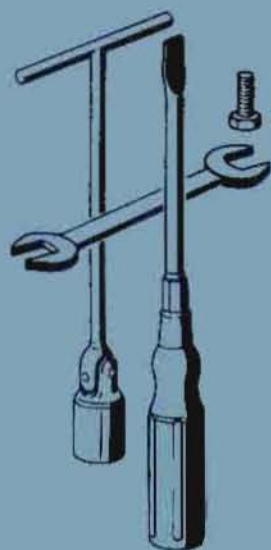




**V35**

# WORKSHOP MANUAL



**V50**

COD. 19920101

SEIMM MOTO GUZZI · SERVIZIO PUBBLICAZIONI TECNICHE  
COD. 13920101

1000 K - 1-78 - Printed in Italy - Mariani - Almé - Bergamo

## INDEX

<b>1</b>	<b>MAIN FEATURES</b>	pag. 9
----------	----------------------	--------

<b>2</b>	<b>MAINTENANCE OPERATIONS</b>	pag. 13
----------	-------------------------------	---------

- 1 Engine lubrication
- 2 Replacing the oil cartridge in the sump
- 3 Cleaning the wire gauze filter and the sump
- 4 Lubrication of the gearbox
- 5 Lubrication of rear drive box
- 6 Lubrication of front fork
- 7 Sundry lubrications
- 8 Controls and instruments
- 9 Ignition key
- 10 Light switches
- 11 Horn, flash light and turn signal control
- 12 Engine starting and emergency stop switch
- 13 Right front brake control lever
- 14 Left front brake and rear brake control pedal
- 15 Gear control
- 16 Fuel filter cap
- 17 Front and rear brake fluid reservoir
- 18 Fuel taps
- 19 Terminal block with fuses
- 20 Steering lock
- 21 Seat locking device
- 22 Side stand
- 23 Adjusting the clutch control lever
- 24 Adjusting the right front brake lever
- 25 Adjusting the left front brake and the rear brake pedal
- 26 Adjusting the throttle control grip
- 27 Adjusting the steering
- 28 Adjusting the swinging arm play
- 29 Adjusting the rear suspension
- 30 Adjusting rocker clearance
- 31 Lubrication and maintenance operations

**3****TORQUE LOADINGS**

pag. 21

**4****SPECIFIC WORSCHOP TOOLS**

pag. 23

**5****ENGINE UNIT**

pag. 25

- 1 Removal of engine-gearbox front the frame - Separation of engine from gearbox
- 2 Removing the rocker box covers
- 3 Stripping the cylinder heads
- 4 Removing the cylinder barrels
- 5 Removing the compression rings and oil scrapers from the piston
- 6 Removal of pistons
- 7 Separating the crankcase covers
- 8 Replacing the seal in timing cover (engine mounted)
- 9 Dismantling the con-rods
- 10 Dismantling the crankshaft
- 11 Removing the flywheel
- 12 Dismantling the timing group

**6****LUBRICATION**

pag. 46

- 1 Removing the oil sump
- 2 Dismantling the oil pump
- 3 Removing the oil pressure relief valve
- 4 Oil pressure light switch
- 5 Removing the oil cartridge front the sump
- 6 Removing the wire gauge filter from the oil sump

**7****CARBURATION**

pag. 50

- 1 Carburettors
- 2 Carburettor setting
- 3 Levelling the floater
- 4 Manual adjustment of carburation and idling speed
- 5 Adjusting carburation using a vacuumeter
- 6 Stripping the carburettor
- 7 Air filter and breather unit

**8****CLUTCH**

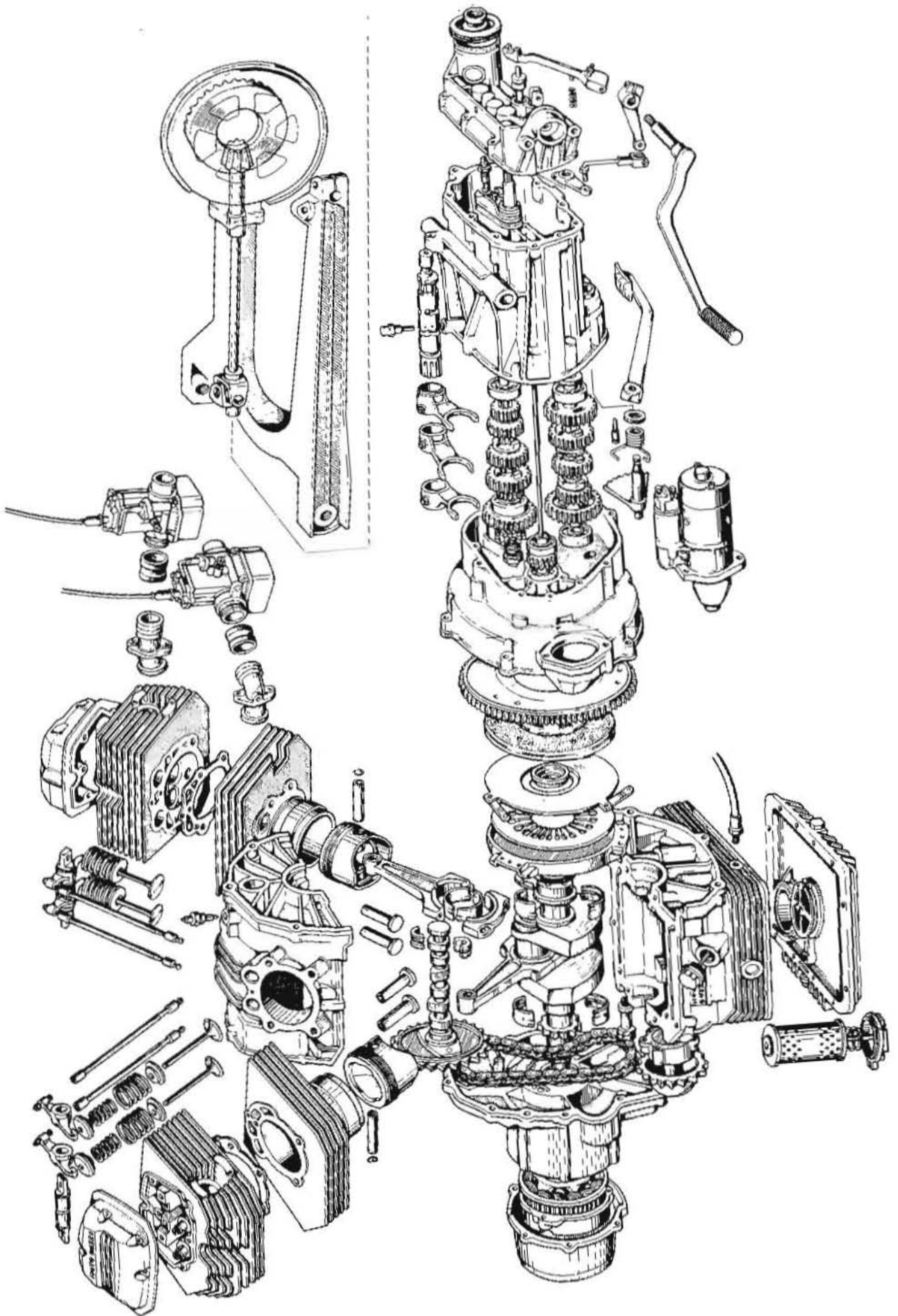
pag. 55

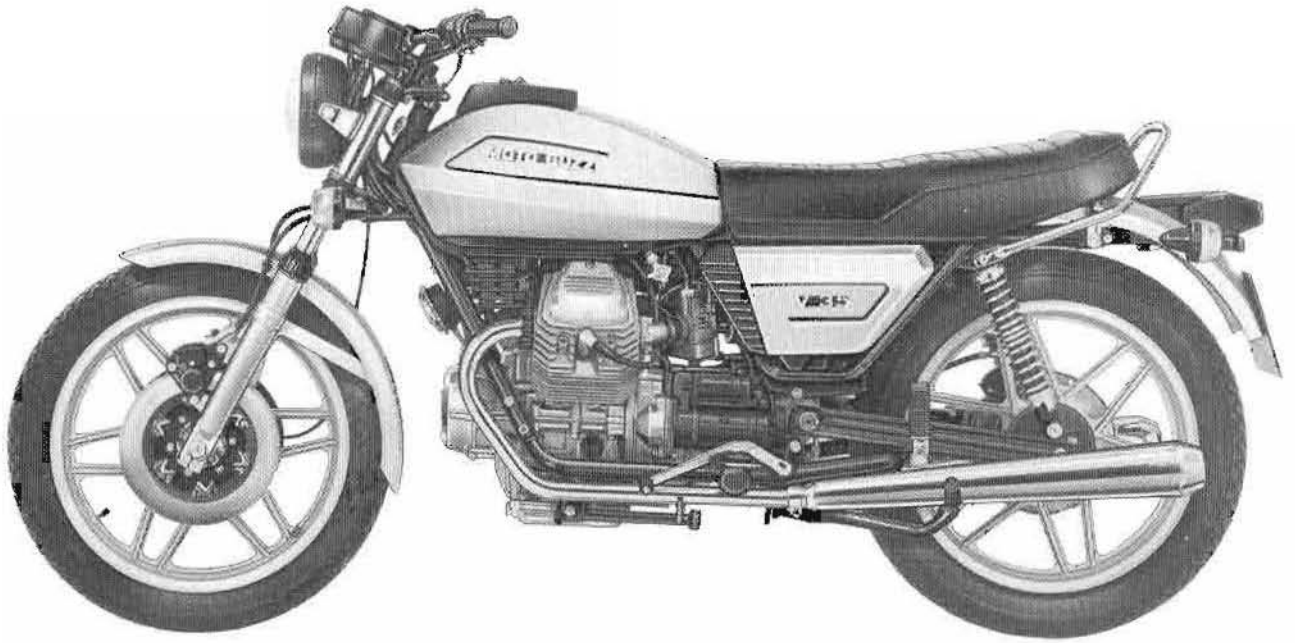
**9****THE GEARBOX**

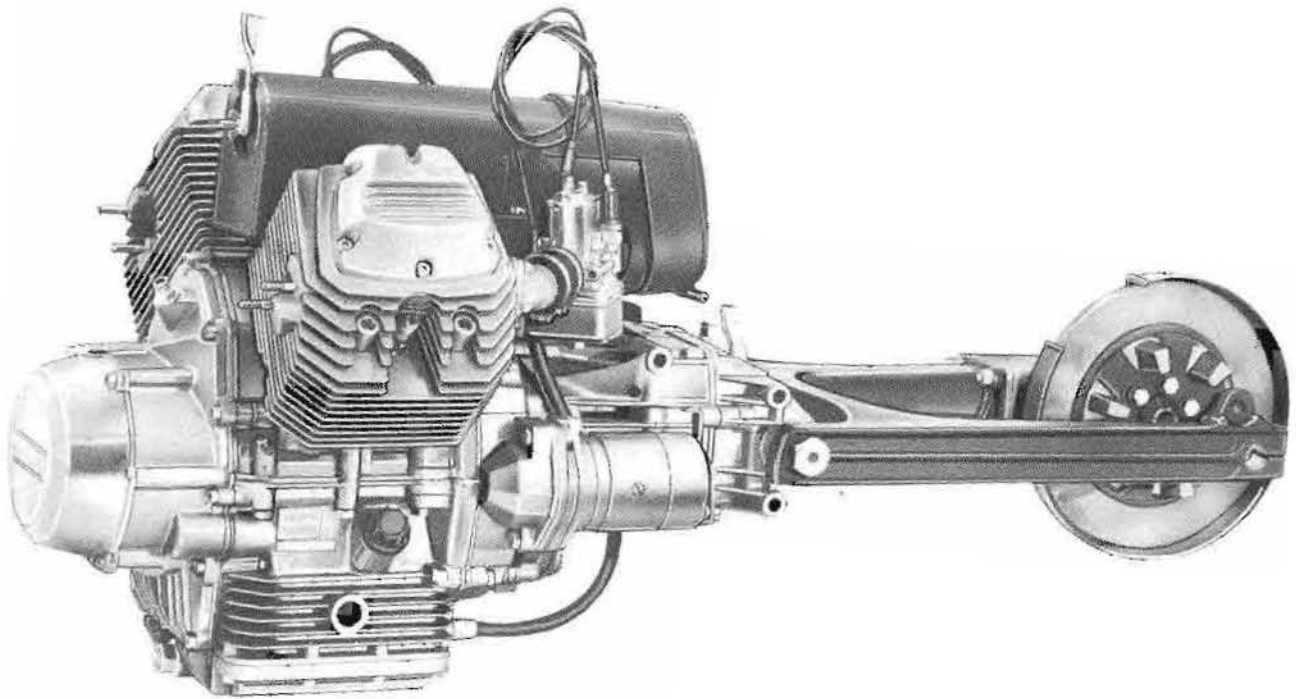
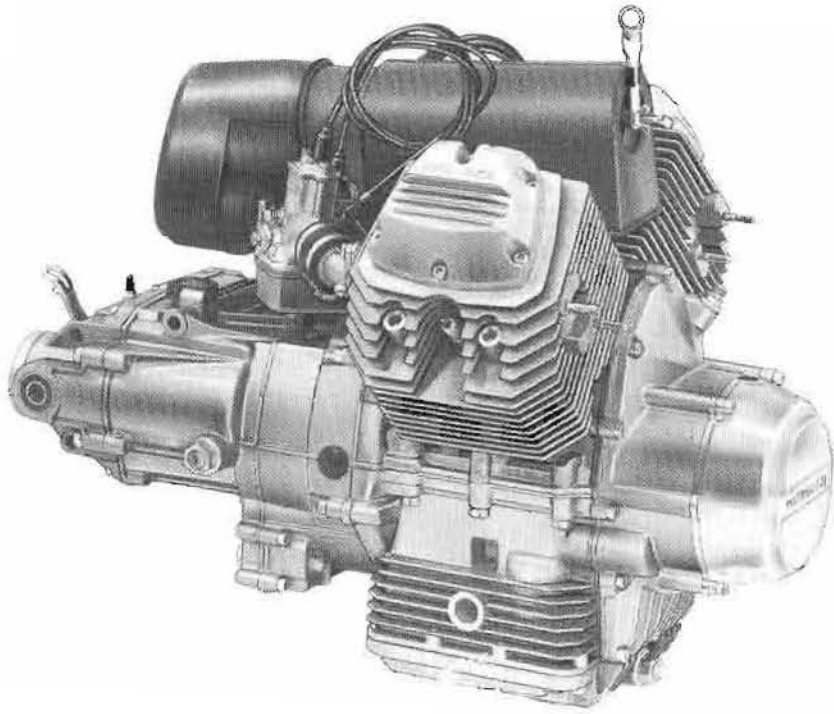
pag. 57

- 1 Removing the gearbox from the frame and swinging arm from the gearbox
- 2 Clutch housing
- 3 Clutch
- 4 Gearbox
- 5 Gearbox cover
- 6 Gear-shafts assembly
- 7 Gear selector

<b>10</b>	<b>KICK STARTER OPERATED MODEL (optional)</b>	pag. 66
<b>11</b>	<b>SWINGING ARM COMPLETE WITH REAR DRIVE BOX</b>	pag. 68
	1 Drive box 2 Swinging arm	
<b>12</b>	<b>FRAME</b>	pag. 76
<b>13</b>	<b>FRONT FORK</b>	pag. 79
	1 Fork sleeve	
<b>14</b>	<b>REAR SUSPENSION</b>	pag. 83
<b>15</b>	<b>STEERING</b>	pag. 84
<b>16</b>	<b>WHEELS</b>	pag. 85
	1 Front wheel 2 Rear wheel 3 Tyres 4 Wheel balancing 5 Removing an re-fitting the tyres 6 How to check and overhaul the braking circuits for the right front and rear brakes 7 Calipers for right front, left and rear brakes 8 Pipes 9 Braking discs 10 Braking circuit faults 11 Recommendations	
<b>17</b>	<b>ELETRICAL EQUIPMENT</b>	pag. 97
	1 Battery 2 Alternator 3 Regulator 4 Rectifier 5 Starter motor (.4 HP) 6 Starter motor (.7 KW) 7 Electronic ignition 8 Checking ignition timing using a strobe lamp 9 Electric equipment	
<b>18</b>	<b>KEY TO WIRING DIAGRAM</b>	pag. 107
	1 Key to wiring diagram (Police)	
<b>19</b>	<b>INCHES AND MILLIMETERS CONVERSION CHART</b>	pag. 109









# 1 MAIN FEATURES

	V 35	V 50
<b>ENGINE</b>		
— cycle	4-stroke	4-stroke
— number of cylinders	2	2
— cylinder disposition	V type, 90°	V type, 90°
— bore	66 mm	74 mm
— stroke	50.6 mm	57 mm
— displacement	346.26 cc	490.291 cc
— compression ratio	10.8	10.8
— max output	33.6 HP at 8100 rpm	45 HP at 7500 rpm
— nominal power	5 HP	6 HP
<b>VALVE GEAR</b>	OHV, push rod operated	OHV, push rod operated
— inlet	opens 18° before TDC closes 50° after BDC	opens 18° before TDC closes 50° after BDC
— exhaust	opens 53° before BDC closes 15° after TDC	opens 53° before BDC closes 15° after TDC
— rocker clearance for valve timing	1 mm (.039")	1 mm (.039")
— normal rocker clearance:		
— inlet	0.10 mm (.0039")	0.10 mm (.0039")
— exhaust	0.15 mm (.0059")	0.15 mm (.0059")
<b>LUBRICATION</b>	pressure, lobe type pump, oil tank in crankcase	pressure, lobe type pump, oil tank in crankcase
— warning light for insufficient oil pressure	on panel board	on panel board
— oil filters	wire gauze and cartridge type, easily replaceable	wire gauze and cartridge type, easily replaceable
<b>IGNITION</b>	electronic	electronic
— maximum advance	34° at 5000-5500 rpm	34° at 5000-5500 rpm
— gap between rotor block (on crankshaft) and metal tips of «Pickup»	0.15 ÷ 0.20 mm (.0059 ÷ .0078")	0.15 ÷ 0.20 mm (.0059 ÷ .0078")
— spark plugs	long thread type dia. 14 x 1.25 Marelli CW 9 LP or Bosch W 260 T 30 or Lodge 2 HLN or Champion N 6 Y	long thread type dia. 14 x 1.25 Marelli CW 9 LP or Bosch W 260 T 30 or Lodge 2 HLN or Champion N 6 Y
— ignition coils	2	2
<b>CARBURATION</b>	down draught 2 Dell'Orto carburettors Dell'Orto type VHB 24 FD (right) VHB 24 FS (left)	down draught 2 Dell'Orto carburettors Dell'Orto type VHB 24 FD (right) VHB 24 FS (left)

	V 35	V 50
COOLING	by air	by air
EXHAUST SYSTEM	dual exhaust pipes and silencers, interconnected	dual exhaust pipes and silencers, interconnected
GENERATOR-ALTERNATOR	fitted on front end of crankshaft (14 V - 20 A)	fitted on front end of crankshaft (14 V - 20 A)
STARTING	electric starter, pedal starter on request	electric starter, pedal starter on request
TRANSMISSIONS		
CLUTCH	dry type, single plate with diaphragm spring. controlled by lever on left side of handlebar	dry type, single plate with diaphragm spring. controlled by lever on left side of handlebar
PRIMARY DRIVE	helical gears. Ratios: 1 to 1.846 (13 - 24)	helical gears. Ratios: 1 to 1.642 (14 - 23)
SPEED CHANGE	5 speeds, constant mesh gears, frontal engagement, foot controlled on left side of machine	5 speeds, constant mesh gears, frontal engagement, foot controlled on left side of machine
— internal gear ratios:		
low gear	1 to 2.727 (11/30)	1 to 2.727 (11/30)
2nd gear	1 to 1.733 (15/26)	1 to 1.733 (15/26)
3rd gear	1 to 1.277 (18/23)	1 to 1.277 (18/23)
4th gear	1 to 1.045 (22/23)	1 to 1.045 (22/23)
high gear	1 to 0.909 (22/20)	1 to 0.909 (22/20)
SECONDARY DRIVE	cardan shaft with bevel gears	cardan shaft with bevel gears
— ratio	1 to 3.875	1 to 3.875
— overall gear ratios:		
low gear	1 to 19.506	1 to 17.351
2nd gear	1 to 12.396	1 to 11.026
3rd gear	1 to 9.134	1 to 8.125
4th gear	1 to 7.475	1 to 6.649
high gear	1 to 6.502	1 to 5.783
CYCLE PARTS		
FRAME	tubular structure, cradle type	tubular structure, cradle type
SUSPENSIONS	telescopic front fork with hydraulic dampers rear swinging arm with externally adjustable springs	telescopic front fork with hydraulic dampers rear swinging arm with externally adjustable springs

	V 35	V 50
<b>WHEELS</b>	single piece light alloy casting	single piece light alloy casting
— front	WM 2/1,85 x 18" CP2	WM 2/1,85 x 18" CP2
— rear	WM 3/2,15 x 18" CP2	WM 3/2,15 x 18" CP2
<b>TYRES</b>		
— front	Pirelli 90/90 S 18 or 3.00 - 18 Metzeler 3.00 - 18 R (Block C 5) Michelin 3.00 - 18 R (M 38)	Pirelli 100/90 S 18 (MT 15) Metzeler 3.25 - 18 R (Block C 5) Michelin 3.25 - 18 H (M 38)
— rear	Pirelli S 18 (ribbed) Metzeler 3.00 S 18 (Block C 5) Michelin 3.00 S 18 (M 38)	Pirelli 100/90 S 18 (MT 15) Metzeler 3.50 S 18 (Block C 66) Michelin 3.50 S 18 (M 38)
<b>BRAKES</b>		
— front	disc type with 2 cylinders operated by caliper. lever controlled from the right side handlebar with cable connection from lever to master cylinder. hydraulic transmission independant from the rear brake disc dia. 260 mm (20.23") cylinder dia. 32 mm (1.25") master cylinder dia. 12.7 mm (.5")	disc type with 2 cylinders operated by caliper. lever controlled from the right side handlebar with cable connection from lever to master cylinder. hydraulic transmission independant from the rear brake disc dia. 260 mm (20.23") cylinder dia. 32 mm (1.25") master cylinder dia. 12.7 mm (.5")
— rear	disc type with double cylinder fixed caliper. pedal operated from the right hand side of the machine. control by metal rod from pedal to master cylinder. disc dia. mm 235 (9.25") cylinder dia. 32 mm (1.26") master cylinder dia. 15.875 mm (.624) hydraulic transmission the rear brake connection is by hydraulic transmission in common with a second front brake of same sizes as the hand lever operated right front brake	disc type with double cylinder fixed caliper. pedal operated from the right hand side of the machine. control by metal rod from pedal to master cylinder. disc dia. mm 235 (9.25") cylinder dia. 32 mm (1.26") master cylinder dia. 15.875 mm (.624) hydraulic transmission the rear brake connection is by hydraulic transmission in common with a second front brake of same sizes as the hand lever operated right front brake
<b>OVERALL DIMENSIONS AND WEIGHTS</b>		
— wheel base (fully loaded)	1.395 mts (54.5")	1.395 mts (54.5")
— length	2.080 mts (82")	2.080 mts (82")
— width	0.750 mm (29.85")	0.750 mm (29.85")
— heigth	1.035 (39.4")	1.035 (39.4")
— weigth (dry)	152 kg (303 lbs)	152 kg (303 lbs)

	V 35	V 50
<b>PERFORMANCES</b>		
— max speed, solo rider	abt 150 km/h (93 mph)	abt 170 km/h (105 mph)
— fuel consumption	3.7 lts (77 mpg Imp. 63 mpg USA)	4 lts (70 mpg Imp. 58 mpg USA)
<b>FUEL AND OIL CAPACITIES</b>		
— fuel tank	16.5 lts (3.6 gl. Imp. 4.1 gl. USA) petrol 98/100 NO-RM	16.5 lts (3.6 gl. Imp. 4.1 gl. USA) petrol 98/100 NO-RM
— reserve	2 lts. (3½ pints Imp. 4.2 pints USA)	2 lts. (3½ pints Imp. 4.2 pints USA)
— sump	2.25 lts. (4 pints Imp. 4.7 pints USA) oil Agip Sint 2000 SAE 10 W/50)	2.25 lts. (4 pints Imp. 4.7 pints USA) oil Agip Sint 2000 SAE 10 W/50)
— gear box	1 lt. (2.1 pints USA 1.75 pints Imp.) oil Agip F.1 Rotra MP (SAE 90)	1 lt. (2.1 pints USA 1.75 pints Imp.) oil Agip F.1 Rotra MP (SAE 90)
— rear drive box	0.170 lts. (10½ cu. in.) of which 0.160 (10 cu. in.) of oil «Agip F.1 Rotra MP SAE 140» and 0.010 (½ cu. in.) of oil «Agip Rocol ASO/R»	0.170 lts. (10½ cu. in.) of which 0.160 (10 cu. in.) of oil «Agip F.1 Rotra MP SAE 140» and 0.010 (½ cu. in.) of oil «Agip Rocol ASO/R»
— front fork (each leg)	0.070 lt. (2.45 oz. Imp. 2.38 oz. USA) liquid Agip F.1 ATF Dexron	0.070 lt. (2.45 oz. Imp. 2.38 oz. USA) liquid Agip F.1 ATF Dexron
— front and rear braking circuits	fluid Agip F.1 Brake fluid (SAE J 1703)	fluid Agip F.1 Brake fluid (SAE J 1703)

## 2 MAINTENANCE OPERATIONS

The efficiency and conservation of the various engine and frame components are largely dependant on an accurate and periodical maintenance. The indicated periods and mileages for the various operations apply to a vehicle used normally. If the motorcycle is used on dusty or unasphalted roads or at continuous high speed on motorways, more frequent controls are necessary. Any time your byke undergoes any impact for any reason whatever, consult your dealer, also in case of light impacts. Each vehicle is supplied with a suitable set of tools for emergency operations.

### 2.1 ENGINE LUBRICATION (Fig. 5)

**Oil level check:** every 500 km (300 miles) or so check the oil level in the crankcase. The oil should just skim the top mark on dipstick «A». If not, top up with oil of same brand and specification. This check should be carried out when the engine has run a short while and with the filler cap fully screwed in.

**Oil change:** every 500-1000 km (300-600 miles) and then every 3000 km (1800 miles) change the oil in the crankcase. Do this on a warm engine and allow all the old oil drain completely from the drain plug.

«A» = oil filler cap.

«B» = rear oil drain cap.

«C» = front oil drain cap.

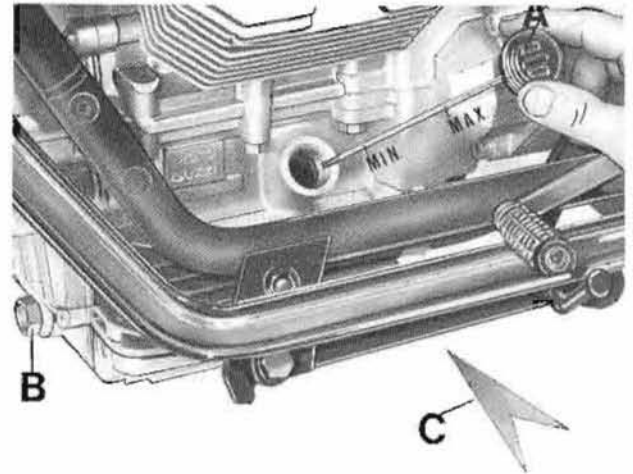
Quantity required: 2,250 lts. (abt. half Imp. gl. - .47 US gl.).

### 2.2 REPLACING THE OIL CARTRIDGE IN THE SUMP (fig. 6)

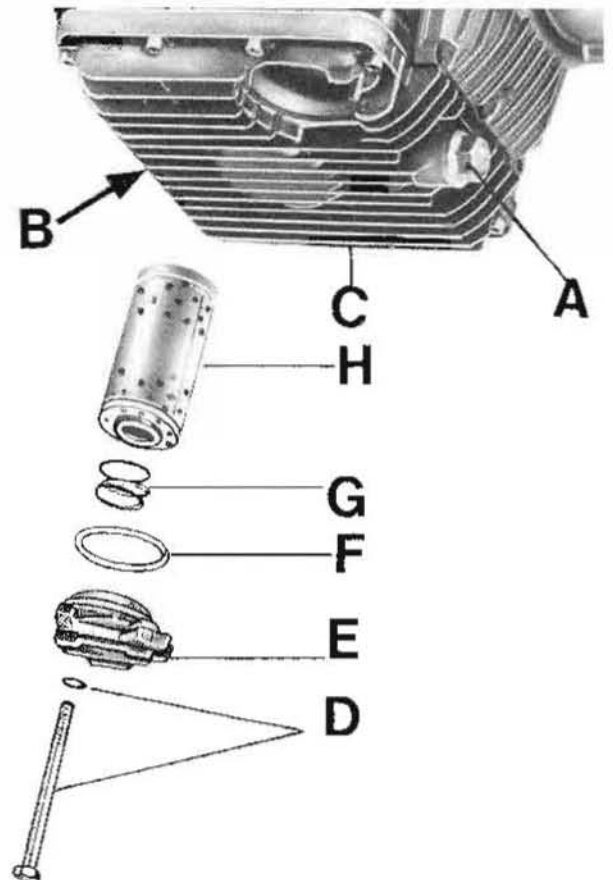
After the first 500-1000 km (300-600 miles) and then every 6000 km (3600 miles), replace the cartridge in the oil sump as follows:

- undo drain caps «A» and «B» from sump «C»,
- allow all the old oil to drain from the sump; also filler cap «A» in fig. 5;
- undo the screw and washer securing cartridge «H» and withdraw the cartridge assembly complete with cover «E», gasket «F», spring «G» and cartridge «H»;
- replace cartridge «H» and if necessary seal «F» on cover «E».

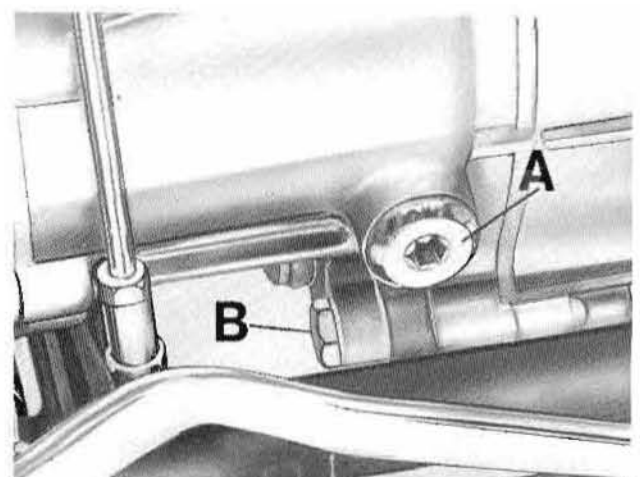
Re-assemble the complete unit reversing the dismantling sequence and introduce the specified quantity of oil before screwing down the filler cap.



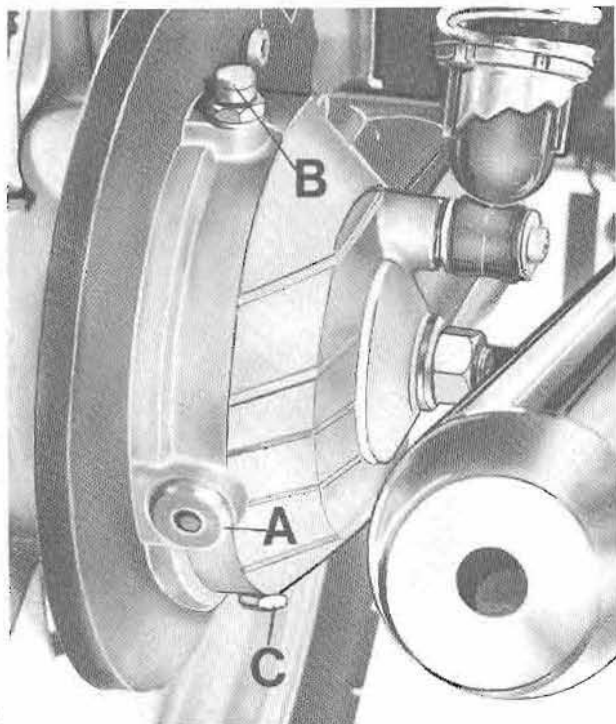
5



6



7



8

### 2.3 CLEANING THE WIRE GAUZE FILTER AND THE SUMP

After the first 500-1000 km (300-600 miles) i.e. after the first oil and cartridge change, and then every 15.000 km it is a good rule to dismantle the oil sump from the crankcase, take out the wire gauze filter and to thoroughly clean everything in a petrol bath. Then dry off the filter and oil ways in the sump with compressed air. In re-assembling the sump don't forget to replace its gasket.

### 2.4 LUBRICATION OF THE GEAR BOX (Fig. 7)

**Checking the oil level:** every 3000 kms (1800 miles) make sure that the oil level skims filler cap «A». If not, top up with oil of same quality and density till it starts seeping through the level plug.

#### Oil change

Every 10.000 kms (6000 miles) or so the gearbox oil should be replaced

This operation should be done when the gearbox is warm as in this condition the oil is fluid and more easily drained.

Allow all the old oil to drain completely before introducing new oil.

«A» = oil filler plug.

«B» = drain plug.

Quantity: 1 liter of Agip F.1 Rotra MP 90 (1.76 pints Imp. - 2.11 pints USA).

### 2.5 LUBRICATION OF REAR DRIVE BOX (fig. 8)

#### Checking oil level

Every 3000 km (1800 miles) ensure that the oil skims filler and level plug «A». If lower, top up with oil of same quality and density.

#### Oil change

Every 10000 km (6000 miles) or so replace the oil in the box. This operation is best carried out with the box warm as in this condition the oil is fluid and more easily drained.

Before introducing any fresh oil, ensure the old one has completely drained.

«A» = filler and level plug.

«B» = vent plug.

«C» = drain plug.

Quantity. 0.170 l. (5.9 oz. Imp. - 5.75 oz. USA) of which 0.160 lt. (5.6 oz. Imp. - 5.4 oz. USA) Agip F.1 Rotra MP SAE 90 and 0.010 lt. (.35 oz. imp. and .034 oz. USA) of Agip Rocol ASO/R.

### 2.6 LUBRICATION OF FRONT FORK (EACH LEG) (fig. 9)

Proceed as follows:

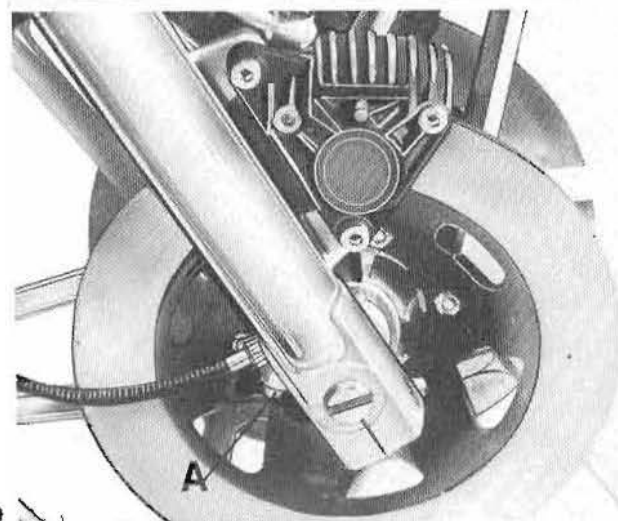
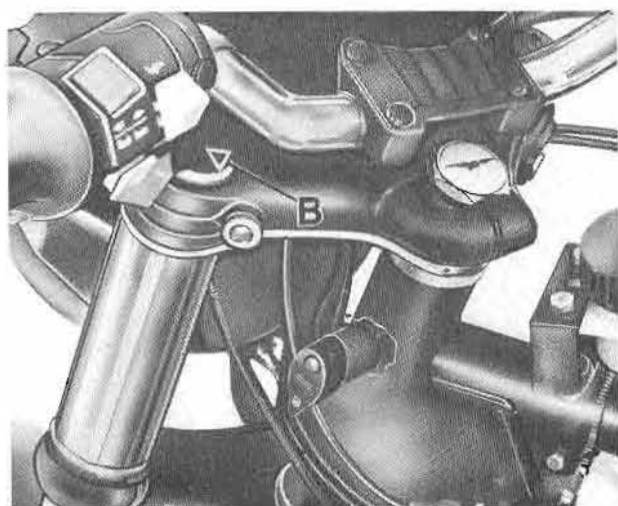
- undo drain plug and washer «A»;
- undo Allen filler screw «B».

Allow all the old oil to drain before any fresh liquid is introduced.

«A» = drain screw.

«B» = filler screw.

Quantity: 0.070 lt. (2.45 oz. Imp. - 2.38 oz. USA) of Agip F.1 ATF Dexron in each leg.



9

## 2.7 SUNDRY LUBRICATIONS

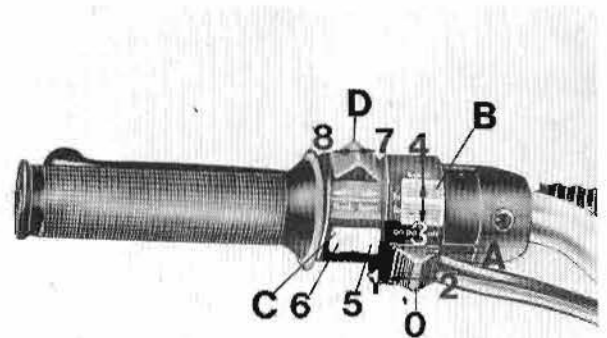
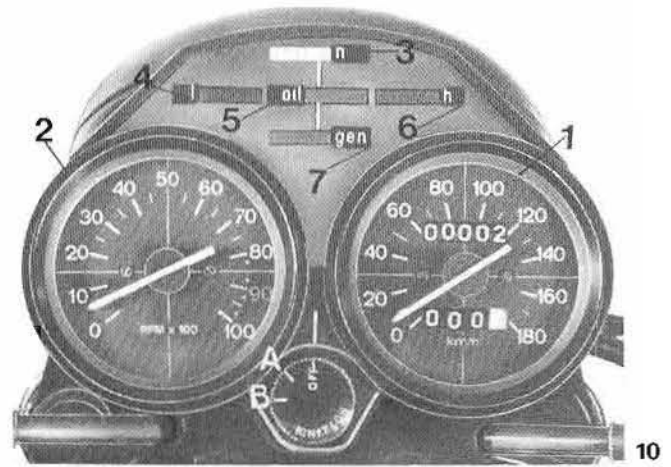
Lubricate periodically:

- steering cups and balls;
- swinging arm bearings;
- control cable terminals;
- articulations of prop stands;
- speedo drive.

## 2.8 CONTROLS AND INSTRUMENTS

Panel board (fig. 10)

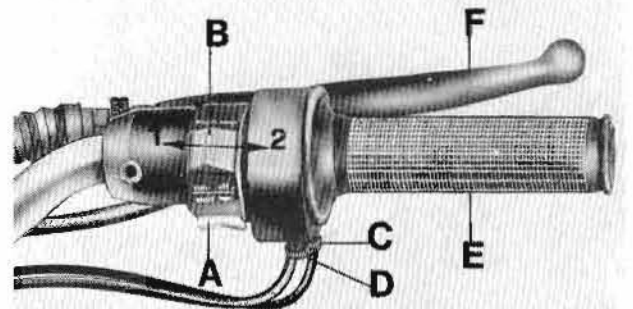
- 1 speedometer (with partial zero reset);
  - 2 rev-counter;
  - 3 warning light, neutral indicator (orange). Lights up with gear change in neutral position. (n);
  - 4 (l) warning light, parking light (green);
  - 5 (oil) warning light, Oil pressure gauge. Goes out when pressure is sufficient for engine lubrication. If it does not go out, pressure is incorrect and the engine should be immediately stopped for the necessary controls;
  - 6 (h) warning light (blue), high beam «ON»;
  - 7 (gen) warning light (red) indicating current delivery from generator. Goes out when the engine reaches a certain number of revolutions.
- When driving in daylight, all lights should be off. At night time the low beam or eventually the high beam only should be lit.



## 2.9 IGNITION KEY (fig. 10)

The key has 3 positions:

- «OFF» In line with reference mark on panel. Machine at standstill, key removable;
- «A» In line with reference mark on panel (turned clockwise). Machine ready to be started. All contacts «ON», key not removable;
- «B» In line with reference mark on panel (turned clockwise). Machine stopped. With switch «A» (fig. 11) in position «O» the parking lights are «ON», key removable.



## 2.10 LIGHT SWITCHES (fig. 11)

Are located on left hand side of the byke

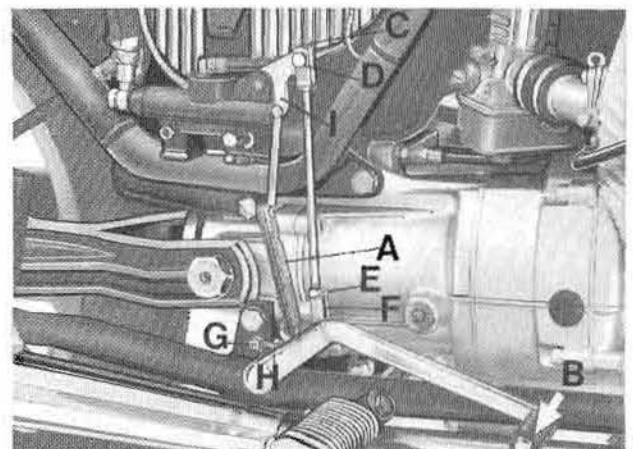
Switch «A» controls:

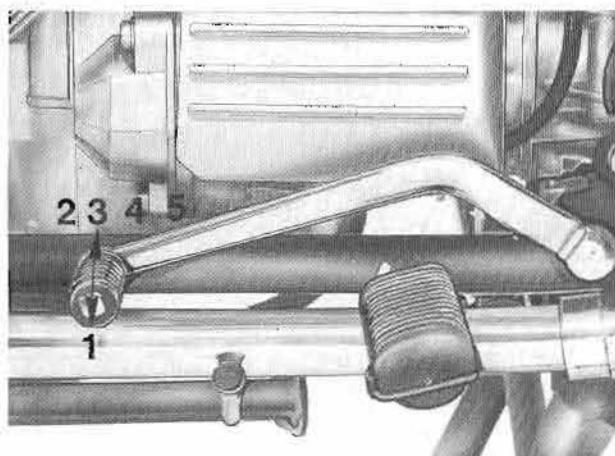
- parking lights (position «0»);
- riding lights (position «1»);
- lights off (position «2»).

Switch «B»

With switch «A» in position «1»:

- low beam «ON» (position «3»);
- high beam «ON» (position «4»).





14

### 2.11 HORN, FLASH LIGHT AND TURN SIGNAL CONTROL (fig. 11)

On left hand side of the handlebar.

#### Buttons «C»

- «5» horn;
- «6» flash light.

#### Switch «D»

- «7» control for right turn signal;
- «8» control for left turn signal.

### 2.12 ENGINE STARTING AND EMERGENCY STOP SWITCH (fig. 12)

On right hand side of handlebar.

With ignition key (fig. 10) in position «A» the machine is ready to be started.

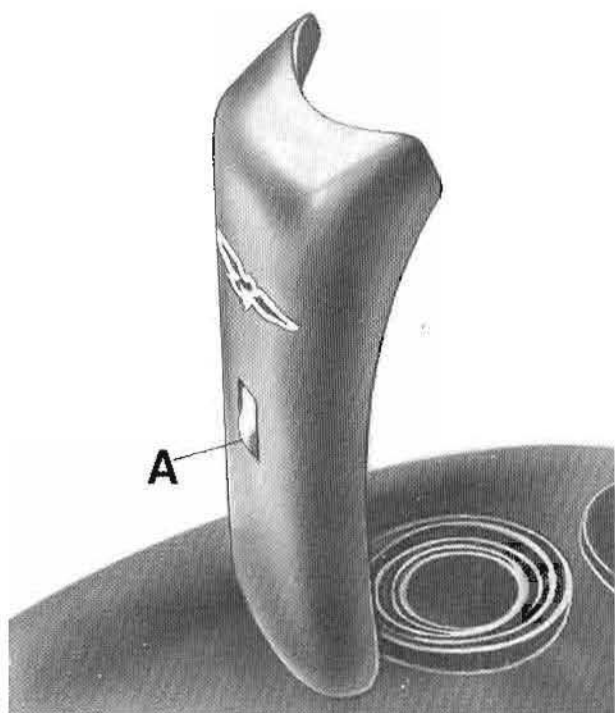
To start the engine:

- set switch «B» to position «1» (RUN);
- pull clutch lever fully;
- on a cold engine, move starter lever (fig. 82) to position «A» (START);
- press button «A» (Start).

For an emergency stop:

- move switch «B» to position «2» (OFF).

As soon as the engine is stopped, turn ignition key (See fig. 10) clockwise to the point where mark «OFF» is lined up with the panel mark and withdraw the key.



15

### 2.13 RIGHT FRONT BRAKE CONTROL LEVER («F», fig. 12)

It is on the right side of the handlebar and controls the right front brake.

### 2.14 LEFT FRONT BRAKE AND REAR BRAKE CONTROL PEDAL («B», fig. 13)

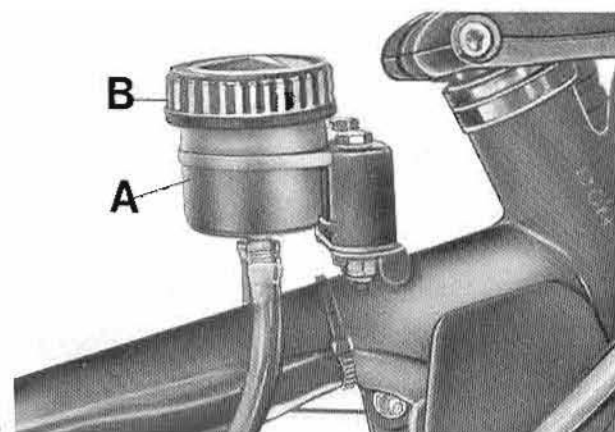
This pedal is located on the right side of the machine and it is link connected to the master cylinder. It operates both the front left brake and the rear brakes at the same time.

### 2.15 GEAR CONTROL (fig. 14)

The control pedal is located on the left side of the machine and has two positions:

- «low» - Lever towards the ground;
- 2nd, 3rd, 4th, 5th - Lever upwards;
- neutral - in between low and 2nd gear.

Before changing gear, don't forget to pull the clutch lever completely.



16



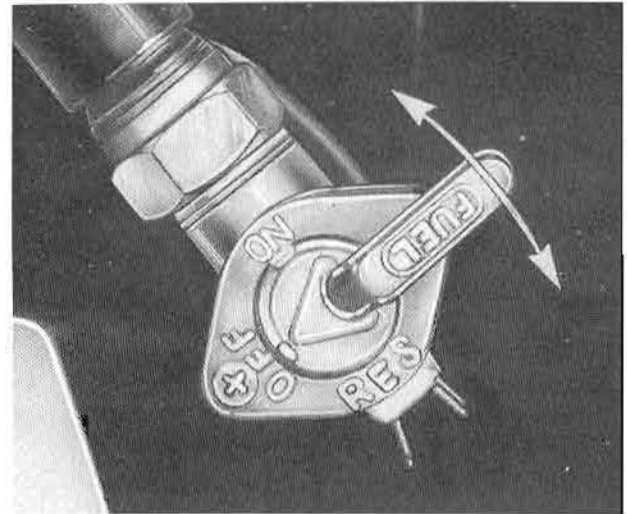
## 2.16 FUEL FILTER CAP (fig. 15)

This cap is opened by pressing button «A».

## 2.17 FRONT AND REAR BRAKES FLUID RESERVOIR (fig. 16)

Press button «A» (fig. 15) to get access to this and to raise the cover with cap.

To check the fluid level, remove cap «B» from reservoir «A» and ensure the fluid tops always the separator which divides the reservoir in two parts, one for the front brake and the other for the rear brake.



17

## 2.18 FUEL TAPS (fig. 17)

Are located at the rear of the fuel tanks. The taps lever (FUEL) has 3 positions:

- «ON» open, vertical, upwards;
- «RES» reserve, vertical, downwards;
- «OFF» closed, horizontal.

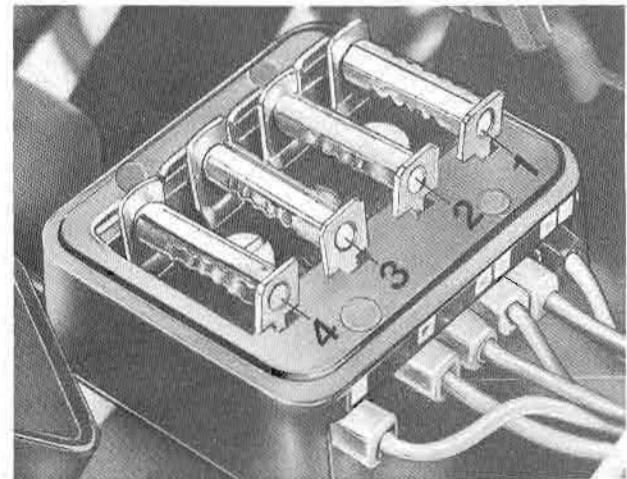
## 2.19 TERMINAL BLOCK WITH FUSES (fig. 18)

It is centrally located on the machines. It is accessible by raising the seat (See chapter «Seat locking device») and removing the cover after undoing the screw securing it to the fuse holder box.

This box contains 4 fuses «16 A».

- Fuse 1 - Rear stop light-Flash.
- Fuse 2 - Starter relay, rear brake stop light, flash light relay, horn.
- Fuse 3 - Warning lights (GEN-OIL-n), high beam and its indicator light, low beam.
- Fuse 4 - Parking lights - panel lights - Warning light «I».

Before replacing any fuse it is necessary to look for and eliminate the cause for its burning.



18

## 2.20 STEERING LOCK (fig. 19)

To lock and unlock the steering, proceed as follows:

### Locking

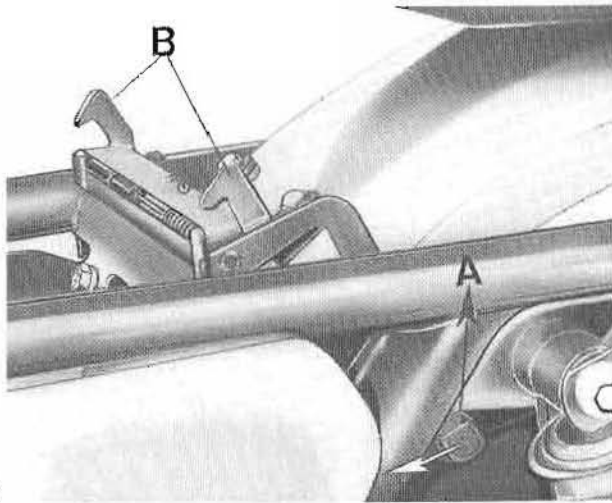
Turn the handlebar fully to the right.  
Insert the key into the lock set, turn it counterclockwise and push it fully in, release it, and take it off.

### Unlocking

Insert the key into the lock set, turn it counterclockwise, release it and slip it off.



19



20

## 2.21 SEAT LOCKING DEVICE (fig. 20)

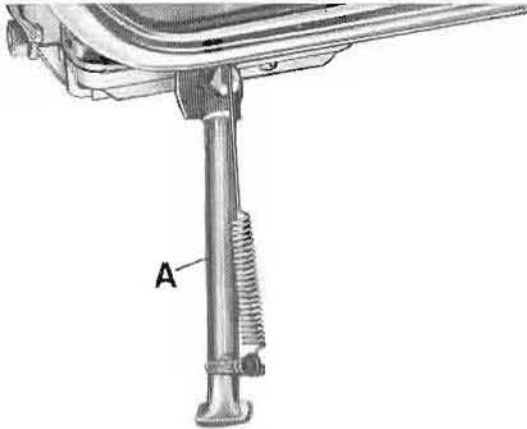
It is located at the left rear end of the seat.

### To unlock

Operate on lever «A» shifting it towards the front wheel (See arrow) so as to unhook hooks «B» that keep the seat secured to the device. Then lift the seat.

### To lock

Lower the seat until hooks «E» snap.



21

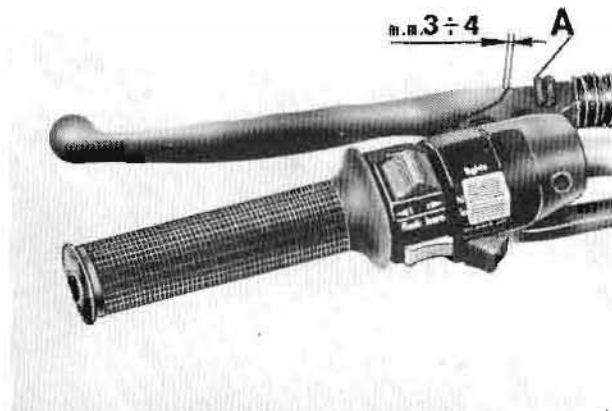
## 2.22 SIDE STAND («A» fig. 21)

This stand should be used only for brief stops. When re-starting ensure it is fully raised or else serious trouble may occur. The picture shows the first type of side stand; the second type has 2 return springs.

## 2.23 ADJUSTING THE CLUTCH CONTROL LEVER (fig. 22)

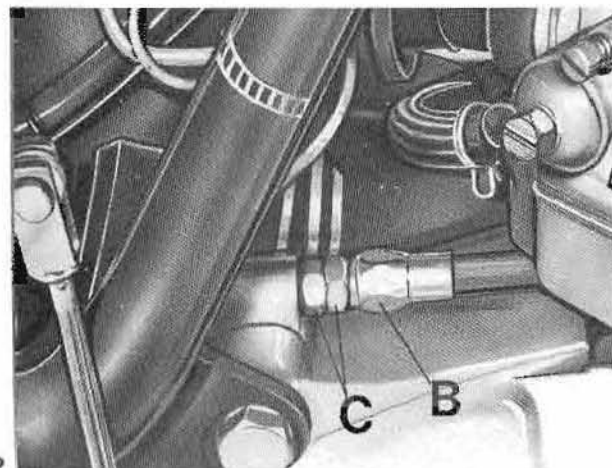
If the play at the handlebar lever is more or less than 3-4 mm (1/8") operate on adjuster «A» to obtain the correct distance.

This adjustment can also be made by loosening counternuts «C» and operating on adjuster «B». The counternuts are located on the right hand side of the gearbox.



## 2.24 ADJUSTING THE RIGHT FRONT BRAKE LEVER (fig. 23)

This lever should be adjusted when the play at the handlebar is more or less than 3-4 mm (1/8"). Operate on thumb screw «A» to obtain the correct play. This adjustment can also be made by operating on adjuster «B» after slackening counternuts «C».



22

## 2.25 ADJUSTING THE LEFT FRONT BRAKE AND THE REAR BRAKE PEDAL (fig. 13)

Check the play between master cylinder control linkage and control lever «I» as follows:

- set up a feeler gauge «A» between linkage and lever end;

- admissible play: 0.005 - 0.15 mm (.0019 - .0059").

If the play is not within these limits:

Remove cotter pin «C», withdraw pin «D», loosen counternut «E» and screw in or out fork «F» until the ideal position for pedal «B» is found. Re-fit pin retaining rod «D» and cotter pin «C».

Finally, loosen counternut «G» and adjust lever «H» return spring.

### 2.26 ADJUSTING THE THROTTLE CONTROL GRIP («E» fig. 12)

To adjust the travel of the twist grip, screw in or out screw «D».  
To harden the return of the grip, screw in or out screw «C».

### 2.27 ADJUSTING THE STEERING (fig. 24)

For safe riding, the steering should be so adjusted as to allow free movement to the handlebar but without excessive play.

To take up excessive play:

- loosen steering head fixing bolt «A»;
- undo steering head securing nut «B»;
- Screw in or out adjuster «C» by means of a center punch until the correct play is obtained.

After this has been done, lock nut «B» and steering head fixing bolt «A».

### 2.28 ADJUSTING THE SWINGING ARM PLAY (fig. 18)

The swinging arm has to oscillate freely without any play.

It is properly adjusted when both end spindles project by the same amount. This adjustment is made using special tool n. 10903100 (45 in fig. 25). At the end of this operation tighten both nuts «A».

### 2.29 ADJUSTING THE REAR SUSPENSION (fig. 26)

The external spring of the rear suspension can be adjusted to 3 positions by means of spanner «A» in the tool kit.

If the dampers' action is irregular, have them checked by your dealer.

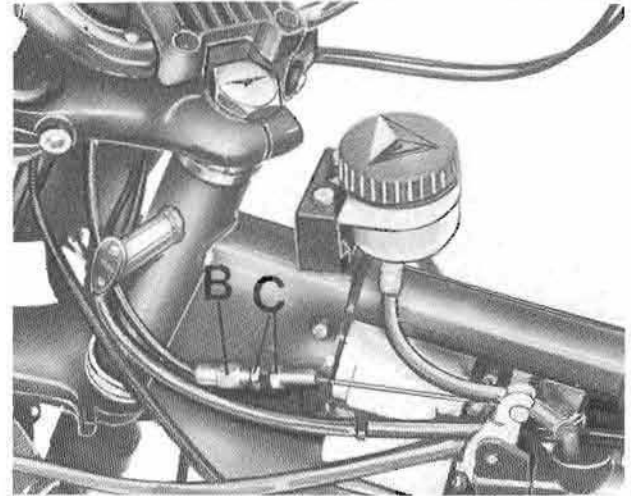
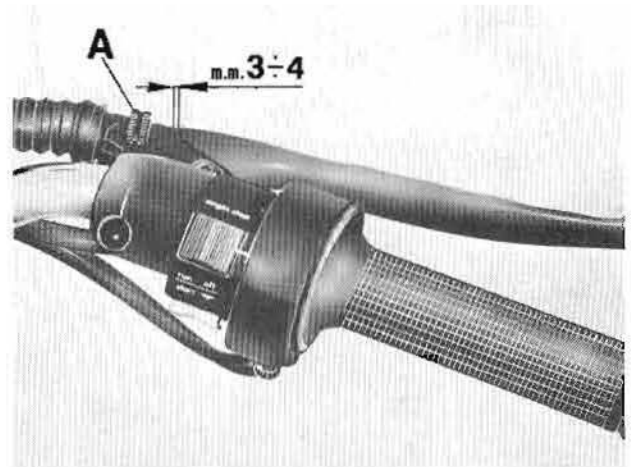
Don't forget that good machine stability depends on both dampers being adjusted to the same position.

### 2.30 ADJUSTING ROCKER CLEARANCE (fig. 27)

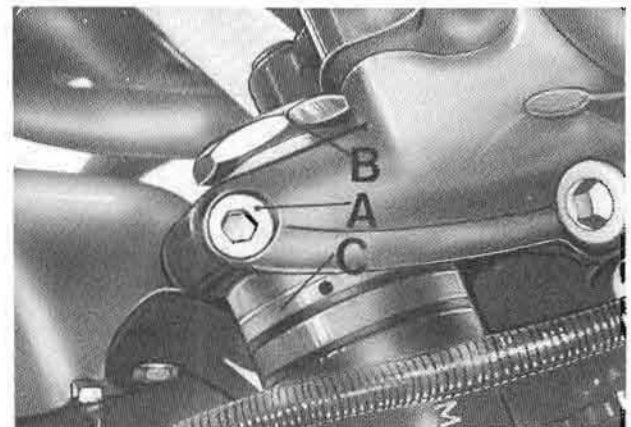
This adjustment has to be done in strict accordance with the prescribed valve gearing timing diagram and on a COLD ENGINE with piston at TDC, i.e. with both valves closed at the end of the compression stroke. Adjust by removing the rocker box cover, as follows:

- 1 slacken nut «B»;
- 2 screw in or out adjuster «A»;
- 3 insert the feeler gauge «C» blade between valve and rocker and ensure play is as specified i.e. 0.10 mm (.0039") for the inlet valve and .015 mm (.0059") for the exhaust valve.

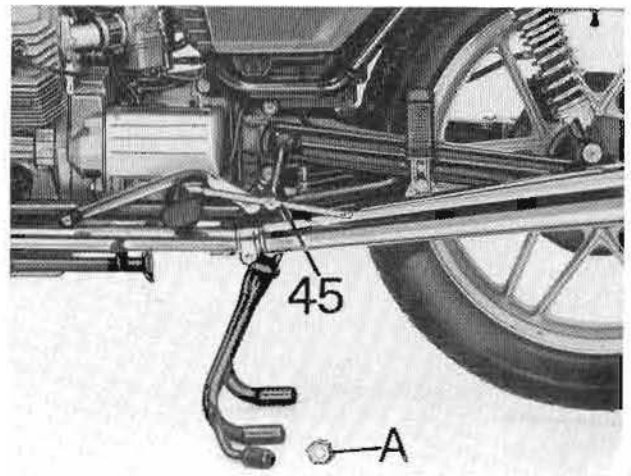
Finally, keep a firm hold on adjuster «A» and tighten nut «B».



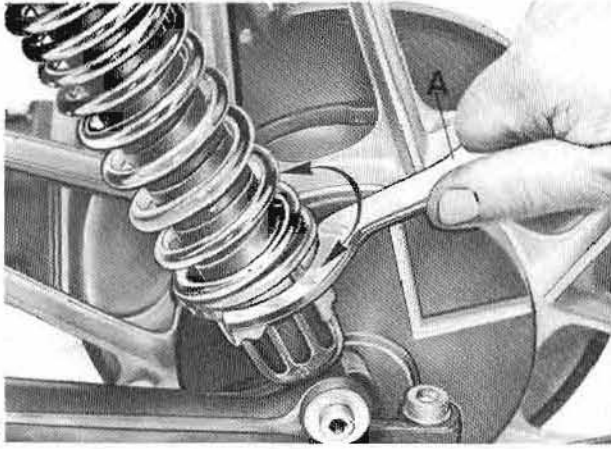
23



24



25



## 2.31 LUBRICATION AND MAINTENANCE OPERATIONS

### Monthly (or every 3000 km - 1800 miles)

Check the electrolyte level in battery.

### Periodically

Check tyre pressure.

Lubricate cable ends and prop stands articulations.

### Every 500 km (300 miles)

Check oil level in crankcase.

### After the first 500-1000 km (300-600 miles)

Replace the crankcase oil.

Check tightness of all nuts and bolts.

Check rocker clearance.

### Every 3000 km (abt 2000 miles)

Replace the crankcase oil.

Check rocker clearance

Check oil level in gearbox.

Check oil level in rear drive box.

### Every 5000 km (3000 miles)

Check brake fluid level in reservoir.

### Every 6000 km (3600 miles)

Replace the oil filter cartridge in sump.

### Every 10.000 km (6000 miles)

Replace the air filter cartridge.

Clean the fuel tank, filters, taps, and fuel lines.

Replace the gearbox oil.

Clean and grease all battery connections.

### Every 15.000 km (9000 miles)

Replace the fluid in the braking circuits.

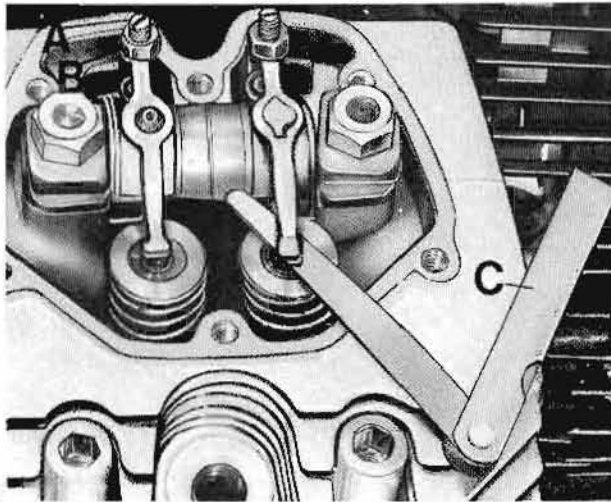
### Every 20.000 km (12.000 miles)

Check condition of wheel bearings.

