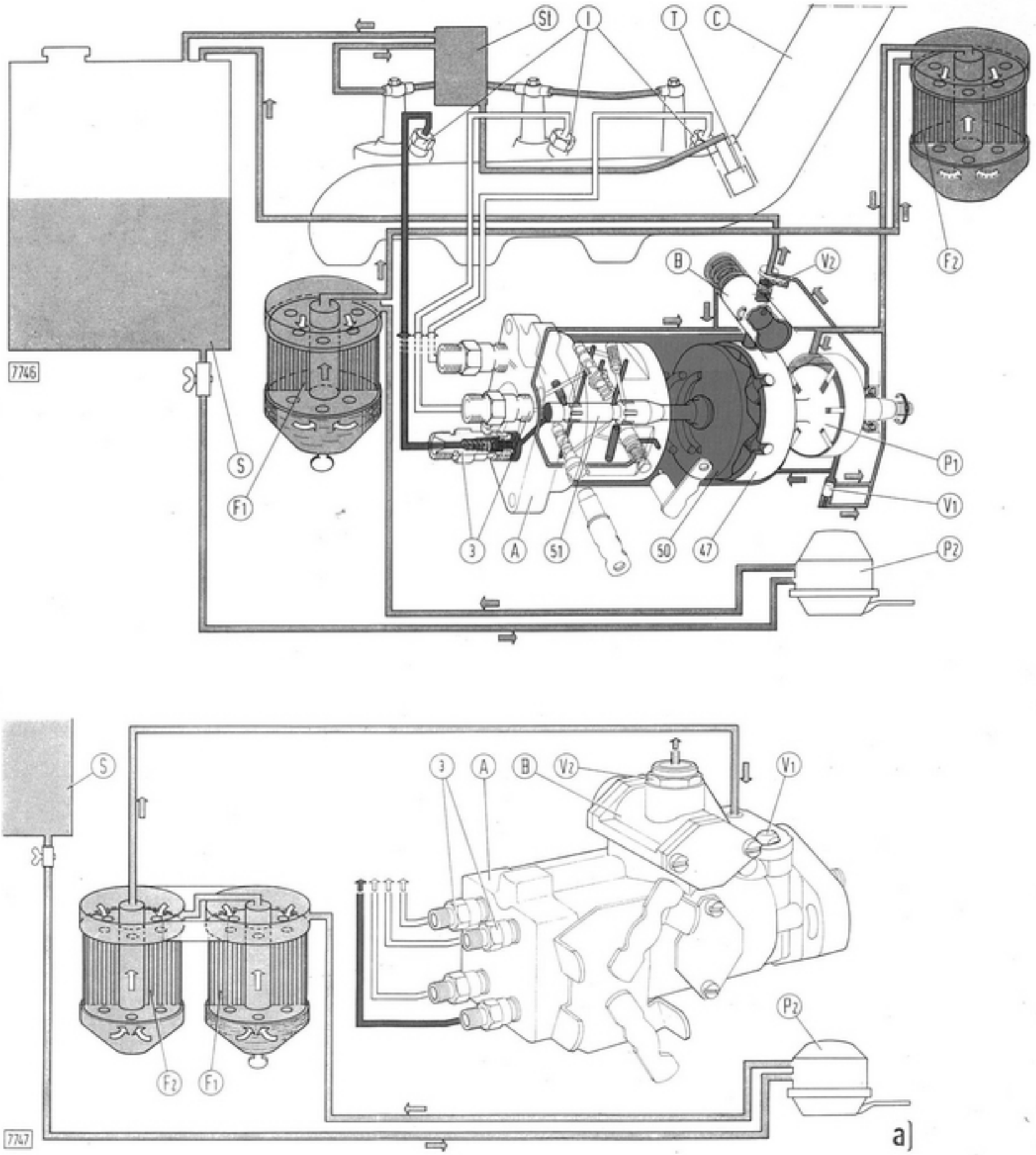
Fig. 60 - Fuel System Diagram - Model 455 C (3-cylinder), Bosch EP/VA-CL Type Injection Equipment

a. Variant applicable to Model 605 C (4-cylinder)

A. Hydraulic Head Assembly
B. Automatic Advance Variator
C. Inlet Manifold
F_1. Fuel Filter (in-line)
F_2. Fuel Filter (in-line)
I. Fuel Injectors
P_1. Transfer Pump (vane type)
P_2. Lift Pump (diaphragm type)
S. Fuel Tank
St. Thermostarter Reservoir
T. Thermostarter
V_1. Pressure Regulating Valve
V_2. Bleed and Check Valve
3. Fuel Delivery Connectors
47. Roller Carrier
50. Cam Plate
51. Rotor



Priming (inlet and outlet) and return pressures (plus thermostarter)

Transfer pressure

Injection pressure

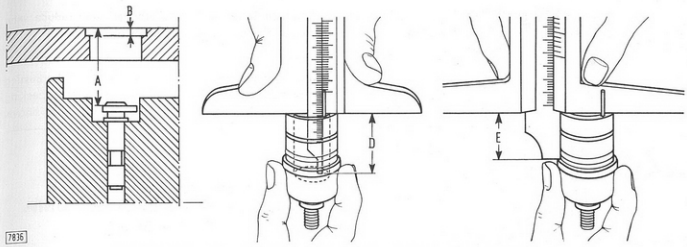


Fig. 61 - Dimensions A, B, D and E for Shut-off Spring Preload Adjustment

— The P.M. spring washer should face as shown in inset (a) and the ring filter is to be positioned with the round gauze passages offset with respect to the washer teeth.

— Advance variator piston (B) is to be positioned with the pressure side, incorporating orifice (13), facing towards regulating valve (V_1).

To Adjust Advance Spring Preload

On reassembly insert the same thickness of shims (S_3, Fig. 58) between spring and cover as found on dismantling. Final adjustment is carried out during bench testing when the piston stroke is checked at different speeds as prescribed (see Calibration Table) using tool No. **292817**.

To Adjust Shut-off Spring Preload

Thickness of shims (S) which determines the preload of spring (69, Fig. 64) fitted to the end of shuttle (70) is obtained as described below. Take measurements (A, B, D and E, Fig. 61), subtract A − B = C and D − E = F, and sum C + F = G.

Thickness of shims (S) is given by S = G − V, where G is the total depth of the spring seat, and V is the actual preloaded spring length as given on page 52 (see Assembly Data).

To Adjust Rotor Spring Preload and Check Spill Cut-off

To determine the required thickness of rotor spring shims (S_1, Fig. 58) take the two following measurements:—

— Depth of rotor seat on cam plate (see L_1, Fig. 62) from hydraulic head-to-pump contact face.

— Rotor protrusion (see L_2) from hydraulic head flange. To this end, replace spacer (M) No. **290778** for the return spring on the rotor, refit cup (54) and original shim (S_2).

The difference between (L_1) and (L_2) gives the thickness of shims (S_1, Fig. 58) to insert between rotor and cup. After inserting the shims check that dimensions (L_1 and L_2, Fig. 62) are identical.

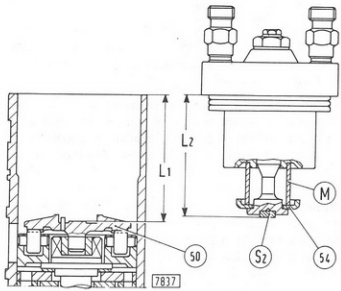


Fig. 62 - Adjusting Rotor Spring Preload
L_1. Rotor seat depth - L_2. Rotor protrusion (including S_2) - M. Spacer No. 290778 - S_2. Spill cut-off shim - 50. Cam plate - 54. Spring cup.

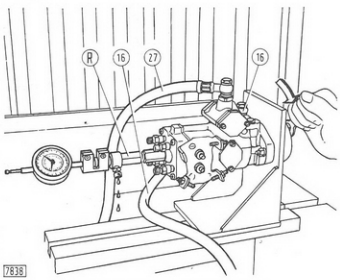


Fig. 63 - Checking Spill Cut-off
(The arrow indicates pump shaft direction of rotation).
R. Tool No. 290774 with dial gauge - 16. Test machine feed line - 27. Test machine return line.

Remove spacer No. **290778** and reassemble the pump refitting shim (S_3) between cam plate and rotor.

To check the rotor spill cut-off proceed as follows:—

— Place the pump assembly on the test machine (see Fig. 63), fit the drive coupling to the shaft and connect calibration fluid line (16) to the pump inlet and return line (27) to the check valve connector.

— Fit tool No. **290774** (R) with attached dial gauge to the hydraulic head.

— Feed the pump with calibration fluid at .2 kg/cm² (2.8 p.s.i.) and zero the dial gauge with the rotor in start of stroke position, when fluid should issue from the spill pipe.

— Turn the drive shaft anti-clockwise by hand (see arrow) until the fluid flow through the spill pipe ceases and take a dial gauge reading. The spill cut-off point is given on page 52 under "Assembly Data".

Note: To ensure that the actual point of spill cut-off has been reached, turn the pump shaft clockwise to back the rotor by .02 mm. (.0008 in.), when the fluid should start flowing again.

To adjust spill cut-off alter shim thickness (see S_3, Fig. 58) as necessary, i.e. increase thickness if rotor stroke to spill cut-off is longer than prescribed, and reduce shim thickness if the stroke is insufficient.

Note: Any change in (S_3) thickness involves readjusting (S_1) shims which, in turn, must be done after rechecking dimensions (L_1 and L_2, Fig. 62) as described above.

TO TEST AND CALIBRATE THE BOSCH INJECTION PUMP (455 C - 605 C)

Place the pump on the test machine, fit the drive coupling and establish the following hydraulic connections (see Fig. 65):—

— Test machine fluid line (16) to transfer pump inlet port, inserting 1.5 kg/cm² (21 p.s.i.) gauge of kit No. **290761**.

— Replace tool No. **292817** (T) for advance variator cover (29, Fig. 56) and connect 10 kg/cm² (142 p.s.i.) gauge of kit No. **290761** to check transfer pump outlet pressure.

— Test machine return line (27, Fig. 65) to check valve connector and pump delivery connectors to the injectors.

Fill the pump with calibration fluid and bleed by running for a while at 100 r.p.m., .2 kg/cm² (2.8 p.s.i.) test machine feed pressure.

Note: If in the course of pump overhaul major pump components (such as hydraulic head, cam plate, or transfer pump) have had to be renewed, running-in will be required prior to testing.
To this end run the pump for approximately 20 minutes at the rated speed, .2 kg/cm² (2.8 p.s.i.) feed pressure, and maximum fuel.

Subsequently, carry out the following checks in the order given in the table of page 53.

CONTROL LEVER POSITIONING

With the overhauled pump on the test machine, fit the control levers to the associated spindles and carry out the following adjustment:—

— Run the pump at the speed indicated for test No. 1

Inlet and return pressure (back leakage from excess fuel plunger)

Transfer pressure

Metering pressure

Injection pressure

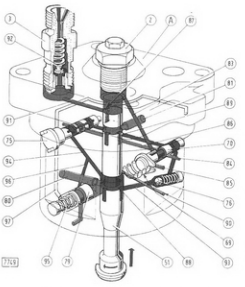
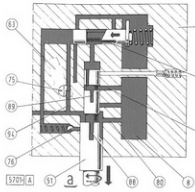


Fig. 64 - Fuel System Diagram - Bosch Type Distributor Pump

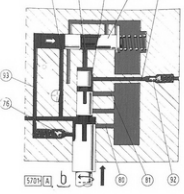
A. Hydraulic head
G. Shuttle stroke (from mechanical stop)
H. Shuttle stroke (from hydraulic stop)
2. Centre plug
3. Delivery connector
8. Rotor inlet chamber
51. Pumping and distributing rotor
60. Max. fuel and shut-off control lever
63. Throttle lever
69. Regulating spring
70. Shuttle valve
75. Metering valve
76. Non-return valve
78. Excess fuel plunger
80. Rotor filling port, metering section
81. Rotor filling port, injection section
82. Shut-off slot
83. Gallery, pumping chamber-to-shuttle
84. Exhaust port
85. Pressure release port
86. Compensating gallery
87. Segmental slot, distributor
88. Segmental slot, metering section
89. Segmental slot, injection section
90. Metering pressure inlet/exhaust gallery
91. Delivery line
92. Delivery valve
93. Metering pressure outlet gallery
94. Metering valve gallery
95. Excess fuel spring
96. Metering pressure bypass gallery
97. Return line

Phantom View of Hydraulic Head During Fuel Delivery



a. Filling Stroke

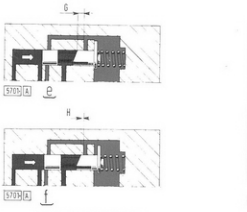
From inlet chamber (8), which is fed by the transfer pump, fuel is directed to the metering section of the rotor through filling port (80), and to the injection section through filling port (81).



b. Spill Cut-off

When filling ports (80 and 81) are closed fuel pressure passes non-return valve (76) and acts on shuttle (70) through galleries (93 and 94); higher up, fuel pressure is directed through segmental slot (87) which meets delivery line (91) at the instant of injection. The delivery fuel pressure also acts on the shuttle via gallery (83).

As metering pressure cau
with inlet chamber (8),
(92) closes. Additional f
The shuttle continues its



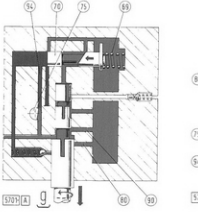
e, f and g. Fuel Metering

When the rotor returns toward starting position, spring (69) causes the shuttle to move back, thereby exhausting the metering fuel pressure through ports (94, 90 and then 80). Fuel flow through (94) is checked by the helix of throttle monitored metering valve (75) which controls the rate of flow to permit the return of the shuttle right up against the mechanical stop.

Time T_1 the shuttle takes to return to the mechanical stop is virtually constant for a given throttle lever position. Time T_1 actually available for shuttle return is from the start of rotor return and the instant of spill cut-off (see b). Accordingly, T_1 diminishes with increasing engine speed. Whilst T_1 does not exceed T_2 the shuttle can complete its return stroke to the mechanical stop which will result in a maximum fuel condition (see G, e) whereas when T_1 exceeds T_2 the shuttle stops short of its full stroke (hydraulic stop) and fuel delivery will be reduced accordingly (see H, f).

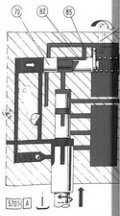
After engine starting (see i), speed increases fast and the consequent reduction of T_2 brings about a quick reduction in fuel delivery until a speed corresponding to the position of the accelerator is attained.

To increase speed the throttle lever is moved so as to increase the effective area of port (94). To reduce speed the lever must be moved in the opposite direction. Upon obtaining the desired speed, the metering system will take over to ensure that it is maintained, regardless of changes in load, right up to full load. That is any engine load increase causes a fall in engine speed resulting in a longer T_2 which means an extension of shuttle stroke, causing compensating changes of fuelling; thus, the engine can take the increased load maintaining the selected speed within close limits. Conversely, when the load is reduced a shorter shuttle return stroke will prevent revving-up.



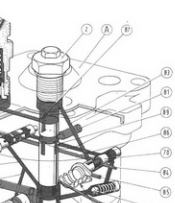
h. Compensated Fuel Metering

Metering valve (75) incorporates two opposed helix grooves which can alter the shuttle return stroke. The main groove controls the effective area of the port of metering valve gallery (94), whilst the other groove controls the effective area of the port of compensating gallery (86) which discharges directly into filling chamber (8). During metering valve rotation, the closure of port (94) causes port (86) to open, and vice versa. The combined action of the two ports provides the necessary degree of compensation over the engine speed range.

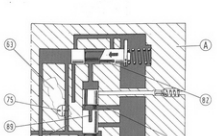


i. Shut-off

Manual rotation of shut-off lever (60), wh
rotation, connects shut-off slot (82) wit
port (85) to exhaust the injection pressure
(8).



w of Hydraulic Head During Fuel Delivery



a. Filling Stroke

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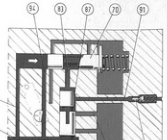
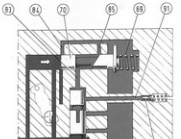
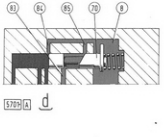


b. Spill Cut-off

When filling ports (80 and 81) are closed fuel pressure passes non-return valve (76) and acts on shuttle (70) through galleries (93 and 94); higher up, fuel pressure is directed through segmental slot (87) which meets delivery line (91) at the instant of injection. The delivery fuel pressure also acts on the shuttle via gallery (83).





c and d. End of Delivery

As metering pressure causes the shuttle to increase the effective area of port (85, c), which communicates with inlet chamber (8), fuel pressure in gallery (83) and delivery line (91) decreases, and delivery valve (92) closes. Additional fuel pressure is exhausted into inlet chamber (8) through gallery (83) and port (85). The shuttle continues its stroke until port (84, d) is uncovered, when the metering pressure is exhausted.

d g. Fuel Metering

move back, thereby exhausting the metering fuel pressure through ports (94, 90 and then 80). 5) which controls the rate of flow to permit the return of the shuttle right up against the mechanical stop.
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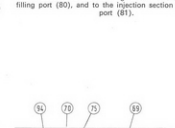
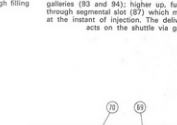
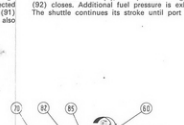




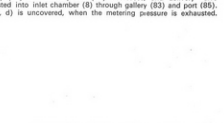
h. Compensated Fuel Metering

Metering valve (75) incorporates two opposed helix grooves which can alter the shuttle return stroke. The main groove controls the effective area of the port of metering valve gallery (94), whilst the other groove controls the effective area of the port of compensating gallery (86) which discharges directly into filling chamber (8). During metering valve rotation, the closure of port (94) causes port (86) to open, and vice versa. The combined action of the two ports provides the necessary degree of compensation over the engine speed range.



i. Shut-off

Manual rotation of shut-off lever (60), which causes shuttle rotation, connects shut-off slot (82) with pressure release port (85) to exhaust the injection pressure into filling chamber (8).



l. Excess Fuel

On starting and at very low engine speed filling chamber pressure is virtually nil, and excess fuel plunger (79) is forced by spring (95) to connect the metering section of the rotor with filling chamber (8) via bypass gallery (96), so as to prevent any metering pressure build-up. Shuttle (70) abuts the mechanical stop and the full rotor stroke results in maximum fuel delivery to the injectors. Increasing engine speed causes a filling chamber pressure build-up which overcomes the excess fuel spring and moves the plunger downwards, thereby discontinuing communication between rotor and filling chamber to re-establish normal fuel metering conditions.

and, using tool No. **292556**, bring shuttle spindle (68, Fig. 65) to a position from which leftward rotation will bring about fuel shut-off and rightward rotation will cause an increase in fuel delivery.

