SHOP MANUAL ■ ENGINE □ CLUTCH □ GEARBOX

GIULIA TI
GIULIA SPRINT GT
GIULIA TI SUPER

ALFA ROMEO

GTBB4 11/11/75

This Manual, supplied to all authorised ALFA ROMEO Repair Shops, contains instructions for the servicing, overhaul and re-conditioning of the engine, clutch and gearbox.

The operations are amply illustrated so that the detail and unit concerned can be quickly identified and the tools to be used and the correct method of operation can be seen.

Only genuine ALFA ROMEO spares should be used if any assemblies or parts have to be replaced; only in this way can complete interchangeability and fully satisfactory performance be guaranteed.

It is also recommended that the tools specially designed for the various operations be used for all overhaul and reconditioning works.

This Manual should be kept continuously up-to-date by the addition of new information and instructions issued at intervals by the Technical Service Division in the regular « Information Sheets » and « Modification Instructions » which should be copied on to the blank pages at the end of the handbook.

ALFA ROMEO

Direzione Assistenza

CONTENTS

GENERAL SERVICING INSTRUCTIONS

To avoid damage to parts when disassembling and reassembling, always work with the correct wrenches, extractors and tools (special and general).

If a few taps are needed to loosen tight-fitting, use a copper or aluminium mallet for steel parts; for light alloy parts (covers, housings, etc.) use a wooden or plastic mallet.

When disassembling, check that parts which should be marked are stamped with the correct number or reference mark; any original parts (previously replaced) found unmarked should be so stamped.

Components of different assemblies should be kept separate, and nuts should be loosely screwed onto their original studs or bolts.

Before washing parts, brush or wipe off the thickest dirt (to avoid soiling the solvent in the washing tank); then wash with paraffin or hot water and soda and remove any remaining dirt with compressed air; dry all parts immediately after washing so that they do not rust.

A hydraulic press or some other suitable means of applying pressure should be used if parts have to be trued; hammering reduces mechanical strength and should be strictly avoided.

After parts have been ground or honed, wash them thoroughly and blast with compressed air to remove all traces of abrasive powder. When reassembling, clean components (particularly after regrinding) with compressed air blast or a clean, dry brush.

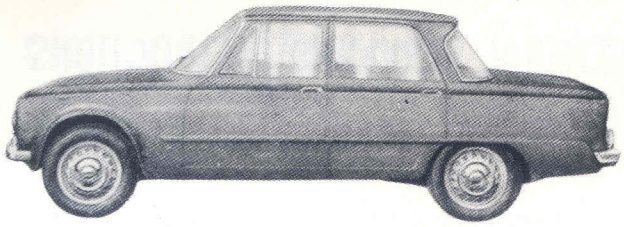
When reassembling, lubricate all mechanical parts properly (except graphite bushings) to prevent seizing and scoring when the engine is first run.

Use a brush and absolutely clean oil to apply a film of oil to all parts which have to be lubricated on reassembly; the brush, the oil and its container should be kept completely free from dust and should be used for the above purpose only.

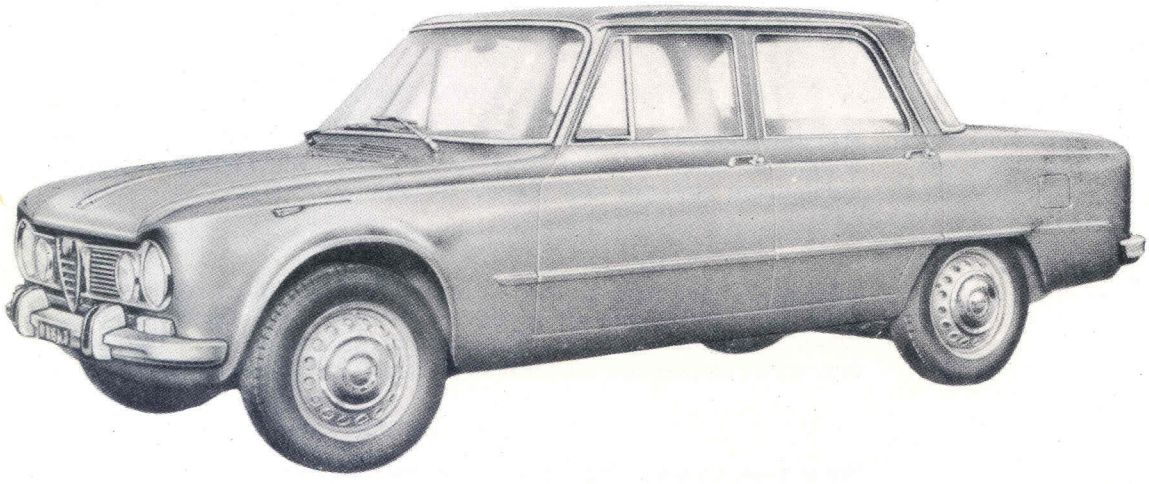
Use adhesive paper or clean rags to protect those parts of the engine into which dust or foreign particles could penetrate as a result of their being uncovered during disassembling.

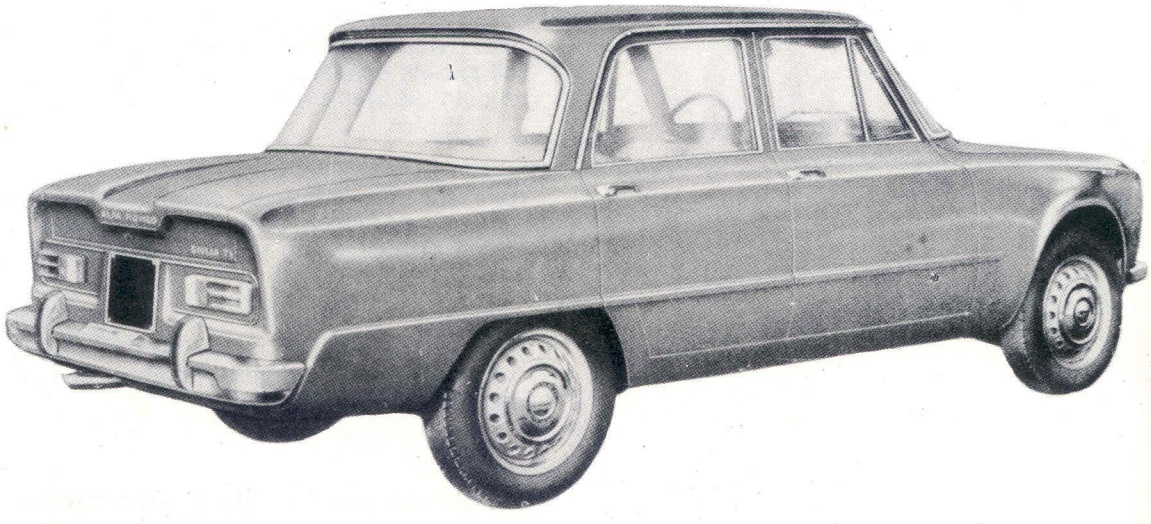
When reassembling, renew all gaskets, oil seals, spring washers, tabwashers and lockplates, palnuts and any component not in perfect condition.

Always use genuine ALFA ROMEO spares.



GIULIA 1600 TI





TECHNICAL FEATURES

Engine	Number and layout of cylinders		4 in line
	Bore and stroke		78 x 82 mm
	Total displacement		1570 cc
	Maximum power at 6000 rpm	HP DIN	92
		HP SAE	106
Chassis	Front wheel track		1310 mm
	Rear wheel track		1270 mm
	Wheel base		2510 mm
	Minimum turning circle		10,900 mm
	Overall length		4140 mm
	Overall width		1560 mm
	Overall height		1430 mm
	Dry weight		1060 kgs
	Number of seats		6
	Tyres (Michelin X - Pirelli Cinturato S)		155-15

Inflation pressures with cold tyres

FRONT 1.6 kg/cm² (22.7 psi) REAR 1.7 kg/cm² (24.1 psi)	with low load and short bursts of speed
FRONT 1.8 kg/cm² (25.6 psi) REAR 2.1 kg/cm² (29.8 psi)	with full load and max. continuous speed on highways

Performance after running in period

Maximum speeds for each gear with **41 : 8** final drive

1st	**40 km/h**	25 mph
2nd	**66 km/h**	41 mph
3rd	**97 km/h**	60 mph
4th	**131 km/h**	82 mph
5th	**165 km/h**	103 mph
Reverse ..	**44 km/h**	27 mph

To avoid damaging engine, do not exceed these maximum speeds.
The performances shown are intended for use in ambient conditions as found in center Europe.

Fuel consumption

Per **100 km** (62 mi.) to italian CUNA standard approx. **10.4 lts** (27.1 mpg GB-22.6 mpg US)

FUEL, OIL AND WATER

Water (engine and radiator) . . . . . approx. 7.5 lts (1.65 gals GB) (1.98 gals US)

Fuel: for best engine performance, we recommend premium grade fuel with an octane number of not less than 92 (RM) . . . . . approx. 46 lts (10.1 gals GB) (12.1 gals US)

Fuel reserve approx. 6-7 lts (1.3-1.5 gals GB) (1.6-1.8 gals US)

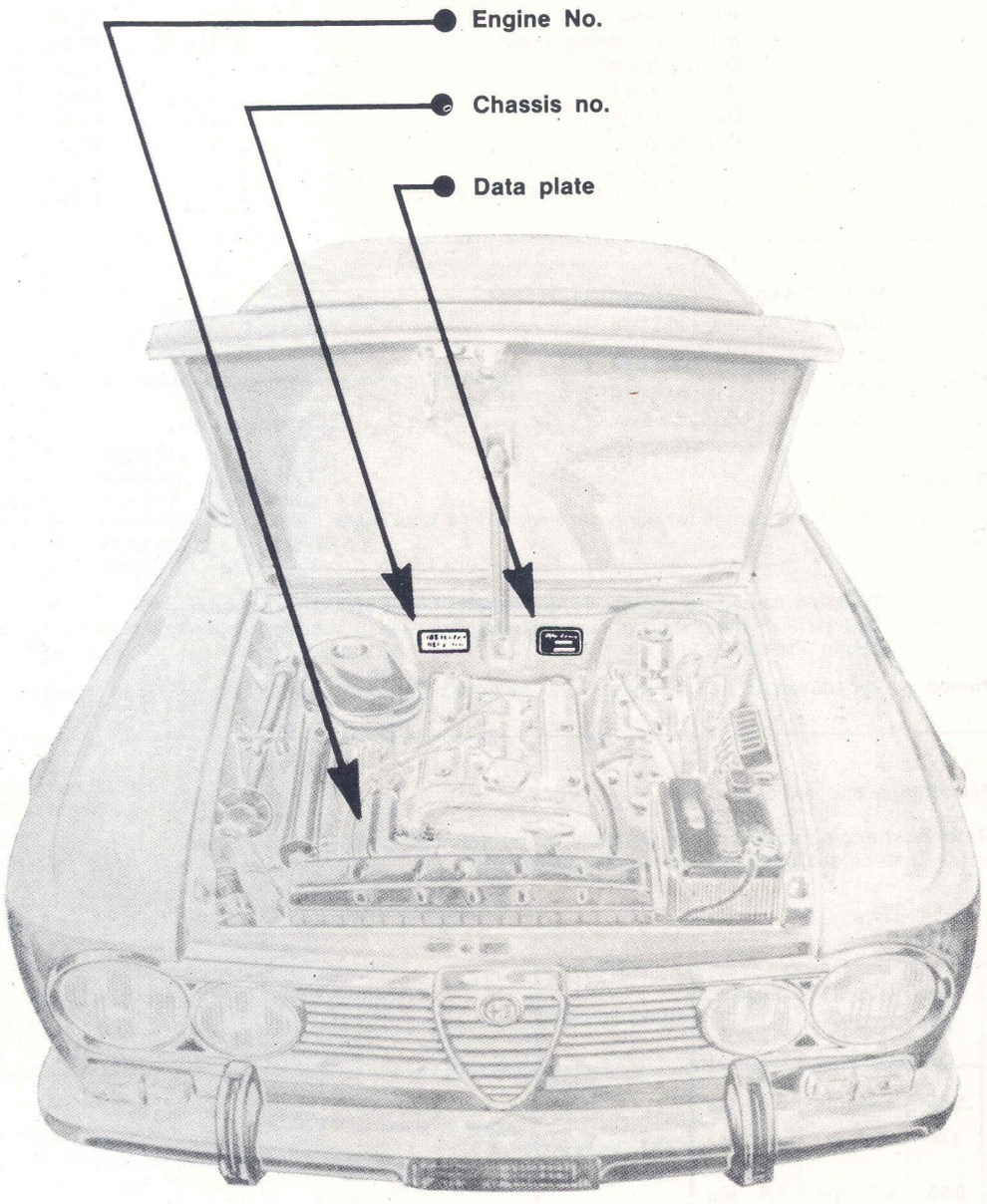
RECOMMENDED LUBRICANTS

Part	kg ▼	GB units	US units	Classification	Commercial equivalents AGIP	ESSO	SHELL
Engine sump (when full)	**5.80**	5.75 qts	6.90 qts	SAE 20 W 50 API MS	AGIP F.1 Woom SAE 20W/50	UNIFLO	SHELL Super Motor-Oil «100»
Quantity needed for regular changing (danger level)	**4.00**	3.95 qts	4.7 qts				
Total amount of oil in circuit (sump, filter and passages)	**6.55**	6.5 qts	7.8 qts				
Gearbox as specified by the red transfer, if any, on gearbox.	**1.65**	3.2 pts	3.8 pts	SAE 90 API EP	AGIP F.1 Rotra MP SAE 90	ESSO Gear Oil GX 90	SHELL Spirax 90 HD
Rear axle	**1.25**	2.5 pts	3.0 pts				
Steering box	**0.36**	.7 pt	.8 pt				
Propeller shaft sliding sleeve				NLGI 1	AGIP F.1 Grease 15	ESSO Multi-purpose Grease H	SHELL Retinax G
Front wheel bearings				NLGI 2/3	AGIP F.1 Grease 33 FD	ESSO Norva 275	SHELL Retinax AX

In countries where the recommended lubricants are not available, it is possible to replace them with products of other leading makes provided that in accordance with the prescribed specifications and grades.

SAE - Society of Automotive Engineers
API - American Petroleum Institute
NLGI - National Lubricating Grease Institute

IDENTIFICATION



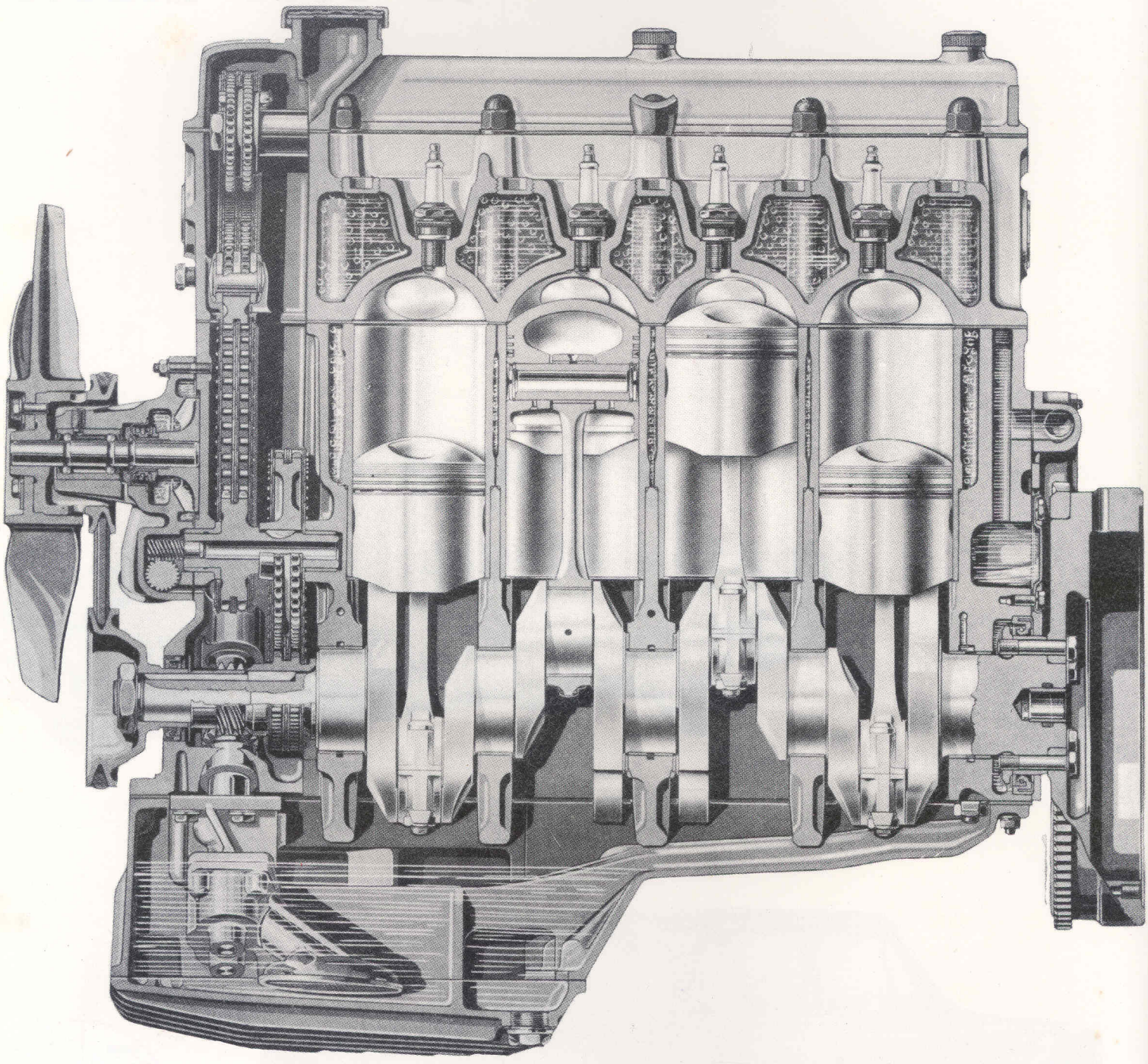
Engine no.
Model and serial no. of engine are stamped on right-hand side of crankcase.

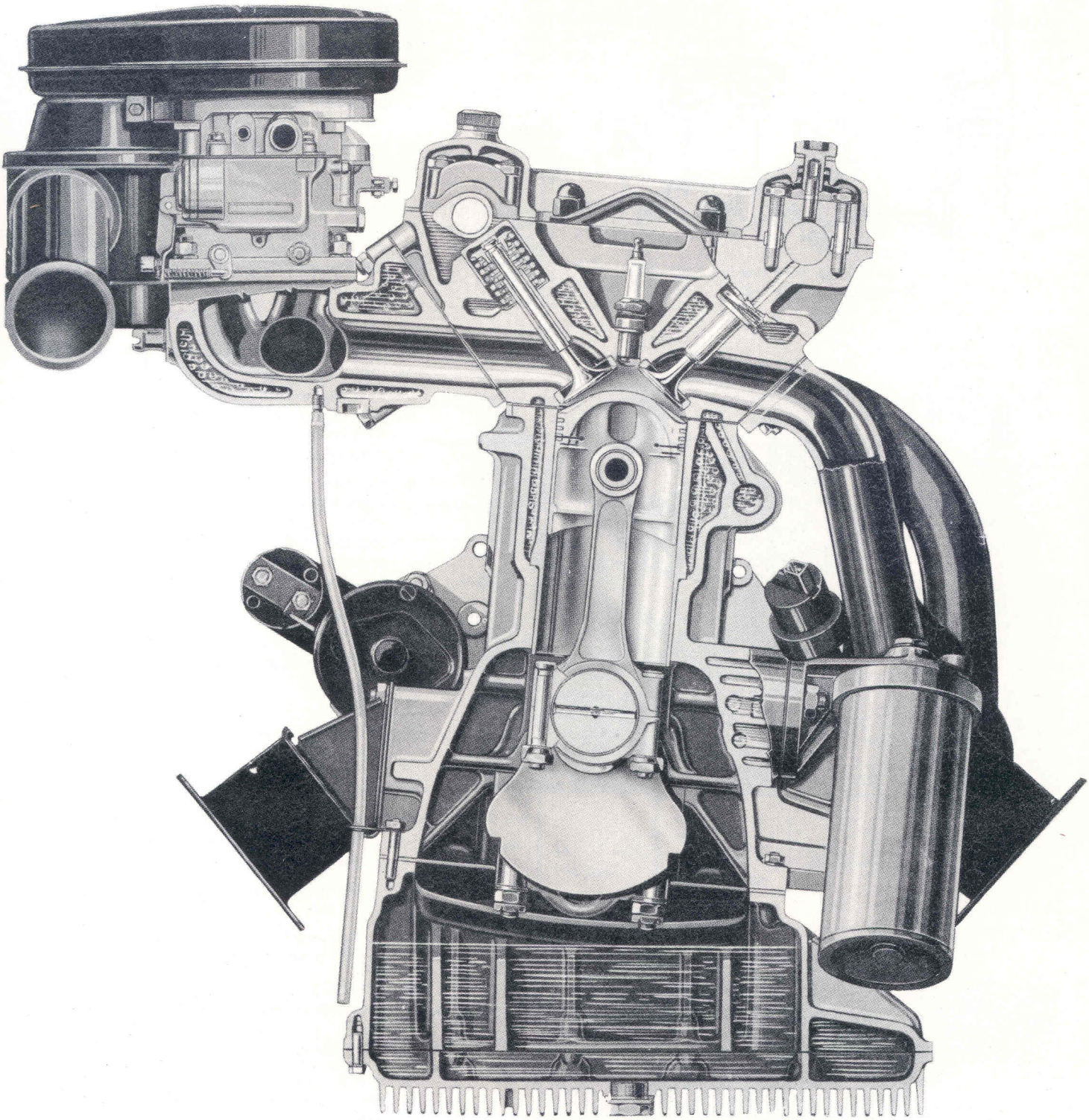
Chassis No.
Chassis serial no. is stamped on bulkhead right-hand top (in the engine compartment).

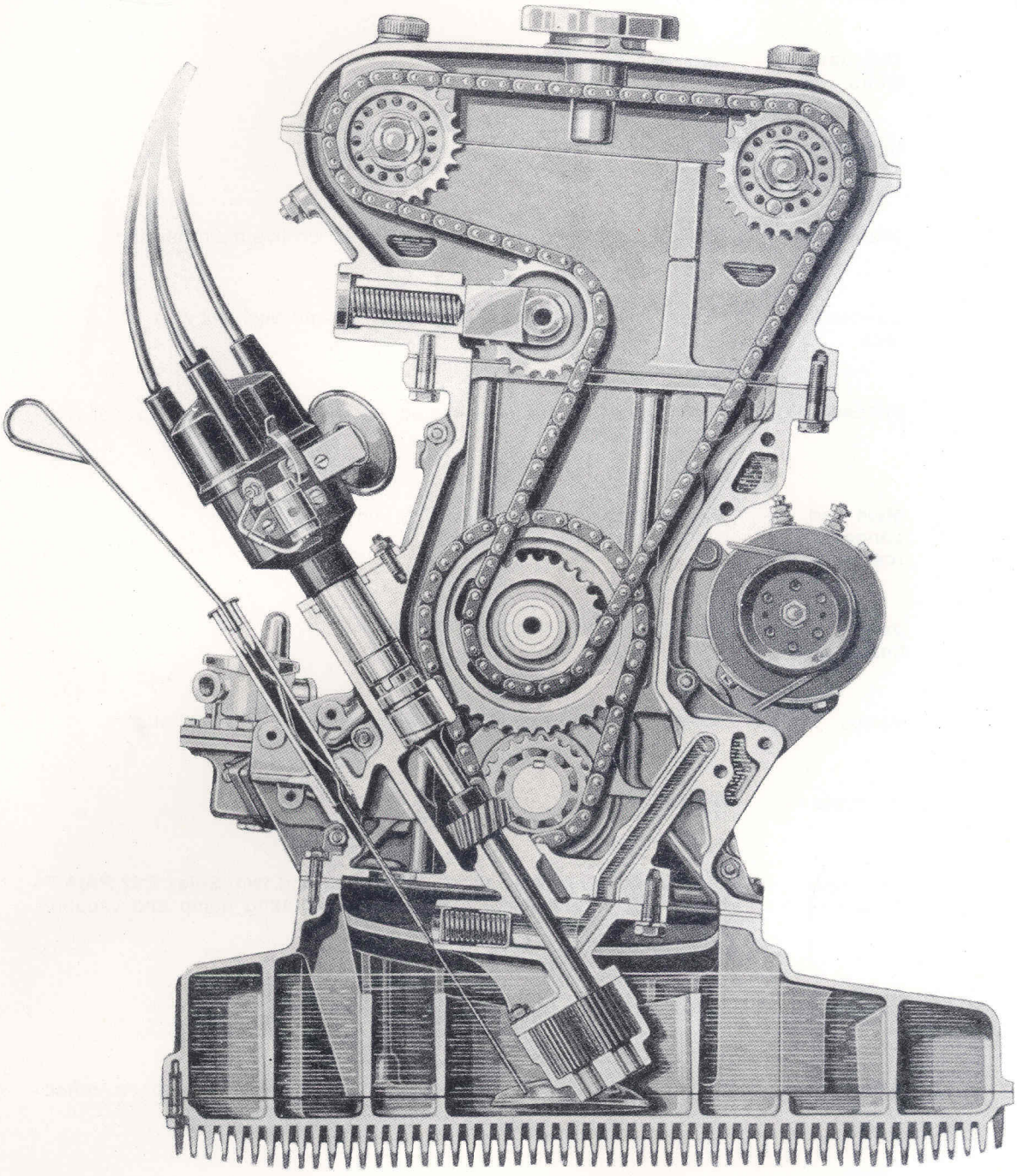
Data plate
Data plate is attached to bulkhead top (in the engine compartment) and stamped with car model and type approval no.

Paint specifications
Paint specification plate is attached to bulkhead top (in the engine compartment) and stamped with paint type, color and manufacturer's name.

ENGINE



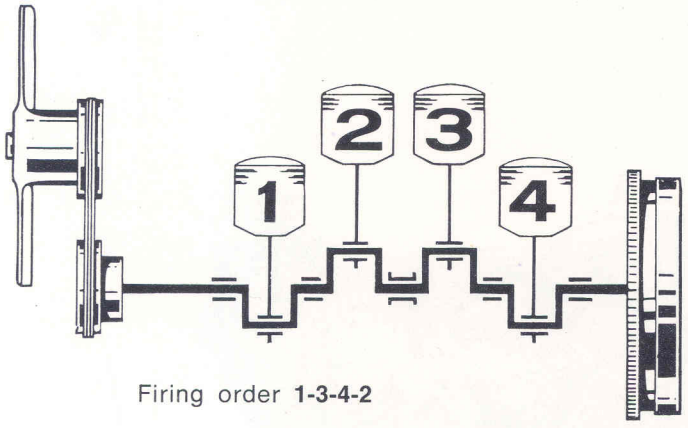




ENGINE SPECIFICATIONS

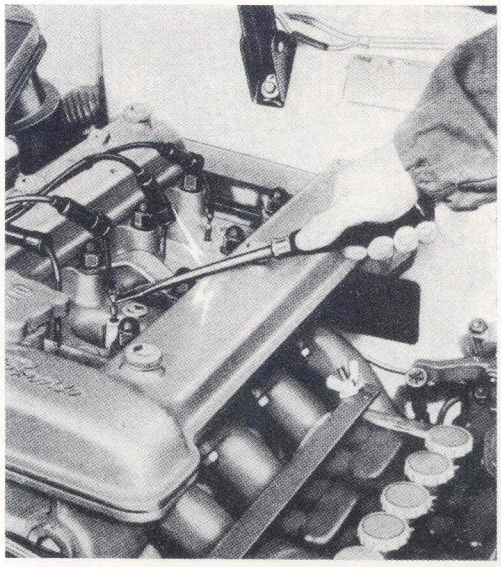
Engine type	**00.514**
Cylinder block	light alloy.
Cylinder liners	special cast iron, removable.
Cylinder head	light alloy, water cooled, valve seat inserts.
Crankshaft	treated alloy steel, with counterweights, on five main bearings.
Connecting rods	forged treated steel, with bronze small end bushing.
Pistons	light alloy, with chromium-plated, compression ring, oil scraper ring and oil control ring.
Main and connecting rod bearings	thin steel shell, lined with antifriction metal.
Valve timing gear	two chain-driven overhead camshafts.
Valves	overhead, two per cylinder, directly operated by camshafts
Oil sump	light alloy.
Fuel feed system	mechanically-operated diaphragm pump and twin **Solex C32 PAIA 7** downdraft carburettor with choke, accelerating pump and vacuum control of second barrel throttle.
Ignition	battery and distributor with vacuum advance regulator.
Lubricating system	forced lubrication by gear pump; the system includes a relief valve.
Cooling system	water coolant, with radiator and fan; forced circulation by centrifugal pump; coolant temperature controlled by a thermostat.
Filters	oil: full-flow filter in series with the delivery circuit, with clogged-element bypass. air: silencer-type cleaner with dry element.
Starting	with 12-volt cranking motor.

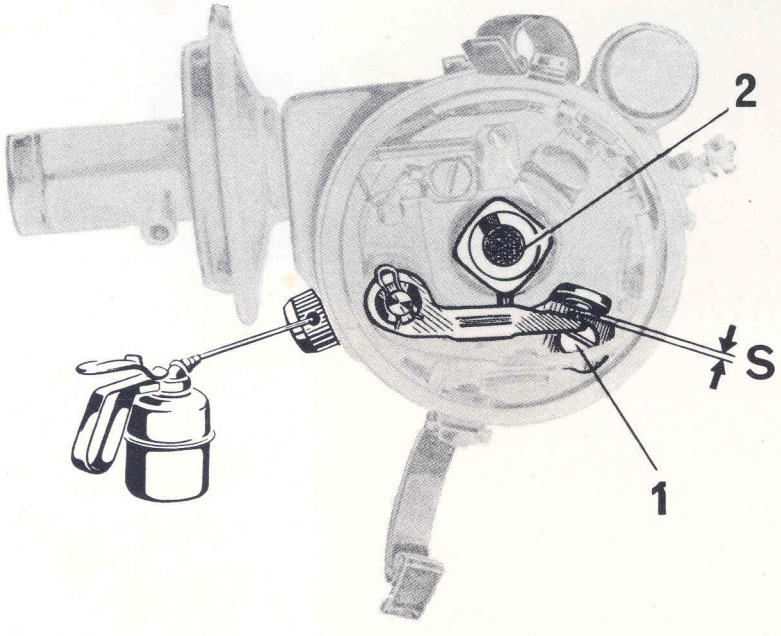
IGNITION



Firing order **1-3-4-2**

LODGE 2 HL





Spark plug inspection

- The plugs are of the type with a power electrode centred among four «earthed» points. **No adjustment of the distance between electrodes is necessary.**
- Using a screwdriver, earth the central electrode of a plug. If the plug sparked properly, the speed of the engine will decrease.
- WARNING: do not disconnect the plug cables when the engine is running, of the distributor capacitor may be damaged.
- If necessary, remove the plugs and clean them with a wire brush.
- Test the plugs on the bench, making sure that the spark jumps properly at a pressure of about **8 kg/cm²** (114 psi).
- Tighten the plugs when cold to **2.5-3.5 kgm** (18 - 25.3 ft. lbs.) with a torque wrench and tool **A.5.0115**; before installing on engine, lubricate plug threaded shank with graphite grease.

Distributor: BOSCH JFU 4

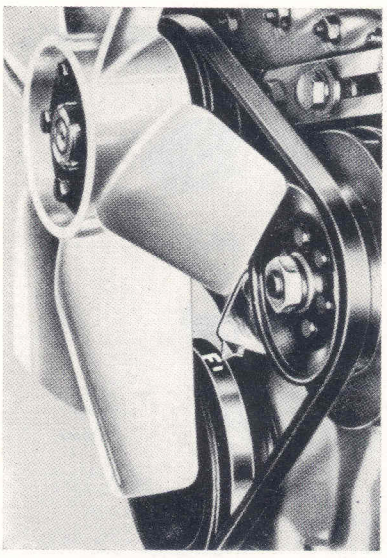
Inspection of cap and contact points:

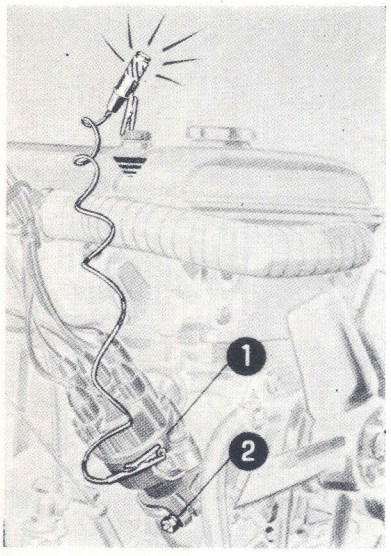
- Check:
  - · that the interior of the cap shows no signs of moisture, carbon deposits or cracking;
  - · that the centre carbon brush works freely in its holder and that the spring is functioning properly;
  - · the insulation of the rotor arm;
  - · the condition of the terminals, both on the rotor arm and on the cap;
  - · that contact breaker points are clean and smooth.
- Check by means of a feeler gauge that the gap between the points is as specified:
  S = .35 to .40 mm (.014-.016 in.).
- If the points are corroded, smooth them with a very fine file and then wash them with petrol.
- Adjust the contact gap to the specified value by means of the adjusting screw **1** (use a screwdriver and feeler gauge).
- Apply some drops of oil through the suitable oiler and soak the felt **2**.
- Clean the cam with a lint-free cloth and smear it with petrolatum.
- Sparingly lubricate the contact-breaker arm pin with grease.

IGNITION

Check the static advance

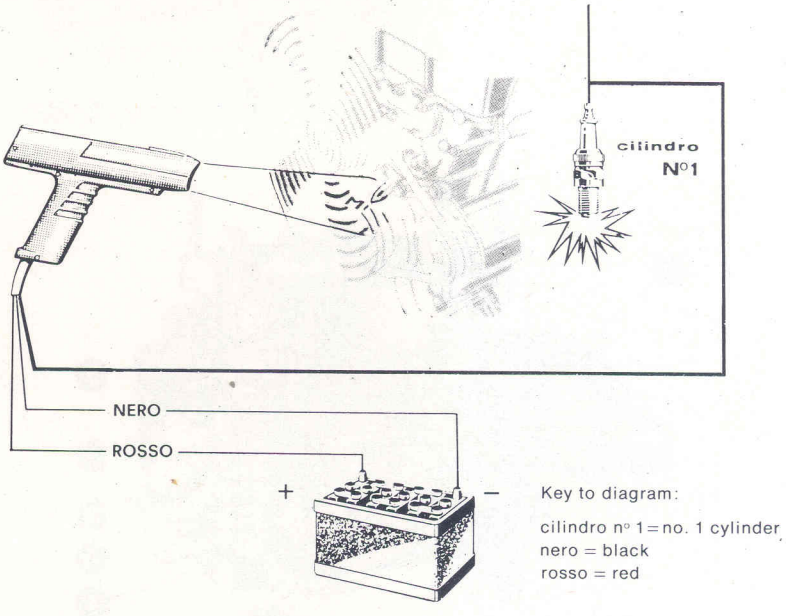
- Bring the static advance mark **F** cut in the drive pulley into line with the reference plate by slightly rotating the crankshaft.
- Check that, in this position, the contact breaker points are about to separate; when a 12-volt lamp is connected between the distributor input terminal **1** and the ground, it should light up immediately the points open.
- Slacken bolt **2** and turn the body of the distributor to make the required adjustment. (Clockwise to retard and counterclockwise to advance).





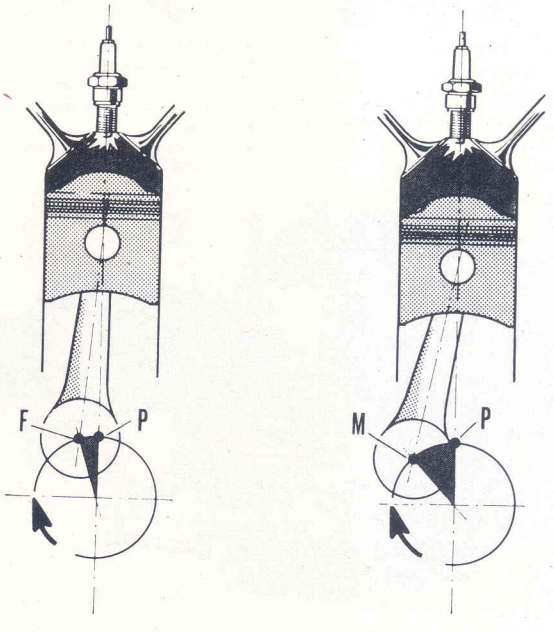
Check the automatic advance with a stroboscopic gun

- Disconnect the rubber pipe from the vacuum advance regulator.
- Make the connections (see diagram).
- Run the engine at about 5,000 rpm and direct the light from the stroboscopic gun onto the pulley; if the timing is correct, the **M** (max. advance) stamped on the pulley will be seen in line with the reference plate.
- If it is found that the max. advance is greater or less than the prescribed value, adjust the static advance accordingly, as it is better to have correct timing at high speeds.



Key to diagram:

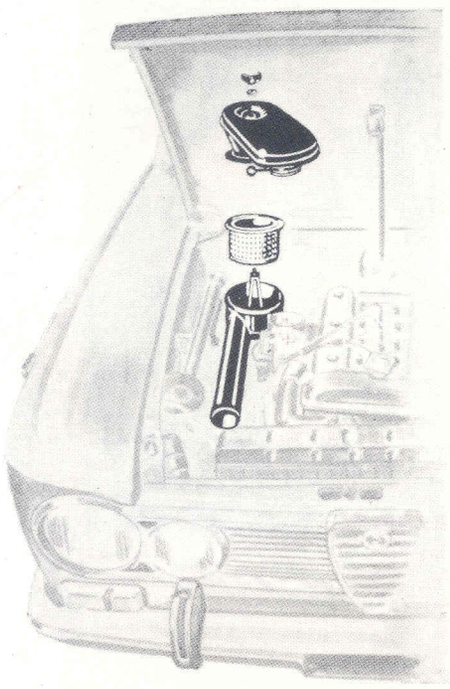
cilindro n° 1 = no. 1 cylinder
nero = black
rosso = red



Advance values (before **T.D.C.**)

- Static **F** = **3°** ± **2°**
- Maximum **M** = **43°** ± **3°** at 5,000 rpm.

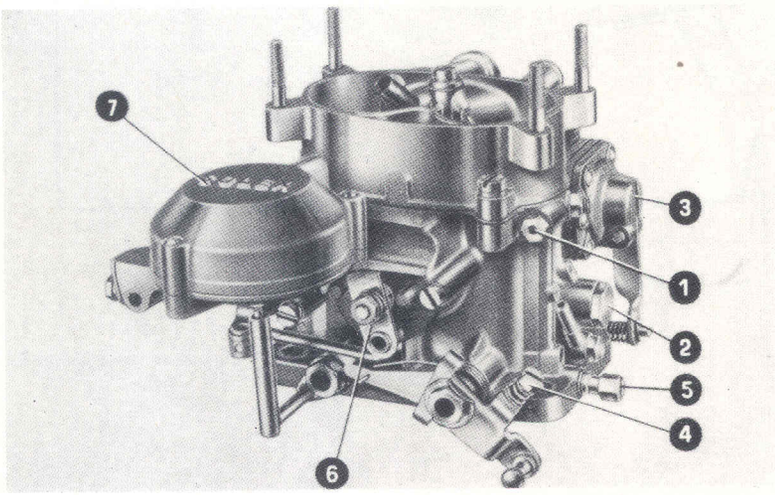
FUEL FEED



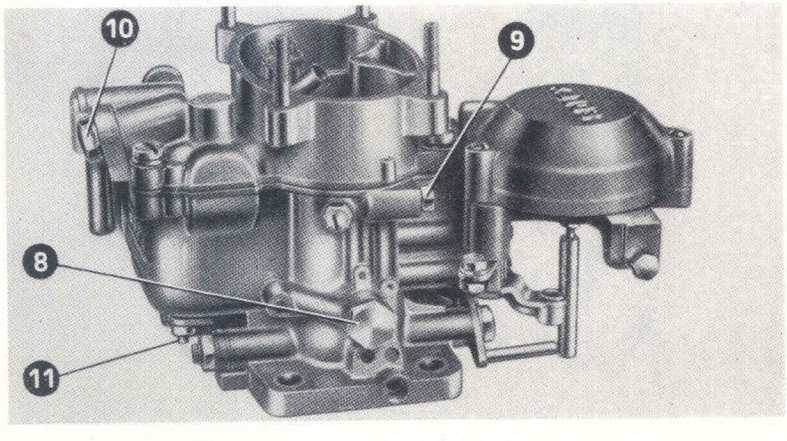
AIR CLEANER

Cleaning or replacement of the element

- Loosen the clamp which fastens the air inlet duct to the carburettor.
- Unscrew the wing nut fastening the duct to cleaner body.
- Remove the duct and withdraw the element.
- Thoroughly wash the element with petrol.
- Replace the element if damaged or if impossible to clean properly.



1 Idling jet, no. 1 barrel
2 Main jet, no. 1 barrel
3 Accelerating pump
4 Adjusting screw for minimum opening of 1st throttle
5 Idling mixture adjusting screw
6 Choke control lever
7 Vacuum capsule
8 Main jet, no. 2 barrel
9 Idling jet, no. 2 barrel
10 Filter
11 Adjusting screw for minimum opening of 2nd throttle



SOLEX C 32 PAIA-7 CARBURETTOR

Cleaning and inspection of jets:

- Remove jets **1, 2, 8** and **9** and blow through with compressed air. Do not use a metal probe as this could alter the jet diameter.
- Check that the numbers stamped on the jets are the same as those given in the table.

Idling adjustment (with engine hot)

- Tighten the screw **11** for a quarter turn (to prevent binding of the 2nd throttle) and lock in the jam nut.
- Screw slowly in the screw **4** to make the engine run faster.
- Loosen the screw **5** until the engine begins to «hunt», then gradually screw it in until the engine runs smoothly.
- Unscrew the screw **4** very slowly until the engine speed is approximately 500-600 rpm.
- If the engine again begins to «hunt», slightly tighten screw **5**; **in no case must this screw be tightened to its maximum extent.**

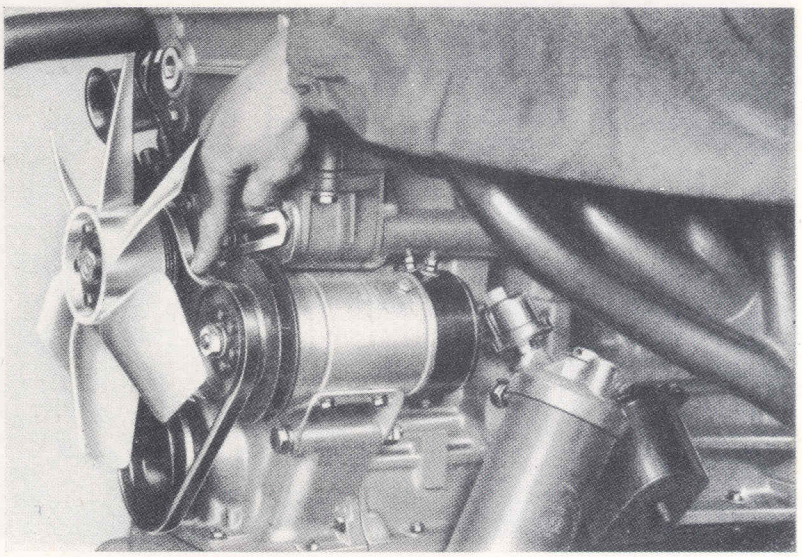
Jet specifications	1st barrel	2nd barrel
Venturi	23	23
Main	125	130
Idling	45	70
Main air metering	190	190
Idling air metering	100	60
Accelerating pump	45	—
Choke	120	—

FAN BELT
CYLINDER HEAD NUTS

FAN AND GENERATOR DRIVING BELT
PIRELLI: model n. 60675

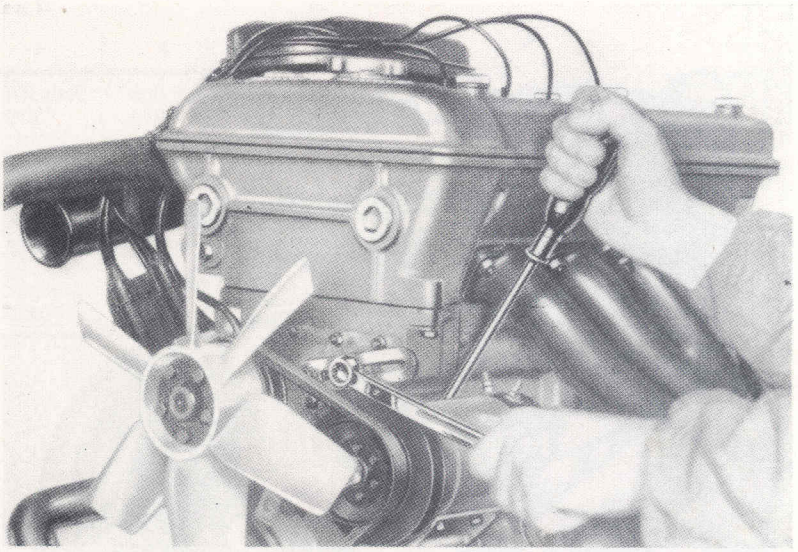
Tension check

- Belt tension should be enough to drive generator and fan pulley without slipping nor straining the bearings.
  When the tension is correct the sag of the belt tested as shown should be: **10 to 15 mm** (about 1/2").



Tension adjustment

- Loosen the nut on adjusting arm pivot pin and the nut on the generator securing bolt.
- Move the generator outwards by rotating it on its hinge; if necessary use a screwdriver or similar as a lever; then relock the nuts.
- Check that sag is as stated above.
- Check that warning light on dashboard goes off when engine speed exceeds 1100 rpm.



CYLINDER HEAD NUTS

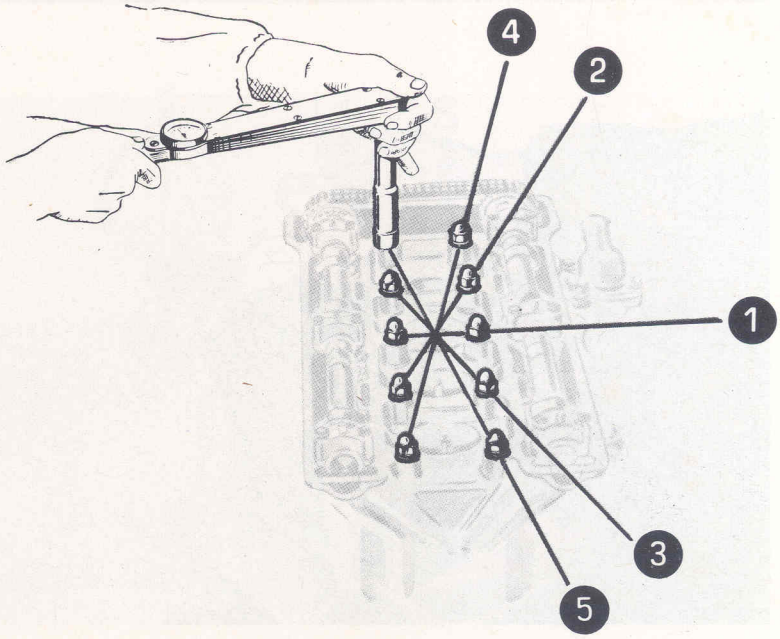
Tightening torque specifications

- **After reconditioning:**
  lubetorque when cold to:
  6.2 to 6.4 (44.7 to 46.2 ft-lbs).
  Then, warm up the engine (better if actually driving the car) and relock without slackening to **6.6 to 6.7 kgm** (47.7 to 48.5 ft-lbs).
  After tested the car, when cold and in correct sequence, slacken the nuts by one and one half turn and lubetorque to **6.2 to 6.4 kgm** (44.7 to 46.2 ft-lbs).

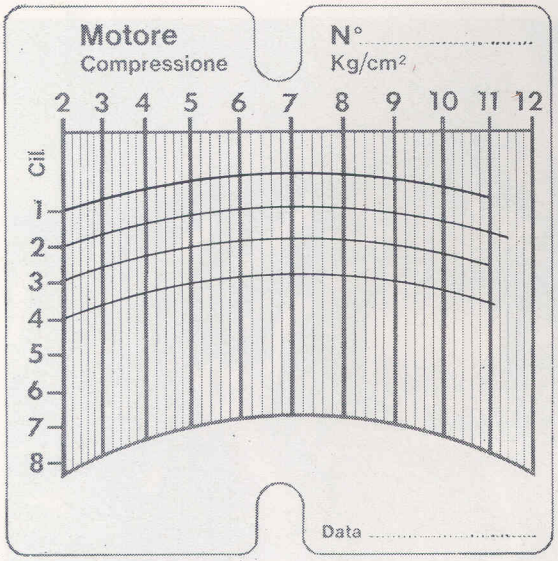
  Warning - Whenever performing any repair involving the removal of cylinder head the gasket must be replaced with a new one.

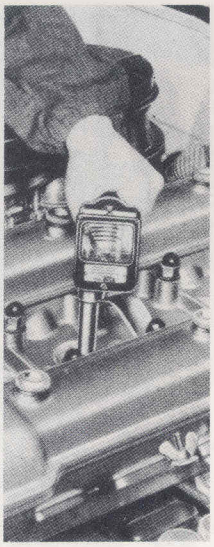
Tightening sequence

- Tighten the cylinder head nuts in the sequence shown to avoid harmful straining and to allow the gasket to bed in perfectly between the two joining surfaces.



CYLINDER COMPRESSION TIMING CHAIN TENSION



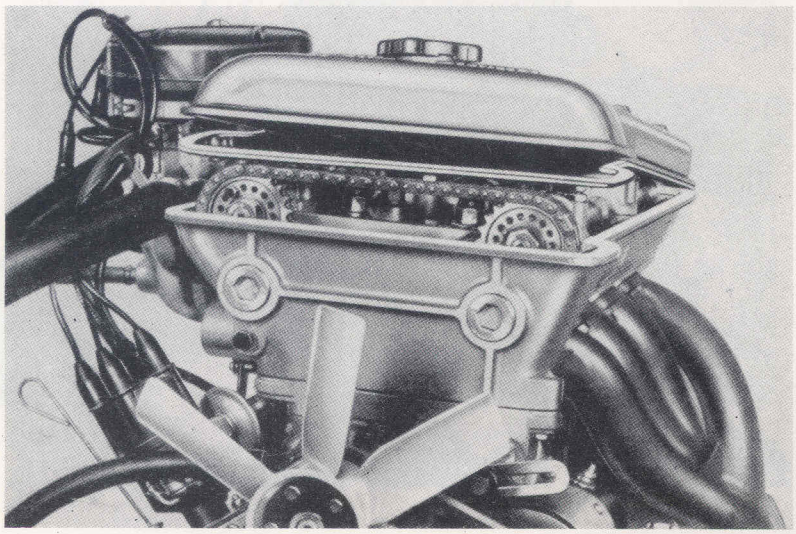


Cylinder compression check

To check the cylinder compression use a suitable recording gauge and proceed as follows:

- warm up the engine to normal operating temperature:
- remove all spark plugs and obtain recordings by cranking the engine with the starting motor.
  Pressure variation between cylinders shoud not exceed 10% of the highest reading.

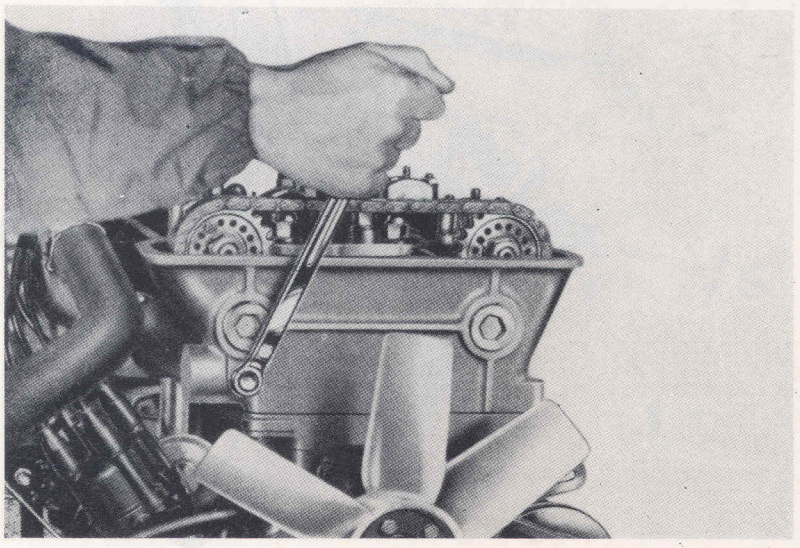
Motore = Engine
Compressione = Compression
Data = Date



Adjust chain tension

- Unscrew the camshaft cover retaining nuts and remove the cover.

N.B. - On reassembly, check that the gasket is in good condition; if not, replace it with a new one. Then relock the cover retaining nuts gradually and in diagonal order so as to avoid straining the camshaft journal bearings which house the cover retaining studs.



Chain tension adjustment

Proceed as follows:

- run engine at idling speed (900/1000 rpm); while performing the following adjustment any revving up of the engine must be absolutely avoided;
- slacken off the setscrew securing the chain tensioner; wait a few minutes to allow the tensioner to tighten the chain, then lock the chain tensioner setscrew firmly.

VALVE CLEARANCE

Check valve clearance

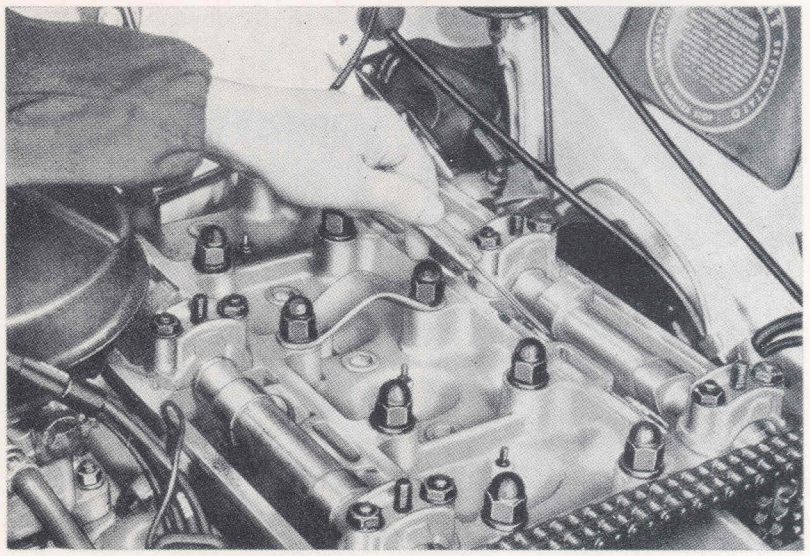
- Check that clearance **G**, measured when the engine is cold at the unlobed profile of the cam, falls within the following limits:

  Intake **.475 - .500 mm**
  (.0187 - .0197 in.)

  Exhaust **.525 - .550 mm**
  (.0206 - .0216 in.)

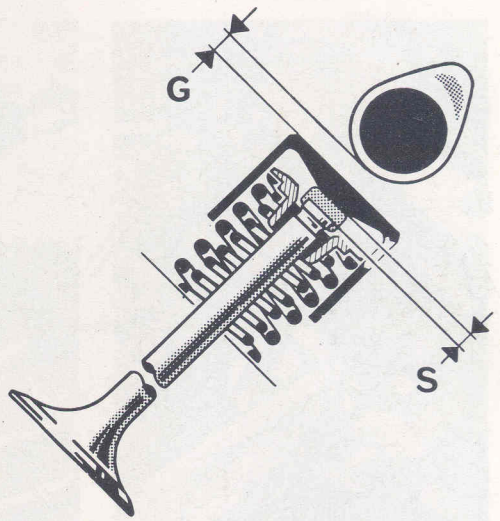
Valve clearance adjustment

- Measure and record the clearance found along with the excess to be taken up to reset the correct clearance.

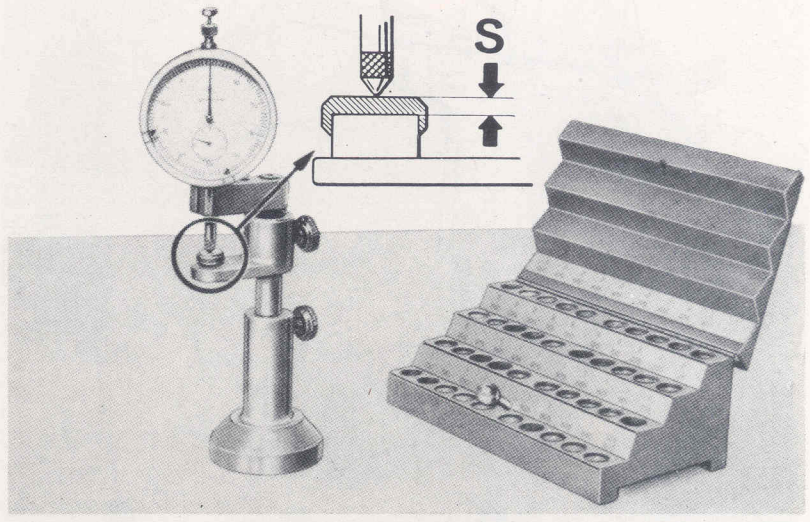


Example

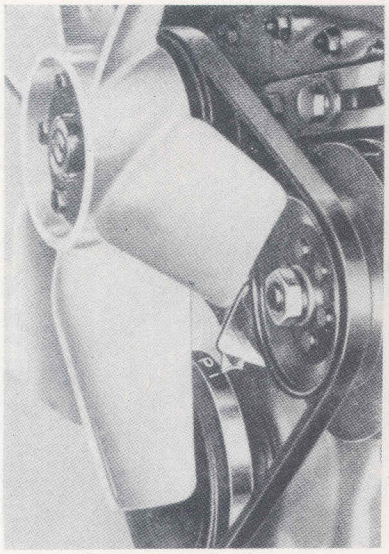
	Clearance	CYLINDER 1	2	3	4
INTAKE .0197" (.500 mm)	Clearance recorded	.450 mm .0177"	.475 mm .187"	.425 mm .0167"	.500 mm .0197"
	Correction required	**—.050 mm —.0020"**	**—.025 mm —.0010"**	**—.075 mm —.0030"**	— —
EXHAUST .0216" (.550 mm)	Clearance recorded	.400 mm .0156"	.450 mm .0176"	.400 mm .0156"	.600 mm .0236"
	Correction required	**—.150 mm —.0060"**	**—.100 mm —.0040"**	**—.150 mm —.0060"**	**+.050 mm +.0020"**

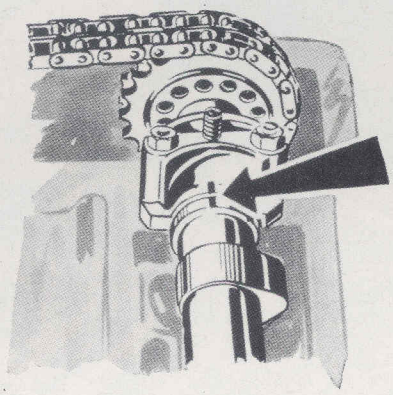


- Rotate the crankshaft until the timing marks cut in the camshaft journals are in line with those on the journal bearings.
- Move the chain tensioner backwards, slacken the chain and secure the tensioner in retracted position.
- Remove the journal bearings from the camshaft at the intake side and, taking care that the chain does not move with respect to the sprocket, take out the camshaft together with the chain; then rest the unit on the center of the head. The same applies to the camshaft at the exhaust side.
- Using suitable pliers, remove the valve cups.
- Withdraw the valve adjusting pad and measure its thickness.
- Fit a new pad of correct thickness **S.** For the selection of the proper adjusting pad use the dial gauge **7600.31.002** complete with the bracket **C.5.0111/1** (Ref. Tool Bulletin no. 51/2).
  Note: the adjusting pads are made available in a series of thicknesses ranging from **1.3 to 3.5 mm** (.051 to .138 in.) in increments of **.025 mm** (.001 in.).
- Relief valve cups, camshafts and chain.
- **Recheck valve clearance.**



VALVE TIMING

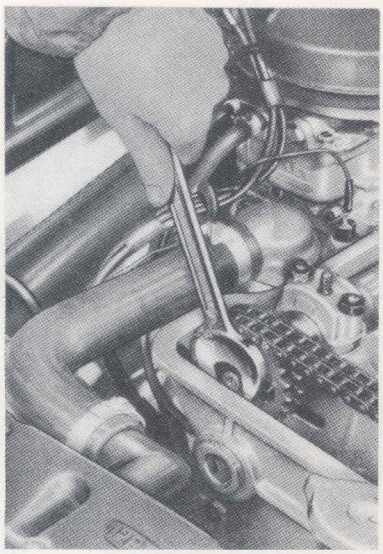


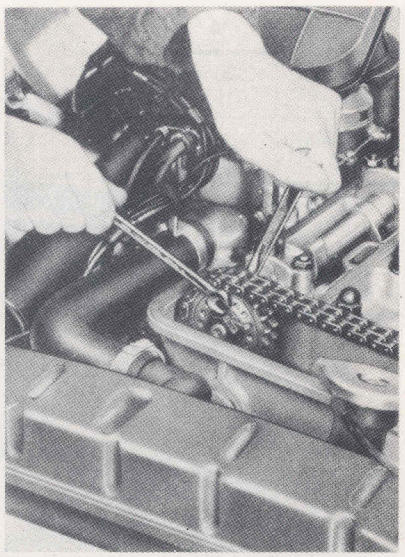


Valve timing adjustment

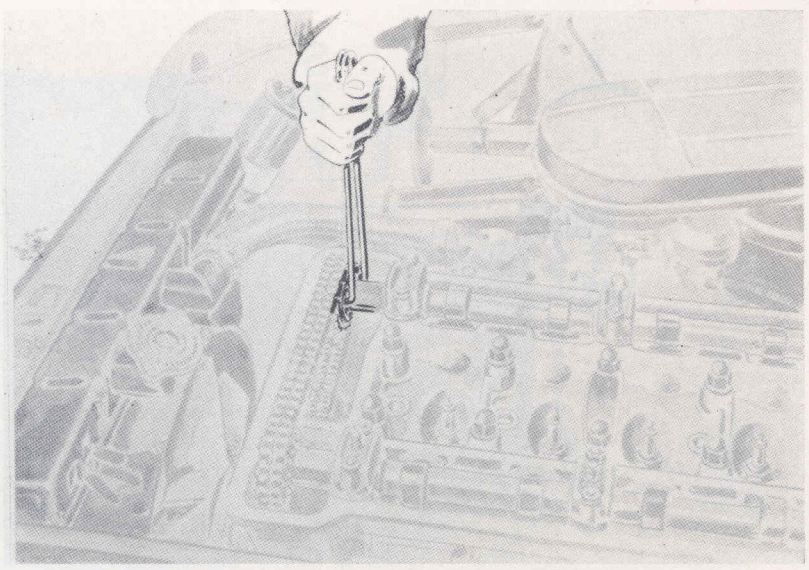
(to be performed when valve clearance and chain tension are correct).

- Rotate the crankshaft until the timing mark **P** (TDC) cut in the pulley is in line with the reference plate on front cover.
- Check that timing marks, cut in the camshaft front journals, are aligned with those on the journal bearings when no. 1 cylinder cams are pointing outwards as shown.





- If the marks are misaligned, loosen the screw locking the sprocket to the camshaft.
- Remove the locating bolt which keys the sprocket to the camshaft flange.

