



URRACO 2.4

Lamborghini

Workshop
Manual

90112400

English
Italian

SPECIFICATION AND GENERAL DATA.

LAMBORGHINI - URRACO 250

Specification and general instructions
for revision and
rules for assembly

Service Management

Automobili Ferruccio Lamborghini S.p.A.

SPECIFICATION AND GENERAL DATA.

SPECIFICATION AND GENERAL DATA

1) Weights and overall dimensions

Weight ready for the road (with full equipment) ...	1.262 kg
Distribution of weight (front	518 kg
(rear.....)	750 kg
Overall length	4.250 mm
Overall width	1.765 mm
Max. height above ground (unladen)	1.161 mm
Max. height above ground (laden)	101 mm
Front axle overhang	1.000 mm
Rear axle overhang	800 mm
Min. turning diameter of most external body point.	11,30 mm

2) Supplies

Water.....	12 lt
Oil:	
Engine (sump and filter)	
(AGIP SINT 2000 SAE W 20/50	8,50 lt (7,2 kg)
Gear box - differential	
(AGIP ROTRA MP SAE 90).....	3,50 lt (3 kg)
Rack steering	
(HYPOID oil SAE 90).....	0.280 + 0.010 lt (0,2 kg)
Brake assembly (AGIP oil F.1. Brake fluid	
HD-CASTROL. GIRLING AMBER brake fluid).....	0.300 lt
Petrol	80 lt
Petrol reserve	16 lt
Petrol consumption per 100 km. (CUNA)	18,1 lt
Maximum range	450 km

3) Engine

Type of engine	L 240
No. and arrangement of cylinders	8 in V at 90°
Bore and stroke	86 x 53 mm
Total cylinder capacity.....	2469 cm ³
Compression ratio	10.4 : 1
No. of crankshaft main bearings	5
Valve arrangement	verticale
No. of camshafts	2
Position of camshafts	overhead
Drive	cog belt
Valve clearance (cold)	
Inlet	0,45 mm
Exhaust	0,45 mm

Timing diagram

Inlet	(opening commences	26° before TDC
	(closing ends	66° after BDC
Exhaust	(opening commences	62° before BDC
	(closing ends.....	18° after TDC
Carburettors	.....	Weber IDF
Number.....	.....	4
Petrol supply pressure to carburettors....	.....	0,2 kg/sq.cm.
Actual pressure of cooling system.....	.....	1,09 kg/sq.cm.
Thermostat.....	.....	SAVARA 10041/80
Aperture of thermostat:	opening commences at 65°C ÷ 67°C/149° F. ÷ 153°.	
	At F./85° C (185° F.) ÷ 87° C. (189° F.) it must be fully open.	
Air filter: dry cartridge (FIAMM) 2.		
Oil filter .....	.....	FIAMM cartridge type FT 4662
Max. engine h.p. (DIN) .....	.....	210 h.p.
Peak r.p.m. ....	.....	6800 revs/min.
Max. torque .....	.....	23 kgm.
Max. torque rpm. ....	.....	5600 revs/min.
Tax rating (Italy) .....	.....	29 h.p.

4) Ignition assembly

Battery .....	.....	URANIO 6 MC 4 B
Battery voltage.....	.....	12 V.
Battery capacity .....	.....	55 amp/hr.
Polarity .....	.....	Negative to earth
Coil .....	.....	Marelli BZR -201-A
Distributor .....	.....	Marelli S -127 E
Direction of brush rotation.....	.....	Clockwise
Aperture of contacts .....	.....	0,35 + 0,05
Static ignition timing .....	.....	18° before TDC
Max. centrifugal advance @4500 m/l'.....	.....	30° before TDC
Sparking plugs .....	.....	Bosch 235 P.21
	(distance between electrodes 0,35 mm.)	
Alternator .....	.....	Bosch K1- 14V-55 A 2
Voltage regulator.....	.....	Bosch RS- ADNI/14V.

5) Transmission

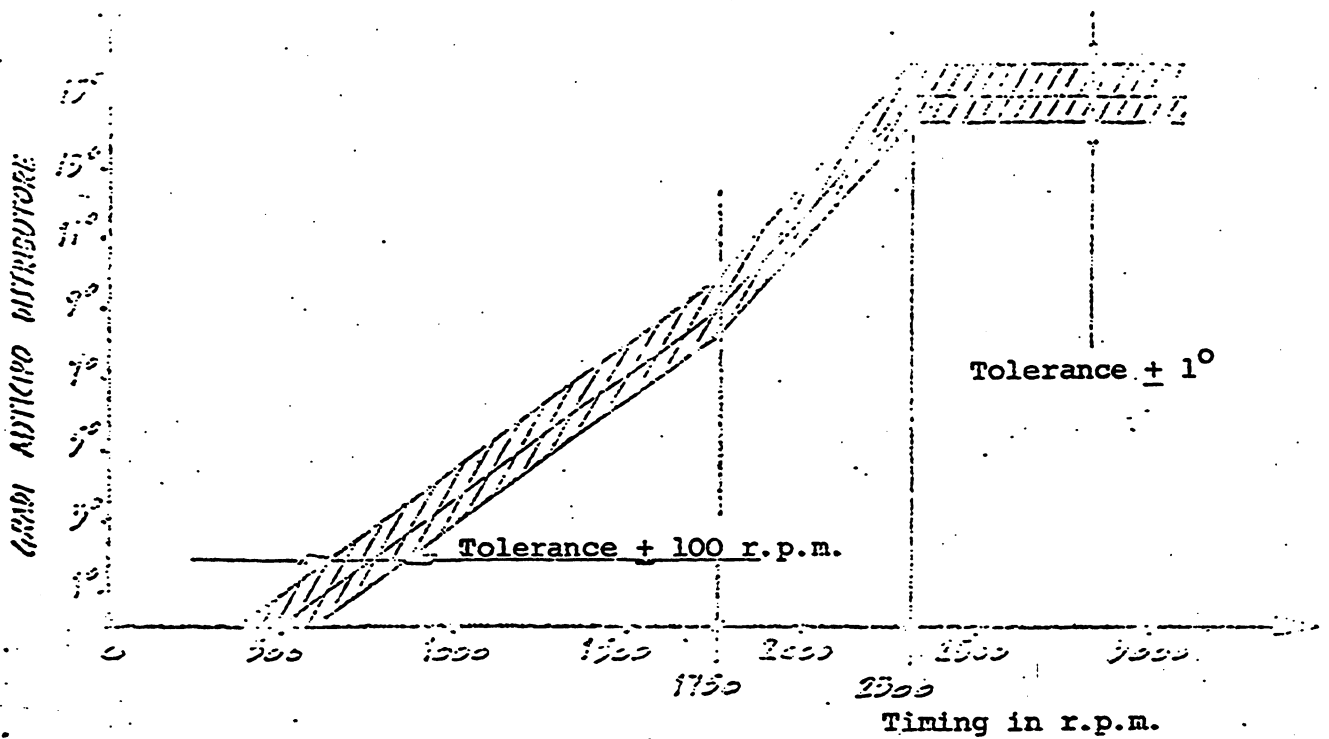
Clutch	Monodisc, dry, with diaphragm springs Fichtel & Sachs AE-854-854
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DIAGRAM OF AUTOMATIC ADVANCE AND POWER
CURVES TORQUE AND CONSUMPTION

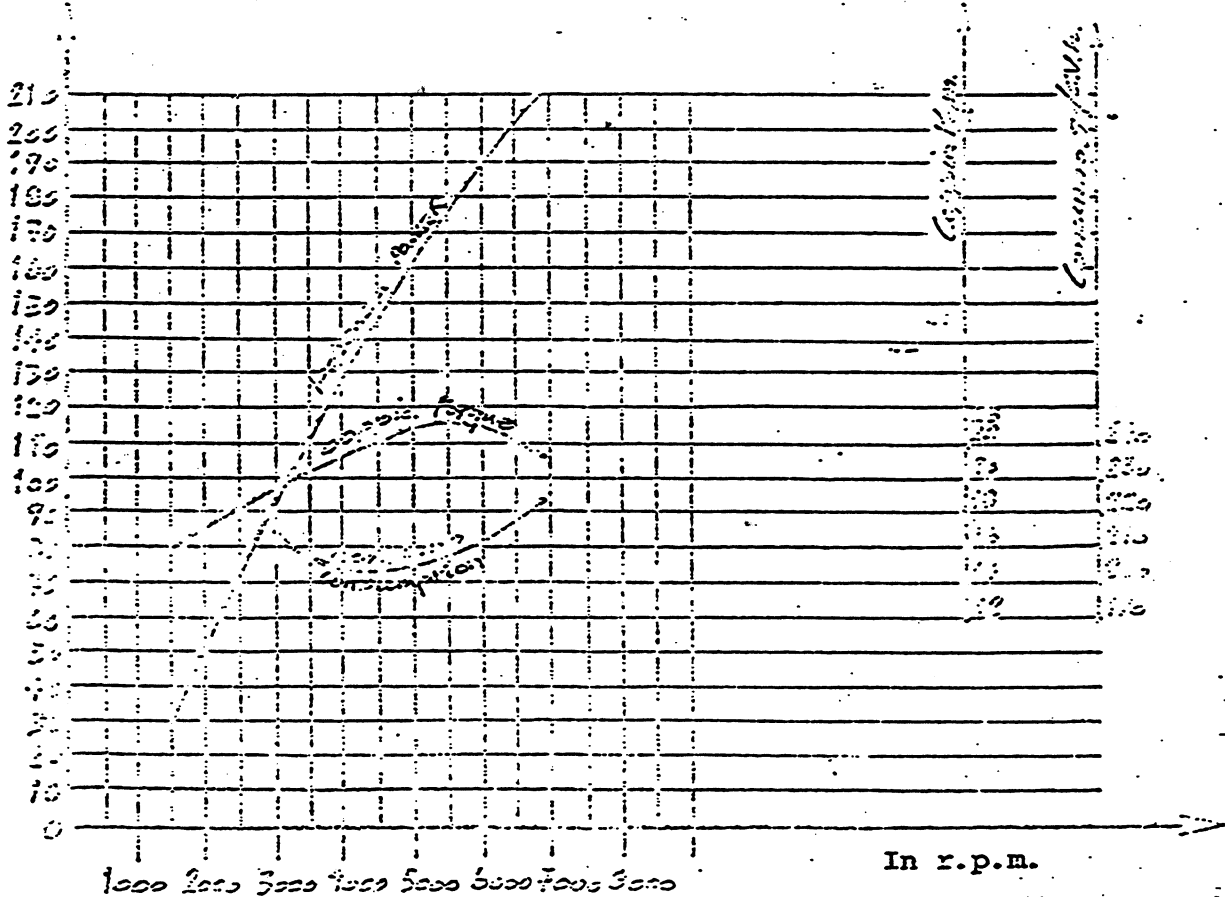
LAMBORGHINI
MOTOR

MODEL 3500
SERIAL NO. 10000

TRIVOLI



C.N.



Gear ratios for 5 forward drives, all synchronised. Reverse also synchronised.

1st gear ratio	1 : 2,687
2nd gear ratio	1 : 2,105
3rd gear ratio	1 : 1,565
4th gear ratio	1 : 1,185
5th gear ratio	1 : 0,903
Reverse gear ratio	1 : 2,540
Differential ratio 16,68 =	1 : 4,025

