LOMBARDINI

overhaul handbook

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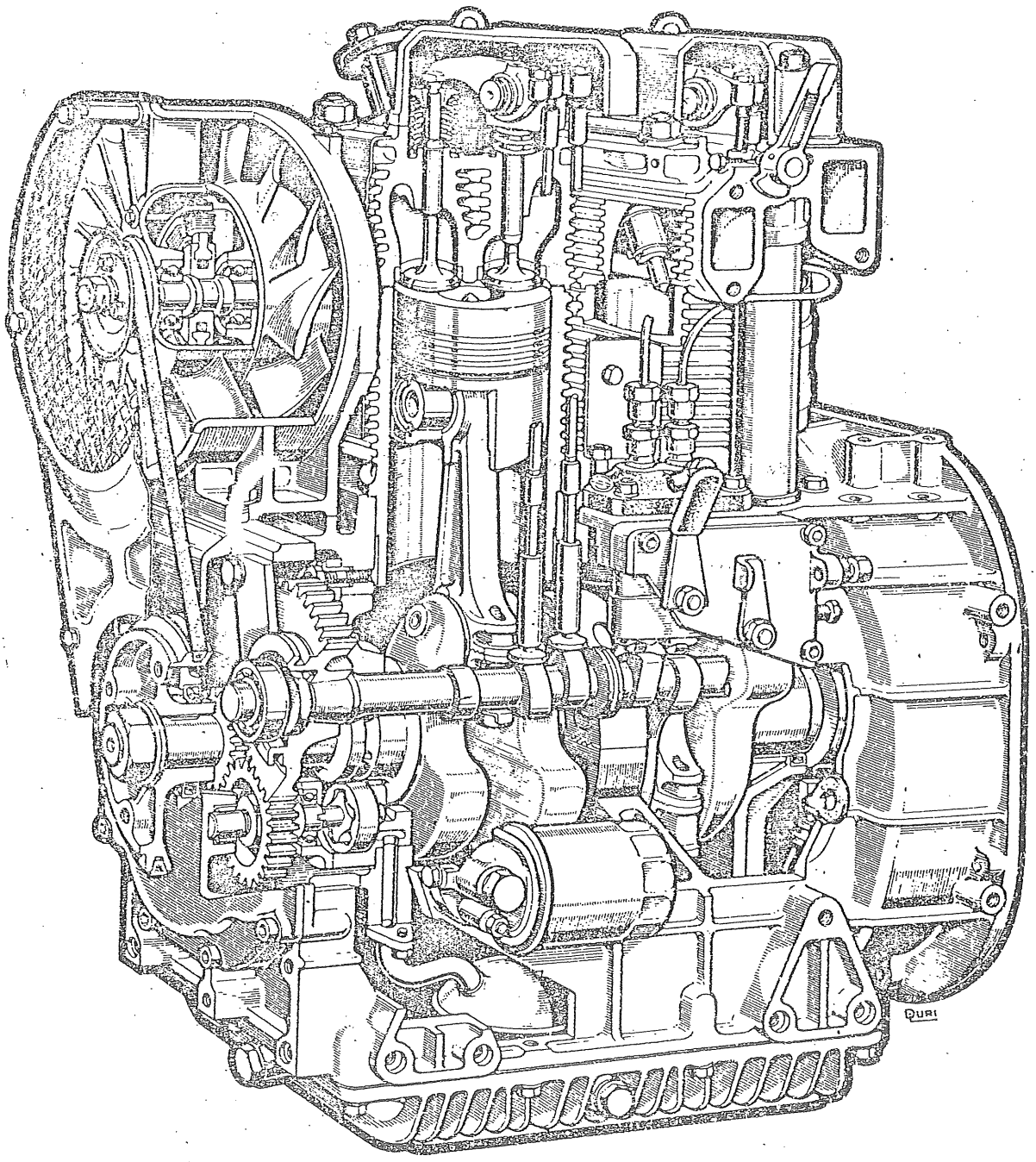

INDEX

D I S A S S E M B L Y

WARNING.

The instructions apply to engines updated to the publication date of the Workshop Manual. Check for possible modifications in the Service Letter File.

ENGINE IDENTIFICATION.

Engine type is marked on the plate placed on the air shroud.
The serial number is written on the plate and on the opposite side of the crankcase.
(Figs.I - 2).

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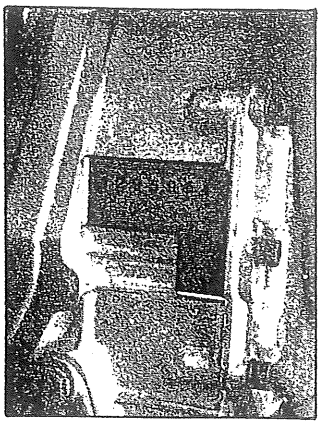
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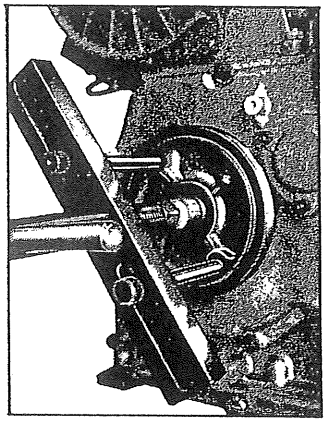
ENGINE PLACEMENT.

Set engine on rebuild stand and secure it by means of bolts through mount holes on air shroud side.

DISASSEMBLY.

After disassembling the accessories and external parts, strip down main internal assemblies with the special tools shown in the illustrations.
PULLER 7271-3595-28 for flywheel and blower drive pulley (Figs.3 - 4).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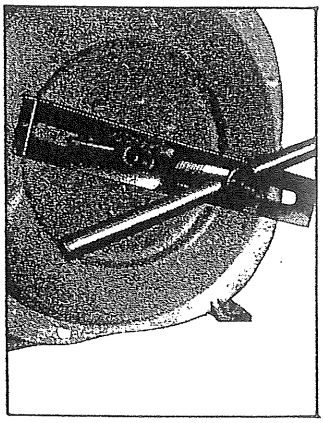
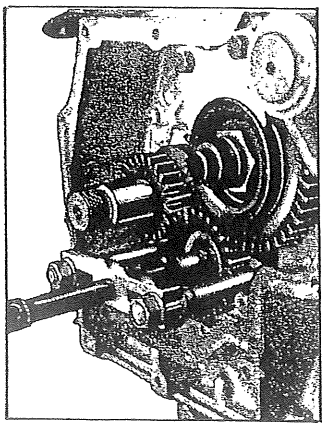

4

UNIVERSAL PULLER FOR OIL PUMP GEAR (Fig.5)

Avoid removing gear with hammer taps which would cause deformation to pump body.

UNIVERSAL PULLER FOR BALL BEARING OF OIL PUMP GEAR SHAFT (Fig.6).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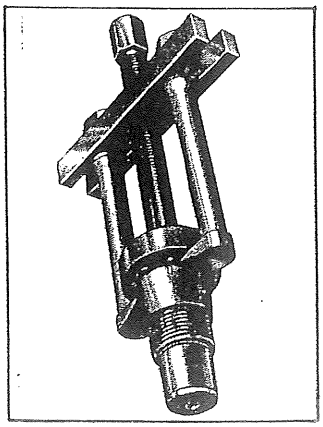
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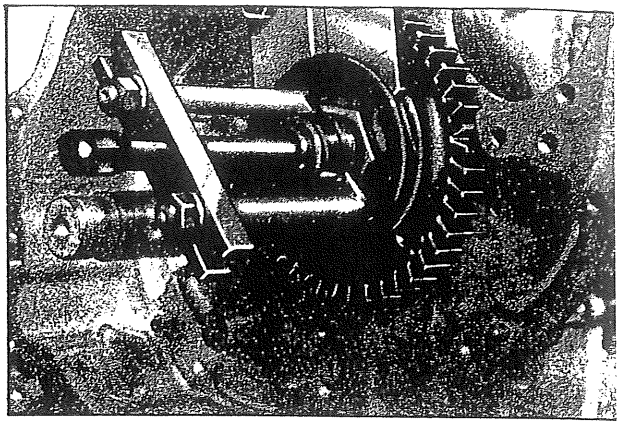
UNIVERSAL PULLER FOR ROLLER BEARING OF CAM SHAFT (Fig.7).

Avoid using other tools not to damage bearing housing and camshaft thread.



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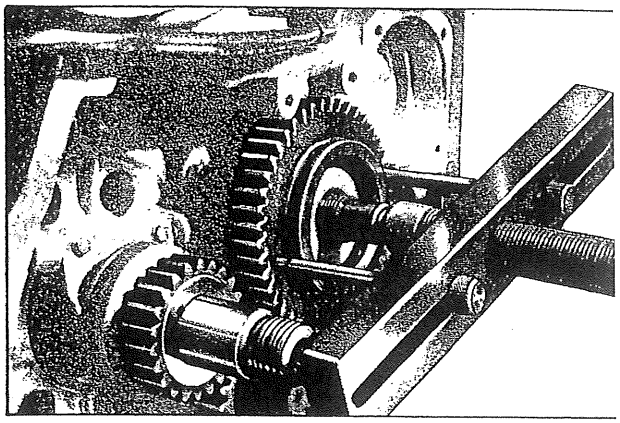
PULLER 7271-3595-28 FOR CAMSHAFT GEAR (Fig.8)



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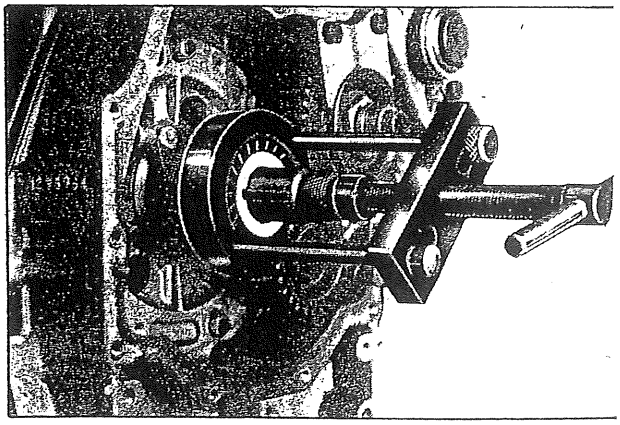
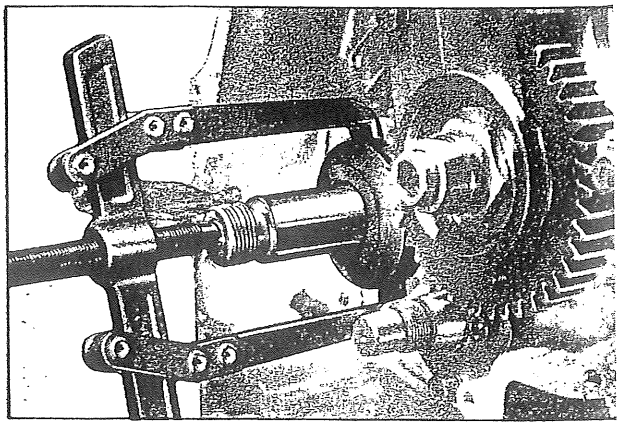
PULLER 7070-3595-26 WITH BRACE FOR CRANK-SHAFT DRIVING GEAR (Fig.9).

