Introduction

It is important to remember that the engine, like any other mechanism, requires adequate care and attention in order to maintain it in perfect running order. Before starting the engine, carefully read the instructions in this booklet concerning operation and maintenance. These instructions should be closely followed.

It must be remembered that negligent or inadequate maintenance may cause damage or defective running of engine parts and cause, furthermore, the decay of the guarantee.

Attached to this booklet are some exploded views of the engine, which illustrate, better than any description, the structure and component parts of the unit. In these illustrative tables, each part is numbered to facilitate reference to the parts catalogue.

ENGINE CHARACTERISTICS	AL185	AL186
CYCLE DIESEL	**4-stroke**	**4-stroke**
CYLINDER VERTICAL	1	1
BORE mm	85mm	85mm
STROKE mm	80mm	90mm
DISPLACEMENT cm3	454cm^3	510 cm^3

DIRECTION OF ROTATION	clockwise when looking at engine from flywheel side.
REVERSE GEAR	mechanical.
REVERSE AND REDUCTION GEAR RATIO	1:2,4.
REVERSE GEAR DIRECTION OF RO-TATION	anticlockwise when looking from reverse gear side.
REDUCTION GEAR DIRECTION OF ROTATI ON	clockwise when looking from reverse-reduction gear side.

The descriptions and illustrations of this booklet are not binding. Although the main features of the engine herein described and illustrated remain unaltered, the ARONA Company reserves the right to effect (without obligation to immediately revise this publication) any modification of components, details or accessories which it feels necessary for any reason of technical or commercial nature.

Fuel Injection System

This is composed of an injection pump, an atomizer fixed to an atomizer block and a fuel tank with built in filter.

A) INJECTION PUMP

This is a Bosch type: it is seated in a special housing in the crankcase. The cam acts on the pump unit roller through a rocker arm. See Fig. 1 on page 24 for stripping and re-assembly instructions regarding the component parts of the injection pump.

Fuel supplement. — The stroke of the fuel flow regulator fork is limited by a sliding rod. By means of an external handle, the sliding rod may be pulled outwards to allow the regulator fork to complete its stroke; this increases the capacity of the injection pump for easy starting. When the engine starts running, the first movement of the regulator fork allows the sliding rod to re-enter its normal position (Fig. 5 page 27).

B) ATOMIZER AND ATOMIZER BLOCK

The atomizer is a multiple jet type; it is clamped to the atomizer block by a ring nut. The parts of the unit are illustrated in Fig. 2 page 26. The atomizer has asymmetrically positioned jets and care must be taken to locate the reference dowels correctly: the dowels are arranged such that the unit is re-assembled in its pre-established position.

Setting and cleaning the atomizer. — The setting of spring (7) which operates needle (10) of the atomizer may be adjusted, if necessary, by turning the spring housing screw (3) which is then locked into position by cap (1).

The setting pressure must be 180 Kg. per sq. cm.

If the atomizer is dirty, the inner part may be cleaned with the aid of a small wooden stick and petrol; the needle in clean light gasoil to ensure that the needle will slide freely in its housing. The atomizer jets may be cleaned with a piece of thin steel wire.

C) FUEL TANK

This is mounted on the engine. On the underside of the tank is located the housing for the **fuel filter,** fibre cartridge type, which can be easily replaced by unscrewing the lock nut holding the filter unit inside the tank.

D) LUBRICATION

Force-feed lubrication of the crankshaft main bearings and the big-end bearings is effected by a gear pump.

The pump is driven by the crankshaft through two cylindrical gears. The circuit is fitted with a safety valve. The pump draws oil from the crankcase through an in-feed tube and pumps it into the crankshaft. The inside of the crankpins is provided with a cavity and sealing cap such that the oil is subjected to centrifugal force and impurities retained in the cavity. Oil is fed into the main and big-end bearing through feed holes.

Reverse gear lubrication: by the engine oil.

Max sump capacity:

— Kg. 2,2 Marine engine

— Kg. 1,75 Industrial engine

—

E) COOLING

Direct by sea water with volumetric pump. Bronze body and impeller.

F) STARTING

Electric by dynastart or by means of a pull-cord wound round the keyed pulley fitted to the flywheel.

Recommended fuel and lubricants

		Cold climate	Temperate climate	Tropical climate
Engine	O	Diesel Gamma SAE 10W	Diesel Gamma SAE 20W/30	Diesel Gamma SAE 30
Reverse gear	O	Same	Same	Same
Reduction gear	O	Same	Same	Same
Injection pump	O	Same	Same	Same
Oil bath air filter	O	Same	Same	Same
Various lubricating nipples	G	Grease 30	Grease 30	Grease 30
Starting motor	O G	Diesel Gamma SAE 10W Grease 30	Diesel Gamma SAE 20W/30 Grease 30	Diesel Gamma SAE 30 Grease 30
Dynamo	G	Grease 30	Grease 30	Grease 30
Thrust bearing and supports	O	Diesel Gamma SAE 10W	Diesel Gamma SAE 20W/30	Diesel Gamma SAE 30

For dependable trouble free operation of the engine, as well as for protection of the injection components, use fuel having the following characteristics
Heat value – not less than 10500 kilocalories
Specific weight .830 - .860 kilograms per cubic decimetre
Diesel Index more than 52
Engler viscocity 20^{o}C= 1.3 – 1.9
Sulphur content – not more than 1%

Oil

The engines have to be operated only with AGIP F.1 Diesel Gamma detergent oils having the viscosity ratings indicated in the table above, in relation to the climatic conditions in which they operate. Where AGIP products are unavailable the engine manufacturer recommends the use of:

- Engine oil – "HD" oil – S1 (DG – DM service of the API category
- Lubricating nipples – Lithium grease (N.L.G.I. No 2)

Other information concerning lubrication:

- The lubricant is poured into the engine through filler cap (17 page 9).
- Oil level is checked by dipstick (23 on page 9) on which maximum and minimum levels are marked. The oil level must not go above or below the indicated levels.
- The oil level must be checked frequently and when the engine is in a perfect vertical position; if necessary, top up with fresh oil to the maximum level indicated on the dipstick.
- **After the first 20 hours running** and, subsequently, **every 100 hours** unscrew drain cap (24 page 9) and drain out oil from the crankcase. Re-fill with fresh oil to the prescribed level.
- An oil drain pump is supplied. (Ref. 11 page 9).

Fuel. — The most suitable fuel is **diesel oil.** Fill tank through filler cap. (19 page 9). Fuel level should be at least 2 cms below the filler rim in order to avoid loss of fuel through the breather hole in the filler cap.

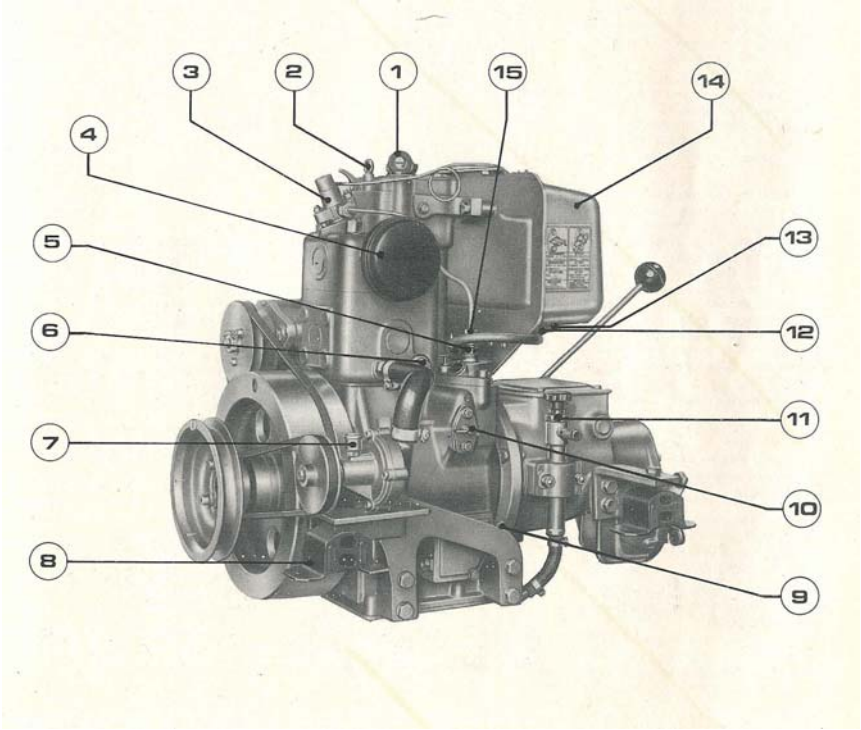
Fuel must be carefully filtered during filling and should not contain any water in suspension.
It should be remembered that impurities in the fuel are almost the only, but very frequent, cause of atomizer trouble, which leads to loss of power and heavy fuel consumption. Impurities in the fuel can also cause abnormal wear in the pump unit and atomizer.

