REPAIR MANUAL

Farymann Diesel Engines

ENGINE MODEL

K/A/L/R/S

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Preface

We congratulate you on your choice of a **FARYMANN** engine and wish you much pleasure with this German quality product.
These operating instructions are based on the most recent state of development. Every case was taken in their preparation in order to exclude the possibility of any errors. However, we accept no liability for any errors of representation or description or for omissions.

All those involved in the installation, commissioning, operation, maintenance or repair of the engines must read and observe the operating instructions and particularly the "**Safety**" chapter.

The engine has been constructed to the state of the technology and in accordance with recognised safety regulations. Nevertheless, dangers to life and body of the user or third parties or damage to the engine and other damage can occur during its use. The engine may therefore only be used when it is in a technically perfect state and operates safely. In particular, malfunctions which could impair safety are to be rectified immediately. **FARYMANN DIESEL** GmbH is not responsible for damage resulting from incorrect use. Such risk is borne solely by the user.

Correct use also includes observance of the operating instructions and compliance with the operating, servicing and maintenance conditions. The engine may only be operated and serviced by reliable, trained personnel in compliance with the relevant accident prevention regulations as well as other generally-recognised rules of safety and industrial medicine.

FARYMANN DIESEL GmbH accept no liability for any damage resulting from unauthorised modifications or changes to the engine. Replacement parts must meet the technical requirements specified by **FARYMANN DIESEL**. This is guaranteed if original replacement parts are used. The fitment and/or use of parts and accessories not delivered by **FARYMANN DIESEL** can under certain circumstances decrease the design features of your engine. **FARYMANN DIESEL** GmbH accept no responsibility for damage resulting from the use of non-original replacement parts or accessories.

Lampertheim Farymann Diesel Germany

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INTRODUCTION

FARYMANN builds air- as well as watercooled diesel engines using always the same distinctive design features with all models, may it be horizontal or vertical or the V-configuration.

The simplicity and resemblance in built-up facilitates maintenance and service requires an absolute minimum on special tools.

Although this workshop manual is primarily based on the aircooled vertical single cylinder engine, all instructions can easily be applied to the other models, where as reference is made to some characteristic features of the V-twin line.

COMBUSTION:

FARYMANN builds exclusively DIESEL engines. They are all of the 4 cycle type using overhead valve configuration.

The direct injection combustion method is used on all engines. An open combustion chamber is located in the piston top.

Direct injection is outstanding in its efficiency which results in low fuel consumption and clean exhaust. It facilitates hand start even at low temperatures and makes ignition paper cartridges obsolete.

COOLING:

Aircooled engines:

Cooling is accomplished by a flow of air from the flywheel fan. No V-belts involved; as long as the flywheel turns the engine is cooled. Air is drawn into the flywheel fan and is discharged through shrouding to the fins of cylinder and cylinder head.

Note:

Arrangements must be made to ensure that the cooling air is never recirculated or restricted neither on the intake side (flywheel) nor the outlet on cylinder and cylinder head on the camshaft side.

Watercooled engines:

The only difference to the aircooled engines is that the finned cylinder and cylinder head are replaced by a watercooled cylinder and cylinder head. Almost all other parts rest identical to the basic engine.
The watercooled system incorporates a selfpriming water circulation pump, using fresh or direct seawater. Automotive type circulating pumps can be supplied for thermosyphon, radiator or two circuit cooling systems (using heat exchangers).

LUBRICATION:

All single cylinder engines are splash lubricated. They are exclusively equipped with ball and roller bearings. No lub-oil filter is fitted to these engines.

V-twin models,having only one heavy duty roller bearing as main bearing on P.T.O. side (flywheel), have a built-in gear type lubrication pump forcing lub-oil to all necessary parts. An automotive type "spin-on" lub-oil filter is fitted to the outside of the crankcase.

GOVERNOR:

A high precision frictionless operating governor is standard with all engines. Being totally enclosed into the engine crankcase it needs no servicing or lubrication.

The governor is linked to the fuel pump rack and to the acceleration lever outside the crankcase. Engines may be equipped with a fixed-speed or variable speed governor maintaining the accurate engine speed under varying load conditions.

To ease starting at low temperatures all engines are equipped with a lever for excess starting fuel. This lever does allow the pump rack to travel into its maximum position during the starting operation.

INJECTION EQUIPMENT:

ROBERT BOSCH injection equipment is exclusively used on all engines. Injection timing employs the "spill cut-off" method. Nozzles are of the 3-hole type.

ROTATION, POWER TAKE OFF:

Looking at the flywheel, which is the principal power take-off, the sense of rotation is counter clockwise as it is standard with all combustion engines manufactured in Europe.
Camshaft P.T.O. flange turns counter clockwise as well; half of the rated power can be taken off the camshaft.
The camshaft is driven by the crankshaft through a 2:1 gear reduction. When power is taken off the camshaft a shockless smooth load is stipulated (V-belt drive and other high flexible couplings are recommended).

V-twin engines are provided with a P.T.O. on crankshaft on the gear side. Sense of rotation is clockwise.

It is normally use to flange hydraulic pumps or belt-drive alternators, etc.

ENGINE DESIGNATION

To assist the mechanic during repair work, we have summarized a few notes and details on the engine. This data is not only meant for the information of the workshop, but will also help customers when making reference to the spare parts list.

Use of these instructions presupposes the necessary engineering knowledge and trade skills.

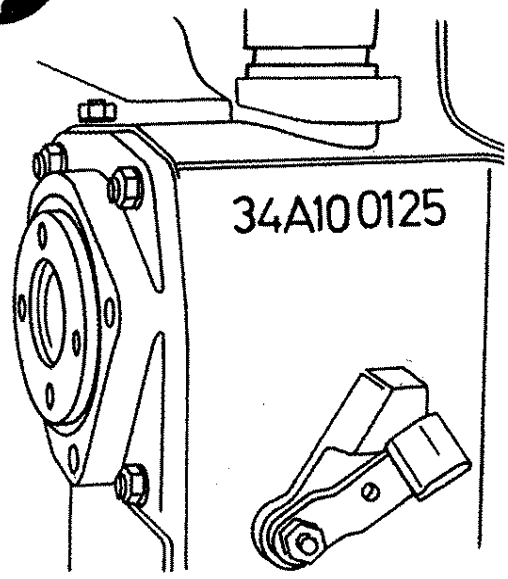
We strongly recommend the exclusive use of original Farymann spare parts for repair purposes. This is the only way to guarantee perfect repairs. Please consult our agents and approved workshops when spare parts are needed. Appropriate details will be found in the spare parts lists. It is always essential to indicate the engine serial number.

This number will be found on the type plate. It is also punched into the crankcase above the governor lever.

34 = Year of manufacture
34 = 1980

A 10 = Engine Type

0125 = Serial Number



ENGINE DATA (next page)

Figures given, especially for engine timing, are always approximate and do vary slightly among individual engines.

Timing figures for 2 cylinder engines do refer to cylinder no. 1 only (the one next to flywheel) whilst cylinder no. 2 is then automatically o.k.

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ENGINE DATA

INDUSTRIAL DIESEL ENGINES AIRCOOLED	Model			25 A (L 14)	25/28 E (L 20/28)		29 C	36/36 A (A 16/12)		36/36 E (A 20/22)		41 A/E (A 14/24)		71/75 A (R 16/12)	95 A (S 10)	(G 20/24)
CHARACTERISTICS	[1] NUMBER o. CYLINDERS CONFIGURATION vert./horiz./V			1 st	1 lg		1 st	1 st		1 lg		1 st/lg		2 v	2 v	1 lg
	[2] PISTON DIA mm			80	80/85		90	95/98		95/98		98		98/98	105	105/115
	[3] TOTAL DISPLACEMENT cm³			412	412/465		470	562/618		562/618		678		1162/1236	1558	1125/1350
	[4] OUTPUT DIN 6270	HP KW		8 5.8	8 /8.5 5.8/6.2		8.8 9.0	10 /12 7.4/ 8.8		10 /12 7.4/ 8.8		11.5 8.5		20 /21,5 14.7/15.8	25 18.4	16 /20 11.8/14.7
	[5] SPEED max. RPM			3000	3000/2500		3600	3000		3000		2500		2500	2500	1800
	[6] SUMP CAPACITY max. Liters			1.2	2.4		1.9	2.3/2.9		2.7		1.8/2.7		3.5	4	1.8
	[7] STANDARD FLYWHEEL DIA. mm			310	310		308	310		310		310		308	352	519
TIMING	[8] VALVES (approx.)	INTAKE opens mm BTDC		30-35	30-35		24-30	35-40		35-40		35-40		98	110	110
		EXHAUST closes mm ATDC		25-30	25-30		18-24	25-30		25-30		25-30		70	95	90
					L 20	L 28		A 10	A 12	A 20	A 22	A 14	A 24			
	[10] INJECTION spill cut-off	RPM 1500		15 25	15 22	17 17	– 22	10 22	12 24	10 20	10 22	12 24	16 22	21 23	25 31	25-30 35-40
		RPM 2000														
	[11] end of delivery mm BTDC	RPM 2500		30 40	28 32	20 –	25 25	30 37	32 42	25 30	28 32	32 42	28 32	27 –	38 –	– –
		RPM 3000														
	[12]	3600		–	–		32	–		–		–		–	–	–
	[13] NOZZLE OPENING Pressure bar			175	175		200	175		175		175		175	175	160
	[14] VALVE CLEARANCE			intake + exhaust 0.1 mm (0...4°) engine being cold / All valve seats cut under 45° angle.												
REPAIR FIGURES	[15] VALVE intake mm	protrudes in recess		– 1.1	– 1.1		– 0.1-0.2	A 10 / A 12 1.1 / – – / 0.9		A 20 / A 22 1.1 / – – / 0.9		0.9		– 1.0	– 1.0	– 1.3-1.5
	[16] VALVE exhaust mm	protrudes in recess		– 0.6-0.7	– 0.6-0.7		– 0.1-0.2	1.4 / – – / 0.7		1.4 / – – / 0.7		0.7		– 1.0	– 1.0	– 1.0-1.2
	[17] PISTON mm	protrudes in recess		0.7-1.0 –	0.7-1.0 –		0.78-0.82 –	0.8-1.05 –		0.8-1.05 –		0.7-0.9 –		0.77-1.05 –	0.9-1.08 –	0.45-0.95 –
	[18] RING END GAP mm			0.3-1.0	0.3-1.0		0.4-0.6	0.4-1.0		0.4-1.0		0.4-1.0		0.4-1.0	0.5-1.5	0.5-1.5
	[19] CRANKSHAFT End play mm			0.05-0.15	0.05-0.15		0.05-0.15	0.05-0.15		0.05-0.15		0.05-0.15		0.05-0.15	0.05-0.15	0.05-0.15
TIGHTENING TORQUE mkp/Nm	[20] CYLINDER HEAD Hex.-Nut (Socket Wrench)	mkp/Nm mm		5.5/54 17	5.5/54 17/15		5/49 15	5.5/54 17		5.5/54 17		5.5/54 17		6/59 19	8/78 17	10/98 24
	[21] ROCKER BRACKET Hex.-Nut (Fork Span)	mkp/Nm mm		8/78 22	8/78 22		–	8/78 22		8/78 22		8/78 22		8/78 22	8/78 22	8/78 22
	[22] MAIN BEARING PLATE Hex.-Nut (Socket Wrench)	mkp/Nm mm		3/29 13	3/29 13		3.5/34 13	4.5/44 17		4.5/44 17		4.5/44 17		4.5/44 17	4.5/44 17	3/29 17
	[23] CON. ROD BOLT Bolt (Socket Wrench)	mkp/Nm mm		–	–		5.5/54 14	6/59 17		6/59 17		6/59 17		6.5/64 17	7.5/74 17	12/118 19
	[24] INJECTOR CLAMP Hex.-Nut (Fork Span.)	mkp/Nm mm		2/20 13	2/20 13		0.5/5 13	2/20 13		2/20 13		2/20 13		2/20 13	2/20 13	2/20 13
	[25] DELIVERY VALVE Cap Nut (Ring Span.)	mkp/Nm mm		3.5-4/34-39 19	3.5-4/34-39 19		3.5-4/34-39 19	3.5-4/34-39 19		3.5-4/34-39 19		3.5-4/34-39 19		3.5-4/34-39 19	3.5-4/34-39 19	3.5-4/34-39 22
	[26] INJECTION PUMP Bolt (Fork Span.)	mkp/Nm mm		2/20 13	2/20 13		3/29 13	2/20 13		2/20 13		2/20 13		2.5-3/25-29 13	2.5-3/25-29 13	2.5-3/25-29 13
	[27] FLYWHEEL Hex.-Nut (Socket Wrench)	mkp/Nm mm		40	40		40	40		IMPACT WRENCH 40		40		40	40	50

Sawtooth figures underneath tightening torques give spanner sizes in mm. Conversion: 1 mkp = 7.233 ft lb = 9.81 Nm / 1 cu in = 16.4 cm³ / 1 in = 25.4 mm / 1 Kp/cm² = 14.2 psi / H = vertical / lg = horizontal

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Safety Instructions / Warning

	The engine must be handled only in accordance with the instructions specified by the manufacturer and transported by using the devices designed by the manufacturer!
	When handling consumables and other chemical substances, observe the product-related safety regulations!
	When handling inflammable consumables, do not smoke!
	Vapour of lubricating oil or fuel may catch fire when getting into contact with ignition sources!
	Be careful when handling hot or corrosive consumables (risk of burning or scalding)!
	Without particular permission never carry out maintenance and repair work when the engine is running! Ensure that the engine cannot start unintentionally!
	Before starting the engine, make sure that nobody is at risk! Always check that the safety devices that have been removed are refitted upon completion of the maintenance and repair work. See to it that all tools used are removed from the engine!
	Never carry out work on safety valves (e.g. modification of the spring tension)! Defective safety valves must be replaced immediately!
	Used consumables and filters must be disposed of in accordance to the regulations in force at the respective site.
	Before or when starting the engine, check: – all lines, hoses and screwed connections for leaks! – the safety devices for completeness and obvious damage!
	When starting the engine by hand, only use the starting device authorized by the manufacturer (starting handle with kick back limiter, recoil-starting) and observe the handling instructions! Never use cold starting aids on an ethyl oxide basis!
	Due to explosion hazard it is forbidden, even in case of emergency, to start a compressed-air started engine with fuel gas or oxygene!

Safety Instructions / Warning

	Operate IC engines only on sufficiently ventilated sites! Before starting the engine in enclosed environment, make sure that there is sufficient ventilation!
	See to it that the engine is slowing down to full stop only after 10 - 20 seconds!
	Any safety devices of the engine or the machine in which the engine is installed must be refitted upon completion of the maintenance and repair work!
	Before starting any work on the electrical components, the power supply to all live parts must be cut off!
	Carry out maintenance and repair work only if the engine parts are positioned on stable ground!
	Liquids which might issue under high pressure (e. g. fuel, oil) may penetrate the skin and cause severe injuries!
	For carrying out cleaning work on the engine always use a detergent which is non-combustible or where the flash point is above 65 °C!

WARNING !

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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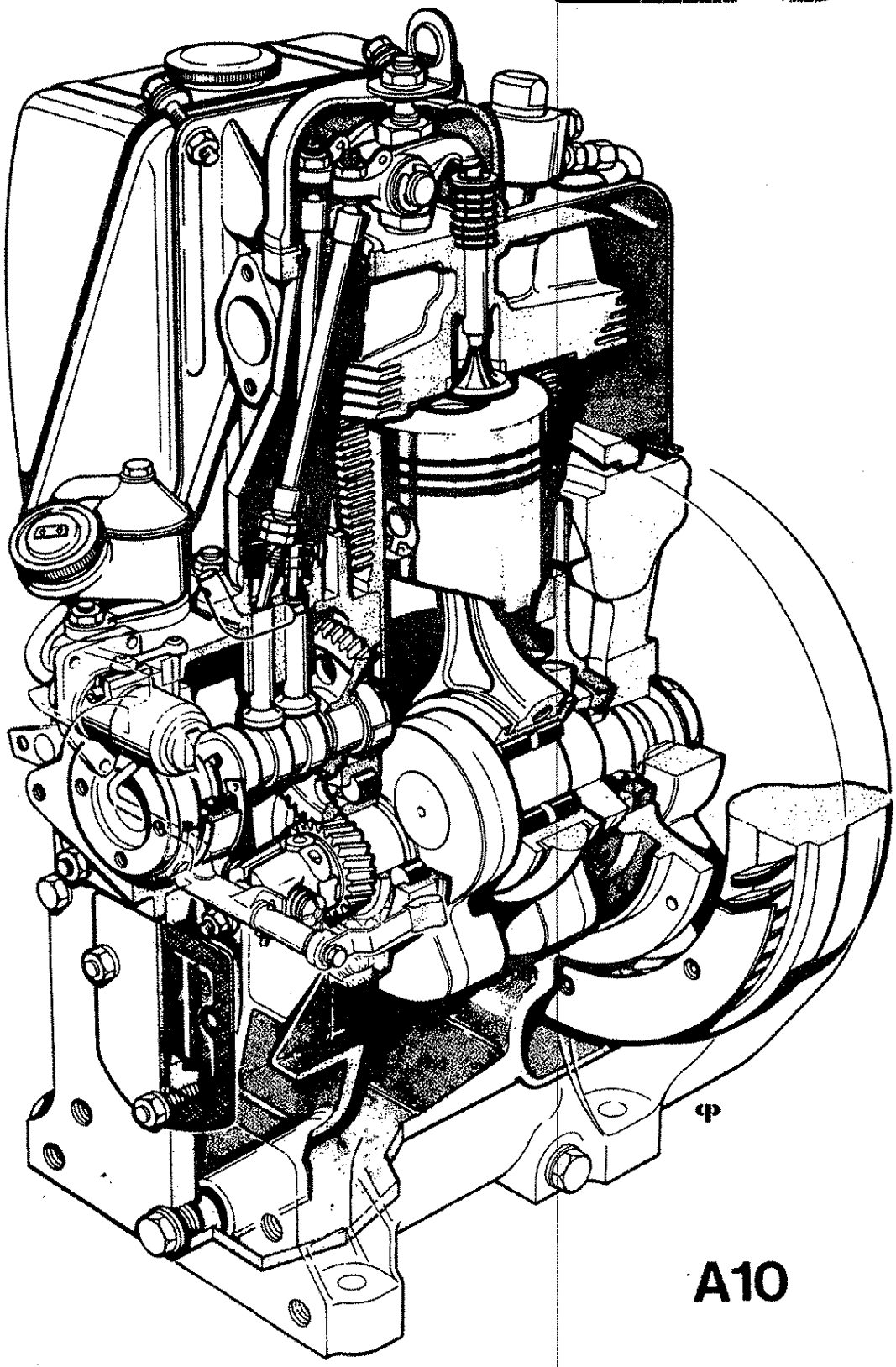
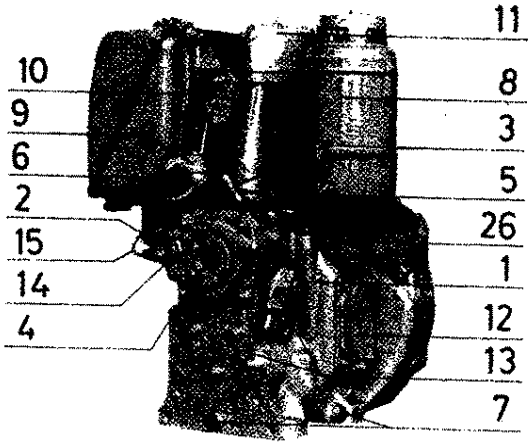
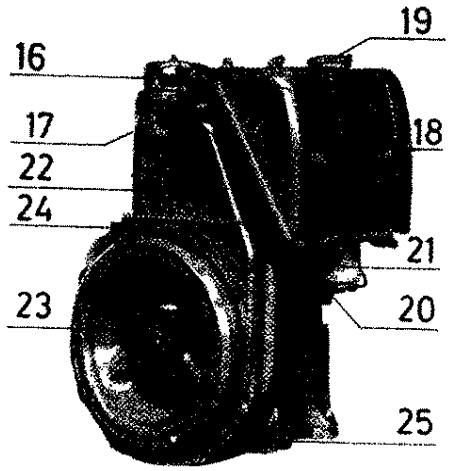
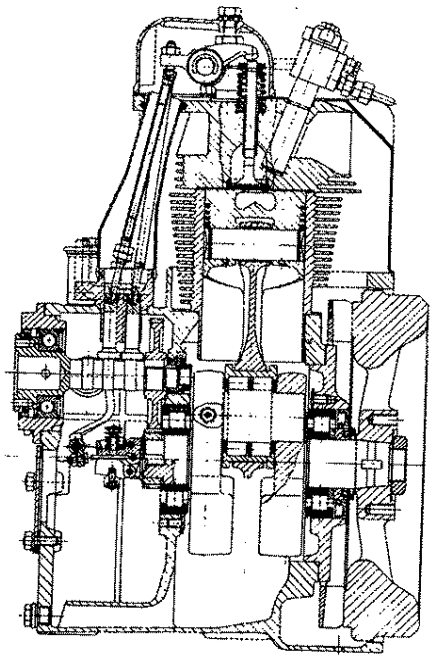


A10

A 10







1	Acceleration Lever
2	Excess starting fuel
3	Decompression lever
4	Camshaft P.T.O.
5	Dipstick
6	Lube-oil filler
7	Oil drain plug
8	Aircleaner
9	Crankcase breather
10	Exhaust port
11	Rocker arm cover
12	Inspection cover
13	Governor inspec. cover
14	Injection pump
15	Fuel pressure line
16	Nozzle holder
17	Fuel return line
18	Fuel tank
19	Fuel filler cap
20	Fuel feed line
21	Fuel filter
22	Air shroud
23	Flywheel P.T.O. flange
24	TDC mark crankcase
25	Flywheel housing flange
26	Starter motor flange
27	Oil strainer
28	Crankcase cover
29	Inspection cover
30	Oil filter "spin-on"
31	Oil-cooler
32	Oil pressure switch

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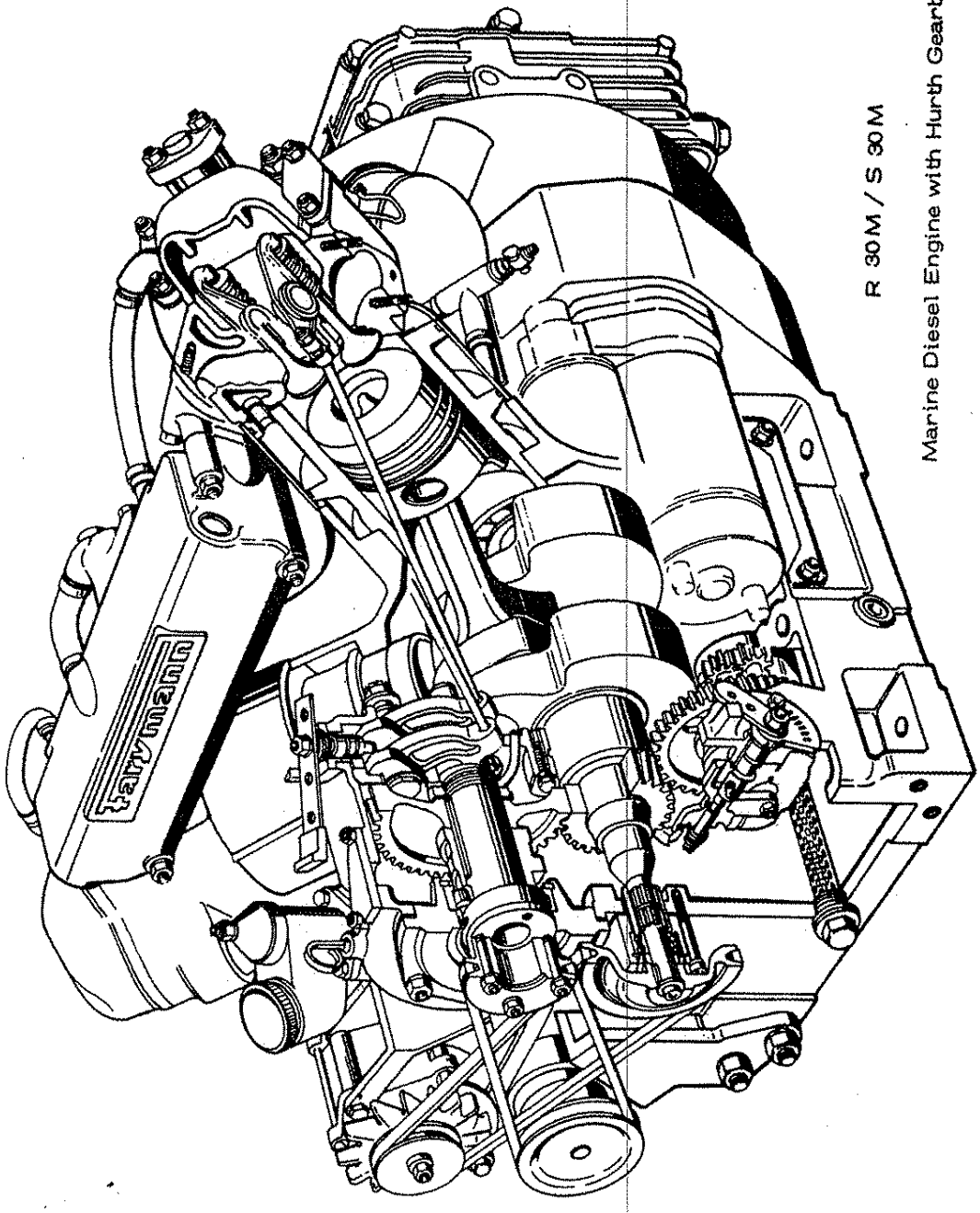
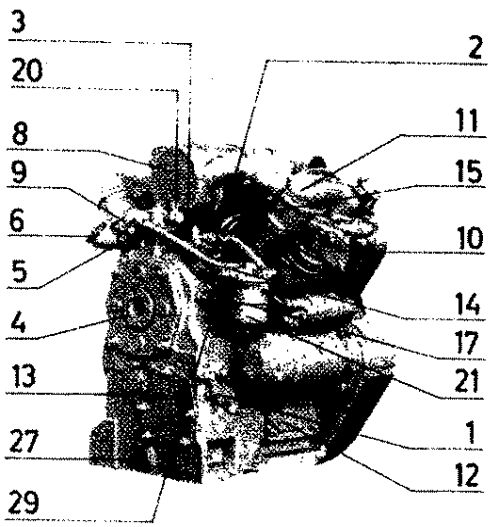
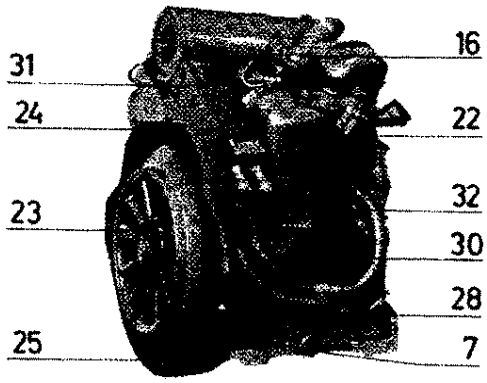


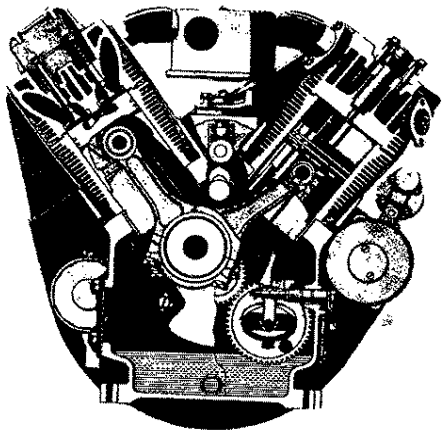
R 30 M / S 30 M

Marine Diesel Engine with Hurth Gearbox

S 10







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30	Oil filter "spin-on"
31	Oil-cooler
32	Oil pressure switch

DISMANTLING

Before starting to dismantle the engine, make sure to what extent dismantling is actually necessary. Clean dismantled components thoroughly. Either use commercial warm cleaning agents, e.g. P3 or wash the parts out in diesel fuel or petrol.

