B.R. 33057/16
D.T.S. 42

BRITISH RAILWAYS - WESTERN REGION

THE
ENGLISH ELECTRIC
16 C.S.V.T. ENGINE

M. & EE. Training Unit,
SWINDON
JULY 1974
2nd Edition

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SUPPLEMENT FOR THE

16 C.S.V.T. ENGINE AS

FITTED TO LOCOMOTIVES NO. 400 - 449

(ENGLISH ELECTRIC CO. LTD.)

TO BE USED ONLY IN CONJUNCTION

WITH THE ENGLISH ELECTRIC ENGINE

12 C.S.V.T. & 12 S.V.T. BOOK.

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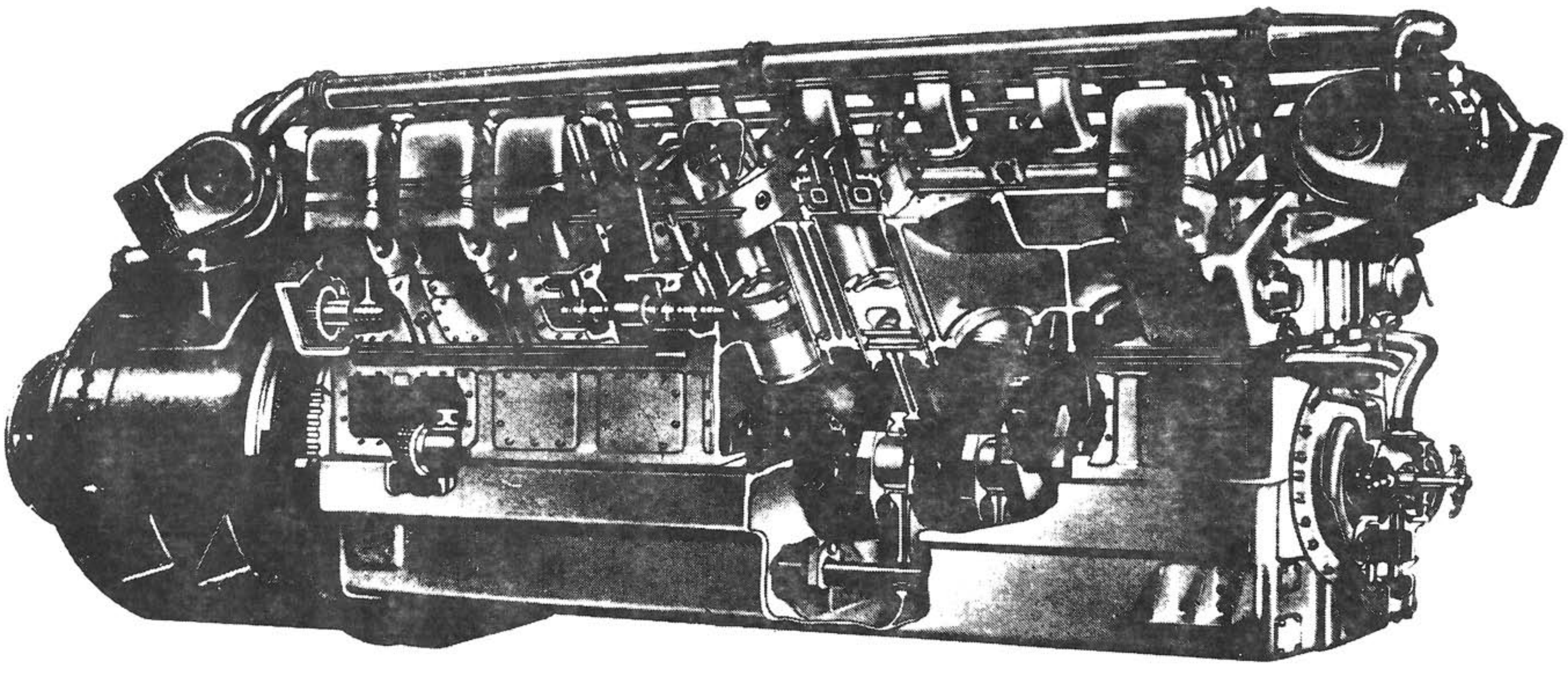

FIG 1 16 CYLINDER CHARGED COOLED SUPERCHARGED VEEFORM TRACTION ENGINE

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INTRODUCTION.

The 16 C.S.V.T. engine is a development on the 12 cylinder engine as fitted to the 31 and 37 class locomotives.

The engine build up and maintenance are very similar and in many cases identical.

The main differences being in the support systems i.e. coolant, lubricating oil, and fuel.

The 16 C.S.V.T. engine has 16 cylinders, 4 turbochargers and intercoolers. It also has a Woodward governor very similar to the class 31 engine.

This supplement details the differences to be found on the 16 C.S.V.T. engine.

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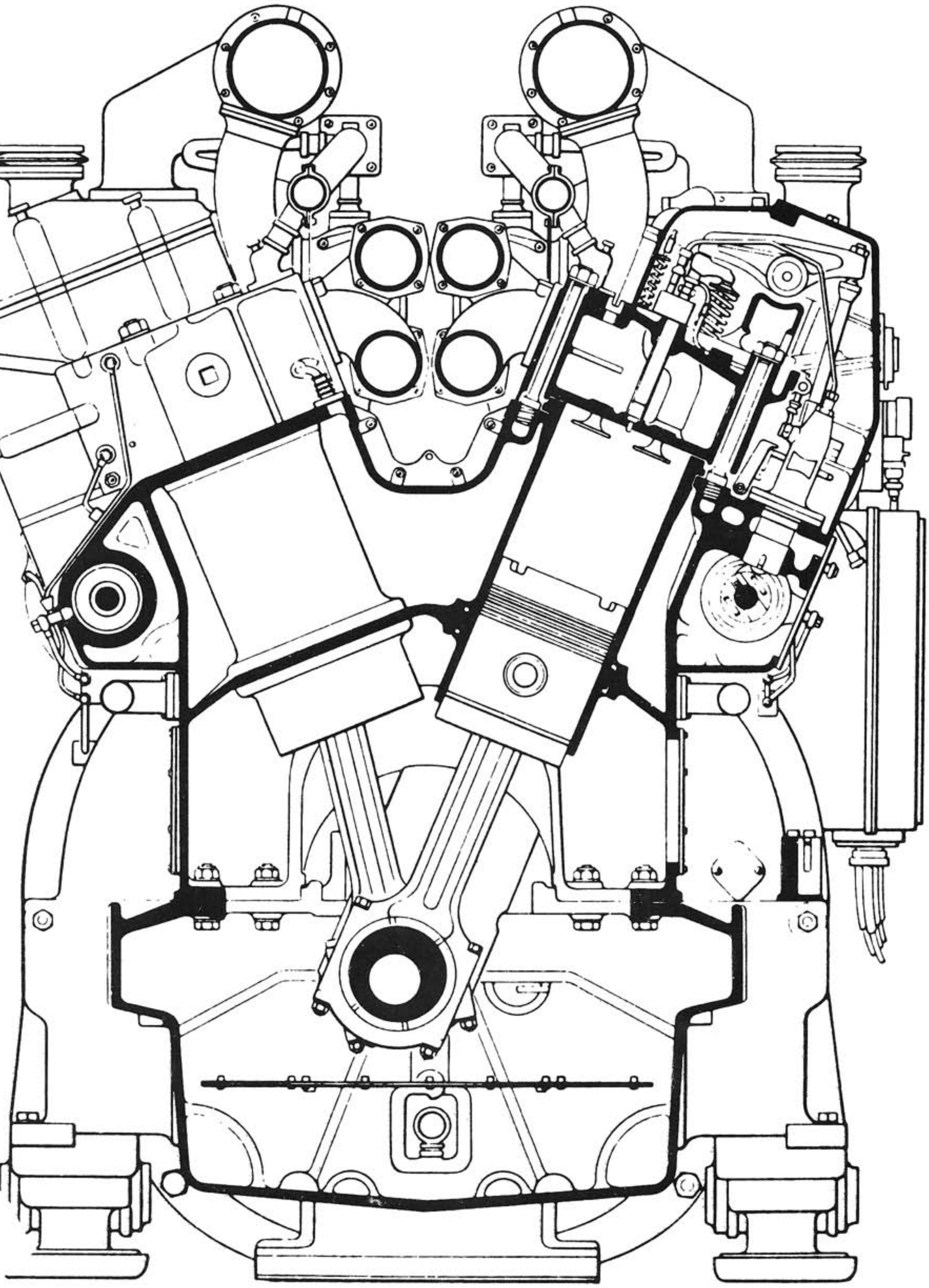
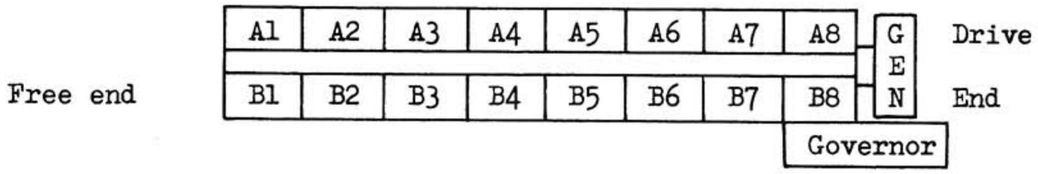


FIG 2 CROSS SECTION OF C.S.V.T. ENGINE

ENGINE DATA

Type	E.E. 16 C.S.V.T.
Idling Speed	450 R.P.M.
Maximum Speed	850 R.P.M.
H.P. Developed	2700 at 850 R.P.M.
Overspeed Trip Operates	980 - 1000 R.P.M.
Bore and Stroke	10" x 12"
Compression Ratio	11.7 to 1
Crankshaft Rotation	Clockwise (looking from generator)
Camshaft Rotation	Anti-clockwise (looking from generator)



Firing Order

B bank 1 5 7 3 8 4 2 6

A bank 8 4 2 6 1 5 7 3

Valve Settings

Inlet	Open-close	80 B.T.D.C. - 35 A.B.D.C.
Exhaust	Open-close	45 B.T.D.C. - 65 A.T.D.C.

Point of Injection (B.T.D.C. compression stroke)

Cylinder No.	1	2	3	4	5	6	7	8
A bank	26½	26	25½	25	25	25	25	25
B bank	25½	25	24½	24	24	24	24	24

Corrected Timing

A bank 24°

B bank 23°

Valve Tappet Settings

Inlet	0.006"	Cold
Exhaust	0.008"	Cold

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Fuel Pump

Fuel pump type	Bryce CC 20A S335
Plunger dia.	20 MM
Plunger stroke	15 MM
Identifying mark on pump	20/A
Max fuel pump rack (balance point)	11.5 MM
Min fuel pump rack (engine stopped)	28-30 MM

Injector

Injector holder type	C.A.V. B.K.B. 200T 5131b
Injector nozzle type	C.A.V. B.D.L. 140T 6332
Number of holes in nozzle	6
Injector pressure setting	3000 p.s.i.

Control Air Pressure	75 p.s.i.

Charge Air

Blower type — Napier H.P. 200

Air supply - inertia filters - secondary filters - turbo blower - intercoolers

Max charge air (100% load)	10.0 p.s.i.
Reducing Valve setting (blower gland)	12-14 p.s.i.
Blowing speed at full load	17.500 RPM

Fuel System

Fuel pressure (full load)	10 p.s.i. 16 p.s.i. idling
Fuel tank capacity	1.100 gallons

Lub Oil System

Sump capacity	130 gallons talona 945
Normal working pressure	50-60 p.s.i.
Low oil pressure	850 RPM (immediate) 36 p.s.i.
Shutdown	450 RPM (15 sec delay) 18 p.s.i.
Thermostatic valve oil to cooler at	149°F

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Coolant Systems

Two systems:

(a) Main engine (engine jacket)

(b) Intercoolers - lub oil cooler

High water temperature light bright if:-

(a) Temperature in engine system reaches 200°F

(b) Temperature in intercooler system reaches 115°F

(c) Low water temperature 39°F

Diversion Valve (Air Operated)

Opens - 60°F

Closes - 80°F

Temperature Control - Electric Fan (actuated by probes in system)

(a) Fan runs as soon as engine starts

(b) At 160°F shutters open (air operated)

(c) At 170°F fan speeds up

(d) At 180°F top fan speed

(e) At 200°F H.W.T. light bright

Capacity of engine system	305 gallons	(200 engine (105 radiator
Capacity of intercooler system	80 gallons	
Capacity of header tank	25 gallons	

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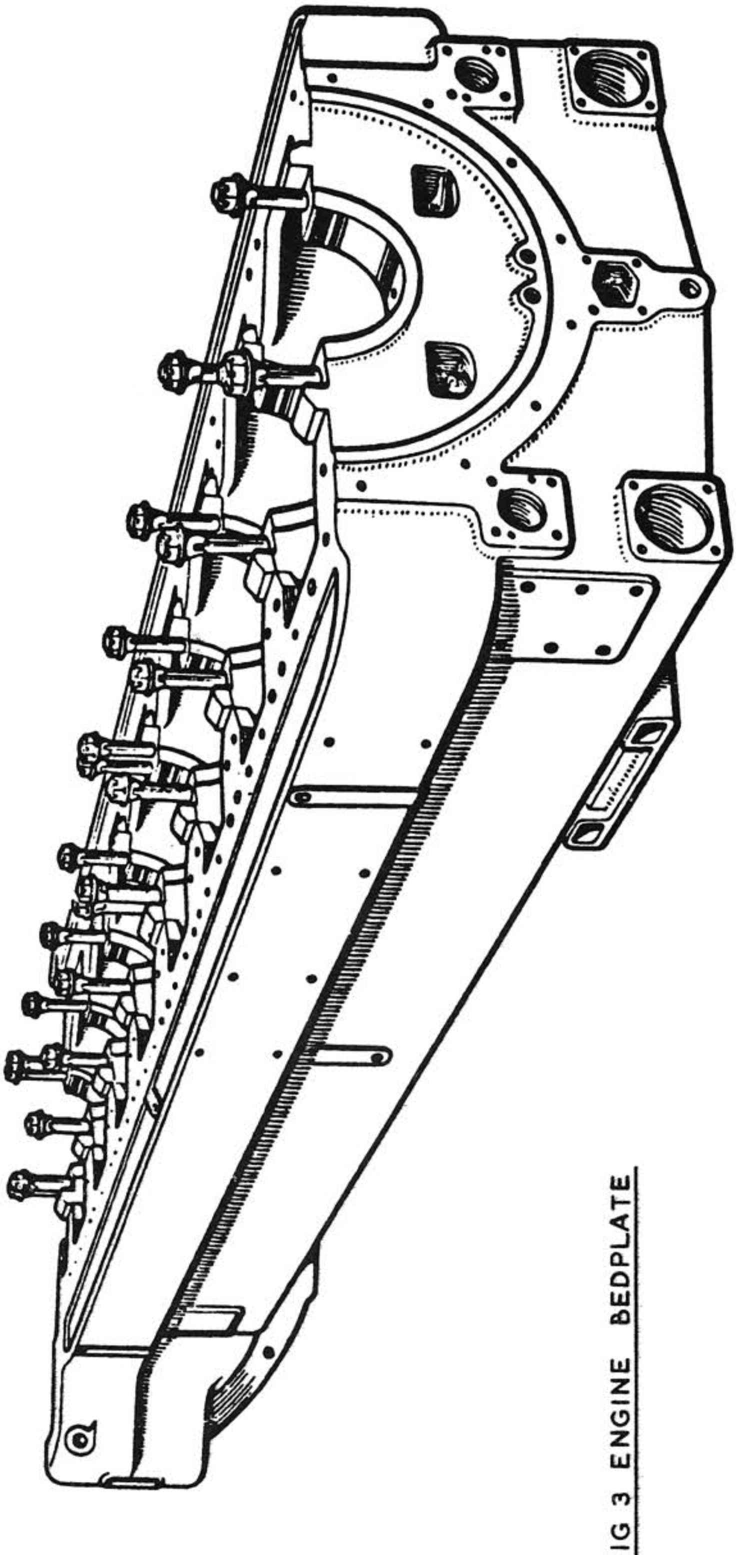

FIG 3 ENGINE BEDPLATE

BED PLATE Fig. 3

DESCRIPTION

The Bed plate is made of cast iron.

It has ten transverse walls cast integral with, and ribbed to the main walls.

Nine of the transverse walls are shaped to support the lower half of the main bearing shell. These walls are also machined to locate and secure the main bearing top cap. This location is called the register.

The main bearing cap is secure to the transverse wall register by 2, $1\frac{3}{8}$" BSF bolts and self locking nuts.

No. 5 main bearing cap (from free end) is secured by 4, $1\frac{3}{8}$" BSF bolts and self locking nuts. The reason being, No. 5 transverse wall is wider than the others, and the main bearing is wider. This is to give added support to the crankshaft at a point approximately halfway along its length.

No. 9 main bearing is also a wide bearing to take load of generator, and its cap is retained by 4, $1\frac{3}{8}$" BSF studs.

No. 8 is the thrust bearing.

The main oil rail runs the full length of the Bed plate.

The transverse walls are drilled to conduct oil from the main oil rail to the main bearings.

No. 10 transverse wall (at drive end) is where the crankshaft passes out of the engine to drive the generator. Oil leakage at this point is prevented by a labrinth seal. The bottom half of this seal locates in the bottom half of No. 10 transverse wall.

On the top face of the bed plate are drilled holes to receive the securing bolts of the crankcase.

At the free end of the bed plate there are seven separate attachment faces.

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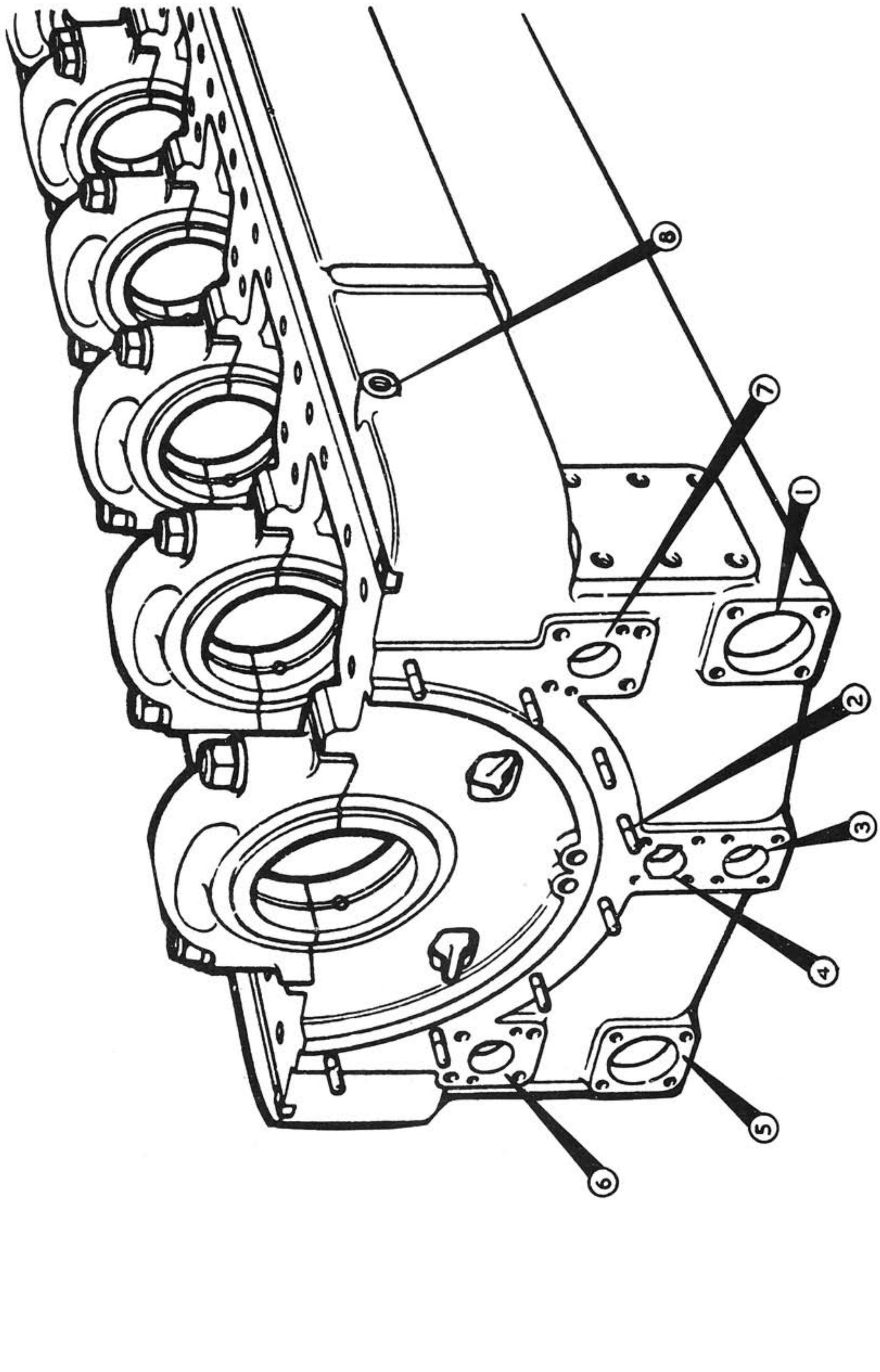

FIG 4 BEDPLATE ATTACHMENT FACES

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LOOKING FROM FREE END Fig. 4.

(1) Face for main lub oil pump suction filter (four $\frac{5}{8}$" B.S.F. studs).

(2) Face for lower half of auxiliary drive (eight $\frac{5}{8}$" B.S.F. studs).

(3) Face for bed plate lub oil drain (four $\frac{3}{8}$" B.S.F. set bolts).

(4) Face for main oil to crankcase main bearings, big and small ends (four $\frac{1}{2}$" B.S.F. studs).

(5) Support face for intercooler bracket (four $\frac{5}{8}$" B.S.F. studs).

(6) Face for lub oil pipe, relief valve to sump (four $\frac{5}{8}$" B.S.F. studs).

(7) Face for sump filling pipe (four $\frac{5}{8}$" B.S.F. studs).

(8) Connection for the sill drain i.e. one on each side of the bed plate

UNDERSIZE MAIN BEARINGS Fig. 5.

If a main journal has been reground and an undersize bearing fitted, a yellow stripe will be painted on the crankshaft web or balance weight on each side of the effected main and the undersize stamped on the balance weight or web in a yellow square i.e. M.J. U/S 0.020" (or whatever undersi e applies).