Ensure that all steering bearings and cups are well greased.

Replace the oil in the fork legs.

Clean the starter motor and generator commutators with a petrol moistened rag.



### 3 TORQUE LOADINGS

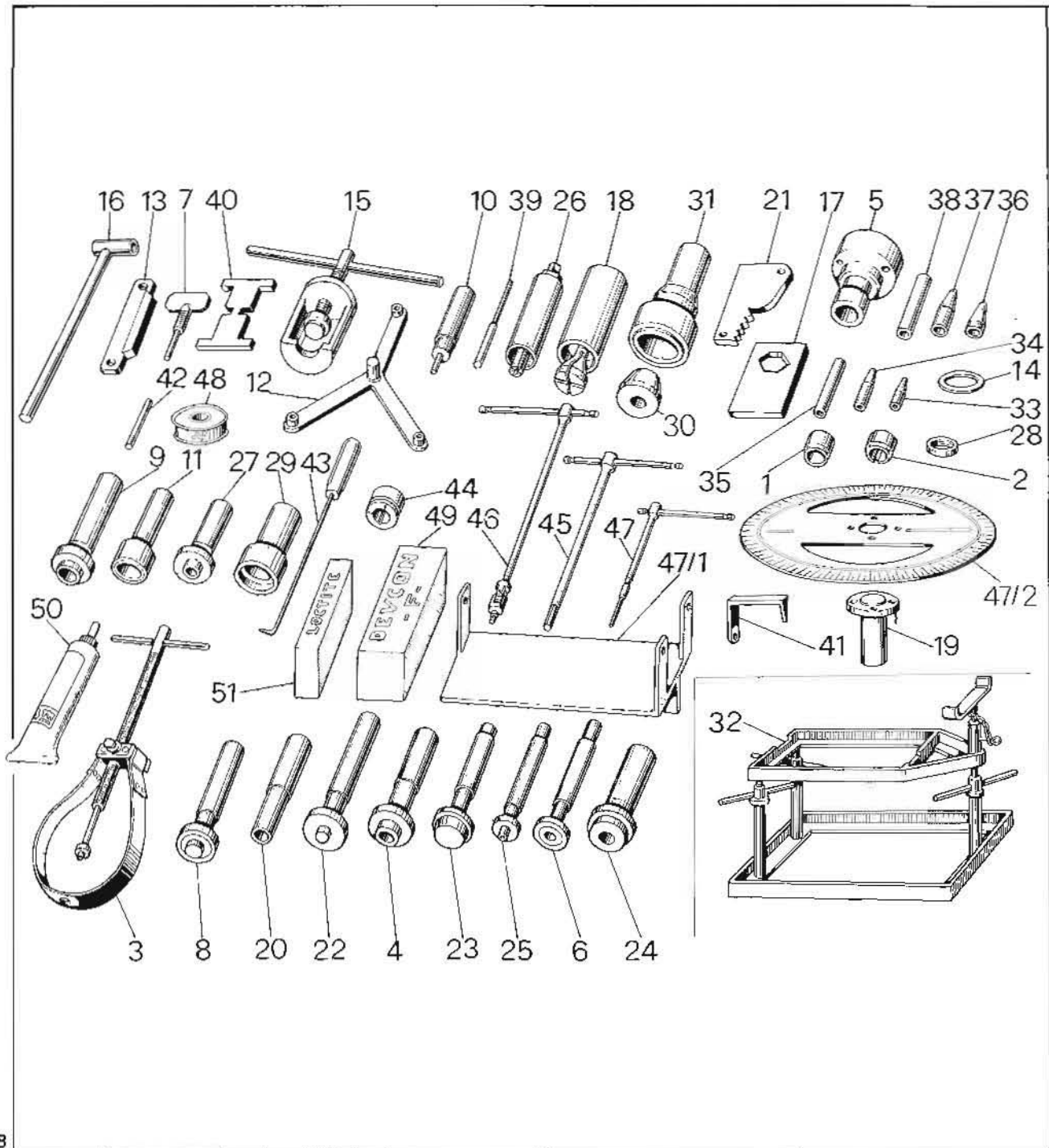
DESCRIPTION	Kgm	ft/lbs
<b>Cylinder heads</b>		
Screws, rocker box cover . . . . .	1	7
Spark plugs . . . . .	2 - 3	15 - 22
<b>Crankcase and covers</b>		
Nut, cylinder head to crankcase . . . . .	4	29
Nuts, crankcase joining . . . . .	2,2 - 2,5	16 - 18
Screws, timing cover . . . . .	1	7
Screws, oil sump . . . . .	1	7
<b>Connecting rod</b>		
Nut, selflocking, big end . . . . .	2,2 - 2,5	16-18
Bolt, flywheel . . . . .	4	7
Bolt, crown wheel . . . . .	1	
<b>Valve gearing</b>		
Screw, camshaft flange . . . . .	3	22
Nut, camshaft gear . . . . .	1,5	10,5
<b>Starter motor</b>		
Screws, starter motor securing . . . . .	3	22
<b>Fuel feed</b>		
Screws, intake pipe . . . . .	1	7
<b>Lubrication</b>		
Screws, oil pump . . . . .	1	7
Screw, oil cartridge cover . . . . .	2,5	18
<b>Ignition</b>		
Bolt, generator securing . . . . .	0,5	3
<b>Clutch</b>		
Nut, clutch shaft . . . . .	10	70
<b>Gear box</b>		
Nuts, mainshaft . . . . .	10	70
<b>Engine to machine</b>		
Nut, front stud . . . . .	4,5	32
Nut, short and long screw . . . . .	4,5	32
Screws, gearbox to clutch housing cover . . . . .	2,5 - 3	18 - 22
<b>Rear drive</b>		
Nut, bevel gear to housing . . . . .	10	70
Screws, crown wheel to hollow spindle . . . . .	4,2	30
Screws, cover to drive box . . . . .	2,5	18
Screws, brake disc to hollow spindle . . . . .	2,2 - 2,4	16-18

DESCRIPTION	Kgm	ft/lbs
<b>Frame</b>		
Screws, cradle to frame . . . . .	8	58
Screws, center stand . . . . .	3,5	25
<b>Front suspension</b>		
Screws, front fork plate (top) . . . . .	4,5	32
Screws, front fork bottom plate . . . . .	4,5	32
Screws, damper securing . . . . .	3	22
Screws, fork leg to wheel spindle . . . . .	4,5	32
<b>Rear suspension</b>		
Screws, top and bottom securing . . . . .	3	22
<b>Front wheel and brake disc</b>		
Nut, wheel spindle . . . . .	14 - 15	98 - 105
Screws, brake disc to hub . . . . .	2,2 - 2,4	16 - 18
<b>Rear wheel</b>		
Nut, wheel spindle . . . . .	14 - 15	98 - 105
Screw, wheel spindle to swinging arm . . . . .	4,5	32
<b>Steering - Instruments</b>		
Bush, steering lock . . . . .	5 - 6	43 - 52
Screws, panel securing . . . . .	2,5	18
Screws, handlebar to panel . . . . .	3	22

## 4 SPECIFIC WORKSHOP TOOLS

(fig. 28)

POS.	PART N.	DESCRIPTION
1	19 92 73 00	Bush, seal fitting on layshaft.
2	19 92 74 00	Bush, seal mounting on timing cover.
3	19 90 78 00	Puller, gudgeon pin.
4	19 92 61 00	Punch, bevel set seal.
5	19 92 88 00	Tool, alignment of bevel set.
6	19 82 87 00	Punch, pressing in seal on gear selector spindle.
7	19 90 28 00	Tool, positioning of sector for pedal starting.
8	19 92 94 00	Tool, clutch shaft bearing (in clutch housing).
9	19 92 60 00	Punch, pressing of seal in drive box
10	19 90 59 00	Punch, fitting of seal on clutch shaft.
11	19 92 72 00	Punch, fitting of seal in timing cover.
12	19 90 65 00	Tool, clutch assembling and centering.
13	19 91 18 00	Tool, holdfast, flywheel.
14	19 92 72 02	Spacer, fitting seal on layshaft.
15	19 90 70 00	Puller, seal inside bevel set.
16	19 90 71 00	Tool, holdfast clutch shaft, layshaft, and bevel pinion.
17	19 90 54 00	Tool, main shaft and clutch shaft locking nuts.
18	19 92 75 00	Puller, roller bearing outer race in drive box.
19	19 92 95 00	Hub, timing disc
20	19 92 62 00	Punch, bevel pinion bearing.
21	19 92 77 00	Tool, holdfast, drive gear for gearbox stripping.
22	19 92 63 00	Punch, taper roller bearing for main shaft in gearbox.
23	19 92 64 00	Punch, taper roller bearing outer race on bevel set carrier.
24	19 92 65 00	Punch, bearing outer race in drive box.
25	19 92 66 00	Punch, swing arm bearing on gearbox cover.
26	19 92 76 00	Puller, removal of swing arm bearing from gearbox cover.
27	19 92 67 00	Punch, clutch shaft seal on clutch housing.
28	19 92 78 00	Reduction bush, for fitting valve stripping tool (listed as n° 10 90 72 00)
29	19 92 79 00	Punch, pressing of roller bearing inner race on hollow shaft in drive box.
30	12 91 20 00	Tool, seal fitting on crankshaft, flywheel side.
31	19 92 71 00	Punch, pressing flange seal on crankshaft, flywheel side.
32	18 91 24 50	Stand, engine support.
33	18 92 65 00	Tool, fitting of gasket on floater, brake pump, right front brake.
34	18 92 66 00	Tool, fitting of gasket on floater, pump for right front brake.
35	18 92 67 00	Tool, fitting of pump lockring, right front brake pump.
36	14 92 65 00	Tool, fitting of gasket on pump floater, left front and rear brakes.
37	14 92 66 00	Tool, fitting of gasket on pump floater, left front and rear brakes.
38	14 92 67 00	Tool, fitting of pump lockring, left front and rear brakes.
39	14 92 64 00	Tool, removal of floater, right front brake, left front brake, and rear brakes.
40	14 92 69 00	Tool, checking of carburettor floater level.
41	19 92 81 00	Tool, arrow for checking valve timing and ignition.
42	14 92 66 00	Tool, removal of generator-alternator from crankshaft.
43	14 92 93 00	Tool, removal of pickup rotor from main shaft.
44	19 92 80 00	Tool, ignition timing control (to be fitted on main shaft key).
45	10 90 31 00	Wrench, Allen screw, 8 mm hex.



28

POS.	PART N.	DESCRIPTION
46	10 91 47 00	Wrench, socket, Allen screws 6 mm hex.
47	10 91 39 00	Wrench, Allen screws, 5 mm hex.
47/1	19 90 25 00	Stand, gearbox support.
47/2	19 92 96 00	Degree plate.
<b>SPECIAL PRODUCTS</b>		
48	00 01 00 00	Telfon (923.499.909) Tape for threads.
49	00 01 02 00	Devcon «F» - Filling paste for blowholes.
50	00 01 03 00	ER 847 3M - Sealing compound for crankcase covers.
51	00 01 04 00	Loctite 601 (804.585.601) - Nuts and bolts.



## 5 ENGINE UNIT

### 5.1 - a REMOVAL OF ENGINE-GEARBOX FROM THE FRAME - SEPARATION OF ENGINE FROM GEARBOX (fig. 29)

- Withdraw the breather pipes from the rocker boxes after loosening the retaining springs;
- extract the oil recovery pipe from crankcase to breather;
- undo intake pipe «B» securing screws «A» from cylinder head;
- remove re-cycling device «C» complete with air filter, vent pipe, and carburetors complete with intake pipes;
- undo nuts «F», take off flange «H» and spacers «G», securing the exhaust pipes to the cylinder heads;
- undo the screws of strap «L» connecting both exhaust pipes;
- undo nuts «D» and take off the silencers and foot-rests (E) securing screws. Remove silencers complete with exhaust pipes «I»;
- disconnect the engine from the frame by undoing nut «M» on retaining bolt «N»;
- undo the engine-gearbox joining screws «O» using the special wrench for Allen screws part n° 10 91 47 00 (46 in fig. 28) and part n° 10 91 39 00 (47 in fig. 28). Then actuate the clutch operating arm on the

gearbox cover so as to separate the engine «P» from the gearbox. Withdraw the engine from the cradle arms.

#### b Checking operations

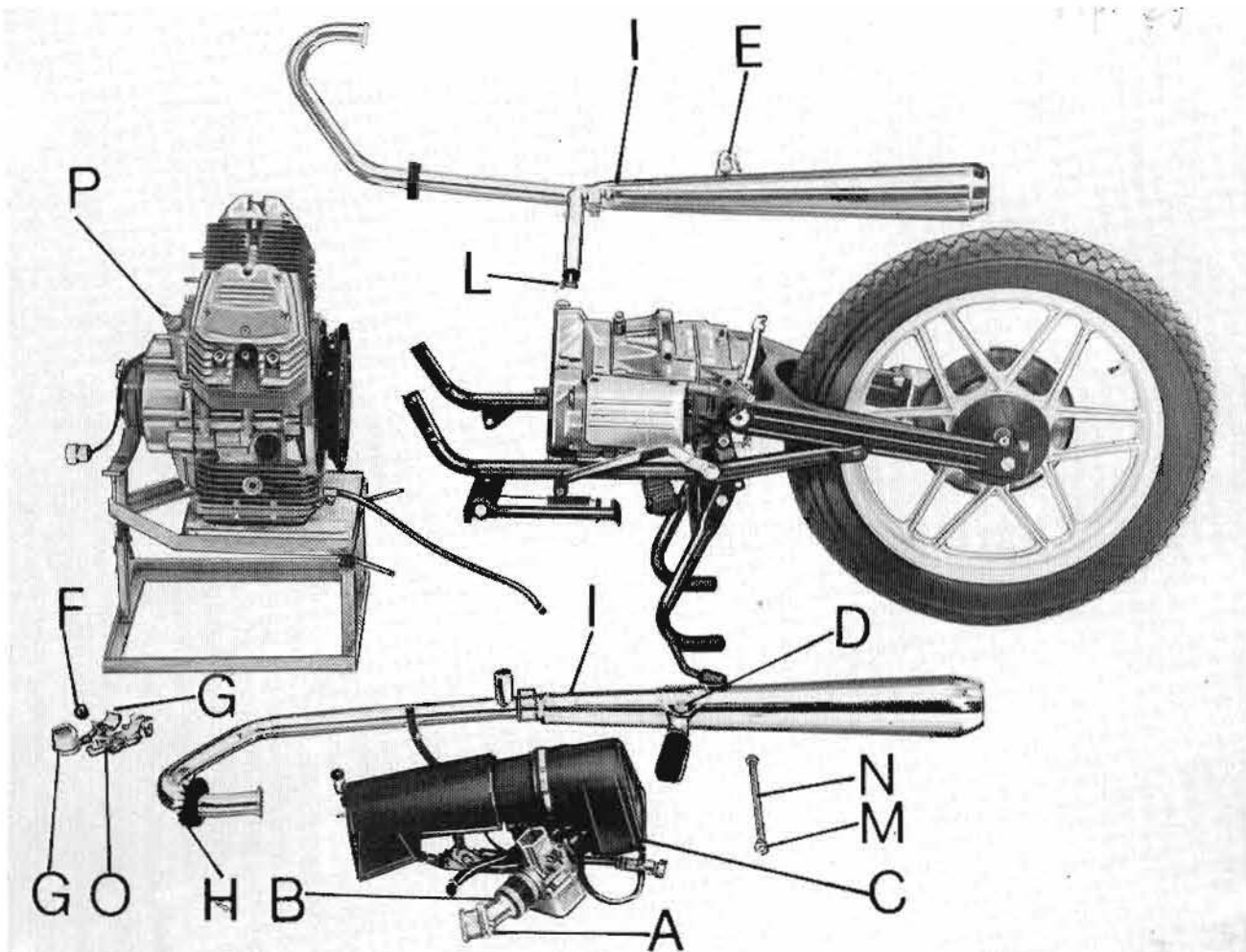
- Ensure the cylinder head-intake pipe gaskets are in good state. If crumpled or damaged, replace;
- check condition of the breather pipes in cylinder head and crankcase. If nicked, or cracked, replace;
- ensure the exhaust pipes and silencers are in good condition. If dented, replace;
- clean out the exhaust pipes and silencers. The removal of carbon deposits will greatly improve the efficiency of the engine.

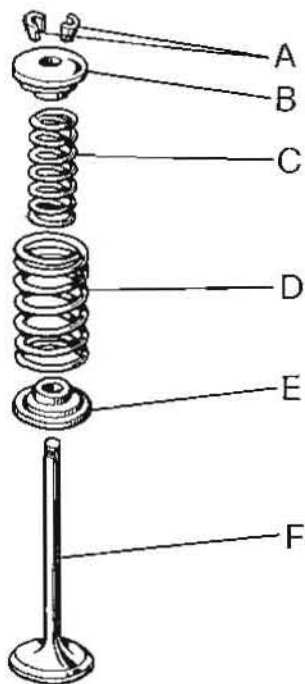
#### c Re-assembly

Refit the removed parts in the reverse order described for removal.

### 5.2 - a REMOVING THE ROCKER BOX COVERS

- Use wrench part N. 10 91 39 00 (47 in fig. 28) to undo the retaining Allen screws and remove the covers after loosening the retaining clips and withdrawing the breather pipes.





#### b Checking operations

- Ensure the contact surfaces are quite smooth. If scored, smoothen with very fine emery paper;
- ensure the covers have no casting defects and in the case of any blow holes fill in with Devcon «F» paste part N. 00 01 02 00 (49 in fig. 28).

#### c Re-assembly

When re-fitting the rocker box covers don't forget to change the gasket and to tighten the hold down nuts in a diagonal sequence, completing the operation with a torque wrench loaded to 1 kgm (7 ft/lbs).

### 5.3 - a STRIPPING THE CYLINDER HEADS

- Undo the rocker pin nuts, also the nuts securing the heads and barrels to the crankcase, proceeding in a diagonal sequence;
- remove the top rocker spacers, rocker pins, bottom spacers, push rods, and lift up the cylinder heads from the studs.

Removal of valves:

- fit up tool 10 90 72 00 (See fig. 31) using reduction bush part N. 19 92 78 00 (28 in fig. 31) on the top collar of the valve to be dismantled and at the center of the valve head. Screw in the tool to compress the spring and with a mallet tap lightly the tool on the top collar to detach both collets «A» from top collar «B» (See fig. 30). This procedure will prevent the tool from deforming. When both collets «A» are loosened, screws in the tool until the collets can be taken off the valve seats.

Then screw out the tool and remove it from the valve head.

Collar «B», inner spring «C», outer springs «D», bottom collar «E» with shims can now be slipped out and the valve «F» withdrawn from the head.

#### Removing valve guides:

The guides are removed by means of a special drift and a mallet, tapping from the inside.

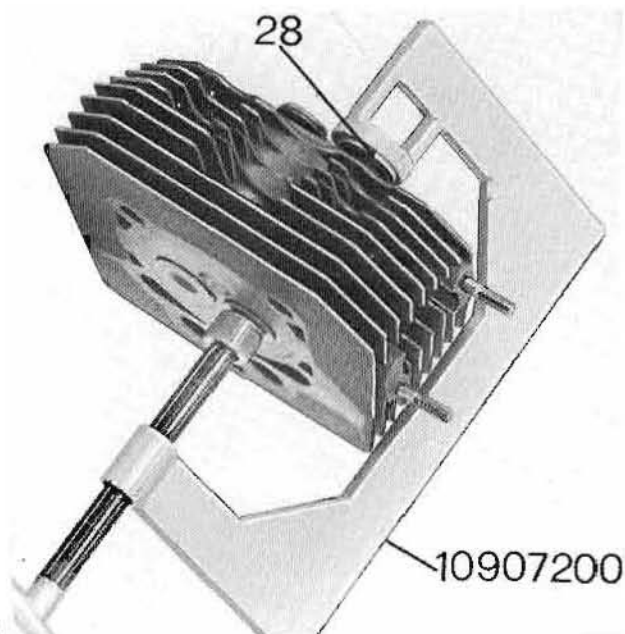
Replace the guides when worn out to such an extent that by replacing the valve only, the valve stem-valve guide I/D clearance cannot be eliminated (See data table and fig. 32).

#### b Checking operations

- Ensure the cylinder head - cover joining surfaces are not dented or scored. If so, smoothen out the faces with fine emery paper.
- Check tightness of valves in their seats. Pour some petrol in the head and if any seeps through, the valves have to be ground in. If after this operation the valves are not perfectly tight, then it will be necessary to mill off the seats, and to re-grind the valves or replace the valve.

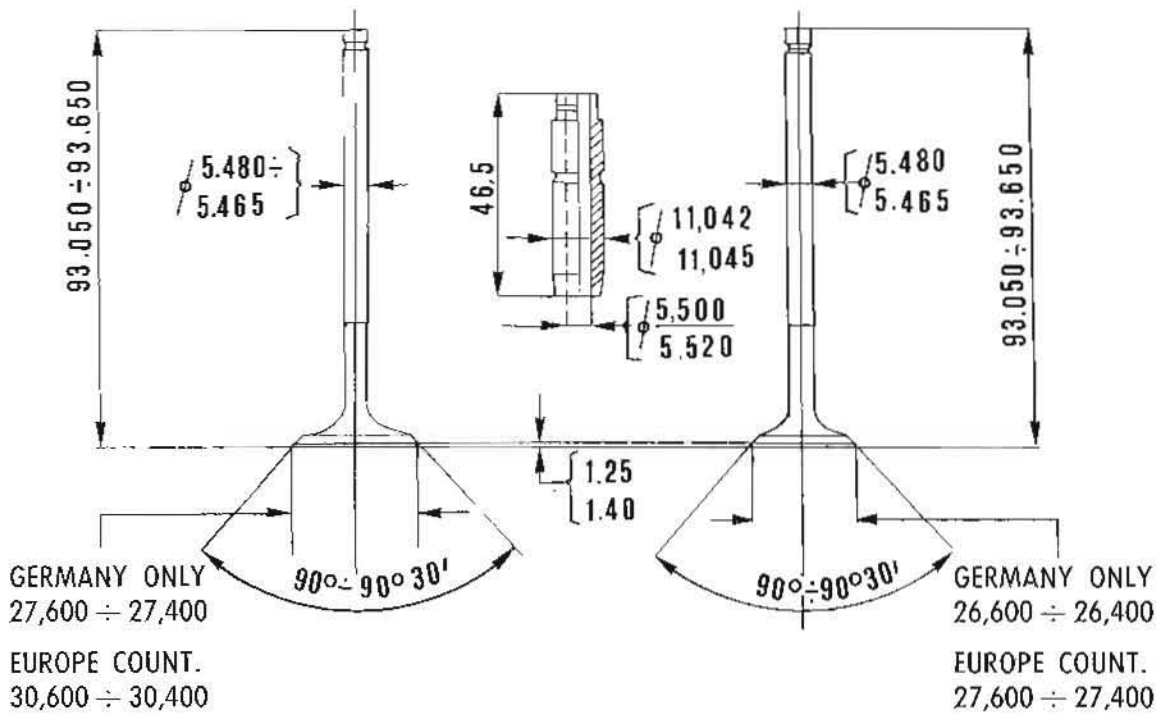
Inclination angle of the valve head is  $90^{\circ}30'$  (See fig. 32). Inclination angle of the seats is  $89^{\circ}30'$  (See fig. 33).

- Ensure the play between stem and guide is as specified in the table and in dwg fig. 32.



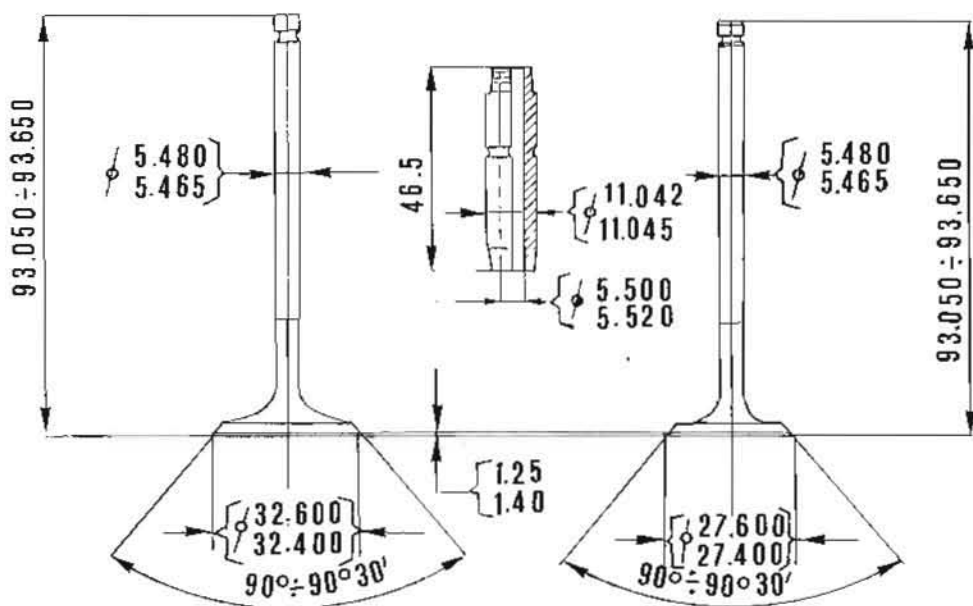
**INTAKE VALVE**

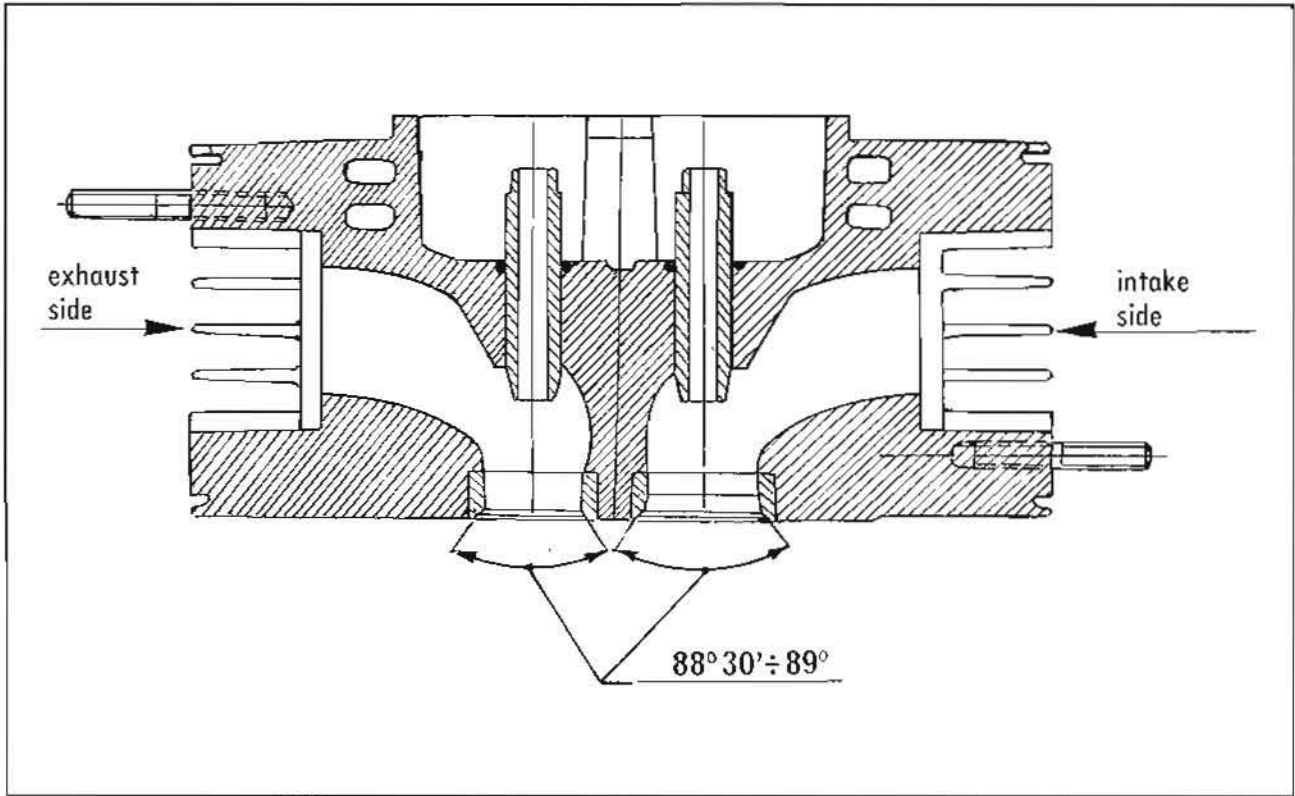
**EXHAUST VALVE**



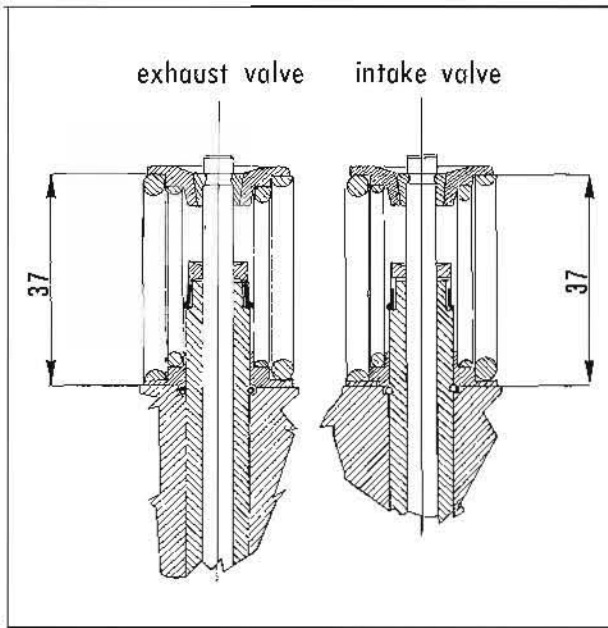
**INTAKE VALVE**

**EXHAUST VALVE**





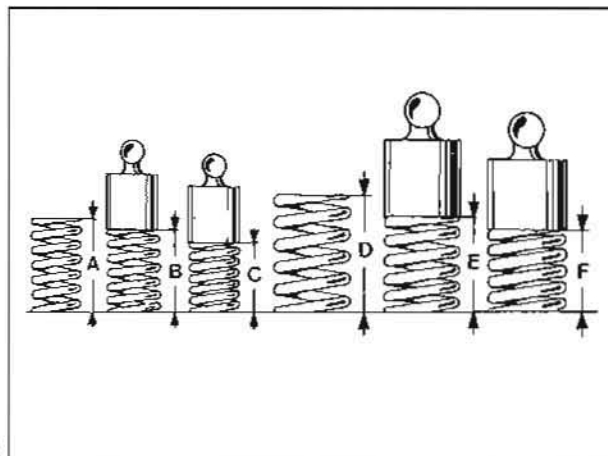
33



34

**Inspection of valve springs:**

■ On valves fully assembled (collars, springs, collets and valves) the outer spring should be compressed to 37 mm (1.456") See dwg 34. It should not be forgotten that a fully open valve should still have 1 mm travel before the inner spring compresses completely. Add or remove shims until this measurement is obtained.



35

**Inner spring (fig. 35)**

Free length	A = 36 mm (1.42")
Loaded 8 kgs (17 lbs)	B = 31.5 mm (1.38")
Loaded 20 kgs (44 lbs)	C = 24,45 mm (.986")

**Outer spring (fig. 35)**

Free length	D = 40.5 mm (1.6")
Loaded 18 kgs (39 1/2 lbs)	E = 36 mm (1.42")
Loaded 43.5 kgs (96 lbs)	F = 28,95 mm (1.15")

Load tolerance ± 4%

## VALVE - VALVE GUIDE COUPLING DATA

	I/D of valve guide	Valve stem dia.	Clearance on assembly
Inlet	5.500 ÷ 5.520 mm (.216 ÷ .2172")	5.480 ÷ 5.465 mm (.2157 ÷ .2152")	0.020 ÷ 0.055 mm (.00078 ÷ .00210")
Exhaust	5.500 ÷ 5.520 mm (.216 ÷ .2172")	5.480 ÷ 5.465 mm (.2157 ÷ .2152")	0.020 ÷ 0.050 mm (.00078 ÷ .00210")

### c Re-assembly

Press in the valve guides on the heads using a suitable punch and mallet, tapping from the outside. However, it is necessary to first pre-heat the head to about 60°F (140°C) and to lubricate the valve guide and the housing in the head. After the guide has been pressed into the cylinder head housings, ream out the I/D to bring it down to the size indicated in the table and in dwg fig. 32.

O/D of valve guides: 11.042 ÷ 11.055 mm (.4346 - .4351").

Hole size in head 11.000 ÷ 11.018 mm (.433 - .4337").

Guide-head interference fit 0.037 ÷ 0.042 mm (.0014 - .0016").

Now re-fit the valve assembly consisting of: valve, collars, springs and collets with any necessary shims. Do so using special tool N. 10 90 72 00 (fig. 31) used for dismantling plus the special reduction bush (N. 19 92 78 00, fig. 31, 28), reversing the dismantling sequence.

In fitting the cylinder heads on the barrels be sure not to obstruct the oil ways by incorrect fitting the head gasket.

To prevent deformation of the cylinder heads, be sure to tighten the hold down nuts in a diagonal sequence (See fig. 36), completing the operation with a torque wrench set to 4 kgm (29 ft/lbs). Finally, lock the Allen screw fixing the head to the cylinder.

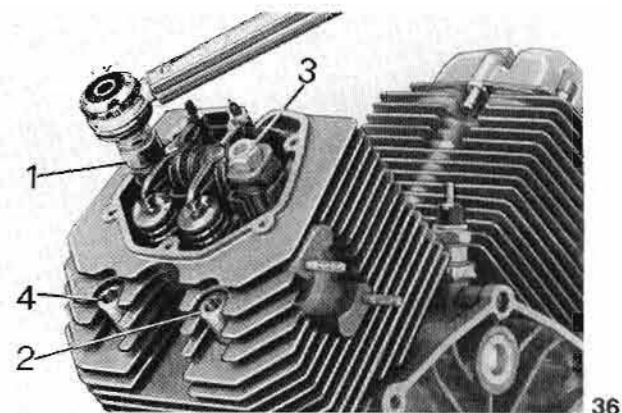
### 5.4 - a REMOVING THE CYLINDER BARRELS

- Lift up the barrels from the studs;
- remove seals from cylinders;
- take out cylinder base gaskets from the studs.

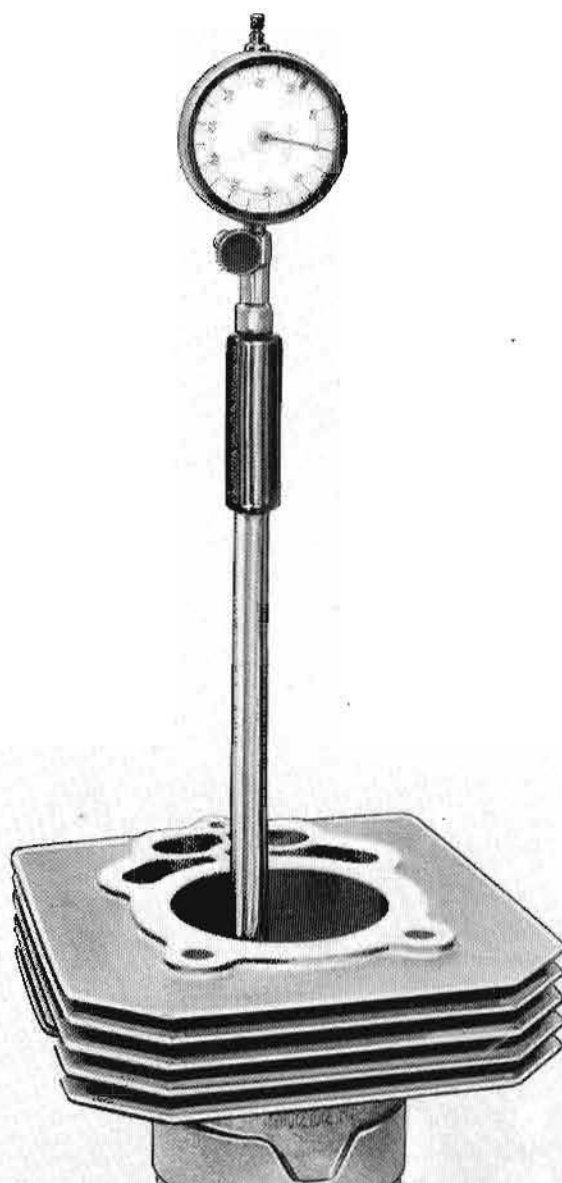
### b Checks

Check cylinder wear at 3 different heights in a transversal and longitudinal directions. Dial gauge has to be previously set to zero on a slip ring (fig. 37 and dwg fig. 38).

If the chromium plated surface at the cylinder top is worn down to more than 0.1 mm (.0039") or if any scoring or ovalization is detected, the cylinder should be replaced.

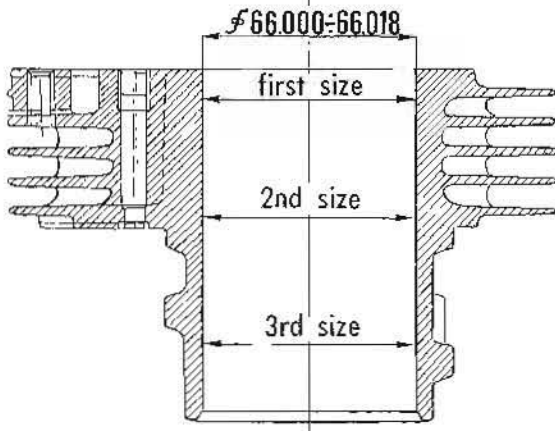
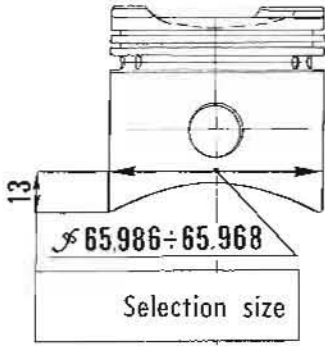


36

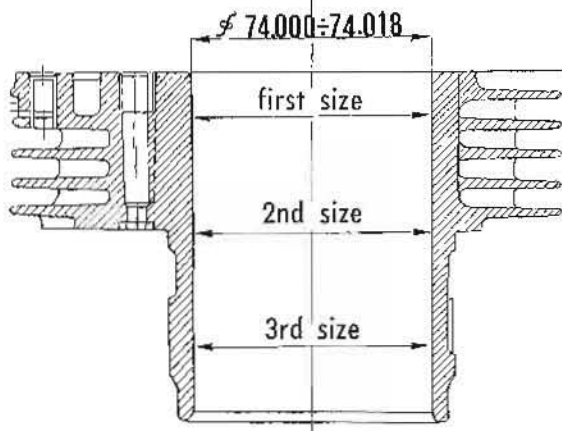
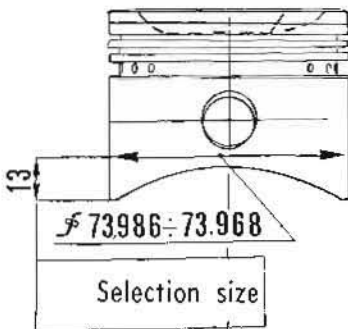


37

V 35



V 50



Selection of cylinder diameter - V 35 model

CLASS A	CLASS B	CLASS C
66.000 ÷ 66.006 mm (2.5984 ÷ 2.5986")	66.006 ÷ 66.012 mm (2.5986 ÷ 2.5988")	66.012 ÷ 66.018 mm (2.5988 ÷ 2.5990")

Selection of cylinder diameter - V 50 model

CLASS A	CLASS B	CLASS C
74.000 ÷ 74.006 mm 2.9134 ÷ 2.9136")	74.006 ÷ 74.012 mm (2.9136 ÷ 2.9138")	74.012 ÷ 74.018 mm (2.9138 ÷ 2.9140")

Cylinders of class A-B-C have always to be matched with pistons of same class.

c Re-fitting

- Fit new gasket «A» on crankcase studs, insert the cylinder barrel after ensuring that the lubricating passages in the gasket and in the barrel overlap each other;
- replace also seals «E» and «F» on the push rods, also the cylinder head asbestos gasket (See fig. 39).

INTAKE TUBES

European model

The intake tubes are marked «D» V 50 (right), «S» V 50 (left). The same tubes fit also the V 35 model (except the V 35 - Germany).

5.5 - a REMOVING THE COMPRESSION RINGS AND OIL SCRAPERS FROM THE PISTON

These rings should be removed from the piston with great care to prevent breakages. Widen the ring ends just sufficiently to slip them off the piston.

b Checking operations

- Ensure the piston slots clearance is as specified in the table and in fig. 40 (height clearance).
- Check piston ring gap with a feeler gauge with the rings in the barrel (See «Piston rings gap» and fig. 41).

Piston rings and oil scraper - Piston slots height clearance

- Compression rings «A» and «B» in fig. 42  
0.030 ÷ 0.062 mm (.00118 ÷ .00244")
- Scraper ring «C» in fig. 42  
0.030 ÷ 0.062 mm (.00118 ÷ .00244")

**Piston ring gaps**

- Compression rings («A» and «B» in fig. 42)  
0.25 ÷ 0.45 mm (.0098 ÷ .0177")
- Oil scraper («C» in fig. 42)  
0.20 ÷ 0.45 mm (.0078 ÷ .0177")

**c Re-assembly**

When fitting the piston rings pay attention to the end gaps which have to be out of line with each other.

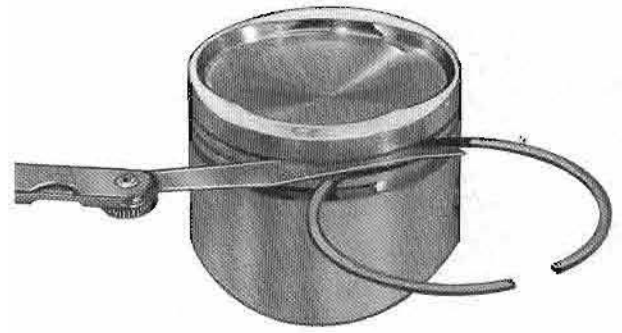
**5.6 - a REMOVAL OF PISTONS**

To remove piston «D» in fig. 42 from the small end it is necessary to push out gudgeon pin «E» after removing its retaining circlip «F» using tool 19 90 78 00 (3 in fig. 43).

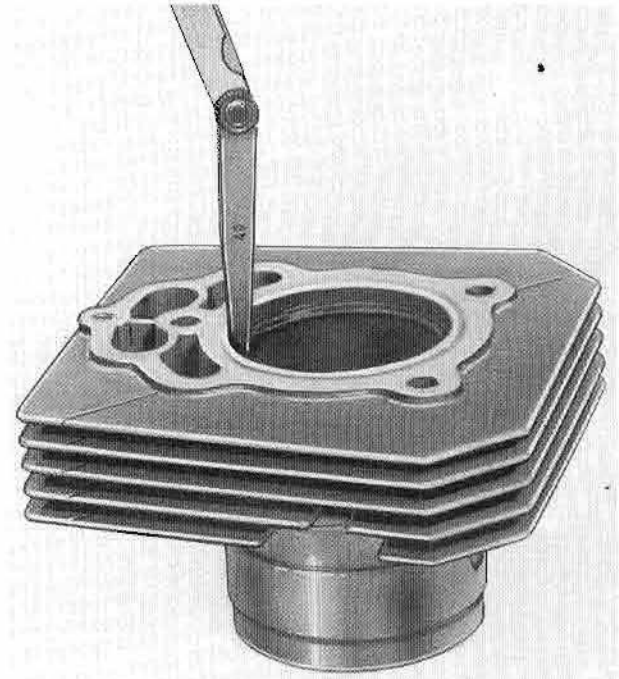
When overhauling, always remove all carbon deposits from the piston crown and slots.

**b Checking operations**

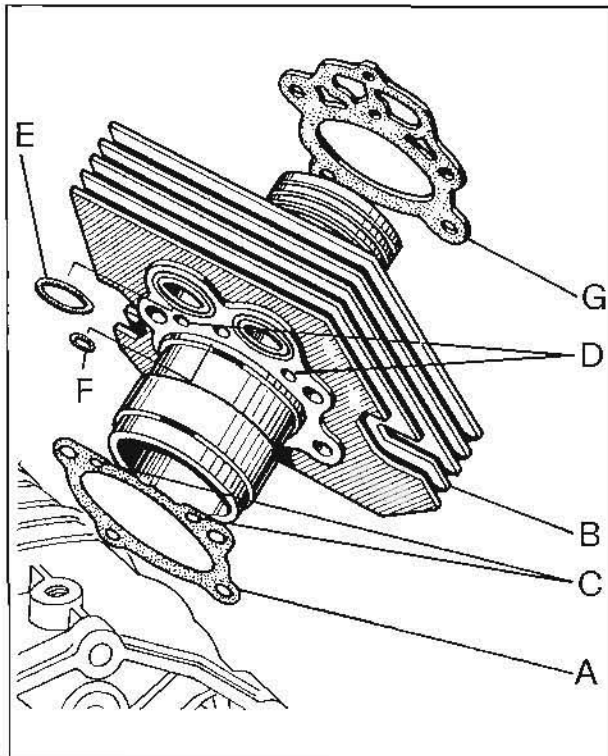
- Ensure the piston-barrel clearance is as specified 0.014 ÷ 0.050 mm (.00055 ÷ .0019").
- Check piston weights. Max permissible difference: 1.5 grams (.05 oz.).
- The selection measurements indicated in the table have to be taken at 13 mm (.511) from the piston base in an orthogonal sense to the piston pin axis. Make sure the piston is marked with its selection letter (A-B-C) and letter «C» (spark plug side). See arrows 1 and 2 in fig. 46.



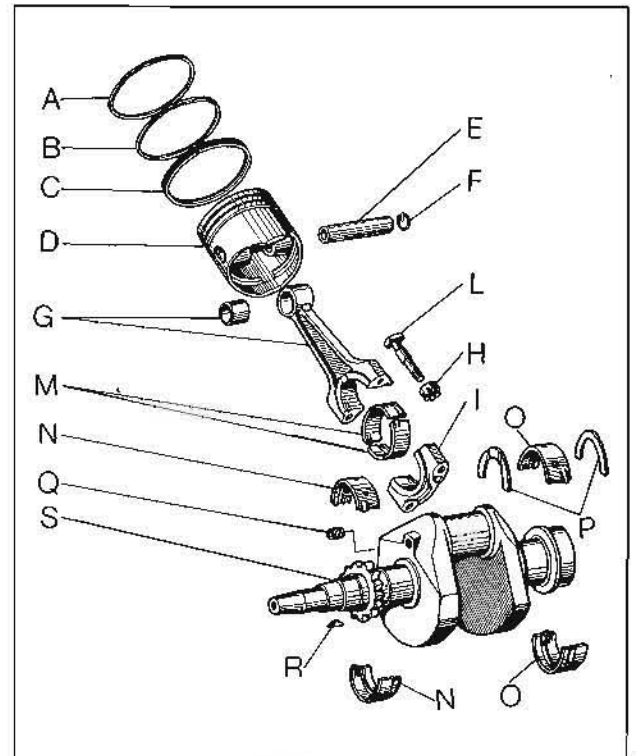
40



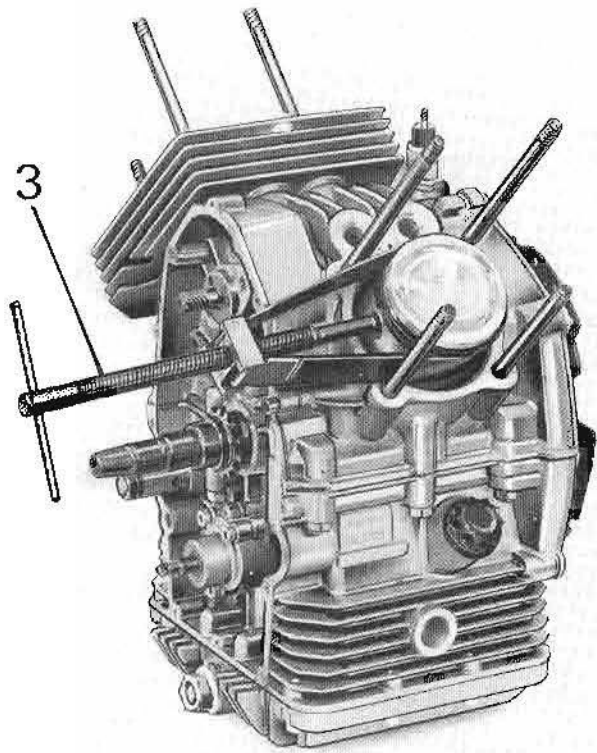
41



39



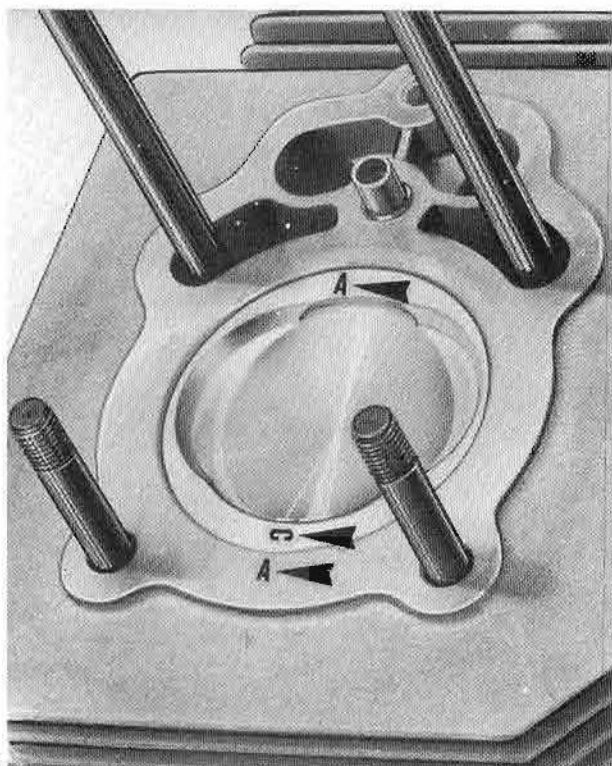
42



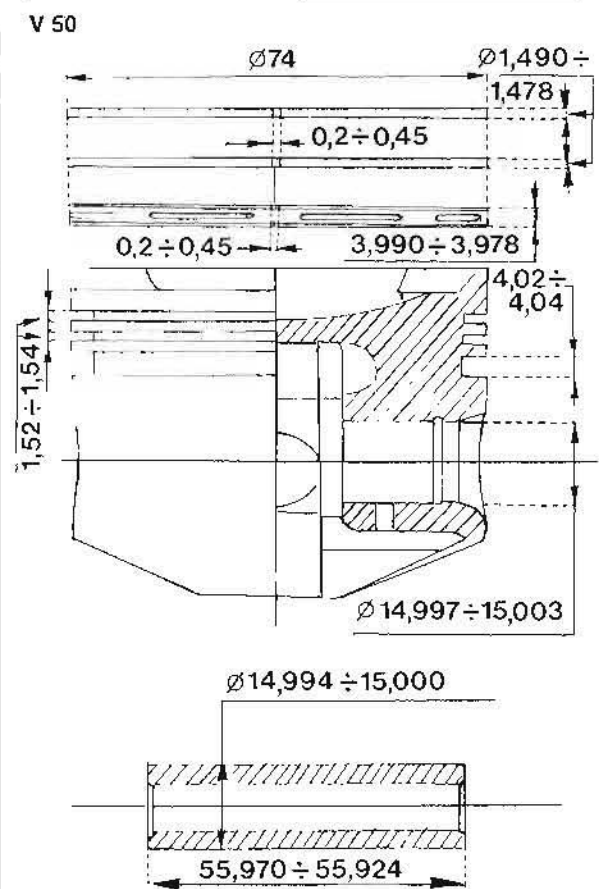
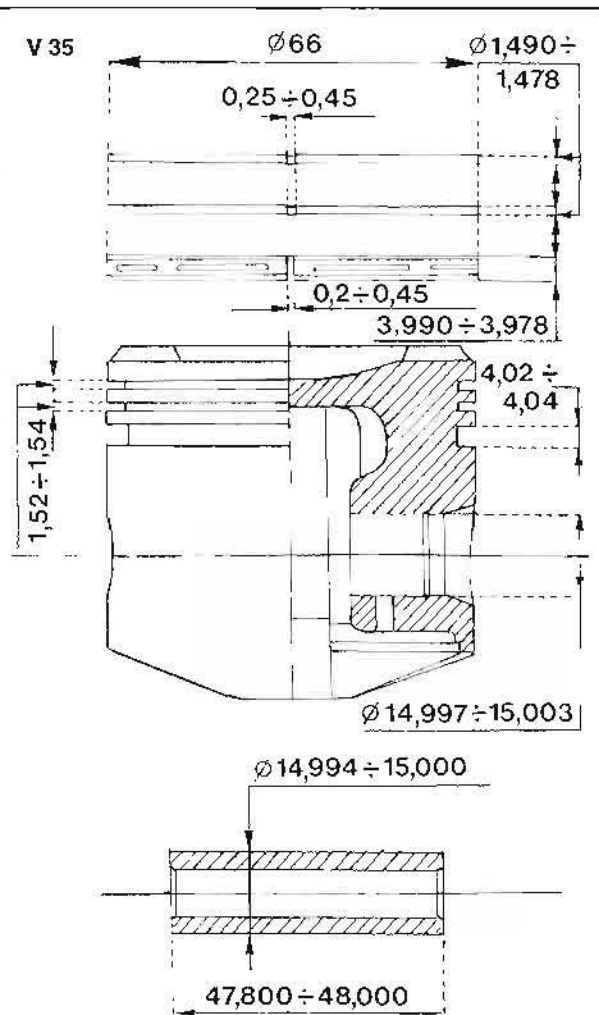
43



44



45



46



### Selection of pistons diameter - V 35 model

CLASS A	CLASS B	CLASS C
65.968 ÷ 65.974 mm (2.597 ÷ 2.5973")	65.974 ÷ 65.980 mm (2.5973 ÷ 2.5975")	65.980 ÷ 65.986 mm (2.5975 ÷ 2.5978")

### Selection of piston diameter - V 50 model

CLASS A	CLASS B	CLASS C
73.968 ÷ 73.974 mm (2.9119 ÷ 2.9121")	73.974 ÷ 73.980 mm (2.9121 ÷ 2.9123")	73.980 ÷ 73.986 mm (2.9123 ÷ 2.9125")

Pistons must always be matched with cylinders of same class.

### Matching data - Gudgeon pin-piston hole clearance (Dwg fig. 46)

O/D of pin	Piston hole dia.	Negative allowance and interference fit on ass. y
14.994 ÷ 15.000 mm (.5902 ÷ .5905")	15.003 ÷ 14.997 mm (.5905 ÷ .5903")	From a clearance of 0.009 mm (.00035") to an interference fit of 0.003 mm (.000118")

### Gudgeon pin selection (fig. 46)

CLASS	COLOUR	DIAMETER
2	white	15.000 ÷ 14.997 mm (.5905 ÷ .5903")
1	black	14.997 ÷ 14.994 mm (.5903 ÷ .5902")

### Piston hole selection (fig. 46)

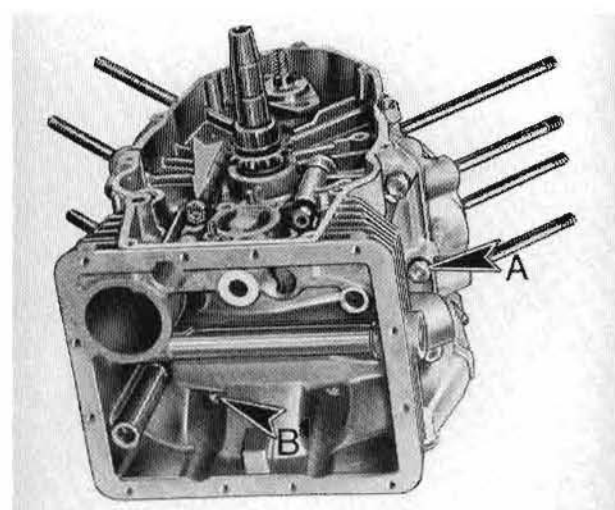
CLASS	COLOUR	DIAMETER
2	white	15.003 ÷ 15.000 mm (.5906 ÷ .5905")
1	black	15.000 ÷ 14.997 mm (.5905 ÷ .5903")

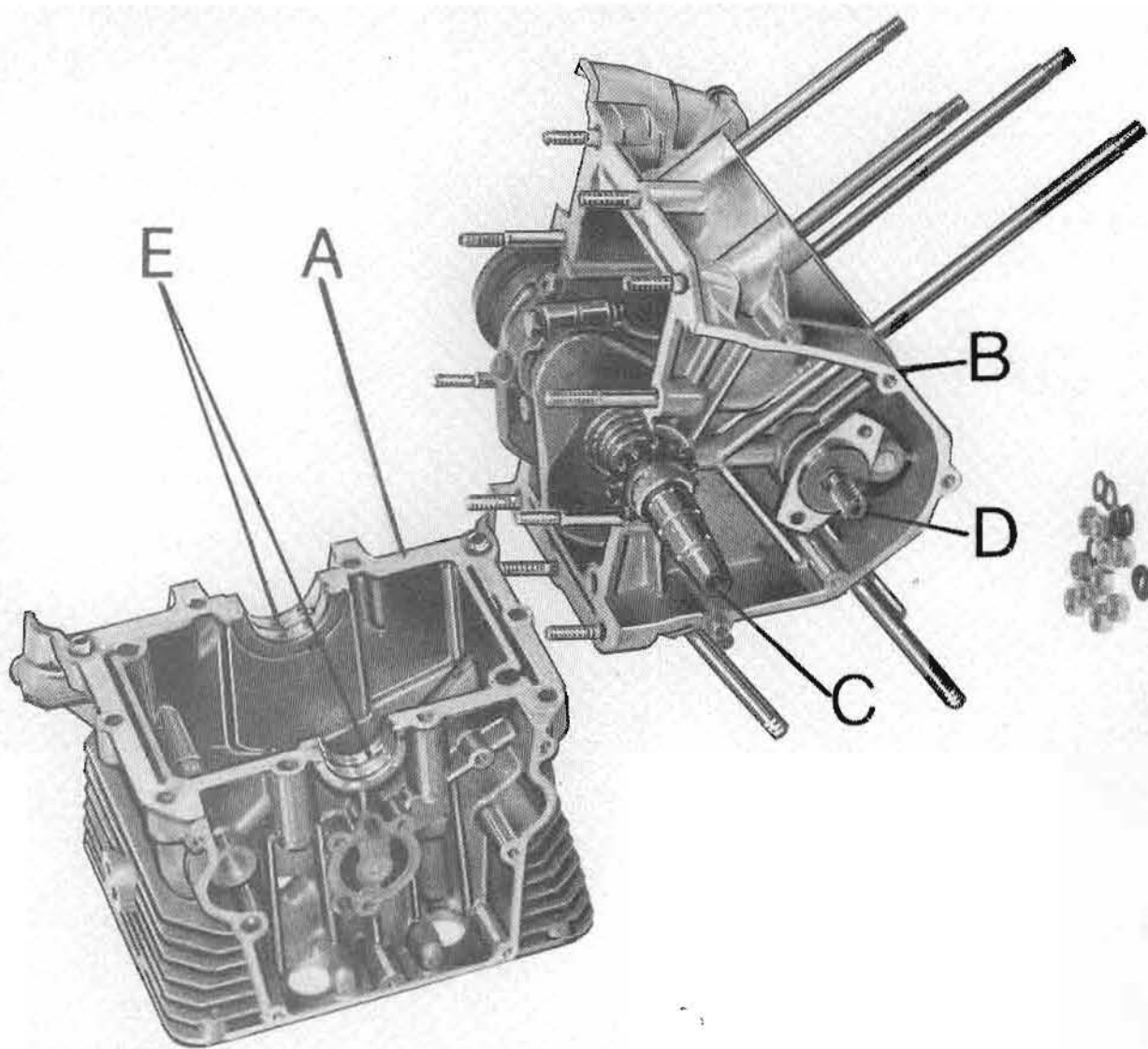
### c Re-fitting

To re-assemble piston «D» with pin «E» on small end «G», heat up the piston in oil to a temperature of about 60°C (140°F) in order to allow the piston to expand sufficiently for the pin to be pushed in (See fig. 42).

### 5.7 - a SEPARATING THE CRANKCASE COVERS

- Drain the oil and remove the sump complete with filters and oil pressure gauge. Then:
  - undo nuts «A» and «B» in fig. 47. Using a plastic mallet, tap bottom crankcase half «A» lightly to free it from the studs fitted on the top half «B» (See fig. 48).





48

From the top cover remove:

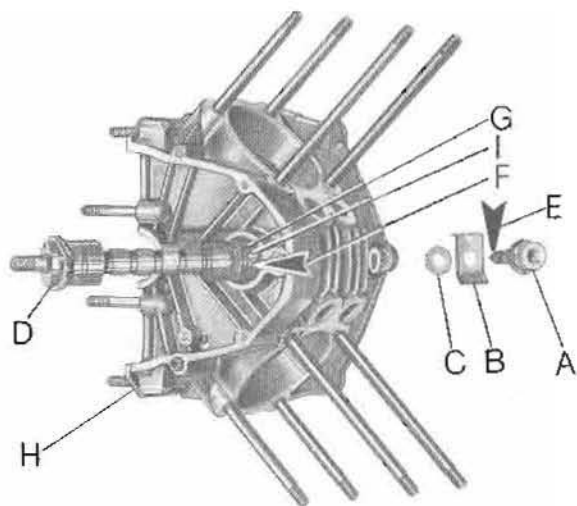
- crankshaft complete with con-rod («C» in fig. 48);
- camshaft «D» after unscrewing its retainer «A» with lock-plate «B» and washer «C» (See fig. 49).

#### b Checks

- Ensure the cover joining faces are unscored or nicked.
- Check the threaded portion of the studs. If damaged or stripped, replace the stud or studs.
- Blow out all oilways in the covers with compressed air.

#### c Re-fitting

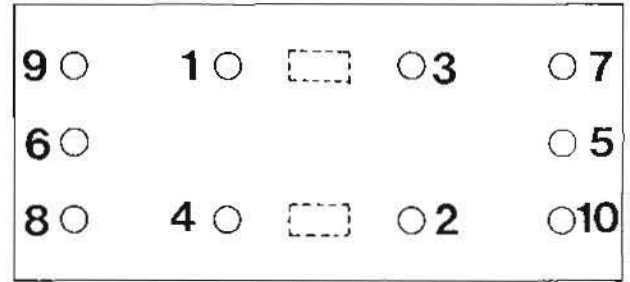
- Introduce camshaft «D» in its housing on top cover «H» after ensuring that both sectors «G» with circlip «I» are properly mounted. Fit connector «A» with washer «C», also lock-plate «B», ensuring that the end of the connector «A» shown by arrow «E» enters into the hole shown by arrow «B» (See fig. 49).



49

- Fit half bearings «E» in their housings in cover «B», then set up the crankshaft complete with con-rods «C» on the bearings and then fit the half bearings in the bottom crankcase cover «A» (See fig. 48).