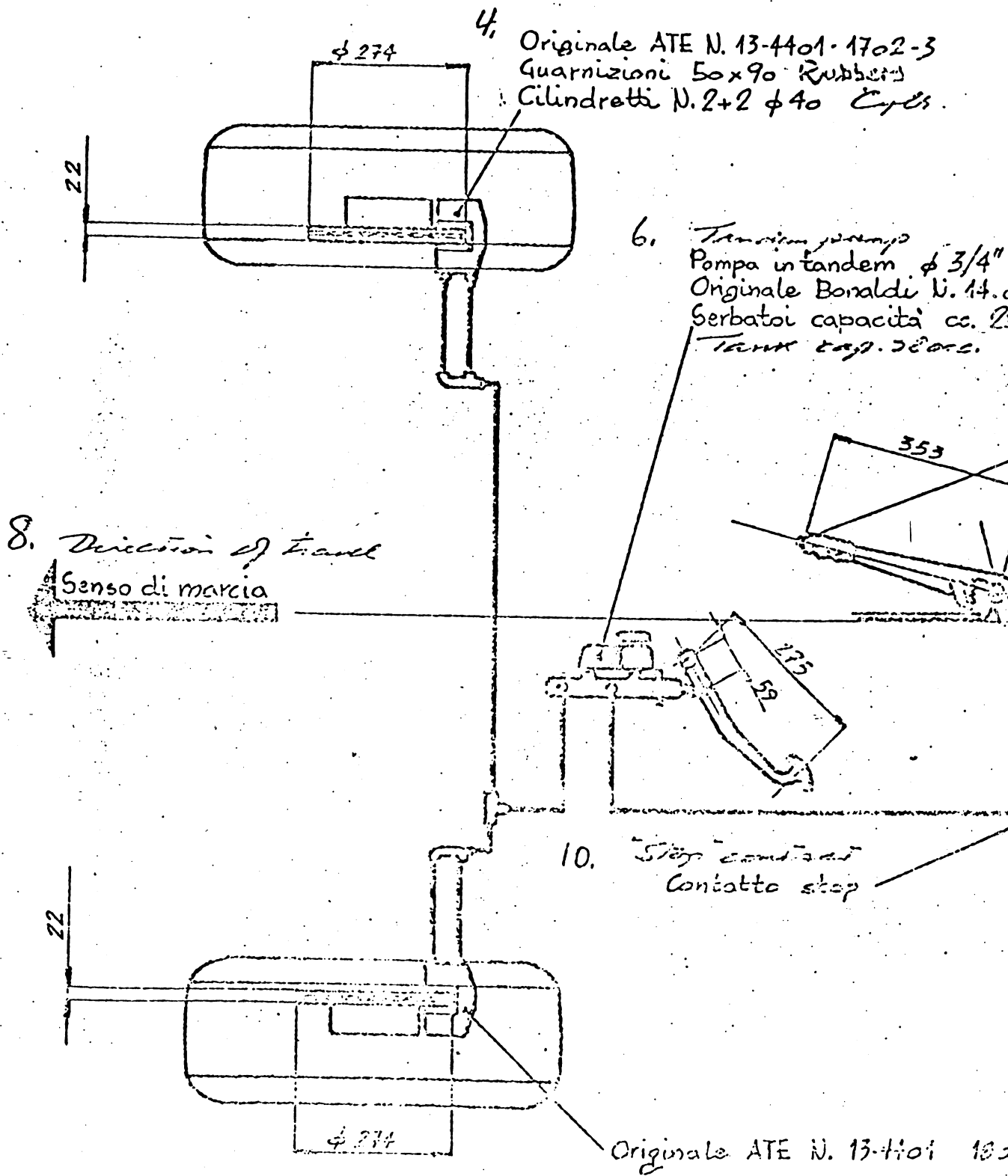
6) Chassis

Coachwork	Self-bearing
Front suspension.....	Macpherson
Flexible coupling unit	Coil springs
Front shock-absorbers.....	Hydraulic telescopic
Make	RIV
Front stabiliser bar	Ø 15 mm.
Toe-in - front wheels	0
Camber - front wheels	57' positive
Caster - front wheels	7°
Rear suspension	Person mc.
Flexible coupling	Helicoidal springs
Rear shock-absorbers	Hydraulic telescopic
Make	RIV
Stabiliser bar	Ø 15 mm.
Toe-in - rear wheels	2 ÷ 3 mm.
Camber - rear wheels	1° negative
Wheelbase	2450 mm.
Front track width)	1460 mm.
Rear track width) laden	1460 mm.
Brakes	Disc brakes to the 4 wheels
Dimensions of front discs	Ø 274 mm.
Front brake pads	FRENDO 104 H6 - 133107-9051-
Dimensions of rear discs	Ø 274 mm.
Front brake callipers.....	ATE dx.N.13-4401-1702-3 sn.N.13-4401-1802-3
Rear brake callipers.....	ATE dx.N.13-4341-060 -3 sn.N.13-4341-050 -3
Rear brake pads	FRENDO 104 H6-138107-7722-2
Swept surface area of pads	202 + 124 = 326 sq.cm.
Vacuum pump	orig. BONALDI drwg.14.07374
Brake pump	orig. BONALDI drwg.14.05800
Tyres	205/70 VR 14 to the 4 wheels
Make	Michelin

Tyre pressure (Michelin 205/70 VR 14)

	FRONT		REAR	
	kg/sq.cm.	lbs/sq.in	kg/sq.cm	lbs/sq.in
Speed 180 km/hr.	2,3	32,706	2,5	35,550
up to 232 km/hr.	2,5	35,550	2,7	38,39

1. Diagram of Brakes Assy.



FRENTO di SERVIZIO: a disco idraulico - comando a pedale; due circuiti indipendenti;
 conglobato col freno di soccorso - integral with emergency brake.
 FRENTO di STAZIONAMENTO: meccanico - comando manuale mediante leva - arponismo
 di arresto agente sulle ruote posteriori.
 : stopper gear acting on the rear axles.

- 5. Originali ATE N. 13-4341-060 8.3
- Guarnizioni 40x76,5
- 6. Cilindretti N. 2+2 ϕ 34

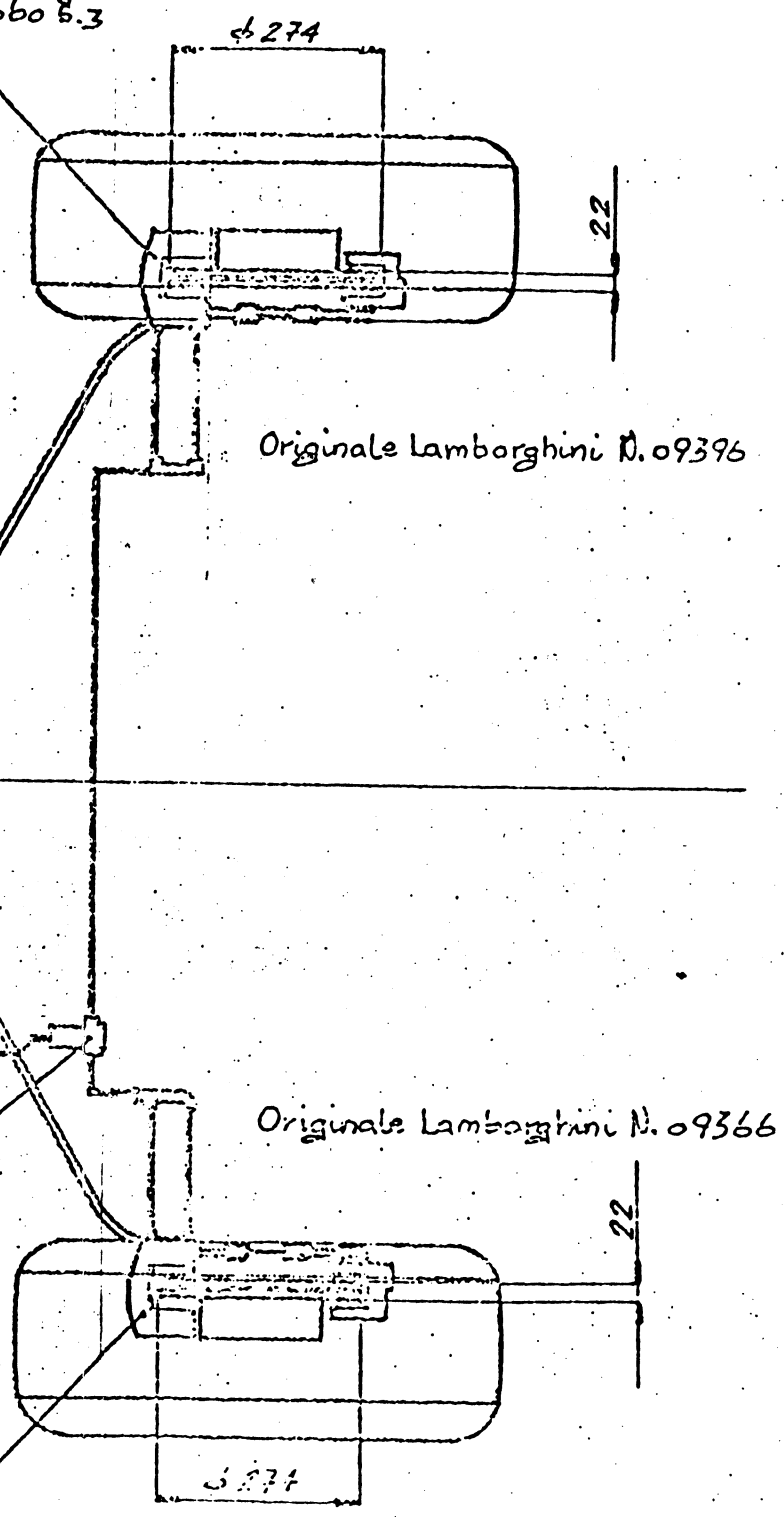
4"
 0630
 230

7. Total ratio
 Rapporto totale 59

9. Cavo Bowden, ϕ 3
 Cable

11. Pressore control
 regolatore di pressione
 originale Boraldi 11-07374

12. Originali ATE N. 13-4341-050 8.3



7) Identification Data

Engine and chassis numbers : Inside the engine compartment near to petrol filler cap.

8) Performance

Speed at 1000 rpm. in Top gear with tyres 205 x 70 and differential ratio 16/68.....30,9 km/hr.

Running-in period9) Service Date9a) Renewal of engine oil

After the first 1500 km. of 'running in' and then after every 5.000 km. it is necessary to renew the engine oil and, after every 10.000 km., the oil filter cartridge.

The procedure is as follows:

Before removing the used oil, it is advisable to keep the engine running for some minutes, in order to heat up the oil.

Then remove the used oil by turning the relative plug at the rear of the sump. After the oil has been removed, screw in the plug. Remove the oil filter cartridge (1505914), using the appropriate tool (lever with chain, see fig. 2) and insert a new one, of the original Fiamm make. To tighten up the cartridge no tools are required; it will suffice to tighten it by hand.

Then insert the new oil in the engine via the filler pipe on the l.h. cover of the camshafts, using 8,5 litres or 7,2 kg. (8 in the sump and 0,5 in the filter).

Use only AGIP SINT 2000 OIL (SAE 20 W/50). With the car situated firmly on level ground, the oil level in the sump should be checked from time to time.

It should always be within the limits indicated on the dipstick and if necessary oil should be added, but always exclusively of the same type as that found in the engine.

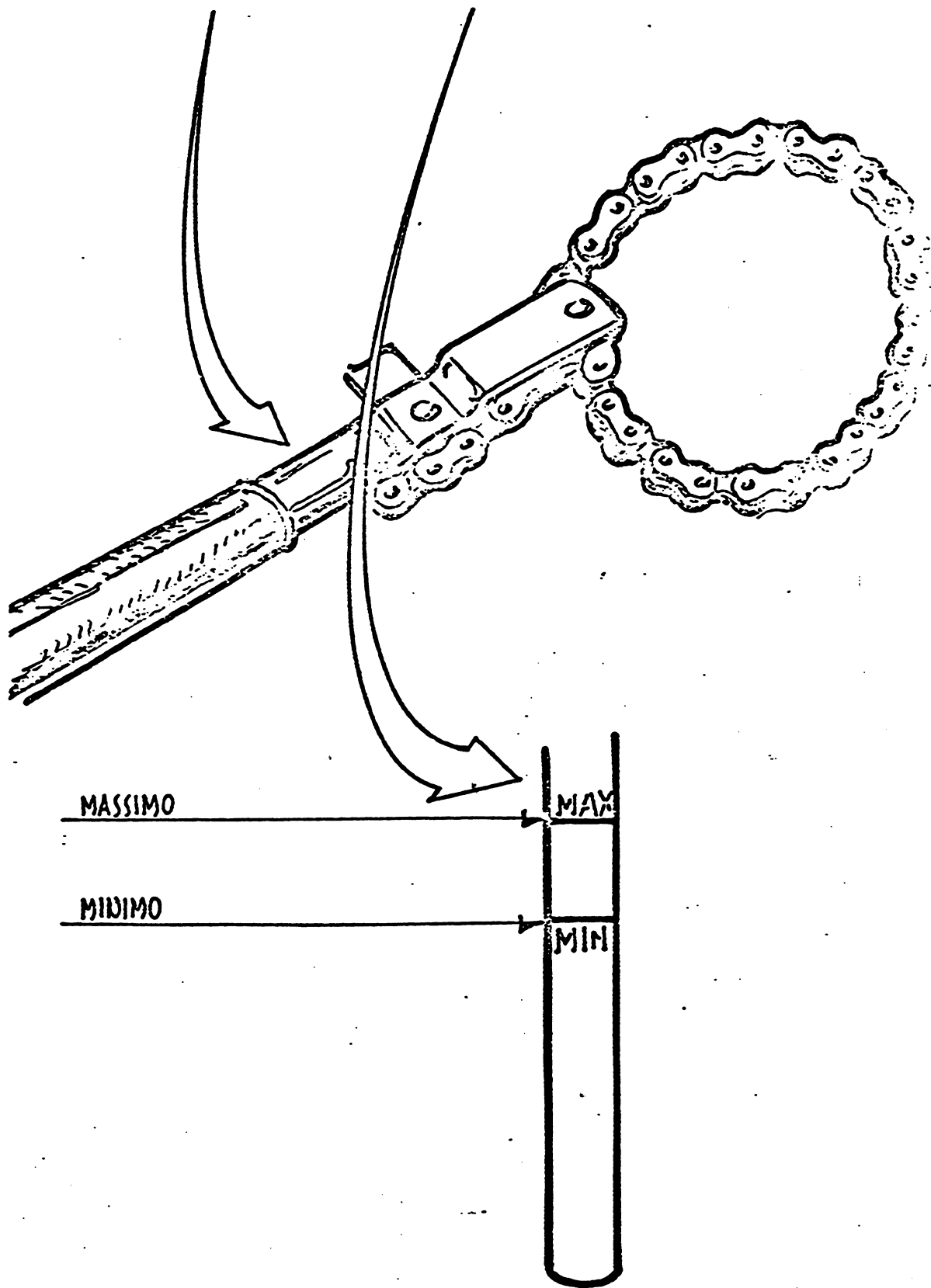
9b) Renewal of oil in gear box and differential

After the first 1500 km. and subsequently after every 10.000 km. the gear box oil must be renewed.



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OIL FILTER CARTRIDGE REMOVER - DIPSTICK



The used oil should be discharged via the plug TN 893.22.03 (Table 14 C.P.R.).
 The new oil should be inserted via the plug 893.1802.
 The correct level is reached when the oil begins to spill over the level hole on the righthand side of the gear box, viewed facing the flywheel. (Capacity 3,5 litres or 3 kg).
 The correct oil to use is: AGIP ROTRA SAE 90.

9c) Brakes

The brake assembly (see diagram) comprises:

- the hydraulically-controlled disc brakes to the four wheels
- two separate circuits for the front and rear wheels
- vacuum pump on the rear circuit, with the following specification:
 - ratio 0,46
 - cut-in pressure: 18 kg/sq.cm.
 - decrement 20%.

