and the top of the plunger when the plunger is at the top of its stroke.

This can be found by the use of the plunger head clearance gauge 18G538A in the following manner.

Remove from No. 1 element on the pump the delivery valve holder, valve and spring, volume reducer, and joint washer.

Select the appropriate adaptor from the three supplied and assemble the dial gauge to it. When clamping the gauge make sure that the extension is central and does not foul the bore of the adaptor. Screw the adaptor and gauge into the position normally occupied by the delivery valve holder until the adaptor is tight against the top face of the valve guide.

Turn the camshaft until No. 1 element is at T.D.C. and zero the gauge.

Insert a suitable lever under the plunger control arm and gently lever the plunger upwards until it can be felt to touch the under side of the valve guide. Note the dial gauge reading, the difference from zero being the plunger head clearance.

This clearance must be between ·0315 and ·0512 in. (·8 and 1·3 mm.). Correct, if necessary, by exchanging the tappet spacer disc.

Phasing

To commence phasing connect the pump inlet to the test rig and bleed the pump. Turn off the fuel supply and remove No. 1 delivery valve spring and volume reducer, if not already removed. Connect the test pipe 18G233 to No. 1 element outlet, turn the camshaft until No. 1 element plunger is at the bottom of its stroke, then turn on the fuel. The fuel will flow through the suction chamber of the pump, entering No. 1 element barrel by two open ports, and will flow out from the test pipe.

Turn the camshaft **in the direction of rotation** until No. 1 plunger starts to lift; as the ports are progressively closed by the plunger the fuel issuing from the test pipe will gradually diminish. Tap the camshaft round in the final stages very gradually until fuel ceases to drip from the pipe. This is the point of inlet port closure—take note of the position on the degree plate.

Replace the delivery valve, spring, and volume reducer to No. 1 element and remove these components from the next element in order of injection, i.e. No. 3. Check the inlet port closing point of this element, which should be 90° after No. 1; make a note of any correction required.

Check the phase angles of all elements in the order of injection and take note of the correction required. A maximum variation of $\pm\frac{1}{2}°$ of the phase angle is permitted. Variations exceeding this must be corrected by exchanging the tappet spacer.

The spacers are made in five graded thicknesses varying in steps of ·004 in. (·1 mm.) as follows:

Spacer thickness	*No. stamped on spacer*
·177 in. (4·5 mm.)	1
·181 in. (4·6 mm.)	2
·185 in. (4·7 mm.)	3
·189 in. (4·8 mm.)	4
·193 in. (4·9 mm.)	5

The difference of ·004 in. (·1 mm.) of spacer thickness is equivalent to approximately $\frac{1}{2}°$ of camshaft rotation. Therefore, fitting a thicker spacer will advance the inlet closing point by $\frac{1}{2}°$, while a thinner spacer will retard the inlet closing point by the same amount.

Remove the pump body from the camshaft casing and change the spacers as necessary. The spacer of No. 1 element should not be exchanged, but used as a datum for the adjustment of the other three elements.

After any adjustment to the phase angles check the clearance of the plungers, except No. 1, when at the top of their strokes, as detailed in the paragraph preceding **'Phasing'** on this page.

Assemble the pump body to the camshaft casing, but this time fit the plunger springs and spring plates with the shims between the control arm and lower spring plate.

Check that the plunger foot has a vertical clearance of ·002 to ·017 in. (·05 to ·425 mm.) when held in position on its tappet by the lower spring plate so that the plunger can be turned freely by its control fork. Adjust as necessary by means of plunger shims (see **'GENERAL DATA'**).

Refit the governor inner housing to the pump body.

Insert the control rod through the bores in the camshaft casing; at the same time thread on the control forks, which must be engaged with their respective plunger arms. Fit the control rod stop and the stop control housing. The maximum fuel delivery stop screw should be fully unscrewed for adjustment when testing.

Position the control forks on the control rod. The fork at the governor end should be secured by its clamp at the extreme end of the square portion. The remaining forks should be secured so that the gap between the adjacent forks is ·787 in. (20 mm.).

When refitting the inlet union to the pump care must be taken to centralize the copper washer which is fitted between this union and the pump body, as there will be a tendency for the washer to drop into the undercut at the end of the thread.

Refit the governor (see Section D.12).

Section DD.5

FUEL INJECTION PUMP CALIBRATION

This adjustment is made to balance the output of all pumping elements throughout their delivery range.

The method described below is for use on a fuel injection pump test bench using a matched set of test injectors (nozzle type BDN.12.SD.12, holder type BKB.50.SD.19b set at 175 atmospheres).

Fit the pump coupling flange and timing indicator. Check that the timing mark on the flange aligns with the mark on the indicator at the point of inlet port closure on No. 1 element. Re-mark if necessary.

Mount the pump, less governor, on the test bench. Link up the drive and connect the fuel supply.

Fit the setting gauge 18G215 to the front half of the governor housing. Adjust the maximum fuel stop, using the fingers only, until the centre face of the transverse link just abuts against the setting gauge and secure the stop with the locknut. This will give a control rod setting of ·276 in. (7 mm.). Do not overtighten the maximum fuel stop as this may distort the transverse link and so give a false control rod setting.

NOTE.—The control rod setting position is the distance from the centre face of the governor transverse link to the joint face of the governor front half, i.e. the distance (X) in Fig. DD.9.

With the control rod in this position, check the output, which must be 3 c.c.±·2 c.c. per element for 200 shots at 225 pump r.p.m. Adjustment is accomplished by slackening the clamp screws securing the control forks and moving the forks slightly on the control rod. Secure them in position and re-check the output.

Remove the setting gauge 18G215 and check that all elements cease to deliver at 600 pump r.p.m. when the control rod is set ·118 in. (3 mm.) from the zero position.

Maximum fuel setting

Refit the governor. Set the control rod to give an average delivery, over all four elements, of 10·6±·2 c.c. in 200 shots at 600 pump r.p.m. The control rod setting is made by adjusting the maximum fuel stop screw position. The position of the control forks on the control rod must not be altered to obtain an acceptable maximum fuel setting.

In arriving at this figure the output from each element must be between 10·2 and 11·0 c.c. Examples of correct and incorrect settings follow:

(*a*) Pump readings: 11·0, 11·0, 11·0, 10·2 c.c.

Average delivery:

$$\frac{11{\cdot}0+11{\cdot}0+11{\cdot}0+10{\cdot}2}{4} = 10{\cdot}8 \text{ c.c.}$$

This is **acceptable,** as each element reading lies between 10·2 and 11·0 c.c. and the average is within 10·6±·2 c.c.

(*b*) Pump readings: 10·2, 10·2, 10·2, 10·4 c.c.

Average delivery:

$$\frac{10{\cdot}2+10{\cdot}2+10{\cdot}2+10{\cdot}4}{4} = 10{\cdot}25 \text{ c.c.}$$

Although the output of each element is within the limits of 10·2 to 11·0 c.c. the average delivery figure of 10·25 c.c. is **not acceptable,** as it is outside the lowest average delivery limit of 10·4 c.c. by ·15 c.c.

To correct this setting adjust the maximum fuel stop (not the individual forks) so that each element output is increased. As the average output is ·15 c.c. outside the lowest acceptable limit, the output of all elements must be increased by this amount plus a tolerance, in this case ·2 c.c., without which the average delivery would still only be to the lowest limit acceptable.

The readings will then be 10·55, 10·55, 10·55, 10·75 c.c., giving an average delivery over all four elements of 10·6 c.c., which is ideal.

Similarly, if the average delivery happens to be in excess of 10·8 c.c., then each element output must be reduced by the excess amount plus a tolerance to give an average output as near as possible to the ideal of 10·6 c.c. with the output from each element lying between 10·2 and 11·0 c.c. If a satisfactory maximum fuel setting cannot be obtained by this method and the pump is correctly calibrated as outlined previously, the faulty pumping element or elements must be renewed.

When the maximum fuel setting is correct lock and seal the maximum fuel stop screw with wire and lead seal to discourage unauthorized adjustment, using sealing pliers 18G541 (see page D.33).

Section DD.6

DESCRIPTION—PNEUMATIC GOVERNOR

The governor is mounted to the rear of the injection pump and uses the suction created in the engine induction system to control the amount of fuel delivered to the engine. Connection between the throttle unit (venturi) (mounted on the air inlet manifold) and governor is made by two suction pipes. The main suction pipe connects the main port on the engine side of the throttle valve to the port in the governor housing leading directly into the governor chamber. The auxiliary suction pipe connects the auxiliary port on the atmospheric side of the throttle valve to the governor chamber via the damping valve assembly. The inlet from the auxiliary suction pipe is through the port in the governor housing to an external annular groove in the valve guide; this groove is connected to the governor chamber by two radial holes communicating with the valve guide bore.

The diaphragm is a synthetic rubber moulding retained in the governor housing by a steel plate and spring ring. The centre of the diaphragm is clamped between two dished plates and mounted on the governor guide; this guide engages a slot in the transverse link, thus connecting the diaphragm assembly to the pump control rod. The governor spring is positioned between

the diaphragm dished plate and the wall of the governor housing; the dished plate and bosses in the housing wall keep the spring centralized.

Thus the damping valve moves inside its guide in relation to the diaphragm movement. The damping valve guide assembly is screwed into the rear of the governor housing for anti-surge adjustment; an external locknut secures it in position.

The throttle valve in the throttle unit (venturi) is controlled by the accelerator, and when this valve is moved to the closed position an increased suction is created on the engine side of the valve. This is transmitted through the main suction pipe to the governor

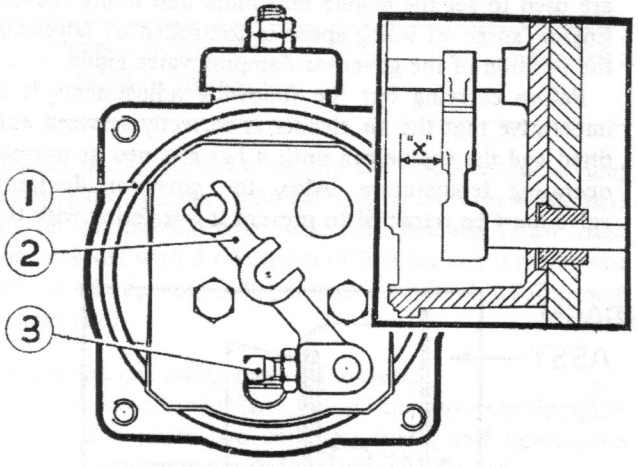


Fig. DD.9

The fuel injection pump—transverse link arrangement

1. Governor case (front half).
2. Transverse link.
3. Control rod locking screw x = ·276 in. (7 mm.).

chamber, thus reducing the pressure on that side of the diaphragm. As the chamber on the other side of the diaphragm is open to atmospheric pressure, the diaphragm is drawn back against the pressure of the spring, thus moving the pump control rod so as to reduce the amount of fuel delivered. Closing the throttle valve, therefore, reduces the engine speed, whilst opening the throttle valve reduces the suction on the diaphragm, so that the spring returns the pump control rod towards the increased fuel delivery position, thus increasing the engine speed. When the engine is at rest the pump control rod is held in the maximum fuel delivery position by the diaphragm spring.

The maximum speed of the engine is determined as a result of the throttle valve being fully opened, giving an increase in engine speed with consequent increasing air velocity in the throttle unit (venturi). The increase in air velocity in the throttle unit (venturi) causes a gradually increasing suction in the main port, which is transmitted to the diaphragm, and this draws back the pump control rod, limiting the speed of the engine.

The fluted damping valve prevents hunting or surging of the engine at idling speeds. From the diagram it can be seen that when the engine is idling the pressure in the governor chamber will be low, the diaphragm spring becoming compressed, and the valve head will be in line with the radial holes in the guide. If the diaphragm moves too far towards the stop position the fluted portion of the valve head lines up with the radial holes in the guide and will admit air from the auxiliary port. As this port is connected to the auxiliary suction pipe the air is at approximately atmospheric pressure and will therefore relieve the suction on the diaphragm. The damping valve thus acts as a buffer, preventing excessive oscillations of the diaphragm at idling speeds.

Section DD.7

REMOVING, OVERHAULING, AND REPLACING THE PNEUMATIC GOVERNOR

Remove the two suction pipes from the governor.

Remove the four set bolts and withdraw the rear half housing after disengaging the guide from the slot in the transverse link.

Before dismantling, test the diaphragm in the governor unit for leakage by pushing in the diaphragm so as to compress the spring. Seal the two suction pipe connections by placing your fingers over the two inlet unions and release the diaphragm. If no leakage exists the diaphragm will remain in the extended position, but if the diaphragm returns to the compressed position this indicates a leakage in or around the diaphragm which will affect governor operation. If leakage is apparent the diaphragm must be renewed.

To remove the diaphragm from its housing extract the spring ring, which has an ejector hole for ease of removal; the spring then forces out the retaining plate and diaphragm assembly. Remove the spring.

Release the transverse link from the control rod by removing the nut and locking screw.

Unscrew the nut and locknut securing the governor filter and withdraw the cover-plate and filter capsule.

Remove the two set bolts and the countersunk set screw securing the governor front half housing and remove the housing from the pump body.

Inspect the diaphragm for signs of perishing or cracks which are liable to affect efficient operation. If there is the slightest doubt as to its condition it should be renewed as follows:

(1) Unscrew the locknut from the governor guide and remove the plain washer, the outer dished washer, and the diaphragm.

(2) Fit a new diaphragm (see Fig. DD.10), replace the dished washer, lip facing outwards, and carefully retighten the locknut.

Inspect the diaphragm spring for signs of damage or weakness. It should be checked for length against a new one; renew the spring if there is any appreciable variation between lengths.

Ensure that the valve guide and its radial connecting holes are completely free; they should be blown out, using a compressed-air jet.

Inspect the valve on the end of the governor guide; it should be perfectly smooth and not bent in any way.

Wash the air filter capsule in petrol (gasoline). When dry, dip the capsule in clean engine oil and allow to drain for approximately 30 minutes before replacing.

The reassembly and installation of the governor is a reversal of the dismantling procedure, but note the following points.

Coat the damping valve and bush with Oildag colloidal graphite grease.

Test the governor for leakage as described previously.

After replacing the transverse link check that the link and pump control rod move perfectly freely as any tightness will cause defective governor operation. **Do not overtighten** the tapered set screw which secures the link to the rod as this will cause the end of the rod to expand, making it difficult to remove the link at a later date.

Before putting the engine into service adjust the governor as described below.

NOTE.—Under no circumstances must the engine be run without the throttle unit (venturi) or the inlet manifold fitted, or with either of the two suction pipes disconnected.

To adjust

Two adjustable stop screws, which limit the opening and closing of the throttle unit (venturi) butterfly valve, are used to set the engine maximum and idling speeds. Engine 'surge' at idling speed is controlled by adjusting the position of the governor damping valve guide.

Before carrying out the following adjustments it is imperative that the air cleaner is correctly serviced and fitted and the engine run until it has attained its normal operating temperature. Also, the governor damping valve must be retracted to prevent it interfering with the

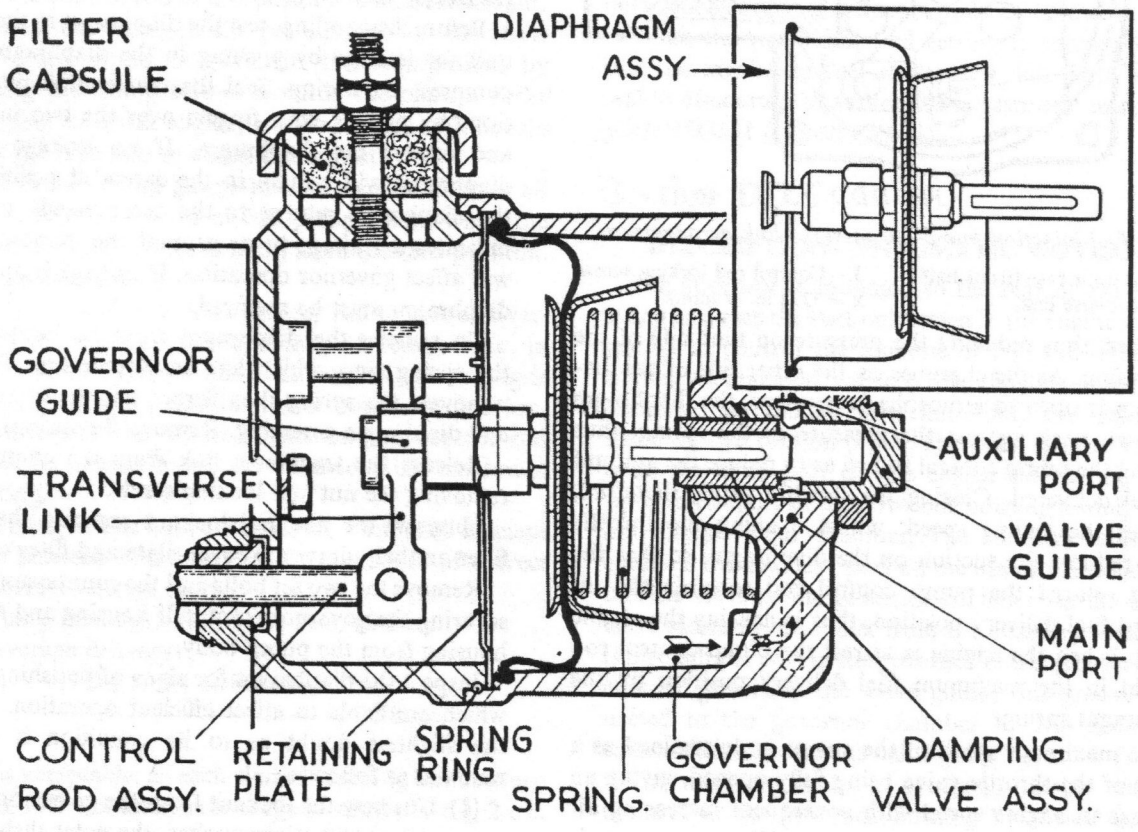


Fig. DD.10

A sectional view of a correctly assembled diaphragm. Note the support washer fitted between the diaphragm front plate and the locknut. When servicing the early-type diaphragm assemblies opportunity should be taken of fitting this washer (Part No. 17H1461)

Altitude	*Maximum fuel output for 200 strokes at 600 pump r.p.m.*	*Adjustment on maximum fuel stop screw*
	Tractor (OEA/2)	*Tractor (OEA/2)*
0 to 6,000 ft. (0 to 1830 m.)	10·4 to 10·8 c.c.	Standard setting
6,000 to 8,000 ft. (1830 to 2440 m.)	9·0 to 9·4 c.c.	Screw in $\frac{2}{3}$ turn from standard
8,000 to 10,000 ft. (2440 to 3050 m.)	7·8 to 8·2 c.c.	Screw in $1\frac{1}{3}$ turns from standard
10,000 to 12,000 ft. (3050 to 3660 m.)	6·5 to 6·9 c.c.	Screw in 2 turns from standard

action of the governor during the operation of setting the engine maximum light running speed. This is essential as the permissible maximum light running speed must be achieved with a minimum of fuelling and a maximum of throttle opening if the engine is to develop full power under load.

Maximum and idling speed adjustment

(1) Slacken the locknut, retract the governor damping valve guide two complete turns, and tighten the locknut to secure the guide in this position.
(2) Adjust the maximum speed stop screw on the throttle unit (venturi) to give an engine maximum light running speed of 2,150 to 2,240 r.p.m. as shown on a tachometer, thus giving a maximum governed speed under load of 2,000 r.p.m.
(3) Lock the maximum speed stop screw with the locknut, and to discourage unauthorized adjustment seal the screw with wire and a lead seal, using sealing pliers 18G541.
(4) Slacken the locknut, screw in the damping valve guide until the engine is running free of 'surge', and tighten the locknut to secure the damping valve guide in this position.
(5) Check the engine maximum light running speed to ensure that it has not been increased by the interference of the damping valve with the governor action. If necessary, adjust the damping valve guide to restore the engine maximum light running speed to the figure given in paragraph (2).
(6) Check the engine idling speed, using a tachometer, and, if necessary, adjust the idling stop screw on the throttle unit (venturi) to give an idling speed of between 520 and 550 r.p.m.

To obtain engine idling free from 'surge' it may be necessary to vary the position of both the idling stop screw and the governor damping valve guide. If the governor damping valve guide is adjusted the engine maximum running speed must be checked as described in paragraph (5).

Section DD.8

ALTITUDE SETTINGS

Before an engine leaves the Factory both the fuel pump calibrations and the governor settings are adjusted for sea-level conditions. If an engine is to be operated above zero altitude further adjustments are necessary. Reference to the schedule above will show the variations in maximum fuel output and in maximum fuel stop screw setting which are considered adequate for the altitudes indicated.

When an engine is operated at an altitude greater than that for which it is governed its maximum governed speed will increase. To obviate the possibility of excessive r.p.m. during the operation of resetting the governed speed slacken the locknut and screw in the maximum stop screw on the venturi to its fullest extent. Continue the operation as described in the latter half of the preceding Section.