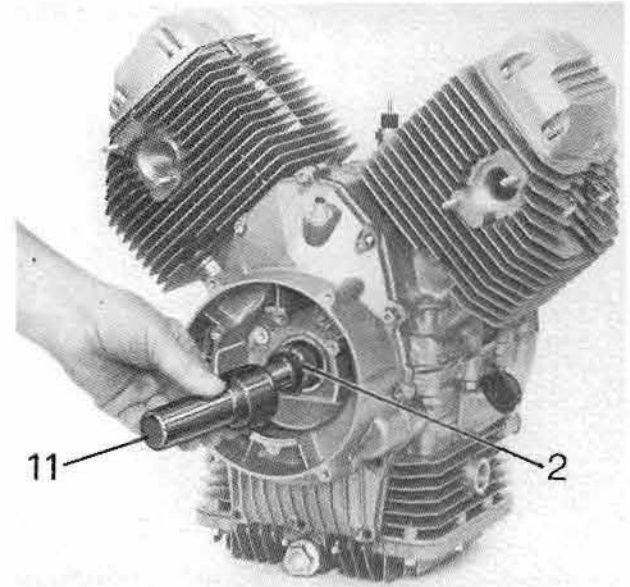
- Smear the union faces with sealing compound N. 00 01 03 00 (50 in fig. 28) and position the lower cover on the top cover studs. Tighten nuts «A» and «D» in fig. 47 and complete the operation with a torque wrench set to 2.2 - 2.5 kgm (16-18 ft/lbs) in the sequence shown in fig. 50.



### 5.8 REPLACING THE SEAL IN TIMING COVER (ENGINE MOUNTED) (fig. 51)

This operation is carried out as follows:

- set up tool 19 92 74 00 (2 in fig. 51) on the crankshaft;
- insert the seal on the tool;
- using punch 19 92 72 00 (11 in fig. 51) and a mallet, press the seal home in its housing on the timing cover. This replacement has to be done after removing: generator cover, generator, pickup cover plate, rotor, pickups and after the damaged seal has been removed from the cover.

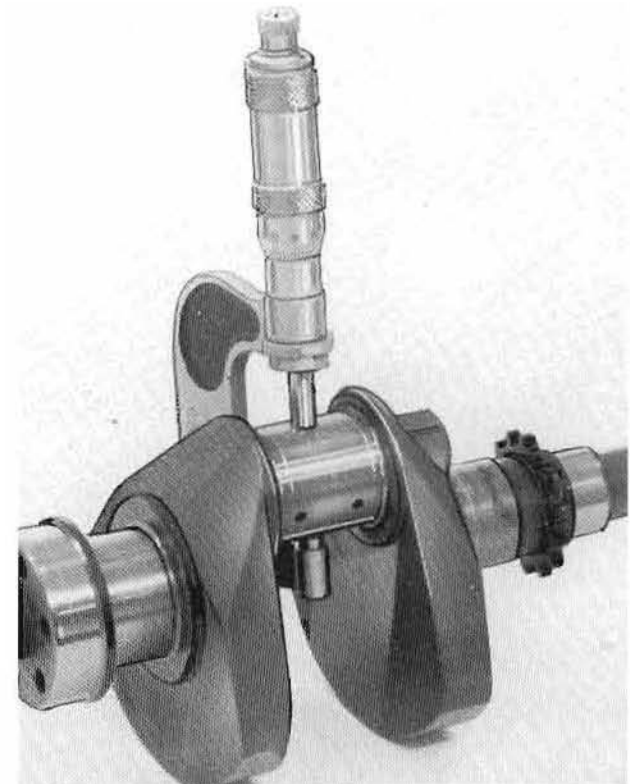


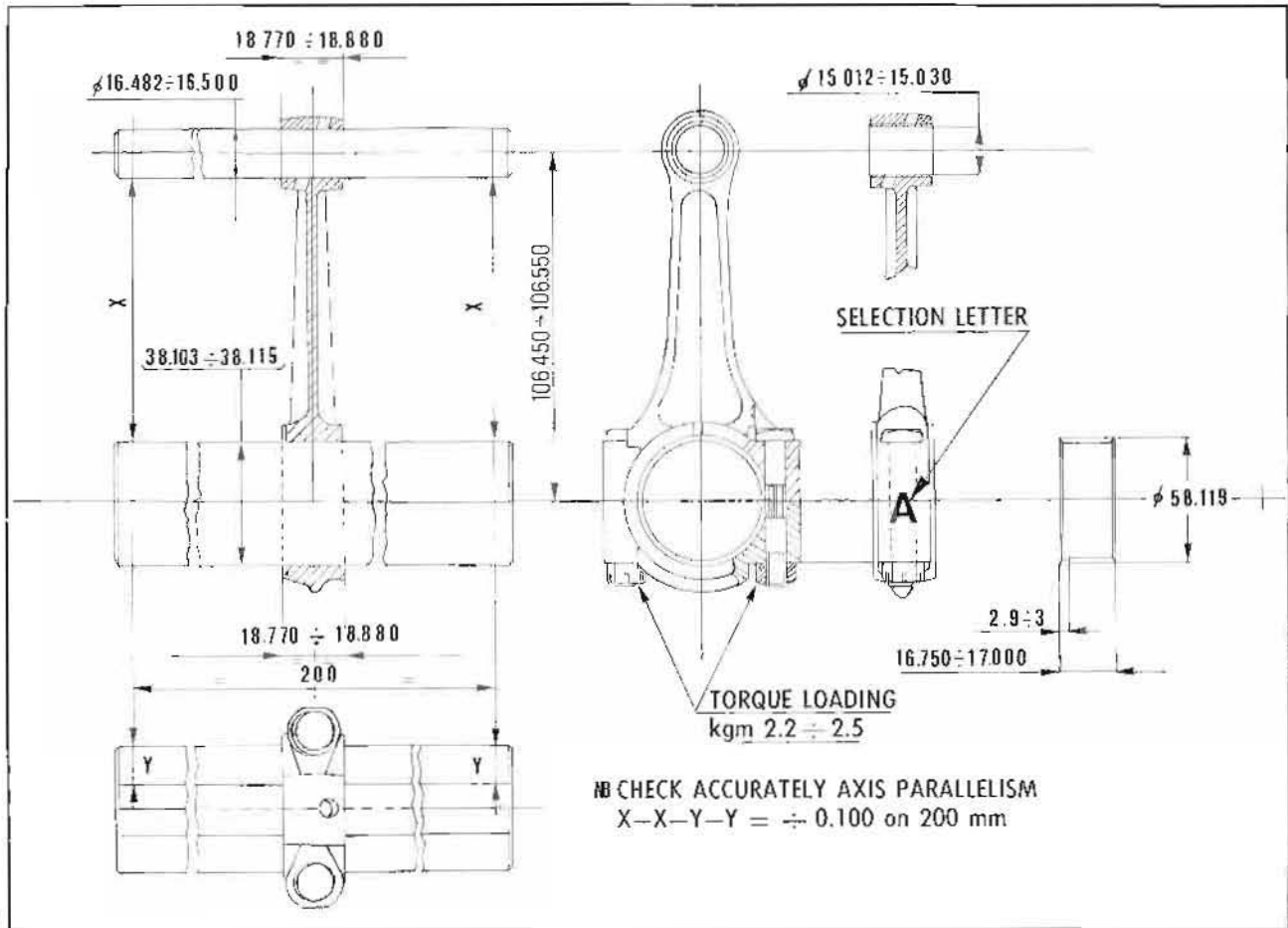
### 5.9 - a DISMANTLING THE CON-RODS

- After removing the complete crankshaft-connecting rod assembly from the top crankcase cover («C» in fig. 48), undo the self locking nuts «H» and remove the con-rod caps «I» (See fig. 42);
- take off cap retaining screws «L» from con-rod «G» (See fig. 42);
- remove bearings «M» from the con-rods and caps (See fig. 42);
- if worn out, push out the small end bush by the aid of a suitable punch.

#### b Checks

- The bearings for con-rods «M» are of thin wall type in white material and in case of seizures or excessive wear have to be replaced. When replacing the con-rod shells it is necessary for the shaft to be re-ground. Before doing so, however, it is advisable to measure the shaft at the major wear point (See table «Diameter of con-rod pins» and fig. 52).
- Ensure also that the small end bushes are not seized or deeply scored. Replace, as necessary (See pertinent table and drawing n. 53).
- Check parallelism of axis i.e. before fitting the con-rods make sure the small and big end holes are «square» that is parallel to each other.





53

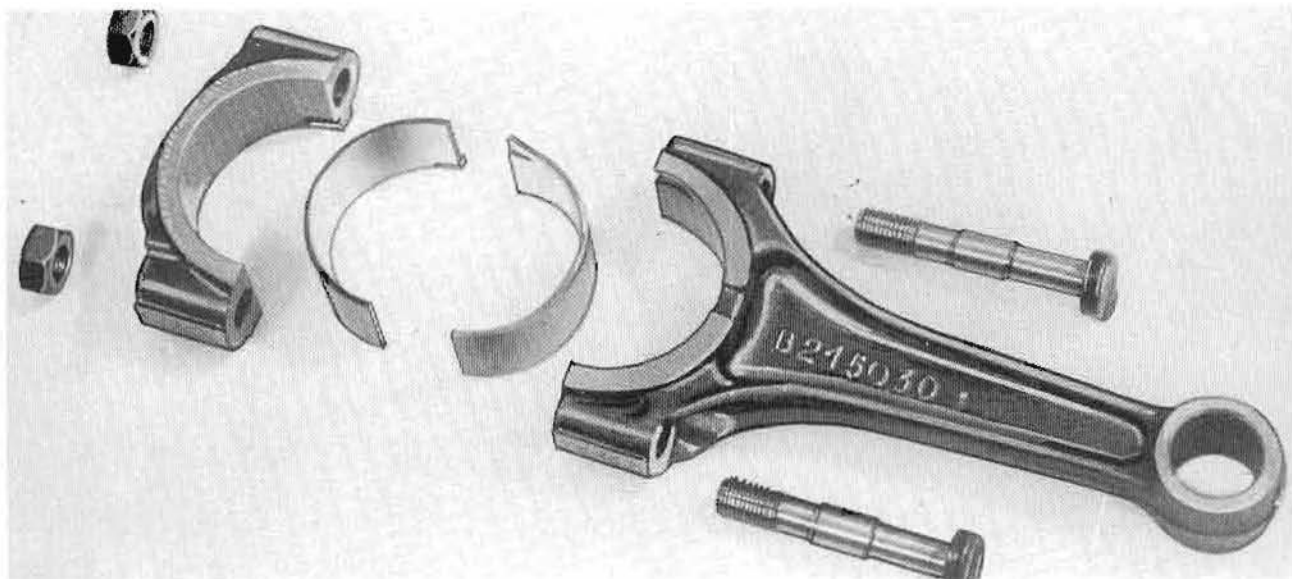
Possible deformations can be rectified by means of a fork lever set up on the co-rod.  
Maximum offset permissible for the small and big end axis is  $\pm 0.10$  mm (.0039") as measured at a distance of 200 mm (7.874"). See Dwg fig. 53 and stripped con-rod assembly in fig. 54.

Selection of con-rod

Class «A» Bleu colour mark	Class «B» White colour mark
38.103 $\pm$ 38.109 (1.500 $\pm$ 1.503)	38.109 $\pm$ 38.115 (1.503 $\pm$ 1.506)

Selection of con-rod complete with bearings

GROUP	WEIGHT
A	290 $\pm$ 294 gr (10.22 $\pm$ 10.37 oz.)
B	294 $\pm$ 298 gr (10.37 $\pm$ 10.51 oz.)
C	298 $\pm$ 302 gr (10.51 $\pm$ 10.65 oz.)
D	302 $\pm$ 306 gr (10.65 $\pm$ 10.79 oz.)
E	306 $\pm$ 310 gr (10.79 $\pm$ 10.93 oz.)



54

### Thickness of con-rod bearings

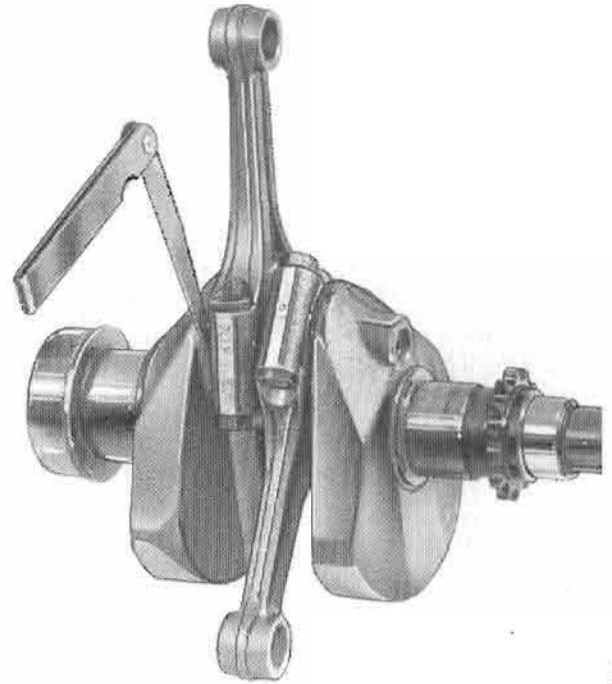
ORIGINAL PRODUCTION N° 61 06 20 10	
1.537 ÷ 1.543 (.06061 ÷ .06084")	1.527 ÷ 1.533 (.06021 ÷ .06045")

Housing diameter: 38.103 ÷ 38.115 mm (1.500 ÷ 1.5006").

Shaft diameter: 34.987 ÷ 34.999 mm (1.3773 ÷ 1.3778").

Bearing-shaft clearance:

- min. 0.020 max 0.064 mm (.00078 ÷ .0025") at 90° from connection plane;
- min. 0.040 max 0.084 mm (.0015 ÷ .0033") at 20° from connection plane (See drawing fig. 53);
- conrod-crankshaft clearance on assembly: 0.265 ÷ 0.515 mm (.010 ÷ .020") (See fig. 55).



55

### Size of bush in small end and piston pin

I/D of bush pressed in small end	Piston pin diameter	Pin-bush clearance
15.012 ÷ 15.030 mm (.5909 ÷ .5916")	14.994 ÷ 15.000 mm (.5902 ÷ .5905")	0.012 ÷ 0.036 mm (.00047 ÷ .0014")

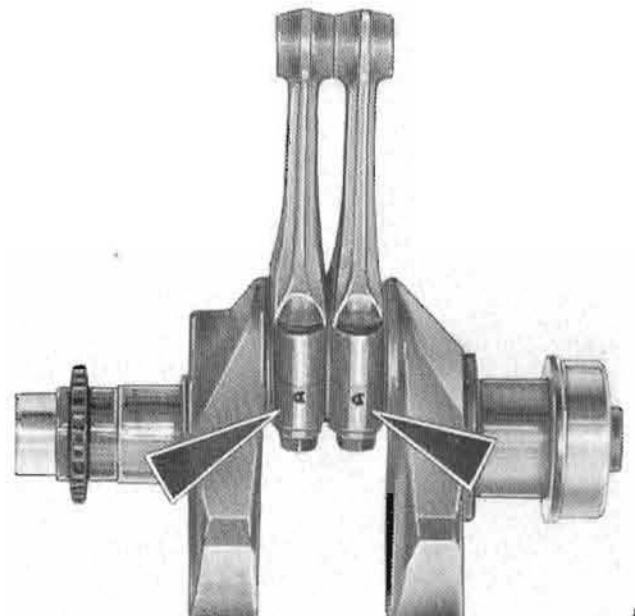
### c Re-fitting

- Ensure that on assembly the con-rods are marked with the same letter (A-B-C-D-E in fig. 56) and on the other side have the same number as stamped on the cap (See fig. 57);
- screw on the nuts on the cap securing screws and tighten with a torque wrench set to 2.2 ÷ 2.5 kgm (16-18 ft/lbs) (See dwg fig. 53 and fig. 58).

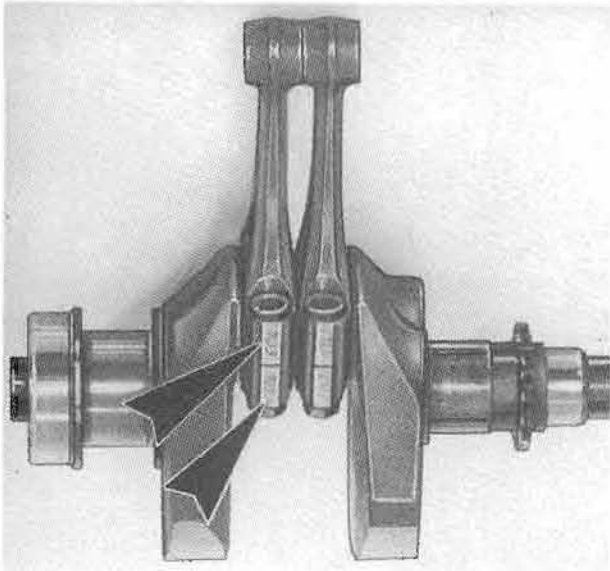
### d Replacement of con-rods or their bearings on the machine

Proceed as follows:

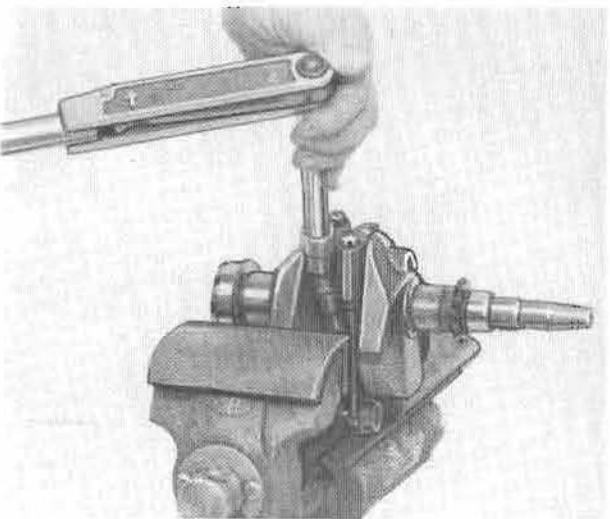
- remove the right and left cylinder head-barrel assemblies;
- using puller 19 90 78 00 (3 in fig. 43), push out the gudgeon pins after removing their retaining circlips;
- remove the generator cover, generator, pickup cover, «O» ring, and the rotor from the crankshaft;
- disconnect the electronic ignition connectors;
- remove timing cover and timing gear assembly together with the oil pump gears and chain;
- undo the oil pressure gauge and support;



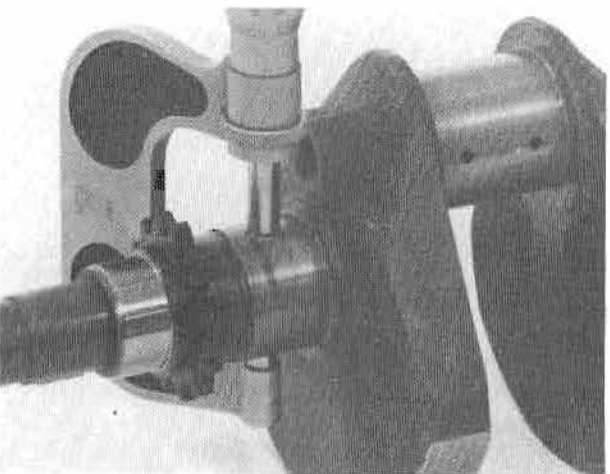
56



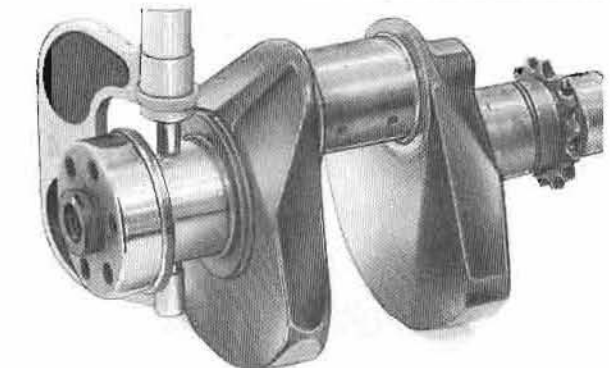
57



58



59



60

- withdraw the camshaft from the housing in the crankcase, placing one hand in the bore of a cylinder to prevent the tappets from dropping down;
  - turn the crankshaft to the point where the con-rod securing nuts can be unscrewed through the bore of one cylinder. Repeat the operation for the other 2 nuts;
  - when the cap retaining nuts have been unscrewed, insert one hand into the cylinder bore to grip the con-rods and with the other hand take out the con-rod caps (one at the time) or viceversa.
  - when the con-rod and/or bearings have been replaced; re-fit the con-rods on the crankshaft and tighten the nuts using a torque wrench set to  $2,2 \pm 0,25$  kgm (16-18 ft/lbs);
  - insert the tappets into their housings, also the camshaft.
- For all other assembly operations, reverse the dismantling sequence.

#### 5.10 - a DISMANTLING THE CRANKSHAFT

After removing the crankshaft from the top crankcase cover (See «C» in fig. 48) and stripped it of the con-rods with half bearings (See section 5.9), remove from crankcase the circlips retaining the half-bearings on pin «O» (drive side) and timing side «N». Then undo plug «Q», take out the pickup rotor retaining key «R» and remove the generator rotor from crankshaft «S» (See fig. 42).

#### b Inspection

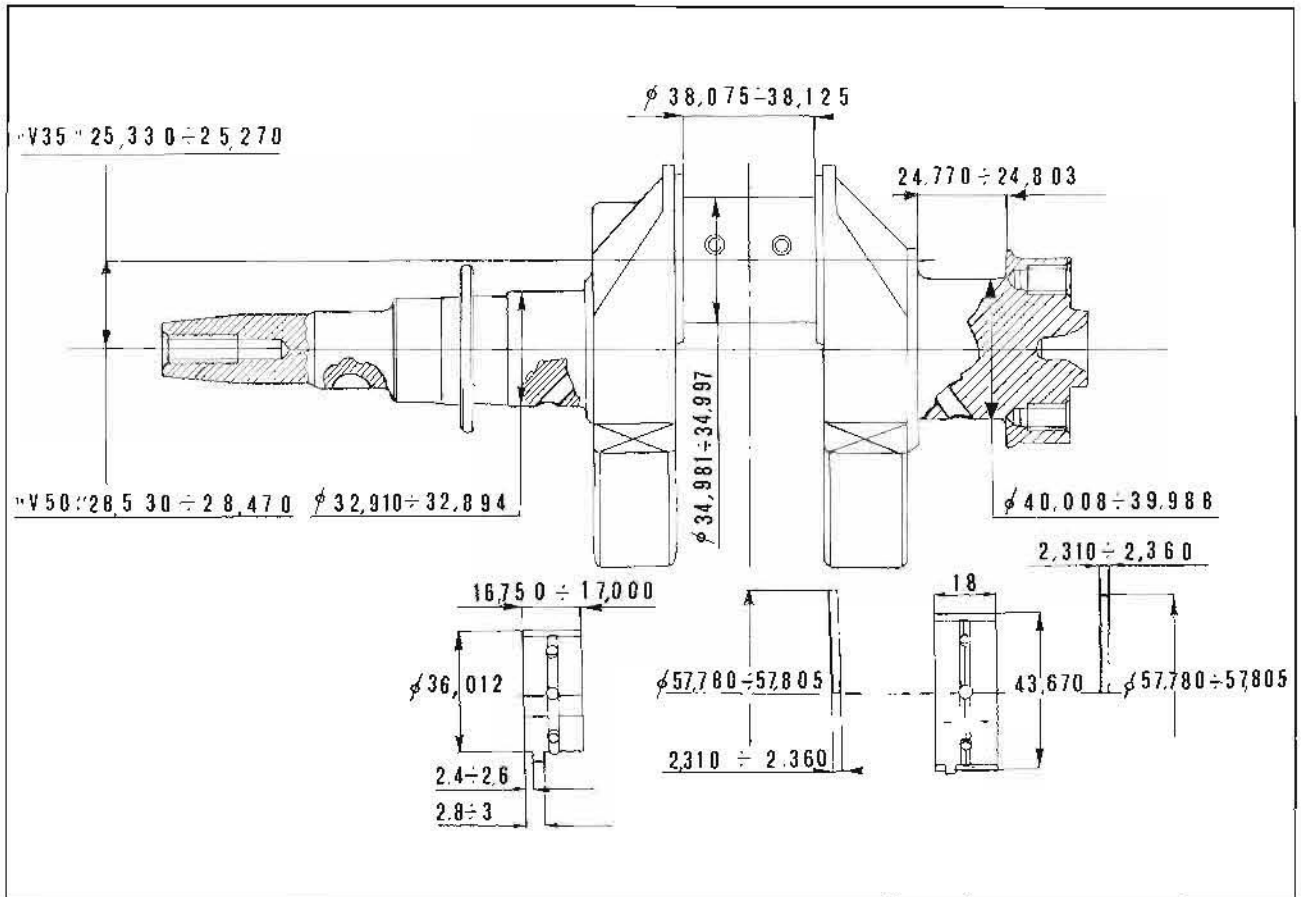
Check crankpin and conrods. If only lightly scored, polish them with very fine carborundum. If deeply scored or ovalized, re-ground the crankshaft pins down to the correct size for coupling with the o/s big end bearings (See o/s table for big end diameters and figg. 59-60-60/1). Before re-fitting the crankshaft plug don't forget to blow through the oil passages with compressed air to free them and to smear the plug with Loctite (n. 00 01 04 00 in fig. 28) before tightening. The shaft is statically balanced by applying a weight of 0.8355 - 0.8655 kg (1.84 - 1.90 lbs.) for the «V 35» and 0.9265 (1.972 - 2.038 lbs.) for the «V 50».

Ensure the housings of the pickup and generator retaining key are not burred.

Main shaft diameter (timing side)

Original production bearings
$32,910 \pm 0,009$ mm (1.2956 $\pm$ 0.0004")

Bearing housing diameter (timing side):  $35,996 \pm 0,016$  mm (1.417  $\pm$  0.0006")



60/1

**Overall Thickness of main Bearings (timing side)**

Original production bearings
1.537 ± 1.543 mm (.0606 ± .0608")

Bearing-mainshaft clearance (timing side):  
min. 0.000 - max. 0.44 cold (.0017")

**Mainshaft diameter, drive side**

Original production bearings
40.008 ± 39.988 (1.5751 ± 1.5749")

Bearing housing diameter, drive side: 43.657 ± 43.670 mm (1.718 ± 1.719)

**Overall thickness of bearings, drive side**

Original production bearings
1.807 ± 1.816 mm (.0712 ± 0.715")

**Big end pin diameter**

Original production bearings
34.987 ± 34.999 mm (1.3777 ± 1.3778")

**Thickness of half collar on main shaft, drive side**

Original production bearings
2.310 ± 2.360 mm (.0909 ± .0928")

■ Shoulders main journal (drive side) 24.770 (.975") ± 24.803 (.976"); 0/5 0.2 mm (0.1 mm) each sholder: 24.970 ± 25.003 mm (.983 ± .984").

**Selection of big end pin**

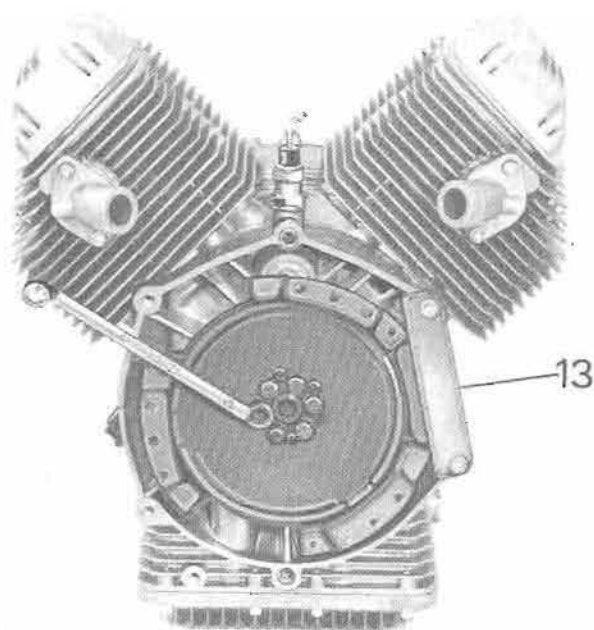
Class «A» Bleu colour mark on sholder timing side	Class «B» White colour mark on sholder timing side
34.987 ± 34.993 (1.3773 ± 1.3775")	34.993 ± 34.999 (1.3775 ± 1.3778")

■ Max admissible offset of the two crankshaft axis (con-rod pin, drive, and timing side pins) should not exceed 0.02 mm (.00079") at a distance of 40 mm (1.57").

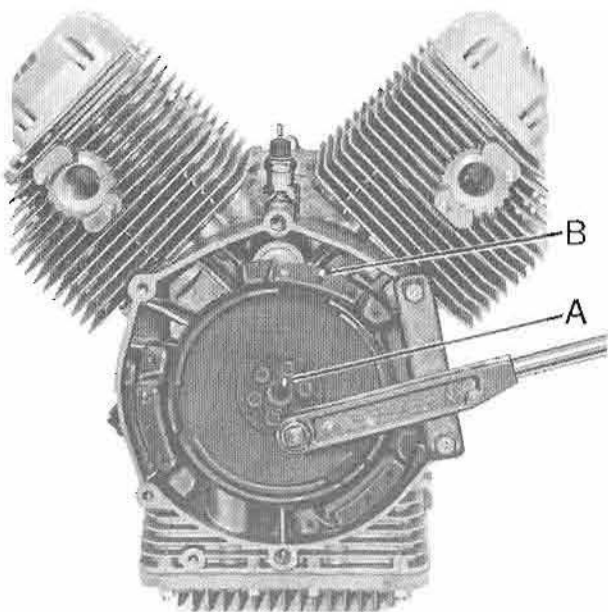


61

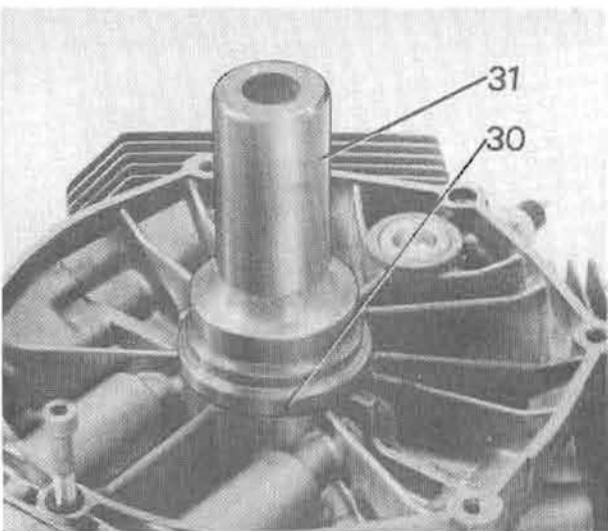
62



63



64



- Crankshaft-bearing clearance (drive side): min. 0.017 - max. 0.068 mm (.0006 ÷ .0026").
- Side play (Drive side): 0.35 ÷ 0.40 mm (.013 ÷ .015").
- Mainshaft-bearing drive side 0.017 min. - 0.068 max. (.00066 ÷ .0026").
- Ensure the crankshaft has a mark on the pin (drive side) (See «A» in fig. 61).

**NB** If the shaft needs re-grinding, it is necessary to return it to the factory as it is specially treated (ammonia hardening).

#### c Re-fitting

- Fit key «R» in its keyway on the crankshaft (See fig. 42) and using a copper mallet tap on it to ensure it is properly seated;
- Re-fit the conrods on the crankshaft (See section 5.9 «Re-assembly»);
- re-fit the shaft in its crankcase housings (See 5.7).

#### 5.11 - a REMOVING THE FLYWHEEL

- Keep a firm hold on the flywheel by the aid of tool part N. 19.91.18.00 (13 in fig. 62) and using a socket wrench undo the bolts securing it to the crankshaft.

#### b Checks

- Ensure the flywheel is not cracked or dented, if so, replace.
- Check the fixing bolts. If stripped or damaged, replace.

#### c Re-fitting

When re-fitting the flywheel on the crankshaft make sure that mark «A» on the shaft is in line with mark «B» on the flywheel (fig. 63).

Tighten the securing bolts in a diagonal sequence using a torque wrench set at 4 kgm (28 ft/lbs).

#### d Fitting the seal on the flywheel cover

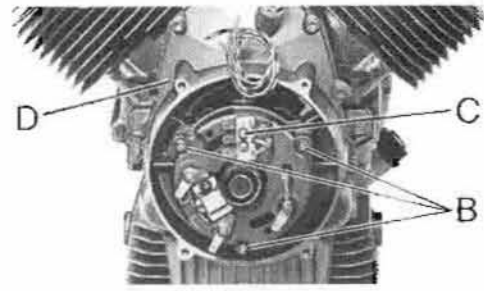
This operation is done by the aid of tool 12.91.20.00 (30 in fig. 64) and punch N. 19.92.71.00 (31 in fig. 64).

#### 5.12 - a DISMANTLING THE IGNITION GROUP

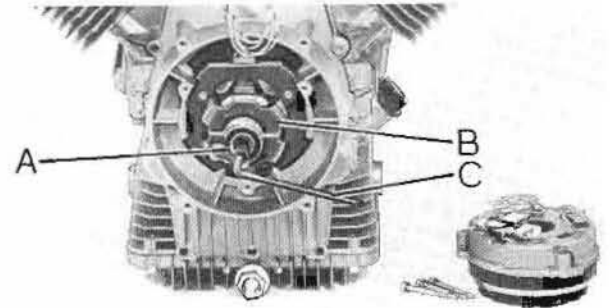
- Undo the screws which secure stator «C» to timing cover «D» and remove stator (See fig. 65).
- Undo screw «A» securing generator «B» to the main shaft, using special wrench «C» (See fig. 65/1).
- In the threaded hole of the crankshaft introduce tool 14.92.66.00 (42 in fig. 28) and screw on screw A using wrench «C» until you hear rotor «B» snap away from the shaft (See fig. 65/1).



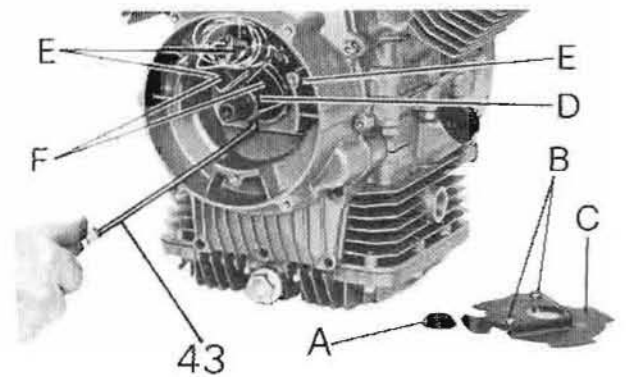
- Undo screw «A» and withdraw the tool from the threaded hole (See fig. 65/1).
- Take out seal «A», undo screws «B», and remove the pickup cover plate «C» (See fig. 66).
- Remove rotor «D» (fig. 66) using tool 14 92 93 00 (43 in fig. 66) if necessary.
- Undo screws «E» and remove both pickups «F» in fig. 66.
- Undo screws «A» and remove timing cover «B» with gasket «C» (See fig. 67).
- Undo screws «F» retaining gear «G» on camshaft «M», also nut and washer «H» retaining oil pump gear «I» from oil pump spindle «N».
- From shaft «M» and «N» take off gears «G» and «I» complete of chain «L» (See fig. 67).
- Undo screws «D» and remove chain guide «E» (See fig. 67).
- Undo Allen screws «A» and remove rocker covers «B» with gaskets «C» (See fig. 68).
- Undo nuts «D» and remove rocker holder «B» after removing top and bottom shims «C» (See fig. 69).
- Remove rocker spindle «B» after removing circlips «A», rockers «E» and from the rockers: adjusting screw «F» with counternut «G», shims «H» and the oil delivery sleeve to rockers «I». Finally take out pushrods «L». Tappets «M» shall be removed from their housing after the crankcase covers have been separated (See section 5.7) and after removing camshaft «N» by unscrewing connector «O» and washers «P», also lockplates «Q». Lastly, remove both sectors «R» and seal «S» (See fig. 69).



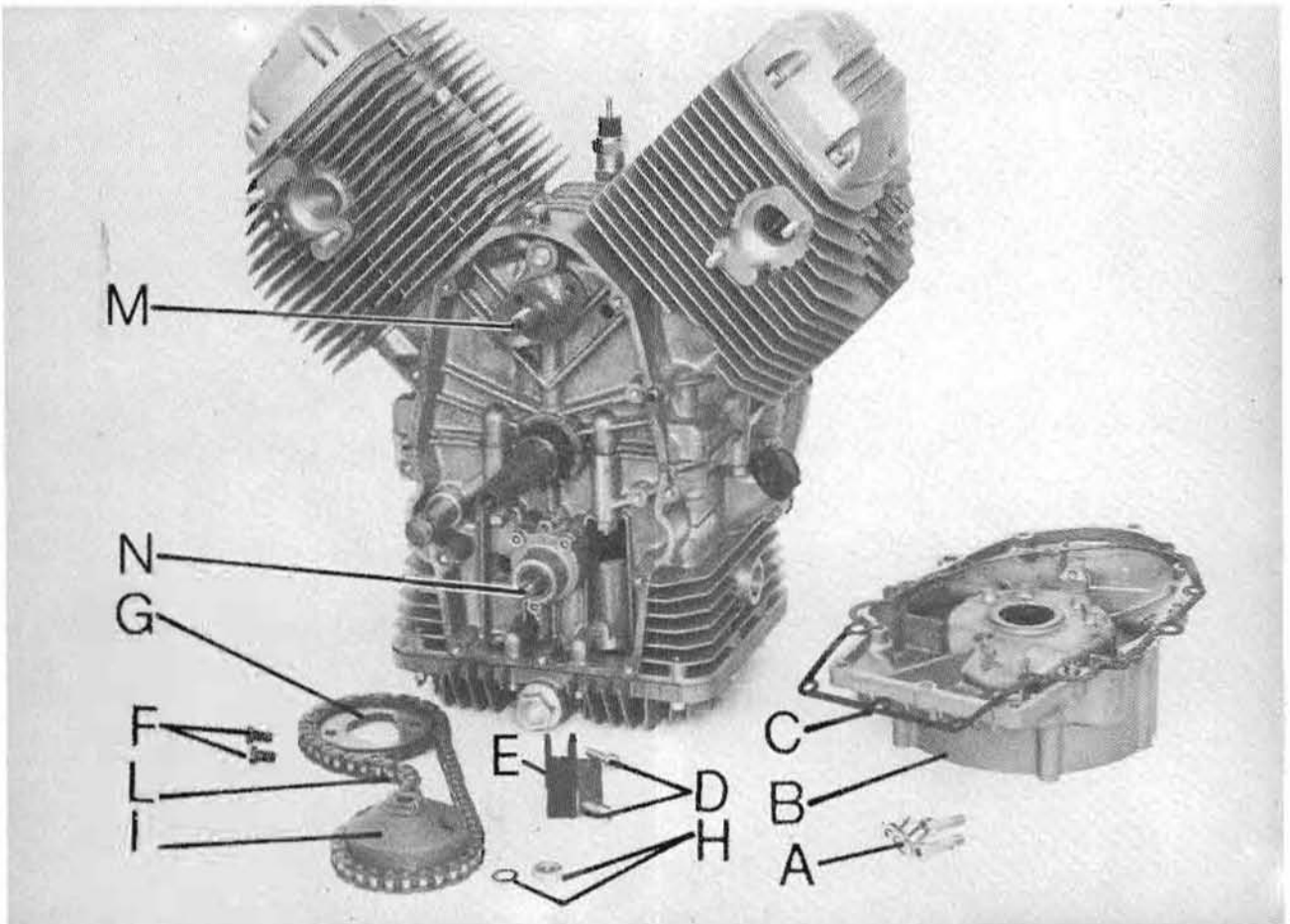
65



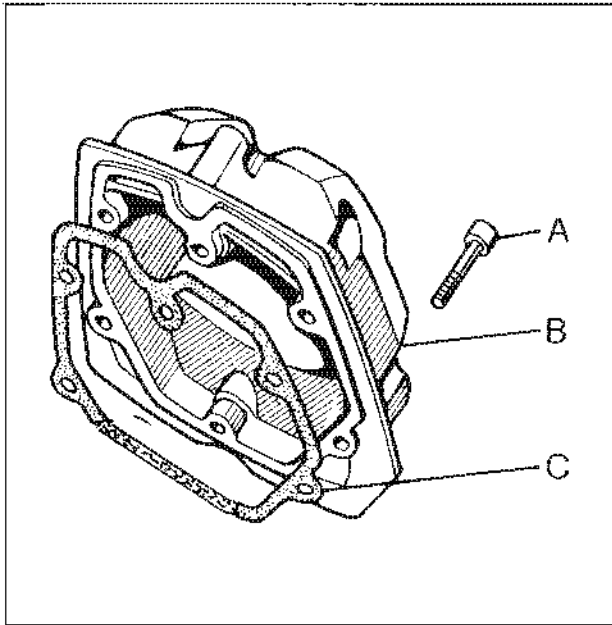
65/1



66



67



68

**b Checking operations**

Timing data (See fig. 70)

Inlet valve:

- opens 18° before TDC;
- Closes 50° after BDC.

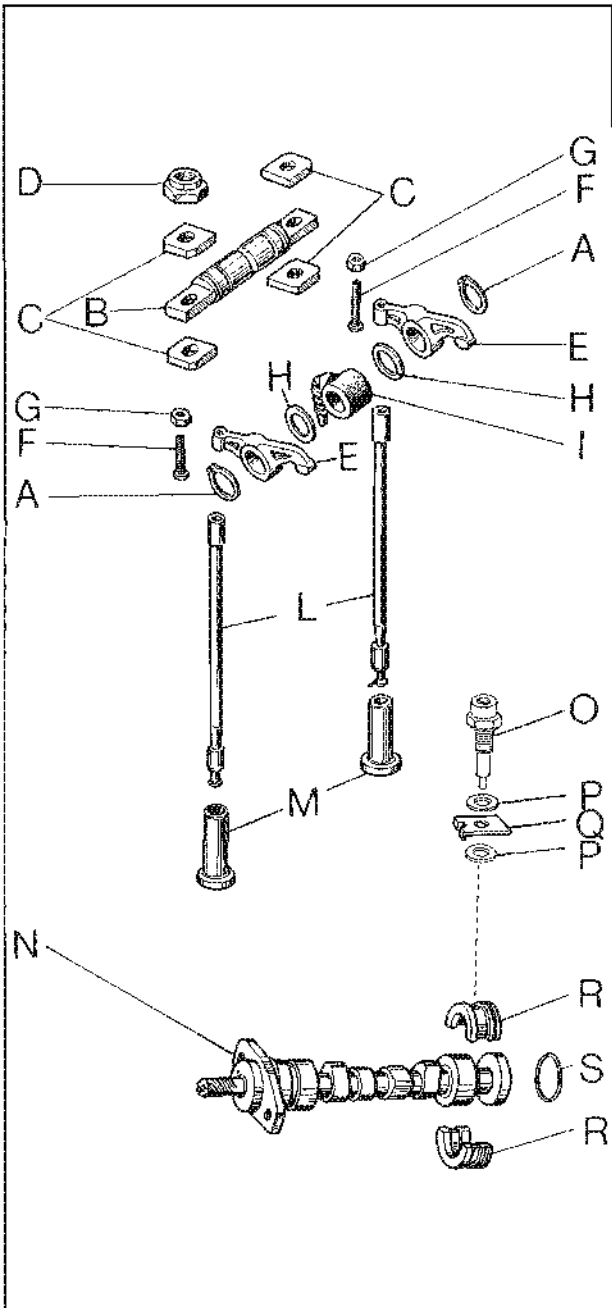
Exhaust valve

- opens 53° before BDC;
- closes 15° after TDC.

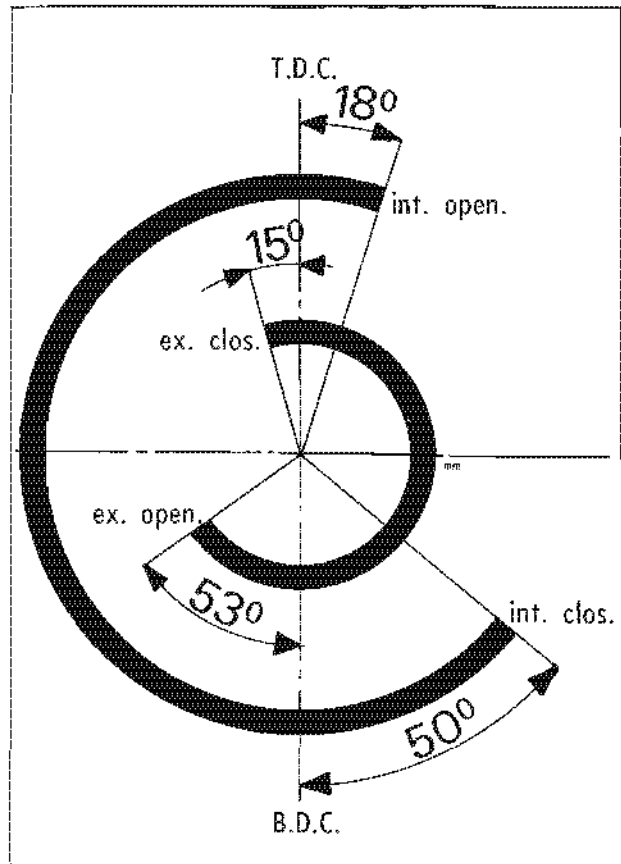
Valve clearance for valve timing: 1 mm (.039").

Normal rocker clearance:

- inlet: 0.10 mm (.0039");
- exhaust: 0.15 mm (.0059").



69



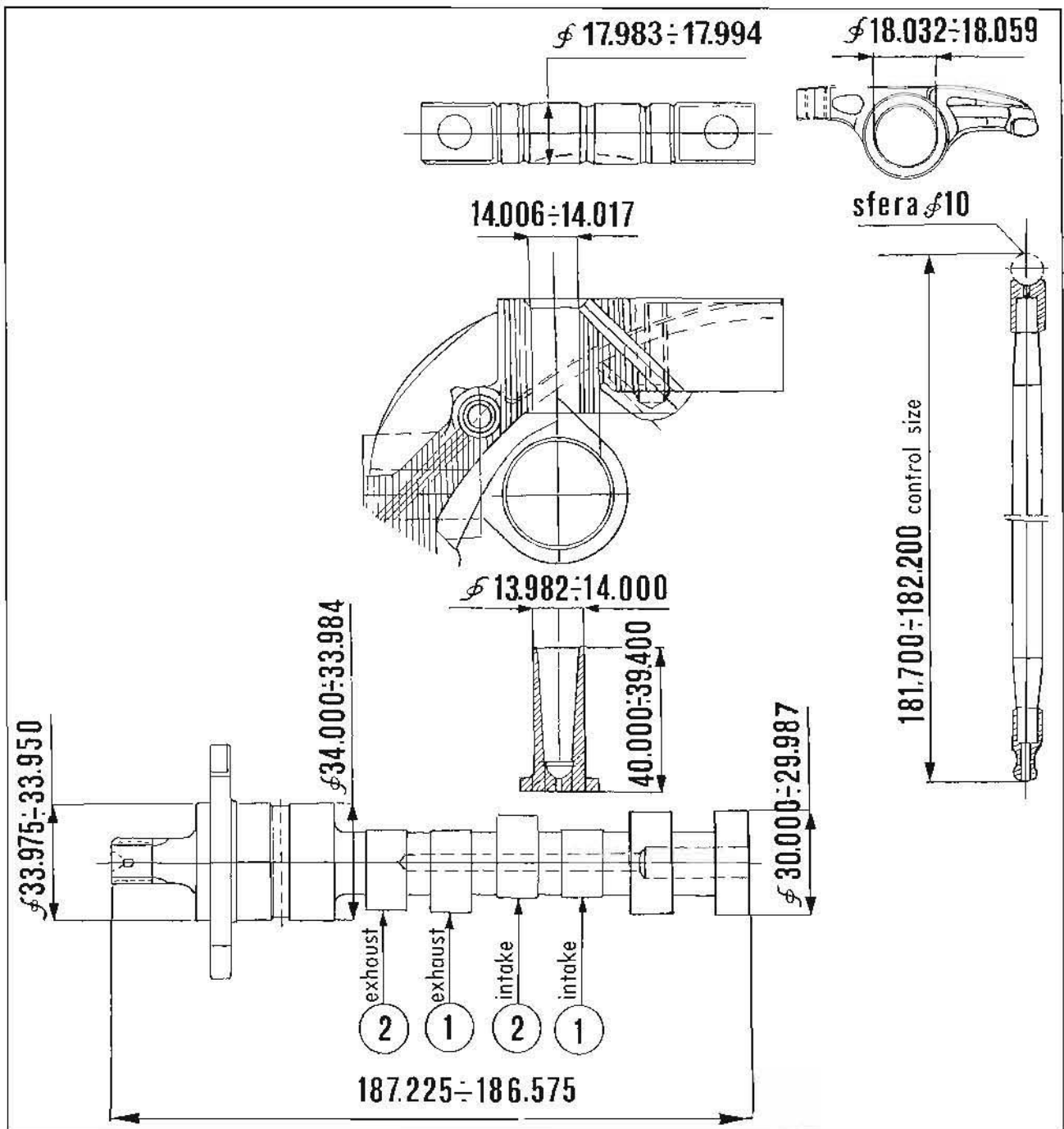
70

Timing shaft supports and housing diameter in top crankcase cover (fig. 70/1)

	Shaft-journal dia	Housings dia. in crankcase	Original clearance
Timing side	33.950 ÷ 33.975 (1.336 ÷ 1.3375")	34.025 ÷ 34.050 (1.3393 ÷ 1.3404")	0.050 ÷ 0.100 (.0019 ÷ .0039")

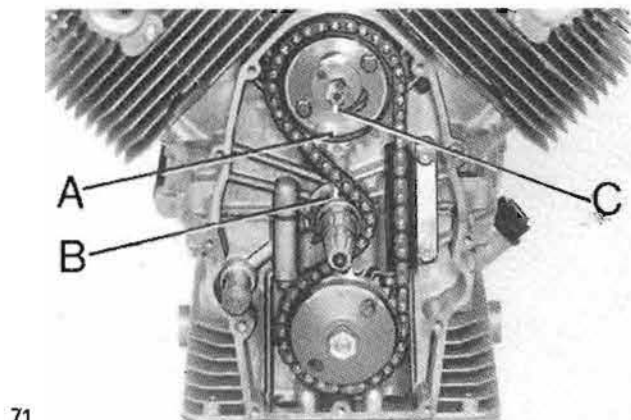
Tappet-crankcase seat data (original production) (fig. 70/1)

Seat i/D	Tappet O/D	Original assembly clearance
14.006 ÷ 14.017 mm (.5513 ÷ .5517")	13.982 ÷ 14.000 mm (.5504 ÷ .05511")	0.006 ÷ 0.035 mm (.0002 ÷ .0013")



Rocker-pin coupling data (original production)

Rocker I/D	Pin dia	Original assembly clearance
18.032 ÷ 18.059 mm (.7099 ÷ .7109")	17.983 ÷ 17.934 mm (.7079 ÷ .7059")	0.034 ÷ 0.076 mm (.00133 ÷ .00299")



Ensure that:

- the lappet contact surface is quite smooth. If scored or in any way damaged, replace;
- the camshaft ends and the cam lobes are not excessively worn or scored. If so, replace the camshaft;
- the push rods are straight and their ball ends perfectly smooth.  
If bent or scored, replace.

Straightness of the push rods is checked as follows:

— set them up on a surface face and roll them ensuring their adherence to it all along their length;

— ensure there is no play at the ball ends. This can be detected by letting them drop on a surface plate from a small height. If on impact there is a high pitched metallic sound, this means the contact ends have no play.

**c Timing the valves on a bench**

First of all ensure the mark on camshaft gear «A» is in line with the mark on camshaft gear «B» and the mark on camshaft «C» (See fig. 71). Then time the valves as follows:

- the engine is properly timed when the three mentioned reference marks A-B-C are in line with each other (fig. 71).  
However, if it is desired to check valve timing (See fig. 70), proceed as follows:

**1** Remove rocker covers and adjust rocker clearance to 1 mm (.039").

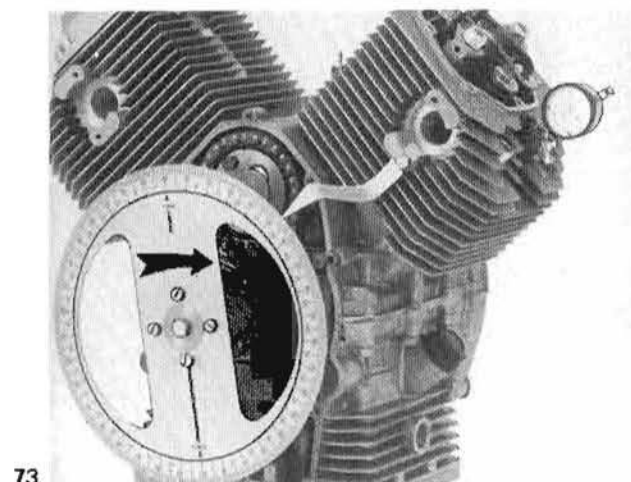
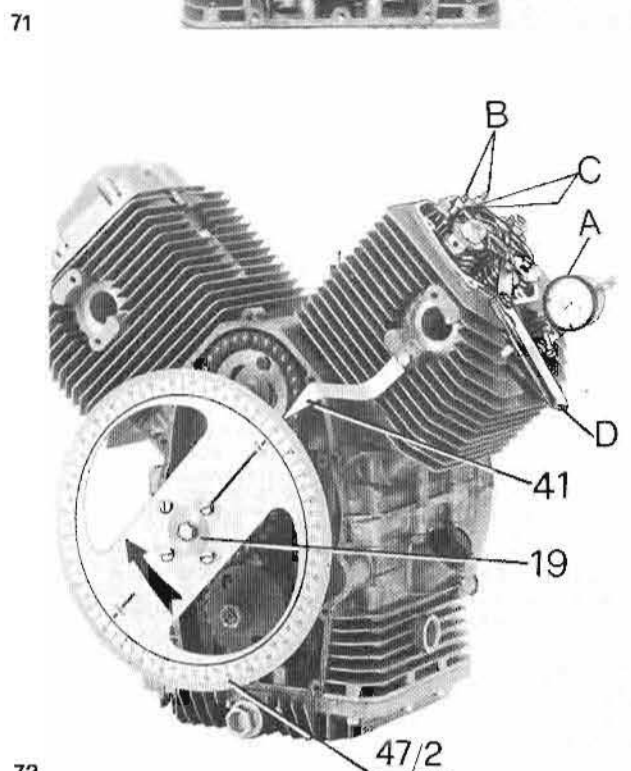
**2** Set the left cylinder (1) at TDC, compression stroke.

**3** On the crankshaft (drive side) fit tool 19 92 95 00 (19 in fig. 72) and index 19 92 81 00 (41 in fig. 72), as shown in the picture.

**4** On the tool fit degree plate in such a way that the TDC mark faces the arrow.

**5** Set up a dial gauge in the plug hole of the left cylinder so its probe contacts the piston crown.

**6** Turn slowly the crankshaft in a clockwise direction and then anticlockwise in order to determine exactly the TDC position by looking at the gauge. Then, if necessary, move the arrow (41 in fig. 72) so as to read the exact TDC position on the gauge.



7 Turn the shaft clockwise and by finger touch check when the ball end of the exhaust valve push-rod starts to get hard. This indicates that the valve is starting to open. At this stage, check that the degrees shown by the arrow on the degree plate are as specified in the timing table (See fig. 70). Then, keeping to the data in the timing table it is possible to check the closing of the exhaust valve and the opening and closing of the inlet valve.

8 Remove the gauge from the plug hole and re-fit the plug. Remove the control arrow and the complete degree plate.

9 Check rocker clearance operating on screws «B» after slackening counternuts «C» and insert the feeler gauge blade «D» between valve and rocker (See fig. 72).

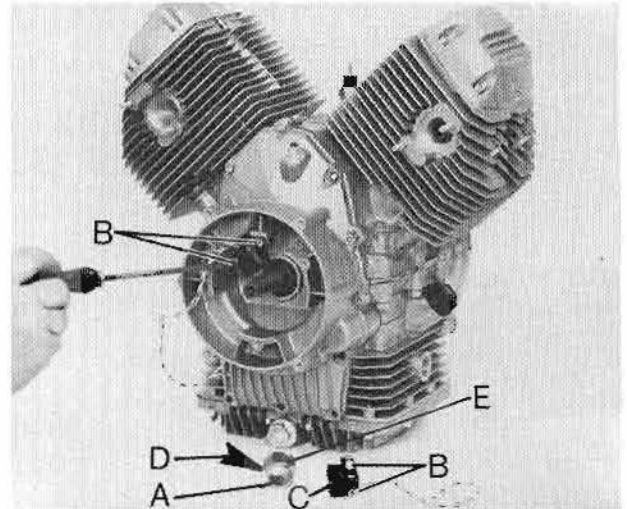
Normal clearance:

- inlet: 0.10 mm (.0039");
- exhaust: 0.15 mm (.0059").

#### d Re-fitting

Reverse the dismantling operations except that:

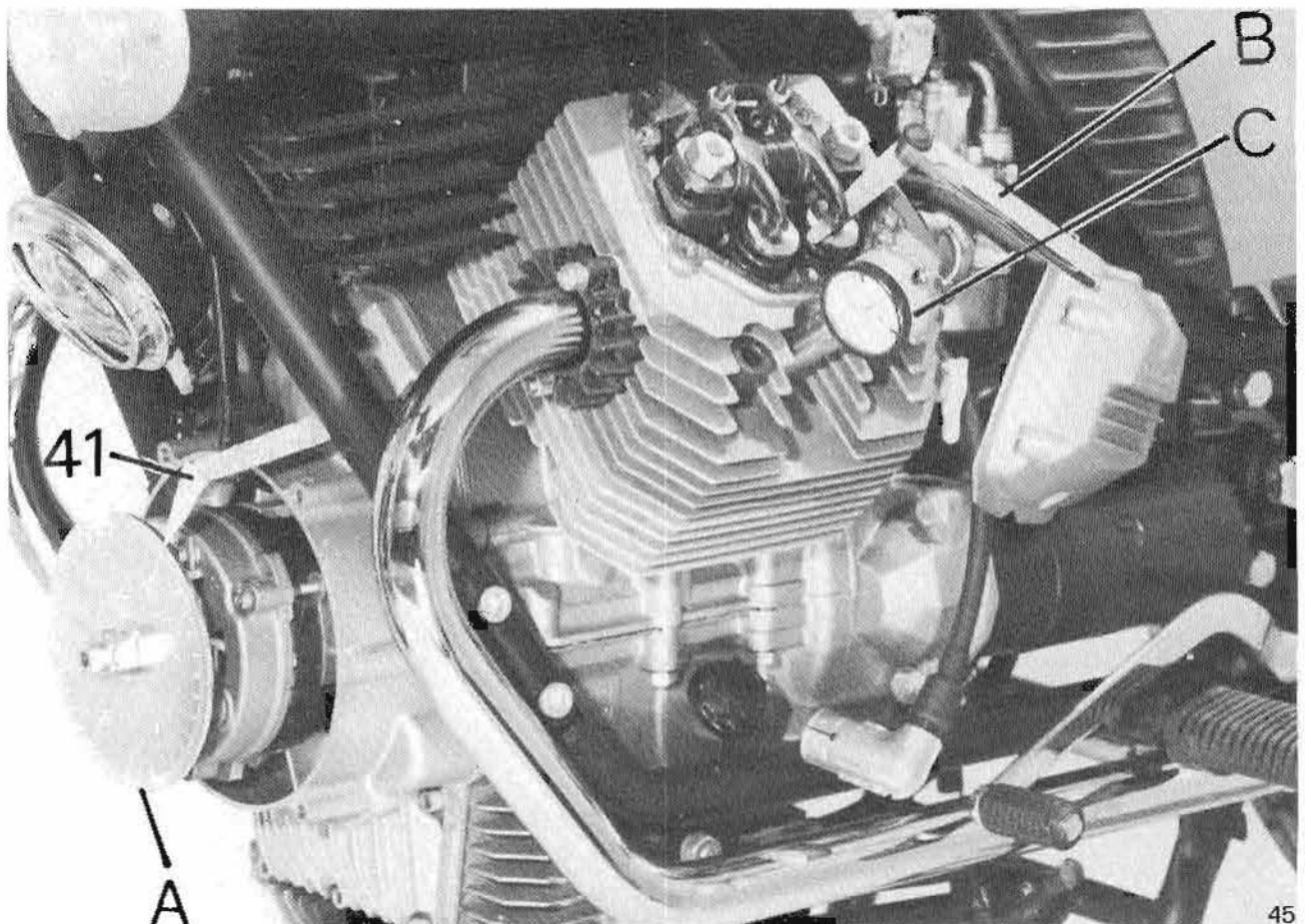
- 1 When re-fitting the gears on the camshaft-oil pump assembly complete with chain it is necessary to ensure the mark on camshaft gear «A» is in line with the mark on mainshaft «B» and the mark on camshaft «C» (See fig. 71)
- 2 Ensure the above operation is carried out with the piston at TDC, valve closed, firing stroke.
- 3 Fit the rotor (A) with the relieved section facing inwards (See arrow «D» in fig. 75).



75

#### e Checking valve timing with the engine on the machine

Proceed as above described except points 3 and 4. On the mainshaft, fit degree plate 14 92 74 00 («A» in fig. 74) with the «O» position facing the arrow (41 in fig. 74). Then using a suitable screw secure the degree plate to the generator-alternator unit. Complete the assembly and time ignition as described in sections 11.6 and 11.7 «Electronic ignition».



74

## 6 LUBRICATION

### 6.1 - a REMOVING THE OIL SUMP (See fig. 76)

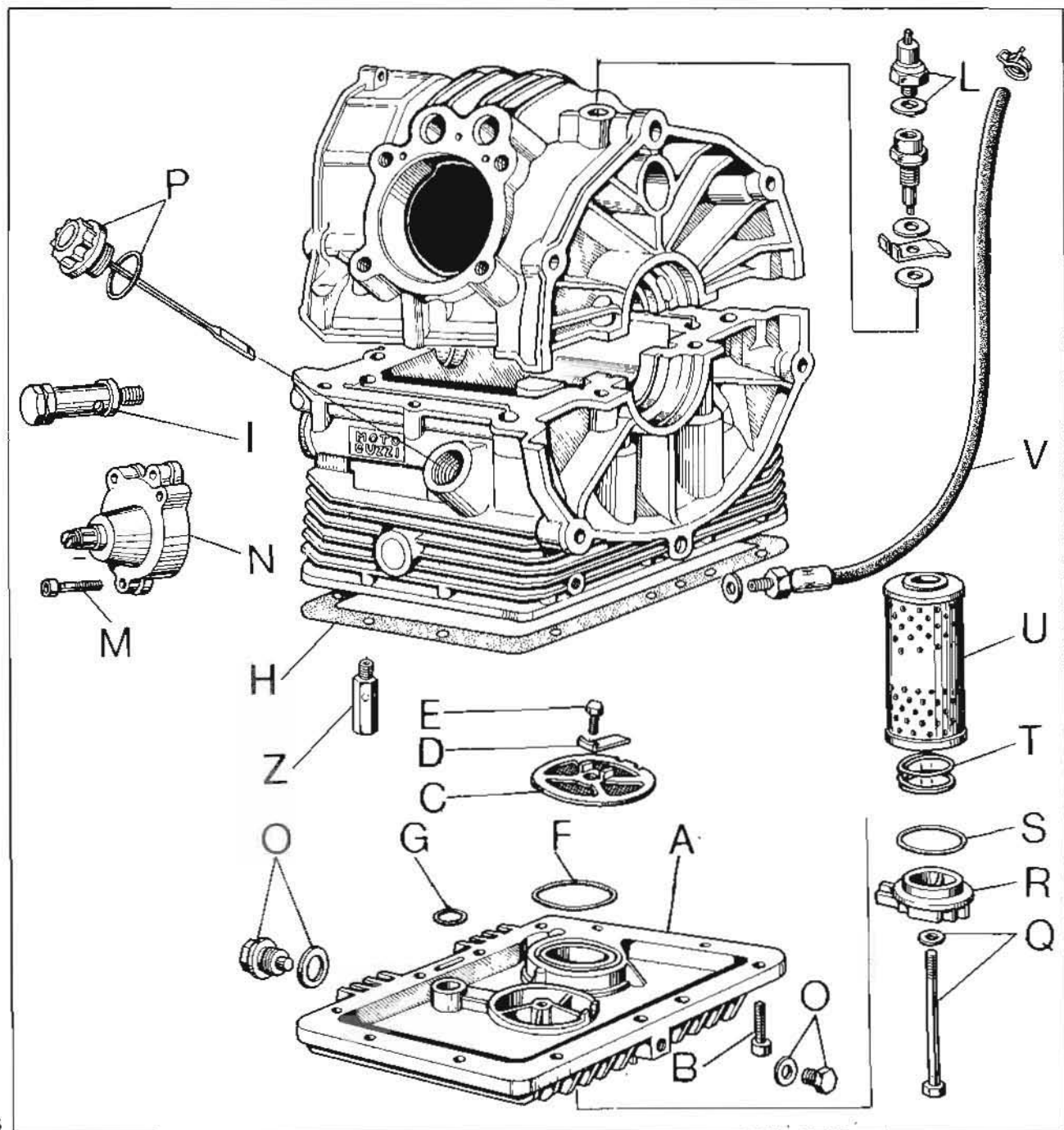
- Drain the oil undoing plugs «O» and filler cap «P»;
- undo screw «Q», remove plug «R», gasket «S», spring «T» and filtering cartridge «U»;
- undo screws «B» and remove sump «A» from the crankcase. From the oil sump remove:
  - wire gauze filter «C» after straightening lock-plate «D» and undoing screw «E»;
  - remove seals «F» and «G» and sump gasket «H».