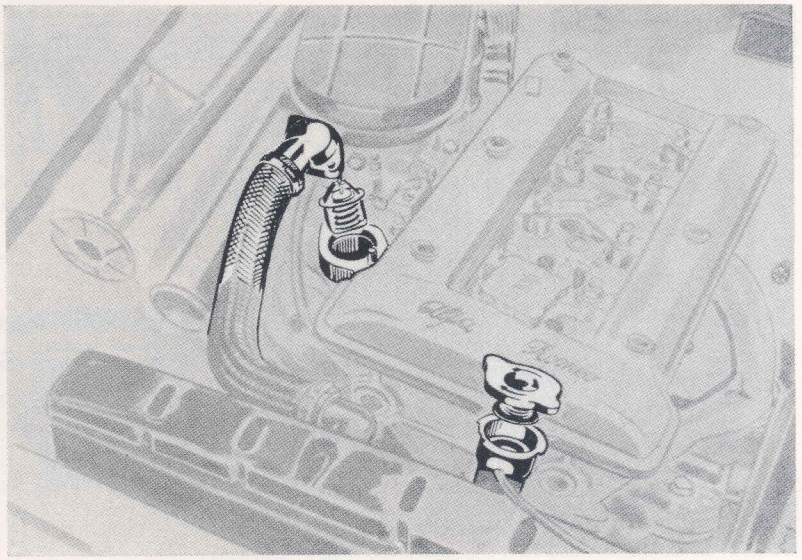


- Using tool **A.5.0103** (Ref. Tool Bulletin no. 61/3) turn the camshafts without moving the chain so as to bring the reference marks into alignment.
- In the holes which are now aligned, refit the locating bolt and lock the screw again.

COOLING SYSTEM
OIL AND WATER LEAKAGE

COOLING SYSTEM

- Withdraw the thermostat from its housing.
- Disconnect the hose from intake manifold.
- Check that thermostat starts to open at about **82° - 87° C** (180° to 190° F) and replace it if not within these limits.
- Check the radiator cap, making sure that the spring is not broken, that the seal is in good condition and that the pressure-reducing valve is working properly.



OIL AND WATER LEAKAGE

Check for any sign of oil leaks from:

1 camshaft cover

2 joining surface between cylinder block and head

3 joining surface between fuel pump mounting flange and crankcase

4 sump gaskets

5 crankcase front cover

6 crankshaft front and rear packings.

Check for any sign of water leaks from:

2 joining surface between cylinder block and head

7 radiator

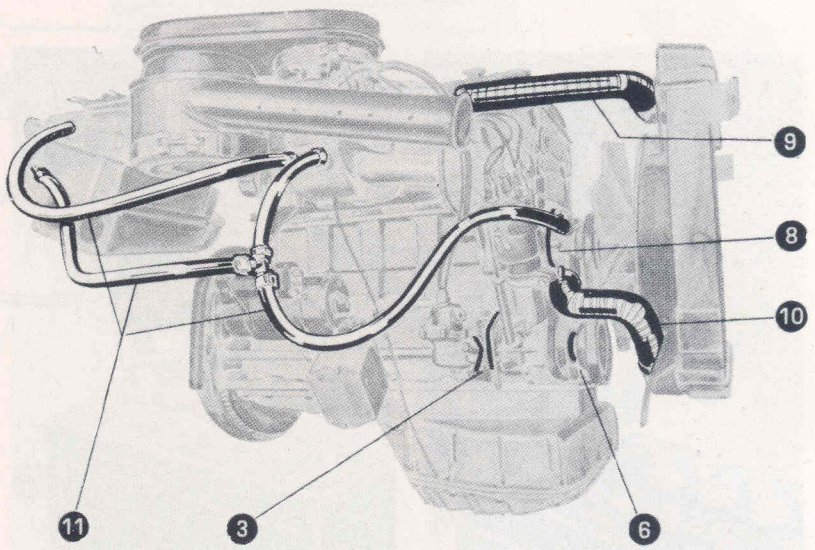
8 joining surface between water pump and front cover.

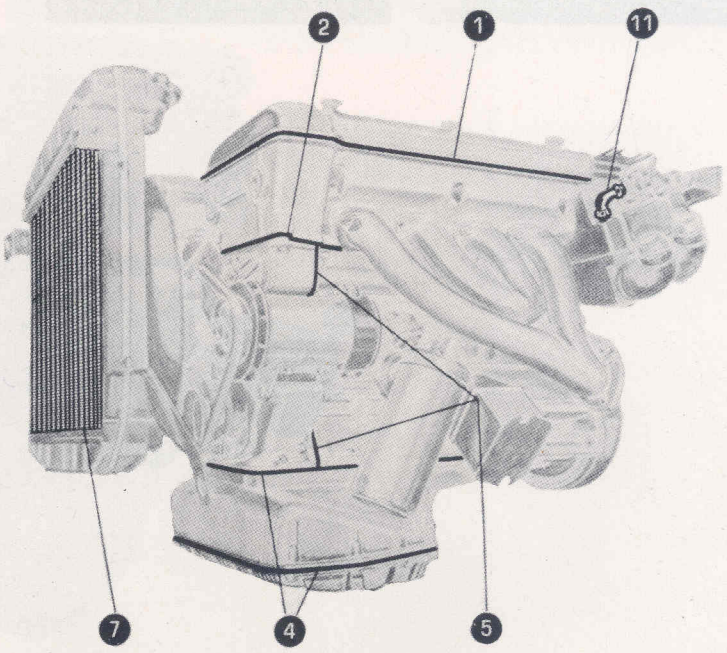
Check the following units for good conditions:

9 hose from intake manifold to radiator

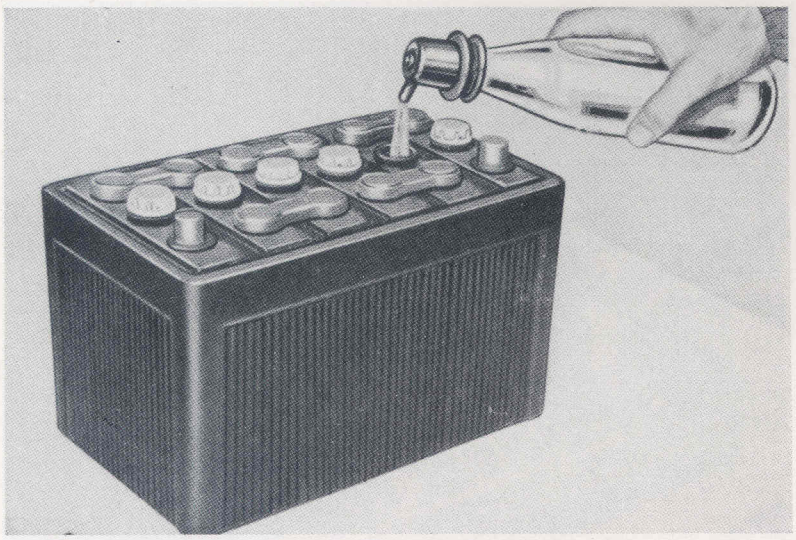
10 hose from radiator to water pump

11 rubber hoses and connections of heating system.

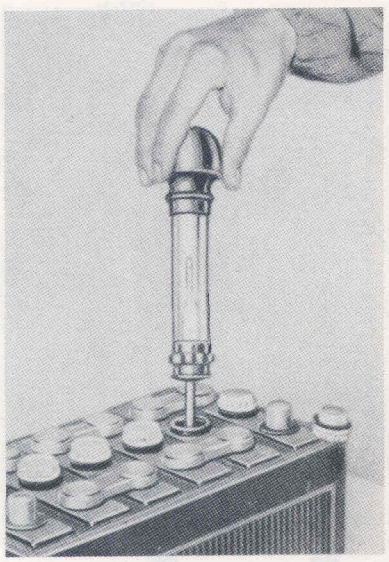


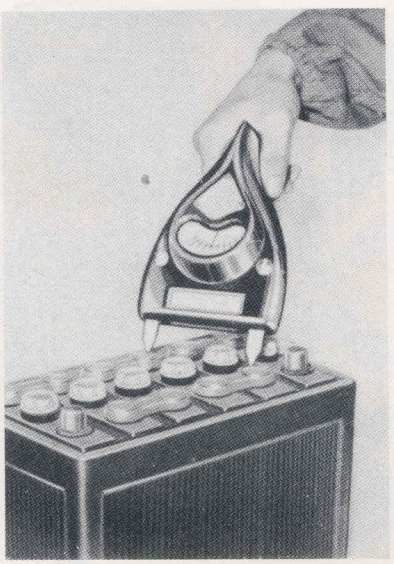


BATTERY

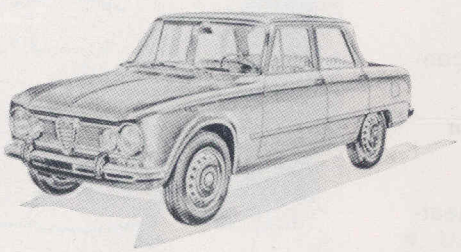


- Using a wooden rule as a dipstick check that water level is not more than **4-5 mm** (3/16") above the plates.
- Top up with distilled water only.



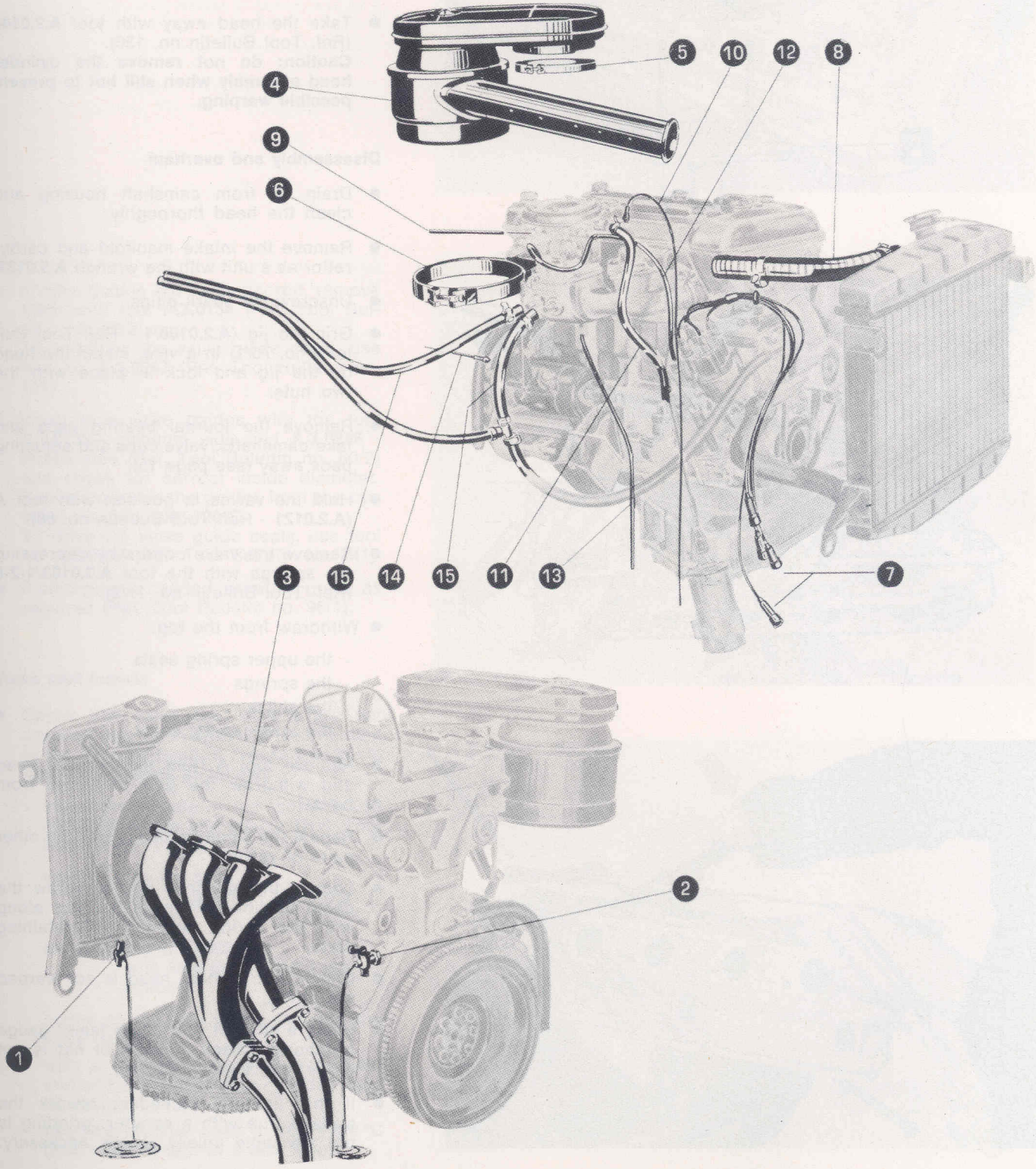


- Check the charge of battery cells using a hydrometer as shown; the specific gravity should be **1.23 to 1.28** (equivalent to 27 to 31.5 Baumè).
  If distilled water has been added to a battery, the specific gravity shall not be measured until mixing is complete; to facilitate mixing, charge the battery for about half an hour.
- If no hydrometer is available, test the charge of the battery cells with a fork voltmeter: each cell should give an output of **1.9 - 2** volts.
  When a voltmeter is used it partially discharges the cell; it should therefore be kept in contact with the terminals for **a few seconds** only.

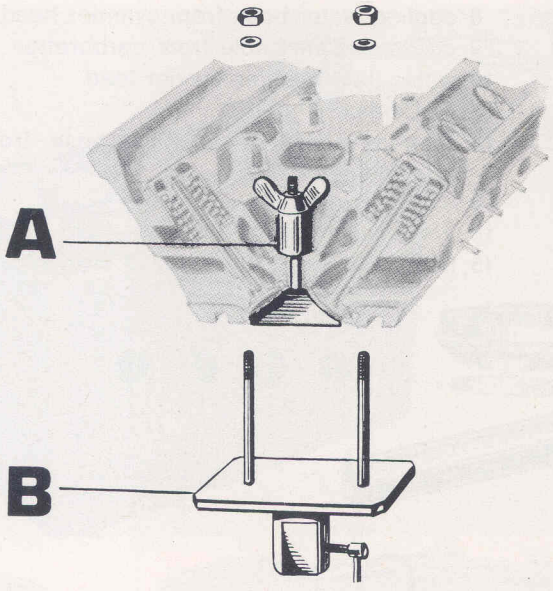


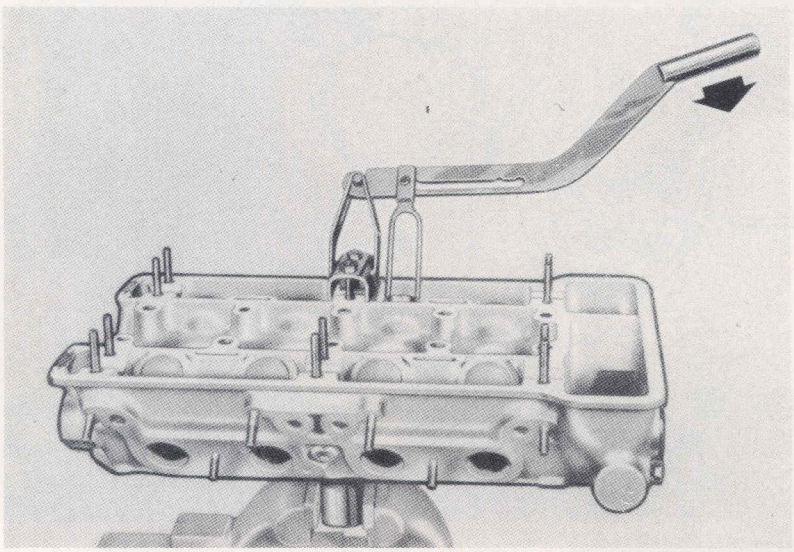
PREPARATORY STEPS FOR CYLINDER HEAD REMOVAL

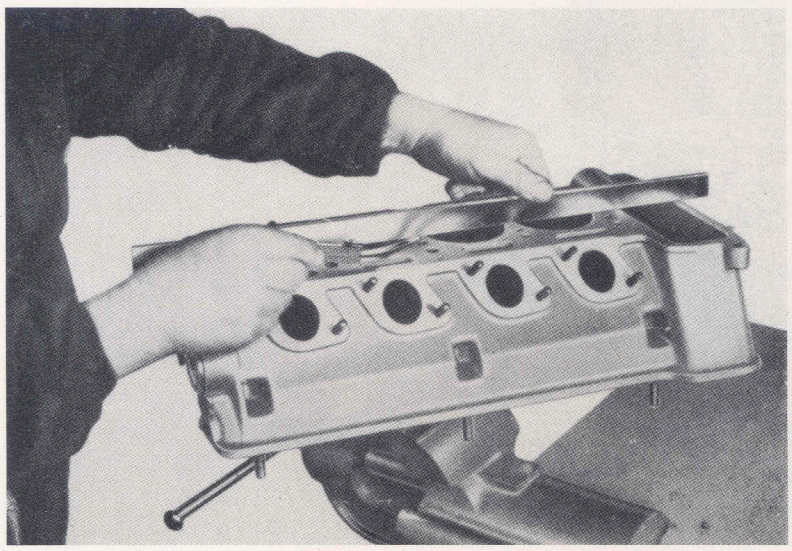
- Drain coolant from:
  - **1** radiator
  - **2** cylinder block
- Remove:
  - **3** exhaust manifold from cylinder head
  - **4** air cleaner assembly (loose clamp **5** on carburettor and **6** on cylinder head)
  - **6** clamp from cylinder head
  - **7** spark plug leads
  - **8** cooling water hose from cylinder head
  - **9** choke flexible cable from carburettor
  - **10** water thermometer sender lead
  - **11** fuel delivery hose
  - **12** vacuum advance regulator hose from ignition distributor
  - **13** fuel drain pipe
  - **14** throttle control
  - **15** two water pipes from intake manifold.



CYLINDER HEAD







Removal from cylinder block

- Remove camshaft cover from cylinder head.
- Disconnect the timing chain and secure its ends to prevent them from dropping into cylinder block.
- Unscrew the nuts fixing head to block and the two screws securing front cover to head.
- Take the head away with tool **A.2.0146** (Ref. Tool Bulletin no. 130).
  Caution: do not remove the cylinder head assembly when still hot to prevent possible warping.

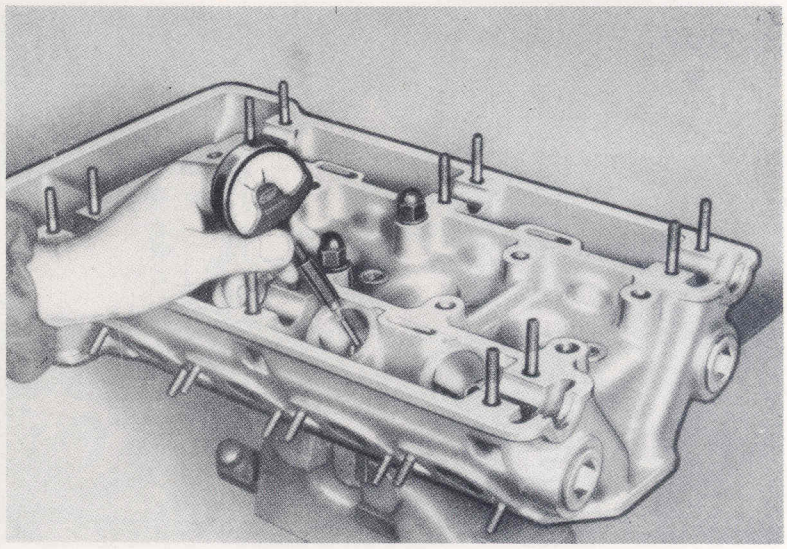
Disassembly and overhaul

- Drain oil from camshaft housing and clean the head thoroughly.
- Remove the intake manifold and carburettor as a unit with the wrench **A.5.0133.**
- Unscrew the spark plugs.
- Grip the jig (**A.2.0108/1** - Ref. Tool Bulletin no. 76/1) in a vice, install the head on the jig and lock in place with the two nuts.
- Remove the journal bearing caps and take camshafts, valve cups and adjusting pads away (see page 15).
- Hold the valves in position with tool A (**A.2.0121** - Ref. Tool Bulletin no. 88).
- Remove the valve cotters by depressing the springs with the tool **A.3.0103/1-2-6** (Ref. Tool Bulletin no. 11/2).
- Withdraw from the top:
  - the upper spring seats
  - the springs
  - the shims
  - the lower spring seats.
- Remove tool A from the cylinder head and withdraw the pair of valves from below.
- Repeat the same procedure for the other pairs of valves.
- Loosen the setscrew and withdraw the chain tensioner from its housing along with the spring and tapered retaining plate.
- Check that cylinder head is not warped out of flat.
- Using a straight rule and a feeler gauge as shown, check that out of flat is not more than **.1 mm** (.0039 in.).
- If this limit is exceeded, rework the surface true with a scraper; grinding is not advisable unless strictly necessary.

CYLINDER HEAD

Valve guides

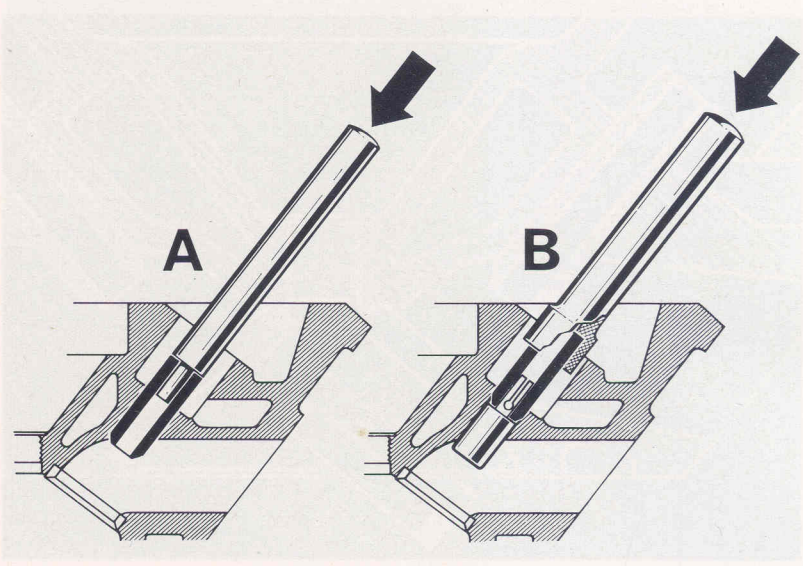
- Check that the bore of valve guides shows no sign of seizing; if there are gummy or carbon deposits, clean the guides with a suitable swab.
- Check with the gauge **C.5.0115** (Ref. Tool Bulletin no. 103) that the inside diameter of guides is **9.000-9.015 mm** (.3544-.3549")



A If valve guides are badly scored, remove them with tool **A.3.0134** (Ref. Tool Bulletin no. 80/2).
To withdraw the valve guide seals, use tool no. **A.3.0247** (Ref. Tool Bulletin no. 141).

B Insert new valve guides with the tool **A.3.0133** - exhaust side and **A.3.0246** - intake side (Ref. Tool Bulletin no. 80/2) and check for correct inside diameter. Before inserting the guides heat the cylinder head to **100°-120°C.**
To drive the valve guide seals, use tool no. **A.3.0244** (Ref. Tool Bulletin no. 141).

- If enlarging is needed, bore the guide as required (Ref. Tool Bulletin no. 96/1).



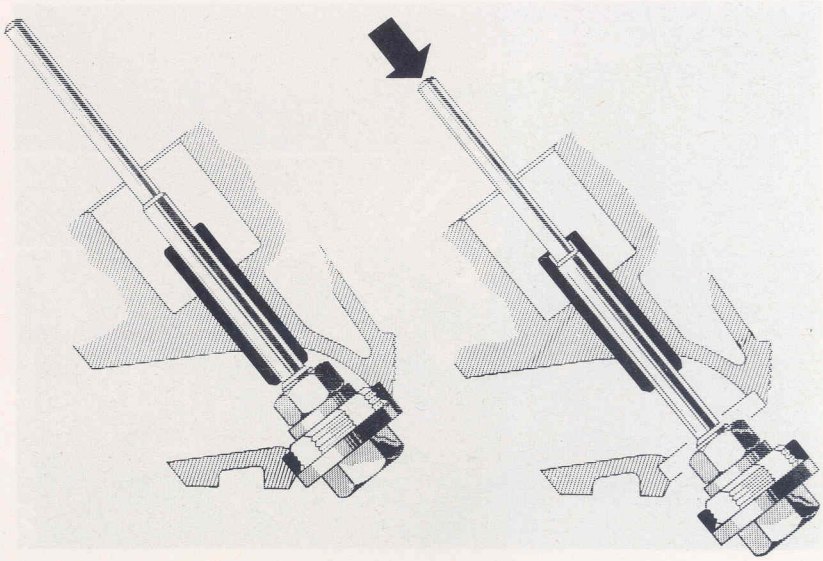
Valve seat inserts

- Check that valve seat inserts are not cracked and flush with the countersink in the cylinder head. If cracked or flush, renew the inserts as follows:
  - insert the spindle of the tool **A.3.0053** complete of tap and spacer (Ref. Tool Bulletin no. 118/1):

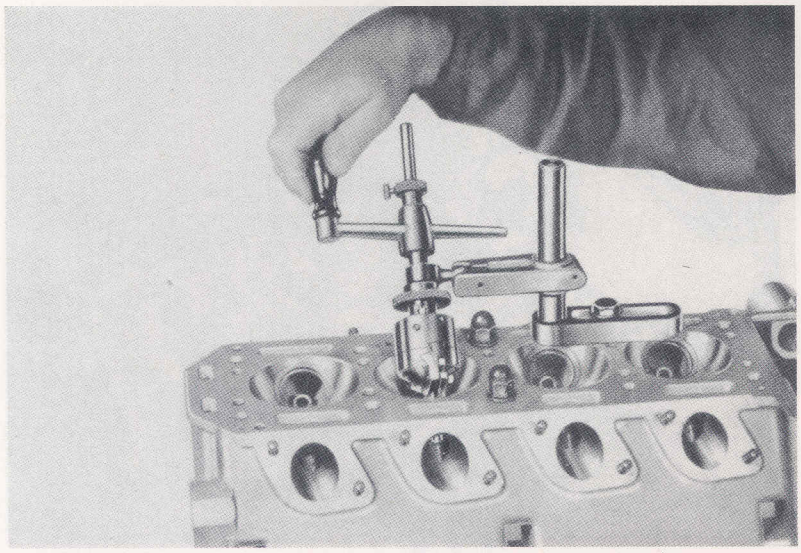
    intake: tap **U.4.0004** with **42.5 mm** (1.675") dia. spacer

    exhaust: tap **U.4.0002** with **38.5 mm** (1.516") dia. spacer

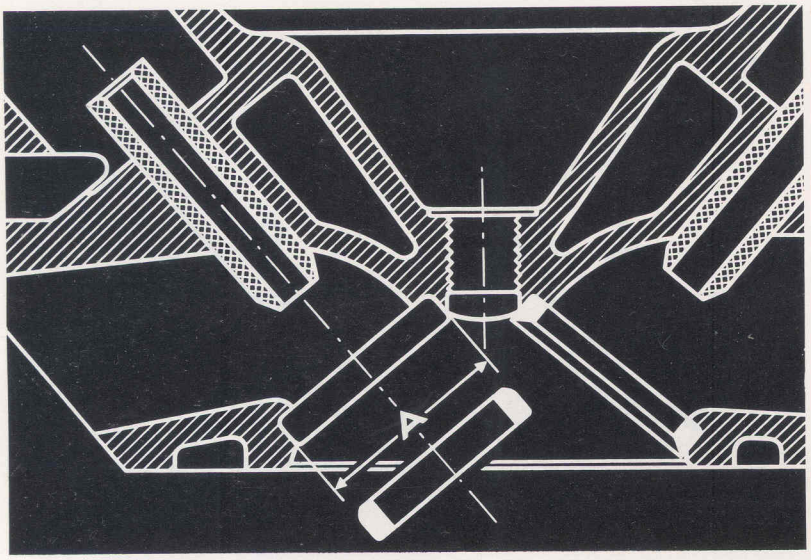
  - screw all the way in the tap into the valve insert;
  - with a lead or copper mallet, eject tool and seat insert from cylinder head as shown;
  - heat the cylinder head to **100° - 120 °C** (212° - 248° F) and fit a new insert.



CYLINDER HEAD



- After the installation, countersink the new insert to an angle of **30°** with the tool **A.1.0002** (Ref. Tool Bulletin no. 14).

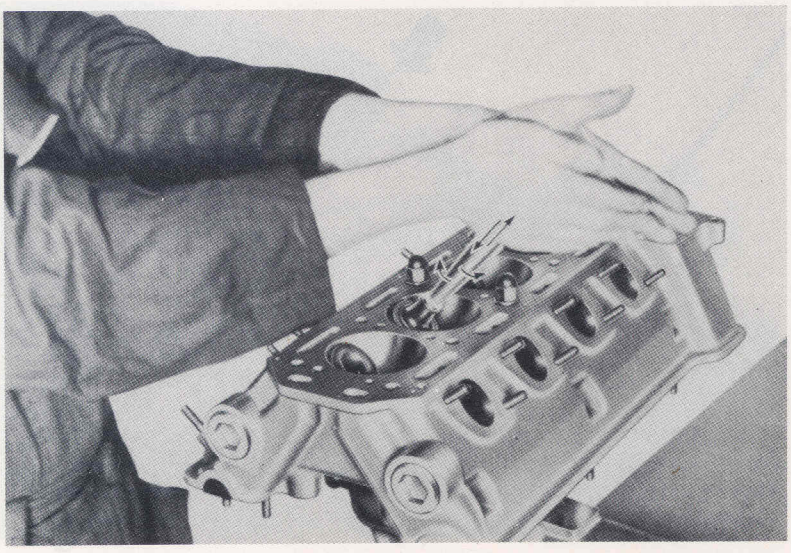


Note

- If the housing of valve seat insert is worn or scored it shall be counterbored with the tool **A.1.0002** (Ref. Tool. Bulletin no. 14) up to the following oversize:

  intake **A = 42.772 - 42.797 mm**
  (1.6840 - 1.6849 in.)

  exhaust **A = 38.772 - 38.797 mm**
  (1.5265 - 1.6274 in.).



Valves

- Check that valves are not warped and that valve poppet is not burnt; if damaged, renew the valves.
- Check valve stem for correct diameter:

  intake valve: **8.960 - 8.987 mm**
  (.3527 - .3538 in.)

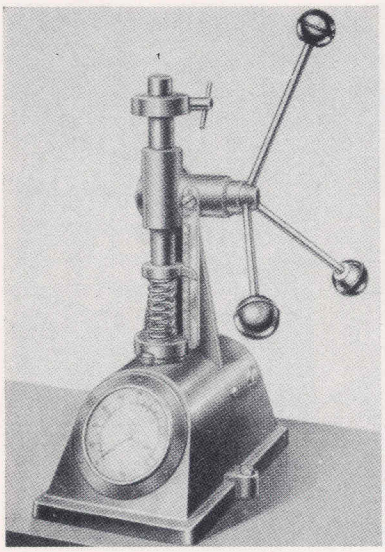
  exhaust valve: **8.935 - 8.960 mm**
  (.3518 - 3527 in.).

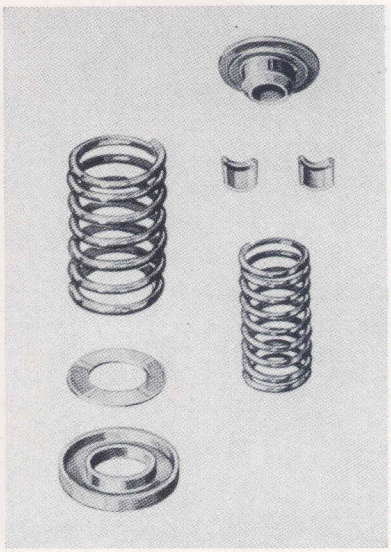
- Lap each valve in its seat with the aid of a suitable tool and using a fine grain lapping powder suspended in oil.
  Take care not to interchange the valves; refer to figures stamped on them.
  After lapping, wash carefully with fuel oil and dry with compressed air.

CYLINDER HEAD

- Check springs for proper calibration with a suitable test rig:

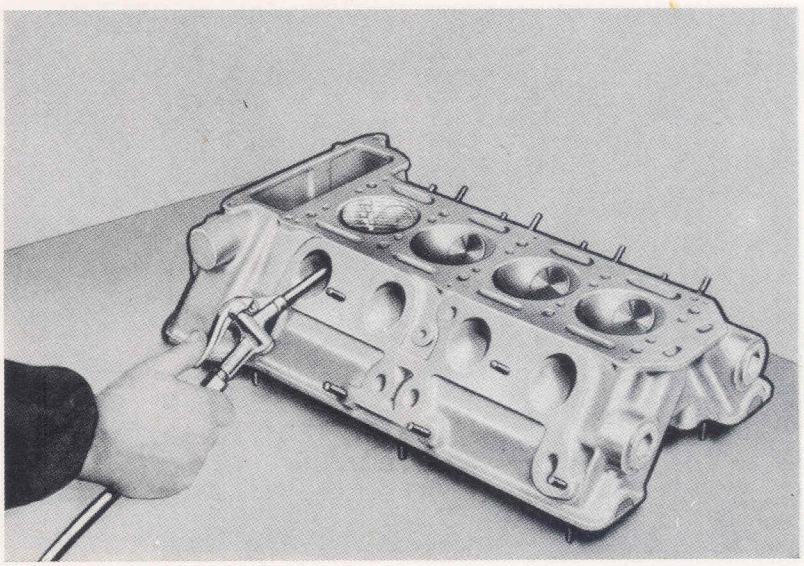
		Free length	Loaded condition	
			Length	Test load
SPRING	large	**51.3 mm** (2.02 in.)	**27.5 mm** (1.08 in.)	**35.6 to 37.1 kg** (78.5 to 81.8 lbs)
	small	**46.5 mm** (1.83 in.)	**26.0 mm** (1.02 in.)	**21.2 to 23.16 kg** (46.7 to 51.1 lbs)





- Check that valve cotters, spring seats and shims are not worn or damaged.

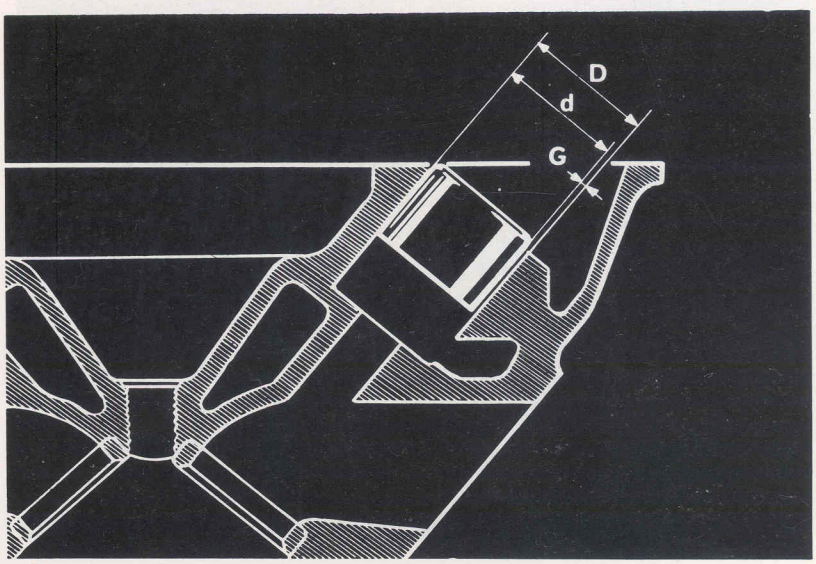
- After installation of valve springs, spring seats, shims and cotters, check the valves for leakage as follows.
- Fill the combustion chamber with petrol and blow compressed air into intake and exhaust ports.
- Air bubbles will be seen if the valves and seats do not seal properly: in this case lap valves and seats together again.



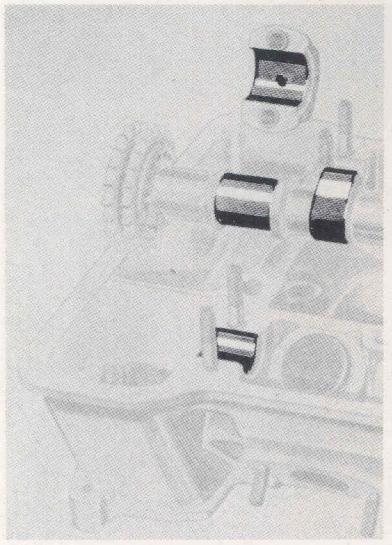
- Inspect the valve cups to make sure that the top surface is flat and shows no sign of scoring or seizing.
- Check that top surface of the adjusting pads is not damaged.
- Check that outside diameter of valve cups and inside diameter of their housings in cylinder head fall within the following limits:

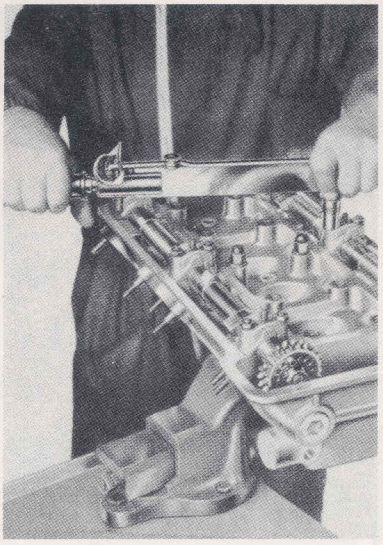
Diameter	Standard	Oversized
d	**34.973 to 34.989 mm** (1.3773 to 1.3775 in.)	**35.173 to 35.189 mm** (1.3848 to 1.3853 in.)
D	**35.000 to 35.025 mm** (1.3779 to 1.3789 in.)	**35.200 to 35.225 mm** (1.3859 to 1.3868 in.)

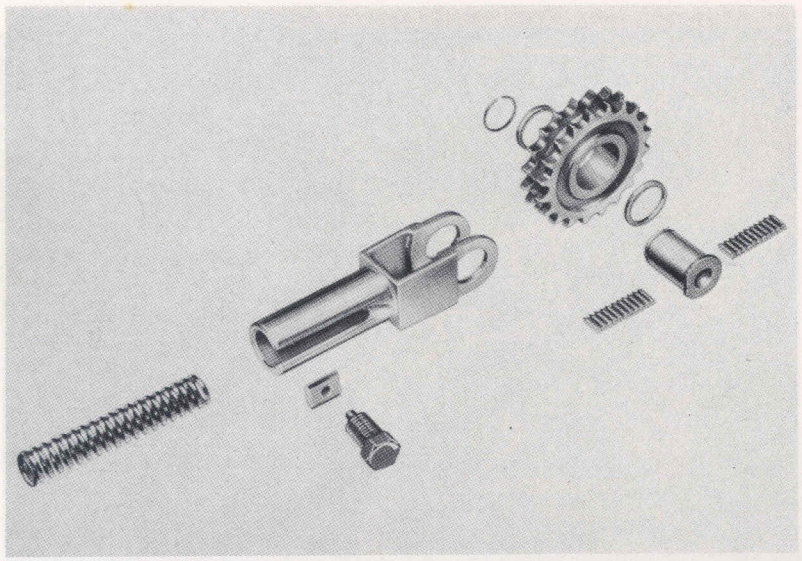
Clearance **G** = **.011 to .052 mm** (.0005 to .0020 in.).

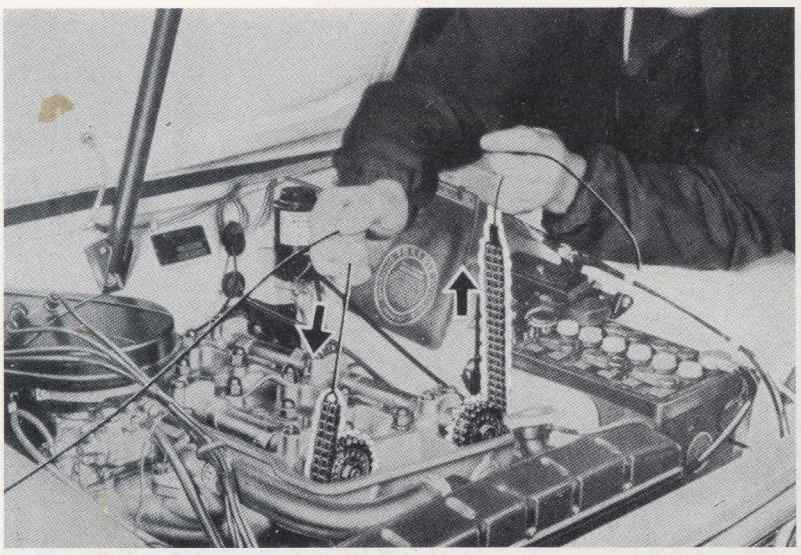


CYLINDER HEAD









Camshafts

- Check cam working surface for excessive wear and working surface of journals and journal bearings for scoring and any sign of seizing. If only minor or skin defects are found, they must be smoothed out with an oil stone. However, if the affected parts are severely damaged or worn, renew them.
- Assemble the camshafts on cylinder head and lock (in oil) the bearing retaining nuts with a torque wrench to **2.00 to 2.25 kgm** (14.5 to 16.3 ft-lbs).

Chain tensioner

- Check the spring for proper calibration with a suitable test rig:
  free length: **98 mm** (3.9 in.);
  length under test load: **58 mm** (2.3 in.);
  test load: **20.8 to 22.8 kg** (46 to 50 lbs).
- Inspect the locking plate and its thrust faces for damage and excessive wear.
- Check pin and rollers for wear.
- For removal and inspection of camshaft drive chain follow this procedure:
  - tie a length of wire — about 1.5 meters (5 feet) — to an end of the chain;
  - slide out the chain from the end opposite the wire leading the wire to follow the chain;
  - in this way, when chain is withdrawn the wire will stay in place of the chain ready for an easier installation.
- Chain inspection:
  - check that rollers are not broken or seized on pins;
  - check links for free movement;
  - check the chain as a whole for binding.
- Whenever the chain is disconnected it is a good rule to replace the detachable end link and the clip with new parts.

Note: after the chain has been reassembled, check the valve timing as outlined on page 16.

Reassemble the cylinder head

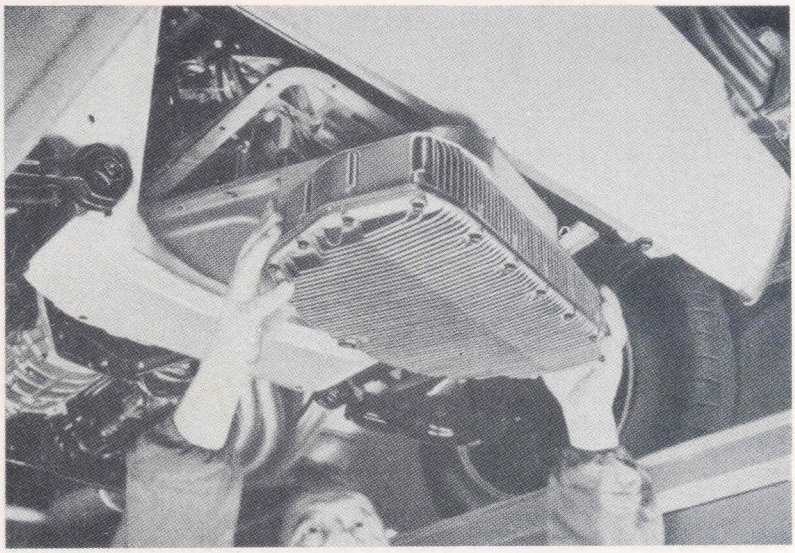
- Fit the intake manifold and carburettor assembly on cylinder head.
- Install the head on cylinder block taking care to renew the gasket and to lock the retaining nuts according to tightening specifications given on page 13.
- To complete the assembly of engine components, reverse the order of removal given on page 19.

LUBRICATING SYSTEM UNITS

OIL SUMP

- Unscrew the drain plug with the wrench **A.5.0106** (Ref. Tool Bulletin no. 66/2) and drain oil from sump.
- Loosen and remove the nuts securing sump to crankcase and, by tilting it conveniently, take the sump off from the front end of car.
- Remove the screws joining sump bottom to sump.

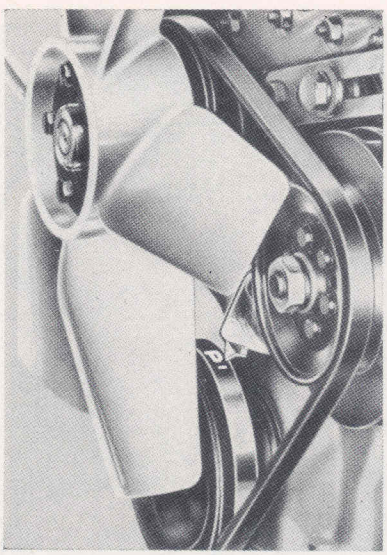
  On reassembly renew the gaskets between sump bottom and sump as well as those between sump and crankcase.

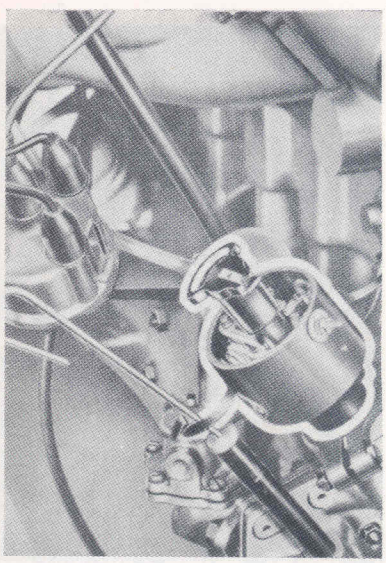


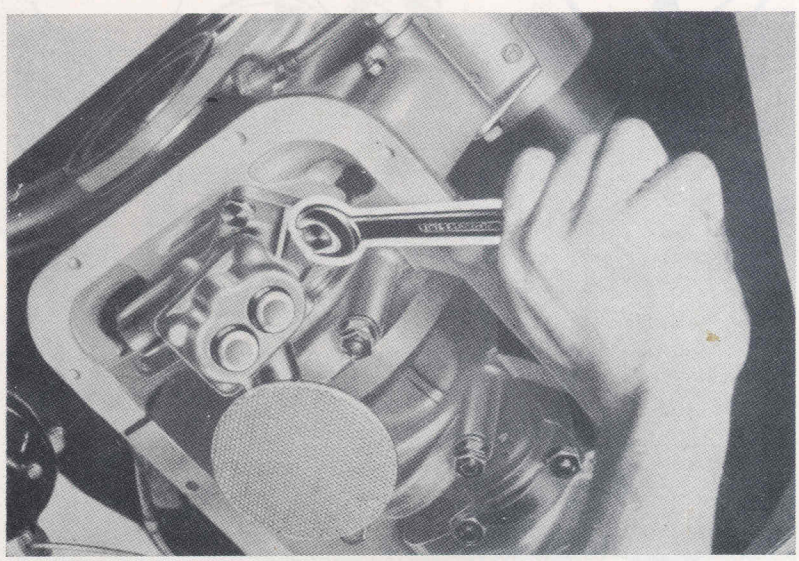
OIL PUMP

To remove the oil pump from crankcase proceed as follows:

- take the oil sump off;
- bring no. **1** piston at **TDC** on compression stroke: reference **P** on crankshaft pulley in line with the reference plate on front cover and distributor rotor arm pointing toward the engine front end.

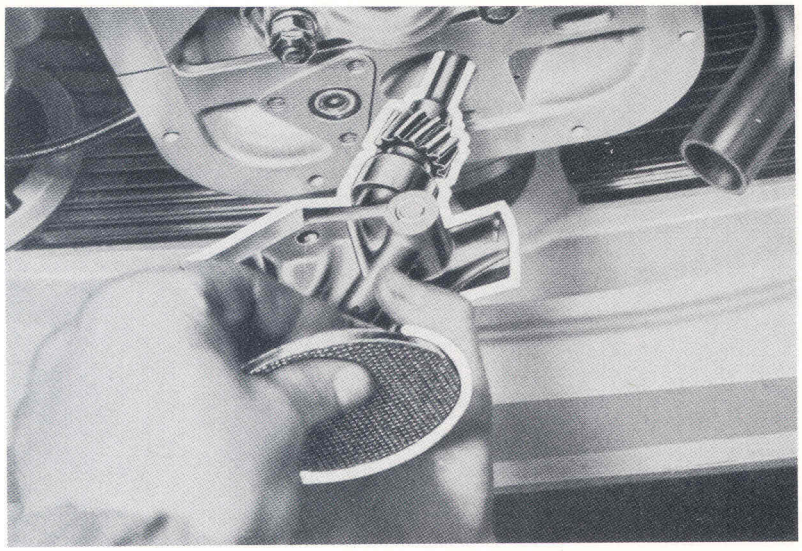




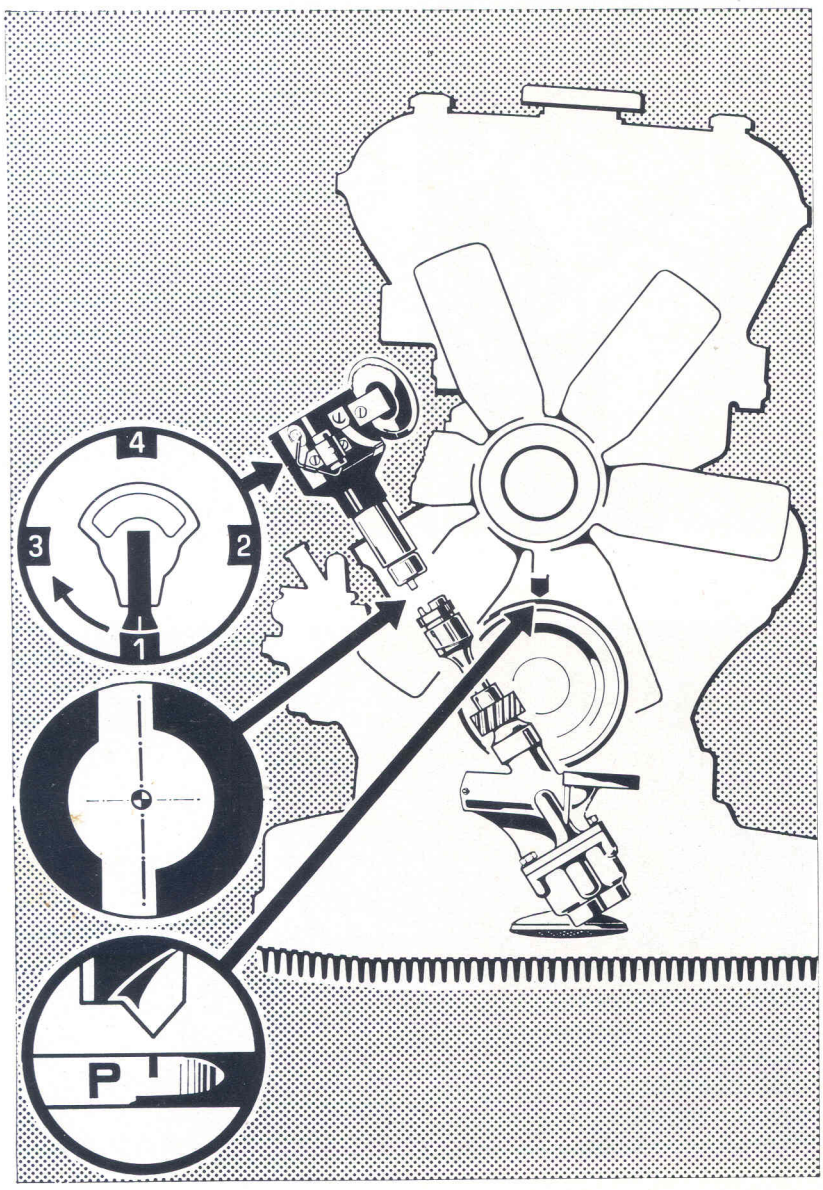


- Remove the screws fixing the oil pump to crankcase.

LUBRICATING SYSTEM UNITS



- Take out the pump by withdrawing it from the bottom.
- For pump overhaul refer to page 60.



To reassemble the pump to crankcase follow the instructions below:

- align the coupling on pump drive shaft as shown, that is the tooth on distributor shaft shall engage the off-set slot in the pump shaft (no. **1** piston at **TDC** on compression stroke: reference **P** on crankshaft pulley in line with the reference plate on front cover and rotor arm pointing toward the engine front end).

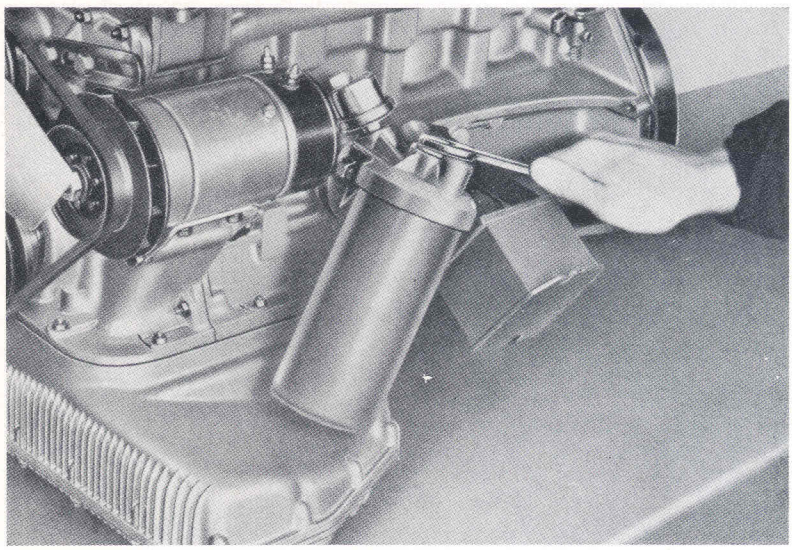
- Install the pump into crankcase.
  If the rotor-to-pump coupling should not fit properly for the tooth is misaligned with respect to slot, take the pump out again and rotate the drive shaft so as to engage the drive pinion in the next tooth in either direction until the coupling engages.

- Secure the pump to crankcase by locking the retaining screws.
- Refit the sump and replenish with oil.
- Check ignition timing as outlined on page 11.

LUBRICATING SYSTEM UNITS

OIL FILTER

To change the filter element unscrew the threaded plug which joins together filter bracket and housing and take the housing off from the bottom by tilting it conveniently as shown.

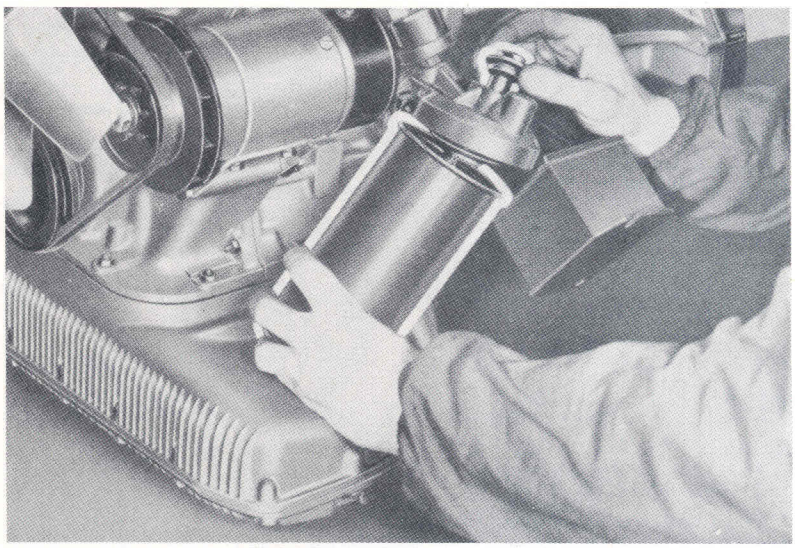


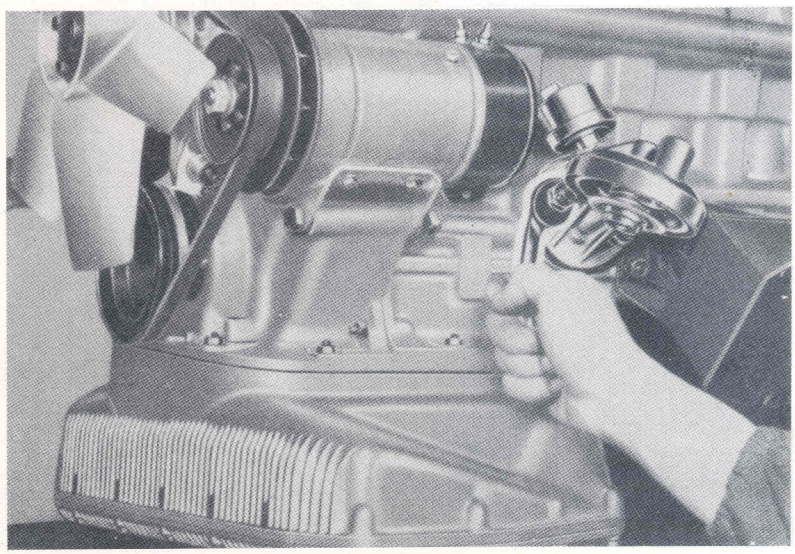
Change the filter element and wash the housing with gasoline; then dry it with compressed air.

Check that the following gaskets are in good conditions:

- between filter housing and bracket;
- on threaded plug;
- between filter element and housing bottom.

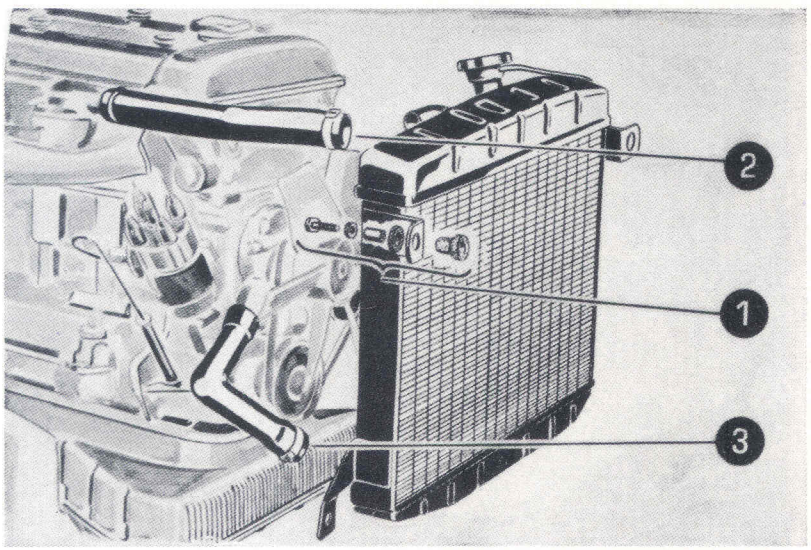
Check gasket retaining cups for good conditions.
Replenish the housing with the oil specified for the engine.
On reassembling do not overtighten the plug securing filter housing to bracket or warping will result.
While the engine is running make certain there is no oil leakage from filter.





- To remove the filter bracket for inspection purposes, unscrew from the underside of car the fastening nuts.
- For inspection of pressure relief valve, refer to page 61.

COOLING SYSTEM



RADIATOR

Drain coolant from radiator and engine as instructed on page 19.
Remove the radiator attaching parts **1**.
Disconnect:

- hose **2**, from radiator to cylinder head
- hose **3**, from radiator to water pump.

Take the radiator off paying attention not to damage the fan blades.

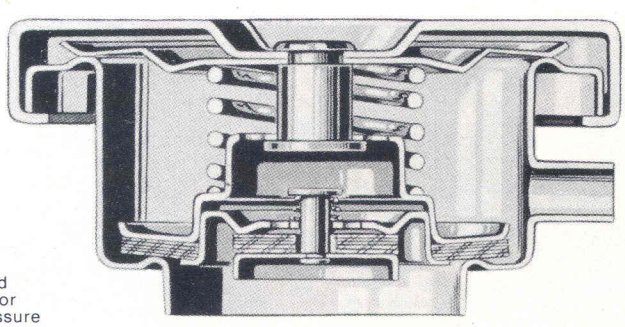
Inspect the radiating elements for good appearance.

Examine the weldings of brackets, side straps and connections.

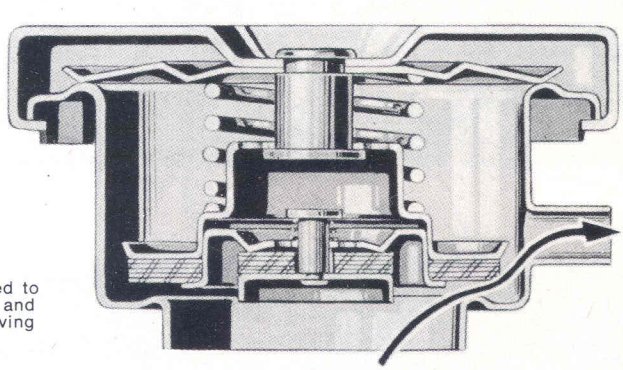
Make sure that inside surfaces of radiator are not excessively scaled. If scale deposits have formed refit the radiator and flush the system as follows:

- fill the cooling system with a solution of 300 grs (10.6 ozs) of sodium bicarbonate in 8 lts (1.8 Imp. gals) (2.1 U.S. gals) of water;
- run the engine slowly for 10 to 15 minutes;
- drain the solution off thoroughly;
- allow the engine to cool down and then circulate running water while leaving the drain cocks open;
- refill cooling system with clean water and run the engine slowly for a few minutes;
- drain system once more and replenish with coolant again.

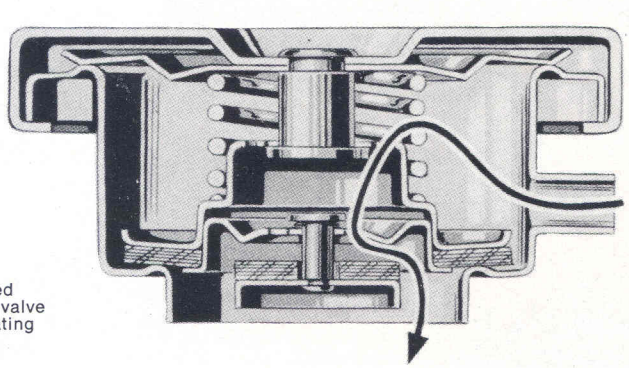
This flushing procedure should be performed both before adding antifreeze to the engine coolant and after draining the antifreeze from the cooling system.



Cap closed and radiator under pressure



Cap opened to first catch and valve relieving pressure



Cap closed and inlet valve compensating suction

Radiator cap

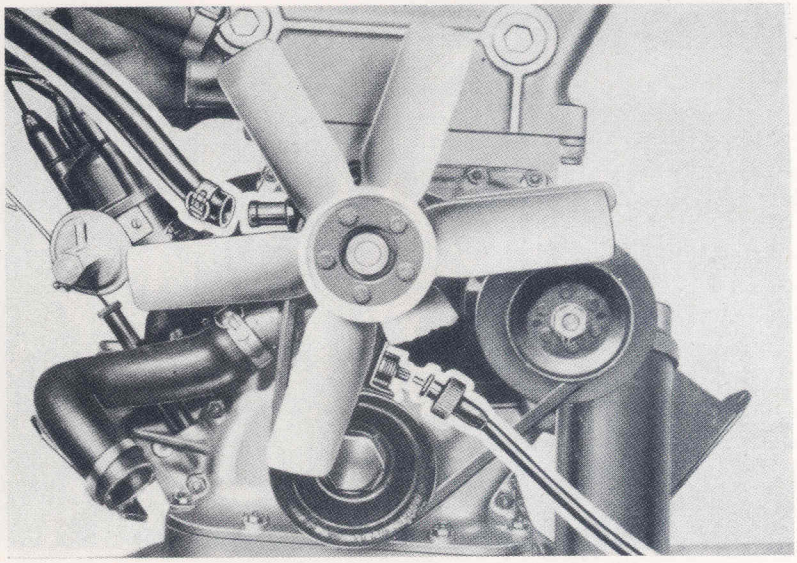
Examine the cap to make sure the spring is not broken, the gasket is in good condition and the relief and inlet valves operate properly.
After reassembly of radiator and with the engine running check the hoses for possible leakage.

