TECALEMIT AUTO EQUIPMENT DIVISION

PUBLICATION TJ/1 Issue 3

TJ PETROL INJECTION MK2

AND PERFORMANCE CONVERSION SYSTEM

INSTRUCTION MANUAL

INSTALLATION AND MAINTENANCE INSTRUCTIONS

LIST OF ILLUSTRATIONS

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GENERAL DESCRIPTION AND INSTALLATION MANUAL
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INTRODUCTION

1. The T.J. petrol injection system is based on the principle of continuous injection into the induction tract of each cylinder between the throttle butterfly and the inlet valve. Complexities of timed injection are therefore avoided. The advantages of the T.J. system may be summed up as follows:

(1) Increased power output resulting from improved engine breathing. The absence of carburettor and choke permits a larger air charge per cylinder.

(2) Improved specific fuel consumption achieved by accurate fuel metering and precise distribution.

(3) Smoother engine running, particularly at low speed as all cylinders are fed with an equal fuel/air charge, quicker engine pick-up and consequently better acceleration.

2. The controlling parameters of the T.J. system which ensure that correct mixture is provided under all conditions of load and speed are:

(1) Engine speed

(2) Degree of throttle opening

The first parameter, engine speed, is provided by the Engine Driven Pulse Pump, normally operating at engine speed. The pump delivery pressure is proportional to the square of the engine speed.

The second, degree of throttle opening, is provided by the Control Unit. This is a cam operated valve, the degree of opening being determined by the angular position of the throttle to which it is linked.

The combined effect of these two units gives a linear flow characteristic for a fixed throttle opening and increased engine speed.

BASIC PRINCIPLE (Fig. 1)

3. The basic fuel injection system comprises the Engine Driven Pulse Pump (E.D.P.P.) and the Control Unit together with a junction box to split the feed between the injector nozzles. The nozzles incorporate calibrated restrictors which, when fed from a common pressure source, ensure an equal supply of fuel to each engine cylinder.

This system, however, has several shortcomings:

(1) At low engine speed the E.D.P.P. cannot raise sufficient pressure to suppress fuel vaporisation. This leads to vapour locks, incorrect fuel metering and uneven distribution.

(2) When the engine is stationary, fuel can drain back to tank resulting in difficult starting and necessitating constant fuel system bleeding.

(3) The temperature of the fuel arriving at the junction box may rise to an unsatisfactory level and may be of too high a pressure to achieve good atomisation at the injector nozzles.

(4) Fuel can pass to the cylinders before the engine is turning and produce a flooded engine, impossible to start.

Other components must therefore be added to the system to ensure easy starting and precise fuel metering throughout the power range.

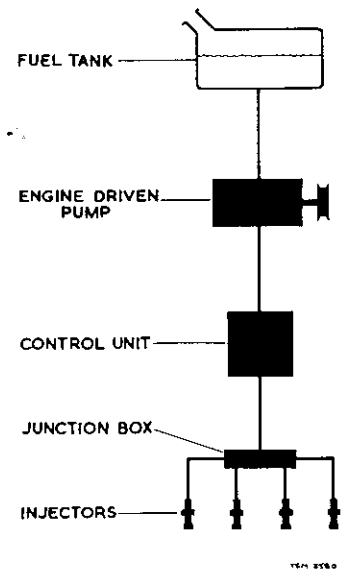

Fig. 1 BASIC PRINCIPLE

COMPLETE SYSTEM

4. With the additional control components the full system comprises :

(1) Electric Gear Pump (Fig. 3)
This raises the basic pressure of the system and overcomes the fuel vaporisation deficiency of the basic system. The pump comes into operation when the ignition is switched on, and provides the basic pressure for the system. See Fig. 2

(2) Check and Bleed Valve (Fig. 4a)
Fitted to prevent fuel draining back to the tank when the engine is stationary. It acts as a non-return valve and permits one way flow from the electric pump to the system. An internal bleed hole is incorporated to vent air which may be drawn into the pump line if the fuel tank becomes empty.

(3) Equalizing Valve (Fig. 6a)
This unit acts as a pressure reducer and passes the fuel at the correct pressure to the rail distributor.

(4) Rail Distributor (Fig. 5a)
Distributes the fuel equally between the injector nozzles.

(5) Engine Driven Pulse Pump (Fig. 7a)
Although basic system pressure is provided by the electric pump, an additional pressure component is necessary to give increased fuel metering as engine speed increases. This is one function of the E. D. P. P. The second function is to produce a signal to initiate fuel flow to the nozzles when the engine is rotated by the starter.

(6) Control Unit (Fig. 8a)
This governs the amount of fuel supplied to the engine, throughout the power range, by means of a cam operated variable orifice controlled by the accelerator pedal, thus providing maximum power compatible with good economy. Additional fuel however, is required during acceleration periods; this demand is satisfied by the inclusion of an acceleration device to supply the extra fuel when required. Cold start and quick warm up facilities are also provided, linked to the existing choke cable.

(7) Pulse and Dual Relief Valves (Fig. 10)
This assembly fulfills three functions:
(i) Controls the datum pressure of the system, see Para. 6(3).
(ii) Reacts to the pulse signal from the E. D. P. P. to allow fuel to flow to the nozzles when the starter is engaged.
(iii) Provides return to tank for surplus fuel.

(8) Filtration
Adequate filtration of all fuel passed through the system is accomplished by the insertion of three filters, one between the fuel tank and the electric pump, the second between the E. D. P. P. and the control unit and the third between the control valve and the equalizing valve.

The complete system layout is shown in Fig. 14.

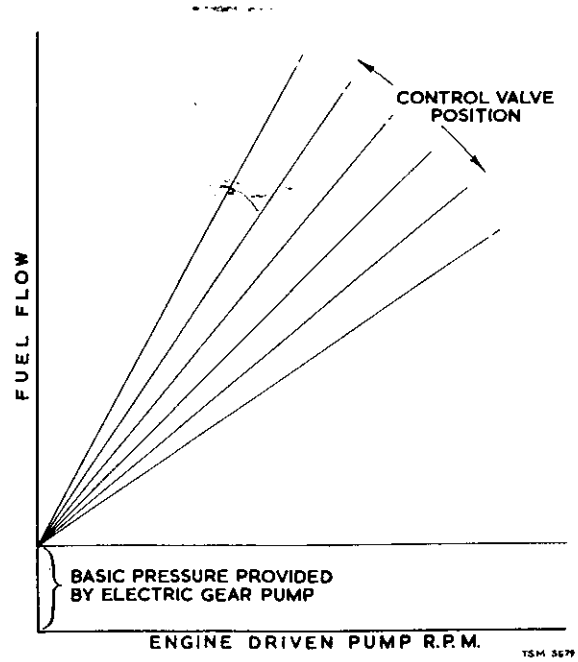

Fig. 2 FLOW CHARACTERISTIC GRAPH

(5) Engine Driven Pulse Pump - this is a rotor type pump, belt driven from the engine at engine speed and incorporating a pulse signalling device. Refer to Fig. 7b. At the ignition-on stage, fuel from the electric pump enters at (7), fills the rotor chamber and flows through a drilling into the line (8) to the Pulse and Dual Relief Valve. It also flows through a duct around the rim of the rotor and leaves the pump at (9) to the Control Unit. These pressures are equal. See Para. 6 (2). Fuel also flows through duct (10) if the rotary valve (12) of the pulse signal device is aligned, and into the diaphragm pressure receiver (11), compressing the diaphragm spring. When the engine is cranked over, the rotary valve also rotates since it is virtually an extension of the pump drive spindle, and closes the inlet (13) to the pressure receiver and opens the outlet from the receiver into the line (14) to the Pulse and Dual Relief Valve Assembly. Therefore, at all times when the engine is running a pulsating pressure signal exists in line (14). See Fig. 7c.

Rotation of the pump rotor also raises the pressure in line to the Control Unit and to the Equalizing Valve which is now composed of two components - datum pressure (see Para. 6 (3)) and E. D. P. P. pressure.