### b Checks

- If the wire gauze filter is dirty, clean it in a petrol bath and dry it off with compressed air.
- Ensure the rubber seals are not crumpled. If so, replace.

### c Re-fitting

- After these controls and/or any replacements, re-fit the components reversing the dismantling sequence but don't forget to always replace the sump-crankcase gasket even if it still appears to be in good or-



der, also to tighten the sump securing screws in a diagonal sequence, using a torque wrench set to 1 kgm (7 ft/lbs). The cartridge securing screws have to be tightened with the wrench set to 2.5 kgm (18 ft/lbs).

After re-fitting drain plugs with gasket «O», introduce new oil. Quantity: 2.250 lts (4 pints Imp. - 4.7 pints USA) of Agip Sint 2000 SAE 10W/50 or equivalent. Finally screw on filler cap «P».

### 6.2 - a DISMANTLING THE OIL PUMP

■ Dismantle valve gearing as described in section 5.12.

■ From the crankcase remove oil pump «N», after undoing Allen screws «M» (fig. 76). To strip the oil pump (see fig. 77):

- remove key retaining gear «B»,
- take out pump spindle «A»;
- take out inner rotor «C»;
- take out outer rotor «D»;
- take out bearing «F» from pump body «E».

### b Inspection

#### ■ Pump body

Ensure the outer and inner faces are not scored or nicked.

Pump body data:

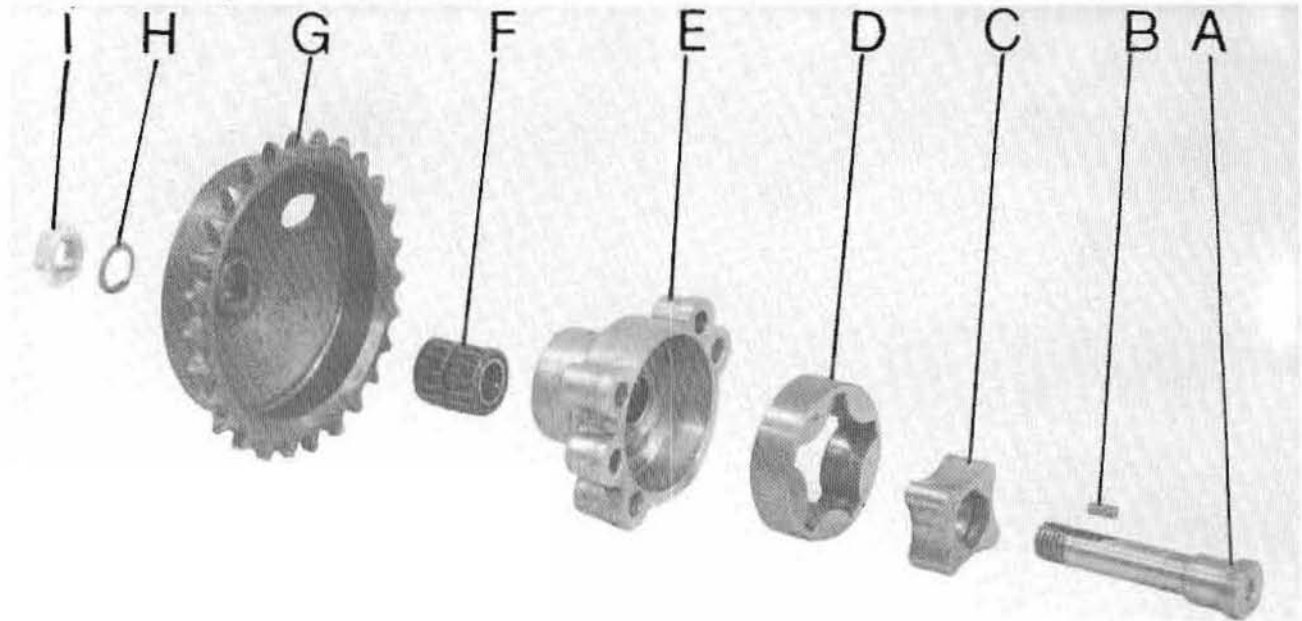
- outer rotor housing diameter  $40.650 \pm 40.675$  mm ( $1.600 \pm 1.609$ ");
- diameter of pump spindle hole  $12.016 \pm 12.043$  mm ( $.4729 \pm .4741$ ");
- diameter of roller bearing housing  $21.972 \pm 21.993$  mm ( $.865 \pm .8657$ ");
- housing thickness for outer rotor  $12.030 \pm 12.070$  mm ( $.4735 \pm .4750$ ").

#### ■ Outer rotor

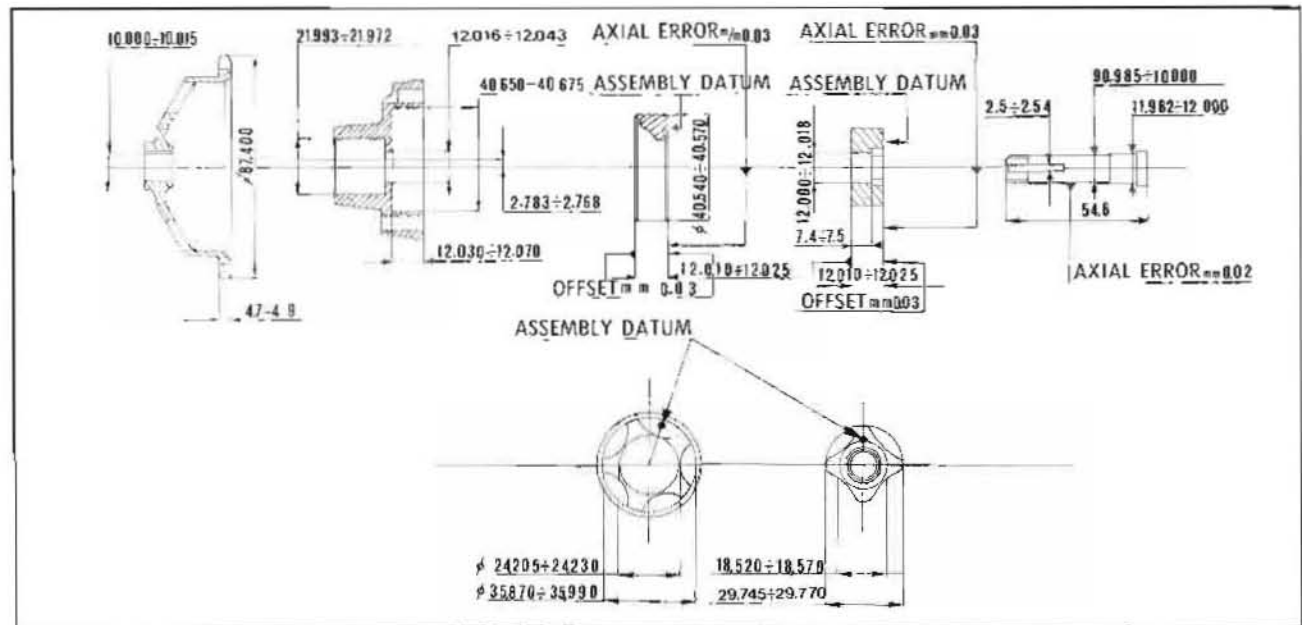
Check all the inner and outer surfaces. If scored in any way damaged, change both rotors

Data of outer rotor:

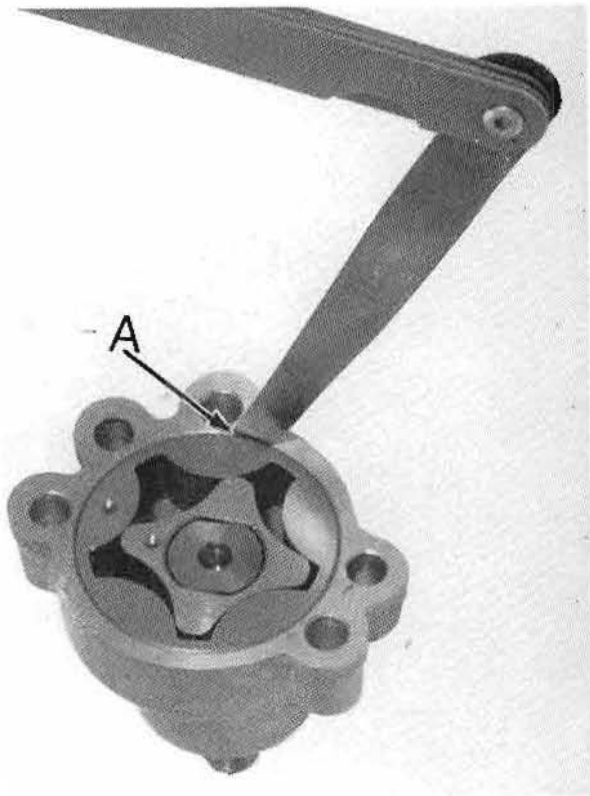
- O/D:  $40.540 \pm 40.570$  mm ( $1.596 \pm 1.598$ ");
- I/D:  $24.205 \pm 24.230$  mm ( $.9523 \pm .9538$ ");
- thickness:  $12.010 \pm 12.025$  mm ( $.4728 \pm .4734$ ").



77



78



79

Data of inner rotor:

Check smoothness of the inner and outer surfaces. If scored or nicked, replace both rotors.

— O/D:  $29.745 \div 29.770$  mm ( $1.170 \div 1.172$ ");

— I/D of pump spindle housing:  $12.000 \div 12.018$  mm ( $.472 \div .4728$ ");

— thickness:  $12.010 \div 12.025$  mm ( $.4727 \div .4733$ ").

▪ *Roller bearings*

Check if in good state. Replace them if damaged.

▪ *Oil pump spindle*

Check their condition, the thread not stripped, the key in the slot not burred, and the contact surface of the inner rotor is undamaged. If so, replace the spindle.

Spindle data:

— pump body-housing

diameter  $11.982 \div 12.000$  mm ( $.4717 \div .4724$ ");

— roller bearing

housing dia.  $9.985 \div 10.000$  mm ( $.368 \div .393$ ").

▪ *Assembly clearances:*

— pump body-outer rotor

$0.080 \div 0.135$  mm ( $.0031 \div .0053$ ") (fig. 79);

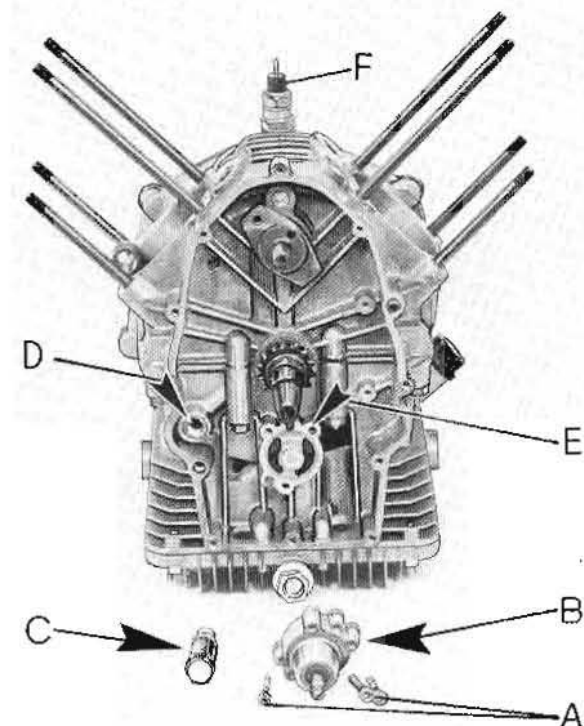
— pump body housing-spindle

$0.016 \div 0.061$  mm ( $.00062 \div .0024$ ").

c **Re-fitting** (See fig. 80)

After re-fitting oil pump «B» assemble it in the threaded holes in the crankcase «E» (see arrow) tightening it with Allen screws «A» with a torque wrench loaded to 1 kgm (7 ft/lbs).

Before finally securing the pump on the crankcase ensure that its spindle turns quite freely.



80

6.3 - a **REMOVING THE OIL PRESSURE RELIEF VALVE**

Using a suitable wrench, undo oil pressure valve «C» from its threaded housing in the crankcase (See fig. 80). To strip the various valve components, proceed as follows (See fig. 81):

- undo plug «A»;
- remove gasket «B» from the plug;
- remove pressure adjusting disc «C»;
- remove spring «D»;
- remove plunger «E»;
- valve «F» body is now completely bare.

b **Inspection of the oil pressure relief valve**

▪ Check efficiency of the pump, ensuring the plunger slides up and down freely in valve body «F» (fig. 81). If necessary, dismantle it to remove any foreign matter preventing it from operating properly.

The valve is factory pre-set to allow it to lift at  $4.2\text{--}4.8$  kg/cm<sup>2</sup> ( $5.97 \div 6.82$  lbs/sq.in).



Valve calibration is checked by the aid of a compressed air gauge, to ensure pressure is at the specified amount.

This control can be carried out on an engine assembled on the machine as follows:

- undo the warning light carrier (F) in fig. 80 from the crankcase housing and screw the gauge cable into it.

Start the engine, run it up to its normal operating temperature, and observing the gauge dial ensure it is within the prescribed limits (4.2 ÷ 4.8 kg/cm<sup>2</sup> - 5.97 ÷ 6.82 lbs/sq.in).

If lower, fit up one or more adjusting discs «C» over the spring.

If higher, remove one or more discs till the correct pressure is attained;

- ensure spring «D» (fig. 81) when compressed to 19.5 mm (.767") gives a load of 4.675 ÷ 4.825 kg (10.3 - 10.6 lbs). Free length of springs is 28.650 ÷ 29.350 mm (1.127 ÷ 1.154") Ø 7 mm (.275") effective spring coils 15;

- be sure the threaded portion of the pump body and plug is in good state. If not, replace as necessary;

- check smoothness of the plunger. If scored or nicked, replace it.

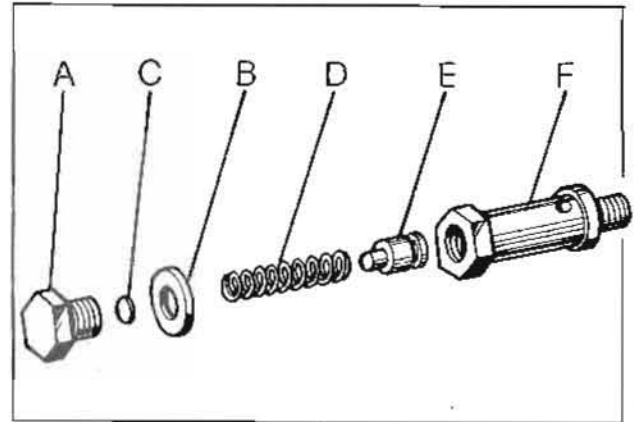
#### c Re-assembly

The valve components are re-assembled in a reversed sequence. Finally, re-fit complete relief valve «C» into its threaded housing in the crankcase (See arrow «D» in fig. 80).

### 6.4 OIL PRESSURE LIGHT SWITCH

(See «F», fig. 80)

This switch is fitted in the crankcase and is cable connected to a red warning light on the panel board. If the operating pressure is too low, the lamp does not go out and warns something is wrong with the engine. In such an event, the engine should be immediately stopped and the cause for the pressure drop looked for. When the pressure is correct, the light goes out as soon as the engine has reached a certain number of revolutions.



81

#### 6.5 - a REMOVING THE OIL CARTRIDGE FROM THE SUMP (fig. 76)

- Drain the sump oil after undoing drain plugs «O» with gaskets and filler cap «P»;
- undo screw «Q», remove plug «R», gasket «S», spring «T», and filtering cartridge «U».

#### b Inspection of cartridge

The cartridge should be changed after the first 500-1000 km (300-600 miles) i.e. after the first oil change and after every 6000 km (3600 miles) i.e. every 2 oil changes.

Ensure the gasket «S» on plug «R» (fig. 76) is not crumpled or has lost its elasticity. If so, replace it.

#### c Re-fitting

Reverse the dismantling sequence. The cartridge cover securing screw on the sump has to be tightened down with a torque wrench set at 2.5 kgm (18 ft/lbs). At the end of this operation, re-fit drain plugs and gaskets «O» (fig. 76) and fill up the sump with fresh oil (Quantity: 2.250 lts - 4 pints Imp., 4.7 pints USA) - Brand: Agip Sint 2000 SAE 10W/50.

After letting the engine idle for a few minutes, check again if the oil level is up to the top mark on the dipstick. If so, re-fit filler cap and gasket «P» (fig. 76).

### 6.6 REMOVING THE WIRE GAUGE FILTER FROM THE OIL SUMP (See fig. 76)

Repeat the same operations as described in section 6.1.

## 7 CARBURATION

### 7.1 CARBURETTORS (See fig. 82)

Both models fit 2 Dell'Orto carburetors VHB 24 FD (right) and VHB 24 FS (left).

Carburetors controls:

- throttle twist grip on the right side of the handlebar;
- easy starter lever: for cold starts «A»; for riding «B».

### 7.2 CARBURETTOR SETTING

	V 35 Europe (gold colour screw on filter carrier union)	V 50
Choke	Dia. 24 mm	Dia. 24 mm
Throttle valve	40	40
Atomizer	260 AH	260 AH
Main jet	102	105
Idling jet	40	40
Easy starter jet	60	60
Taper needle	E 2 (2nd notch)	E 2 (2nd notch)
Floater	14 gr (abt 2 oz.)	14 gr (abt 2 oz.)
Idling screw opening	1½ turns	1½ turns

### 7.3 LEVELLING THE FLOATER

Ensure the floater has the same weight stamped on it, it has no deformations, and turns freely on its needle. Hold the carburettor in the indicated position so that the floater equalizer just touches the taper needle and the needle contacts its seat.

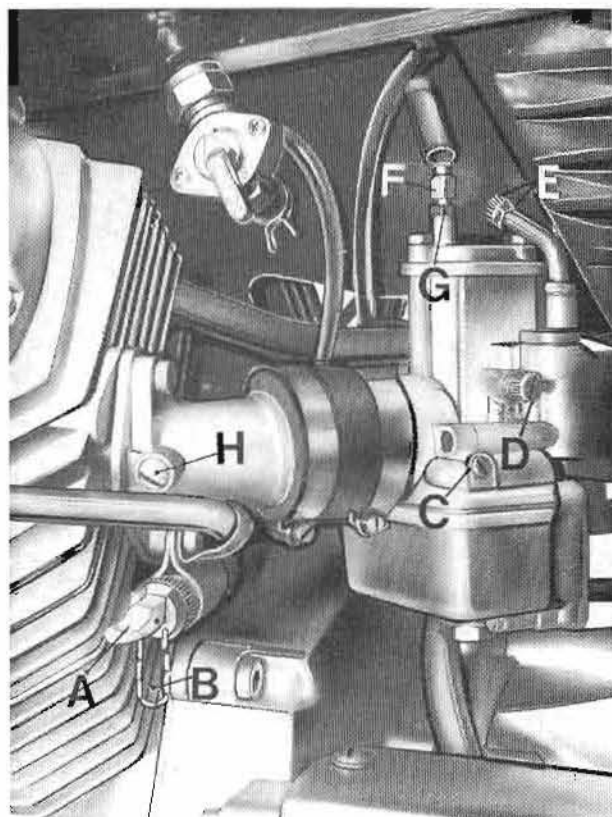
In this condition, check if both floater halves are at same height (23.5 mm = .920") as compared to the plane of the carburettor body (fig. 83).

This operation is carried out using tool 14 92 69 00 (40 in fig. 28).

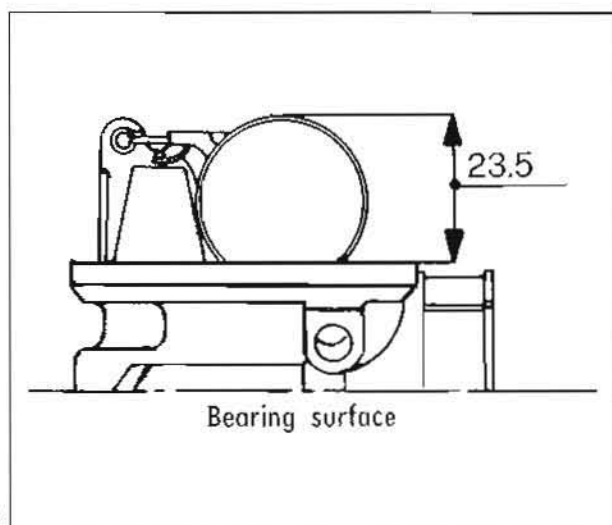
### 7.4 MANUAL ADJUSTMENT OF CARBURATION AND IDLING SPEED (See fig. 82)

Proceed as follows:

- 1 run the engine up to its normal operating temperature;
- 2 drive idling speed screws home fully and then unscrew them 1½ turns;



82



83

3 using both your hands, check if the exhaust pressure at the silencers exit is about the same with the engine running at no more than 1000 ÷ 1200 rpm.

To obtain this speed it may be necessary to screw in the carburettor screw of the cylinder giving a lower pressure or to screw out the screw of the carburettor giving a higher pressure;

4 turning screw «C», adjust each cylinder so it gives its best carburation i.e. when a slight increase of the revs number is perceived and then re-adjust the idling speed as described in section «3»;

5 disconnect one of the plug leads (one at the time) and ensure the engine stops exactly after the same amount of firing strokes. If not, Unscrew screw «D» concerning the carburettor of the cylinder giving a higher number of firings or screw in the screw of the carburettor concerning the cylinder giving a lower number of firing strokes;

6 adjust idling speed at 1000 ÷ 1200 rpm, screwing in or out idling screw «D» by the same amount;

7 ensure that with the throttle grip fully closed, there is a cable terminal-adjuster «F» play of about 1 ÷ 1.5 mm (.039 ÷ .059"). If not, loosen nuts «G» and screw in or out adjusters «F».

This done, dont forget to lock again nuts «G»;

8 check synchronization of the throttle valves opening proceeding as follows: by the aid of an assistant, turn gradually and slowly the twist grip ensuring with both hands that the pressure increase at the silencer exits is even and synchronous.

If not, i.e. one cylinder is more advanced than the other, adjust the control cable operating on thumb adjuster «F» after undoing nut «G» until the pressure emitted by both cylinders is even;

9 ensure both starter control cable terminals at the thumb adjuster ends have a free play of about 3 mm (.118").

## 7.5 ADJUSTING CARBURATION USING A VACUOMETER (See fig. 84)

Proceed as follows:

1 set up the byke on the centre stand;

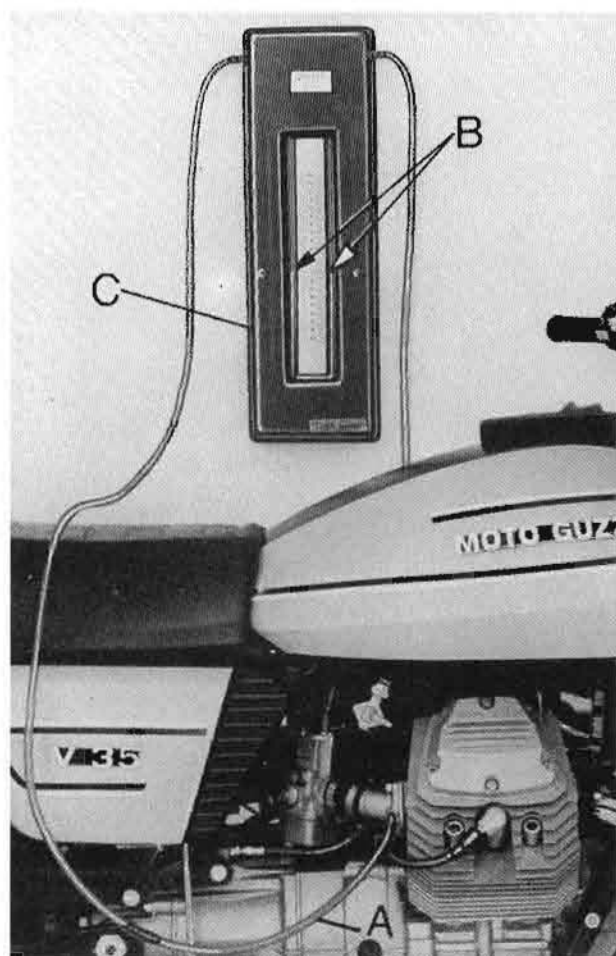
2 drive screws «C» (fig. 82) home fully and undo them 1½ turns for each carburettor;

3 remove plugs and washers on intake pipe «H» (fig. 82);

4 screw in the vacuumeter pipe connectors «A» in the intake pipe holes;

5 with the engine at idling speed and its operating temperature, adjust screws «D» until both mercury columns «B» are at same height on the vacuumeter dial «C» (fig. 82);

6 adjust position of idling screws «C» to obtain the highest possible idling revolutions and then re-check the position of the mercury columns on vacuumeter dial «C». If necessary, repeat operation n. 5;



7 after adjusting idling speed (1000 ÷ 1200 rpm), synchronize both carburettors as follows:

— start the engine and gradually open the twist grip observing on the vacuumeter dial if both mercury columns are lined up. If not, operate on the throttle cables «F» adjusters (fig. 78) after loosening nut «C» in fig. 78 till both columns are aligned.

This done, ensure that both cables at the adjuster ends «F» (fig. 78) have a play of 1 ÷ 1.5 mm (.039 ÷ .059"). Finally, unscrew the vacuumeter line connectors, and re-fit the plugs with aluminium washers «H» (fig. 78);

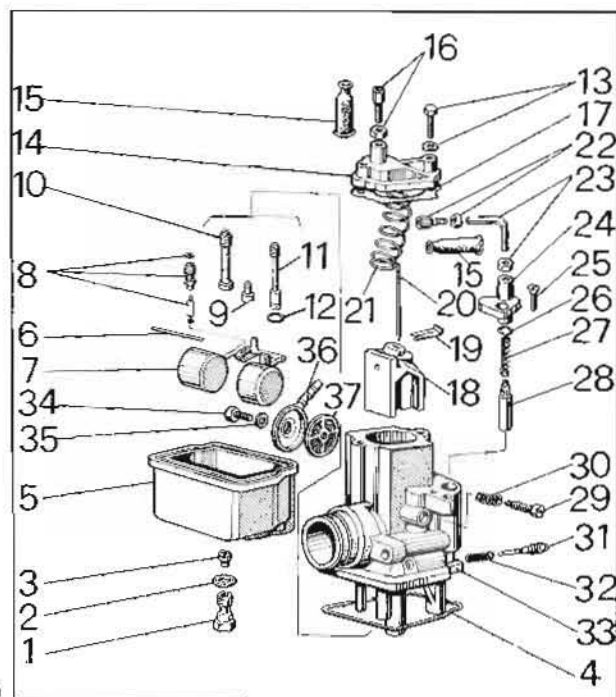
8 ensure also that both terminals of the starter control cables at the adjuster (E) fig. 78 have a play of about 3 mm (.0118").

### 7.6 - a STRIPPING THE CARBURETTOR

(See fig. 85)

Remove:

- plug «1» securing mixing chamber cover «5» to carburettor body «33»;
- washer 2 from plug 1;
- unscrew main jet «3» from plug «1»;
- remove gasket «4» from mixing chamber «5»;
- pin «6» and floater «7»;
- needle jet «8» with washer;
- idling jet «9» from carburettor body;
- choke «10» from carburettor body;
- easy starter jet «11» with seal ring «12»;
- throttle valve cover screws and washers «13»;
- throttle valve cover «14» and from cover: throttle control cable adjuster with locknut «16», washer «17», throttle valve «18», needle clip «19», taper needle «20», spring «21»;
- cap 16 from adjuster «22» and the small tube with counternut «23»;
- screw «25» retaining starter valve «24»;
- «O» ring for easy starter valve «26»;
- starter spring «27» and starter valve «28»;



85

- throttle valve adjusting screw «29» with spring «30»;
- idling screw «31» with spring «32»;
- screw 34 with washer 35 securing banjo union 36;
- fuel filter 37 from carburettor body 33.

Wash all parts in petrol and blow through all carburettor ducts, jet orifices, and the fuel filter with compressed air.

### b Inspection

Check wear of seats and taper needle. Ensure the throttle valve is in good conditions, there are no holes or bumps in the floater, also all gaskets and seals are still efficient. Otherwise, replace them.

Avoid using steel wires or needles to clean the jet orifices as this might upset carburation. Clean with nylon thread or brass wire.

### c Re-assembly

Reverse the dismantling operations but always change all paper gaskets, «O» rings, and seals.

### 7.7 - a AIR FILTER AND BREATHER UNIT

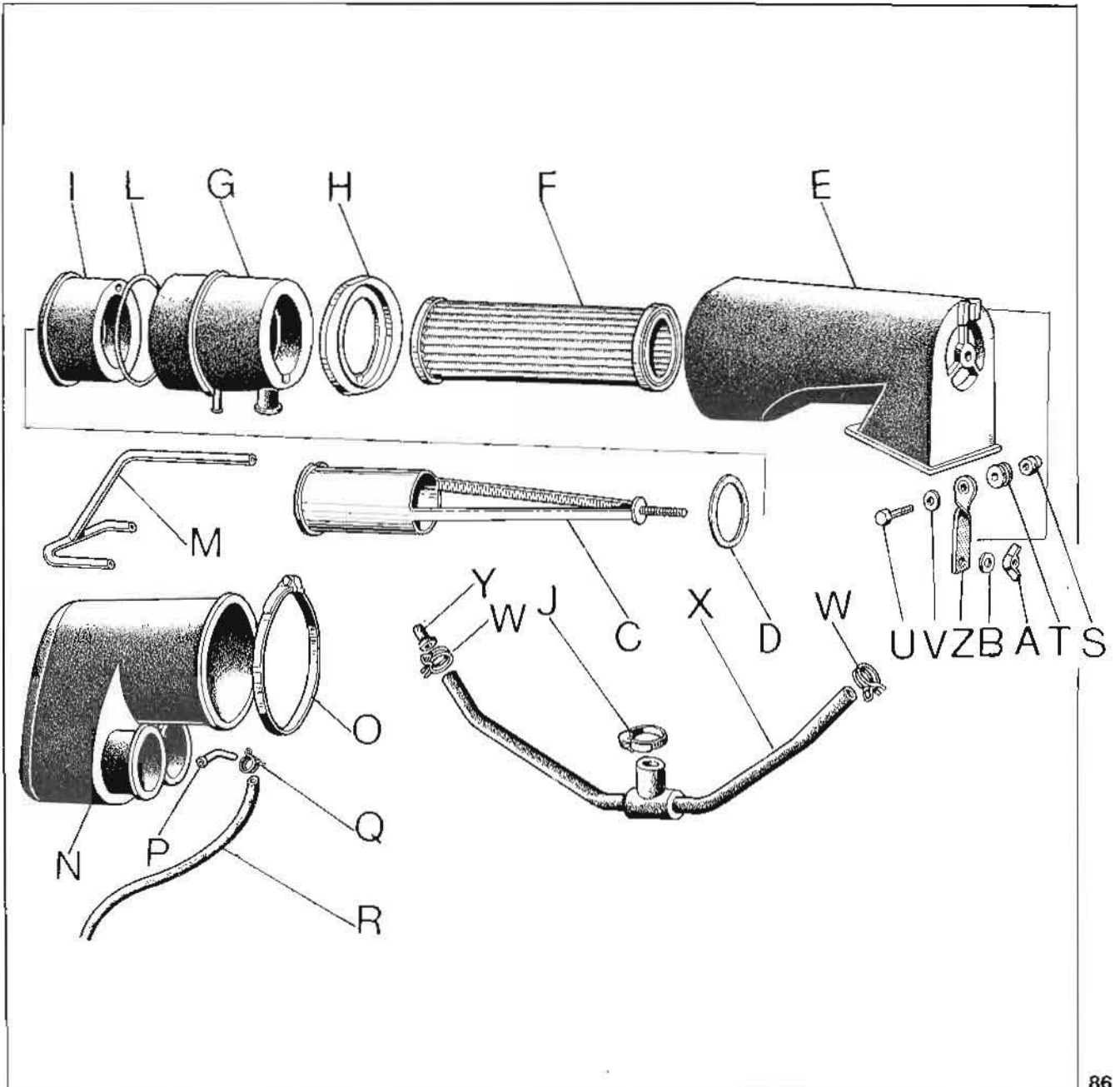
(figg. 86-87-88-89)

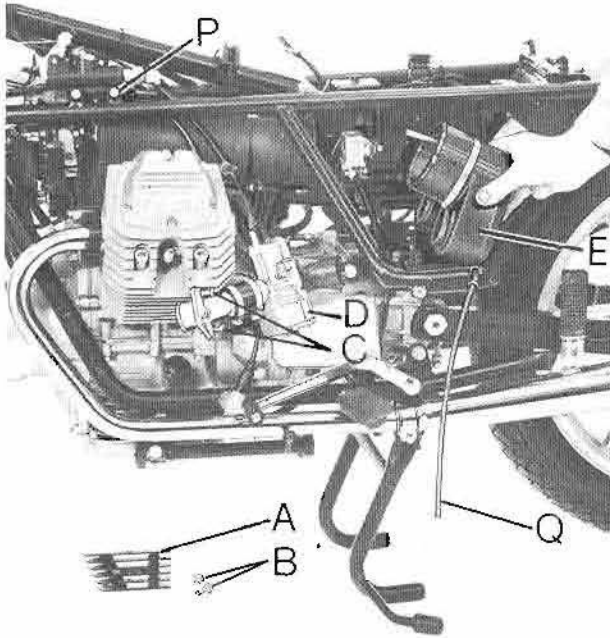
This group consists of:

- carburettor sleeve «N» with securing strap «O»;
- pipe connection on breather «P» with securing clip «Q», breather pipe «R» and the other pipe taking the recovered oil to the sump;
- pipe unions in heads «Y» and the oil recovery pipe securing clips from heads «X» to breather body «G»;
- screw «U» retaining housing «E» to frame, also washers «V», grommet «T», nut «S», and plate «Z»;
- undo nuts with washer «A» and grid plate «B» on the left of the vehicle;
- undo the nuts securing filter housing «P» to the front frame;
- undo the screws securing the air intake tube to left cylinder head «C» and remove the carburettor complete with air intake tube from rubber sleeve «E» but without undoing the small plastic tubes. Sleeve «E» has also to be removed from the right carburettor;
- loosen the clips and remove fuel lines from the left carburettor;
- loosen the retaining strap screws and remove rubber sleeve «E» from the battery carrier, paying attention to drain tube «Q»;
- remove the oil recovery pipes from cylinder head and breather unit;
- undo wing nut «G» retaining the central body to bracket with washer «F»;
- lift out the inner assembly from housing «H» (sleeve and plastic components) from cartridge «L» and filter carrier «I»;
- remove cartridge «L» from filter body «I»;
- yving nut «A» with washer «B» securing felter carrier «C» plate «Z» with seal «D»;
- sleeve «I» with seal «L»;
- breather body «G» with tube «M», cartridge «F» from filter body «I».

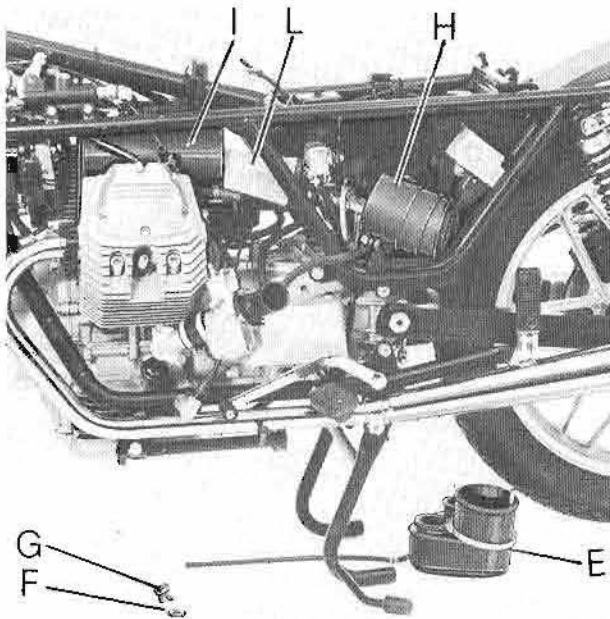
**b Removing the filter cartridge (fig. 87-88-89)**

- Lift up the saddle by the aid of the special lever («A» in fig. 20).
- Remove side covers.
- Disconnect battery strap.
- Undo battery nuts and disconnect positive and grounding cables, lifting up the battery from its carrying plate.
- Disconnect the fuel tank retaining strap at the rear and after closing the taps and disconnected the fuel lines, lift up the tank at the front side.

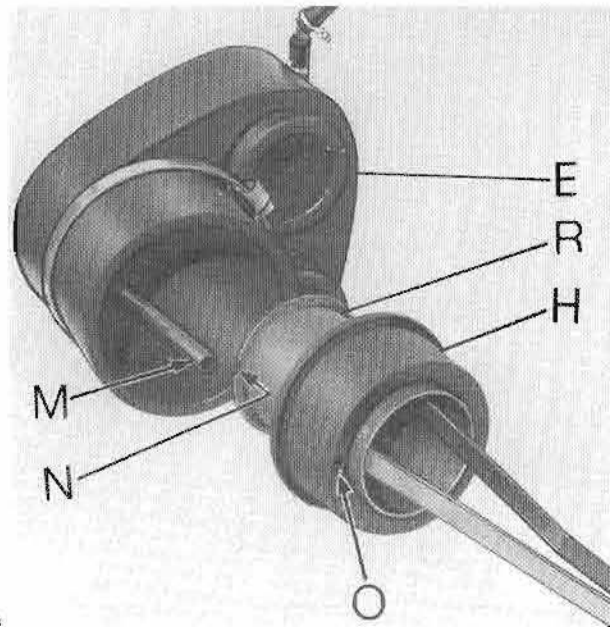




87



88



89

### c Inspection

If the filter (L) is very dirty, replace it with an original one otherwise blow it through with low pressure compressed air. Normally, the air filter should be replaced every 10.000 km (6000 miles) or so and more frequently when riding on very dusty roads. Check cleanliness of the breather and wash all parts in petrol, drying off with compressed air. Ensure also the cylinder head-breather and breather-engine lines are in good state, with no cracks or holes. Otherwise replace them.

### d Re-assembly

After the cartridge is replaced with an original one, re-fit: sleeve and components in line on the housing and tighten wing nut «G» just sufficiently to prevent them from coming out.

Fit fuel line on left carburettor «D» and position this on the cylinder head. Re-fit rubber sleeve «E», ensuring the banjo union of the breather is properly centered in its housing and on the carburettor intake tubes. Secure the retaining strap, screw on wing nut «G», left carburettor with intake pipe on the head and the breather lines. Finally tighten the housing securing screw to the frame.

NB *The re-assembly operation is made easier if a reference mark is traced on each component in coincidence with hole «O» on sleeve «H», of relief «N» on filter carrier «R» so that the small breather tube «M» can be more easily introduced.*

### e Cleaning operations

Every 10.000 km (6000 miles) or whenever there is an irregular flow of fuel to the carburettors, the taps, tank, carburettor filters and lines should be cleaned. Wash them in a petrol bath and dry off with compressed air. It is well also to blow through the tap ducts, filters and lines.

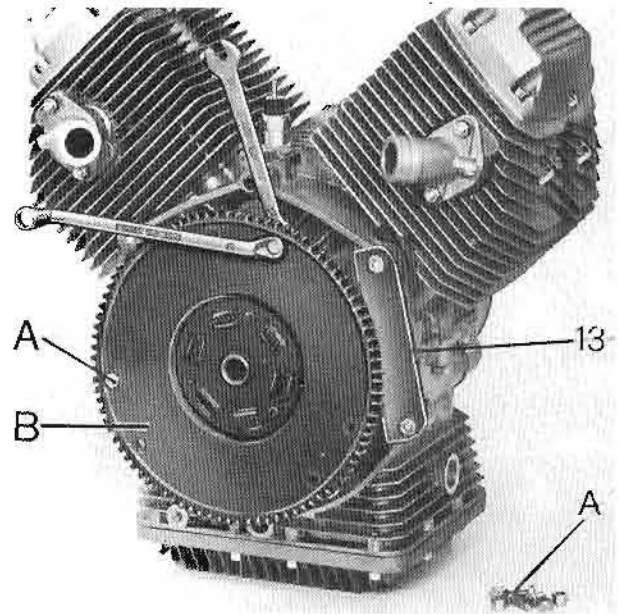
## 8 CLUTCH

### a Removal

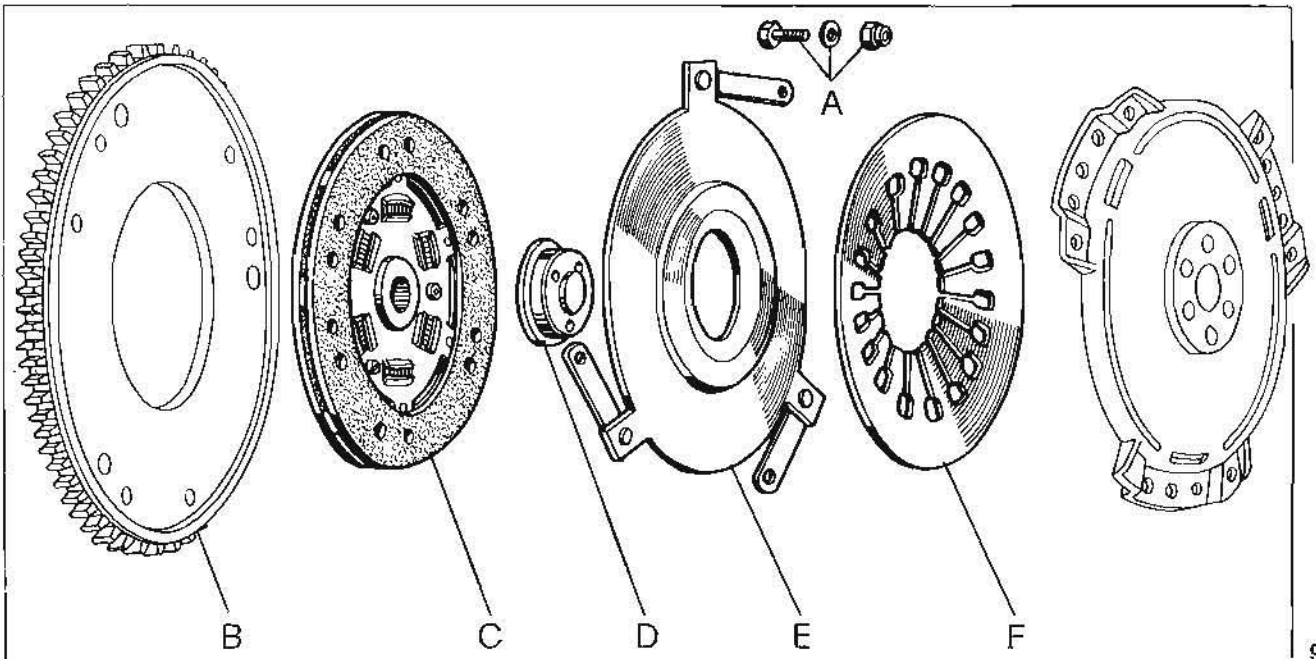
- Set up flywheel holding tool N. 19 91 18 00 (13 in fig. 90) on the crankcase.
- Undo screws «A» of starting ring gear «B» and remove the gear.
- Remove (See fig. 91):
  - clutch plate «C»;
  - pressure cap «D»;
  - pressure plate «E»;
  - diaphragm spring «F».

### b Inspection

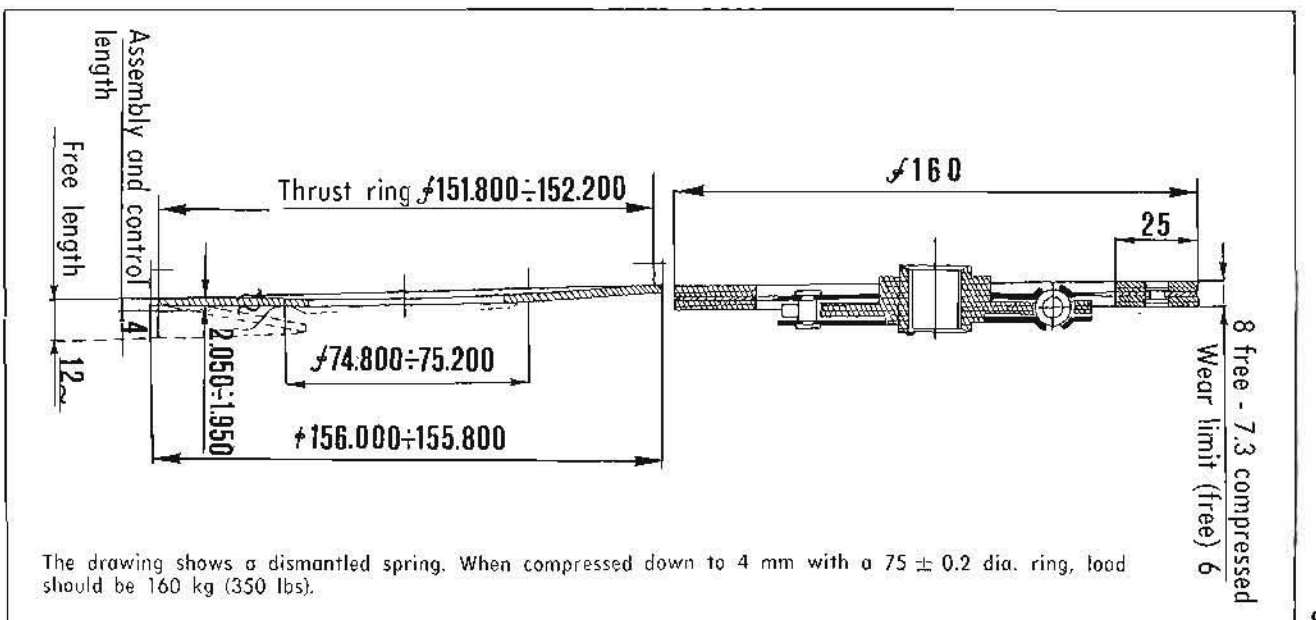
- Ensure plate «C» is not scored. If worn down to less than 6 mm (.23") replace the plate. Original size: 8 mm (.31").



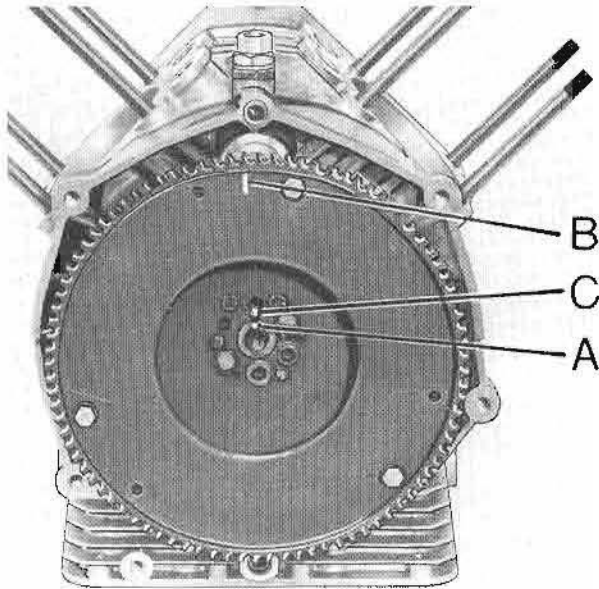
90



91



92



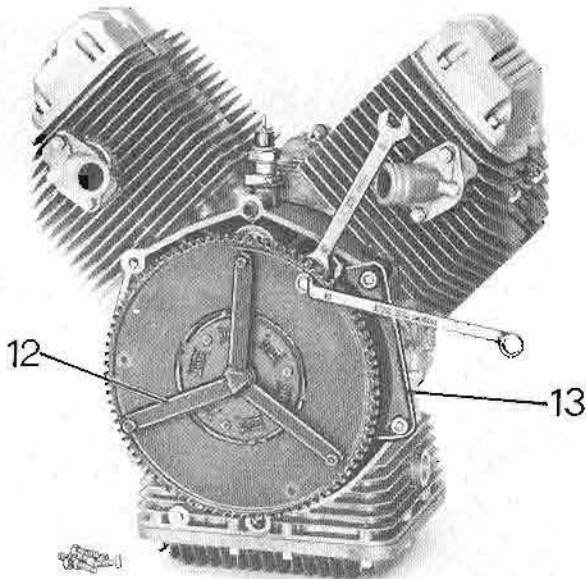
93

- Check elasticity of the diaphragm spring (See dwg fig. 92), also its load. When compressed to 4 mm (.15") with a ring of 75 mm dia. ( $\pm 0.2$ ) the spring should give a load of 160 kgs (350 lbs). Replace the spring if the load is lower.

#### c Re-assembly

To refit the clutch group and ring gear on the flywheel, reverse the dismantling sequence but ensure that:

- mark A on the crankshaft is in line with flywheel mark «C» and with ring gear mark «B» (See fig. 93);
- tool 19 90 65 00 (12 in fig. 94) and tool 19 91 18 00 (13 in fig. 94) are fitted to ensure the clutch is properly centered due to the above marks having to be perfectly in line with each other. After fitting it on the clutch plate hub, insert the tool and fix it provisionally on the ring gear. Then by the aid of suitable wrenches fit the screws, washers, and nuts in the free holes and tighten the first three nuts. Remove the tool and after fitting the other 3 screws, tighten the nuts. Finally remove the flywheel holding tool.



94



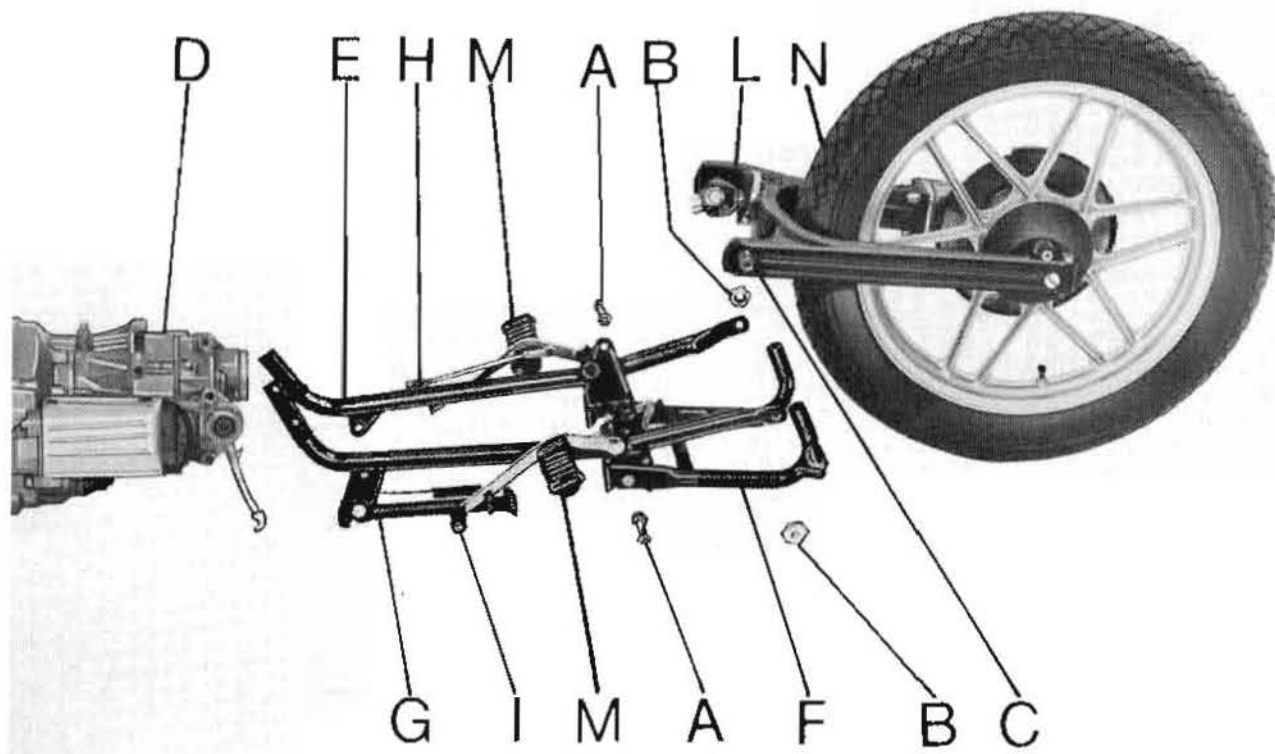
## 9 THE GEARBOX

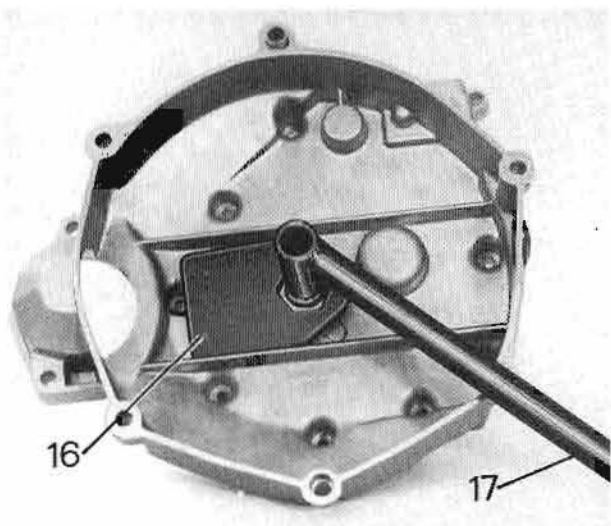
### 9.1 - a REMOVING THE GEARBOX FROM THE FRAME AND SWINGING ARM FROM THE GEARBOX (See fig. 95)

- Remove screws «A» securing the gearbox to the frame cradle members.
- Remove split pin and withdraw the clutch operating rod on the gearbox cover.
- Undo both nuts «B» on pins «C» securing the swinging arm to the gearbox casing.
- Lift out gearbox «D» from swinging arm «L». If necessary, remove from casing «E»:
  - centre stand «F»;
  - side stand «G»;
  - footrests «M»;
  - gearbox operating lever «I» complete of rod and fork;
  - left front and rear operating lever «H» c/w rod and fork.

#### b Inspection

- Ensure centre stand «F» is not deformed and the return spring is still efficient. A 10 mm elongation (.39") of the spring should give a load of 30 kg (66 lbs).





96

- Check straightness of the side stand (G) and the efficiency of its return spring. Under a load of  $4.2 \pm 5\%$  kg (9.2 lbs) the spring should compress to 10 mm (.39").
- Check for possible deformation of the front and rear brake control levers, gearbox operating lever, and the footrests.
- Check threaded portion of the spindles connecting the swinging arm to the gearbox. If stripped, replace the shafts.

#### c Re-assembly

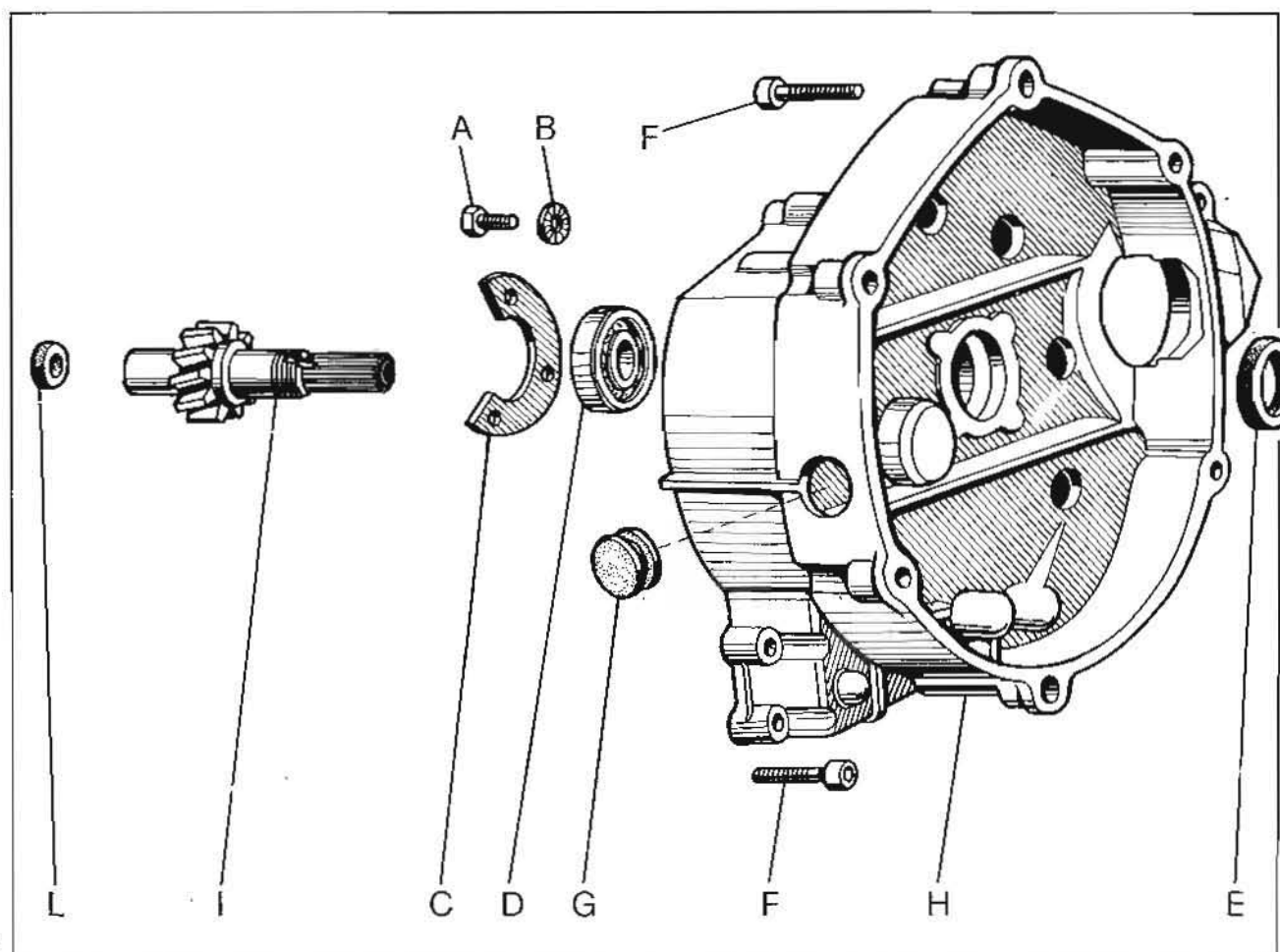
Reverse the dismantling sequence.

## 9.2 CLUTCH HOUSING

### a Removal

Proceed as follows:

- undo filler cap «T» and drain plug «Z» to drain the oil from the gearbox (fig. 109);
- undo Allen screw «F» (fig. 97) securing the clutch
- tap lightly the clutch housing with a hide mallet to separate it from the gearbox. Remove the housing c/w clutch shaft;



97

- set up nut holdfast tool part N. 19 90 71 00 (16 in fig. 96) and using tool 19 90 54 00 (17 in fig. 96) turn the shaft slowly to undo the nut itself;
- remove gear «I» (See fig. 97) from bearing «D» on clutch housing «H» tapping lightly with a hide mallet from the inside;
- undo 3 screws «A» with washers «B» and remove plate «C» retaining bearing «H» to the cover (See fig. 97);
- using a suitable punch tap lightly from the inside to remove bearing «D» from its seat in the cover;
- by the aid of a suitable punch take out seal «E» tapping lightly from inside the cover;
- remove the rubber sealing plug from inspection hole «G».

#### b Inspection

- Check condition of the bearing. Replace it if damaged.
- Check teeth wear of the clutch gear, also smoothness of its splines. Replace the gear, if necessary.
- Check condition of the gear and cover seals.

#### c Re-assembly

- Using punch 19 92 94 00 (8 in fig. 98) press in the bearing after having lubricated its inner and outer surfaces.
- Fit bearing retainer «C» with washer «B» on the cover and tighten screw «A» (See fig. 97).
- Fit the seal on the clutch shaft using punch 19 90 59 00 (10 in fig. 99).
- Insert the splined end of the clutch gear in the previously mounted bearing and tap it with a mallet in its housing.
- Re-fit the seal using punch 19 92 67 00 (27 in fig. 100) and bushing 19 92 73 00 (1 in fig. 100).
- Tighten the nut on the threaded end of the clutch shaft using tool 19 90 71 00 (16 in fig. 96) and tool 19 90 54 00 (17 in fig. 96).

### 9.3 CLUTCH

#### a Removal (See fig. 101)

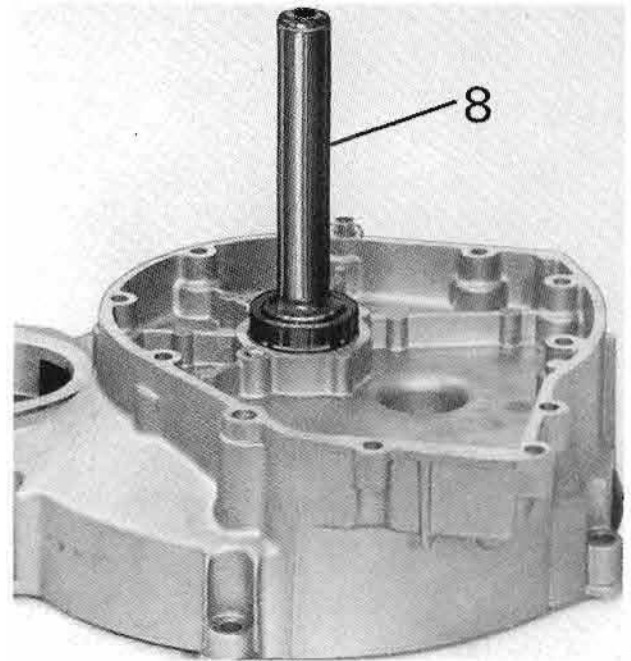
Press on the clutch operating rod to take off the cover.