This trouble can be avoided by adopting the following system:
Fuel decanter. — It is inevitable that fuel delivered from tanker vehicles should contain impurities and particles in suspension. The only effective method of purifying large quantities of fuel is to let it stand. For this purpose, we advise a metal drum as shown in fig. 4 page 27. Tap 1) allows drainage of impurities, which settle on the bottom, whilst purified, fuel is drained from tap 2).

Arrangement of outside members of engine

The photographs indicate the location of control and regulating members, connections and accessories assembled on the engine.

1) Starter sump plug
2) Eyebolt for engine lifting
3) Injector-holder and injector
4) Intake air filter
5) Injection pump delivery connector
6) Zinc plug and engine water drainage
7) Water pump greaser
8) Shock absorber on engine small end
9) Accelerator control lever
10) Fuel supplement handle and stop drive
11) Oil drain pump
12) Fuel filter disassembly bolt
13) Fuel filter
14) Fuel tank
15) Union for injection pump delivery pipe
16) Valve lifter lever
17) Oil supply plug
18) Fuel supply cap
19) Reversing gear engagement and disengagement lever
20) Propeller shaft connecting flange
21) Shock absorber on reversing gearbox
22) Oil filter
23) Oil level dipstick
24) Oil drainage plug
25) Starting pulley
26) Dynamotor
27) Drainage pipe connector
28) Engine water outlet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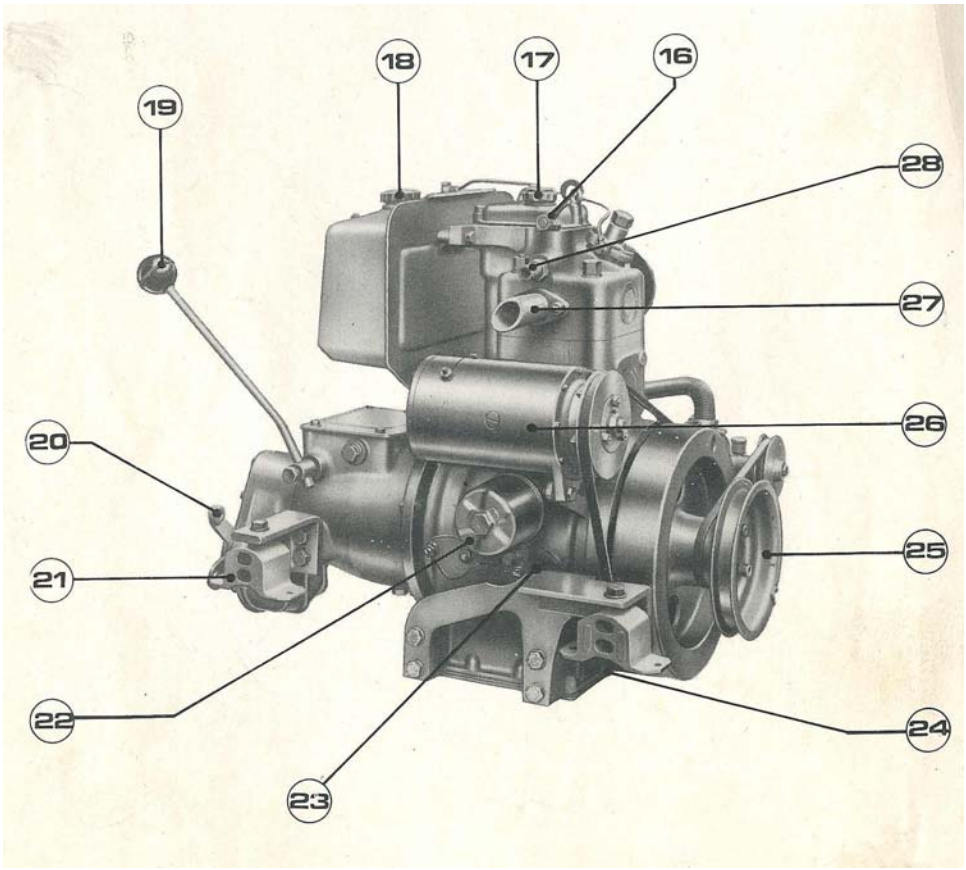
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A) BEFORE STARTING THE ENGINE

Before starting the engine, the fuel infeed tube must be primed up to the injector in the following manner:

- Give the fuel supplement by pulling out handle (10 on page 9) without turning the handle, as shown in fig. 5 page 27. At the same time, shift the accelerator control to the middle position (slightly accelerated).
- Wind the starter rope clockwise round the pulley (25 on page 9), then pull the rope until the piston is on the compression stroke and tends to rewind the rope on the pulley.

This operation of pulling and rewinding the rope, making use of the compression of the engine and the inertia of the flywheel," primes the fuel infeed tube up to the injector. In general, when starting up for the first time (or when the engine has stopped due to lack of fuel), 7 or 8 pulls on the starter rope are necessary, i.e. until the characteristic noise of the injector in operation is heard.
(Where electric starting is fitted, it is obviously sufficient to turn on starter until the engine fires).

B) STARTING THE ENGINE BY ROPE

a) Give fuel supplement (by pulling out handle – 10 on page 9) without turning it, as per fig. 5 page 27.
b) Shift accelerator control to mid-position (slightly accelerated).
c) Wind rope clockwise on pulley (25 page 9), then pull sharply for the entire length of rope to start engine.

(For subsequent starting, when the **engine is warmed up,** a sharp pull on the rope is sufficient).

C) SYSTEM FOR ELECTRIC STARTING

The standard outfit for electric starting with dynamotor as provided herein includes:

a. the decompression control lever,
b. the warning light.
c. the starter key,
d. the electric cables (Battery excluded).

For electric connections, follow fig. 17 page 31.

Note: Place the voltage regulator D) in vibrationless position if possible; it is suggested to fasten it to the battery housing, preferably arranged as shown in figure, with terminals downwards.

VERY IMPORTANT: Remember to place earth connection for said regulator.

D) STARTING

To start the engine fitted with dynamotor, after preliminary operations for starting as shown on page 7:

1. Put the compression on, keeping lever A) down.
2. Turn up key C): the engine will start running. Let it accelerate for a few seconds, then punt decompression off, leaving lever A).
3. After starting, leave the key, which will automatically return to the first notch. Never bring the key back to the zero position, while the engine is running: the charge check performed by warning light B) would then be switched off.

   It is then very important: with running engine to keep key on first notch. With standstill engine to keep key on rest position.

4. Check performance of battery B) charge warning light. With running engine the light must be off. This means the dynamotor is charging the battery as required. If with running

engine the light keeps being on, then dynamotor is not charging and a plant inspection is to be effected at the earliest convenience.

WARNING: Never stop engine by shifting decompression lever A).

E) STARTING THE ENGINE IN A COLD CLIMATE

If starting is difficult because of low temperature, proceed as follows:

1. Remove rubber plug (1 fig. 9 page 27) (marked « starter ») located on the rockerbox cover.
2. Pour some lubricating oil of the type used in the engine into the reservoir (2 on fig. 9 page 27). The quantity of oil poured in should be about equal to the capacity of the reservoir.
3. Close the reservoir with plug (1 fig. 9 page 27).
4. Repeat all operations for normal starting.

F) AFTER STARTING

1. Adjust engine revs by shifting the accelerator lever (9 on page 9) to the left to increase (+) and to the right to decrease (—).
2. Where remote control is fitted, shift the appropriate hand lever.
3. When the engine is firing, handle (10 on page 9) will automatically return to its normal running position and reduce the fuel flow to normal.

G) STOP THE ENGINE

To stop the engine, turn handle (10 on page 9) to the left **(stop)** without pulling outwards, such that the flow of fuel is shut off. Hold handle to the left until the engine stops. (Fig 8 on page 27).

If engine is not running for a long time or in a cold climate, it is advisable to drain the cooling water by loosening plug on the cylinder (6 on page 9) and let water flow.

Routine Maintenance

The following checks and cleaning operations, which we recommend should be carried out with reasonable frequency, are as follows:

A) CHECK AND CLEAN THE ATOMIZER:

See page 4.

B) CLEAN THE FUEL FILTER

(fig. 3 page 26): We recommend that the filter be cleaned very frequently, in the following manner:

1. Disconnect outfeed tube from cover 3) and empty fuel out of the tank.
2. Unscrew nut 1), remove cover 3) and withdraw the filter cartridge 6).
3. Dip the filter cartridge in gasoil or petrol to clean it. Replace the filter if heavily impregnated with impurities.
4. Carefully wash the inside of the cover 3), then dry it with a clean rag. Ensure that gasket 4) is well seated in its place.
5. Re-assemble all as stated in fig. 3 page 26.
6. Reconnect the fuel outfeed tube.

C) CLEANING THE AIR INTAKE FILTER.

It is very important to clean the filter more or less frequently according to the dust content of the atmosphere in which the engine is run. **If necessary, the filter must be cleaned every day.**
To strip down the filter (fig. 14 ^, page 30), open clips 5) and withdraw reservoir 4). Pull out the filter element 3) and wash it by dipping in kerosene or gasoil.

Remove all the oil contained in the reservoir 4), wash the reservoir with kerosene or gasoil, then refill with clean oil up to the level Indicated on the internal oil level guide plate 6).
To reassemble the filter, bring the reservoir 4) up to the upper housing 1), ensure that the rubber gasket is well seated then put the clips 5) in the closed position.