Section DD.9

AUXILIARY VACUUM PIPE RESTRICTOR FITTING

When renewing or replacing the pneumatic governor vacuum pipes ensure that they are fitted correctly and that the restrictor is positioned in the auxiliary vacuum pipe as illustrated in Fig. DD.11.

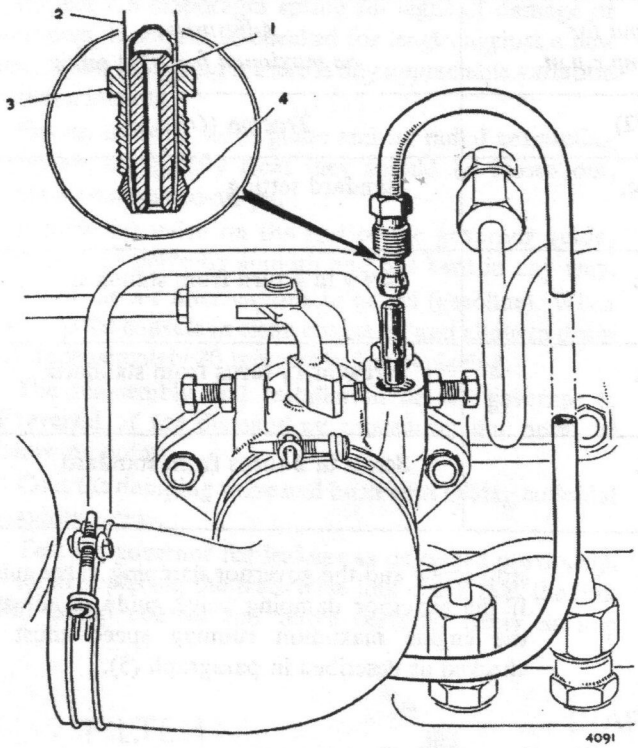


Fig. DD.11

The correct positioning of the restrictor in the auxiliary vacuum pipe

1. Restrictor.
2. Auxiliary vacuum pipe.
3. Nut.
4. Olive.

Should the auxiliary and the main vacuum pipes be reversed or the restrictor be fitted in the main vacuum pipe, the engine governing will be adversely affected.

Section DD.10

FUEL INJECTION PUMP LUBRICATION (FIRST STAGE MODIFICATION)

A modification to improve facilities for internal lubrication and to give complete dustproofing is to be introduced on the four-element fuel injection pump in two separate stages.

The first stage, commencing at Engine No. 34T/B/D43811, incorporates a cast side cover with a convex profile, housing a filler plug and a new leak-off assembly which is fitted higher in the cover and has a longer pipe than the earlier assembly.

The shape of the new cover has necessitated the fitting of the outer pair of pump fixing bolts from underneath. The existing outer set screws have, therefore, been replaced

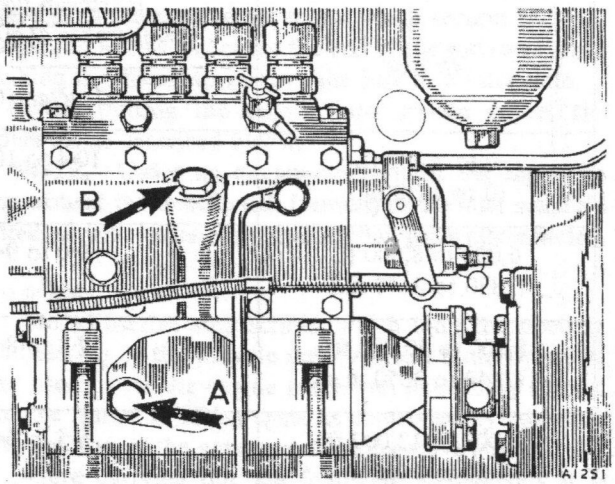


Fig. DD.12

The four-element Simms fuel injection pump with first stage modification

A. Cam box drain plug.
B. Filler plug.

by nuts and bolts and the outer tappings in the pump bracket are drilled to $\frac{11}{32}$ in. (8·73 mm.) diameter. The original set screws and tapped holes continue on the engine side of the pump bracket. A new stop control cable clip is also required with the modified pump.

A modified pump may be used to replace an early type, provided the longer leak-off pipe assembly is fitted.

The early-type mounting bracket can be adapted to accommodate the modified pump fixing bolts if required. The outside holes of the early bracket must be drilled out to $\frac{11}{32}$ in. (8·73 mm.) diameter and the under sides spot-faced $\frac{7}{8}$ in. (22·22 mm.) diameter to provide a seat for the new-type fixing bolt. Alternatively, the early-type bracket and fixing bolts can be used with a modified pump if the side cover is first removed and replaced after the fixing bolts are in position.

If this procedure is adopted, ensure that no foreign matter enters the pump body during operations. Fit a new stop control cable clip (Part No. AMK2602).

Before putting a new four-element fuel injection pump into service remove the plugs from apertures (A) and (B) illustrated in Fig. DD.12, which shows the first stage modification injection pump. Pour engine oil (Ref. A, page P.6) via (B) until the oil emerges from (A). This procedure is to ensure that oil has reached the cam box, since the oil passage through the tappets is restricted and oil will flow through very slowly (if the plug is left in

position at [A] oil may reach the level of [B] before sufficient oil has reached the cam box).

Refit plug (A) and continue to pour oil quickly via (B) until the level reaches the bottom thread of the filler neck. **Do not** wait for oil to drain down past the tappets; replace plug (B) **immediately.** If an accurate measure is available the quantity of oil required to raise the level from plug (A) to the bottom thread of the filler (B) is ·4 pint (230 c.c.). This initial lubrication procedure must be carried out whenever a Simms four-element fuel injection pump is rebuilt or overhauled.

During service

Periodic maintenance is required on fuel injection pumps with the first stage modification.

Every 200 hours remove plugs from apertures (A) and (B) and allow oil to drain completely away from (A).

Refit the plug at (A) and fill the pump quickly via (B) with engine oil (Ref. A, page P.6) until the level reaches the bottom thread of the filler neck. Replace the plug at (B) immediately without waiting for the oil level to settle; the amount of oil required is as detailed above.

Section DD.11

FUEL INJECTION PUMP LUBRICATION (FINAL STAGE MODIFICATION)

The final stage of the fuel injection pump lubrication modification referred to in Section DD.10 is incorporated on four-element fuel injection pumps fitted to some engines numbered 34T/B/D49218 to 49248 and on all engines numbered 34T/B/D49600 onwards.

The lower plug in the cast cover has been omitted and the leak-off pipe assembly has been moved to a position high in the cam box. Internal modifications have also been made to facilitate lubrication.

No periodic maintenance is required on pumps with the final stage modification, but before putting into service or after dismantling or overhauling such pumps the following lubrication procedure must be carried out.

Remove the filler plug and pour in engine oil (Ref. A, page P.6) until oil flows from the leak-off pipe assembly in the cam box. Provision should be made to catch the surplus oil. Replace the filler plug securely.

Care must be taken to prevent the ingress of foreign matter during the lubrication operation.

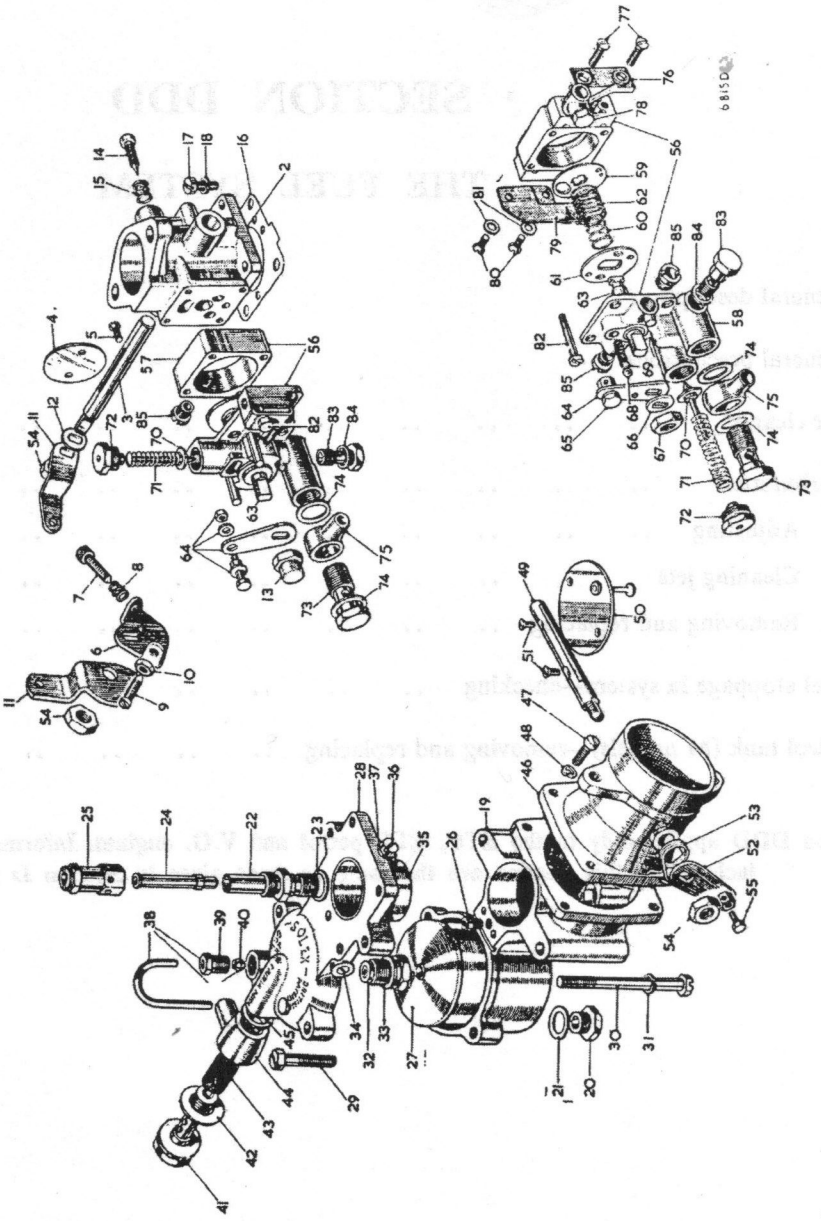
See page DD.16 for Service tools

SECTION DDD

THE FUEL SYSTEM

Section DDD applies only to the ETC, ETD petrol and V.O. engines. Information and instructions not included in this Section are the same as those given in Section D for the 3 DL.

THE CARBURETTER COMPONENTS



KEY TO THE CARBURETTER COMPONENTS

No.	Description
2.	Chamber—throttle.
3.	Spindle—throttle.
4.	Butterfly.
5.	Screw—butterfly fixing.
6.	Plate—throttle abutment.
7.	Screw.
8.	Spring.
9.	Screw.
10.	Locknut.
11.	Lever—throttle.
12.	Distance washer.
13.	Nut for spindle.
14.	Screw.
15.	Spring.
16.	Gasket.
17.	Screw.
18.	Washer.
19.	Float chamber.
20.	Drain plug.
21.	Washer for plug.
22.	Carrier.
23.	Washer.
24.	Main jet.
25.	Cap for main jet.
26.	Auxiliary jet.
27.	Float.
28.	Cover for float-chamber.
29.	Screw (short).
30.	Screw (long).
31.	Washer for long screw.
32.	Needle valve.
33.	Washer for needle valve.
34.	Plug.
35.	Choke tube.
36.	Screw.
37.	Washer.
38.	Pipe assembly—air vent.
39.	Nut—union.
40.	Nipple.
41.	Bolt—banjo union.
42.	Washer (large).
43.	Gauze for filter.
44.	Banjo union.
45.	Washer (small).
46.	Body—strangler.
47.	Screw.
48.	Washer.
49.	Spindle—strangler.
50.	Butterfly.
51.	Screw—butterfly fixing.
52.	Lever assembly—strangler.
53.	Spring for lever.
54.	Nut—lever to spindle.
55.	Bolt—fixing cable to lever.
56.	Starter—petrol and paraffin.
57.	Body.
58.	Cover.
59.	Valve—starter.
60.	Spring—valve.
61.	Valve—air.
62.	Spring—air valve.
63.	Spindle—valve.
64.	Lever—starter.
65.	Bolt—cable fixing.
66.	Washer.
67.	Nut.
68.	Ball.
69.	Spring.
70.	Needle.
71.	Spring.
72.	Guide.
73.	Bolt—banjo union.
74.	Washer.
75.	Banjo union.
76.	Support—starter cable.
77.	Screw—support fixing.
78.	Bolt—cable fixing.
79.	Shield—dust.
80.	Screw.
81.	Washer.
82.	Screw—starter fixing.
83.	Jet—petrol.
84.	Washer for jet.
85.	Air jet.

GENERAL DESCRIPTION

M models

Two fuel tanks are provided, one for 1½ gallons (6·8 litres) of petrol (gasoline) and the other for 14 gallons (63 litres) of vaporizing oil, the feed to the carburetter being by gravity.

Integral with each supply pipe to the carburetter is a combined glass filter sediment bowl and fuel tap.

A gauze pencil-type filter is fitted in the main vaporizing oil supply tank.

The 30 FV3 carburetter comprises the main vaporizing carburetter and a four-position starting petrol carburetter giving instant starting without the necessity of draining fuel. The starting procedure for this type of carburetter is given in **'GENERAL INFORMATION'**, page 6, and it is very important that the correct procedure is followed closely if difficult starting is to be avoided.

PM models

The Solex 30 FV2 carburetter is gravity-fed from a 14-gallon (63-litre) fuel tank which is fitted with a gauze pencil-type filter.

A single, combined glass sediment bowl and fuel tap is fitted between the supply tank and the carburetter.

Starting is by an air intake choke, and the correct starting procedure is given in **'GENERAL INFORMATION'**, page 7.

GENERAL PRECAUTIONS

Always use a funnel with a strainer when filling the fuel tanks.

Never refuel when the engine is running.

Always keep all fuel containers clean.

Section DDD.1

CARBURETTER

M models

Four-position starting carburetter

The carburetter is designed to operate on vaporizing oil, but has provision for starting at very low temperature and warming up on petrol (gasoline). A special starting device is employed for this purpose which is in itself an auxiliary petrol (gasoline) carburetter integral with the main instrument.

The petrol (gasoline) starter is brought into action by pulling out the starting carburetter control knob on the instrument panel. When the governor control lever is placed against the starting stop the main throttle is closed and the operation of the starting carburetter allows a rich petrol (gasoline) mixture to enter the inlet manifold.

When the control on the instrument panel is pulled out as far as it will go the lever (K) rotates the valve plate (Q) until a hole in it registers with the opening (G) in the carburetter throttle tube.

Petrol (gasoline) entering at (N) passes through the calibrated jet (O) but is checked at the needle valve (P).

When the engine is cranked with the governor control lever in the starting position the throttle butterfly is closed and the inlet manifold depression passes via the opening (G) to the secondary valve plate (H), which is drawn inwards against the predetermined effective resistance of a compression spring. Simultaneously the depression withdraws the needle (P) from its seating and allows petrol (gasoline) to pass through to the mixing chamber, where it is emulsified by the air entering at the jet (J).

The engine fires on this rich mixture, and after a few seconds the governor control lever must be pulled back slowly to the normal running stop, opening the throttle slightly, and the lever (K) must be closed by the control on the instrument panel to the second position, which is determined by a spring-loaded ball registering with the lever.

When the lever is in this position the valve plate (Q) has rotated to align a smaller hole with the opening (G) with the result that the mixture is weakened. After the engine has run for approximately a minute the lever (K)

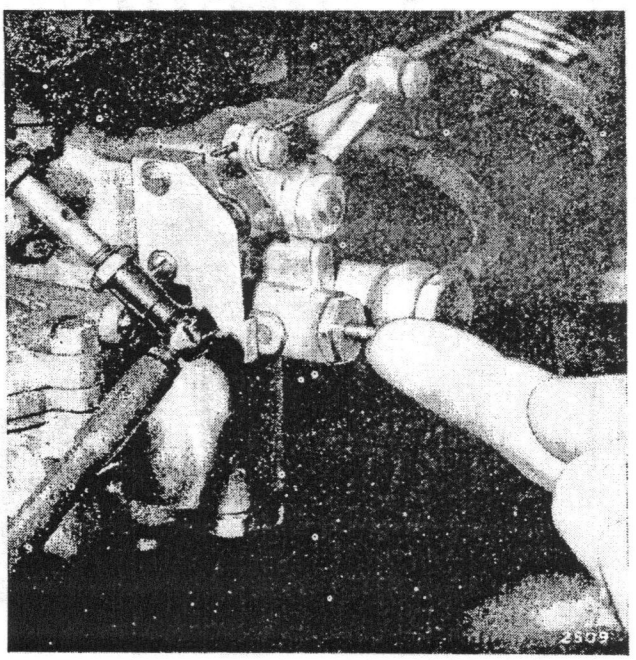


Fig. DDD.1

The location of the spring-loaded needle valve on the side of the carburetter fitted to M model tractors

must be closed still further to give a slightly weaker mixture by pushing in the control on the instrument panel to the third position.

As the engine warms up and the temperature gauge needle reaches a position half-way through the red sector the control on the dashboard is pushed in and the lever (K) rotates the valve plate (Q) to close the opening (G). The inlet manifold depression is now unable to control the secondary plate (H), which is forced back into its seating by the compression spring. The valve (P) is also closed by a spring and the petrol (gasoline) supply is cut off, leaving the engine to run solely on vaporizing oil.

Main carburetter

When the engine is idling the throttle butterfly (F) is nearly closed and depression or suction occurs at the orifice regulated by the volume control screw (D) and the hole below the upper edge of the throttle butterfly. The fuel drawn up the vertical channel is also emulsified by air entering the carburetter through a small fixed-diameter bleed (M) leading into the pilot jet cavity. The quantity of fuel and consequently the idling mixture is regulated by the control screw (D), which weakens the mixture as it is screwed into the carburetter body.

The main jet (T) is held in a carrier by the jet cap (S). Air entering the holes (U) rises to the top, descends into the annulus between the main jet and its carrier, and enters the centre of the main jet via the small holes in the jet side. The result is a mixture of air and fuel issuing from the top of the spraying assembly, finally emulsified by the main air stream passing through the choke tube (R) on its way to the engine.

PM models

This carburetter, a Solex 30 FV2 (Fig. DDD.3), is similar in operation to the carburetter fitted to M model tractors, except that starting from cold is assisted by operation of a choke in the air inlet instead of an auxiliary starter carburetter.

To start from cold the choke butterfly (W) should be closed and the throttle (F) opened approximately half-way. Immediately the engine fires the choke is gradually released by pushing in the control on the instrument panel, and when the engine has become sufficiently warm to continue running with the full air supply the choke is opened wide by pushing the control button right in.

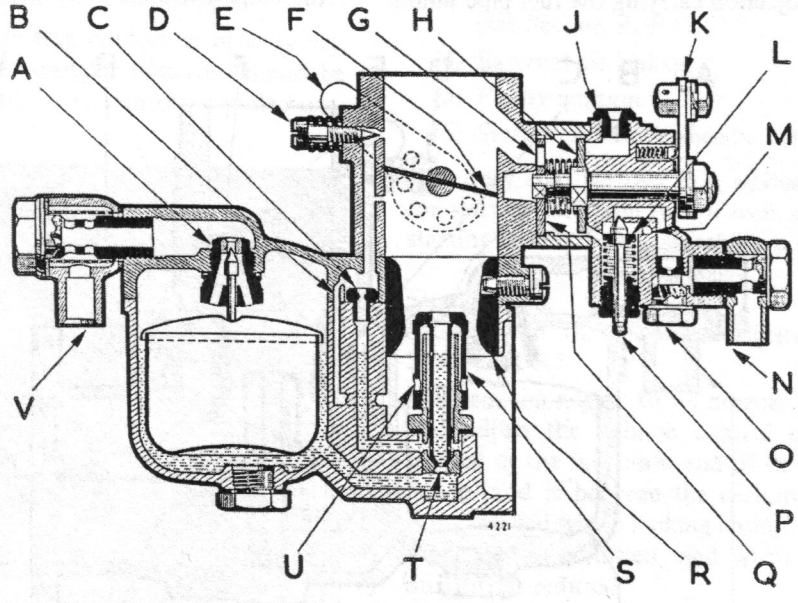


Fig. DDD.2

The FV3 carburetter fitted to M model tractors

A. Needle valve.
B. Pilot air jet.
C. Pilot jet.
D. Volume control screw.
E. Throttle lever.
F. Throttle butterfly.
G. Feed duct.
H. Secondary plate.
J. Air jet.
K. Lever.
L. Needle head plate.
M. Atmospheric relief hole.
N. Petrol (gasoline) entry.
O. Petrol (gasoline) jet.
P. Needle valve.
Q. Valve plate.
R. Choke tube.
S. Main jet cap.
T. Main jet.
U. Air entry holes.
V. Fuel entry.

