FIAT

# MODEL 850

Sedan
Coupe
Roadster
Family
Idroconvert

# SHOP MANUAL

FIAT - SERVICE DEPARTMENT - TURIN

FIAT

# MODEL 850

## SEDAN - COUPE
## ROADSTER - FAMILY
## IDROCONVERT

# SHOP MANUAL

FIAT - SERVICE DEPARTMENT - TURIN

# SECTION INDEX

**IMPORTANT**

All the dimensions in metric units shown in this publication are the official ones.

Dimensions are also given in British and American units for prompt reference, and they have been calculated to a degree of approximation according to the need for accuracy in individual measurements.

# Section 1

## GENERAL INFORMATION

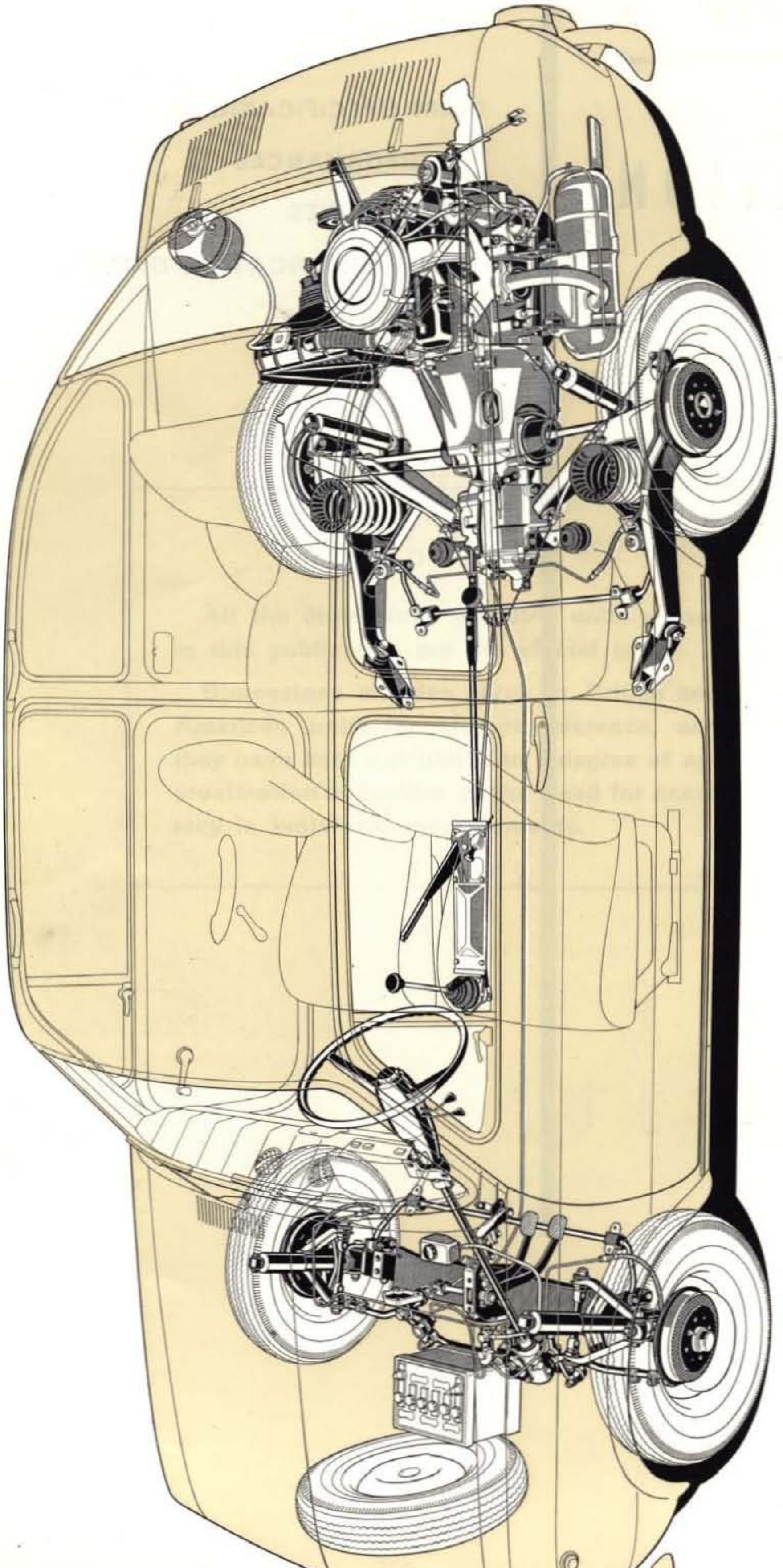


Fig. 1 - Phantom view of the mechanical units of the vehicle.

# GENERAL INFORMATION

**Specifications, features and service procedures outlined in this publication are intended to apply to the Sedan Version.**

**Differing parts, data and procedures of Coupe, Roadster, Station Wagon and Idroconvert Versions, as referred to the Sedan, are described in Section 13.**

**Wear limit figures are given just for the serviceman's information and should not be taken as absolute values.**

## MAIN SPECIFICATIONS

### Identification Data.

| | | |
|---|---|---|
| Chassis type | | 100G |
| Engine type | « Standard » version | 100G.000 |
| | « Super » version | 100G.002 |

### Engine.

| | |
|---|---|
| Location | rear |
| Cycle | 4-stroke, gasoline |
| No. of cylinders | 4, in-line |
| Bore | 2.559″ (65 mm) |
| Stroke | 2.500″ (63.5 mm) |
| Piston displacement | 51.44 cu.in (843 cm$^3$) |
| Compression ratio: | |
| – « Standard » version | 8.0 to 1 |
| – « Super » version | 8.8 to 1 |
| Maximum horsepower (SAE): | |
| – « Standard » version | 40 |
| – « Super » version | 42 |
| at « Standard » version | 5,300 r.p.m. |
| at « Super » version | 5,300 r.p.m. |
| Maximum horsepower (DIN): | |
| – « Standard » version | 34 |
| – « Super » version | 37 |
| at « Standard » version | 4,800 r.p.m. |
| at « Super » version | 5,000 r.p.m. |
| Taxable horsepower (Italy) | 11 |
| Cooling | permanent circuit mixture |

### Clutch.

Single plate, dry.
Diaphragm-type pressure spring.

### Transmission - Differential.

Rear drive.
Gear ratios:

| | |
|---|---|
| 1st, synchromeshed | 3.636 to 1 |
| 2nd, » | 2.055 to 1 |
| 3rd, synchromeshed | 1.409 to 1 |
| 4th, » | 0.963 to 1 |
| Reverse | 3.615 to 1 |
| Hypoid final drive gear ratio | 4.625 to 1 (8/37) |

### Steering.

Worm-and-sector.

| | |
|---|---|
| Gear ratio | 13 to 1 (2/26) |
| Turning circle | 31′ 6″ (9.60 m) |

### Front Suspension.

Independent wheel.
Transversal semi-elliptic spring, upper control arms, hydraulic shock absorbers, sway bar.

| | |
|---|---|
| Toe-in (full load) | .079″ to .157″ (2 to 4 mm) |
| Camber (full load): | |
| – angle | 2° 10′ ± 15′ |
| – amount, at wheel rim | .472″ to .512″ (12 to 13 mm) |
| Caster | 9° ± 1° |

### Rear Suspension.

Independent wheel.
Coil springs, control arms, hydraulic shock absorbers, sway bar.
Rear wheel toe-in (full load) .039″ to .118″ (1 to 3 mm).

### Brakes.

| | |
|---|---|
| Drum diameter | 7.283″ (185 mm) |
| Master cylinder bore | 3/4″ |
| Bore of wheel cylinders: | |
| – front | 7/8″ |
| – rear | 3/4″. |

### Wheels and Tires.

| | |
|---|---|
| Disc wheels, size | 4.00-12″ |
| Tire size | 5.50-12″ |

Tire pressure:

| | Front | | Rear | |
|---|---|---|---|---|
| | psi | kg/cm² | psi | kg/cm² |
| — four people and luggage | 15.6 | 1.1 | 25.6 | 1.8 |
| — five people and luggage | 17.1 | 1.2 | 28.4 | 2 |

## Electric System.

Voltage . . . . . . . . . . . . . . . 12
Battery (20-hr discharge rate), capacity 36 Amp. hrs
Generator FIAT type D 90/12/16/3 CS . 230 Watts
Generator regulator FIAT type GN 2/12/16.
Starting motor FIAT type E 76-0,5/12 S Var. 9.

## Weights.

Curb weight (with water, oil, fuel, spare wheel, tool kit and accessories) . . . . . . . . 1,477 lbs (670 kg)
Accomodation . . . . . . . . 4-5 people plus 110 lbs (50 kg) luggage
Payload, maximum . . . . . . 882 lbs (400 kg)
Gross weight, full load . . . . 2,359 lbs (1,070 kg)
Distribution of gross weight on axles:
- front . . . . . . . . . . . 904 lbs (410 kg)
- rear . . . . . . . . . . . 1,455 lbs (660 kg)

## Performances.

**Speed,** maximum, under full load, with level road in good condition and run-in engine:
first gear . . . . . . . . . . 19 mph (30 km/h)
second gear . . . . . . . . . 34 mph (55 km/h)
third gear . . . . . . . . . . 53 mph (85 km/h)
fourth gear, abt:
- « Standard » version . . . 75 mph (120 km/h)
- « Super » version . . . . . 78 mph (125 km/h)

**Gradeability,** under full load, with level road in good condition and run-in engine:
first gear . . . . . . . . . . . . . . 31%
second gear . . . . . . . . . . . . . 17%
third gear . . . . . . . . . . . . . . 10%
fourth gear . . . . . . . . . . . . . . 6%

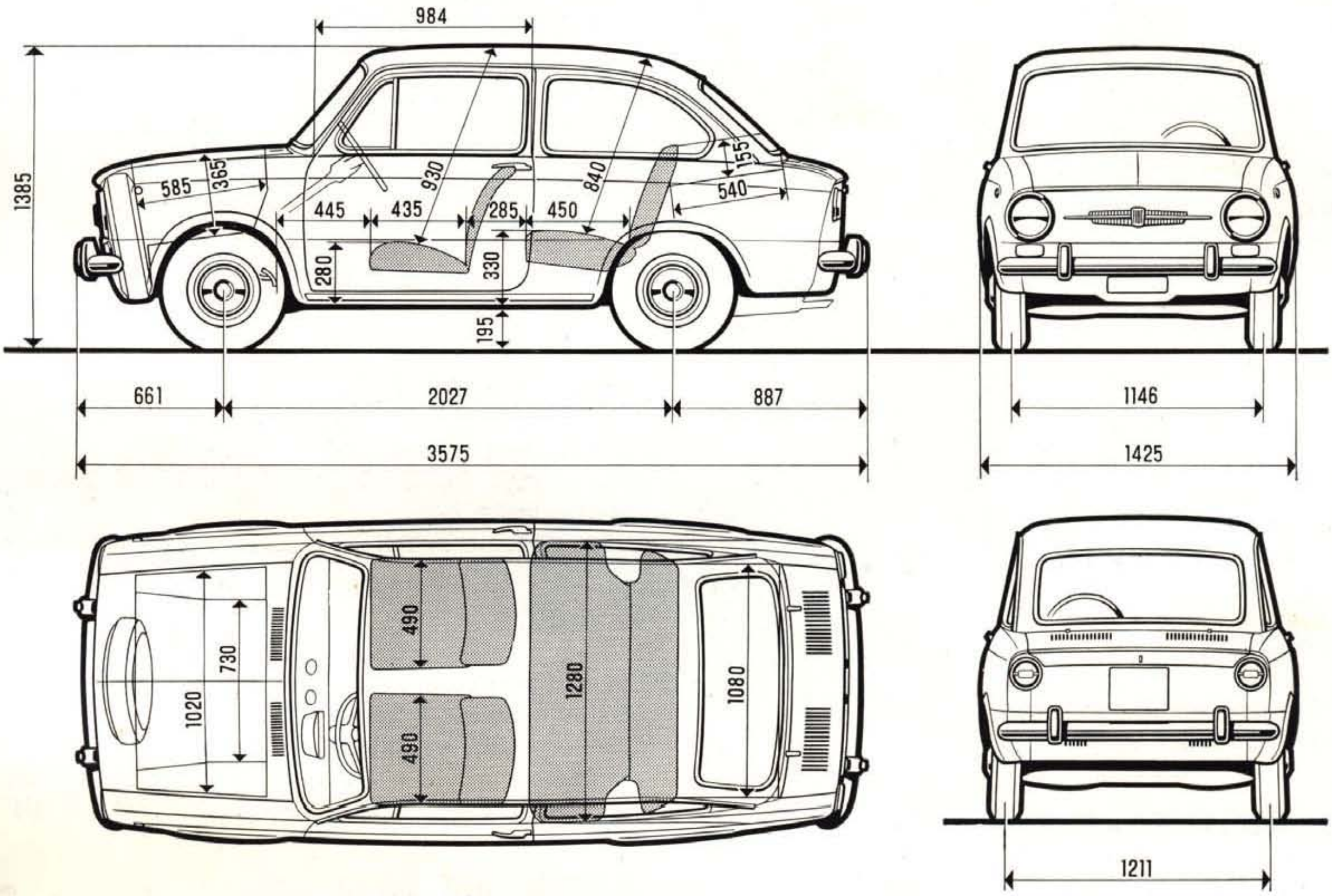



**Fig. 2 - Leading dimensions of car (metric).**

Overall height applies to an unloaded vehicle.

# CAPACITIES

| UNIT | QUANTITY | | | | FILL-IN |
|---|---|---|---|---|---|
| | Imp. units | U.S. units | lt | kg | |
| Fuel tank . . . . . . . . . . | 6.60 gals | 7.93 gals | 30 | — | 83 octane gasoline (R. M.), « Standard » version; 92 octane gasoline, min. (R. M.), « Super » version |
| Radiator, engine and heating system . . . . . . . . . . . | 1.65 | 1.98 | 7.5 | — | Mixture of water and FIAT Paraflu 11 fluid (50% by volume) (1) |
| | pints | pints | | | |
| Sump and filter (*) . . . . . | 5.72 | 6.87 | 3.25 | 2.90 | FIAT oil (3) |
| Transmission and differential | 3.70 | 4.44 | 2.10 | 1.90 | FIAT W 90/M oil (SAE 90 EP) |
| Steering gear . . . . . . . . | 0.211 | 0.254 | 0.12 | 0.11 | FIAT W 90/M oil (SAE 90 EP) |
| Braking system . . . . . . . . | 0.457 | 0.549 | 0.26 | 0.26 | FIAT special « blue label » fluid |
| Front shock absorbers (each) | 0.299 | 0.359 | 0.170 | 0.155 | FIAT S.A.I. fluid |
| Rear shock absorbers (each) | 0.264 | 0.317 | 0.150 | 0.135 | FIAT S.A.I. fluid |
| Windshield washer reservoir | (2) | (2) | — | (2) | Water and FIAT D.P./1 fluid mixture (concentrated solution). |

(*) The total capacity of sump, pipings and crankshaft is 6.48 G.B. pts - 7.80 U.S. pts (3.3 kg). The quantity shown in the table applies to routine oil changes, which should be made every 6,000 miles (10,000 km) or six months. Every 300 miles (500 km), check oil level.
(1) The coolant has non-oxidizing, non-corrosive, non-foamy, non-scaling properties and will not freeze up to —31° F (—35° C).
(2) Pure water .66 G.B. qts - .79 U.S. qts (0.75 kilos) plus .6 oz (17 gr) solution in summer and 1.20 oz (34 gr) solution in winter.
(3) Use the following grades of oil:

| TEMPERATURE | | FIAT UNIGRADE OIL (supplement 1 level oils which fill MS sequence requirements) | FIAT MULTIGRADE OIL |
|---|---|---|---|
| Below +5° F (—15° C), minimum . . . . . . . . | | VS 10 W (SAE 10 W) | — |
| Between 32°F (0°C) and +5°F (—15°C), minimum | | VS 20 W (SAE 20 W) | 10 W 30 |
| Above 32° F (0°C), minimum | Below 95°F (35°C), maximum | VS 30 (SAE 30) | 20 W 40 |
| Above 32° F (0°C), minimum | Above 95°F (35°C), maximum | VS 40 (SAE 40) | 20 W 40 |

**WARNING** - These FIAT oils are detergent, and oils of different grade or make should not be used for topping up. If detergent oils are being used for the first time on an engine which is not new, the system should be carefully drained and flushed.

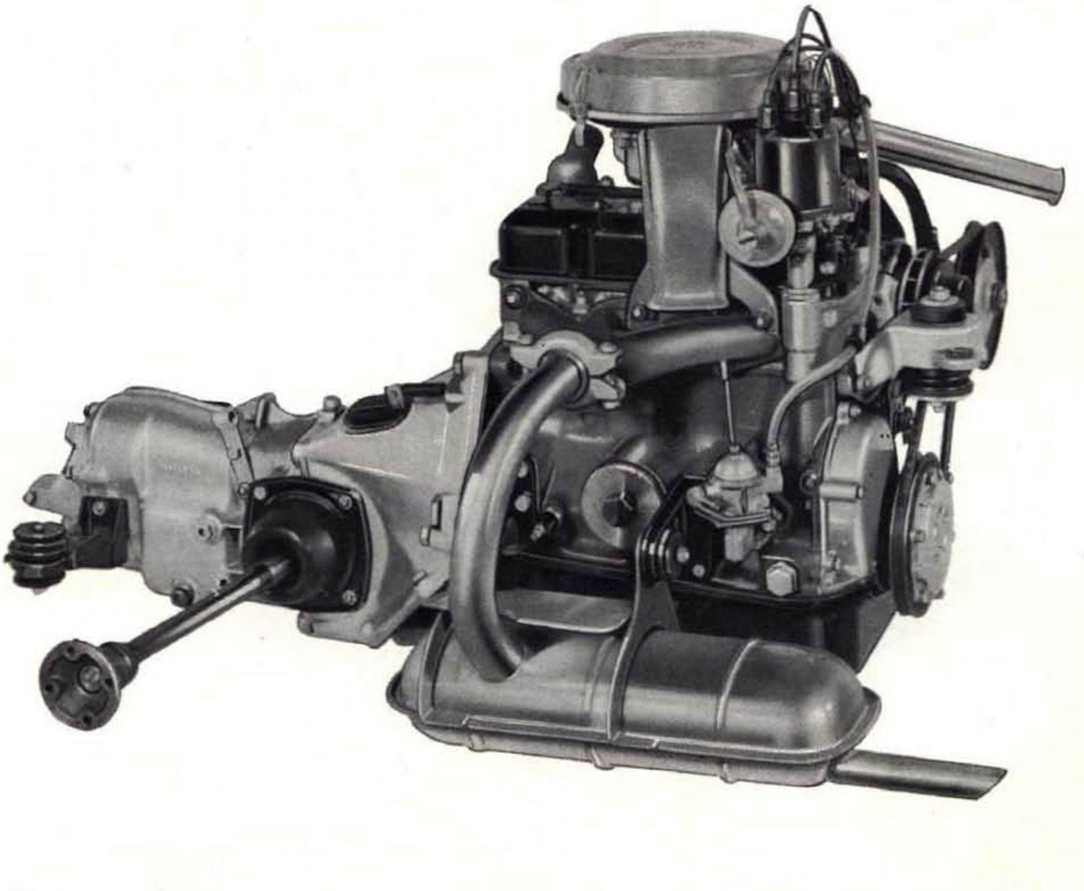
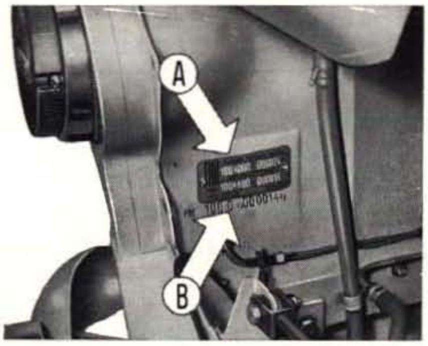


**Fig. 3.**

**Power plant (engine-clutch-transmission and differential assy).**

# UNIT IDENTIFICATION DATA



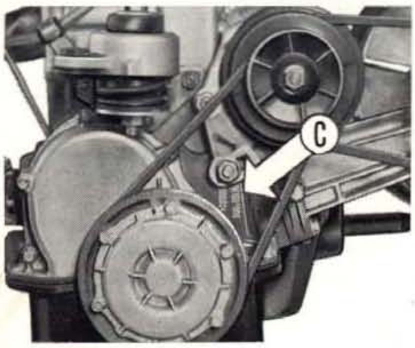




**Fig. 4.**

**Location of unit identification numbers.**

A. Unit identification plate. - B. Chassis type (100G) and serial number. - C. Engine type (100G.000 for the « Standard » version and 100G.002 for the « Super » version) and serial number.

NOTE - Starting from car with parts serial number 667161, plate "A" and stamping "B,, are located on partition wall between engine compartment and fuel tank.

## SPARE PARTS

When placing orders for spare parts, state:

– car Model;

– engine serial number or serial number for spare parts, according to whether parts for engine or running gear are requested;

– number of spare part or parts on order, as given in spare parts catalogue.

## CAR KEYS

Each new car is equipped with two sets of keys to suit:

– ignition and starting switch;

– door locks.

A code number is stamped on key bow.

To have car key duplications made through the cutting machine **Ap. 5013**, just specify the code number of the key on order and relevant description.

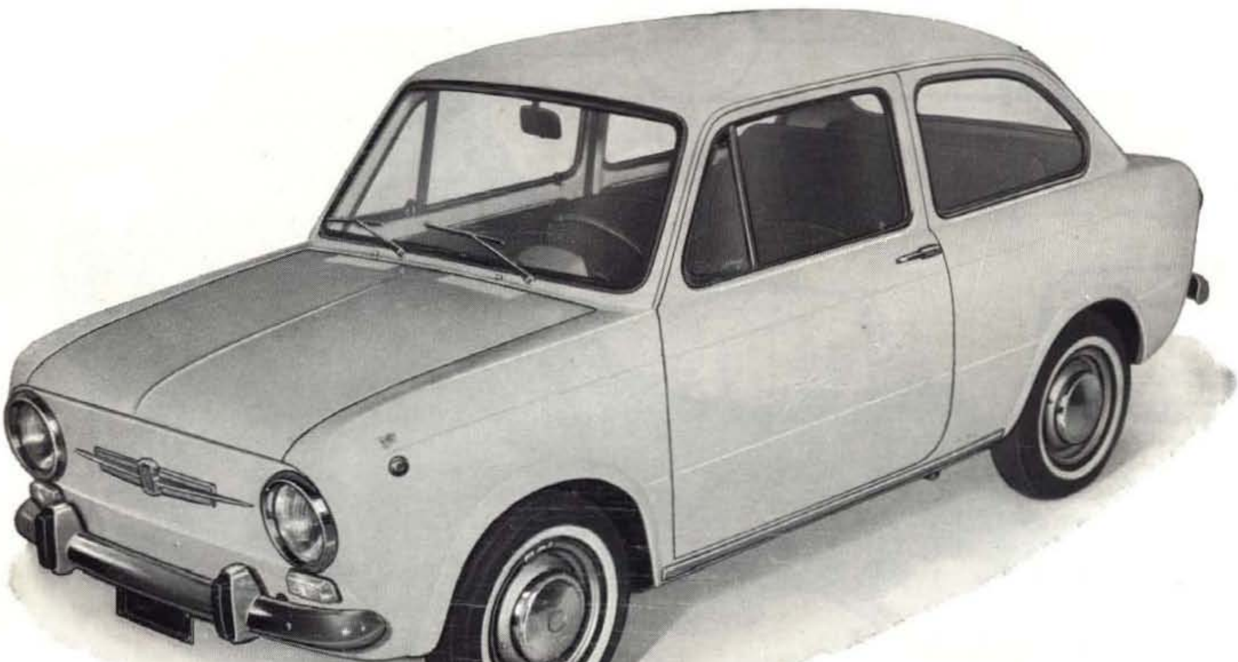


**Fig. 5**

**Car Model 850.**

# Section 2

# ENGINE



2

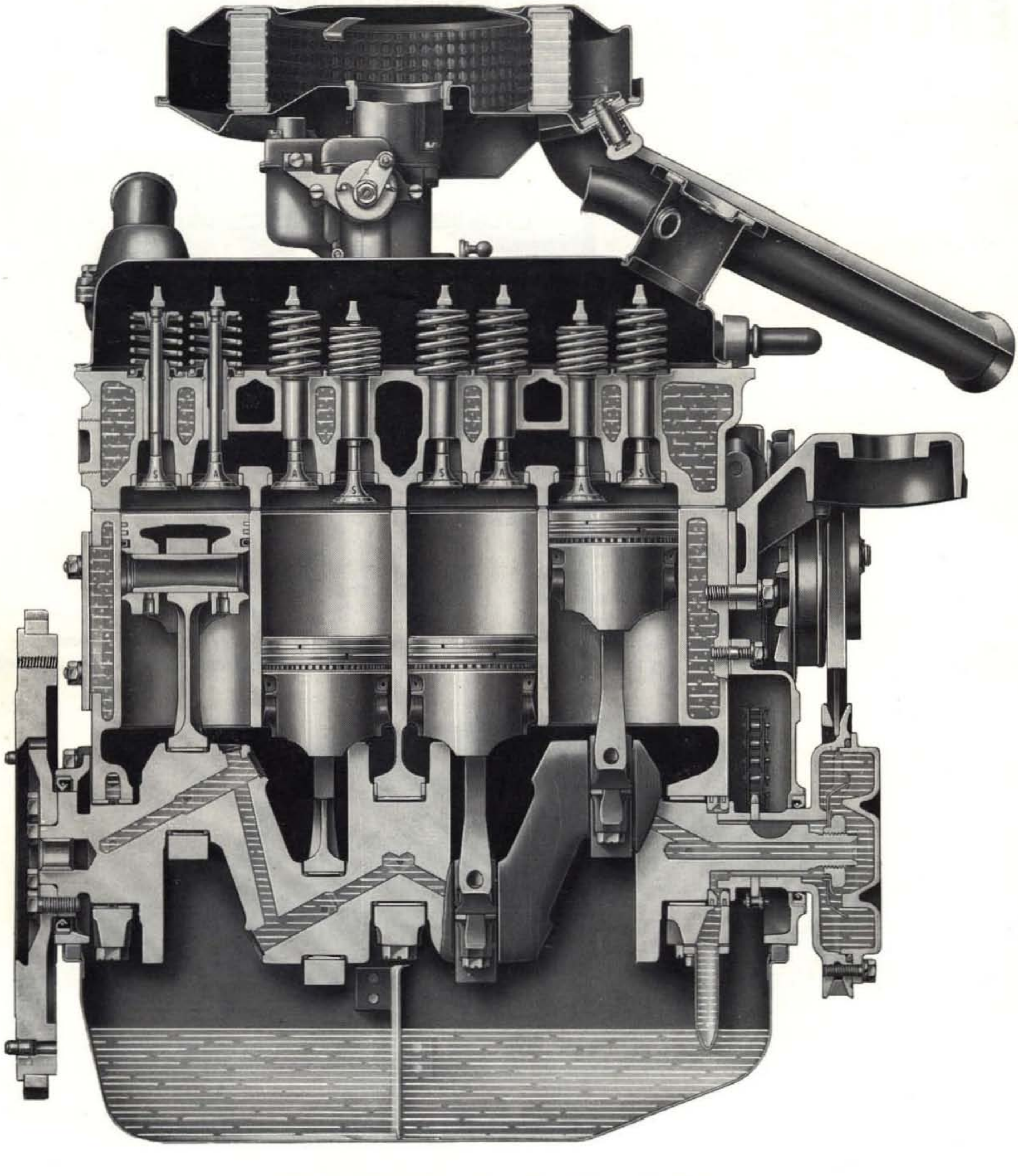


Fig. 6 - Side sectional view of engine across cylinders.

# ENGINE



## MAIN SPECIFICATIONS

| | « Standard » Version | « Super » Version |
|---|---|---|
| **Engine.** | | |
| Type | 100G.000 | 100G.002 |
| Cycle and strokes | Otto, four-stroke | |
| No. of cylinders, in line | four | |
| Bore | 2.559″ (65 mm) | |
| Stroke | 2.500″ (63.5 mm) | |
| Displacement | 51.44 cu.in (843 c.c.) | |
| Compression ratio | 8.0 to 1 | 8.8 to 1 |
| Maximum horsepower (DIN) | 34 | 37 |
| at | 4,800 r.p.m. | 5,000 r.p.m. |
| Maximum horsepower (SAE) | 40 | 42 |
| at | 5,300 r.p.m. | 5,300 r.p.m. |
| Maximum torque (DIN) | 39.8 ft.lbs (550 kgcm) | 40.5 ft.lbs (560 kgcm |
| at | 3,200 r.p.m. | 3,400 r.p.m. |
| Maximum torque (SAE) | 42.7 ft.lbs (590 kgcm) | 44.1 ft.lbs (610 kgcm) |
| at | 3,400 r.p.m. | 3,600 r.p.m. |
| Taxable horsepower (Italy) | 11 | |
| **Crankshaft.** | | |
| No. of main bearings | three | |
| Bearings | steel backed babbitt | |
| Thrust ring halves | two, intermediate bearing top | |
| Rotation | counterclockwise | |
| **Connecting Rods.** | | |
| Bearings | steel backed babbitt | |
| **Pistons.** | | |
| Type | steel-belted, slipper design | |
| First ring | compression | |
| Second ring | oil | |
| Third ring | oil radial slotted | |
| Boss bore | .079″ (2 mm) offset | |
| Pin | press fitted in small end | |

*(continued)*

**Main Specifications** *(continued)*.

| | 100G.000 | 100G.002 |
|---|---|---|
| **Valve Gear.** | | |
| Drive | chain | |
| Valves | overhead | |
| Camshaft | in crankcase | |
| **Fuel System.** | | |
| Pump type | mechanical, diaphragm | |
| Driven by | camshaft | |
| Carburetor, single: Weber or Holley Europea, type | 30 ICF | 30 ICF 1 |
| or | | |
| Solex, type | 30 PIB 4 | 30 PIB 4 |
| Air cleaner | pleated paper cartdridge | |
| Recirculation device of blow-by gases and oil vapours | | |
| **Lubrication.** | | |
| Pump type | gear | |
| Filter type | centrifugal | |
| Pressure relief valve. | | |
| Metered pressure | 42.7 to 56.9 psi (3 to 4 kg/cm$^2$) | |
| **Cooling.** | | |
| Type | permanent mixture | |
| Pump type | centrifugal | |
| Radiator type | fin and tube | |
| Fan and pump drive | belt | |
| Thermostat | engine outlet duct | |
| **Ignition.** | | |
| Type | battery, camshaft driven distributor | |
| Firing order | 1 - 3 - 4 - 2 | |
| Static advance | 11° | 10° |
| Centrifugal automatic advance (to engine) | 28° | 25° |
| Vacuum advance (to engine) | 13° | |
| Breaker point gap | .0165" to .0189" (0.42 to 0.48 mm) | |
| Spark plugs | Marelli CW 240 L - Champion N 4 | |
| – gap | .024" to .028" (0.6 to 0.7 mm) | |
| – diameter and pitch, metric | 14 × 1,25 | |
| **Starting.** | | |
| Type | motor drive | |
| Pinion drive | solenoid | |
| Control | key | |
| **Engine Mountings.** | | |
| Type | resilient, rubber blocks at three points | |

# ENGINE TROUBLE DIAGNOSIS AND CORRECTIONS

## Engine Will Not Start.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Weak battery. | 1) Check and recharge battery as recommended under « Battery ». |
| 2) Corroded or loose battery terminal connections. | 2) Clean, examine and tighten clamps to battery terminals. Replace cables and clamps if they are too much corroded. |
| 3) Defective starting motor. | 3) Locate failure and correct as recommended under « Starting Motor ». |
| 4) Damaged ignition switch contacts. | 4) Locate failure and correct as recommended under « Starting and Ignition Switch ». |
| 5) Weak coil. | 5) Check coil and replace by a new one. |
| 6) Loose or broken ignition cables from coil to distributor and from distributor to spark plugs. | 6) Examine and reset circuit or replace faulty cables. |
| 7) Cracked distributor cap. | 7) Replace cap. |
| 8) Moisture or dirt deposits on distributor cap contact points or current leads. | 8) Wipe and clean leads and points. |
| 9) Distributor breaker contact points dirty, oxidized or blackened; pitted points or excessive point gap. | 9) Clean contacts and adjust point gap as recommended under « Ignition Distributor ». |
| 10) Distributor rotor cracked, showing signs of burning or wet. | 10) Clean or replace rotor, if necessary. |
| 11) Center spring-mounted distributor cap contact worn or broken or with distorted pressure spring. | 11) Replace contact and contact spring. |
| 12) Shorted condenser or with poor insulation. | 12) Bench test condenser and replace it, if defective. |
| 13) Fouled spark plugs or excessive spark plug gap. | 13) Clean spark plugs and set gap as recommended under « Spark Plugs ». |
| 14) Improper timing (ignition). | 14) Check and set timing as recommended under « Ignition Timing ». |
| 15) Incorrect fuel level in carburetor bowl. | 15) Check fuel level in bowl and adjust it, if necessary, as recommended under « Carburetor ». |
| 16) Dirt or water in fuel line or carburetor. | 16) Remove and thoroughly clean carburetor; if trouble recurs, flush and blow fuel tank and lines. |
| 17) Defective fuel pump. | 17) Remove and rebuild fuel pump. |

## Engine Stalls.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Idling speed too low. | 1) Increase throttle opening slightly and adjust mixture rating as recommended under « Carburetor ». |
| 2) Fuel mixture too lean or too rich. | 2) Adjust mixture rating as recommended under « Carburetor ». |
| 3) Needle valve in carburetor stuck. | 3) Rebuild as recommended under « Carburetor ». |
| 4) Incorrect fuel level in carburetor bowl. | 4) Check and adjust fuel level. |
| 5) Carburetor flooding. | 5) Proceed as recommended under « Carburetor ». |
| 6) Dirt or water in fuel line or carburetor. | 6) Remove and throughly clean carburetor; if trouble recurs, flush and blow fuel tank and lines. |
| 7) Loose or corroded battery terminals. | 7) Clean terminals and tighten nuts as recommended under « Battery ». Replace cables and terminal clamps if they are too much worn. |
| 8) Loose ignition cables from coil to distributor and from distributor to spark plugs. | 8) Examine and reset circuit. |
| 9) Loose ignition switch connections. | 9) Examine and reset circuit. |
| 10) Spark plugs dirty, damp or gaps set too wide. | 10) Clean spark plugs and set gap as recommended under « Spark Plugs ». |
| 11) Distributor breaker contact points dirty, oxidized or pitted or point gap set too wide. | 11) Clean contacts and adjust point gap as recommended under « Ignition Distributor ». |
| 12) Distributor rotor contact worn. | 12) Replace distributor rotor. |
| 13) Inoperative automatic centrifugal advance. | 13) Rebuild ignition distributor as recommended in covering chapter. |
| 14) Defective coil or condenser. | 14) Inspect and replace both of them, if necessary. |
| 15) Exhaust system restricted. | 15) Thoroughly clean exhaust silencer, exhaust piping and manifold. |
| 16) Incorrect valve tappet clearance, as adjusting screws have become loose from poor tightening. | 16) Adjust tappet clearance as recommended under « Valve Mechanism ». |
| 17) Engine overheating. | 17) Check water level in expansion tank, fan and water pump drive belt tension, water pump and thermostat operation, and overhaul as required. |