D) REMOVAL OF CALCAREOUS SCALES.

Dissolve about 2% of sodium carbonate in water and filter the solution. Circulate this solution in the engine after removing the water already there and run the engine for about 30'.
Change the solution for clean water and run the engine for 5', then repeat the operation with more clean water before permanent use (i.e. carry out a double rinse with fresh water).

E) RUNNING IN.

A certain running in period is necessary (besides that normally carried out by the factory) for new engines such that all mechanical parts settle down gradually. To run in the engine, run it for 50 hours, at 70% load capacity.

Technical data on Assembly and timing

A) TOP DEAD CENTRE

(fig. 12 page 29).
Point 2) indicates the flywheel position when the piston is at top dead centre. Point 2) is located on the engine cylinder.
When dot 3) coincides with point 2) coincides with point 2), the piston is at T.D.C.
When dot 3) coincides with point 1) pump action starts (I.P.).
The injection advance is 28 degrees equivalent to 65 mm. on the flywheel.

B) CHECKING START OF PUMP ACTION

If, at any time, the injector is renewed, the start of the Pump Action must be checked as follows:

a. Unscrew injection pump infeed union and remove the valve (but not the valve seating) and its spring. Replace infeed union and screw up.
b. Turn the engine slowly through the compression stroke by turning the flywheel in its normal direction of rotation: fuel will flow out of the infeed tube union.
c. When the piston closes the cylinder intake hole, fuel will stop flowing out. This is the start of the Pump Action and must coincide with 28 degrees equivalent to 65 mm. on the flywheel, before the T.D.C.

If it is necessary to advance or retard the Pump Action, make use of the shim gaskets located under the injection pump fixing flange as follows:

1) Add shim gaskets to **retard** pump action.
2) Remove shim gaskets to **advance** pump action.

Attention. — Should it be necessary to renew the injector rocker arm, **do not** withdraw the rocker shaft which is fixed to the crankcase since its position is established at the factory in order to give the correct advance setting (fig. 7 page 27).

Should it be essential to change a worn rocker arm pin, note the marking on the pin flange: there may be the number or no marking at all.

The marks indicate that the pin with respect to flange is offcenter or that it is true.

C) CHECKING END OF PUMP ACTION.

The end of pump action is set by moving the fuel supplement handle flange, the lower bolt-hole of which is slotted.

Loosen the fastening bolts and swing the flange as required. (Fig. 6, page 27).
The following guide will serve as an out-of-works check: the pump action should be effected through 15°.

To check the end of pump action, adopt the same procedure used for checking the start of pump action. When start of pump action position has been reached, turn the flywheel slowly until Diesel fuel re-appears from the infeed tube union. The setting must be adjusted such that this point is reached about 15° **after** start of pump action.

D) ENGINE TIMING

After stripping down and overhauling the engine, re-assemble and time the camshaft with the crankshaft as indicated in fig. 10 page 28.
When the main shaft is in the **top dead centre** position of the induction stroke, set the gear markings 2) and 3) as shown in fig. 10.

E) TAPPET CLEARANCE

It is very important to frequently check the clearance between tappets and valves. This check must be effected **after the first 20 hours of running and every 15 days thereafter.**
Tappet clearance is adjusted by screwing the tappet adjustment screw in or out after first loosening the lock nut.
Clearances when the engine is cold are as follows:

Inlet 0,20 mm. **Exhaust 0,20 mm.**

Measurements are to be made after having brought the piston to the Top Dead Center at the end of the compression phase.

F) PISTON ASSEMBLY

An arrow F) is stamped on the crown of the piston (fig. 11 page28).
Important, when assembling the piston, arrow F) Must be on the injection pump, i.e. pointing in the direction of rotation of the main shaft.

Reversing Gear and causes of trouble

A) REVERSING GEAR

The reversing gear is of the planet wheel type. directly built in the engine on the side opposite the flywheel and automatically lubricated with the same oil as the engine.
The control lever is moved towards the flywheel to obtain forward running, in the opposite direction to obtain reverse running.

PROBABLE CAUSES OF TROUBLE

Problem

Reversing gear clutch slipping

Cause 1
Excessive play between clutch plates

Remedy 1
Insert the special tapering punch into the centre one of the three holes on the periphery of the plate thrust-ring and push right down, causing the ball to move and release the plate thrust-ring, which must be rotated to the right (to reduce the play) still pressing on the punch. During the operation keep the outlet shaft stationary. Remove the punch and restore the locking of the plate thrust-ring. After adjustment, check the pressure on the plates, engaging and disengaging the clutch.
Failure to adjust in good time accelerates plate wear.

Cause 2
Excessive play of the brake band

Remedy 2
After removing the cover of the reversing gear box, loosen the bolts located on the right and left of the said box. With a hook wrench unlock the right and left ring nuts located internally between the box and individual control levers; rotate the ring nuts the amount necessary to restore the play of the band (clockwise to increase it, counter-clockwise to decrease it).

Take great care that the ring nut is turned exactly the same amount on the right lever and the left lever, since unequal regulation causes irrational division of the braking load, with consequent rapid wear of the bands. Lastly relock the ring nuts inside and the bolts outside the box.

Problem
Excessive heating of reversing gear oil

Cause 1
Thrust bearing seized

Remedy 1
Take down and change

Cause 2
Planet gear bearings seized

Remedy 2
Take down and change

Disassembly and overhaul of the engine

Below are some instructions for overhaul of the engine and replacement of component parts.
No consideration is given to operations common to all types of engines, such for example as valve grinding or replacement of a ball bearing, which do not require notions other than those used in automobile practice.

A) ENGINE DISASSEMBLY

After dismantling the accessory parts (tank, filter, fuel pipes, etc.), the procedure is as follows:
1) Dismantle the flywheel, using an extractor, which engages in the holes on the flywheel plate.
2) Dismantle the head and the bottom plate.
3) Dismantle the connecting rod, making use of a pipe wrench.

4) Dismantle the main bearing on the flywheel side and the plate on the distribution side, using two bolts screwed into the two holes on the edge, until they react on the crankcase.
5) Remove the tappets, camshaft, injection pump and regulator unit.
6) Take out the crankshaft, making sure the gear is not dragged on the bearing bush.

B) ENGINE OVERHAUL B.I. • LINER WEAR

a) If the diameter is not larger than 85.10 mm. it is only necessary to change the piston rings: in such case there will be a higher oil consumption until the new rings have adjusted themselves. It must be borne in mind that, in the event of negligent supervision, high oil consumption may be a cause of serious damage.

The troubles that occur in many parts of the engine if it operates without oil even for a very short time are in fact universally known. To avoid this it is advisable to restore the initial roughness of the liner by passing a hand wrapped with emery cloth (grain 80-100) over the inside with a suitable movement.

The operation must be performed as follows (fig. 15 on page 30).
1) One hand is wrapped with a strip of emery cloth (grain 80-100).
2) The hand is inserted in the liner and, keeping it pressed against the wall, is moved from the top to the bottom part, rotating it to the right at the same time. 3) Repeat the action, but rotating the hand in the opposite direction (i.e. to the left), so that the result is a surface with crossed lines, as can be seen in fig. 16 on page 30. The roughness of the new liner **is** 0,80-1 micron.

b) For a diameter in excess of 85.10 mm. the liner must be bored, substituting the piston designed for the required enlargement. The piston rings will also have to be of enlarged type.
Two enlargements are possible:
0,5 and 1 mm.

Hence the diameter of the ground liner may have one of two values:

0 0 0
85,5 + 086 +
0,02 0,02

B.2. • PISTON RINGS

To carry out a check the piston rings are inserted in the bottom part of the cylinder; verify that the distance S) between the two ends, at the cut (fig. 13 on page 29), does not exceed:

0,8 mm. for the seal rings 1 mm. for the scraper ring

If such value is higher, or if the piston rings are found not to adhere perfectly to the surface of the liner on the whole of their circumference, they must be changed.

Before assembling the new piston rings, carry out the check already described, bearing in mind that the distance between the two ends must be:

0,4 mm. for the seal rings 0,3 mm. for the scraper ring

If the play is found to be less, it must be brought to the right value by operating with a very fine file on the ends of the ring.

We repeat that if the rings only are changed, roughness must be restored as indicated above.

B.3. • PISTON PIN • BUSHING • PISTON

The piston pin must be lightly forced into the piston, while it must have
a clearance not exceeding 0.07 mm. in relation to the bushing of the connecting rod small end. If a check of any wear of the piston pin shows a larger clearance, the bushing must be changed. After replacement and boring the clearance between piston pin and hole must be 0.02-0.03 mm.

B.4. • ENGINE SHAFT

The engine shaft must be carefully washed so that its condition can be checked, and in particular the state of out-of-roundness of the connecting rod and bearing pins.

Remove the closing flange of the chamber in the connecting rod pin:
this chamber is the place where part of the foreign matter contained in the oil accumulates (through centrifugal force).

