THE EXTERNAL ADJUSTMENTS SPECIFIED IN OPERATION 7A—09—45 MUST BE CARRIED OUT.

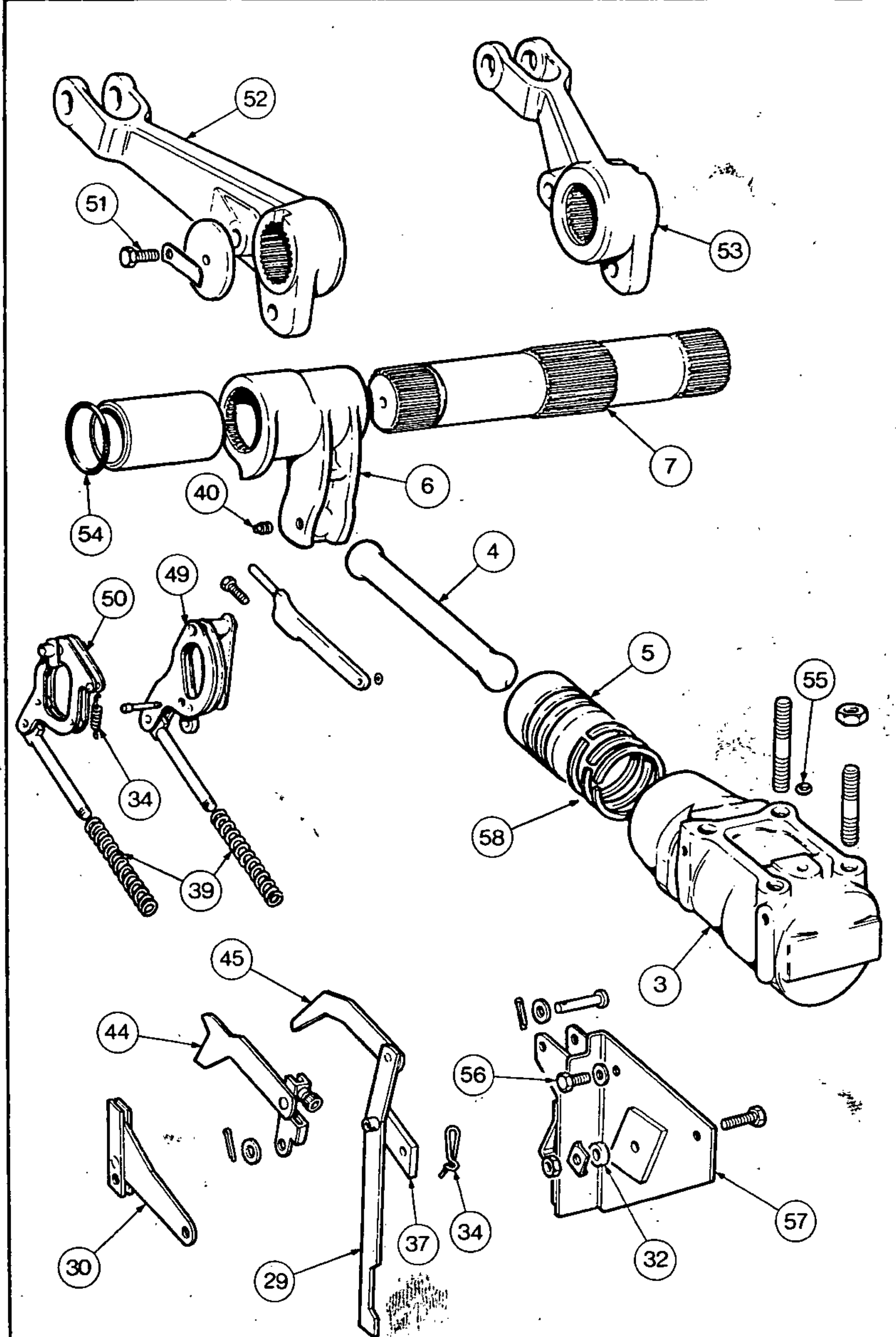

FIG. 12

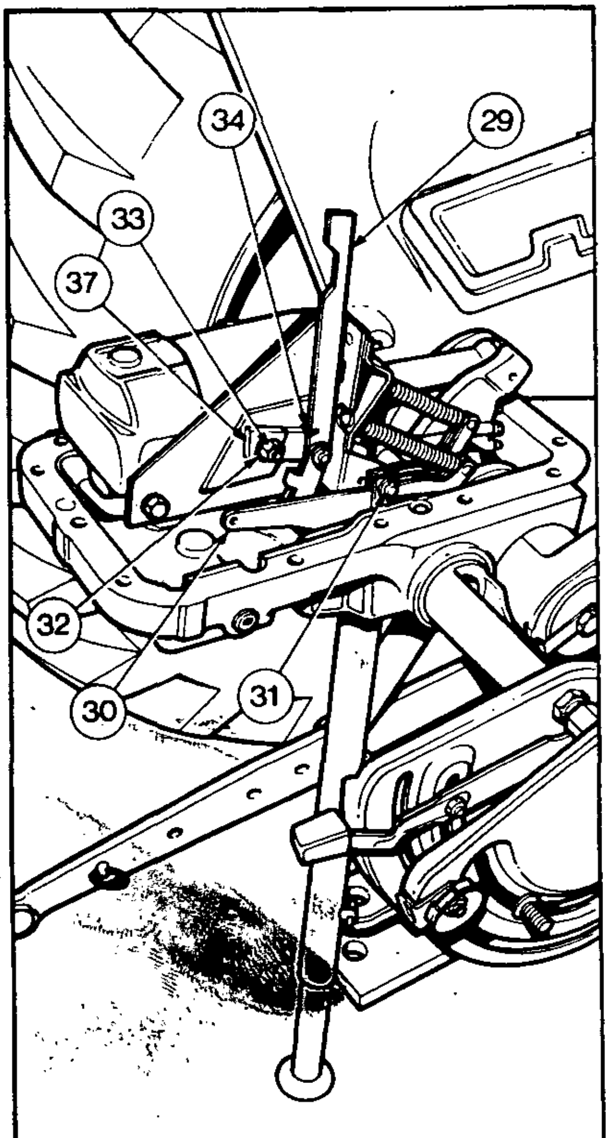

FIG. 13

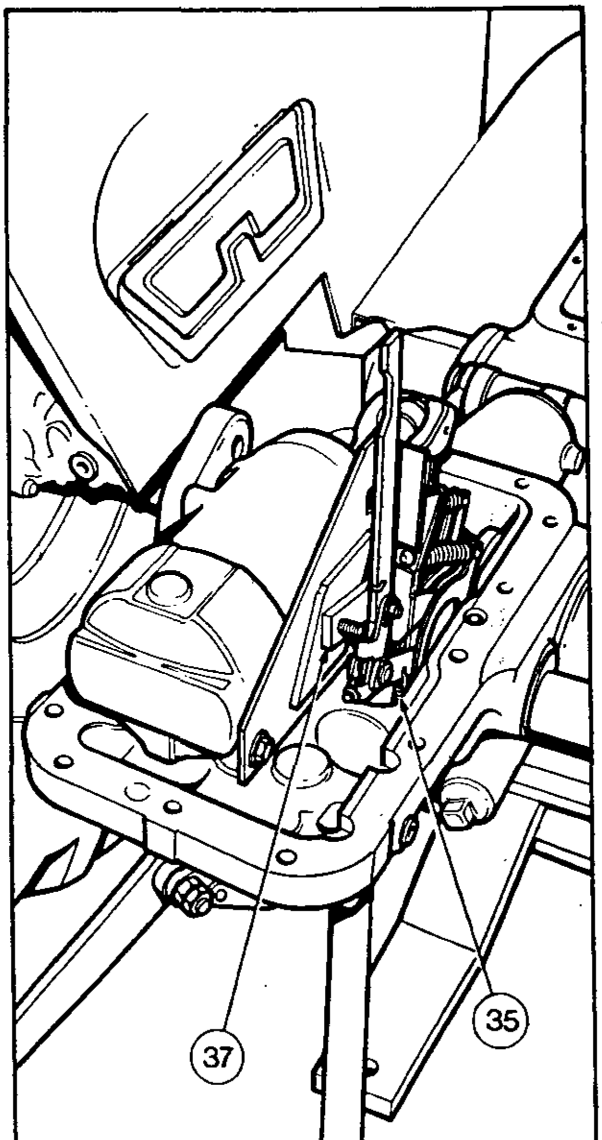

FIG. 14

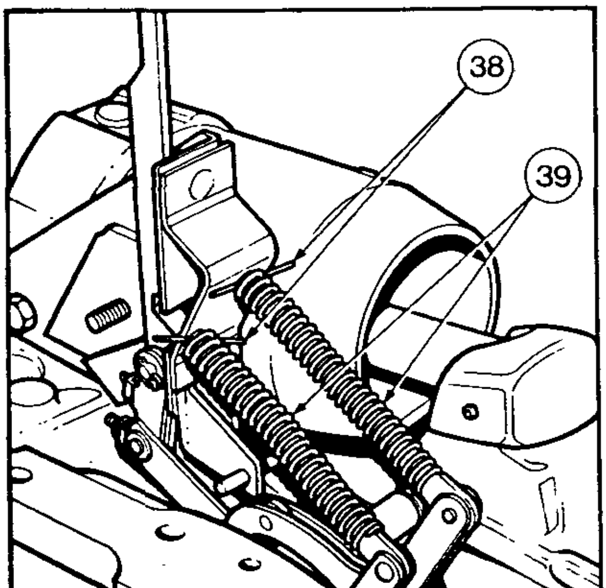

FIG. 15

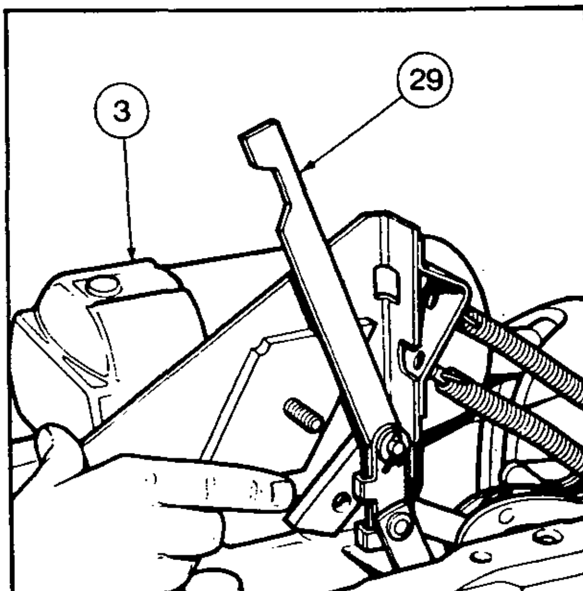

FIG. 16

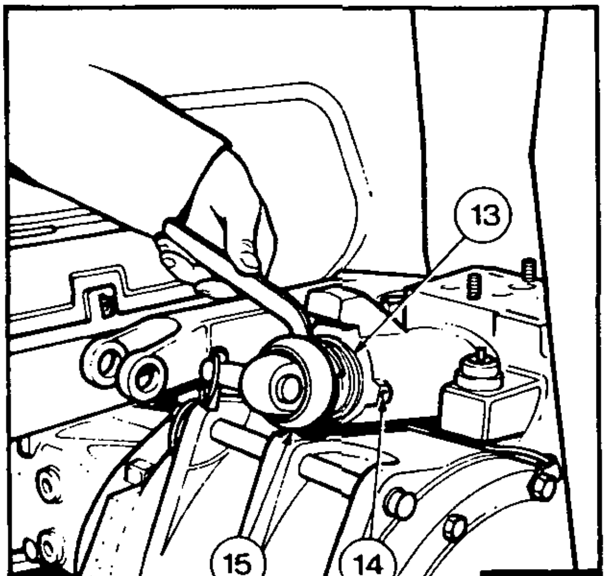

FIG. 2

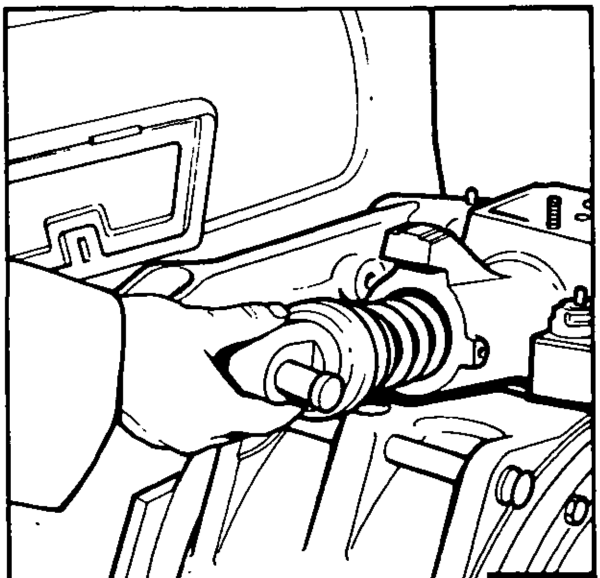

FIG. 3

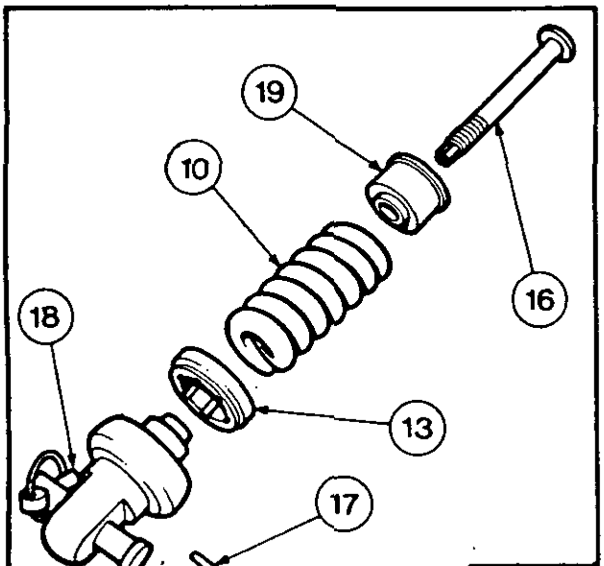

FIG. 4

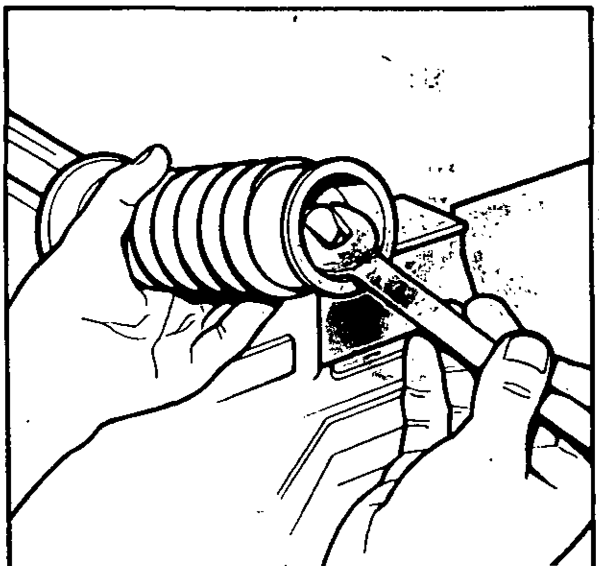

FIG. 5

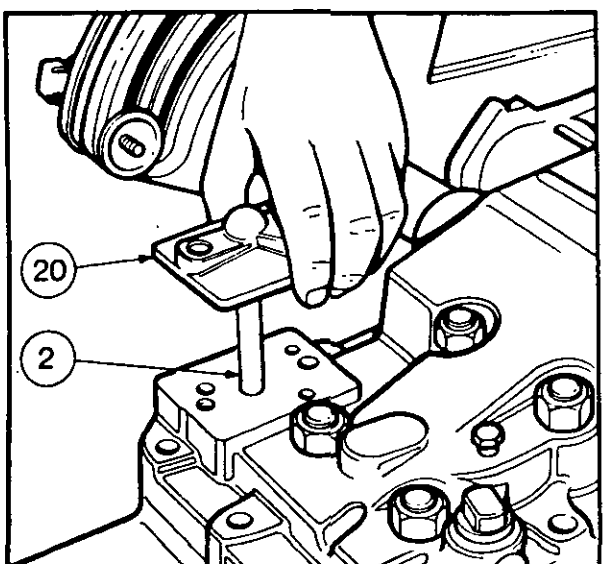

FIG. 6

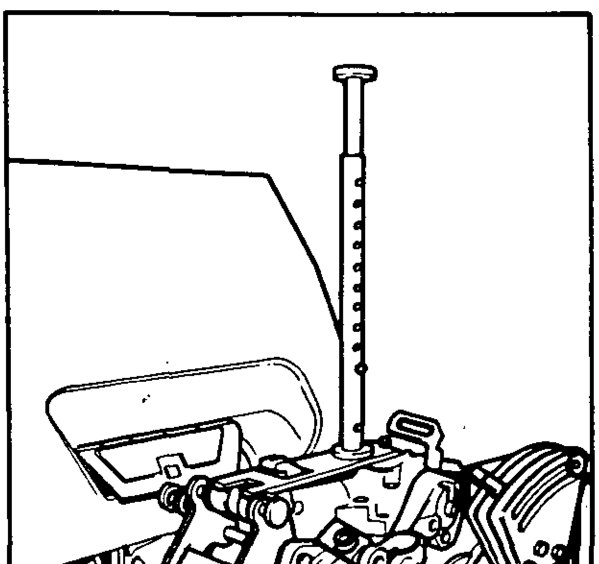

FIG. 7

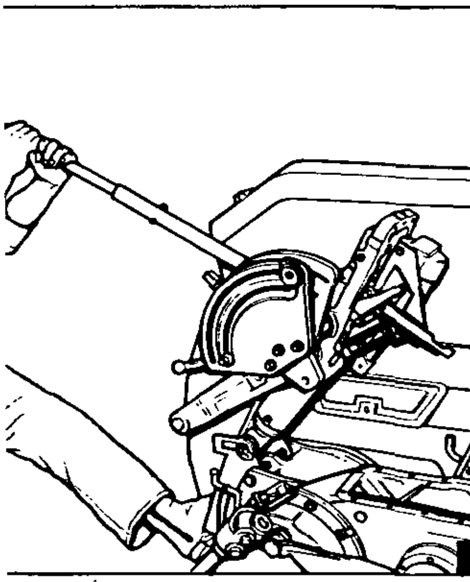

FIG. 8

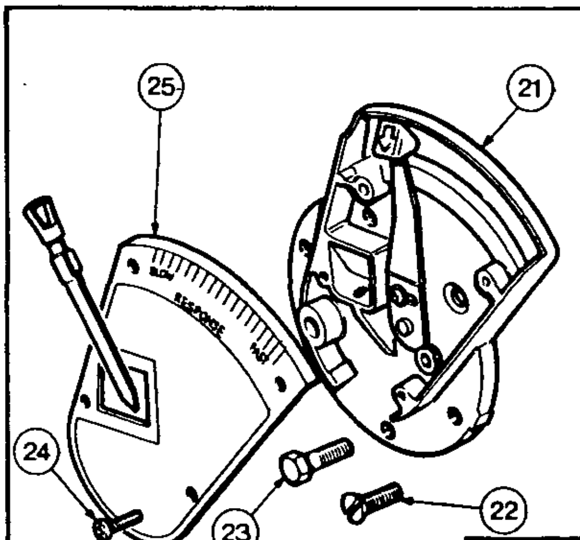

FIG. 9

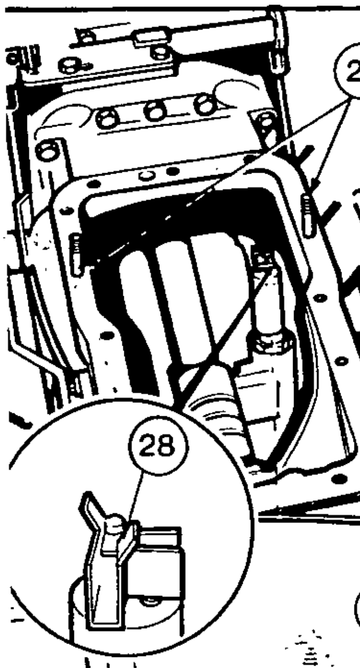

FIG. 10

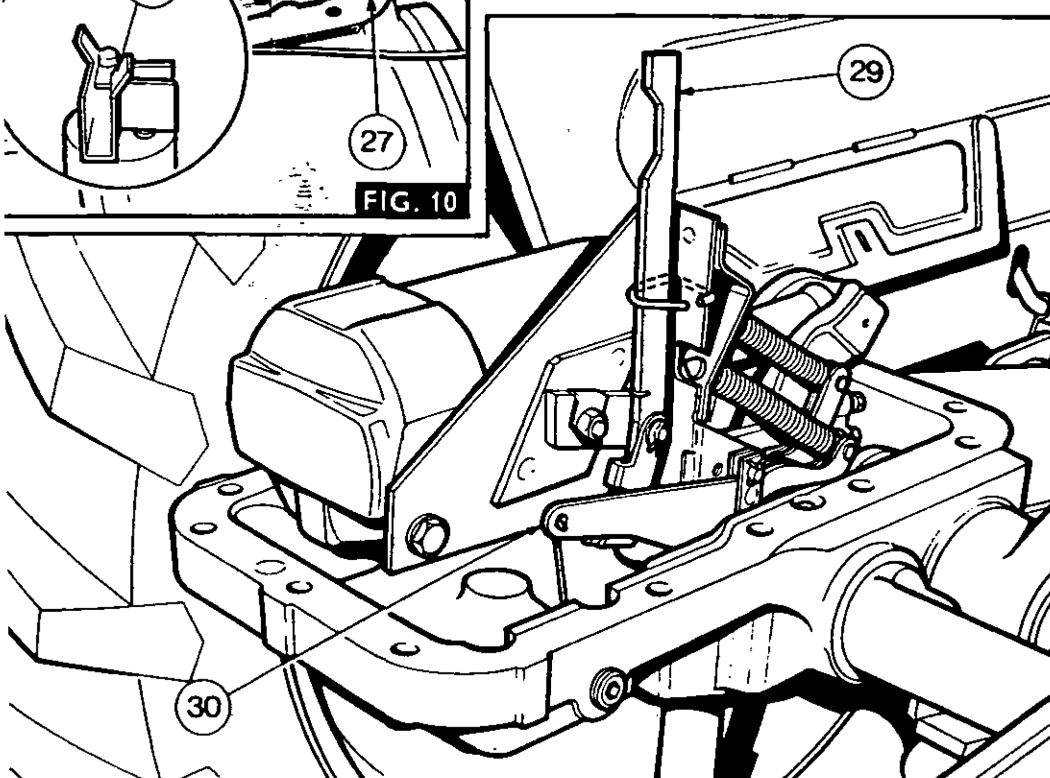

FIG. 11

1. Fig. 10. Fit the two guide studs (26) to the centre housing, as shown.
2. Fit a new lift cover gasket (27).
3. Position the Pressure Control adjuster assembly (28), as shown.
4. Place the lift arms in the down position.
5. Fig. 11. Using suitable pieces of wire retain the vertical lever (29) and the Pressure Control link (30), as shown.
6. Fig. 8. Taking care not to damage any parts, manoeuvre the lift cover assembly into position, over the guide studs, onto the centre housing, ensuring that the Pressure Control link locates in the Pressure Control adjuster assembly.
7. Remove the two guide studs, MF 226A, MF 226A—3 and the two pieces of wire retaining the vertical lever and Pressure Control link.
8. Fig. 6. Carefully locate the standpipe (2) through the lift cover and into the bore in the hydraulic pump.
9. Refit the standpipe cap (20) and secure it with the two bolts and spring washers.
10. Secure the lift cover and the parking brake ('5' line tractors only) to the centre housing and tighten the bolts to a torque of 9 kg m (65 lbf ft).
11. Refit the control beam.
12. Secure the lift rods to the lift arms.
13. Refit the Auto-Hitch (if fitted) to the lift arms.
14. Carry out the internal adjustments, as stated in operation 7A—10—46.
15. Refit the seat.

HYDRAULIC LIFT COVER

Servicing 7A—04—41

Special tools required:— See operation 7A—03—38.

Figs. 12 to 22

Disassembly

1. Remove the lift cover as stated in operation 7A—03—38.
2. Fig. 13. Remove the split pin (31) and the washer retaining the Pressure Control link (30), and remove the link.
3. Release the tabwasher, then remove the nut (33), tabwasher and spacer (32) on the slide pivot (37).
4. Release the spring (34) on the vertical lever (29).
5. Fig. 14. Remove the Position Control spring (35).
6. Release the slide pivot (37) from the bolt.
7. Fig. 15. Fit a pair of pins (38) to retain the springs (39) on their rods.
8. Fig. 16. Remove the four nuts securing the ram cylinder (3) to the lift cover, then lift off the ram cylinder, taking care not to damage the vertical lever (29).
9. Fig. 17. Remove the connecting rod (4) and the Allen screw (40).
10. Using a No. 10 32 UNF×11 mm ($\frac{7}{16}$ in) bolt remove the pin (41), securing the quadrant support (42) to the lift cover, as shown.
11. Fig. 18. Withdraw the quadrant support (42) and the Belleville spring (43) and shim, simultaneously lifting out the vertical lever (29) and the cams (44 and 45).
12. Fig. 19. Remove the Allen plug (46) in the left hand side of the lift cover, then remove the linkage pivot shaft retaining screw (47).
13. Fig. 20. Withdraw the linkage pivot shaft (48) as shown, then lift out the links (49 and 50).
14. Fig. 12. Remove the bolt (51) and tabwasher, then slide off the right hand lift arm (52).
15. Figs. 12 and 21. Drive the lift shaft (7) and the remaining lift arm (53) out of the lift cover, then remove the ram arm (6). Remove the 'O' rings (54).

Reassembly

1. Fig. 12. Place the ram arm (6) in the lift cover, then slide the lift shaft (7), complete with a new 'O' ring (54) into the lift cover and through the ram arm (6), aligning the master splines.
2. Refit the right hand lift arm (52), plus a new 'O' ring (54) aligning the master spline.
3. Refit the bolt (51) and the tabwasher.
4. Fig. 20. Place the Position Control link (50) and the Draft Control link (49) in position, then slide in the linkage pivot shaft (48).
5. Fig. 18. Refit the vertical lever (29) and the cams (44 and 45), simultaneously sliding the quadrant support (42), complete with the shim and the Belleville spring (43)—concave towards the lift cover, into position.
6. Fig. 22. Secure the quadrant support (42) to the lift cover by compressing the Belleville spring and driving in the pin (41).
7. Fig. 19. Ensuring that the linkage pivot shaft (48) is fully located against the side of the lift cover, retighten the Allen screw (47), then refit the plug (46) to the left hand side of the lift cover.
8. Degrease the threads of the Allen screw (40) and the threads in the ram arm (6), then locate the connecting rod (4) in its socket.
9. Apply one drop of Loctite 270 'Stud Lock' to the threads of the Allen screw (40). Screw the Allen screw into the ram arm until it bottoms on the annular groove in the connecting rod, then back it off ¼ turn.
10. Fit a new 'O' ring (55) to the ram cylinder feed port.
11. Fig. 16. Refit the ram cylinder and support bracket assembly to the lift cover, relocating the connecting rod in the piston and the two rods in the holes in the support bracket.
12. Refit the four ram cylinder securing nuts and tighten them to a torque of 16 kg m (120 lbf ft).
13. Fig. 15. Remove the guide rod spring retaining pins (38).
14. Fig. 14. Refit the position Control spring (35).
15. Fig. 13. Locate the spring (34) on the vertical lever (29) and on the slide pivot (37).
16. Fig. 12. Locate the slide pivot (37) on the bolt, then refit the spacer (32), tab washer and the nut (33).
17. Refit the Pressure Control link (30) and secure it with the washer and the split pin (31).
18. Refit the lift cover as stated in operation 7A—03—38.

RAM CYLINDER

Servicing 7A—05—42

Special tools required:— See operation 7A—03—38.

Figs. 12 to 16

Disassembly

1. Remove the ram cylinder, as stated in items 1 to 8 of operation 7A—04—41.
2. Fig. 12. Remove the bolts (56) securing the support bracket (57) to the ram cylinder (3).
3. Withdraw the piston (5) from the ram cylinder, then if necessary, remove the piston rings (58).

Examine all components for wear, or damage, replacing any defective components. Details of dimensions and tolerances of the ram cylinder are given in the specification.

Reassembly

1. If necessary, fit the piston rings (58) to the piston (5).
2. Refit the piston to the ram cylinder (3).
3. Bolt the support bracket (57) to ram cylinder (3) with the bolts (56).
4. Refit the ram cylinder, as stated in items 10 to 18 of operation 7A—04—41.

HYDRAULIC LINKAGE

Removal and Refitment 7A—06—42

Special tools required:— See operation 7A—03—38.

Figs 12 to 20 and 22.

Removal

1. Remove the linkage as stated in items 1 to 8, and 10 to 13 of operation 7A—04—41.

Refitment

1. Refit the linkage, as stated in items 4 to 7, and 10 to 18 of operation 7A—04—41.

QUADRANT AND SUPPORT ASSEMBLY

Removal and Refitment 7A—07—42

Special tools required:— See operation 7A—03—38.

Figs. 12 to 18 and 22.

Removal

1. Remove the quadrant and support assembly as stated in items 1 to 8, 10 and 11 of operation 7A—04—41.

Refitment

1. Refit the quadrant and support assembly, as stated in items 5 to 7 and 10 to 18 of operation 7A—04—41.

QUADRANT AND SUPPORT ASSEMBLY

Servicing 7A—08—42

Special tools required:— See operation 7A—03—38.

Fig. 23.

Disassembly

1. Remove the quadrant and support assembly, as stated in operation 7A—07—42.
2. *Fig. 23.* Remove the two bolts (59) and washers securing the outer quadrant (61).
3. Remove the nut (60) securing the lever (64) to the Draft Control shaft (67), and remove the outer quadrant, complete with the lever.
4. Remove the two spacer bolts (74) securing the inner quadrant (66) to the support (42).
5. Drive out the pin (68), and remove the inner quadrant (66), complete with the lever (65).
6. If necessary, remove the levers (64 and 65) and the stop knobs (63) from the quadrants.
7. Withdraw the Draft Control shaft (67) from the support (42).
8. Remove the circlip (70), and withdraw the Position Control shaft (71) from the support.
9. Remove the 'O' rings (72) and the bush (69).

Reassembly

1. Fit new 'O' rings (72) to the shafts and the support.
2. Slide the Position Control shaft (71) into the support (42) and refit the circlip (70).
3. Fit the bush (69) into the Pressure Control shaft, then slide the Draft Control shaft (67) into the Pressure Control shaft.
4. If necessary, refit the levers (64 and 65) and the stop knobs (63) to the quadrants. Assemble the friction washers, as shown, in the following order:— steel washer (75), polyurethane washer (76), with the shiny side against the quadrant (61 and 66), nylon washer (77), steel washer (75), and then tighten the screw (62), to give a clearance of approximately 20 mm (0.75 in) between the screw head and the steel washer.
5. Refit the inner quadrant (66), locating the lever on its shaft (71), and secure the quadrant to the support with the two spacer bolts (74).
6. Fit a new pin (68), as shown.
7. Refit the outer quadrant (61), locating the lever (64) on its shaft (67) and secure the quadrant with two bolts (59) and washers.
8. Secure the Draft Control lever (64) to its shaft (67) with the nut (60). Do not overtighten the nut (60) as the pin (68) will shear and the roller (73) will not turn freely.
9. Refit the quadrant and support assembly, as stated in operation 7A—07—42.

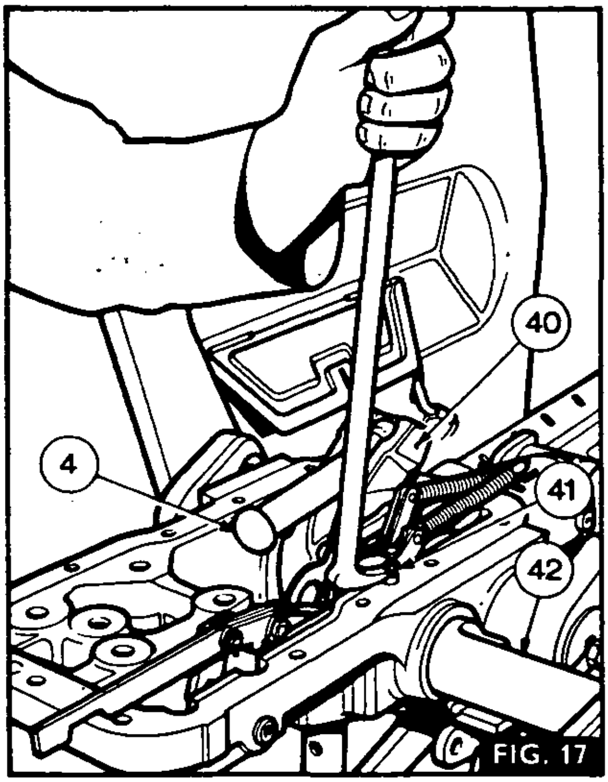

FIG. 17

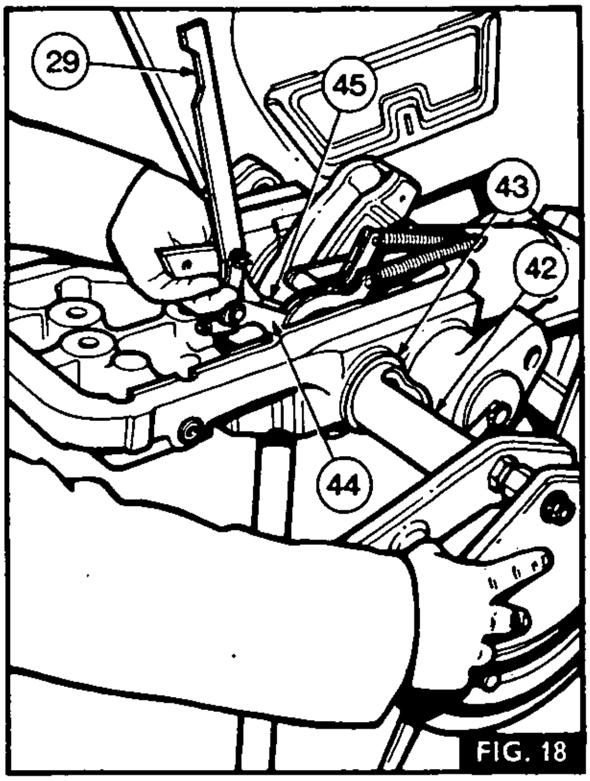

FIG. 18

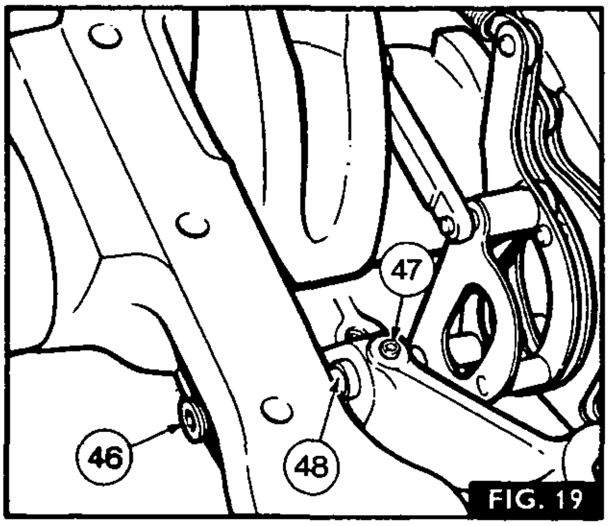

FIG. 19

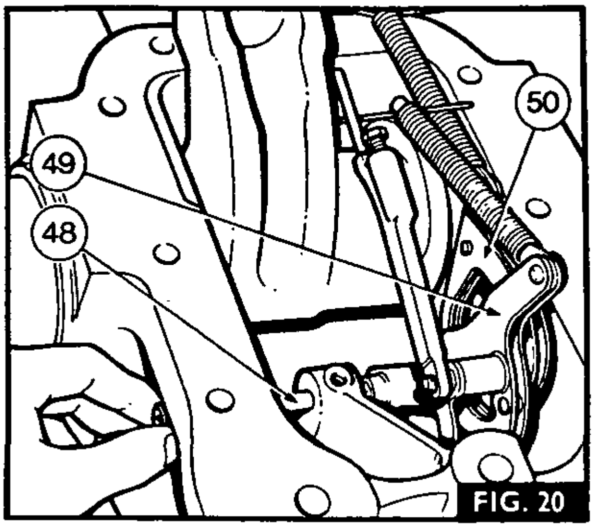

FIG. 20

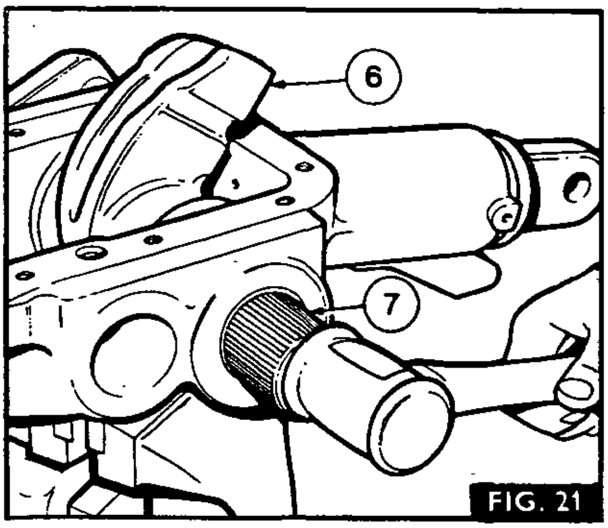

FIG. 21

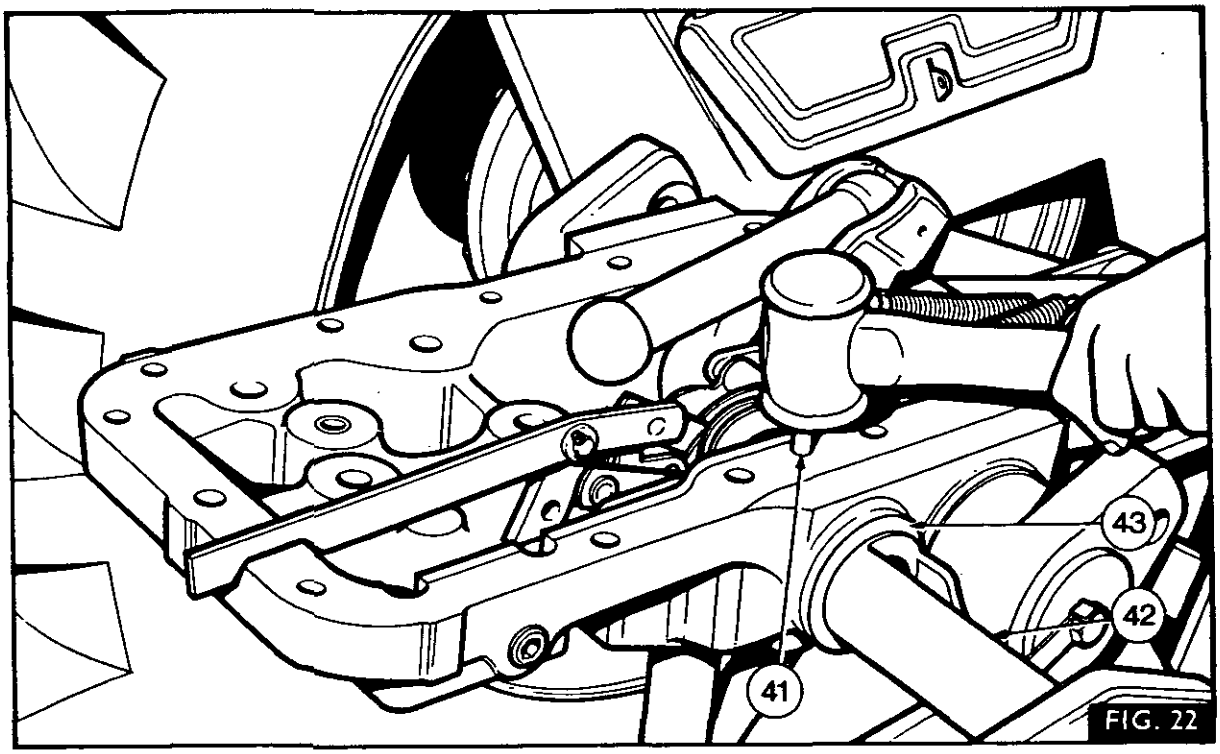
43
42
41

FIG. 22

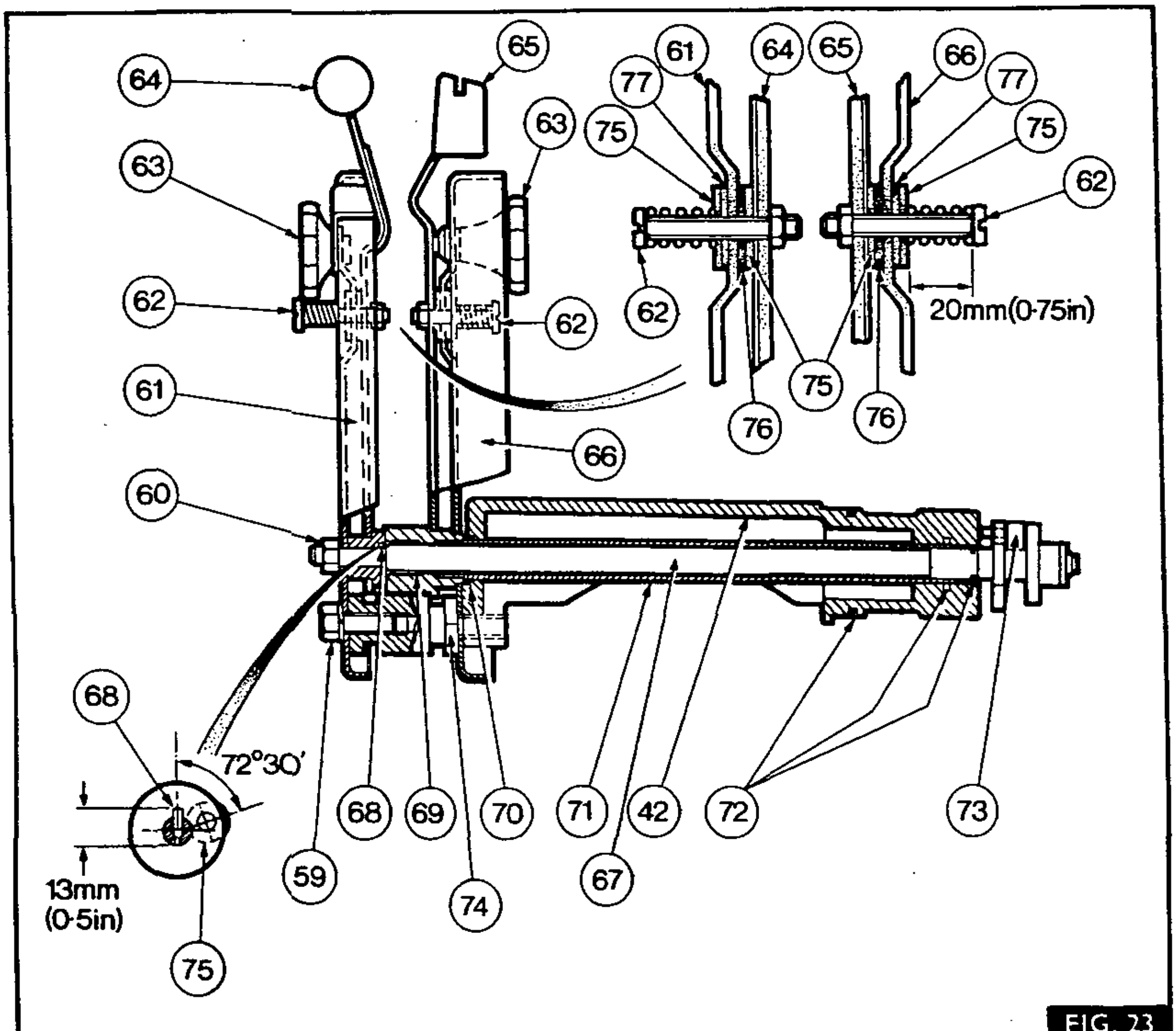
64
65
63
61
77
75
64
65
66
77
75
62
63
62
62
62
20mm(0·75in)
75
61
76
76
66
60
68
72°30′
13mm
(0·5in)
75
68
69
70
71
42
72
73
59
74
67

FIG. 23

HYDRAULIC ADJUSTMENTS

External Adjustments 7A—09—45

Special tools required:— See operation 7A—03—38

Figs. 12 and 23 to 29

Procedure:—

1. Remove the lift cover, as stated in operation 7A—03—38

Control Spring Internal and External End Float

1. Fig. 24. Remove the Allen screw (14).
2. Pull back the rubber boot (15).
3. Using MF 163, unscrew the retainer (13) from the lift cover.
4. Withdraw the control spring assembly from the lift cover.
5. Remove the nylon plug.
6. Fig. 25. Drive out the pin (17) and screw the plunger (16) into the head (18) until all the end float is eliminated and the spring (10) is tight to turn, by hand.
7. Fit a new securing pin (17).
8. Slide the control spring assembly into the lift cover.
9. Fig. 24. Place the Draft Control lever in the fully DOWN position, and using a suitable wedge (36), ensure that the draft rod (79) is not touching the control spring plunger.
10. Tighten the retainer (13) using MF 163 until all the end float is eliminated. Do not over-tighten the retainer, otherwise the end float will reappear.
11. Refit the rubber boot (15).
12. Fit a new nylon plug, then refit and tighten the Allen screw (14) to a torque of 0,7 kg m (5 lbf ft).
13. Remove the wedge (36).

Lift Arm End Float

1. Fig. 12. Release the tabwasher securing the bolt in the left hand arm (53), then slacken the bolt (51).
2. Fully tighten the right hand lift arm retaining bolt and secure with the tabwasher.
3. Tighten the left hand retaining bolt (51) until the lift arms will move freely throughout their range, but without any end float.
4. Secure the bolt with the tabwasher.

Quadrant Location

1. Fig. 23. Slacken the two bolts (59) and the spacer bolts (74) securing the quadrants to the support.
2. Locate the inner quadrant (66) in the centre of the elongated holes and secure it with the two spacer bolts (74), then locate the outer quadrant (61) in the centre of the elongated holes and secure it with the two bolts (59).

Draft Control Rod

1. Place the Draft Control lever in the fully UP position.
2. Fig. 26. Using MF 333, adjust the setscrew on the Draft Control rod (79) to give a clearance of 5,8 mm (0·230 in) between the setscrew head and the lift cover casting, as shown.

Draft Control

1. Fig. 27. Slacken the locknut and unscrew the Allen screw (78), on the vertical lever (29), to the end of the thread.
2. Release the tabwasher and slacken the nut (33) on the vertical lever slide pivot (37).
3. Place the Draft Control lever between the sector marks on the quadrant.
4. Place the Position Control lever in the TRANSPORT position.
5. Position MF 273 (A) on the lift cover and apply a load of 1,4 kg (3 lb) to the end of the vertical lever as shown.
6. Locate MF 356 (B) on the lift cover as shown.
7. Adjust the vertical lever slide pivot (37) until the vertical lever (29) just contacts the pin on MF 356.
8. Tighten the slide pivot nut (33), recheck the vertical lever (29) position and secure the nut with the tabwasher.

Position Control

1. Place the Draft Control lever in the fully UP position.
2. Place the Position Control lever in the TRANSPORT position.
3. Fig. 28. Position MF 272 (C) onto the lift cover as shown, then locate the ram arm onto the tool.
4. Position MF 273 (A) on the lift cover and apply a load of 1,4 kg (3 lb) to the end of the vertical lever as shown.
5. Locate MF 356 (B) on the lift cover as shown.
6. Adjust the Allen screw (78) on the vertical lever (29) until the vertical lever just contacts the pin on MF 356.
7. Tighten the locknut and check the position of the vertical lever.

Pressure Control

1. Fig. 29. Set the Pressure Control adjuster (28) so that the adjusting screw (30) is in the middle of its travel.
2. Set the diaphragm adjusting setscrew (81) to an initial setting of 14 mm ($\frac{9}{16}$ in), taken between the lever and the outside head of the setscrew, as shown.
3. Refit the lift cover, as stated in operation 7A—03—38.

HYDRAULIC ADJUSTMENTS

Internal Adjustments 7A—10—46

Special tools required:— MF 148A Pressure Test Kit.
MF 166 Adapter.
MF 357 Screwdriver Adjuster.
MF 359 Pressure Control Bleed Pipe.
Rule.

Figs. 29 and 30 to 34

Preparation for Internal Adjustments

1. Attach a weight of 400 kg (900 lb) to the lower links.
2. Place the Draft Control lever in the fully DOWN position.
3. Connect the pressure test kit MF 148A and adapter MF 166 to the tapped port in the lift cover.
4. Remove the side cover as stated in items 11 to 13 of operation 7A—03—38, then locate MF 359 in the orifice in the Pressure Control valve body (as shown in Fig.31) and place the other end in the side cover aperture, so that the oil is returned to sump.
5. Place the Draft Control lever in the fully UP position.
6. Start the engine and set the engine speed at 'tick-over', then operate the Position Control lever through the quadrant range to expel all the air from the system.
   Warm up the oil in the transmission to a temperature of 50 to 70°c (120 to 169° F).

Pressure Control Maximum Setting

1. Place the Draft Control lever in the fully DOWN position.
2. Fig. 30. Remove the rear bolt from the stand pipe cap and fit MF 357.
3. Place the Draft Control lever in the fully UP position.
4. Place the Position Control lever in the CONSTANT PUMPING position.
5. Start the engine and set the engine speed at 1200 rev/min.
6. Using MF 357 adjust the Pressure Control adjusting screw (80, Fig. 29) to give:—
   MF 148 Tractor— 179 kg/cm² (2550 lbf/in²)
   MF 165, 168, 185 and 188 Tractors— 211 kg/cm² (3000 lbf/in²)
7. Fully lower the links and stop the engine, then remove MF 357 and refit the existing bolt.

Pressure Control Final Adjustment

1. Fig. 31. Remove the tube, of MF 359, from the side cover aperture and place it in a five litre (one gallon) container.
2. Start the engine and set the engine speed at 1200 rev/min.
3. Place the Draft Control lever in the fully UP position.
4. Place the Position Control lever in the CONSTANT PUMPING position.

**5. Adjust the diaphragm setscrew (81, Fig. 29) until a flow of 5 litre/40s (1 Imp. gal/35s) is obtained.

6. Stop the engine, and place the tube, of MF 359, in the side cover aperture, so that the oil is returned to sump.

NOTE—THE FOLLOWING METHOD CAN BE USED AS AN ALTERNATIVE, BUT IT MUST BE EMPHASISED THAT IT IS AN APPROXIMATE SETTING AND THE FIRST METHOD SHOULD BE CARRIED OUT AS SOON AS THE OPPORTUNITY ARISES.

1. Start the engine and set the engine speed at 1200 rev/min.
2. Place the Draft Control lever in the fully UP position.
3. Place the Position Control lever in the CONSTANT PUMPING position.
4. *Fig. 29. Screw the diaphragm setscrew (81)* in until the needle on the gauge begins to fluctuate.

**5. Screw the setscrew out until the fluctuations cease, then unscrew a further EIGHT flats.

6. Stop the engine.

Position Control Setting

1. Place the Draft Control lever in the fully UP position.
2. Place the *Position Control lever* in the CONSTANT PUMPING position.
3. Start the engine and set the engine speed at 1200 rev/min.
4. Fig. 32. When the links are fully raised, scribe a line (A) across the top cover casting and the lift arm.
5. Place the Position Control lever in the TRANSPORT position.
6. The links should drop until the scribe lines are 1,6 to 4,7 mm ($\frac{1}{16}$ to $\frac{3}{16}$ in) apart.
7. If the distance is incorrect, slacken the bolts (59) and spacer bolts (74) securing the quadrants and rotate the inner quadrant (66) and lever until the setting is correct.
8. Tighten the quadrant spacer bolts (74) and recheck the setting.

Draft Control Setting

1. Place the Position Control lever in the TRANSPORT position.
2. Start the engine, and set the engine speed at 1200 rev/min.
3. Using the Draft Control lever set the lower links in the horizontal position.
4. Fig. 33. The Draft Control lever should be in the sector marks on the quadrant, if not, slacken the bolts (59) securing the outer quadrant (61) and rotate the quadrant until the links remain stationary in the horizontal position with the lever in the sector marks.
5. Tighten the quadrant bolts (59) and recheck the setting.
6. Stop the engine and fully lower the links, then remove MF 359, MF 148A and MF 166.

Response Control

1. Fig. 34. Refit the Response Control side cover (21), with a new gasket and secure it with the five bolts (23) and the screw (22).
2. Release the locking screw (82) and place the Response Control lever (83), 6 mm ($\frac{1}{4}$ in) from the SLOW position.
3. Rotate the inner adjusting lever (84), until the cam just contacts the Response Control lever on the pump, and tighten the screw (82).
4. Refit the Response Control cover plate and secure it with the four screws.
5. Add approved oil to the transmission until the required level is reached.

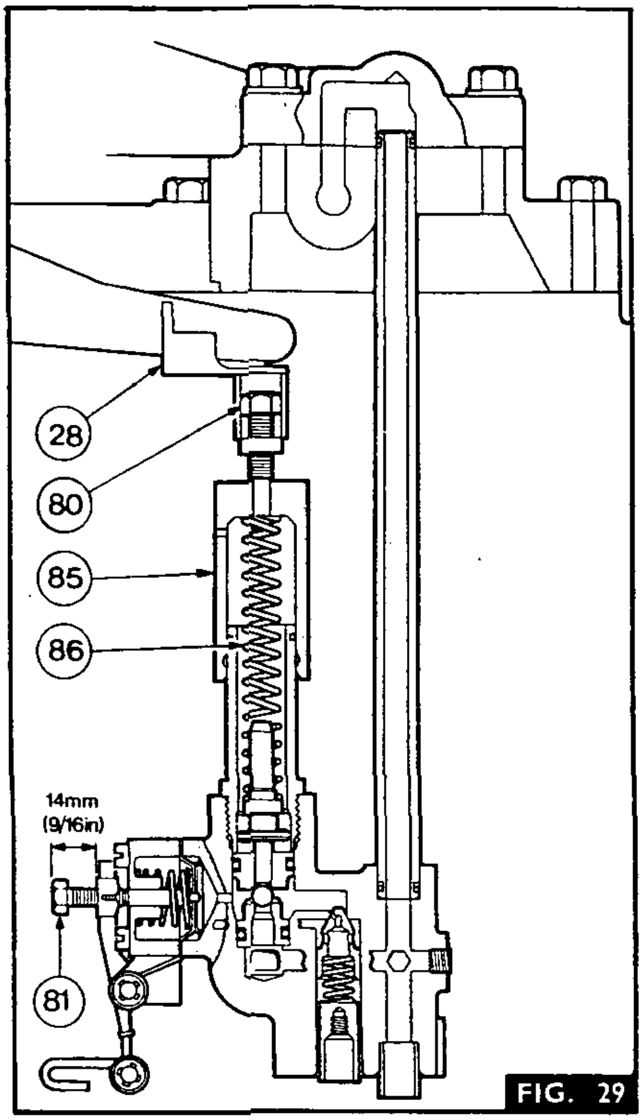

FIG. 29

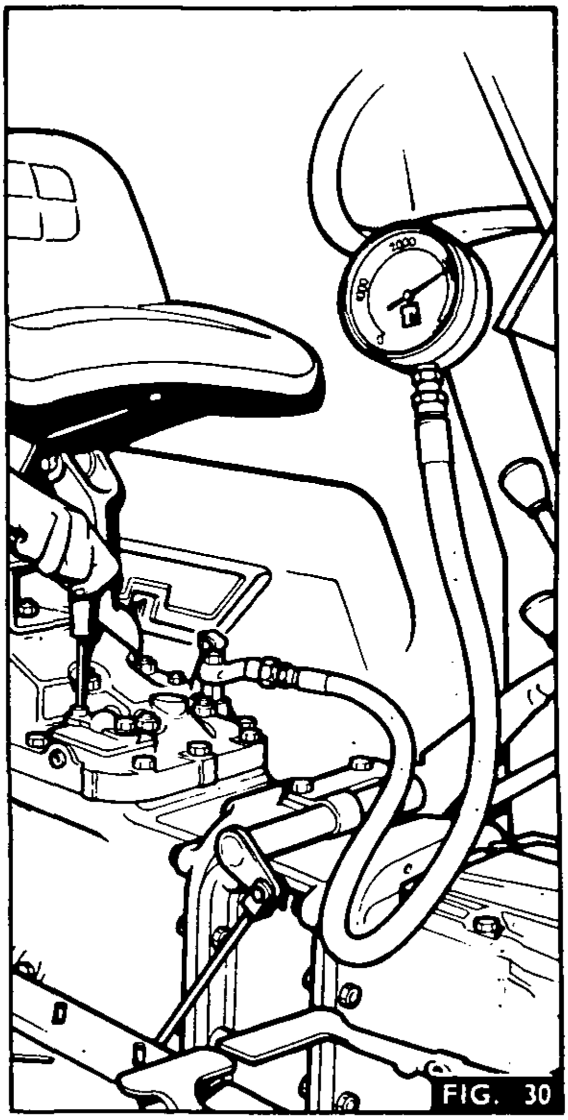
FIG. 30

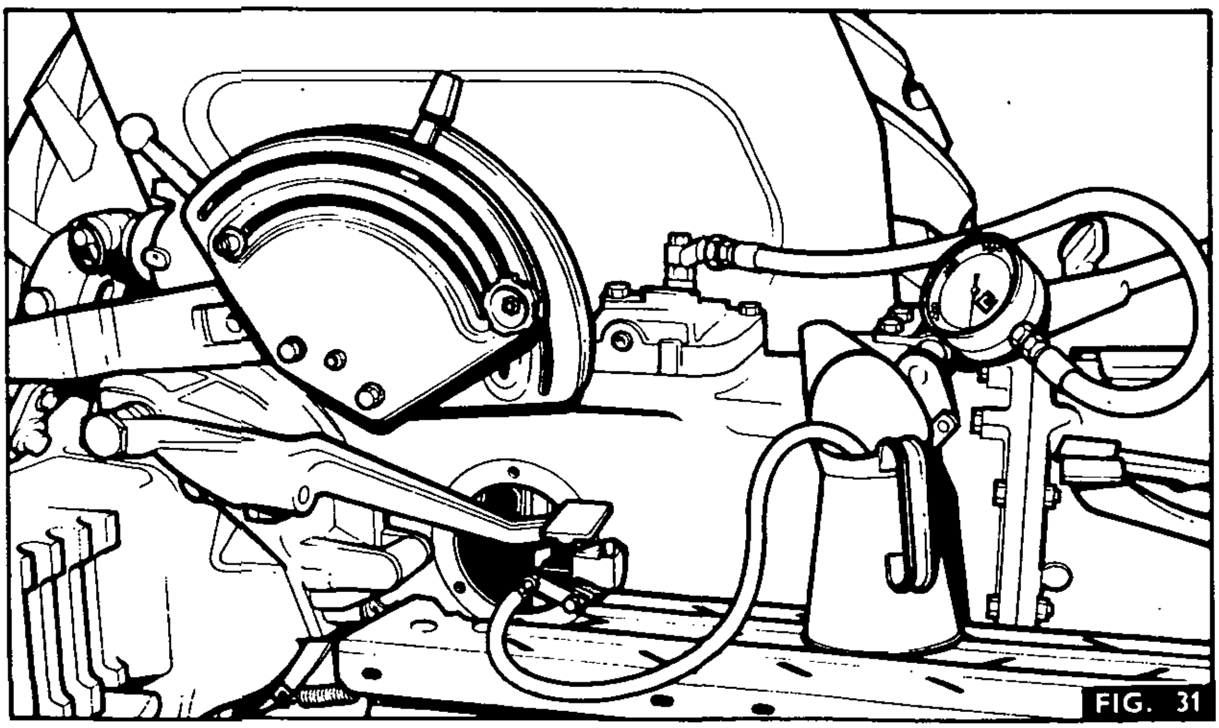
FIG. 31

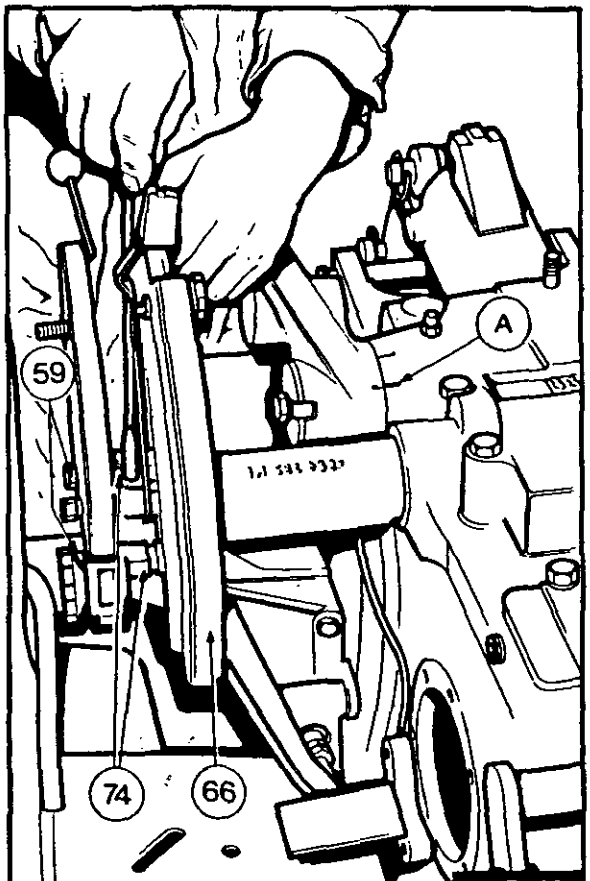

FIG. 32

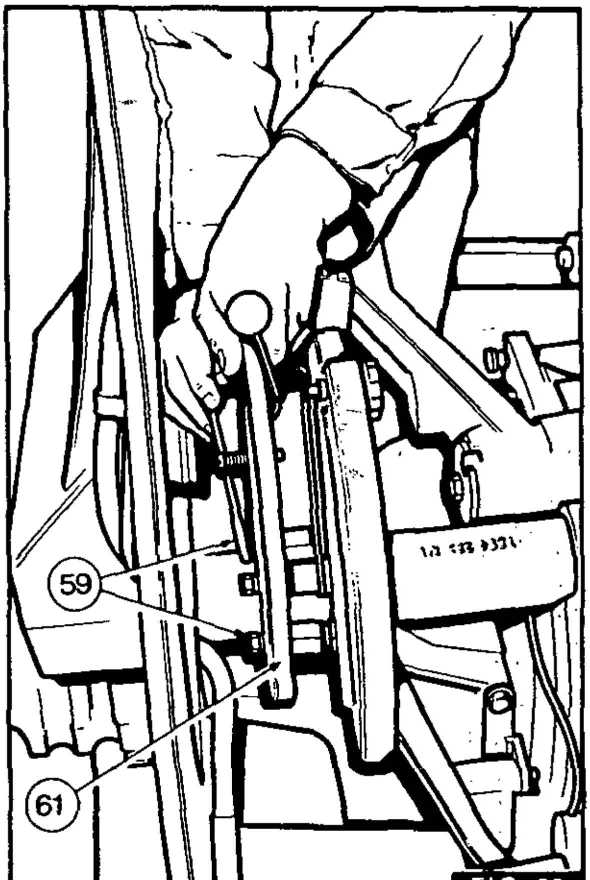

FIG. 33

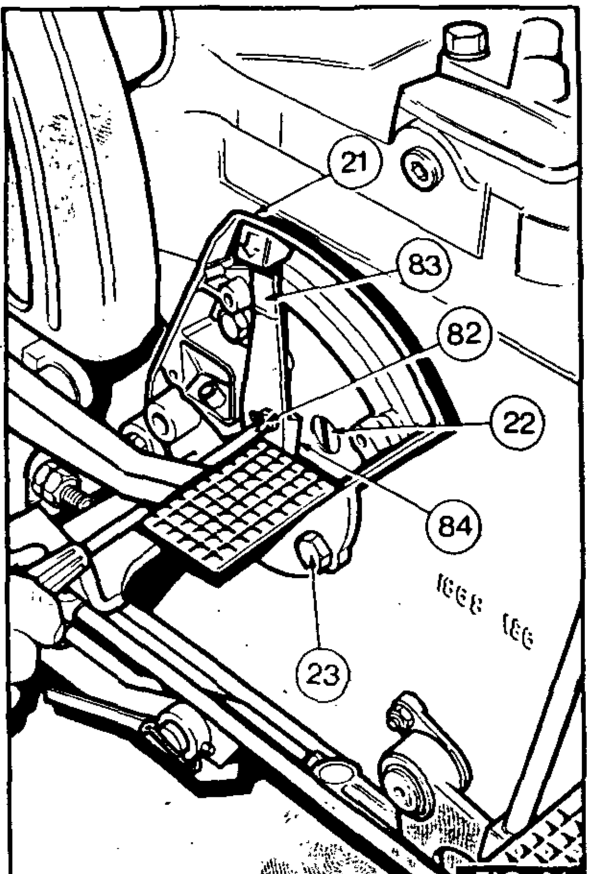

FIG. 34

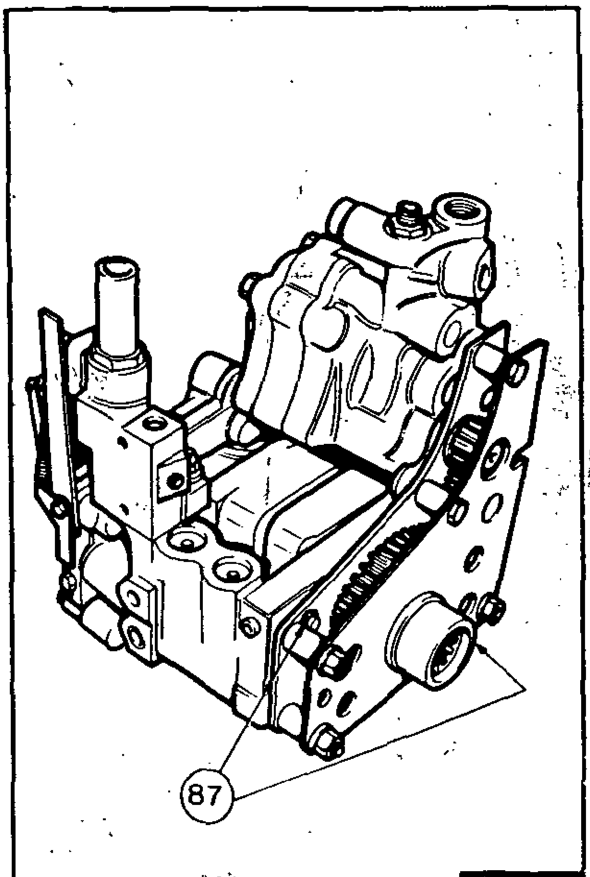

FIG. 35

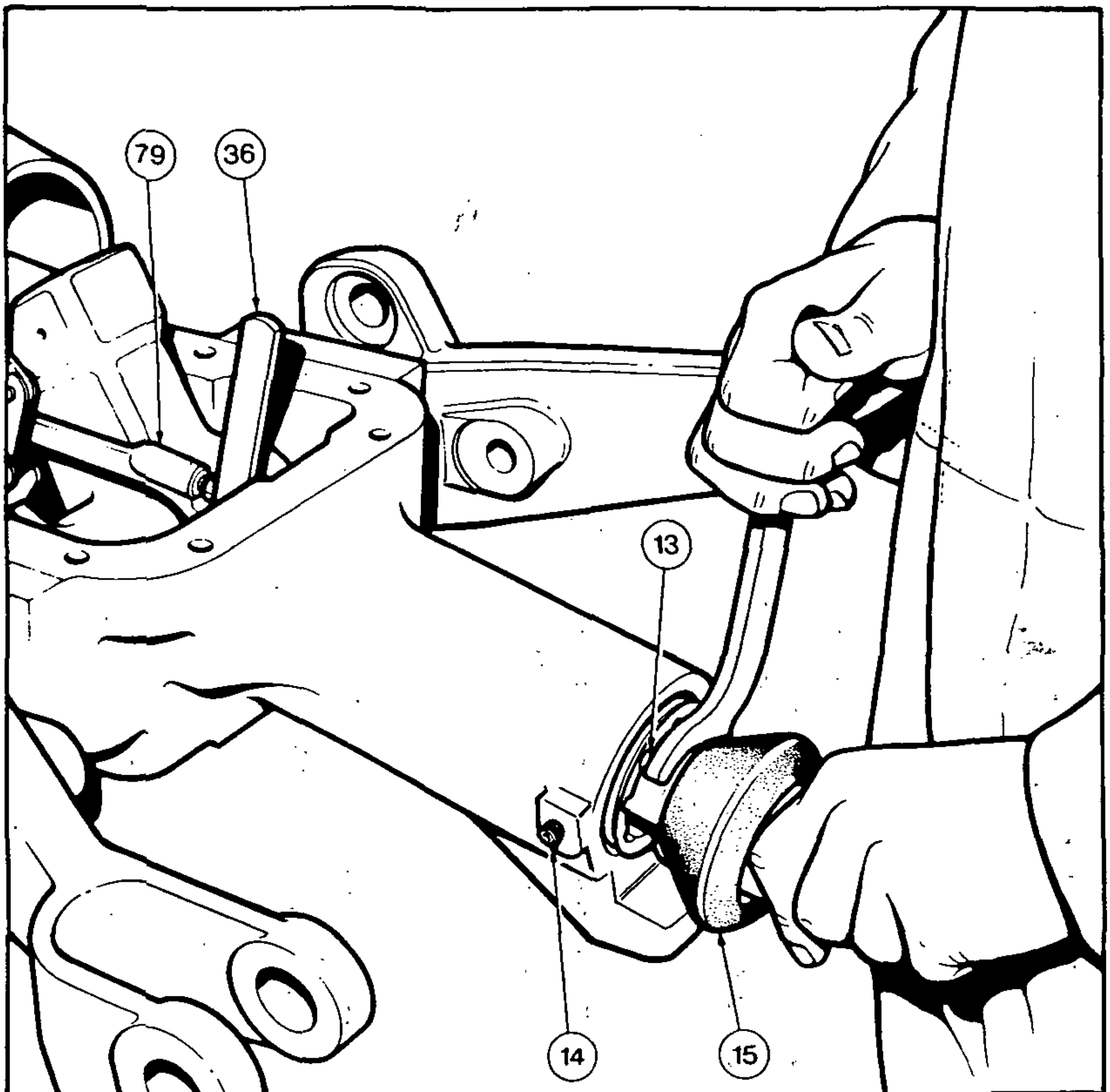

FIG. 24

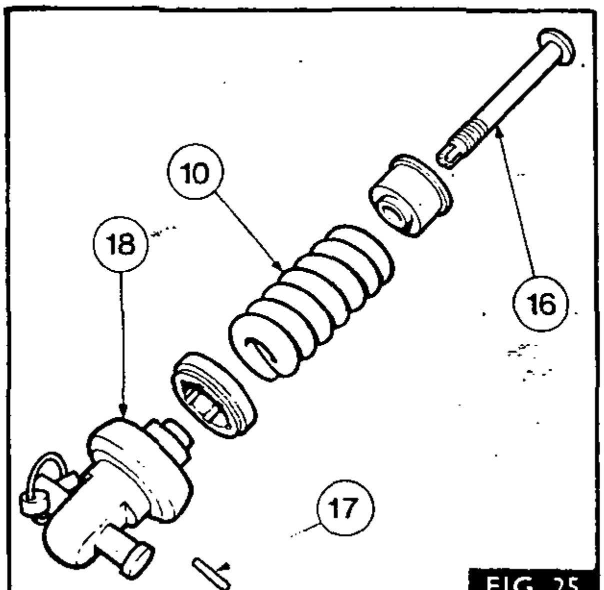

FIG. 25

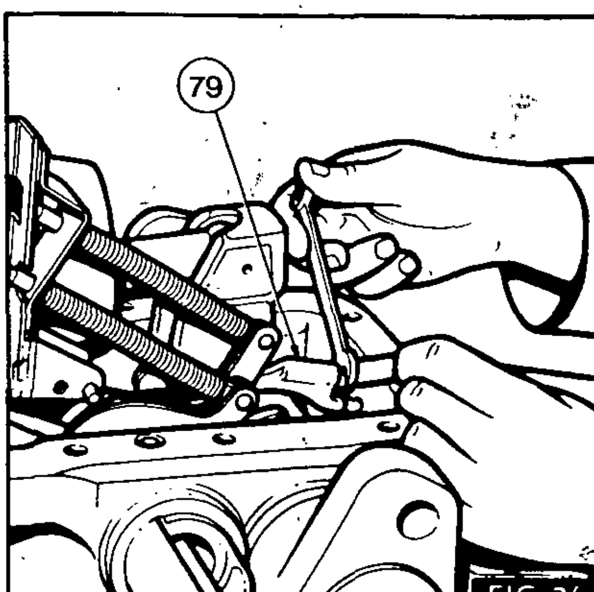

FIG. 26

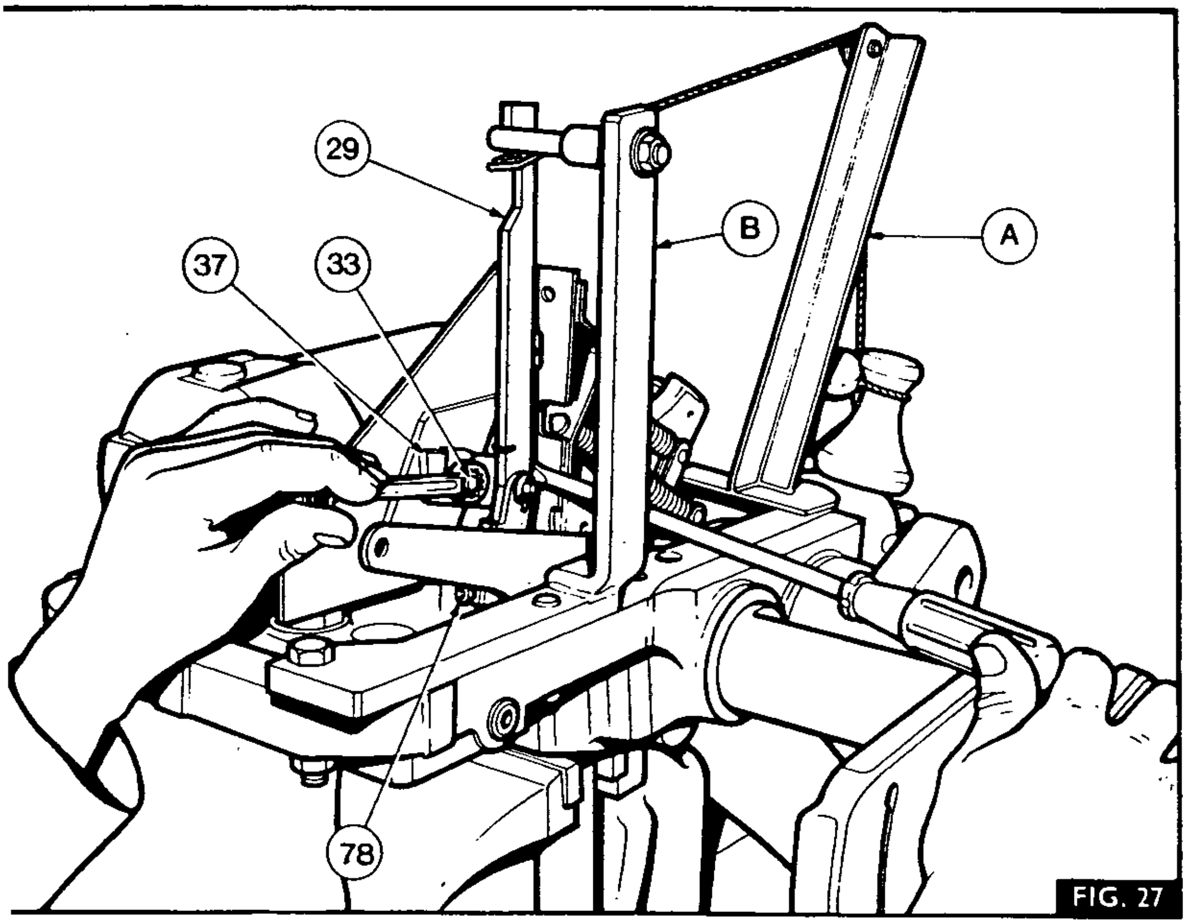

FIG. 27

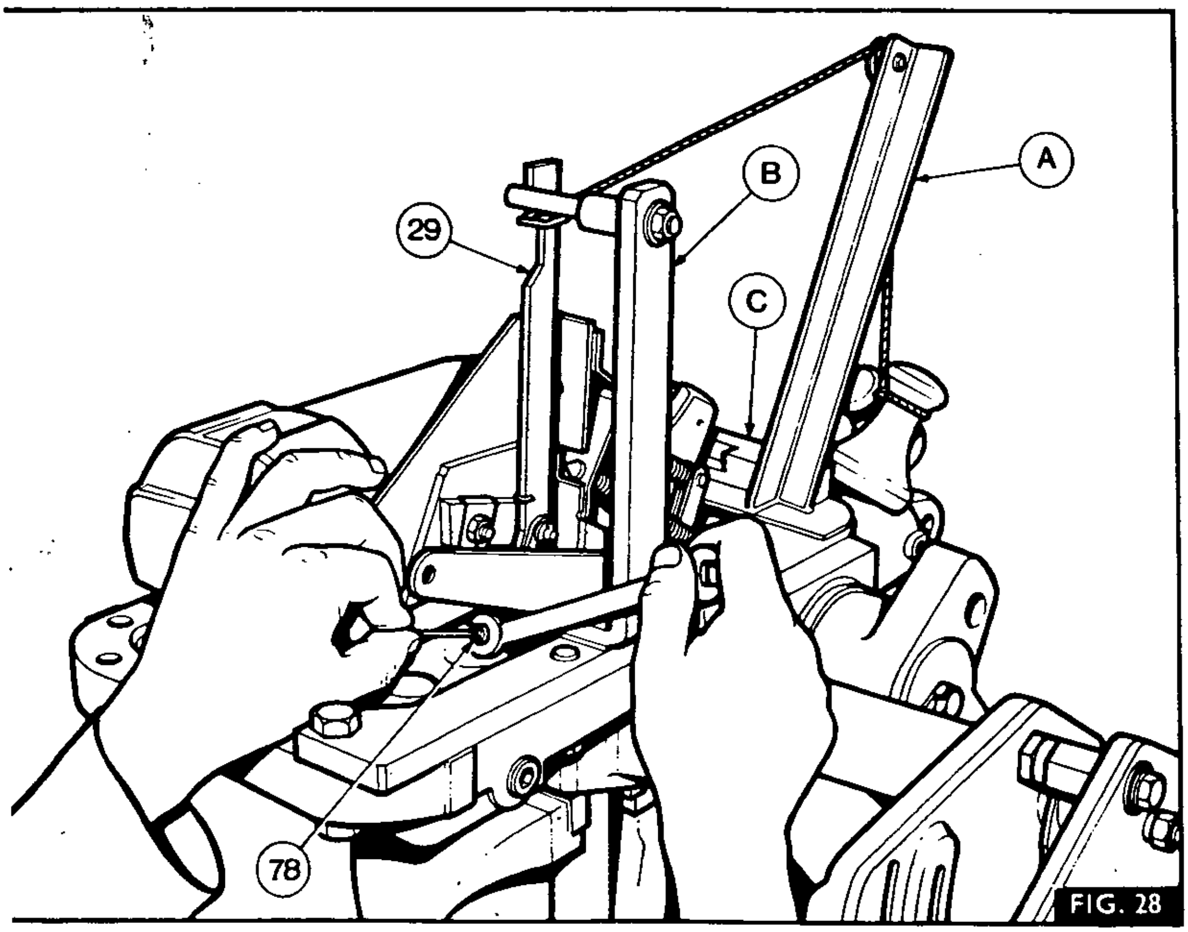

FIG. 28

HYDRAULIC PUMP

Removal and Refitment 7A—11—49

Special tools required:— See operation 7A—03—38

Fig. 29 and 35

Removal

Tractors not fitted with a Multi-Power/Auxiliary Pump

1. Remove the lift cover, as stated in operation 7A-03-38.
2. Fig. 29. Remove the Pressure Control adjuster (28), tube (85) and spring (86).
3. Remove the split pin from the shear tube and remove the tube and the rear drive shaft.
4. Remove the p.t.o. side cover, as stated in Part 5.
5. Remove the p.t.o. shaft, as stated in Part 5.
6. Remove the two nuts securing each dowel pin and remove the pins.
7. Manoeuvre the hydraulic pump out of the top of the centre housing.
8. Remove the split pin and the coupler from the front of the camshaft.

Tractors fitted with a Multi-Power/Auxiliary Pump

1. Remove the lift cover, as stated in operation 7A—03—38.
2. Fig. 29. Remove the Pressure Control adjuster (28), tube (85) and spring (86).
3. Remove the split pin from the shear tube and remove the tube and the rear drive shaft.
4. Remove the p.t.o. side cover, as stated in Part 5.
5. Split the tractor between the centre housing and the gearbox/spacer housing, as stated in Part 3.
6. Remove the auxiliary feed pipe from the auxiliary pump (auxiliary pump tractors only).
7. Remove the two nuts securing each dowel pin and remove the pins.
8. When i.p.t.o. is fitted, move the hydraulic pump, auxiliary pump and the i.p.t.o. unit forwards.
9. Withdraw the hydraulic pump and the Multi–Power/auxiliary pump, as a complete assembly, from the front of the centre housing.
10. Fig. 35. Remove the two 'C' clips (87), and withdraw the Multi-Power/auxiliary pump from the hydraulic pump.

Refitment

Tractors not fitted with a Multi-Power/Auxiliary Pump

1. Refit the coupler to the front of the camshaft and secure it with a new split pin.
2. Position the hydraulic pump in the centre housing, locating the pump on the p.t.o. drive shaft.
3. Place the p.t.o. gear in position and refit the p.t.o. shaft, as stated in Part 5.
4. Refit the dowel pins, with new 'O' rings, then locate the dowel pins in the hydraulic pump and secure with two nuts each side.
5. Refit the p.t.o. side cover, as stated in Part 5.
6. Refit the rear drive shaft and shear tube and locate the split pin to give 0,83 to 2,54 mm (0·015 to 0·100 in) end float.
7. Fig. 29. Refit the Pressure Control spring (86), tube (85) and adjuster (28).
8. Refit the lift cover, as stated in operation 7A—03—38.

Tractors fitted with a Multi-Power/Auxiliary Pump

1. Fig. 35. Locate the Multi-Power/auxiliary pump on the hydraulic pump and secure it in place with the two 'C' clips (87).
2. When i.p.t.o. is fitted, locate the i.p.t.o. unit on the p.t.o. shaft splines.
3. Position the hydraulic pump and the Multi-Power/auxiliary pump in the centre housing, locating the camshaft splines in the i.p.t.o. unit.
4. Refit the dowel pins, with new 'O' rings, then locate the dowel pins in the hydraulic pump and secure with two nuts each side.
5. Refit the feed pipe to the auxiliary pump (auxiliary pump tractors only).
6. Refit the p.t.o. side cover, as stated in Part 5.
7. Reconnect the centre housing to the gearbox/spacer housing, as stated in Part 3.
8. Refit the rear drive shaft and shear tube and locate the split pin to give 0,38 to 2,54 mm (0·015 to 0·100 in) end float.
9. Fig. 29. Refit the Pressure Control spring (86), tube (85) and adjuster (28).
10. Refit the lift cover as stated in operation 7A—03—38.

HYDRAULIC PUMP

Servicing 7A—12—49

Special tools required:— See Operation 7A—03—38, and
MF 349 Valve Seat Forming Tool.
MF 350 Valve Circlip Replacer.
MF 351 Valve Plug Remover and Replacer.
MF 352 Control Valve Spring Retainer.
MF 353 Control Valve Body 'O' Ring Guide.
MF 354 Control Valve Body Replacer.

Figs 36 to 41.

Disassembly

1. Remove the hydraulic pump, as stated in operation 7A—11—49.
2. Fig. 36. Remove the clip (139) and the pin retaining the link (140), and detach the link from the lever (125).
3. Remove the clip (124), lever (125) and the two rollers (122) and the pin (123).
4. Remove the four bolts (121) and washers securing the strainer housing (132) to the rear body (99) and remove the strainer housing, complete with the strainer and the Response Control unit.
5. Remove the two bolts (126) and washers securing the end plate (127), and remove the end plate and the gasket (129).
6. Disassemble the strainer assembly by removing the clip (115), nut (116), spring (117), washer (118), 'O' ring (119), strainer (120), cover (130) and the 'O' ring (131).
7. Release the spring (110) from the Response Control lever (108), then remove the two bolts (105 and 106) and washers, and remove the lever (108), retainer (107), bush (104) and the washer (109).
8. Remove the bush (112), spring (113) and the ball (114) from the strainer housing (132).

9. If necessary, disassemble the non-return valve by removing the circlip (138), cap (137), spring (135), retainer (134) and the seal (133) and withdraw the valve (128) from the housing (132).
10. Remove the nut (142) and washer securing the Pressure Control valve (12), and carefully remove the valve.
11. Remove the oscillator end cap (89).
12. Fig. 36 and 37. Using MF 352, compress the collar (93) and remove the retaining ring (92).
13. Fig. 36. Withdraw the control valve (9) from the rear body (99).
14. Taking care that the spring (98) is not ejected, remove MF 352, then remove the collar (93) guide (94), spring (98) and the disc (97).
15. Remove the four nuts (88 and 88a) and detach the front body (90).
16. Withdraw the two valve chambers (154) from the rear body (99), complete with the front cam block (155), pistons (143), cam follower (145), oscillator tube (95) and the rear cam block (144).
17. Separate the valve chambers (154) from the pistons (143) and remove the cam blocks (144 and 155) from the pistons.
18. Withdraw the camshaft (96) from the rear body (99).
19. If necessary, remove the split pin and the clevis pin (91) retaining the cam follower (145) to the oscillator tube (95).
20. Taking care not to damage the rear body (99) and the control valve body (136), drive out the body (136), then remove the 'O' ring (103) back-up washer (102), sleeve (101) and the washer (100). Remove the 'O' ring and the back-up washer from the control valve body.
21. Fig. 36 and 38. Remove the circlip (146), retaining the valve chamber plug (147) then using MF 351, remove the plug as shown.
22. Fig. 36. Remove the back-up washer (148), 'O' ring (149), outlet valve spring (150), outlet valve (151), inlet valve spring (152) and the inlet valve (153) from the valve chamber (154).
23. Repeat items 21 and 22 for the other three valves.

Examination

Check the condition of all components for wear, or damage, replacing any defective components. Always replace 'O' rings, back-up washers, gaskets and circlips. Lubricate the 'O' rings with an approved oil before fitting.