## Engine Has No Power.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect ignition timing. | 1) Inspect and set ignition timing as recommended under « Ignition Timing ». |
| 2) Weak coil or condenser. | 2) Bench test coil and condenser as recommended under « Ignition Coil » and « Ignition Distributor ». Replace both parts, if necessary. |
| 3) Reduced accelerator pedal travel. | 3) Locate failure and correct it. |
| 4) Distributor rotor contact worn. | 4) Replace distributor rotor. |
| 5) Defective centrifugal or vacuum advance (distributor). | 5) Rebuild ignition distributor and vacuum advance, as recommended in covering chapters. |
| 6) Excessive play in distributor shaft. | 6) Rebuild distributor and replace damaged parts. |
| 7) Weak spring in breaker contact point. | 7) Replace distributor breaker arm, spring and point assembly. |
| 8) Distributor cam worn. | 8) Overhaul distributor and replace cam body. |
| 9) Insufficient distributor point dwell. | 9) Adjust point dwell angle as recommended under « Ignition Distributor ». |
| 10) Spark plugs dirty, damp or gap set too wide. | 10) Clean spark plugs and set gap as recommended under « Spark Plugs ». |
| 11) Low grade fuel. | 11) Use fuel with recommended octane number. |
| 12) Weak valve springs. | 12) Take down cylinder head and check spring pressure by comparing figures with those tabulated under « Valve Springs ». |
| 13) Valves sticking when hot, burned or twisted. | 13) Overhaul valves and valve guides as recommended under « Cylinder Head »; replace as required. |
| 14) Incorrect valve tappet clearance. | 14) Adjust tappet clearance as recommended on page 67. |
| 15) Worn camshaft lobes. | 15) Check valve timing and compare data with those in valve timing diagram, as shown under « Valve Mechanism »; replace camshaft, if necessary. |
| 16) Valve timing incorrect. | 16) Time valves as recommended in covering chapter. |
| 17) Poor compression. | 17) Check compression (106.7 to 113.8 psi - 7.5 to 8 kg/cm$^2$, Standard Version; 120.9 to 135.1 psi - 8.5 to 9.5 kg/cm$^2$, Super Version) using a pressure gauge; if pressure is too low, locate failure and rebuild engine. |
| 18) Defective fuel pump. | 18) Rebuild fuel pump and replace worn parts. |
| 19) Too rich or lean fuel mixture. | 19) Check calibration of carburetor jets as outlined in covering chapter; proceed as required. |
| 20) Incorrect fuel level in carburetor bowl. | 20) Check fuel level in bowl and adjust as recommended under « Carburetor ». |
| 21) Engine overheating. | 21) Check water level in expansion tank, fan and water pump drive belt tension, water pump and thermostat operation and overhaul as required. |

# Engine « Lopes » or Misses at Idle.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect carburetor idle adjustment. | 1) Adjust idle as recommended under « Carburetor ». |
| 2) Dirty or plugged jets or passages in carburetor. | 2) Remove carburetor and clean jets and passages. |
| 3) Dirt or water in fuel line or carburetor. | 3) Remove and thoroughly clean carburetor; if trouble recurs, flush and blow fuel tank and lines. |
| 4) Carburetor flooding. | 4) Remove and rebuild carburetor, paying particular attention to fuel level in bowl. |
| 5) Leaking gaskets or spacer between carburetor and intake manifold. | 5) Check carburetor mounting flange for distortion, replace gaskets and tighten nuts properly. |
| 6) Leaking gaskets between intake manifold and cylinder head. | 6) Check intake manifold flanges for distortion and gaskets for damage and proceed as required. |
| 7) Blown cylinder head gasket. | 7) Check mating surfaces for level, replace gasket and tighten screws at specified torque. |
| 8) Incorrect valve tappet clearance. | 8) Adjust clearance as recommended under « Valve Mechanism ». |
| 9) Stiffened, burned or warped valves. | 9) Rebuild cylinder head. |
| 10) Worn camshaft lobes. | 10) Check valve timing and compare data with those in valve timing diagram, as shown under « Valve Mechanism »; replace camshaft, if necessary. |
| 11) Worn timing chain. | 11) Replace chain. |
| 12) Uneven compression rates. | 12) Using pressure gauge, check compression in each cylinder and rebuild engine, if required. |
| 13) Engine overheating. | 13) Check coolant level in expansion tank, fan and water pump drive belt tension, water pump and thermostat operation and overhaul as required. |
| 14) Incorrect ignition timing. | 14) Set ignition timing. |
| 15) Leaks in ignition wiring. | 15) Locate leaks and correct as necessary. |
| 16) Defective mechanical or vacuum advance mechanisms. | 16) Rebuild ignition distributor and vacuum advance as recommended under « Ignition Distributor ». |
| 17) Excessive play in distributor shaft. | 17) Rebuild ignition distributor and replace worn parts. |
| 18) Distributor cam worn. | 18) Rebuild ignition distributor and replace cam body. |
| 19) Spark plugs damp, dirt or the gaps set too wide. | 19) Clean spark plugs and adjust gap as recommended under « Spark Plugs ». |

## Engine Misses at High Speed.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Dirty jets in carburetor, especially the main jets and emulsion wells. | 1) Remove jets and blow clean. |
| 2) Dirt or water in fuel line or carburetor. | 2) Remove and thoroughly clean carburetor; if trouble recurs, flush and blow fuel tank and lines. |
| 3) Incorrect ignition timing. | 3) Set ignition timing as recommended in covering chapter. |
| 4) Weak coil or condenser. | 4) Bench test coil and condenser and replace by new ones, if necessary. |
| 5) Distributor breaker points dirty or incorrectly spaced. | 5) Clean and adjust points. |
| 6) Distributor rotor contact worn. | 6) Replace distributor rotor. |
| 7) Loose ignition wiring. | 7) Check wiring cables and reset contacts. |
| 8) Excessive play in distributor shaft. | 8) Rebuild ignition distributor and replace worn parts. |
| 9) Spark plugs dirty, damp or the gaps set too wide. | 9) Clean spark plugs and adjust gap as recommended under « Spark Plugs ». |
| 10) Weak distributor point contact. | 10) Smooth distributor points and adjust gap. |
| 11) Insufficient spring tension on contact breaker arm. | 11) Replace breaker arm assembly. |
| 12) Distributor cam lobe worn. | 12) Rebuild ignition distributor and replace cam body. |
| 13) Detonation or preignition. | 13) Check spark advance and set ignition timing, where necessary. Make sure that spark plugs are of the Factory recommended grade and in serviceable condition.<br>If piston and combustion chambers are carboned up, use higher grade fuel. |
| 14) Weak valve springs. | 14) Remove cylinder head and replace springs. |
| 15) Worn camshaft lobes. | 15) Check valve timing and compare data with those in valve timing diagram as shown under « Valve Mechanism »; replace camshaft, if necessary. |
| 16) Badly worn diaphragm in fuel pump. | 16) Remove fuel pump and replace diaphragm as recommended under « Fuel Pump ». |
| 17) Engine overheating. | 17) Check coolant level in expansion tank, fan and water pump drive belt tension, water pump and thermostat operation and overhaul as required. |

## Engine Misses While Idling.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Spark plugs dirty, damp or the gaps set too wide. | 1) Clean spark plugs and adjust gap as recommended under « Spark Plugs ». |
| 2) Broken or loose ignition wires. | 2) Check wiring cables for secure fastening to terminals and spark plug inserts. |
| 3) Burned or pitted breaker contact points, or set with insufficient gap. | 3) Overhaul and adjust contact points as recommended under « Ignition Distributor ». |
| 4) Coil or condenser defective. | 4) Bench test coil and condenser and replace them, if required. |
| 5) Distributor cap cracked. | 5) Replace cap. |
| 6) Distributor rotor contact worn. | 6) Replace distributor rotor. |
| 7) Excessive play in distributor shaft or shaft cam worn. | 7) Rebuild ignition distributor and replace worn parts. |
| 8) Burned, warped or pitted valves. | 8) Overhaul cylinder head and replace valves. Proceed as recommended under « Cylinder Head ». |
| 9) Incorrect valve tappet clearance. | 9) Adjust clearance as recommended under « Valve Mechanism ». |
| 10) Incorrect carburetor idle adjustment. | 10) Adjust idle speed as recommended under « Carburetor ». |
| 11) Incorrect fuel level in carburetor. | 11) Check and adjust float level as recommended under « Carburetor ». |
| 12) Poor compression. | 12) Check compression using a pressure gauge; if pressure is too low, locate causes and remove them. |

## Crankshaft Knocks.

These knocks are usually detected as metallic, heavy and dull knocks which increase in frequency with the engine speed. Excessive crankshaft end play (shoulder play) causes a sharper, drier noise which occurs at irregular intervals.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Excessive clearance between main bearings and journals. | 1) Remove crankshaft, check journals and bearing condition; grind crankshaft and replace bearings as outlined under « Crankshaft ». |
| 2) Excessive end play. | 2) Check end play and use oversize thrust rings, if necessary. |

*(continued)*

**Crankshaft Knocks** *(continued).*

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 3) Out-of-round or tapered main bearing journals. | 3) Remove crankshaft, check journal diameter: next grind crankshaft and replace bearings as outlined under « Crankshaft ». |
| 4) Crankshaft out of balance. | 4) Remove crankshaft and check balance with flywheel and clutch installed as outlined under « Crankshaft ». |
| 5) Poor oil delivery. | 5) Check and rebuild oil pump as outlined in relevant chapter. See that the oil lines are not plugged or restricted. |
| 6) Low oil pressure. | 6) Take down and disassemble engine, then:<br>a) Check the oil pressure relief valve for binding and proceed as required.<br>b) Check the seal rings in crankshaft rear bearing oil shield disk for wear and replace them, if worn. |
| 7) Loose flywheel on crankshaft. | 7) Tighten flywheel screws with specified torque. |
| 8) Improper or diluted oil. | 8) Replace oil by correct grade as tabulated on page 7. |

## Noisy Connecting Rods.

Connecting rod noises are usually more intense than main bearing knocks. The noise is more evident, as a rule, with the engine idling and in neutral and becomes louder when engine speed is increased. Connecting rod noise can be best located by short circuiting one spark plug at a time.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Excessive clearance between con rod bearings and journals. | 1) Take down rod bearings and check wear of rod bearings and journals. If necessary, replace bearings and grind crankshaft. |
| 2) Out-of-round or tapered connecting rod journals. | 2) Remove crankshaft, grind connecting rod journals and replace bearings. |
| 3) Poor oil delivery. | 3) Check and rebuild oil pump as outlined in relevant chapter. See that oil lines are not plugged or restricted. |
| 4) Low oil pressure. | 4) Take down and disassemble engine, then:<br>a) Check the oil pressure relief valve for binding and proceed as required.<br>b) Check the seal rings in crankshaft rear bearing oil shield disk for wear and replace them, if worn. |
| 5) Misaligned connecting rods. | 5) Dismantle connecting rod-piston assemblies and align connecting rods as outlined in covering chapter. |
| 6) Improper or diluted oil. | 6) Replace oil by correct grade as tabulated on page 7. |

## Noisy Pistons.

The most common piston noise is « slap », due to the piston rocking from side to side in the cylinder. Piston slap causes a hollow, muffled, bell-like sound. It is especially audible when driving at low speed under load.

| POSSIBLE CAUSES | REMEDIES |
| --- | --- |
| 1) Excessive clearance between pistons and cylinder barrels causes piston « slap » or « rocking ». | 1) Replace pistons and rebore cylinders, if necessary. |
| 2) Excessive clearance of rings in piston grooves. | 2) Remove and inspect pistons and rings and replace as required. |

## Noisy Piston Pins.

The most common piston pin noise is the result of excessive pin clearance. This is characterized by a sharp, metallic, double knock generally audible with the engine idling.

| POSSIBLE CAUSES | REMEDIES |
| --- | --- |
| 1) Excessive piston pin clearance in piston boss. | 1) Install oversize piston pins proceeding as directed under « Pistons - Connecting Rods ». |

## Noisy Valves and Tappets.

Noisy valve action has a characteristic clicking noise occurring at regular intervals. The frequency of this clicking is generally less than other engine noises, because the valves are operated by the camshaft running at one-half of crankshaft speed.

| POSSIBLE CAUSES | REMEDIES |
| --- | --- |
| 1) Excessive rocker arm-to-valve stem clearance. | 1) Adjust to specified tappet clearance. |
| 2) Threads stripped on adjusting screw. | 2) Check threads on screw and rocker arm seat and replace as required. |
| 3) Broken valve springs. | 3) Replace valve springs. |
| 4) Excessive valve stem-to-guide clearance. | 4) Check valve stem diameter and valve guide inside diameter, then replace worn parts. |
| 5) Excessive tappet-to-crankcase guide hole clearance. | 5) Replace tappets by oversizes as directed in covering chapter. |
| 6) Excessive wear on one or more camshaft lobes. | 6) Replace camshaft. |

## Vibrations Originating at Engine.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Misfiring. | 1) Check and overhaul ignition as outlined in covering chapter. |
| 2) Defective carburetion. | 2) Check and blow clean carburetor jets and passages and adjust idling speed. |
| 3) Crankshaft out of balance. | 3) Remove and balance crankshaft as outlined under « Crankshaft ». |
| 4) Connecting rods and pistons of different weights. | 4) Dismantle connecting rod - piston assemblies and equalize weights as outlined in covering chapter. |
| 5) Tappets misadjusted. | 5) Adjust to specified tappet clearance. |
| 6) Engine mountings worn or too tight. | 6) Replace mountings. |

## Low Oil Pressure.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect grade of oil. | 1) Change to correct oil quality as reported on lubrication chart (page 7). |
| 2) Defective or stuck oil pressure relief valve. | 2) Overhaul or replace valve. |
| 3) Worn or damaged oil pump gears. | 3) Rebuild oil pump as outlined in covering chapter. |
| 4) Excessive clearance between main and connecting rod bearings and journals. | 4) Remove and inspect crankshaft; if necessary, grind crankshaft and replace bearings. |
| 5) Inaccurate low oil pressure indicator. | 5) Inspect and replace damaged parts. |
| 6) Damaged seal ring at flywheel end of crankshaft. | 6) Replace seal ring as directed under « Oil Seals ». |

## High Oil Pressure.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Wrong grade engine oil (too heavy). | 1) Change to correct oil quality as reported on lubrication chart (page 7). |
| 2) Defective oil pressure relief valve. | 2) Overhaul or replace valve. |
| 3) Restricted oil passages. | 3) Flush engine lubrication circuit thoroughly. |

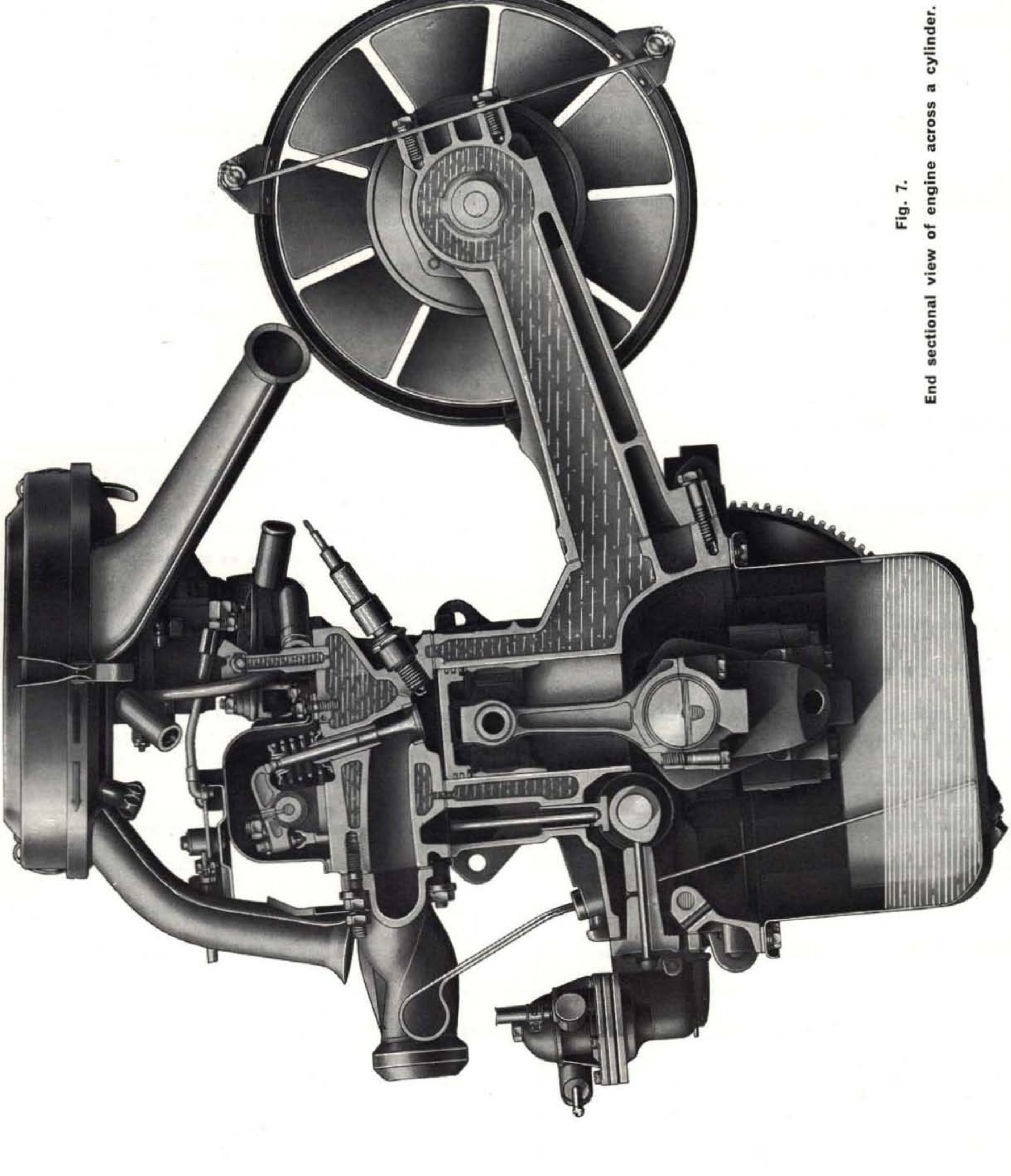


Fig. 7.
End sectional view of engine across a cylinder.

# REMOVAL AND INSTALLATION OF ENGINE

To remove the engine from the car, proceed as follows.

Raise the car at rear and set it on two stands **D. 15051** at control arms.

Disconnect the battery plus cable.

Remove the rear headlining.

Remove the lower linings of engine compartment and the engine compartment lid.

Disconnect the carburetor fuel inlet line at pump and the low oil pressure indicator cable at sending unit.

Remove the oil drain plug and let oil out using the vessel **D. 15136.**

Now drain the cooling system. Remove the seal (early production cars), the radiator filler cap and the screw on downside of radiator. Flow coolant into vessel **D. 15137.**

Disconnect wires at: heat indicator sending unit on head, ignition coil, generator, starting motor and license plate lamp.

Disconnect accelerator and choke control cables at carburetor.

Disconnect coolant inlet and outlet hoses from engine; loosen hose clamps using wrench **D. 50013.**

Remove the lock ring securing the air conveyor to radiator.

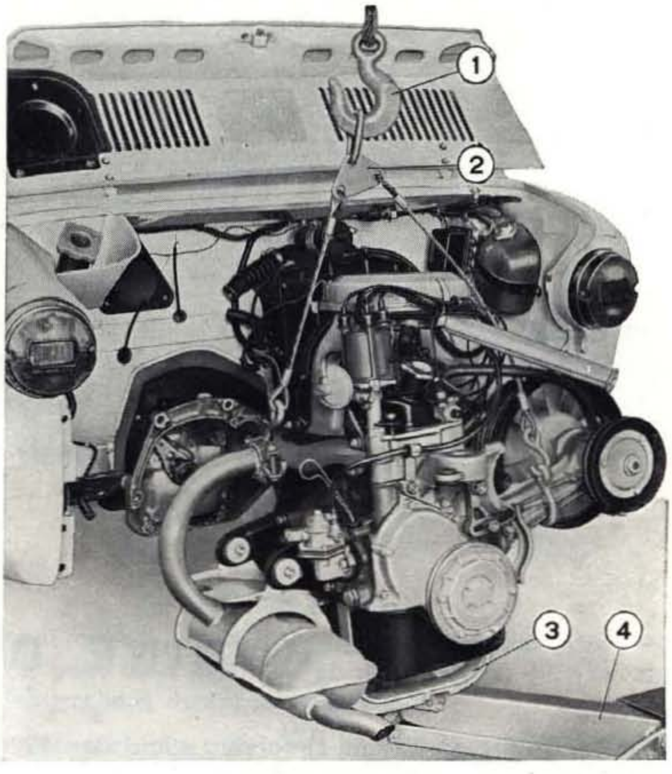



**Fig. 9 - Lifting out engine.**

1. Hoist hook. - 2. Fixture A. 60511/1/2. - 3. Adapter A. 60534. - 4. Hydraulic jack.

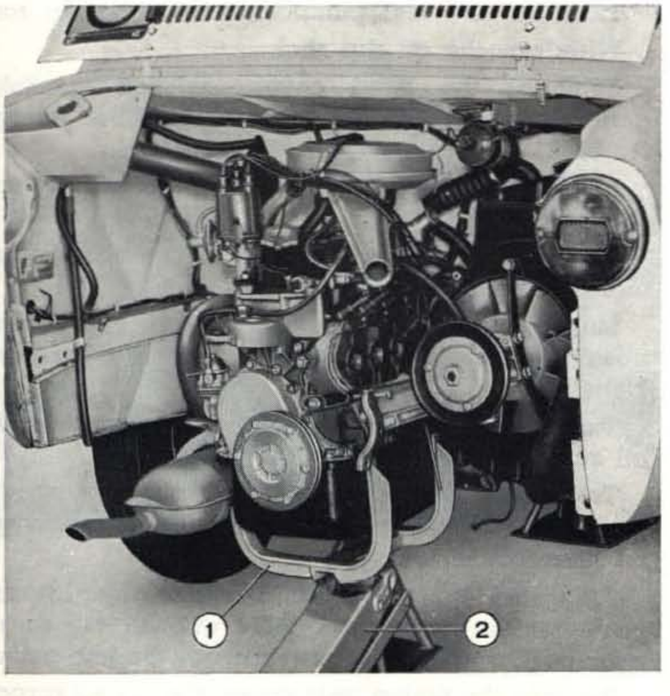



**Fig. 8 - Removing engine.**

1. Adapter A. 60534. - 2. Hydraulic jack.

Take out the generator fan water pump and centrifugal oil filter drive belts.

Remove the generator and, using wrench **A. 50095,** the starting motor.

Remove the rear bumper assembly.

Fit adapter **A. 60534** to the hydraulic jack and set it under the crankcase (fig. 8).

Remove the lower rear lining after the engine rear mounting nut and mounting-to-body link screw have been backed out.

Working from underside, untie the engine from the transmission using articulated wrench **A. 55035.** Tilt the engine lightly for more ease in this operation.

At last remove the engine assembly from its compartment.

To do so recourse can be made both to the hydraulic jack and a chain hoist with hook **A. 60511/1/2,** as shown in fig. 9.

To remove the engine transmission and differential assembly fit the adapter **A. 60531** to the hydraulic jack and go on with the following additional steps:

Disconnect the shock absorbers at bottom mounting.

Disconnect the wheel shaft slip joints.

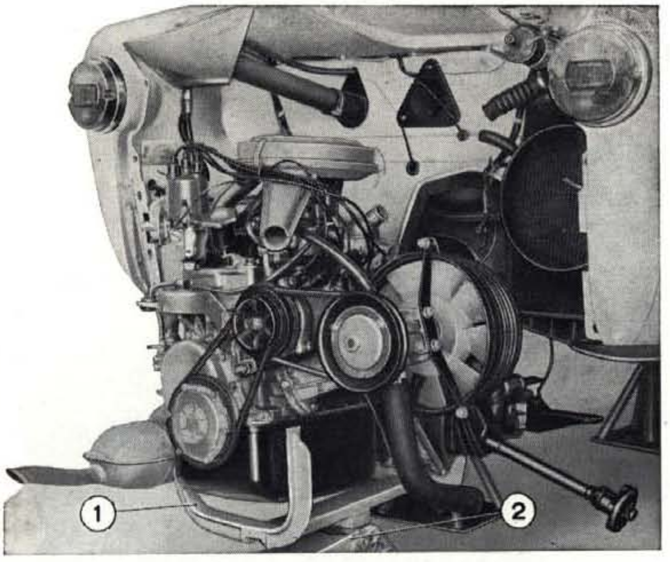



**Fig. 10 - Removing engine and transmission assembly.**
1. Adapter A. 60531. - 2. Hydraulic jack.

Disconnect the clutch release control cable.

Disconnect the speedometer cable.

Detach the gear actuating lever rod.

Remove transmission side mounting screws at body.

Recall that in case the engine is removed as an assembly with transmission and differential, it will be unnecessary to take down the generator and starting motor.

---

**No special difficulty will be encountered for installation of engine: just reverse the removal procedure. Tying engine to transmission-differential assembly deserves much care: the clutch shaft should fit all the way into the hub splines of driven plate.**

---

# ENGINE DISASSEMBLY

Arrange the engine on revolving stand **Arr. 22204** fitted with « L » rails **Arr. 22204/1.**

Prior to installing engine on stand, take out the exhaust piping and the water pump and fan assembly.

Place stand clamping arms **Arr. 22205/9** (fig. 11) on engine, then proceed as follows:

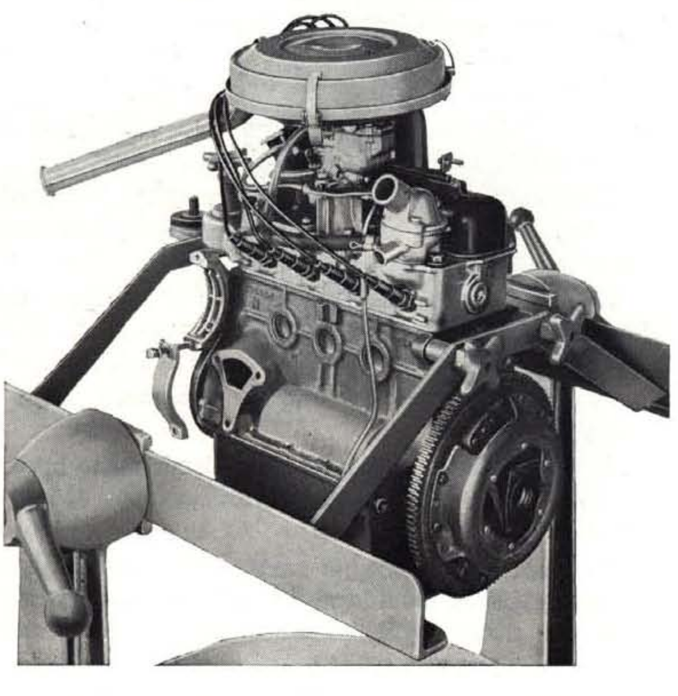


**Fig. 11 - Engine on revolving stand Arr. 22204.**

Remove air cleaner.

Remove the ignition distributor complete with cap and spark plug feeding cables.

Disconnect the carburetor fuel inlet line at pump.

Remove the carburetor.

Remove the thermostat and elbow from cylinder head.

Take out the fuel pump and control push rod.

Withdraw the oil dip stick.

Remove: the head cover, exhaust manifold, generator mounting and spark plugs. Use wrench **A. 50087** to screw out spark plugs.

Remove the rocker arm and shaft assembly and slide off push rods.

Withdraw the oil relief valve and low oil pressure indicator sending unit.

Lift out the clutch assembly. Mark the relative position of clutch to flywheel, for correct reinstallation.

Turn the engine upside down and remove the oil sump (fig. 12).

Take out the oil pump with oil delivery pipe to front main bearing cap and withdraw the centrifugal oil filter cover.

Affix tool **A. 60282** on flywheel (fig. 13) and using ratchet wrench **A. 89854** with 32 mm socket back out the hub-pulley nut; remove the hub-pulley.

Remove the timing gear cover, the driven sprocket, the timing chain and slide off the camshaft spacer.

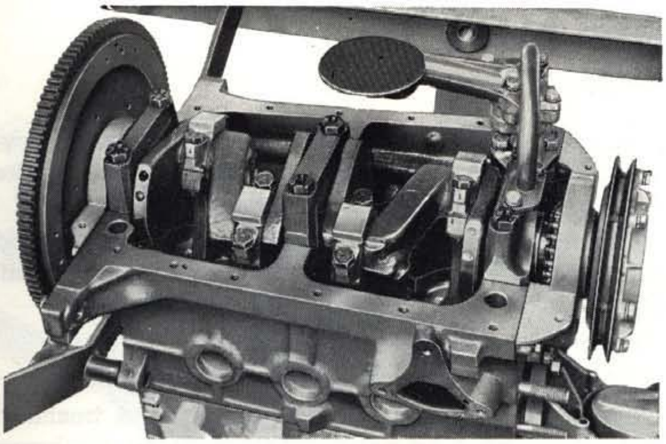


Fig. 12 - Crankcase without oil sump.

Use puller **A. 40005/2** with items **/5** and slide off the timing drive driven sprocket (fig. 14).

Reverse the engine and take down the cylinder head complete with valves and springs; backing out one head screw disengages also the heat indicator sending unit.

Again turn over the engine, remove the rod bearing caps and working from the underside withdraw connecting-rod piston assemblies.

Remove the flywheel, the crankshaft rear seal cover, main bearing caps, timing gear end oil

**NOTE - During engine disassembly or rebuild, use care to keep main and connecting bearing inserts of each journal well apart.**

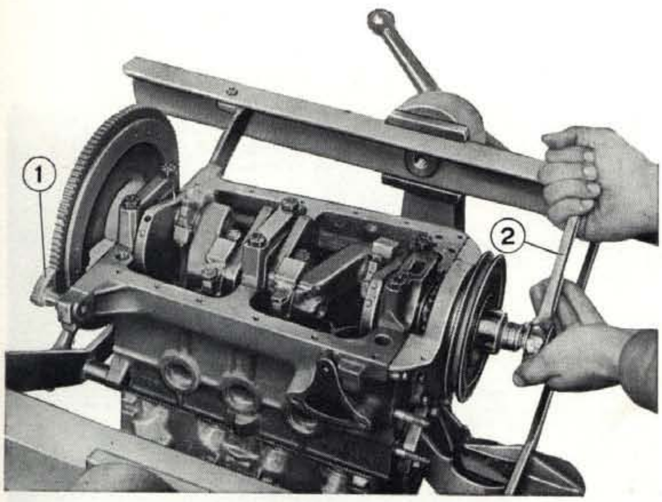




**Fig. 13 - Backing out hub-pulley lock screw.**
1. Flywheel stop A. 60282. - 2. Ratchet wrench A. 89854.

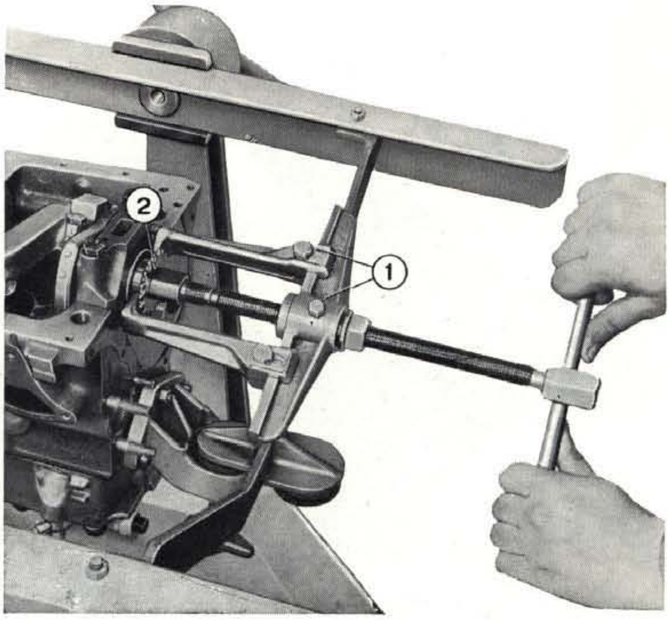




**Fig. 14 - Pulling timing drive sprocket.**
1. Puller A. 40005/2/5. - 2. Timing drive sprocket.

seal cover, main bearing caps, timing gear end oil seals and then the crankshaft (fig. 15), bearing inserts and thrust ring halves.

Remove the camshaft bushing screw, withdraw the camshaft and slide off tappets from their seats (fig. 16).

Unfasten the crankcase from stand and thoroughly wash all components.

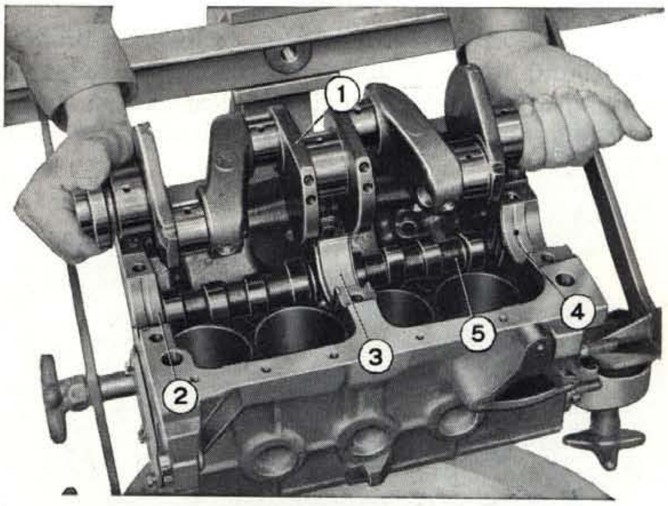




**Fig. 15 - Lifting out crankshaft.**
1. Crankshaft. - 2. Front main bearing. - 3. Intermediate main bearing. - 4. Rear main bearing. - 5. Camshaft.

# ENGINE ASSEMBLY

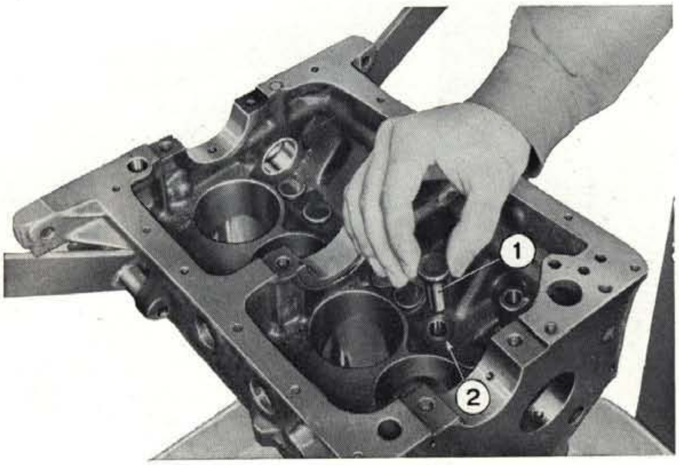



**Fig. 16 - Fitting tappets.**

1. Tappet. - 2. Tappet seat in crankcase.

To assemble the engine proceed as follows.

Clamp the crankcase to the revolving stand.

Position tappets into seats (fig. 16).

Install in this order: intermediate camshaft bushing, using driver **A. 60292**, and flywheel end bushing; bushings should be inserted and then reamed with tool **A. 90326** (fig. 17).

---

**NOTE - For installation of bushings adhere to directions outlined on page 65.**

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Install the crankshaft complete with main bearing inserts and thrust ring halves, next to a thorough cleaning of all parts. Recall that thrust rings should be positioned with the groove facing the shaft shoulder.

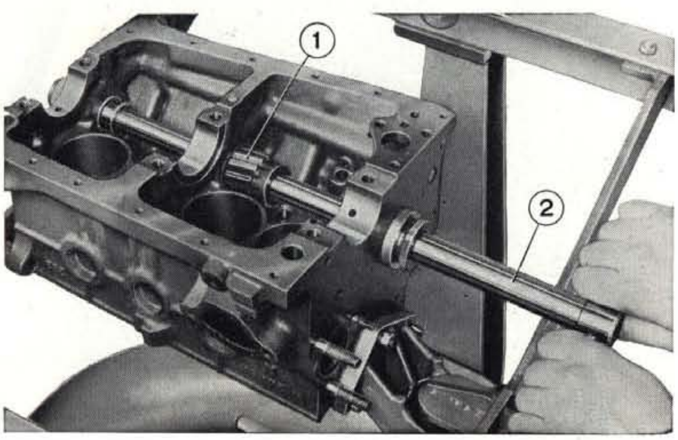


**Fig. 17 - Reaming intermediate camshaft bushing.**

1. Reamer for intermediate bushing. - 2. Reamer chuck A. 90326.

Fit main bearing caps and bearing inserts, drawing up with 44.8 ft.lbs (6.2 kgm) of torque; make sure that the shaft turns freely.

Check clearance between main bearings and journals against data on page 50; check crankshaft end play (see page 50).

Fit timing end oil seals on crankshaft.

Fit the timing drive drive sprocket spacer.

