HEALTH AND SAFETY

TO PROMOTE SAFFTY AND TO AVOID RISK TO HEALTH. USERS OF PETTER DIESEL ENGINES SHOULD OBSERVE THF FOLLOWING PRECAUTI0NS.

ENSURE THAT THE ENGINE IS CORRECTLY INSTALLED, OPERATED AND MAINTAINED. ALWAYS FOLLOW MAKERS INSTRUCTIONS.

BEFORE STARTING THE ENGINE REMOVE AS MUCH OF THE LOAD AS POSSIBLE.

WHEN USING A STARTING ROPE DO NOT WINDTHE ROPE ROUND HAND OR WRIST.

MAKE SURE THE ROPE IS NOT FRAYED.

***WHEN USING* A STARTINGHANDLE HOLD THE HANDLE FIRMLY *WITH THE* THUMB ON TOP OF THE GRIP AND NOT ROUND IT. KEEP THE HANDLE AND SHAFT CLEAN AND LUBRICATED TO ENSURE EASY WITHDRAWAL OF HANDLE.**
DO N0T REMOVE GTUARDS.

KEEP CLEAR OF HOT, MOVING, OR ELECTRICAL PARTS.

IF THE ENGINE IS INSTALLED IN AN ENCLOSED SPACE, VENT THE EXHAUST FUMES TO ATMOSFHERE.

WHEN TESTING FUEL INJECTORS DO NOT DIRECT THE: SPRAY AT ANY EXPOSED PART OF THE BODY. IT CAN PENETRATE THE SKIN.

Publication No. 355791

PETTER DIESEL ENGINES TYPE AB1W-AC1W ISSUE 2 Publication No. 340937

Alteration as follows:

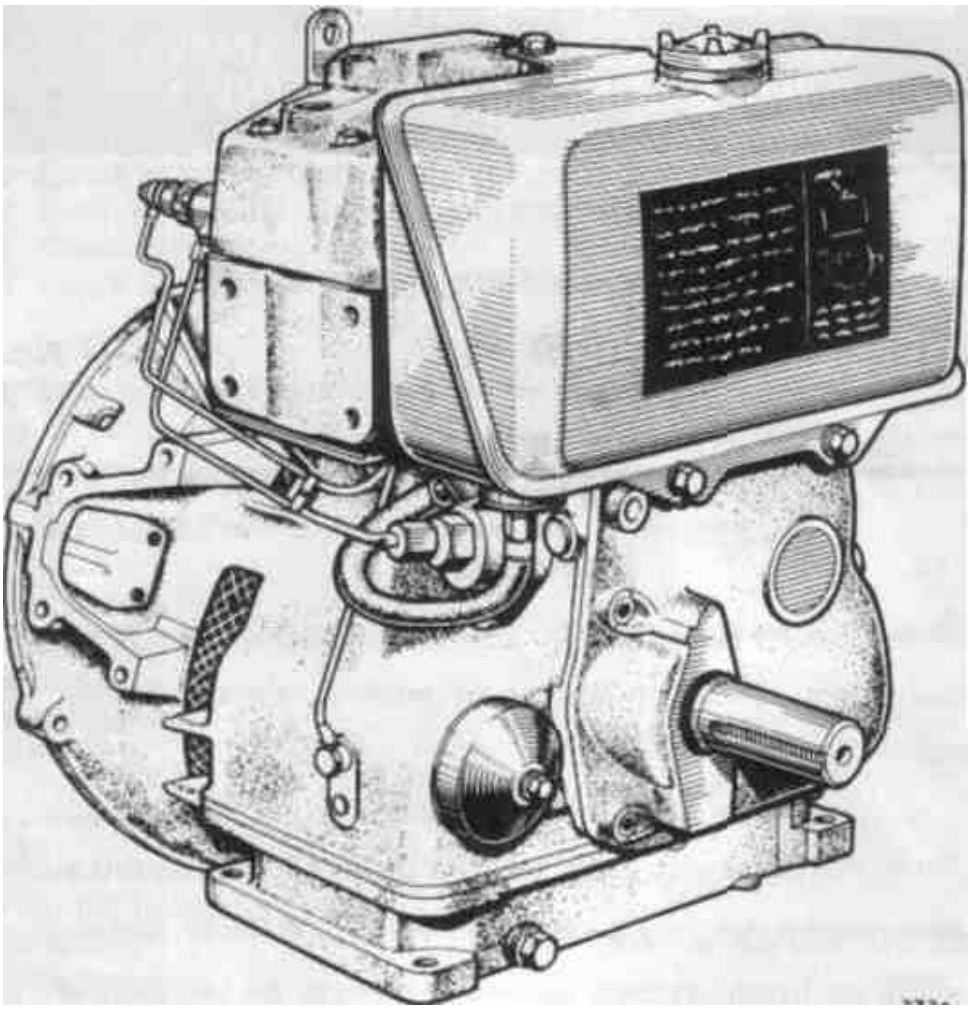
TECHNICAL DATA
TORQUE SPANNER SETTINGS

	lbf ft	kgf m
Cylinder head nut.....	20	2.77
Should read:		
Cylinder head nut.....	21	2.91
Cylinder head/rocker support nut	24	3.32

*Supplement No. 340949 September **1974***

Petter Diesel Engines

TYPES AB1W and AC1W



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This book will help the user to get the best results from the engine. No engine wilt run without care. but it wilt give good service if given the attention described in this book.

Please record details of engine and installation in the spaces below

PETTER

TYPE **No.**

BS Rating **bhp** **rev/min**

ENGLAND

USE ONLY GENUINE PETTER SPARES
WHEN WRITING QUOTE ENGINE **Nº**

Copy details from engine label

ENGINE INSTALLATION **PLANT No.**

IMPORTANT

When purchasing parts or giving instructions for repairs customers should, in their own interest, always specify;

Genuine Petter Parts

Parts that have not been supplied by the *Petter* organisation cannot be relied upon for correct material dimensions or finish *Fetters* cannot, therefore, be responsible for any damage arising from the use of such parts and the guarantee will be invalidated

In your own interest, therefore, specify:

Genuine Petter Parts

Please remember

. . . an engine needs fuel--
Keep fuel, tank, filter and piping clean
... an engine needs lubricating oil-
Use the correct grade of oil Keep oil level topped up.
... an engine needs air--
Keep air cleaner clean Keep air inlet manifold and entire exhaust system free of carbon and any other restriction.
... an engine needs cooling--
Keep cooling system free from obstruction.

•

After approximately 20 hours initial running of a new or overhauled engine the following points should receive attention:

(a) Check valve clearance
(b) Drain lubricating oil from sump and refill with clean oil
(c) Check fuel filter
(d) Check all nuts, bolts, etc.. for tightness

•

Requests for parts and service should be directed to:

Overseas

The appointed Petter agent or dealer in the territory

United Kingdom

Petters Ltd. Service Division,
Hamble,
Southampton
S03 5NJ

Phone: Hamble 2061
Telex: 47626
Telegrams:
Petter Hamble Telex

or Service Depots at

Petters Ltd. Service Depot,
Broomhill Industrial Estate,
Kirkintilloch,
Dunbartonshire

Kirkintilloch 041 -776 2316/7/8
Telex: 778204

Petters Ltd. Service Depot,

Limewood Road. Seacroft, Leeds LS14 ILS

Leeds 649101

Petters Ltd Service Depot,
Cliff Works, Burton-on-the-Wolds,
Loughborough, Leics

Wymeswold 880333

Potters Ltd Service Depot,

Bridge Works. Staines. Mddx. TW183AR

Staines 51333

a

technical data AB1W

Bore (nominal)..... 3in (76.2mm)
Stroke 2. 25in (57.15mm)
Power and speed (BS continuous rating):
2.4 bhp at 1500 rev/min
3.0 bhp at 1800 rev/min
3.5 bhp at 2100 rev/min
4.2 bhp at 2500 rev/min
5.0 bhp at 3000 rev/min
5.5 bhp at 3600 rev/min
Cubic capacity ..... 159 in^3 (261 cm^3)
Compression ratio..... 16.25 to 1
Lubricating oil pressure (min *)*..... 35 lbt/in^2 (2.46 kgf/cm^2)
Fuel injection release pressure..... 2350/2650lbf/in^2 (165.2/186.3kgf/cm^2)

Fuel injection timing (by spill):
Fixed speed
Up to 2200 rev/min..... 23° before TDC
2201 to 2700 rev/min..... 26° bef ore TDC
2701 to 3300 rev min..... 29° bef ore TDC
3301 to 3600 rev min..... 34° bef ore TDC
Variable speed ..... 29° before TDC
Inlet valve opens .....13° before TDC
Inlet valve closes ..... 38° after BDC
Exhaust valve opens ..... 38° before BDC
Exhaust valve closes..... 13° after TDC
Reduction gear ratio..... 6:1
Fuel tank capacity (engine mounted)..... 9 pints (5.13 litres)
Oil capacity ..... 31/4 pints (1.9 litres)
Lubricating oil..... See approved list
Fuel..... A high-grade light distillate diesel fuel in accordance with B.S. Specification No 2869 1967 Class A1 or A2

Water capacity:	Temperate	Tropical
Cooling tank.	48 gal (218 litres)	120 gal (545 litres)
'Run through' water per bhph.....	3 gal (13 6 litres)	
Starter motor battery.....	12 Volts 50 Ampere hour (min.)	

Negative earth

NOTE: Oil capacities, etc , are based on the Imperial (UK.) gallon

Bore (nominal).....	**3in (76.2mm)**
Stroke.	2.625in (66.68mm)
Power and speed (B.S. continuous rating):	
	2.8 bhp at 1500 rev/min
	3.3 bhp at 1800 rev/min
	4.0 bhp at 2100 rev/min
	6.0 bhp at 2500 rev/min
	6.0 bhp at 3000 rev/min
	6.5 bhp at 3600 rev/min
Cubic capacity.....	185 in^3 (304 cm^3)
Compression ratio	17 to 1
Lubricating oil pressure (min.).....	35 tot/in^2 (2.46 kgf/cm^2)
Fuel injection release pressure.....	2350/2650 lbt/in^2 (165. 2/186 $3kgf/cm^2$)
Fuel injection timing (by spill):	
Fixed speed	
Up to 2200 rev/min.....	26° before TDC
2201 to 2700 rev/min.....	28° be fore TDC
2701 to 3300 rev/min.....	32° be fore TOC
3301 to 3600 rev/min.....	33° be fore TDC
Variable speed.....	28° before TDC
Inlet valve opens.....	13° before TDC
Inlet valve closes.....	38° after BDC
Exhaust valve opens.....	38° before BDC
Exhaust valve closes	13° after TDC
Reduction gear ratio	6:1
Fuel tank capacity (engine mounted).....	9 pints (5.13 litres)
Oil capacity.....	43/4 pints (2.7 litres)
Lubricating oil.....	See approved list
Fuel.....	A high-grade light distillate diesel fuel in accordance with B S Specification No 2869 1967 Class A1 or A2
Water capacity:	Temperate Tropical Cooling tank
.....	70 gal (318 litres) 170 gal (773 litres)
'Run through' water per bhph.....	3 gal (13.6 litres)
Starter motor battery.....	12 Volts 50 Ampere hour (min.)
Negative earth	

NOTE: Oil capacities, etc. are based on the Imperial (UK) gallon 5

Camshaft end float	0.003/0 010in (0.08/0.25mm)
Crankshaft end float (new).....	0.005/0 01 Pin (013/0 43mm)
Crankshaft end float (not to exceed).....	0020m (0 51mm)
Crankpin ovality (not to exceed)	0.0025m (0 063mm)
Cylinder bore wear (not to exceed).....	0 010in (0 25mm(
Piston ring gap (new)	0.012/0 017m (0 30/0.43mm)
Piston ring gap (not to exceed)	0.045m (1 14mm)
Exhaust valve lift by decompressor (max)	0.015m (038mm)
Bumping clearance	0.022/0 026m (0 56/0 66mrn)
Valve rocker clearance (cold).....	0004m (0 10mm)
Valve depth from cylinder head face (new)	0039/0057in (0 99/1 45mm)
Main bearing-clearance (new)	00008/00029m (0020/0 077mm)
Large end bearing clearance (new).....	00010/0 0035m (0025/0 090mm)
Small end bush diameter (fitted).....	0.8753/0 8757m (22 233/22 243mm)
Reduction gear power take-off shaft end float	0.002/0 005in (005/0.13mm)

Cylinder rebormg diameters:

Standard.....	3-000/3 001 m (76 20/76 23mm)

Oversize:

0 020in	3.020/3 021 m (76 71 /76 73mm)
0 030in	3.030/3 031 in (76 96/76 99mm)
0.040m.....	3 040/3 041 m (77 22/77 24mm)

Crankshaft regnnding diameters:

Main journal and crankpin Standard.....	1 6250/16245m (41 275/41 262mm)

Undersize

0.010in.....	1.6150/1.6145in(41 021/41 008mm)
0.020in.....	1.6050/1.6045m (40 767/40 754mm)

Lubricating oil pump

Rotor end clearance (new).....	0.001/00025in (0025/0 064mm)
Rotor end clearance (not to exceed)	0005m (0127mm)
Rotor form clearance (new)	0002/0 005m (0051/0127mm)
Rotor form clearance (not to exceed)	0008m (0203mm)
Shaft/bore clearance (new)	00015/0 003m (0038/0 076mm)
Shaft/bore clearance (not to exceed)	0005m (0 127mm)
Rotor shaftdiameter(new)	0.5918/0 5923in (15.032/15.044mm)

TORQUE SPANNER SETTINGS		**lbf.ftkgf.m**
Large end boll		253.46
Cylinder head nut		202.77
Injector stud nut	AB1W	101.38
Injector stud nut	AC1W	131.80
Flywheel nut		15521.43
Flywheel extension or gearwheel bolt		273.73
Lubricating oil pump screw		101.38
Lubricating oil filter centre bolt		101.38
Fuel pump delivery union body.		152.07
Crankshaft and camshaft extension shaft screw		141.94
Crankshaft gearwheel retaining screw		273.73
Camshaft gearwheel retaining screw.		273.73
Starting handle shaft retaining screw (Raised Hand Starting)		273.73
Mounting plate screw (4 1 Hand Starling)		182.49
Sliding plate locating screw (41 Hand Starting)		182.49
Sliding plate stop screw (4 1 Hand Starting) (Flywheel end)		81.10
Gearwheel retaining clip screw (4:1 Hand Starting) (Flywheel end)		121.66
Gearwheel retaining screw (41 Hand Starting) (Gear end)		182.49

APPROVED LUBRICANTS

Supplier	U.K. Winter & Summer *Up to 30℃ (86℉)*	Tropical *Above 30℃ (86℉)*
Shell Oil Co. Ltd.	Rotella SX 10W Rotella TX 10W Rotella TX 10W/30 X-100 10W Talona Oil 10W	Rotella SX 20 20W Rotella TX 20 20W Rotella SX 20W/40 Rotella TX 20W/40 Super Oil Tractor Oil Universal
Mobil Oil Co. Ltd.	Delvac Special 10W/30 Delvac 1210	Delvac Special 10W/30 Mobiliand Universal Mobiloil 20W 30 Delvac 1220 Mobilgard 212
B.P. Companies Ltd	Vanellus 10W Super Visco-Static 10W/40	Vanellus 20W Vanellus 20W 30 Super Visco-Static 20W/50 Energol 1C M20W Tractor Oil Universal 20W/30
Castrol Ltd.	Deusol CRI 10 Deusol CRB 10 Deusol CRB 10W/30 Castrol CRI 10 Castrol CRB 10 Agricastrol Multi-Use 10W/30	Deusol CRI 20 Deusol CRB 20 Deusol CRB 10W/30 Oeusol CRM Castrol CRB 20 Castrol 210 MX Agricastrol Multi-Use 20W/30
Esso Petroleum Co Ltd.	EssolubeHD 10W Essolube HDX 10W Essolube 0.3 HP 10W Essolube D-3 10W Essolube HDX 10W/30 Motor Oil 10W	Essolube HO 20W Essolube HDX 20W Essolube D-3 HP 10W Essolube D-3 10W Essolube HDX 10W/30 Motor Oil 20W
Caltex (UK) Ltd.	Supreme Five Star 10W/30 Custom Five Star 10W/30 Five Star 10W RPM Delo200 10W/30 RPM Delo 200 10W RPM Delo 100 10W	Supreme Five Star 10W/30 Custom Five Star 10W/30 Five Star 20/20W RPM Delo200 10W/30 RPM Delo 200 20/20W RPM Delo 100 20/20W
Chevron International Oil Co Ltd.	Delo Special 10W Delo200 10W	Delo Special 20/20W Delo 200 20/20W
Texaco Ltd.	Ursa Extra Duty 10W Ursa Extra Duty 10W/30 Havoline 10W Havoline 10W/40	Ursa Extra Duty 20W Ursa Extra Duly 10W/30 Havoline 20/20W Havoline 10W/40
Gulf Oil (G.B.) Ltd	Gulflube XHD 10W Gulflube XHD 10W/30 Multi-G 10W/30	Gulflube XHD 20/20W Gulflube XHD 10W/30 Mulli-G 10W/30 Superfleet 20W/30

TROUBLE LOCATING CHART

Trouble	Reason	Causes	Suggested Remedy
	Low temperature	**Failure to prime (see Cold Starting)**	**Prime with lubricating oil**
	Fuel supply failure Check by turning engine and listen for the characteristic squeak in the injector	**No fuel in tank',** **Air in pipe line.** **Broken fuel pipe or leaking connection** **Fuel filler choked** **Faulty injector nozzle** **Fuel pump plunger sticking** **Fuel pump tappet sticking**	**Fill tank and bleed fuel system, if applicable** **Repair or renew the pipe or tighten the connection** **Fit new fuel filter element** **Fit new nozzle** **Fit new pump** **Free and clean tappet**
Engine will not start	**Poor compression**	**Valves sticking** **Cylinder head loose** **Cylinder head gasket blown** **Piston rings stuck in groove** **Worn cylinder and piston** **Valves not sealing properly**	**Free the valves** **Tighten all nuts** **Fit new gasket** **Check rings and clean the piston** **Overhaul the engine** **Check valve springs** **Grind in if necessary** **Check the valve clearance**
	Incorrect lubricating oil	**Too high a viscosity oil causing excessive engine drag**	**Drain the sump and fill with correct oil**

TROUBLE LOCATING CHART-contd.