Section DDD.2

TO CHECK FOR FUEL STOPPAGE IN THE SYSTEM

If a stoppage is suspected remove the glass filter bowl and check whether the fuel flows freely when the tap is turned on. If the flow is small or there is none at all the fault lies in the pipe between the tank and the filter or in the fuel tank pencil filter. If, however, the flow of fuel is satisfactory, replace the filter and the filter bowl, allowing the fuel to flow over the sides of the glass bowl before finally tightening the retaining nut.

Disconnect the banjo union on the carburetter. Again turn on the tap. If the flow is restricted the stoppage is either in the main fuel filter or the pipe between the filter and the carburetter is choked. A full flow of fuel will indicate that the stoppage is caused by the small gauze filter in the banjo union or by the carburetter jets. Clean the filter and jets as described in Section DDD.3.

Section DDD.3

CLEANING THE JETS

Starting carburetter (M models)

The petrol (gasoline) jet has a hexagon head and is screwed into the projection carrying the fuel pipe union.

Unscrew the jet (see Fig. DDD.7), remove the sealing washer, wash in petrol (gasoline), and blow out to dry. Never clean out jets with wire or sharp instruments.

Main jet

Extract the screws securing the air intake pipe to the carburetter flange.

The lower half of the carburetter body and float-chamber can now be released by removing the two screws from the float-chamber cover and the two long screws which secure it from the under side of the body.

The main jet cap (see Fig. DDD.7) is unscrewed with a spanner applied to the upper hexagon.

Lift out the jet, wash it with petrol (gasoline), and blow it out. While the float-chamber is off, the pilot jet and the float-chamber needle valve on the under side of the float-chamber cover are also accessible for cleaning and checking.

Before replacing, lift out the float and wash and blow out the fuel and air channels in the main body.

Section DDD.4

CARBURETTER ADJUSTMENTS

Choke tubes and jets

The choke tubes and jets are carefully determined by the manufacturers. They are supplied to suit the engine

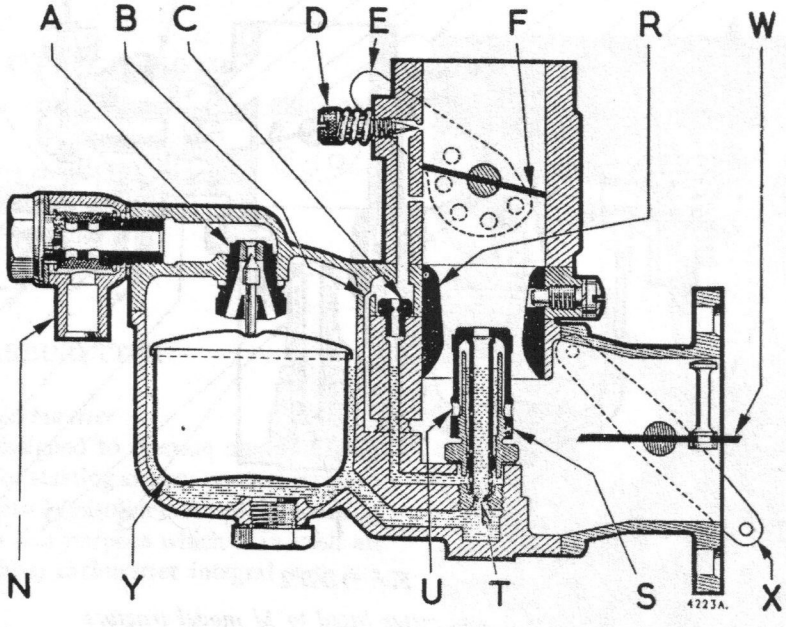


Fig. DDD.3

The FV2 carburetter fitted to PM model tractors

A. Needle valve.
B. Pilot air jet.
C. Pilot jet.
D. Volume control screw.
E. Throttle lever.
F. Throttle butterfly.
N. Petrol (gasoline) entry.
R. Choke tube.
S. Main jet cap.
T. Main jet.
U. Air entry holes.
W. Choke butterfly.
X. Choke lever.
Y. Float.

for operation under all normal conditions and no alterations should be necessary. It is strongly urged that none be made without consulting the manufacturers.

Always keep the choke tube securing screw tight. If this screw is slackened the choke tube is able to fall down and block the air intake, causing the carburetter to become saturated.

Flooding

Fuel leakage from the carburetter may be due to:

(1) A loose or faulty joint at—
  (*a*) The main jet carrier.
  (*b*) The float-chamber needle valve.
  (*c*) The float-chamber drain plug.
  (*d*) The fuel pipe unions.
(2) Dirt on the needle valve seating or badly worn needle valve.
(3) A punctured float.

When not in use the fuel supplies should always be turned off.

Difficult starting

If difficult starting is experienced check the following:

(1) Stoppage or restriction in the fuel supply.
(2) Instrument panel starting control incorrectly set. On PM models the strangler butterfly should be closed completely when the control is pulled out.

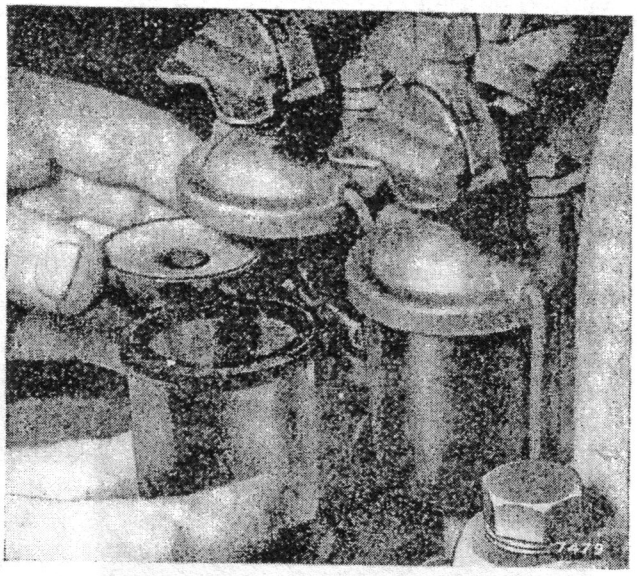


Fig. DDD.4

The sediment bowl removed from the petrol (gasoline) tap on a model M tractor to show the filter gauze

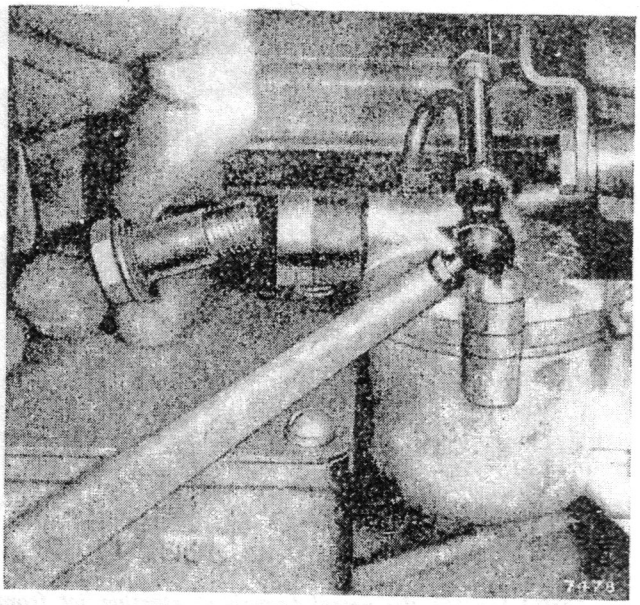


Fig. DDD.5

The filter on the shank of the banjo union bolt withdrawn from the float-chamber cover

(3) Throttle butterfly not fully closed when the governor control lever is in the starting position (see Section FFF.1).
(4) External air leakage.
(5) Faulty ignition.
(6) Starter carburetter needle valve sticking or frozen.

In very cold weather it is advisable to set the engine for starting and then turn it over several times with the starting handle before switching on the ignition.

Slow running

Carry out the governor adjustments as detailed in Section FFF.1.

Warm the engine to its normal working temperature and adjust the volume control screw. This screw is located at the induction end of the carburetter near the flange, and is between the carburetter and the engine. It is provided with a locking spring. When it is unscrewed more fuel is admitted, and when it is screwed in the quantity is reduced.

With the governor control lever in the idling position, adjust the volume control screw until even running is obtained. This adjustment will probably alter the engine speed, necessitating a further adjustment to the governor control lever idling position. It will be found that a careful setting of both the volume control screw and the governor control lever is required to give the best results.

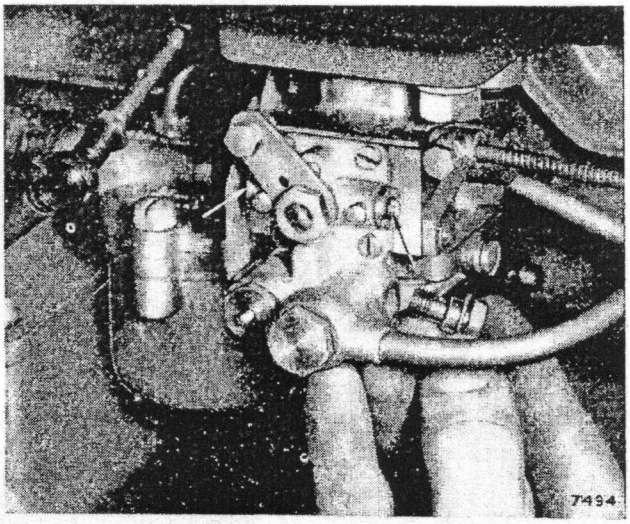


Fig. DDD.6

Withdrawing the petrol (gasoline) starting jet from an FV3 carburetter. The air jets are indicated by the arrows

Section DDD.5

REMOVING AND REPLACING THE CARBURETTER

Extract the four screws securing the air intake pipe to the square carburetter flange.

Fig. DDD.7

The main jet assembly

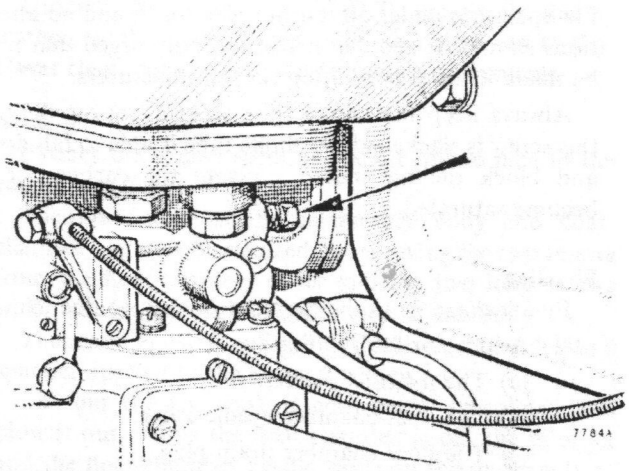


Fig. DDD.8

The location of the volume control screw is indicated by the arrow

Disconnect one end of the carburetter throttle control link by means of the snap clips on the ball joint.

Disconnect the starting control.

Turn off the fuel supply and disconnect the fuel pipe unions, taking care not to lose the fibre washers or damage the filter on the banjo bolt which secures the main fuel pipe to the float-chamber cover.

Release the carburetter from the manifold studs.

Any dismantling which may be necessary should be done with clean hands on a clean bench. Note the way in which the various components are assembled and wash them in clean petrol, drying off with compressed air.

Before refitting the carburetter, place a straight-edge across the carburetter flange and check it for distortion.

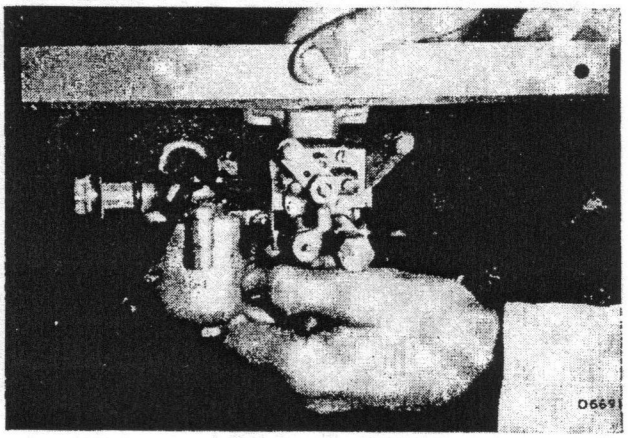


Fig. DDD.9

Use a straight-edge to check the flange for distortion

If necessary, the carburetter throttle tube must be plugged with clean cloth and the flange carefully trued with a file. A distorted flange is a source of air leakage which may be indicated by difficult starting, poor idling, and poor performance generally.

Refit the carburetter to the manifold, ensuring that the packing washers are in position first. Use a new joint washer if necessary.

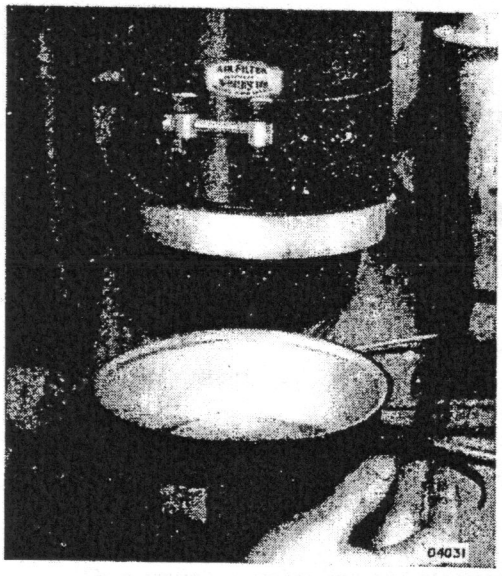


Fig. DDD.10

The air cleaner bowl is released by raising the two clips as shown

Section DDD.6

AIR CLEANER

Every week or every 50 hours the oil in the air cleaner bowl should be changed.

Release the bowl from the cleaner body, drain off the old oil, and swill out any sediment with vaporizing oil. Wipe clean and refill with engine oil to the level marked inside the bowl.

Periodically the pre-cleaner on the air intake pipe should be inspected to make sure that it is not clogged and the gauze interior of the air cleaner should be washed with petrol (gasoline) or vaporizing oil.

Should the gauze be entirely blocked by chaff, etc., the complete air cleaner must be renewed.

The oil in the air cleaner bowl should be changed daily when the tractor has been working in dusty conditions.

Section DDD.7

REMOVING THE PETROL (GASOLINE) TANK

(M Models)

Remove the pre-cleaner and extension pipe from the air cleaner unit. Extract the two securing screws and lift off the bonnet.

Detach the fuel pipe at the tap and filter unit and drain the tank—capacity 1½ gallons (6·8 litres).

Release the pipe from the union below the tank.

Remove the tank retaining rod nuts and washers and lift out the tank.

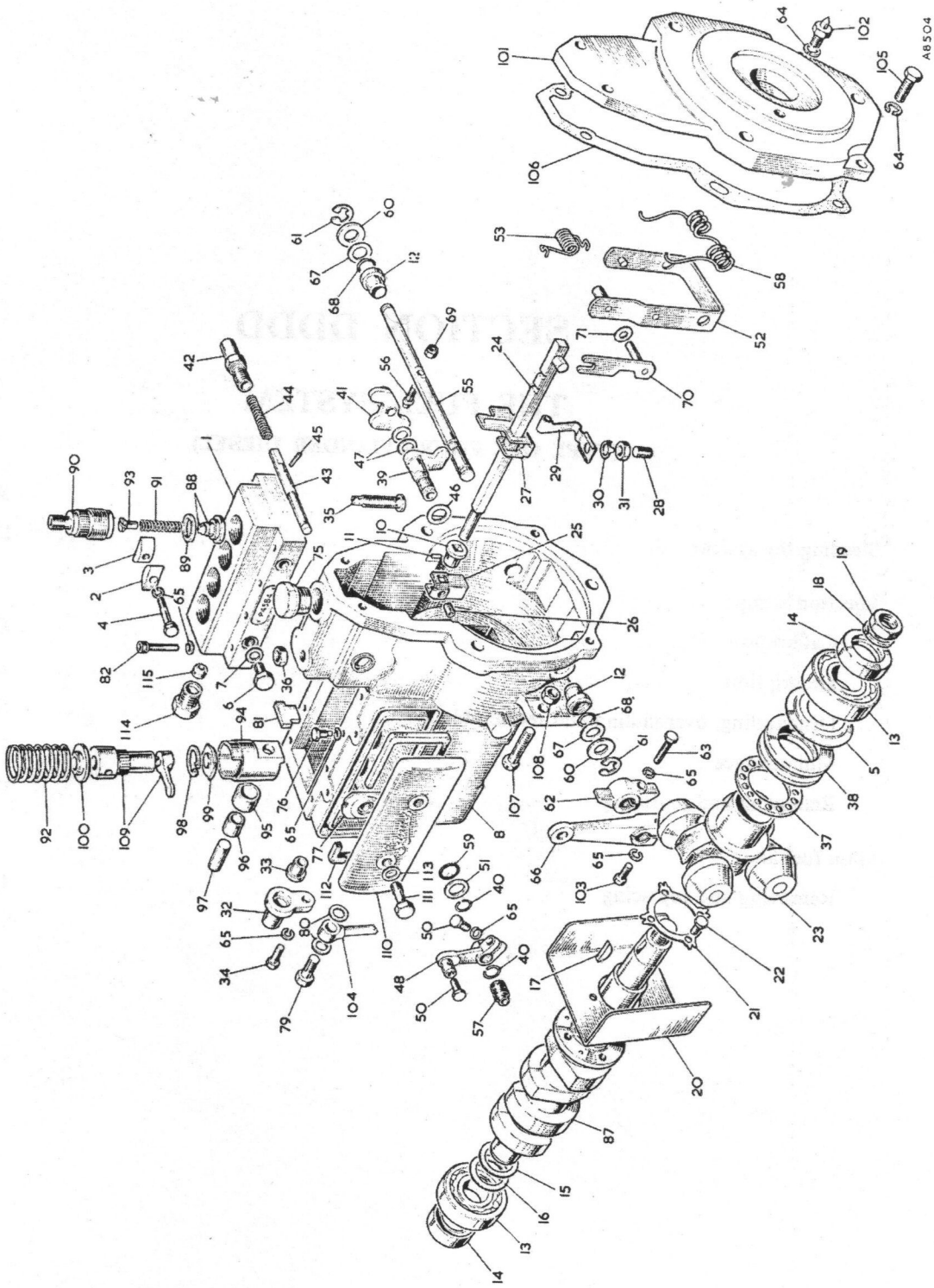
Replacing the tank is a reversal of the above procedure.

SECTION DDDD

THE FUEL SYSTEM

(TYPE OEE FOUR-CYLINDER DIESEL)

COMPONENTS OF THE FUEL INJECTION PUMP



KEY TO THE COMPONENTS OF THE FUEL INJECTION PUMP

No.	Description
1.	Pump body.
2.	Clamp—plain.
3.	Clamp—threaded.
4.	Screw—clamp.
5.	Baffle washer—front bearing.
6.	Screw—air vent.
7.	Joint washer.
8.	Pump unit housing.
10.	Bush—front—control rod.
11.	Groverloc pin—bush.
12.	Bush—control shaft.
13.	Ball bearing—camshaft.
14.	Oil seal—camshaft.
15.	Shim—0·1 mm.
16.	Shim—0·2 mm.
17.	Woodruff key.
18.	Washer—spring.
19.	Nut.
20.	Backplate.
21.	Tab washer.
22.	Screw—backplate.
23.	Governor weight assembly.
24.	Control rod.
25.	Control fork.
26.	Screw—control fork.
27.	Maximum stop fork.
28.	Screw—stop fork.
29.	Spring—excess catch.
30.	Locking tab—stop fork.
31.	Locknut.
32.	Cover—control rod.
33.	Bush—rear—control rod.
34.	Screw—cover.
35.	Screw—maximum fuel stop.
36.	Nut for screw.
37.	Thrust bearing.
38.	Thrust pad.
39.	Stop shaft assembly.
40.	Spring ring.
41.	Maximum stop lever.
42.	Bearing—excess shaft.
43.	Excess shaft.
44.	Return spring.
45.	Groverloc pin—excess shaft.
46.	Thrust washer—stop shaft.
47.	Sealing washer—stop shaft to lever.
48.	Stop control lever.
50.	Screw—stop control lever.
51.	Washer.
52.	Rocking lever.
53.	Spring.
55.	Control shaft.
56.	Pin—governor spring.
57.	Shroud—excess shaft.
58.	Governor spring.
59.	'O' seal—stop control shaft.
60.	Washer—control shaft.
61.	'E' clip—control shaft.
62.	Stop quadrant.
63.	Screw—stop.
64.	Washer—spring—¼ in.
65.	Washer—spring—2 B.A.
66.	Control lever.
67.	Shim washer.
68.	Nu-lip ring.
69.	Nut—governor spring pin.
70.	Link plate.
71.	Shim—link plate.
75.	Oil filler plug.
76.	Screw—bridge plate.
77.	Bridge plate.
79.	Screw—oil level banjo.
80.	Joint washer—banjo.
81.	'T' piece—tappet locating.
82.	Screw—body to housing.
87.	Camshaft.
88.	Delivery valve and guide.
89.	Joint ring—valve.
90.	Holder—delivery valve.
91.	Spring—delivery valve.
92.	Spring—plunger return.
93.	Volume reducer.
94.	Tappet body.
95.	Roller—tappet.
96.	Bush—tappet roller.
97.	Pin—tappet roller.
98.	Retainer—tappet spacer.
99.	Spacer—tappet.
100.	Disc—spring—lower.
101.	Cover—governor.
102.	Timing indicator.
103.	Screw—control lever.
104.	Banjo and pipe—oil level.
105.	Screw—governor cover.
106.	Gasket—governor cover.
107.	Stop screw—control lever and quadrant.
108.	Nut—stop screw.
109.	Barrel and plunger.
110.	Cover—inspection.
111.	Bolt—cover.
112.	Seal—inspection cover.
113.	Washer—inspection cover bolt.
114.	Inlet union.
115.	Olive—inlet pipe.