Handbrake with mechanical control acting on the rear wheels.

The brake adjustment is primarily:

- 1) directly on the brake pads and then on the lever. In the first case, the adjustment is on the callipers, to leave a clearance of about 4 mm. (2 on each side) between the pads and the disc. Then operate the adjustable tie-rod which is fixed directly to the lever. This can be reached by uncovering the casing from the lever, which should then be given two free 'steps' and begin to brake at the third 'step'.

After every 5.000 km. the oil in the two chambers of the brake pump 420.8256 should be checked (Table 19 C.P.R.) which supply the brake assembly. This must be at the correct level (one centimetre below the upper floor of the containers). If the level has decreased, add more oil and check all parts of the assembly to ensure there will be no leakages.

The oil to be used is AGIP F 1 BRAKE FLUID SUPER HD. Make sure that the oil has not been contaminated and has been supplied in properly sealed containers.

- 2) The chambers should be filled most carefully, not allowing drops of oil to fall on the coachwork, as they are highly corrosive and could damage it.

9d) Bleeding the brake fluid

To bleed the brakes, use a plastic tube (internal diam. 6 mm) and a container (if possible, a glass bottle).

Insert one end of the tube in a drain screw (there are three for each calliper) and the other into the container. Press the brake pedal several times as far as it will go and then, holding this position, unscrew the bleed valve. The first discharge from this will be oil mixed with air, and then pure oil. Execute the same operation for all the bleed screws.

N.B. Bleed the brakes whenever the pads are changed or any other maintenance operation of the brake circuit is performed.

9e) Lubrication

Every 10.000 km. grease the bushings of the rear hub bearings.

Every 20.000 km. grease the gear change control.

After a similar time, grease the homokinetic couplings of the half-shafts, proceeding as follows:

- release the screws fixing one end of the half-shafts
 - remove the half-shaft from the part to which it was applied
 - check the coupling for grease
 - if none, add AGIP F 1 GR-SM grease up to the surface level of the joint.
- Before remounting the joint in its seating, ensure the casing is in good condition. If there are any signs of damage, renew the same. Refit the joint and execute the same operation for all the others.

GREASE TO BE USED: AGIP F1 GR SM

For the bushings: AGIP F1 GREASE 33 FD.

9f) Cooling system

The water is drained from the cooling system via tap 1701905 (Table 8 - C.R.R. catalogue of spare parts). The water should be inserted via the filler tube 1704296 on the reserve water tank.

Make sure that the heater tap is open. After filling, run the engine for 10 minutes, at various speeds, to release any air left in the system.

During this operation, the water must circulate also in the heater radiator.

Turn off the engine and add more water if necessary.

The correct water level is found when it is slightly beneath the lower edge of the filler pipe.

9g) Antifreeze

During the cold season, when the external temperature is about 0°C., the cooling system must be drained and refilled with a mixture of water and AGIP F1 ANTIFREEZE, in the following proportions:

: Drain the water in the radiator via the relative valve.

Recommended proportions for antifreeze mixture

20%	—	—	- 10°C
25%	—	—	- 12°C
30%	—	—	- 15°C
35%	—	—	- 20°C
40%	—	—	- 26°C
45%	—	—	- 35°C

REVISION INSTRUCTIONS AND ASSEMBLY DATA.

THE ENGINE

The engine is a four-stroke engine, situated centrally and transversally. It is supplied exclusively with supergrade petrol of a 98/100 octane content.

The cylinder block is of light alloy.

The cylinder liners are made of special cast iron, inserted "wet".

There are two cylinder heads, with inserted valve guides and seatings.

The crankshaft has 5 main journals rotating on 5 anti-friction thin shell bearings.

Four half-ring shoulders for the crankshaft are mounted on the main bearing. The big end bearings are thin-walled bearings coated with antifriction material.

The light alloy pistons have three rings, the first a sealing ring, the second an oil scraper ring and the third an oil-duct scraper ring.

We now describe in detail and in chronological order the operations to be performed for the complete assembly of the engine.

N.B. The various parts will be indicated with the designations given in the Spare Parts Catalogue (C.P.R.) L 240 URPA00.

1a) Assembly of cylinder liners on base

This assembly is made, cold, in the following manner:

- Clean the cylinder liner thoroughly
- Clean the seating of the base to prevent foreign matter from obstructing the insertion of the liners and excessively increasing the stroke to the detriment of the cylinder head fittings.
- Apply a little oil to that part of the liner which has to be inserted in the base.
- Insert the liner.
- Check the bore and stroke, remembering that each colour (green or rose symbol) of the corresponding liner, relates to a different measurement.
- The stroke of the free liner ranges from 0,10 mm. to 0,23 mm.

1b) Extraction of liner from cylinder block

The liner is removed manually:

- Withdraw the liner, rotating it through several degrees clockwise or anticlockwise.
- if the operation is found to be difficult, press the liner into the base and repeat the previous operation.

1c) Assembly of the main bearing shells (Vandervell)

Fix the base on to a rotary stand and mount the half shells MM 08560 - 08559 (Table 3 C.P.R.) on the main bearing seatings.

Mount the half-shells MM 05772 - 05778 (Table 3) on the main bearings of the lower base.

Mount the lower base (without crankshaft) tightening with a dynamometric spanner the \varnothing 12 mm. nuts up to 5,8 kg. and those of \varnothing 8 mm. to 2,8 kg to obtain the correct setting.

Check with the bore gauge previously set on the shaft collar, that the clearance between the collar and the bearing is that required.

Dismantle the sub-base and remount the shaft (see Drawing no. 4).

1d) Clearance between shells and main bearing collars

Check the clearance between main bearing collars and shells, bearing in mind that the diameter of the collars is (see drawing):

max. = 62,979 mm.

min. = 62,966 mm.

The measurement of the internal diameter of the shells should give:

max. = 63,036 mm.

min. = 63,005 mm.

The clearance between the shells and the collar, on mounting, should be:

0,026 ÷ 0,070 mm.

If the measured clearance is less than 0,025 mm. check the housing of the main bearings with the bore gauge, until the clearances requested have been found.

1e) Mounting the piston rings

The piston rings should be mounted, bearing in mind that the marking "TOP" on the same should be directed upwards in relation to the piston.

The clearance of the mounted segments is:

-external conical segment (08977) 0,30 - 0,45 mm.

-lower torsional segment (08977) 0,30 - 0,45 mm.

-ROF with coil springs 0,25 - 0,40 mm.

1f) Clearance between liner and piston

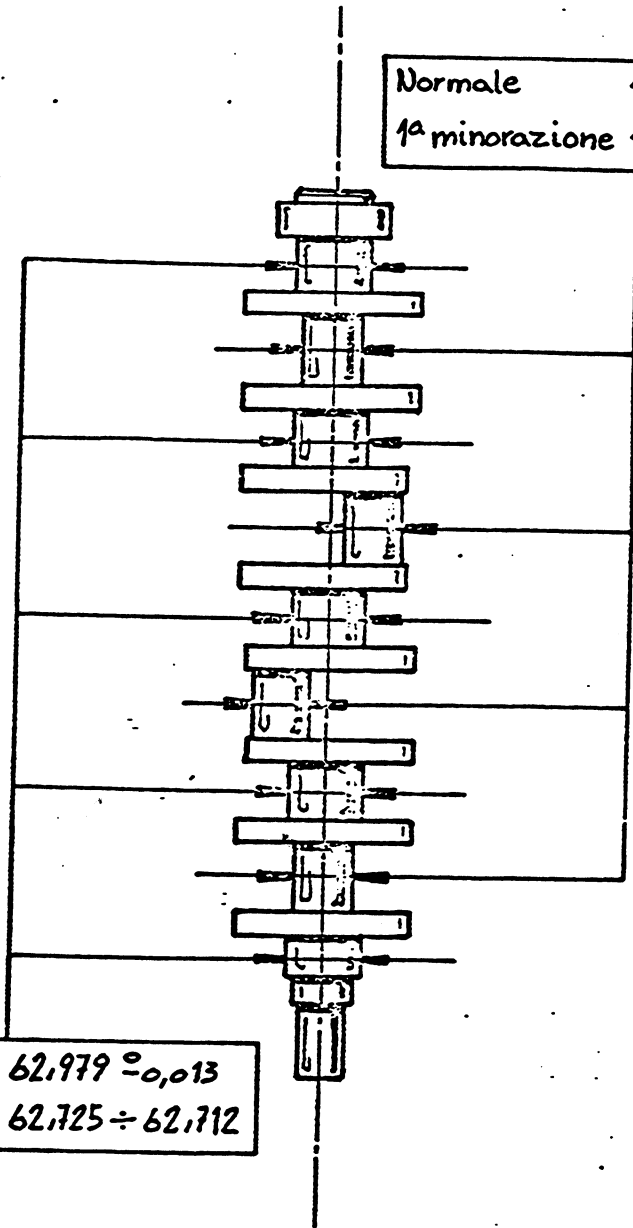
The dimensions of the liners to be mounted are indicated in the following table:

Clearance of the internal diameter of the liner	
86,000 - 86,010	Rose
86,010 - 86,020	Green



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CRANKSHAFT AND CAMSHAFT DIAMETERS



Normale $45,490 \div 45,500$
1^a minorazione $45,236 \div 45,246$

Normale $62,979 \pm 0,013$
1^a minorazione $62,725 \div 62,712$

These liners have three sets of pistons, with the following dimensions:

d	d1	d2	Colour
85,865 ÷ 85,885	85,880 ÷ 85,890	85,800 ÷ 85,820	Rose
85,875 ÷ 85,895	85,890 ÷ 85,900	85,810 ÷ 85,830	Green

For the weights, the pistons are divided into three sets, each of which must be coupled with the corresponding sets of connecting rods

Weights of pistons in grammes	
A	515 ÷ 520
B	520 ÷ 525
C	525 ÷ 530

1g) Coupling of pistons with connecting rods

The pistons of series A B and C are coupled to the connecting rods of series A B C.

1h) Coupling of the connecting rods to the pistons

The weight of the connecting rod in grammes is indicated on the big end bearing where the "stop" of the half-shell is indicated. It is important, in fact, that the connecting rods in one and the same engine should be of identical weight. On the other hand, the letter for coupling with the piston is indicated both on the barrel and cap of the big end.

To insert the gudgeon pin in its proper seating, an aluminium punch should be used, noting that on the piston, in the part where the pin is inserted, there is a coloured symbol (white or black) corresponding to the one on the pin itself.

1i) Clearance between gudgeon pin and small end (Bronze bush)

The small end, when mounted, has an internal diameter of:

Max. diam. = 21.000 mm.

Min. diam. = 20.995 mm.

The external diameter of the gudgeon pin is:

Max. diam. = 21.000 mm.

Min. diam. = 20.995 mm.

There is therefore a clearance between the gudgeon pin and the small end of:

Max. = 0.005 mm.

Negative allowance = 0.005 mm.

To check the correct value for the coupling between the small end and the gudgeon pin, the usual method is followed:

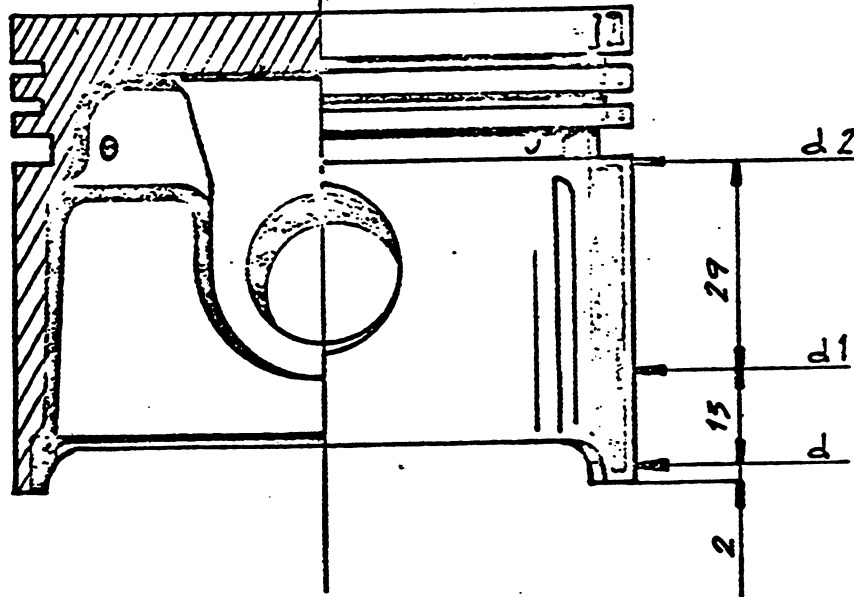
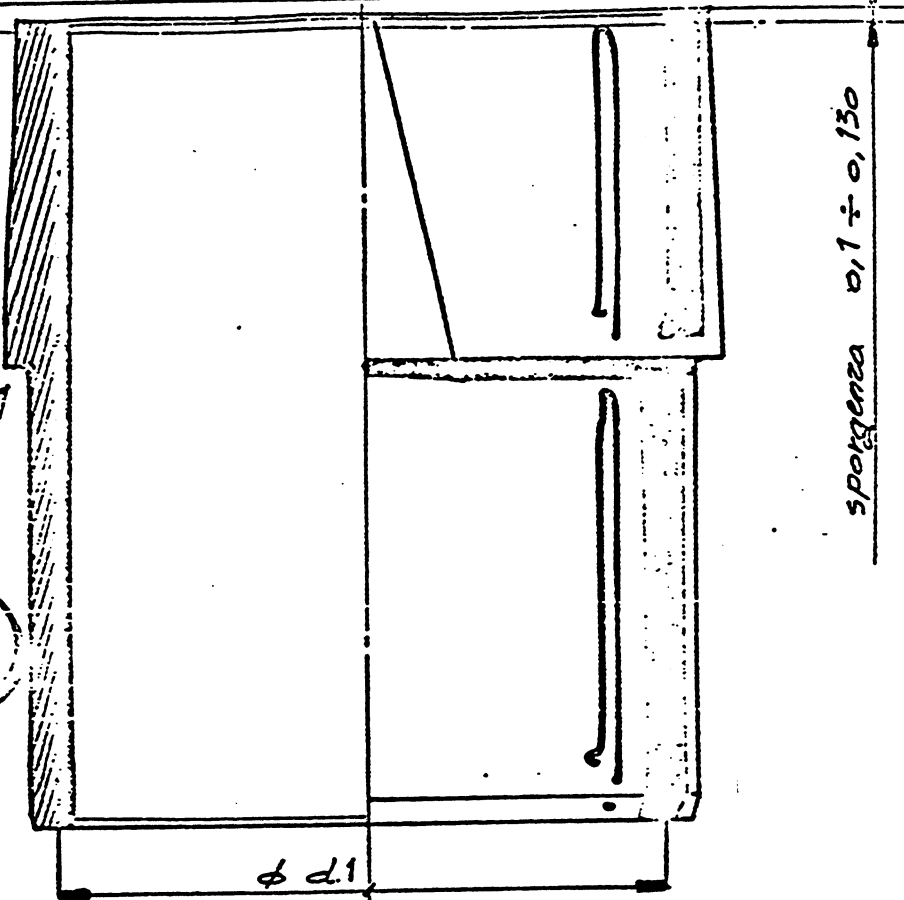
-insert the pin in the small end bearing and hold the two ends between the thumb and the first finger and allow the big end to fall in. Its actual speed should be as uniform as possible.