WATER PUMP - ENGINE MOUNTINGS

Water pump

Remove the radiator as previously described.

- Disconnect:
  - tachometer flexible shaft;
  - hose for water return from intake manifold to pump.



Loosen the nut fixing generator to adjusting arm.

Rotate the generator inwards.

Free the belt from pulleys.

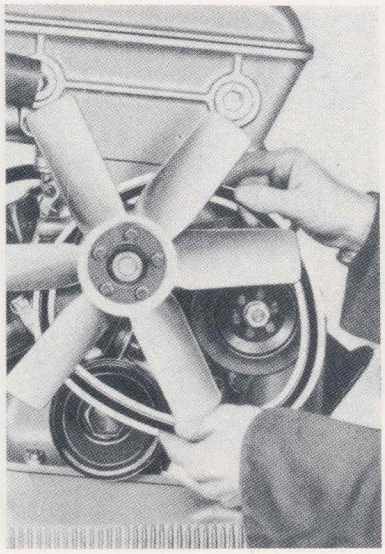
Remove the belt tension adjusting arm.

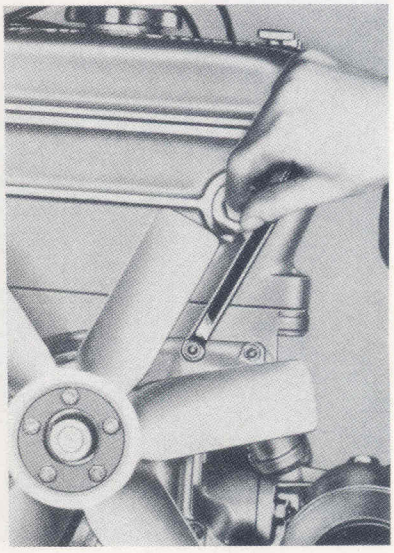
Rotate the generator outwards.

Take off the pump body and fan assembly.

For water pump overhaul refer to page 62.

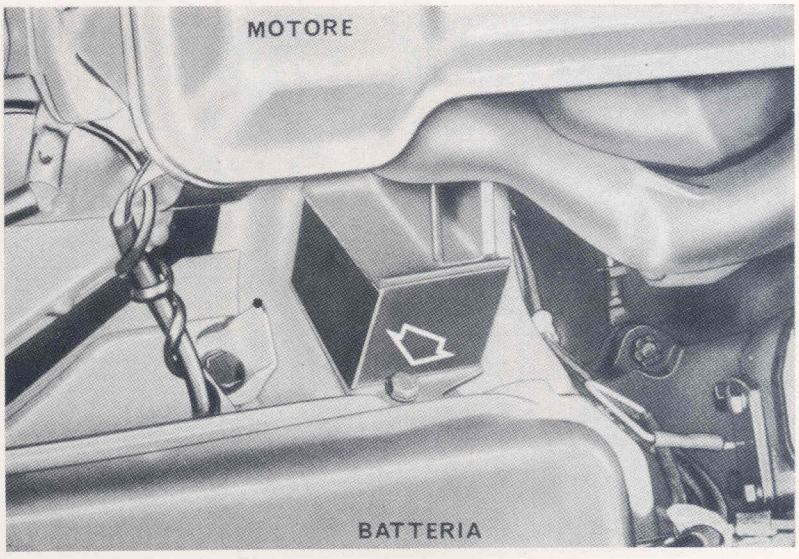
Note: to reassemble the pump on cylinder block reverse the disassembly procedure; after installation of the pump, adjust the belt tension as described on page 13.





Motore = Engine

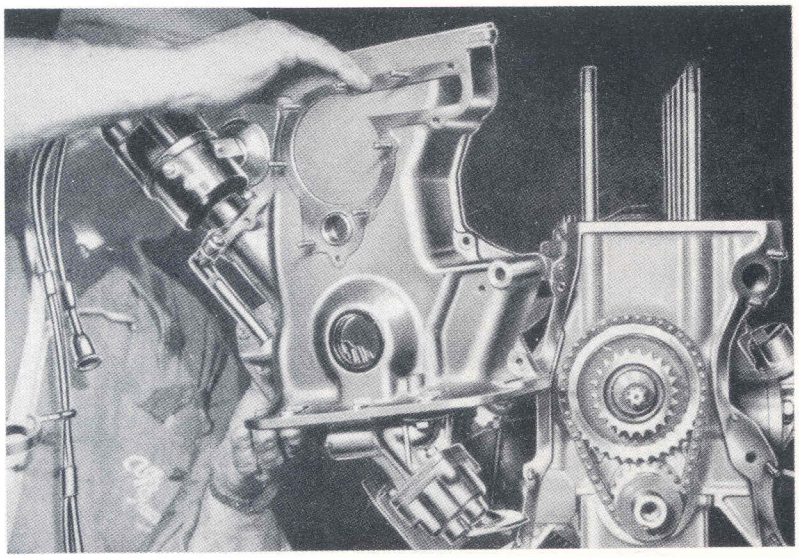
Batteria = Battery



Replacement of engine mountings

- Remove the bonnet support from chassis.
- Hook the engine to a hoist and slightly release the load on mounting pads.
- Unscrew the nuts fastening the mounting pads to engine and body.
- To remove the mounting from the exhaust side, take off oil filter housing and bracket as outlined on page 27.

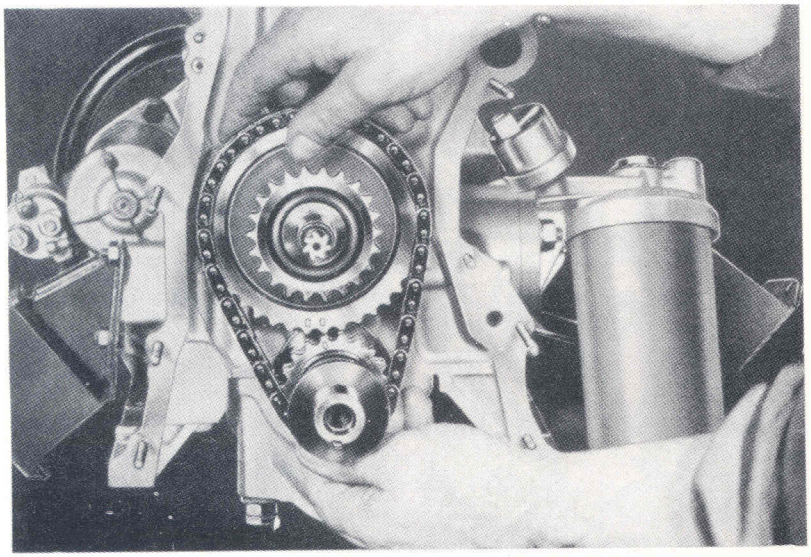
CRANKCASE FRONT COVER



Preparatory steps

Remove:

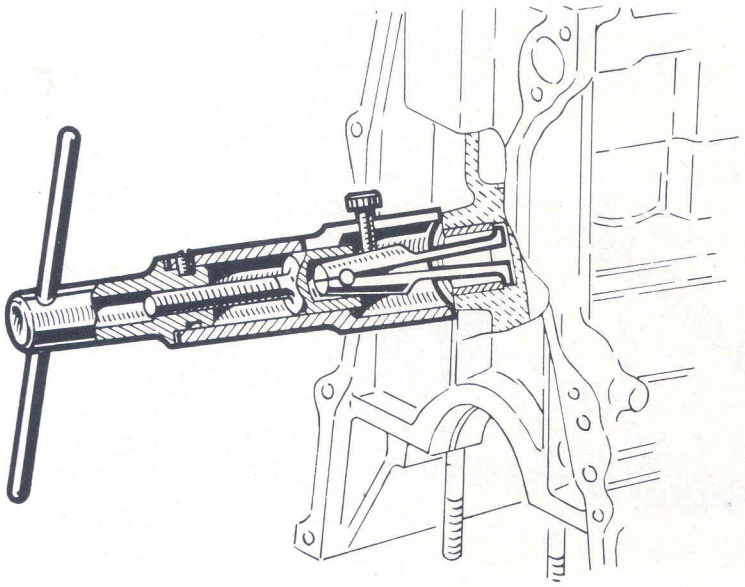
- radiator (refer to page 28);
- water pump (page 29);
- generator and its mounting flange;
- cylinder head (page 19);
- oil sump (page 25);
- fuel pump and bracket;
- crankshaft pulley.



Removal - Inspection and repairs

Remove the front cover - oil pump - ignition distributor group from the crankcase (on reassembly, replace the two gaskets between cover and crankcase).

- Slide out sprockets, chain, oil pump drive pinion and idle sprocket as a unit.
- Check:
  - gear teeth for good appearance;
  - chain rollers for any sign of damage or seizing on their pins;
  - links for free movement and the chain as a whole for binding.



- If the spacer between idle sprocket shoulder and the abutment on crankcase is worn down, replace it with a new one.
- Measure the diameters and calculate the clearance between bushing in crankcase and idle shaft, and the clearance between idle shaft and bushing in front cover;

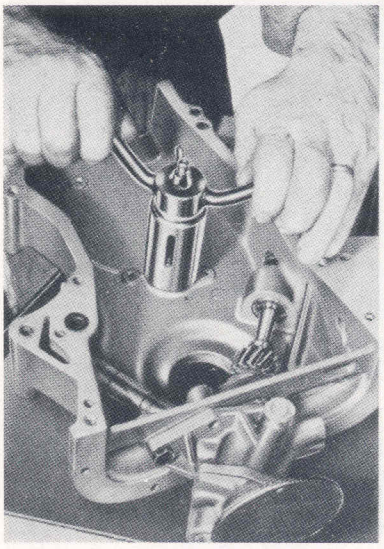
  permissible clearance: **.040 to .074 mm** (.0016 to .0029 in.);

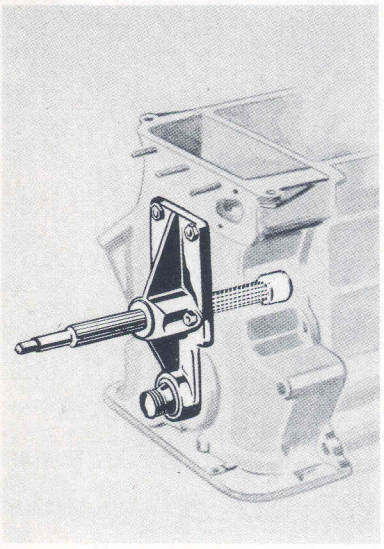
  wear limit: **.1 mm** (.0039 in.).
- If necessary pull out the bushings from cover and crankcase with the puller **A.3.0210.** (Ref. Tool Bulletin no. 126) and replace them with new ones by following this procedure:

CRANKCASE FRONT COVER

- install the new bushings into their seats in cover and crankcase;
- fit and secure the cover onto crankcase;
- assemble the guide **A.4.0112** and ream the bushings to an inside diameter from **20.677 to 20.698** mm (.8141 to .8148 in.) by means of the reamers **U.2.0040** for roughing and **U.2.0041** for finishing.
  Check diameter and alignment of bores with the tool **C.8.0103** (Ref. Tool Bulletin no. 94/1).

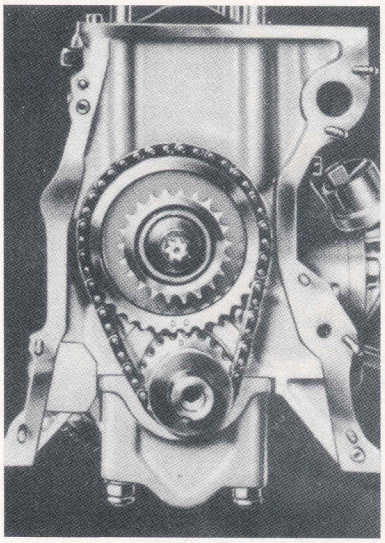
  Finishing I.D.: **20.677 to 20.698** mm

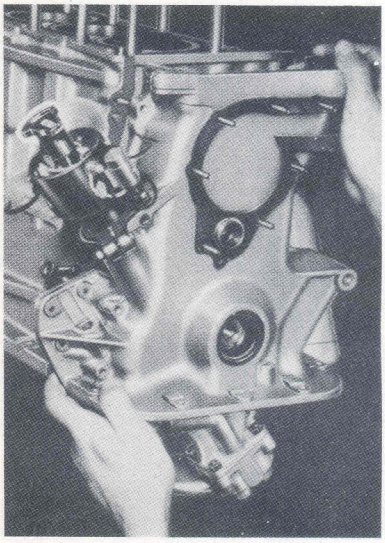


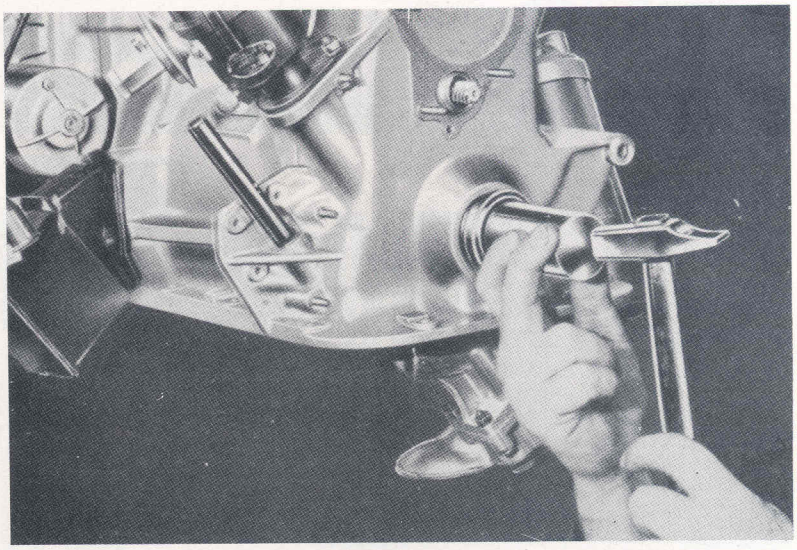


Reassemble the front cover

- Install chain, sprockets and spacer as a unit **taking care to align the timing reference marks on sprockets.**
- Rotate the ignition distributor shaft so that the rotor arm is pointing toward the front end as shown.
- Fit the cover on crankcase and make sure the rotor arm is positioned as described above; if necessary, take the cover out again and rotate the oil pump drive shaft so as to position the rotor arm properly.

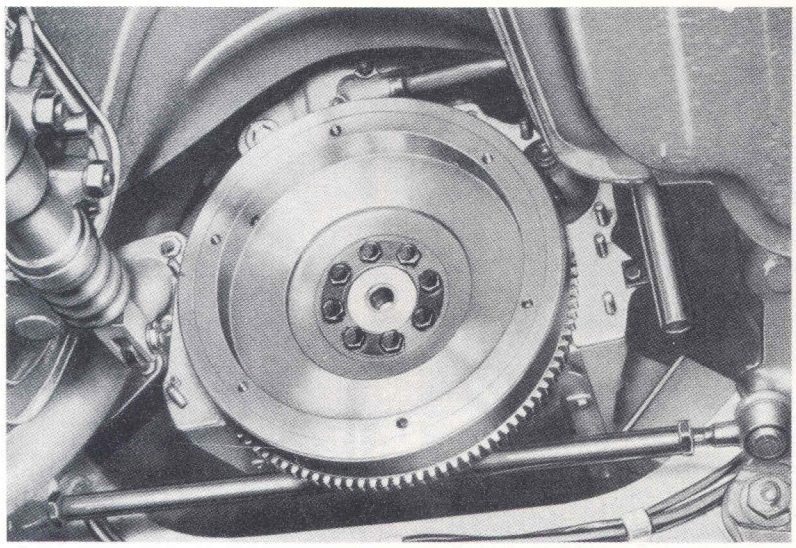


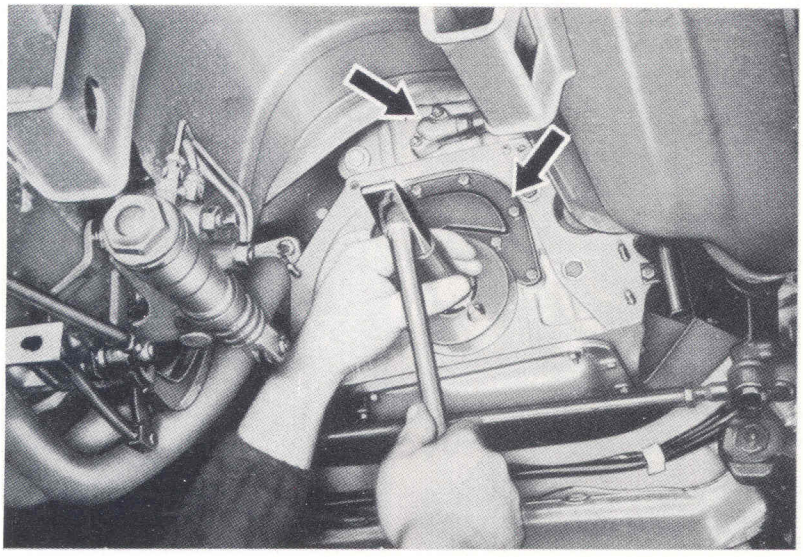




- Secure the cover to the crankcase.
- Insert the packing into front cover with the driver **A.3.0146**.
  Before inserting the packing into its housing make sure the cover fits the crankcase in such a way that the tools is centered on crankshaft.
- Assemble the drive pulley onto the shaft and secure it with the locknut.
- Complete the assembly by reversing the disassembly procedure.
- On completion of assembly check the valve timing as described on page 16.

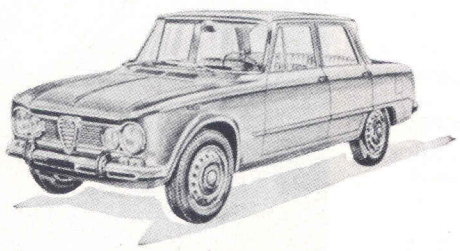
FLYWHEEL





Replace the flywheel ring gear

- Remove:
  - the gearbox (see page 82);
  - the clutch (see page 75).
- Loosen and remove in alternate sequence 4 of the 8 bolts which fasten the flywheel to the crankshaft and screw in 4 studs in their place in order to avoid the half-rings from getting out of the seat; then remove the remaining 4 bolts and take the flywheel off.
- If oil leakage is found, check the following:
  - the gasket on cover of oil vent chamber and on vent pipe connection;
  - the crankshaft rear packing; if necessary, replace it with a new one by using the driver **A.3.0178.**
- When cold separate the ring gear from flywheel with a hydraulic press.
- Heat the new ring gear to 100° C (212° F) in an oil bath and fit it onto the flywheel.
- Rotate the crankshaft to bring no. 1 piston at TDC; then install the flywheel on crankshaft and align the mark cut in the flywheel with the centerline of crankpins 1 and 4.
- Fit new safety plates.
- Smear the bolts with oil and tighten to **4.2 - 4.5 kgm** (30.4 - 32.5 ft-lbs) with a torque wrench.
- Carefully bend the tabs of safety plates.



REMOVAL OF ENGINE

Preparatory steps

- Drain off water from engine and radiator through the drain cocks.
- Drain off oil from sump (see page 25).
- Disconnect battery cables.

From the underside of car:

Detach:

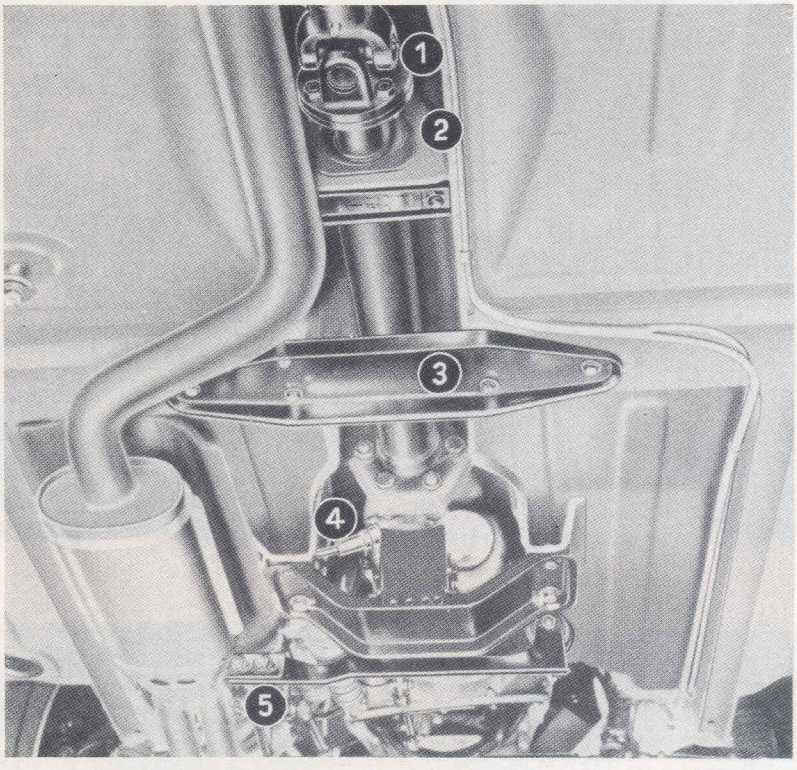
1 the front section of propeller shaft from the rear section at the intermediate joint flange;

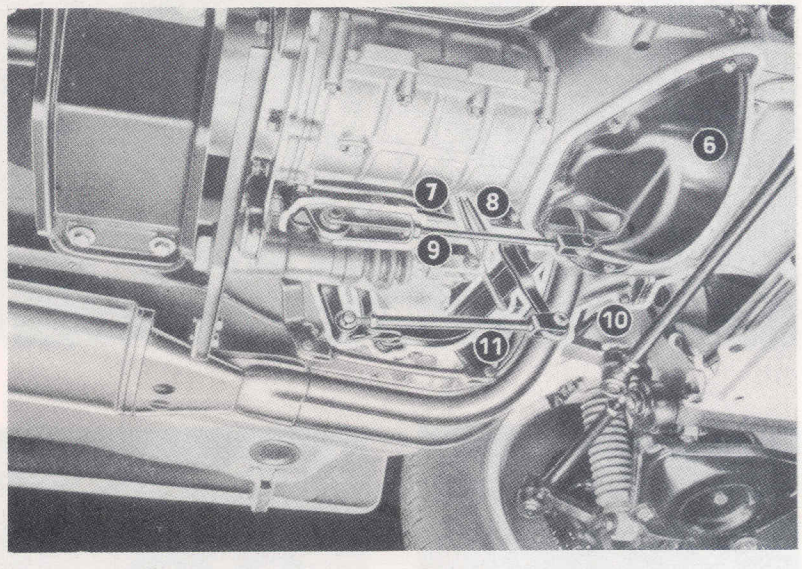
2 the support of propeller shaft central bearing;

3 the cross plate;

4 the odometer flexible shaft;

5 the exhaust pipe bracket from gearbox;





6 the clutch protection cover;

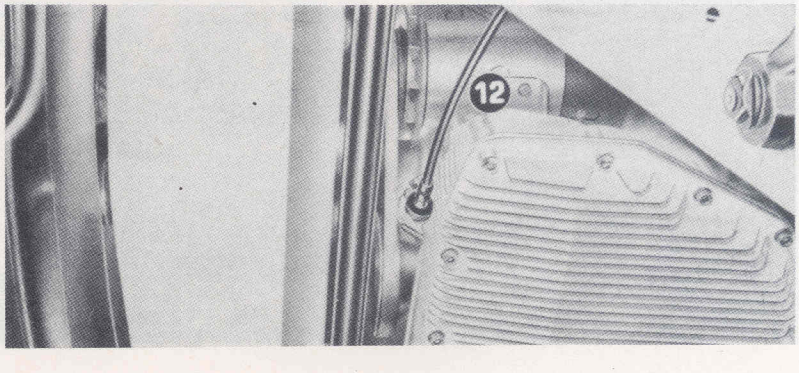
7 the gear selection lever;

8 the cables of back up lamp switch;

9 the clutch disengaging lever;

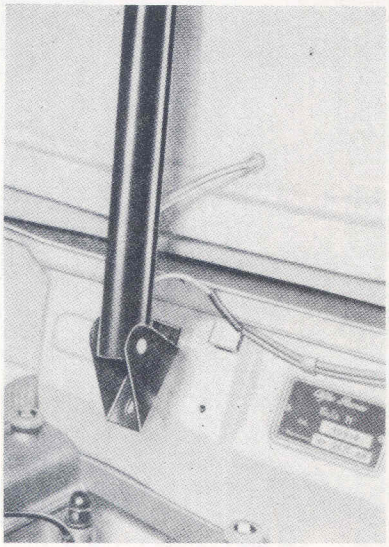
10 the manifold from exhaust pipe;

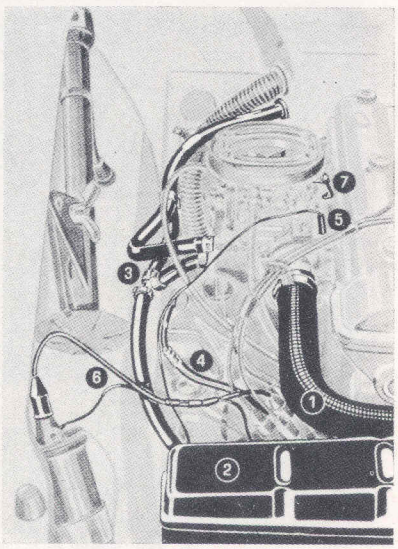
11 the gear engaging lever;

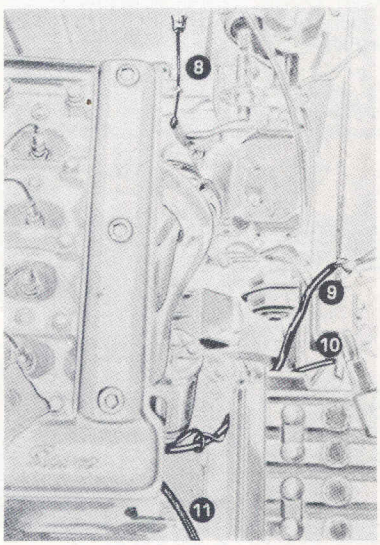


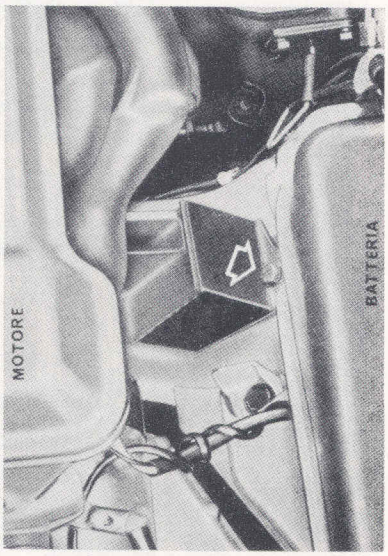
12 the tachometer flexible shaft.

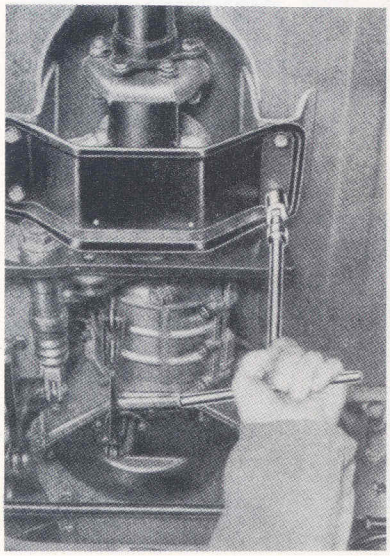
REMOVAL OF ENGINE

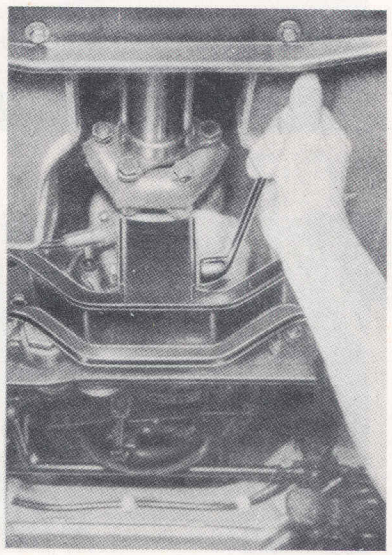












From the engine compartment

- Remove:
  - · the strut for supporting bonnet from body;
  - · the air cleaner;
  - **1** the hose from cylinder head to radiator;
  - · the hose from radiator to water pump;
  - **2** the radiator from body (as shown on page 28);
  - **3** the hose from water pump to intake manifold and the hoses to heater;
  - **4** the petrol delivery pipe from tank to pump;
  - **5** the lead from water thermometer bulb;
  - **6** the leads from coil;
  - **7** the choke control cable;
  - · the throttle control tie rod;
  - **8** the accelerator hand control cable;
  - **9** the generator leads;
  - **10** the cable from oil pressure gauge union;
  - **11** the engine bonding wire;
  - · the starting motor leads.

Batteria = Battery

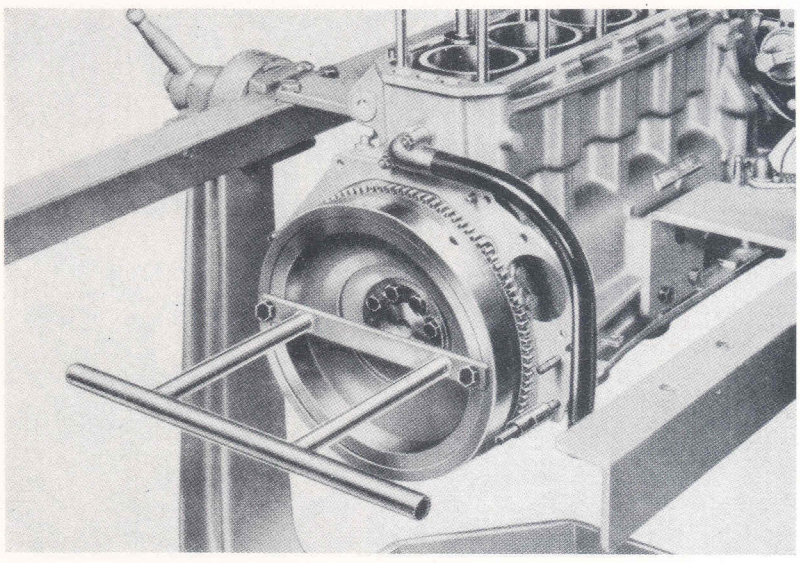
Motore = Engine

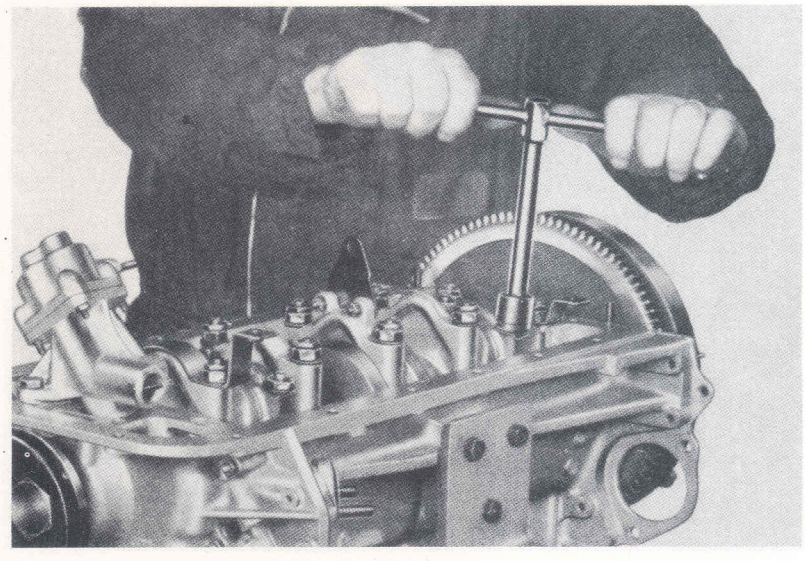
Removal of engine-gearbox unit

- Hook up the engine with a hoist and give a light pull.
- Unscrew the bolt fastening the gearbox supporting cross member to car floor.
- Unscrew the bolt fastening the gearbox to cross member and remove the latter.
- Detach the engine mountings from chassis.
- Take the engine-gearbox unit out by tilting it conveniently.

DISASSEMBLY

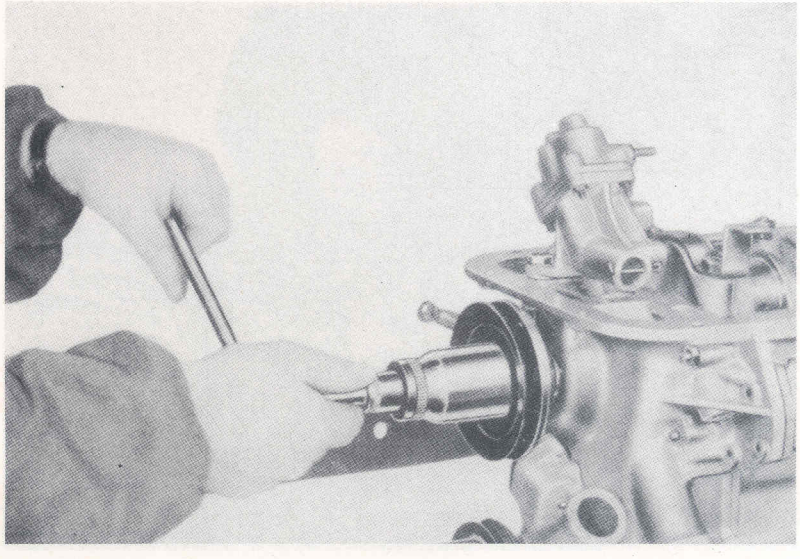
- Remove the gearbox and the front section of propeller shaft.
- Put the engine on a stand.
- Remove from cylinder block:
  - the cylinder head (page 20);
  - the oil sump (page 25);
  - the oil filter and its bracket (page 27);
  - the starting motor.
- Fit the parts of tool **A.2.0117**, (Ref. Tool Bulletin no. 77/1) for retaining the cylinder barrels, on cylinder head studs.
- Mount the tool **A.2.0122**, for turning the crankshaft, on flywheel.





Con. rods and pistons

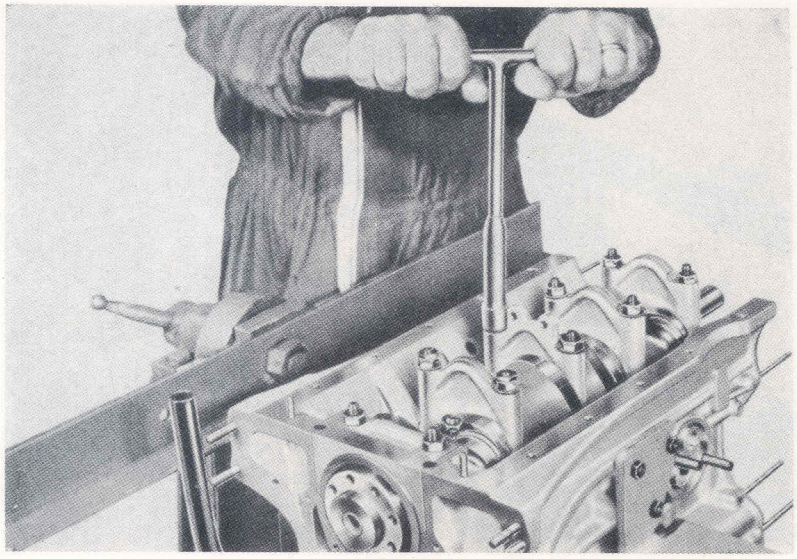
- Unscrew the nuts on con. rod bearing caps and remove the caps and the half shells.
- Withdraw the pistons along with con. rods from the top of cylinder block; to do this push the con. rods upward taking care not to hit or scratch the barrels with the con. rod big end.
- Mark the pistons for reassembly in the original order.



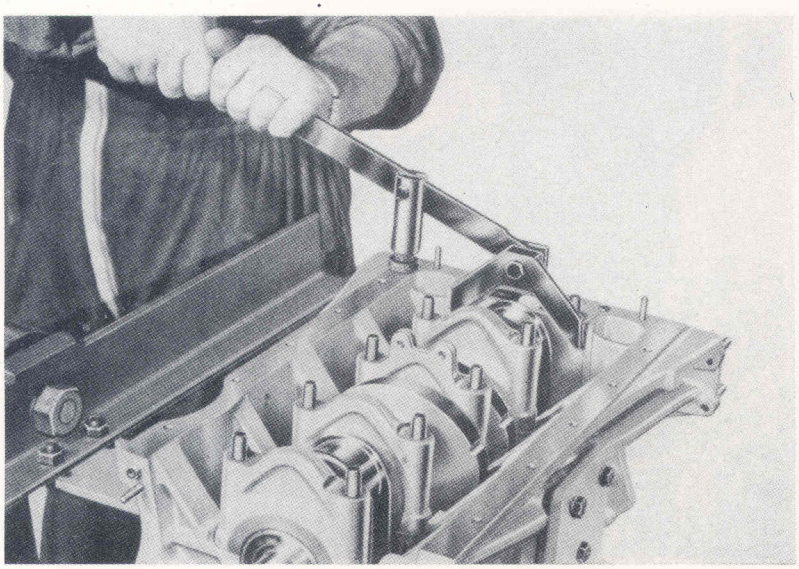
Crankshaft

- Unscrew the nut securing the crankshaft pulley and remove nut and pulley.
- Remove the front cover, the water pump, the ignition distributor and the oil pump as a unit (see page 30).
- Slide out sprockets and chain, oil pump drive pinion and idle sprocket as a unit (see page 30).

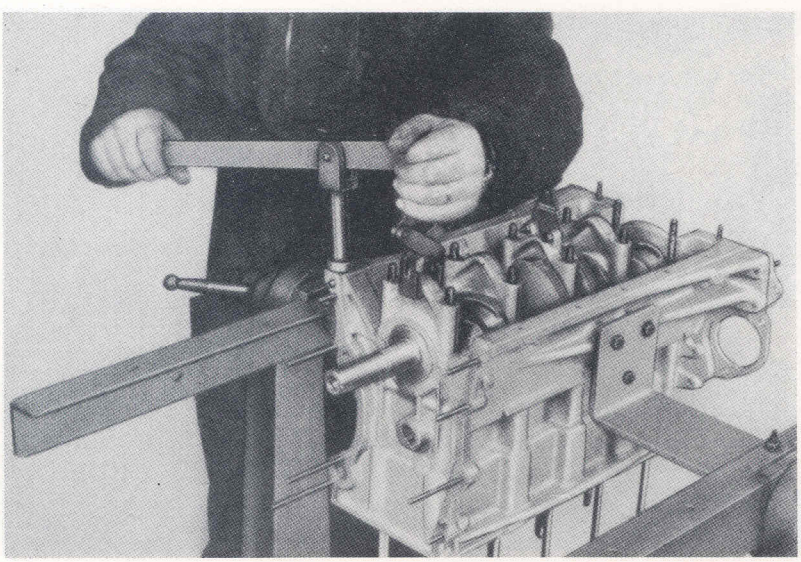
DISASSEMBLY



- Remove the tool **A.2.0122** from the flywheel.
- Unscrew the nuts securing the flywheel and remove the flywheel.
- Unscrew the nuts securing the main bearing caps starting from the central bearing.



- Remove the rear main bearing cap with the aid of the lever **A.3.0139/1** and the puller **A.3.0139/2** (Ref. Tool Bulletin no. 87).



- Remove the other main bearing caps with the tool **A.3.0182.**
- Take a careful note of the assembly order of main bearing shells so as to reassemble them in the original positions.
- Remove the crankshaft from crankcase.

INSPECTION AND CHECKING

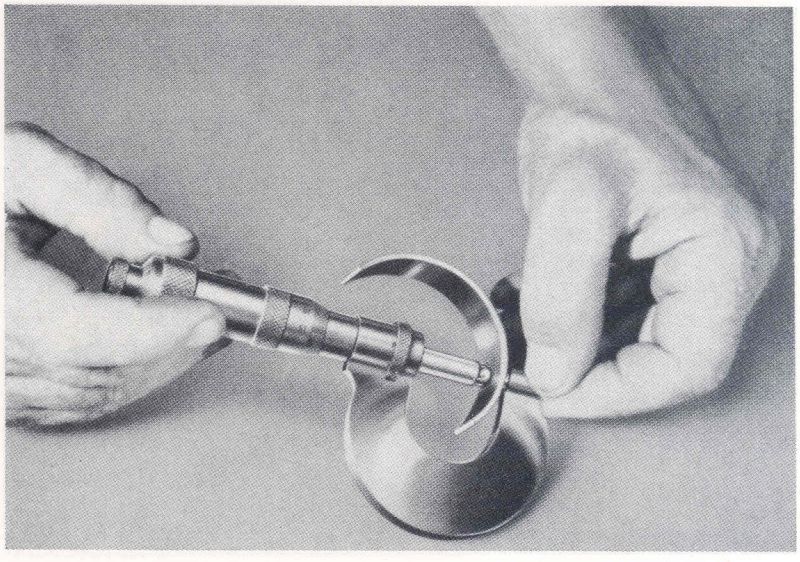
Con. rods

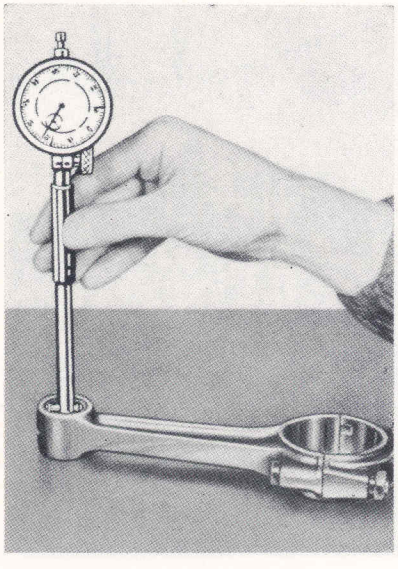
- Inspect the surface of con. rod bearings for no sign of scratching or seizing and that antifriction layer is not worn down to the pink metal underneath, even in small spots.
- Check the clearance between crankshaft journals and big end bearings as follows:
  - measure the inside diameter of big end bearing seat with a suitable dial gauge;
  - measure the outside diameter of relavant journal with a micrometer gauge in two positions at right angle;
  - to measure the actual thickness of the antifriction bearing without errors or damage, insert a 10 mm (3/8 in.) dia. ball between bearing and gauge as shown;
  - the clearance is the difference between diameters of big end bearing seat and its journal plus twice the bearing thickness.

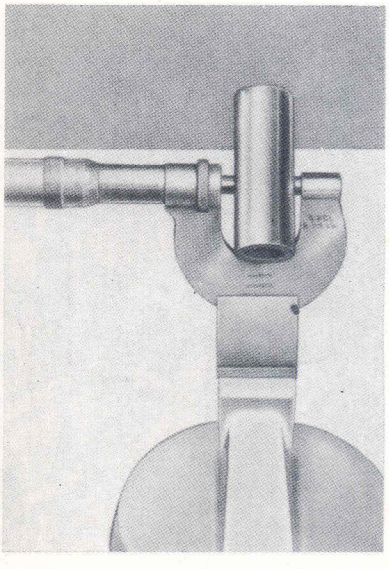
  If the clearance exceeds **.15 mm** (.0059 in.) the journal must be reground without exceeding the minimum allowable diameter; then replace the bearings with the oversized ones (see page 70).
  Never scrape the bearings; renew them when the pink layer under the friction metal appears even in small spots.
- Remove the piston pin retainer ring with a suitable tool.
  Withdraw the piston pin and check for no sign of scratching or binding.
  Measure the pin diameter and the inside diameter of hole in piston and check that clearance falls within the specified limits (see page 70).
- Check the inner surface of small end bearing for any sign of binding.
  Check with a suitable dial gauge the inside diameter of small end bearing and that the bearing-to-pin clearance falls within the specified limits (see page 70).
  If not, take the small end bearing off and replace it with a new one using a suitable tool and a press. After the installation bore the bearing to

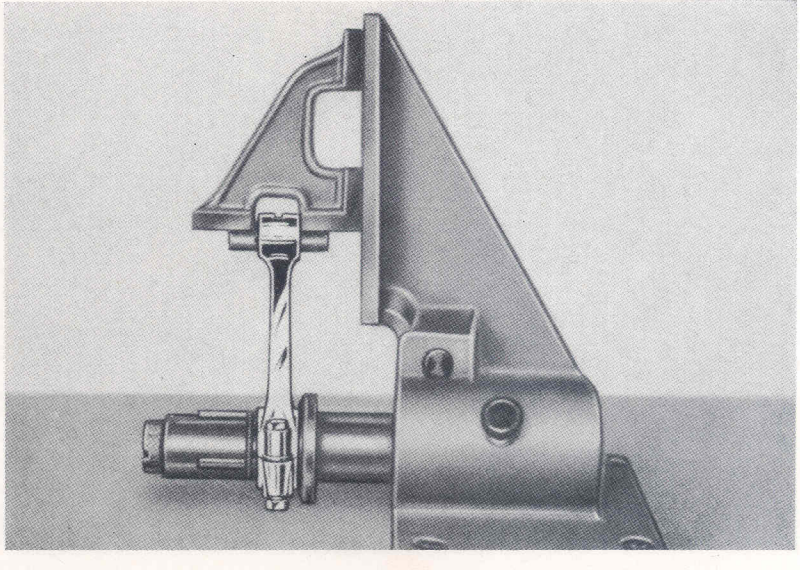
  22.005 - 22.015 mm (.8664 - .8667 in.)

  in diameter.
- Check that centerline of big end hole is parallel with centerline of small end hole as shown.
  The maximum out of parallelism is **.05 mm** (.002 in.) measured over a base of **100 mm** (3.94 in.).
  If required, straighten the con. rod with a press.
  Examine the con. rods with a magnaflux detector for no sign of cracking.

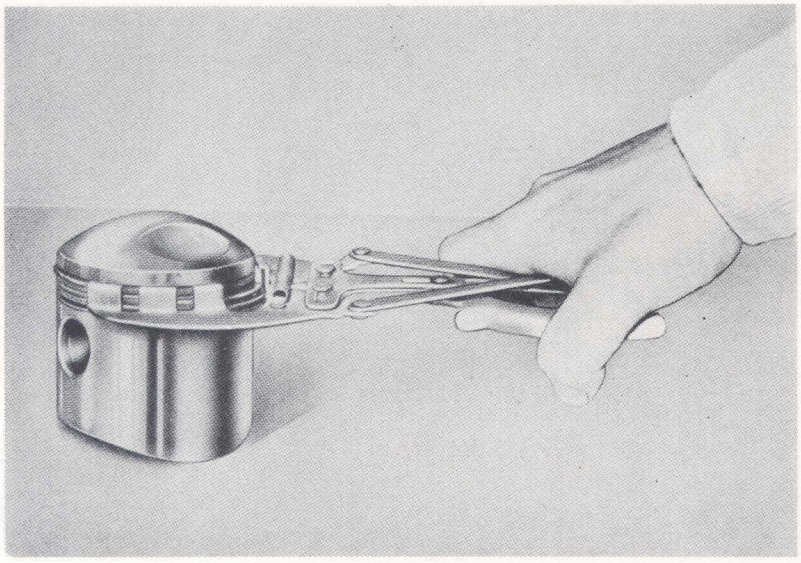






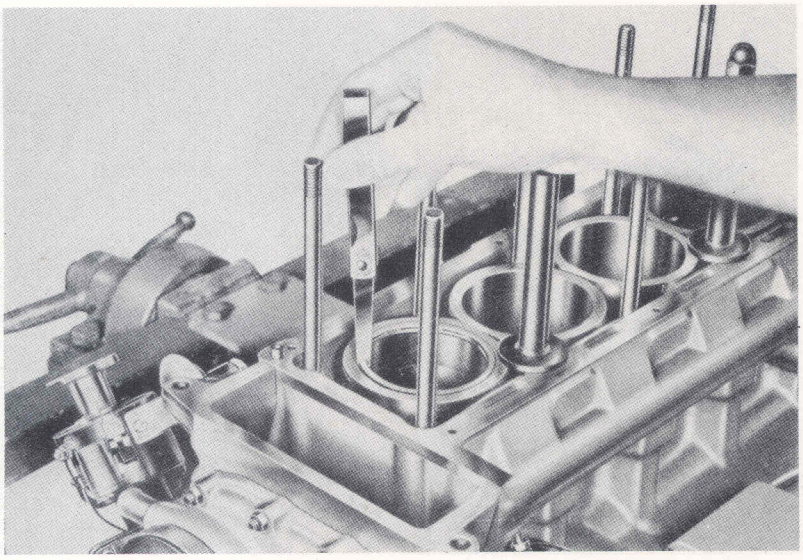


INSPECTION AND CHECKING



Pistons

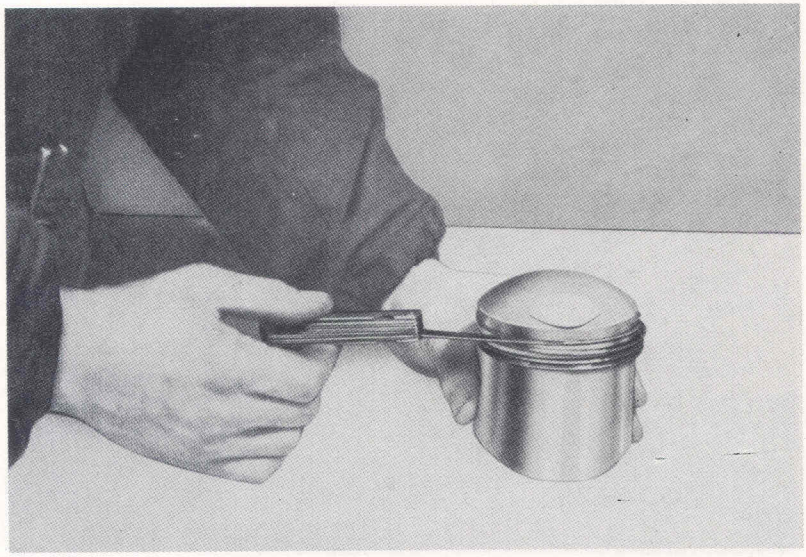
- Remove the piston rings from their grooves by using suitable pliers. In order to avoid breakage, stretch the piston ring ends only as strictly required for withdrawal.
- Set rid of carbon deposits and wash the piston rings in petrol; after cleaning check that rings show no deep scratches or any sign of binding.



- Insert the piston rings one at a time into their cylinder barrel taking care they lie flat at right angle to cylinder bore.
- Measure the ring gap with a feeler gauge:

specified gap: .3 to .45 mm (.012 to .017 in.)

wear limit: 1.0 mm (.039 in.)



- Scrape down the carbon deposits built up on piston head; clean the ring grooves and wash the pistons with a solvent.
- Check that piston skirt shows no sign of binding or deep scratches.
- Refit piston rings in their grooves with the same pliers as outlined in the disassembly procedure.
- With a feeler gauge check that the end play of rings in their grooves is:

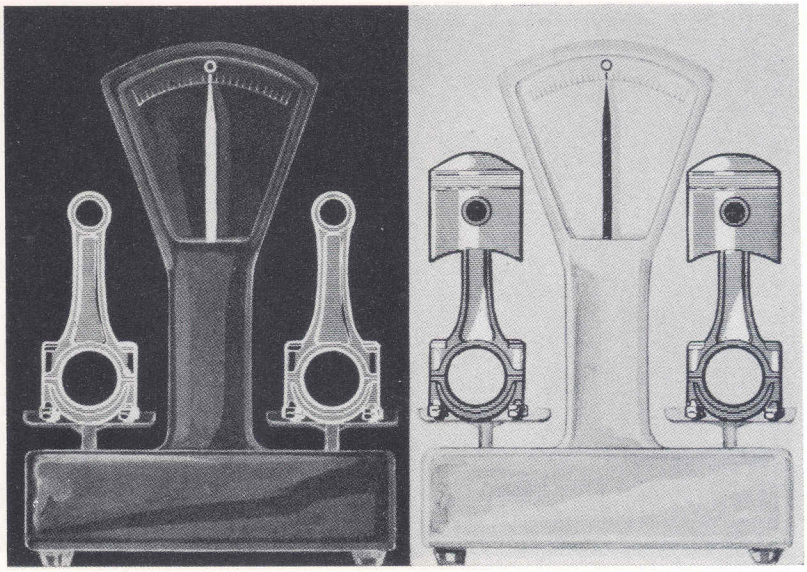
chromium-plated compression ring: .045 - .072 mm (.0018 - .0028 in.)

oil scraper ring: .035 - .062 mm (.0014 - .0024 in.)

oil control ring: .025 - .052 mm (.0010 - .0020 in.)

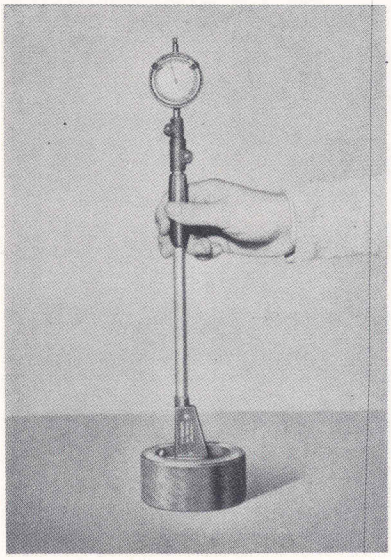
INSPECTION AND CHECKING

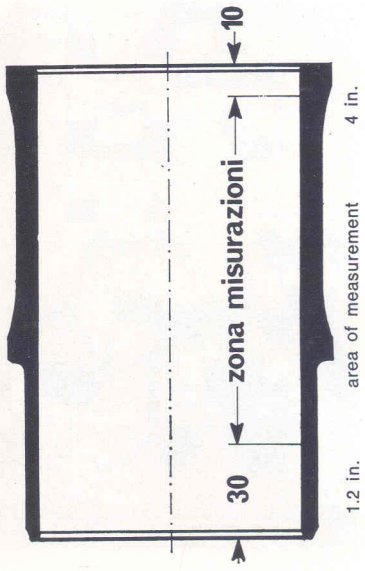
- On a central zero scale, check that the difference in weight between con. rods of the same engine complete with caps, bearings and bolts does not exceed **2 grammes** (.07 ozs.).
- Repeat the weighing with the pistons completely assembled to the con. rods. The difference in weight should not exceed **5 grammes** (.17 ozs.).
- If necessary, grind off the flash from con. rod forging seam.



Cylinder barrels

- Remove barrels and inspect the inner surface for good condition.
- Zero set a bore dial gauge on the reference ring **C.8.0100** and check the inside diameter, the elongation and taper of barrels at the positions shown in the illustration and in two directions at right angle (see table on page 69).



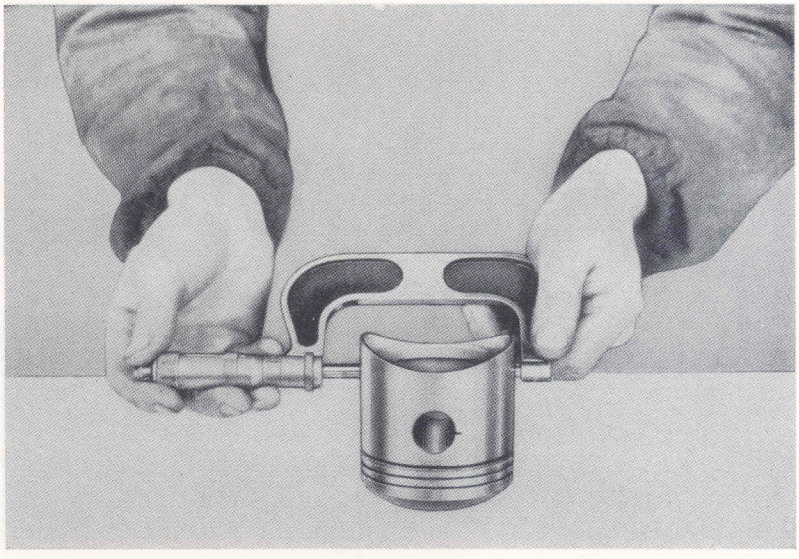


- Measure the outside diameter of pistons at right angle to the wrist pin hole and at a position of:
  11 mm (.43 in.) (Mahle make)
  12 mm (.47 in.) (Borgo make)
  from lower edge of skirt.
- The clearance between piston and barrel should be:

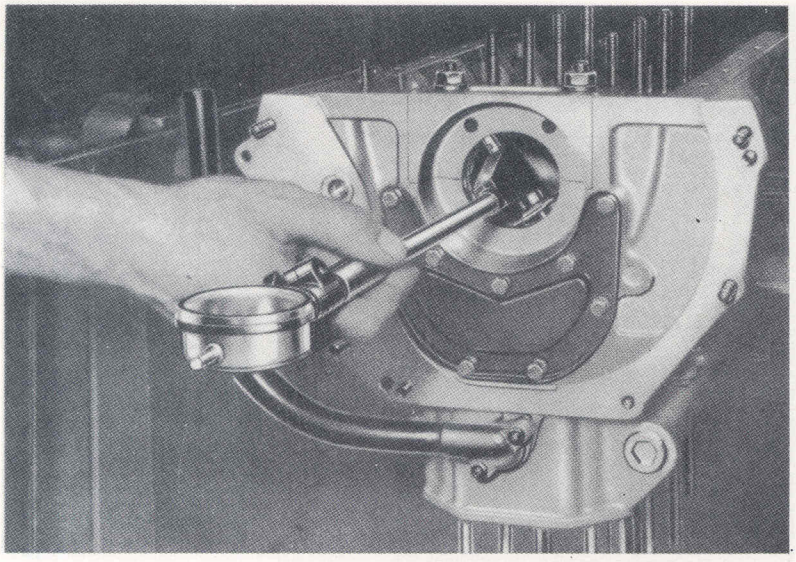
specified clearance = **.055 - .074 mm** (.0022 - .0029 in.) (Borgo) / **.030 - .049 mm** (.0012 - .0019 in.) (Mahle)

wear limit = .150 mm (.0059 in.)

- If clearance does not fall within the above limits replace the unit (barrel, piston, rings and pin).
  Replace the gasket between barrel and cylinder block at every reassembly.

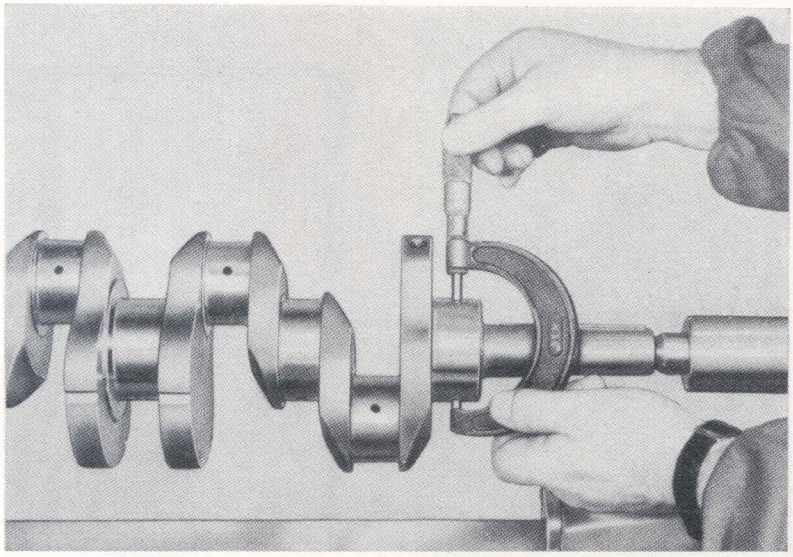


INSPECTION AND CHECKING



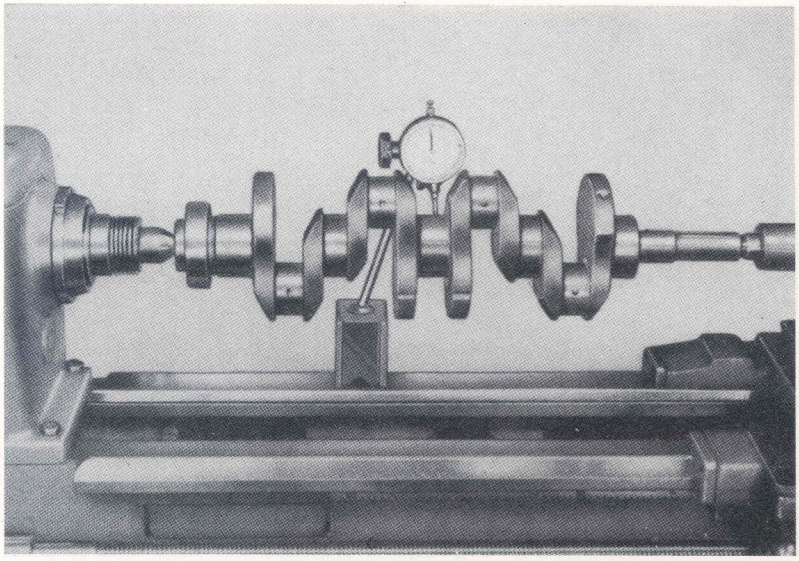
Crankshaft

- Examine the crankshaft with a magnaflux detector; if it shows any sign of crackings discard it.
- Inspect the surfaces of crankshaft journals and remove possible minor scratches with an oil stone.
- If these surfaces are deeply scored, scratched or show sign of binding, regrind the journals without exceeding the minimum dimensions given in the table on page 71.
- Check the main bearing-to-journal clearance as follows:
  - measure the inside diameter of main bearing seat with a dial gauge;



  - measure the outside diameter of the respective journal with a micrometer gauge on two positions at right angle;
  - to measure the actual thickness of the antifriction bearing without errors or damage, insert a 10 mm (3/8 in.) dia. ball between bearing and gauge;
  - the clearance is the difference between diameters of main bearing seat and its crankshaft journal plus twice the bearing thickness.

specified clearance: **.014 to .058 mm** (.0006 to .0022 in.)
wear limit: **.150 mm** (.0059 in.)



- Check that elongation and taper of journals fall within the specified limits given in the table on page 71. To this end take at least two readings in positions at right angles at both ends of each journal.
- Place the crankshaft between centers of a test rig.
  Check the alignment of main journals with a dial gauge:

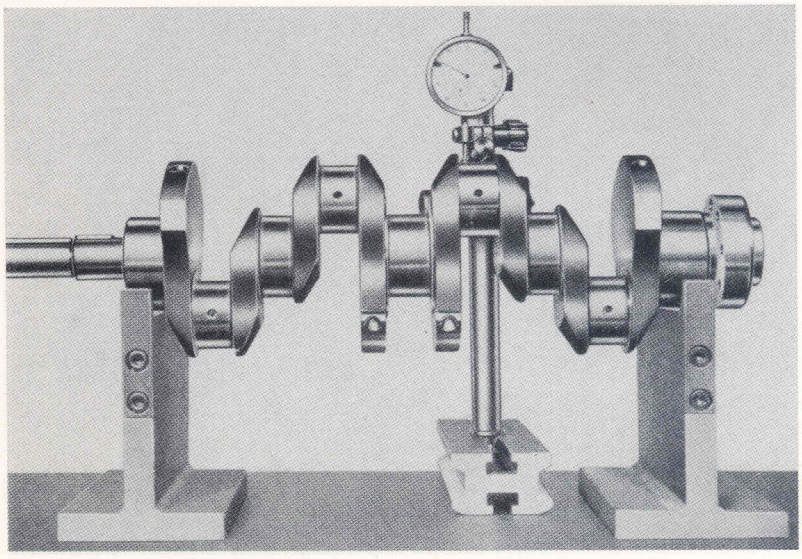
  maximum permissible misalignment: .01 mm (.0004 in.).

INSPECTION AND CHECKING

- Check:
  - the alignment of the pairs of crankpins:

    maximum permissible misalignment: .07 mm (.0027 in.)