- Maintain the same speed, turn metering valve spindle (72) clockwise to increase delivery, and stop when no further increase in delivery occurs.
- Bring pump speed to test No. 2 rating and turn shuttle spindle (68) by trial and error until the position corresponding to the specified delivery is found.
- Hold the shuttle spindle still, bring pump speed to test No. 3 rating and turn metering valve spindle (72) until the prescribed delivery is obtained.

Hold both spindles in position and install the control levers ensuring that upper lever (60, Fig. 56) abuts maximum fuel adjusting screw (62), and lower lever (63) contacts maximum speed adjusting screw (65).

Note: Prior to refitting the return spring to shuttle lever (60, Fig. 56) ensure that upon moving the lever anti-clockwise delivery is discontinued before stop position is reached. If necessary, alter lever position relative to spindle. The return spring of throttle lever (63) should be refitted only after completing the idling check.

TO CHECK TRANSFER PRESSURE AND ADJUST REGULATING VALVE

Run the pump at the speed indicated for test Nos. 4, 5 and 6 and check for incorrect transfer pressure ratings using a 0-16 kg/cm² (0-230 p.s.i.) pressure gauge.

To adjust turn regulating valve adjusting screw (53, Fig. 58) using tool No. **292557**, screw in to increase and back off to reduce. Prior to backing off remove retainer (52), using tool No. **292553**, valve plunger and spring.

TO CHECK SPEED ADVANCE

Using tool No. **292817** (T, Fig. 65), check advance piston stroke (see B, Fig. 58) at the speed indicated for test Nos. 7, 8 and 9.

This check is influenced by transfer pressure and tester feed pressure and, therefore, should be carried out first. To adjust piston stroke alter the thickness of piston spring preload shims (S_3, Fig. 58) as necessary.

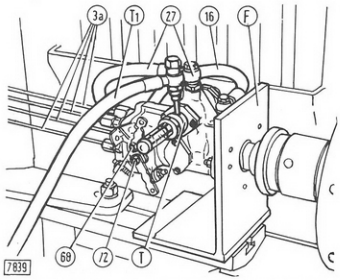


Fig. 65 - Injection Pump in Position on Test Machine
F. Pump bracket tool No. 290763 - T. Advance gauge tool No. 292817 - T_1. Pressure line connected to 0-10 kg/cm² gauge of kit No. 290761 - 3a. Fuel delivery lines to injectors - 16. Test machine feed line - 27. Pump body return line (connected to graduated burette, if applicable) - 68. Shuttle spindle - 72. Metering valve spindle.

TO CHECK FUEL DELIVERY AND GOVERNOR OPERATION

Start testing from the highest speeds and work downwards according to the data given in the Calibration Table.

a. Excess Fuel

Carry out test Nos. 10 and 11 at the prescribed speeds with both throttle and shuttle levers in fully open position. If the prescribed delivery is not obtained it could be that excess fuel plunger (79, Fig. 64) is incorrectly positioned (check the associated retaining plug), or excess fuel spring (95) is inefficient.

b. Maximum (Governed) Speed

Hold both control levers in fully open position, bring pump speed to the ratings given for test Nos. 12 and 13 and check fuel delivery, which should be nil at governor drop-off speed, and as prescribed at the lower governor cut-in rating. To adjust turn maximum speed adjusting screw (65, Fig. 56) as necessary.

c. Maximum Fuel and Back Leakage

Scan the delivery curve at the speeds indicated for test Nos. 14, 15, 16 and 17, with the throttle and shut-off controls fully open. To adjust turn screw (62, Fig. 56) as necessary, noting that the maximum permissible

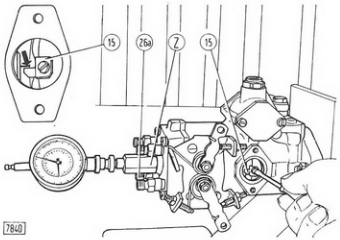


Fig. 66 - Timing the Pump

Z. Tool No. 290781 with dial gauge - 15. Timing pointer (to be aligned to cam plate mark arrowed in the inset) - 26a. Delivery connector marked "A" (corresponding to injector of engine cylinder No. 1).

delivery variation (spread) between injectors is 2.5 mm³/cycle. If the spread is found to be greater than the above, the cause may be traced to the injectors, delivery valves or connectors thereof (incorrectly tightened).

Where applicable, also check back leakage flow by connecting pump body return line (27, Fig. 65) to a graduated burette. If the back leakage flow is lower than prescribed, the cause could be low transfer pump output or inefficient check valve.

d. Minimum (Idling) Speed

Set throttle lever (63, Fig. 56) against idling speed adjustment screw (66) and shut-off lever (60) abutting maximum fuel adjusting screw (62).

Run the pump at the speeds given for test Nos. 18 and 19 and check fuel delivery, which should be nil at the higher limit, and as prescribed at the lower speed. To adjust turn screw (66) as necessary.

INTERNAL TIMING

Remove centre plug (2, Fig. 56) from the hydraulic head and turn the pump drive shaft to align segmental slot (87, Fig. 64) to delivery connector (26a, Fig. 66) marked "A", coupled to engine cylinder No. 1. Fit tool No. **290781** (see Z) and zero the dial gauge with the rotor in start of stroke position.

Remove timing cover (48, Fig. 56) to gain access to the timing pointer (see Fig. 66) and slowly rotate the drive shaft anti-clockwise until the rotor has moved 1 mm (.040 in.). Hold the shaft still and align pointer (15) to the cam plate mark applied in production.

BOSCH INJECTION PUMP CALIBRATION DATA (455 C - 605 C)

For injection pump calibration, use either of the following test procedures.

TEST PROCEDURE A

Bosch test machine with WSF 2044/4X injector spring and EFEP 182 spray nozzles.

RABOTTI test machine with graduated ring nut injectors incorporating FIAT 656829 springs and EFEP 182 spray nozzles.

Pipes, 2 × 6 × 840 mm.

Release pressure, 150 kg/cm² (2,133 p.s.i.).

TEST PROCEDURE B

BOSCH or RABOTTI test machine with injector bodies and nozzles as fitted to engine.

Pipes, 1.5 × 6 × 700 mm.

Release pressure, 225 to 235 kg/cm² (3,200 to 3,343 p.s.i.).

CALIBRATION FLUID

FIAT CFB at 40° + 5 °C. (for lower test temperatures add .25 mm³/cycle to each degree).

Feed pressure, .2 kg/cm² (2.8 p.s.i.).

ASSEMBLY DATA

Rotor stroke to spill cut-off:—

— Model 455 C, .7 ± .02 mm. (.0280 ± .0008 in.).

— Model 605 C, .5 ± .02 mm. (.0200 ± .0008 in.).

Pre-loaded shuttle spring length (dimension V, page 49), 24.6 mm. (.9685 in.).

Shims supplied as spare parts:—

— Rotor spring pre-load shims (S_1, Fig. 58), thickness range, 1, 1.2, 1.4, 1.6 and 1.8 mm. (.040, .048, .056, .064 and .072 in.).

— Spill cut-off shims (S_2), 1.80 to 2.90 mm. in .05 mm steps (.072 to .114 in. .002 in. steps).

— Advance spring pre-load shims (S_3), .6, .8, 1, 1.2, 1.4 and 3 mm. (.024, .032, .040, .048, .056 and .118 in.).

BOSCH DISTRIBUTOR PUMP TYPE EP/VA 3/110 H - 1200 CL 134-4 - 769589 (455 C)

TEST DESCRIPTION	TEST No.	Control lever position L_1 = Shuttle L_2 = Throttle	Speed r.p.m.	Transfer pressure Kg/cm²	Advance piston stroke (²) mm	PROCEDURE A Injector delivery cm³/1000 shots	PROCEDURE A Back leakage cm³/100 shots	PROCEDURE B Injector delivery cm³/1000 shots	PROCEDURE B Back leakage cm³/100 shots
Control lever position (¹)	1	—	1200	—	—	—	—	—	—
	2		700±5	—	—	61.5 to 63.5	—	50 to 52	—
	3		1250	—	—	27 to 35	—	18 to 26	—
Transfer pressure	4	—	100	0.6 to 1.1	—	—	—	—	—
	5		700±5	5 to 5.5	—	—	—	—	—
	6		1200	7 to 7.5	—	—	—	—	—
Speed advance	7	—	250 to 400	—	0 (start)	—	—	—	—
	8		700±5	—	4 to 5	—	—	—	—
	9		1150 to 1200	—	9.5 (end)	—	—	—	—
Excess fuel	10	L_1 : max L_2 : max	250	—	—	up to 65	—	up to 55	—
	11		100	—	—	130 or over	—	130 or over	—
Governed speed (⁴)	12	L_1 : max L_2 : max	1300 to 1350	—	—	0	—	0	—
	13		1250	—	—	27 to 35	—	18 to 26	—
Maximum fuel and back leak (³)	14	L_1 : max L_2 : max	1200^{+0}_{-20}	—	—	57.5 to 59.5 (⁵)	—	44 to 46 (⁵)	—
	15		1000	—	—	—	45 to 70	—	45 to 70
	16		700±5	—	—	61.5 to 63.5	—	50 to 52	—
	17		500±5	—	—	63 to 65	80 to 110	53 to 55	80 to 110
Idling speed (⁴)	18	L_1 : max L_2 : min	400 to 500	—	—	0	—	0	—
	19		350	—	—	12 to 22	—	10 to 18	—

BOSCH DISTRIBUTOR PUMP TYPE EP/VA 4/110 H - 1100 CL 136-1 - 769521 (605 C)

Control lever position (¹)	1	—	1100	—	—	—	—	—	—
	2		800±5	—	—	56.6 to 59.5	—	47.5 to 50.5	—
	3		1150	—	—	27 to 35	—	18 to 26	—
Transfer pressure	4	—	100	0.6 to 1.1	—	—	—	—	—
	5		800±5	4.7 to 5.2	—	—	—	—	—
	6		1100	6 to 6.5	—	—	—	—	—
Speed advance	7	—	250 to 400	—	0 (start)	—	—	—	—
	8		800±5	—	3.5 to 4.5	—	—	—	—
	9		1050 to 1100	—	6.5 (end)	—	—	—	—
Excess fuel	10	L_1 : max L_2 : max	300	—	—	up to 62	—	up to 56	—
	11		100	—	—	130 or over	—	130 or over	—
Governed speed (⁴)	12	L_1 : max L_2 : max	1200 to 1250	—	—	0	—	0	—
	13		1150	—	—	27 to 35	—	18 to 26	—
Maximum fuel and back leak (¹)	14	L_1 : max L_2 : max	1100^{+0}_{-20}	—	—	54.5 to 57.5 (⁵)	—	45.5 to 48.5	—
	15		1000	—	—	—	45 to 70	—	45 to 70
	16		800±5	—	—	56.5 to 59.5	—	47.5 to 50.5	—
	17		500±5	—	—	59.5 to 62	80 to 110	51.5 to 54	80 to 110
Idling speed (⁴)	18	L_1 : max L_2 : min	400 to 500	—	—	0	—	0	—
	19		350	—	—	12 to 22	—	10 to 18	—

(¹) Preliminary inspection on overhauled pumps (see page 50)
(²) Use tool No. 292817 (adjust by altering thickness of shims S_2, Fig. 58)
(³) Maximum spread 2.5 mm³/cycle
(⁴) Adjust screw (65, Fig. 56)
(⁵) Adjust screw (62)
(⁶) Adjust screw (66)

C.A.V. INJECTION PUMP (455 C - 505 C - 605 C)

The C.A.V. fuel injection equipment (see Fig. 67) incorporates the following:—

— Vane type transfer pump (P_1, Fig. 68) with integral regulating valve (V_1) supplying a gradually higher pressure with increasing rotational speed (see Fig. 80).

— Pumping and distributing rotor (46, Fig. 68) fitted with two pump plungers (13) which pump and distribute fuel pressure to the injectors (see Fig. 81).

— All-speed centrifugal weight mechanical governo (2, Fig. 68).

— Automatic advance variator (B, Fig. 68), operate by fuel pressure from the transfer pump (see Fig. 71)

— Transfer pressure damper (97, Fig. 69), applicabl to pumps fitted to 3-cylinder engines (models 455 and 505 C), which stabilises transfer pressure.

The pump is controlled through throttle lever (36, Fig. 69 and shut-off lever (32).

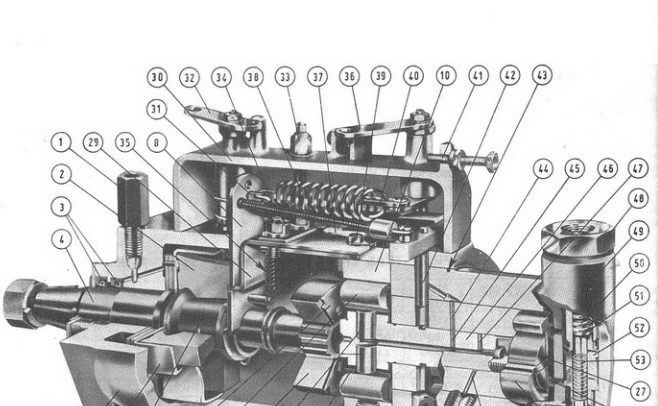


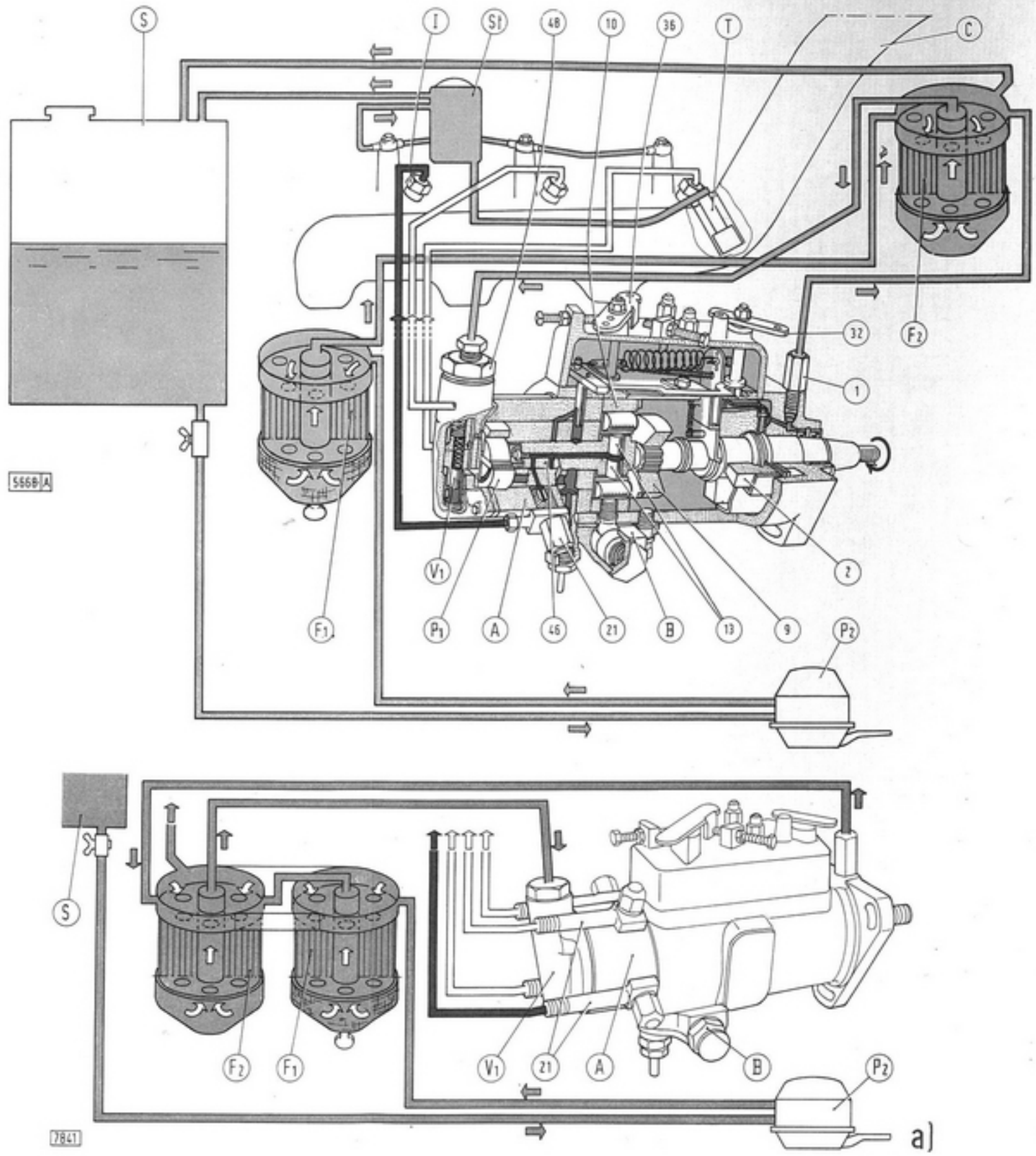
Fig. 67 - Section through C.A.V. Fuel Injection Pump

1. Drain connector - 2. Governor flyweight - 3. Shaft seals - 4. Drive shaft - 5. Thrust sleeve - 6. Weight retainer - 7. Pump body - 8. Governor control arm - 9. Internally splined drive plate - 10. Cam ring - 11. Maximum fuel adjustment plate - 12. Roller - 13. Pump plunger - 14. Roller shoe - 15. Circlip (timing ring) - 16. Housing stud - 17. Advance device housing - 18. Cam advance lever - 19. Head locating fitting and transfer pressure fuel passage to advance piston chamber - 20. Manual start-retard control - 21. Delivery connector - 22. Delivery port - 23. Hydraulic head - 24. Head seal - 25. Transfer pump liner - 26. End plate retaining screw - 27. Transfer pump rotor - 28. Vanes - 29. Control bracket - 30. Control cover - 31. Idling spring guide - 32. Shut-off control lever - 33. Cover retaining nut - 34. Spring-loaded linkage hook - 35. Governor arm spring - 36. Throttle control lever - 37. Shut-off bar - 38. Governor spring - 39. Control bracket retaining screw - 40. Throttle link - 41. Maximum speed adjusting screw - 42. Metering valve - 43. Head sealing ring - 44. Metering port - 45. Inlet port - 46. Rotor - 47. Distributing port - 48. Inlet connection - 49. End plate and regulating valve - 50. Retaining spring - 51. Spring guide - 52. Valve sleeve - 53. Regulating spring - 54. Piston - 55. Priming spring

Fig. 68 - Fuel System Diagram - Models 455 C and 505 C (3-cylinder), C.A.V. (type DPA) Injection Equipment

a. Variant applicable to Model 605 C (4-cylinder)

A. Hydraulic Head Assembly
B. Automatic Advance Variator
C. Inlet Manifold
F_1. Fuel Filter (in-line)
F_2. Fuel Filter (in-line)
I. Fuel Injectors
P_1. Transfer Pump (vane type)
P_2. Lift Pump (diaphragm type)
S. Fuel Tank
St. Thermostarter Reservoir
T. Thermostarter
V_1. Pressure Regulating Valve
1. Drain Connector
2. Governor Weights
9. Drive Plate
10. Cam Ring
13. Pump Plungers
21. Delivery Connector
32. Shut-off Lever
36. Throttle Lever
46. Rotor
48. Inlet Connection



Priming (inlet and outlet) and return pressures (plus thermostarter)

Transfer pressure

Injection pressure

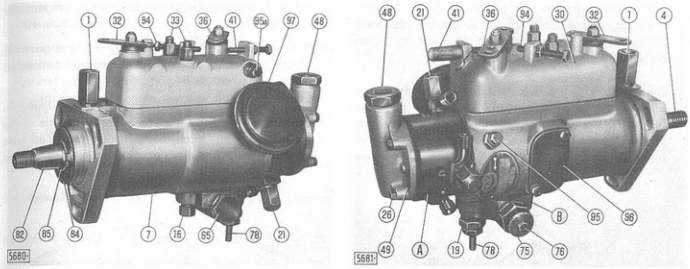


Fig. 69 - Injection Pump for 3-cylinder Engine

A. Hydraulic head - B. Automatic advance variator - 1. Drain connector - 4. Drive shaft - 7. Pump body - 16. Advance housing stud - 19. Head location fitting and transfer pressure fuel passage to advance piston chamber - 21. Delivery connector - 26. End plate screw - 30. Control cover - 32. Shut-off lever - 33. Control cover retaining nuts - 36. Throttle lever - 41. Maximum speed adjusting screw - 48. Inlet connection - 49. End plate and regulating valve - 65. Piston plug - 75. Piston spring cap - 76. Cap screw (advance tester connection) - 78. Manual start-retard lever - 82. Woodruff key - 84. Thrust washer - 85. Circlip - 94. Idling adjustment screw - 95. Vented head screw - 95a. Governor vent screw - 96. Cover plate - 97. Transfer pressure damper (applicable to 3-cylinder engine applications only, where it is fitted in place of a head screw).