Reassembly

1. If necessary, form new valve seats, using MF 349 as follows:—
   Cut out the old top seat, then the bottom seat using the refacing tool. Using the seat forming tool, form a new top seat by tapping the tool with a hammer, invert the tool and form a new bottom seat in the same manner. Thoroughly clean the valve chambers.
2. Refit the inlet valve (153), inlet valve spring (152), outlet valve (151) and the outlet valve spring (150).
3. Fig. 36 and 38. Assemble a new back-up washer (148) and a new 'O' ring (149) to the plug (147), then using MF 351, push the plug into the valve chamber until the circlip groove can just be seen.
4. Fig. 36 and 39. Position a new circlip (146) in MF 350, then using the tool as shown, secure the plug (147) in the valve chamber with the circlip.
5. Using MF 351, pull the plug up against the circlip.
6. Repeat items 2 to 5 for the other three valves.
7. Fig. 40. Using MF 353, fit a new back-up washer (158) and a new 'O' ring (157) to the control valve body (136), as shown.
8. Fig. 37. Locate the washer (100) and the sleeve (101) in the rear body (99).
9. Fig. 36 and 41. Assemble a new 'O' ring (103) and a new back-up washer (102) to the end of the control valve body (136), then using MF 354, carefully drive the body (136) into the front body (99), aligning the pin at six o'clock.
10. Fig. 36. If necessary, secure the cam follower (145) to the oscillator tube (95) with the clevis pin (91) and a new split pin.
11. Fit new 'O' rings (156) into place on the front and rear bodies (90 and 99).
12. Refit the valve chambers (154) onto the pistons (143), with new piston rings, if necessary.
13. Place the cam follower (145) between the pistons.
14. Place the camshaft (96), with the front and rear cam blocks (155 and 144), into the pistons.
15. Refit the rear body (99), making sure the oscillator tube (95) aligns with the aperture in the rear body.
16. Refit the front body (90), then lubricate the threads of the studs with an approved oil, and secure the front body with the four nuts (88 and 88a) tightened to a torque of 4 kg m (30 lbf ft), ensuring at all times that the pistons move freely.
    NOTE—THE SPECIAL NUTS (88a) MUST BE FITTED TO THE TOP RIGHT HAND AND THE BOTTOM LEFT HAND STUDS.
17. Lubricate the control valve (9) with an approved oil, then slide it into the rear body (99).
18. Refit the disc (97), spring (98), guide (94) and the collar (93) into the oscillator tube (95) and retain them in position with MF 352.
19. Secure the collar (93) with a new retaining ring (92) and then remove MF 352.
20. Refit the oscillator end cap (89).
21. Refit the Pressure Control valve (12) and secure it with the washer and the nut (142) tightened to a torque of 4 kg m (30 lbf ft).
22. If necessary, reassemble the non-return valve by locating the valve (128) in the housing (132) and refitting the seal (133), retainer (134), spring (135), cap (137) and the circlip (138).
23. Locate the ball (114), spring (113) and the bush (112) in the strainer housing (132).
24. Locate the lever (108) in position, then fit the washer (109), bush (104) and the retainer (107) and secure them with the washer and the bolt (106) tightened to a torque of 1 kg m (10 lbf ft).
    NOTE—COAT THE BOLT THREADS WITH HYLOMAR SQ 32M SEALING COMPOUND.
25. Refit the washer and bolt (105) to secure the retainer (107).

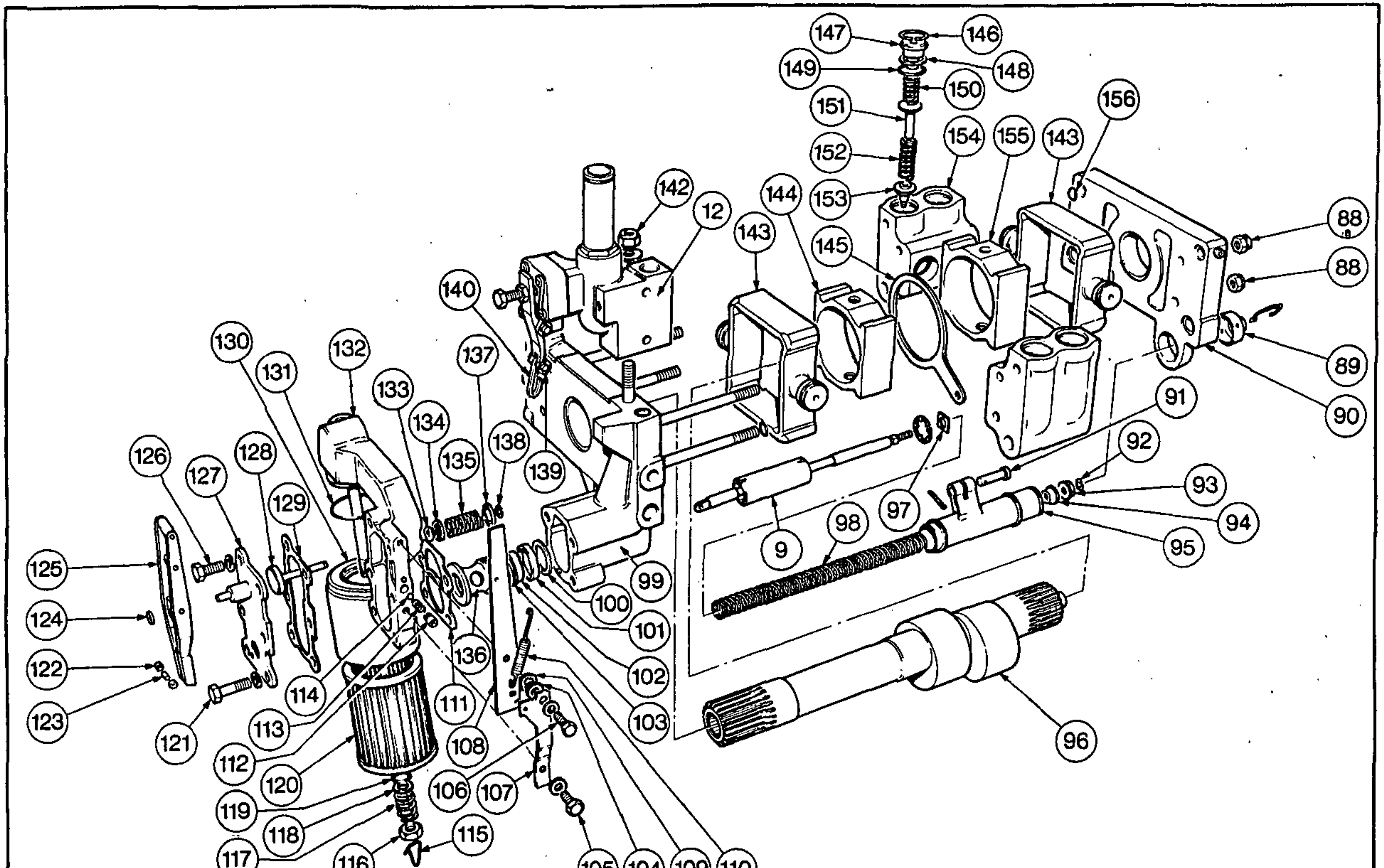
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FIG. 36

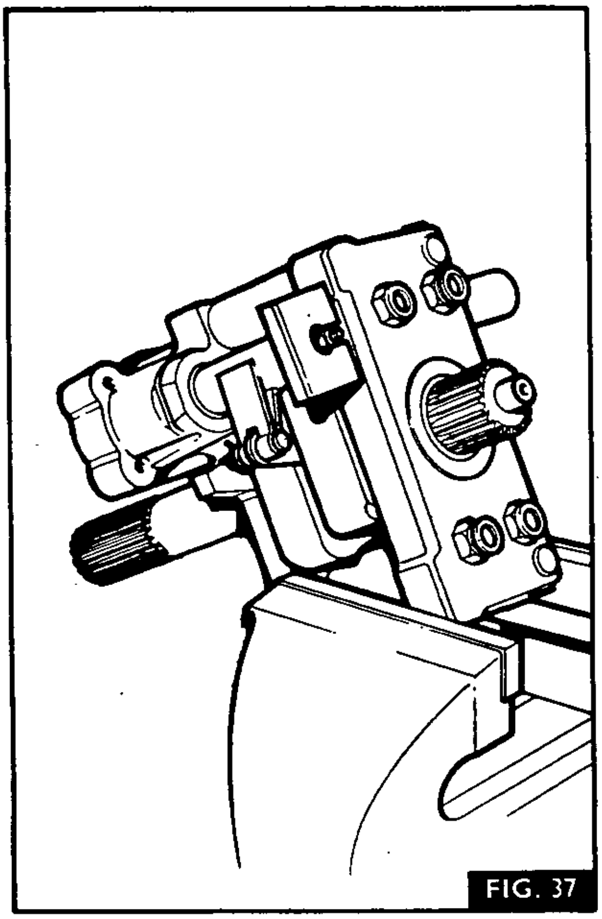

FIG. 37

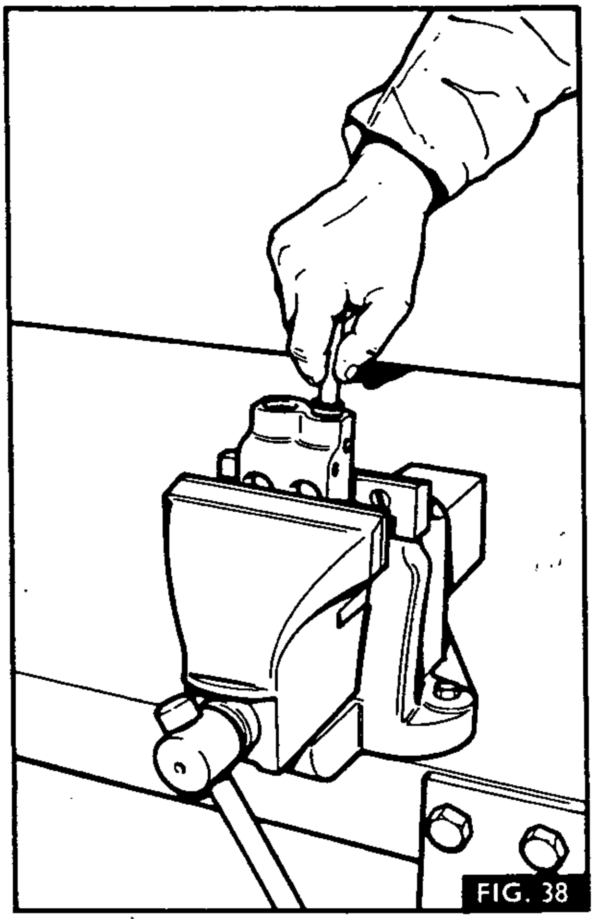

FIG. 38

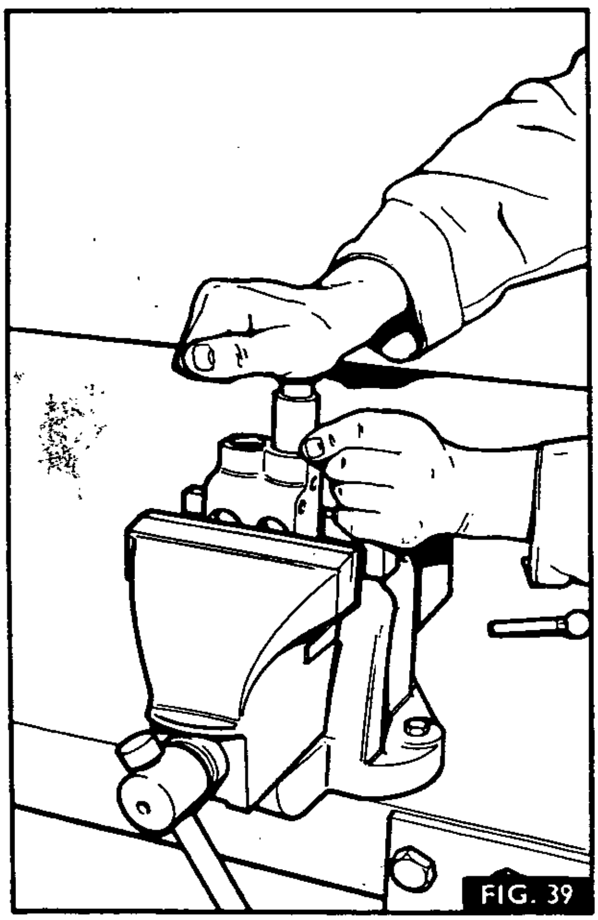

FIG. 39

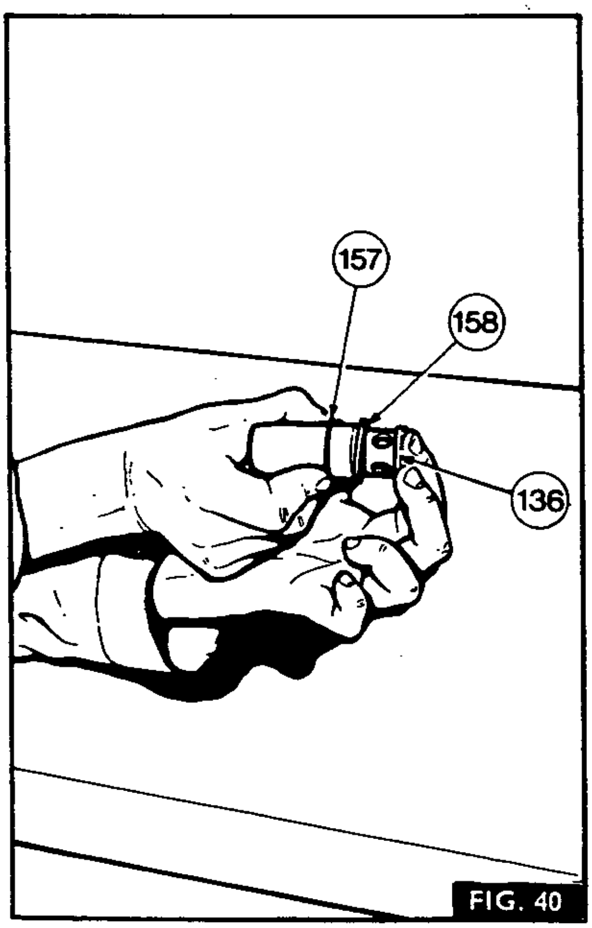

FIG. 40

26. Reassemble the strainer housing by locating a new 'O' ring (131) on the strainer housing (132) and refitting the cover (130), strainer (120), a new 'O' ring (119), washer (118), spring (117), nut (116) and the clip (115).
27. Refit the end plate (127), with a new gasket (129) and secure it in position with the two washers and bolts (126). Do not fully tighten the bolts at this stage.
    NOTE—COAT THE BOLT THREADS WITH HYLOMAR SQ 32M SEALING COMPOUND.
28. Refit the strainer housing (132), with a new gasket (111), making sure that the pin on the control valve body (136) locates in the strainer housing correctly.
29. Secure the strainer housing to the rear body with the four washers and bolts (121). Torque the bolts (121 and 126) to 2 kg m (15 lbf ft), checking at all times that the control valve continues to slide freely.
    NOTE—COAT THE BOLT THREADS WITH HYLOMAR SQ 32M SEALING COMPOUND.
30. Refit the lever (125), two rollers (122) and the pin (123), then refit the clip (124).
31. Attach the link (140) to the lever (126) and secure the outer end with the pin and the two clips (139).
32. Refit the hydraulic pump, as stated in operation 7A—11—49.

HYDRAULIC PUMP

Control Valve Removal and Refitment 7A—13—53

Special tools required:— See operation 7A—03—38, and MF 352 Control Valve Spring Retainer. MF 353 Control Valve Body 'O' Ring Guide. MF 354 Control Valve Body Replacer.

Figs. 36, 39, 40 and 41.

Removal

1. Remove the control valve, as stated in items 1 to 4, 11 to 15 of operation 7A—12—49.
2. Fig. 36. Remove the split pin and the clevis pin (91) securing the oscillator tube (95) and remove the tube.
3. Remove the control valve body, as stated in item 20 of operation 7A—12—49.

Examination

Check the condition of all components for wear, or damage, replacing any defective parts. Always replace back-up washers, 'O' rings, gaskets and circlips. Lubricate the 'O' rings with an approved oil before fitting.

Refitment

1. Refit the control valve, as stated in items 7 to 9, of operation 7A—12—49.
2. Fig. 36. Refit the oscillator tube (95) to the rear body and secure it to the cam follower (145) with the clevis pin (91) and a new split pin.
3. Refit the control valve as stated in items 16 to 20 and 28 to 32 of operation 7A—12—49.

PRESSURE CONTROL VALVE

Removal and Refitment 7A—14—53

Special tools required:— See operation 7A—03—38.

Fig. 36

Removal

1. Remove the hydraulic pump, as stated in operation 7A—11—49.
2. Fig. 36. Remove the clip (139) and the pin retaining the link (140) and detach the link from the lever (125).
3. Remove the nut (142) and the washer securing the Pressure Control valve (12) and carefully remove the valve.

Refitment

1. Refit the Pressure Control valve (12) and secure it with the washer and the nut (142) tightened to a torque of 4 kg m (30 lbf ft).
2. Attach the link (140) to the lever (125) and secure the other end with the pin and the two clips (139).
3. Refit the hydraulic pump, as stated in operation 7A—11—49.

PRESSURE CONTROL VALVE

Servicing 7A—15—53

Special tools required:— See operation 7A—03—38.

Fig. 42

Disassembly

1. Remove the Pressure Control valve, as stated in operation 7A—14—53.
2. Fig. 42. Remove the four screws (170) and the springs (169) securing the diaphragm body (166), then remove the body, spring (167) and the diaphragm (168).
3. If necessary, remove the lever (171) and the spring (165) from the diaphragm body (166).
4. Remove the distance piece (162), spring (161) and the valve (160).
5. Unscrew the guide (175), then remove the spring support (174), plunger (176) and the ball (177).
6. Taking care not to damage the valve body, withdraw the guide (173) and the 'O' ring (172), then withdraw the seat (163), back-up washer (159) and the 'O' ring (164).

Examination

Examine all the components for signs of wear, damage, scoring or pitting and replace if necessary.

Reassembly

1. Fit a new 'O' ring (164) and a new back-up washer (159) to the seat (163), then locate the seat (163) in position.
2. Fit a new 'O' ring (172) to the guide (173), then locate the guide in position.
3. Refit the ball (177), plunger (176), with the tappered end towards the ball, and the spring support (174).
4. Degrease the threads of the guide (173) and the threads in the valve body, then screw the guide into the valve body by half a thread.

5. Apply three equally spaced drops of Loctite 270 'Stud Lock' to the threads of the guide, then tighten the guide to a torque of 4 kg m (30 lbf ft).
6. Refit the valve (160), and the spring (161), then refit the distance piece (162) so that it is flush with the face of the valve body.
7. Assemble the diaphragm (168), spring (167) and the diaphragm body (166) to the valve body and secure them with the springs (169) and the four screws (170).
8. If necessary, refit the lever (171) and the spring (165) to the diaphragm body (166).
9. Refit the Pressure Control valve, as stated in operation 7A—14—53.

STRAINER HOUSING AND RESPONSE CONTROL

Removal and Refitment 7A—16—54

Special tools required:— See operation 7A—03—38

Fig. 36

Removal

1. Remove the strainer housing as stated in items 1 to 4 of *operation* 7A—12—49.

Refitment

1. Refit the strainer housing as stated in items 28 to 32 of operation 7A—12—49.

STRAINER HOUSING AND RESPONSE CONTROL

Servicing 7A—17—54

Special tools required:— See operation 7A—03—38.

Fig. 36

Disassembly

1. Remove the strainer housing, as stated in operation 7A—16—54.
2. Disassemble the strainer housing and the Response Control, as stated in items 5 to 9 of operation 7A—12—49.

Examination

Check the condition of all components for wear or damage, replacing any defective components. Always replace 'O' rings and gaskets.

Reassembly

1. Reassemble the strainer housing and the Response Control, as stated in items 22 to 27 of operation 7A—12—49.
2. Refit the strainer housing, as stated in *operation* 7A—16—54.

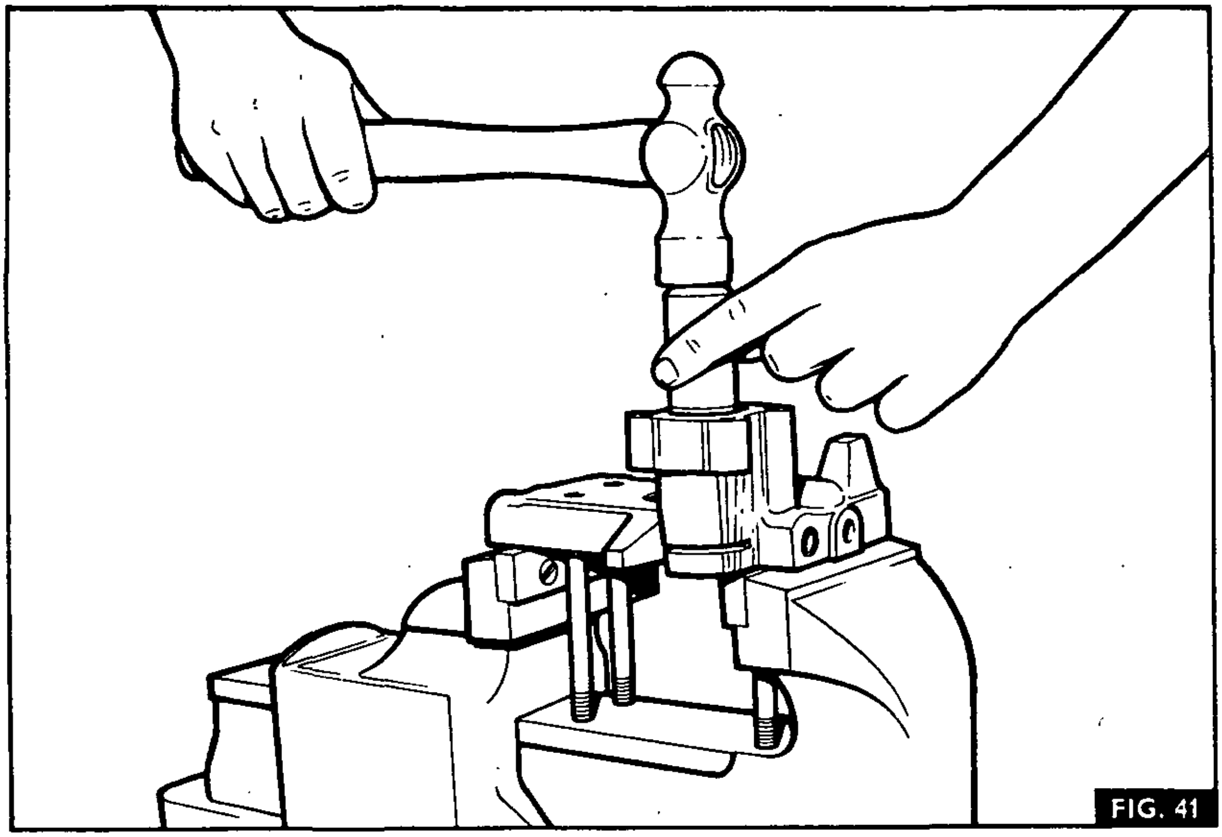

FIG. 41

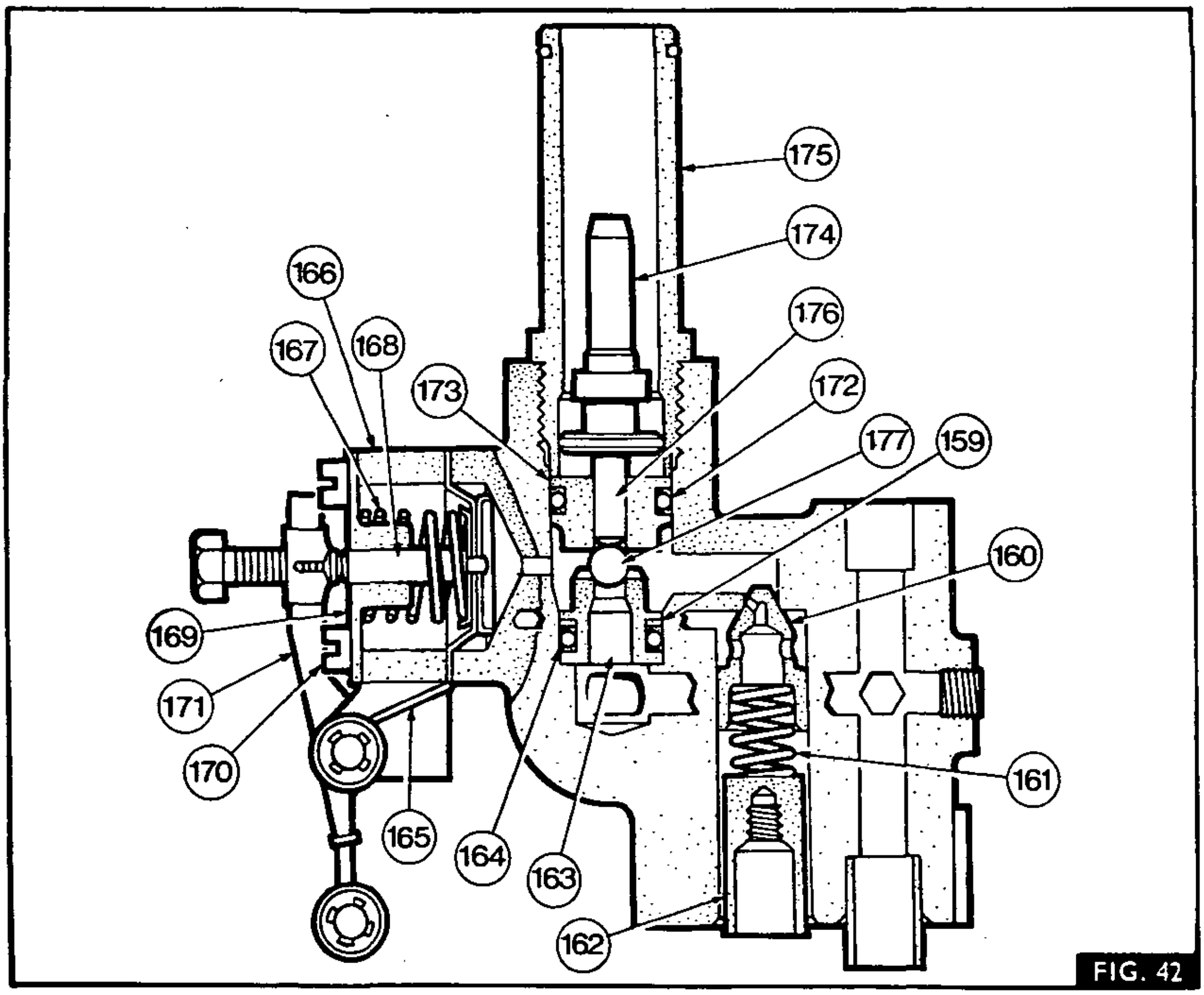
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FIG. 42

AUXILIARY HYDRAULICS

Part 7 Section B

GENERAL

The auxiliary hydraulic system is available for all Multi-Power tractors. The auxiliary hydraulic pump provides oil for up to three services :– Multi-Power, Independent p.t.o. and Auxiliary (external) services.

A single, or two spool control valve is available for use with auxiliary hydraulic tractors and can be used for both single-acting and double-acting hydraulic services.

Auxiliary hydraulic tractors are normally fitted with a filter as standard equipment and oil cooler is fitted to tractors with spool valves. Some tractors are fitted with the low output (Multi-Power only) type of pump and are not fitted with either a cooler, or a filter.

A combining valve can be fitted, to supplement the output of the auxiliary pump 28,6 lit/min (6.3 Imp gal/min), with the output of the tractor linkage pump of 14,1 lit/min (3.1 Imp gal/min) to give a total output of 42,7 lit/min (9.4 Imp gal/min) at 2000 engine rev/min. The linkage pump output is made available for external services, by screwing the combining valve knob fully out. When using combined flow, the 'Position Control' lever must be placed in the 'Constant Pumping' and the 'Draft Control' lever at the fully raised position. The rear linkage must not be used when the combining valve is open.

The combined flow of both pumps is available to external service provided that the pressure required is not in excess of 169 Kg/cm^2 (2400 lb/in^2) with the combining valve closed, or 211 Kg/cm^2 (3000 lb/in^2) with the combining valve open.

OIL COOLER

Removal and Refitment 7B-01-02

Removal

1. Remove the grille door.
2. Fig. 1. Slacken the two wingnuts (1) and pull the oil cooler forwards.
3. Disconnect the two hoses (2) at the top of the cooler.
4. Mask off the hose connections using suitable plugs or masking tape to prevent the ingress of dirt.
4. Lift the cooler clear of the tractor.

Refitment

1. Place the oil cooler in position over the bottom retaining pins.
2. Fig. 1. Reconnect the two pipes (2) to the oil cooler.
3. Push the oil cooler into place and secure it with the two wing nuts (1).
4. Refit the grille door.

AUXILIARY OIL FILTER UNIT

Removal and Refitment 7B-02-02

Removal

1. Fig. 2. Mark one of the metal pipes (3) and its mating union on the filter head (5), then disconnect both metal pipes (3).
2. Disconnect both hoses (2) at the filter head.
3. Mask off all open connections using suitable plugs and caps, or masking tape.
4. Remove the two nuts, bolts and spring washers (4) securing the filter head (5) to its bracket.

Refitment

1. Place the filter unit in position, then secure it with the nuts, bolts and spring washers.

NOTE – PLACE SPRING WASHERS UNDER THE BOLT HEADS.

2. Reconnect the two hoses (2) to the front end of the filter.
3. Refit the two metal pipes (3), aligning the two identification marks.

AUXILIARY OIL FILTER

Servicing 7B-03-02

Disassembly

1. Fig. 3. Unscrew the filter housing (10) from the filter head (5).
2. Remove the element (8) sealing rings (7 and 9) and the 'O' ring (6). Thoroughly clean all components with paraffin, then examine the filter head and housing for cracks, or damage. Always fit a new element and seals.

Reassembly

1. Fit a new sealing ring (9) to the base of the body, then fit a new element (8).
2. Locate the upper sealing ring (7) in the top of the element.
3. Fit a new 'O' ring (6) to the filter head (5), then screw the body and element assembly on to the head.

AUXILIARY OR MULTI-POWER PUMP UNIT

Removal and Refitment 7B-04-02

Special Tools Required: See operation 7A-14-31

Removal

1. Remove the hydraulic pumps, as stated in operation 7A-14-31.
2. Fig. 5. Remove the circlip (23) securing the pump driven gear (36) to the pump drive shaft.
3. Remove the two special bolts (24), spacers (33) and the Allen screw (22) securing the pump drive assembly to the pump.
4. Slide the pump out of the plated drive unit, removing the driven gear (36).

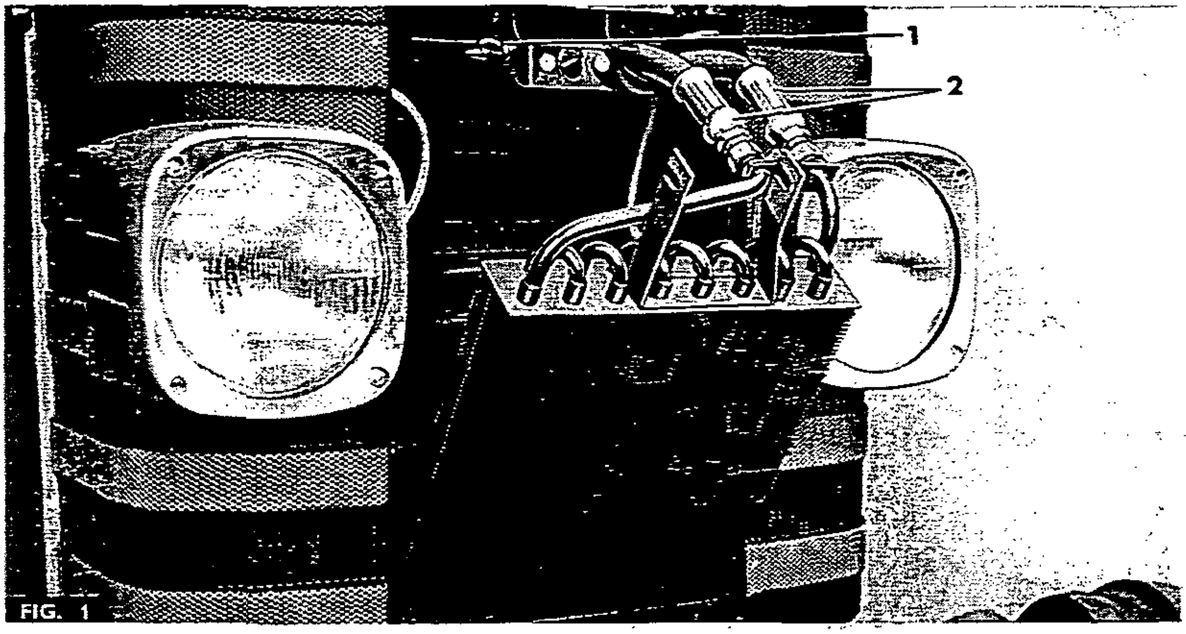


FIG. 1

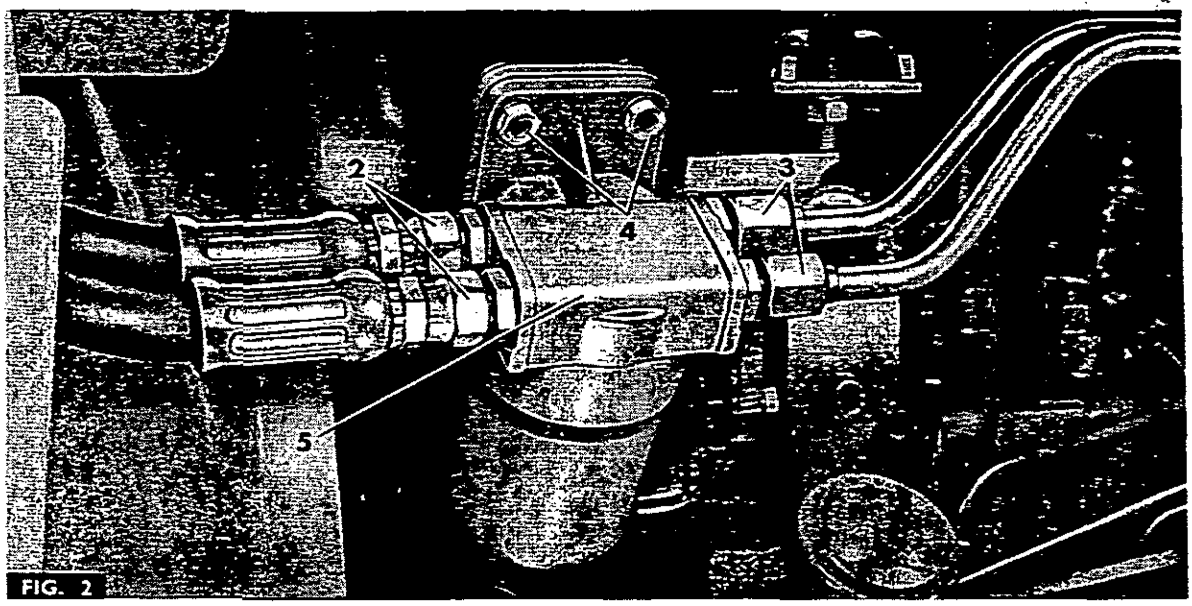


FIG. 2

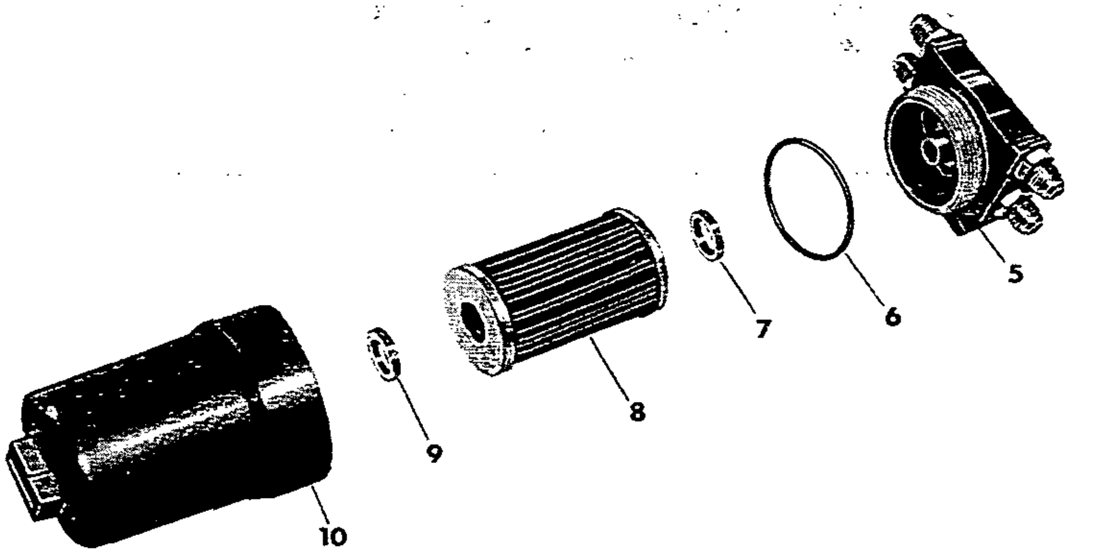


FIG. 3

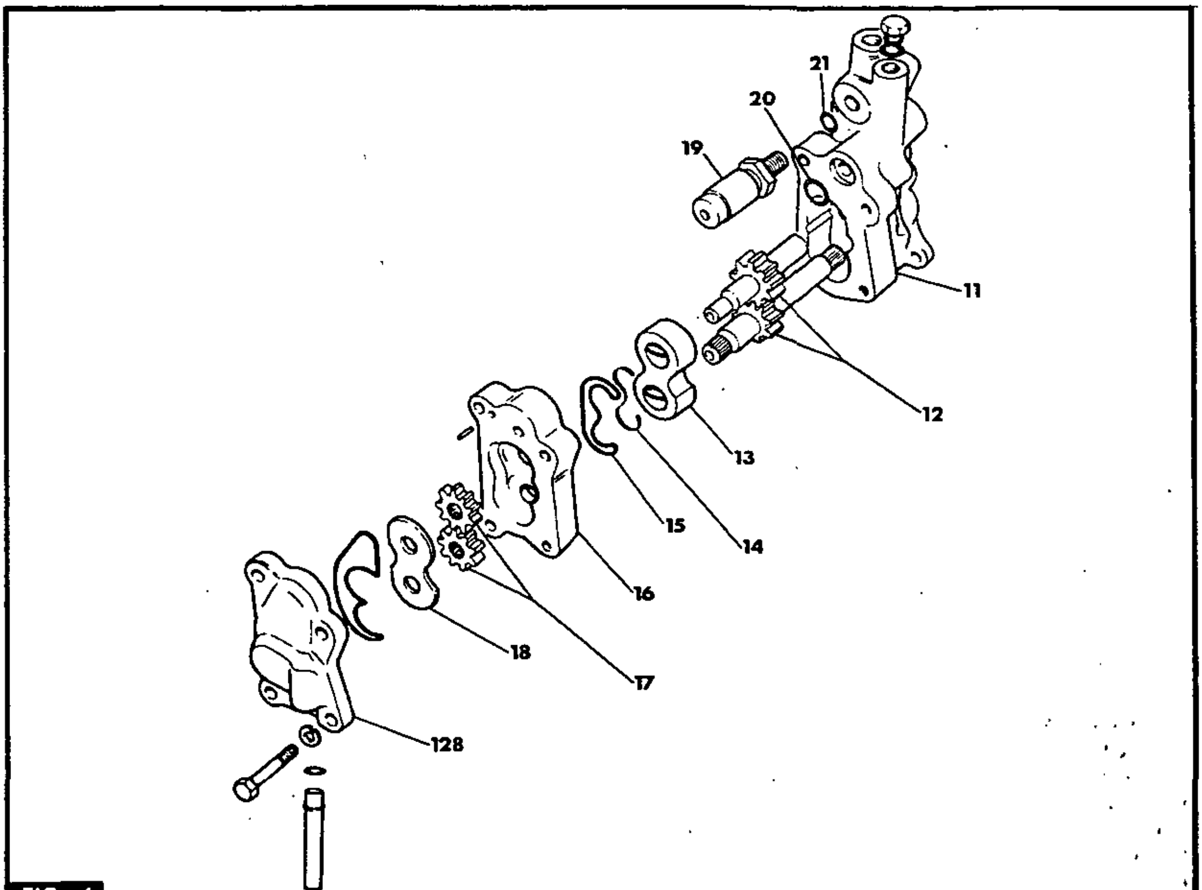


FIG. 4

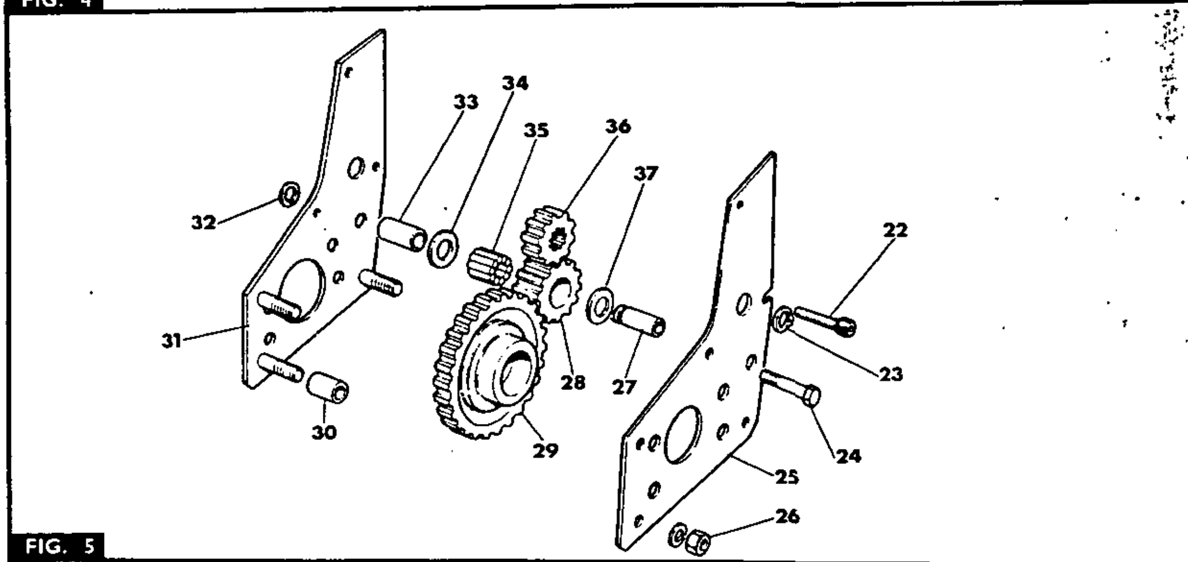


FIG. 5

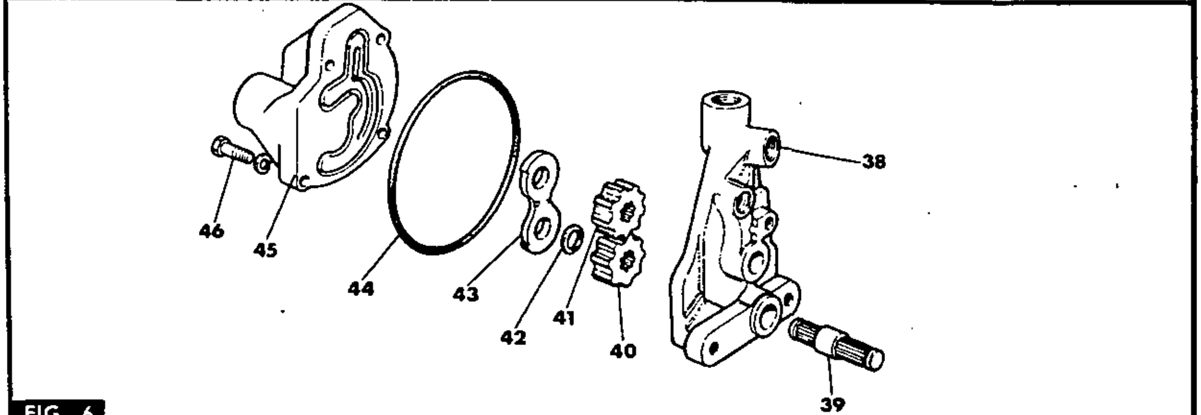


FIG. 6

Refitment

1. Position the plated drive unit on the auxiliary pump, ensuring that the flat machined on the idler gear shaft (27) abuts against the pump and that the driven gear (36) is correctly mounted on the pump driveshaft.
2. Refit the circlip (23) to the pump driveshaft to secure the driven gear (36).
3. Refit the two special bolts (24), spacers (33) and the Allen screw (22).
4. Tighten the two bolts (24) to a torque of 3,0 Kg-m (22 lb-ft) and the Allen screw (22) to a torque of 2,7 Kg-m (20 lb-ft), then check the backlash between any of the gears. The total backlash between the three gears (two measurements) must be between 0,050 to 0,406 mm (0.002 to 0.016 in).
5. Refit the hydraulic pump as stated in operation 7A-14-31.

AUXILIARY PUMP

Servicing 7B-05-05

Special tools Required: See operation 7A-14-31

Disassembly

1. Remove the auxiliary pump, as stated in operation 7B-04-02.
2. Fig. 4. Remove the bearing plate (18).
3. Suitably mark each gear in relation to its shaft.
4. Remove the body (16), complete with the gears (17) rubber seal (15) and P.T.F.E seal (14).
5. Remove the 'O' ring (20).
6. Remove the floating bearing (13) and the gears (12) from the body (11).
7. If necessary, remove the main relief valve (19) and the 'O' ring (21).

Examination:

Bearings: Examine the bearings (13 and 18) for wear on their faces and in their bores. Pay particular attention to the lubricating scrolls. Score marks, between the bearing bores can cause high leakage losses. During major overhaul the bearings should be renewed, but if not badly worn, they can be salvaged, by polishing as follows:

Place a sheet of 'O' grade emery paper, lubricated with paraffin on a true, flat surface (e.g. a surface plate, or sheet of plate glass), then polish the bearing face, using a light, rotary motion.

Outer diameters of the bearings can be lightly polished to obtain free movement in the body.

Bodies: Inspect the bodies (11 and 16) for external damage and cracks. Examine bores for wear and damage. The gears always cut a light track on the inlet side of the body bores. The depth of this track must not exceed 0,010 mm (0.004 in). Examine the bearing face in the pump body for wear and damage, as this can cause high leakage losses.

Examine the bearing bores for wear. If they are worn excessively, the pump body must be replaced.

Gears: Examine the gears (12 and 17) for scored or worn faces or journals, damaged teeth and surface cracks.

Slight wear or scoring on the journals can be removed by polishing between lathe centres, using 'O' grade emery paper lubricated with paraffin. Check the widths of the drive and driven gears. Their actual width is relatively unimportant, provided that each pair are within 0,005 mm (0.0002 in) of each other and that the journals are within 0,013 mm (0.0005 in) of one another. Spare gears are only available as matched pairs.

Check the gear faces for flatness by smearing a bearing face with engineer's "blue" and rotating the gear against it. This will also reveal any sharp edges on the teeth which can be removed with a fine needle or by stoning.

Under working conditions, hydraulic pressure within the pump loads the gears towards the inlet side of the body, thus cutting the running track. If the bearings, or gear journals wear, the gears move over and deepen the running track. Therefore, if the running track is worn past, or to the limit, for re-use, the fitting of a new floating bearing (13) may not improve the pump efficiency, as the new bearing will hold the gears and prevent them from bottoming in the running track.

Always fit a set of new seals and 'O' rings on reassembly.

Reassembly

1. Lightly lubricate the faces and bores of all bearings and gears with clean hydraulic oil.
2. Fig. 4. Fit the gears (12) in the pump body (11).
3. Fit a new 'O' ring (20) to the pump body (11).
4. Fit the floating bearing (13) with its machined recess adjacent to the gears and the relieved radii on the outlet side of the pump. Check that the floating bearing is 0,05 to 0,13 mm (0.002 to 0.0055 in) below the face of the pump body.
5. Fit a new seal (15) to the centre body (16), then fit the new P.T.F.E. seal (14) between the OUTER edge of the rubber seal and the pump body.
6. Refit the centre body to the pump, taking care not to displace the seals.
7. *Refit the gears (17) on the shafts, aligning the* marks on the shaft.
8. Refit the bearing plate (18) ensuring that the machined recess is adjacent to the gears. Check that bearing plate is 0,05 to 0,18 mm (0.002 to 0.007 in) below the face of the centre body.
9. Refit the pressure relief valve (19) using a new 'O' ring (21).
10. Refit the auxiliary pump, as stated in operation 7B-04-02
11. Carry out hydraulics test as stated in operation 7B-16-31

MULTI-POWER PUMP

Servicing 7B-06-06

Special Tools Required: See operation 7A-14-31

Disassembly

1. Remove the Multi-Power pump as stated in operation 7B-04-02.
2. Fig. 6. Remove the four bolts (46) from the end plate, then remove the end plate (45) and seal (44).
3. Remove the pressure plate (43) from the body (38).
4. Remove the gears (40 and 41) from the body, then remove the circlip (42) and slide the drive gear (40) off the shaft (39).

Examination

Examine the pressure plate (43) for wear on the faces and bores. Score marks between the bearing bores can cause high leakage losses. During major overhaul, the pressure plate (43) should be renewed, but if not badly worn, it can be salvaged, by polishing, as follows:

Place a sheet of 'O' grade emery paper, lubricated with paraffin, on a true, flat surface (e.g. a surface plate, or sheet of plate glass), then polish the bearing plate, using a light, rotary motion.

Outer diameters of the pressure plate can be lightly polished to obtain free movement in the body.

Inspect the body (38) for external damage or cracks and examine the bores for wear, or damage. The gears always cut a light track on the inlet side of the body bores. The depth of this track must not exceed 0,10 mm (0.004 in). Examine the bearing face in the pump body for wear or damage, as this can also cause high leakage losses.

Examine the diameter of the driven gear spigot for wear. This will normally show up as a step on the diameter and if wear has taken place, the running track wear in the body bore will be excessive, necessitating replacement of the body.

Inspect the gears (40 and 41) for scored or worn faces, damaged teeth, or surface cracks. Slight wear or scoring on the gear faces can be polished in a similar manner to that of the bearing plate. Check the width of the gears. Their actual width is relatively unimportant, provided that they are within 0,005 mm (0.0002 in) of each other.

Visually inspect the sealing face of the end plate (45) for damage, cracks, or scoring and check the flatness with a straight edge.

Replace any defective components and fit a new seal (44) and circlip (42).

Reassembly

1. Lightly lubricate the faces and bores of the bearings and gears with clean hydraulic oil.
2. Refit the drive gear (40) to the shaft (39), securing it with a new circlip (42).
3. Carefully slide the gears (40 and 41) into the pump body (38).
4. Fit the bearing plate (43) with the relieved edge and recessed face on the outlet side of pump. Check that the bearing plate is 0,05 to 0,18 mm (0.002 to 0.007 in) below the body face.
5. Fit a new seal (44) into the end plate (45), locate the end plate in position and fit the four bolts, tightening them to a torque of 2,75 Kg-m (20 lb-ft).
6. Refit the Multi-Power pump, as stated in operation 7B-04-02 carrying out the hydraulic tests as stated in operation 7B-15-31 before refitting the lift cover.

PLATED DRIVE UNIT

Servicing 7B-07-06

Special Tools Required: See operation 7A-14-31

Disassembly

1. Remove the auxiliary, or Multi-Power pump, as stated in operation 7B-04-02
2. Fig. 5. Remove the three nuts (26) and spring washers, then remove the plate (25), and the spacers (30).
3. Lift out the drive gear (29), then remove the thrust washer (37) idler gear (28) complete with needle rollers (35) and second thrust washer (34).
4. Push the idler shaft (27) complete with its circlip (32) out of the side plate (31).

Examination

Check the gear teeth for wear, chipping, or other damage. Examine the bores of the gears and the needle rollers for wear. Check the idler shaft and thrust washers for wear, scoring, or pitting.

Replace any defective components.

Reassembly

1. Refit the idler shaft (27) to the side plate (31).
2. Fit a thrust washer (34) to the idler shaft.
3. Fit the idler gear (28), needle rollers (35) and the second thrust washer (37).

NOTE – PETROLEUM JELLY CAN BE USED TO FACILITATE FITMENT OF THE NEEDLE ROLLERS.

4. Refit the drive gear (29).
5. Refit the three spacers (30) then refit the drive plate (25) and secure it with the three nuts (26) and spring washers. Tighten the nuts progressively and evenly to a torque of 3 Kg-m (22 lb-ft).
6. Refit the auxiliary, or Multi-Power pump, as stated in operation 7B-04-02

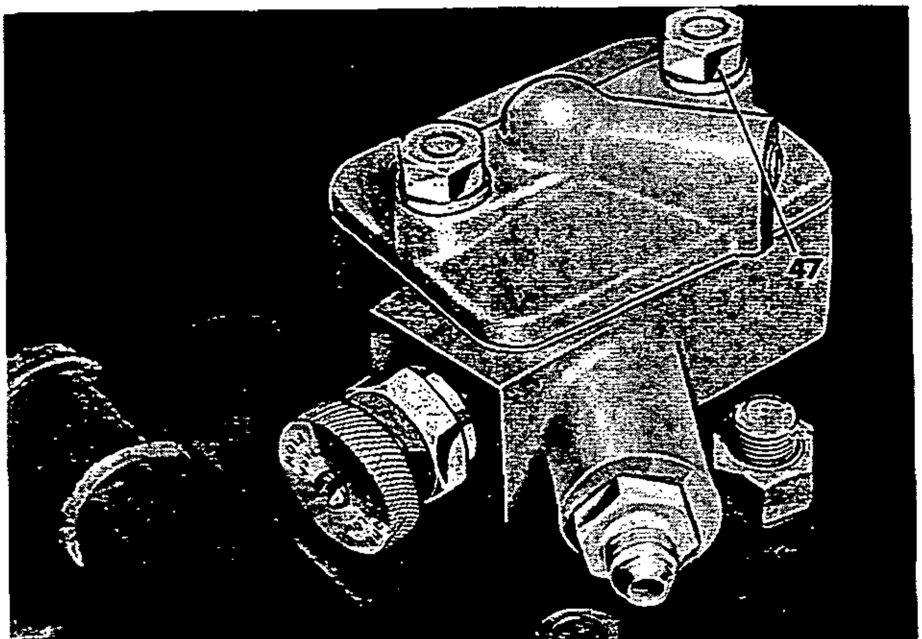


FIG. 7

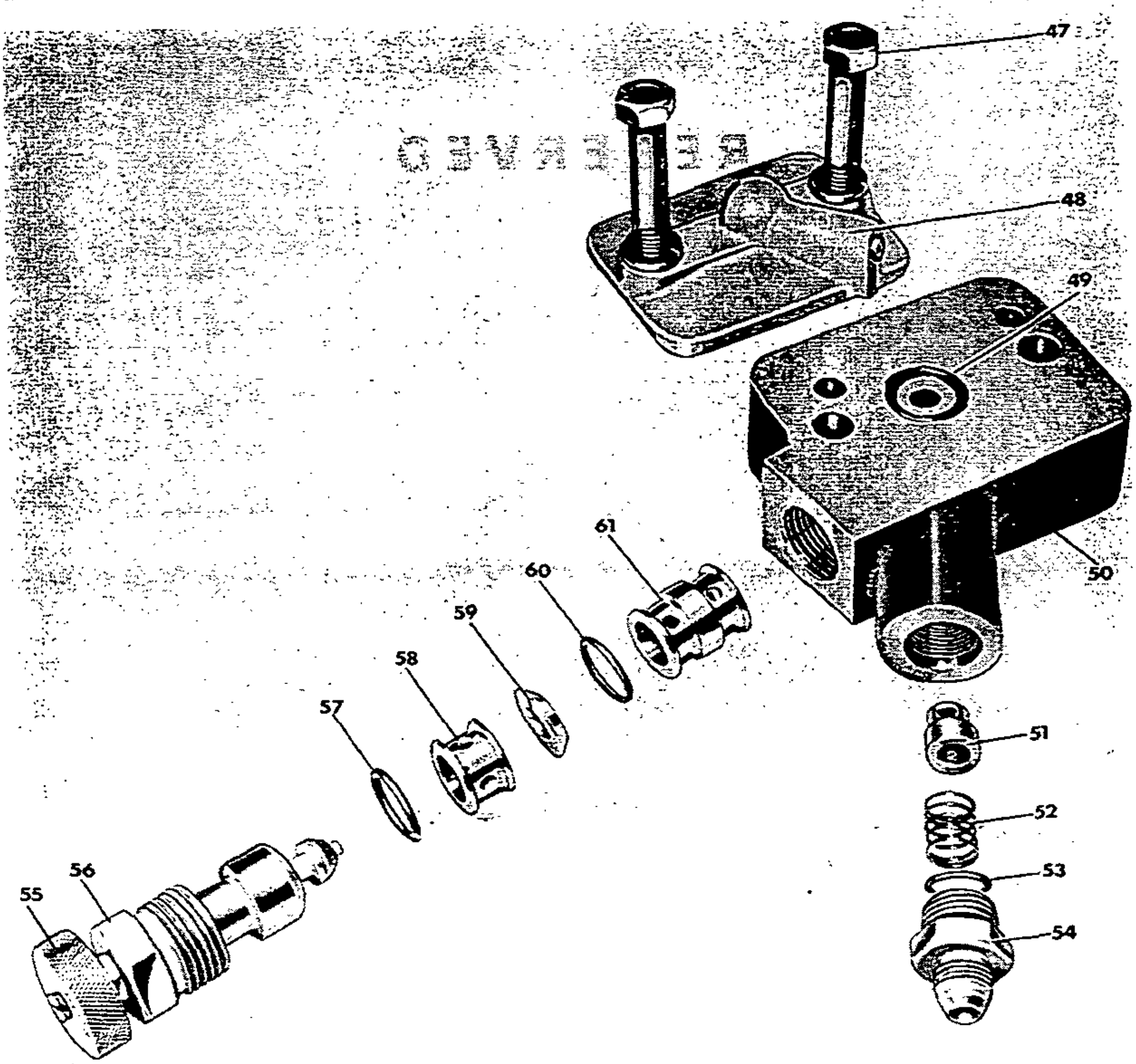


FIG. 8

COMBINING VALVE

Removal and Refitment 7B-08-09

Removal

1. Place the 'Draft Control' lever in the 'Down' position and the spool valve lever in 'Drop' to relieve the hydraulic system of pressure.
2. Disconnect the feed pipe from the combining valve.
3. Fig. 7. Remove the two bolts (47) and spring washers securing the combining valve and transfer cap to the lift cover.
4. Remove the transfer cap.
5. Carefully ease the combining valve off the hydraulic standpipe, taking care not to disengage the standpipe from the hydraulic pump.

Refitment

1. Fit a new 'O' ring to the standpipe and clean the joint face.
2. Fit a new 'O' ring (49) to the top of the combining valve.
3. Carefully locate the combining valve on the standpipe, ensuring that the standpipe is properly located in the combining valve and in the lift pump.
4. Clean both the top face of the combining valve and the transfer cap, then locate the transfer cap on the combining valve and refit the bolts (47) and spring washers.

COMBINING VALVE

Servicing 7B-09-09

Disassembly

1. Remove the combining valve, as stated in operation 7B-08-09.
2. Fig. 8. Remove the connector (54) 'O' ring (53), spring (52) and check valve (51) from the combining valve body (50).
3. Slacken the union nut (56), then remove the knob and guide assembly (55), 'O' ring (57) spacer (58) seat (59) 'O' ring (60) and distance piece (61).

Examination

Examine all components for wear, or damage and replace any defective components. Always fit new 'O' rings.

Reassembly

1. Refit the distance piece (61) new 'O' ring (60) seat (59) spacer (58) second new 'O' ring (57), then screw in the knob and guide assembly with the nut (55 and 56).
2. Refit the check valve (51) and spring (52). Replace the connector (54) with a new 'O' ring (53).
3. Refit the combining valve, as stated in operation 7B-08-09.

WOOSTER SPOOL VALVE

Fig. 10. The spool valve is available in two forms; single or twin spool. The design of both valves is basically similar, and performance characteristics are identical; the valve being capable of controlling double-acting rams, single-acting rams, or hydraulic motors, if modified slightly.

The valve body (63) is a cast-iron casting, with cast-in galleries and is bored to accept precision ground spools (62).

The spools protrude from one end of the valve body and engage a bell-crank lever (82), movement of which determines the positioning of the spools and thus the flow of oil. The position of the bell-crank lever is maintained by a spring loaded ball (81) which engages one of the three slots in the radial selector plate (80).

The opposite end of the spool bore is enlarged to house the kick-out mechanism (75). The open ends of the spool bores are sealed by plugs (74) retained by circlips (73). The ball and spring valve (77 and 78), retained by the screwed plug (76) prevents unequal pressure in the hydraulic circuit thereby preventing jerky operation.

Kick-out Mechanism

Fig. 9. To prevent excessive exhausting of the circuit pressure relief valve, the Wooster spool valve incorporates a mechanism which returns the spool and actuating lever to the neutral position when a pressure of 140,5 Kg/cm^2 (2000 lb/in^2) is reached. The mechanism is as follows:–

The main spool (62) which slides in the valve body (63) is cross-drilled (A) and bored (B). Screwed into the end of the spool is a tubular spool extension (64) which houses a poppet valve (67) and valve guide (65) which is retained by a pin (66).

The valve guide is cross-drilled (C) to allow oil to flow into the chamber formed by the spool extension (64), but this cross-drilling is blocked off by a spigot on the poppet valve. The poppet valve is held against the end of the valve guide (position shown dotted) by the inner helical spring (68), whose pressure can be adjusted by the screwed plug (69). The tubular spool extension is also cross drilled (D) to allow oil to flow into an annular cavity formed between the two telescopic sleeves (70 and 71). When the spool is in the neutral position, both sleeves are fully extended (right hand sleeves as shown, left hand sleeve shown dotted) and are retained in this position by the outer spring (72).

Operation of the Kick-out Mechanism

Fig. 9. When the spool actuating lever is moved from the neutral position to either the raising or lowering position, oil is directed by the spool to various parts and galleries within the valve which determine whether lifting or lowering will occur. When the spool is moved the cross drilling (A) will always align with the port receiving oil from the hydraulic pump(s). Oil flows down the cross-drilling (A) along the spool centre bore (B) and into the valve guide (65). If the pressure is sufficient, it will lift the poppet valve (67) off its seat, against the pressure spring (68) and allow the oil to flow through the cross-drilling (D) into the annular chamber between the sleeves (70 and 71) where it can go no further. The pressure of oil will now continue to increase until the combined force of the oil pressure and the outer spring (72) force the left hand sleeve (70) back into the extended position (shown dotted) thus moving the spool and actuating lever back into the neutral position.

Figure 9 shows the spool set in the raising position. The action when lowering is generally similar, except that the left hand sleeve remains in its original position, and the right hand sleeve moves with the spool.

The kick-out mechanism will operate in all cases except when lowering a single acting ram, where no pressure is created in the system.

GENERAL NOTES WHEN FITTING AND OPERATING AUXILIARY HYDRAULICS

1. All hydraulic systems must have a correctly adjusted pressure relief valve. Adjusting relief valves to open at a higher pressure than is normally recommended is dangerous and can also cause extensive damage to components within the system.
2. All components which come into contact with the hydraulic fluid must be kept scrupulously clean. Even minute particles of dirt or grit can cause extensive damage to pumps, seals, rams and motors.
3. The pressure relief valve should not be allowed to blow continuously, as this can cause overheating and frothing of the hydraulic fluid, thus reducing the lubricational properties of the oil, allowing air bubbles to enter the system and may cause the oil to become so thin that it can aggravate leaks past seals.
4. Always ensure that the hydraulic system contains sufficient fluid to supply the whole system. Lack of oil will result in vapour locks and jerky operation.
5. All unions must be kept tight and all seals must be effective, for the system to work efficiently.
6. If any of the services fail to function, never remove a hose to see whether fluid is flowing. Switch off the tractor engine first, fit a pressure gauge and check the flow.
7. When fitting hydraulic hoses, always route them in such a manner that no kinking or twisting of the hose occurs. Kinking and twisting of hoses restricts flow, reduces efficiency and in extreme cases, can cause over-heating of the hydraulic fluid.

WOOSTER SPOOL VALVE OPERATION

The following set of flow diagrams are intended as a guide to the correct methods of arranging auxiliary hydraulic equipment to give the best performance in the field. Every possible variation of machine and flow cannot be shown in this publication. Indeed, if they were, they would serve only to confuse rather than clarify.

All equipment described in the following diagrams is of the type described in section seven of this manual, except where stated.

Flow within the Wooster Spool Valve

The following description of flows within the valve is intended as a guide which should enable fitters to trace a fault within the valve by checking for flow at various lever positions.

In all of the following illustrations, up to three different colours are used, and illustrate the condition of the hydraulic oil as follows :

RED	– Oil under pressure
YELLOW	– Oil flowing back to pump or sump
BLUE	– No flow (hydraulic lock)

In some cases, the point at which pressurised flow ends and free flow begins is obscure. Under these circumstances, pressurised flow is shown all through the valve (e.g. neutral). In some cases, flow back to pump and pressurised flow combine to flow back to pump. In these cases, only YELLOW will be shown from where the flows combine (e.g. single-acting lowering).

Neutral (Fig. 10)

When the actuating lever on the spool valve is in the Neutral (central) position, oil (red) flows into the spool valve through the inlet port (G). Due to the positioning of the spool(s) the oil then flows straight through the cross-porting (E) into the exhaust port (F) and then back to the pump. When the spool is in neutral position, the port(s) connecting the ram or motor (H and I) are cut off from the oil flow and can neither lift nor lower. Even though there is a direct flow from the inlet to the exhaust port, there will be a certain amount of back-pressure within the system which will lift the ball valve (78) and allow oil to completely fill the valve. The position of the switch valve (79) is not important.

Double–Acting Raising (Lever Back) (Fig. 11)

Oil (red) is fed from the inlet port (G) into the spool bore. As one spool is in the neutral position, no oil is fed into either of its ports. The oil pressure then lifts the ball valve (78) and oil flows along the cross-drilling to the 'LIFT' port (H). The oil then flows into the ram and extends it. As the ram extends, oil (yellow) is forced from the opposite side of the ram and is fed back into the valve through the DROP port (I). Spool positioning is such that the oil flows along the return gallery to the exhaust port (J). The switch valve (79) must be fully closed, as shown.

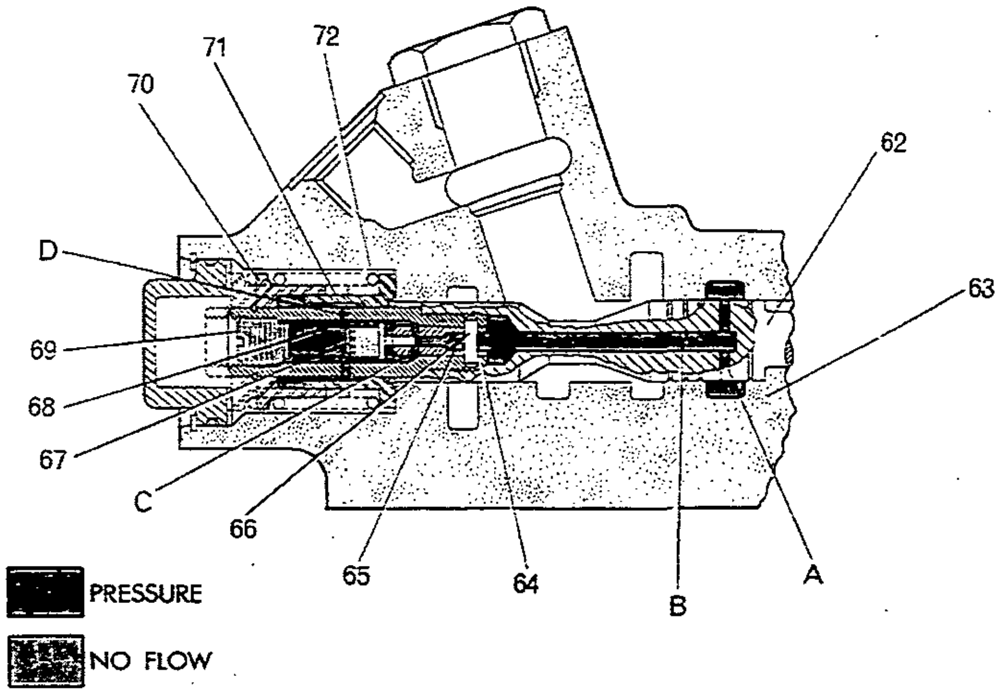

72
71
70
62
D
63
69
68
67
C
66
65
64
B
A
PRESSURE
NO FLOW

FIG. 9

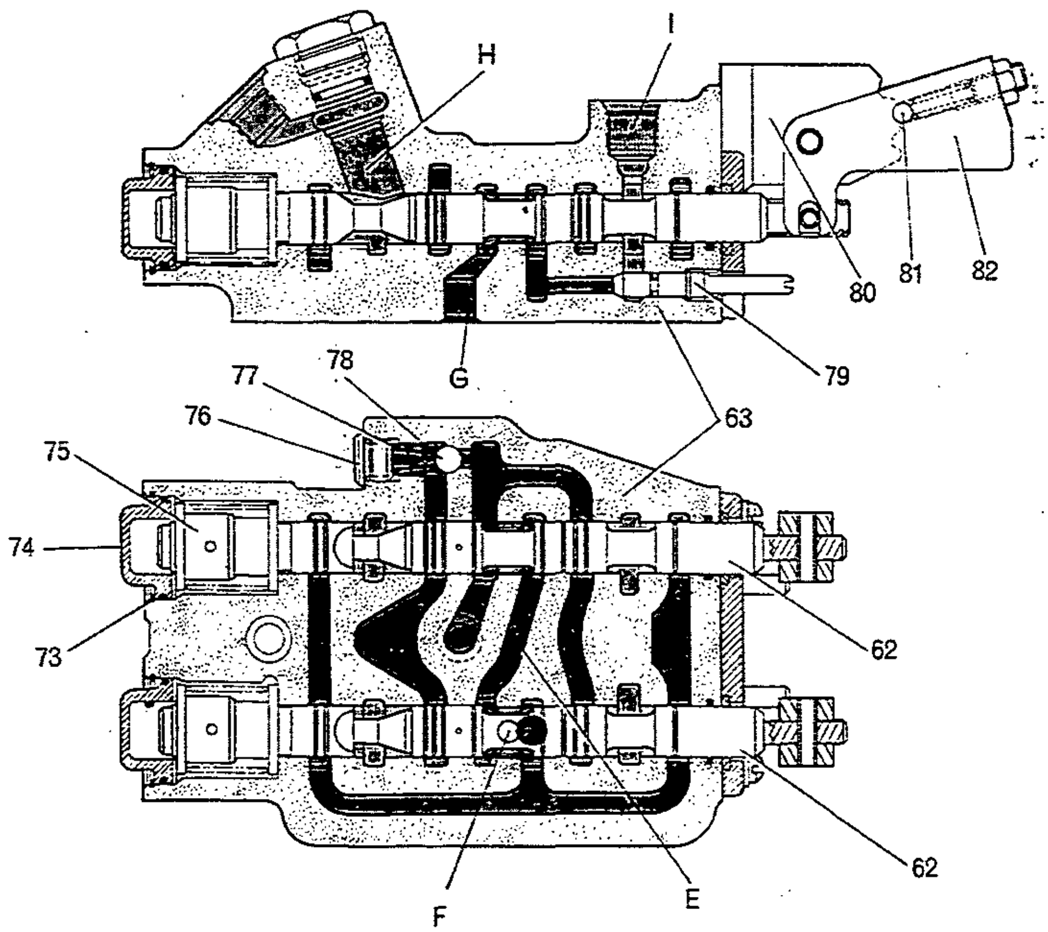

I
H
80
81
82
79
G
78
77
76
63
75
74
62
73
62
F
E

FIG. 10

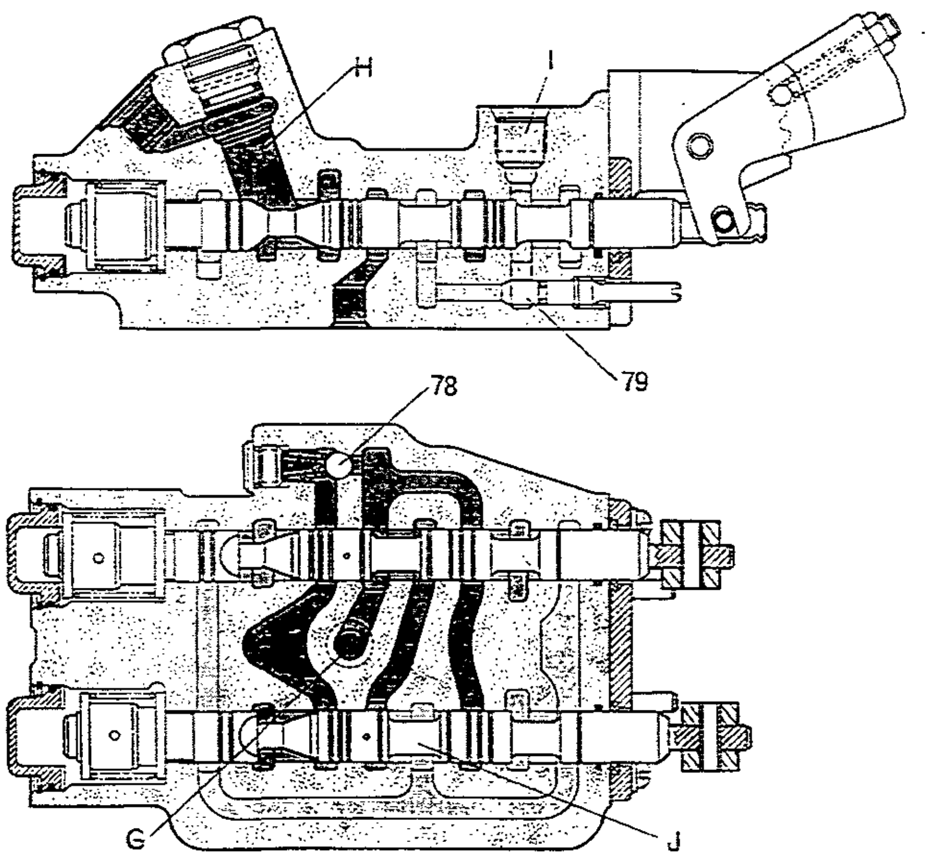


FIG. 11

PRESSURE.

FLOW.

NO FLOW.

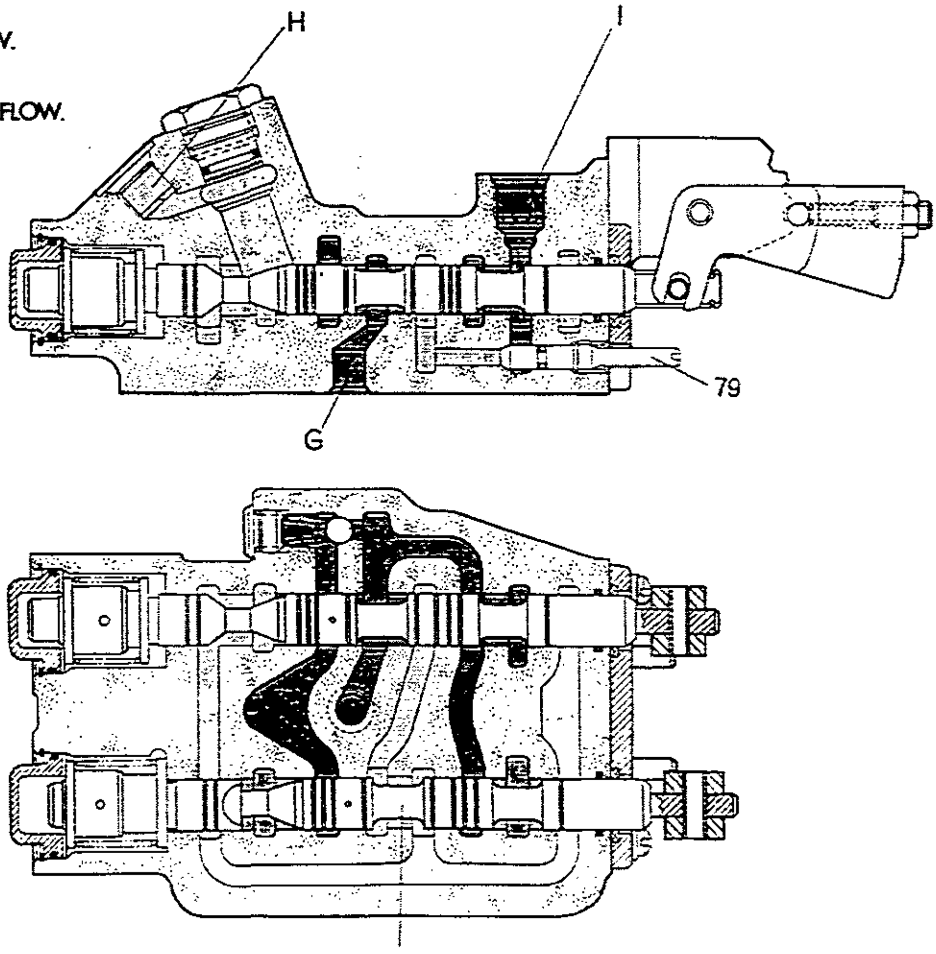


FIG. 12

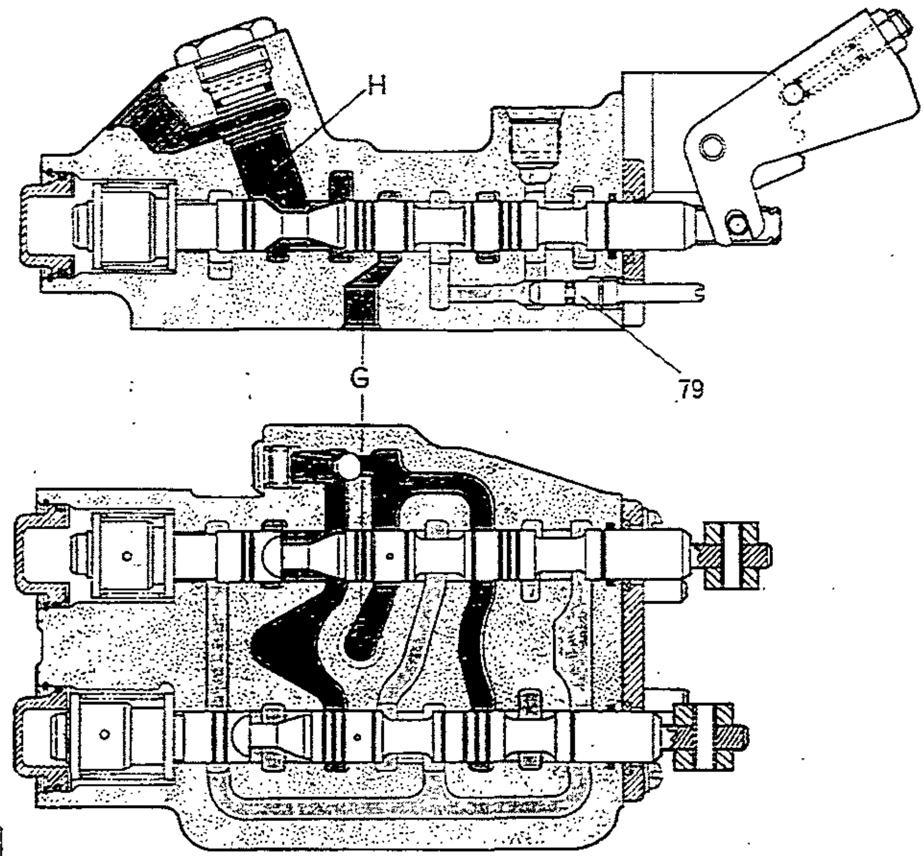


FIG. 13

PRESSURE

FLOW

NO FLOW

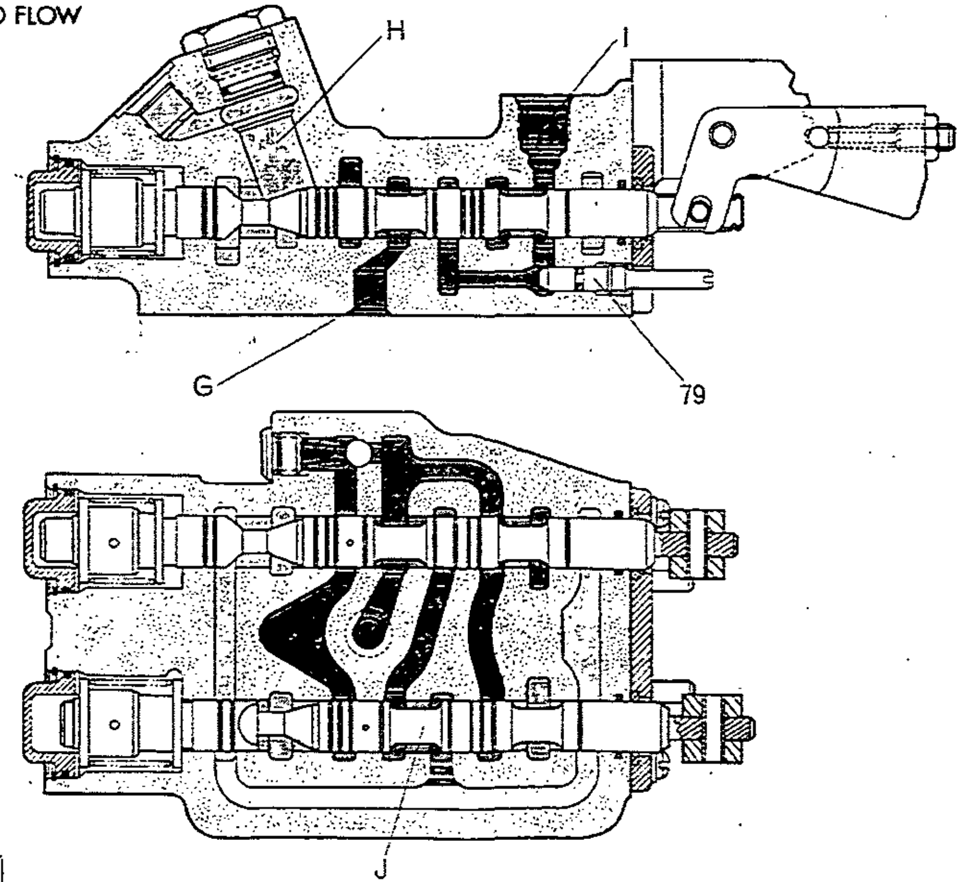
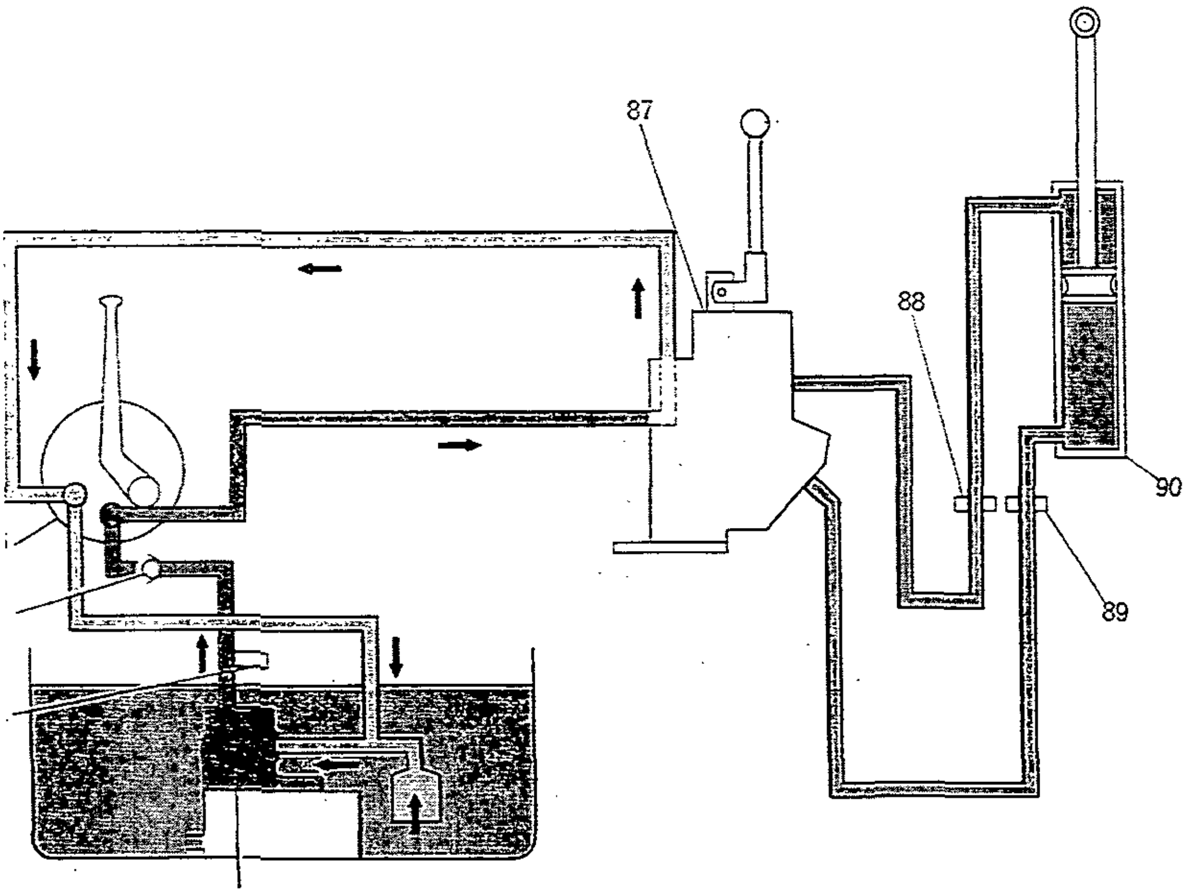