Section DDDD.1

DESCRIPTION

The Simms Minimec Fuel Injection Pump is a highly efficient unit manufactured to extremely fine limits. It must therefore be handled with extreme care, and scrupulous cleanliness must be maintained whenever any work is carried out on the pump as the slightest damage or particle of dirt will be detrimental to its efficient operation.

The pump contains as an integral part of the unit an entirely new mechanical-type governor with its housing cast as part of the cambox.

The pump comprises two main assemblies:

The light alloy cambox and governor housing, containing the camshaft and bearings, the tappets, control rod, governor assembly, linkage and excess fuel device, and, bolted to the cambox by eight Allen screws, the steel body containing the fuel passages and pump elements.

The advantage with this method of construction is the ease with which the body can be removed from the cambox for inspection of the elements without removing the governor, camshaft, or tappets.

Elements of 8 mm. are fitted, the element barrels being located in the pump body by means of serrations. The plunger is the normal Simms type, fuel delivery being controlled by an inclined groove or helix.

Fuel control is effected by means of a square-sectioned control rod upon which are clamped four forks each engaging a plunger arm. Movement of the control rod causes angular movement of the arm and partial rotation of the plunger. This method of fuel control considerably reduces backlash, which would effect calibration, in that there is only one clearance i.e. between the fork and the rounded end of the control arm, the radial effect of this clearance at the plunger axis is negligible.

The spill control edge (plunger helix) is formed by a groove machined at an angle across the periphery of the plunger; this groove is connected to the top of the plunger by radial and axial drillings. This method of spill control permits the maximum amount of bearing surface for the plunger, thus reducing the rate of wear and the amount of leakage past the plunger.

The inlet and spill ports in the barrel are 180° apart and are connected by an annular groove in the pump body which is also connected to the main fuel gallery.

Conventional type delivery valve assemblies are fitted above each barrel. The valve holders are round and serrated on the outside diameter instead of the usual hexagonal shape, allowing a reduction in pitch between the elements and therefore a shorter and more compact pump unit.

A coil spring and volume reducer are housed in the holder; the spring fits over the valve shoulder to seat it on

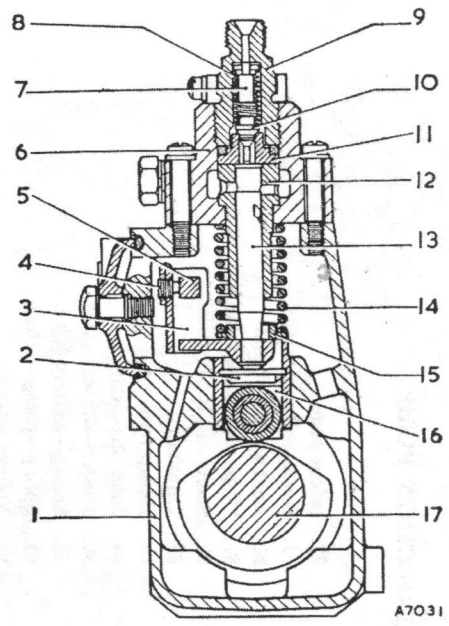


Fig. DDDD.1

The Minimec fuel injection pump

1. Cambox.
2. Tappet pad.
3. Control fork.
4. Control fork clamp screw.
5. Control rod.
6. Pump body.
7. Volume reducer.
8. Delivery valve spring.
9. Delivery valve holder.
10. Delivery valve.
11. Valve guide.
12. Barrel.
13. Plunger.
14. Plunger return spring.
15. Bottom spring plate.
16. Tappet.
17. Camshaft.

the guide. The portion of the valve which engages in the guide is reduced in diameter to form a close-fitting piston and then fluted. This arrangement with the help of the return spring ensures a snap return of the valve to its seat when the fuel pressure in the barrel is relieved and thus, by relieving the line pressure between the valve and the injectors, terminates the spray of fuel into the combustion chamber without dribble.

The camshaft which is mounted in the lower portion of the pump body runs on two ball bearings pressed into the housing. Roller-type tappets are employed; the tappet barrels are slotted on one side to accommodate the plunger levers and counterbored to carry the phase adjustment discs. To prevent the tappets from rotating a flat on the outside of each tappet abuts against locating 'T' pieces fitted in slots between the 'Siamese' tappet bores.

The plunger return spring lower plates are made in graded thicknesses in order to control the necessary vertical end-float of the plunger so that it can be turned freely by its control fork.

An excess fuel device is mounted above the governor

at the driving end of the pump. Its purpose is to provide fuel, in excess of that required for normal running, for starting the engine in very cold conditions. When excess fuel is required for cold starting the action of pressing the excess fuel button trips a baulking spring on the control rod permitting the rod to move forward under spring pressure until it is against the stop lever. When the engine starts and the speed increases the governor takes control and moves the control rod away from the maximum fuel position. The maximum fuel stop is returned to its original position once again limiting the control rod travel to the pre-determined setting.

The excess fuel position of the control rod can only be obtained when the engine is stopped. Under normal running conditions operation of the excess fuel button will not trip the excess fuel device. A stop assembly is also incorporated in the excess fuel device. Movement of the lever to the stop position moves the control rod past the idling position preventing further injection of fuel.

The mechanical governor is of the centrifugal all-speed type allowing the engine to be set and maintained at any speed between idling and maximum. The governor is driven by means of a backplate bolted to the camshaft. The governor weight assembly, which is a sliding fit on the camshaft, consists of the weight carrier and two sets of roller weights which rotate against the backplate. Each set comprises two outer rollers connected by a weight pin, and an inner slipper upon which the weight pin rotates, A ball-bearing thrust race and a steel thrust pad, which slide on the weight carrier hub, convey the outward movement of the governor weights to the control rod by means of a rocking lever in which two pins engage in a groove in the steel thrust pad.

Movement of the control lever and control shaft in the governor housing is changed, by means of a speed control spring fitted to the control shaft, to a loading upon the governor thrust pad. The result is a balance between the centrifugal force of the rollers and the pressure of the speed control spring which is relative to the position of the control lever. Any fluctuations in engine speed are immediately overcome and a constant speed is maintained.

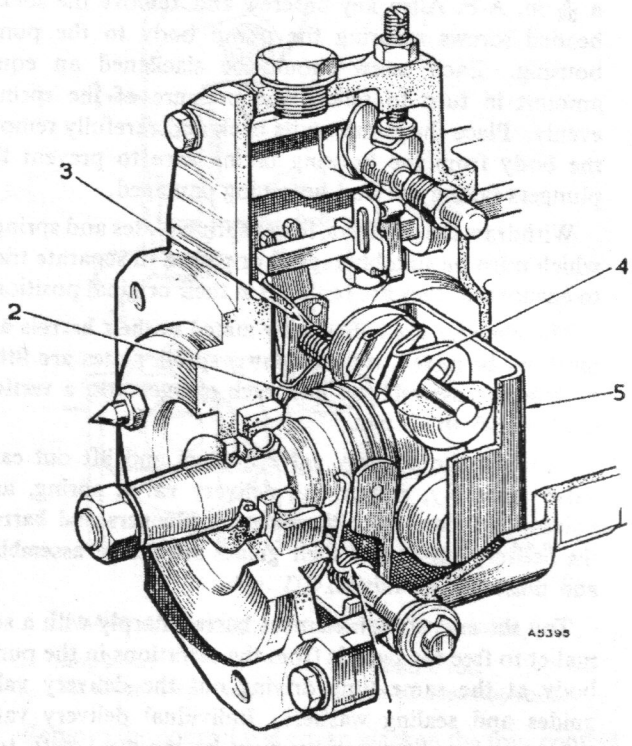


Fig. DDDD.2

The Simms mechanical governor

1. Speed control spring.
2. Thrust bearing and grooved thrust pad.
3. Rocking lever assembly.
4. Governor weight assembly.
5. Governor backplates.

Section DDDD.2

DISMANTLING AND REASSEMBLING THE FUEL INJECTION PUMP

As with all fuel injection equipment absolute cleanliness is essential when dismantling the Simms Minimec fuel injection pump. The workshop in which these operations are carried out should be absolutely clean and the atmosphere free from dust or dirt. A bench with a suitable covering such as zinc or linoleum and fitted with a vice having copper or zinc jaw shields should also be available.

Cotton waste, rags or cloth wipers should not be used for cleaning purposes. A clean covered vessel containing a supply of freshly filtered Shell Fusus A, or fuel oil should be available for washing parts. Avoid handling the parts more than is necessary and do not touch the working surfaces of the pumping elements, delivery valves and camshaft.

Remove the oil filler plug from the governor end of the pump housing and drain the pump of lubricating oil.

Remove the inspection cover and withdraw the cover joint washer.

Unscrew and remove the two locating set screws with spring washers from the top of the pump housing, turn the inspection cover securing screw bridge plates through an angle of 90° and withdraw them from the inspection opening in the pump housing.

Remove the delivery valve holder clamp screws and clamps and slacken the delivery valve holders using tool 18G699. Slacken the two fuel gallery air vent plugs.

Maintain a firm pressure on the pump body and using

a $\frac{5}{32}$ in. A.F. Allen key unscrew and remove the socket headed screws securing the pump body to the pump housing. Each screw should be slackened an equal amount in turn to relieve the pressure of the springs evenly. Place the pump on its back and carefully remove the body from the housing taking care to prevent the plungers falling out and becoming damaged.

Withdraw the plungers, lower spring plates and springs, which must be suitably tagged or placed in separate trays to ensure that they are replaced in their original positions.

The plungers are individually mated to their barrels and must not be mixed, while the lower spring plates are fitted by selective assembly to give each plunger arm a vertical float of ·05 to ·2 mm.

Unscrew the delivery valve holders and lift out each valve assembly, comprising delivery valve, spring, and volume reducer. **Like the pumping plungers and barrels the delivery valves and their guides are mated assemblies and must not be mixed.**

Tap the end of each element barrel sharply with a soft mallet to free the barrels from the serrations in the pump body at the same time driving out the delivery valve guides and sealing washers. Individual delivery valve guides and sealing washers may be removed with tool 18G237 without dismantling the pump. This tool is inserted into the valve guide after removing the valve and when the pump camshaft is turned the rising plunger ejects the tool complete with valve guide and sealing washer from the pump body.

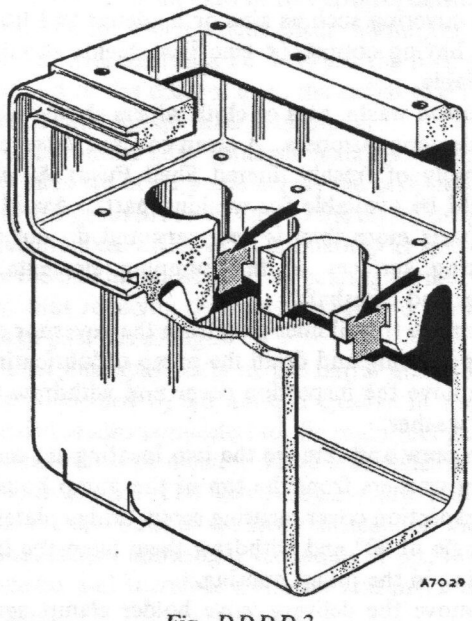


Fig. DDDD.3

A section through the cambox, showing the tappet-locating 'T' pieces

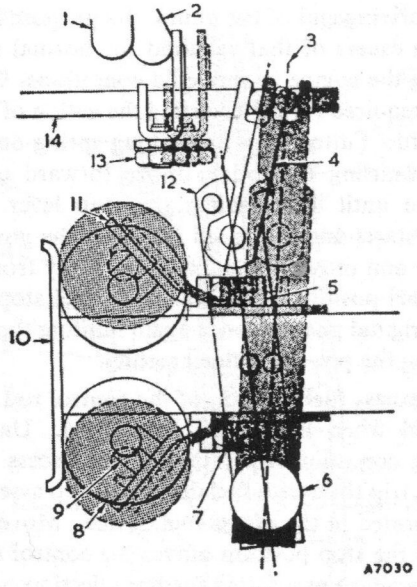


Fig. DDDD.4

Diagram of governor operation

1. Stop lever.
2. Maximum fuel stop lever.
3. Idling speed.
4. Link plate.
5. Thrust pad.
6. Control shaft.
7. Thrust bearing.
8. Outer roller.
9. Inner roller.
10. Backplate.
11. Weight carrier.
12. Rocking lever.
13. Maximum stop fork.
14. Control rod.

Withdraw the tappets from the pump housing, placing them in separate trays with their respective element components so that they may be refitted into their original positions. The tappet roller bushes and roller pins may be removed from the tappets but the spacer discs should be left in position as they control the phase angle between each injection.

Turn the camshaft until one of the cams adjacent to each of the tappet locating 'T' pieces is at B.D.C. and slide out the 'T' pieces from between the tappet bores.

Unscrew the drive coupling nut and withdraw the coupling flange from the tapered and keyed end of the camshaft using tool 18G236. Withdraw the coupling key from the camshaft.

Unscrew and remove the four set screws and carefully withdraw the cover and joint washers from the governor end of the pump housing.

Remove the oil seal and withdraw the camshaft drive end bearing outer race from the governor cover.

Slacken the clamp screw and withdraw the control lever from the serrated end of the control shaft. The lever and end of the control shaft should be marked in relation to each other, before the lever is withdrawn, to assist reassembly.

Unscrew the nyloc nut from the governor spring drive

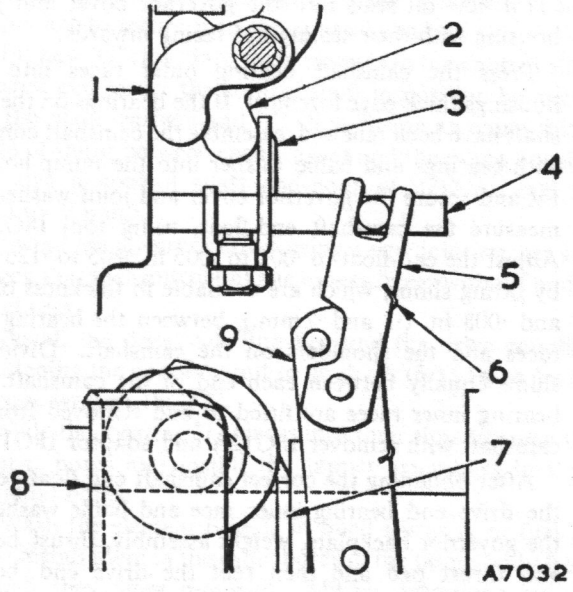


Fig. DDDD.5

Position of rocking lever assembly at maximum fuel

1. Stop lever.
2. Maximum stop lever.
3. Maximum stop fork.
4. Control rod.
5. Link plate.
6. Link plate spring.
7. Governor weight carrier.
8. Backplate.
9. Rocking lever.

pin in the centre of the control shaft. Lift the drive end of the camshaft upwards, rotate the control shaft towards the idling position and withdraw the drive pin from the control shaft. While unscrewing the nyloc nut rotate and hold the control shaft in the maximum speed position. This will hold the drive pin in contact with the governor spring and so prevent the head of the pin becoming disengaged from its machined recess in the control shaft.

Remove the 'E' clip, washer, and any shims that may be fitted from each end of the control shaft and withdraw the shaft from the pump housing to release the governor spring and rocking lever assembly. Remove the 'O' rings from their recesses in the control shaft bushes. If necessary, hold back the long end of the link plate spring and dismantle the rocking lever, noting the hardened steel thrust washer located on the link plate pivot pin.

Withdraw the camshaft and governor assembly from the pump housing. Remove the cages complete with balls and withdraw the camshaft bearing inner races, using remover 18G12A and adaptor 18G12E, noting the adjusting shims fitted between the inner races and the camshaft shoulders.

Withdraw the thrust pad, thrust bearing and governor weight assembly from the camshaft.

Press back the locking washer tabs and remove the four set screws to release the back plate from the camshaft.

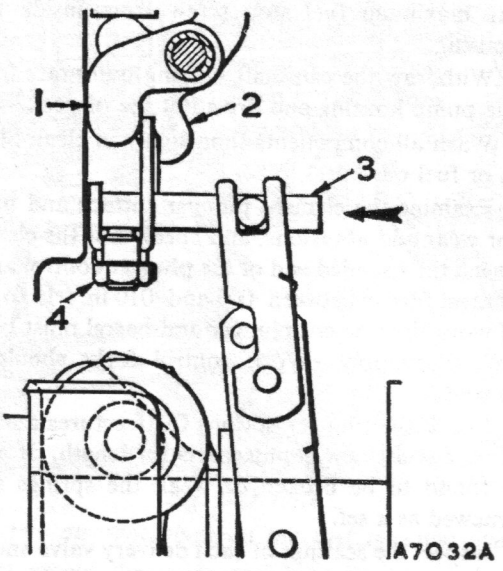


Fig. DDDD.6

Position of rocking lever assembly at excess fuel

1. Stop lever.
2. Maximum stop lever.
3. Control rod.
4. Maximum stop fork.

Remove the control rod cover, slacken the four control fork set screws, using a $\frac{1}{8}$ in. A.F. Allen key, and withdraw the control rod from the governor end of the pump housing, removing the control forks, which should be kept in their order of assembly, as they become free from the control rod. Press back the lock washer and unscrew the lock nut and socket headed screw to release the maximum fuel stop fork assembly from the control rod. Withdraw the excess fuel catch spring from the maximum fuel stop fork.

Remove the rubber shroud and its retaining clip from the excess fuel shaft. Slacken the clamping screw and withdraw the stop lever from the serrated end of the stop shaft assembly. Before removal, the stop lever and stop shaft should be marked in relation to each other to facilitate reassembly in the same position.

Unscrew the excess fuel shaft bearing and remove the shaft return spring from inside the bearing. Replace the bearing to support the excess fuel shaft and tap out the Groverloc pin securing the maximum fuel stop lever assembly to the excess fuel shaft. Withdraw the excess fuel shaft to release the maximum fuel stop assembly, noting the two fibre washers positioned on the shaft between the maximum fuel and stop levers.

Remove the spring clip and plain washer from the stop shaft assembly and withdraw the shaft from inside the pump housing, noting the hardened steel thrust washer on the shaft. Remove the stop control shaft 'O' ring from its recess in the pump housing.

Cut the sealing wire, unscrew the locknut and unscrew

the maximum fuel stop screw from inside the pump housing.

Withdraw the camshaft bearing outer race from inside the pump housing and drive out the oil seal.

Wash all components thoroughly in clean Shell Fusus A or fuel oil.

Examine the element plunger surface and barrel bore for wear and abrasions, and check that the clearance between the rounded end of the plunger control arm and its control fork is between ·006 and ·010 in. (·15 to ·25 mm.). If worn the element plunger and barrel must be renewed as an assembly. Worn control forks should also be renewed.

Check the plunger springs for fractures and compare them against new counterparts for length. If any spring is found to be broken or weak the springs should be renewed as a set.

Inspect the seatings of each delivery valve and its guide ensuring that the bore of the guide and the part of the valve machined to form a piston are free from scoring and wear.

Examine the tappets for signs of wear. The tappet rollers and roller bushes should be free from flats or pitting. Check the contact face of the tappet spacer boss for wear. If the slightest sign of wear is visible the spacer must be renewed, but not until the correct size has been determined when phasing the pump.

Check the surface of the cams for wear, renewing the camshaft if necessary.

Examine the camshaft bearings for wear, pitting and scoring and renew the bearings if necessary. If new bearings are fitted it will be necessary to check the camshaft end float as described later.

Check the tappet bores in the pump housing for wear, the tappets should be a sliding fit in their bores when lubricated with fuel oil.

Refit the control shaft and the control rod to the pump housing and check the bushes for evidence of wear. Worn bushes must be renewed and a fitting pin ·3762 to ·3764 in. (9·555 to 9·56 mm.) in diameter should be used to fit the control shaft bushes. The control rod bush at the governor end of the pump housing is retained in position by a Groverloc pin which must be driven into the bush before the bush can be removed from the pump housing. The bore of the other bush for the control rod has an oil drain groove to prevent the build up of fuel oil in the control rod cover and so cause sluggish action of the governor. This bush must be fitted with the drain groove between the 6 and 7 o'clock position as viewed from the outside of the pump. After fitting new bushes fit the control rod and check it for freedom of movement.