TO OVERHAUL

Dismantle the pump using the special tools indicated in the associated list. To prevent transfer pump liner failure (see 27, Fig. 72), which incorporates a left-hand thread, use tool No. **290744** and unscrew in an anti-clockwise direction.

On reassembly note the following points:—

— Metering valve (42, Fig. 81) is available with ,001 mm (.00004 in.) oversize dia.

— Rotary shaft seals (3, Fig. 70) are to be refitted with the sealing lip facing towards the inside and with the spacer sandwiched between them.

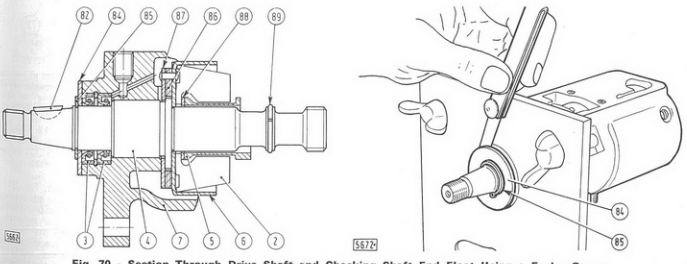


Fig. 70 - Section Through Drive Shaft and Checking Shaft End Float Using a Feeler Gauge

2. Governor weights - 3. Shaft seals - 4. Pump drive shaft - 5. Thrust sleeve - 6. Weight retainer - 7. Pump body - 82. Woodruff key - 84. Thrust washer - 85. Circlip - 86. Rubber damper pads - 87. Damper plate - 88. Thrust washer - 89. Sleeve stop ring.

— Pump drive shaft end float should be .05 to .19 mm. (.002 to .008 in.). To check assess the clearance between thrust washer (84, Fig. 70) and the pump body. Replace the washer as necessary.

— Circlip (15, Fig. 67) is to be positioned in the pump body with the ends towards the centre of cover plate (96, Fig. 69) and with the sharp edge, which is used as timing reference, facing downwards or upwards according to whether the pump is for use on a 3-cylinder or 4-cylinder engine respectively (see Fig. 79).

— For maximum fuel device (see Fig. 74) and governo linkage reassembly and adjustment proceed as directe below.

— Cam ring (10, Fig. 67) should rotate freely in the pump body and the arrow stamped on one of the cam ring faces must point in an anti-clockwise direction, i.e. in the direction of pump rotation as seen

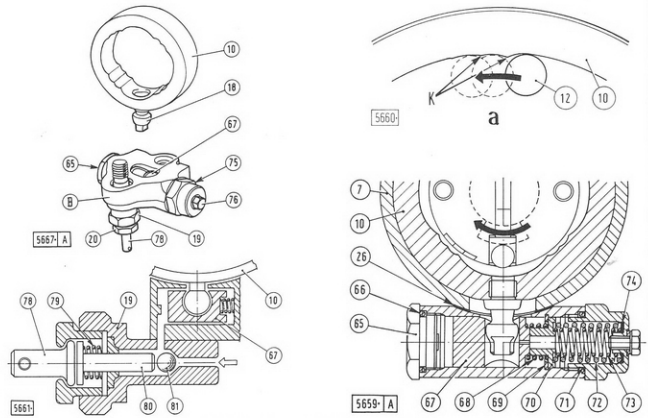


Fig. 71 - Automatic Advance Mechanism

a. Cam ring lobes:—

— The rollers (12) which operate the plungers do not follow the contour of the internal cam ring but contact the cam lobes at points which vary according to the degree of plunger displacement (see Fig. 81, a). Also, the cam lobes are contoured to provide relief of pressure in the injector lines at the end of the injection cycle; this gives a sharp cut-off of fuel and prevents "dribble" at the nozzles. In fact, as roller (12), which moves in the direction of the arrow, reaches the top of the cam lobe is instantaneously backed off along (K), resulting in increased chamber volume.

B. Advance device - K. Roller back-off area - 7. Pump body - 10. Cam ring (6 lobes for 3-cylinder, 4 lobes for 4-cylinder) - 12. Roller - 18. Cam advance lever - 19. Head locating fitting and transfer pressure fuel passage - 20. Manual start-retard control - 26. Gasket - 65. Piston plug - 66. O-ring - 67. Advance piston - 68. Start-retard spring - 69. Circlip - 70. Spring plate - 71. O-ring - 72. Outer piston spring - 73. Inner piston spring - 74. Spring pre-load shims - 75. Piston spring cap - 76. Cap screw (advance tester connection) - 78. Manual start-retard lever - 79. Return spring - 80. Plunger - 81. Non-return valve.

Operation - Transfer pressure reaching fitting (19) via transfer pressure gallery (92, Fig. 81) and transfer pressure port (99, Fig. 81) displaces non-return valve (81) and acts on piston (67) which causes cam advance lever (18) to turn cam ring (10), thereby advancing the ignition timing according to engine speed. Non-return valve (81) has a double (start-retard and speed advance) function. Upon starting, non-return valve ball is pushed against its seat by plunger (80), activated through manual lock (78), to cut off fuel pressure. Consequently, piston (67) is pushed right up to plug (65) and cam ring (10) is held in the full retarded position. When the engine is running the ball acts as a non-return valve to prevent fuel pressure from leaving the advance chamber when the rollers are displaced by the cam ring, thereby quickly reducing ignition timing advance. During deceleration ignition advance reduction is more gradual, as the decreasing transfer pressure delays the normal leakage of fuel past the piston which will move until a new state of equilibrium is reached. Transfer pressure acting on the advance piston is opposed by the resistance of spring (68) at idling speed, and springs (72 and 73) at the higher speeds when the piston starts to exert a thrust on spring plate (70).

from the drive end. The pump data plate carries an identical arrow.

— Transfer pump liner (25, Fig. 72) has a single assembly position and is restrained by locating pin (58) pressed in end plate (49). In case of doubt as to the correct assembly position, note that the locating pin is to be fitted to the side bearing the letter "A" stamped on the outer surface.

To Rebuild and Adjust Maximum Fuel Device

Maximum fuel device operation is explained in Fig. 73.

On reassembly, refit the components to rotor (46, Fig. 74) so that reference slot in front adjusting plate (11a) and the milled recess in the periphery of drive flange (9), with letter "A" facing as shown, are in alignment with the reference line stamped on the rotor.

Prior to retightening screws (64) ensure that maximum roller spacing is as prescribed (see Assembly Data, page 61).

To check roller spacing proceed as follows:—

— Connect one end of tool No. **290755** (R, Fig. 75) to hand pump tool No. **290284** (T) fitted with FIAT CFB fluid, and the other end to one hydraulic head delivery connector holes.

— Actuate the hand pump until a pressure of 30 kg/cm² (427 p.s.i.) is reached. Do not exceed the stated pressure. Turn the rotor by hand until both pump plungers and rollers are thrown fully outwards (maximum fuel position, see Fig. 73) and using a micrometer gauge, check roller spacing and compare with the prescribed value.

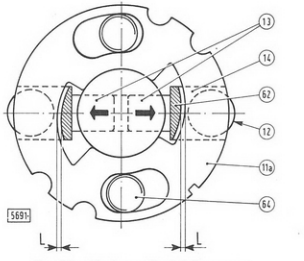


Fig. 73 - Maximum Fuel Adjustment

L. Plunger stroke to maximum fuel position - 11a. Front adjusting plate - 12. Roller - 13. Pump plungers - 14. Roller shoe - 62. Shoe ear - 64. Retaining screw.

Maximum Fuel Device Operation - Maximum fuel delivery to the injectors is related to maximum plunger stroke during the metering phase (see a, Fig. 81). This stroke is controlled by the eccentric slots of adjusting plates (11 and 11a, Fig. 74) which check roller shoe ear displacement (see 14 and 62). Pump plunger stroke can be adjusted by slackening adjusting plate screws (64) and turning the adjusting plates slightly, so as to alter roller shoe ear abutment point (see Fig. 74).

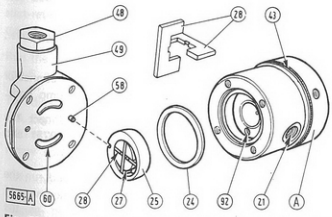


Fig. 72 - Transfer Pump, Hydraulic Head and End Plate

A. Hydraulic head - 21. Delivery connector hole - 24. End plate gasket - 25. Transfer pump liner - 27. Transfer pump rotor - 28. Transfer pump blades - 43. Head sealing ring - 48. Inlet connection - 49. End plate - 58. Liner locating pin - 60. Fuel passage to transfer pump inlet - 92. Transfer pump outlet.

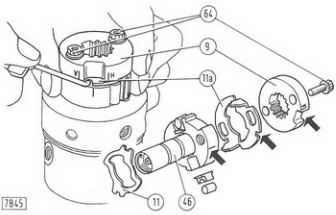


Fig. 74 - Reassembling Maximum Fuel Adjustment Device

(Arrows indicate reference slot in plate 11a, reference letter "A" and milled recess in flange 9 to be in alignment with rotor reference line).

9. Internally-splined drive flange - 11. Rear adjusting plate - 11a. Front adjusting plate - 46. Rotor - 64. Plate and flange retaining screws.

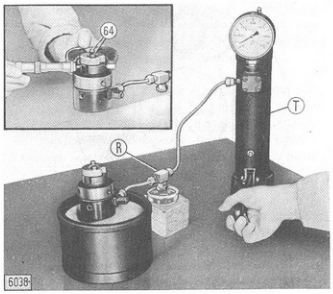


Fig. 75 - Checking Roller Spacing
T. Hand pump No. 290284 - R. Tool No. 290755 with relief valve set to 30 kg/cm² (427 p.s.i.) - 64. Flange retaining screws.

— To adjust, turn the adjusting plates as necessary (see Fig. 74) and retighten the screws to the prescribed torque.

To Reassemble and Adjust Control Linkage

Rebuild referring to Fig. 82 and set the internal dimension between one governor control stud and the metering valve lever pin (see Fig. 76) to the figure quoted in the Assembly Data of page 61.

Adjustment is made by screwing in or backing off the nut on the end of hook lever (34).

When setting, apply a light pressure on governor control arm (8) to hold the metering valve in fully open position, and hold the vernier gauge parallel to axis of pump.

Finally, re-position the governor spring and hook onto control link (see Fig. 83) as directed under Assembly Data, page 61.

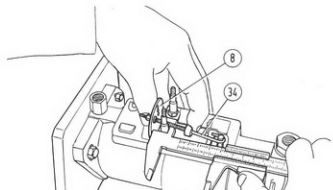


Fig. 76 - Setting Governor Linkage
8. Governor control arm - 34. Hook lever.

TO TEST AND CALIBRATE THE C.A.V. INJECTION PUMP (455 C - 505 C - 605 C)

Place the pump on the test machine, fit the drive coupling No. **290756** and establish the following hydraulic connections (see Fig. 77):—

— Test machine fluid line to fuel inlet connection No. **290751** (A), and vacuum gauge of kit No. **290761**.

— 0-10 kg/cm² gauge to connector No. **290749** (B) fitted in replacement of head screw (95, Fig. 69).

— Test machine return line to drain connector No. **290750** (D, Fig. 77).

— Delivery connectors to fuel injectors.

Fit the necessary test equipment, fill the pump with calibration fluid and bleed as follows:—

— Slacken vent screw (95a, Fig. 69) on control cover, and connector (B, Fig. 77).

— Connect test machine fluid line to connector No. **290750**, open fuel tap and fill the pump body.

— Re-establish normal connections, i.e. connect the tester fluid line to inlet connector No. **290751** and return line to drain connector No. **290750**.

— Slacken the injector delivery connectors and run the pump at 100 r.p.m. Re-tighten the vent screws and the above-mentioned connectors as soon as the issuing fluid is free from air bubbles.

On completion of pump filling check for leakage at the mating faces, connections and seals.

Subsequently, carry out the following checks in the order given in the tables of pages 62 and 63, noting that the pump is to be bled whenever a tool or connector is removed.

Unless otherwise stated, all tests are to be carried out with the shut-off lever not activated.

TO CHECK TRANSFER VACUUM/PRESSURE AND ADJUST REGULATING VALVE

Run the pump at the speed indicated for test Nos. 1 and 2 and check that 406 mm. Hg of vacuum are reached within the specified time. Insufficient vacuum could be due to incorrect reassembly (regulating valve, end plate 49, Fig. 72, or pump liner), inefficient seals, or excessive wear or failure of pump vanes. Subsequently, check the transfer pressure using a 0-10 kg/cm² gauge. If necessary, pump priming should be carried out prior to testing.

If the pressure rating is not as prescribed, renew regulating spring (53, Fig. 80) and spring guide (51).

TO CHECK SPEED ADVANCE AND START-RETARD

Remove cap screw (76, Fig. 69) from the advance device and fit gauge No. **290743** (H, Fig. 77) with the pick-up inserted in the hole of spring plate (70, Fig. 71). On 3-cylinder engine applications, also fit connector No. **290760** (M, Fig. 77) in replacement of manual start-retard control; this connector promotes advance reading accuracy in that it reduces reference pointer flutter.

Run the pump at the speeds indicated for test Nos. 3, 4 and 5, and take ignition advance readings on the gauge.

To adjust alter the thickness of spring pre-load shims (74, Fig. 71), thickness range being .5 to 3 mm (.020 to .120 in.). If the thickness required is outside this range, renew springs (72 and 73).

Refit the manual start-retard control (if applicable) and check that upon activating the control with the pump running at the speed indicated for test No. 6, ignition advance is nil. On 3-cylinder engine applications, check that at the speed indicated for test No. 7 the full advance position is reached. If full advance is not obtained repeat the previous tests.

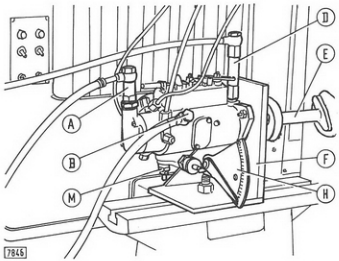


Fig. 77 - Injection Pump in Position on Test Machine
A. Fuel inlet connection No. 290751 (connected to vacuum gauge of kit No. 290761) - B. Connector No. 290749 for transfer pressure check (connected to 0-10 kg/cm² gauge) - D. Drain connector No. 290750 (connected to burette, if applicable) - E. Drive coupling No. 290756 - F. Pump bracket No. 290763 - H. Advance tester No. 290743 - M. Connector No. 290760 (to be fitted in place of manual start-retard control of 3-cylinder engine applications).

TO CHECK TRANSFER PRESSURE AND FUEL DELIVERY AT FULL LOAD AND MAXIMUM TORQUE

Perform tests 8, 9, 10, 11 and 12 at the speeds indicated in the Calibration Table, with the maximum speed adjusting screw (41, Fig. 69) fully backed off to bring the governor control to the fully open position. Transfer pressure readings showing on the 0-10 kg/cm² gauge and fuel deliveries, should be as specified.

To alter the transfer pressure setting adjust the pressure regulating valve as directed under the appropriate heading.

To adjust full load fuel delivery proceed as follows:—

— Remove cover plate (96, Fig. 69) and slacken retaining screws (64, Fig. 74).

— Turn the adjusting plate as shown in Fig. 74, until the prescribed fuel delivery is obtained. Note that .5 mm. (.020 in.) adjusting plate displacement is equivalent to a 1 cm³ fuel volume variation.

— Retighten screws (64) gradually and alternately until the prescribed torque is obtained. To do this use tool No. **290754** (N, Fig. 78) adjusted so that the hexagonal socket for the torque spanner is 127 mm. (5 in.) away from the screw hole centreline.

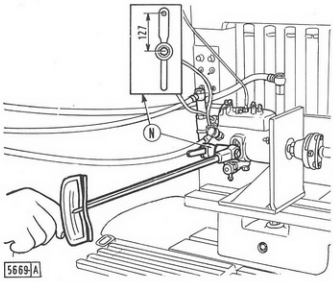


Fig. 78 - Tightening the Maximum Fuel Adjusting Plate Retaining Screws

Note: The hexagonal socket for the torque spanner should be positioned 127 mm. (5 in.) away from the screw hole centreline (see inset). While tightening, keep the spanner aligned to tool (N). N. Tool No. 290754.