Trouble	Reason	Causes	Suggested Remedy
Engine starts but fires intermittently or soon stops	Faulty fuel supply	Water in the fuel Faulty injector nozzle Fuel filter choked Air in fuel pipes	Drain fuel system and fill with clean fuel Fit new nozzle Fit new filter element Bleed the system, if applicable
	Faulty compression	Broken valve spring Sticking valve Pined valve	Fit new spring Free the valve Grind or renew
	Dirty exhaust	Blocked exhaust pipe or similar	Clean out
Engine lacks power and/or shows dirty exhaust	Faulty fuel supply	Faulty fuel pump Faulty injector nozzle Unsuitable fuel	Fit new pump Fit new nozzle Drain the fuel system and fill with correct fuel
	Out of adjustment	Valve clearances incorrect Fuel timing incorrect	Adjust Adjust
	Dirty engine	Blocked exhaust pipe or similar Dirty air cleaner Faulty piston ring Excessive carbon on piston and cylinder head Worn cylinder or piston	Clean out Clean out Fit new ring Decarbonise Overhaul the engine

TROUBLE LOCATING CHART-contd.

Trouble	Reason	Causes	Suggested Remedy
Faulty running	Knocking	Carbon on piston crown Injector needle sticking Fuel timing too far advanced Broken piston ring Slack piston Worn large end bearing Loose flywheel Worn main bearing	Decarbonise Fit new nozzle Adjust timing Fit new ring Fit new piston rings Renew and check lubrication Refit Renew and check lubrication
	Overheating	Cooling system failure: Suction pipe blocked Air leak in suction pipe Broken water pump rotor Faulty water pump seal Overloaded Excessive valve clearance Lubricating oil failure	Check for leaks or blockages Remove and clean Check and tighten fittings Replace rotor and check pump Replace seal and check pump Reduce the load Adjust Check the engine and lubricating oil system for damage If in order, top up sump and check running
	Speed swrg—	Overheating Air in fuel pipes Governor slicking	See above Bleed the system, if applicable Check the governor for correct operation
	Sudden stop	Empty fuel tank Choked injector Fuel pipe broken Seized piston	Fill tank and bleed system, if applicable Fit new nozzle Repair or renew Fit new cylinder and piston
	Heavy vibration	Faulty installation	Check holding down bolts and flexible mountings and couplings if fined

b

Installation

1. Engine bearers

Engine mounting bearers or framework must be of rigid construction and neither deflect nor twist when subjected to the weight of the engine and any ancillary equipment.

2. Erection

(a) Installation drawings are obtainable from *Petters Ltd or their agents*

(b) Provision must be made for:

(i) Oil filler cap removal and oil draining.

(ii) Fuel and oil filler and air cleaner maintenance.

(iii) Starting and operation of controls

(c) Only good quality holding down bolts or studs may be used. Set-screws must NOT be used.

(d) *Petters Ltd or their agents* should be consulted in the following cases:

(i) Before proceeding with any new form of installation.

(ii) Where the use of anti-vibration mountings is contemplated. (An unsuitable choice can be dangerous)

(iii) When a portable installation is contemplated. In this instance a *Petter* engineer should be present when the initial installation is made

(e) *On* direct driven sets the driving and driven units must belined up and a flexible coupling fitted

3. Exhaust

(a) An exhaust manifold flange is available from *Petters Ltd or their agents* and is tapped to enable a threaded exhaust pipe to be fitted.

(b) Exhaust pipe sizes are as follows:

(i) AB1W. This flange is tapped 1in BSP and is suitable for exhaust pipe lengths up to 18in (457mm). For lengths from 18in (457mm) to 10ft (3m) and from 10ft (3m) to 20ft (6m) the manifold must be adapted and exhaust pipes of 1 1/2in BSP and 2in BSP respectively used.

(ii) AC1W. This flange is tapped 11/2 in BSP and is suitable for exhaust pipe lengths up to 6ft (1.83m)
For lengths from 6ft (1.83m) to 20ft (6m), the manifold must be adapted and an exhaust pipe of 2in BSP used

(iii) For exhaust pipe sizes for lengths in excess of 20ft (6m). consult *Fetters Ltd or their agents*

(c) An acoustic type silencer for fitting to an exhaust pipe is obtainable from *Potters Ltd or their agents.* It is important that the thread size of this type of silencer is the same as that of the exhaust pipe, and that a tail-pipe is fitted. The length of the tail-pipe must be ten times the inside diameter of the exhaust pipe. ie a tail-pipe 15in (381mm) long must be fitted to a 11/2 in BSP acoustic silencer.

(d) The exhaust system should be as short as possible and with a minimum of bends, otherwise a serious reduction of power will result.
(e) A short length of flexible exhaust pipe should be included between the engine and main run of piping

4. Air intake

Air is taken in through an air cleaner

Engines installed in confined spaces require good ventilation to ensure a plentiful supply of cool. clean air.

5. Cooling

(a) Open system

(i) Salt water must NOT be used for cooling unless a corrosion inhibitor is fitted, and it is important that brass or copper pipes and fittings are kept to a minimum UNDER NO CIRCUM-STANCES may brass or copper pipes or fittings come into contact with the aluminium on the engine.

(ii) The cooling system must not be connected directly to a main water pressure supply unless a control valve is fitted in the inlet side of the system. The control valve must at all times prevent the system being pressurized

(iii) The cooling system must be so arranged that water remains in the Jacket when the engine is shut down or the water flow is interrupted

(iv) IT IS IMPORTANT that the vertical distance between the water pump. if fitted, and water supply is no more than 2ft (61.0 mm). By fitting a small reservoir to the suction side of the pump, and supplying water through a hose of no more than 3/8 in (9.5mm) bore. the distance may be increased to 10ft (3m) A suitable reservoir and hose is available from *Petters Ltd or their agents.*

(v) To ensure correct circulation, the cooling water inlet should be fitted to the side of the cylinder head on AB1W engines, to the cylinder on AC1W engines and the outlet taken from the top of the cylinder head.

(b) Closed system (thermosyphon) (Fig 1)

(i) Water tanks may be used for cooling and should be filled with clean fresh water (see Technical Data)

(ii) It is recommended that 3/4in (19mm) bore pipes are used to supply water to and from the engine

(iii) The water outlet pipe (A) from the engine should be connected to the top of the cooling tank (B) in a steadily rising manner. The bottom of the cooling tank should be level with or slightly below the bottom of the cylinder Pipes should be as short as possible with a minimum of bends.

(iv) The water level must NOT fall below the top connection. To reduce evaporation a loose fitting lid should be fitted

(v) If two or more tanks are installed, they should be connected by 2in (51 mm) bore pipes (C). The top connecting pipe should be below the level of the previous top connection. The bottom connecting pipe should be about 2in (51mm) from the base.

(vi) A tap should be fitted in the inlet water pipe (D) to the bottom of the cylinder This is to control the temperature of the cooling water from the engine at no greater than 95℃ (203° F) or less than 75℃ (167℉) Pipes should be too hot to hold b ut the water should not boil.

(vii) Under low temperature conditions it is advisable to use an anti-freeze mixture in the cooling tank Make sure that the anti-freeze used is suitable for aluminium alloy engines and contains the correct corrosion inhibitor. Do not allow the antifreeze mixture to remain in the cooling system for more than six months or the corrosion inhibitor may deteriorate When necessary drain the cooling system and refill with a new antifreeze mixture.

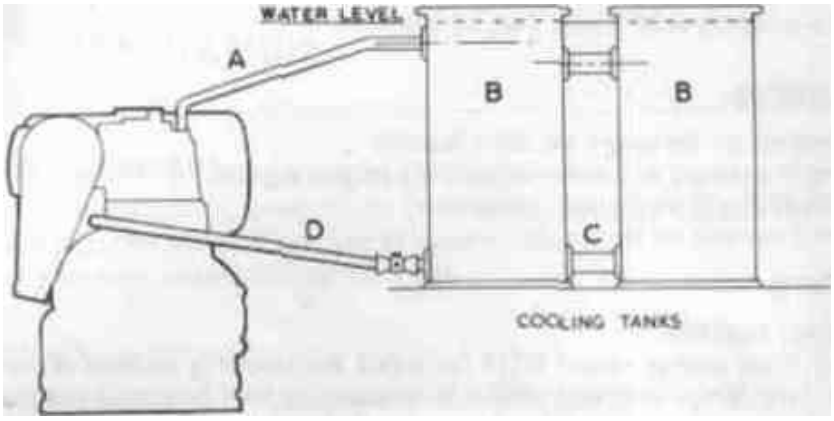


fig. 1

(viii) Do not mix different grades of anti-freeze and always top up with a mixture of the same strength. Make sure that the mixture is suitable for the coldest conditions likely to be encountered

6. Lubrication

(a) The engine oils listed under Approved Lubricants are heavy duty oils with a minimum performance level as specified by:
British Defence Specification No. 21010
or U.S. Specification MIL/L/2104B

(b) Suitable additional heavy duty engine oils will be recommended by a local oil distributor but a minimum performance level as above must be specified.

(c) P*etters Ltd or their agents* should be consulted if doubt arises regarding the selection of an engine oil

(d) MARINE AUXILIARY INSTALLATIONS. Although two viscosities of oil are recommended for different climatic conditions, it is not always

practical to change oils as the engine passes from one climate to another. Under these circumstances, for engines operating fire pumps or other equipment required IN AN EMERGENCY, it is recommended that the oil selected should be of a viscosity suitable for the coldest climate likely to be encountered. It should be noted that this recommendation is made with ease of hand starting as a first consideration.

7. Fuel

(a) The bulk storage of diesel fuel is subject to official regulations, but generally, storage is permitted above ground provided containers of authorised construction and capacity are used DO NOT use galvanised containers or the zinc coating will react with the fuel and damage the fuel injection equipment.

(b) To prevent the harmful effects of moisture absorbed by fuel, provision must be made for draining off water which may accumulate at the base of the storage tank. The amount of water absorbed by fuel can be minimised by keeping storage tanks as full as possible and ensuring that filler caps, inspection covers, etc., have effective sealings

(c) Tank cocks for withdrawing fuel should be fitted a short distance above the base, enabling clean fuel to be withdrawn without disturbing water or sediment

(d) To ensure proper working of the fuel system the fuel must always be CLEAN.

(e) Fuel should be allowed to settle before use Sludge or water at the bottom of the container must not be used. Due to increased engine repair costs, a cheap fuel may prove very expensive in the long run.

(f) Funnels or cans used for fuel should not be used for anything else and must be kept absolutely clean. They should be thoroughly dried before use

(g) The fuel tank should always be filled through a strainer. Occasionally the tank should be flushed out with petrol or paraffin.

(h) The fuel used should be high grade light diesel fuel. gas oil or DERV fuel It should comply with B.S 2869:1967 Class A1 or A2, an extract of which is as follows:

	Class A1	Class A2
Cetane number (min.).....	50	45
Viscosity (kinematic) at 37.8℃(100℉)..	1,6 to 6 .0 cSt	1 6 to 6.0 cSt
Carbon residue Conradson on 10% residue (by weight) (max).....	0.2%	0.2% '
Distillation recovered at 357℃ (675℉) (by volume).	90%	90%
Plash point (closed).....	55℃(130℉)	55℃(130℉)
Water (by volume) (max)	0.05%	0.05%
Sediment (by weight) (max).....	0.01%	0.01%

Ash (by weight) (max).	0.01%	0.01%
Sulphur (by weight) (max).....	0.5%	1.0%

Class A1 fuel is intended primarily for automotive use.
Class A2 is a general purposes fuel.

(i) Winter and summer grades of diesel fuels are marketed during the appropriate seasons and are also graded for that part of the world in which they are intended to be used Diesel fuels available for use in low temperature climates are classified as 'Cold Start Reference Fuels' Make sure that the fuel being used is suitable for the prevailing temperature conditions

(j) Fuels for marine auxiliary engines required to operate under constantly differing climatic conditions should be suitable for the coldest conditions likely to be encountered This is particularly important when considering fire pumps, etc., required to operate in an emergency

(k) Some diesel fuels not suitable for low temperatures may form wax under these conditions. If it is suspected that wax has formed, the whole engine should be gently warmed throughout and the fuel tank. pipes, injector and fuel injection pump then completely drained and flushed with the correct fuel. Refill the fuel system with correct fuel and bleed and prime before attempting to start.

8. Governing

The governor controls the engine at a constant speed irrespective of load variations and will be either a fixed speed type governing the engine at its rated speed only or a variable speed type allowing the governed speed to be varied between idling and full rated speed

The centrifugal forces on the governor balls are transmitted to the fuel pump rack These forces, which vary with the speed of the engine, are balanced by an adjustable speeder spring On a variable speed governor the tension of the speeder spring may be externally altered to give the required governed speed On fixed speed governors the Speeder spring may be adjusted to give an included variation of 10%

For starting purposes only. operation of the overload stop lever fitted to variable speed governors allows the fuel pump rack to move into the excess fuel pump position When the engine runs up to its rated speed the governor closes the rack which is then prevented from returning to the excess fuel position by the ratchet action of the overload stop cam

The overload stop limiting the travel of the rack into the excess fuel position on variable speed engines is set by *Petters Ltd* and the internal adjustment should not be disturbed. Interference with the setting may result in the engine being overloaded or not delivering its rated power Excessive load must be avoided and this will be indicated by the engine running below its RATED speed and/or a dirty exhaust.