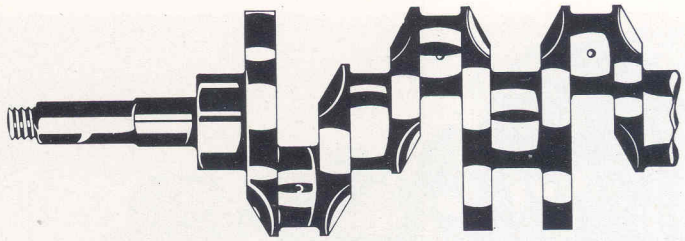
    as measured on full length of each crankpin;

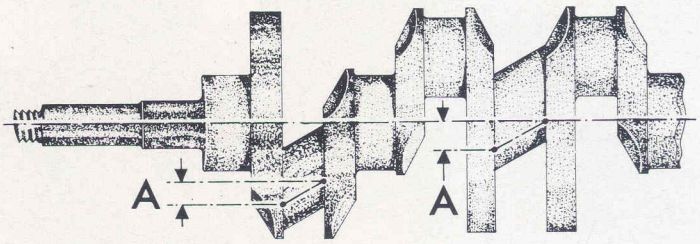


  - the parallelism between crankpins and main journals:

    maximum permissible error: A = .015 mm (.00059 in.)

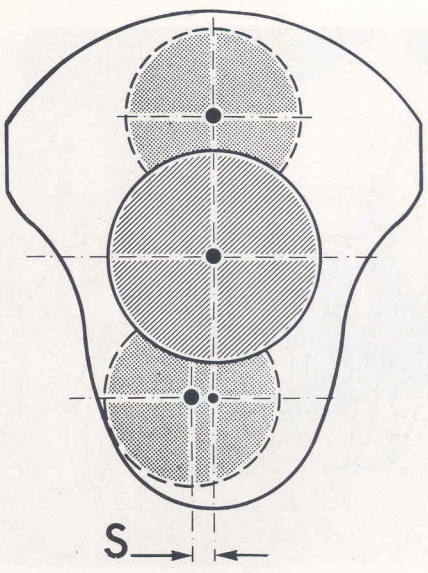
    as measured on full length of each crankpin and main journal with respect to crankshaft centerline;



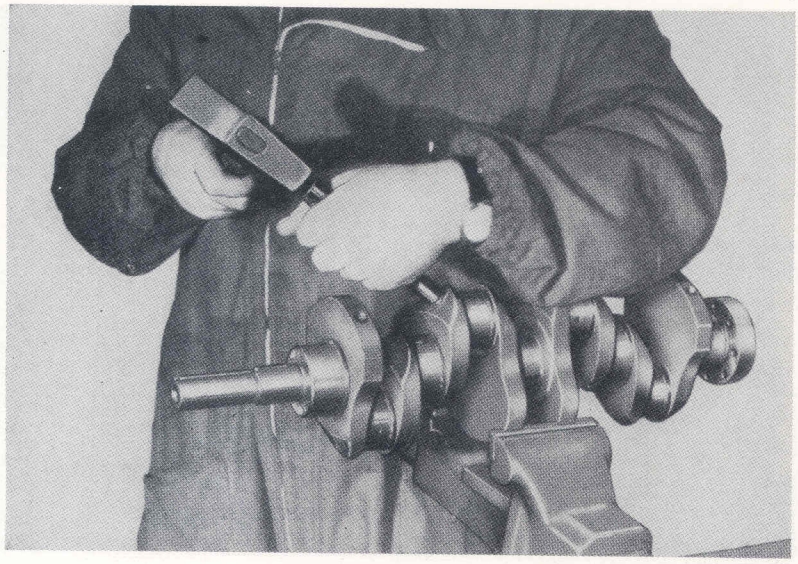


  - that centerlines of crankpins lie in the same plane as the main journal centerline:

    maximum deviation: S = .07 mm (.0027 in.).



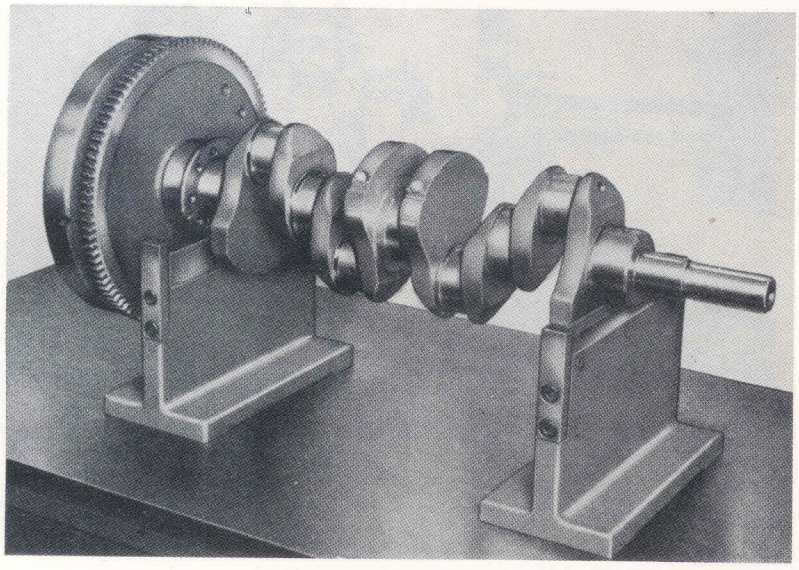
INSPECTION AND CHECKING



- Drill out the aluminium pipe plugs which seal the oil passages.

  Clean the passages with a wire swab, then inject hot fuel oil and dry off with compressed air; at the same time wash the crankshaft thoroughly.

  Fit new pipe plugs and stake in place with tool **A.2.0103**.



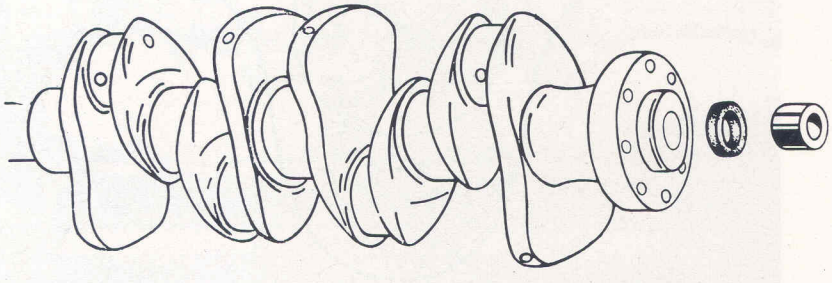
- If the crankshaft has been reground or the ring gear replaced, check the static balance as follows:

  · set the crankshaft and flywheel assembly up on parallel stands on a perfectly level surface (check with a spirit level); if the shaft is balanced it should remain steady in any position; if it tends to rotate, apply mastic to the side opposite that showing a tendency to move downwards; the weight of mastic so applied indicates the balance weight required;

  · remove an equal weight of metal from the crank counterweights by grinding, or reduce weight by drilling holes in the rim of flywheel at a point diametrically opposite the position of the weight added:

  maximum permissible out-of-balance: 30 g. cm (.4 in. oz.).

  If the necessary equipment is available, the crankshaft should be balanced dynamically.
  After balancing remove the flywheel from the crankshaft.



- Check that the felt washer and the bushing which centres the direct drive shaft onto the crankshaft are in good condition.
- To fit new felt washer and bushing proceed as follows:

  · soak the felt in engine oil at 45° C (113° F) for about an hour; let cool down, then install the washer in its seat;

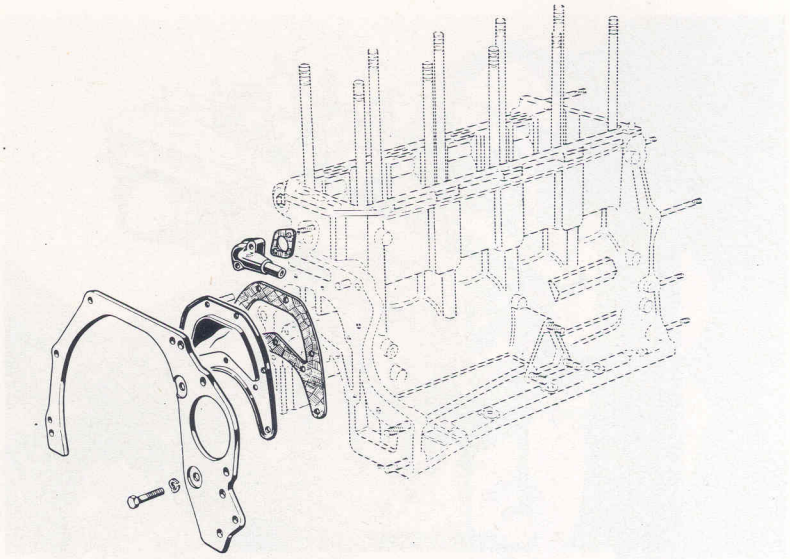
  · soak the bushing in engine oil at 120° C (248° F) for about 4 hours; let cool down, then install the bushing into the crankshaft with the aid of a punch

  16.035 ± .002 mm (.6313 ± .0001 in.) in diameter.

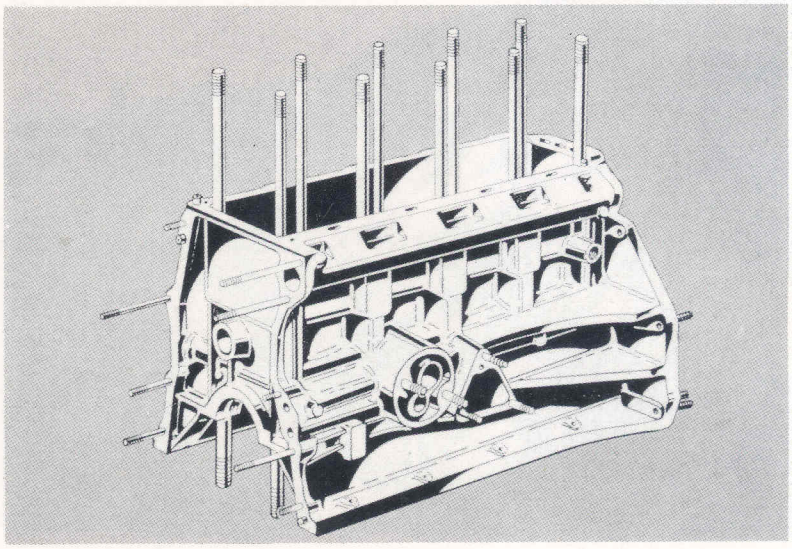
INSPECTION AND CHECKING

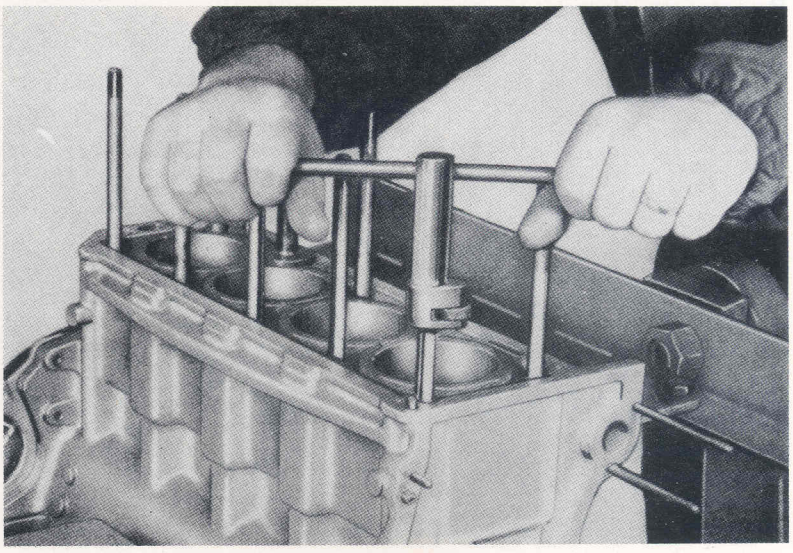
Cylinder block

- Complete the engine disassembly by removing:
  - the oil filter;
  - the rear cover;
  - the oil vent elbow and the pipe;
  - the plate for mounting of starting motor.



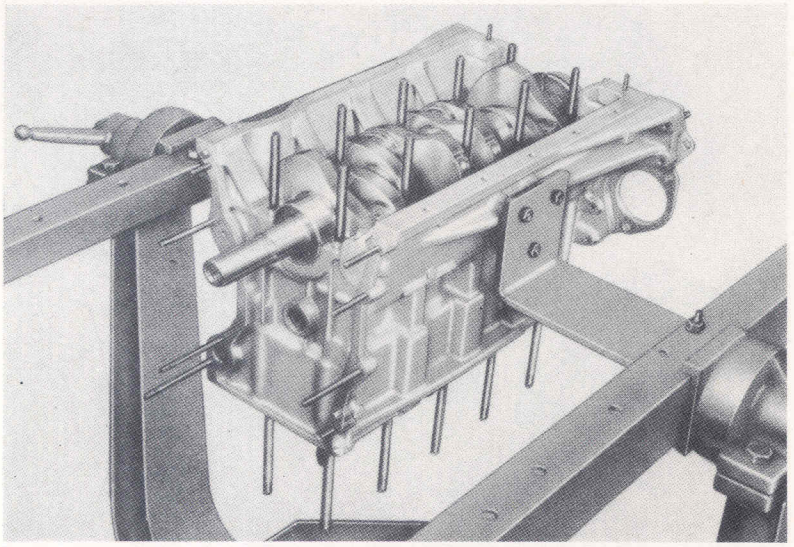
- Wash the cylinder block thoroughly with a solution of sodium bicarbonate in hot water. Rinse with running water, followed by hot fuel oil. Dry with compressed air and check that all water and oilways are completely clear.
- Test water and oil ducts under pressure, as follows:
  - seal off system with suitable flanges, one of which must have a union through which water can be forced under pressure;
  - raise water pressure to about **5 kg/cm²** (71 psi) and check that this pressure is maintained after the inlet cock is closed. If not, find the leak and decide whether the cylinder block can be repaired or must be replaced.





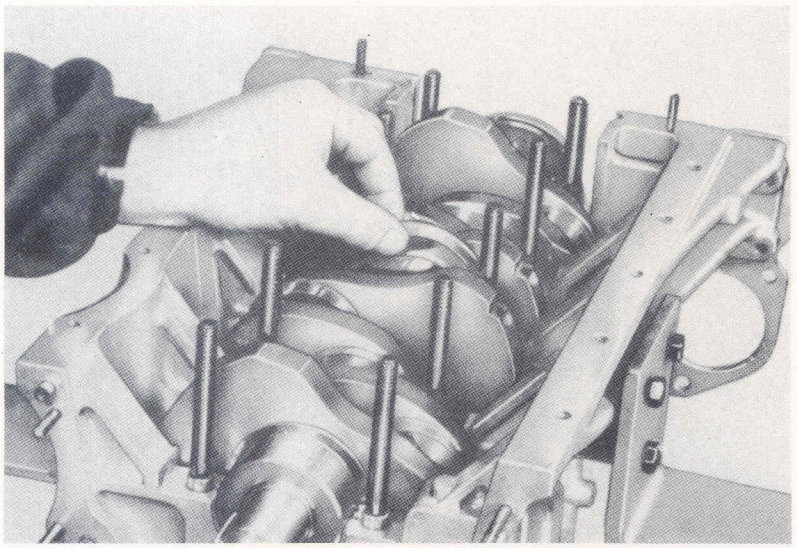
- Check that the cylinder head studs show no sign of warping, straining and that the threads are in good conditions.
  If the studs are damaged, withdraw them with a suitable puller and fit new ones.

REASSEMBLY



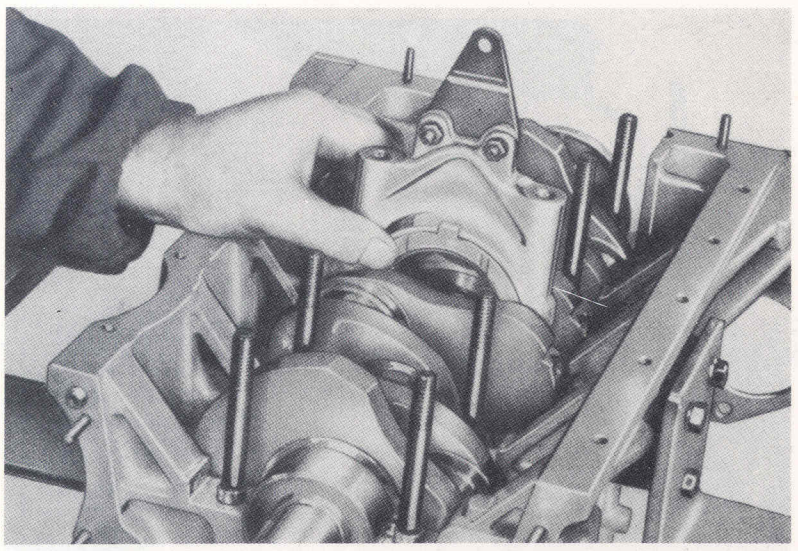
Reinstall the crankshaft

- Fit the main bearing half-shells into their housings in the crankcase and apply a film of engine oil.
- Fit the crankshaft into the crankcase along with the rear oil sealing half-rings.



- Fit the upper thrust washers into their seatings by slipping them round the center main journal.

  The oil grooves on the thrust washers should be turned towards the working surfaces on the crankshaft.



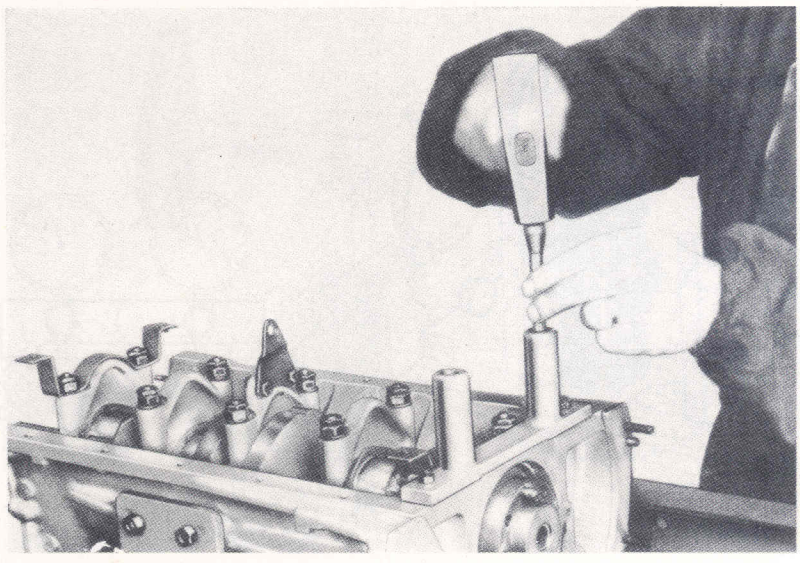
- Fit the half-shells into the main bearing caps.

  Fit the center cap, complete with half-shells and thrust washers, on respective studs.

  Fit the remaining caps in accordance with the numbers marked on them.

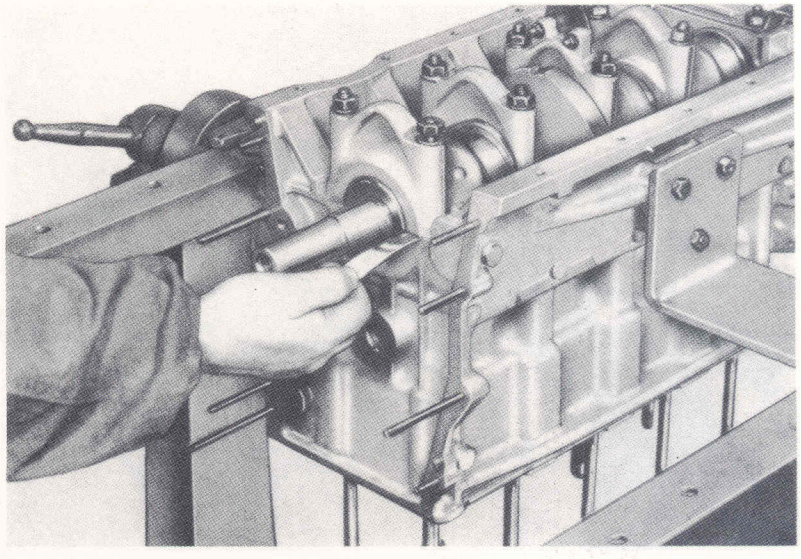
REASSEMBLY

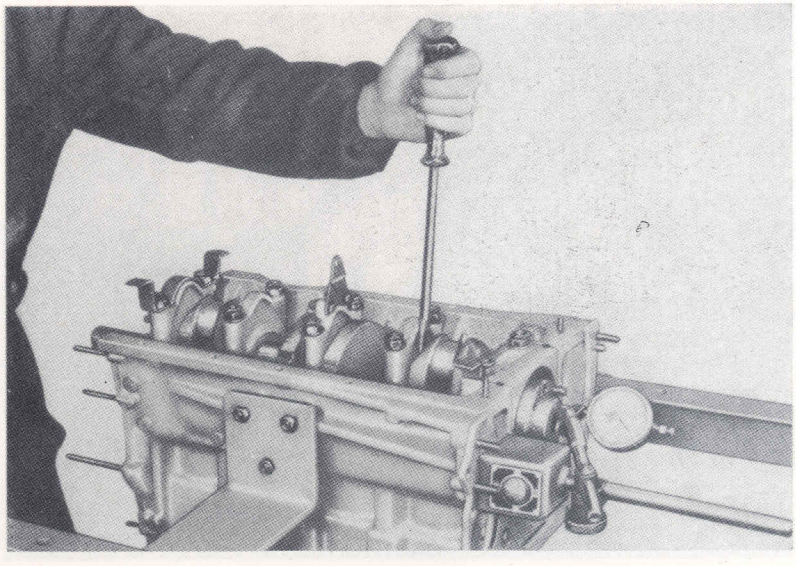
- Insert the rubber plugs, sealing the oil passages, between rear main bearing cap and crankcase with the aid of the driver **A.3.0113** (Ref. Tool Bulletin no. 47/2).



- Lubetorque the main bearing cap nuts to **4.7 - 5 kgm** (34 - 36.2 ft. lbs) starting from the central bearing.
- Check pinch of main bearings caps as follows:
  - slacken one nut and check that pinch is **.08 - .10 mm** (.0030 - .0039 in.) with a feeler gauge.

    If pinch is below the correct figure or nil, rub the cap faces on very fine emery cloth laid on a surface plate until the prescribed clearance is obtained.





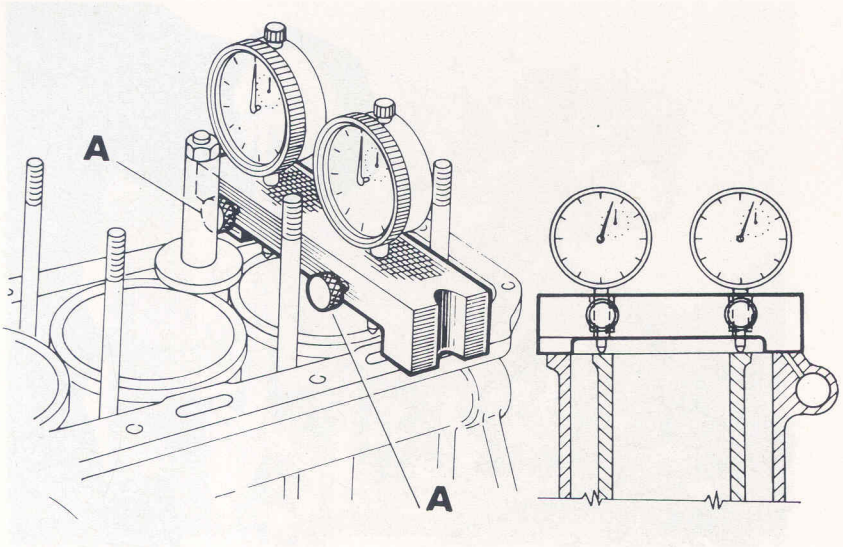
- Check that crankshaft end play is as prescribed:

  .07 - .26 mm (.003 - .010 in.)

  wear limit: .50 mm (.019 in.).

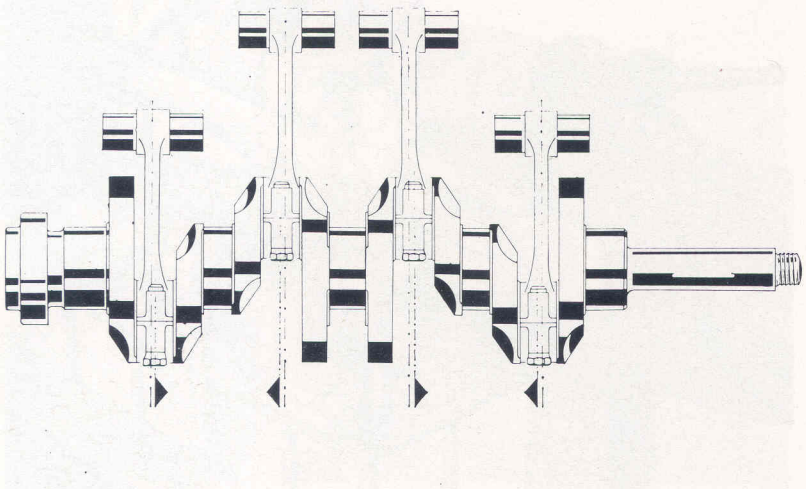
  If end play exceeds the prescribed wear limit, fit thicker thrust washers (see table on page 71).

REASSEMBLY



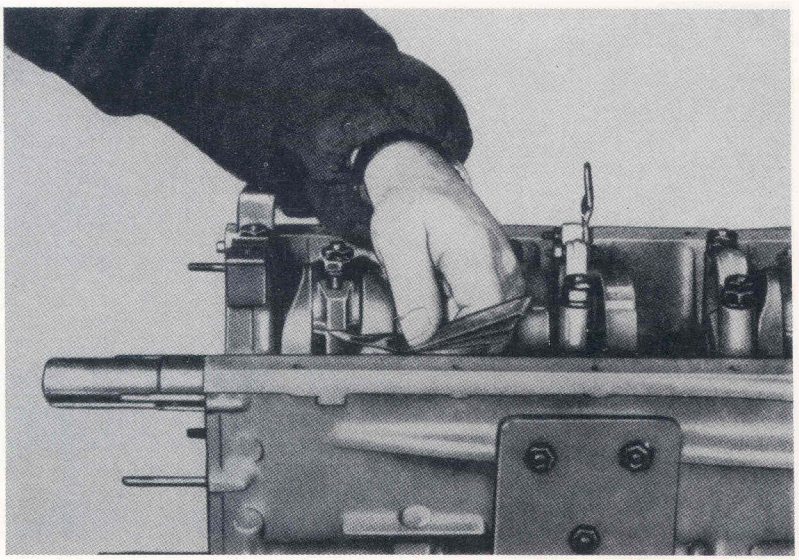
Reassemble the barrels, pistons and con. rods

- Insert the barrels with their seals into the cylinder block according to the reference numbers. Secure the dial gauges to the tool **C.6.0148** with setscrews «A» (Ref. Tool Bulletin no. 144) and check the projection of barrels from cylinder block:
  specified projection: F = .00 - .06 mm (.000 - .002 in.).
- Fit the parts of barrel retaining tool **A.2.0117** (Ref. Tool Bulletin no. 77/1) on cylinder head.
- Fit pistons, wrist pins and half-shells on con. rods making sure that con. rods and pistons are coupled according to reference numbers stamped on them.



- Apply engine oil film to pistons and rings and insert con. rod and piston assemblies into the barrels with the aid of the suitable sleeve and in accordance with the reference numbers.
  The con. rods, being asymmetric, must be positioned as shown in the figure.

Note - Make sure the gaps of piston rings are staggered.



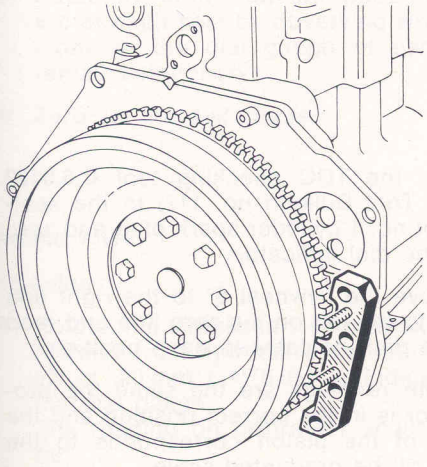
- Fit connecting rod caps complete with half bearings, in accordance with the numbers marked on them; lubetorque bolts with a torque wrench to:
  5 - 5.3 kgm (36.2 - 38.3 ft. lbs.).
- Check pinch of connecting rod caps as follows:
  - slacken one nut and check that pinch is **.08 - .10 mm** (.0030 - .0039 in.) with a feeler gauge.

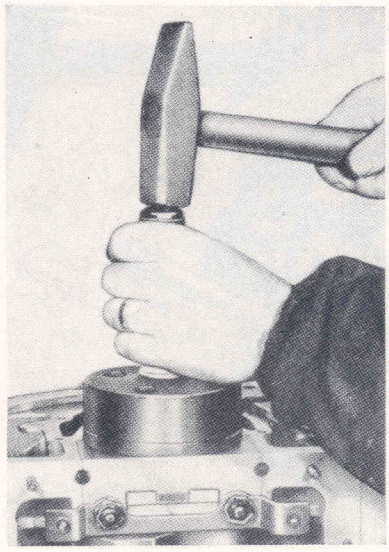
    If pinch is below the correct figure or nil, rub the cap faces on very fine emery cloth laid on a surface plate until the prescribed clearance is obtained.
- Fit the stop nuts.

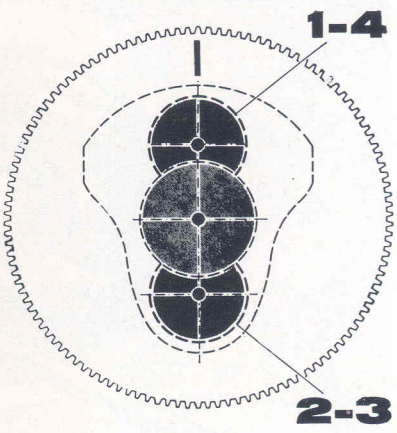
REASSEMBLY

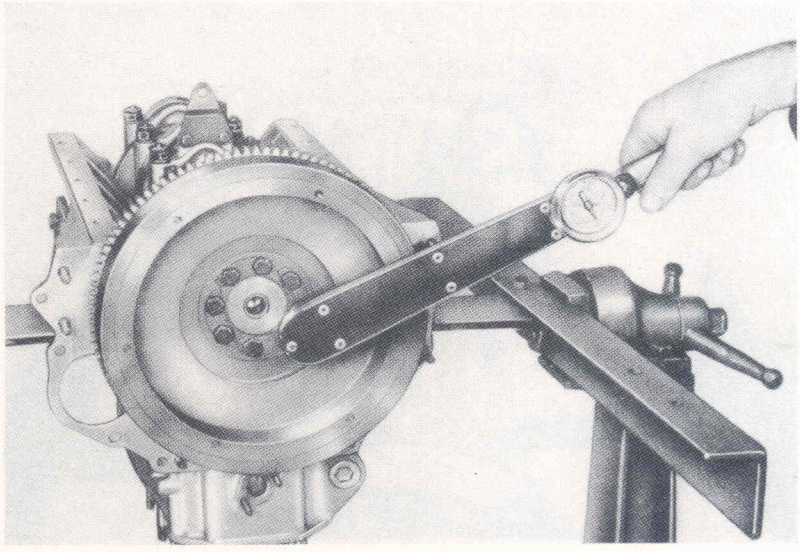
Reassemble the engine

- Insert the rear packing on the crankshaft with the tool **A.3.0178**.
- Rotate the crankshaft to bring no. 1 piston at TDC; then install the flywheel on crankshaft and align the mark cut in the flywheel with the centerline of crankpins 1 and 4 as shown in the figure.
- Fit new safety plates.
- Smear the bolts with oil and tighten to **4.2 - 4.5 kgm** (30.4 - 32.5 ft-lbs).
  To do this, hold the flywheel with tool no. **A.2.0145**. (Ref. Tool Bulletin no. 124).
  Carefully bend the tabs of safety plates.









Complete the engine reassembly as follows:

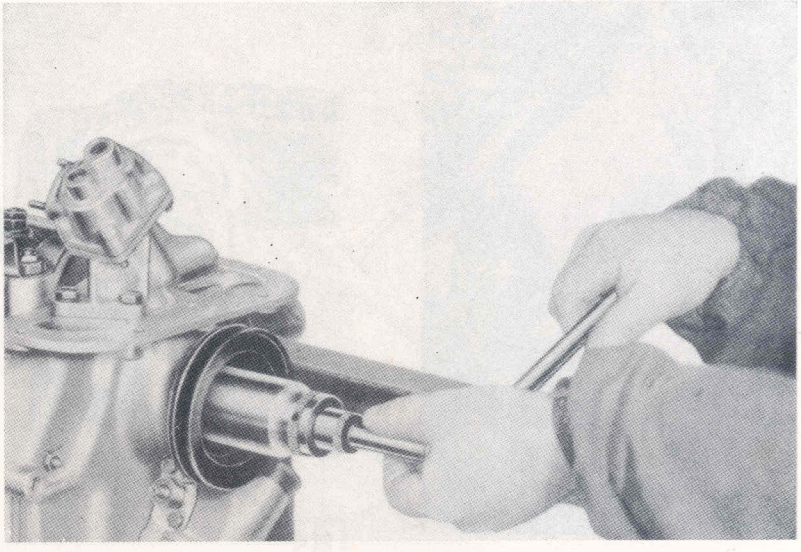
- Refit:
  - the chain and the drive and idle sprockets making sure the timing reference marks are aligned (see page 31);
  - the timing chain;
  - the oil pump drive pinion;
  - the ignition distributor, the oil pump and the front cover as a unit; to do this, follow the instructions given on page 26 and 31.

Replace the front packing with a new one, if necessary; to install this packing use the special tool **A.3.0146**.

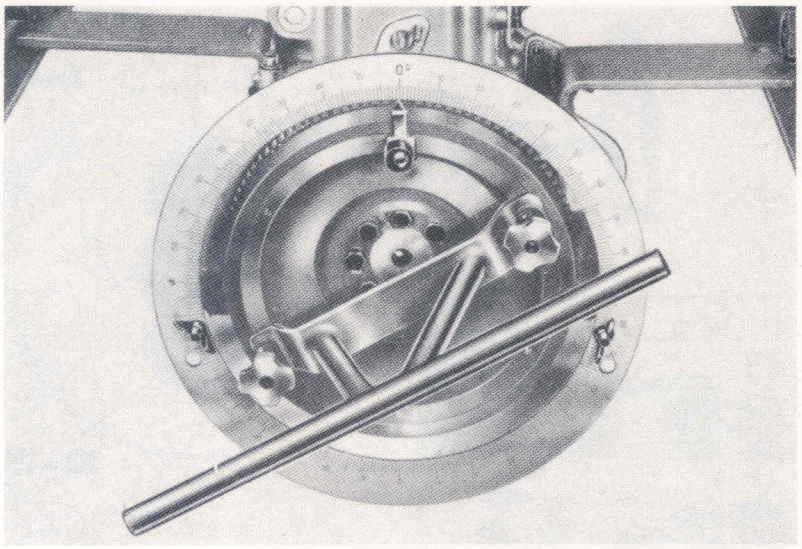
Fit the drive pulley on crankshaft with tool **A.5.0126**.

- Renew the gasket and place the cylinder head on cylinder block; tighten the nuts to the torque specified on page 13.
- Connect the timing chain and stretch it with the tensioner while cranking the engine slowly.
- Install the water pump and the fan on front cover.

On completion of reassembly, carry out the valve timing as described on page 16.

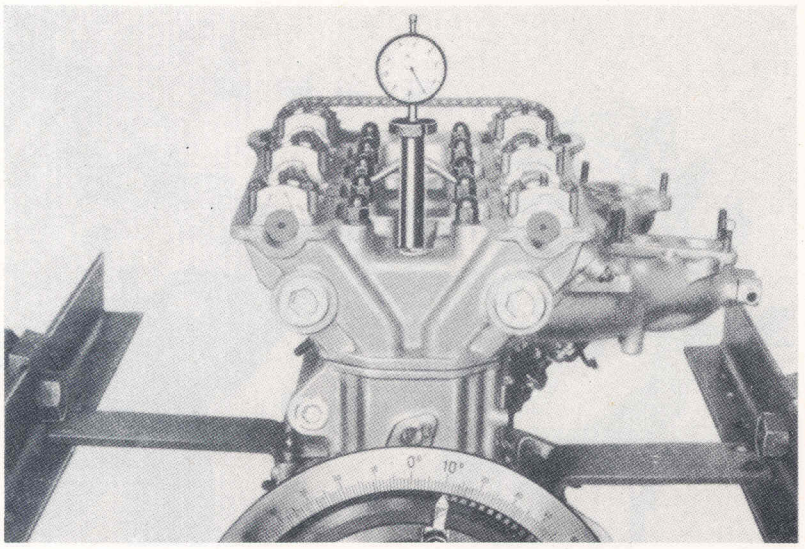


CHECKING THE VALVE TIMING



Check the position of TDC

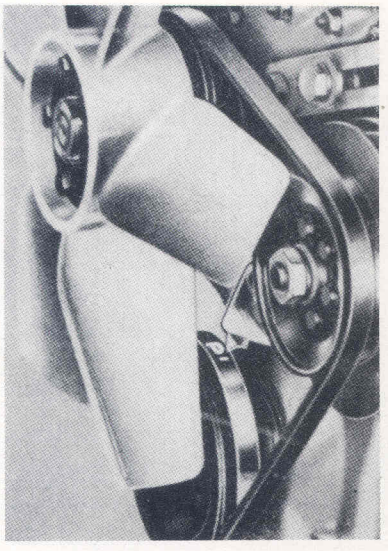
- Apply:
  - the protractor to crankcase (scale **C.6.0111**; spacer **A.2.0180**);
  - the pointer to flywheel **A.2.0179** (Ref. Tool Bulletin no. 140);
  - the brace **A.2.0122** to flywheel, for rotating the crankshaft.
- Rotate the crankshaft until the pointer and the zero on the scale are in line.

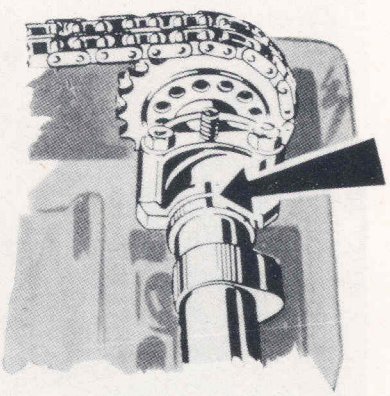


- Place the TDC checking tool **C.6.0122** (Ref. Tool Bulletin no. 117) in the seating of no. 1 cylinder spark plug and zero set the dial indicator:
  - move the flywheel 5° to the right and 5° to the left on the zero line and read the dial indicator in each position.

  If both readings are the same the protractor is in the correct position and the TDC of the piston corresponds to the zero of the graduated scale.

  If this is not the case, adjust the protractor on the crankcase until the two readings coincide and then lock the scale in position.





Check the reference marks

- Set the pointer on the flywheel so that it coincides with the zero on the scale.
- Check that the marks cut on the camshaft flanges and on the fan drive pulley **P** are in line.

CHECKING THE VALVE TIMING

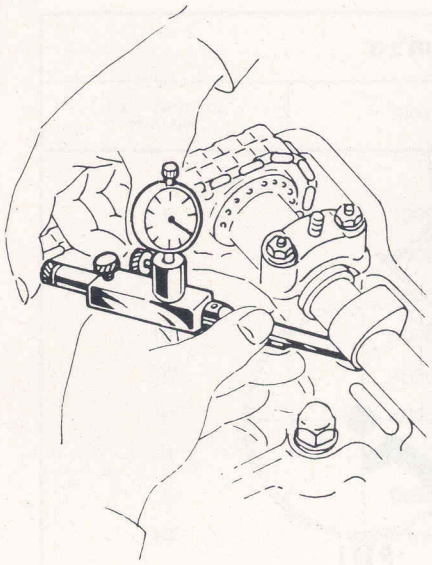
Check the valve opening and closing angles

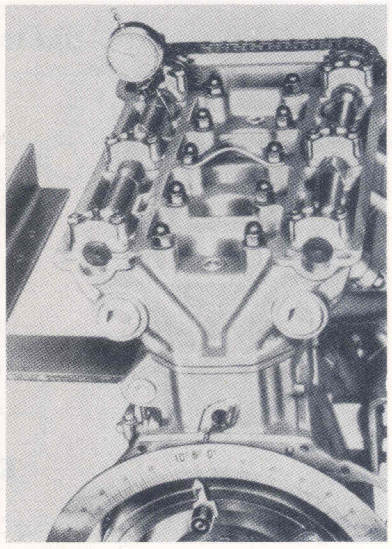
- Using the feeler gauge **C.6.0123** (Ref. Tool Bulletin no. 122) check that, with the engine cold, clearance between the unlobed profile of each cam and the top of valve cup is:

  intake valves: **.475 - .500 mm** (.0187 - .0197 in.)

  exhaust valves: **.525 - .550 mm** (.0206 - .0216 in.).

- Place the tool **A.2.0120** (Ref. Tool Bulletin no. 78) on no. 1 cylinder and position the dial gauges so that sensing needles rest on the valve cups.
- Rotate the crankshaft and trace the dwell arc of each cam by observing where the index of the dial gauge of each cam remains stationary.
- Zero set the dial gauge.



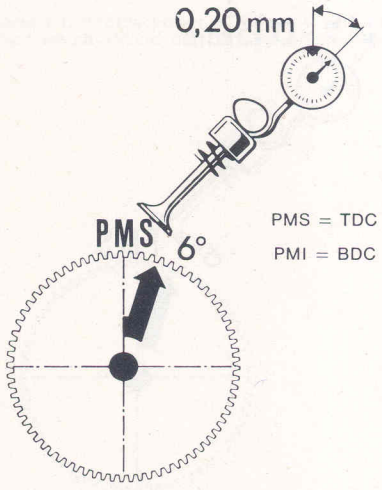


Intake valve

Opening

- Rotate the crankshaft counterclockwise (viewed from flywheel end) until a valve lift of **.20 mm** (.0078 in.) is indicated on the dial gauge.
  The reading on protractor scale should be:

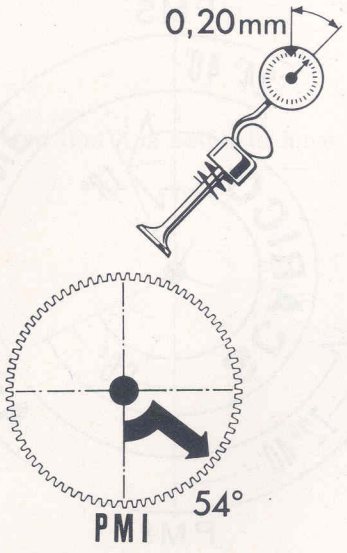
  6° ± 1° 30'.



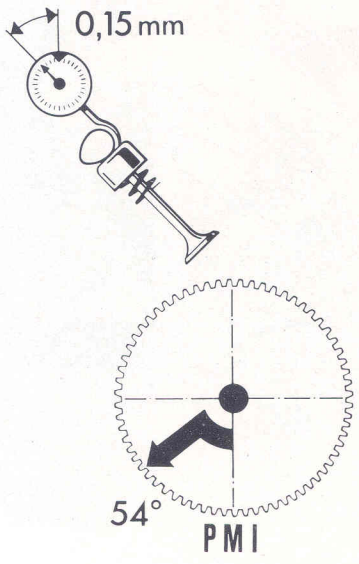
Closing

- Continue to turn the crankshaft counterclockwise (flywheel end) until the intake valve is completely closed and the dial gauge index remains stationary.
  Zero set the dial.
  Then rotate the crankshaft clockwise for about half a turn; again rotate it counterclockwise until a valve lift of **.20 mm** (.0078 in.) is indicated.
  The reading on protractor scale should be:

  54° ± 1° 30'.



CHECKING THE VALVE TIMING

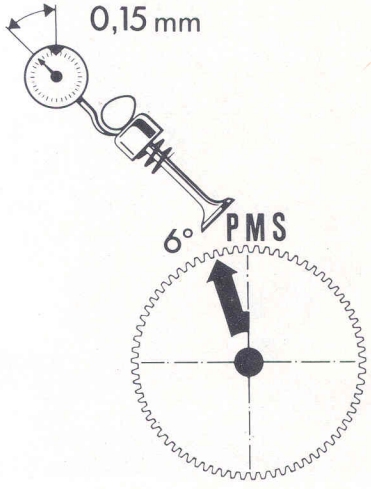


Exhaust valve

Opening

- Zero set the dial gauge as previously described.
- Rotate the crankshaft counterclockwise (flywheel end) until a valve lift of **.15 mm** (.006 in.) is indicated on the dial gauge. The reading on protractor scale should be:

54° ± 1° 30'.



PMS = TDC
PMI = BDC
Scarico = exhaust
Aspirazione = intake

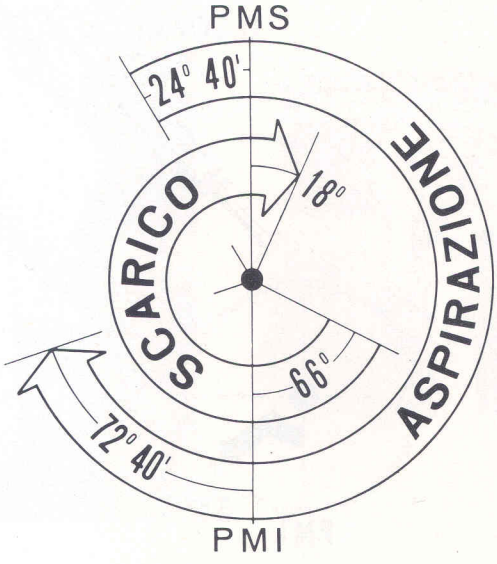
Closing

- Continue to turn the crankshaft counterclockwise (flywheel end) until the exhaust valve is completely closed and the dial gauge index remains stationary.

  Zero set the dial.

  Then rotate the crankshaft clockwise for about half a turn; again rotate it counterclockwise until a valve lift of **.15 mm** (.006 in.) is indicated.
  The reading on protractor scale should be:

6° ± 1° 30'.



Actual diagram of valve timing

- If the results of timing check are as prescribed, the valve timing actual diagram with the engine cold is a shown.

Direction of rotation as viewed from engine front end.

ENGINE RUNNING IN

Running in and testing on bench

- After overhaul, if piston & barrel assemblies, rings and/or main & con. rod bearings has been renewed, the engine must be carefully run in.
- Set the engine up on a suitable test bench provided with a hydraulic brake and connect the test equipments, the cooling and electric circuits.
- Follow the running in schedule shown in the table and record the power output at each speed.

Note - To calculate the power output use the following formula:

Power = weight × rpm × bench constant.

BERLINA			
Test duration minutes	RPM	Power output	
		Cv *	HP
5'	1000	—	—
5'	2000	4.4	4.3
5'	3000	14.7	14.5
10'	4000	34.8	34.3
15'	4500	49.5	48.8
10'	5000	68.0	67.1
5'	5500	90.75	89.5
5'	6000	* *	* *
10'	adjustments	—	—

* These figures do not represent maximum power at full throttle.

* * At this engine speed full throttle power is recorded and a check is made of fuel consumption which should be: **220 ÷ 240 g/Cvh** (.49-.53 lb-HP-h).

Testing and checking

- During engine running in check the advance for correct values:

  Static advance: **3° ± 2°**.

  Maximum advance: **43° ± 3° at 5000 rpm**.

  Adjust as required by acting on distributor body, bearing in mind that it is better to have correct timing at high speeds.

- Check that oil pressure is maintained as follows:

  maximum pressure: **4.5 - 5 kg/cm²** (65 - 70 psi);

  minimum pressure at full speed: **3.5 kg/cm²** (50 psi);

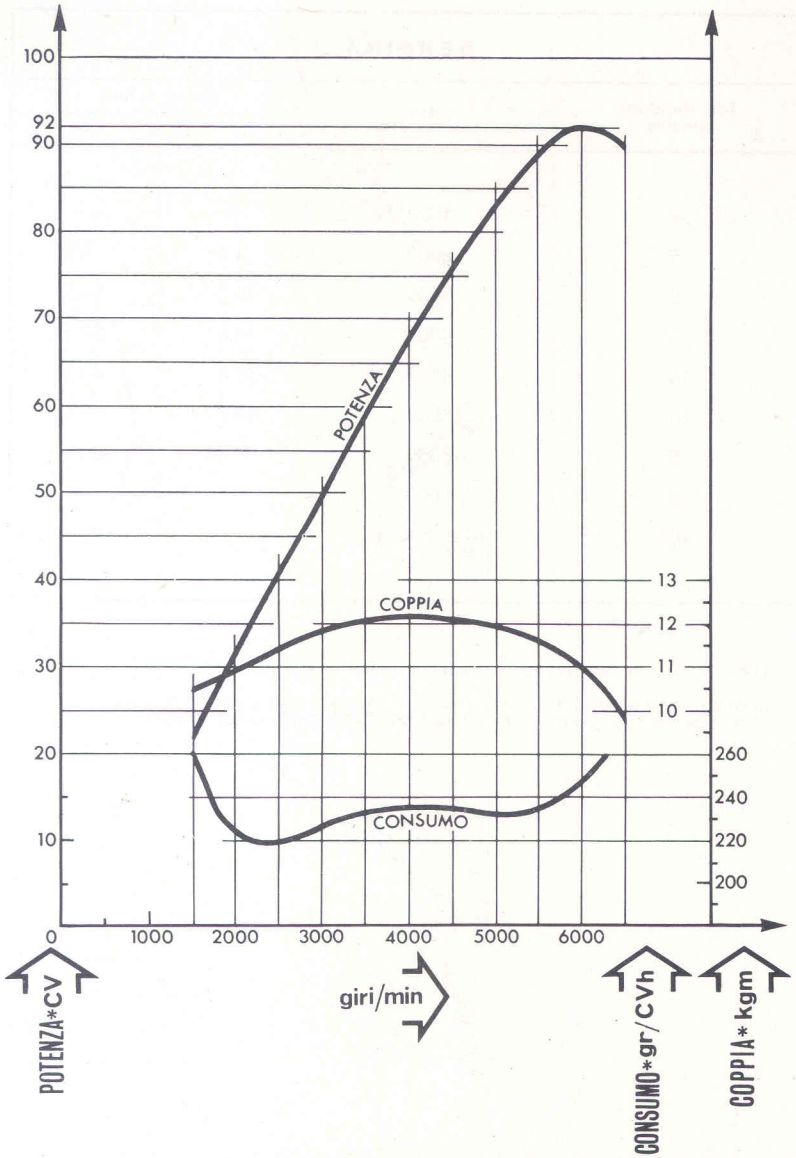
  minimum pressure at idling speed: **.5 - 1 kg/cm²** (7 - 14 psi).

- During the tests check the following temperatures:

  water: 85° - 90° C (185° - 194° F)

  oil: 90° - 100° C (194° - 212° F).

ENGINE RUNNING IN



Engine performance graph

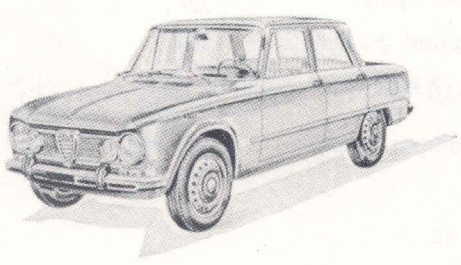
These graphs depict the average performance attained with a run in engine equipped with all accessories and the same induction and exhaust system as that installed on the car.

Potenza = Power output
Coppia = Torque
Consumo = Fuel consumption
giri/min = RPM

Distance	Maximum speeds					
	1st gear	2nd gear	3rd gear	4th gear	5th gear	
1st **1000 km** (600 miles)	**26** (16)	**44** (27)	**64** (40)	**87** (54)	**110** (68)	**km/h** (mph)
1000 to **3000 km** (600 to 1900 miles)	**32** (20)	**54** (33)	**79** (50)	**107** (66)	**135** (84)	**km/h** (mph)

Road running in

After engine reconditioning, in order to allow the main units to bed down gradually a running in period must be observed during which the maximum performance must never be demanded of the car.



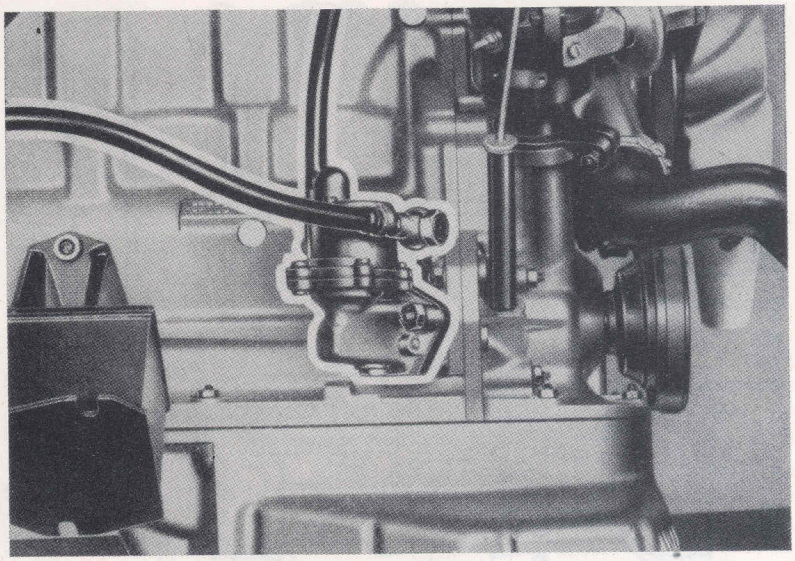
FUEL PUMP

Fuel pump

Removal from engine

Disconnect the inlet and delivery hose.

Loosen the screws securing pump to crankcase and remove the pump; withdraw the push rod from its housing in the crankcase.



Disassembly

Loosen the two screws **1** and remove the top cover, the gasket **2** and the funnel **13**.

Withdraw from the top of pump body:

3 the filter gauze;

4 the seat of inlet valve spring;

- the springs **5** and **14** of inlet and outlet valves;
- valve assembly **6** and **15**.

Loosen the screws which join together pump body and bottom cover.

Remove from the bottom cover:

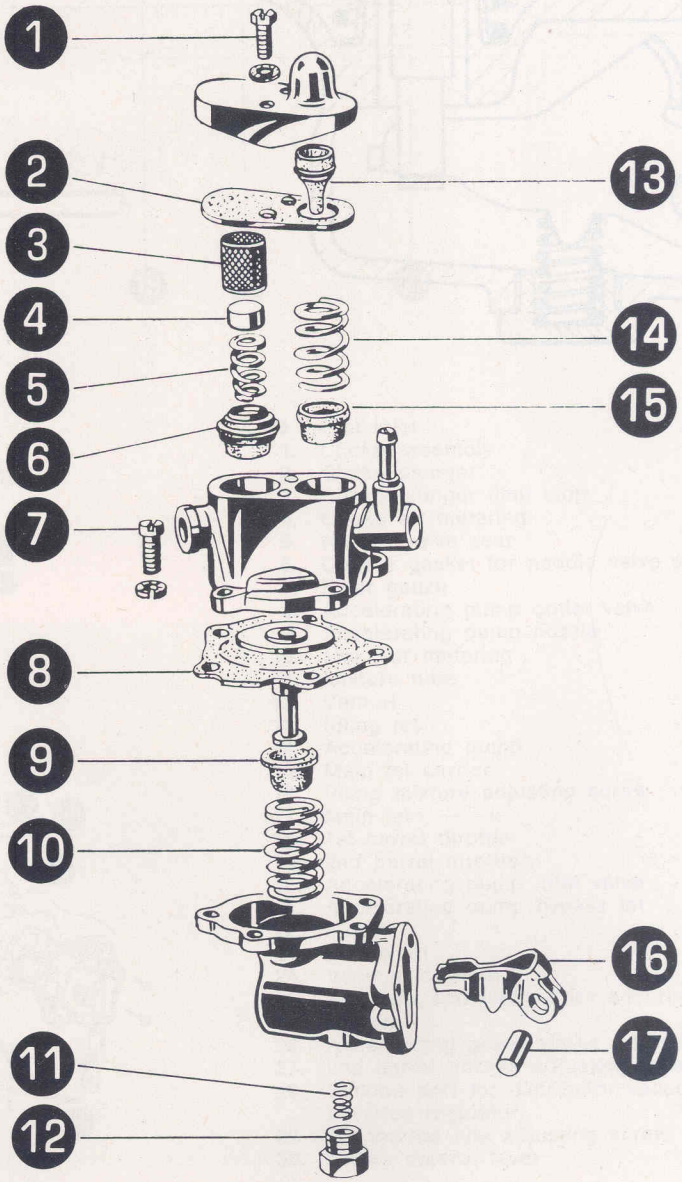
8 the diaphragm assembly;

9 the rubber cup;

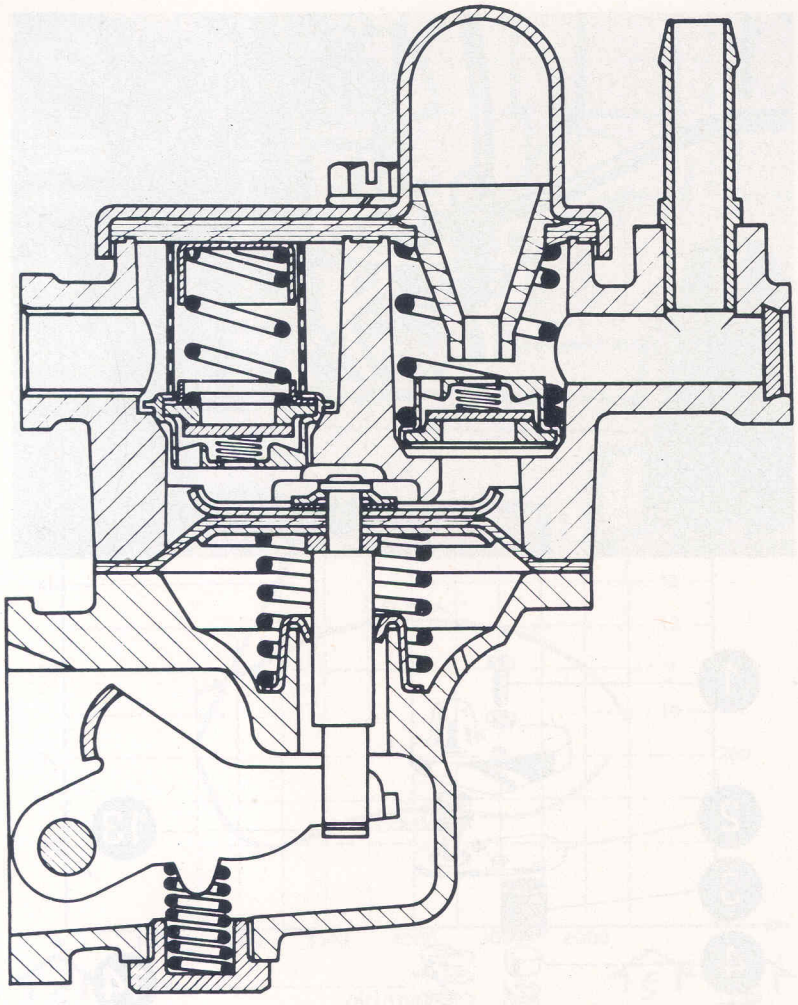
10 the diaphragm return spring.

Unscrew the spring seat **12** from bottom cover and remove the rocker arm return spring **11**.

Pull the pivot pin **17** out of bottom cover and remove the rocker arm **16**.



FUEL PUMP



Inspection, reassembly and testing

- Clean the inlet and outlet valves with petrol; if worn, renew them.
- Check the diaphragm for good condition and make sure it is firmly gripped between the retaining discs. Renew the diaphragm assembly if worn or damaged.
- Check the rocker arm pivot pin for any sign of wear or seizing; renew it, if necessary.
- Check the operation of the following springs:
  - rocker arm return;
  - valve closing;
  - diaphragm return.

  Replace them with new ones, if necessary.

  Renew the filter gauze.

  On installation renew the gasket between pump mounting flange and crankcase.