Inappropriate tools for disassembling of gear might damage toothing (Fig.8).



9

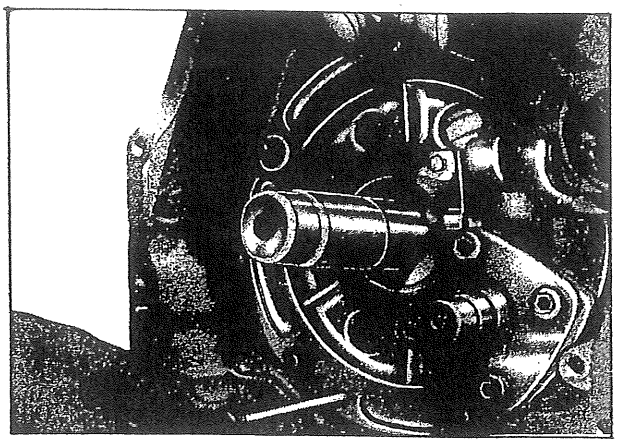
UNIVERSAL PULLER FOR GOVERNOR ASSEMBLY (Fig.10).



10

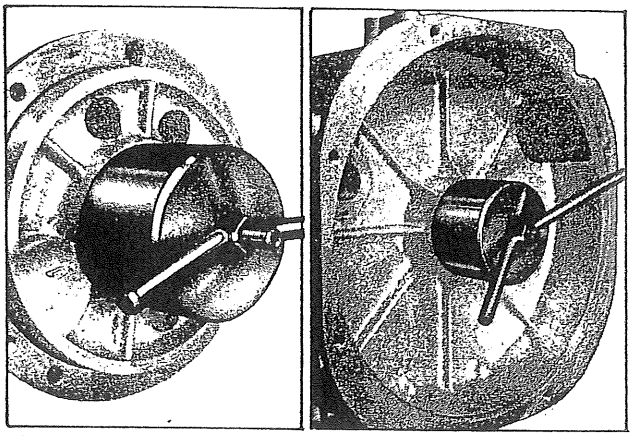
GEAR TRAIN SIDE MAIN SUPPORT.

For disassembly use M8 x I,25 threaded bolts or pins (Fig.II).



11

55 mm. dia. BUSH PULLER 7276-3595-36 FOR MAIN BEARINGS (Fig.I2).



12

OVERHAUL / CHECKS.

The instructions apply to engines updated to the publication date of the Workshop Manual. Check for possible modifications in the Service Letter File.

CYLINDER HEADS.
Do not remove cylinder head when hot as this would cause deformation. Descale carbon deposits and check mating face on cylinder. If deformed, lap until face is restored.

COMPRESSION RELEASE LEVER.
If provided, a pressure release lever is set on each cylinder head (A - Fig.I3). Make certain the O ring is in perfect condition and the eccentric pin is not worn. The pin diameter must be II,95 to II,97 mm. and the height of the cam IO,4 to IO,5 mm. For different dimensions replace pin and reset sleeve in the head seat.

ROCKER ARMS.
Remove plug from shaft. Dip shaft in bath of oil and solvent. Remove dirt in the ducts with a metal needle. Replace plug. Clearance between rocker arms and shaft should be 0,03-0,06 mm. If clearance exceeds 0,1mm. replace worn parts. If surface contacting valve stem is worn, replace rocker arm.

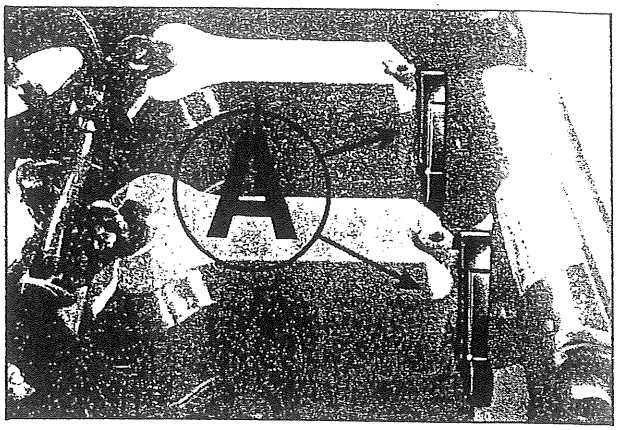
VALVES - GUIDES - SEATS.
After disassembling and descaling with a wire brush, check conditions of valves and replace them if valve heads are deformed, cracked or worn out.
To re-use slightly worn valves, we recommend restoring seat area with a 45° valve grinder.

DIMENSIONS FOR VALVES, GUIDES AND SEATS AFTER ASSEMBLING IN CYLINDER HEAD (Fig.I4), mm.

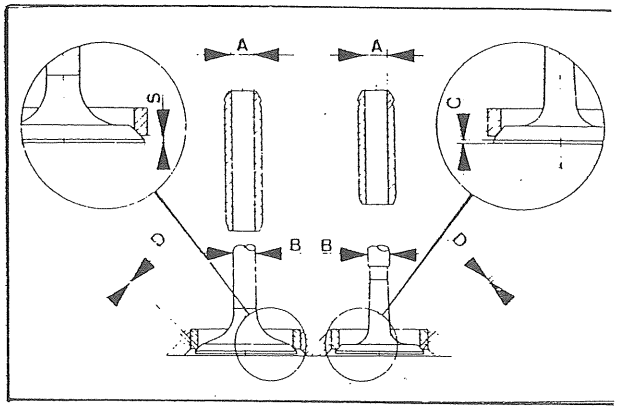
Dimension	New	Worn Limit
A	8,03-8,05	0,15 (clearance)
B	7,98-8,00	
C	0,60-0,80	0,40
D	I,40-I,60	2,00
S	I,30-I,50	0,90

Check that guides bore has no scores, seizure marks or carbon deposits. Clean with wire brush and gasoline and check clearance from table above. Guides can be replaced with others having a 0,5 oversize O.D., proceeding as follows :

- Remove worn guides with a punch from cylinder head surface.
- Ream housings in cylinder head.
- Grind oversize guides to an O.D. of 0,05-0,06 mm. in excess to the housing dia.
- Heat up cylinder head in oven to I60°-I80°C.
- Drive in guides with a press or punch (Fig.I5
- Insert valves and check that they slide freely in guides with 0,03-0,07 mm. clearance.



13



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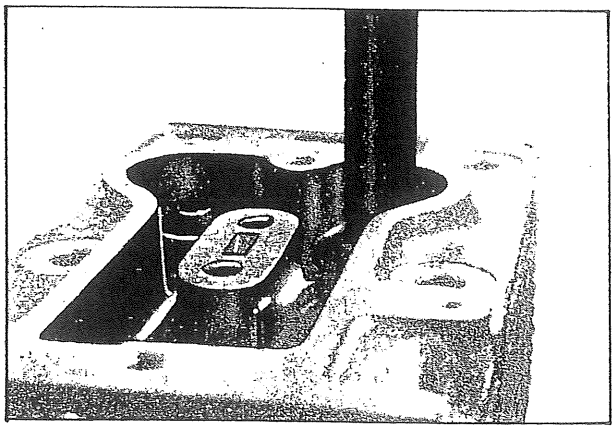
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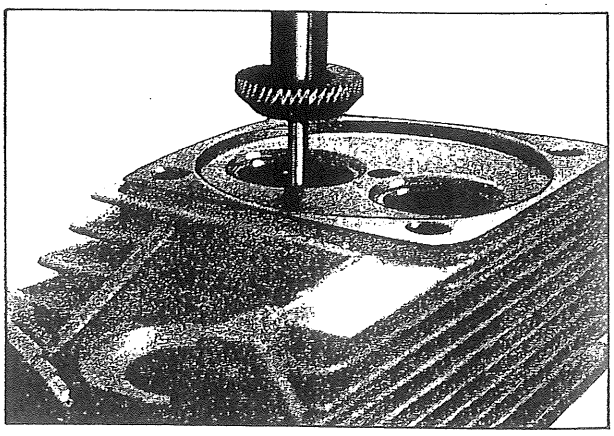

16

With standard 45° cutters with 40-42 mm. dia. and 8 mm. stem mill valve seats to the following dimensions (Fig.I6).

Ø Intake seat dia. 36 mm.

Ø Exhaust seat dia. 32 mm.

Lap valves in seat with fine grinding compound in oil suspension.
If after seat milling the dimension S (Fig.I4) is less than 0,9 mm. or if mating face width (D Fig.I4) exceeds 2 mm., replace seat as follows :

- With a 2-3 mm. tip drill a few holes in some spot of the seat and cut through with a chisel without damaging housing.
- Pull out seat.
- Heat head in oven to I60°-I80°C.
- Insert seat and set it with a plug or a used valve.

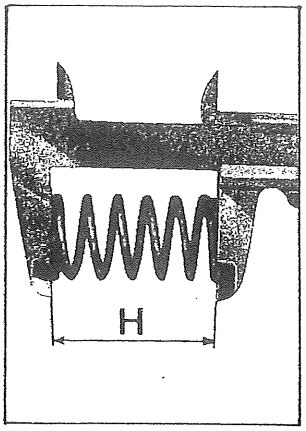
We recommend having this job done by a skilled grinding shop.
Seat and valve grinding or replacement always require lapping.
When assembling valves, insert rubber seal on intake valve stem.

VALVE SPRINGS.
Check if springs are damaged or have lost their elasticity. Free length must be 5I,5 to 52,5 mm.
Replace springs if length is shorter (Fig.I7)

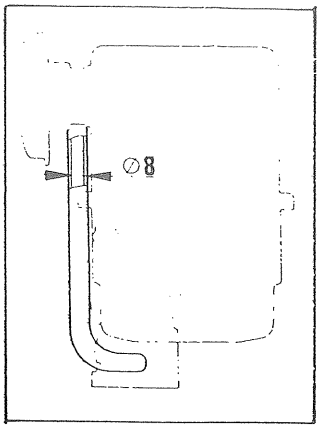
BREATHER.
A hose between fuel pump support and air cleaner, recycles oil vapours and provides suction inside the crankcase (Fig.I8).
Replace the hose (int.dia.8 mm.) if broken or out of shape.

FILTERS.
Air cleaner. (Fig.I9).
Disassemble and replace seal ring (I) and rubber spacer (2) if damaged (Fig.20). Replace gasket between filter and manifold.
Wash filter element (3) with kerosene or solvent and replace it if metal screen is clogged or damaged.Clean bowl with kerosene and fill with clean oil up to level (4).
Engines operating for special purposes or under dusty conditions require special high capacity filters or with cyclonic prefilters.
After assembling engine, check vacuum at the intake (pg 32)at maximum r.p.m. If excessive, replace air cleaner filter element to prevent suction of oil from bowl, smoke or power loss.