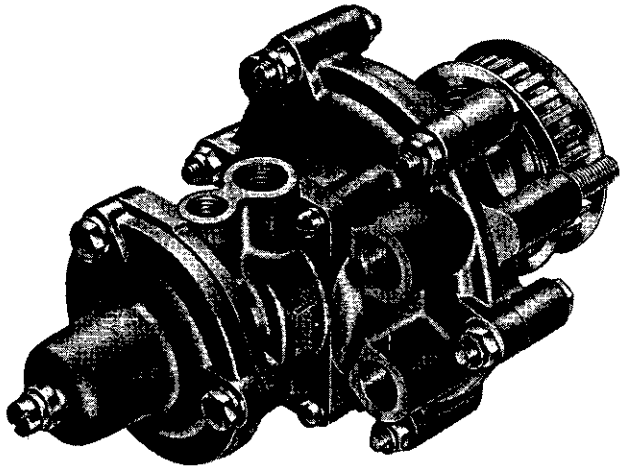

Fig. 7a ENGINE DRIVEN PULSE PUMP

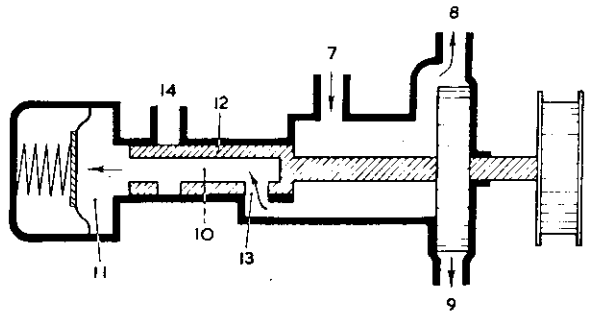

Fig. 7b ENGINE DRIVEN PULSE PUMP, FUNCTIONAL DIAGRAM

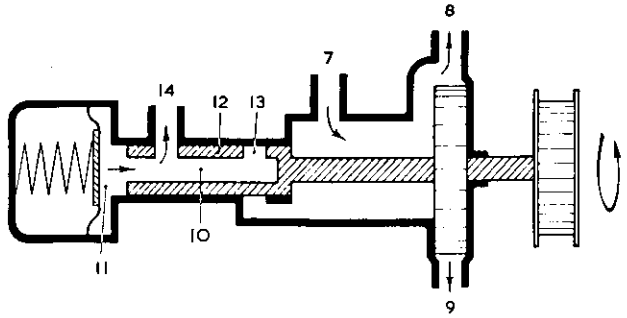

Fig. 7c ENGINE DRIVEN PULSE PUMP, FUNCTIONAL DIAGRAM

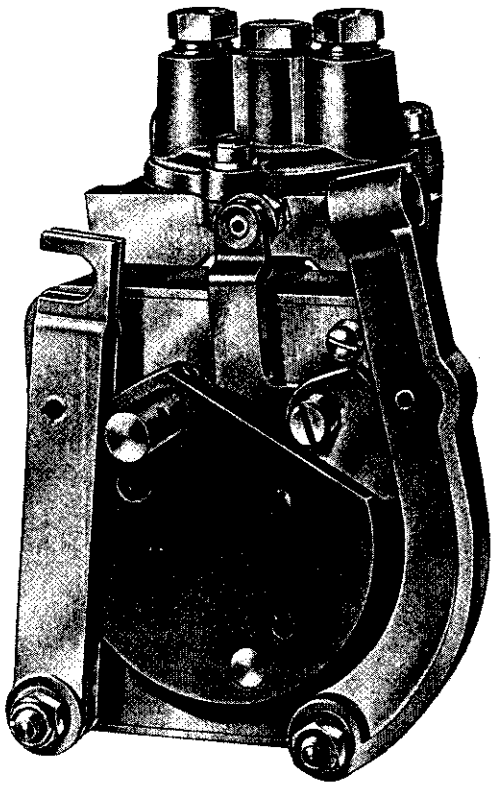

Fig. 8a CONTROL UNIT

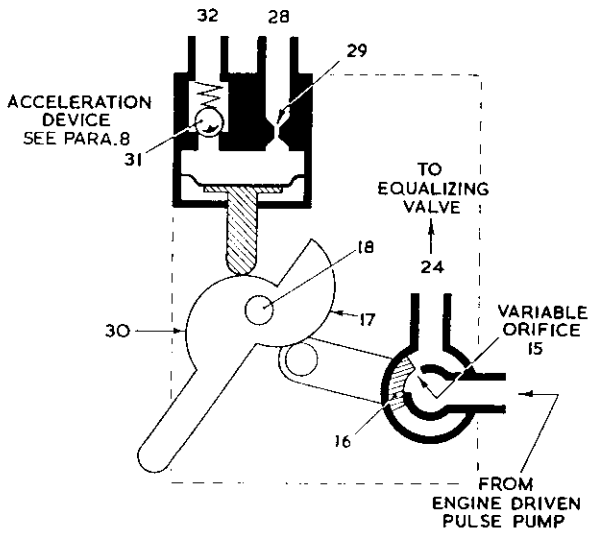

Fig. 8b CONTROL UNIT, FUNCTIONAL DIAGRAM

(6) Control Unit (Fig. 8b) - this unit controls the amount of fuel metered to the engine, and incorporates a variable orifice (15). For any given engine speed, the fuel flow is determined by the degree of opening of the orifice. The unit comprises a rotary sleeve valve (16) operated by a cam (17) mounted on a shaft (18) which is directly linked to the accelerator pedal. On the outside of the unit at one end of the shaft an eccentric cam form is fitted, see Fig. 12a. This operates a lever attached to the inner cable linking the control unit to the throttle spindle. Another lever supports the cable outer cover. The geometry of the eccentric and lever arrangement produces a differential movement between eccentric cam and the throttle butterflies to give accurate control at small throttle openings. Towards full open position control is less sensitive.

Thus for any given throttle opening the cam will be rotated and the sleeve valve orifice (15) positioned

COMPONENT OPERATION

5. The following paragraphs describe, briefly, the operation of each unit, building up to complete system operation. See Para. 6 and Figs 11a and b.

(1) Electric Gear Pump - a conventional spur gear type pump, draws fuel from the tank through an element filter and delivers it to the system where it first passes through the check and bleed valve.

The sensitivity of the pump is such that slight voltage variations may affect fuel flows through the engine driven pump. To prevent this a D.C. voltage stabilizer is installed between the vehicle's electrical system and the fuel pump. This governs the power supply to the pump at 11 volts.

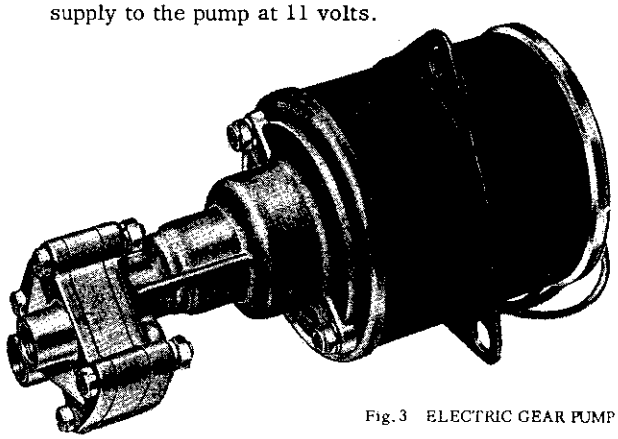

Fig. 3 ELECTRIC GEAR PUMP

(2) Check and Bleed Valve - a diaphragm non-return valve. Referring to Fig. 4b fuel from the electric pump enters at (1) and becomes effective over the large area of the diaphragm, opens it against spring pressure and flows from outlet (2). Back pressure from the system can only be effective on the smaller surface area of the diaphragm and is unable to open the valve. A through drilling in the check and bleed valve casting is utilized as a return for fuel surplus to system requirements and has no effect on the operation of the valve. A small bleed hole (3) is drilled between this return duct and the pressure side of the diaphragm to allow any air induced in the pump line to be vented to the tank.

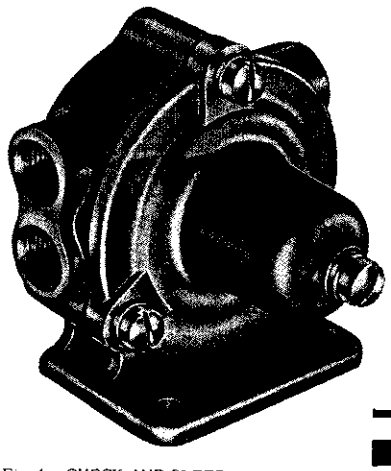

Fig. 4a CHECK AND BLEED VALVE

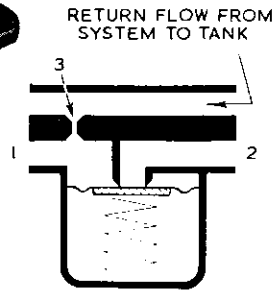

Fig. 4b CHECK AND BLEED VALVE, FUNCTIONAL DIAGRAM

(3) Rail Distributor

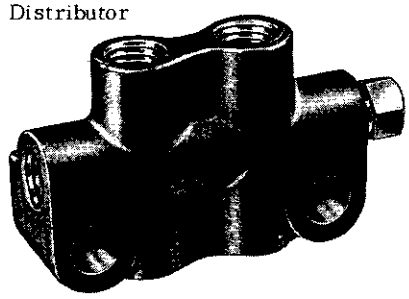

Fig. 5a RAIL DISTRIBUTOR

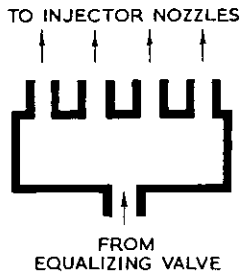

Fig. 5b RAIL DISTRIBUTOR, FUNCTIONAL DIAGRAM

(4) Equalizing Valve - this contains a diaphragm which controls the fuel supply to the injector nozzles in response to fuel pressures acting on the upper side of the diaphragm, see Fig. 6 b. The diaphragm is supported on the underside by a spring, the setting of which is slightly higher than basic pressure.

With the ignition switched on and the system pressurised by the electric pump the diaphragm remains closed, since the pressure entering at (4) from the control unit is basic pressure and the spring retains the diaphragm on its seat.

As the E.D.P.P. commences rotation a pressure pulse signal from the E.D.P.P. to the pulse relief valve initiates a pressure rise in the fuel entering the equalizing valve at (4) which is sufficient to open the diaphragm and allow fuel to pass to the nozzles via outlet (5).

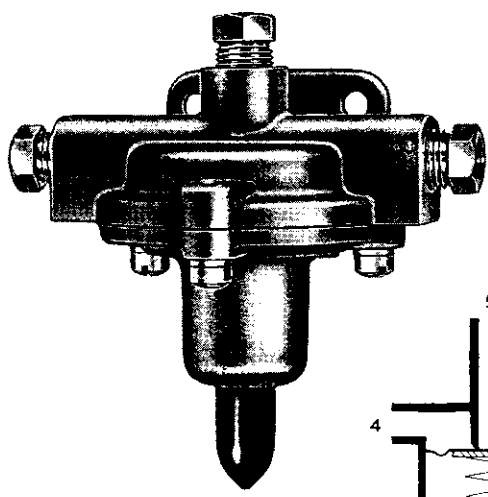

Fig. 6a EQUALIZING VALVE

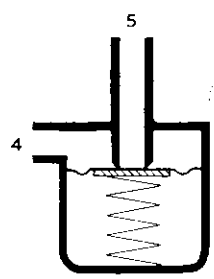

Fig. 6b FUNCTIONAL DIAGRAM

T.J. PERFORMANCE CONVERSION

idle adjust at 1000 RPM rate control box shut off
Grease tap

NOZZLES

JUCTION BLOCK ②

SINGLE 18 P.S.I. RELIEF VALVE

FUEL TANK

BENDIX PUMP 30 gall per hr circulate

RELIEF VALVE ②

out to tank

SWIRL POT

OUT IN

CONTROL UNIT

TO CONTROL BOX.

SUPPLY IN.