  Reassemble the pump by reversing the order of disassembly.
- Set the pump on a suitable test bench and carry out the following performance tests;

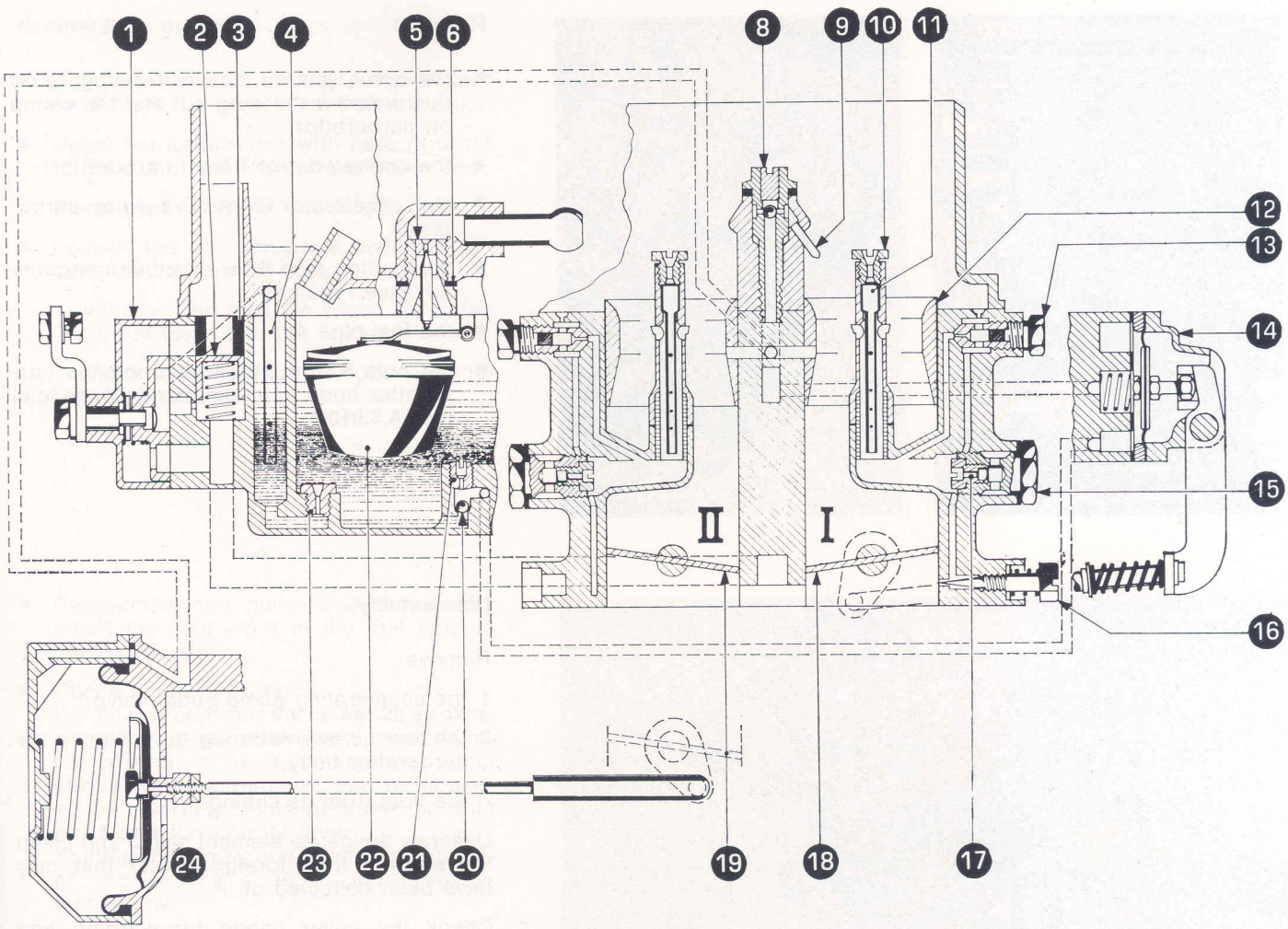
  rate of operation corresponding to an engine speed of **2500 - 3000 rpm**;

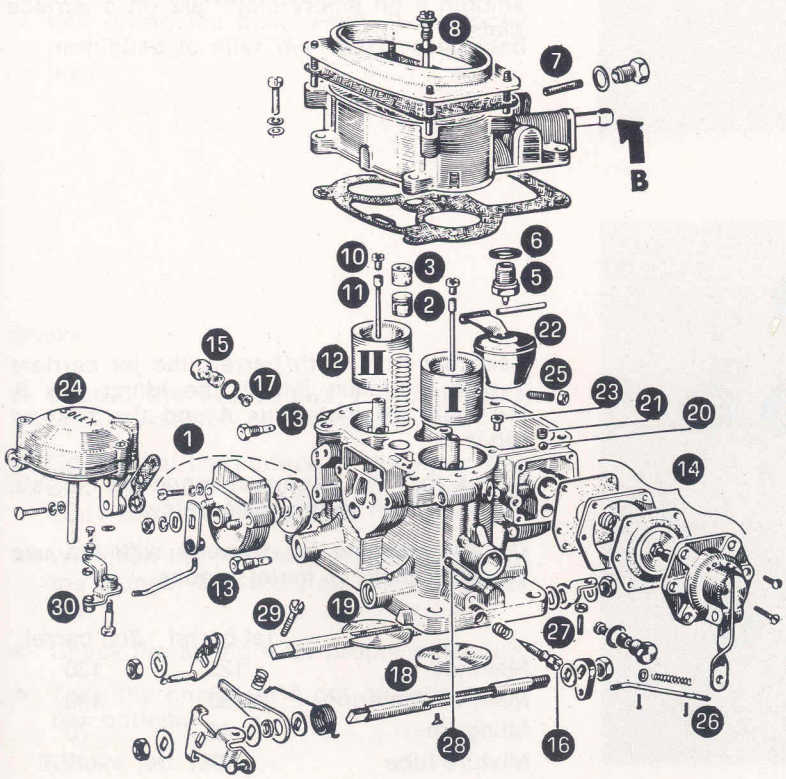
  delivery with no outlet pressure: **110 lt/h** (24.2 gph GB) (29 gph US);

  outlet pressure with no flow: **3-4 m H_2O** (4.2 - 5.6 psi);

  delivery with an outlet pressure of **2 m H_2O** (2.8 psi): **60 lt/h** (13.2 gph GB) (15.8 gph US)

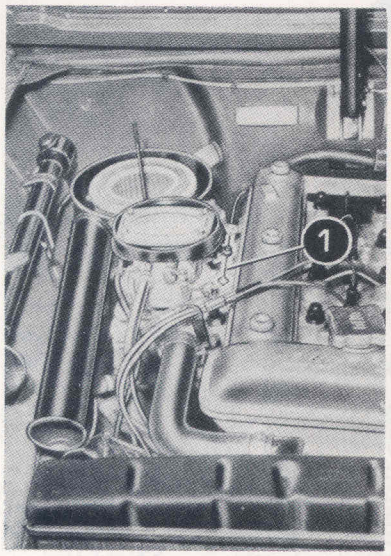
SOLEX C. 32 PAIA 7 CARBURETTORS

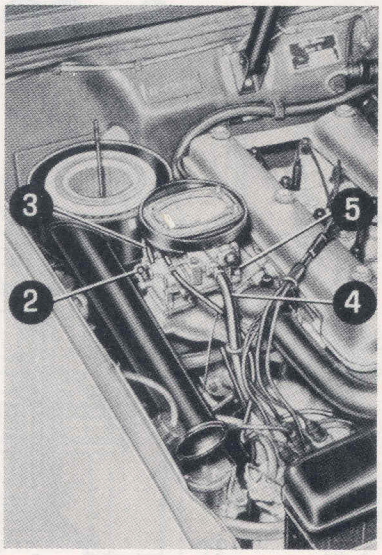




B. Fuel inlet
1. Choke assembly
2. Choke plunger
3. Choke plunger limit stop
4. Choke air metering
5. Needle valve seat
6. Copper gasket for needle valve seat
7. Filter gauze
8. Accelerating pump outlet valve
9. Accelerating pump nozzle
10. Main air metering
11. Mixture tube
12. Venturi
13. Idling jet
14. Accelerating pump
15. Main jet carrier
16. Idling mixture adjusting screw
17. Main jet
18. 1st barrel throttle
19. 2nd barrel throttle
20. Accelerating pump inlet valve
21. Accelerating pump bypass jet
22. Float
23. Choke jet
24. Vacuum capsule
25. Setscrew and locknut for securing venturi
26. Accelerating pump stroke adjuster
27. 2nd barrel throttle adjusting screw
28. Suction port for distributor vacuum advance regulator
29. 1st throttle idle adjusting screw
30. Choke control lever

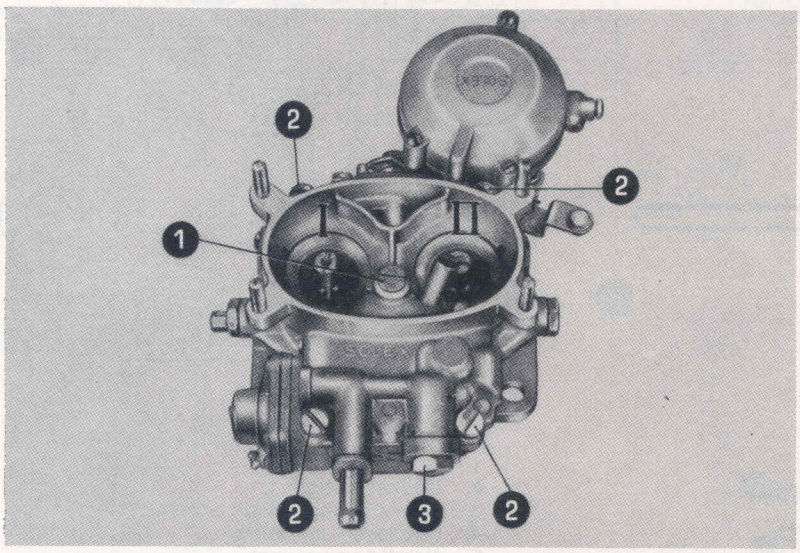
SOLEX C. 32 PAIA 7 CARBURETTORS





Remove:

- the cover from air cleaner housing; to do this unscrew the wing nut and the clamp on carburettor;
- the choke control **1** from carburettor;
- the accelerator control **2** from carburettor;
- the suction pipe **3** for distributor vacuum advance regulator;
- the fuel pipe **4**;
- the nuts **5** from studs securing the carburettor body to intake manifold (special tool **A.5.0108**).



Disassembly

Remove:

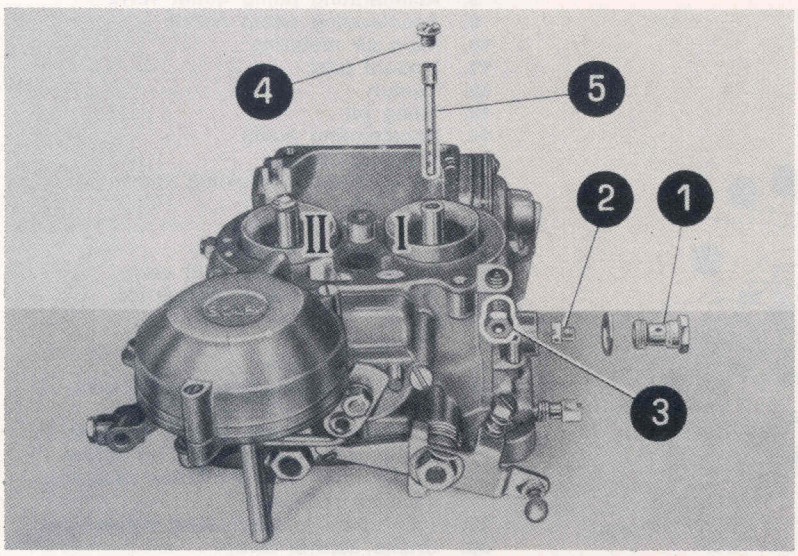
1 the accelerating pump outlet valve;

2 the four screws securing the cover to the carburettor body;

· the float from its chamber.

Unscrew the gauze element seat **3** and clean the element from foreign matter that may have been collected on it.

Check the cover flange for warping and the joining surface for smoothness; if not, smooth it on emery cloth laid on a surface plate.



Take out from both barrels the jet carriers **1** with the main jets **2**, the idling jets **3**, the main air meterings **4** and the mixture tubes **5**.

Check that the figures stamped on the jets are as shown in the table below.

Do not alter the jet diameter with the use of sharp tools or metal probes.

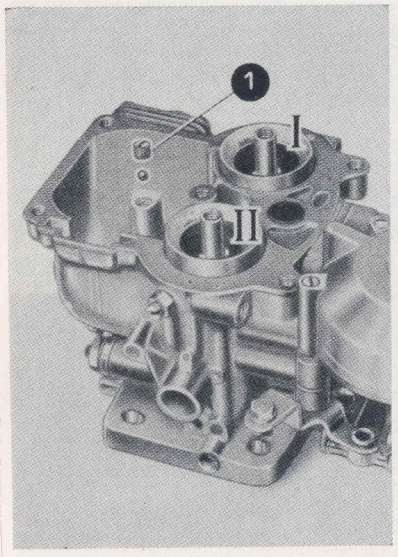
	1st barrel	2nd barrel
Main jet	125	130
Main air metering	190	190
Idling jet	45	70
Mixture tube	17 T	17 T

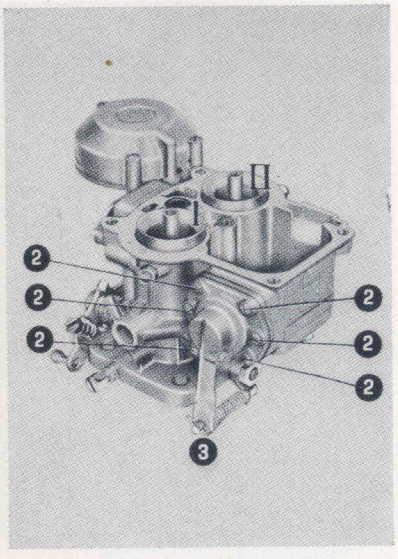
SOLEX C. 32 PAIA 7 CARBURETTORS

Accelerating pump

- Unscrew the accelerating pump bypass jet **1** from the bottom of float chamber.
- Upset the carburettor with care in order to take the ball out of the valve seat.

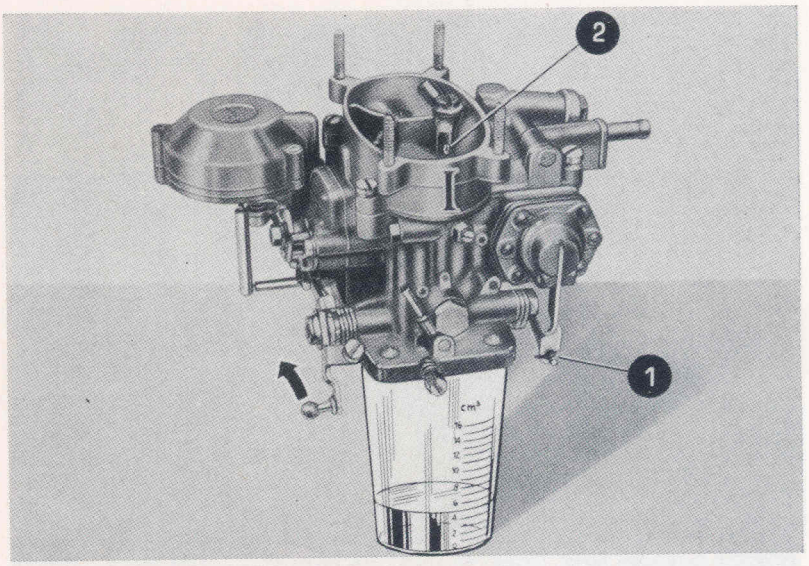
  Pump bypass jet: 40.
- Loosen the six screws **2** securing the pump to carburettor body:
  - withdraw the split pin which locks the control lever **3** to the linkage;
  - check the diaphragm for good operating conditions.





- Reassemble the pump and temporarily insert the split pin **1** in the first hole of stroke adjuster.
- Check pump delivery:
  the flow should be: **4-6 cc per 20 strokes.**
  If the flow is not within the specified limits correct it by adjusting the pump stroke. Small increments can be obtained by inserting shims between the split pin **1** and the control lever.
  Shifting the pin by one hole in the adjuster rod causes a 100% increment in pump flow.

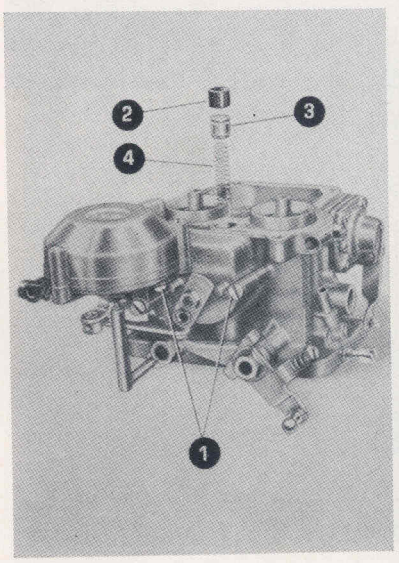
  Note - The pump nozzle **2**, a calibrated jet, is not turnable but fixed in the position giving the best result. **It is strictly prohibited to alter the nozzle calibrated hole.**

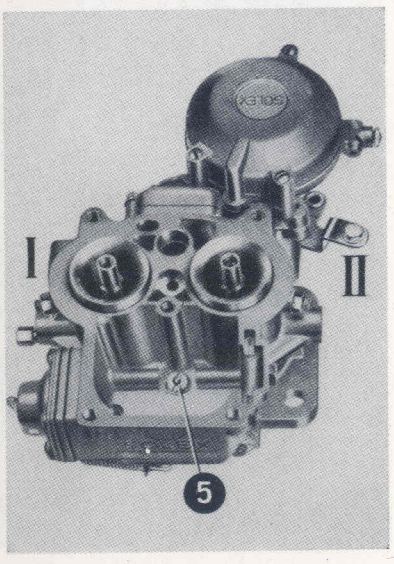


Choke

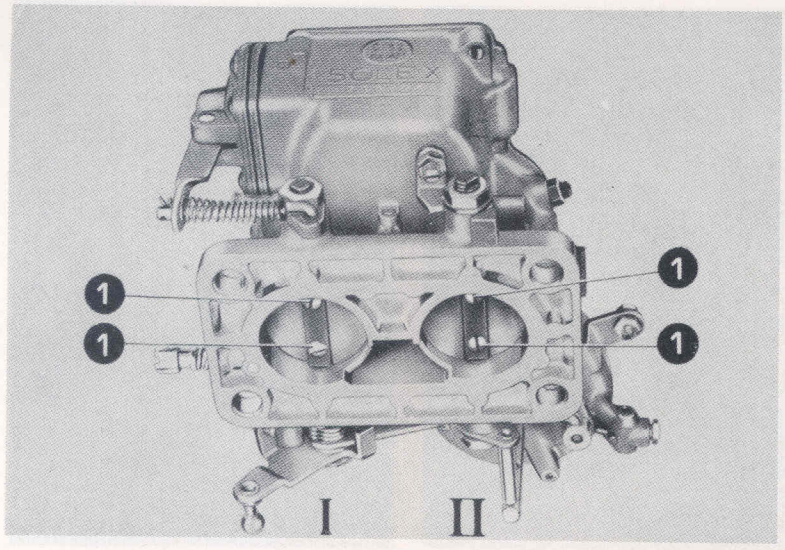
- Loosen the two screws **1** securing the choke assembly to carburettor body.
- Check that the surface of the valve disc and the mating surface on carburettor body are flat and smooth.
- Withdraw the limit stop **2** and check that the plunger **3** slides freely without binding.
- Check the spring **4** for proper operation.
- Take the choke jet **5** out of float chamber bottom.

  Choke jet: 120.





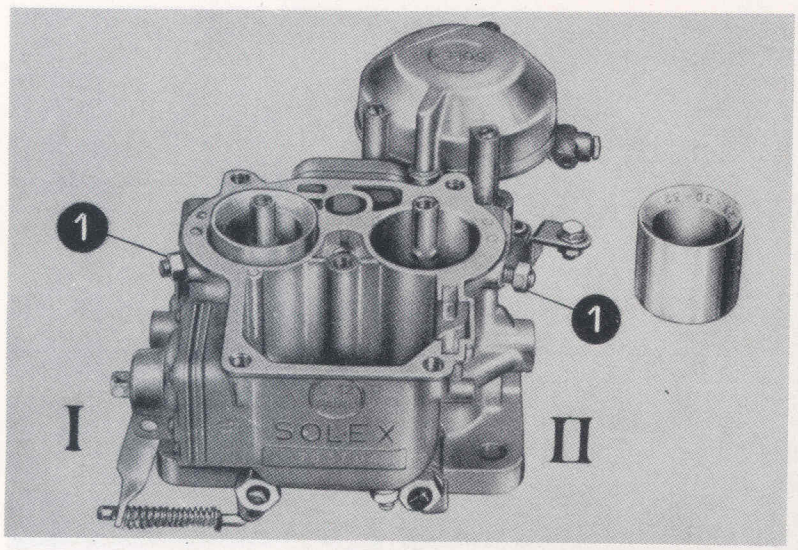
SOLEX C. 32 PAIA 7 CARBURETTORS



Throttle valves

It is not advisable to remove the throttles unless absolutely necessary.

To remove the throttles loosen the screws **1**. If the throttle spindles show signs of scoring or seizing, replace them (bore and rebush the seats in the carburettor body, if necessary).



Venturi

- Loosen the setscrews **1**.
- Take the venturi tubes out of carburettor body.

Note - A built-in dowel properly position the venturi tubes with respect to carburettor body so that any misfit on reassembly is avoided.

2nd throttle actuating vacuum capsule

The second throttle actuating vacuum capsule starts to operate when more power is needed.

Usually, if the engine is accelerated with no load, the vacuum capsule should not operate.

If the car, during a road test, should not attain the maximum speed range, check the vacuum capsule for proper operation as follows:

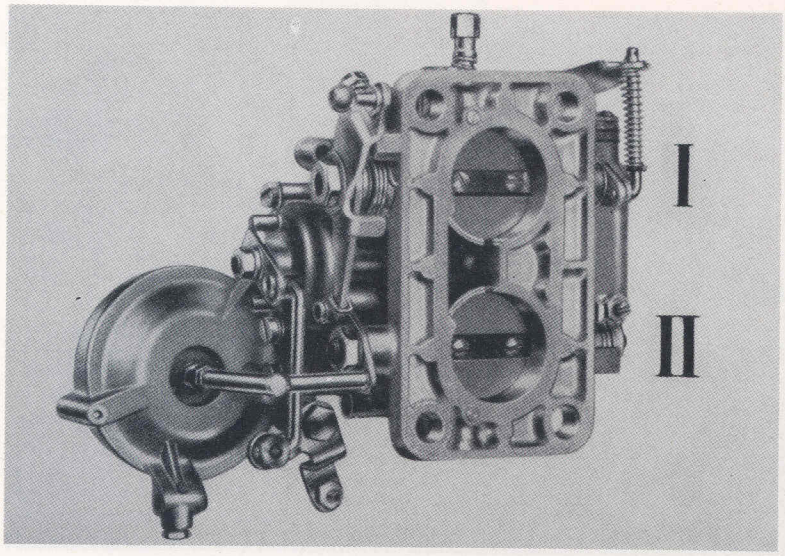
a) check that the throttle is not seized in its barrel owing to wrong adjustment of throttle opening screws;

b) check that linkage connecting the throttle to the vacuum capsule works freely without any binding;

c) check that the vacuum pipe is not obstructed throughout its run from 1st venturi to vacuum chamber;

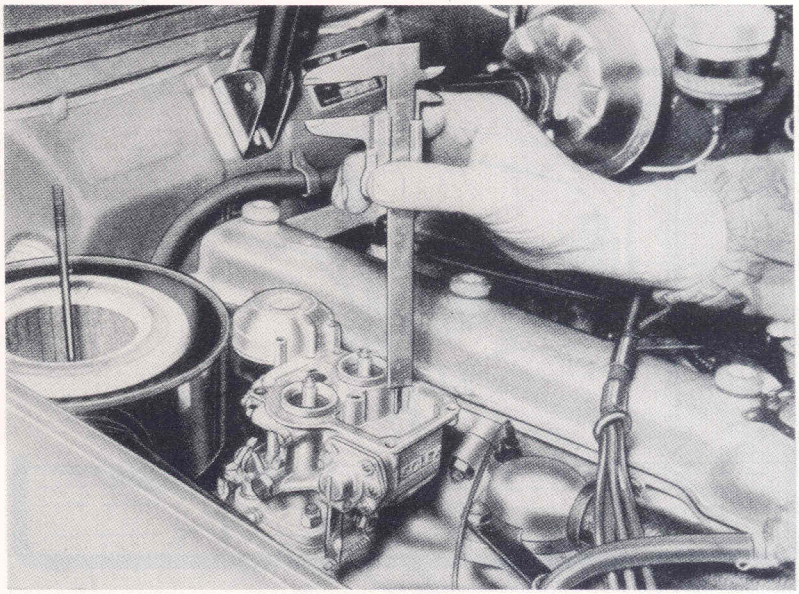
d) check that the rubber diaphragm is properly fitted but not squeezed between the capsule halves in such a way as to obstruct the suction port.

Unless strictly necessary, it is recommended not to disassemble the vacuum capsule to avoid damaging the rubber diaphragm on reassembly.



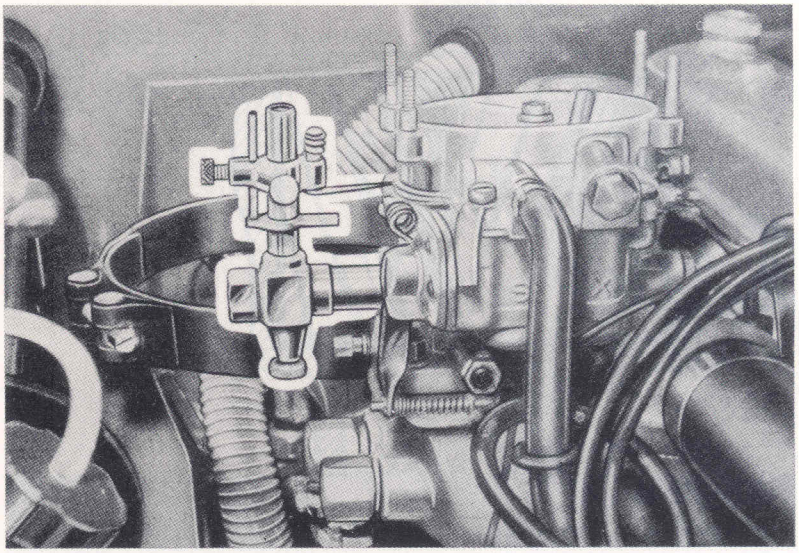
SOLEX C. 32 PAIA 7 CARBURETTORS

Level of fuel in float chamber



- To check the level of fuel in float chamber proceed as follows:
  - reinstall the carburettor onto car;
  - place the car on level ground;
  - run the engine at slow speed for about one minute then stop the engine;
  - detach the feed pipe from carburettor and discharge the fuel from pipe completely;
  - remove cover and float from chamber;
  - take measurement with a gauge as shown;
  - the distance from fuel level to float chamber flange should be **18 - 19 mm** (.71 - .75 in.).

- The fuel level can also be measured with the more accurate and quicker method of communicating vessels as follows:
  - fit the indicator in place of main jet;
  - actuate the fuel pump and check that the level is **13 mm** (.51 in.) below the flange mating surface.



If the level is not as above specified, check the needle valve and the float:

needle valve seat = 175;

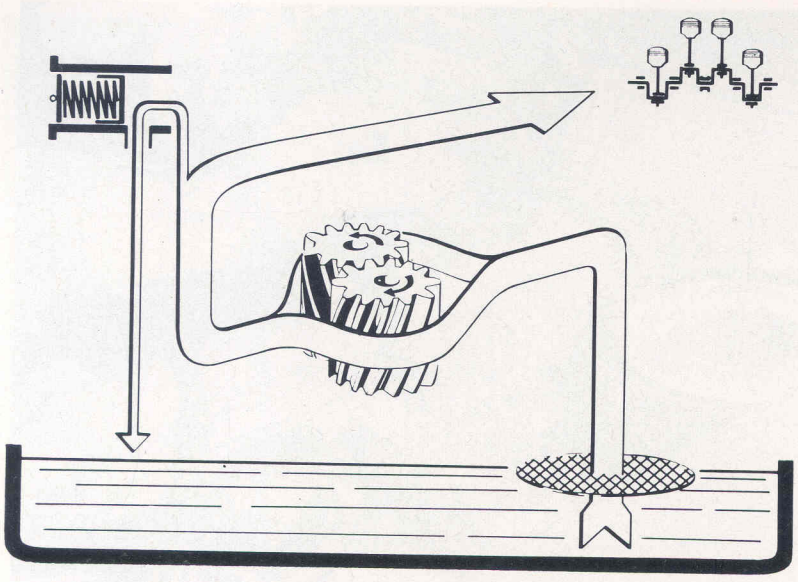
copper gaskets under valve seat: 1 mm (.039 in.) **thick**

float weight: 7.2 grs (.25 oz.).

Do not touch at all the float arm; insert shims as required under the valve seat.
If the thouble persists check the feed pump delivery.

Note - After refitting the carburettor to engine adjust idle as outlined under «Engine tune up».

LUBRICATION

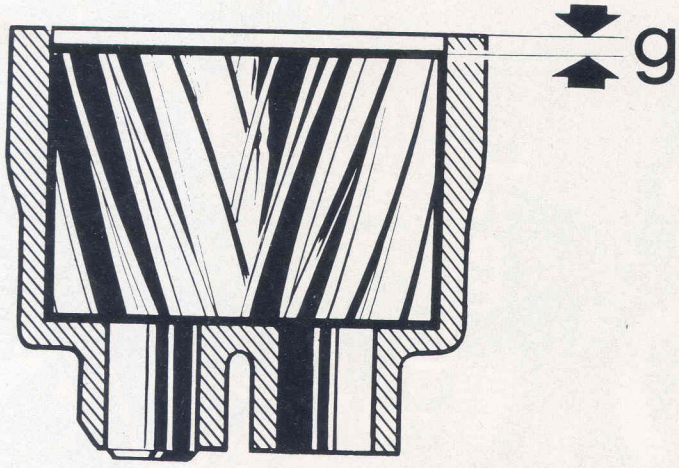


OIL PUMP

- For removal of pump from engine see page 25.

Disassembly

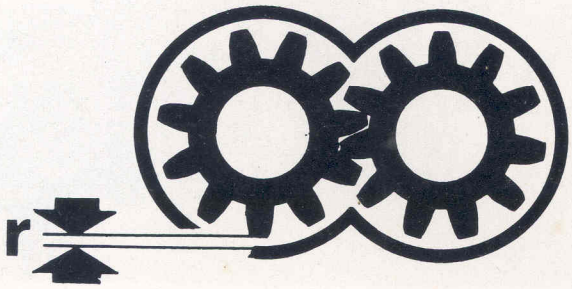
- Unscrew the nuts securing the gear housing to pump body and disassemble the pump as follows.
- Withdraw the pump driven gear from its spindle in gear housing.
- Pull out the pump drive gear from pump shaft with the aid of a press.
- Withdraw the pin keying the driven pinion to pump shaft and remove the pinion.
- Remove the split pin retaining the relief valve plunger.
- Then remove:
  - the spring seat;
  - the spring;
  - the plunger (with tool **A.3.0210** - Ref. Tool Bulletin no. 126).



Inspection and checking

- Check the gear end play **g** with a feeler gauge

  permissible end play: .2 - .5 mm (.0078 - .0197 in.).
- Inspect the gear teeth for excessive wear. Check the abutment surfaces of gears for any sign of scoring or scratching.

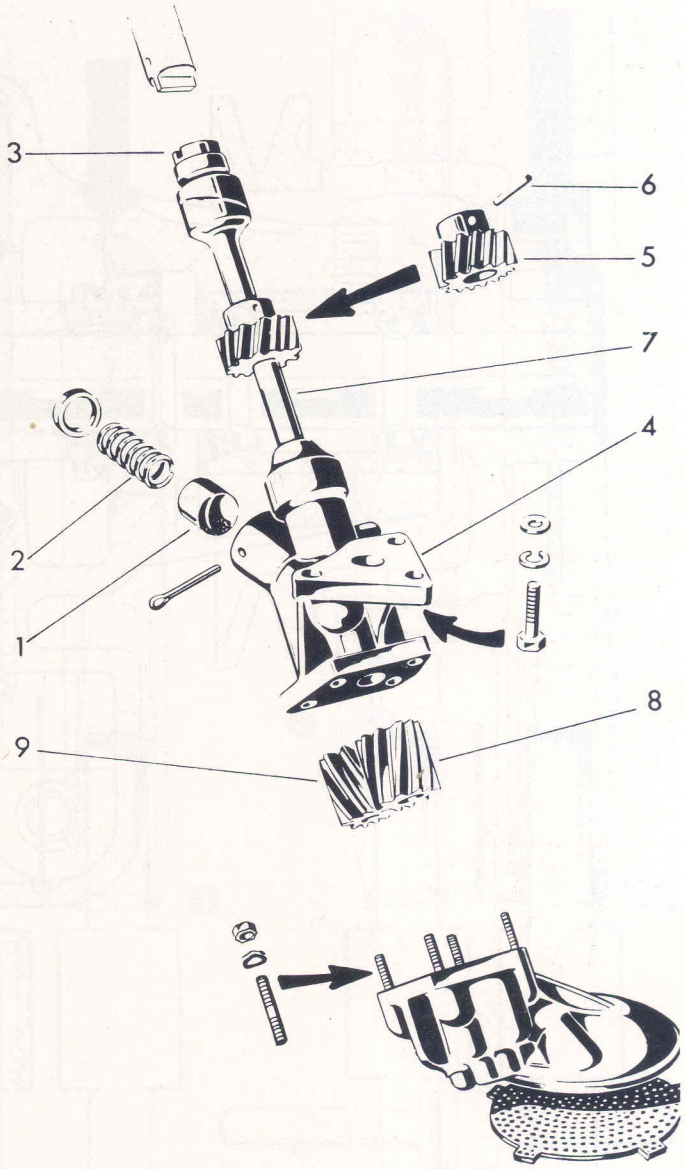


- Check the radial clearance **r** between gears and housing:

  specified clearance: .020 - .062 mm (.0008 - .0024 in.).
- Check that the driven gear spindle is firmly fitted into its seat.

LUBRICATION

- Check:
  - the working surface of relief valve plunger **1**: if it shows sign of scratches, smooth them out;
  - the spring **2** against the following specifications:
    free length **48.25 mm** (1.9 in.)
    length under a load of
    15.71 kg (34.6 lbs) = **32.25 mm** (1.27 in.);
  - the condition of coupling slot **3** and that the play between slot and tooth on distributor drive shaft **7** is not excessive.
- Inspect the surface of mounting flange **4**. It must be perfectly flat and smooth to prevent oil leakage.



Reassembly

Reassemble the pump as follows:

- Insert the driven pinion **5** on shaft and secure it with the dowel pin **6**.
- Fit the shaft into pump body and shrink the drive gear, previously heated at **80° - 100° C** (176° - 212° F), on the shaft.
- Reassemble the pump in reverse order of disassembly.
- On completion of reassembly, check that the pump gears **8** and **9** run freely; tap lightly on gear housing with a lead mallet, if necessary.
- Reinstall the oil pump on the engine as outlined on page 26.

Oil pressure test

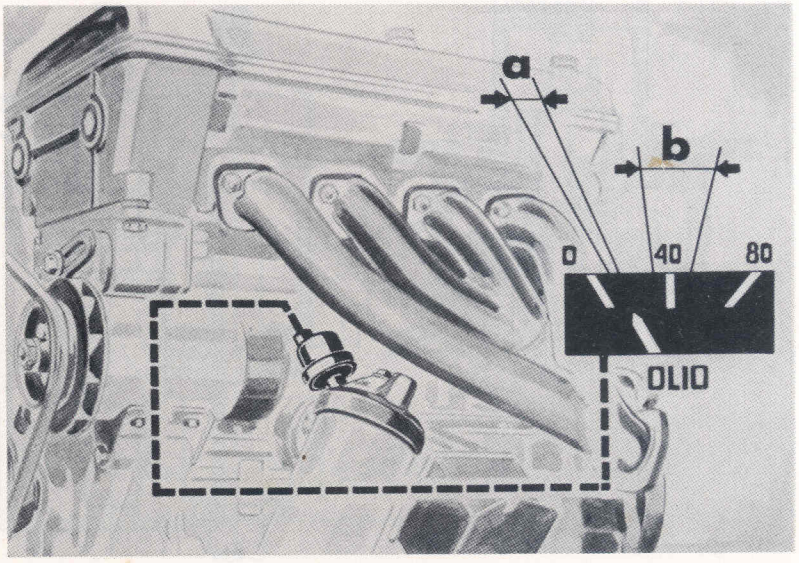
- Check oil pressure under the following conditions:

  a) **idle range:** min. **.5 - 1 kg/cm²** (7 - 14 psi)

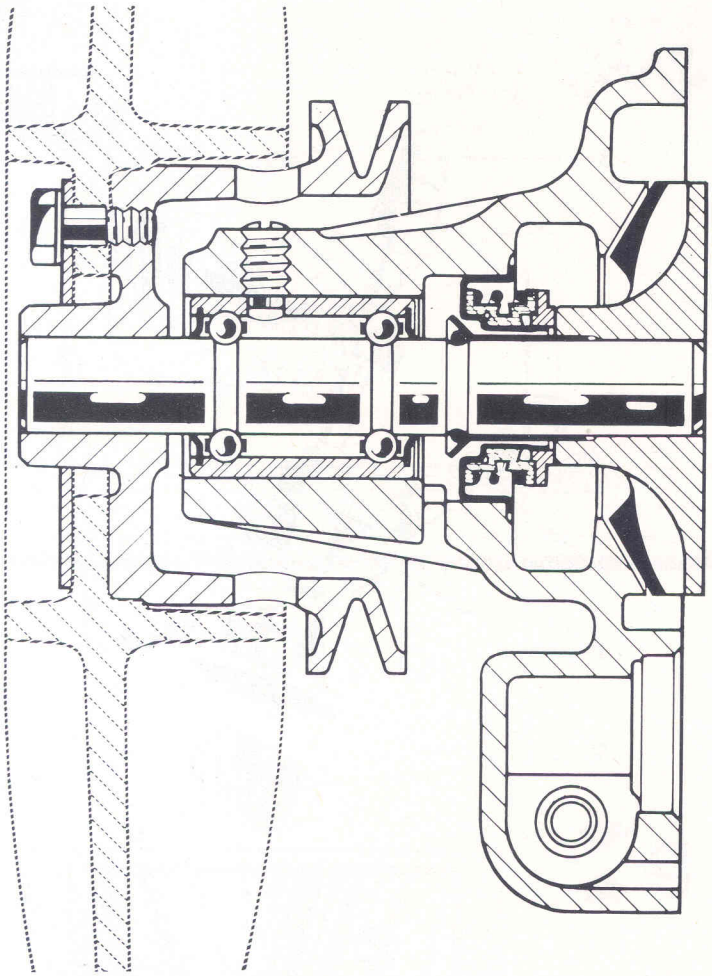
  b) **top speed range:** min. **3.5 kg/cm²** (50 psi)

  max. **4.5 - 5 kg/cm²** (65 - 70 psi)

- In the case a drop in pressure is indicated by the gauge and no external cause, such as the abnormal wear of crankshaft bearings, oil leakage from seals, etc. is ascertained, the trouble may be due to worn pump gears or gear housing.
  Other causes of pressure drop may be the yielding of spring **2**, oil leakage past the relief valve **1** or the sticking of valve plunger in its cylinder.



COOLING SYSTEM

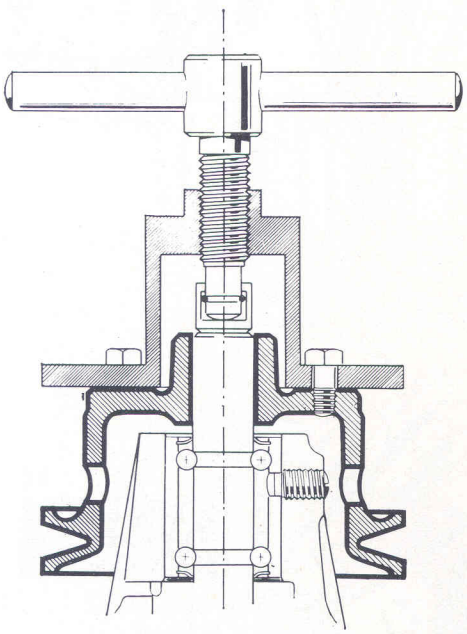


WATER PUMP

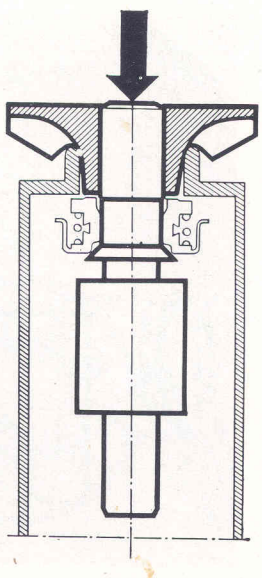
- Remove the water pump from engine as instructed under «Overhaul without removing engine» page 29.

Disassembly

- Loosen the screw fastening the fan to the pulley and remove the fan.



- Withdraw the pulley from the shaft with the puller **A.3.0147**.
- Loosen the grubscrew securing the bearing to pump body.
- With the aid of a press, remove the shaft, the impeller and the packing as a unit from pump body.



- Remove the following items only if repair or replacement is required:
  - the impeller from pump shaft (with tool **A.3.0136**);
  - the packing, the thrower and the retainer ring.

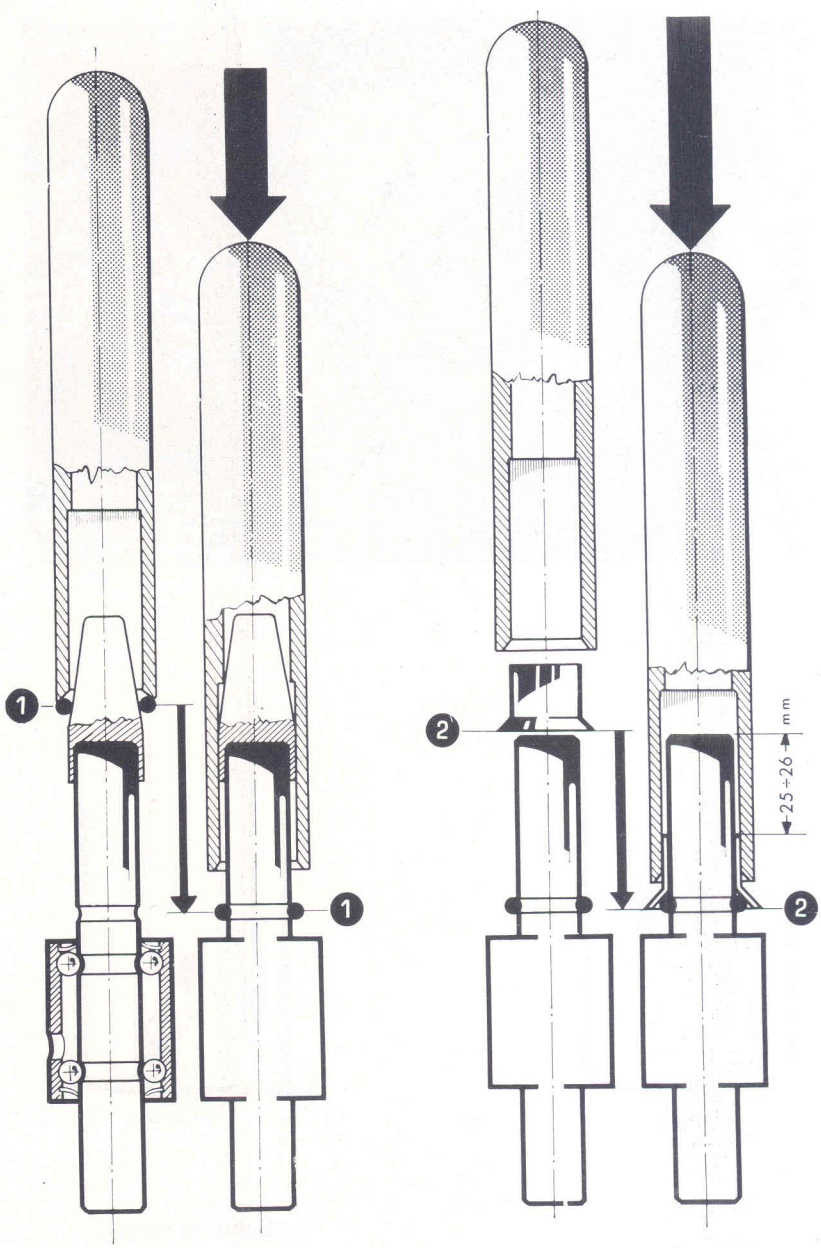
Inspection and checking

- Check the packing and the bearing for good conditions; if the bearing is damaged, replace the bearing and shaft assembly.
- Check that the impeller is not worn or corroded.

- Descale the parts by rubbing and washing in a solution of sodium bicarbonate in water; then rinse thoroughly in fresh water.
- Make sure the water outlet port is not obstructed.
- On reassembly, replace non satisfactory parts with new ones.

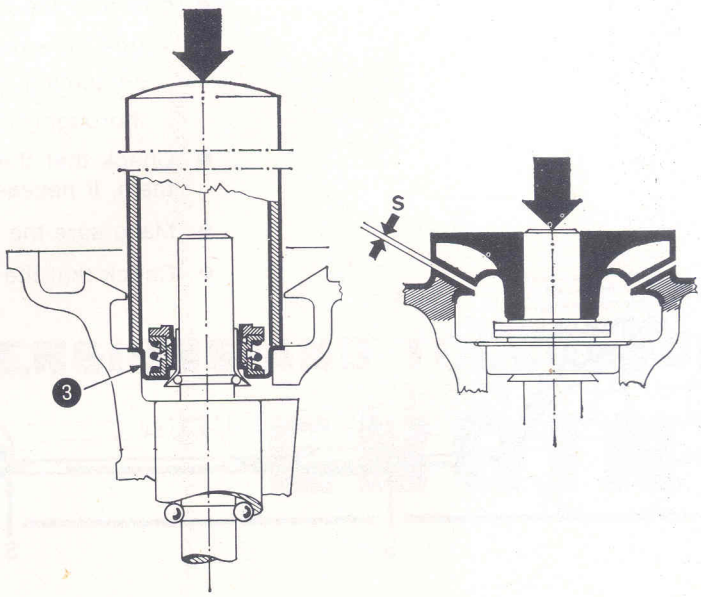
Reassembly

- Refit the thrower retainer ring **1** to shaft with the tools **A.3.0155** and **A.3.0137**.
- Insert the thrower **2** onto shaft with the tool **A.3.0137**.
- Heat the pump body to **80° C** (176° F) and insert the shaft assembly into the pump body taking care to align the hole in the bearing with the threaded seat for the grubscrew.

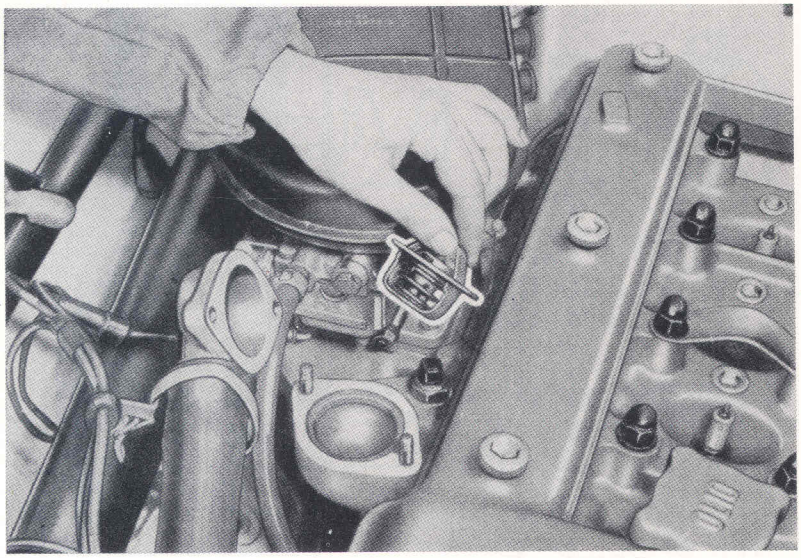


- Fit the packing **3** into the pump body with the tool **A.3.0177**.
  It is recommended to replace the packing at every reassembly.
- Heat the impeller to about **80° C** (176° F) and shrink it onto the shaft with the aid of a press.
  Stop pressing in when the clearance **S** between impeller vanes and pump body is: **.5 mm** (.02 in.).
  Heat the pulley at **80°-100° C** (176°-212° F) and install it on pump shaft.

Note - To mount the pump on engine follow the instructions given on page 29.

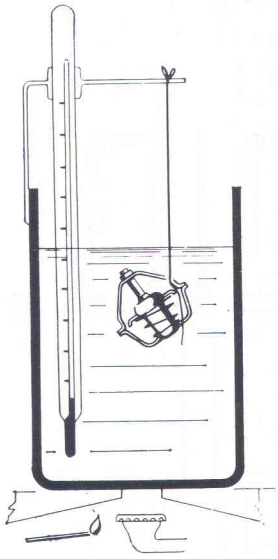


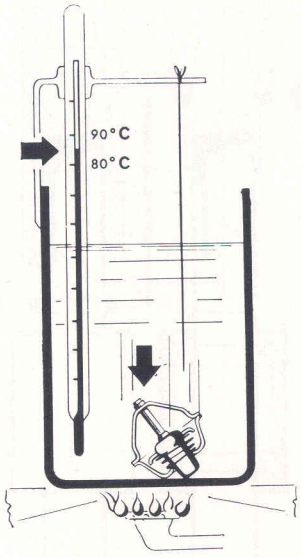
COOLING SYSTEM - EXHAUST SYSTEM



Thermostat

- The thermostat is installed in the water outlet duct from intake manifold jacket.
- For disassembly, remove the outlet duct elbow and take out the thermostat.



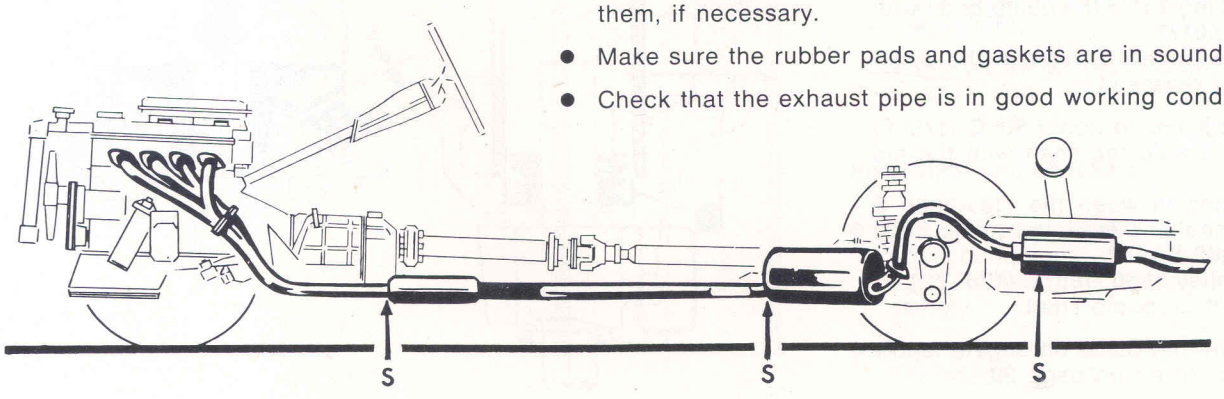


- Check the thermostat for proper operation as follows:
  - dip it in a water container;
  - heat the water so that the temperature gradient is **1° C** every 2 minutes;
  - check that the valve starts opening at the prescribed temperature of **82-87° C** (180 - 189° F).

The above check can also be performed by the following empirical method: hang the valve to a nylon string; at the prescribed temperature the thermostat sinking to the container bottom indicates the opening of valve.

Exhaust system

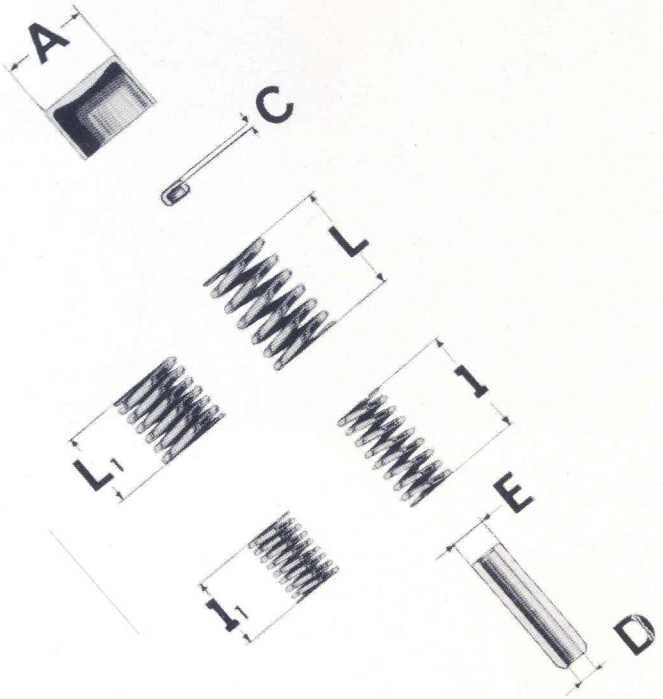
- Overhaul the exhaust manifold as follows:
  - free the exhaust pipe from supports at the point **S**;
  - detach the exhaust manifold from cylinder head and exhaust pipe;
  - thoroughly clean the inside of manifold with a wire swab.
- Check that the mounting flanges are not warped out of flat; true them, if necessary.
- Make sure the rubber pads and gaskets are in sound conditions.
- Check that the exhaust pipe is in good working conditions.



DIMENSIONS AND TOLERANCES

ENGINE

VALVES



VALVES

		Standard	Oversized	CLEARANCES New	CLEARANCES Wear limit
VALVE CUP	A	**34.973 - 34.989 mm** (1.3773 - 1.3775")	**35.173 - 35.189 mm** (1.3848 - 1.3853")	**.011 - 052 mm** (.0005 - .0020")	**.070 mm** (.0027")
CUP SEAT	B	**35.000 - 35.025 mm** (1.3779 - 1.3789")	**35.200 - 35.225 mm** (1.3859 - 1.3068")		

ADJUSTING PAD	C	Thickness ranging from **1.3** to **3.5 mm** in increments of **.025 mm** (.051 to .138") (.001")

			Free length
SPRING	large	L	**51.3 mm** (2.02")
	small	I	**46.5 mm** (1.83")

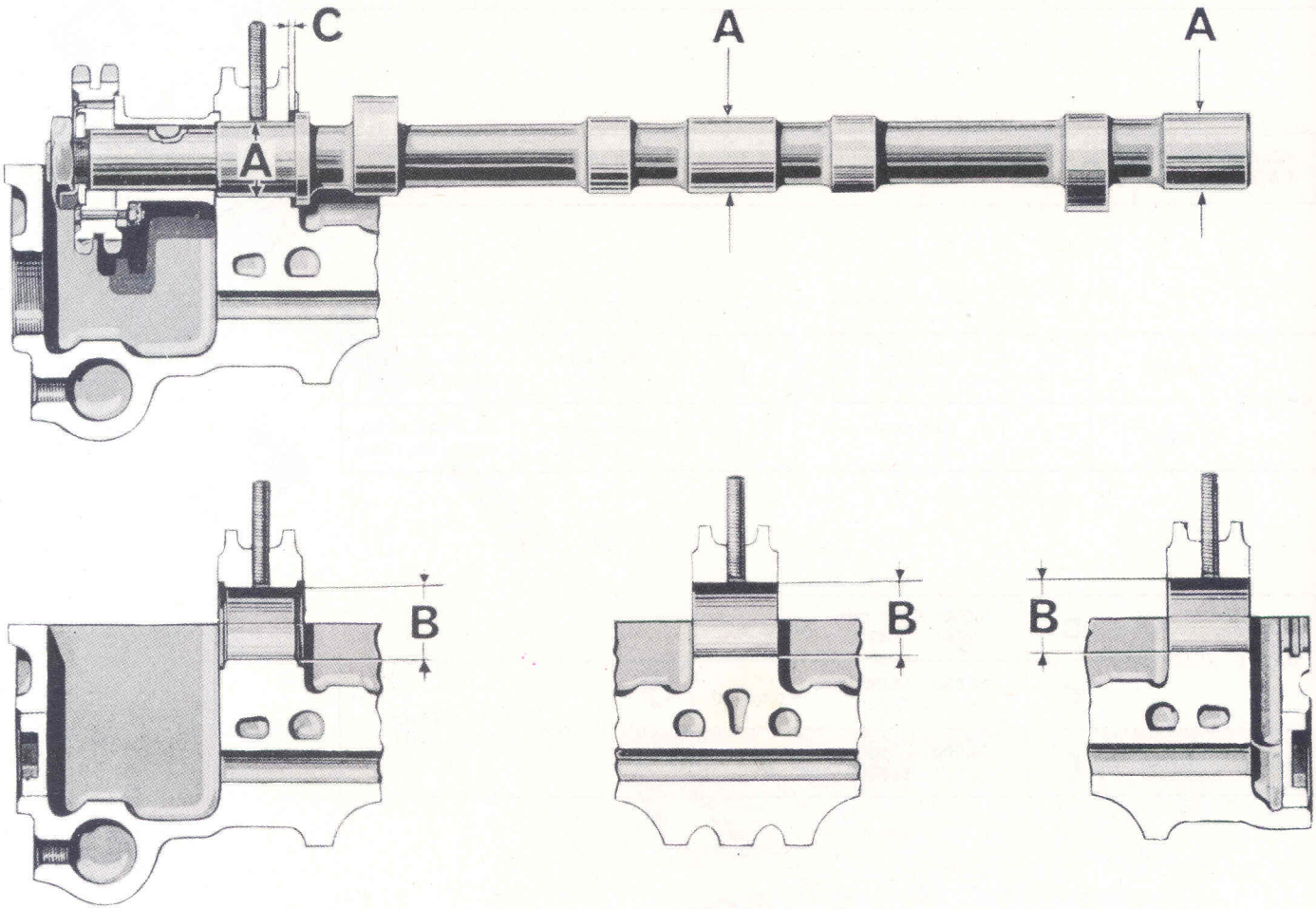
	Length under load	Test load
L_1	**27.5 mm** (1.08")	**35.6 - 37.1 kg** (78.5 - 81.8 lbs)
I_1	**26.0 mm** (1.02")	**21.2 - 23.16 kg** (46.7 - 51.1 lbs)

VALVE GUIDE	D	**9.000 - 9.015 mm** (.3544 - .3549")	installed	
	E	**14.033 - 14.044 mm** (.5525 - .5529")	removed	interference **.015 - .044 mm** (.0007 - .0017")
GUIDE SEAT	F	**14.000 - 14.018 mm** (.5512 - .5518")		

		INTAKE Standard	INTAKE Oversized	EXHAUST Standard	EXHAUST Oversized	
SEAT INSERT HOUSING	H	**42.472 - 42.497 mm** (1.6722 - 1.6731")	**42.772 - 42.797 mm** (1.6840 - 1.6849")	**38.472 - 38.497 mm** (1.5147 - 1.5156")	**38.772 - 38.797 mm** (1.5265 - 1.5274")	Interference **.100 - .176 mm** (.004 - .0017")
SEAT INSERT	G	**42.597 - 42.648 mm** (1.6771 - 1.6790")	**42.897 - 42.948 mm** (1.6889 - 1.6908")	**38.597 - 38.648 mm** (1.5196 - 1.5215")	**38.897 - 38.948 mm** (1.5314 - 1.5333")	

		SANTAMBROGIO Intake	SANTAMBROGIO Exhaust	ATE Exhaust only	
VALVE	M	**8.960 - 8.987 mm** (.3527 - .3538")	**8.935 - 8.960 mm** (.3518 - .3527")	**8.935 - 8.960 mm** (.3518 - .3527")	Clearance **D** minus **M**: Intake **.013 - .053 mm** (.0006 - .0022"); Exhaust **.040 - .080 mm** (.0017 - .0031"); Wear limit = **.1 mm** (.004")
	N	**106.630-107.030 mm** (4.1981 - 4.2137")	**105.900-106.300 mm** (4.1693 - 4.1850")	**106.050-106.150 mm** (4.1753 - 4.1791")	
	O	**41.000 - 41.150 mm** (1.614 - 1.620")	**37.000 - 37.150 mm** (1.4567 - 1.4625")	**37.000 - 37.200 mm** (1.4567 - 1.4645")	

CAMSHAFTS

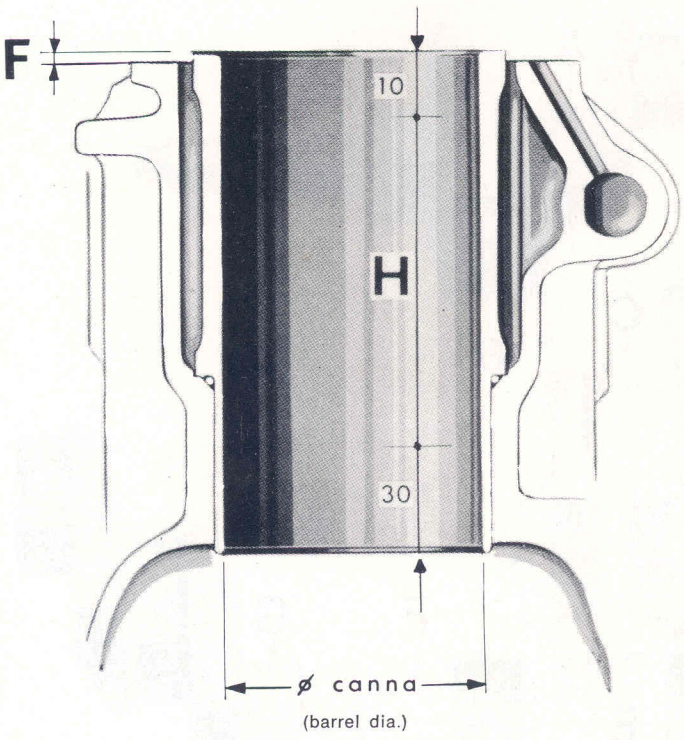


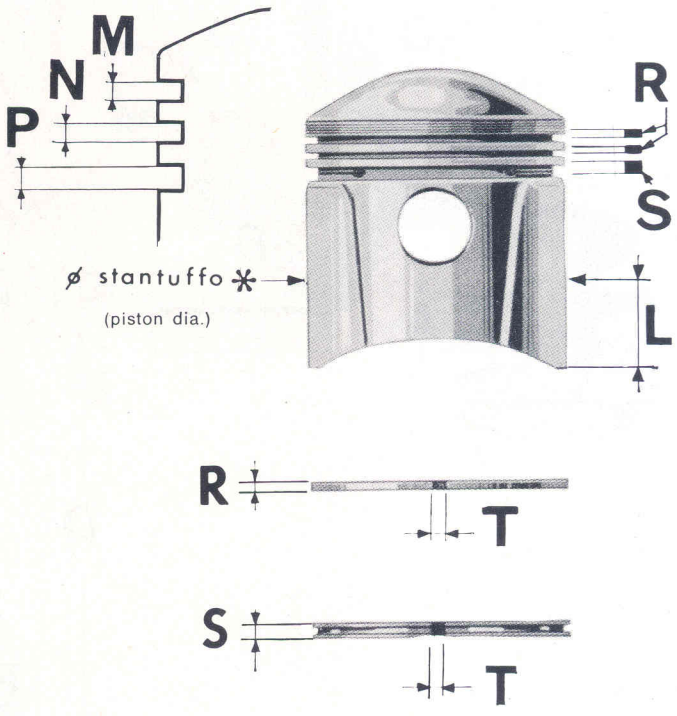
JOURNAL	A	**26.959 - 26.980 mm** (1.0614 - 1.0622")	Clearance	**.020 - .074 mm** (.0008 - .0028")
BEARING	B	**27.000 - 27.033 mm** (1.0630 - 1.0642")		

END PLAY	C	**.065 - .182 mm** (.0026 - .0071")

CYLINDER BARRELS - PISTONS

10 mm = .4 in.
30 mm = 1.2 in.