TO CHECK EXCESS FUEL OPERATION

Carry out test 13 at the prescribed speed. Insufficient delivery could be due to excessive leakage of fuel past the pump plungers.

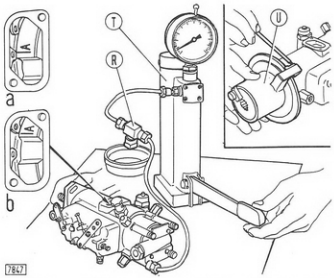


Fig. 79 - Internal Timing at 30 kg/cm² (427 p.s.i.) and Applying External Timing Mark

a. Corret internal pump timing (3-cylinder engine version) - b. Correct internal pump timing (4-cylinder engine version) - T. Hand pump No. 290284 - R. Marking gauge tool No. 290755 with 30 kg/cm² relief valve (to be connected to hand pump and "W" fitting, on 3-cylinder engine applications, or "X" fitting, on 4-cylinder engine applications - U. Tool No. 290757.

TO CHECK SHUT-OFF OPERATION

Hold the throttle lever in fully open position and the shut-off control closed, while running the pump at the speed indicated for test No. 14. Fuel delivery should be as prescribed. Excessive fuel delivery could be due to excessive leakage of fuel past the metering valve.

TO CHECK MINIMUM (IDLING) SPEED

Back off screw (94, Fig. 69) completely, run the pump at the speed given for test No. 15, and check that fuel delivery is as prescribed. Idling adjustment screw (94) is to be set with the engine fitted to the tractor.

TO CHECK MAXIMUM (GOVERNED) SPEED

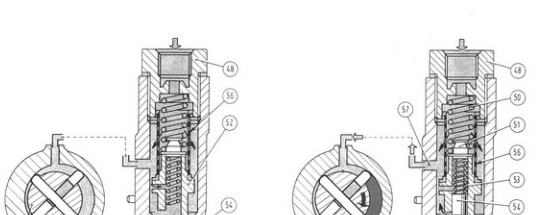
Run the pump at the speed indicated for test N. 16 and adjust the maximum speed stop (41, Fig. 69) until the specified fuel delivery is obtained (governor cut-in.).

Re-check that at maximum speed, full-load (test No. 17), the fuel delivery is not less than that of test No. 10, and clamp screw (41) using the locknut provided. If fuel delivery is found to be lower, repeat test No. 16 and back off screw (41) slightly, so as to raise the governor cut-in speed as necessary.

INTERNAL TIMING

Remove the pump from the test machine and connect fitting marked "W", for 3-cylinder engines, or "X", for 4-cylinder power units, corresponding to the injector of cylinder No. 1, to one end of tool No. **290755** (R, Fig. 79).

Connect the other end of the tool to hand pump No. **290284** (T) filled with FIAT CFB fluid and operate the hand pump until a pressure of 30 kg/cm² (427 p.s.i.) is reached. Do not exceed the specified pressure. Turn the pump drive shaft anti-clockwise until a definite resistance is felt, indicating that the rollers are in contact with the cam ring lobes (spill cut-off). Remove the cover plate and align the sharp timing edge of the circlip to the reference line "A" stamped on the internally-splined drive flange (see insets a. and b.).



Priming (inlet) pressure

Transfer pressure

a. Priming (engine shut-off)

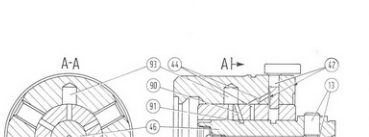
Fed by the hand pump, fuel enters inlet connection (48), pushes piston (54) downward and leaves through port (60). Thus, the fuel passages in the hydraulic head can be primed through outlet (92), by-passing transfer pump (27) which, when stationary, does not allow any leakage of fuel past the rotor vanes.

b. Regulating (engine running)

Transfer pressure pushes piston (54) upward to compress regulating spring (53). Fuel pressure discharges through regulating port (59) and joins the main stream to transfer pump inlet. As the effective area of port (59) depends on pump output, i.e. on rotational speed, the higher the pump speed the greater the transfer pressure.

Fig. 80 - Transfer Pump and Regulating Valve Operation Diagram

27. Transfer pump - 48. Inlet connection - 50. Retaining spring - 51. Spring guide - 52. Valve sleeve - 53. Regulating spring - 54. Piston - 55. Priming spring (in operating position) - 56. Nylon filter - 57. Fuel passage to transfer pump inlet - 59. Regulating port - 60. Fuel passage to transfer pump outlet - 62. Transfer pump outlet to metering valve.



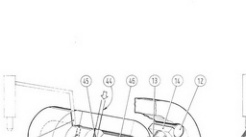


Fig. 81 - Section through Hydraulic Head and Head Operation Diagram

10. Cam ring (3-cylinder = 6 lobe, 4-cylinder = 4 lobe) - 12. Cam roller - 13. Pump plungers - 14. Roller shoe - 21. Tapped delivery outlet hole - 22. Sleeve outlet drillings (3-cylinder = 6 off but only 3 used, 4-cylinder = 4 off) - 42. Metering valve with metering slot - 44. Metering port (1 off) - 45. Rotor filling ports (one to each engine cylinder) - 46. Rotor - 47. Rotor delivery port (1 off) - 90. Interconnecting sleeve port (3 off) - 91. Interconnecting rotor annulus - 93. Compression volume cavity (3 off) (Applicable to 3-cylinder engine applications only - Note: When the retraction volume is compressed during the non-pumping portion of the cycle, i.e. when the cam rollers ride over the three unused lobes of the cam ring, pressure is distributed over the volume cavities) - 92. Transfer pressure gallery - 98. Cambox end annular groove - 99. Advance device connection hole.

a. Rotor in charging position - When one of rotor filling ports (45) is in register with metering port (44), metered fuel pressure is directed between plungers (13) to help centrifugal force in displacing the plungers outwards. Distributor port (47) is well out of register with the discharge port in the head. Further rotation of the rotor brings metering port (44) and rotor filling ports (45) out of register and charging is discontinued.

b. Rotor in discharge (injection) position - Rollers (12) have reached the slopes of opposite cam ring lobes, forcing plungers (13) together and discharging the fuel. Note that distributor port (47) in the rotor is in register with one of fuel outlets (22), while the inlet ports in the rotor are out of register with the metering port.

Fig. 82

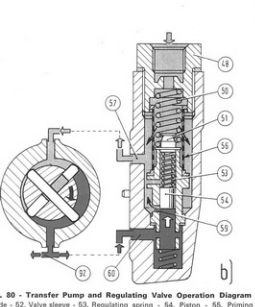
2. Governor weights - 4. Pump drive shaft - 31. Idling spring guide - 32. Shut-off lever - spring (working in tension) - 40. Throttle lin

a.

With the engine stationary and throttle lever inwards (to the left in the diagram) by contr right and metering valve (42) is in full fuel (2) tend to open out and move thrust sleeve resistance of governor spring (38), which in sleeve (5) moves in the direction of the arro metering valve (42) which controls the effect are in equilibrium the engine stabilises at the so as to increase the load on governor spring spring is reduced to a minimum, and governo maintai

When the selected speed has been reached, regardless of load variation. A fall in engine sp whereupon the governor control arm rotates response to increased fuelling. If the engine sp the metering valve to reduce fuelling and res (32) anti-clockwise (see white arrows), which

The spring of hook lever (34) enables th



. 80 - Transfer Pump and Regulating Valve Operation Diagram

de - 52. Valve sleeve - 53. Regulating spring - 54. Piston - 55. Priming spring (in operating position) - 56. Nylon filter - 57. Fuel passage to
ng port - 60. Fuel passage to transfer pump outlet - 62. Transfer pump outlet to metering valve.

Priming (inlet) pressure

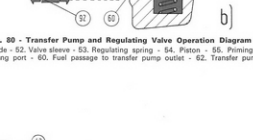
Transfer pressure

a. Priming (engine shut-off)

Fed by the hand pump, fuel enters inlet connection (48), pushes piston (54) downward and leaves through port (60). Thus, the fuel passages in the hydraulic head can be primed through outlet (92), by-passing transfer pump (27) which, when stationary, does not allow any leakage of fuel past the rotor vanes.

b. Regulating (engine running)

Transfer pressure pushes piston (54) upward to compress regulating spring (53). Fuel pressure discharges through regulating port (59) and joins the main stream to transfer pump inlet. As the effective area of port (59) depends on pump output, i.e. on rotational speed, the higher the pump speed the greater the transfer pressure.



ead Operation Diagram

Pump plungers - 14. Roller shoe - 21. Tapped delivery
ylinder – 4 off) - 42. Metering valve with metering
linder) - 46. Rotor - 47. Rotor delivery port (1 off) -
Compression volume cavity (3 off) (Applicable to
essed during the non-pumping portion of the cycle, i.e.
is distributed over the volume cavities) - 92. Transfer
dvance device connection hole.

a. Rotor in charging position - When one of rotor filling ports (45) is in register with metering port (44), metered fuel pressure is directed between plungers (13) to help centrifugal force in displacing the plungers outwards. Distributor port (47) is well out of register with the discharge port in the head. Further rotation of the rotor brings metering port (44) and rotor filling ports (45) out of register and charging is discontinued.

b. Rotor in discharge (injection) position - Rollers (12) have reached the slopes of opposite cam ring lobes, forcing plungers (13) together and discharging the fuel. Note that distributor port (47) in the rotor is in register with one of fuel outlets (22), while the inlet ports in the rotor are out of register with the metering port.

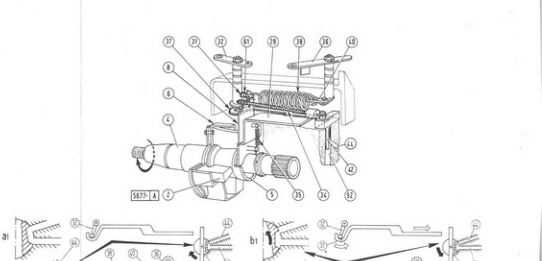


Fig. 82 - Governor Mechanism and Operation Diagram

2. Governor weights - 4. Pump drive shaft - 5. Thrust sleeve - 6. Weight retainer - 8. Governor control arm - 29. Control bracket - 31. Idling spring guide - 32. Shut-off lever - 34. Hook lever - 35. Retaining spring - 36. Throttle lever –37. Shut-off bar - 38. Governor spring (working in tension) - 40. Throttle link - 42. Metering valve - 44. Metering port - 61. Idling spring - 92. Transfer pressure gallery.

a. No-load operation and speed selection

With the engine stationary and throttle lever (36) in any position, governor weights (2) are fully closed and thrust sleeve (5) is held inwards (to the left in the diagram) by control arm (8) under the load of governor spring (38). Hook lever (34) is held fully to the right and metering valve (42) is in full fuel position (a_1). As soon as the engine is running engine speed increases quickly, weights (2) tend to open out and move thrust sleeve (5) to the right. However, the sleeve cannot move until centrifugal force overcomes the resistance of governor spring (38), which in turn depends on throttle lever position. When the selected speed is reached (see a), thrust sleeve (5) moves in the direction of the arrow and, through control arm (8) and hook lever (34), reduces the fuelling by rotating metering valve (42) which controls the effective area of metering port ($44, a_2$); when the two opposed forces acting on the thrust sleeve are in equilibrium the engine stabilises at the selected speed. To increase engine speed turn throttle lever (36) anti-clockwise (see arrows) so as to increase the load on governor spring (38); to reduce engine speed, turn clockwise. At idling speed the tension of the governor spring is reduced to a minimum, and governor action is virtually opposed by the light idling spring (61) only, so that stable idling can be maintained when changes of centrifugal force are small.

b. Operation under load and shut-off

When the selected speed has been reached, governor action maintains it within close limits up to the corresponding maximum load, regardless of load variation. A fall in engine speed due to increased load (see b) causes the flyweights to move inwards (see black arrows), whereupon the governor control arm rotates the metering valve towards the open position (b_2), and the engine speed increases in response to increased fuelling. If the engine speed tends to increase owing to a reduction in load, the flyweights move outwards, closing the metering valve to reduce fuelling and restore the selected speed. The engine can be shut down instantly by turning shut-off lever (32) anti-clockwise (see white arrows), which causes the shut-off bar (37) to rotate the metering valve to the no-fuel position (b_1).

The spring of hook lever (34) enables the engine to be shut down at any speed without need for over-riding the governor.

Hold the pump in the timed position, fit flange marking tool No. **290757** (U) set to the degree position stated under "Assembly Data" to the pump drive shaft with attached key, and scribe a timing mark on the mounting flange.

PRESSURE TESTING

After removing the pump from the test machine carry out a pressure test adopting the following procedure:—

— Close the pump fuel inlet using plug No. **290748** and fit connector No. **290753** to the pump drain connector and apply a supply of compressed air at 1.4 kg/cm² (20 p.s.i.).

— Immerse the entire pump in a bath of clean fuel oil and turn on the air supply. Any leak can be traced by the air bubbles given off.

C.A.V. INJECTION PUMP CALIBRATION DATA (455 C - 505 C - 605 C)

For fuel injection pump calibration use either of the following procedures.

TEST PROCEDURE A

BOSCH test machine with WSF 2044/4X injector springs and EFEP 182 spray nozzles.

RABOTTI test machine with graduated ring nut injectors incorporating FIAT 656829 springs and EFEP 182 spray nozzles.

Pipes, 2 × 6 × 865 mm.

Release pressure, 175 kg/cm² (2,483 p.s.i.).

TEST PROCEDURE B

BOSCH or RABOTTI test machine with injector bodies and nozzles as fitted to engine.

Pipes, 2 × 6 × 700 mm., 455 C and 505 C models.

Pipes, 1.5 × 6 × 700 mm., 605 C model.

Release pressure, 225 to 235 kg/cm² (3,200 to 3,343 p.s.i.).

CALIBRATION FLUID

FIAT CFB at 30° + 5 °C.

Feed pressure, .2 kg/cm² (2.8 p.s.i.).

ASSEMBLY DATA

Governor control stud to metering valve lever pin (see Fig. 76), 53 to 54 mm. (2.08 to 2.13 in.).

Governor spring attachment position on control arm (8, Fig. 83), hole No. 1.

Governor spring attachment position on throttle link (40, Fig. 83), hole No. 3.

Roller spacing (see Fig. 75):—

— Model 455 C, 49.98 mm. (1.9677 in.).
— Model 505 C, 50.03 mm. (1.9697 in.).
— Model 605 C, 49.70 mm. (1.9565 in.).

External timing mark degree position with respect to shaft key:—

— Models 455 C and 505 C, 268°.
— Model 605 C, 253°.

Drive shaft thrust washer thickness (see 84, Fig. 70), 2.05, 2.18 and 2.31 mm. (.082, .087 and .092 in.).

Advance spring pre-load shim thickness (see 74, Fig. 71), .2, .5, 1 and 2 mm. (.008, .020, .040 and .080 in.).

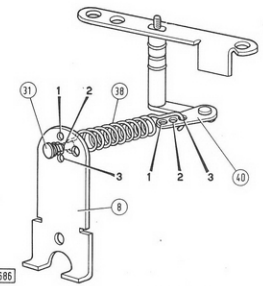


Fig. 83 - Governor Spring Positioning
8. Governor control arm - 31. Idling spring guide - 38. Governor spring - 40. Throttle link.

C.A.V. DISTRIBUTOR PUMP TYPE DPA 3233410-769516 (455 C)

TEST DESCRIPTION	TEST No.	Control lever position (1)	Speed r.p.m.	Time to reach 406 mmHg inlet vacuum seconds	Transfer pressure Kg/cm²	Advance (*) degrees	PROCEDURE A: Injector delivery cm³/1000 shots	PROCEDURE A: Back leakage cm³/100 shots	PROCEDURE B: Injector delivery cm³/1000 shots
Transfer vacuum/ pressure	1-2	—	100	uo to 60	1.2 to 1.8	—	—	—	—
Speed advance (1)	3	—	800	—	—	3 to 4	—	—	—
	4		1200	—	—	5.8 to 6.3	—	—	—
	5		180	—	—	1.2 to 1.5	—	—	—
Start retard (2)	6	—	300	—	—	0	—	—	—
Full advance	7	—	900	—	—	5.8 to 6.3	—	—	—
Transfer pressure	8-9-10(4)	max	1200^{+0}_{-20}	—	5 to 6	—	46 to 49(*)	5 or over	45.6 to 49.5 (*)
Back leak									
Max. fuel	11-12		800±5	—	3.8 to 4.6	—	42.5 to 45.5 (*)	—	49 to 52(*)
Excess fuel (2)	13	max	100	—	—	—	40 or over	—	—
Shut-off	14	max	200	—	—	—	up to 4	—	—
Idling speed (3)	15	min	200	—	—	—	up to 5	—	—
Governed speed (4)	16	max	1270	—	—	—	up to 9	—	—
	17		1200^{+0}_{-20}	—	—	—	46 to 49	—	—

C.A.V. DISTRIBUTOR PUMP TYPE DPA 3233420-769517 (505 C)

Transfer vacuum/ pressure	1-2	—	100	up to 60	1.2 to 1.8	—	—	—	—
Speed advance (1)	3	—	800	—	—	3 to 4	—	—	—
	4		1300	—	—	5.8 to 6.3	—	—	—
	5		180	—	—	1.2 to 1.5	—	—	—
Start-retard (2)	6	—	300	—	—	0	—	—	—
Full advance (3)	7	—	900	—	—	5.8 to 6.3	—	—	—
Transfer pressure	8-9-10(4)	max	1300^{+0}_{-20}	—	5 to 6	—	51 to 54(*)	14 or over	48.5 to 51.5 (*)
Back leak									
Max. fuel	11-12		800±5	—	3.8 to 4.6	—	46.5 to 49.5 (*)	—	52 to 54(*)
Excess fuel (2)	13	max	100	—	—	—	44 or over	—	—
Shut-off	14	max	200	—	—	—	up to 4	—	—
Idling speed (3)	15	min	200	—	—	—	up to 5	—	—
Governed speed (4)	16	max	1370	—	—	—	up to 9	—	—
	17		1300^{+0}_{-20}	—	—	—	51 to 54	—	—

C.A.V. DISTRIBUTOR PUMP TYPE DPA 3249460 - 769520 (605 C)

TEST DESCRIPTION	TEST No.	Control lever position (1)	Speed r.p.m.	Time to reach 406 mmHg inlet vacuum seconds	Transfer pressure Kg/cm²	Advance (2) degrees	PROCEDURE A Injector delivery cm³/1000 shots	PROCEDURE A Back leakage cm³/100 shots	PROCEDURE B Injector delivery cm³/1000 shots
Transfer vacuum/ pressure	1-2	—	100	up to 60	0.8 to 1.4	—	—	—	—
Speed advance (3)	3	—	800	—	—	4 to 5	—	—	—
	4		1100	—	—	6.8 to 7.3	—	—	—
	5		180	—	—	1.5 to 2	—	—	—
Start-retard (4)	6	—	300	—	—	0	—	—	—
Full advance (5)	7	—	—	—	—	—	—	—	—
Transfer pressure Back leak	8-9-10(6)	max	1100^{+0}_{-20}	—	4 to 5	—	40.5 to 43(8)	5 or over	47 to 49.5(8)
Max. fuel	11-12		800±5	—	3.2 to 4	—	44 to 47(8)	—	47.5 to 50.5 (8)
Excess fuel	13	max	100	—	—	—	40 or over	—	—
Shut-off	14	max	200	—	—	—	up to 4	—	—
Idling speed (7)	15	min	200	—	—	—	up to 5	—	—
Governed speed (6)	16	max	1170	—	—	—	up to 9	—	—
	17		1100^{+0}_{-20}	—	—	—	40.5 to 43	—	—

(1) On 3-cylinder engine applications, fit tool No. 290760 (M, Fig. 77) in place of start-retard device
(2) Manual start-retard activated
(3) After start-retard device reassembly on 3-cylinder engine applications only
(4) Back off maximum speed adjusting screw (41, Fig. 69) completely and adjust fuelling through adjustment plates (see Fig. 74)
(5) Back off idling adjustment screw (94, Fig. 69) completely
(6) Adjust maximum speed screw (41, Fig. 69)
(7) Shuf-off lever (32, Fig. 69) to be activated during test No. 14 only
(8) Check using tool No. 290743 (H, Fig. 77) and adjust by altering thickness of shims (74, Fig. 71)
(9) Maximum spread, 4 mm³/cycle

BOSCH AND C.A.V. INJECTION PUMP REFITTING AND EXTERNAL TIMING (455 C - 505 C - 605 C)

Refit the injection pump to the engine according to the following instructions:—

— Smear gasket (12, Fig. 57) with jointing compound and place in position over the mounting flange.