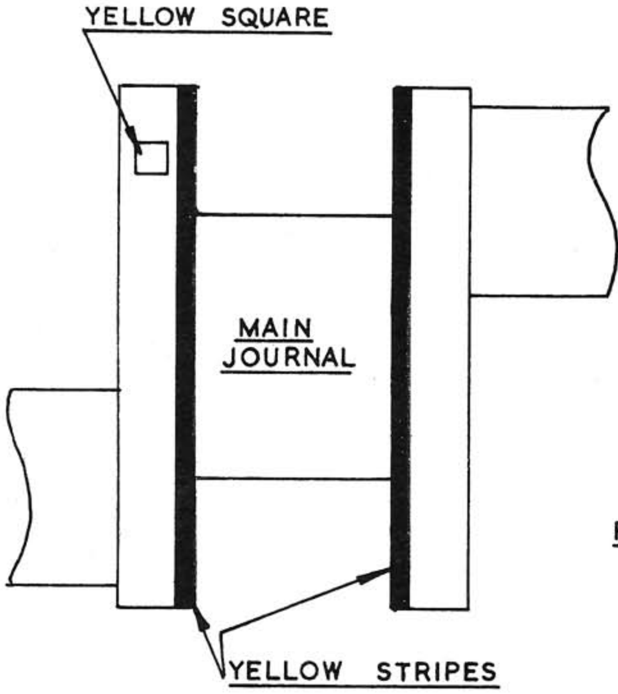

FIG 5

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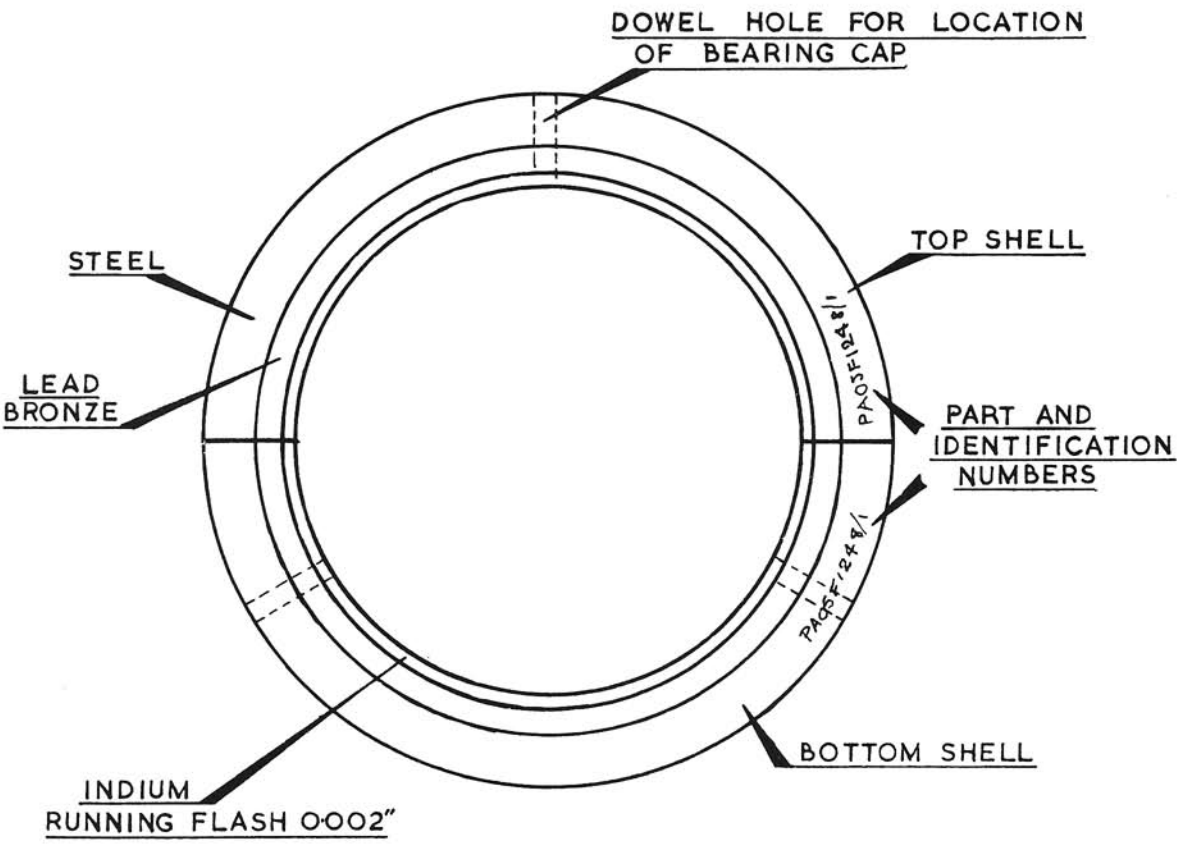
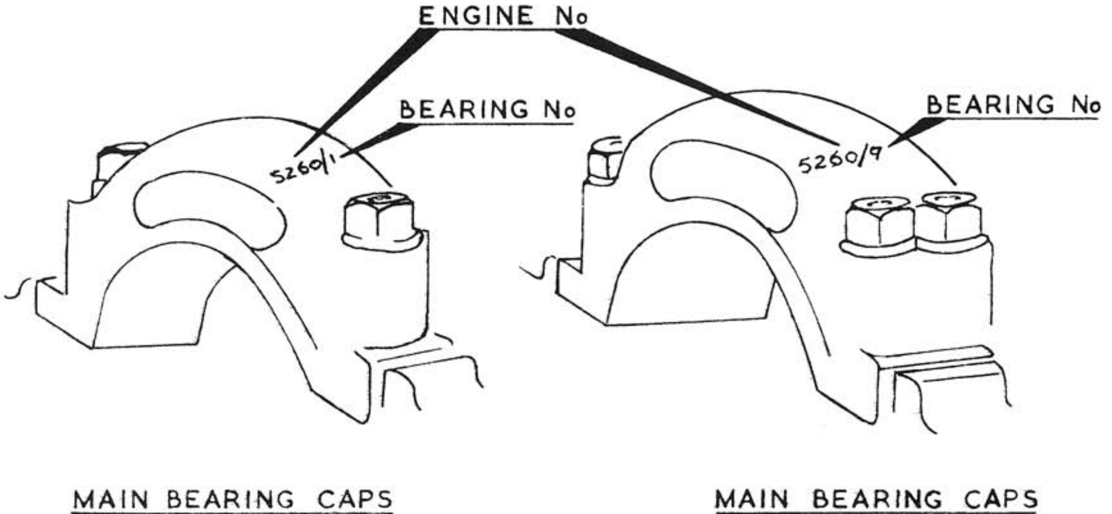


FIG 6 MAIN BEARING SHELLS



MAIN BEARING CAPS
No 1,2,3,4,6,7,8,

MAIN BEARING CAPS
No 5 & 9

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12 C.S.V.T. BEARINGS MUST NOT BE FITTED TO 16 C.S.V.T. ENGINES.

Reason:- 16 C.S.V.T. bearings are of a stronger metallic composition.
16 C.S.V.T. bearings can be fitted to 12 C.S.V.T. engines.

The main bearings (top and bottom halves) are precision steel shells, lead bronzed lined with an indium running flash on the surface of approximately 0.002".

Main bearing shells MUST NOT be filed or scraped or shims fitted.

No. 8 is the thrust bearing.

No. 5 is a wide bearing to support crankshaft halfway along its length.

No. 9 is a wide bearing to support load of flywheel and generator.

Nos. 1, 2, 3, 4, 6, 7 and 8 are each retained by two $1\frac{3}{8}$" B.S.F. bolts and self locking nuts.

Nos. 5 and 9 are each retained by four $1\frac{3}{8}$" B.S.F. bolts and self locking nuts.

INTER-CHANGEABILITY OF BEARINGS

Nos. 1, 2, 3, 4, 6, 7 and 8 bearings are inter-changeable as new. Nos. 5 and 9 are inter-changeable as new.

No. 8 thrust bearing can only be changed with 16 C.S.V.T. engines of the same crankshaft web thickness.

MAIN BEARING SHELL MARKINGS

The bearing numbers are marked in adjacent positions on each shell on the free end flange, on the R.H. side. Each thrust bearing is marked on the rim of the free end flange, on the front side.

MAIN BEARING CAPS

Engine and bearing No. stamped on top, caps are NOT INTER-CHANGEABLE

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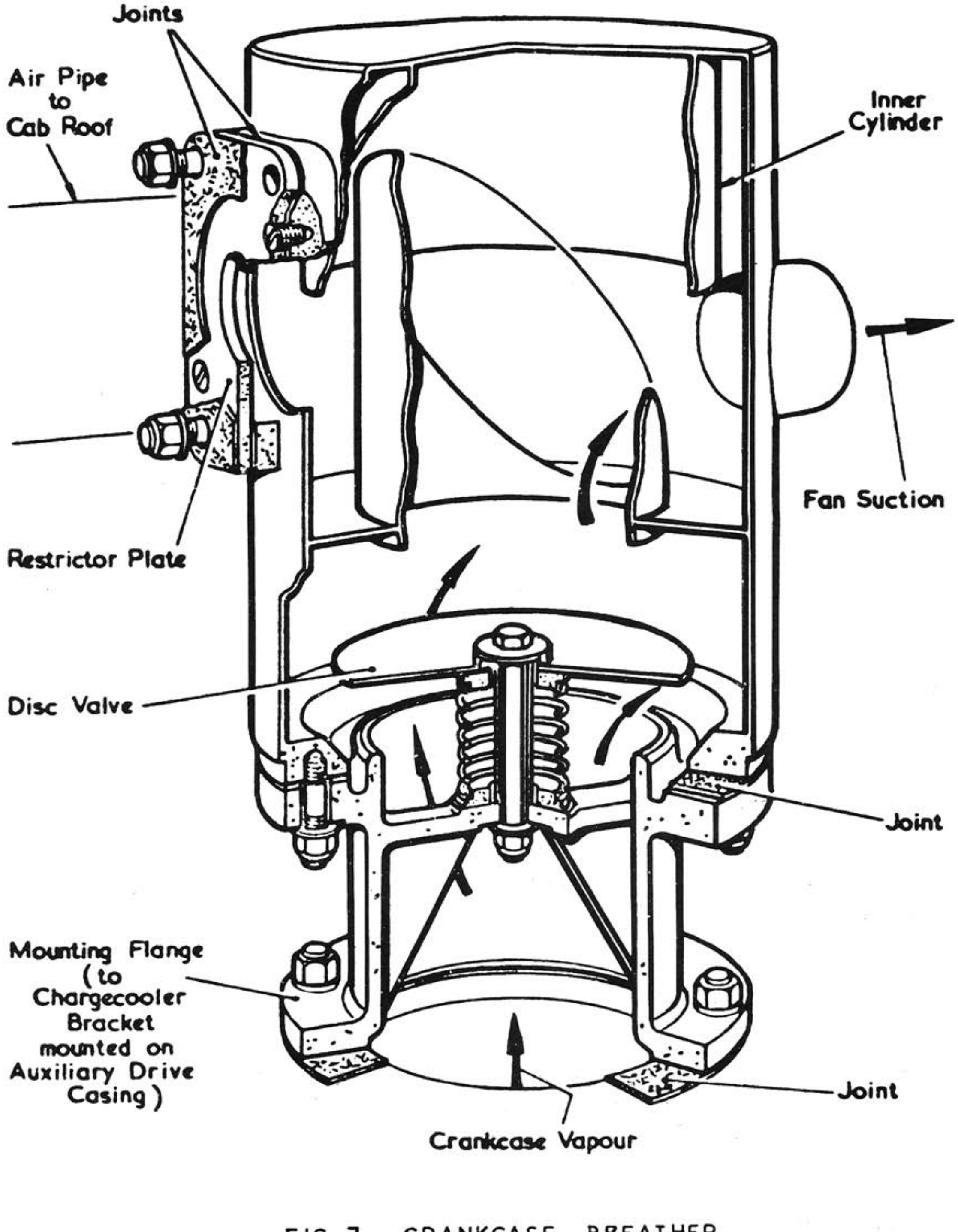

FIG 7 CRANKCASE BREATHER

CRANKCASE BREATHER Fig. 7.

LOCATION

Mounted on top face of auxiliary drive box at free end of engine.

PURPOSE OF BREATHER

(1) To relieve pressure

(2) To act as a condenser for vapor carried over

(3) Limit depression to a designed level

(4) Prevent secondary explosion in event of crankcase explosion

MODIFIED BREATHERS

Are being fitted, the pipe from the breather to the roof is removed and a wire mesh is fitted to the breather flange (like Class 31 breather).

To stop depression being caused by fan suction a vent is fitted in the engine room roof.

CRANKCASE PRESSURE

Crankcase pressure, arising from blow-by of combustion gas past the piston rings, is relieved through the breather illustrated opposite. The pressure, if unrelieved, could cause leakage of lubricating oil through the crankshaft oil seals.

OPERATION OF BREATHER

Under normal running conditions the crankcase is filled with warm air, laden with oil mist, together with small quantities of combustion gases which pass through the breather and the horizontal pipe to atmosphere. The oil mist condenses into droplets in the inner cylinder and runs back into the engine.

The vertical pipe incorporates a restrictor which ensures that the crankcase pressure is slightly below atmospheric pressure so that the oil mist is not drawn out by the depression in the fan compartment when the fan is running. This pipe connects the breather to the locomotive roof so that fumes do not enter the engine compartment if the fan is not running.

CRANKCASE EXPLOSION

In the event of a crankcase explosion the sudden pressure rise is relieved through the open disc valve. The primary pressure wave is followed by a partial vacuum in the crankcase which closes the valve thus preventing the inrush of a charge of air which could cause a secondary and more violent explosion.

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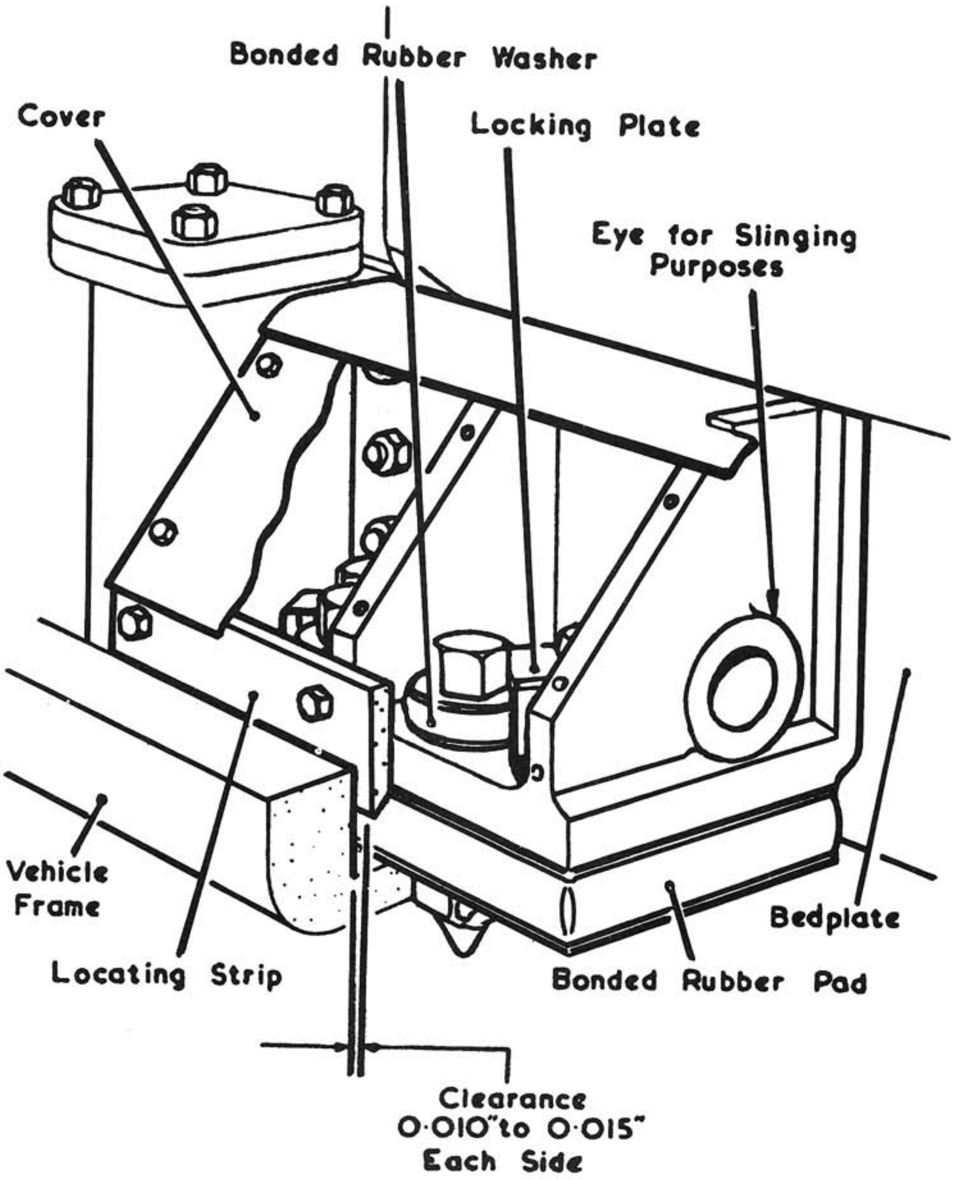

FIG 8 POWER UNIT BEARERS (ENGINE)

THE POWER UNIT

The power unit is mounted on four resilient bearers, one on either side of the generator and one on either side of the engine bed plate at the free end.

Each bearer bracket is secured to the vehicle frame by four bolts, a bonded rubber washer being placed under the head of each bolt and a rubber pad, 1.3/4 in thick, being interposed between the bracket and the vehicle frame to provide the resilient mounting. These rubber washers and pads are protected by steel covers but care must be taken to keep oil and grease away from them.

The free end bearer brackets are bolted to the bed plate and those at the flywheel end are welded to the generator casing.

Rubbing pieces, fitted to the vehicle frame, limit the movement of the power unit.

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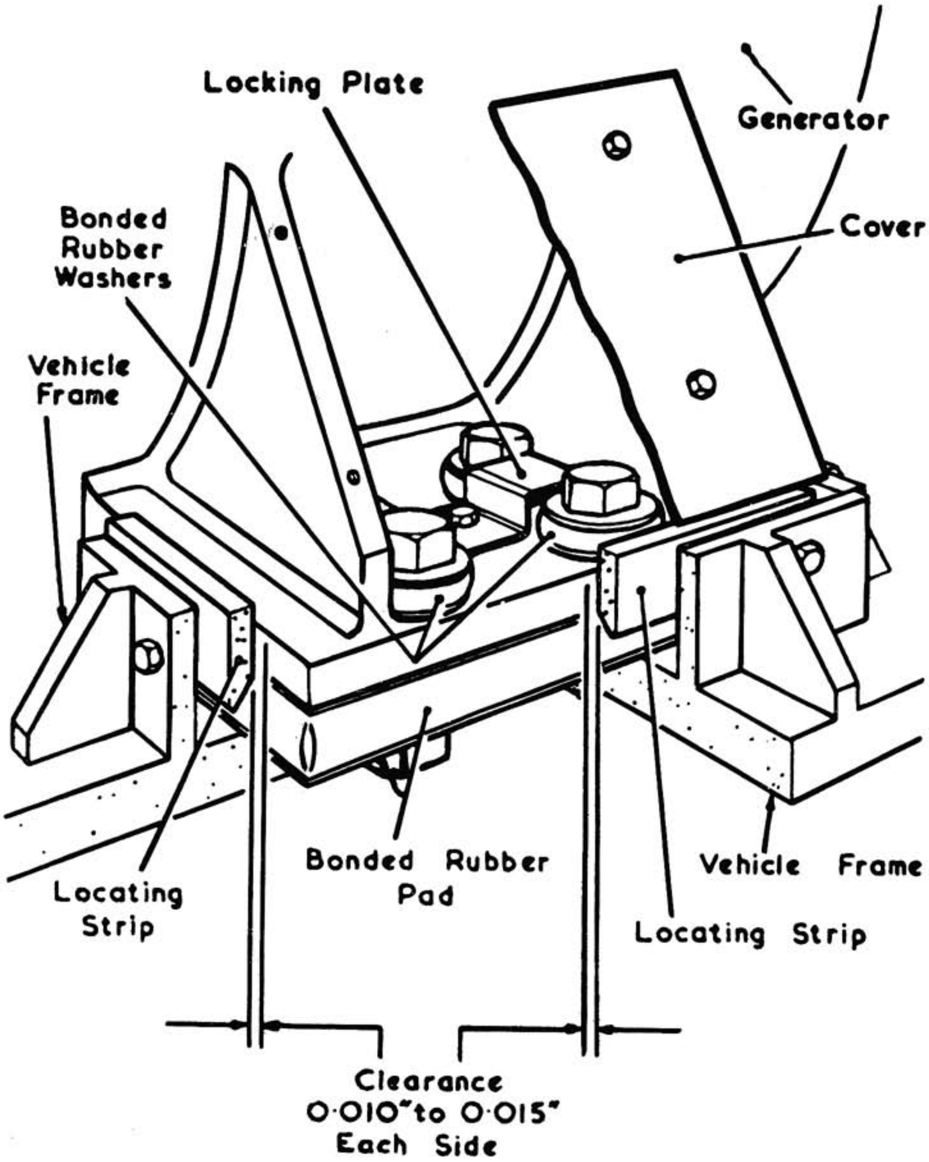

FIG 9 POWER UNIT BEARERS (GENERATOR)

MAINTENANCE

Incorrect tightening of the power unit bearings can cause excessive vibration.

Tighten bearers in following manner:-

(1) Remove locking plates and loosen holding down bolts.

(2) Retighten as follows - The holding down bolts should be screwed down until the steel backed washer situated under the bolt head can be just turned by hand. The bolt should then be tightened a further half turn.

(3) Refit locking plates.

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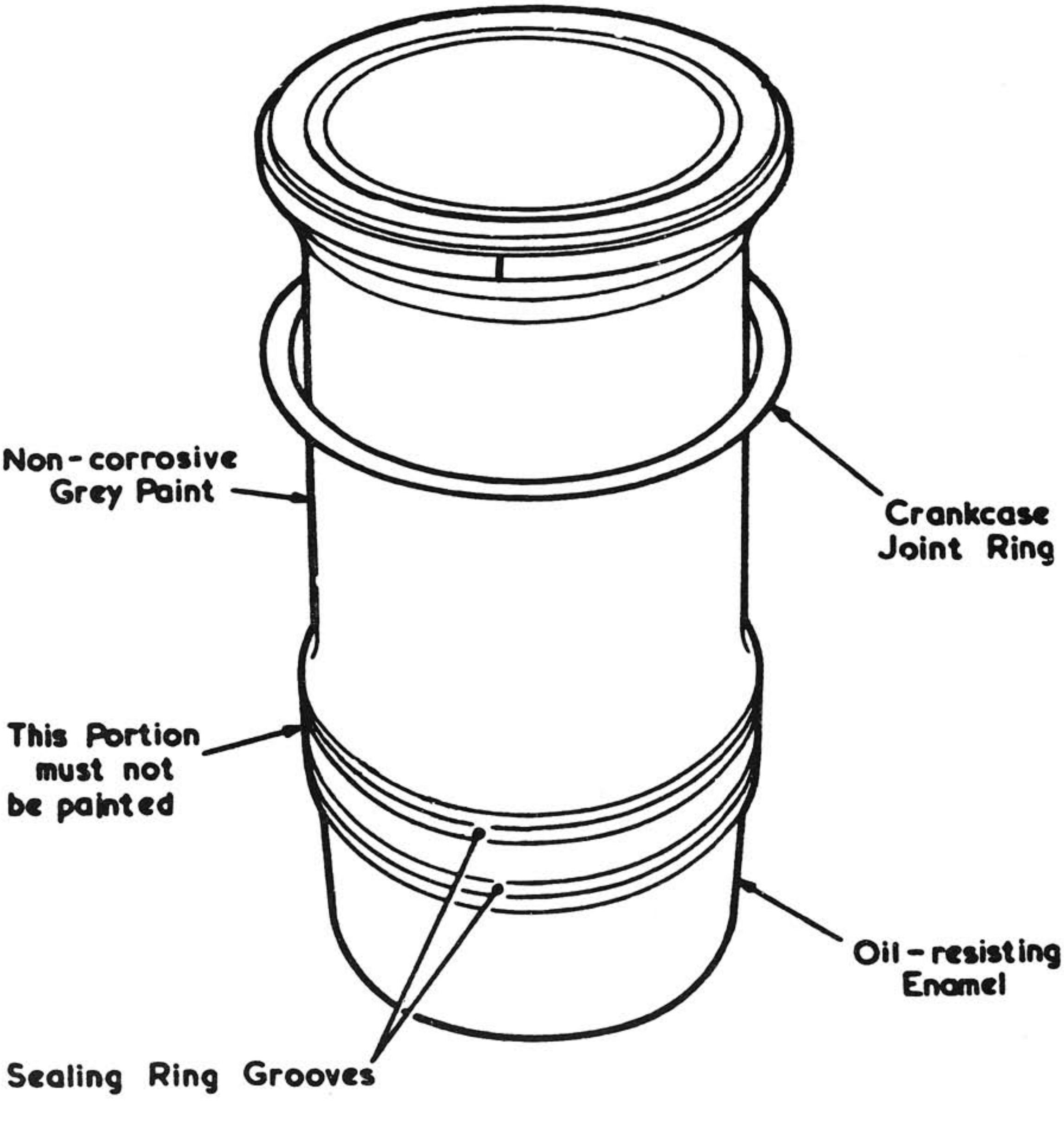

FIG 10 CYLINDER LINER

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CYLINDER LINER Fig. 10.