Whenever the shaft is dismantled, this chamber and the oil inlet holes must be carefully cleaned. The maximum permissible wear limit is 0.10 mm.

The diameters of the pins on the new shaft are:

Connecting rod pin

0

0-42—

0.013

Flywheel side bearing

0

0 40—

0,010

Distribution side bearing pin

0

0 42—

0.010

Two undersize for the connecting rod pin are provided for: 0,25 and 0,50.

The connecting rod bearing is in fact of foliated type and does not allow any adjustment; hence the operation of grinding the appropriate pin is of great importance, since correct play depends on the precision with this operation is performed. The pin can thus have two values:

0
41.75
0,013

0
0 41,5 —
0,013

For the main bearing pins the procedure is different as the appropriate bearings must be bored to size, after their operation in the bearing boxes, according to the diameter to which the pins have been reduced as a result of grinding.

Grinding must remove only what is indispensable in order to obtain a perfectly smooth and round surface.

The maximum reduction allowed for main bearing pins is 1 mm.
The play resulting from coupling the main bearing pins-bearing must be:

0.04 • 0,06 mm.

B.5. • INJECTION PUMP

It must be inspected in a specialized Workshop, since only an expert is capable of judging whether the pumping element and valve need to be changed or not.

B.6. • CYLINDER AND CYLINDER-HEAD HOLDING-DOWN STUDS

The studs holding down the cylinder and cylinder-head (Table 1) are coated with special material resisting marine corrosion.

If on disassembly it is found that the coating is damaged and leaves the metal bare, the stud must be changed for a new one with the coating intact. Otherwise, the stud will oxidize in time, with the risk that it may break.

Values of tightening couples

Cylinder-head nut	6 Kgm.
Nut fastening spray nozzle holder	2,5 Kgm.
Nut fastening flywheel	14 Kgm.
Connecting rod screw	5,5 Kgm.

Table of the most common causes of engine breakdown

Problem	Probable cause	Remedy
Engine knocks more than usual	The atomiser is dripping fuel, which enters combustion chamber without being atomised	Remove atomiser from its block and withdraw needle (see page 4). Clean needle and slide with naptha. If after cleaning there is no improvement renew the atomiser.
	Wrong injection pressure	The injection pressure must be as prescribed. Adjust atomiser setting (see page 4)
	The big end bearing has too much clearance.	Check crank pin and bearing.
The engine splutters and stops	Lack of fuel	Fill up with carefully filtered diesel oil
	Engine is overloaded	Reduce load
	The air filter is dirty	Clean the filter – Page 13
	The injection pump or the atomiser are not functioning properly.	Repair or replace faulty components
Engine will not start	Fuel filter clogged	Clean filter, and if necessary the tubing
	Inlet and exhaust valves sticking	Lubricate valve guides with a few drops of naptha
	Inlet and exhaust valves not correctly set	Set tappets to normal clearance
	Low compression (engine offers low resistance to top dead centre on compression stroke)	Valves not closing properly. Grind in valves. When refitting cylinder head tighten down bolts evenly.
		Piston rings coked up or damaged and do not hold compression. Clean rings so that they turn smoothly in the piston channelling. Renew rings found in poor condition.

The Injection pump

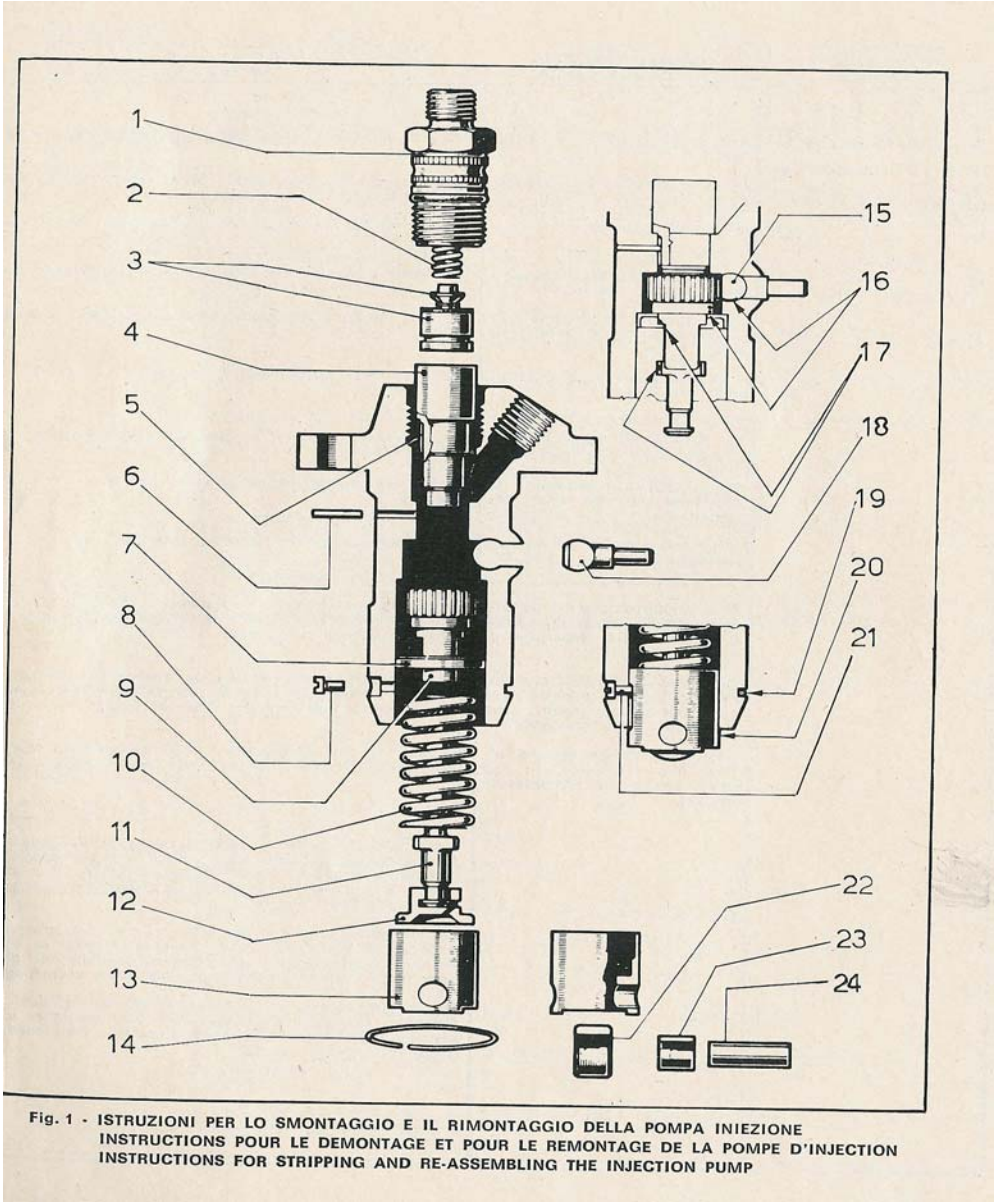
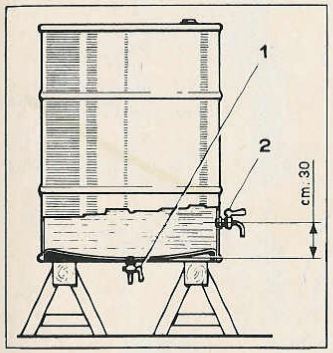


Fig. 1 - ISTRUZIONI PER LO SMONTAGGIO E IL RIMONTAGGIO DELLA POMPA INIEZIONE
INSTRUCTIONS POUR LE DEMONTAGE ET POUR LE REMONTAGE DE LA POMPE D'INJECTION
INSTRUCTIONS FOR STRIPPING AND RE-ASSEMBLING THE INJECTION PUMP

1) Fuel pipe infeed union.
2) Valve spring.
3) Infeed valve with seat and gasket.
4) Cylinder — Must never be substituted singly but always with piston. To take out, tap with a piece of fibre or brass.
5) Cylinder position fixing notch.
6) Cylinder position dowel. Must enter cylinder notch.
7) Upper spring cap.
8) Rocker stop stud.
9) Adjustemt coupling.
10) Rocker spring.
11) Piston — Do not replace without new cylinder.
12) Lower spring cap.
13) Rocker block.
14) Split ring holding rocker stop stud.
15) Slide adjustment rod up to middle position.
16) The mark etched on the adjustment rod must coincide with the two dots etched under the coupling.
17) The mark on the coupling must coincide with the mark on the piston intake vane.
18) Adjustment Rod.
19) Remove ring,
20) push rocker block upwards,
21) and withdraw stop stud.
22) Outer roller.
23) Inner roller.
24) Pin.

Figures 4, 5 and 6



1) Rubinetto di spurgo.
2) Rubinetto combustibile depurato.

1) Purgeur.
2) Robinet du combustible purifié.

1) Drainage tap.
2) Purified fuel tap.

Fig. 4 - RECIPIENTE PER DECANTAZIONE DEL COMBUSTIBILE.
CUVE DE DECANTAGE DU COMBUSTIBLE.
FUEL DECANTER TANK.