Immediately before reassembly all parts should be rinsed thoroughly in clean Shell Fusus A or fuel oil.

Fit new oil seals into the governor cover and pump housing with their sealing lips facing inwards.

Press the camshaft bearing outer races into their housings thick edge foremost. If the bearings on the camshaft have been renewed, assemble the camshaft complete with bearings and baffle washer into the pump housing. Fit and secure the governor cover and joint washer, and measure the camshaft end-float, using tool 18G538A. Adjust the end-float to ·002 to ·005 in. (·05 to ·126 mm.) by fitting shims, which are available in thickness of ·004 and ·008 in. (·1 and ·2 mm.), between the bearing inner races and the shoulders on the camshaft. Divide the shims equally between each end of the camshaft. The bearing inner races are fitted to and removed from the camshaft with remover 18G12A and adaptor 18G12E.

After obtaining the correct camshaft end float remove the drive end bearing inner race and baffle washer; fit the governor backplate, weight assembly, thrust bearing and thrust pad and then refit the drive end bearing shims, baffle washer, and inner race. Use a new lock washer for the backplate set screws and tighten the set screws to 60 lb. in. (·69 kg. m.), using torque wrench 18G537.

Refit the maximum fuel stop screw and lock nut. Install the stop shaft assembly, excess fuel shaft and maximum fuel stop lever, with its curved leg facing outwards fitting the hardened steel thrust washer between the stop shaft and pump housing. The fibre washers on the excess fuel shaft are fitted between the two stop levers. Secure the maximum fuel stop lever to the excess fuel shaft, using a new Groverloc pin, and then fit the excess shaft bearing and shaft return spring. Install the external stop lever with its clamping slot vertical when the lever is in the 'run' position, and then refit the rubber shroud to the excess fuel shaft.

Assemble the maximum stop fork and the excess catch spring to the control rod, using a new lock washer to retain the locknut and ensuring that the stop fork engages in its locating slots in the control rod. When assembled correctly the fork and catch spring will be on the side of the control rod opposite to the rod operating pin.

Install the control rod in the pump housing, at the same time fitting the control forks to the rod. Secure No. 4 element control fork ·5 mm. from the squared end of the control rod and space the remaining forks so that there is 25 mm. between the fork centre lines. This is an initial setting final adjustment being made during calibration. Fit the control rod cover.

Install the assembled camshaft after packing the bearings with a multi-purpose grease and place the rocking lever in position, ensuring that it is located in the governor thrust pad groove and that it engages the control rod. Fit the control shaft at the same time fitting the governor

spring. Fit the governor spring drive pin using a new nyloc nut to secure it to the control shaft.

Fit new 'O' rings into their recesses in the control shaft bushes and secure the control shaft in position by means of the plain washers and 'E' clips, fitting an equal thickness of shims between each washer and the pump housing to give a control shaft end-float of ·002 to ·008 in. (·05 to ·2 mm.).

Install the governor cover using a new joint washer and check that the control linkage moves freely without undue slackness.

Install the drive coupling key and the drive coupling tightening the coupling nut to 46 lb. ft. (6·33 kg. m.) with torque wrench 18G372.

Slide the locating 'T' pieces into their slots between the tappet bores and install the tappet assemblies in their original bores.

Wash the element barrels in Shell Fusus A or fuel oil and install them in the same bores in the pump body from which they were removed. Master serrations on the barrels and in the bore in the pump body ensure that the barrels are located correctly.

Wash the delivery valve components in Shell Fusus A or fuel oil. Place the valve guide in position on top of the element barrel, install a new joint ring and insert the delivery valve into the guide. Fit the spring and volume reducer on top of the valve and secure the whole assembly with the delivery valve holder which should be tightened to 350 lb. in. (4 kg. m.) using torque wrench 18G537 and tool 18G699.

Wash the pumping plungers in Shell Fusus A or fuel oil. If the pump is being reassembled using the original camshaft, tappets and pumping elements, then the lower spring discs and plunger springs should be installed over the plunger barrels and the plungers inserted into their respective barrels. When any of these components have been renewed it will be necessary to check and adjust the pump so that the elements commence injection at the correct interval of $90 \pm \frac{1}{2}°$ of injection pump camshaft rotation. This adjustment is known as phasing.

To check the phase angles, assemble the pumping elements to the pump body as described above but do not fit the plunger springs and the spring discs. Install the pump body on the pump housing, ensuring that the plunger arms are located correctly in the control forks and secure the body in position by two screws at opposite corners. The phase angles should be checked by the fuel flow method on a test bench having a degree plate for measuring the angular rotation of the camshaft.

Before phasing, it is essential to set No. 1 tappet to give an inlet stroke of ·094 to ·102 in. (2·4 to 2·6 mm.). (plunger travel from B.D.C. to spill cut-off).

Connect the test oil supply to the pump inlet.

Remove all the delivery valve components from No. 1

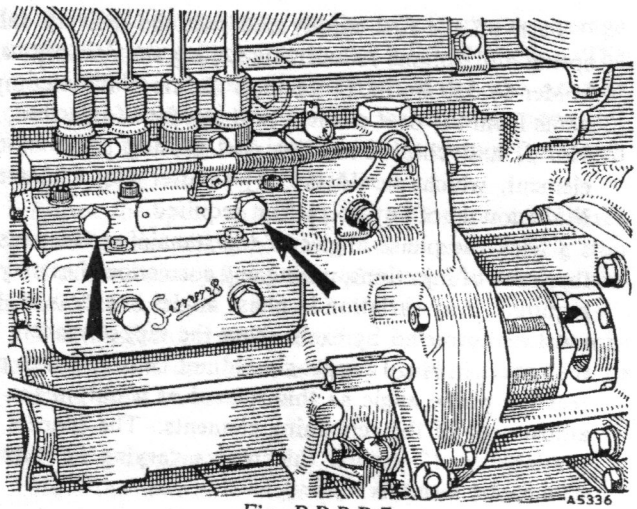


Fig. DDDD.7

The two air vent plugs on the fuel injection pump

element except the guide and joint washer and rotate the pump camshaft to position No. 1 plunger at B.D.C. Assemble clearance gauge set 18G 538 A, using the appropriate adaptor. Screw the adaptor into the delivery valve holder position until it is tight against the joint washer. Ensure that the plunger contacts the tappet spacer and then zero the gauge.

Turn on the test oil supply and note that oil flows from the top of the gauge adaptor. Rotate the camshaft slowly in the normal direction of rotation until the exact point at which the flow of test oil ceases. Note the gauge reading, the difference from zero being the length of the inlet stroke. To adjust the inlet stroke exchange No. 1 tappet spacer as required after turning off the test oil supply.

Check No. 1 element plunger head clearance, which should be ·040 to ·060 in. (1·0 to 1·5 mm.). Zero the gauge with the element plunger at T.D.C. Gently lever the plunger upwards until it contacts the delivery valve guide. The gauge reading from zero is the plunger head clearance. Exchange No. 1 tappet spacer as required, noting that the inlet stroke must remain within the given limits.

Remove the gauge set and replace the delivery valve holder only.

To commence phasing connect test pipe 18G 233 to No. 1 element outlet and rotate the camshaft until No. 1 plunger is at B.D.C.

Turn on the fuel supply and rotate the camshaft slowly in the normal direction of rotation until the rising-plunger closes the barrel inlet port to cut off the flow of fuel from the test pipe. The flow of fuel from the test pipe will gradually diminish as the plunger rises, and the camshaft should be rotated in the final stages very gradually until fuel just ceases to drip from the test pipe. This is point of commencement of injection and the degree plate must be set to zero.

Turn off the fuel supply and refit the delivery valve, spring and volume reducer, tightening the delivery valve holder to 350 lb. in. (4 kg. m.). Remove these components from the next element in the order of injection, i.e. No. 3, and check the inlet port closing point of this element, which should be 90±½° after No. 1 element. Make a note of any correction required.

Check the phase angles of the remaining elements in the order of injections, noting any correction that may be required. Any variation in phase angles in excess of ±½° must be corrected by exchanging the tappet spacers but the spacer in No. 1 tappet should not be changed to correct the phase angle as this is used as a datum for the adjustment of the remaining elements. The spacers are available in 12 graded thicknesses varying in steps of ·004 in. (·1 mm.) as follows:

Spacer thickness	*No. on spacer*
·153 in. (3·9 mm.)	1
·157 in. (4·0 mm.)	2
·161 in. (4·1 mm.)	3
·165 in. (4·2 mm.)	4
·169 in. (4·3 mm.)	5
·173 in. (4·4 mm.)	6A
·177 in. (4·5 mm.)	7
·181 in. (4·6 mm.)	8
·185 in. (4·7 mm.)	9A
·189 in. (4·8 mm.)	10
·193 in. (4·9 mm.)	11
·197 in. (5·0 mm.)	12

The difference of ·004 in. (·1 mm.) of spacer thickness is equivalent to ½° of camshaft movement, therefore fitting a spacer ·004 in. (·1 mm.) thicker will advance the inlet port closing point by ½° while a thinner spacer will retard the closing point by the same amount.

Remove the pump body from the pump housing and change the tappet spacers as necessary, fitting the spacer retainers with their convex side next to the spacer. Refit the pump body and check as described above for No. 1 element the plunger head clearance of Nos. 2, 3, and 4 elements, which should be not less than ·060 in. (1·5 mm.). Tighten the delivery valve holders to 350 lb. in. (4 kg. m.), using torque wrench 18G537 and tool 18G699, then refit the clamps to lock the holders in position.

Remove the pump body, and install the lower spring discs and the springs. Reassemble the body to the pump housing, and while tightening the securing screws maintain a firm pressure on the top of the body. Check that each plunger arm has a vertical end-float of ·002 to ·008 in. (·05 to ·2 mm.) throughout the plunger stroke by measuring the clearance between the plunger arm and lower spring disc. This clearance enables the plunger to be turned freely by its control fork and is obtained by changing the lower spring discs. The spring discs are available in 16 graded thicknesses varying in steps of ·004 in. (·1 mm.) as follows:

Effective thickness of disc	*No. on disc*
·025 in. (·65 mm.)	1B
·029 in. (·75 mm.)	2B
·033 in. (·85 mm.)	3B
·037 in. (·95 mm.)	4B
·041 in. (1·05 mm.)	5B
·045 in. (1·15 mm.)	6B
·049 in. (1·25 mm.)	7B
·053 in. (1·35 mm.)	8B
·057 in. (1·45 mm.)	9B
·061 in. (1·55 mm.)	10B
·065 in. (1·65 mm.)	11B
·069 in. (1·75 mm.)	12B
·073 in. (1·85 mm.)	13B
·077 in. (1·95 mm.)	14B
·081 in. (2·05 mm.)	15B
·085 in. (2·15 mm.)	16B

Fill the pump housing via the filler orifice with ⅛ pint (320 c.c.) of one of the recommended grades of engine oil and replace the filler plug. **Do not overfill.**

Calibrate the pump as described below and then install the two inspection cover bridge plates and the inspection cover.

Section DDDD.3

CALIBRATION

This adjustment is made to balance the output of all pumping elements throughout their delivery range. The method described below is for use on a fuel injection pump test bench, using a matched set of test injectors (nozzle Type BDN.12S.D12, holder Type BKB.50S.D19b, set at 175 atmospheres).

Refit the pump coupling flange and check that the timing mark on the periphery of the flange aligns with the pointer on the pump mounting face at the point of inlet port closure on No. 1 element. Re-mark the pump coupling flange if necessary.

Mount the pump on the test bench and link up the drive. Connect the test oil supply to the pump inlet, and the high pressure pipes to the pump outlets and the test injectors.

Prime and bleed the fuel injection pump. Start the test machine and, if necessary, bleed the high pressure pipes to the test injectors.

Set No. 4 control fork ·020 in. (·5 mm.) from the end of the square section of the control rod.

Hold the pump control lever in the maximum speed position, and then adjust the maximum fuel delivery stop screw to give an output from No. 4 element of 11·2±·2 c.c. for 200 shots at 600 pump r.p.m. Lock the maximum fuel stop screw in position. Balance the remaining elements to No. 4 by adjusting the control forks to give an

average delivery over all four elements of 11·2±·2 c.c. for 200 shots at 600 r.p.m. pump. In arriving at this figure the output from each element must be between 10·8 and 11·6 c.c.

Examples showing correct and incorrect settings are given herewith:

(*a*) Pump readings: 11·4, 11·6, 11·6, 11·0 c.c.
Average delivery:

$$\frac{11{\cdot}4+11{\cdot}6+11{\cdot}6+11{\cdot}0}{4} = 11{\cdot}4 \text{ c.c.}$$

This is **acceptable** as each element output lies between 10·8 and 11·6 c.c., and the average output is within 11·2±·2 c.c.

(*b*) Pump readings: 11·0, 11·0, 10·8, 10·8 c.c.
Average delivery:

$$\frac{11{\cdot}0+11{\cdot}0+10{\cdot}8+10{\cdot}8}{4} = 10{\cdot}9 \text{ c.c.}$$

This is **not acceptable** as the average output lies outside 11·2±·2 c.c. although each element output is within the limits of 10·8 and 11·6 c.c.

To correct this setting, adjust the maximum fuel stop so that each element output is increased. As the average output in example (*b*) is ·1 c.c. outside the lowest acceptable limit, the output of all elements must be increased by this amount plus a tolerance, in this case ·2 c.c., without which the average delivery would still only be to the lowest limit acceptable.

The readings will then be 11·3, 11·3, 11·1, 11·1 c.c., giving an average delivery of 11·2 c.c., which is ideal. Similarly, if the average delivery happens to be in excess of 11·4 c.c., then each element output must be reduced by the excess amount plus a tolerance to give an average output as near as possible to the ideal of 11·2 c.c. The value of the tolerance is determined by the amount required to increase or decrease the average output to, as near as possible, the ideal, with the output from each element lying between 10·8 and 11·6 c.c.

Adjust the speed to 250 r.p.m. with the control lever forward in the idling position, and reset the idling stop so that the delivery from each of the elements is approximately 3 c.c.

If a satisfactory maximum fuel setting cannot be obtained by this method the faulty pumping elements or element must be renewed.

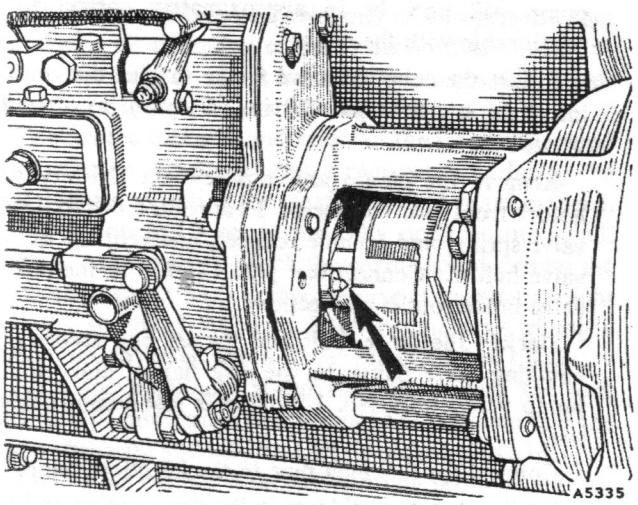


Fig. DDDD.8

The timing mark on the periphery of the pump flange and the timing pointer on the pump mounting face

Test for governing

Hold the control lever in the maximum speed position and take the pump speed up to 1,010 r.p.m., when the control rod should start to move. At a pump speed of 1,100 to 1,120 r.p.m. fuel delivery should shut off completely. Reset the maximum speed stop if necessary.

NOTE.—Movement of the control rod can be seen if the control rod cover at the rear of the pump is removed. This is preferable to removing the inspection cover as at high speed an appreciable amount of oil can be lost from the aperture.

Section DDDD.4

REMOVING AND REPLACING THE FUEL INJECTION PUMP

Disconnect all the pipe connections from the injection pump, the inlet pipe from the fuel filter, four pressure pipes from the fuel injectors and the leak-off plug and pipe.

Disconnect the accelerator linkage and the flexible stop control from the levers on the injection pump.

Remove the two set screws and spring washers securing the injection pump support bracket to the cylinder block, and the three stud nuts securing the pump to the drive adaptor housing.

Withdraw the pump rearwards to disengage the coupling, and remove the pump complete with coupling flange and support bracket from the engine.

Remove the set screw and spring washer to release the support bracket from the base of the injection pump.

Before replacing the injection pump it is necessary to set the engine for injection timing with No. 1 piston at 25° B.T.D.C. on its compression stroke.

Remove the valve rocker cover.

Turn the crankshaft slowly in its normal direction of rotation until the exhaust valve (No. 1) of No. 1 cylinder is just closing, and the inlet valve (No. 2) of the same

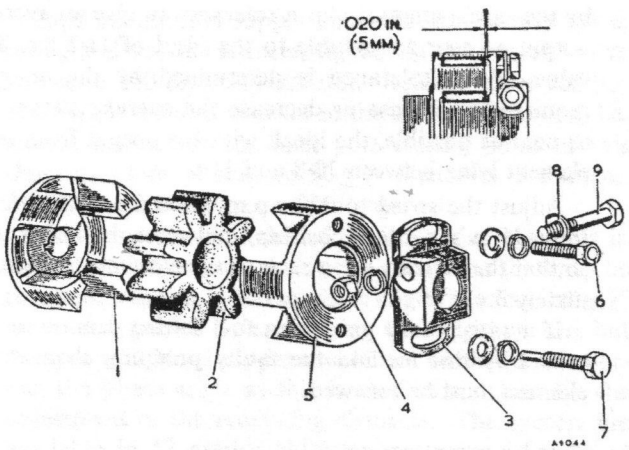


Fig. DDDD.9

The injection pump drive coupling

1. Pump flange.
2. Insert.
3. Dog flange.
4. Nut—clamp bolt.
5. Driving flange.
6. Set screw.
7. Dowel screw.
8. Tab washer.
9. Clamp bolt.

cylinder is just opening. This indicates that No. 1 piston is commencing to move downwards on its induction stroke.

Remove the inspection cover from the left-hand side of the clutch housing on the tractor, and continue turning the crankshaft until the 25° B.T.D.C. mark on the rear face of the flywheel coincides with the pointer located in the clutch housing. No. 1 piston is now at 25° B.T.D.C. on its compression stroke.

Refit the support bracket to the base of the injection pump and then align the timing mark on the periphery of the pump flange with the timing pointer on the mounting face of the injection pump.

Offer up the injection pump to the engine, engaging the drive coupling as the pump is pushed onto its mounting studs.

Ensure that the drive coupling dowel bolt is properly located in the hole in the pump flange.

Fit and tighten the three nuts and spring washers to secure the injection pump to the drive adaptor housing and then secure the pump support bracket to the cylinder block.

Press back the locking tab and slacken the clamp bolt and nut securing the injection pump coupling flange to the drive shaft. Adjust the coupling driving flange on the drive shaft to give the coupling insert an end-float of ·020 in. (·5 mm.) as shown in Fig. DDDD.9.

Tighten and lock the driving flange clamp bolt and nut, and re-check the coupling insert end-float.

Slacken the two set bolts, securing the coupling driving flange to the dog flange, and turn the pump flange by hand to align the timing mark on the periphery of the pump flange with the pointer on the injection pump mounting face.

Tighten the two set bolts to secure the drive coupling adjustment and then check that the flywheel is still in the timing position of 25° B.T.D.C.

The foregoing timing procedure should be used only when installing an original injection pump and drive coupling. If the injection pump has been overhauled, or when installing a new injection pump or drive coupling, or if there is no timing mark on the pump flange then the point of inlet port closure for No. 1 pumping element must be found to accomplish the timing procedure.

The term inlet port closure refers to the instant when the flow of fuel through the barrel inlet port from the fuel gallery is cut off by a pumping plunger on its upward stroke, and corresponds to the theoretical commencement of injection for that pumping element. The flow of fuel through each element barrel inlet port is cut off at two points during one complete revolution of the pump camshaft, one on the upward stroke and the other on the downward stroke of the pumping plunger. The correct cut-off point for injection timing is the one on the upward stroke of the plunger.

Ensure that the injection pump drive coupling is assembled correctly. The coupling dowel bolt must be fitted in the position opposite to the driving flange clamp bolt and nut.

Set the engine with No. 1 piston at 25° B.T.D.C. on its compression stroke and install the injection pump as described previously, ensuring that the coupling dowel bolt locates in the hole in the pump flange. The injection pump will now be in approximately correct timing relationship with the engine.

Adjust the coupling drive flange to give the coupling insert an end-float of ·020 in. (·5 mm.), as described previously.

Remove the clamp and unscrew the delivery valve holder from No. 1 element. Remove the delivery valve, valve spring, and volume reducer, and refit the delivery valve holder. Connect test pipe 18G233 to the delivery valve holder outlet connection.

Slacken the dowel bolt and the set bolt securing the coupling drive flange to the dog flange, and turn the pump flange until No. 1 plunger is just commencing to rise.

Connect the fuel inlet pipe to the injection pump.