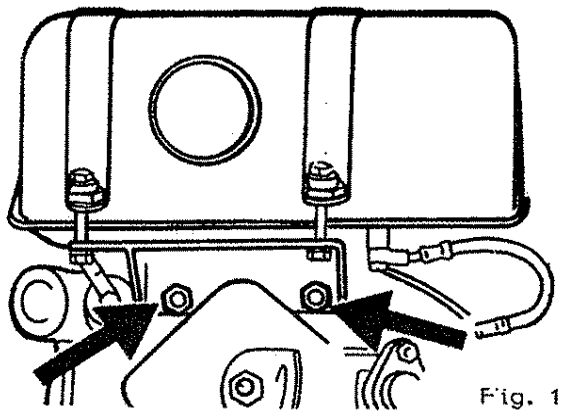


Fig. 1

For complete dismantling, all the accessories and fittings such as the V-belt pulleys, dynamo mountings, starter, water pump with tubing, oilbath air filter must be removed.

In the case of vertical engines, remove the fuel tank as well, together with its support.

Remove high pressure pipe between fuel injection pump and injector. Seal off the outlet port of fuel injection pump to prevent ingress of dirt.

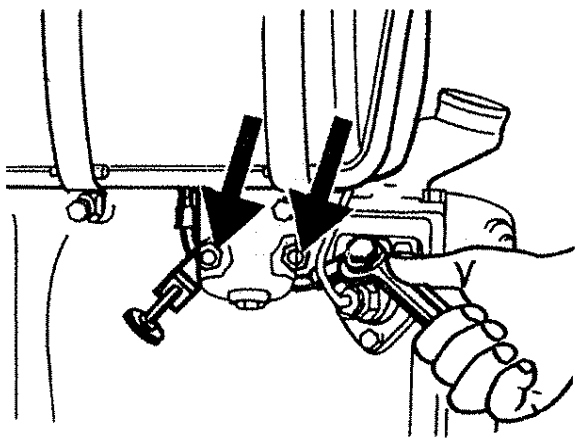


Fig. 2

For this purpose release the fuel intake line and disconnect it at the fuel pump.
Figs. 1 and 2

Further dismantling down to the crankcase is then easy.

CYLINDER AND PISTON

Remove cylinder by sliding it up over the four studs.

Note: In the case of V-twin engines, the cylinders used on air cooled units are interchangeable as new parts, but if they are to be used again, they should be suitably marked to ensure they will be replaced in their respective left and right hand positions. Cylinder assemblies used on water cooled V-twin engines are not interchangeable.

Remove the gudgeon pin circlip (see Fig. 3) and push gudgeon pin out of piston - remove piston from connecting rod. In the case of V-twin engines, mark the pistons to ensure correct replacement in their respective bores.

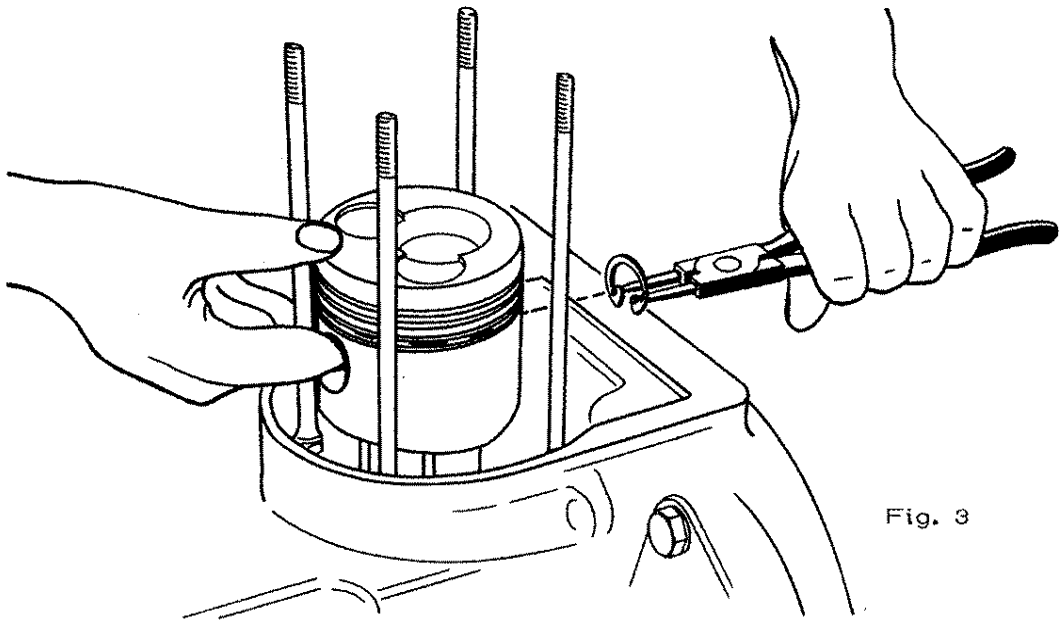


Fig. 3

Note that the combustion chamber in the piston top is always off-center towards the flywheel side. Special care should be taken when reassembling.

CONNECTING ROD

Remove the inspection cover on the side of the crankcase which provides access to the connecting rod big end - see Fig. 4.

Release the connecting rod bolts through the exposed opening in the cover and remove them. Remove the connecting rod upwards through the cylinder bore.

CONNECTING ROD (Cont'd)

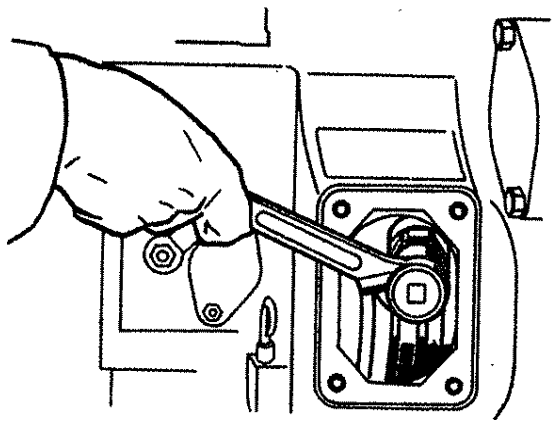


Fig. 4

K14, K30 and L series engines have connecting rods without a split big end and the connecting rod is removed with the crankshaft assembly.

Note: The connecting rod big end bearing on K14, K30 L-series and A-series engines is of the double roller type and will remain part of the crankshaft assembly even when the connecting rod is removed with the A-series.

Shell type big end bearings are employed on V-twin engines and K50 series and should be removed when the connecting rod caps are removed. They should not be mixed up, but kept with their respective rods.

INJECTION PUMP

Take off the complete breather valve (B). The small rod with ball joints on each end linking the governor lever with the injection pump rack can be withdrawn from the ball head of the pump rack. Use a wire hook to facilitate this work if necessary.

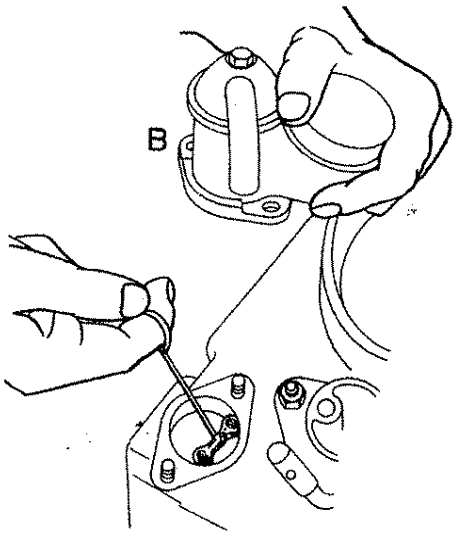


Fig. 5

-17-

-18-

INJECTION PUMP (Cont'd)

V-twin Engines:
Remove the fuel filter complete with bracket which will provide access through the crankcase to the fuel pump rack.

Press down the excess fuel button and put the fuel pump rack into the centre position.

Removal of the fuel injection pump is now common to both type engines.

Remove the setscrews and remove the fuel pump from crankcase. Turn pump slightly if necessary. Do not apply force. Do not damage the shims underneath the fuel pump flange - keep them in a safe place for replacement with the pump.

CAMSHAFT

To remove the camshaft the tappet guide with decompression device as well as the injection pump (and the fuel feed pump if fitted) have essentially to be removed first.
The push rods and protection tube having been taken off already, remove the 2 nuts holding the tappet guide. When extracting the tappet guide, watch for tappets which may fall into the crankcase.
After removing the 4 nuts, holding the camshaft bearing flange, the latter can then be pried off by means of 2 forcing screws. The flange can then be removed completely with camshaft and gear wheel. If necessary rotate the flywheel slightly to free the cam gear from the gear on the crankshaft (Fig. 6).

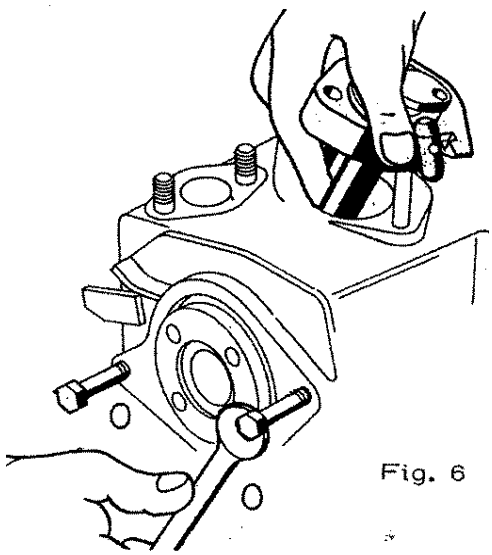


Fig. 6

Remove flange complete with camshaft assembly.

Dismantling the camshaft assembly is common to both engine types.

To separate the camshaft from its bearing flange, first take off the gear by removing the nut on the end of the camshaft which is secured by a lock washer and holds the slide bearing as well as the gear.

CAMSHAFT (Cont'd)

Remove circlip holding inner race of ball bearing and drive the camshaft out of flange and bearing with mallet or hand press.

If necessary, replace the ball bearing and oil seal in the flange. The outer race of the bearing is secured on both sides with a circlip.

The bush in the crankcase which supports the rear of the camshaft, can be renewed if necessary, after the crankshaft has been removed.

V-twin Engines

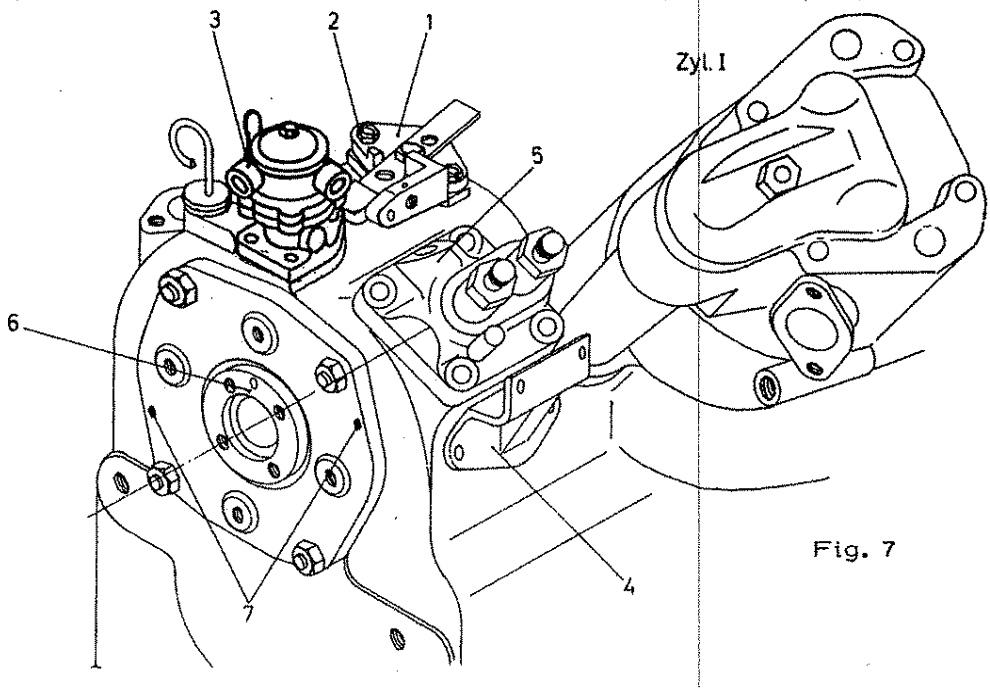


Fig. 7

Attention:

Definetely follow each step after the other to avoid damages to cam-followers and cams.

- Take off all parts mounted to camshaft flange.
- Remove both cylinder head covers, loosen rocker arm support and remove push rods.
- Remove complete decompression device (1) by unscrewing nuts (2) and insert special tool X (no. 0888.923.01.5) as shown in Fig. 7 to disengage cam-followers from camshaft.
  Warning: Proper insertion of tool X is imparative, otherwise cam-followers will breack.
- Remove fuel feed pump (3) (if applicable).

CAMSHAFT (Cont'd)

- After removal of bracket (4) disconnect governor lever from pump rack (Ball pivot).
- Remove fuel injection pump (5) (see Fig. 7) as described on page 19.
- Remove dipstick.
- Turn camshaft to bring marking "O" on flange (6) to top center. Then remove the four nuts of the bearing flange. With two hex. bolts M 8 x 25 (DIN 933) inserted into threaded holes (7) the bearing flange can be pried off, holding the complete camshaft assembly.

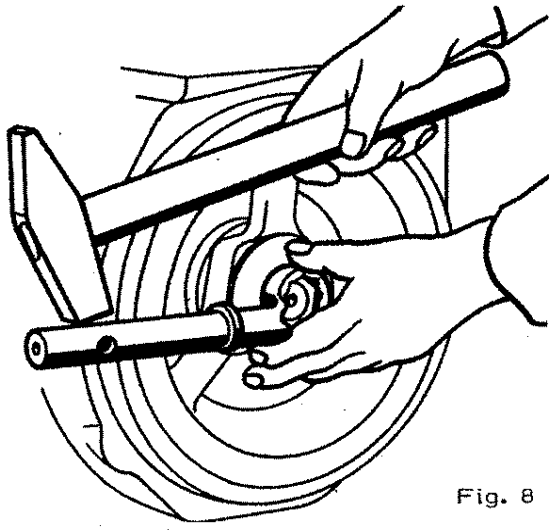


Fig. 8

THE FLYWHEEL

The flywheel is fixed to a self-locking taper and can only be removed with a special extracting tool. Release the flywheel nut by 2 to 3 turns only, using an impact wrench. Fig. 8

Fit the extractor and remove the flywheel. Do not attempt to pull the flywheel from the shaft with the flywheel nut removed as it is necessary to use this nut as a safety stop when the flywheel is released from the crankshaft taper. Then unscrew the flywheel nut completely. Fig. 9

Special tools: Flywheel extractor

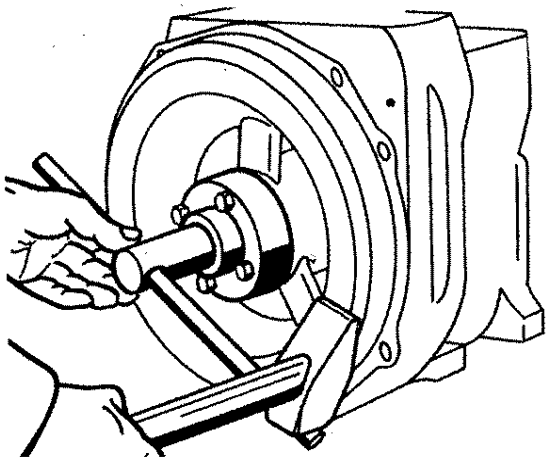


Fig. 9

OIL SEAL (Flywheel Side)

After taking off the flywheel watch number and position of cup springs between flywheel and angle ring (Fig. 26). Pull off angle ring using its inner groove (see Fig. 26 - 3) and then remove damaged oil seal. When replacing oil seal it is advised to replace the angle ring (see Fig. 26) as well.

Remove angle ring using its inner groove to prise it off. Remove spring loaded oil seal.

CRANKSHAFT

Remove the nuts holding the main bearing plate flywheel side and pry off the plate using two forcing screws illustrated in Fig. 10. After removing the main bearing plate the complete crankshaft with small gear wheel and governor can be withdrawn.

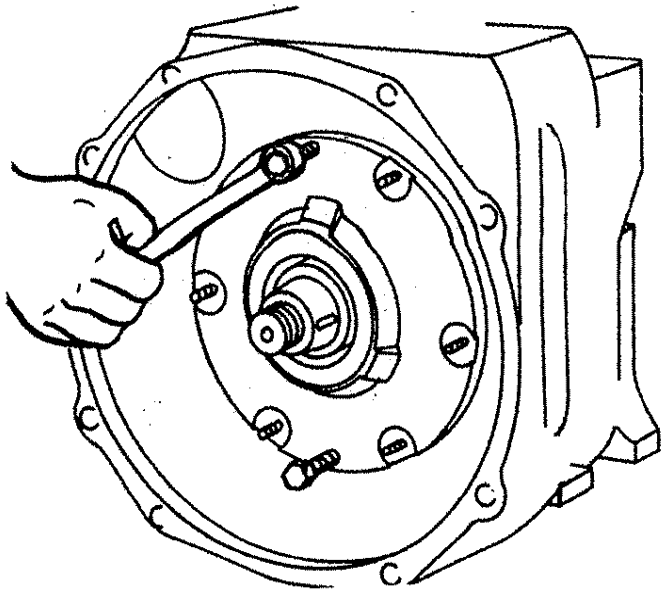


Fig. 10

GOVERNOR

With single cylinder engines, the governor is fitted to the front of the crankshaft.
To remove the governor, release the locking washer and remove the complete governor by means of a socket spanner.
Note: The governor has a left hand thread. Release by turning clockwise.

With V-twin engines, the governor forms a unit with the lubricating oil pump and is accessible through the governor inspection cover and removal of the speed regulation linkage is necessary.

Governor is fitted to crankshaft directly with single cylinder engines only!

MAIN BEARINGS

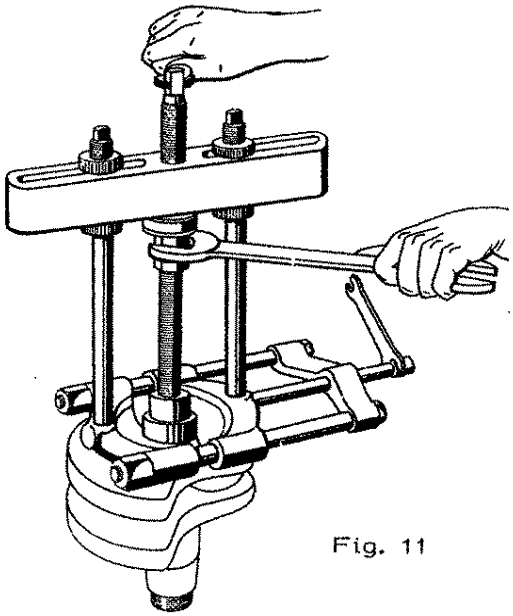
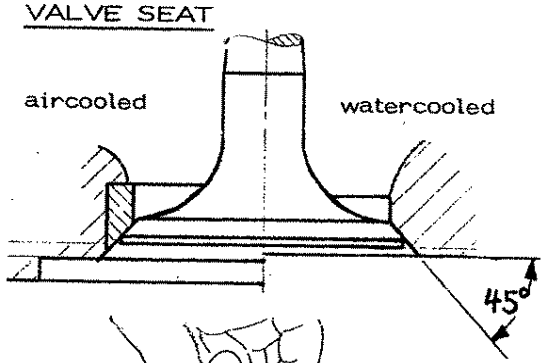


Fig. 11

With single cylinder engines both main bearings are roller bearings whilst V-twin engines have only one on the flywheel side. The roller bearing on flywheel side serves as thrust bearing for the crankshaft on all Farymann engines, i.e. fixed bearing on flywheel side, loose bearing on gear side.

If roller bearings have to be replaced the inner races must be pulled off the crank pins. Always make sure that the inner races are firmly seated. If they are loose the crank or crank webb concerned has to be replaced. With an extractor tool the inner races of the main bearings can be pulled off undamaged (see Fig. 11). The tool is suitable to pull-off the crankshaft gear as well.

VALVE SEAT



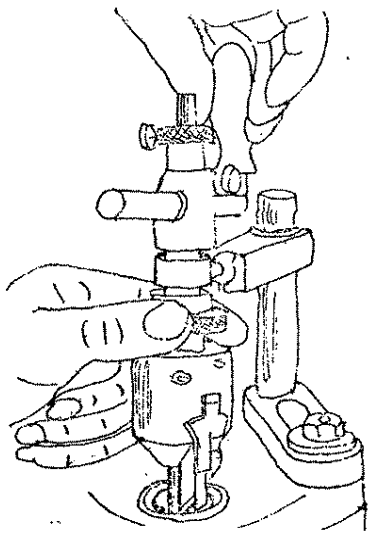


Fig. 12

All seats are cut under a straight 45° angle. When seat overhaul is necessary we highly recommend the HUNGER special valve seat cutter, Model VDI (see Fig. 12). If this cutter is used no grinding-in is necessary.

With all watercooled engines, having grey-cast head, valve seat is integral with head, whilst with all aircooled engines valve seat is an insert into the aluminium cylinder head.
If the latter seat is beyond repair proceed as follows:

- put cylinder head in lathe, centered on respective valve guide;
- turn out valve seat until a small rim remains, which can then be easily removed.

To fit new valve seat heat cylinder head up to approx. 180° C (360° F) and drive new seat into its thoroughly cleaned location.

-22-

ASSEMBLING

To assemble the engine, the sequence of operations for dismantling is more or less reversed.

It is of great help to use the corresponding spare parts list when reassembling the engine. Tables in parts list show the exact sequence of fitting of the different parts.

TESTING OF REBUILT ENGINE

An engine that has been complete overhauled such as having the cylinder replaced and fitted with new bearings, piston and rings and valves should go through a run-in period perferably on a test bed before any mount of load is applied to the engine.

The proper running-in of the engine will help to establish polished surface and proper clearance between the various operating parts and thus add years to the life of the engine.

CONROD BEARING

Single cylinder engines:

The built up crankshaft of these engines has a multirange roller bearing as con-rod bearing, which is specially designed by FARYMANN and is patented in countries the world over.

Replacement of this bearing can only be done by mechanics who have undergone a thorough training in the FARYMANN factory.

V-twin models:

With V-twin engines, the big end bearings are of the shell type and are easily replaced. However, if the crankshaft big end journal is worn, it can be reground 0,5 mm undersize or a replacement crankshaft fitted.

A replaceable small end bush is fitted to all type connecting rods.

MAIN BEARINGS

Attention:
Outer and inner race of roller bearing are matched by the bearing manufacturer. Extreme care should be taken that this is respected when assembling.