C drive arrangements

9. Engine marks

Power can be taken from more than one shaft at the same time provided the total power absorbed is not greater than the rated power of the engine. Drive and starting arrangements are as follows:

MARK I Drive at half engine speed on camshaft extension at end remote from flywheel Rope starting at flywheel end

MARK II Drive at engine speed on crankshaft extension at end remote from flywheel Rope starting at flywheel end

MARK VI Drive at engine speed from flywheel end. Rope starting at end remote from flywheel

10. Pulley drive (Fig. 2)

Allow for 21/2% increase between centres

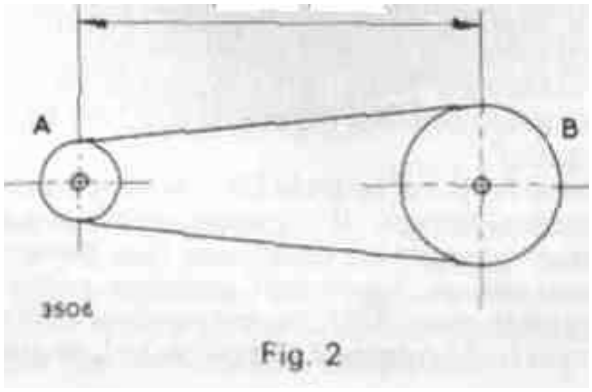


Fig. 2

When belt drives are used the belts should be as close to the engine as possible

To prevent damage to new vee belts when fitting, the distance between the centre of the engine pulley (A) and the driven pulley (B) must be capable of a reduction from the designed running position.

Provision must also be made for an increase of at least 2 1/2% over the designed running position to provide adjustment for belt stretch and wear during the life of the belts Multiple belts should always be renewed in matched sets

11. Rotation

Standard engine rotation is clockwise when viewed from the flywheel end.

Operation

12. To prepare a new or overhauled engine for starting (Fig 3)

(a) Check that the cooling system is in order and free from obstruction.
(b) Remove the oil filler cap and, with the engine level, fill with lubricating oil to the high level mark on the dipstick. (To remove the cap. push down and twist) Replace cap (After a few minutes running stop the engine and lop up the oil. as the level always falls slightly after initial circulation.)
(c) A81W. Unscrew the nut on the air cleaner cover, remove the cover

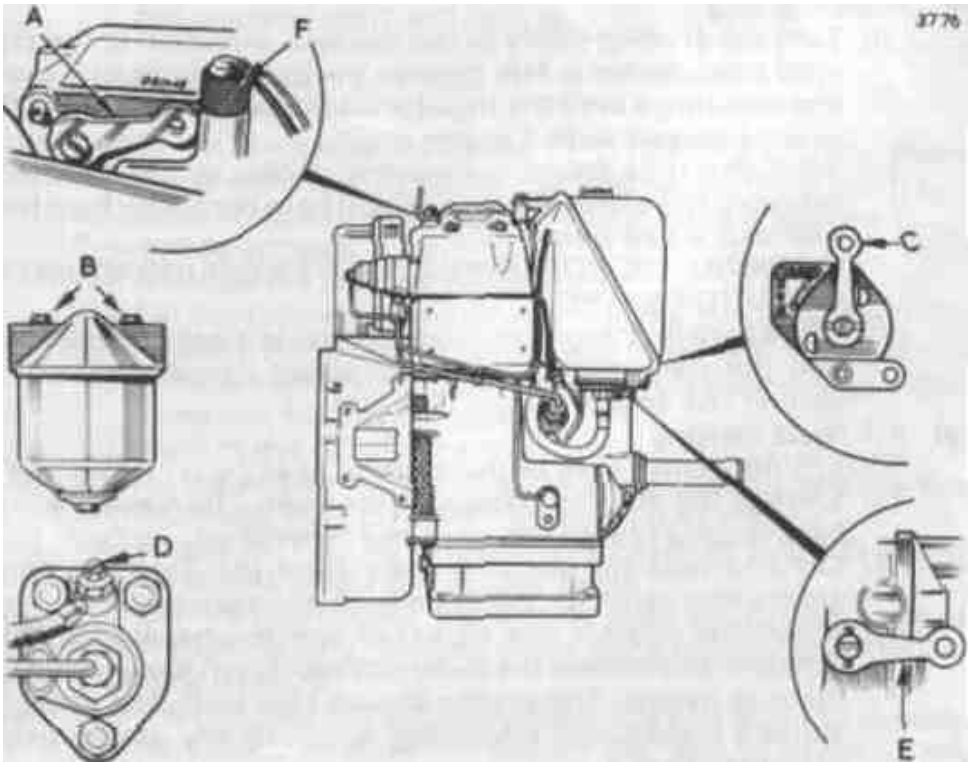


Fig. 3

and element and dip the cover In a bath of clean lubricating oil. Allow the cover to drain Replace the element and cover making sure that the element is correctly seated on the sealing rings

(d) Lift the decompressor lever (A) and turn the engine fifteen revolutions to help circulate the oil
(e) Fill the fuel tank and bleed the fuel system, if required.

13. **To bleed fuel system (Fig. 3)**

(a) Some engines are fitted with a self-bleeding fuel system and require no

attention.

(b) If a separately mounted fuel filter is fitted loosen the two vent screws (B) on top of the filter and keep loose until clean, bubble-free fuel leaks out Retighten the screws.

(c) On engines not fitted with a self-bleeding fuel infection pump move the stop/run lever (C) to the 'RUN' position, i.e . horizontal. Loosen the vent screw (D) on the fuel injection pump and turn the engine a few times until clean, bubble-free fuel leaks out Retighten the vent screw

(d) If a fuel feed pump is fitted fuel will not flow unless the priming lever is operated or the engine turned.

14. **To start (Figs. 3 & 4)**

(a) If a water pump reservoir is fitted, ensure that it is full and the cap is on.

(b) Remove the load from the engine.

(c) Move the stop/run lever (C) to the "RUN" position, i.e., horizontal.

(d) If a variable speed control is fitted, set the control lever to the half speed position then push down and release the overload stop lever (E).

(e) If a two-speed control is fitted, set the control in the 'RUN' position.

(f) Rope starting

(i) Turn the starting pulley in the opposite direction to the arrow until a resistance is felt Bounce the pulley vigorously against the resistance until the injector has squeaked ten times. (This is unnecessary with a warm engine)

(ii) Wind the rope round the starting pulley in the direction of rotation. The end of the rope should be in the pulley from two to two-and-a-half turns

WARNING-THE ROPE SHOULD NOT BEWOUND ROUND THE OPERATOR'S WRIST

(iii) Make sure that the decompressor lever is disengaged and then pull the rope smartly until it unwinds completely from the pulley. The engine should now fire

(g) 4:1 hand starting

(i) Lift the centre boss of the starting gear

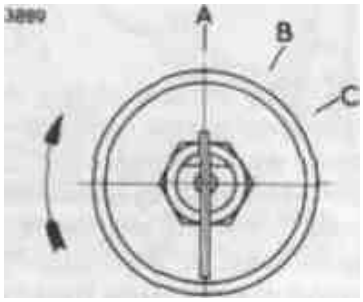
(ii) Engage the starting handle in the boss The handle will not fully engage unless the boss has been lifted

(iii) Lift and hold the decompressor lever (A) Turn the handle slowly and listen for the squeak of the injector.

(iv) When the injector has squeaked turn the handle as fast as possible and release the decompressor lever. Keep turning the starting handle. The engine should now start. The gears and starting handle will disengage automatically as the engine increases speed.

(h) Raised hand starting

(i) Lift the decompressor lever (A) and turn the starting handle in the direction of rotation slowly until the injector is heard to squeak. When the injector has squeaked, turn the starting handle as fast as possible. When maximum speed is reached, disengage the decompressor lever and keep turning until the engine fires.



STARTER SWITCH OPERATION
Fig. 4

(i) Electric starting
  (i) Make sure that the decompressor lever is disengaged.
  (ii) With the starter switch key in position (A) the circuit is 'off'.
  (iii) Turn the key clockwise to position (B). The circuit Is now "on"
  (iv) To operate the starter motor turn the key past position (B) to position (C). When the engine fires release the key immediately The key is spring-loaded and will return to position (B) Leave the key in this position while the engine is running Do not operate the starter motor for more than 20 seconds at a time.
  (v) If when the engine is running there is no charge current **the** red warning light will light up.

15. **Cold starting (Fig. 3)**
  (a) AB1W. At temperatures below 13℃ (55℉) and if the engine is cold. it is essential to prime the engine for hand starting, and advisable if battery power is low when electric starting.
  Proceed as follows:
    (i) Remove the priming plunger (P).
    (ii) Fill the priming chamber with engine oil - NOT fuel.
    (iii) Replace the priming plunger and press down.
    (iv) It is advisable to keep a quantity of lubricating oil in a suitable container for this purpose.
    (v) Start in the normal manner.
  (b) Should the engine fire and then stop, prime again and release the overload stop lever (E) before attempting to start.
  (c) AB1W and AC1W. At temperatures below 0℃ (32℉) and if the engine is cold. prime the engine twice.
  (d) If under cold conditions the engine does not run up to its rated speed after starting, operate the priming plunger again while the engine is running.
  (e) To minimise cold starting difficulties, it is a wise policy to keep the engine under cover when not in use and to ensure that an SAE 10W viscosity engine oil is used (see Approved Lubricants).
  (f) Below -4℃ (25℗) rope starting is not recommen ded.
  (g) Below -9℃ (16℉) consult *Fetters Ltd or their agents* for starting instructions.

16. **To stop**

(a) It is advisable to run on light load for a few minutes before stopping.
(b) Move the stop/run lever to the 'STOP' position, ie. vertical, and hold in this position until the engine Stops.

17. **Important dont's**

(a) **DON'T** stop the engine by means of the decompressor .This will lead to damaged valve seats and cylinder head joints
(b) **DON'T** stop the engine by allowing the fuel tank to run dry.
(c) **DON'T** remove or alter the setting of the overload stop or operate the overload stop lever when the engine is running This will cause overheating, excessive wear and possibly piston seizure.
(d) **DON'T** forget to grease the starting handle shaft Make sure the starling handle can be freely withdrawn
(e) **DON'T** forget to drain the cooling system before leaving the engine to stand idle in cold weather If cooling tanks are used. they should also be drained when not using an anti-freeze mixture.

18. Clutch

If a *Petter* clutch is fitted it should be adjusted in accordance with the instructions given under General Maintenance.

19. Daily

(a) Check lubricating oil and top up if necessary
(b) Check that the cooling system is in order and free from obstruction.
(c) If a water pump reservoir is fitted, check that it is full and that the cap is on

NOTE

The following maintenance recommendations are for average operating conditions Under very dusty conditions, air cleaners, lubricating oil and fuel filters will require more frequent attention. Decarbonising may be required more frequently when engines are running on light load for long periods

20. Every 50 hours

(a) Clean the air cleaner (oil bath type).

21. Every 250 hours

(a) Check all nuts. bolts, etc.. for tightness. (The cylinder head nuts must NOT be tightened when the engine is hot.)
(b) Make sure the fuel tank filler cap vent hole is clear.
(c) Clean the air cleaner (paper element type).
(d) Clean out deposit from exhaust system.
(e) Drain the sump. flush out with flushing oil and refill with new oil. (Paraffin may be used if flushing oil is unobtainable but the engine must not be run with paraffin in the sump)
(f) Check the fuel system for leaks
(g) Check the valve clearance and adjust if necessary.
(h) Fit new lubricating oil filter element and joint ring.
(i) Lubricate the speed control linkage
(j) Lubricate the 4:1 or raised hand starting if fitted.
(k) Grease speed control rod
(l) If fitted, check the water pump impellor and seal for damage and replace if necessary.

22. Every 500 hours

(a) Fit new air cleaner element (paper element type).
(b) Flush out the cylinder and cylinder head with clean fresh water and examine the corrosion inhibitor union, if fitted If this shows signs of deterioration fit a new one. (This is not necessary if cooling tanks are

used)

23. Every 1000 hours

(a) Clean out the fuel tank thoroughly
(b) Fit new fuel filter element
(c) Flush out the cylinder and cylinder head with clean fresh water and fit new corrosion inhibitor union.
(d) Fit new cylinder head gasket

24. Every 2000 hours

(a) Decarbonise
(b) Clean out piston oil return holes Check cylinder bore wear
(c) Examine the crankshaft bearings and renew if clearance is excessive
(d) Clean the oil pump strainer
(e) Remove the fuel injector and test spray If in order replace without further interference.

general maintenance

25. To drain cooling system

(a) **Remove the plugs from the cylinder This will allow the cooling water to drain out of the cylinder and cylinder head**

(b) **Remove the water pump outlet pipe if fitted, and drain the cooling water from the hose**

(c) **When replacing the cylinder plugs, it is advisable to wrap 1 ½ turns** of 'P T F E ' tape round the threads This will prevent the plugs sticking and corroding

There is no need to prime the cooling system when a water pump is fitted **as** the pump is self priming.

26. To flush out cylinder and cylinder head

(a) This operation must be carried out every 1000 hours, or every 500 hours with open system cooling, or once a year depending upon which comes first

(b) Drain and remove the fuel tank.

(c) Drain the cooling water from the cylinder and cylinder head.

(d) Disconnect the cooling water outlet hose and remove the plug and pipe fittings from the cylinder head

(e) By inserting a piece of wire through the various orifices in the cylinder and cylinder head. rake out any silt that has collected in the cooling system This should be carried out while flushing with clean fresh water, preferably under pressure

(f) The use of a descaling agent wilt be of assistance in removing any inaccessible or stubborn deposits

(g) It may be found necessary to flush the cooling system frequently when using water with a high silt content

(h) A new corrosion inhibitor union must be fitted every 1000 hours or once a year. but the old one may be refitted after 500 hours operation if not deteriorated and not in operation for more than one year

(i) When replacing the plugs and pipe fittings, it Is advisable to wrap 11/2 turns of "P.T.F.E ' tape round the threads. This will prevent the threads sticking and corroding.

27. To remove water pump (Fig. 5)

(a) Remove the water pipes from the pump.

(b) Remove the water pump by carefully sliding it off the pump shaft.
(c) Remove the pump cover (A) and joint (B) and remove the impeller (C).
(d) Inspect the water sealing washer (D), water thrower (E). seal in the pump body (F) and the impeller for damage, and replace if necessary.
(e) It is not necessary to remove the cam plate from the inside of the pump body.

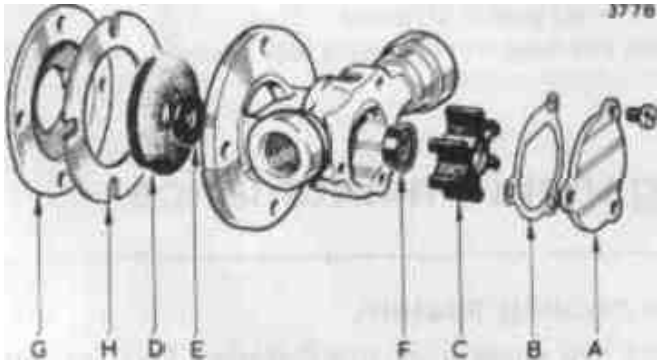


Fig. 5

28. To replace water pump (Fig. 5)

(a) Replace the water pump adaptor (G) and shim (H). if removed. Replace the water sealing washer and water thrower, leaving a gap between them
(b) Carefully slide the water pump body onto the shaft with the cam plate screw uppermost and tighten up. Ensure that the water thrower is just clear of the pump body.
(c) Ensure that the pump shaft does not touch the pump cover when the water pump is replaced. If it does, extra shims must be added between the adaptor plate and the pump body
(d) Replace the impeller on the shaft and refit joint and cover plate. The joint must be positioned so that the camplate is covered.
(e) Replace the inlet and outlet pipes.

29. Decarbonising

A carbon deposit forms on piston and cylinder head and the presence of an excessive carbon deposit is usually indicated by a dirty exhaust and a falling off of power.

Decarbonising necessitates the removal of the cylinder head. followed by the removal of all carbon and the grinding in of the valves These operations are described in subsequent paragraphs.

Sets of joints are obtainable from *Petters Ltd or their agents.*

30. To remove cylinder head

(a) Drain the cylinder and cylinder head
(b) Remove the cooling water inlet and outlet pipes.

(c) Remove the fuel tank and fuel pipes, placing the pipes in clean fuel (see "Fuel system').

(d) Remove the crankcase to rocker-box oil pipe *fe)* Remove the exhaust silencer or manifold, and the air cleaner and manifold assembly.