FUEL FILTER.
It is built in the standard fuel tank on the flywheel side of the crankcase.
Remove filter element (I Fig.2I) from tank. Replace filter element and gaskets (2-3-4) if clogged or damaged. Clean tank internally. On request a filter detached from tank can be supplied. For installation and spares please refer to the Master Catalogue.



17



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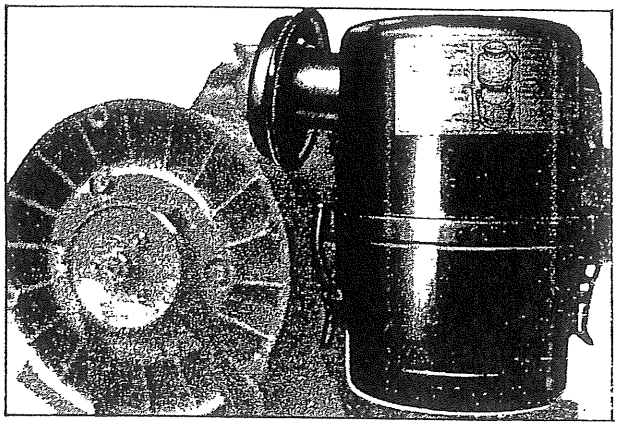
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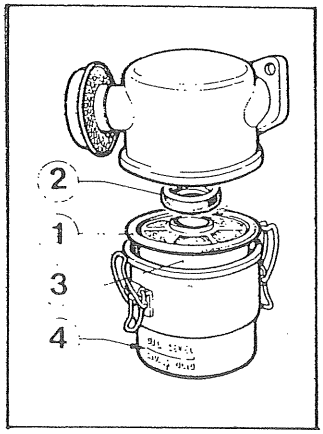

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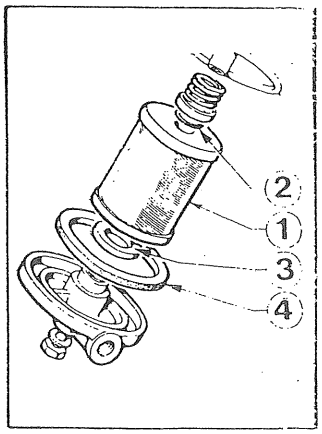

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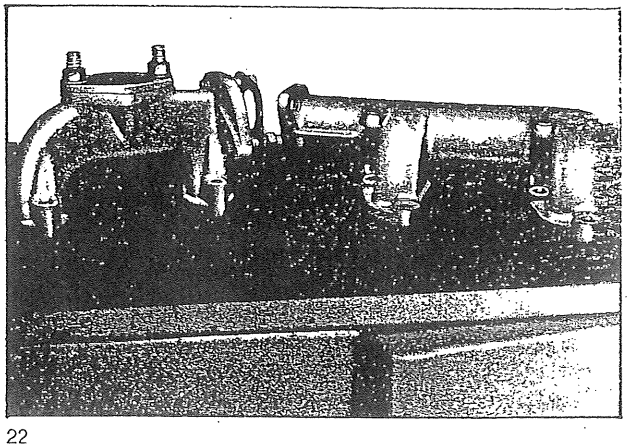

22

MANIFOLDS.

Check that connecting flanges to head are on the same plane, level them out if they are out of shape and always replace gaskets to prevent unfiltered air from being sucked in (Fig.22).

Inspect contact surface on intake manifold and air cleaner support.

PUSH RODS PROTECTION TUBES.

Replace seal rings. Check protection tubes and replace them if damaged or out of shape.

CYLINDERS.

Check with dial gauge wo inside diameters perpendicular to each other at three different heights (Fig.23).

INTERNAL DIAMETER OF CYLINDERS, mm.:

Engine	Standard	1st oversize + 0.5	2nd oversize + 1.0	diff. a-b
904	90.00÷90.02	90.50÷90.52	91.00÷91.02	0.00÷0.01
914-L20	95.00÷95.02	95.50÷95.52	96.00÷96.02	

Replace piston rings if cylinder diameter exceeds not more than 0,10 mm. the new dimensions or if it exhibits very light scores. In this case restore original roughness of cylinder by honing inside surface with emery cloth (grain size 80-100) soaked in Diesel fuel and working in a helical movement so as to obtain a crosshatched surface pattern of 0,8-1,2 microns (Fig.24).

If inside surface shows scores or wear beyond 0,10 mm. rebore cylinder and install oversize rings and pistons.

PISTONS AND RINGS.

Pistons diameter , in mm.

Engine	Standard	1st oversize + 0.5	2nd oversize + 1.0
904	89.85÷89.86	90.35÷90.36	90.85÷90.86
914-L20	94.85÷94.86	95.35÷95.36	95.85÷95.86

Measure piston skirt diameter at 2 mm. from base perpendicularly to piston pin (Fig.25) Maximum piston skirt wear must not exceed 0,05 mm. If cylinder wear is over 0,05 mm. and if cylinder wear is not over 0,10 mm., replace pistons and rings.

Check that piston pin bore is not out of round more than 0,05 mm.; otherwise, replace piston and piston pin.

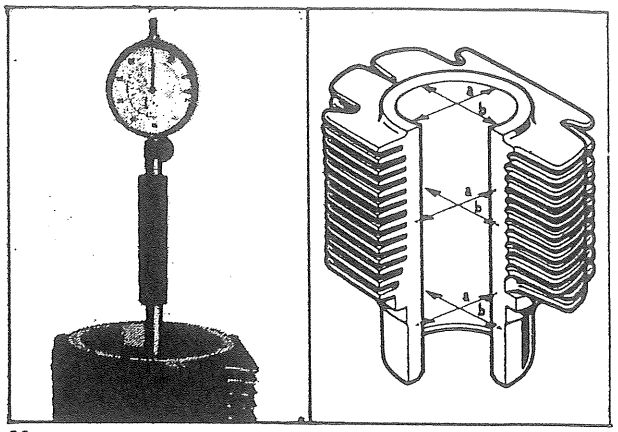
Remove rings with expander and descale accurately piston grooves.

Check for perfect mating between rings and cylinder throughout entire cylinder periphery, measure ring gaps and, if necessary, file ring ends (Fig.26).

DISTANCE OF PISTON RINGS ENDS , mm.

I-2-3 compression ring.	Oil control ring.
0,35÷0,55	0,25÷0,40

Make sure rings move freely in grooves and with a feelergauge measure ring to groove clearance. Replace piston and rings if dimensions exceed (Fig.27):



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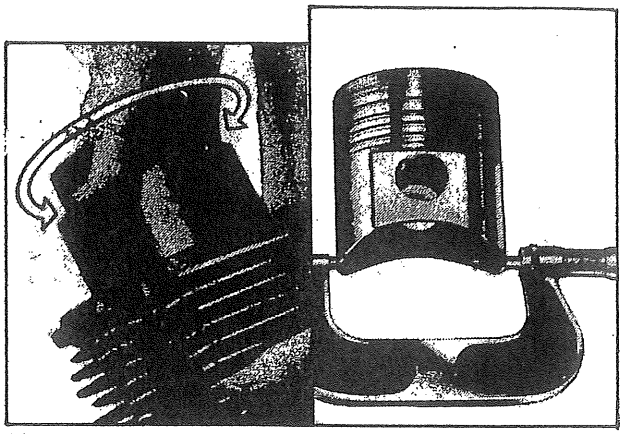
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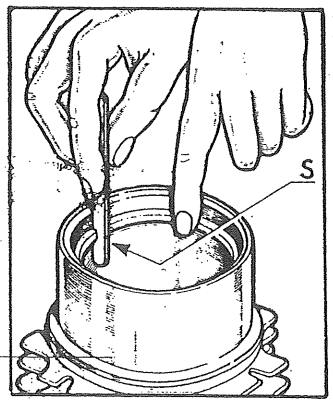

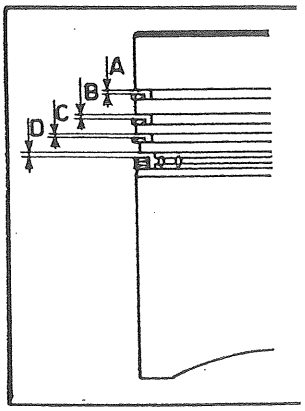

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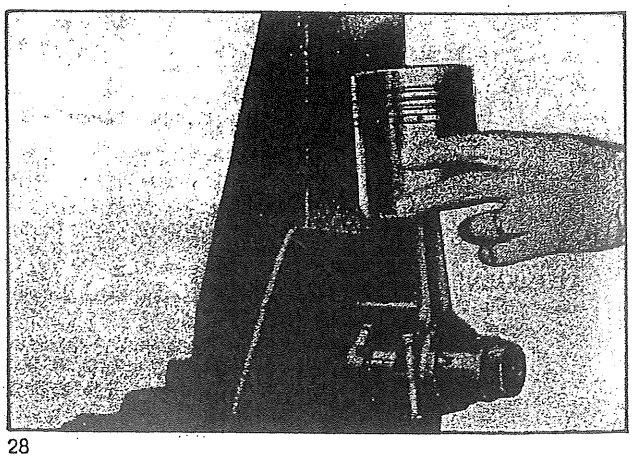

28

Ist compression ring	A	0,I5 mm.
2nd,3rd compression rings	B-C	
Oil control ring	D	0,I0 mm.

Should any replacement take place, make sure that weight of one piston does not differ more thas 6 grams from the other.

PISTON PINS AND CONNECTING RODS.
Check that piston pin has no trace of seizure marks; otherwise replace it. Measure piston pin and small end bushing diameters. Verify and replace outsized parts.

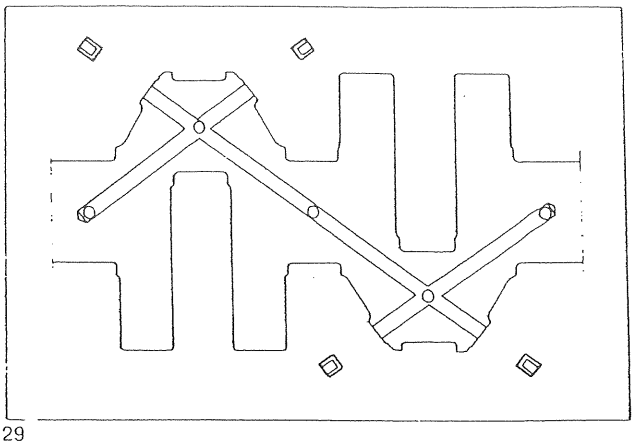
DIMENSIONS , in mm.

Bushing after assembly	Piston pin	Clearance	Limit
28,020÷28,030	27,995÷28,005	0,015÷0,035	0,050

Check parallelism of connecting axis (Fig.28) Maximum allowable out-of-alignment is 0,02mm. in any direction at the end of piston pin. If connecting rod is slightly out of alignment, straighten it out under a press with gradual stressing. Check that connecting rods weight difference does not exceed I0 grams.