Set the stop control lever in the run position and hold the control lever in the maximum power position. Operate the fuel lift pump priming lever to prime the fuel system, and bleed the main fuel filter and the injection

pump. The fuel will now be flowing from the test pipe attached to No. 1 delivery outlet.

Turn the injection pump flange slowly by hand in the normal direction of rotation, when No. 1 element plunger will commence to rise from its B.D.C. position. As the element inlet port is progressively closed by the rising plunger, the fuel issuing from the test pipe will gradually diminish. Turn the pump flange very slowly in the final stages; the instant of inlet port closure will be observed when there is no drip of fuel from the test pipe for a period of 14 to 15 seconds. Tighten the dowel bolt and set bolt to secure the coupling driving flange taking care not to disturb the coupling setting.

Check that the flywheel is still in the 25° B.T.D.C. position, and then scribe a timing mark on the periphery of the pump flange, in alignment with the timing pointer on the injection pump mounting face. If a used drive coupling is fitted delete the old timing mark from the pump flange.

Remove the test pipe and the delivery valve holder from No. 1 element and install the delivery valve, valve spring, and volume reducer after washing them in clean fuel oil. Refit the delivery valve holder and valve holder clamp.

Reconnect the fuel injector feed pipes, the oil leak-off plug and pipe, and the accelerator linkage and flexible stop control cable. Ensure that both the control levers have a full range of movement.

Bleed the fuel system as described in Section DDDD.7.

To adjust

After fitting either a new or overhauled injection pump the engine maximum light running speed and idling speed must be checked and adjusted if necessary. Before making either of these adjustments it is imperative that the engine air cleaner is correctly serviced and fitted.

Run the engine until it has attained its normal operating temperature—**this is most important.**

Slacken the locknut, and screw in the maximum speed stop screw to prevent excessive engine r.p.m. during the initial stages of setting the maximum light running speed.

Set the control lever in the fully open position and, using a tachometer to check the engine speed, retract the maximum speed stop screw to give a maximum light running speed of 2,120 to 2,160 r.p.m., thus giving a maximum governed speed under load of 2,000 r.p.m.

Lock the maximum speed stop screw with the lock nut, and to discourage unauthorized adjustment seal the screw with wire and lead seal, using sealing pliers 18G541.

Return the control lever to the idling position, slacken the idling stop screw locknut, and adjust the stop screw to give an engine idling speed of 520 to 550 r.p.m. Tighten the locknut to secure the idling stop screw in this position.

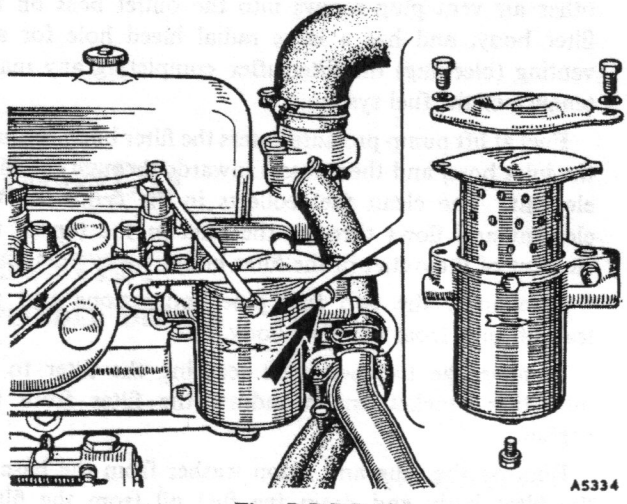


Fig. DDDD.10

The main fuel filter. The large arrow indicates the air vent plug

Section DDDD.5

FUEL INJECTION PUMP MAINTENANCE

The unit is designed and manufactured so that the minimum amount of servicing is required, but it is necessary to drain and refill the unit with ⅛ of a pint (·35 litre) of engine lubricating oil at every engine oil change (200 hours).

Early Minimec fuel injection pumps were not provided with drain and level plugs, but the oil can be replaced in such units by pouring in at the oil filler ⅛ of a pint (·35 litre) of engine lubricating oil. Any oil in excess will drain off from the overflow pipe.

Section DDDD.6

REMOVING AND REPLACING THE MAIN FUEL FILTER

The main fuel filter, mounted on a bracket attached to the front right-hand side of the cylinder block, is a Simms Type FF having a renewable paper element.

The filter consists of a diecast aluminium-alloy body with drain plug, a pressed-steel cover secured by two bolts, the filter element, and two air vent plugs. There are no separate seals or springs. The element has moulded ends completely protecting all clean surfaces from dust. Incorporated in the upper end of the element, which forms all the seals, is the protective passage for the clean fuel.

Both air vent plugs screw into the filter body. The one which secures the auxiliary pipe from the fuel injector leak-off pipe, has a small radial bleed hole and permits continuous air-venting of the filter during operation. The

other air vent plug screws into the outlet boss on the filter body, and has a large radial bleed hole for air-venting (bleeding) the filter after completing any maintenance of the fuel system.

Fuel at lift pump pressure enters the filter body through the inlet boss, and then passes inwards through the filter element. The clean fuel collects in the centre of the element and flows through the duct in the top of the element of the outlet in the filter body.

Disconnect the two fuel pipe connections and the leak-off pipe from the filter body.

Remove the two set bolts securing the filter to its mounting bracket and withdraw the filter from the engine.

Remove the plug and nylon washer from the base of the filter body and drain the fuel oil from the filter.

Unscrew the two set bolts with plain washers to release the pressed-steel cover from the filter body. Withdraw the filter element from the filter body.

Unscrew and remove the air-vent plug with nylon washer from the outlet connection boss on the filter body.

The paper-type filter element cannot be washed or cleaned in any way and should be renewed.

Wash the filter body thoroughly in petrol (gasoline) and allow to dry. Blow clean the inlet and outlet ports and the air-vent plug apertures with compressed air.

Reassemble and replace the filter assembly by reversing the foregoing instructions.

Bleed the fuel system of air as described in Section DDDD.7.

Periodical renewal of the element

Unscrew and remove the two set bolts with plain washers to release the pressed-steel cover from the filter body.

Withdraw the old filter element upwards from the filter body.

If necessary remove the drain plug and flush out the filter body with clean fuel oil to remove any residue. Refit the drain plug and nylon seal washer.

Install a new element in the filter body and refit the pressed-steel cover.

Bleed the fuel system of air as described in Section DDDD.7.

Section DDDD.7

BLEEDING THE SYSTEM

The help of an assistant is required when air-venting the fuel system.

Ensure that there is an adequate supply of fuel in the tank and then slacken the plug directly over the main fuel filter outlet pipe union (Fig. DDDD.10).

Operate the hand primer on the fuel lift pump until fuel, free from air bubbles, issues from the vent plug and then tighten the plug.

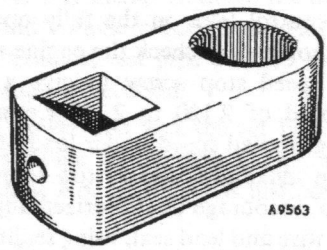
Slacken the two air vent plugs in the fuel injection pump body (Fig. DDDD.7) and repeat the procedure until air-free fuel issues from the vent plugs. Tighten the plug.

Finally, bleed each fuel delivery pipe in turn. Start the engine, or operate the starter motor, and slacken the union nut at the injector nozzle end of the pipe, and as soon as fuel free of air bubbles flows from the connection retighten the union nut.

SERVICE TOOLS

18G699. Delivery Valve Holder Spanner (Simms 'Minimec' Pump).

This tool is essential when removing or replacing the delivery valve holders.



SECTION DDDDD

THE FUEL SYSTEM

(TYPE OEG THREE-CYLINDER DIESEL)

The information in this Section applies to the fuel system on the 2·8-litre engine. Information not given in this Section is the same as that given in Section DDDD for the 3·8-litre engine

Section DDDDD.1

DESCRIPTION

The Simms Minimec fuel injection pump fitted to the 2·8-litre engine is a three-element unit similar to the injection pump described in Section DDDD.1 except in the number of elements.

Section DDDDD.2

DISMANTLING AND REASSEMBLING THE FUEL INJECTION PUMP

Follow the instructions in Section DDDD.2, noting that the phase angles for the three-element pump are 120±½°.

Section DDDDD.3

CALIBRATION

Follow the instructions in Section DDDD.3, but set the maximum fuel delivery to 11·7±·2 c.c. for 200 shots at 600 r.p.m. with a maximum variation between elements of 11·3 to 12·1 c.c.

Section DDDDD.4

FUEL INJECTION PUMP MAINTENANCE

Follow the instructions in Section DDDD.5, noting that only ½ pint (·28 litre) of oil is required in the three-element pump.

Section DDDDD.5

MAIN FUEL FILTER

The main fuel filter, mounted on a bracket attached to the cylinder block, is a Simms Type FH employing a resin-impregnated material as the filtration medium.

The filter consists of a filter head, filter element, and bottom plate. Made of diecast aluminium, the filter head incorporates the inlet and outlet connections, the air bleed point, and the filter mounting flange. A fixing bolt passes through the centre boss of the filter head and screws into the pressed-steel bottom plate, clamping the filter element between the filter head and bottom plate. The filter element, which is contained within its own metal canister, is sealed at the filter head and bottom plate by sealing rings which seat on the outer rim of the canister. An 'O' ring located in an annular groove on the centre boss of the filter head, and over which the centre tube of the element canister fits, seals the dirty side of the filter from the clean side.

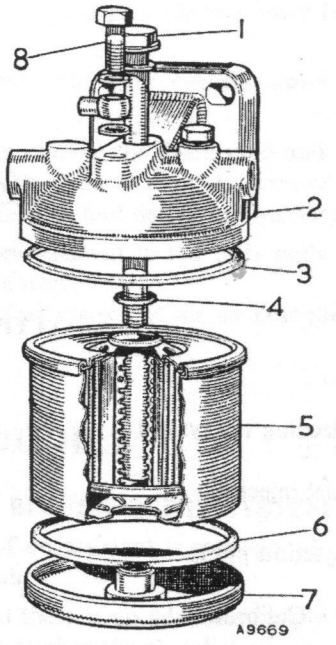


Fig. DDDDD.1

Simms Type FH Fuel Filter

1. Fixing bolt.
2. Filter head.
3. Sealing ring.
4. 'O' ring.
5. Filter element.
6. Sealing ring.
7. Bottom plate.
8. Banjo bolt.

In operation, fuel at lift pump pressure passes through the filter head and down the centre tube of the element canister. The fuel then passes inwards through the filter element, and to the outlet connection in the filter head via a series of holes in the canister top plate. Continuous air-bleeding of the filter is provided by connecting the air bleed point to the fuel injector leak-off pipe.

Removing and replacing

Disconnect the two fuel pipe connections and the leak-off pipe from the filter head. Remove the two nuts and bolts securing the filter to its mounting bracket and lift the filter from the engine.

To replace the filter, reverse the above procedure and then bleed the fuel system as described in Section DDDDD.6.

Renewing the filter element

The filter element can be renewed without removing the filter from the engine.

Unscrew the fixing bolt in the centre of the filter head and detach the bottom plate. Remove the element,

using a twisting movement to release it from the sealing ring in the filter head. Clean the filter head and bottom plate, and renew the 'O' ring and sealing rings. Fit a new filter element carefully to the filter head, ensuring that it seats correctly on the sealing ring. Replace the bottom plate complete with sealing ring and tighten the fixing bolt.

Finally, bleed the fuel system as described in Section DDDDD.6.

Section DDDDD.6

BLEEDING THE SYSTEM

Ensure that there is an adequate supply of fuel in the tank, and slacken the banjo bolt on the filter head. Operate the fuel lift pump, and when the fuel issuing from the banjo union is free from air bubbles tighten the banjo bolt. Slacken the air vent plugs in the fuel injection pump body. Operate the fuel lift pump until air-free fuel issues from the vent plugs, then tighten the vent plugs.

Finally, bleed each fuel delivery pipe in turn. Start the engine, or operate the starter motor, and slacken the union nut at the injector end of the fuel delivery pipe. As soon as the fuel issuing from the union is free from air bubbles retighten the union nut.

Section DDDDD.7

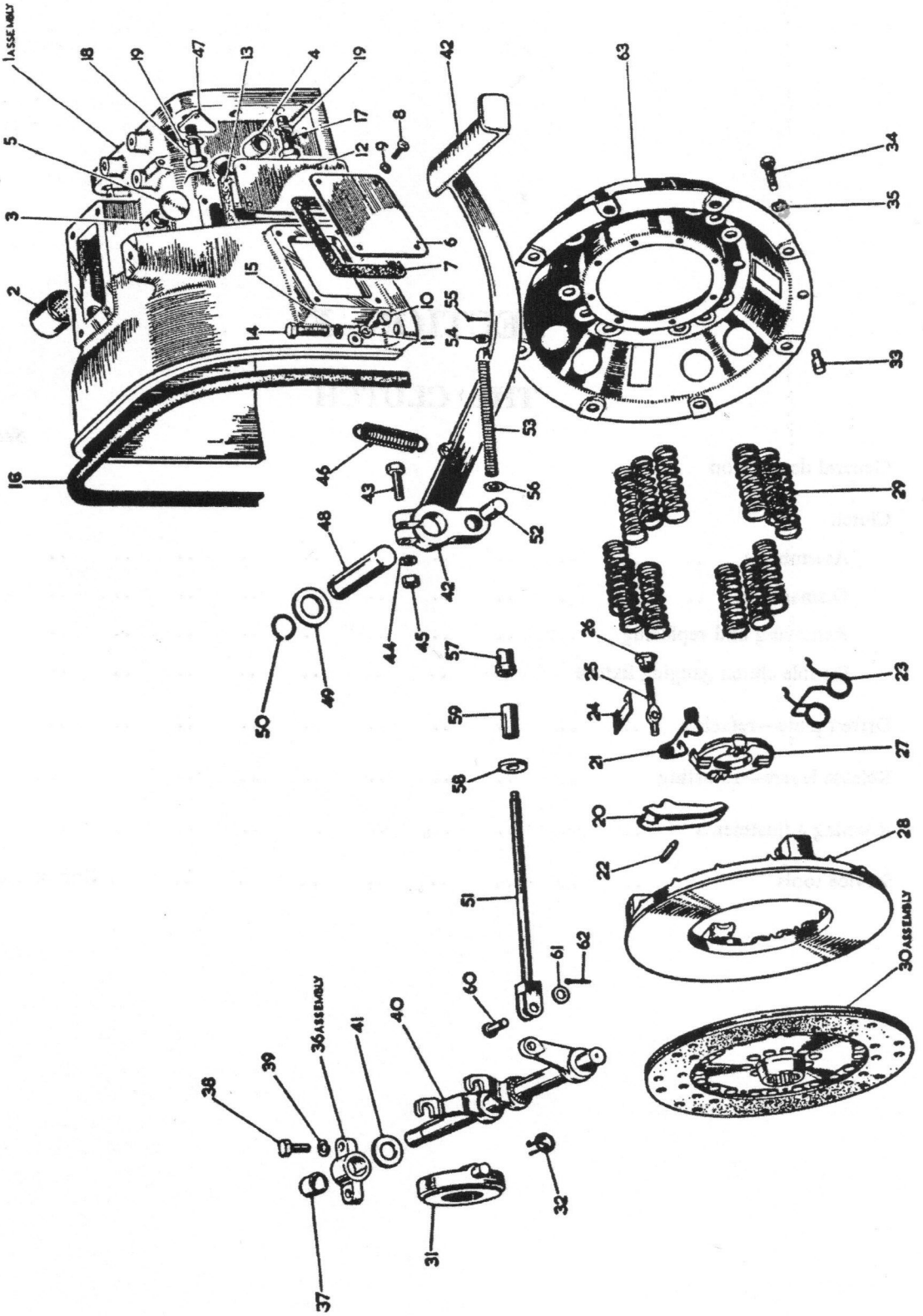
FUEL INJECTORS

Follow the instructions in Section D.13 to D.15, noting that the injectors fitted to the 2·8-litre engine have a spray cone angle of 140°.

SECTION E

THE CLUTCH

THE CLUTCH AND CLUTCH CROSS-SHAFT ASSEMBLY



KEY TO THE CLUTCH AND CLUTCH CROSS-SHAFT ASSEMBLY

No.	Description
1.	Clutch and steering housing assembly.
2.	Bush—steering.
3.	Bush—cross-shaft.
4.	Bush—clutch pedal shaft.
5.	Plug—core.
6.	Cover—clutch inspection.
7.	Joint.
8.	Screw.
9.	Washer—spring.
10.	Pointer—timing.
11.	Washer—spring.
12.	Cover—control inspection.
13.	Joint.
14.	Bolt—housing to main frame.
15.	Washer—spring.
16.	Strip—rubber sealing.
17.	Bolt—housing to gearbox casing.
18.	Bolt—housing to gearbox casing.
19.	Washer—spring.
20.	Release lever.
21.	Lever retainer.
22.	Lever pin.
23.	Spring—anti-rattle.
24.	Strut.
25.	Eyebolt.
26.	Nut for eyebolt.
27.	Plate—release lever.
28.	Plate—pressure.
29.	Spring—pressure plate (green).
30.	Driven plate assembly.
31.	Release bearing assembly.
32.	Spring retainer.
33.	Dowel.
34.	Bolt.
35.	Washer—spring.
36.	Bracket—clutch withdrawal shaft—assembly.
37.	Bush.
38.	Bolt—bracket to frame.
39.	Washer—spring.
40.	Shaft—clutch withdrawal.
41.	Washer.
42.	Clutch—pedal.
43.	Bolt.
44.	Washer—spring.
45.	Nut.
46.	Spring—pedal return.
47.	Plate—anchor (for spring).
48.	Clutch pedal shaft.
49.	Washer—plain.
50.	Circlip.
51.	Rod assembly—clutch operating.
52.	Pin—trunnion.
53.	Spring—locking.
54.	Washer—plain.
55.	Split pin.
56.	Washer—pressed.
57.	Nut—clutch adjusting.
58.	Washer—packing.
59.	Distance piece.
60.	Pin for operating rod jaw
61.	Washer.
62.	Split pin.
63.	Cover—clutch.

DESCRIPTION

The clutch is of the single-plate dry disc type, no adjustment for wear being provided in the clutch itself. Individual adjustment is provided for locating each release lever during manufacture and once the adjusting nut is locked in place it should never be disturbed unless the clutch is dismantled for the replacement of parts.

The general construction can be followed by reference to Fig. E.1 and the following description.

Driven plate assembly

This consists of a splined hub and flexible steel driven plate, to the outer diameter of which are fixed the annular friction facings. This plate is attached to the splined hub by a spring mounting which provides a torsion cushion.

Withdrawal bearing assembly

This comprises the graphite release bearing mounted in a cup attached to the throw-out fork, and a release plate is attached to the inner ends of the release levers by means of the retainer springs. Release is accomplished by moving the release bearing forward into contact with the release plate and applying pressure to the release levers.

Cover assembly

Each release lever is pivoted on a floating pin which remains stationary in the lever and rolls across a short flat portion of the enlarged hole in the eyebolts (see Figs. E.1 and E.6). The outer ends of the eyebolts extend through holes in the clutch cover and are fitted with adjusting nuts by means of which each lever is located in its correct position. The outer or shorter ends of the release levers engage the pressure plate lugs by means of struts which provide knife-edge contact between the outer ends of the levers and the pressure plate lugs, eliminating friction at this point. Thus the pressure plate is pulled away from the driven plate, compressing the 12 small thrust coil springs which are assembled between the pressure plate and the clutch cover.

When the foot pressure is removed from the clutch pedal the clutch springs force the pressure plate forward against the driven plate, gradually and smoothly applying the power of the engine to the rear wheels.

Section E.1

RUNNING ADJUSTMENTS

The only adjustment necessary throughout the life of the driven plate friction facings is to restore the free movement of the clutch pedal. As the driven plate facings wear the pressure plate moves closer to the flywheel face,

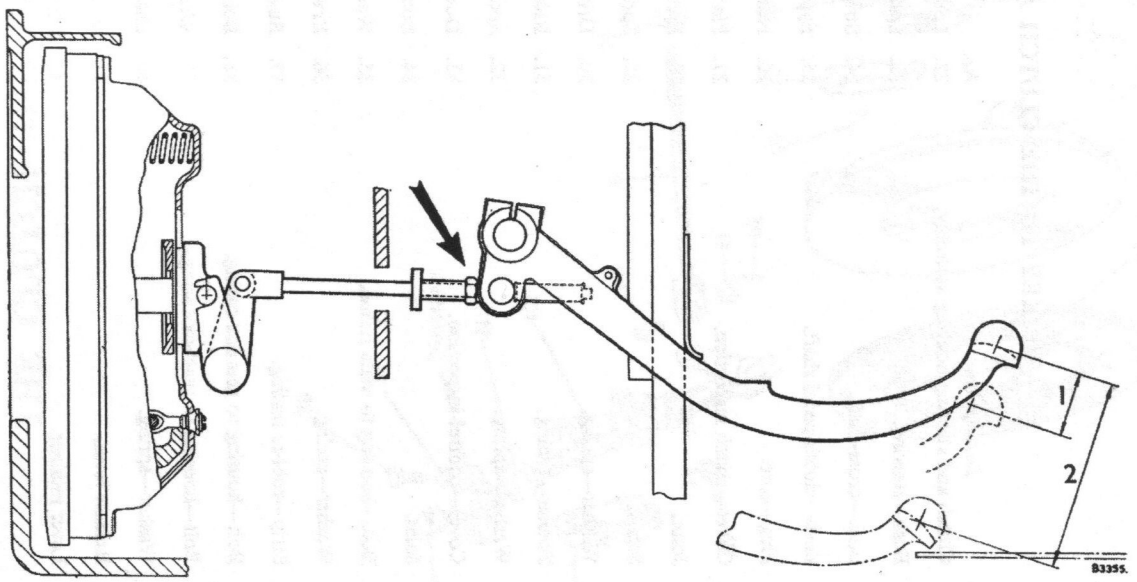


Fig. E.1

The clutch in section, showing its components with the arrow indicating the nut for adjusting the pedal-free movement

1. Initial free movement 1 in. (25 mm.). 2. Total travel 6 in. (154 mm.).

and the outer or shorter ends of the release levers follow. This causes the inner or longer ends of the levers to travel farther towards the gearbox and decrease the clearance between the release lever plate and the release bearing. The effect on the clutch pedal is to decrease the distance it moves downward away from the stop before the release bearing comes into contact with the release lever plate.