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DIMENSIONS OF CYLINDER LINERS AND PISTONS

filo basamento



Colore	Lanna	d	d1	d2
Rosa	86,00 ÷ 86,01	85,865 ÷ 85,885	85,880 ÷ 85,890	85,800 ÷ 85,820
Verde	86,01 ÷ 86,02	85,875 ÷ 85,895	85,890 ÷ 85,900	85,810 ÷ 85,830

11) Mounting the shells on the big end bearings (Vandervell)

Place the half-shells in position on the connecting rod
Tighten with the dynamometric spanner the bolts on the
big end, applying a torque of 6 kgm.
Slacken off completely one of the bolts of the big end.
Using the thickness gauge, check the clearance between
the bearing surfaces of the cap and the barrel. This
should be 0,08 mm. - 0,10 mm. which value ensures the
correct "pull" of the half-shells in their housing.

1m) Mounting the crankshaft bearing bolts

These 12 mm. bolts near to the crankshaft should be
screwed to the base, using a torque of 3,5 kgm.
The outer 8 mm bolts should be screwed to the base,
using a torque of 1,8 kgm.

1n) Mounting the crankshaft

Before mounting the crankshaft on the bedplate, the
bearing for the primary shaft of the gear box has to be
mounted. Insert the distance pieces (1401245) in the
main bearing. Check the oil return ducts to the sump
so that:

the external diameter is according to the drawing, to
avoid stress on the rubber gasket which would otherwise
no longer enter its seating.

ensure that the length is within the clearance allowed,
in order not to affect the stroke of the small rod.
Carefully mount the rubber washers at the ends and
insert the liners in their seatings, making sure
to avoid oil leakage as a result of hasty handling
(see drawing no. 6).

Mount the sub-base, tighten the \emptyset 12 mm. nuts to 5,8
kgm. and those of 8 mm. to 2,8 kgm.

Make sure that the axial clearance of the shaft is.....

Mount the rear oil retainer, using the appropriate
compass (see fig. 6).

Repeat this operation for the front oil retainer (fig.
6).

1o) Clearance between connecting rod collars and big end bearings

- The internal diameter of the mounted big end bearing is:

max. int. diam. 45,582 mm.

min. int. diam. 45,550 mm.

The diameters of the collars are as follows:

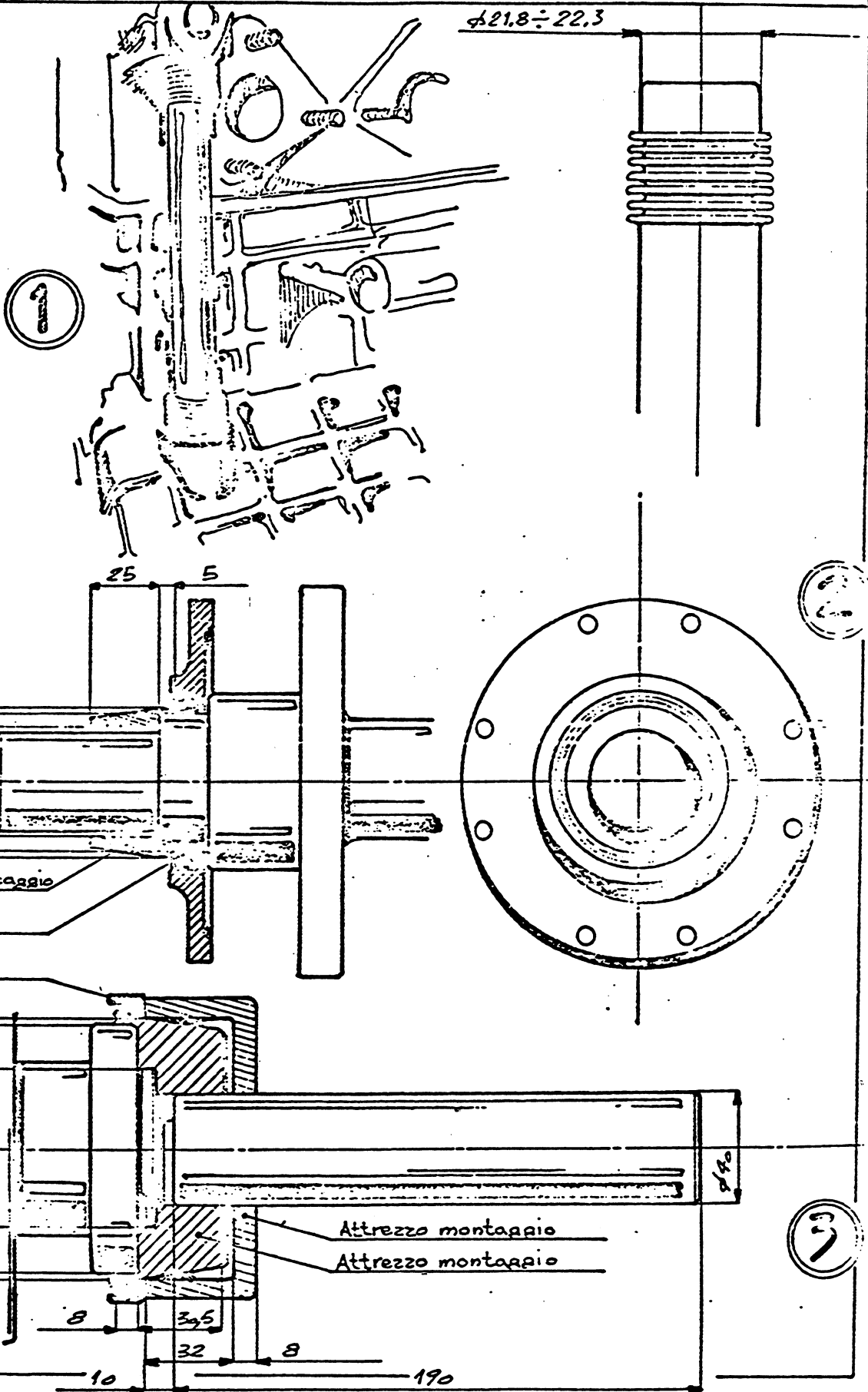
max. diam. 45,500 mm.

min. diam. 45,490 mm.



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MOUNTING THE OIL RETURN PIPES (1) FRONT OIL
RETAINER (2) AND REAR OIL RETAINER (3)



We thus get:

max. clearance = 0.092 mm.

min. clearance = 0.050 mm.

1p) Assembly of the connecting rods to the crankshaft and pistons

When assembling the connecting rods, the lubrication holes must be borne in mind.

The connecting rods as per Drwg. 08552 are mounted with pistons nos. 1,2,3 and 4. Those to Drwg. no. 08553 with pistons nos. 5,6,7 and 8.

-the pistons, complete with connecting rods, are inserted in the liners, using the appropriate tool (see Drawing no. 7).

-each connecting rod is mounted by rotating the crankshaft each time, so that the relative collar is centred on the axis of the cylinder concerned.

Then mount the big end cap, after injecting engine oil into the big end, and partly tighten the nuts to the bolts of the big end.

Mount all the connecting rods, ensuring that the big ends are free on the shaft collars.

To check this, shake each connecting rod, holding with the spanner one of the nuts to the bolts of the big ends.

Finally tighten up the nuts to the bolts of the big end, using the dynamometric spanner with a torque of 6 kgm.

2) Preparation and assembly of oil pump

Clean the body of the oil pump (1508026 Table 5 C.P.R.) and remove with a scraper any burrs left over from machining.

2a) Emplacement of the shaft on the driving gear

-place the driving gear in the stove and raise the temperature to 250°C.

-Smear the part of the shaft to be inserted in the driving gear with a thin layer of tallow.

-remove the driving gear from the stove and, using a punch, insert the pin and allow it to cool.

-make sure that the small piston (1508247) is within tolerance and has a clearance, vis-a-vis its seating, of 0,047 to 0,075 mm.

-mount the two stud bolts 8300808 on the pump body.

-mount the gear and lubricate with oil.

-Seal the pump body with the washer (?) fixed with the bolts (810063C).

-mount the small piston after giving it a slight film of oil.

-insert the spring and tighten the cover (1507628).

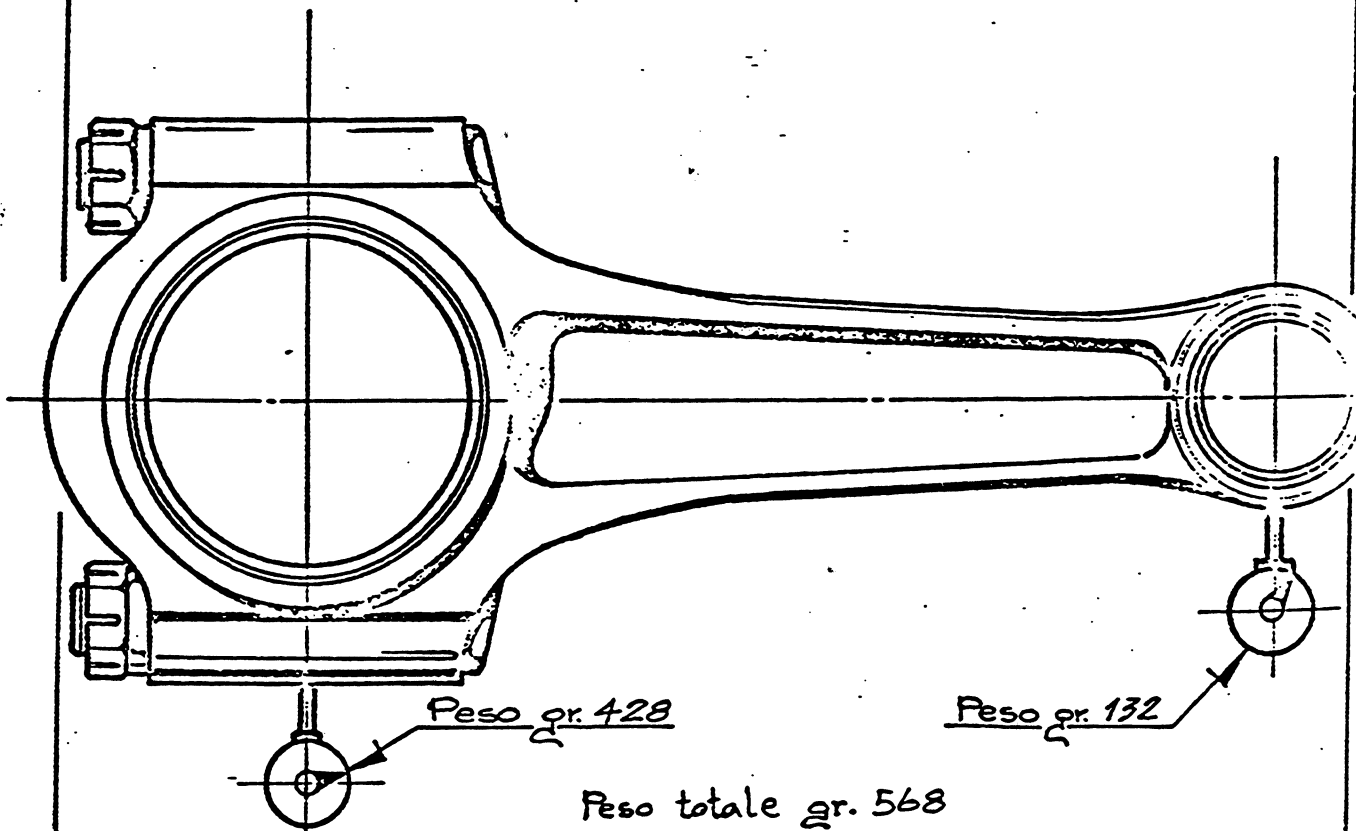
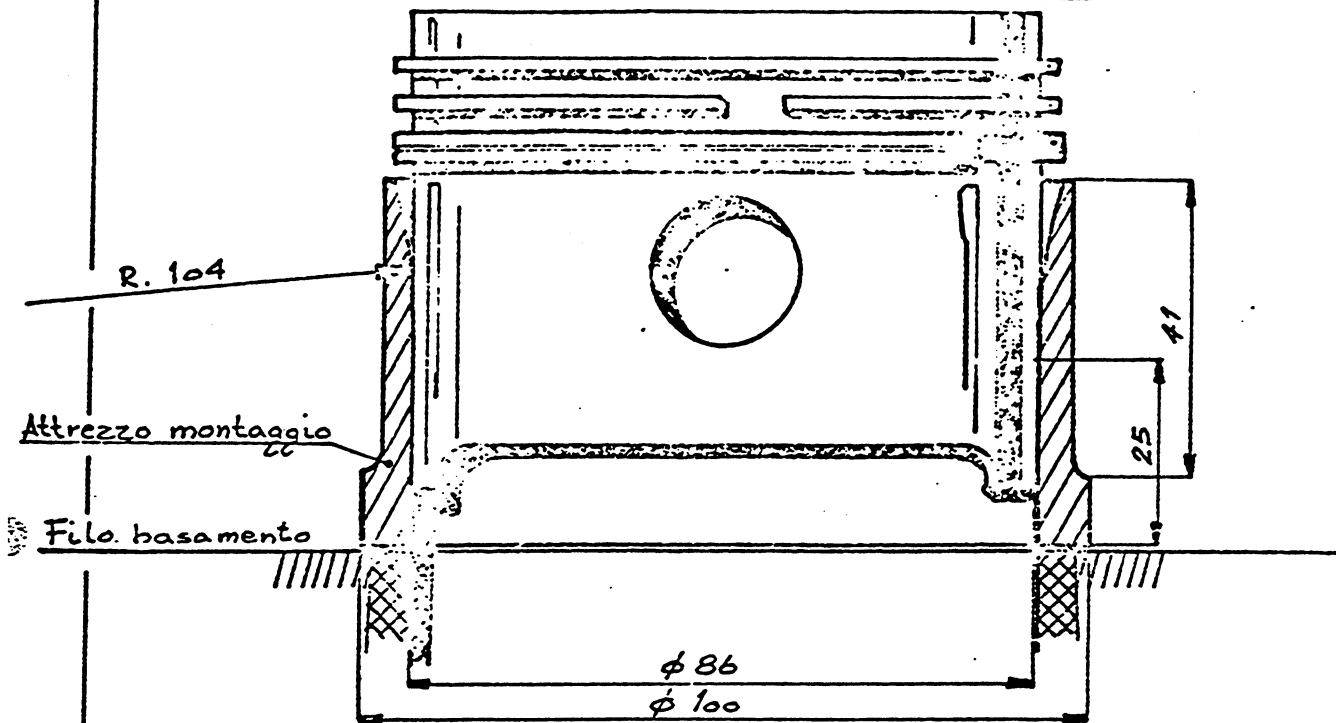
-ensure that with the spring (1500927) the small piston leaves the oil discharge aperture fully open.