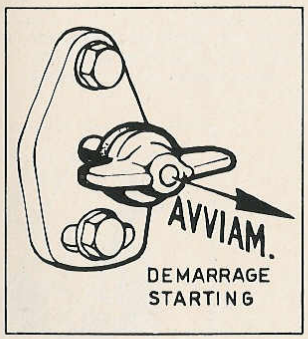


Fig. 5 - AVVIAMENTO - Tirare in fuori la maniglia per ottenere il supplemento combustibile.
DEMARRAGE - Tirer la poignée vers l'extérieur pour obtenir le supplément combustible.
STARTING - Pull out handle to obtain fuel supplement.

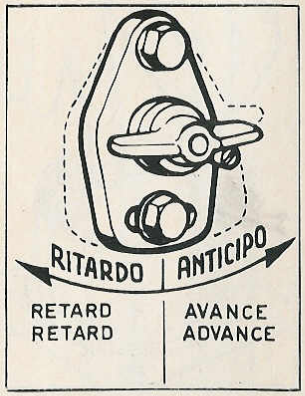


Fig. 6 - REGISTRAZIONE DELLA FINE POMPATA.
REGLAGE DE FIN POMPAGE.
SETTING END OF PUMP ACTION.

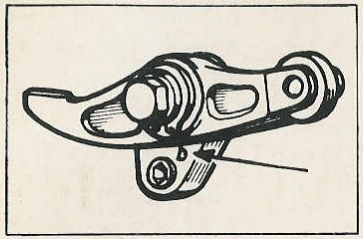


Fig. 7 - PERNO DI SUPPORTO DEL BILANCIERE INIEZIONE.
AXE DE CULBUTEUR POMPE INJECTION.
INJECTOR ROCKER SHAFT.

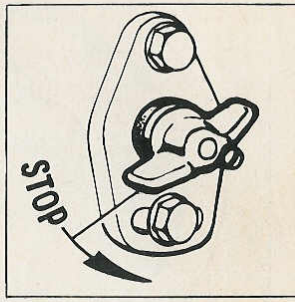


Fig. 8 - COMANDO STOP - Girare verso sinistra la maniglia senza tirare.
COMMANDE DU STOP - Tourner la poignée vers la gauche sans la tirer
STOP CONTROL - Turn handle to the left without pulling outwards.

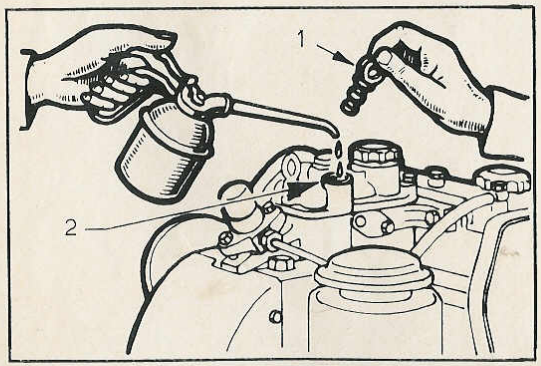


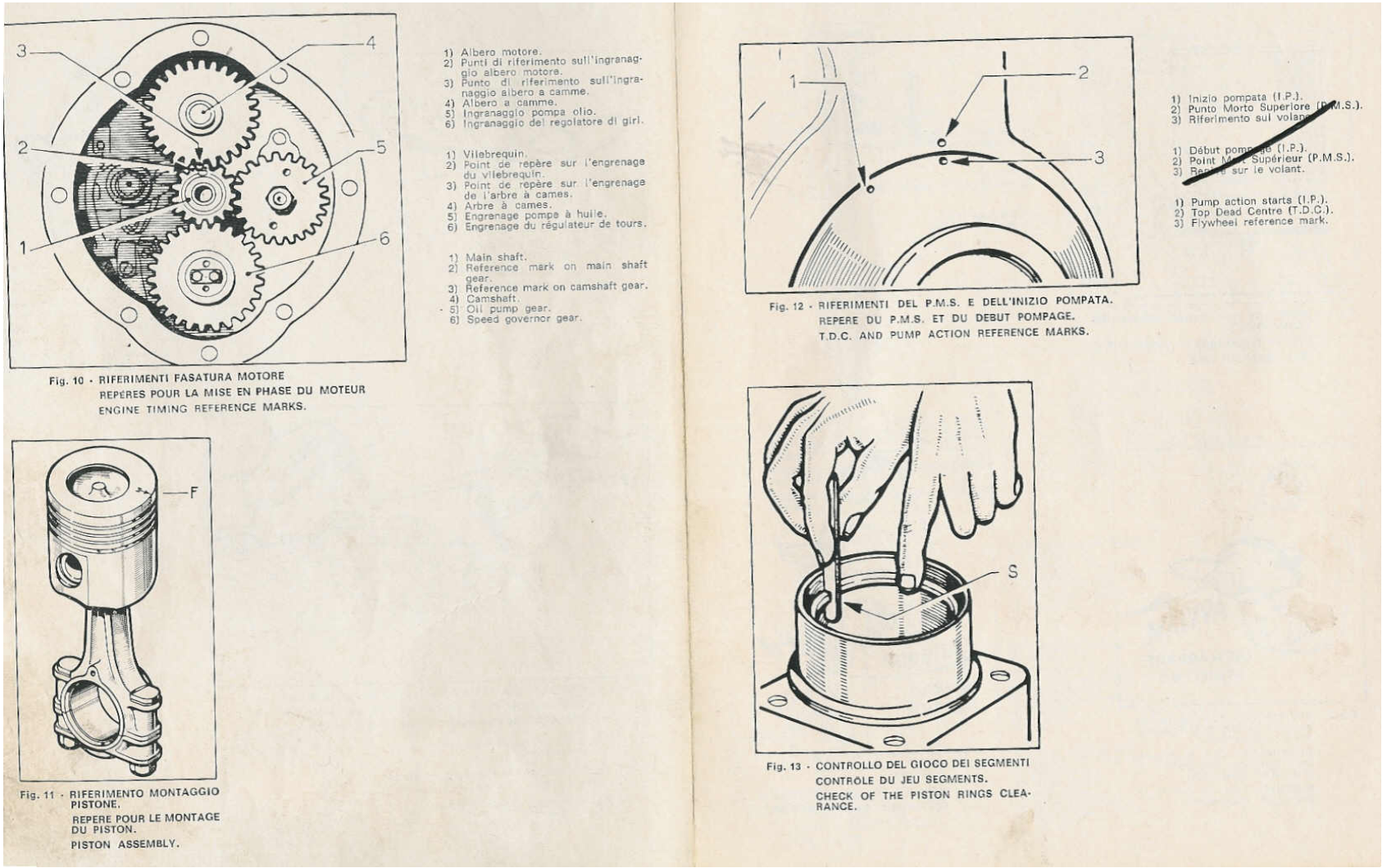
Fig. 9 - PREPARAZIONE PER L'AVVIAMENTO IN CLIMA RIGIDO.
PREPARATION POUR LE DÉMARRAGE EN CLIMAT FROID.
PREPARATION FOR STARTING IN COLD CLIMATE.

1) Tappo di chiusura pozzetto starter.
2) Pozzetto starter.

1) Bouchon de fermeture du puits du starter.
2) Puits du starter.

1) Rubber plug for starter reservoir.
2) Starter reservoir.

Figures 10, 11 , 12 and 13



1) Albero motore.
2) Punti di riferimento sull'ingranaggio albero motore.
3) Punto di riferimento sull'ingranaggio albero a camme.
4) Albero a camme.
5) Ingranaggio pompa olio.
6) Ingranaggio del regolatore di giri.

1) Vilebrequin.
2) Point de repère sur l'engrenage du vilebrequin.
3) Point de repère sur l'engrenage de l'arbre à cames.
4) Arbre à cames.
5) Engrenage pompe à huile.
6) Engrenage du régulateur de tours.

1) Main shaft.
2) Reference mark on main shaft gear.
3) Reference mark on camshaft gear.
4) Camshaft.
5) Oil pump gear.
6) Speed governor gear.

Fig. 10 - RIFERIMENTI FASATURA MOTORE
REPÈRES POUR LA MISE EN PHASE DU MOTEUR
ENGINE TIMING REFERENCE MARKS.

Fig. 11 - RIFERIMENTO MONTAGGIO PISTONE.
REPERE POUR LE MONTAGE DU PISTON.
PISTON ASSEMBLY.

1) Inizio pompata (I.P.).
2) Punto Morto Superiore (P.M.S.).
3) Riferimento sul volano.