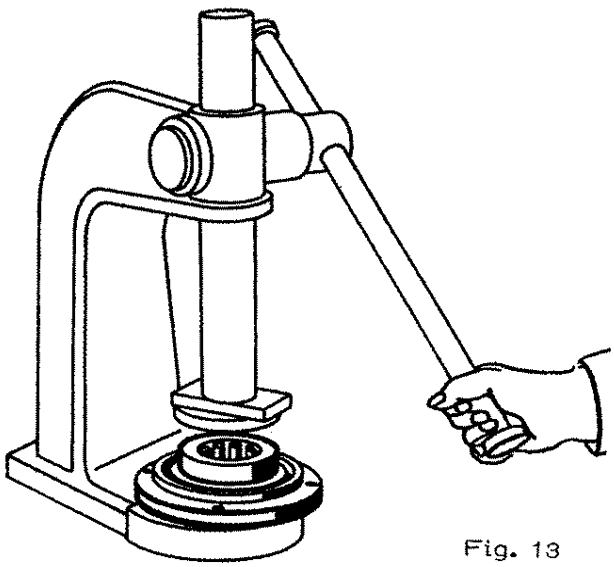
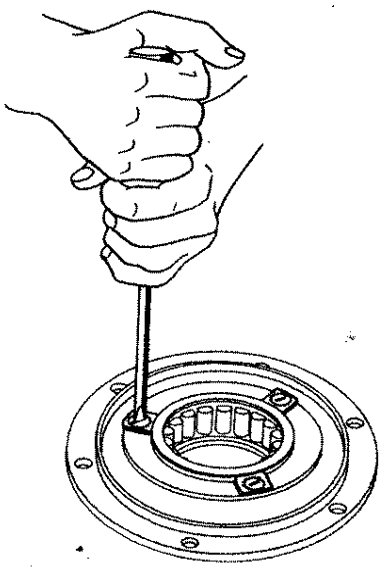


Fig. 13

Heat the inner races of the main bearings in an oilbath of about 90 – 100° C (200° F) and push them as fast as possible onto the pins. Preferably using a suitable length of pipe.

The outher race containing roller cage and rollers must be firmy pressed into the crankcase housing (gear side) and the main bearing plate (flywheel side). Preferably a hand press with suitable dolly should be used (Fig.13).

Only knock into position if this is absolutely necessary. If so use a flexible hammer or a piece of wood. Ensure bearings are not tilted, otherwise severe damage will be caused to bores and races.



Make sure that the outer races are firmly seated in their respective bores to prevent them from rotating and damaging the crankcase or main bearing plate.

In the crankcase as well as in the main bearing plate outer races are held in position by fixing segments provided for this purpose which are screwed down using bevel lock-washers and screws (Fig. 14).

Fig. 14

CRANKSHAFT REGRINDING (V-twin Engines only)

Engine Type "R"

	Std.	0,5 mm undersize
Main & Big End Bearing Dia.	65,015/64,985 mm (2.5596/2.5584 in)	64,515/64,485 mm (2.5399/2.5387 in)

Fillet Radii
- Main Bearing 2 - 0,5 mm (0.078 in)
- Big End Bearing 3,5 mm (0.138 in)

Engine Types "P" and "S"

	Std.	0,5 mm undersize
Main Bearing Dia.	80,015/79,985 mm (3.1501/3.1490 in)	79,515/79,485 mm (3.1305/3.1293 in)
Big End Bearing Dia.	75,015/74,985 mm (2.9533/2.9521 in)	74,515/74,485 mm (2.9336/2.9324 in)

Fillet Radii
- Main Bearing 2 - 0,5 mm (0.078 in)
- Big End Bearing 3,5 (0.138 in)

CRANKSHAFT GEAR

The crankshaft gear should be thoroughly heated (180° C / 360° F) on a hot plate and after inserting the key into the crank pin, shrink the gear onto the crank pin on the timing gear side (Fig. 15).

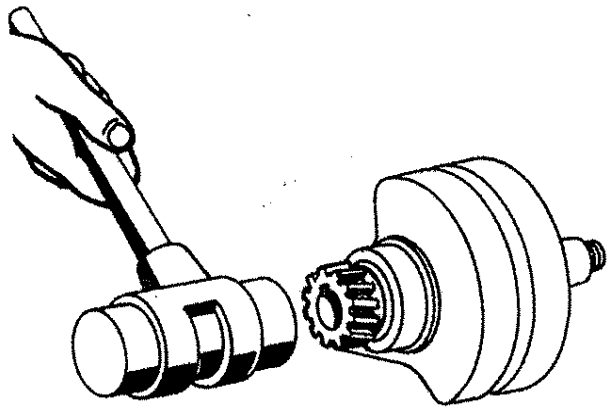
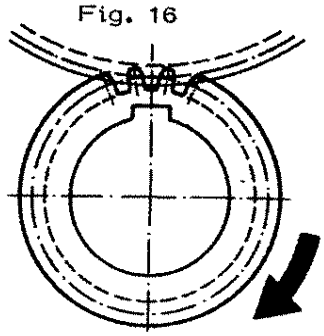


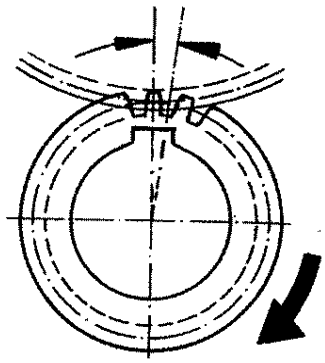
Fig. 15

Crankshaft Gear (Cont'd)

Fig. 16



No. 1 - "normal"



No. 2 - "advanced"

Note: Helical Gear Positions.

The gear (where helical toothed) can be fitted to the crankshaft either way round.

The face of the gear where the key slot is exactly centred underneath the tooth gap should be seen after assembling to crankshaft - see Fig. 16. This positions is referred to as the "normal position" and applies to all engines except those mentioned below. The gear is marked on the outer face.

With A 30 series engines, the gear can be fitted the wrong way round which results in advanced timing of approximately 6 mm on the flywheel rim - in this condition, the tooth gap is slightly off centre to the left.

With K 30 series engines, the two sides are distinguished by the position of the key slot in relation to the tooth gap or tooth.

With position No. 1 - "normal" - the tooth gap is opposite the key slot.

With position No. 2 - "advanced" the tooth is directly opposite the key slot.

Fit as follows:

Crankshaft rev/min up to 2000 - Position No. 1
Crankshaft rev/min above 2000 - Position No. 2

The L 14 engine has straight gears and the above does not apply.

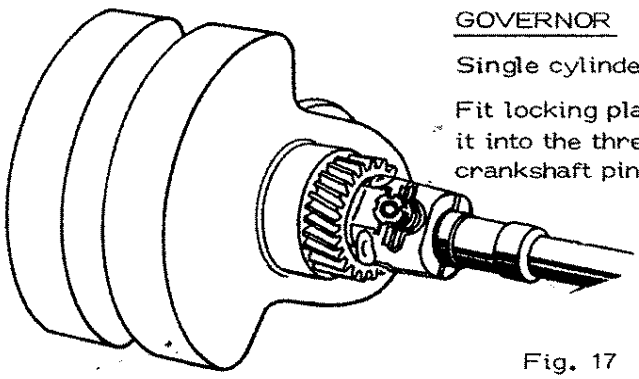


Fig. 17

GOVERNOR

Single cylinder engines:

Fit locking plate on the governor and screw it into the threaded hole on the gear side crankshaft pin.

Important:
The governor has a left hand thread. Tighten down in an anticlockwise direction with a socket wrench and lock in position - see Fig. 17. Always use a new locking plate.

Governor (Cont'd)

Remove the governor pin and insert again after greasing well so that it cannot drop out when the crankshaft ist fitted.

Governor V-twin models

With V-twin models the governor is not fitted to the crankshaft but forms a unit with the lube-oil gear pump

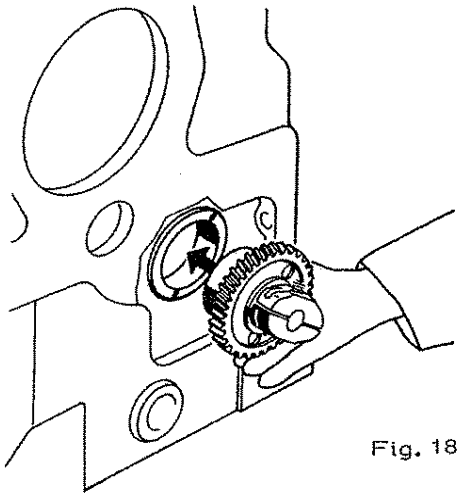


Fig. 18

The pump body is lodged in the crankcase partition containing the oil galleys for suction and discharge of the lube-oil. (See Fig. 18)

As shown in Fig. 18 present the the unit (assembly of gear pump, gear wheel and governor) and slide it into the bore of the crankcase partition.

As space is very limited, some skill should be applied to manoeuvre pump-governor-unit into crankcase.

To align holes in pump body to threaded holes in crankcase, use special tool as shown in Fig. 19

Then fit Allen-screws and tighten as shown in Fig. 20.

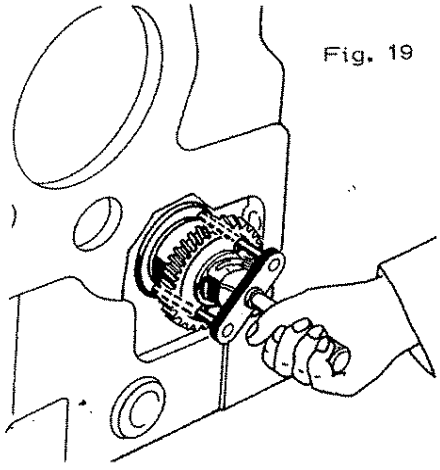


Fig. 19

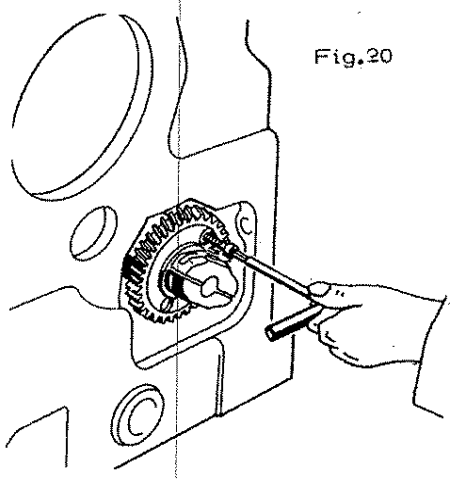


Fig. 20

CRANKSHAFT

Before fitting a new crankshaft and/or flywheel, the taper on the flywheel end of the crankshaft should be ground into the tapered bore of the flywheel using grinding compound - see Fig. 21 . It is important to note that the main area of contact should be to the engine side of the shaft.

After a good surface finish is obtained, carefully wash away the grinding compound with petrol or paraffin.

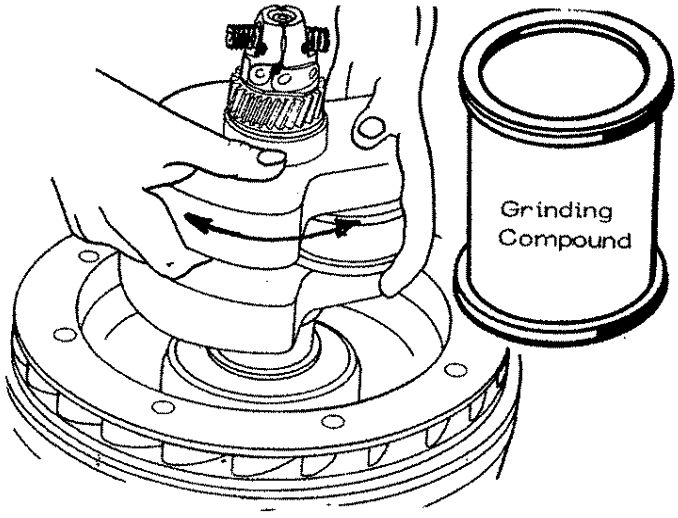


Fig. 21

Insert the crankshaft into the crankcase and carefully slide it into the bearing on the gear side without applying any force. (Fig. 22)

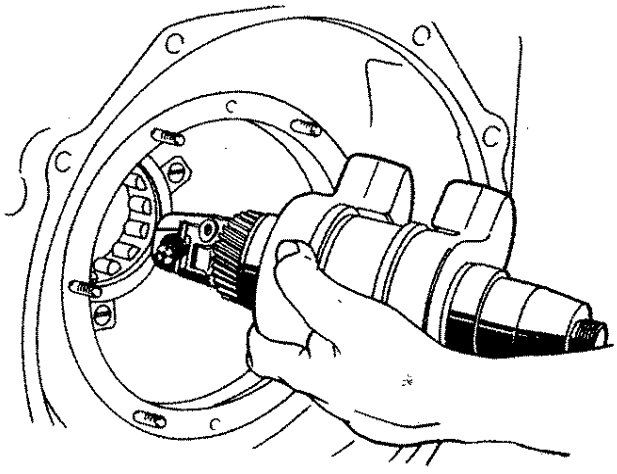


Fig. 22

V-twin engines:

Crankshafts of V-twin models are equipped with a slide bearing on the timing gear side. When inserting the crankshaft extreme care should be taken that the crankshaft gear does not harm the surface of the slide bearing bush located in the crankcase. Thin shim metal sheet should be slung around the gear pinion so it passes through the bearing bush without causing damage. This procedure can only be applied if the governor lube-oil pump unit with its gear wheel has been taken out of the crankcase.

Crankshaft (Cont'd)

Attention:

Single cylinder engines:

It is possible that main bearing (roller bearing) gear side has a rather tight fit. To avoid that crankshaft with the bearing inner race is presented not exactly in line, proceed as follows:

Mount complete main bearing plate as described hereunder onto crankshaft flywheel side. Insert this complete subassembly into crankcase as described.

Thus the inner race of main bearing gear side is pushed into its roller cage with the crankshaft perfectly alined through the main bearing plate.

MAIN BEARING PLATE

Fit the oil seal in the main bearing plate with the main bearing outer race already in position. Press seal down as smoothly as possible using a hand press (Fig. 23).

Oil Seal

When oil seal has to be replaced it is advised to replace the angle ring as well (see Fig. 27).

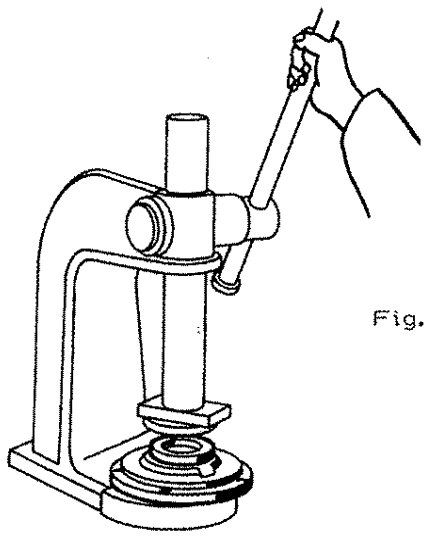


Fig. 23

MAIN BEARING PLATE (Cont'd)

After applying the gasket to the crankcase housing, place the main bearing plate and drive it home, applying blows with a flexible hammer to the very periphery of the bearing plate. Take care not to get the bearing plate out of alignment (Fig. 24).

Present the fixing nuts and tighten with a torque wrench following sequence illustrated in Fig. 25.

Torque values: See special chart at the end of the manual.

After tightening: Check free-wheeling of crankshaft.

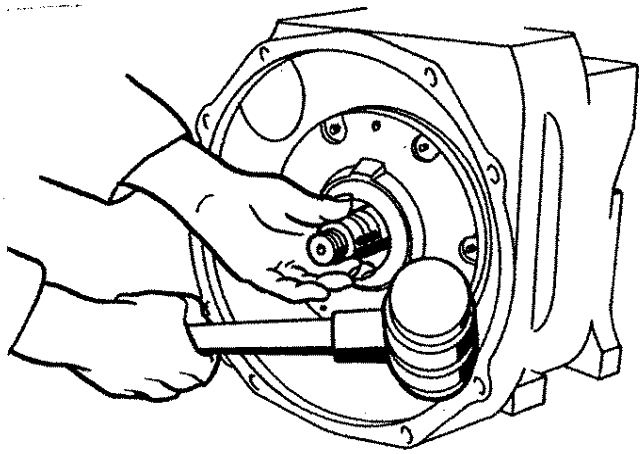


Fig. 24

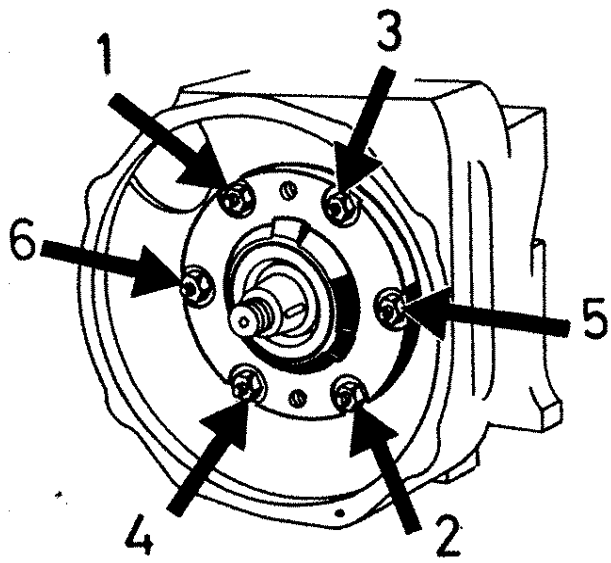


Fig. 25

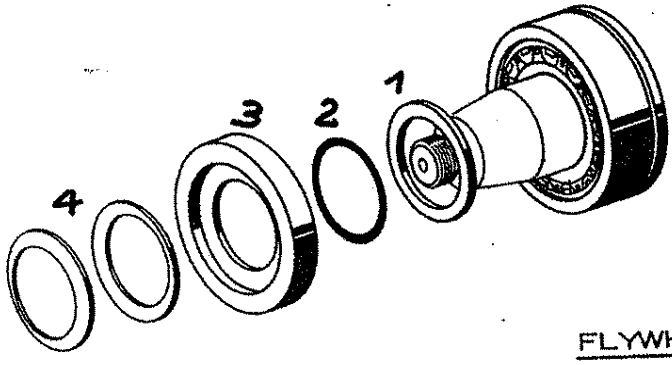


Fig. 26

FLYWHEEL REASSEMBLY

Fit main bearing thrust ring(1), rubber O-ring (2), angle ring (3), cup springs (4) onto crankshaft pin. (Fig. 26).
Oil seal (fitted to main bearing plate) and angle ring should be well oiled before the latter is carefully threaded in.

Main bearing, P.T.O.-side (fixing crankshaft in axial direction), holds crankshaft in between crank web and flywheel whilst cup springs compensate machining tolerances of taper on crank pin and flywheel hub.

Note the number and positioning of the cup springs.

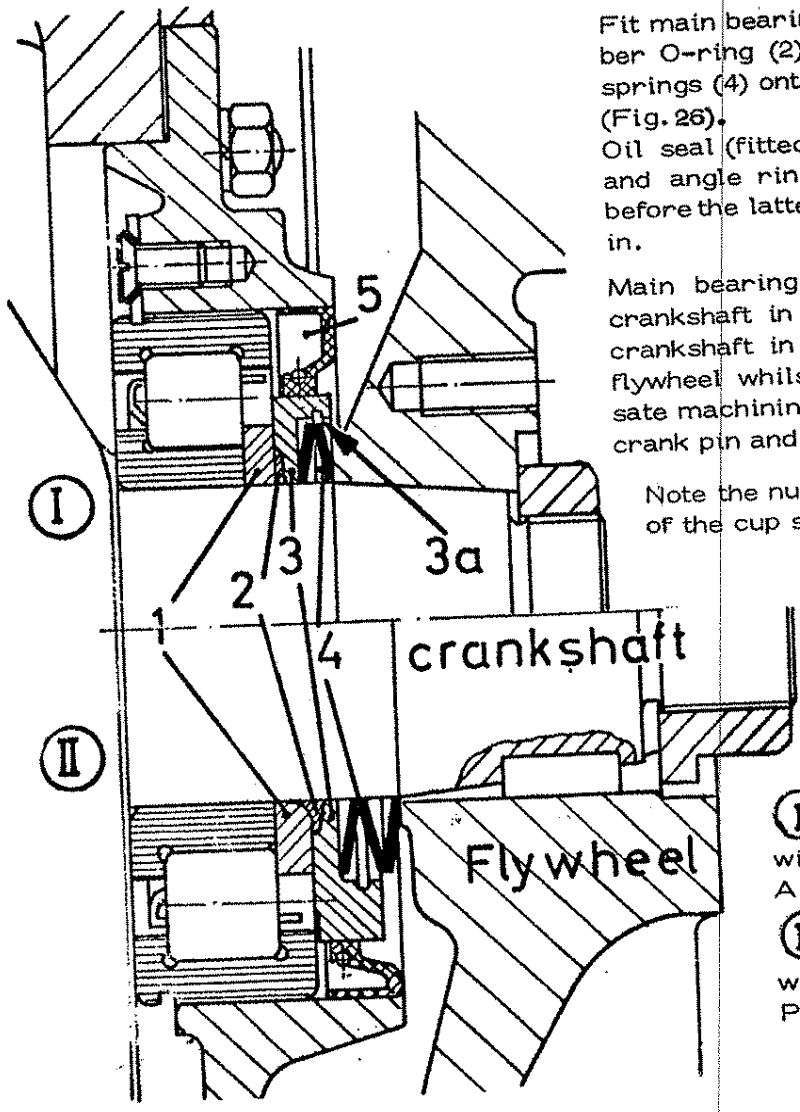


Fig. 27

(I.) 2 (two) cup springs with engines Type K, L, A and the V-twin R.

(II.) 3 (three) cup springs with V-twin engines Type P and S.

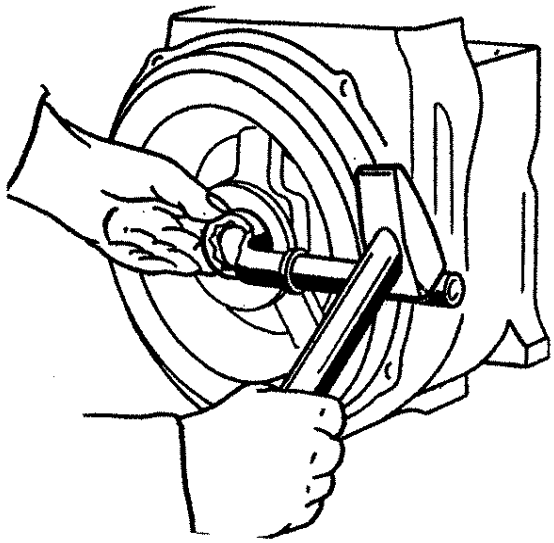


Fig. 28

When presenting the flywheel, be sure key is in position in its key slot on the shaft and that the key way in the flywheel hub is lined up accurately with the key.

Note:
Key serves only to position flywheel. Power is transmitted through press-fit of taper only. For this reason be sure taper has proper surface (see Fig. 21)

Fit the flywheel and tighten the flywheel nut. Tighten strongly with the impact wrench. (Fig. 28).

Flywheel must give firm metallic sound when topping crankshaft (inside nut) with hammer.

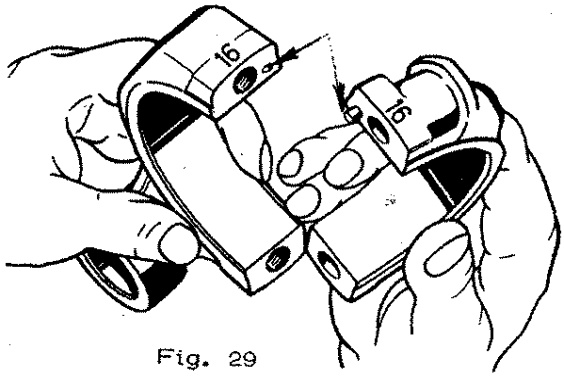


Fig. 29

CONNECTING ROD

Fit the connecting rod cap, ensuring the marks on the cap and rod coincide - see Fig. 29.

Where the connecting rod has a split big end, insert the rod through the top of the crankcase and position it on the big end bearing - see Fig. 30.

With K 5/6 and R Series Engines inspection opening is in bottom of crankcase.

CONNECTING ROD (Cont'd)

No lock washer should be applied!