CRANKSHAFT.
Cleaning.
Remove expansion plugs (Fig.29).
Immerse shaft in kerosene or solvent bath. With a metal tip remove all sludge from oil drillings.

Checks.
Make certain that crankshaft has no cracks, otherwise replace it. Crank journals and crankpins must have no scoring or seizure marks. Light scores or dents should be removed with a very fine carborundum file and finished with an equally fine-grain emery cloth. Coupling cones, splines and threads must not be out of shape. If they are, replace crankshaft. With a micrometer measure in two perpendicular directions the diameter of the crank journals and crankpins (Fig.30) If wear exceeds 0,I0 mm. grind shaft and install undersize bearings.
After seizure, overheating or grinding make a Magnaflux check to make sure there are no surface cracks. After finishing or grinding, the hardness of the crank journals should be 50-60 Rockwell C. If below replace crankshaft Finished journals surface must be without scratches and have a roughness of 0,2-0,5 microns.
ATTENTION: during grinding of the main bearing and connecting rod journals, keep the journals fillet radius as indicated in Fig. 3I. If during grinding operations any material is removed from the shoulder of gear train side journal, it is necessary to remove the same quantity of material from the thrust surface of the facing thrust rings by bringing the value of journal overall length C (Fig.35) back to the standard measure (see table).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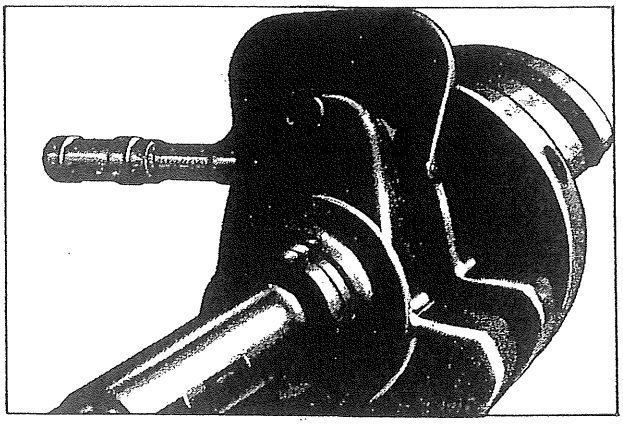
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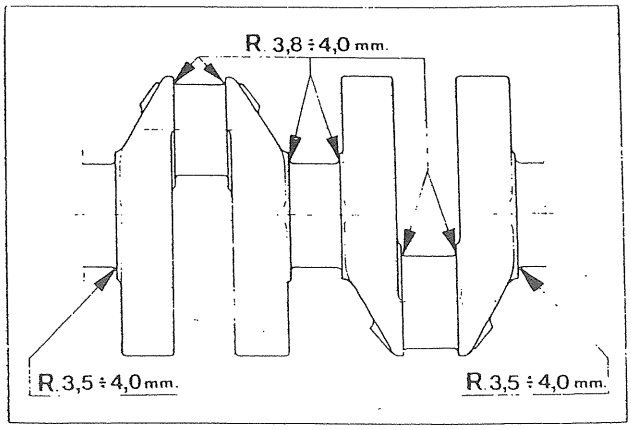

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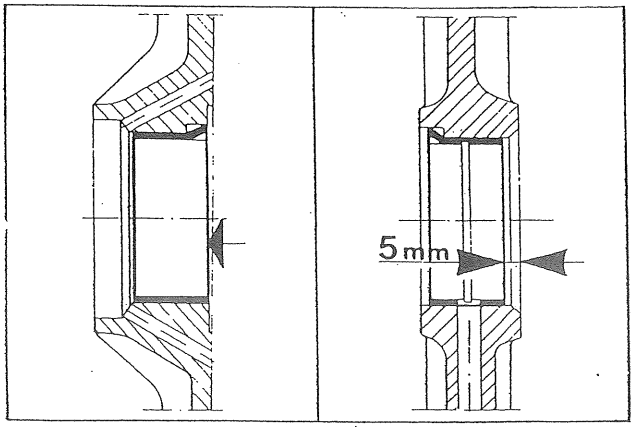
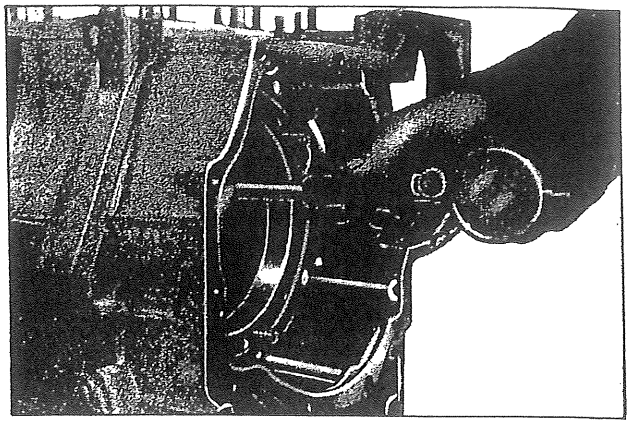


32 33

To remove main bearings from housings use puller 7276-3595-36. Assemble flywheel side bearing on crankcase as per Fig.32 and the gear train side bearing as per Fig.33, matching hole with oil line. Lubricate outside with vaseline to facilitate bearings setting on and prevent formation of air pockets. After assembly check internal diameter (Fig.34). Connecting rod big end bearings and centre support main bearing support require no adjustment. Those on flywheel side are supplied with 0,3 mm excess metal for reaming after mounting, according to table dimensions.



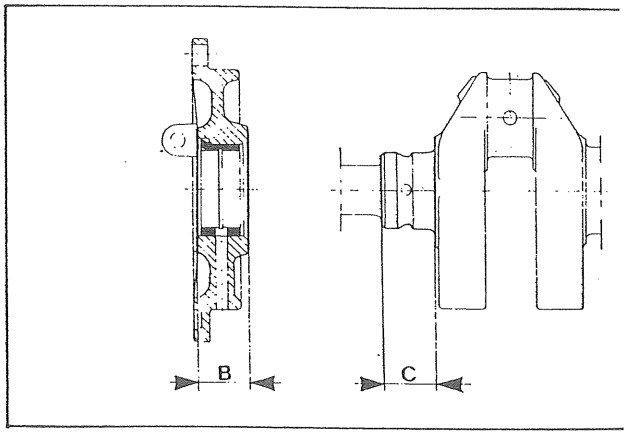
34

DIMENSIONS OF CENTRE BEARING JOURNAL, in mm.

Dimension	Journal dia.	Bearing-Journal Clearance	
		Assembly	Worn limit
Nominal	55,34÷55,35		
Ist U.size 0,25	55,09÷55,10	0,05÷0,09	0,12
2nd U.size 0,50	54,84÷54,85		

DIMENSIONS OF MAIN BEARING JOURNALS, in mm.

Dimension	Main bearing journal dia.	Bearing-Journal Clearance	
		Assembly	Worn limit
Nominal	54,94÷54,95		
Ist U.size 0,25	54,69÷54,70	0,05÷0,07	0,12
2nd U.size 0,50	54,44÷54,45		



35

DIMENSIONS OF CONNECT. ROD JOURNALS, in mm.

Dimension	Journal dia.	Bearing - Journal Clearance	
		Assembly	Worn limit
Nominal	49,989÷50,000		
Ist U.size 0,25	49,739÷49,750	0,03÷0,07	0,10
2nd U.size 0,50	49,489÷49,500		

END PLAY.

Check on four diametrically opposed points that dimensions of the gear train side support (B) and of the crankshaft journal (C) (Fig.35) are according to the following table (mm):

B	C
33,90 ÷ 33,95	34,10 ÷ 34,15

Crankshaft end play is 0,15-0,25 mm. and it is not adjustable. If play exceeds above values, check tightening of nut on the gear train side and replace unsuitable parts.

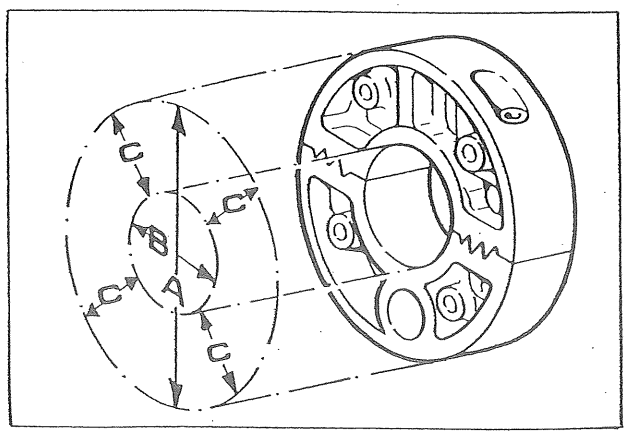
CRANKSHAFT CENTRE SUPPORT.

It must be free from dents or burrs in the toothed end. With tightening of bolts at 2,5 Kgm. the external diameter (A) and the housing of the bearing (B) must be mm. (Fig.36)

A	B
154,980÷154,990	59,074÷59,093

Permissible concentricity error(C)is0,01 mm.

For different sizes, replace support.



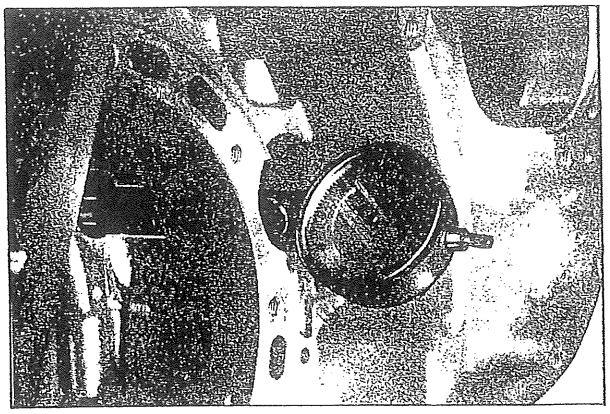
36

CAMSHAFT.

Remove bearing and gear (Fig. 7-8). Replace roller bearing if radial play is not within 0,01-0,05 mm. or if tracks or rollers are damaged.

Clean oil pipes.

Check that cams and journals are not worn or scratched and make sure that "O" ring of camshaft cover (on flywheel side of the crankcase) is in perfect condition and seals perfectly. Check alignment. If deflection of central journal exceeds 0,10 mm. straighten shaft under a press.