-turn the small shaft of the driving gear by hand and make sure there is no resistance at any point.



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MOUNTING THE PISTONS IN THE LINERS
AND CONNECTING ROD WEIGHTS



OIL PRESSURE (100°C)

	1000 rpm.	0,9 kg/sq.cm
	2000 rpm.	1,5 kg/sq.cm.
Capacity of Pump	3000 rpm.	2,8 kg/sq.cm.
A 7000 = 80 1/1'	4000 rpm.	4 kg/sq.cm.
	5000 rpm.	5 kg/sq.cm.
	6000 rpm.	5,5 kg/sq.cm.
	7000 rpm.	6 kg/sq.cm.

3) Mounting valve guides on the heads (Table 8)

heat the heads in the stove up to 160°. insert the valve guides in their respective housings. in mounting (new heads) the following diameters should be taken for the housings:

max. diam. of housing	15.018 mm.
min. diam. of housing	15.000 mm.

for the external diameter of the guides (see fig...)

max. diameter	15.066 mm.
min. diameter	15.048 mm.

We thus get:

negative allowance max.	0.066 mm.
negative allowance min.	0.030 mm.

3a) Extraction of valve guides from heads

The extraction of the valve guides from the heads is made after heating the heads in the stove up to 170°C.

3b) Mounting of valve seatings on the heads (Table 8)

Heat the heads in the stove up to 160°C. (Max. 175°) Then mount the valve seatings in the respective housings. For first assembly (with new heads) proceed as follows:

1) Suction

for the housings:

max. diam. of housing	44.946 mm.
min. diam. of housing	44.916 mm.

for the maximum external diameter 'd' of the seatings (see fig...)

max. diam.	45,111 mm.
min. diam.	45,085 mm.

We thus get :

Max. negative allowance	0,195 mm.
Min. negative allowance	0,139 mm.

2) Exhaust

For the housings:

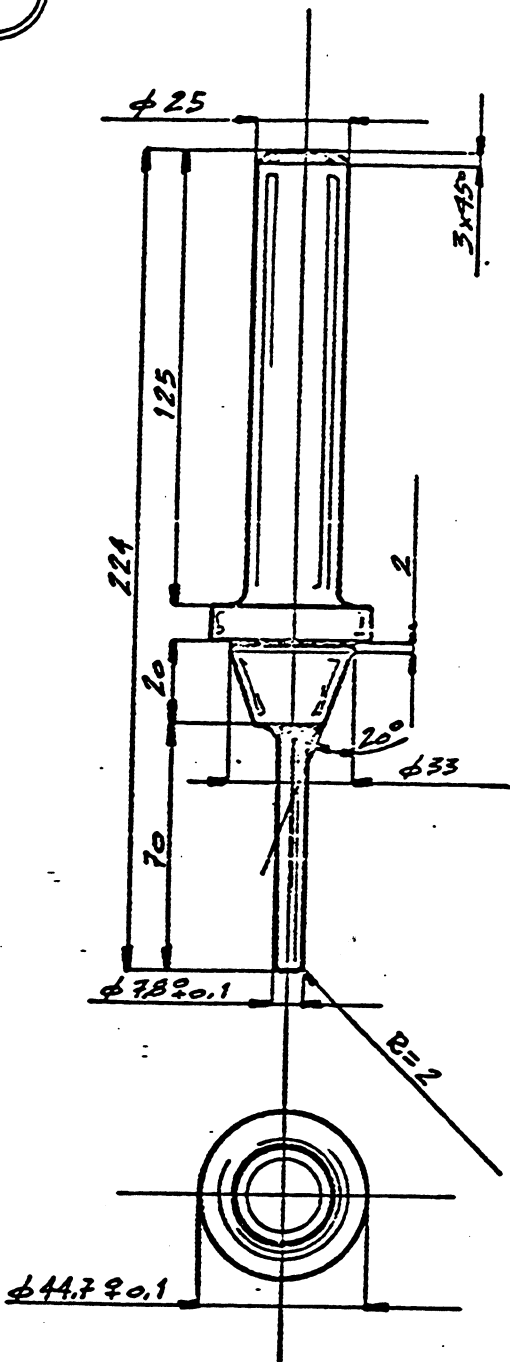
max. diameter of housing	= 36,946 mm.
min. diameter of housing	= 36,916 mm.



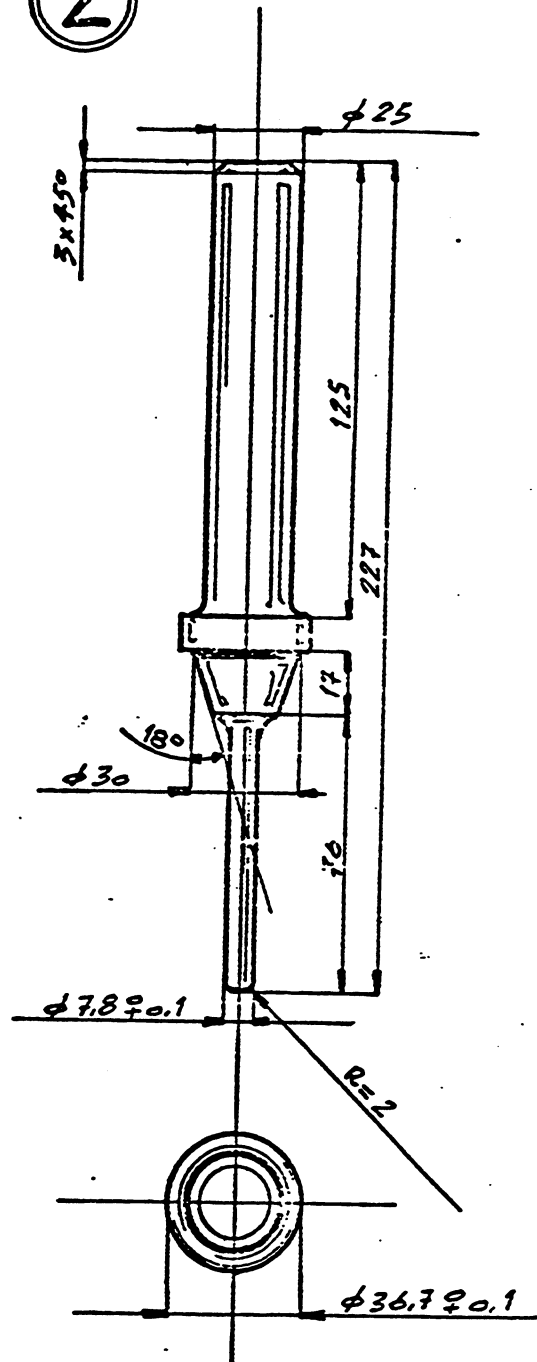
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MOUNTING, TOOLS FOR VALVE SEATINGS (1)
EXHAUST (2) AND VALVE GUIDES (3)

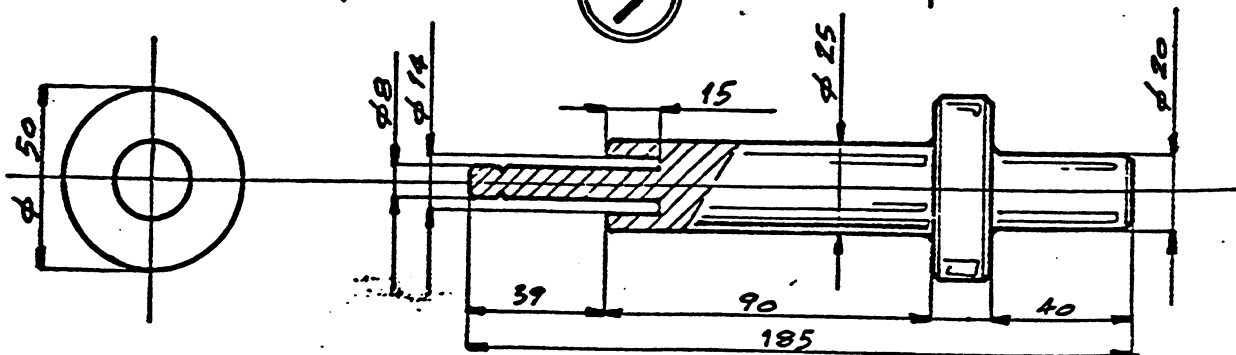
1



2



3



Whilst for the external diameter of the seatings:

max. diam. = 37,121 mm

min. diam. = 37,091 mm.

We thus get:

negative allowance = max. 0,075 mm.

negative allowance = min. 0,058 mm.

3c) Extraction of valve seatings from the heads

The withdrawal of the valve seatings from the heads is made after heating the head in the stove up to 180°C.

1) INLET

max. clearance 0,060 mm.

min. clearance 0,027 mm.

2) EXHAUST

max. clearance 0,070 mm

min. clearance 0,037 mm. A

3d) Mounting of valves on the cylinder head (fig. 9)

The valves are mounted on the cylinder head, using the appropriate tool (see drawing).

For the clearance between the valve stem and the valve guide, after mounting, see Table "A".

4) Emplacement of camshafts, and setting

-clean the camshaft bedplate in the seatings bearing the shaft

-clean the shaft and lubricate it.

-insert it in the bedplate.

-mount the oil retainers on the front and rear cover plates sealing off the camshafts.

-mount the cover plates on to the supports.

-key the pulley to the front part of the shaft, insert the centering dowel, tighten the screw and rivet the seal.

-mount the cartridges and the bowl.

-fix the bearing to the head, tightening the nuts to 2,8 kgm.

-check the clearance of each valve, slowly turning the shaft, using the appropriate tool, and changing the cartridges to obtain a clearance, cold, of 0,45 mm.

To change the cartridges, use the following tool (see drawing).

Execute the same operation for both camshafts, in order to obtain the same clearance.

rotate the shaft so that the notch on the rear of the pulley coincides with the index marking on the support.