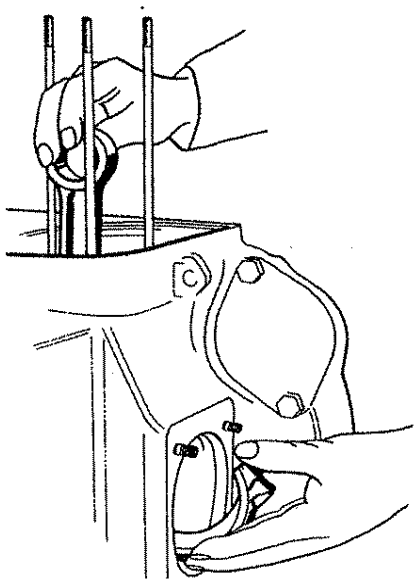


Fig. 30

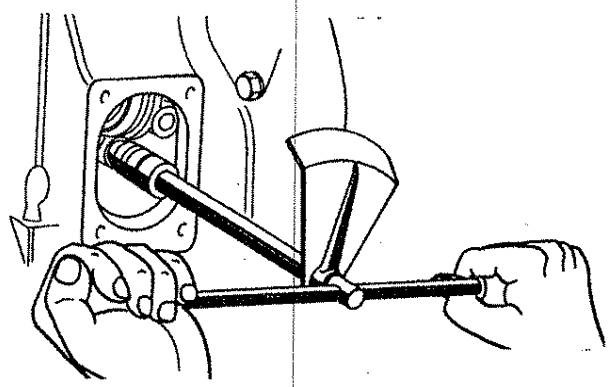


Fig. 31

Do use new setscrews, tighten to the correct torque - see Fig. 31

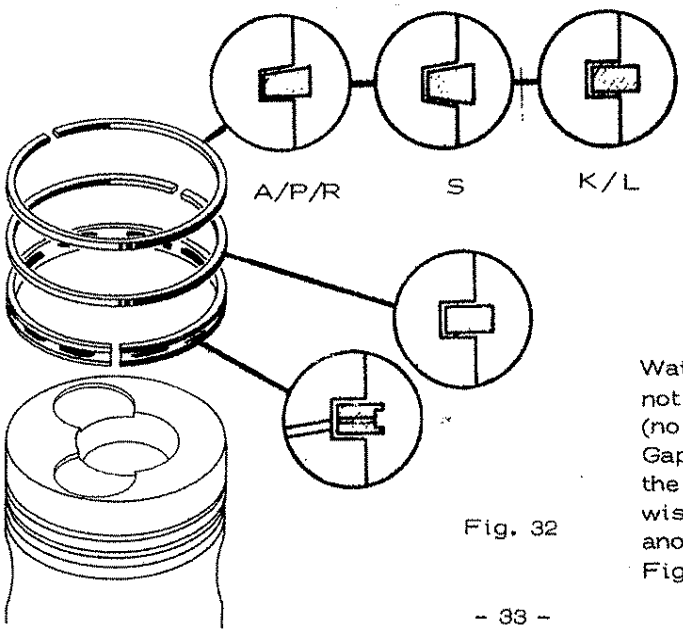


Fig. 32

PISTON RINGS

The top compression ring being chromium plated, has different section with different engine ranges.

Section of other rings is identical.
Piston rings have to be fitted before piston is assembled.

Watch that piston ring gaps are not located one above the other (no overlap).
Gaps should not be located above the gudgeon pin bore, but otherwise should be as far from one another as possible.
Fig. 32

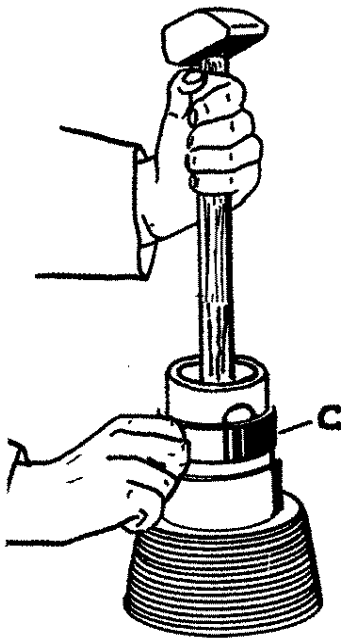


Fig. 33

PISTON & CYLINDER

Cylinders fitted to air cooled engines are a single item and if undue wear is present, the complete cylinder should be replaced.

For liners of water cooled engines see special paragraph, page 57.

Thorough oil the piston and rings and by means of a ring clamp (C), push the piston assembly into the base of the cylinder as far as to keep the gudgeon pin bore free - see Fig. 33.

Present the cylinder with the piston to the crankcase.

The piston should be positioned so that the combustion chamber will be directly underneath the injector, i.e., the combustion chamber, being off-center, should be to the flywheel end when the piston has been fitted.

Pull the connecting rod up into the piston. Centre the small end bush with the gudgeon pin and push the latter right through - see Fig. 34.

Fit the gudgeon pin retaining circlip.

Before pushing the cylinder down home onto the crankcase, fill the gudgeon pin bore with oil.

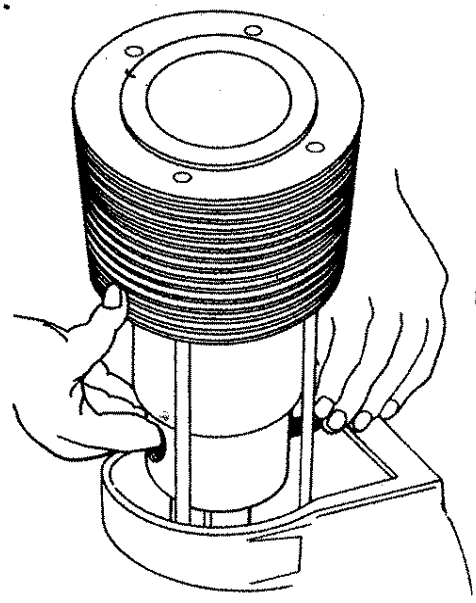


Fig. 34

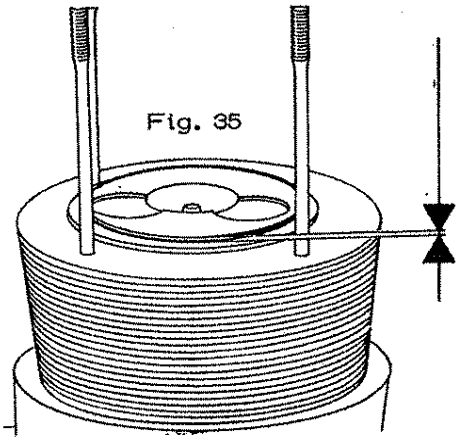


Fig. 35

ADJUSTMENT OF TOP DEAD CENTRE

TDC IGNITION CYCLE

K 5 series engines:
As these engines do not have any cylinder-head gasket, piston at T.D.C. is in reset to liner.

K 5 series: 0.6 – 0.8 mm reset

With all other engines piston does protrude. See chart below:

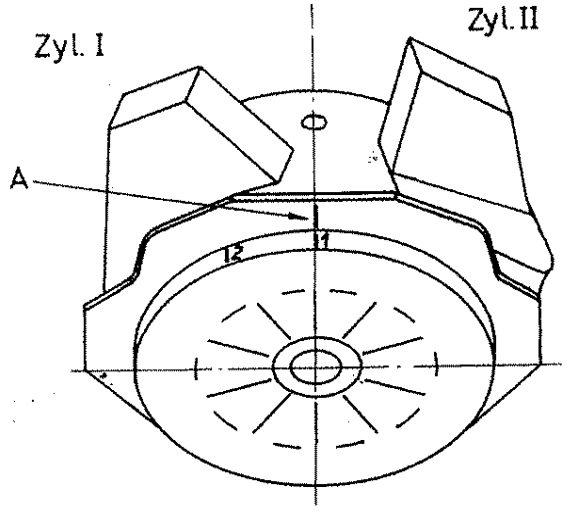
Engine Range	K 8	L	A 1o- A 2o	A 14- A 24	R	S
Protrudes (mm)	o,5-o,98	o,7-1,o	o,8-1,o5	o,7-o,9	o,77-1,o5	o,8-1,o8

Compare to T.D.C. mark on flywheel and flywheel housing.

T.D.C. firing stroke of fully fitted engine:

Remove rocker arm cover and crank engine until both valves are closed. Adjust marking (1) on flywheel opposite marking (A) on crankcase.

The same applies to cylinder No. II when observing marking (2) Fig. 36. If marking is covered by accessories, adjustment of TDC firing stroke can be made as follows:
Remove rocker arm cover and crank engine until both valves are closed. (Not necessary if camshaft has been removed). Push one valve open with spanner or screw driver and turn engine until piston connects with valve. TDC firing stroke is then easily ascertained.



TDC exhaust stroke: The overlap of intake and exhaust valve is absolutely symetric to the TDC exhaust stroke. Turn flywheel in matching this overlap and thus ascertain TDC exhaust stroke, both valves being open the same amount or "rocking".

Fig. 36

CAMSHAFT

To fit the camshaft, set the piston to T.D.C. - Fig. 35. Introduce the camshaft with flange and gear into fittet bore in the crankcase - Fig. 37

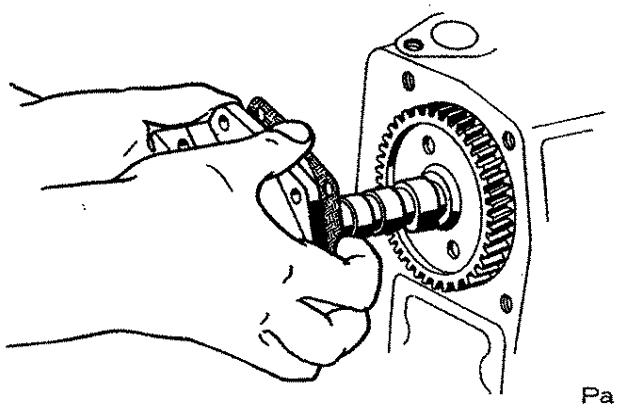


Fig. 37
Part No. visible

The marking on the gear wheel should coincide with the punched-in line in the tappet guide bore, after the gear meshes with the pinion on the crankshaft (with helical gear - models K34/K5/K6 with straight gears).

Attention when installing in model "L" engines

On models L28-L3o with straight gears, the marking on the gear wheel (part No. visible) is slightly to the left of the mark in the tappet guide bore - Fig. 38.

For models L 14 - L 2o

Retardet position: Gear wheel with part No. in front (visible). Up to speed of 2.5oo rpm, mark is to the left of the centre of the gear wheel slot.

Premature position

Gear wheel with part No. at the rear (not visible). For speeds in excess of 2.5oo rpm, mark is to the right of the centre of the gear wheel slot.

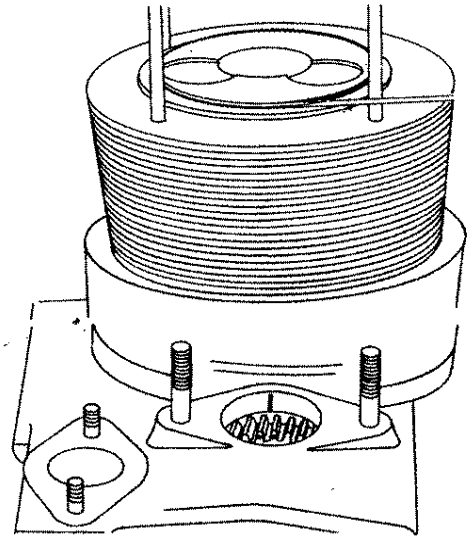


Fig. 38

CAMSHAFT V-TWIN ENGINES

The cam-followers are lifted by reaching through bearing shield opening. Tool "X" is inserted through the opening of the decompression device and holds cam-followers in lifted position.

Bring piston No. 1 to TDC exhaust stroke.

Mount tool "Y" to the rear threaded holes of the injection pump flange. Insert ready assembled camshaft and observe that the marking on the camshaft gear wheel is opposite to the pointer of tool "Y" after it meshes with crankshaft pinion (helical gear).
Remove tools and re-assemble the various engine parts.

Attention:
After mounting of push rods and tightening the rocker arm support adjust valve clearance.

Sketches of Tools:

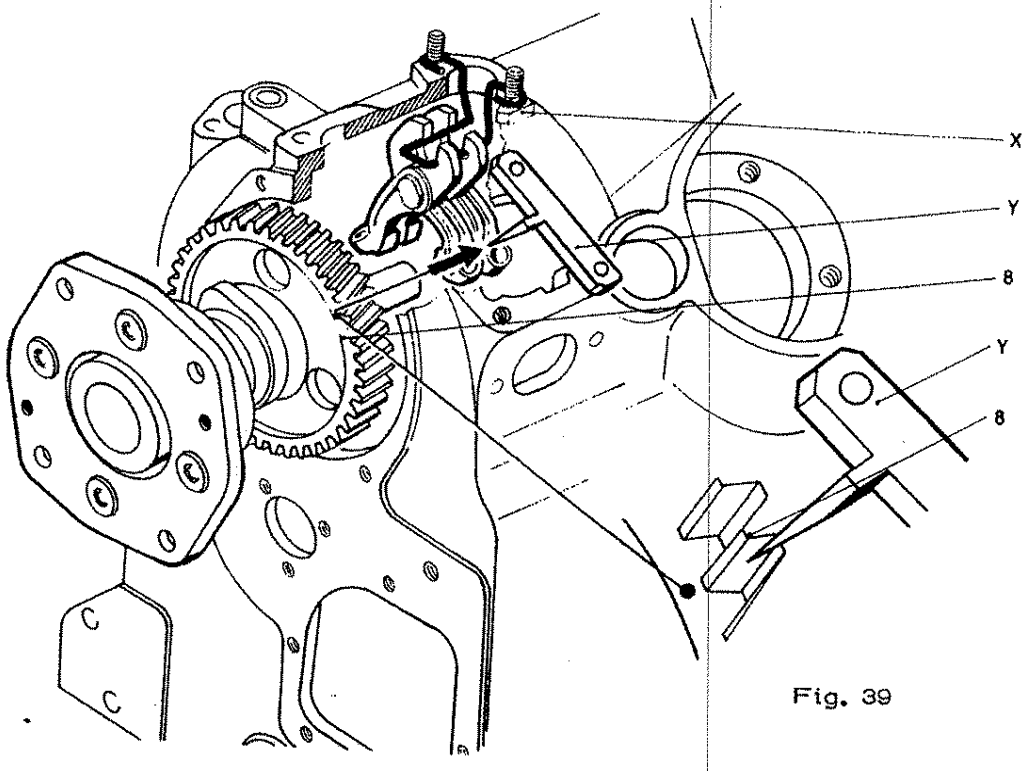


Fig. 39

CYLINDER HEAD

The valve and valve seats can be reconditioned in an orthodox manner. The valve seat angle is 45°.

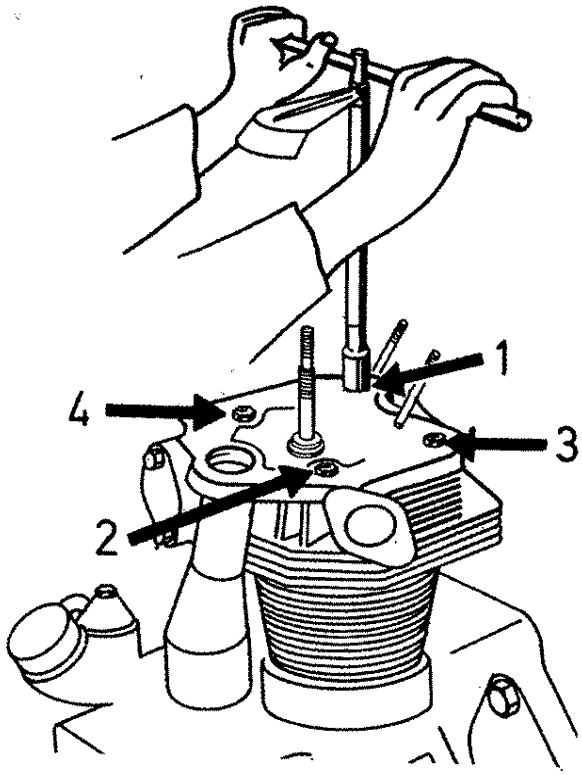


Fig. 40

When recutting a valve seat, do not remove material unnecessarily. If the valve seats are too deep, difficult starting will be experienced and engine efficiency will be reduced. New valve seat inserts should be fitted if this condition occurs. When replacing inserts, heat the cylinder head to 80 - 90° C (176 - 194° F) and then centrically press in the inserts.

Replace valve guides, rocker levers and rocker shaft with bracket, if these are unduly worn.

After mounting a tappet guide (incorporating decompression device) fit push-rod protection tube with its O-rings. Present cylinder head, with gasket put into exact position. A little grease will help to keep gasket in place.
Tighten cylinder head nuts with torque wrench always diagonally opposite to each other, in sequence indicated on Fig. 40, starting from the nozzle side. See table for torque values.

PUSH RODS

Single Cylinder Engines:

Looking at engine from camshaft side push rod for exhaust valve (left side on cylinder head) goes into tappet close to cylinder. Push rod (with nuts) for intake valve goes into tappet close to camshaft flange.

PUSH RODS (Cont'd)

V-Twin Engines:

Cam, respectively cam followers closest to cylinders do actuate the intake valves.

Cam, respectively cam followers nearer to camshaft flange do actuate the exhaust valves.

Decompression device on P + S engines operates the cam followers closest to cylinders, decompressing the intake valve.

Decompression on R engines operates cam follower closer to camshaft flange thus decompressing the exhaust valves.

With industrial engines the exhaust ports on the cylinder heads are always on the outside of the engine, with marine engines the exhaust ports are facing each other on the inside of the cylinder heads thus giving the possibility to fit the water cooled exhaust manifold.

Position of push-rods in cam followers and the operation of the latter does remain identical with industrial and marine engines, with the exception that the upper end of the push rods do attack the other rocker arm.

VALVE CLEARANCE

Valve clearance on Farymann Engines, all models, marine or industrial, water or air cooled, should be watercooled 0,2 - 0,3 mm (0,008 - 0,012")
aircooled 0,1 mm (0,004")

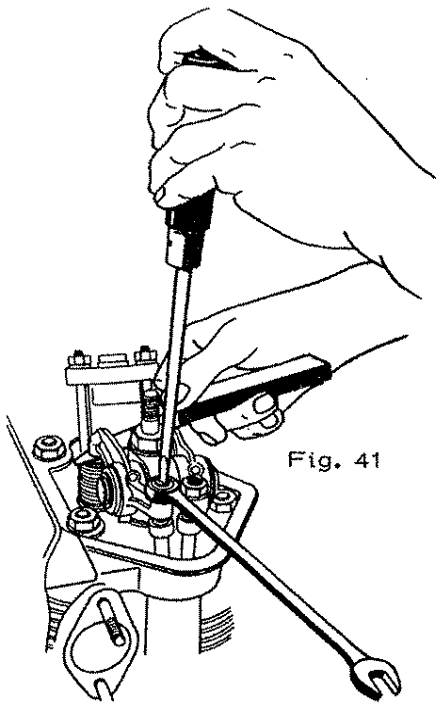


Fig. 41

with the engine being cold and respective piston set to TDC firing stroke. Adjust clearance with feeler gauge as shown on Fig. 41.
This clearance is valid for intake as well as exhaust valves.
Prior to checking, make sure that all cylinder head holding down nuts as well as rocker arm bracket nut are securely tightened.
When engine warms up, cylinder liner and head will dilate more than pushrods and therefore clearance will increase.

As aluminium cylinder head of aircooled engine will dilate more than greycast of watercooled marine engine, valve clearance with aircooled engines can be kept below above figures. With these engines the experienced mechanic will set clearance to the effect that he can just turn pushrod freely between his fingertips after locknut is tightened.

VALVE TIMING

Turn engine flywheel in sense of rotation, i.e. anticlockwise, until inlet valve opens (E.ö.). Chalkmark flywheel opposite T.D.C. mark (O.T.) on flywheel housing. (Fig. 42)

Continue to turn flywheel until exhaust valve closes (A.S.) and chalkmark. (Fig. 43)
Respective distances of both chalkmarks to the T.D.C. mark on flywheel should be checked with respective tables. If values are very much different, check if gears have been meshed correctly when camshaft was fitted.
See Fig. 38 or 39 respectively.

Distance from E.ö. (inlet opens) to A. s. (exhaust closes) gives the valve overlap.
For exact timing values (mm) see "Engine Datas"
Check flywheel diameter - see chart Fig. 54.

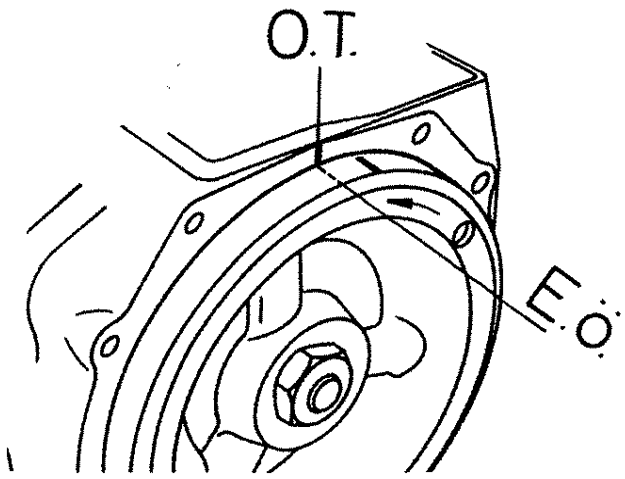


Fig. 42

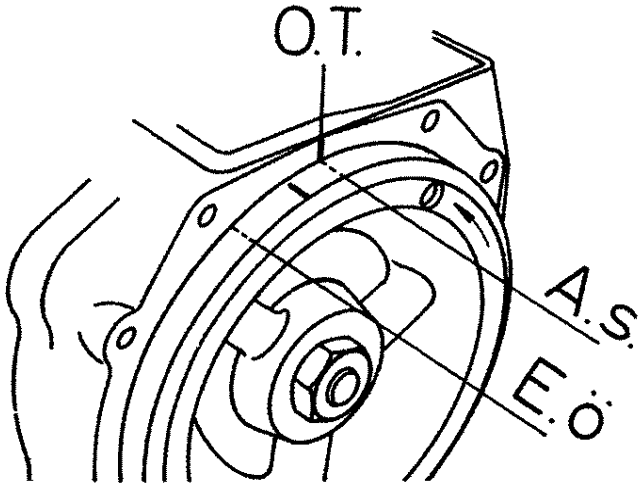


Fig. 43

DECOMPRESSION DEVICE

Any adjustment on decompression device should only be done after cylinder head nuts and rocker arm bracket have been tightened and valve clearance adjusted.

Single Cylinder Engines

A small cam machined on shaft of decompression lever (1) located in the tappet guide lifts through tappet (2) pushrod (with threaded section and two nuts locked against each other) actuating the intake valve. Fig. 44.

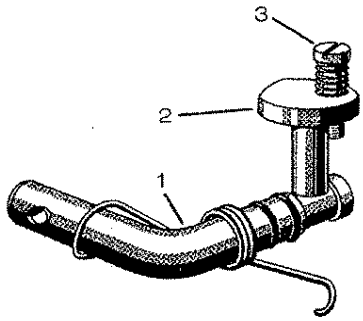


Fig. 44

Cap screw (3) holds tappet under spring load (2) to tappet guide. With decompression lever pulled into it's maximum position intake valve should be pressed open at maximum 1,0 mm (0,04").

This has to be checked after setting of valve clearance. If not correct adjust by means of the two nuts on push-rod.

V-twin engines:

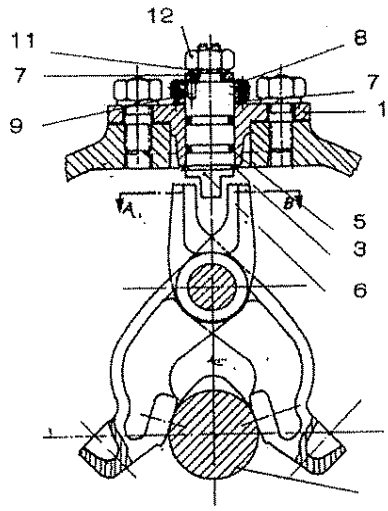


Fig. 45

Decompressor works on intake valves of both cylinders with P and S engines.(Decompressor shaft of R-engines actuates exhaust valves.)A cam (6) actuated through lever (10) pushes the cam followers apart thus decompressing both intake valves.
When assembling it should be checked first if decompression on both intake valves is exactly the same. Loosen holding-down nuts, pull decompression lever a little bit until firm contact with camfollowers can be felt. Thus, the complete device will centre itself automatically. Hold lever in this position and tighten holding down nuts.
Now the correct decompression stroke can be adjusted.
Loosen lock nut and bolt (2) limiting the way on decompression lever(10). Adjust stroke of both intake valves to 1 mm maximum when operating decompression lever (10). Fasten lock nut, fit rocker arm covers.

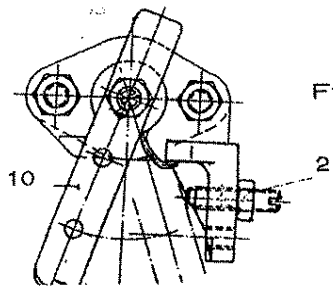


Fig. 46

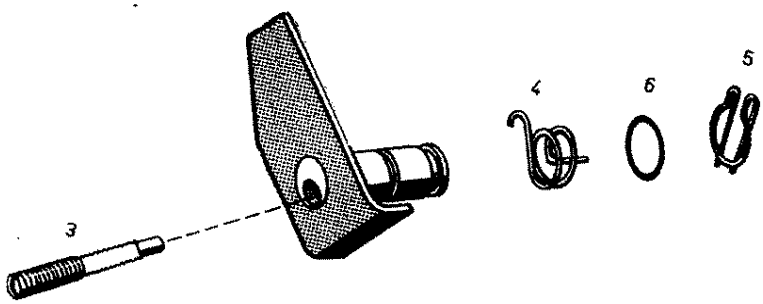


Fig. 47

EXCESS STARTING FUEL LEVER

The camshaft bearing flange holds the starting fuel device.

Threaded pin (3) located in taper bore in lever axle limits the travel of the fuel pump rack.
Pin (3) is set on FARYMANN test bed according to the required output of the engine so that exhaust does not smoke under continuous full load.

Pin setting is secured by spring (5) and should not be touched with normal engine repair.

Spring (4) holds lever in its normal (downward, rack travel limited) position. When starting the engine with the help of this starting device, lever (2) is lifted and with it, pin (3) permitting the pump rack to travel to its maximum position.
When operator releases lever (2) pin comes to rest on pump rack and lever (2) stays in a slightly upward position.
After the engine has started and reached first time a speed which is approx. 40-50 RPM above its set (full) speed, the governor automatically permits the pump rack to be pulled back beyond the "limited" full load position allowing pin (3) and lever (2) to be drawn back into initital position by spring(4).