37

CAMSHAFT JOURNALS DIMENSION in mm. (Fig.37)

Ø Journal	Housing-Journal Clearance	
	Assembly	Worn limit
29,940-29,960	0,040÷0,085	0,100
40,940-40,960		

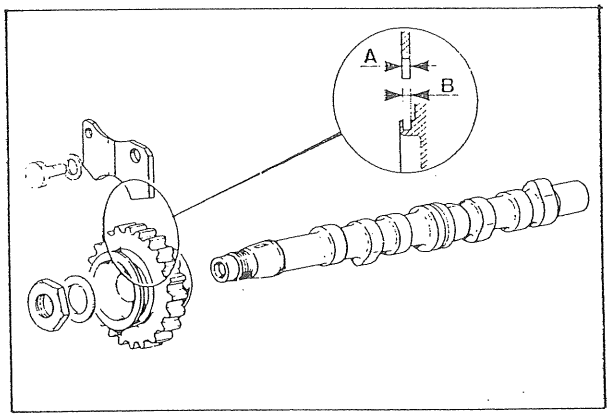
If clearance between journal and housing exceeds 0,100 mm. replace worn parts.

CAMSHAFT END PLAY.

Thickness of setting plate (A) and width of groove (B) on camshaft gear, in mm. (Fig.39)

A	B
5,7 - 5,8	6,0 - 6,1

Camshaft end play on assembling is 0,2-0,4 mm. If it exceeds 0,8 mm. replace worn parts. After camshaft is assembled, check cam timing (see page 28).



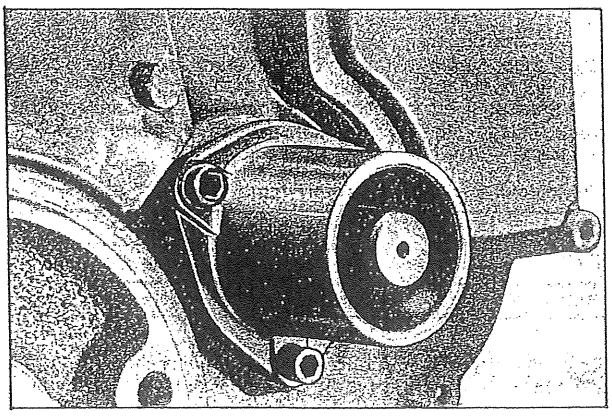
39

HAND CRANK STARTING.

It is installed on the camshaft gear and on the gear train housing cover (Fig.40).

When disassembling remove extension on camshaft to avoid any damage on the seal ring.

Check and replace, if worn, seal ring and gaskets.



40

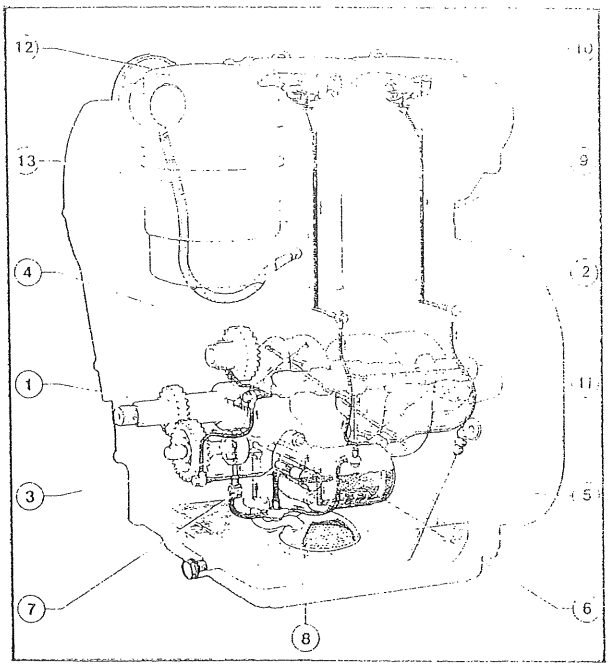
TAPPETS AND PUSH RODS.

Make following checks and replace worn parts;

- Tappet surface must be free from any mark or scratch which, if light, may be removed with a small carborundum block.
- Spherical end surface of push rod and tappet surface must be free from marks.
- Push rods must be straight and with spherical end surfaces in good condition.

Check following dimensions and clearances, in mm.

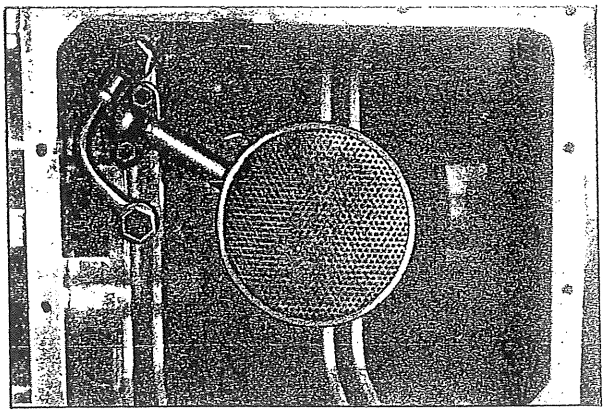
Housing dia.	I4,00-I4,02
Tappets dia.	I3,96-I3,98
Assembling clearance	0,02-0,06
Worn limit clearance	0,I0



41

LUBRICATING SYSTEM.

Lubrication is gear-pump forced type with fullflow filtering at pump outlet.
Components in Fig.4I :
I - crankshaft; 2 - camshaft; 3 - oil pump; 4 - hydraulic pump gear; 5 - oil filter; 6 - oil cartridge; 7 - control valve; 8 - internal oil filter; 9 - rocker arms lubrication pipes; I0 - rocker arm shaft; II - dipstick; I2 - air cleaner; I3 - breather hose.
Clean and check all oil ducts in crankcase and pipes leading to rocker arm shafts, to gear train side support and, if provided, to hydraulic pump shaft.
See that screen of oil suction strainer is not clogged or torn (Fig.42), that duct is not damaged and that fastening flange to crankcase is smooth.
Always replace flange gasket to avoid air suction.


42

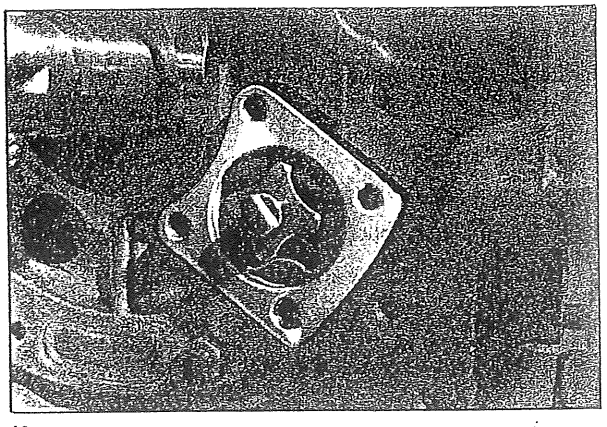
LUBE OIL PUMP.

It is a pump with lobe rotors and it is driven by the crankshaft by means of gears (Fig.43).
Checking of rotors.
After disassembly and washing check rotors and replace same if they are worn on the lobes or on the centres.
Dimensions and clearances between lobes of rotors in the positions shown in Fig.44 must not exceed values of table.

Dimensions and clearances lobes-rotors, in mm.

A , B	C		D	
	On assembly	Limit	On assembly	Limit
14,95÷14,97	0,01÷0,06	0,10	0,02÷0,10	0,20

For different values replace rotors making sure that their thickness (A e B) does not differ of more than 0,02 mm.


43

END PLAY AND HOUSING ON SUPPORT.

Make sure that dimensions of components and clearances correspond to values given in table, in mm. (Fig.45):

A	B	C	D	Play	
				On assembly	Limit
18,00 18,03	14,95 14,97	---	---	0,03÷0,11	0,13
---	---	40,60 40,63	40,54 40,57	0,03÷0,09	

) Equipped with pump support and bolts tightened at 2,5 Kgm.

Parts not according to given dimensions must be replaced.
Replace ball bearing on pump support if radial play too high or if tracks and balls are damaged.

CAPACITY OF OIL PUMP.
13 litres/min. with engine at 3000 rpm.

OIL FILTER.
Replace filter cartridge. Check condition of filter head and replace it if out of shape. Check spring of pressure regulator as well as condition of seat.
Oil pressure with hot engine, measured on filter, is shown in the table. At starting, with cold engine, pressure may exceed 4 Kg/cm2.

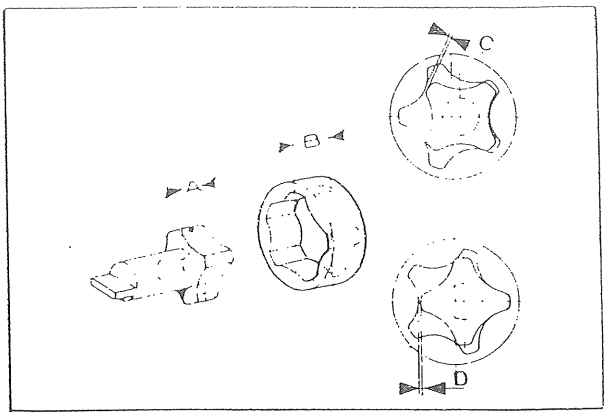
HOT OIL PRESSURE, Kg/cm2 .

Rpm.	Pressure
950 (lowest idle)	2,5-3,0
2200	3,1-3,6
2600	3,3-3,8
3000	3,5-4,0

If different pressures are recorded :
- Remove sealing cap (Fig.46).
- Remove cylinder for pressure adjustment.
- Remove distance washers from the cylinder for values above those shown in the table; add washers for values under those shown.

BLOWER DRIVE PULLEY.
Lap grooves in correspondance of the oil seal ring with very fine emery cloth so as to obtain spirals with opposite direction to the rotating sense and replace ring. The diameter of hub must be 49,94-50,00 mm (Fig.47).
Check belt grooves and replace belt if worn or damaged.

AIR BLOWER.
It houses the alternator (Fig.48).
Check vanes of stator and rotor and replace them if they are damaged. Make sure that rotor radial and end play are not excessive.
If ball bearings are worn, replace them. Remove cover (Fig.49) on the shroud and clean regularly cylinder and head fins as described on page 4.