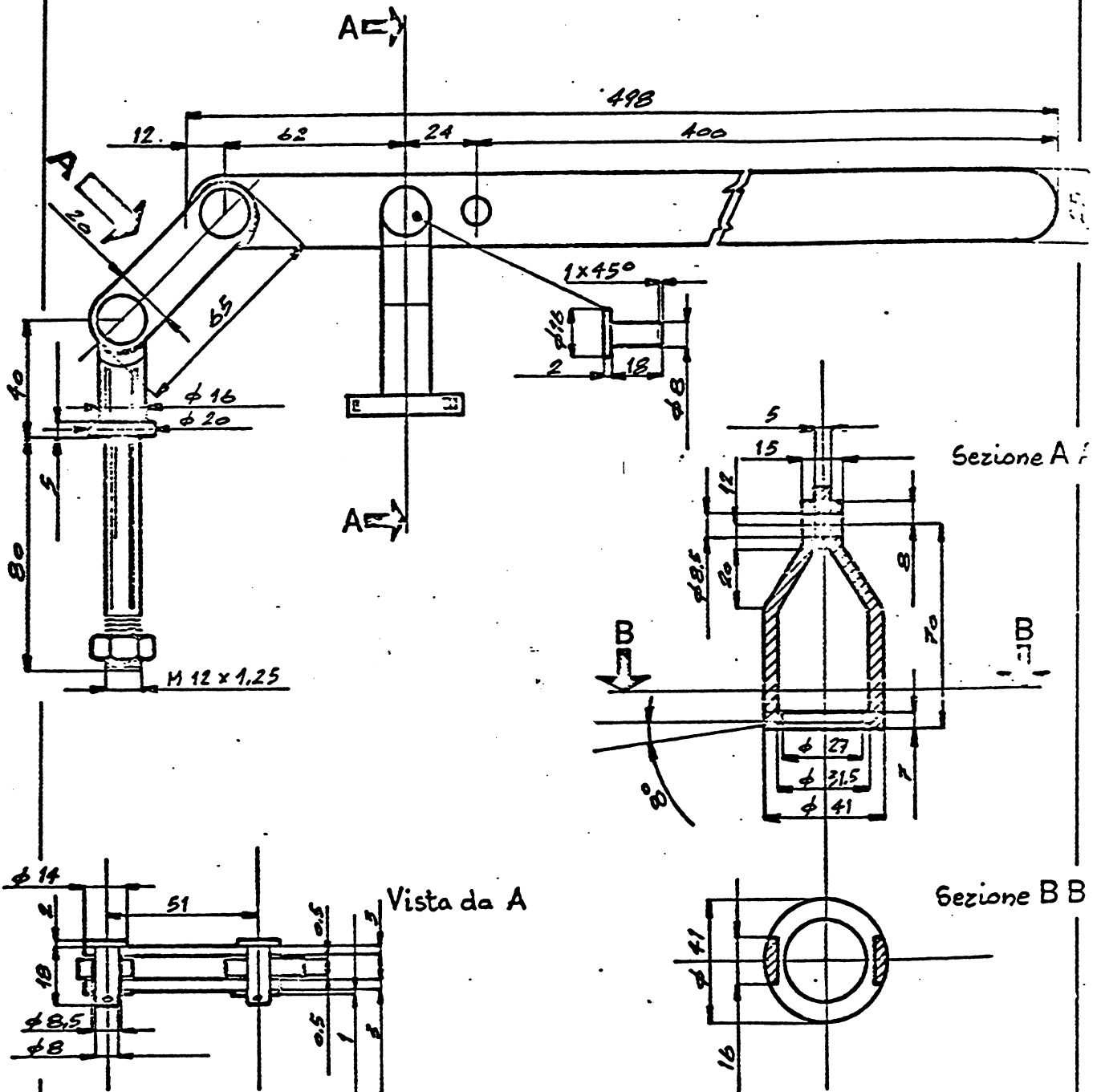
In this position, the camshaft is balanced.

Then mount the belts.



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VALVE MOUNTING TOOL



5) Mounting the stud bolts and fixing the cylinder heads

The stud bolts to fix the cylinder heads (\varnothing 12 mm.) are tightened to the cylinder block, using a torque of 3 kgm.

5a) Mounting the cylinder heads

Mount the gaskets MT 1105813

Place the cylinder head in position and tighten, in alternative order, the nuts of the fixing bolts, using the dynamometric spanner at 6 kgm. (the nuts must be tightened in the order indicated in drawing no. 10). Fit the mountings of the camshafts and tighten the nuts (\varnothing 8 mm.) to 2,8 kgm. Fit the gaskets and the cover plates (1105772 and 1105771).

6) Mounting and tensioning of the timing belts

Place piston no. 1 at TDC. This occurs when the reference symbol on the flywheel (P.MSM) coincides with the marking on the gear-box housing inspection window.

Turn the camshafts, already mounted with the pulleys, to bring them into the position described in paragraph 4.

(The marking on the pulley should be in the direction of the index symbol on the camshaft bearing).

Mount the "V" belt so that its teeth enter the apertures in the camshaft pulley without causing excessive deflection 'f' in the belt, between the two points "e" and "b" in the drawing. (see Drawing no. 11). Holding the belt firmly, insert it in the pulley connected to the drive shaft and then place it on the automatic belt-tensioner (see figure 11).

The tension of the belt is continuous and automatic.

For a correct setting of the automatic device, the end-of-run screw in the drawing should be at a distance from the stop "R" of 1,2 - 1,5 mm. (with engine cold).

This because the tensioner will take up any slack in the belt, caused by the heat from the engine when it is running.

7) Timing of distributor

The timing of the distributor has now become an easy matter, the procedure being as follows:

Piston no. 1 must be at TDC.

Camshafts in the position already indicated (paras. 4 and 6). Camshafts in the balanced position, namely with the marking on the pulleys coinciding with the index symbol on the camshaft cover plate.

Mount the belt as described in para. 6.

The engine is then in phase.



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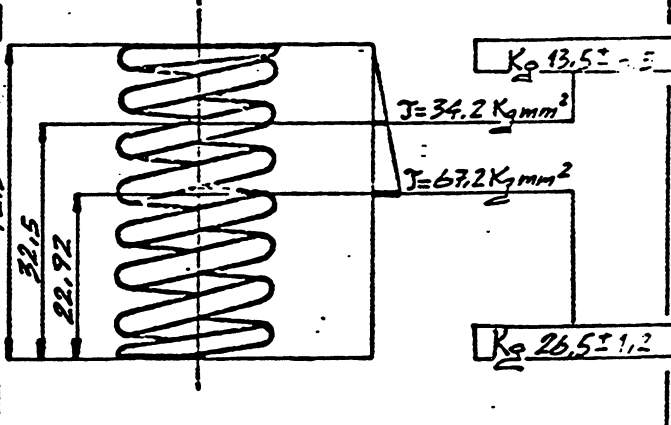
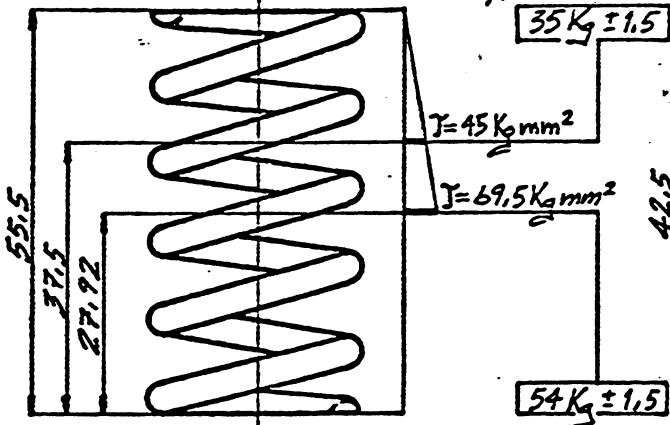
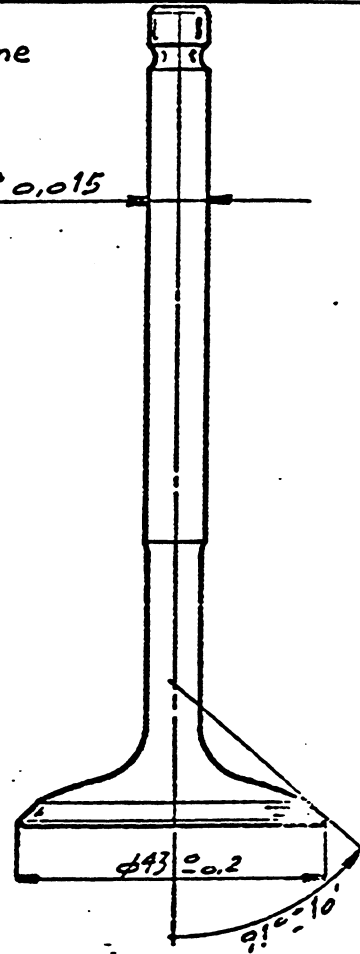
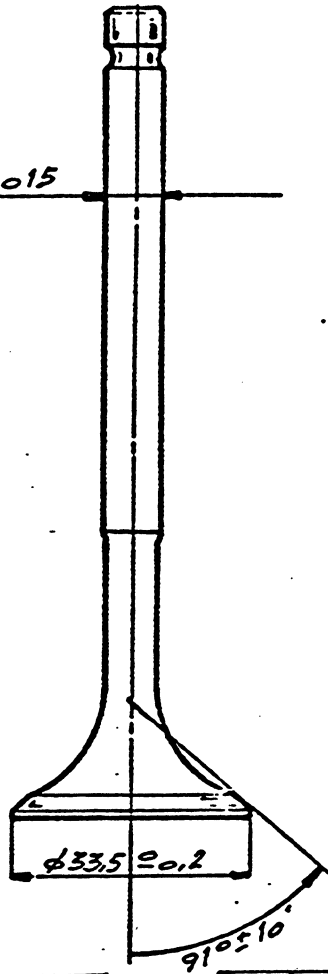
**DIMENSIONS OF VALVES AND SPRINGS -
TIGHTENING OF CYLINDER HEAD BOLTS**

Scarico

Aspirazione

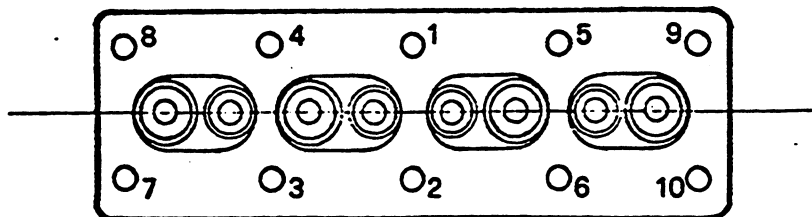
$\phi 7,985 \pm 0,015$

$\phi 7,995 \pm 0,015$



Molla esterna

Molla interna



ordine di serraggio

8) Mounting the central cover plate

Clean the central cover plate (1805883 Table 9 C.P.R.) and remove any burrs left over from machining. Clean all parts to be mounted and place them in clear order on a stand. Mount the breather connection on the cover plate, using pad and hammer. Mount on the cover plate the self-lubricating bushings of the accelerator shaft. Place the central carburettor control lever in position (1308538) after inserting the bushing (8801003) in its seating.

Insert the two washers, one above and one below (8401007). Connect the spring (1306153) to the lever and connect the whole with the pin (1306143) to the cover plate.

Mount the three stud bolts 8300322 to fix the distributor. Assemble the compass of the water pump shaft bearing in the following manner:

- mount the bearing 8501701 and the stop ring 8573501 on the compass.
 - insert the small shaft with worm screw 1706751 in the seating of the bearing, and fix it with ring 8581501.
 - mount the retaining rings 8611705 and 8611601; a thrust washer between the sealing ring and the rotor, and the rotor with lip washer 8860401, washer 8411002 and tighten with nut 8200501.
- Bend the washer 8411002 to prevent the nut from slackening.
- fix the compass, now complete with its elements, to the cover plate, after mounting the two "OR" rubber washers as oil retainers 8606201 with bolt 8100830.
 - mount the oil retainer 8612502 and the stop ring 8574301 at the rear of the cover plate.
- Key the pulley 1205843 and its ring 8251701 to the shaft with the tongue 8860402.

In the lower part of the central cover plate, where the distributor gear passes, mount the bearing 8501704, so that it beats, at the top, against bolt 8100401, and below against the stop ring 8574301.

To eliminate play between the bearing and the stop ring, insert washers 8403401, of variable thickness.

9) Timing the ignition

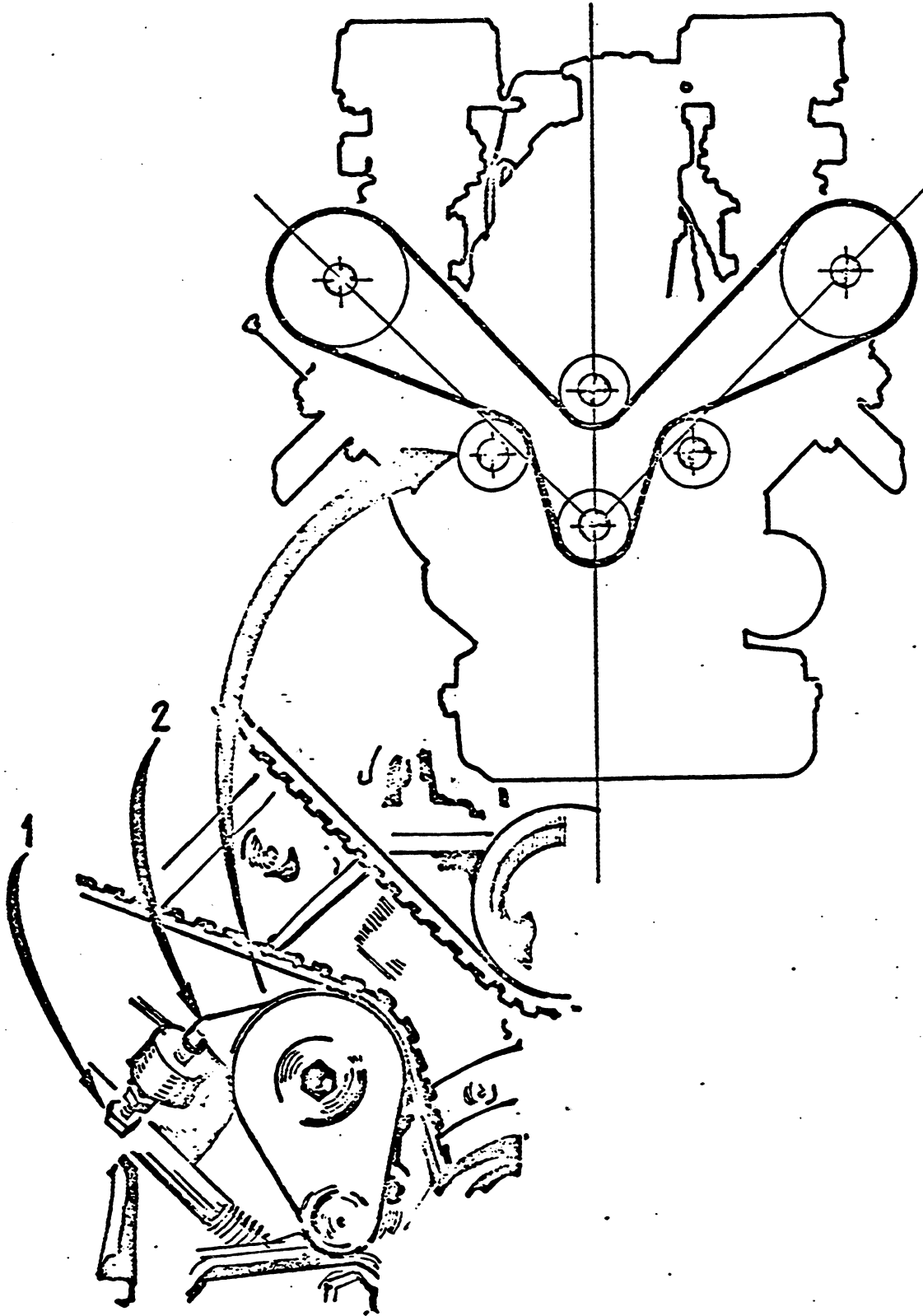
After timing the distributor, rotate the crankshaft through almost a complete turn, clockwise (facing the fan) and stopping it when the advance marking (AA) of Inlet on the flywheel corresponds with the marking on the gear box casing.