* to be measured at right angle to wrist pin hole

BARREL - TO - PISTON FIT

		CLASS **A** BLUE		CLASS **B** PINK		CLASS **C** GREEN	
		PISTON O.D.	BARREL I.D.	PISTON O.D.	BARREL I.D.	PISTON O.D.	BARREL I.D.
PISTON MAKE	BORGO	**77.920 - 77.930 mm** (3.0677 - 3.0681")	**77.985 - 77.994 mm** (3.0703 - 3.0706")	**77.931 - 77.940 mm** (3.0682 - 3.0685")	**77.995 - 78.004 mm** (3.0707 - 3.0710")	**77.941 - 77.950 mm** (3.0686 - 3.0688")	**78.005 - 78.014 mm** (3.0711 - 3.0714")
	MAHLE	**77.945 - 77.955 mm** (3.0687 - 3.0690")		**77.956 - 77.965 mm** (3.0691 - 3.0694")		**77.966 - 77.975 mm** (3.0695 - 3.0698")	

BARREL-TO-PISTON CLEARANCE	BORGO	**.055 - .074 mm** (.0022 - .0029")	wear limit **.15 mm** (.0059')
	MAHLE	**.030 - .049 mm** (.0012 - .0019")	

BARREL	Projection from cylinder block	**F**	**.00 - .06 mm** (.000 - .002")
	Reading points	**H**	Diameter (see table) Elongation: **.010 mm** (.0004") new barrels; **.100 mm** (.004") wear limit Surface roughness 20 - 40 microinches RMS

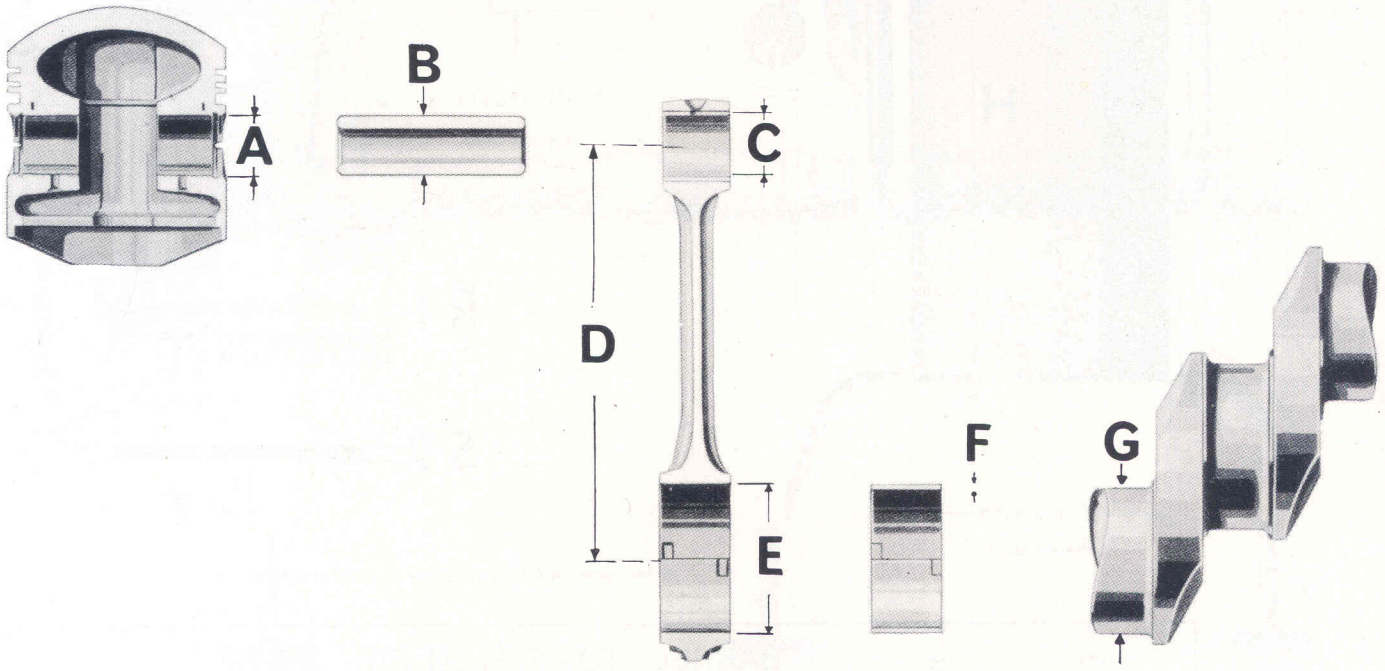
PISTON	Dia. reading point		**L**	**11 mm** (MAHLE) (.43") **12 mm** (BORGO) (.47")
	Ring grooves	Chromium-plated	**M**	**1.785-1.800 mm** (.0703-.0708")
		Oil scraper	**N**	**1.775-1.790 mm** (.0699-.0704")
		Oil control	**P**	**4.015-4.030 mm** (.1581-.1586")

Thickness of compression & scraper rings	**R**	**1.728-1.740 mm** (.0681-0.685")
Thickness of oil control ring	**S**	**3.978-3.990 mm** (.1567-.1571")

End play **M** minus **R** =	**.045-.072 mm** (.0018-.0028")	Wear limit = **.10 mm** .004"
End play **N** minus **R** =	**.035-.062 mm** (.0014-.0024")	
End play **P** minus **S** =	**.025-.052 mm** (.0010-.0020")	

Gap of rings	**T**	**.300-.450 mm** (.012-017") wear limit = **1 mm** (.039")	to be inspected in ring gauge or in cylinder barrels

CONNECTING RODS



			BLACK	WHITE
PISTON PIN HOLE I.D.	BORGO	A	**22.000 - 22.002 mm** (.86614 - .86621")	**22.003 - 22.005 mm** (.86626 - .86633")
	MAHLE		**21.996 - 21.999 mm** (.86597 - .86608")	**21.999 - 22.002 mm** (.86608 - .86621")
PISTON PIN O.D.		B	**21.994 - 21.997 mm** (.86590 - .86602")	**21.997 - 22.000 mm** (.86602 - .86614")

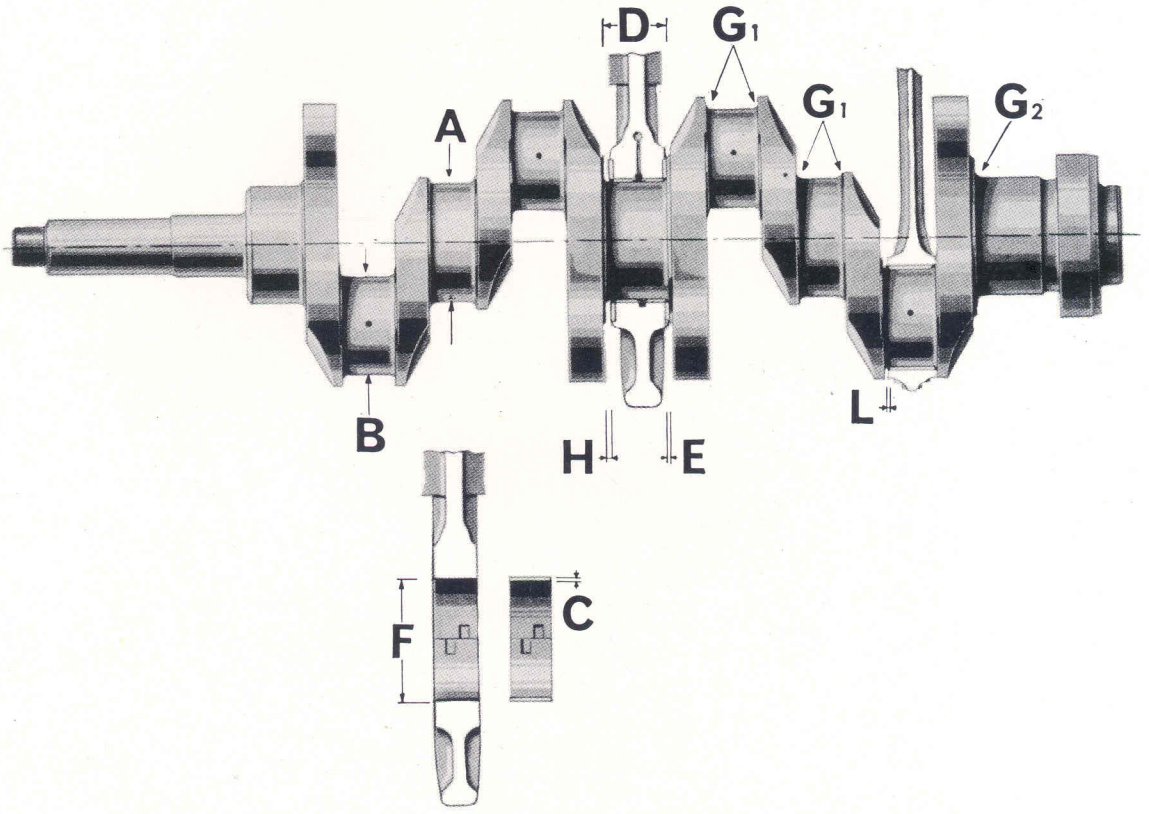
		BLACK	WHITE
CLEARANCE A minus B	BORGO	**.003 - .008 mm** (.00012 - .0003")	**.003 - .007 mm** (.00012 - .0002")
	MAHLE	**+.005 to - .001 mm** (+.00019 to - .00004")	**+.005 to - .001 mm** (+.00019 to - .00004")
CLEARANCE **C** minus **B**		**.008 - .021 mm** (.0003 - .0008")	**.005 - .017 mm** (.0002 - .0006")

CONNECTING ROD	**C**	**22.005 - 22.015 mm** (.8664 - .8667")
	D	**147.955-148.045 mm** (5.8250 - 5.8285")
	E	**53.695 - 53.708 mm** (2.1140 - 2.1144")

CONNECTING ROD BEARING THICKNESS	**F**	Standard	**1.829 - 1.835 mm** (.0720 - .0722")
		1st oversize	**1.956 - 1.962 mm** (.0770 - .0772")
		2nd oversize	**2.083 - 2.089 mm** (.0820 - .0822")

CLEARANCE (**E** minus twice **F**) minus **G**	**.025 - .063 mm** (.0010 - .0025") wear limit = **.15 mm** (.006")

CRANKSHAFT



			STANDARD	UNDERSIZE	
				1st	2nd
JOURNALS	MAIN	A	**59.960 - 59.973 mm** (2.3606 - 2.3611")	**59.706 - 59.719 mm** (2.3506 - 2.3511")	**59.452 - 59.465 mm** (2.3407 - 2.3411")
	CON. ROD	B	**49.987 - 50.000 mm** (1.9680 - 1.9685")	**49.733 - 49.746 mm** (1.9581 - 1.9585")	**49.479 - 49.492 mm** (1.9480 - 1.9485")

MAX. TAPER = **.01 mm** (.0004")
on journal full length
MAX. MISALIGNMENT = **.01 mm** (.0004")
MAX. ELONGATION = **.007 mm** (.0003")
MAX. OUT OF PARALLELISM = **.015 mm** (.0006")
on journal full length
MAX. SURFACE ROUGHNESS = 6 microinches RMS

		STANDARD	OVERSIZE	
			1st	2nd
MAIN BEARING THICKNESS	C	**1.829 - 1.835 mm** (.0720 - .0722")	**1.956 - 1.962 mm** (.0770 - .0772")	**2.083 - 2.089 mm** (.0820 - .0822")
MAIN JOURNAL LENGTH	D	**30.000 - 30.035 mm** (1.1811 - 1.1824")	**30.127 - 30.162 mm** (1.1861 - 1.1874")	**30.254 - 30.289 mm** (1.1911 - 1.1924")
THRUST RING THICKNESS	E	**2.311 - 2.362 mm** (.0911 - .0929")	**2.374 - 2.425 mm** (.0935 - .0954")	**2.438 - 2.489 mm** (.0960 - .0980")

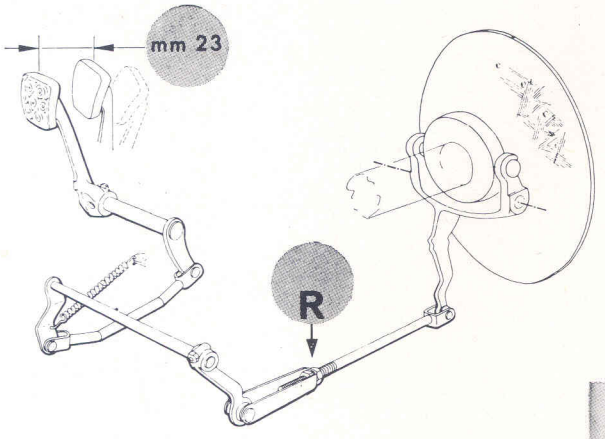
MAIN BEARING SEAT		F	**63.657 - 63.676 mm** (2.5062 - 2.5069")
FILLET RADII	CRANKPINS AND MAIN JOURNALS	G_1	**1.7 - 2.1 mm** (.069 - .082")
	MAIN JOURNAL (flywheel side only)	G_2	**3.7 - 4.1 mm** (.146 - .161")

CLEARANCE (**F** minus twice **C**) minus **A**			**.014 - .058 mm** (.0006 - .0022")

END PLAY	CRANKSHAFT	H	**.076 - .263 mm** (.003 - .010")
	CON. ROD	L	**.200 - .300 mm** (.008 - .012")

CLUTCH

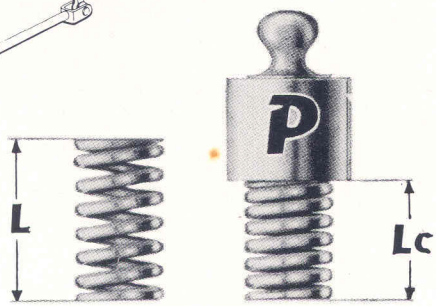
ADJUSTMENT DATA AND INSPECTION SPECIFICATIONS



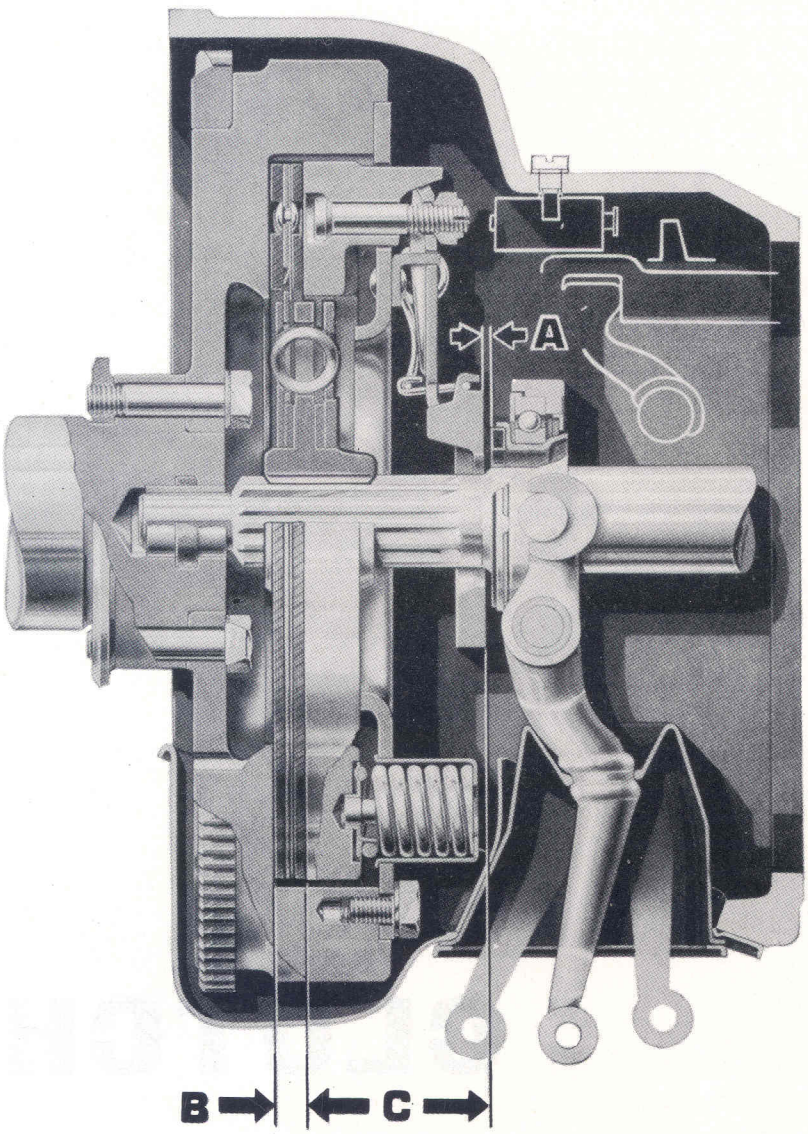
Pedal free travel: **23 mm** (about 1 in.).

When pedal free travel is reduced to **10 - 12 mm** (about 1/2 in.) owing to wear of driven plate facing, the free travel must be restored by adjusting the nut **R**.

After the adjustment firmly secure the adjusting nut with its locknut.



Length of engaging spring:
L = **43.5 to 45.5 mm** (1.71 to 1.79 in.);
Lc = **29 mm** (1.14 in.) under a load:
P = **45 - 49 kg** (99 to 108 lbs).



A = **2 mm** (0.79 in.).

Clearance between the thrust ring and throwout bearing.

With this amount of clearance the pedal free travel is **23 mm** (about 1 in.).

B = **9.1 to 9.4 mm** (.358 to .370 in.).

Thickness of driven plate when engaged (with new facings).

Wear limit: about **6 mm** (.236 in.).

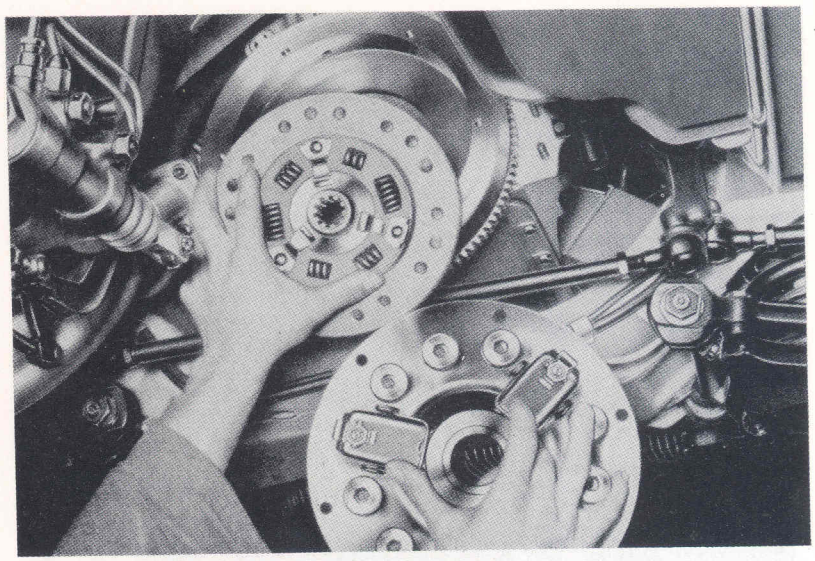
C = **48.8 to 50.4 mm** (1.93 to 1.94 in.).

Distance between pressure plate face and thrust ring face.
This dimension is to be measured on a suitable fixture and independently of driven plate thickness.

REMOVAL AND DISASSEMBLY

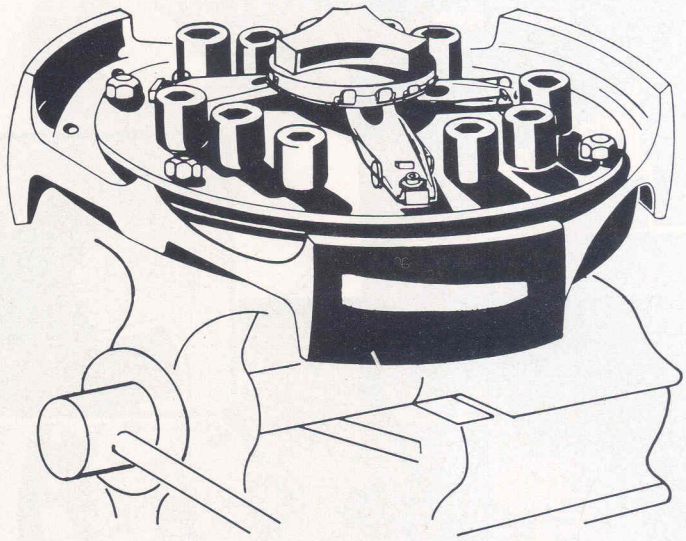
Removal from car

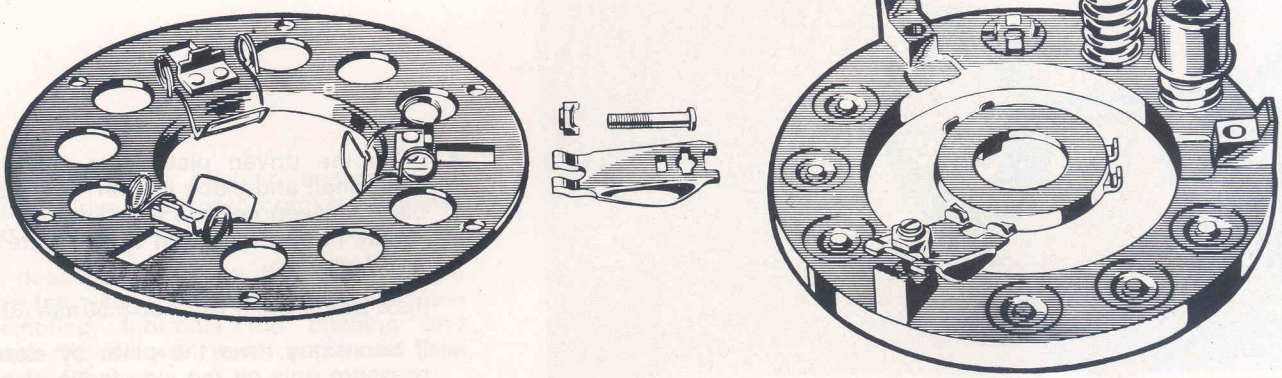
- Remove the gearbox as described on page 82.
- Unscrew the screws securing the clutch unit to the flywheel.
- Remove the clutch unit, driven plate included, taking care not to soil the facings with oil or grease.



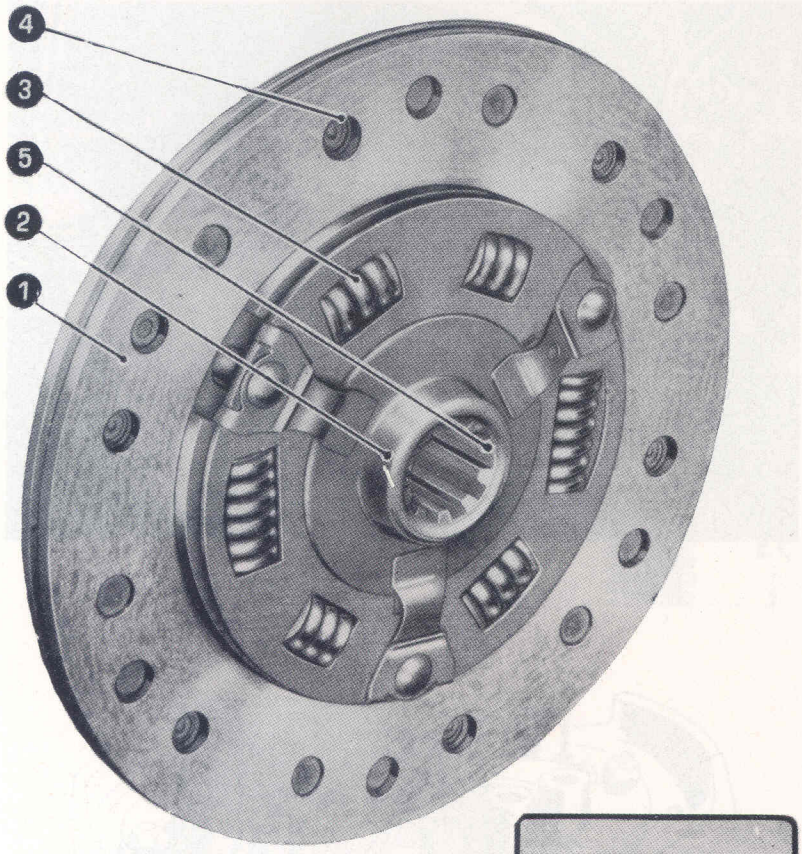
Disassembling the clutch unit

- Set up the clutch unit on the jig **C.6.0104** (Ref. Tool Bulletin no. 50); screw all the way down the screws so as to compress the engaging springs.
- Clear the thrust ring from spring retainers and remove the ring.
- If necessary, remove the stakings which lock the nuts to the toggle lever bolts and without rotating the nuts unscrew the bolts with a screwdriver; then take out the toggle levers.
- Mark the position of thrust ring with respect to the flange; on reassembly, align these parts again according to the reference marks made so that balance of the system is not altered.
- Loosen the screws slowly and in diagonal order so as to relieve the springs gradually.
- Break down the unit in its parts.





INSPECTION AND CHECKING



- Check that:

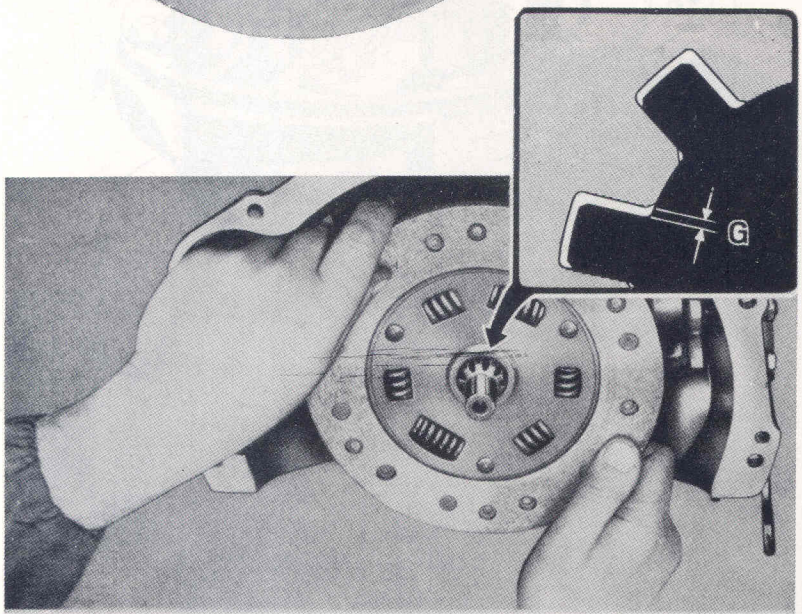
1 driven plate facings are dry; if they are stained with lubricants the affected area must be cleaned with petrol and dressed with a wire brush; however, reface the plate if facings are deeply soaked with oil;

2 driven plate is firmly secured to its hub;

3 springs in the coupling work properly;

4 facings rivets are well riveted into their holes;

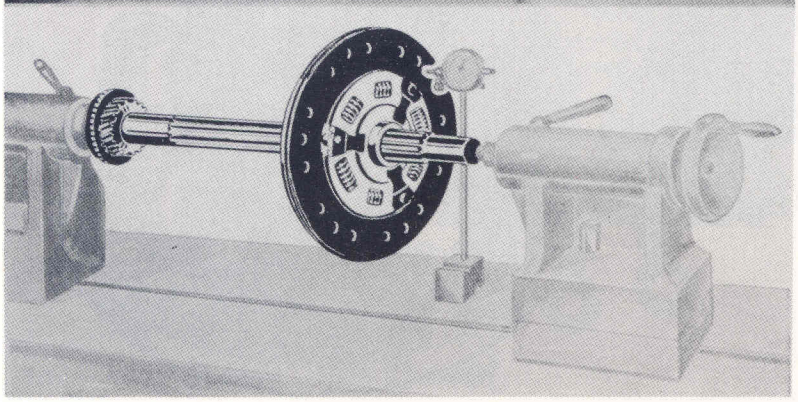
5 with a suitable stone smooth off possible dents or burrs on the egdes of hub splines.



- Check the clearance between side faces of splines in the clutch driven plate and in the gearbox direct drive shaft.

  Factory assembly clearance:

  G = .03 to .11 mm (.0012 to .0043 in.).
  Wear limit: **.3 mm** (.0118 in.).



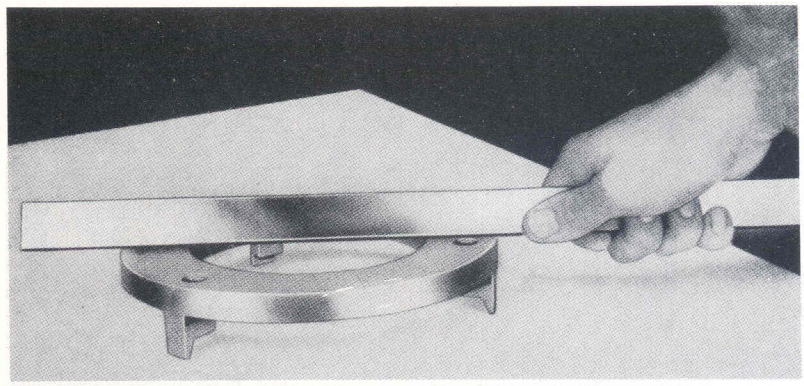
- Slide the driven plate onto the direct drive shaft and place the parts so assembled between centers as shown.
  Check flatness and run out of plate with a dial gauge:

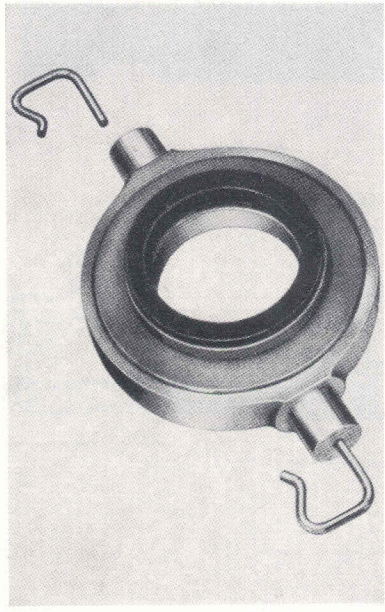
  max. permissible run out = **.50 mm** (.02 in.)

  If necessary, true the plate by exerting pressure only on the side faces of plate.

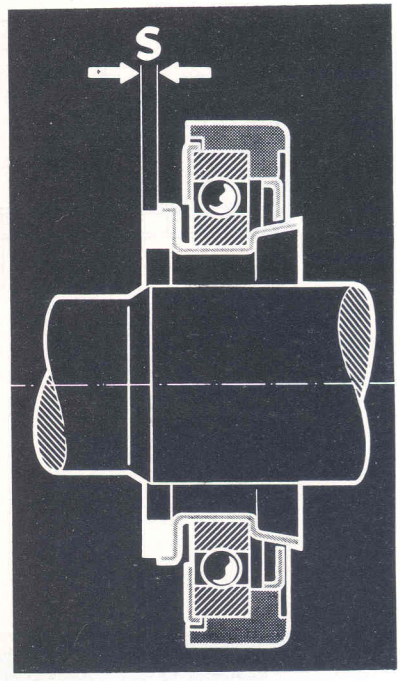
INSPECTION AND CHECKING

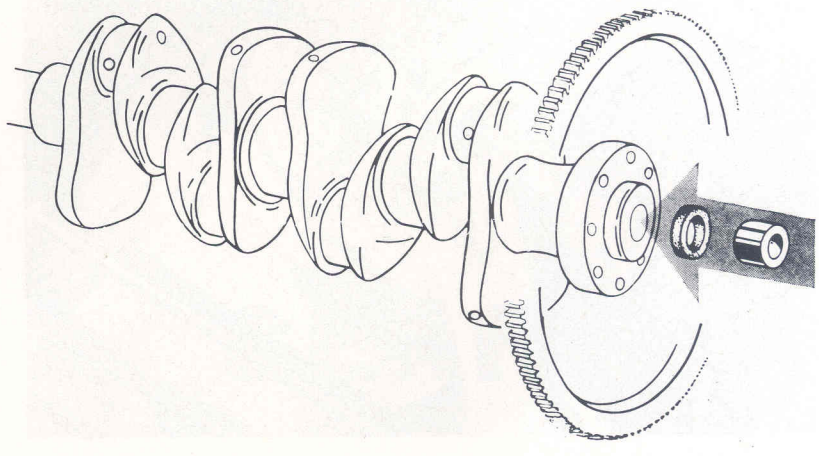
- Check that pressure plate and flywheel friction surfaces are smooth and flat. Re-grind the surfaces, if necessary.





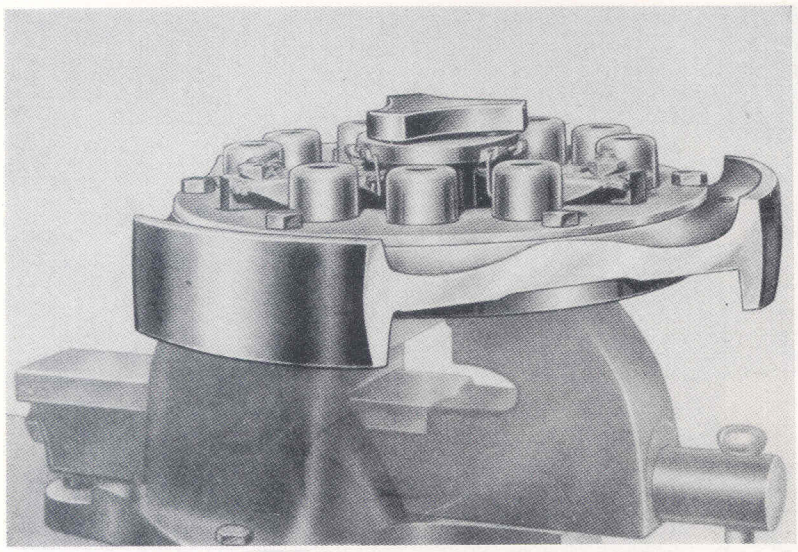
- Check the throwout bearing for any undue noise or excessive play; make sure the graphite ring projection **S** is not reduced to such a point as to leave uncovered the inner seat edge.





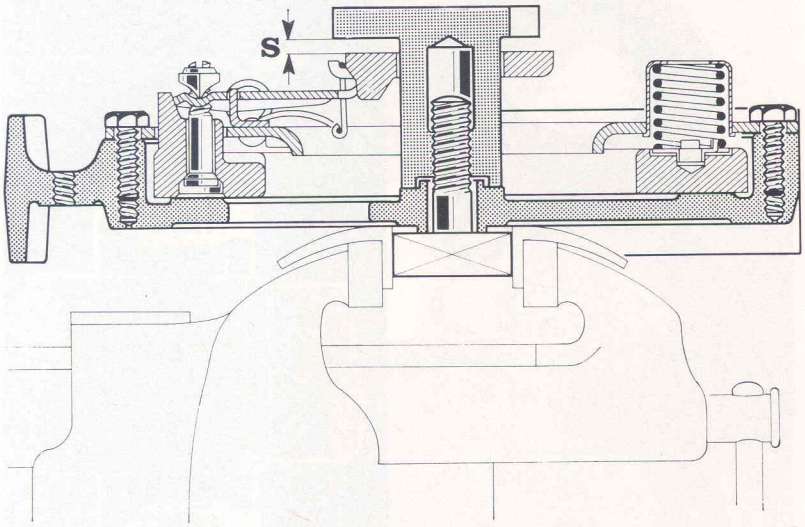
- Check that the bushing centering the direct drive shaft onto crankshaft shows no sign of seizing or excessive wear.
- If necessary, replace the bushing and the felt washer with new ones. On reassembling, lubricate the bushing and soak the felt with warm engine oil (see page 42).

REASSEMBLY, CHECKING AND REINSTALLATION



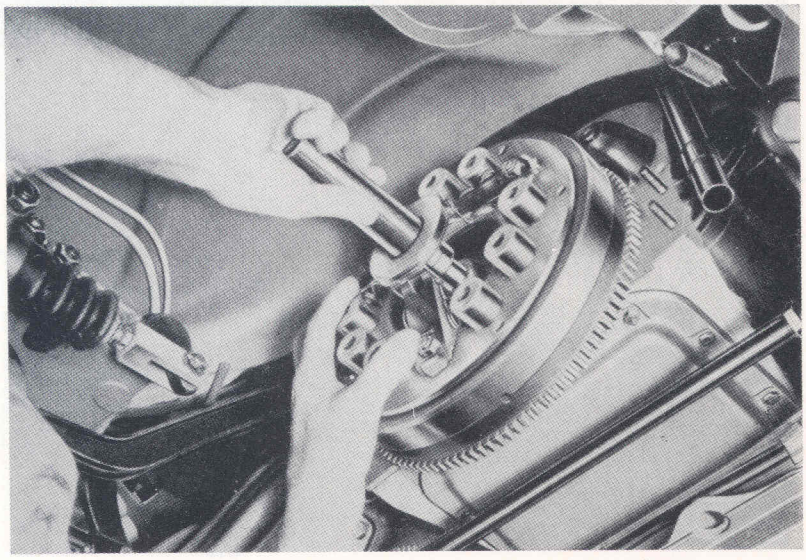
Reassembly

- Assemble the clutch on the jig **C.6.0104**. On reassembly, make sure to align the thrust ring and the flange according to the reference marks so as not to alter the balance of the system.
  Before assembling the thrust ring inspect it to make sure the surfaces which bear the toggle lever reaction, are not excessively indented. With an oil stone smooth out the gals and bring the surfaces flat in the same plane.
- Check that the levers are in the same plane with a dial gauge and remove possible damage from bearing surfaces with an oil stone.



- Assemble the thrust ring and engage the spring retainers.
- With a feeler gauge check that the distance **S** between the reference plane of the jig and the thrust ring is **1±.8 mm** (.039±.031 in.).

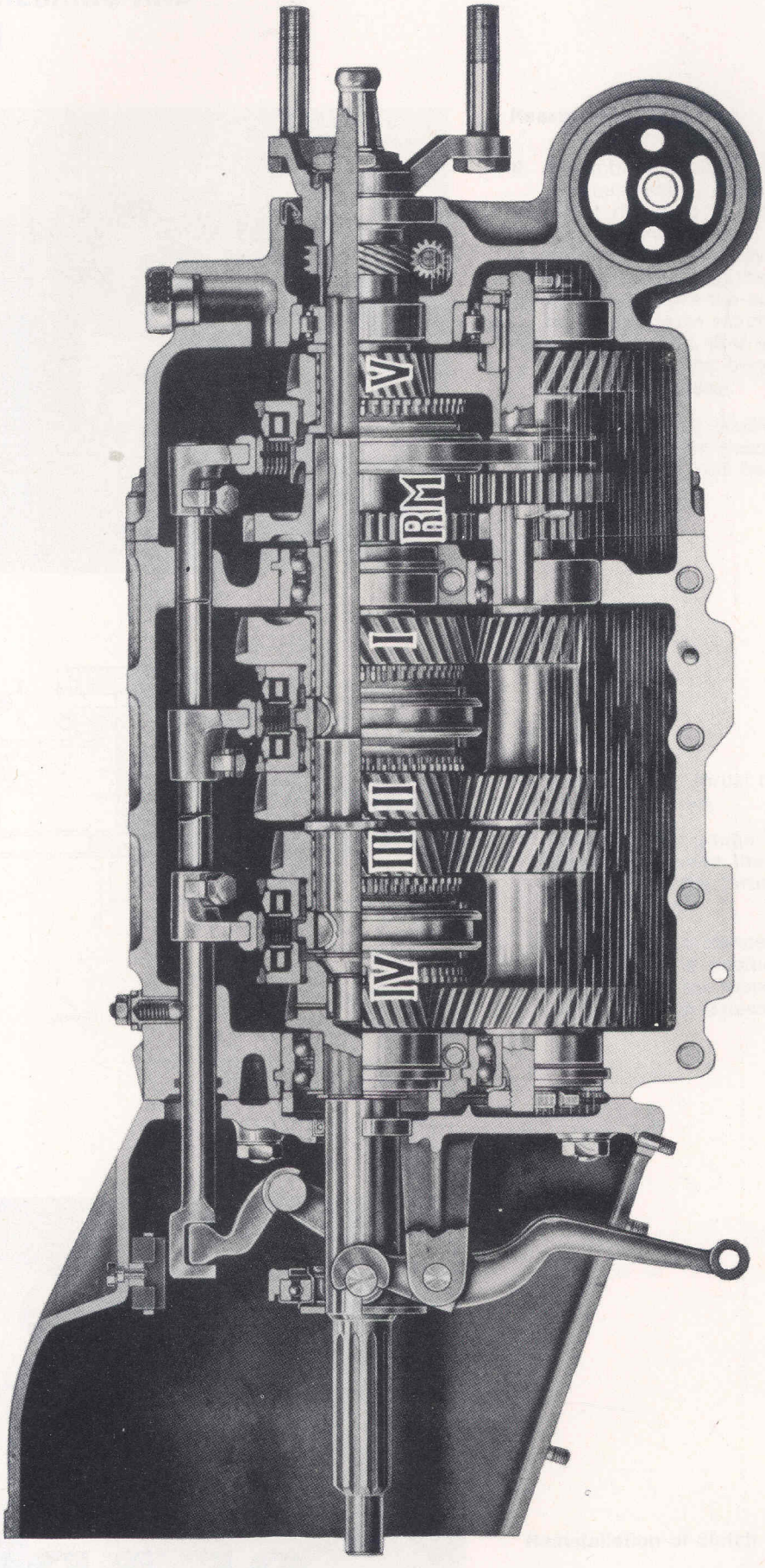
  If the above distance is not as prescribed, adjust the position of toggle levers by acting on the respective bolts with the 14 mm wrench (special tool no. **A.5.0166)**.

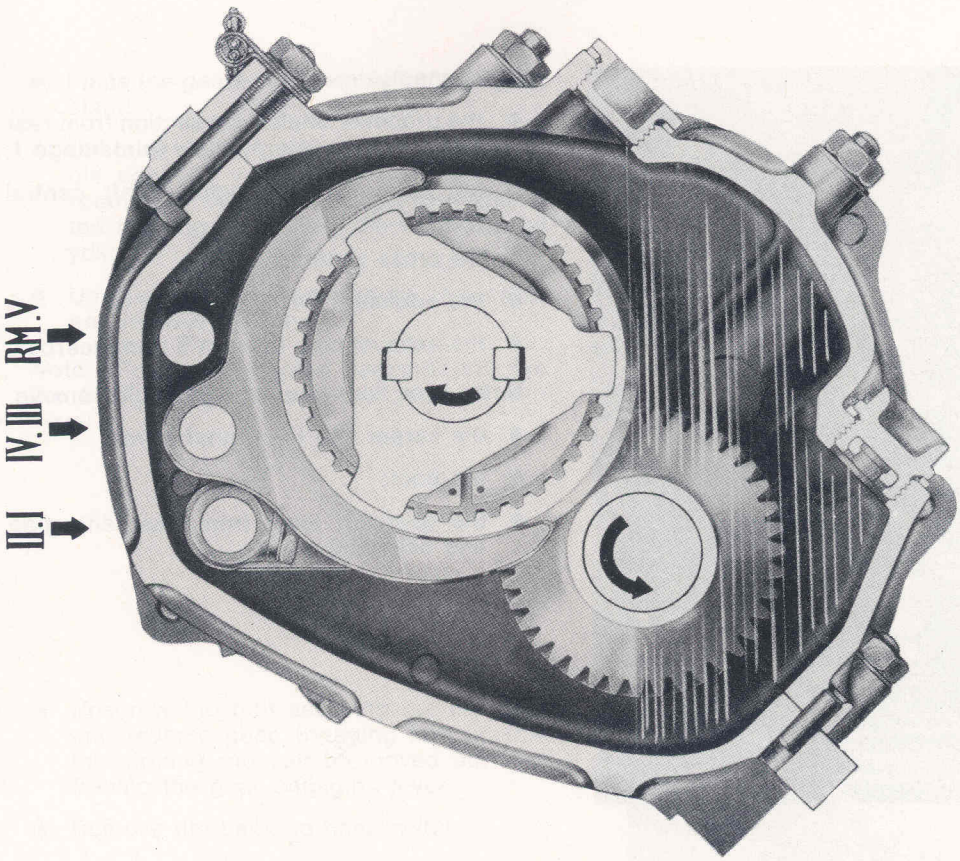


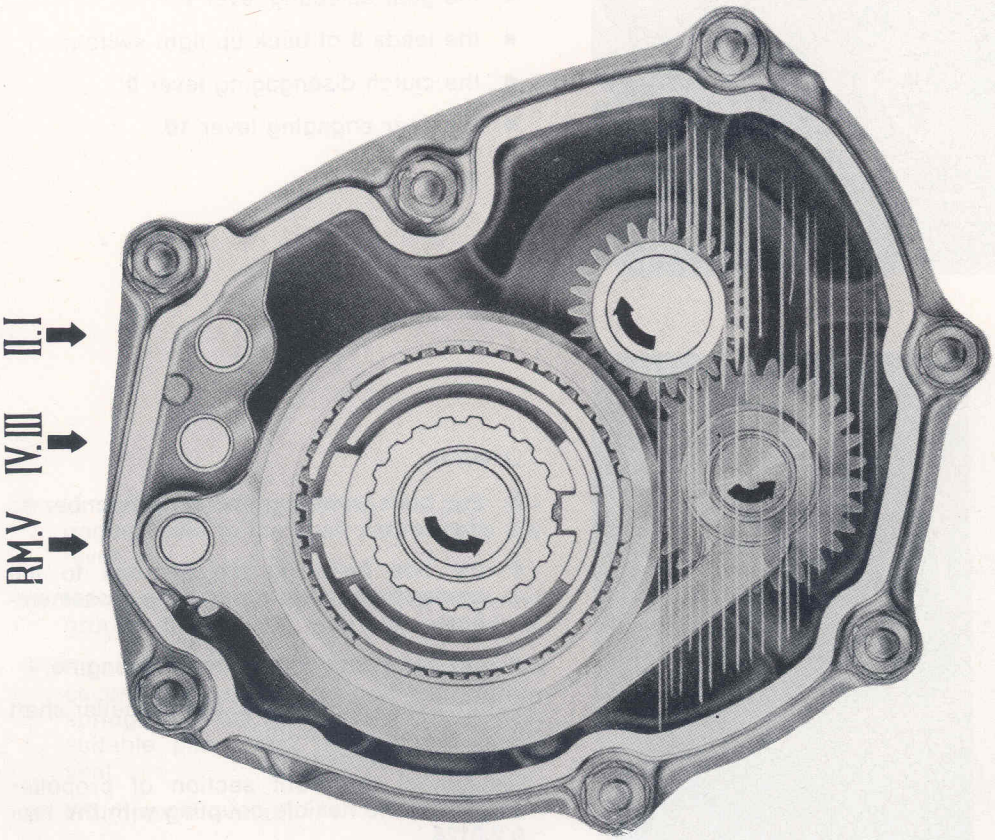
Reinstallation of clutch unit

- Assemble the clutch unit to flywheel centering the driven plate on flywheel with the tool **A.4.0103**; then gradually tighten the clutch mounting bolts.

GEARBOX


V
RM
I
II
III
IV

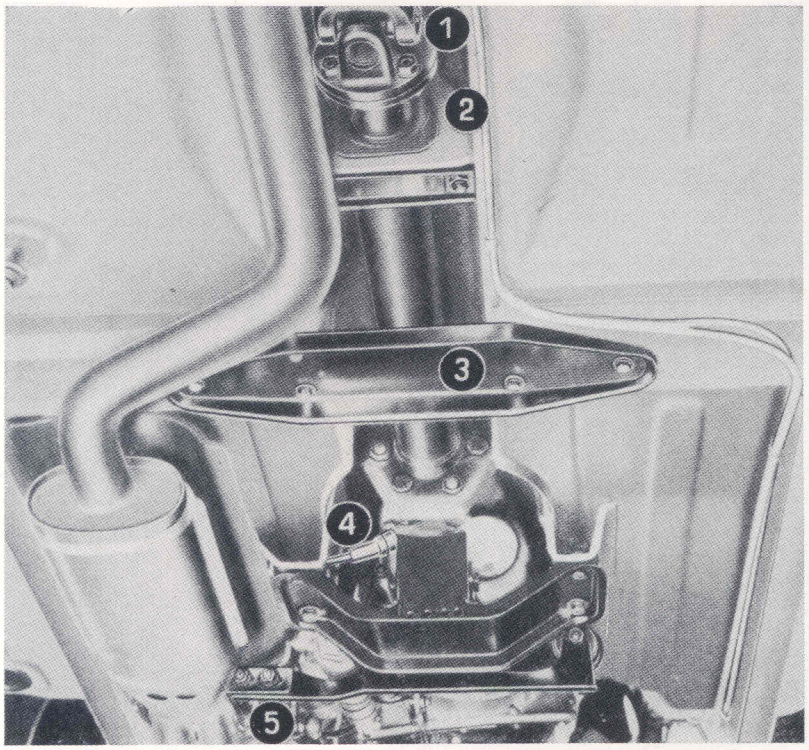




Transmission ratios

1st	gear	3.304 : 1
2nd	gear	1.988 : 1
3rd	gear	1.355 : 1
4th	gear	1.000 : 1
5th	gear	.791 : 1
REVERSE		3.010 : 1

REMOVAL FROM CAR

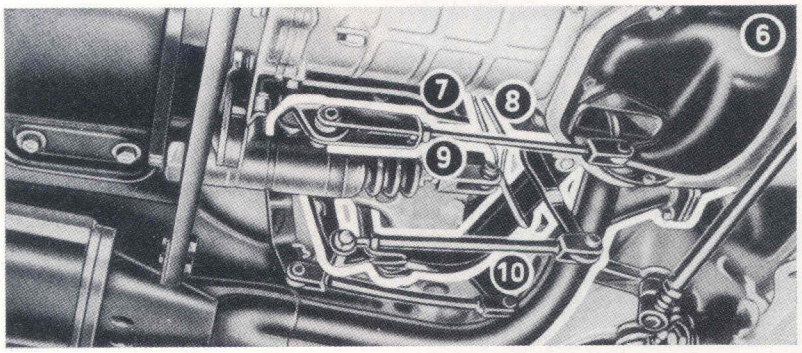


Disconnect:

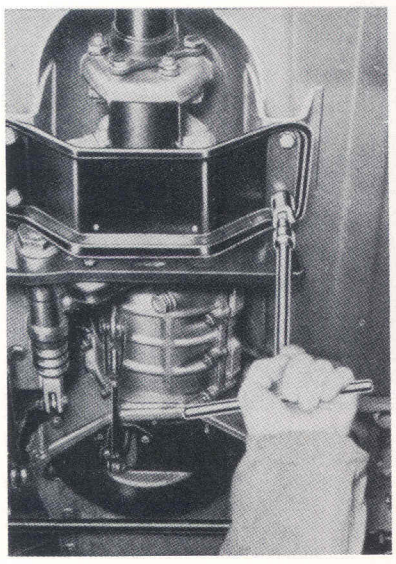
- the propeller shaft front section from rear section at the intermediate joint flange **1**;
- the support of propeller shaft central bearing **2**;
- the cross plate **3**;
- the odometer flexible shaft **4**;
- the exhaust pipe bracket **5** from gearbox.

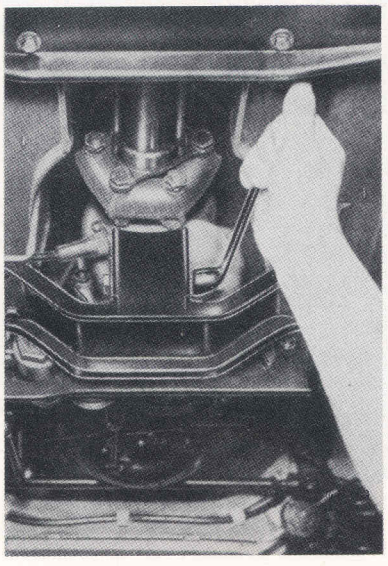
Note - For floor-mounted gearshift remove:

- the carpet and the tunnel cover;
- the boot;
- the gearshift lever from gear engaging and selecting swivel;



- the clutch protection cover **6**;
- the gear selecting lever **7**;
- the leads **8** of back up light switch;
- the clutch disengaging lever **9**;
- the gear engaging lever **10**.





Unscrew:

- the bolts securing the crossmember to the floor;
- the bolt fastening the gearbox to the crossmember and remove the crossmember;
- the bolts securing gearbox to engine.

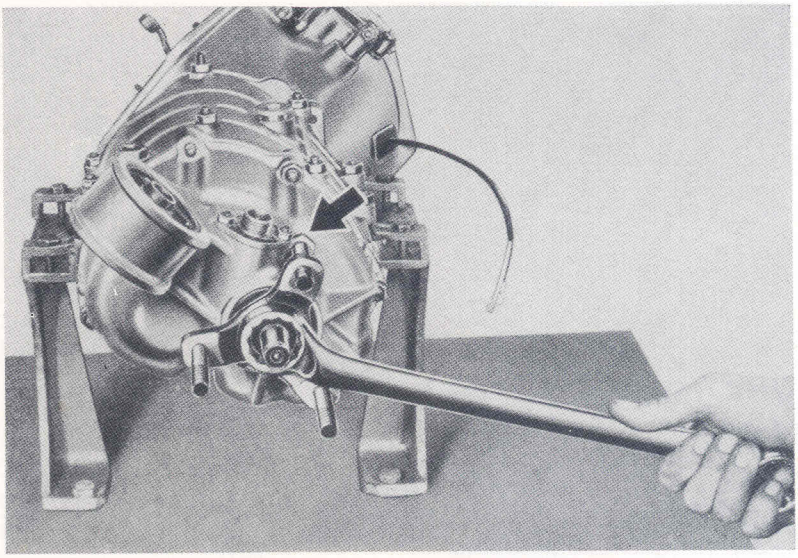
Remove the gearbox and the propeller shaft front sections as a unit.
Drain oil from gearbox.
Disconnect the front section of propeller shaft from the flexible coupling with the tool **A.2.0124.**

Note - Reassemble the gearbox onto the car in reverse order of removal.

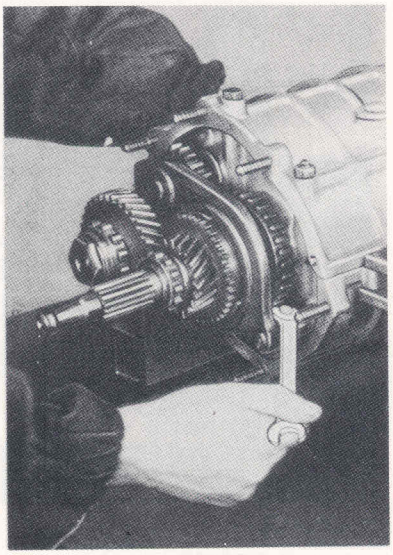
DISASSEMBLY

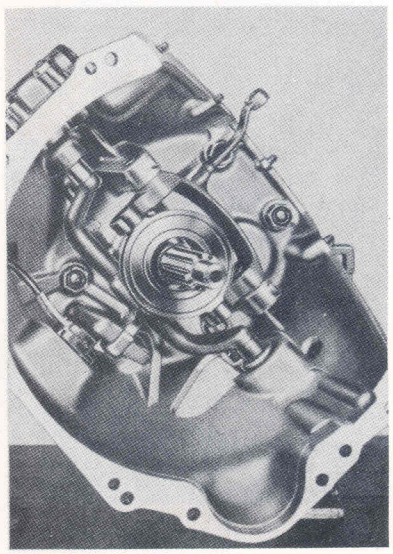
- Place the gearbox assembly on a suitable stand.
- Unscrew the ring nut securing the flexible coupling yoke (keep the yoke from rotating by bringing a bolt at rest against the housing as shown) then remove the yoke.
- Unscrew the nuts securing the rear cover and remove the cover.

Note - For floor-mounted gearshift, engage the 3rd gear to remove the gearbox rear cover.

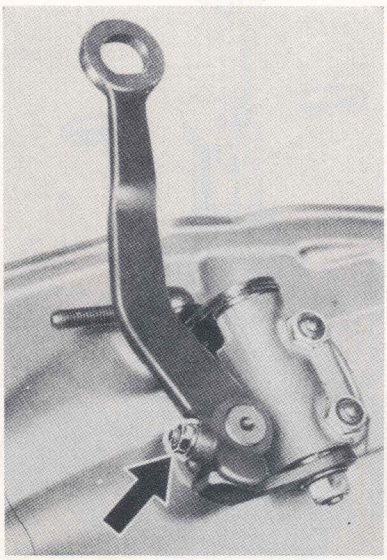


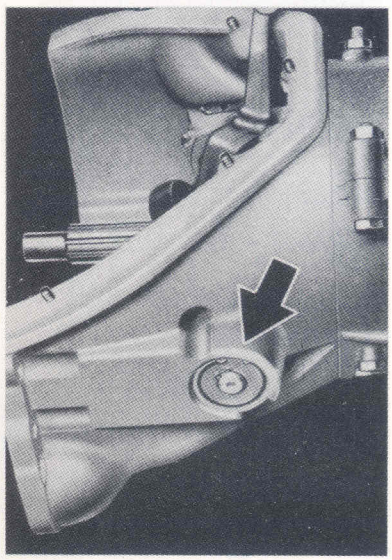
- Unscrew the bolt securing the 5th gear and reverse gear engaging fork so that the striking rod can be moved out thus freeing the gear engaging lever.
- Remove the back-up light switch.
- Remove the throwout bearing from the fork.



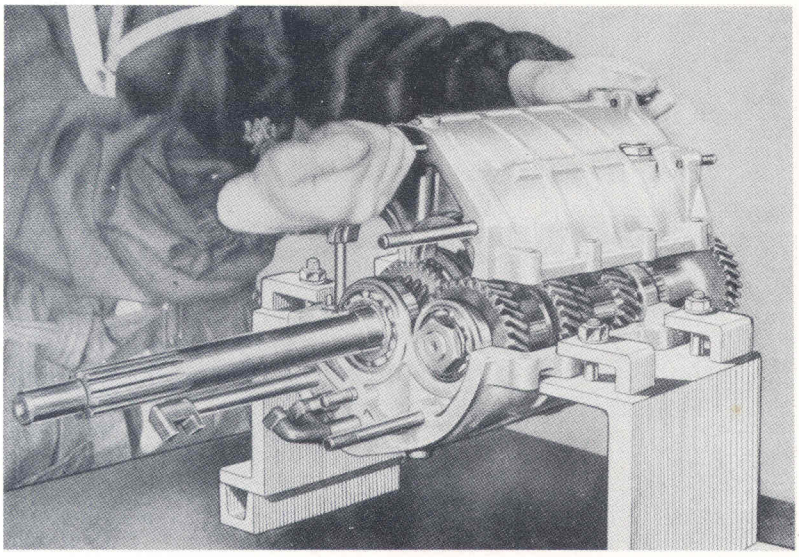


- Unscrew the nut securing the gear engaging lever to the shaft and remove the lever.
- Remove the small retainer ring from the groove in the shaft with suitable pliers.
- Remove the large retainer ring, which secure the seat for reverse gear return spring, from the groove in the boss with suitable pliers and remove the spring seat.
- Withdraw the shaft.
- Unscrew the nuts securing the clutch housing to the gearbox half-casings and remove the housing.



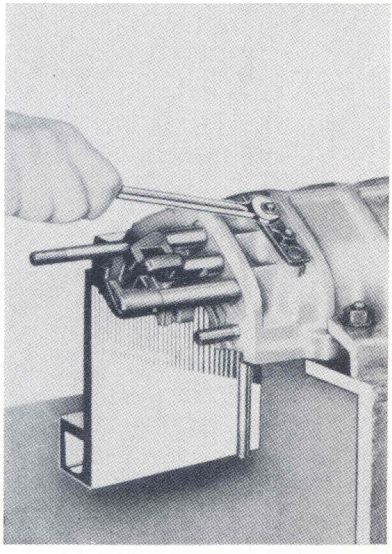


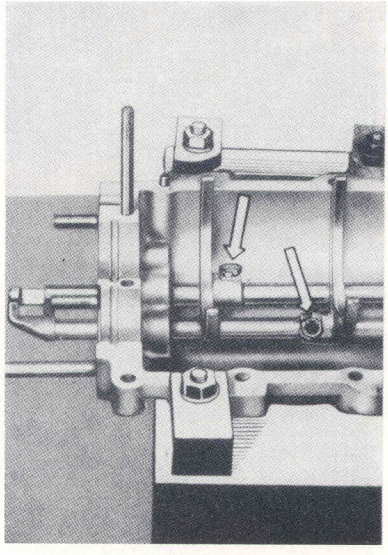
DISASSEMBLY



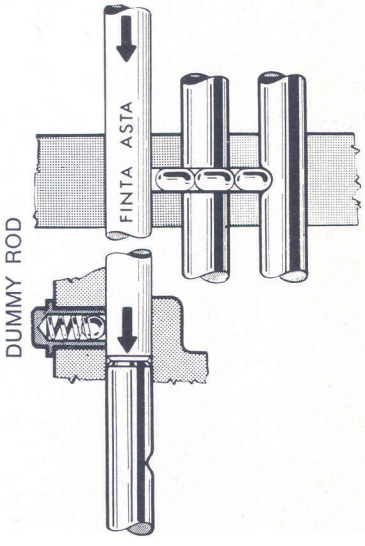
- Unscrew the nuts fastening the half-casings; separate the casing by tapping lightly with a soft mallet and remove the shaft assemblies.

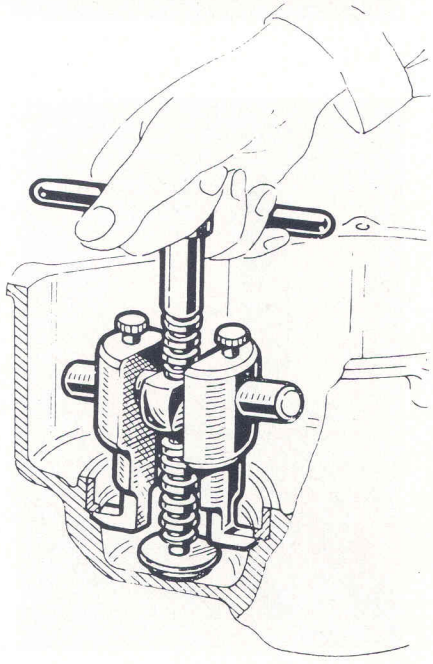
Warning: take care not to damage the half-casing joining surfaces as these must seal without a gasket.





- Unscrew the nuts securing the plate which holds the striking rod ball plungers and withdraw plungers, springs and balls.
- Loosen the setscrews locking the forks to the striking rods, slide out the rods and remove the interlock rollers.



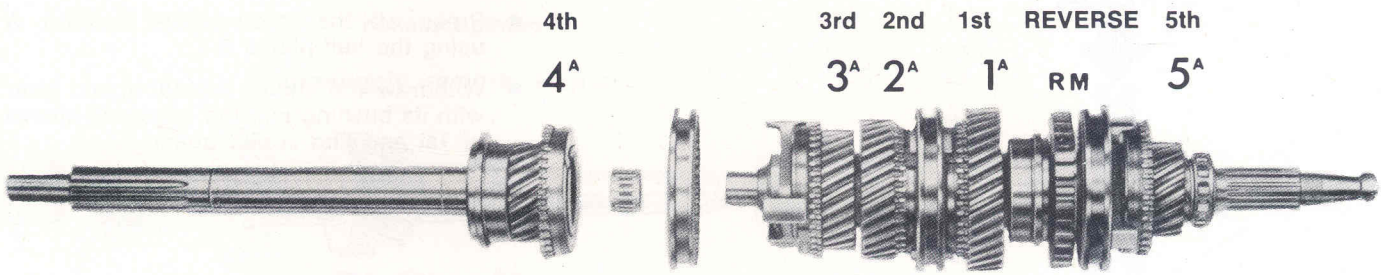


- If only one striking rod has to be taken out to repair a fault proceed as follows:
  - insert a dummy rod from the end opposite that of striking rod withdrawal, so as to hold in position the ball and the interlock rollers.

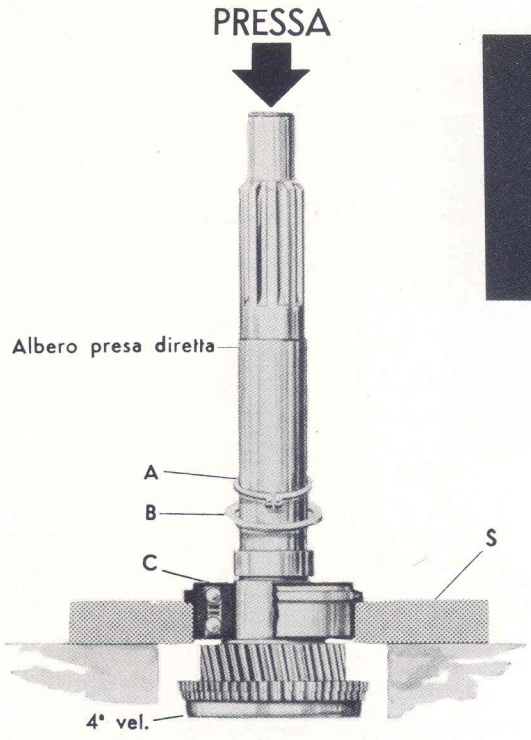
If necessary, remove the outer race of the countershaft rear bearing from the cover with the puller **A.3.0287** (Ref. Tool Bulletin no. 128/1).

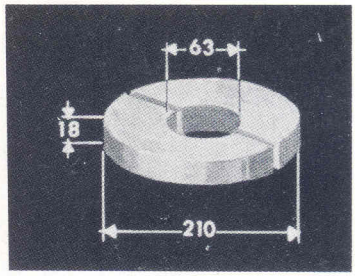
This bearing race should be reinstalled with a suitable punch and the aid of a press.

DIRECT DRIVE & MAINSHAFT



- Separate the mainshaft from the direct drive shaft and remove the roller bearing cage (the races are the shafts themselves).





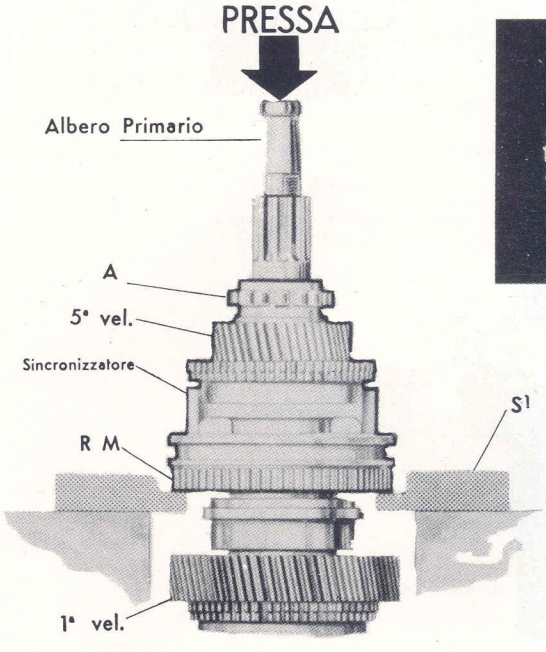
S

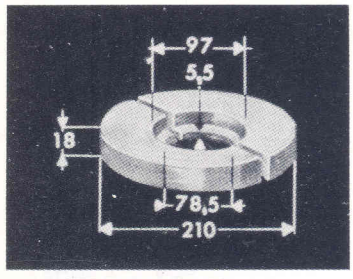
210 mm = 8.27''
97 mm = 3.82''
78.5 mm = 3.09''
63 mm = 2.48''
18 mm = .71''
5.5 mm = .22''

Disassemble the direct drive shaft

- Remove the retainer ring **A** and withdraw the shim **B**.
- Press off the bearing **C** using two half plates **S** as shown.