— Introduce the end of the pump drive shaft with attached Woodruff key in the bore of drive gear (1), and position the elongated holes in the mounting flange over the retaining studs.

— Refit drive gear retaining nut (3) and turn the pump body until the reference mark originally applied to engine block and pump flange (see Fig. 39) are correctly aligned. Refit and retighten the stud nuts, reinstall the fuel lines and bleed the system as directed on page 39 under Fuel Filters.

If the external timing marks are missing or suspected to be incorrect, check the timing as follows:—

— Remove cover plate (48, Fig. 56, or 96, Fig. 69), turn the engine flywheel, and bring the cam plate timing mark in alignment with the timing pointer (see Fig. 66) on Bosch pumps, or letter "A" stamped on the drive flange in alignment with the sharp timing edge of the timing circlip (see Fig. 79) on C.A.V. pumps.

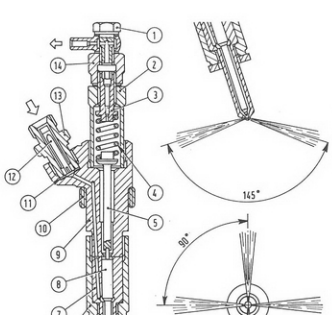


Fig. 84 - Section through Fuel Injector

a. Spray angles - 1. End plug - 2. Adapter - 3. Release pressure adjusting screw - 4. Spring - 5. Spindle - 6. Nozzle nut - 7. Nozzle - 8. Needle valve - 9. Injector body - 10. O-ring - 11. Sealing washer - 12. Rod filter - 13. Fuel inlet adapter - 14. Nut.

As this timing position corresponds to the point of commencement of injection (spill cut-off) in No. 1 cylinder, check through bell housing aperture (see Fig. 21, c) that the engine timing pointer is aligned to "INIEZ BOSCH" or "INIEZ C.A.V." marks.

If adjustment is needed, slacken the injection pump retaining nuts and turn both the pump body and the engine flywheel until correct alignment is obtained.

As a safeguard against possible valve timing errors or incorrect injection pump reassembly, take off the rocker cover and check that No. 1 piston is at the end of the compression stroke (i.e., valves closed).

Rescribe the external timing marks on pump flange and engine block to facilitate subsequent pump timing.

TO ADJUST THROTTLE LINKAGE AND CHECK ENGINE RUNNING

Remote control link (7, Fig. 3, b, c) is to be adjusted so that when the hand throttle control is moved to the minimum (up) and maximum (down) speed positions the pump throttle lever abuts the idling adjustment screw and the maximum speed adjustment screw respectively.

Subsequently, check that no-load minimum and maximum engine speeds are as specified (see page 14). To adjust turn the pump idling and maximum speed screws as necessary.

FUEL INJECTORS

Injector nozzles incorporate four equi-spaced orifices spray angle being 145° (see Fig. 84).

Carefully remove all traces of carbon from the nozzle tip using a metal wire brush and clear the spray orifices using tool kit No. **A. 65026 (291357)**.

Clean the injector fuel passages using a compressed air line.

Check injector release pressure using hand pump No. **290284**; the correct pressure is 225 to 235 kg/cm² (3,200 to 3,343 p.s.i.). To adjust, insert a hexagon key in socketed screw (3) and turn as necessary.

When injector spring (4) is renewed, increase the release pressure setting by 5 kg/cm² (71 p.s.i.) to allow for initial settling.

THERMO-STARTER

The thermo-starter (optional) consists of a heater plug (T, Figs. 48, 60 and 68) screwed into the entrance of the inlet manifold, and a reservoir (St) filled with injector leak-off fuel.

The heater plug incorporates an electrical resistor (5) the end (6) of which causes the fuel vapour to ignite.

When at rest, push rod (1) holds ball (3) in its seat to prevent the ingress of fuel. If the starter switch is turned to the first click clockwise, resistor (5) is energised.

and the resulting heat expands the resistor which moves towards the inside of the manifold.

Thus, the push rod releases the ball. As fuel comes into contact with the resistor it vaporises and ignites, thereby heating the air within the manifold to facilitate engine starting when the starter switch is turned to the second click.

After starting, the electrical circuit is de-energised, resistor (5) cools down and valve (3) closes.

To by-pass the thermo-starter when starting the engine, simply turn the starter switch anti-clockwise.

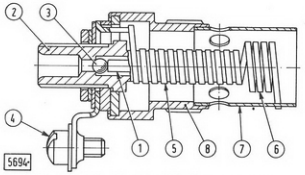


Fig. 85 - Section though Thermo-starter
1. Push rod - 2. Valve body - 3. Ball - 4. Terminal screw - 5. Heating resistor - 6. Fuel igniting resistor - 7. Shield - 8. Holder.

LUBRICATION SYSTEM

LUBRICATION SYSTEM DATA

Oil Pump	Gear type, camshaft-driven
Drive ratio	2 to 1
Oil pressure after warm-up	3 to 4 kg/cm² (42 to 56 p.s.i.)
Drive shaft running clearance in bush	.016 to .055 mm. (.0006 to .0022 in.)
Driven gear running clearance on stub shaft	.017 to .057 mm. (.0007 to .0023 in.)
Pump gear backlash	.1 mm. (.004 in.)
Gear end clearance in pump body	.025 to .126 mm. (.0010 to .0050 in.)
Gear tooth clearance in pump body	.060 to .170 mm. (.0024 to .0067 in.)
Relief valve spring length:—	
— Free	45 mm. (1.772 in.)
— Under 6.48 to 7.00 kg. (14.2 to 15.4 lb.)	34.5 mm. (1.358 in.)
— Under 10.75 to 11.65 kg. (23.6 to 25.5 lb.)	27.5 mm. (1.083 in.)
Oil Filters	Gauze type on inlet and paper cartridge on outlet

OIL PUMP

The oil pump is accessible after removing the engine oil sump.

In the course of overhaul assess the amount of wear affecting the various components by comparison to the dimensions given in Fig. 86. If replacement parts are needed remember that drive shaft (5) and drive gear (3) are supplied as a single piece; this is because the gear is shrunk on the shaft. Also note that the bore diameter quoted for bush (9) is to be obtained after press fitting.

On reassembly, adhere to the specified tightening torque figures (see page 169).

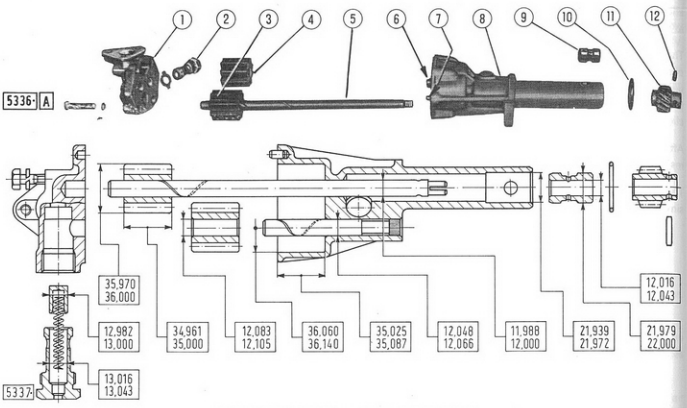


Fig. 86 - The Oil Pump (dimension in mm.)

1. Cover - 2. Relief valve - 3. Drive gear - 4. Driven gear - 5. Drive shaft - 6. Driven gear stub shaft - 7. Dowel - 8. Pump body - 9. Bush - 10. O-ring - 11. External drive gear - 12. Pin.

OIL FILTER

The oil filter (F, Figs. 88, 89 and 90) is a throw-away cartridge consisting of container, paper element and external seal. A by-pass valve (13) will enable unfiltered oil to enter the engine should the filter become clogged.

Every 400 working hours renew the cartridge (see Fig. 87). To prevent oil leakage:—

— Smear the external seal with engine oil.

— Fit the cartridge by turning until contact with the mounting flange is established.

— Turn the cartridge by hand through a further $^{3}/_{4}$ turn.

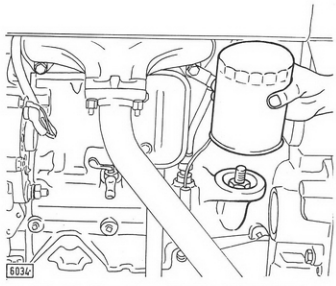


Fig. 87 - Removing or Refitting the Oil Filter

OIL PRESSURE WARNING LIGHT

The dashboard mounted red warning light comes on if:—

— Oil pressure is low. However, note that the light is also normally on when the master switch is operated, and when starting a cold engine.

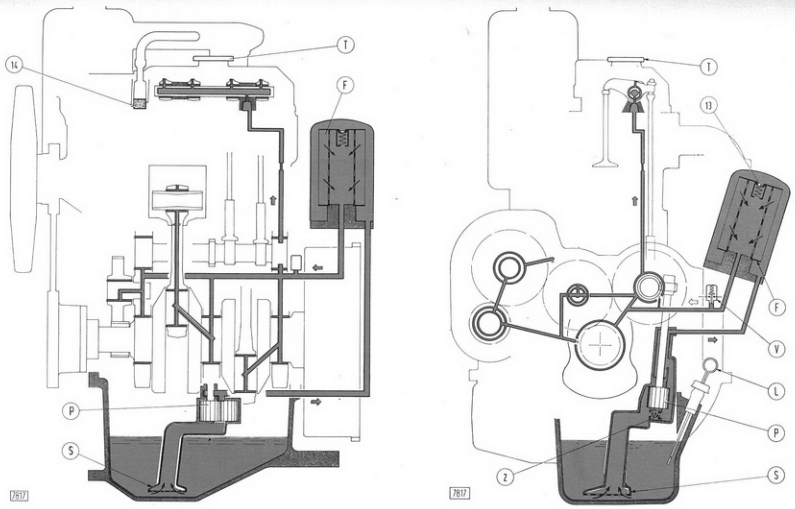


Fig. 88 - Lubrication System Diagram - Model 355 C

F. Oil filter - L. Dipstick - P. Oil pump - S. Gauze filter - T. Oil filler - V. Oil pressure warning transmitter - 2. Relief valve (set to 3.6 kg/cm² - 51 p.s.i.) - 13. By-pass valve (cuts in when filter upstream-downstream pressure differential exceeds .9 to 1.1 kg/cm² or 13 to 16 p.s.i.) - 14. Breather.

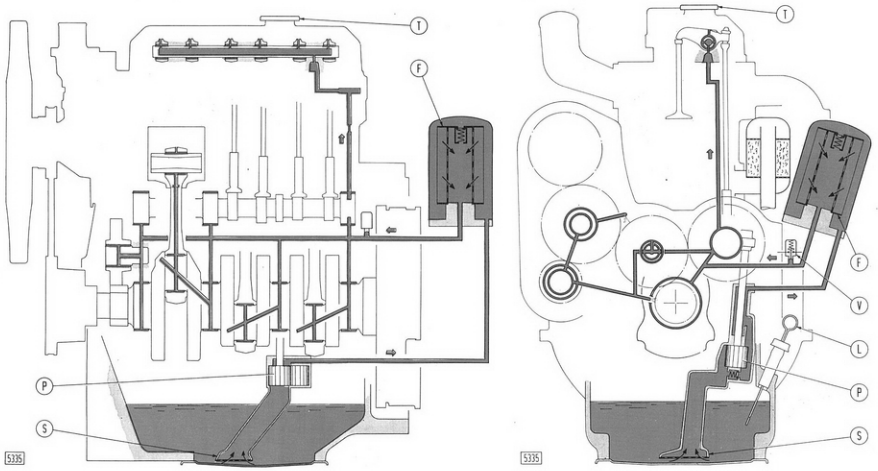
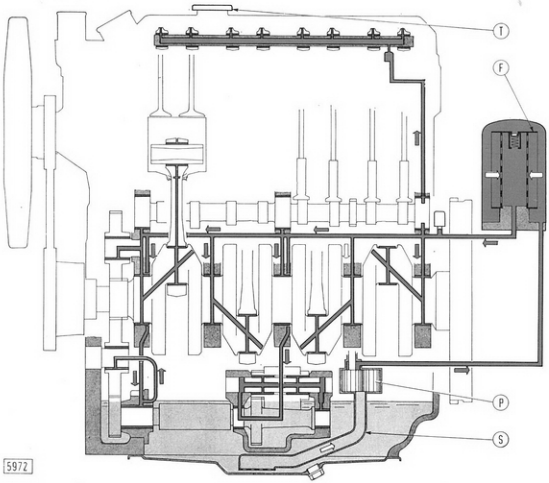


Fig. 89 - Lubrication System Diagram - Models 455 C and 505 C
F. Oil filter - L. Dipstick - P. Oil pump - S. Gauze filter - T. Oil filler - V. Oil pressure warning transmitter.



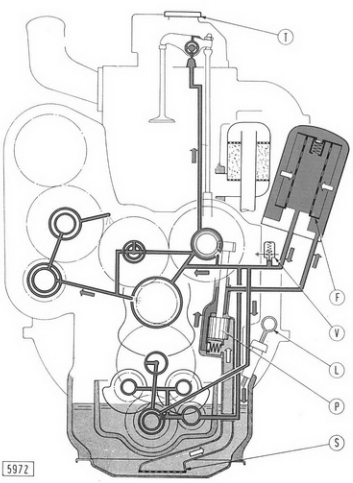


Fig. 90 - Lubrication System Diagram - Model 605 C
F. Oil filter - P. Oil pump - S. Gauze filter - T. Oil filler - V. Oil pressure warning transmitter.

— Inefficient transmitter switch (V, Figs. 88, 89 and 90).

If the warning light fails to come on when the master switch is operated, the possible causes are:—

— Blown fuse.
— Burnt out warning light bulb.
— Open circuit across transmitter and warning lamp.

COOLING SYSTEM

COOLING SYSTEM DATA

Water Pump	Centrifugal, impellor type
Drive ratio	1.42 to 1
Impellor clearance in pump body	1 to 1.25 mm. (.04 to .05 in.)
Impellor interference fit on shaft	.027 to .060 mm. (.0010 to .0024 in.)
Fan hub interference fit on shaft	.015 to .061 mm. (.0006 to .0024 in.)
Thermostat	Wax type
Alternative makes	SAVARA or CITMF
Starts to open at	81 to 85 °C.
Fully open at	95 °C.
Minimum valve displacement at 95 °C.	7.5 mm. (.3 in.)
Radiator	3-deep vertical tubes
Fan	Suction type, plastics
Number of blades:—	
— Model 355 C	7
— Models 455 C, 505 C and 605 C	9

WATER PUMP

To overhaul the water pump proceed as follows:—

— Remove cover (8, Fig. 92) and shaft retaining screw (3).

— Lightly tap the end of shaft (2) to break the film of oxide between shaft and impellor and withdraw the latter using extractor No. **291182/1** (see Fig. 91).

Take off water seal (5, Fig. 92) only if replacement is necessary, i.e. if the carbon face in contact with the impellor bush is worn or damaged to the point of preventing efficient sealing.

On reassembly, note the following points:—

— Bearing (2, Fig. 92) is sealed and does not require lubrication.

— Impellor (7) must be fitted flush with the end of the shaft. Also, on completion of reassembly check the clearance between impellor and pump body. The correct clearance (A, Figs. 92 and 93) is 1 to 1.25 mm. (.04 to .05 in.).

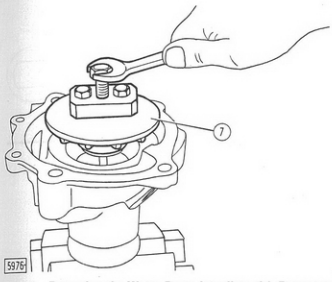


Fig. 91 - Removing the Water Pump Impellor with Extractor No. 291182/1
7. Impellor.

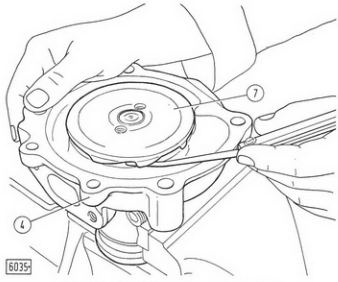


Fig. 93 - Checking Impellor Clearance
4. Pump body - 7. Impellor.

RADIATOR

The radiator incorporates vertical tubes and copper fins.

Steam is discharged through vent pipe (12, Fig. 94) connecting the filler with the atmosphere.

The radiator cap houses a pressure release valve (13) set to .5 kg/cm² (7 p.s.i.), and a vacuum release valve (14).

These valves should be periodically checked.

The optional extra radiator curtain for use in cold climates is controlled from the driving seat through a chain (16).