V-twin Engines:

The excess starting fuel device is incorporated into the BOSCH fuel injection pump and can be operated through a push-button on the pump itself.

K 5 Series:

Excess starting fuel device in form of small plunger fitted to the crankcase below the injection pump. Pull down for starting. It operates exactly like the device described above.

INJECTION PUMP MODELS (ROBERT BOSCH)

1) SERIES K50

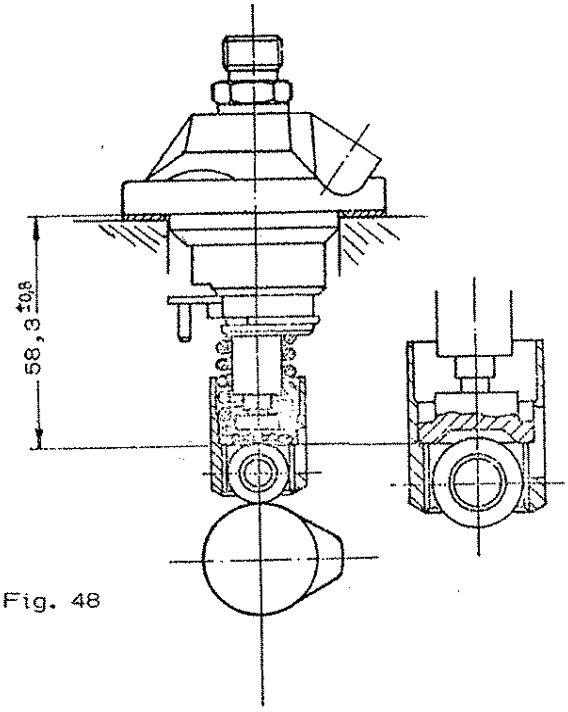


Fig. 48

Engines Series K5 / K 6 are equipped with the new 1 Q... injection pump. The roller tappet, normally being part of an injection pump is fitted separately into the crankcase. Therefore pump's fitting dimension has not to be checked between cam base circle and mounting flange (see page 45) but between the latter and the small rim, not the roller, inside the roller tappet upon which the pump plunger rests.

Fitting dimension: 58,3 ± 0.8 mm

The large tolerance requires special shims, see table page 46.

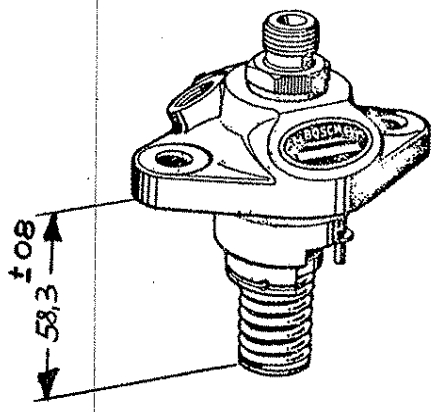


Fig. 49

2) SINGLE CYLINDER ENGINES (K14, L and A Range)

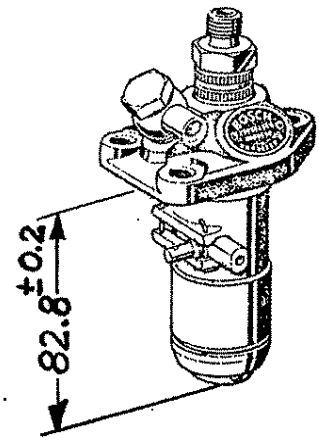
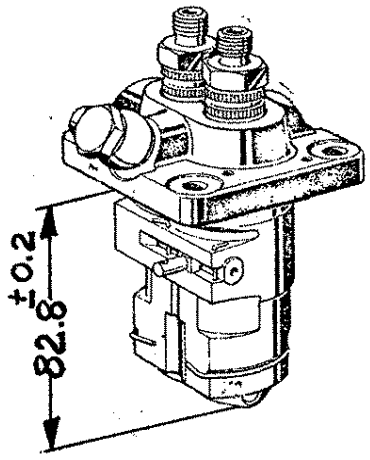


Fig. 50

Injection pump model 1 KA.... with roller tappet incorporated. To check fitting dimensions see page 45 – Fig. 53. Available shims as per table page 46.

INJECTION PUMP MODELS (Cont'd)

3) V-TWIN ENGINES



Injection pump model 2 KA ..... with roller tappets incorporated. When dismantling or refitting pump check that pump rack is centred and excess starting fuel button is pressed down. Fitting dimensions same as above.

Fig. 51

INJECTION PUMP

The pump must be introduced with the pump rack centred; with the V-twin engines the excess starting fuel button has to be pressed down to achieve this.

With single cylinder engines lift the starting fuel lever if necessary and turn the pump slightly. Fig. 54

After tightening cap screws (see torque chart) the ball joint of the small link lever (Fig. 4) can be connected to the pump rack. It must positively lock home.

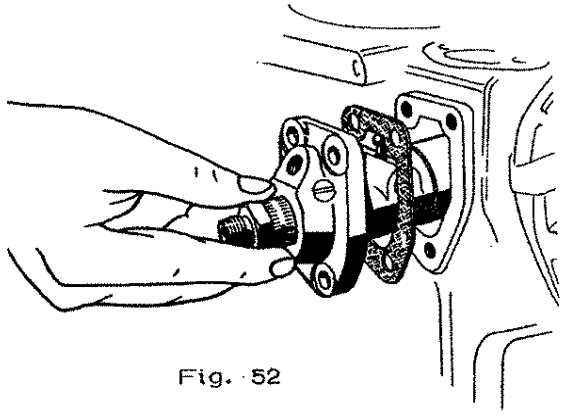


Fig. 52

Before introducing pump, put acceleration lever into max. position. Check that pump rack can freely travel to and fro.

ALL INJECTION PUMPS

are fitted with control edge on upper end of plunger, which consequently asks for injection timing END of delivery.

INJECTION PUMP TIMING

SHIMS

A figure punched into the crankcase near the injection pump, mounting flange gives the number of shims initially fitted. This figure indicates also the thickness in 1/10 of a mm, e.g. 9 = 9/10 mm.

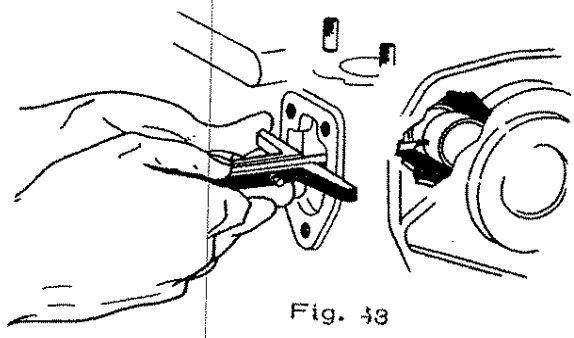


Fig. 53

A tolerance is specified for each fuel pump's fitting dimension. This dimension – distance from pump's mounting flange to lower edge of plunger roller – is punched on the name plate of the injection pump, e.g. pump PFR 1 K .. 82,8 mm ± 0,2. If the spill cut-off has to be modified always check that you stay within the given tolerance. A depth-gauge should be used to check the distance from the mounting flange on the crankcase to the cam base circle. Fig.53. Watch that depth-gauge definitely touches camshaft on opposite side of cam.
This distance indicates how many shims can still be fitted (retarding of spill cut-off = retarding of injection) or removed (advancing of spill cut-off = advancing of injection).

All timing is checked on flywheel rim, i.e. distance between TDC mark on crankcase and TDC mark on flywheel rim.

INJECTION PUMP TIMING (Cont'd)

Determination of Shims

(In case the complete injection pump is to be replaced)

Example: A 10 engine flywheel dia.: 310 mm
rated speed : 2800 RPM
spill cut-off : 25–35 mm

Example:

		1	2	3
Existing thickness of total shims (Figure punched into crankcase)	(1/10 mm)	6	4	6
Spill cut-off measured	(mm)	12	40	45
Spill cut-off value (data chart)	(mm)	25 – 35		
Timing too late / early		late	early	early
Shims to be removed	(1/10 mm)	4		
added	(1/10 mm)		2	2
Distance flange-base circle	(Fig. 36)	82,4	82,4	82,4
Corrected shims	(1/10 mm)	2	6	8
TOTAL DISTANCE	(mm)	82,6	83,0	83,2
Dimension on new pump	(mm)	82,8 ± 0,2		
Within tolerance of pump		yes	yes	no
New distance on flywheel (approx.) (Chart Fig.54)	(mm)	17 + 12 = 29	40 – 8 = 32	--

Example No. 3:

As the tolerance of the new pump only allows adding or removing of 2 shims (+ 0,2 mm) correct timing on example No. 3 cannot be achieved through this method.

It indicates, however, that when reassembling:

- either the pinion gear on crankshaft was not fitted correctly (see Fig. 15 and 17);
- or when fitting the camshaft the correct mesh of the timing gear was not observed.

Available Shims:

Engine Range	Series K50		K / L / A	G	R / P / S
Shim Material	Plastic	Metal	Plastic	Metal	Metal
Available Thickness	0.2/0.4	1.0	0.2/0.5	0.2/0.3/ 0.4/0.8	0.2/0.3/ 0.5
Marking on Shim	non	non	non	non	II / III / V

Standard timing values given in chart are based on standard flywheel diameter. If engine is equipped with special flywheel chart no. 54 helps to convert.

2 shims (0,2 mm) are equivalent to 7 mm on 250 mm dia flywheel
but 13 mm on 480 mm dia flywheel
This example is represented through dotted line in chart 54.

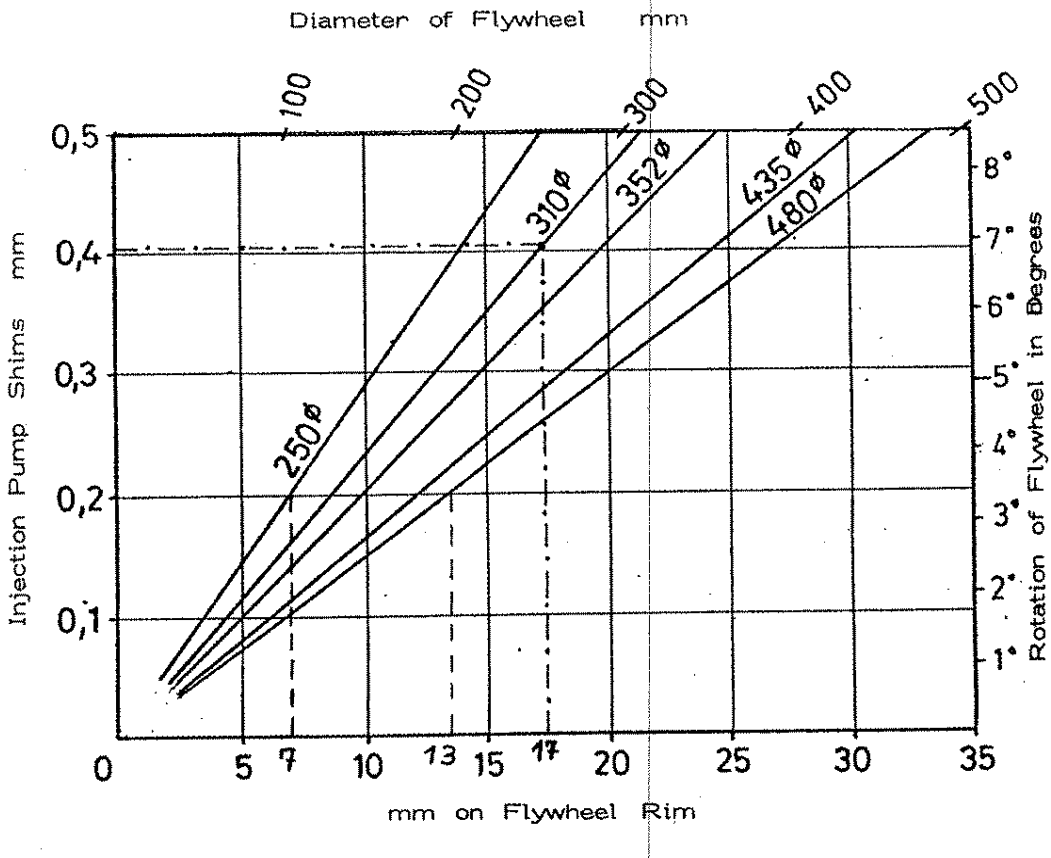
Note:

Chart 54

mm on flywheel rim do not show the true timing values but indicate only variation of timing value per shim underneath injection pump.

Curves do represent the most common flywheel diameters. On right side flywheel rotation is indicated in angle degrees e.g.: 3 shims (0,3 mm) under injection pump will retard spill cut-off about 5,2°. In contrary to mm measured on flywheel rim these angle degrees have no function of flywheel diameter.

Fig. 54



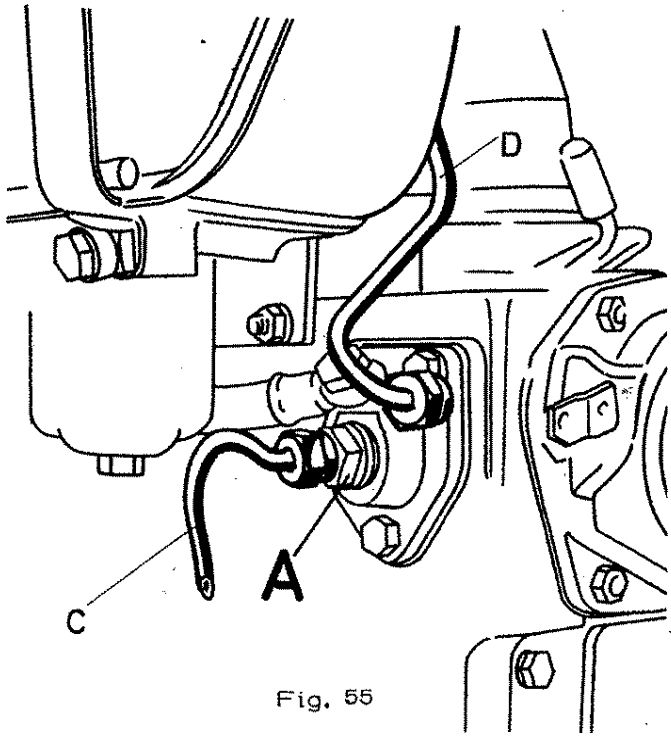


Fig. 55

INJECTION TIMING

First the delivery valve (B) has to be taken out in dismantling the delivery valve holder (A) from the injection pump. Overflow pipe (C) should then be fitted to the injection pump in place of the normal pressure line (D) as indicated in Fig. 55.

With the current line of FARYMANN engines the spill cut-off at the end of delivery indicates the exact timing. The respective tables therefore give the distance of the TDC mark on the rim of the standard flywheel from the TDC mark on the flywheel housing. Tables give outside dia. of standard flywheel as well as 2 figures indicating 2 distances before TDC inside which the spill cut-off (end of delivery) should occur.

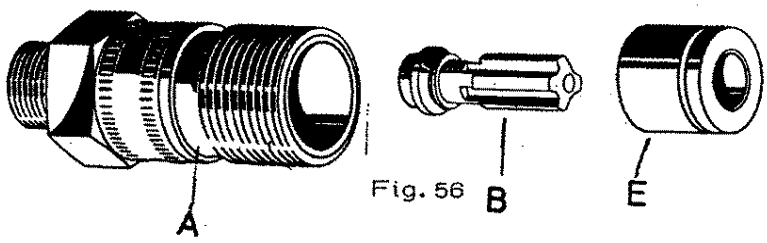


Fig. 56

As a general rule: - the faster the engine runs, the earlier the injection begins, the earlier the injection ends (end of delivery) - the bigger is the distance from TDC mark on flywheel at spill cut-off to TDC mark on flywheel housing.

As a general rule it can be said that the range of tolerance for the spill cut-off is 5 mm on single cylinder engines and 10 mm on 2-cylinder (V-twin) engines.

ENGINE SPEED GOVERNING SYSTEM

The following diagram illustrates the mode of operation of the governor system, which is identical with all Farymann engines, single cylinder as well as V-twin's.

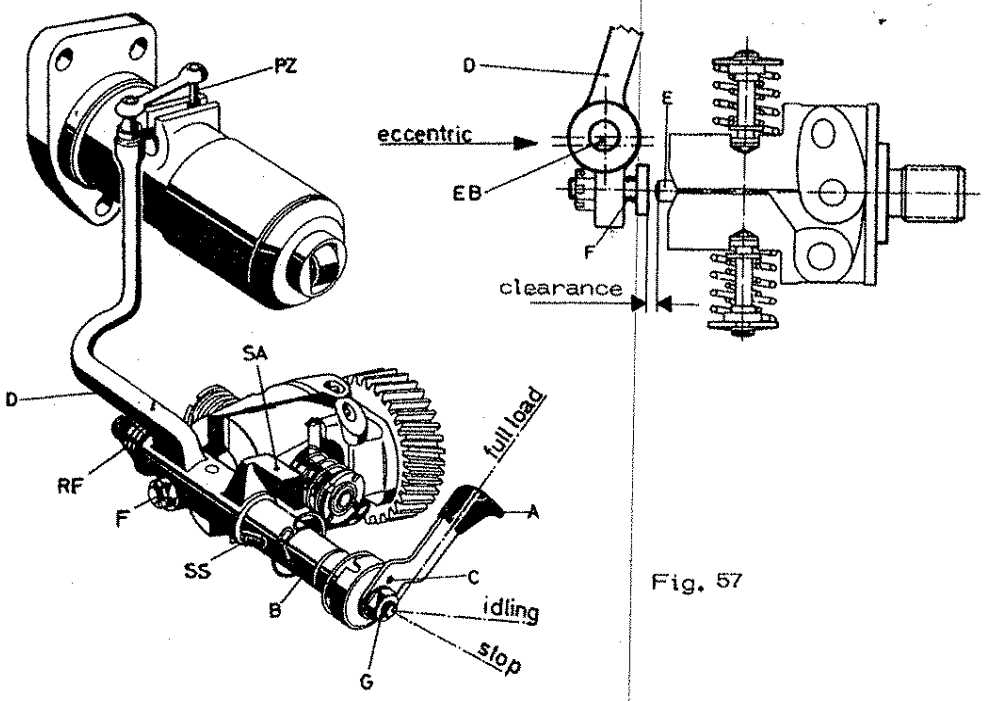


Fig. 57

The coil spring (RF) by means of governor lever (D) pulls constantly injection pump-rack (PZ) towards the full-load position.

Depending on speed or load requirement this movement is governed by both, the acceleration lever (A) and the governor, i.e. the governor pin (E).

Governor lever (D) pivots on excentric extension (EB) of shaft (B). When acceleration lever (A) is put into "full-load" position, the excentric extension of shaft (B) swings governor lever (D) away from the governor, thus allowing coil spring (RF) to pull (via upper part of governor lever (D) the pump rack (PZ) toward full load position. This pivoting of lever (D) is than limited by the tappet bolt (F) contacting the governor pin (E).

Pressuming this to be "high idling" and only now load is put on the engine, the engine speed will drop, the governor pin will be pushed back by the recoil spring (RF) pivoting the governor lever and pump rack more to the full-load position.

The engine (with the higher amount of fuel injected) will instantly compensate the loss of speed and the governor (with its predetermined top speed) will once again limit the pivoting of lever (D) via its governor pin (E).

For this combined effect a clearance between the governor pin and the tappet bolt is essential.

THE GOVERNOR

is set to its rated speed on the test bench. Mechanical damage is extremely uncommon so that repairs to the governor will not be necessary, quite apart from the fact that the governor cannot be repaired simply by changing individual components.

The illustration below shows that it is a simple centrifugal governor with governing springs, which are carefully set under an initial load during tests on test bed.

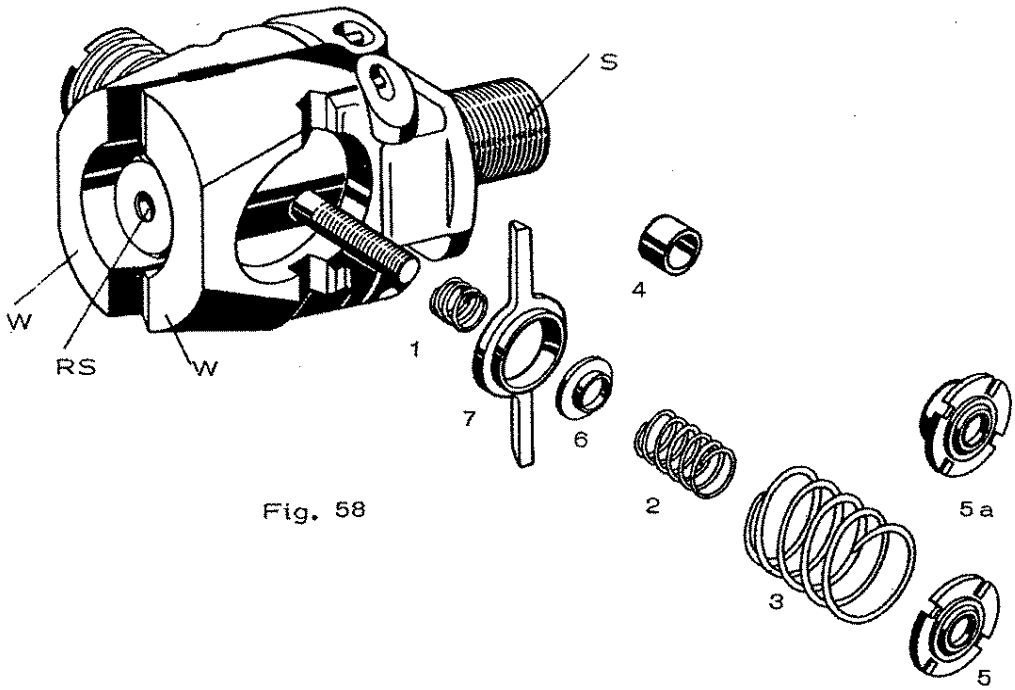


Fig. 58

The main shaft (S) with a left hand thread on its end by which it is fastened to the crankshaft, holds the two flyweights and in a central bore (RS) the governor pin.
The flyweights are held together by identical sets of springs which consist of:

1. Spring governing the intermittent speed range, i.e. between idling and full load.

THE GOVERNOR (Cont'd)

2. Full load spring.
3. Idling spring.
4. A spacer which replaces the spring (1) if no intermittent governing is required, i.e. generator service.
5. Cross-slotted nut holding spring-sets to shaft.

5 a. Used with engines for professional fishing requiring good governor at low speed. Nut has collar which compresses full load spring (2) more.

BASIC GOVERNOR SETTING

Put acceleration lever (A) outside of engine into full load position. With help of a spanner or screw drive separate the two flyweights of the governor completely, force them apart as much as possible. (Watch out to keep clear of governor lever!)

This will make the governor pin (E) protrude to its maximum, pushing via tappet bolt (F) governor lever (D) and eventually pump rack (PZ) into the "stop" position (no fuel injected).

In this position there should be almost no (or maximum 0,1 mm - 0,004 in.) clearance between tappet bolt (F) and governor pin (E). If necessary set clearance by adjusting tappet bolt (F). Retighten its locknut.

GOVERNOR PIN CLEARANCE

The position of the eccentric shaft (B) in relation to the acceleration lever (A) is determined by means of a pin (C).

Set the acceleration lever to the low speed position. In this position separate the centrifugal weights of the governor beyond the idle spring tension. It will be easy to feel when the pressure point of the full load springs is reached. If the acceleration lever is now moved, the clearance should be maximum 1 mm between the governor pin (E) and the tappet bolt (F). This clearance can be adjusted by releasing or tightening the tappet bold (F).

Governor Pin Clearance (Cont'd)

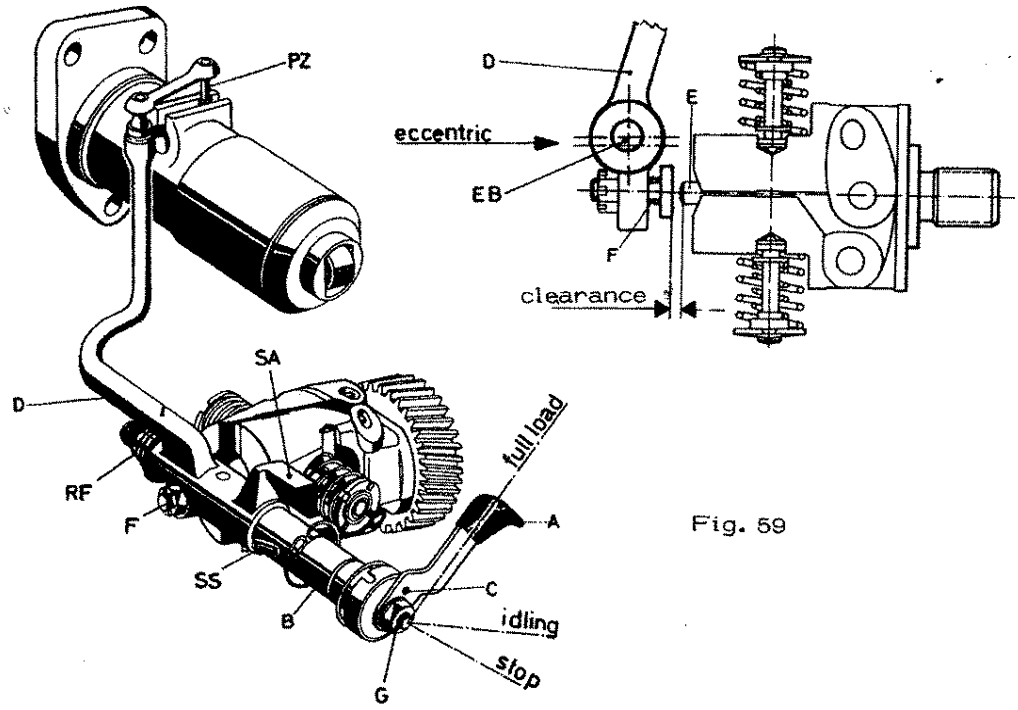


Fig. 59

SPEED OR GOVERNOR ADJUSTMENT

The adjustment must always be set on the test bench. Any unskilled correction may not only impair running, but may also result in serious damage, e.g. racing of the engine. Intervention is therefore only recommended when it is absolutely essential, e.g. when new components are fitted.