DESCRIPTION

The alloy cast iron liner is of the separately inserted wet type.

It is flanged at the top and secured in position by the cylinder head.

The outside walls are painted with a non-corrosive grey paint, and the lower end is painted with oil resistant enamel.

It has two externally machined grooves at the lower end of the liner to receive 2 synthetic rubber rings to locate the liner in the bottom part of the block bore and to form a water tight seal with the block. This also allows the liner to 'slide' during longitudinal expansion.

The top liner-block joint is made with a soft steel ring, coated both sides with hylomar jointing compound. This forms the upper coolant seal of the liner.

The correct location of the liner is established by lining up scribbed reference lines on the flange and the block.

LINER WEAR

When a cylinder head is removed the liner should be checked for wear in the bore along the centre line and at right angles to the line of the engine. MAXIMUM PERMITTED WEAR 0.040" in either direction. Maximum wear can be expected at the upper limit of the piston ring travel, that is approximately 2 3/8" from the top of the liner.

If wear is severe a ridge will have been formed by the ring. This ridge must be removed by use of the correct cutting tool when new rings or pistons have to be fitted.

NEW LINER BORE

10.000" 10.001"

Class 37 (12 C.S.V.T. engines) and Class 31 (12 S.V.T. engines) must not be fitted to Class 50 (16 C.S.V.T. engines).

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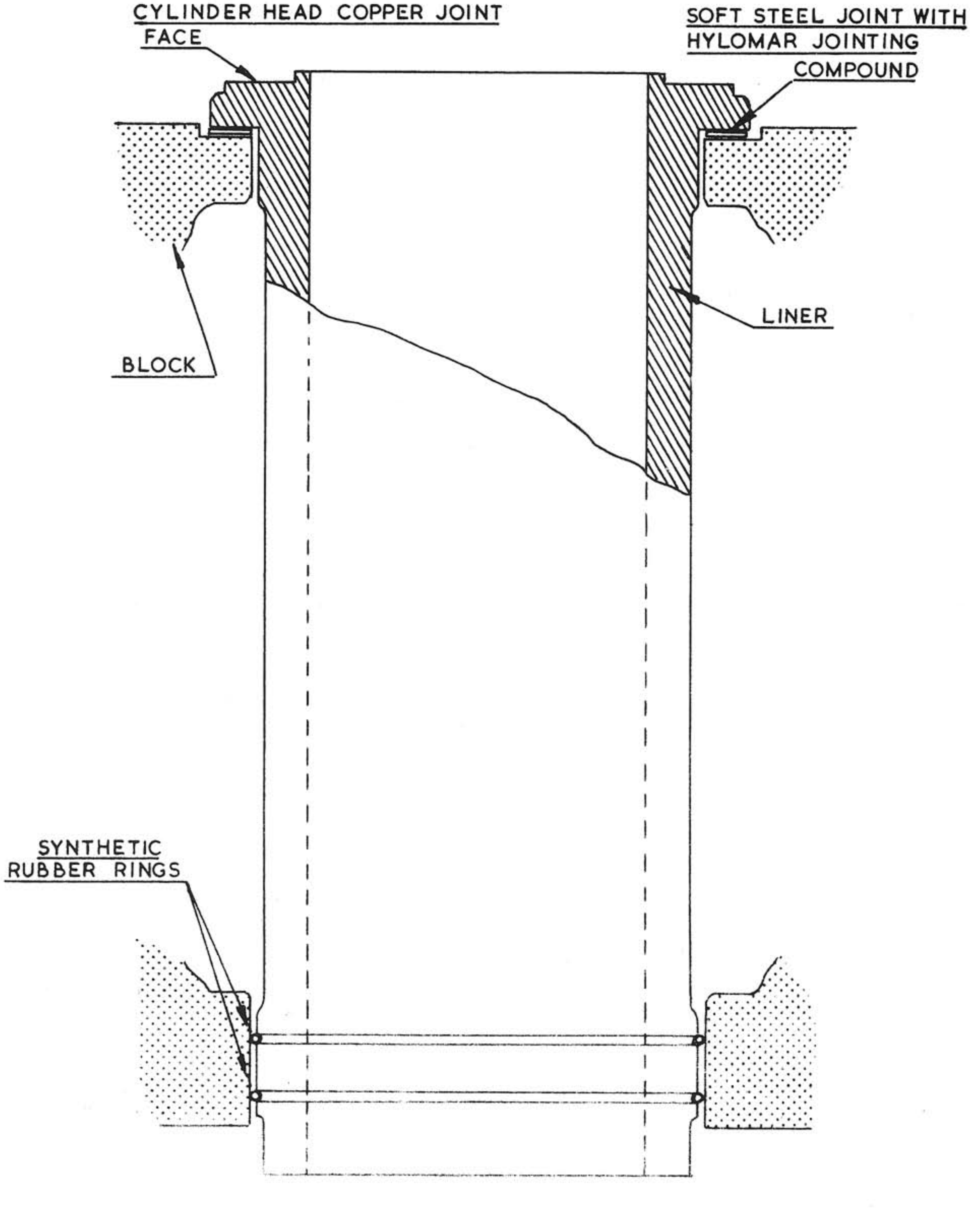

FIG 11 LINER - BLOCK JOINT

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Cylinder liner - cylinder block joint. Fig. 11.

This joint is made in the following manner:-

IMPORTANT - ENSURE JOINTING SURFACES ARE CLEAN.

(1) The liner top joint is to be lapped in to the cylinder block, using coarse and fine lapping paste as necessary. The bottom rubber rings are left off for this operation. N.B. If a new liner is used it may be tight at its bottom fit in the block, make sure the bottom block bore is clean. If it is, then a file may be used on the liner to 'ease' it.

(2) A good and continuous joint surface must be established by means of the lapping. When this is achieved, clean off all traces of lapping paste and ensure all jointing faces are clean.

(3) Sling liner with special lifting tool (tool ref: 718/1).

(4) Apply hylomar jointing compound to joint face under top liner flange.

(5) Fit soft steel ring over liner body and stick it to the hylomar underneath flange.

(6) Ensure rubber ring grooves are scrupulously clean. Roll on rubber rings into first (from bottom) and second grooves in that order. ENSURE RINGS ARE NOT TWISTED.

(7) Apply soft soap or swarfega to bottom part of liner and on rubber rings.

(8) Ensure the top and bottom block bores are scrupulously clean.

(9) Apply hylomar to block top jointing face.

(10) Lower liner into bore, keeping liner 'true', ensure steel joint stays in place and does not catch the block edge. If weight of liner becomes insufficient to finally insert liner, use insertion tool ref: 718/2.

IMPORTANT: It is essential to keep the liner square with the crankcase as the liner enters the lower block bore. Any tendency to cross bind should be relieved by use of a rawhide hammer upon its top face to square liner up.

(11) Liner-block reference line must be in line.

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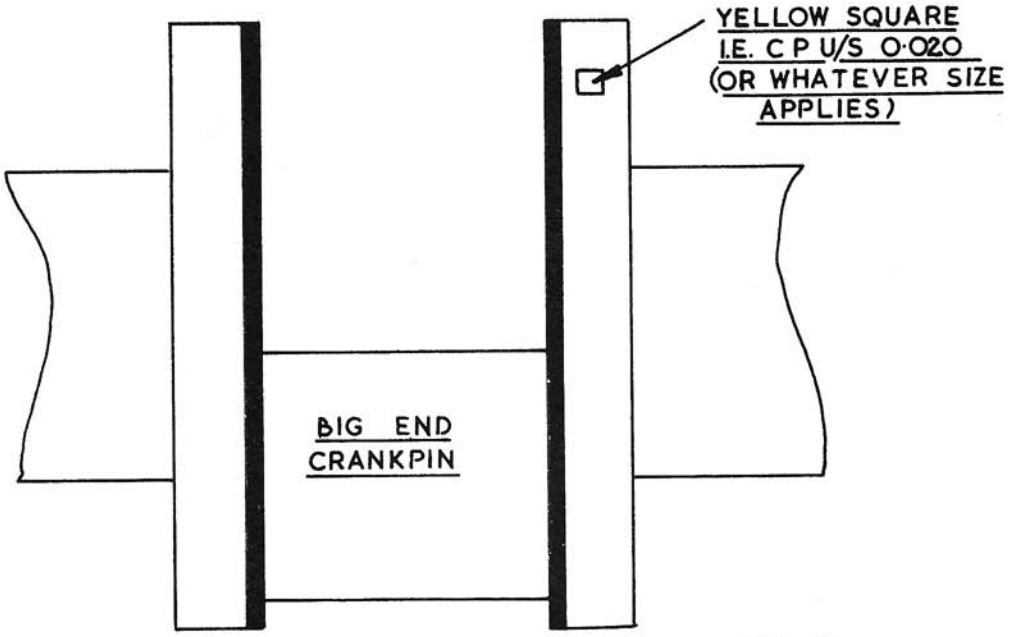

FIG 12

IDENTIFICATION OF UNDERSIZE CRANKPIN

If a crankpin has been reground a yellow stripe will be painted ½" wide on the web and balance weight on each side of the effected crankpin. (see Fig. 12)

BIG END BOLTS

These must be stretch loaded to an elongation of 0.021" - 0.024" identified by figure 24 stamped on rod (now refer to pages 23 - 32 in 12 C.S.V.T. 12 S.V.T. Book.

CYLINDER HEADS (D.P.)

16 C.S.V.T. cylinder heads are of a stronger casting than the 12 S.V.T. head. 12 C.S.V.T. 12 S.V.T. cylinder heads MUST NOT be fitted to the 16 C.S.V.T. engine. 16 C.S.V.T. heads can be fitted to the 12 C.S.V.T. 12 S.V.T. engine.

IDENTIFICATION OF 16 C.S.V.T. HEADS (D.P.)

There are two core plugs on either side of the head but only one on the 12 C.S.V.T. 12 S.V.T. heads, also the casting on top face is level on 16 C.S.V.T.

CYLINDER HEAD - LINER JOINT Fig. 13.

The joint is made of 1 thick copper ring.

The joint is made in the following manner:-

(1) Ensure the liner top face and cylinder head is scrupulously clean. The joint faces must be continuous and free from bruising.

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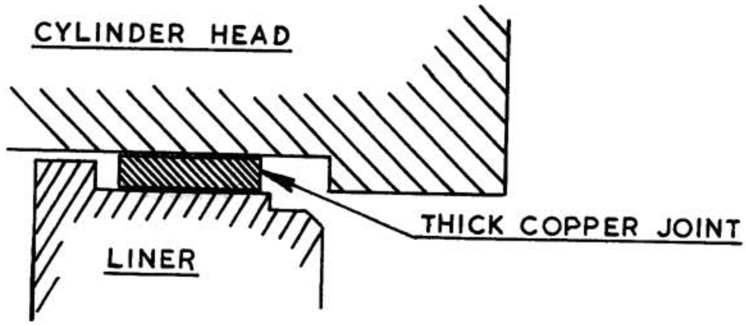

FIG 13 CYLINDER HEAD JOINT

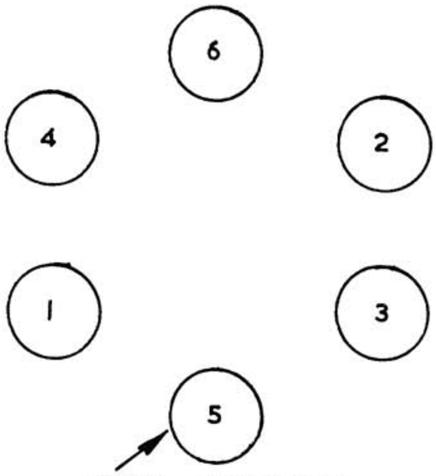

FIG 14 TORQUE SEQUENCE

(2) Fit copper joint on liner with Hylomar jointing compound.

(3) Lower head over studs on to liner.

(4) Position cylinder head and secure exhaust manifold BEFORE tightening down head.

(5) Coat cylinder head studs with molycote 'G' paste.

(6) Fit nuts and ratchet head EVENLY down in sequence. Fig. 14.

(7) Further tighten nuts down in sequence to 300 lb.ft. 500 lb.ft. and finally 600 lb.ft.

N.B. No. 5 nut is a smaller nut and must be fitted in this position to accommodate rockers.

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CYLINDER HEADS (MAINTENANCE)

If for any reason any cylinder head has been removed it should be again tightened on the first B, C, D or E exam.

It is important to tighten in the correct sequence

Important points that must be adhered to:-

(1) Ensure torque spanner is correctly set and recently tested.

(2) When checking the torque, each nut should be slackened back by approximately half a flat and then tightened to correct torque. This prevents false figures being obtained through binding of the nuts on the threads.

(3) Each valve tappet clearance should be checked with engine cold and piston at T.D.C. compression stroke.

(4) Ensure that the tappets are secured by the locknuts on completion.

Tappet Clearance - Inlet 0.006) COLD
Exhaust 0.008)

VALVE TAPPETS (MAINTENANCE)

Procedure as on page 4 12 C.S.V.T. 12 S.V.T. Book, bear in mind different tappet setting order 41

B bank	1	5	7	3	8	4	2	6
A bank	8	4	2	6	1	5	7	3

N.B. Tappets can also be set when the cam follower is on the base circle of the cam (valves fully closed).

An inspection of the cam followers must also be made for signs of wear or fracture.

VALVE ROCKER GEAR (MAINTENANCE)

(1) Remove all rocker covers.

(2) Check with spanner that all valve rocker lever lock nuts are tight and all valve bridge piece lock nuts are also tight.

(3) If rocker lever and bridge piece lock nuts are found to be loose, reset tappets and retighten nuts - recheck tappet clearances after tightening.

(4) Idle engine to ensure all valve gear is receiving lubrication.

CYLINDER HEAD VALVES

To prolong valve life the valves are faced with stelite. THESE VALVES MUST NOT BE GROUND. The only means of restoring valve and valve seat is by a special re-facing machine. This is a Main Works function.

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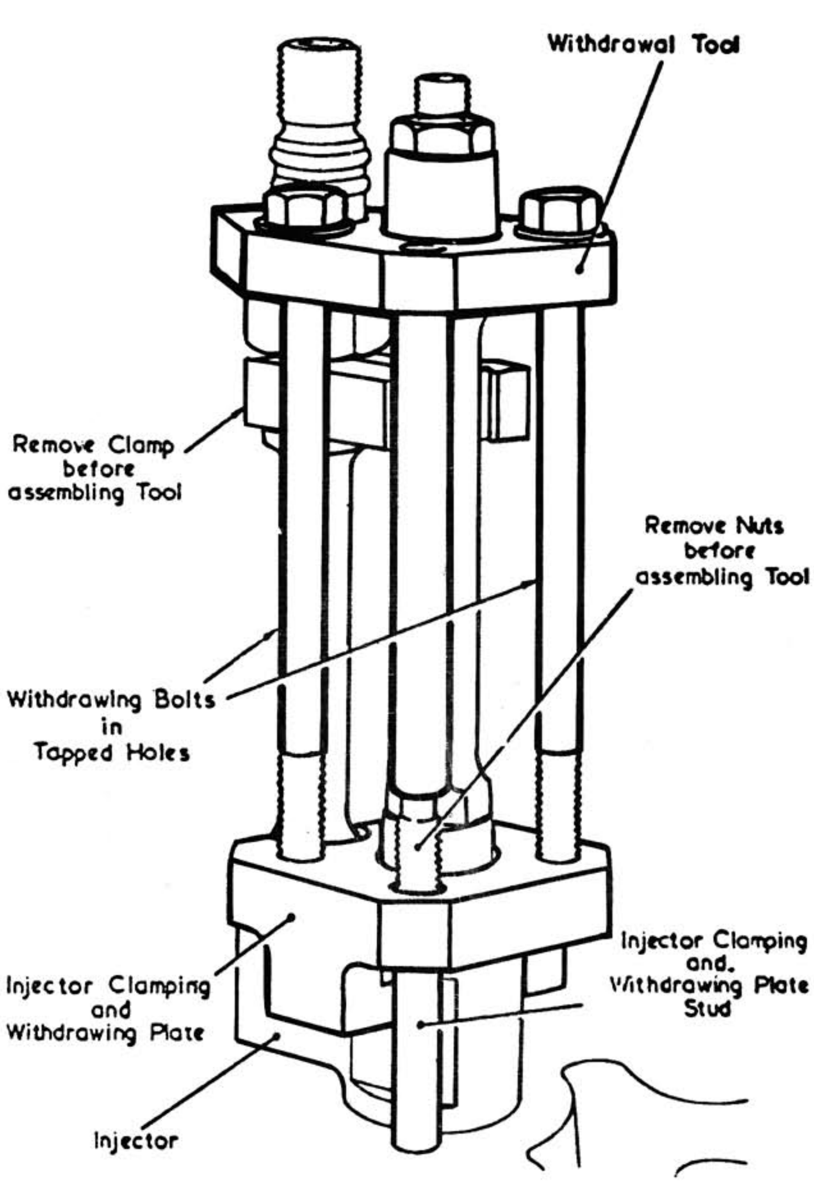

FIG 15 FUEL INJECTOR WITHDRAWAL

CYLINDER HEAD VALVE SPRINGS (MAINTENANCE) (all engines)

It is required to examine the valve springs, if any spring is found damaged or broken, the spring can be changed in the following manner (provided no valve damage is present).

(1) Observe all safety precautions.

(2) Open decompressors.

(3) Bar engine until the piston of the cylinder concerned is at T.D.C. compression stroke (all valves closed).

(4) Remove cover, injector H.P. and leak off pipes and fuel leakage trough.

(5) Release rocker bracket (4 $\frac{5}{8}$ BSF self locking nuts) and lift off. BE CAREFUL NOT TO LOSE OR DISPLACE THE OIL TRANSFER TUBE UNDER LEFT HAND ROCKER PILLAR.

(6) Remove push rods, slacken off jubilee clips on push rod guard tubes.

(7) Remove nuts and take off intermediate cover.

(8) Remove valve bridge pieces and remove injector, using correct tool. Fig. 15.

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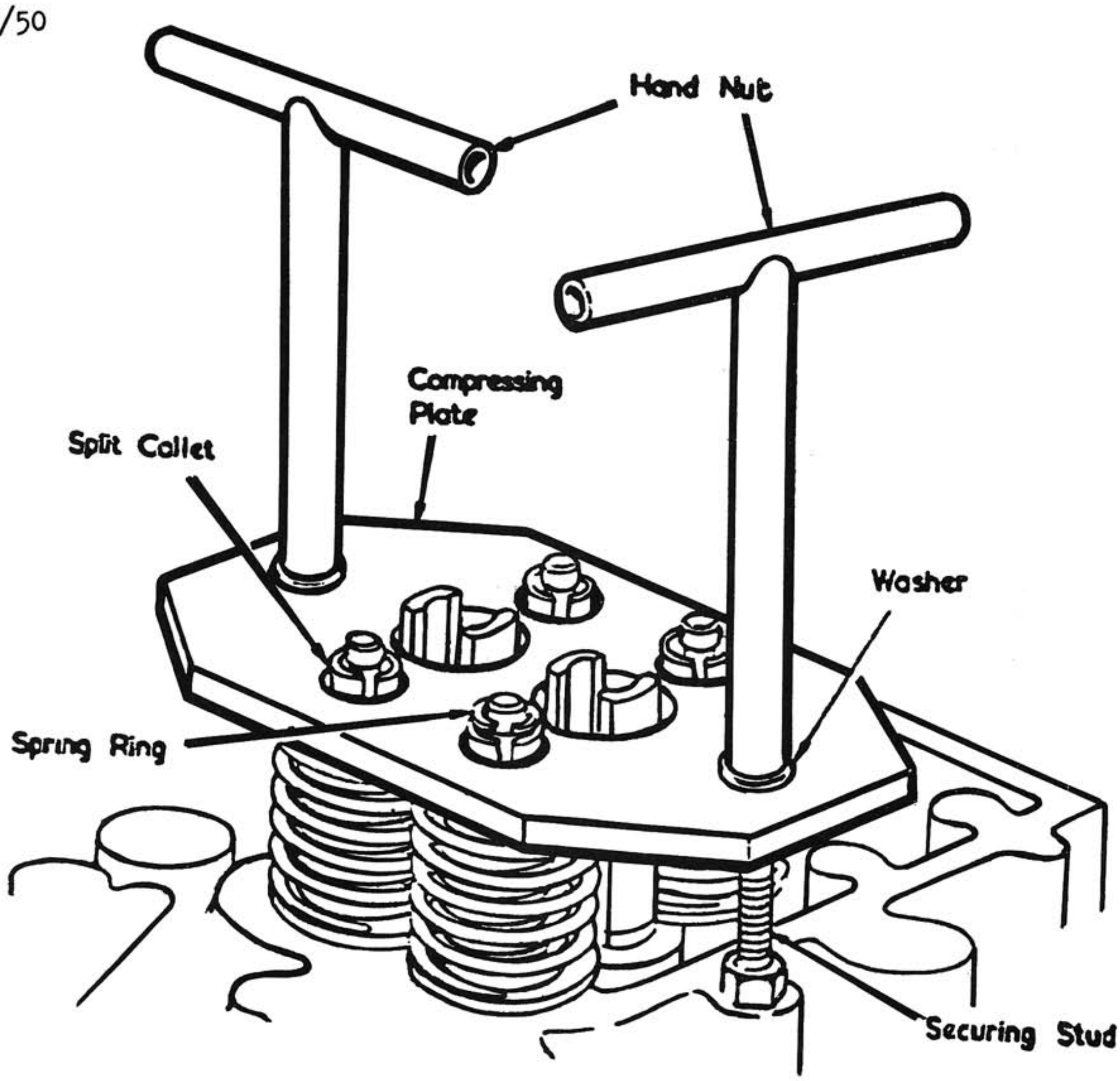

FIG 16 VALVE LIFTING TOOL

(9) Fit temporary plug in injector tube.