Pressa = Press
Albero presa diretta = Direct drive shaft
4ª vel. = 4th gear





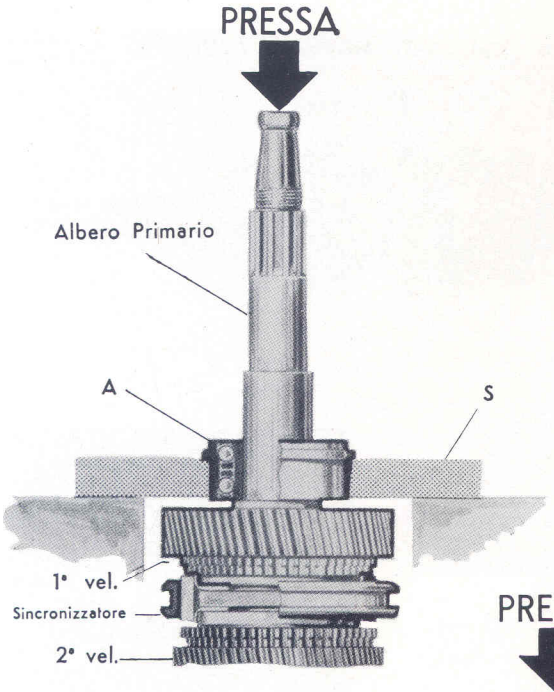
S1

5ª vel. = 5th gear
Albero primario = Mainshaft
Sincronizzatore = Synchromesh
RM = Reverse
1ª vel. = 1st gear

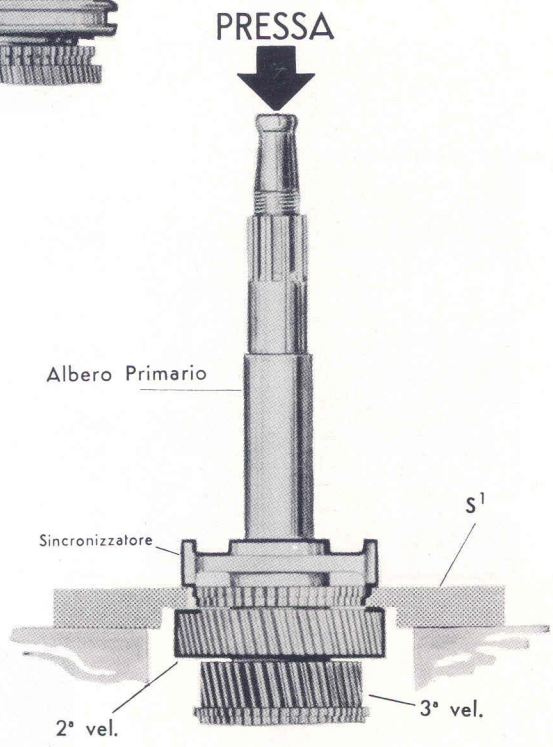
Disassemble the mainshaft

- Using the half-plates **S1** press off the rear bearing **A** of the **5th** speed gear with its synchronizing hub and sleeve, the **reverse gear** and remove the key.

MAINSHAFT



- Press off the intermediate bearing **A** using the half-plates **S**.
- Withdraw the shims, the **1st** speed gear with its bushing and the engaging sleeve of **1st** and **2nd** speed gears.



Pressa = Press

Albero primario = Mainshaft

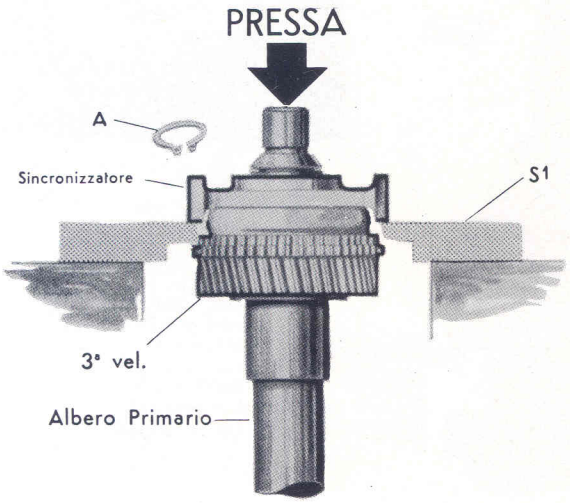
Sincronizzatore = Synchromesh

1ª vel. = 1st gear

2ª vel. = 2nd gear

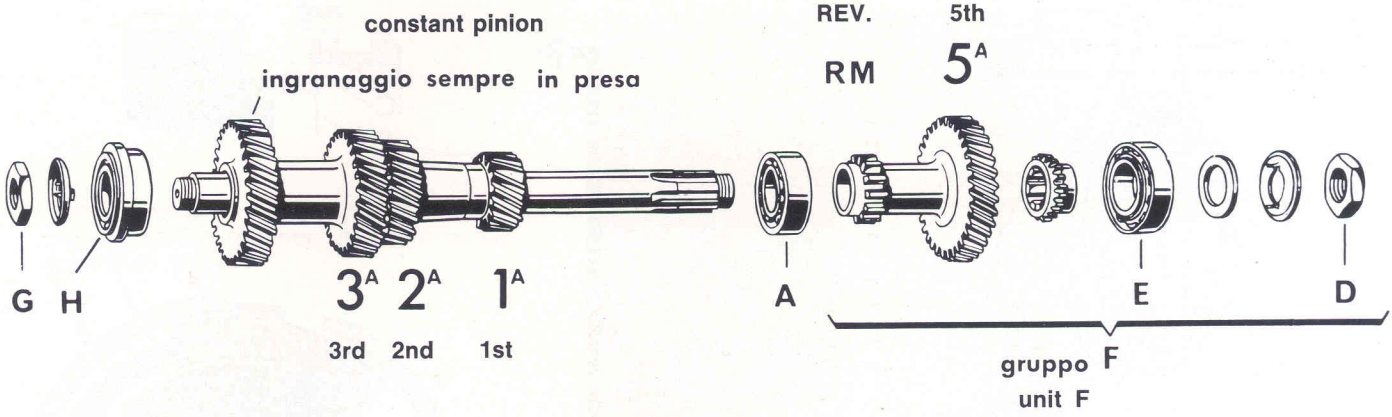
3ª vel. = 3rd gear

- Press off the synchronizing hub of **1st** and **2nd** speed gears using the half-plates **S¹**.
- Remove the keys and slide out the **2nd** speed gear.

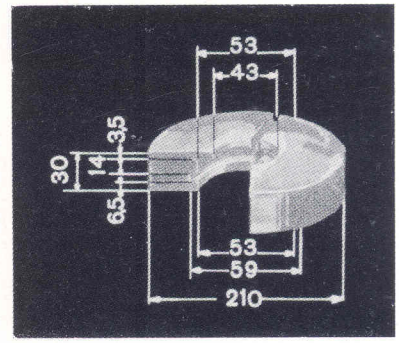


- Remove the retainer ring **A** of the **3rd & 4th** speed gear synchronizing hub.
- Press off the hub using the half-plates **S¹**.
- Slide out the **3rd** speed gear and remove the keys.

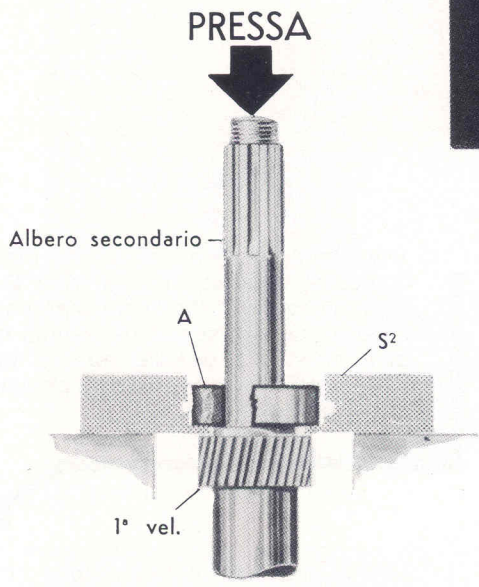
COUNTERSHAFT



- Grip the shaft in a vice with lead jaws.
- Unscrew the nut **D**, remove the roller bearing **E** and the **reverse & 5th** speed gear assembly (unit **F**).



S²

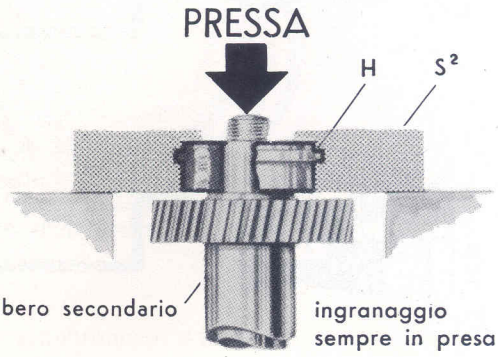


210 mm = 8.27''
59 mm = 2.32''
53 mm = 2.09''
43 mm = 1.69''
30 mm = 1.18''
14 mm = .55''
6.5 mm = .25''
3.5 mm = .14''

- Withdraw the intermediate bearing **A** using two half-plates **S²** as shown.

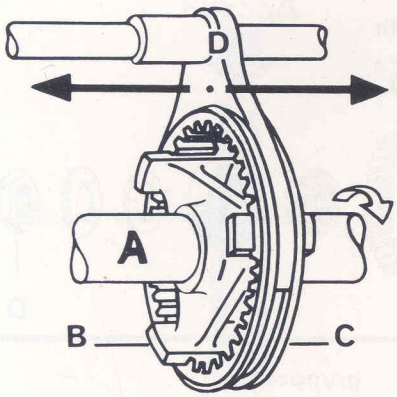
Pressa = Press
Albero secondario = Countershaft
1ª vel. = 1st gear
ingranaggio sempre in presa = Constant pinion

- Again grip the shaft between lead jaws and unscrew the nut **G** securing the front bearing.



- Slip the half-plates **S²** over the rim **H** of front bearing and withdraw the bearing.

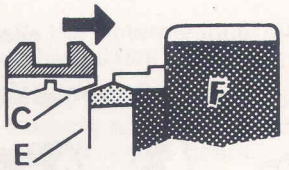
SYNCHROMESH: OPERATING PRINCIPLE

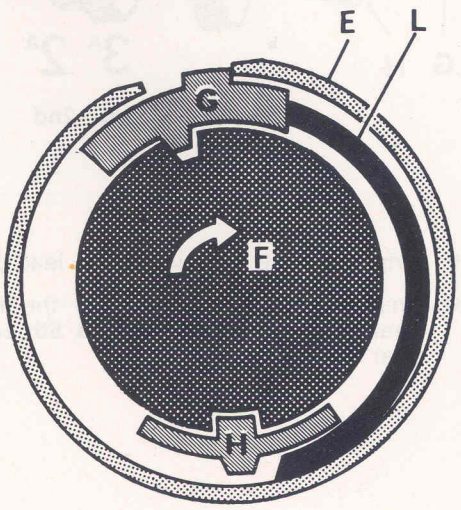


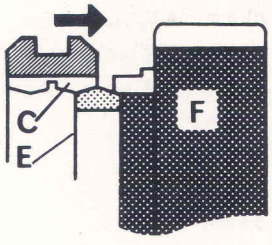
A Shaft
B Hub
C Sleeve
D Fork
E Ring
F Gear
G Stop
H Segment
L Strip

The shaft **A**, the hub **B** and the sleeve **C** rotate solidly together.
As it rotates, the sleeve **C** can be moved back and forth by the fork **D**.

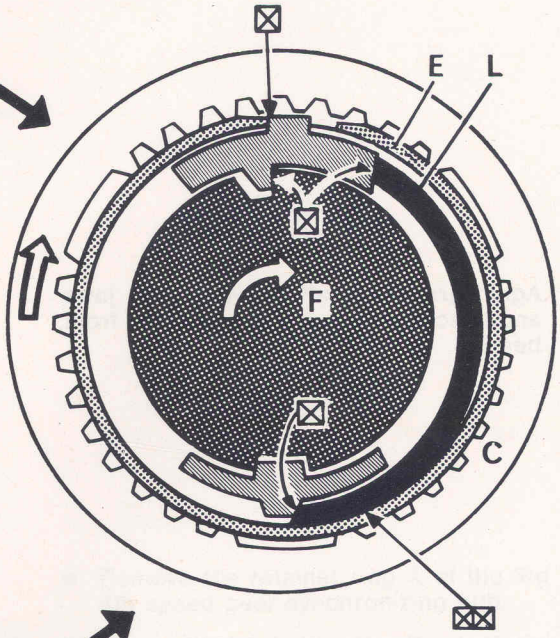
From the neutral position, the sleeve **C** starts moving toward ring **E** which is idle together with **G**, **H** and **L**.

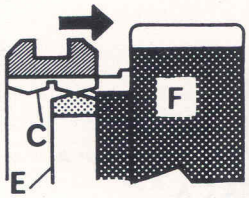




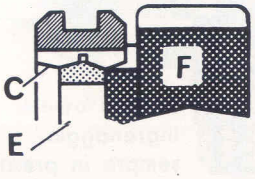


The sleeve **C** goes on in its movement and comes in contact with the ring **E** which then starts to rotate at the same speed as the sleeve. A thrust thus arises at the points marked **X** so that the strip **L** presses against the ring **E** at the point **XX** thus increasing pressure between ring **E** and sleeve **C**.



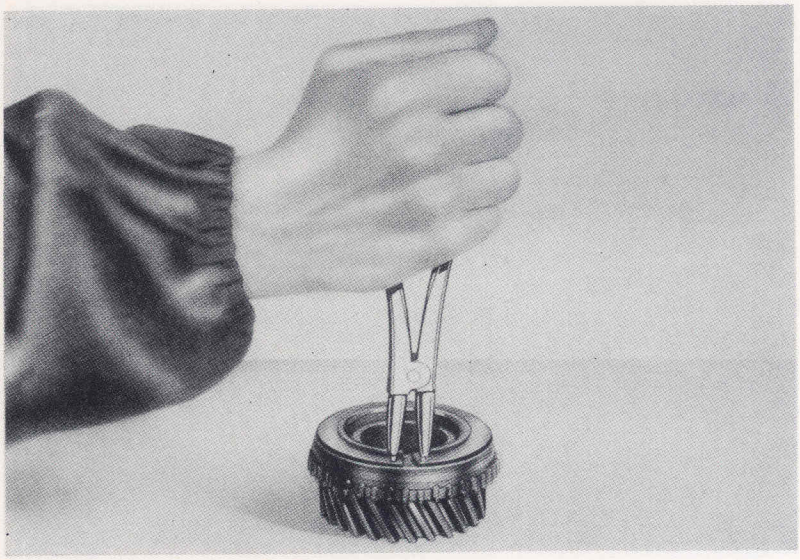


As the sleeve **C** continues to move, the ring **E** is forced over the teeth of the sleeve **C.** The ring **E** is compressed as a result and outward pressure at the point marked **XX** increases, so that there is no possibility of slipping between sleeve **C** and ring **E.**

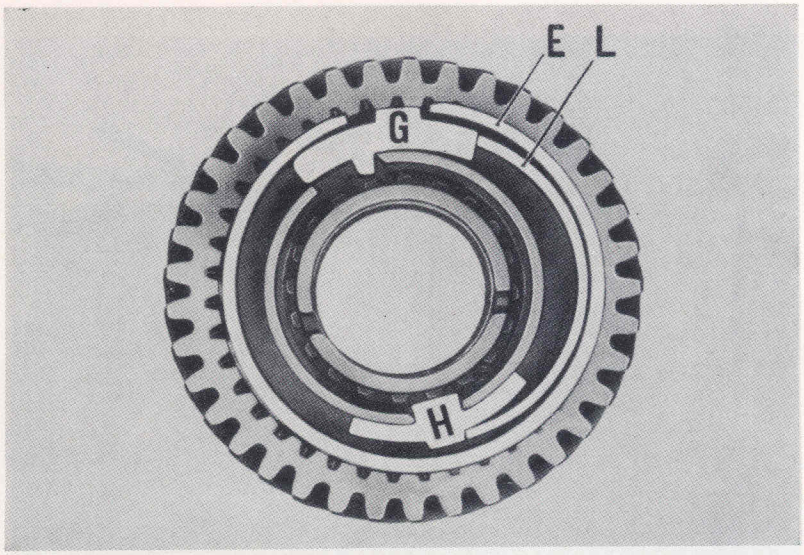


The sleeve **C** and the gear **F** are now turning at the same speed, thus the gear engages easily and smoothly.

SYNCHROMESH INSPECTION



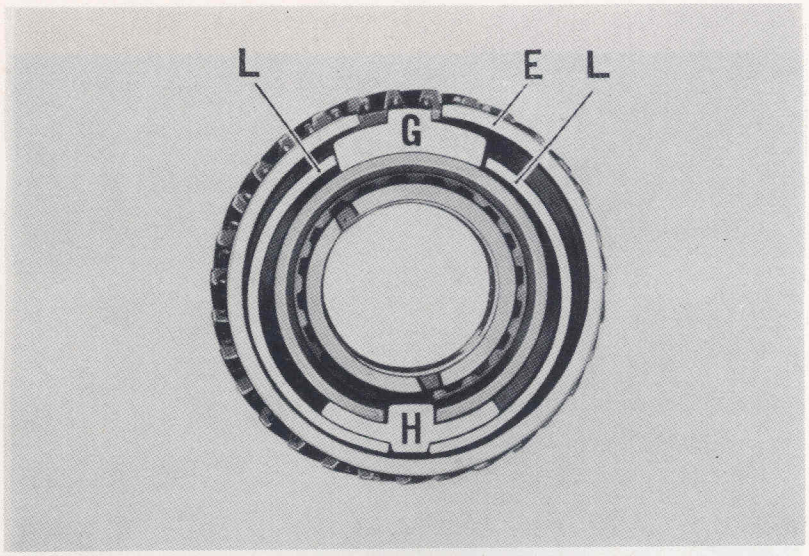
- Disassemble the synchromesh unit by removing the retainer ring with suitable pliers as shown.



1st gear synchromesh unit

- Check that:
  - the engaging teeth shown no sign of seizing or excessive wear;
  - the synchronizing sleeves slide freely on their hubs.

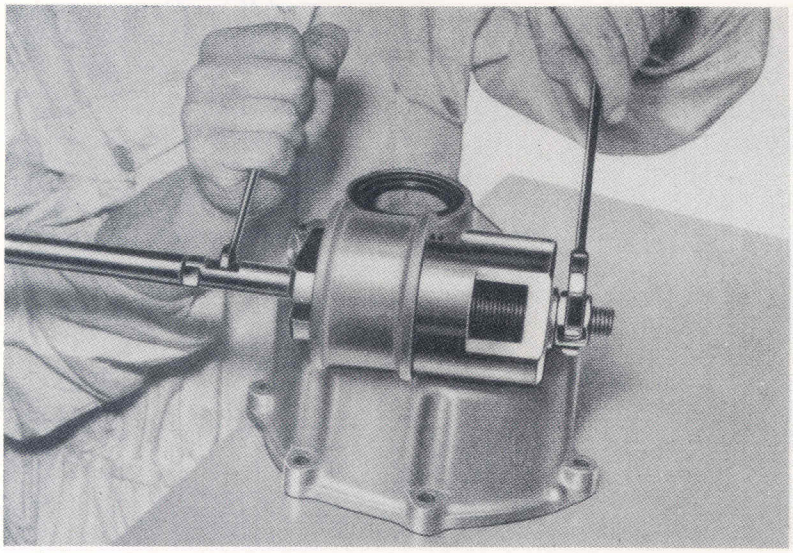
- Check that all synchronizing elements are in good conditions:
  - the rings **E** must shown no sign of excessive wear;
  - the stop **G** and the segment **H** must show no sign of scoring at the contact points with the strips.



2nd, 3rd, 4th & 5th gear synchromesh units

- Reassemble the synchromesh units, taking care that the stop **G**, the segment **H**, the strips **L**, and the ring **E** are properly positioned.

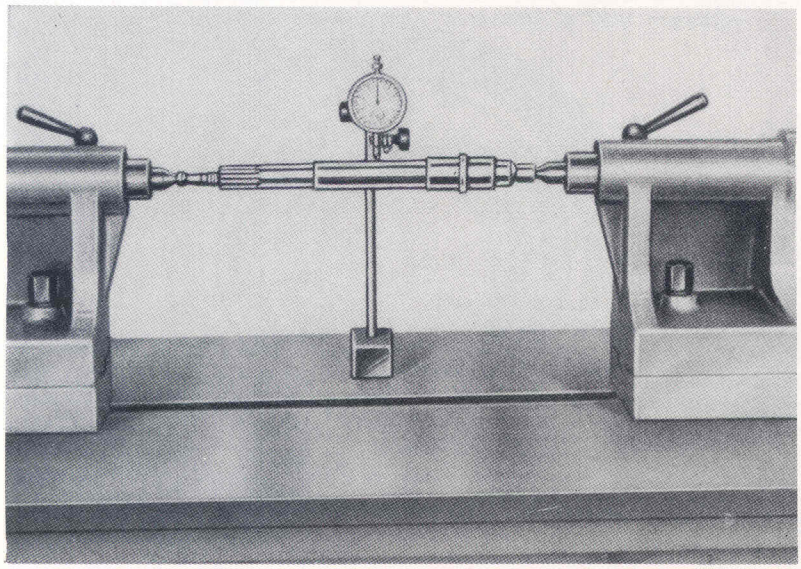
CHANGING SILENTBLOCK MOUNTING PADS INSPECTION AND CHECKING



Changing silentblock mounting pads

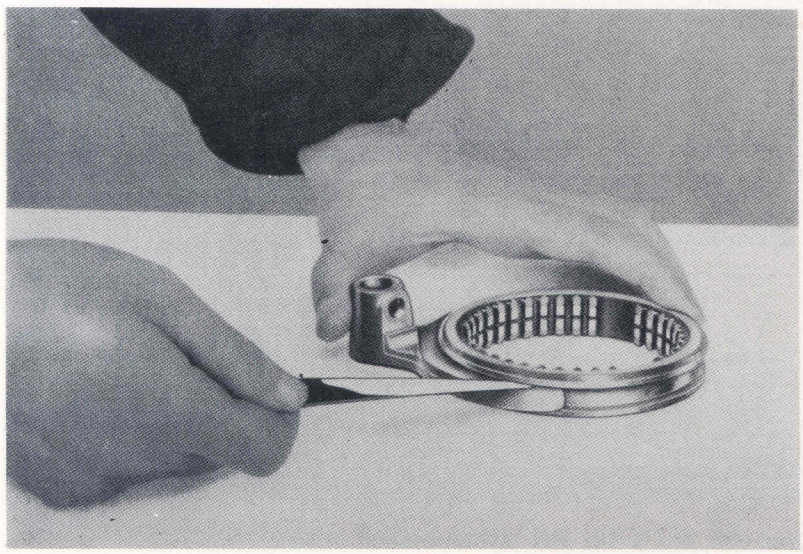
- If necessary, remove the silentblock mounting pads supporting the engine/gearbox unit with the tool **A.3.0118** (Ref. Tool Bulletin no. 46/1. Use the same tool for refitting the silentblock mounting pad.

Note - Removal and refitting of silentblock can be performed without removing the gearbox from car.
However, it is necessary to carry out the preparatory steps for engine removal in order to enable the operator to tilt the engine/gearbox unit and to use the proper special tool.



Inspection and checking

- Place the mainshaft between centers and check the run-out with a dial gauge. The run-out should not exceed: **.05 mm** (.002 in.).
  If this is exceeded, straighten the shaft with a press or replace it with a new one.
- Check that bearings show no sign of seizing or excessive wear.



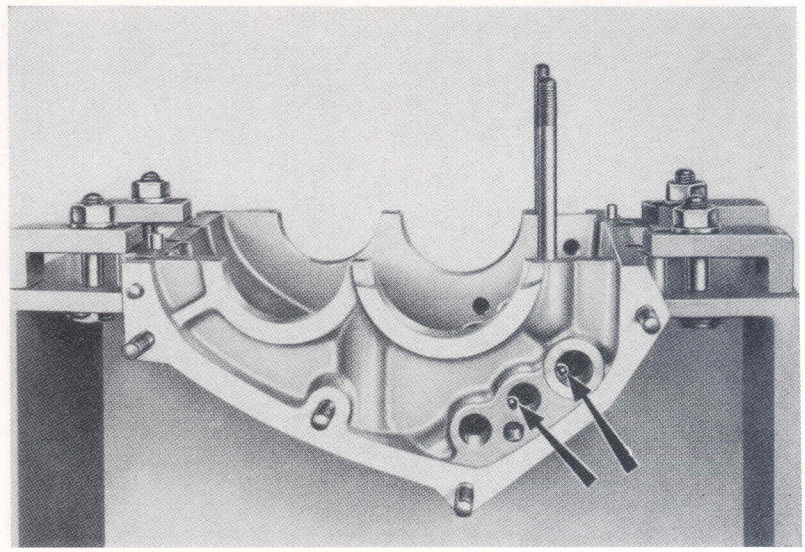
- Check that the working surfaces of the forks and sleeves show no sign of seizing or excessive wear.
- Check that the end play between forks and sleeves is:

  .25 - .50 mm (.0098 - .0197 in.)

  wear limit: .70 mm (.0275 in.).

INSPECTION AND CHECKING

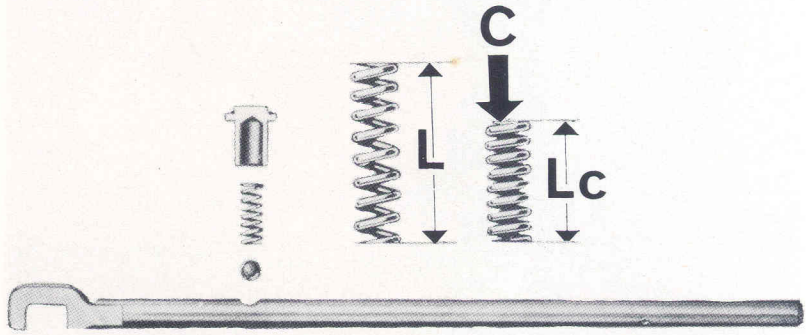
- Check that interlock rollers slide freely in their grooves and that working surfaces of rollers and striking rods are perfectly smooth.
  If a roller should stick, blend the fillet of the striking rod notch with a file.



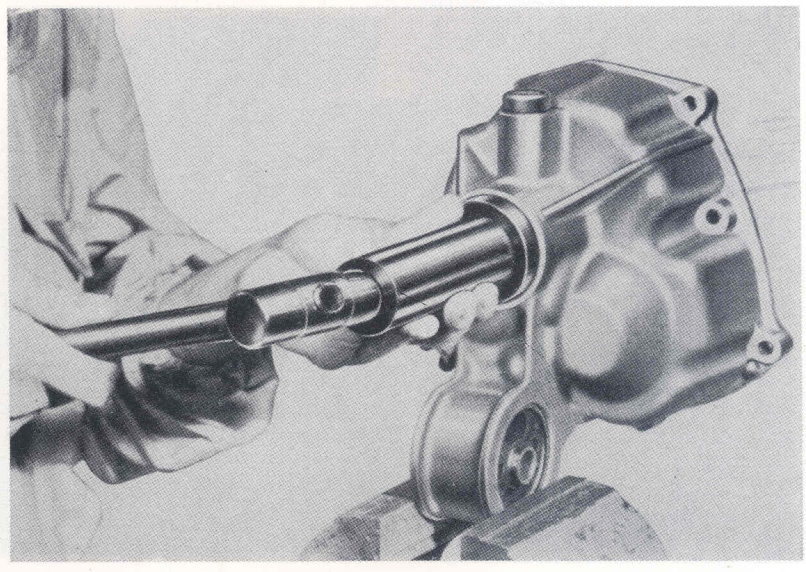
- Check the ball springs for good appearance, and that lengths and load are as prescribed:

  L = 15.2 mm (.598 in.)
  Lc = 10 mm (.394 in.) under a load
  C = 4.67 - 5.05 kg (10.4 - 12.1 lbs).

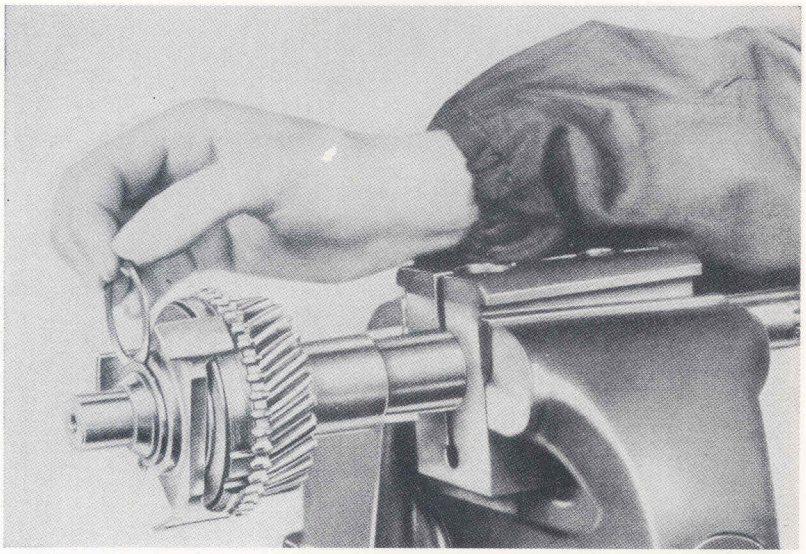
- Check the balls and the notches in striking rods for good conditions.



- Inspect the packings in front and rear covers for good appearance.
  However, it is always advisable to replace them. For installing the packings use the tool **A.3.0180**.



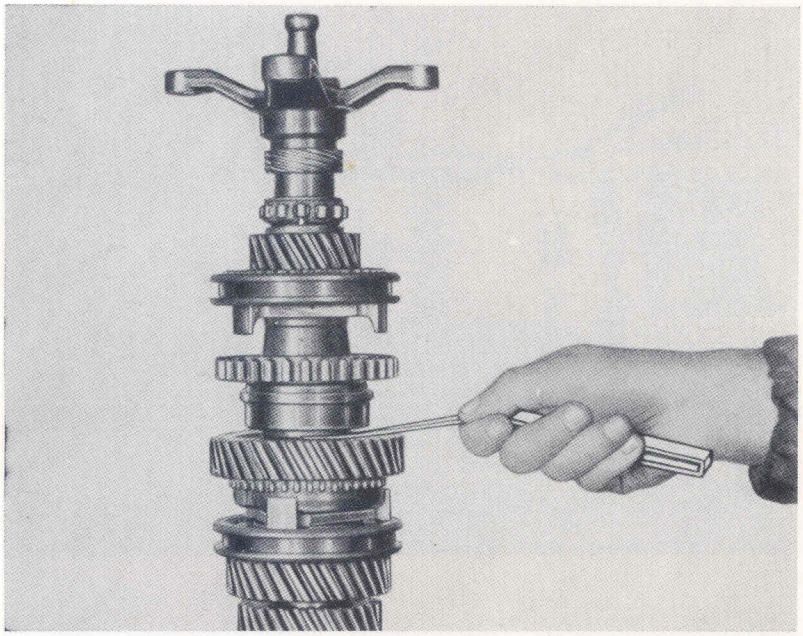
REASSEMBLY



- Place the mainshaft on the tool **A.3.0185** and reverse the order of disassembly according to the following:
  - before assembling, heat the synchronizing hubs to **150° C** (302° F);
  - with the retainer rings fitted, there should be no end play on the direct drive shaft and on **3rd & 4th** speed gear hub; if end play exists, take it up by shiming as required;
  - the end play on mainshaft driven gears with all parts assembled and with the nut locked to a torque of **7.5 - 8 kgm** (54.3 - 57.8 ft-lbs) should not exceed:

    .24 mm (.0095 in.) **for 1st speed gear**

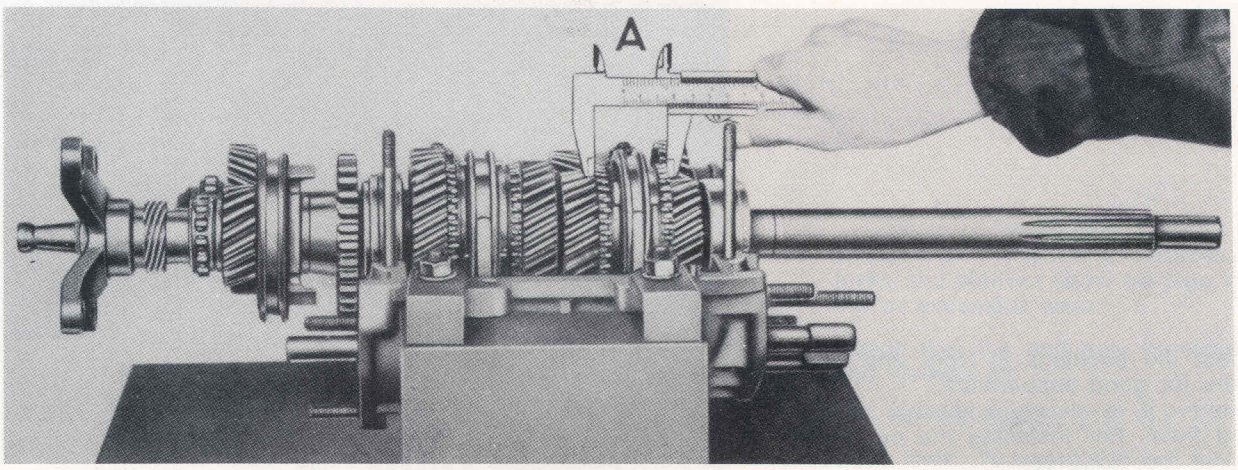
    .21 mm (.0083 in.) **for 2nd & 3rd speed gears.**



- Tighten the countershaft nuts to a torque of **8 kgm** (57.8 ft-lbs).
- After reassembling the direct drive and mainshaft, proceed as follows:
  - install the flexible coupling yoke on the mainshaft and lock the nut to **12 kgm** (86.8 ft-lbs) with a torque wrench and the tool **A.5.0127**;
  - fit the group of two shafts into the half-casing and with a vernier caliper check that:

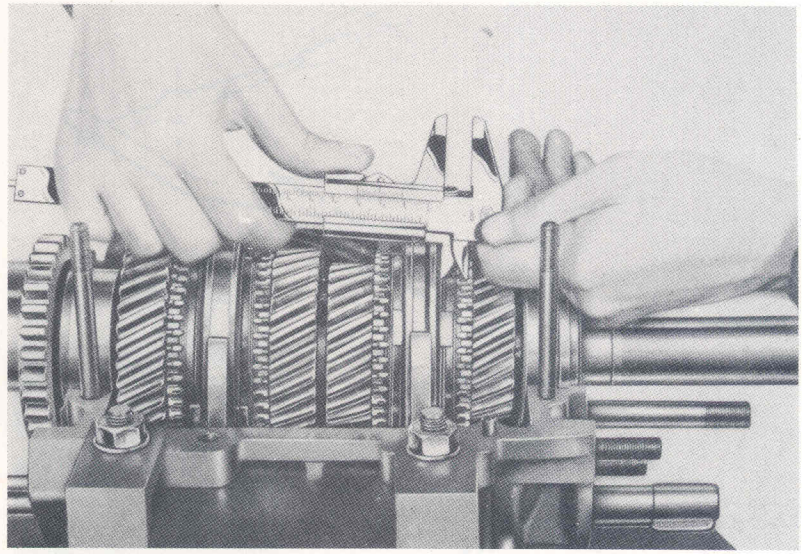
    A = 42 - 42.2 mm (1.654 - 1.661 in.).

If not so, replace the shim between 1st gear bushing and mainshaft bearing inner race accordingly.

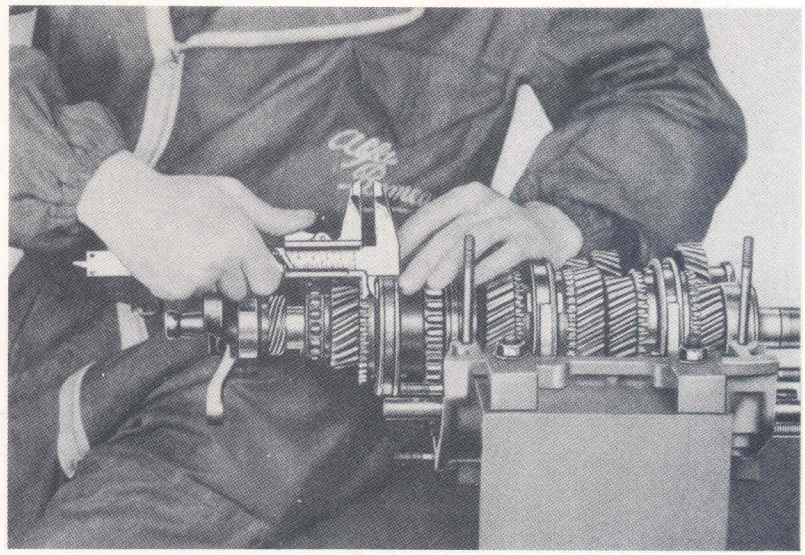


REASSEMBLY

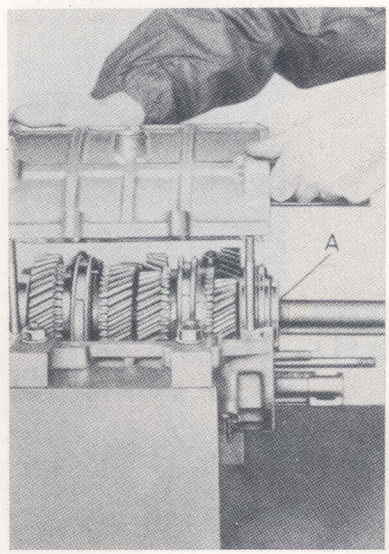
- Before setting the forks on the respective striking rods make certain that:
  - in neutral position, the sleeves of **3rd & 4th** speed and **1st & 2nd** speed gears are equally spaced between the abutments in the engaging teeth of driven gears; to do this use a vernier caliper;

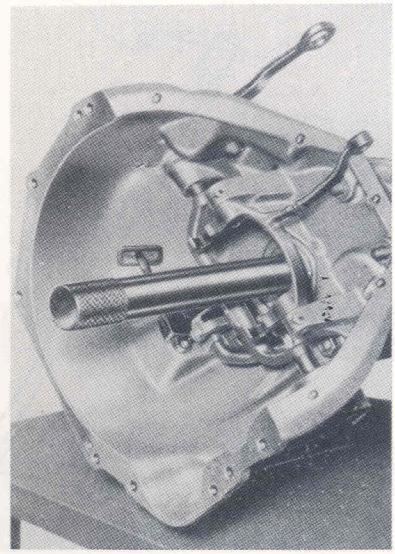


  - in neutral position, the **5th** speed sleeve rear edge is at **10 mm** (.394 in.) from the abutment in the gear engaging teeth.



- Before joining the two half-casings together:
  - set the centering ring **A** in its seat;
  - insert the sliding pinion of reverse gear train onto its spindle.

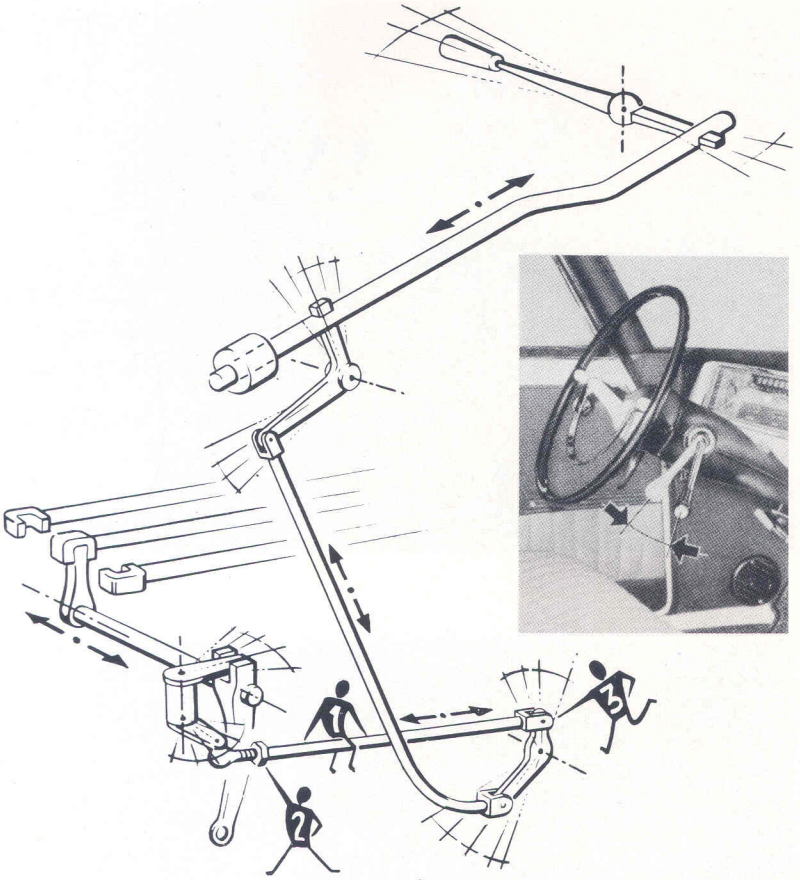




- Install the clutch cover on gearbox. Use the tool **A.3.0114** (Ref. Tool Bulletin no. 24/1) to protect the packing during reassembly.

For floor-mounted gearshift check that, in neutral position, the finger of inner swivel is engaged with the **3rd & 4th** gear striking rod.

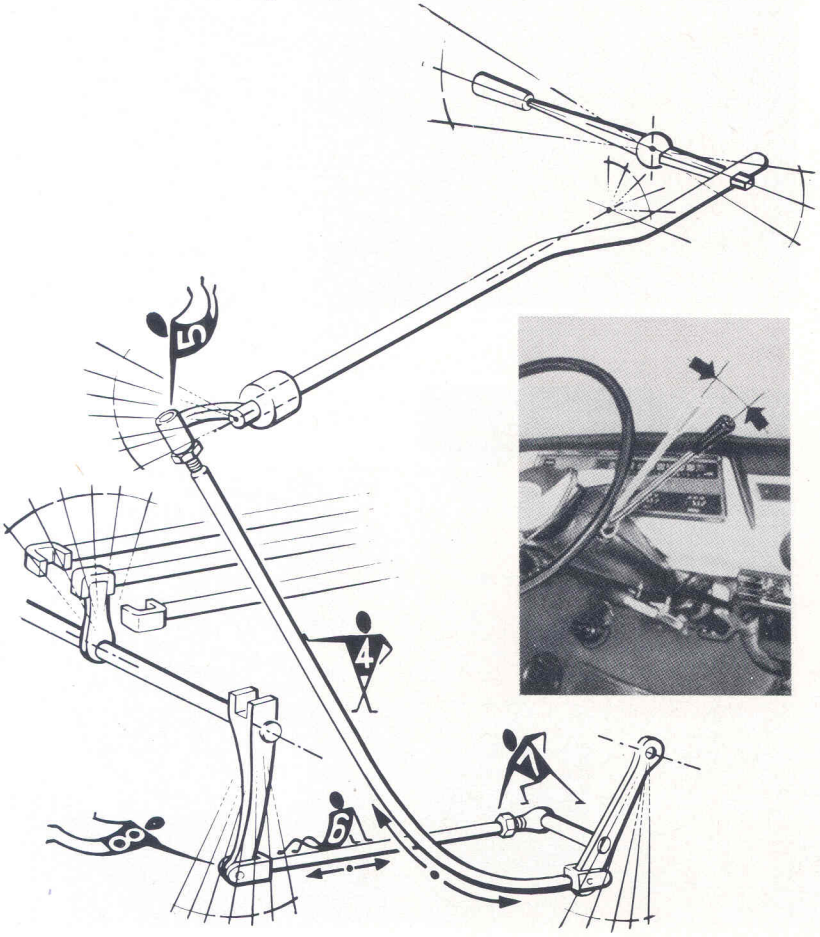
ADJUSTMENT OF CONTROL LINKAGE



Checking gear selector control

- Engage the **1st** or **2nd** gear and check that the shift lever can be moved further toward the steering wheel.
- Engage **5th** or **reverse** gear and check that the shift lever can be moved further toward the dashboard.
- Check that both the above travels are approximately the same.
- If there is no travel toward the steering wheel or it is shorter than travel toward the dashboard **lengthen** the push-pull rod **1** by acting on the adjuster **2**.
- If on the other hand there is no travel toward the dashboard or it is shorter than travel toward the steering wheel, **shorten** the push-pull rod **1** by acting on the adjuster **2**.

To adjust the rod, free it from the lever **3** by removing the pivot pin.



Checking the gear engaging control

- Engage one of the odd gears (**1st, 3rd** or **5th**) and check that the shift lever can be moved further after engagement.
- Engage one of the even gears (**2nd** or **4th**) or the **reverse** and check that shift lever can be moved further after engagement.
- Check that both the above travels are approximately the same.
- If there is no travel with odd gears or it is shorter than travel with even gears or reverse, **shorten** the push-pull rod **4** by acting on the adjuster **5**.
- If on the other hand there is no travel with even gears or the **reverse,** or it is shorter than travel with odd gears, **lengthen** the rod **4** by acting on the adjuster **5**.

If the correct travel cannot be obtained by the above adjustments, adjust the lower push-pull rod **6** by means of the adjuster **7**. To adjust this rod, detach it from the lever **8** by removing the pivot pin.

SPECIAL INSTRUCTIONS FOR

GIULIA T. I. SUPER

GIULIA SPRINT G. T.

The following pages deal with the special features regarding the GIULIA TI SUPER and GIULIA SPRINT GT models. For items not covered here refer to GIULIA TI model.

TECHNICAL FEATURES

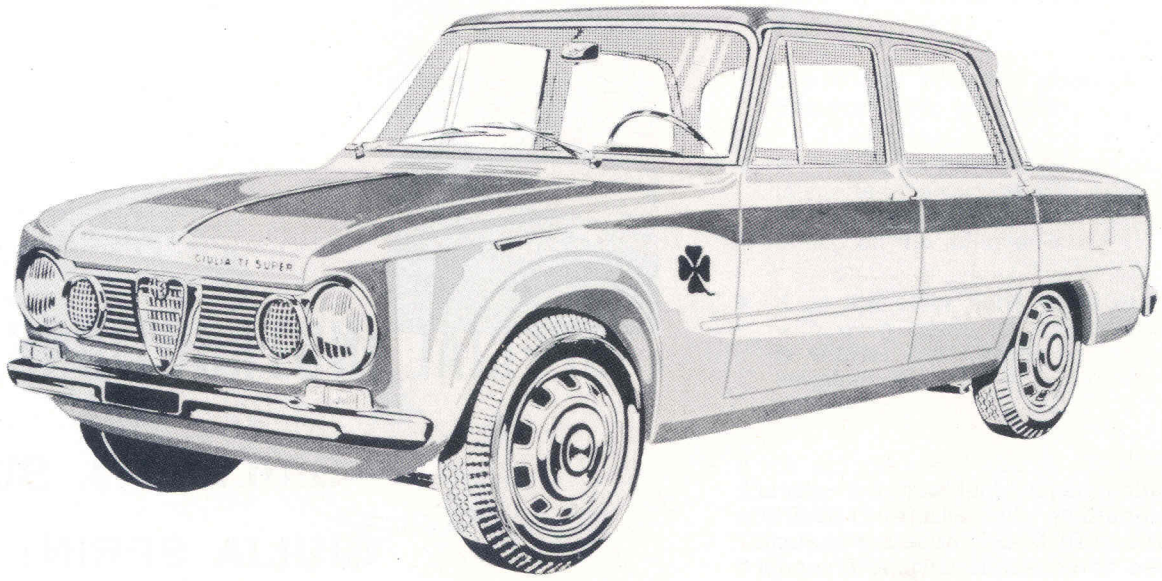
Engine	Number and layout of cylinders		4 in line
	Bore and stroke		78 x 82 mm
	Total displacement		1570 cc
	Maximum power at 6500 rpm	HP	112 DIN / 129 SAE
Steering gear	Recirculating ball or worm-and-roller type		
Chassis	Wheel track	front	1310 mm
		rear	1270 mm
	Wheel base		2510 mm
	Minimum turning circle		10900 mm
	Overall length		4115 mm
	Overall width		1560 mm
	Overall height		1430 mm
	Dry weight		910 kg
	Number of seats		4
	Tyres (Pirelli Cinturato HS)		155-15

Inflation pressures with cold tyres		FRONT	REAR
touring riding with only short burst of speed	with LOW load	**1.7 kg/cm²** (24.1 psi)	**1.7 kg/cm²** (24.1 psi)
	with FULL load	**1.9 kg/cm²** (27 psi)	**1.9 kg/cm²** (27 psi)
continuous top speed on HIGHWAYS	with LOW load	**2.0 kg/cm²** (28.4 psi)	**2.2 kg/cm²** (31.3 psi)
	with FULL load	**2.2 kg/cm²** (31.3 psi)	**2.2 kg/cm²** (31.3 psi)

Performance after running-in (maximum speeds) with **41 : 8** final drive

	km/h	mph		km/h	mph
1st	**44**	27	4th	**146**	91
2nd	**73**	45	5th	**over 185**	115
3rd	**108**	67	Reverse	**48**	30

The performances shown are intended for use in ambient conditions as found in center Europe.

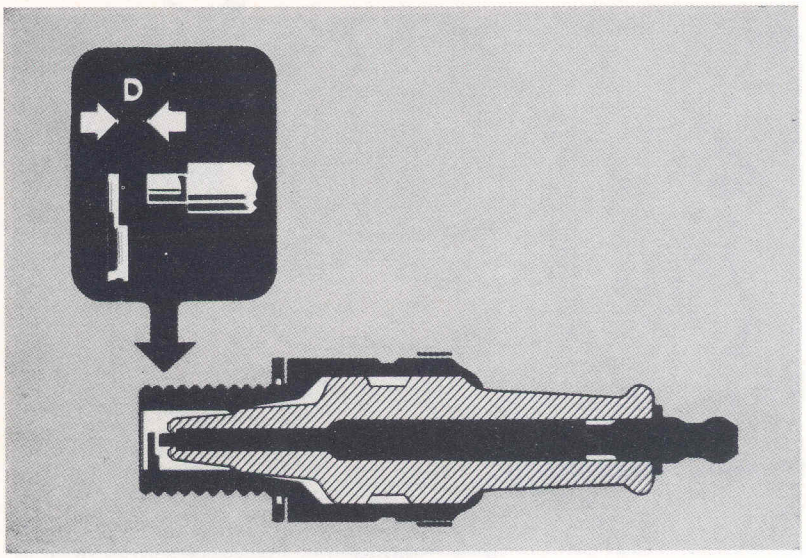


IGNITION

Checking LODGE RL 47 plugs

- Earth the centre electrode of the plug by means of a screwdriver. If the plug sparked properly, now the engine will slow down.
- WARNING: do not disconnect the cables from the plugs with the engine running or the distributor capacitor may be damaged.
- Remove any defective plugs and clean them with a wire brush.
- Reset the electrode gaps:

  D = .38 - .46 mm (.015 - .018 in.).
- Tighten the plugs with a torque wrench and tool **A.5.0115**, at a torque of **2.5 - 3.5 kgm** (18.1 - 25.3 ft. lbs.) when cold, after smearing the threads with graphite grease.

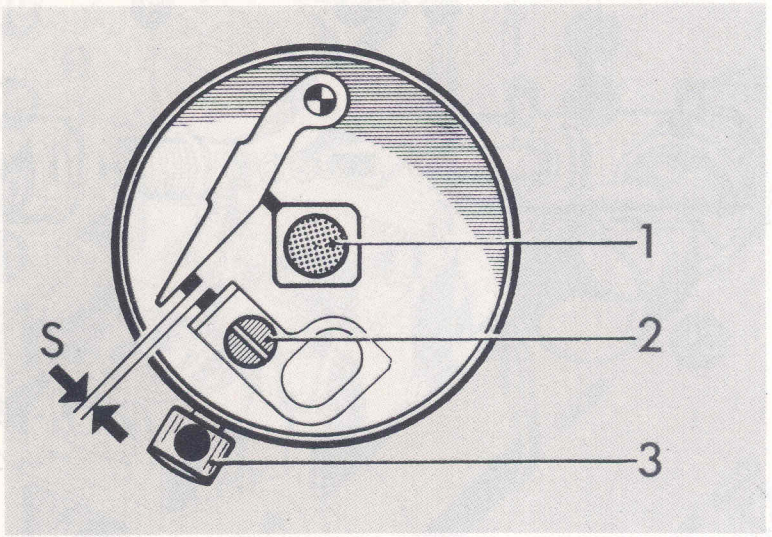


Distributor BOSCH JF 4

This distributor is fitted with the centrifugal advance governor.

- Check with a feeler gauge the gap between the points:

  S = .35 - .40 mm (.0138 - .0157 in.).
- If the points are corroded, smooth them out with a small file and then wash them in petrol.
- Adjust the gap to the correct value by means of the adjusting screw **2** (use a screwdriver and feeler gauge).
- Lubricate by introducing a few drops of oil into the oiler **3** and saturate the felt **1**.



Timing check

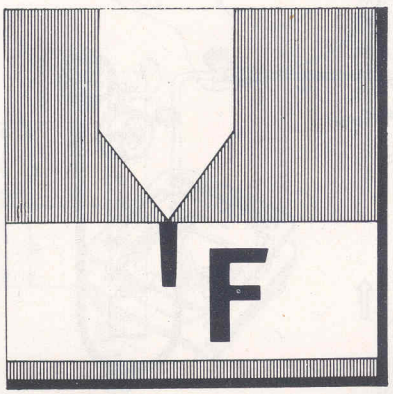
- The timing check should be carried out as indicated on page 11.

  Check the values of ignition advance:

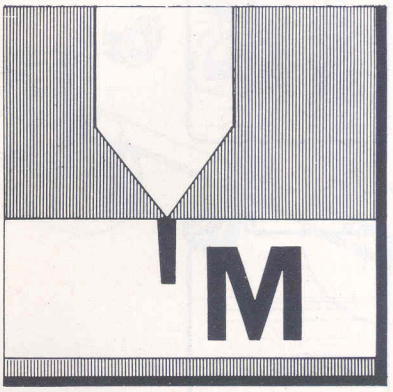
  Fixed advance = **5° ± 2° before TDC**

  Maximum advance = **46° ± 3° at 5000 rpm**

  If the maximum advance is outside these limits, alter the fixed advance, as it is preferable to have the advance exactly right at the higher engine speeds.

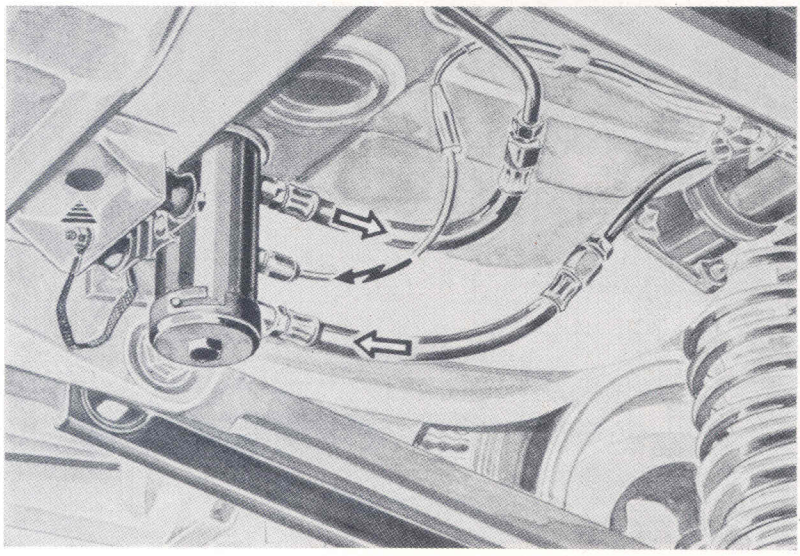


F = Fixed advance reference mark on the drive pulley.

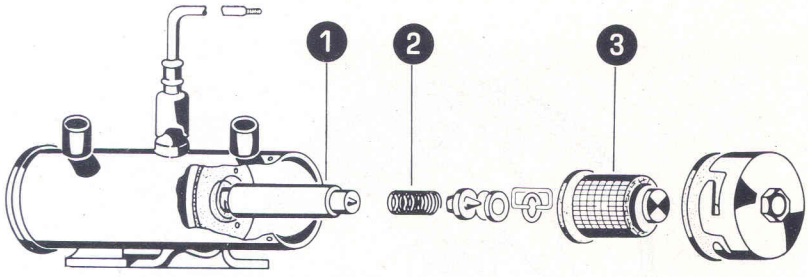


M = Maximum advance reference mark on the drive pulley.

ELECTRIC FUEL PUMP

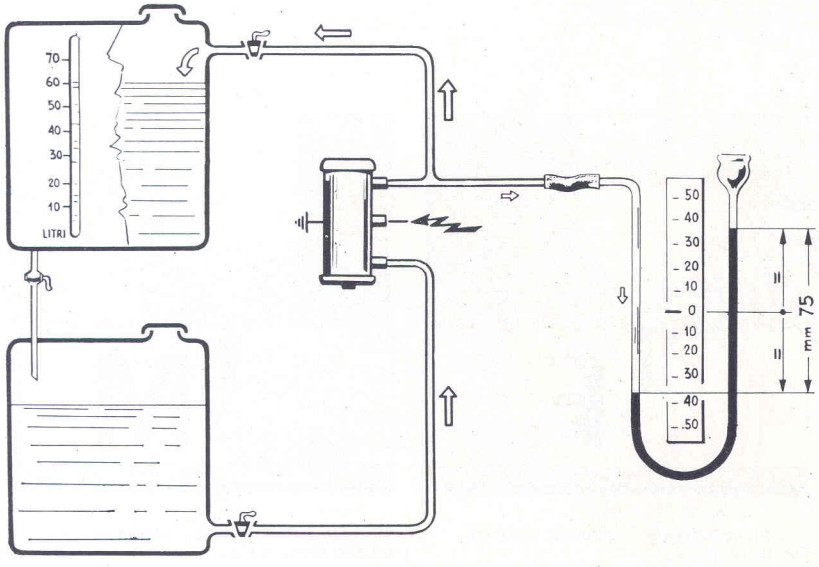


- The Bendix electric fuel pump is located under the floorboards.
- To remove the fuel pump from the car proceed as follows:
  - remove the connectors to the inlet and delivery pipes;
  - disconnect the electrical cable;
  - remove the pump by unscrewing the nuts securing it to the body.



Inspection and checking

- Remove the pump cover and disassemble the pump into its component parts.
- Check:
  - **1** that the pump plunger is not worn or scored;
  - **2** that the plunger return spring is in good condition;
  - that the gaskets are in good condition;
  - **3** that the petrol filter is efficient.
- Carefully clean the parts with petrol and dry with compressed air.



- Reassemble the pump.
- Set up the pump on a suitable test bench and check the following:

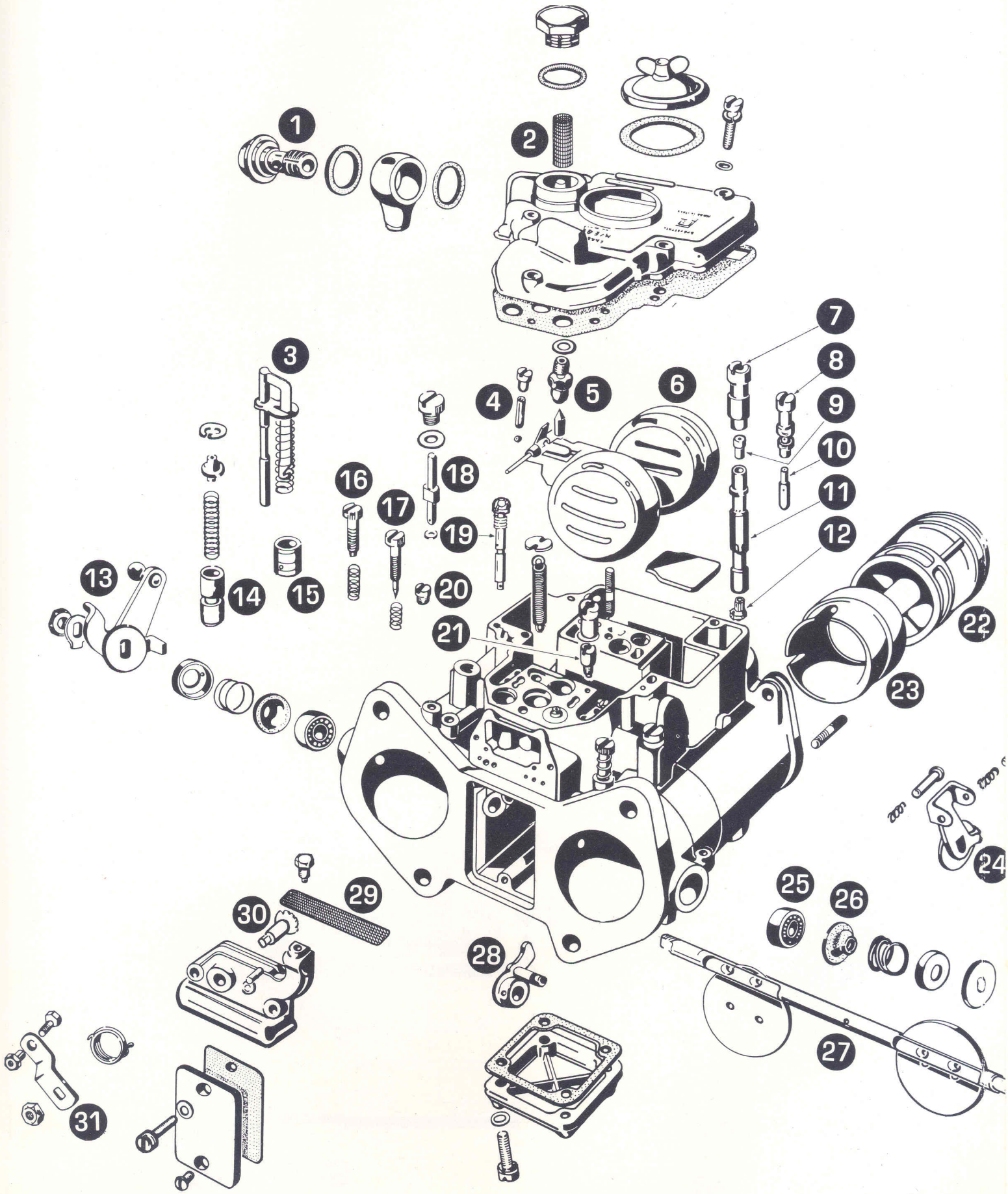
  Outlet pressure = **75 mm Hg** (1.5 psi)

  Delivery = **60 - 70 lt/h**
  (13.2 - 15.4 gph GB)
  (15.9 - 18.5 gph US).
- If these requirements are not met, replace the pump by a new one.