(e) Remove the fuel injector. Cover the holes in the injector against admission of dirt, etc

(f) Remove the rocker box cover, rocker assembly and withdraw the push rods.

(g) Remove the cylinder head nuts and lift off the cylinder head.

31. To remove valves

(a) Hold the valve on the seat and depress the valve spring cap and remove the split collets. Valve, spring, spring plate and cap can now be removed.

32. To remove carbon

(a) Turn crankshaft until piston is at top of its stroke

(b) Scrape carbon from the cylinder head and top of the piston with a broad blunt tool Emery cloth must NOT be used Do not allow carbon dust to fall between the piston and the cylinder bore.

(c) Thoroughly clean out the exhaust and inlet ports and manifolds.

(d) IT IS IMPORTANT that the recesses at the end of the valve guide bores are free from carbon

(e) Thoroughly clean the valves and examine the valve seats. If these show signs of pitting, they should be ground in.

(f) Make sure the valves are seating properly Leaking valves cause loss of compression and difficult starting.

(g) **DO NOT** remove the air cell from the cylinder head. If a carbon deposit has formed in the air cell nozzle, it may be cleaned with a soft piece of wire.

(h) Clean injector bore and seating faces.

33. To remove valve guides

(a) EXTREME CARE AND CLEANLINESS is essential at all times when removing or replacing the valve guides

(b) Thoroughly wash the cylinder head with petrol or paraffin to ensure that all carbon, oil and dirt has been removed

(c) To remove the valve guides, place the cylinder head in boiling water for two minutes Support the head on blocks at least ½ in (1.3mm) thick, to prevent the valve guides bottoming Press out the guides from the valve seat side with the aid of a hand press and punch.

(d) If a press is not available, a drift may be used, but SPECIAL CARE MUST BE TAKEN to avoid the drift slipping, scoring or otherwise damaging the bores

(e) DO NOT USE EXCESSIVE FORCE if heavy resistance is

encountered, but replace the cylinder head in boiling water for a further two minutes

(f) When pressing out the guides ensure that the punch does not score or damage the bores in any way Failure to observe this precaution may result in the new guides being loose in the cylinder head.

34. To replace valve guides

(a) Before fitting new guides, ensure that the bores in the cylinder head and the body of the guides are clean.

(b) Place the cylinder head in boiling water for two minutes, enter the guides squarely in the bores from the rocker box side, and press home to the shoulder

(c) If a press is not available, a drift may be used, but SPECIAL CARE MUST BE TAKEN to avoid the drift slipping, scoring or otherwise damaging the bores

(d) The valve guides MUST NOT BE REAMED.

(e) Grind in the valves

35. To grind in valves

(a) Care must be taken that the valves are returned to their correct seating for this operation

(b) Place a very small quantity of grinding paste evenly around the valve seat and insert the valve Partially rotate the valve backwards and forwards on its seating, exerting a gentle but firm pressure

(c) Periodically lift the valve from its seating and give it half a turn. Thus ensuring that the grinding paste is evenly spread

(d) It is unnecessary to continue grinding once the faces of the valve and its seating have a clean, even. matt-surfaced appearance. A polished surface must not be expected and is unnecessary

(e) Wash out the ports thoroughly with petrol or paraffin making sure that all traces of grinding paste are removed from the valves and guides

(f) Replace the valves and rotate them backwards and forwards a few times If the valves have been correctly ground a thin polished line will appear all round the seat.

36. To replace cylinder head

(a) Generally reverse the instructions for removal and dismantling. The rocker bushes and push rod ends should be smeared with molybdenum-disulphide grease before assembly

(b) It is IMPORTANT that the exhaust and inlet valves be returned to their correct positions

(c) If the valves are distorted or very badly pitted, fit new ones

(d) If new valves or guides are fitted, the valves must be ground in.

(e) Whenever the cylinder head is removed after the engine has been run, a new gasket MUST be fitted.

(f) Before completing reassembly check the bumping clearance (see Technical Data) as follows:

(i) Insert a length of lead wire or soft solder through the injector port in the cylinder head. Pull through sufficient to allow approximately 1 in (25mm) to be positioned flat on the cylinder head between the inlet and exhaust valves. Wind any surplus wire around the injector studs.

(ii) Replace the cylinder head and tighten the nuts in the correct sequence with a torque spanner. See *(g)* below

(iii) Turn the engine over TDC and (hen carefully remove the wire.

(iv) Measure the thickness of the now flattened wire with a micro-meter If the clearance is outside the limit, adjust by changing one or more of the shims at the base of the cylinder, and recheck the bumping clearance

(g) As the engine is fitted with long through studs from crankcase to cylinder head it is MOST IMPORTANT that the cylinder head nuts are correctly tightened and in the right sequence. Tighten the cylinder head nuts using a torque spanner set to the figure shown under Technical Data. Proceed as follows:

(i) Screw down each cylinder head nut until finger tight.

(ii) Tighten each nut a quarter of a turn at a time working diagonally across the cylinder head until all the nuts are tight.

(h) Adjust the valve rocker clearances (see Technical Data).

(i) Tighten the injector stud nuts using a torque spanner set to the figure shown under Technical Data (See 'To replace fuel injector'.)

(j) Run the engine for at least one hour and allow to cool

(k) When cold. retighten the cylinder head nuts and readjust the valve rocker clearances.

(l) After approximately 20 hours normal running check the cylinder head nuts again for tightness.

37. To adjust valve rockers (Fig. 6)

(a) To adjust the clearance, set the engine with valves closed (TDC of firing stroke), loosen the locknut (A) and turn the rocker adjusting screw (B) with a screwdriver Measure the gap with a feeler gauge. and when the correct setting is obtained (see Technical Data) retighten the locknut Recheck the gap

(b) IMPORTANT. The cylinder head must be firmly bolted in position with all nuts finally tightened, before the rocker clearances are adjusted

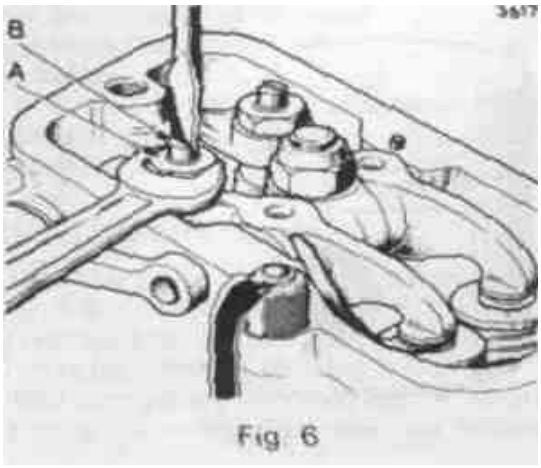


Fig. 6

38. To remove cylinder and piston

(a) Remove the cylinder head
(b) Lift the cylinder off the crankcase and draw it off the piston.
(c) To remove the piston, lake out one gudgeon pin circlip and push out (he gudgeon pin. If the gudgeon pin is a tight fit in the piston, wrap the piston in a cloth soaked in hot water After a few minutes the gudgeon pin will be released and can be pushed out

39. Cylinder maintenance

(a) When the cylinder bore wear has reached the maximum (see Technical Data) the cylinder should be bored out and an oversize piston and rings fitted
(b) The cylinder should be rebored and honed to the sizes shown under Technical Data

40. Piston maintenance (Fig. 7)

Excessive lubricating oil consumption. loss of compression and knocking are signs that a piston may need attention

(a) If the ring gaps are excessive (see Technical Data) the rings should be renewed To measure the gaps remove the rings from the piston noting the order of assembly and which ring face is uppermost
(b) Remove all the carbon deposit from the rings and ring grooves The small holes (A) in the scraper ring grooves should receive attention as their purpose is to return excess oil to the sump
(c) Insert the piston into the cylinder bore with the crown towards the bottom end of the bore to about ½ in (13mm) from the bottom edge Insert the rings one at a time, pushing each ring hard against the piston crown to ensure that it is level in the cylinder bore. Withdraw the piston sufficiently to allow the gap to be checked with a feeler gauge.
(d) Assemble the rings on the piston in the correct order with the correct face uppermost Rings should not be slack or stuck fast in the groove. With the piston held in a horizontal position the rings should not fall downwards unless the piston is shaken.
This applies only to a piston and rings free from grease or oil.

(e) When the engine has been fully run-in, the bore will have a highly polished and very hard surface If new rings are fitted without the cylinder being rebored or resleeved. the new rings will not bed in satisfactorily Under these conditions the cylinder should be removed and the hard polished bore lightly roughened using a medium grade emery cloth The roughening should be carried out radially by hand and should be sufficient only to produce a matt surface on the bore.

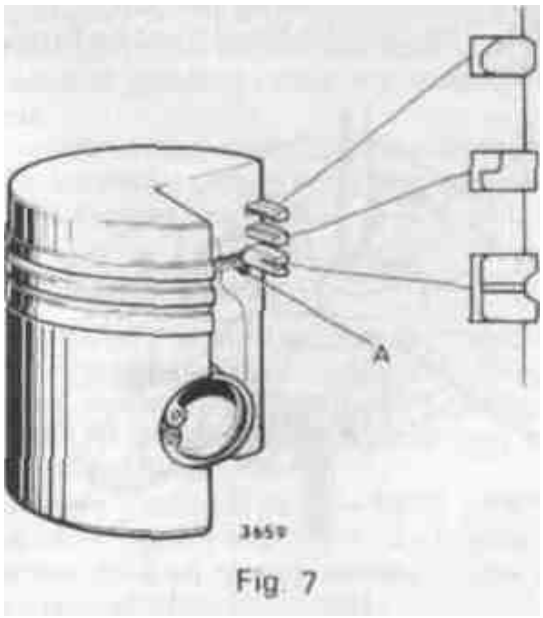


Fig. 7

Alternatively, a suitably sized de-glazing too! of the rotary brush type with silicone-carbide tips may be used provided method used is in accordance with manufacturers instructions After this treatment the cylinder must be thoroughly washed in petrol or paraffin to remove all traces of carborundum

(f) To allow the piston rings to bed in satisfactorily it is recommended that the engine be run on half load whenever possible after overhaul.

41. To replace cylinder and piston

(a) Generally reverse the instructions for removal and dismantling
(b) Take care that the piston ring gaps are not in line but well distributed around the piston circumference
(c) Replace the shims between the cylinder and crankcase. The thickness of the shims controls the bumping clearance between the piston and cylinder head at TDC.
(d) Check the bumping clearance (see Technical Data). See To replace cylinder head
(e) After completing reassembly, check the valve rocker clearance.

42. To examine connecting rod

(a) Drain the sump
(b) Remove the cylinder head. cylinder and sump
(c) Grasp the large end of the connecting rod and check for undue play or shake in the bearing The flywheel should be rocked backwards and forwards during this operation

(d) Check that the large end bolts are tight (see Technical Data)
(e) Check for undue wear in the small end bush by rocking the piston whilst holding the connecting rod firmly

43. To remove connecting rod

(a) Remove cylinder head and cylinder.
(b) Drain the oil from the sump.
(c) Remove the sump
(d) Unscrew the large end bolts and withdraw the connecting rod and piston assembly, being careful to note in which position the bearing halves are fitted.

44. Connecting rod maintenance

(a) When fitting a small end bush take care that the oil hole coincides with (hat in the connecting rod and that the bush enters the connecting rod squarely In the absence of a press, a block of wood and mallet may be used for driving it home
(b) *New* small end bushes are supplied with a reaming allowance, and after fitting must be reamed to the size shown under Technical Data.
(c) Large end bearings are of the precision thin wall steel back type and consist of two half shells lined with bearing metal. They should be replaced in their original positions
(d) New bearings are machined to give the required fit when in position and should not be scraped or bedded in, neither should shims of any description be fitted If the faces of the connecting rod or its cap are filed the rod becomes useless regarding replacement bearing shells When fitting make sure that the connecting rod bore, the outside of the shells and their split faces are clear
(e) Connecting rods and caps are stamped with an assembly serial number and care must be taken that numbers are correctly assembled and on the same side
(f) Undersize bearings are obtainable from *Petters Ltd or their agents.*

45. To replace connecting rod

(a) Generally reverse the instructions for removal, making sure that the connecting rod cap is away from the dipstick side of the engine.
(b) Tighten the large end bolts using a torque spanner set to the figure shown under Technical Data
(c) *Do* not over-tighten the large end bolts or the bearing may distort. If a torque spanner is not available, the bolts may be tightened using a moderate force on a spanner gripped approximately 8in (200mm) from the bolt
(d) When replacing the cylinder and cylinder head, check the bumping clearance and valve rocker clearance.

46. 4:1hand starting (flywheel end)

(a) To remove
    (i) Remove the starting gearwheel guard.
    (ii) The gearwheels can now be greased using a high melting point

grease. The sliding plate assembly, locating screws and starting handle shaft recess can be lightly oiled without further dismantling

(iii) Remove the mounting plate assembly from the bellhousing if necessary, by removing the two capscrews and two n-setscrews.

(iv) Remove the starting gearwheel retaining clip and circlip. and remove the gearwheel.

(b) To replace

(i) Generally reverse the instructions for removal.

(ii) If the mounting plate has been removed, and the sliding plate assembly dismantled, tighten the locating screws, capscrews and setscrews using a torque spanner set to the figure shown under Technical Data.

(iii) After assembly check that load required to lift the gearwheel into mesh, using a spring gauge, is 15 to 20 Ib (6.8 to 9.1 kg) for engines running between 1000 and 1800 rev/min, and 24 to 28 Ib (109 to 12.7kg) for engines running above 1800

(iv) The gearwheel retaining clip can be adjusted by setting the bracket to give the required loads.

(v) Replace the guard.

47. 4:1 hand starting (gear end)

(a) To remove

(i) Remove the starting gear guard

(ii) The gearwheels can now be greased using a high melting point grease The sliding plate assembly, locating screws and starting handle shaft recess can be lightly oiled without further dismantling

(iii) Remove the starting gearwheel retaining clip and circlip. And remove the gearwheel

(iv) Remove the crankshaft extension shaft gearwheel retaining screw and plate, and withdraw the gearwheel which is keyed to the shaft.

(v) Remove the screws securing the sliding plate and remove the plate from the return spring

(vi) Remove the remaining screws from the mounting plate and remove the mounting plate and guard from the engine gear cover

(b) To replace

(i) Generally reverse the instructions for removal.

(ii) When replacing the return spring, ensure that it is correctly located in the mounting plate and the spacer and washer are fitted

(iii) Ensure that the return spring is located in the sliding plate before positioning and replacing the locating screws

(iv) Ensure that the extension shaft key is fitted before replacing the gearwheel

(v) Before replacing the starting gearwheel, tighten all the locating

screws and the crankshafl extension gearwheel using a torque spanner set to the figure shown under Technical Data

(vi) Replace the starting gearwheel, retaining clip and guard.

48. Raised hand starting

(a) To remove

(i) Loosen the starting handle shaft retaining screw, but do not remove it

(ii) Remove the circlip on the top shaft, and take off the washers.

(iii) Remove the five capscrews retaining the outer chain housing and draw it off the dowels

(iv) Remove the retaining screw from the top shaft and remove the starting handle shaft, upper chainwheel, chainwheel retaining shaft and chain

(v) Remove the outer circlip and washer from the bottom shaft and gently slide the chainwheel and clutch assembly off the shaft Remove the inner circlip.

(vi) Remove the two remaining capscrews from the back of the inner chain housing and remove the housing from the spigot.

(b) Maintenance

(i) Thoroughly clean and inspect all parts, paying particular attention to wear on the bushes, clutch and oil seal

(ii) Before replacement, immerse the chain and liberally oil the chain wheels with *Shell Ensis 20* oil or equivalent, and pack the clutch with water resistant grease

(c) To replace

(i) Generally reverse the instructions for removal.

(ii) IT IS IMPORTANT that the chainwheel and clutch assembly is fitted the correct way round When fitting this unit ensure that when turned clockwise the clutch binds, and when turned anti-clockwise the clutch is free.

(iii) Tighten the Starting handle shaft retaining screw using a torque spanner set to the figure shown under Technical Data.

(iv) if a water pump is fitted, ensure that the impeller is correctly fitted to the shaft

49. To remove flywheel

(a) Remove any fittings from the bellhousing and flywheel.