Install the camshaft and its timing end bushing. Line up the bushing hole with the hole on crankcase and secure the bushing with the dowel screw.

Try the camshaft some turns to make sure that it rotates freely in bushings.

Fit the driven sprocket on camshaft and check clearance between sprocket and spacer (fig. 18); again remove the sprocket.

Install drive and driven sprockets with timing chain set with the chain stretcher outward. Timing marks on sprockets should be indexing.

Draw up the driven sprocket screw with 36.2 ft.lbs (5 kgm) of torque and bend over the safety plate (fig. 19).

Fit the flywheel end cover with seal, after setting the cover gasket; use inserter **A. 60281** to fit cover (fig. 20).

Install the flywheel, tightening the lock screws with 25.3 to 28.9 ft.lbs (3.5 to 4 kgm) of torque. Use tool **A. 60282** for this step.

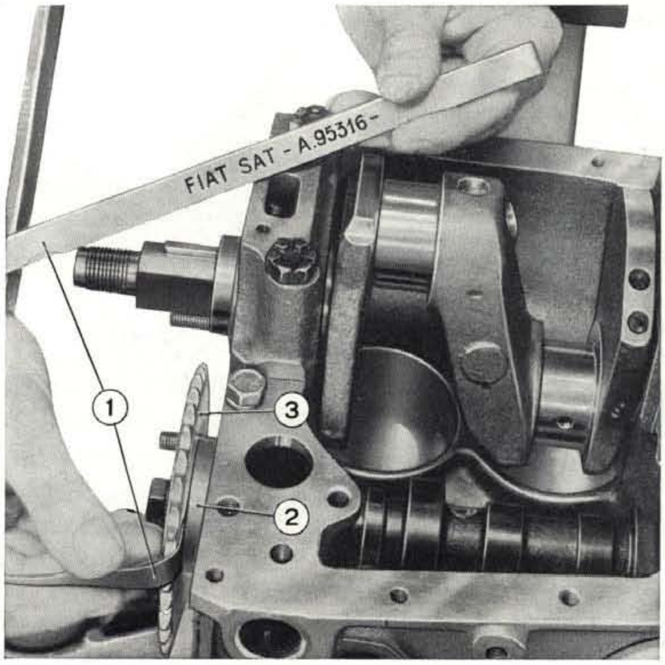


**Fig. 18 - Checking driven sprocket-to-camshaft spacer clearance.**

1. Feeler gauge A. 95316. - 2. Camshaft spacer. - 3. Driven sprocket.

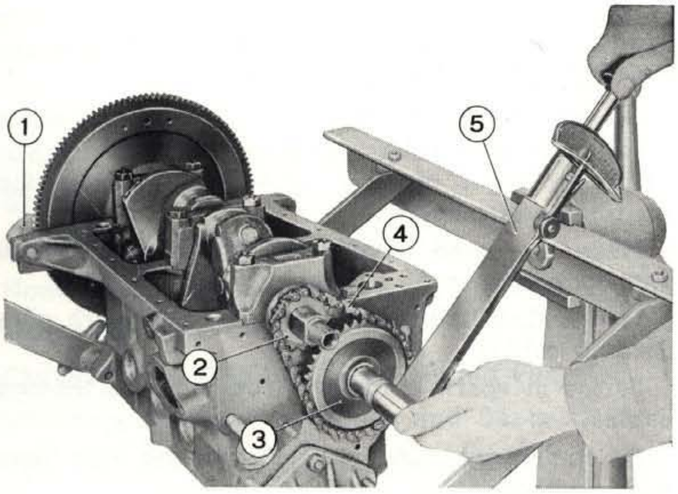


**Fig. 19 - Tightening camshaft driven sprocket screw.**
1. Tool A. 60282. - 2. Drive sprocket. - 3. Driven sprocket. - 4. Timing chain. - 5. Torque wrench.

Fit the timing gear cover with oil seal, setting the cover gasket on crankcase; tighten down the lock screws.

Install the hub-pulley, the centrifugal oil filter baffle ring, the safety plate; draw up the lock nut with 72.3 ft.lbs (10 kgm) of torque (fig. 21).

Fit the oil pressure relief valve and low oil pressure indicator sending unit.

Install the centrifugal oil filter cover and gasket, drawing up lock screws with 5.8 ft.lbs (0.8 kgm) of torque (fig. 22).

Fit the connecting rod and piston assembly into the cylinder bore, with rings arranged as specified on page 39; use tool **A. 60273** (shown in fig. 62) in this step.

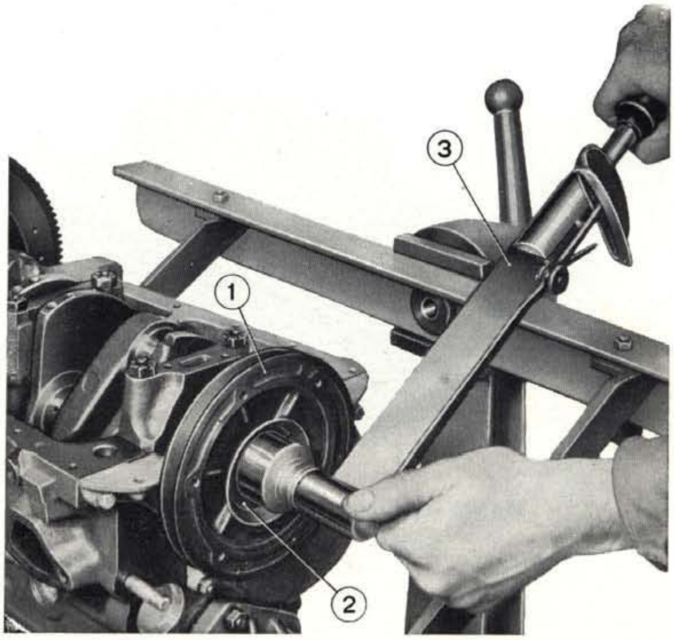


**Fig. 21 - Tightening hub-pulley nut.**
1. Hub-pulley - 2. Baffle ring. - 3. Torque wrench.

Fit connecting rod bearing and cap assemblies and draw up lock screws with 36.2 ft.lbs (5 kgm) of torque. Check that the big end is free to slide on journal.

Install the oil pump and gasket, then mesh the drive shaft gear with the camshaft gear; check the camshaft for a free rotation. Fit the oil pump-to-front main bearing cap pipe.

Position both sump half-gaskets on crankcase mating edges; arrange the flywheel and timing gear end gaskets on oil sump (fig. 23). Fit the oil

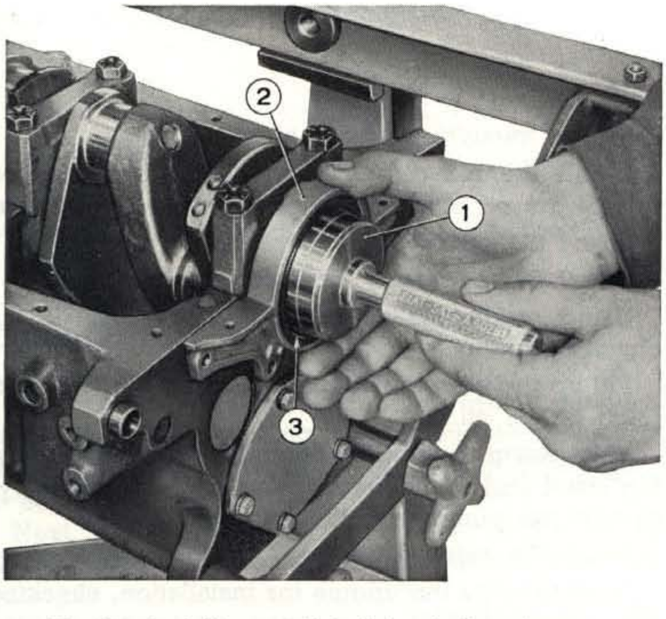


**Fig. 20 - Installing crankshaft front oil seal cover.**
1. Inserter A. 60281. - 2. Crankshaft front oil seal cover. - 3. Oil seal.

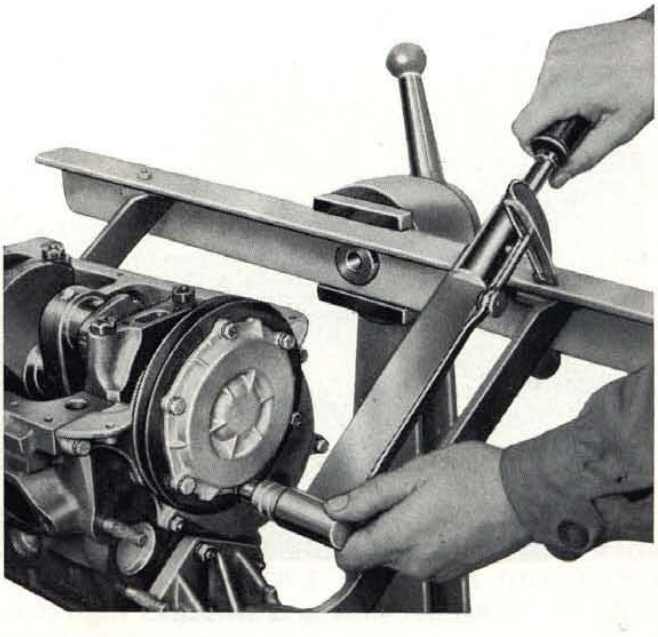

**Fig. 22 - Tightening centrifugal oil filter cover.**


**Fig. 23 - Fitting oil sump gasket.**
1. Gasket. - 2. Oil sump.

sump to the crankcase and secure it with lock screws.

Position the head gasket and install the cylinder head complete with valves, springs and tappets; fit the thermal switch and secure the cylinder head, tightening the hold-down screws in the sequence and to the torque specified on page 55.

Install the push rods and the rocker, shaft and support assembly, the lock nuts of which should be torqued to 14.5 ft.lbs (2 kgm).

Adjust the tappet clearance as directed on page 67.

Install the exhaust manifold, carburetor, thermostat, fuel pump with control push rod and spacer, the ignition distributor without cap, so to check the breaker point opening.

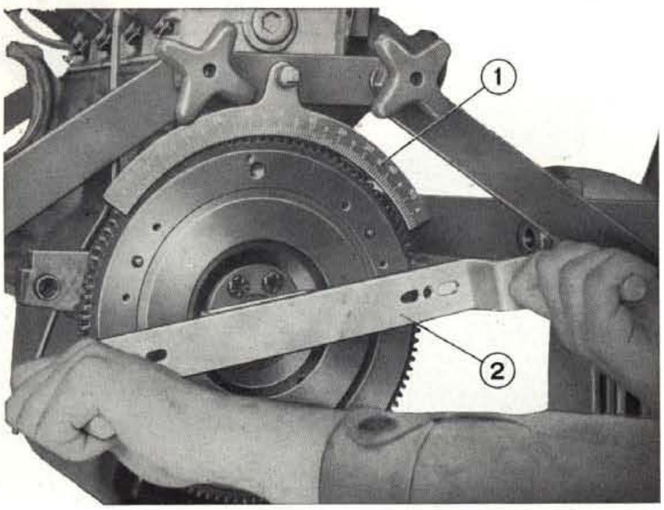


**Fig. 24 - Affixing sector scale.**
1. Sector scale A. 95694. - 2. Flywheel crank A. 60186.

Affix the sector scale **A. 95694** (fig. 24) and turn the flywheel to index the timing mark at 10° advance. For this step use crank **A. 60186.**

Set the distributor with the breaker points about to open; using feeler gauge **A. 95316** check the points for a gap of .0177" (0.45 mm) and lock the distributor in position.

Place the head cover and gasket and secure with lock screws.

Fit the distributor cap complete with spark plug feeding cables.

Screw in spark plugs and connect with feeding cables.

Fit coolant inlet and outlet hoses and lock them with clamps.

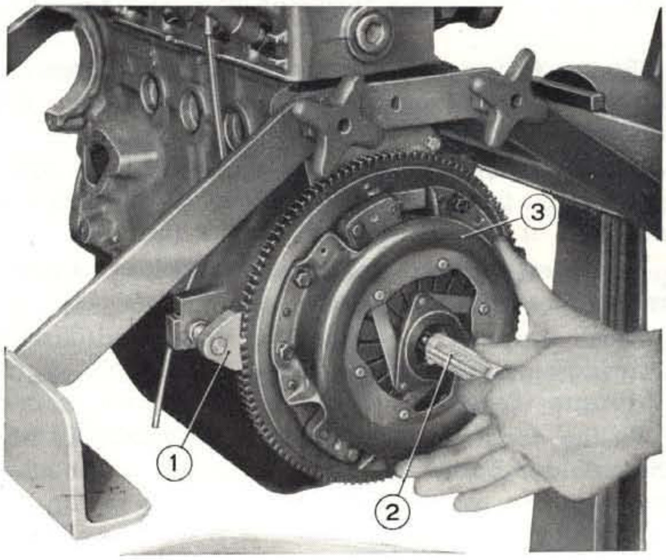


**Fig. 25 - Installing clutch assembly.**
1. Tool A. 60282. - 2. Guide pin A. 70085. - 3. Clutch assembly.

Fit the vacuum advance tube.

Install the air cleaner and tie up recirculation device tubes of blow-by gases and oil vapours.

Insert the oil dip stick.

Install the generator mounting bracket.

Using guide pin **A. 70085** (fig. 25) install the clutch assembly.

Fill up the engine with 6.48 G.B.pts - 7.80 U.S.pts (3.30 kg) of oil.

Take down the engine assembly from the revolving stand and fit the water pump and fan assembly; secure the pump with lock screws.

Install the exhaust piping.

Next arrange the engine for installation, checking the clutch shaft for no signs of damage at the splined end.

# CYLINDER BLOCK AND CRANKCASE



## MAIN SPECIFICATIONS

| DESCRIPTION | | in | mm |
|---|---|---|---|
| Cylinder bore (*) | | 2.5591 to 2.5610 | 65.000 to 65.050 |
| Standard tappet seat diam | | .5516 to .5523 | 14.010 to 14.028 |
| Camshaft bushing seat bore: | | | |
| – valve gear end | Class B | 1.9882 to 1.9886 | 50.500 to 50.510 |
| | Class C | 1.9886 to 1.9890 | 50.510 to 50.520 |
| | Class D | 1.9961 to 1.9965 | 50.700 to 50.710 |
| | Class E | 1.9965 to 1.9969 | 50.710 to 50.720 |
| – intermediate | | 1.8276 to 1.8287 | 46.420 to 46.450 |
| – flywheel end | | 1.4142 to 1.4154 | 35.921 to 35.951 |
| Main bearing saddle bore | | 2.1459 to 2.1465 | 54.507 to 54.520 |
| Length of intermediate transverse member between thrust ring seats | | .9149 to .9173 | 23.240 to 23.300 |
| Piston clearance in cylinder | | .0008 to .0016 | 0.020 to 0.040 |
| Wear limit | | .006 | 0.15 |

(*) Cylinder bores are graded into classes with .0004" (0.01 mm) progression.

## Cleaning.

Immerse the crankcase, for some twenty minutes, in a wash tank containing a water and soda solution which has been pre-heated to 176° to 185° F (80° to 85° C).

Next submit the crankcase to a heavy jet of above solution to remove all sediments from oil passages.

Thoroughly blow the cylinder block, especially oil passages, with an air blast.

## Checking Cylinder Barrels.

Examine cylinder barrels: if light scoring marks are detected, remove them by refacing with an extremely refined emery cloth wrapped around a hone.

Now check piston for clearance in cylinder within .006" (0.15 mm).

**Fitting clearance of piston in cylinder bore, measured at 1.555" (39.5 mm) apart from piston top at right angles to pin, should be .0008" to .0016" (0.020 to 0.040 mm).**

# ENGINE ASSEMBLY

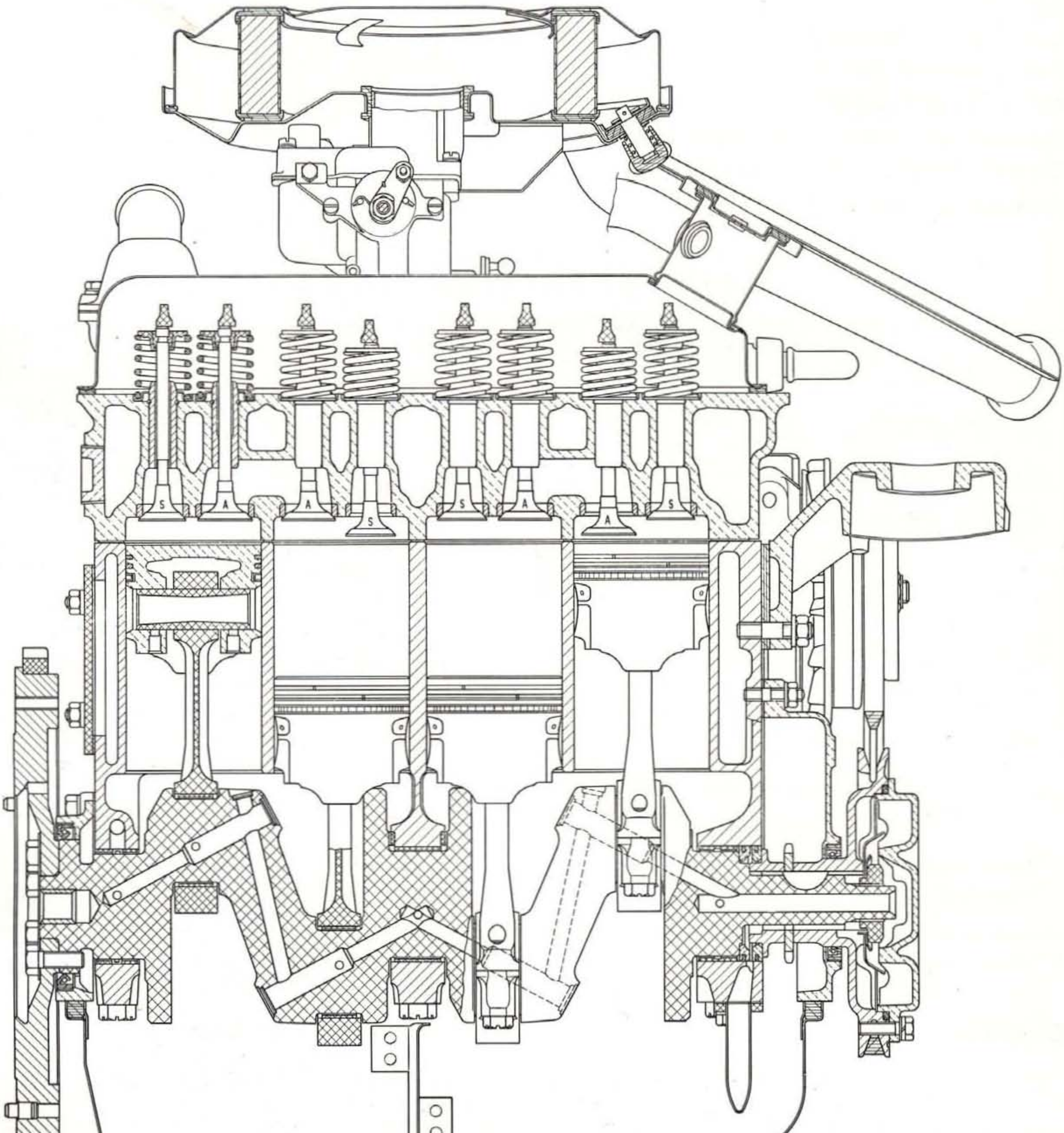


**Fig. 26 - Side sectional view of engine across cylinders.**

The measurement of cylinder bore must be taken both lengthwise and crosswise at two heights (fig. 27). Set the dial indicator at zero using the master gauge **A. 95647** (fig. 28).

If barrel wear or out-of-round are such as reconditioning is required, proceed as follows:

– in case little stock must be removed (less than .006" - 0.15 mm), honing will do;

– in case stock removal exceeds .006" (0.15 mm), cylinders must be rebored.

Recall that reboring must not go beyond .0236" (0.6 mm).

Honing and reboring should be made to correspond to piston oversizes (.0079" - .0157" - .0236", 0.2 - 0.4 - 0.6 mm) and to the recommended piston clearance of .0008" to .0016" (0.020 to 0.040 mm).

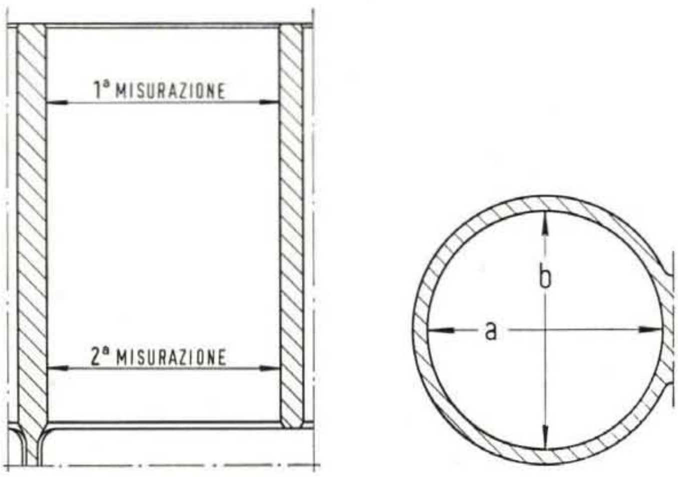


**Fig. 27 - Diagram for measuring cylinder bores.**
1ª = First - 2ª = Second - Misurazione = Measurement

As shown in fig. 29, letters are stamped on the lower face of crankcase to indicate the bore size.

As a matter of fact, cylinders are graded into classes on the ground of the bore diameter (2.5590" to 2.5610" - 65.000 to 65.050 mm) with a .004" (0.01 mm) progression.

Standard pistons, like cylinders, are divided into classes so that each cylinder and piston should belong to the same class.

## Honing Cylinder Barrels.

Gauge the cylinder bores to determine the diameter to which barrels should be lapped.

Clamp the cylinder block to the hone table.

Lap barrels first with a set of medium-grain stones, then using very fine-grain stones.

For better smoothness of barrels, polish them with extremely refined emery cloth wrapped around hone head.

Repeat lapping operation at remaining cylinders.

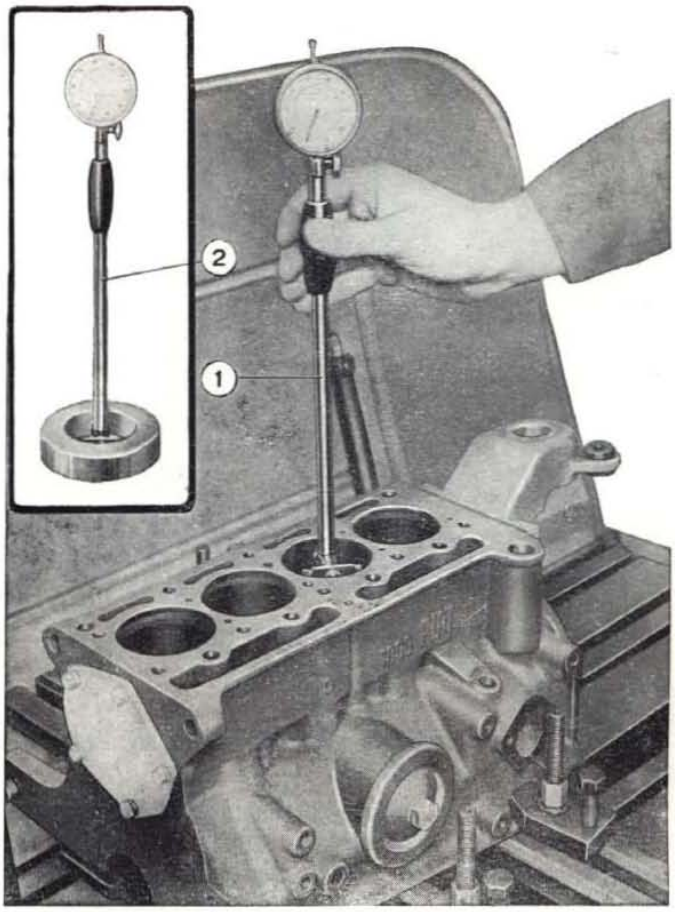


**Fig. 28 - Using dial indicator to measure cylinder bores.**
1. Dial indicator. - 2. Zero setting indicator with master gauge A. 95647.

## Reboring Cylinder Barrels.

After clamping the crankcase to the boring machine table, insert the machine spindle head with centering device in a cylinder bore (fig. 31).

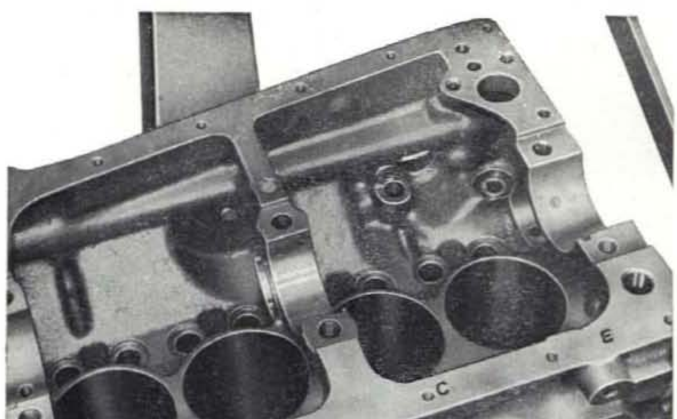

**Fig. 29 - Letters showing cylinder bore classes on lower face of cylinder block.**

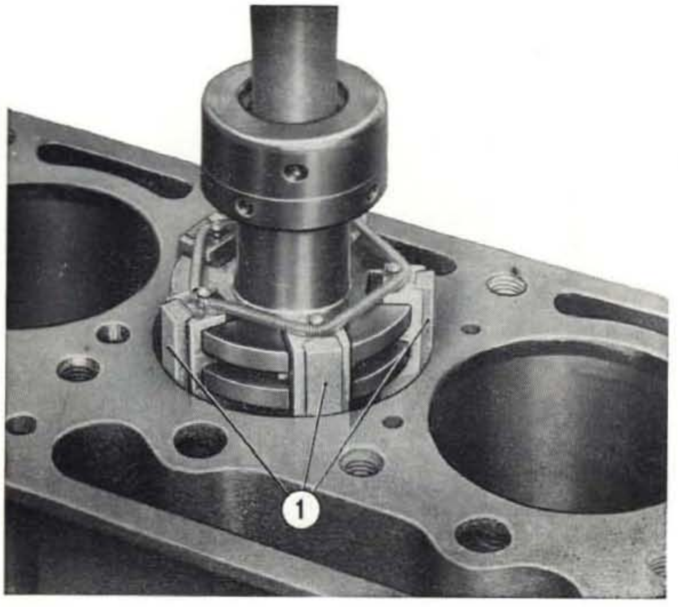


**Fig. 30 - Honing cylinder barrels.**
1. Hone abrasive stones.

Align the spindle to the bore, then lock the machine table in position.

Remove the dial plunger and set cutter projection by means of the cutter setting device to the desired diameter, as shown in fig. 32.

Next start the boring machine into operation.

When reboring has been completed with a .0016" to .0020" (0.04 to 0.05 mm) coat of stock in excess hone and polish with very fine grade abrasives as previously outlined.

Cylinders can be rebored with the portable boring bar **Ap. 5022** as well.

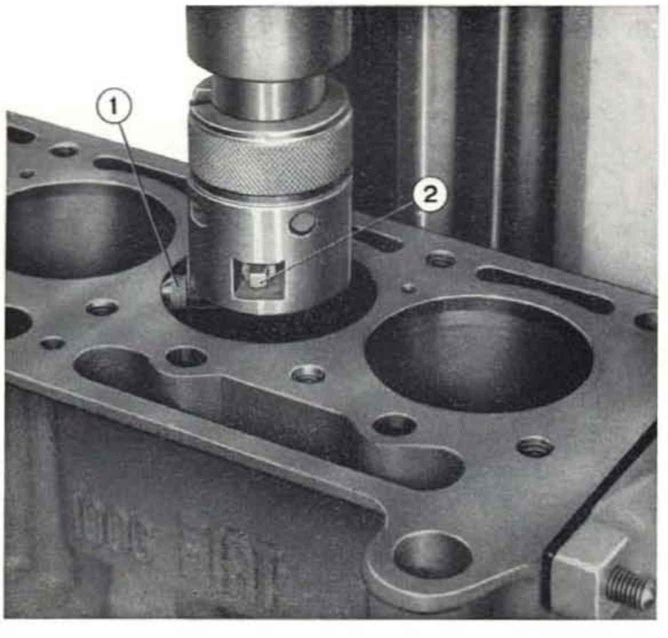


**Fig. 31 - Aligning cylinder bore, preparatory to boring operation.**
1. Centering plunger. - 2. Micrometer caliper shoulder setting screw.

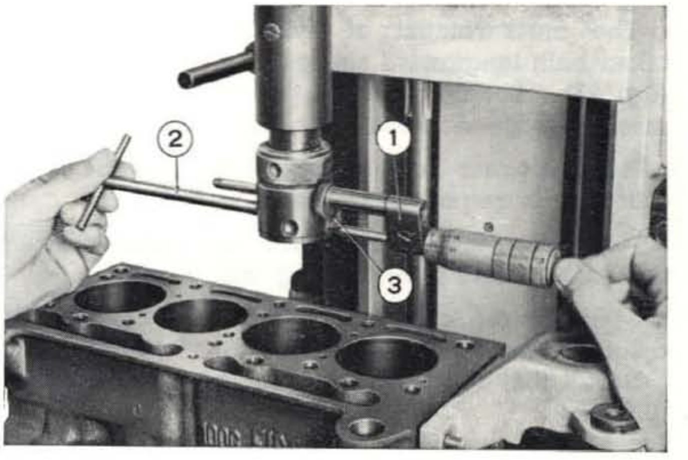


**Fig. 32 - Measuring cutter projection, preparatory to boring operation.**
1. Cutter setting device rod. - 2. Cutter setting wrench. - 3. Cutter.

## Checking and Grinding Cylinder Head Mating Face.

The cylinder block may show distortions on the head mating face.

---

**NOTE - Cylinder head mating surface can be also inspected for level using a straightedge and a feeler gauge as shown in fig. 34.**

**Straightedge should be placed at both diagonal lines of cylinder block face; also centrally, in longitudinal direction.**

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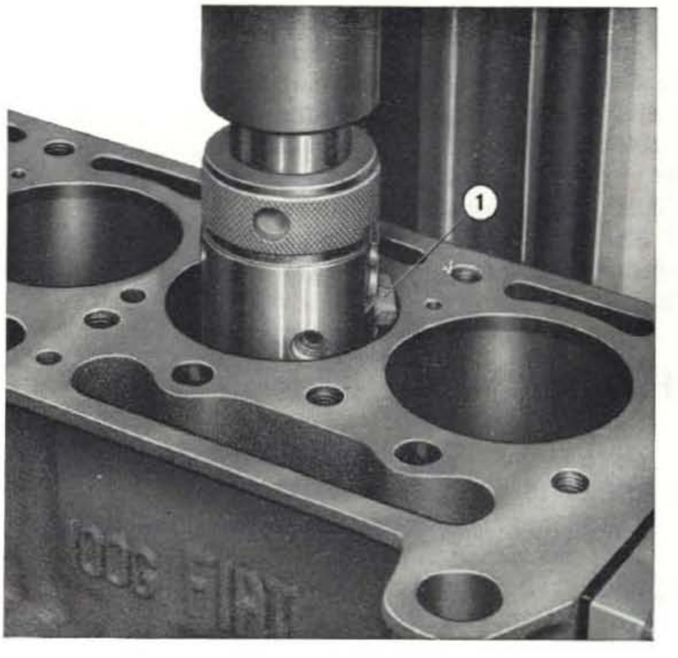


**Fig. 33 - Reboring cylinders.**
1. Cutting tool.

Coat a surface plate with lampblack and check the areas where grinding is necessary to smooth out surfaces.

Use a surface grinder trying to remove least possible stock.

## Checking Camshaft Bushings and Seats.

Intermediate and flywheel end bushings of camshaft are installed with a **press fit**, whereas the chain end bushing is fitted into place with a **clearance**.

The chain end bushing is graded into four classes according to its diameter.

The same applies to the bushing seats on crankcase.

Always make sure that there is enough interference at intermediate and flywheel end bushings lest they are apt to revolve in their bores in operation.

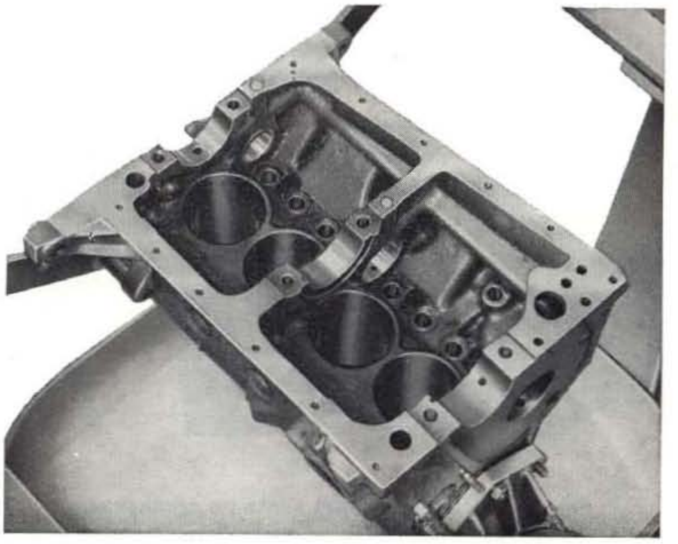

**Fig. 36 - Bottom view of crankcase.**

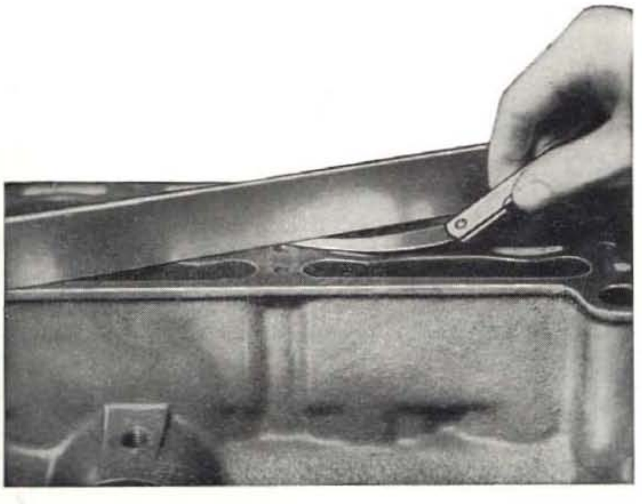

**Fig. 34 - Checking lower face of crankcase.**

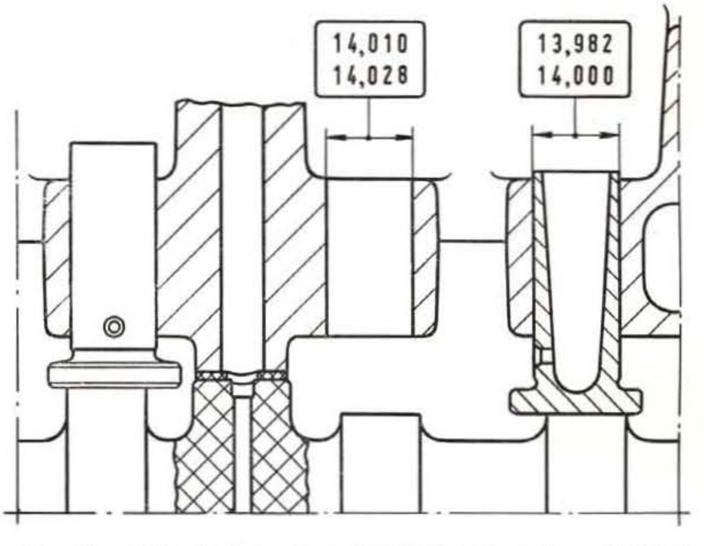


**Fig. 37 - Critical dimensions (metric) of tappets and tappet seats on crankcase.**

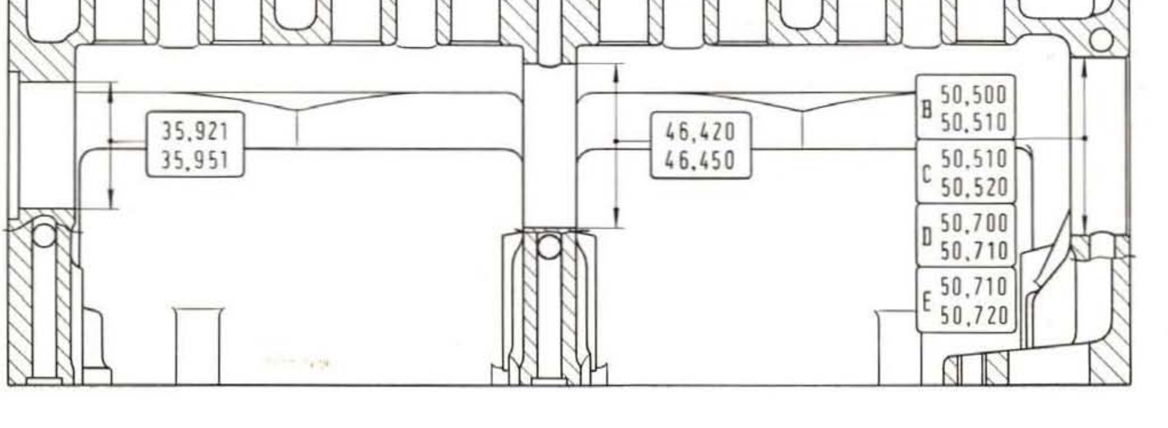


**Fig. 35 - Critical dimensions (metric) of camshaft bushing seats.**
Timing end bushing seating bore is graded into four classes.