(10) Remove spring ring above the collet on the valve concerned and fit valve lifting tool. Fig. 16.

(11) Screw down on the hand nuts evenly, until the spring plates are sufficiently depressed to enable the split collets of the valve concerned to be removed.

(12) Release the hand nuts evenly. Remove the lifting tool and withdraw the top spring plate and faulty valve spring.

(13) Renew spring refit lifting tool. Tighten hand nuts evenly until split collets can be refitted.

(14) Remove lifting tool and refit spring ring.

(15) Refit intermediate cover and secure push rod guard jubilee clips.

(16) Refit push rods.

(17) Ensure oil transfer tube is in place and sealing ring is fitted, then refit and secure rockers.

(18) Reset tappet clearances.

(19) Remove injector tube temporary plug and refit injector, fit fuel leakage trough and secure H.P. and leak off pipes.

(20) Run engine and ensure no leaks or unusual noises.

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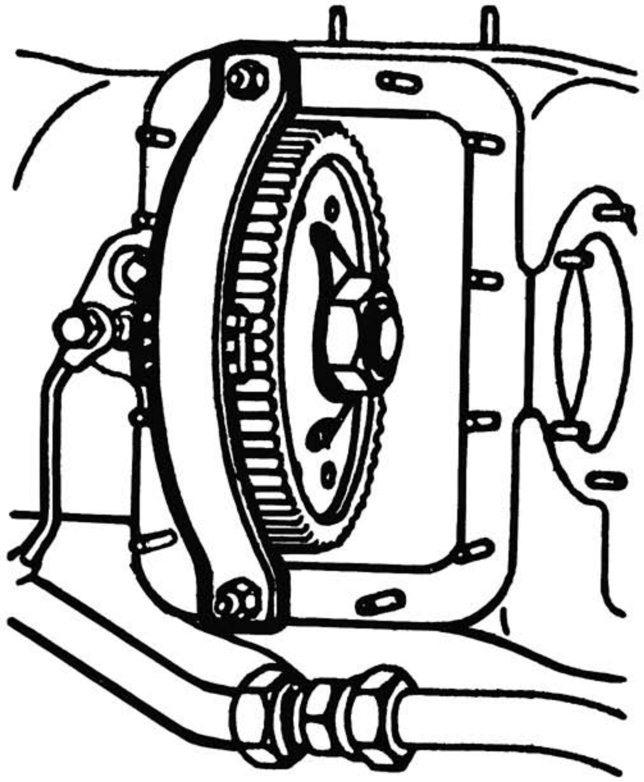

FIG 17 GEAR WHEEL LOCKING DEVICE

CAMSHAFTS

Are the same as the 12 C.S.V.T. 12 S.V.T. engines with the exception that:-

No. 8 and 16 cylinder cams are part of the shaft and cannot be changed individually.

If any cam is damaged that section of camshaft has to be changed.

MAINTENANCE

Inspect cams and followers for signs of wear and distortion. The camshaft gear wheel lock nut may have to be checked for tightness in the following manner:-

(1) Remove camshaft gear wheel cover from both banks.

(2) Fit gear wheel locking device to both camshaft gear wheels. Fig.17.

(3) Check security of lock nuts and tighten if necessary.

(4) Remove locking device and fit cover.

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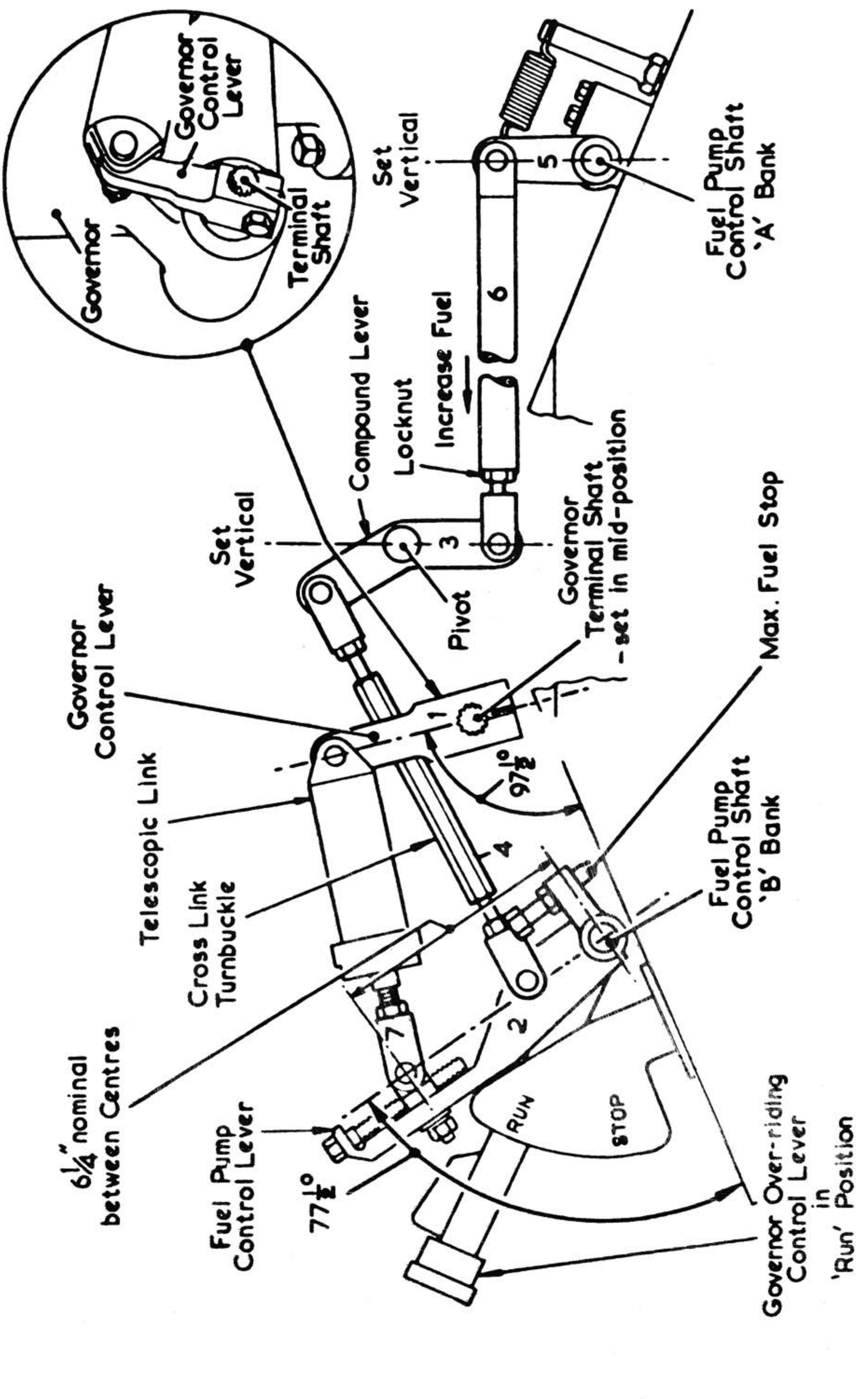

FIG 18 FUEL PUMP CONTROL MECHANISM

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CAMSHAFT CHAIN, TIMING AND ADJUSTMENT

This is the same as detailed on pages 50 - 60 in the 12 C.S.V.T. 12 S.V.T. Book. The only difference being the injection point which must be used.

INJECTION TIMING B.T.D.C. compression stroke

Cylinder No.	1	2	3	4	5	6	7	8
B Bank	25½	25	24½	24	24	24	24	24
A Bank	26½	26	25½	25	25	25	25	25

On modified camshafts the free end of the shaft will be marked CORR. If this is the case the injection timing is:-

B Bank 23^o B.T.D.C. all cylinders

A Bank 24^o B.T.D.C. all cylinders

CHANGING INDIVIDUAL PUMP

Before removing fuel pump:- with engine shut down and the over-riding lever at RUN record accurately the distance between the pump body and the rack stop collar on No. B8 pump (nearest governor). This reading is the no fuel point reading and should not be less than 28 mm. This reading must be used as the No Fuel Gauge when fitting a new pump. Now proceed as page 66 & 123 12 C.S.V.T. 12 S.V.T. Book.

SLACK FUEL PUMP TAPPETS

If any tappets found loose proceed as page 68, item (a) - (i) in 12 C.S.V.T. 12 S.V.T. Book.

FUEL CONTROL MECHANISM

Setting fuel control linkage and fuel pump rack to 'balance' and no fuel position.

16 C.S.V.T. class 50 only. Using 11.5 mm balance setting and 28-30 mm no fuel setting gauge.

IMPORTANT Before any linkage is disturbed record accurately the no fuel rack reading on No. B8 pump (with shut down handle at Run) This reading must be used as the no fuel reading and it should not be less than 28 mm or greater than 30 mm.

INTRODUCTION Refer to Fig.18.

A new or reconditioned governor is rig tested and is not adjusted when connecting to the fuel control linkage.

The governor is 'matched' to the engine i.e. the design H.P. 2700 by adjustment of:-

(1) Fork end rod 7.

(2) Effective length of lever 2.

cont...

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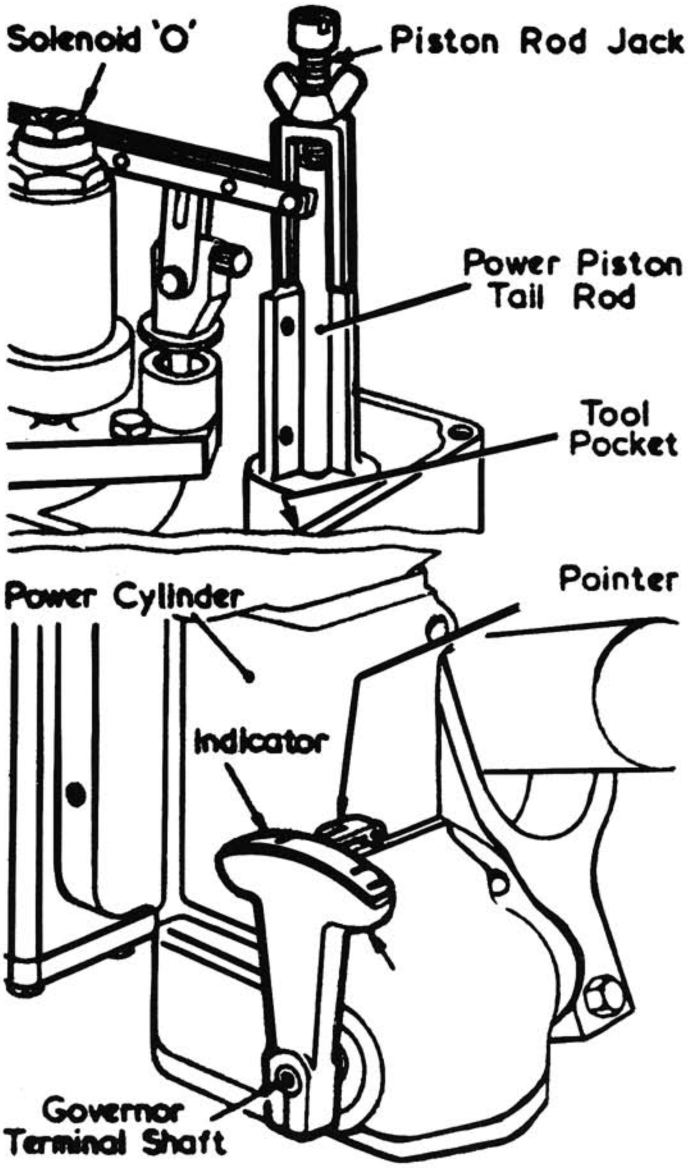

FIG 19 FUEL CONTROL LINKAGE

This adjustment is set on load bank at Works and MUST NOT BE ALTERED AT THE DEPOT.

Should attention become necessary because of stiffness of linkage or wear, the position or length of linkage must not be altered and the following adhered to when linkage is refitted.

(1) Observe all Safety Precautions.

(2) Set linkage to NO FUEL (engine shut down) position.
Overriding lever in RUN position.

(3) With the overriding lever at RUN ensure that the gap between the pump body and the stop is the same as recorded off No. B8 pump which should not have been less than 28 mm. Adjust individual pumps if necessary.

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(4) Ensure that when the overriding level is placed to stop position the fuel pump rack reading is 30 mm.

(5) Set the governor overriding control at RUN by use of the piston rod jack on the governor power piston. See Fig. 18.

(6) Turn the control shafts until the governor rack reads 8.2 insert balance setting gauge 11.5 mm without force or slackness between the fuel pump rack collar and the body of the pump nearest the fly wheel end of B bank. Hold the control shafts at this position and using an identical Balance Point gauge 11.5 mm check the rack measurement of the fuel pump at the fly wheel end of A bank.

(7) The rack setting of both pumps should be substantially equal, but if there is a sign ficant difference it will indicate that the fork end of rod (6) requires adjustment.

(8) The rack settings of all pumps must be checked with the Balance Point gauge, adjustment of individual pumps at the Balance Point may be necessary.

(9) Check that any adjustments carried out at the Balance Point have not resulted in any rack measurements being less than the No Fuel gauge setting which may cause the engine to overspeed, or more than the 'Gov. minimum' (shut down) setting, which could cause damage to the fuel pumps.

Important

It is important that no fuel pump rack reading exceeds 30 mm or is less than 28 mm in the shut down position.

Maximum Stop

Must be set on the load bank, but a check can be made as to its correct setting by taking loco on full load run and ensuring the gap between the maximum stop screw and the crankcase is 0.012" - 0.015". at maximum engine R.P.M. on full load.

CHANGING GOVERNOR AT DEPOT

When coupling the fuel control mechanism to the governor:- The governor can be coupled at the terminal shaft in the no fuel position then proceed as in items 2 - 9,

FUEL CONTROL MECHANISM (MAINTENANCE)

Clean external linkage between the governor control rods and fuel injection pumps, ensure that shaft and linkage movement is free and lightly lubricated with engine lubricating oil. Check that with the free movement of the fuel rack on each fuel injection pump the full fuel setting can be obtained. If any defect is found or adjustment is required, this must be reported to the supervisor.

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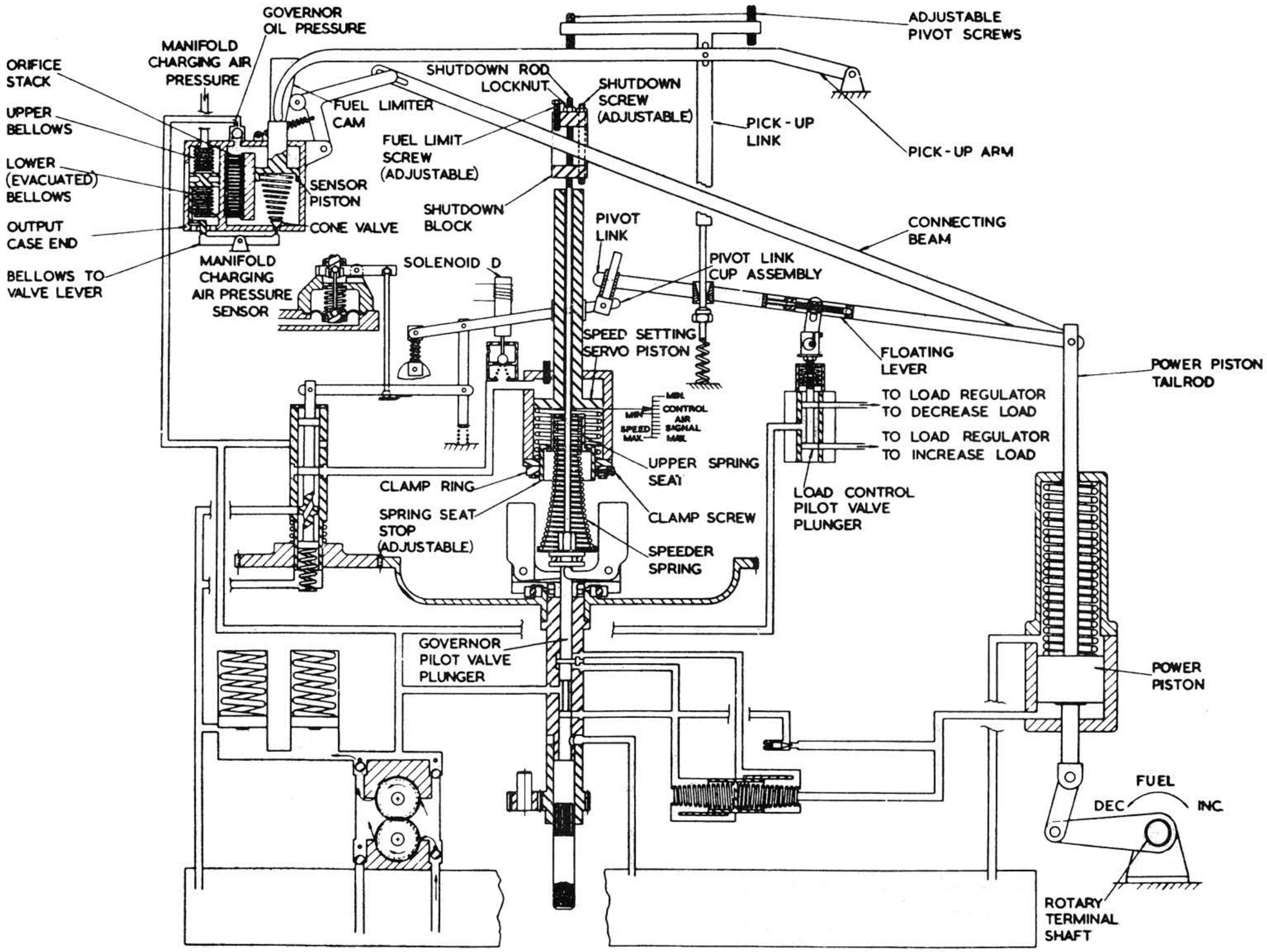

FIG 20 THE WOODWARD GOVERNOR

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GOVERNOR

INTRODUCTION

This governor is very similar to the Class 31 Governor. The main difference being:-

(1) Engine oil is used to operate the load control vane motor no torque detection switch fitted.

(2) The low lub oil pressure shut down operates at 36 p.s.i. (immediate at 850 R.P.M.) at 18 p.s.i. (15 sec. delay at idling)

(3) The shut down solenoid de-energises to shut engine down.

(4) A Turbo Charger protection unit and fuel limiter is fitted.

(5) Different air setting. (See below *)

Besides the differences above the function and operation of the governor details can be found on pages 88 - 104 in the 12 C.S.V.T. 12 S.V.T. Book.

TWO-SLOPE DE-RATING PRESSURE BIAS LOAD CONTROL Fig. 21.

Purpose of Apparatus

To prevent overloading in event of Blower failure.

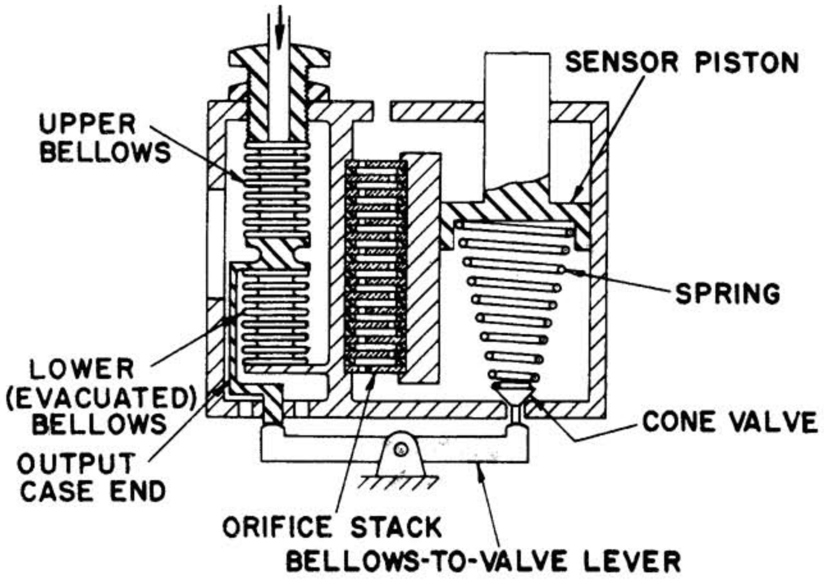

FIG 21 MANIFOLD CHARGING AIR PRESSURE SENSOR

* Engine responds at 15 p.s.i. at 20^{o} position on controller.

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Operation - with turbo chargers functioning correctly.

(1) Charge air (from manifold) enters sensor unit pressure down bellows.

(2) Bellows to valve lever moves down on its left hand side and up on its right.

(3) Cone valve is unseated and oil around spring (which is supplied through a restrictor stack) is vented to governor sump).

(4) Sensor piston moves down (because of unrestricted governor oil pressure on top of piston).

(5) The cone valve is re-seated and oil pressure builds up again and a balance takes place between the sensor piston and the bellows (the cone valve is normally just off its seat).

(6) The only thing to alter the balance is charge air pressure change at the bellows.

(7) Because the sensor piston moved down (item 4) the pick up arm moves down and pick up link moves down which is linked to the floating lever.

(8) Because of the slot in the pick up link, the load control pilot valve is now free to move down to increase load on engine.

Operation - low or no charge air (charger fault)

(1) Charge air low or fails at upper bellows.

(2) Bellows to valve lever moves up on its left hand side and down on its right.

(3) Cone valve seats and oil pressure builds up under sensor piston.

(4) Sensor piston rises, lifts pick up arm, which lifts pick up link, which picks up floating lever and load control pilot valve.

(5) Thus the load control pilot valve is held up which decreases load on engine.

The adjustable pivot screws determine the proportion of pick up link movement for a given sensor movement.

The adjustable stop screw in the pick up arm determines the point beyond which an increase in charge air no longer affects the load control system.

CHARGE AIR PRESSURE FUEL LIMITER Fig. 20.

Purpose of apparatus - to prevent over fueling on acceleration.

Operation - acceleration.

(1) Driver opens controller fully.

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(2) Speed setting piston moves down which causes the governor pilot valve to supply oil to the power piston which moves up to increase fuel.

(3) At the top of the sensor piston is a fuel limit cam attached to this is a connecting beam which passes underneath the shut down block on the speed setting piston and is attached to the power piston.

(4) With insufficient charge air build up the sensor piston is up which holds the connecting beam up under the shut down block and prevents the speed setting piston moving down further which prevents the governor pilot valve supplying oil to the power piston to increase fuel.

(5) When sufficient charge air is obtained, the sensor moves down, the connecting beam moves down, thus allowing downward movement of the speed setting piston to increase fuel.

OVERSPEED UNIT

INTRODUCTION

This unit is identical to the one fitted to the Class 31 and 37 except the 1/32nd clearance is 0.055" on the 16 C.S.V.T. engine.