ENGINE DRIVEN PUMP

ELECTRIC PUMP

(FLAT FACE UPWARDS)

MAIN RESTRICTOR 14 8 Bart as bed
For regulation over whole range
42 45 48 supplied extra

CRANK PULLEY

CHECK + BLEED VALVE

DEV 1061/62

(7) Injector Nozzles - when the fuel system has reached a condition where the equalizing valve diaphragm is open, permitting fuel to pass to the injectors, it is essential that this fuel be accurately apportioned between the cylinders.

To accomplish this each injector nozzle is fitted with a calibrated capillary tube, see Fig. 9b. When fed from a common pressure source these capillary tubes deliver equal amounts of fuel. It should be noted that the end of the capillary is set back from the nozzle tip. If it were flush with the tip it would be subjected to full manifold depression causing a high pressure differential across the tube under idle and part throttle conditions. This would upset the flow characteristics of the system.

When the tube is set back as shown an annular air space is formed. This allows air to be drawn from the atmospheric side of the throttle butterfly through a transfer hole in the manifold casting to the nozzle pocket. Air is then drawn from the nozzle pocket through the annular air space via the two holes in the nozzle body.

The effect of this bleed action reduces the depression at the end of the capillary tube to a few inches water gauge pressure, even when the manifold depression is approaching 20" Hg.

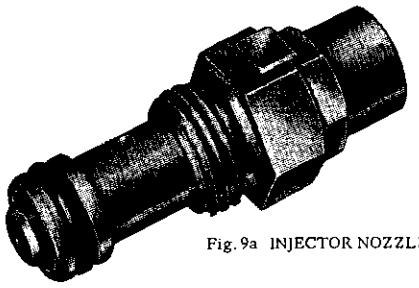

Fig. 9a INJECTOR NOZZLE

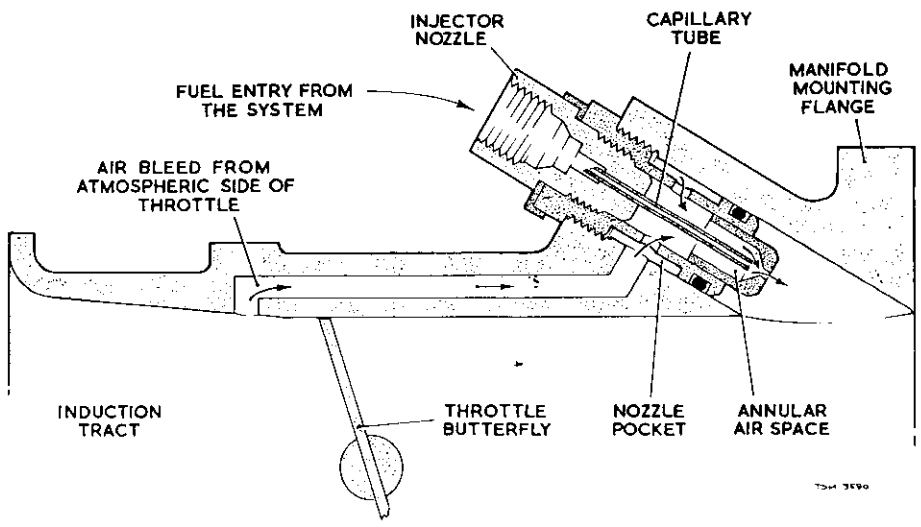

Fig. 9b INJECTOR NOZZLE, SECTION VIEW

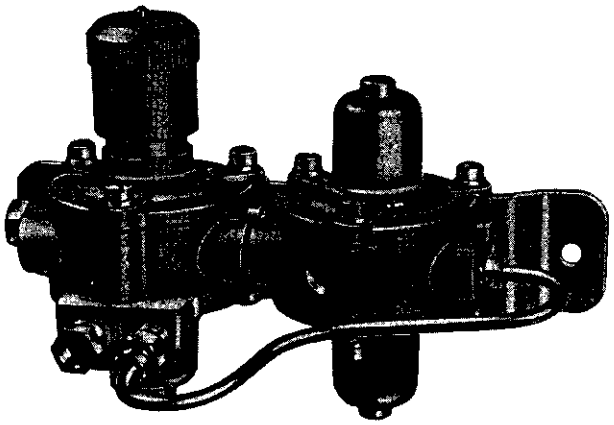

Fig. 10 PULSE AND DUAL RELIEF VALVE ASSEMBLY

(8) Pulse and Dual Relief Valve - this assembly comprises two valve units linked together and mounted on a common bracket. In order to understand the operation of this assembly it is necessary to consider the system as a whole, referring to Figs. 11a and 11b, as follows.

SYSTEM OPERATION

6. Ignoring cold starting, warm up and acceleration conditions which are covered fully in subsequent paragraphs, system operation passes through two stages :-

PRIMARY STAGE. Ignition on - engine stationary

SECONDARY STAGE. Ignition on - engine turning via the starter to the idling speed condition.

Primary Stage (Fig. 11a)

(1) When the ignition is switched on, the electric pump draws fuel from the tank through a filter and discharges it into the system under pressure. This fuel passes through the check and bleed valve described in Para. 5 (2), to the inlet (7) of the E.D.P.P. Fuel leaves the E.D.P.P. through two outlets, see Para. 5 (4), one line (9) to the control unit via a disc type filter, the other via line (8) to the Pulse and Dual Relief Valves.

This assembly comprises two diaphragm valves, one being the Pulse Unit, the other, the Relief Valve Unit. The Pulse Unit incorporates two opposed, spring loaded diaphragm valves. The upper (19) is adjustable, the lower (20) fixed. Fuel entering at (21) is effective, through a common duct, on both diaphragms. As pressure builds up, both valves open. Fuel pressure is now effective through a small bleed hole in diaphragm (19) supporting the spring pressure and thus closing the valve. Therefore, the load holding diaphragm (19) closed is pressure entering through the bleed hole, plus the spring loading. The combined effort of these is greater than the load on diaphragm (20) which opens further and allows fuel to flow to the Relief Valve Unit.

This unit also consists of two opposed spring loaded diaphragms, the upper (22), being the main relief valve which controls the basic pressure of the system. Fuel passing through diaphragm (20) builds up pressure until the setting of diaphragm (22) is achieved. This then opens and allows fuel to pass into the return to tank line (23).

A pressure known as BASIC pressure now exists throughout the system equal to the setting of diaphragm (22).

(2) Reference to Fig. 11 (a) shows that this pressure is effective on the upper side of the equalizing valve diaphragm via line (24) from the control valve. Since the spring supporting the diaphragm is set to a value slightly higher than basic pressure the diaphragm remains closed and no fuel can pass to the rail distributor. The system is now pressure primed ready for starting.

Secondary Stage (Fig. 11b)

(3) When the starter is engaged and the engine turns, the E.D.P.P. also rotates. Immediately, a pulse pressure signal is transmitted via the E.D.P.P. pulse signal line (14) to the Pulse and Dual Relief Valve as described in Para. 5 (4). Entering the Pulse Unit at (25) on the spring side of diaphragm (20) the combined effort, spring plus pulse pressure, closes the diaphragm valve. Fuel pressure entering at (21) now has to overcome the forces holding diaphragm (19) closed. As stated in Para. 6 (1) these forces comprise adjustable spring pressure plus basic fuel pressure entering through the bleed hole in the diaphragm.

When pressure builds up to this setting and diaphragm (19) opens a pressure known as DATUM pressure exists upstream of (19). Referring to Fig. 11b it can be seen that datum pressure is now applied to the upper side of the equalizing valve diaphragm whereas the pressure on the underside is still only as determined by the spring which is slightly higher than basic pressure but LESS than datum pressure. Therefore fuel at datum pressure is sufficient to open the equalizing valve and pass via the injector nozzles to the engine.

Assuming the engine to be running normally the constant pulses of fuel pressure entering the pulse unit at (25) must have a relief circuit. The fuel passes from the pulse diaphragm chamber, via a restrictor and line (26) to the secondary relief valve chamber. When pressures here exceed the spring setting, diaphragm (27) opens and relieves excess pulse pressure into the tank return line (23).

The relief valve assembly is also used as a convenient fuel supply source for the accelerator valve via line (28). This has no effect on the operation of the Pulse and Dual Valve Assembly.