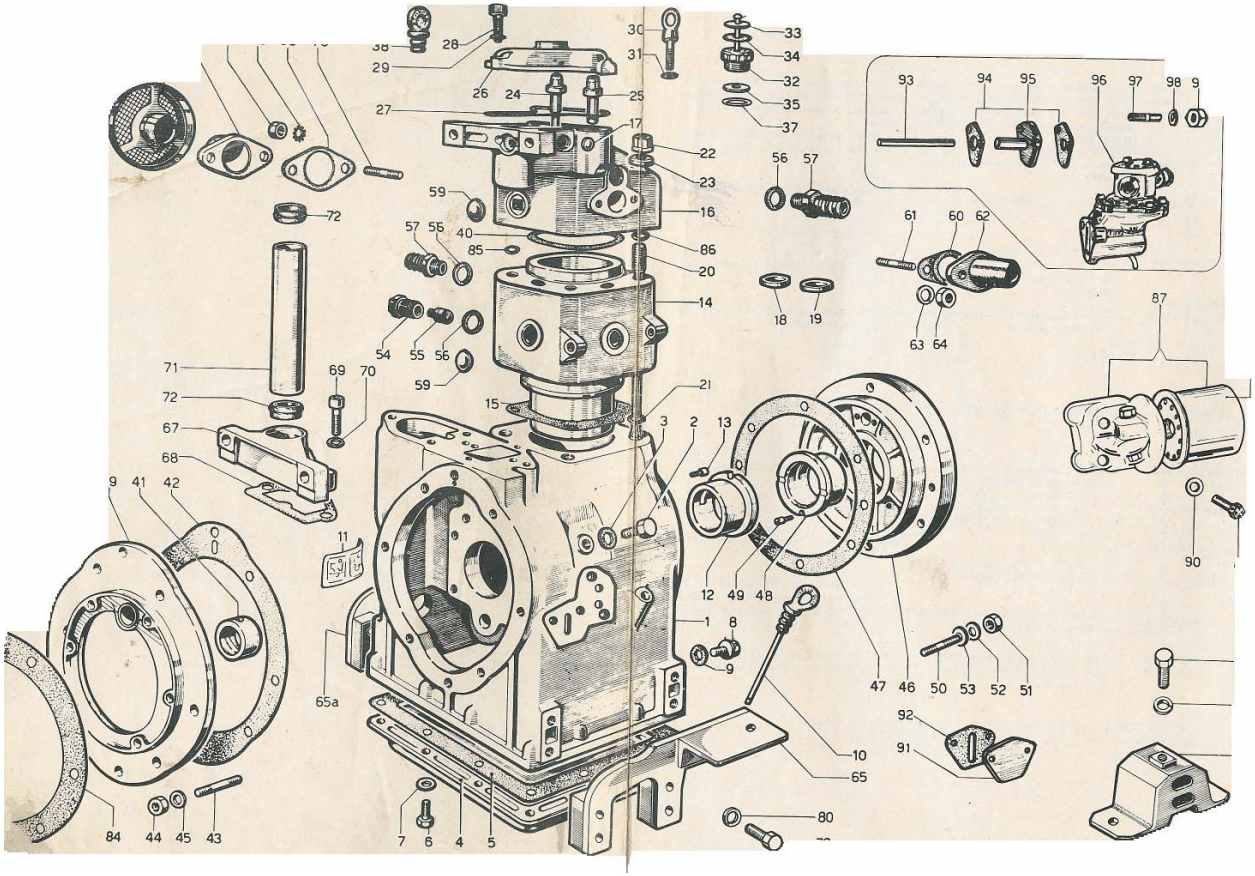
1) Début pompage (I.P.).
2) Point Mort Supérieur (P.M.S.).
3) Repère sur le volant.

1) Pump action starts (I.P.).
2) Top Dead Centre (T.D.C.).
3) Flywheel reference mark.

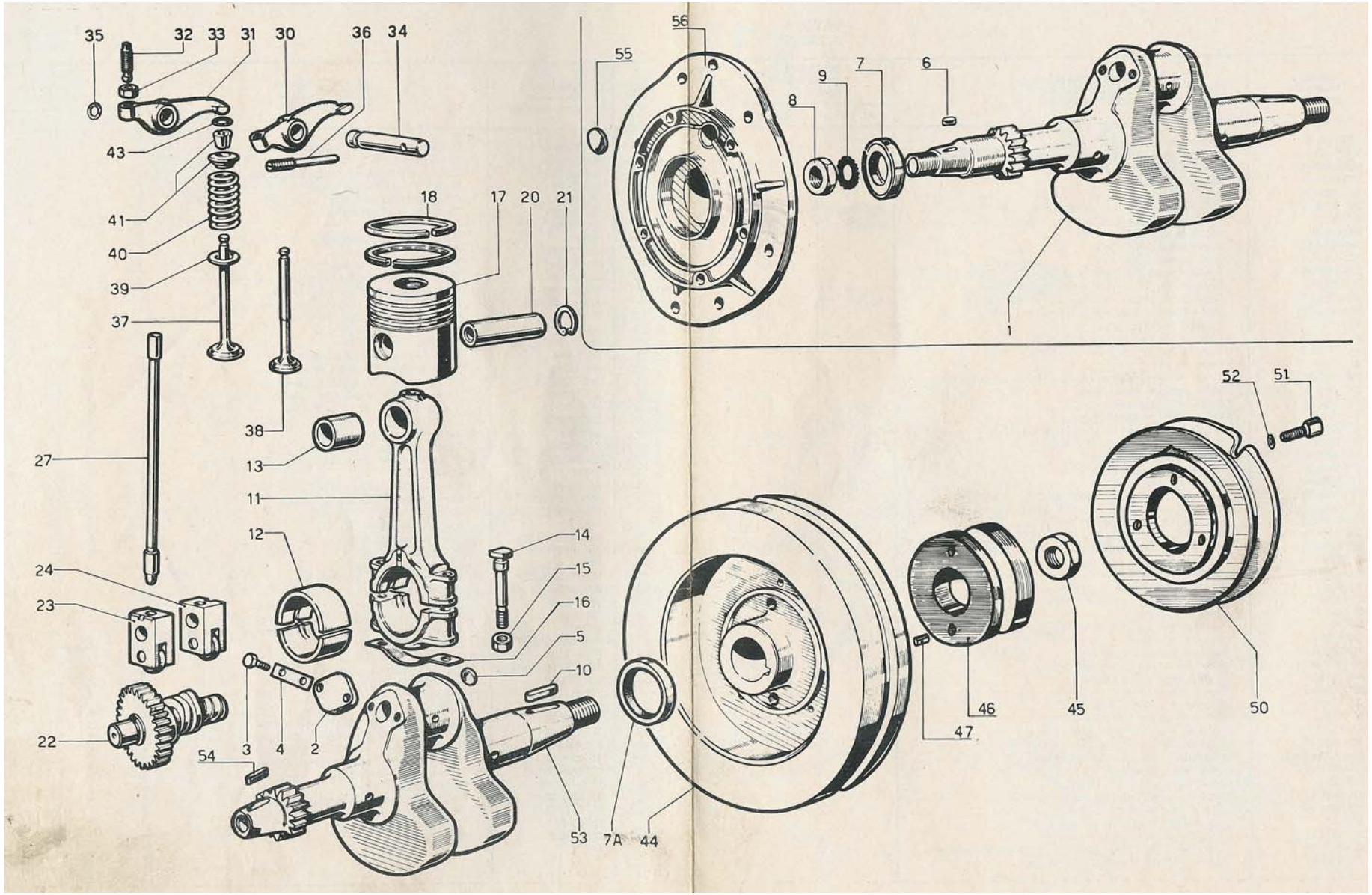
Fig. 12 - RIFERIMENTI DEL P.M.S. E DELL'INIZIO POMPATA.
REPERE DU P.M.S. ET DU DEBUT POMPAGE.
T.D.C. AND PUMP ACTION REFERENCE MARKS.

Fig. 13 - CONTROLLO DEL GIOCO DEI SEGMENTI
CONTRÔLE DU JEU SEGMENTS.
CHECK OF THE PISTON RINGS CLEARANCE.