(b) Secure the flywheel by inserting a hexagon wrench key or steel rod through the timing hole in the bellhousing. and locating it in the hole in the flywheel periphery This rod must not be loose, but a good fit in the flywheel hole.

(c) Bend back the tabwasher and remove the flywheel retaining nut.

(d) Remove the securing rod

(e) A simple extractor will be required to remove the flywheel, as it is fitted on a tapered shaft and located by a key.

(f) Remove the flywheel locating key

50. To replace flywheel

(a) Generally reverse the instructions for removal.

(b) Ensure (hat the flywheel locating key is replaced in the crankshaft before fitting the flywheel
(c) A new tabwasher must be fitted before tightening the flywheel retaining nut. Tighten the flywheel nut using a torque spanner set to the figure shown under Technical Data
(d) When the nut is tight, knock up the tabwasher
(e) If a 4 1 hand starting arrangement is fitted, the gearwheels should be greased and the sliding plate, locating screws and the starting handle shaft recess oiled Tighten the flywheel extension gearwheel bolts using a torque spanner set to the figure shown under Technical Data.

51. To remove crankshaft

(a) Remove the cylinder head. cylinder, connecting rod and flywheel
(b) Remove any starting arrangement or fitting from the gear cover
(c) AC1W. Remove the main bearing housing oil pipe.
(d) Remove the gear cover The cover is dowelled to the crankcase.
(e) Remove the crankshaft extension shaft at the gear end. if fitted
(f) Remove the crankshaft gearwheel retaining bolt Withdraw the gearwheel with a simple extractor.
(g) Remove the nuts retaining the flywheel end main bearing housing. Remove the housing taking care not to damage the oil seal
(h) Withdraw the crankshaft by pulling towards the flywheel end.

52. Crankshaft maintenance

(a) Carefully examine the bearing journals and crankpin They should be free from score marks and ovality should not exceed the maximum (see Technical Data).
(b) If these defects are present the crankshaft should be reground to the diameter shown under Technical Data and undersize bearings fitted
(c) Carefully clean out the oil holes and make sure they have radiused edges.

53. Main bearing maintenance

(a) Main bearings are of the precision thin **wall steel backed sleeve** type lined with bearing metal
(b) When removing a gear end bearing from the crankcase or a flywheel end bearing from the bearing housing, heal the crankcase or bearing housing to a temperature of 93/120℃ (200/250℉) be fore pressing out the bearing
(c) When fitting a bearing, the crankcase or bearing housing should again be heated as above and the outer surface of the bearing should be smeared with molybdenum-disulphide grease or tallow before pressing in It is an advantage if the bearing can be placed in a domestic type refrigerator for a time before fitting
(d) Do not remove the bearings unnecessarily or their tightness in the crankcase or bearing housing may be affected It is not advisable to remove the bearings more than five times
(e) When fitting a bearing take care that it enters squarely.
(f) New bearings are machined to give the required fit when in position and should not be scraped or bedded in. neither should shims of any

description be fitted

(g) Undersize bearings are obtainable from *Petters Ltd or their agents.*

54. To replace crankshaft and time engine (Fig 8 & 9)

(a) Generally reverse the instructions for removal.

(b) Fit new bearings if the old ones have excessive clearance or show signs of the metal having run

(c) Make sure the main bearing housing is correctly fitted with the oil drain hole at the bottom

(d) When fitting new thrust washers, be sure that the grooved sides are away from the bearing housing and that the tongues (A) are located in their respective recesses Fit new pins (B)

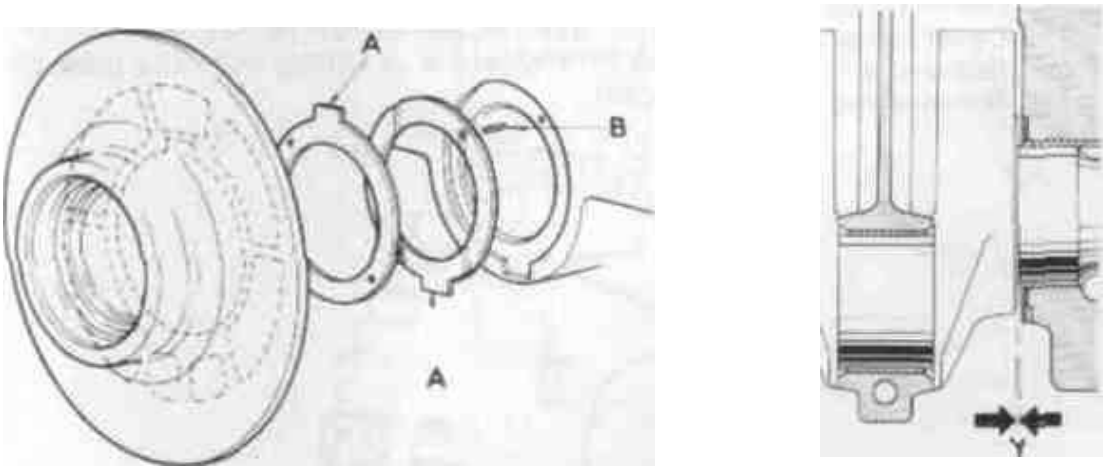


Fig. 8

(e) Check the end float (Y) and if excessive fit new thrust washers (see Technical Data)

(f) When assembling the gearwheels make sure that the teeth marked with dots are in their relative positions

(g) Tighten the crankshaft gearwheel retaining screw and extension shaft screws, if fitted, using a torque spanner set to the figure shown under Technical Data.

(h) AC1W. Proceed as follows

(i) Loosely fit the crankcase-to-rocker-box oil pipe at the crankcase end. Feed the crankcase-to-main-bearing-housing oil pipe through the flywheel guard and loosely attach to the crankcase-to-rocker-box oil pipe banjo.

(ii) Fit the pipe to the main bearing housing union and tighten the nut.

(iii) Remove the crankcase-to-rocker-box oil pipe.

(i) Replace the flywheel.

(j) If a starting arrangement is fitted to the gear cover, maintenance should be carried out before replacing

(k) If a water pump is fitted, ensure that the impeller is correctly fitted to the shaft

Before completing reassembly, check the bumping clearance.

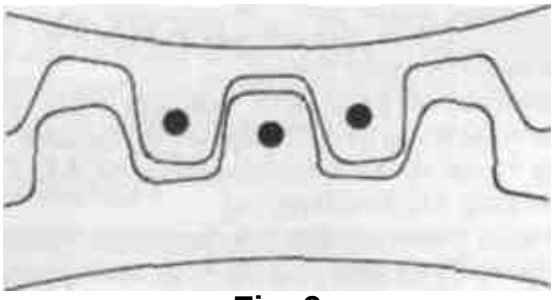


Fig. 9

55. To remove camshaft (Fig. 10)

(a) Drain oil from the sump

(b) Drain and remove the fuel tank Remove the fuel pipes placing them in clean fuel (see 'Fuel system'). Remove fuel injection pump. Cover holes in injector against admission of dirt. etc.

(c) Remove any starting arrangement or fitting from the gear cover.

(d) Remove the gear cover.

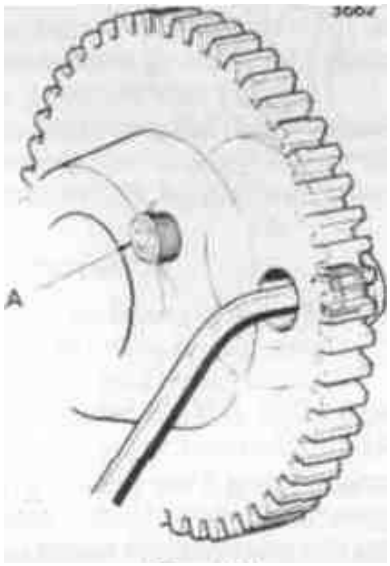


fig.10

(e) Remove the rocker cover, rocker support and rocker assembly and withdraw the push rods

(f) Turn the engine onto its side to prevent the tappets from falling into the sump

(g) Remove the extension shaft from the camshaft gearwheel, if fitted.

(h) Remove the screws (A) retaining the camshaft thrust plate These are accessible through holes in the gearwheel. Withdraw the camshaft and gearwheel assembly from the gear end of the engine

(i) The gearwheel is a tight fit on the camshaft. To fit a new thrust plate remove the gearwheel retaining bolt and press the shaft from the gearwheel The gearwheel is keyed to the shaft.

56. Camshaft maintenance

(a) Carefully examine the faces of the cams. If these are worn or chipped it will be necessary to fit a new camshaft.

57. To replace camshaft and time engine (Fig 9 & 11)

(a) Generally reverse instructions for removal
(b) Check the camshaft end float (Y) and if excessive fit a new thrust plate (see Technical Data)
(c) When assembling the gearwheels make sure that the teeth marked with dots are in their relative positions
(d) Tighten the camshaft gearwheel retaining screw and extension shaft screws, if fitted, using a torque spanner set to the figure shown under Technical Data.
(e) Retime the fuel injection pump and adjust the valve clearances.

Y

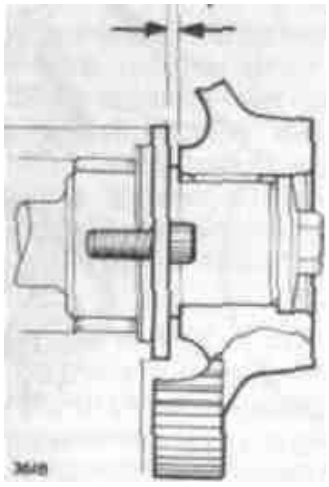


Fig. 11

58. To remove governor (Fig. 12)

(a) Remove the gear cover.
(b) Remove the screws (A) securing the governor assembly to the crankcase and withdraw it.

59. Crankcase breather maintenance

Under normal circumstances the breather assembly will not require maintenance. However, if removal is necessary proceed as follows;
(a) Drain and remove the fuel tank.
(b) Remove the breather pipe. cover and valve.
(c) Remove the breather housing and seal from the crankcase. A special tool for this purpose is available from *Petters Ltd or their agents.*
(d) Thoroughly clean all parts in paraffin or clean fuel.
(e) Examine the seal and valve for damage and replace if necessary.
(f) When fitting the cover, ensure that the pipe connection is parallel to the crankshaft and facing the flywheel end.

60. To remove governor linkage (Fig. 12)

(a) Remove the governor.
(b) Remove the gearwheel from the camshaft.
(c) Move the stop/run lever (B) to the "RUN" position, i.e , horizontal.

(d) Remove the screws (C) securing the governor stop cover (D), or speed control bracket if fitted and remove it.

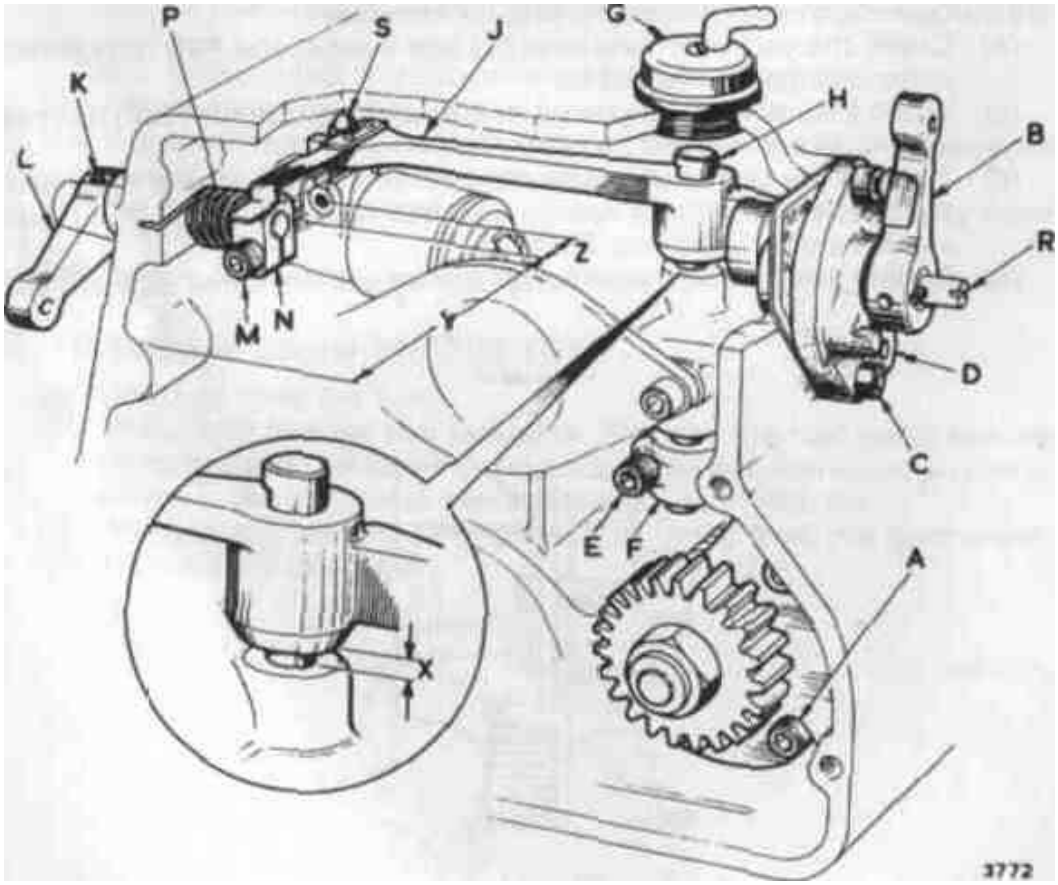


Fig. 12

(e) Loosen the governor bracket screw (E) and remove the bracket (F). speeder spring and speeder spring plunger.

(f) Remove the breather assembly (G) and withdraw the shaft (H) and fuel pump operating lever (J).

(g) The overload stop is set by *Petters Ltd and* should NOT be disturbed unless a new fuel pump is fitted. However, if oil is leaking from the spindle or the overload stop return spring is damaged remove the pin (K) securing the overload stop lever (L) and remove the lever.
The spindle and return spring (P) can now be withdrawn from the inside of the crankcase DO NOT loosen the screw (M) clamping the overload stop (N) to the spindle on AB1W engines

61. Governor and linkage maintenance (Fig. 12)

(a) Thoroughly clean all parts in paraffin or clean fuel, paying particular attention to all bearings and governor balls.

(b) Examine the faces of the governor sliding and rotating housings **for** signs of wear If worn, the governor assembly must be replaced

(c) If oil leaks at the overload stop spindle or the stop/run lever spindle (R), carefully remove the spindle and renew the oil seal. When refitting the spindle ensure that it is free from burrs

62. To replace governor and linkage (Fig 12)

(a) Generally reverse the instructions for removal

(b) Ensure that the fuel pump lever fork end is correctly located on the fuel pump rack ball (S)

(c) Before replacing the overload stop assembly, adjust the governor linkage to the correct position as follows:

(i) With the governor bracket screw (E) loose, make sure that the governor bracket fork ends are hard against the governor thrust bearing when the faces of the governor sliding and rotating housings are together.

(ii) Push the fuel pump operating lever as far as possible to the fuel pump fully open position

(iii) Tighten the governor bracket locking screw.

(iv) Check the setting (X) between the operating shaft bush and the operating lever with a feeler gauge. This should be 0.010 in (0.25mm)

(v) Replace the overload stop assembly.

(d) If the overload stop mechanism has been moved on AC1W engines, or the overload stop cam moved on its spindle on AB1W engines, the overload setting will have to be checked. For procedure, see: To fit new fuel injection pump'

(e) If the speeder spring adjuster on variable speed engines has been disturbed, check the distance from the crankcase boss to the end of the adjuster, this should be 5/8in (16mm).

63. Lubricating oil system (Fig. 13)

(a) The lubricating oil system is as follows:

(i) A rotary oil pump (A) is mounted in the crankcase at the gear end. The pump is driven by a gear from the camshaft

(ii) Oil is drawn through a strainer (B) and fed to the filter (C)

(iii) Oil flows from the filter via a hole in the crankcase to the gear end main bearing It is then transferred via holes in the crankshaft to the large end bearing and the flywheel end main bearing.