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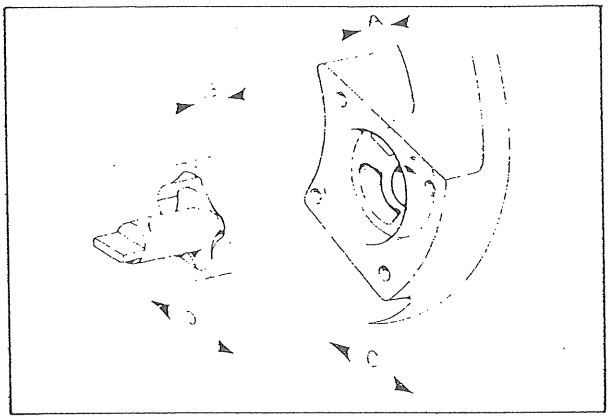

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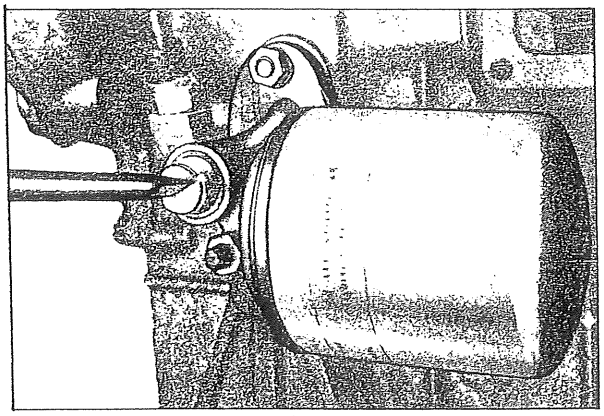
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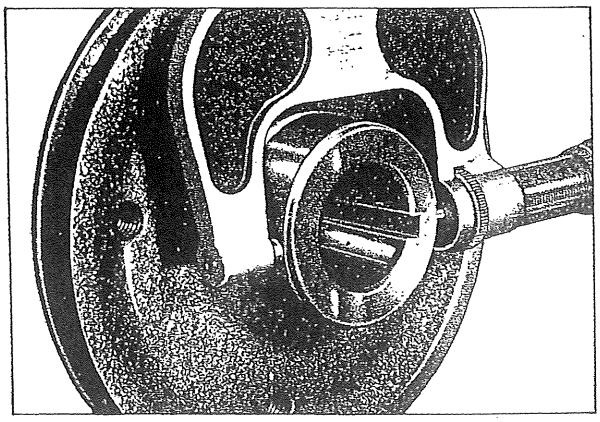

47

FUEL SYSTEM.

In the engines equipped with standard tank the fuel system is arranged as shown in Fig. 50.

Components :

I - Tank ; 2 - fuel feeding pump; 3 - filter 4 - injection pump; 5 - delivery pipes; 6 - injectors; 7 - drip-oil pipes.

With detached tank and filter, the fuel system is arranged as follows :

the fuel is sucked from the tank by the feed pump which, through a cartridge filter, sends it to the injection pump. At this point it is sent, under high pressure, to the injectors.

FUEL FEEDING PUMP.

The fuel feeding pump is a diaphregm type and is operated by a camshaft eccentric through a metal push rod. The pump is provided with an external lever for manual priming. Check that maximum projection of push rod from support is 9,8-10,2 mm., adjustable by means of gaskets; if above value is not obtainable, replace push rod.

SPECIFICATIONS OF FUEL FEEDING PUMP.

Engine rpm	Flow litres I'	Delivery pressure metres water column
3000	I,6	3 - 4
2600	I,4	
2200	I,2	

INJECTION PUMP.

The BSOCH type injection system consists of a pump that includes in one sole body the constant stroke pumping elements, each of which feeds a cylinder. The pump is embedded in a crankcase housing and it is directly operated by the camshaft (Fig.5I). Speed governor and extra fuel and stop device are separated from pump.

Components in Fig.52:

I - pump body; 2 - union; 3 - seal ring; 4 - filler; 5 - shim; 6 - spring; 7 - valve; 8 - seat; 9 - gasket; I0 - plunger; II - cylinder I2 - rack; I3 - toothed sleeve; I4 - spring; I5 - top plate; I6 - plate retainer; I7 - tappet; I8 - tappet roller;

Each plunger is coupled with its own cylinder wherefore no interchangeability is possible.

If testing tools for injection equipment are not available, have a Qualified Injection System Shop overhaul pumps and injectors (Fig.53)

Cross reference table on page I8 gives the Lombardini ref. nos. for the different components against those of the various manufacturers.

INJECTION PUMP CHECKING.

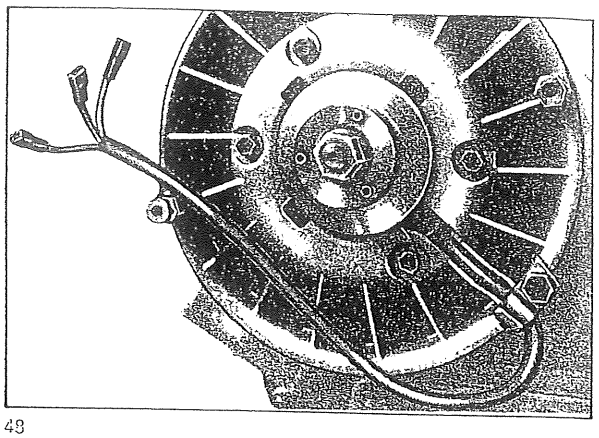
Before any attempt to check or disassemble the pump, make sure that fuel filter is not clogged and ducts are not choked.

Clean tank thoroughly and replace filter.

I) Unions tightness check.

- Connect pump delivery pipes and tighten unions.
- Feed pump and operate it.

If leaks occur, replace unions.



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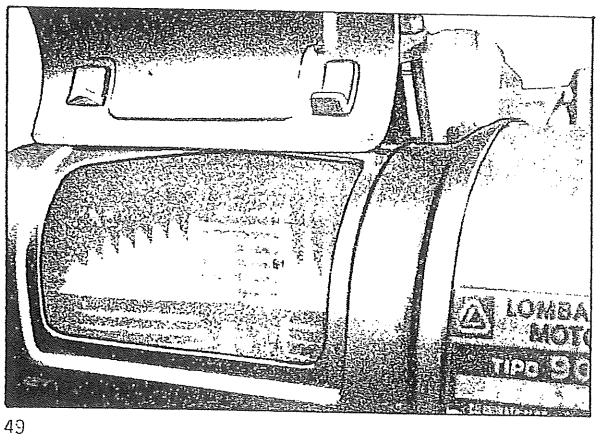

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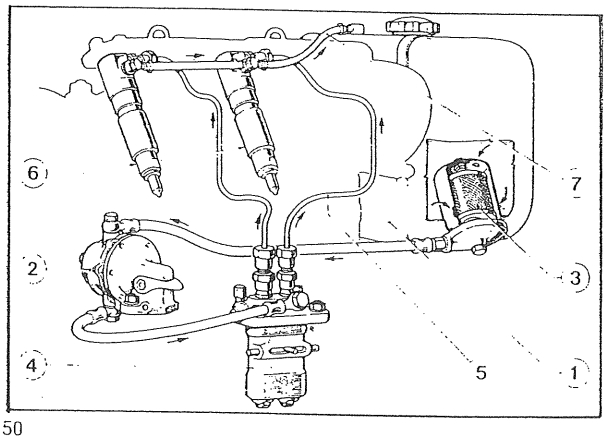

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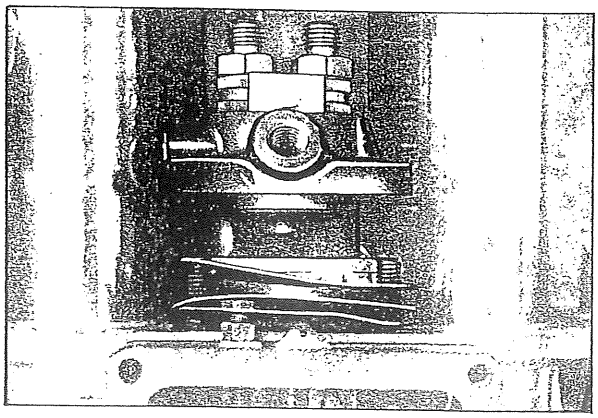
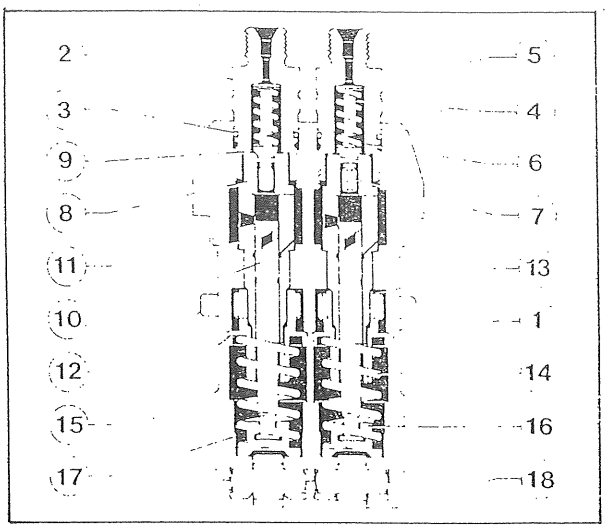


51

2) PUMPING ELEMENT TIGHTNESS CHECK.
This test is merely indicative as the pressures obtainable vary depending on pumping speed.

- Connect a delivery union to a 600 Kg/sq cm. pressure gauge provided with a safety valve (Fig.53).
- Set rack in intermediate position.
- Operate pumping element until the system is in compression.

If pressure at gauge does not reach 300 Kg/sq cm. replace pumping element. Repeat test on the other pumping element.

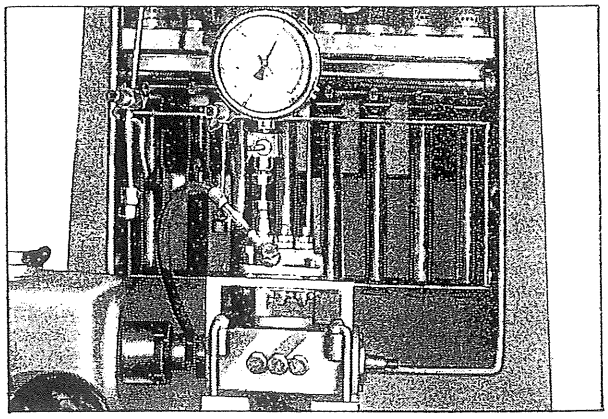


52

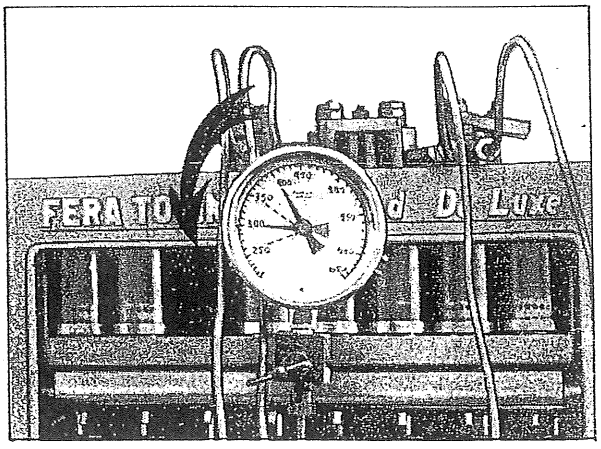
3) FUEL DELIVERY VALVE TIGHTNESS CHECK.

- Set pump as in previous test (with rack in intermediate position).
- During test, gauge pressure will progressively reach a maximum value followed by a sharp drop to a lower value which signals valve closing.

The pressure drop must be 30-50 Kg/cm2.
If lower, replace valve (Fig.54).
Repeat test on the other pumping element.