Mount the distributor and tighten the 3 nuts so that it can rotate through a few degrees on its seating.



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BELT TENSION - TIMING CONTROL



600

600

- Using an inspection lamp (fig. 12) with one pole directed to the secondary circuit A of the distributor and the other to earth;
 - Retard the distributor (rotating it anticlockwise, seen from the damper) so that the bulb remains lit for some degrees of displacement of the aforementioned.
 - carefully turn the distributor clockwise until the light goes out (this is the moment at which the spark occurs between the contacts).
- Tighten the three fixing nuts on the distributor flange. Rotate the drive shaft anticlockwise, until the bulb lights up, and continue the rotation. When the light goes out, make sure that the marking AA coincides with the marking on the gear casing.
- N.B. If they do not coincide, repeat the phasing.

10) Mounting of the clutch assembly

Mount the bearing CSN 8501502 (Table 3 C.P.R.) in its seating on the drive shaft and fix it with seeger SGN 8573501.

- insert the dowel GRN 3850806 on the flange of the drive shaft and mount the flywheel MM 2108645 tightening the bolts BN 8100802 using the dynamometric spanner at 2,8 kgm.

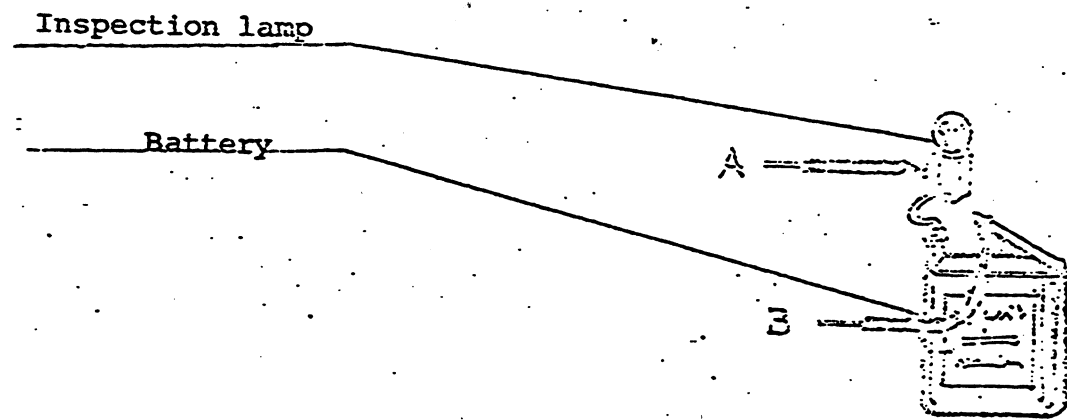
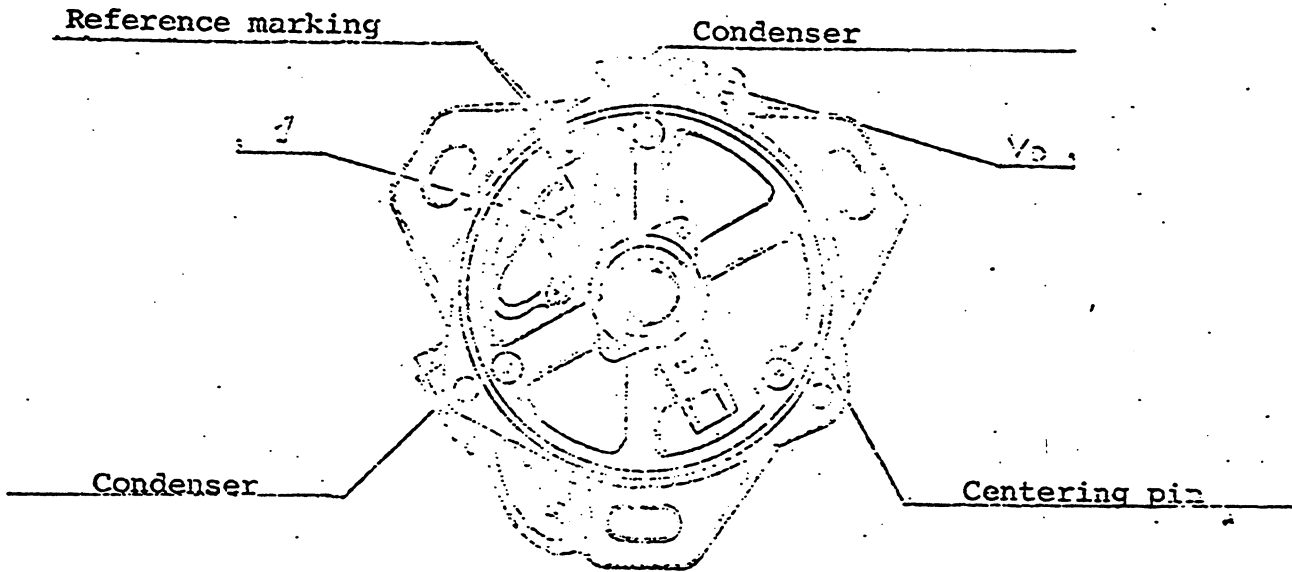
Then seal the stops RFN 8410801.

Mount the disc 2108646, thrust plate and diaphragm, and fix it to the flywheel with screws 8700811.

Tighten up with the dynamometric spanner at 2,8 kgm., keeping the clutch disc centred with the appropriate tool.

Mount the gear box, taking care with the entrance of the protruding part (channelled) of the primary shaft of the gear box, in the clutch splines (already centred previously with centering of 2 pins) in the gear box housing, with the bedplate.

The rotor arm is in such a position that the contact breaker (1) is about to open



Mobil^{*} SHC^{*}

A New Concept in Automotive Engine Lubrication

Mobil SHC is a unique multiviscosity fluid which represents a totally new concept in automotive engine lubrication. This exceptional product is manufactured from novel synthesized hydrocarbon fluids (SHC) possessing outstanding physical properties. The patented process used in the manufacture of these SHC fluids permits the synthesis of a material with features specifically designed to give optimum performance characteristics over a wide range of engine lubricating and operating conditions.

SHC fluids can best be described as exceptionally high quality paraffinic hydrocarbons. When combined with appropriate additives the result is **Mobil SHC**, an engine oil of "unique" performance capabilities.

Product Description

Mobil SHC is a wide multi-viscosity (SAE 10W-50) synthetic engine lubricant with outstanding high and low temperature properties which far exceed those of the best multi-viscosity mineral oil base products. In addition to its very high viscosity index it has a very low pour point and exceptionally good low temperature fluidity, permitting easy engine starting under extreme cold weather conditions. The unique properties of the SHC base fluid result in thicker oil films at high temperature, leading to reduced oil consumption, less wear, better oil pressure retention and good hot starting. These factors contribute to better engine protection and longer engine life.

Mobil SHC has outstanding oxidation and thermal stability which provide resistance to degradation under the most arduous service conditions of high speed/high temperature operation such as that encountered in racing or rally events. The use of carefully researched detergent/dispersant/corrosion inhibitor additives also ensures that the formation of harmful engine deposits and rust is minimized resulting in improved engine cleanliness.

Typical Properties are shown in Table I.

Table I
Typical Properties

Characteristic	Typical Value
Specific Gravity	0.882
Pour Point F (C)	below -65 (below -55)
Flash Point F(C)	445 (230)
Viscosity cSt 210 F	24.0
cSt 100 F	135
CCS P 0 F	18
CCS P -20 F	60
CCS P -30 F	98
Viscosity Index	220
Sulfated Ash, %	0.88

^{*} Trademarks of Mobil Oil Corporation

Reasons for Development

Over the years, the evolution in the design of passenger cars with improved performance and reliability while maintaining operating economy has resulted in higher specific output engines, decreased crankcase capacities and increased intervals between oil changes, all factors which maximize the demand in oil performance.

At the same time, traffic density has increased in the city areas worldwide so that many cars operate for extended periods under start-stop conditions which contribute to moisture condensation, low temperature deposits, and corrosion. New superhighways which permit longer periods of sustained high speed driving result in higher engine operating temperatures, particularly in the summer. In addition, to minimize air pollutants, engines have been modified with emission control devices including closed positive crankcase ventilation (PCV) systems.

Vehicle manufacturers and the oil industry have kept pace with these changes and defined new severity performance levels for engine oils. The 1972 API designation "Service SE" includes a new series of engine tests which have been substantially increased in severity over the 1968 MS test level. Sequences IIB, IIIB and V-B have been replaced by Sequences IIC, IIIC and V-C, respectively. The results are increased protection against low temperature rust and sludge formation, increased high temperature oxidation stability and higher ability to keep a PCV valve assembly clean. Worldwide, especially in Europe, test requirements have also been refined in recent years. The Coordinating European Council (CEC) Tests are consolidating on a series of European procedures for engine oil quality which demand improved lubricant performance. Mobil SHC has been developed to exceed the standards set by these tests.

The high performance of Mobil SHC in all these tests demonstrates outstanding detergent, dispersant and anti-wear properties to guard against deposits, corrosion and wear of engine parts under all operating conditions. Deposit forming materials are kept in finely divided state and the protection is effective in both high temperature and low temperature operating conditions. The additive treatment is particularly effective in reducing cam and tappet wear.

Performance

Mobil SHC is a true SAE 10W-50 engine oil which stays within these viscosity limits in service. It exceeds the performance requirements of API service classification SE/CC, Military Specification MIL-L-46152, General Motors Specification GM 6136-M and Ford Motor Company designation M2C-101-C. It meets or exceeds performance criteria as defined by current CEC test procedures as well as many specialized European car builder tests under development. Typical performance data for Mobil SHC in these critical tests are shown in Table II.

It should be noted that the results of Mobil SHC are outstanding in both the severe, high temperature oil oxidation and engine deposit and wear test (Sequence IIIC), and in low temperature sludge and varnish deposit test (Sequence V-C).

In addition to its superior SE quality level, Mobil SHC exceeds the requirements of the Caterpillar 1-H test with diesel performance exceeding API Service Designation "CC." This test evaluates the lubricant's ability to resist carbon and lacquer formation under severe high temperature diesel engine conditions.

To take into account the differences in engine design and driving conditions which exist all over the world, Mobil SHC has been evaluated both in U.S. and European engine tests.

These tests are either standardized European builder approval procedures or proposed Coordinating European Council (CEC) test sequences. Examples of these are the Ford Cortina (high temperature), Fiat 124 AC (preignition), Peugeot 204 and 504 (cam wear protection), MGB (skew gear wear protection) and Daimler Benz OM 615 (wear protection) among others. Results of these tests for Mobil SHC are shown in Table III.

Mobil SHC was also tested in rotary engines and performed satisfactorily.