An approved coolant inhibitor should be used to protect the cooling system against corrosion. FIAT **LPR 67** inhibitor has the advantage of being compatible with anti-freeze, and should be mixed 5% by volume.

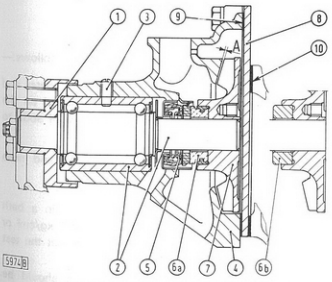


Fig. 92 - Section through the Water Pump
A = 1 to 1.25 mm. or .04 to .05 in., impellor clearance - 1. Drive hub - 2. Drive shaft assembly - 3. Retaining screw - 4. Pump body - 5. Water seal - 6a. Impellor bush (seal-mounted solution) - 6b. Impellor bush (press-fitted solution) - 7. Impellor - 8. Cover - 9. Gasket - 10. Gasket.

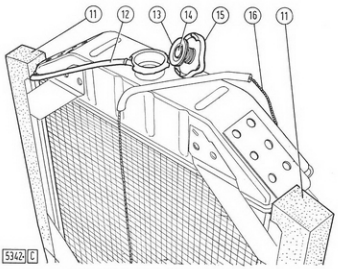


Fig. 94 - The Radiator Assembly
11. Sealing surround - 12. Vent pipe - 13. Pressure release valve (set to .5 kg/cm² or 7 p.s.i.) - 14. Vacuum release valve - 15. Filler cap - 16. Curtain control chain (for use in cold climates).

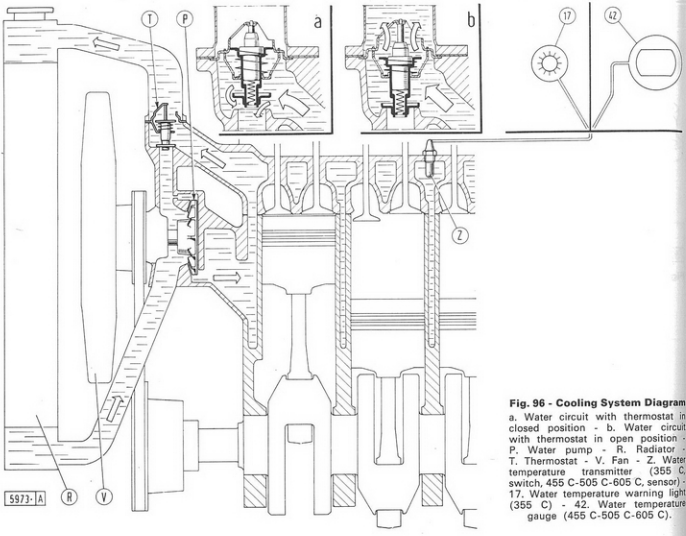


Fig. 96 - Cooling System Diagram
a. Water circuit with thermostat in closed position - b. Water circuit with thermostat in open position - P. Water pump - R. Radiator - T. Thermostat - V. Fan - Z. Water temperature transmitter (355 C, switch, 455 C-505 C-605 C, sensor) - 17. Water temperature warning light (355 C) - 42. Water temperature gauge (455 C-505 C-605 C).

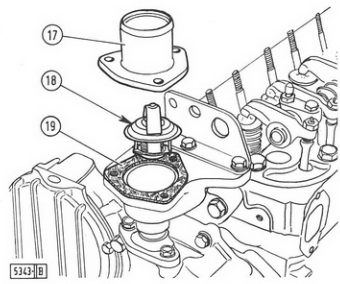


Fig. 95 - Removing or Refitting the Thermostat
17. Cover - 18. Thermostat - 19. Gasket.

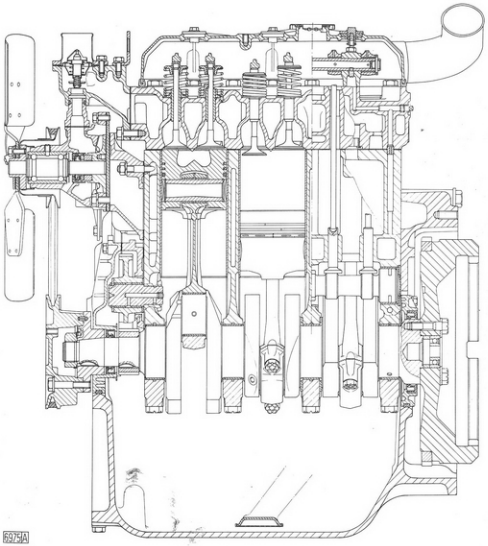
To recondition a furred radiator proceed as follows:—

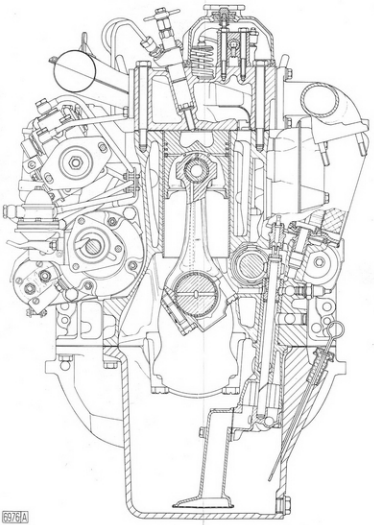
— Prepare a descaling solution using warm water and **FIAT Descaler** in the proportion indicated on the container, or 30 grammes of bicarbonate of soda to each litre of water.

— Pour the solution in the radiator, drain and rinse thoroughly.

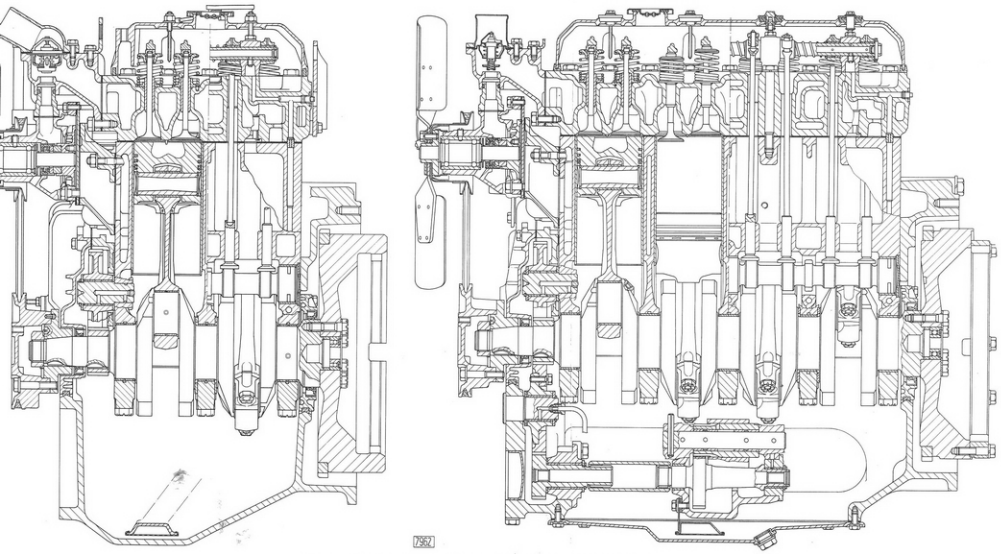
To check the radiator for leakage, immerse in a bath of water at 20° to 40° C. and pressurise at 1 kg/cm² or 14 p.s.i. for approximately two minutes. Repeat the test at least three times.

Whenever possible, the cleaning operation should be extended to the entire system, filling as indicated above and running the tractor for a minimum of one hour. Subsequently, stop the engine and drain through the valves provided.





Sections through 3-cylinder Engine (Models 455 C and 505 C)



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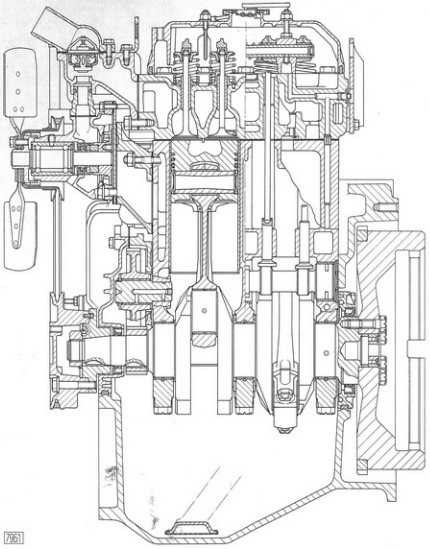
Sections through 2-cylinder Engine (Model 355 C) and 4-cylinder Engine (Model 605 C)



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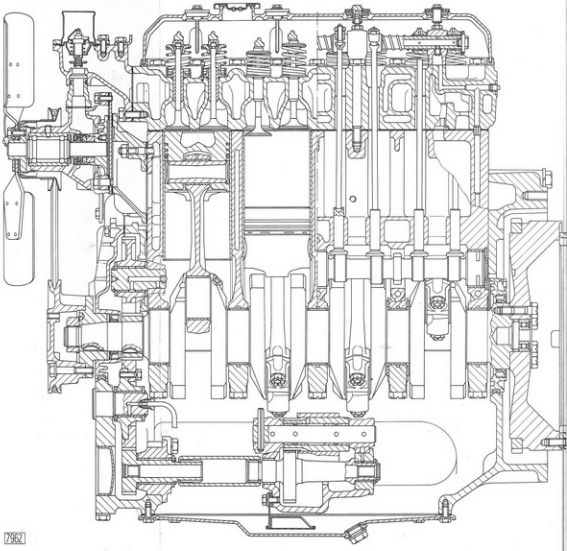

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Sections through 2-cylinder Engine (Model 355 C) and 4-cylinder Engine (Model 605 C)

The cooling system should also be flushed prior to using any anti-freeze.

The following table contains the **FIAT anti-freeze** percentage by volume in relation to atmospheric temperature.

Anti-freeze %	20	30	40	50
Effective down to °C.	−8	−15	−25	−35

THERMOSTAT

The thermostat is housed in the cylinder head water outlet connector (see Fig. 95). As no adjustment is possible, the thermostat must be renewed if the requirements of the data table are not met.

TO ADJUST BELT TENSION

The fan/water pump/alternator belt tension is correct when a yield of 10 to 15 mm. or $^1/_2$ in. is obtained by applying a 5 to 7 kg or 11 to 15 lb. load on the belt leg between crankshaft and alternator (see A, Fig. 97).

To adjust, proceed as follows:—

— Slacken alternator nut (1).

— Swing the alternator until the correct tension is obtained, and retighten the nut.

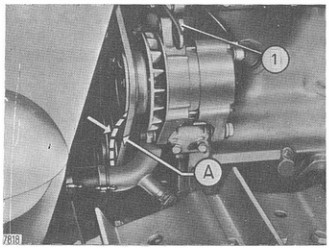


Fig. 97 - Checking and Adjusting Fan/Water Pump/Alternator Belt Tension

A. Normal belt yield (10 to 15 mm. or $^1/_2$ in. under 5 to 7 kg. or 11 to 15 lb.) - 1. Alternator clamping nut.

WATER TEMPERATURE GAUGE AND WARNING LIGHT

The water temperature warning light (fitted to Model 355 C) comes on when the water temperature reaches a dangerous level (104° to 110 °C.).

The water temperature gauge (fitted to Models 455 C, 505 C and 605 C incorporates a coloured scale divided into three sectors as follows:—

— White sector . . . . . 30 to 65 °C.
— Green sector . . . . . 65 to 105 °C.
— Red sector . . . . . 105 to 115 °C.

In normal running conditions, the needle should lie over the green sector.

If gauge inefficiency is suspected, test by immersing the sensor in water and compare with a reference gauge. Repeat the test several times to obtain a true reading.

TACHO-HOURMETER

The dashboard-mounted cable-operated oil pump gear-driven tacho-hourmeter indicates engine speed, P.T.O. speed (both in r.p.m.). and hours of operation.

The hourmeter is geared to a constant engine r.p.m. rate (see page 7).

MASTER CLUTCH

MASTER CLUTCH DATA

Type:—	
— Models 355 C-455 C-505 C	Dry, single plate
— Model 605 C	Dry, twin plate
Control	Mechanical, manual lever
Engagement	Overcentre
Clutch shaft diameter in release bearing assembly	31.961 to 32.000 mm. (1.2583 to 1.2598 in.)
Release bearing assembly I.D.	32.050 to 32.112 mm. (1.2618 to 1.2642 in.)
Shaft running clearance	.050 to .151 mm. (.0020 to .0060 in.)
Release lever pivot pin diameter	9.964 to 10.000 mm. (.3923 to .3937 in.)
Release lever housing diameter	10.040 to 10.098 mm. (.3953 to .3975 in.)
Pivot pin working clearance	.040 to .134 mm. (.0016 to .0053 in.)
Release lever carrier working clearance	.200 to .439 mm. (.0080 to .0173 in.)
Gear tooth backlash:—	
— Drive plate-to-annulus	.1 to .4 mm. (.004 to .016 in.)
— Backing plate-to-pressure plate (also intermediate plate for Model 605 C)	.110 to .206 mm. (.0043 to .0081 in.)
Drive plate thickness (Models 355 C-455 C-505 C)	9.5 to 10.5 mm. (.374 to .413 in.)
— Minimum thickness of used drive plates	6.5 mm. (.256 in.)
Drive plate thickness (Model 605 C)	6.5 to 7.5 mm. (.256 to .295 in.)
— Minimum thickness of used drive plates	4.5 mm. (.177 in.)
Intermediate plate thickness (605 C)	6 mm. (.236 in.)
Control lever pivot pin diameter	21.900 to 22.000 mm. (.8622 to .8661 in.)
Pivot pin housing diameter	22.040 to 22.092 mm. (.8677 to .8697 in.)
Pivot pin working clearance	.040 to .192 mm. (.0016 to .0075 in.)
Thrust spring length:—	
— Free	37 mm. (1.46 in.)
— Under 14.55 to 16.05 kg (32 to 35 lb.)	20 mm. (.78 in.)
Gearbox Synchro-brake	
Type	Brake disc
Control	Release bearing assembly during clutch disengagement
Lining thickness	4.5 mm. (.177 in.)

DESCRIPTION

Tractors Models 355 C-455 C-505 C (see a, Fig. 102) are fitted with a dead centre dry single plate clutch, whereas tractor Model 605 C incorporates a dry, twin plate clutch (see b, Fig. 102).

The operation of the two clutches is similar. Bonded asbestos drive plate (1) is integral with the engine flywheel and works between backing plate (2), splined to clutch shaft (11), and pressure plate (3) integral with the fixed disc. The pressure plate is operated through three release levers (14, see d), pivoting on carrier (7) and controlled by manual lever (L) through release bearing assembly (10).

When the clutch is released, the pressure plate compression load remains virtually unchanged even with used plates, owing to thrust plate deflection.

Clutch engagement (see e) is made easier by the action of six thrust springs (4). Release bearing collar at the end of disengagement travel retains the gearbox main shaft through bonded asbestos disc (15) so facilitating gear engagement.

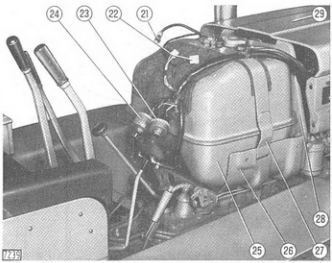


Fig. 98 - View of the Tractor with the Rear End Panelling, Firewall and Dashboard removed

21. Tachometer drive - 22. Connectors - 23. Lighting ignition switch - 24. Thermostarter/ignition switch - 25. Fuel tank - 26. Fuel tank mounting - 27. Fastener - 28. Front firewall - 29. Bonnet.

TO OVERHAUL

The following operations and illustrations concerning single plate clutch of tractor model 505 also apply, as a general rule, to Models 355 C and 455 C. The differences relating to Model 605 C are illustrated in Fig. 102, b.

With the exception of periodic adjustment, servicing necessitates clutch removal. To reach the clutch assembly (see Fig. 99) remove:—

- Rear end panelling, rear firewall and dashboard.
- Fuel tank (25, Fig. 98) with associated lines and fasteners.
- Fuel tank mounting (26) complete with front firewall (28), disconnecting alternator warning relay, voltage regulator and fuse box.
- Retaining screws, clutch release bearing assembly hose nut and gearbox/clutch housing cover complete with gearshift lever (see Fig. 105).

Remove retaining screws (C_1, Fig. 102) and withdraw clutch shaft-to-gearbox main shaft drive coupling by pushing the complete shaft unit slightly forward.

Remove clutch unit (see Fig. 99) aligning the shaft front end with one of three cutouts on the engine flywheel.

On model 605 C, remove first annulus (34, Fig. 102 b) integral with the engine flywheel.

Note: To prevent split drive plates (1, Fig. 100) from falling down on removal, release the clutch.

Lock the clutch on a bench vise (see Fig. 100), disengage the clutch and remove the split drive plate.

Mark the relative position of the pressure plates, unscrew nut (C_1) and dismantle the clutch assembly as shown in a, b, c.

Check the components for wear (see Data Table page 74). Check pressure plate surfaces; if necessary skim removing as little material as possible.

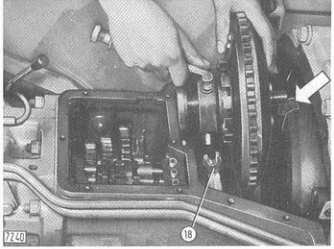


Fig. 99 - Removing (or Refitting) the Single Plate Clutch Assembly

(The arrow points to one of the three cutouts on engine flywheel)
18. Release bearing assembly fork.

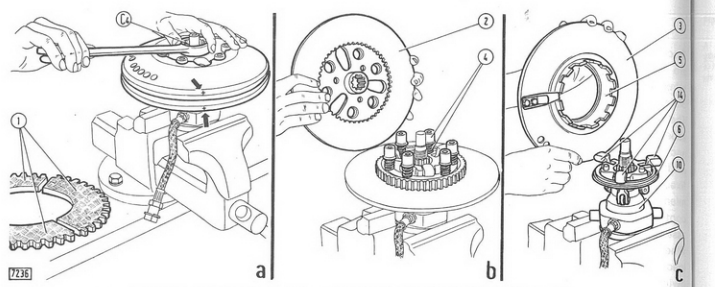


Fig. 100 - Dismantling (or Reassembling) the Single Plate Clutch Assembly

a. Removing backing plate retaining nut (the arrows point to the reference mark to be applied on dismantling) - b. Removing the backing plate - c. Removing pressure plate and associated ring nut - C_4. Backing plate retaining nut - 1. Split drive plate - 2. Backing plate - 3. Pressure plate - 4. Thrust springs and cups - 5. Ring gear - 6. Release lever ring - 10. Release bearing assembly - 14. Release levers.