Engine speed adjustment is possible in a range of about 50 RPM by altering the pretension of the governor springs through a few turns in either direction of the cross-slotted nuts.

To increase speed : tighten the cross-slotted nuts

To reduce speed: slacken the cross-slotted nuts

Speed Governor Adjustment (Cont'd)

For larger speed variations, the governor springs, according to chart on page 55, must be changed.

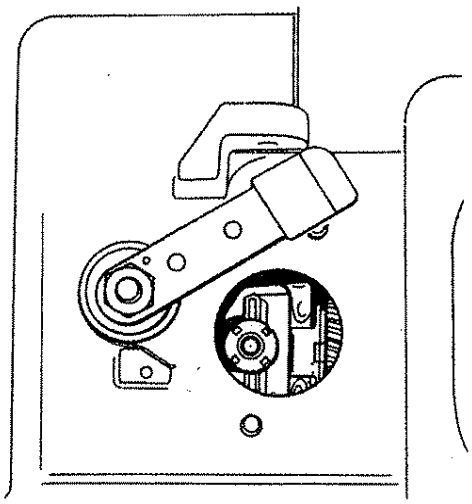


Fig. 60

For this purpose the oval cover located at the side on the crankcase behind the acceleration lever (see Fig. 60) must be removed. After rotating the flywheel to the correct governor position, carefully remove the cross-slotted nut through the exposed opening. Remove the full load spring and fit one of the springs, which will now be needed. Refit the cross-slotted nut. Turn the flywheel further until the cross-slotted nut on the opposite side of the governor is exposed, and proceed as above.

Every speed correction must be checked with a tachometer (revolution counter).

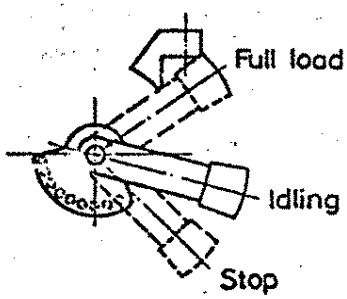
Cross slotted nuts are fitted with a plastic stop device and need not to be secured additionally in their relevant position.

If ever set of springs is exchanged, always fit new cross-slotted nut.

ENGINE SPEED REGULATION

Regulations available with FARYMANN engines. Initial position of acceleration lever, drawn in full line, achieved through different torsion springs fitted between lever and crankcase.

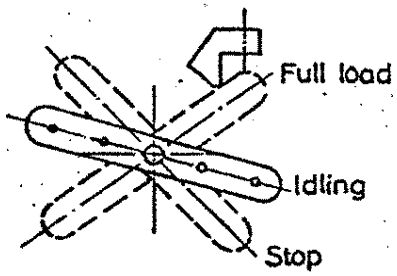
Possibilities do not interfere with internal governor system being identical with all Farymann engines.



VARIABLE SPEED REGULATION
Code No. 099.022.024.6

Lever remains in any position between idling and full load (full speed) due to ratchet plate. To stop engine, lever has to be pushed down and held in stop-position until complete engine halt and returns to idling when released.

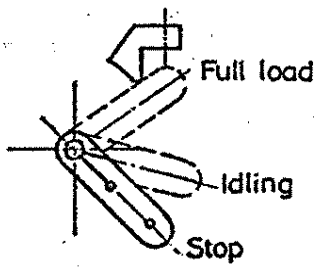
Torsion spring:
Single cyl. engines: 099.807.040.4
V-twin engines: 099.807.026.4



VARIABLE SPEED REGULATION
(Remote Control)
Code No. 099.022.025.6

Same as above, but to reduce friction when remotely controlled ratchet has been omitted. Remote control through "Push + Pull" cable only, as stop operation demands push action.

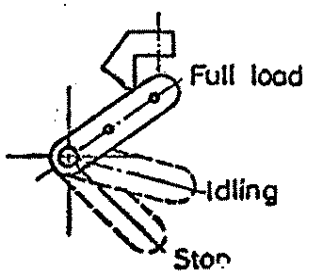
Torsion spring: 099.807.004.4



VARIABLE SPEED REGULATION
(Vehicle application)
Code No. 099.022.026.6

Remote control through simple "Pull" cable possible. Lever returns always back to stop position. Hand lever on bowden cable should be equipped with ratchet to prevent gliding accidentally into stop position when moving from full speed to idling.

Torsion spring: 099.807.003.4



FULL SPEED - FULL LOAD REG.
Code No. 099.022.027.6

Lever always returns to full load - full speed position. Applied for constant speed loads such as generating sets etc. Remote control through simple "pull-to-stop" cable. Release after engine halt to allow accel. lever to travel back into full speed position.

Torsion spring:
Single cyl. engines: 099.807.026.4
V-twin engines: 099.807.036.4

ACCELERATION LEVER

Dismantling and fitting.

Lever is positioned on excentric shaft (E) by means of index pin (26). Coil spring (11) rests on boss (2) on engine crankcase with vehicle application or on boss (3) with variable, full-speed and marine application.

Boss (2) serves as well as full-speed limit for acceleration lever.

Other end of coil spring is hooked to recess (N) of ratchet plate or cup spring respectively. Recess (A) in central bore of ratchet plate or cup spring allows for adjustment of ratchet (pin (33) should properly rest in ratchet, i.e. at idling etc.) or tensioning of torsion spring, without interfering with index pin (26). Ratchet pin (33) is located with its spring (19) in bore (5) of boss (3).

Attention: It is of utmost importance to securely hold acceleration lever (16) to counteract tightening torque of nut (30) when fitting as otherwise internal levers will break!

Resting of acceleration lever against boss (2) determines engine top speed. If acceleration lever supplied is not convenient we highly recommend to either order correct lever from factory or fit your own on to the original.

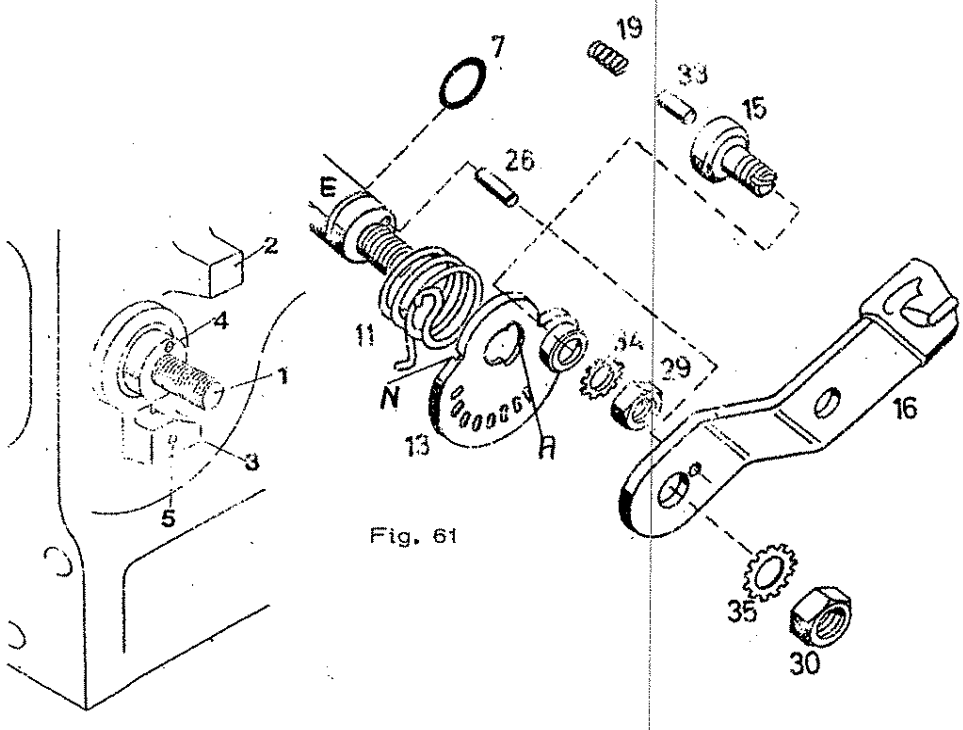


Fig. 61

ADJUST IDLING SPEED

(Numbers refer to Fig. preceding page.)

In order to allow snap-pin (33) to rest properly in a notch at idling speed, excentric notch in head of screw (15) can be adjusted as shown in Fig. Screw (15) is tightened to ratchet plate by nut (29) and lockwasher (34).

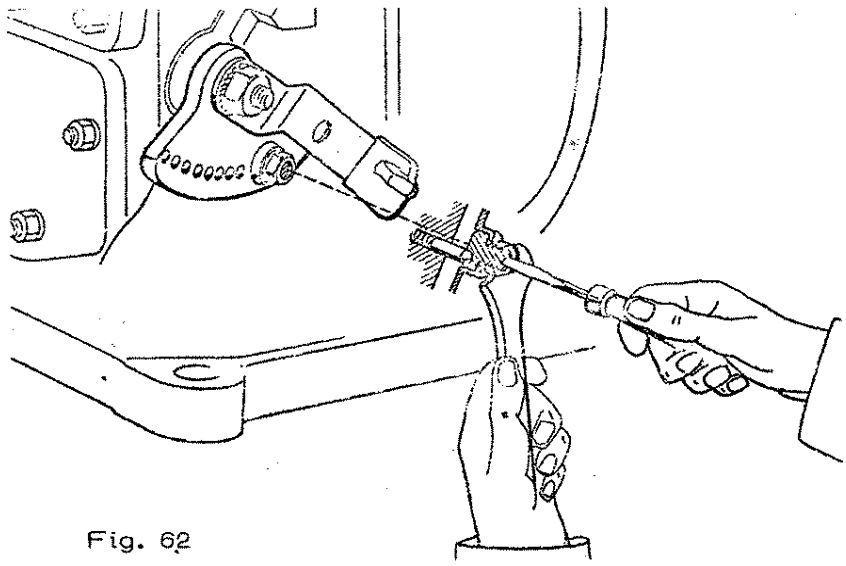


Fig. 62

CONVERSION OF ENGINE SPEED REGULATION

1) Conversion: "VARIABLE" → "VEHICLE APPLIC."

Parts being exchanged against →

Fig. No.	Designation	Engine Model	Drawing Parts No.	Fig. No.	Designation	Drawing Parts No.
1	Torsion spring	Single cyl. engines	099.807.035.4	13	Torsion spring	099.807.003.4
		V-twin eng.	099.807.026.4			
2	Ratchet plate	All engines	099.920.004.4	14	Spring cup	099.920.003.4
3	Acceleration lever	Single cyl. vertical	099.905.086.4	15	Acceleration lever	099.905.001.4
		Single cyl. horizontal	099.905.032.4			
		V-twin eng.	099.905.068.4			099.905.002.4
4	Screw	All engines	099.507.004.4		Obsolete	
5	Hex.-nut		M 6 DIN 934-6			
6	Toothed washer		A 6,4 DIN 6798			
7	Pin	Single cyl.	3x13,8 DIN 5402			
		V-twins	3x16,4 DIN 5402			
8	Coil spring	All engines	099.805.011.4			
9	Lever	Single cyl. horizontal (not shown)	264.413.029.4			
10	Bracket		264.655.056.4			
11	Grommet		264.861.004.4			
12	Clip		5 SXN 04L 0248.22.0.054			
		All engines		16	Hollow screw	0404.22.4.020
				17	Hex.-nut	M 8 DIN 934-6
				18	Cable clamp	0470.22.5.806

Fig. 63

"VARIABLE"

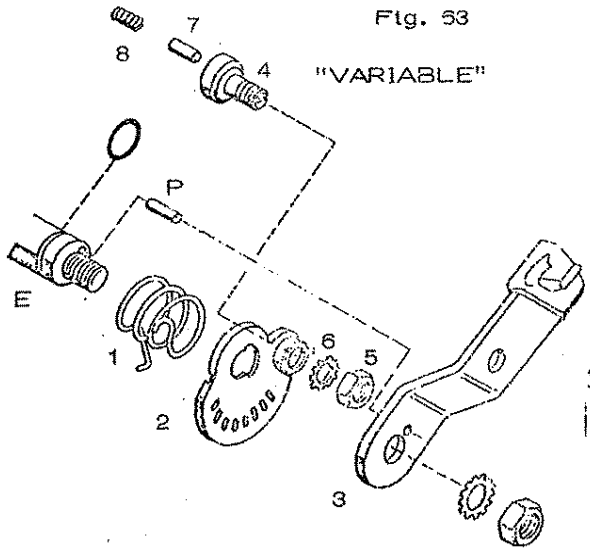
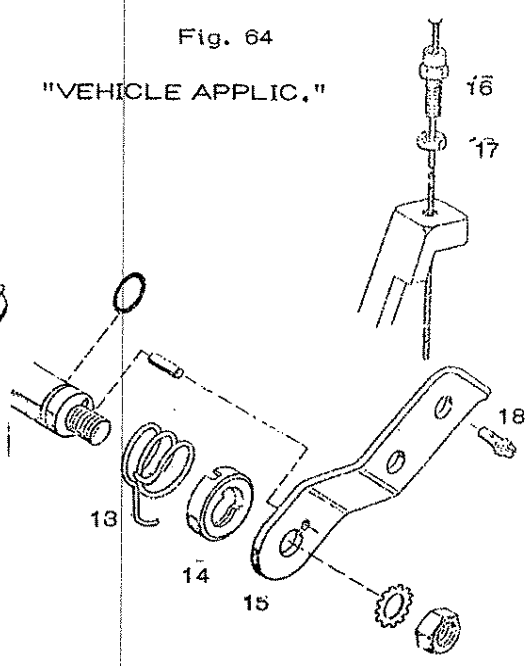


Fig. 64

"VEHICLE APPLIC."



CONVERSION OF ENGINE SPEED REGULATION

2) Conversion "VARIABLE" → "FULL SPEED" (Gen.-set)

Parts being exchanged against →

Fig. No.	Designation	Engine Model	Drawing Parts No.	Fig. No.	Designation	Drawing Parts No.
1	Torsion spring	V-twin eng.	088.807.026.4	20	Torsion spring	099.807.036.4
2	Ratchet plate	All engines	099.920.004.4	14	Spring cup	099.920.003.4
2-12	See # I conversion table preceding page				Obsolete	
1 *	Spring (intermitt. speed)	All engines		4	Bush	
1 * 2 * 3 *	Springs complete set	A-Range standard genarator 1200 393 00		2 3	Springs (gen.-set), existing options: 1500 RPM 1800 " 2500 " 3000 "	
5a *	Slotted nut with collar	Marine governor L30,A30, A40		5	Slotted nut	
1 * 2 * 3 *	Springs complete set	R-Range standard governor 1200 397 00		2 3	Springs (gen.-set), existing options: 1500 RPM 1800 "	
	Governor complete	P,S Range standard governor			Governor complete, existing options: 2500 RPM 3000 "	

* These figures refer to Fig. 58, page 43

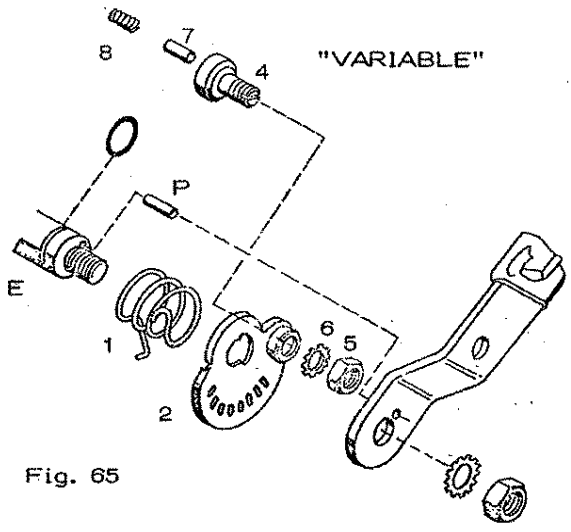


Fig. 65

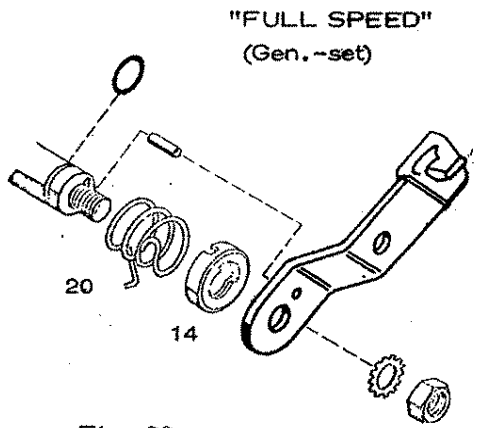


Fig. 66

CONVERSION OF ENGINE SPEED REGULATION

3) Conversion: "VARIABLE" → "MARINE"

Parts being exchanged against →

Fig. No.	Designation	Engine Model	Drawing Parts No.	Fig. No.	Designation	Drawing Parts No.
3	Acceleration lever	K30,L30,A30	099.905.086.4	21	Acceleration lever	099.905.032.4
		A 40	099.905.032.4			164.905.060.4
		R30,P30,S30	099.905.088.4			099.905.094.4
-	Governor springs complete set	K30, A40 R30,P30,S30	--	-	Governor springs complete set (marine gov.)	--

Fig. 67

"VARIABLE"

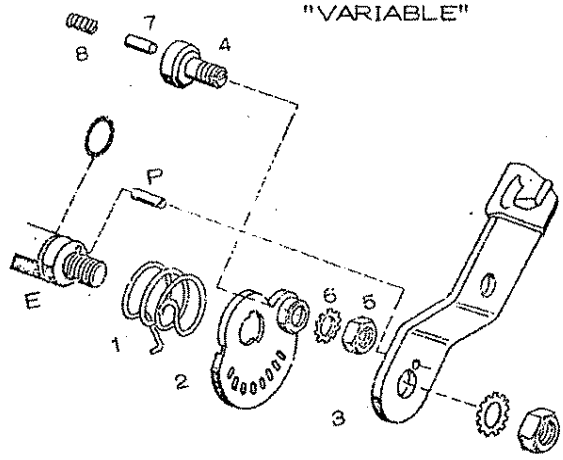
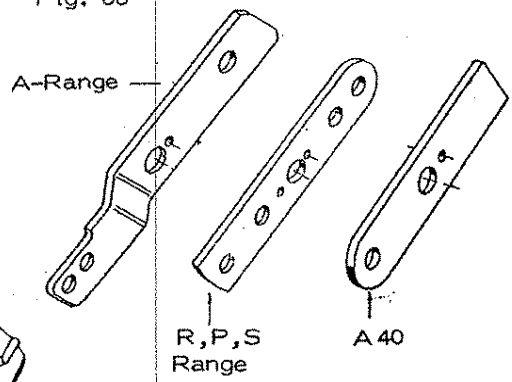


Fig. 68

"MARINE" (21)



GOVERNOR SPRINGS

Optional sets of springs to be exchanged against original sets.
Sets of governor springs are coded with drawing number of respective governor diagram.
When modifying engine speed, see chart below if camshaft and/or injection pump have to be exchanged at the same time.
Engine speeds given are mean values only.

Example: Series K5/K6 - springs for 2500 RPM (D 5424) can be set to any speed between 2450 and 2550 RPM.

Engines	Series K5 / K6						Governor No. 12 00 401 02	
Rev./min.	1500	1800	2000	2300	2500	2850	3000	3600
Variable speed	D 5300	D 5098	D 5099	D 5423	D 5424		D 5425	D 5412
Gen.-set						D 5203	D 5042	D 5191
Camshaft K 34	721.077.4							
Camshaft K 54	721.089.4	721.074.4						
Camshaft K 55	721.069.4	721.075.4						
Injection Pump K34/54/55	PFE 1 Q 65/30							
Injection Pump K64	PFE 1 Q 65 / 30							

Engines	L 14, L 20, L 28								Governor Model No. 12 00 306 03		
Rev./min.	1000	1400	1500	1800	2000	2200	2300	2400	2500	2800	3000
Variable speed	D 4156	D 4292	D 4550	D 4174	D 4157	D 4175	D 4177	D 4178	D 4158	D 4179	D 4159
Gen.-set			D 4699	D 4700	D 5138				D 5255		D 4293
Injection pump	PFR 1 K 55 A 265 / 11 Without L 28									1 K 65 A 331 / 11	
Camshaft L 14	721.067.4					721.036.4					
Camshaft L 20,28	721.043.4										

Engines	L 30, A-Range	Gover Model No. 12 00 393 00 (12 00 306 03 Gen.-set)											
Rev./min.	1000	1500	1700	1800	2000	2100	2200	2300	2400	2500	2700	2800	3000
Variable speed	D 4623	D 4624	D 4625	D 4626	D 5223		D 4998	D 4631	D 5204	D 5205		D 5232	D 532
Gen.-set		D 4699		D 4700	D 5136					D 5255			D429
Injection Pump A-Range	PFR 1 K 55 A 265 / 11									PFR 1 K 65 A 331 / 11			
Injection Pump L30	PFR 1 K 55 A 265 / 11												1K65A331/1
Camshaft A10-14,30	721.029.4					721.009.4							
Camshaft A20-24,40	721.030.4					721.010.4							
Camshaft L30	721.067.4												

Engines	R-Range - Governor No. 12 00 397 00					S-Range - Governor No. 12 00 400 00			
Rev./min.	1500	1800	2000	2200	2300	2400	2500	2800	3000
Variable speed	D 4064	D 4065	D 4981	D 4994	D 4519		D 4927	D 4088	D 4613
Gen.-set	D 4306	D 4498	D 4337	D 4405	D 4496		D 4763		D 4723
Injection Pump R-Range	PFR 2 K 65 A 405 / 11								
Injection Pump S-Range	PFR 2 K 70 A 405 / 11								
Camshaft R-Range	530.017.4								
Camshaft S-Range	530.016.4					530.011.4			

CIRC.NO. 55 b

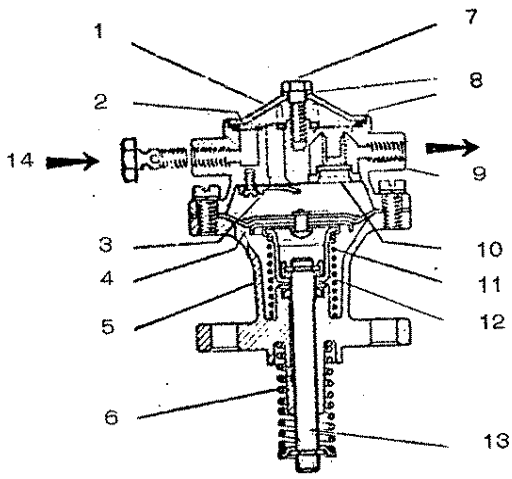
Düsen
Düsenhalter

Nozzles
Nozzle Holders

Injecteurs
Porte Injecteurs

Motor Type Engine Type Type Moteur	Düse Nozzle Injecteur			Düsenhalter komplett Nozzle Holder complete Porte Injecteur complet			Abspritzdruck WKG. Pressure Press.d'inject.
	BOSCH Bezeichnung Designation	BOSCH No.	Farymann No.	BOSCH Bezeichnung	BOSCH No.	Farymann No.	bar
K 54 / 64 L30,L28,L38	DLLA 150 P 11	0433.171.012	537.208.2	KBEL 53 PZ/13	0432.191.878	.537.004.1	196
L14/L20 A10,12,14 A20,22,24 A30/A40 A32/A42 R10/R12 R30/R32 S10/S30	DLLA 150 S 422	0433.271.184	537.204.2	KBEL95 S10/13	0432.291.757	537.008.1	172

MECHANICAL FUEL TRANSFER PUMP



The pump, fitted with a screen in the inlet banjo bolt (14), is equipped in addition with a fuel strainer (2). Both should be checked and possibly cleaned about every 60 hours.

After cleaning outside of pump and dismounting of cover (1) lift out joint (8) and plastic strainer (2). Wash strainer in clean fuel and put it back with pins on strainer turned upwards. After fitting of cover (1) bleed fuel lines.

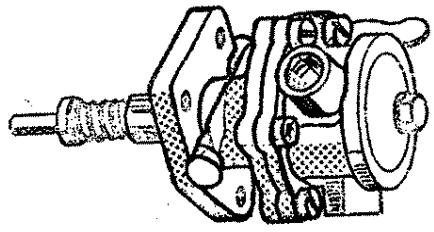
When refitting banjo bolts always use new copper washers.

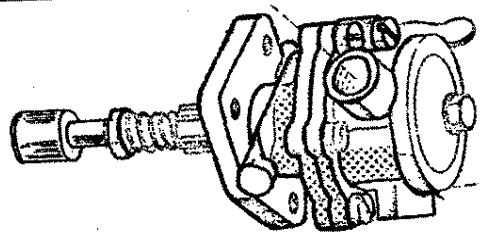
1 Cover
2 Fuel strainer
3 Intake valve
4 Diaphragm
5 Pumpbody
6 Spring (plunger)
7 Screw
8 Gasket
9 Headcasting
10 Exit valve
11 Spring (diaphragm)
12 Retainer
13 Plunger
14 Banjo bolt with screen

Fitting of pump:

Whilst the basic pump is identical with all Farymann engines the plunger length (fitting dimensions) is different:

Engine Range	K/L/A/R	P/S
Pump Model	0526.15.0.667	0.526.15.1.667
Distance flange to cam-base-circle mm	$61 + 0.5$	$71{,}25 \pm 0.5$





Plunger length should be approx. 1 mm longer, i.e. pump fitted with plunger 1 mm compressed.
Plastic shims available with 0.5 and 0.35 mm thickness. Be careful when tightening pump flange (light alloy casting), check before it seats absolutely flush.