Now remove:

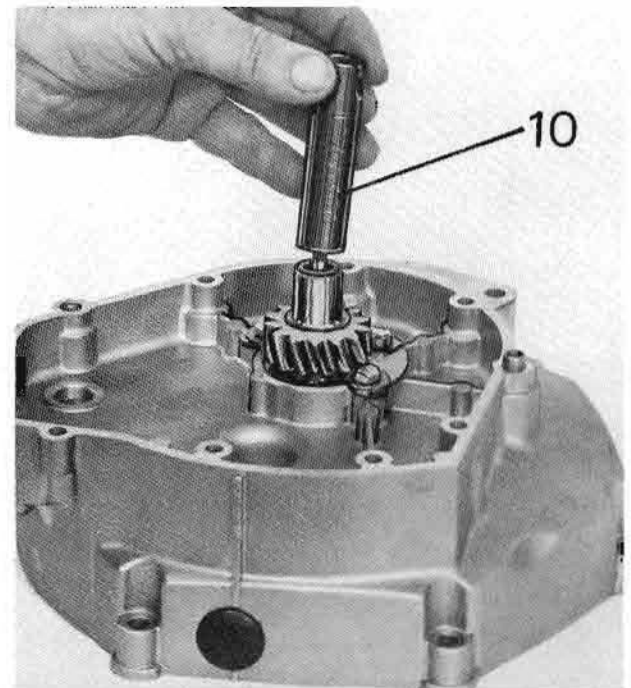
- outer body «A» and from this seal «B»;
- thrust bearing «C»;
- inner body «D» and control rod «E»;
- lever return spring from its housing «F»;
- split pin «G» withdrawing dowel «H» and clutch operating rod complete with adjusting screw «L» and nut «M».

#### b Inspection

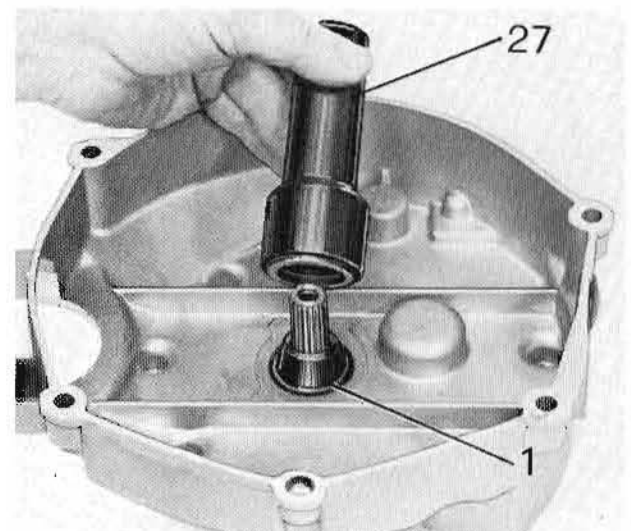
- Ensure the surface of the outer body contacting the boss on the cover is not scored or damaged. If so, replace the outer body.



98

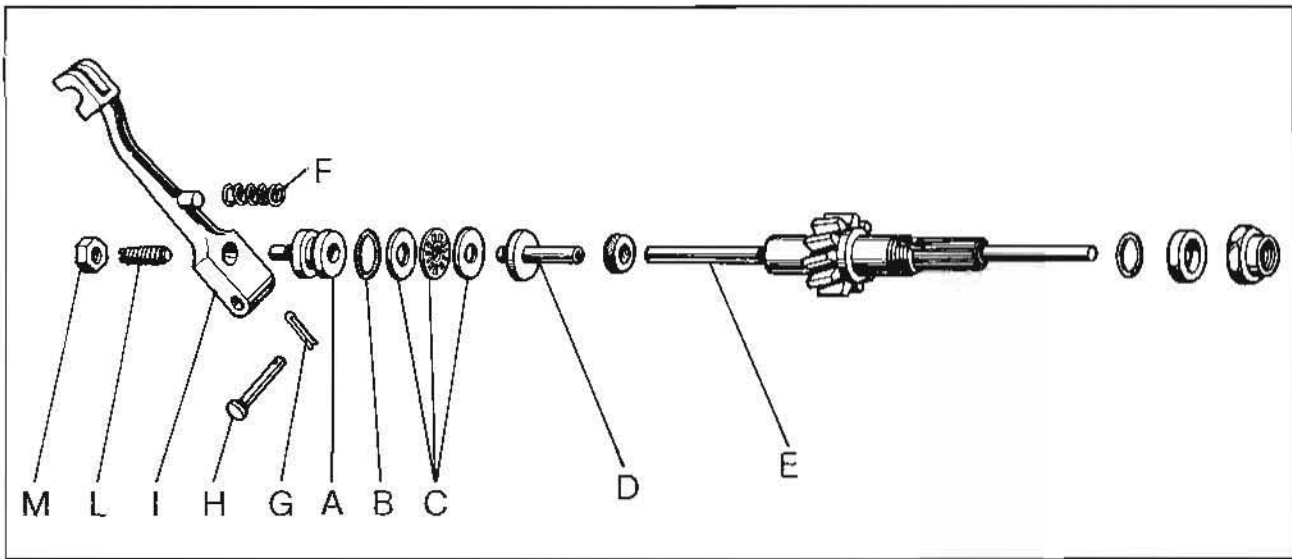


99



100

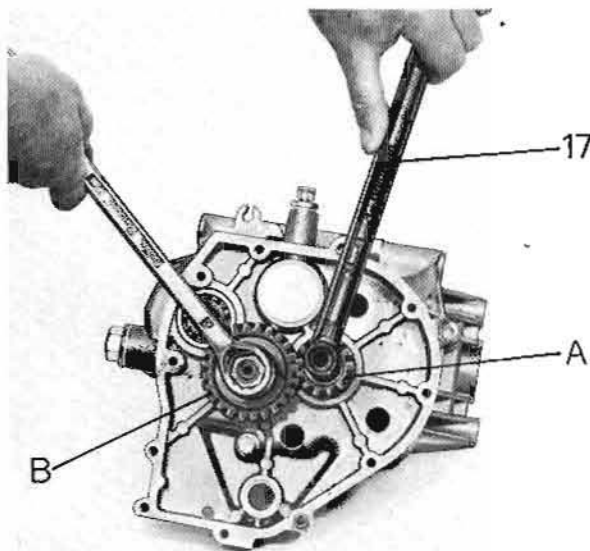
- Ensure the seal is not crumpled or hardened. In any case, it is a good rule to always replace this.
- Check condition of the thrust bearing and its rollers. If damaged, replace it.
- Ensure the end section of the inner body is not unduly worn. If so, replace both the inner and outer body.
- Check straightness of the control rod. Do so by rolling it on a flat surface on which it should contact all along its length. If bent, straighten or replace it.
- Check efficiency of the lever return spring. If deformed or has lost its efficiency, replace it.
- Ensure the adjusting screw on the clutch operating arm is not worn or stripped and in either case, replace the screw.



101

#### c Re-assembly

To re-assemble the clutch, reverse the dismantling operations but ensure that spring «F» is properly sealed in its housing on the cover and that lever «I» is secured with a rubber band to vent plug («A» in fig. 105).



102

### 9.4 GEAR BOX

#### a Dismantling

- Undo filler and level cap with washer «T», also drain plug «Z» with gasket to drain the gearbox oil.
- Set up the casing on its supporting plate part N. 19 90 25 00 (47/1 in fig. 108) previously gripped in a vice.
- Set up clutch shaft «A» in gearbox casing «C» (fig. 102) so that its gear engages main shaft gear «B».
- Fit holdfast tool 19 90 54 00 on the shaft splines (17 in fig. 102).

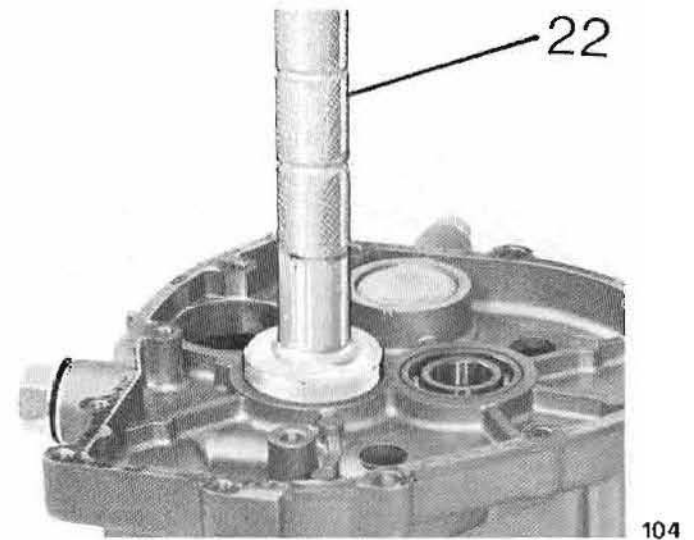
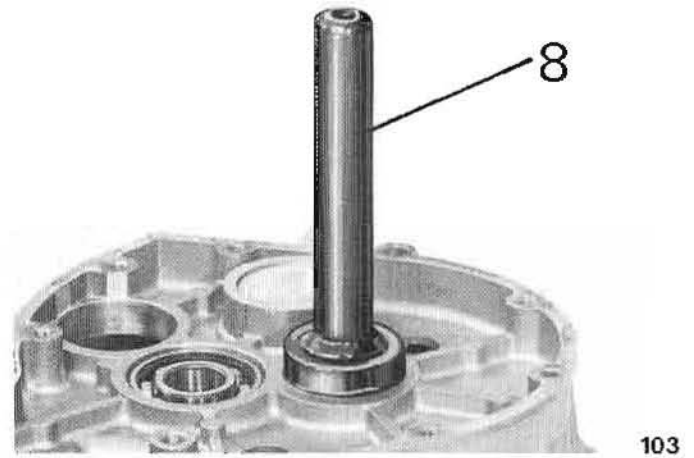
- Undo the clutch gear securing nut, remove shim, take off bushing, and the gear.
- Remove vent plug with washer «H» (fig. 109) and from the casing remove spring «I» and plunger «L».
- Undo the Allen screws fixing the cover to casing «M» (fig. 109) and with a hide mallet tap lightly to separate the cover from the gearbox complete with gears and shafts.
- Undo screws «N» and «O» securing the bearing plates and remove these («Q» and «R») (fig. 109), withdrawing the complete gear-shafts group from the cover.
- By the aid of a punch, remove layshaft bearing «V» (fig. 109).

#### b Inspection

- Check that the joining faces are not scored or nicked and if so, smooth out with fine emery paper.
- Check condition of bearing «V» (fig. 109) and if necessary replace it.

#### c Re-assembly

- Re-fit the clutch shaft bearing by the aid of tool part N. 19 92 94 00 (8 in fig. 103).
- Re-fit main shaft bearing using tool 19 92 63 00 (22 in fig. 104).
- Re-fit layshaft bearing «V» (fig. 109) tapping it with a hide mallet into its housing so it sits perfectly. The other components are assembled reversing the dismantling operations.



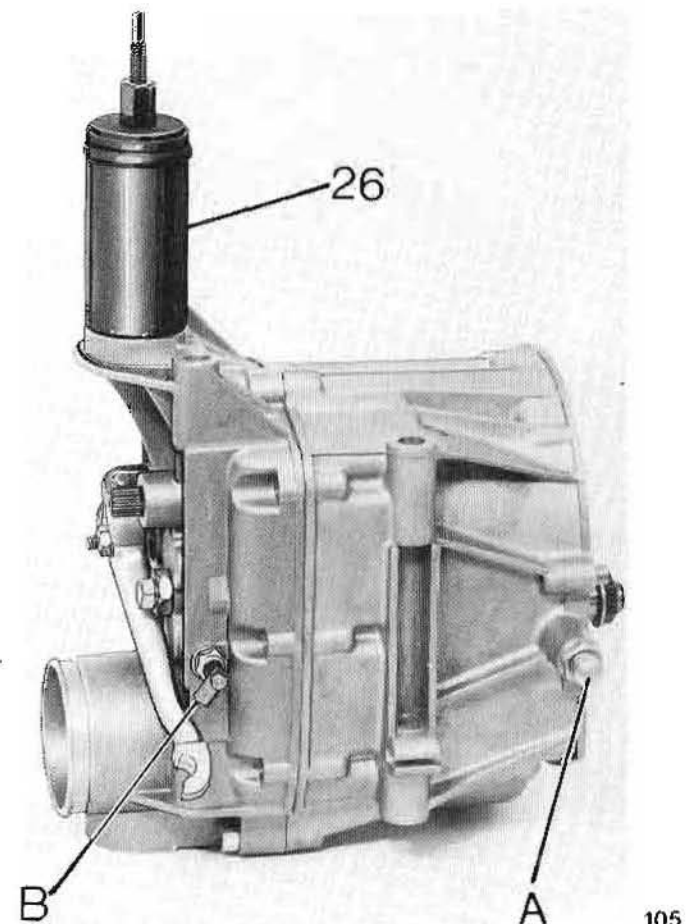
### 9.5 GEARBOX COVER

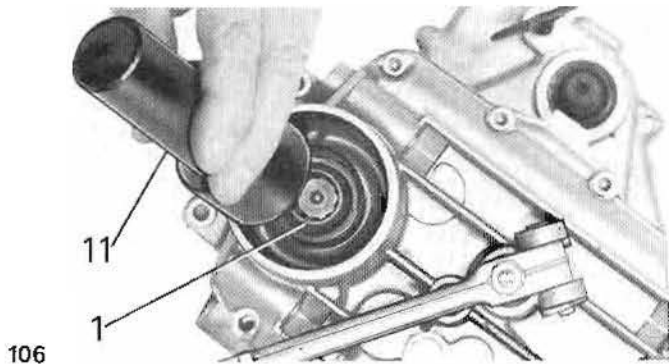
#### a Removal

- Undo the securing screws and remove the pre-selector lever.
- Loosen nut «B» and undo the preselector lever positioning screw «A» in fig. 109.
- Tap lightly on preselector «B» (fig. 110) with a mallet and take it out from the inside of cover «F» (fig. 109).
- Remove bushing «C».
- Remove preselector spring «A» (fig. 110).
- Remove layshaft seal «D» (fig. 109) with a suitable punch.
- Remove the swinging arm spindle bearings from the casing by the aid of puller 19 92 76 00 (26 in fig. 105).
- Undo neutral indicator switch «B» shown at «B» in fig. 105 and at «C» in fig. 109.

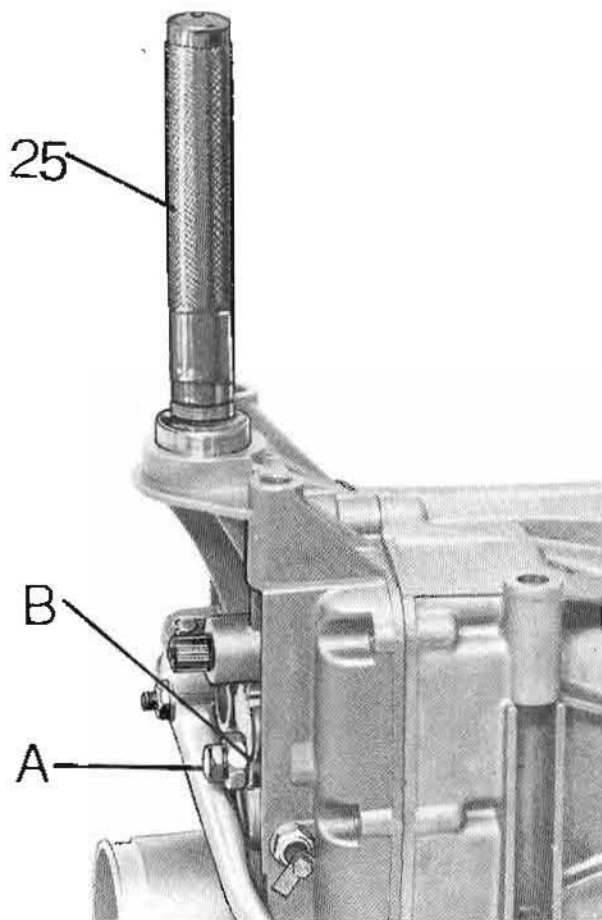
#### b Inspection

- Ensure adjusting screw «A» (fig. 109) is not damaged or stripped. If so, replace it.
- Ensure seals «D» and «E» in fig. 109 have not become hard or crumpled.
- Ensure preselector spring «A» (fig. 110) is not deformed or has lost its elasticity. If so, replace it.
- Check condition of bearing «C» (fig. 109). If worn out or too slack in its housing, replace it.

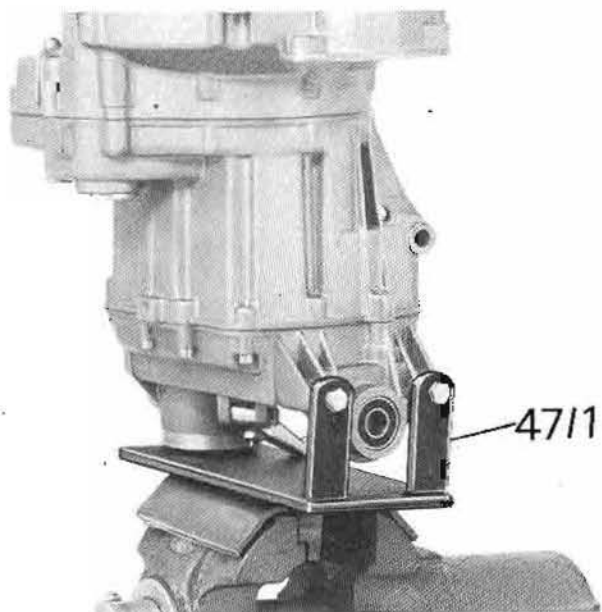




106



107



108

- Ensure cover joining face «F» (fig. 109) is not scored or nicked. If only lightly scored, smooth it out with fine emery paper.
- Ensure neutral indicator switch «B» (fig. 105) and «G» (fig. 109) is still efficient. If not, replace it.

### c Re-assembly

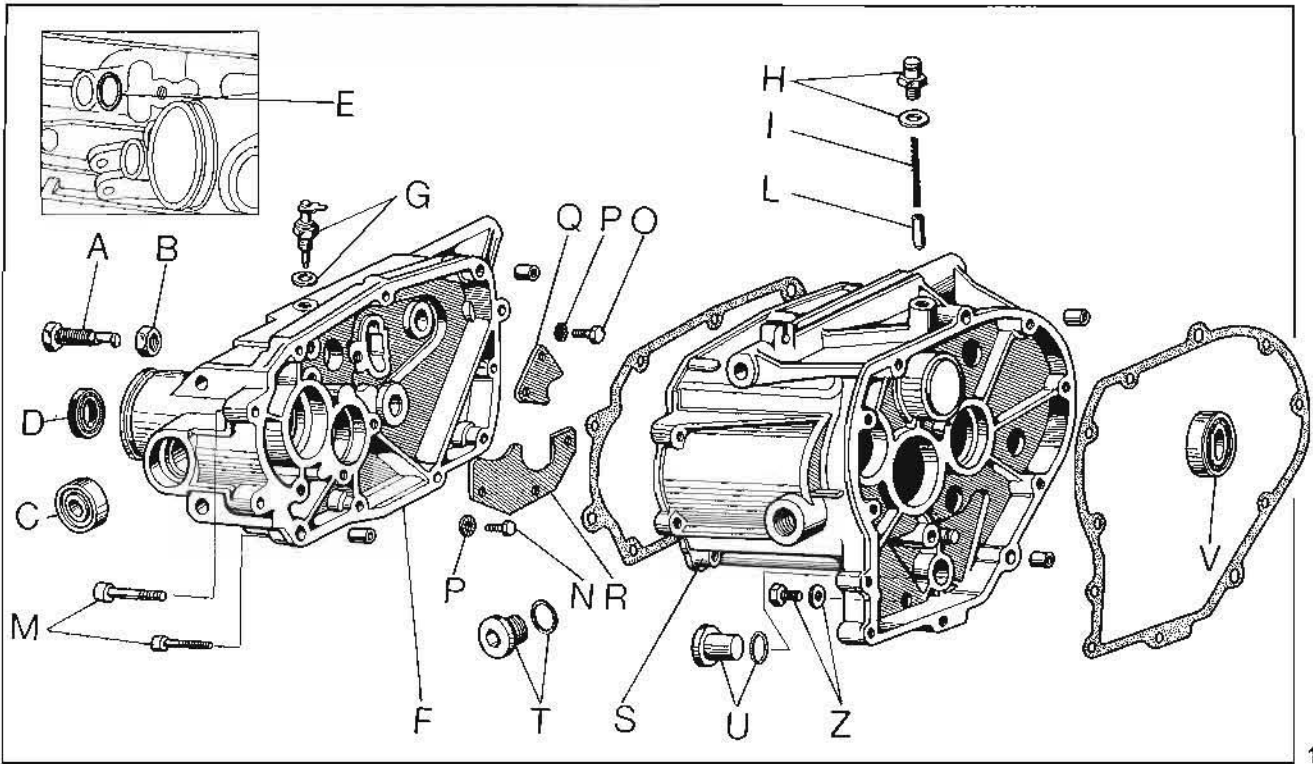
- Re-fit layshaft seal by the aid of punch 19 92 72 00 (11 in fig. 106), bushing 19 92 73 00 (1 in fig. 106, and spacer part N. 19 92 72 02 (14 in fig. 28). See also «D» in fig. 109.
- Assemble the preselector shaft seal in the cover.
- Assemble eccentric screw «A» and nut «B» on the cover (See fig. 107 and 109).
- Re-fit swinging arm bearings «C» (fig. 109) in the cover. Use tool 19 92 66 00 (25 in fig. 117) and bush «C» in fig. 110.
- Refit spring «A» (fig. 110) on the preselector shaft.
- Assemble preselector «B» (fig. 110) complete with springs in the cover, inserting the two spring ends on the eccentric screw (observe the correct positioning of this spring on removal) and the preselector spindle in its casing housing after fitting grommet «E» (fig. 109).
- Re-fit lever «G» (fig. 114) on preselector spindle «B» (fig. 110) tightening it with screw «E» with washer «I» (fig. 114).

## 9.6 GEAR-SHAFTS ASSEMBLY (See fig. 111)

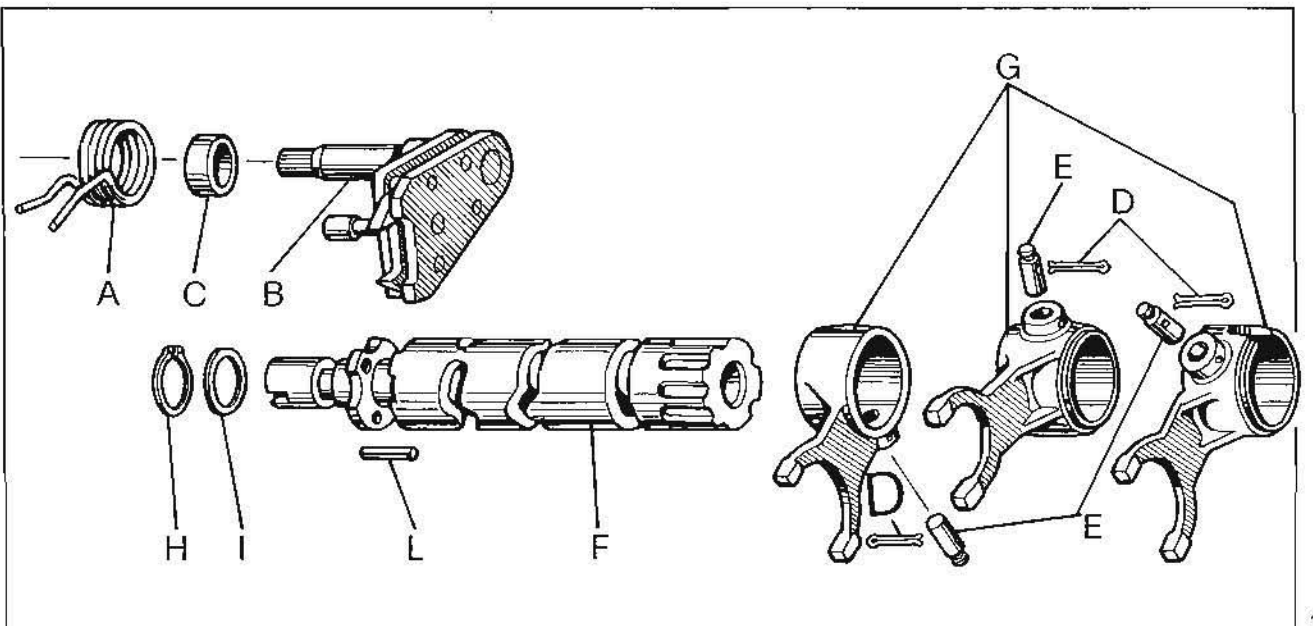
### a Dismantling

- Remove split pin «D» and withdraw the pins from fork «E» (fig. 110).
- Withdraw the desmodromic shaft (F), remove selector forks «G» and the pins (L) contacting pre-selector «B» lugs (fig. 110).
- From the main shaft (U) in fig. 112, in addition to the previously dismantled parts i.e. nuts «A», washers «B», bush «C», and gear «D» remove:

- bearing «E»;
- nut «F» with washer «G»;
- bearing «H»;
- «O» ring «I»;
- 2nd gear «J»;
- «O» ring «M»;
- 3rd gear «N»;
- tab washer «O»;
- circlip «P»;
- 4th gear «Q» (sliding);
- circlip «R»;
- tab washer «S»;
- high gear «T».



109

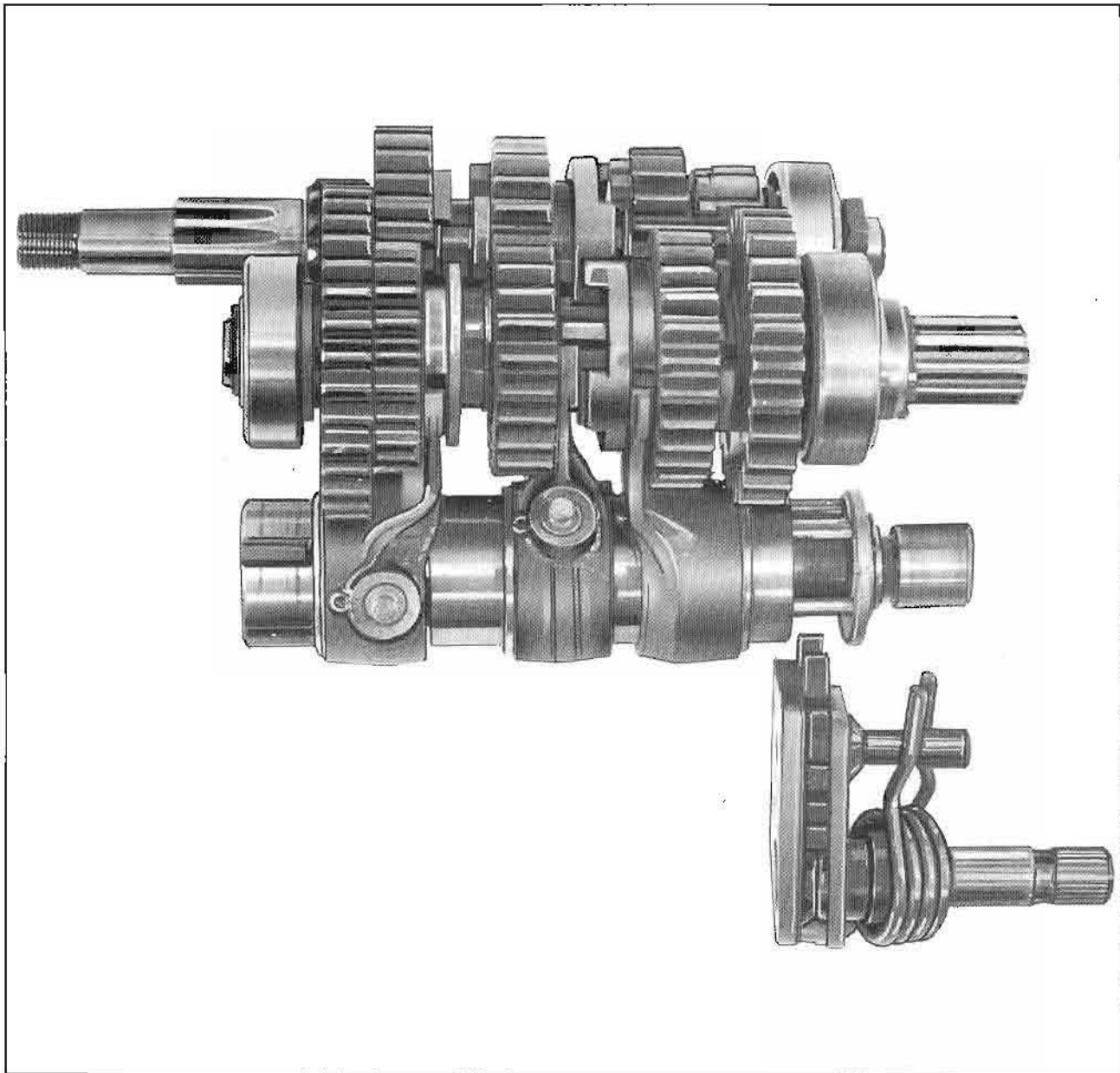


110

■ From layshaft «Z» (fig. 113) remove:

- circlip «A»;
- shim washer «B»;
- bearing «C»;
- shim washer «D»;
- low gear «E»;
- high gear «F»;
- circlip «G»;
- tab washer «H»;
- 4th gear «I»;
- circlip «L»;

- tab washer «M»;
- 3rd gear «N» (sliding);
- circlip «O»;
- tab washer «P»;
- 2nd gear «Q»;
- circlip «R»;
- shim «S»;
- spacer «T»;
- «O» ring «W»;
- bearing «U»;
- shim «V».



111

## b Inspection

- Check wear of teeth and grooves on the shaft mounted gears. If worn or nicked, replace the damaged part or parts.
- Ensure the splines and the teeth of the gear machined on main shaft «U» are in good state. If worn out or damaged, replace the main shaft (fig. 112).
- Check splines on the layshaft. If scored or damaged, replace the shaft.
- Make sure the circlips have not lost their elasticity otherwise replace them.
- Check the tab washers are still in good state or else replace them.
- Check condition of the low gear bush on layshaft. If excessively worn replace it, bearing in mind these data:

— I/D of the bush pressed into the gear:  $18.016 \div 18.034$  mm (.7092  $\div$  .7099");

— Diameter of shaft where the low speed gear operates:  $17.991 \div 18.000$  mm (.708  $\div$  .7086");

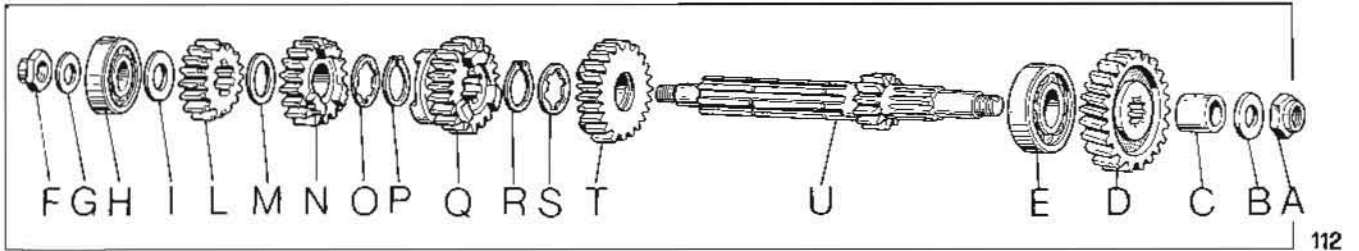
— Assembly play of layshaft-1st gear bush:  $0.016 \div .043$  mm (.00062  $\div$  .0017").

- Check wear of the desmodromic shaft splines contacting the pawl and the selector fork pins. If wear is excessive, change the shaft. Check also wear where the selector stop pawl operates. If excessively worn, replace the drum.

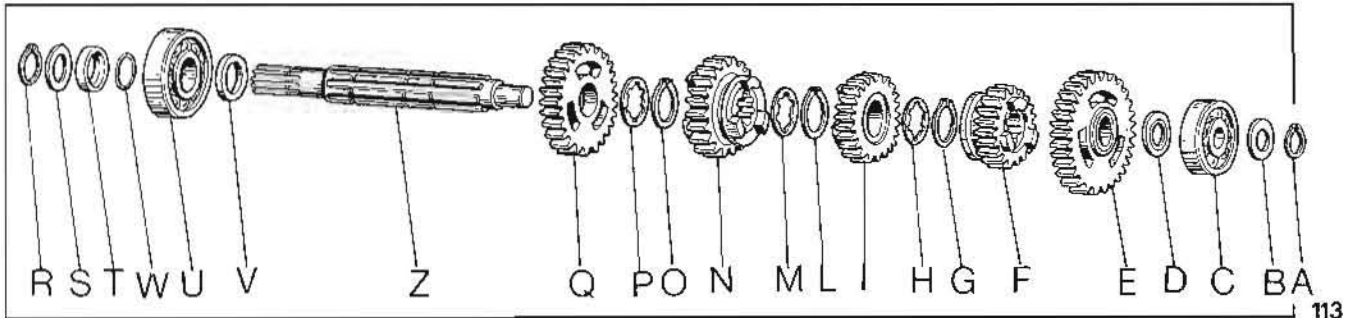
## c Re-assembly

Reverse the dismantling sequence and see figg. 110-111-112-113.





112



113

## 9.7 GEAR SELECTOR

### a Dismantling (See fig. 114)

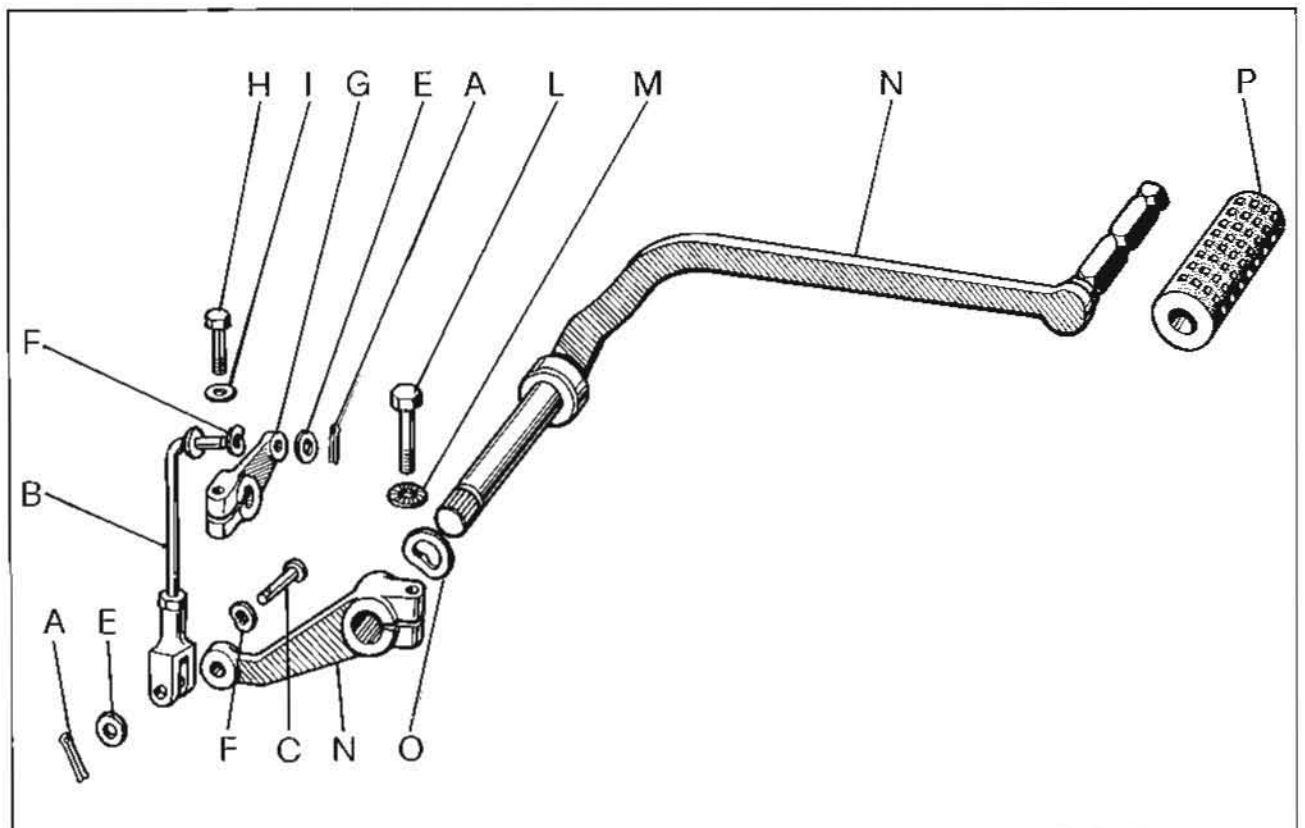
- Remove split pins «A» from spindle «C» and from the rod complete with selector fork «B».
- Take out pin «C» from spindle «B» and lever «N». Then washers «E» and «F». Undo gear lever securing bolt «H» with washer «I» and remove gear operating lever «G». Undo bolt «L» with washer «M» and remove lever «N» with washer «O» from lever «N» and from the lever take out rubber pedal «P».

### b Inspection

- Ensure the grooves and threaded portions of the levers and spindles are not stripped or damaged. If so, replace the levers.
- Check thread of all lever securing bolts, and replace them if stripped or damaged.
- Check elasticity of both shakeproof and crinkled washers and replace if necessary.

### c Re-assembly

Reverse the dismantling operations but replace the split pins.



114

## 10 KICKSTARTER OPERATED MODEL (optional)

### a Dismantling (See fig. 115)

- Undo retaining bolt «B» from quadrant «C» and remove kickstarter lever «A».
- Remove the clutch housing from the gearbox, the quadrant stop assembly consisting of: Screws «D», plate «E», rubberised plate «F».
- Using a mallet, tap on quadrant spindle «C», unhook spring «L» from the lug on the gearbox, and withdraw the quadrant.
- From the quadrant shank take off:
  - «O» ring «G»;
  - circlip «H» using a suitable pair of pincers;
  - washer «I»;
  - return spring «L».
- Undo nut «M» with washer «N» using holdfast tool part N. 19 90 54 00 (17 in fig. 102).  
From the main shaft remove:
  - spring «O»;
  - gear «P»;
  - bush «Q»;
  - gear «R».

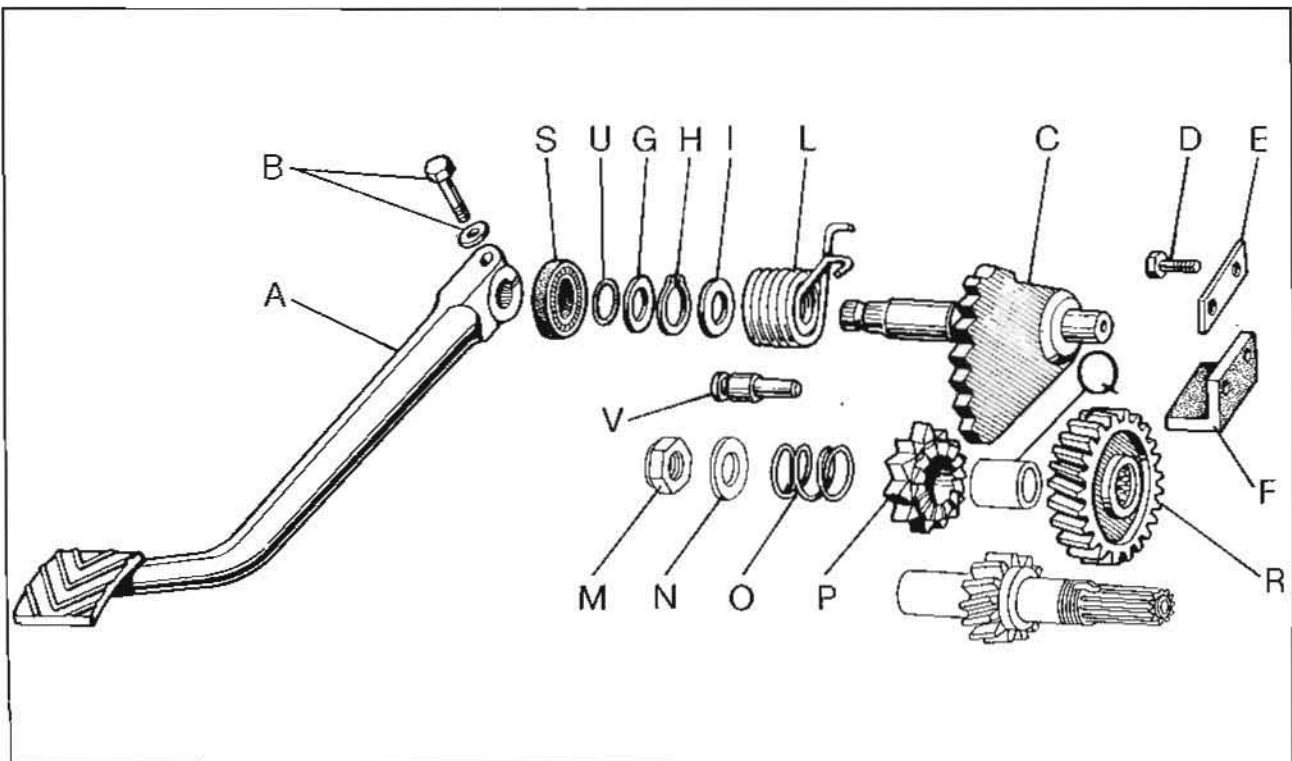
### b Inspection (fig. 115)

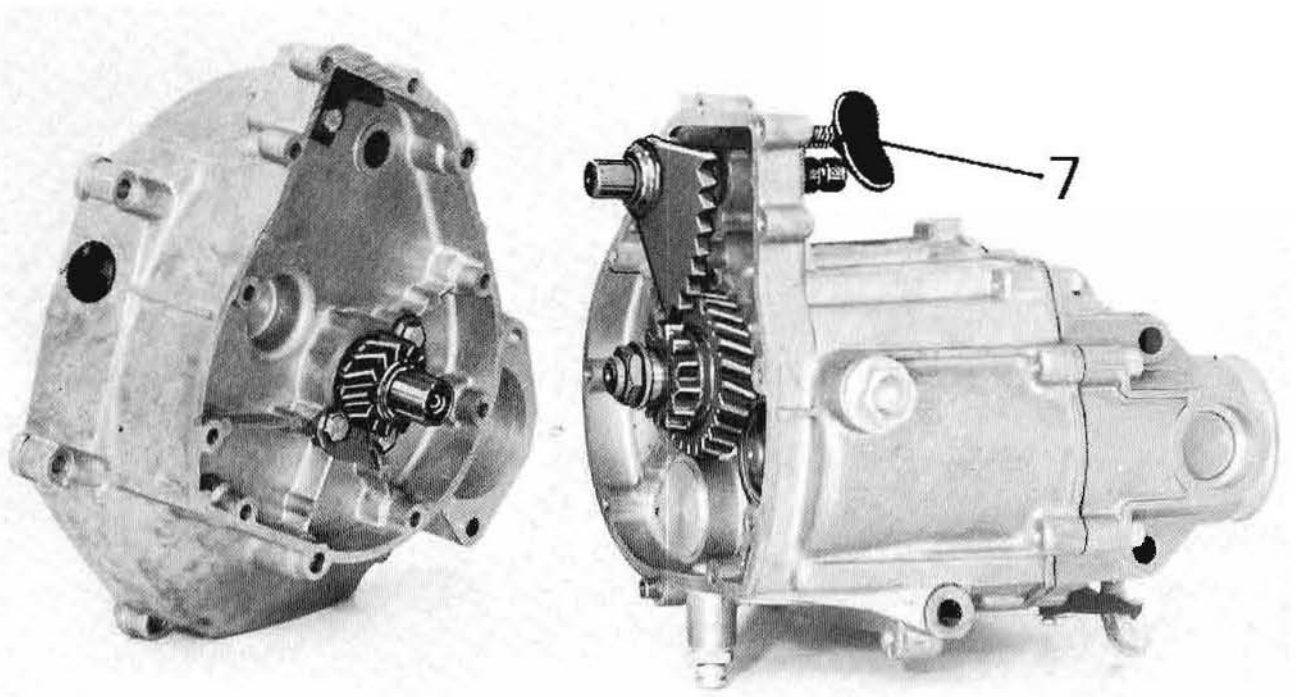
- Ensure seal «S» is not crumbled or damaged or deformed. If so, replace it.
- Ensure circlip «H» is still in good state or else replace it.

- Ensure spring «L» is not deformed or damaged. Replace it in such an event.
- Ensure the splines on the shaft and quadrant gear are undamaged or excessively worn. If so, replace the quadrant complete with spindle.
- Ensure the rubberised plate «F» on the clutch housing is not damaged or worn. If so, replace it.
- Ensure gears «P» and «R» retaining spring «O» is still efficient. If deformed or has lost its elasticity, replace it.  
However, before doing so check its load: when compressed to 9.5 mm (.369") the load should be 0.95 kg (abt 2 lbs.).
- Ensure the outer tothing and front dogs of gears «P» and «R» are not damaged, chipped or scored. If so replace the damaged gear or gears.

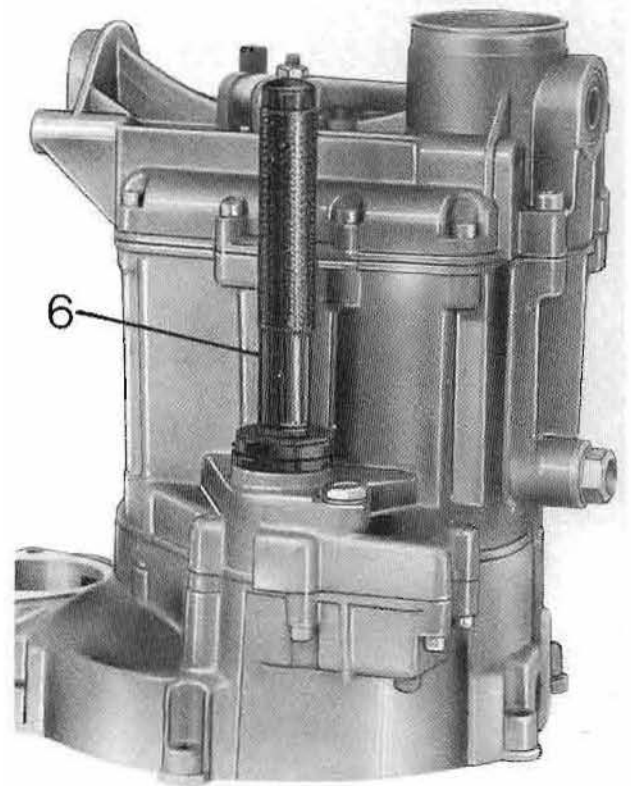
### c Re-assembly

Reverse the dismantling operations but remember that in fitting the clutch housing on the gearbox casing it is necessary to introduce spring tensioning tool N. 19 90 28 00 (7 in fig. 116) in the oil drain hole. When the complete gearbox is assembled on the clutch housing, remove the above tool and re-fit the oil drain plug with its gasket.  
Now assemble the seal by the aid of tool 19 92 87 00 (6 in fig. 117).





116



117

## 11 SWINGING ARM COMPLETE WITH REAR DRIVE BOX

### a Removal (See fig. 118)

- Take out the cardan joint (C) from swinging arm «D».
- Undo clip retaining screw «F» and remove gaiter «G».
- Undo nuts A and threaded pins «B».
- Remove shim «S» from the R/H side.
- Undo the 4 nuts and washers «I» and lift out the complete rear drive box «E» from the swinging arm.
- Withdraw sleeve «L», spring «M», circlip «N», metal retainer «O», and gear «P».

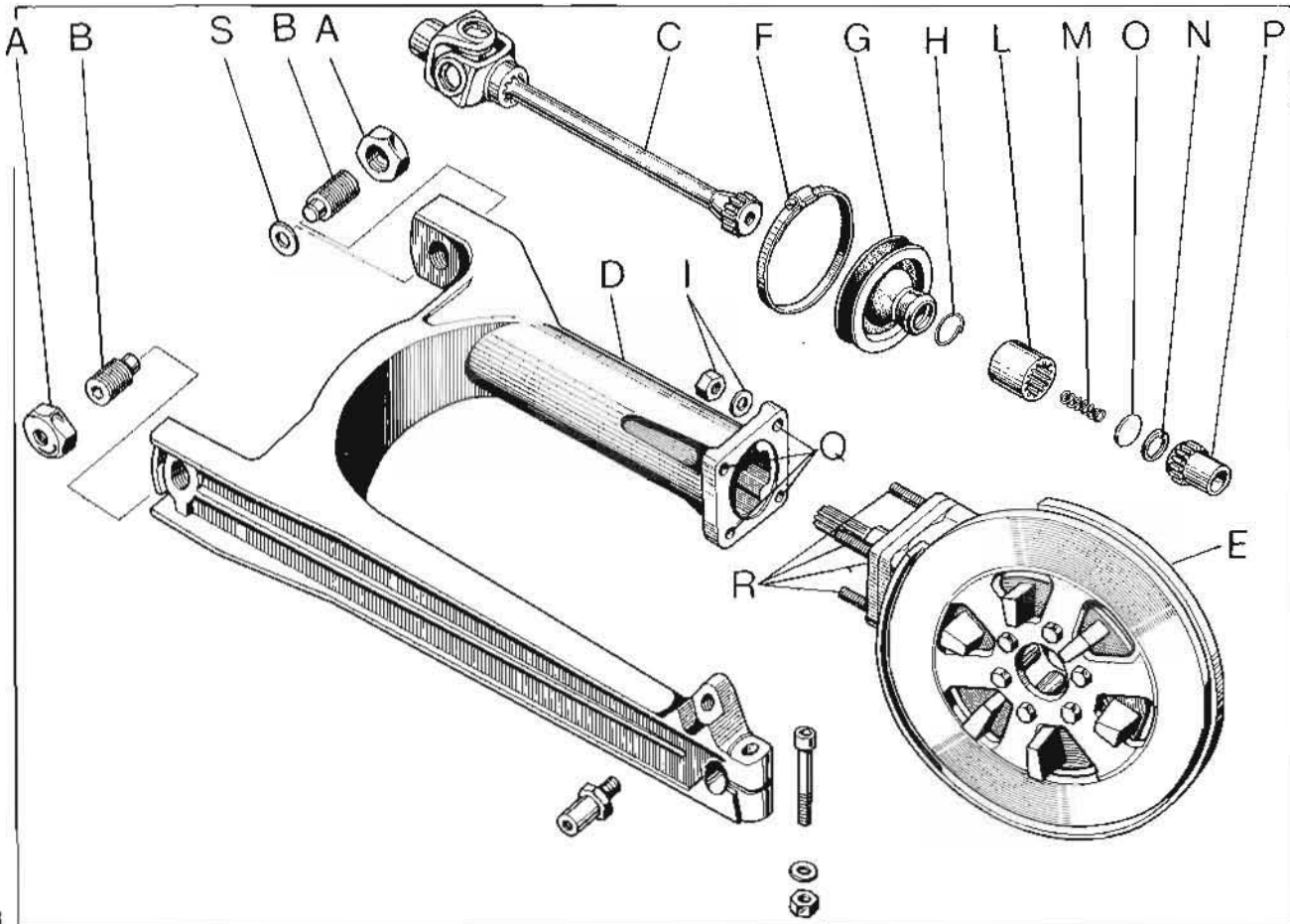
### b Inspection

- Ensure the cardan shaft is in good condition, check wear of the gear operating in sleeve «L» splines and the cardan joint splines are not damaged. If so, replace the cardan joint.
- Ensure the rubber gaiter is not cracked or broken. If so, replace it.
- Ensure the threaded portion of the securing spindles and nuts are not damaged or stripped. Replace, as necessary.
- Check condition of the sleeve splines. If chipped or damaged, replace the sleeve.

- Check efficiency of the spring. If deformed or flat, change it. When compressed to 9 mm (.35") the spring (M) load should be  $3.8 \div 4$  kg (8.36  $\div$  9.6 lbs).
- Check elasticity of the circlip and replace it, if necessary.
- Ensure the toothed section and the splines of pinion «P» are in good state. If excessively worn or damaged, change the pinion.

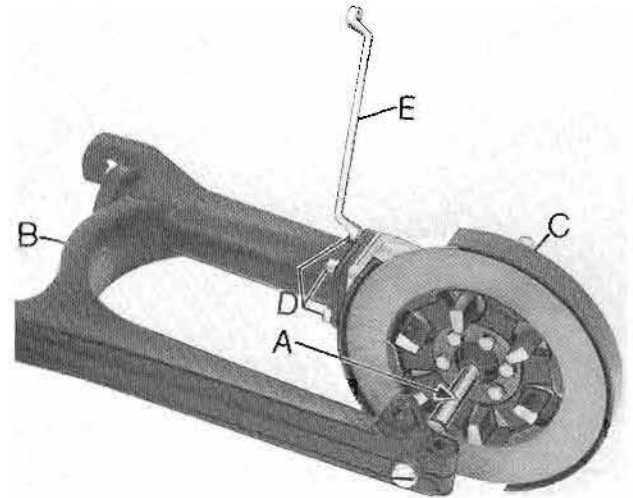
### c Re-assembly

- Re-fit gear «P» on the bevel pinion shank, spring retainer «O», spring «M», and sleeve «L». In the swinging arm flange holes «Q» insert the studs «R» located on box «E» (See fig. 118). Screw in nuts «I» but do not tighten fully, insert the shank of cardan joint «C» in sleeve «L» making sure that spring «M» enters in the shaft housing (See fig. 118). Insert spindle «A» through the right arm of the fork «B» (fig. 119) and box «C» and then turn box «C» until spindle «A» can be easily removed. At this stage tighten nuts «D» with socket wrench «E». At the end of this operation ensure that spindle «A» can be effortlessly withdrawn, otherwise repeat the operation (See fig. 119).
- When re-fitting the cardan joint on the layshaft it is necessary to ensure that spring «M» (fig. 118) does not come out of its housing by keeping the spring assembly pressed in with a screwdriver.



If the job is done properly, there should be a little dampening on the cardan joint on the drive box.  
When fitting spring «M» (fig. 118) dont forget to smear it with Agip F. 1 Grease 30 to make its fitting easier.

- Tighten the gaiter clip securing screw on the cardan joint.
- Re-fit the swinging arm in the gearbox by means of pins «B» (fig. 118) and adjust the pins so that the arm can oscillate freely without any play. Finally tighten nuts «A» in fig. 118.  
If the swinging arm has to be adjusted when fitted on the machine proceed as follows: using wrench «B» remove nut «A» and screw in or out pins «C» by the same amount.



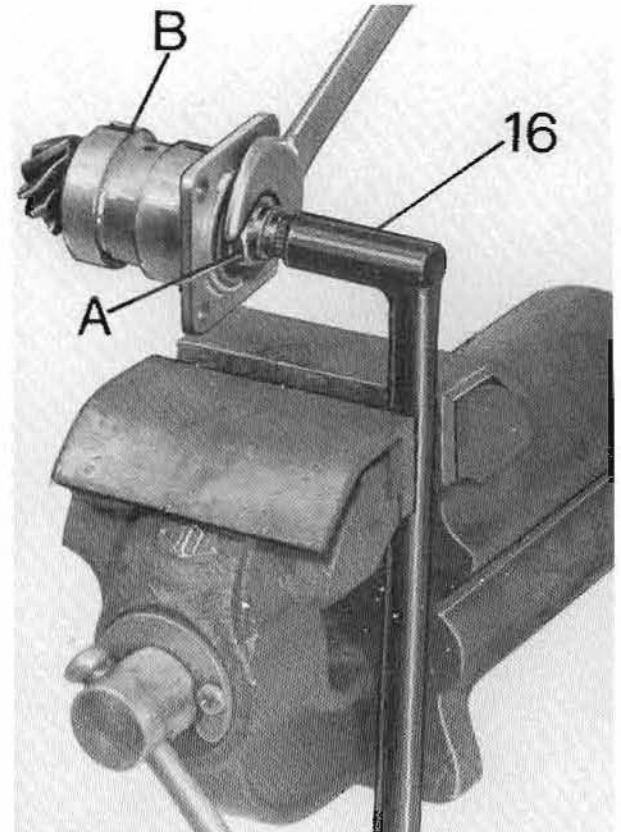
119

## 11.1 DRIVE BOX

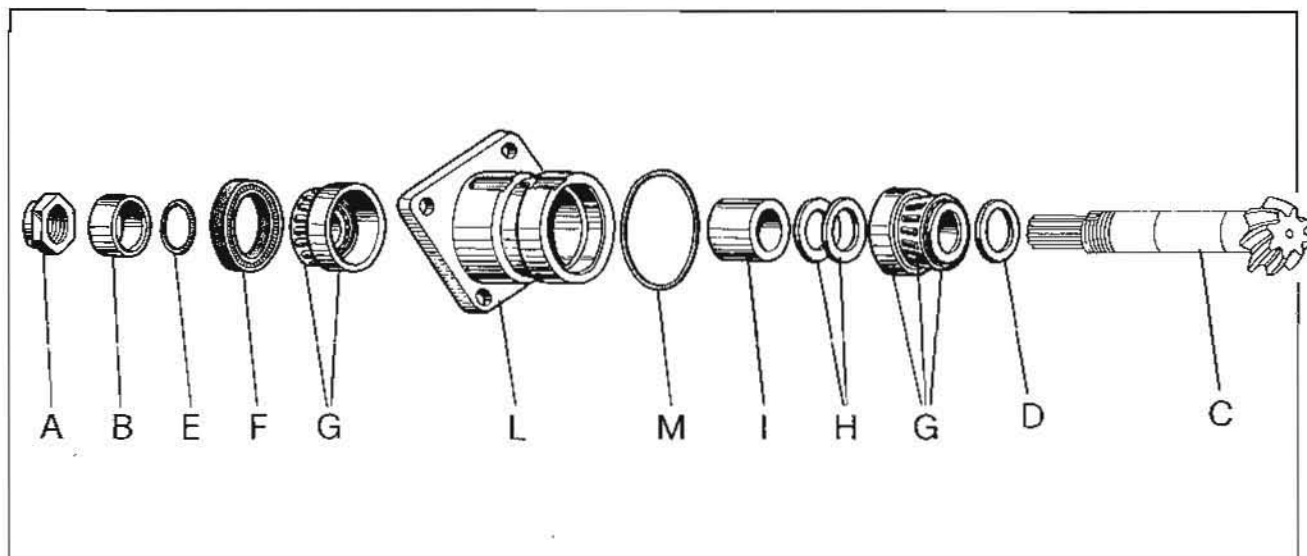
### a Removing the bevel pinion housing

After removing the complete drive box from the right arm of the rear fork («D» in fig. 118), proceed as follows:

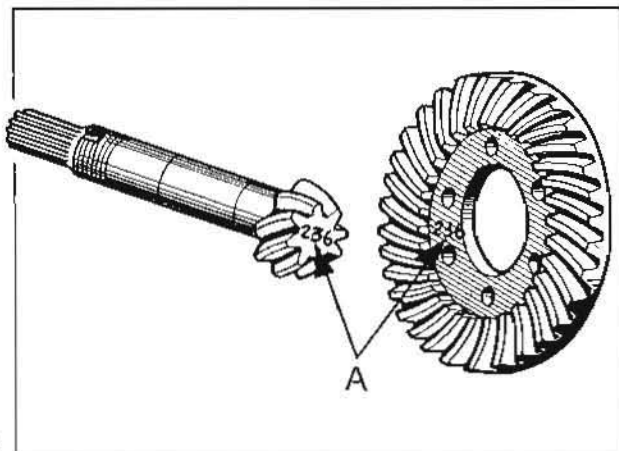
- Withdraw complete housing «B» (fig. 120) from the drive box.
- Grip holdfast tool part N. 19 90 71 00 (16 in fig. 120) in a vice.
- Insert the splined end of the pinion in the tool and by the aid of a suitable flat spanner undo nut «A» and remove (See fig. 121):
  - Bush «B»;
  - Pinion «C»;
  - Shim «D»;
  - Seal «F»;
  - Taper roller «G»;
  - Shim «H»;
  - Spacer «I»;
  - Gasket «M» from the bare housing.



120



121



### b Inspection

- Check pinion teeth wear. If excessively worn or chipped, change the bevel gear set.
- Ensure both taper roller bearings are in good condition and the rollers not worn. If so, replace the bearing.
- Ensure the shims are not deformed. Replace them if bent.
- Check efficiency of the seals. If damaged or crumbled, replace.
- Check thread of the pinion retaining nut. Replace if damaged or stripped.

### c Re-assembly

If the bevel pinion is changed, it is necessary to change the crown wheel as well. Be sure in such case that both gears bear the same number (See «A» in fig. 112).

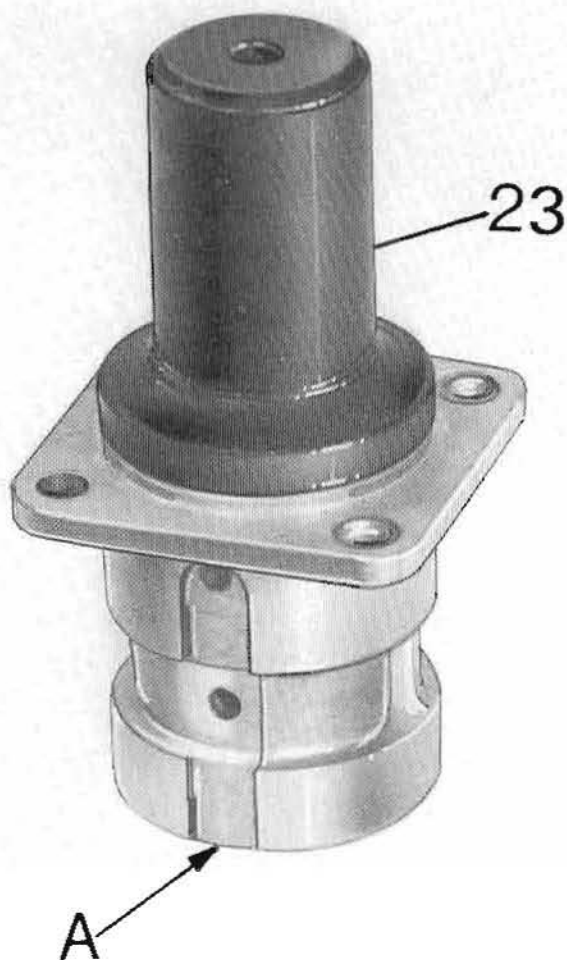
To re-assemble the other components, reverse the dismantling sequence bearing in mind that:

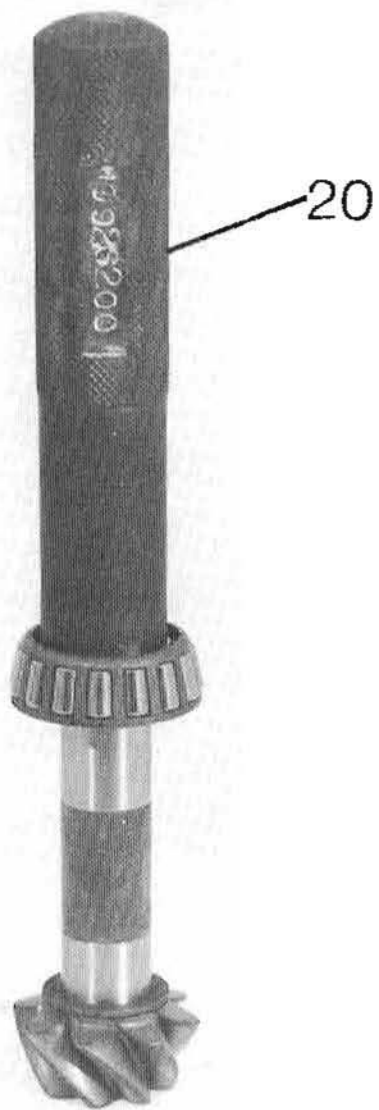
- the outer race of the taper bearings in the pinion housing are fitted using punch 19 92 64 00 (23 in fig. 123);
- the bearing on the bevel pinion is fitted with punch N. 19 92 61 00 (4 in fig. 125).