MAINTENANCE

It is required on 'D' exam to check the operation of the overspeed unit.

To check overspeed proceed as follows:-

IMPORTANT 1000 R.P.M. MUST NOT BE EXCEEDED AND UNIT MUST NOT BE RESET WITH ENGINE RUNNING.

(1) Observe all safety precautions.

(2) Bring engine to normal.

(3) With reverser in Engine Only, gradually raise engine speed from idling (450 R.P.M.) to max (850 R.P.M.)

N.B. Listen for any signs of excess vibration between 450 - 850 R.P.M. If excessive vibration is present this could point to:-

(1) Vibration damper fault.

(2) Power unit holding down bolts incorrectly tightened.

(3) Fuel starvation.

(4) With engine at working temp (and at 850 R.P.M.) place hand tacho on the end of auxiliary generator.

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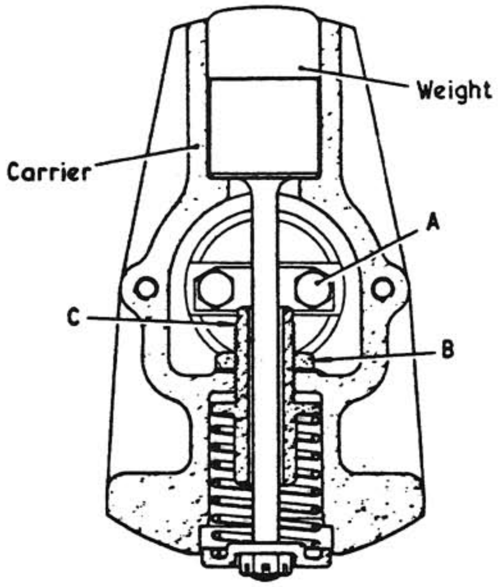

FIG 22 OVERSPEED UNIT

(5) Raise engine speed to overspeed condition by pressing downwards on the telescopic link near governor.

(6) Ensure overspeed unit stops engine at 1000 R.P.M. (a shock will be felt at telescopic link when overspeed unit operates.

DO NOT EXCEED 1000 R.P.M.

(7) If speed is correct - reset unit.
If incorrect proceed as follows:-

(8) Remove cover of overspeed unit.

(9) Release lock nut 'B'. Fig. 22.

(10) Screw adjuster C clockwise to raise tripping speed.
Screw adjuster C anti-clockwise to lower tripping speed.

N.B. Any adjustment must be in small stages as any appreciable alteration of the spring will alter tripping speed considerably.

(11) Secure lock nut 'B' use new tab washer, refit cover and place reset handle in its clip.

(12) Reset tripping speed as in 2 - 7.

(13) If trip speed is correct reset handle and secure.

(14) If trip speed is not correct, repeat 8 - 12.

(15) If a new unit is required remember to set clearance at 0.055" between weight and paw.

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TURBO BLOWER

INTRODUCTION

The 4 Napier blowers are similar to the blowers fitted to the 12 C.S.V.T. and 12 S.V.T. engines. The slight differences are below:-

AIR SUPPLY TO TURBINE GLAND LABYRINTH SEAL (MAINTENANCE)

The air pressure to turbine gland labyrinth seal must be checked as follows:-

(1) Remove $\frac{3}{8}$" B.S.P. plug from the distribution block situated at the point at which the low pressure pipe from the reducing valve bifurcates to each blower.

(2) Connect pressure gauge into distribution block.

(3) Start engine and obtain approximately 85 p.s.i. main reservoir pressure.

(4) Check that the gauge fitted into the distribution block reads between 12 and 14 p.s.i.

(5) Adjust reducing valve, if necessary, to give a reading within this range, but if this is not possible report to the Supervisor.

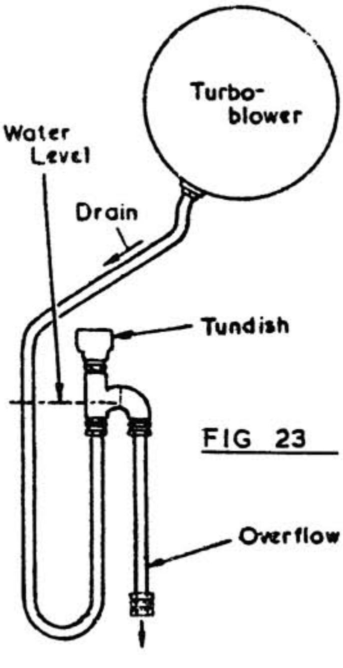

FIG 23

TURBO BLOWER DRAIN PIPE WATER SEAL Fig. 23.

The drain from the base of the turbo blower turbine casing prevents the accumulation of water during periods when the loco is idle. The drain terminates in an open U tube water seal, which prevents blocking of the pipe due to hardening of combustion products.

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TURBO BLOWER IMPELLER WASHING

INTRODUCTION

Regular cleaning of impeller increases the efficiency of the blower.

CLEANING SOLUTION

4 pints Emulsol B.R. Cat. No. 9/7/20311
4 pints water

This solution should be prepared in a 1 gallon capacity polythene container and must be shaken vigorously to form an emulsion.

CLEANING PROCEDURE (MAINTENANCE)

NOTE Cleaning to be carried out before oil is changed in turbo charger sumps.

(1) Observe all safety precautions.

(2) Start engine, bring to normal working temperature.

(3) Place F.&.R. handle in the E.O. position and raise engine speed to approx. 600 R.P.M. (controller position 6).

(4) Using syringe (Telcalemit Type 162 DTT 1421) inject 2 pints of the solution (approx. 4 fillings) into each turbo blower in turn by fitting the nozzle of the syringe into the self sealing adaptor on the pipe connector to the compressor casing.

(5) On completion return the controller to the OFF position (i.e. engine idling) and run the engine for at least 5 minutes before shutting engine down. This will clear exhaust system of any remnants of the washer solution.

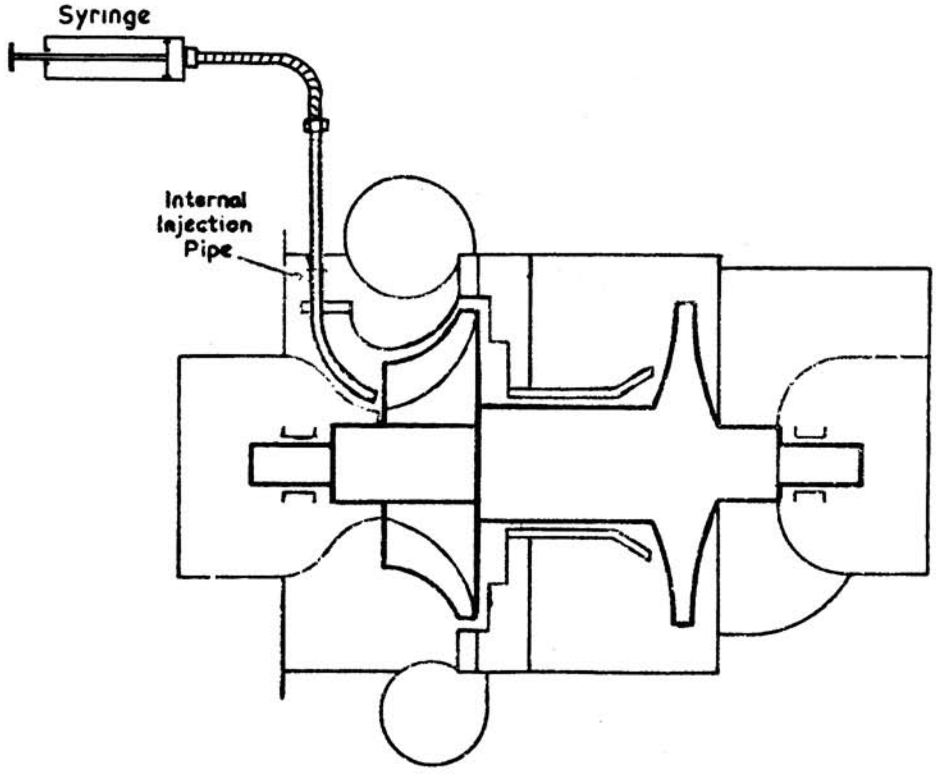

FIG 24 TURBO-BLOWER IMPELLER WASHING

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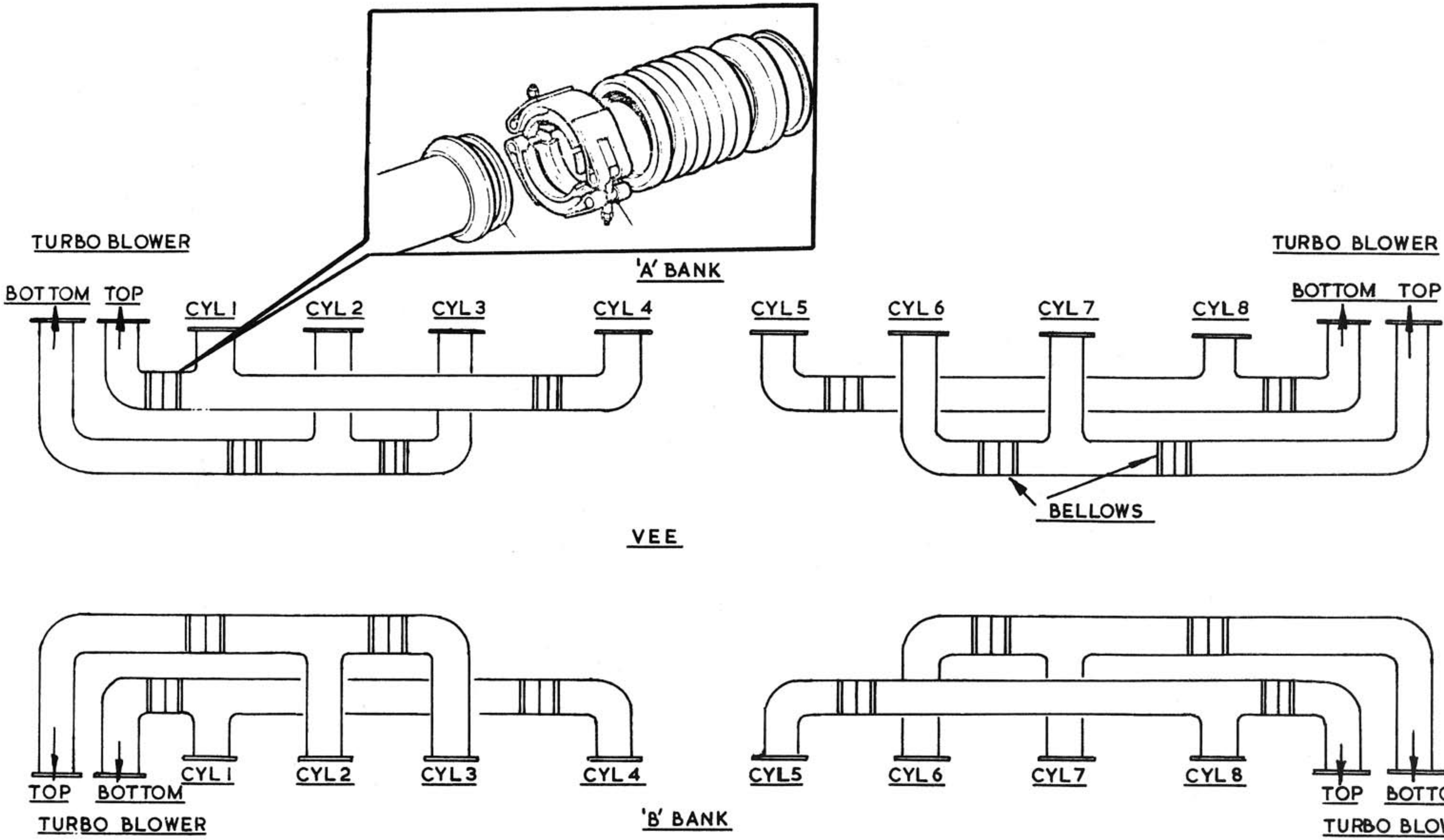

FIG 25.16 C S V T EXHAUST PIPES

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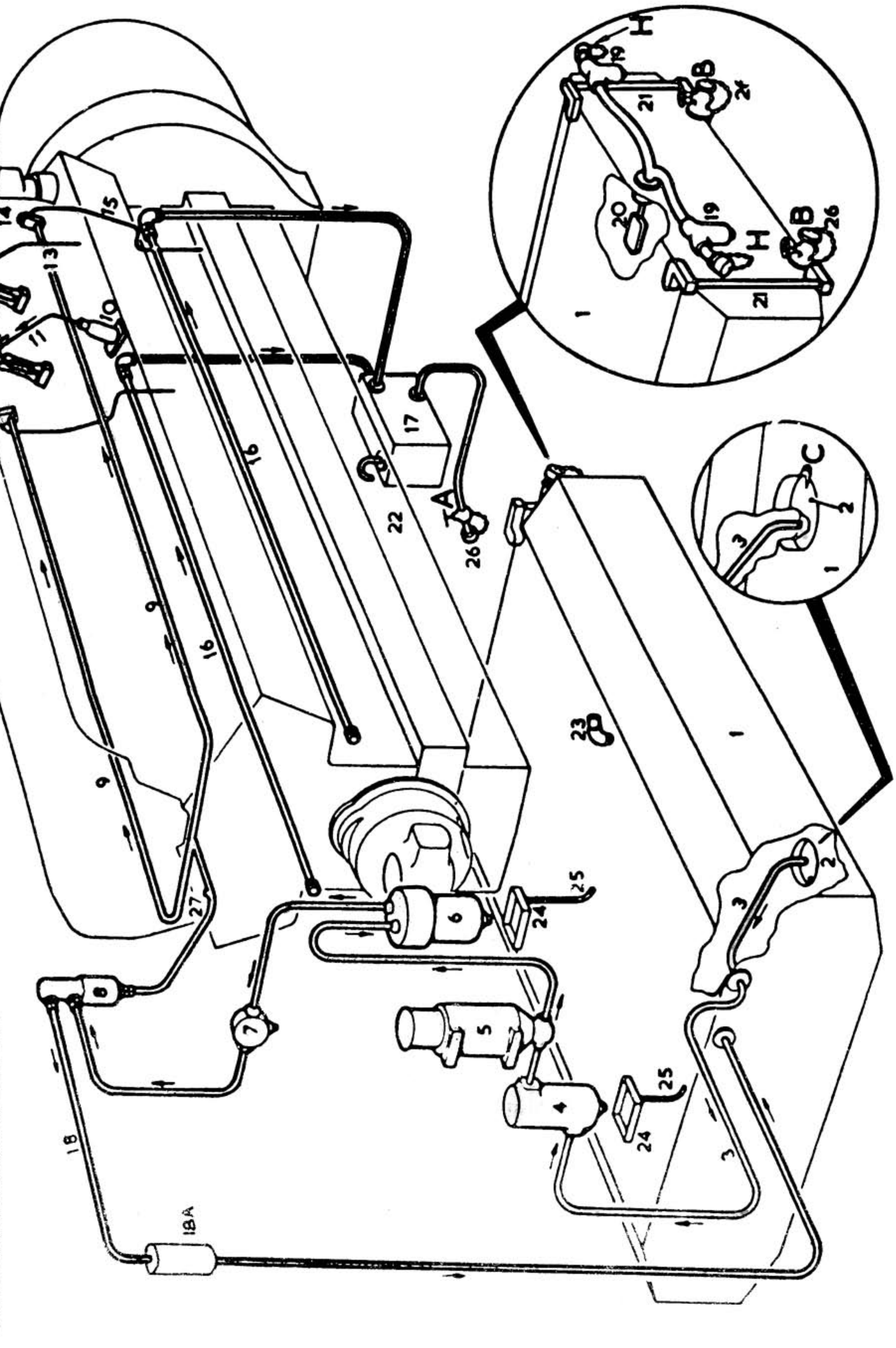

FIG 26 FUEL OIL SYSTEM

1	MAIN FUEL TANK
2	MAIN FUEL TANK SUMP
3	SUCTION PIPE TO MOTOR-DRIVEN PUMP
4	SUCTION STRAINER
5	MOTOR-DRIVEN FUEL SUPPLY PUMP
6	FILTER
7	PRESSURE DAMPING VESSEL
8	AIR SEPARATOR (RELIEVES AT 10 P.S.I.)
9	FUEL FEED RAIL
10	INJECTION PUMP (EACH CYLINDER)
11	SUPPLY TO INJECTOR
12	INJECTOR
13	LEAK-OFF FROM INJECTOR
14	FUEL FEED RAIL VENT
15	DRAIN FROM VENT TO BEDPLATE VALANCE
16	FUEL DRAIN FROM CAMBOXES
17	FUEL DRAINAGE COLLECTING TANK
18	FUEL RELIEF RETURNED TO MAIN FUEL TANK
18A	ANTI-SYPHON UNIT
19	FILTER
20	FLOAT VALVE
21	CONTENTS GAUGE
22	DRAINAGE COLLECTING TANK VENT AND OVERFLOW
23	MAIN FUEL TANK VENT AND OVERFLOW (EACH SIDE OF LOCO)
24	DRIP TRAY
25	DRIP TRAY DRAIN TO ENGINE TRAY
26	BLANKING CAP AND CHAIN
27	TEST PRESSURE GAUGE CONNECTION

DRAINING AND REFILLING POINTS

A	DRAINAGE COLLECTING TANK DRAIN VALVE
B	MAIN FUEL TANK DRAIN VALVE
C	MAIN FUEL TANK SUMP DRAIN PLUG
H	PRESSURE FILLER

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FUEL OIL SYSTEM

DESCRIPTION OF CIRCUIT

Fuel is drawn from tank through suction strainer by a motor driven fuel pump and is delivered to the fuel injection pumps through a fuel filter, a pressure damping vessel and an air separator which incorporates a pressure relief valve. Fuel and air is discharged by the air separator and piped through an anti-syphon tank back to the main tank.

Fuel leak off from the injectors is piped into the camboxes, which are in turn drained into a collecting tank. On modified engines the fuel goes through a separate pipe to waste from the leak off.

PRIMING SYSTEM

When any part of the fuel system has been dismantled the system must be primed as follows:-

Start motor driven fuel pump (5) open vents at the end of each fuel rail (14) by Nos. 1 and 8 cylinders.

Close vents when all air is removed.

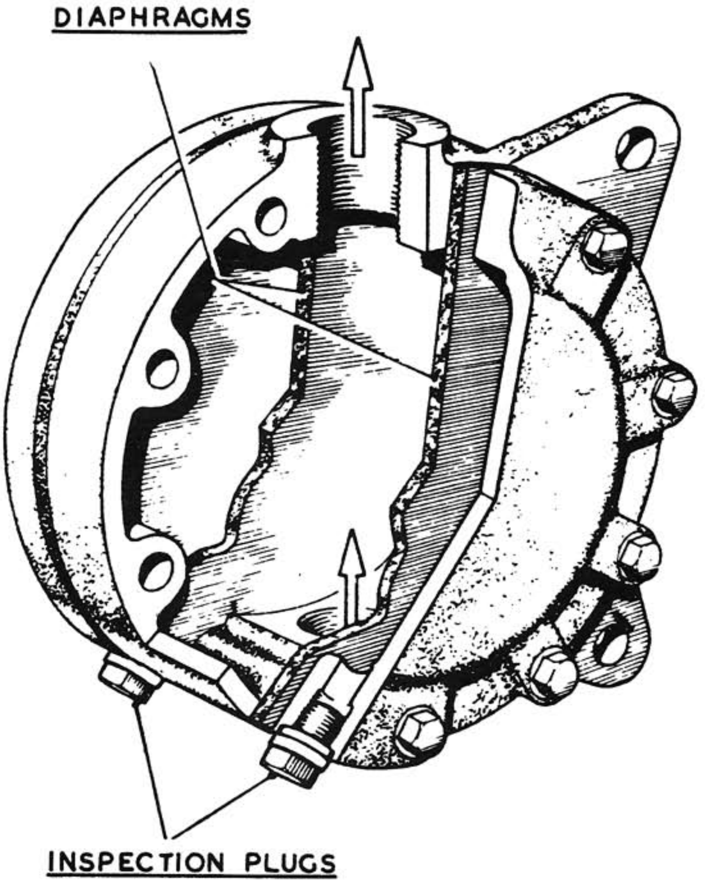

FIG.27. DAMPING VESSEL

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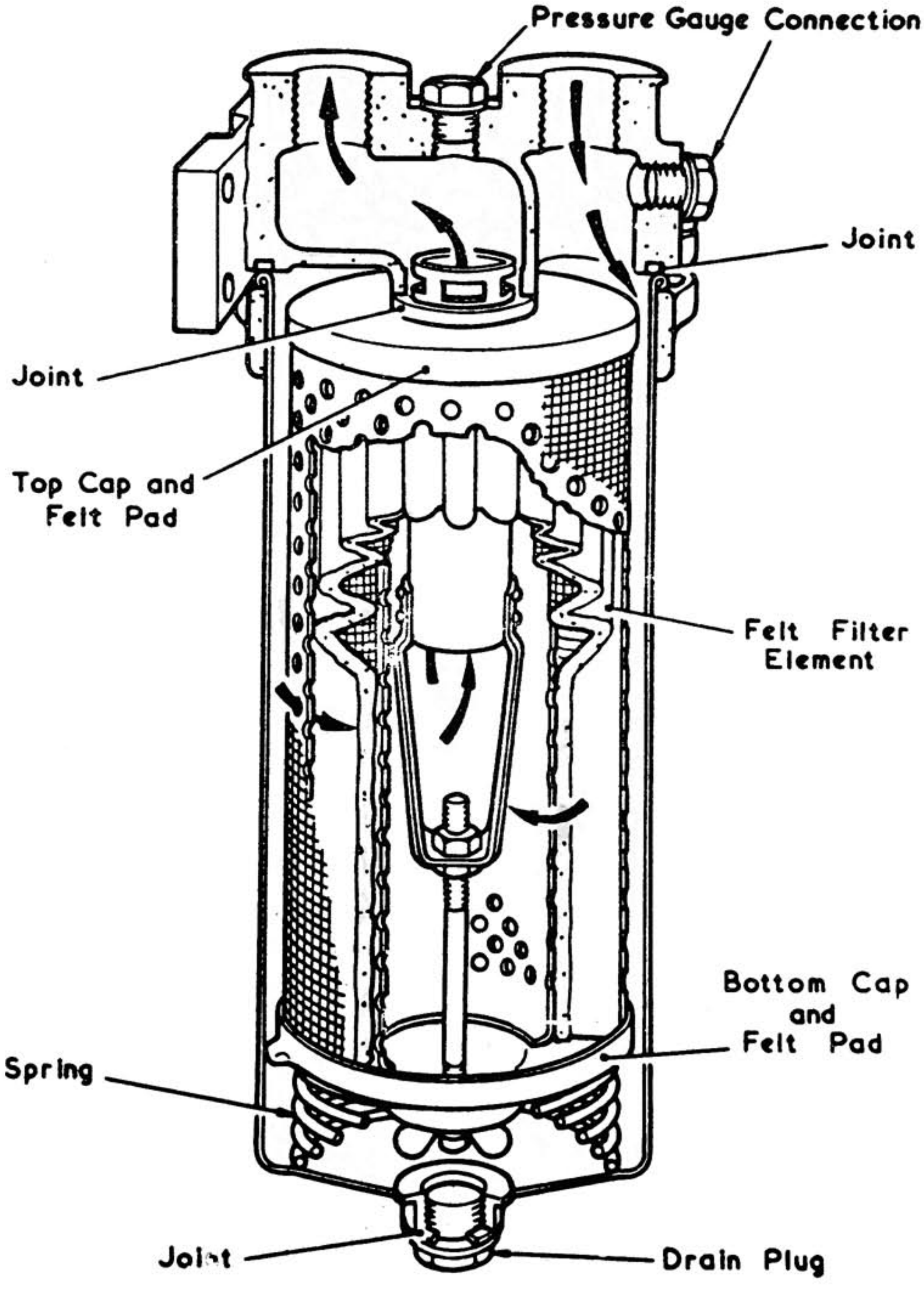

FIG28. FUEL FILTER

DAMPING VESSEL (7) Fig. 27.