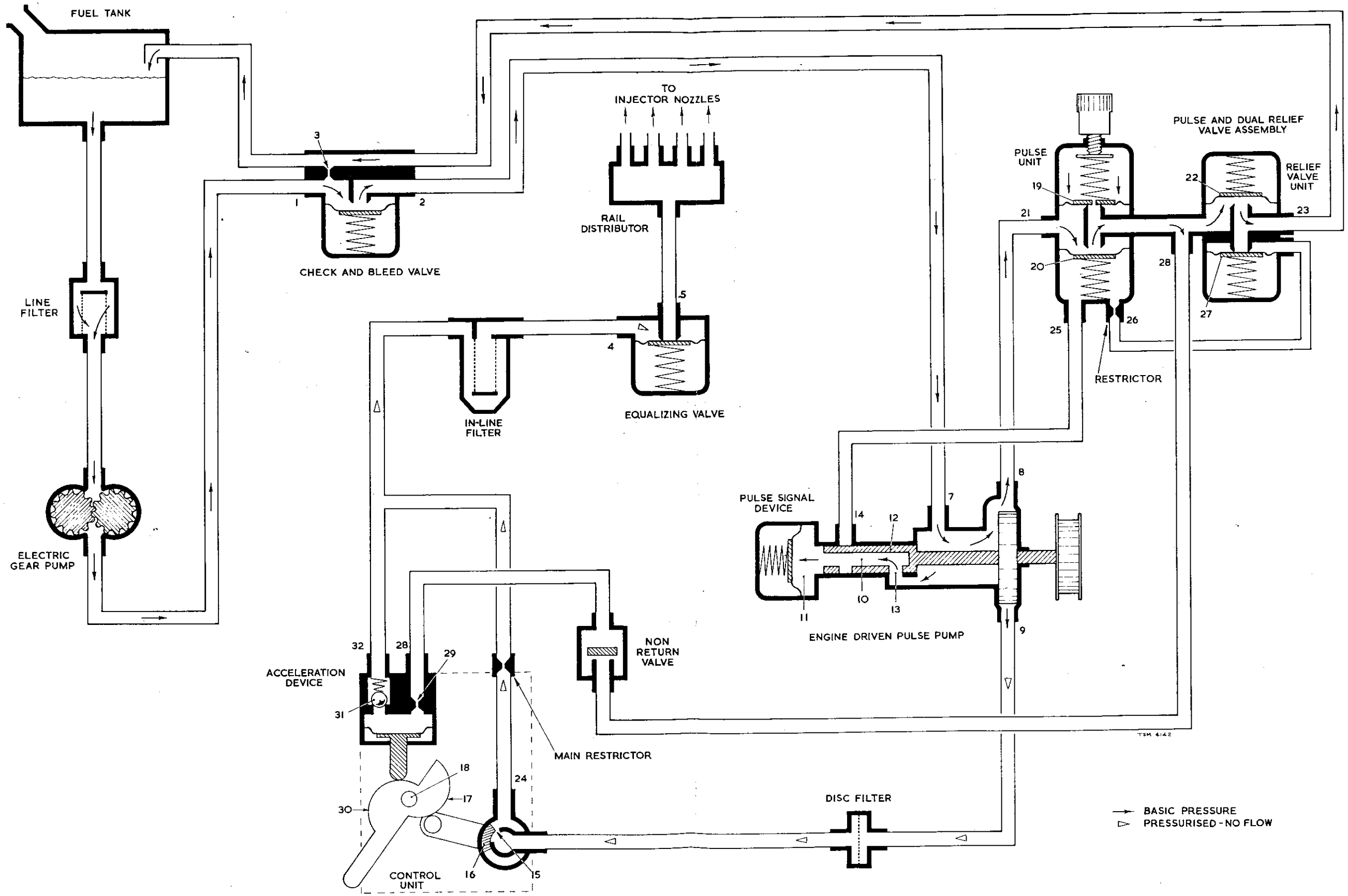

Fig.11a COMPLETE SYSTEM, PRIMARY STAGE, FUNCTIONAL DIAGRAM

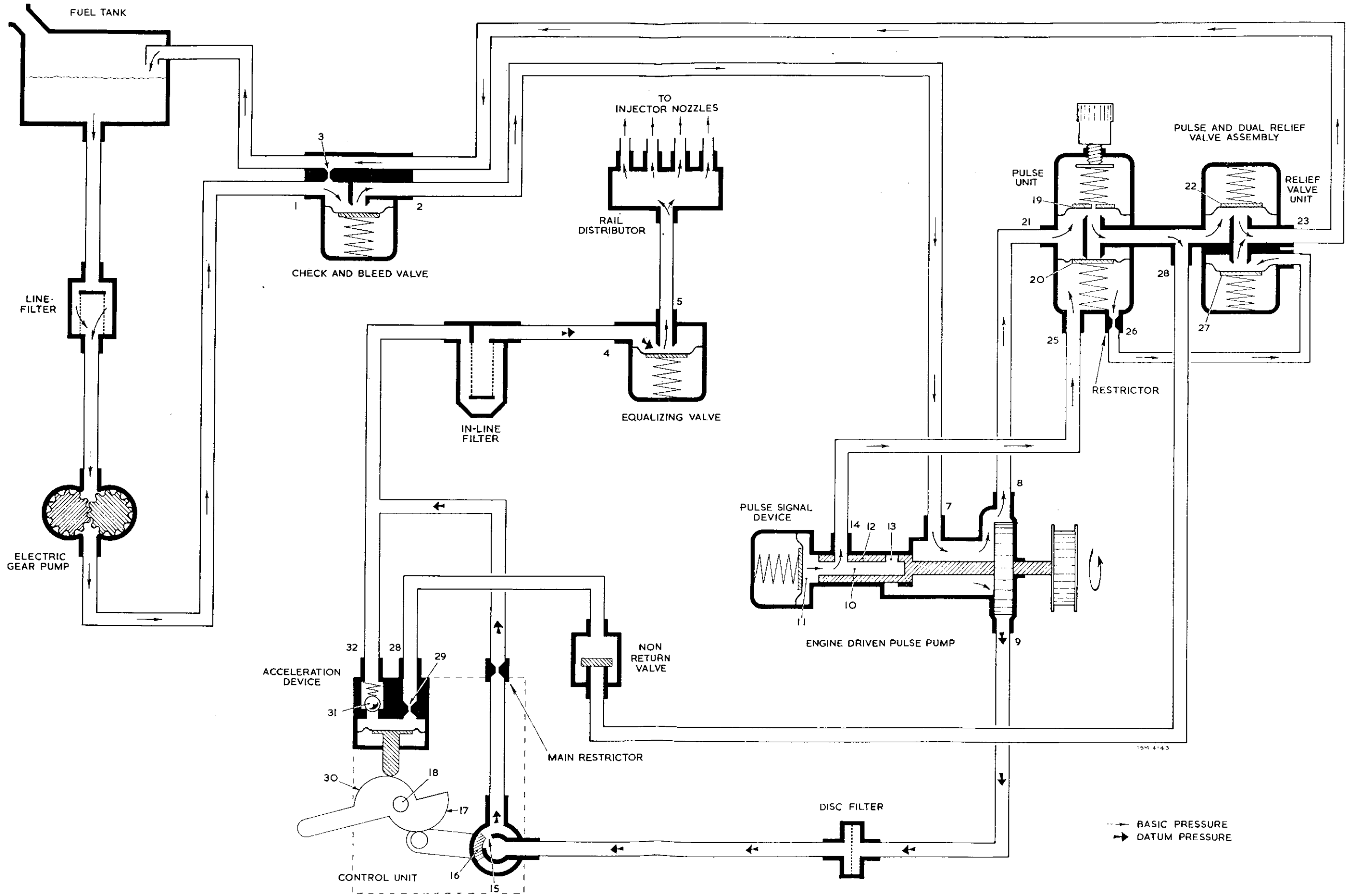

Fig. 11b COMPLETE SYSTEM, SECONDARY STAGE, FUNCTIONAL DIAGRAM

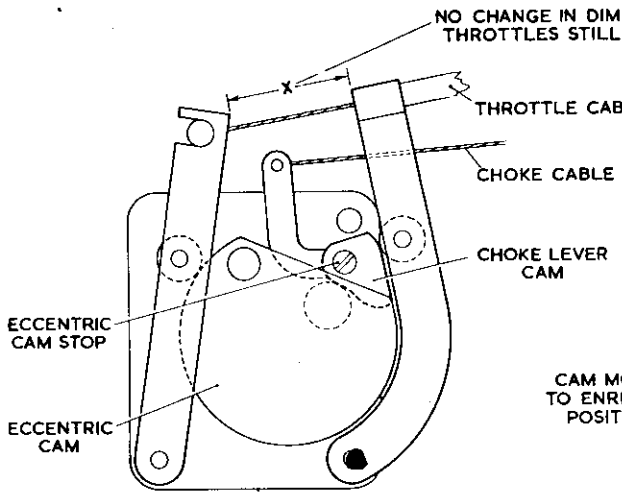

Fig. 12a STATIC PRE-START POSITION

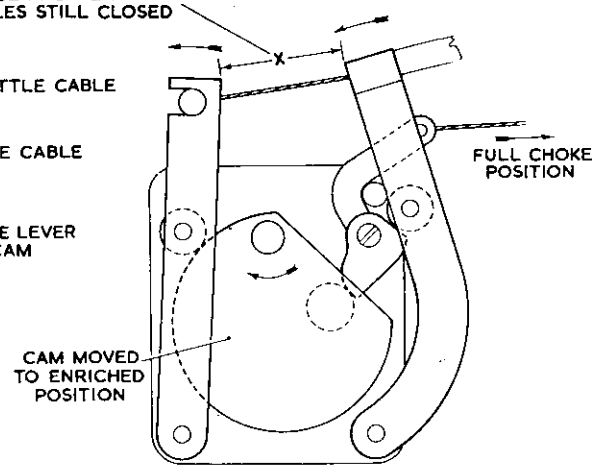

Fig. 12b COLD START POSITION

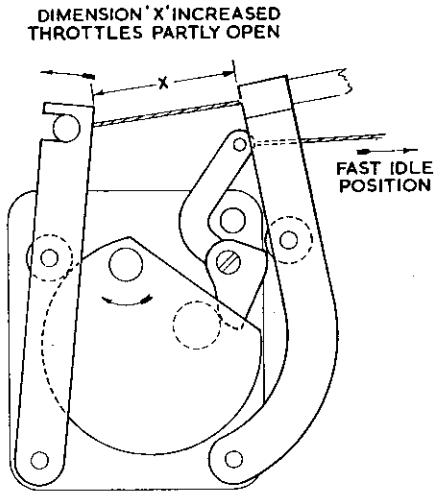

Fig. 12c FAST IDLE POSITION FOR QUICK WARM UP

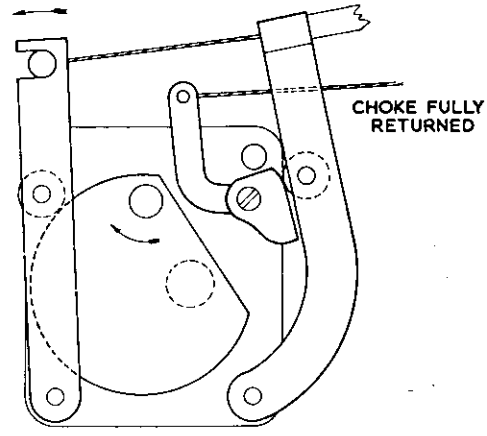

Fig. 12d NORMAL RUNNING ABOVE IDLE SPEED

COLD START AND FAST IDLE

7. For cold start purposes, an additional lever is mounted on the Control Unit to which the vehicles choke cable is attached. The lower end of this lever carries a cam which, when the control unit levers are in the normal pre-start position, bears against a roller mounted on the rear face of the eccentric cam. Another roller carried by the throttle cable outer cover support lever also bears against the choke lever cam.

The geometry of these cams and levers is such that when the choke cable is pulled to its full extent the choke lever cam takes up the position shown in Fig. 12b, the eccentric has been partially rotated, opening the variable orifice but no appreciable opening of the throttle butterflies has occurred; a rich position has now been set for starting.