Check three release levers (14, Fig. 100); in production, they are selected to match release lever ring (6, Fig. 103) according to the same plane X-X; in case of doubt (irregular wear of backing/pressure plates and drive plate) or following gear replacement, check the release levers as follows:—

— Fit the lever to tool Part No. **290564** and apply a dial gauge.

— Act on the lever according to the direction of the arrow: the reading on the dial gauge should be the same for all levers; a maximum deviation of .05 mm. (.0020 in.) is allowed.

If necessary skim the contact surfaces using emery cloth, as required.

Smear surfaces (E, Fig. 102) with a thin film of NEVER-SEEZ lubricant, then rebuild the clutch as illustrated in Fig. 101 lining up the reference marks applied on dismantling (see a, Fig. 100). Retighten backing plate locking nut (C_4) to the specified torque.

When refitting the clutch assembly to the tractor, check engine flywheel ball bearing for wear (31, Fig. 102). To renew the ball bearing, remove the flywheel retaining screws and snap ring.

The new ball bearing should be positioned with the dust seal facing the clutch; then, pack the associated housing with grassofiat G 9 or other approved lubricant.

Refit the gasket and cover of gearbox/clutch housing.

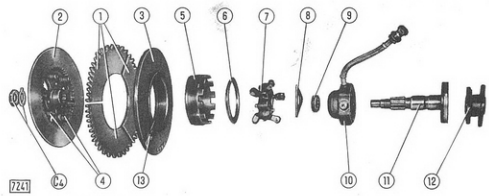
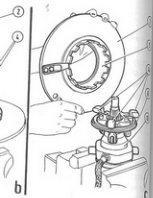


Fig. 101 - Exploded View of Single Plate Clutch Assembly

C_4. Backing plate retaining nut complete with tab washer - 1. Split drive plate - 2. Backing plate - 3. Pressure plate - 4. Thrust springs with cups - 5. Ring nut - 6. Release lever ring - 7. Release lever carrier - 8. Thrust plate - 9. Spacer - 10. Release bearing assembly with hose - 11. Clutch shaft - 12. Drive coupling - 13. Ring nut spring retainer.



e Clutch Assembly

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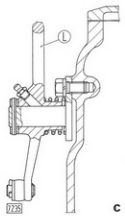

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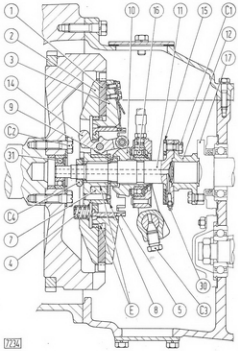
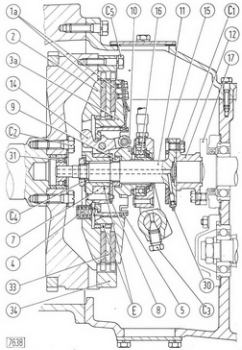


a



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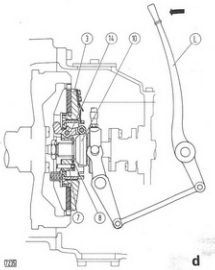

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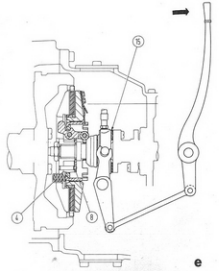

e

Fig. 102 - Section through Master Clutches
a. Single-plate clutch (Models 355 C - 455 C - 505 C) - b. Twin-plate clutch (Model 605)

c. Section through control lever pivot pin - d. Section through a released single plate clutch (control lever L fully forward) - e. Section through a disengaged single plate clutch (control lever L fully back: the clutch shaft stops owing to gearbox synchro-brake disc action) - C_1. Drive coupling retaining screws - C_2. Engine flywheel retaining screws - C_3. Clutch control fork retaining screw - C_4. Backing plate retaining nut - C_5. Annulus retaining screws. - E. Surfaces to be smeared with a thin film of Never-Seez lubricant - L. Clutch control lever - 1. Single plate clutch drive plate - 1a. Twin-plate clutch drive plates - 2. Backing plate - 3 and 3a. Pressure plate - 4. Thrust springs - 5. Ring nut - 7. Release lever carrier - 8. Thrust plate - 9. Spacer - 10. Release bearing assembly - 11. Clutch shaft - 12. Drive coupling - 14. Release lever - 15. Gearbox synchro-brake disc - 16. Ball bearing - 17. Gearbox main shaft - 30. Lubricator - 31. Clutch shaft bearing in flywheel - 33. Intermediate plate - 34. Annulus.

Note: On P.M. tractors, bearing lubricators have been eliminated.

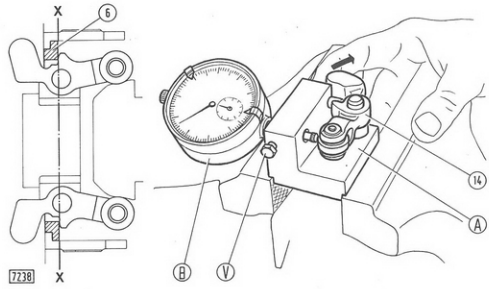

Fig. 103 - Checking Clutch Release Lever Position

A. Tool Part No. 290564 - B. Dial gauge - V. Gauge retaining screw - X-X. Lever abutment plane - 6. Release lever ring - 14. Release levers.

TO ADJUST

The clutch is correctly set when it is released with a clear click and with a force of 14 to 16 kg (31 to 35 lb.) applied to the lever handle when the engine is stopped (see Fig. 104).

As a consequence of plate wear, the effort required to release the clutch gradually diminishes and the click becomes less clear.

Perform the adjustment every 400 working hours.

To adjust the master clutch remove either upper cover or lower inspection cover and proceed as follows:—

— Bring the gearshift lever in neutral.

— Rotate the engine flywheel/clutch assembly to reach ring nut spring retainer (13).

— Engage any gear and, using Part No. **290727** (H), raise the spring retainer and screw in or back off the ring nut according to wether the effort is higher or lower than specified.

Note : Every 400 working hours, generally it is enough to unscrew the ring nut by two notches relative to the spring to obtain a correct setting. Also note that with the engine running less effort is required.

Subsequently, pack the clutch shaft front bearing with grassofiat G 9 or other approved grease through A.M. lubricator (30, Fig. 102), blanked by cover (32, Fig. 104) on the L.H. side of the clutch housing.

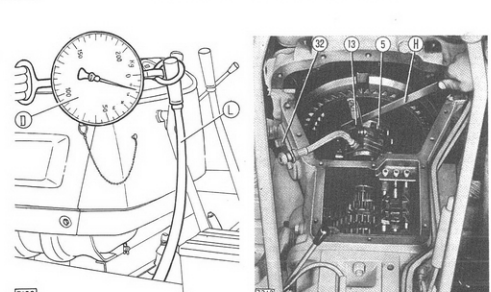

Fig. 104 - Checking Clutch Effort and adjusting the Ring Nut

D. Spring balance - L. Clutch control lever - H. Tool Part No. 290727 - 5. Ring Nut - 13. Ring nut spring retainer - 32. Clutch shaft front bearing lubricator blanking cover.

GEARBOX AND SPEED-REDUCTION UNIT

GEARBOX AND SPEED-REDUCTION DATA

Speeds	6 forward and 2 reverse
Gear type	Spur slinding mesh, manual lever
Gear ratios:—	
— First and second forward	47/16 = 2.938 to 1
— Third and fifth forward	34/29 = 1.172 to 1
— Fourth and top forward	29/34 = .853 to 1
— First and second reverse	(33/16) x (25/33) = 1.56 to 1
Speed-reduction ratios:—	
— To select first, third, fourth forward and first reverse	(29/25) x (33/21) = 1.823 to 1
— To select second, fifth, top forward and second reverse	1 to 1
Shim thickness:—	
— Reverse gear	3.892 to 4.000 mm. (.1567 to .1575 in.)
— Speed-reduction idler gear	1.47 to 1.53 mm. (.058 to .060 in.)
Speed-reduction drive gear hub dia. in bushes	69.954 to 70.000 mm. (2.7540 to 2.7559 in.)
Fitted bush I.D.	70.080 to 70.140 mm. (2.7590 to 2.7620 in.)
Hub running clearance	.080 to .186 mm. (.0031 to .0073 in.)
Bush thickness	1.94 to 1.98 mm. (.076 to .078 in.)
Bush interference fit	.101 to .181 mm. (.0040 to .0071 in.)
Selector shaft diameter	14.973 to 15.000 mm. (.5895 to .5905 in.)
Selector shaft housing bore	15.016 to 15.059 mm. (.5911 to .5928 in.)
Selector shaft working clearance	.016 to .086 mm. (.0006 to .0034 in.)
Gear/shaft spline backlash	.010 to .106 mm. (.0004 to .0042 in.)
Gear tooth backlash	.10 to .20 mm. (.0040 to .0080 in.)
Selector shaft detent spring length:—	
— Free	35.5 mm. (1.397 in.)
— Under 11.7 to 12.9 kg (25.4 to 28.4 lb.)	31.5 mm. (1.240 in.)
Speed-reduction sleeve/bevel pinion spline backlash	.010 to .106 mm. (.0004 to .0042 in.)
Speed-reduction driven gear/sleeve spline backlash	.170 to .270 mm. (.0067 to .0106 in.)

DESCRIPTION

The gearbox, of the spur, sliding mesh gear type has three forward speeds plus reverse.

The speed reduction unit, on the gearbox layshaft rear end, double the speed range for a total of six forward and two reverse speeds.

Speed reduction engagement and gear selection are controlled through three selector shafts and one spring-loaded manual lever (C, Fig. 106) which automatically returns to the neutral position.

Starter inhibitor switch (24) permits engine starting only when the gearshift lever is in neutral (F).

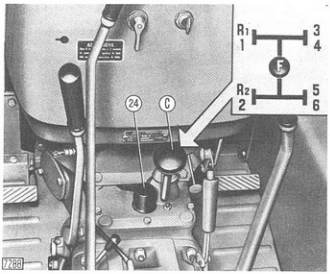

Fig. 106 - Gearshift Lever Positions
C. Gearshift lever - F. Neutral - 1, 2, 3, 4, 5, 6. Forward speeds - R_1 and R_2. Reverse speeds - 24. Starter inhibitor switch.

TO OVERHAUL

Separate the engine/front suspension unit from the gearbox as directed on page 75. Moreover, remove:—

- Lower side panels.
- Suspension mounting brackets (27, Fig. 107), track shoes (28) and braces (29).
- The bonnet, complete with L.H. side panel and R.H. pedal floorboard.

Disconnect lines (30, Fig. 108) from the hydraulic lift pump, plug and move away from engine.

Apply lifting chain Part No. **290740** to the eyes provided on the engine, take up the weight with a tackle, remove gearbox casing retaining screws and lift off engine/front suspension unit (see Fig. 108).

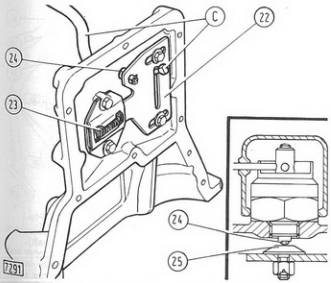

Fig. 105 - Gearbox Cover and Speed Selector
C. Gearshift lever - 22. Spring-loaded plate - 23. Spring - 24. Starter inhibitor switch - 25. Starter inhibitor switch control.

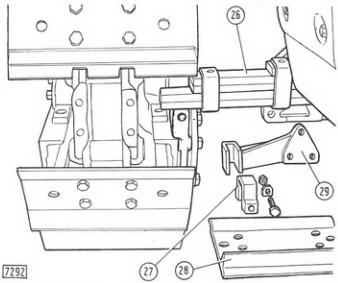

Fig. 107 - Front View of Suspension Leaf Spring
26. Leaf spring - 27. Suspension mounting bracket - 28. Track shoe - 29. Brace.

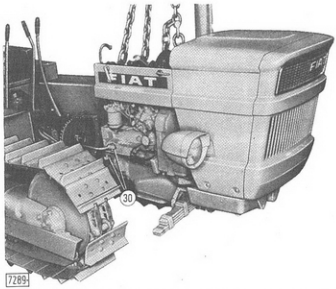

Fig. 108 - Removing (or Refitting) Engine/Front Suspension Unit using Lifting Chain Part No. 290740
30. Hydraulic lift pump lines.

Note: Release the clutch to prevent split drive plate from falling.

Remove the floorboards, drain lube. oil, remove retaining screws and lift off gearbox/clutch assembly using lifting chain Part No. **291260** and tackle (see Fig. 109).
The following operations can be better performed with the gearbox placed on rotary stand Part No. **290086**.

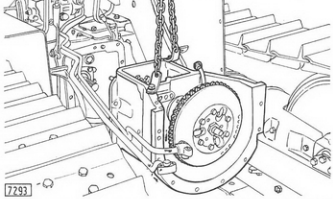

Fig. 109 - Removing (or Refitting) Gearbox/Clutch Assembly using Lifting Chain Part No. 291260

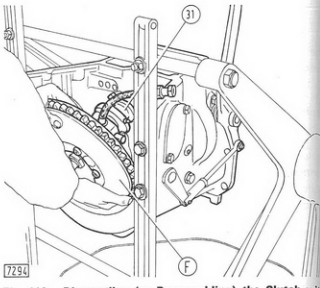

Fig. 110 - Dismantling (or Reassembling) the Clutch with the Gearbox on Rotary Stand Part No. 290086
F. Clutch assembly - 31. Drive coupling.

Subsequently, dismantle the components noting the following:—

1. Clutch assembly (F, Fig. 110).
   Disconnect drive coupling (31) from the gearbox main shaft.
2. Gearshift mechanism (see Fig. 111).

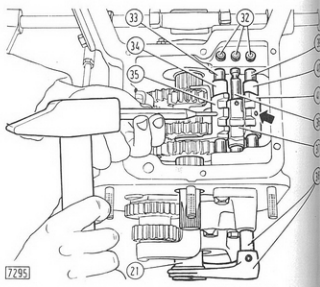

Fig. 111 - Removing a Selector Fork Spring Pin
(The arrow points to a correctly positioned spring pin; the cut should be on the longitudinal axis of the selector shaft). - 21. Sleeve - 32. Plugs - 33, 34 and 35. Selector shaft, spacer and fork of third, fourth, fifth and top forward speeds (spacer length = 22.4 to 22.6 mm. - .88 to .89 in.) - 36, 37 and 38. Selector shaft, sector and fork of speed reduction control - 39, 40 and 41. Selector shaft, spacer and fork of first/second forward speeds and first/second reverse speeds (spacer length = 20.3 to 20.5 mm. - .81 to .81 in.).

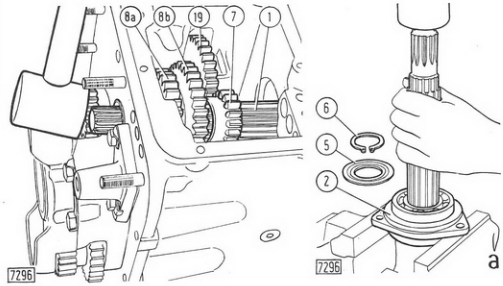

Fig. 112 - Dismantling the Main Shaft and Front Cover Assembly

a. Front cover complete with ball bearing. - 1. Main shaft. - 2. Front cover assembly - 5 and 6. Oil sealing ring and circlip - 7. 1st-2nd forward/ 1st-2nd reverse speed drive gear - 8a. 3rd-5th forward speed drive gear - 8b. 4th-top forward speed drive gear - 19. 1st-2nd reverse speed idler gear.

Withdraw spring pins and selector shafts, tapping from the front.

Remove plugs (32) to take out the three detent balls and the two speed reduction selector shaft locking balls with the associated springs (see Fig. 118).

Note : If also layshaft (17, Fig. 114) has to be dismantled, remove front cover (10, Fig. 115) and slacken locking nut (C_1) thus causing two speeds to be engaged at the same time.

3. Main shaft (1, Fig. 112) and sliding gears (7, 8a, 8b).

Remove front cover retaining nuts and withdraw the shaft assembly, tapping from the rear.

In case of inner gasket/bearing replacement, remove circlip (6) and withdraw cover (2) tapping as shown in (a).

4. Speed reduction assembly (see Fig. 113).

Remove and dismantle on bench, withdrawing idler gear pins and separating carriers as shown in a, b, c.

5. Layshaft (17, Fig. 114) and gears (12, 13 and 14, Fig. 115).

Unscrew nut (C_1) and withdraw the shaft tapping from the front.

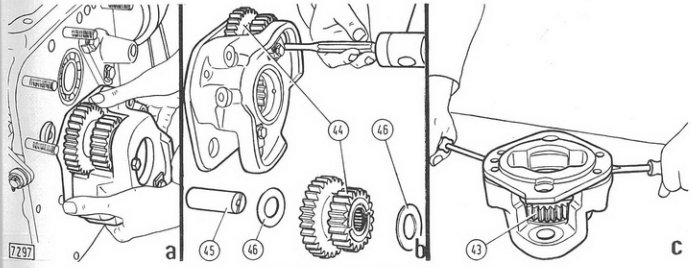

Fig. 113 - Speed Reduction Unit

a. Removing (or Refitting) the speed reduction unit - b. Withdrawing idler gear pins - c. Separating carriers - 43. Driven gear - 44. Idler gears - 45. Idler gear pins - 46. Shims.

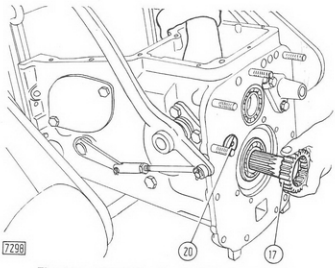

Fig. 114 - Removing (or Refitting) Layshaft
17. Layshaft - 20. Reverse speed idler gear shaft.

6. Reverse speed idler gear and shaft (19 and 20, Fig. 115). Withdraw shaft (20) using impulse extractor Part No. **290795**, with threaded adaptor M 10 x 1.25.

Thoroughly clean the parts and check for wear according to the dimensions given in the Data Table. The spline surfaces should not show any sign of pick-up or wear.

The backlash should be as specified. Speed reduction gears (43 and 44, Fig. 113) and reverse gear (19, Fig. 115) should not show undue end clearance; if necessary, renew the shims.