COOLING WATER CIRCUIT

SINGLE CYLINDER ENGINES

Water coming up from circulating pump flows into cylinder water jacket (1), passes thru Transfer-tubes (5), Figure 71.
into cylinder head (2). Passing thru thermostat cooling water from head and by-pass (4) is injected into watercooled ex-haust elbow (3).

To ensure mainflow of cooling water enters water jacket and head, by-pass (4) is fitted with throttle.

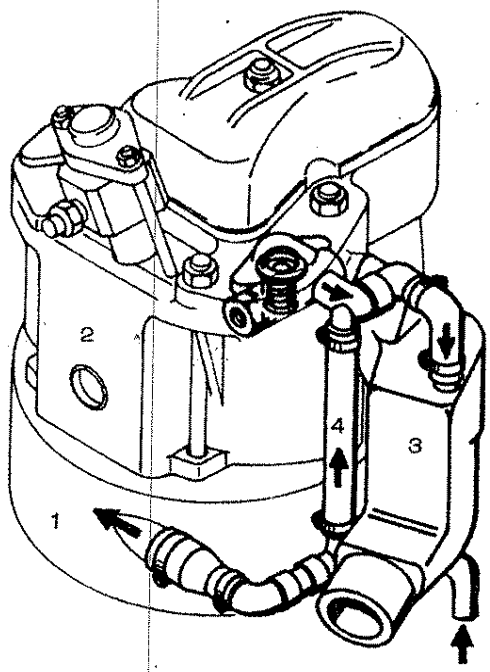


Fig.69

2-CYLINDER ENGINES

Circuit basically as above with the exception that cooling water from both cylinder heads (1) (2) and by-pass (3) enter water cooled exhaust manifold (4) before entering water cooled exhaust elbow (6) via water line (5).

Attention: Both cylinder heads are fitted with one thermostat each (7 + 8) which serve more as a throttle to assure in combination with throttle in by-pass line an even distribution of cooling water to both cylinders.

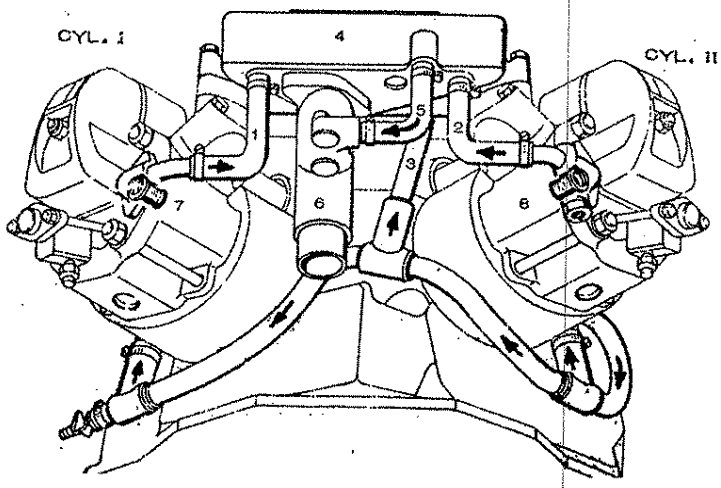


Fig. 70

WATER JACKET

Consist of glass fibre reinforced plastic, withstanding any freeze-up and corrosion.

When fitting proceed as follows:

Keep plastic water jacket in hot water for about 5 minutes to reduce its brittleness for the fitting operation.

- Make sure grooves (2.2) of o-rings and inside of water jacket (3) are absolutely clean.
- Fit o-rings into grooves.
- Cover both o-rings and inside of water jacket (3) slightly with grease or oil.
- Push water jacket carefully onto cylinder. From bottom end of cylinder with engines K30, L30, A30, R30 and P30; from upper end with engine S30. If too tight to push with hands use press or apply careful light blows with rubber mallet.
- Fit circlip (4) into its groove (4.4)

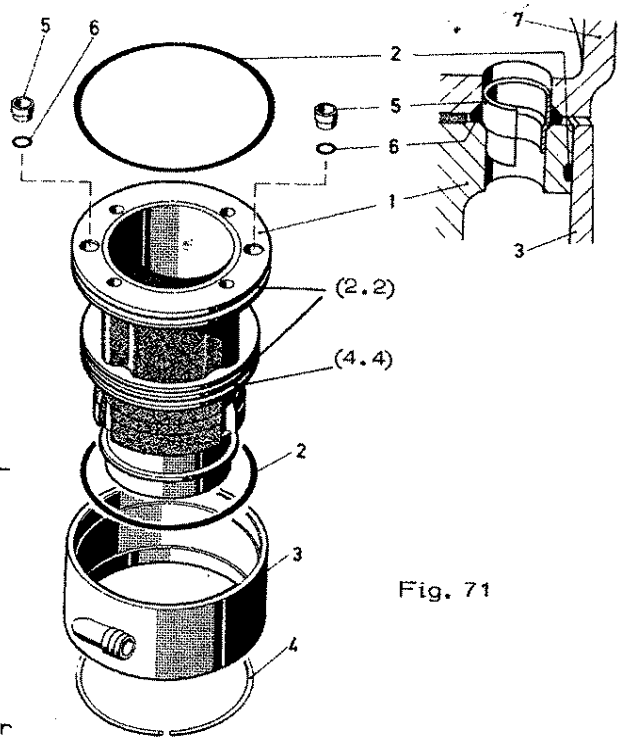


Fig. 71

- If possible apply up to 10 atm water pressure to check for tightness.

WATER TRANSFER TUBES (5) - Fig. 71

Cooling water is transferred from cylinder into cylinder head by two water transfer tubes (5).
When assembling proceed as follows:

- Fit tubes into bores on upper rim of liner (1).
- Fit rubber o-ring (6) over tube and position cylinder head gasket.
- Present cylinder head (7) and check that transfer tubes slide properly into their respective bore in cylinder head.

THERMOSTAT

Are set to open at 55° C (120° F) to avoid desposit of salt and minerals with the direct seawater cooling system. Thermostat fits into cylinder head and is centered in a small reset and held in position by gasket (1) and cover (2). A small bore in its flange permits water to pass whilst engine is cold and thermostat closed. To prevent bore being clogged by deposits a small cotter pin (S) is fitted in bore. Moving in the flow of water, it keeps the passage free. When fitting thermostat check that

- it enters cylinder head freely
- it is centered
- that cotter pin can move freely

Fig. 72.1 and 72.2 show thermostat in closed position;
Fig. 72.3 in full open position.

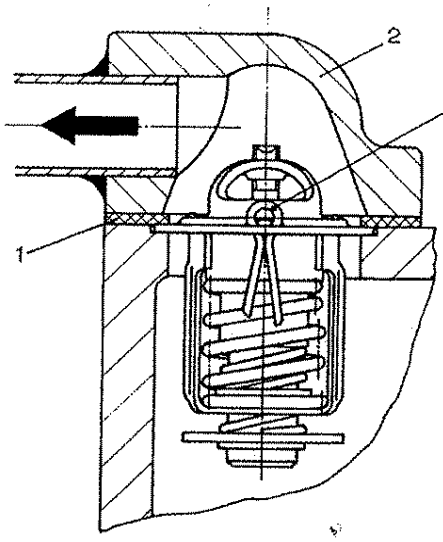


Fig. 72.1

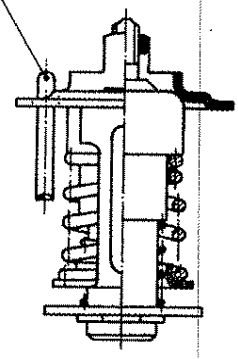


Fig. 72.2

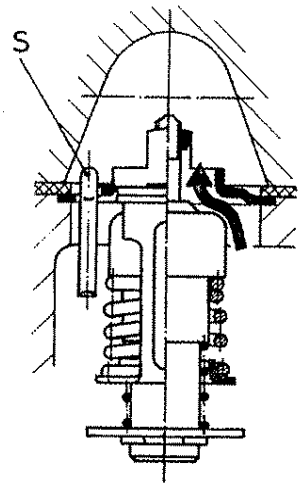


Fig. 72.3

If thermostat fails and no replacement is available immediately, operation of engine can be continued without thermostat. However by-pass line must be shut down.

- Single cylinder engines: see no. 4 in Fig. 69.
- Twin cylinder engines: see no. 3 in Fig. 70.

To shut down remove from exhaust manifold and plug manifold union as well as end of by-pass line.

LUBE-OIL CIRCUIT

2-Cyl. Engines aircooled

Lube-oil is aspirated thru strainer (1) by lube-oil gear pump (2) and discharged towards spin-on lube-oil filter (3). Filtered oil flows back into crankcase oil duct (5) via filter adapter union (4) to pass around relief valve (6) and to leave crankcase via banjo union (7) towards aircooled oil cooler (not shown). Relief valve (6) is a protection to the oil cooler and will open as soon as the latter is clogged. In this case the oil is discharged directly into the oil duct (10) and towards spray tube (12) and main relief valve (13).
Oil returns from oil cooler via banjo union (8), passes freely thru relief valve (6) to arrive in crankshaft main bearing (11) via oil duct (10). A certain quantity of oil is led to 2 spray tubes (12) for lubrication of valve gear. If oil pressure mounts above 6 kp/cm^2 the circuit's main relief valve (13) discharges oil directly back into crankcase thru bore (14).
Oil pressure switch (9) opens electric circuit under pressure.

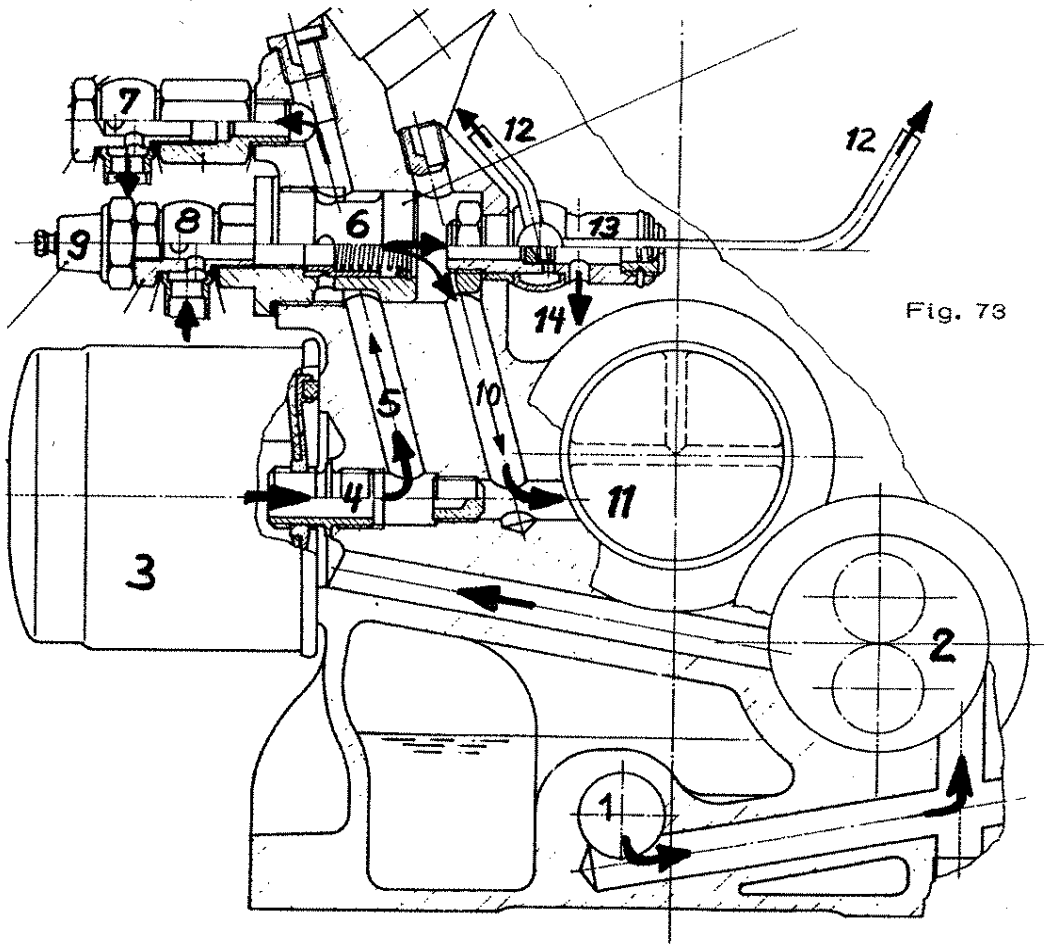


Fig. 73

LUBE-OIL CIRCUIT

2-Cyl. Engines watercooled

Circuit identical to the one explained on pages 58/59 with exception of oil cooler and relief valve (6 - see Fig. 73).

Lube-oil coming from pump (2) passes through watercooled oil cooler before entering spin-on oil filter (3).

See to it that square section rubber gasket (16) between oil cooler and crankcase is correctly fitted in between its inner and outer steel guide ring.

Tightness achieved only by tightening oil filter which holds oil cooler onto crankcase.

Cooling water enters cooler through tube (14) coming directly from circulating pump and leaves cooler through tube (15) towards cylinder liners and by-pass water line (3) see Fig. 74.

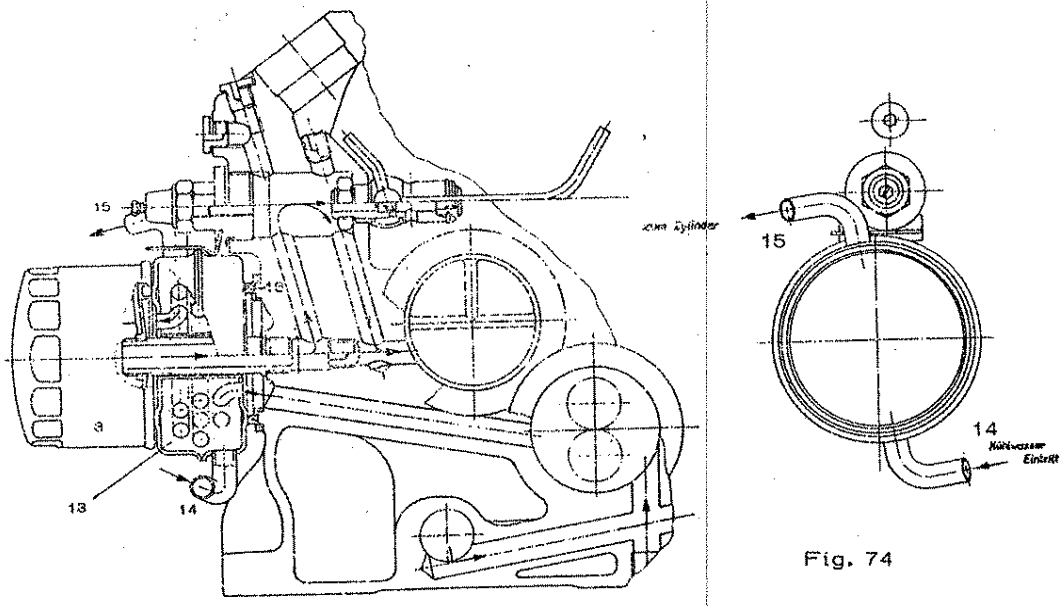


Fig. 74

Relief valve (6 - as per Fig. 73) is omitted with watercooled engines as its sole purpose is to protect the aircooled lube-oil cooler, whilst the main relief valve (13 - as per Fig. 73) rests identical.

ENGINE RATING

The German Bureau of Standards DIN defines engine ratings as follows:

A - RATING (DIN 6270)

Continuous rating A is the maximum effective output which the engine can furnish continuously with the limited output being such as to permit an overload.
Working condition: constant load and constant speed.

B - RATING (DIN 6270)

The rating B is the maximum effective output which the engine can furnish during a certain time with the limited output being such as to forbid this "Rating B" to be surpassed.
Engines set for a blocked "rating B" to be yielded in uninterrupted continuous operation are indicated as "Rating B for continuous operation". This rating is not overloadable and can be taken off in heavy continuous operation.

> Nominal ratings given with FARYMANN DIESEL engines do coincide with the "blocked rating B for continuous operation".

DIN 6270 refers to the following standard conditions.

Atmosphere pressure: 736 TORR corresponding to 300 m (985 ft) above sea-level
Ambient temperature: 20° C (68° F)
Rel.atmos.humidity : 60 %

Simplified calculation of derating for varying ambient conditions:
Deduct 1 % of output for every additional 100 m (330 ft)
Deduct 3 % of output for every additional 10° C (18° F)

F - RATING (DIN 70 020)

Intermittent maximum output, the engine can furnish for a short period of time without mechanical or thermal overload, i.e.:
Variable load and variable speed (vehicle application)

DIN 70 020 refers to p_o = 760 torr = sea level
t = 20° C (68° F)

1 BHP (B.S.E.) = 1.014 PS (DIN)
1 PS (DIN) = 1,15 - 1,25 HP (SAE)

RECOMMENDED HD-ENGINE LUBE-OILS

(Other brands of HD Lube-oils of same quality not mentioned below can equally be used.)

Company	HD-LUBE-OILS according to API Classification	
	C C	C D
AGIP	Agip F. 1 Diesel Gamma	Agip F. 1 Diesel Sigma
ARAL	Aral Kowal Engine Oil Aral oils of the HD-range	Aral Kowal S3 Engine Oil Aral oil HD S 3
BAYWA	BayWa Engine oil HD-super BayWa engine oil HD-B	BayWa HD Superior S 3 BayWa Universal HD
BP	BP Energol HD BP Energol DS-B BP Vanellus/Vanellus-T	BP Vanellus S 3 BP Energol DS 3
CHEVRON	Chevron Delo Special Oil Chevron Delo 200 Engine Oil	Chevron Delo 300 Engine Oil
ELF	elf Performance	elf Disal HD 3
ESSO	Essolube HDX Essolube SDX	Essolube D-3 Esso Estor D-3
FINA	Fina Solna HD S 1 Fina Delta Engine Oil	Fina So na S 3
FUCHS	Renolin HD Pena Pura HD Pena Pura HD Super Pena Pura Universal HD	Pena Pura HD Superior Pena Pura Universal HD
MOBIL	Mobil Delvac 1100 Mobil Delvac 1200	Mobil Delvac 1200 Mobil Delvac 1300
SHELL	Shell Rotella SX/Rotella TX Shell Melina Oils Shell Talona Oils	Shell Rimula CT
TOTAL	Total HD 1 B Total HP D	Total HD 3 Total HP D

Working condition, oil change interval and API-classification (oil quality):

Condition	Working Hours	API Classification	(Previous Designation)
Normal	50 - 60	C C	HD-SI or MIL-L-2104 A
Heavy *	100 - 120	C D	HD-B or MIL-L-2104 B as well as MIL-L-2104 A SUPPLEMENT 1
		C D	

* Heavy working conditions: Long idling periods, high ambient temperatures (above + 30° C = + 86° F) dusty environment, diesel fuel with more than 0.5 % sulphur.

RECOMMENDED HD-ENGINE LUBE-OILS

(Other brands of HD Lube-oils of same quality not mentioned below can equally be used.)

Company	HD-LUBE-OILS according to API Classification	
	C C	C D
AGIP	Agip F. 1 Diesel Gamma	Agip F. 1 Diesel Sigma
ARAL	Aral Kowal Engine Oil Aral oils of the HD-range	Aral Kowal S3 Engine Oil Aral oil HD S 3
BAYWA	BayWa Engine oil HD-super BayWa engine oil HD-B	BayWa HD Superior S 3 BayWa Universal HD
BP	BP Energol HD BP Energol DS-B BP Vanellus/Vanellus-T	BP Vanellus S 3 BP Energol DS 3
CHEVRON	Chevron Delo Special Oil Chevron Delo 200 Engine Oil	Chevron Delo 300 Engine Oil
ELF	elf Performance	elf Disal HD 3
ESSO	Essolube HDX Essolube SDX	Essolube D-3 Esso Estor D-3
FINA	Fina Solna HD S 1 Fina Delta Engine Oil	Fina So na S 3
FUCHS	Renolin HD Pena Pura HD Pena Pura HD Super Pena Pura Universal HD	Pena Pura HD Superior Pena Pura Universal HD
MOBIL	Mobil Delvac 1100 Mobil Delvac 1200	Mobil Delvac 1200 Mobil Delvac 1300
SHELL	Shell Rotella SX/Rotella TX Shell Melina Oils Shell Talona Oils	Shell Rimula CT
TOTAL	Total HD 1 B Total HP D	Total HD 3 Total HP D

Working condition, oil change interval and API-classification (oil quality):

Condition	Working Hours	API Classification	(Previous Designation)
Normal	50 - 60	C C	HD-SI or MIL-L-2104 A
Heavy *	100 - 120	C D C D	HD-B or MIL-L-2104 B as well as MIL-L-2104 A SUPPLEMENT 1

* Heavy working conditions: Long idling periods, high ambient temperatures (above + 30° C ≈ + 86° F) dusty environment, diesel fuel with more than 0.5 % sulphur.

MAINTENANCE

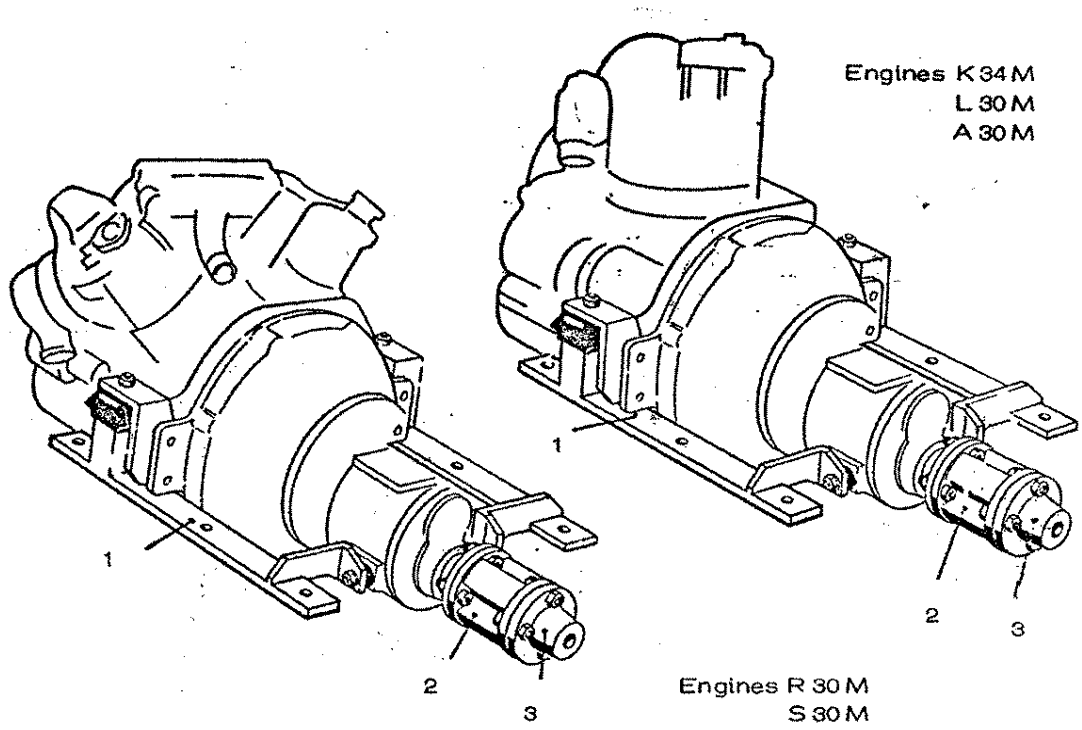
Daily:	Check engine oil level. Oilbath aircleaner - check oil level, if atmosphere is dusty, clean daily. Drytype aircleaner - under dusty conditions check daily, renew paper cartridge if necessary.
After 20 hours:	Change oil and check valve clearance on all or rebuilt engines. Check all nuts and bolts for tightness (for tightening torques see chart page 3).
Every 100 hours:	Change oil Check V-belt tension (generator, waterpumps etc.) Oilbath aircleaner - clean thoroughly (earlier when necessary) Drytype airfilter - renew paper cartridge if necessary Check valve clearance (engine cold). Check all fuel lines for leakages Under dusty conditions: clean cooling air intake, blower in flywheel and cooling fins on cylinder and cylinder head
Every 300 hours:	Change oil Renew oil filter (2-cylinder engines only) Clean oil strainer Flush crankcase (if sludge is present) Check decompression device
Every 500 hours:	Check and clean crankcase breather Clean fuel tank Fuel filter - check and renew cartridge if necessary

ENGINE LUBE-OIL

The SAE classification of the engine applied lube-oil depends on the ambient temperature at the time of starting the engine. A lube-oil of proper viscosity is very important for easy handstart and even protects the battery of electric-start engines.

DURING WINTER		DURING SUMMER
Below + 10° C + 50° F HD SAE 10 W	Between 0° C and + 35° C + 32° F and + 95° F HD SAE 20 W / 20	Above + 30° C + 86° F HD SAE 30

The lube-oil quality and the oil change intervals depend fully on working conditions of the engine and the actual state of the lube-oil (see bottom chart next page).