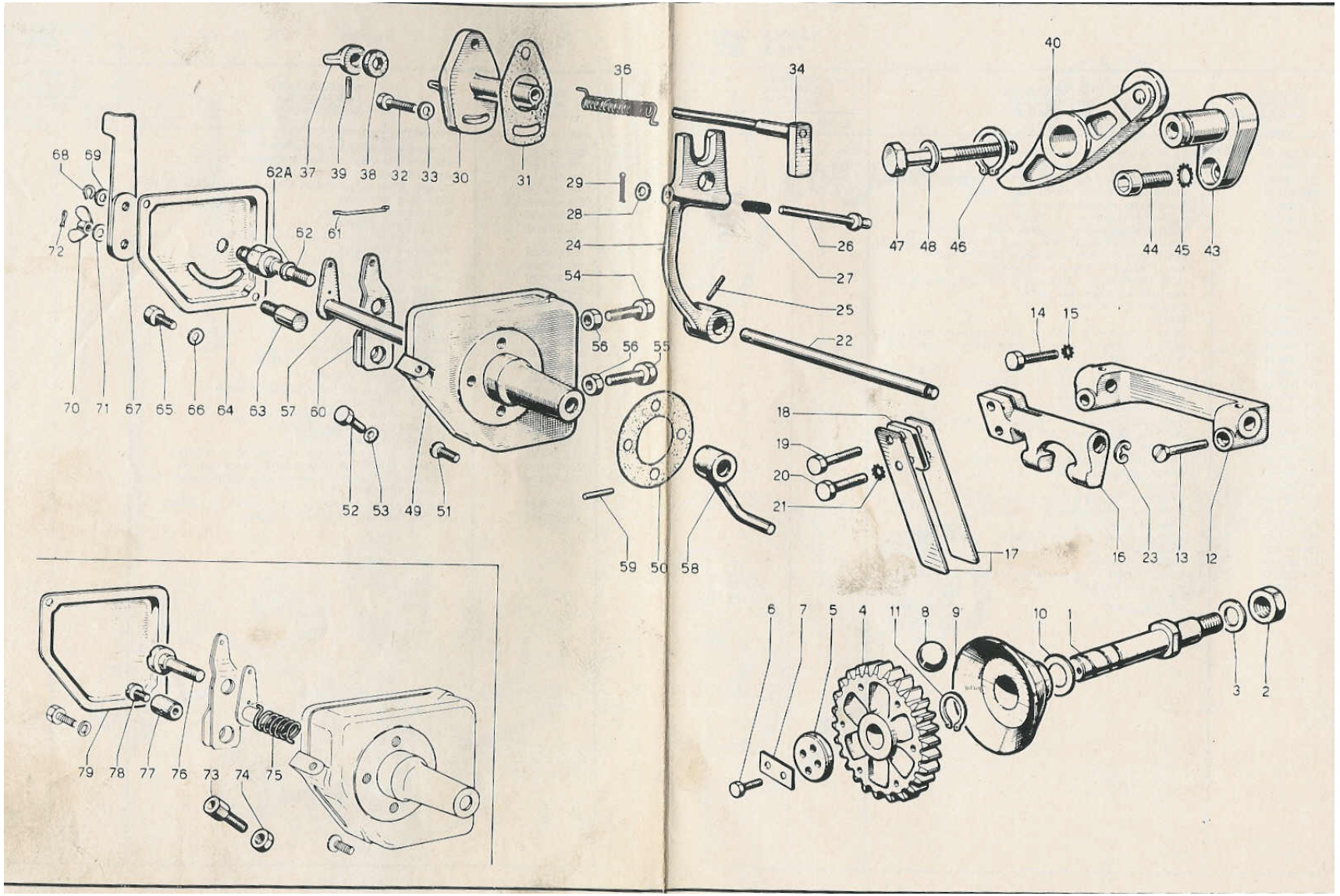
Crankcase – Cylinder head – Table 1



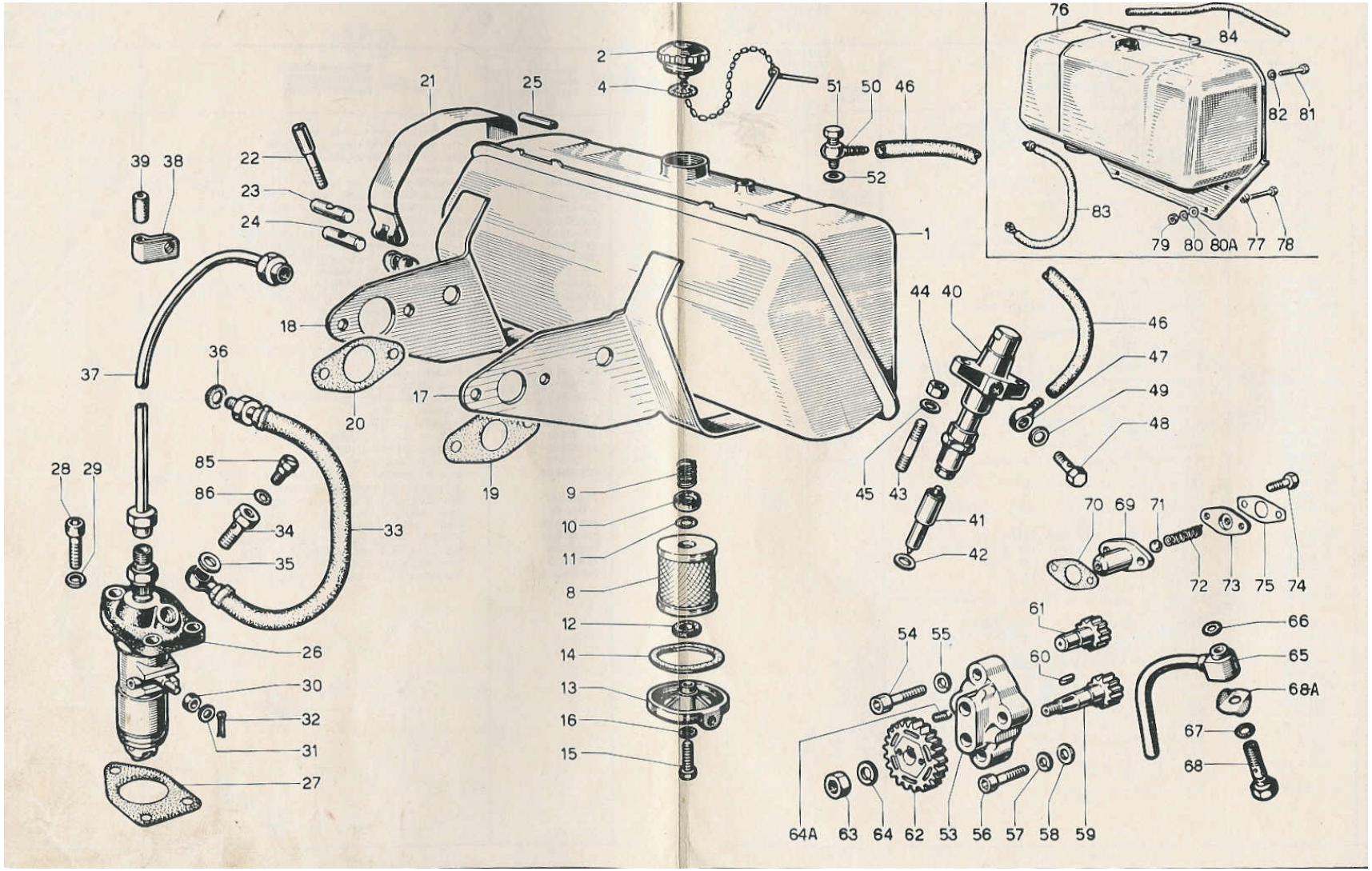
Crankshaft – Con Rod assembly – Drive – Table 2



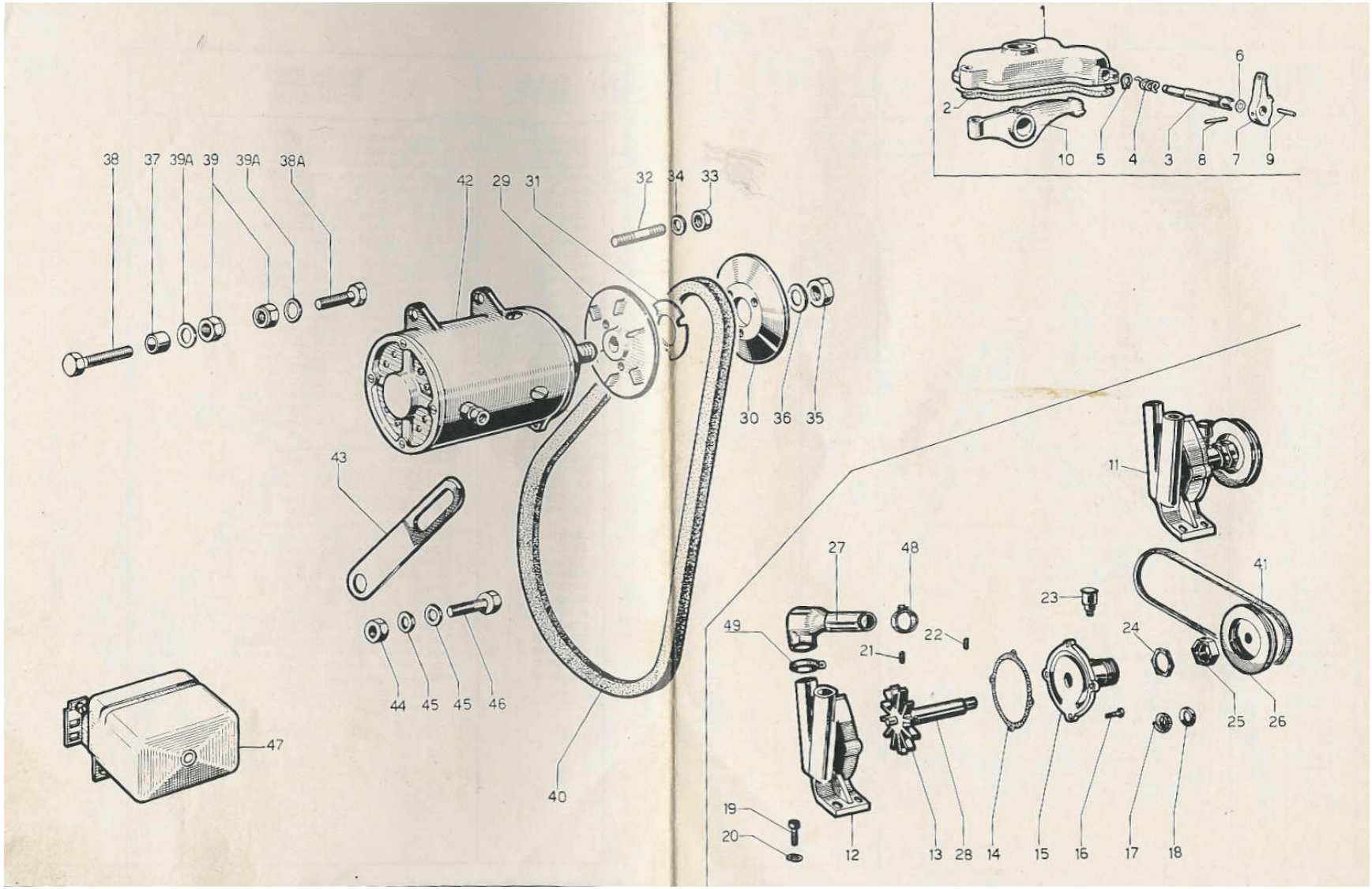
Governor – Accelerator Control – Table 3