When this pedal movement is reduced to ½ in. (12·7 mm.) measured at the pedal pad, the nut on the rod passing through the trunnion of the clutch pedal must be rotated in the required direction until there is the correct movement of 1 in. (25·4 mm.) at the pedal pad before the actual clutch spring resistance is felt.

These measurements apply to tractors fitted with a single clutch of 11 in. (28 cm.) or 13 in. (33·02 cm.) diameter. For adjustment to a double clutch see Section Q.33.

Remove the inspection plate on the left-hand side of the clutch cover to expose the forward end of the clutch operating rod, and lubricate the pivot pins at either end. Examine the clutch thrust mechanism at the same time.

Section E.2

REMOVAL AND REPLACEMENT OF THE CLUTCH

To remove the clutch with the engine in position in the frame remove the bonnet, fuel tanks, and clutch housings as detailed in the operations No. 1 to No. 26 in Section A.21.

Remove the locking wire and withdraw the two clevis pins from the transmission driving sleeve.

Slide the driving sleeve forward along the shaft.

Carefully remove the two spring retainers securing the release bearing to the withdrawal shaft fork.

Unscrew the four bolts securing the withdrawal shaft brackets to the main frame and remove the brackets and shaft.

Slacken the eight bolts securing the clutch assembly to the flywheel. These must be released gradually, a turn at a time in diagonal sequence, in order to prevent the thrust spring pressure distorting the clutch casing.

When the pressure is released remove the bolts and withdraw the complete clutch assembly together with the transmission shaft from the flywheel.

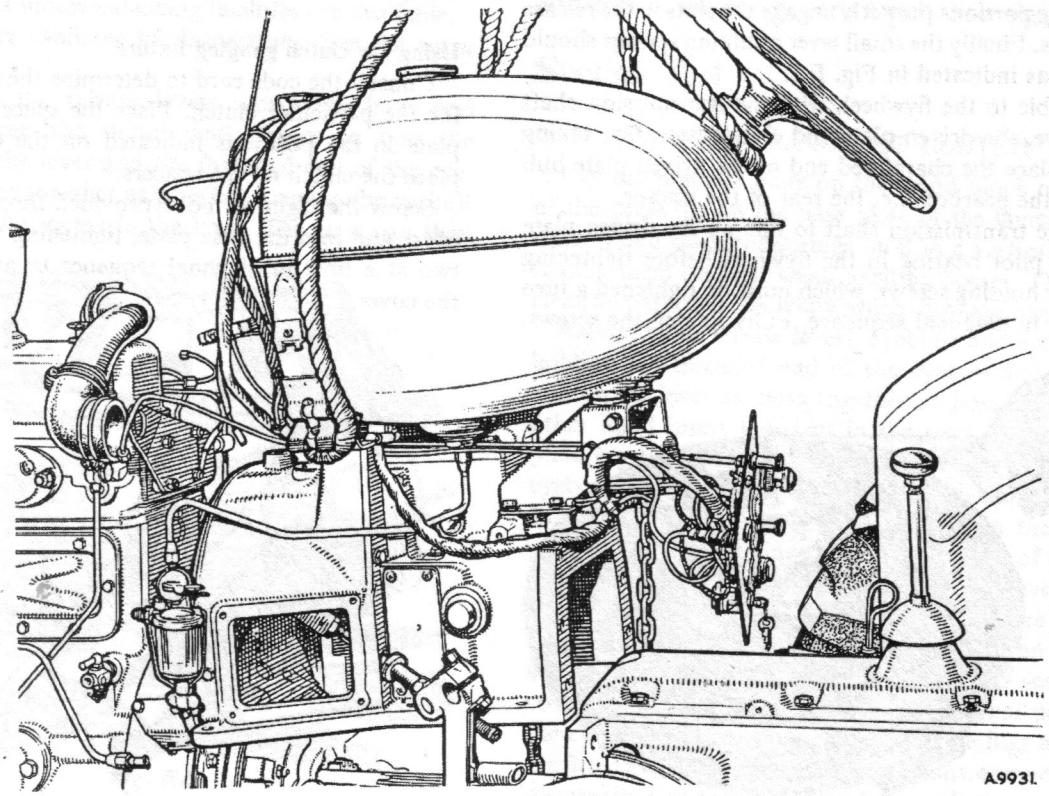


Fig. E.2

The fuel tank, steering gearbox, and clutch housing are lifted clear as an assembly to give access to the clutch and transmission shaft

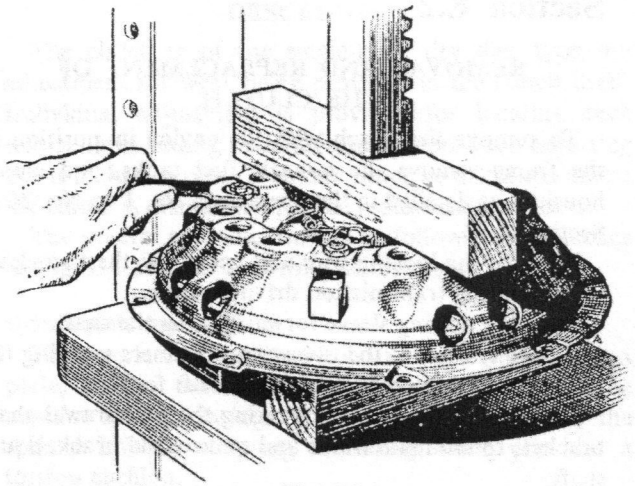


Fig. E.3

Compressing the springs with wood blocks and a press

Reassembly

Check the adjustment of the release levers and if necessary adjust them as indicated in the latter half of Section E.5.

Replace the release lever plate, taking care that the projecting portions properly engage the slots in the release lever ends. Finally the small lever retaining springs should be fitted as indicated in Fig. E.1.

Assemble to the flywheel, with the transmission shaft and sleeve, the driven plate and clutch assembly, taking care to place the chamfered end of the driven plate hub towards the gearbox, i.e. the rear of the tractor.

Use the transmission shaft to line up the driven plate with the pilot bearing in the flywheel before tightening the cover holding screws, which must be tightened a turn at a time in diagonal sequence. Fully tighten the screws.

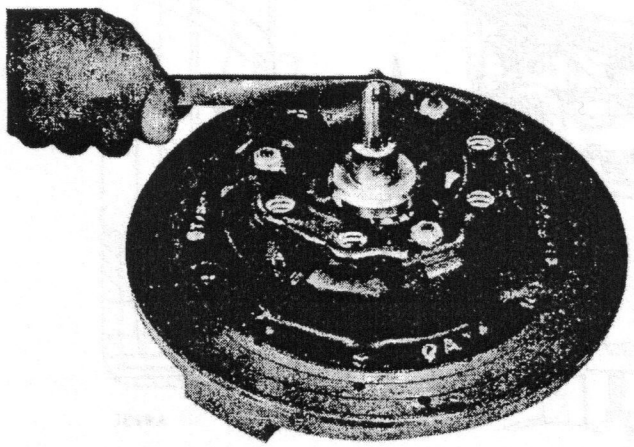


Fig. E.4

Using the actuator to compress the clutch springs for dismantling or setting the assembly

Replace the withdrawal shaft and release bearing assembly.

Smear a little Duckham's Keenol grease on the transmission and primary shaft splines, slide back the sleeve, and locate in position with a clevis pin which must be fitted in the hole nearest the plain end of the sleeve and into the transmission shaft.

Fit a second clevis pin into the inner of the two remaining holes to engage the plug in the end of the primary shaft.

Secure the clevis pins with locking wire.

Reassembly of the remaining components is a reversal of the dismantling procedure.

Check, and if necessary restore, the clutch pedal free movement to 1 in. (25·4 mm.) at the pedal pad as described in Section E.1.

Section E.3

DISMANTLING THE CLUTCH

Two methods are possible in dismantling the clutch: (*a*) Using the clutch gauging fixture 18G99A, and (*b*) Using a press and blocks of wood.

Using the clutch gauging fixture

Consult the code card to determine the correct spacers for the particular clutch. Place the spacers on the base plate in the positions indicated on the code card and place the clutch on the spacers.

Screw the eight set bolts provided through the clutch cover and into the base plate, tightening them a turn or two at a time in diagonal sequence to avoid distorting the cover.

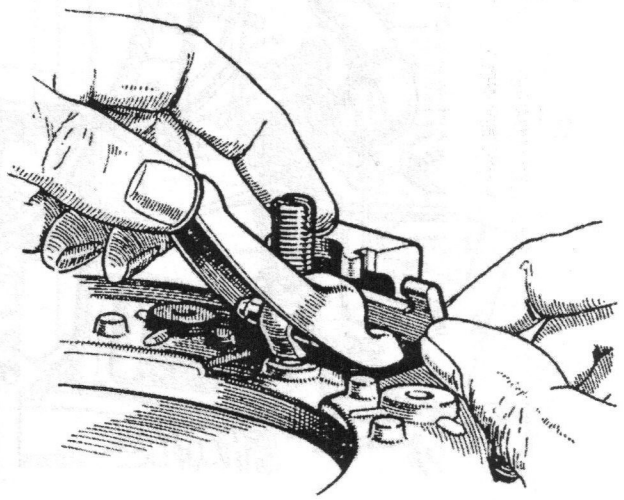


Fig. E.5

Assembling the release levers and struts to the pressure plate

Unscrew and completely remove the four eyebolt nuts.

Unscrew the eight set bolts securing the cover to the base plate, again in diagonal sequence a turn or two at a time, until all load is relieved from the thrust springs.

Lift the cover off the clutch and carry out whatever additional dismantling may be necessary.

Using a press and wood blocks (Fig. E.3)

Place the cover on the bed of a press with the pressure plate resting on wood blocks so arranged that the cover is left free to move downwards. Place a block or bar across the top of the cover, resting it on the spring bosses.

Apply pressure to the cover with the spindle of the press and, holding it under compression, remove the three adjusting nuts. The pressure from the press may now be released gradually until the clutch springs are fully extended.

While stripping down the cover-plate assembly, the parts should be marked so that they may be reassembled in the same relative position to each other, to ensure that the correct balance is maintained. When a new pressure plate is fitted it is essential that the complete cover and pressure plate assembly be accurately balanced, for which reason it is not a practical proposition to fit new pressure plates unless balancing facilities are available.

All parts are available for inspection when the cover is lifted off.

To remove the release levers, grasp the lever and eyebolt between the thumb and fingers so that the inner end of the lever and the threaded end of the eyebolt are as near together as possible, keeping the eyebolt pin seated in its socket in the lever. The strut can then be lifted over the ridge on the end of the lever, making it possible to lift the eyebolt off the pressure plate. It is advisable to renew any parts which show signs of wear.

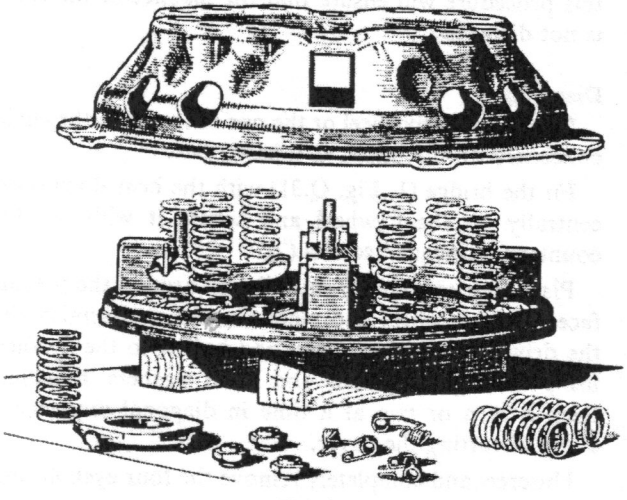


Fig. E.6

Support the clutch pressure plate on the wood blocks used for dismantling and make sure that the release levers and thrust and anti-rattle springs are correctly located before refitting the cover

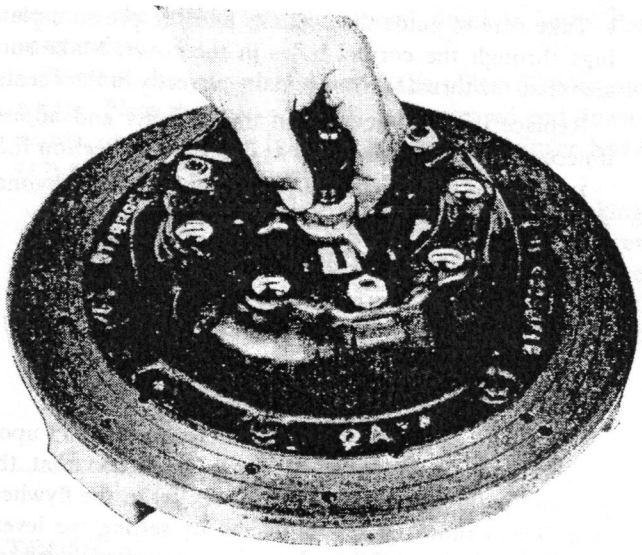


Fig. E.7

Checking the setting of the release levers

Section E.4

ASSEMBLING THE CLUTCH

Lay the pressure plate on the wood block on the bed of the press (or on the base plate of the clutch gauging fixture) and place the springs on it in a vertical position, seating them on their small locating bosses. Thoroughly clean all parts and renew any which show appreciable wear.

Assemble the release levers, eyebolts and eyebolt pins, holding the threaded end of the eyebolt and the inner end of the lever as close together as possible. With the other hand insert the strut in the slots of the pressure plate lug just sufficiently to allow the plain end of the eyebolt to be inserted in the hole in the pressure plate. Move the strut upwards into the slots in the pressure plate lugs, over the ridge on the short end of the lever, and drop it into the grooves formed in the lever.

Lay the cover over the parts, taking care that the anti-rattle springs are inpo sition as shown on page E.2 and that the springs are directly under the seats in the cover. Also make sure, if using the original parts, that the eyebolts, eyebolt nuts, pressure plate lugs and cover are fitted in their correct relative positions, as marked when dismantling, to ensure correct balance being maintained.

Insert the eight set screws through the cover holes and screw them a little at a time in diagonal sequence into the base plate, or, alternatively, compress the springs, using a press and wooden blocks.

Take care to guide the eyebolts and the pressure plate lugs through the correct holes in the cover. Make sure also that the thrust springs remain correctly in their seats.

Replace the eyebolt nuts on the eyebolts and adjust, if necessary, the release levers as described in Section E.5.

Release the cover set screws a little at a time in diagonal sequence, relieving the pressure slowly and evenly.

Remove the clutch assembly from the base plate.

Section E.5

ADJUSTING THE RELEASE LEVERS

Satisfactory operation of the clutch is dependent upon accurate adjustment of the release levers, so that the pressure plate face is maintained parallel to the flywheel face. This cannot be accomplished by setting the levers parallel to the face of the release bearings after the clutch has been assembled to the flywheel because of the variations in the thickness of the driven plate.

For an accurate adjustment the universal gauging fixture 18G99A must be used.

Using the gauging fixture

After carrying out any necessary servicing, reassemble the parts on the clutch pressure plate, place the cover on it and the whole assembly on the base plate of the gauging fixture. It is essential that the correct spacers be used, as indicated on the code card.

Bolt the cover to the base plate and screw the adjusting nuts onto the bolts until the tops of the nuts are flush with the tops of the bolts. Screw the actuator into the base plate and work the handle a dozen times to settle the mechanism. Remove the actuator. Screw the pillar firmly into the base plate and place the appropriate adaptor (see code card) on the pillar with the recessed side downwards; place the gauge finger in position.

Turn the adjusting nuts until the finger just touches each release lever, pressing downwards on the finger assembly to ensure that it is bearing squarely on the adaptor. Remove the finger and the pillar and replace the actuator; operate the actuator several times. Re-check with the finger assembly and make any necessary further adjustments.

Lock the adjusting nuts.

Section E.6

TO REFACE THE DRIVEN PLATE

Drill out the rivets, using a $\frac{1}{8}$ in. (3·2 mm.) diameter drill. **Do not punch them out.**

Rivet one new facing into position. If the proper tool is not available use a blunt centre-punch to roll the rivet shanks securely against the steel plate.

Rivet the second facing on the opposite side of the plate with the clearance holes over the rivet heads already formed during the fitting of the first facing.

Mount the plate on a mandrel between centres and check the run-out by means of a clock indicator set as near to the edge of the plate as possible. If the run-out is more than ·015 in. (·38 mm.) the plate should be trued by prising it in the requisite direction after locating the high-spots.

It is important that the two working faces of the facings should be parallel to each other and it is advisable to grind the surfaces so that they are parallel to each other after they have been fitted to the plate.

Section E.7

DOUBLE CLUTCH GAUGING FIXTURE

The double clutch gauging fixture 18G563 consists of a kit of parts which, used in conjunction with a suitable flywheel, will enable any Nuffield Tractor clutch to be quickly dismantled, rebuilt, and finally adjusted to a high degree of accuracy, and should therefore be used in preference to gauging fixture 18G99A.

Detailed below is the procedure for dismantling and reassembling a single-plate clutch. Double clutch procedure is detailed in Section Q.34. Before commencing to dismantle the clutch mark the main components to enable them to be reassembled in their original positions; this procedure will ensure that the balance of the clutch is not disturbed.

Dismantling

Place a spare flywheel or the one taken from the engine concerned on the bench as a base plate.

Fit the bridge (1, Fig. Q.31) with the boss downwards centrally on the flywheel and secure it with the two countersunk-headed screws (2).

Place four spacers (5) equi-distant around the pressure face of the flywheel and place the clutch assembly (less the driven plate) in position and bolt it to the flywheel, using the eight set bolts and plain washers, tightening them a turn or two at a time in diagonal sequence to avoid distorting the cover.

Unscrew and completely remove the four eyebolt nuts.

Unscrew the eight set bolts securing the cover to the base plate, again in diagonal sequence a turn or two at a time, until all load is relieved from the thrust springs.

Lift the cover off the clutch and carry out whatever additional dismantling may be necessary.

Reassembling

Arrange the four spacers (5) onto the base plate and place the pressure plate onto these. Assemble the clutch and screw in the eight set bolts, in diagonal sequence, until the clutch cover is in contact with the base plate.

To centralize the clutch-driven plate when resetting the clutch assembly, Service tool No. 18G563A should be used, together with Service tool No. 18G563, instead of the independent power take-off transmission drive sleeve.

Screw the adjusting nuts onto the eyebolts until the nuts are flush with the tops of the bolts. Do not fit the release lever plate at this stage.

Screw the joggling assembly (9) into the bridge and operate the joggler handle several times to settle the mechanism.

Remove the joggler and screw the pillar (7) into the bridge. Place the spacer adaptor, (4) recessed end downwards, onto the pillar followed by the gauge finger body (12) fitted with gauge finger (14).

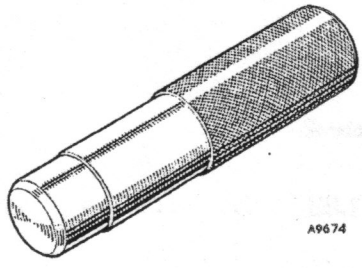
Press downwards on the gauge finger body, making good contact on the spacer, and turn the gauge finger body slowly. Adjust each eyebolt nut so that its respective release lever just contacts the gauge finger as it is brought over. Again joggle the clutch and re-check the adjustment with the gauge finger.

Lock the adjusting nuts.