FIG. 14

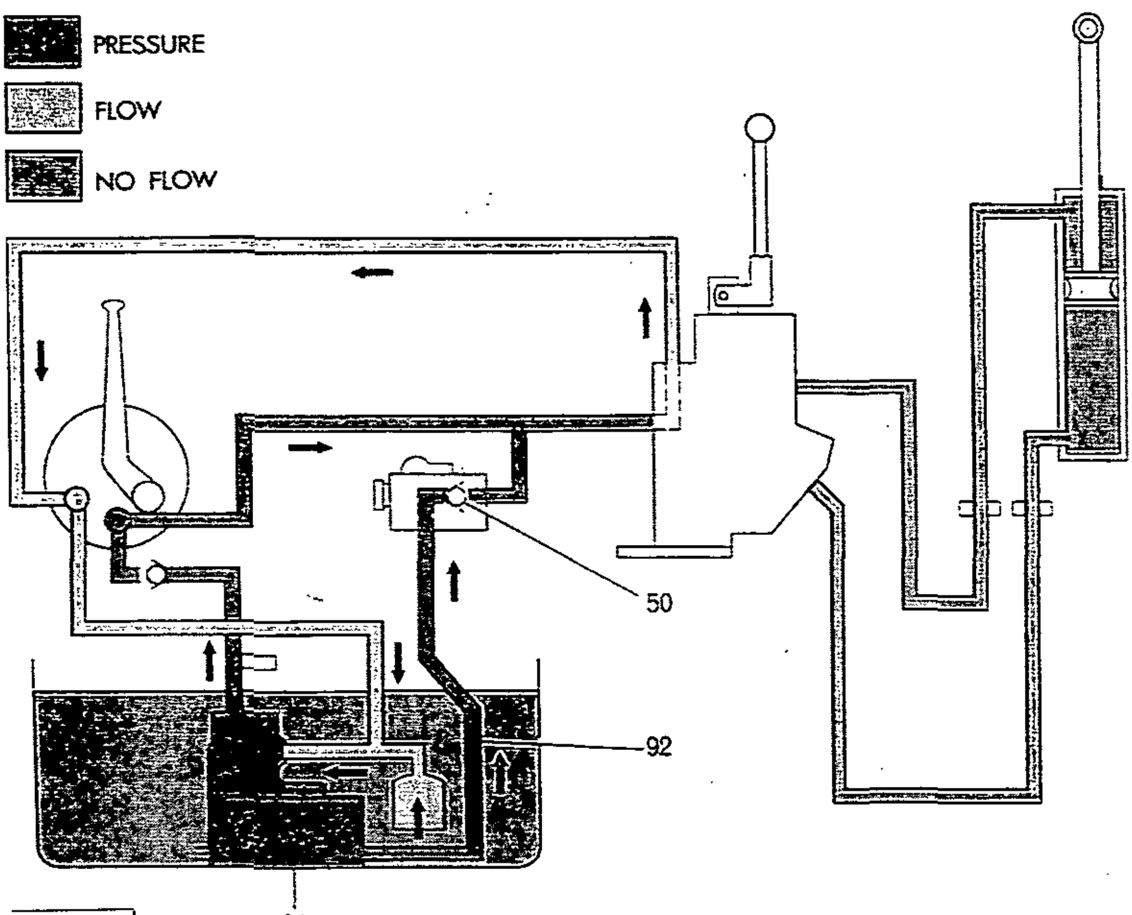


IG. 15A

PRESSURE

FLOW

NO FLOW



IG. 15B

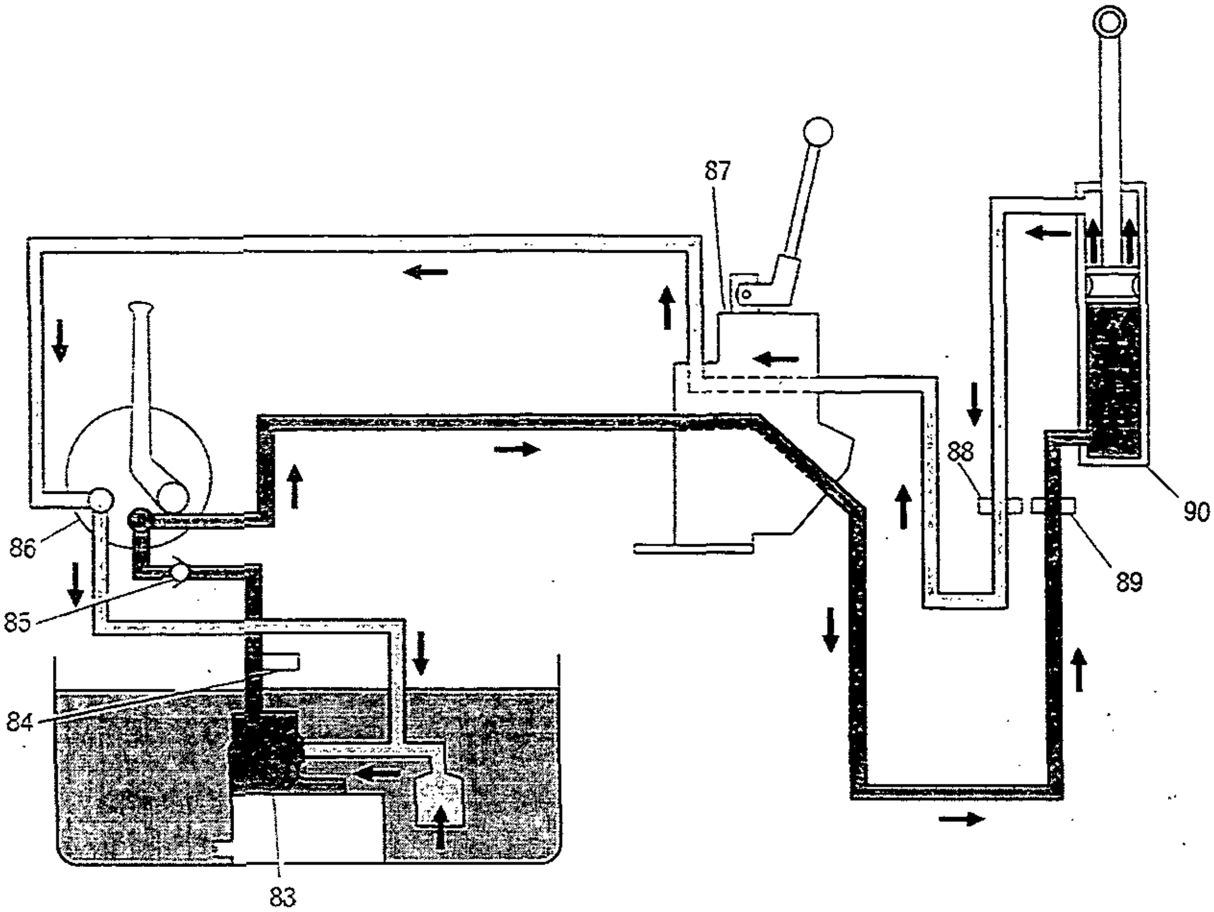


FIG. 16A

PRESSURE
FLOW
NO FLOW

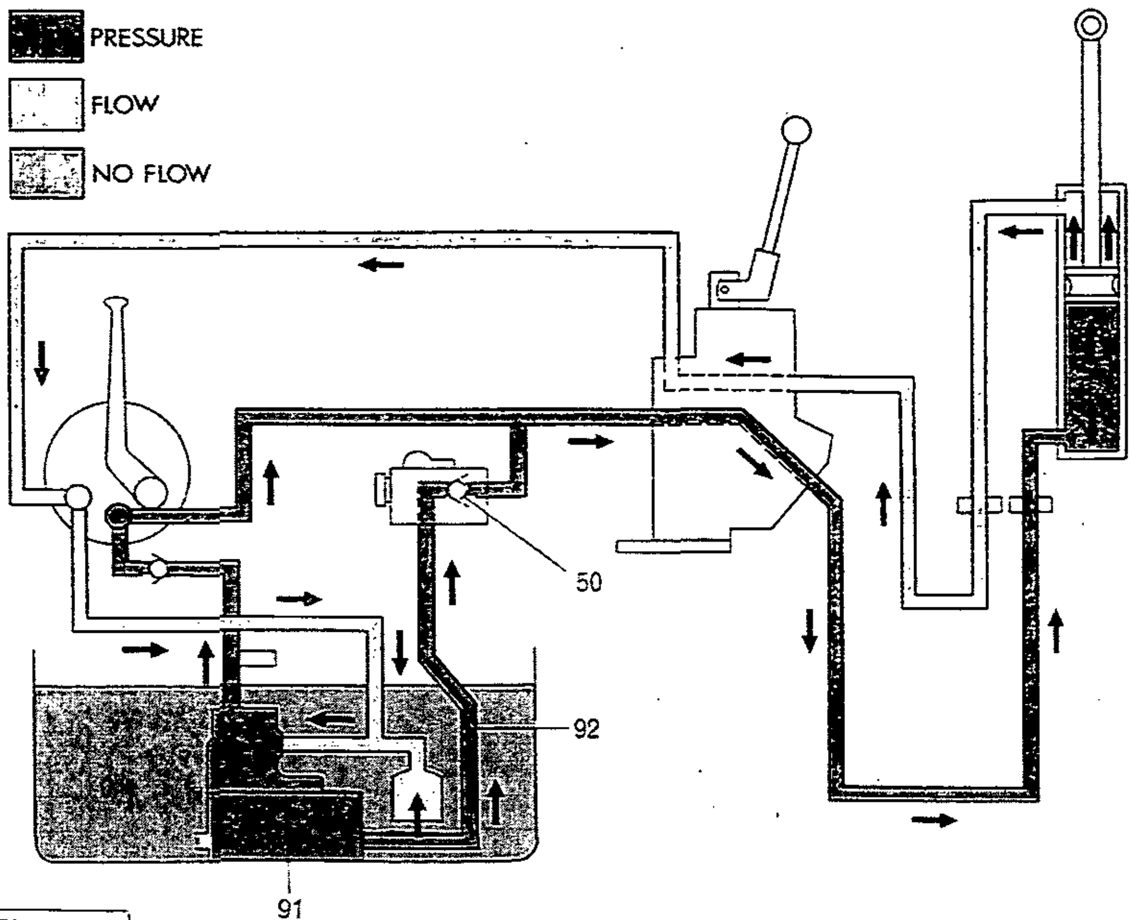


FIG. 16B

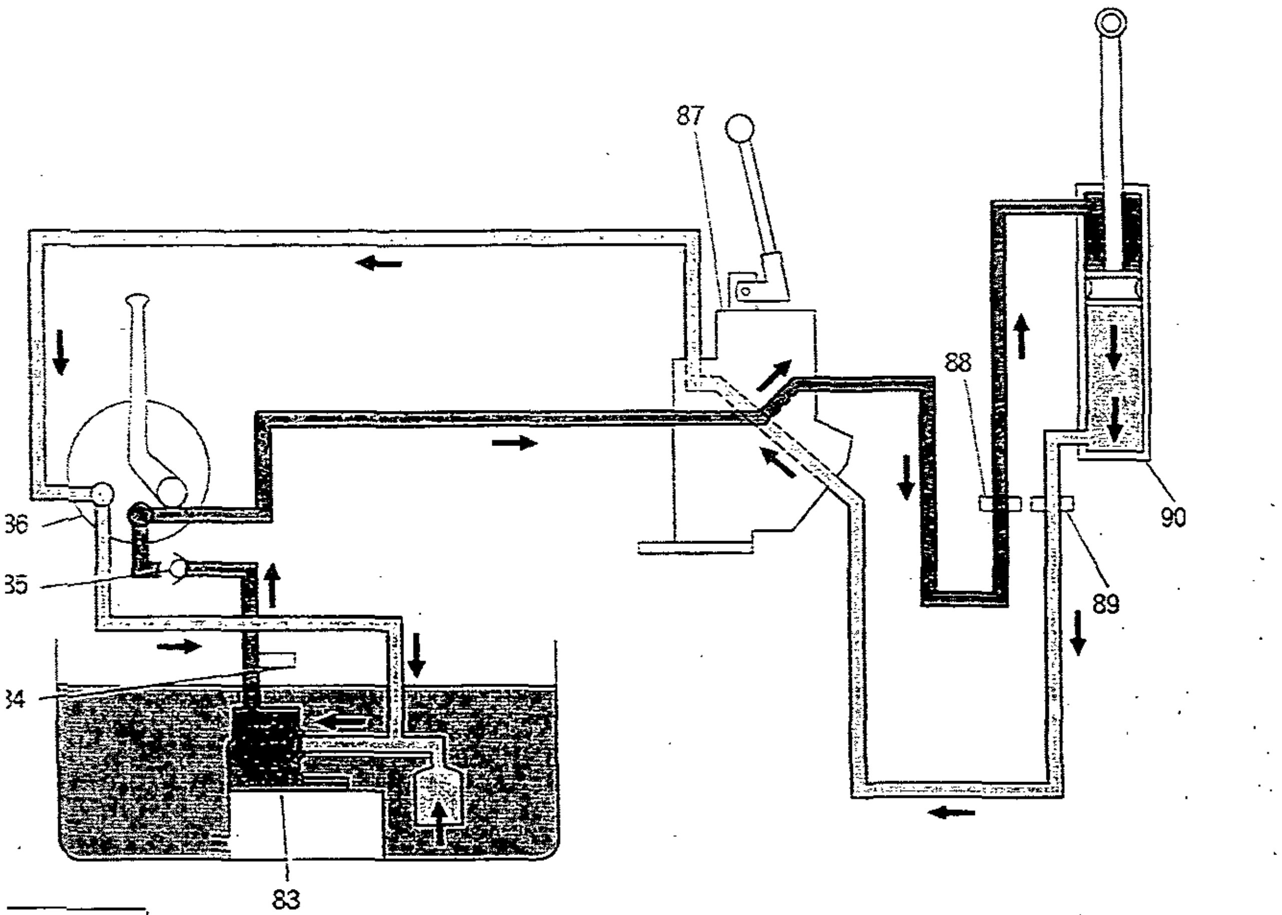


FIG. 17A

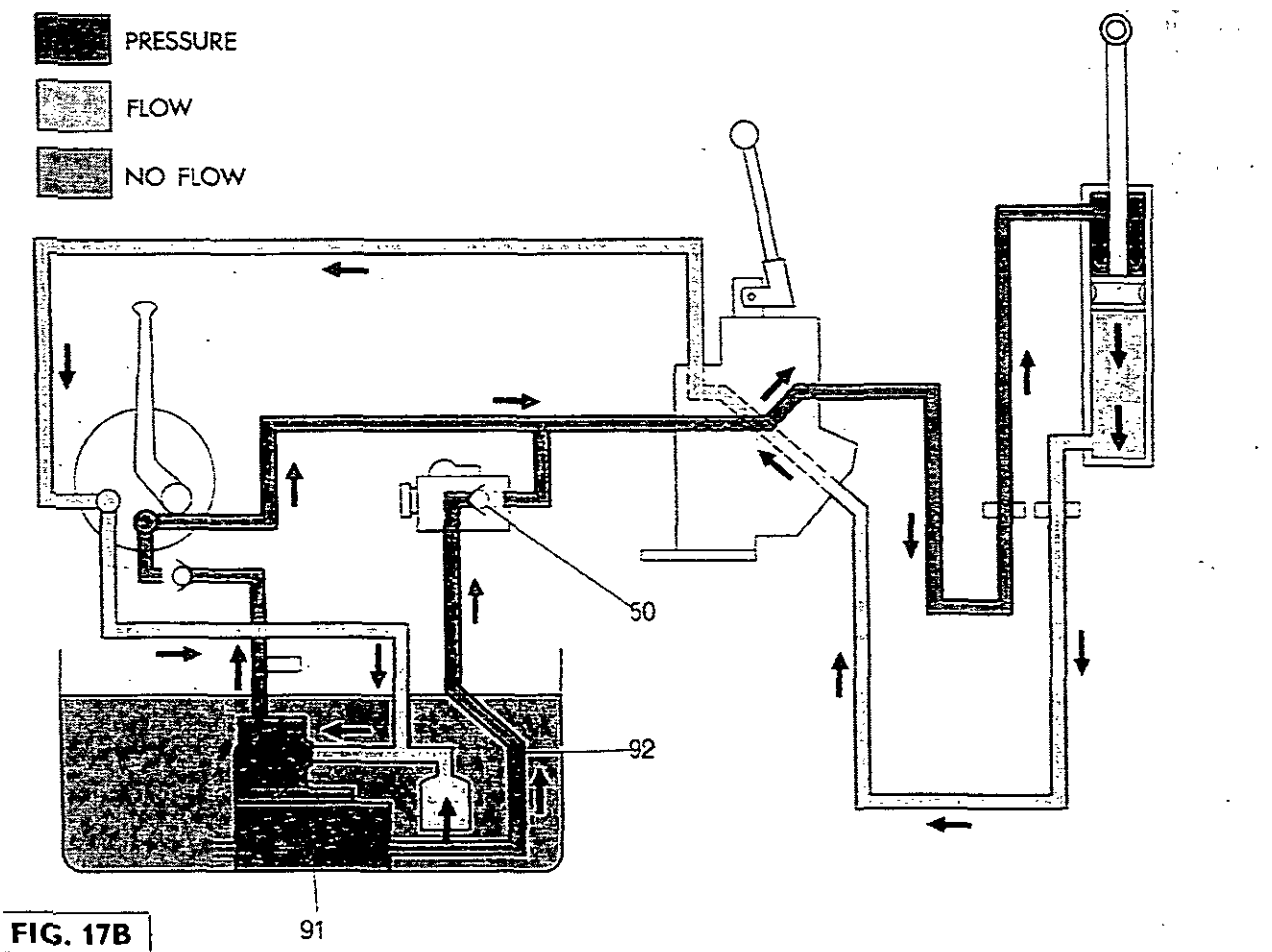


FIG. 17B

Double-Acting Lowering (Lever Forward) (Fig. 12)
When the lever is pushed forward, oil (red) is fed from the inlet port (G), out of the 'DROP' port (H) to the ram, thus expelling oil (yellow) from the opposite side of the ram back to the 'LIFT' port (I). The oil then flows along the return gallery to the exhaust port (J). The switch valve (79) must be fully closed, as shown for double-acting operation.

Single–Acting Neutral (Lever Central)(Not illustrated)
The neutral flow for single-acting is similar to that for double-acting except that the 'DROP' port (H Fig. 4) is blanked off by the self-sealing quick release hose coupling.

Single-Acting Raising (Lever Back) (Fig. 13)
For single-acting operation the switch valve (79) must be unscrewed five full turns from 'fully in' position. Oil (red) flows from the inlet port (G) into the spool bore. The oil is directed by the spool to the 'LIFT' port (H) where the oil then flows to the ram and extends it. As the 'DROP' port is blanked off, there is no flow from the ram back to the spool, and consequently, no flow back to pump from the valve. The oil (blue) in the return gallery, to all intents and purposes, does not flow.

Single–Acting Lowering (Lever Forward) (Fig. 14)
With the actuating lever placed in the forward position, the position of the spool is such that oil (red) enters the valve through the inlet port (G) and is directed by the spool to the 'DROP' port (I). As the 'DROP' port is blanked off, and the switch valve (79) is open, the oil returns straight into the exhaust port (J). Oil (yellow) is also flowing from the ram as it contracts, and enters through the 'LIFT' port (H). Due to the position of the spool, the oil is directed from the 'LIFT' port into the return gallery, where it flows into the exhaust port (J) and combines with the pump flow, to flow back to tank (shown as yellow).

CIRCUIT FLOWS

The following flows, although purely diagramatic, are intended as a guide to the correct methods of setting up hydraulic circuits on tractors fitted with the auxiliary pump. Each particular flow will have a two-part illustration; part A being for the auxiliary pump alone and part B for the combined auxiliary and linkage pumps, as the basic flow is similar once the flows have combined.

There are non-return valves incorporated in the circuit to prevent damage if one of the pumps malfunctions. The relief valve is fitted between the auxiliary pumps and non-return valve in the auxiliary pump circuit and thus allows the full 211 Kg/cm^2 (3000 lb/in^2) to be used for short periods. The non-return alve in the linkage pump circuit is in the combining valve.

Key to All Circuit Diagrams Fig. 15A to 21B

83	Auxiliary Hydraulic Pump	
84	Pressure relief valve.	
85	Non-return valve.	
86	P.t.o. side cover	
87	Wooster spool valve.	
88	Upper 'Pioneer' coupler	(yellow, or blue identification tag).
89	Lower 'Pioneer' coupler	(red, or white identification tag).
90	Double-acting ram	
91	Tractor linkage lift pump	
92	Tractor standpipe	
50	Combining valve	
93	Single-acting ram	
94	Special balance pipe	
95	Hydraulic motor	

Double–Acting Ram-Wooster Spool Valve
Neutral (Lever Central) Fig. 15A and 15B
Oil (red) is drawin into the auxiliary pump through the filter and pumped, under pressure, to the manifold on the p.t.o. side cover. The oil is then piped into the Wooster spool valve inlet port, where, due to spool positioning, it flows straight out again through the exhaust port on the valve (see Fig. 12). The oil (now yellow) flows down the return pipe to the p.t.o. cover, where it is piped back into the hydraulic pump. As approximately 25% of the oil delivered by the pump is required to operate the Multi-power and does not return to the pump, the required quantity isdrawn through the filter.

When the combined pumps are employed as shown in Figure 5B oil (red) flows from the linkage lift pump, up the standpipe to the combining valve, which if open, will allow the oil to be piped to the tee-piece on the spool valve, and thus supplement the output of the auxiliary pump. When combined pumps are employed, the oil pumped by the tractor linkage pump will also be returned to the auxiliary pump. There will therefore, be very little intake through the filter into the auxiliary pump.

Double-Acting Ram-Wooster Spool Valve
Raising (Lever Back) (Fig 16A and 16B)
Oil (red) is drawn into the pump(s) and is piped via either the p.t.o. side cover, or the combining valve to the tee-piece union on the spool valve. The oil, directed by the spool position, flows from the valve out of the 'LIFT' port to the quick release coupling hose which has either a white (L.H.) or red (R.H.) coloured identification tag. Connected to the quick release coupling is the ram hose, along which the oil flows to the ram. When the oil pressure exceeds the load, the ram extends. Oil (yellow) is forced from the opposite side of the ram and flows along the second ram hose, which is connected to the upper quick release coupling [yellow (L.H.) or blue (R.H.) identification tags]. The oil re-enters the spool valve through the 'DROP' port, and is routed through the valve, back through the p.t.o. side cover to the auxiliary pump.

Double-Acting Ram-Wooster Spool Valve
Lowering (Lever Forward) Fig. 17A and 17B
Oil (red) is drawn into the pump(s) and is piped to the spool valve tee-piece union, via either the p.t.o. side cover or the combining valve. The oil is directed by the spool to the 'DROP' port on the valve, which is connected to another quick release coupling hose [yellow (L.H.) or blue (R.H.) identification tags].

The oil flows through the quick-release coupling, and along the ram hose to the ram which contracts. As the ram contracts, the oil (yellow) on the opposite side of the ram is forced back along the hose to the other quick release coupling hose [white (L.H.) or red (R.H.) identification tags] and into the valve through the 'LIFT' port. The oil then flows from the valve, through the p.t.o. side cover and into the pump, to be re-circulated.

Single–Acting Ram-Wooster Spool Valve
Neutral (Lever Central) Fig 18A and 18B

The neutral flow for single-acting rams is generally similar to that for double-acting, except that only one ram hose is employed. The self-sealing, quick release coupling prevents flow from the'DROP' port hose. The switch valve must be unscrewed five full turns from the 'fully in' position.

Single-Acting Ram-Wooster Spool Valve
Raising (Lever Back) Fig. 19A and 19B

Oil (red) is drawn into the pump(s) and is pumped, under pressure, to the spool valve, via either the tractor standpipe and combining valve, or the p.t.o. side cover. The oil is channelled through the valve to the 'LIFT' port. From the 'LIFT' port the oil flows along the quick release coupling hose, (white or red identification tag) to the ram hose and finally into the ram. The ram extends. The return pipe from the valve to the pump may contain some oil (blue), but as very little of this will be drawn back into the pump, a condition of 'no flow' may be considered to exist.

Single-Acting Ram-Wooster Spool Valve
Lowering (Lever Forward) Fig. 20A and 20B

When the valve actuating lever is placed in the forward position, filtered oil (red) is drawn from the pump(s) and is routed to the spool valve, via either the tractor standpipe and and combining valve, or the p.t.o. side cover. The oil flows into the valve and is routed to the 'DROP' port. As this is blanked off, but the switch valve is open, the oil flows to the return port. The oil (yellow) in the ram is forced out as the ram contracts, due to gravity or spring pressure, and the oil flows back along the quick release coupling hose to the 'LIFT' port. As the spool is in the lowering position, the oil flows into the return gallery and combines with the pump flow, to flow back to the auxiliary pump.

Hydraulic Motor (Single-Acting Operation)
(Lever Back) Fig. 21A and 21B

Oil (red) is drawn into the pump(s) and flows to the spool valve via either the p.t.o. side cover, or the tractor standpipe and combining valve. The oil flows from the 'LIFT' port on the valve, along the quick release coupling hose (white/or red tag) to the motor hose. The oil flows into and drives the motor, the exhausted oil (yellow) flowing back to the upper quick release coupling hose (yellow or blue tag). The oil can either flow through the valve back to the return hose, or through the balance hose to the return pipe and then back to the pump. The by-pass hose is required to prevent burst seals when stopping the motor, i.e. when the valve is placed in the neutral position, the flow of oil to and from the motor, which is rotating at speed, will continue. Its momentum will allow it to carry on running for a short time, during which it will draw oil from the pressure side of the motor and attempt to transfer it to the non-pressure side. As the oil cannot escape, the seals in the circuit will fail. The balance pipe allows the oil to flow back to the pump without this pressure building up.

IMPLEMENTS WITH THEIR OWN SPOOL VALVES

When fitting machines with their own valves, certain precautions must be taken to ensure safe, efficient operation.

A pressure relief valve must be fitted.

If the machine is to be removed from the tractor, the p.t.o. side cover must be restored to its original condition. The manifold, banjo bolts, washers and gaskets (Figure 22) must be refitted.

NEVER UNDER ANY CIRCUMSTANCES, FIT BLANKING PLUGS IN PLACE OF THE MANIFOLD AND BANJO BOLTS

Operation

Precise instructions as to the correct operational technique cannot be given, due to the wide range of equipment and differing procedures. Manufacturers of such equipment usually provide more specialised instructions and should be consulted if these are not readily available.

WOOSTER SPOOL VALVE

Kit Fitment 7B-10-18

Auxiliary Hydraulic Tractors

Assembly

1. Remove the seat.
2. Remove the top bolts and nut securing each trumpet housing to the centre housing.
3. Place the 'Draft Control' lever in the 'DOWN' position.
4. Fig. 35. Remove the two bolts (47) securing the transfer cap (48) then carefully ease off the transfer cap, ensuring that the standpipe is not displaced from its location in the hydraulic pump.
5. Fit the combining valve, as stated in operation 7B-08-09
6. Drain the transmission oil to the 'MIN' mark on the dipstick.
7. Remove the two bolts securing the L.H. footplate to its rear support bracket.
8. Remove the UPPER bolt securing the L.H. footplate rear support bracket to the centre housing, then slacken the lower bolt and swing the bracket downwards to clear the side cover.
9. Remove the two banjo bolts and the manifold from the p.t.o. side cover.
10. Fig. 23. Fit the two unions (93 and 94) to the p.t.o. side cover, as shown.
11. Refit the footplate rear support bracket to the p.t.o. side cover, but do not refit the footplate to bracket bolts.

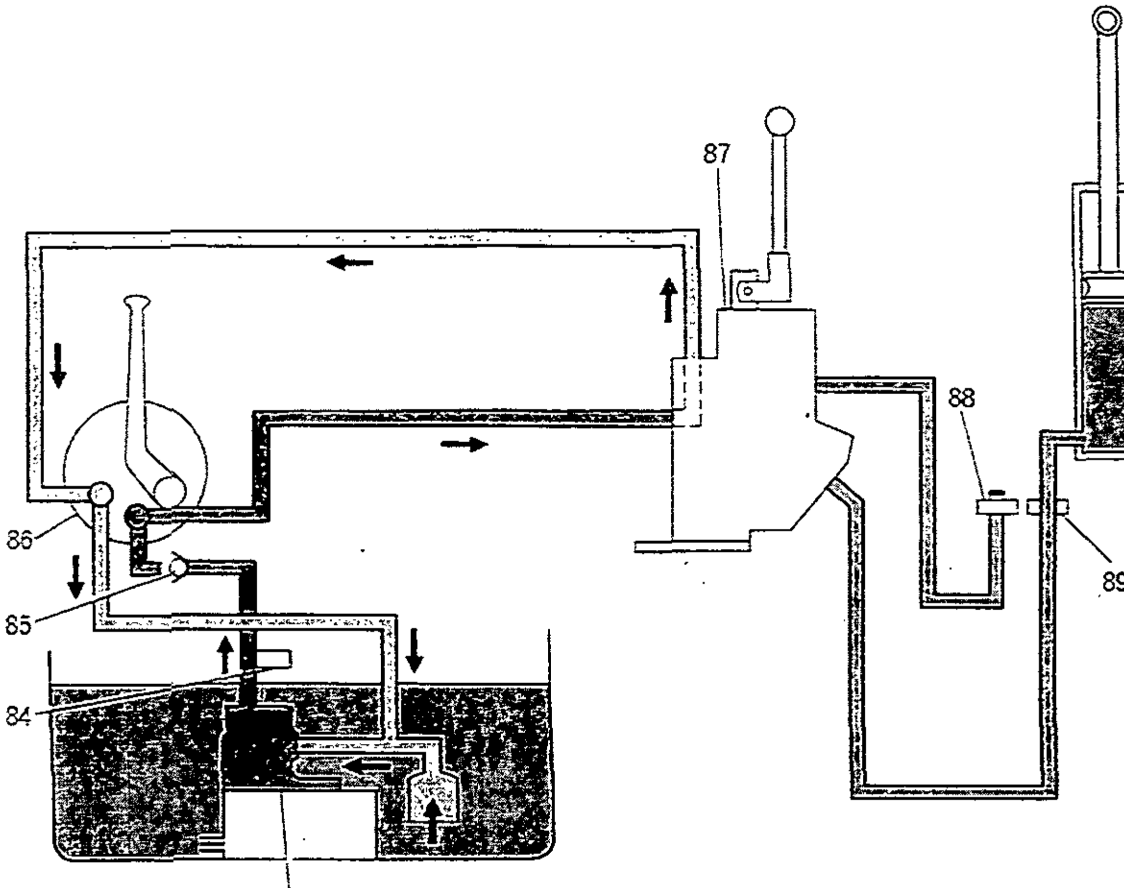


FIG. 18A

PRESSURE
FLOW
NO FLOW

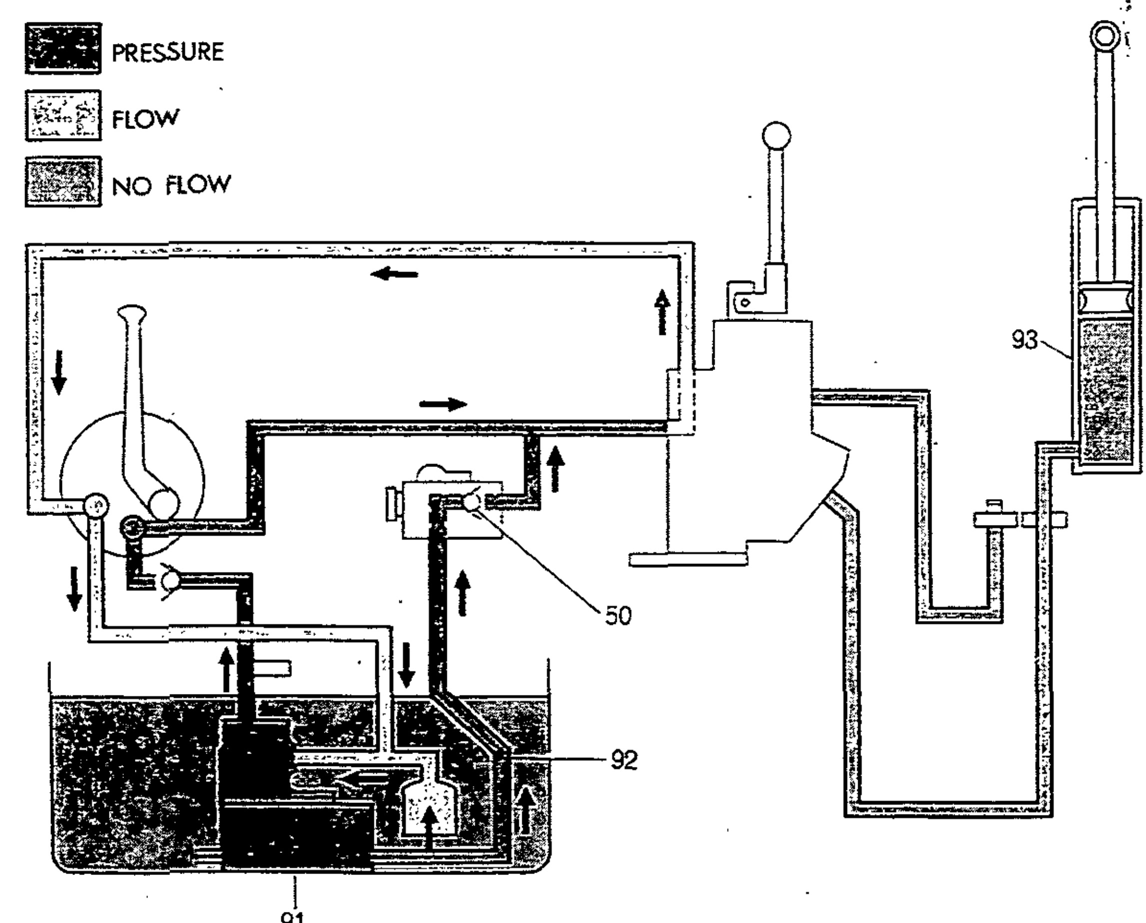


FIG. 18B

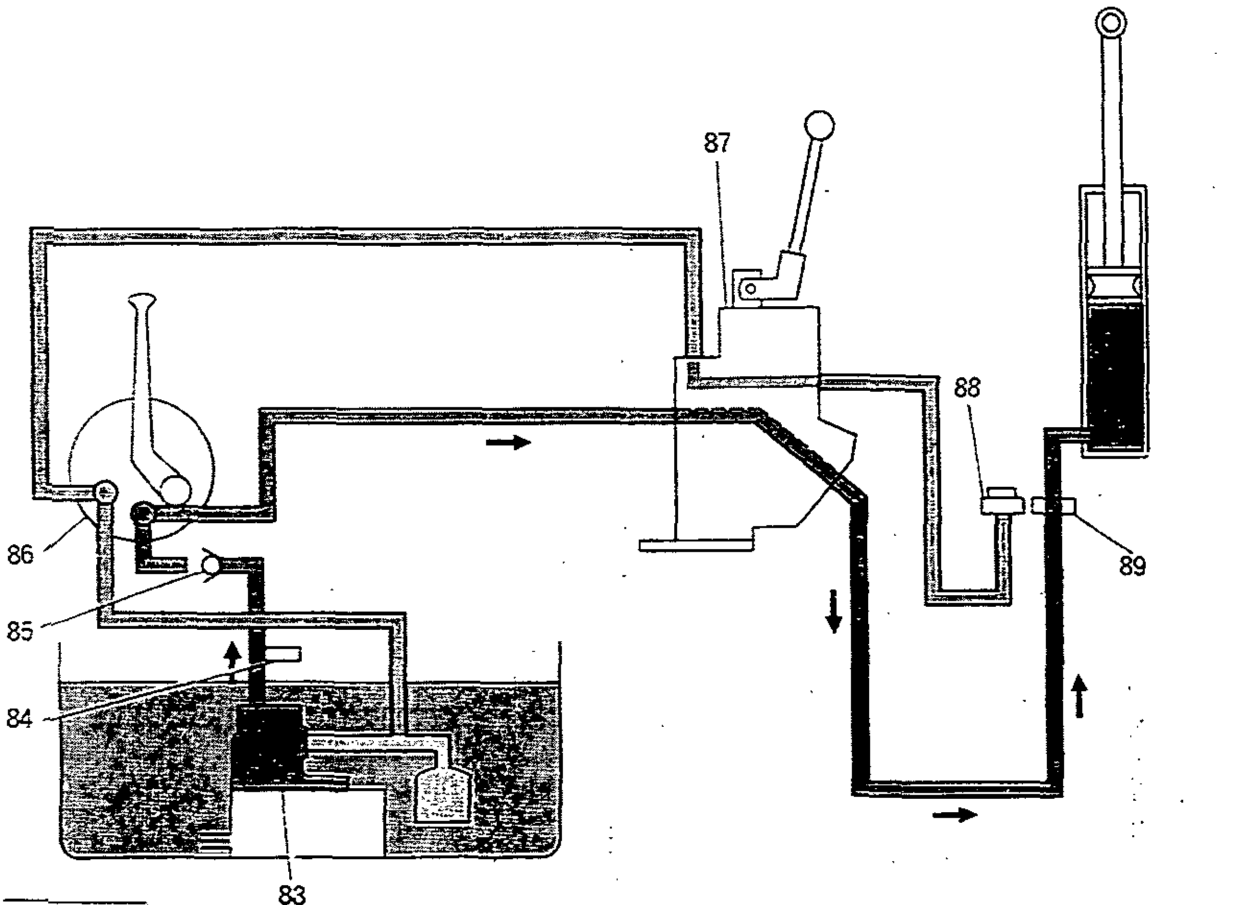


FIG. 19A

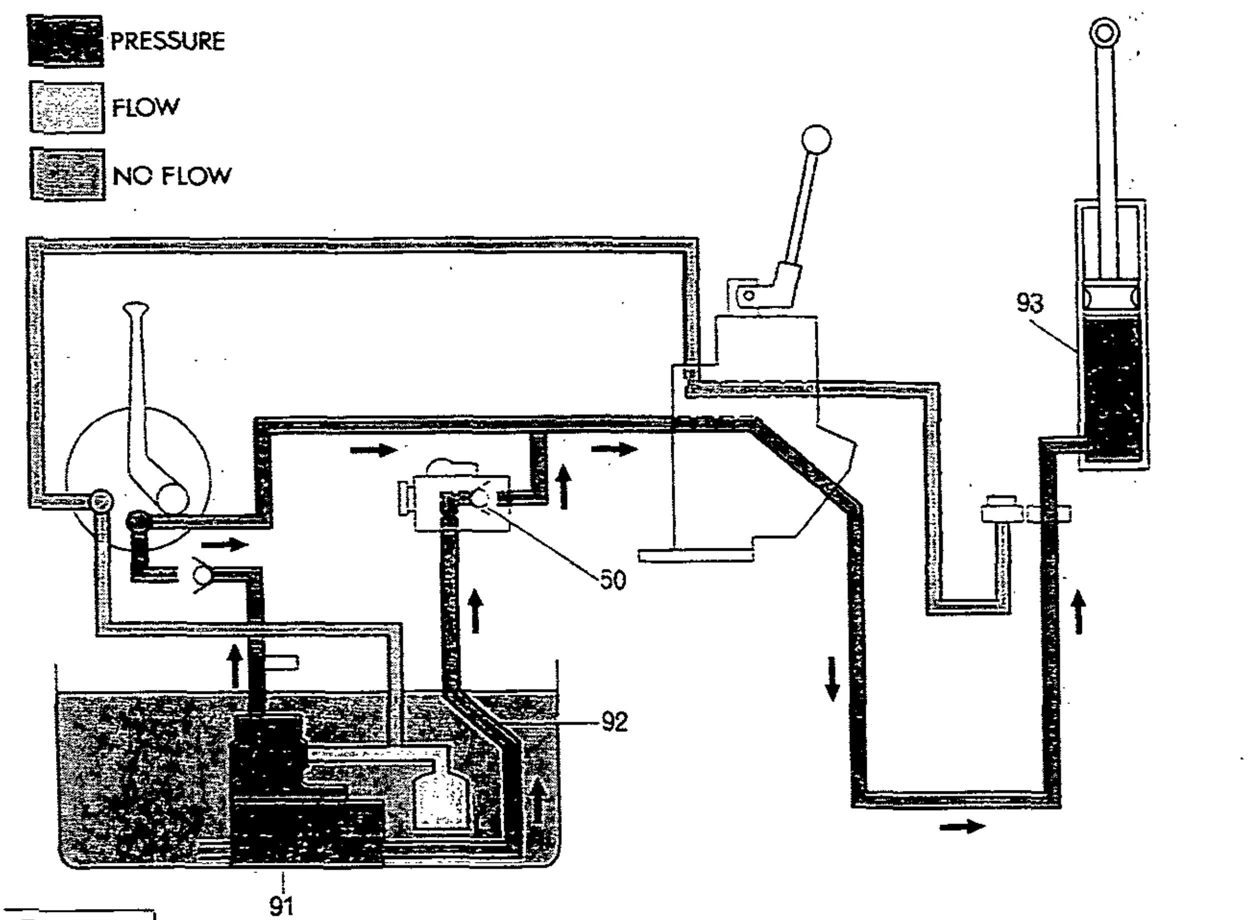


FIG. 19B

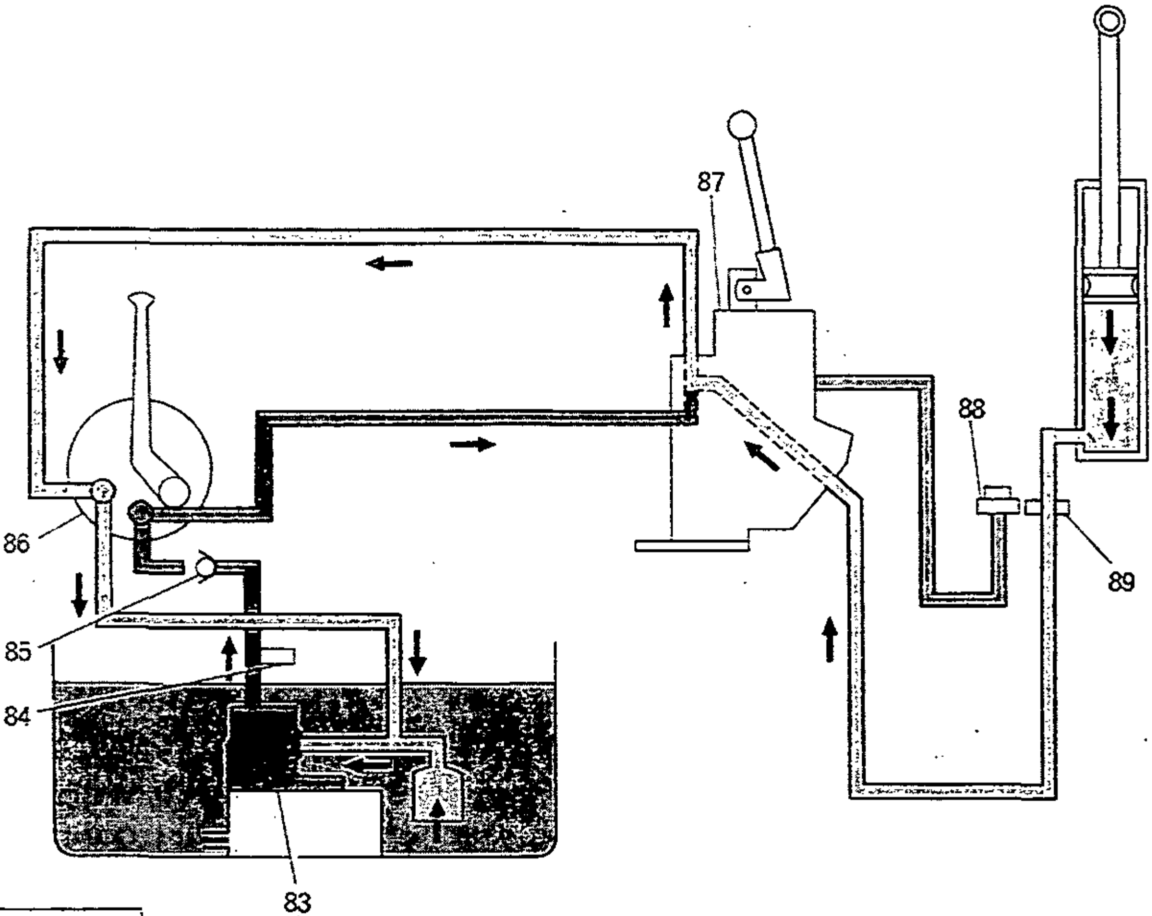


FIG. 20A

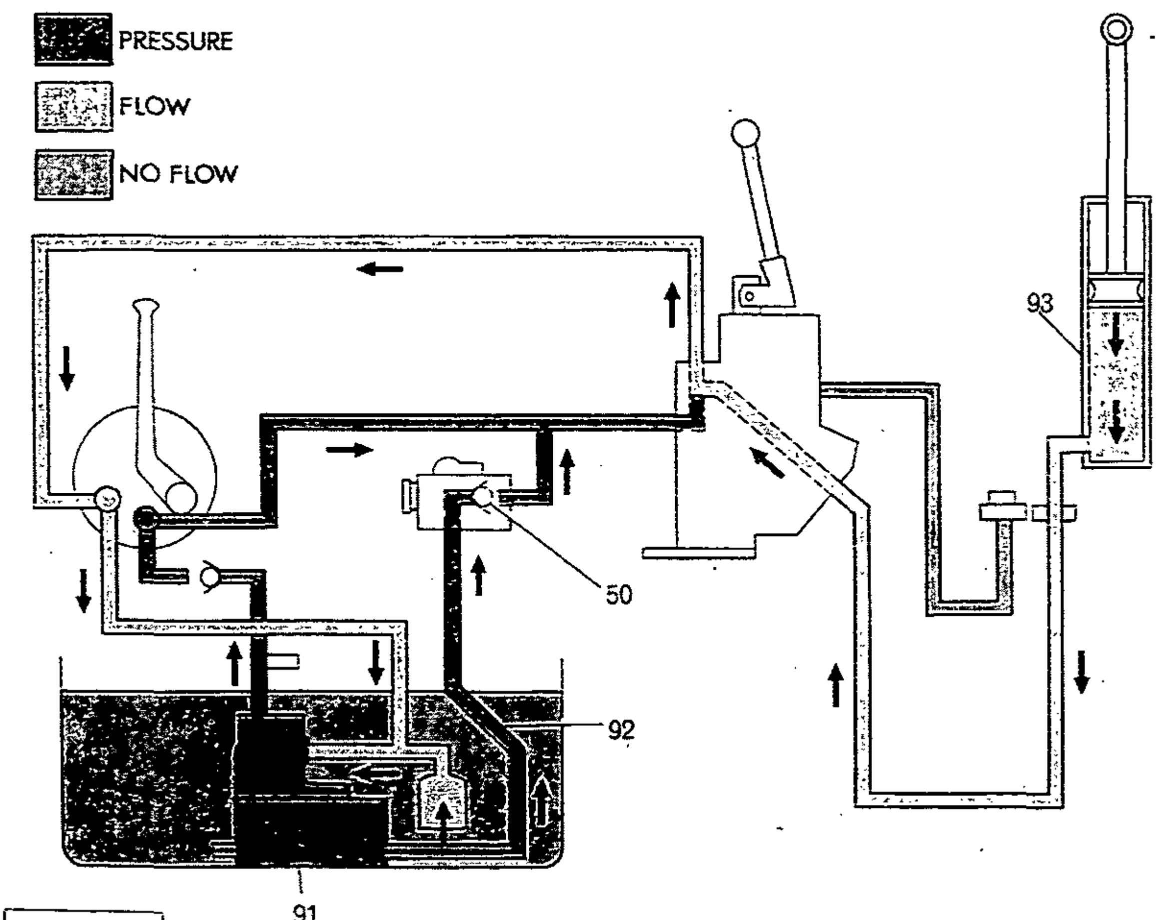


FIG. 20B

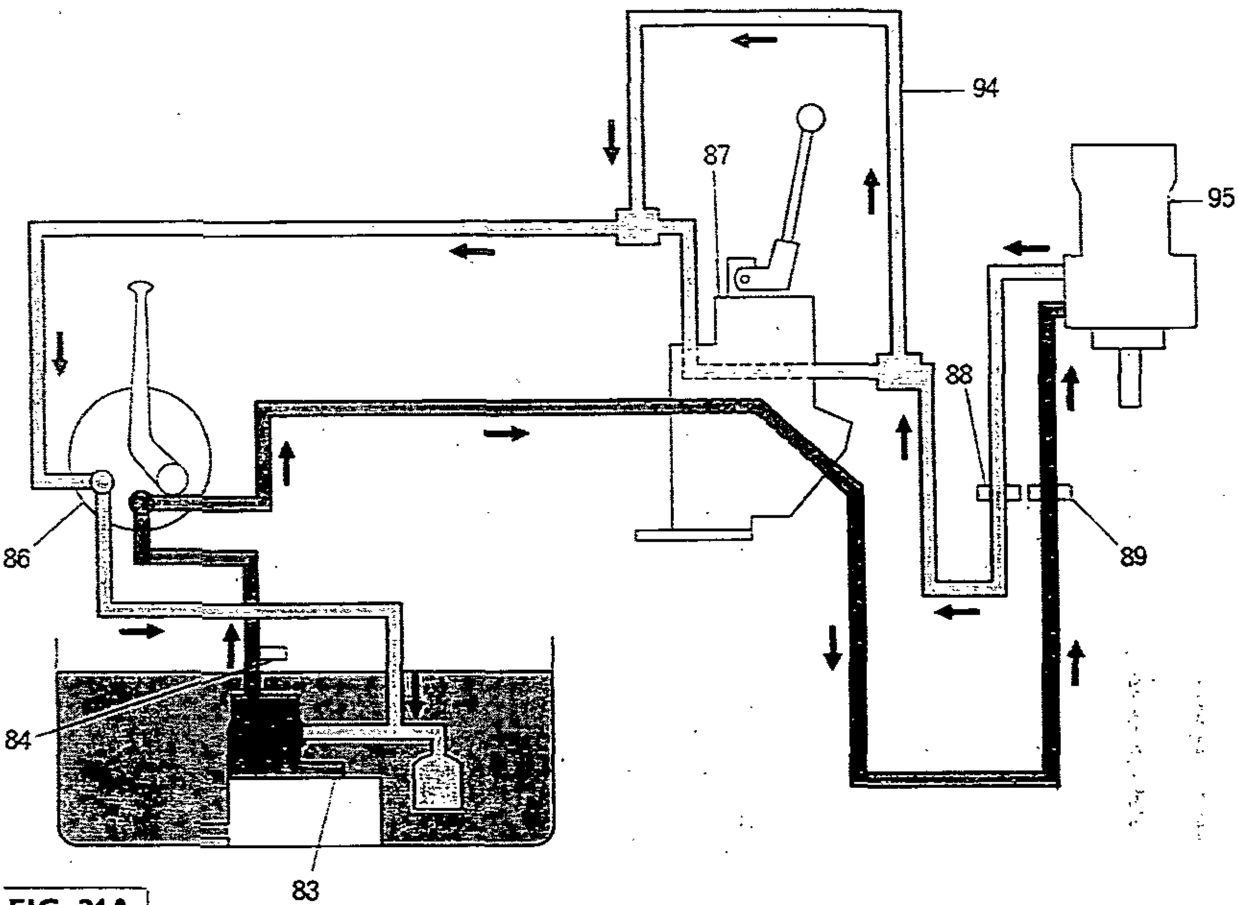


FIG. 21A

PRESSURE

FLOW

NO FLOW

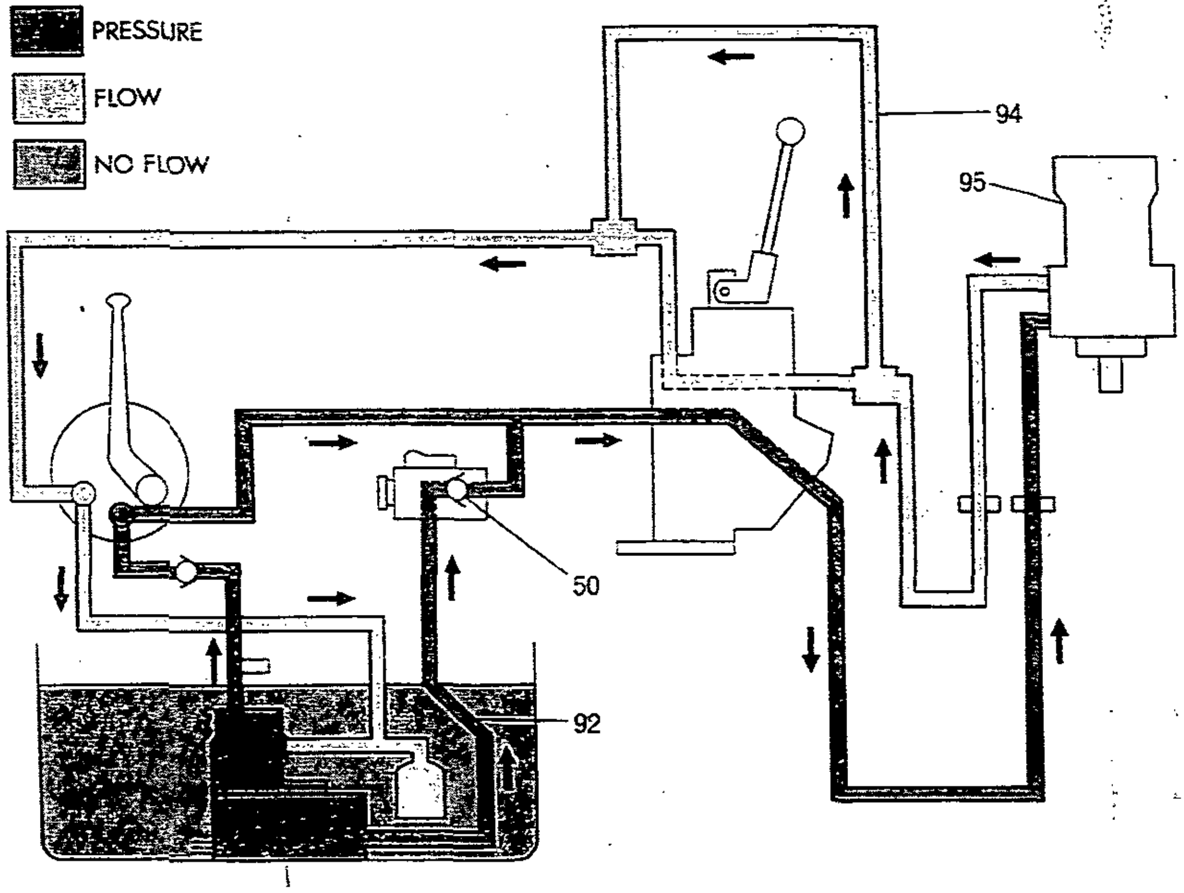


FIG. 21B

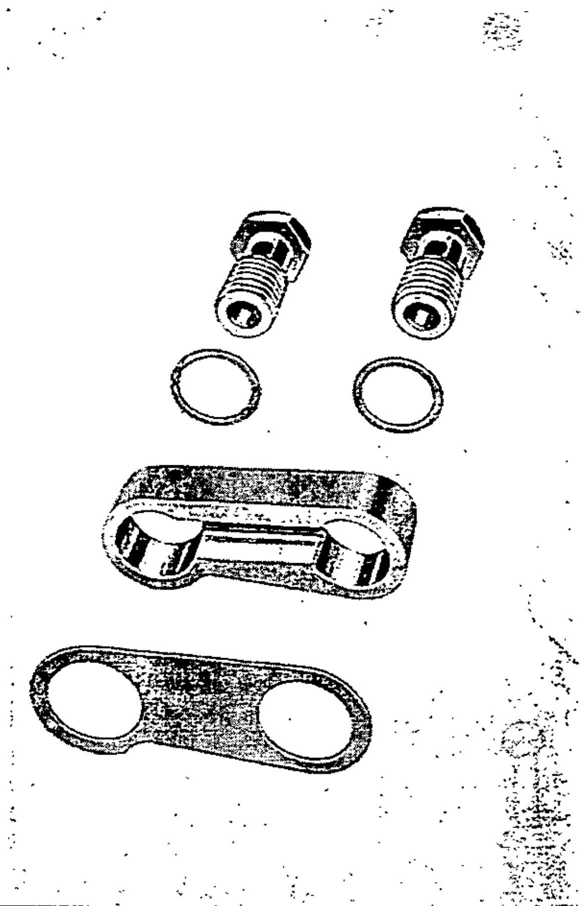


FIG. 22

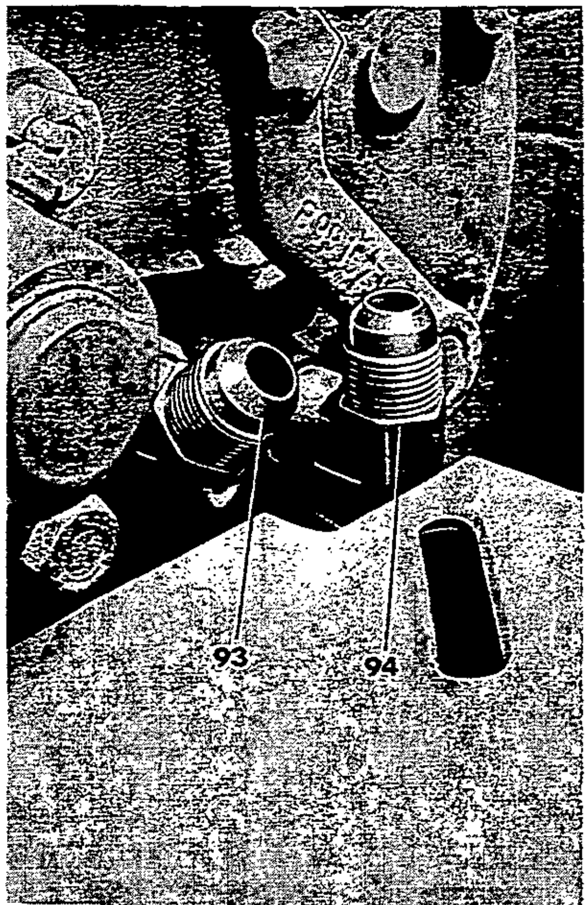


FIG. 23

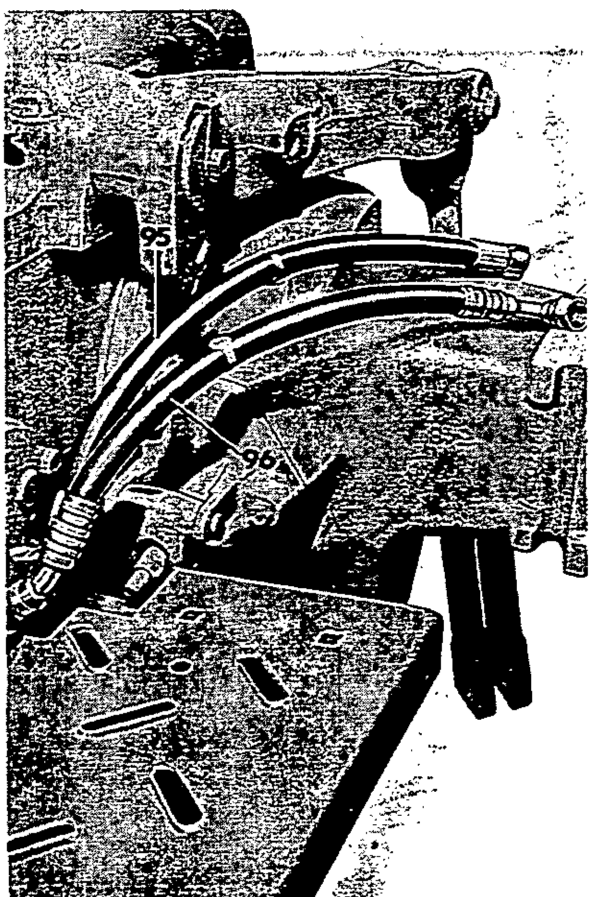


FIG. 24

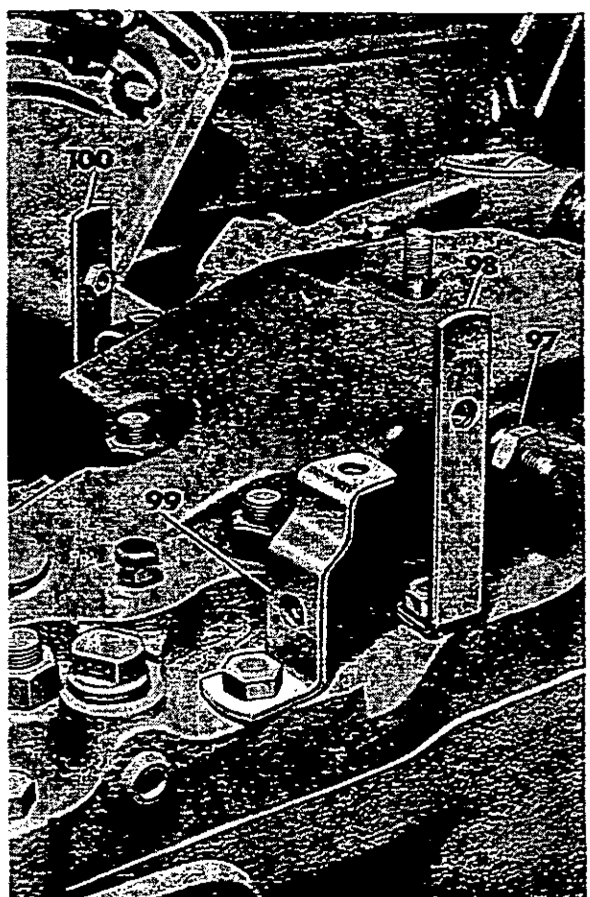


FIG. 25

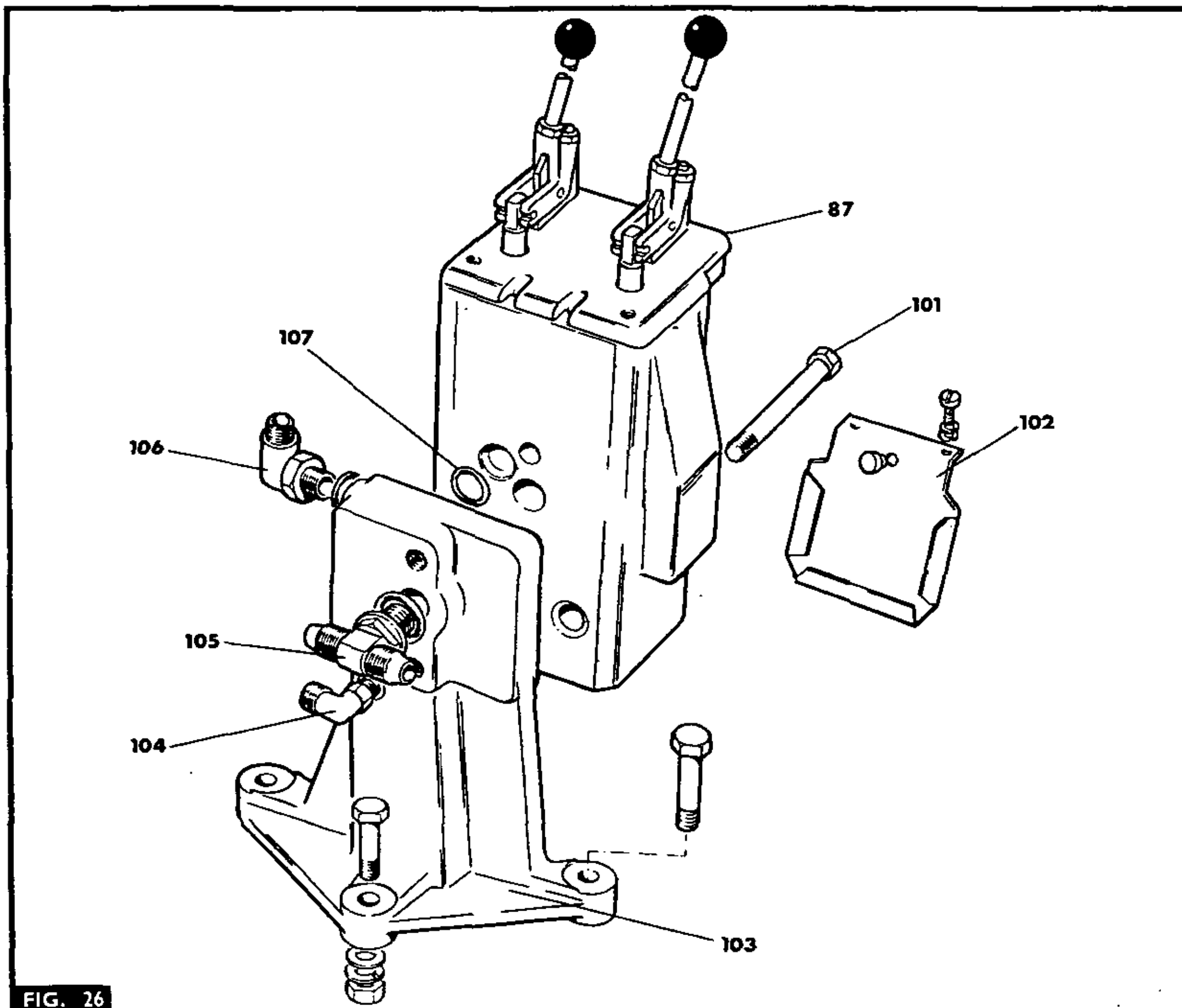

87
101
107
102
106
105
104
103

FIG. 26

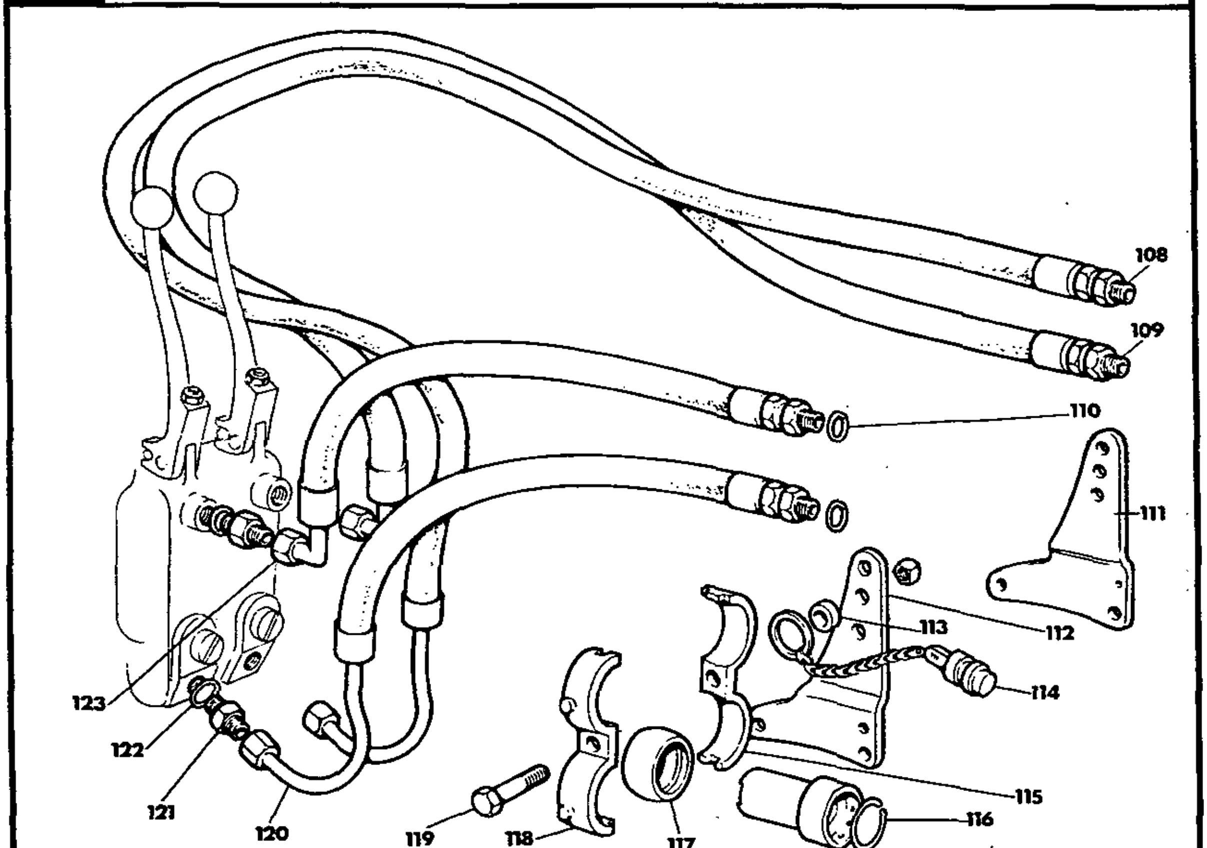

108
109
110
111
113
112
114
123
122
121
120
119
118
117
115
116
88/89

FIG. 27

12. Fig. 24. Fit the feed and return hoses (95 and 96) to the two unions, as shown.
13. Fig. 25. Remove the Allen plug from the lift cover, just forward of the cross shaft, then fit the union (97) with an 'O' ring.
14. Remove the lift cover bolts shown, and fit the hose clamps (98, 99 and 100), securing them with three new bolts: two of 7⁄16UNC x 108 mm (4¼ in) and one of 7⁄16 UNC x 57 mm (2¼ in). Re-torque the lift cover bolts to 9,0 Kg-m (65 lb-ft).
15. Fig. 26. Clean the front face of spool valve (87) and the mating face of the manifold (103), then fit an 'O' ring (107) to each of the three ports on the valve body. Place the body and manifold together and fit the two Allen screws (101) to secure them.
16. Fit and 'O' ring to the tee-piece (105), then screw the tee-piece into the upper hole on the front of the manifold.
17. Fit an 'O' ring to the smaller 90° elbow (104) then screw the elbow into the lower hole in the front of the manifold.
18. Fit an 'O' ring to the larger 90° elbow (106), then screw the elbow into the side of the manifold.

NOTE – THE TEE-PIECE AND THE ELBOWS MUST, WHEN FULLY SCREWED IN, FACE IN THE DIRECTIONS SHOWN IN FIG. 26.

19. Fit the plate (102), securing it with two screws, plus flat and spring washers. Press in the rubber grommet.
20. Figs. 27 and 28. Place the spool valve, front face downwards on a bench, then fit the four adapters (121) using 'O' rings (122) to the four tapped ports in the valve body.
21. Fit the four hoses as follows: Short hose with 90° connector (123) to 'DROP No. 1', Long hose with 90° connector to (108) to 'DROP No.2'; Short hose with curved connector (120) to 'LIFT No.1'; and the long hose with the curved connector (109) to 'LIFT No. 2'.
22. Slide a 'Pioneer' coupler (88/89) into each gimbal ring (117) and secure them with the snap rings (116).
23. Using an 'O' ring (110) for each, screw the 'Pioneer' couplers on to the hoses.
24. Fig. 29. Assemble the 'Pioneer' couplers in pairs, with two clamps (115 and 118), a spacer (113) and a pair of plugs and chains (114) per side. Slide the bolt (119), through the clamps and spacer, then locate the plug chain rings over the spacer, before bolting the assembly to the brackets (111 and 112), through the middle hole in the bracket.

NOTE –THE BRACKETS (111 AND 112) ARE 'HANDED' (LEFT AND RIGHT) AND THE TWO SHORT HOSES MUST BE FITTED TO THE L.H. BRACKET (112). ALSO, THE HOSES WITH THE 90° CONNECTORS MUST BE PLACED IN THE UPPER CLAMP SOCKETS.

25. Fit a colour code tag to each hose as follows:

L.H.		R.H.	
Upper	Yellow	Upper	Blue
Lower	White	Lower	Red

26. Fig. 28. Fit the triangular plate (124) as shown, and secure it with a bolt (125) nut and spring washer through the R.H. hole in the base of the manifold.
27. Place the spool valve on the footplate and secure it with one bolt, flat washer, spring washer and nut. DO NOT yet fully tighten the nut.
28. Fig. 30. Fit the leak off pipe (126) to the union on the lift cover then connect it to the 90° elbow (104) on the front of the manifold.
29. Fit the feed pipe (127) connecting it to the union (54) on the combining valve and to the tee-piece (105) on the manifold.
30. Connect the feed pipe (95) (rear connector on side cover) to the tee-piece (105), as shown.
31. Connect the return pipe (96) to the 90° elbow (106) on the side of the manifold.
32. Fit the remaining two bolts, flat washers, spring washers and nuts to secure the manifold and valve to the footplate.

NOTE – DO NOT FORGET TO FIT THE FENDER WIRING TAG.

33. Fig. 29. Locate the 'Pioneer' coupler support brackets (111 and 112) on the studs on the trumpet housings, then refit the bolts and nuts.
34. Fig. 30. Fit the clamps to the components already fitted (98, 99 and 100) to secure the hoses to the lift cover.
35. Fig. 29. Fit the sealing plugs (114) to each of the 'Pioneer' couplers.
36. Refit the tractor seat.

Adjustment 7B-11-25

Fig. 30. To change from single acting, to double acting operation, screw the switch valve (A) fully in.

To change to single-acting operation, screw the switch valve out five full turns.

WOOSTER SPOOL VALVE

Kit Fitment 7B-12-25

(Non-Auxiliary Hydraulic Tractors)
This operation is almost identical to operation 7B-10-18 except that the feed pipe (95 Fig. 30) is not used, its connections being blocked off by a banjo bolt at the p.t.o. side cover and by a cap on the tee-piece (105).

Selector Valve Fig. 31

The selector valve provides the facility to select any one service of three, leaving the remaining two isolated, and is of the six port, spring offset type.

The valve body (129), has cast-in galleries and is precision bored to accept the spool (131). The spool, has attached at one end, an operating lever, (132) secured by a roll pin (130). The external ports are EXT 1 (128), EXT 2 (134), and a port (R) (135) which must remain plugged. For convenience, EXT 1 port has twin outlet points to enable a pair of single acting services to operate simultaneously, as for example, with a front end, loader.

An instruction plate is affixed to the top of the valve by the two valve securing bolts (133) and plain washers.

OPERATION

Operation of the valve lever moves the spool (131) through an axial and fore and aft plane against the return spring, positioning of the spool also being governed by a cam formed on the front edge of the body.

Fig. 32. With the lever in the LINKAGE position (i.e. Vertical), oil flows from the hydraulic pump standpipe into the valve inlet port (K) and passes along the gallery into the linkage lift ram cylinder, through port (L). The tractor lower links can be operated in the normal manner. The other ports EXT 1 (128) and EXT 2 (134) are isolated.

Fig. 33. With the lever in EXT 1 (*i.e. lever left*) the oil flow is diverted by the spool (131) into the EXT 1 ports (128). The oil in the lift ram cylinder is "locked-in" by the spool. The lower links will be maintained in the fully raised position (i.e. Transport). EXT 2 port (134) is isolated. To prevent the lower links from dropping due to ram cylinder leakage (when EXT 1 is selected), a compensating valve, consisting of a ball (141) and spring (139) is incorporated between the EXT 1 port (128) and the ram cylinder port (L). When the ram cylinder pressure is less than in the EXT 1 port, the ball (141) will lift off its seat; oil will flow from the inlet port (K) through the cross drilling (M), past the ball and into the second cross drilling (N) to the lift ram chamber (L), thus maintaining ram cylinder pressure. When the pressure has equalised, the spring (139) will push the ball back on to its seat.

NOTE – THE COMPENSATING VALVE OPERATES ONLY WHEN EXT 1 IS SELECTED.

Fig. 34. Movement of the lever to the EXT 2 position (i.e. lever to the right) permits oil to flow from the inlet port (K) where the flow is diverted by the spool to the EXT 2 port (134). The flow to EXT 1 (128) and the ram cylinder is isolated.

To protect the ram cylinder from induced, high pressure from an outside source, when isolated (e.g. a heavy implement being transported on the three point linkage "bouncing" due to rough ground) a relief valve (144) is fitted. This relief valve opens at 225 Kg/cm^2 (3200 lb/in^2).

SELECTOR VALVE

Kit Fitment 7B-13-26

1. Place the 'Draft Control' lever in the 'Down' position.
2. Fig. 35. Remove the two bolts (47) and spring washers securing the transfer cap (48), then carefully ease off the transfer cap, ensuring that *the standpipe is not displaced from its location* in the hydraulic pump.
3. Fit a new back-up washer and 'O' ring to the top of the standpipe and an 'O' ring to the port.
4. Fig. 36. Fit an 'O' ring (145) to the lift ram cylinder port, as shown.
5. Place the selector valve gasket in position, ensuring that the oilways are clear, then carefully locate the selector valve on the standpipe, fit the instruction plate plain washers and special 7/16 UNC x 73 mm (2 7/8 in) bolts (133). Tighten the bolts to 5,5 Kg-m (40 lb-ft).

NOTE – OVERTIGHTENING OF THE BOLTS CAN CAUSE THE SPOOL TO STICK; ALSO LEAKAGE.

SELECTOR VALVE

Servicing 7B-14-26

Disassembly

1. Place the 'Draft Control' lever in the 'Down' position.
2. Disconnect any hoses, then plug or mask any ports and connections to prevent the ingress of dirt.
3. Fig. 31. Remove the bolts (133), plain washers and the instruction plate, then carefully remove the valve from the standpipe.
4. Drive out the roll pin (130) and remove the lever (132).
5. Fig. 32. Using a soft faced drift, gently tap the spool (131) towards the rear of the valve, to force out the welsh plug (136). Withdraw the spool from the valve body (129), complete with the return spring (138).
6. Remove the seals (142 and 143) from the body.
7. Remove the screw (137) and remove the spring (139) and ball (141).
8. Fig. 36. Ony if necessary, remove the relief vale plug (146).
9. Fig. 32. Remove the ball (150), poppet (151), spring (152) and second poppet (147).
10. If the relief valve has been removed, remove the valve seat (149), complete with its 'O' ring (148). This operation requires the use of a small wire extractor hook (see Fig. 37).

Examination

Check all components for wear or damage, paying particular attention to the spool and bore, also the relief valve poppet. Always fit new 'O' rings and seals.

Reassembly

1. Fig. 32. If necessary, fit a new 'O' ring (148) to the valve seat (149) then slide the valve seat into the body (129).

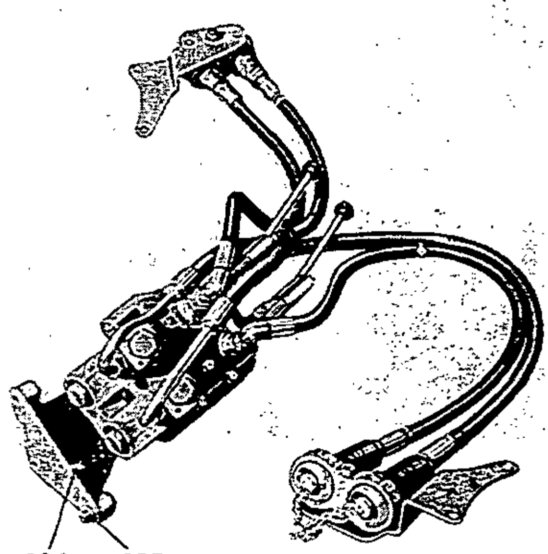


FIG. 28

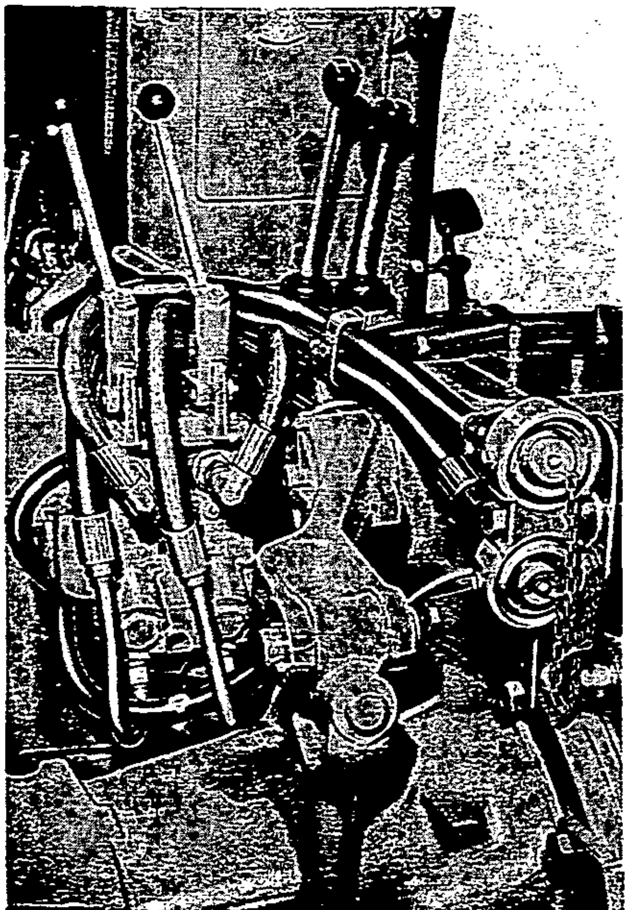


FIG. 29

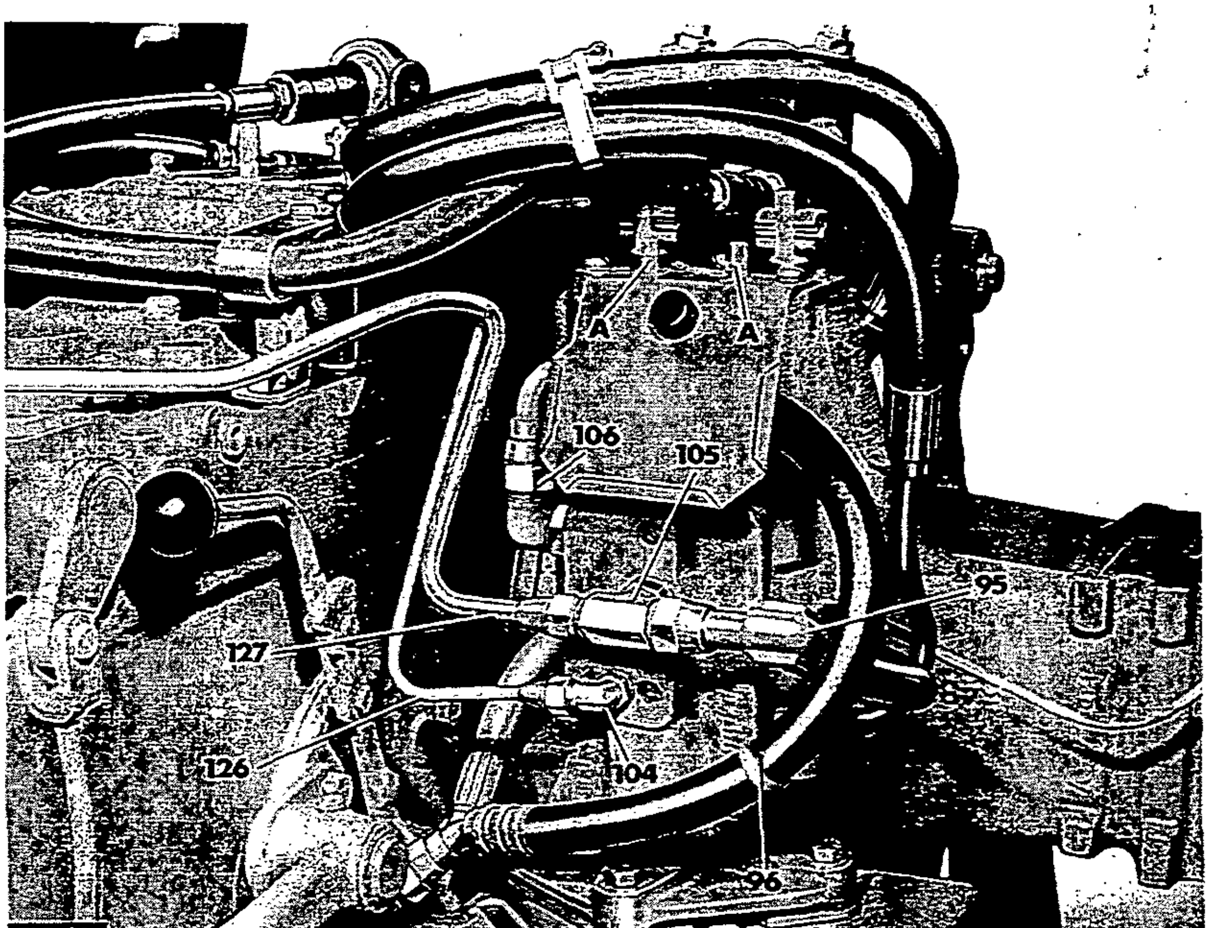


FIG. 30

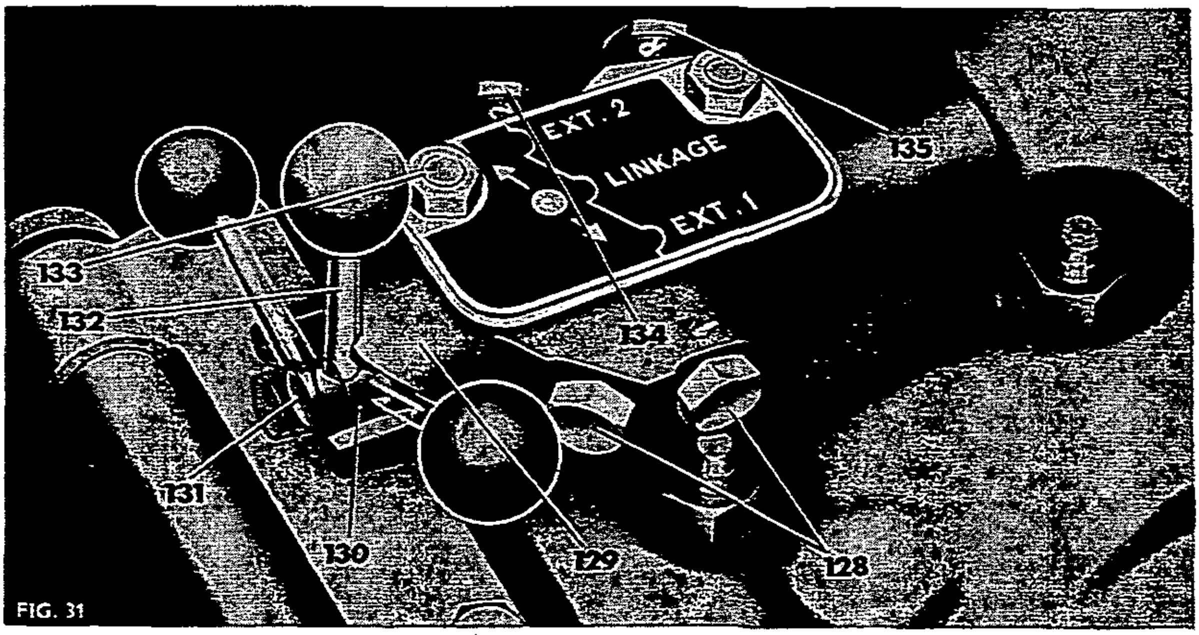
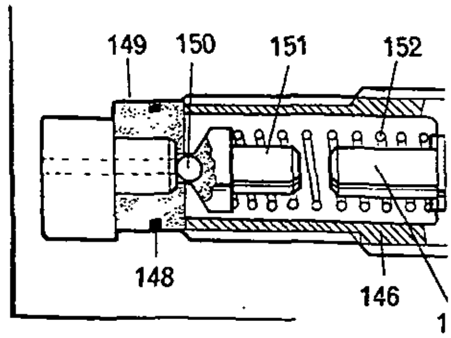


FIG. 31



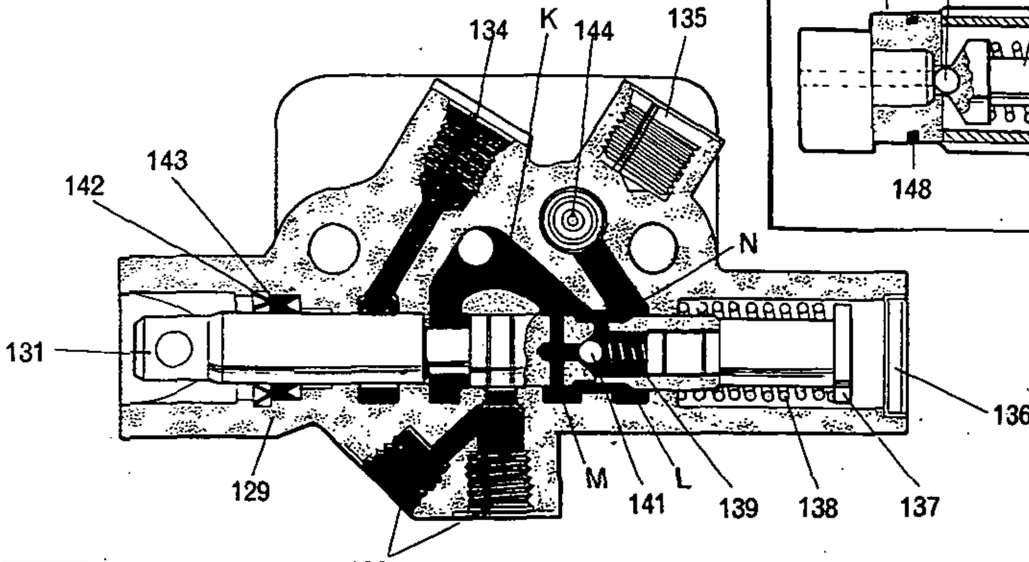


FIG. 32

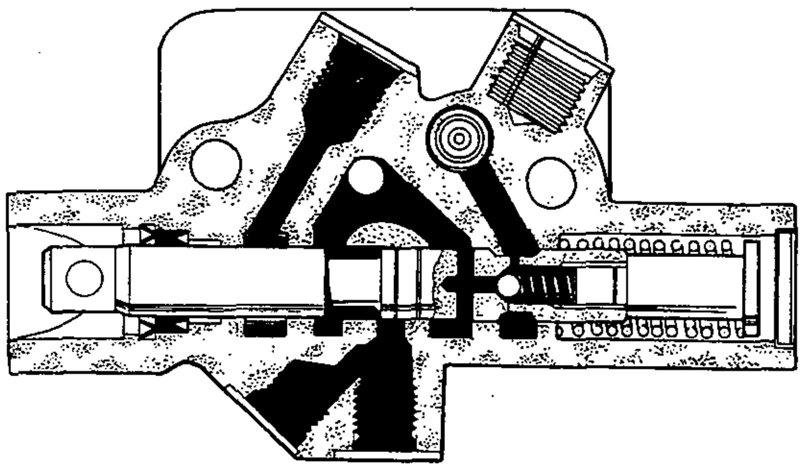
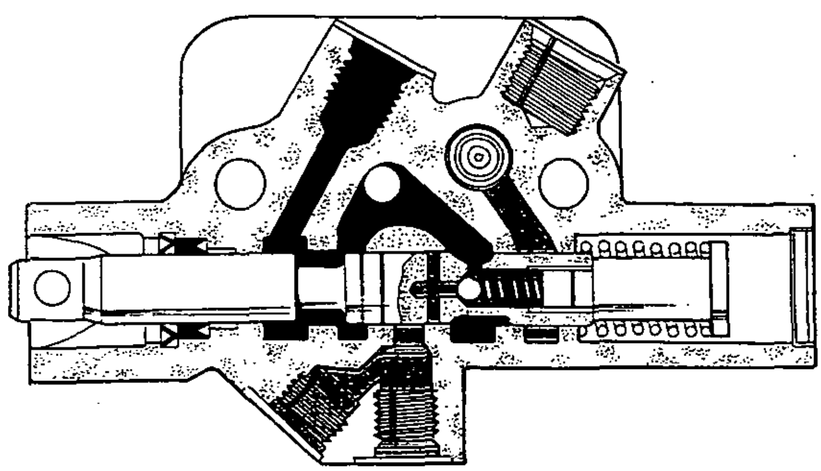


FIG. 33



NO FLOW

PRESSURE

FIG. 34

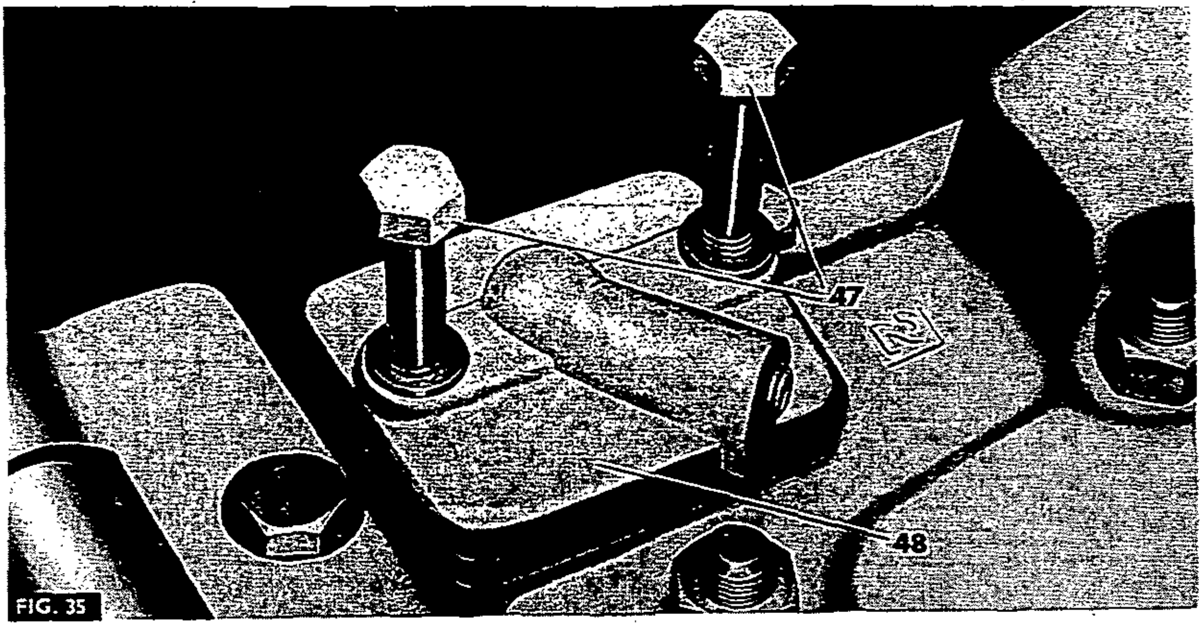


FIG. 35

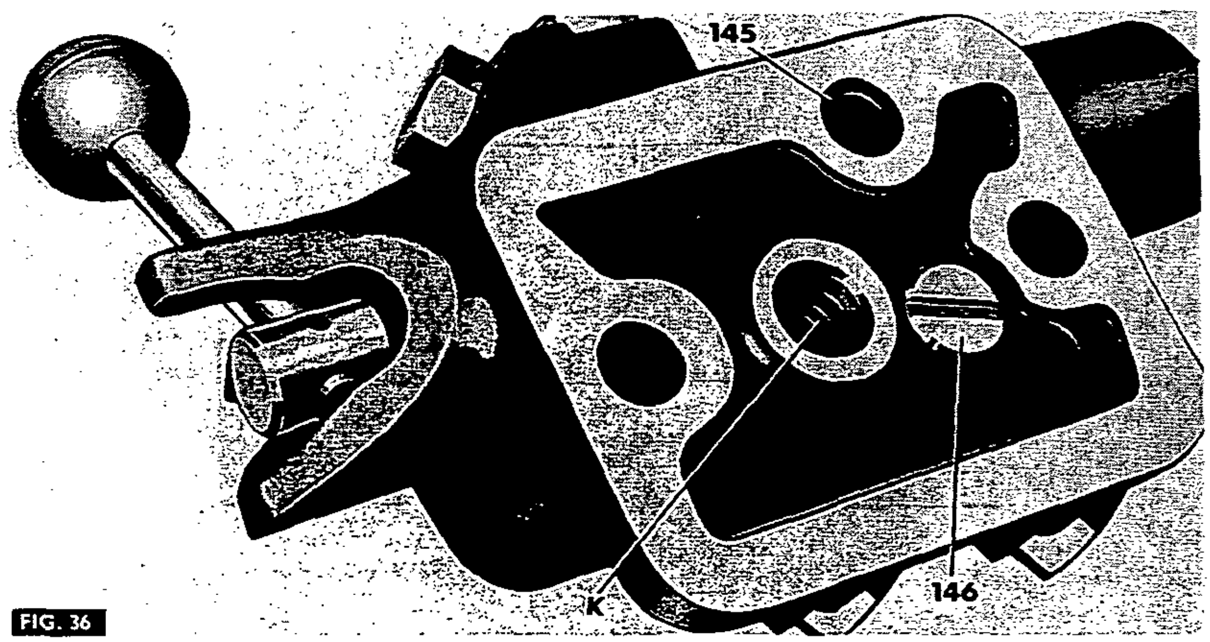


FIG. 36

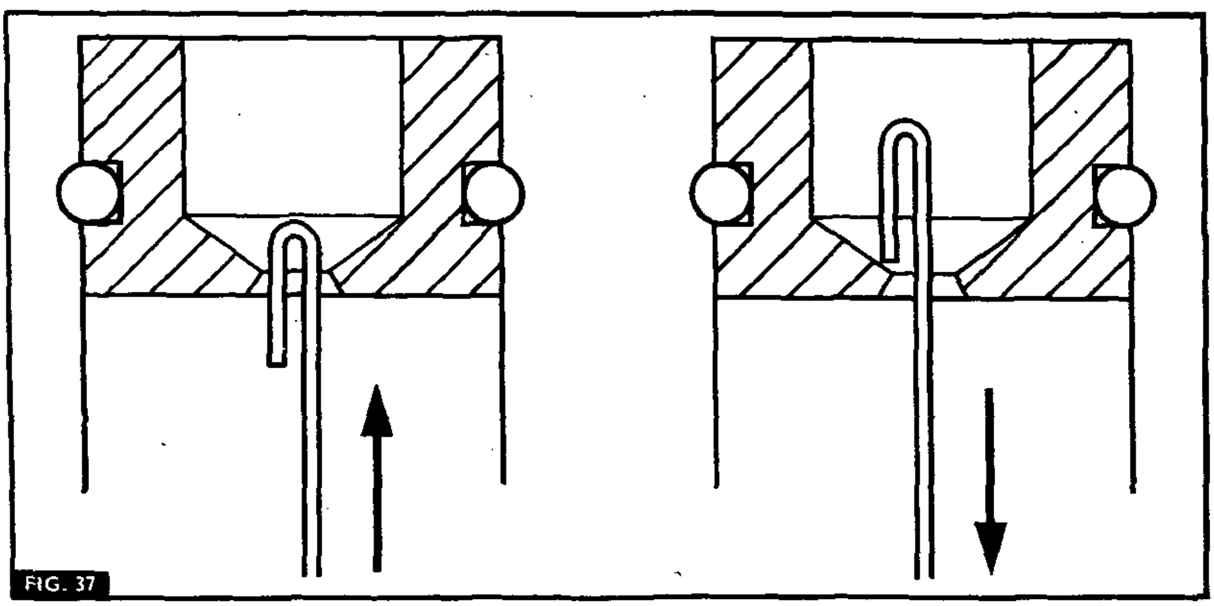


FIG. 37

2. Invert the body (129) and locate the ball (150) in the seat, then fit the poppet (151) spring (152), second poppet (147) and screw in the plug (146).
3. Refit the ball (141), spring (139) to the spool, and apply Loctite 'Hydraulic Seal' (grade brown) to the threads of the screw (137), then fit the screw to the spool.
4. Fit the distributor seal (143) into the valve body, with its flat face towards the front.
5. Place the spool return spring (138) in the rear of the valve body, then, insert the spool (131) through the spring (138) into the spool bore, taking care not to damage, or dislodge the seal (143).
6. Fit the wiper ring (142) to the valve with its flat face to the rear. This operation can be facilitated by the use of a piece of tube, approximately 20 mm (0.8 in) outside diameter, with a wall thickness of 1,2 mm (18 SWG) and radiused at one end to suit the ring. This tube can then be used to drive home the wiper ring against the distributor seal.
7. Push the spool (131) against the spring from the rear, taking care not to displace the seals, until the lever (132) can be inserted into the spool. Select EXT 2, the new roll pin (130) can then be easily driven into position to secure the lever.
8. Carefully tap a new welsh plug (136) into the rear of the spool bore.
9. Refit the selector valve to the tractor, as stated in operation 7B-13-00.