(iv) The flywheel end main bearing housing and valve rockers **are** supplied with oil by external pipes

(v) A pressure relief valve is incorporated to control the oilpressure.

(b) The cylinder, small end bearing and camshaft are splash lubricated.

(c) The crankcase can be drained by removing the plug at the bottom of the sump.

(d) Oil must always.be CLEAN and containers, funnels, etc.. must be kept in a spotless condition Use only approved oil. Cheap. unsuitable or dirty oil will cause trouble.

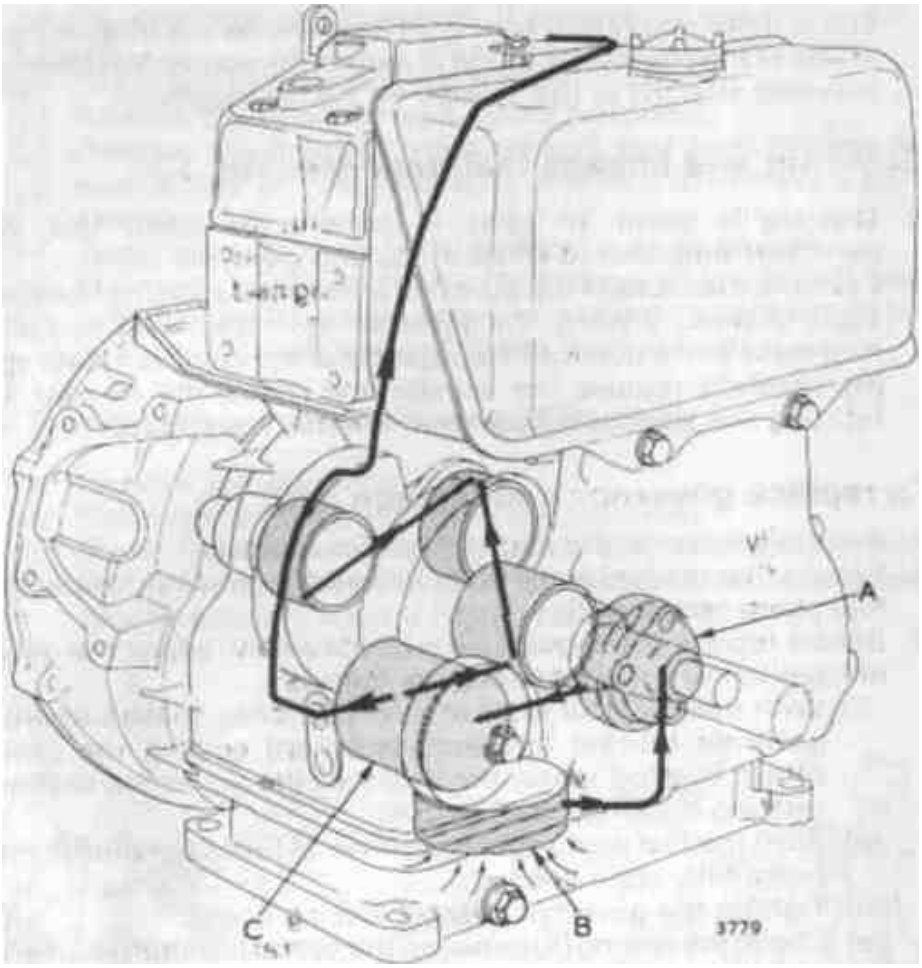


fig. 13

64. To clean oil filter

(a) Unscrew the bolt at the centre of the filter cover and withdraw the cover and element

(b) Thoroughly clean out the cover and renew the joint ring.

(c) If the element shows a large deposit of dirt. it should be replaced by a new element, obtainable from *Petters Ltd or their agents.* Do not attempt to clean the element

(d) When replacing the element, tighten the centre bolt using a torque spanner set to the figure shown under Technical Data.

65. Oil pump strainer

(a) To remove

(i) Drain oil from the sump.

(ii) Remove sump

(iii) Remove the centre bolt and spring plate and remove the strainer

(b) To clean, wash the strainer in clean paraffin or fuel.

(c) To replace, generally reverse the instructions for removal, making sure that the strainer is correctly seated in the sump.

66. To remove oil pump

(a) Drain oil from the sump.

(b) Drain and remove the fuel tank.

(c) Remove the gear cover

(d) Loosen the oil pump gearwheel retaining nut

(e) Remove the camshaft and gearwheel assembly.
(f) Remove the nut retaining the oil pump gearwheel and remove the gearwheel The gearwheel is keyed to the shaft.
(g) Remove the screws securing the pump and withdraw the pump.
(h) The backplate is dowelled to the body.

67. Oil pump maintenance

(a) Thoroughly clean all parts.
(b) Carefully examine the rotors and shaft If they are scored or show signs of wear fit new pump (see Technical Data)

68. To replace oil pump

(a) Generally reverse the instructions for removal.
(b) Pour a small quantity of lubricating oil into the pump through the port before assembling the pump to the engine
(c) Tighten the oil pump screws using a torque spanner set to the figure shown under Technical Data

69. Fuel system

(a) Fuel from the tank flows through a filter to the injection pump which supplies it under high pressure to the injector
(b) A small amount of fuel is always leaking back along the injector nozzle needle and this is returned to the fuel system by a pipe.
(c) The quantity of fuel injected during each cycle is very small and the fuel injection equipment is manufactured to very fine limits IT REQUIRES EXTREME CARE AND ABSOLUTE CLEANLINESS IN HANDLING
(d) Should any part of the fuel system, including pipes, be removed from the engine, it should be placed >n a clean container which is filled with clean fuel NO FILING. GRINDING, SCRAPING OR , SAWING SHOULD BE CARRIED OUT WITHIN A PEW YARDS OF DISMANTLED FUEL INJECTION EQUIPMENT
(e) Replace the equipment wet No rag, cloth or waste should touch it.
(f) Unless the user has been trained in the care and repair of fuel injection equipment, he should not dismantle it in any way other than as described in subsequent paragraphs.
(g) Fuel pumps and injectors should be returned to *Petters Ltd or their agents* for repair or replacement Users are advised to keep a nozzle in their spares kit so that a faulty one can be renewed immediately.
(h) If the exhaust becomes dirty, it is an indication that either the engine is being overloaded or the fuel injection system requires servicing.

70. To clean fuel filter

(a) To remove element
    (i) Drain the fuel tank.
    (ii) Remove the tank-to-pump fuel pipe.
    (iii) Carefully unscrew the fuel filter element plug and remove it from the tank.
(b) If the element shows a large deposit of dirt, remove the tank and wash out with paraffin or clean fuel. Fit a new element, obtainable from

Petters Ltd or their agents. Do not attempt to clean the element.

(c) To replace the element

(i) Generally reverse the instructions for removal making sure that the element seal is in good condition.

71. To clean fuel filter (separately mounted)

(a) Unscrew the clamp bolt at the centre of the filter bowl and withdraw the bowl complete with element.

(b) Thoroughly clean out the bowl and examine the joint ring.

(c) If the element shows a large deposit of dirt. fit a new element. obtainable from *Petters Ltd or their agents. Do* not attempt to clean the element.

(d) It is advisable to fit a new joint ring when the element is changed.

(e) Reassemble the filter

(f) Bleed the fuel system.

72. To remove fuel injection pump

(a) Drain the fuel tank and remove.

(b) Remove the tank-to-pump and pump-to-injector fuel pipes.

(c) Remove the pump. noting the number and total thickness of shims between the fuel pump and crankcase.

73. To dismantle fuel injection pump (Fig. 14)

NOTE: Fuel injection pumps fitted to all variable speed engines are subjected to special calibration by the manufacturers and only the delivery side may be dismantled The pump/control side must NOT be dismantled and should be returned to the manufacturers or to ***Petters*** *Ltd or their agents* for servicing.

(a) Delivery side

(i) Thoroughly clean the exterior of the pump.

(ii) Unscrew the delivery union body (A), lift out the delivery valve spring (B) and the delivery valve (C).

(iii) Withdraw the delivery valve seat (D). the joint (E) and sealing ring (F).

(b) Pump/control side (fixed speed engine only)

(i) Rotate the circlip(G) in its groove until the dowel (H) is between the ends of the circlip.

(ii) Press down the tappet and roller assembly against the spring pressure and shake out the dowel (H)

(iii) Remove the tappet (J) together with the roller and roller pin. Note the number and thickness of the calibrating shims (K) between the tappet and the lower spring plate (L)

(iv) Remove the lower spring plate (L). the plunger (M) and the plunger spring (N). Note the assembly mark on the plunger arm farthest from the rack (P).

(v) Remove the upper spring plate (R) and the pinion (S). Note the assembly marks on one tooth of the pinion (S) and on the rack (P). Note also the relative position of the 'STOP' mark and arrow on the rack before sliding out the rack from the pump body.

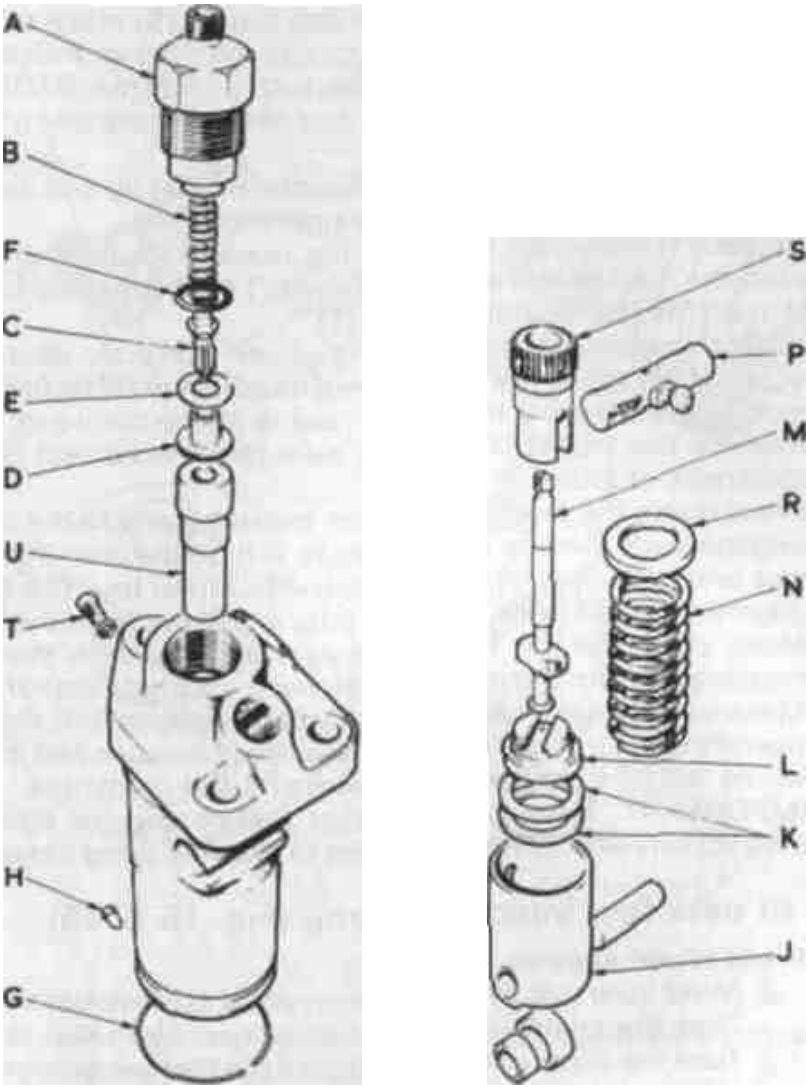


Fig. 14

(vi) Remove the element locating screw (T) and push out the element (U) through the top of the pump

74. Fuel injection pump maintenance

(a) Each plunger of a pump assembly is mated to one element and must never be used in another.

(b) Make sure the delivery valve Joint and sealing ring are in good condition and that the valve is seating correctly. Leaking valves cause loss of fuel injection pressure and difficult starting.

(c) Make sure the rack is free throughout its travel.

75. To replace fuel **injection pump (Fig. 14)**

(a) Generally reverse the instructions for removal and dismantling.

(b) Thoroughly clean all parts in clean fuel and assemble wet.

(c) The sealing ring (F) should be fitted over the lower shoulder of the union body (A) before the union body is screwed into the pump body. Failure to observe this precaution may result in the ring being crushed between the union body and the joint (E). Tighten the delivery union

body using a torque spanner set to the figure shown under Technical Data.

(d) When assembling the rack (P) and pinion (S) make sure that the marked tooth of the pinion is opposite the mark on the rack and that the rack is assembled in the pump body so that the 'STOP' mark and arrow will be towards the gear end of the engine when the pump is fitted

(e) Make sure that the element (U) can be moved up and down slightly when the locating screw (T) is tightened.

(f) Replace the plunger (M) with the marked locating arm engaged with the marked slot in the pinion (S). ie., the marked locating arm is towards the locating screw (T).

(g) With the element, plunger and pinion correctly assembled, the scroll at the top of the plunger will be adjacent to the fuel port in the side of the element when the rack is in the centre of its travel.

(h) Replace the tappet (J) making sure that the correct number and thickness of shims is used.

(i) Press down the tappet and roller assembly and fit the dowel (H) to engage with the slot in the tappet. Rotate the dowel to line up its slot with the ends of the circlip (G) and then turn the circlip in its groove until the ends of the circlip are away from the dowel.

(j) Make sure that the fuel pump cam is away from the fuel pump housing and turn the engine until the exhaust or inlet valve is open.

(k) Make sure that the fuel pump rack ball engages with the fuel pump operating lever fork and that the correct number and thickness of shims is fitted between the pump and the crankcase.

(l) IMPORTANT New fuel injection pumps require special fitting instructions and these are given in the following paragraph.

76. To fit new fuel injection pump (Fig. 15 & 16)

(a) *Fixed speed engines*

(i) Make sure that the fuel pump cam is at the bottom of its stroke. Turn the engine until the exhaust or inlet valve is open

(ii) Turn the stop/run lever (B) until the fuel pump operating lever fork end is at the centre of the fuel pump housing.

(iii) Fit the fuel pump. Make sure that the fuel pump rack ball (S) has engaged with the operating lever fork.

(iv) Time the fuel pump

(b) AB1W. V*ariable speed engines*

(i) to (iii) as for fixed speed engines.

(iv) Loosen the overload stop cam screw (M).

(v) Turn the stop/run lever fully towards the 'STOP' position, and measure the distance (Y) between the end of the fuel pump rack and the gear cover face using a depth gauge

(vi) Add 0 SOOln (12 70mm) (Z) to the depth gauge reading and reset the fuel pump rack in this position by turning the stop/run lever towards the 'RUN' position.

(vii) Hold the rack in this position and set the overload stop cam (N) to just touch the overload stop on the fuel pump operating lever.

With the overload stop cam in this position, tighten the cam screw (M)

(viii) Check that the total movement from the fully forward (stop) position to the overload stop position is 0.500 in (12 70mm).

(c) AC1W variable speed engines

(i) to (iii) as for fixed speed engines.