When the engine has started and the choke allowed to return until the choke cam takes up the position shown in Fig. 12c, the variable orifice will be reduced to a less rich position but the throttle butterflies will be opened to a fast idle position for quick warm up.

ACCELERATION

8. Because the normal system operation provides maximum power with good economy it is necessary to provide additional fuel during periods of acceleration.

This is accomplished by means of the cam operated diaphragm valve mounted on the Control Unit. See Fig. 11a. Fuel from the Relief Valve Assembly of the Pulse & Dual Relief Valve is fed into the acceleration valve diaphragm chamber through a small drilling (29). When the throttle is snapped open cam (30), mounted on the throttle lever shaft (18) forces the diaphragm upwards, reducing the chamber volume. The pressure increase is sufficient to lift the outlet non-return valve ball (31) off its seat. Fuel is then discharged into line (32) to the equalizing valve at (6), providing additional fuel for acceleration.

A non-return valve is interposed in the line, between the Pulse and Dual Relief Valve and the inlet to the acceleration valve to prevent any reverse flow through the small entry hole.

INSTALLATION

9. General

(1) Cleanliness of components, work areas and tools is of the utmost importance when installing TJ petrol injection equipment. All components must be kept in dust-proof containers until actually required.

(2) All piping must be routed and clipped well clear of the exhaust system and where it passes through bulkheads or panelling protective grommets must be employed.

(3) Sharp bends likely to develop kinks must be avoided.

(4) Blanking plugs should be left in position until final connections are made.

(5) A nylon tube assembly tool, Part No. AT 86133, is available from Tecalemit (Eng.) Ltd. This permits end fittings to be assembled in situ.

10. Electric Gear Pump

(1) This is mounted close to the fuel tank in a protected but ventilated position. Whenever possible the pump should be below the level of the tank with the outlet connection uppermost. See Fig. 13.

(2) Avoid installation on part of the bodywork which may act as a sounding board.

(3) Pump connections are marked IN and OUT. The existing take off from the tank is coupled to the IN connection with the line filter supplied, interposed between tank and pump.

11. Voltage Stabilizer Unit

(1) This should be mounted in the engine compartment in the coolest accessible place, i.e. side wing valance adjacent to front bulkhead.

(2) Connect the pump into the vehicle's electrical system at a point that is:-

(a) Alive only when the ignition is on and also when the key is turned in the start position.

(b) Does not suffer a severe voltage drop when the starter motor is engaged.

(3) Connect wiring from voltage stabilizer unit to electric pump, see wiring diagrams, Fig. 18.

WARNING: Always complete the wiring from the voltage stabilizer to the electric pump before making the live connection from the stabiliser unit into the ignition switch.

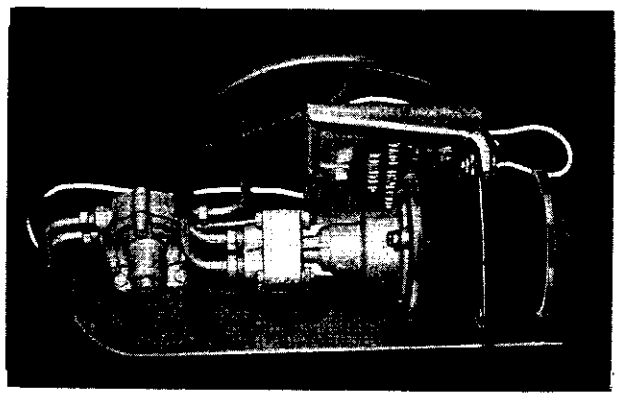

Fig. 13 INSTALLATION OF ELECTRIC GEAR PUMP AND CHECK AND BLEED VALVE

12. Check and Bleed Valve

This valve is fitted adjacent to the electric pump with the valve dome pointing downwards. Connections can be determined from the piping circuit, Fig. 14.

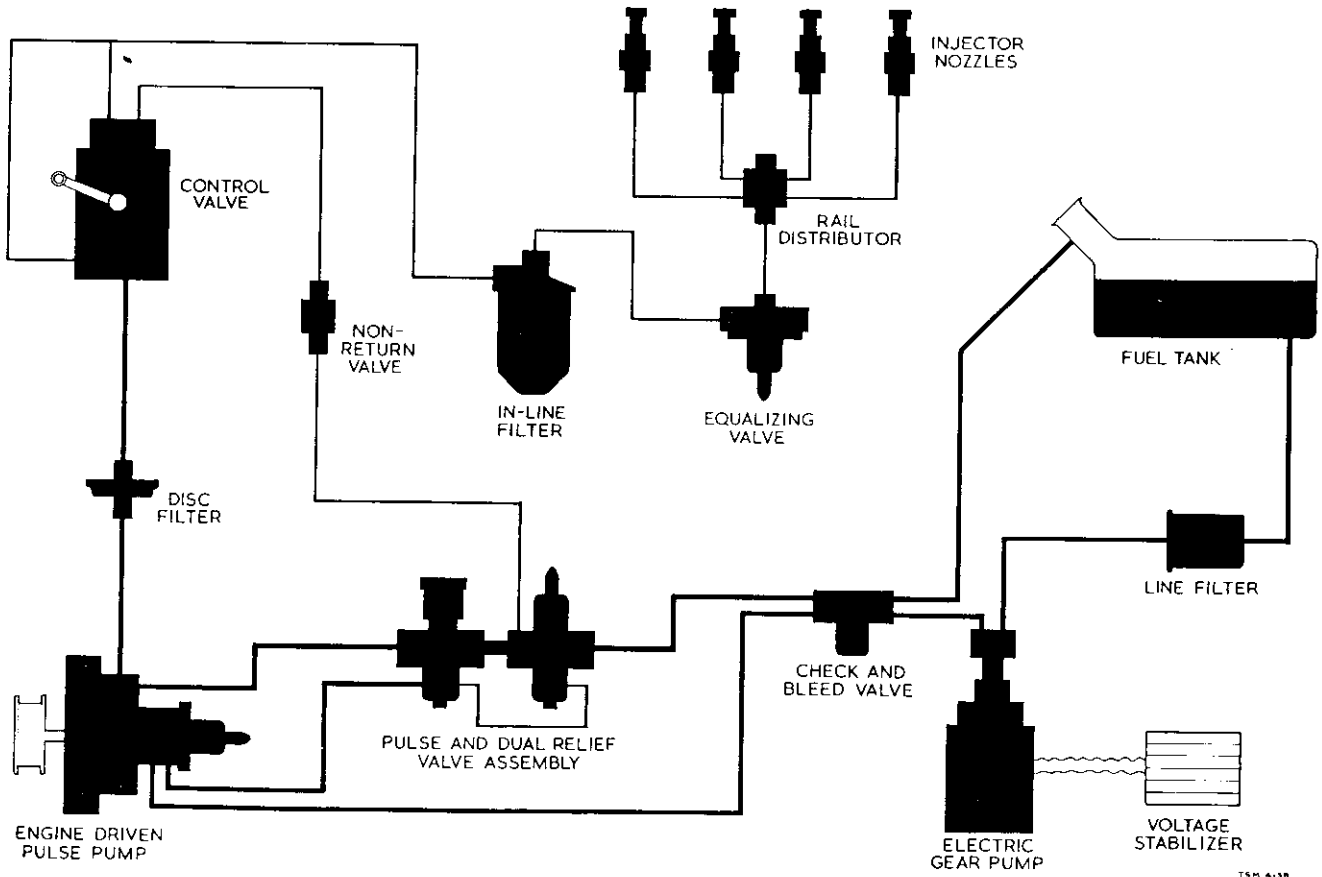

Fig. 14 PIPING CIRCUIT

13. Return to Tank Connection

To avoid drilling holes in the fuel tank the return line is normally connected to the tank filler pipe. This requires one hole to be drilled and a connector installed. To prevent spillage the connection should be as far from the filler cap as possible. See Fig. 15.

If the tank is vented through the filler cap ascertain that it vents in both directions. If only one way, a $\frac{1}{8}$ in (3 mm) hole should be drilled in the vent valve.

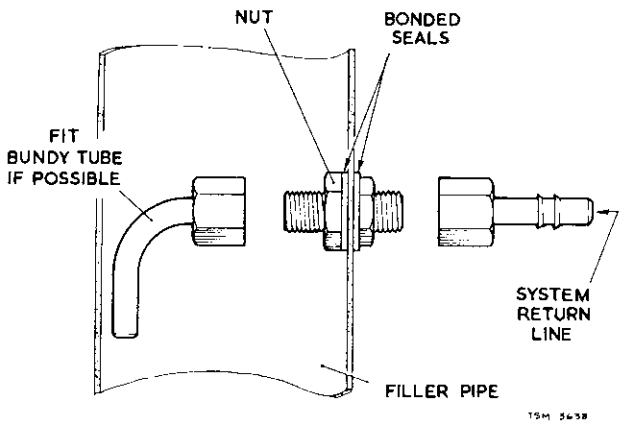

Fig. 15 RETURN TO TANK CONNECTION

14. Engine Driven Pulse Pump

(1) The E.D.P.P. is mounted at the front of the engine on a bracket provided, with the outlet connection at the highest point.

(2) Direction of rotation of the pump must be clockwise when viewed from the driving pulley end.

(3) The crankshaft pulley retaining nut or bolt must be removed and the drive pulley and bolt, Fig. 16, fitted in its place.

If the engine is to be used at speeds in excess of 6000 r.p.m. for prolonged periods a crankshaft pulley to pump pulley ratio is selected which will reduce the maximum pump speed to 6000 r.p.m. This is determined at the factory and must not be changed.

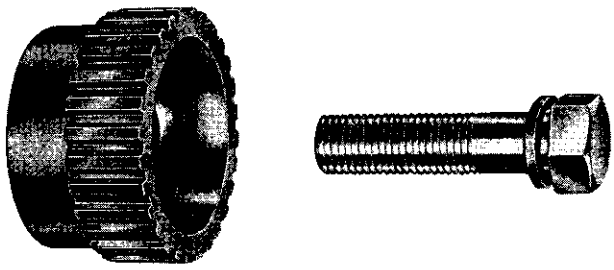

Fig. 16 CRANKSHAFT DRIVE PULLEY

(4) The drive belt between the two pulleys must not be over-tensioned. When correctly fitted there should not be less than $\frac{3}{8}$ in. - $\frac{1}{2}$ in. (10 - 13 mm) lateral movement of the belt.