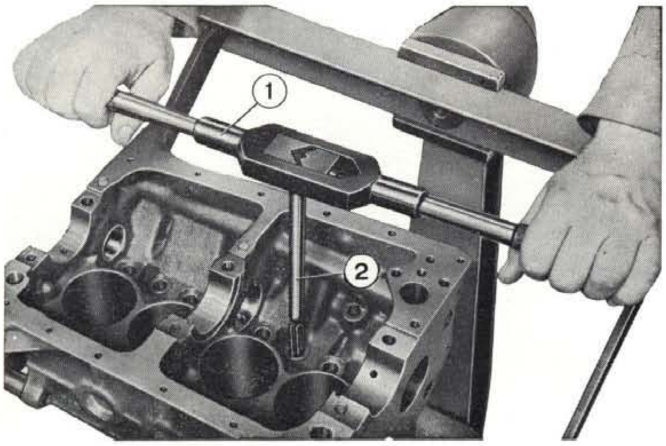


Fig. 38 - Reaming tappet seats on crankcase.
1. Reamer handle. - 2. Tappet seat reamer A. 90318/1.

Check the wear of internal faces of bushings as well as the clearance of bushings to camshaft journals against specifications on page 29.

## Checking and Reaming Tappet Seats.

Should excessive play (over .0031" - 0.08 mm) between tappets and their seats on crankcase be detected, replace tappets by oversizes. Gauge the diameter of the tappet seat in order to determine the amount of wear and consequently the width of reaming necessary. Tappets come for service in two oversizes: .002" and .004" (0.05 and 0.10 mm).

Use reamer **A. 90318/1** if .002" (0.05 mm) oversize tappets must be fitted, while reamer **A. 90318/2** will ream seat for .004" (0.10 mm) oversize tappets (fig. 38).

Next check that clearance between tappets and seats is as recommended, or .0004" to .0018" (0.010 to 0.046 mm).

For more data on tappets, see covering chapter, page 65.

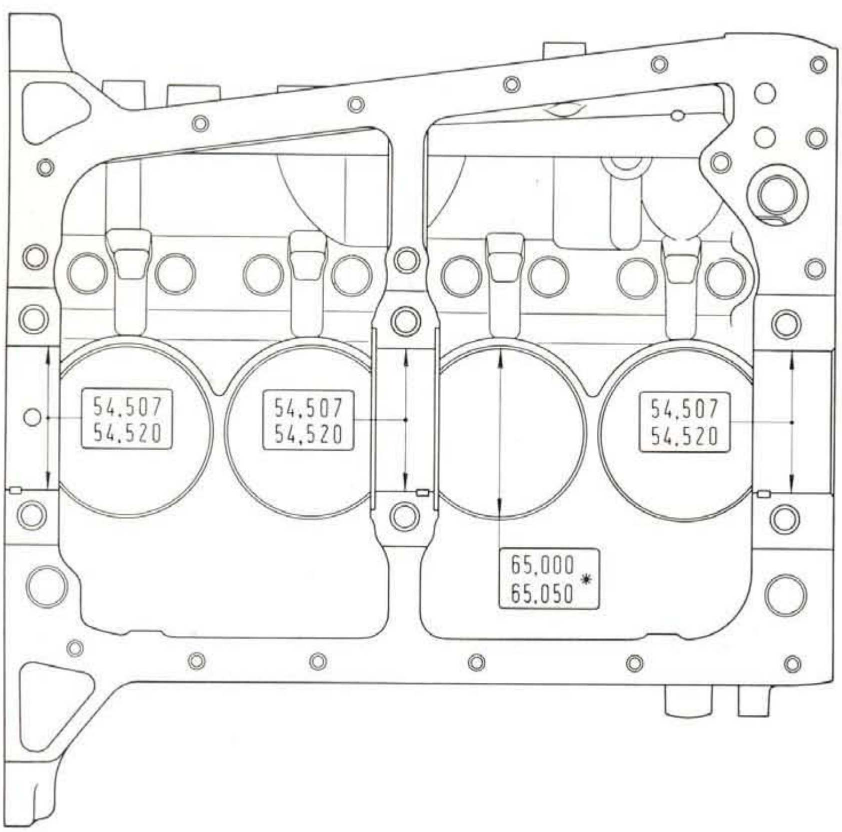


Fig. 39.

Critical dimensions of crankcase (metric).

Diameter of main bearing saddle bores and cylinder bores.

* Cylinder bores are graded into classes with .0004" (0.01 mm) progression.

# PISTONS - CONNECTING RODS



## MAIN SPECIFICATIONS
## PISTONS - PINS - RINGS - CONNECTING RODS - BEARINGS

| DESCRIPTION | in | mm |
|---|---|---|
| Standard piston diameter, at right angle to pin: | | |
| – 1.555″ (39.5 mm) apart from piston head — Class A | 2.5578 to 2.5582 | 64.970 to 64.980 |
| Class C | 2.5586 to 2.5590 | 64.990 to 65.000 |
| Class E | 2.5594 to 2.5598 | 65.010 to 65.020 |
| Pistons for service | Std, .0079-.0157-.0236 O.S. | 0.2-0.4-0.6 |
| Piston boss bore — Class 1 | .7867 to .7868 | 19.982 to 19.986 |
| Class 2 | .7868 to .7870 | 19.986 to 19.990 |
| Class 3 | .7870 to .7871 | 19.990 to 19.994 |
| Piston ring groove height — Top groove | .0703 to .0711 | 1.785 to 1.805 |
| Center groove | .0793 to .0801 | 2.015 to 2.035 |
| Bottom groove | .1558 to .1566 | 3.957 to 3.977 |
| Standard piston pin diam — Class 1 | .7862 to .7864 | 19.970 to 19.974 |
| Class 2 | .7864 to .7865 | 19.974 to 19.978 |
| Class 3 | .7865 to .7867 | 19.978 to 19.982 |
| Piston pins for service | Std, .0079 O.S. | 0.2 |
| Piston ring thickness: | | |
| – first compression ring | .0680 to .0685 | 1.728 to 1.740 |
| – second oil ring | .0779 to .0783 | 1.978 to 1.990 |
| – third radial-slotted oil ring | .1535 to .1547 | 3.900 to 3.930 |
| Piston fit in bore (at right angle to pin, 1.555″ - 39.5 mm - apart from piston head): | | |
| – clearance of new parts | .0008 to .0016 | 0.020 to 0.040 |
| – wear limit | .006 | 0.15 |

*(continued)*

**Main Specifications - Pistons - Pins - Rings - Connecting Rods - Bearings** *(continued).*

| DESCRIPTION | in | mm |
|---|---|---|
| Piston pin in boss: | | |
| – clearance of new parts | .0003 to .0006 | 0.008 to 0.016 |
| – wear limit | .0020 | 0.05 |
| Piston ring side fit (vertically): | | |
| – first compression ring: clearance of new parts | .0018 to .0030 | 0.045 to 0.077 |
| – first compression ring: wear limit | .006 | 0.15 |
| – second oil ring: clearance of new parts | .0010 to .0022 | 0.025 to 0.057 |
| – second oil ring: wear limit | .006 | 0.15 |
| – third radial-slotted oil ring: clearance of new parts | .0011 to .0030 | 0.027 to 0.077 |
| – third radial-slotted oil ring: wear limit | .006 | 0.15 |
| Ring end gap in bore: | | |
| – first compression ring: clearance of new parts | .0079 to .0138 | 0.20 to 0.35 |
| – second oil ring: clearance of new parts | .0079 to .0138 | 0.20 to 0.35 |
| – third radial-slotted oil ring (compressed) | touch fit | |
| Piston rings for service: | | |
| – compression and oil rings | Std, .0079-.0157-.0236 O.S. | 0.2-0.4-0.6 |
| – radial-slotted oil ring | Std, .0157 O.S. | 0.4 |
| Connecting rod big end bore | 1.7188 to 1.7193 | 43.657 to 43.670 |
| Connecting rod small end bore | .7850 to .7856 | 19.943 to 19.954 |
| Standard con rod bearing shell thickness | .0711 to .0713 | 1.807 to 1.813 |
| Connecting rod bearings for service | Std, .01-.02-.03-.04 U.S. | 0.254-0.508-0.762-1.016 |
| Piston pin-to-small end press fit | .0006 to .0015 | 0.016 to 0.039 |
| Connecting rod bearing-to-journal: | | |
| – clearance of new parts | .0010 to .0028 | 0.026 to 0.071 |
| – wear limit | .004 | 0.10 |

## Cleaning.

Remove carbon deposits from piston top and ring grooves using a curved scraper tool.

Eliminate all foreign matter from oil holes in piston and connecting rod.

Rings are cleaned with extremely refined emery cloth.

Next to cleaning, painstakingly check parts for cracks or such damages as replacement is required.

## Checking Piston Clearance in Bore and Piston Pin Clearance in Boss.

Clearance of pistons in cylinder bores should be checked (fig. 40) having mind to their class division. Therefore pistons and cylinders should belong to the same class.

**Standard** pistons are also graded into three divisions according to the pin boss bore.

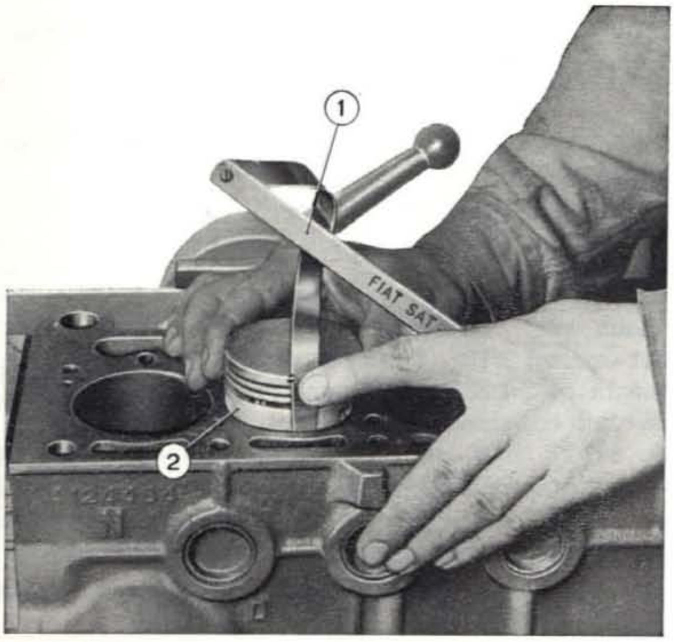


**Fig. 40 - Checking piston clearance in cylinder bore.**
1. Feeler gauge A. 95316. - 2. Piston.

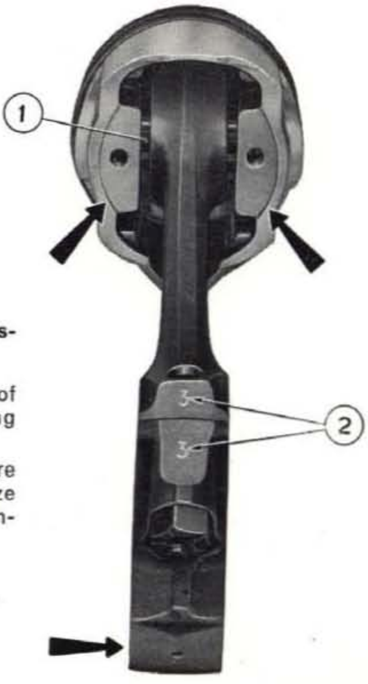

**Fig. 41.**
**Connecting rod and piston assembly.**

1. Piston pin. - 2. Location of connecting rod-cylinder pairing number.

Arrows point to the areas where stock can be milled out to equalize the weight of pistons and connecting rods.

The same grading applies, of course, also to pins which should belong to the same division as pistons they are fitted to.

The letter and number showing piston class and division of pin bore are stamped on the boss base (fig. 42), while the division of pins is stamped on pin face.

The clearance specified between piston pin and bosses is .0003″ to .0006″ (0.008 to 0.016 mm).


**Fig. 42.**
**Piston upside down, showing pin boss base.**

C. Class of piston skirt to match with cylinder. - 2. Division of piston boss bore to match with pin.

| Numero di ordinazione | DIAMETRO STANTUFFI NORMALI DI RICAMBIO |
|---|---|
| 4100732 | 64,970 ÷ 64,980 |
| 4119282 | 64,990 ÷ 65,000 |
| 4119284 | 65,010 ÷ 65,020 |

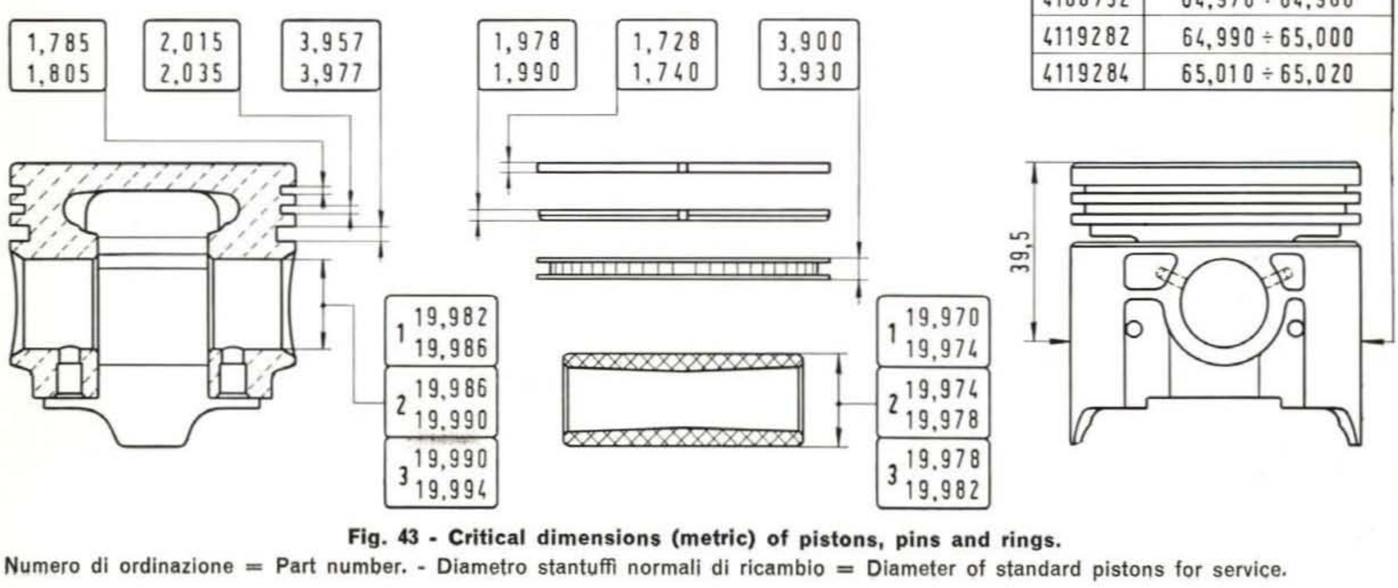


**Fig. 43 - Critical dimensions (metric) of pistons, pins and rings.**
Numero di ordinazione = Part number. - Diametro stantuffi normali di ricambio = Diameter of standard pistons for service.

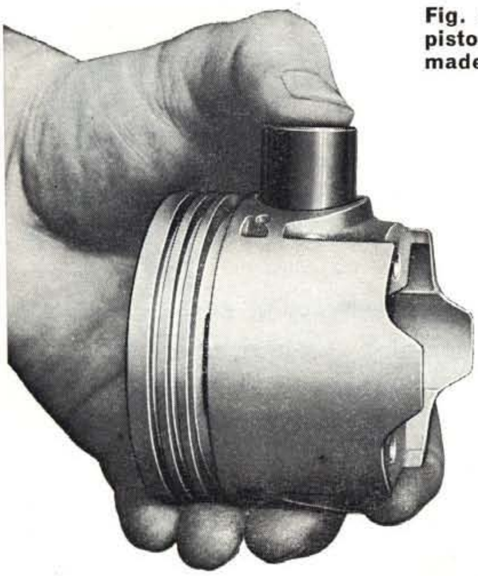

**Fig. 44 - Insertion of piston pin should be made by sheer thumb pressure.**

**CONDITIONS FOR A CORRECT FIT OF PISTON PIN IN PISTON**

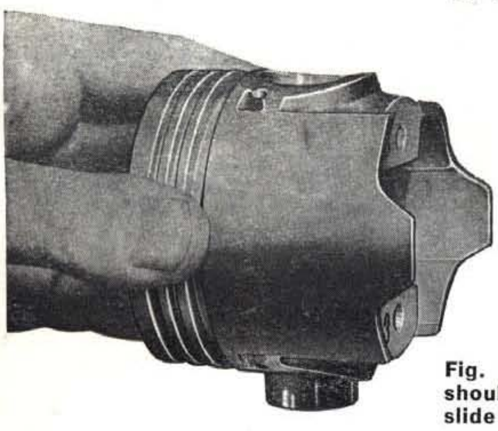

**Fig. 45 - Piston pin should not be apt to slide away from boss.**

To check the piston-to-pin fit, lubricate the pin with light engine oil and insert it in piston bosses. If the fit is correct, the pin will enter by sheer thumb pressure (fig. 44) and, holding the piston with the pin in vertical position, the pin should not be apt to slide away from the boss (fig. 45).

---

**The fitting clearance of piston in cylinder bore, measured at right angle to the pin and 1.555" (39.5 mm) apart from the piston head, should be .0008" to .0016 (0.020 to 0.040 mm). The wear of piston should be added to that of cylinder to figure the actual clearance of parts.**

---

**Oversize** pistons are supplied for service in the following rates: .0079" - .0159" - .0236" (0.2 - 0.4 0.6 mm), **without class division in skirt diameter and boss bore.**

**Oversize** piston pins are supplied for service in the .0079" (0.2 mm) rate, **without class division.**

## Checking Piston and Connecting Rod Weight.

Prior to installing, check the four pistons for an even weight within ± .09 oz (2.5 grams).

If a set of pistons ranging in the above weight limit is not available, mill the necessary amount of stock from the base of pin bosses, as shown in figures 41 and 46, so to equalize the weight of the piston set. However, the stock removal should not exceed 3/16" (5 mm) in depth against a nominal height of 2 1/32" (51.5 mm) and 2 1/4" (57.5 mm) in circle diameter.

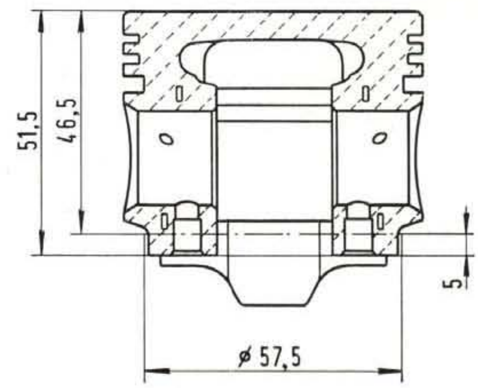


**Fig. 46 - Milling diagram of piston to equalize the set weight.**
⌀ 57,5 = 2 $^1/_4$" diam. - 5 = $^3/_{16}$" - 51,5 = 2 $^1/_{32}$" - 46,5 = 1 $^{25}/_{32}$".

The same inspection should be made on connecting rods, the weight difference of which, in the same set, should be within the limit of .21 oz (6 grams).

In case the weight exceeds specified tolerance range, remove the stock in excess by milling cap underside.

## Piston Rings.

### PISTON RING SIDE CLEARANCE

The side clearance of piston rings should be checked as shown in fig. 47; place ring into piston groove and slide in the stock of feeler gauge **A. 95316.**

Should side clearance exceed the limit of .0030" (0.077 mm), gauge parts to determine if the wear is in the ring, the groove or both.

Renew worn part or parts.

### CHECKING RING END GAP

Prior to fitting rings on piston, slide them into the cylinder and check the end gap (fig. 48); the gap should be as tabulated on page 36. Otherwise grind ring ends using grinder **A. 60188** or renew piston rings, if necessary.

Radial-slotted oil ring should show no end gap.

**NOTE - It is important, for correct operation and life of engine, that the side clearance of piston rings is kept within specified limits.**

**As a matter of fact, the absence of side clearance of rings causes blow-by, excessive oil consumption and premature wear of rings and cylinders. In turn excessive side clearance will bring about aggravated wear of lands and play.**

### INSTALLATION

The inside diameter of piston rings is lesser than the diameter of piston skirt and therefore rings should be spread for placing them into piston grooves.

Piston ring installation and removal is facilitated through the use of pliers **A. 60182.**

**NOTE - After installing piston rings, set them so that gaps are staggered around piston some 120°.**

## Removing Piston Pin.

The piston pin is a press fit in the small end and rocks in the piston boss, to which it is fitted loosely.

For a correct installation and removal of piston pin special tools should be used. To assemble the connecting rod-piston-pin assembly, the connecting rod should be heated to 608° F (320° C) for such an expansion of the small end as the pin can be inserted.

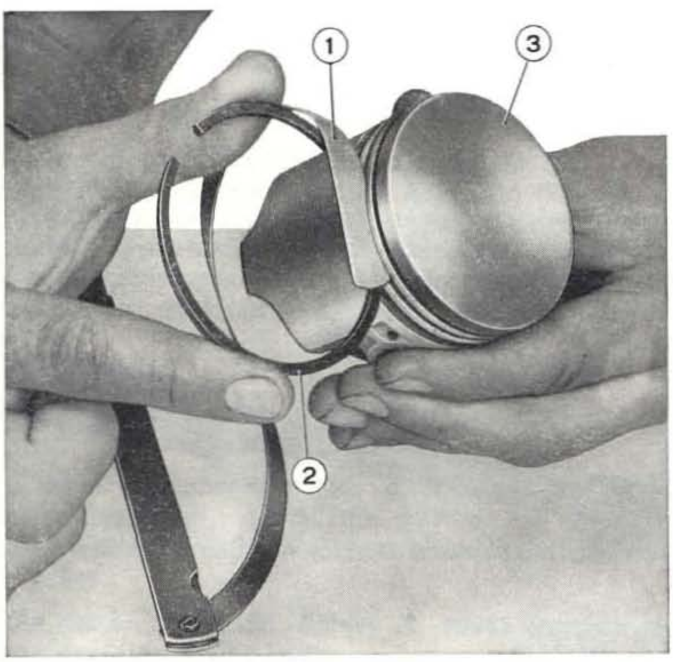


**Fig. 47 - Checking piston ring side clearance.**
1. Feeler gauge A. 95316. - 2. Piston ring. - 3. Piston.

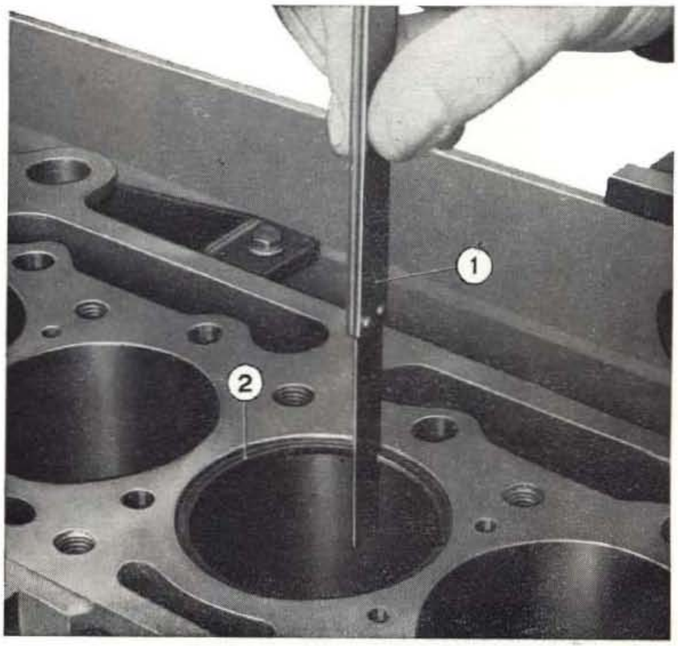


**Fig. 48 - Checking end gap of piston rings in cylinder.**
1. Feeler gauge A. 95118. - 2. Piston ring.

| | |
|---|---|
| Piston pin - to - small end press fit . . . . . . . | .0006" to .0015" (0.016 to 0.039 mm) |
| Piston pin-to-piston boss clearance . . . . . . | .0003" to .0006" (0.008 to 0.016 mm) |

The piston pin should be driven out on an arbor press, as shown in fig. 49, using holder **A.95605** and tool **A. 60285.**

**NOTE - Disassembled parts can be used again, if they are free from damage.**

**Take care, therefore, to mark components to be sure that the same parts are employed on reassembly.**

## Piston, Pin, Connecting Rod Assembly.

For easy insertion of piston pin in small end, the small end must be expanded by heating to 608° F (320° C), as outlined earlier.

To do so, use an electric oven with thermostat control, where con rods should be placed with the small end toward the interior (fig. 53).

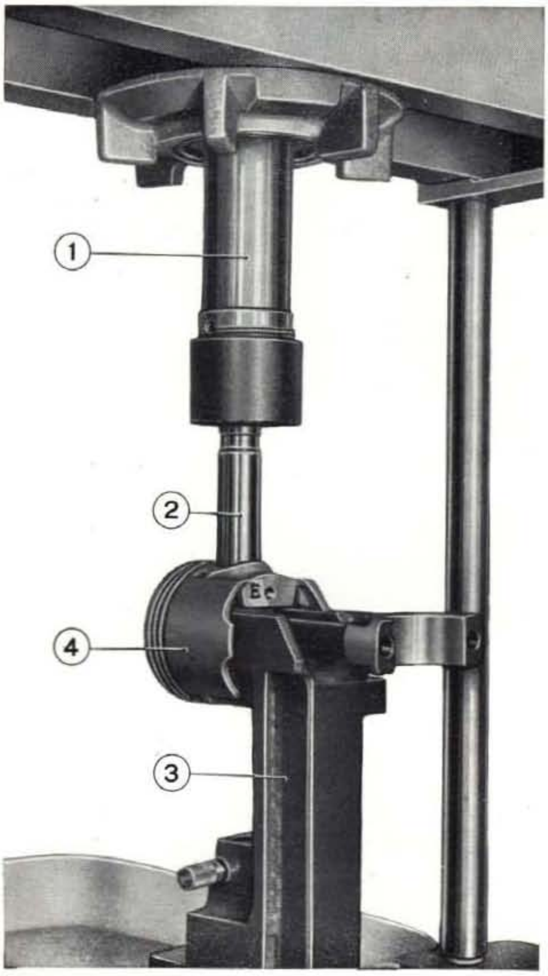


**Fig. 49 - Pressing out piston pin.**
1. Press arbor. - 2. Guide pin of tool A. 60285. - 3. Holder of tool A. 95605. - 4. Connecting rod-piston-pin assembly.

**Fig. 50.**
**Holder of tool A. 95605.**

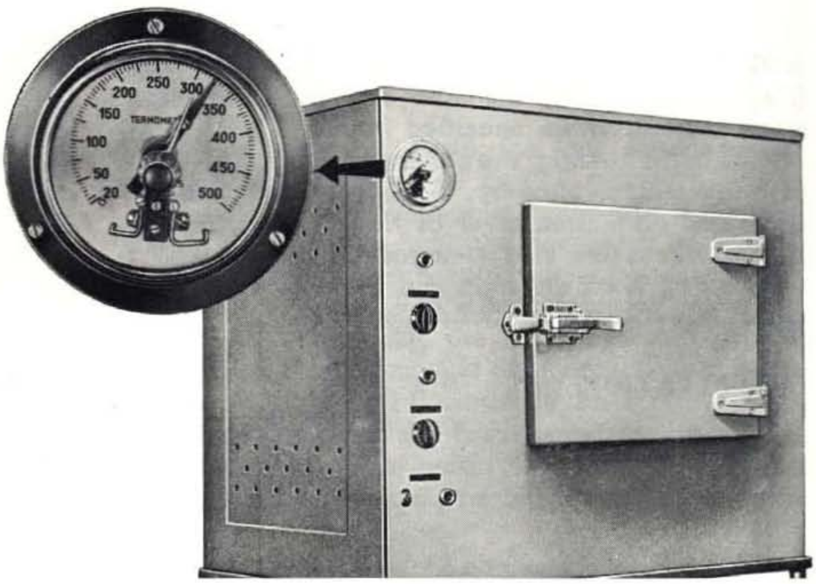

**Fig. 51 - Electric oven for heating connecting rods.**
The thermostat, set at 608° F (320° C), is also shown in an enlarged view.

Set the oven at 608° F (320° C) and when the red light goes out to indicate that this temperature has been reached, withdraw connecting rods.

Connecting rods should remain for fifteen minutes in an oven which has been pre-heated to 608° F (320° C).

---

**CAUTION ! - The connecting rod will cool off very rapidly. For a correct fit of piston pin in the small end, the pin must be driven in as quickly as possible. After the connecting rod has cooled off, no repositioning of the piston pin is possible.**

---

Install the piston pin as follows:

1) Select the pin and slide it onto the arbor (1, fig. 52) of tool **A. 60275**, then fit the guide pin (2) at the arbor end; stop the pin with the screw (3).

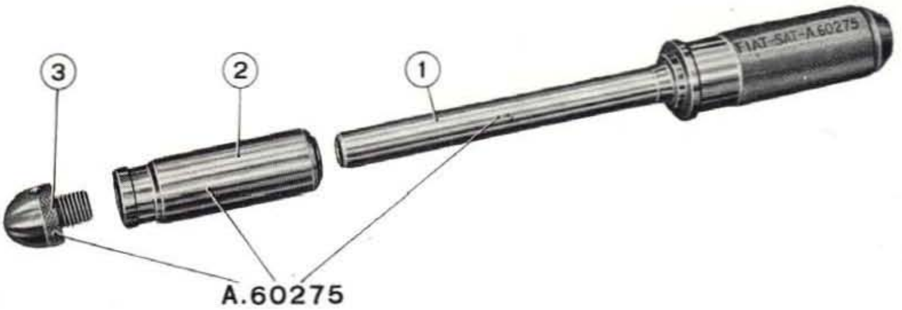


**Fig. 52 - Tool A. 60275 for piston pin removal and installation.**
1. Arbor. - 2. Guide pin. - 3. Stop screw.

Use care to turn in the pin screw just a fraction to avoid that it may be overtightened as a result of piston pin expanding in touch with a hot connecting rod.

2) Recall that the piston does not present a symmetrical design and therefore there is a fixed installing position for this part: **the connecting rod number should be on the opposite side to the piston skirt class letter and boss division number which are stamped on piston boss base** (fig. 54).

3) Clamp the connecting rod in a vise, immediately after withdrawing it from the oven. Place the piston on to the connecting rod, so to line up the pin boss with the small end eye. Use care that the piston is positioned as outlined earlier. Grab the tool **A. 60275**, to which the piston pin has been attached, as per item 1), and drive the pin into the boss and small end bore until the shoulder of the tool abuts against the boss face (fig. 55).

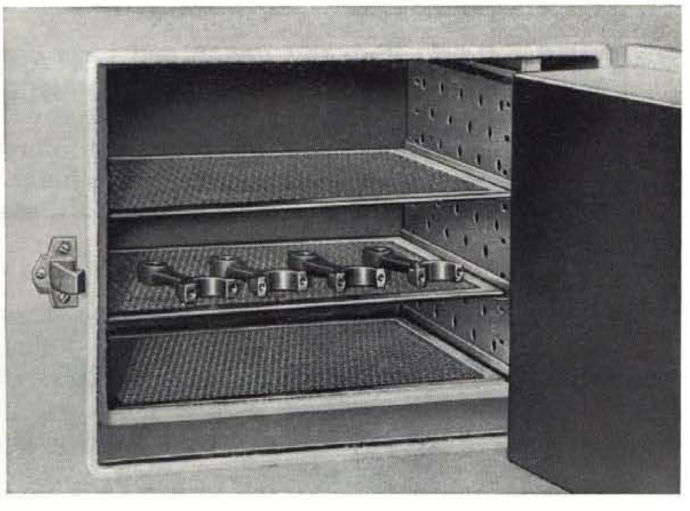

**Fig. 53 - Location of connecting rods in oven.**

**During this operation the piston should be brought horizontally** to abut against the small end, so as the pin boss contacts the small end eye (fig. 55). The pin will slide thus into seat without difficulty.

## Checking Piston Pin Drag.

After the connecting rod, piston and pin have been assembled, check the piston pin against slide resistance using a torque wrench and fixture **A. 95605**.

As shown in fig. 56, fixture **A. 95605** consists of a holder (1), which is the same as used for pin removal, a threaded rod (9) and a dial indicator with clamp (4, 5).

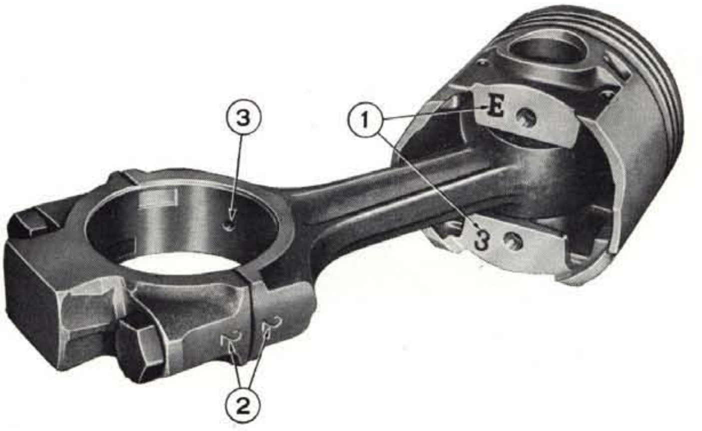


**Fig. 54 - Position of piston to connecting rod.**
1. Piston skirt class letter and piston boss division number. - 2. Connecting rod number. - 3. Oil hole.

Proceed as follows:

1) Clamp the fixture holder (5, fig. 57) in a vise and affix the connecting rod-piston-pin assembly to the holder.

2) Lower the indicator clamp (2), slide the threaded rod (6) through the pin hole and into the holder until the rod end (7) abuts against the pin face.

Screw the rod end nut (4) all the way down, so to take up any play of the rod to the fixture holder.