(iv) Set the overload stop cam step initially to 0.670m (170mm) from the gear cover locating face. A special tool for adjusting the cam is obtainable from *Petters Ltd or their agents.*

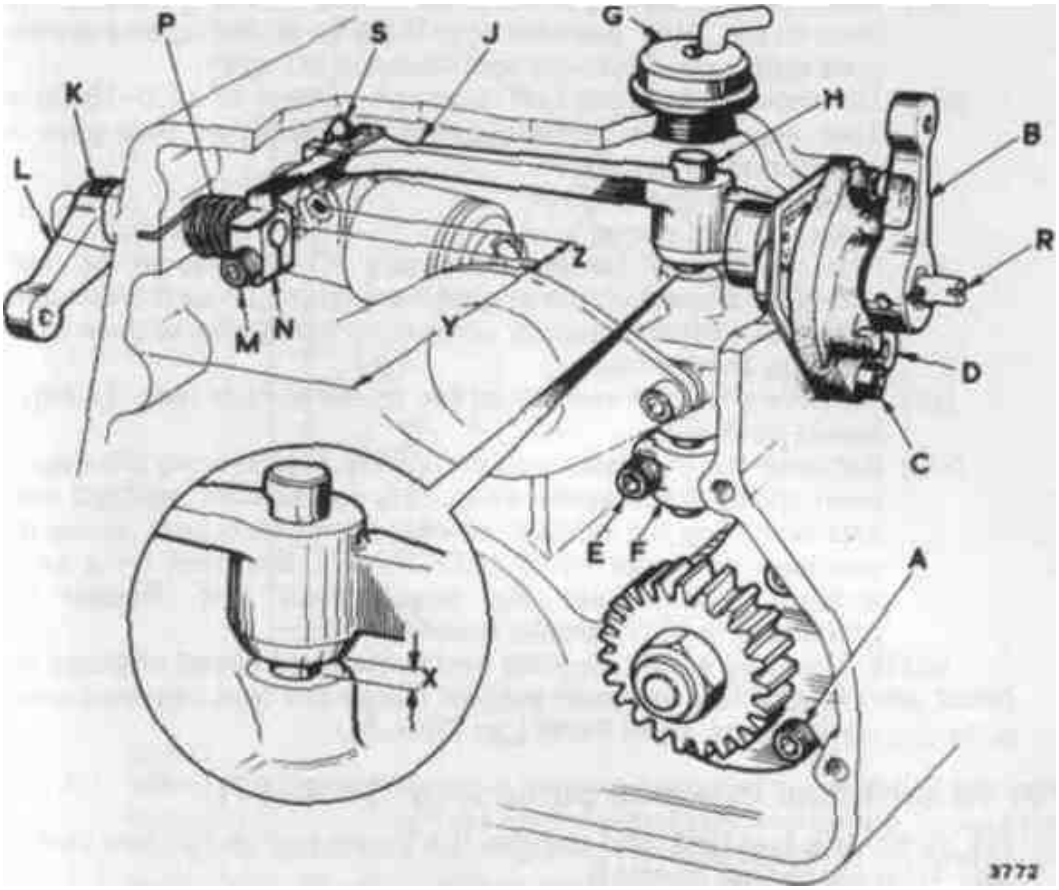


fig. 15

The overload stop lever must be held against its stop during any adjustment to the cam.

(v) With the stop/run lever in the stop position, i.e., vertical, move the fuel pump operating lever fully out by pulling the spring until the fuel pump has reached its stop position.

(vi) Measure the distance from the step on the leaf spring to the gear cover locating face. Note this dimension (Y).

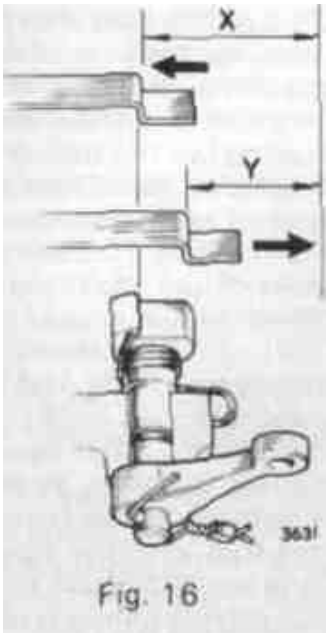


Fig. 16

(vii) Allow the leaf spring to move forward by moving the stop/run lever to the 'RUN' position until the step is resting on the over-load stop cam. Measure the distance (X) again.

(viii) The movement of the leaf spring (X Y) must be 14.0-15.0 mm. This may be set by readjusting the overload stop cam as mentioned in (iv) above.

(ix) Reassemble the engine.

(x) Time the fuel pump.

(xi) Run the engine for approximately 20 minutes at its rated speed, as shown on the engine nameplate, on as much load as possible without causing smoke, to bring the engine to its working temperature.

(xii) Remove the load and adjust the speed control (see 'To adjust speed control')

(xiii) Recheck the overload stop setting by accelerating the engine from idling to full speed as quickly as possible, without load, and watching for exhaust smoke If smoke occurs, move the overload stop cam in a CLOCKWISE direction by a small amount, and repeat the acceleration test Repeat the procedure until no smoke occurs.NOTE Variable speed engines and some fixed speed engines are fitted with special fuel injection pumps Quote the type required when ordering new pumps. (See Parts List Plate N)

77. To time fuel injection pump (Fig. 14 & 17)

(a) Drain the fuel tank and remove the pump-to-injector fuel pipe

(b) To set stop/run controls

(i) On AB1W fixed speed engines running at 3000 rev/min and below, and on all AC1W engines, move the stop/run lever to the 'RUN' position, ie . horizontal

(ii) On AB1W fixed speed engines running at speeds above 3000 rev/min. and on AB1W variable speed engines, move the Stop/run lever towards the 'STOP' position, i.e . vertical, and fix

it at approximately 10° before the vertical positio n

(c) On all variable speed engines, move the speed control to the full speed position but DO NOT OPERATE THE OVERLOAD STOP LEVER.

(d) Unscrew the delivery union body (A) and remove, making sure that the sealing ring (F) Is withdrawn also Lift out the delivery valve (C) and spring (B). placing them in clean fuel. Do not disturb the delivery valve seat (D) or joint washer (E).

(e) Position the sealing ring on the delivery union body and replace in the pump body leaving out the delivery valve and spring Replace the pump-to-iniector pipe. connecting the pump end only

(f) With the decompressor lever disengaged, turn the flywheel until it is a quarter of a turn before TDC on the compression stroke

(g) Pour a smallquantityoffuel into the tank and bleed the fuel filter, if fitted. A small stream of fuel should now flow from the pump-to-injector pipe

(h) Engage the decompressor lever and turn the flywheel slowly by hand in a clockwise direction until the flow from the pipe stops Find by repeated trial the EXACT flywheel position at which this happens This position is known as the spill point.

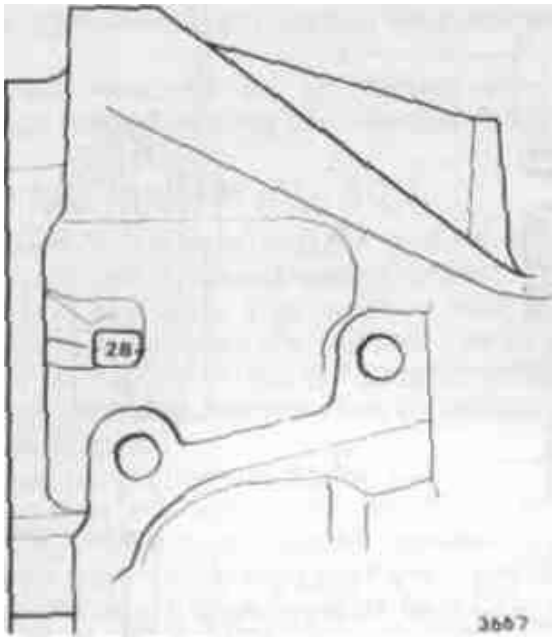


Fig. 17

(i) Read off the angle through the timing hole at the mark on the bellhousing Check this with the figure shown under Technical Data If the angle is too large, add shims between the pump and crankcase until the correct timing is obtained. If too small, remove shims.

(j) When the correct timing is obtained, reassemble the fuel injection equipment including the fuel delivery valve and spring Ensure that the union body sealing ring is not damaged and is located on the union body shoulder before replacing in the pump

(k) Tighten the delivery union body using a torque spanner set to the figure shown under Technical Data

78. To remove and test fuel injector

(a) Disconnect the fuel feed and leak-off pipes from the injector.
(b) Remove the injector flange nuts and carefully lever out the injector, and on an AC1W engine, the nozzle shield washer
(c) Reconnect the injector to the pump-to-injector pipe in such a way that the nozzle points away from the engine
(d) With the speed control lever, if fitted, in the full speed position, and with the stop/run lever in the 'RUN' position turn the engine over slowly The fuel should squirt out suddenly in a fine mist spray which should stop as suddenly If the nozzle fails to spray, or gives a solid squirt of fuel. or dribbles after the spray has stopped, fit a new nozzle
(e) When testing, BE CAREFUL to see that the spray is not directed at any exposed part of the body The force behind the spray will cause it to penetrate the skin

79. Fuel injector maintenance (Fig. 18)

(a) An injector servicing kit consisting of brass wire brush, nozzle scraper and spray hole cleaner is obtainable from *Fetters Ltd or their agents la)* Thoroughly clean the exterior of the injector.
(b) Remove the nozzle holder cap nut (A)
(c) Remove the spring adjusting screw (B) and remove the spring pad (C). the spring (D) and the spring pressure rod (E)
(d) Remove the nozzle nut(P)and the nozzle assembly (G) Each needle of a nozzle assembly is mated to one nozzle body and must never be used in another.
(e) To ensure a thorough cleaning of all parts they should be left in a bath of clean fuel. After this treatment, any remaining carbon can be scraped off with a soft brass wire brush or piece of clean wood or brass.
(f) The nozzle holder and nozzle joint faces must be clean with a mirror-like appearance The nozzle and nozzle nut clamping shoulders must be clean
(g) The nozzle body fuel holes (H) should be cleaned by pushing a wire or twist drill (J)down into the fuel chamber (K) being careful not to scratch the joint face.
(h) Insert a nozzle scraper (L) down into the fuel chamber, press sideways and rotate to remove carbon, etc.
(i) Soft carbon can be removed from the spray hole with a spray hole cleaner (M)
(j) Wash the nozzle body and needle in clean fuel and assemble wet.

(k) To fit a nozzle assembly to the nozzle holder body. hold it hard against the pressure face and tighten the nozzle nut

(l) To complete the assembly of the injector, grease the spring assembly and replace it. together with the adjuster and cap nut

(m) Reset the fuel injector release pressure to the figure shown under Technical Data. A test pump for this purpose can be obtained from *Petters Ltd or their agents.* To adjust the release pressure, screw in the adjusting screw (8) to increase the pressure or out to decrease it

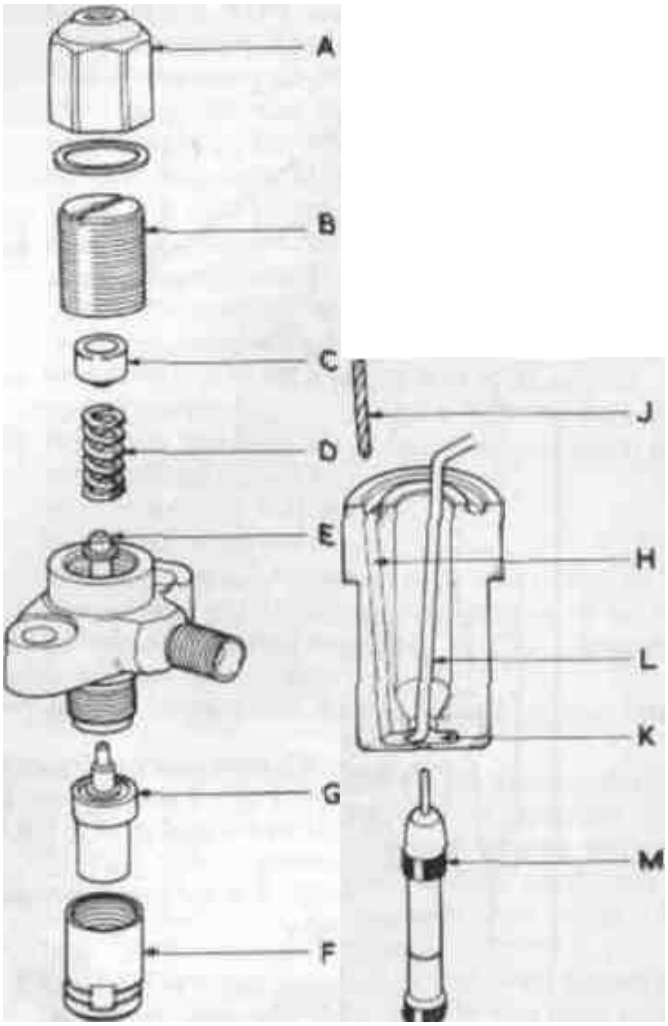


fig 18

(n) Injectors not required for immediate use should have pipe connections sealed against the admission of dirt, etc.

80. To replace fuel injector (Fig. 19)

(a) AB1W Examine the joint washer and renew if necessary.

(b) AC1W A new nozzle shield washer (A) MUST be fitted before the injector (B) is replaced This washer must be fitted so that the dimple side is away from the injector nozzle.

(c) It is MOST IMPORTANT that the pump-to-injector pipe is correctly fitted or the pipe and injector may be damaged. Proceed as follows

(i) Loosely fit the injector flange nuts

(ii) Fit the pipe and tighten the union nuts finger tight, then give them a third of a turn with a spanner

(iii) Tighten the injector stud nuts evenly, using a torque spanner set to the figure shown under Technical Data.

(iv) Reconnect the leak-off pipe.

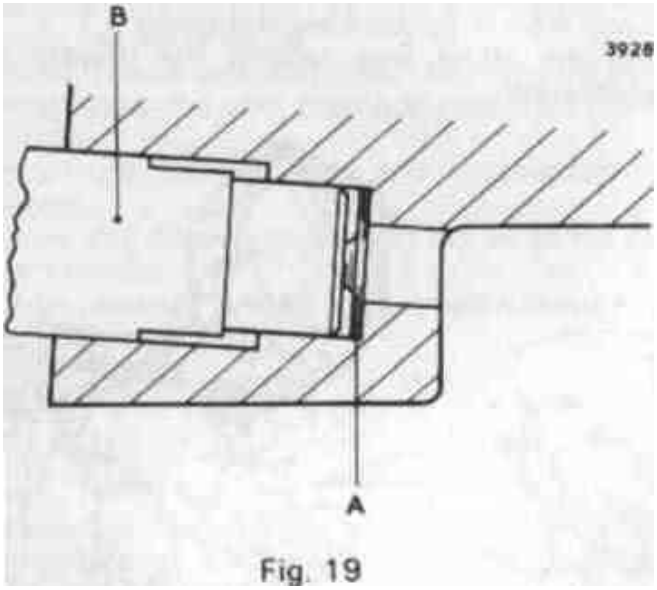


Fig. 19

81. To adjust speed control (Fig 20 & 21)

The centrrfugal forces on the governor balls are transmitted to the fuel pump rack These forces, which vary with the speed of the engine, are balanced by an adjustable speeder spring This adjustment allows a set range of speed To adjust the speed outside this range a different fuel pump and springs may be required and these are obtainable from *Fetters Ltd or their agents.* The speed is set by *Fetters Ltd* and should not require further adjustment. However, if the setting is disturbed, adjustments are carried out as follows:

(a) Fixed speed

(i) Loosen the locknut (C) on the dipstick side of the engine and screw in the adjuster (B) to increase the speed or out to decrease it. Tighten the locknut The speed should be set at 4% above the rated speed as shown on the engine nameplate. when running without load.

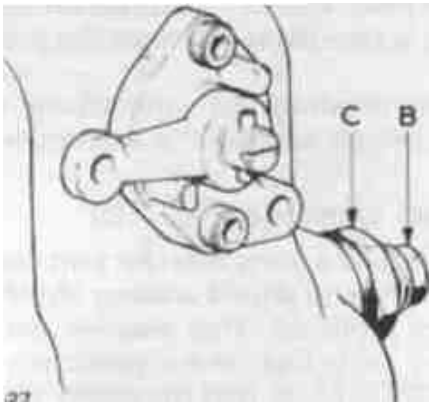


Fig 20

(b) Variable and two-speed control

(i) Set the variable speed lever (D) or two-speed control knob (E) in the idling position

(ii) Loosen the grubscrew (F) on the idling stop (G) and adjust the idling speed to approximately 1000 rev/min by moving the control rod (H) towards the gear end to increase the speed or away from it to decrease the speed

(iii) Set the idling stop against the bracket and tighten the grubscrew.