Refitting

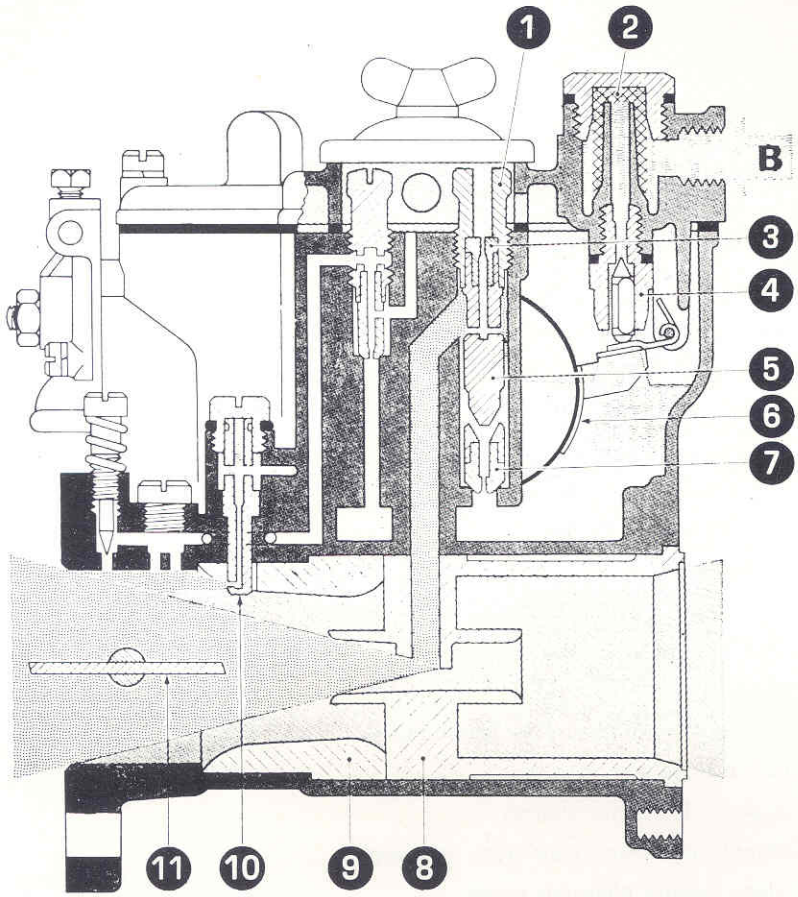
- Refit the pump to the car, checking that:
  - the feed and ground connections to the pump are correct;
  - there are no air locks in the pipes or connectors;
  - the pipes are not buckled or obstructed.

WEBER 45 DCOE 14 CARBURETTORS

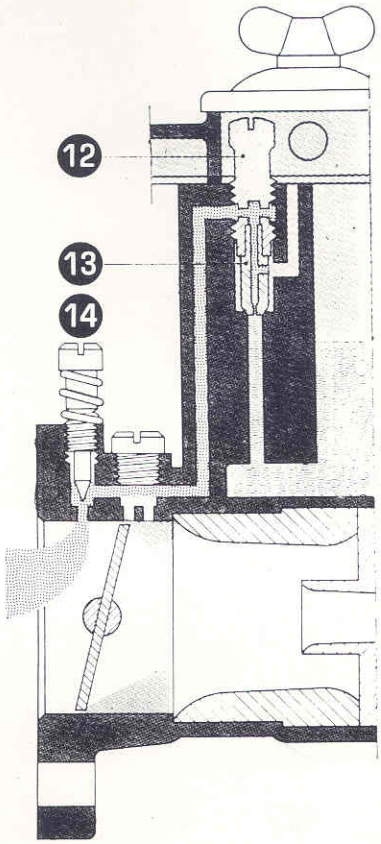


1 Petrol inlet connector
2 Filter gauze
3 Acceleration pump control rod
4 Acceleration delivery valve
5 Needle valve
6 Float
7 Mixture tube holder
8 Idler jet holder
9 Air restrictor jet
10 Idler jet
11 Mixture tube
12 Main jet
13 Throttle control lever (rear carburettor)
14 Choke valve
15 Acceleration pump plunger
16 Throttle adjusting screw (rear carburettor)
17 Idling mixture adjusting screw
18 Acceleration pump jet
19 Choke jet
20 Steady acceleration port inspection screw
21 Inlet and outlet valve
22 Mixer
23 Venturi
24 Throttle control lever (front carburettor)
25 Ball bearing
26 Dust cover
27 Spindle with throttle valves
28 Acceleration pump control lever
29 Choke air filter gauze
30 Toothed quadrant for choke valve
31 Choke control lever

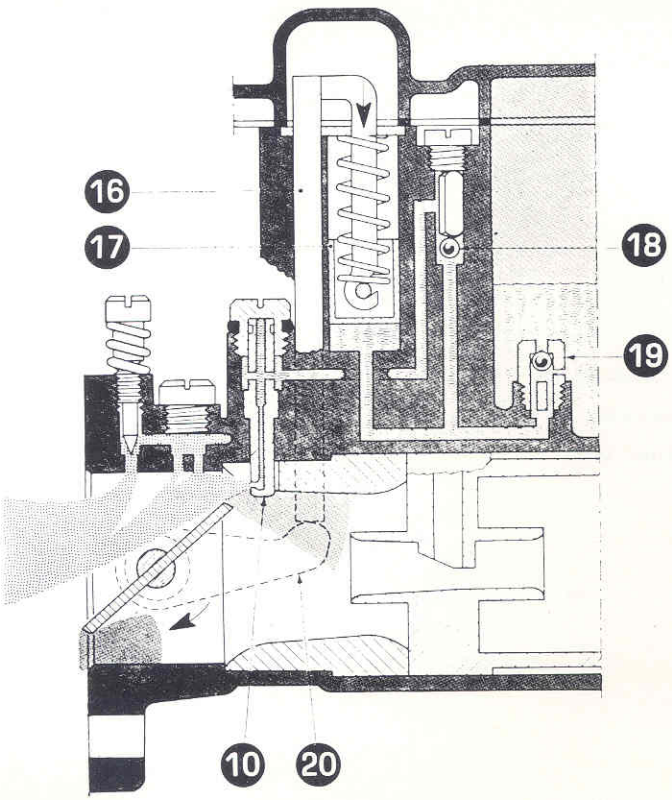
FULL LOAD RUNNING



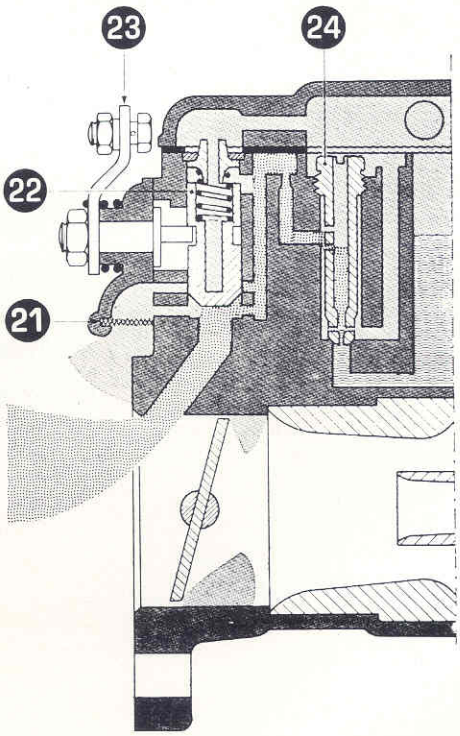
IDLING AND STEADY ACCELER

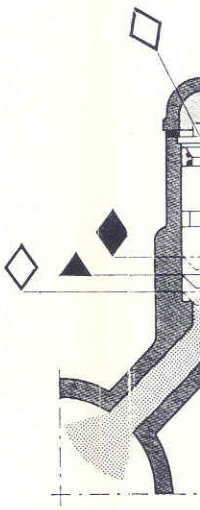


ACCELERATION



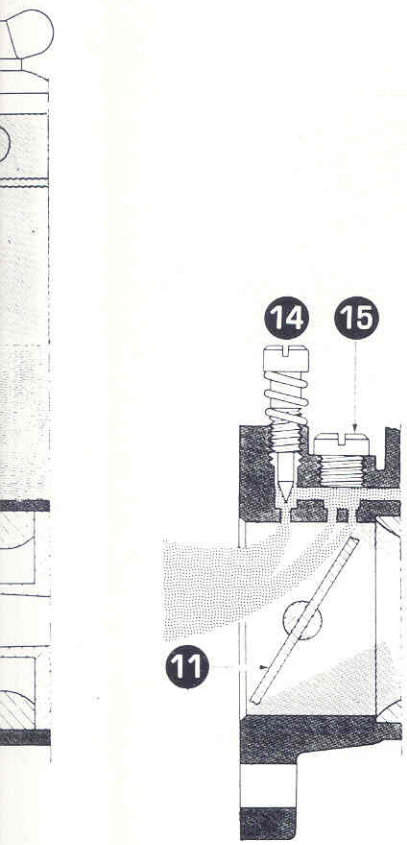
CHOKE



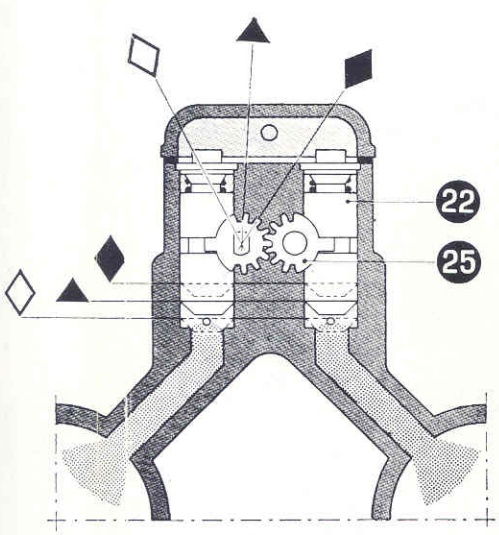


WEBER 45 DCOE 14 CARBURETTORS

EADY ACCELERATION



OKE



B Petrol intake
1 Mixture tube holder
2 Filter gauze
3 Air restrictor
4 Needle valve
5 Mixture tube
6 Float
7 Main jet
8 Mixer
9 Venturi
10 Acceleration pump jet
11 Throttle valve
12 Idler jet holder
13 Idler jet
14 Idling mixture adjusting screw
15 Steady acceleration port inspection screw
16 Acceleration pump control rod
17 Acceleration pump plunger
18 Delivery ball valve
19 Inlet and outlet valve
20 Pump control lever
21 Choke air filter gauze
22 Choke valve
23 Choke control lever
24 Choke jet
25 Toothed quadrant for choke valve

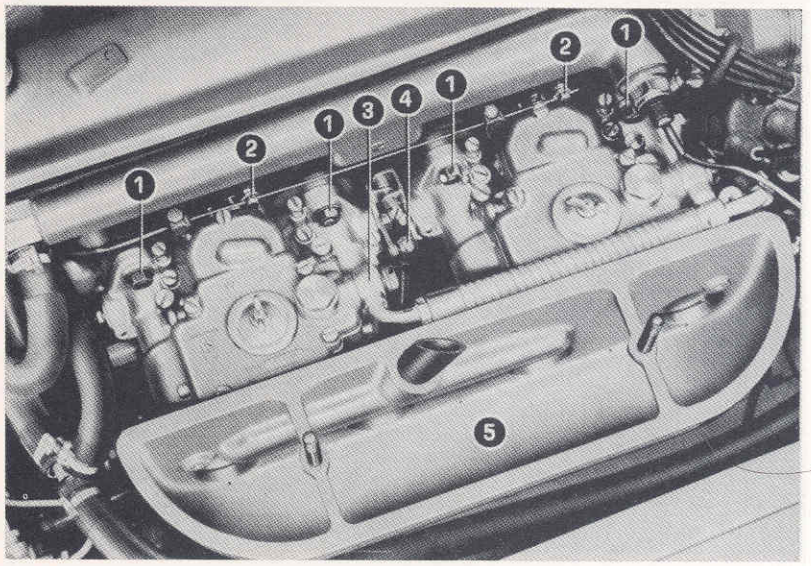
Position of valve plunger **22** and choke control lever **23**:

◆ Choke in
▲ Choke partly in
◇ Choke out

WEBER 45 DCOE 14 CARBURETTORS

Removal from the engine

- Remove:
  - the air intake cover from the carburettor; first remove the air intake tube clamps;
  - the air intake box **5** from the carburettor;
  - the choke wire **2** from the carburettor body;
  - the throttle control **4** from the carburettor body;
  - the petrol feed pipe **3**;
  - the nuts **1** from the studs which fix the carburettor body to the intake manifold.

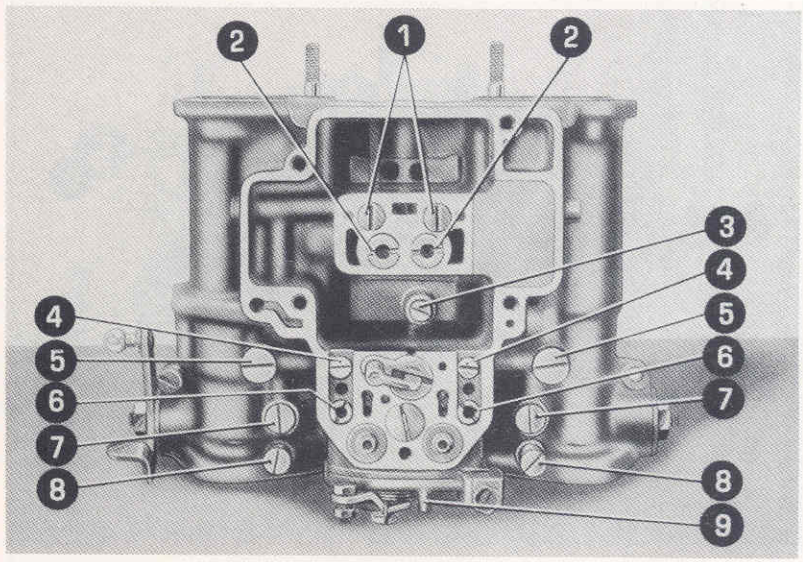


Dismantling

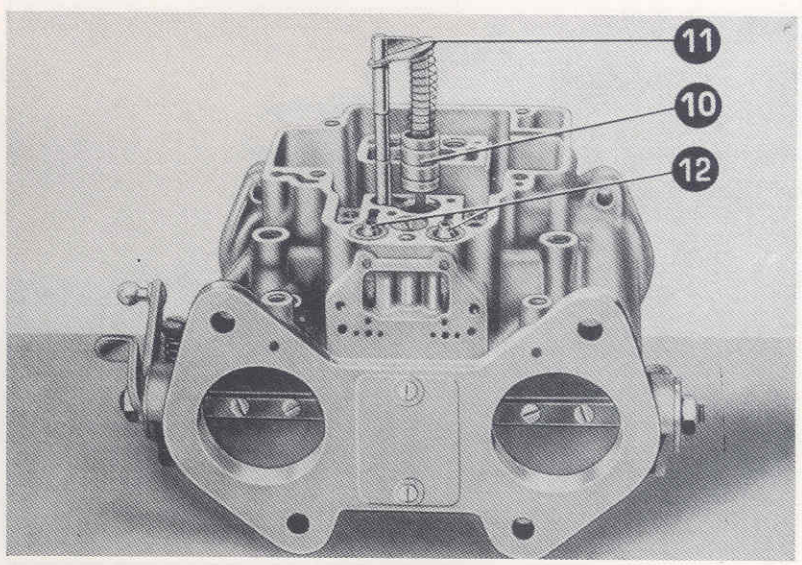
- Remove:
  - the cover from the carburettor and disassemble the petrol filter gauze, the float, the needle valve, the gasket.

Warning: lift off the cover very carefully so as not to distort the float.

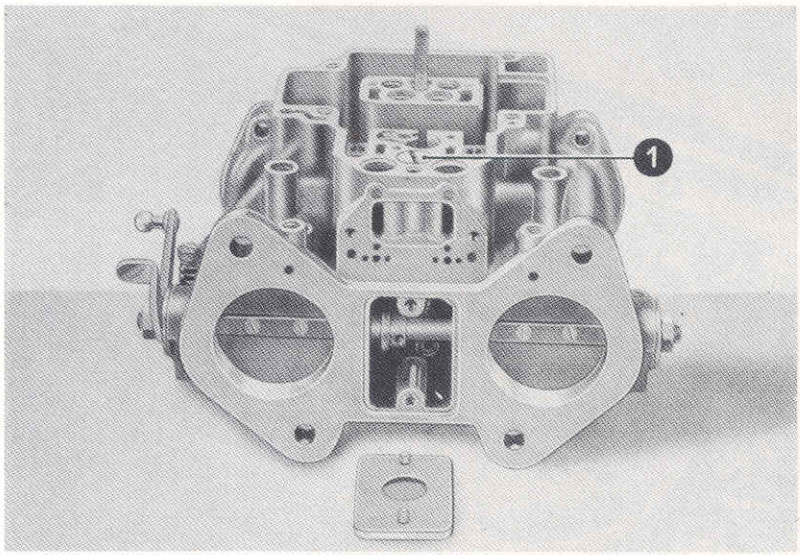
- Remove:
  - **1** the idling jet holder and its jet;
  - **2** the main jet;
  - **3** the inlet valve from the acceleration pump (screw plugs, ball seats and balls);
  - **4** the acceleration pump delivery valve;
  - **5** the acceleration pump jet;
  - **6** the choke jet;
  - **7** the inspection screws from the steady acceleration port trap;
  - **8** the idling mixture adjusting screw;
  - **9** the choke assembly.



- Remove:
  - the acceleration pump **10**, after detaching the spring plate **11** from its seat on the body by means of a screwdriver;
  - the choke valves **12** with their springs and spring seats after releasing the circlips from the body.



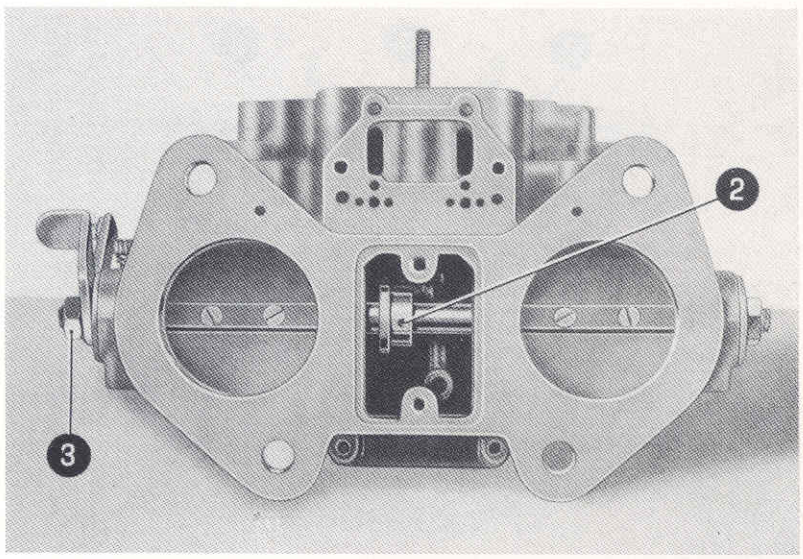
WEBER 45 DCOE 14 CARBURETTORS



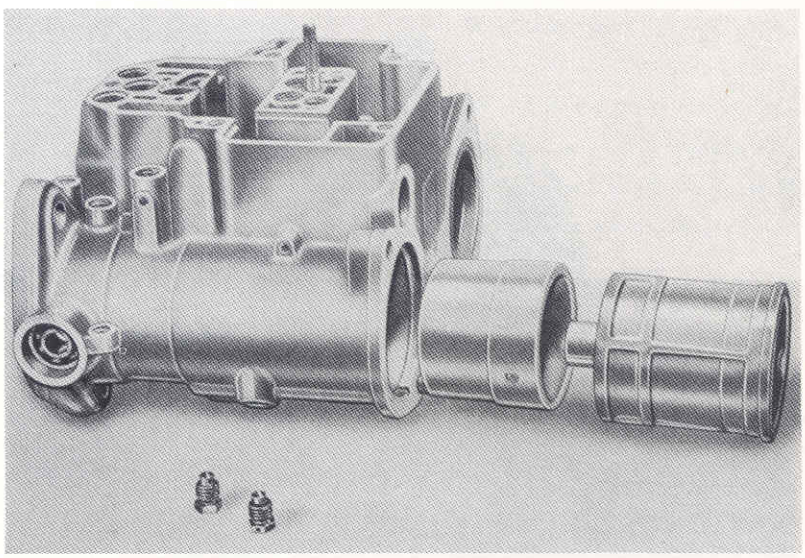
Unless absolutely necessary, it is inadvisable to remove the throttle valve spindle.

If this operation has to be performed:

- remove the small cover as shown;
- disengage the spindle return spring after removing the retaining plate **1**;



- mark the positions of the throttle valves with respect to the spindle and of the spindle to the body of the carburettor;
- detach the throttle valves from the spindle;
- remove the locking pin **2** from the pump control lever;
- unscrew the nut **3** and withdraw from the spindle the control lever with its shim, the spring retaining cover, the spring and the dust cover;
- withdraw the spindle from the opposite side, at the same time removing the acceleration pump control lever, the spring and the retaining cover.



- Remove the end cover from the float chamber, situated in the lower part of the carburettor.
- Remove the mixers and the venturis after having loosened the setscrews.

WEBER 45 DCOE 14 CARBURETTORS

Cleaning

- Very carefully wash with petrol and clean with compressed air all the parts dismantled, being careful to remove all impurities which may have been deposited in the filter trap bottom, the float chamber bottom, in the passages or in the calibrated jet bores, the air restrictors (air calibrators), the mixture tubes, the idling mixture passages, steady acceleration ports, etc.

Warning: when cleaning jets and calibrated bores in general, **never use metal needles or other tools** which may change the diameters of the bores.

Inspection and checking

- Check that the numbers stamped on the jets are in agreement with those given in the table.

Choke

1	jet	65

Idling

2	jet holder	—
3	jet	55
	· axial hole	220
	· air calibrator hole	120

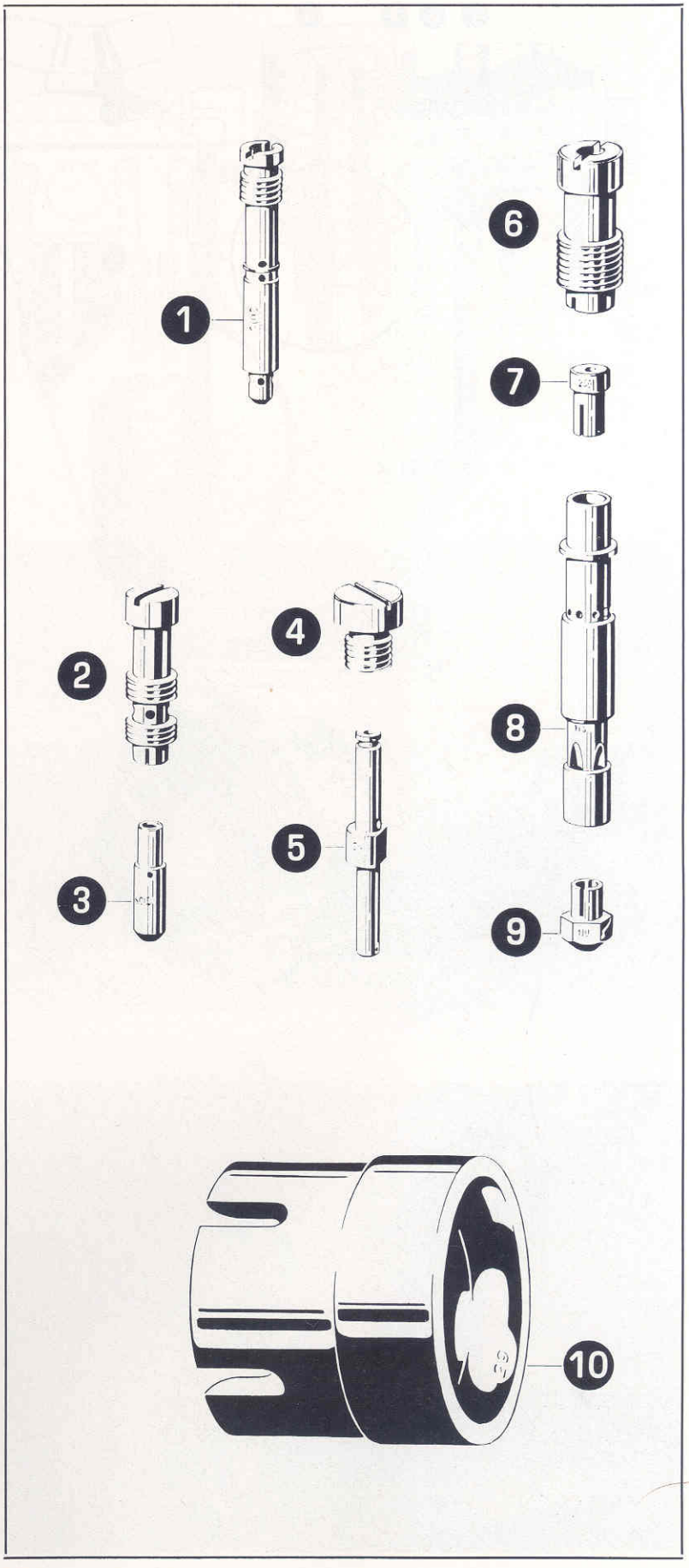
Acceleration

4	screw plug	—
5	pump jet	50

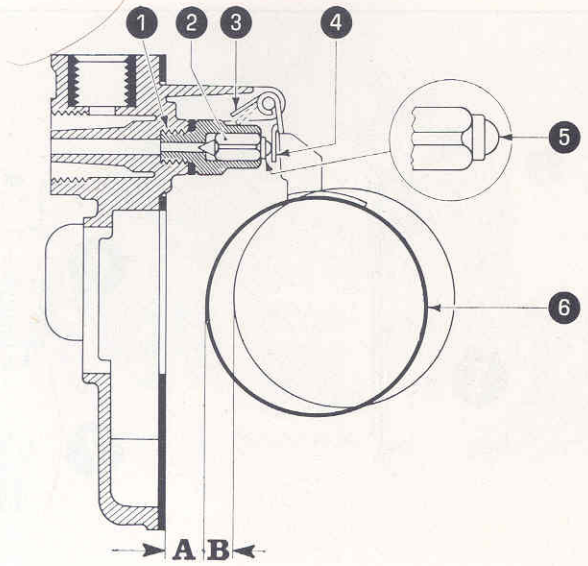
Running

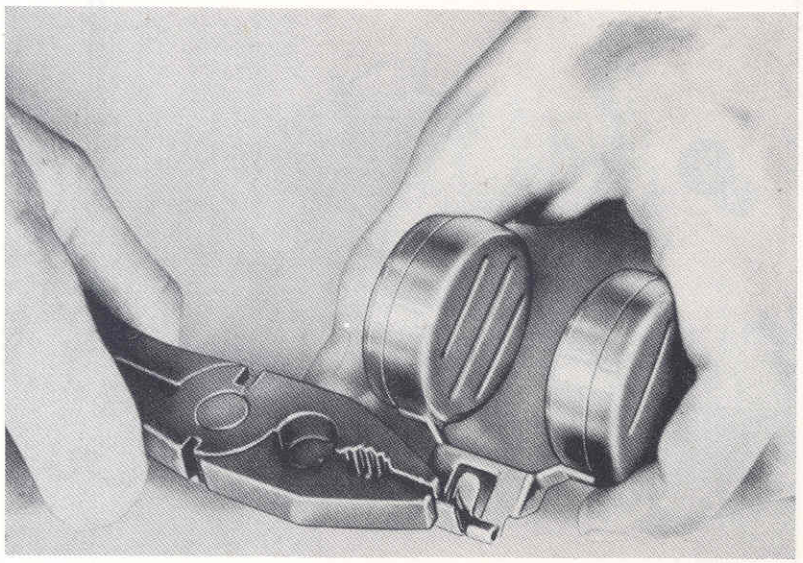
6	main jet holder		—
7	air calibrator		180
8	mixture tube (8 radial holes)		100
9	main jet	summer	115
		winter	120
10	**Venturi**		30.00 mm

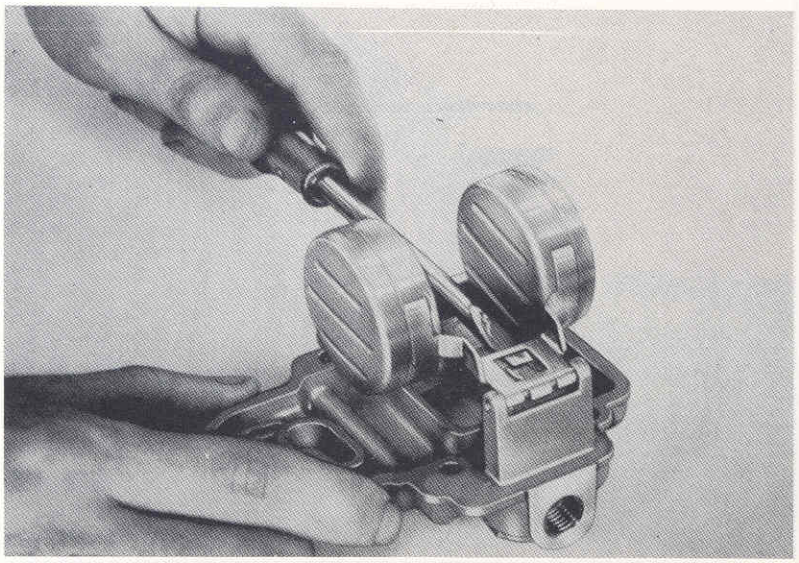
Note - The diffusing jets, air calibrator jets (or restrictors), etc. are marked in the positions shown in the figures.



WEBER 45 DCOE 14 CARBURETTORS







The float level should be set by following the instructions below:

- Make sure that the float is of the correct weight (**26 grs** - .9 oz.), that it is not leaking anywhere and is not dented, and that it can rotate freely about the pivot pin.

  The weight of the float cannot be altered; consequently, haphazard repairs (tinning, etc.) can impair the proper operation of the float itself.

- Check that the needle valve **1** is well screwed into the seating and that the spring loaded ball **5**, part of the needle **2**, is not jammed.

- Hold the carburettor cover in a vertical position as shown in the figure so that the float **6** does not depress the ball **5** mounted on the needle **2**.

  With the cover vertical and the float tongue **4** in light contact with the needle ball, the two floats should be at a distance from the cover joining surface of **A = 8.5 mm** (.33 in.) with the gasket fitted and well stuck to the cover.

- When the level has been set, check that the travel **B** of the float is **6.5 mm** (.26 in.) adjusting if necessary the position of the float pivot tail **3**.

- If the float position is not correct, alter the position of the float tongue itself to achieve the correct level, making sure that the tongue remains at right angle to the needle centerline and that its contact surface has no notches which might impede the free movement of the needle.

- Then fit the carburettor cover and check that the float can move freely without friction on the walls of the float chamber.

WEBER 45 DCOE 14 CARBURETTORS

PRECAUTION

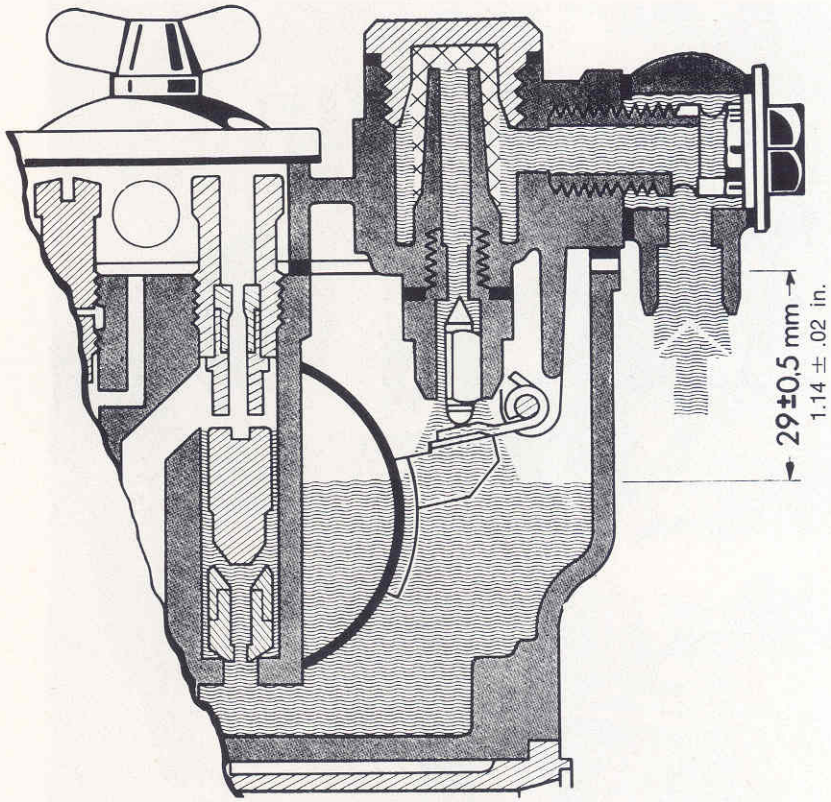
The float level should be checked whenever the float or the needle valve has been changed. In the latter case it is also advisable to change the gasket.
The adjustment described above will correspond to a fuel level, from the upper face of the float chamber, of **29±.5 mm** (1.14± .02 in.).

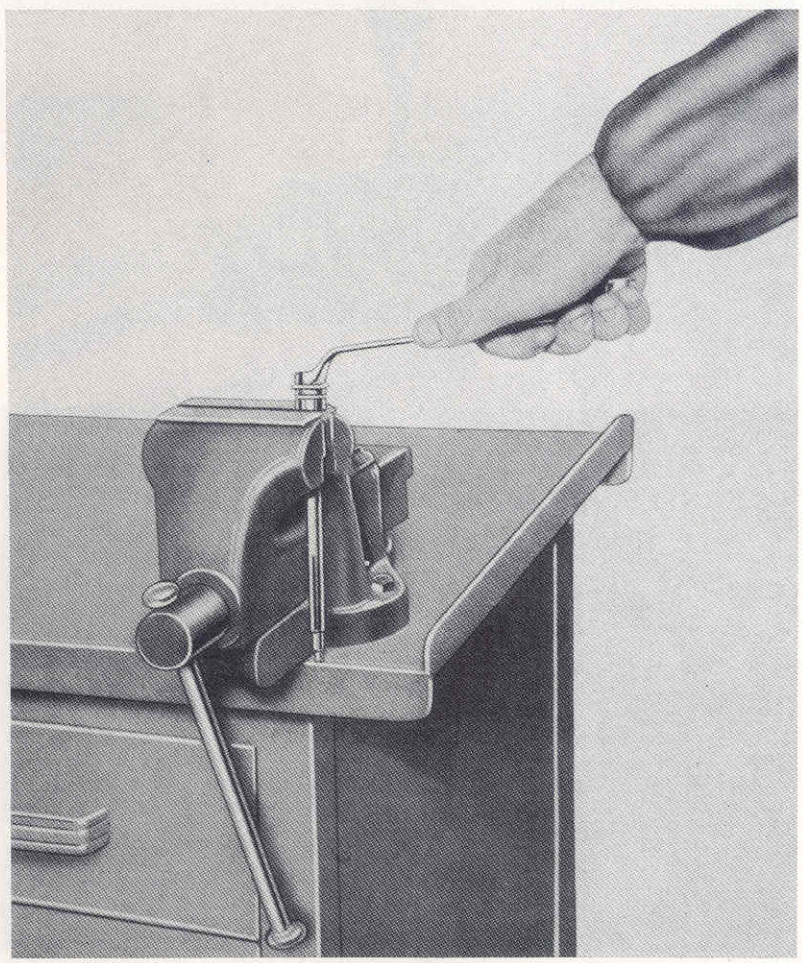
This level can be checked as shown on page 108.

- Check that the joining surfaces or the cover itself and on the carburettor body are in good condition. If necessary, where it is possible to grind without impairing the values which are the basis of the calibration of the carburettor, (petrol level with respect to the positions of the jets), remove the minimum necessary amount of material.

Note - When grinding is finished the whole of the carburettor must be carefully cleaned to remove all traces of dust which may have been deposited in the channels, traps, etc. during the work.

- Check the condition of all seals.



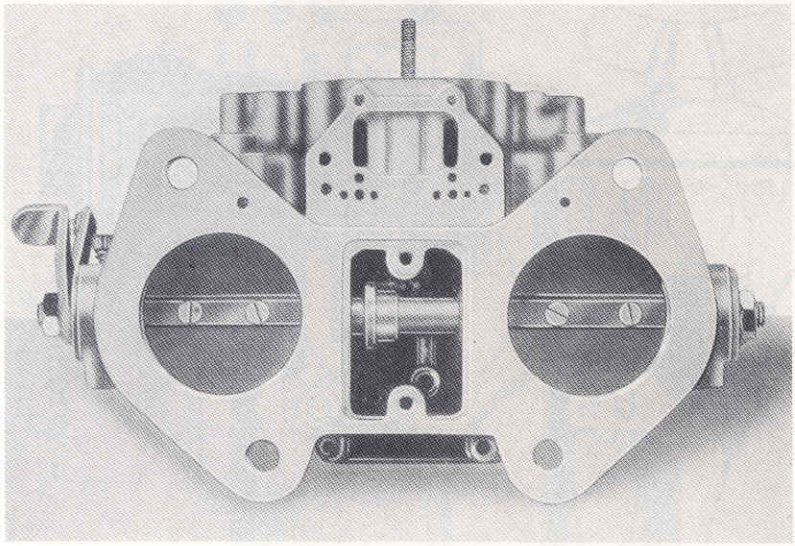


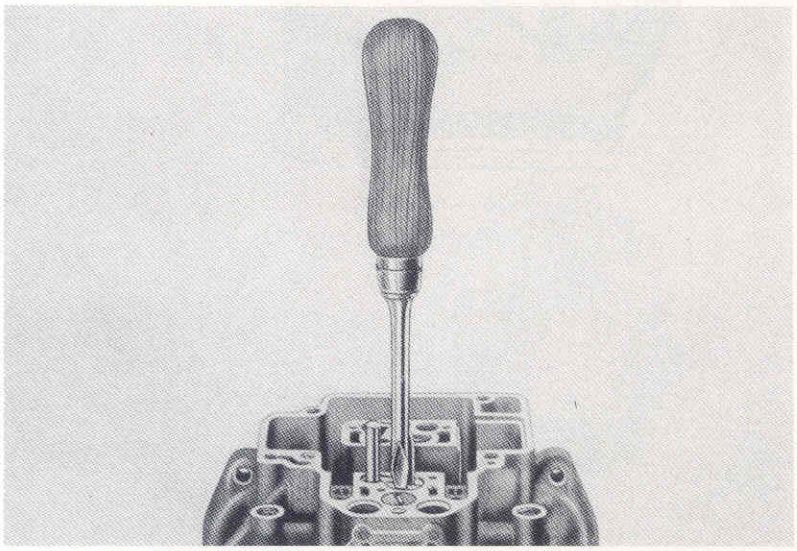
Reassembling the carburettor

The carburettor should be reassembled in reverse order of disassembly, bearing in mind the following points:

- Lubricate the ball bearings supporting the throttle valve spindle with bearing grease.
- Before the spindle is fitted to the body and to avoid distortion of the spindle while tightening the nut at the end opposite to the control lever, it is advisable to tighten this nut in a vice fitted with lead jaws, gripping the spindle itself close to the nut to avoid damaging the milled seatings for the throttle valves.
- The reference marks made on the throttle valves and on the spindle must coincide.

WEBER 45 DCOE 14 CARBURETTORS

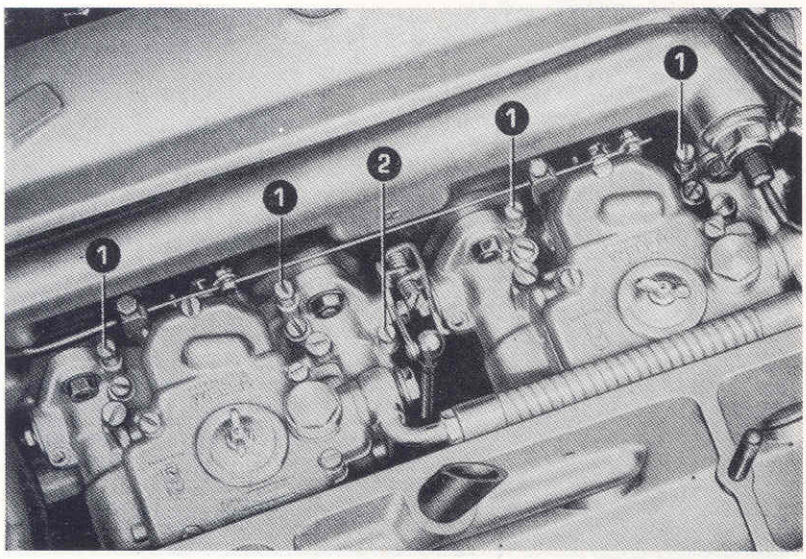




- Before fitting the throttle valves to the spindle, fully unscrew the opening adjusting screws.
- Fit, centre and secure one throttle at a time, taking particular care with the centring so as to obtain a proper fit with the throttles in contact with the bores of the barrels. With a correctly centred throttle, if it is looked at in back light, no light should be seen around the valve. Some light may be tolerated in the areas close to the spindle.

  When the first valve has been fitted, the second should be fitted in the same way.

  Before fitting the return spring, check that the spindle complete with valves rotates freely.
- To refit the acceleration pump on the body press on the spring plate with a screwdriver so as to insert the plate into its proper groove on the body.
- To refit the two plungers of the choke assembly, press with a screwdriver on the retainer rings so as to force them into their respective grooves on the body.
- The jet assemblies must be firmly secured into the carburettor.
- The idling mixture adjusting screws should never be screwed fully home to avoid breaking the needle seat.
- In refitting to the carburettor the cover complete with float, make sure that the float itself is well clear from the float chamber walls.
- When reassembly is complete, check the tightness of all seals to ensure that there will be no leakage.



Provisional idling adjustment

Before refitting the carburettor to the engine carry out a provisional adjustment of the adjusting screws in the following manner:

1 Idling mixture adjusting screw: two turns from the closed position.

2 Throttle opening adjusting screw: half a turn from the point of contact.

WEBER 45 DCOE 14 CARBURETTORS

Refitting the carburettors to the engine

When refitting the carburettors to the engine **make sure that there are no defects in the joints between the carburettor and the engine,** so as to prevent seepage of air downstream of carburettors.

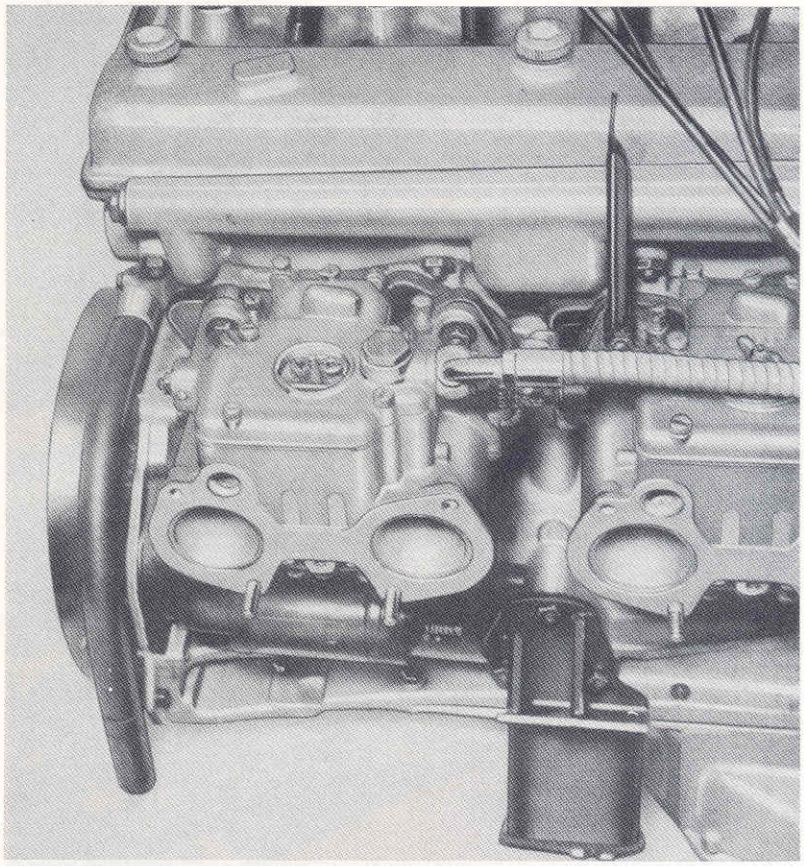
Any such seepage would cause irregular carburetion and consequent malfunctioning of the engine.

Alignment of throttles, idling adjustment and adjustment of control linkage.

To obtain good matching of the two carburettors and correct adjustment of the control linkage, proceed as follows:

a) **Alignment of throttles:**

- disconnect the control linkage **T** from the carburettors;
- almost fully loosen the screws **F** and **S** until the throttle control lever stop is just making contact against the boss;
- then screw in the screw **S** until contact is made, so that the throttles in the two carburettors are aligned;
- screw in screw **F** until it makes contact, then screw it in a further half turn.

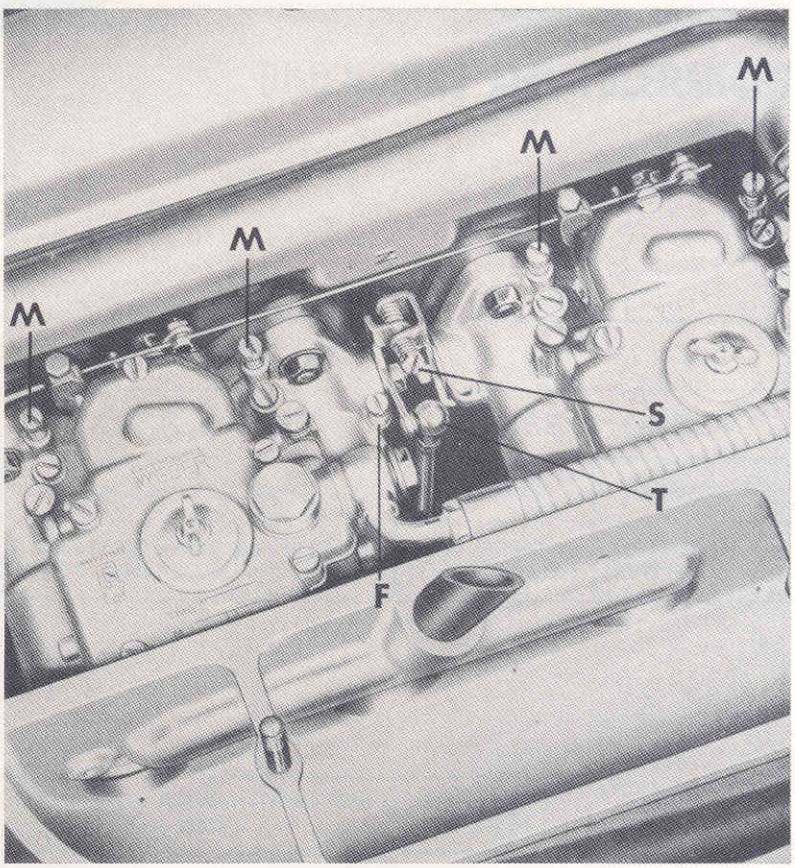


b) **Idling speed adjustment**

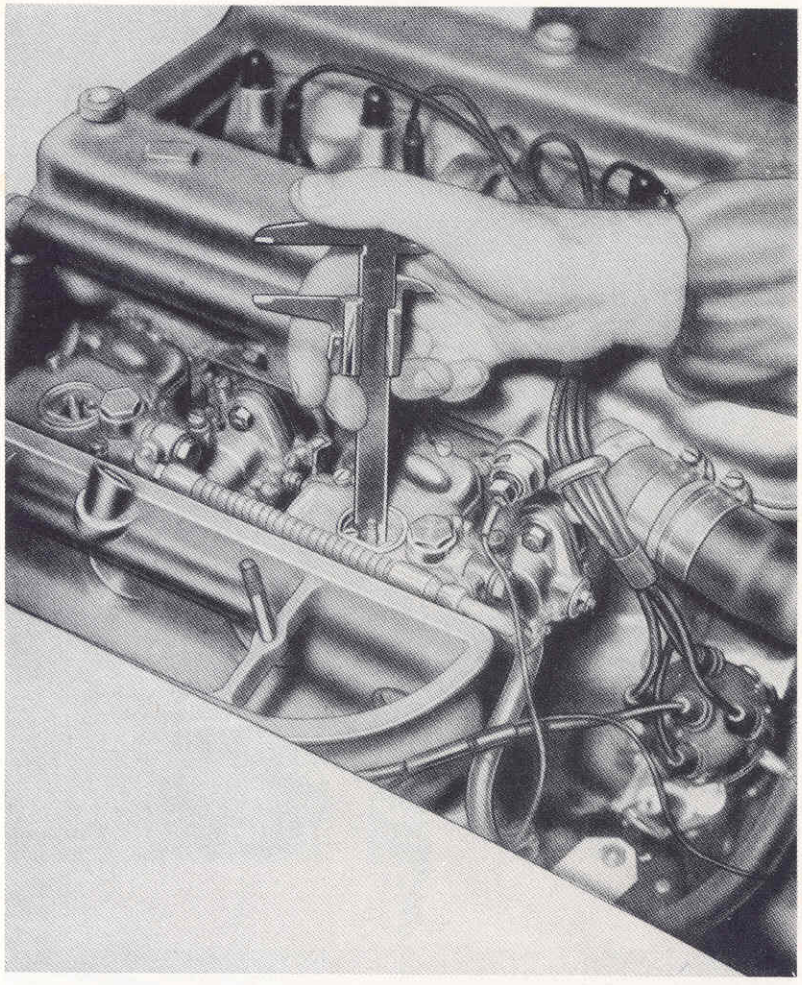
When the throttles have been aligned and still with the control linkage disconnected:

- check that the spark plugs and the ignition system are in good order;
- unscrew the screws **M about one turn** from the closed position;
- start the engine and warm it up;
- re-connect the control linkage;
- operate the throttles a few times, making sure that they function without sticking;
- screw in progressively the screws **M** until the engine runs smoothly;
- unscrew the screw **F** very slowly until the engine is idling at 600 to 700 rpm.

If the engine starts to race, tighten the screws **M** slightly. **On no account should these screws be screwed right down.**



WEBER 45 DCOE 14 CARBURETTORS



Adjustment of control linkage

When the throttles have been aligned and the idling adjusted, proceed with the adjustment of the carburettor control linkage.
For this purpose the adjustable rod should have been reconnected to the throttle control lever. Having slackened the locknut on the rod, adjust rod length so that there is a slight preload on the lever itself when the pedal is in the rest position.

Checking the fuel level in the float chambers with the carburettors on the car

If it is necessary to carry out this check, level the car and for each carburettor carry out the following operations:

- Remove the jet inspection cover and both main jets.
- By means of a syringe, draw off from the wells a quantity of petrol sufficient to cause a substantial lowering of the level.
- Refit the cover and run the engine at idling speed for some seconds.
- Again remove the cover and measure with a gauge the fuel level with respect to the upper face of the float chamber. The level should be **29±.5 mm** (1.14± .02 in.). If this is not so, adjust the float as directed on page 104 and check the tightness of the needle valve, renewing it if there is any leak.

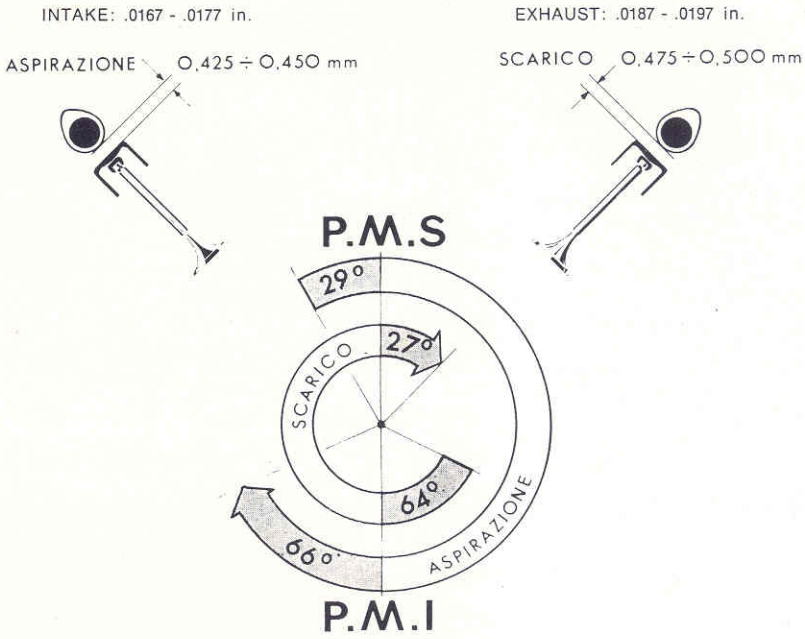
VALVE CLEARANCES TIMING CHECK

Checking valve clearances

- Check that the valve clearances measured with the engine cold and at the dwell arc of the cams, is within the limits given in the diagram.

Timing check

- With the valve clearances as specified, check the opening and closing angles of the valves as directed on pp. 48 et seq.
- This check is carried out by observing that for a lift of the intake and exhaust valves of **.05 mm** (.002 in.) the readings on the protractor correspond to the **actual values** given in the diagram.



Scarico = Exhaust
Aspirazione = Intake
PMS = TDC
PMI = BDC

Variations with respect to the GIULIA TI:

DIMENSIONS AND TOLERANCES

		BARREL - TO - PISTON FIT					
		CLASS **A** BLUE		CLASS **B** PINK		CLASS **C** GREEN	
		PISTON O.D.	BARREL I.D.	PISTON O.D.	BARREL I.D.	PISTON O.D.	BARREL I.D.
PISTON MAKE	BORGO only	**77.910 - 77.920 mm** (3.0673 - 3.0677")	**77.985 - 77.944 mm** (3.0703 - 3.0706")	**77.920 - 77.930 mm** (3.0677 - 3.0681")	**77.995 - 78.004 mm** (3.0707 - 3.0710")	**77.930 - 77.940 mm** (3.0681 - 3.0685")	**78.005 - 78.014 mm** (3.0711 - 3.0714")

BARREL-TO-PISTON CLEARANCE **.065 - .084 mm** (.0026 - .0033") - wear limit = **.15 mm** (.006")

TECHNICAL FEATURES

Engine	Number and layout of cylinders		4 in line
	Bore and stroke		78 x 82 mm
	Total displacement		1570 cc
	Maximum power at 6000 rpm	HP	106 DIN / 122 SAE
Chassis	Wheel track	front	1310 mm
		rear	1270 mm
	Wheel base		2350 mm
	Minimum turning circle		10700 mm
	Overall length		4080 mm
	Overall width		1580 mm
	Overall height		1315 mm
	Dry weight		950 kg
	Number of seats		4
	Tyres (Michelin XA - Pirelli cinturato S)		155 x 15

Inflation pressures with cold tyres

		FRONT	REAR
With reduced load and short bursts of maximum speed	MICHELIN	**1.7 kg/cm²** (24.1 psi)	**1.7 kg/cm²** (24.1 psi)
	PIRELLI	**1.7 kg/cm²** (24.1 psi)	**1.8 kg/cm²** (25.6 psi)
With full load and continuous maximum speed (HIGHWAYS)	MICHELIN	**1.9 kg/cm²** (27 psi)	**1.9 kg/cm²** (27 psi)
	PIRELLI	**1.8 kg/cm²** (25.6 psi)	**2.1 kg/cm²** (29.8 psi)

Performance after running in (max. speeds)

with **41 : 9** final drive

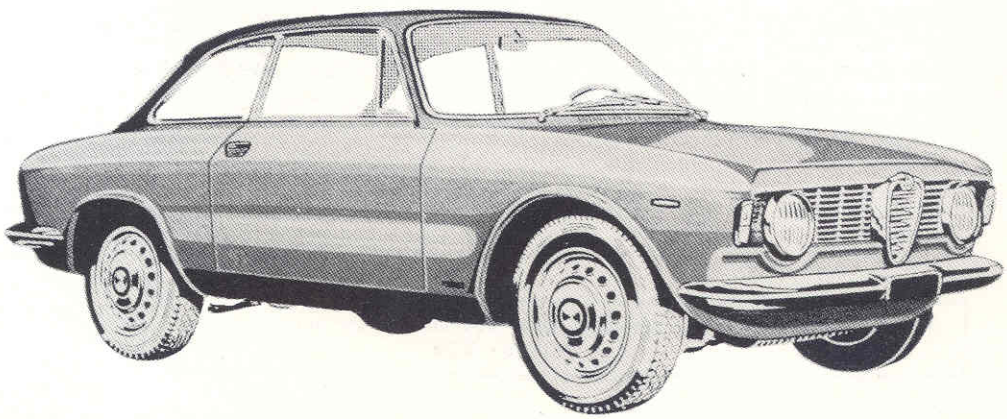
	km/h	mph		km/h	mph
1st	**43**	27	4th	**142**	112
2nd	**73**	45	5th	**over 180**	89
3rd	**106**	66	Reverse	**48**	30

The maximum speeds indicated should not be exceeded or mechanical damage may result.

The performance given are applicable for use in normal Central European environmental conditions.

Fuel consumption

Per 100 km, (CUNA standard) with full load . . . . . abt. 9.5 lts (29.8 mpg GB) (24.8 mpg US)



IGNITION

Distributor

For inspection and checking the distributor see the GIULIA T.I. Super (page 97).

Timing check

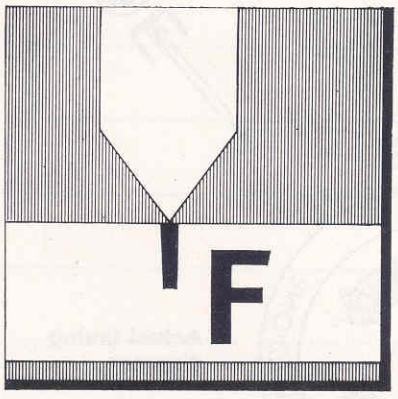
The timing is checked in the manner described on page 11 of the Manual.

Check the ignition advance values:

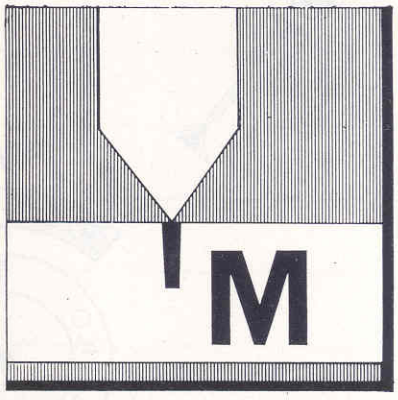
Static advance: 3° ± 1° before TDC

Max. advance: 43° $^{+0°}_{-3°}$ at 5300 rpm.

If the max. advance is greater than or smaller than the specified value, adjust the static advance, as it is preferable to have the advance exact at the high speeds.



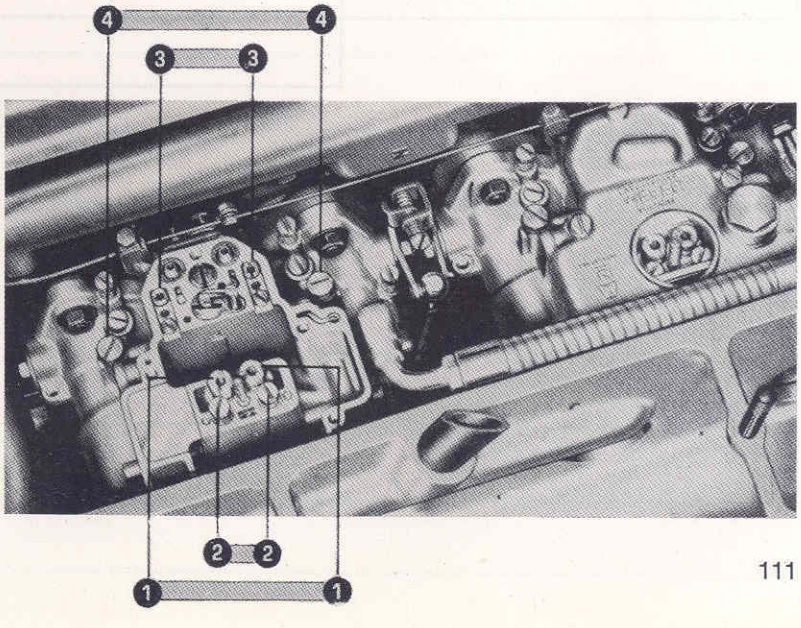
F = Fixed advance reference mark on the drive pulley.



M = Maximum advance reference mark on the drive pulley.

WEBER 40 DCOE 4 CARBURETTOR

- For overhaul and adjustment of the carburettors, see **GIULIA T.I.** Super (page 101).



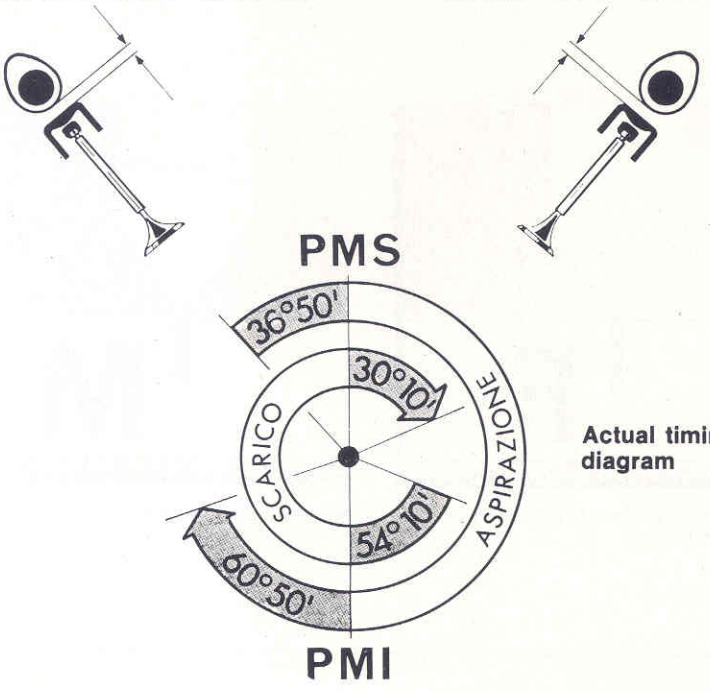
Adjustment data:

1	**Main jets** (with 1/8" dia. ball)	**127**
	Main air restrictor jets	**220**
2	**Idling jets**	**50**
	axial hole	**150**
	air restrictor jet	**120**
3	**Choke jets F 5**	**65**
4	**Acceleration pump jets**	**35**
-	**Venturis**	**30.00 mm**

VALVE CLEARANCES TIMING CHECK

aspirazione 0,475÷0,500 mm

scarico 0,525÷0,550 mm



Actual timing diagram

INTAKE: .0187-.0197 in.

EXHAUST: .0206-.0216 in.

PMS = TDC
PMI = BDC
Aspirazione = Intake
Scarico = Exhaust

- Check the valve clearances with the engine cold, measured at the dwell arcs of the cams.

- The direction of rotation is that seen looking from the front of the engine.

Timing check

- With the valve clearances at the specified values, check the opening and closing angles of the valves in the manner described on pp. 48 etc. The nominal values are given in the following table.

	INTAKE		EXHAUST	
	OPENING	CLOSING	OPENING	CLOSING
VALVE LIFT	**.20 mm** (.0078 in.)		**.15 mm** (.0059 in.)	
Angular reading on the protractor fitted on the flywheel	**18° 30'** before **TDC**	**42° 30'** after **BDC**	**42° 30'** before **BDC**	**18° 30'** after **TDC**
	permissible angular tolerance ± **1° 30'**			

Notes

ALFA ROMEO
DIREZIONE ASSISTENZA TECNICA
CENTRO DIREZIONALE
20020 ARESE (Milano)

Pubblic. n.° 1008 R 4 - 9/75 - 1000
Printed in Italy

02593