3) Raise the clamp of the dial indicator (2) horizontal, stop it with the pressure screw (3) and

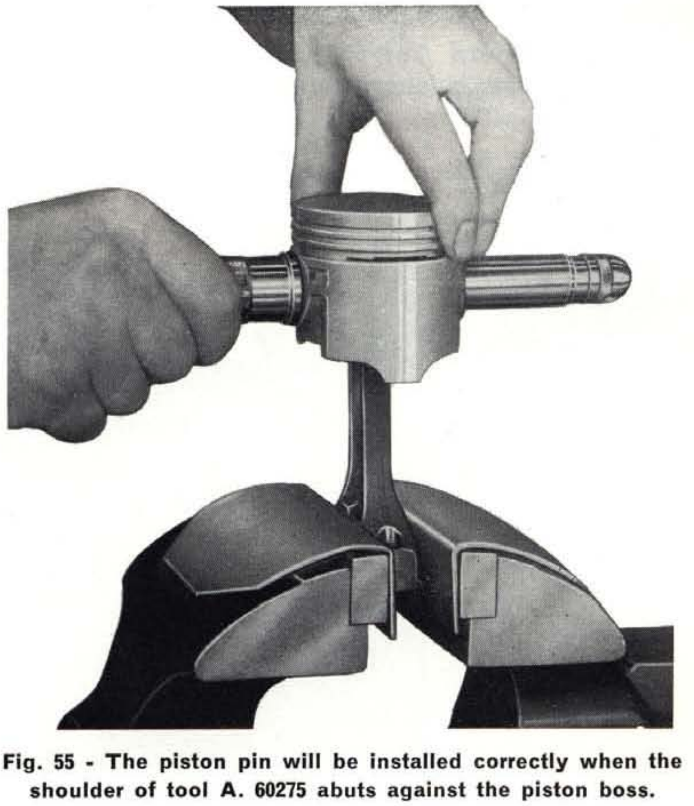

**Fig. 55 - The piston pin will be installed correctly when the shoulder of tool A. 60275 abuts against the piston boss.**

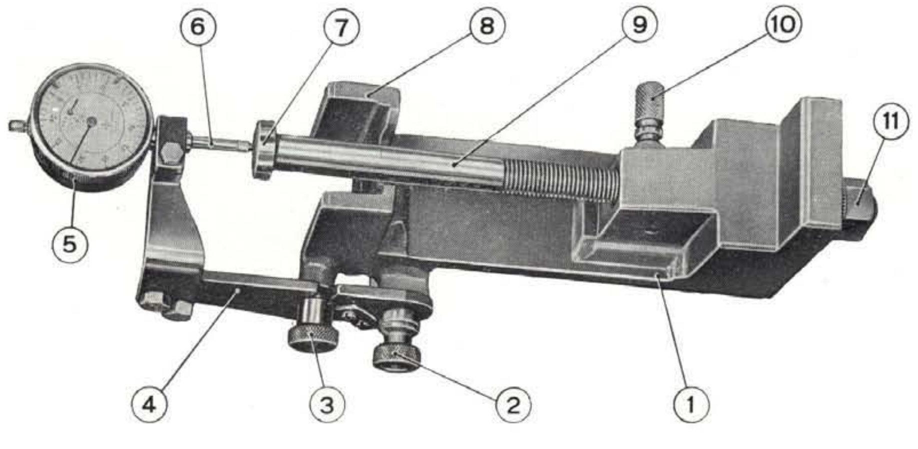


**Fig. 56.**

**Fixture A. 95605 for checking piston pin drag.**

1. Holder. - 2. Dial indicator clamp pin. - 3. Clamp pressure screw. - 4. Dial indicator clamp. - 5. Dial indicator. - 6. Dial indicator plunger. - 7. Rod end. - 8. Holder head, housing the connecting rod piston and pin assembly. - 9. Threaded rod. - 10. Rod stop pin. - 11. Rod nut.

rest the plunger (8) of the indicator (1) at the end (7) of the rod in the pin hole.

Set the indicator pointer at zero and working on the stop knob (3) set the stop pin into the rod spline to hold the rod stationary.

4) Apply a torque wrench on the rod nut and draw it up with 9.4 ft.lbs (1.3 kgm) of torque, which corresponds to an axial load of 882 lbs (400 kg).

The piston pin-connecting rod fit will be correct if, as the action of the torque wrench ceases and the rod nut is turned out to its original position (start in), the dial needle moves back to zero reading from the position taken under the test load.

Should piston pin ride loose in small end, replace the connecting rod by a new one because there is not the press fit as specified.

Now, prior to fitting the piston, pin and connecting rod assembly to engine, proceed as follows:

– Using fixture **Ap. 5051**, check the assembly for misalignment as shown in fig. 59. Minor distortions of connecting rod stem can be corrected by means of bending bar **A. 60189.**

– Oil piston pin through holes in piston bosses.

– Install the assembly with the connecting rod identification number facing the side opposite the camshaft (fig. 61).

**WARNING - Connecting rod yokes and caps are identified in production with a number stamping to show the cylinder to which rods should be paired. When installing new connecting rods, use care to always stamp such pairing number with cylinder.**

## Connecting Rod Bearings.

Examine the internal face of rod bearing inserts: if light scratches are noticed, remove them using an extremely refined grinding wheel. Should deep

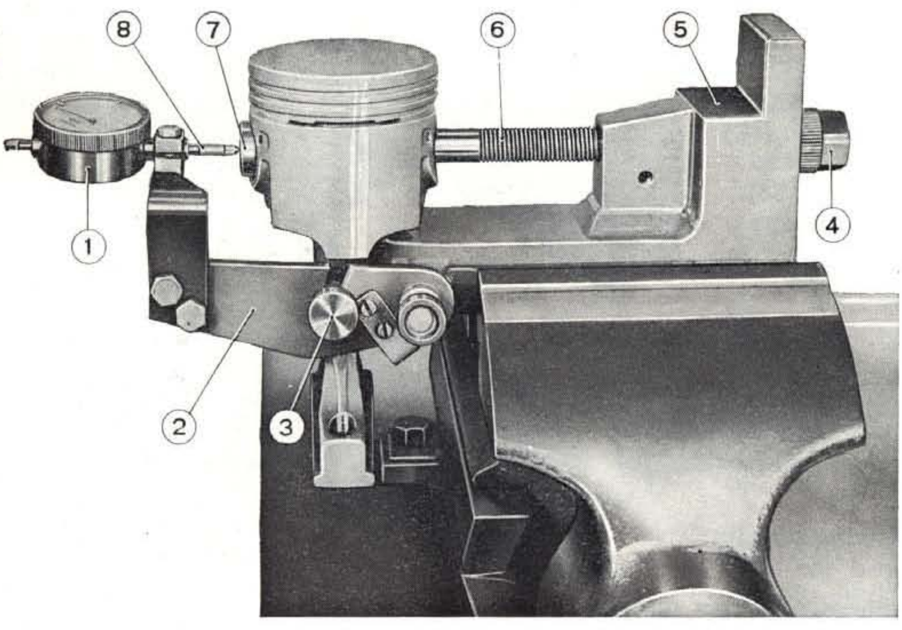


**Fig. 57.**

**Arranging connecting rod, piston and pin assembly on fixture A. 95605 for drag test of piston pin.**

1. Dial indicator set at zero. - 2. Dial indicator clamp. - 3. Clamp pressure screw. - 4. Rod nut. - 5. Holder. - 6. Threaded rod. - 7. Rod end in touch with piston pin. - 8. Indicator plunger in touch with rod end.

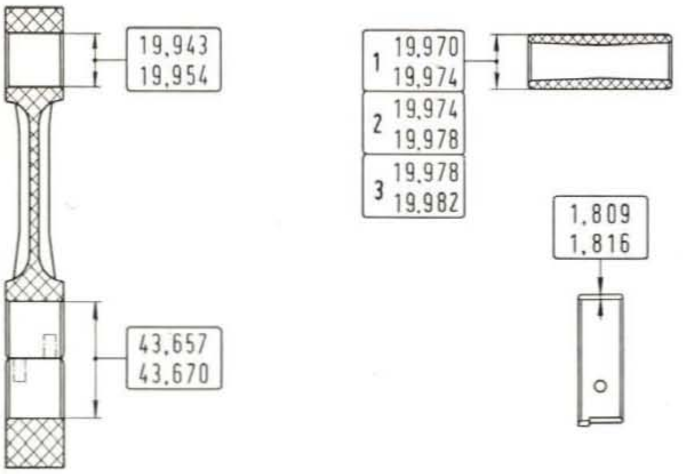


**Fig. 58 - Critical dimensions (metric) of connecting rod, rod bearing insert and piston pin.**
(Early type)

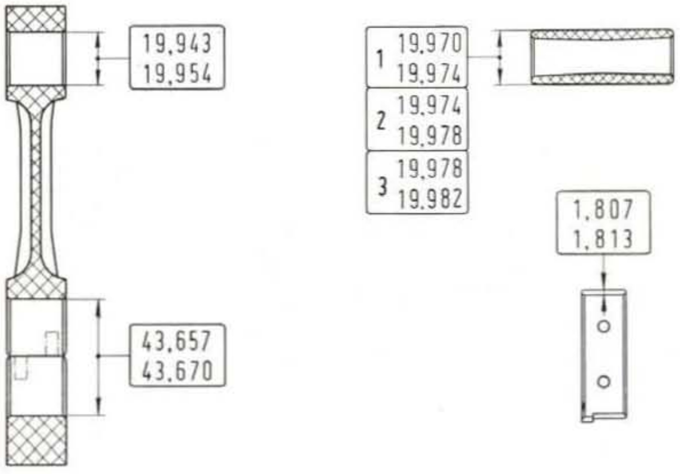


**Fig. 60 - Critical dimensions (metric) of connecting rod, rod bearing insert and piston pin.**
(Late type)

notches or signs of wear be evident, renew the bearings. Actually the babbitt coat allows for no reworking or adaptation of thin-wall bearings.

Check clearance between connecting rod bearings and journals using « Plastigage » calibrated wire type PG1 as follows:

– Thoroughly wipe all components.

– Tie piston-connecting rod assemblies to crankshaft journals according to pairing numbers.

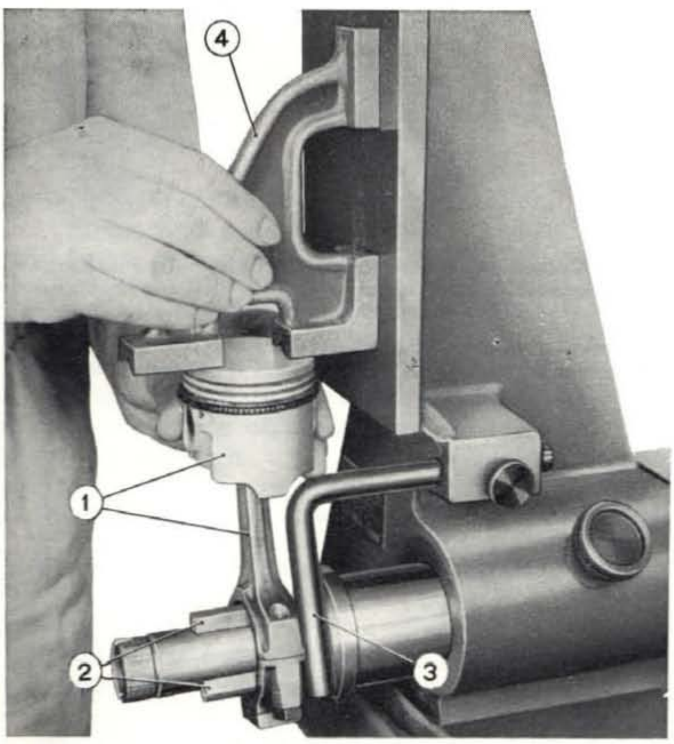


**Fig. 59 - Checking connecting rod-piston and pin assembly for misalignment.**
1. Connecting rod piston and pin assembly. - 2. Spreaders. - 3. Locating bar. - 4. Square gauge.

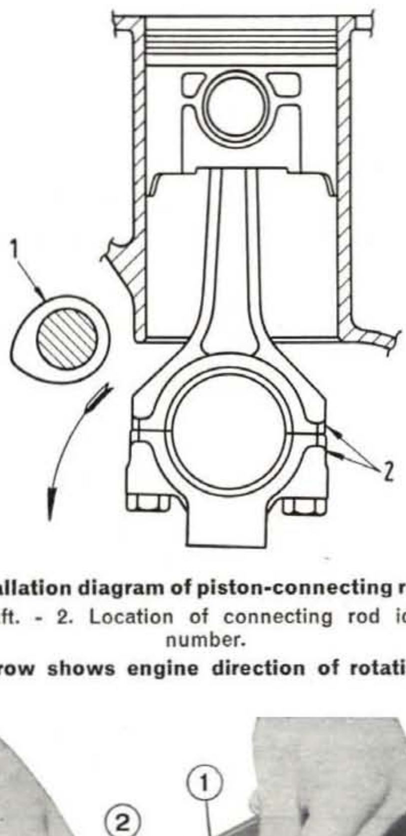


**Fig. 61 - Installation diagram of piston-connecting rod assembly.**
1. Camshaft. - 2. Location of connecting rod identification number.
**Arrow shows engine direction of rotation.**

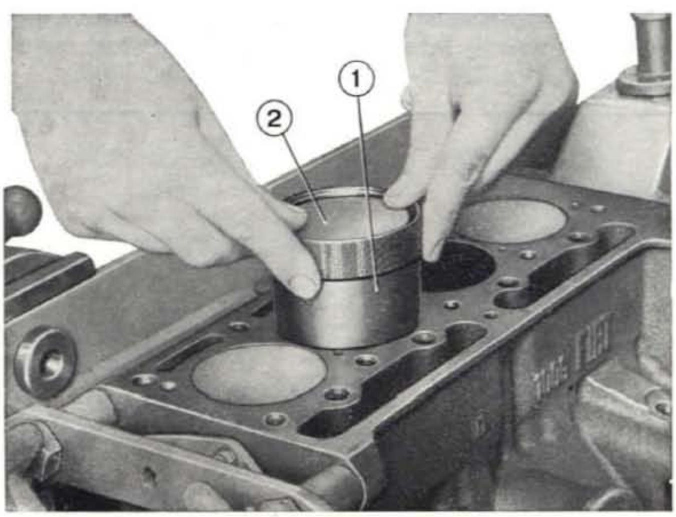


**Fig. 62 - Installing connecting rod-piston assembly.**
1. Tool A. 60273. - 2. Piston complete with pin and rings.

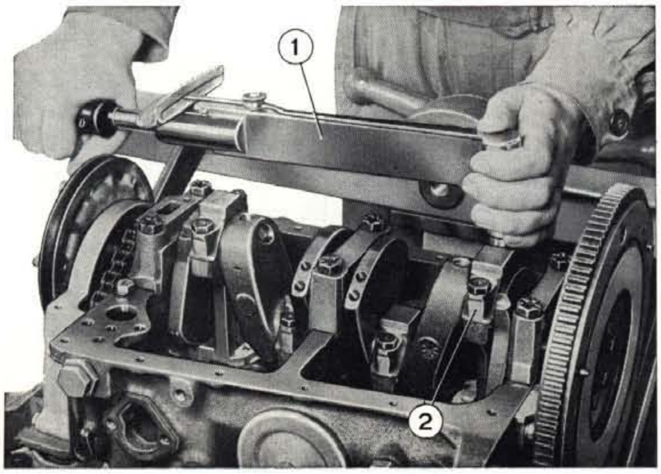


**Fig. 63 - Securing connecting rod bearing caps.**

1. Torque wrench. - 2. Con rod bearing cap.

– Place a piece of calibrated wire on journal.

– Fit connecting rod bearing caps and draw up cap screws with 25.3 ft.lbs (3.5 kgm ) of torque (fig. 63).

– Remove caps and determine the amount of clearance comparing the width of the flattened « Plastigage » with the graduations on the envelope (fig. 64).

If clearance proves to be within the tolerance range of .0010″ to .0028″ (0.026 to 0.071 mm) or not in excess of .004″ (0.10 mm) wear limit, bearing can still be used with crankpins unaltered in diameter.

Conversely if clearance is greater than above figures, replace rod bearings by undersizes (see table) and grind crankpins as outlined on page 46 and to the values tabulated hereafter.

**SERVICE NOTE - Early type connecting rod bearings shown in fig. 58 can be safely replaced by the late type. In case the connecting rod is to be renewed, install late type connecting rod and bearings.**

## CRANKPIN DIAMETERS

| Standard | Undersizes | | | |
|---|---|---|---|---|
| | .01″ (0.254 mm) | .02″ (0.508 mm) | .03″ (0.762 mm) | .04″ (1.016 mm) |
| 1.5742″ (39.985 mm) | 1.5642″ (39.731 mm) | 1.5542″ (39.477 mm) | 1.5442″ (39.223 mm) | 1.5342″ (38.969 mm) |
| 1.5750″ (40.005 mm) | 1.5650″ (39.751 mm) | 1.5550″ (39.497 mm) | 1.5450″ (39.243 mm) | 1.5350″ (38.989 mm) |

## CONNECTING ROD BEARING INSERT THICKNESSES

| Standard | Undersizes | | | |
|---|---|---|---|---|
| | .01″ (0.254 mm) | .02″ (0.508 mm) | .03″ (0.762 mm) | .04″ (1.016 mm) |
| .7114″ (1.807 mm) | .8114″ (2.061 mm) | .9114″ (2.315 mm) | 1.0114″ (2.569 mm) | 1.1114″ (2.823 mm) |
| .7134″ (1.813 mm) | .8138″ (2.067 mm) | .9138″ (2.321 mm) | 1.0138″ (2.575 mm) | 1.1138″ (2.829 mm) |

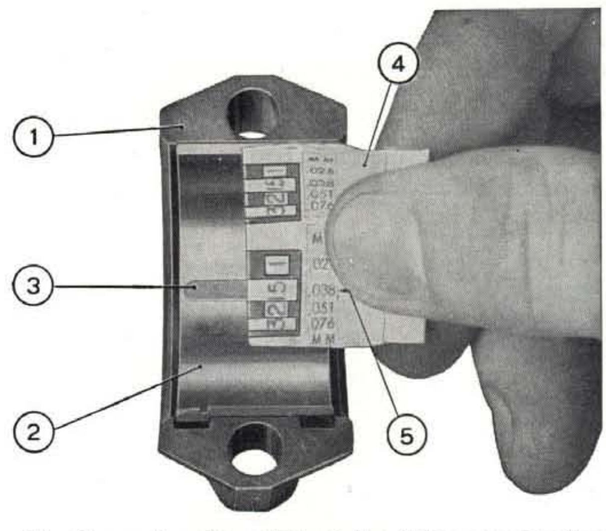


**Fig. 64 - Comparing the width of the flattened « Plastigage » with the envelope graduation scale to check connecting rod bearing insert-to-journal clearance.**

1. Con rod bearing cap. - 2. Bearing insert. - 3. « Plastigage » wire. - 4. Envelope with graduation scale. - 5. Clearance reading.

# CRANKSHAFT AND MAIN BEARINGS



## MAIN SPECIFICATIONS

| DESCRIPTION | in | mm |
|---|---|---|
| Main bearing journal standard diameter . . . . | 1.9994 to 2.0002 | 50.785 to 50.805 |
| Main bearing saddle bore . . . . . . . . . . | 2.1459 to 2.1465 | 54.507 to 54.520 |
| Standard main bearing shell thickness . . . . . | .0721 to .0725 | 1.832 to 1.841 |
| Main bearing inserts for service . . . . . . . | Std, .01-.02-.03-.04 U.S. | 0.254-0.508-0.762-1.016 |
| Crankpin journal standard diameter . . . . . . | 1.5742 to 1.5750 | 39.985 to 40.005 |
| Main bearing-to-journal:<br>– clearance of new parts . . . . . . . . . .<br>– wear limit . . . . . . . . . . . . . . . | <br>.0008 to .0024<br>.004 | <br>0.020 to 0.066<br>0.10 |
| Length of center main bearing journal, shoulder-to-shoulder . . . . . . . . . . . . . . . . | 1.1055 to 1.1071 | 28.080 to 28.120 |
| Width of center transverse member, between thrust ring seats . . . . . . . . . . . . . . | .9149 to .9173 | 23.240 to 23.300 |
| Center main bearing thrust ring thickness . . . | .0909 to .0929 | 2.310 to 2.360 |
| Oversize thrust ring thickness . . . . . . . . | .0959 to .0979 | 2.437 to 2.487 |
| Crankshaft end fit, thrust rings installed:<br>– clearance of new parts . . . . . . . . . .<br>– wear limit . . . . . . . . . . . . . . . | <br>.0024 to .0102<br>.014 | <br>0.06 to 0.26<br>0.35 |
| Maximum misalignment of main bearing journals | .0020 (*) | 0.05 (*) |
| Maximum misalignment of crankpins to main bearing journals . . . . . . . . . . . . . . . | ± .0197 | ± 0.5 |
| Maximum out-of-round of crankpin and main bearing journals, after grinding . . . . . . . . . | .0002 | 0.005 |
| Maximum taper of crankpin and main bearing journals, after grinding . . . . . . . . . . . | .0002 | 0.005 |

*(continued)*

(*) Total indicator reading.

**Main Specifications** *(continued)*.

| DESCRIPTION | in | mm |
|---|---|---|
| Squareness of flywheel resting face to crankshaft centerline: – Max. out-of-true with dial indicator plunger set laterally some 1 $^7/_{32}$″ (31 mm) apart from crankshaft rotation axis . . . . . . . . . . | .0010 | 0.025 |
| Flywheel: – parallel relationship of driven plate face to crankshaft mounting face: max. out-of-true | .004 | 0.1 |
| – squareness of above faces to rotation axis: max. out-of-true . . . . . . . . . . . . . . | .004 | 0.1 |

## Checking and Grinding Crankpins and Journals.

The crankshaft must show no signs of cracking at crankpins and journals as well as crankarms: otherwise the crankshaft should be replaced lest shattering may result in operation.

If light scores are noticed, reface by a very fine carborundum stone.

In case of deep notches or if journals are found to be out-of-round in excess of .002″ (0.05 mm), regrind journals having mind to fitting clearances and the undersize range of replacement bearings.

In fact crankpins and journals should be ground, depending on the state of wear, so that final diameters are conforming tabulated data and crankarm fillet radii are as shown in figures 66-67-68 and 69.

Next fit bearing undersizes at each journal so to keep fitting clearance within limits tabulated under « Main Specifications ».

Install the crankshaft on grinding machine using tool **A. 60080** which should be placed as shown in fig. 65.

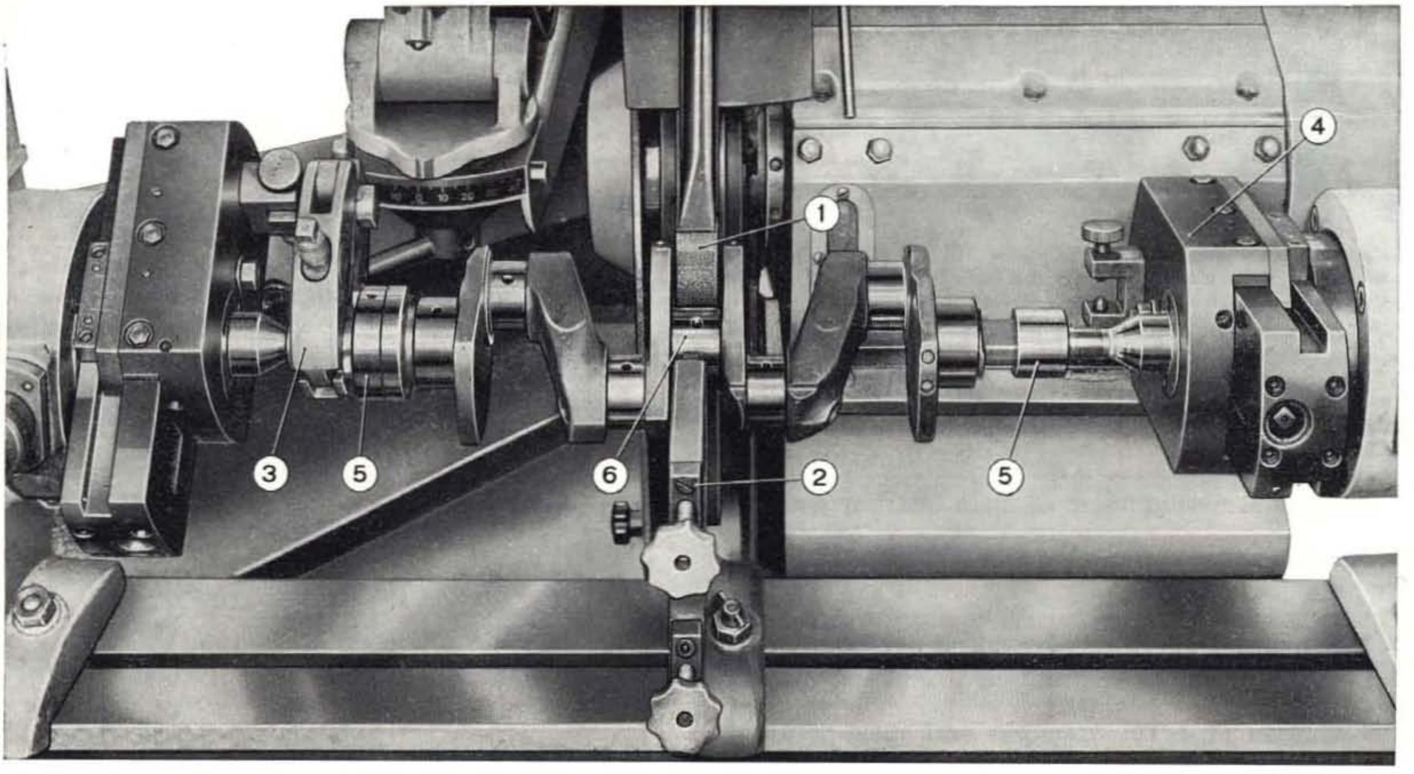


**Fig. 65 - Grinding main bearing journals on grinding machine.**
1. Grinding wheel. - 2. Journal holder. - 3. Clamp. - 4. Slide. - 5. Tool A. 60080. - 6. Journal.

## CRANKARM FILLET SPECIFICATIONS

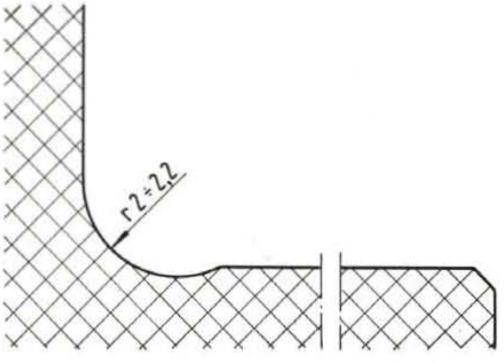


**Fig. 66 - Fillet radii for chain end main bearing journal shoulder.**

r 2÷2,2 = .079'' to .087''

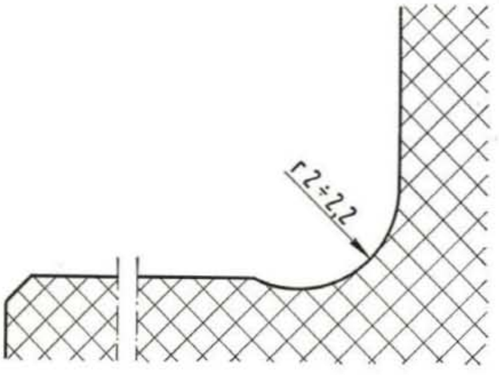


**Fig. 67 - Fillet radii for flywheel end main bearing journal shoulder.**

r 2÷2,2 = .079'' to .087''

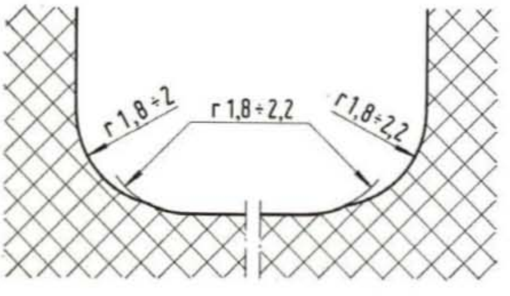


**Fig. 68 - Fillet radii for intermediate main bearing journal shoulder.**

r 1,8÷2 = .071'' to .079'' - r 1,8÷2,2 = .071'' to .087''

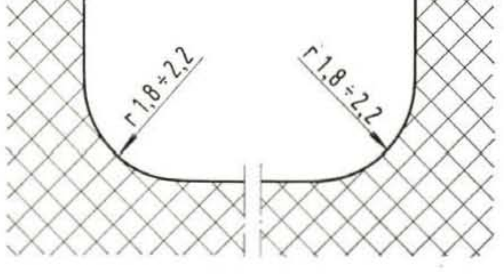


**Fig. 69 - Fillet radii for connecting rod bearing journal shoulders.**

r 1,8÷2,2 = .071'' to .087''

**Fig. 70 - Crankshaft.**

In foreground, oil passage ports on crankpins and journals

After grinding polish journals and then thoroughly wash the crankshaft to remove all particles of abrasive material left.

Oil passages should be cleaned by means of repeated jets of petrol under pressure (fig. 70).

## Flywheel and Ring Gear.

Check the conditions of ring gear teeth; if chips or serious damage are detected, renew the ring gear assembly.

The ring gear must be installed on the flywheel by means of an arbor press; pre-heat the ring gear in an oil bath at 176° F (80° C).

Mating faces of flywheel to crankshaft and driven plate should be mirror-like and free from scores.

Moreover, above faces must be thoroughly flat and at right angles to flywheel rotation axis.

Support the flywheel on A (fig. 71) and locate it in crankshaft seat: the dial indicator set at B and C should show no runout in excess of .004'' (0.1 mm).

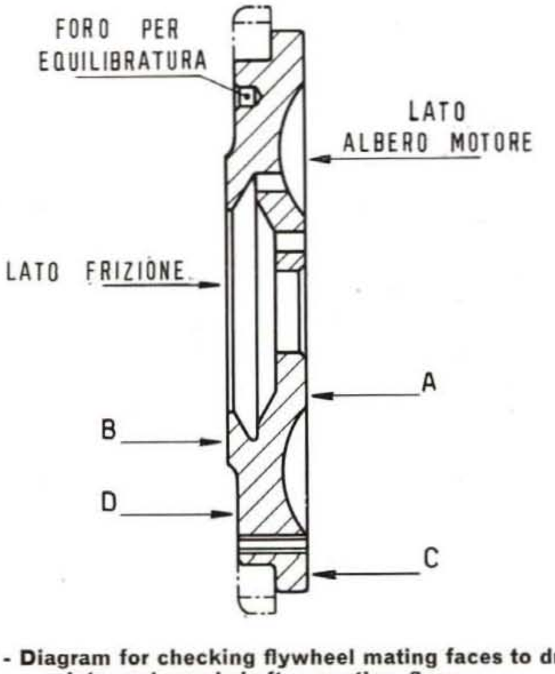


**Fig. 71 - Diagram for checking flywheel mating faces to driven plate and crankshaft mounting flange.**

Foro per equilibratura = Balance hole. - Lato frizione = Clutch side. - Lato albero motore = Crankshaft side.

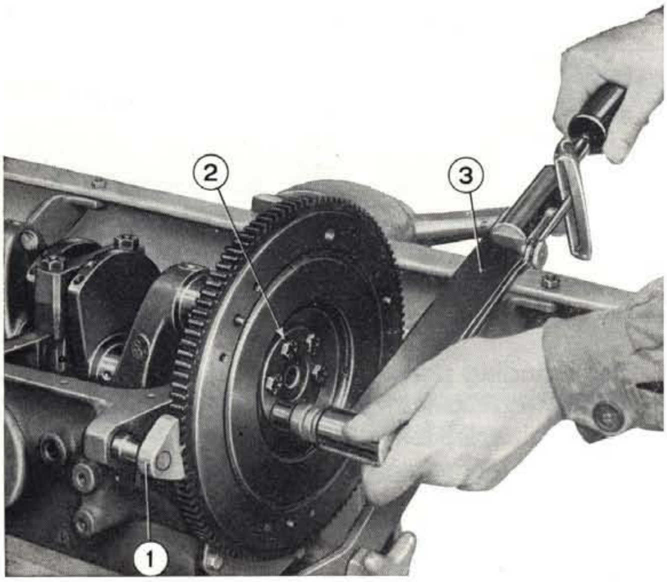


**Fig. 72 - Tightening flywheel mounting nuts.**
1. Tool A. 60282. - 2. Flywheel mounting nuts. - 3. Torque wrench.

### CRANKPIN DIAMETERS

| Standard | Undersizes | | | |
|---|---|---|---|---|
| | .01″ (0.254 mm) | .02″ (0.508 mm) | .03″ (0.762 mm) | .04″ (1.016 mm) |
| 1.5742″ (39.985 mm) 1.5750″ (40.005 mm) | 1.5642″ (39.731 mm) 1.5650″ (39.751 mm) | 1.5542″ (39.477 mm) 1.5550″ (39.497 mm) | 1.5442″ (39.223 mm) 1.5450″ (39.243 mm) | 1.5342″ (38.969 mm) 1.5350″ (38.989 mm) |

### MAIN JOURNAL DIAMETERS

| Standard | Undersizes | | | |
|---|---|---|---|---|
| 1.9994″ (50.785 mm) 2.0002″ (50.805 mm) | 1.9896″ (50.536 mm) 1.9902″ (50.551 mm) | 1.9796″ (50.282 mm) 1.9802″ (50.297 mm) | 1.9696″ (50.028 mm) 1.9702″ (50.043 mm) | 1.9596″ (49.774 mm) 1.9602″ (49.789 mm) |

## Checking Crankshaft Balance.

Arrange « V » blocks **A. 95732** on a surface plate.

Place crankshaft, flywheel and clutch assembly on « V » blocks.

If the crankshaft has a tendency to rotate on either side, correct by applying putty on the opposite side; the weight of the putty applied is the amount of crankshaft unbalance.

Drill at D (fig. 71) to remove excess weight.

## Checking Crankpin and Journal Alignment.

Support the crankshaft at ends on « V » blocks **A. 95731** and using a dial indicator check:

– alignment of journals: max. out-of-true .002″ (0.05 mm) (total indicator reading) (fig. 73);

– alignment of crankpins: max. out-of-true to journals ± .020″ (0.5 mm) (fig. 73);

– out-of-round of crankpins and journals: max. out-of-true after grinding .0002″ (0.005 mm);

– taper of crankpins and journals: max. out-of-true after grinding .0002″ (0.005 mm);

– squareness of flywheel mounting face to crankshaft axis: turn the crankshaft and set a dial indicator laterally at some 1.221″ (31 mm) from shaft axis, runout should not exceed .001″ (0.025 mm).

Distortions, if any, must be corrected by means of an arbor press.

## Cleaning Oil Passages.

For a thorough cleaning of oil passages passage plugs must be first removed. Reface plug seat with cutter **A. 94016/10/14** which is operated by chuck **A. 94016**.

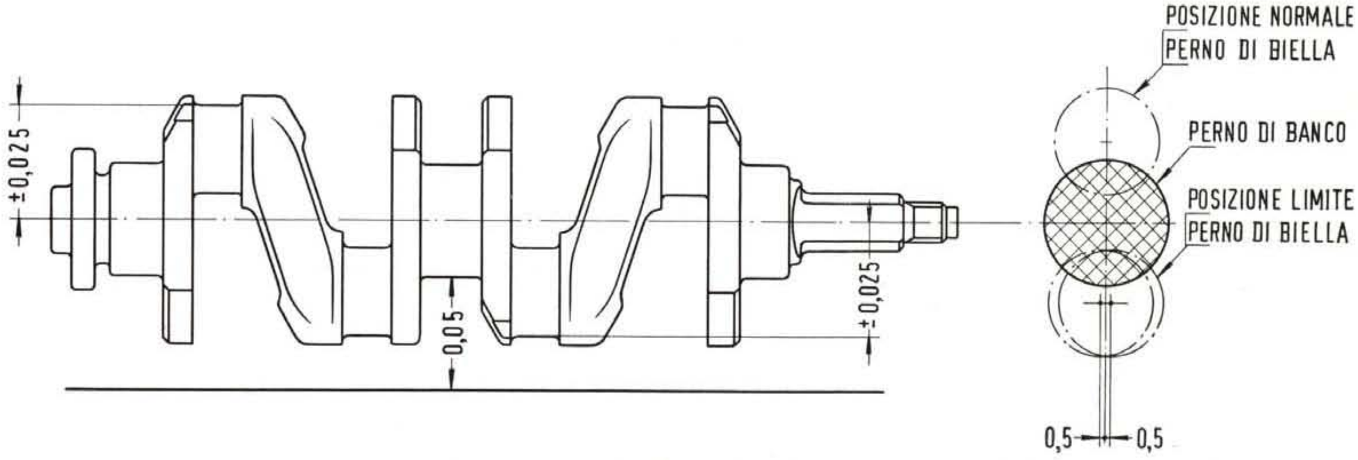


**Fig. 73 - Allowances on alignment of main journals to crankpins.**
0.05 = .002″ - 0.5 = .02″ - ± 0.025 = ± .001″.
Posizione normale perno di biella = Regular position of crankpin. - Perno di banco = Main journal. - Posizione limite perno di biella = Extreme position of crankpin.