15. Fan Spacers

Installation of the crankshaft pulley and adaptor sometimes moves the fan belt pulleys out of alignment. If this arises, spacers should be fitted behind the fan to move it forward. Ensure that the existing bolts are still long enough to secure the fan, replacing them if necessary.

16. Pulse and Dual Relief Valve Assembly

Unless specific instructions are given, this assembly should be bolted to the inside of the wheel arch close to the E.D.P.P. It must be positioned so that the knurled adjusting knob is easily accessible, noting that the engine will be running and hot when adjustment at this point is necessary.

17. Control Unit

This unit should be positioned such that most of the existing accelerator linkage can be used without modification. This is largely determined by available space and bonnet line.

18. Equalizing Valve

This is normally supplied mounted on a bracket already fitted to the manifold block carrying the throttle bodies.

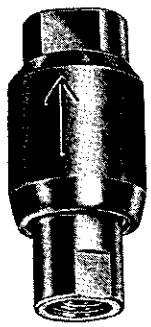

Fig. 17 NON-RETURN VALVE

19. Non-return Valve

This valve is positioned in the line between the dual valve assembly and the inlet to the acceleration device. Direction of flow is indicated by an arrow on the valve body and it is essential to correct operation that it be fitted with this arrow pointing vertically upwards. See Fig. 17.

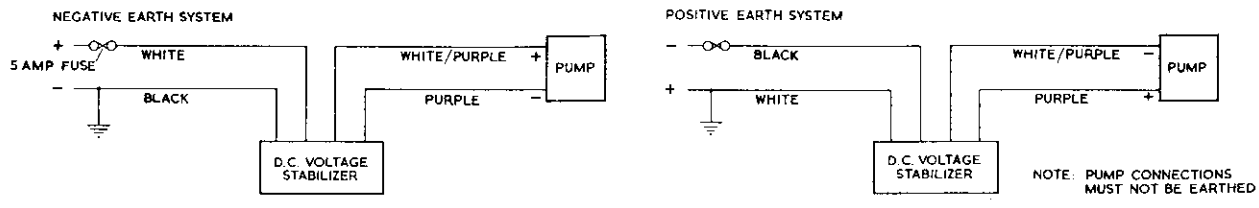

Fig. 18 VOLTAGE STABILIZER - WIRING DIAGRAMS

POST INSTALLATION - PRELIMINARY ADJUSTMENT

20. Refer to Fig. 19 and proceed as follows:-

(1) Foreign matter, metallic particles etc., may enter the fuel system during installation work in spite of the most stringent precautions. It is therefore imperative that the fuel system be flushed before commencing any post installation adjustments, as follows:-

(a) Disconnect both feed pipes into pressure equalizing valve and lead the pipes into a 1 gallon measure.

(b) Switch on the vehicle's ignition and allow a minimum of half gallon of fuel to be pumped through the system into the measure. Switch off the ignition and reconnect the two pipelines to the equalizing valve.

(c) Switch on the ignition and bleed air from both pipelines by slackening the connections and tightening up when air free fuel emerges.

(2) Disconnect the cable (Control Unit to throttle butterflies) and unscrew the idle stop screw fully. Adjust the screw on the fork linkage between the throttle bodies until the spring loaded plunger below the screw (with spade lever between) is in the mid position. Slacken the clamp bolt on one of the levers and fully close the butterflies, re-tighten the clamp bolt. Adjust the idle stop screw to just open the butterflies and reconnect the cable, adjust cable throttle body end to give a small amount of slack. Screw in all air balance screws until they just contact their seats.

(3) Start the engine and run it at approximately 1000 r.p.m. Connect an air flow meter (Uni-Sync.) and adjust the air bleed screws to obtain the same meter reading from each pair of throttle bodies. Obtain the same meter readings on each pair of throttle bodies using the adjusting screw on the fork linkage between the units. Recheck the readings from all intakes and trim finally on the air bleed screws if necessary.

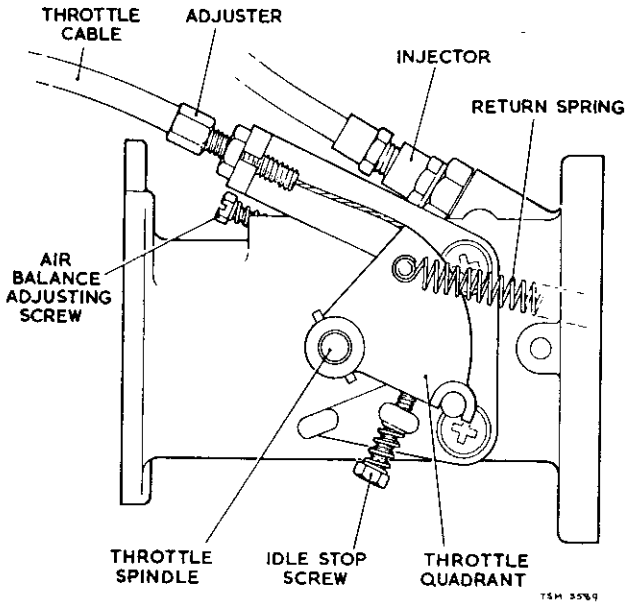

Fig. 19 THROTTLE BODY - ADJUSTMENT POINTS

FINAL ADJUSTMENT

21 (a) Remove the blanking grommet from the rear of the Voltage Stabilizer unit. Connect a voltmeter across the output terminals numbers 3 and 4 (No. 3 terminal positive). Start the engine and run at approximately 2500 r.p.m., carefully adjust the potentiometer (small disc with screwdriver slot) to give an 11 volt reading.

1/16 of a turn = $\frac{1}{2}$ volt.

(b) Make up a pipe with a 'T' connection to fit between the control unit and disc filter. Connect an accurate 0-30 or 0-50 lbf/in^2 gauge to the 'T' connection.

(c) Start the engine and open the control unit 5° (.080 in. (2 mm)).

(d) Adjust the cable to give an engine speed of 1000 r.p.m. Adjust the pressure, using the knurled knob on the dual valve, until the gauge indicates the pressure given in the Initial Tuning Data, supplied with each T.J. petrol injection kit.

(e) Stop the engine, remove the gauge and 'T' connection pipe. Refit the standard pipe.

(f) Start the engine and adjust the idle stop screw to obtain correct idle speed.

(g) Adjust the throttle cable tension so that with the throttles just starting to open a .040 in. (1 mm) clearance exists between the eccentric cam on the Control Unit and its stop. See Fig. 12 a .

If this clearance exceeds .040 in. the engine will run rich over the whole operating range, if less than .040 in. it will be weak over the whole range.

When correctly adjusted ensure that the outer cable locknut is securely tightened.

FAULT DIAGNOSIS

Fault	Possible Cause	Remedy
1. Engine will not start.	(a) Lack of fuel reaching the engine	(a) (1) Check Voltage Stabilizer, see Para. 21 (a) (a) (2) Check P1 pressure, see 21 (b) to (e) inclusive. (a) (3) Disconnect all nozzle feed pipes from the nozzles. Hold them below the level of the equalizing valve while the engine is being turned over. If there is no fuel discharge from the pipes and nozzles are not blocked proceed as follows:- (i) Check that the electric pump is running. Examine the tank to pump line for presence of air which indicates either a blocked line filter or fuel level in tank below the take off pipe. (ii) Slacken one of the end connections to the rail distributor. With the pump running, a strong flow of fuel should emerge. If the flow is weak, examine piping between pump and rail distributor for crimping. If piping is satisfactory, renew the electric pump (iii) Disconnect the pulse signal connection at the Pulse Unit. If, with the electric pump running, a continuous flow of fuel emerges from the open connection of the Pulse Unit, the diaphragm is punctured and the Pulse and Dual Relief Valve must be removed. If a flow of fuel as above does not occur, crank the engine. If there is no pulsating discharge from the pulse signal pipe the engine driven pump is faulty and must be renewed. (iv) Remove the line filter between E.D.P.P. and the Control Unit. Renew the filter if necessary. (v) Remove the main restrictor and inspect for blockage. Blow through using an air line or copper/brass wire probe. See Fig.11 a (vi) If fuel is being delivered to the Control Unit but discharge is very small and does not increase as the valve is opened, remove it from the vehicle and detach the flat cover. Check that the roller arm return spring is still in place and that the roller follows the fuel cam. If satisfactory in this respect renew the Control Unit. Also renew the unit if the roller fails to follow the cam. DO NOT ATTEMPT TO FREE THE VALVE SPINDLE IN THE HOUSING.
	(b) Excessive fuel wetting the sparking plugs.	(b) Inspection of the plugs will indicate over-fueling. To isolate the cause proceed as follows:- (i) Disconnect the pulse signal pipe from the E.D.P.P. at the Pulse Unit. If, when the electric pump is on, there is a continuous fuel flow from the pipe renew the E.D.P.P. (ii) Remove the 5/32 in. bundy tube from the Pulse and Dual Relief Valve Assembly. If, with electric pump on and engine being cranked over, no fuel is emitted from the restrictor fitted in the Pulse Unit outlet in the 'bundy' line, the restrictor should be removed and cleaned. See Figs.11 a and b .