### d Removing the brake disc, casing cover, hollow spindle, crown wheel, bearings and seals.

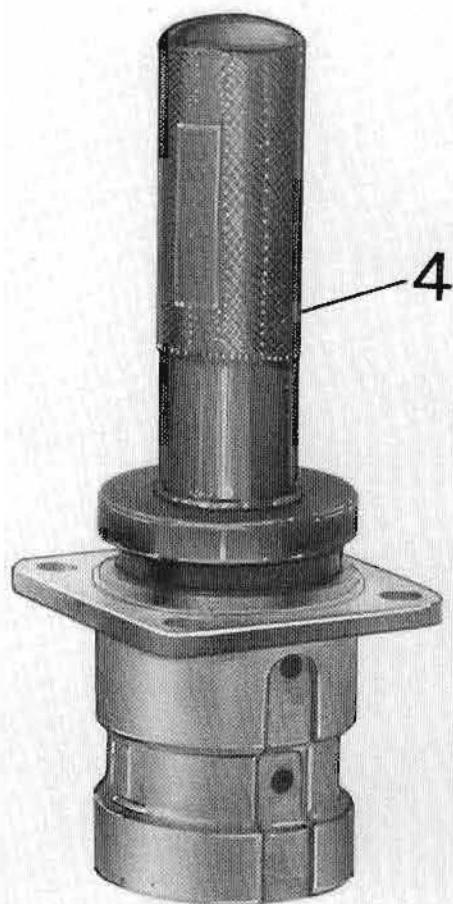
(See fig. 126)

- Undo screws «A» and remove brake disc «C» from the hollow shaft.
- Undo screws «E» with crinkled washers «F» and take off the complete casing cover (G), gasket «H», and shim «I».
- From cover «G» take off circlip «L» from its housing on hollow shaft «D» and remove:
  - roller bearing «M»;
  - bearing inner race «N» using puller 19 90 70 00 (15 in fig. 127);
  - shim «O»;
  - O-ring «P»;
- 4 screws «R» after flattening flaps «X» and removing nuts «T»;
- crown wheel «Q»;
- hollow shaft «D» from bearing on cover «G». Tap this out lightly with a plastic mallet. Seal ring «S»;
- Take out bearing «U» from cover «G» using a suitable punch.
- Remove outer race from roller bearing «V» from housing «AA» (fig. 126) using special puller 19927500 (18 in fig. 128):
  - O-ring «AB».
  - Seal «AC».
  - Seal «AD».

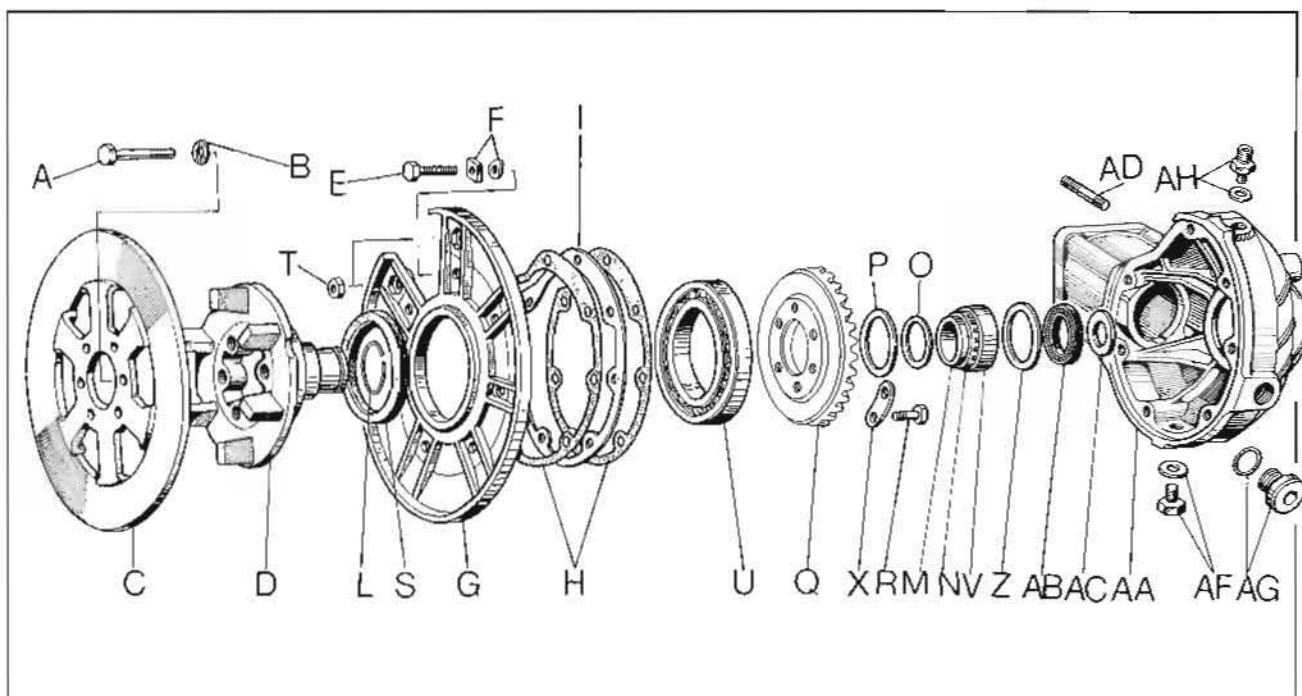




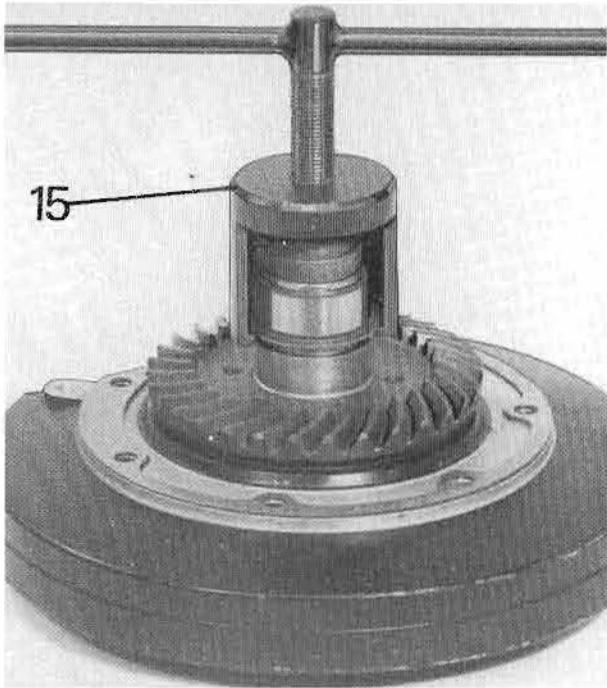
124



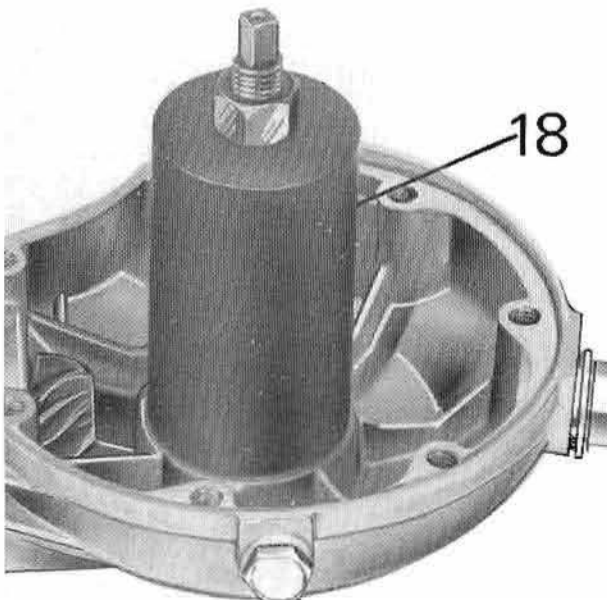
125



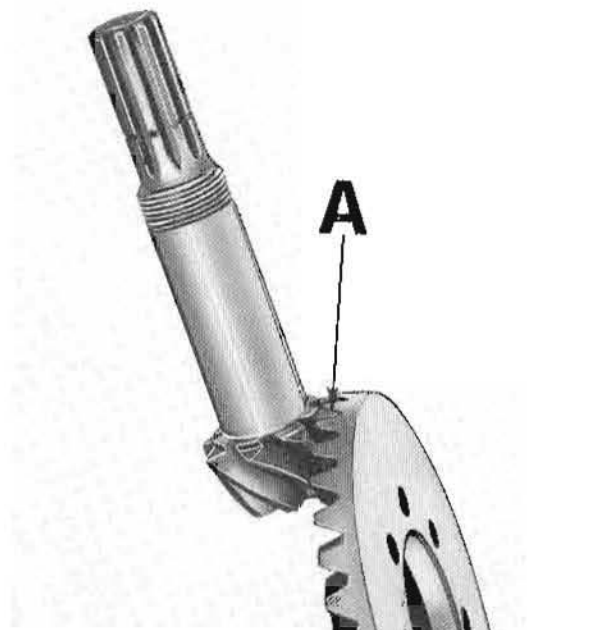
126



127



128



129

If necessary remove:

- casing studs «AD»;
- oil drain plug and washer «AF»;
- oil filler and level cap with washer «AG»;
- oil vent plug with washer «AH».

#### e Inspection

- Ensure the braking disc is free from scorings and is not excessively worn. If the scoring is deep, replace the disc. See section «brake disc», para 16.9.
- Ensure the hollow shaft juts on which the cush drive works is not excessively worn, also that the surfaces contacted by the seal ring (S), bearing in cover «G», inner race of bearing on housing «AA» and the circlip groove on the hollow shaft «L», are in good state. Replace as necessary.
- Ensure rubber seal «AB» has not lost its elasticity. If crumbled replace.
- Check for wear or chippings of the crown wheel teeth «Q» and if necessary replace the complete bevel set.
- Ensure the union faces are dead smooth and not heavily scored or nicked. If only lightly scored smooth out the surface using very fine emery paper.

#### f Pinion-wheel coupling clearance (bevel set)

Pinion-crown wheel clearance is adjusted as follows:

- Using 2 nuts «A» and washers, provisionally fit up the complete pinion housing on the casing (fig. 131).
- Set up tool 19 92 88 00 on the crown wheel (5 in fig. 130).
- Insert the tool into the cage of the bearing in the casing.
- Check pinion-crown alignment («A» in fig. 129 and arrow «D» in fig. 131).
- If offset, place suitable shims between pinion and taper bearing. It is also necessary to check the contact area of the pinion-crown wheel teeth proceeding as follows:
  - 1 Smear the pinion teeth with a suitable coloured compound such as engineer blue;
  - 2 provisionally fit up the crown wheel-hollow shaft assembly and the cover on the casing;
  - 3 Set up a universal type puller on the hollow shaft to keep the crown wheel lightly pressed at the brake disc side using suitable centre spacers;
  - 4 Rotate pinion «B» in its normal running direction keeping a fast hold on crown wheel «C» so that rotation occurs under a certain load, thus leaving a distinct contact mark on the pinion teeth:



— if the contact is correct, the pinion teeth mark will appear as shown at «1» (fig. 132) (pinion seen from the driving shaft side);

— if the contact mark is as shown at «2» (fig. 132), the crown wheel is too near the rotational axis of the pinion. Move the crown wheel away reducing the pressure on spacer «1» (fig. 126);

— if the contact is as shown at «3» (fig. 132) the pinion is too near the rotational axis of the crown wheel. Move away the pinion reducing thickness of shims «D» in fig. 121;

— if the contact is as shown at «4» (fig. 132), the pinion is too far from the crown wheel rotational axis. Move the pinion nearer increasing the thickness of shim «D» in fig. 121;

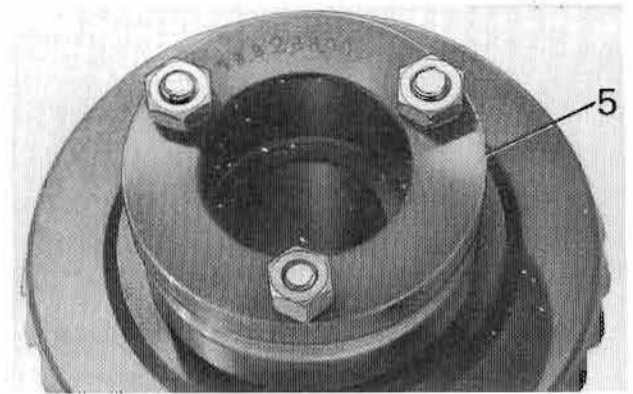
— if the contact is as shown at «5» (fig. 132) the crown wheel is too far away from the rotational axis of the pinion. Move the crown wheel nearer by reducing the size of shim «I» (fig. 126).

A properly assembled bevel set should have a teeth clearance of  $0.10 \div 0.15 \text{ mm}$  (.0039 ÷ .0059").

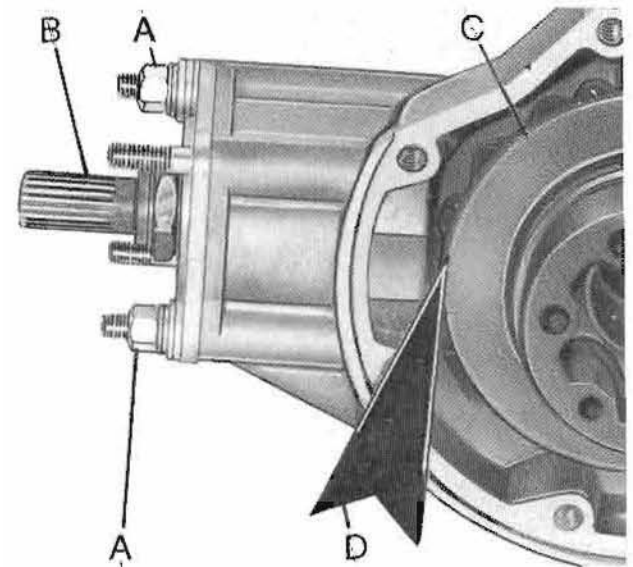
### c Re-assembly

Reverse the dismantling operations but keep in mind that:

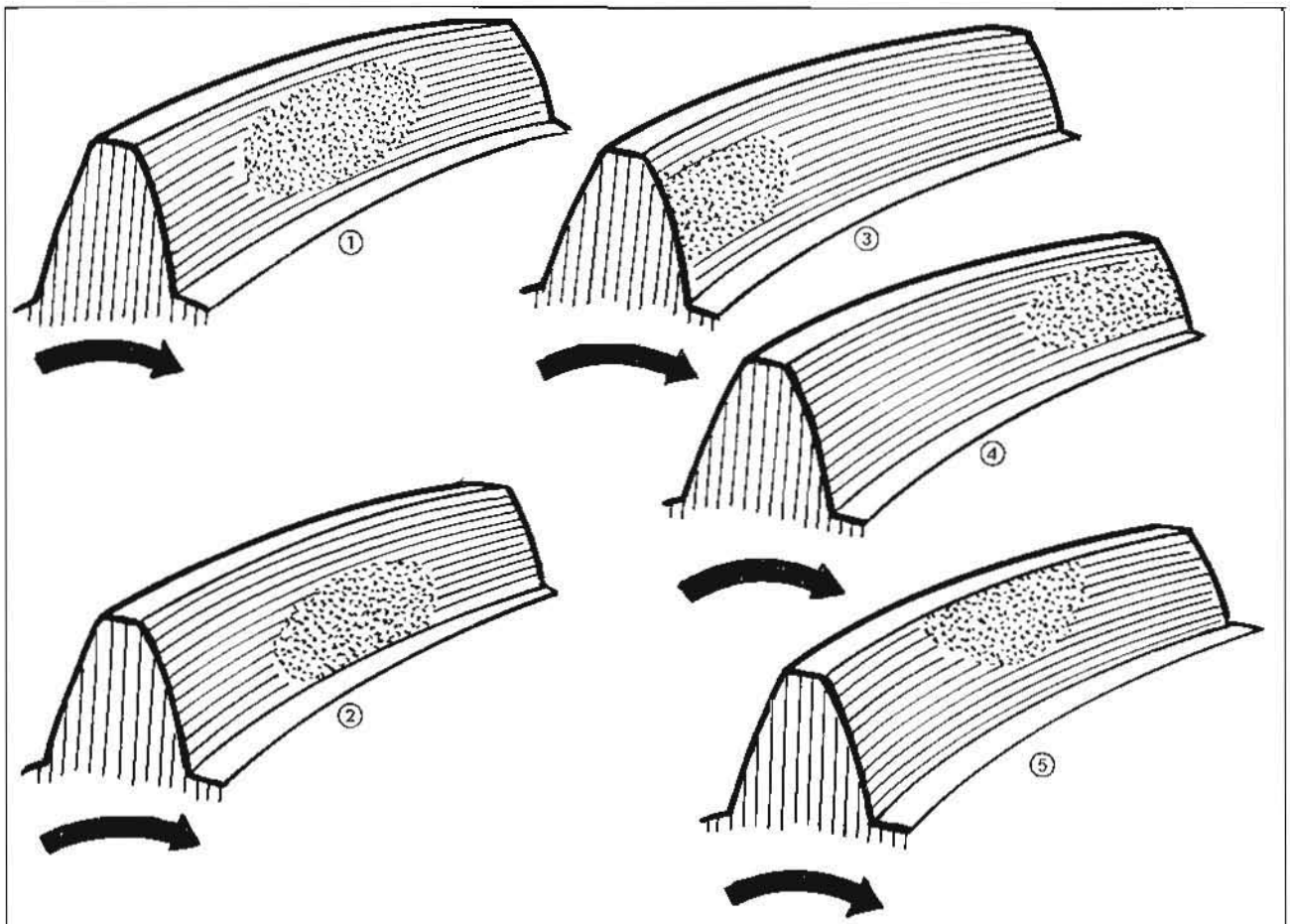
- The seal on casing is fitted by the aid of punch 19 92 60 00 (9 in fig. 133).
- The inner race of the roller bearing in the casing is fitted by the aid of punch 19 92 65 00 (24 in fig. 134).



130

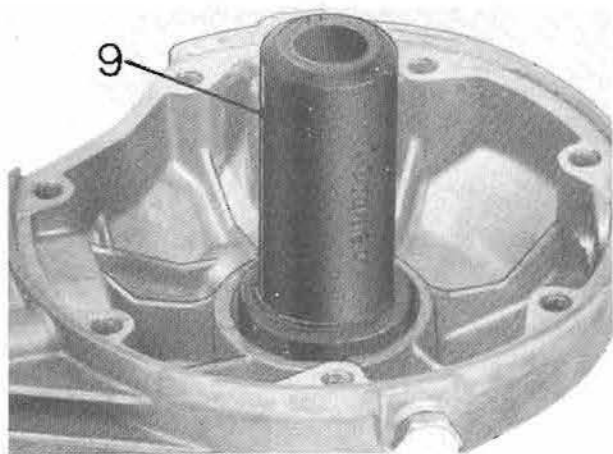


131

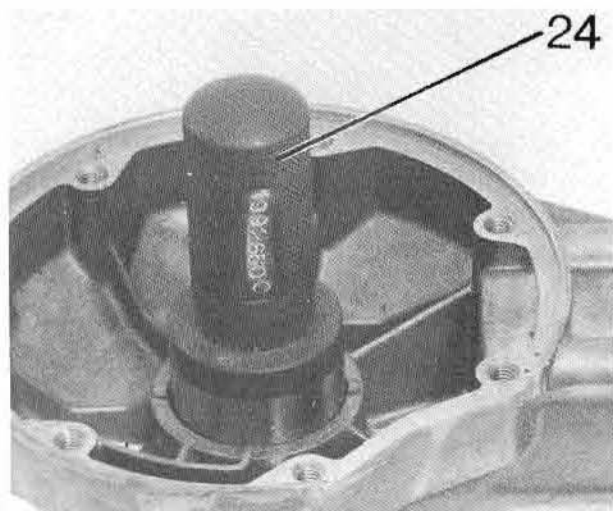


132

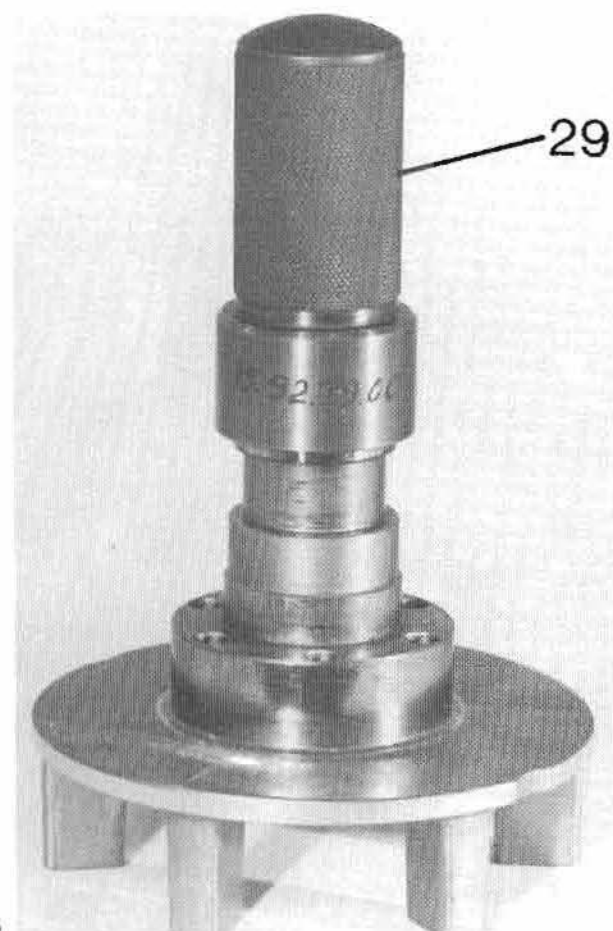
133



134



135



■ The inner race of the roller bearing on the hollow shaft is fitted with punch 19 92 79 00 (29 in fig. 135).

■ The brake disc is assembled on the hollow shaft as follows:

— tighten the disc securing screws with a torque wrench set at  $2.2 \div 2.4$  kg (16-18 lbs/ft);

— check side play of disc which should not exceed 0.2 mm (.0078"). In re-fitting the bevel pinion housing on the drive box ensure the oilways «A» are fitted in a vertical direction (See fig. 123).

## 11.2 SWINGING ARM

### a Removal (See fig. 118)

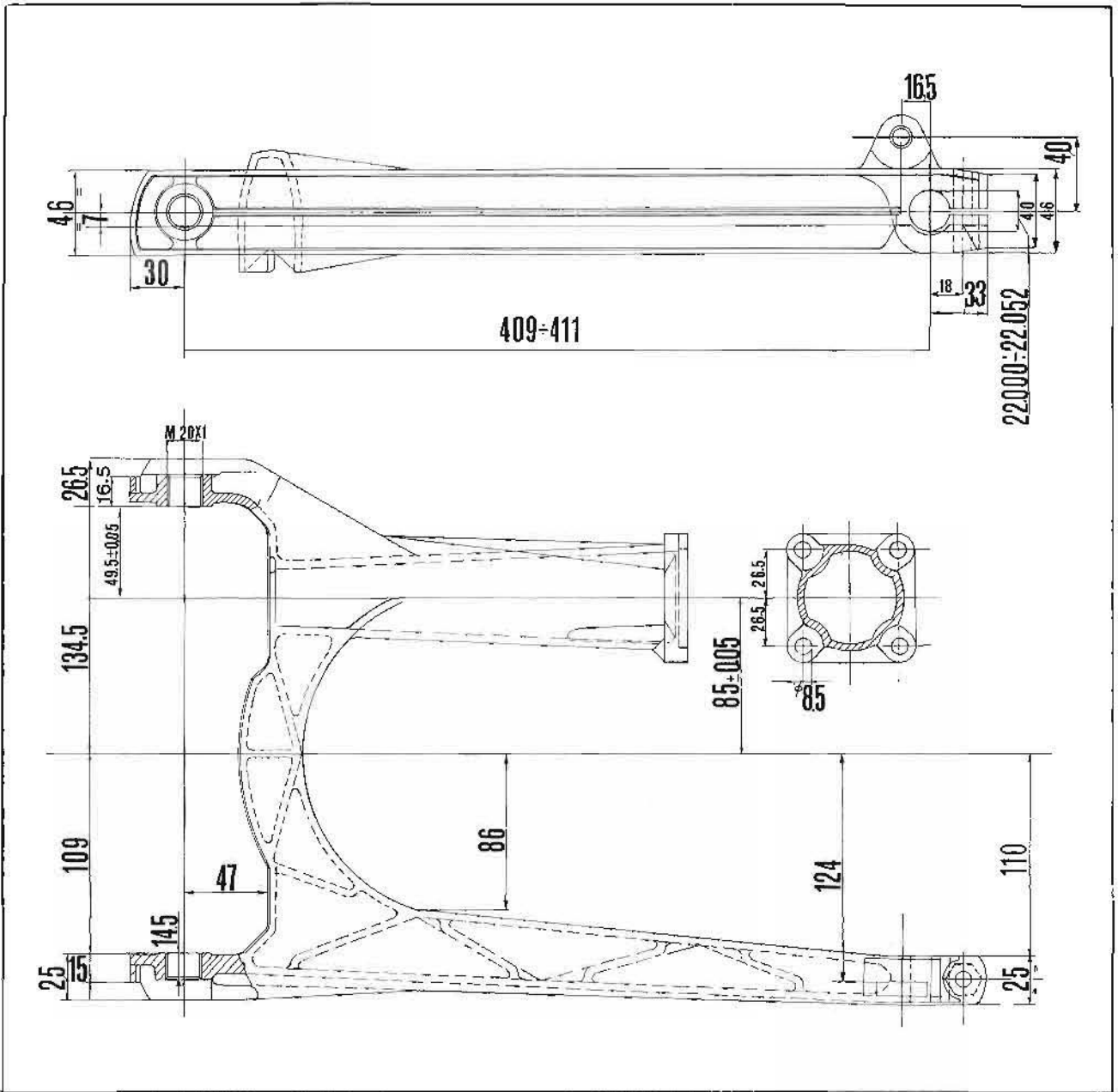
- Remove rear wheel.
- Remove the complete rear drive box «E» after undoing nuts with washers «I» and withdrawing the cardan joint from the R/H arm of the rear fork.
- Undo nuts «A» and loosen pins «B» so as to withdraw the rear fork off the gearbox.
- Remove shims «S» between R/H arm of the fork and the gearbox.

### b Inspection

Ensure the arms of the rear fork are not cracked or bent. If possible, straighten keeping to the sizes and dimensions in dwg fig. 136.

### c Re-assembly

Is a reversal of the dismantling operations. To adjust the rear fork see para 2.28.



## 12 FRAME

### a Removing the complete frame unit from the engine-gearbox-swinging arm-rear drive box assembly

Proceed as follows:

- raise the seat using special lever «A» (fig. 20);
- remove side covers, disconnect positive and ground cables, unhook retaining strap, and lift out the battery from its housing;
- undo the fuel line retaining clips and take away the pipes, unhook the rear rubber strap securing the fuel tank and remove this;
- disconnect the electric cables from the terminals on the alternator and on the pickups, after removing the generator cover and its securing screws;
- disconnect the starter motor cables from the electro-magnetic switch;
- unscrew the cable from the speedo drive;
- disconnect the oil pressure switch cable and the neutral indicator switch cable on gearbox;
- disconnect the plug leads;
- disconnect the easy starter cable from the L/H carburettor;
- undo cover screws of both carburettors and remove covers complete with throttle valves;
- disconnect the clutch cable from its operating arms on the gearbox and remove cable;
- undo the screw securing the filter box the frame;
- detach the rear brake caliper and place it in the battery housing;
- fit the engine supporting stand part N. 18 91 24 50 (32 in fig. 137) under the engine after placing a wooden cover on the open end of the stand;

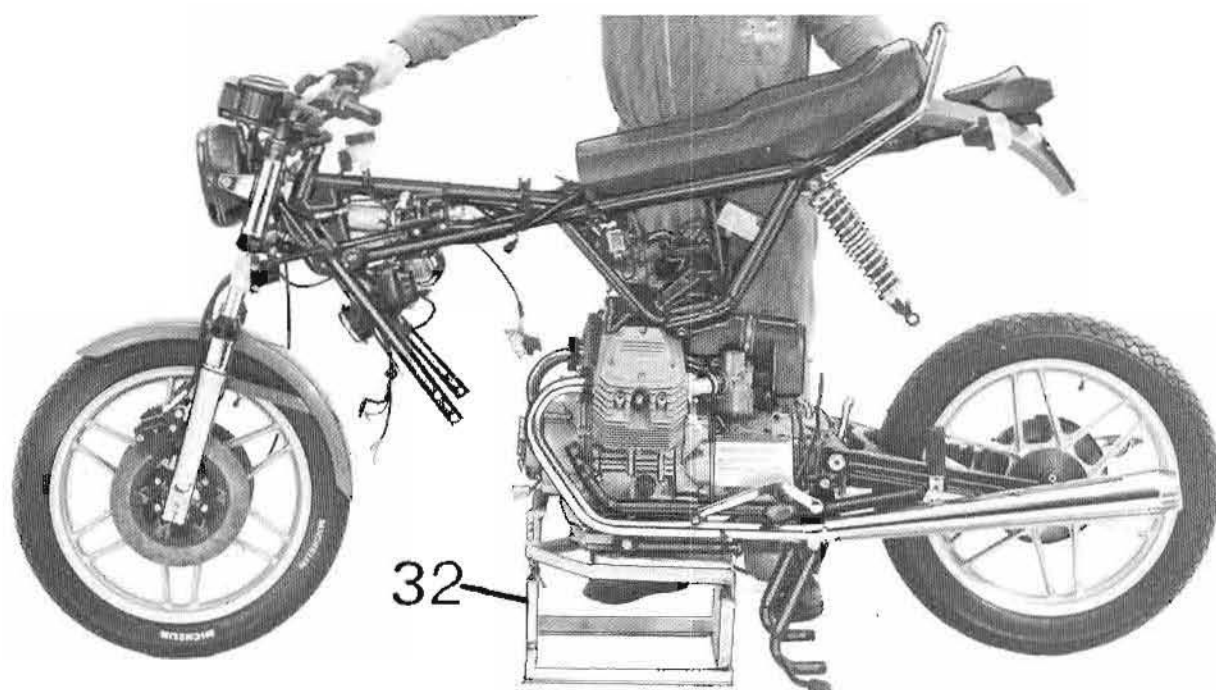
- disconnect the rear brake operating rod, taking off the split pin securing it to the operating lever on the pump;
- undo the screws on the L/H arm and on the drive box, and take out the rear dampers from bosses «D»;
- undo the 4 Allen screws «A» with nuts and washers using special wrench N. 10 90 31 00 (45 in fig. 28) These secure the stays to frame cradle;
- undo the 2 Allen screws with nuts securing the frame to the gearbox cover;
- withdraw the rod securing the gearbox to the frame;
- lift up the frame as shown in fig. 137 with a forward motion so as to prevent the air filter housing from bumping against the battery carrying plate.

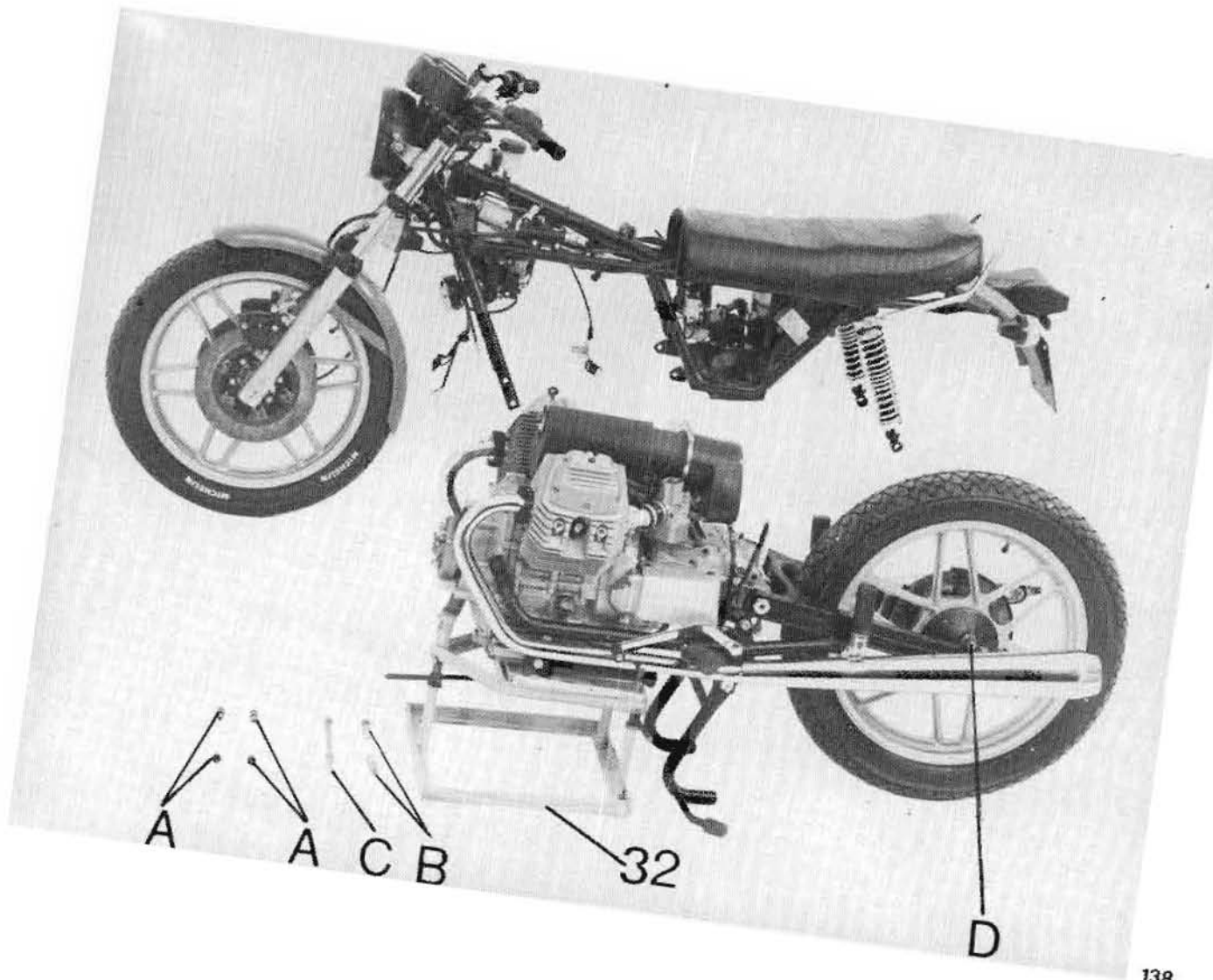
### b Inspection

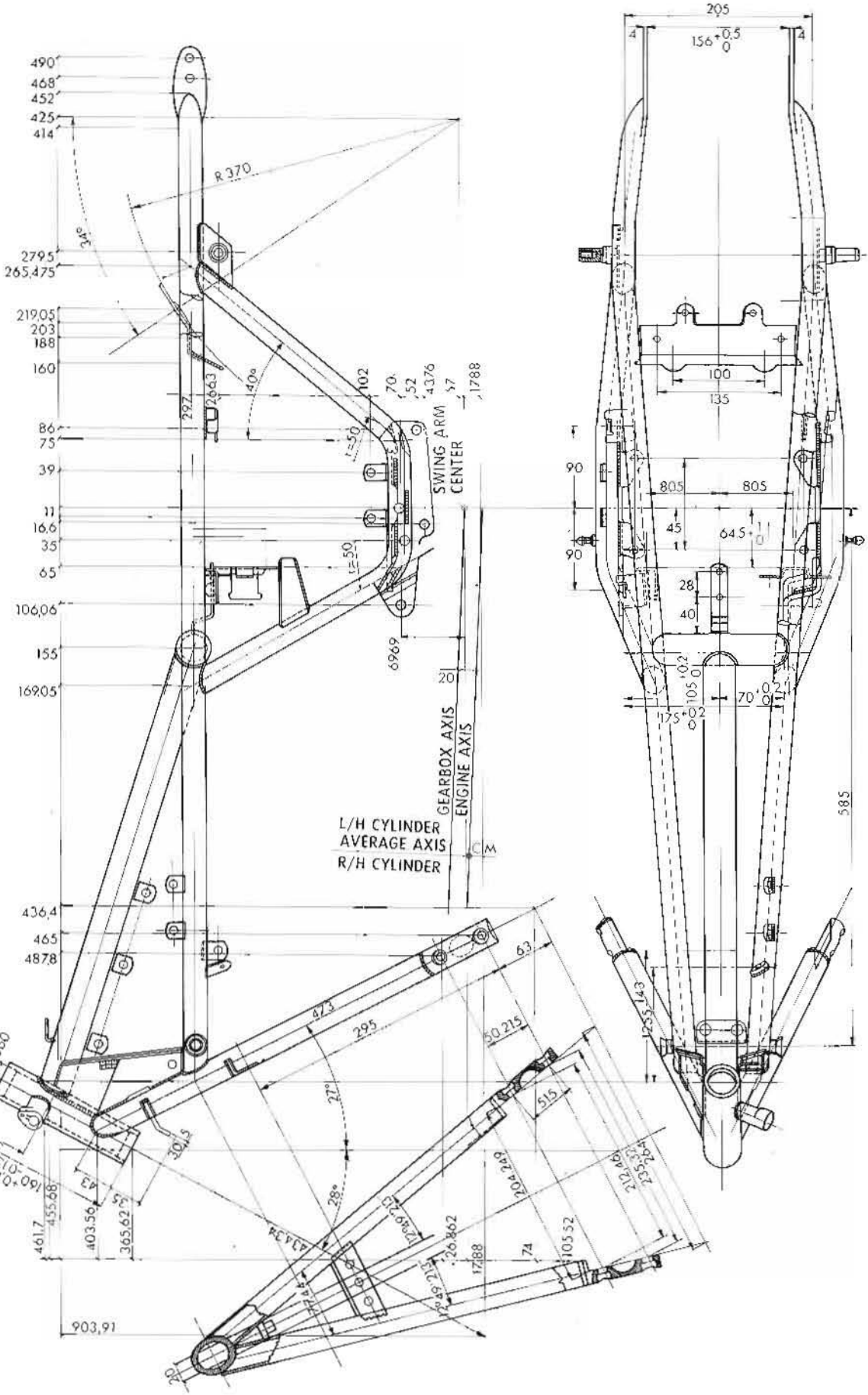
- Ensure all cables are in good state. Replace, as necessary.
- Check the efficiency of all the electrics located on the frame and in case of damage have them repaired in a qualified workshop.
- Ensure the battery is quite efficient and the acid is at correct level (See «Electrical equipment - Battery»).
- If the frame has suffered heavy impacts (crashes or falls), square up keeping to the sizes indicated in dwg. n. 139.

### c Re-assembly

Reverse the dismantling operations.







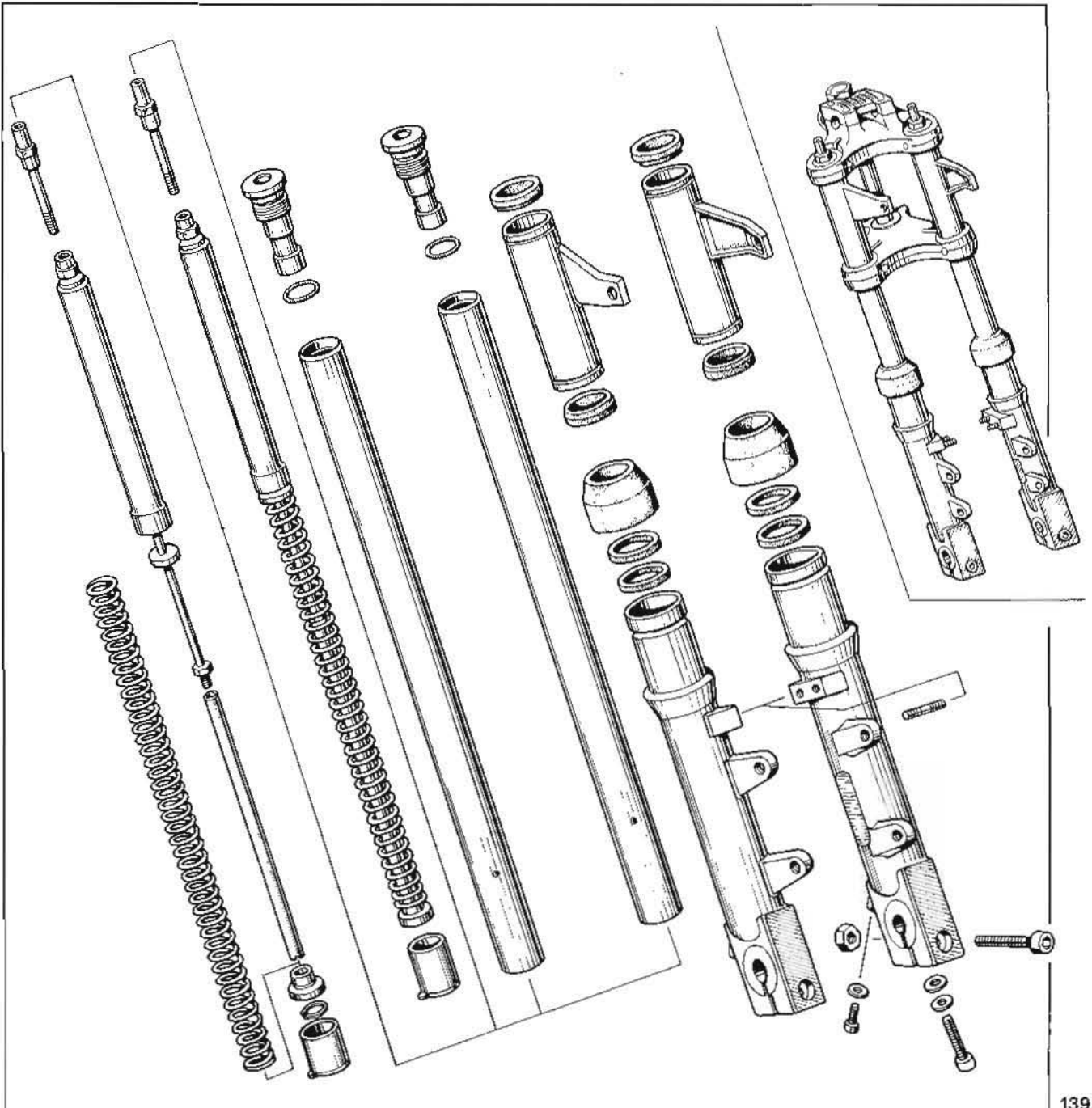
## 13 FRONT FORK

(fig. 139/1)

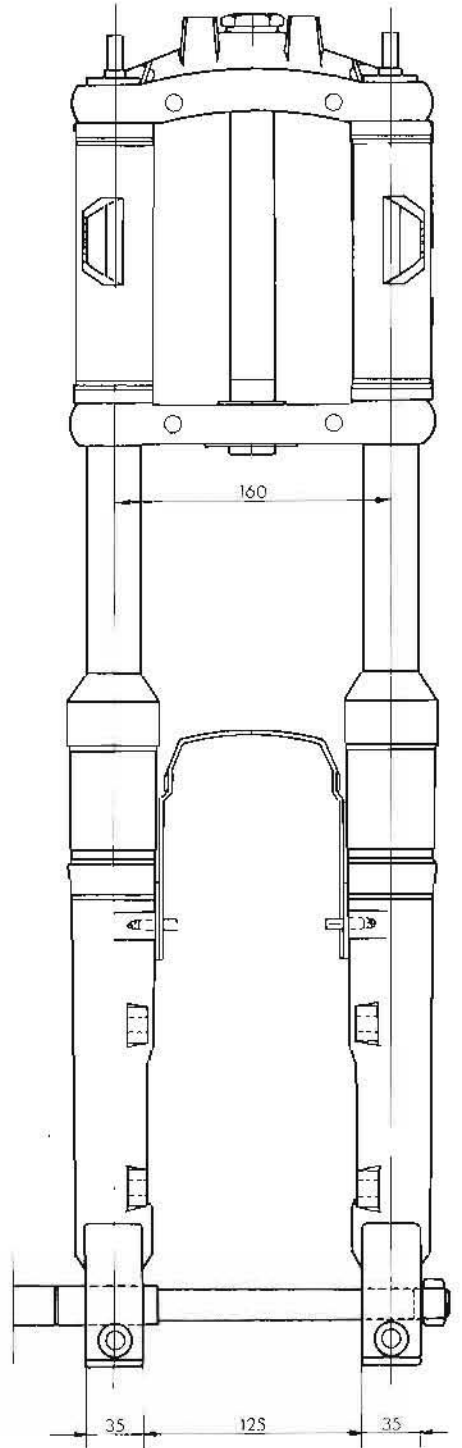
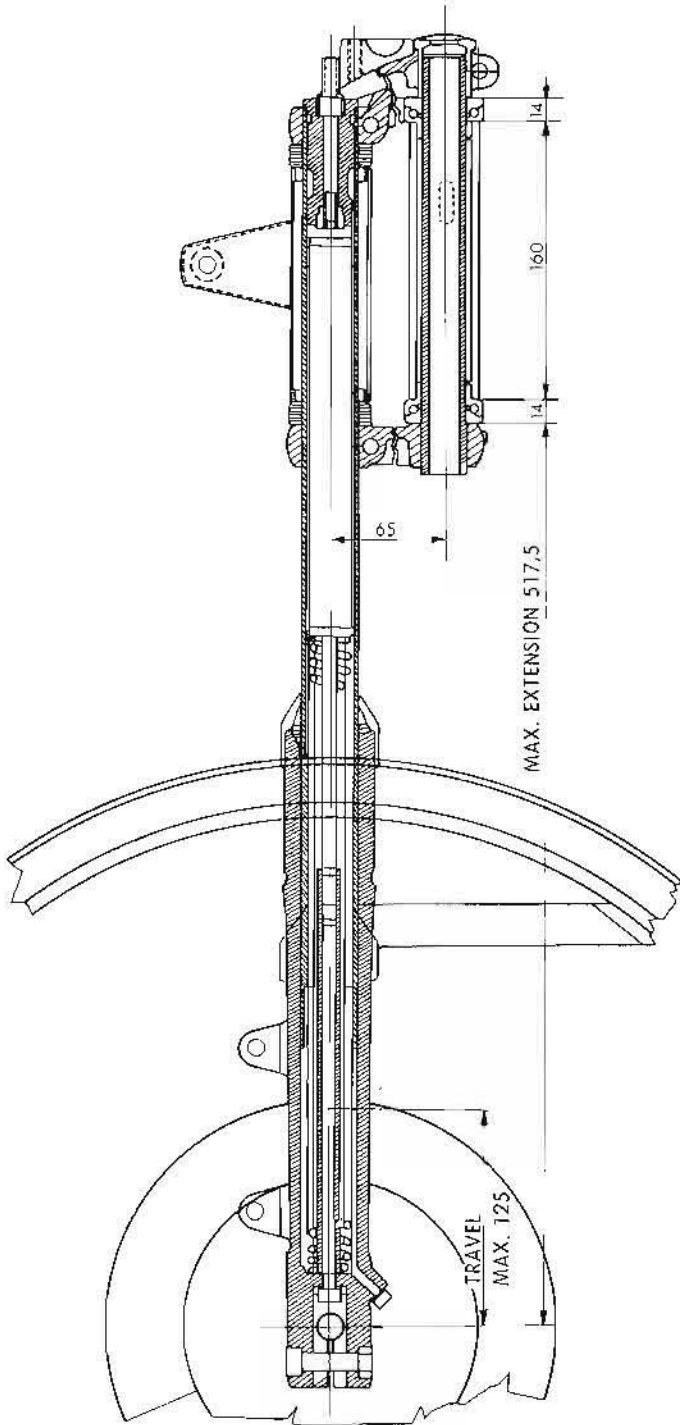
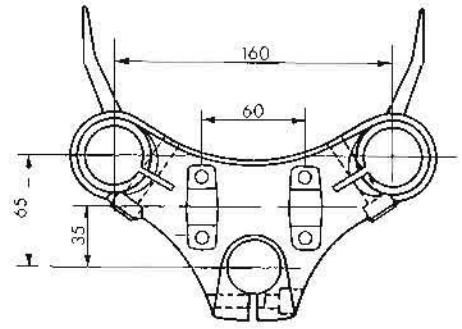
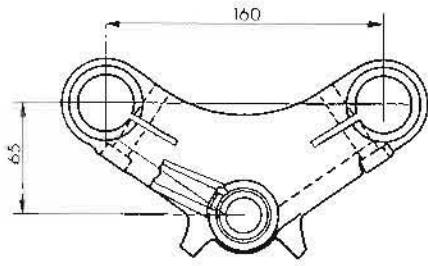
### a Removal from frame

Proceed as follows:

- raise the seat using special lever «A» (fig. 20);
- disconnect battery plus and grounding cables;
- unhook rear securing strap and remove fuel tank;
- undo retaining screws and remove headlight from fork lugs after disconnecting the connectors from the terminal board;
- undo panel securing screws and remove panel complete with instruments;
- disconnect the connectors from the board, front turn light indicator cables, rectifier cable, oil pressure switch cable, and undo the thumb screws on the speedo and rev-counter drives;
- undo screws and remove calipers c/w lines, also the cable guiding eyelet on the mudguard;
- remove front wheel, front mudguard and handle-bar supporting plate;
- unscrew the top cap and withdraw the complete fork assembly.  
Each cap contains 22 balls.



139/1





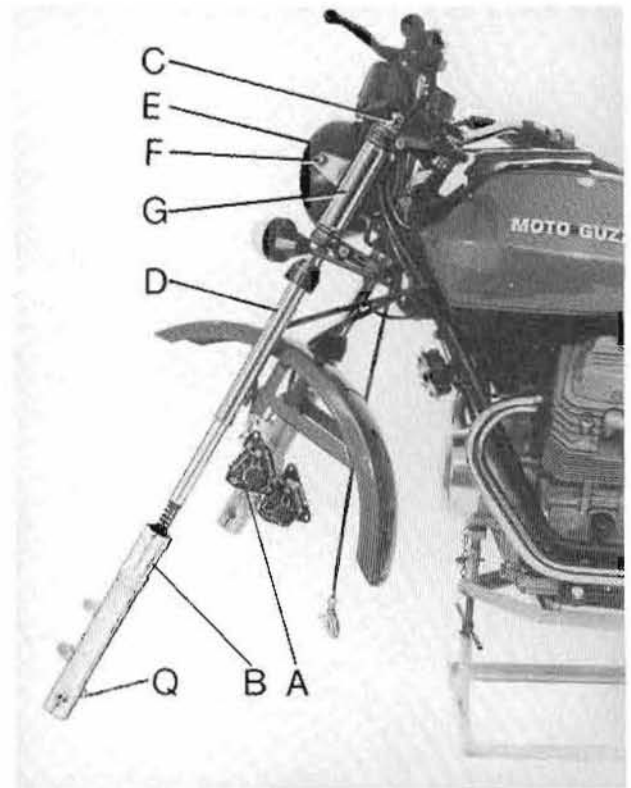
## b Inspection

- ensure the steering cap grooves containing the balls are undamaged. Replace as necessary;
- make sure all balls show up bright, or else replace them;
- check condition of all electric cables and replace if necessary;
- if the fork has undergone severe impacts because of falls or crashes, straighten observing the dimensions indicated in dwg. 140.

## c Re-assembling the fork

Reverse the dismantling sequence. When re-fitting the caps be sure to pack them with grease Agip F. 1. Grease 30 before introducing the balls (22 each cap).

It is also recommended to fit the turn lights bracket after the fork is assembled.



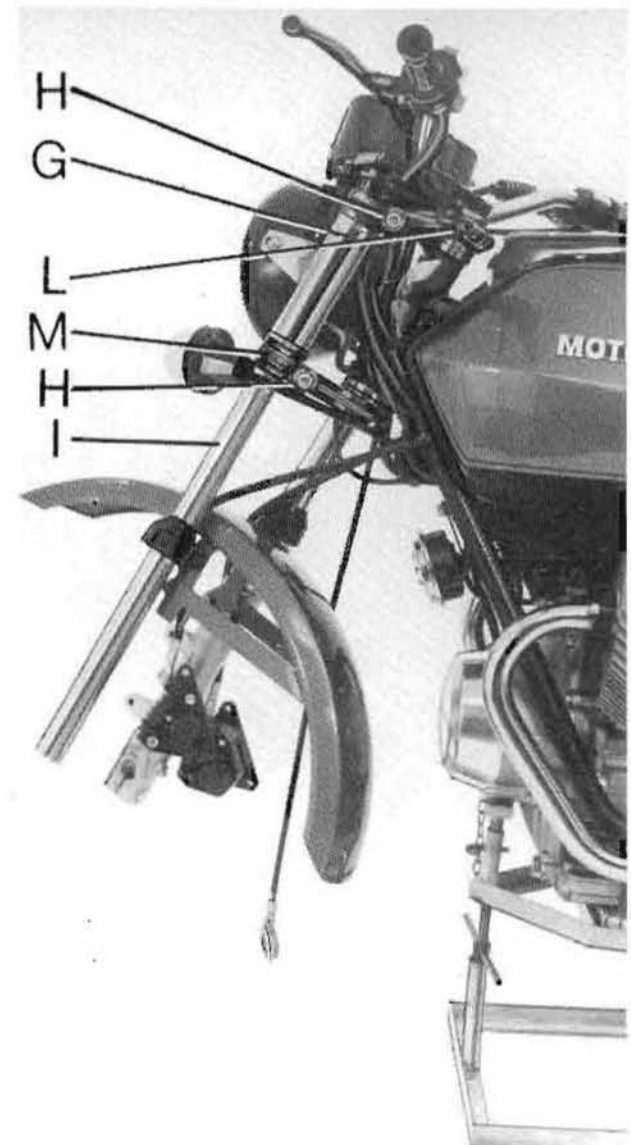
141

## 13.1 FORK SLEEVE

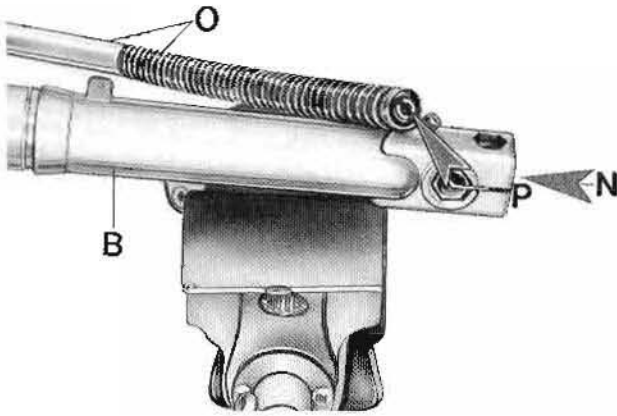
### a Removal from fork on vehicle

Proceed as follows:

- remove front wheel (See section «Removing the front wheel»);
- loosen the mudguard securing screws of left slider «B» (fig. 141);
- undo the bolt securing the bottom yoke to the front mudguard;
- drain the fork oil, undoing bolt with washer «Q» (fig. 141);
- undo retaining screws and remove caliper «A» from left slider «B» (fig. 128);
- remove instrument panel as previously described. If slider «B» only has to be dismantled (fig. 141) (complete with spring and damper) without removing the steering unit, proceed as follows:
  - undo screw «C» (fig. 141) securing the damper to the fork tube;
  - take out the sleeve-spring-damper assembly from the fork tube (See fig. 141);
  - disconnect the headlight connectors «E» (See fig. 141);
  - undo screws «F» (fig. 141) and remove headlight «E» from the fork lugs (fig. 141);
  - undo screws «H» retaining fork cover tubes «I» to steering head «L» and bottom yoke «M» (fig. 142);
  - withdraw fork cover tubes «I» and the top headlight cover «G» (fig. 142);
  - unscrew «N» and take off slider «B» and the damper assembly with spring «O» (fig. 143).



142



143

## b Inspection

### ▪ Fork cover:

— Ensure the chromed part is free from scoring, the cover tube is straight and the thread not nicked or stripped. If so replace the fork cover.

### ▪ Rod diameter:

—  $34.690 \div 34.715$  mm ( $1.3656 \div 1.3666$ ").

### ▪ Fork slider:

— it is in light alloy. Ensure its inner surface is quite free from scoring or nicks.

### ▪ I/D of slider:

—  $34.750 \div 34.790$  mm ( $1.368 \div 1.3696$ ").

▪ Tube-slider assembly clearance:  $0.040 \div 0.100$  mm ( $.00157 \div .0039$ ").

### ▪ Fork spring (See fig. 144):

— ensure the fork spring is not deformed or its elasticity impaired;

— free spring length:  $362 \div 365$  mm ( $14.252 \div 14.370$ " );

— spring length when compressed to 357 mm ( $14.055$ " ) should give a load of  $4.8$  kg  $\pm 3\%$  ( $10\frac{1}{2}$  lbs), on assembly;

▪ spring length (static load) should give a load of  $97.5 \pm 3\%$  ( $224\frac{1}{2}$  lbs).

If the spring has flattened, replace it.

### ▪ Seal ring on sliders:

— check their efficiency, if crumbled or brittle, change them.

### ▪ Rubber ring retainer on fork damper:

— ensure it is not squashed or crumbled. If so, replace it.

### ▪ Fork dampers:

— should never be tampered with. Check both at same time, ensuring they have the same load and so prevent irregular operation of the fork. If the dampers are no longer efficient, have them checked or replaced.

### ▪ Bottom fork yoke:

— check straightness of the steering fork. If the threaded portion is ruined or stripped, replace the yoke.

### ▪ Steering head:

— ensure the threaded portion is not damaged or stripped or else replace the head.

## c Re-assembly

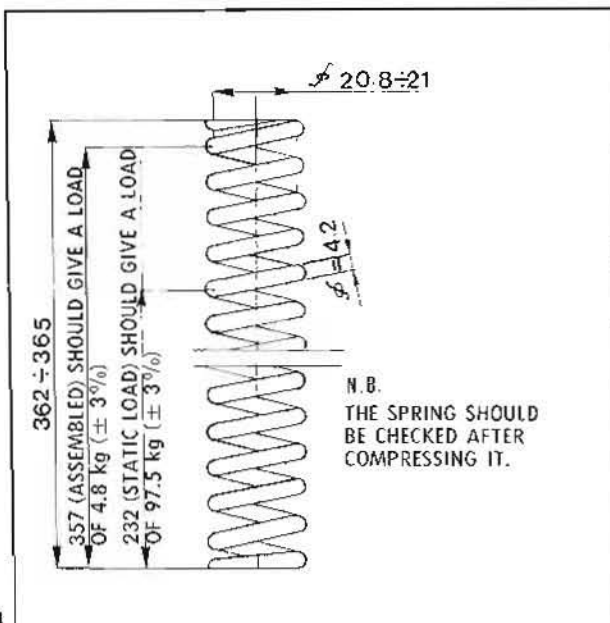
Is a reversal of the dismantling operations except that.

▪ in re-fitting the spring assembly, rod «O» on slider «B», it is necessary to ensure that notches «P» fit tightly in slider notch «B».

Before tightening screw «N» (fig. 143) don't forget to re-fit drain bolt and washer «Q» (fig. 141).

Before fitting the leg-damper-spring assembly on the fork rod, be sure to introduce in the fork leg 0.070 lts of fluid ( $2\frac{1}{2}$  oz) Agip F. 1 ATF Dexron.

The other fork leg is similarly dismantled and assembled.



144

## 14 REAR SUSPENSION

### a Dismantling from the frame

- Unscrew the nuts securing it to the frame and remove the shock absorbers from the bosses on the frame, rear fork, and drive box.

### b Inspection (See fig. 145)

- Check conditions of springs «A» and both shock absorbers «B» at the same time to ensure they have the same load and so prevent offsetting the swinging arm and the rear drive box.

In case of inefficient shock absorbers, replace either the springs or the complete shock absorber.

- Ensure rubber bushings «C» are not crumbled or hardened. If so, replace them.

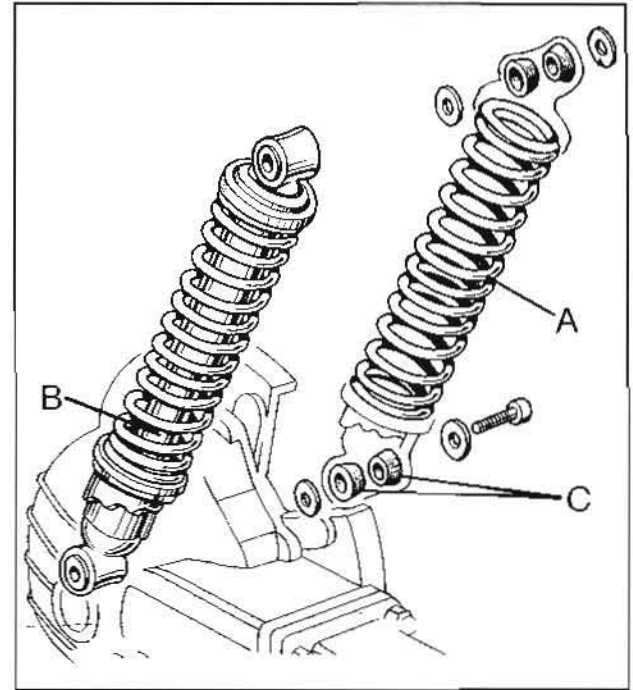
A dismantled spring should have the sizes indicated in drawing n. 146.

In case of inefficient damper operation, it is better to apply to the makers for repair, or replace the complete units.

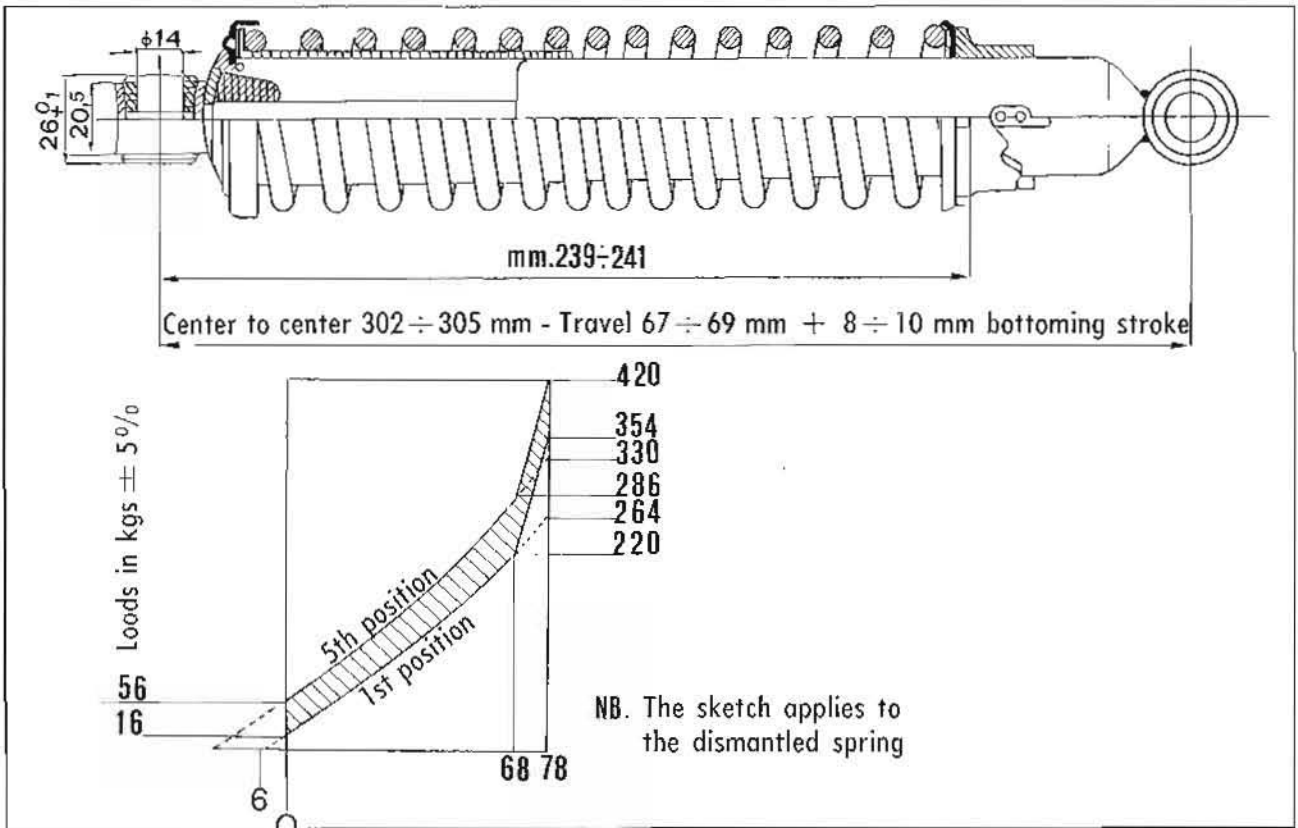
Don't forget that good stability is mostly dependant on the springs being adjusted to the same position and load.