HYDRAULIC TESTS

When carrying out all pressure and flow tests, clean, fresh oil, of the recommended grade must be used and should be warmed to a temperature of 50°C (120°F) by running under load, before testing. The use of either excessively hot, or cold oil can seriously affect the instrument readings and pump performance.

Special Tools Required: See operation 7A-14-31
MF 260 Gauge
MF 810-4/1 Adapter
MF 260-4/1 Adapter
MF 260-4/1 Cap
Elbow Part No. 357 197 X 1

Relief Valve

1. Remove the lift cover, as stated in operation 7A-14-31.
2. Fig. 38 Disconnect the Multi-Power feed pipe from the union on the top front of the pump and fit the cap MF 260-4/4 in its place, as shown.
3. Remove the plug from the top of the pump and fit the elbow, Part No. 357 197 X 1, adapter MF 810-4/1 and the MF 148A gauge.
4. Start the tractor engine. With the oil at the correct temperature the gauge should indicate minimum pressures as follows:
   500 to 550 engine rev/min — 46 Kg/cm² (650 lb/in²)
   2000 engine rev/min — 53 Kg/cm² (750 lb/in²)
5. Switch off the tractor engine.

Multi-Power Operating Pressure

1. Carry out the relief valve test, as stated in previous column.
2. Remove the cap MF 260-4/4 from the outlet union on the pump and refit the Multi-Power feed pipe.
3. Fig. 39. Remove the MF 148A gauge and adapter MF 810-4/1 and fit in their place, adapter MF 260-4/1 and plug MF 260-4/4 as shown, then screw in the MF 260 gauge.
4. Start the tractor engine and select Multi-Power 'HIGH'. With the oil at the correct temperature, the gauge should indicate the following minimum pressure:
   2000 engine rev/min — 13 Kg/cm² (190 lb/in²).
5. Switch off the tractor engine.
6. Remove the MF 260 gauge, adapter MF 260-4/1, and elbow, Part No. 357 197 X 1 from the pump then refit the plug and washer.
7. Refit the lift cover as stated in operation 7A-14-31.

High Capacity Pump — 7B-16-31

Special Tools Required: MF 260 Gauge
810 Test Kit
MF 148A Gauge
MF 260-4 Adapters and Plugs

Multi-Power Relief Valve

1. Fig. 40. Release the rear Multi-Power pipe as shown and fit adapter MF 810-4/1 and the MF 148A gauge, as shown.
2. Start the tractor engine. With the oil at the correct temperature, the gauge should indicate the following minima:
   500 to 550 engine rev/min — 46 Kg/cm² (650 lb/in²)
   2000 engine rev/min — 53 Kg/cm² (750 lb/in²)
3. Switch off the tractor engine, then remove the MF 148A gauge.

Multi-Power Flow Test

1. Carry out the Relief Valve test as stated above.
2. Release the clamp securing the two Multi-Power pipes to the steering box.
3. Fig. 41. Release the second Multi-Power pipe and fit another MF 810-4/1 adapter, then attach the 810 kit as shown (INLET hose to REAR pipe). Fit 70 Kg/cm² (1000 lb/in²) gauge to the 810 kit.
4. Start the engine and screw in the restrictor on the 810 kit until 21 Kg/cm² (300 lb/in²) is indicated on the gauge.
5. Press the diverter button and time the flow of 4,5 litres (1 Imp gal), into a suitable measure. Time taken should not exceed:
   72 seconds @ 500 t0 550 rev/min
   40 seconds @ 1000 rev/min
   Switch off the engine

Filter By-Pass Valve

1. Carry out the Relief Valve and Flow tests as stated on page 31.
2. Fig. 42. Remove the two pipes from the front of the filter and fit the two MF 260-4/4 caps, as shown.
3. Start the engine and select Multi-Power 'LOW'.
4. Fully unscrew the restrictor on the 810 kit. The pressure indicated should be between 6,3 and 8,4 Kg/cm^2 (90 to 120 lb/in^2) at 500 to 550 engine rev/min.
5. Stop the tractor engine.
6. Remove the MF 260-4/4 caps, the 810 kit and the MF 810-4/1 adapters from the tractor, then reconnect the relevant pipes and refit the pipe clamp.

Multi-Power Operating Pressure

1. Fig. 43. Disconnect a Multi-Power pipe, as shown then fit adapter MF 260-4/1 and the MF 260 gauge.
2. Start the tractor engine and select Multi-Power 'HIGH'. With the oil at the correct temperature,

the gauge should indicate the following minimum pressures:

2000 engine rev/min	13 Kg/cm^2 (190 lb/in^2).

3. Switch off the engine and remove the MF 260-4/4 adapter and the MF 260 gauge.
4. Reconnect the Multi-Power pipes.

By-Pass Test – MF 260 Gauge.

The by-pass valve can be tested using the MF 260 gauge, MF 260-4/1 adapter and MF 260-4/4 caps, as shown in fig 44 if required, or if the 810 kit is not available. Procedure and pressures are identical to those referred to when using the 810 kit.

Auxiliary Relief Valve.

1. Fit the 'Pioneer' adapters MF 810–1/1 to the 810 gauge.
2. Fig. 45. Attach both couplers to the quick couplers as shown (INLET hose to the LOWER quick coupler).
3. Screw the 280 Kg/cm^2 (4000 lb/in^2) gauge into the 810 kit then screw the restrictor knob fully in.
4. Start the tractor engine and run at 2000 rev/min.
5. Pull the spool valve lever rearwards and hold it there. The pressure should be 169 Kg/cm^2 (2400 lb/in^2).
6. Release the lever and unscrew the restrictor valve.

Flow Check

1. Screw in the combining valve knobs fully.
2. Pull the spool valve lever fully rearwards and adjust the restrictor until 70 Kg/cm^2 (1000 lb/in^2) is indicated.
3. Press the diverter button and time the flow of 4,5 litres (1 Imp gal) into a suitable measure, then release the diverter button. The flow at 2000 engine rev/min should not take longer the 10 seconds.

Spool Valve 'Kick-out'

1. Fully unscrew the restrictor knob.
2. Pull the spool valve lever rearwards.
3. Screw in the restrictor until the lever 'Kicks-out' and note the maximum pressure. The 'Kick-out' should operate at 112 to 127 Kg/cm^2 (1600 to 1800 lb/in^2).
4. The 'Kick-out' mechanism can be adjusted, if necessary, by screwing the grub screw (69 Fig. 9) in or out.
5. Remove the 810 kit from the tractor.

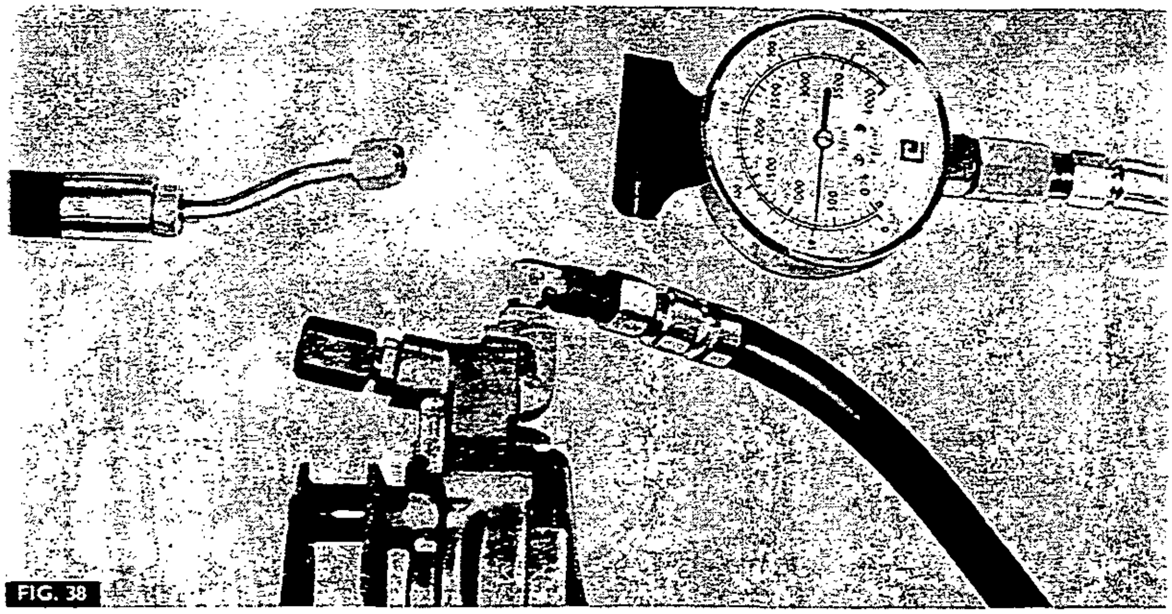


FIG. 38

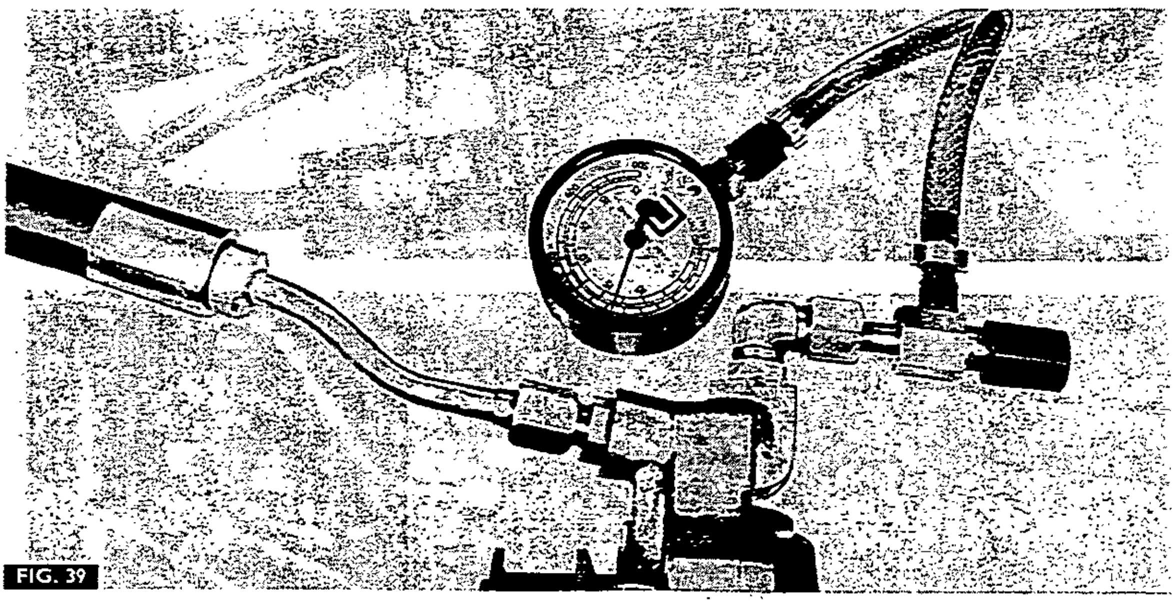


FIG. 39

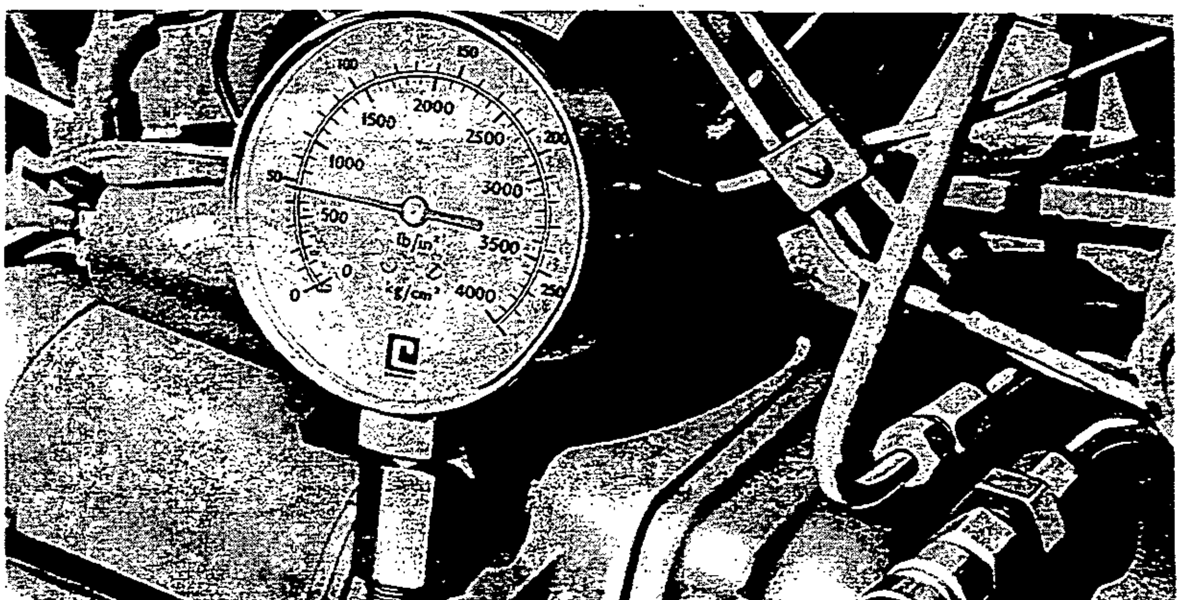


FIG. 40

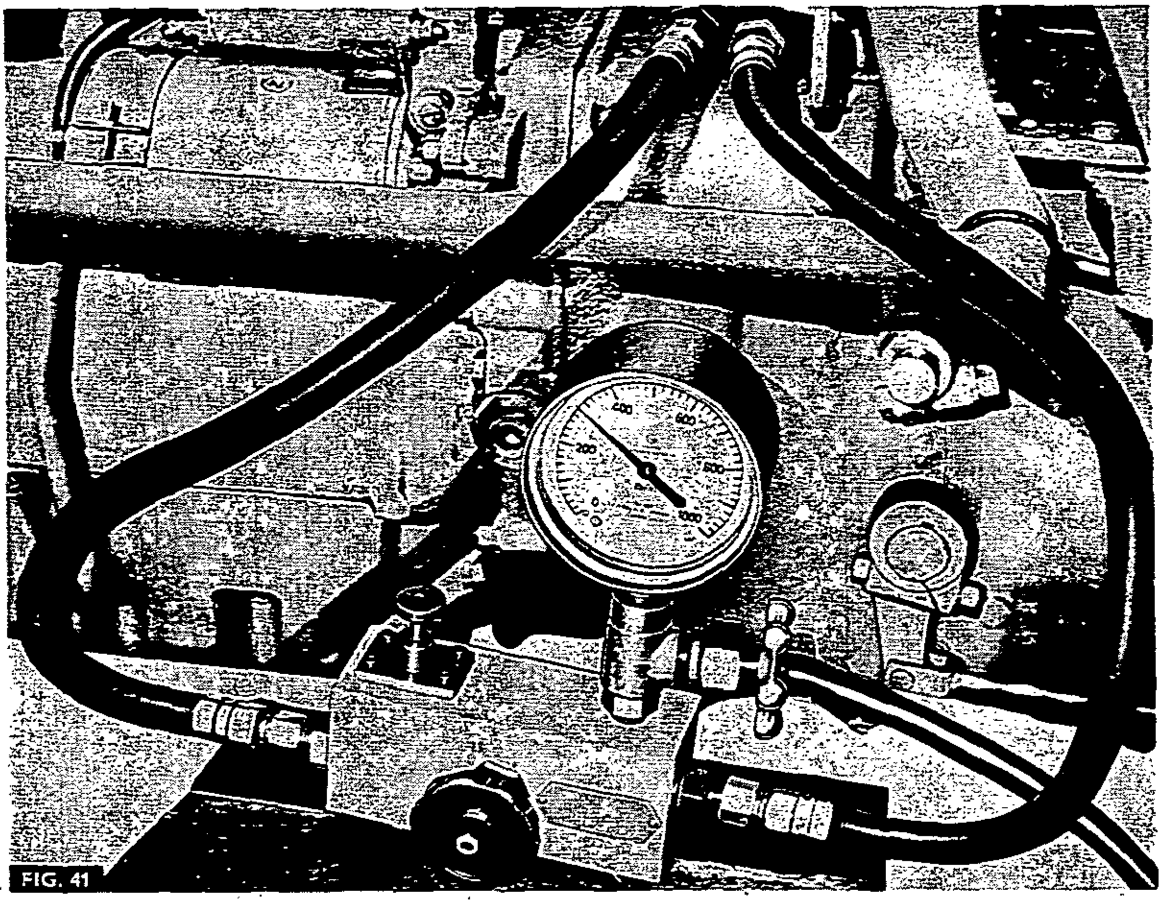


FIG. 41

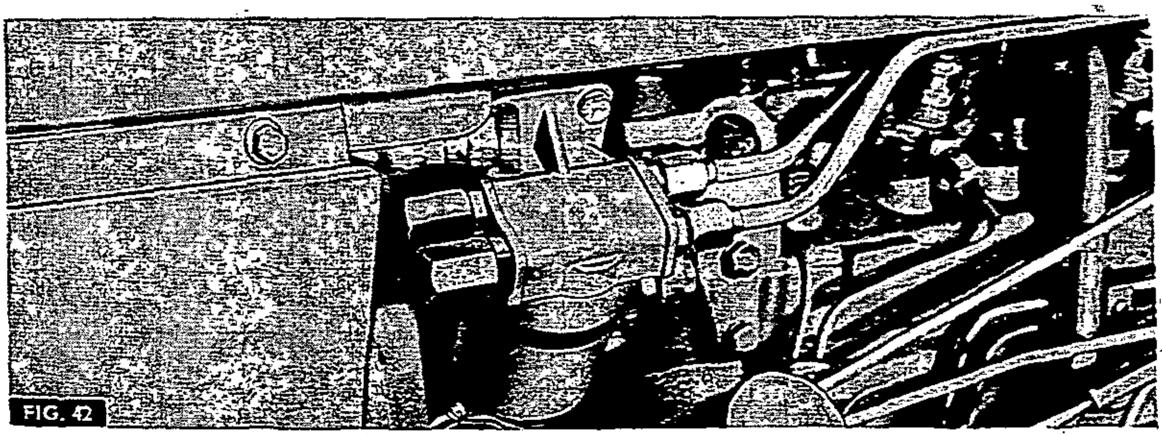


FIG. 42

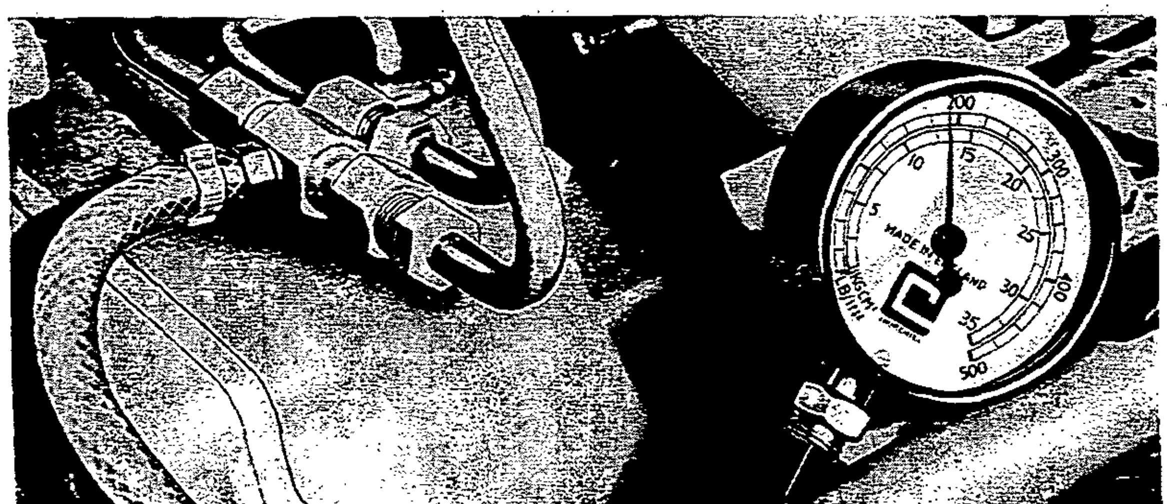


FIG. 43

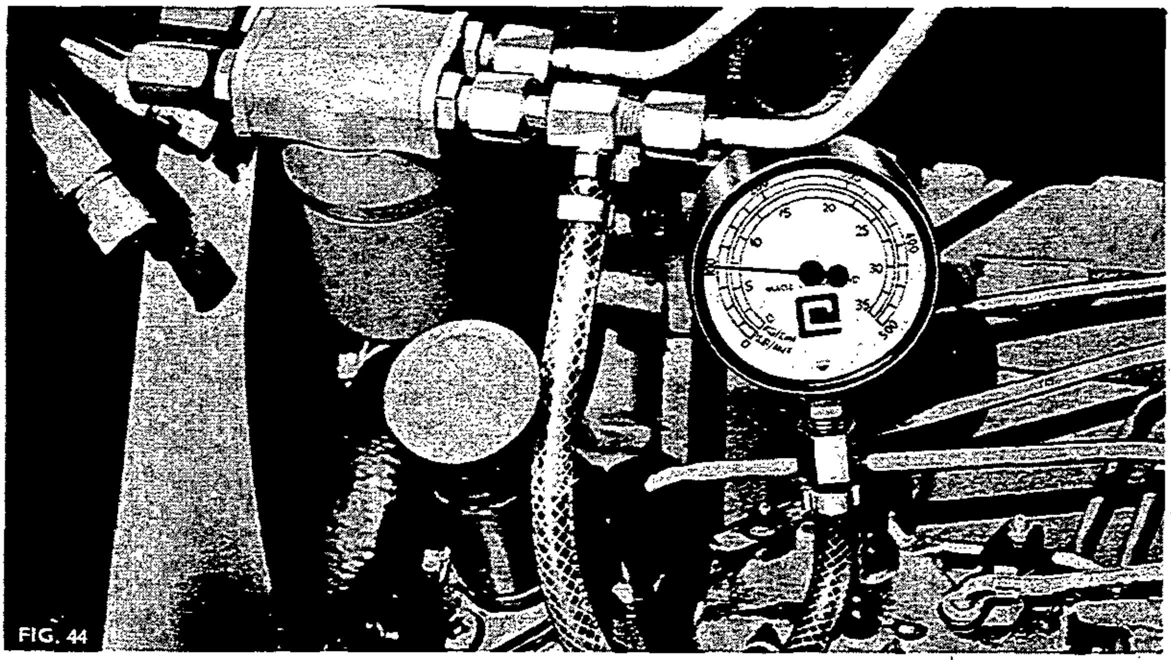


FIG. 44

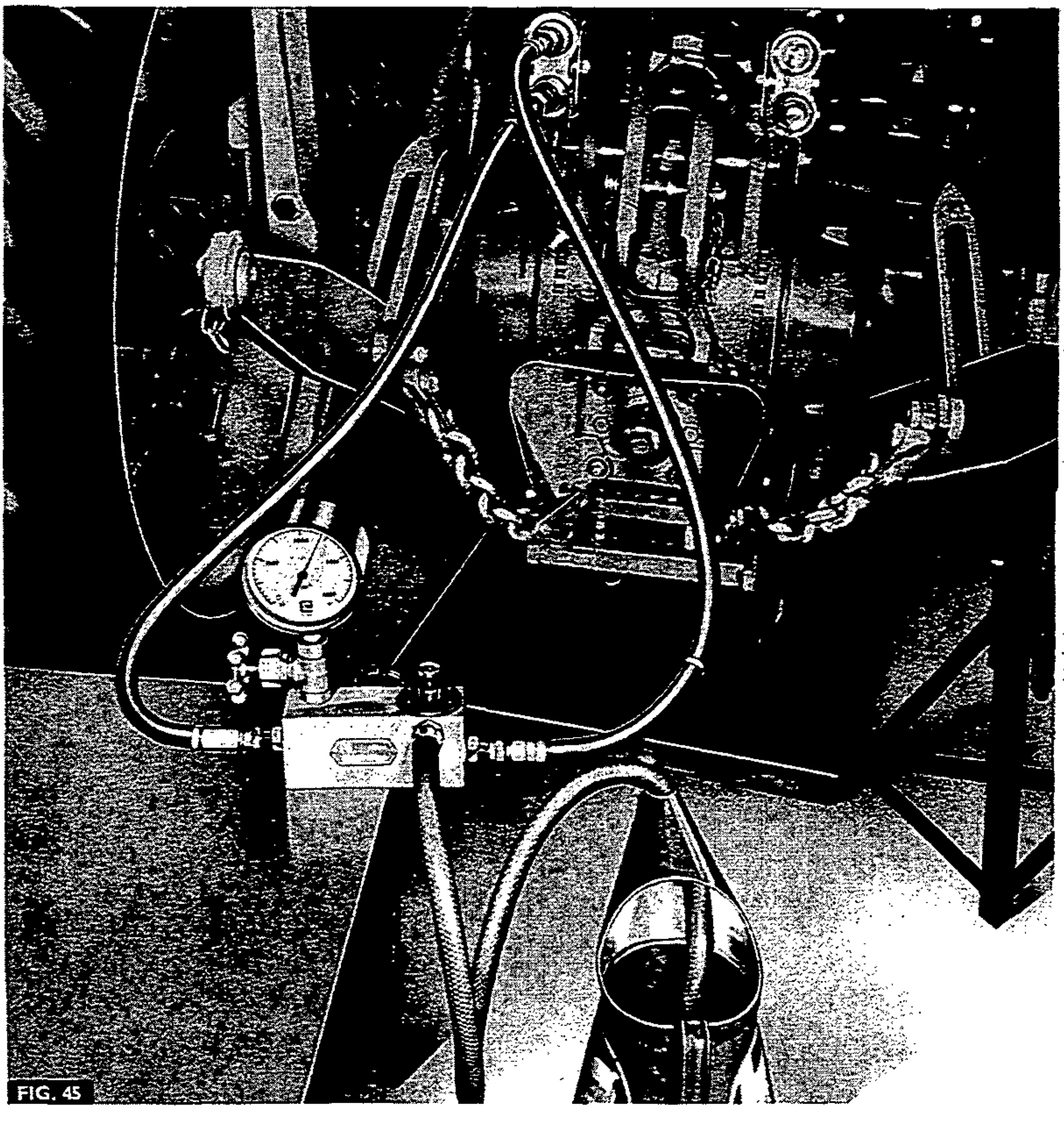


FIG. 45

KONTAK SPOOL VALVES

Part 7 Section B

KONTAK SPOOL VALVES

FUNCTION

The Kontak spool valve is capable of controlling the following services:–

1. Single Acting Rams.
2. Double Acting Rams.
3. Hydraulic Motors.

Single Acting Rams
To operate single acting rams, only the LOWER 'Pioneer' quick release couplers are used.
To extend the ram, pull the lever rearwards.
To lower the ram, push the lever forwards.
NOTE – TO SET THE VALVE FOR SINGLE ACTING OPERATION SEE ADJUSTMENTS.

Double Acting Rams
When operating double acting rams, the LOWER 'Pioneer' quick release coupler should be connected to the hose which feeds the side of the ram which causes it to EXTEND.
To extend the ram, pull the lever rearwards.
To lower the ram, push the lever forwards.

Hydraulic Motors
Although not specifically designed for use with hydraulic motors, these valves can be used satisfactorily, if the following points are observed:–

1. Always connect the motor feed to the LOWER coupler.
2. NEVER connect the motor return hose to the quick release couplers. Always connect the return hose directly to either the 'R' port on the selector valve (tractor working off linkage pump only) or to the FRONT port on the p.t.o. side cover (auxiliary pump, or combined flow applications.

** 3. Always contact your Distributor or Dealer when fitting hydraulic motors, to ensure that the hydraulic circuit is completely satisfactory.

NOTE – A SPECIAL SPOOL VALVE UNIT, FOR USE FOR REVERSIBLE HYDRAULIC MOTORS IS MANUFACTURED BY KONTAK LTD. FOR DETAILS OF THIS SPECIAL VALVE AND OTHER SPECIALISED APPLICATIONS (E.G. DETENTS, KICK-OUT ETC.,) PLEASE CONTACT KONTAK DIRECT.

ADJUSTMENTS

For Single Acting Operation

1. Fig. 1. Remove the special $\frac{7}{8}$ –14 UNF plug from the bottom of the spool valve.
2. From the spool valve kit, fit the standard $\frac{7}{8}$ – 14 UNF plug (2) (without a spigot) to the hole at the bottom of the spool valve.

NOTE – ENSURE THAT THE NEW PLUG HAS AN 'O' RING FITTED.

** 3. If the outlet hose kit is not being fitted, also fit the ¾–16 UNF plug (9) from the kit to the lower outlet port on the spool valve.
Do not lose, or discard the special $\frac{7}{8}$ –14 UNF plug (1), as this may be required at a later date for the valve to be used for double acting operation.

For Double Acting Operation

1. Fig. 1. If necessary, remove the standard $\frac{7}{8}$ – 14 UNF plug (2) (without a spigot) from the bottom of the spool valve.
2. Fit the special $\frac{7}{8}$ –14 UNF plug (1) (with a spigot and two 'O' rings) to the hole at the bottom of the spool valve.

** 3. If the outlet hose kit is to be fitted, if necessary, remove the ¾–16 UNF plug (9) from the lower outlet port on the spool valve.

WARNING – NEVER TRY TO OPERATE THE VALVE FOR DOUBLE ACTING OPERATION WITH THE PLUG (3) SCREWED INTO THE LOWER OUTLET PORT.

SPOOL VALVE
FITTING INSTRUCTIONS 7B-17-38

1. Fig. 2. Thoroughly degrease the threads on the operating levers and the cranks, then apply two drops of Loctite Grade AV 'Stud Lock' (Red) to the threads before assembly. Screw the operating lever(s) (4) into the crank(s) on the spool assembly (5).
Tighten the locknut (s) (6).
2. Locate the spool assembly (5) against the mounting bracket (7) and secure it with three $\frac{3}{8}$ UNF x 70 mm (2¾ in.) bolts (8), plus flat washers, lockwashers and nuts.
3. If necessary, fit the new p.t.o. handle and assemble the Auxiliary Hydraulic or Combined Flow feed and return hoses to the p.t.o. side cover, as stated in the following specifications.
4. Locate the spool valve mounting bracket on the tractor footplate and secure it with one $\frac{3}{8}$ UNF x 32 mm (1½ in.) (9) through the front hole and two $\frac{3}{8}$ UNF x 38 mm (1½ in.) bolts (9A) through the rear holes.

NOTE – IF A HORIZONTAL EXHAUST IS FITTED, EQUAL PILES OF FLAT WASHERS SHOULD BE USED TO PACK THE BRACKET CLEAR OF THE SILENCER BOLT.

5. Adjust the position of the operating lever(s) (4) to clear the seat and to suit the operator.

HYDRAULIC SELECTOR VALVE

(This information supersedes that stated in Operation 7B-13-26).

FUNCTION

The hydraulic selector valve is used to feed oil to any one of three services, leaving the other two isolated. The three services are:–

Lever Position	Tractor Linkage	Port 1	Port 2
LINKAGE	Operates Normally	Isolated	Isolated
'EXT 1'	Links Fully Raised	Flow Available	Isolated
'EXT 2'	Links remain at Pre-set Height	Isolated	Flow Available

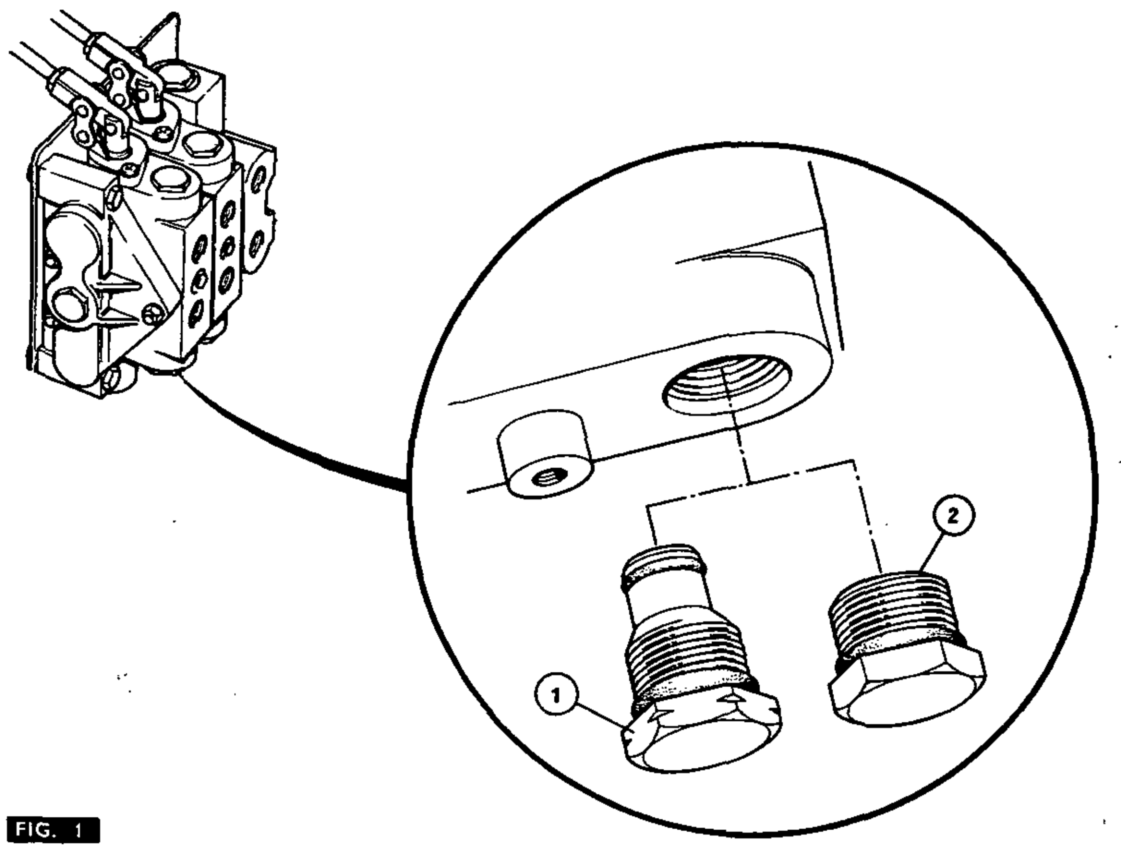


FIG. 1

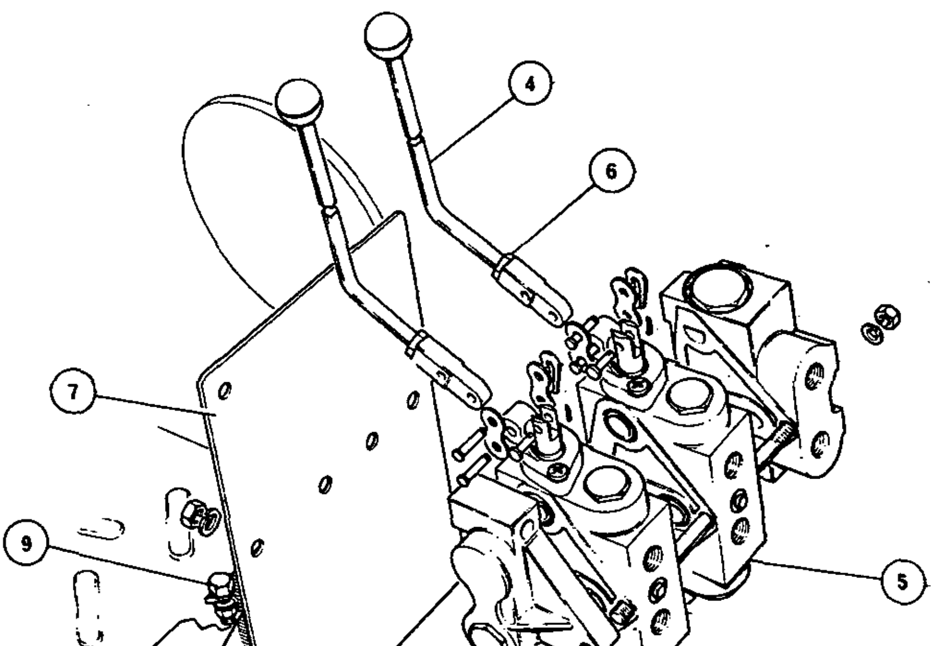


FIG. 2

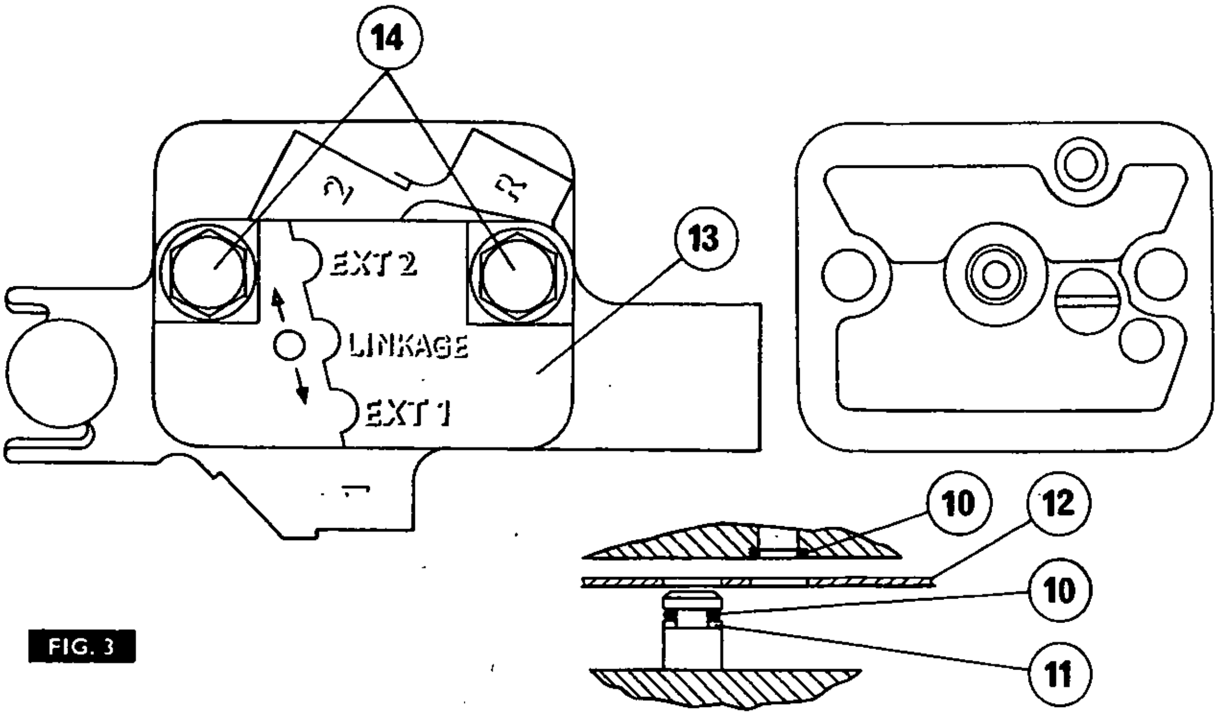


FIG. 3

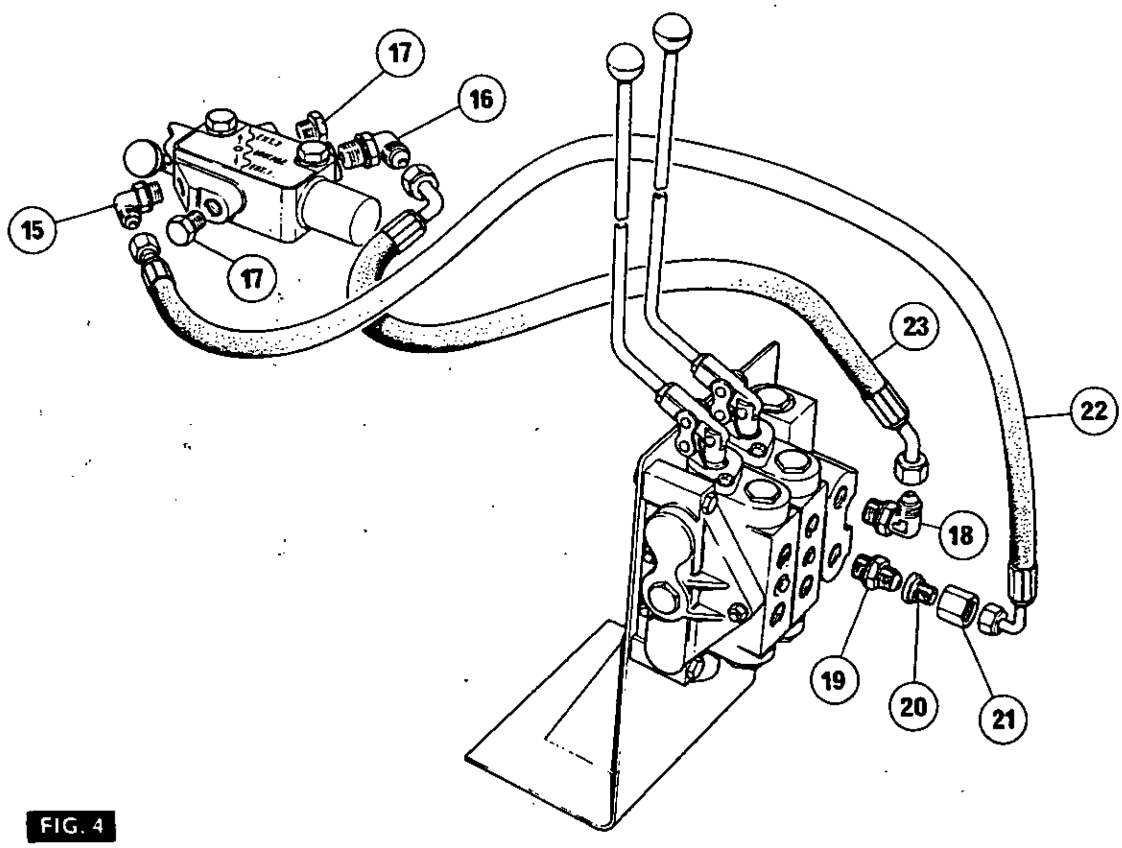


FIG. 4

Flow Available: 15 lit/min (3.3 Imp. gal/min or 3.9 U.S. gal/min).
Max. Pressure: 179,3 kg/cm^2 (2550 lb/in^2).
Hydraulic H.P.: 4.4 @ 140 kg/cm^2 (2000 lb/in^2).

FITTING INSTRUCTIONS 7B-18-41

1. Place the 'Draft Control' lever in the 'Down' position.
2. Remove the two bolts and spring washers securing the transfer cap to the lift cover, then carefully ease off the transfer cap, ensuring that the standpipe is not displaced from its location in the hydraulic pump.
3. Fig. 3. Remove the old 'O' ring and back-up washer (10 and 11 respectively), from the standpipe.
4. Fit a new 'O' ring (10) and back-up washer (11) to the standpipe.
5. Clean the bottom face of the selector valve, then fit an 'O' ring (10) to the shallow recess in the bottom face of the selector valve.
6. Place the selector valve gasket (12) in position, making sure that all of the holes are clear, then locate the selector valve on the standpipe.
7. Fit the instruction plate (13), then fit the two special $\frac{7}{16}$ UNC x 73 mm ($2\frac{7}{8}$ in.) bolts (14), with a flat washer and a lockwasher for each.
8. Carefully torque the bolts to 3,5 kg m (25 lb ft).

NOTE – DO NOT USE THE EXISTING TRANSFER CAP BOLTS. ALSO, DO NOT OVERTIGHTEN THE BOLTS, AS THIS CAN CAUSE LEAKAGE OF THE SELECTOR VALVE AND MAY CAUSE THE SPOOL TO STICK.

The various plugs, connectors and elbows should be fitted as stated in operations 7B-19-41, 7B-22-42, or 7B-23-45.

LINKAGE PUMP FEED HOSE KIT

FUNCTION

This feed hose kit supplies oil to the spool valve and permits oil to return to the 'R' Port on the selector valve.

ADJUSTMENT

If the tractor linkage has to be kept at a pre-set height above the ground, the following changes must be made to the arrangement of the supply hose kit:–

1. Fit the $\frac{9}{16}$–18 UNF plug (17) to front Port 1 in place of the $\frac{9}{16}$–18 UNF 90° elbow (15).
2. Fit the $\frac{9}{16}$–18 UNF 90° elbow (15) to Port 2.
3. In place of the feed hose (22) make up a longer hose, connecting it to the reducing adapter (20) at the lower R.H. port on the back of the spool valve and to the 90° elbow (15) at Port 2.

Flow Available: 15 lit/min (3.3 Imp. gal/min or 3.9 U.S. gal/min).
Max. Pressure: 179 kg/cm^2 (2550 lb/in^2).
Hydraulic H.P.: 4.4 @ 140 kg/cm^2 (2000 lb/in^2).

FITTING INSTRUCTIONS 7B-19-41

Fig. 4.

1. Assemble and fit the spool valve to the tractor, as stated in operation 7B-17-38.
2. Fit the hydraulic selector valve kit, as stated in operation 7B-18-41.
3. Screw the $\frac{9}{16}$–18 UNF 90° elbow (15) into front Port 1 on the selector valve. Lock the elbow (15) to face rearwards.
4. Screw the ¾–16 UNF 90° elbow (16) into the 'R' port on the selector valve. Lock this elbow also to face rearwards.
5. Fit a $\frac{9}{16}$–18 UNF blanking plug (17) to rear Port 1 and Port 2 of the selector valve.
6. Screw the ¾–16 UNF 90° elbow (18) into the upper R.H. port at the back of the spool valve. Lock the elbow to point vertically upwards.
7. Screw the ¾–16 UNF straight connector (19) into the lower R.H. port on the back of the spool valve.
8. Insert the reducing adaptor (20) into the tube nut (21), then screw the nut on to the straight connector (19).
9. Attach the selector valve feed hose (22) ($\frac{9}{16}$–18 UNF end fittings) with its straight end to the 90° elbow at Port 1 on the selector valve and its 90° end to the reducing adaptor (20).
10. Attach the return hose (23) (¾–16 UNF end fittings) with its 45° end to the 90° elbow (18) at the upper R.H. port of the spool valve and its 90° end to the 90° elbow (16) on the selector valve.

AUXILIARY HYDRAULIC FEED HOSE KIT

FUNCTION

This feed hose kit supplies oil to the spool valve and allows oil to return to the front port on the side cover.

Flow Available: 31,8 lit/min (7.0 Imp. gal/min or 8.4 U.S. gal/min).
Max. Pressure: 169 kg/cm^2 (2400 lb/in^2).
Hydraulic H.P.: 9.8 @ 140 kg/cm^2 (2000 lb/in^2).

Tractors with Early Type P.t.o. Side Cover

NOTE – THE P.T.O. SIDE COVER REFERRED TO IN THESE INSTRUCTIONS WAS FITTED TO ALL HIGH CAPACITY MULTI-POWER TRACTORS FROM 1965 ONWARDS UP TO THE CUT-IN OF INDEPENDENT P.T.O. IN DECEMBER 1971, WHEN ONLY NON-I.P.T.O. MULTI-POWER TRACTORS CONTINUED TO HAVE THIS TYPE OF SIDE COVER UNTIL THE FINAL CESSATION OF PRODUCTION IN MARCH 1972. THIS SIDE COVER IS IDENTIFIED BY HAVING THE FRONT PORT SLIGHTLY ABOVE THE REAR ONE. THE COVER IS MANUFACTURED FROM CAST IRON.

FITTING INSTRUCTIONS 7B-20-41

Fig. 5.

1. If necessary, fit the p.t.o. lever extension kit 884 391 M91 (24) (not supplied in the kit) to the p.t.o. lever.
2. Remove the manifold from the p.t.o. side cover.
3. Screw a ¾–16 UNF straight connector (19) into each port on the p.t.o. side cover.
4. Attach the feed hose (25) to the REAR port on the side cover.
5. Attach the straight end of the return hose (26) to the FRONT port on the side cover.
6. Assemble the spool valve unit and bolt it to the tractor footplate as stated in operation 7B-17-38.
7. Screw a ¾–16 UNF 90° elbow (18) into the two R.H. ports on the back of the spool valve. Lock the upper elbow to point vertically upwards. The lower elbow must be locked to point downwards at approx. 20° away from the tractor.

8. Route the feed hose round the front of the mounting bracket and connect it to the lower 90° elbow on the back of the valve.
9. Route the return hose across the front of the valve bracket, then over the top of the valve and couple its 90° end to the 90° elbow, at the upper R.H. port on the back of the spool valve.

AUXILIARY HYDRAULIC FEED HOSE KIT

Tractors with Later Type P.t.o. Side Cover

NOTE – THE P.T.O. SIDE COVER REFERRED TO IN THESE INSTRUCTIONS IS FITTED TO ALL TRACTORS WITH I.P.T.O. FROM FIRST PRODUCTION (DECEMBER 1971) AND TO ALL HIGH CAPACITY PUMP MULTI-POWER TRACTORS BUILT FROM MARCH 1972. THIS TYPE OF SIDE COVER IS IDENTIFIED BY HAVING THE FRONT PORT BELOW THE REAR ONE. THE COVER IS MANUFACTURED FROM LIGHT ALLOY AND A LONGER, CAST ALLOY, P.T.O. LEVER IS ALSO FITTED.

FITTING INSTRUCTIONS 7B-21-42

Fig. 6.

1. Drive out the roll pin securing the p.t.o. lever and remove the lever.
2. Fit the new, extended, p.t.o. lever (27), supplied in the kit and secure it with the new roll pin.
3. Remove the manifold from the p.t.o. side cover.
4. Thread a 1 in–12 UNF locknut (28) on to one of the manifold banjo bolts, then screw the manifold bolt into the FRONT port pipe.
5. Pull the snap ring off the front port pipe, then screw the locknut into position. Remove the manifold banjo bolt.
6. Remove the snap ring from the REAR port pipe, then fit a second locknut (28).
7. Screw a ¾–16 UNF straight connector (19) into each port on the p.t.o. side cover.
8. Attach the feed hose (25) to the REAR port on the side cover.
9. Attach the straight end of the return hose (26) to the FRONT port on the side cover.
10. Assemble the spool valve unit and bolt it to the tractor footplate, as stated in operation 7B-17-39.
11. Screw a ¾–16 UNF 90° elbow (18) into the two R.H. ports on the back of the spool valve. Lock the upper elbow to point vertically upwards. The lower elbow must point downwards and at approximately 20° away from the tractor.
12. Route the feed hose round the front of the mounting bracket and connect it to the lower 90° elbow on the back of the spool valve.
13. Route the return hose across the front of the valve bracket, then over the top of the valve and couple its 90° end to the 90° elbow at the upper R.H. port on the back of the spool valve.

COMBINED FLOW FEED HOSE KIT

FUNCTION

The combined flow hose kit supplies oil to the spool valve from both the selector valve and the p.t.o. side cover. Oil is returned from the spool valve to the front port of the side cover.

ADJUSTMENT

If the tractor hydraulic linkage has to be kept at a preset height above the ground, the following changes must be made to the arrangement of the supply hose kit:–

1. Fit the $\frac{9}{16}$ –18 UNF plug (17), from the selector valve kit, to front Port 1, in place of the non-return valve (30) and 90° elbow (31).
2. Fit the non-return valve and 90° elbow (30 and 31) to Port 2 of the selector valve.
3. In place of the feed hose (22), make up a new, longer hose, connecting it to the reducing adapter (20) at the lower R.H. port on the back of the spool valve and to the $\frac{9}{16}$–18 UNF 90° elbow (31) at Port 2.

Flow Available:	46,7 lit/min (10.3 Imp. gal/min or 12.4 U.S. gal/min).
Max. Pressure:	179 kg/cm^2 (2550 lb/in^2) but with only 15 lit/min flow.
Hydraulic H.P.:	14.2 @ 140 kg/cm^2 (2000 lb/in^2).

Tractors with Early Type P.t.o. Side Cover

For details of types and tractor identification, see 'Auxiliary Hydraulic Feed Hose Kit' on page 7B-42.

FITTING INSTRUCTIONS 7B-22-42

Fig. 7.

1. If necessary, fit the p.t.o. lever extension kit 884 391 M91 (24) (not supplied in the kit) to the p.t.o. lever.
2. Remove the manifold from the p.t.o. side cover.
3. Screw a ¾–16 UNF straight connector (19) into the FRONT port on the side cover.
4. Screw the larger (¾–16 UNF) non-return valve (29) into the REAR port on the side cover.
5. Screw a ¾–16 UNF straight connector (19) into the non-return valve (29).
6. Attach the straight end of the return hose (26) to the straight connector (19) at the FRONT port on the side cover.
7. Attach the feed hose (25) to the straight connector (19) on the non-return valve (29) (REAR port on the side cover).
8. Fit the selector valve kit, as stated in operation 7B-18-40.
9. Assemble the spool valve unit and bolt it to the tractor footplate as stated in operation 7B-17-39.
10. Screw the smaller $\frac{9}{16}$–18 UNF non-return valve (30) into front Port 1 of the selector valve.
11. Screw the $\frac{9}{16}$ –18 UNF 90° elbow (31) into the non-return valve (30).
12. Attach the straight end of the selector valve feed hose (22) ($\frac{9}{16}$–18 UNF end fittings) to the 90° elbow (31).
13. Fit a $\frac{9}{16}$ –18 UNF plug (17) to rear Port 1 and Port 2 of the selector valve.
14. Fit a ¾–16 UNF plug (9) to the 'R' port on the selector valve.
15. Screw the ¾–16 UNF tee-piece (32) into the lower, R.H. port on the back of the spool valve. Lock the tee-piece with its 90° angle union pointing downwards and approximately 20° away from the tractor.
16. Screw a ¾–16 UNF 90° elbow (18) into the upper R.H. port on the back of the selector valve. Lock the elbow to point vertically upwards.

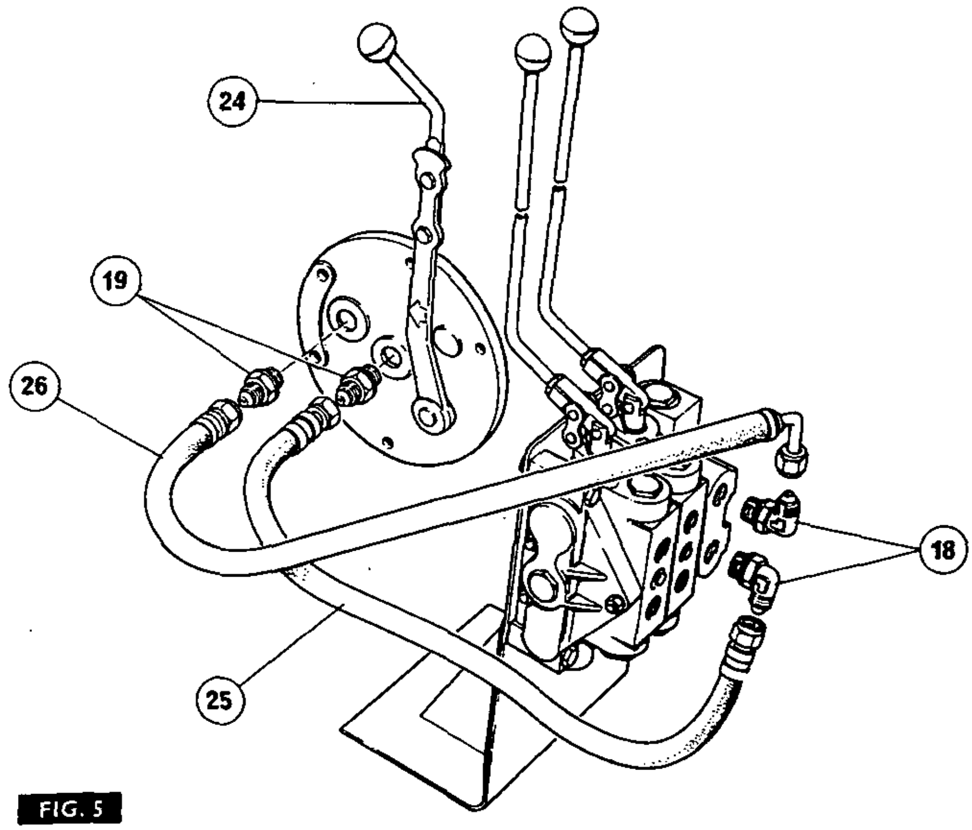


FIG. 5

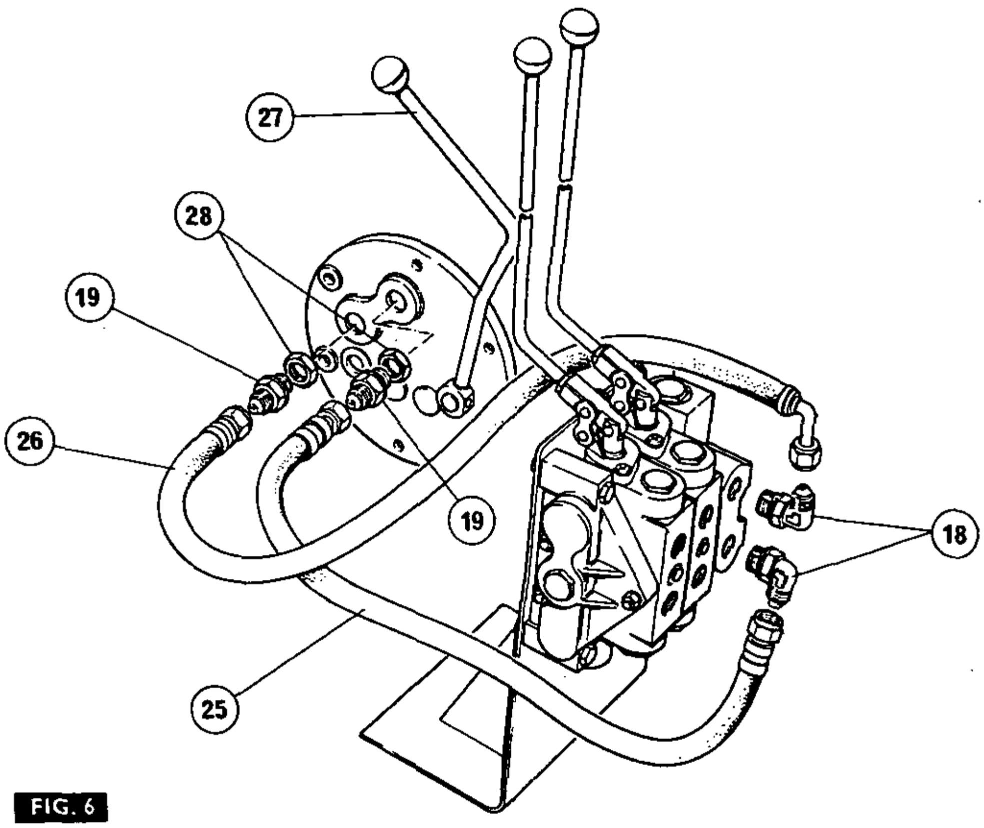


FIG. 6

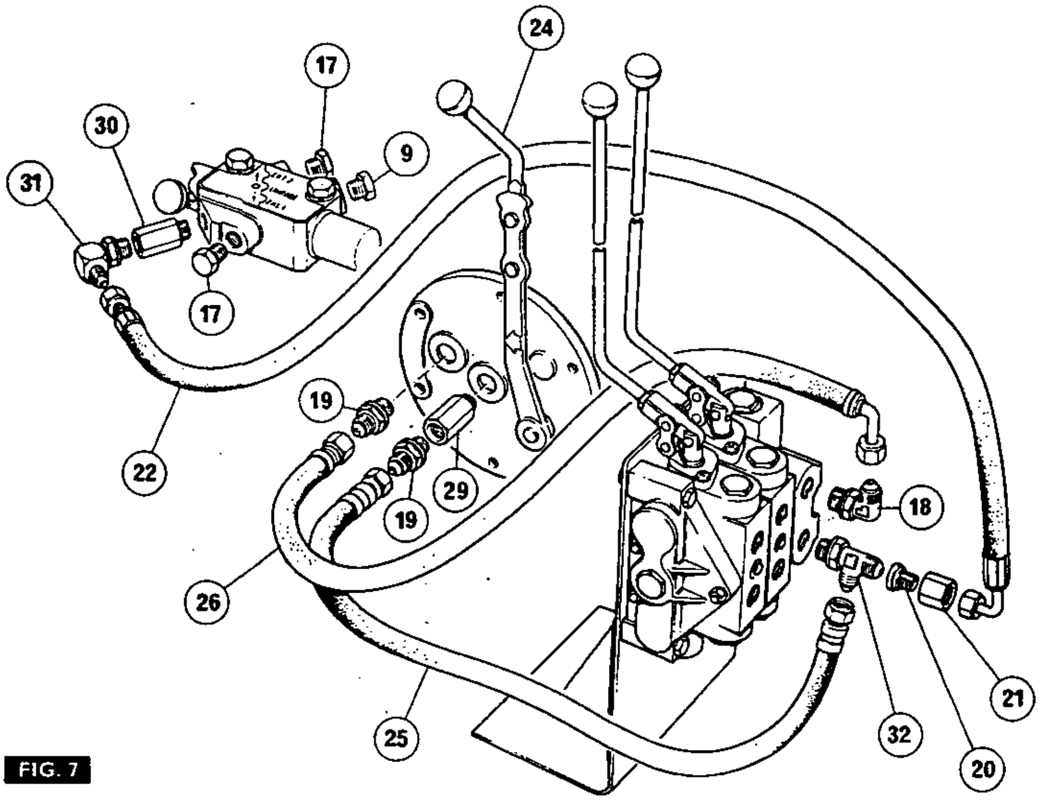

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FIG. 7

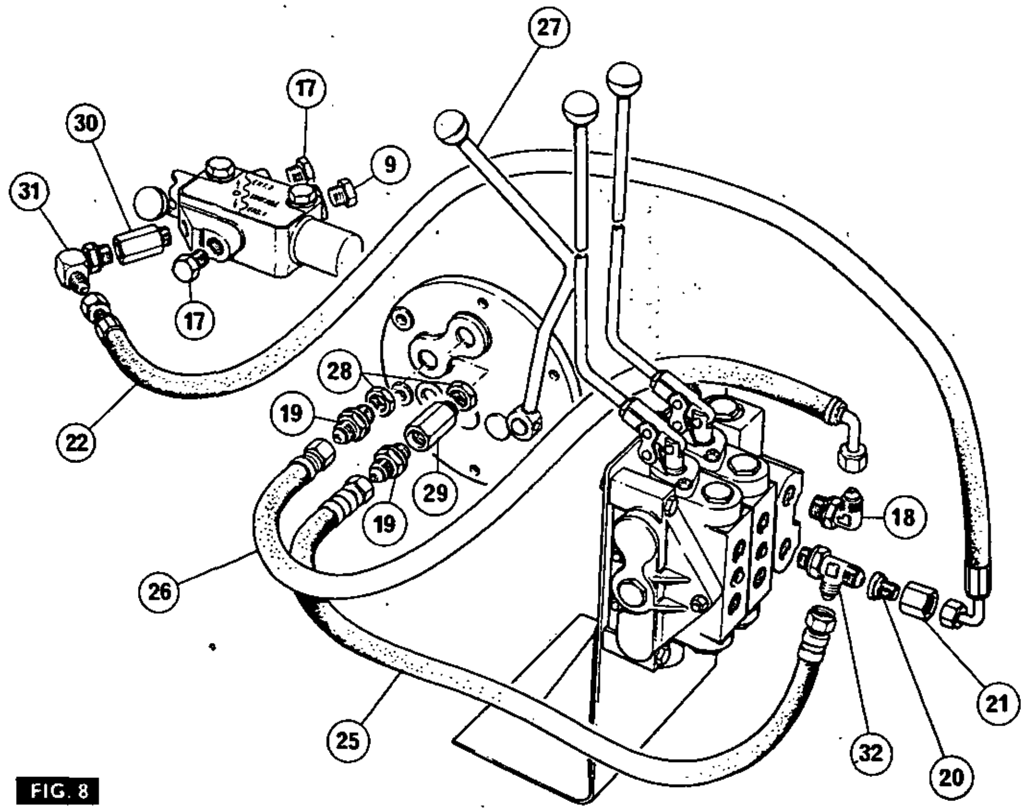
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FIG. 8

17. Insert the reducing adapter (20) through the tube nut (21), then screw the nut on to the horizontal portion of the tee-piece (32).
18. Route the side cover feed hose (25) across the footplate and attach it to the vertical portion of the tee-piece (32).
19. Route the return hose (26) across the front of the spool valve mounting bracket, then over the spool valve and attach its 90° end to the 90° elbow (18) at the upper R.H. port on the back of the spool valve.
20. Attach the 90° end of the selector valve feed hose (22) to the reducing adapter (20).

COMBINED FLOW FEED HOSE KIT

Tractors with Later Type P.t.o. Side Cover
For details of types of tractors and identification, see 'Auxiliary Hydraulic Feed Hose Kit' on page 7B-42.

FITTING INSTRUCTIONS 7B-23-45
Fig. 8.

1. Drive out the roll pin securing the p.t.o. lever and remove the lever.
2. Fit the new, extended, p.t.o. lever (27), supplied in the kit and secure it with the new roll pin.
3. Remove the manifold from the p.t.o. side cover.
4. Thread a 1 in–12 UNF locknut (28) on to one of the manifold banjo bolts, then screw the manifold banjo bolt into the FRONT port pipe on the p.t.o. side cover.
5. Pull the snap ring off the front port pipe of the p.t.o. side cover, then screw the locknut (28) into position. Remove the manifold banjo bolt.
6. Remove the snap ring from the REAR port pipe, then fit a second locknut (28).
7. Screw a ¾–16 UNF straight connector (19) into the FRONT port on the p.t.o. side cover.
8. Screw the larger (¾–16 UNF) non-return valve (29) into the REAR port on the p.t.o. side cover.
9. Screw a ¾–16 UNF straight connector (19) into the non-return valve (29).
10. Attach the straight end of the return hose (26) to the straight connector (19) at the FRONT part of the p.t.o. side cover.
11. Attach the feed hose (25) to the straight connector (19) on the non-return valve (29), (REAR port).
12. Assemble the selector valve kit, as stated in operation 7B-18-41.
13. Assemble the spool valve unit and bolt it to the tractor footplate, as stated in operation 7B-17-38.
14. Screw the smaller ($\frac{9}{16}$–18 UNF) non-return valve (30) into front Port 1 of the selector valve.
15. Screw the $\frac{9}{16}$ –18 UNF 90° elbow (31) into the non-return valve (30).
16. Attach the straight end of the selector valve feed hose (22) ($\frac{9}{16}$–18 UNF end fittings) to the 90° elbow (31).
17. Fit a $\frac{9}{16}$–18 UNF plug (17) to rear Port 1 and Port 2 of the selector valve.
18. Fit a ¾–16 UNF plug (9) to the 'R' port on the selector valve.
19. Screw the ¾–16 UNF tee-piece (32) into the lower, R.H. port on the back of the spool valve. Lock the tee-piece with its 90° angle union pointing downwards and approximately 20° away from the tractor.
20. Screw a ¾–16 UNF 90° elbow (18) into the upper R.H. port on the back of the spool valve. Lock the elbow to point vertically upwards.
21. Insert the reducing adapter (20) through the tube nut (21), then screw the nut on to the horizontal portion of the tee-piece (32).
22. Route the side cover feed hose (25) across the footplate and round the valve to connect to the 90° angle of the tee-piece (32).
23. Route the return hose (26) across the front of the spool valve mounting bracket, then over the spool valve and attach its 90° end to the 90° elbow (18) at the upper R.H. port on the back of the spool valve.
24. Attach the 90° end of the selector valve feed hose (22) to the reducing adapter (20).

OUTLET HOSE KIT

FUNCTION

Quick Release Pioneer Couplers
To fit an implement hose to a 'Pioneer' coupler, grasp the coupler, forward of the gimbal clamp and pull the coupler rearwards. Holding the coupler in this position, insert the implement hose end adapter. Release the coupler and check for correct engagement.

WARNING – KEEP THESE COUPLERS CLEAN AND PLUGGED, WHEN NOT IN USE.

FITTING INSTRUCTIONS 7B-24-45
Fig. 9.

1. *Assemble the spool valve unit and feed hose kit, as stated previously.*
2. Screw a ¾–16 UNF straight connector (19) into the upper port(s).
3. Screw the extended ¾–16 UNF straight connector (33) into the lower port(s).
4. Attach the 90° end(s) of the outlet 'feed' hose(s) (34 and 35) to the upper straight connector(s) (19) (These are the larger diameter hoses).
5. Attach the 90° end(s) of the outlet 'return' hose(s) (36 and 37) to the lower straight connector(s) (19 and 33). (These are the smaller diameter hoses).
6. Fig. 10. Remove the top two fixings from the L.H. trumpet housing, then locate the L.H. coupler mounting bracket (38) and refit the nut and bolt.

6A. Twin Spool Only:– Repeat operation (6) for the R.H. coupler mounting bracket.

7. Slide a 'Pioneer' coupler (39), through each gimbal ring (40) and secure each one with a retaining ring (41).
8. Fit an 'O' ring (42) to each outlet hose end, then screw a 'Pioneer' coupler assembly on to each hose.

9. Assemble the 'Pioneer' couplers in pairs, with two clamps (43), a spacer (44) and a pair of plugs (45). Slide a $\frac{7}{16}$ UNF x 75 mm (3 in), bolt (46) through the brackets and the spacer, then locate the loops of the plugs (45) over the spacer, before bolting the assembly to the mounting bracket (38) (centre hole).

9A. Twin Spool Only:– Repeat operation (9) for the R.H. pair of hoses.

NOTE – THE HOSE(S) FROM THE UPPER PORT(S) (34 OR 35) IS THE BOTTOM HOSE IN THE CLAMP(s).

10. Remove the lift cover bolt, just forward of the L.H. lift arm.

10A. Twin Spool Only:– Also remove the lift cover bolt, just forward of the R.H. lift arm.

11. Tractors with De Luxe Seat Only:– Modify the hose clamp bracket(s) (47) as shown in Fig. 11.

12. Fig. 10. Secure the hose clamp bracket(s) (47) to the lift cover with the $\frac{7}{16}$ UNC x 108 mm (4¼ in) bolt(s) (48). Torque the bolt(s) to 9,0 kg m (65 lb ft).

13. Secure the hoses in pairs to the clamp bracket(s) (47), using the 'U' clamp(s) (49), plus a ¼ UNF x 41 mm (1$\frac{5}{8}$ in) bolt (50) and a ¼ UNF locknut (tractors with spring suspension seat only).

NOTE – IF NECESSARY, BEND THE BRACKET(S) (47) TO ENSURE A STRAIGHT HOSE RUN BETWEEN THE CLAMP(S) AND THE COUPLERS. ALSO, DO NOT CLAMP THE HOSES TIGHTLY, AS THEY MUST BE FREE TO SLIDE IN THE CLAMPS TO PERMIT COUPLING AND UNCOUPLING.

13A. Fig. 12. De Luxe Seat Tractors Only:– Secure the hoses to the clamp bracket(s) with a plastic strap (51).

14. Twin Spool Only. Remove the tractor seat.

15. Fig. 9. Twin Spool Only. Fit the hose retainer plate (52) over the seat location studs, locating the two R.H. hoses between the bend in the end of the retainer plate and the front of the lift cover.

16. Refit tractor seat.

17. Fit the plastic plugs (45) into the 'Pioneer' couplers.

SPOOL VALVE UNIT REMOVAL AND REFITMENT — 7B-25-46

Fig. 2.

Removal

1. Disconnect all of the feed, return and outlet hoses from the spool valve.
2. Remove the three bolts (8) and spring washers, then lift off the valve.

Refitment

1. Align the valve against the mounting bracket (7), then refit the three bolts (8), nuts and spring washers.
2. Reconnect all of the feed, return and outlet hoses.

SPOOL BLOCK REMOVAL AND REFITMENT — 7B-26-46

Fig. 13.

Removal

1. Remove the spool valve from the tractor, as stated in operation 7B-25-46.
2. Remove the three nuts and studs (52) securing the spool valve assembly.
3. Part the end plates (53 and 54) from the spool blocks (55) and remove the 'O' rings (56 and 57).
4. Thoroughly clean the mating faces of the spool blocks and the end plates.

Refitment

1. Fit four new 'O' rings (56 and 57) to the recesses in the L.H. plate and the spool blocks.
2. Place the valve on a flat surface, with the feed ports uppermost, then align the valve sections and refit the three studs (52) nuts and lock-washers.
3. Torque the nuts to 2 kg m (15 lb ft).
   DO NOT OVERTIGHTEN THE NUTS AS THIS COULD CAUSE THE SPOOLS TO STICK.
4. Refit the spool valve to the tractor, as stated in operation 7B-25-46.

SPOOL BLOCK SERVICING — 7B-27-46

Fig. 11.

Disassembly

1. Split the spool block from the main assembly, as stated in operation 7B-25-47.
2. Remove the upper plug (1) from the spool block.
3. If a double-acting plug (1) is fitted, remove both 'O' rings (58 and 59); or, conversely, if the single-acting plug (2) is fitted, remove the 'O' ring (58).
4. Remove the lower plug (1) and remove both 'O' rings (58 and 59).
5. Withdraw the check valve body (60) from the spool block, then remove the poppet (61) and spring (62). Remove the 'O' ring from the valve body (48).
6. Remove the centreing spring cover retaining screws (63), then lift off the cover (64).
7. Remove the retaining screw (65) spring guides (66) and spring (67).
8. Remove the upper cover screws (63) and remove the cover. Remove the seal (68).
   DO NOT MOVE THE SPOOL FROM ITS CENTRAL POSITION.
9. Gently rotate and pull the spool towards the pull rod (TOP) end of the spool block, until the lower 'O' ring (69) is uncovered. DO NOT COMPLETELY REMOVE THE SPOOL.
10. Remove the lower 'O' ring (69) from its groove in the spool block.