Primary Performance Features

**Table II
Test Sequences**

	API Designation SE Requirements	Mobil SHC Typical Performance
Oldsmobile Sequence IIC		
Average Engine Rusting (10=Clean)	8.4 min.	8.7
Oldsmobile Sequence IIIC		
100 F Viscosity Increase at 40 h %	400 max.	11
Average Engine Ratings at 64 h		
Piston Skirt Varnish (10=Clean)	9.3 min.	9.3
Oil Ring Land Varnish (10=Clean)	6.0 min.	7.6
Sludge (10=Clean)	9.0 min.	9.4
Ring and Lifter Sticking	None	None
Scuffing and Wear at 64 h:		
Cam or Lifter Scuffing	None	None
Cam plus Lifter Wear, in.,		
Avg.	0.0010	0.0005
Max.	0.0020	0.0009
Ford Sequence VC		
Average Engine Sludge (10=Clean)	8.5 min.	9.2
Average Piston Skirt Varnish (10=Clean)	7.9 min.	9.0
Average Engine Varnish (10=Clean)	8.0	8.6
Oil Screen Clogging %	5 max.	0
Oil Ring Clogging %	5 max.	0
Compression Ring Sticking	None	None
CRC L-38		
Bearing Weight Loss, mg	40 max.	15
API Designation CC Requirements		
Caterpillar 1-H		
Top Groove Carbon Fill % Vol.	30 max.	22
Second Groove Coverage % Area	50 max.	Essentially Clean
Second Land and Below	Essentially Clean	Clean

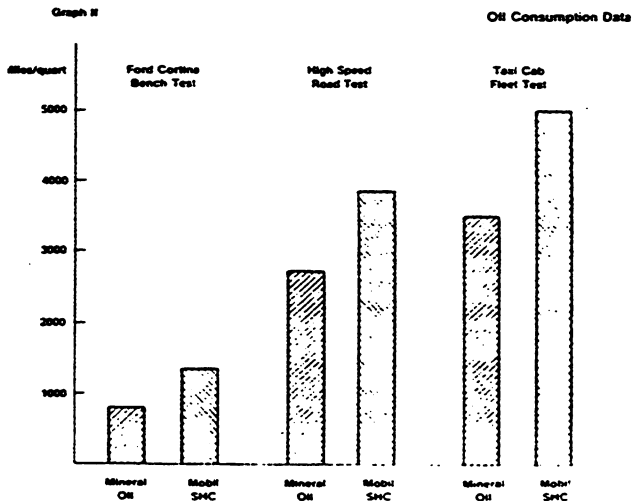
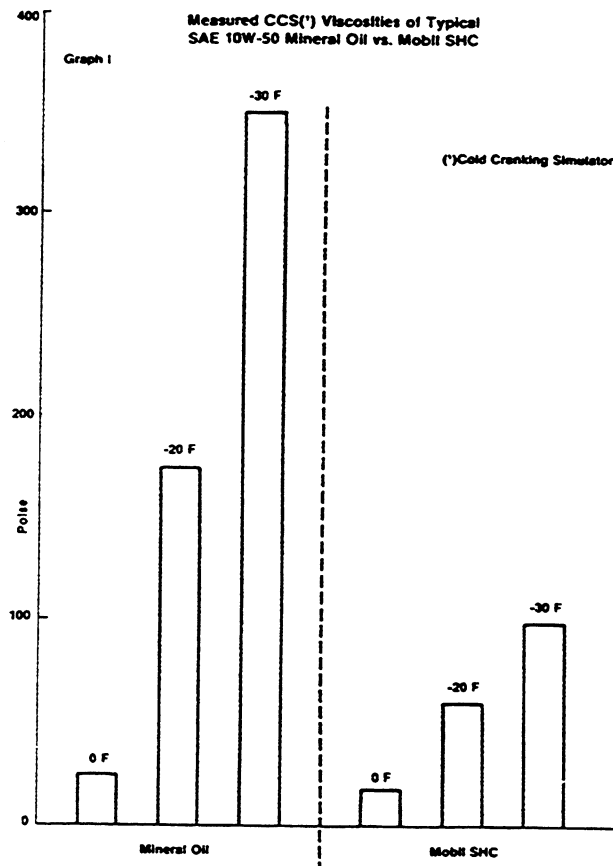
Table III

Test	Requirements	Typical Results
Ford Cortina Seq. II		
Ring Sticking Merits (10=Clean)	8.5	10.0
Piston Skirt Exterior (10=Clean)	8.8	9.4
Piston Skirt Interior (10=Clean)	5.6	10.0
Fiat 600 D		
Filter Sludge, g, max.	55	54
Filter Sludge Merit, min.	6.0	7.0
Top Deck Sludge (10=Clean)	9.5	9.5
Rocker Arm Cover (10=Clean)	9.5	9.7
Timing Gear Cover (10=Clean)	9.5	9.7
Fiat 124 AC		
Hours to preignition, min.	60	94
Peugeot 204		
Cam Demerits, max.	10	6
Rocker Arm Demerits, max.	10	4
Total Demerits, max.	20	10
Peugeot 504		
Cam Demerits, max.	45	10
Tappet Demerits, max.	45	12
Total Demerits, max.	90	22
Daimler Benz OM615		
Cam Wear	Pass	Pass
Liner Wear	Pass	Pass
MGB Skew Gear Test		
Gear Condition	Pass	Pass
Petter W-1		
Bearing Wt. Loss, mg. max.	25	12
Visc. Increase, % Max.	50	39.7
Ring Sticking	None	None
Piston Skirt (10=Clean)	8.5	10
MWM KD12E		
FAM Rating (100=Clean) 50 h, min.	50	77

Special Performance Features

Low Temperature Starting

Graph I compares the viscosity of Mobil SHC compared with a conventional mineral oil SAE 10W-50 product at temperatures of 0 F, -20 F and -30 F. The unique low temperature properties of SHC base stocks allow Mobil SHC to stay fluid down to temperatures as low as -65 F. This leads to significant advantages in engine starting capability at temperatures below freezing. Cold starting characteristics have been demonstrated in Peugeot, Renault and Citroen engines which have shown that Mobil SHC gives easier starting than even a special SAE 5W arctic oil.

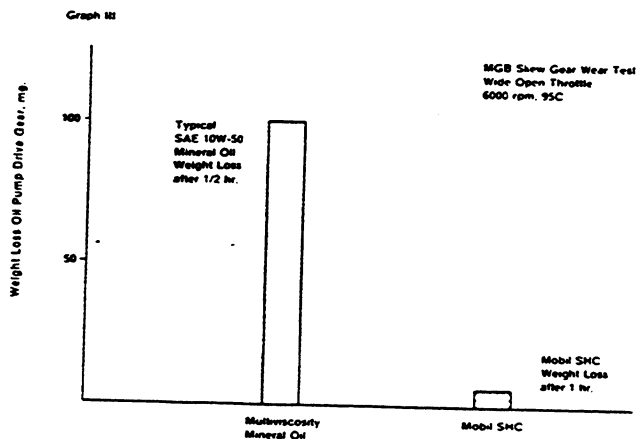


Oil Consumption

Mobil SHC gives much lower oil consumption (28 to 40% reduction — See Graph II) than conventional products. This is due to its unique physical and chemical properties giving greater film thickness, higher viscosity at high operating temperatures and lower volatility. Oil consumption has been measured in Cortina engines in the laboratory, in Fiat and Daimler Benz taxis and under high speed operation in U.S. Ford and G.M. vehicles. A reduction in oil consumption means less oil being burned in and emitted from the combustion chamber.

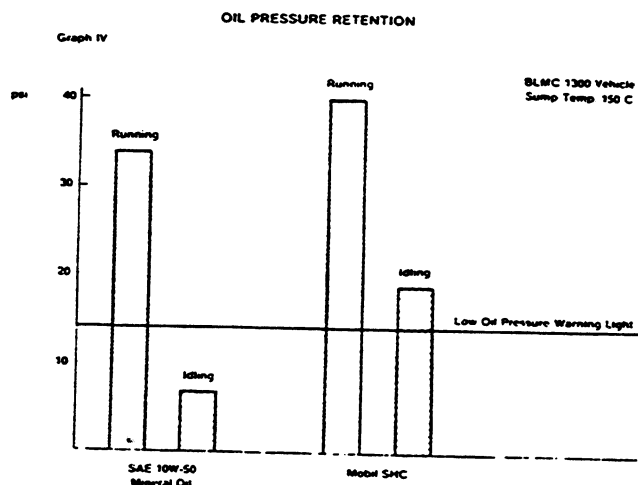
Reduced Wear

Compared to a typical SAE 10W-50 engine oil Mobil SHC provides greater protection to heavily stressed engine parts such as valve train components, gears, piston rings and cylinder liners. This leads to substantially reduced wear as evidenced by results obtained in the critical MGB skew gear test. In this test an MGB engine is run for one hour at 6,000 rpm under wide open throttle with an oil temperature of 95 C. As shown in Graph III Mobil SHC provides a dramatic reduction of wear on the critical skew gears.



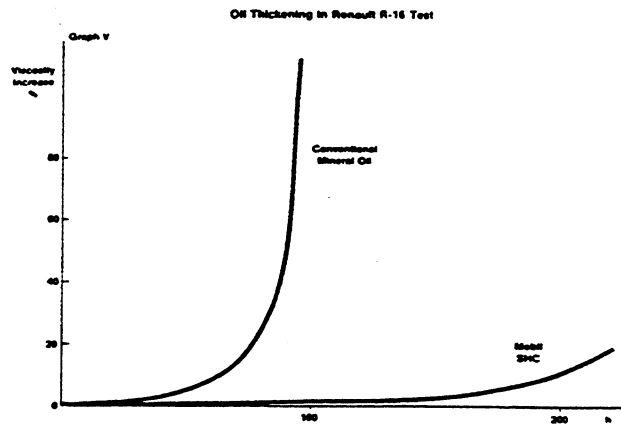
Oil Pressure Retention at Hot Idle

After sustained high speed driving most engine lubricants undergo severe oil thinning due to high temperatures and polymer shearing. This leads to marked loss of oil pressure under hot idling conditions and can result in starting difficulties due to rapid draining of oil from lubricated parts (temporary hot seizure). Tests in a BLMC 1300 vehicle with common sump lubrication of engine and integral gear box showed that Mobil SHC is effective in preventing such difficulties due to its outstanding oil pressure retention. Mobil SHC gives almost a three fold improvement over conventional oils. (See Graph IV)



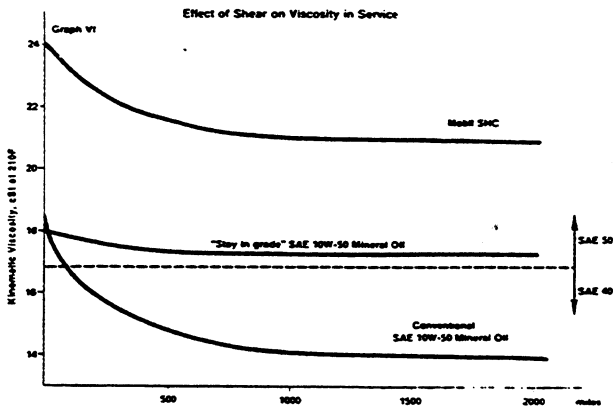
High Temperature Stability/ Oxidation Resistance

Oil thickening due to high temperature oxidation can be a problem in high performance vehicles operating under severe service conditions such as sustained high speed driving or trailer towing. The high temperature stability and oxidation resistance of SHC base fluids far exceeds that of mineral oils. Therefore Mobil SHC shows far superior viscosity stability and minimizes the formation of harmful deposits under severe high temperature and high load conditions. This performance reserve is shown in high temperature tests conducted in Renault R 16 (See Graph V) and Ford Pinto overhead cam engines. In the Renault R 16 test conventional mineral oils can have a life of 100-120 hours before engine malfunction occurs due to oil thickening or excessive deposits. Mobil SHC run for 200 hours gives only slight viscosity increase and no engine operating problems. Similar results were obtained in the Ford Pinto and Oldsmobile IIC oxidation tests.



Shear Stability

Mechanical shearing in engines and integral gear boxes can cause a substantial loss in engine oil viscosity due to permanent shear of the viscosity index improver. With typical multi-viscosity engine oils these shear stresses can result in SAE 10W-50 fluid becoming SAE 10W-40 or even SAE 10W-30 depending on the type of viscosity improver used.

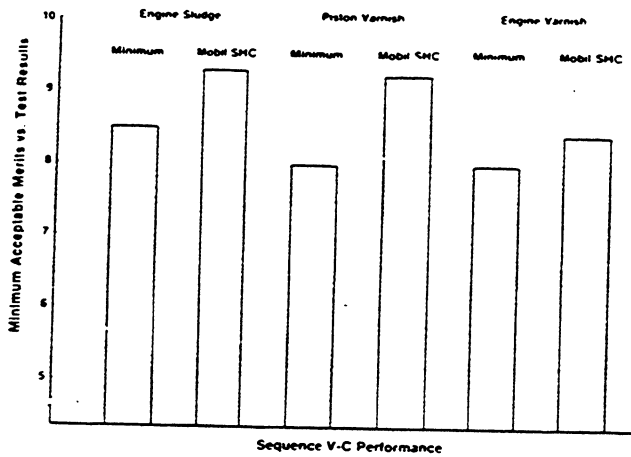


When compared to a "stay in grade" SAE 10W-50 mineral oil product (See Graph VI) Mobil SHC exhibits higher operating viscosity which contributes to better wear protection, easier hot starting and lower oil consumption than this "stay in grade" mineral oil.

Tests carried out in rig, chassis rolls, and fleets have proved that Mobil SHC even under the shear encountered in the most severe European cars stays in grade—it is a true SAE 50 oil which due to its high operational viscosity provides greater film strength to reduce wear and friction.

Mobil SHC resists deterioration even at high temperature stress resulting in reduction of viscosity due to thermal breakdown.

Graph VII



Engine Cleanliness

In addition to providing a lubricating film for the moving parts of the engine one of the major tasks of an engine oil is to keep the engine clean and free of sludge, ring sticking, varnish, and carbon deposits. The unique chemical composition of Mobil SHC in combination with its carefully balanced additive treatment provides excellent engine cleanliness as shown in the Ford VC test which simulates stop-and-go traffic under a combination of low and mid-range temperatures. Graph VII shows the VC test results vs. the test limits.

Summary of Performance Benefits

Less Battery Drain, Faster Starting

- Lower cold temperature viscosity

Less Engine Wear

- Greater film thickness at high temperature
- Faster film formation after starting
- Higher oil pressure retention

Improved Cleanliness, Longer Engine Life

- Greater viscosity stability
- Greater oxidation stability

Longer Valve Life

- Reduced valve deposits

Lower Oil Consumption

- Higher viscosity at operating temperature
- Greater viscosity stability

Easier Hot Starting

- Greater viscosity retention

Compatibility of Mobil SHC With Conventional Mineral Oils

To gain maximum benefit of the outstanding properties of this unique synthetic product, it is desirable but not mandatory to flush the engine and use a completely fresh fill of Mobil SHC. It can be topped up with a conventional engine oil without any harm to the engine, and with minimum degradation of Mobil SHC because Mobil SHC is completely miscible and compatible with conventional mineral based engine lubricants.