(iv) Set the speed control to the full speed position. (Variable speed)

(v) Set the control knob to the 'RUN' position (Two-speed)

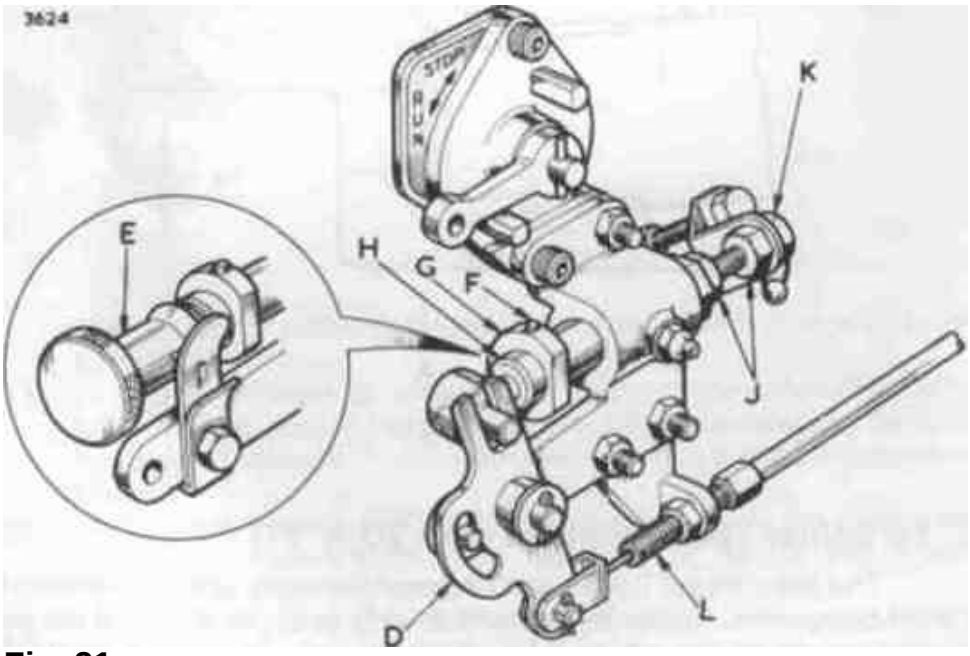


Fig. 21

(vi) Loosen the locknuts (J) and adjust to full speed or speed required by screwing in the adjusting screw (K) to increase the speed or out to decrease it The speed should be set at 8% above the rated speed as shown on the engine nameplate. when running without load. ie, 3240 for 3000 rev/min engines and 3888 for 3600 rev/min engines Tighten the lockouts and fit new seal and locking wire.

(vii) Recheck the idling speed and adjust if not correct.

(viii) To adjust the control cable, set the speed control in the idling position, screw in the cable adjuster (L) until there is a small amount of slack in the inner cable, i e., the control lever can Just be moved before the inner cable begins to move the plunger

82. Air cleaner maintenance.

(a) Paper element type

(i) Unscrew the nut on the cover and remove the cover.

(ii) Remove the element. The element may be cleaned by blowing compressed air from the inside to the outside Do not attempt to clean the element by any other means.

(iii) A strong light directed into the inside of an element and viewed from the outside will reveal any damage to the paper corrugations If the element is damaged or shows a large deposit of dirt. fit a new element obtainable from *Petters Ltd or their agents*

(iv) On AB1W engines thoroughly wash out the cover in petrol or paraffin and allow to drain. After making sure the gauze is clean, dip the cover in a bath of clean lubricating oil and allow to drain before refitting.

(v) Replace the element and cover making sure that the element sealing rings and inlet manifold seal are in good condition.

(b) Oil bath type

(i) Remove the bottom cup and thoroughly clean out the sediment.

(ii) Remove the cleaner and wash out in petrol or paraffin and allow to drain.

(iii) Refit the. cleaner and fill the cup with clean engine oil to the level indicated

(iv) Refit the cup.

83. Clutch (Fig. 22)

(a) To remove

(i) Remove the screws (A) securing the clutch housing (B) to the crankcase and withdraw the housing complete with the operating lever and shaft.

(ii) Slacken each setscrew (C) securing the clutch to the flywheel half a turn at a time working diagonally across the clutch until all the clutch spring pressure is released. Remove the setscrews.

(iii) Remove the clutch (D) and clutch plate (E) from the flywheel. The clutch is dowelled 10 the flywheel.

(iv) The clutch should not be dismantled unless special tools are available for assembly and balancing the clutch

(b) Clutch maintenance

(i) Parts most likely to wear are the clutch pressure plate (F), thrust bearing (G) and the clutch linings.

(ii) The surfaces of the flywheel and clutch pressure plate should have a clean, even, polished appearance. If the surfaces have a glazed or varnished appearance make sure that oil is not penetrating to the clutch housing from the engine

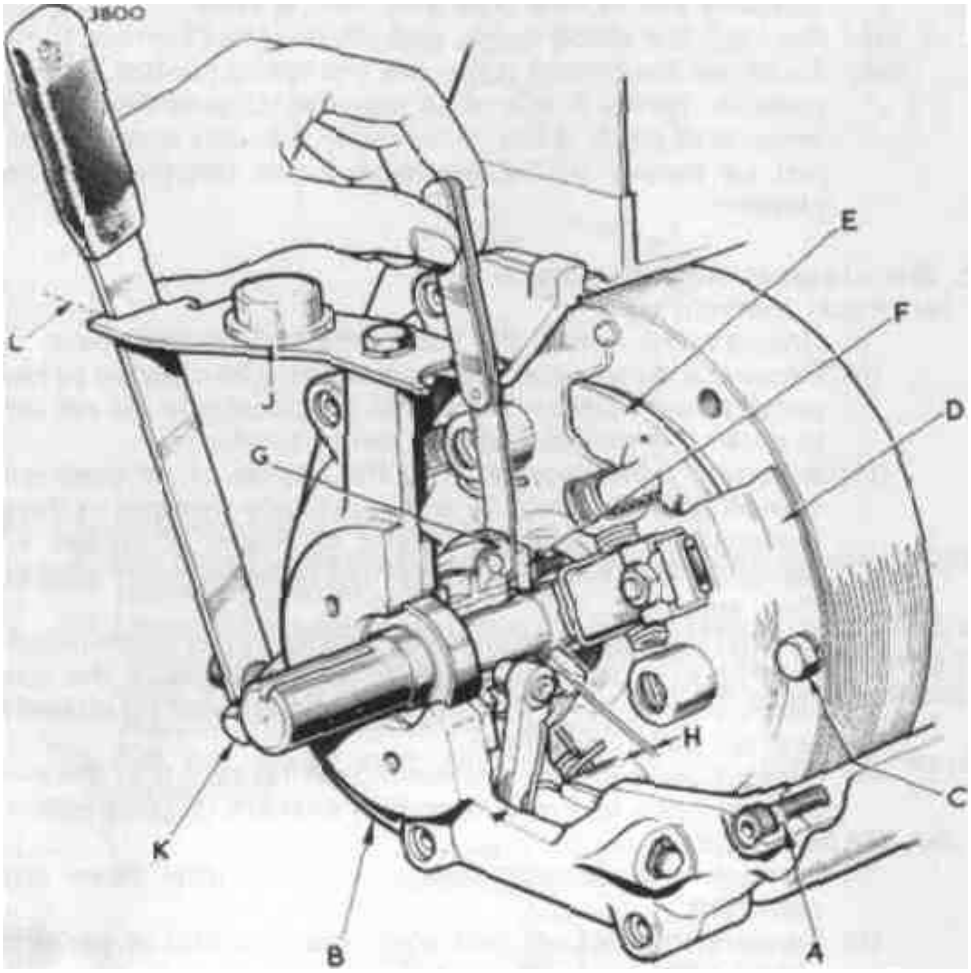


Fig. 22

(iii) If the clutch plate linings or splines are worn fit a new clutch plate. Do not attempt to fit new linings.

(iv) Check the clearance (H) between the clutch pressure plate (F) and the thrust bearing (G) The clearance should be 0.10/0.15 in (2.5/2.8mm) and may be checked by removing the plug (J) and inserting a feeler gauge between the pressure plate and the thrust bearing. To adjust the clearance, loosen the operating lever pinch bolt (K) With the lever in the engaged position (L) turn the yoke shaft against the spring pressure until the feeler gauge is gripped between the thrust bearing and pressure plate and then tighten the pinch bolt. Check the clearance and replace the plug.

(c) To replace

(i) Generally reverse instructions for removal

(ii) Make sure that the clutch plate is fitted with the longer end of the splined hub away from the flywheel

(iii) Make sure that the clutch plate is centralised.

84. Reduction gear

(a) To remove

(i) Drain and remove the fuel tank

(ii) Remove the screws securing the bearing housing and remove the housing complete with the power take-off shah and reduction gearwheel. Remove the shims

(iii) Remove the reduction gear housing.

(iv) Remove the nuts retaining the driving gearwheel.

(b) Reduction gear maintenance

(i) Examine the bearings and fit new parts if rollers or roller tracks show signs of wear.

(ii) Examine the driving and driven gearwheels. Renew if the teeth are scored or show signs of wear

(c) To replace

(i) Generally reverse the instructions for removal making sure the oil seals are in good condition.

(ii) Check the power take-off shaft end float (see Technical Data) and if not correct, alter the total thickness of the shims behind the bearing housing.

85. Electric starting equipment (negative earth) (Fig. 23)

(a) This consists of a battery-operated starter motor engaging with a gear ring on the flywheel, a dynamo for battery charging, a regulator and switch. Operating the switch energises a solenoid which engages a motor pinion with the gear ring The pinion remains engaged until the switch is released, but a free-wheel prevents overspeeding the motor when the engine fires.

Starter motor

(a) Mounting

Make sure the motor is securely mounted on the engine Fit the mounting bracket to the engine before mounting the starter motor.

(b) Lubrication

Bearings are lubricated on assembly and require no attention between overhaul periods.

(c) Terminals

Main terminals and all circuit connections must be clean and tight. Terminal shrouds should be in position

(d) Brush gear

Remove the cover and inspect the brushes and commutator Brushes should be free in their slides Springs should seat squarely on the brushes See that the insulation is in good condition The brushes and commutator should be free from dust and grease and contact surfaces clean, smooth and uniform in colour

(e) Solenoid

The solenoid should move freely and contact faces be clean and unburnt Do not attempt to clean the solenoid without disconnecting the battery

Dynamo and instrument box

(a) Mounting

(i) The dynamo and instrument box must be installed as close to the engine as possible

(ii) The framework containing the engine and dynamo must be of sufficiently rigid construction as to prevent any movement between the engine and dynamo when running This is particularly important when anti-vibration mountings are used

(iii) IT IS IMPORTANT that the driving and dynamo pulleys are in line and parallel with each other to within 0.020in (0.50mm). Pulley alignment may be checked by placing a Straight edge across the pulley faces The distance between pulley centres to allow for belt removal and replacement should be 11 in (279mm) A further 11/16 in (17.5mm) is required for tensioning the belt. If further adjustment is found necessary the belt must be replaced

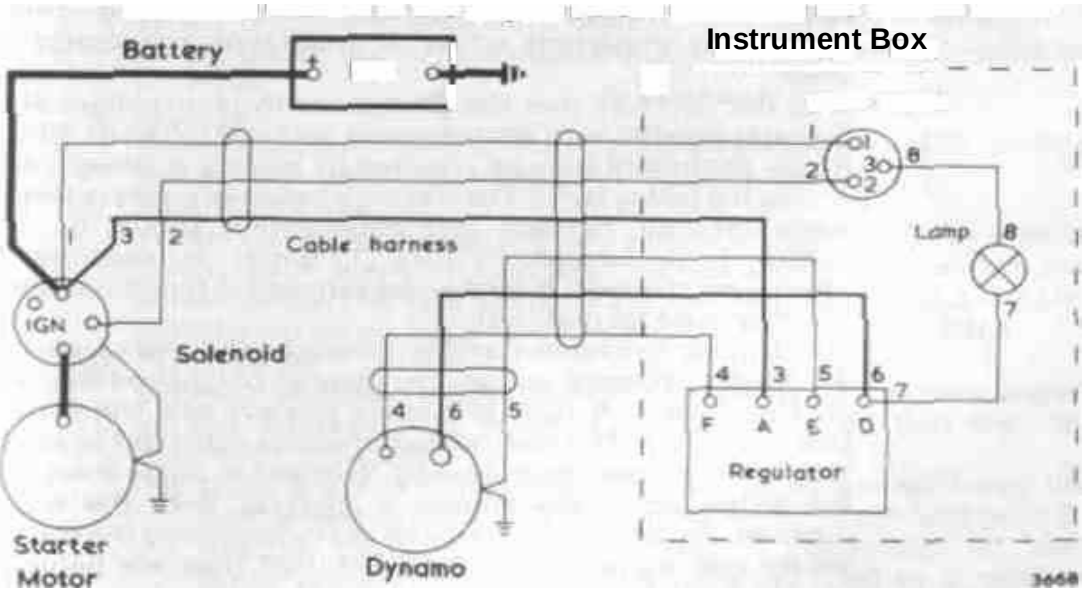


fig. 23

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1 Brown	14/0.25mm 0.75mm^2	(14/0.010 in)
2 White/Red	14/0.25mm 0 75mm^3	(14/0.010 in)
3 Brown	28/0 30mm 2 Omm^2	(28/0.012 in)
4 Brown/Green	14/0.25mm 0.75mm^2	(14/0.010 in
5 Black	14/0.25mm 075mm^2	(14/0.0l0 in)
6 Brown/Yellow	28/0 30mm 2 Omm^2	(28/0.012 in)
7 Brown/Yellow	14/0 25mm 0 75mm^2	(14/0.0I1 in)
8 White	14/0.25mm 0 75mm^2	(14/0.010 in)

(iv) The dynamo driving belt tension should be checked carefully A slack belt overheats, causes low dynamo output and may work off the pulleys A tight belt leads to early belt and dynamo bearing failure The belt tension must be sufficient to ensure that the slack side does not sag, fluctuate or bulge away from the pulley when the engine is running. With the engine stopped, the belt tension may be set by loosening the dynamo pivots and adjusting strap Ensure that they are tightened again after adjustment.

When correctly tensioned, the belt will feel tighter than a conventional V-belt

(v) As the rotation of the dynamo is critical, ensure that it is correct when related to the engine An arrow is stamped on the dynamo casing The engine rotation is clockwise when viewed from the flywheel end A reverse rotation dynamo is available from *Petters Ltd or their agents.*

(b) Lubrication

Bearings are lubricated on assembly and require no attention between overhaul periods

(c) Terminals

Main terminals and all circuit connections must beclean and tight. Terminal shrouds should be in position.

(d) Brush gear

Remove the cover and inspect the brushes and commutator Brushes should be free in their slides Springs should seat squarely on the brushes See that the insulation is in good condition The brushes and commutator should be free from dust and grease and contact surfaces clean, smooth and uniform in colour.

(e) Wiring

(i) A cable harness is supplied by *PettersLtd,* but if this is found to be of insufficient length for the installation it may be extended by using the appropriate wire and insulated connectors

(ii) As the instrument box is flexibly mounted, an earth lead has been included in the cable harness to link the instrument box to the dynamo If the dynamo and engine are not secured to a common base. it is advisable to link these units with an earth lead. RegulatorAdjustments should not be made other than by an electrical engineer.

86. Protection and preservation

(a) Covers

When not in use engines should be protected by a waterproof cover Under tropical conditions a permanent awning should be provided.

(b) Storage

Before dispatch from the factory engines are preserved for storage and should not be disturbed until required for use.

(c) Intermittent use

When not in regular use engines should be run for a thirty minute period each week to lubricate internal parts and boil off any

condensation that has formed External unpainted parts should be wiped with an oil rag and external controls, etc.. lubricated.

(d) Preservation

Engines remaining idle for more than a month may corrode, and as serious damage may result it is recommended that they be preserved as follows:

(i) Drain the sump. flush out with flushing oil and refill with the appropriate grade of *Shell* lubricating oil which will provide internal protection (Alternatively, a lubricating oil with preservative properties will be recommended by a local oil distributor.)

(ii) Drain the fuel tank and filter and refill with approximately 1 pint (0.57 litres) of *Shell Fusus* oil or *Calibration Fluid C* Bleed and prime the fuel system and run the engine on light load for five minutes The fuel system is now adequately protected

(iii) Drain and flush the cooling system

(iv) The air inlet and exhaust manifolds should be sealed against the ingress of moisture

(v) Protected engines require no attention before use other than removing the sealing covers and adding fuel