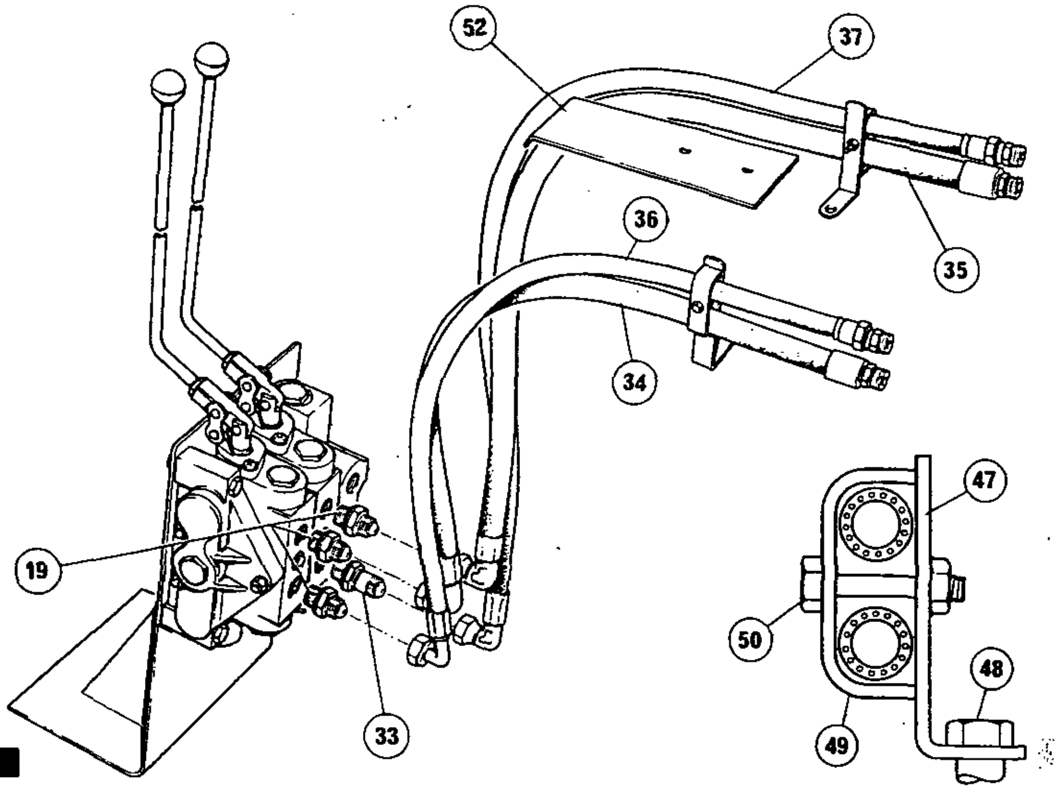


FIG. 9

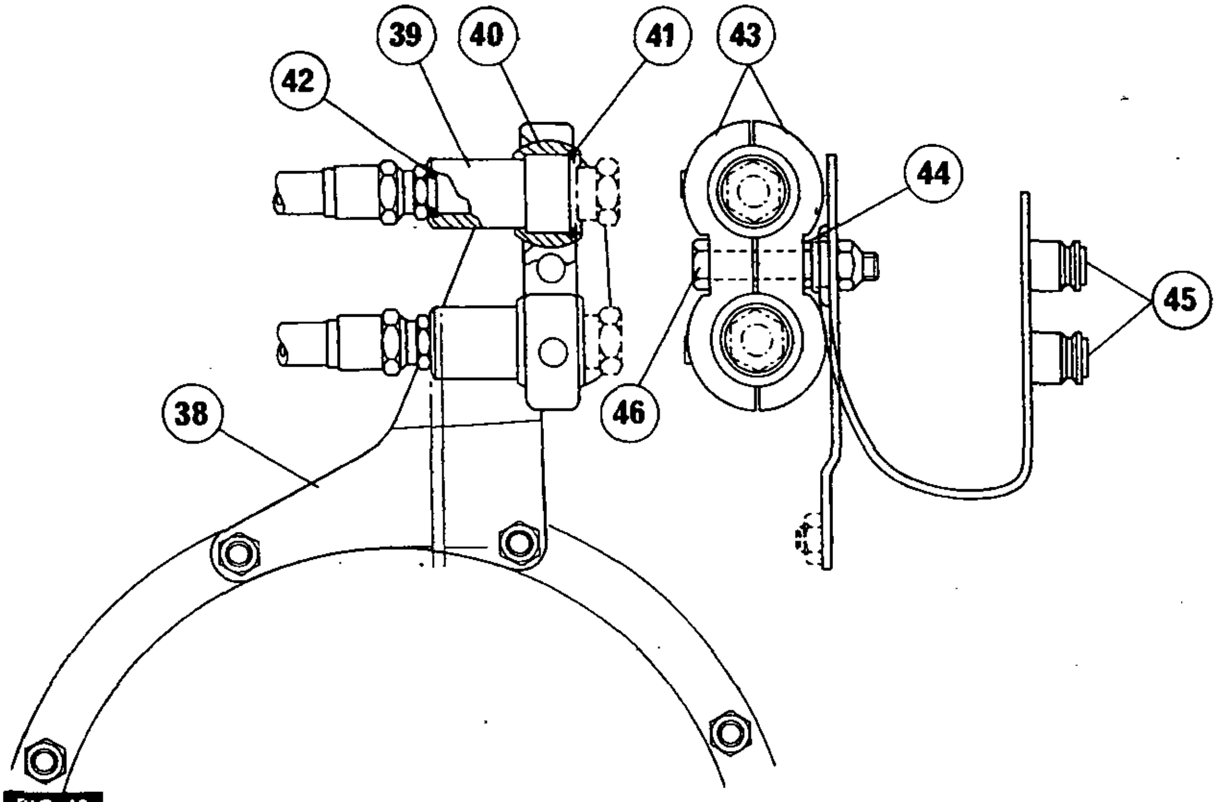


FIG. 10

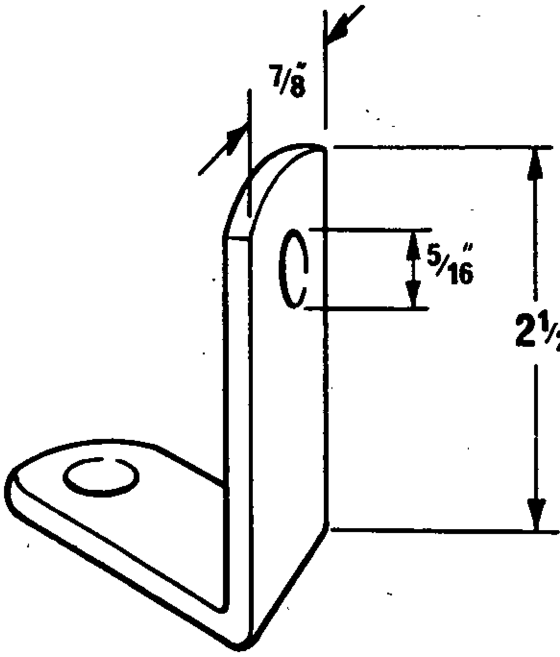


FIG. 11

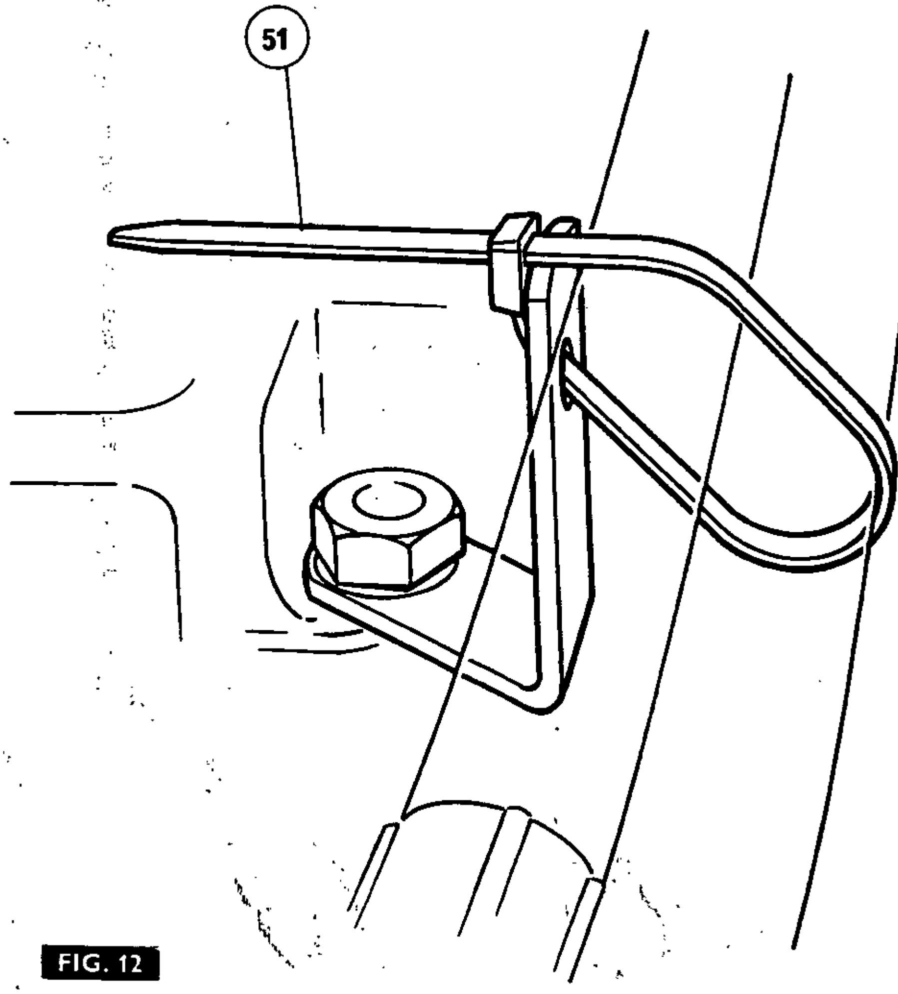


FIG. 12

11. Gently rotate and push the spool downwards, away from the pull rod end of the spool block, until the upper 'O' ring (69) is uncovered. DO NOT COMPLETELY REMOVE THE SPOOL.
12. Remove the upper 'O' ring from its groove.

Examination
Check the condition of the check valve poppet and its seat in the spool block. Poor seating of the poppet can result in jerky operation.

Check that the spool slides smoothly in the spool block but DO NOT REMOVE THE SPOOL COMPLETELY. Always fit new 'O' rings and a new seal (68).

Reassembly
1. Fit a new 'O' ring (69) into the upper groove, then very carefully rotate and push the spool upwards until the lower groove is exposed.
2. Fit a new 'O' ring (69) to the lower groove, *then carefully centralise the spool.*
3. Thoroughly degrease the threads in the end of the spool and the retaining screw (65).
4. Apply one drop of Loctite 'Hydraulic Seal' (Brown) to the threads of the retaining screw (65), then assemble the spring guides (66) and the spring (67) on to the screw (65) and refit the screw to the spool.
5. Refit the centreing spring cover (64) and screws (63).
6. Slide a new seal (68) on to the spool, then refit the upper cover.
7. Fit a new 'O' ring to the check valve body (60).
8. Fit the spring (62) and poppet (61) to the check valve body (60) then slide the body onto the spool block.
9. Fit new 'O' rings (58 and 59) to the lower plug (1) then refit the cover plug to the spool block.
10. Dependent upon whether a single acting plug (2), or a double-acting plug (1) is fitted, fit either one (58) or two (58 and 59) new 'O' rings, then refit the plug.
11. Reassemble the spool to the block, as stated in operation 7B-25-46.

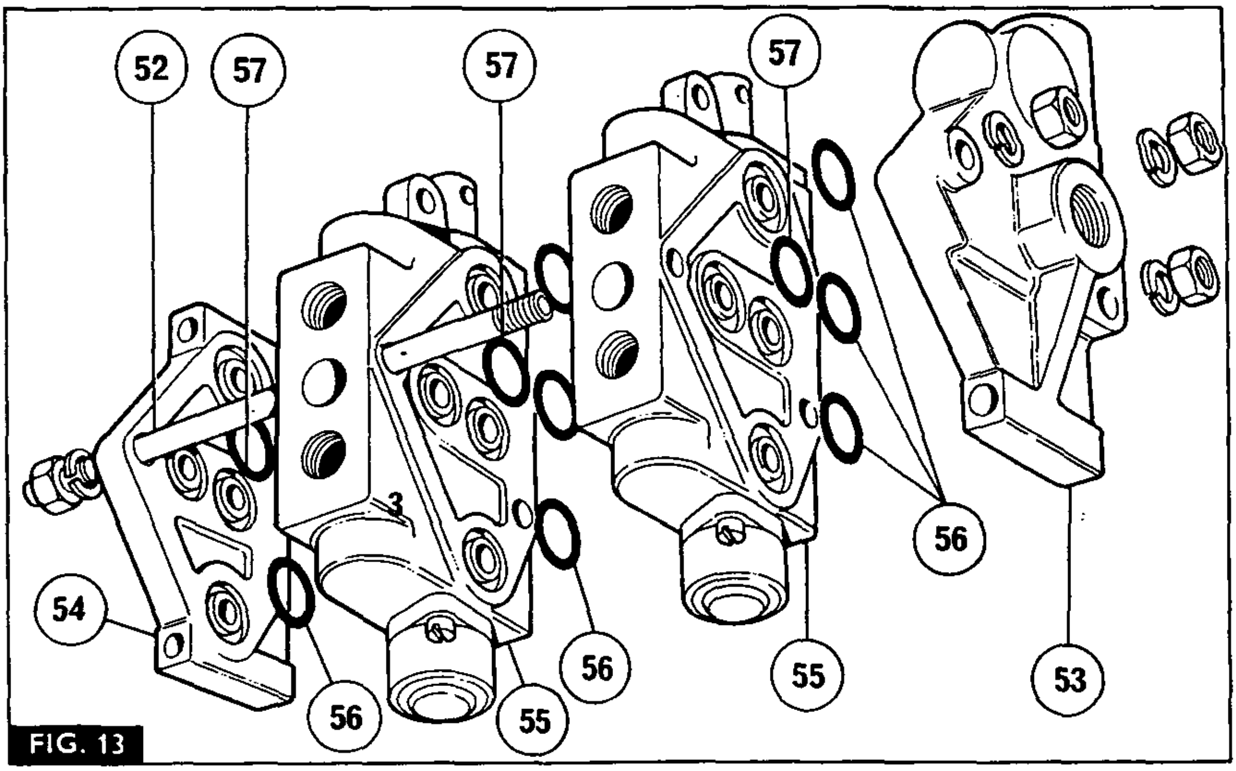

52
57
57
57
56
54
3
56
55
56
55
53

FIG. 13

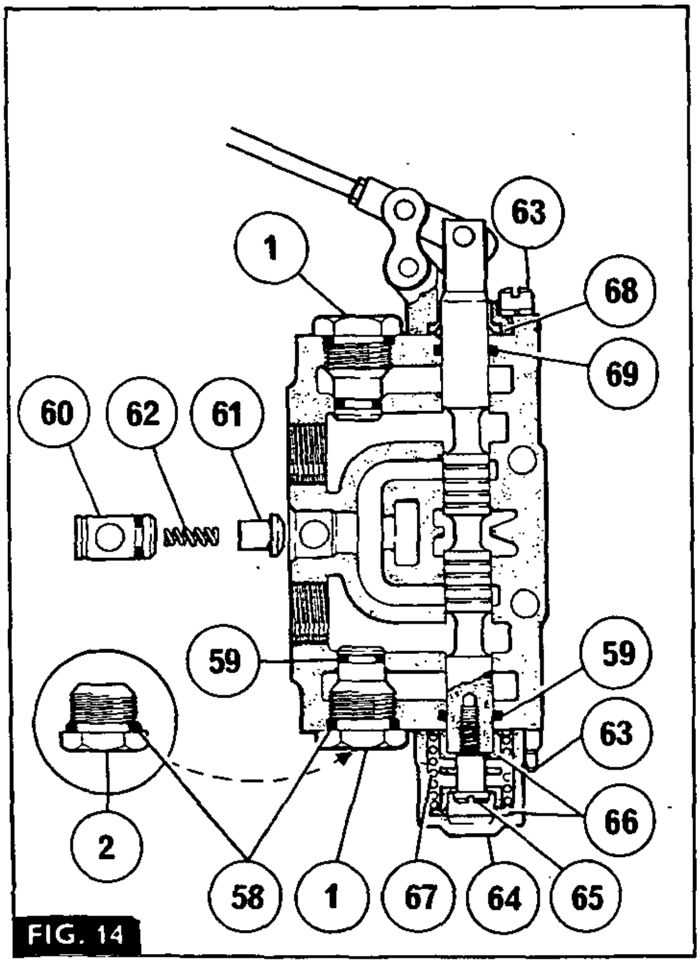

63
1
68
69
60
62
61
59
59
63
66
2
58
1
67
64
65

FIG. 14

LINKAGE AND DRAWBARS

Part 7 Section C

GENERAL

Fig. 1. The three point linkage controls the movements of the mounted and semi-mounted implements. The linkage comprises five main components:– top link (1), lower links (3), lift rods (2), check chains (4) and control beam (5).

TOP LINK

Fig. 2. The top link is of the three-piece, barrel, turnbuckle type and is adjustable for length between the dimensions stated in the specification section.

Adjustment Procedure

1. Fig. 2. Release the locking clip (6).
2. Rotate the barrel (7) until the required length is achieved. Do not permit the ball ends to rotate.
3. Return the spring clip to the engaged position, to retain the ball ends in the correct plane.

LOWER LINKS

The lower links (3) carry the implement and are also used when attaching the Pressure Control coupler or the linkage drawbar. Vertical, but not lateral movement of the lower links determines the height of the implements from the ground, or its depth of penetration.
The lower links fitted to this tractor have provision for interchangeability of the ball ends.

Interchanging Ball Ends 7C-01-02

1. Fig. 3A. Pull the spring clip upwards, as shown.
2. Rotate the ball until the narrow portion aligns with the slot in the lower link, then remove the ball.
3. Fig. 3B. Fit the new ball by locating it with the narrow section in line with the slot, then refit the spring clip, as shown.

NOTE – FOR CATEGORY 1 IMPLEMENTS, THE CHECK CHAIN LENGTH MUST BE SET AS SHOWN IN FIG. 4A AND FOR CATEGORY 2 IMPLEMENTS, AS SHOWN IN FIG. 4B.

LIFT RODS

The lift rods (2) connect the lift arms to the lower links. The L.H. lift rod is normally set to its correct length on assembly and is not adjusted thereafter. The R.H. lift rod incorporates a bevel gear levelling box, which allows the upper portion of the rod to be screwed into, or out of, the lower portion of the lift rod, thus adjusting the height of the R.H. lower link in relation to the left.

NOTE – THE LIFT ROD BOLTS MUST ALWAYS BE FITTED TO THE FORWARD HOLE IN THE LOWER LINKS AND THE LOCKNUTS SHOULD BE ADJUSTED SO THAT THE LIFT ROD BOLTS CAN ROTATE.

L.H. Lift Rod Fig. 5

The L.H. Lift Rod should be adjusted for length on assembly with the punch work on the upper rod just beginning to show from the lower fork. At this setting the distance between the centres should be 612 mm (24⅛ in).
Other than daily greasing of the nipple on the lift rod, no other servicing is required.

R.H. Levelling Box and Lift Rod Fig. 6

The R.H. Lift Rod is adjustable for length to allow the implement to be levelled during, or after attachment. Adjustments are made by rotating the handle which drives through a bevel gearbox to the lift rod. The lift rod screws into, or out of the lower lift fork. The nominal length of the R.H. lift rod is 612 mm (24⅛ in) and the range of adjustment is ±38 mm (1½ in).

Levelling Box Servicing 7C-02-02

Disassembly

1. Fig. 7. Remove the complete levelling box from the tractor by removing the split pin and clevis pin from the knuckle on the levelling box.
2. Unscrew the levelling gear shaft (19) out of the lower fork.
3. Using a 5 mm (3/16 in) diameter drill, remove one head from the double countersunk rivet (14) which secures the bevel gear (12) to the handle spindle (13).
4. Withdraw the levelling handle (13) and bevel gear (12) from the levelling box (9).
5. Remove the split pin (21) and the clevis pin (10) from the levelling box and remove the knuckle (8).
6. Remove the circlip (18) and the thrust washer (17) from the gear shaft.
7. Using a soft faced mallet, tap the end of the gear shaft (19) to force the dished expansion plug (11) out of the levelling box.
8. Slide the gear shaft (19) out of the levelling box, then remove the bearing (16).

The spring (20) and the grease nipple need not be removed.

Examination

Examine all components and replace any which are worn, or damaged.
When reassembling, always fit a new rivet (14), dished expansion plug (11), bearing (16), thrust washer (17), circlip (18) and split pins (21).

Reassembly

1. Fit the new bearing (16) into the levelling box (9), then slide the gear shaft (19) into place, securing it with the new thrust washer (17) and circlip (18).
2. Drive a new dished expansion plug (11) into the levelling box, using a suitable drift.
3. Refit the levelling handle (13) to the levelling box, then refit the bevel gear (12) and secure it by fitting and peining the new rivet (14).
4. Refit the knuckle (8) securing it with the clevis pin (10) and a new split pin (21).
5. Charge the levelling box with a recommended grease, until grease exudes past the seals.
6. Screw the gear shaft into the lower fork and adjust for length, then refit the knuckle, clevis pin and a new split pin to the lift arms.

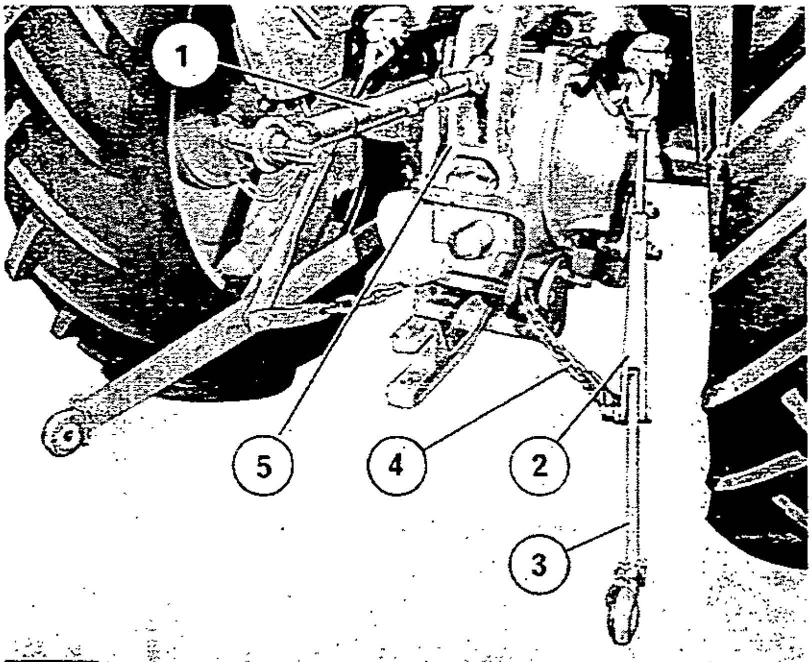


FIG. 1

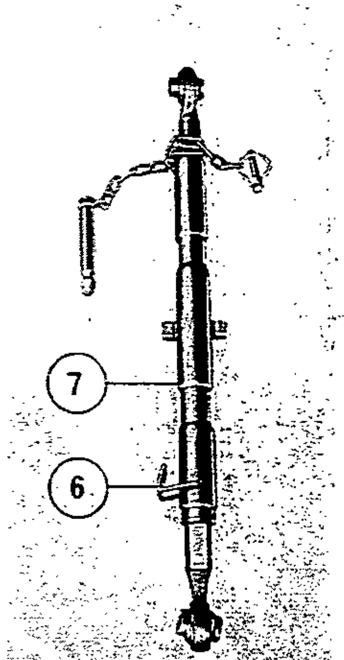


FIG. 2

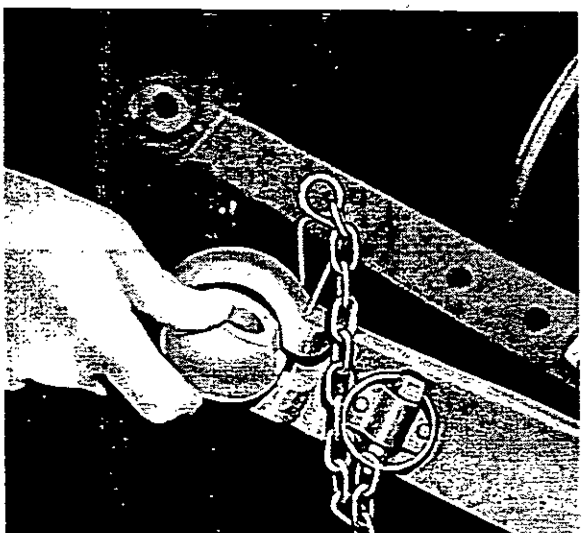


FIG. 3A

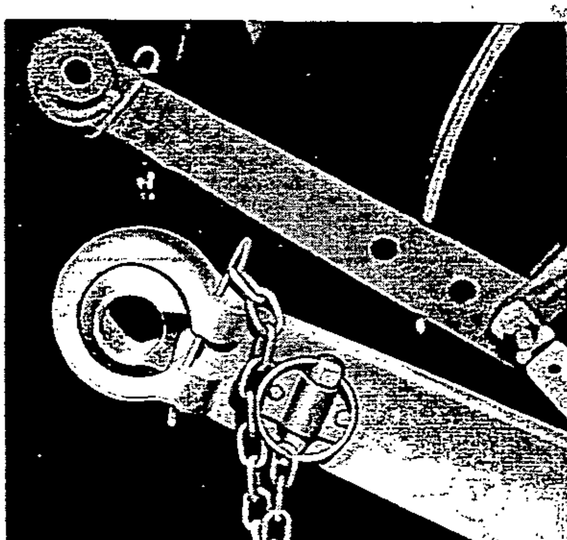


FIG. 3B

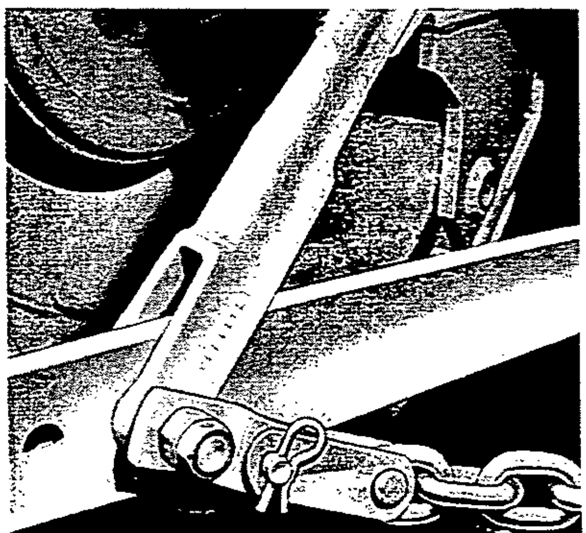


FIG. 4A

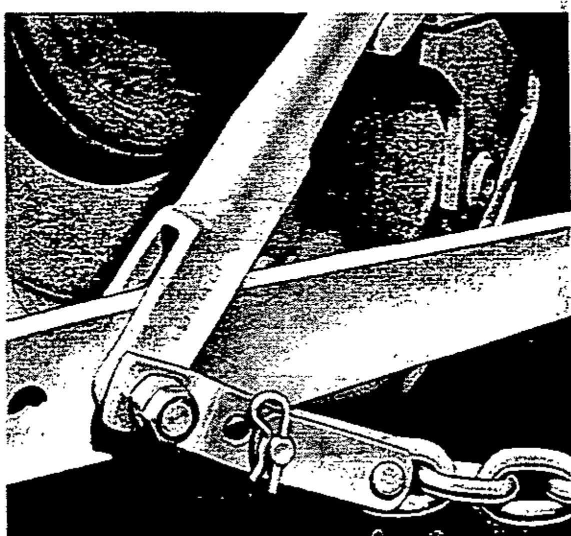


FIG. 4B

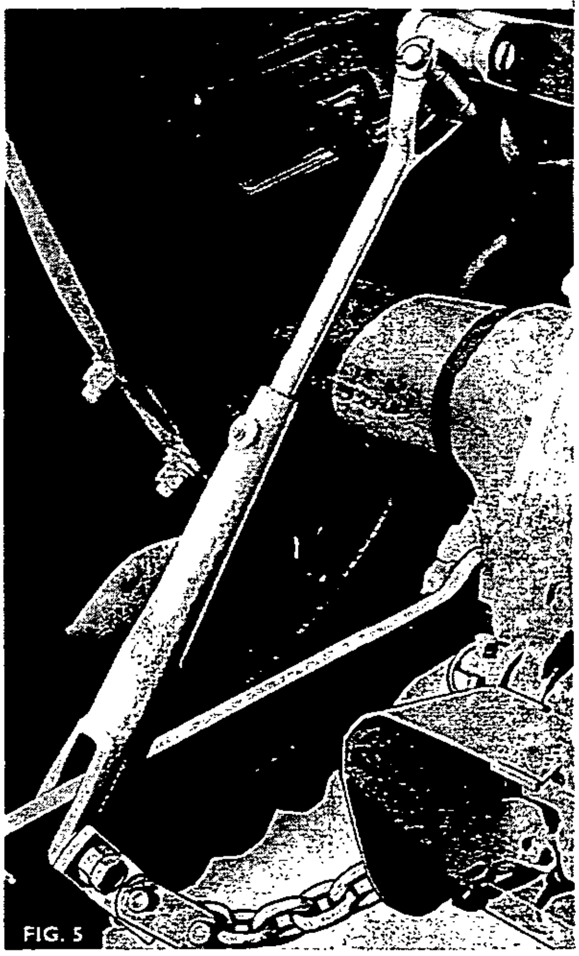


FIG. 5


FIG. 6

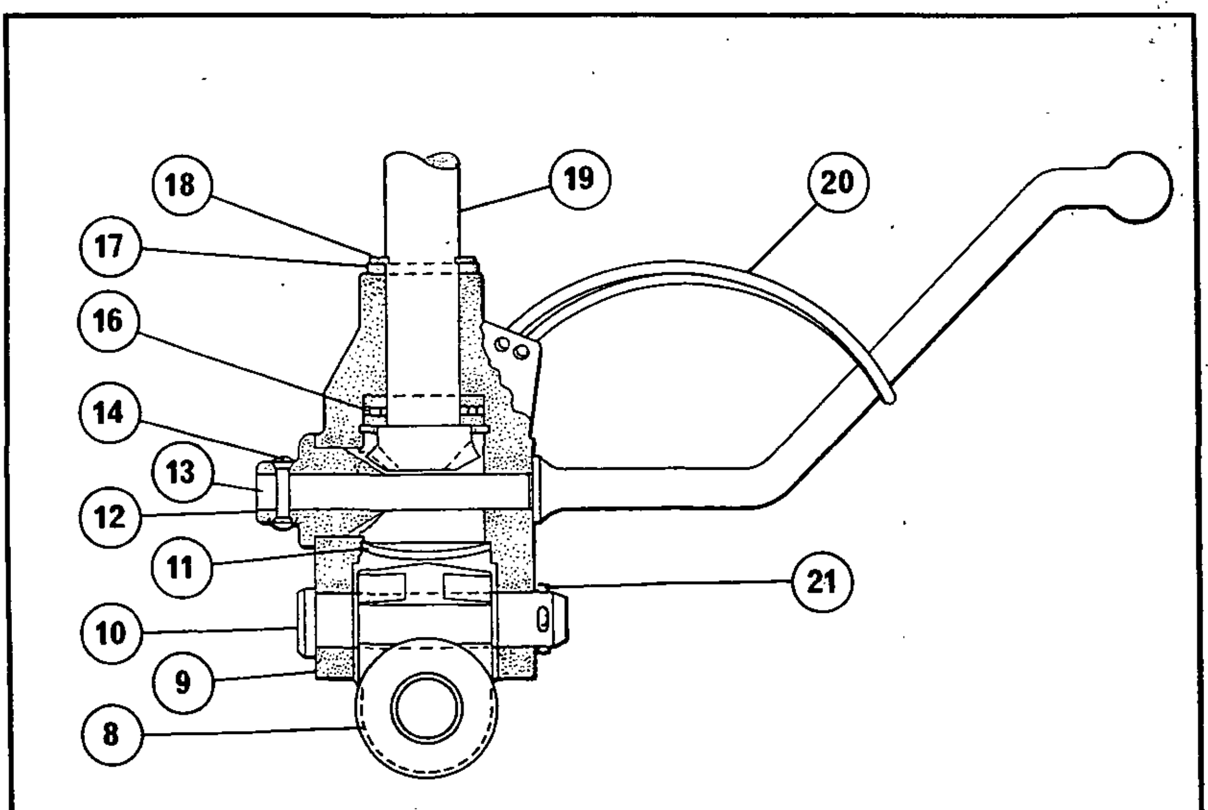


FIG. 7

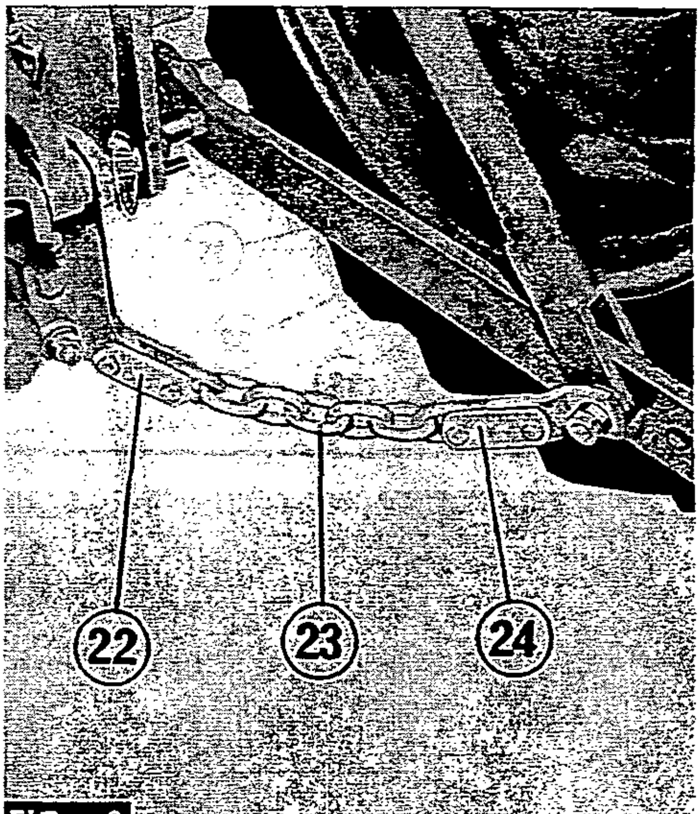


FIG. 8

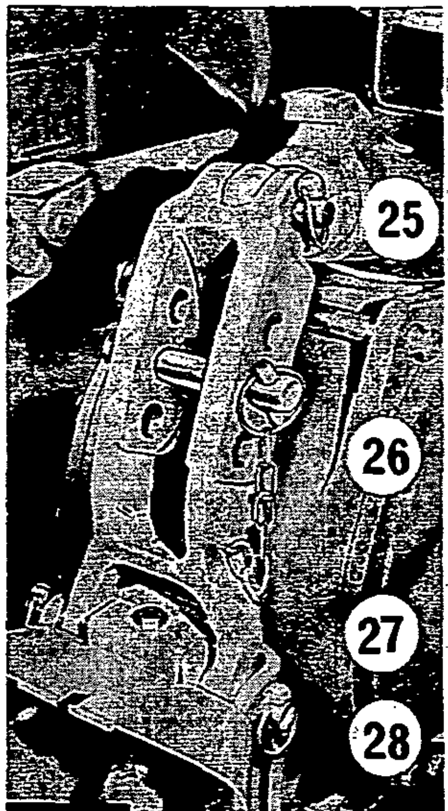


FIG. 9

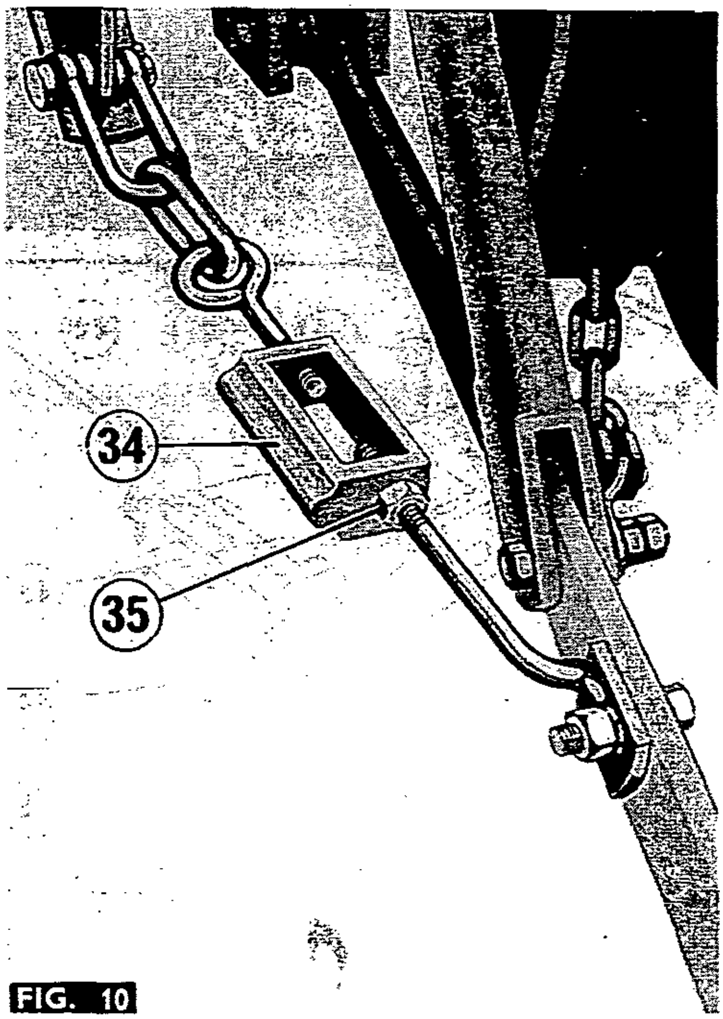


FIG. 10

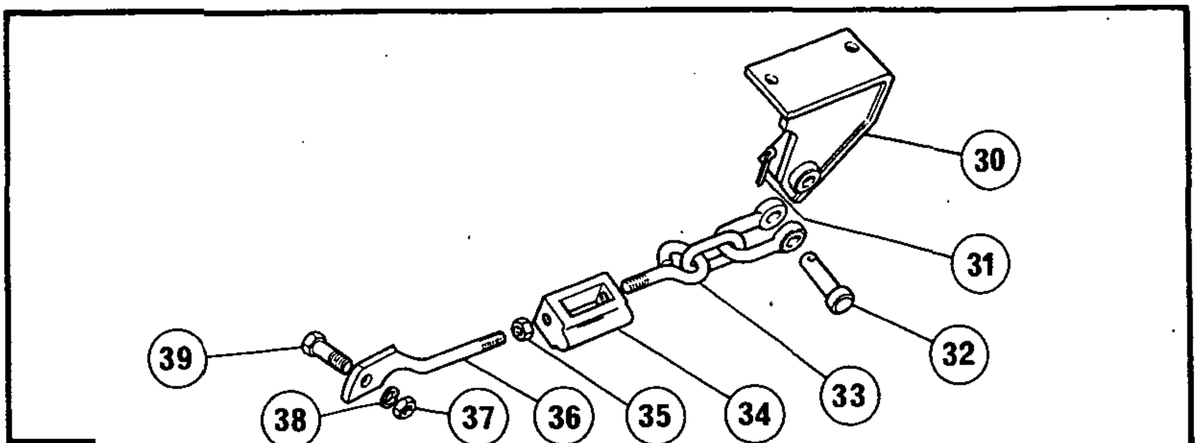


FIG. 11

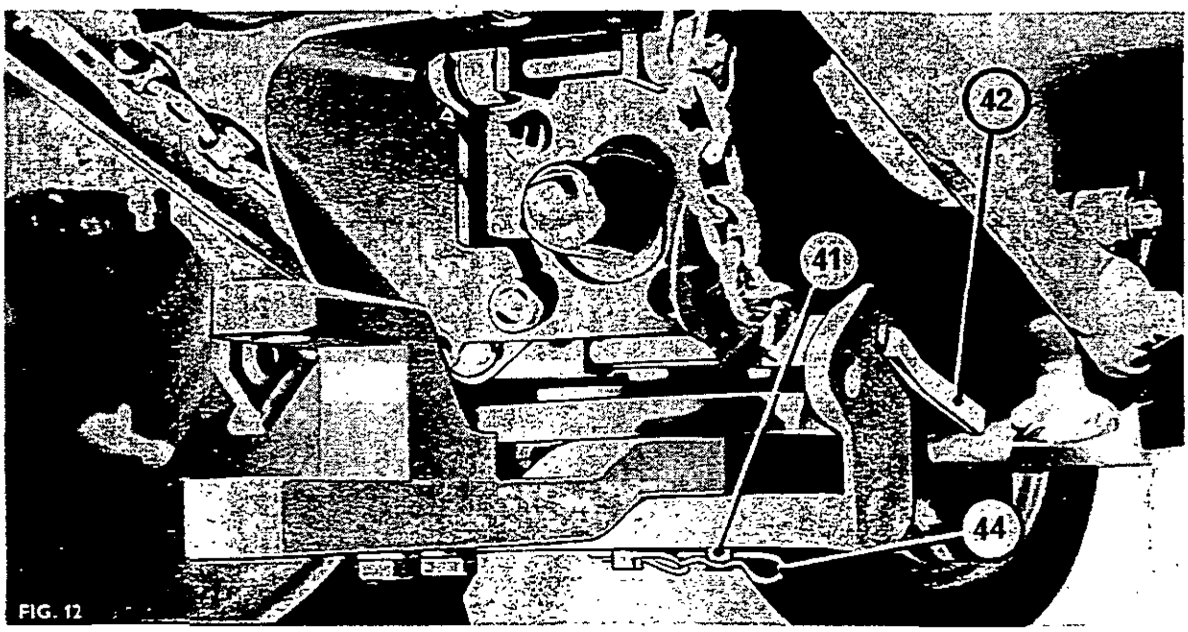


FIG. 12

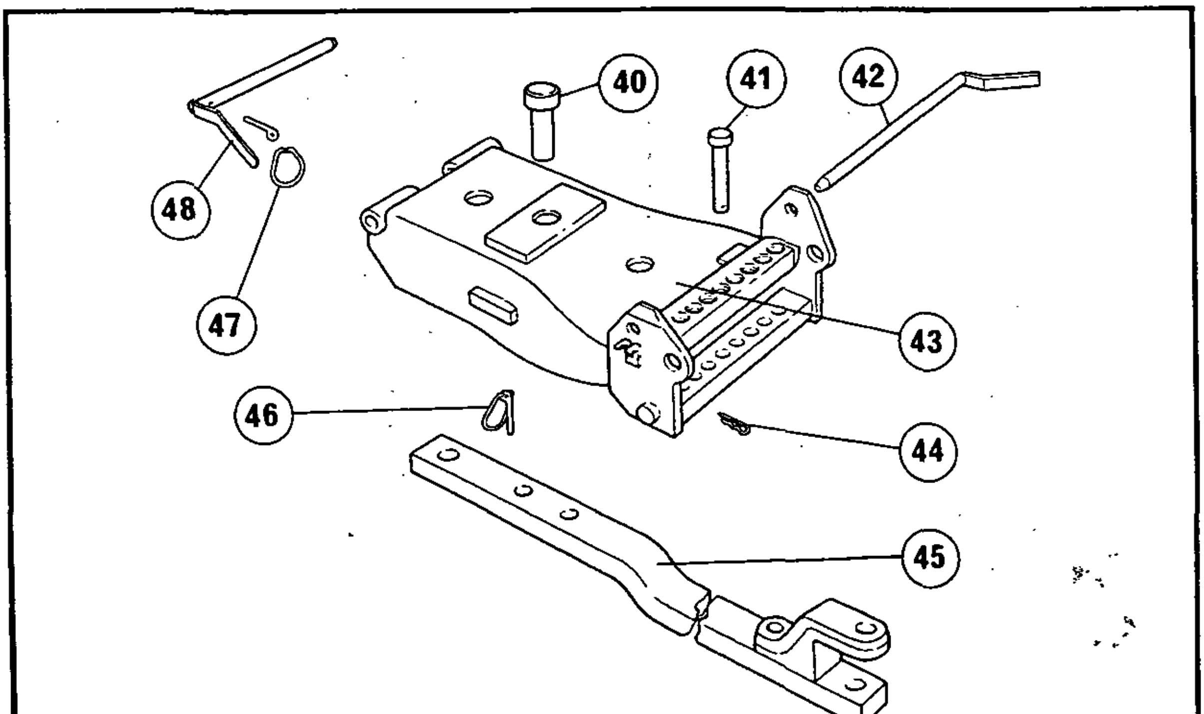


FIG. 13

CHECK CHAINS Fig. 8

The check chains restrict the movement of the lower links in a transverse plane, preventing the lower links or the implement they are carrying from striking the tractor's rear tyres. The check chains are attached to the rear of the tractor centre housing by the check chain anchor bracket and to the lower links by cranked brackets secured to the lower links by the lift rod retaining bolts.

The check chains comprise of the following components:–
Fig. 8. A pair of parallel side links (24) at the lower link end of the chain, seven plain chain links (23), and a pair of slightly shorter parallel side links (22) at the anchor bracket end.
According to the setting of the linkage for either Category 1 or Category 2 implement (See page 7C-02) the length of the chains are:–
Category 1 :– 308 mm (12⅛ in)
Category 2 :– 330 mm (13 in)

Check Chain Anchor Bracket
The one piece check chain anchor bracket with four stud, plus two bolt fixing is standard equipment The check chain anchor bracket also acts as the lower pivot point for the control beam.

CONTROL BEAM Fig. 9

The control beam connects the top link to the tractor hydraulic linkage when using Draft Control and thus governs the action of the implement.

Control Beam Removal and Refitment 7C-03-07
1. Fig. 9. Remove the linch pin (25) and withdraw the pin (26) securing the control beam to the control spring pull rod.
2. If necessary, remove one of the Auto-Hitch support brackets to permit removal of the lower pin.
3. Remove the linch pin (28) from the opposite end of the lower pivot pin (29) to that from which the Auto-Hitch support bracket has been removed, then withdraw the lower pin, complete with the other linch pin. Lift the control beam clear of the tractor.

STABILISERS Fig. 10

Stabilisers are fitted to prevent transverse movement of the lower links where an implement must be retained in a constant position relative to the tractor centre-line, to ensure accurate alignment, either with the crop rows, or the p.t.o. shaft. Adjustments are made by slackening the locknut (35) and rotating the turnbuckle (34) to give the required length, then retightening the locknut. Before working with soil engaging implements the chains should be adjusted to permit 50 mm (2 in) of sideways movement at the end of each lower link.

Stabiliser Kit Fitment
Two chain stabiliser kits are available for MF 148 tractors: A kit for tractors fitted with the U.K. safety frame and a seperate kit for tractors without the safety frame. Basic assembly for both kits is similar and is dealt with by one set of fitting instructions:–
1. Remove both nuts and washers from the fender attachment bolts.
2. Fig. 11. Locate the brackets (30) on the fender bolts and secure them with the washers and nuts tightened to a torque of 17 kg-m (125 lb-ft).

   NOTE – THE BRACKETS ARE MARKED 'L' AND 'R' TO INDICATE L.H. AND R.H. FITMENT
3. Assemble the chains (33) turnbuckle (34) locknut (35) and the link (36) together for each side of the tractor.
4. Align the rear links (36) with the holes in the lower links and secure them with the bolt (39), washer (38) and nut (37).
5. Align the shackles of the chains (33) with the holes in the bracket (30), then secure them with the clevis pins (32) and split pins (31).
6. Adjust the stabilisers for length, then liberally smear the threaded portions of the links and chains with grease to ensure ease of adjustment at a later date.

SWINGING DRAWBAR Fig. 12

The swinging drawbar conforms to British Standards, having a clevis hitch point at 356 mm (14 in) from the p.t.o. shaft. The maximum static load permissible at this setting is 765 kg (1700 lb). An alternative position, which places the drawbar clevis at 254 mm (10 in) from the p.t.o. shaft is provided. At this setting the maximum static load is 990 kg (2200 lb).

Swinging Drawbar Kit Fitment
1. Check the contents of the kit against the list provided.
2. Fig. 13. Slide the drawbar assembly (45) into the mounting frame (43) and fit the drawbar pin (40), then fit the two locating pins (41) securing them with the hairpins (44).
3. Place the mounting frame and drawbar assembly on a jack and raise it into position, secure it at the front with the support pin (48) and linch pin (47) and at the rear with the other support pin (42) and linch pin (46). Remove the jack.

Adjustments
Offset: Figs 12 and 14
1. Remove the linch pin and withdraw the support bar (42), thus freeing the drawbar frame.
2. Remove the two hairpins (44) from the locating pins (41) and remove the locating pins.
3. Reset the drawbar in the required position.
4. Refit the locating pins (41) and secure them with the hairpins (44).
5. Raise the drawbar frame and secure it with the support pin (42) and linch pin.

Length: Figs 12 and 13
1. Remove the linch pin and withdraw the support bar (42).
2. Push the drawbar pin (40) upwards, thus freeing the drawbar.
3. Adjust the drawbar for length and refit the drawbar pin (40).
4. Raise the drawbar frame and secure it with the support pin (42) and linch pin.

Height: Fig. 15
The drawbar can be adjusted for height. The procedure is similar to that for length adjustment. When inverting the drawbar the clevis adapter can be placed either on top, or underneath, as shown, but the bolts must be kept tight.

AUTO-HITCH Fig. 16

The Auto-Hitch is a supplementary lifting mechanism fitted to the swinging drawbar frame to enable implements fitted with a ring type drawbar attachment to be easily coupled to the tractor.
The hitch hook can, if required be replaced by the swinging drawbar by simply lowering the hitch, removing the pin and sliding out the hook, then replacing it by the drawbar.

Operation
Raising:– The quadrant control levers should be positioned as follows:–
'Draft Control' lever – 'Transport' i.e. fully back.
'Position Control' lever – Move to 'Transport' (adjacent to 'Constant Pumping'). The tractor lift arms will rise, lifting the hitch hook. When the 'Transport' position is reached, the latches will engage automatically, thus relieving the tractor linkage of weight.
Lowering:– Leave the 'Draft Control' lever in 'Transport'.
Move the 'Position Control' lever to 'Constant Pumping'; this will raise the hook frame clear of the latches. Pull the release lever rearwards to disengage the latch hooks, then, continuing to hold the release lever, move the 'Position Control' lever to 'Down'. the hitch will then lower.

Auto-Hitch Kit Fitment
1. Unpack the kit and check the contents against the packing list.
2. Fig. 13. Remove the linch pin and withdraw the support bar (42), thus freeing the drawbar frame (43).
3. Remove the three rearmost bolts securing each trumpet housing.
4. Fig. 17. Assemble one hook support bracket (49) to the centre housing, tightening the Allen screws to 11 kg-m (80 lb-ft).
5. Slide the cross shaft (51) through the bush in the hook support bracket already fitted, then fit the other hook support bracket.
6. Remove the masking tape from the spigots on the support brackets, then slide the latch hooks (50) on to the spigots. Secure each hook with a large washer and split pin.
7. Fig. 18. Assemble the cross shaft levers (54) on to the cross shaft (51) shimming them on each side with one thick washer and an equal number of thin washers.
8. Fit the ball (52) to the handle (53), then fit the handle to the R.H. cross shaft lever, securing it with a roll pin through either the centre hole (tractors with De Luxe seat) or the upper hole (tractors with Spring Suspension seat).
9. Secure the cross shaft levers (54) to the cross shaft (51) with a roll pin (55) on each side. Ensure that the cross shaft can rotate freely.
10. Assemble the springs (57) to the pull rods (58).
11. Locate the pull rods (58) in the support brackets (49), then fit the clevis pins (56) through the hooks (50) and the cross shaft levers (54) by compressing the springs. Secure the clevis pins with the four small split pins.
12. Fig. 19. Assemble the latches (62) and the support bar (61) to the drawbar frame, as shown, and secure the support bar with the two long, large split pins.
13. Remove the split pin and clevis pin securing each lift arm to the lift rod knuckle.

WARNING – AS THE CLEVIS PIN IS REMOVED, THE LOWER LINK AND LIFT ROD WILL DROP.

14. Fig. 20. Locate the lift arm extension (65) against the lift arm, then loosely fit the two long bolts (63), plate (64), spring washers and nuts.
15. Raise the lower links and lift rods and fit the new, longer clevis pins (66), securing them with split pins.
16. Fully tighten the lift arm extension bolts (63).
17. Fig. 21. Screw a nut on to the threaded portion of each lift chain (68) then screw an eye (67) on to each chain.
18. Attach the chains to the lift arm extensions with clevis pins and secure with two split pins.
19. Place a strip of metal 1,5 mm x 25 mm x 150 mm ($\frac{1}{16}$ in x 1 in x 6 in) on top of the drawbar frame, above the locating pins (41, Fig. 22), then jack up the frame, as shown, until the strip of metal is trapped between the frame and the drawbar mounting bracket.
20. Start the tractor engine, select 'Constant Pumping' with the 'Position Control' lever and 'Transport' with the 'Draft Control' lever. The lower links will fully raise. Stop the engine.
21. Adjust the length of the lift chains (68) by screwing the eyes up or down, until the eyes will just slide on to the spigots on the latches (62, Fig. 19).

NOTE – ENSURE THAT THE CHAINS ENGAGE THE LATCHES WITH EXACTLY EQUAL TENSION.

22. Remove the eyes from the spigots on the latches and SHORTEN the chains by screwing the eyes up a further FOUR turns, then fully tighten the nut on the threaded portion of the chains.
23. Lower the links slightly, refit the eyes and secure them with the medium size split pins.
24. Remove the jack, then lower the hitch by moving the lever (53) forwards, and moving the 'Position Control' lever to the 'Down' position.
25. Fig. 22. Remove the metal strip, then push out the drawbar pin (40) and withdraw the drawbar.
26. Fit the hitch hook (69), refitting the drawbar pin (40), then if necessary remove the hairpins (44) and locating pins (41) and refit them to centralise the hook.
27. Fig. 23. Remove the p.t.o. shield (if fitted) then remove the two nuts (71), spring washers and spacers securing the bottom of the check chain anchor bracket.
28. Fit the hook stop plate (70), spring washers and nuts (71), discarding the two spacers.
29. Fig. 24. Remove the long pin and fit the linkage check bracket (72) as shown.

Adjustment 7C-04-08
Every 500 hours, the adjustment should be checked. If the adjustment is incorrect, adjust as detailed in operations – 19 to 25.

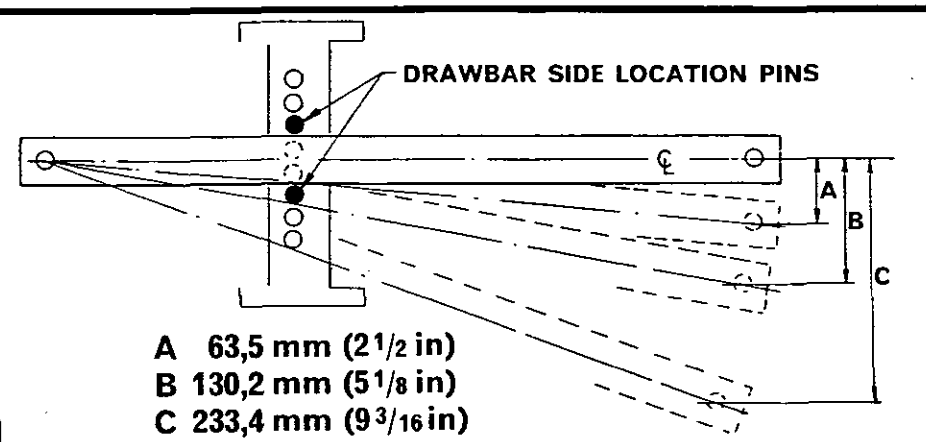


FIG. 14

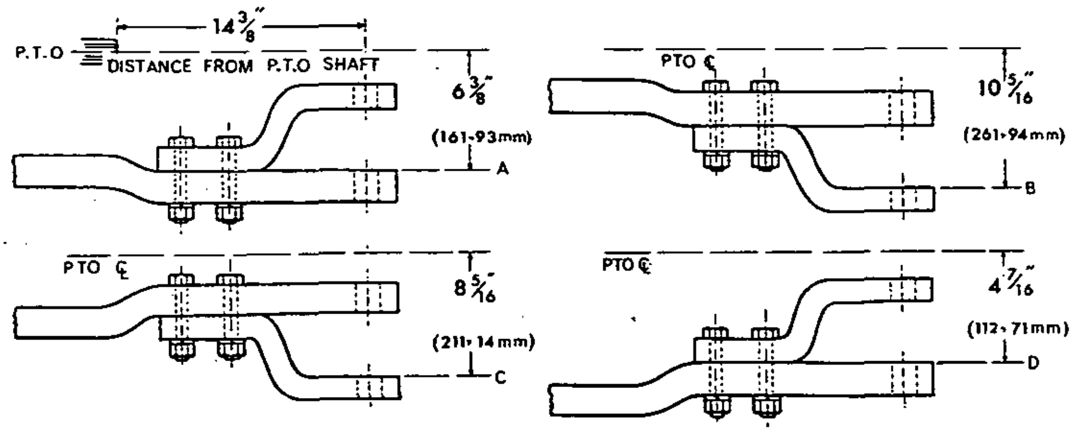


FIG. 15

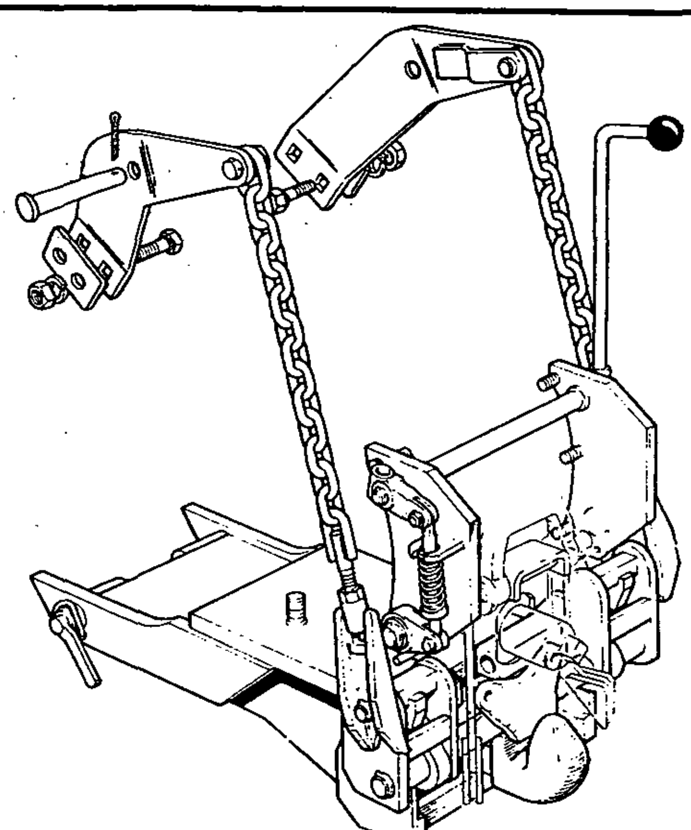


FIG. 16

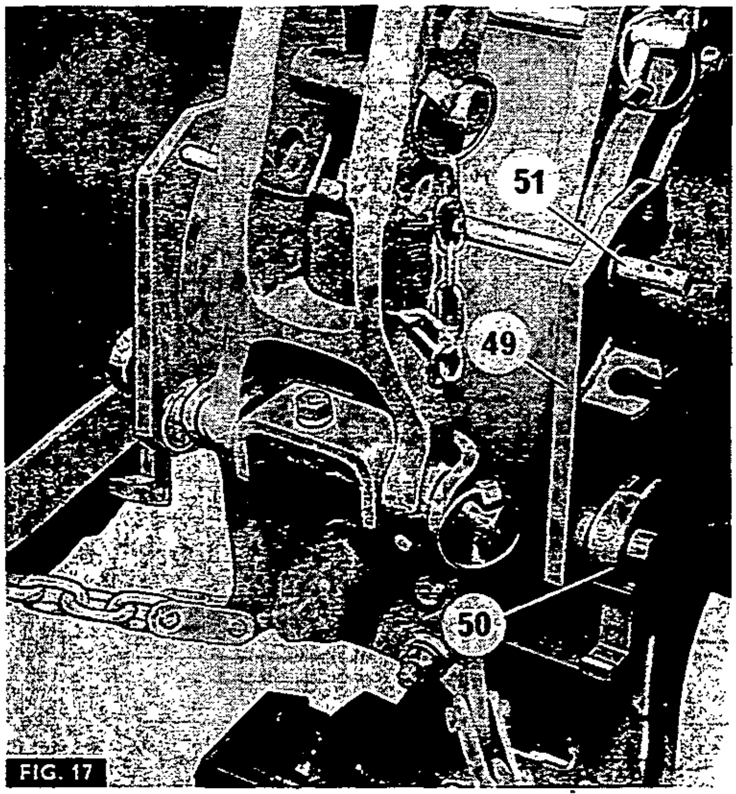


FIG. 17

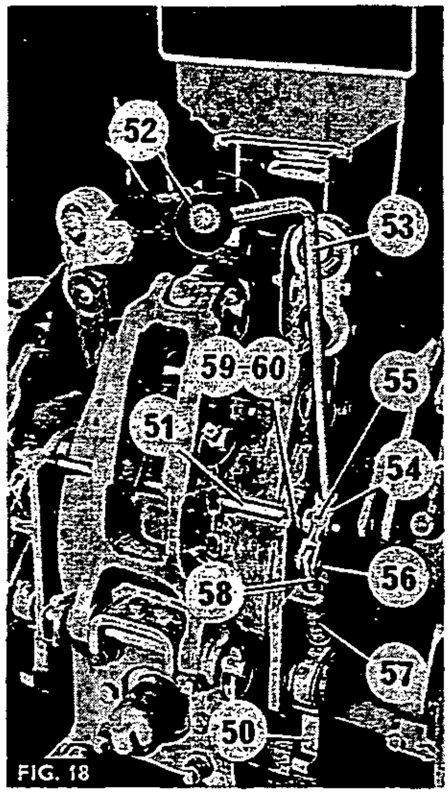


FIG. 18

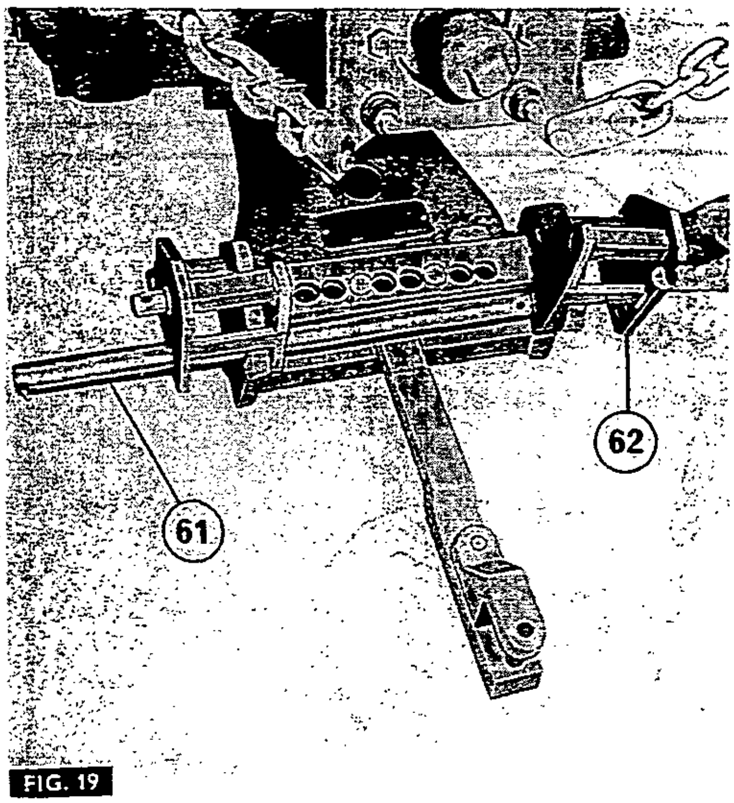


FIG. 19

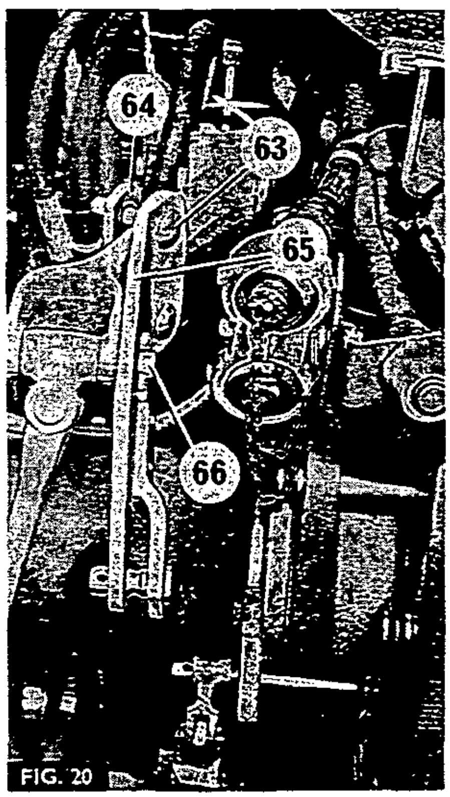


FIG. 20

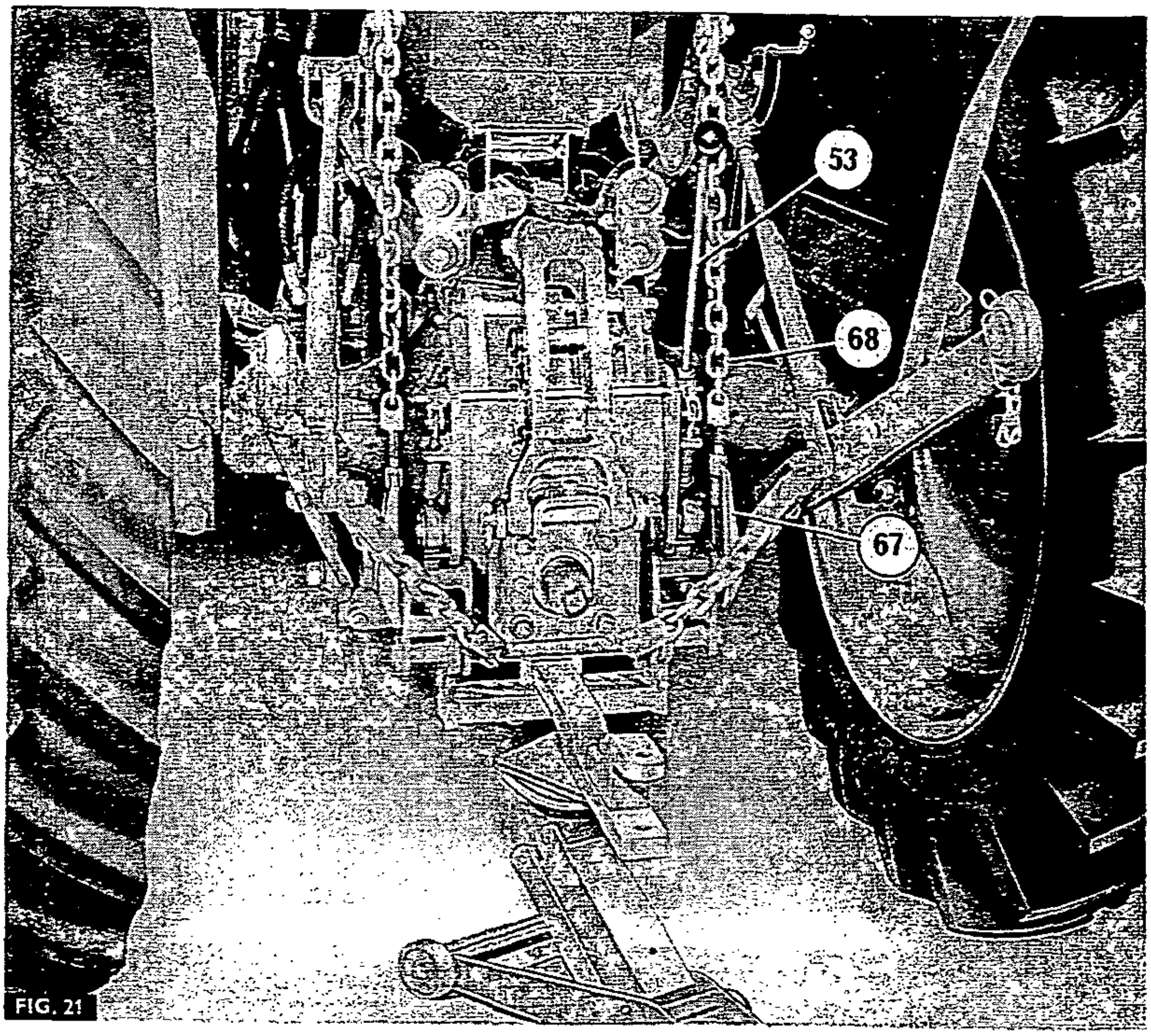


FIG. 21

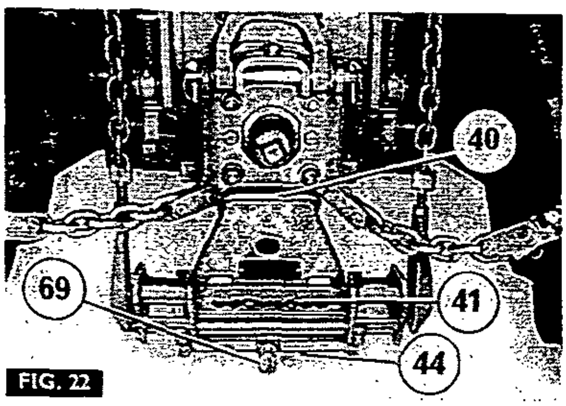


FIG. 22

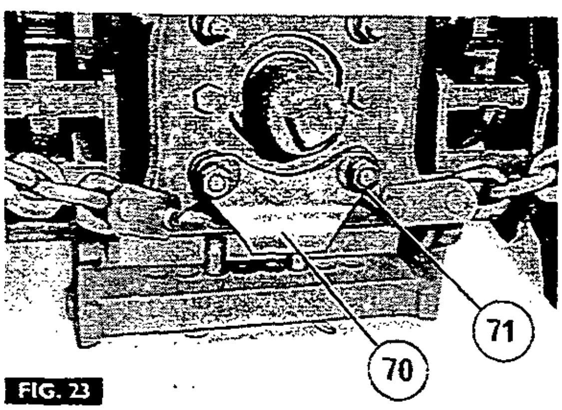


FIG. 23

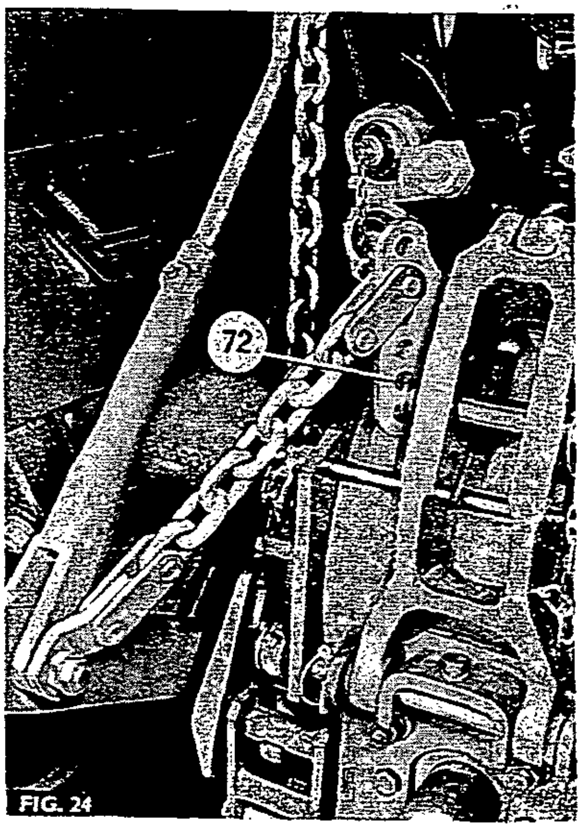


FIG. 24

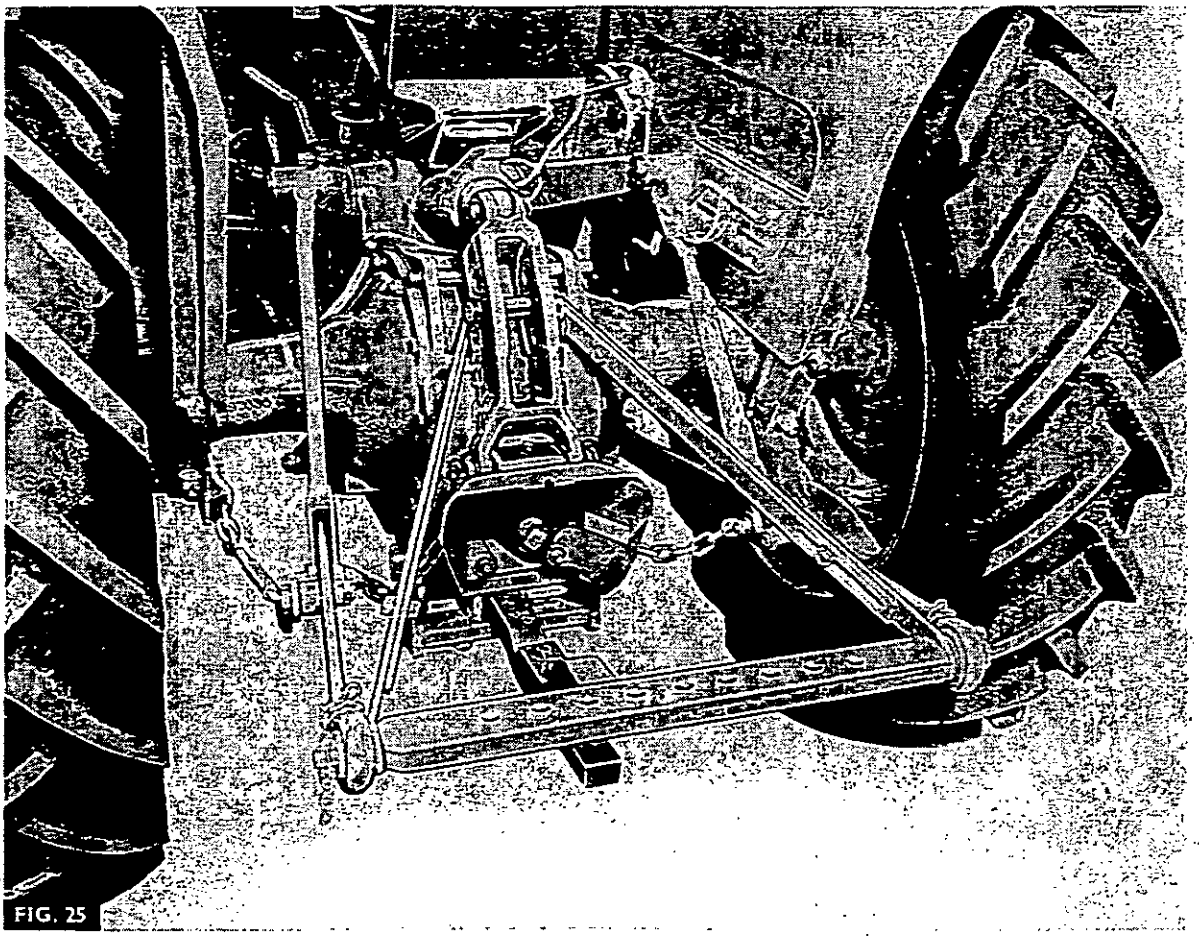


FIG. 25

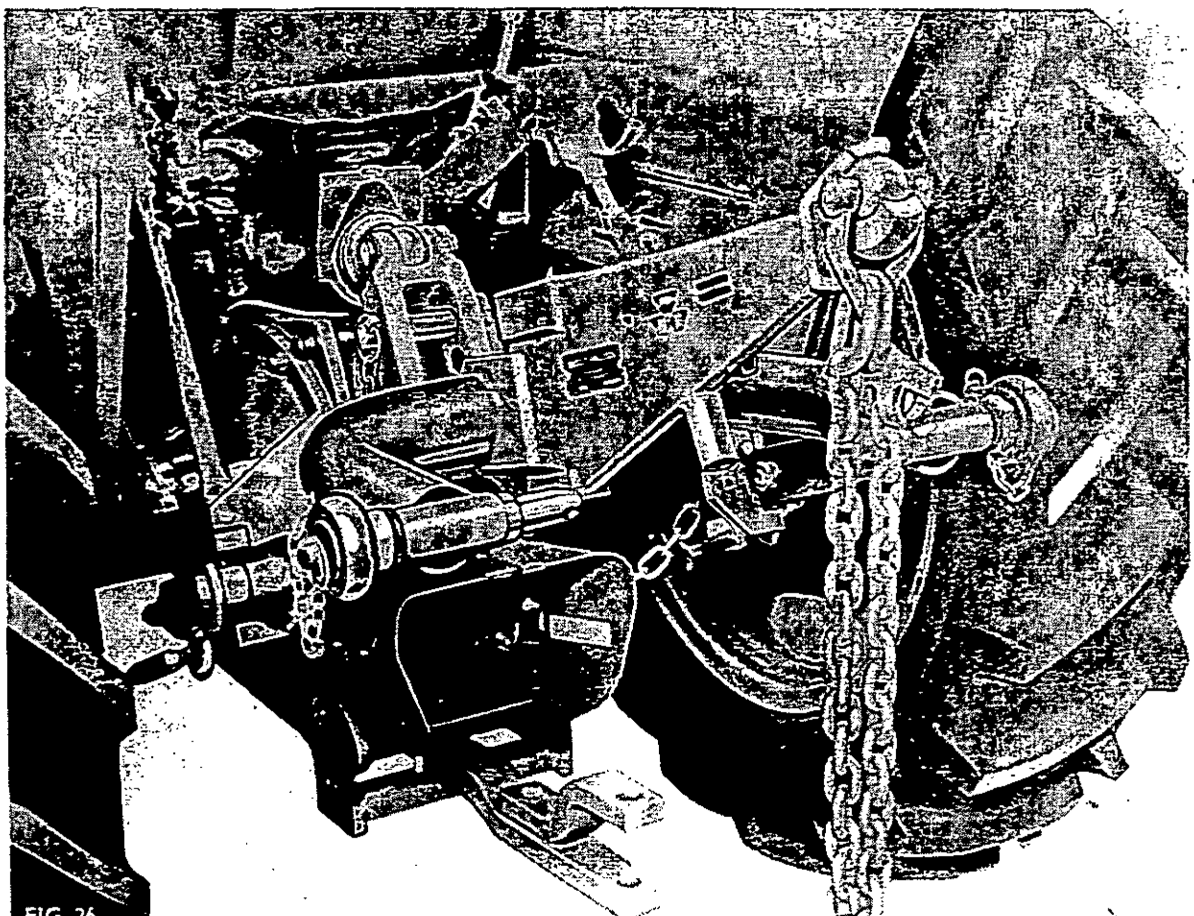


FIG. 26

Auto-Hitch used as a Swinging Drawbar
The Auto-Hitch can be converted to a swinging drawbar by substituting the drawbar for the hitch hook.
To remove the hook.
1. Lower the Auto-Hitch.
2. Remove the hitch hook securing pin and pull the hook rearwards and out of the mounting frame.
3. Remove the hairpins and locating pins at the rear of the mounting frame and slide the drawbar into the frame, refitting the securing pin. The drawbar can be positioned as shown in Fig. 14 and secured by refitting the locating pins and hairpins.

WARNING – DO NOT ATTEMPT TO LIFT THE AUTO-HITCH MECHANISM WITH THE DRAWBAR OFFSET AND A LOAD APPLIED.

Linkage Check Bracket Fig. 24

When a two-wheel trailer is used with the Auto-Hitch, the tractor lower links may foul the trailer drawbar when turning. To prevent such an occurrence, the linkage check bracket has been provided as part of the Auto-Hitch Kit.
After the trailer has been hitched, connect the check bracket by removing the hairpin and headed pin securing the L.H. check chain to the anchor bracket. Align the flat links in the end of the check chain with a convenient hole in the check bracket. Re-fit the headed pin and hairpin.

LINKAGE DRAWBAR Fig. 25

The linkage drawbar can be used when towing trailed implements with low weight transfer. To prevent excessive transverse movement, a pair of drawbar stays are fitted. These stays are adjustable for length to permit the height of the drawbar to be set as required and then locked in position.

WARNING – NEVER SET THE DRAWBAR ABOVE THE REAR AXLE CENTRE-LINE, OTHERWISE THE TRACTOR WILL BECOME EXTREMELY UNSTABLE WHEN TOWING.

Drawbar Fitment Fig. 25
1. Remove the long pin from the tractor centre housing.
2. Loosely assemble the pairs of stays, fitting the bolts only to the slotted holes.
3. Attach the stays to the centre housing as shown, securing them with the long pin and linch pin.
4. Fit the drawbar mounting pins to the holes in the stays, then into the lower link balls and secure them with linch pins.
5. Adjust the height of the drawbar using the tractor hydraulic lift system. When the notches in the stays are aligned, the drawbar will be at the normal working height of 500 mm (19½ in).
6. Finally tighten the outer bolts and fit the centre bolts to a pair of aligning holes.
7. Place both of the hydraulic control levers in the fully lowered position (i.e. 'Drop').

WARNING – IF THE LEVERS ARE PLACED IN THE RAISED POSITION, THE STAYS MAY BE BENT, OR BROKEN, WHEN THE TRACTOR ENGINE IS STARTED.

PRESSURE CONTROL COUPLER Fig. 26

The Pressure Control Coupler enables weight to be transferred to the tractor rear wheels when working with trailed implements, thus improving traction.
This additional weight transfer also gives improved braking performance by minimising wheel-locking and slewing when descending steep gradients.

Description
The coupler consists of a curved, tubular cross-member with fabricated location lugs and dual Category mounting pins, by means of which the beam is attached to the tractor lower links. Attached to the tubular member is a hinged hook, carrying the coupling chain, which is attached by the safety release ball and the adjusting claw.

Modification of Implement Drawbars
Before operating, certain modifications must be made to the implement drawbar to ensure adequate strength to attach the chain and where necessary to ensure that the coupler chain will clear the p.t.o. shaft, if used. As the Pressure Control coupler is used in conjunction with a variety of drawbar designs and applications, the following modifications are suggested:–
Drawbars fitted to implements are of three basic types:–
1. 'A' frame (rigid) of tubular, or angle-iron construction.
2. 'Pole' type (rigid) of round, or square tube construction.
3. 'Hinged' type which may be of either of the above types.

Any of the above types of drawbars may need strengthening to withstand the lifting force applied by the coupler chain.
If the implement is powered by a p.t.o. driveshaft alterations must also be made to enable the coupler chain to clear the p.t.o. shaft.
Figures 27 to 30 show the recommended methods of modifying the implement drawbar for added strength and to give p.t.o. shaft clearance.
Strengthening can be achieved:–
a) By welding an angle-iron section on to the underside of a round tube drawbar.
b) By welding an identical angle-iron seciton to the existing angle-iron drawbar to form a square section tube.

All drawbars must have a chain anchor bracket welded on to retain the chain at its correct angle in relation to the boom and drawbar. When turning, the chain must slide freely through the anchor brackets, otherwise, rapid chain wear will occur. Square, or angle section drawbars may need chain guides to assist the chain in sliding. Various methods of keeping the chain clear of the p.t.o. shaft can be employed, according to the type of drawbar fitted.
MF machinery which is operated in conjunction with the Pressure Control coupler should be modified to allow chain attachment. Modification procedure for such machinery is detailed in the General Machines Workshop Service Manual, Publication No. 819 218 M1.

For implements other than those manufactured by MF the following principle modifications for the various drawbar types are as follows:–

Figure 27 'A' Frame type of round tube construction.
Figure 28 'A' Frame type of square tube, or angle iron construction.
Figure 29 'Pole' type, showing alternatives for round or square constructions.
Figure 30 'Pole' type, non-p.t.o., showing alternatives for round, or square sections.

NOTE – THE P.T.O. DRIVE SHAFT MUST HAVE A MINIMUM CLEARANCE FROM THE COUPLER CHAIN OF 25 MM (1 IN).

Adjustments

To allow one design of Pressure Control coupler to be fitted to MF135, 148, 165 and 168 tractors, the ball end mounting pins are reversible for Categories 1 and 2 and the lugs welded to the tubular cross member have adjustable adapter plates to compensate for the varying width of the lower links according to the particular tractor.

The adapter plates should be positioned as shown in Fig. 31. The reversible ball end mounting pins have alternative end diameters of 22,23 mm (⅞ in) and 28,58 mm (1⅛ in) to suit Category 1 and 2 ball ends respectively.

Coupler to Tractor Fitment

1. Ensure that the adapter plates are correctly adjusted as shown in Figure 31.
2. Check that the required ball end mounting pin faces outwards.
3. Place the coupler frame between the tractor lower links, then engage the ball end mounting pin and the frame bracket on the left lower link and then on the right lower link, secure the ball end mounting pins with the linch pins.

Coupler to Implement Attachment

1. Raise the coupler on the lower links, using 'Pressure Control'.
2. Attach the implement drawbar on to the tractor swinging drawbar.
3. Lower the coupler on the tractor using 'Position Control' until the tubular cross member is parallel to the ground.
4. Fig. 32. Loop the chain through the chain anchor bracket(s) and engage the nearest available chain link in the adjusting claw.
5. Tension the chain by moving the control quadrant lever to increase 'Pressure'.

NOTE – THE MAXIMUM CHAIN ANGLE SHOULD NOT EXCEED 45° FIG. 33.

Operation

1. Attach the coupler to the tractor and implement.
2. Move the 'Draft Control' lever fully back.
3. Move the 'Position Control' lever into the black 'Pressure' sector of the inner quadrant to the 'LOW' position. Move the lever back just sufficiently to give adequate traction, then set the adjustable stop to align with the lever. If difficult conditions are encountered, increase the pressure by moving the lever towards 'High' until traction is obtained. Always return the lever to the set position when conditions improve.

Stowage for Transport

Fig. 34. If a tractor fitted with the Pressure Control coupler is to be driven without an implement attached, the boom should be stowed by slewing it to the right and engaging the spring clip (73).