Fault	Possible Cause	Remedy
2. Engine starts but idles irregularly.	(a) Induction manifold air leaks.	(a) (1) See Fault 1, Remedies (a) (1) and (2). (a) (2) Examine for signs of leakage - renew gasket as necessary.
	(b) Unbalanced air supply to cylinders.	(b) Check, using uni-sync equipment. Adjust as required. See Para. 20 (3).
	(c) Uneven distribution of fuel.	(c) (1) Usually due to a blocked nozzle, evidenced by one sparking plug indicating weak mixture while the remainder show a stage richer. Remove and clean the nozzle, renew at earliest opportunity. Note: Replacement nozzle MUST bear the same number as this indicates the flow range. (c) (2) If one plug indicates a richer mixture than the others a restricted air bleed to the nozzle tip is indicated. This can be confirmed by placing a finger over the nozzle air bleed hole on the atmosphere side of the throttle butterfly. If the nozzle bleed is blocked this will have little effect on the running when compared with the 'stumble' resulting from doing the same thing to a 'good' cylinder. To prove the fault interchange the suspect nozzle with one from another cylinder. If the fault follows the nozzle it should be renewed. If the fault remains with the same cylinder remove the manifold and blow through the nozzle bleed passage. On refitting the manifold the fault persists, change the manifold.
3. Engine starts and idles but stalls when accelerator pedal is depressed.	(a) Cable link between Control Unit and throttle spindle out of adjustment.	(a) (1) See Fault 1, Remedies (a) (1) and (2). (a) (2) Re-adjust cable - see Para. 21 (g).
	(b) Fuel blockage or Control Unit fault.	(b) Check as Fault 1, Remedy (a) (3), (iv) and (v).
4. Heavy fuel consumption.	(a) Fuel leak.	(a) (1) See Fault 1, Remedies (a) (1) and (2). (a) (2) Carefully examine the complete system for signs of leakage.
	(b) Throttle cable out of adjustment.	(b) Check and re-adjust cable as necessary - See Para. 21(g).
5. Engine lacks power and plugs indicate a weak mixture.	(a) Restriction in fuel supply.	(a) See Fault 1, Remedies (a) (1), (2) and (3) (iv), (v) and (vi).
	(b) Acceleration device faulty.	(b) Disconnect the feed from the Dual Relief Valve assembly to the acceleration device at the Control Unit. Plug the Dual Relief Valve connection. Renew the acceleration device if fuel flows from the inlet connection.

Fault	Possible Cause	Remedy
6. Engine slow to pick up on acceleration.	(a) Snail cam below acceleration device not operating.	(a) (1) See Fault 1, Remedies (a) (1) and (2). (a) (2) Check that cam securing pin has not sheared - that cam rotates with its spindle and raises the ball follower.
	(b) Faulty acceleration device.	(b) Disconnect the line between acceleration device and the distributor at the distributor. With the electric pump running operate the accelerator pedal and ensure that a discharge of fuel occurs from the disconnected pipe. If there is no discharge renew the acceleration device.
7. Engine difficult to start when hot.	Dual Relief Valve assembly defective.	See Fault 1, Remedies (a) (1) and (2).

APPENDIX 1

THE T.J. PERFORMANCE CONVERSION SYSTEM

DESCRIPTION

1. The basic metering parameters of the performance conversion system are the same as for the T.J. Mk.2 system. See Instruction Manual TJ/1 para.2.

The complete system comprises:

(1) Electric Gear Pump - see paras. 4(1) and 5(1).

(2) Check and Bleed Valve - see paras. 4(2) and 5(2).

(3) Rail Distributor - see paras.4(4) and 5(3).

(4) Control Unit - see paras. 4(6) and 5(6).

(5) Engine Driven Fuel Pump - Although the basic system pressure is provided by the Electric Fuel Pump, an additional pressure component is required to give increased fuel metering as engine speed increases. An additional filter is provided in the inlet to the pump. A range of camshaft pulleys of various sizes is available to ensure that the pump speed does not exceed 6500 r.p.m.

(6) Relief Valve - This controls the datum pressure of the system and is pre-set at 18 lbf/in^2 (1.3 kgf/cm^2). The valve is identified by a GREEN plastic cap.

(7) Equalizing Valve - This unit acts as a pressure reducer and passes fuel at the correct pressure to the rail distributor. The valve is pre-set at 17½ lbf/in^2 (1.2 kgf/cm^2), and is identified by a BLUE plastic cap.

(8) Swirl Pot - This serves two functions:

(a) It contains a large capacity filter, needed where special purpose fuel tanks are fitted, e.g. rubber lined tanks sometimes throw off debris from the welding flash.

(b) An anti-surge device to assist in eliminating fuel surge caused by high 'G' forces resulting from acceleration, braking, cornering and 'yumping' (rally term). Fuel surge induces air into the system and must, therefore, be reduced to an absolute minimum.

(9) High Flow, Low Pressure Fuel Pump - This pump supplies the fuel feed to the swirl pot, and is normally the vehicles' existing fuel pump.

COMPONENT INSTALLATION

2. The following points should be noted before commencing installation work.

(1) Cleanliness of components, work areas and tools is of the utmost importance when installing TJ petrol injection equipment. All components must be kept in dust-proof containers until actually required.

(2) All piping must be routed and clipped well clear of the exhaust system and where it passes through bulkheads or panelling protective grommets must be employed.

(3) Sharp bends likely to develop kinks must be avoided.

(4) Blanking plugs should be left in position until final connections are made.

(5) A nylon tube assembly tool, Part No. AT 86133, is available from Tecalemit (Eng.) Ltd. This permits end fittings to be assembled in situ.

3. Remove all existing carburation equipment, including the induction manifold and proceed as follows:

(1) Electric Gear Pump -Install this unit close to the fuel tank in a protected but ventilated position. Whenever possible the pump should be below the level of the tank with the outlet connection uppermost. Avoid installation on part of the bodywork which may act as a sounding board.

(2) Check and Bleed Valve - This unit is virtually part of the electric gear pump and its installation is covered in operation (1).

(3) Rail Distributor -Install this unit as close as possible to, and below the level of, the injector nozzles.

(4) Control Unit - Mount the control unit in such a position that most of the accelerator linkage can be used without modification. This is largely determined by available space and bonnet line.

(5) Engine Driven Fuel Pump - This is mounted at the front of the engine on the bracket provided, with the outlet connection marked CV at the highest point. Direction of rotation must be clockwise when viewed from the driving pulley end. Remove the existing crankshaft pulley and securing bolt and fit the pulley and bolt supplied. If the engine is to be used at speeds in excess of 6500 r.p.m. for prolonged periods, a crankshaft pulley to pump pulley ratio is selected which will reduce the maximum pump speed to 6500 r.p.m. This is determined at the factory and must not be changed.

(6) Relief Valve - Unless specific instructions are given, this unit should be secured to the inside of the wheel arch close to the Engine Driven Pump.

(7) Equalizing Valve - This is normally supplied mounted on a bracket already fitted to the manifold block carrying the throttle bodies.

(8) Swirl Pot - Secure the swirl pot as close to the high flow, low pressure fuel pump, (normally the vehicles' existing fuel pump), as possible. Install it in an upright position with the two 'ears' uppermost. This is essential to correct operation of the pot.

PIPE WORK

4. Refer to the piping layout, Fig. 1, and make the connections as follows:

(1) Wherever possible, the existing feed line, A, from the tank to the high flow L.P. fuel pump, should be utilized. If the tank take off incorporates a fine filter element, this should be removed. If it is found necessary to fit a new nylon tube feed pipe, a variety of fittings is supplied to make it possible to connect to the pump. If difficulty is experienced, a length of Hestane rubber tubing is also included to provide a tight fitting push-on connection between pump and nylon tube.

(2) The base of the swirl pot is an aluminium casting incorporating two ports, marked IN and OUT. Connect line B between the L.P. pump outlet and swirl pot port IN.

(3) The electric gear pump and the check and bleed valve are supplied mounted on the same bracket, and interconnected by Bundy tubing. Install line C between the swirl pot port OUT to the remaining port in the electric gear pump.

(4) Fit the line D between the check and bleed valve and the engine driven pump. Connect to the check and bleed valve at the port located 180° from the port to which the feed from the electric gear pump (bundy tube) is coupled. Connect at the pump end to the tapping on the rear of the pump casing marked IN.

(5) Install line P between the engine driven pump and the relief valve, (green cap identification). Use the pump port marked DRV. The relief valve has two ports marked DRV. Connect to either of these but ensure that the remaining DRV port is securely blanked off, using the plug provided.

(6) Route the pipe R between the check and bleed valve and the relief valve (green cap). Connect to the relief valve port marked RT. The check and bleed valve has only two interconnected ports left; connect to either port.

(7) Couple pipe S to the remaining port on the check and bleed valve and route the pipe to the swirl pot. Make the connection to either of the two ports in the top of the swirl pot.

(8) Connect the pipe E between the remaining swirl pot port and the fuel tank. If no tapping is available on the fuel tank, it will be necessary to make a tapping into the tank filler neck. Refer to the Instruction Manual, Para. 13. All required fittings are supplied.

(9) Install line F between the engine driven pump and the disc filter, connecting between the pump high pressure port marked CV and the IN side of the disc filter.

(10) Route line G between the disc filter and the control valve. Connect between the OUT side of the disc filter and the port in the side of the control valve. This port is set in a raised boss and is marked EDP.

(11) Install pipe H between the control valve and equalizing valve (blue cap). Fit the 7/16 in. x 5/32 in. adaptor into the port located in the flat top surface of the control valve and fit the main restrictor to this adaptor. Fit a similar adaptor into one of the two equalizing valve ports marked DRV and blank off the other DRV port, using the plug provided. Couple pipe H between the main restrictor and the adapted part of the equalizing valve, using the 5/32 in. thin wall nylon tube supplied.

(12) Fit a 7/16 in. x 5/32 in. adaptor into the equalizing valve port marked RT. Connect line M between this port and any port in the rail distributor, using the 5/32 in. thin wall nylon tube supplied.

(13) Connect the fuel feeds between the rail distributor and the injector nozzles, using the red nylon tube provided. Ensure that all the nozzle feed pipes are of similar length. Maximum tolerance $\pm$ 1 in. ($\pm$ 25 mm).