### c Re-assembly

- Reverse the dismantling operations.



145



146

## 15 STEERING

### a Dismantling (See fig. 147)

- Place stand 18 91 24 50 (32 in fig. 28) with a suitable wooden board under the oil sump.
- Remove front wheel after unscrewing and removed the left fork leg caliper (See «Removing the front wheel» 16.1).
- Undo 4 screws «A» securing the top cap to the handlebar lugs on the steering head and tilt over the complete handlebar towards the fuel tank.
- Unscrew bolts «B» securing the complete panel board to the fork covers and tilt it forward.
- Undo the screws securing the headlight to the fork cover lugs «C», disconnect the cables and remove the headlight.
- Undo the nut on steering column «D».
- Undo screws «F» securing the steering head to the fork covers and take off top linking plate «G».
- Undo screws «H» securing the right caliper to the fork cover and take out the rubber rings securing the pipes from the master cylinder to calipers «I». Also the speedo and rev-counter cables from the mudguard.
- Undo nuts «O» and remove the mudguard from the fork sliders.
- Undo lock ring «M» and withdraw the fork complete with bottom yoke from the frame, taking care not to drop fork covers «N».
- Remove the balls (44) and if necessary use the special punch to pull out caps «P» from their housings.

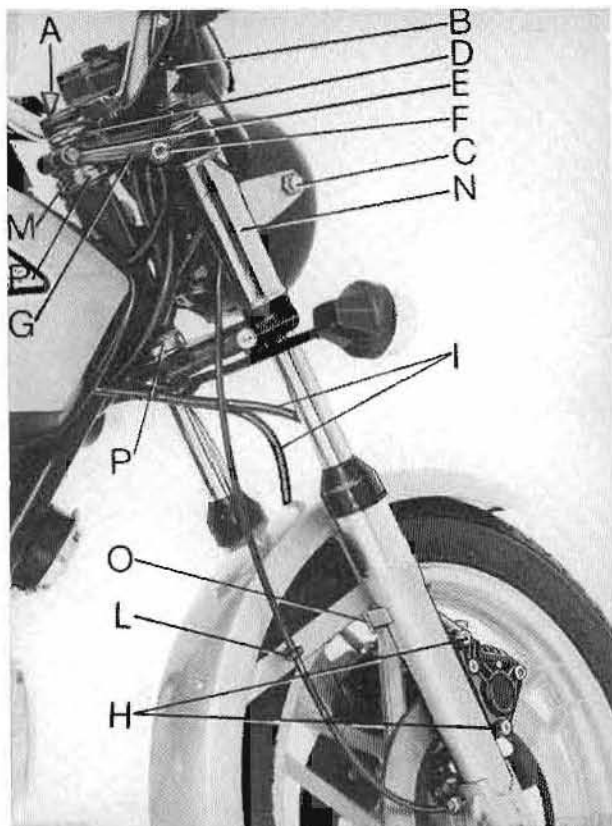
### b Inspection

- Ensure the caps grooves are in good condition. If damaged or excessively worn, change the four caps.
- Check condition of the balls which should show up bright and perfectly round. If not, change the balls.

### c Re-assembly

Is a reversal of the dismantling operations but before fitting the caps don't forget to pack them with grease before plunging the balls into them.

Finally, adjust the steering as indicated in section 2.27.



147

## 16 WHEELS

### 16.1 FRONT WHEEL

#### a Removal from fork (See fig. 148)

Proceed as follows:

- set up the motorcycle on the center stand and place supporting stand part n. 18 91 24 50 (32 in fig. 28) under the sump with a suitable wooden board to keep the wheel off the ground;
- undo the caliper securing screws from the left fork slider and disconnect the slider from caliper «A» with its pipe;
- undo wheel spindle fixing nut and washer «B» on the L/H side;
- loosen the bottom cover screws to the wheel spindle «C»;
- withdraw wheel spindle from the hub, observing the mounting position of washer «E» and spacer «F»;
- remove the R/H braking disc from the caliper on the fork cover, and take out the wheel from the fork legs.

#### b Removing the front wheel hub (See fig. 149)

After removing the wheel, the hub on it is removed as follows:

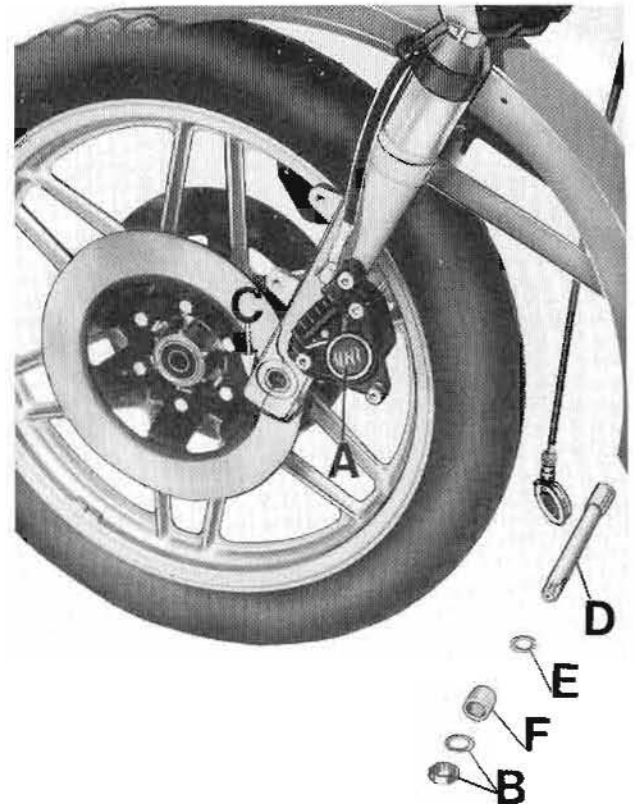
- undo six self-locking nuts «A», take out their screws «B», and remove both discs «C»;
- using the special punch, remove both bearings «D» and spacers «E».

**Important** After removing the wheel from the fork it is strongly recommended not to actuate the brake control lever on the handlebar as this may cause the plungers to drop out from the master cylinder with consequent loss of fluid.

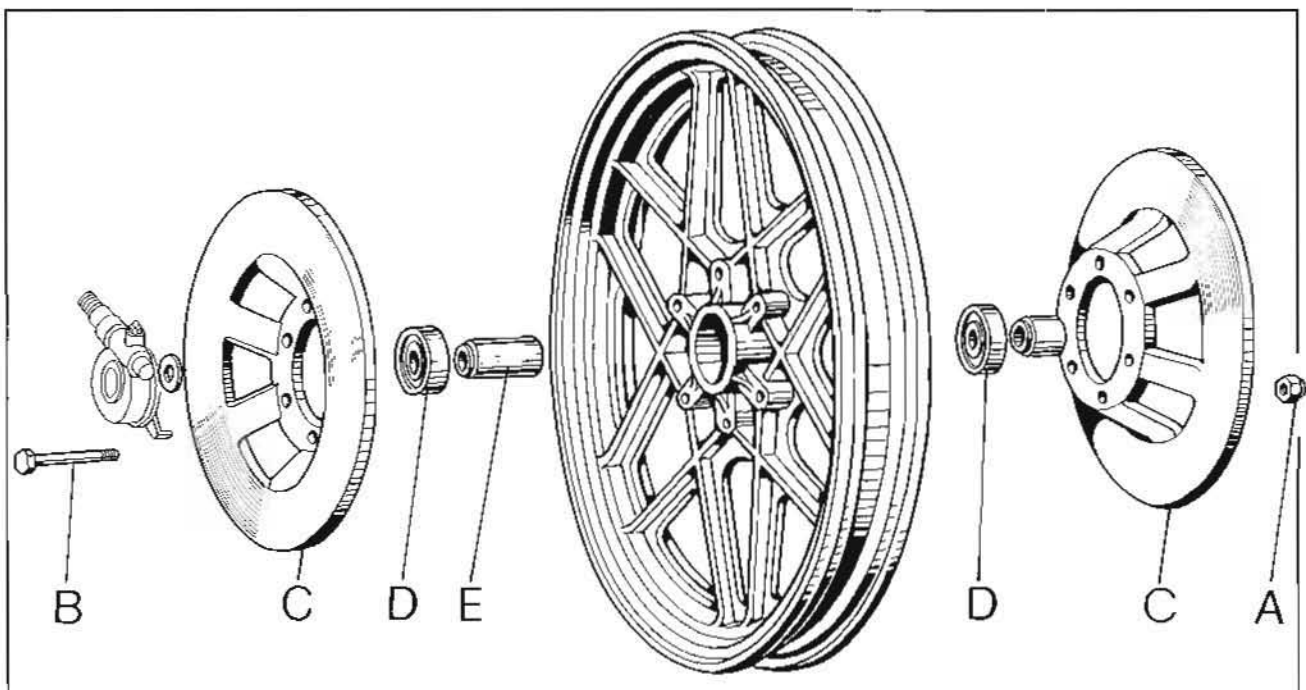
If this should happen, push the plungers up again in their housings and top up the reservoir.

Proceed now to bleed the air from the circuit.

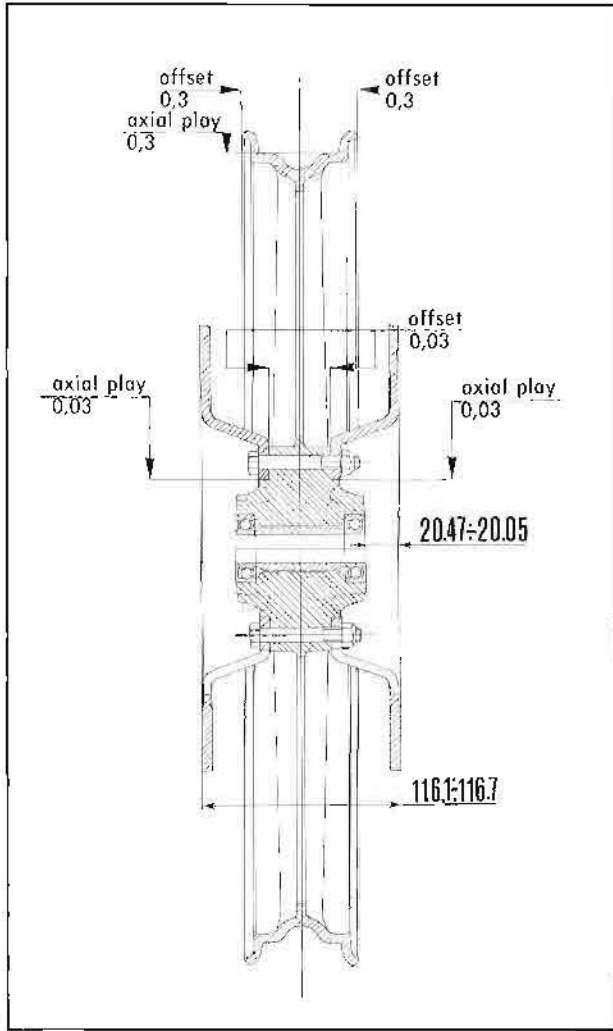
To check end and side play, see drawing fig. 150.



148



149



## 16.2 REAR WHEEL

### a Removal of rear wheel from swinging arm and drive box (fig. 151)

Proceed as follows:

- set up the byke on the center stand;
- undo nut «A» with washer «B» from the sprindle on the drive box side;
- loosen screw «C» securing spindle «D» to the rear fork arm;
- withdraw spindle «D» from the box, hub, and swinging fork arm;
- remove shim «E»;
- lean the byke to the right so as to allow the wheel to be taken off the swinging fork arm and rear drive box.

To refit the wheel, reverse the dismantling operations.

### b Removing the rear wheel hub (fig. 152)

Proceed as follows:

- remove cushioning springs «A» from the wheel hub;
- using a suitable punch, remove both bearings «B» with their spacer «C».

Re-assemble reversing the dismantling operations. Check end and side play against drawing n. 152/1.

## 16.3 TYRES

Tyres are included in the components that have always to be kept under control as the vehicle stability, riding, comfort, and even the rider's safety are dependant on them.

Accordingly, it is strongly recommended to never use tyres with less than 2 mm tread (5/64").

An incorrect tyre pressure may also affect the vehicle stability and cause the tyres to rapidly wear out.

Recommended tyre pressures:

#### Front wheel

Solo or with pillion:

- |            |                          |
|------------|--------------------------|
| — Pirelli  | } kg/cmq 2 (28 lbs/s.i.) |
| — Metzeler |                          |
| — Michelin |                          |

#### Rear wheel

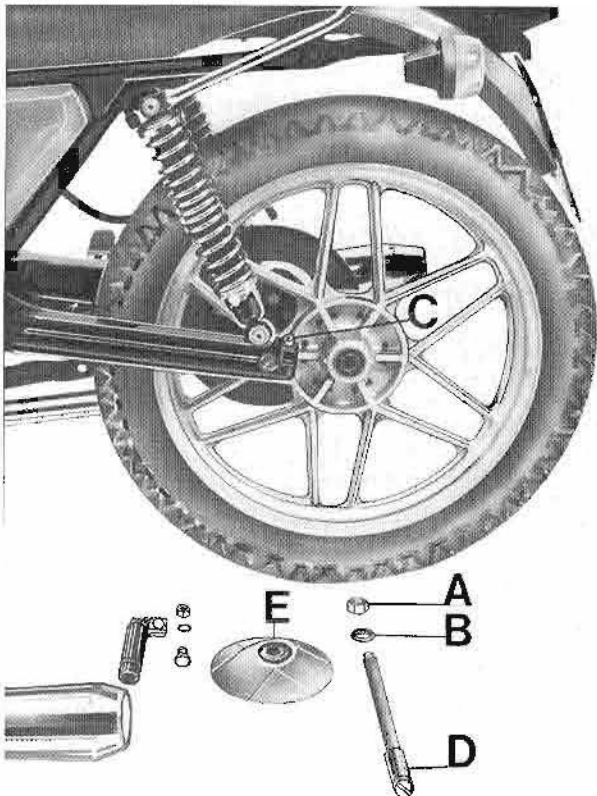
Solo:

- |            |                            |
|------------|----------------------------|
| — Pirelli  | } kg/cmq 2.2 (31 lbs/s.i.) |
| — Metzeler |                            |
| — Michelin |                            |

With pillion:

- |            |                            |
|------------|----------------------------|
| — Pirelli  | } kg/cmq 2.4 (34 lbs/s.i.) |
| — Metzeler |                            |
| — Michelin |                            |

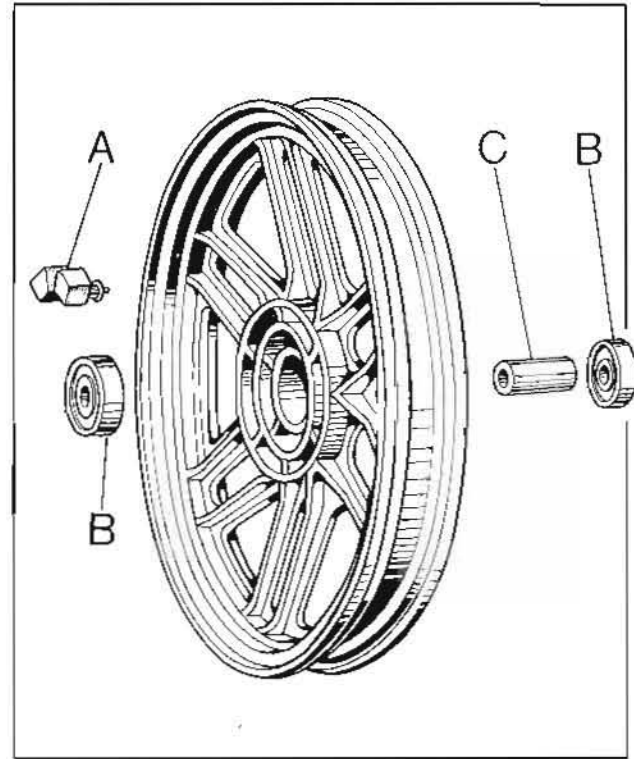
The above figures apply for normal riding (cruising). If using the motorcycle at constant high speed or on highways, it is recommended to increase pressure by 0.2 kg/cmq (3 p.s.i.).



## 16.4 WHEEL BALANCING

To improve stability and decrease vibrations at high speeds, the wheels have to be kept well balanced. If a balancing machine is not available, a wheel can be balanced as follows:

- remove the wheel and suspend it on a fork;
- lightly spin the wheel several times and see if it always stops in different positions, thus indicating a correct balance;
- if one point of the wheel always stops at the bottom, put a balance weight on a spoke opposite this point;
- Repeat this operation until the wheel is correctly balanced.



152

## 16.5 REMOVING AN RE-FITTING THE TYRES

These models fit light alloy rims which do in effect offer considerable mechanical resistance but can easily suffer damage if inappropriate tools are used for removing or re-assembling the tyres.

Accordingly, for these operations it is strongly recommended to use tools without ribbings or sharp edges where they contact the wheel rim. The contact surface should be quite wide, very smooth, and with all edges suitable rounded off.

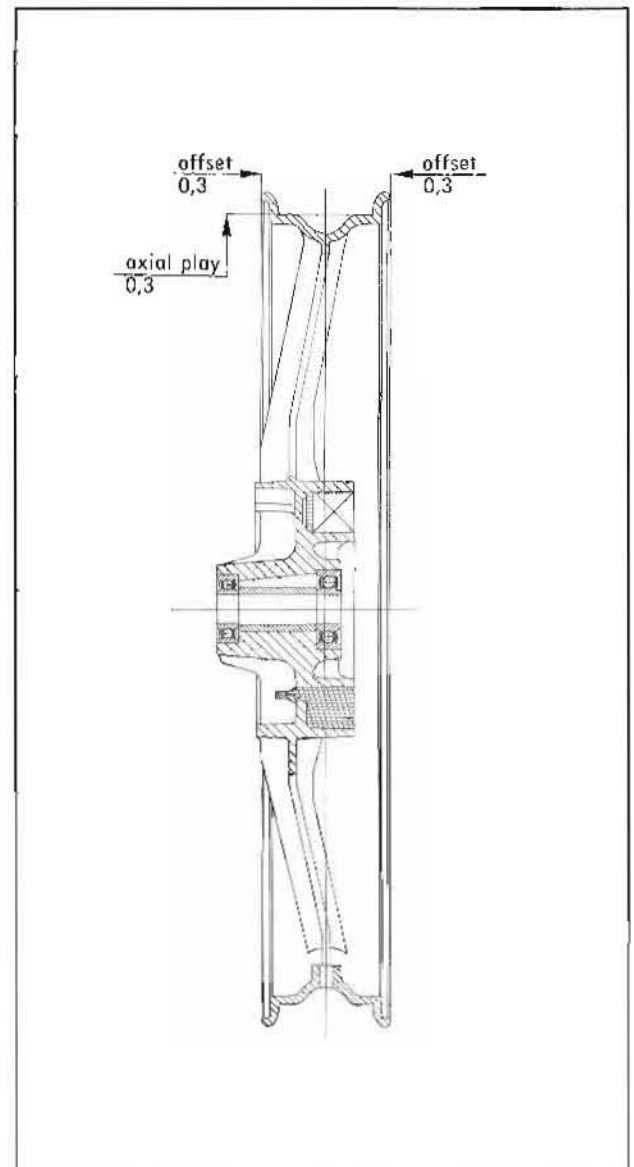
The use of any of the special lubricants available on the market, will make the fitting and bedding down of the tyres on the rim a much easier job and also prevent excessive stress on the tools. Do not forget that the tyre beads should always be a perfect fit in the central rim channel. When fitting a tyre, and if this has an arrow stamped on its side, make sure to assemble it with such arrow pointing to the normal riding direction in the case of the rear tyre and viceversa for the front tyre (i.e. pointing in the direction opposite to the riding direction).

## 16.6. HOW TO CHECK AND OVERHAUL THE BRAKING CIRCUITS FOR THE RIGHT FRONT AND REAR BRAKES

### 1 General maintenance

Periodically check the level of the fluid in the reservoir for the front and rear master cylinders. It should never be below the top of the reservoir separator.

- every 5000 km (3000 miles), top up the fluid reservoir with fluid from an original container to be opened just before topping;
- every 15.000 km (9000 miles) or at most every year, the braking circuits fluid should be completely renewed;



152;1

■ for good braking efficiency be sure the fluid pipes are always full of fluid without air bubbles. The presence of air is evidenced by a long and elastic movement of the control lever.

To clean out the braking circuits, use only fresh fluid of recommended type. Never use alcohol to clean or compressed air to dry.

Recommended fluid: Agip F.1 Brake Fluid (SAE 170 3C).

## 2 Air bleeding

This operation is needed every time the movement of the control lever or pedal is long and elastic due to the presence of air bubbles in the braking circuit.

### Front right braking circuit (fig. 154)

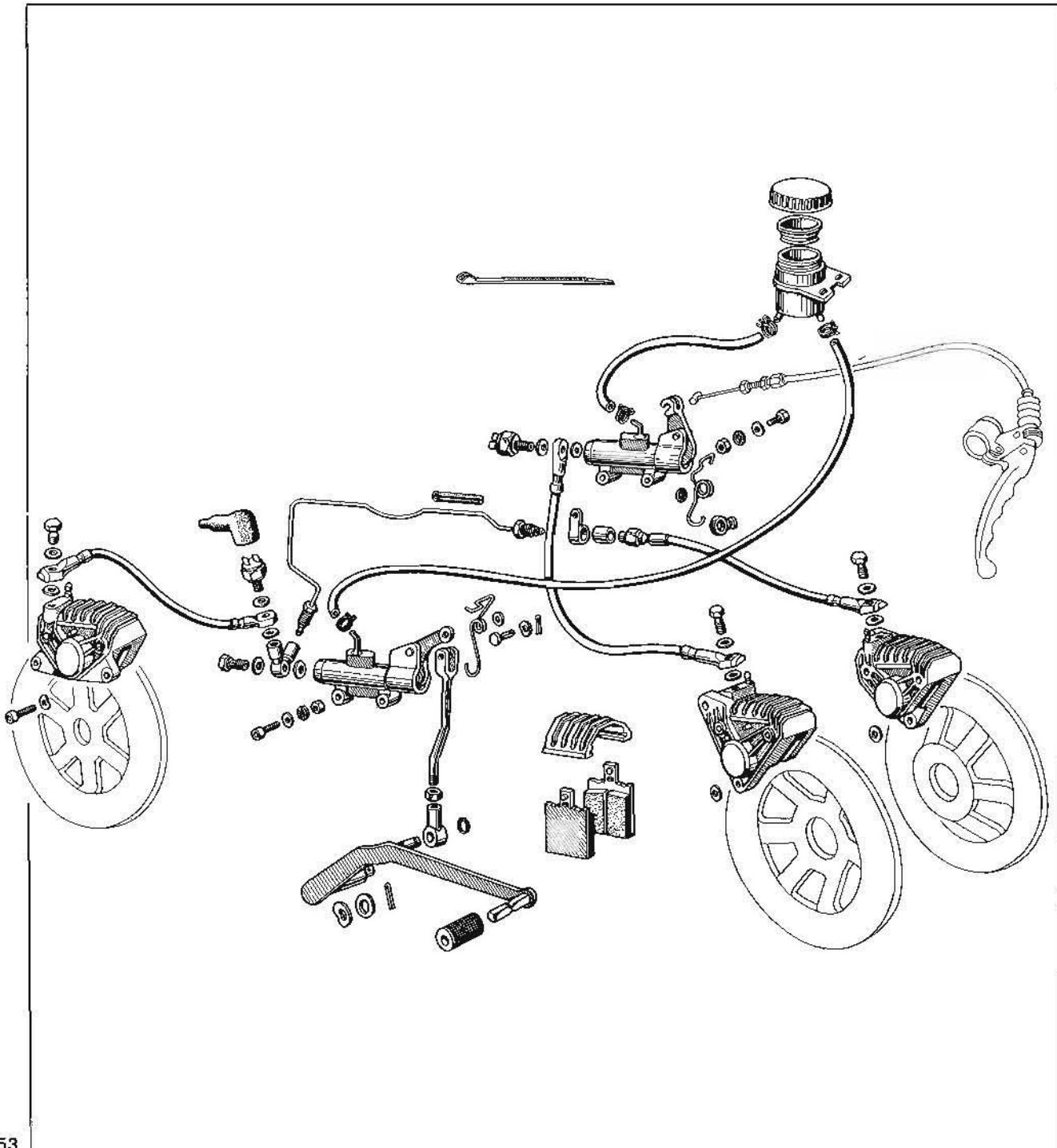
■ Proceed as follows:

■ set up the byke on the center stand;

■ If necessary, fill up fluid reservoir «A» (Always ensure that during the bleeding operation the fluid level never drops below the top of the plate separator);

■ bleed operating on caliper «D»:

a remove rubber cap from drain plug «C» and fit a transparent flexible pipe in it with the other end in a transparent container «F» partially filled up with fluid of same type;





b loosen drain plug «C»;

c completely pull the handlebar lever several times, releasing it slowly and waiting a few seconds before pulling it again. Repeat this operation until the pipe plunged into the transparent container «F» emits airless fluid;

d keep control lever «B» completely pulled and close drain plug «C» tightly; remove plastic tube «E», and re-fit the rubber cap.

If the air bleeding operation has been carried out correctly, the efficiency of the braking action will be immediately perceived after the initial idle movement of lever «B». If it is not so, the bleeding operation has to be repeated.

*Remark This operation does not completely bleed the air from the circuit. The remaining air is automatically emitted after a short time of riding. This will entail a less elastic and shorter lever movement.*

### Front left and rear braking circuit (fig. 155)

Proceed similarly as done for the right front brake circuit except that instead of pulling the handlebar and keeping down the lever, this is done on the pedal control by pushing it down and keeping it down.

### 3 Checking fluid level in reservoir and replacing the fluid

The fluid level in reservoir «A» (fig. 154) has to be checked frequently to ensure it is never below the top separating plate:

- periodically, or whenever necessary, top up the fluid in reservoir «A» (fig. 154);
- access to the reservoir is obtained by unlatching the catch with ignition key and pressing down button «A» in fig. 15, raising the cover, undoing plug «B» and removing the rubber gaiter.

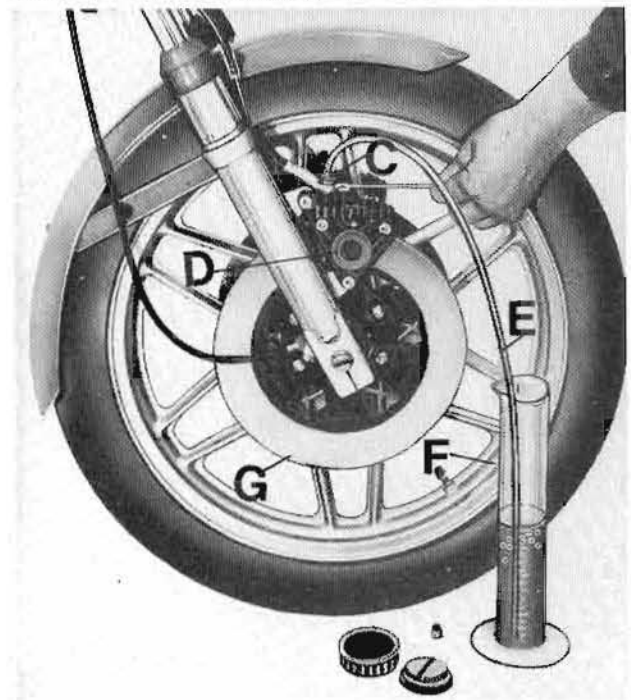
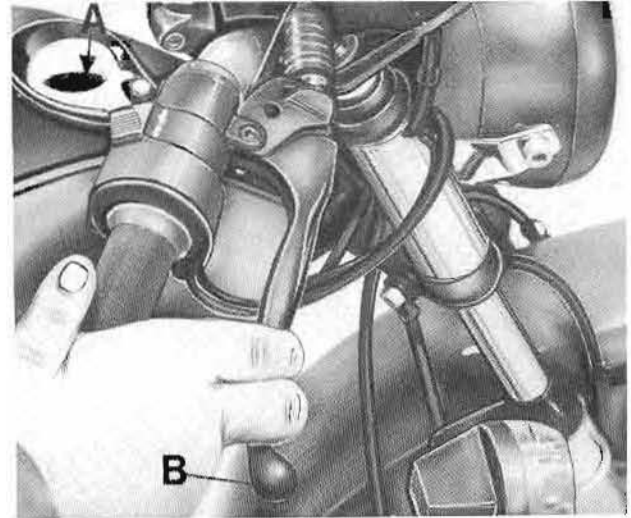
*To top up always use fluid taken from a container opened just before pouring in;*

- every 15.000 km (9000 miles) or at most every year replace the braking fluid in the reservoir. To obtain an efficient braking action, it is necessary for the fluid pipes to be always full of fluid without air. A long and elastic movement of the control lever and/or pedal evidences the presence of air bubbles in the circuit.

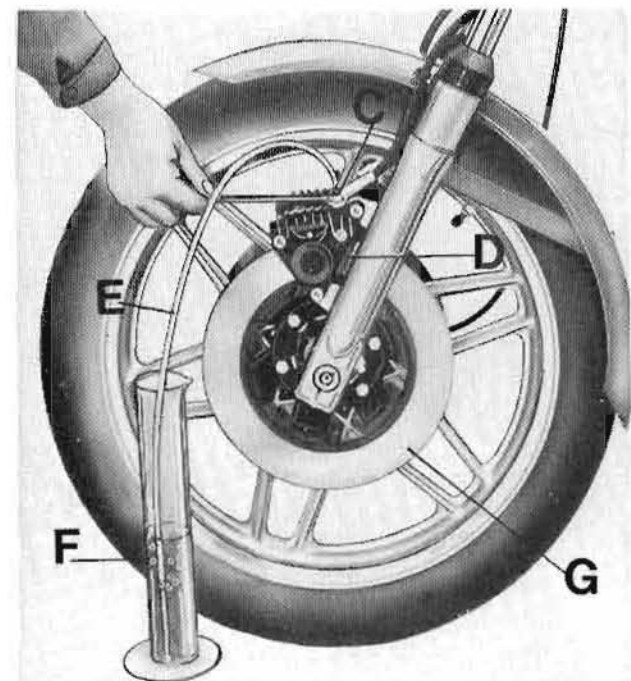
When washing the braking circuits, use only fresh fluid. Never use alcohol for washing or compressed air for drying.

For metal part use trichloroethylene.

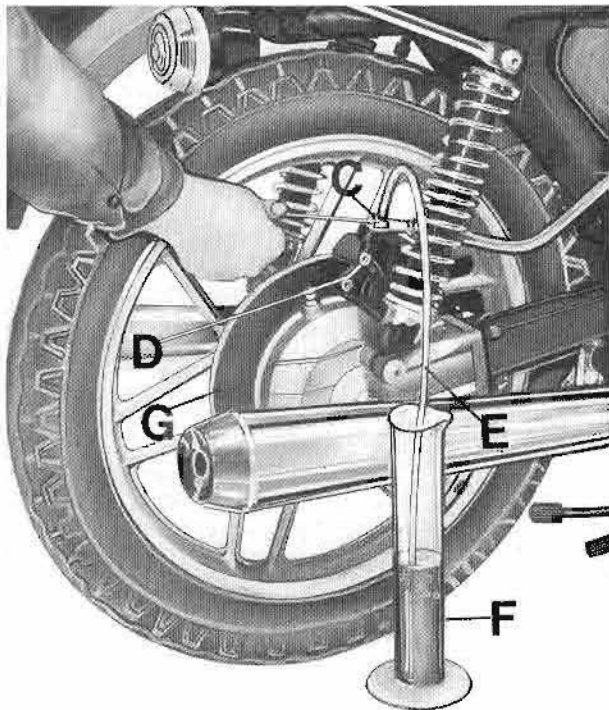
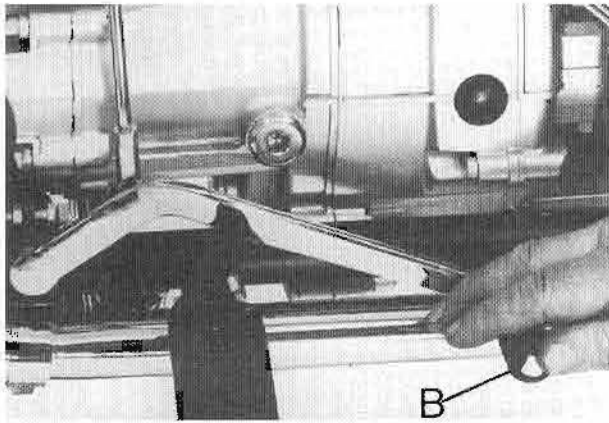
To lubricate, never use mineral oil or grease. If no suitable lubricant is available, it is recommended to moisten the rubber or metal components with brake fluid. Fluid recommendation: Agip F.1 Brake fluid (SAE J 1703).



154



155



#### 4 General procedure for dismantling components from the braking circuit

Before any part is removed, clean it thoroughly on the outside. Carefully plug up all pipe ends to prevent the entrance of foreign matter. After the parts have been removed, clean them thoroughly in trichloroethylene (metal parts) and the rubber parts with the specified liquid. Ensure the rubber gaskets and seals do not get in contact with trichloroethylene. Handle all delicate components with care. After cleaning, dry all parts with clean rags and moisten the cylinder walls and plungers with brake fluid to prevent oxidation.

#### 5 Master cylinder for the right front brake (fig. 156)

The right front brake cylinder is bolted on the L/H side of the frame.

To access to it:

- raise the seat using special lever («A» in fig. 20);
- disconnect the rubber strap securing the fuel tank at the rear;
- close taps, disconnect pipes, and remove the tank;
- check floater-lever end clearance which should be 0.05 – 0.15 mm (.00197 ÷ .0059"). If not, adjust (See section 2.24). Periodically grease scraper 7 and floater shank 4. Never use mineral oil or grease.

#### 6 Master cylinder for front left and rear brakes (fig. 159)

It is centrally located on the right hand and access to it is by removing the right cover. Ensure there is 0.05 ÷ 0.15 mm (.00197 ÷ .0058") clearance between floater and lever end. If not, adjust as described in section 2.25.

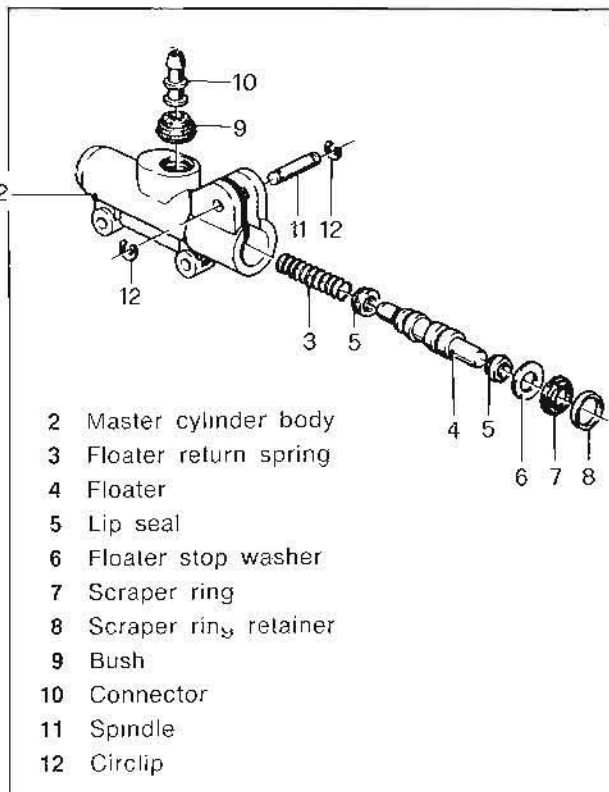
Periodically lubricate scraper 9 and floater stem 5 but do not use mineral oil or grease.

#### 7 Overhauling and replacement of master cylinder components - Tools to be used for the right front cylinder (fig. 156)

If the master cylinder operation is incorrect (fluid leakage at lever side, decreased braking ability etc.) it is necessary to replace gaskets «5» as follows:

- 1 disconnect the fluid delivery pipe from master cylinder to right front caliper;
- 2 drain fluid from reservoir;
- 3 disconnect pipe from cylinder to right front caliper;
- 4 plug up these pipes;
- 5 remove master cylinder from frame;
- 6 remove control lever «2» from pump body after removing circlip «13» and withdrawing pin «12»;

155



156

7 insert tool 14 92 64 00 (39 in fig. 157) in the fluid duct and tapping lightly with a plastic mallet push out the floater, paying attention not to score the hole walls and the outer surface of the floater;

8 from floater remove lock ring «8», scraper «7» and stop washer «6»;

9 from master cylinder remove return spring «3» and guide bush «9»;

10 if necessary, remove connector «10» and bush «9»;

11 clean accurately floater and master cylinder body and check if damaged. Check also I/D of master cylinder and O/D of floater;

- max allowed hole dia. 12.843 mm (.5054")
- min allowed floater dia. 12.657 mm (.4982")

12 check gaskets «5» and bush «9»; if the gaskets are still in good condition, do not remove them; if they need replacement, remove them using a suitable tool;

13 fit new gaskets «5» on floater using tool 18 92 65 00 (33 in fig. 158) and tool 18 92 66 00 (34 in fig. 158), paying attention to the mounting position;

14 on floater fit washer «6», scraper «7», and lock ring «8». Insert spring «3» on floater;

15 fit the whole assembly in the master cylinder hole, fit lock ring «8» using tool 18 92 67 00 (35 in fig. 158) and lightly tap with a mallet to drive stop washer «6» fully home;

16 fit bush «9» and connector «10»;

17 fit lever on master cylinder using pin «11» and circlips «12»;

18 secure the complete master cylinder to the frame;

19 connect fluid delivery pipe from tank to master cylinder and pipe from master cylinder to caliper;

20 re-check the lever end-floater clearance;

21 fill fluid reservoir and bleed the air from the braking circuit.

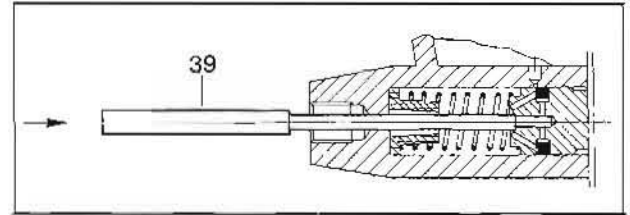
*Remark Before mounting the rubber and metal components be sure to lightly moisten them with the specified brake fluid or special grease. Never use mineral oil or grease.*

**8. Inspection and replacement of components the master cylinder for the front left and rear brakes - Tools to be used (See fig. 159)**

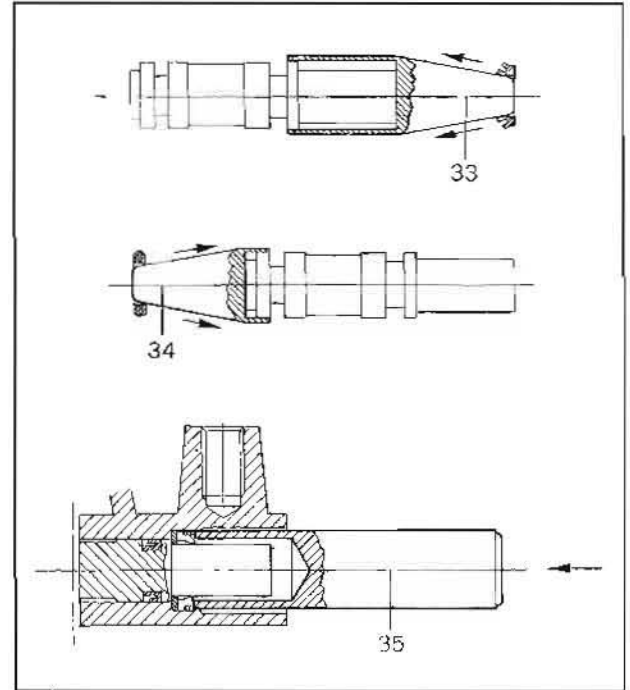
Proceed as for the right front brake except for points 11-13-15 which are replaced as follows:

▪ **Point 11**

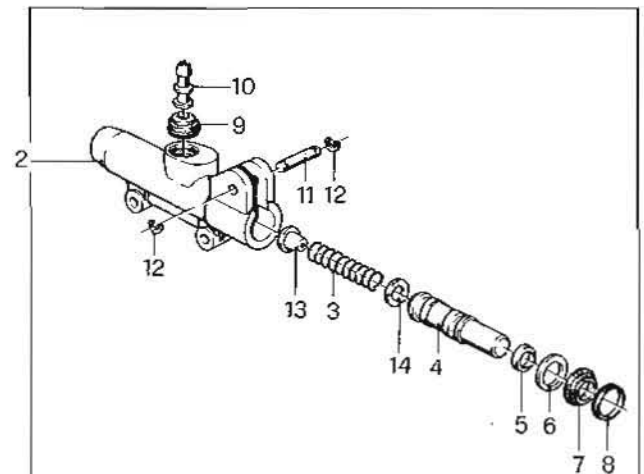
- maximum admissible hole dia. 15.918 mm (.6267")
- minimum admissible floater dia. 15.832 mm (.6232")



157

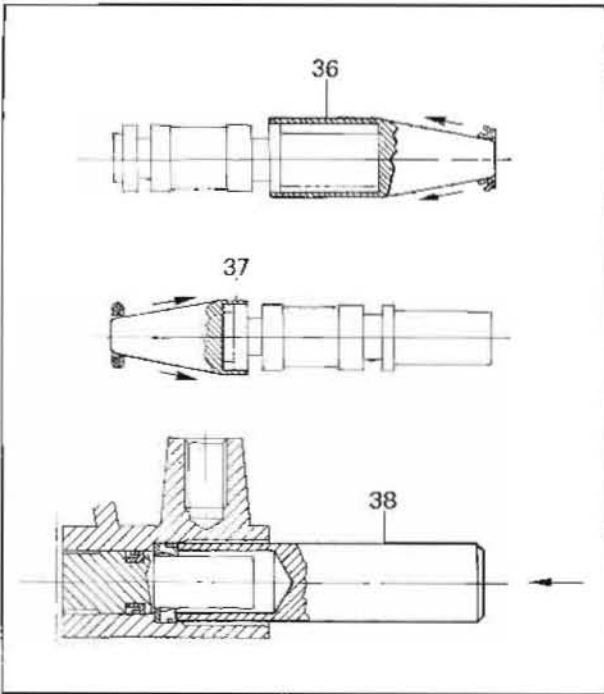


158



- 2 Master cylinder body
- 3 Floater return spring
- 4 Floater
- 5 Washer
- 6 Floater stop washer
- 7 Scraper ring
- 8 Scraper ring retainer
- 9 Bush
- 10 Connector
- 11 Spindle
- 12 Circlip
- 13 Spring guide
- 14 Lip seal

159



#### Point 13

— On floater «5» refit: gasket «7» using tool 14 92 65 00 (36 in fig 159/1) and gasket «6» using tool 14 92 66 00 (38 in fig 159/1). Pay attention to the mounting position of gasket «7».

#### Point 15

— Insert the whole assembly in the master cylinder hole «2», seal «10» using tool 14 92 67 00 (37 in fig. 159/1) and tapping the tool lightly with a mallet till stop washer «8» is driven home completely.

### 16.7 CALIPERS FOR RIGHT FRONT, LEFT AND REAR BRAKES (See fig. 160)

These calipers consist of two light alloy bodies (2 and 3) joined by two screws «8».

Each body incorporates a cylinder housing which acts as a guide for piston «5».

Sealing is assured by a gasket lodged in a groove inside the cylinder housing. The sealing is automatically adjusted by the wear of pads «9» which increases the piston exit out of the cylinder housing. Dust cap «6» which is internally secured to the round groove of the piston and externally around the annular hole of the cylinder, prevents the entrance of moisture and foreign matter.

The 2 pistons act directly on the 2 pads secured by pin «12». Two taper pins «10» pressed in spring «11» prevent pad flapping, and make the settling down of the disc easier after braking. Cap «13» mounted over the caliper prevents the cap from getting too wet because of rain or mud.

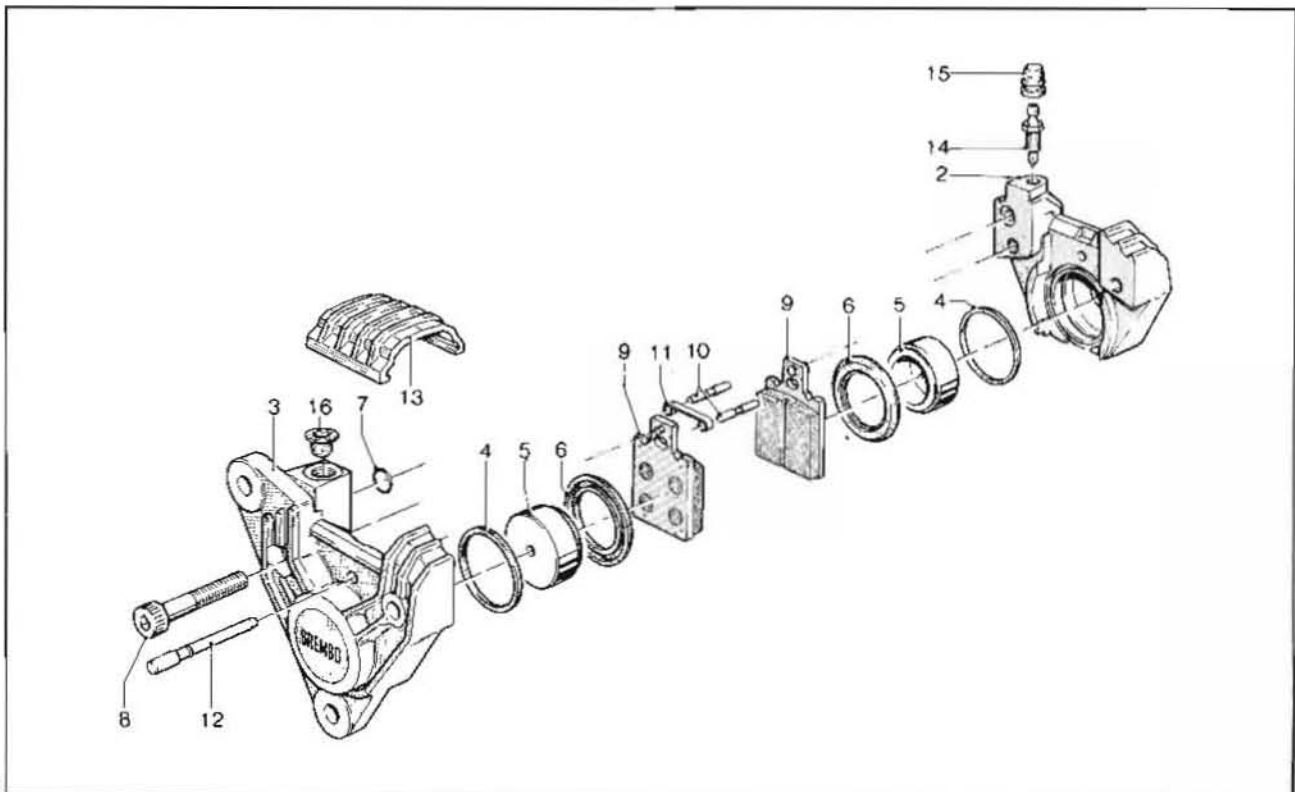
Brake fluid is delivered through the hole in one of the caliper bodies and hydraulic connection between the caliper bodies is assured by two inner holes. Sealing is assured by gasket «7».

Each caliper body is provided with a drain plug «14» for the bleeding of the air bubbles.

#### a Inspection and check (See fig. 161)

Every 5000 km (3000 miles) it is well to check pad wear as follows:

- remove cap «A»;
- remove central pin «B», spring «D» and pins «C»;
- slip off pads «E»; pad thickness:



- new pad 7 mm (.27");
- wear limit 3.5 mm (.13").

If thickness is under the wear limit, the pads have to be replaced. The friction material has not be used right down to the metal plate as if this contacts the disc it will not only irremediably damage it but prevent proper thermal insulation between pads and brake fluid.

Replace pads as follows:

- push pistons inside the caliper bodies, being careful not to damage the dust caps;
- fit new pads «E»;
- fit pads retaining pins «C» with spring «D», also central pin «B».

By using the above procedure it is not necessary to bleed the air from the circuits. It is sufficient to operate the lever or pedal several times to allow the plungers to assume their normal operating position (pad-disc clearance 0.2 mm (.00787").

**Important:** for about 100 km (60 miles) after pad replacement, it is recommended to operate the new pads gently in order to allow the friction material to evenly and properly settle down.

*Note* When replacing the pads it is a good rule to take out a small amount of fluid from the reservoir as the backing of the pistons might cause the fluid to overflow.

#### b Inspection and replacement of caliper components

The replacement of caliper gaskets is necessary when fluid leakages occur through the cylinder housings. Traces of fluid will be noticed on the disc and calipers, also the level of the oil in the reservoir will drop down considerably and in continuity. Fluid leakages will cause poor braking efficiency and a too elastic movement of the pedal or lever.

To replace the gaskets, proceed as follows:

- Remove and plug up the fluid delivery pipe;
- remove caliper from the fork cover;
- remove pad slot sealing cap;
- remove pin, spring, retaining pins, and the pads;
- separate the caliper bodies;
- remove dust cap from the leaking caliper body;
- from the body remove the piston using a jet of compressed air. Do this operation with care so as not to score the plunger surface. Using a needle, remove the defective gasket from its housing with care so as not to score the cylinder walls;
- clean the plunger and cylinder thoroughly, checking for damages. It is also advisable to check wear of the cylinder and piston:

- max admissible I/D of cylinder  
32.071 mm (1.2626");



— min admissible O/D of piston  
31 930 mm (1.256");

- fit a new gasket in the cylinder housing;
- fit the plunger into the cylinder (Do this only by finger pressure);
- fit the dust cap after ensuring it is not cracked or torn (ensure it is properly anchored in its housings on the piston and caliper);
- join up both caliper bodies, ensuring the gasket seats properly in its housing. Use a torque wrench set to 2.5 – 2.9 kgm (18 – 21 ft/lbs);
- fit caliper on fork cover. Tighten screws to a torque of 2.2 – 2.4 kgm (16 – 18 ft/lbs);
- fit pads, retaining pins and position spring with pin;
- connect fluid delivery pipe to caliper
- bleed the braking circuit

**NB** Before mounting, ensure all rubber and metal parts are moistened with brake fluid. Never use mineral oil or grease.

## 16.8 PIPES

Check their condition accurately and replace immediately if in any way damaged.

## 16.9 BRAKING DISCS

The discs are the rotating parts contacted by the pads during the braking action and their condition can have a marked influence on braking efficiency. For specific motorcycle purposes, the surfaces of the braking discs have been suitably treated to prevent oxidations. This treatment is done on the braking surfaces. However, after several brakings, this protective film is rubbed away, thus creating an ideal pad-disc coupling.

## 16.10 BRAKING CIRCUIT FAULTS

CAUSE	REMEDY
<p><b>Brake screeching</b></p> <p>Caliper not completely locked Missing or defective springs Worn out pads Oil or greasy pads Fitting of incorrect type pads</p>	<p>Tighten securing screws Fit new spring Fit new pads, after checking condition of disc Replace pads Replace pads</p>
<p><b>Excessive heating of disc (normal riding)</b></p> <p>Piston locking, pads glued to disc No play at control lever</p>	<p>Check condition of plungers, clean pads, housing in caliper Adjust lever play according to instructions</p>

## a Inspection and checks

Checking the brake disc is very important. The disc surface should always be perfectly clean, free from dust, oil, grease or any other dirt, and unscored. If deeply scored, the disc should be dismantled and re-ground on a special machine.

The admissible parallelism and offset on a disc are

- parallelism of contact surface and braking part of disc 0.050 mm (.00197");
- braking part of disc 0.050 mm (.00197");
- braking part of disc (circular check) 0.015 mm (.00059");
- braking part of disc (radial check) 0.060 mm (.0023").

Diameter of braking discs	
Front dia	Rear dia
260 mm (10.236")	235 mm (9.25")

Thickness of front and rear discs	
Standard	Minimum
6.250 – 6.540 mm (.246 – .254")	5.800 mm (.227")

When overhauling or replacing a disc, check its wobbling with a gauge. This should not exceed 0.2 mm (.0078").

If the play is greater, check mounting position of the disc on wheel hub, also the wheel bearing play.

Tighten the wheel hub screws with a wrench set to 2.2 – 2.4 kgm (16 – 18 ft/lbs).

CAUSE	REMEDY
<p><b>Poor braking</b></p> <p>Dirty or oily brake disc Excessively worn or vitrified pads Oily or greasy pads Plungers jammed</p>	<p>Clean disc Change pads, check disc Replace pads Restore sliding to plungers</p>
<p><b>Brake locking</b></p> <p>Friction coefficient of pads too high Disc oxidized</p>	<p>Fit proper pads Grind-in disc</p>
<p><b>High pad wear</b></p> <p>Pads jammed in housings, brake disc surface in continuous contact Plunger jammed Disc deeply scored</p>	<p>Clean pad housing in caliper, check if properly mated with guides Restore sliding condition Grind-in or replace disc.</p>
<p><b>Irregular or slantways pad wear</b></p> <p>Dirty pad housings Piston slides improperly Defective pad spring Caliper mounted slantways</p>	<p>Clean pad housings Restore sliding condition Replace springs Check and fit up properly</p>
<p><b>Control lever run too long</b></p> <p>Disc wobbling more than 0.2 mm Presence of air bubbles in the braking circuit Deeply scored brake disc</p>	<p>Grind or replace brake disc Bleed the air from the circuit Grind disc or replace disc</p>
<p><b>Sticking of master cylinder floater</b></p> <p>U-bolt securing screws excessively tightened Lever bolt excessively tightened (non-original bolt) Lever-cylinder housing coupling incorrect (lever too thick) Scraper deformed by etching liquids Defective floater return spring</p>	<p>Loosen screws partially Loosen bolt partially Replace lever Strip master cylinder, clean and check components (replace if scored or seized) and replace fluid Change the spring</p>
<p><b>Fluid leakage from reservoir</b></p> <p>Damaged gaiter Damaged reservoir rim</p>	<p>Fit gaiter properly in its housing, close cap gently Replace gaiter Repair or replace pump</p>

## 16.11 RECOMMENDATIONS

All «N» type rubber components (master cylinder seals and gaskets, scraper, gaiter, caliper joining gaskets, dust cap) are made of special compound resisting to the brake fluid action but not to the etching action of mineral oils, diesel oil, or solvents which are sometimes used to wash down the byke. Accordingly, it is strongly recommended to avoid any contact of these liquids with rubber parts of the brakings circuit.

For instance, it might occur that the scraper ring due to getting in contact with such liquids may, also partially, stick to the floater and so prevent it from sliding properly.

**For some unknown reasons, the caliper gaskets are somewhat subject to sticking to the plungers.**

This peculiarity may occur within a comparatively period of time (abt 2 – 4 months). This time, however, is influenced by many factors such as machining tolerance, rubber compound tolerances, ambient con-

ditions when the calipers are either stored or the machine is kept inoperative for long periods.

If an event of this kind turns up, it is necessary to proceed as follows:

**a** pull the front cylinder lever or push the pedal repeatedly for the rear cylinder till the correct pad-disc distance is obtained;

**b** if the above operation does not give satisfactory results, proceed as follows

- remove the plastic cap from the caliper;
- remove one pad and actuate the master cylinder so as to allow the plunger to come out from its housing in the caliper about 4 ÷ 6 mm (.157 – .236”),
- push in the plunger taking care not to damage it, or the disc, or the rubber components;
- re-fit the pad;
- proceed likewise for the other pad;
- operate as indicated at a).

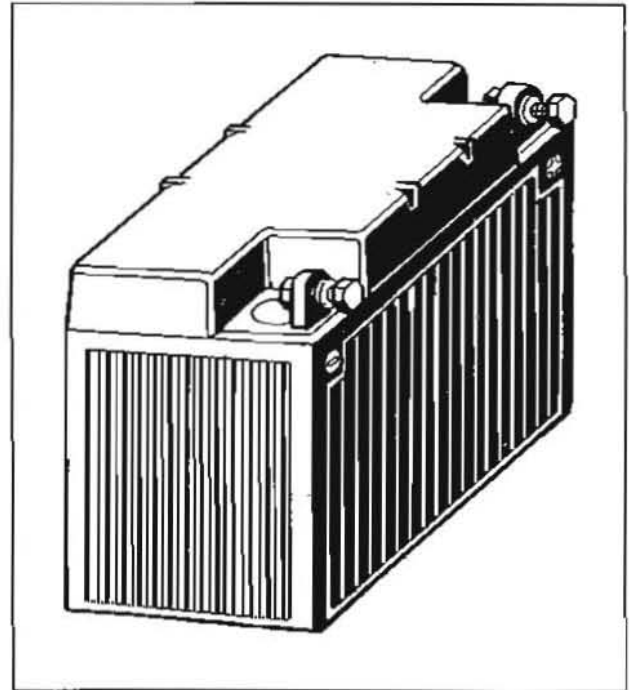
*Note* When carrying out the above operations make sure the pad position is not reversed.



## 17 ELECTRICAL EQUIPMENT

The electrics consist of:

- battery;
- starter motor;
- electronic boxes;
- pickups (mounted on timing cover);
- rotor (metal block mounted on crankshaft);
- ignition coils;
- rectifier;
- regulator;
- terminal block with fuses (4 fuses - 16 A);
- relay for starter motor;
- relay for flash lights;
- headlight;
- tail light;
- turn light lamps;
- ignition key switch;
- light switch;
- turn light switch, horn, flash lighting;
- start and stop switch;
- horn;
- panel indicator lights: neutral (orange), parking and town driving (green), oil pressure (red), high beam (blue), generator (red).



162

### 17.1 BATTERY («A» fig. 162)

These models fit a 12V battery with a 20 Ah capacity which is directly charged by the generator. Access to the battery is obtained by raising the seat using special lever «A» in fig. 20 and disconnecting its anchoring rubber strap «A» and cables «B» and «C» (See fig. 163) and taking out the battery from its housing.

#### a Putting a new dry battery in service

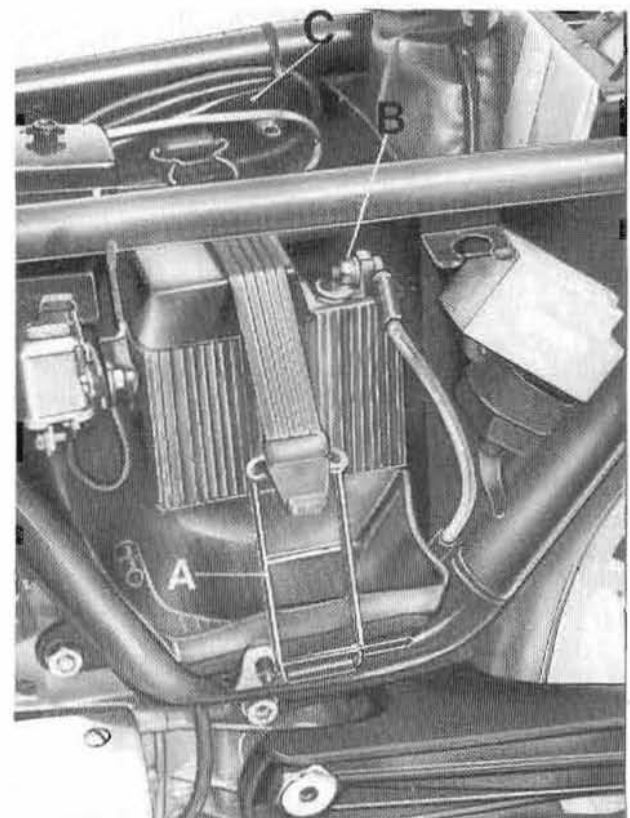
1 Remove seal and undo the plugs. In each cell introduce sulphuric acid for batteries with a specific gravity of 1.26 (30° Bé), at a temperature of + 15° C (59° F).

Correct level is when the acid skims the top of the plate separator or splash guard.

2 Let the battery rest for about 2 hours.

3 Charge the battery for 6-9 hours at an intensity equal to about 1/10th of its capacity until the acid reaches a specific gravity of 1.27 = 31° Bé constantly for at least 3 hours charge.

4 After the battery is charged, level up the acid, plug up, and clean terminals accurately.



163

**b Maintenance in service**

Climate	Specific gravity at filling	Specific gravity at end of charge	Max temperature permissible during charge
<b>Temperate</b> (usually under 32° C (90° F))	1260	1270 ÷ 1280	50° C (122° F)
<b>Tropical</b> (usually over 32° C (90° F))	1230	1220 ÷ 1230	60° C (140° F)

- 1 Ensure the electrolyte level tops always the plate separators. Do this adding only distilled water. Never add sulphuric acid.
- 2 Should too frequent water additions be required, it is best to have the electric circuits checked as the battery works under heavy load and will quickly wear out.
- 3 The electric system should also be checked when the battery shows a tendency to discharge.
- 4 If a battery (new or used) is left inoperative for a certain period of time, it should be re-charged every month.
- 5 Always keep the terminals well clean, keeping them greased with pure vaseline jelly.
- 6 Always keep the top battery cover thoroughly clean, avoiding overflows of acid which reduce insulation and corrode the battery housing.

**NB** If the battery is to operate in tropical climates (average temperature higher than 33° C (91° F)) it is recommended to reduce the acid gravity to 1.230.

**c Measuring specific gravity and temperature of electrolyte (fig. 164)**

This operation should be done periodically on each cell after checking the acid level. To make this control, use a suitable hydrometer as shown in fig. 164. The temperature is measured using a round end thermometer completely immersed in the electrolyte of the cell concerned.

**d Correction of the specific gravity reading in respect of temperature**

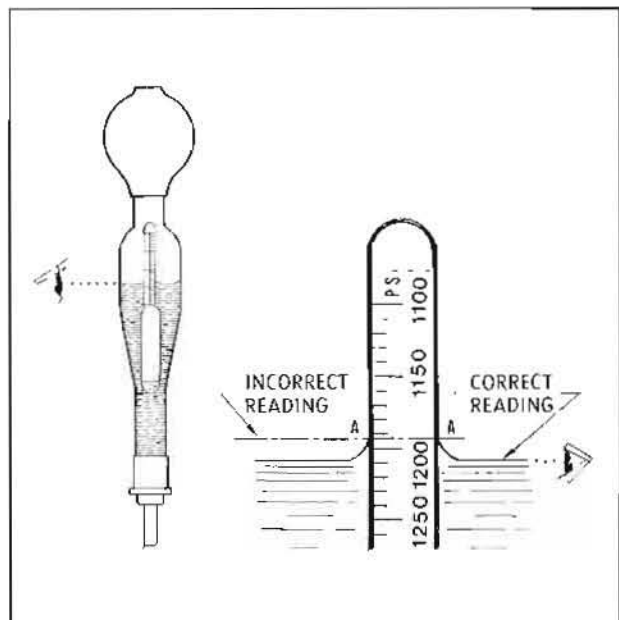
All readings should be brought down to the standard temperature of 25° C (77° F). For each 10° C (50° F) difference it is necessary to add or detract 7 g/l to bring the reading down to the said value of 25° C.