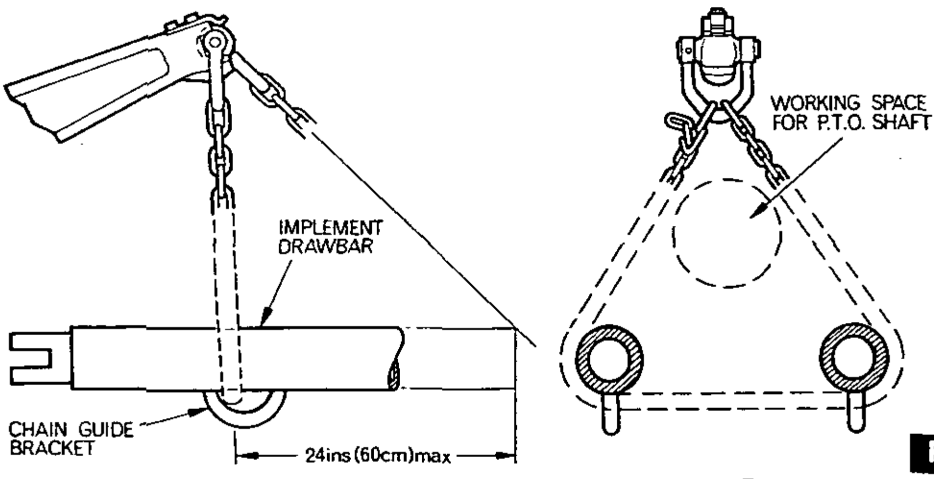


FIG. 27

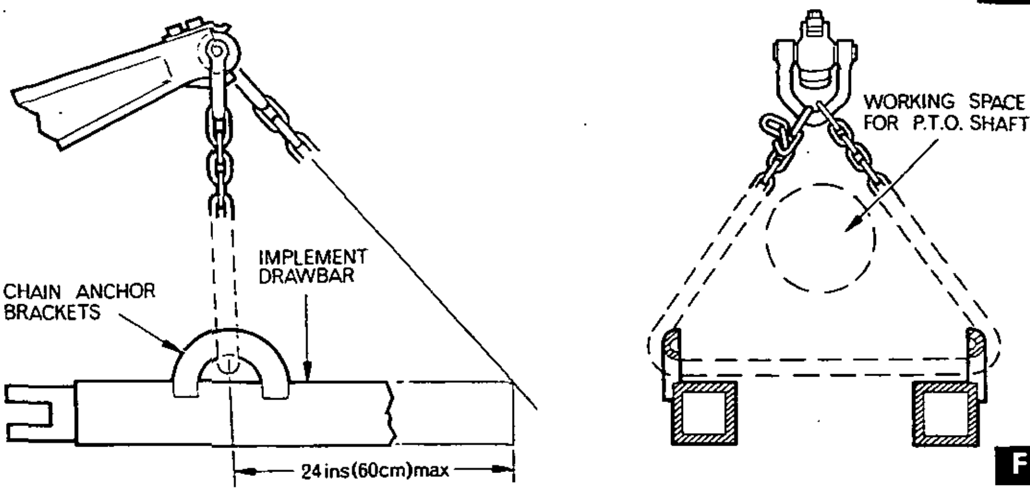


FIG. 28

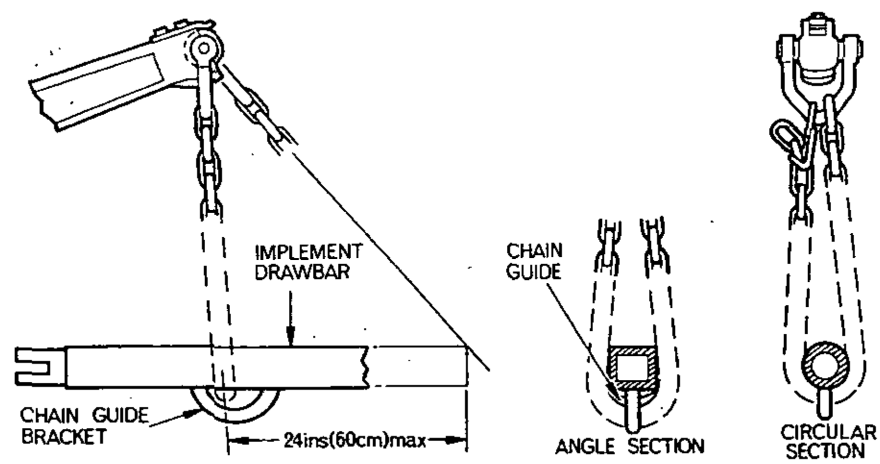


FIG. 29

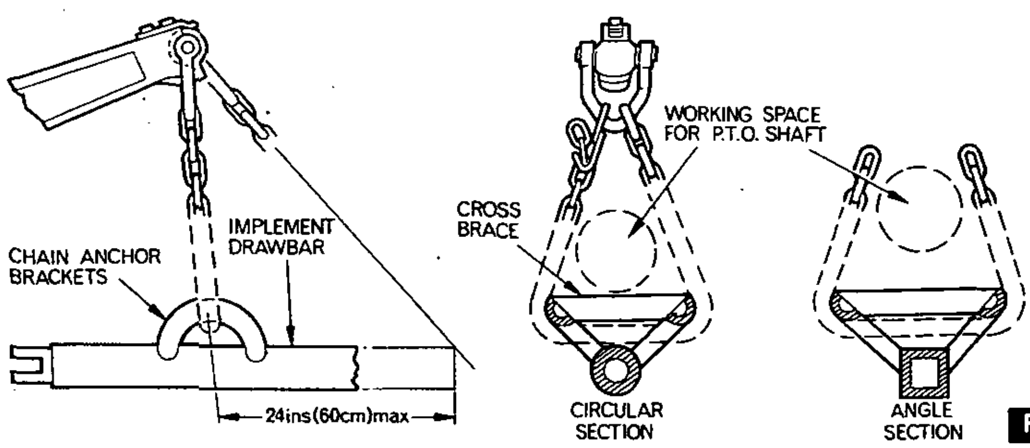


FIG. 30

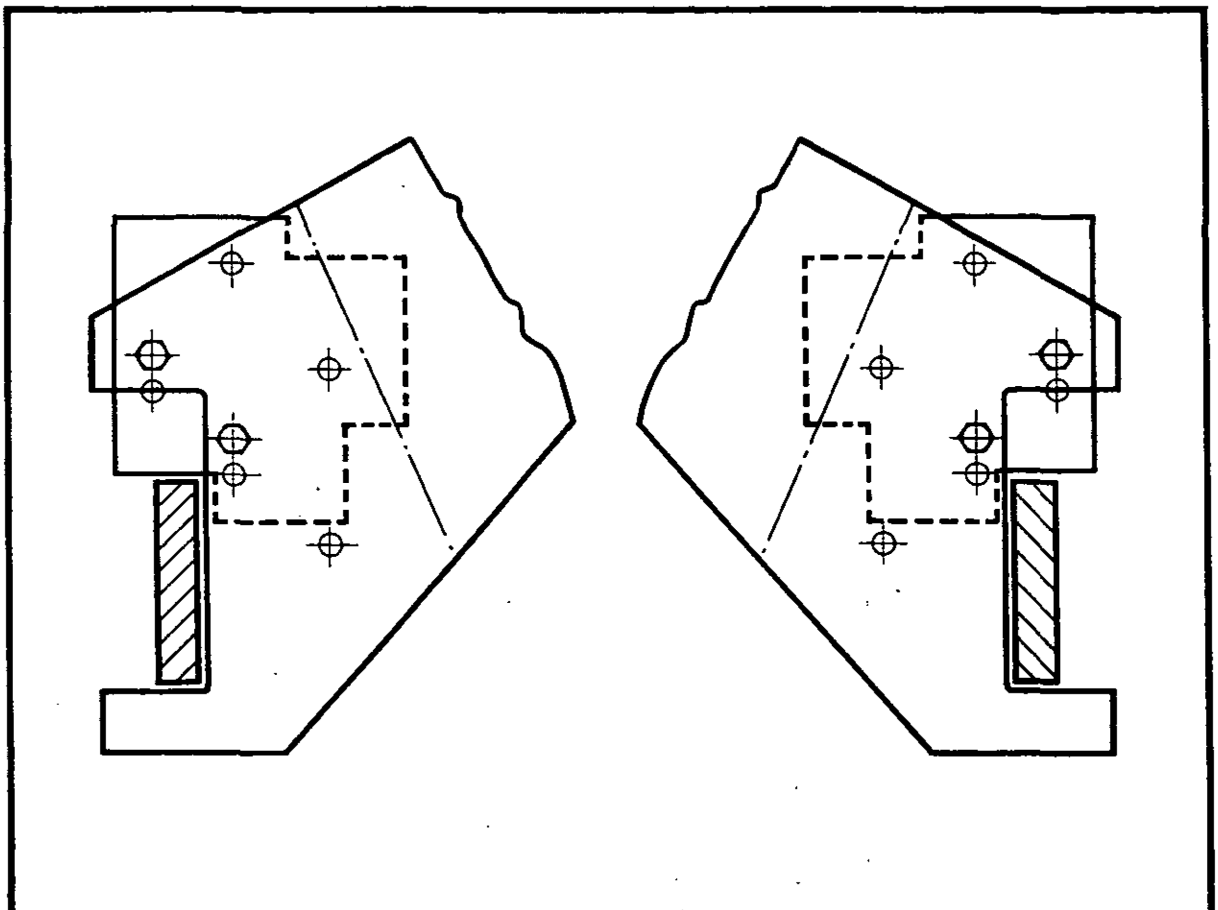


FIG. 31

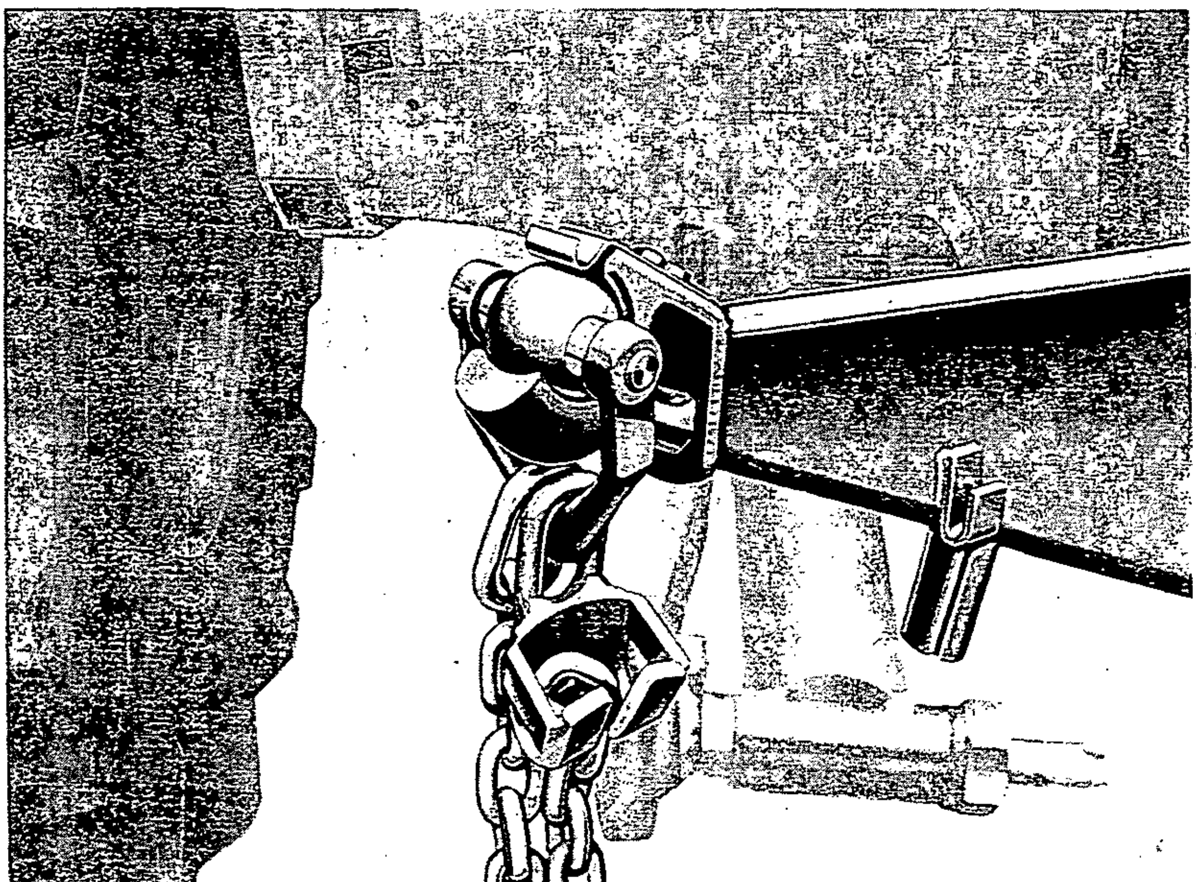


FIG. 32

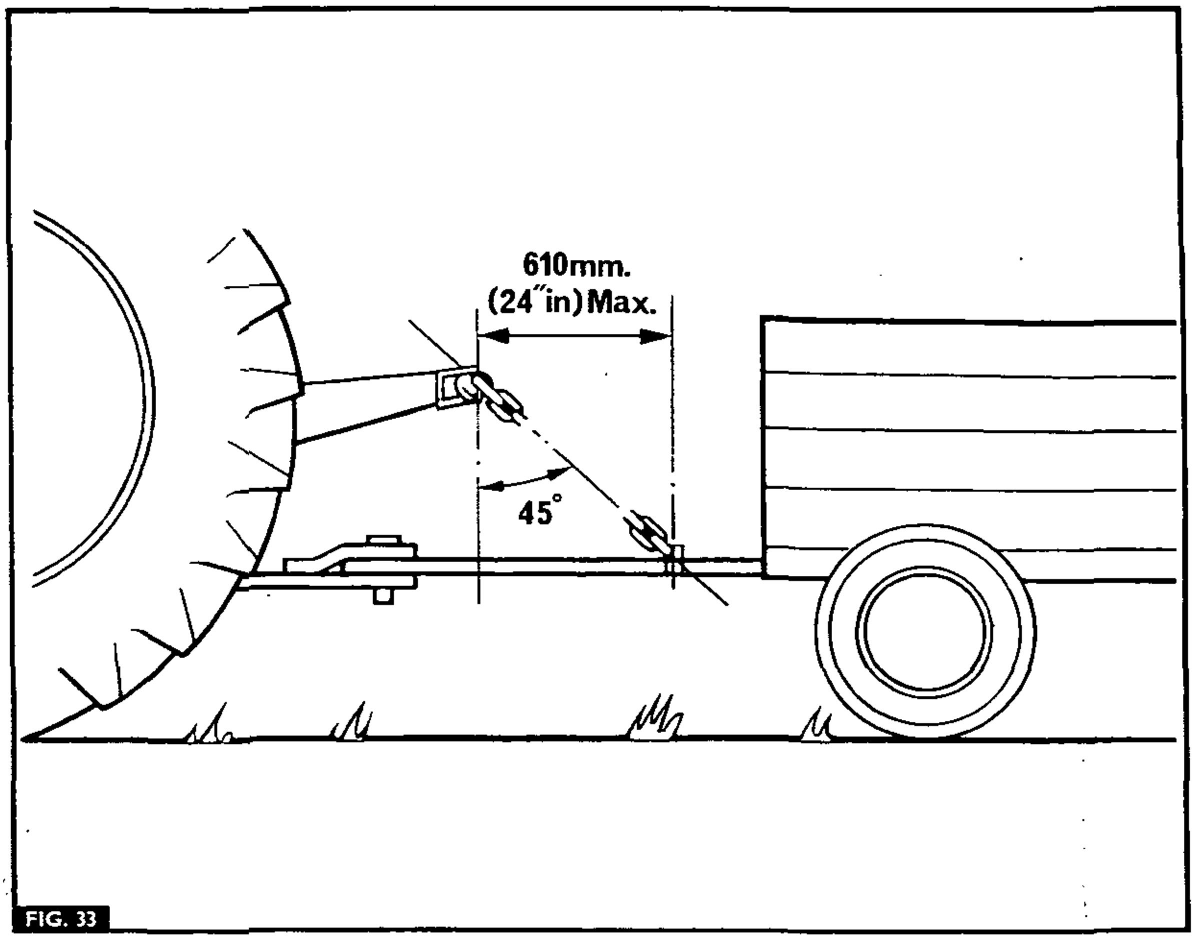


FIG. 33

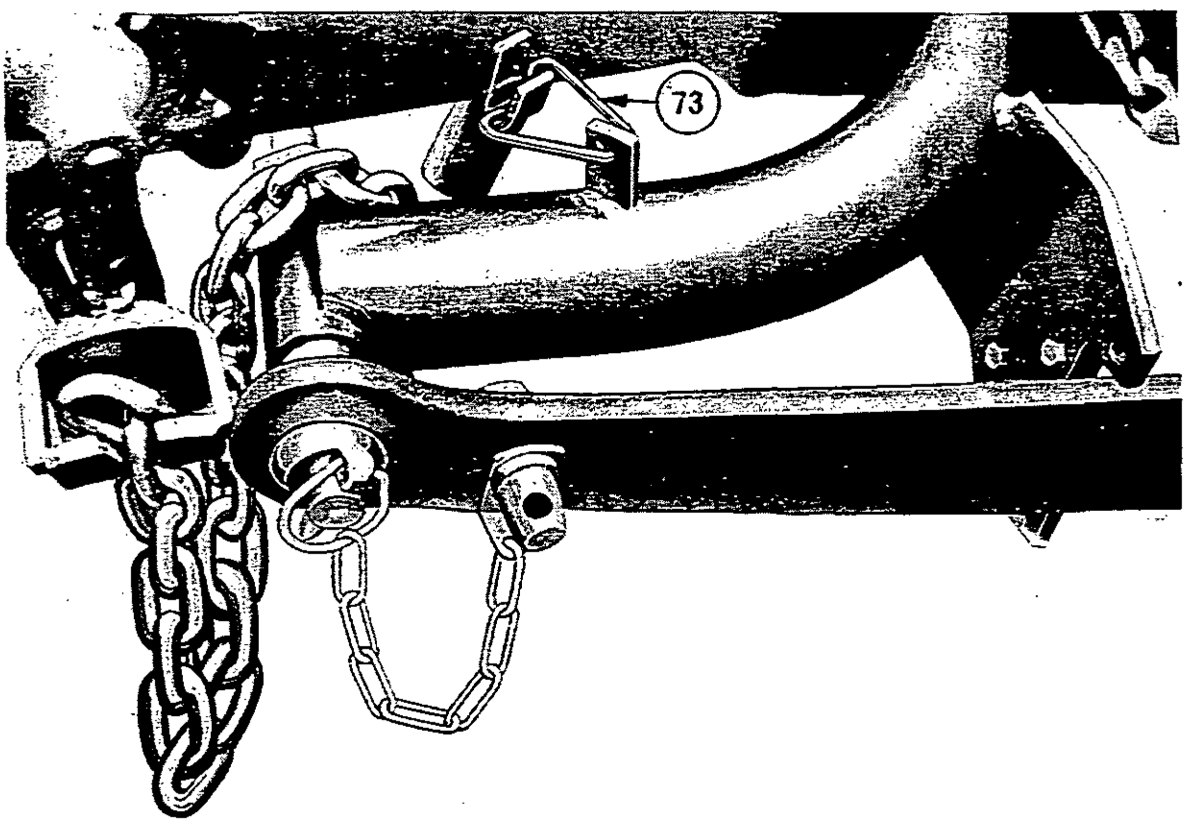


FIG. 34

LINKAGE AND DRAWBARS

Part 7 Section C

GENERAL

Fig. 1. The three point linkage controls the movements of the mounted and semi-mounted implements. The linkage comprises four main components:– top link (1), lower links (3), lift rods (2), checks chains (4).

TOP LINK

Fig. 2. The top link is of the three-piece, barrel, turnbuckle type and is adjustable for length between the dimensions stated in the specification section.

Adjustment Procedure 7C-01

1. Fig. 2. Release the locking clip (5).
2. Rotate the barrel (6) until the required length is achieved. Do not permit the ball ends to rotate.
3. Return the spring clip to the engaged position to retain the ball ends in the correct plane.

LOWER LINKS

The lower links (3) carry the implement and are also used when attaching the Pressure Control coupler or the linkage drawbar. Vertical but not lateral movement of the lower links determines the height of the implements from the ground, or its depth of penetration.
The lower links fitted to this tractor have provision for interchangeability of the ball ends.

Interchanging Ball Ends 7C-02

1. Fig. 3A. *Pull the spring clip (7) upwards,* as shown.
2. Rotate the ball until the narrow portion aligns with the slot in the lower link, then remove the ball.
3. Fig. 3B. Fit the new ball by locating it with the narrow section in line with the slot, then refit the spring clip, as shown.

NOTE – FOR CATEGORY 1 IMPLEMENTS, THE CHECK CHAIN LENGTH MUST BE SET AS SHOWN IN FIG. 4A AND FOR CATEGORY 2 IMPLEMENTS, AS SHOWN IN FIG. 4B.

LIFT RODS

The lift rods (2) connect the lift arms to the lower links. The L.H. lift rod is normally set to its correct length on assembly and is not adjusted thereafter. The R.H. lift rod incorporates a bevel gear levelling box, which allows the upper portion of the rod to be screwed into, or out of, the lower portion of the lift rod, thus adjusting the height of the R.H. lower link in relation to the left.

L.H. Lift Rod Fig 5.
The L.H. Lift rod should be adjusted for length on assembly with the centre punch mark on the upper rod just beginning to show from the lower fork. At this setting the distance between centres should be 515 mm (20¼ in) for standard tractors, or 556 mm (21¾ in) for tractors with 11-32 tyres. Other than daily greasing of the nipple on the lift rod, no other servicing is required.

R.H. Levelling Box and Lift Rod Fig 6.
The R.H. Lift rod is adjustable for length to allow the implement to be levelled during, or after attachment. Adjustments are made by rotating the handle (13) which drives through a bevel gearbox to the lift rod. The lift rod screws into, or out of the lower lift fork. The nominal length of the R.H. lift rod is 515 mm (20¼ in) for standard tractors and 556 mm (21¾ in) for tractors with 11-32 tyres and the range of adjustment is ± 38 mm (1½ in).

Levelling Box Servicing 7C-03

Disassembly

1. Fig 7. Remove the complete levelling box from the tractor by removing the split pin and clevis pin from the knuckle on the levelling box.
2. Unscrew the levelling gear shaft (19) out of the lower fork.
3. Using a 5 mm (3/16 in) diameter drill, remove one head from the double countersunk rivet (14) which secures the bevel gear (12) to the handle spindle (13).
4. Withdraw the levelling handle (13) and bevel gear (12) from the levelling box (9).
5. Remove the split pin (21) and the clevis pin (10) from the levelling box and remove the knuckle (8).
6. Remove the circlip (18) and the thrust washer (17) from the gear shaft.
7. Using a soft faced mallet, tap the end of the gear shaft (19) to force the dished expansion plug (11) out of the levelling box.
8. Slide the gear shaft (19) out of the levelling box, *then remove the bearing (16).*

The spring (20) and the grease nipple need not be removed.

Examination
Examine all components and replace any which are worn, or damaged.
When reassembling, always fit a new rivet (14), dished expansion plug (11), bearing (16), thrust washer (17) circlip (18) and split pins (21).

Reassembly

1. Fit the new bearing (16) into the levelling box (9), then slide the gear shaft (19) into place, securing it with the new thrust washer (17) and circlip (18).
2. Drive a new dished expansion plug (11) into the levelling box, using a suitable drift.
3. Refit the levelling handle (13) to the levelling box, then refit the bevel gear (12) and secure it by fitting and peining the new rivet (14).
4. Refit the knuckle (8) securing it with the clevis pin (10) and a new split pin (21).
5. Charge the levelling box with a recommended grease, until grease exudes past the seals.
6. Screw the gear shaft into the lower fork and adjust for length, then refit the knuckle, clevis pin and a new split pin to the lift arms.

CHECK CHAINS Fig 8.

The check chains restrict the movement of the lower links in a transverse plane, preventing the lower links or the implement they are carrying from striking

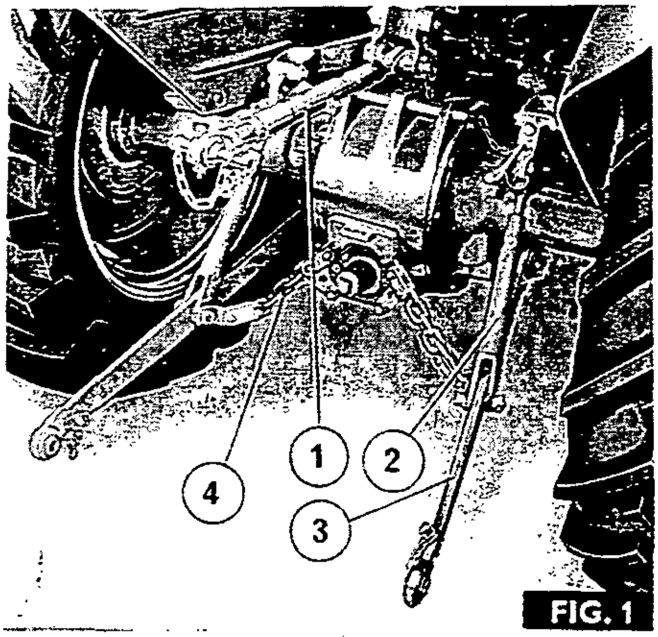


FIG. 1

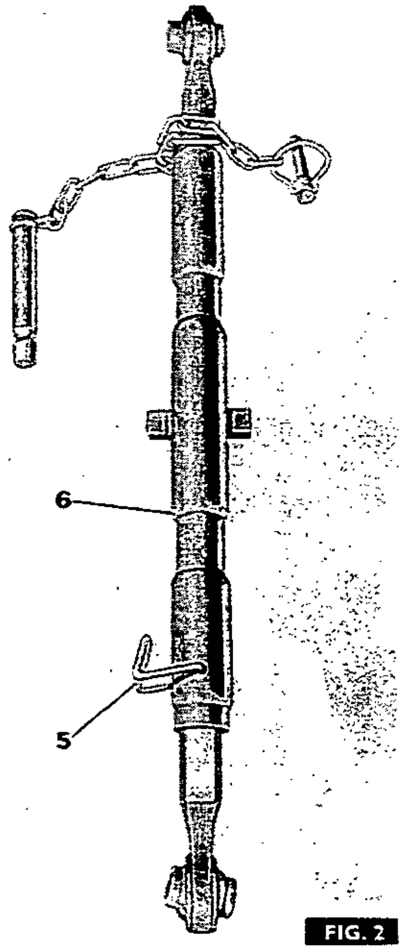


FIG. 2

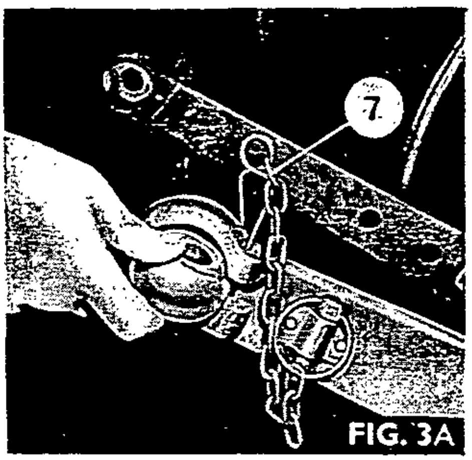


FIG. 3A

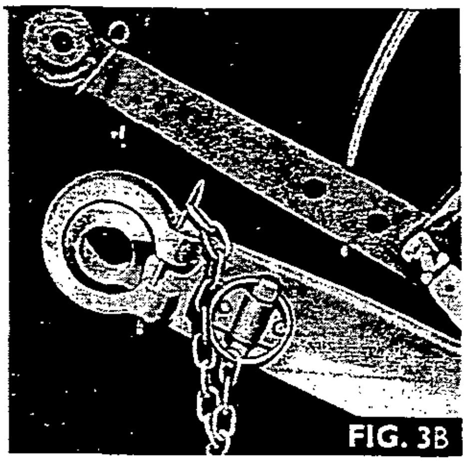


FIG. 3B

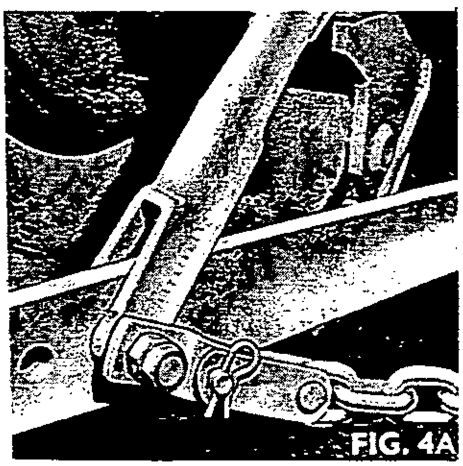


FIG. 4A

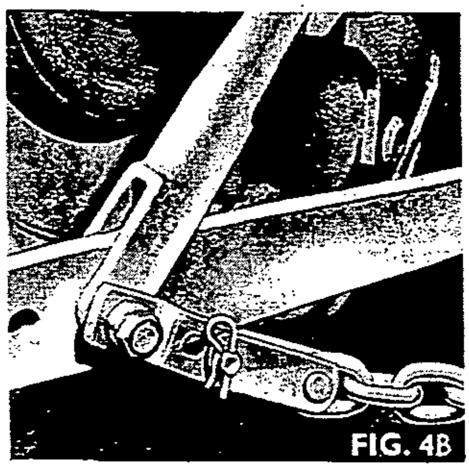


FIG. 4B

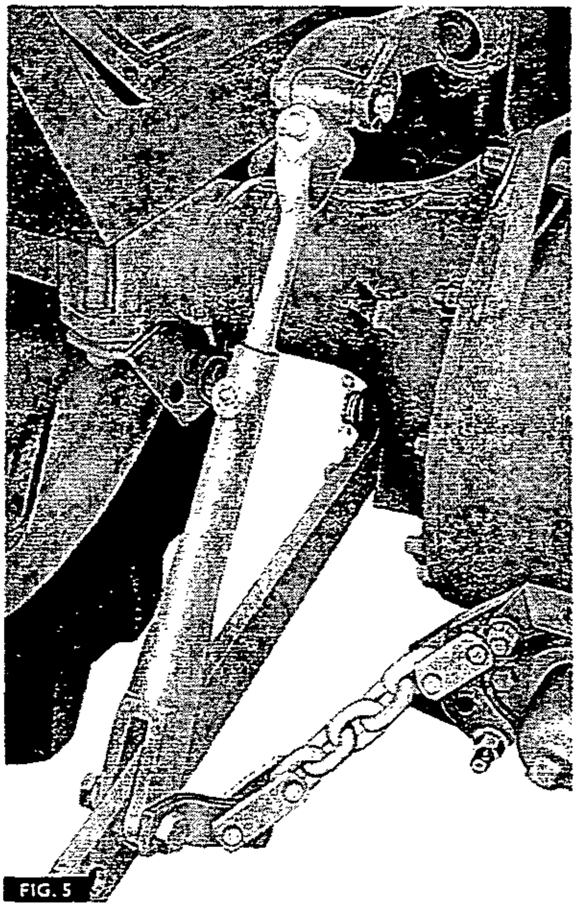


FIG. 5

FIG. 6

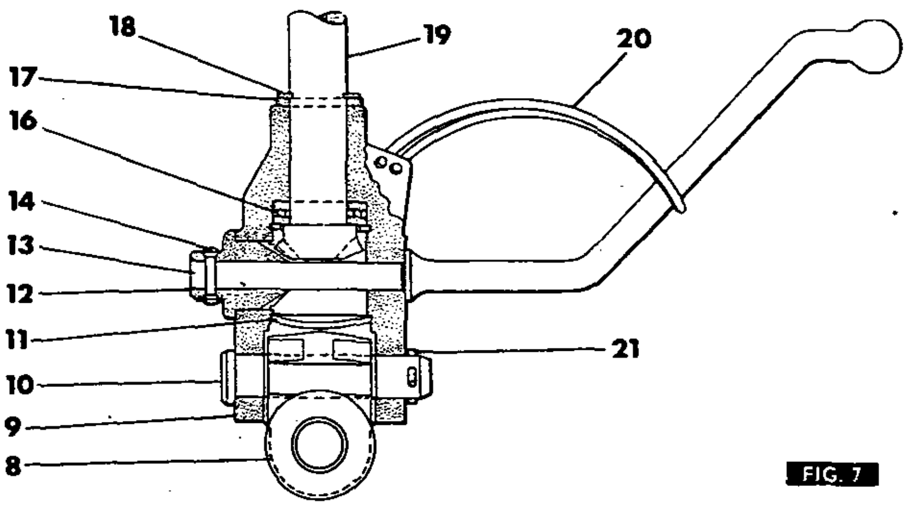


FIG. 7

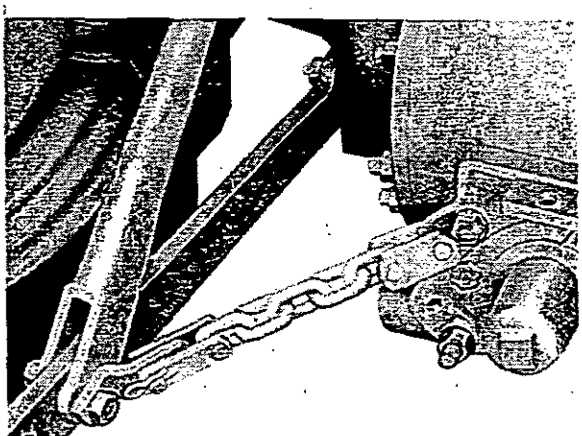


FIG. 8

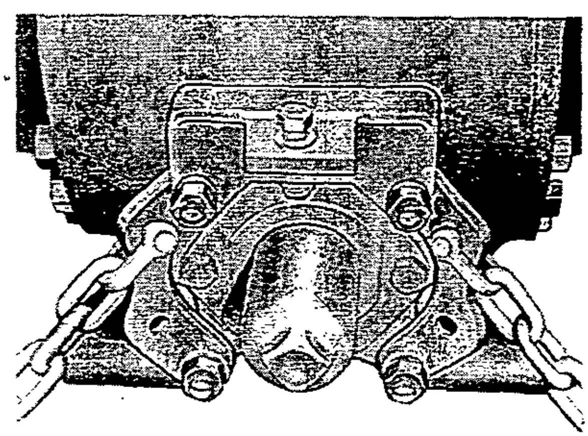


FIG. 9

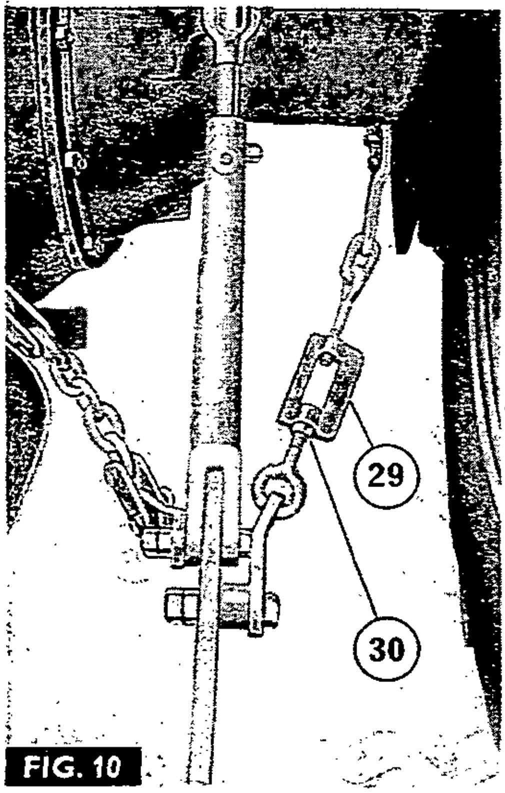


FIG. 10

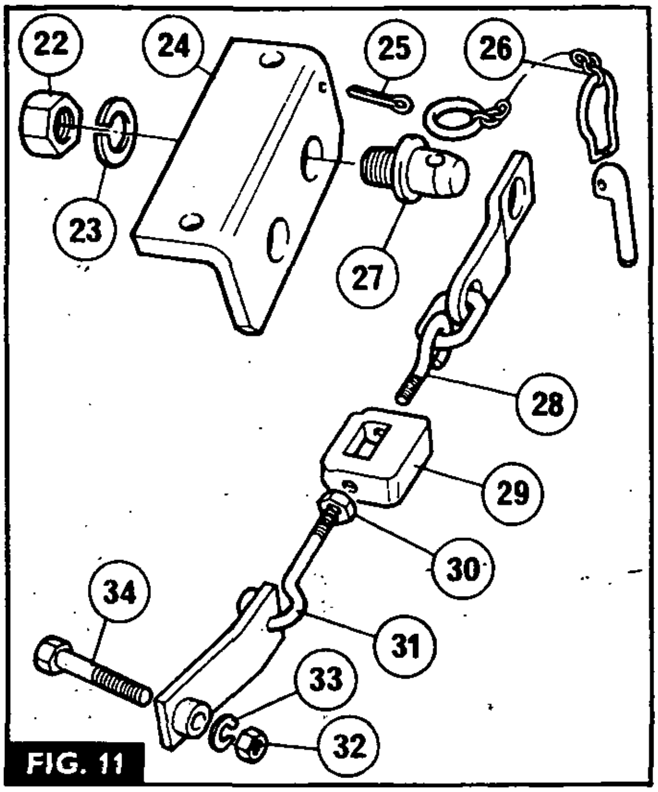


FIG. 11

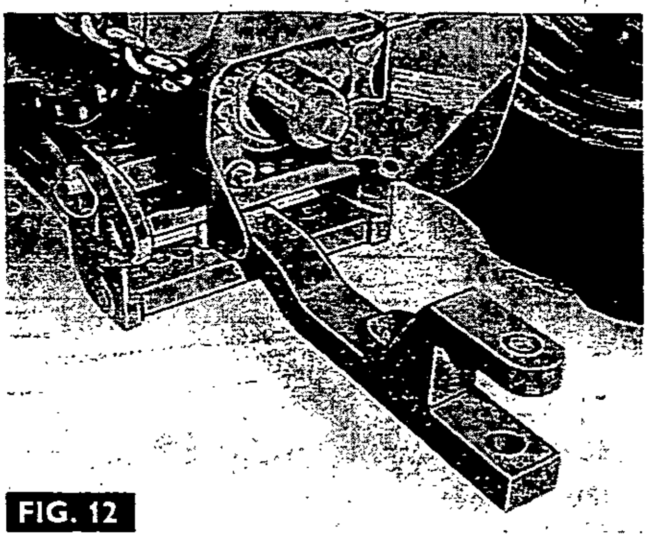


FIG. 12

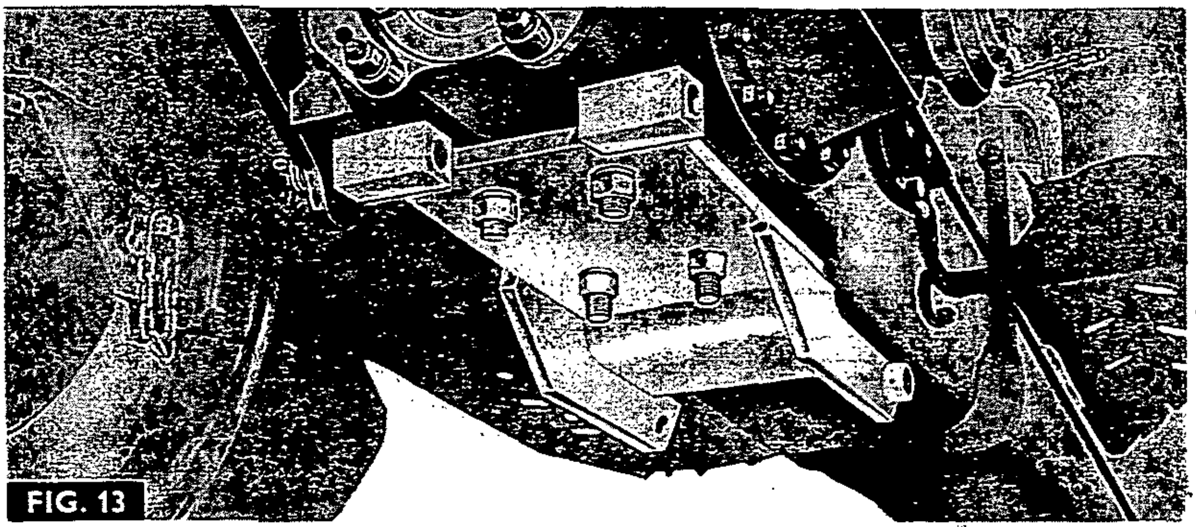


FIG. 13

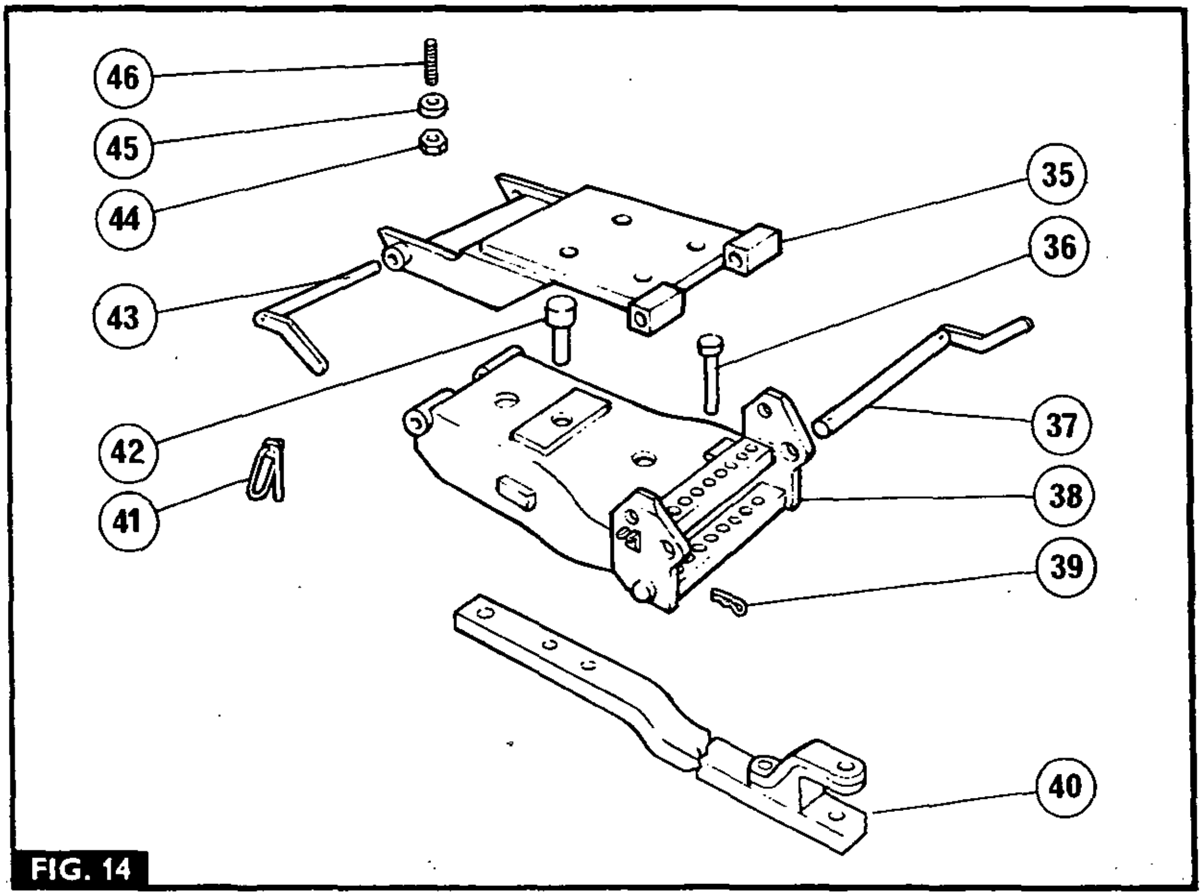
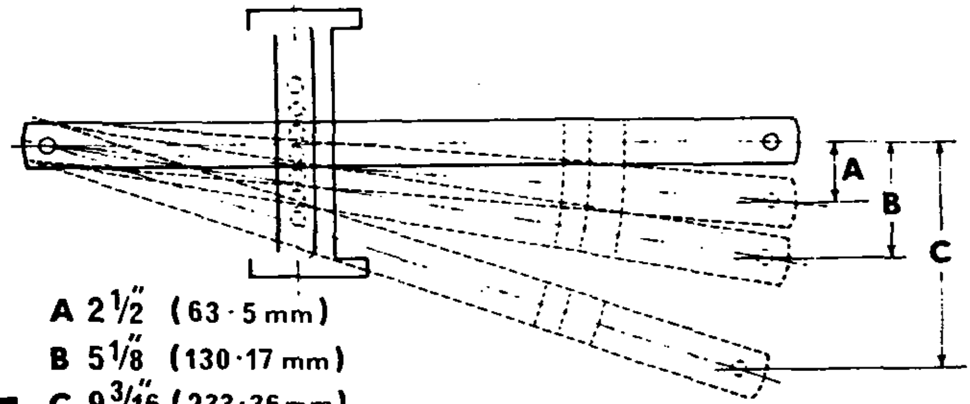


FIG. 14



A 2½" (63·5 mm)
B 5⅛" (130·17 mm)
C 9 3/16" (233·36 mm)

FIG. 15

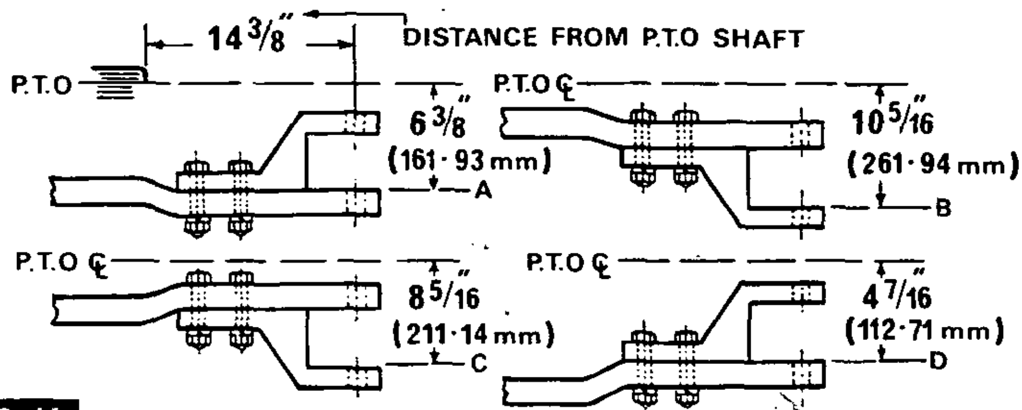


FIG. 16

the tractor's rear tyres. The check chains are attached to the rear of the tractor centre housing by the check chain anchor brackets and to the lower links by cranked brackets secured to the lower links by the lift rod retaining bolts.
According to the setting of the linkage for either Category 1 or Category 2 implements,

Category 1:– 187 mm (7 ⅜ in) – standard
Category 2:– 209 mm (8¼ in) – standard
Category 1:– 270 mm (10 ⅝ in) – 11-32 tyres
Category 2:– 292 mm (11¼ in) – 11-32 tyres

Check Chain Anchor Bracket Fig 9.
The check chain anchor brackets are bolted to the centre housing on either side of the p.t.o. shaft. The check chains must always be fitted to the upper holes on MF 135 tractors.

STABILISERS Fig 10.

Stabilisers are fitted to prevent transverse movement of the lower links where an implement must be retained in a constant position relative to the tractor centre-line, to ensure accurate alignment, either with the crop rows, or the p.t.o. shaft. Adjustments are made by slackening the locknut (30) and rotating the turnbuckle (29) to give the required length, then retightening the locknut. Before working with soil engaging implements the chains should be adjusted to permit 50 mm (2 in) of sideways movement at the end of each lower link.

Stabiliser Kit Fitment. Fig 11. 7C-04
Three chain stabiliser kits are available for MF 135 tractors:–
Standard tractors with U.K. safety frames.
Standard tractors without safety frames.
Tractors with 11-32 tyres and without safety frames.

NOTE – THERE ARE NO KITS FOR TRACTORS WITH 11-32 AND SAFETY FRAMES.

The under fender brackets differ for each kit and must be correctly identified, as the anchor pin centre-line must always align with the lower link pivot point.

NOTE – MF 135 TRACTORS BUILT BEFORE SERIAL NO. 35914 CANNOT BE FITTED WITH CHAIN STABILISERS AS THEY DO NOT HAVE THE THREE HOLES IN THE LOWER LINKS.

1. Remove the nuts and washers from the fender attachment bolts.
2. Locate the brackets (24) on the bolts with gussets facing outwards, then refit the nuts and washers. Re-tighten the nuts to a torque of 17 kg-m (125 lb-ft). This is most important if a safety frame is fitted.
3. Fit the anchor pins (27) to the forward holes in the brackets. The anchor pin nuts and washers (22 and 23) are fitted on the gusset side (outside) of the brackets.
4. Assemble the linch pin (26) and attach it to the forward end of the anchor bracket (21) using a split pin (25).
5. Assemble the chain components (28, 29, 30 and 31).
6. Attach the chain (28) to the anchor pin and insert a linch pin.
7. Attach the rear end of the chain (31) to the rearmost hole in the lower link using a bolt, nut and spring washer (32, 33 and 34).

NOTE–IF A FOUL CONDITION EXISTS BETWEEN BRACKET (31) AND THE BOLT THROUGH THE LIFT ROD FORK, AN ADDITIONAL SPACING WASHER MAY BE USED.

NORMAL DUTY SWINGING DRAWBAR Fig 12.

The swinging drawbar conforms to British Standards, having a clevis hitch point at 356 mm (14 in) from the p.t.o. shaft. The maximum static load permissible at this setting is 765 kg (1700 lb). An alternative position, which places the drawbar clevis at 254 mm (10 in) from the p.t.o. shaft is provided. At this setting the maximum static load is 990 kg (2200 lb).

Swinging Drawbar Kit Fitment 7C-05
1. Check the contents of the kit against the list provided.
2. Clean the base of the centre housing adjacent to the four ¾ UNC tapped holes and clean out the holes themselves.
3. Fig 14. Screw the ¾ UNC ends of the four studs (46) fully into the tapped holes in the centre housing.
4. Fig 13. Locate the mounting bracket (35) on the four studs, then secure it with the four nuts (44) and spring washers (45). Tighten the nuts to 27,5 kg-m (200 lb-ft).
   The use of a hydraulic jack to raise the mounting bracket, will facilitate this operation.
5. Fig 15. Slide the drawbar assembly (40) into the mounting frame (38), fitting the drawbar pin (42), the locating pins (36) and the hairpins (39).
6. Place the mounting frame and drawbar assembly on a jack and raise it into position secure it with the front support pin (43) and the rear pin (37), securing them with a linch pin (41).

Adjustments 7C-06
Offset: Fig. 14 and 15 Remove the linch pin (41) and withdraw the support bar (37), thus freeing the drawbar frame. Remove the two hairpins (39) and the locating pins (36) then reset the drawbar in the required position. Refit the locating pins (36), the hairpins (39) to secure the drawbar, then refit the rear pin (37) and the linch pin (41).
Length: Remove the linch pin (41) and the support bar (37). Push the drawbar anchor pin (42) upwards this freeing the drawbar. Adjust the drawbar for length, refit the anchor pin (42), raise the drawbar frame, then refit the rear pin (37) and the linch pin (41).
Height: Fig 16. The drawbar can be adjusted as shown, but the bolts must be kept tight.

AUTO-HITCH Fig 17.

The Auto-Hitch is a supplementary lifting mechanism fitted to the swinging drawbar frame to enable implements fitted with a ring type drawbar attach-

ment to be easily coupled to the tractor.
The hitch hook can, if required be replaced by the swinging drawbar by simply lowering the hitch, removing the pin and sliding out the hook, then replacing it by the drawbar.

Operations
Raising:– The quadrant control levers should be positioned as follows:–
'Draft Control' lever – 'Transport' i.e. fully back.
'Position Control' lever – Move to 'Transport' (adjacent to 'Constant Pumping'). The tractor lift arms will rise, lifting the hitch hook. When the 'Transport' position is reached, the latches will engage automatically, thus relieving the tractor linkage of weight.
Lowering :– Leave the 'Draft Control' lever in 'Transport'.
Move the 'Position Control' lever to 'Constant Pumping'; this will raise the hook frame clear of the latches. Pull the release lever rearwards to disengage the latch hooks, then, continuing to hold the release lever, move the 'Position Control' lever to 'Down'. The hitch will then lower.

Auto-Hitch Fitment 7C-07

1. Unpack the kit and check the contents against the packing list and figure 18.
2. Fig. 14. Place a hydraulic jack under the drawbar frame, then remove the linch pin (41) and the support bar (37), Lower the support bar to the ground.
3. Remove the three rearmost bolts from each side of the centre housing.
4. Fig. 19. Assemble one hook support bracket (52), to the centre housing, tightening the Allen screws (53) to 11 kg-m (80 lb-ft).
5. Slide the cross shaft (59) through the bush in the hook support bracket already fitted, then fit the other hook support bracket.
6. Remove the masking tape from the spigots on the support brackets, then slide the latch hooks (49) on to the spigots. Secure each hook with a large washer (68) and split pin.
7. Fig. 20. Assemble the cross shaft levers (58) on to the cross shaft (59) shimming them on each side with one thick washer (65) and an equal number of thin washers (66).
8. Fit the ball (60) to the handle (61), then fit the handle to the R.H. cross shaft lever, securing it with a roll pin (68) through either the centre hole (tractors with De Luxe seat) or the upper hole (tractors with the Spring Suspension seat).
9. Secure the cross shaft (59) to the cross shaft levers (58) with a roll pin (68) on each side. Ensure that the cross shaft can rotate freely.
10. Assemble the spings (54) to the pull rods (55).
11. Locate the pull rods (55) in the support brackets (52), then fit the clevis pins (69) through the hooks (49) and the cross shaft levers (58) by compressing the springs. Secure the clevis pins with the four small split pins.
12. Fig. 21. Fit a latch (72) to the drawbar frame.
13. Repeat operation 12 on the opposite side.
14. Centralise the support bar (56) and fit the two long, large split pins through the holes in the ends of the support bar.
15. Remove the split pin and clevis pin securing each lift arm to the lift rod knuckle.

WARNING. – AS THE CLEVIS PIN IS REMOVED, THE LOWER LINK AND LIFT ROD WILL DROP.

16. Fig. 22. Locate lift arm extension (62) against the lift arm, then loosely fit the bolts (64) and the plate (50) plus spring washers and nuts.
17. Raise the lower links and lift rods and fit the new, longer clevis pins (63), securing them with split pins.
18. Fully tighten the lift arm extension bolts (64).
19. Fig. 23. Screw a nut on to the threaded portion of each lift chain (47) then screw an eye (51) on to each chain.
20. Attach the chains to the lift arm extensions using the pins (57) and split pins.
21. Place a strip of metal 1 mm x 25 mm x 150 mm (1/16 in x 1 in x 6 in) on top of the drawbar frame, above the locating pins (36), then jack up the frame, as shown until the strip of metal is trapped between the frame and the drawbar mounting bracket.
22. Start the tractor engine, select 'Constant Pumping' with the 'Position Control' lever and 'Transport' with the 'Draft Control' lever. The lower links will fully raise.
23. Adjust the length of the lift chains (47) by screwing the eyes up, or down, until the eyes will just slide on to the spigots on the latches (72).

NOTE. ENSURE THAT THE CHAINS ENGAGE THE LATCHES WITH EXACTLY EQUAL TENSION.

24. Remove the eyes from the spigots on the latches and SHORTEN the chains by screwing the eyes up a further FOUR turns.
25. Lower the links slightly, refit the eyes and secure them with the medium size split pins.
26. Remove the jack, then lower the hitch by moving the lever (61) forwards, then moving the 'Position Control' lever to the 'Down' position.
27. Remove the metal strip, then push out the drawbar pin (42) and withdraw the draw bar (40).
28. Fig. 24. Fit the hitch hook (71), refitting the drawbar pin (42), then remove the hairpins (39) and locating pins (36) and refit them to centralise the hook.
29. Fig. 25. Remove the p.t.o. shield (if fitted) then remove the two nuts (73) spring washers and spacers securing the bottom of the check chain anchor bracket.
30. Fit the hook stop plate (70) and the nuts and spring washers, discarding the two spacers.
31. Fig. 26. Remove the long pin and fit the linkage check bracket (48) as shown.

Adjustment 7C-08
Every 500 hours, the adjustment should be checked. If the adjustment is incorrect, adjust as detailed in operations – 21 to 27.

Auto-Hitch used as a Swinging Drawbar
The Auto-Hitch can be converted to a swinging drawbar by substituting the drawbar for the hitch hook.
To remove the hook:–

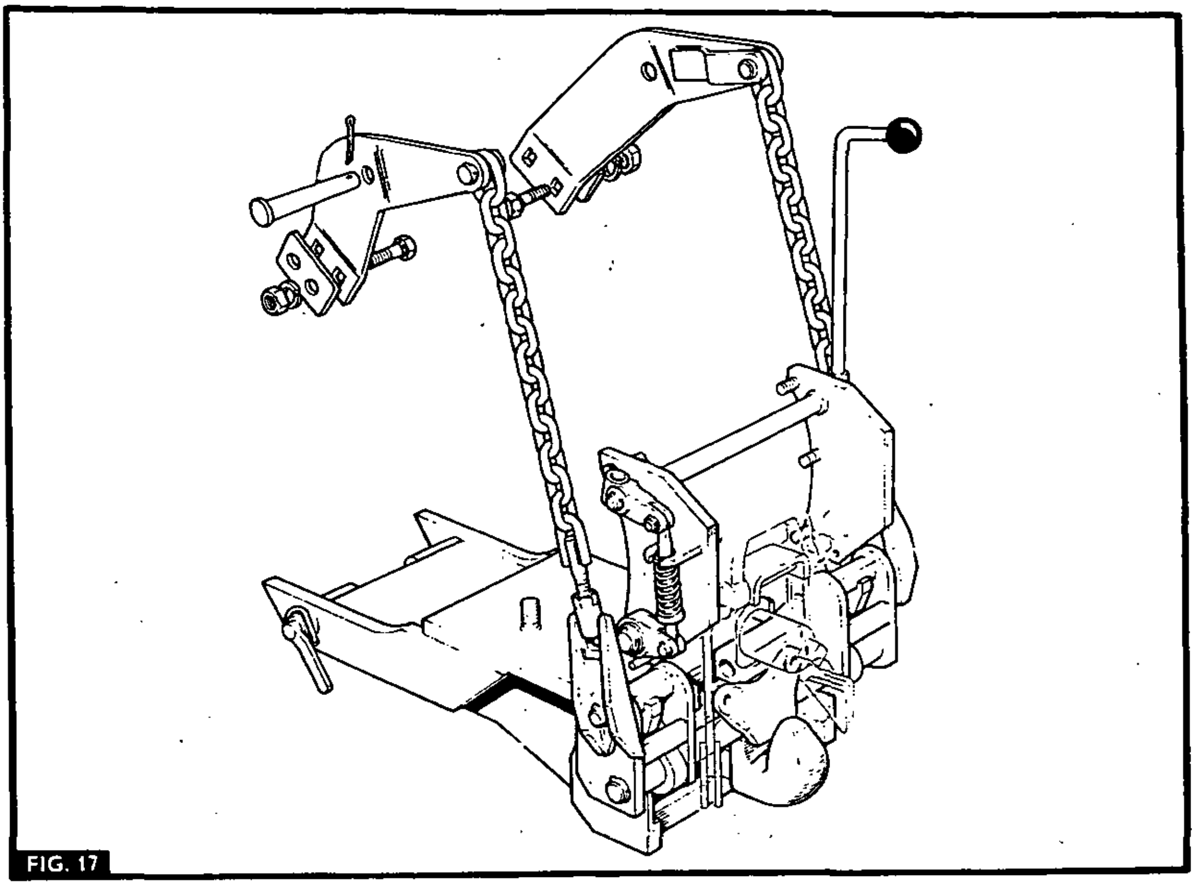


FIG. 17

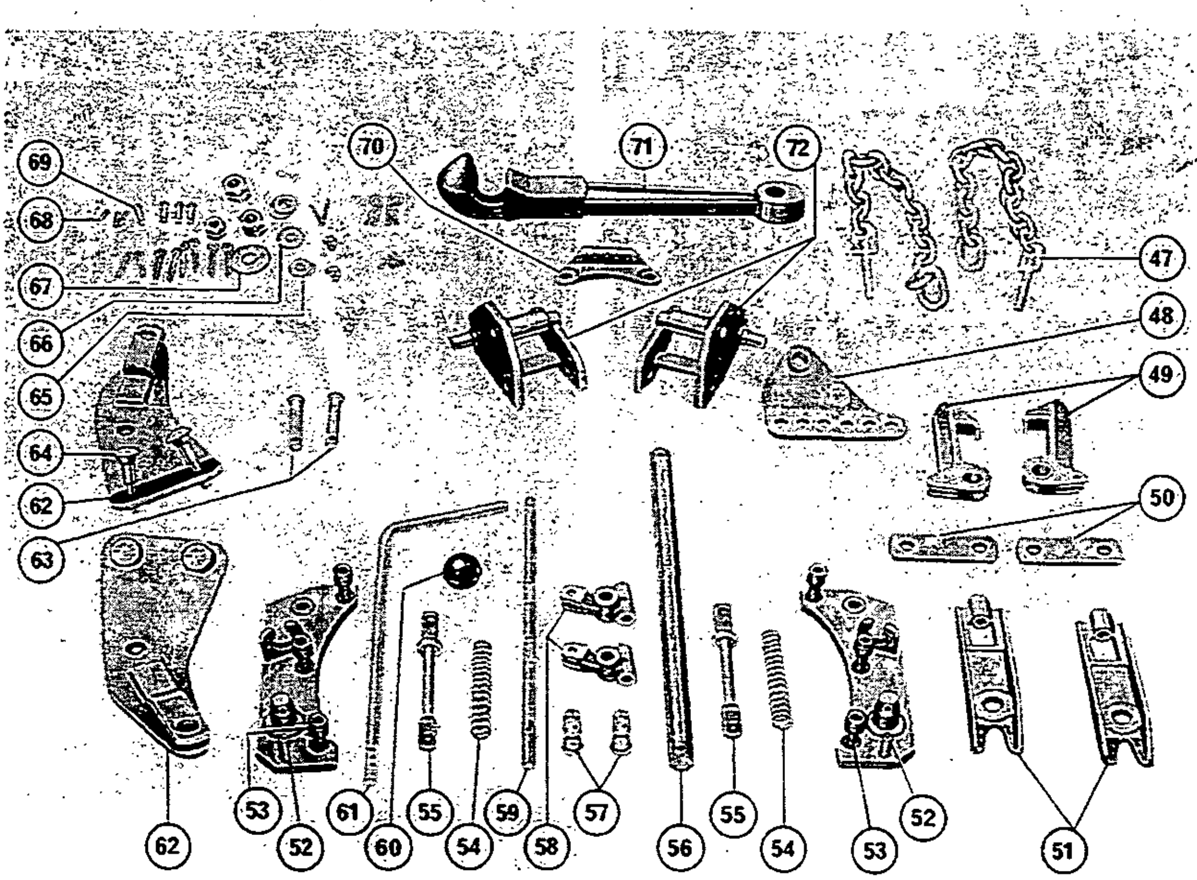

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FIG. 18

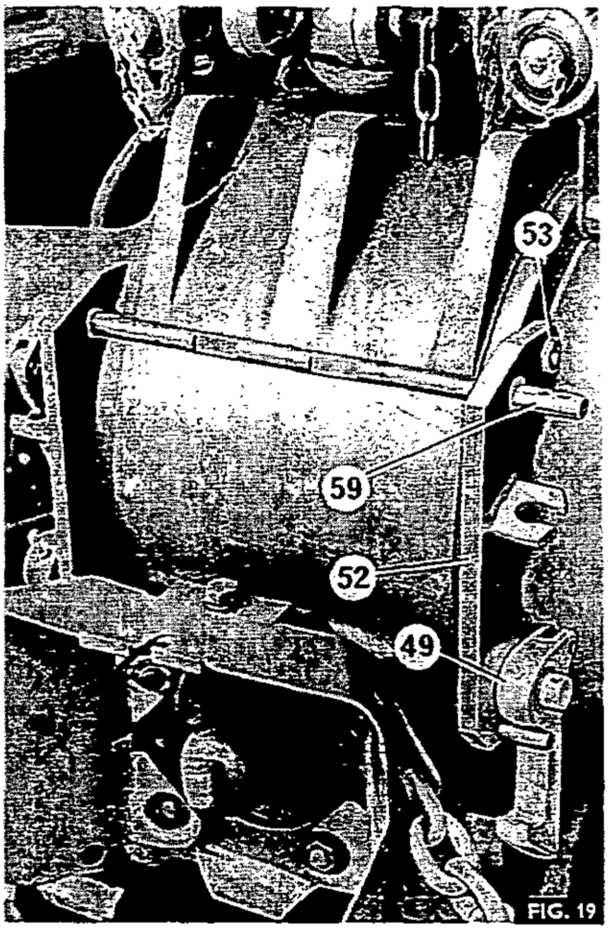


FIG. 19

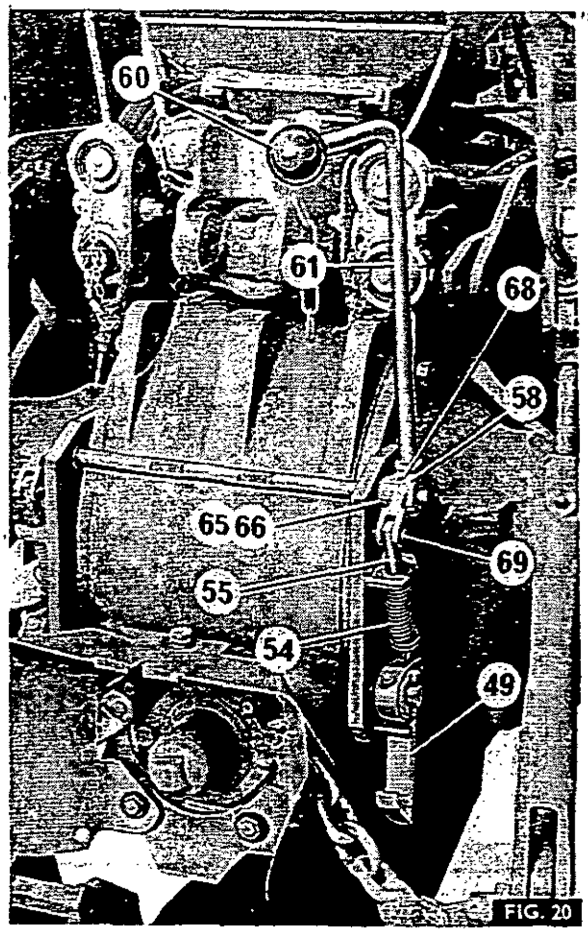


FIG. 20

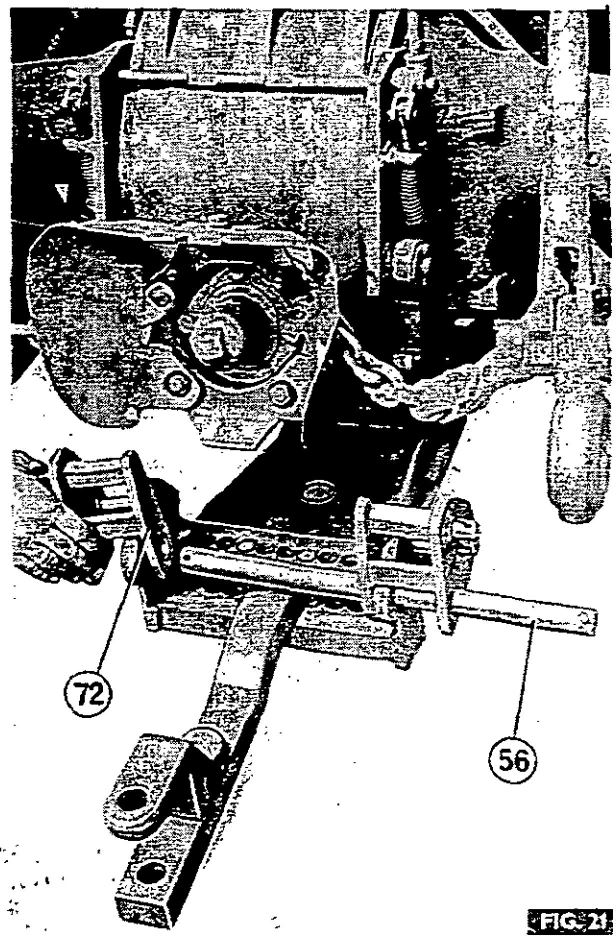


FIG. 21

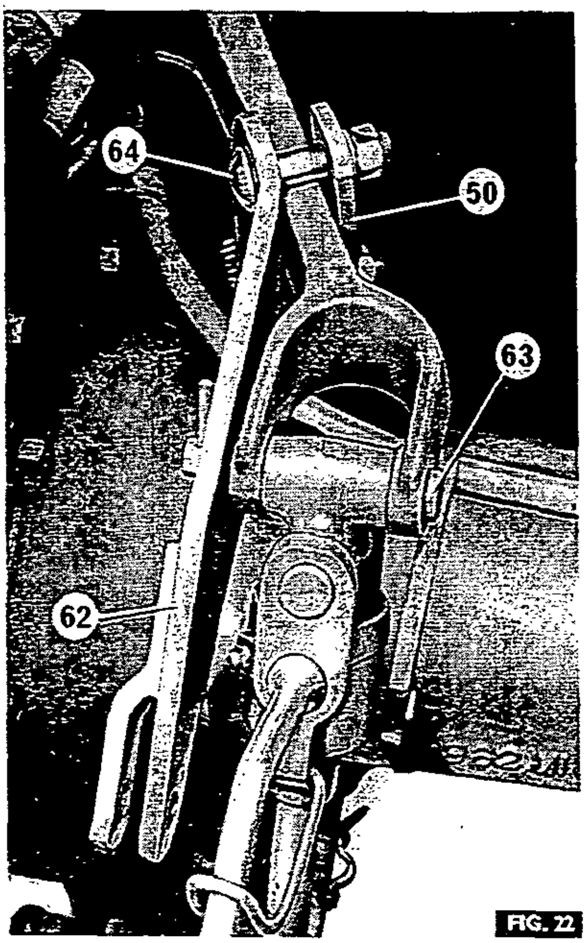


FIG. 22

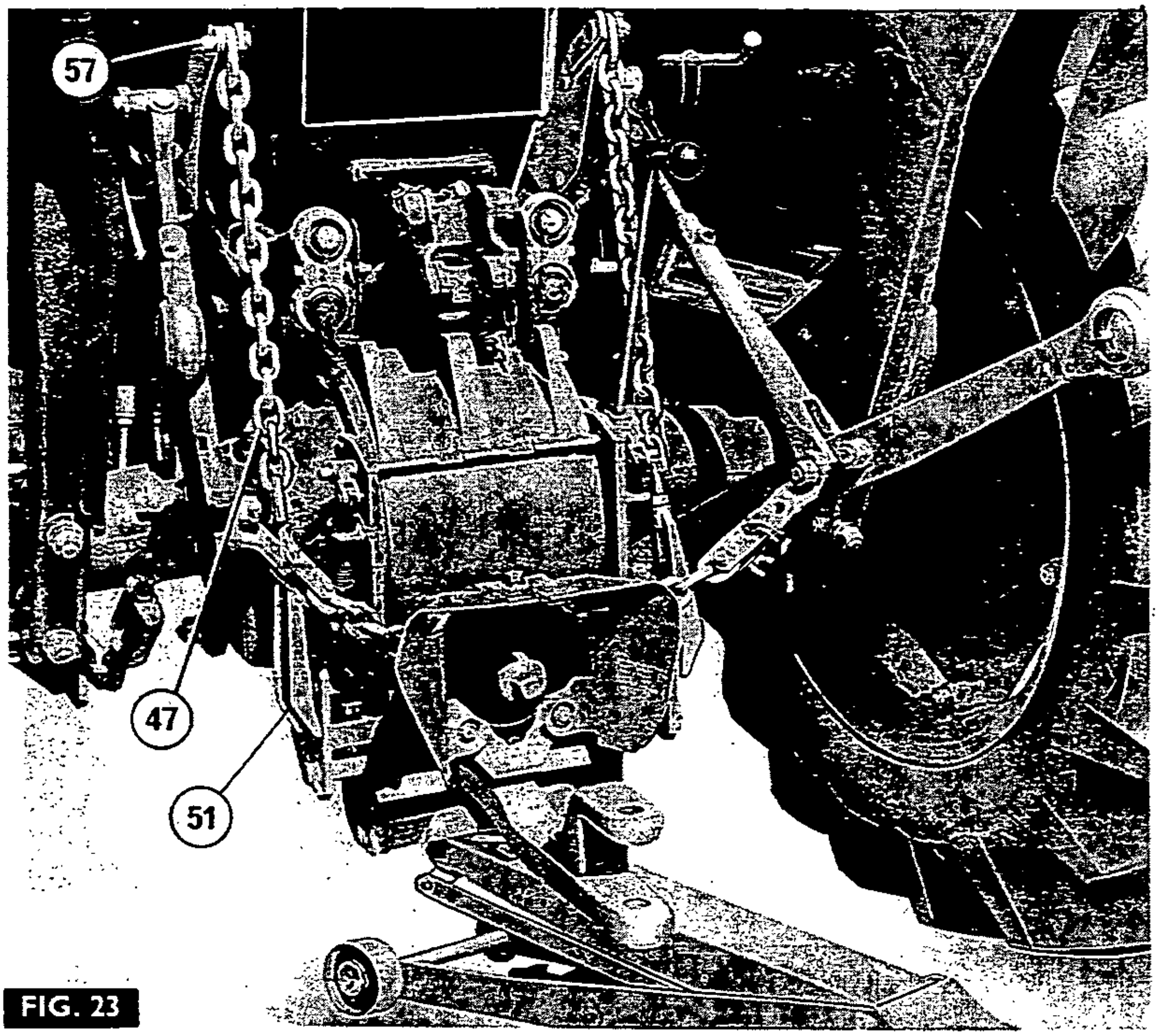


FIG. 23

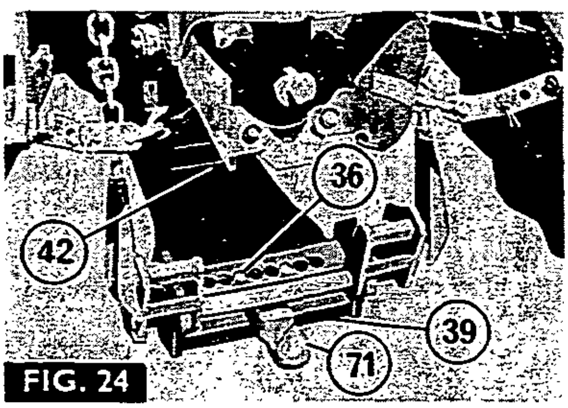


FIG. 24

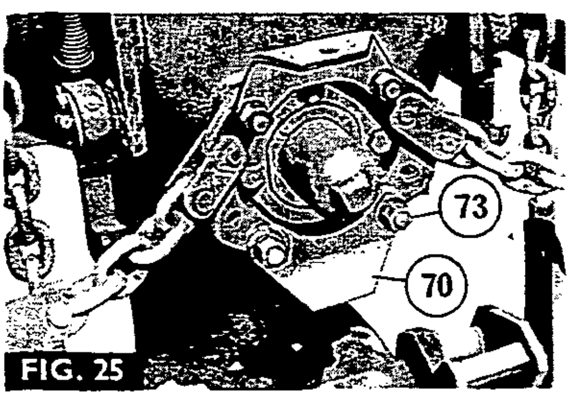


FIG. 25

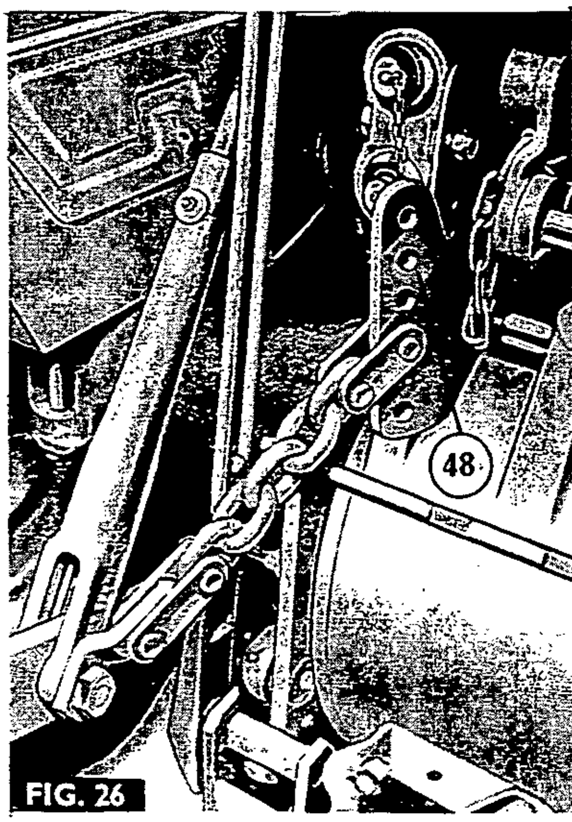
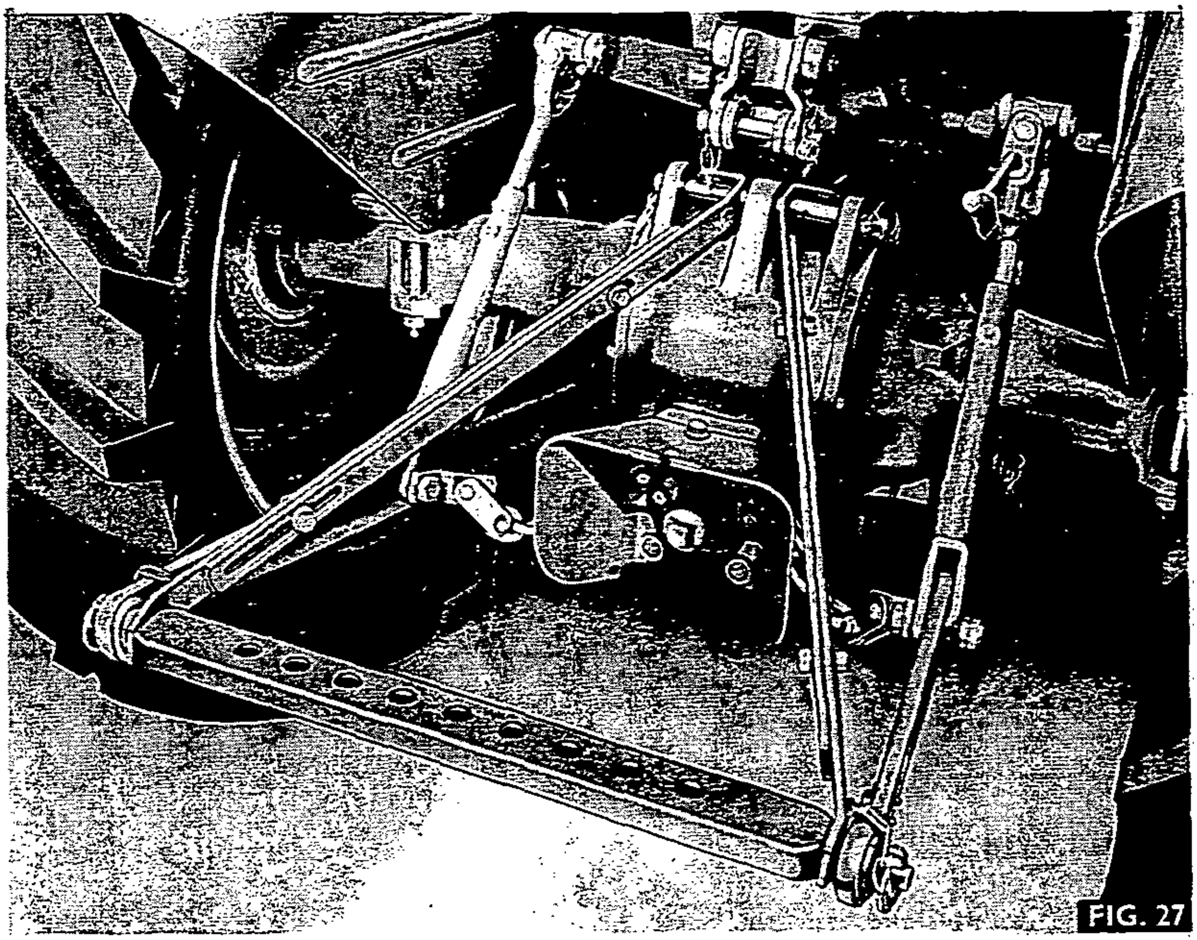


FIG. 26



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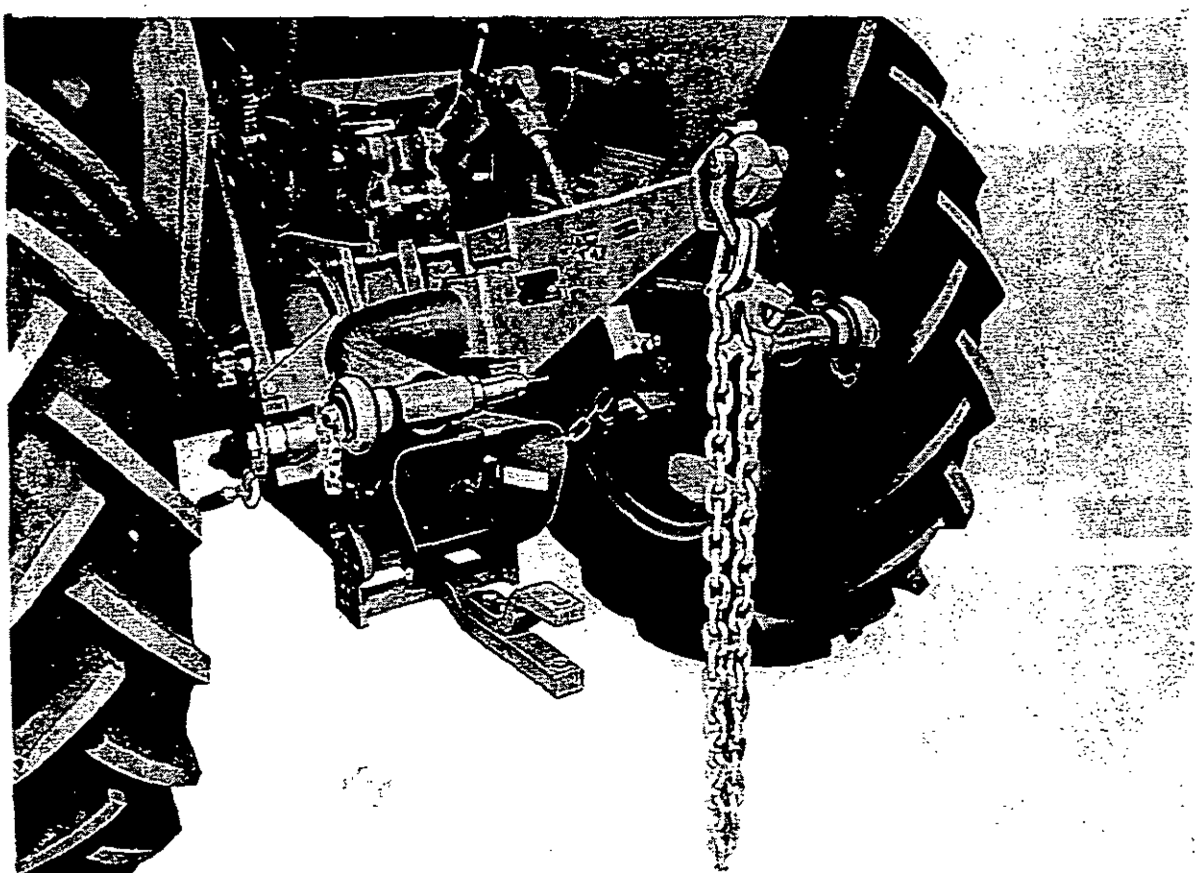

FIG. 28

1. Lower the automatic hitch.
2. Remove the hitch hook securing pin and pull the hook rearwards and out of the mounting frame.
3. Slide the drawbar between the headed pins at the rear of the mounting frame and re-fit the securing pin. The drawbar can be adjusted radially as stated. (see figure 15).

WARNING. – DO NOT ATTEMPT TO LIFT THE AUTO-HITCH MECHANISM WITH THE DRAWBAR OFFSET AND A LOAD APPLIED.[

Linkage Check Bracket Fig 26.
When a two-wheel trailer is used with the Auto-Hitch, the tractor lower links may foul the trailer drawbar when turning. To prevent such an occurrence, the linkage check bracket has been provided as part of the Auto-Hitch Kit.
After the trailer has been hitched, connect the check bracket by removing the hairpin and headed pin securing the L.H. check chain to the anchor bracket. Align the flatlinks on the end of the check chain with a convenient hole in the check bracket. Re-fit the headed pin and hairpin.

LINKAGE DRAWBAR

The linkage drawbar can be used when towing trailed implements with low weight transfer. To prevent excessive transverse movement, a pair of drawbar stays are fitted. These stays are adjustable for length to permit the height of the drawbar to be set as required and then locked in position.

WARNING – NEVER SET THE DRAWBAR ABOVE THE REAR AXLE CENTRE-LINE, OTHERWISE THE TRACTOR WILL BECOME EXTREMELY UNSTABLE WHEN TOWING.

Drawbar Fitment. Fig 27. 7C-09
1. Remove the long pin from the tractor centre housing.
2. Loosely assemble the pairs of stays, fitting the bolts only to the slotted holes.
3. Attach the stays to the centre housing as shown, securing them with the long pin and linch pin.
4. Fit the drawbar mounting pins to the holes in the stays, then into the lower link balls and secure them with linch pins.
5. Adjust the height of the drawbar using the tractor hydraulic lift system. When the notches in the stays are aligned, the drawbar will be at the normal working height of 450 mm (17½ in).
6. Finally tighten the outer bolts and fit the centre bolts to a pair of aligning holes.
7. Place both of the hydraulic control levers in the fully lowered position, (i.e. 'Drop').

WARNING. – IF THE LEVERS ARE PLACED IN THE RAISED POSITION. THE STAYS MAY BE BENT, OR BROKEN, WHEN THE TRACTOR ENGINE IS STARTED.

PRESSURE CONTROL COUPLER Fig 28.

The Pressure Control Coupler enables weight to be transferred to the tractor rear wheels when working with trailed implements, thus improving traction. This additional weight transfer also gives improved braking performance by minimising wheel-locking and slewing when descending steep gradients.

Description
The coupler consists of a curved, tubular cross-member with fabricated location lugs and dual Category mounting pins, by means of which the beam is attached to the tractor lower links. Attached to the tubular member is a hinged hook, carrying the coupling chain, which is attached by the safety release ball and the adjusting claw.

Modification of Implement Drawbars 7C-10
Before operating, certain modifications must be made to the implement drawbar to ensure adequate strength to attach the chain and where necessary to ensure that the coupler chain will clear the p.t.o. shaft if used. As the Pressure Control coupler is used in conjunction with a variety of drawbar designs and applications, the following modifications are suggested:–
Drawbars fitted to implements are of three basic types:–
1. 'A' frame (rigid) of tubular, or angle-iron construction.
2. 'Pole' type (rigid) of round, or square tube construction.
3. Hinged type which may be of either of the above types.

Any of the above types of drawbars may need strengthening to withstand the lifting force applied by the coupler chain.
If the implement is powered by a p.t.o. driveshaft alterations must also be made to enable the coupler chain to clear the p.t.o. shaft.
Figures 29 to 32 show the recommended methods of modifying the implement drawbar for added strength and to give p.t.o. shaft clearance.
Strengthening can be achieved:–
a) By welding an angle-iron section on to the underside of a round tube drawbar.
b) By welding an identical angle-iron section to the existing angle-iron drawbar to form a square section tube.

All drawbars must have a chain anchor bracket welded on to retain the chain at its correct angle in relation to the boom and drawbar. When turning, the chain must slide freely through the anchor brackets. otherwise, rapid chain wear will occur. Square, or angle section drawbars may need chain guides to assist the chain in sliding. Various methods of keeping the chain clear of the p.t.o. shaft can be employed, according to the type of drawbar fitted.
MF machinery which is operated in conjunction with the Pressure Control coupler should be modified to allow chain attachment. Modification procedure for such machinery is detailed in the General Machines Workshop Service Manual, Publication No. 819 218 M1.

For implements other than those manufactured by MF the following principle modifications for the various drawbar types are as follows:—

Figure 29 'A' Frame type of round tube construction
Figure 30 'A' Frame type of square tube, or angle iron construction
Figure 31 'Pole' type, showing alternatives for round or square constructions
Figure 32 'Pole' type, non-p.t.o., showing alternative for round, or square sections

NOTE. – THE P.T.O. DRIVE SHAFT MUST HAVE A MINIMUM CLEARANCE FROM THE COUPLER CHAIN OF 25 MM (1 IN).

Pressure Control Coupler Fitment 7C-11

1. Ensure that the adapter plates are correctly adjusted as shown in figure 33.
2. Check that the required ball end mounting pin faces outwards.
3. Place the coupler frame between the tractor lower links and engage the ball end mounting pin and extended bracket on the left lower link and secure with linch pin then on the right hand link and secure the ball end mounting pins with the linch pins.

Adjustments 7C-12

To allow one design of Pressure Control coupler to be fitted to MF135, 165 and 185 tractors, the ball end mounting pins are reversible for Categories 1 and 2 and the lugs welded to the tubular cross member have adjustable adapter brackets to compensate for the varying width of the lower links according to the particular tractor.
Fig. 33. The adapter bracket should be positioned as shown.
The reversible ball end mounting pins have alternative end diameters of 22,23 mm (7/8 in.) and 28,57 mm (1.1/8 in.) to suit Category 1 and 2 ball ends respectively.

Coupler to Implement Attachment

1. Raise the coupler on the lower links, using 'Position Control'.
2. Attach the implement drawbar on to the tractor swinging drawbar.
3. Lower the coupler on the tractor using 'Position Control' until the tubular cross member is parallel to the ground.
4. Fig. 34. Loop the chain through the chain anchor bracket(s) and engage the nearest available chain link in the adjusting claw.
5. Tension the chain by moving the control quadrant lever to increase 'Pressure'.

NOTE – THE MAXIMUM CHAIN ANGLE SHOULD NOT EXCEED 45^{o} (Fig. 35).

Operation

1. Attach the coupler to the tractor and implement.
2. Move the 'Draft Control' lever fully back.
3. Move the 'Position Control' lever into the black 'Pressure' sector of the inner quadrant to the 'LOW' position. Move the lever back just sufficiently to give adequate traction, then set the adjustable stop to align with the lever. If difficult conditions are encountered, increase the pressure by moving the lever towards 'High' until traction is obtained. Always return the lever to the set position when conditions improve.

Stowage for Transport

Fig. 36. If a tractor fitted with the Pressure Control coupler is to be driven without an implement attached, the boom should be stowed by slewing it to the right and engaging the spring clip (74).