Purpose - To dampen pressure fluctuation set up by injection.

Maintenance

Remove both inspection plugs and if any fuel oil is present the diaphragms must be renewed as follows:-

(a) Disconnect the pipework.

(b) Separate the castings by removing the bolts and renew both diaphragms.

(c) Clean the joint faces then re-assemble the unit, ensuring the bolts are evenly tightened to avoid distortion. Refit inspection plugs checking that the joint washers are in good condition.

(d) Reconnect to pipework.

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MAINTENANCE - C EXAM Fig. 28.

This filter consists of a corrugated fabric element mounted between an inner and outer tube of perforated metal and gauze, the wing nut securing the filter element assembly must NOT be unfastened but the filter cleaned without dismantling the element. Drain the casing through the drain plug, remove securing nuts (NOT WING NUT), withdraw casing and filter assembly. Completely immerse filter element in clean fuel oil to clean, replace in casing and refit to head casting. Ensure drain plug is tight and filter casing correctly secured. Prime the system.

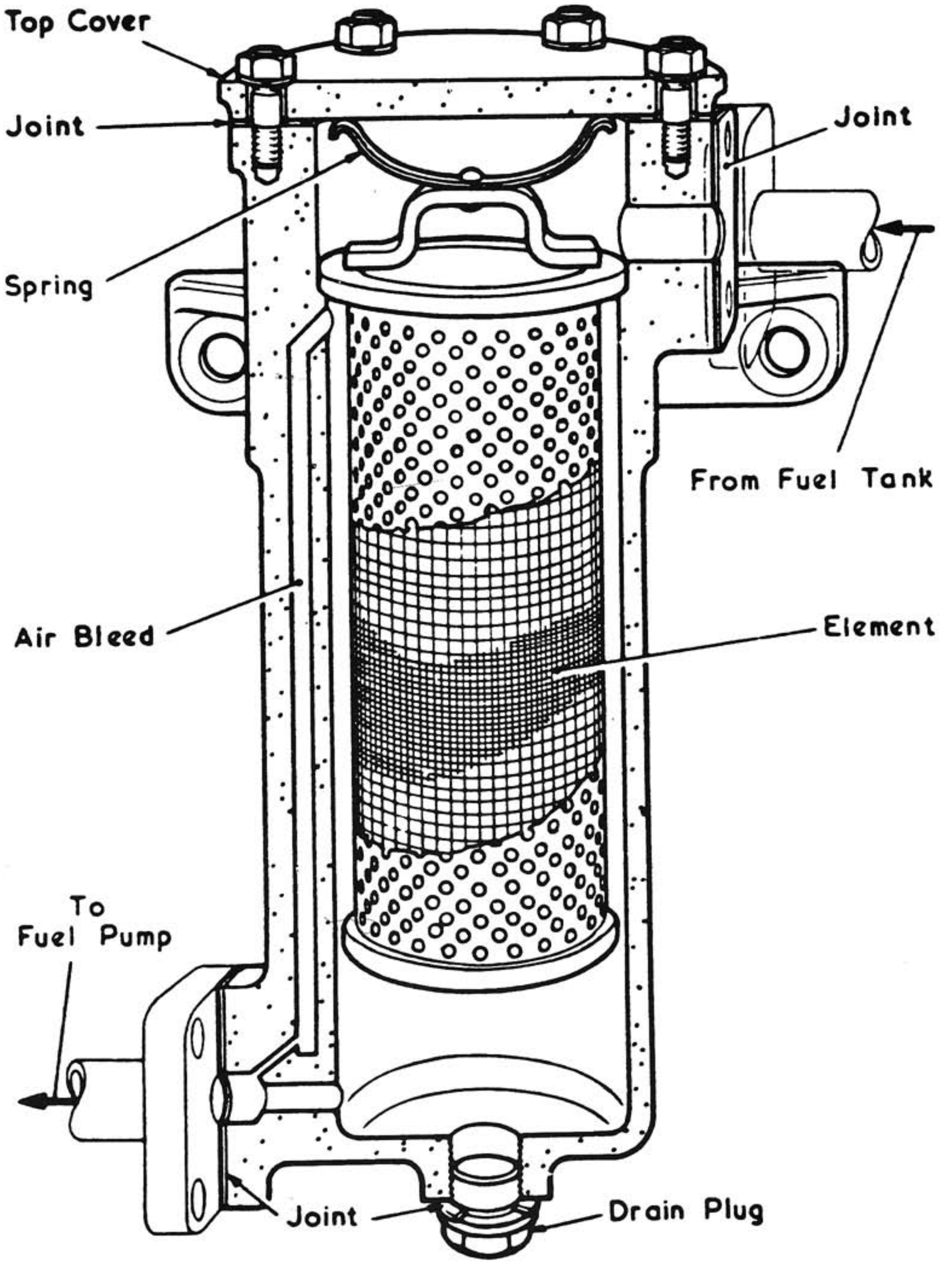

FIG 29 FUEL SUCTION STRAINER

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MAINTENANCE - D EXAM

Remove the drain plug and drain casing, then remove the securing nuts and withdraw the casing and filter assembly. Remove element and dismantle. Fit new filter element, felt pads, joint rings and sealing washer, ensuring that the element is correctly re-assembled. Clean out casing before replacing filter element into position, replace casing and ensure drain plug is correctly tightened. Prime system.

FUEL SUCTION STRAINER Fig. 29.

It is essential to avoid failure in service that strainer is clean according to MP 11 Maintenance Schedule.

The fuel suction strainer is a combined suction vessel and fuel strainer and contains a detachable strainer element of metal gauze.

The fuel suction strainer is located above the outlet from the fuel tank and the inlet of the fuel supply pump. It ensures that a head of fuel is always available to the supply pump when starting, regardless of the fuel level in the fuel tank.

After a period of shut-down the fuel pipe between the fuel tank and suction strainer drains off fuel oil.

When the motor driven fuel supply pump is started the fuel level in the suction strainer falls, and any air contained in the fuel pipe is drawn into the suction strainer.

Should air be allowed to continuously accumulate in the suction strainer a failure of the engine fuel supply would result. This condition is prevented by an air bleed which entrains the air in the fuel leaving the suction strainer.

Air entrained in this way does not affect the fuel supply pump operation and re-separates in the combined air-separator and relief valve.

IMPORTANT

When this filter is cleaned at maintenance, it is essential to prime the bowl with clean fuel.

MAINTENANCE - C EXAM

Remove cover of suction strainer casing, withdraw gauze element and wash in clean fuel oil. Examine gauze for defects - obtain replacement element if gauze is damaged. Fit element and replace casing cover after ensuring that joint is in good condition.

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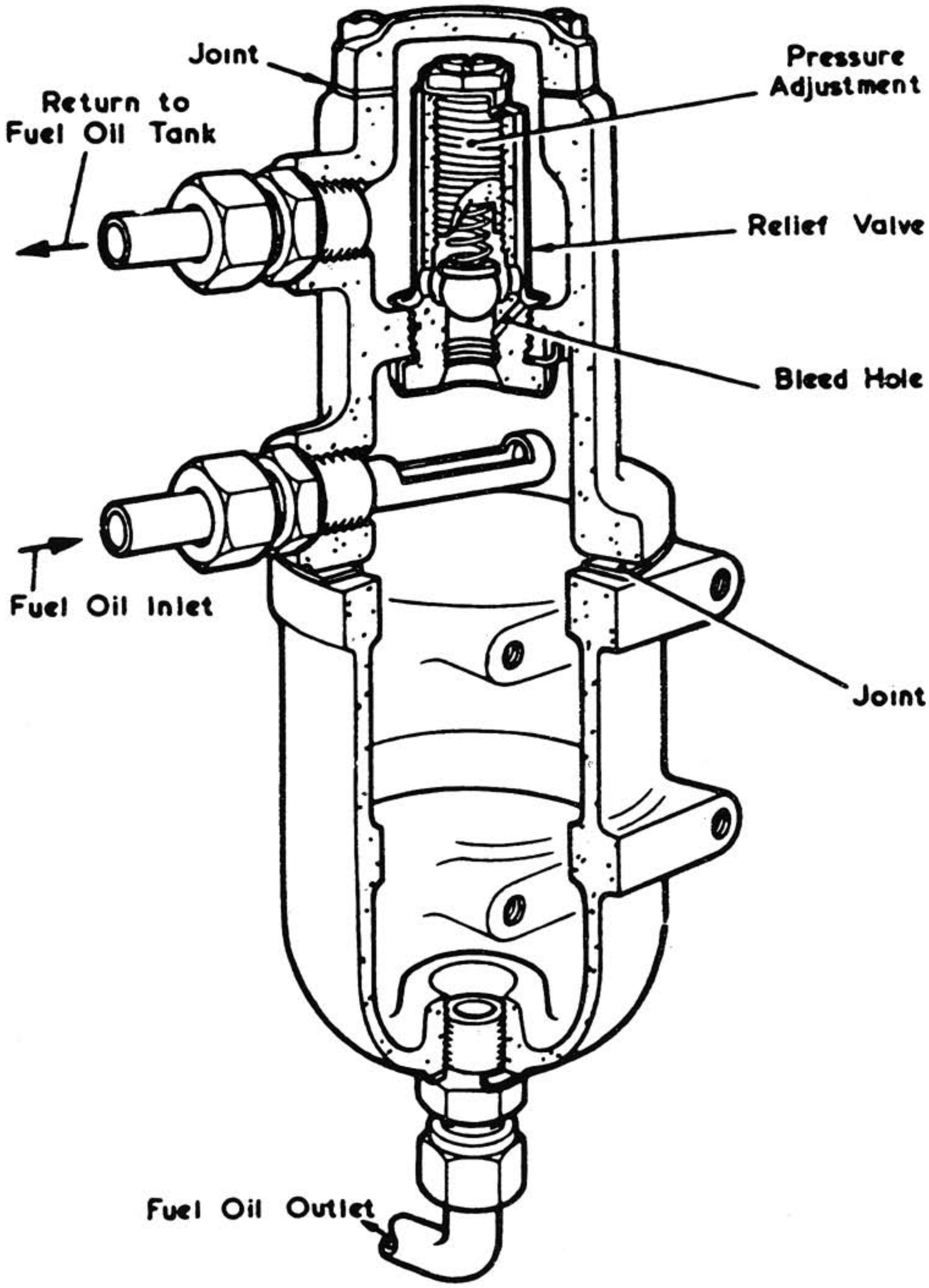

FIG 30 AIR SEPARATOR & RELIEF VALVE

The combined air separator and relief valve is illustrated above.

The function of the air separator is to remove any entrained air which may be in the fuel thus obviating the risk of pump plunger seizure due to fuel starvation.

The relief valve maintains a constant pressure in the rail of 10 p.s.i. (0.70 kg.sq.cm). Full load 16 p.s.i. at idling.

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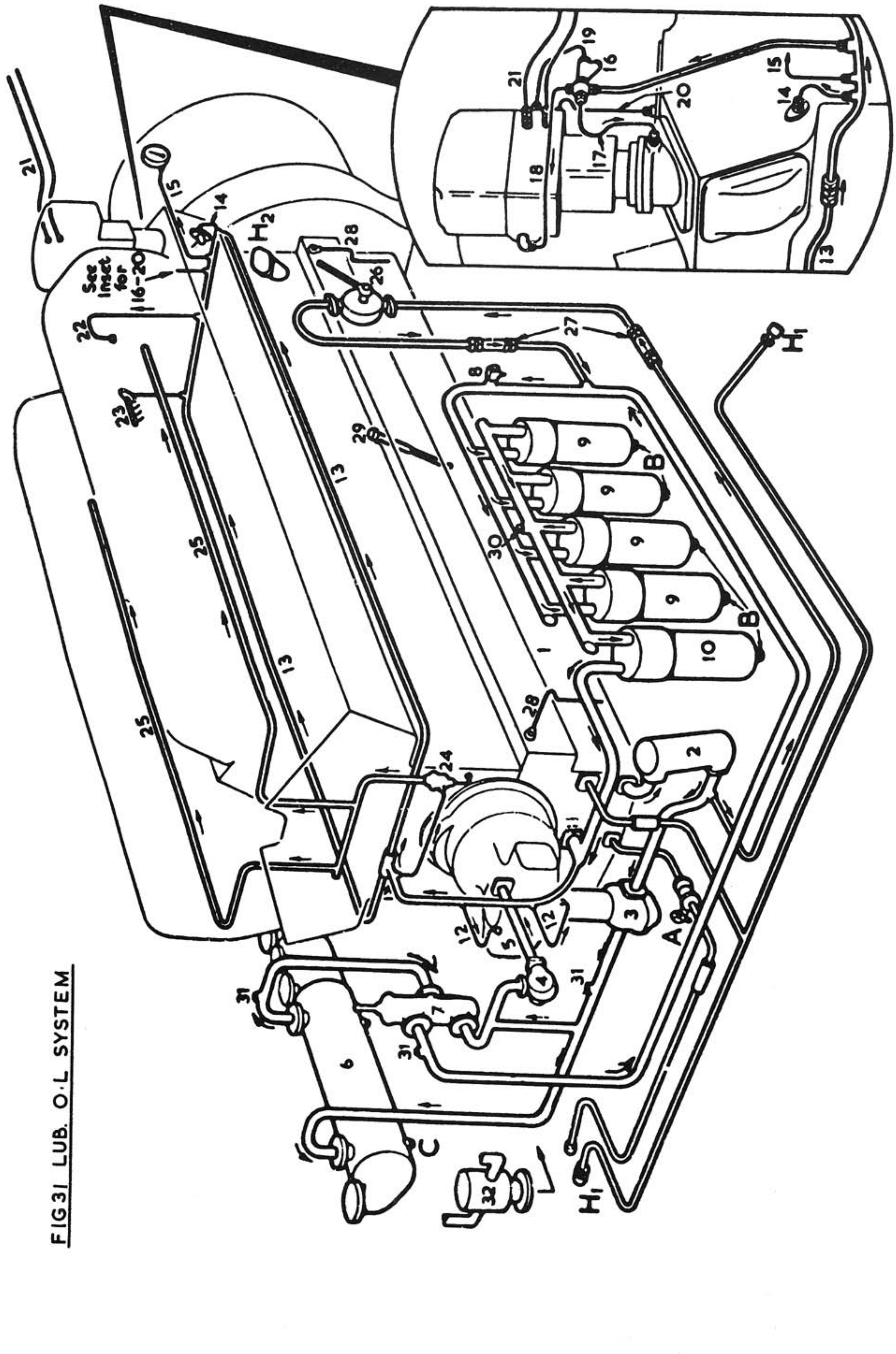

FIG 31 LUB. O.L SYSTEM

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1	BEDPLATE SUMP
2	SUCTION STRAINER
3	ENGINE-DRIVEN PUMP
4	H.P. RELIEF VALVE
5	H.P. RELIEF TO BEDPLATE SUMP
6	LUB OIL COOLER
7	THERMOSTATIC VALVE
8	SAMPLING VALVE
9	FILTER
10	STRAINER
11	INLET TO MAIN SYSTEM
12	H.P. OIL TO AUXILIARY DRIVE
13	H.P. OIL TO CAMSHAFT BEARINGS
14	H.P. OIL TO 'B' BANK CAMSHAFT DRIVE CHAIN SPRAYER
15	H.P. OIL TO PRESSURE GAUGE
16	STRAINER
17	H.P. OIL TO GOVERNOR DRIVE
18	H.P. OIL TO GOVERNOR L.O.P. SHUT-DOWN DEVICE
19	H.P. OIL TO GOVERNOR LOAD CONTROL VALVE
20	DRAIN TO CRANKCASE
21	OIL TO AND FROM GOVERNOR LOAD CONTROL VALVE AND LOAD REGULATOR
22	H.P. OIL TO CAMSHAFT DRIVE CHAIN TENSIONER
23	H.P. OIL TO 'A' BANK CAMSHAFT DRIVE CHAIN SPRAYER
24	PRESSURE REDUCING VALVE
25	L.P. OIL TO VALVE GEAR
26	HAND PRIMING PUMP
27	NON-RETURN VALVES
28	BEDPLATE VALANCE DRAINS (EACH END, EACH SIDE)
29	OIL LEVEL DIPSTICK
30	AIR VENT PLUG
31	THERMOMETER POCKET
32	CRANKCASE BREATHER (ON CHARGE-COOLERS BRACKET ON AUXILIARY DRIVE CASING)

<u>DRAINING AND REFILLING POINTS</u>

A	BEDPLATE SUMP DRAIN VALVE (PADLOCKED)
B	FILTERS AND STRAINER DRAIN COCK
C	LUB OIL COOLER DRAIN COCK (EACH END OF CYLINDER)
H1	PRESSURE FILLER (EACH SIDE OF LOCO)
H2	HAND FILLER ON CRANKCASE DOOR

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LUB OIL CIRCUIT

CIRCUIT DESCRIPTION Fig. 31, page 43.

Oil from the bed plate is drawn through a suction strainer (2) by the engine driven lub oil pump (3) and is delivered to the lub oil system.

The oil normally passes through the lub oil cooler (6) if the temperature is above 149°F. If below 149°F a thermostatic valve (7) allows the oil to by-pass the cooler and go direct to the lub oil filters (9).

From the cooler the oil passes through the filters (9) and a strainer (10) and then into the engine which supplies internally (through drillings in the bed plate, crankshaft and hollow drilled con rod) the main bearings, big and small end bearings.

A pressure relief valve (4) limits the pressure in the system to 60 - 70 p.s.i. Any oil relieved by this valve returns to the engine bed plate.

Just where the supply enters the bed plate a pipe leads off to supply the camshaft bearings (13), the governor low oil pressure device (18), the governor drive (17), the governor load control valve and vane motor (19) and to spray feed the chain (14).

Coming off the supply pipe to the camshaft is a supply through a reducing valve (24) to the valve rockers, push rods and cam followers (25).

A hand operated pump (26) is fitted for the purpose of priming the lub oil system.

LOW OIL PRESSURE PROTECTION

The governor will give a warning light in the cab and stop the engine if the oil pressure falls to 36 p.s.i. (above idling) (18 p.s.i. (at idling). Shut down is immediate above idling and a delay of approx 15 secs at idling.

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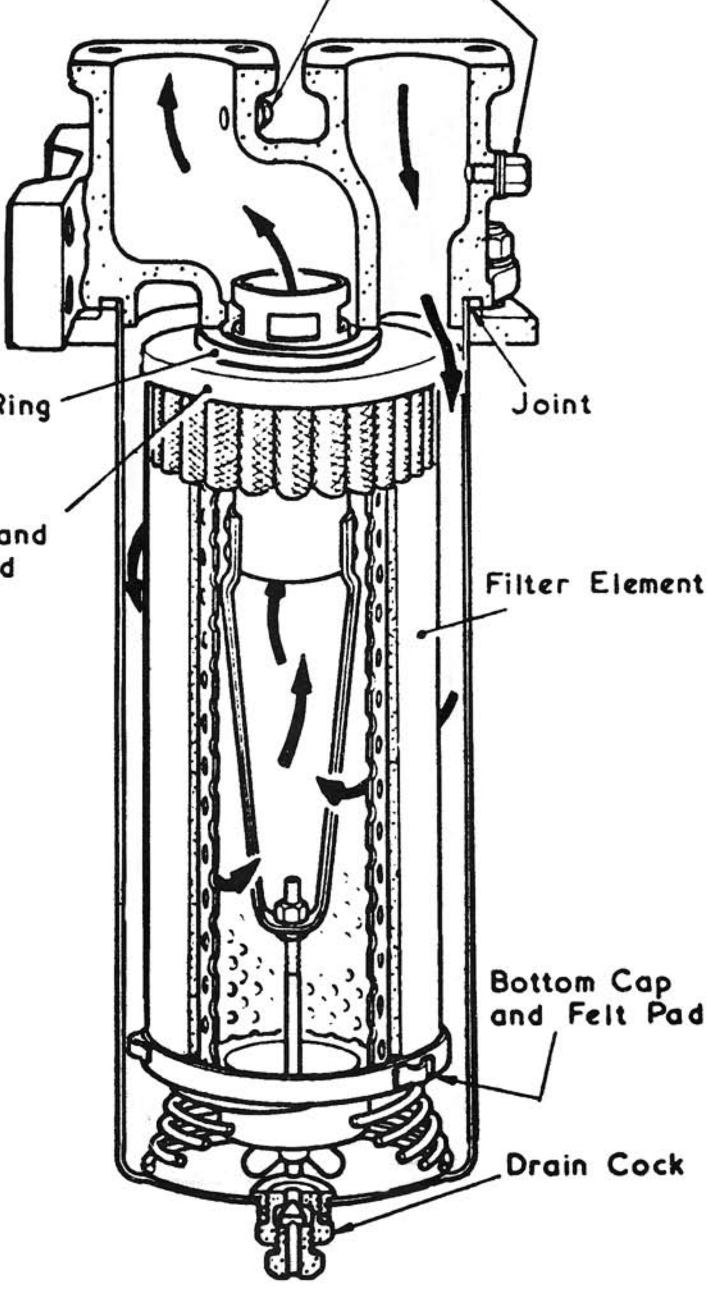

FIG 32 LUB OIL STRAINER(10)

LUBRICATING OIL STRAINER Fig. 32. of the wire mesh type is fitted between the filter and the engine main oil galleries.

The strainer consist of a fabricated tread, a main case assembly, an element complete with top and bottom caps and felt washers, a spring and the necessary joint rings.

A drain cock is fitted and in the main case a pressure gauge connection.

MAINTENANCE "D" EXAMS.

Remove strainer and examine for pressure of metallic particles - report to Supervisor if such particles are present. Clean strainer in fuel oil, drain and dry before replacing.