SERVICE TOOLS

18G563. Double Clutch Gauging Fixture

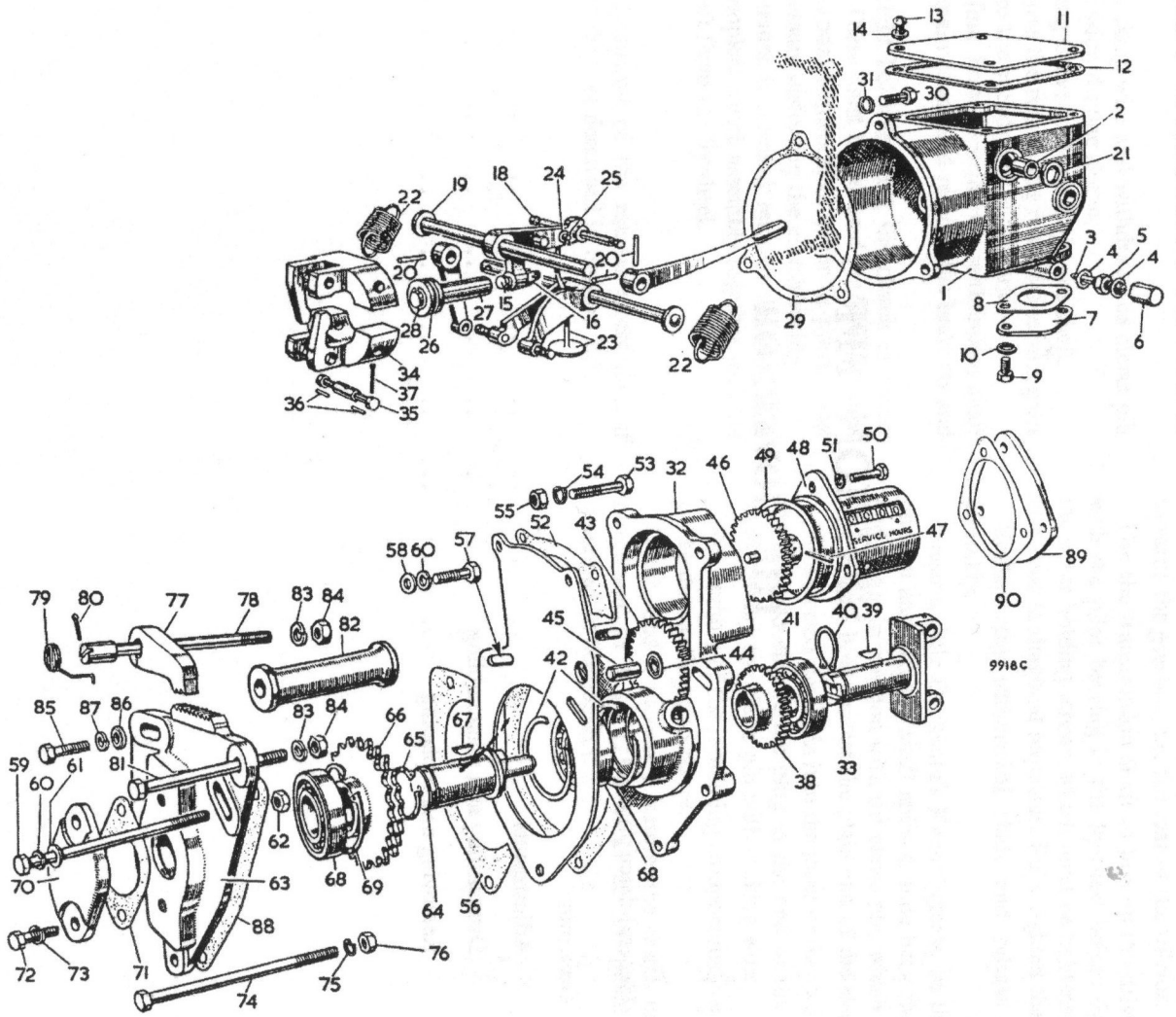
When used in conjunction with a spare flywheel, which forms the base plate, the fixture is invaluable for dismantling, rebuilding, and finally adjusting to a high degree of accuracy both single- and double-plate clutches.



18G563A. Double Clutch Centralizer

To be used in conjunction with 18G563 to facilitate the centralizing of the driven plate.

THE GOVERNOR AND SERVICE HOUR-METER DRIVE COMPONENTS



KEY TO THE GOVERNOR AND SERVICE HOUR-METER DRIVE COMPONENTS

No.	*Description*
1.	Governor casing.
2.	Bush.
3.	Screw—flow adjusting.
4.	Copper washer.
5.	Locknut.
6.	Domed nut.
7.	Cover-plate—damper cylinder.
8.	Joint.
9.	Bolt.
10.	Spring washer.
11.	Cover-plate—casing top.
12.	Joint.
13.	Screw.
14.	Spring washer.
15.	Contact button.
16.	Locknut.
18.	Pin—spring retaining.
19.	Collar.
20.	Taper pin.
21	Sealing ring—lever shaft.
22.	Tension spring.
23.	Damper piston.
24.	Washer.
25.	Split pin.
26.	Thrust bearing.
27.	Spindle.
28.	Circlip.
29.	Joint.
30.	Bolt.
31.	Spring washer.
32.	Housing—governor drive.
33.	Drive shaft.
34.	Bobweight.
35.	Spindle for bobweight.
36.	Needle roller for spindle.
37.	Split pin.
38.	Gear—hour-meter drive.
39.	Key for gear.
40.	Circlip for drive shaft.
41.	Bearing—drive shaft.
42.	Circlip—bearing.
43.	Gear—intermediate.
44.	Bush.
45.	Pin for intermediate gear.
46.	Gear—driven.
47.	Pin for gear.
48.	Flange—hour-meter fixing.
49.	Joint.
50.	Bolt.
51.	Spring washer.
52.	Joint.
53.	Bolt.
54.	Spring washer.
55.	Nut.
56.	Joint.
57.	Locking bolt.
58.	Washer.
59.	Bolt.
60.	Spring washer.
61.	Plain washer.
62.	Nut.
63.	Housing—front bearing.
64.	Shaft for chain wheel.
65.	Circlip shaft.
66.	Chain wheel.
67.	Key for chain wheel.
68.	Bearing (front).
69.	Circlip—bearing.
70.	Front cover.
71.	Joint.
72.	Bolt.
73.	Spring washer.
74.	Bolt—fulcrum.
75.	Spring washer.
76.	Nut.
77.	Locating paw.
78.	Pawl pivot bolt.
79.	Spring.
80.	Split pin.
81.	Bolt.
82.	Distance piece.
83.	Spring washer.
84.	Nut.
85.	Locking bolt.
86.	Washer.
87.	Spring washer.
88.	Joint—bearing housing to timing cover.
89.	Cover plate.
90.	Gasket.

GENERAL DESCRIPTION

The centrifugal-type engine speed governor is driven by a chain from the crankshaft and is connected directly to the carburetter throttle spindle.

When the load on the engine is suddenly reduced, causing the engine to speed up, pivoted bobweights move outwards under the influence of centrifugal force and operate levers and linkage to close the throttle opening. Extra loading on the engine reduces the engine speed, and as the bobweights close inwards tension springs re-open the throttle.

A damper is provided to prevent dangerous snap opening of the throttle.

An hour-meter (optional equipment) may be fitted to the governor assembly. It is driven from the governor shaft through a train of gears and records the number of hours run on the assumption of an engine speed of 1,100 r.p.m.

At engine speeds in excess of 1,100 r.p.m. the meter reads 'fast' and at speeds below 1,100 r.p.m. it reads 'slow', but over an average week of work the meter provides a record which is sufficiently accurate for all practical purposes.

Section FFF.1

GOVERNOR ADJUSTMENTS

Carburetter connecting link

The adjustment to the carburetter connecting link is carried out with the engine at rest and either hot or cold. The adjustment is provided to make sure that the throttle is completely closed when the lever on the outside of the governor is raised to its maximum extent. This point is reached when the lever is felt to contact the internal stop.

If the throttle does not close with the governor lever against its stop, then the engine will continue to run when the governor control lever is pushed forward to its fullest extent. The engine may also be difficult to start from cold.

The adjustment is as follows: detach one end of the link between the governor lever and the carburetter throttle lever by opening the spring clips on the socket and lifting it from the ball. Raise the governor lever to its stop and close the carburetter butterfly.

Unless it is possible to re-engage the socket of the connecting link with the ball the link must be shortened or lengthened to suit the position of the levers by releasing the locknuts and rotating the link the required amount. The link is provided with right- and left-hand threads and should be turned until the sockets are slightly farther apart than the ball ends (see Fig. FFF.1). After adjustment and retightening the locknuts ensure that the ball joints have freedom of movement at all points in the travel of the link.

Setting the damper

The damper is controlled by a flow-adjusting screw secured by a locknut. These are located at the base of the governor casing and are covered with a dome nut. The adjustment is factory-set and will not normally need alteration.

The object of the damper is to prevent surging. If the engine speed tends to surge increase the damper effect by screwing in the flow-adjusting screw. If the governor does not respond quickly enough to a change in position of the governor control lever screw the adjusting screw outwards and thus reduce the effect of the damper.

To check the setting of the damper proceed as follows: run the engine until it is thoroughly warm and then stop it. Move the governor control lever forward and then pull it slowly rearwards until the throttle operating lever on the governor has just fallen to its lowest point. Leave the governor control lever in that position.

Raise the throttle operating lever by hand until the throttle is fully closed and hold it in that position for a few seconds in order to ensure that the damper cylinder is completely filled with oil when released. Make sure that the damper is full by pumping the governor arm slightly until oil is felt beneath the piston. The lever should fall to its lowest position in 1·5 to 2 seconds. Should it not do so, readjust the damper flow. Flow is reduced by adjusting the screw inwards and increased by adjusting outwards.

If after this adjustment hunting continues, check that one of the bobweight tension springs has not broken and that there is sufficient oil in the governor casing. If the oil level is low, adjustment of the flow-adjusting screw will have no effect on the damper.

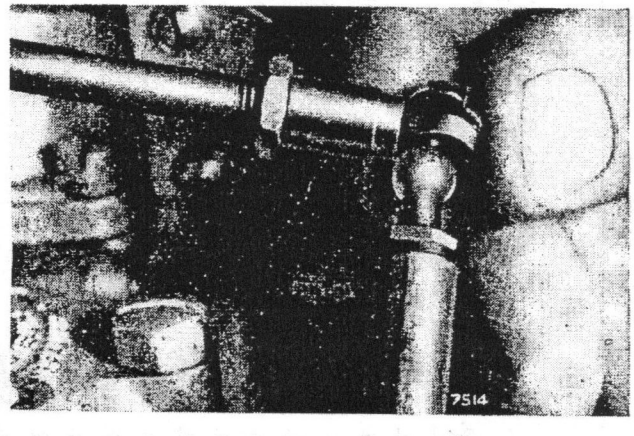


Fig. FFF.1

When correctly adjusted the link should be slightly longer than the distance between the ball-ends to ensure complete closing of the throttle

Governor control lever (Models 4 MV and 4 M)

For convenience of working four stops are provided for the governor control lever. They are the starting stop, idling stop, normal running stop, and maximum speed stop. When the engine is warm it may be run with the lever in any position between the idling stop and maximum speed stop to suit the work in hand.

To reach the starting position the lever must be pressed to the left and moved fully forward. If necessary, the carburetter connecting link must be adjusted until the throttle butterfly is fully closed with the lever in this position.

By moving the lever slightly to the rear the bolt head on the lever will move into position behind the bolt head on the bracket to determine the idling position. When the engine is warm and running on vaporizing oil only with the control lever pushed against the idling stop the engine speed should be between 550 r.p.m. and 600 r.p.m. The speed may be checked with a revolution counter applied to the front end of the crankshaft.

If the engine does not run at the required speed slacken the bolts securing the governor lever bracket and pivot the bracket forward to reduce the speed and rearward to increase it. Re-check that the throttle butterfly closes when the lever is placed in the starting position after moving the bracket.

From the idling stop the lever is moved rearward to the normal running stop. This is set at 1,400 r.p.m., but the stop may be adjusted by the knurled knob within the range of 1,000 r.p.m. to 1,600 r.p.m. to suit the work in hand.

The maximum speed stop is reached by pressing the lever to the left and moving it to the rear as far as it will go. This position is set to give an engine speed of 2,000 r.p.m. and will not normally require attention.

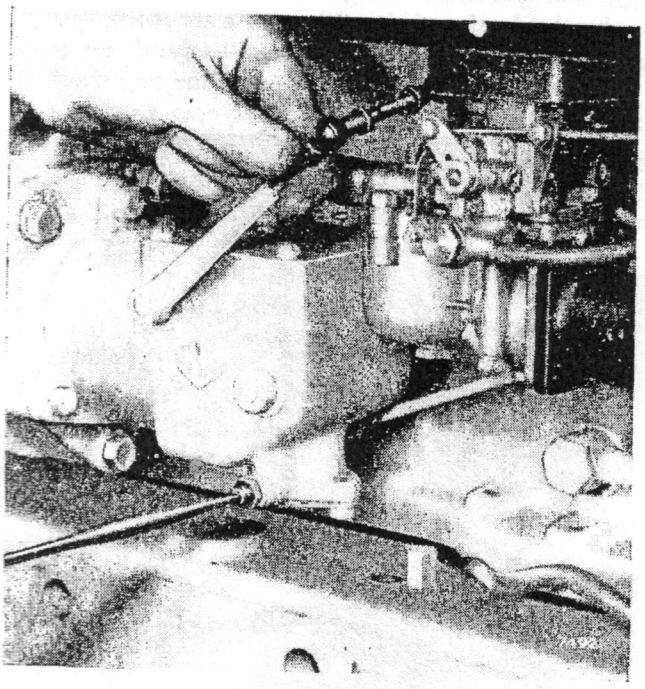


Fig. FFF.2

Setting the governor hydraulic damper with the throttle lever held in the raised position

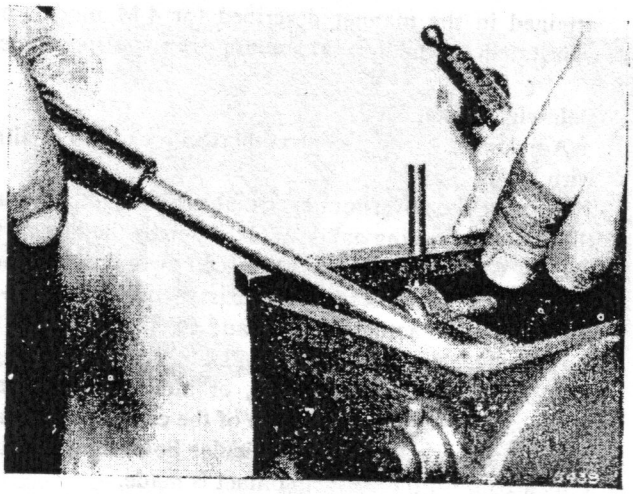


Fig. FFF.3

Using governor setting gauge 18G476. *With the bobweights prised out to the maximum position the top of the pad on the actuating lever should just contact the under side of the setting gauge peg*

Governor control lever (4 PM models)

Four stops are provided for the governor lever: they are the idling stop, starting stop, normal running stop, and maximum speed stop. The lever may be used in either position to suit the work in hand.

When the lever is pressed to the left and moved forward as far as it will go the idling position is reached. When warm the engine should run at 400-500 r.p.m. while the lever is in this position. Check the speed with a revolution counter applied to the front end of the crankshaft.

If the engine does not run at the required speed slacken the bolts securing the governor lever bracket and rotate the bracket on the forward bolt. Movement forward will reduce the engine speed and movement to the rear will increase it. Retighten the bolts when the bracket is in the correct position.

By moving the governor lever slightly to the rear the bolt head on the lever will move into position behind the bolt head on the bracket to determine the starting position of the lever.

The normal running and maximum speed stops are

Expand the circlip from the governor drive shaft and drive the shaft through the bearing.

Remove the driving gear and key from the shaft and press off the bearing.

The front bearing cannot be pressed from the drive housing until the retaining circlip is removed.

Extract the two nuts and bolts and remove the cover-plate and driven gear.

The bobweights are pivoted on the lugs of the drive shaft on two spindles carried at each end by 11 needle rollers. The spindles are retained in the drive shaft lugs by two split pins which pass through the spindles and the lugs. When the split pins are removed the spindles can be tapped out, the rollers released, and the bob-weights removed.

Slide out the thrust bearing and spindle from the governor casing. The thrust bearing is secured to the spindle by a circlip and care should be taken not to overstrain or fracture this circlip when removing the bearing.

Take care during dismantling not to put unnecessary strain on the three governor casing lugs. Extract the four screws and remove the governor cover-plate. Raise the throttle lever to its highest point, where the tension on the springs is at a minimum, and unhook and remove the springs.

Raise the throttle lever until the damper is out of the cylinder and disconnect the piston connecting rod from the lever.

Remove the cover-plate and joint from the damping cylinder.

The taper pins which secure the actuating lever and the fork lever to the shafts can be tapped out by using a hammer and suitable drift through the damping cylinder. Take care not to damage the walls of the damping cylinder and mark the taper pins so that they can be replaced in their original positions.

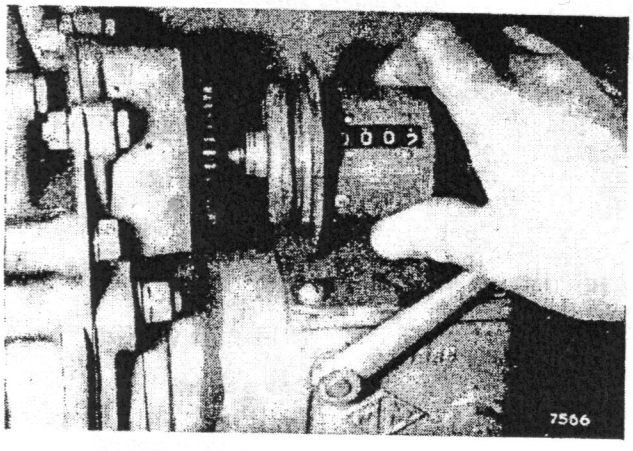


Fig. FFF.5

Withdrawing the service hour-meter from its drive housing. The hour-meter is optional equipment

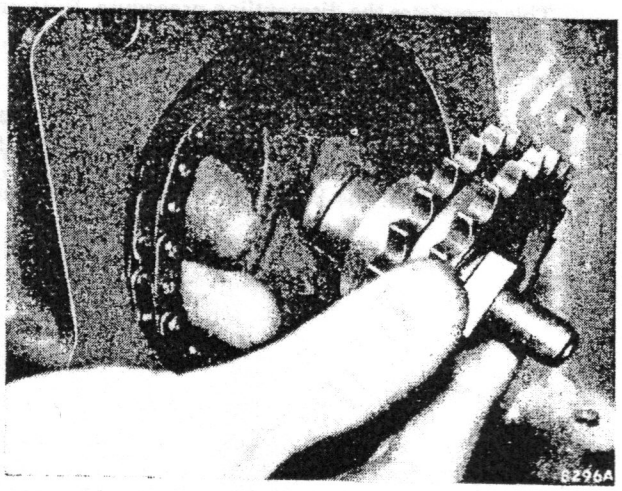


Fig. FFF.6

Withdrawing the governor chain wheel and shaft after releasing them from the front bearing housing

To remove the external levers drive out the taper pins securing them to the shafts. The shafts, bushes, and felt washers or oil seals can then be removed.

The throttle lever is a serrated fit on the shaft, and particular care must be taken when withdrawing the shaft to avoid damage to the bushes. To assist dismantling, a collar with a taper pin is fitted to the shaft and the shaft may be withdrawn with the throttle lever in position after removing the pin and collar.

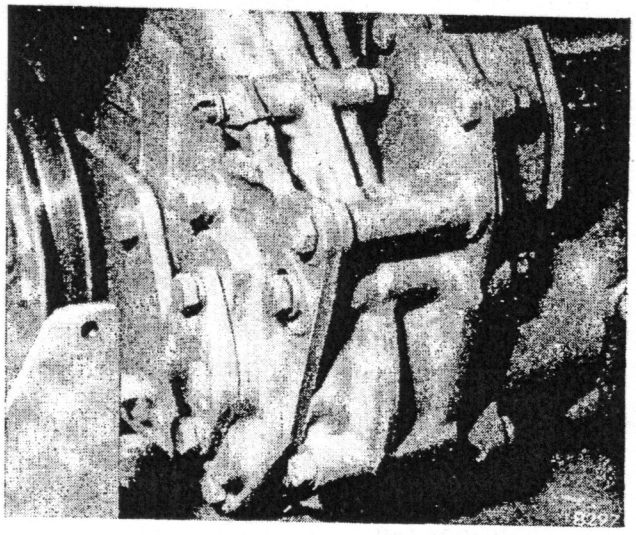


Fig. FFF.7

The front bearing housing and ratchet-type tensioner fitted to the governor

This completes the dismantling procedure. Reassembly follows the reverse of the above procedure closely, but take careful note of the following points:

(1) If new bushes have been fitted into the casing clean off any fraze before assembling the shafts.

(2) Ensure that the bobweights are an easy fit on the drive shaft and that when the shaft is held horizontally and rotated the weights fall freely.

(3) Keep the bobweights in the fully out position by means of a piece of wire and adjust the contact button so that the pad on the actuating lever just contacts the machined peg of the setting gauge 18G476 (see Section FFF.1).