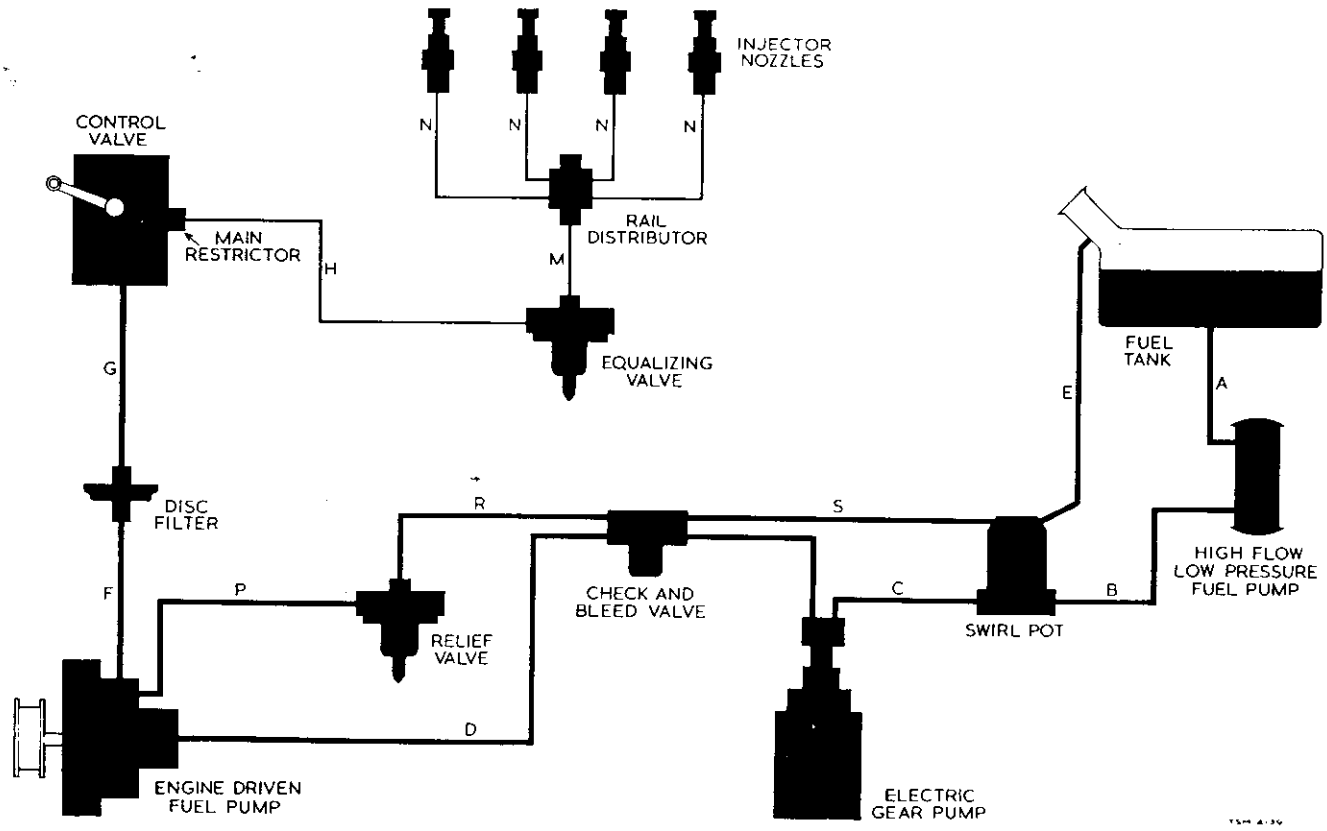

FIG. 1 PIPING LAYOUT

POST INSTALLATION ADJUSTMENT

5. Refer to Fig. 2 and proceed as follows:

(1) Foreign matter, metallic particles, etc., may enter the fuel system during installation work in spite of the most stringent precautions. It is therefore imperative that the fuel system be flushed before commencing any post installation adjustments, as follows:

(a) Disconnect both feed pipes into pressure equalizing valve and lead the pipes into a 1 gallon measure.

(b) Switch on the vehicle's ignition and allow a minimum of half gallon of fuel to be pumped through the system into the measure. Switch off the ignition and reconnect the two pipelines to the equalizing valve.

(c) Switch on the ignition and bleed air from both pipelines by slackening the connections and tightening up when air free fuel emerges.

(2) Disconnect the cable (Control Unit to throttle butterflies) and unscrew the idle stop screw fully. Adjust the screw on the fork linkage between the throttle bodies until the spring loaded plunger below the screw (with spade lever between) is in the mid position. Slacken the clamp bolt on one of the levers and fully close the butterflies, re-tighten the clamp bolt. Adjust the idle stop screw to just open the butterflies and reconnect the cable, adjust cable throttle body end to give a small amount of slack. Screw in all air balance screws until they just contact their seats.

(3) Start the engine and run it at approximately 1000 r.p.m. Connect an air flow meter (Uni-Sync.) and adjust the air bleed screws to obtain the same meter reading from each pair of throttle bodies. Obtain the same meter readings on each pair of throttle bodies using the adjusting screw on the fork linkage between the units. Recheck the readings from all intakes and trim finally on the air bleed screws if necessary.

(4) Adjust the throttle cable tension so that, with the throttles just starting to open, a .040 in. (1 mm) clearance exists between the eccentric cam on the Control Unit and its stop. See Fig. 12a of the Instruction Manual.

If this clearance exceeds .040 in. the engine will run rich over the whole operating range, if less than .040 in. it will be weak over the whole range.

When correctly adjusted ensure that the outer cable locknut is securely tightened.

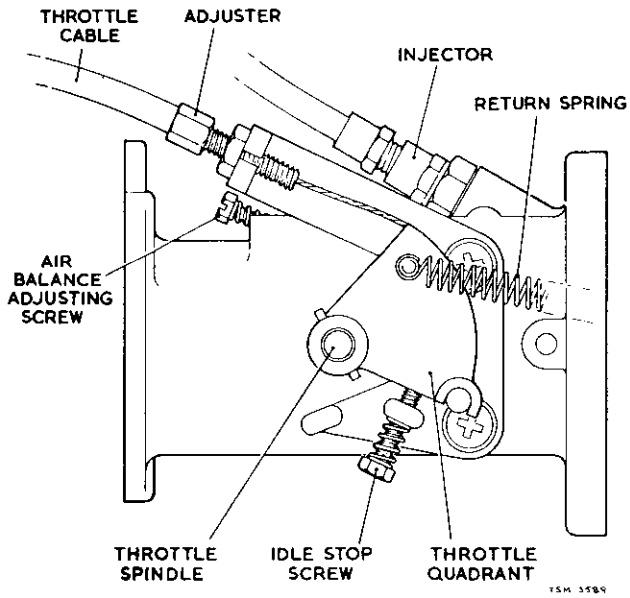

FIG. 2 THROTTLE BODY-ADJUSTMENT POINTS

FAULT DIAGNOSIS

Fault	Possible Cause	Remedy
1. Engine will not start.	Lack of fuel reaching the engine.	Disconnect all nozzle feed pipes from the nozzles. Hold them below the level of the equalizing valve and switch on the electric fuel pump. Close the throttle. If there is no discharge from the pipes and the nozzles are not blocked, proceed as follows: (a) Check that the electric pump is running. Examine the tank to pump line for presence of air which indicates either a blocked line filter or fuel level in tank below the take off pipe. (b) Slacken one of the end connections to the rail distributor. With the pump running, a strong flow of fuel should emerge. If the flow is weak, examine piping between pump and rail distributor for crimping. If piping is satisfactory, renew the electric pump. (c) Remove the line filter between E.D.P.P. and the Control Unit. Renew the filter if necessary. (d) Remove the main restrictor and inspect for blockage. Blow through using an air line or copper/brass wire probe. See Fig. 1. (e) If fuel is being delivered to the Control Unit but discharge is very small and does not increase as the valve is opened, remove it from the vehicle and detach the flat cover. Check that the roller arm return spring is still in place and that the roller follows the fuel cam. If satisfactory in this respect, renew the Control Unit. Also renew the unit if the roller fails to follow the cam. (f) Remove the GREEN cap from the Relief Valve and screw in the adjusting screw until a fuel flow is observed.
2. Engine starts but idles irregularly.	(a) Induction manifold air leaks. (b) Unbalanced air supply to cylinders. (c) Uneven distribution of fuel.	(a) Examine for signs of leakage - renew gasket as necessary. (b) Check, using uni-sync. equipment. Adjust as required. See Para. 5(3). (c) (1) Usually due to a blocked nozzle, evidenced by one sparking plug indicating weak mixture while the remainder show a stage richer. Remove and clean the nozzle, renew at earliest opportunity. Note: Replacement nozzle MUST bear the same number, as this indicates the flow range. (c) (2) If one plug indicates a richer mixture than the others, a restricted air bleed to the nozzle tip is indicated. This can be confirmed by placing a finger over the nozzle air bleed hole on the atmosphere side of the throttle butterfly. If the nozzle bleed is blocked, this will have little effect on the running when compared with the 'stumble' resulting from doing the same thing to a 'good' cylinder. To prove the fault, interchange the suspect nozzle with one from another cylinder. If the fault follows the nozzle, it should be renewed. If the fault remains with the same cylinder, remove the manifold and blow through the nozzle bleed passage. On refitting the manifold the fault persists, change the manifold.

Fault	Possible Cause	Remedy
3. Engine starts and idles but stalls when accelerator pedal is depressed.	(a) Cable link between Control Unit and throttle spindle out of adjustment. (b) Fuel blockage or Control Unit fault.	(a) Re-adjust cable - see Para. 5(2). (b) Check as Fault 1.
4. Engine lacks power and plugs indicate a weak mixture.	(a) Restriction in fuel supply. (b) Acceleration device (when fitted) faulty.	(a) See Fault 1- Remedies (a), (b) and (c). (b) Disconnect the outlet pipe from the acceleration device. With the electric pump running, check that fuel emerges from the outlet. If there is no discharge, renew the acceleration device.
5. Engine slow to pick up.	(a) Weak mixture. (b) Acceleration device (when fitted) snail cam out of adjustment.	(a) Increase the slack in the green cable. (b) When correctly adjusted, the flat on the cam below the acceleration device plunger must be exactly parallel with the flange joint of the device. Adjust if necessary by slackening the Allen screw securing the cam to the shaft.
6. Plug reading weak.	Weak mixture.	Plug cut to be made as follows: Run car at maximum torque in top gear. Cut ignition and all pumps, simultaneously depressing the clutch pedal. Bring the car to a stop and remove the plugs for examination. If the plugs are weak, fit a larger main restrictor and if rich, fit a smaller main restrictor.