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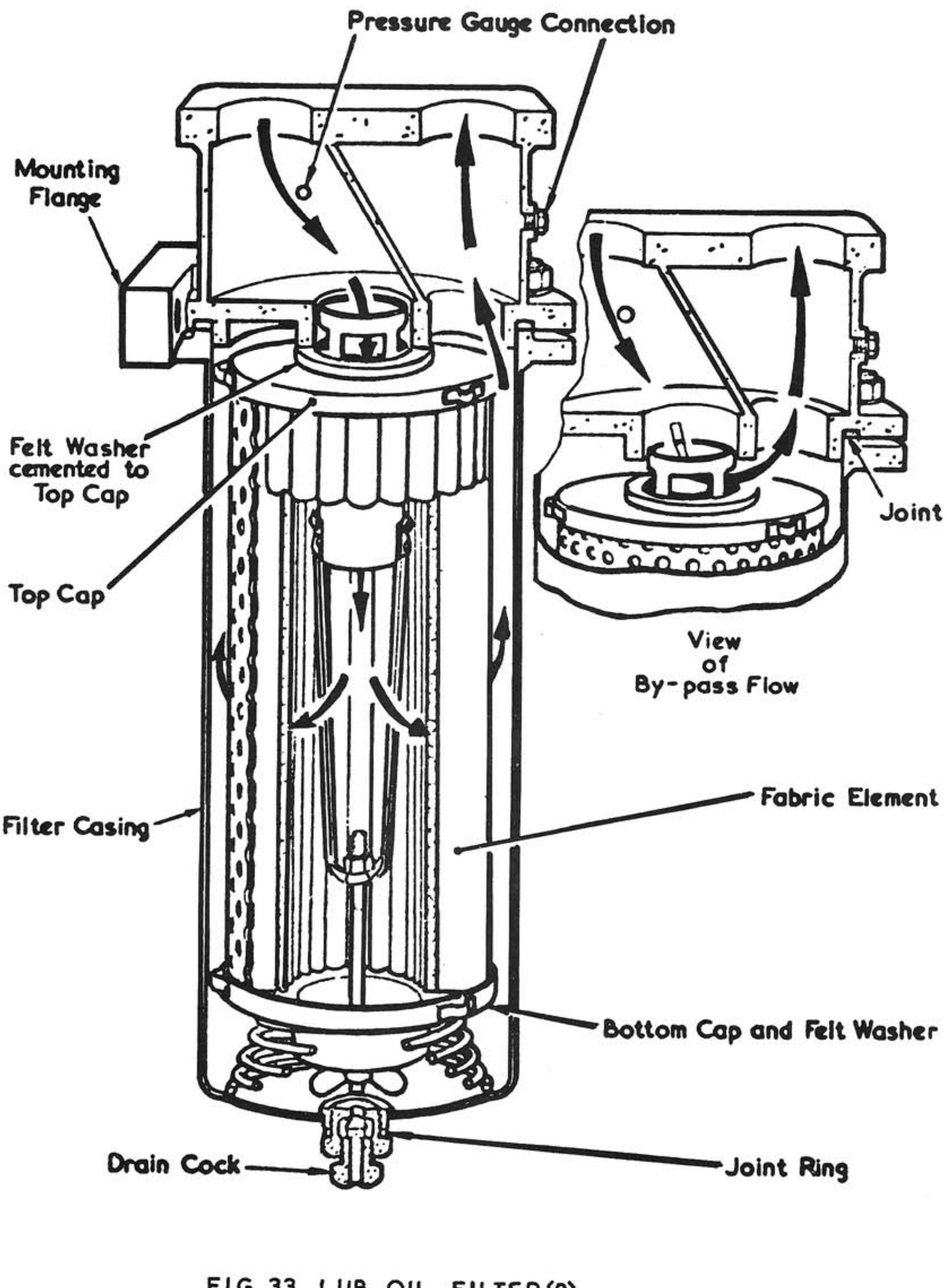

FIG 33 LUB OIL FILTER (9)

LUBRICATING OIL FILTERS Fig. 33 are of the renewable fabric element type, and have integral by-pass arrangement.

Each filter consist of a fabricated head, a main case assembly, an element complete with top and bottom caps and felt washers, a spring and necessary joint rings.

A drain cock is fitted in the main case, and pressure gauge connection in the head.

Failure to renew elements at the scheduled time will result in choked filters.

cont....

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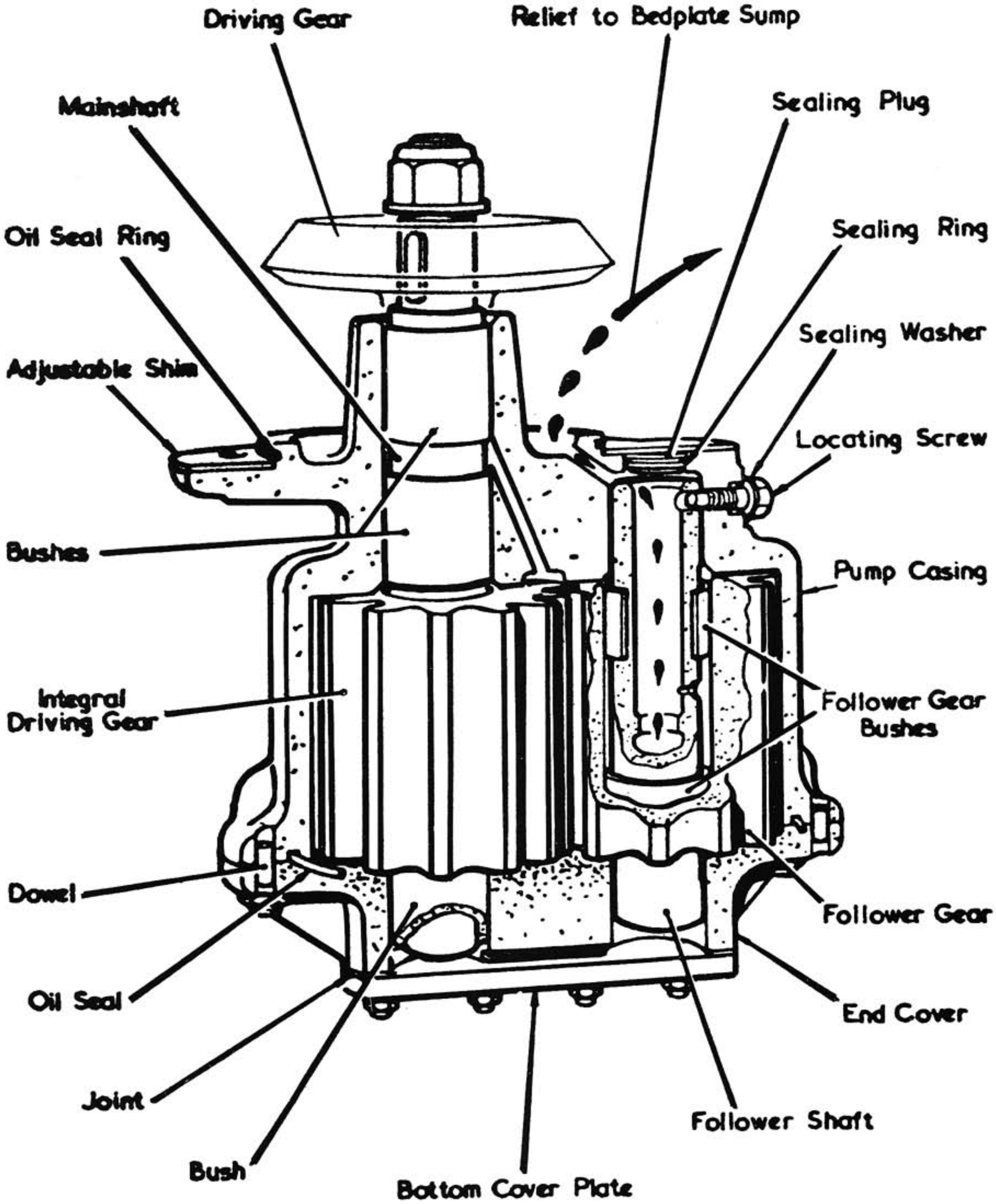

FIG 34 LUB OIL PUMP

The pressure differential between the inlet and outlet sides would build up a pressure sufficient to force the element down against the spring and the filters would then be by-passed. Dirty oil could thus be passed into the engine and may lead to the onset of Bearing troubles.

MAINTENANCE "D" EXAM.

Drain filter casings. Remove elements and joint rings. Clean out casing and fit new elements and joint rings. Refit casings and prime lubricating oil system using engine hand pump.

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<u>THE LUBRICATING OIL PUMP</u> Fig. 28 is a self-priming gear type pump mounted on the free end of the engine, and is gear driven from the crankshaft.

The driving shaft is integral with the internal driving gear and runs in bushes pressed into the pump casings, and the end cover. The follower gear is bushed and is free to run on a shaft held stationary by a retaining screw.

<u>IMPORTANT.</u> If ever a pump is changed or removed the correct backlash between pump and auxilary drive must be established by use of shim joints between pump body and auxilary drive box.

N.B. If auxilary box and oil pump has a yellow stripe it indicates that the shim is screwed to the box "and no setting" of backlash is required.

BACKLASH should be 0.012 - 0.018 as it is preset. Max. permissable 0.035.

<u>LUBRICATING OIL COOLER</u> Fig. 29. Water circulates through the tubes and the oil flows around the tubes in the main cylinder in the reverse direction.

The cooler is also used to allow the engine jacket water to heat the charge cooling water. Directions of flow can be seen in Fig. 36.

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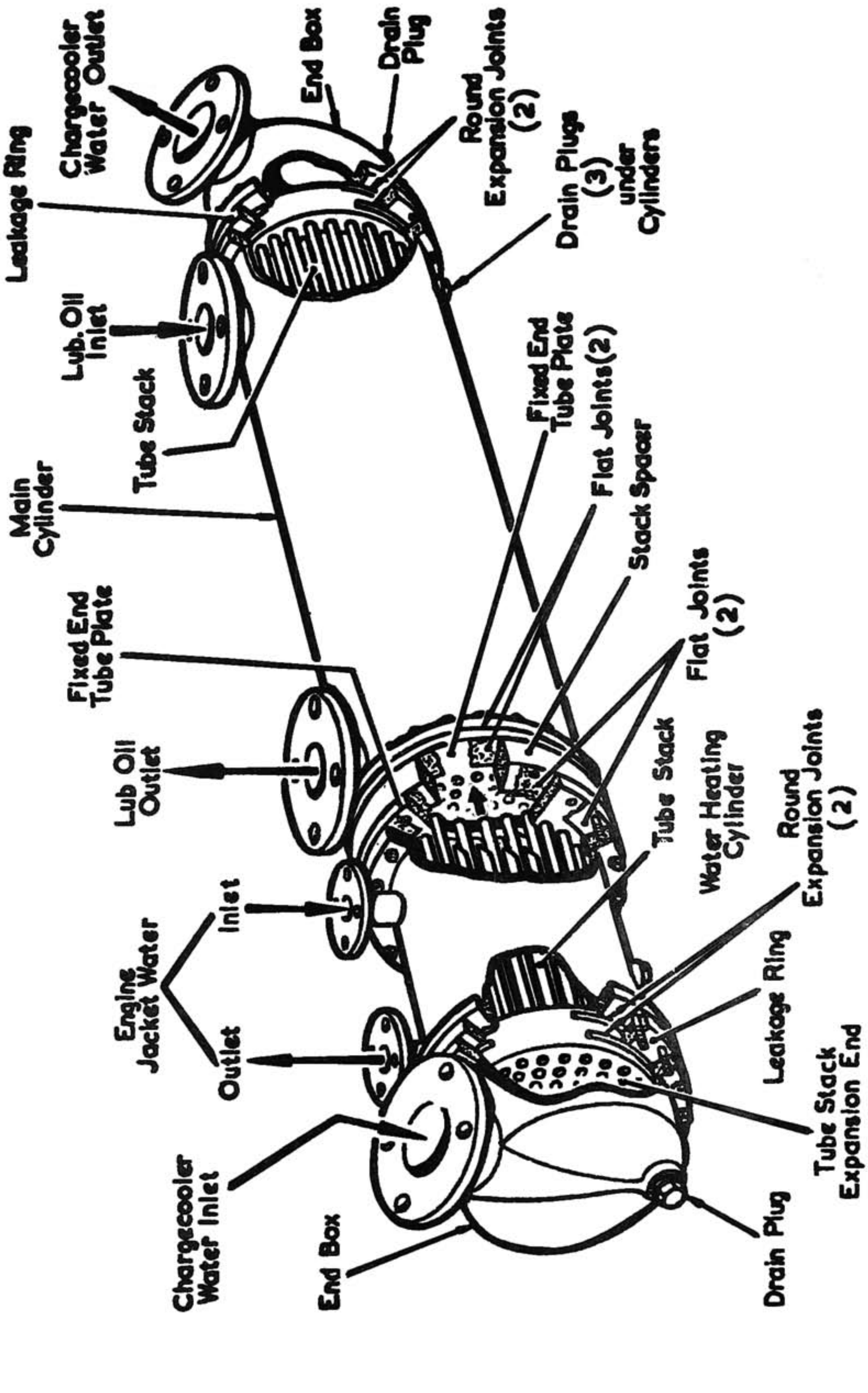

FIG 35 LUB OIL COOLER

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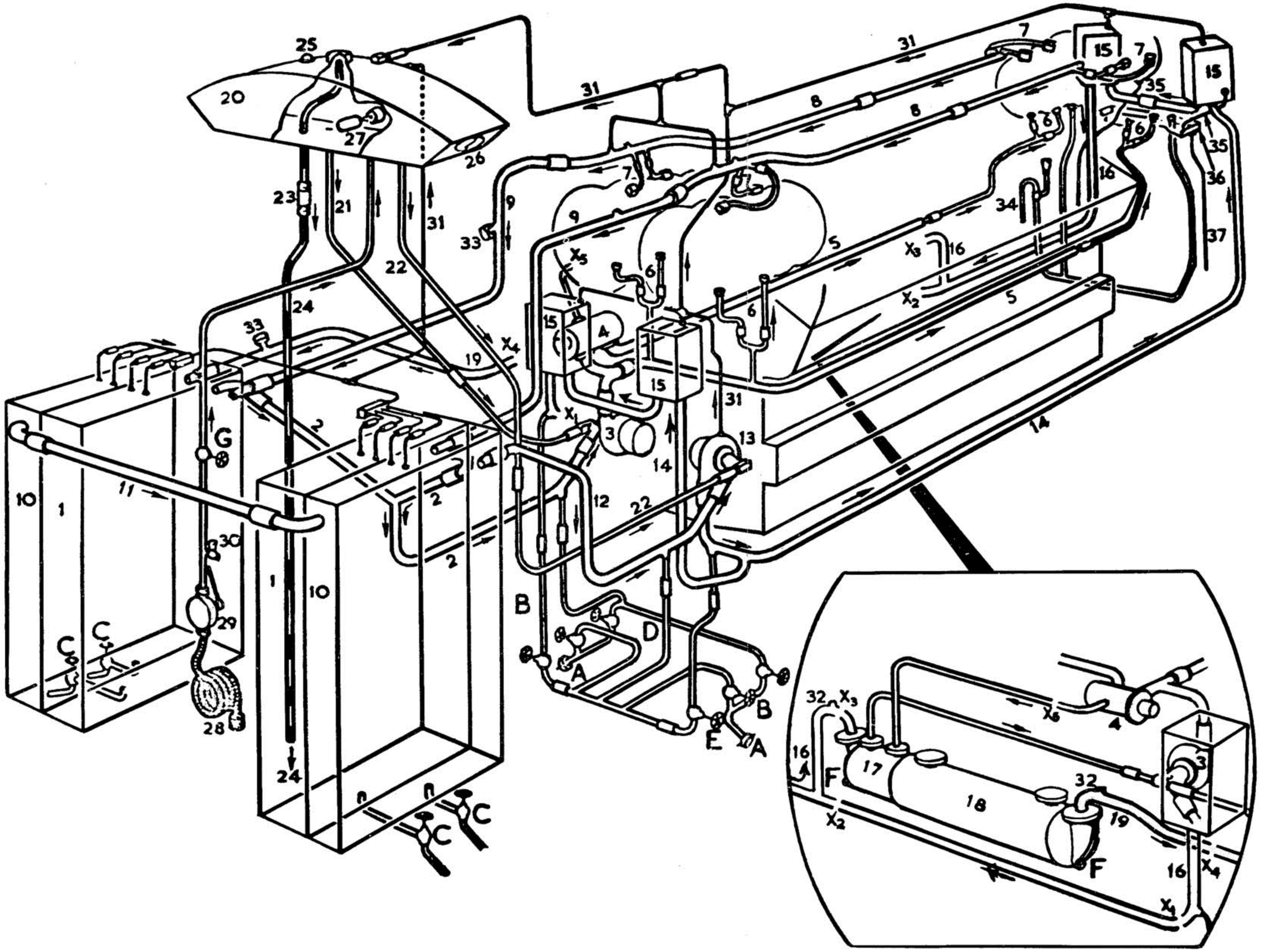

FIG 36 COOLING WATER SYSTEM

ENGINE COOLING SYSTEM

1 RADIATOR (INNER)

2 OUTLET PIPES TO PUMP

3 ENGINE COOLING WATER PUMP

4 THERMOSTATIC DIVERSION VALVE

5 INLET RAIL TO CYLINDER JACKETS AND CYLINDER HEADS

6 INLETS TO TURBO-BLOWER

7 OUTLETS FROM TURBO-BLOWER

8 OUTLET MANIFOLD FROM CYLINDER HEADS

9 RETURN PIPE TO RADIATOR

CHARGECOOLER AND LUBRICATING OIL COOLER SYSTEM

10 RADIATOR (OUTER)

11 RADIATORS TRANSFER PIPE

12 OUTLET PIPE TO PUMP

13 CHARGECOOLERS AND LUBRICATING OIL COOLER COOLING WATER PUMP

14 PIPE, PUMP TO CHARGECOOLER

15 CHARGECOOLER

16 PIPE, CHARGECOOLER TO LUBRICATING OIL COOLER

17 JACKET WATER HEATER

18 LUBRICATING OIL COOLER

19 PIPE, LUBRICATING OIL COOLER TO R.H. RADIATOR

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HEADER TANK.

20 HEADER TANK FOR BOTH SYSTEMS.

21 MAKE-UP PIPE FOR ENGINE COOLING SYSTEM

22 MAKE-UP PIPE FOR CHARGECOOLERS AND LUBRICATING OIL COOLER SYSTEM.

23 PRESSURISING VALVE

24 OVERFLOW PIPE

25 ANTI-VACUUM VALVE

26 CONTENTS GAUGE (EACH SIDE OF TANK)

27 LOW-LEVEL SHUT-DOWN SWITCH

28 FLEXIBLE SUCTION HOSE WITH STRAINER

29 EMERGENCY-FILLING HAND PUMP

30 PRIMING COCK

31 VENT PIPES TO HEADER TANK

32 THERMOMETER POCKET

33 TEMPERATURE PROBE FOR RADIATOR SHUTTER CONTROL

34 TURBO-BLOWER CASING DRAIN AND WATER SEAL

35 CHARGECOOLER CONDENSATE DRAIN

36 DRIP TRAY

37 DRIP TRAY DRAIN

DRAINING AND REFILLING POINTS

A DRAINING AND REFILLING CONNECTION (EACH SIDE OF LOCO.)

B DRAINING AND REFILLING VALVE (EACH SIDE OF LOCO.)

C RADIATOR DRAIN VALVE

D ENGINE COOLING SYSTEM DRAIN VALVE

E CHARGECOOLERS AND LUBRICATING OIL COOLERS SYSTEM DRAIN VALVE

F LUBRICATING OIL COOLER DRAIN PLUG

G EMERGENCY FILLING HAND PUMP.

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COOLING WATER CIRCUIT DESCRIPTION.

The cooling water comprises two separate systems:-

System (1) for engine cooling.

System (2) for intercoolers and lubricating oil cooling.

System (1) - Engine Cooling. The engine driven water pump (3) draws water from the inner radiators (1) on both banks and pumps it into the engine jacket to cool the liners and cylinder heads (5). It also supplies water (6) to the 4 Turbo chargers (15).

The water leaves the turbo charger outlets (7) and the outlet from the cylinders (8) and returns through (9) to the inner radiator on both banks.

System (2) - Intercooling and Lubricating Oil Cooling. The engine driven intercooler pump (13) draws water from B bank outer radiator (10) and pumps it to the 4 intercoolers (15) and then to the intercooler water heater (17) and the lubricating oil cooler (18). From the lubricating oil cooler it returns to the outer radiator on A bank, through the transfer pipe (11) to the outer radiator (10) on B bank and is again drawn off by the intercooler pump (13).

DIVERSION VALVE (4) Fig. 37, is connected into the engine cooling circuit to permit heating of the charge cooling water.

OPERATION OF VALVE. The valve is operated by air pressure applied through the adjustment cover from an electrically operated magnet valve. When the intercooler temperature is above 80°F the magnet valve is de-energised so no air is applied to the bellows unit.

Water from the engine cooling system enters the valve inlet chamber but is prevented from passing through to the outlet chamber by the seal valve.

When the intercooler water temperature drops to 60°F the magnet valve is energised, air pressure is applied to the bellows unit which moves down and unseats the seal valve. Engine cooling water can now flow through the seal valve to outlet which goes to the intercooler water heater (17) to heat the intercooler water. The water then returns to the suction side of the engine cooling water pump (3). When the intercooler water reaches 80°F the engine cooling water ceases to flow to the intercooler water heater because the magnet valve becomes de-energised.

So the diversion valve keeps the intercooler temperature between 60°F and 80°F.

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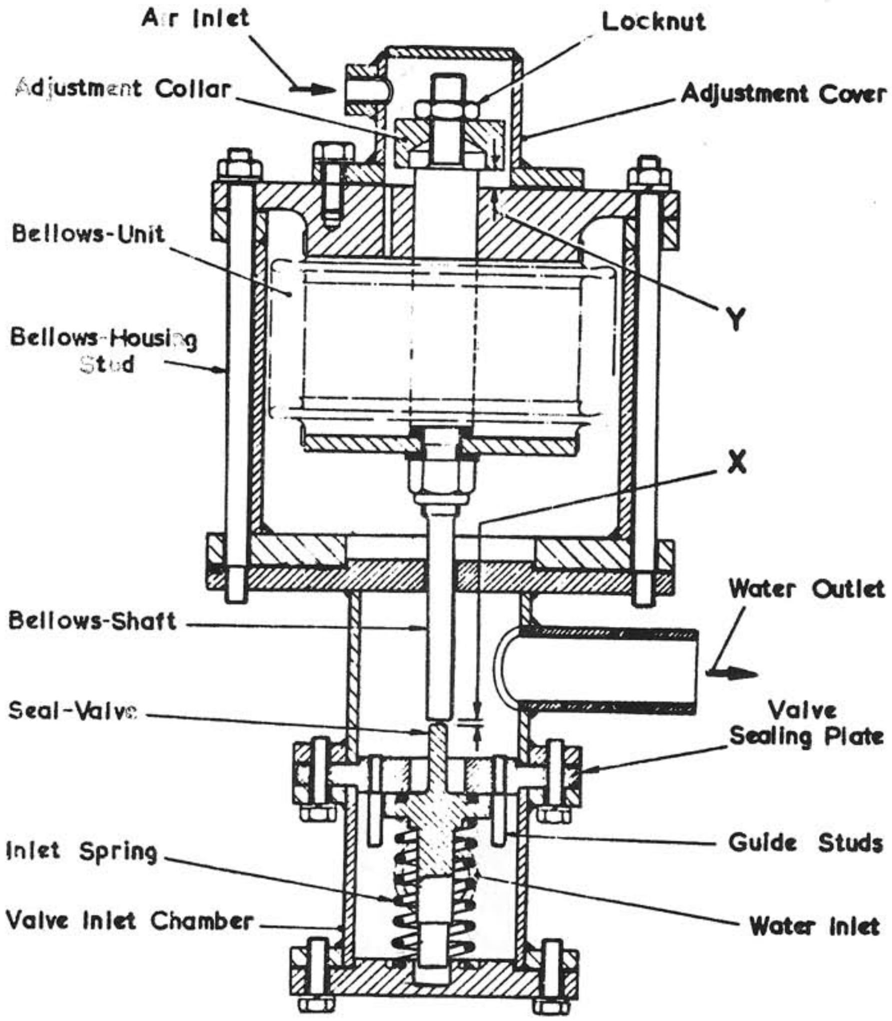

FIG 37 DIVERSION VALVE

HEADER TANK. The common header tank is fitted with a level gauge and also a low water level switch which is arranged to shut the engine down if water level falls below a safe value. This tank tops each system up through pipes 21 and 22.