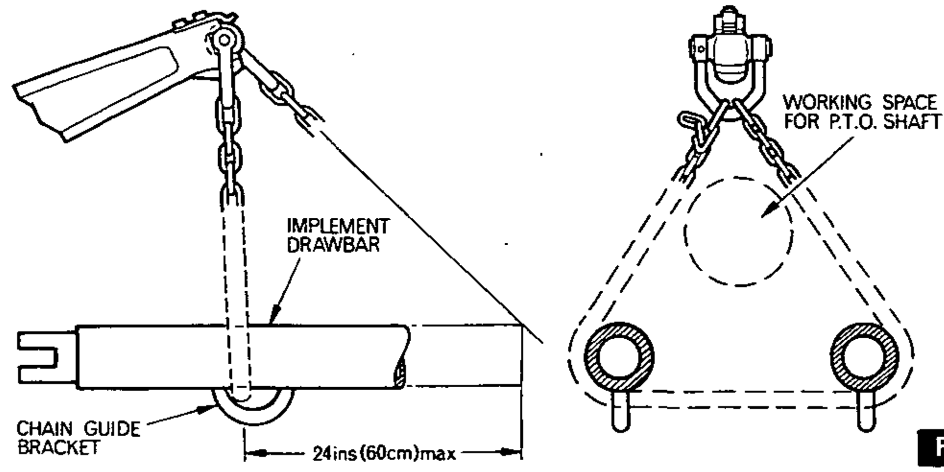

FIG. 29

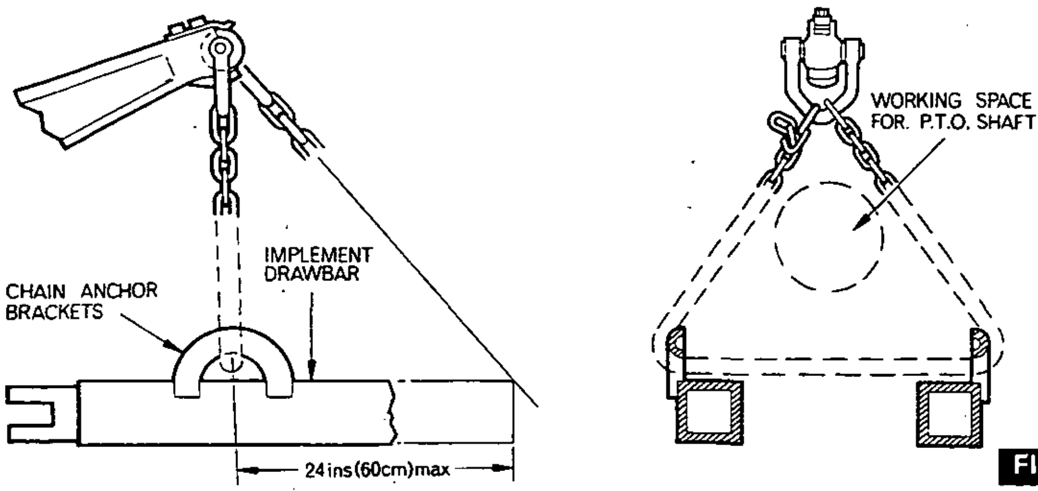

FIG. 30

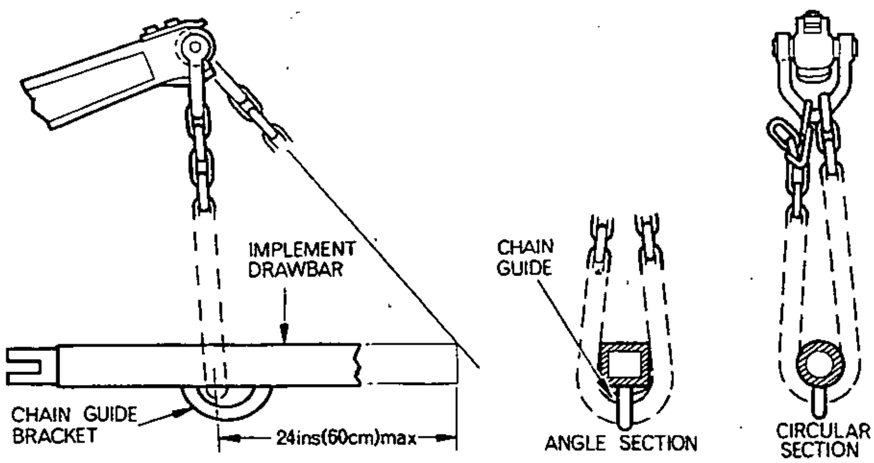

FIG. 31

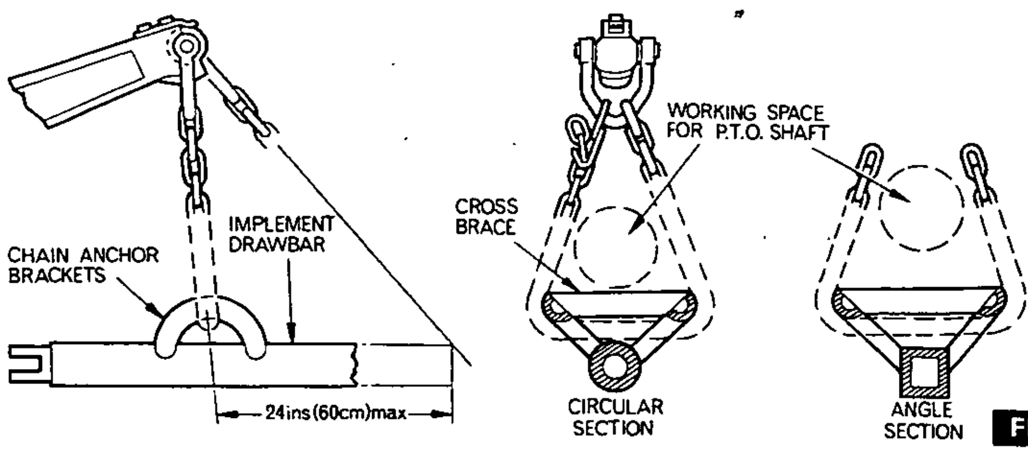

FIG. 32

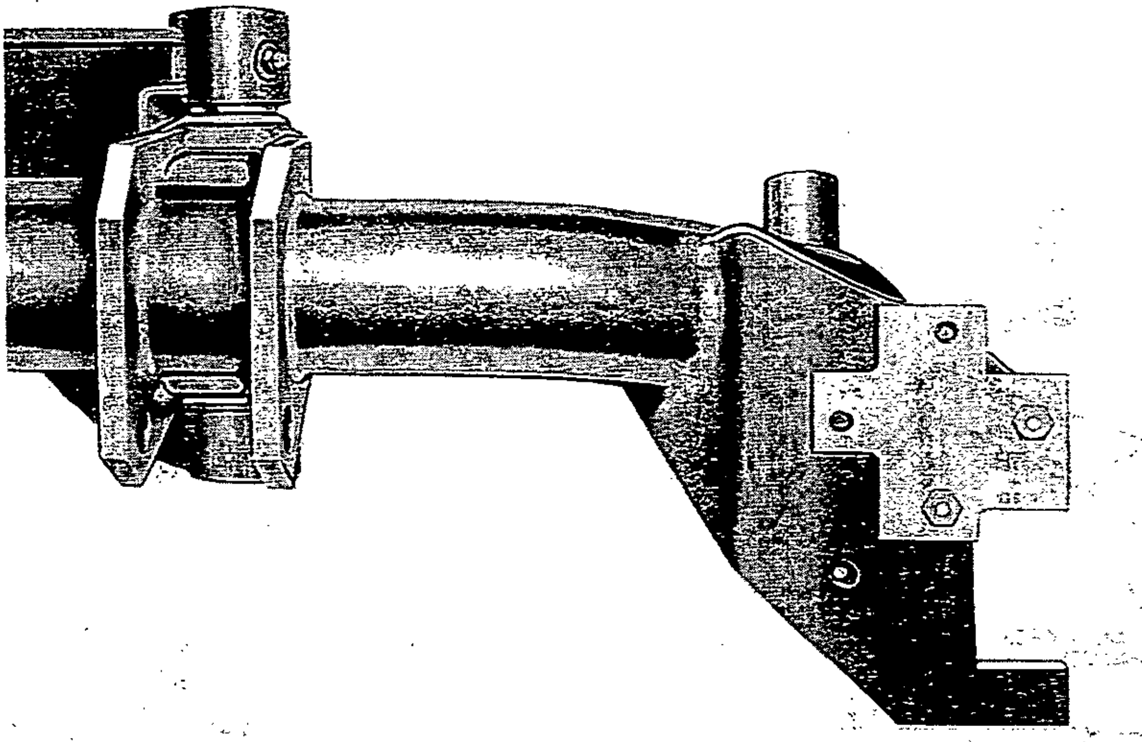

FIG. 33

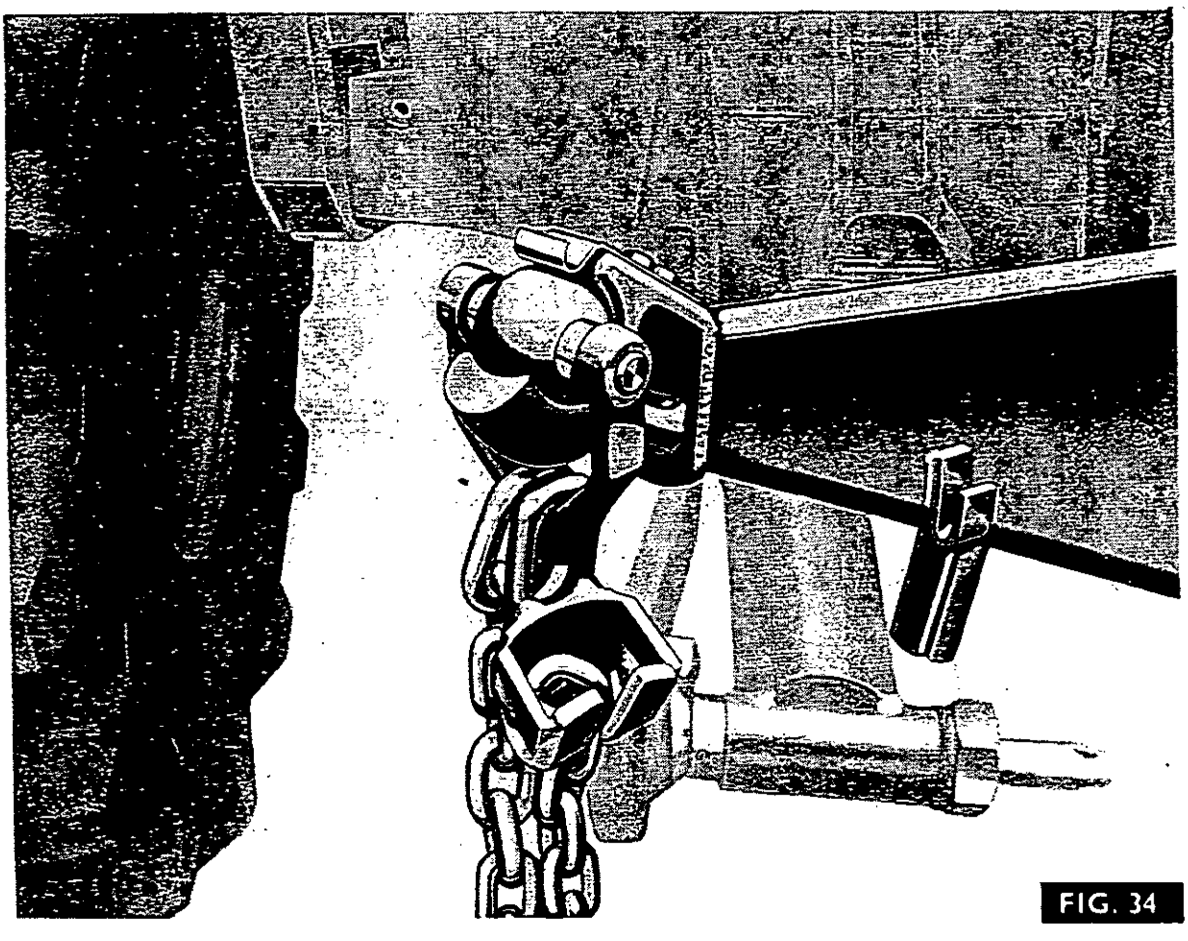

FIG. 34

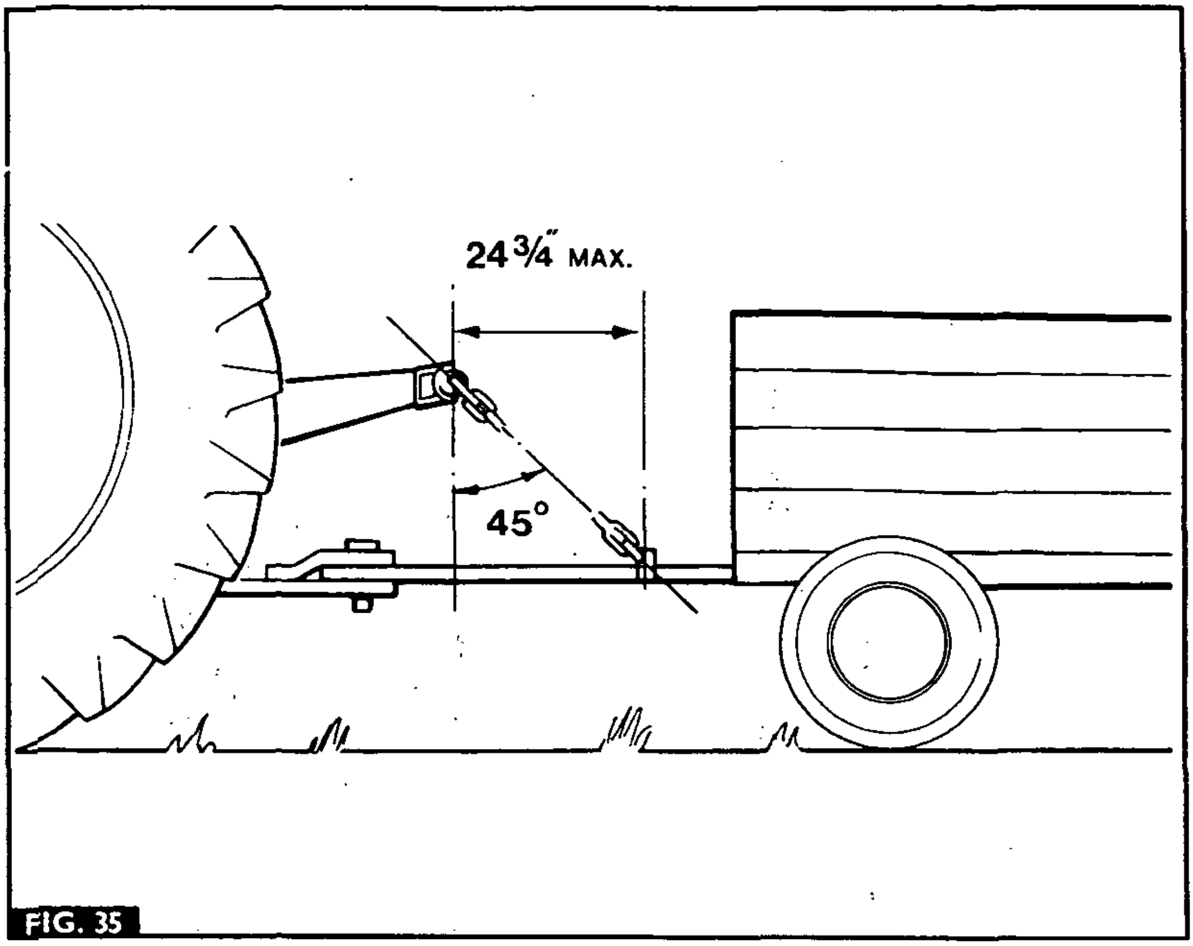

FIG. 35

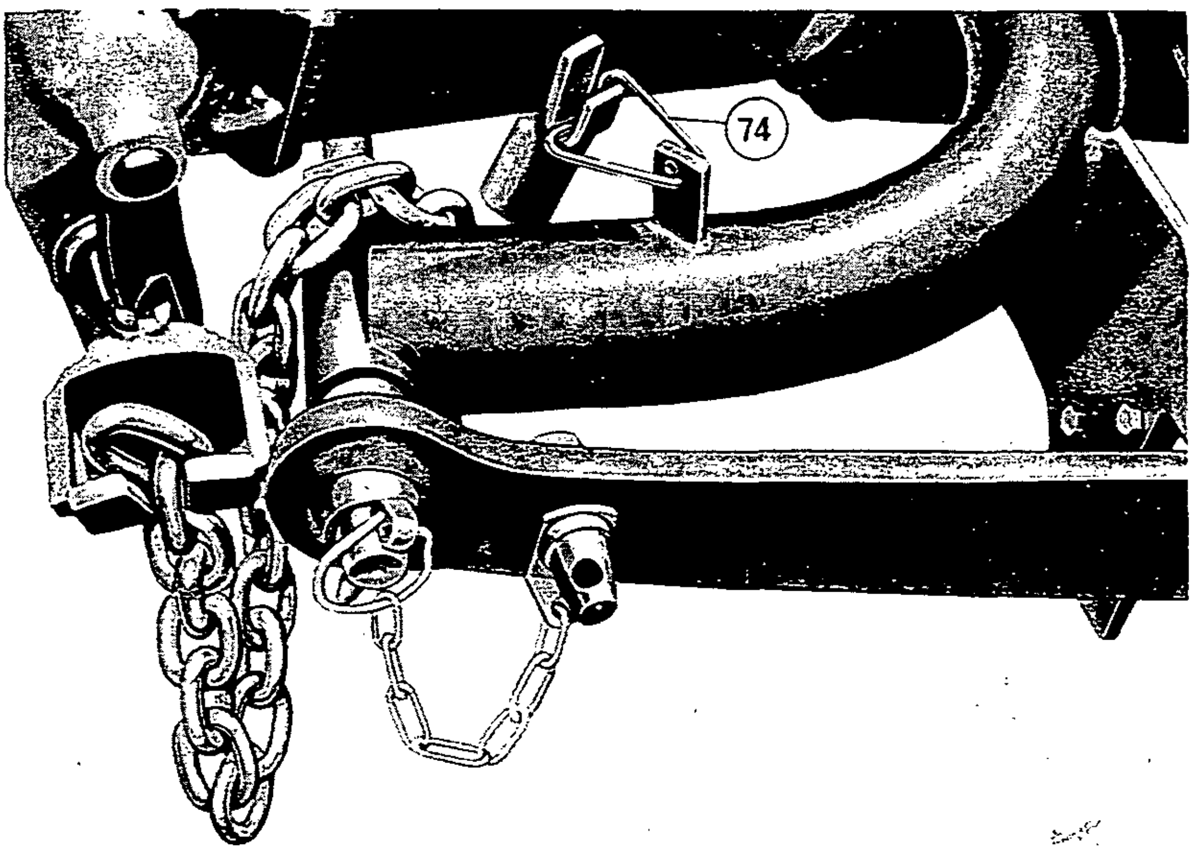

FIG. 36

ELECTRICAL SYSTEM

Part 8 Section A

Operation No.	Table of Contents	Page No.

GENERAL

The electrical system of this tractor is a 12 volt Negative earth system with compensated voltage control regulator. Fig. 1 shows the layout of all the electrical components and associated wiring.

The battery is mounted on a platform, at the rear of the fuel tank, and access is gained through a detachable panel on the tractor hood. The dynamo is mounted on the right hand side of the engine and is driven by an endless belt from the crankshaft pulley. The dynamo has adjustable mountings to enable the correct belt tension to be maintained. A voltage control regulator is mounted behind the engine bulkhead, beneath the instrument panel. The starter motor is bolted to the right hand side of the engine.

A neutral safety switch is fitted on top of the transmission case, which renders the starter motor inoperative until the Dual Range Selector Lever is in the Neutral Position.

The electrical equipment should be serviced at the times stated in the Operator Instruction Book, particular attention should be paid to the cleanliness and tightness of the battery terminals.

25 amp line fuses are fitted to protect the thermostart, cigarette lighter and lighting circuits. A blown fuse must always be replaced with one of the same capacity.

Before any operation is carried out on the electrical system, disconnect the battery terminals.

Key to Fig. 1

1. Thermostart
2. Dynamo
3. Wiring Harness
4. Starter Motor
5. Battery Lead
6. Battery Earth
7. Neutral Safety Switch
8. Battery
9. Control Box
10. Starter Switch
11. Cigarette Lighter

BATTERIES

Batteries are supplied either dry and uncharged or filled and charged or dry with their plates in a charged condition. Routine Maintenance is the same for all.

Battery Maintenance

Wipe away any foreign matter or moisture from the top of the battery, and ensure that the connections and the fixings are clean and tight. Every 100 hours, or more frequently in hot weather, examine the level of the electrolyte in the cells. If necessary, add distilled water to bring the level up to the top of the perforated separator guard.

The use of a Lucas Battery Filler will be found helpful in this topping up process as it ensures that the correct electrolyte level is obtained automatically and also prevents distilled water from being spilled over the battery top. Use only distilled water when topping up.

NOTE – NEVER USE A NAKED LIGHT WHEN EXAMING A BATTERY, AS THE MIXTURE OF OXYGEN AND HYDROGEN GIVEN OFF BY THE BATTERY WHEN ON CHARGE, AND TO LESSER EXTENT WHEN STANDING IDLE, CAN BE DANGEROUSLY EXPLOSIVE.

Battery Servicing

Vent Plugs
Ensure that the ventilating holes in each vent plug are clear.

Level of Electrolyte
The surface of the electrolyte should be level with the top of the perforated separator guard. If necessary, top-up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of *water* by evaporation and electrolysis) should be made good by dilute acid of the same specific gravity as that already in the cell.

Cleanliness
Ensure that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

Hydrometer Tests
Measure the specific gravity of the acid in each cell, using a hydrometer. To avoid misleading readings, do not take hydrometer readings immediately after topping-up.

The readings given by each cell should be approximately the same. If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives an indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore for convenience in comparing specific gravities, this is always corrected to 15.5°C (60°F), which is adopted as a reference temperature. This method of correction is as follows:

For every 2.8°C (5°F) *below* 15.5°C *deduct* .002 from the observed reading to obtain the true specific gravity at 15.5°C (60°F).

For every 2.8°C (5°F) *above* 15.5°C *add* .002 to the observed reading to obtain the true specific gravity at 15.5°C. The temperature must be that indicated by a thermometer actually immersed in the electrolyte and not the air temperature.

Compare the specific gravity of the electrolyte with the values given in the chart below and so ascertain the state of charge of the battery. If the battery is in a discharged state, it should be re-charged, either on the vehicle by a period of daytime running or on the bench from an external supply.

Key to Fig. 2

1. Battery
2. Voltage Regulator
3. Dynamo
4. Fuel Gauge Sender Unit
5. Starting Aid
6. Fuse
7. Heat Start Switch
8. Fuel Gauge
9. Cigarette Lighter
10. Ammeter
11. Neutral Safety Switch
12. Starter Motor

Colour Code Fig. 2

B	Black	R	Red
G	Green	U	Blue
N	Brown	W	White
P	Purple	Y	Yellow
O	Orange	K	Pink
S	Slate	M	Maroon

State of Charge	Home and Climates ordinarily below 80°F (26.6°C): Specific Gravity of Electrolyte (Corrected to 60°F (15.5°C))	Climates frequently over 80°F (26.6°C): Specific Gravity of Electrolyte (Corrected to 60°F (15.5°C))
Fully charged	1.270 – 1.290	1.210 – 1.230
About half discharged	1.190 – 1.210	1.130 – 1.150
Completely discharged	1.110 – 1.130	1.050 – 1.070

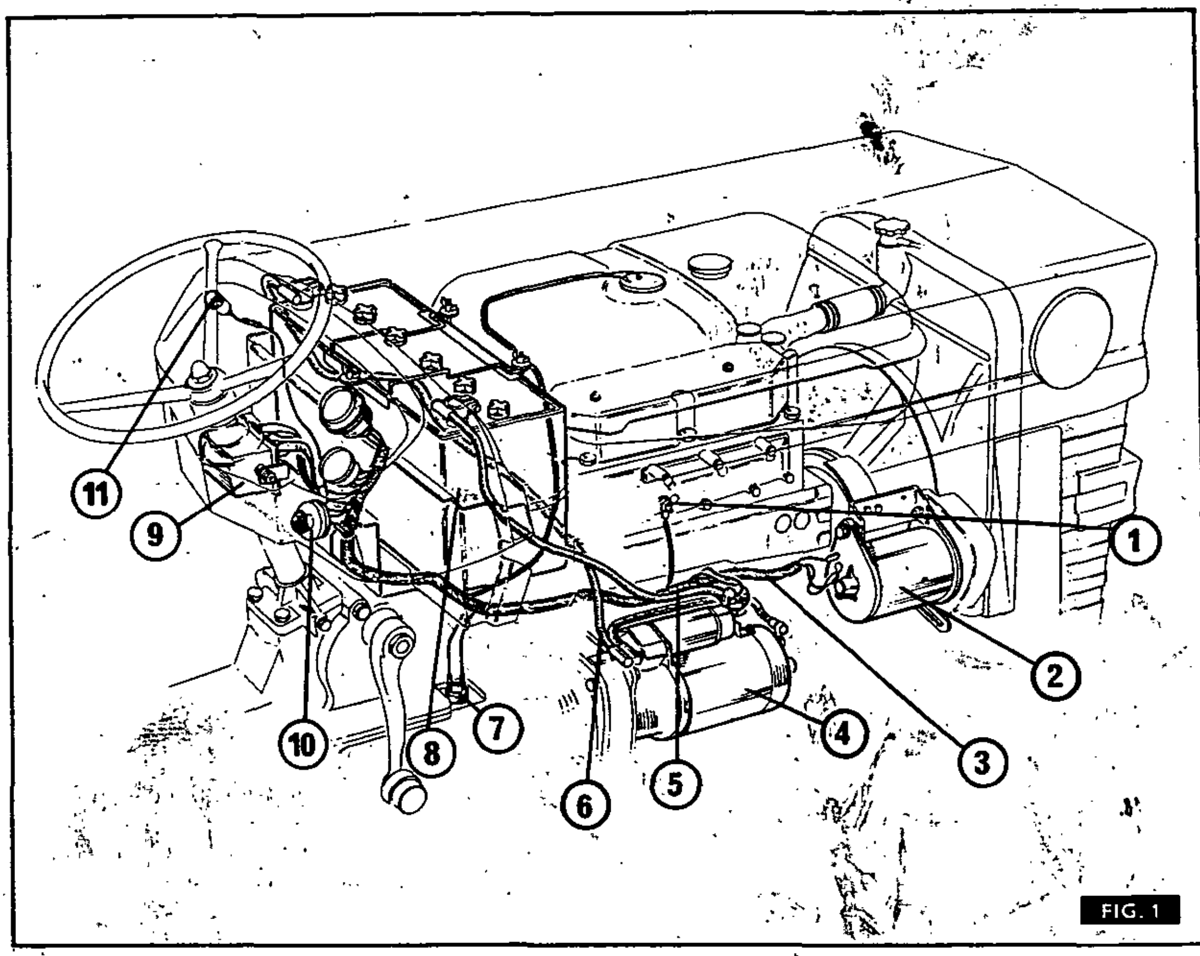
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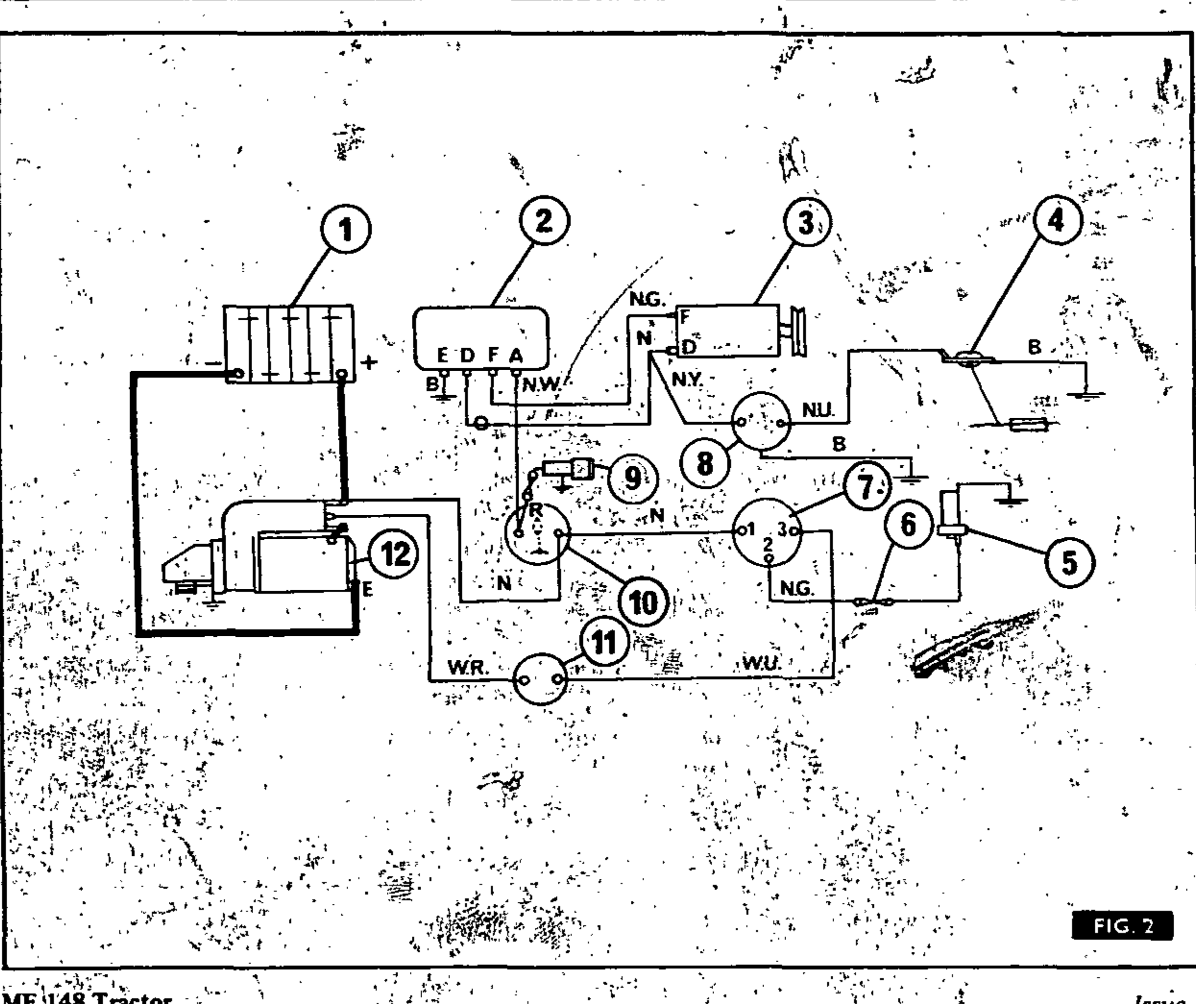
FIG. 1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N.U.
B
B
8
9
R
N
7
1
3
2
6
5
12
E
N
10
N.G.
11
W.R.
W.U.

FIG. 2

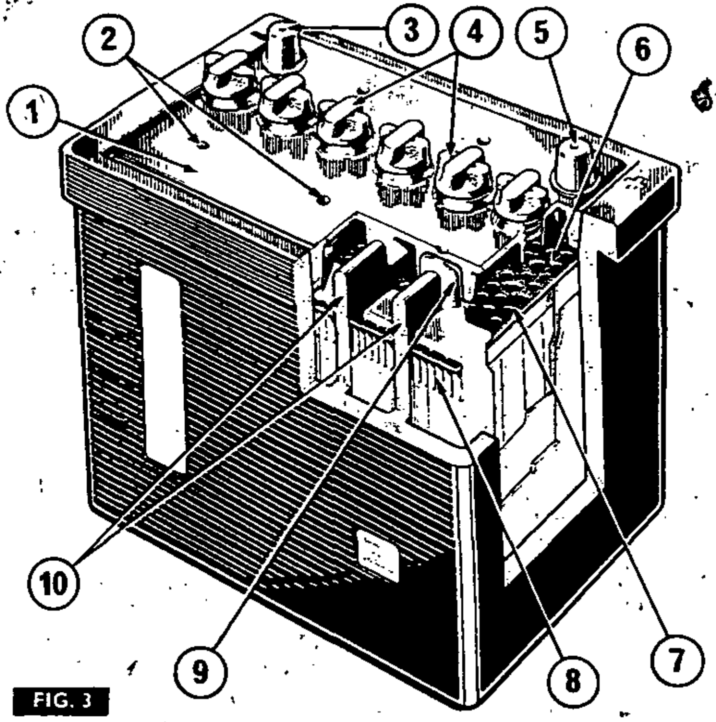

FIG. 3

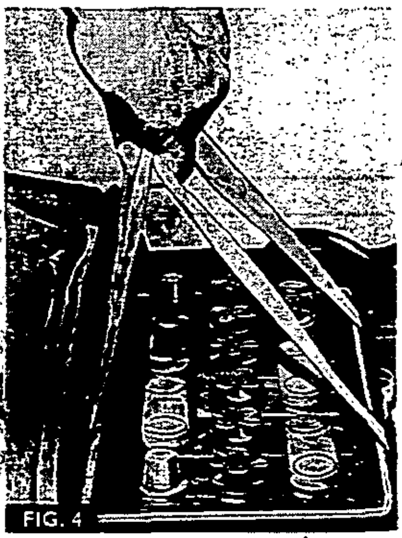
FIG. 4

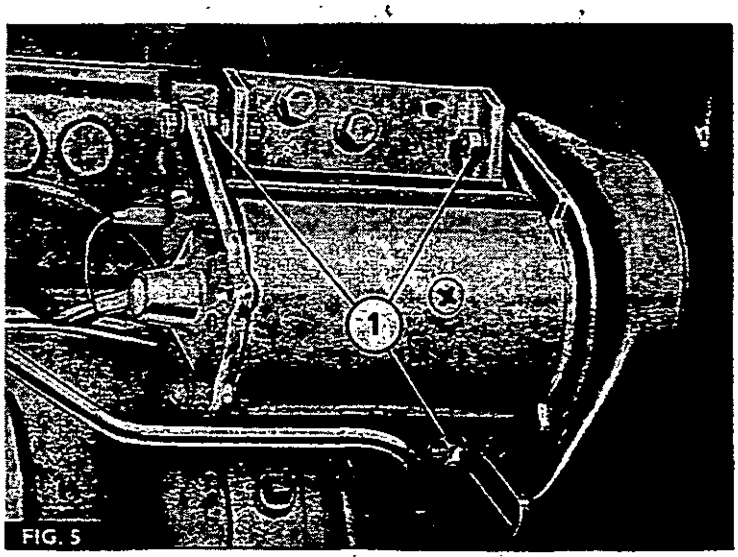

FIG. 5

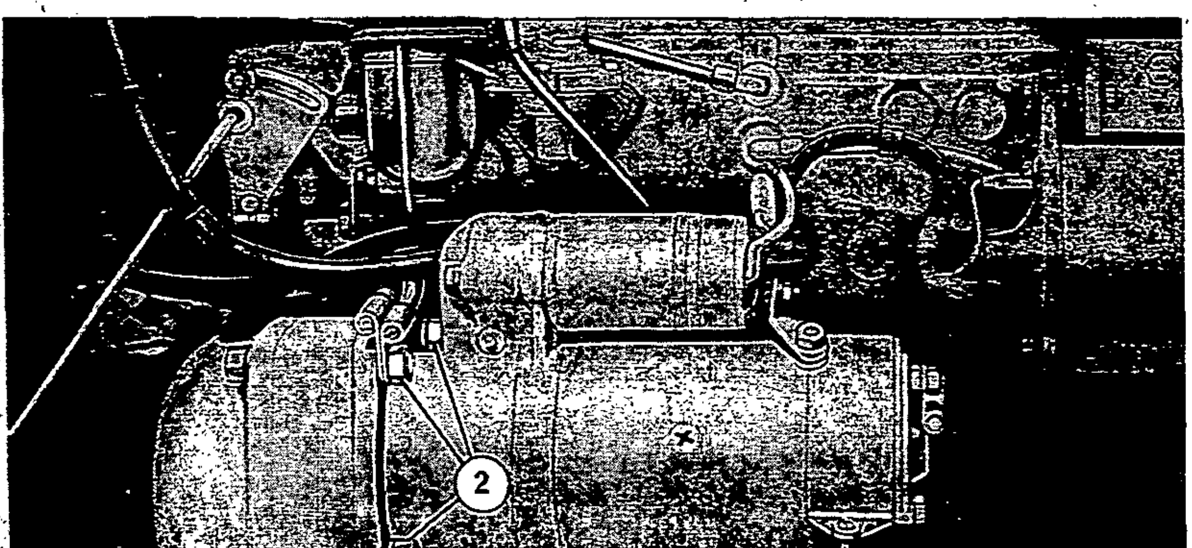

FIG. 6

Key to Fig. 3

1. Top Cover
2. Access Points to Cell Terminals
3. Terminal Post (Negative)
4. Filler Plugs
5. Terminal Post (Positive)
6. Splash Plate
7. Level of Electrolyte
8. Separators
9. Cell Terminals
10. Cell Wall

HIGH-RATE DISCHARGE TEST

The high-rate or heavy discharge test is a timed on-load voltage check applied separately to each cell of the battery. Before testing, a battery should have been off charge for at least some hours and each cell must be at least 70% charged, having a minimum electrolyte density of 1.230 S.G. in climates normally below 26.6°C (80°F) or 1.170 S.G. in hotter climates.

Use only a suitably rated tester, (300 ampere element). A cell in good condition will maintain a constant 1.2 – 1.5 volt reading on the test meter for 10 seconds when the prongs of the tester are passed on to adjacent interconnectors or terminals. A weak cell will show a rapidly falling voltage. If all the cells appear weak, this may indicate that the battery is merely discharged but otherwise healthly.

RECHARGING FROM AN EXTERNAL SUPPLY

If the above tests indicate that the battery is merely discharged and is otherwise in a good condition, it should be recharged, either on the tractor by a period of daytime running or on the bench from an external supply.

If the latter, the battery should be recharged at the rate given in the specification until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the top of the separator guard by the addition of distilled water.

A battery that shows a general falling off in efficiency, common to all cells, will often respond to the process known as 'cycling'. This process consists of fully charging the battery, as described above, and then discharging it by connecting it to a lamp board, or other load, taking a current equal to the charging current. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell failing to 1.8. If the battery discharges in a shorter time, repeat the cycle of charge and discharge.

PREPARING NEW UNFILLED UNCHARGED BATTERIES

Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging.

Approximately:

790 cc (1 ⅜ pint) 96 amp/hr.

1220 cc (2 ⅛ pint) 125 amp/hr.

is needed for each 2-volt cell.

SPECIFIC GRAVITY OF ACID REQUIRED WHEN FILLING

Home and Climates ordinarily below 26.6°C (80°F): Specific Gravity of Acid (Corrected to 15.5°C (60°F) – 1.260.

Climates frequently over 26.6°C (80°F): Specific Gravity of Acid (Corrected to 15.5°C (60°F) – 1.210.

Electrolyte of the specific gravity required is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1.840 S.G. The mixing must be carried out either in a lead-lined tank or in a suitable glass or earthenware vessel. Slowly add the acid to the water, stirring with a glass rod. *Never add the water to the acid,* as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The approximate proportion of acid and water are indicated in the following table:

To obtain Specific Gravity
(corrected to 15.5°C (60°F)) of:
1.260
1.210
Add 1 vol. of acid of 1.840 S.G.
(corrected to 15.5°C (60°F) to:
3.2 volumes of water (1.260 S.G.)
4.3 volumes of water (1.210 S.G.)

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings and pouring the electrolyte into the battery.

Filling the Battery

The temperature of the acid, battery and filling-in room must not be below 0°C (32°F). Remove the vent plugs and half-fill each cell with electrolyte of the appropriate specific gravity. Allow the battery to stand for six to twelve hours (in order to dissipate the heat generated by the chemical action of the acid on the plates) before resuming the filling to the top surface of the separator guard. Allow to stand for a further two hours and then proceed with the initial charge.

Initial Charge

The initial charging rate is given in the specification. Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 48 to 80 hours, depending on the length of time the battery has been stored before charging. Some harmless frothing may occur during the first few hours. This can be minimised by reducing the charging current. Conversely, frothing will be increased if the specified charging rate is exceeded.

NOTE – BOTH 96 AMP AND 125 AMP BATTERIES MAY BE FILLED IN ONE STAGE TO THE SEPARATOR GUARD. THEY MUST THEN BE ALLOWED TO STAND FOR 12 HOURS BEFORE THE INITIAL CHARGE IS BEGUN. IF NECESSARY, ADD MORE ACID TO RESTORE ELECTROLYTE LEVELS TO THE SEPARATOR GUARDS.

MAXIMUM PERMISSIBLE ELECTROLYTE TEMPERATURE DURING CHARGE.

Home and Climates normally below 26.6°C (80°F):
37.7°C (100°F)
Climates frequently over 26.6°C (80°F):
48.8°C (120°F)

Keep the current constant by varying the series resistance of the circuit or the generator output. This charge should not be broken by long rest periods. If, however, the temperature of any cell rises above the permissible maximum, the charge must be interrupted until the temperature has fallen at least 5.5°C (10°F) below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separator guard by the addition of acid solution of the same specific gravity as the original filling-in acid, until specific gravity and voltage readings have remained constant for five successive hourly readings.

If the charge is continued beyond that point, top up with distilled water.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 15.5° (60°F), it lies within the specified limits. If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced, either by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate miximg of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any electrolyte above the top of the spearator guard.

PREPARING NEW DRY-CHARGED BATTERIES FOR SERVICE

SPECIFIC GRAVITY OF ACID REQUIRED WHEN FILLING

Home and Climates ordinarily below 26.6°C (80°F): Specific Gravity of Acid
(corrected to 15.5°C (60°F)
1.260

Climates frequently over 26.6°C (80°F): Specific Gravity of Acid
(corrected to 15.5°C (60°F)
1.210

Filling the Cells

Remove the sealing tape from the vent plugs (when applicable) and fill each cell with correct specific gravity acid to the top of the perforated separator guard in one operation. The Temperature of the filling room, battery and acid should be maintained at between 15.5°C and 37.7°C (60°F and 100°F). If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

Freshening Charge (When Necessary)

After filling, allow to stand for 20 minutes and then re-check the specific gravity and temperature of the electrolyte in each cell. The battery is then ready for service, unless the above checks show the electrolyte temperature to have risen by more than 5.5°C (10°F), or the specific gravity to have fallen by more than 10 points – 0.010 S.G. In this event, it will be necessary to recharge the battery at the appropriate recharge rate, see the specification, until the specific gravity values remain constant for three successive hourly readings and all cells are gassing freely. During charging, keep the electrolyte in each cell level with the separator guard by adding distilled water – NOT ACID.

Removal and Refitment 8A-01-06

1. Remove the battery access panel.
2. Disconnect both battery terminals.
3. Remove the three wing nuts and washers securing the battery retainer and remove the retainer.

4a. Fig. 4. If a battery harness is fitted lift out the battery.

4b. For batteries without a harness it is necessary to make a sling by using two pieces of rope positioned beneath the battery.

5. Replace the battery in reverse procedure, ensuring that the terminal posts are free from corrosion, and before replacing the terminals, smear the posts with petroleum jelly.

DYNAMO

The dynamo is a shunt-wound two-pole two-brush non-ventilated machine, arranged to work in conjunction with a Lucas regulator unit. The output of the dynamo is controlled by the regulator unit and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the dynamo gives a high output, whereas if the battery is fully charged, the dynamo gives only sufficient output to keep the battery in good condition without any possibility of overcharging.

Dynamo Maintenance

Lubrication

Every 500 running hours or 6 months remove the neoprene plug and inject a few drops of high quality engine oil into the hole marked 'Oil' in the commutator-end bearing housing.

Inspection of Brushgear

At 1000 running hours or 1 year, the dynamo should be removed from the engine and the brushgear be inspected by a competent automobile electrican.

Belt Adjustment

Every 100 hours inspect the dynamo driving belt and, if necessary adjust to take up any undue slackness by turning the dynamo on its mounting. Care should be taken to avoid overtightening the belt, the tension needed being just enough to drive without slipping. See that the pulleys are properly aligned, otherwise undue strain will be thrown on the dynamo bearings.

To adjust the belt tension, slacken the bolts (1, Fig. 5) and swing the dynamo outward until there is 20 mm (¾ in) movement of the belt. Retighten the dynamo bolts (1).

Removal and Refitment 8A-02-06

Fig. 5

1. Remove the two wires from dynamo terminals.
2. Slacken the bolts (1) on the dynamo and swing the dynamo towards the engine.
3. Remove the fan belt.
4. Remove the bolts (1) and lift off the dynamo and the fan belt guard.
5. Replace in reverse sequence to above and adjust the fan belt to give a deflection of 20 mm (¾ in), midway between the fan pulley and the crankshaft pulley.

NOTE – SEE PERKINS WORKSHOP MANUAL FOR SERVICING DETAILS.

STARTER MOTOR

The starter motor is of similar construction to the dynamo except that heavier gauge conductors are used in the construction of the armature and field coils.

Removal and Refitment 8A-03-07

1. Fig. 6. Disconnect the wires at the starter motor relay, and the main lead to the battery.
2. Remove the bolts (2) securing the starter motor to the engine.
3. Pull the starter clear.
4. Replace in reverse sequence to above.

   NOTE – SEE PERKINS WORKSHOP MANUAL FOR SERVICING DETAILS.

CONTROL BOX

All settings are accurately adjusted before control boxes leave the factory and must not be disturbed unnecessarily. Any subsequent attention that may be required after the period of warranty has expired should only be carried out by a qualified automobile electrician. The control box is a sealed unit but the cover is pierced with two 12.7 mm (½ in) dia. holes for permitting screwdriver access to the voltage regulator and cut-out relay adjusting screws. The holes are plugged with a pair of linked rubber blanks which can be withdrawn when making voltage measurements and adjustments.

The control box frame is at generator potential and so, also, are the adjusting screws, since these pass through tapped holes in the frame. It is therefore advisable before making an adjustment to select a small screwdriver having an adequately insulated blade, and thus obviate short-circuiting of the generator in the event of the control box cover becoming earthed. If necessary, a piece of insulating tubing of suitable length and bore can be sleeved on to an otherwise uninsulated screwdriver blade.

CONTROL BOX SERVICING

CHARGING CIRCUIT

Preliminary Checking
Before disturbing any electrical adjustments, examine as follows to ensure that the fault does not lie outside the control box:

1. Check the battery by substitution or with an hydrometer and a heavy discharge tester.
2. Inspect the dynamo driving belt. This should be just taut enough to drive without slipping.
3. Check the dynamo by substitution, or by disconnecting the dynamo cables and linking large terminal 'D' to small terminal 'F' and connecting a 0-20 first-grade moving-coil voltmeter between this link and earth, and then running the dynamo up to about 1,000 rev/min when a rising voltage should be shown. If satisfactory, restore the generator connections.
4. Inspect the wiring of the charging circuit and carry out continuity tests.
5. Check earth connections, particularly of the control box.
6. In the event of reported undercharging, ascertain that this is not due to little running of the tractor or continuous use at idling speed.

VOLTAGE REGULATOR ELECTRICAL SETTING

Checking and Adjustment

Fig. 7
Checking and adjusting of the open-circuit voltage setting should be completed as rapidly as possible so as to avoid errors resulting from heating of the voltage regulator shunt coil.

1. Disconnect the cable from control box terminal 'A'.

   WARNING – DO NOT ALLOW THE END OF THE CABLE REMOVED TO CONTACT ANY EARTHED PARTS OF THE TRACTOR.

2. Remove the linked rubber blanks (1) from the control box cover.
3. Start the engine and drive the generator at about 3000 rev/min.
4. Using test prods, (2 & 3), measure the voltage between the exposed head of one of the adjusting screws and a good earth. This should be between the following limits, according to the ambient temperature:

Ambient Temperature	*Open-circuit Generator Voltage*
10°C. (50°F.)	16.1 – 16.7
20°C. (68°F.)	16.0 – 16.6
30°C. (86°F.)	15.9 – 16.5
40°C. (104°F.)	15.8 – 16.4

An unsteady reading may be due to the voltage regulator contacts requiring cleaning, in which event, remove the cover and clean the contacts, preferably using silicon carbide paper, followed by methylated spirits (denatured alcohol). If the reading is steady but occurs outside the appropriate limits, the voltage regulator must be re-adjusted. In this event, proceed as follows otherwise stop the engine, restore the original connections and refit the rubber blanks.

NOTE – WHEN VIEWED FROM THE DOMED EMBOSSED END OF THE COVER WITH RUBBER BLANKS UPPERMOST, THE LEFT HAND HOLE GIVES ACCESS TO THE VOLTAGE REGULATOR ADJUSTING SCREW AND THE RIGHT HAND HOLE TO THE CUT-OUT RELAY ADJUSTING SCREW.

5. Clip one of the voltmeter leads (of appropriate polarity) to a good earthing point.
6. Using a test prod, contact the other voltmeter lead against the exposed head of the cut-out relay adjusting screw (2).
7. Turn the voltage regulator adjusting screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct open circuit is obtained.
8. Check the setting by stopping the engine and then again raising the generator speed to 3000 rev/min.
9. Stop the engine, restore the original connections and refit the rubber blanks.

CUT-OUT RELAY ELECTRICAL SETTING

Checking and Adjustment
Checking and adjustment of the cut-in and drop-off voltage settings should be completed as rapidly as possible so as to avoid errors resulting from heating of the cut-out relay shunt coil. For this test remake the connection between control box terminal 'A' and its associated cable.

CUT-IN VOLTAGE

Testing

Figure 7
1. Disengage the linked rubber blanks from the control box cover.
2. Using test prods, measure the voltage between the exposed head of one of the adjusting screws and a good earth whilst the generator speed is slowly increased from zero.
3. Observe the voltmeter pointer, which should slowly rise and then drop back slightly at a reading between the limits 12.7 – 13.3 volts. The cut-in voltage is that reached immediately before the pointer drops back.
4. If the cut-in voltage occurs outside the limits 12.7 – 13.3 volts, adjust the cut-out relay in a manner similar to that described for adjusting the voltage regulator, turning the cut-out relay adjusting screw clockwise to raise the cut-in voltage, or anti-clockwise to lower it.
5. Re-check the setting by increasing the generator speed from zero.
6. Stop the engine, disconnect the voltmeter and refit the rubber blanks.

Key to Fig. 7
1. Linked Rubber Blanks
2. Screwdriver with Insulated Blade
3. Voltmeter Prod

Key to Fig. 8
1. Voltage Regulator Adjusting Screw
2. Cut-out Relay Adjusting Screw
3. Fixed Contact Blade
4. Cut-out Relay Armature

TESTING DROP-OFF VOLTAGE

1. Disconnect the cable from control box terminal 'A'.

   WARNING – DO NOT ALLOW THE END OF THE DISCONNECTED CABLE TO CONTACT ANY EARTHED PARTS OF THE TRACTOR.

2. Connect the voltmeter between control box terminal 'A' and a good earthing point.
3. Start the engine and drive the generator at about 3000 rev/min.
4. Observe the voltmeter pointer, while slowly decelerating the engine. Opening of the cut-out relay contacts, indicated by the voltmeter pointer dropping to zero, should occur between the limits 8.5 – 11.0 volts. If the drop-off voltage occurs outside these limits, remove the control box cover and adjust the contact pressure, otherwise, stop the engine and restore the original connections.
5. Stop the engine, remove and disconnect the control box.
6. Remove the control box cover, secured to the base by a rolled-over edge.
7. Bend carefully the fixed contact blade towards the cut-off relay armature to reduce the drop-off voltage or away from the armature to raise the voltage.
8. Re-check the setting and, if necessary, re-adjust until the correct drop-off voltage is obtained.
9. Refit the control box cover, bending back the rolled-over edge into its former position round the base.
10. Restore original connections.

CLEANING CUT-OUT RELAY CONTACTS

Only strips of fine glass paper must be used to clean the cut-out relay contacts. Carborundum stone, emery cloth or silicon carbide paper must never be used. The use of fine glass paper should be followed by methylated spirits (de-natured alcohol).

CONTROL BOX

Removal and Replacement 8A-04-08

1. Remove the lower instrument panel as stated in Part 2B.
2. Fig. 9. Disconnect the wire from the terminals.
3. Remove the two nuts securing the control box to the mounting bracket.
4. Remove the control box.
5. Assemble in the reverse sequence, connecting the wires as shown in Fig. 2.

STARTER SWITCH

The starter switch is actuated by a key and is only effective when the dual range gear is placed in the neutral "S" position. The switch has a spring-loaded action which holds the key in the "O" position normally. To start the tractor in normal conditions turn the key clockwise to the "S" position. In cold weather the key should be turned to the "H" and then the "HS" position to ensure easy starting. For detailed starting instructions, see the Operator Instruction Book.

STARTER SWITCH

Removal and Replacement 8A-05-08

1. Remove the nut and the instruction plate on the front of the starter switch.
2. Pull the switch through to the back of the instrument panel.
3. Disconnect the wires.
4. Replace in the reverse order, attaching the wires as shown in Fig. 2.

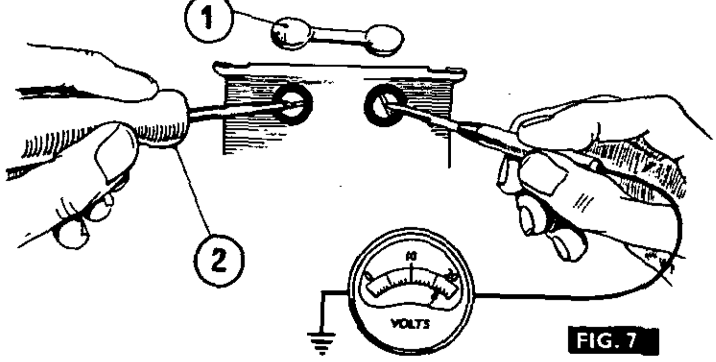

FIG. 7

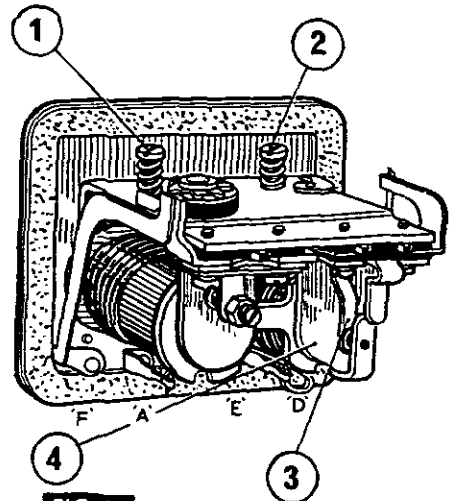

FIG. 8

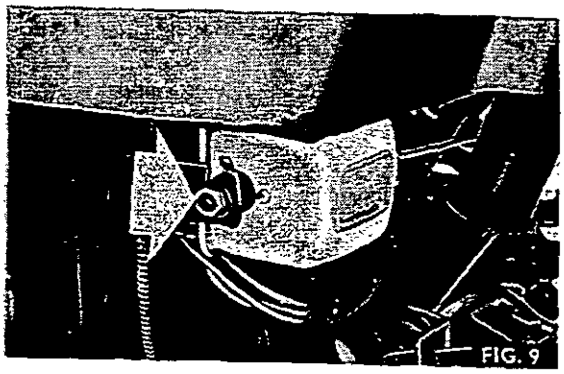

FIG. 9

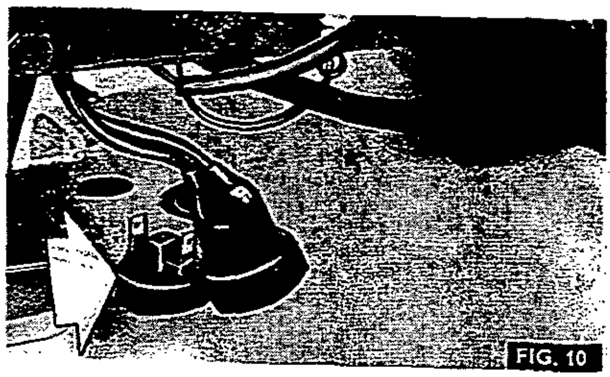

FIG. 10

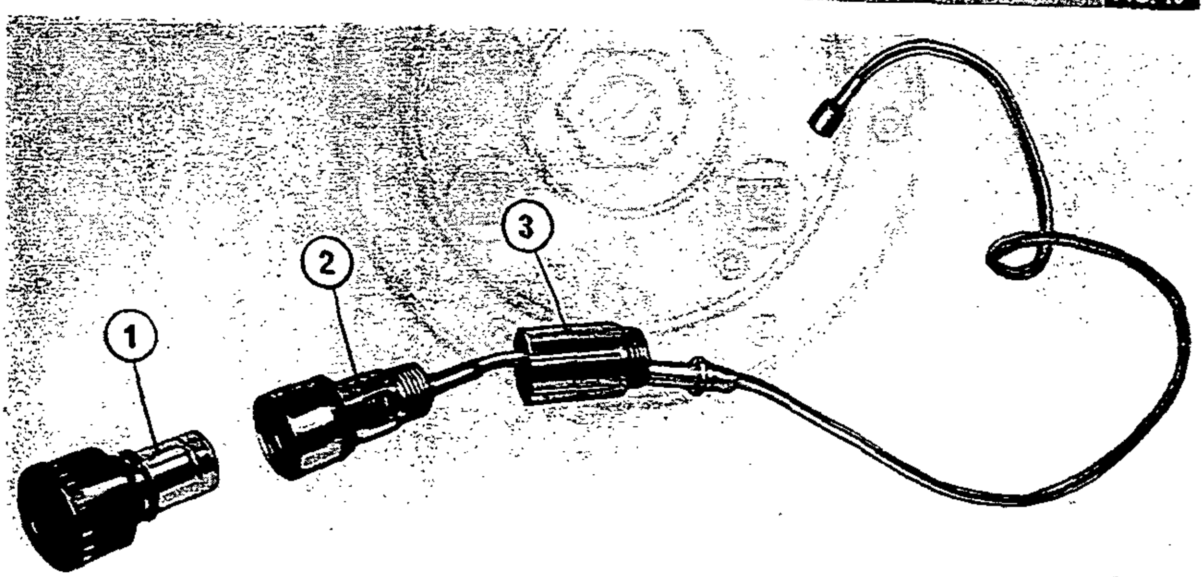

FIG. 11

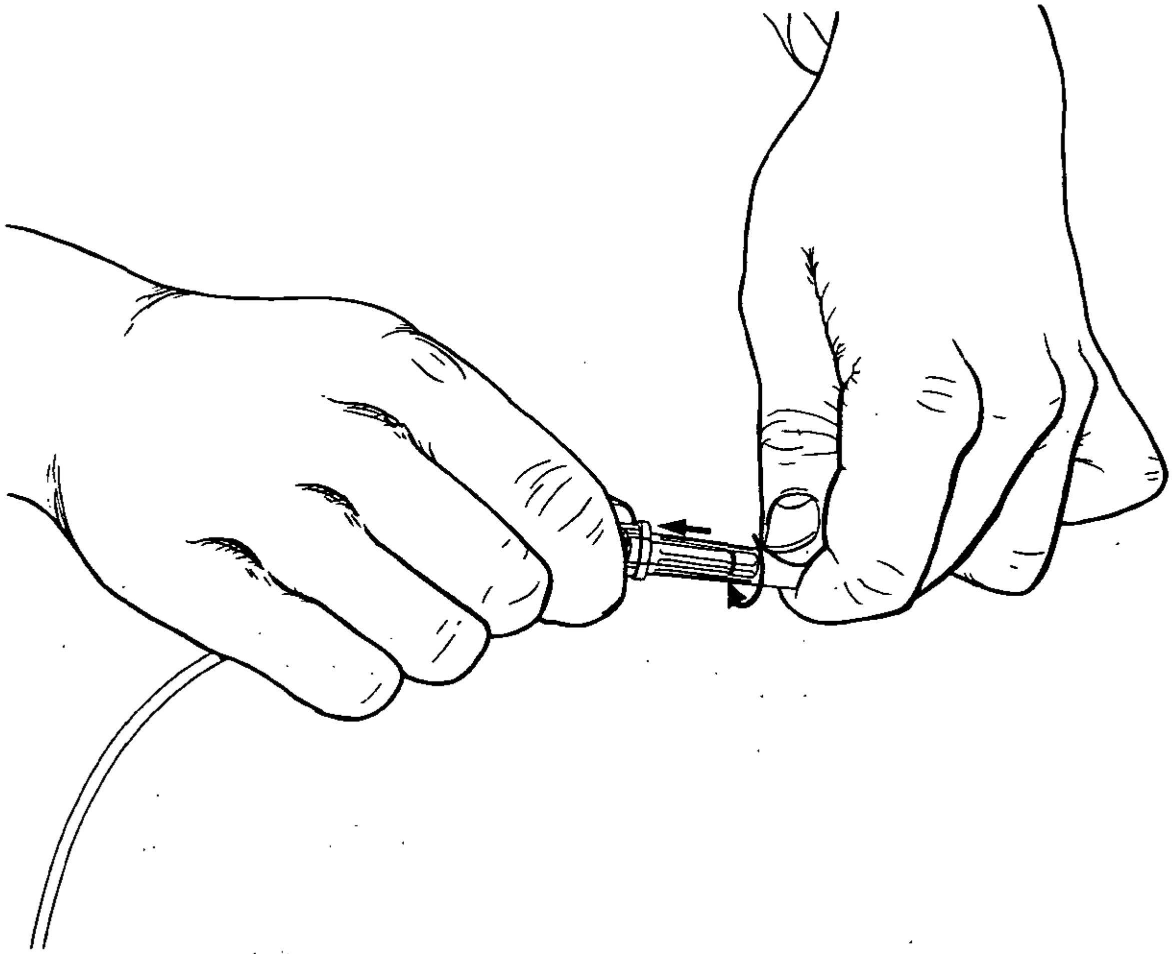

FIG. 12

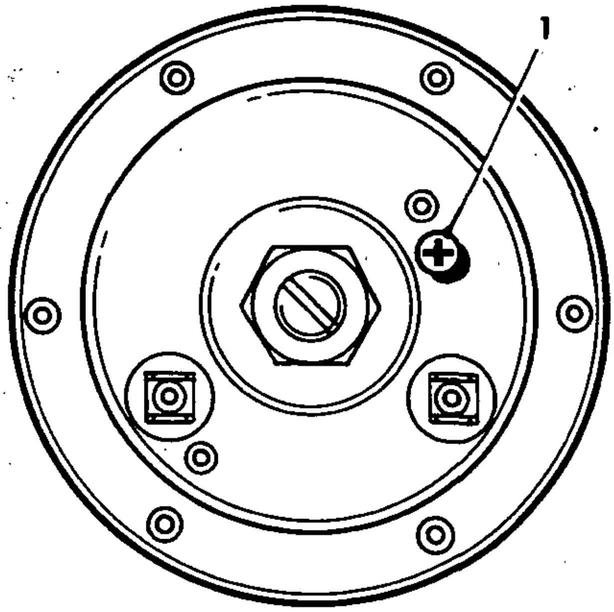

FIG. 13

NEUTRAL SAFETY START SWITCH

This switch prevents the tractor engine from being started when in gear. Engagement of either HIGH or LOW range breaks the starter switch circuit, thus preventing the starter solenoid becoming engaged.

NEUTAL SAFETY SWITCH

Removal and Replacement 8A-06-11

1. Fig. 10. Lift up the rubber cover and disconnect the two wires at the switch.
2. Unscrew the neutral safety switch.
3. Replace in the reverse sequence.

CIGARETTE LIGHTER (Optional Extra)

Fitting Instructions 8A-07-11

The cigarette lighter is available as an optional extra and is fitted as follows:

1. Remove the battery access panel.
2. Remove the rubber plug from the lighter hole.
3. Fig. 11. Pull the lighter unit (1) from the centre piece (2).
4. Unscrew the outer cover (3) from the lighter (2).
5. Place the centre of the lighter (2) through the hole in the instrument panel from the top.
6. Screw the outer cover (3) onto the centre piece (2) under the instrument panel
7. Connect up the wire to the live side of the ammeter on tractors without lights, and the feed terminal on the light switch for tractors with lights.

FUSES

Removal and Replacement 8A-08-11

Access to the fuses is gained by removing the battery access panel.

1. Remove the battery access panel.
2. Fig. 12. Holding both ends of the fuse casing, push the top of the fuse in and turn in an anti-clockwise direction as shown.
3. Pull the top of the casing clear and tip out the fuse.
4. Replace the new fuse, of the same capacity, in the reverse sequence to above.

WIRING HARNESS

Removal and Refitment 8A-09-11

1. Remove the battery access panel and disconnect the battery.
2. Disconnect the following wires:
   (a) Three at the fuel gauge
   (b) Four at the ammeter
   (c) Three at the starter switch
   (d) Four at the control box
   (e) Two at the neutral safety switch
   (f) Two at the starter motor
   (g) Two at the dynamo
   (h) One at the thermostart
   (j) Two at the fuel gauge sender unit
   (k) Two earth wires bolted to the battery carrier.
3. Remove the rubber clip securing the harness to the oil pipe adjacent to the dynamo.
4. Carefully pull the harness clear of the tractor.
5. Refit the harness to the tractor, threading it underneath the battery carrier and reconnect the wires as shown in Fig. 2.

HORN

Before being passed out of Works, every horn is adjusted to give its best performance. It should require no further attention until it has given a long period of service.

If the horn fails to sound or its performance becomes uncertain, the fault will not necessarily be in the horn. First see that the trouble is not due to such defects as a loose or broken connection in the wiring of the horn circuit or to a discharged battery. A short circuit in the horn wiring will cause the fuse (when fitted) to blow. In this event, examine the wiring for the fault and rectify accordingly, before renewing the fuse.

Poor performance can also be caused by loosening of the fixing bolts. Check and tighten as necessary.

If examination shows the above points to be in order the horn may need adjustment but this should not become necessary until the horn has been in service for a long period.

HORN ADJUSTMENT (Fig. 13)

Adjustment does not alter the pitch of the note but merely takes up wear of moving parts. While adjusting, short out the fuse (if fitted), otherwise it may blow. If the horn does not sound after making an adjustment, release the horn push instantly.

A small serrated adjustment screw is provided on that side of the horn at which the cables terminate. Turn this screw anti-clockwise until the horn just fails to sound, then turn it back for about one quarter of a turn.

WARNING – THE CENTRAL SLOTTED STEM AND LOCKING NUT MUST NOT BE DISTRUBED.

A model 6H horn in correct adjustment will pass 2.75 – 3.25 amperes (12 volt) – measured on a first grade moving coil 0-10A ammeter. If a suitable instrument is available, connect it in series with the horn and turn the adjustment screw clockwise to increase the current, or anti-clockwise to decrease it. (When adjusting the horn by the aid of an ammeter, the aim is to obtain the best performance with the lease current).

INSTRUMENTS AND INSTRUMENT PANEL

Part 8 Section B

Table of Contents

GENERAL

Tractormeter (1, Fig. 1 and Fig. 2a and 2b)
The tractormeter is a multi-purpose instrument which indicates engine rev/min, miles or kilometres per hour and equivalent engine running hours on one dial. The layout of this dial is as follows:

1. The top outer set of figures and graduations indicate the engine speed in rev/min.
2. The top inner set of figures and graduations are sub-divided into bands and indicate the tractor ground speed in high range, 5th, 6th, 7th and 8th gear respectively (8 speed transmission Fig. 2a) or high range, high ratio 4th, 5th and 6th gear (Multi-Power transmission Fig. 2b), working form the inner band outwards.
3. The lower set of figures gives ground speeds for low range 1st, 2nd, 3rd and 4th gears respectively. (8 speed transmission), or low range, high ratio, 1st, 2nd and 3rd gears respectively (Multi-Power transmission), working from the inner band outwards.
4. The rectangular aperture in the lower centre of the dial shows the readings on an odometer which is geared to register one unit for every hour of work that the tractor engine performs at approximately 1500 rev/min. If the engine speed is higher or lower, units will be registered more quickly or slowly respectively. This hour recorder gives a more accurate guide to tractor usage than would a mileage recorder, because some tractors supply power whilst stationary. The tractormeter also has markings to show normal speeds of belt pulley and p.t.o.

Ammeter *(2, Fig. 1)*
The ammeter indicates whether the battery is being charged, or is discharging. If a heavy discharge is indicated the battery will lose power and starting will become difficult, or impossible.

Fuel Gauge (3, Fig. 1)
The fuel gauge indicates the quantity of fuel in the tank as a fraction of the tank capacity, not in gallons, or litres.

Temperature Gauge (4, Fig. 1)
The temperature gauge indicates the temperature of the coolant in the radiator and engine. NOT the quantity of coolant in the system. GREEN indicates normal operating temperature.

Oil Pressure Gauge (5, Fig. 1)
This gauge indicates the state of the engine oil pressure, and does NOT give an indication of the quantity of oil in the engine. The normal operating pressure is in the GREEN sector of the dial.

Air Cleaner Service Indicator (6, Fig. 1)
This indicator shows RED when the dry air cleaner requires attention. To reset the indicator, press the button on the top of the body.

INSTRUMENT PANEL ASSEMBLY

Removal and Refitment 8B-01-02
Special Tools Required: MF 268 Steering Wheel Remover

Removal
1. Remove the three bolts each side securing the hood to the instrument panel and detach the lower instrument panel from the upper panel.
2. Remove the two bolts securing the instrument panel to the steering column.
3. Remove the battery access panel and disconnect the following wires;
   Two leads from the battery.
   Four wires from the starter switch.
   Two wires from the fuel gauge.
   Four wires from the light switch (if fitted).
   Two wires from the horn switch (if fitted).
4. Disconnect the oil pressure gauge pipe at the gauge.
5. Press the ammeter through the instrument panel.
6. Disconnect the tractormeter drive cable at the tractormeter.
7. Remove the temperature gauge bulb from the engine and release the tube back to the instrument panel.
8. Remove the steering wheel as stated in Part 6A and then remove the grease nipple, felt washer, cover and rubber collar from the steering column.
9. Remove the split pin and washer securing the Multi-Power control rod to the lever (if fitted).
10. Remove the clip securing the rod to the hand throttle lever, and then remove the two bolts, nuts and washers securing the hand throttle lever bracket to the battery carrier.
11. Figs. 3 and 4. Manoeuvre the instrument panel over the steering column and clear of the tractor, then if necessary, remove the hand throttle lever and the instruments.

Refitment
1. If necessary refit the instruments and the hand throttle lever to the instrument panel.
2. Place the instrument panel over the steering column and secure it to the steering column with the two bolts.
3. Secure the hand throttle lever bracket to the battery carrier with two bolts, washers and nuts and then reconnect the rod to the hand throttle lever and secure with the clip.
4. Reconnect the Multi-Power lever (if fitted) to its linkage using a new split pin.
5. Refit the rubber collar, cover, felt washer and grease nipple to the steering column, then refit the steering wheel as stated in Part 6A.
6. Reconnect the temperature gauge to the engine.
7. Reconnect the tractormeter drive cable to the tractormeter.
8. Reposition the ammeter in its rubber housing in the instrument panel
9. Reconnect the oil pressure gauge pipe to the gauge.
10. Reconnect the following wires;
    Two wires to the fuel gauge.
    Four wires to the starter switch.
    Four wires to the light switch (if fitted).
    Two wires to the horn switch (if fitted).
    Two leads to the battery.
11. Secure the instrument panel to the hood with three bolts each side and then refit the battery access panel.

TRACTORMETER

Removal and Replacement 8B-02-02

Removal
1. Remove the battery access panel.
2. Fig. 5. Disconnect the tractormeter drive cable from the back of the tractormeter.
3. Remove the two nuts and washers securing the tractormeter to the bracket beneath the instrument panel, then push the tractormeter upwards out of the panel.

Replacement
1. Fit the new tractormeter to the instrument panel and secure it with the two nuts, spring washers and bracket.
2. Reconnect the tractormeter drive cable to the tractormeter.
3. Refit the battery access panel.

Drive Cable Removal and Replacement 8B-03-02

Removal
1. Remove the battery access panel.
2. Disconnect the tractormeter drive cable from the rear end of the engine.
3. Disconnect the drive cable from the back of the tractormeter.
4. Withdraw the cable from the battery carrier.

Replacement
1. Feed the new cable through the battery carrier and connect it to the tractormeter.
2. Connect the drive cable to the engine.
3. Refit the battery access panel.

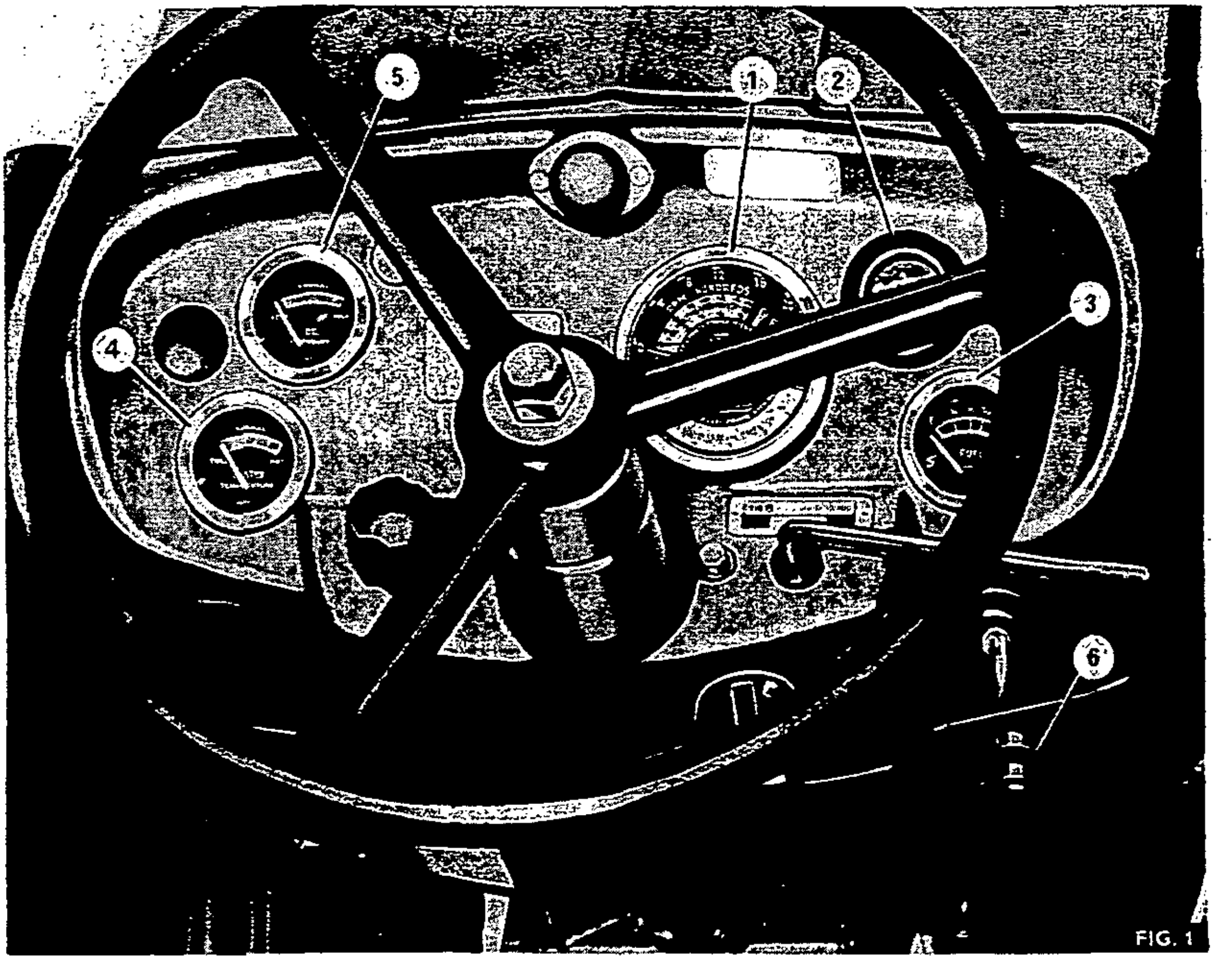

FIG. 1

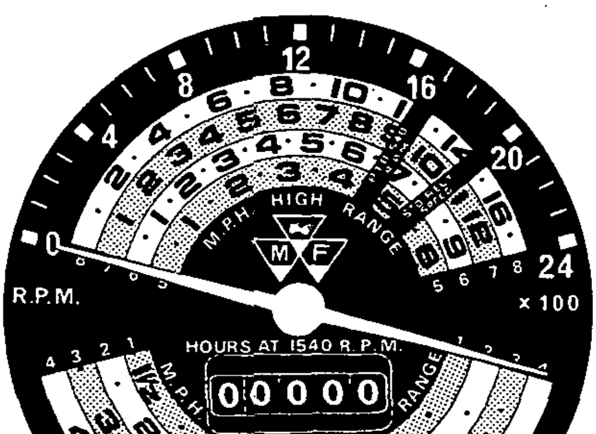

FIG. 2a

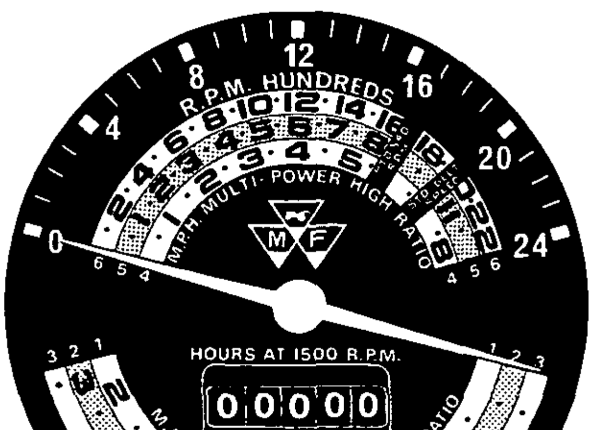

FIG. 2b

FIG. 3

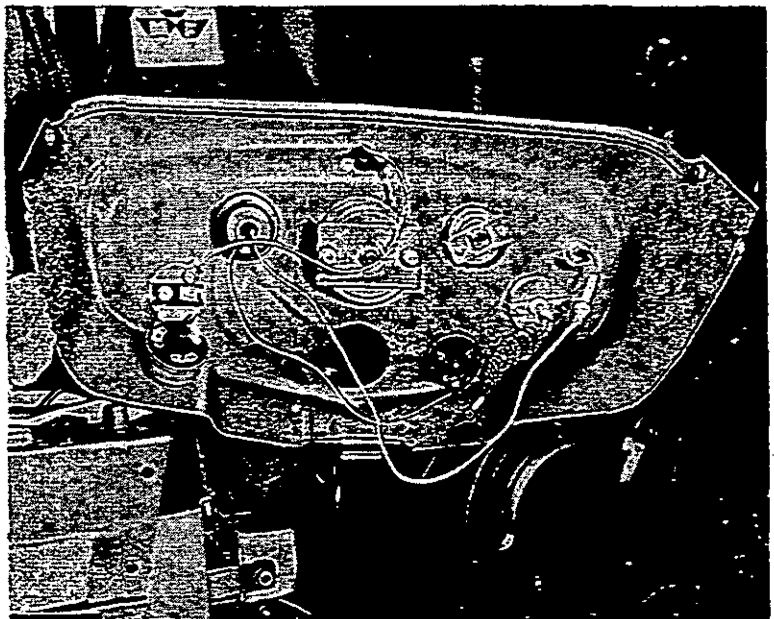

FIG. 4

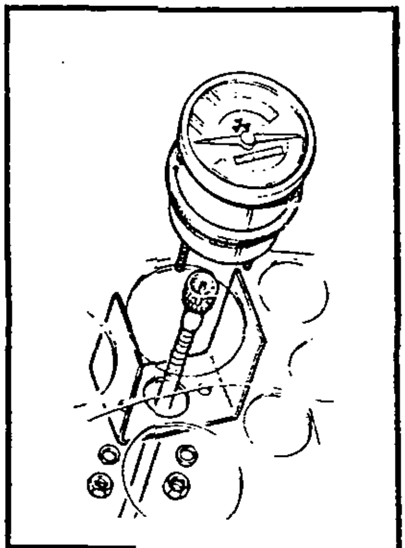

FIG. 5

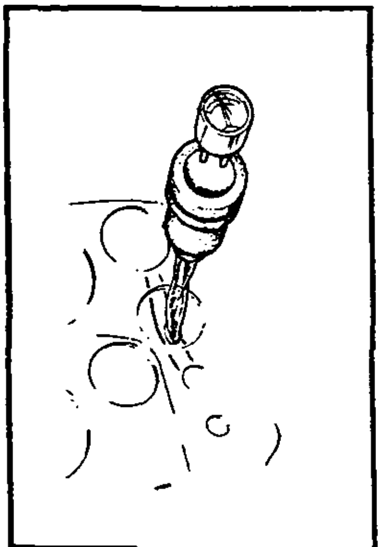

FIG. 6

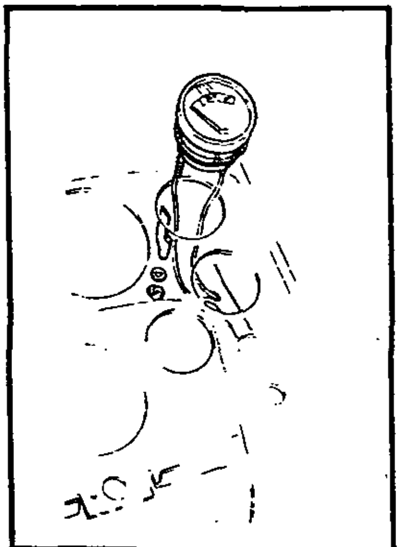

FIG. 7

FIG. 8

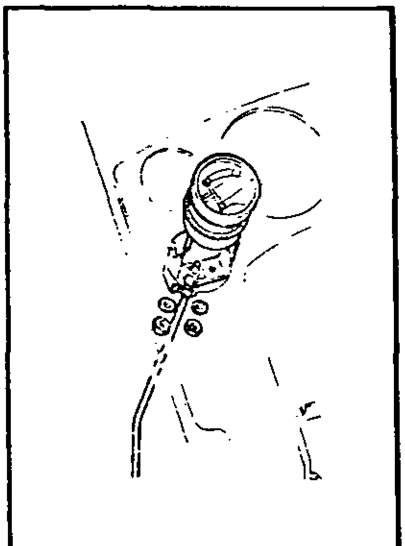

FIG. 9

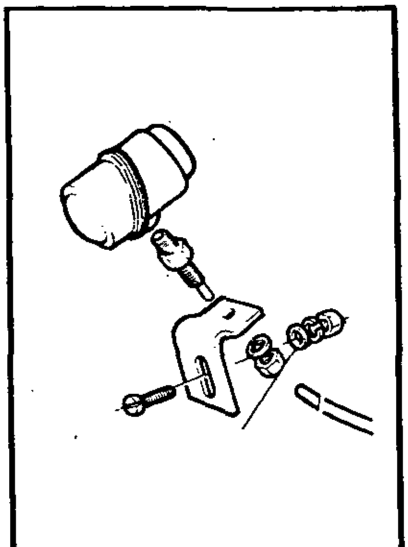

FIG. 10

AMMETER

Removal and Replacement 8B-04-05

Removal
1. Remove the battery access panel.
2. Fig. 6. Push the ammeter up through the instrument panel.
3. Roll back the rubber sleeve on the ammeter.
4. Disconnect the wires from the back of the ammeter.

Replacement
1. Connect the wiring to the new ammeter (see the wiring diagram in Part 8A).
2. Fit the ammeter into the rubber sleeve, then feed the sleeve into the instrument panel. Fully locate the sleeve in the instrument panel.
3. Refit the battery access panel.

FUEL GAUGE

Removal and Replacement 8B-05-05

Removal
1. Remove the battery access panel.
2. Fig. 7. Disconnect the two wires from the back of the fuel gauge.
3. Remove the two knurled nuts and washers securing the fuel gauge to the bracket and remove the bracket.
4. Push the fuel gauge upwards through the instrument panel.

Replacement
1. Push the fuel gauge downwards into the instrument panel.
2. Secure the gauge with the bracket, two spring washers and nuts.
3. Connect the two wires to the back of the fuel gauge.
4. Refit the battery access panel.

TEMPERATURE GAUGE

Removal and Replacement 8B-05-05

Removal
1. Remove the temperature gauge bulb from the engine and release the tube back to the instrument panel.
2. Remove the battery access panel.
3. Fig. 8. Remove the two nuts and spring washers securing the gauge to the bracket.
4. Push the gauge upwards through the instrument panel and remove complete with tube.

Replacement
1. Push the tube and gauge downwards into the instrument panel.
2. Secure the gauge with the bracket, two spring washers and nuts.
3. Connect the temperature gauge bulb to the engine.
4. Refit the battery access panel.

OIL PRESSURE GAUGE

Removal and Replacement 8B-07-05

Removal
1. Remove the battery access panel.
2. Fig. 9. Disconnect the oil pressure pipe from the rear of the gauge.
3. Remove the two nuts and spring washers securing the gauge to the bracket.
4. Push the gauge upwards through the instrument panel.

Replacement
1. Push the gauge downwards into the instrument panel.
2. Refit the two spring washers and nuts to secure the gauge to the bracket.
3. Reconnect the oil pressure pipe to the rear of the gauge.
4. Refit the battery access panel.

Pipe Removal and Replacement 8B-08-05

Removal
1. Remove the battery access panel.
2. Disconnect the oil pressure pipe from the rear of the gauge.
3. Disconnect the oil pressure pipe from the engine.
4. Pull the oil pressure pipe out through the battery carrier.

Replacement
1. Feed the new oil pressure pipe into position through the battery carrier.
2. Connect the oil pressure pipe to the engine.
3. Connect the oil pressure pipe to the rear of the gauge.
4. Refit the battery access panel.

AIR CLEANER INDICATOR

Removal and Replacement 8B-09-05

Removal
1. Remove the battery access panel.
2. Fig. 10. Disconnect the tube, from the air cleaner to the indicator, at the indicator adapter.
3. Remove the screw, nut and washers securing the indicator mounting bracket to the lower instrument panel and remove the indicator complete with the bracket.
4. Remove the nut and washer securing the adapter to the bracket and then remove the adapter from the indicator.

Replacement
1. Fit the adapter to the indicator and secure the adapter to the mounting bracket with the nut and spring washers.
2. Place the indicator in position on the lower instrument panel and secure with the screw, washer and nut.
3. Connect the tube to the indicator adapter and refit the battery access panel.

3-A-152 DIESEL ENGINE

No. of Cylinders	3.
Bore	3.6" (91.44 mm.)
Stroke	5" (127 mm.)
Cubic Capacity	152.7 cu. ins. (2,502 c.c.)
Compression Ratio	17.4 : 1.
Firing Order	1, 2, 3.
Brake H.P. (Bare Engine) ...	37. *
Belt H.P.	
Equivalent Crankshaft Torque ...	

*Subject to official confirmation

TIGHTENING TORQUES

Cylinder Head Nuts	55 - 60 lbs. ft. (7.60 - 8.29 Kg. m.)
Connecting Rod Nuts	*70 - 80 lbs. ft. (9.68 -11.06 Kg. m.)*
Main Bearing Setscrews	110 -120 lbs. ft. (15.21 -16.59 Kg. m.)
Flywheel Setscrews	75 lbs. ft. (10.37 Kg. m.)
Balance Weight Setscrews ...	*50 - 55 lbs. ft. (6.91 - 7.60 Kg. m.)*
Nozzle Cap Nuts	50 lbs. ft. (6.91 Kg. m.)