53

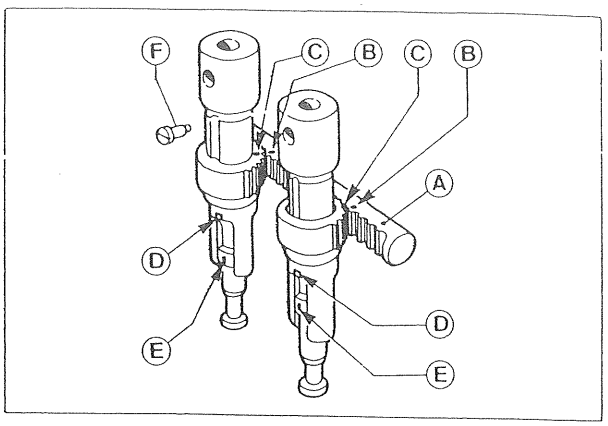
4) DELIVERY DATA.
Maximum delivery necessary to obtain max.power at highest rpm is 30,5-31,5 cc/1000 pumping strokes at 1500 rpm.
Tappet rollers must not be interchanged since they determine pumping timing. When replacement is necessary, check timing of each element as described on page 27.


54

PUMP REASSEMBLY.

After replacing worn parts, reassemble pump in following sequence (Fig.55) :

- Insert in pump body the toothed sleeves making point (C) match point (B) on rack.
- Lock cylinders with eccentric screws (F) on pump body.
- Assemble valves with seats, springs, fillers; lock with delivery unions.
- Insert plungers so that points (E) correspond to (D) on the toothed sleeves.
- Lock retainers and springs; lock tappets with retainer.
- Check on test stand that pumping element fuel delivery is even and adjust acting on screw (F).



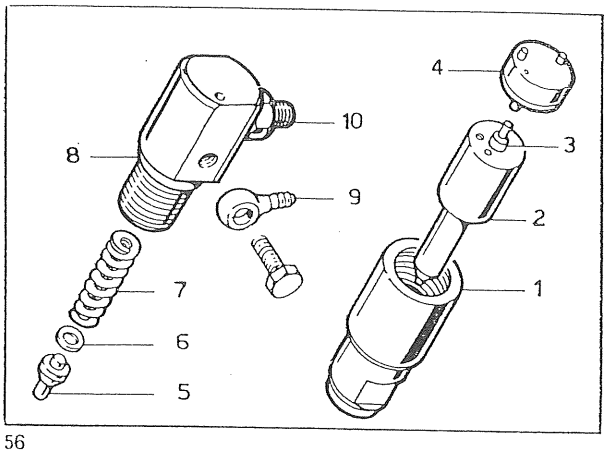
55

INJECTORS.

Components of Fig.56 :

I - Locking ring nut; 2 - Nozzle; 3 - Nozzle needle; 4 - Flange; 5 - Pressure rod; 6 - Adjusting washer; 7 - Spring; 8 - Nozzle holder; 9 - Drip-oil pipe union bolt; IO - Inlet union.

Clean nozzle inside with a tooth pick and some gasoline; clean needle with doeskin and discharge holes with 0,28 mm steel wire trying not to deform them.

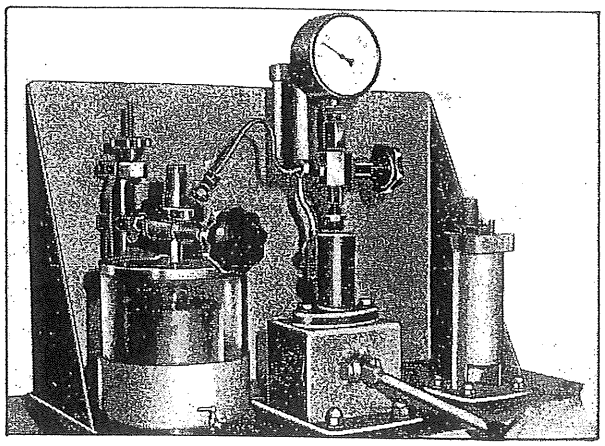


56

NOZZLE CHARACTERISTICS :

Numbers of holes	Ø mm	Injection angle
4	0,28	160°

- Checking.
  Employ SHELL FUSUS OIL A or Diesel oil.Reassemble injector and check efficiency on test stand.
- Starting pressure.
  2IO-220 Kg/cm2 adjustable with distance washers between spring and pressure rod. Replace spring if correct pressure is not obtainable and in this case calibrate at 220-230 Kg/cm2 to compensate for adjustments during service.
- Leak-by time.
  Adjust pressure at I50 Kg/cm2 and check that same reaches IOO Kg/Cm2 in a period of IO secs. minimum and 45 secs. maximum; for different time period replace injectors.
- Needle Tightness.
  Bring pressure to I95 Kg/cm2 and hold it for IO secs. Check that during this period no dripping of Diesel oil occurs on the injection centre: some humidity is permissible. If dripping occurs slightly smoothen needle tip with abrasive or replace needle if trouble persists.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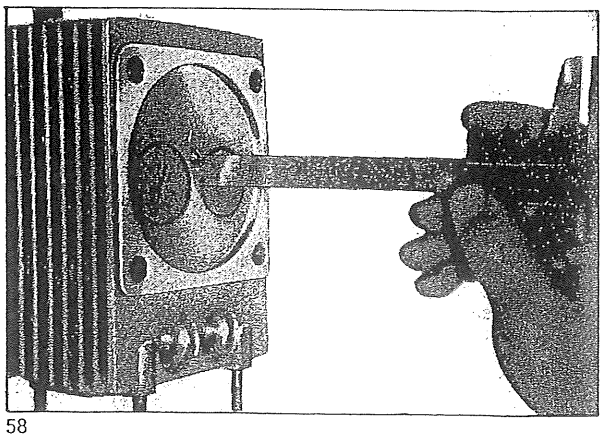
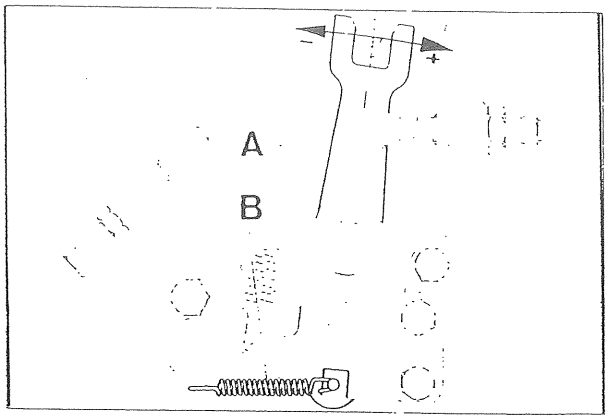
Reassemble injector in cylinder head housing and check that nozzle tip projection as compared to head face is 4,0-4,5 mm., adjustable with a 0,5 mm. distance washer between injector and housing (Fig.58).

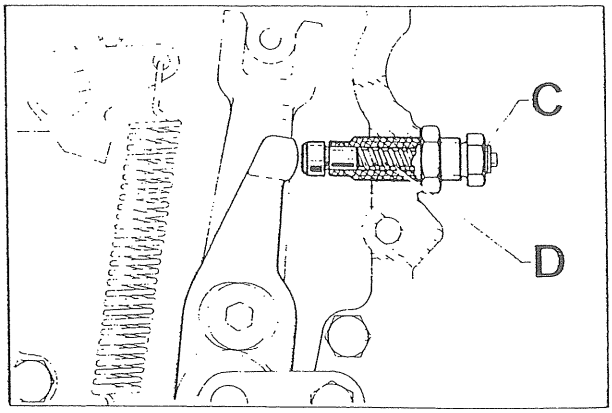

58

EXTRA FUEL DEVICE AT STARTING.
The device is automatic and allows the injection pump control lever to make an extra travel all the way to the position of the rack maximum delivery before the governor calls it back.
Check that lever A (Fig.59) runs freely for its full travel and spring (B) is not damaged or has lost its elasticity.
Spring free length is 29,5-30,5 mm.



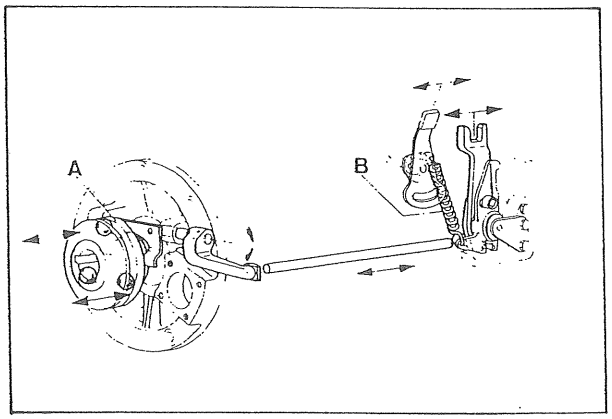
59

TORQUE CONTROL AND DELIVERY LIMITING DEVICE.
At maximum torque speed, spring compression (D) inside cylinder under thrust of extra fuel device lever allows greater delivery of fuel necessary for that specific condition (Fig.60). Disassemble device and wash it with kerosene. Tip of moving element, loaded with a weight of 470-500 grs. must travel between 0,5-0,6 mm.
In case of different values, replace whole set.
When disassembling do not change washer thickness (C) as this would vary torque setting. Disassemble device and lubricate moving parts.
The torque device is blocked on type L20.



60

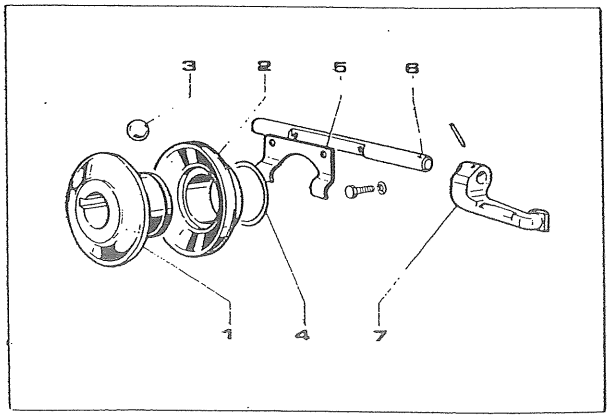
GOVERNING SET.
It is a centrifugal unit with 3 balls of 13/32" dia. (10,319 mm.) housed in a support which is directly engaged to the main shaft.
The balls are sent to the end part of the support by the centrifugal force and effect shifting of a bell (A,Fig.61) which is linked to the rack of the injection pump by means of a yoke and a lever.
A spring (B) loaded by the accelerator controls the effect of the centrifugal force of the balls.
The balance of the two forces keeps the running rate almost constant.



61

CHECKING.
Components in Fig.62.
1 - Bell; 2 - Mobile bell; 3 - Ball; 4 - Locking washer; 5 - Yoke; 6 - Pin; 7 - LInk.

Check condition of balls housings, bell, pin and yoke. Replace worn parts.
Yoke contact surfaces must be on same level as the smallest difference might cause the governor work incorrectly.
The spring free length (B, Fig.61) must be 69,5-70,5 mm., and under load of 5,8 Kg. 82,5-83,5 mm.