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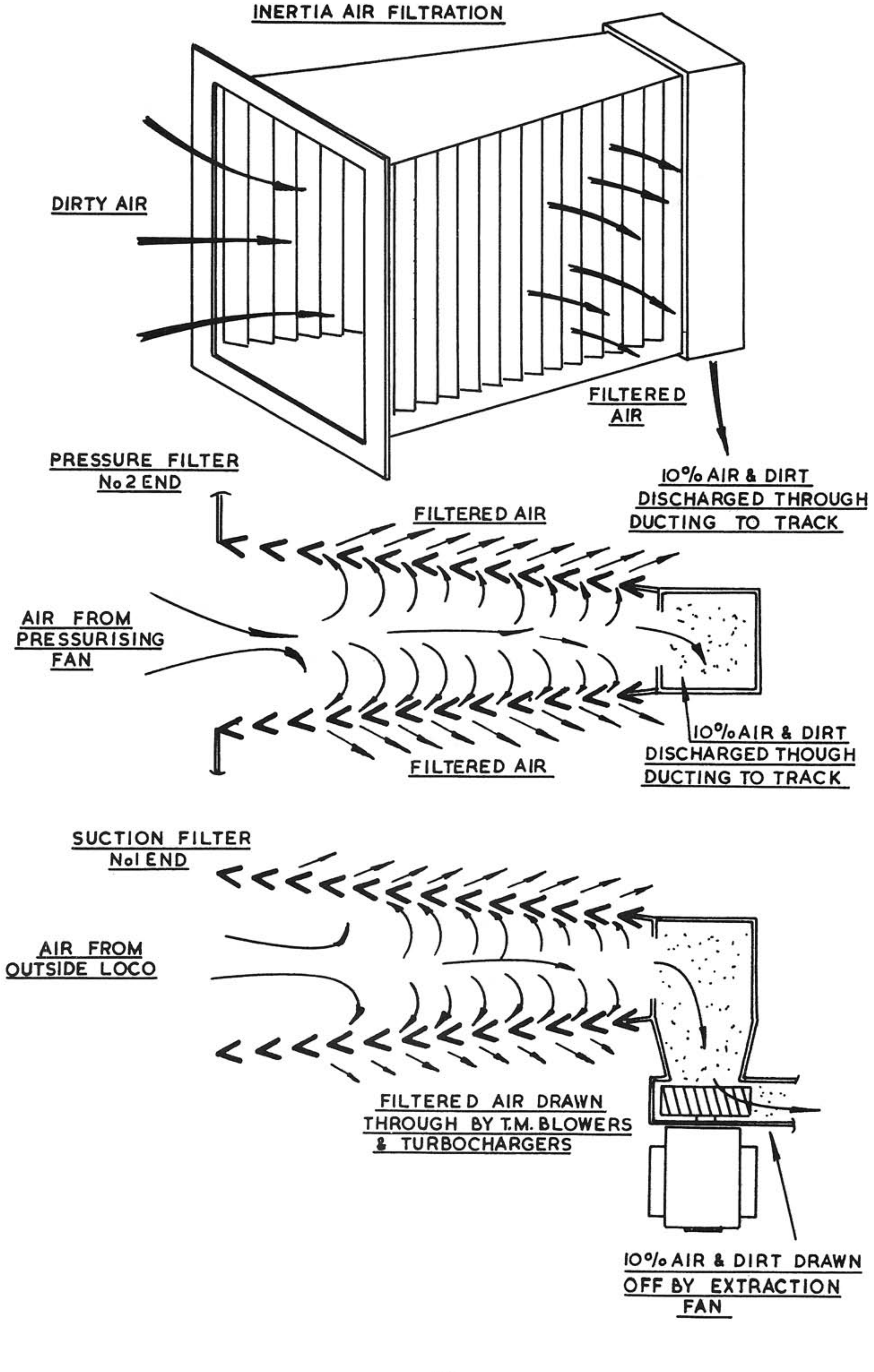
FIG 38 FILTER ELEMENT



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PRESSURISATION. The system is pressurised to about 5 p.s.i. to raise the boiler point and is governed by valve 23.

An anti-vacuum valve 25 is fitted to relieve the depression formed when the cooling water contracts as the engine cools.

HAND FILLING. Between the radiators is a length of nose (28) and a semi rotary pump. To fill open priming cock (30) and cock G.

NORMAL FILLING - through connection (A) and open cock (B) on side of loco for filling until overflow at valve 24 (or by referring to level gauge in header tank.

DRAINING. Open cock E and B to drain intercooler system

Open cock D and B to drain engine system

Open cock C to drain radiators.

ELECTRICAL PROBES are fitted in the cooling water circuits for:-

1. To energise diversion valve when intercooler water temperature falls to 60°F.
   To de-energise when temperature reaches 80°F.
2. To give low water temperature warning at 39°F
3. To give high water temperature warning at 200°F engine system.
4. To give high water temperature warning at 115°F intercooler system.
5. To open radiator for shutters at 160°F.
6. To speed up fan at 170°F.
7. Give top speed fan at 180°F.

INERTIA AIR FILTRATION. Fig. 38.

The clean air required for the Engine and Auxiliary Equipment on this locomotive is drawn through louvres in the body side and passed through filters of the inertia type.

Fig. 30 shows a typical inertia filter element, together with diagrams illustrating the principle of operation of the pressure filter and the suction filter.

The inertia filter works on the principle that if the direction of flow of dust-laden air is suddenly reversed, inertia causes the dust to continue travelling in the original direction of flow and thus becomes separated from the main air stream. About 10% of the air which enters the filter is carried off with the dust into ducting at the rear of the element.

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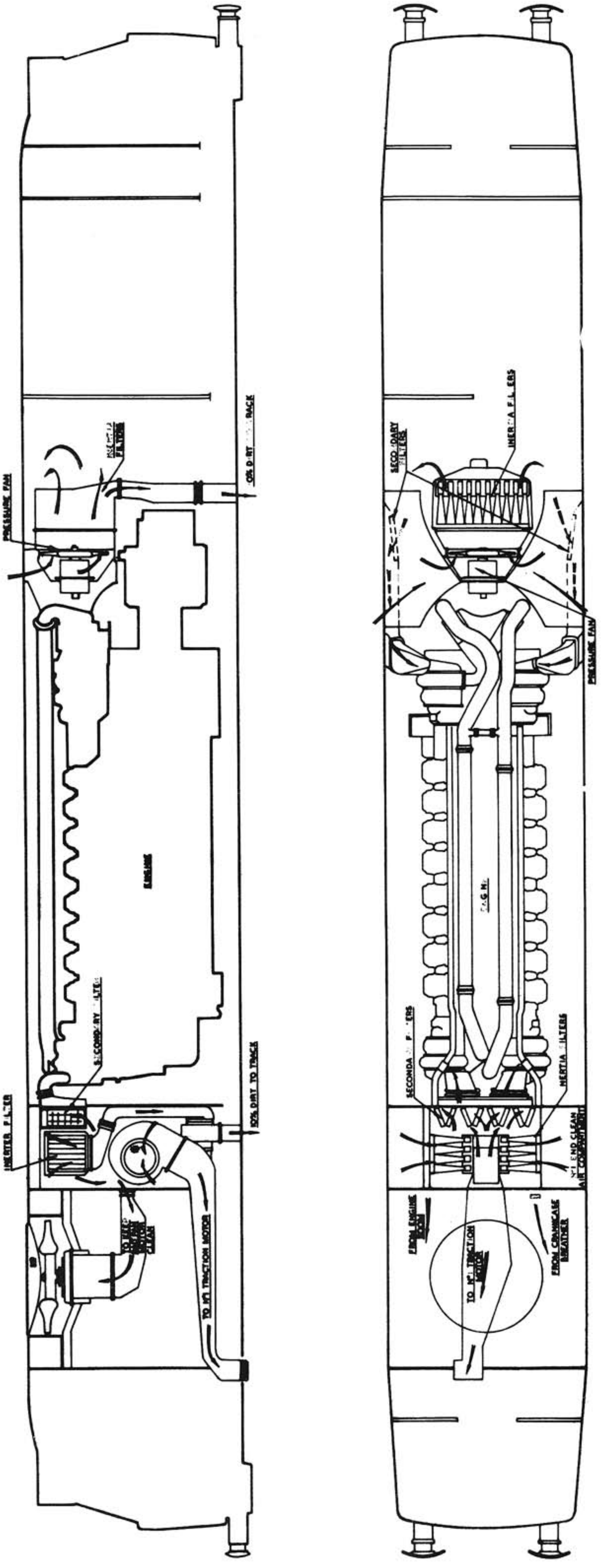

FIG 39 DIAGRAM SHOWING FLOW OF AIR

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At the drive end of the Engine Compartment (No. 2 end) and mounted above the train Heating and Auxiliary Generators is a pressurising fan and two banks of inertia filter elements. This fan forces air through the elements and the 10% air bleed and extracted dust are automatically blown down through ducting to the track.

Adjacent to the free end of the Engine (No. 1 end) is a clean air compartment which is subjected to a partial vacuum created by the action of the turbochargers and No. 1 Traction Motor Blower. The air is drawn into this compartment through the inertia filters mounted near the roof on each side of the compartment. In this case the 10% air bleed and extracted dirt from these filters is drawn off by a small dust extraction fan, which exhausts downwards on to the track.

MAINTENANCE E. EXAM. Remove filter and fit service unit.

SECONDARY FILTERS — After the air comes through the inertia filters it passes through Voke type filters into trunking to the turbochargers.

MAINTENANCE — Remove and replace with new filters, ensuring that the securing clips and seals at the edges of the racks, into which the filter elements fit, are in good condition.

Fig. 39 on page 58 shows the air flow in the locomotive.

Fig. 40 on page 60 shows the air intake position and the access covers on locomotive body.

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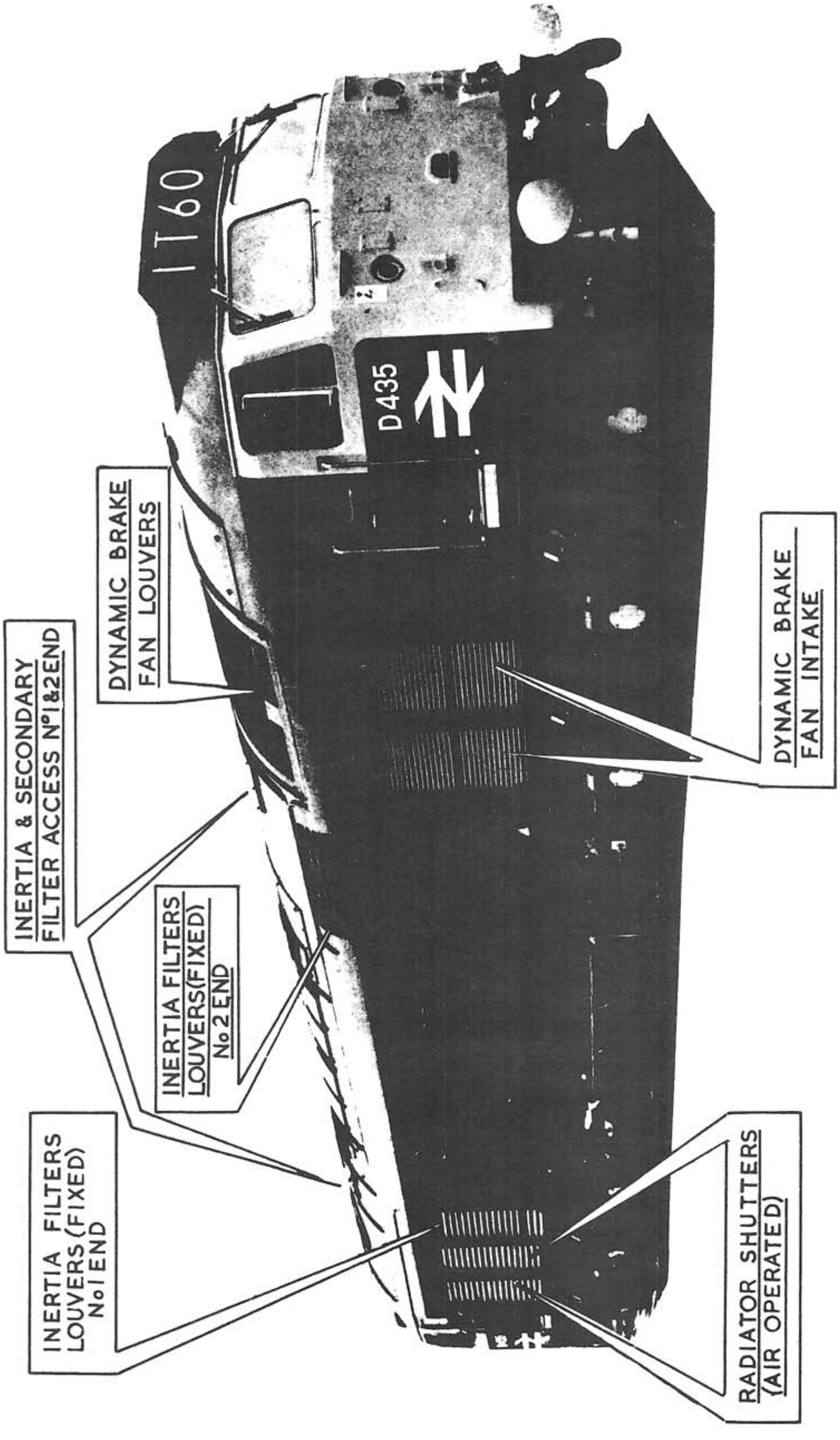

FIG 40 AIR INTAKE POSITIONS ON LOCOMOTIVE

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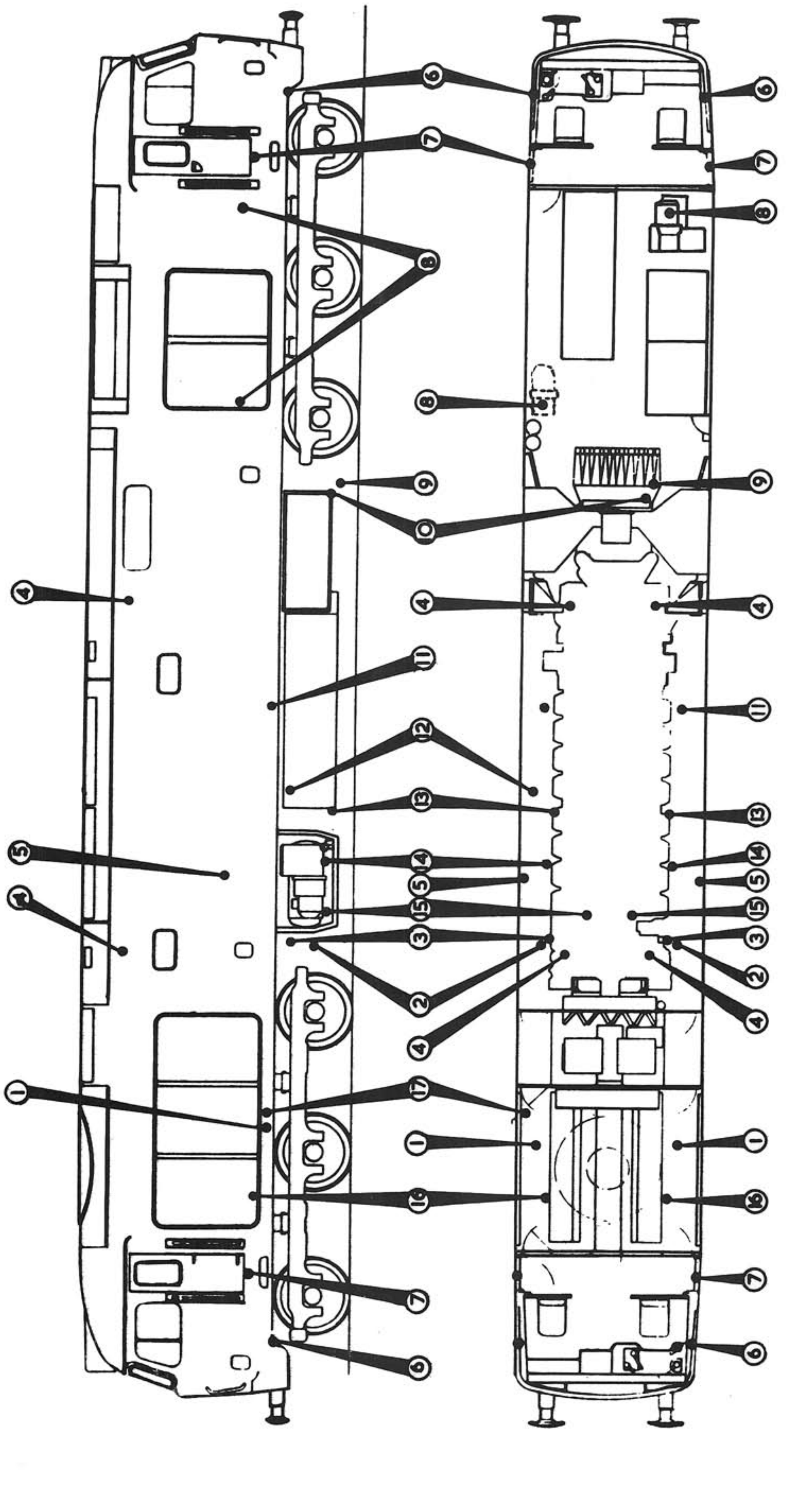

1 FILTER COMPT & RADR COMPT DRAINS
2 ENGINE BEDPLATE
3 COOLING SYSTEM (WATER)
4 TURBO BLOWER SUMPS (TWO AT EACH POINT)
5 AIR SYSTEM ANTI FREEZER
6 WINDOW DRAINS
7 DOOR DRAINS
8 EXHAUSTER TANKS
9 URINAL DRAIN
10 CENTRIFUGAL DIRT COLLECTOR
11 FUEL TANK VENT
12 ENGINE SUMP (LUB OIL)
13 FUEL TANK
14 COMPRESSOR SUMP
15 COMPRESSOR AFTER-COOLER & RESERVOIRS
16 RADIATOR
17 HEADER TANK OVERFLOW

FIG 41 DRAINING POINTS

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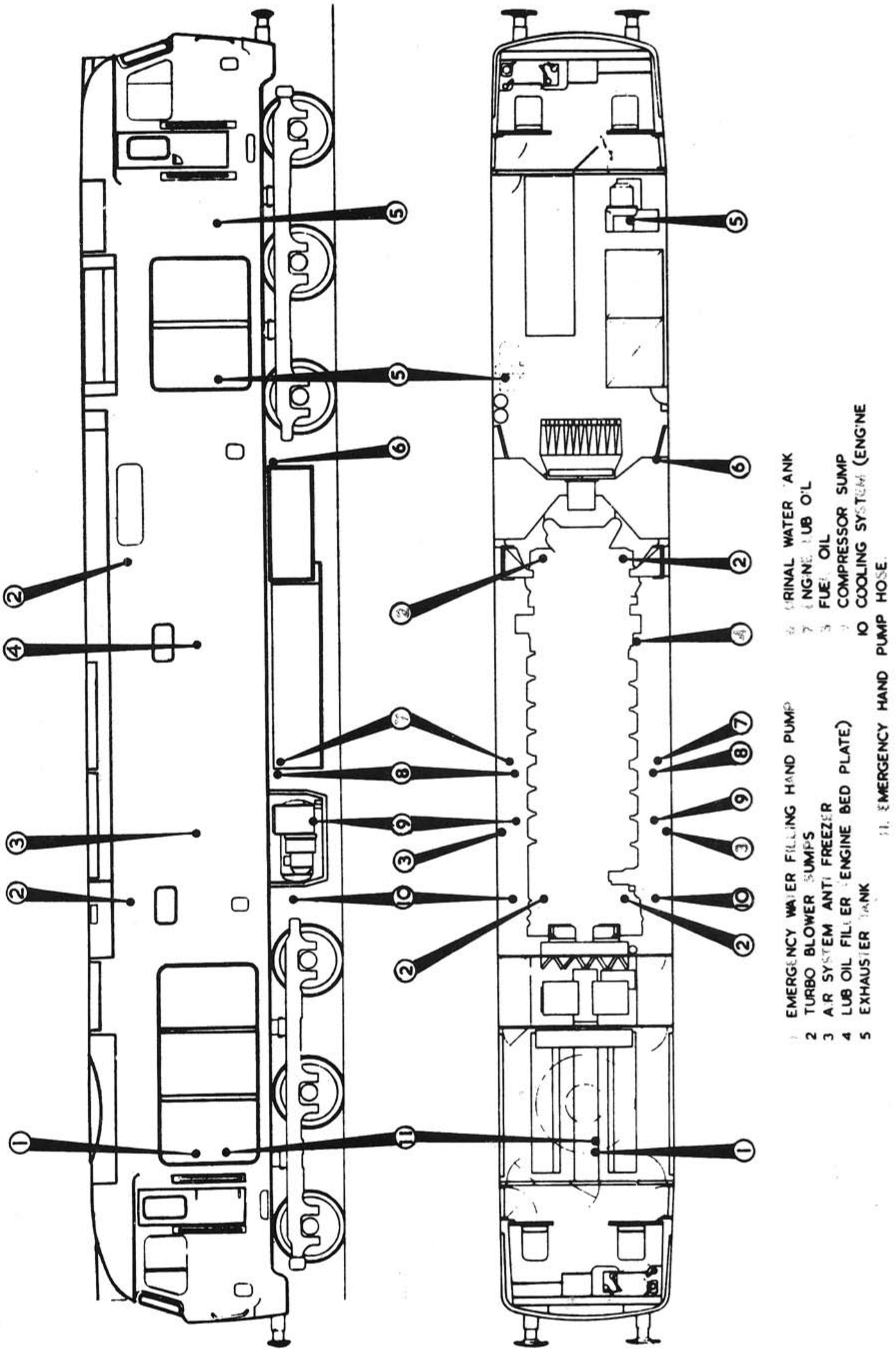

FIG 42 FILLING POINTS

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