Flush oil passages by a gasoline jet and dry with air blast.

Next insert new passage plugs using driver **A. 86014** and stake them around by means of a punch.

## Main Bearings.

Minor scratches on main bearing inserts can be smoothed out by means of an extremely refined grinding stone.

In case of grooves, signs of seizure or remarkable wear renew bearing inserts.

In fact thin-wall bearings cannot be reworked or adapted.

If on inspection bearing inserts turn out to be still usable, check their clearance to crankshaft journals as follows:

– Place a piece of « Plastigage » calibrated wire on journal (fig. 76).

– Install main bearing journals and inserts.

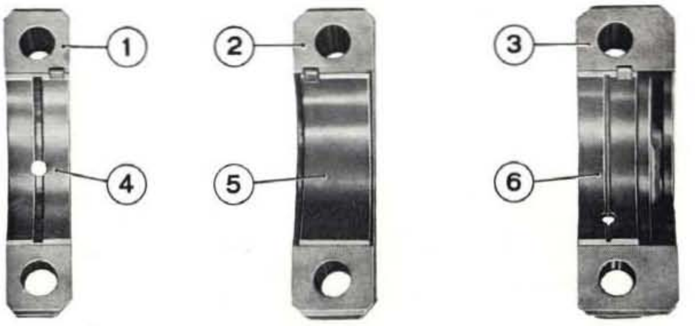


**Fig. 74 - Main bearing caps with bearing inserts in place.**
1. Front cap. - 2. Intermediate cap. - 3. Rear cap. - 4, 5, 6. Bearing inserts.

**MAIN BEARING INSERT THICKNESSES**

| Standard | Undersizes | | | |
|---|---|---|---|---|
| | .01″ (0.254 mm) | .02″ (0.508 mm) | .03″ (0.762 mm) | .04″ (1.016 mm) |
| .7212″ (1.832 mm) .7248″ (1.841 mm) | .7712″ (1.959 mm) .7748″ (1.968 mm) | .8212″ (2.086 mm) .8248″ (2.095 mm) | .8712″ (2.213 mm) .8748″ (2.222 mm) | .9212″ (2.340 mm) .9248″ (2.349 mm) |

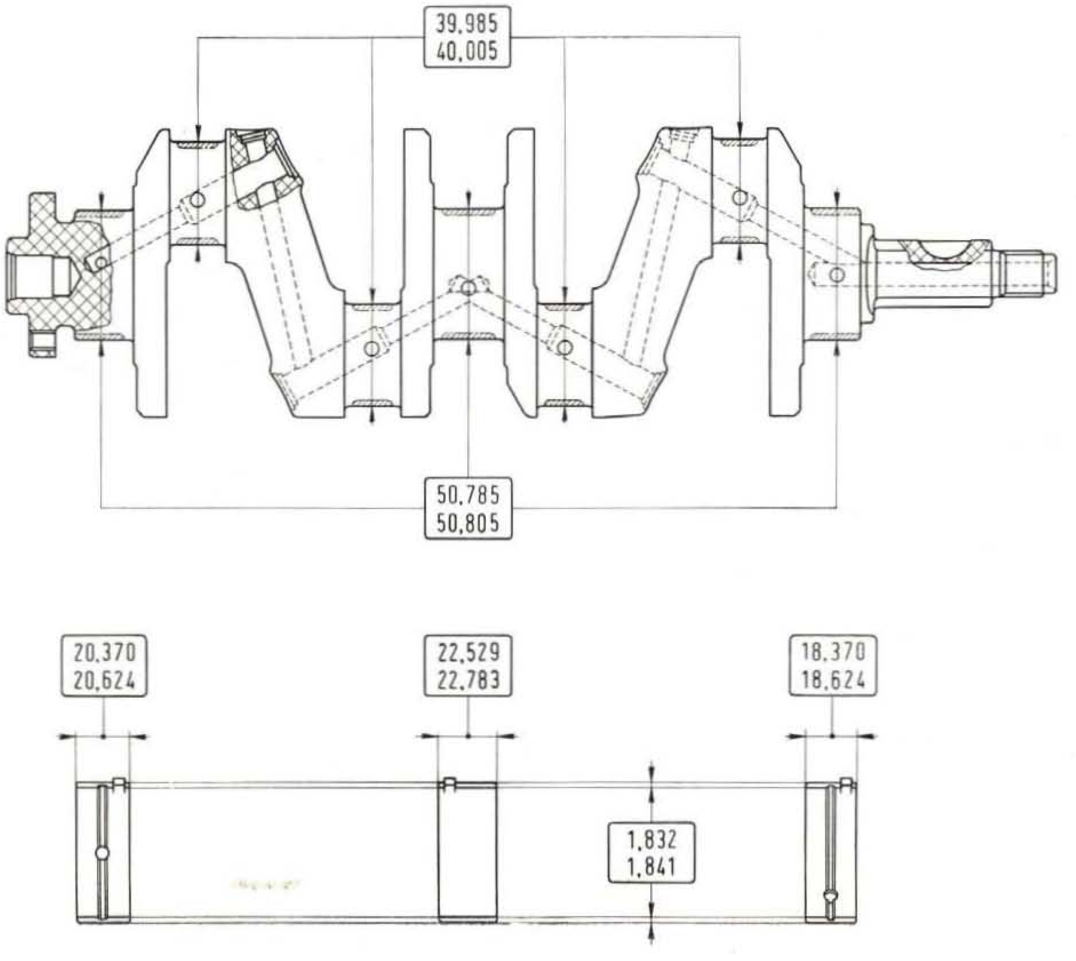


**Fig. 75 - Critical dimensions (metric) of crankshaft and main bearing inserts.**

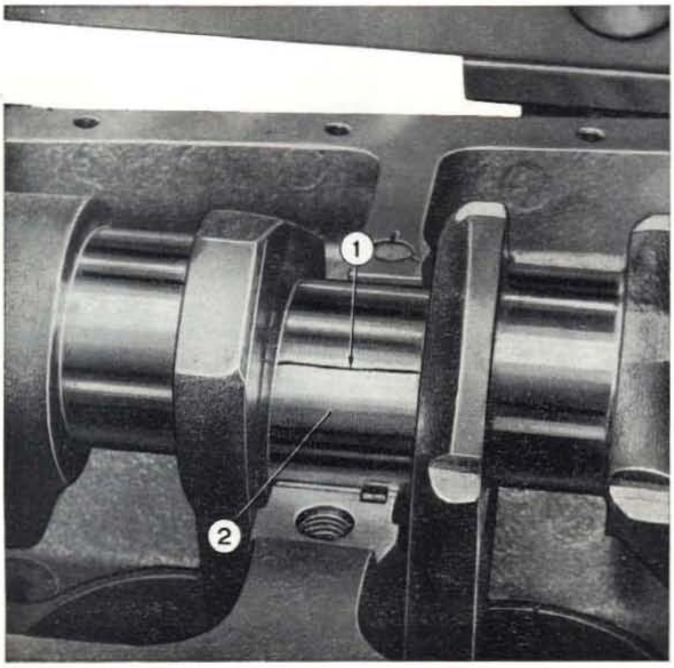


**Fig. 76 - Arrangement of calibrated wire on main journal.**
1. Piece of « Plastigage ». - 2. Journal.

— Draw up main bearing cap screws with 44.8 ft.lbs (6.2 kgm).

— Remove caps and compare the width of flattened « Plastigage » with the graduation scale on envelope (fig. 77). The number within the graduation on the envelope indicates the bearing clearance.

The fitting clearance of main bearings to journals is .0008" to .0024" (0.020 to 0.060 mm).

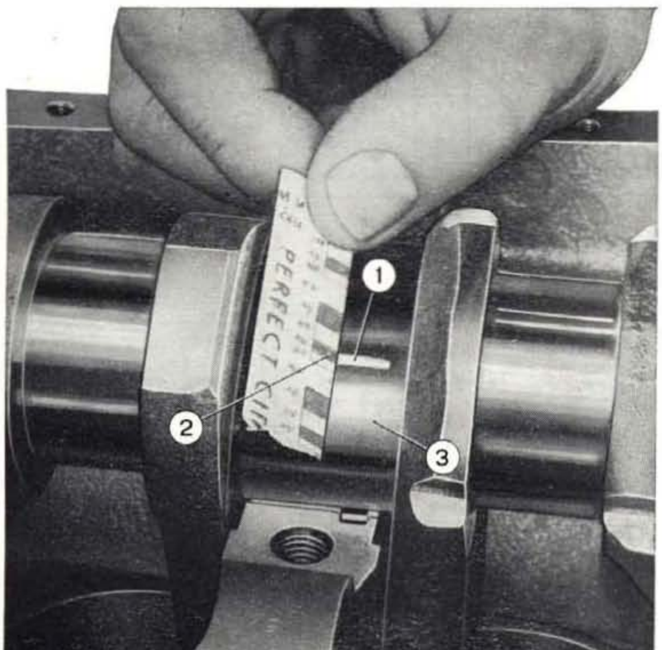


**Fig. 77 - Comparing the width of flattened « Plastigage » with the graduations on the envelope.**
1. Flattened calibrated wire. - 2. Clearance reading. - 3. Main journal.

Should clearance not be within the wear limit of .004" (0.10 mm) replace bearings by undersizes (see table).

After all necessary checks and replacements have been completed, fit bearing caps and tighten screws to the prescribed torque (fig. 79).

The crankshaft rotating freely indicates that it was installed correctly with specified clearance of bearings to journals.

## Checking End Play.

After the crankshaft has been installed, check the end play between the intermediate bearing thrust rings and crankshaft shoulders.

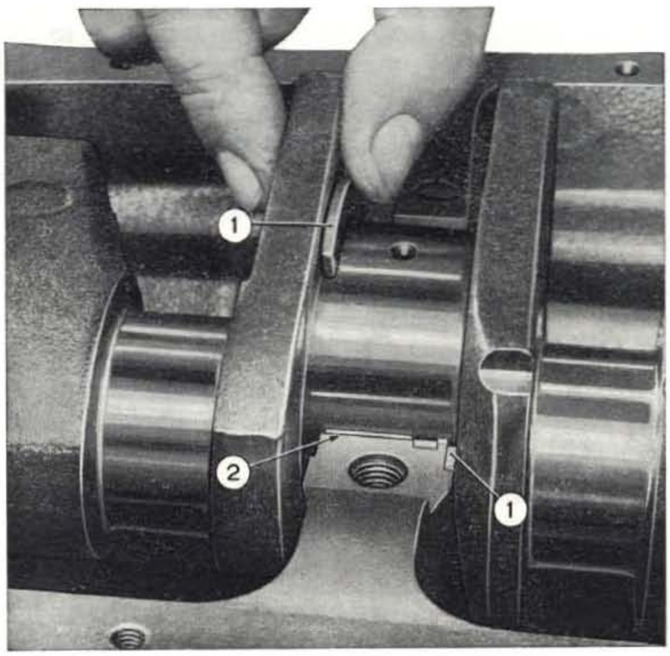


**Fig. 78 - Fitting thrust ring halves.**
1. Thrust ring halves. - 2. Intermediate main bearing insert.

Apply the magnetic dial indicator and insert two screwdrivers as shown in fig. 80.

Move the crankshaft axially and note the dial reading to check that the end play is within .0024" to .0102" (0.06 to 0.26 mm).

Should end play exceed the top limit of .0138" (0.35 mm), replace thrust rings by .005" (0.127 mm) oversizes which are supplied for service.

When fitting replacement thrust ring halves, recall that the grooved face of rings should be toward the shaft shoulder.

## Oil Seals.

During engine rebuild, check to make sure that crankshaft oil seals at timing gear cover and flywheel end are free of damage and serviceable; otherwise renew them.

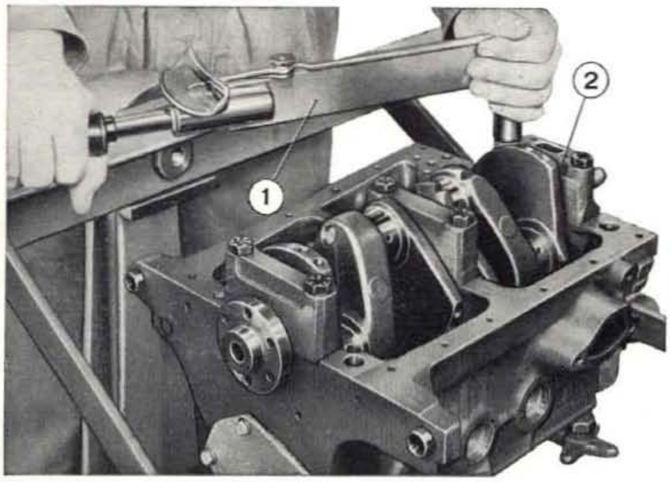


**Fig. 79 - Tightening main bearing cap screws.**
1. Torque wrench. - 2. Main bearing cap.

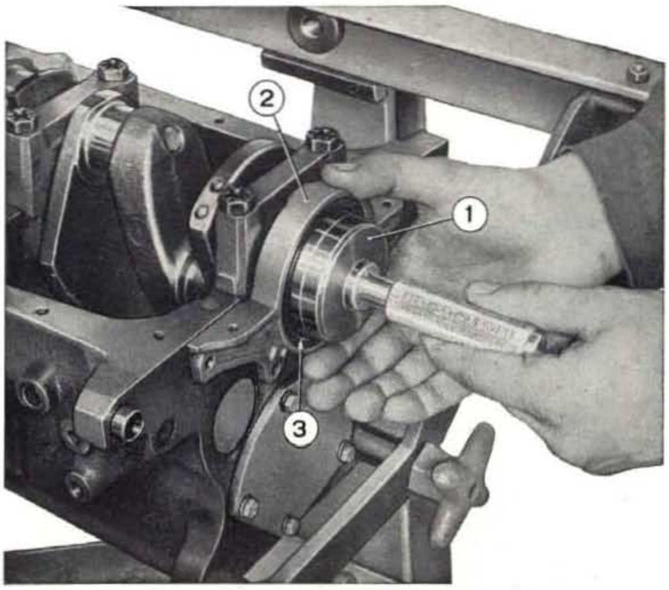


**Fig. 81 - Installing crankshaft front seal cover.**
1. Inserter A. 60281. - 2. Crankshaft front seal cover. - 3. Oil seal.

The installation of flywheel end oil seal is facilitated through the use of tool **A. 60281** (fig. 81) which allows for the correct placement of cover to the flywheel mounting flange on crankshaft.

This way any risk of oil leakage from distortion of cover will be definitely eliminated.

## Clutch Shaft Pilot Bushing.

An oilless-type bronze bushing for clutch shaft support is press fitted into crankshaft end.

If pilot bushing turns out to be too much worn, renew it.

Do not rework the interior of the bushing in place.

To take out the bushing use ram puller **A. 40006/1** in conjunction with item **A. 40006/2** (fig. 82).

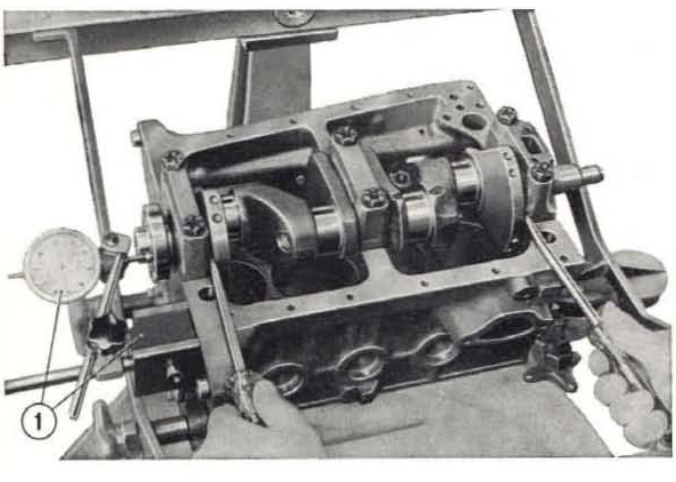


**Fig. 80 - Checking crankshaft end play.**
1. Magnetic dial indicator.

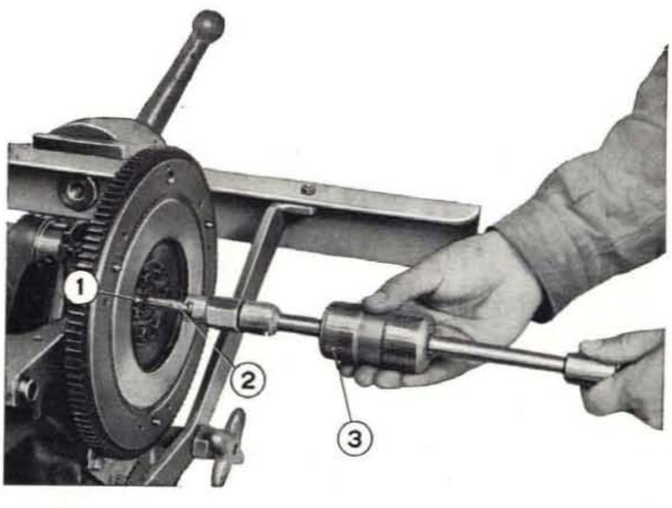


**Fig. 82 - Pulling clutch shaft pilot bushing.**
1. Clutch shaft pilot bushing. - 2. Adapting item A. 40006/2. - 3. Ram puller A. 40006/1.

# ENGINE ASSEMBLY

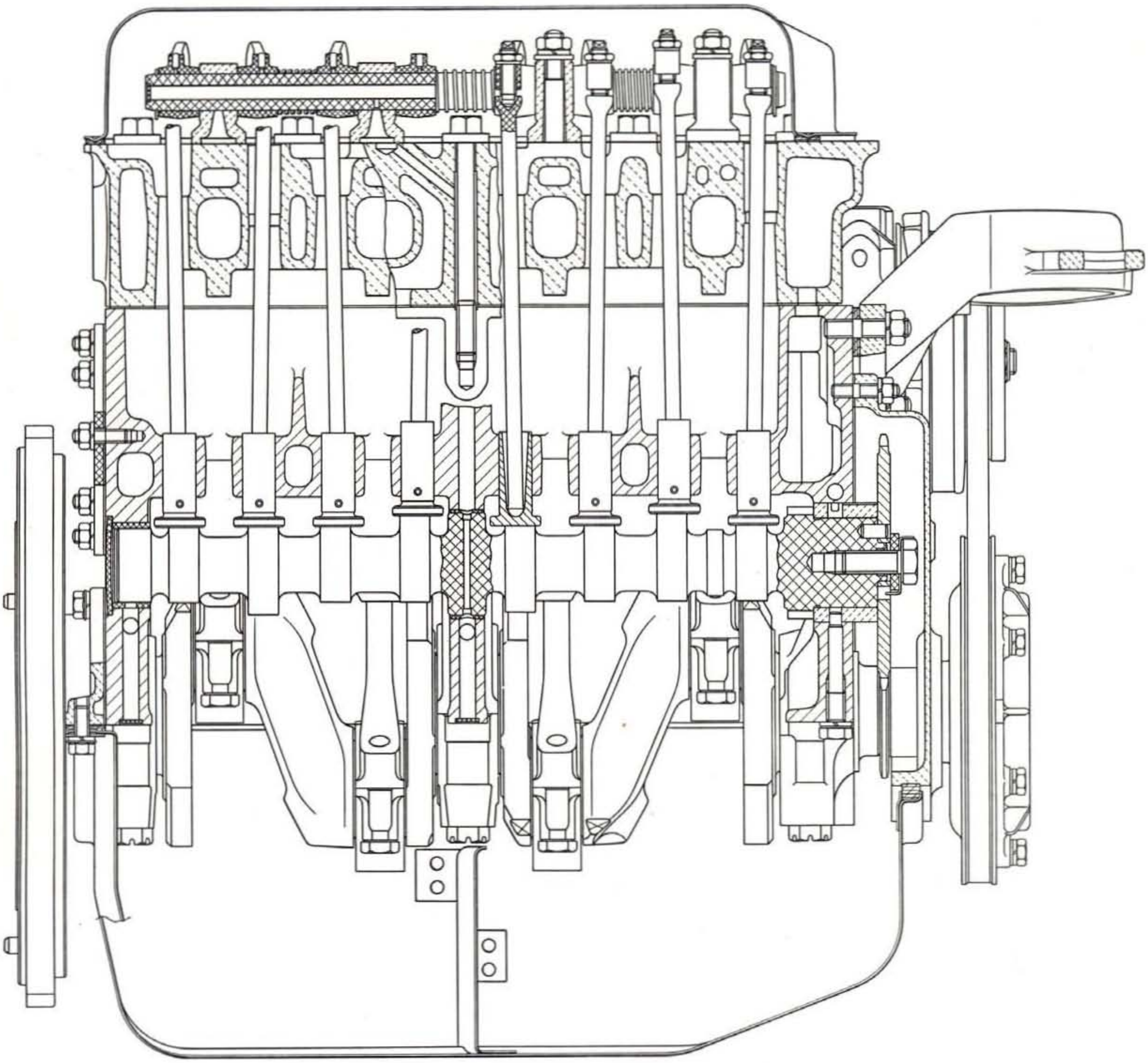

Fig. 83 - Side sectional view of engine across valve mechanism.

# CYLINDER HEAD
## VALVES - VALVE GUIDES - SPRINGS AND ROCKERS



## MAIN SPECIFICATIONS

| DESCRIPTION | in | mm |
|---|---|---|
| Valve guide seat bore in head | .5098 to .5109 | 12.950 to 12.977 |
| Valve guide O.D. | .5122 to .5130 | 13.010 to 13.030 |
| Bore of valve guides fitted in head | .2765 to .2772 | 7.022 to 7.040 |
| Valve guide-to-seat press fit | .0013 to .0031 | 0.033 to 0.080 |
| Valve stem diameter | .2750 to .2756 | 6.985 to 7.000 |
| Valve stem-to-guide fit: | | |
| – clearance of new parts | .0009 to .0022 | 0.022 to 0.055 |
| – wear limit | .006 | 0.15 |
| Valve seat angle | 45° ± 5′ | |
| Valve face angle | 45° 30′ ± 5′ | |
| Valve head diameter – intake | 1.063 | 27 |
| Valve head diameter – exhaust | .984 | 25 |
| Maximum runout of valve for a full turn of stem, with dial plunger set at center of contact face | .0008 | 0.02 |
| Valve seat height (contact face): intake and exhaust | .0512 to .0591 | 1.3 to 1.5 |
| Valve seat I.D. – intake | .945 | 24 |
| Valve seat I.D. – exhaust | .866 | 22 |

*(continued)*

**Main Specifications** *(continued).*

| DESCRIPTION | in | mm |
|---|---|---|
| Valve spring I.D. | .8228 | 20.9 |
| Length of free spring | 1.7087 | 43.4 |
| Length of seated spring, valve closed:<br>– under 51.6 ± 2.6 lbs (23.4 ± 1.2 kg) of load | 1.3386 | 34 |
| Length of seated spring, valve open:<br>– under 102.5±5.1 lbs (46.5±2.3 kg) of load | .9724 | 24.7 |
| Minimum permissible load of seated springs, with closed valve:<br>– spring height 1.3386" (34 mm) | 46.3 lbs | 21 kg |
| Valve lift { intake<br>exhaust | .3386<br>.3386 | 8.6<br>8.6 |
| Rocker shaft support bore diam | .5909 to .5916 | 15.010 to 15.028 |
| Rocker shaft diameter | .5901 to .5906 | 14.988 to 15.000 |
| Rocker shaft support-to-shaft fit:<br>– clearance of new parts<br>– wear limit | .0004 to .0016<br>.006 | 0.010 to 0.040<br>0.15 |
| Rocker bore diam | .5909 to .5917 | 15.010 to 15.030 |
| Rocker-to-shaft fit:<br>– clearance of new parts<br>– wear limit | .0004 to .0016<br>.006 | 0.010 to 0.042<br>0.15 |
| Rocker spring:<br>– I. D.<br>– free height<br>– height under 4.9±.33 lbs (2.2±0.15 kg) of load | .6102<br>2.0353<br>.9843 | 15.5<br>51.7<br>25 |

# MISCELLANEOUS

## Removal and Installation.

Remove the cylinder head if compression losses are evident from poor tightness of valves or combustion chamber must be decoked after a certain period of running.

To take down the head proceed as follows:

Remove: air cleaner, carburetor, ignition distributor assembly, head cover, coolant inlet and oulet pipes, exhaust piping from manifold and exhaust manifold from head, spark plug cables and heat indicator sending unit wire.

Lift out rocker, shaft and support assembly as well as push rods.

Remove head hold-down screws; thermostat and heat indicator sending unit, too, are thus disengaged.

To install the head just reverse the above outlined procedure recalling the following points:

– Always set new gaskets both at head and cover.

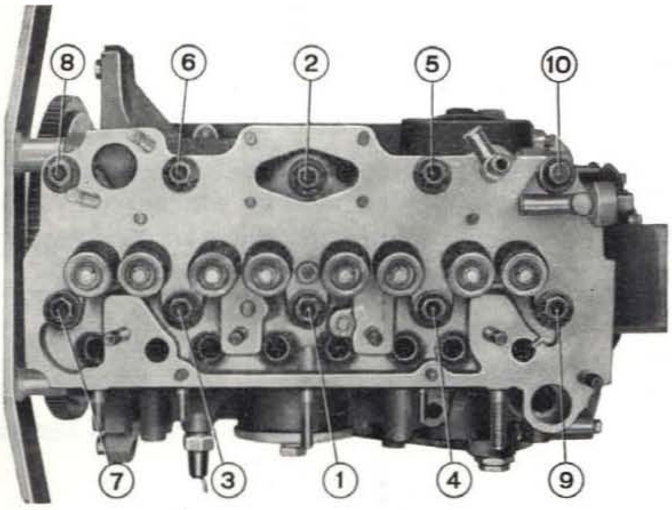


**Fig. 84 - Cylinder head screws tightening sequence.**
1st pass: torque to some 21.7 ft.lbs (3 kgm). - 2nd pass: torque to 28.9 to 36.2 ft.lbs (4 to 5 kgm).

– Tighten head hold-down screws according to the sequence shown in fig. 84, in two passes:

1st pass, up to a torque of some 21.7 ft.lbs (3 kgm);

2nd pass, torque screws to 28.9 ft.lbs (4 kgm), as specified.

## Disassembly and Assembly.

Arrange the head on supporting plate **A. 60283** (fig. 85).

Position tool **A. 60084** as shown in fig. 85 and compress springs so that valve locks are disengaged. Take down spring parts and back out spark plugs.

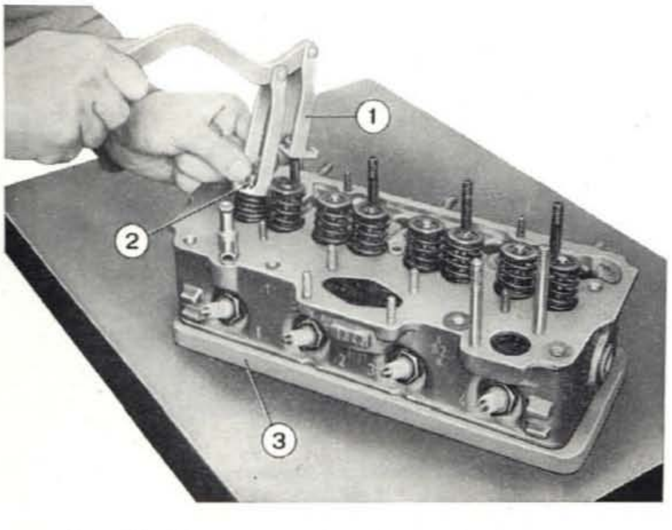


**Fig. 85 - Removing valves from cylinder head.**
1. Spring compressor A. 60084. - 2. Valve locks. - 3. Supporting plate A. 60283.

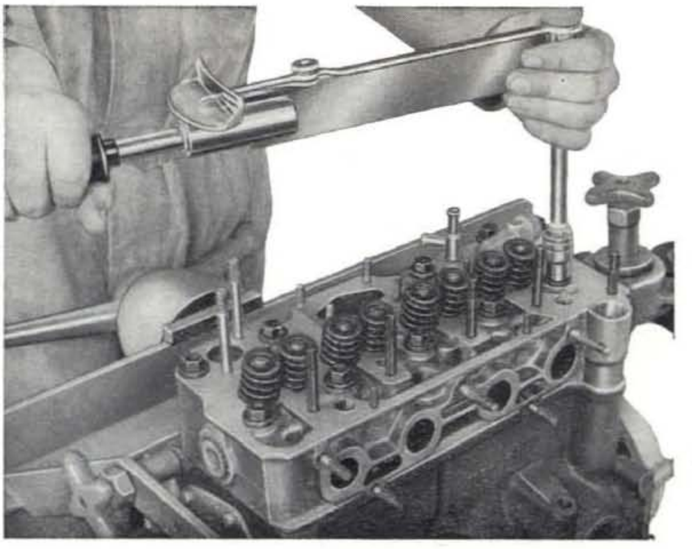

**Fig. 86 - Tightening head screws by means of torque wrench.**

Remove supporting plate and working from the underside slide off valves from guides.

For disassembly proceed in reverse order to assembly.

# CYLINDER HEAD

## Cleaning.

Place the head on fixture **A. 60041** (fig. 87).

Using wire brush **A. 60036** and a portable drill, decoke combustion chambers (fig. 87).

Remove scale deposits from exhaust ducts and coolant jackets; check and clean intake ducts and oil delivery passage to rockers.

Use wire brush **A. 60117** and clean valve guide ports.

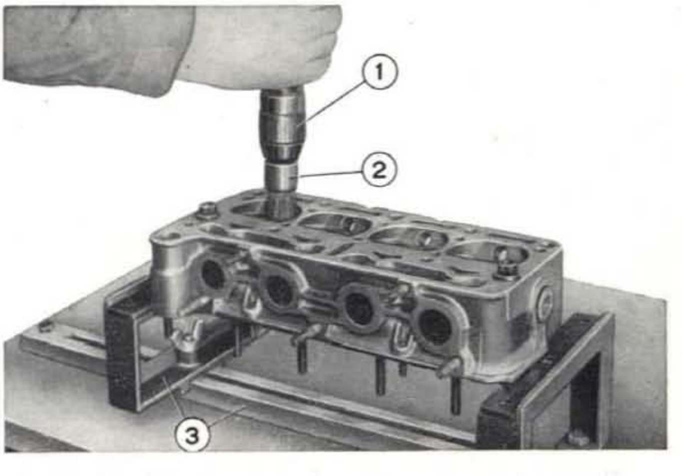


**Fig. 87 - Decoking and cleaning combustion chambers.**
1. Drill. - 2. Wire brush. - 3. Head holding fixture A. 60041.

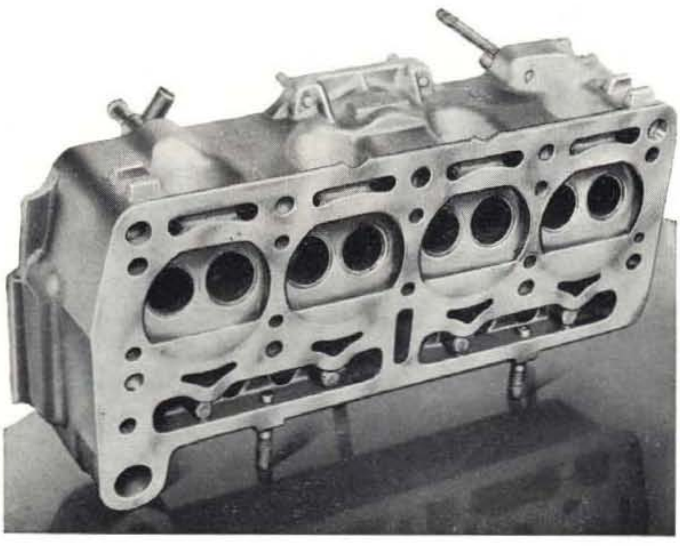

Fig. 88 - Checking cylinder head on surface plate.

## Checking and Grinding Head Bottom Face.

Coat surface plate with a film of lampblack and slide about the head on the surface plate.

The lampblack pattern should be uniformly spread over the whole head face (fig. 88).

If not so distortion is evident and the head must be ground on surface grinder **M. 1020.**

Use care to remove as little stock as possible.

With gauge **A. 95650** check the depth of combustion chambers (fig. 89) to make sure that they have not been reduced too much.

Set the gauge at center of combustion chamber (see fig. 89) and using feeler **A. 95113**, check against the following clearances between gauge shoulder and head face:

- engine 100G.000 . . .01" (0.25 mm) max.
- engine 100G.002 .04" to .05" (1 to 1.25 mm)

Should head undercutting exceed recommended limits, replace cylinder head by a new one.

After grinding, wash the head thoroughly to remove all stock and abrasive residues.

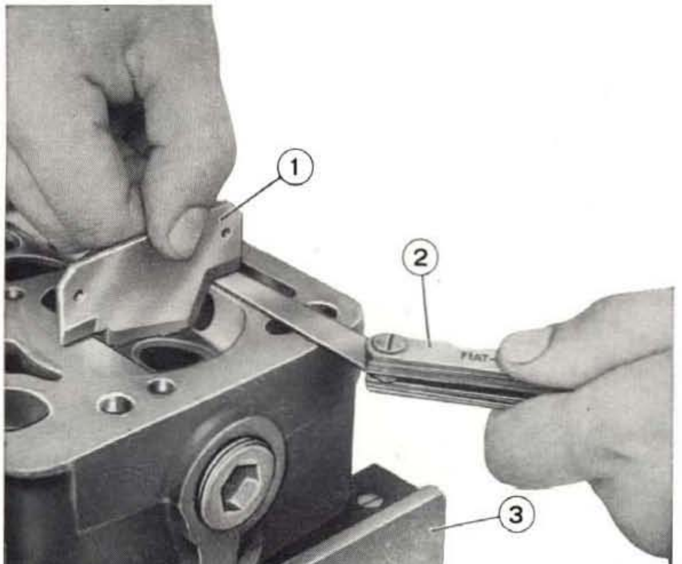


Fig. 89 - Checking depth of combustion chambers.
1. Gauge A. 95650. - 2. Feeler A. 95113. - 3. Head holding fixture A. 60041.

## Checking Water Seal.

Submit the head to the following leakage test of coolant jackets:

- Fit components of fixture **A. 60081** to head.
- Connect hand pump **Ap. 5048** to cock.
- Heat water in tank to 185° to 194° F (85° to 90° C).
- Pump water into head to build up a pressure of 28.5 to 42.7 psi (2 to 3 kg/cm²); at this pressure no leakage should occur.

The presence of cracks or fractures will be indicated by the pressure gauge pointer moving back to zero and the water leaking out of the head. If so, renew the head directly.

## Checking and Reseating Valve Seats.

Valve seats in head should show no evidence of pitting at valve contact area; otherwise grind seats as follows.

Insert pilot **A. 94015** in valve guide; select the pilot which will warrant least possible clearance.

Position taper grindwheel **A. 94084** on spindle **A. 94069.**

Slide coil spring into spindle.

Install spindle on grinder **Ap. 5025.**

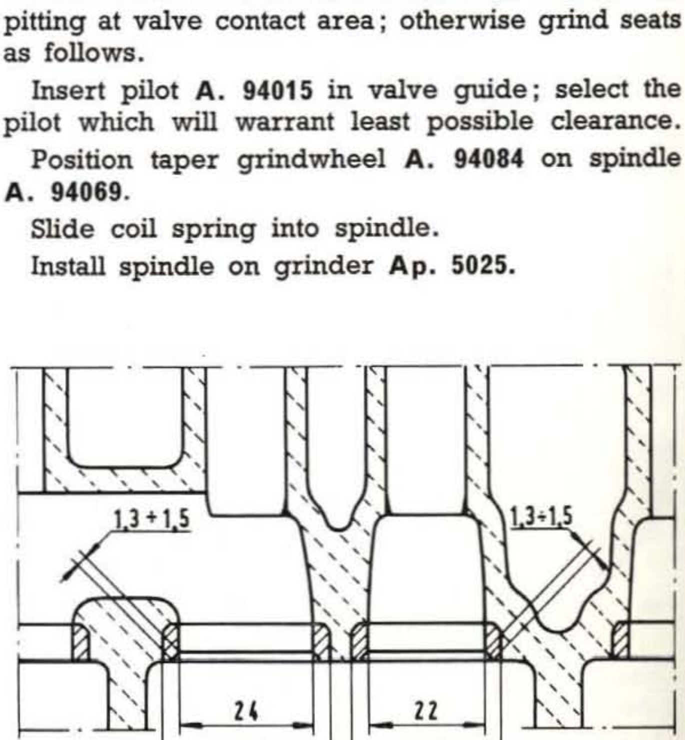


Fig. 90 - Critical dimensions (metric) of valve seats in head.