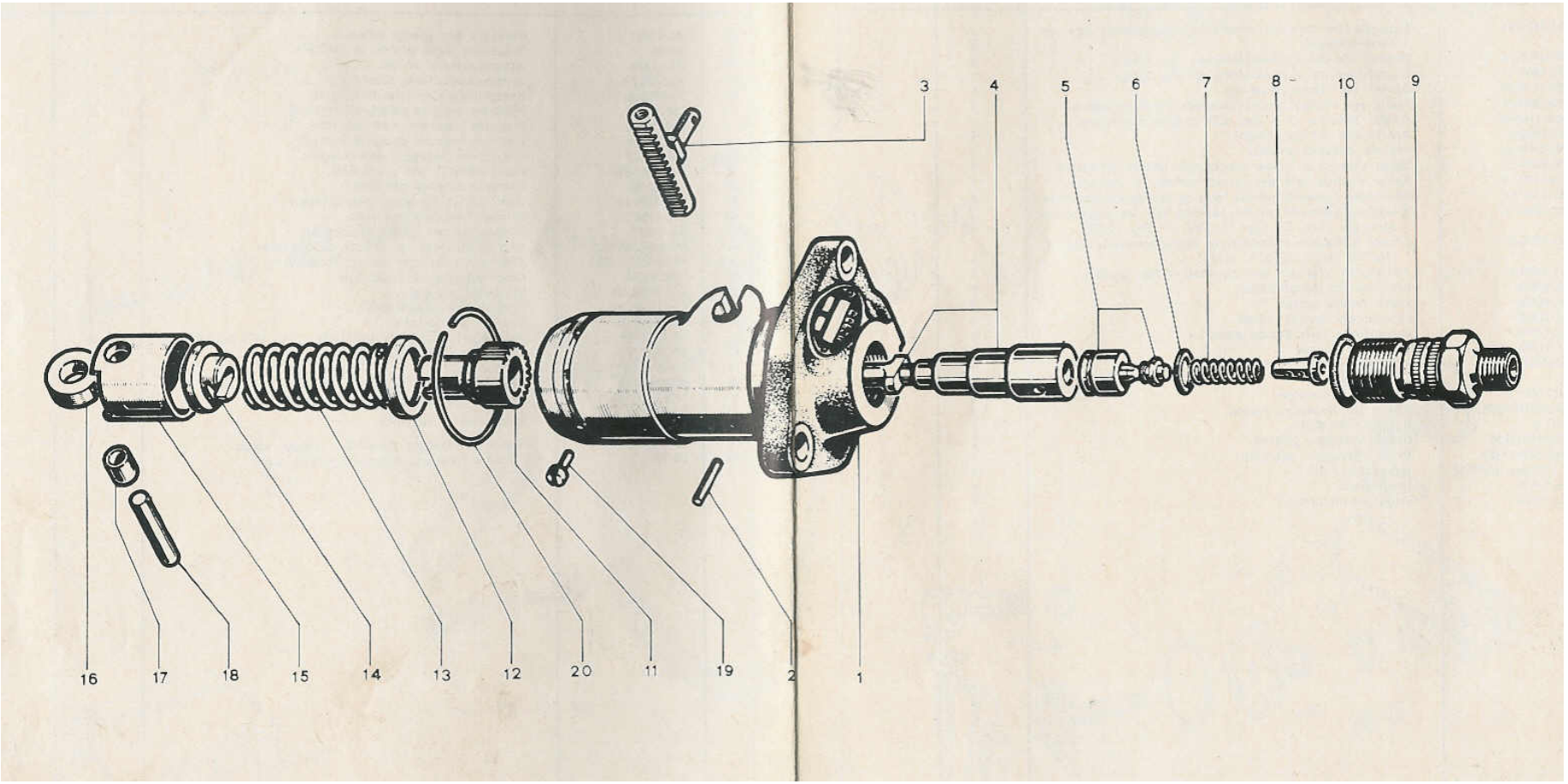
Fuel Circulation – Lubrication – Table 4



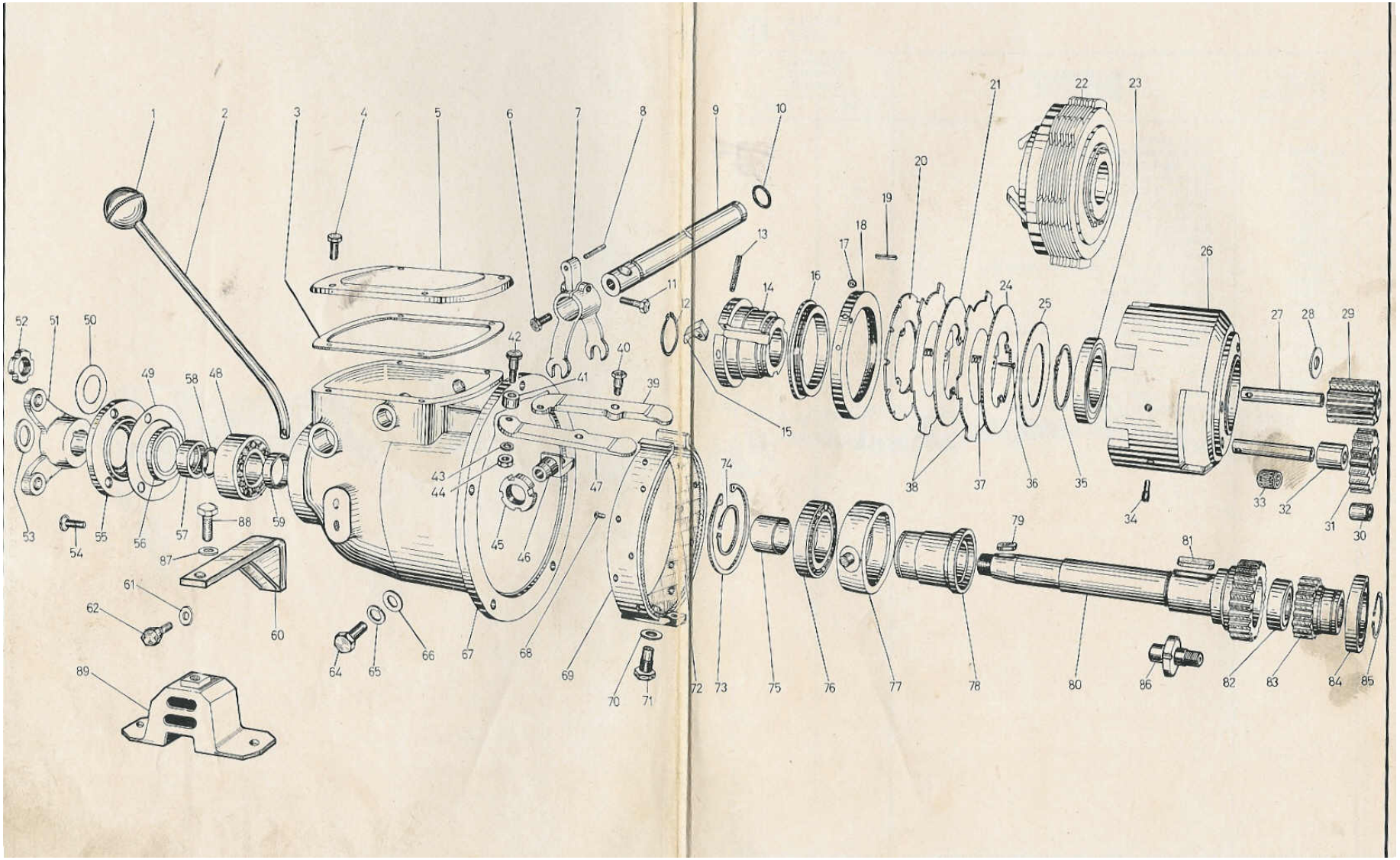
Electric starting equipment – Water pump – Table 5



Fuel Injection Pump – Table 6



Reversing Gear – Table 7



Reduction Gear – Table 8