DIMENSIONS AND TOLERANCES

Component Details	Dimensions New		Clearances New		Remarks
	Ins.	mm.	Ins.	mm.	
Main Bearings					
Housing Bores	2.9165 2.9175	74.079 74.104			
Main Bearing Bore ... ... (*Ref. only*)	2.75126 2.75276	69.8819 69.920			
Crankshaft Clearance ...			.00226 .00426	.05730 .11810	Measured assembled.
Crankshaft					
Main Journal Dia.	2.7490 2.7485	69.824 69.811			
Crankshaft Endfloat					
Rear Main Width	1.87725 1.87425	47.682 47.6059			
Crank Endfloat			.002 .011	.0508 .279	

Component Details	Dimensions New Ins.	Dimensions New mm.	Clearances New Ins.	Clearances New mm.	Remarks
Thrust Washer Thickness ...	.123	3.124			
(Top and Bottom) ...	.125	3.175			
Thrust Washer Dia. ...	3.552	90.220			
(Top and Bottom) ...	3.562	90.475			
			.002	.0508	
			—.020	—.508	
Cylinder Block Recess for	3.572	90.729			
Thrust Washer	3.564	90.526			
Dowel—Main Bearing Cap	.750	19.050			
Diameter	.751	19.075			
			—.0015.	—.038	
			÷.00075	÷.019	
Cylinder Block Bore for	.75075	19.069			
Dowel	.7495	19.037			
Big End					
Crankpin Diameter	2.249	57.125			
	2.2485	57.112			
			.00325	.0825	
			.00175	.0444	
Bearing Bore	2.25175	57.1944			
	2.25075	57.1690			
Conn. Rod Bore	2.3955	60.846			
	2.3950	60.833			
Conn. Rod Big End Width ...	1.5525	39.434			
	1.5502	39.375			
Big End Endfloat			.0095	.2413	
			.0148	.3759	
Crankpin Width	1.565	39.751			
	1.562	39.674			
Small End					
Small End Bore	1.37475	34.918			
	1.37620	34.955			
			—.00525	—.1333	
			—.0023	—.0584	
Small End Bush	1.3785	35.014			
(External Dia.)	1.3800	35.052			
Small End Bush	1.2505	31.763			
(Internal Dia.)	1.2515	31.788			
			.0005	.0127	
			.00175	.0444	
Gudgeon Pin Dia.	1.250	31.75			
	1.24975	31.743			
			—.0005	—.0127	
			—.00025	—.0063	
Gudgeon Pin Holes in Piston	1.250	31.75			
	1.2495	31.737			

Component Details	Dimensions New Ins.	Dimensions New mm.	Clearances New Ins.	Clearances New mm.	Remarks
Rod Alignment between Big end Small-end bores with small-end bush fitted.	At 5" Centres (127 mm.)		±.005" (.127 mm.)		Measured on each side of axis of rod on test mandrel.
Cylinder Block and Liners					
Cylinder Block Bore ...	3.6875 3.6885	93.662 93.687			
			+.001 —.001	+.0254 —.0254	
Liner	3.6885 3.6875	93.687 93.662			
Top Flange of Liner ... ... (Thickness)	.045 .040	1.143 1.016			
			.001 .009	.0254 .2286	Below block top face.
Recess for Top Flange of Liner	.046 .049	1.1684 1.2446			
Liner—Top Dia. (Flange) ...	3.810 3.805	96.774 96.647			
			.005 .015	.127 .381	
Cylinder Block—Top Bore for Liner	3.815 3.820	96.901 97.028			
Total Height of Cyl. Block ...	13.7445 13.7395	349.110 348.983			
Pistons and Sleeves					
Liner Bore	3.6015 3.6025	91.478 91.503			
Ring Groove Width ... (Top, 2nd and 3rd)	.0957 .0967	2.4307 2.4561			Three compression and one scraper fitted above the gudgeon pin and one scraper fitted below.
			.0019 .0039	.0482 .099	
Compression Ring Width ... (Top, 2nd and 3rd) ...	.0938 .0928	2.382 2.357			
Scraper Ring Groove Width	.252 .253	6.400 6.426			
			.002 .004	.0508 .1016	
Scraper Ring Width ...	.250 .249	6.35 6.324			
Fitted Gaps—Rings, Compression and Scraper ...	.009 .013	.2286 .3302			
Camshaft					
Journal Dia. (No. 1) Front ...	1.870 1.869	47.498 47.472			
			.004 .008	.1016 .2032	
Housing Bore (No. 1) Front	1.877 1.874	47.675 47.599			

Component Details	Dimensions New Ins.	Dimensions New mm.	Clearances New Ins.	Clearances New mm.	Remarks
Journal Dia. (No. 2) Centre	1.860 1.859	47.244 47.218			
			.004 .008	.1016 .2032	
Housing Bore (No. 2) Centre	1.867 1.864	47.421 47.345			
Journal Dia. (No. 3) Rear ...	1.840 1.839	46.736 46.710			
			.004 .008	.1016 .2032	
Housing Bore (No. 3) Rear ...	1.847 1.844	46.913 46.837			
Camshaft Spigot Dia. ...	1.9995 1.9985	50.787 50.761			
			.0000 .0025	.0000 .0635	
Camshaft Gear Bore... ...	2.001 1.9995	50.825 50.787			
Camshaft Endfloat					Controlled by leaf spring affixed at rear of timing case front cover.
Cam Lift	.3085 .3165	7.836 8.039			
Tappets and Valves					
Bore in Head	.62575 .6245	15.894 15.862			
			.00075 .0035	.019 .088	
Tappet Stem Dia.	.62375 .62225	15.843 15.805			
Valve Tip Clearance					
Inlet (Cold)			.012	.3048	
Exhaust (Cold)			.012	.3048	
Valve Stem Dia. ... ... (Inlet and Exhaust) ...	.311 .312	7.899 7.924			
			.002 .0045	.0508 .1143	
Valve Guide Bore ... ... (Inlet and Exhaust) ...	.3155 .3140	8.013 7.975			
Valve Guide—Outside Dia....	.501 .5005	12.725 12.712			
			.0000 .0015	.0000 .0381	
Cylinder Head Hole for Guide	.5005 .4995	12.712 12.688			
Valve Head (Inlet and Exhaust) Clearance below Cylinder Head Face (New)	.070	1.778			Not to exceed .140" (3.556 mm.) after regrinding.

Component Details	Dimensions New Ins.	Dimensions New mm.	Clearances New Ins.	Clearances New mm.	Remarks
Valve Head Dia.					
Inlet	1.536 1.532	39.014 38.913			
Exhaust	1.317 1.313	33.452 33.350			
Guide Projection above Spring Seat—					
Inlet	.59375	15.081			
Exhaust	.59275	15.056			
Valve Seating Angle on Valve Head	90° inclusive				
Valve Seat Angle on New Cylinder Head	88° inclusive				
Valve Springs					
Fitted Length: Inner ...	1.1875	30.162			Free Length: Inner 1.365" (34.671 mm.) 1.405" (35.687 mm.)
Outer ...	1.5	38.100			Outer 1.803" (45.796 mm.) 1.783" (45.289 mm.)
Fitted Load: Inner ...	8 lb. ± 1 lb.	3.629 ± .454 kg.			
Outer ...	22.75 ± 2 lb.	10.319 ± .907 kg.			
Full Lift Load:	Inlet				Outlet
Inner ...	23 ± 2 lb.	10.433 ± .907 kg.			23 ± 2 lb. 10.433 ± .907 kg.
Outer ...	50 ± 2 lb.	22.68 ± .907 kg.			50 ± 2 lb. 22.68 ± .907 kg.
Rocker Shaft Dia.	.62375 .62225	15.843 15.805			
			.00075 .0035	.019 .088	
Bush Rocker Lever Bore ...	.6245 .62575	15.862 15.894			
Timing Gear					
Crankshaft Dia. for Gear ...	1.5005 1.500	38.1127 38.100			
			—.001 +.001	—.0254 +.0254	
Crankshaft Gear Bore ...	1.501 1.4995	38.1254 38.087			
Crankshaft Dia. for Crank Pulley	1.5005 1.500	38.1127 38.100			
			.00025 .00175	.00635 .04445	
Crankshaft Pulley	1.50175 1.50075	38.1444 38.119			
Pulley—Crankshaft Seal Dia.	2.255 2.250	57.277 57.15			

Component Details	Dimensions New Ins.	Dimensions New mm.	Clearances New Ins.	Clearances New mm.	Remarks
Crankshaft—Rear Seal Dia....	2.800 2.799	71.12 71.0946			
Idler Gear Hub Dia. ...	2.1238 2.123	53.944 53.924			
			.0012 .0036	.0304 .0913	
Idler Gear Bore	2.125 2.1266	53.975 54.016			
Idler Gear Hub Width ...	1.3275 1.3325	33.718 33.845			
Idler Gear Endfloat			.005 .015	.127 .381	
Idler Gear Width	1.3225 1.3175	33.591 33.464			
Idler Gear Hub Dia. ...	.8745 .8737	22.212 22.191			
			.000 .002	.000 .508	
Cylinder Block Bore ...	.87575 .8745	22.244 22.212			
Idler Retaining Plate Thickness	.140 .110	3.556 2.794			
Water Pump					
Shaft Diameter	.6267 .6262	15.918 15.905			
			—.0028 —.0015	—.0711 —.0381	
Pulley Bore	.6239 .6247	15.847 15.867			
Shaft Diameter	.6267 .6262	15.918 15.905			
			—.0017 —.00045	—.0431 —.0114	
Impeller	.62575 .6250	15.894 15.875			
Shaft Bearing Dia.	1.1811 1.1806	29.999 29.987			
			—.0011 —.0001	—.02794 —.00254	
Body-Bore for Bearing ...	1.1800 1.1805	29.972 29.984			
Fuel Pump Drive					
Gear Bore	1.750 1.751	44.45 44.475			
			.003 .0012	.0762 .0304	
Hub Gear Dia.	1.7488 1.7480	44.419 44.399			

Component Details	Dimensions New Ins.	Dimensions New mm.	Clearances New Ins.	Clearances New mm.	Remarks
Lubricating Oil Pump					
Idler Gear Bore	.750	19.050			
	.751	19.075			
			—.0032	—.0762	
			—.0012	—.0304	
Idler Gear Bush—Outside Dia.	.7532	19.131			
	.7522	19.105			
Idler Gear Bush—Inside Dia.	.6572	16.692			
	.6562	16.667			
			.00085	.0215	
			.00245	.0622	
Shaft—Idler	.65535	16.645			
	.65475	16.630			
			—.00185	—.064	
			—.00025	—.00635	
Pump Body Bore	.6545	16.624			
	.6535	16.598			
Endfloat of Idler on Hub ...			.013	.330	
			.004	.1016	
Oil Pump Driver Gear Bore	.4964	12.608			
	.4972	12.628			
			—.0021	—.0533	
			—.0008	—.0203	
Oil Pump Drive Shaft ...	.4985	12.661			
	.4980	12.649			
			.003	.0762	
			.0015	.0381	
Housing Bore—Oil Pump ...	.501	12.725			
	.500	12.700			
Housing—Rotor Pocket	.751	19.075			
Depth	.750	19.050			
Housing—Rotor Pocket Dia.	1.603	40.716			
	1.604	40.741			
Driver Gear Boss Thickness	.515	13.081			
	.485	12.319			

3A-152 DIESEL ENGINE

THE 3A-152 ENGINE (Refer Figure 1)

The 3A-152 diesel engine is, as its numerical *identification suggests*, a 3-cylinder unit with a capacity of 152 cub. ins. (2·5 litres). This engine, by virtue of its combustion chamber design and nozzle location, combines the advantages of direct and indirect injection types.

This section is concerned with engine removal, overhaul and re-installation and, where applicable, includes reference to special toolage recommendations. Note that reference is made exclusively to the basic engine only, as the various components of the cooling, electrical and fuel systems are dealt with elsewhere in this Manual.

An important and often neglected aspect of engine reclamation work is the necessity for absolute cleanliness. Many cases of unsatisfactory performance and short engine life, following reconditioning, can be directly attributed to inadequate attention to cleanliness.

It is considered prudent to mention that the continued use of an engine due for overhaul can be neither satisfactory nor economic, and cannot justify the increasing risk of total failure and additional repair charges.

The repair instructions covered within this section assume that the engine has been removed from the tractor.

Reference to left and right hand should be interpreted as seen from the driving seat.

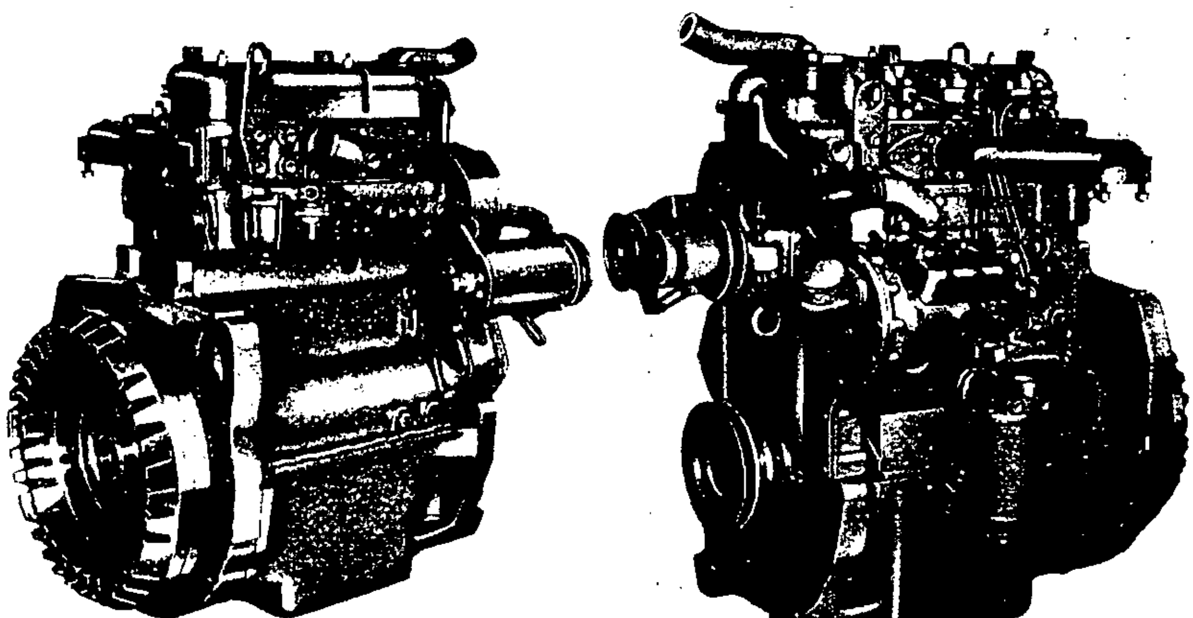

FIGURE 1
GENERAL VIEWS OF 3A-152 ENGINE

REMOVING THE ENGINE

Drain off water from radiator and cylinder block.

Remove hood and cowl assembly.

Disconnect and remove batteries.

Remove fuel tank.

Remove radiator.

Disconnect fuel supply lines to engine.

Disconnect throttle and stop control links.

Disconnect starter motor and generator connections.

Remove starter motor.

Disconnect steering drag links to left and right hand track arms.

Apply parking brake and chock rear wheels.

Support engine and gearbox.

Remove front axle assembly.

Remove nuts and bolts securing engine to transmission housing.

Using special engine removal rig or, alternatively, a block and tackle, separate engine from transmission housing.

Assemble in reverse order.

When offering up engine clutch centre plate to the gearbox primary shaft it may be found advantageous to turn the crankshaft to permit the primary shaft and centre plate splines to line up.

Note.—It will be necessary to bleed the fuel system before attempting to start the engine.

THE CYLINDER HEAD

REMOVING THE CYLINDER HEAD

(Refer Figures 1 and 2)

Release hose clip securing breather pipe to rocker cover, and slide connecting hose clear of rocker cover.

Release the two clips which attach breather pipe to engine, and remove breather pipe.

Slacken off hose clips connecting thermostat housing to water pump, and remove rubber hose.

Remove oil feed pipe connecting cylinder head to camshaft chamber.

Remove injector pipe clip.

Remove injector pipes and leak-off pipes, and seal off all fuel unions.

Remove the injectors.

Remove the rocker cover.

Remove the rocker shaft, ensuring that the middle two nuts are released first.

Slacken off and remove the cylinder head nuts in reverse sequence to that shown in Figure 2. Note that a plain washer is fitted to the waisted stud (No. 15).

Lift off the cylinder head and cylinder head gasket.

Remove the thermostat from the water outlet body.

Remove the inlet and exhaust manifolds. The cylinder head may be skimmed if required providing its thickness is not reduced below 2·98".

DISMANTLING THE ROCKER SHAFT ASSEMBLY (Refer Figure 3)

The removal of the retaining circlips at either end of the rocker shaft will enable the rockers, springs and pedestal brackets to be withdrawn.

Examine all components and renew as necessary. If rocker tips are worn it is advisable to fit new rockers.

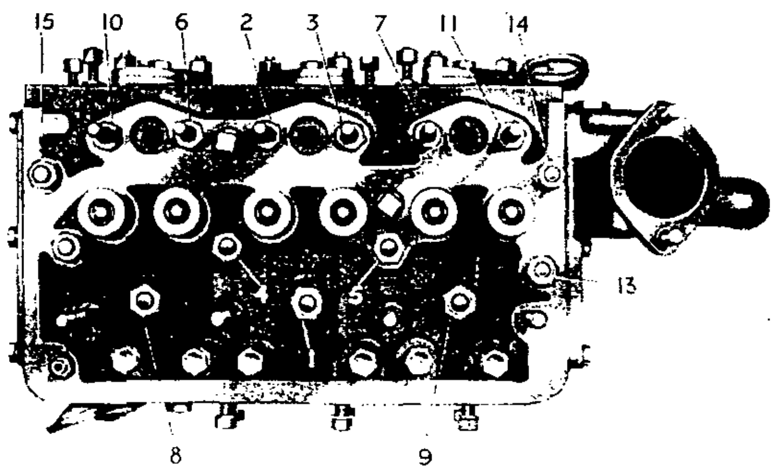

FIGURE 2
SEQUENCE OF TIGHTENING CYLINDER HEAD NUTS

FIRST ISSUE

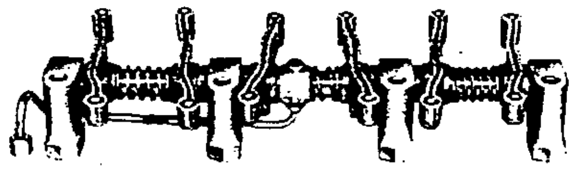

FIGURE 3
THE ROCKER SHAFT ASSEMBLY

REMOVING THE VALVES (Refer Figure 4)

Using a suitable Service Fixture or, alternatively, a valve spring compressor, remove valve cotters, valve caps, springs and valves.

Place valves and springs in a special stand or arrange them on the bench in the order in which they were dismantled. If the valves, after re-facing, are considered fit for further service, they must be returned to their original locations.

VALVE SPRINGS (Refer Figure 4)

Two coil springs are fitted to each valve. Inlet and exhaust springs are identical, and as no damper coils are incorporated they may be fitted either way up. Before re-use, however, all valve springs should be carefully examined, with particular regard to squareness of ends. The fitted length of the inner spring is 1·1875" (30·16 mm.) developing a load of 8 lbs. (3·62 kgs.). The fitted length of the outer spring is 1·5" (38·1 mm.) developing a load of 22·75 lbs. (10·31 kgs.).

The valve and spring assembly is illustrated in Figure 4.

VALVE GUIDES (Refer Figure 5)

The valve guides are a press fit in the cylinder head. Their location being determined by a machined step in their outer diameter.

REMOVING VALVE GUIDES (Refer Figure 5)

Valve guides can be removed and replaced using Service Tool P.D. 1A as illustrated in Figure 5.

When new valve guides are fitted the seats must be re-cut to ensure concentricity of the seat to the valve.

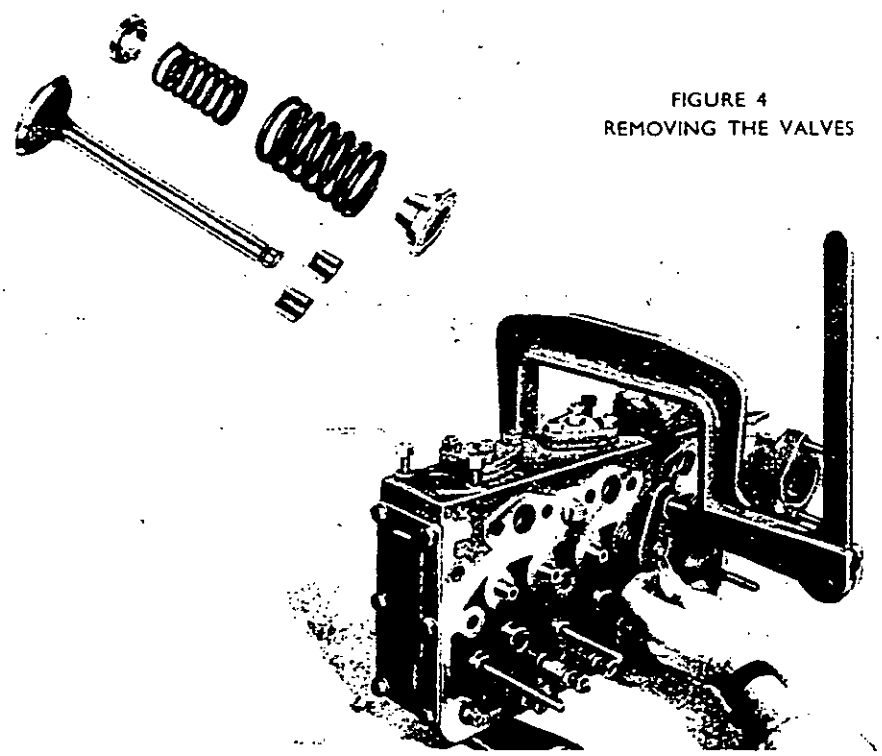

FIGURE 4
REMOVING THE VALVES

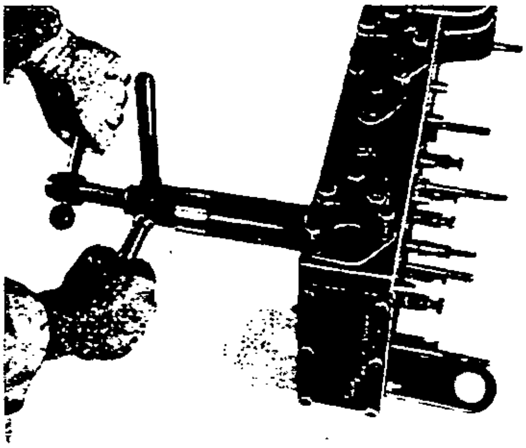

FIGURE 5
FITTING VALVE GUIDES

FIGURE 7
CHECKING VALVE HEAD DEPTH

VALVE SEATS (Refer Figures 6 and 7)

If the valve seats in the cylinder head show signs of pitting, burning or other evidence of leakage, they must be re-faced or re-ground according to their condition. Hand grinding is a finishing process and excessive grinding must be avoided, otherwise the seat angle may be altered and the seat width increased. Excessive grinding will result in "grooving" of the valve face.

FIGURE 6
RE-CUTTING VALVE SEATS

Valve seat reconditioning may be carried out using a proprietary seat grinding machine with a 44° stoned face. Figure 6 shows a valve seat being re-faced by means of a hand cutter.

When stoning or re-cutting valve seats, the minimum of metal should be removed to ensure that the seating face width is maintained as near as possible to original design and not necessarily increased.

Note that the maximum clearance between the cylinder head face and the valve head must not exceed 0·140" (3·556 mm.). This dimension can be checked using Service Tool P.D.17A as shown in Figure 7.

Valve seat inserts are not fitted to production engines. It is possible in most cases, however, to fit inserts to service engines where necessary, i.e., where the existing valve seat is worn or damaged to the point where re-cutting would place the relationship of the valve head to the cylinder head face beyond the service limits of ·066"-·140" (1·676-3·556 mm.). This dimension applies equally to inlet and exhaust valves.

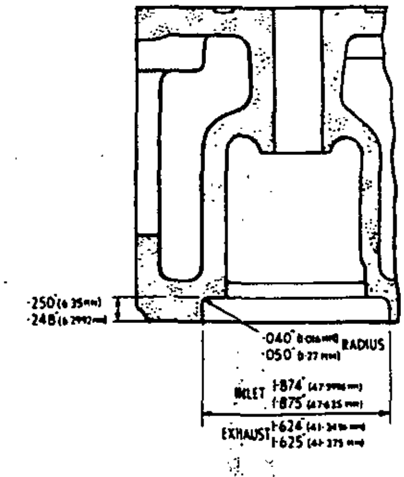

FIGURE 7A
MACHINING DIMENSIONS FOR VALVE SEAT INSERTS

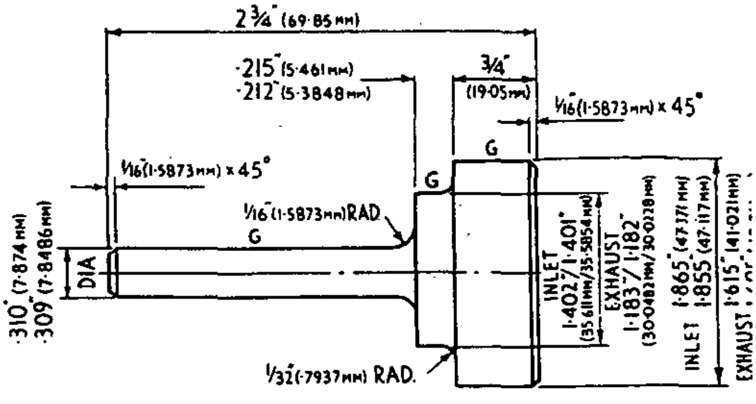

FIGURE 7B
TOOL FOR FITTING VALVE SEAT INSERTS

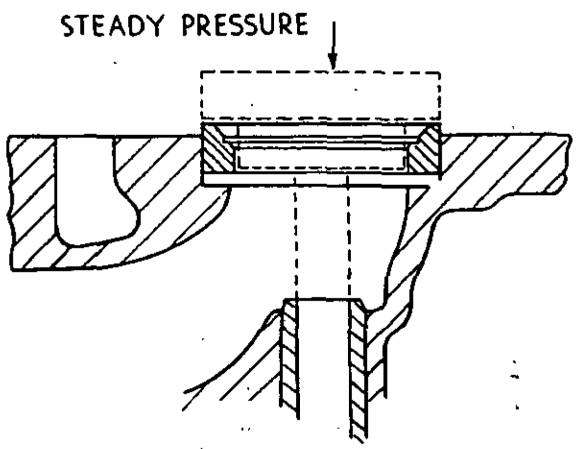

FIGURE 7C
FITTING VALVE SEAT INSERTS

To fit valve seat inserts proceed as follows :—

(1) Withdraw valve guide and thoroughly clean valve guide bore in cylinder head.

(2) Press new valve guide into position.

(3) Using the new valve guide as a pilot, machine the recess in the cylinder head face to the dimensions given in Figure 7A.

(4) Remove all swarf and thoroughly clean the insert recess, taking care to ensure that all burrs are removed.

(5) With the insert and fitting tool assembled as shown in Figure 7C, press insert into position. Note that the insert must be pressed, and not hammered into place. Lubricant should not be employed.

(6) Visually inspect to ensure that the insert has been pressed in squarely and that it is in hard contact with the bottom of the recess.

(7) Cut or grind valve seat face on insert as normal procedure.

Note.—A valve head depth of ·140" (3·556 mm.) is outside the engine production limits, but it represents the maximum permitted depth on service engines. When cutting insert face, it is therefore policy to work as closely as possible to the minimum figure of ·066" (1·676 mm.) in order to permit further re-cutting during subsequent overhauls.

VALVE GRINDING AND RE-FACING

If the valve faces are found to be unduly pitted they should be re-faced on a suitable valve re-facing machine set to 45°.

The re-facing should continue until the face is true, and free from pitting. Excessive grinding will thin the edge of the valve head and render the valve unfit for service, or will unduly lower the valve in its seating, and pocketing will result. If a valve tends towards thinness at the edges, it must be discarded. Valves which are badly burred, burnt, distorted or which have previously been ground to their limits must never be reclaimed.
Always hand grind valves before assembly.

HAND GRINDING

With the valves removed apply a small quantity of medium or fine grinding paste (depending on condition of valve and seat faces) to the valve face and insert valve into guide.

Using a suitable suction tool, rotate valve alternately in clockwise and anti-clockwise directions, occasionally raising the valve off its seat and revolving it a quarter turn before lowering it again. A light spring of suitable length, inserted between the valve head and guide will facilitate this operation.

Add more grinding paste as necessary, and continue as described above until an even, clean, matt-grey finish is obtained on a seating between $\frac{1}{16}''$-$\frac{3}{32}''$ (1·58-2·38 mm.) in width. If such a condition cannot be obtained, it will be necessary to re-face or re-cut the valve and/or seat.

After grinding in the valves carefully, remove all traces of grinding paste.

TAPPETS (Refer Figure 7)

The tappets are of the mushroom foot type and operate directly in the cylinder head. With the cylinder head removed, it is necessary to remove the tappet adjusting screw and locknut before the tappets can be withdrawn. Note that the tappets must be free to rotate and capable of sliding in the cylinder head under their own weight. Tappet faces must not be re-ground. Damaged faces will necessitate the fitting of new tappets.

COMBUSTION CHAMBER CAPS
(Refer Figure 1)

The removal of the combustion chamber caps and the cleaning of the throat passages should be undertaken as a matter of course when cylinder head overhaul is carried out.

Care must be taken on replacing these caps to ensure that they are tightened up evenly. Where possible, new gaskets should be employed. The old gaskets, however, may be used, providing they are first annealed.

DECARBONISING

It is difficult to state a specific period at which decarbonising would be desirable. Provided the fuel system and injection equipment are properly maintained and a reputable grade of fuel is used, it is difficult to imagine the cylinder head being lifted purely for this purpose. Generally the need for decarbonising will not arise before the valves require attention.

To decarbonise the engine, proceed as follows :—

Remove cylinder head as previously described. The valves, guides, rockers, etc., must be cleaned, examined and serviced as required.

Absolute cleanliness must be observed if particles of carbon, etc., are to be prevented from scoring cylinder walls, pistons, bearings, etc.

Carefully clean all carbon from the cylinder head and cylinder block faces and all cylinder head valve parts, ensuring that no burrs exist or are made on the machined faces.

With No. 1 piston midway down its bore, apply a smear of grease inside the top of No. 1 cylinder, and rotate crankshaft until No. 1 piston is at T.D.C. The grease serves as a seal between the piston crown and cylinder walls and prevents carbon becoming trapped between the piston and cylinder.

Cover No. 2 and 3 bores, and all water and oilways.

Using a suitable scraper, remove carbon from No. 1 piston crown, taking care not to scratch the piston and ensuring that a ring of carbon is left round the periphery of the piston crown.

Repeat the above operation for the remaining two pistons.

Clean all piston crowns and cylinder bores with a non-fluffy rag moistened in kerosene.

Lubricate piston crowns and bores and assemble cylinder head.

ASSEMBLING THE CYLINDER HEAD
(Refer Figures 2 and 8)

Thoroughly clean cylinder head and all components.

Lubricate valves, guides and tappets and assemble in head.

Refit induction and exhaust manifolds using new gaskets.

Lightly smear both faces of new cylinder head gasket with a suitable jointing compound.

Place gasket over cylinder head studs, noting that it is marked "Top front".

Fit and tighten cylinder head nuts in recommended sequence (Figure 2), ensuring that a plain washer is fitted to waisted stud No. 15.

Cylinder head nuts should be tightened to a torque of 55/60 lbs./ft. and rechecked after the engine has been run.

Replace the rocker assembly, ensuring that the slot at the rear end of the rocker shaft is in line with the punch mark on the rear pedestal bracket (Figure 8). The relationship of this slot to the

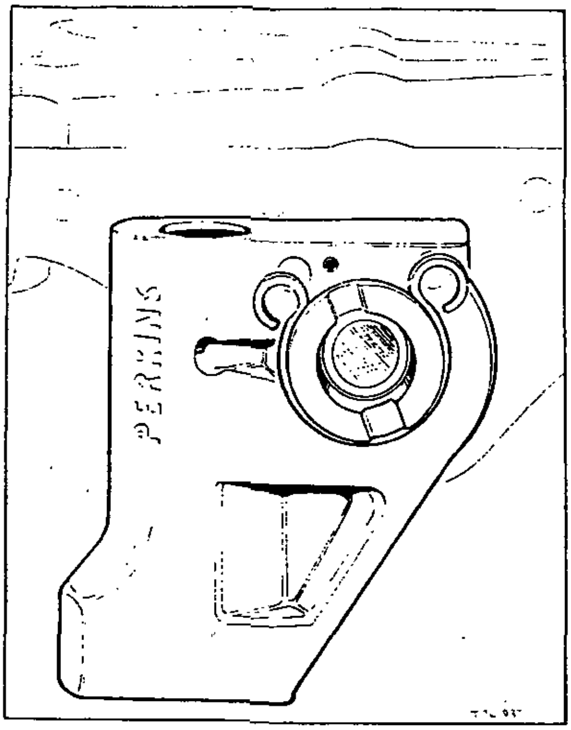

FIGURE 8
ROCKER SHAFT LOCATION MARK

punch mark determines the quantity of oil delivered to the rockers and bearings. Oil flow may be increased or decreased by rotating the shaft in a clockwise or anti-clockwise direction as required. It will generally be found that with the shaft slot and punch mark aligned the oil supply is most satisfactory.

Adjust valve clearances to 0·012" (0·305 mm.) inlet and exhaust.

Refit oil feed pipe between cylinder head and camshaft housing.

Replace injectors, using new washers, and connect up injector pipes and leak-off pipes.

Tighten injectors evenly.

Fit rocker cover and joint.

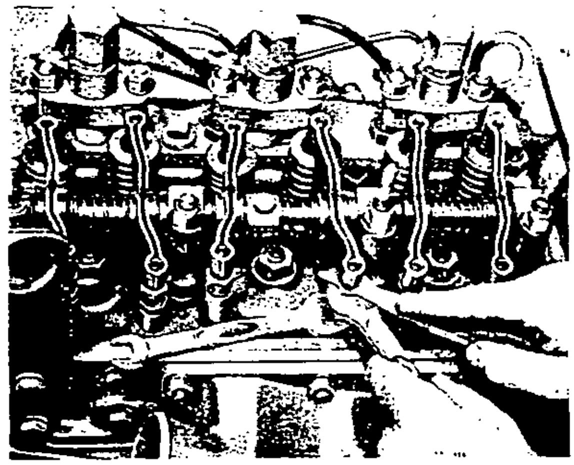

FIGURE 9
ADJUSTING TAPPETS

ADJUSTING VALVE CLEARANCE

(Refer Figure 9)

The three throw 120° crankshaft makes it necessary to adopt a slightly different sequence for tappet adjustment to the normal accepted procedure for four and six cylinder engines.

To adjust tappets proceed as follows :—

Remove the rubber plug in the inspection hole in the left front side of the transmission housing adaptor plate.

Rotate crankshaft until the T.D.C. line on the flywheel is in the centre of the inspection hole and No. 1 piston is on compression stroke (both valves fully closed).

Check and adjust clearances as necessary on Nos. 1, 2, 3 and 5 valves (Figure 9).

Turn crankshaft one revolution (360°) and repeat for Nos. 4 and 6 valves. (T.D.C. mark visible through inspection hole).

Replace rubber plug in adaptor plate.

Valve clearances for both inlet and exhaust should be set to 0·010" (0·254 mm.) hot, and 0·012" (0·305 mm.) cold.

THE LUBRICATING SYSTEM

The lubricating system is of the force feed type, the oil being circulated under pressure by a rotor type pump bolted to the front main bearing cap and driven via an idler gear by the crankshaft gear. Oil is drawn through a sump filter screen and a suction pipe before entering the oil pump, from whence it is pumped through a delivery pipe to a drilling in the cylinder block and to a full flow filter in the left hand side of the engine.

A plunger type relief valve is incorporated in the oil pump body. This relief valve is set to 50-65 p.s.i.

From the full flow filter the oil passes into the main oil gallery in the cylinder block. Passages in the main bearing webs of the crankcase carry the oil from the oil gallery to the main bearings.

The cylinder bores and gudgeon pins are splash lubricated. A transverse drilling at the front of the cylinder block feeds oil from the main oil gallery to an external pipe on the right hand side of the engine. This pipe feeds the centre camshaft bearing. Another external feed pipe connects the camshaft to the rocker assembly.

The camshaft is lubricated by oil draining from the rocker assembly through two oil-ways situated on either side of the centre camshaft bearing. A drilling connects the two chambers. The oil level is controlled by a weir in the front chamber.

Above No. 1 camshaft bearing there is a drilling which serves as a breather to the camshaft chamber and permits a free flow of oil passing over the weir. A drilling under the rear bearing of the camshaft prevents pressure build up between the rear camshaft journal and the tachometer housing seal.

The overflow from the camshaft weir is directed to lubricate the timing gears.

The flow of oil to the rocker assembly can be regulated by rotating the rocker shaft to align or restrict the oil feed passages.

LUBRICATING OIL FILTERS

The oil filters consist of : oil filler strainer, oil sump strainer, and main full flow oil filter.

THE OIL FILLER STRAINER (Refer Figure 10)

This is a coarse wide mesh strainer situated at the base of the oil filler tube.

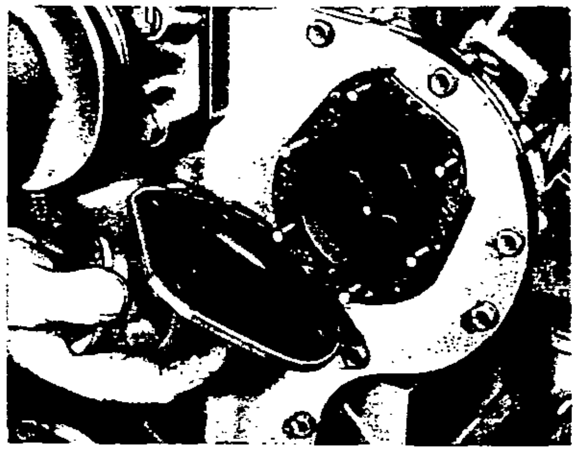

FIGURE 10
THE OIL FILLER STRAINER

THE SUMP STRAINER (Refer Figure 11)

The sump strainer consists of a perforated gauze wire strainer welded to the pressed steel cover at the bottom of the sump.

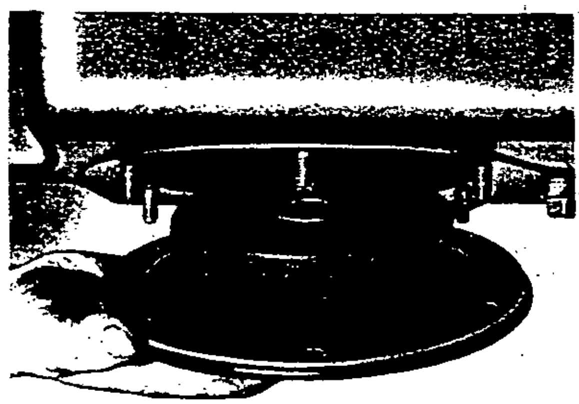

FIGURE 11
THE SUMP STRAINER

THE MAIN FULL FLOW FILTER

The main full flow filter is mounted on the left hand side of the engine crankcase. A replaceable type element is employed to extract foreign bodies from the circulating oil.

OPERATION

The inlet side of the filter body connects to the outside of the filter element. Oil pumped under pressure is forced through the element. Foreign bodies, grit, etc., are removed from the oil as it passes through the filter. The inside of the element connects to the engine and the filtered oil is thus recirculated through the engine.

Should the element become clogged and the passage of oil severely restricted, pressure will build up in the inlet port and will open the spring loaded ball valve in the by-pass assembly, and permit unfiltered oil to reach the engine. Regular oil changing and attention to filter maintenance and element renewal periods will prevent this occurring.

The spring loaded ball valve opens when the difference between inlet and outlet pressures exceeds 13-17 p.s.i.

DISMANTLING THE MAIN FILTER ASSEMBLY (Refer Figure 12)

Unscrew the centre bolt at the bottom of the filter bowl and lower bowl and centre bolt together. The bolt cannot be withdrawn completely, nor can the seal retainer and spring located over the bolt inside the bowl be removed from the bolt.

Remove the two sealing rings from the recess in the filter head. Release and remove the by-pass plug, washer, spring and ball from the head.

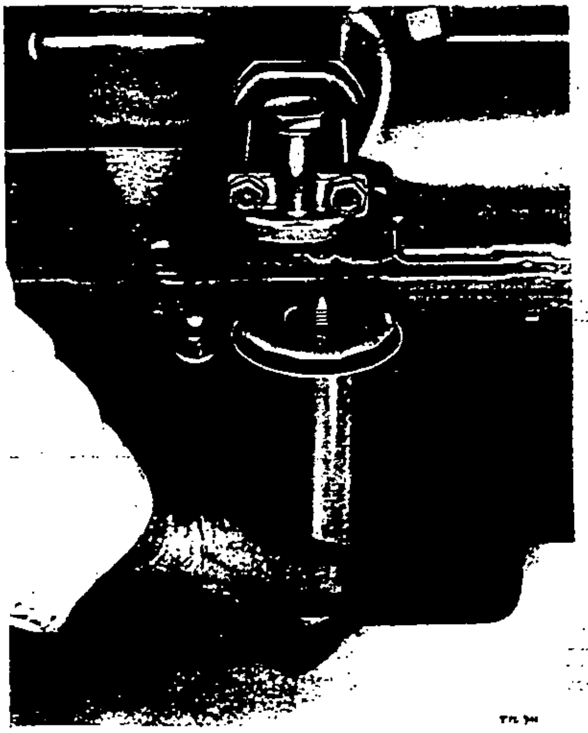

FIGURE 12
DISMANTLING MAIN OIL FILTER ASSEMBLY

ASSEMBLING THE MAIN FILTER

Replace the ball and spring in the by-pass passage and secure with the plug and fibre washer. Locate the large ring seal and the smaller inner seal in the head. Place the filter element over the centre bowl and offer up the bowl assembly to the head, ensuring that the bowl seats properly within the head recess. Tighten the centre bolt to a torque of 10 lb./ft.

THE ENGINE SUMP

The engine sump is of high duty cast iron, has a capacity of 10·5 Imperial pints, and is fitted with a drain plug and dipstick.

A pressed steel cover containing the sump strainer is fitted to the bottom of the sump. This cover enables the strainer to be cleaned without removing the sump.

REMOVING THE SUMP

To remove the sump it is necessary to support the engine, using either an overhead block and tackle or an engine stand. With the engine supported, release the front of the sump from the bolster bracket by removing three setscrews and three nuts and bolts. Release the rear of the sump from the transmission housing adaptor plate by removing the six bolts which secure the sump, adaptor plate, and transmission housing.

The sump can now be removed as follows :—

Remove the two nuts and spring washers from the studs at the front of the sump. These studs go through the sump into the bottom of the timing case.

Remove the two long setscrews and copper washers from the rear of the sump.

The twelve setscrews which hold the sump may now be removed from the cylinder block.

Remove the sump.

Remove the pressed steel cover from the bottom of the sump.

REPLACING THE SUMP

When replacing the sump new joints should be used throughout, *i.e.* between the sump and crankcase flanges and the cork seals at the front and rear of the sump.

Offer up the sump to the crankcase and refit setscrews and nuts. The two long setscrews at the rear of the sump should be fitted with new copper washers.

Tighten the securing bolts by working from the centre to front and rear.

Refit the pressed steel cover, ensuring that the oil pump suction pipe is properly locating in the strainer mesh.

Affix the bolster bracket and transmission housing adaptor plate.

THE OIL PUMP (Refer Figure 13)

The oil pump is secured to the front main bearing cap by three thin-headed setscrews, a protrusion of the idler gear shaft locating in a hole in the bearing cap for positive location.

A bushed idler gear, which is free to rotate on a shaft, and is retained in position by a circlip, transmits the drive from the crankshaft to the oil pump.

The oil pump drive gear is keyed and pressed on to the pump drive shaft. At the other end of the pump drive shaft a four lobed rotor is fitted. This rotor meshes with a five lobed rotor which is free to rotate inside the oil pump body.

As the rotors rotate, the pockets formed between the lobes increase and decrease in volume, causing oil to be transferred from the suction to the pressure side of the pump.

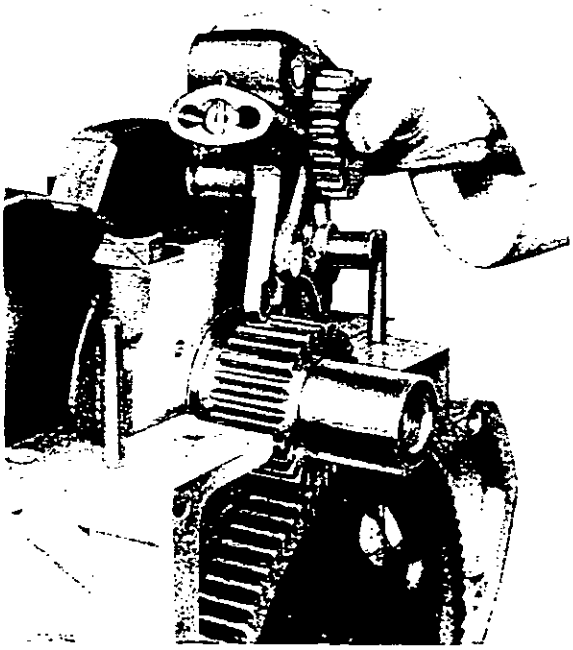

FIGURE 13
THE OIL PUMP

A pressure relief valve mounted on the delivery side of the pump body controls the maximum oil pressure to within 50-65 p.s.i.

The oil pump delivers 5·35 gallons per minute at an engine speed of 2,000 r.p.m.

REMOVING THE OIL PUMP (Refer Figure 13)

Remove the sump.

Remove the two setscrews securing the bridge piece to the block.

Remove the three setscrews securing the bridge piece to the front cover.

Remove the bridge piece.

Remove oil pump idler gear circlip and slide idler gear forward.

Remove the three setscrews securing oil pump and withdraw oil pump.

Assemble in reverse order.

DISMANTLING THE OIL PUMP
(Refer Figures 14 and 15)

With the oil pump suitably held in a vice, remove the pump drive gear using Service Tool P.D.155 (Figure 14).

Remove the key from the keyway of the drive shaft.

Remove the three screws attaching end plate to pump body and withdraw end plate.

Carefully remove the drive and driven rotor from the pump body.

Dismantle the relief valve by removing the split pin and shims where fitted, the spring retaining cap, spring and plunger.

Remove the 'O' sealing ring from the pump body (Figure 15).

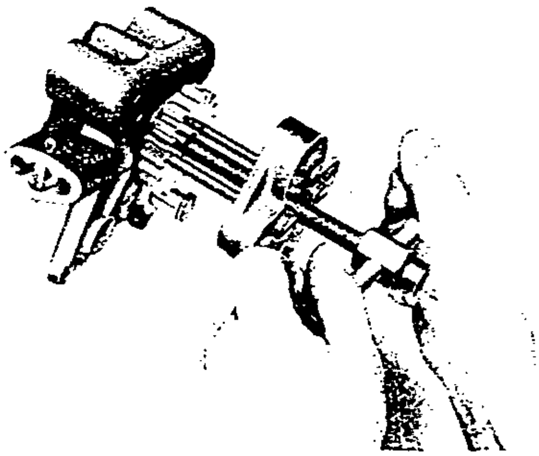

FIGURE 14
REMOVING OIL PUMP DRIVE GEAR

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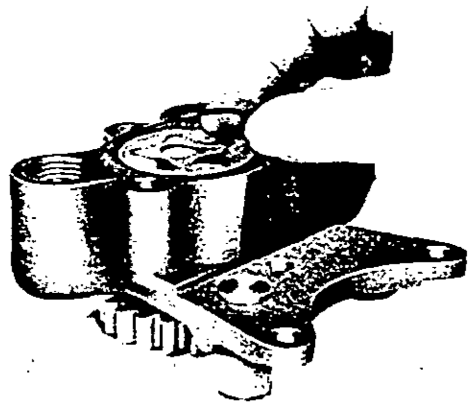

FIGURE 15
REMOVING OIL PUMP 'O' SEALING RING

INSPECTION (Refer Figures 16-18)

Thoroughly clean all components.

Examine rotors for cracks or scoring.

Install the drive and driven rotors in the pump body, ensuring that the chamfered edge of the outer rotor enters the pump body first.

Check the clearance between the maximum dia-meter of the inner rotor and the minimum diameter of the outer, or driven rotor at all points (Figure 16).

If this clearance exceeds 0·006" (0·1524 mm.) a new oil pump should be fitted.

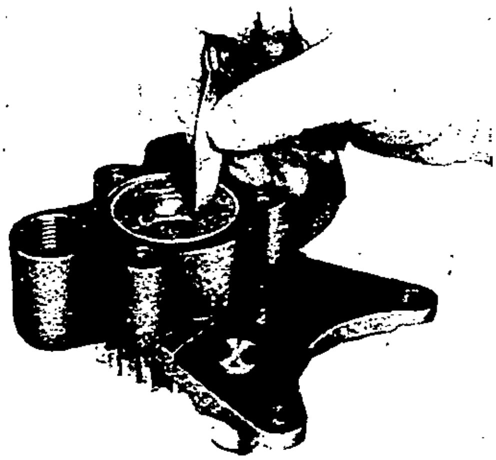

FIGURE 16
CHECKING CLEARANCE BETWEEN DRIVING AND DRIVEN ROTOR

The clearance between the driven rotor and the pump body (Figure 17) must not exceed 0·010" (0·254 mm.). The clearance between the top of the rotors and the surface of the pump body (Figure 18) must not exceed 0·003" (0·0762 mm.).

FIGURE 17
CHECKING CLEARANCE BETWEEN OUTER ROTOR AND OIL PUMP BODY

Note.—If the pump is considered faulty it must be replaced by a complete unit. Component parts are not available as spares.

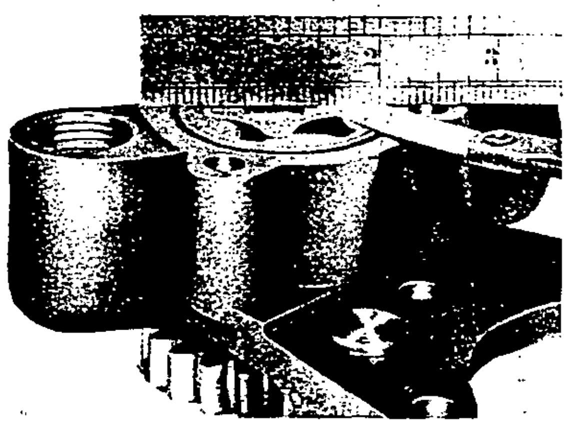

FIGURE 18
CHECKING CLEARANCE BETWEEN ROTOR FACES AND PUMP BODY

ASSEMBLING THE OIL PUMP

Fit the drive and driven rotors in the body, entering the chamfered end of the outer rotor to the body first and replace the 'O' sealing ring and end plate. Replace the three "Philips" screws.

Replace the key in the keyway of the drive shaft, and refit the drive gear, with its flat face outwards. This face should be flush with the end of the drive shaft.

Replace the relief valve and component parts and check that the relief valve lifts at 50-65 p.s.i. This may be checked using suitable hydraulic test equipment or by utilising compressed air.

TIMING CASE COVER AND CRANKSHAFT FRONT OIL SEAL

REMOVING TIMING CASE COVER

Using Service Tool P.D.46B, remove starter dog and washer.

Remove fan belt and generator.

Remove crankshaft pulley.

Remove breather pipe.

Remove generator brackets and adjustable linkage.

Slacken off hose clips connecting water pump to engine.

Remove setscrews securing timing cover.

Two long bolts pass through the timing case to secure a cover at the rear of the timing case, blanking off the power take off bore. In addition to the two long bolts passing through the timing case to secure the generator brackets, a long bolt is also fitted above the position of the generator brackets. The bottom setscrew below the front oil seal is fitted with a copper washer.

Withdraw timing case cover, taking care not to damage the front oil seal located in the timing case cover.

RENEWING CRANKSHAFT FRONT O L SEAL

Carefully prise out old seal from timing case cover. Locate new seal in position, ensuring that lip of seal is adjacent to inner face of timing case.

Using a suitable dolly, carefully tap new seal into position, ensuring that seal is square in timing cover bore.

ASSEMBLING TIMING CASE COVER

Clean mating faces of timing cover and timing case.

Fit new joint and offer up timing cover to engine, taking care not to damage the oil seal as it passes over the crankshaft.

Centralize timing cover using crankshaft pulley, and clamp timing cover in position.

Remove crankshaft pulley and fit and tighten the remaining timing cover setscrews.

Fit breather pipe.

Fit crankshaft pulley and secure in position with washer and starter dog.

Refit water pump hoses to engine and tighten hose clips.

Replace generator bracket, generator, and fan belt.

FIGURE 19
TIMING GEAR AND MARKING

TIMING GEARS (Refer Figure 19)

The camshaft and fuel pump gears are driven by the crankshaft gear through an idler gear. All gears are suitably marked during production to facilitate re-timing, the marks being in line when No. 1 piston is at top dead centre (T.D.C.) on its compression stroke, as illustrated in Figure 19. It will be appreciated that these markings will not align at every rotation of the crankshaft where No. 1 piston is at T.D.C. on its compression stroke.

CHECKING TIMING GEAR BACKLASH (Refer Figure 20)

Remove timing case cover as previously described. Using a feeler gauge, check backlash. Idler gear backlash between camshaft, crankshaft and fuel pump gears should be within 0·003"-0·006" (0·076-0·152 mm.) (Figure 20). Backlash between crankshaft and oil pump idler gear should be 0·012"-0·018" (0·305-0·457 mm.).

Excessive backlash can only be corrected by fitting new gears. Replacement gears are marked on production.

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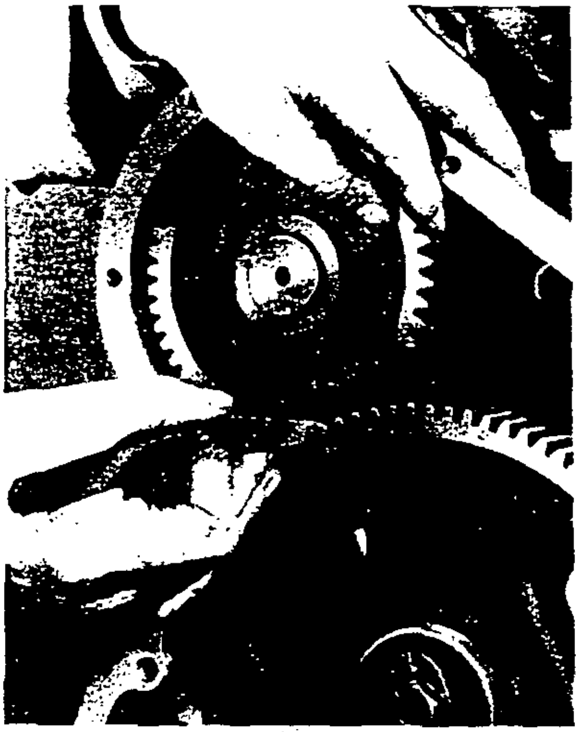

FIGURE 20
CHECKING CAMSHAFT AND IDLER GEAR BACKLASH

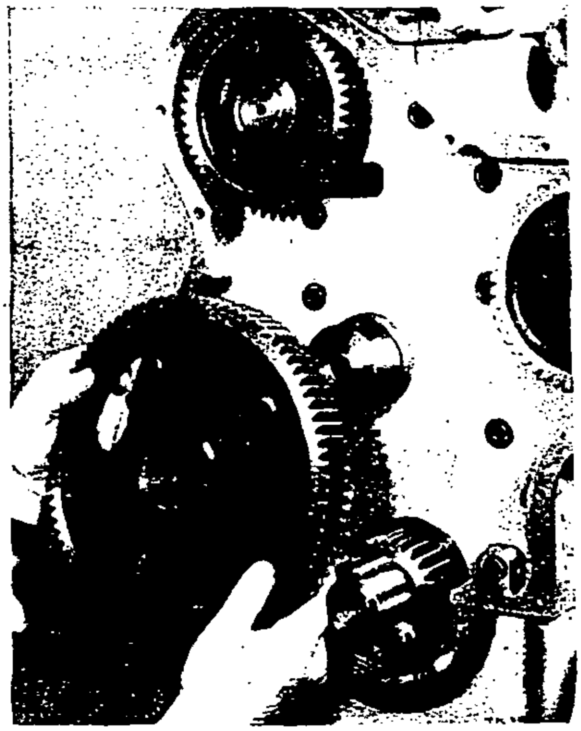

FIGURE 21
REMOVING IDLER GEAR FROM SPIGOT

REMOVING IDLER GEAR AND SPIGOT
(Refer Figures 21 and 22)

Remove timing case cover.

Straighten out lock washer on setscrew, securing idler gear.

Remove setscrew, locking washer and idler gear retaining plate.

Remove idler gear from spigot (Figure 21).

Remove idler gear spigot (Figure 22).

REPLACING IDLER GEAR AND SPIGOT
(Refer Figures 21 and 22)

Place idler gear spigot in position, ensuring that the small locating peg is entered into the through drilling in the spigot (Figure 22). When correctly in position, the spigot flange should be flush with the timing case.

Fit idler gear to spigot, ensuring that timing marks align (Figure 21).

Fit idler gear retaining plate, locking washer, and setscrew.

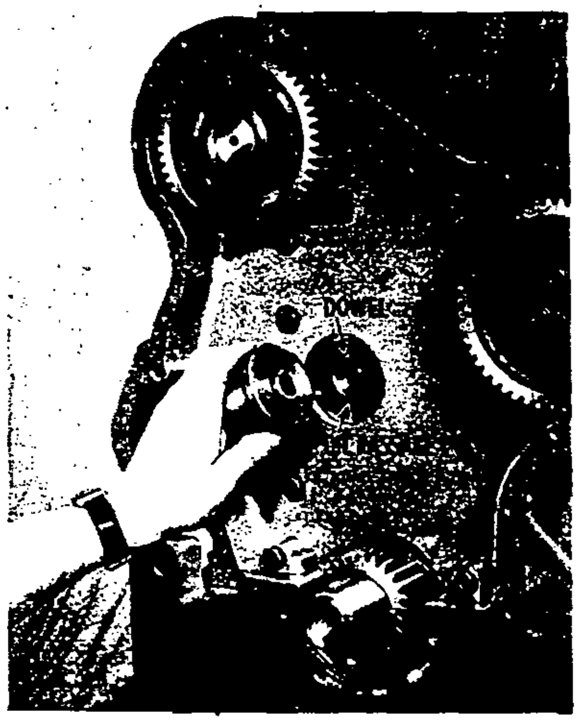

FIGURE 22
REMOVING IDLER GEAR SPIGOT

Tighten setscrew and bend lock washer into position.

Idler gear end float should be within 0·005"-0·015" (0·127-0·381 mm.).

REMOVING CAMSHAFT GEAR
(Refer Figure 23)

Remove the three setscrews and washers securing gear to camshaft.

Withdraw camshaft gear (Figure 23).

FIGURE 23
REMOVING CAMSHAFT GEAR

FITTING CAMSHAFT GEAR (Refer Figure 23)

Remove idler gear.

Release rocker assembly to facilitate turning of camshaft.

On the hub of the camshaft and the camshaft gear will be seen the letter 'D' stamped adjacent to a fixing hole (Figure 23).

Offer up camshaft gear to camshaft, ensuring that the holes adjacent to the letter 'D' are aligned. On no account must the slotted holes be used to attach the gear to the camshaft.

Fit and tighten the three setscrews and washers.

Fit idler gear and align all timing marks.

Replace rocker assembly and adjust tappets.

REMOVING FUEL PUMP GEAR
(Refer Figure 24)

Rotate crankshaft until timing marks align.

Remove idler gear.

Remove setscrews securing fuel pump gear.

Remove fuel pump gear, taking care not to damage the locating dowel (Figure 24).

Assemble in reverse order, ensuring timing marks align.

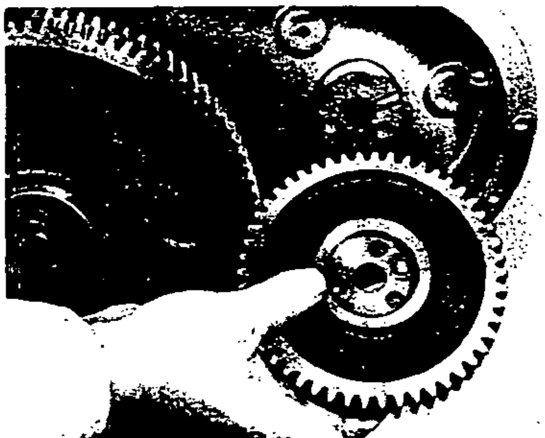

FIGURE 24
REMOVING FUEL PUMP GEAR

REMOVING THE CAMSHAFT
(Refer Figure 25)

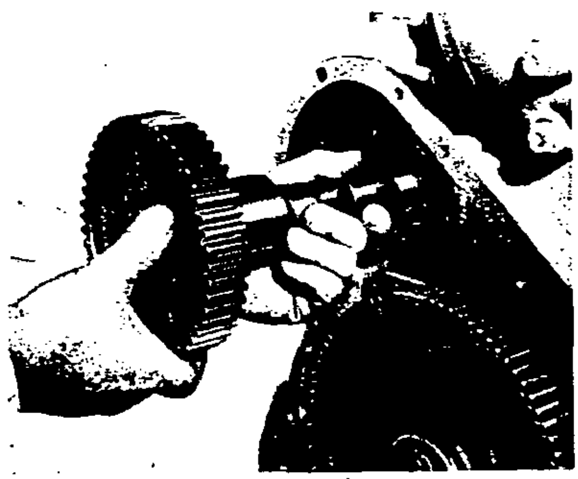

FIGURE 25
REMOVING THE CAMSHAFT

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Remove rocker shaft assembly.

Remove timing case cover.

Remove fuel lift pump.

Remove idler gear.

Raise tappets and carefully withdraw camshaft (Figure 25) continually turning the shaft.

Assemble in reverse order, ensuring that timing marks are correctly aligned.

Note.—Camshaft end float is controlled by a spring riveted to the timing case cover.

REMOVING THE TIMING CASE

Remove rocker shaft assembly.

Remove timing case cover.

Remove idler gear and spigot.

Remove fuel lift pump.

Remove camshaft.

Remove fuel pump driving gear.

Remove all links and pipes from fuel injection pump.

Remove the three nuts, spring washers and plain washers securing fuel pump flange to timing case.

Withdraw fuel injection pump. Ensure that all fuel line connections and pipes are effectively sealed.

Remove sump.

Remove setscrews and shakeproof washers securing timing case to engine block.

Withdraw timing case.

REPLACING TIMING CASE (Refer Figure 26)

To ensure correct location of the timing case, it is advisable to fit and fully locate the idler gear hub to the cylinder block.

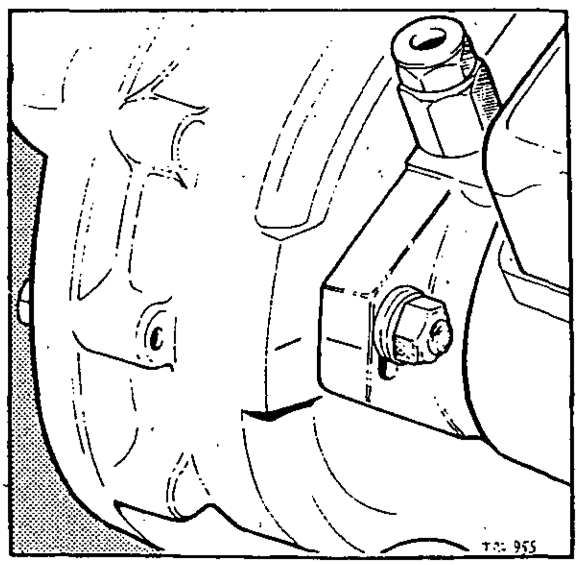

FIGURE 26
TIMING MARKS ON FUEL INJECTION PUMP AND TIMING CASE

Fit new joint and offer up timing case to engine block.

Fit and tighten timing case setscrews.

Fit fuel injection pump to timing case, ensuring scribed lines on pump flange and timing case are in line (Figure 26).

Rotate crankshaft until No. 1 piston is at T.D.C. (Key on crankshaft at T.D.C.).

Fit fuel pump gear to fuel pump, ensuring dowel is properly located.

Raise tappets and carefully insert camshaft.

Fit idler gear to spigot (long tapered flange of gear towards cylinder block and timing marks on crankshaft gear, fuel pump gear, camshaft gear and *idler gear in line*).

Fit sump.

Fit all fuel pipes and links to fuel injection pump.

REMOVING CRANKSHAFT REAR OIL SEAL

Remove flywheel.

Remove adaptor plate from rear of cylinder block and sump.

Remove the two long bolts and self-locking nuts clamping the oil seal housing halves together.

Unscrew the three setscrews securing each half housing, and withdraw housings.

FITTING NEW ROPE TYPE SEALS

Replacement seals should be soaked in clean engine oil for an hour before fitting.

Hand press seals into their respective grooves in housings, leaving 0·010"-0·020" (0·254-0·508 mm.) projecting above each end of groove. This projection serves to ensure intimate contact between the ends of the seals when the housing halves are clamped together. Any gap existing between the mating faces of seal ends will defeat the purpose of the oil seal. A projection exceeding that recommended must be avoided, as excessive overlap may spread and prevent the housing halves from seating properly.

Each rope type seal is of the correct length and must not be trimmed.

A round bar may be employed with advantage to bed the seal into position.

FITTING THE SEAL HOUSINGS

Remove all traces of the old joint between the top half of the housings and the cylinder block, and between the bottom half of the housings and the rear main bearing cap. Smear the exposed inside surfaces of the asbestos seals with a graphited grease and lightly coat the housing abutment faces with jointing compound.

Using new joints, fit the half housings to the cylinder block and rear main bearing cap. Locate, but do not tighten the six securing screws.

Fit and tighten the two long clamping bolts, using new self-locking nuts.

Tighten the housing securing screws.
Fit the transmission adaptor plate to rear of cylinder block, ensuring dowels are correctly located.
Fit flywheel and check for "run-out" and concentricity.

FLYWHEEL AND RING GEAR

REMOVING THE FLYWHEEL

Straighten out tabs on flywheel lock plates.

Remove the six setscrews securing flywheel to crankshaft flange.

Withdraw flywheel.

The pilot bearing can be removed by gently tapping it from the crankshaft flange side.

REMOVING STARTER RING GEAR

The starter ring gear is shrunk onto the flywheel. To remove it, partly cut through the gear with a hacksaw, taking care not to mark the flywheel, and split the ring gear with a chisel.

FITTING STARTER RING GEAR

Thoroughly clean ring gear location on flywheel.

Evenly heat new ring gear to an approximate temperature of 475°F.

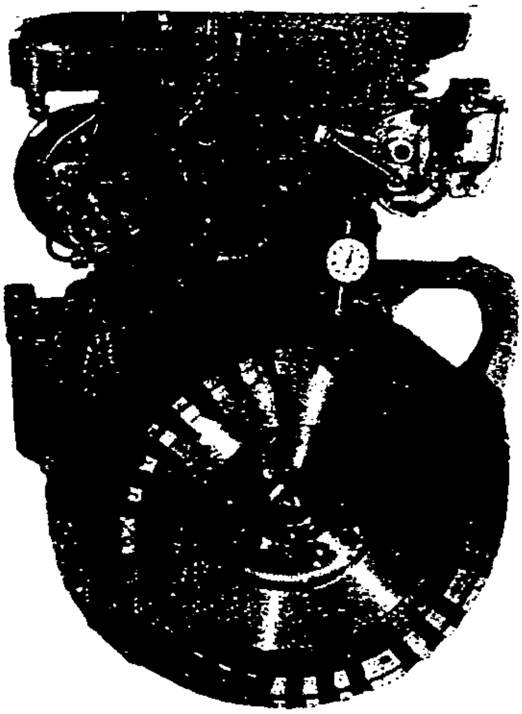

FIGURE 27
CHECKING FLYWHEEL FOR CONCENTRICITY

FIGURE 28
CHECKING FLYWHEEL FOR RUN-OUT

Gently lay ring gear in position on flywheel and allow to cool.

Note.—Leading edge of gear teeth must face towards engine.

REPLACING THE FLYWHEEL

(Refer Figures 27 and 28)

It is essential that the crankshaft flange and flywheel mounting faces are scrupulously clean and devoid of burrs.

There are six tapped holes in the crankshaft flange and one untapped hole. This untapped hole must coincide with the staggered hole in the flywheel. This ensures that the flywheel timing marks are correctly related to the crankshaft.

Fit new locking plates and evenly tighten the six setscrews to a torque of 75 lbs./ft. Do not bend over lockplates at this stage.

Using a dial indicator (Figure 27) carefully check the flywheel for concentricity. The total indicator reading should not exceed 0·008" (0·2032 mm.).

Using dial indicator (Figure 28), check flywheel for run-out. This should not exceed 0·001" (0·0254 mm.) per radius inch (25·4 mm.) from flywheel centre to dial indicator stylus.

Tighten securing screws and re-check torque to 75 lbs./ft.

Bend over tabs of locking plates.

Before fitting clutch assembly check that flywheel pilot bearing is a clearance fit on gearbox primary shaft.

Pack bearing with H.M.P. grease.

Note.—When checking "run-out" it is advisable to apply thrust to the centre of the flywheel to prevent false readings, due to crankshaft end float.

PISTONS AND CONNECTING RODS

In factory built engines, pistons and connecting rods are numbered to correspond to the cylinders to which they are fitted. When dismantling an engine, it is advisable to ensure that an unmarked component has not been substituted during service.

Connecting rods, in addition to being marked for their respective cylinders, are also marked to indicate their weight grading. Should it be necessary to fit a new connecting rod, it must carry the same etched marking as the old rod. The etched number on the displaced rod must be quoted when ordering a replacement (Figure 30).

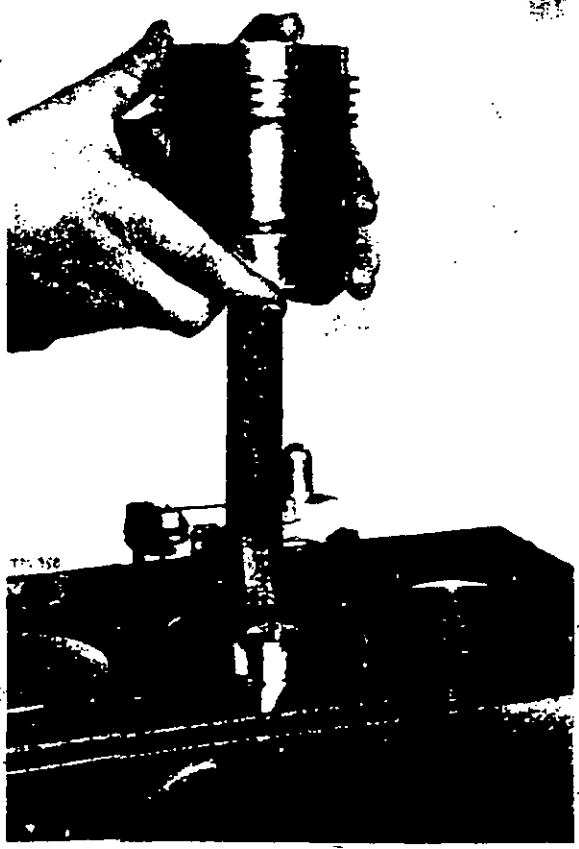

FIGURE 29
REMOVING PISTON AND CONNECTING ROD

REMOVING CONNECTING RODS AND PISTON ASSEMBLIES (Refer Figure 29)

Remove cylinder head and sump.

Rotate crankshaft until piston selected for removal is at the bottom of its stroke. If necessary, remove oil pump inlet and delivery pipes.

Carefully remove any carbon that may have built up round the top of the cylinder bore.

Remove the self-locking nuts from big end bolts and withdraw bearing cap, lower bearing half and the big end bolts.

Turn crankshaft to bring piston to top of its stroke.

Raise connecting rod clear of crankshaft and remove upper bearing half.

Withdraw piston and connecting rod from cylinder (Figure 29).

Fit bearing shells, cap, bolts and nuts to connecting rod.

Repeat above procedure for the remaining two pistons.

REMOVING PISTON FROM CONNECTING ROD

Remove piston and connecting rod from engine.

Thoroughly clean piston and connecting rod and check that they are correctly numbered for their relevant position in the engine.

Remove the two gudgeon pin circlips.

Immerse piston in warm oil or water and push gudgeon pin clear of connecting rod bush.

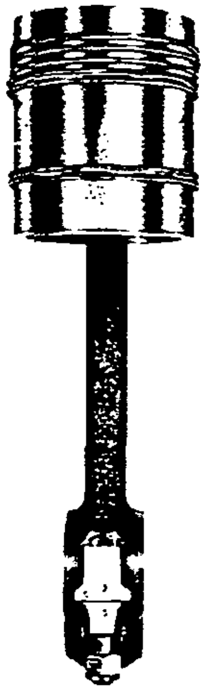

FIGURE 30
PISTON AND CONNECTING ROD

PISTON RINGS

Three compression rings and two oil control rings are fitted to each piston, as follows :—

Top Compression : Cast Iron. Parallel faced.

Second Compression : Cast Iron. Taper faced. Marked 'T' for 'Top'.

Third Compression : Cast Iron. Taper faced. Marked 'T' for 'Top'

First oil control (above gudgeon pin) : Cast iron scraper.

Second oil control (below gudgeon pin) : Cast iron scraper.

When fitting new piston rings into new cylinder liners the ring gap for compression and oil control should be within 0·009"-0·013" (0·229-0·33 mm.) measured in a ring gauge of 3·6" diameter.

ALIGNING CONNECTING RODS

(Refer Figure 31)

Connecting rods must always be checked for truth before re-assembly or before attempting to ream a small end bush.

Large and small end connecting rod bores must be square and parallel with each other within the limits of plus or minus 0·005" (0·127 mm.) measured 5" (127 mm.) each side of the axis of the rod on test mandrel as shown in Figure 31. When checking alignment with gudgeon pin bush fitted the limit plus or minus 0·005" (0·127 mm.) is *reduced to plus or minus 0·0015" (0·0381 mm.).*

When fitting and reaming connecting rod small end bushes, a reaming fixture must be employed. Service Tools 6200A and P.D.39A are recommended for this purpose.

Note.—*Misaligned* connecting rods must be discarded and a new one of similar weight group fitted.

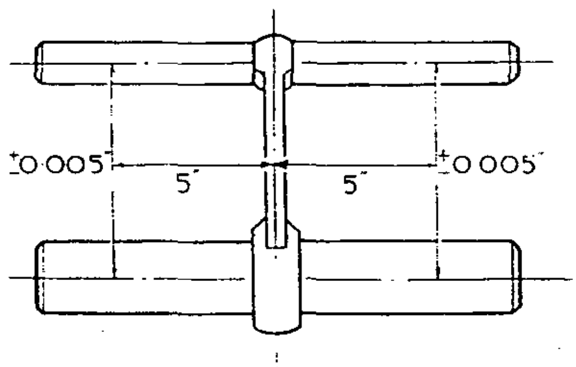

FIGURE 31
CHECKING CONNECTING ROD ALIGNMENT

ASSEMBLING PISTONS TO CONNECTING RODS

If the original pistons are being used they must be assembled to the same connecting rods in their original positions.

Thoroughly clean piston and connecting rod.

Fit one circlip in position to facilitate gudgeon pin location.

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Immerse piston in clean hot oil or water to permit easy entry of the gudgeon pin.

Insert connecting rod between piston bosses, ensuring that piston and connecting rod markings are correctly related.

Insert gudgeon pin in position and fit the second circlip.

Ensure that both circlips are properly located in their respective grooves.

Fit piston rings.

FITTING PISTONS AND CONNECTING RODS (Refer Figures 32 and 33)

Thoroughly clean out cylinder bore and apply a generous coating of clean engine oil.

Lubricate piston.

Locate piston rings so that ring gaps are staggered and evenly spaced.

Fit piston assembly ring, Service Tool P.D.107, to piston, entering it from underside of piston with chamfered edge towards piston crown.

Remove bearing cap, big end bolts and bearing shells. If the old shells are to be re-used, they must not be interchanged.

FIGURE 32
FITTING PISTON TO ENGINE

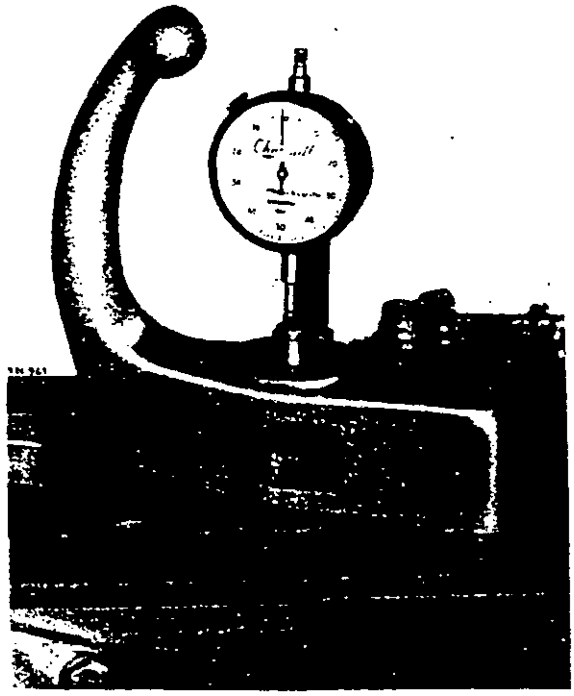

FIGURE 33
CHECKING PISTON HEIGHT

Check that number on connecting rod is to fuel pump side of engine.

Insert connecting rod and piston into cylinder bore.

Gently press piston through assembly ring into cylinder bore (Figure 32).

Turn crankshaft until appropriate crankpin is at B.D.C.

Fit big end bolts and upper bearing half, ensuring that tongue is correctly located.

Lubricate top bearing half and crankpin.

Draw connecting rod into position on crankpin.

Place bottom bearing half in bearing cap.

Lubricate bearing and fit cap to connecting rod, taking care that the position of the connecting rod bolts is not disturbed and that the cap marking coincides with the connecting rod.

Fit new self-locking nuts and evenly tighten to a torque of 70-80 lbs./ft.

With the crankshaft at T.D.C. the proximity of the piston crown to the cylinder block face should be within zero to — 0·005". Pre-top pistons should be within — 0·010" to + 0·004" (Figure 33).

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CYLINDER LINERS

REMOVING CYLINDER LINERS
(Refer Figure 34)

Remove the cylinder head and sump.

Remove pistons and crankshaft.

Remove cylinder head studs.

Using Service Tool No. P.D.50C and adaptor P.D.50C-3, withdraw cylinder liners (Figure 34).

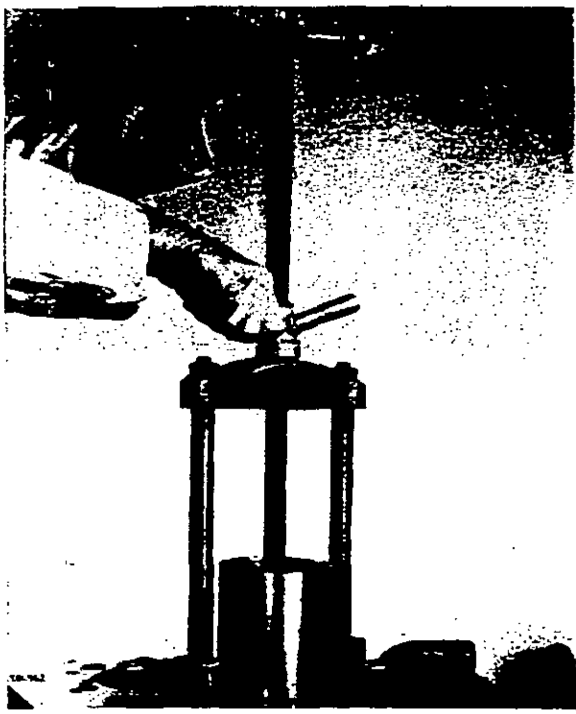

FIGURE 34
REMOVING CYLINDER LINERS

FITTING CYLINDER LINERS
(Refer Figure 35)

Using clean engine oil, lubricate the cylinder bore and the external surfaces of the cylinder liner. This oil should be applied with a pressure gun, or by hand. A brush or cloth must not be used for this purpose.

FIGURE 35
FITTING CYLINDER LINERS

PREPARATION FOR FITTING NEW LINERS

Care must be taken in the handling, transit, and storage of cylinder liners, as the slightest damage or burr can cause considerable distortion when the liner is pressed into position.

After removing the old liner, the parent bore must be thoroughly cleaned, and particular attention given to the top recess for the liner flange.

Ensure that the new liner is thoroughly cleaned. If kerosene has been used for this purpose, the liner must be dried before fitting.

Press or draw cylinder liner into position. Figure 35 shows Service Tool No. P.D.50C being used for this purpose.

It is advisable to allow a settling in period to elapse before checking the fitted internal bore of the liner. The acceptable limits are 3·6015"-3·6025" (91·48-91·504 mm.).

Each liner should be checked in three positions—top, centre and bottom.

When fully in position, the top face of the liner flange should be 0·001"-0·009" (0·0254-0·2286 mm.) below the top face of the cylinder block.

CRANKSHAFT & MAIN BEARINGS

MAIN BEARING CAPS (Refer Figure 36)

The main bearing caps are of high duty cast iron, and are located on ring dowels in the cylinder block. Two high tensile setscrews are fitted per cap and are locked by tab washers. The tab washers should be used once only..

In production, the main bearing parent bores are machined with the caps in position. If, therefore, a main bearing cap becomes damaged for any reason, it will be necessary to replace the complete cylinder block.

All bearings caps are numbered and must be returned to their original positions.

Main bearing and connecting rod bearings are supplied in undersizes of 0·010" (0·254 mm.), 0·020" (0·508 mm.) and 0·030" (0·762 mm.).

FIGURE 36
THE CRANKSHAFT AND BEARINGS

THE CRANKSHAFT

The crankshaft is forged from chrome molybdenum steel, and is fitted with two cast iron balance weights. These balance weights are matched as a pair and secured in position by two setscrews held in position by tab washers. The setscrews are tightened to a torque of 50-55 lbs./ft.

The rear of the crankshaft is machined to provide an oil thrower and an oil return scroll formed by single right hand helix machined to a depth of 0·004"-0·008" (0·1016-0·2032 mm.).

REMOVING THE CRANKSHAFT
(Refer Figures 36 and 37)

Remove flywheel, transmission housing adaptor plate, sump and timing case cover.

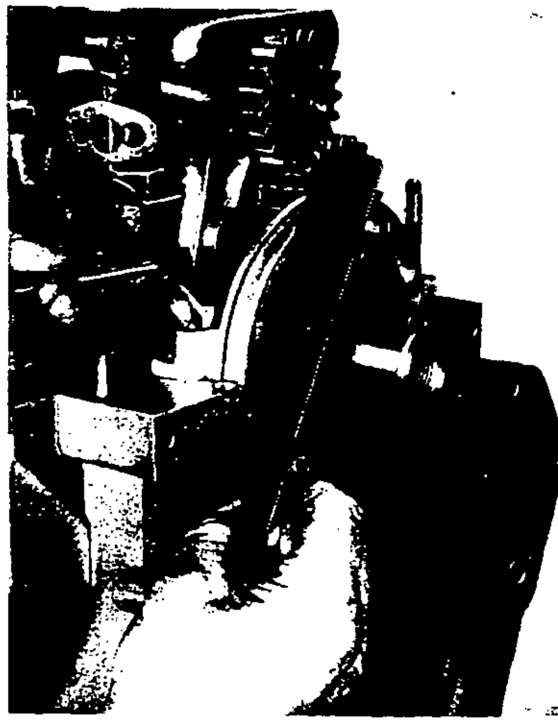

FIGURE 37
FITTING TIMING CASE BOTTOM COVER

Remove lubricating oil pump and idler gear.

Remove timing case bottom cover (Figure 37).

Remove bolts and self-locking nuts clamping the rear main oil seal housings.

Remove connecting rod caps and big end bearings.

Straighten out tabs on main bearing lockplates, and remove bearing cap setscrews.

Withdraw main bearing caps complete with lower bearing shells.

Remove crankshaft thrust washers.

Ensure that bearings—unless renewal is intended—are all identified with their location in the cylinder block and their respective bearing cap.

REPLACING THE CRANKSHAFT
(Refer Figure 36)

Locate upper, main bearing halves in their block positions.

Ensure all oilways and passages are clear and lubricate bearings.

Place thrust washers in position in block, oil grooves facing outwards. A light smear of grease will help retain them in position.

Carefully lower crankshaft into position.

Fit lower bearing halves to main bearing caps.

Fit lower thrust washers to rear main bearing cap.

Place main bearing caps in position, ensuring they are correctly located (Figure 36).

Evenly tighten main bearing caps to a torque of 110-120 lbs./ft.

Secure setscrews by bending over new tab washers.

Fit rear main bearing oil seal housings complete with new oil seals.

Fit timing case bottom cover.

CRANKSHAFT MAIN JOURNAL DIA.

Standard	2·7485"-2·7490"
Undersizes	—0·010", —0·020", —0·030"
Width of Nos. 2 and 3 Journals	1·21475"-1·22275"
Width of No. 4 Journal	1·87425" to 1·87725"
Max. permissible width of No. 4 Journal	1·89125"
Radius on all Journals (must be maintained)	0·09375"-0·109375"

CRANKPIN DIA.

Standard	2·2485"-2·2490"
Undersizes	—0·010", —0·020", —0·030"
Width of Crankpin	1·565"-1·5620"
Max. permissible width of crankpin after grinding	1·5785"
Radius of Crankpin	0·1563"-0·1719"

The surface finish on all surfaces must not exceed 16 micro-inches as measured by a profilometer. Radii on journals and crankpins must be maintained as quoted, otherwise fatigue fracture is likely to occur. After grinding, the sharp corners on the oil holes must be removed, and the shaft crack detected and demagnetised.

DATA

Bore ...	3·6" (91·44 mm.).
Stroke ...	5" (127 mm.).
Number of Cylinders ...	3.
Cubic Capacity ...	152·7 cu. ins. (2·5 litres).
Combustion System ...	Swirl Chamber.
Compression Ratio ...	17·4 : 1.
Firing Order ...	1, 2, 3.
Location of No. 1 Cylinder ...	Front of Engine.
Cylinder Liners ...	Chrome Plated.
Fuel Pump Static Timing ...	18° B.T.D.C.
Letter on Fuel Pump Rotor ...	E.
Letter on Hydraulic Head No. 1 Deliver Port ...	W.
Inlet Valve Opens ...	13° B.T.D.C.
Exhaust Valve Closes ...	10° A.T.D.C.
Valve Overlap ...	23°.
Valve Lift ...	0·36" (9·14 mm.)
Tappet Setting (Hot) ...	0·010" (·254 mm.)
Tappet Setting (Cold) ...	0·012" (·305 mm.)

TORQUE TIGHTENING FIGURES

Cylinder Head Nuts ...	55-60 lbs./ft.
Con. Rod Nuts ...	70-80 lbs./ft.
Main Bearing Setscrews ...	110-120 lbs./ft.
Flywheel Setscrews ...	75 lbs./ft.
Balance Weight Setscrews ...	50-55 lbs./ft.
Flywheel Diameter ...	14·75" (374·65 mm.)
Flywheel Run-out, Clutch Face ...	·001" per inch radius from flywheel centre to the dial indicator.
Flywheel Run-out, Periphery ...	·008".
Number of Teeth on Starter Ring Gear ...	115.
One Inch on Flywheel Rim equals ...	7·773°.
One Degree on Flywheel Rim equals ...	·1287" (3·269 mm.)
Starter Ring Gear Retention ...	Shrunk on.
Fuel Injection Pump ...	C.A.V.
Pressure Setting ...	120 Atmospheres.
Sprays of Atomiser ...	Twin Spray at 30° and 80° from the Vertical.
Fuel Lift Pump ...	A.C. Delco Diaphragm Type.
Fuel Filters ...	Purolator and C.A.V.
Lubricating Oil Pump ...	Rotor Type.
Pumping Capacity ...	Approximately 4·5 galls./min. at 2,000 r.p.m. Engine Speed.
Operating Oil Pressure ...	25-30 p.s.i. or more at Normal Speeds.
Relief Valve Setting ...	50-65 p.s.i.
Sump Capacity ...	10½ pints.
Lubricating Oil Filter Type ...	Tecalemit Full Flow.
Filter By-pass Valve Opens ...	13-17 p.s.i.
Thermostat Type ...	A.C. Delco 1572233.
Thermostat Opening Temperature ...	176°F.
Backlash in Timing Gears ...	·003"/·006" (·0762-·1524 mm.)
Backlash, Lubricating Oil Pump Gears ...	·012"/·018" (·305-·4572 mm.)