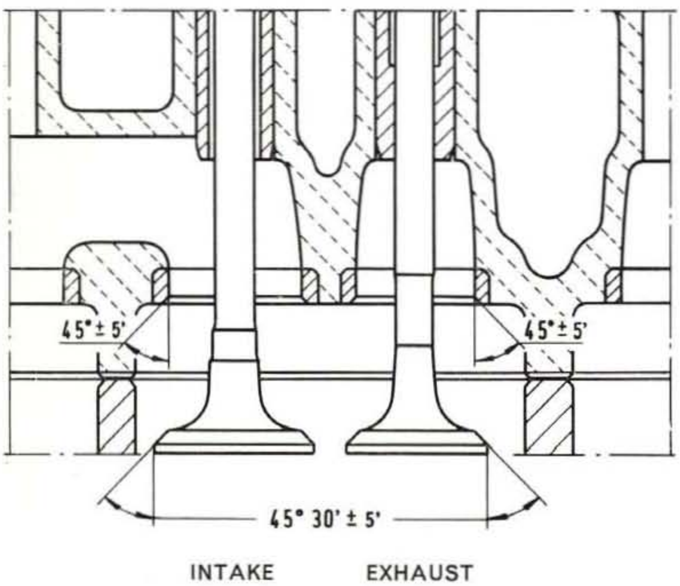


**Fig. 91 - Inclination angles of valves and seats in head.**

Grind valve seats recalling that in brief intervals during which the grindwheel contacts the seat the current should be switched off from grinding machine; this precaution will avoid vibrations which may compromise the issue of grinding work.

It is good practice frequently dressing the grindwheel on dressing machine **Ap. 5050** (fig. 92), so

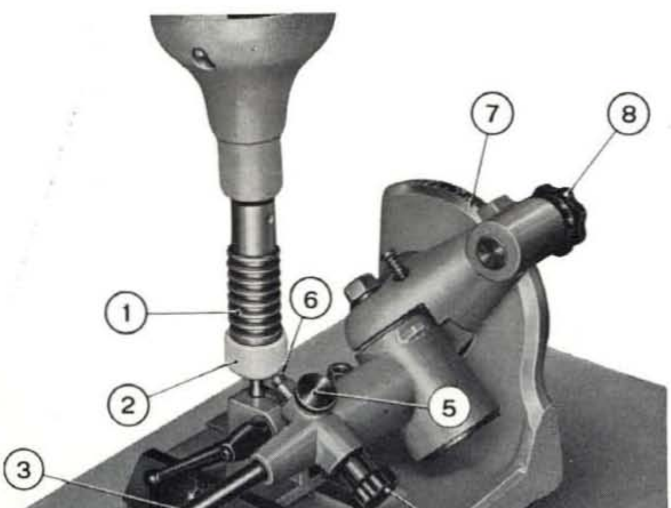


**Fig. 92 - Dressing taper grindwheel A. 94084 on dressing machine Ap. 5050.**

1. Spindle A. 94069. - 2. Grindwheel A. 94084. - 3. Arm control lever. - 4. Cutter travel control knob. - 5. Cutter locking screw. - 6. Diamond cutter. - 7. Working angle graduation scale. - 8. Working angle adjusting knob.

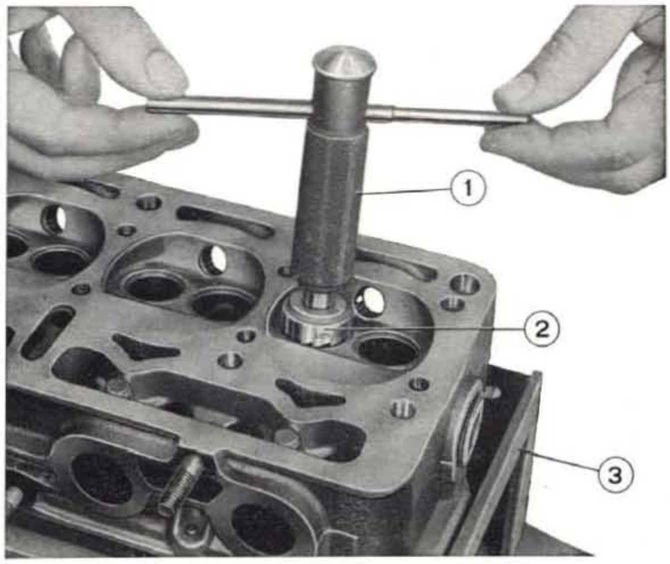


**Fig. 93 - Using 20° cutter to narrow valve seats.**

1. Spindle A. 94058. - 2. 20° cutter. - 3. Cylinder head holding tool A. 60041.

that the wheel taper of 45° ± 5′ is maintained, corresponding to the valve seat angle.

Next, narrow the valve seats as follows:

— Place cutter **A. 94083** (20°) on spindle **A. 94058** and slide spindle onto pilot **A. 94015**.

— Operate the cutter (fig. 93).

— Repeat the procedure above outlined with cutter **A. 94030** (75°) (fig. 94).

Use two cutters alternately until valve seats are fashioned as shown in fig. 98.

**Valve seats in head should be angled at 45° ± 5′.**

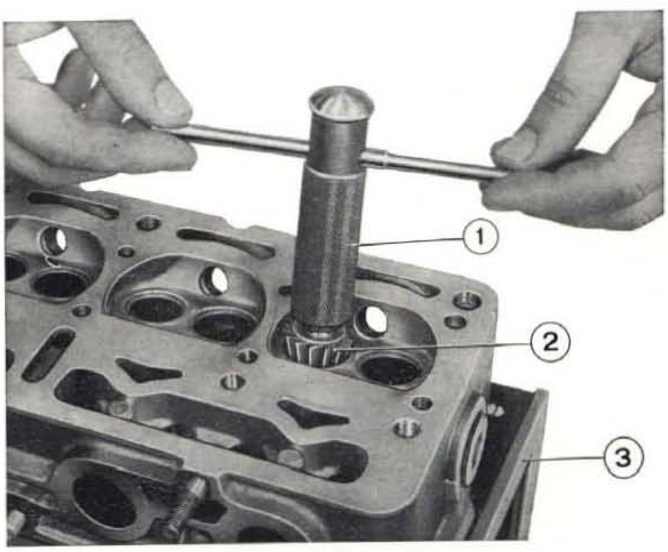


**Fig. 94 - Using 75° cutter to narrow valve seats.**

1. Spindle A. 94058. - 2. 75° cutter. - 3. Cylinder head holding tool A. 60041.

## VALVE SEAT CUTTING DIAGRAMS

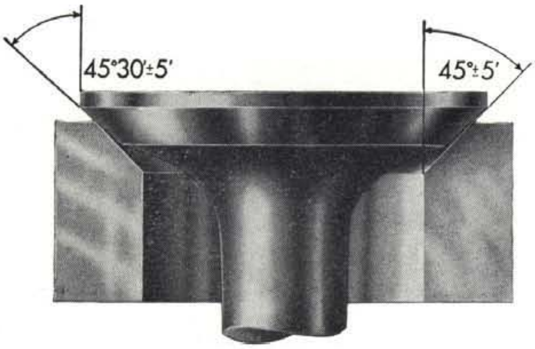


**Fig. 95 - Inclination angles of valve seats in head and valve faces.**


**Fig. 96 - Narrowing valve seat at top with 20° cutter.**

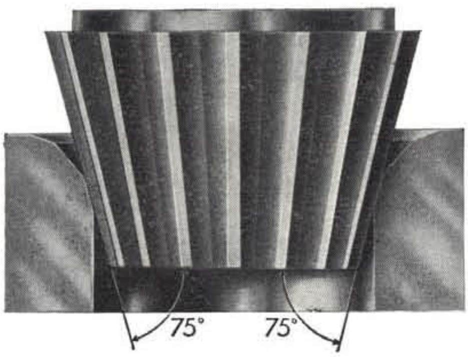


**Fig. 97 - Narrowing valve seat at bottom with 75° cutter.**

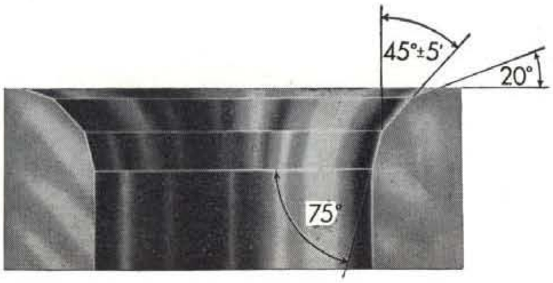


**Fig. 98 - View of a valve seat which has been reseated with 20° and 75° cutters.**

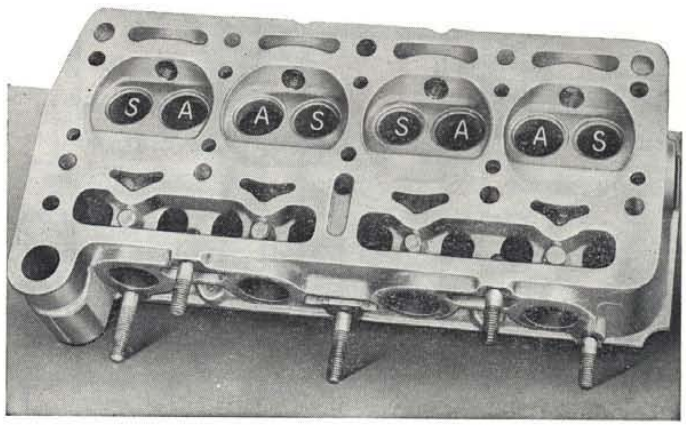


**Fig. 99 - View of valve seats in head.**
A. Intake valve seat. - B. Exhaust valve seat.

# VALVES

## Checking and Refacing.

Remove carbon from valves using electric wire brush **M. 1042.**

Check valve stem for cracks or distortions and replace valve if either condition is evident.

The stem diameter, in a new valve, is .2750" to .2756" (6.985 to 7.000 mm).

Check clearance between valve stem and valve guide (fig. 100): it should be .0009" to .0022" (0.022 to 0.055).

Check valve head for excessive wear or damage; if necessary, reface the valve using grinding machine **M. 1014** as follows:

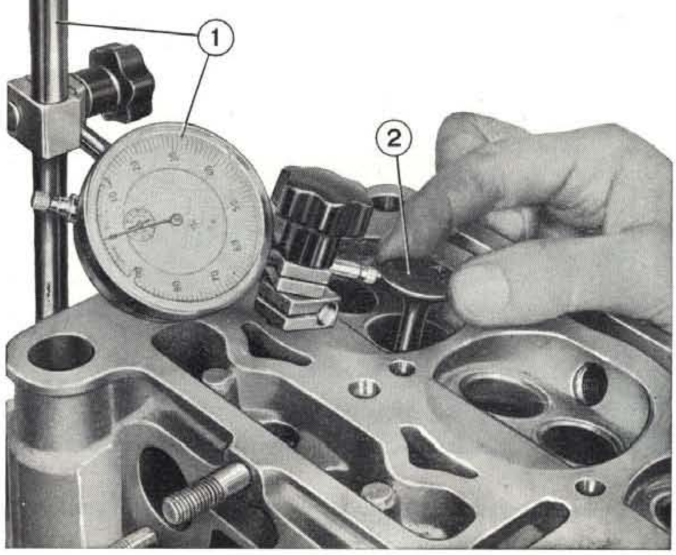


**Fig. 100 - Checking clearance of valve stem in guide.**
1. Magnetic dial indicator. - 2. Valve part way out.

– arrange the valve as shown in fig. 101;

– position the movable base of grinder at a finish angle of $45^{\circ}\ 30' \pm 5'$;

– operate the machine using care to remove minimum possible stock;

– after grinding, check that the thickness of valve head margin is not less than .0197″ (0.5 mm).

In case the stem end must be smoothed out and ground to eliminate pits or depressions from rocker arm contact face, use care to remove as little stock as possible.

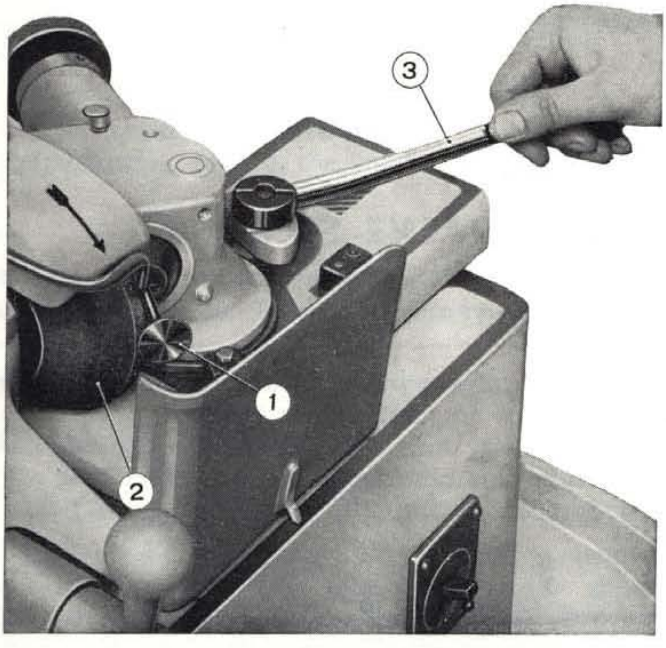


**Fig. 101 - Grinding valve face.**

1. Valve. - 2. Stone. - 3. Movable support actuating lever.

## Valve Sealing Test.

Perform the compression sealing test using tester **A. 60148** along with tools **A. 60041, A. 60041/2** and **A. 60018.**

Proceed as follows:

– thoroughly clean seats and valves;

– arrange the cylinder head on tool **A. 60041** (fig. 102);

– insert valves in guides and plug up spark plug seat by means of tool **A. 60018** (fig. 102);

– position tester **A. 60148** as shown in fig. 102;

– apply heavy force on tool lever and at the same time pump in air with the rubber bulb until the gauge pointer nearly moves to the dial top end.

If the valve head and seat faces are not mating perfectly, air leakage will be indicated by the pointer shifting back to zero more or less rapidly.

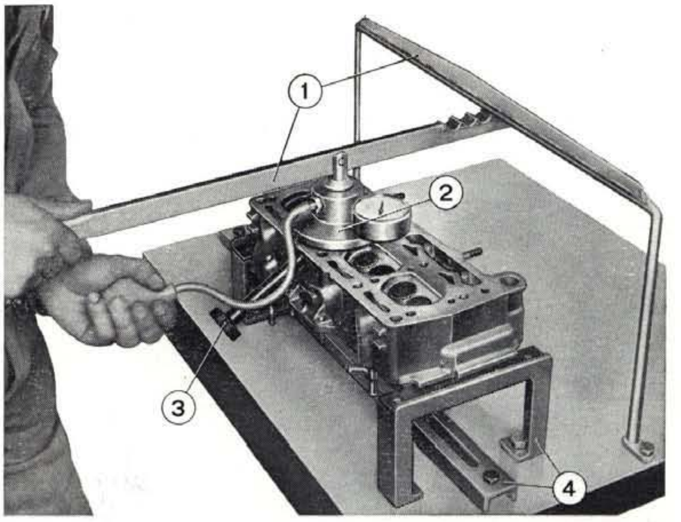


**Fig. 102 - Valve seal test.**

1. Tool A. 60041/2. - 2. Tester A. 60148. - 3. Tool A. 60018. - 4. Head holding tool A. 60041.

In such event again grind valves and seats using special care in this operation.

# VALVE GUIDES

## Inspection and Replacement.

Valve guides are inserted in their bores with a press fit of .0013″ to .0031″ (0.033 to 0.080 mm).

Check valve guides for a loose condition or a weak snap ring.

Check valve guide-to-stem clearance as shown in fig. 100.

The fit of new parts is .0009″ to .0022″ (0.022 to 0.055 mm) while the wear limit is .006″ (0.15 mm).

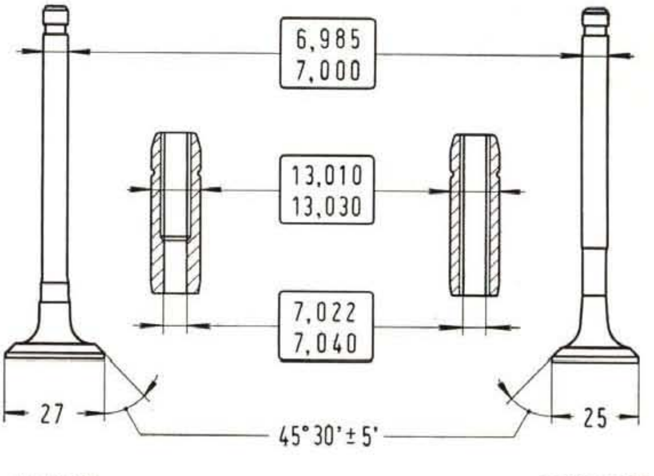


**Fig. 103 - Critical dimensions (metric) of intake valves, exhaust valves and valve guides.**

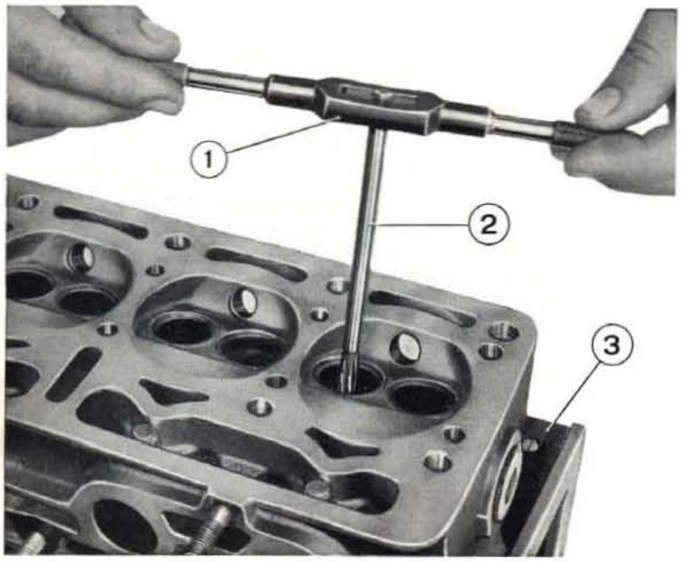


**Fig. 104 - Reaming valve guides.**
1. Reamer handle. - 2. Reamer A. 90313. - 3. Head holding tool A. 60041.

Exhaust valve guides are differing from intake ones as they are threaded throughout their length for lubrication.

Replace valve guides if play between guide and stem cannot be taken up through renewal of valve alone.

Use driver **A. 60084** to replace valve guides.

**NOTE - Valve guides are supplied for service in a finished condition. In case the guides should be exceptionally refaced to remove dents from press fitting, use reamer A. 90313 (fig. 104).**

### VALVE - VALVE GUIDE FITTING SPECIFICATIONS

| Valve Guide Bore | Valve Stem Diameter | Fits of New Parts |
|---|---|---|
| .2765" to .2772" (7.022 to 7.040 mm) | .2750" to .2756" (6.985 to 7.000 mm) | .0009" to .0022" (0.022 to 0.055 mm) |

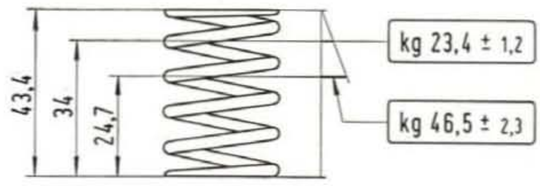


**Fig. 105 - Valve spring specifications.**
Starting from engine N. 392751.

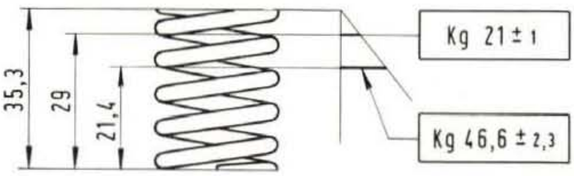


**Fig. 106 - Valve spring specifications.**
Up to engine N. 392750.

## VALVE SPRINGS

### Inspection.

Examine valve springs visually to make certain that they are not cracked or sagged.

Using tester **Ap. 5049** check the spring load comparing data obtained in various conditions with specifications in fig. 105 and chart here below.

**Fig. 107 - Cylinder head with valve springs and spark plugs.**

### VALVE SPRINGS

| Part No. | Working Turns | Total Turns | Inside Diameter | Wire Diameter | A | B | | C | | Minimum Load Referred to B |
|---|---|---|---|---|---|---|---|---|---|---|
| 4127537 | 4 | $5\frac{1}{2}$ | .8228" (20.9 mm) | .1417" (3.6 mm) | 1.7087" (43.4 mm) | 1.3386" (34 mm) | 51.6 lbs (23.4 kg) | .9724" (24.7 mm) | 102.5 lbs (46.5 kg) | 46.3 lbs (21 kg) |

A = Free length. B - C = Length and load, spring check.

## ROCKERS

### Inspection.

Check the surface of rocker shaft and the oil holes in rockers and supports for the evidence of scores or seizure. If so, renew parts affected.

Check the rocker face contacting the valve and the ball seat of rocker contacting the push rod for a mirror-like condition.

The fitting clearance of rocker shaft in rocker opening should be .0004" to .0017" (0.010 to 0.042 mm), while the clearance specification between rocker shaft and support is .0004" to .0016" (0.010 to 0.040 mm).

Wear limit: .006" (0.15 mm).

If on inspection clearance turns out to exceed above figures, replace the item more worn, or both.

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**NOTE - Rocker shaft support nuts must be drawn up with 14.5 ft.lbs (2 kgm) of torque.**

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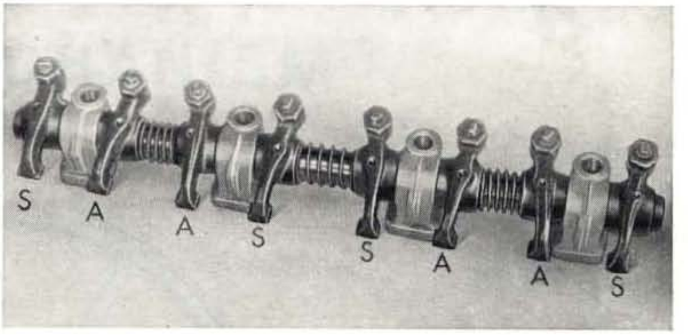


**Fig. 108 - Rocker, shaft and support assembly.**
A. Intake valve rockers. - S. Exhaust valve rockers.

See page 67 for inspection of valve tappet clearance.

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**NOTE - On assembly, recall that exhaust valve rockers are different from those of intake valves. Rockers must be positioned as shown in fig. 108.**

---

### Checking Springs.

Check rocker springs for cracks or weakness.

Use spring tester **Ap. 5049**: under a load of $4.8 \pm .33$ lbs ($2.2 \pm 0.15$ kg) spring length should be .984" (25 mm).

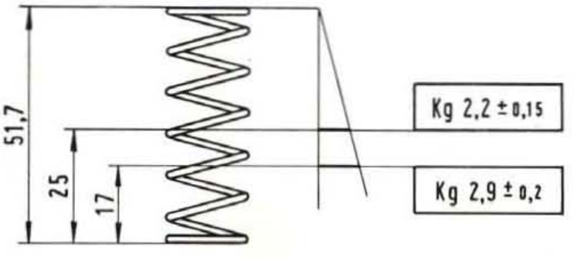


**Fig. 109 - Rocker spring checking data.**

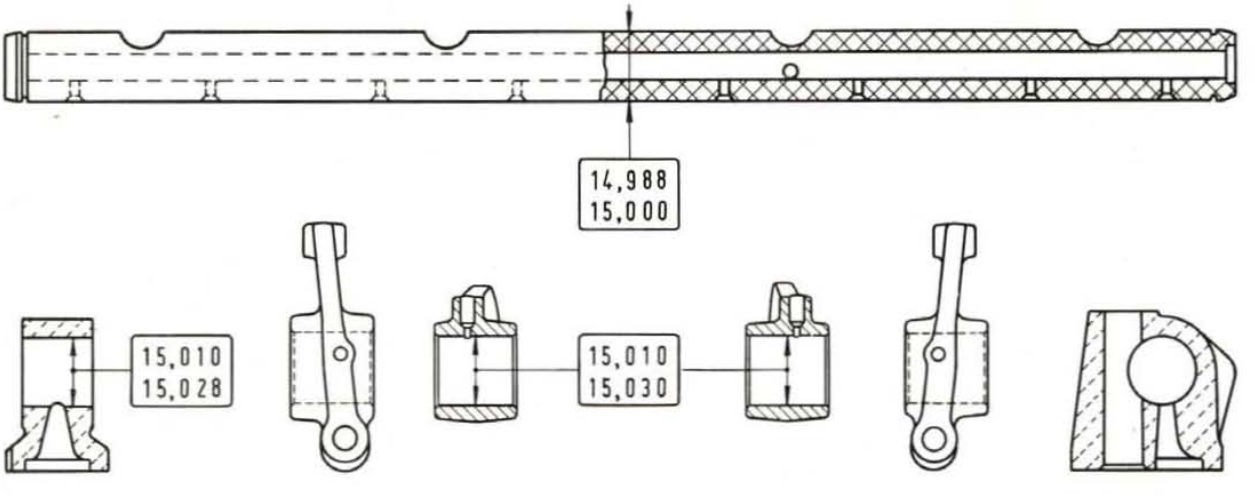


**Fig. 110 - Critical dimensions (metric) of rockers, shaft and supports.**

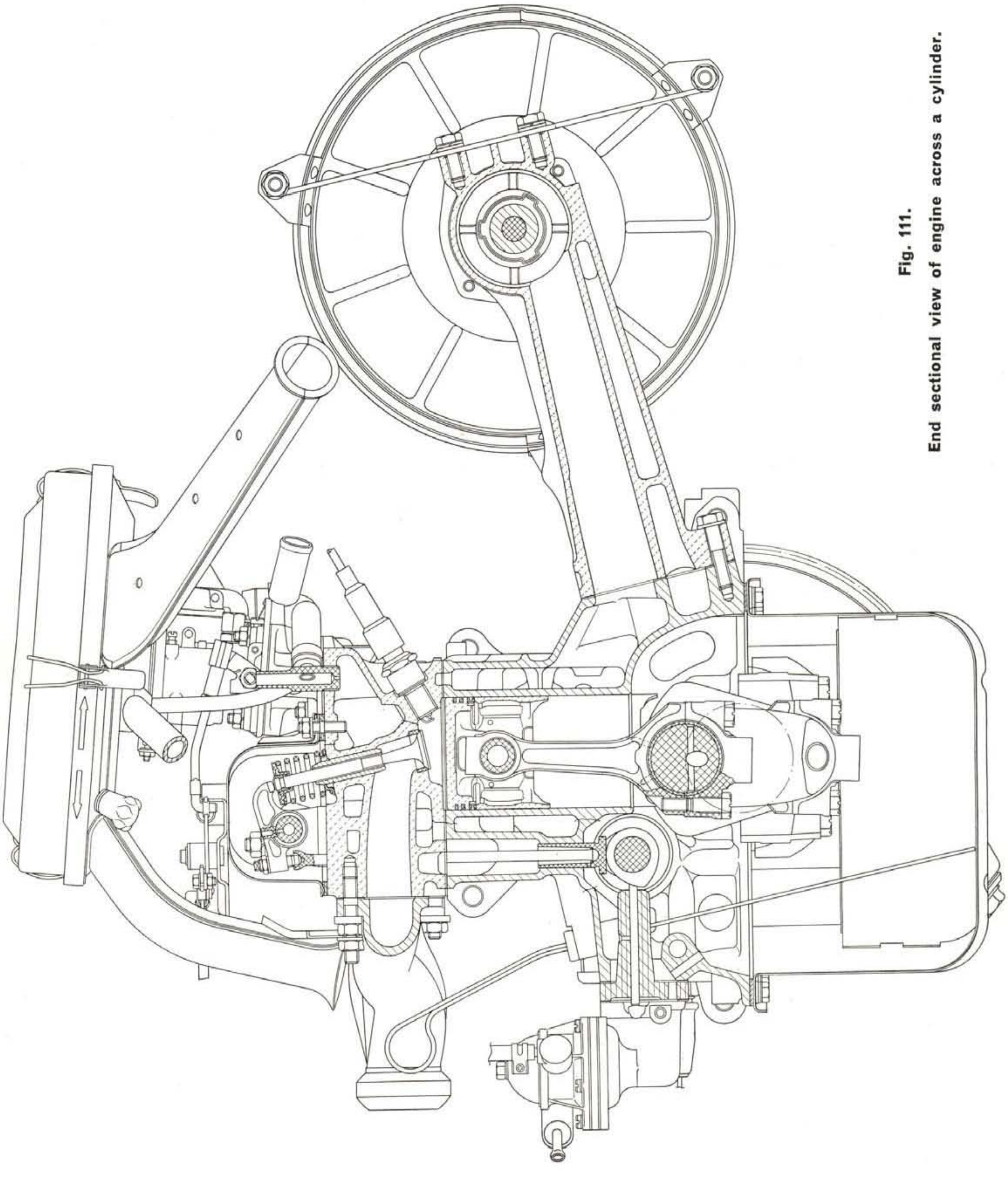

Fig. 111.
End sectional view of engine across a cylinder.

# VALVE MECHANISM



## MAIN SPECIFICATIONS

| DESCRIPTION | | | in | mm |
|---|---|---|---|---|
| Bushing seat bore in crankcase: | | | | |
| – chain end | Class B | | 1.9882 to 1.9886 | 50.500 to 50.510 |
| | Class C | | 1.9886 to 1.9890 | 50.510 to 50.520 |
| | Class D | | 1.9961 to 1.9965 | 50.700 to 50.710 |
| | Class E | | 1.9965 to 1.9969 | 50.710 to 50.720 |
| – intermediate | | | 1.8276 to 1.8287 | 46.420 to 46.450 |
| – flywheel end | | | 1.4142 to 1.4154 | 35.921 to 35.951 |
| Free bushing O.D.: | | | | |
| – chain end | Class B | | 1.9876 to 1.9882 | 50.485 to 50.500 |
| | Class C | | 1.9880 to 1.9886 | 50.495 to 50.510 |
| | Class D | | 1.9955 to 1.9961 | 50.685 to 50.700 |
| | Class E | | 1.9959 to 1.9965 | 50.695 to 50.710 |
| – intermediate | | | 1.8320 to 1.8335 | 46.533 to 46.571 |
| – flywheel end | | | 1.4185 to 1.4200 | 36.030 to 36.068 |
| Bushing bore: | seated | | reamed | |
| – chain end | 1.4970 to 1.4980 (*) | 38.025 to 38.050 (*) | 1.4970 to 1.4980 (*) | 38.025 to 38.050 (*) |
| – intermediate | 1.6960 to 1.7000 | 43.078 to 43.180 | 1.7080 to 1.7088 | 43.384 to 43.404 |
| – flywheel end | 1.2070 to 1.2110 | 30.657 to 30.759 | 1.2215 to 1.2223 | 31.026 to 31.046 |
| Bushing fit in crankcase: | | | | |
| – chain end, clearance | | | .0000 to .0010 | 0.000 to 0.025 |
| – intermediate, press fit | | | .0033 to .0059 | 0.083 to 0.151 |
| – flywheel end, press fit | | | .0031 to .0058 | 0.079 to 0.147 |
| Camshaft journal diameter: | | | | |
| – valve gear end | | | 1.4951 to 1.4961 | 37.975 to 38.000 |
| – intermediate | | | 1.7060 to 1.7070 | 43.333 to 43.358 |
| – flywheel end | | | 1.2195 to 1.2205 | 30.975 to 31.000 |
| Bushing-to-journal fit: | | | | |
| – clearance of new parts | chain end | | .0010 to .0030 | 0.025 to 0.075 |
| | intermediate | | .0010 to .0028 | 0.026 to 0.071 |
| | flywheel end | | .0010 to .0028 | 0.026 to 0.071 |

*(continued)*

*) This bushing, which comes precision finished, is secured by one screw.

**Main Specifications** *(continued).*

| DESCRIPTION | in | mm |
|---|---|---|
| Standard tappet seat bore in crankcase . . . . . . . . . . | .5516 to .5523 | 14.010 to 14.028 |
| Standard tappet O.D. . . . . . . . . . . . . . . . . . . . | .5505 to .5512 | 13.982 to 14.000 |
| Tappets for service . . . . . . . . . . . . . . . . . . . | Std, .0020-.0039 O.S. | 0.05 to 0.10 |
| Tappet-to-seat fit: clearance of new parts . . . . . . . . | .0004 to .0018 | 0.010 to 0.046 |

## CAMSHAFT AND BUSHINGS

Camshaft journals and lobes should show extremely smooth faces. If seizure or scoring marks are detected, replace the camshaft unless damage can be corrected by means of a very fine abrasive stone.

Also check the oil pump and ignition distributor drive gear for chipped or too much worn teeth; if so, renew the camshaft.

Support the camshaft on « V » blocks **A. 95730** which have been placed on a surface plate and using a dial indicator:

— check the intermediate journal for runout in excess of .0008″ (0.02 mm); in case runout is more than .004″ (0.10 mm), straighten the camshaft using an arbor press;

— check that the lobe lift is .3386″ (8.6 mm); this figure applies to both intake and exhaust valve camshaft lobes.

If the camshaft turns out to be still serviceable, check timing data at each cylinder as outlined on page 66 under « Valve Timing ».

### Checking and Reaming Bushings.

Check intermediate and flywheel end bushings (which are press fitted) for out-of-round or a loose condition in their bores; also check that oil holes are lined up with passages in crankcase.

The interior face of bushings should be mirror-like and show no signs of seizure; otherwise replace bushings.

The chain end bushing is fitted in place with clearance (see table) and a screw secures it to crankcase.

The chain end bushing, as well as its seat in crankcase, are graded into classes (figs. 112 and 113) according to the outside diameter.

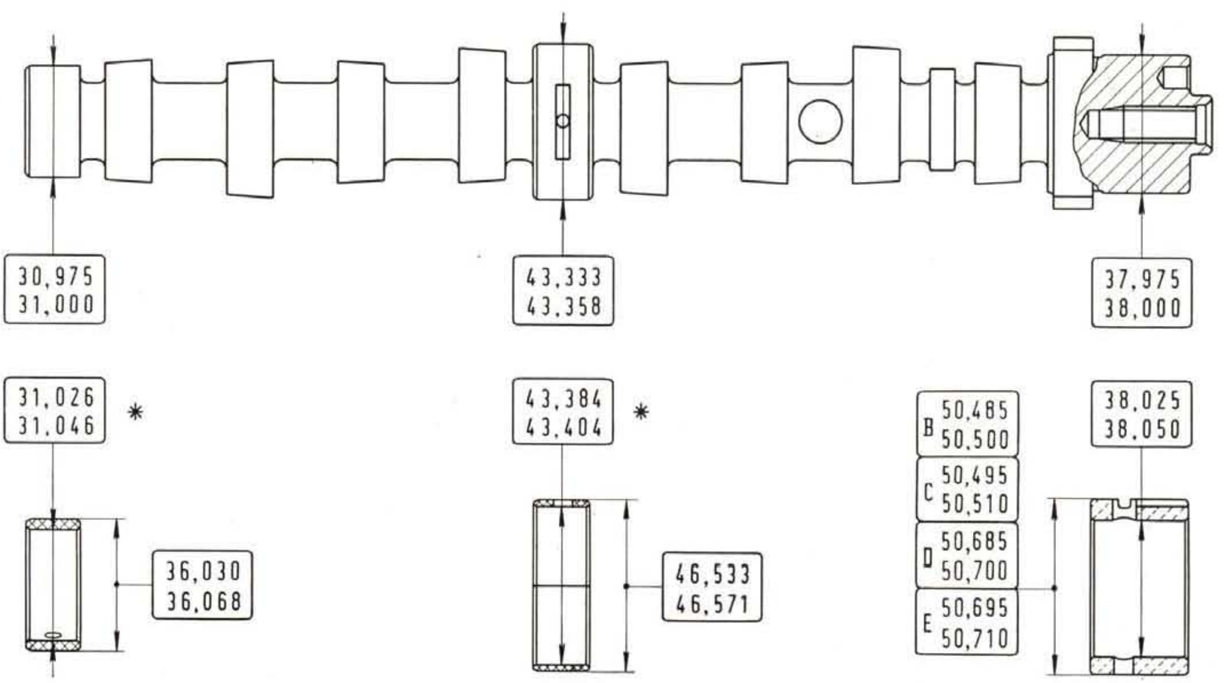


**Fig. 112 - Critical dimensions (metric) of camshaft and bushings.**

These diametrical figures apply to bushings fitted and reamed. — Chain end bushing is graded into four classes.