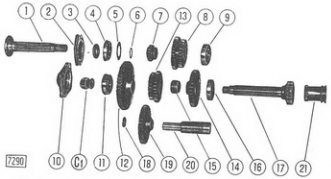

Fig. 115 - Exploded View of the Gear Assembly
C_1. Layshaft locking nut and washer - 1. Mainshaft - 2. Upper cover and plain washer - 3. Seal - 4. Bearing assembly (with circlip) - 5. Oil sealing ring - 6. Snap ring - 7 and 8. Drive gears slidling on main shaft - 9. Bearing - 10. Lower cover and plain washer - 11. Bearing assembly (with circlip) - 12, 13 and 14. Driven gear integral with layshaft - 15. Spacer - 16. Bearing - 17. Layshaft - 18. Thrust ring - 19. Reverse gear - 20. Shaft - 21. Speed reduction sleeve.

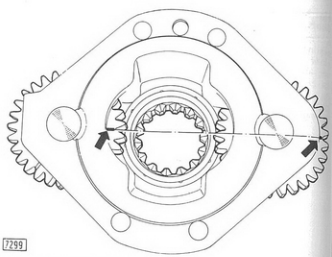

Fig. 116 - Refitting Speed Reduction Idler Gears (Reference Marks Lined-up)

In case of replacement remove bearings and bushes using universal pullers and refit using suitable drifts.

Reassemble the gearbox as shown in Figs. 115 and 119. Moreover:—

— Refit the gears with the tooth lead-in chamfers facing the matching side.

— Refit (on bench) the speed reduction idler gears, lining up the reference marks as shown in Fig. 116. Lock the speed reduction unit to the case before refitting the selector shaft and fork (38, Fig. 111).

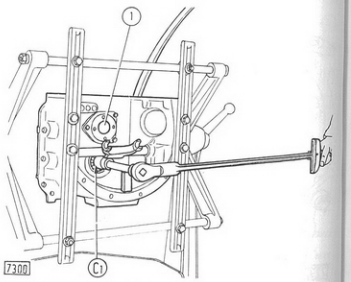

Fig. 117 - Tightening the Layshaft Retaining Nut using a Torque Spanner
C_1. Layshaft retaining nut - 1. Main shaft.

— Retighten layshaft retaining nut (C_1, Fig. 117) to the specified torque: the operation is made easier if performed after main shaft refitting, with two speeds engaged at the same time.

— To refit the gearshift mechanism refer to Figs. 111 and 118.

Finally, refit to the tractor, using a plain gasket between gearbox and bevel drive case mating surfaces and between gearbox case and cover.
Fill up the units with the prescribed lube. oil.

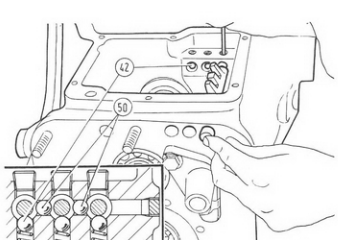

Fig. 118 - Refitting a Gearbox Selector Shaft Holding Down Detent Ball

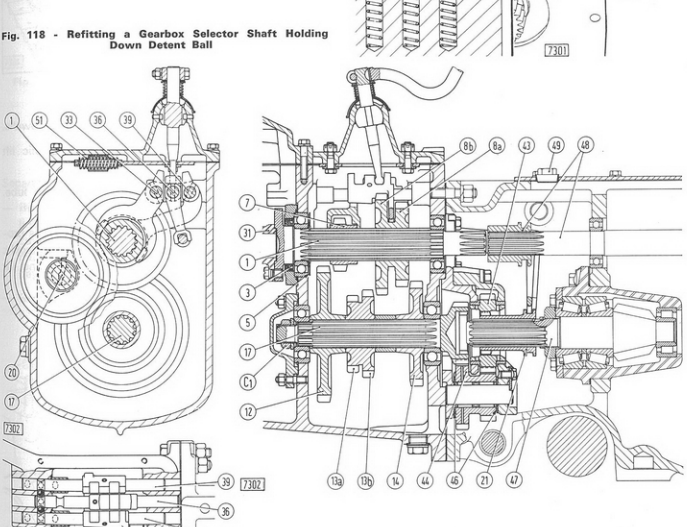

Fig. 119 - Sections through the Gearbox

C_1. Layshaft retaining nut - 1. Mainshaft - 3. Main shaft seal - 5. Oil sealing ring - 7. 1st-2nd forward/1st-2nd reverse speed drive gear - 8a. 3rd-5th forward speed drive gear - 8b. 4th-top forward speed drive gear - 12. 1st-2nd forward speed driven gear - 13a. Reverse speed driven gear - 13b. 4th-top forward speed driven gear - 14.3rd-5th forward speed driven gear - 17. Layshaft - 19 and 20. Reverse idler gear and shaft - 21. Speed reduction sleeve - 31. Master clutch shaft/gearbox main shaft drive coupling - 33. 3rd-4th-5th-top forward speed selector shaft - 36. Speed reduction selector shaft - 39. 1st-2nd forward/reverse speed selector shaft - 43. Speed reduction driven gear - 44. Speed reduction idler gear - 46. Shims - 47. Bevel pinion shaft - 48. P.T.O. drive gear shaft and sleeve - 49. Gearbox-bevel drive/P.T.O lube. oil filler - 51. Gearshift lever spring.

BEVEL DRIVE

BEVEL DRIVE DATA

Reduction ratios:—	
— Model 505 C	44/9 = 4.890 to 1
— Models 355 C-455 C-605 C	44/10 = 4.400 to 1
Gear tooth backlash	.15 to .25 mm. (.006 to .010 in.)
Shim thickness range:—	
— Bevel pinion	.2 - .5 - .1 mm. (.008 - .020 - .040 in.)
— Crown wheel tapered roller bearing pre-load and backlash	.3 - .5 - .7 mm. (.012 - .020 - .040 in.)

TO OVERHAUL

Separate the engine/gearbox unit from axle as follows (see Fig. 120):—

— Remove lower side panel and bonnet complete with L.H. panel.

— Remove leaf spring suspension mounting brackets (27, Fig. 107) associated track shoes (28) and braces (29).

— Remove floorboards complete with front firewalls.

— Disconnect lines (30, Fig. 120) from hydraulic lift pump, plug and move out of the way.

— Disconnect rear lighting connectors and drain lube. oil from gearbox/bevel drive case.

— Apply lifting chain Part No. **290740** to the eyes provided on the engine, take up the weight with a tackle, remove bevel drive/gearbox retaining screws and lift engine/gearbox unit as shown in Fig. 120.

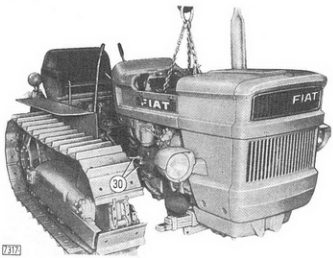

Fig. 120 - Removing (or Refitting) Engine/Gearbox Unit using Lifting Chain Part No. 290740
30. Hydraulic lift pump lines.

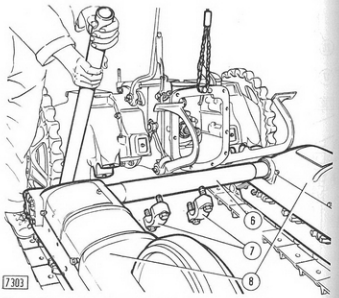

Fig. 121 - Removing the Track Carriages from Bevel Drive/Hub Reduction Case
6. Rear suspension bar - 7. Track carriage retaining caps - 8. Track carriage assemblies.

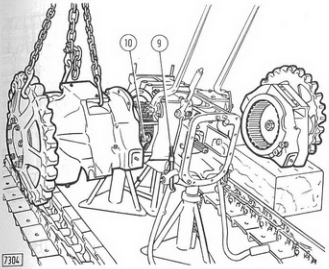

Fig. 122 - Removing (or Refitting) Bevel Drive Case
9. R.H. brake linkage - 10. Brake band control.

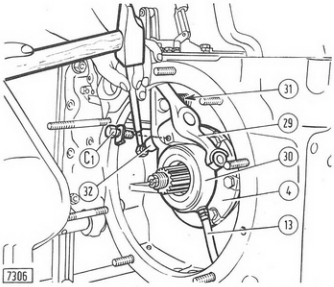

Fig. 124 - Removing the Steering Clutch Sleeve Fork Pivot Pin using Puller Screw and Punch
C_1. Flange/pin retaining screw - 4. Bevel drive bearing housing - 13. Release bearing hose - 29. Fork - 30. Sleeve - 31. Fork return spring - 32. Pivot pin.

Separate the bevel drive case as follows:—

— Remove the hydraulic lift with attached three-point linkage and lines, the drawbar assembly, the rear cover with P.T.O. gears, the belt pulley (if applicable), mudguards with attached rear lights and flood light, paying attention to the electric connectors.

— Separate the track carriages, apply a lifting chain to the front end of bevel drive case (see Fig. 121) and take up the weight of suspension bar (6). Remove caps (7) and push track carriages forward using a suitable lever (8).

— Place the bevel drive case on stands, disconnect brake linkages (9, Fig. 122) from controls (10) and lift off the hub-reduction units using the chain and tackle shown.

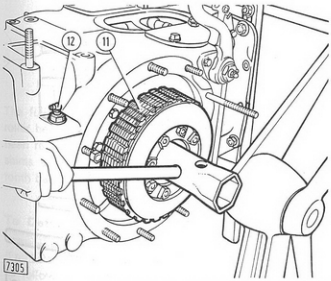

Fig. 123 - Removing the Steering Clutch Locking Nut with the Bevel Drive Case placed on Rotary Stand Part No. 290086
11. Steering clutch locking nut - 12. Steering clutch release bearing lubricator.

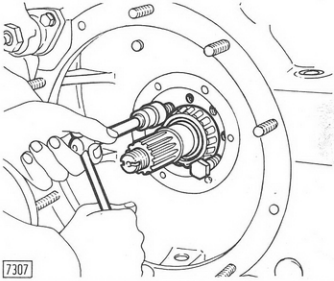

Fig. 125 - Removing the Bevel Drive and Bearing Inner Ring from Shaft, using a Pair of Puller Screws

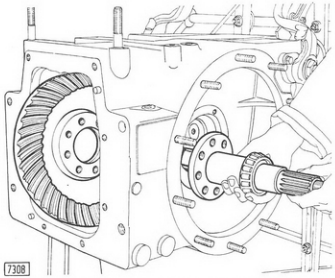

Fig. 126 - Withdrawing the Shaft and Crown Wheel Assembly

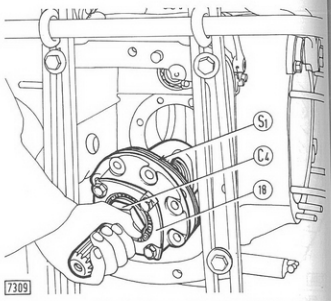

Fig. 127 - Dismantling (or Reassembling) Bevel Pinion Carrier
C_4. Pinion retaining nut - S_1. Shim pack - 18. Bearing plate.

Place the bevel pinion case with attached steering clutches on rotary stand Part No. **290086** (see Fig. 123), withdraw steering clutches (11) with the associated fork and release bearing assembly, withdrawing pivot pin (32) as illustrated in Fig. 124.

Mark the crown wheel shaft supports and remove together with shims (S_2 and S_3, Fig. 129).

Remove crown wheel retaining screws (C_3), slightly rotate the shaft to stagger the drilled holes and slide out the crown wheel, together with L.H. bearing inner ring, using the two puller screws (M 14 x 1.5 thread) shown in Fig. 125.

Slide out the shaft assembly and the crown wheel (see Fig. 126).

Withdraw the bevel pinion carrier assembly (see Fig. 127) and dismantle on bench. To do this, unscrew nut (C_4) remove bearing plate (18) and, using a hydraulic press, withdraw the pinion from the associated carrier (see Fig. 128).

If necessary, withdraw the tapered roller bearing from the pinion using a universal extractor.

Keep the bearing inner rings separate so that they can be refitted in their original position.

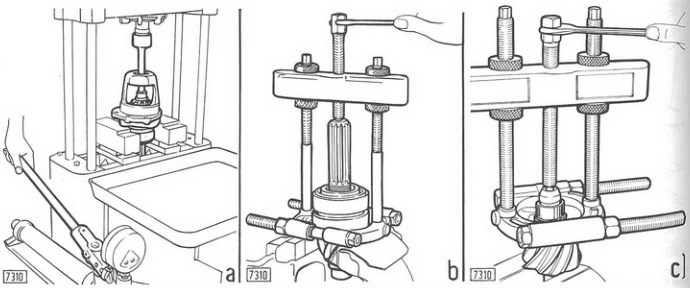

Fig. 128 - Withdrawing Bevel Pinion Assembly from Carrier using a Hydraulic Press (a) and Bearing from Bevel Pinion Shaft using a Universal Extractor (b and c)

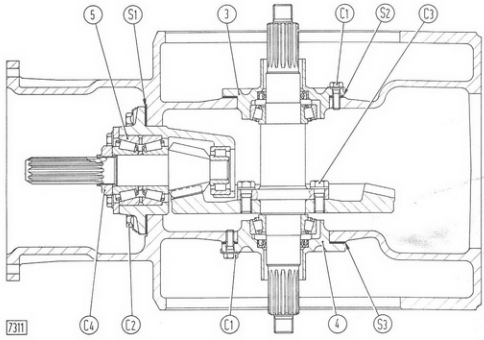

Fig. 129 - Section through the Bevel Drive

C_1. Crown wheel bearing carrier standard (A.M.)/Self-locking (P.M.) screws - C_2. Bevel pinion carrier retaining screws - C_3. Crown wheel retaining screws - C_4. Pinion bearing locking nut - S_1. Pinion adjustment shims - S_2 and S_3. Crown wheel tapered roller bearing pre-load and tooth backlash adjustment shims - 3. R.H. bearing housing - 4. L.H. bearing housing - 5. Double row tapered roller bearing.

This bearing is supplied factory-sealed; therefore, be careful not to reverse inner ring position, otherwise alteration of the end play may occur.

To reassemble the parts refer to Fig. 129, tighten the screws and nuts to the specified torque figures and proceed as directed in the following chapter.

When refitting the units, remember to interpose a gasket between gearbox case and P.T.O. cover.

TO ADJUST

The following adjustments are necessary when tapered roller bearings or housings, or bevel drive assembly have been renewed. In all other cases simply refit the original shims and check rotating torque (see Fig. 133 b) and tooth backlash (see Fig. 134).

To Determine Bevel Pinion Shims (S_1, Fig. 129)

If tool Part No. **290787** (see Fig. 130) is available, proceed as follows:—

— Fit gauge (C) into the case, lock R.H. bearing assembly (3) tightening three retaining screws (C_1) to a torque of 6 kgm (43.3 lb ft), and L. H. bearing (4) by means of retaining screws (V) lubricated and staggered at 120° from each other. Tighten screws (V) alternately up to a maximum torque of .6 kgm (4.33 lb. ft.). At the same time, swing the gauge to bed in the roller bearing.

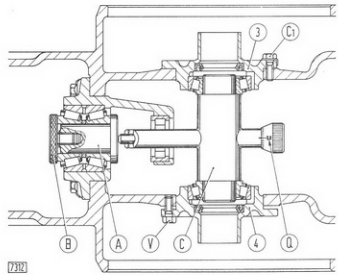

Fig. 130 - Determining Bevel Pinion Shims using Tool Part No. 290787 (A, B, C)

C_1. R.H. bearing housing retaining screws - Q. Dimension to be measured on tool - V. L.H. bearing housing retaining screws - 3. R.H. bearing housing - 4. L.H. bearing housing.

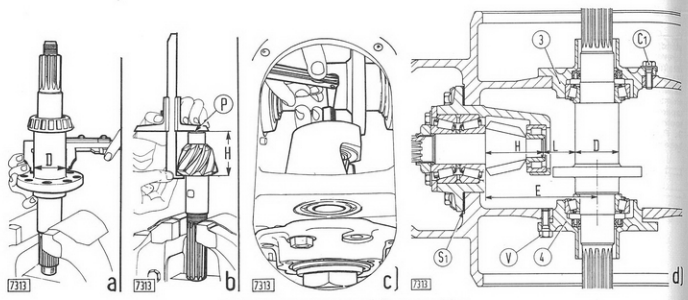

Fig. 131 - Adjusting Bevel Pinion Position

a. Measuring diameter (D) on crown wheel shaft - b. Measuring height (H) on pinion - c. Measuring distance (L) between pinion and crown wheel shaft, using slip gauge and feeler gauge - d. Sectional view - C_1. R.H. bearing housing retaining screws - E. Distance between crown wheel axis and bevel pinion (147 mm. - 5.78 in. nominal) - P. Correction (mm.) on pinion - V. L.H. bearing housing retaining screws - 3. R.H. bearing housing - 4. L.H. bearing housing.

— Fit measuring tool parts (A and B, Fig. 130) to the bevel pinion carrier assembly and fix the carrier to the case without shims.

— Place tool (C) horizontal, screw in the associated knurled knob until the stylus contacts dummy pinion face (A) and read dimension (Q). This indicates the distance between reference marks on gauge body and stylus. For a correct reading, note that one turn of the knob causes the stylus to be displaced 2 mm. (.08 in.) and that, starting from zero, the readings are preceded by sign "—" for the first half turn and by sign "+" for the following turn.

— Take note of the correction value (P, Fig. 131 b) on the pinion expressed in mm. and preceded by "+" or "—" if other than zero.

— Calculate shim thickness (S_1, Fig. 129) using the following formula:—

$$S_1 = Q \pm P$$

Example

Dimension (Q) is 2.8 mm.

Correction value (P) measured on pinion is .3 mm.

Shim pack thickness is given by:—

$$S_1 = 2.8 + .3 = 3.1 \text{ mm.}$$

If correction value (P) measured on pinion were — .3 mm., thickness is:—

$$S_1 = 2.8 - .3 = 2.5 \text{ mm.}$$

— Fit the shim pack (S_1) and read new dimension (Q) on the gauge. Shim pack thickness must be considered correct when (Q) is equal in value and sign to correction value (P) as read on the pinion. (A maximum .1 mm. tolerance is allowed). If higher or lower, correct shim pack thickness as necessary.

If tool Part No. **290787** is not available, adjust bevel pinion position as follows (see Fig. 131):—

— Measure dimensions (D and H) on crown wheel shaft and pinion.

— Refit crown wheel shaft into the case, lock R.H. bearing housing (3) tightening three screws (C_1) to a torque of 6 kgm (43.3 lb. ft.), and L.H. bearing housing (4) by means of three screws (V) lubricated and staggered at 120° from each other. Tighten screws (V) alternately up to a torque of .6 kgm (4.33 lb.ft.) and, at the same time, rotate the shaft by hand to bed in the roller bearings.