- For example, a reading of 15° C (59° F) = 1.290 sp. g;
  - the corresponding gravity brought to 25° C will be 1290 — 7 = 1283 g/l.
- A reading at 35° C (95° F) = 1275 g/l.

The corresponding gravity at a temperature of 25° C (77° F) will be 1275 + 7 = 1282 sp.g. This correction factor should always be within 1270 ÷ 1280.

When measuring specific gravity, the following precautions should be taken:

- take the reading at eye level holding the tube vertically, and ensuring the float is free (See fig. 148);
- after measurement put back the acid in the cell from where it was taken;
- if any drop of acid has dripped, dry them with a wollen cloth;
- the following table indicates the specific gravity ratings in respect to climate.

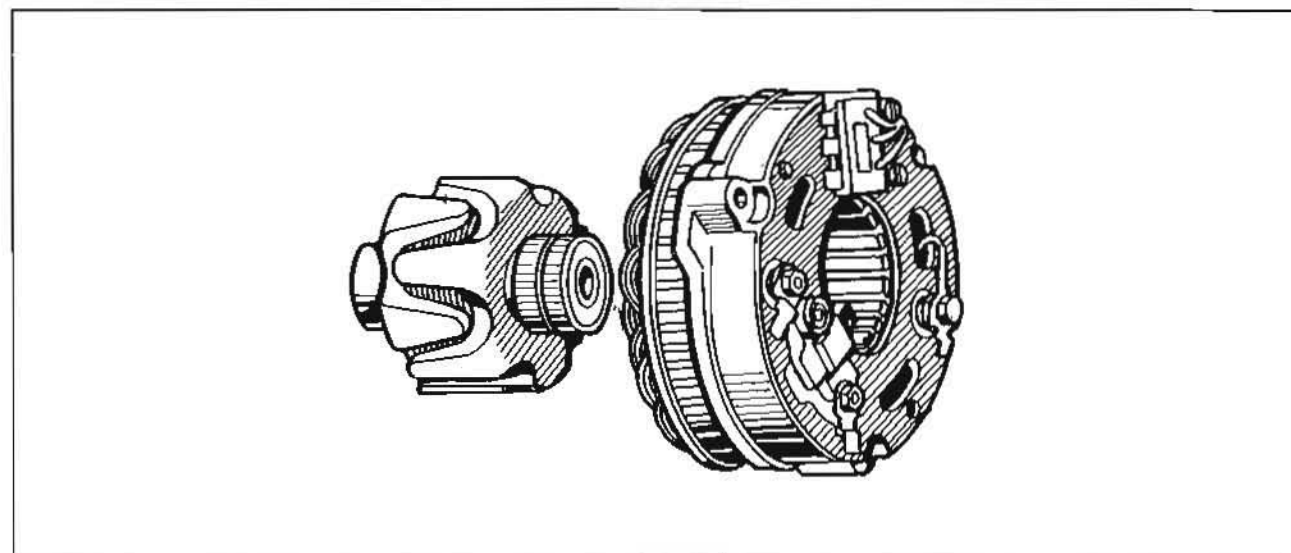


**17.2 ALTERNATOR** («A» in fig. 165)

Main features	BOSCH G1 (R) 14 V 20 A 21 N. 0120340002
Output	280 W - 14 A
Current intensity	20 Ah
Charge starting	1000 rpm.
Peak revs	10000 rpm.
Direction of rotation (seen from commutator side)	Clockwise
Max permissible eccentricity	0.06 mm (.0023")
Field winding resistance	3.4 Ohm + 10%
3-phase winding resistance of stator (A.C.)	.38 Ohm + 10%

**a Testing the alternator on a bench**

Output test	Load	Top speed
Output data (with regulator)	4 A	1250 rpm
	13 A	2100 rpm
	20 A	6750 rpm



**17.3 REGULATOR**

Main features	BOSCH AD 1/14 N. 0190601009
Test speed	4500 rpm
Test load	13 Ah
Adjusting voltage	13.9 ÷ 14.8

**17.4 RECTIFIER**

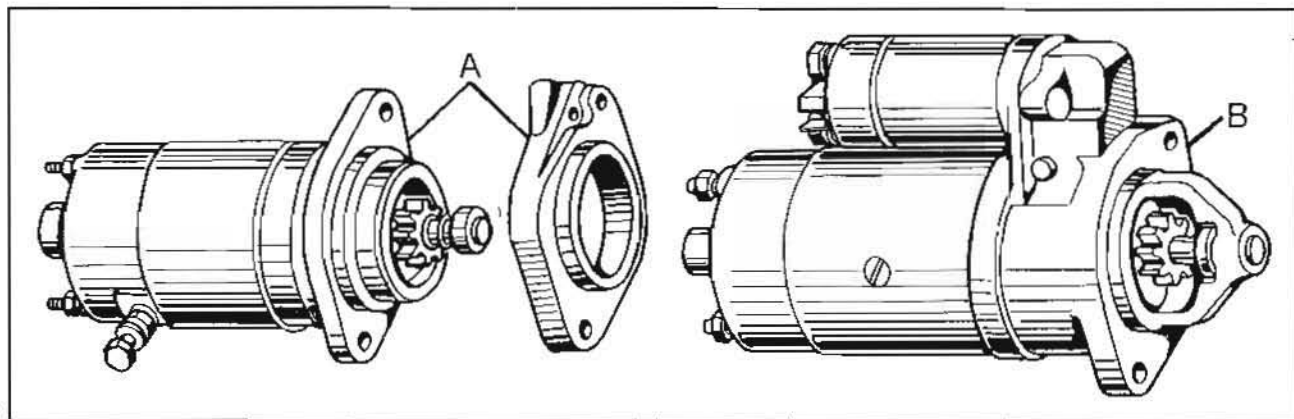
Brand	BOSCH 14 V - 22 A - N. 0197002003
-------	-----------------------------------

17.5 STARTER MOTOR (part N. 0.001.160.010) («A» in fig. 166)

Main features	BOSCH DG 12 V - .4 HP
Voltage	12 V
Output	.4 HP
Pinion	8 teeth - mod. 2.5
Rotation (pinion side)	Anticlockwise
Brush pressure	750 ÷ 1600 gr
Minimum brush length	11.5 mm (.45")

a Electric tests

Operation	Voltage V	Current A	Speed rpm	Torque kgm - ft/lbs
Unloaded	11,5	35 ÷ 55	9000 ÷ 11000	
In short	8,5	340 ÷ 430	—	0.8 (5.5 ft/lbs)
	7,5	300 ÷ 390	—	0.7 (4.7 ft/lbs)



166

17.6 STARTER MOTOR N. 0.001.157.016 («B» in fig. 166)

Main features	BOSCH (DF 12V .7 KW)
Voltage	12 V
Output	.7 KW
Pinion	8 teeth mod. 2.5
Rotation	Anticlockwise
Brush pressure	800 ÷ 900 gr
Minimum brush length	11.5 mm (.45")

a Electric test

Operation	Voltage V	Current A	Speed rpm	Torque kgm <sup>3</sup> - ft/lbs
Unloaded	11,5	20 ÷ 40	6500 ÷ 8500	
In short	9	320 ÷ 400	—	.92 (6.1 ft/lbs)
	8	280 ÷ 360	—	.82 (5.5 ft/lbs)

## 17.7 ELECTRONIC IGNITION

The electronic ignition device requires practically no maintenance as it consists of parts not subject to mechanical wear.

Accordingly no periodical servicing is needed except to any electronic component (electronic boxes or pickups) or in the electrical connections.

### a Operation

With the ignition circuit closed, the current from the battery passes through the electronic switch (transistor) inside the electronic box and goes to the primary circuit of the ignition coil. During the rotation of the rotor, when the metal block «A» on the same gets near the metal tips of magnetic pickup «B», this will generate an electric impulse that goes to the transistor inside the box (See fig. 167 and 171), causing the primary circuit of the coil to be cut off.

Accordingly, the high tension required for the ignition is generated in the secondary winding of the coil itself. From here it goes to spark plug «B» through lead «C» (fig. 167/1).

The pulse sent by the magnetic pickup is independent from the battery voltage.

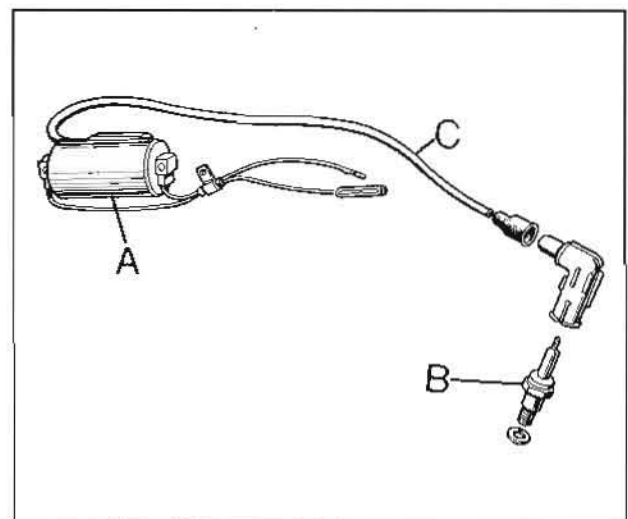
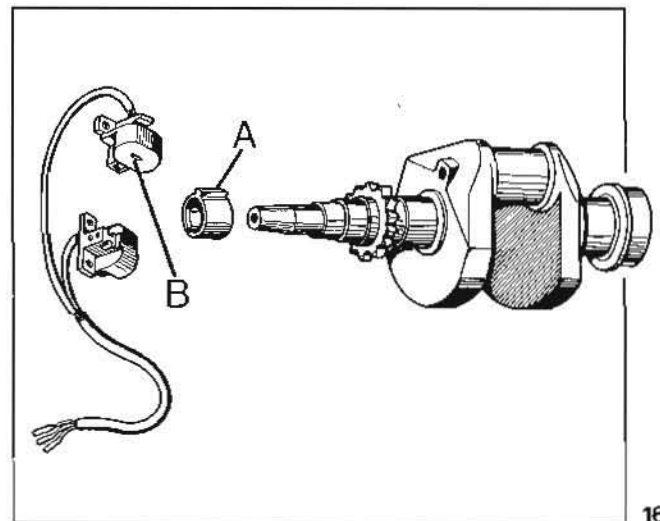
### b Warning

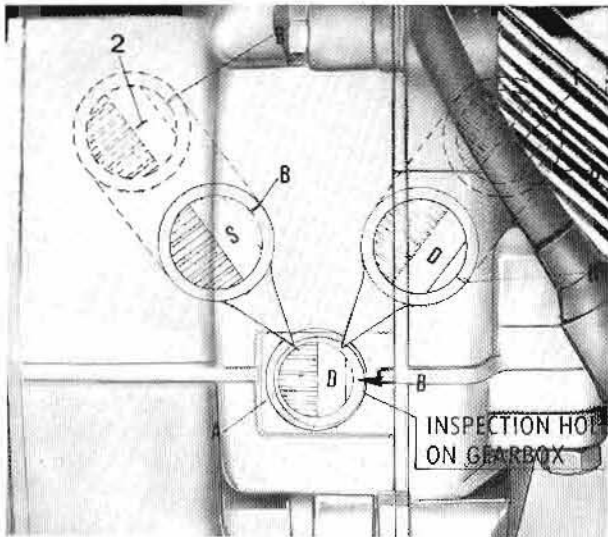
- Reversing the battery poles can cause damage to the electronic box.
- To re-charge battery it is advisable to disconnect it from the electrical system to prevent damaging the electronic box. This applies also whenever any welding operation is done on the vehicle frame.
- The H.T. coils and the electronic boxes are purposely located in well ventilated positions to allow a correct heat dispersion. It is recommended, therefore, not to make any changes or modifications that may reduce or hinder the air flow to these components.
- With the engine still, don't forget to disconnect the ignition switch to prevent battery discharge or possible damage to the ignition system (especially the H.T. coils).

### c Data for electrically checking the magnetic pickups

In case of irregular ignition operation, check the efficiency of the pickups:

- Circuit resistance with pickup body at the temperature of about 20° C (68° F) : 220 Ohm ± 15. For this test use a ohmmeter connected to the cable terminals of the pickup.





168

#### d Manual adjustment of ignition timing

Proceed as follows.

- 1 undo the screws and remove the generator cover,
- 2 remove rubber cap from inspection hole «A» on the clutch housing (fig. 168);
- 3 undo the 3 stator securing screws to timing cover;
- 4 undo the generator rotor securing screw. In the screw hole introduce pin part N. 14 92 66 00 (42 in fig. 28), screw in again the generator screw until the rotor is heard detaching from the crankshaft and then remove the rotor;

5 undo the screws and remove the pickups cover (pick-up).

6 revolve the crankshaft to where by looking through inspection hole «A» (fig. 168) letter «D» on the flywheel is in the middle of said hole «A» (right piston at TDC) - See fig. 168 «B»;

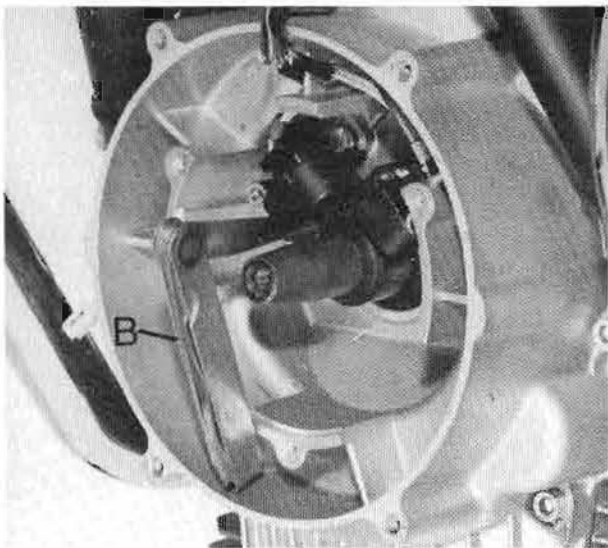
7 ensure mark «E» on the pickup is perfectly aligned with mark «H» on the crankshaft control sleeve. If not aligned, it is necessary to shift the pickup after loosening screws «C» (fig. 169);

8 revolve the crankshaft in a direction opposite the normal running direction and ensure that the center line of rotor block «E» is perfectly aligned with the mark on pickup «F»;

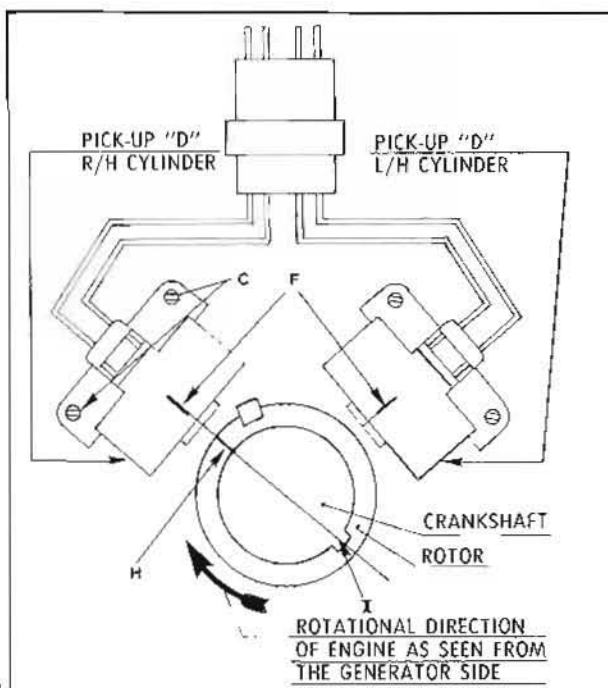
9 insert feeler gauge blade «B» between block «E» and the pickup metal tips «G» and ensure the gap is as recommended ( $0.20 \div 0.30 \text{ mm} = .0078 \div .011''$ ). If gap «A» is not as specified, restore it by loosening screws «C» and suitably shifting pickup «D» (fig. 169);

10 repeat the controls as specified at 6 and 7.

11 the procedure for checking ignition timing for the left cylinder is the same as for the right cylinder except that the crankshaft has to be rotated until letter «S» is seen through inspection hole «A» (fig. 168) i.e. L/H cylinder piston at TDC to be at the center of hole «A» and mark «F» on the pickup for the left cylinder is in line with mark «H» (fig. 169) on the crankshaft sleeve (rotor). Finally re-check clearance as indicated at 8 and 9.



169



169

Note In case control sleeve «A» is removed from the crankshaft, when re-fitting it it is necessary to ensure the relieved section (see arrow D) is fitted inwards (see fig. 75) while mark «E» will have to be visible from the outside.

The left pickup has a yellow mark. The right pickup has a blue mark.

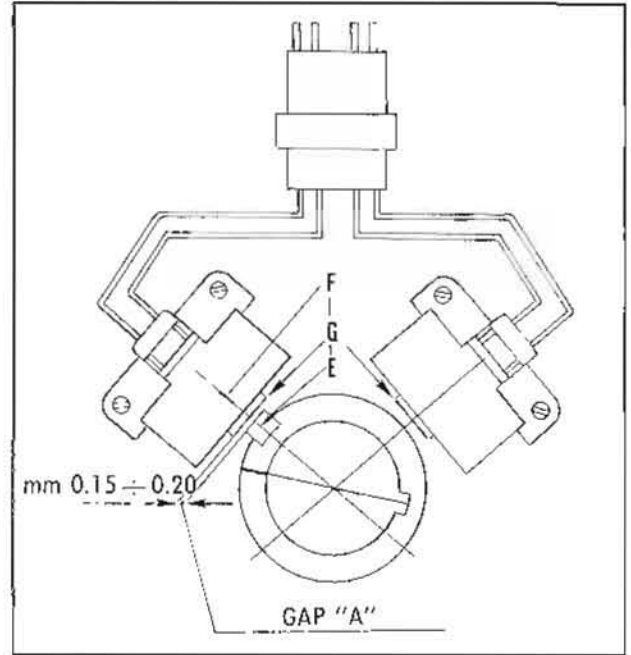
#### e Adjusting ignition timing by the aid of a special tool

Operate as from point 1 to 5 in the previous chapter, fit tool 19 92 80 00 (44 in fig. 170) after removing the rotor, and check that marks «A» on the tool are in line with the marks on pickup «B», also that the tool pickup clearance is nil as it is already contemplated on the tool.

If the above does not occur, operate as follows:

- if the marks are not lined up: loosen the pickup fixing screws on the cover and shift the pickup to the position where the marks are in line with those traced on the tool;
- if there is play between pickup probes and tool: loosen the pickup securing screws on the cover and take the play up completely;
- If it is not possible to insert the tool on the crankshaft: loosen the pickup securing screws and move the pickup just sufficiently to allow the tool to be fitted and take up the eventual play;
- in any case, after carrying out any one of the above operations, before removing the tool from the crankshaft it is necessary to tighten the pickup retaining screws to the cover, after checking the alignment of the marks.

For electrical connections, see ignition diagram (fig. 171).



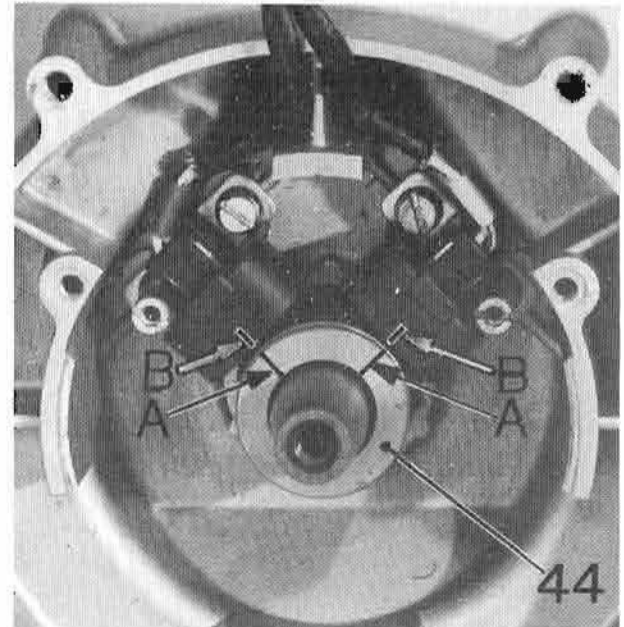
169

### 17.8 CHECKING IGNITION TIMING USING A STROBE LAMP (See fig. 172)

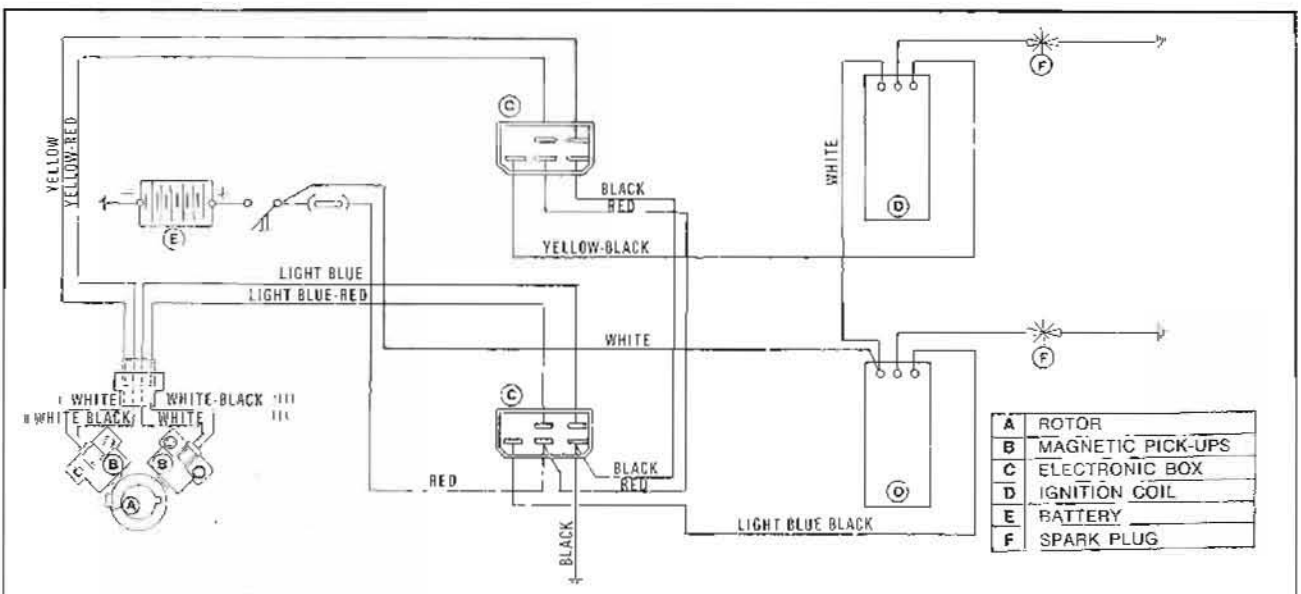
Main purpose of using a strobe lamp for this check is to ensure the electronic boxes and especially the automatic advance (max) are correctly timed.

#### a Checking timing of the R/H cylinder

- remove rubber cap from inspection hole «A» on the R/H side of the clutch housing;
- mark off with light paint the maximum advance mark («1» and «2» for both cylinders) on the fly-wheel (See fig. 168);
- connect cable «B» of lamp «E» to the R/H cylinder spark plug;
- connect the strobe lamp clamped cables «C» and «D» to battery terminals (+ to + and - to -);



170



171

- after checking the electrical connections, start the engine and run it up to its normal operating temperature. Then gradually increase the speed up to 5000 ÷ 5500 rpm (See rev-counter on instrument panel);

- at this stage, direct the strobe lamp beam to inspection hole «A» and ensure that mark 1 on the flywheel is in the middle of the inspection hole itself (See «B» in fig. 168).

If not in the center, it is necessary to control the efficiency of the electronic boxes.

### b Checking timing of the L/H cylinder

Proceed exactly as for the right cylinder except that the strobe lamp cable is connected to the L/H cylinder spark plug.

With the engine running at 5000 ÷ 5500 rpm, mark «2» on the flywheel should show up at the center of inspection hole «A». (See «B», fig. 168).

### c Ignition data

Advance (See dwg fig. 172/1).

- Max advance 35° at 5000 ÷ 5500 rpm.
- Gap between rotor block and pickup probes (on timing cover): 0.20 ÷ 0.30 mm (.0078 ÷ .011").

### d Spark plug

Recommended spark plug brands:

- Marelli CW 9 LP
- Bosch W 260 T 30
- Lodge 2 HLN

Points gap: 0.6 mm (.023").

When re-fitting the spark plugs ensure to properly start them by hand for a few turns to prevent stripings and then to complete the operation with a plug wrench, possibly on a cold engine.

*In any case, the plug should be replaced every 10000 km (6000 miles) even if they appear to be still in good condition.*

## 17.9 ELECTRIC EQUIPMENT

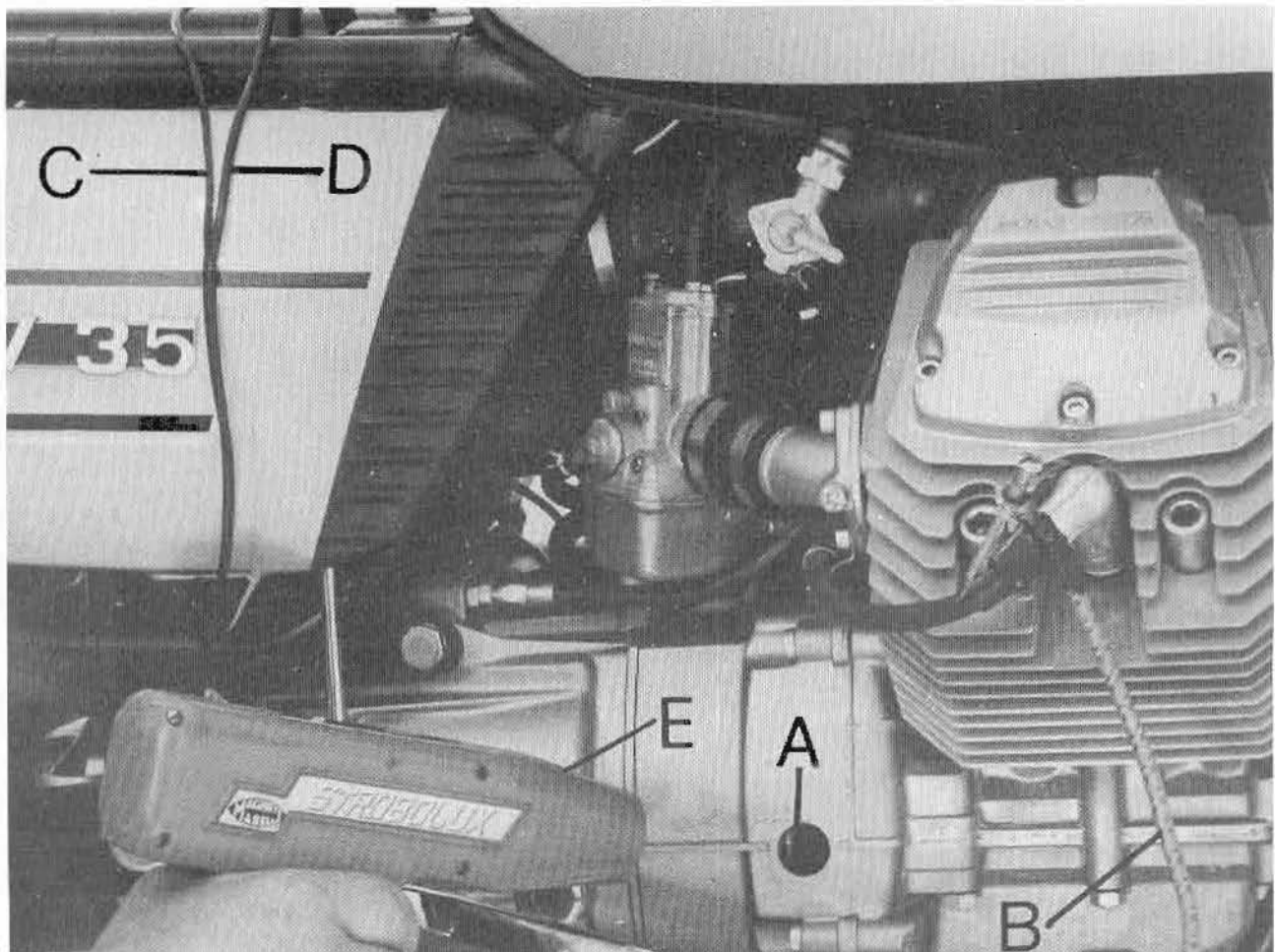
### a Headlight (See fig. 173)

Diameter of headlight «A» is 170 mm (6.69") and it is bolted on the fork covers.

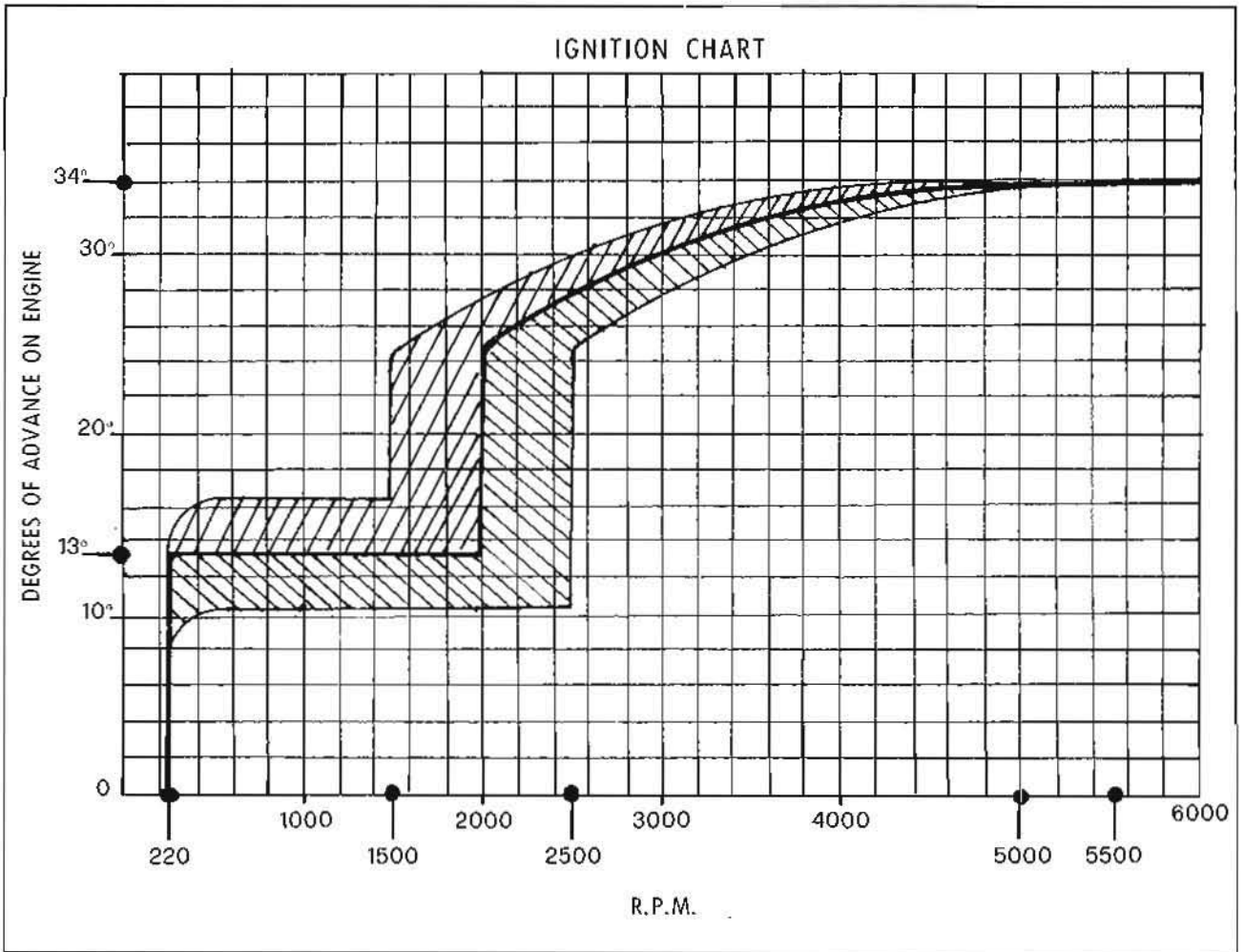
It is fitted with 2 bulbs: one for low and high beam «B», one for parking light «C».

### Replacement of headlight bulbs (See fig. 174)

Undo bottom screw «A», withdraw the beam unit, remove amp holder, and replace the bulb.







172/1

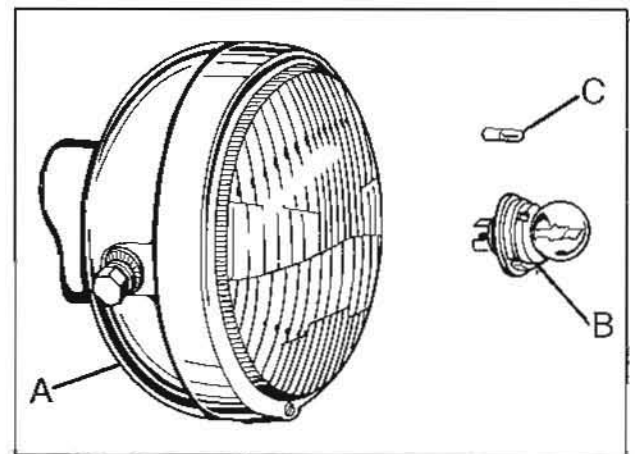
#### Adjusting the headlight beam (See fig. 174)

- horizontal setting is adjusted by screws «B»;
- vertical setting is adjusted by screws «C» and moving the headlight up and down by hand to the correct height.

The center of the high beam must not be higher than 0.865 mts (34") measured at 3 meters (117") distance with the byke off the stand and the rider astride it.

#### b Tail light (See fig. 175)

These models fit a special type tail light «A» with 2 bulbs: 1 for stop light, 1 for parking and town driving light. It is located on the rear mudguard.



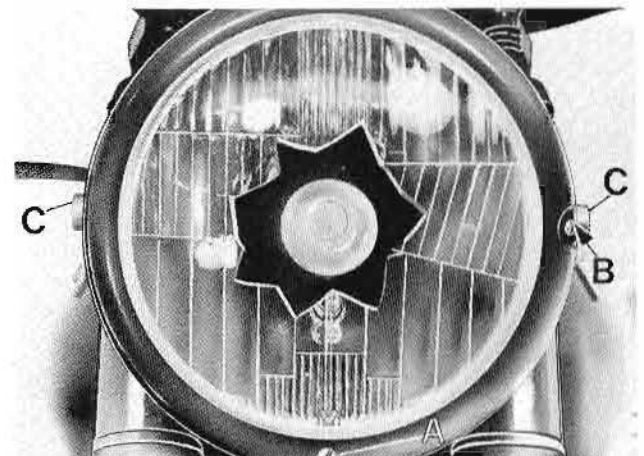
173

#### Bulb replacement (See fig. 176)

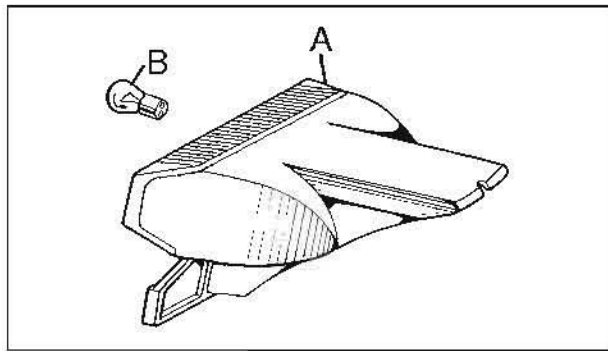
To replace the bulbs, undo screws D, remove reflector, push bulb inwards turning to the left and slip it off the socket.

#### c Front and rear turn lights (fig. 177)

2 front light turn indicators «A» on a bracket secured to the front frame down tube and 2 rear indicators «B» secured to the rear mudguard.



174



175

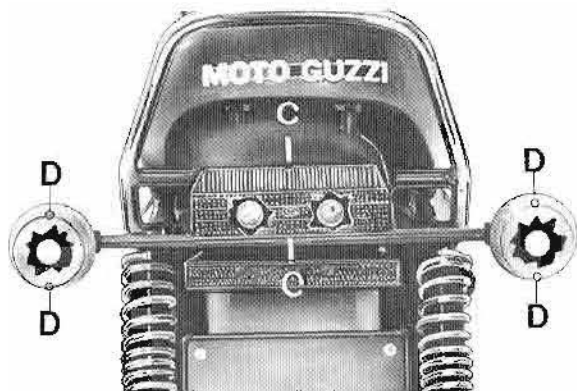
### Replacement of turn light bulbs

Undo screws «E» securing the reflectors to the turn signal light, push the bulb inward turning to the left, and take it off its socket.

**Note** In refitting the reflectors, tighten the screws uniformly and not excessively to prevent breakages.

### d Panel board - Speedometer - Rev-counter (See fig. 178)

To replace bulb «A» from speedometer «B», from rev-counter «C» and the lighted indicators «D» on panel «E» it is necessary to withdraw the speedo and rev-counter sockets, also sockets «G» from the panel. Replace then the burnt out bulbs.



176

### e Bulbs (12 V)

#### ■ Headlight:

- high and low beam 45/40 W («B» in fig. 174);
- parking light 3 W («C» in fig. 174).

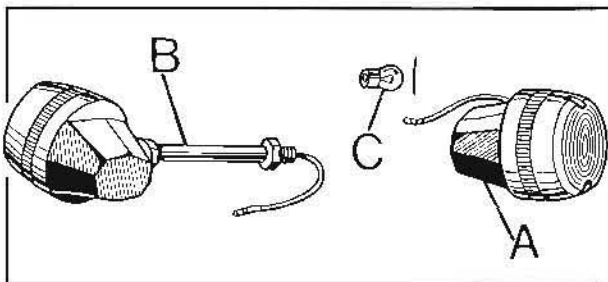
#### ■ Tail light:

- number plate, parking and stop light 5/21 W («B» in fig. 176).

#### ■ Turn signal indicators: 21 W («C» in fig. 176).

#### ■ Warning lights on panel: 1,2 W («E» in fig. 178).

#### ■ Speedo and rev-counter illumination: 3 W («D» in fig. 178).



177

### f Horn («A» in fig. 179)

Brand: «Belli» (9012/2) - current absorption 3 A.

### Overhaul and repair of horn

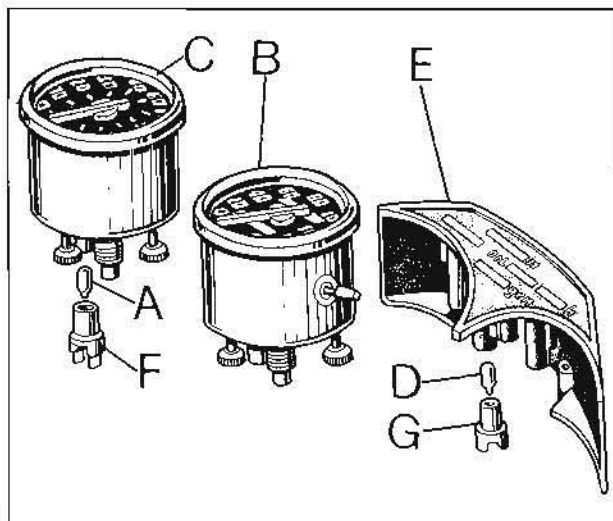
If the horn has lost its tone or has failed altogether, ensure first that the trouble is not in any other component the electric system.

If the horn does not emit any sound, check the efficiency of the button and if all cables are properly screwed down.

If the sound is faint, ensure its fixing bolt is tight.

If the horn sounds continuously, check the ground contact in the connection from button to horn.

If all these controls are negative, it is obvious that the fault lies in the horn itself and it should be entrusted for repair to the makers or to a highly qualified workshop.

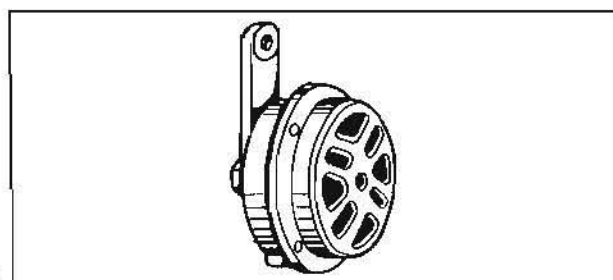


178

### g Cables

Ensure all cables are in perfect state. If scraped or cracked anywhere, replace them.

**NB** Ensure that all additional accessories are connected to terminals that can stand the extra load in order not to go beyond the terminal capacity and so avoid damage the electric system.



179

## 18 KEY TO WIRING DIAGRAM

(fig 180)

- 1 Speedometer (bulb 3 W - 12 V)
- 2 Rev-counter (bulb 3 W - 12 V)
- 3 High beam warning light (bulb 1.2 W - «h» blue)
- 4 Oil pressure warning light (bulb 1.2 W - 12 V - «oil» - red)
- 5 Neutral warning light (bulb 1.2 W - 12 V - «n» - orange)
- 6 Parking light indicator (bulb 1.2 W - 12 V - «l» - green)
- 7 Generator warning light (bulb 1.2 W - 12 V - «gen» - red)
- 8 Low beam
- 9 High beam
- 10 Front parking light (bulb 3 W - 12 V)
- 11 Right front turn signal (bulb 21 W - 12 V)
- 12 Left front turn signal (bulb 21 W - 12 V)
- 13 3-way connector
- 14 12-way connector
- 15 Light and engine starting switch (3 positions)
- 16 Control device for: turn signals, horn and flashing light, lighting
- 17 Control device for engine starting and stopping
- 18 Horn
- 19 Magnetic pickups
- 20 4-way connector AMP
- 21 Rotor
- 22 Oil pressure switch
- 23 Neutral position switch
- 24 Flashing light relay
- 25 Rectifier
- 26 Alternator
- 27 Regulator
- 28 Battery
- 29 Rear brake switch
- 30 Front brake switch
- 31 Electronic box, left cylinder
- 32 Electronic box, right cylinder
- 33 Turn signal flasher unit
- 34 Ignition coil
- 35 Terminal block with fuses
- 36 Starting relay
- 37 Starting motor
- 38 Right rear turn signal (bulb 21 W - 12 V)
- 39 Left rear turn signal (bulb 21 W - 12 V)
- 40 Rear stop light
- 41 Number plate lighting and rear parking light
- 42 Tail light

} bulb 40/45 W - 12 V

} 2 bulbcs 21/5 W - 12 V

### CABLE COLOURS

Bleu	=	Blue
Nero	=	Black
Bianco	=	White
Verde	=	Green
Grigio	=	Grey
Viola	=	Violet
Arancione	=	Orange
Rosso	=	Red
Rosa	=	Pink
Marrone	=	Brown
Giallo	=	Yellow
Azzurro	=	Light blue
Azzurro-Nero	=	Light blue-Black
Bleu-Nero	=	Blue-Black
Bianco-Nero	=	White-Black
Azzurro-Rosso	=	Light blue-Red
Giallo-Rosso	=	Yellow-Red
Verde-Grigio	=	Green-Grey
Verde-Nero	=	Green-Black
Rosso-Nero	=	Red-Black

### FUSES

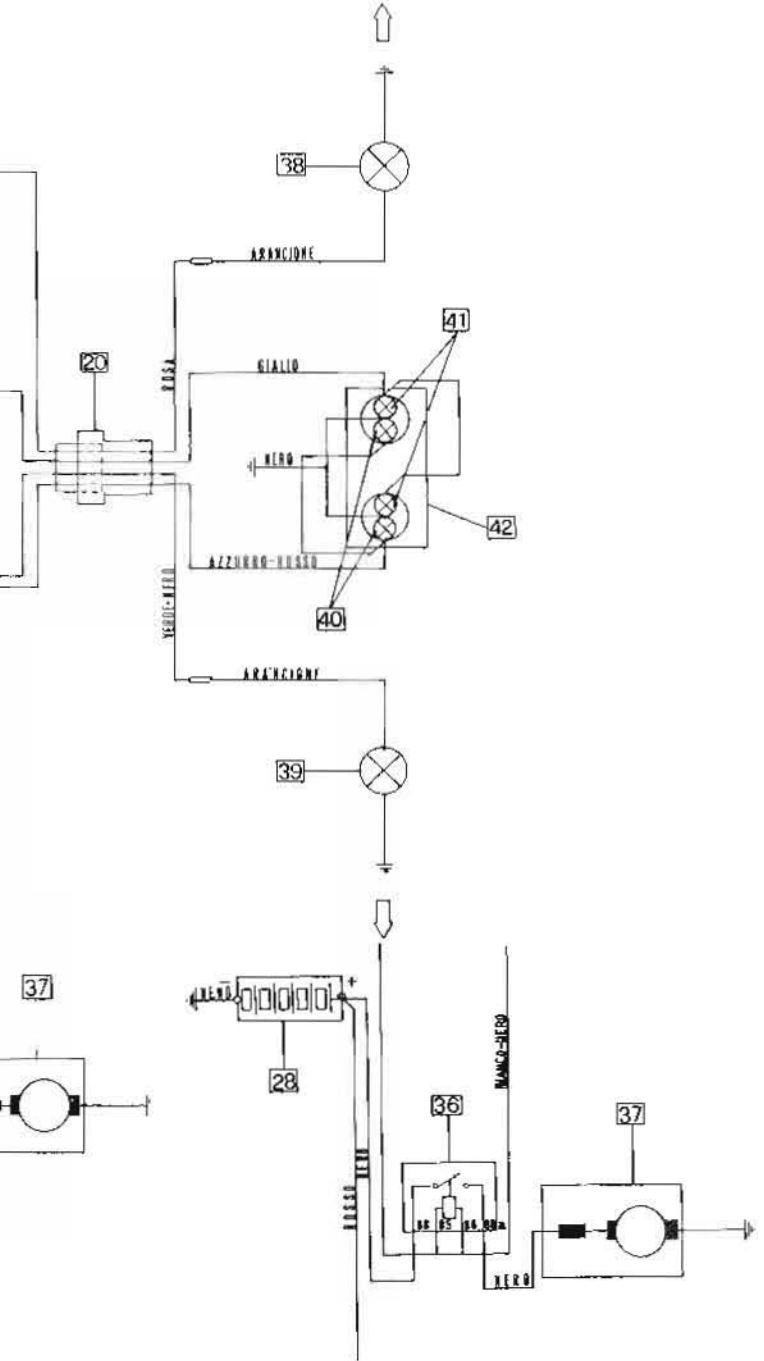
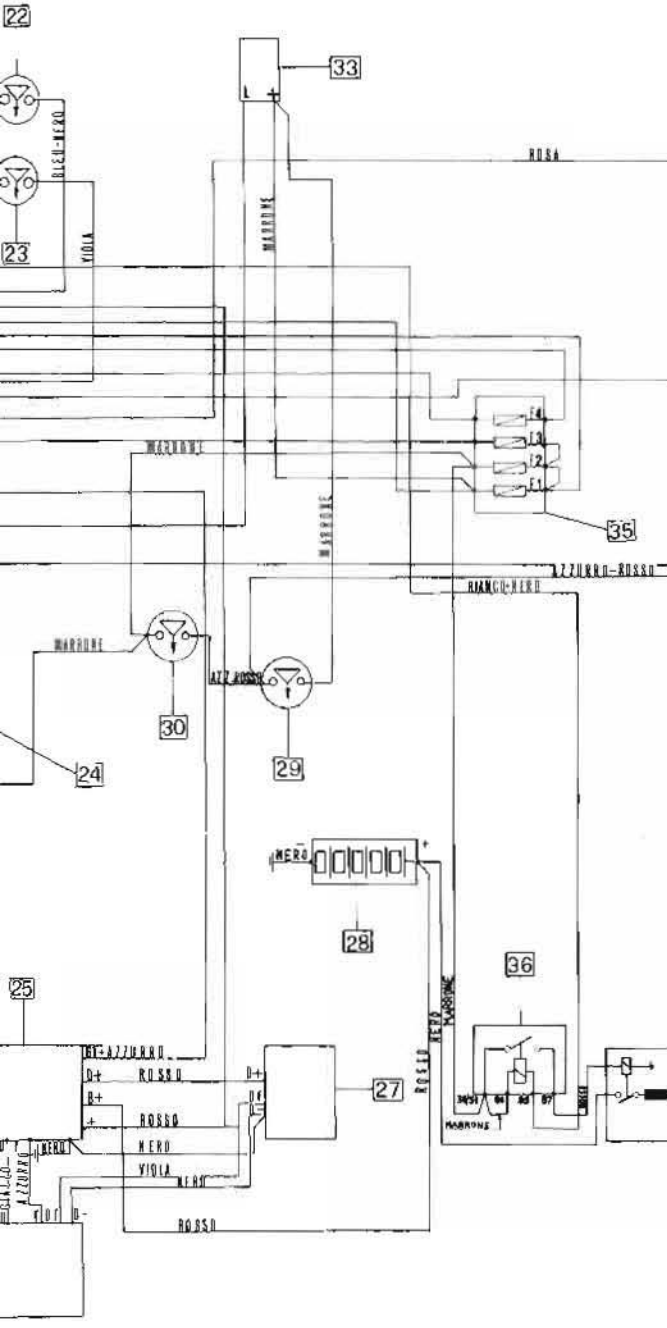
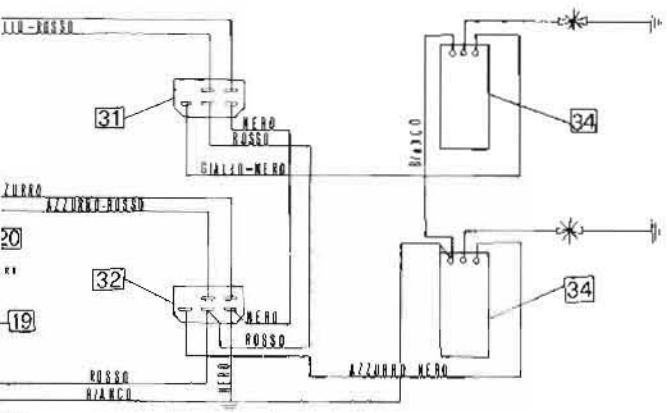
**N. 1:** Stop light (rear brake) - Turn signals.

**N. 2:** Starting relay - Stop light (front brake) - flashing light relay - horn

**N. 3:** Warning lights (gen-oil-n) - High beam and warning - Low beam.

**N. 4:** Parking light (front and rear) - Instrument lighting - Warning light «l».





**18.1 KEY TO WIRING DIAGRAM - POLICE**  
(fig. 181)

- 1 Speedometer (bulb 3 W - 12 V)
- 2 Rev-counter (bulb 3 W - 12 V)
- 3 High beam warning light (bulb 1.2 W - «h» blue)
- 4 Oil pressure warning light (bulb 1.2 W - 12 V - «oil» - red)
- 5 Neutral warning light (bulb 1.2 W - 12 V - «n» - orange)
- 6 Parking light indicator (bulb 1.2 W - 12 V - «l» - green)
- 7 Generator warning light (bulb 1.2 W - 12 V - «gen» - red)
- 8 Low beam                    }
- 9 High beam                    } bulb 40/45 W - 12 V
- 10 Front parking light (bulb 3 W - 12 V)
- 11 Right front turn signal (bulb 21 W - 12 V)
- 12 Left front turn signal (bulb 21 W - 12 V)
- 13 3-way connector
- 14 12-way connector
- 15 Light and engine starting switch (3 positions)
- 16 Control device for: turn signals, horn and flashing light, lighting
- 17 Control device for engine starting and stopping
- 18 Horn
- 19 Magnetic pickups
- 20 4-way connector AMP
- 21 Rotor
- 22 Oil pressure switch
- 23 Neutral position switch
- 24 Flashing light relay
- 25 Rectifier
- 26 Alternator
- 27 Regulator
- 28 Battery
- 29 Rear brake switch
- 30 Front brake switch
- 31 Electronic box, left cylinder
- 32 Electronic box, right cylinder
- 33 Turn signal flasher unit
- 34 Ignition coil
- 35 Terminal block with fuses
- 36 Starting relay
- 37 Starting motor
- 38 Right rear turn signal (bulb 21 W - 12 V)
- 39 Left rear turn signal (bulb 21 W - 12 V)
- 40 Rear stop light                    }
- 41 Number plate lighting and rear parking light    } 2 bulbes 21/5 W - 12 V
- 42 Tail light

- 43 Switch actualing simultaneous flashing of all turn indicator lights
- 44 Syren relay
- 45 Syren relay switch
- 46 Radio switch
- 47 Fuses (15 A)
- 48 Syren

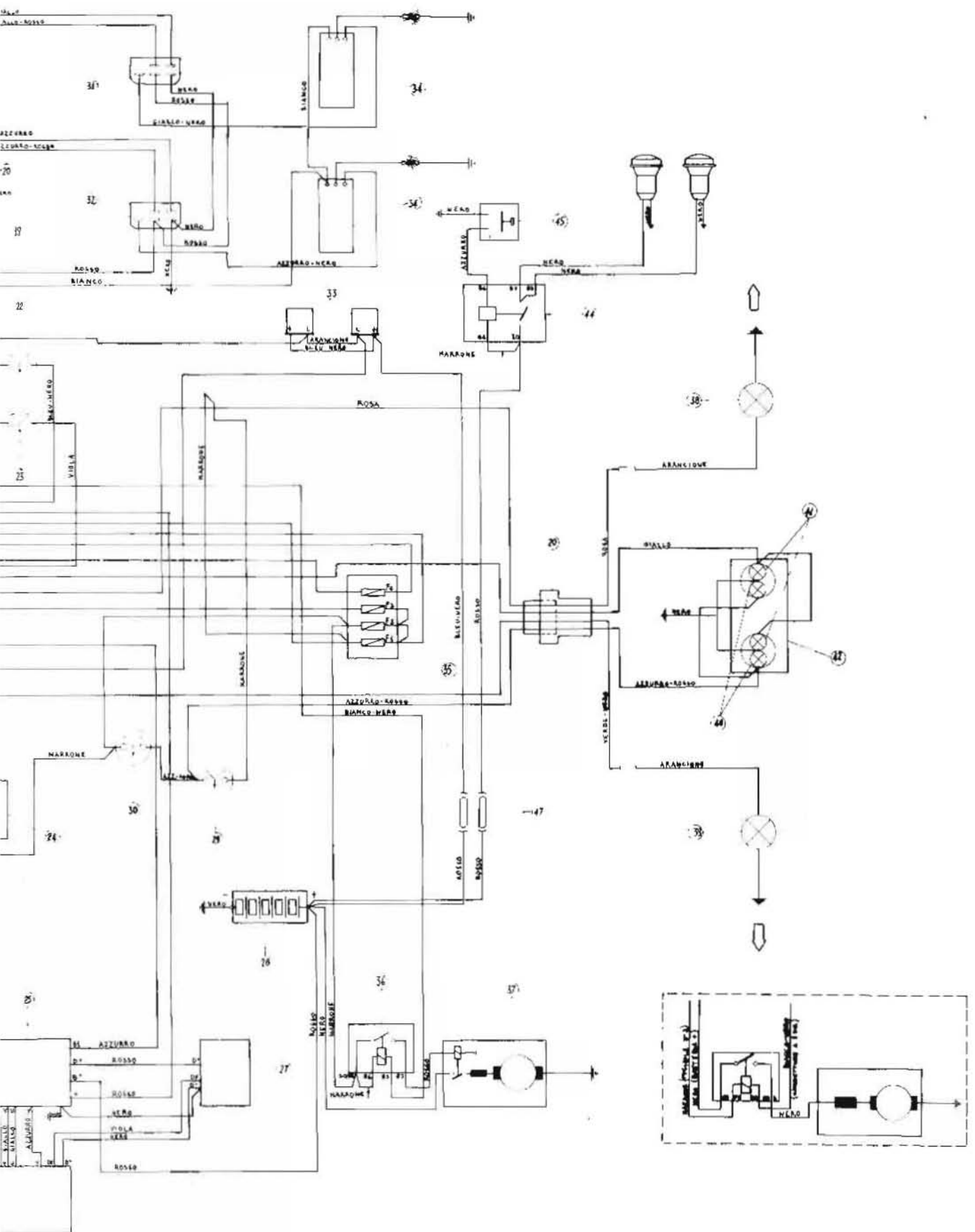
**CABLE COLOURS**

Bleu	=	Blue
Nero	=	Black
Bianco	=	White
Verde	=	Green
Grigio	=	Grey
Viola	=	Violet
Arancione	=	Orange
Rosso	=	Red
Rosa	=	Pink
Marrone	=	Brown
Giallo	=	Yellow
Azzurro	=	Light blue
Azzurro-Nero	=	Light blue-Black
Bleu-Nero	=	Blue-Black
Bianco-Nero	=	White-Black
Azzurro-Rosso	=	Light blue-Red
Giallo-Rosso	=	Yellow-Red
Verde-Grigio	=	Green-Grey
Verde-Nero	=	Green-Black
Rosso-Nero	=	Red-Black

**FUSES**

- N. 1:** Stop light (rear brake) - Turn signals.
- N. 2:** Starting relay - Stop light (front brake) - flashing light relay - horn.
- N. 3:** Warning lights (gen-oil-n) - High beam and warning - Low beam.
- N. 4:** Parking light (front and rear) - Instrument lighting - Warning light «l».







MILLIMETERS TO DECIMAL (Inches) EQUIVALENT											
mm =	DECIMAL (Inches)	mm =	DECIMAL (Inches)	mm =	DECIMAL (Inches)	mm =	DECIMAL (Inches)	mm =	DECIMAL (Inches)	mm =	DECIMAL (Inches)
1	.039	21	.827	41	1.614	61	2.402	81	3.189	125	4.921
2	.079	22	.866	42	1.654	62	2.441	82	3.228	150	5.906
3	.118	23	.906	43	1.693	63	2.480	83	3.268	175	6.890
4	.157	24	.945	44	1.732	64	2.520	84	3.307		
5	.197	25	.984	45	1.772	65	2.559	85	3.346		
6	.236	26	1.024	46	1.811	66	2.598	86	3.386	200	7.874
7	.276	27	1.063	47	1.850	67	2.638	87	3.425	225	8.858
8	.315	28	1.102	48	1.890	68	2.677	88	3.465	250	9.843
9	.354	29	1.142	49	1.929	69	2.717	89	3.504	275	10.827
10	.394	30	1.181	50	1.969	70	2.756	90	3.543		
11	.433	31	1.220	51	2.008	71	2.795	91	3.583	300	11.811
12	.472	32	1.260	52	2.047	72	2.835	92	3.622	325	12.795
13	.512	33	1.299	53	2.087	73	2.874	93	3.661	350	13.780
14	.551	34	1.339	54	2.126	74	2.913	94	3.701	375	14.764
15	.591	35	1.378	55	2.165	75	2.953	95	3.740		
16	.630	36	1.417	56	2.205	76	2.992	96	3.780	400	15.748
17	.669	37	1.457	57	2.244	77	3.031	97	3.819		
18	.709	38	1.496	58	2.283	78	3.071	98	3.858		
19	.748	39	1.535	59	2.323	79	3.110	99	3.898		
20	.787	40	1.575	60	2.362	80	3.150	100	3.937		

DECIMAL (Inches) TO METRIC EQUIVALENT											
DECIMAL (Inches)	= mm	DECIMAL (Inches)	= mm	DECIMAL (Inches)	= mm	= mm	DECIMAL (Inches)	= mm	DECIMAL (Inches)	= mm	DECIMAL (Inches)
.001	.025	.120	3.048	.320	8.128	.520	13.208	.720	18.288	.920	23.368
.002	.051	.130	3.302	.330	8.382	.530	13.462	.730	18.542	.930	23.622
.003	.076	.140	3.556	.340	8.636	.540	13.716	.740	18.796	.940	23.876
.004	.102	.150	3.810	.350	8.890	.550	13.970	.750	19.050	.950	24.130
.005	.127	.160	4.064	.360	9.144	.560	14.224	.760	19.304	.960	24.384
.006	.152	.170	4.318	.370	9.398	.570	14.478	.770	19.558	.970	24.638
.007	.178	.180	4.572	.380	9.652	.580	14.732	.780	19.812	.980	24.892
.008	.203	.190	4.826	.390	9.906	.590	14.986	.790	20.066	.990	25.146
.009	.229	.200	5.080	.400	10.160	.600	15.240	.800	20.320		
.010	.254	.210	5.334	.410	10.414	.610	15.494	.810	20.574	1.000	25.400
.020	.508	.220	5.588	.420	10.668	.620	15.748	.820	20.828	2.000	50.800
.030	.762	.230	5.842	.430	10.922	.630	16.002	.830	21.082	3.000	76.200
.040	1.016	.240	6.096	.440	11.176	.640	16.256	.840	21.336	4.000	101.600
.050	1.270	.250	6.350	.450	11.430	.650	16.510	.850	21.590	5.000	127.000
.060	1.524	.260	6.604	.460	11.684	.660	16.764	.860	21.844	10.000	254.000
.070	1.778	.270	6.858	.470	11.938	.670	17.018	.870	22.098	15.000	381.000
.080	2.032	.280	7.112	.480	12.192	.680	17.272	.880	22.352	20.000	508.000
.090	2.286	.290	7.366	.490	12.446	.690	17.526	.890	22.606	25.000	635.000
.100	2.540	.300	7.620	.500	12.700	.700	17.780	.900	22.860	50.000	1.270.000
.110	2.794	.310	7.874	.510	12.954	.710	18.034	.910	23.114	100.000	2.540.000

# INCHES AND MILLIMETERS CONVERSION CHART

FRACTIONS (Inches) TO DECIMALS (Inches) and METRIC EQUIVALENTS									
FRACTION (Inches)	=	DECIMAL (Inches)	=	mm	FRACTION (Inches)	=	(Inches) DECIMAL	=	mm
		1/64	.016	.397	5/8		.625		15.875
	1/32		.031	.794		21/32	41/64	.641	16.272
		3/64	.047	1.191				.656	16.669
1/16			.063	1.588			43/64	.672	17.066
		5/64	.078	1.984	11/16			.687	17.463
	3/32		.094	2.381			45/64	.703	17.859
		7/64	.109	2.778		23/32		.719	18.256
							47/64	.734	18.653
1/8			.125	3.175	3/4		.750		19.050
		9/64	.141	3.572			49/64	.766	19.447
	5/32		.156	3.969		25/32		.781	19.844
		11/64	.172	4.366			51/64	.797	20.241
3/16			.188	4.763	13/16			.813	20.638
		13/64	.203	5.159			53/64	.828	21.034
	7/32		.219	5.556		27/32		.844	21.431
		15/64	.234	5.953			55/64	.859	21.828
1/4			.250	6.350	7/8		.875		22.225
		17/64	.266	6.747			57/64	.891	22.622
	9/32		.281	7.144		29/32		.906	23.019
		19/64	.297	7.541			59/64	.922	23.416
5/16			.313	7.938	15/16			.938	23.813
		21/64	.328	8.334			61/64	.953	24.209
	11/32		.344	8.731		31/32		.969	24.606
		23/64	.359	9.128			63/64	.984	25.003
3/8			.375	9.525	1	1.000			25.400
		25/64	.391	9.922	2	2.000			50.800
	13/32		.406	10.319	3	3.000			76.200
		27/64	.422	10.715	4	4.000			101.600
7/16			.438	11.113	5	5.000			127.000
		29/64	.453	11.509	10	10.000			254.000
	15/32		.469	11.906	15	15.000			381.000
		31/64	.484	12.303	20	20.000			508.000
1/2			.500	12.700	25	25.000			635.000
		33/64	.516	13.097	50	50.000			1270.000
	17/32		.531	13.494	100	100.000			2540.000
		35/64	.547	13.891					
9/16			.563	14.288					
		37/64	.578	14.684					
	19/32		.594	15.081					
		39/64	.609	15.478					