62

HYDRAULIC PUMP POWER TAKE OFF.
3rd power take off on the gear train side. It is possible to install one IP pump on the blower drive pulley side and one 2P pump on the injection pump side, even at the same time.

IP pump power take off on the blower drive pulley side (Fig.63):
I - Flange; 2 - Centring ring; 3 - 4 Seal rings; 5 - Pinion; 6 - Support; 7 - Bushing; 8 - Gear; 9 - Locking ring; IO - Washer; II - Cover; I2 - Sealing ring.

IP and 2P pumps power take off on the injection pump side (Fig.64) :
I - Cover ; 2 - Support; 3 - Bushing; 4 - Gear 5 - Locking ring; 6 - Washer; 7 - Support 2P pump; 8 - Support IP pump; 9 - Sealing ring; IO - Centring ring; II-I2 Seal rings; I3 - Half coupling; I4 - Half coupling.
Max. torque obtainable 4 Kgm corresponding to I4 metric HP at 2540 rpm for engines at 3000 rpm; I2 metric HP at 2200 rpm. for engines at 2600 rpm.
Reduction ratio I : I,I8.
Replace bushing with puller 7070-3595-49 if worn or if clearance with driving gear of hydraulic pump exceeds 0,I2 mm.
Bushings are supplied with a 0,3 mm thick excess metal to be reamed after assembly.
During assembly make the holes match the oil line on the support and lubricate external part with vaseline or oil to ease keying and prevent formation of minuscule air pockets.

Dimensions of pin of hydraulic pump gear, mm.

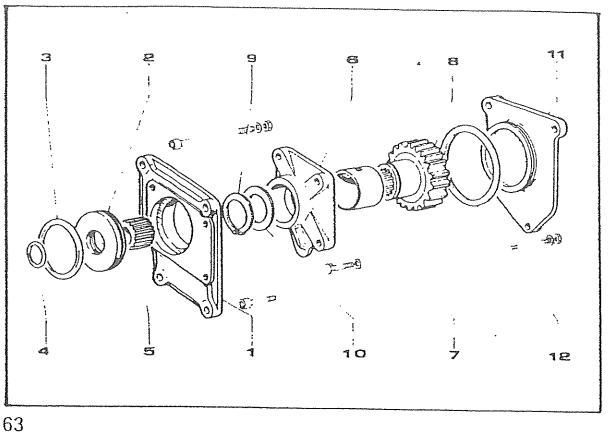
Ø of pin	Bushing-pin clearance	
	On assembly	Limit
34,950÷34,975	0,03÷0,09	0,12

Check integrity of seal rings and replace them if worn. The end play of the gear of the hydraulic pump must be 0,I-0,4 mm. If higher, replace support.

FLYWHEEL RING GEAR.
Check if teeth are worn or damaged.
If necessary replace ring gear as follows :
- Heat up ring gear along inner circumference with petrol heating torch and remove it from flywheel with a punch.
- Heat up new ring the same way and quickly apply it on flywheel, driving it in its seat.

ELECTRICAL EQUIPMENT.
- Electric starting with motor and I2V/I4 or 2I A alternator for battery recharging.
- Electric starting with motor and I2V-28A alternator for battery recharging.
  I2V/I4 or 2IA system.

CHARACTERISTICS.
- I2V/I4 or 2IA DUCATI alternator.
- I2V/I4. or 2IA DUCATI voltage regulator.
- BOSCH I,5 metric HP starting motor.
- Battery prescribed : 70 Ah.



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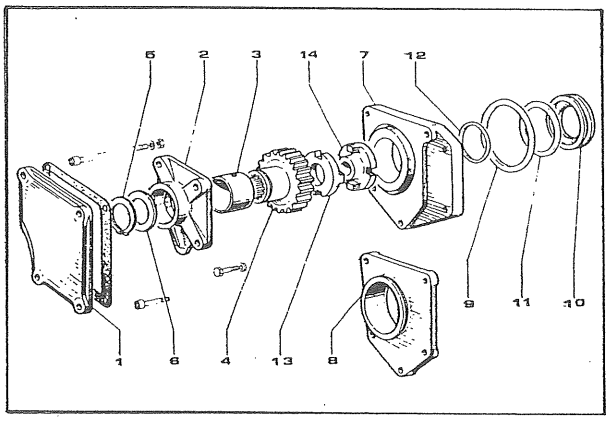

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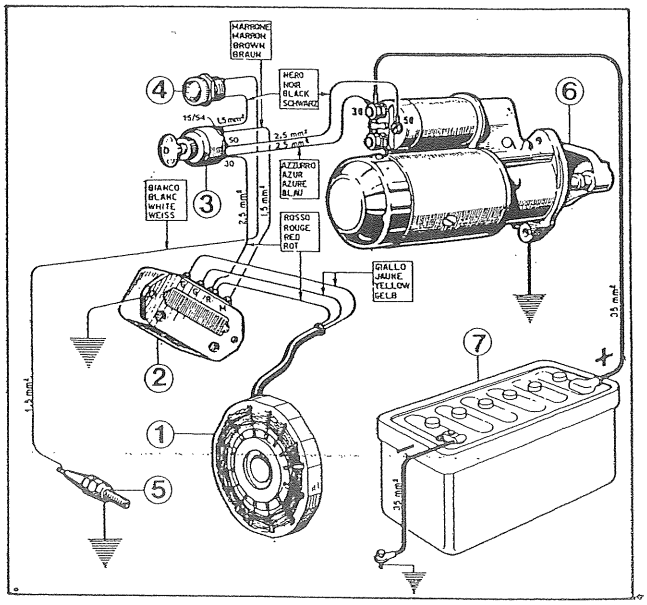


65

I2V-I4 or 2IA SYSTEM (Fig.65).
I - Alternator; 2 - Regulator; 3 - Key switch 4 - Oil pressure warning light; 5 - Pressure switch; 6 - Starting motor; 7 - Battery (not supplied).
I2V-I4 or 2IA System with battery recharging warning light (Fig.66).
I - Alternator; 2 - Regulator; 3 - Key switch 4 - Oil pressure warning light; 5 - Pressure switch; 6 - Starting motor; 7 - Battery (not supplied); 8 - Battery recharging warning light.

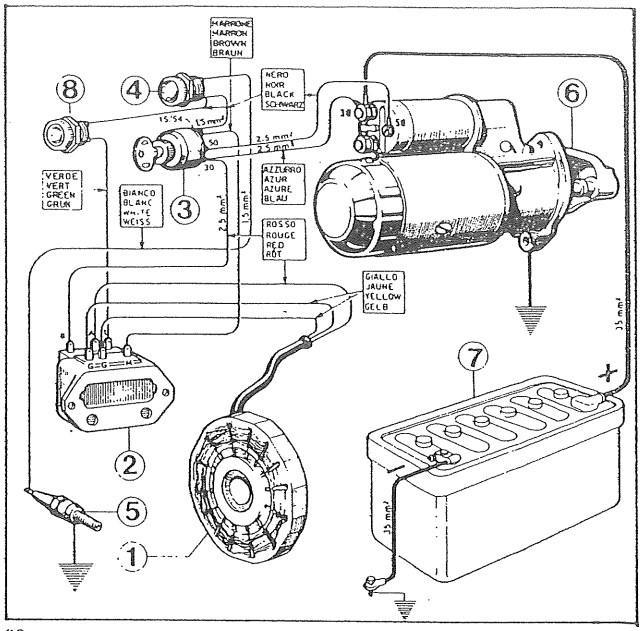
ELECTRICAL SYSTEM CHECK.
Check condition of wires and insulation. If connections are not correct, the following troubles may occur :
I) System delivering half output
° A yellow cable disconnected.
° A yellow cable inverted with a red cable.
° A faultu voltage regulator.
2) System not charging :
° Two yellow cable disconnected.
° Yellow cable grounded (demagnetizes alternator).
° Yellow cable inverted with a brown cable (short circuit).
° Brown cable disconnected or grounded (battery short circuit).
° Red cable disconnected or grounded (short circuit).
° Faulty voltage regulator.

ALTERNATOR.
Stationary armature installed on blower cover and permanent-magnet rotating inductor keyed on blower shaft. When replacing the I2V-I4A alternator with a I2V-2IA type, even the air blower must be replaced.
Check magnetization of rotor with tool n°7000-9727-01 (Fig.67).
° Rest one end of instrument horizontally on magnetic poles.
° Hold tool slider (C) facing line A.
° Free slider; if not attracted, rotor is demagnetized and it should be replaced.
Check that stator windings have no unsoldered connections and burn marks, or grounded wires.
With an Ohmmeter check for continuity between red and yellow cables, as well as for ground insulation (Fig.68).
Replace stator if faulty.
Check assembled alternator as follows :
° Disconnect yellow cables and red cable from voltage regulator.
° Connect between red cable from alternator and one of yellow cable an electric tester.
° Start engine and check for the following voltage readings on instrument :

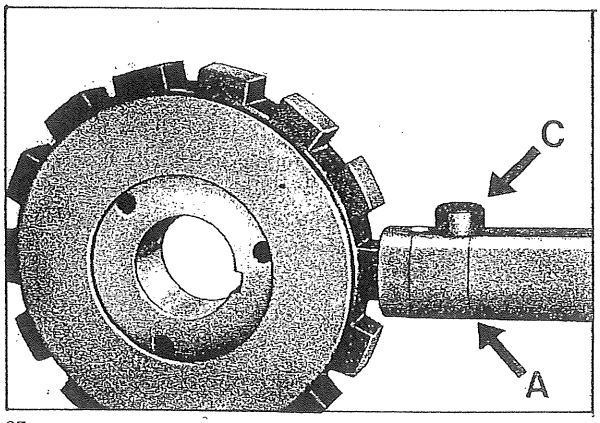
Alternator check :

Engine rpm	VOLT (V)	
	Type 12V - 14A	Type 12V*- 21A
1500	18,5 ÷ 20	30 ÷ 32
2000	24 ÷ 25	45 ÷ 47
2500	31 ÷ 32	57 ÷ 58
3000	37 ÷ 38	68 ÷ 69

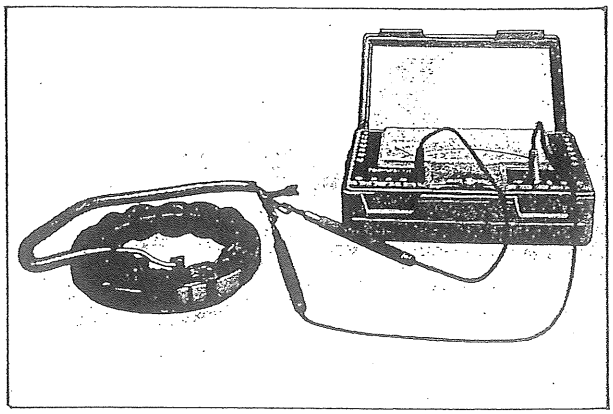
Repeat operation between red and other yellow cable. If voltages are below above readings, rotor is demagnetized. If difference is over 5 Volts, replace alternator.



66



67


68