1 FARYMANN 2-Point Engine Mounts

The 2-point mounts developed by Farymann, proved to be an outstanding flexible mounting for marine diesel engines. 2 special rubber mounts support the engine in its center of gravity and 2 rubber mounts on the sides of the gearbox stabilize the gearbox to the shaft. The complete resilient mounting is supplied ready for installation and is included in the standard scope of delivery.
Make sure that all flexible mounts are not distored. If the engine rails are twisted or pulled to match mounting holes or beds, this will improperly "load" the flex. mounts, reducing their efficiency.

2 FARYMANN flexible Shaft Coupling

This highly flexible gear/shaft coupling is the ideal completion of the above mentioned 2-points suspension, if a fixed shaft is provided. An exact alingment of engine and shaft is however necessary. Bad alignment will surely lead to its destruction. If a shaft with a flexible stuffing bos is applied (shaft with only one bearing on shaft end), the gear/shaft coupling should not be used.

3 Counterflange

As accessory, Farymann supplies a counterflange to match flexible coupling or gearbox flange. The counterflange has a pilot bore.

FUEL SYSTEM

Fuel system with automatic bleeding device, employing fuel feed pump (2). Same continuously passes fuel through filter (4) to fuel injection pump (5). Part of the excessive fuel returns via banjo bolt with built-in throttle (8) and fuel return line (10) to fuel tank.

The return line connecting to tank should be situated as low as possible (5 cm above bottom), to prevent air penetrating fuel system via return line (10) when the engine does not run.

Drain plug (9) for drainage of condensing water and deposits in the tank, if any.

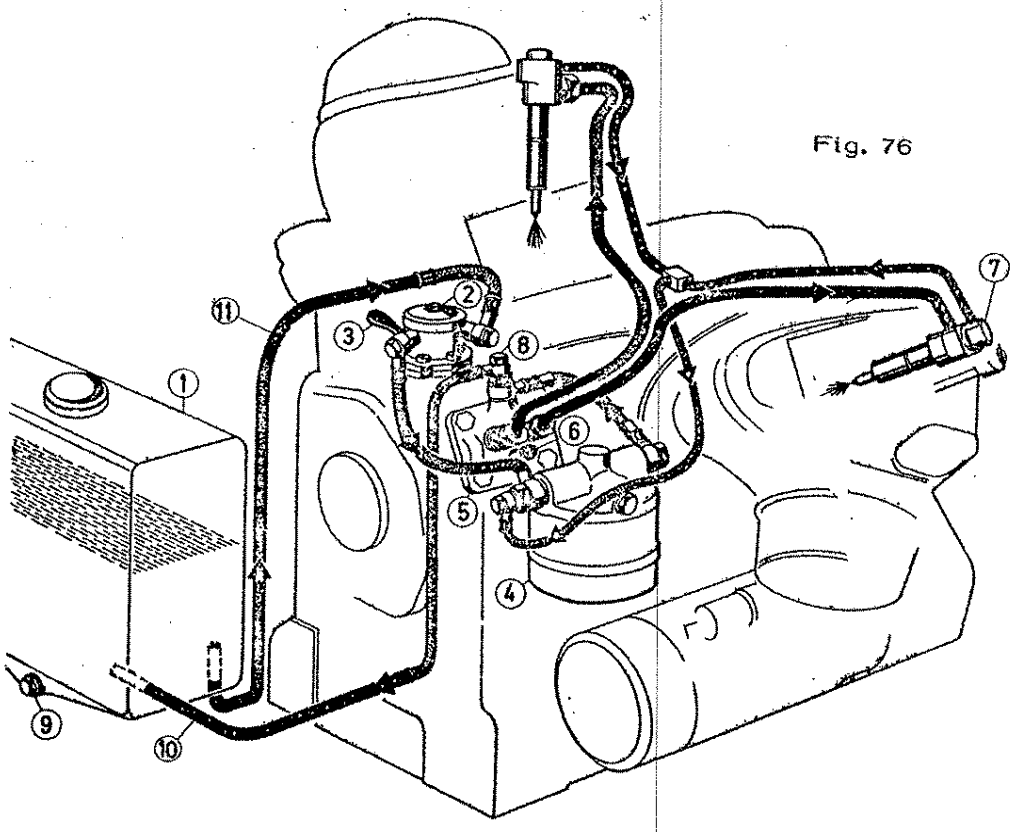


Fig. 76

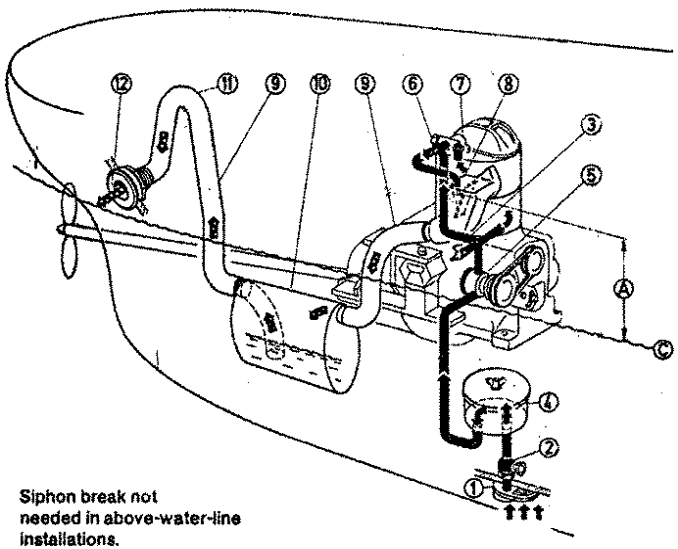
1	Fuel tank	6	Push button for excess starting fuel
2	Fuel feed pump (with pre.-filter)	7	Injection nozzle
3	Primer (fuel feed pump)	8	Banjo bolt with throttle
4	Fuel filter	9	Drain plug
5	Injection pump	10	Fuel return line
		11	Fuel feed line

FARYMANN MARINE DIESEL ENGINE TYPE "A 30 M"

Exhaust and cooling water installation diagram

Direct seawater cooling with water injection into exhaust above water line.

A = 100 mm (4")



Siphon break not needed in above-water-line installations.

C = Water line

A = Minimum height above water line of water injection into exhaust line.

1	Seawater strainer	7	Thermostat		
2	Sea cock	8	Water injection		
3	Drain cock	9	Rubber hose		
4	Seawater filter	10	Water lift silencer		
5	Water pump	11	Goose neck		
6	Temp. Connector	12	Exhaust outlet (thru hull fitting)		

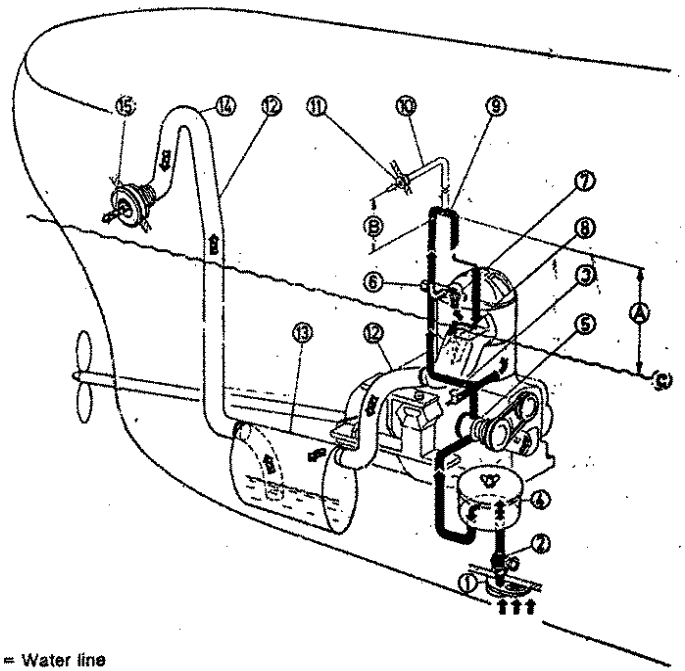
FARYMANN MARINE DIESEL ENGINE TYPE "A 30 M"

Exhaust and cooling water installation

Direct seawater cooling with water injection into exhaust below water line.

A = 300 mm (12")

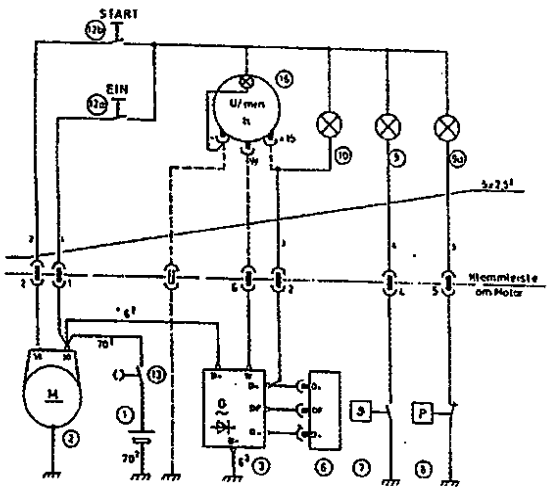
B = 100 mm (4")



C = Water line

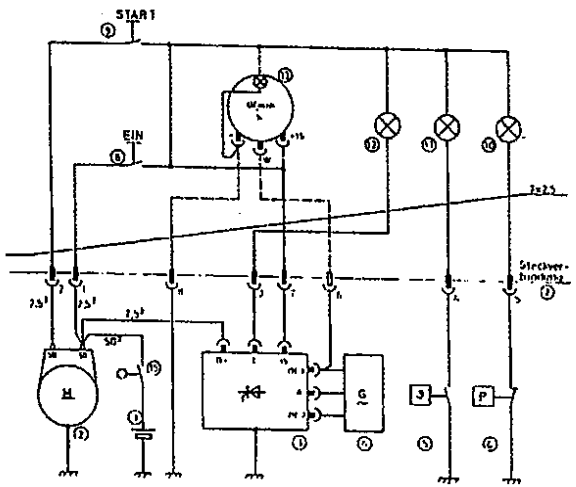
A = Minimum height above water line of water injection into exhaust line.

1	Seawater strainer	7	Thermostat	12	Rubber hose
2	Sea cock	8	Water injection	13	Waterlift silencer
3	Drain cock	9	Water line with T-fitting	14	Gooseneck
4	Seawater filter	10	Breather line	15	Hull fitting (exhaust)
5	Water pump	11	Hull fitting		
6	Temp. Connector				



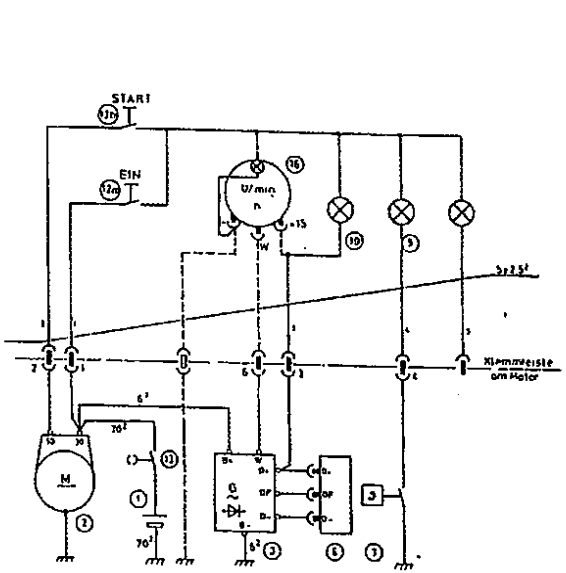
Wiring Diagram R 30 M, P 30 M, S 30 M

1 Battery
2 Starter
3 Alternator
6 Governor
7 Temperature switch
8 Oil pressure switch
9 Temperature warning light
9a Oil Pressure warning light
10 Indicator lamp
12a Running switch
12b Starter (on special order)
13 Battery main switch
16 Tachometer



Wiring Diagram K 34 M

1 Battery
2 Starter
3 Governor
4 Alternator
5 Temperature switch
6 Oil pressure switch
7 Socketclip
9 Starter
10 Oil pressure warning light
11 Temperutre warning light
12 Charge indicator light (on special order)
13 Tachometer
15 Battery main switch



Wiring Diagram L 30 M, L 38 M

1 Battery
2 Starter
3 Alternator
6 Governor
7 Temperature switch
8 Oil pressure switch
9 Temperature warning light
9a Oil Pressure warning light
10 Indicator lamp
12a Running switch
12b Starter (on special order)
13 Battery main switch
16 Tachometer

TROUBLE SHOOTING

This section is a guide to be possible location of the faults that may occur on an engine. Information of possible causes and suggested remedies are also given. But please note that this list can never be complete.

Engine will not start

Reason	Causes	Remedy
If squeak cannot be heard	No fuel in tank	Fill tank only
	Acceleration lever at stop	Set lever to full load
	Vent bore in tank cap plugged	Renew cap
	Fuel line blocked	Check system, remove blockage
Fuel Supply failure check by cranking the engine and listen for the characteristic squeak in the injector.	Fuel filter clogged	Renew filter
	Broken fuel line or leaking connection	Renew pipe / tighten connections
	Vapor lock (fuel too hot)	Cool the fuel
	Fuel too thick (no.2 in winter)	Drain and flush system, fill with proper fuel
	Faulty injector nozzle	Check / repair / renew nozzle
	Faulty injector pump	Check / repair / renew pump
If squeak can be heard	Starting fuel button not pulled	Pull button
	Gasoline instead of diesel in tank	Drain gasoline, flush system, fill with diesel
	Air intake blocked	Check system for blockage
Poor Compression	Decompression device defect	Check / renew decompression device
	Incorrect valve clearance	Adjust valve clearance
	Valve not sealing properly	Check / repair / renew valves
	Valves sticking	Free valves
	Cylinder head loose	Tighten head nuts
	Piston rings stuck in grooves	Check rings and clean the piston
	Worn cylinder and piston	Overhaul the engine
Difficult to crank engine	Starting lead too high	Reduce load
	Lub oil too thick	Change to correct viscosity
	Bearings seized	Overhaul engine
	Piston seized	Overhaul engine

Engine starts but fires intermittently or soon stop

Faulty fuel supply	Fuel filter choked	Renew filter
	Fuel line choked	Check lines for blockage / restriction
	Leaking fuel lines or connections	Check lines, tighten connections
	Water in fuel	Drain fuel, fill with clean fuel
	Faulty injector nozzle	Check / renew nozzle
	Faulty injector pump	Check / repair / renew pump
Faulty compression	Incorrect valve clearance	Adjust valve clearance
	Worn valves	Overhaul cylinder head
	Valves sticking	Free valves
	Piston ring stuck in grooves	Check ring and clean piston
	Worn cylinder and piston	Overhaul engine

Faulty exhaust and intake	Restricted / blocked exhaust Restricted / blocked intake	Check / Clean exhaust system Check / Clean intake system

Engine lacks power and / or smokes black

Operation conditions	Engine overloaded - Power reduction due to altitude and ambient temperature has not been observed	Reduce load
Faulty fuel supply	Gasket under injector missing or too many installed Fuel filter blocked Faulty injector nozzle Faulty injector pump	Correct number of gasket Renew filter Check / renew nozzle Check / repair / renew pump
Out of adjustment	Incorrect valve clearance Incorrect injection timing Complete timing incorrect Piston installed wrongly (18A/C only)	Adjust valve clearance Adjust injection timing Adjust engine timing correctly Correct piston installation
Dirty engine	Blocked air intake Excessive carbon on piston and cylinder head	Clean / renew filter Decarbonize
Engine condition	Faulty piston rings Worn out piston and cylinder Worn out bearings	Check / renew ring set Overhaul engine Overhaul engine

Faulty running

Overheating	Engine overloaded Cooling fins clogged, flywheel air restricted Short circuit of cooling air Lub oil level too high Faulty injector nozzle	Reduce load Clean air passages, remove restrictions Improve cooling air flow (redesign applications) Drain to proper level Check / repair / renew nozzle
Knocking	Carbon on piston crown Injector needle sticking Fuel timing too far advanced Broken piston ring Worn piston Worn bearings Loose flywheel	Decarbonize Fit new nozzle Adjust timing Fit new ring set Renew piston and liner Renew bearings Tighten flywheel nut
Speed is hunting	Overheating Air in fuel pipes Governor sticking Fuel filter choked	See above Check system for leaking connections Free the governor Renew filter

Sudden stop	Empty fuel tank Vent bore in fuel tank cap plugged Vapor lock (fuel too hot) Choked injector Fuel pipe broken Seized piston Seized crankshaft	Fill tank Renew tank cap Cool fuel Renew nozzle Renew pipe Renew piston and liner Repair / renew crankshaft and bearings
Blue smoke	Oil level in oil bath air filter too high Breather valve choked Oil seal at intake valve defect Worn valves / valve guides Worn piston / cylinder	Fill to proper level Renew breather Renew seal Renew valves and guides Renew piston and Cylinder
White smoke	Fuel timing too late Injector nozzle worn out	Adjust timing Remove nozzle
Oil pressure warning lamp on	Oil pressure warning lamp is defect Oil level is too low	Exchange warning lamp Measure oil level, if necessary top up oil
Oil pressure is to low	Pressure valve is defect, ball place in the pressure valve is dirty Oil filter is restricted lub oil pump is defect.	Check / clean if necessary renew

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Fax: 06206/507120 Einkauf
Fax: 06206/507129 Versand

Technische Daten

Lampertheim
Farymann Diesel
Germany

			14 D	15D/15S	15W (K34)	18D/18B (18D)	15W/18W	21A	25E/28E (L20/L28)	29C	32A	32W	36A/38A (A30/A32)	36E/38E (A28/A22)	41A/41E (A44/A24)	37E/43E	71A/75A (R30/R32)	71W/75W (R30/R32)	95A (S10)	95W (S30)
● Lieferbar	□ nicht mehr lieferbar		●	●	●	●	●	●	□	●	●	●	●/□	●/□	●	●	□	□	□	□
Kennd.	Kühlungsart		Luft		Wasser	Luft	Wasser		Luft			Wasser	Luft					Wasser	Luft	Wasser
Kennd.	Zylinderzahl		1														2			
Kennd.	Bauart		stehend						liegend	stehend				liegend	stk./lieg.	liegend	V-Form			
Kennd.	Kolben-Ø	mm	70	75		82			80/85	90	95		95/98	95/98	98	95	95/98	95/98	105	
Kennd.	Hub	mm	60	55				66	62	74			62		90	100	82		90	
Kennd.	Hubvolumen	cm³	231	242		290		348	412/465	470	524		582/618	582/618	678	782	1152/1236	1162/1236	1556	
Kennd.	Leistung, max. nach DIN 6271	kW	2,95	3,9	4,3	4,7	4,3/5,2	5,6	5,8/5,7	7,35	7,9	8,8	7,7/8,8	7,7/8,8	8,5	8,3/9,7	15,4/16,2	16,2/17,0	18,5	19,2
Kennd.	IFN-ISO	PS	4,00	5,3	5,9	6,4	5,9/7,1	7,6	8,0/7,8	10,00	10,7	12,0	10,5/12,0	10,5/12,0	11,5	11,3/13,2	21,0/22,0	22,0/23,2	25,0	26,1
Kennd.	Drehzahl, max.	min⁻¹	3600						3000/2500	3600			3000		2500		3000		2500	
Kennd.	Ölinhalt, max. (Standard-Motor)*	g	585	880	1100	980	1100	1300	2020	1360			1690	2230	1690/2230	1860	2130		3140	
Kennd.	Schwungrad-Ø (Standard-Motor)	mm	222	259					310	308			310		310	352	306		352	
Einstd.	Ventile Einlaß öffnet	mm vor O.T.	29	20-25/28-32	12-17	20-25/28-32	12-17	25-30	30-35	24-30		14-20	38-45	45-55	35-45/45-55	100-114	85-100	70-75	110	95
Einstd.	Ventile Auslaß schließt	mm nach O.T.		15-20	10-15	15-20	10-15	15-20	25-30	18-24		12-16		30-40		135-148	70- 75	50-55	85	80
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 1500	mm vor O.T. ± 2 mm	—	—				—	15	28			10/12	10	12/10	21/24	23	21	25	
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 1800		—	17				18	18/17				15/17	14/15	17/15	24/27	25		29	
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 2000			18					22/18				22/24	20/22	24/22	26/29	27	23	31	
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 2300		—	19				20	26/20	32			30/32	25/28	32/28	32/35	32	27	38	
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 2500								28/—	36			33/37	27/30		35/38	44	38		
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 3000		—	21				22	32/—	40			37/42	30/32	—	37/40	52	45	—	
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 3300			22				23	—				—			—	—			
Einstd.	Fördere. der Einspritzpumpe mit oberliegender Steuerkante 3600		—	25				25		46										
Einstd.	Förderbeginn** der Einspritzpumpe PFE 1 D 85/42 mit unten-liegender Steuerkante 1500	mm vor O.T. ± 2 mm	36-38	—					—	45	42		—							
Einstd.	Förderbeginn** der Einspritzpumpe PFE 1 D 85/42 mit unten-liegender Steuerkante 1800																			
Einstd.	Förderbeginn** der Einspritzpumpe PFE 1 D 85/42 mit unten-liegender Steuerkante 3000		50	36		39				63	60									
Einstd.	Förderbeginn** der Einspritzpumpe PFE 1 D 85/42 mit unten-liegender Steuerkante 3600			39		41				73										
Einstd.	Düsen-Abspritzdruck	bar	200	200					175/200											
Einstd.	Ventilspiel (Ein- und Auslaßventil)***	mm	0,25	0,1	0,2	0,1	0,2	0,1		0,1		0,2				175				
Repar.	Ventil-Einlaß Vorstand	mm	—	—						—			1,0-1,1/—	0,8-0,9/—						
Repar.	Ventil-Einlaß Rückstand		0,7-1,1	0,1-0,2					1,1-1,2	0,1-0,2			—/0,9	—/0,9	1,0-1,2	0-0,1	1,0-1,1			
Repar.	Ventil-Auslaß Vorstand	mm	—	—					—	—			1,3-1,4/—	1,3-1,4/—						
Repar.	Ventil-Auslaß Rückstand		0,7-1,1	0,1-0,2					0,6-0,7	0,1-0,2			—/0,7	—/0,7	0,6-0,8	0-0,1	1,0-1,1			
Repar.	Kolben Vorstand	mm	0,7-0,9	—	0,63-0,93	0,68-0,98	0,63-0,93	0,63-0,98	0,7-1,0	0,65-0,98			0,90-1,05		0,65-0,90	0,635-0,90	0,76-1,05	0,75-1,05	0,58-0,88	0,78-1,03
Repar.	Kolben Rückstand		—	0,48-0,76																
Repar.	Spaltmaß	mm	0,7-0,8	0,48-0,78	0,58-0,92	0,47-0,82	0,58-0,87	0,47-0,82	0,4-0,8	0,47-0,85	0,43-0,85		0,35-0,70		0,50-0,85	0,55-0,865	0,35-0,72	0,35-0,75	0,52-0,92	0,37-0,72
Repar.	Kolbenringstoß	mm	0,4-1,0	0,2-0,5					0,3-1,0	0,2-0,5					0,4-1,0				0,5-1,5	
Repar.	Kurbelwellenlagerzapfen-Spiel Neuzustand	mm	—	0,02-0,05					—	0,02-0,06			—			0,03-0,07	0,03-0,08			
Repar.	Kurbelwellenlagerzapfen-Spiel Verschleißgrenze			0,08						0,09						0,1	0,12			
Repar.	Pleuelgleitlagen-Spiel Neuzustand	mm	0,04-0,1	0,03-0,06					—	0,03-0,08			—			0,03-0,07	0,03-0,08			
Repar.	Pleuelgleitlagen-Spiel Verschleißgrenze		0,15	0,11						0,12						0,13	0,12			
Repar.	Druck**** max.	bar	—	4,0					—	5,0			—			5,0	5,0			
Repar.	Druck**** min.			1,8						2,0						2,0	3,0			
Repar.	Kurbelwellen-Axialspiel	mm	0,03-0,04	0,05-0,15																
Anzug.	Zylinderkopf Moment	N·M mm	20-25	31					54			59				52-56	59		78	
Anzug.	Zylinderkopf Schlüsselweite		13	13						17		15	17				15		19	
Anzug.	Kipphebelbock Moment		—	—					76	—		78				42-46	78			
Anzug.	Kipphebelbock Schlüsselweite								22			22				17	22			
Anzug.	Lagerdeckel Moment		20-25	29-34					29	34		44				42-46	44			
Anzug.	Lagerdeckel Schlüsselweite		13	13					13	13		17				17	17			
Anzug.	Pleuel Moment		20-25	27-31					—	54		59				58-62	64		74	
Anzug.	Pleuel Schlüsselweite		11	13						14		17				17	17		17	
Anzug.	Düsenhalter Moment		8-12	8-12					20							20-23	20			
Anzug.	Düsenhalter Schlüsselweite		10	19					13											
Anzug.	Druckventil Moment								34-39											
Anzug.	Druckventil Schlüsselweite		14	14					19							14	19			
Anzug.	Einspritzpumpe Moment		30-33	28-34					20	28-34		20				20-23	25-28			
Anzug.	Einspritzpumpe Schlüsselweite								13											
Anzug.	Schwungrad Moment		100-105	210-226					390-410							390-410	490-510		650-710	
Anzug.	Schwungrad Schlüsselweite		32	36					46											

* bei Ölwechsel: Einzylinder-Motoren + 80 g; Zweizylinder-Motoren + 130 g

** bei Motoren für Generator- und Pumpen-Antrieb.

*** bei kaltem Motor, alle Ventilsitze unter 45° geschnitten.

**** bei 100 °C Öltemperatur