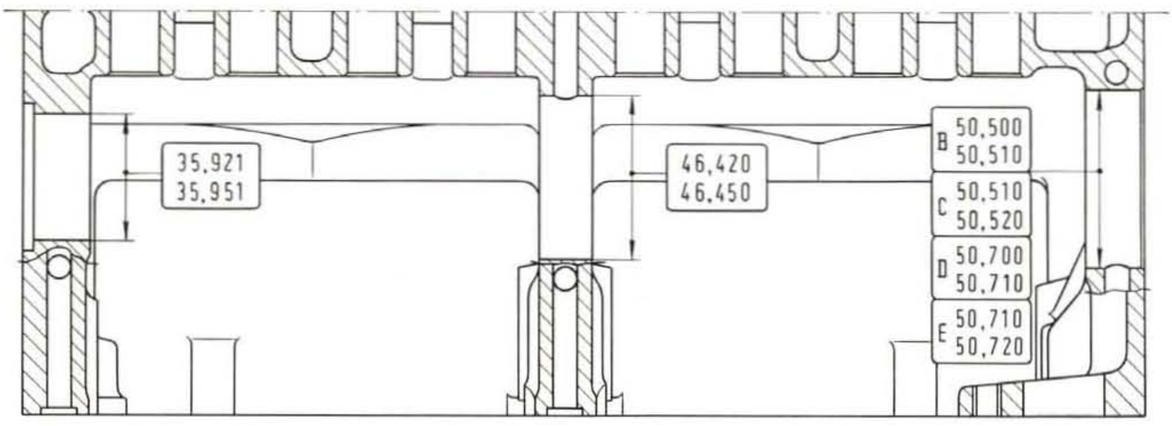


**Fig. 113.**

**Critical dimensions (metric) of bushing seat bores in crankcase.**

Chain end bushing seat is graded into four classes.

On assembly note the class of the seat and install a bushing belonging to the same class.

---

**NOTE - Class number of chain end bushing is stamped on bushing face, while the class number of bushing seat in crankcase is stamped at the bushing screw hole.**

---

If the necessity arises to replace bushings, install new ones recalling the following points:

– chain end bushing comes with inside and outside faces finish machined;

– for correct positioning of this bushing just set it with the chain oil groove up;

– intermediate and flywheel end bushings must be press fitted with the oil inlet holes lined up with passages in crankcase;

– bore sizes of intermediate and flywheel end bushings fitted in place are specified in the table;

– the intermediate and the flywheel end bushings should be finish reamed to the camshaft journal mating bores as tabulated for these bushings fitted in crankcase (see fig. 112); this will warrant perfect alignment and squareness of camshaft bearing axes.

Line ream bushings with reamer **A. 90326** (fig. 115) complying with the manufacturer's directions contained in the tool kit.

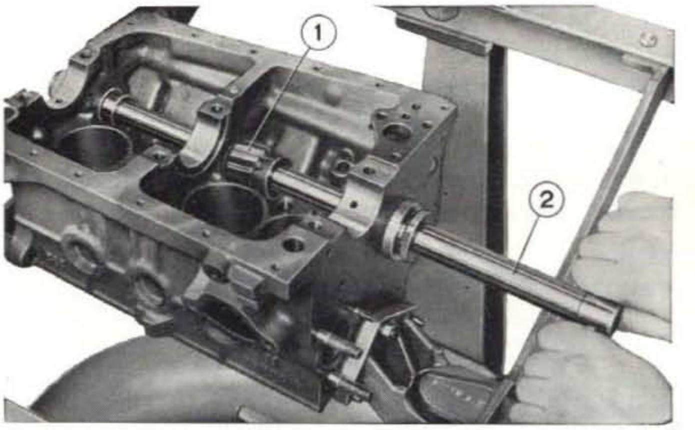


**Fig. 115 - Reaming intermediate camshaft bushing.**

1. Reamer. - 2. Tool A. 90326.

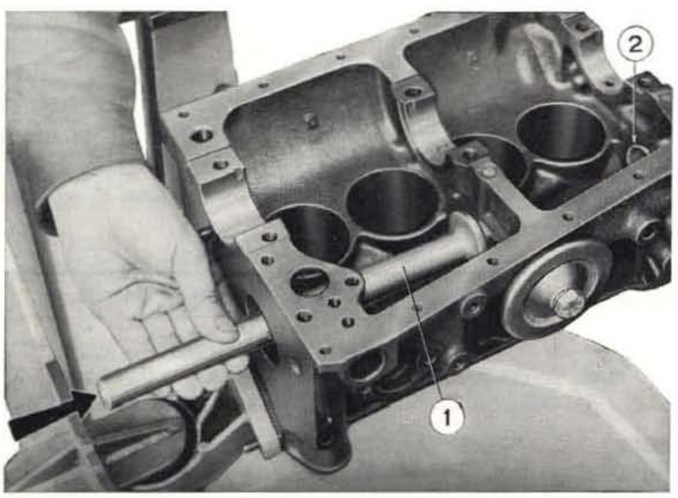


**Fig. 114 - Fitting intermediate camshaft bushing.**

1. Driver A. 60292. - 2. Flywheel end bushing.

## TAPPETS

The tappet face in touch with camshaft lobe should be very smooth and free from scuffs or imprints.

Minor corrections can be made using an extremely refined abrasive stone.

The outer face of tappet and its seating bore in crankcase must not be too much worn, out-of-round nor show signs of scoring.

Tappets are supplied for service in standard size as well as .002″ and .004″ (0.05 - 0.10 mm) oversizes.

When oversize tappets are fitted also their seats in crankcase must be reamed, of course, to restore the clearance specified for these items.

Critical dimensions and standard fits for tappets and seats are tabulated on foot of next page.

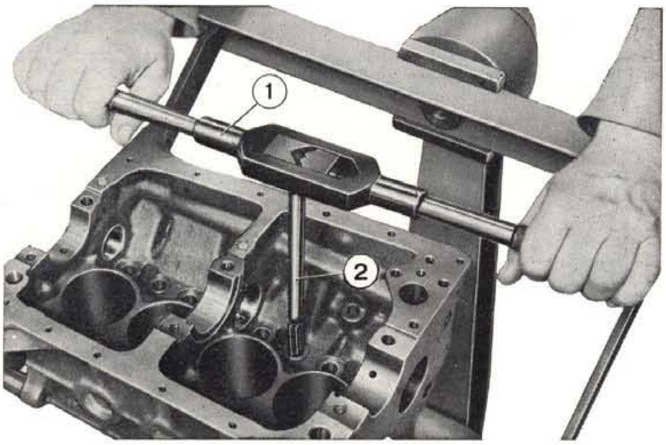


**Fig. 116 - Reaming tappet seats in crankcase.**
1. Reamer handle. - 2. Reamer A. 90318/1.

## PUSH RODS

The push rods controlling rockers should not be distorted and their ball seat which contacts the rocker should not be rough nor show signs of seizure; otherwise replace push rods by new ones.

The opposite end contacting the tappet, too, should not be too much worn or pitted; renew the push rod, if required.

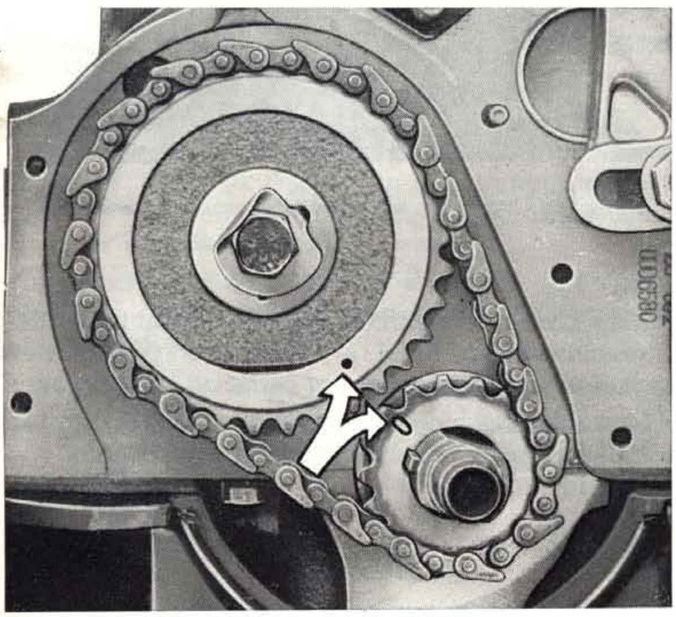

**Fig. 117 - Timing marks on drive and driven sprockets.**
Chain stretchers should always be turned outward, as shown in figure.

## VALVE TIMING

The correct valve timing is obtained when the timing marks on sprockets are indexing as shown in fig. 117.

To line up the timing marks on sprockets, proceed as follows:

– insert the drive sprocket on the front end of crankshaft;

– install the driven sprocket on camshaft and turn it about until the mark machined on its outskirts is in line with the notch on the drive sprocket;

– without moving the camshaft, **take out the driven sprocket,** and mesh the timing chain with the sprockets; reinstall the driven sprocket and chain, using care that the timing marks are indexing (fig. 117); lock the crankshaft and camshaft by placing tool **A. 60282** on the flywheel; use a torque wrench and draw up the driven sprocket screw with 36.2 ft.lbs (5 kgm) of torque, then bend down the lock plate.

Should the necessity arise to check whether the timing marks are stamped in the right place and consequently the correct valve timing has been obtained, proced as follows:

– affix the sector scale **A. 95694** on crankcase;

– fit the crank **A. 60186** with the item **A. 60186/1** on the flywheel;

– temporarily set the tappet clearance of cylinder No. 1 at .0148" (0.375 mm);

– using the crank, turn about the flywheel until the cylinder No. 1 begins the compression stroke, that is the intake valve is just on the way of opening: at this point the flywheel mark (showing T.D.C. of cylinder Nos. 1 and 4) should register 16° before T.D.C.; go on cranking the flywheel until its mark is indexing with the zero sign on sector scale;

**TAPPET - TAPPET SEAT FITTING SPECIFICATIONS**

| SIZES | Crankcase Seat Bore | Tappet Diameter | Fits of New Parts |
|---|---|---|---|
| Standard . . . . . . . . . . . . . . . . . . . . | .5516" to .5523"<br>(14.010 to 14.028 mm) | .5512" to .5505"<br>(14.000 to 13.982 mm) | .0004" to .0018"<br>(0.010 to 0.046 mm) |
| .0020" (0.05 mm) oversize . . . . . . . . . . . | .5535" to .5542"<br>(14.060 to 14.078 mm) | .5531" to .5524"<br>(14.050 to 14.032 mm) | .0004" to .0018"<br>(0.010 to 0.046 mm) |
| .0040" (0.10 mm) oversize . . . . . . . . . . . | .5555" to .5562"<br>(14.110 to 14.128 mm) | .5551" to .5544"<br>(14.100 to 14.082 mm) | .0004" to .0018"<br>(0.010 to 0.046 mm) |

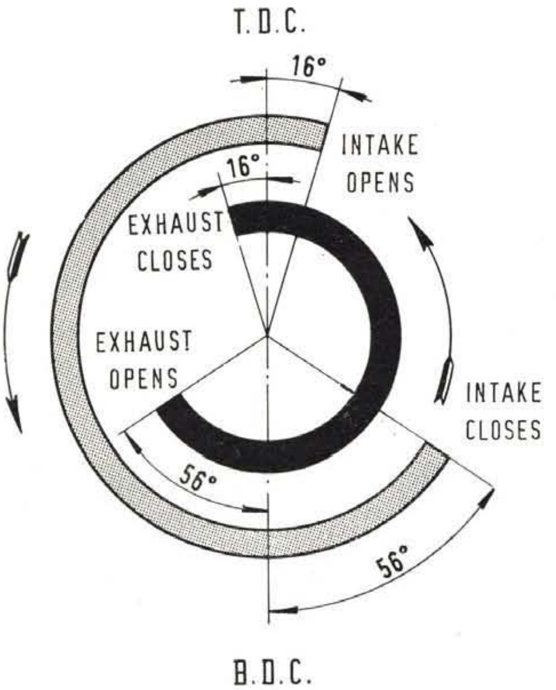


**Fig. 118 - Valve timing diagram at increased tappet clearance of .0148" (0.375 mm).**

— in this position observe the marks on timing sprockets: they should be lined up (fig. 117).

Next to valve timing, crank the flywheel and verify on sector scale that the advance angle at the beginning and the retard angle at the end of the intake stroke as well as the advance angle at the beginning and the retard angle at the end of the exhaust stroke, are as specified in fig. 118.

Reset valve tappet clearance.

## Adjusting Valve Tappet Clearance.

Tappet clearance should be set at .006" (0.15 mm), intake and exhaust, with a cold engine. The adjustment of tappet clearance deserves much care, because if it is other than specified an alteration of the valve timing diagram may result.

As a matter of fact, excessive tappet clearance, in addition to clicking noises, causes a delayed opening and advanced closing of valves, while insufficient tappet clearance reverses the effect. Eventually, should tappet clearance be reduced to nil, valves will stay in part open position all the time, with most harmful consequences on valve and valve seat life.

To adjust tappet clearance, proceed as follows:

— crank the engine until valves of cylinder No. 1 are « at balance », or the intake stroke is about to begin in this cylinder;

— adjust the valve stem-to-rocker arm clearance at cylinder No. 4; in fact this cylinder is at the end of the compression stroke and therefore both valves are closed. Using wrench **A. 50006**, hold the rocker arm setscrew and with a box wrench turn out the lock nut; insert the .006" (0.15 mm) stock of feeler gauge **A. 95111** between the rocker arm and the valve stem, and by means of wrench **A. 50006** turn in or out the setscrew until the feeler stock slides in with some drag: now, firmly hold the setscrew and lock the nut with the box wrench (fig. 119).

After this procedure has been completed at both valves of cylinder No. 4, adjust the tappet clearance at remaining cylinders, recalling that: with valves of cylinder No. 4 « at balance », clearance must be set at cylinder No. 1, with valves of cylinder No. 3 « at balance », clearance must be set at cylinder No. 2, and vice versa.

**WARNING!**

**The crankshaft rotates counterclockwise.**

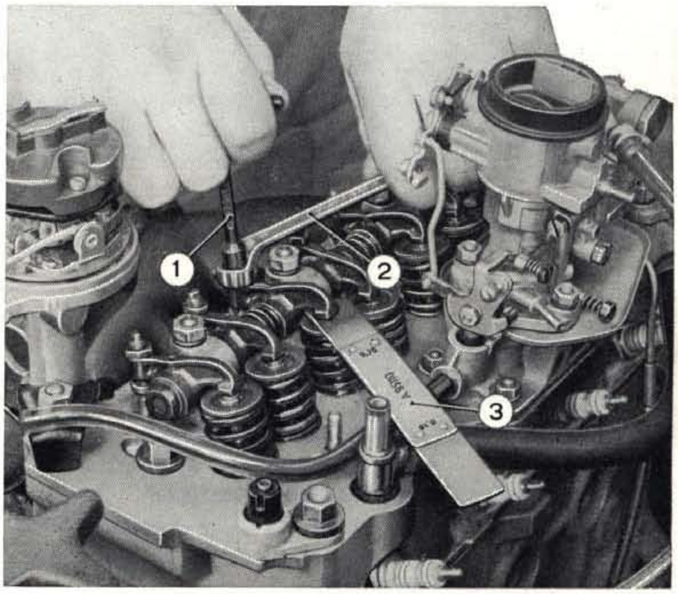


**Fig. 119 - Adjusting valve tappet clearance.**

1. « T » wrench A. 50006. - 2. Box wrench. - 3. Feeler A. 95111.

## TIGHTENING REFERENCE

| ITEM | Part No. | Thread Diameter and Pitch | Material | Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| Main bearing cap screw . . . . | 4052463 | M 10 x 1.25 | R 100 | 44.8 | 6.2 |
| Con rod bearing cap screw . . . | 4112072 | M 8 x 1 | R 100 | 25.3 | 3.5 |
| Cylinder head (and temperature gauge sending unit) holddown screws . . . . . . . . . . . . | 4105331<br>4105332<br>4105333 | M 9 x 1.25 | R 100 | 28.9 | 4 |
| Flywheel mounting screw . . . . | 1/42382/30 | M 8 x 1.25 | R 100 | 25.3 to 28.9 | 3.5 to 4 |
| Driven sprocket-to-camshaft screw | 1/59707/20 | M 10 x 1.25 | R 80 | 36.2 | 5 |
| Rocker shaft support stud nut . . | 1/61008/20 | M 8 x 1.25 | R 80 (stud R 100) | 14.5 | 2 |
| Drive pulley cover screw . . . . | 1/38236/21 | M 6 x 1 | R 80 Znt | 5.8 | 0.8 |
| Generator, fan and water pump drive hub-pulley-to-crankshaft nut | 4064759 | M 18 x 1.5 | R 50 Znt (shaft C 40 Bon) | 72.3 | 10 |
| Air conveyor-to-water pump body screw . . . . . . . . . . . . | 898514 | M 8 x 1 | R 80 Znt | 18.1 | 2.5 |
| Spark plugs . . . . . . . . . . | 4079728<br>4079727 | M 14 x 1.25 | — | 18.1 to 21.7 | 2.5 to 3 |
| Engine mounting bracket-to-transmission stud nut . . . . . . . | 1/61008/11 | M 8 x 1.25 | R 50 Znt (stud R 80 Znt) | 18.1 | 2.5 |
| Engine mounting bracket-to-body shell screw . . . . . . . . . . | 4122373 | M 10 x 1.25 | R 80 Znt | 21.7 to 25.3 | 3 to 3.5 |
| Engine rear mounting bracket-to-body shell screw nut . . . . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (screw 12 NC3 Znt) | 27.5 | 3.8 |
| Side link-to-engine-and-body shell screw nut . . . . . . . . . . | 1/61041/11 | M 8 x 1.25 | R 50 Znt (screw R 80 Znt) | 16.6 | 2.3 |

# ENGINE BENCH TEST



A rebuilt engine should be submitted to a rig test as follows.

## Installing Engine on Test Bench.

Place the engine on test bench.

To secure, use clamping arms **I. 35100 G/3**, front, and **I. 35100 G/4**, rear, as shown in figures 120 and 121.

Then connect:

– the engine exhaust manifold to the exhaust hose of test bench (fig. 121);

– the flywheel to bench prop shaft through the mounting flange.

Next tie up fuel and coolant lines.

Instead of low oil pressure indicator sending unit, connect the oil delivery line to bench oil gauge.

Eventually wire up the ignition distributor and generator to the control board.

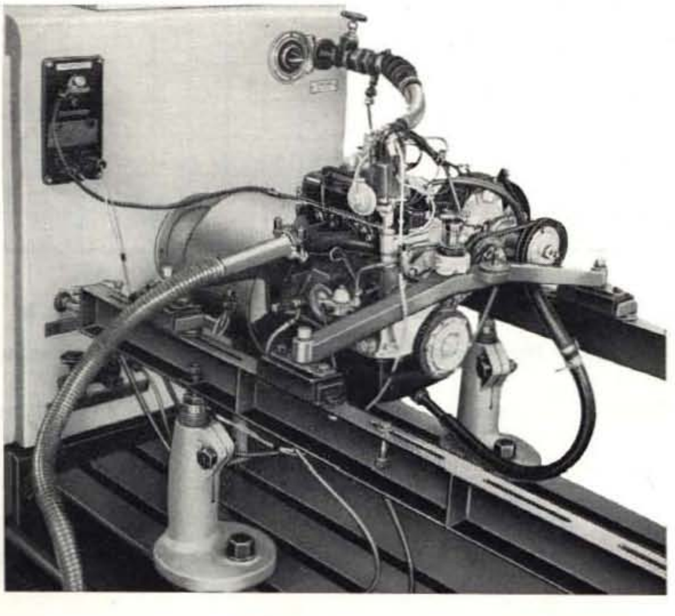

**Fig. 120 - Detail of engine on test bench.**

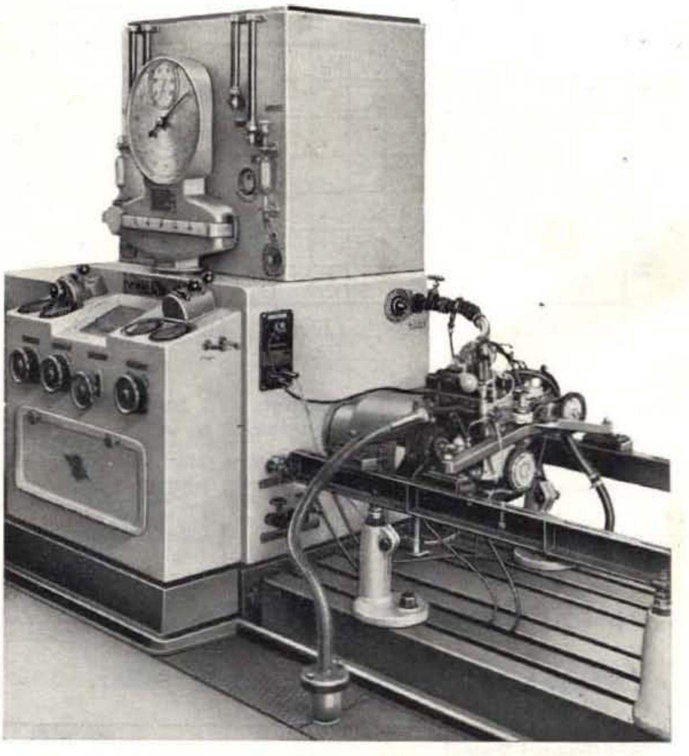

**Fig. 121 - Engine on test bench.**
In foreground the bench exhaust hose.

## Test Procedure.

After starting the engine see whether:

– oil, coolant or fuel leaks occur at faying surfaces, lines and gaskets;

– oil circulates correctly and test bench oil gauge reads 42.7 to 56.9 psi (3 to 4 kg/cm$^2$) as specified;

– troubles are detected in operation.

In case of irregular running, stop engine and remedy the trouble before proceeding with the test.

It should be noted, however, that during the initial test period engine operation is still rough due to friction between contact surfaces of moving parts which still need breaking in, especially when pistons and bearings have been replaced, crankshaft and cylinders ground.

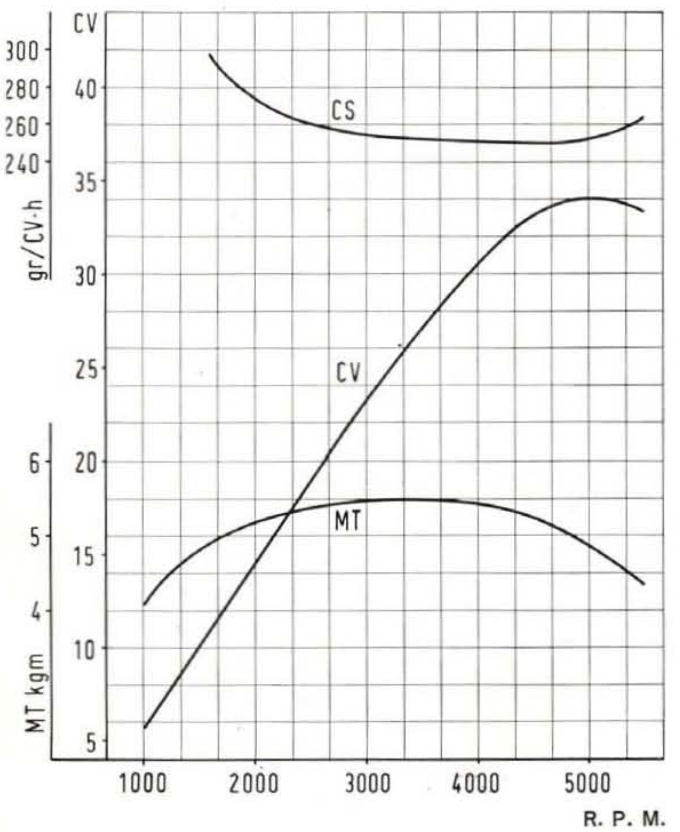


**Fig. 122 - Horsepower, consumption and torque curves of 100G.000 engine.**

Corrected horsepower curve shown in figure refers to a rebuilt and run-in engine with fan and air cleaner, without muffler.
CS = Consumption. - CV = H.P. - MT = Torque.

## Testing Range of Rebuilt Engines.

Comply with the data tabulated hereafter.

| Test Speed Rate r.p.m. | Time - Min. | Brake Load |
|---|---|---|
| 500 | 15′ | No load |
| 2,000 | 15′ | Half load |
| 2,000 | 5′ | Full load |
| Total | 35′ | |

When bench testing a rebuilt engine, avoid revving it up in an attempt to obtain horsepower curve speeds.

Engine break-in will be completed by the Owner who is bound not to drive the car beyond the speed rates specified for the initial use period.

## Horsepower Check-up.

To determine the horsepower developed by the engine at various speed rates, in the conditions shown on foot of figures 122 and 123, use the formula:

Corrected horsepower = Reading of bench indicator

$$\times \frac{760}{p}\sqrt{\frac{273 + t}{293}}, \text{ where:}$$

p = atmospheric pressure
t = temperature of suction air.

## Overhaul after Bench Test.

After the bench test, the engine should be overhauled just in case running troubles have been detected.

Correct as required and then necessarily submit the engine to a new bench test to make sure of its regular operation.

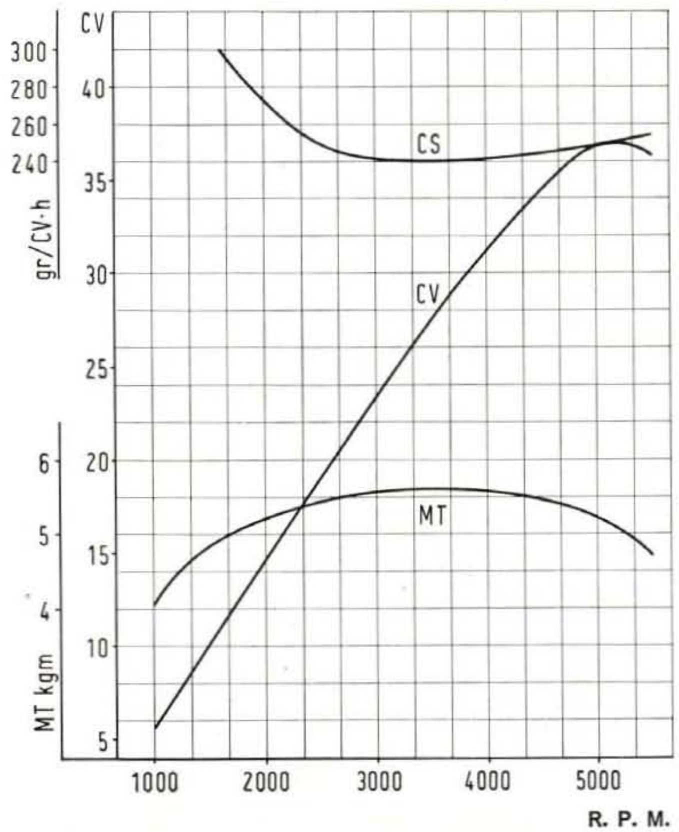


**Fig. 123 - Horsepower, consumption and torque curves of 100G.002 engine.**

Corrected horsepower curve shown in figure refers to a rebuilt and run-in engine with fan and air cleaner, without muffler.
CS = Consumption. - CV = H.P. - MT = Torque.

# Section 3

## LUBRICATION
## COOLING
## FUEL SYSTEM



3

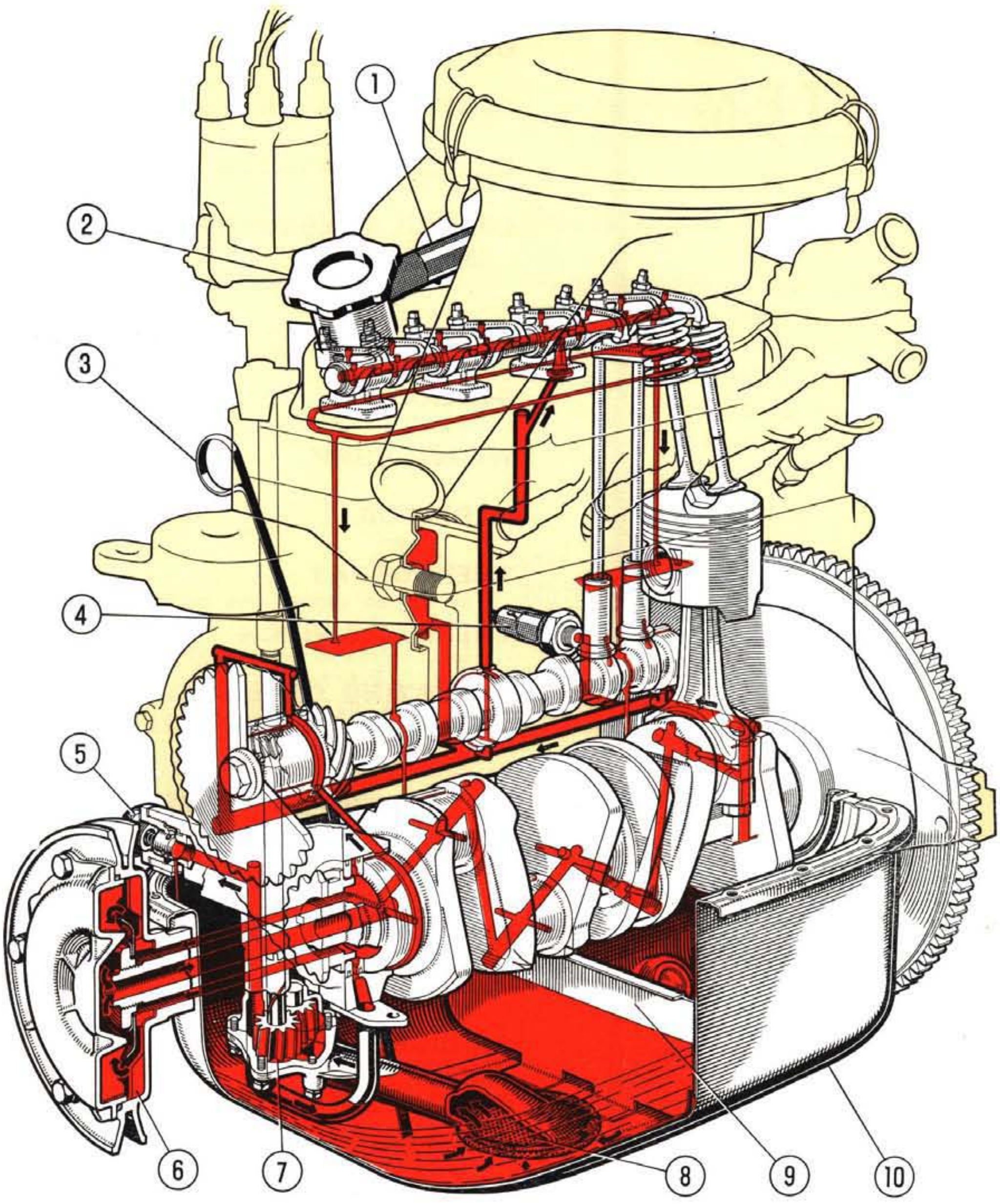


**Fig. 124 - Engine lubrication diagram (cut-away view).**

1. Engine-to-air cleaner pipe for recirculation of blow-by gases and oil vapours in engine interior. - 2. Oil filter cap. - 3. Oil dip stick. - 4. Low oil pressure indicator sending unit. - 5. Oil pressure relief valve. - 6. Centrifugal oil filter. - 7. Gear oil pump. - 8. Oil pump suction filter. - 9. Stabilizer wall. - 10. Oil sump.

# LUBRICATION



Pressure metered type engine lubrication through a gear pump.

The lubrication system (fig. 124) includes, besides the gear pump:

– a suction intake horn (4, fig. 126), with filter screen;

– a centrifugal delivery oil filter (6, fig. 124);

– a pressure relief valve (5);

– a sending unit (4) for low oil pressure indicator.

**Standard oil pressure: 42.7 to 56.9 p.s.i. (3 to 4 kg/cm$^2$).**

## OIL PUMP

The oil pump is mounted on lower edge of crankcase.

When servicing the pump, examine the teeth of gears and replace gears if teeth turn out to be worn or damaged.

Clearance between tooth ends and pump housing must not exceed .006″ (0.15 mm) (fit of new parts .0004″ to .004″ - 0.01 to 0.10 mm).

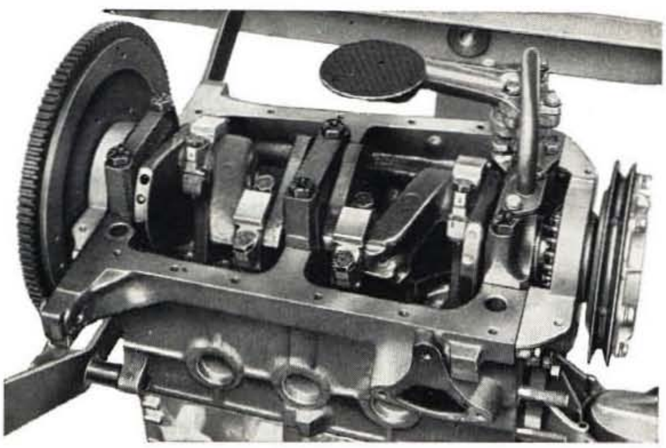

Fig. 125 - Oil pump in place in crankcase.

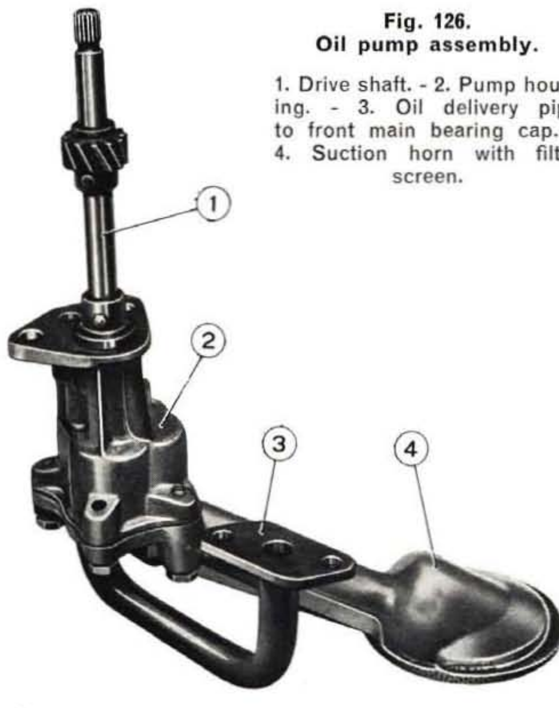


**Fig. 126. Oil pump assembly.**

1. Drive shaft. - 2. Pump housing. - 3. Oil delivery pipe to front main bearing cap. - 4. Suction horn with filter screen.

Clearance between drive gear shaft and seat must not be greater than .006″ (0.15 mm); fit of new parts .0005″ to .0020″ (0.013 to 0.050 mm).

Fitting clearance between pin and driven gear is .0004″ to .0020″ (0.010 to 0.050 mm); this clearance must not exceed .004″ (0.10 mm).

The guide bushing of pump drive shaft is inserted with a press fit of .001″ to .0028″ (0.025 to 0.070 mm).

Clearance between drive shaft and guide bushing must not exceed .006″ (0.15 mm); fit of new parts .0010″ to .0024″ (0.025 to 0.062 mm).

Standard clearance between pump drive gear and camshaft gear should be .0024″ (0.060 mm); wear limit .004″ (0.10 mm).

Check filter screen on suction horn for clogging or tear; in the affirmative, replace the screen.

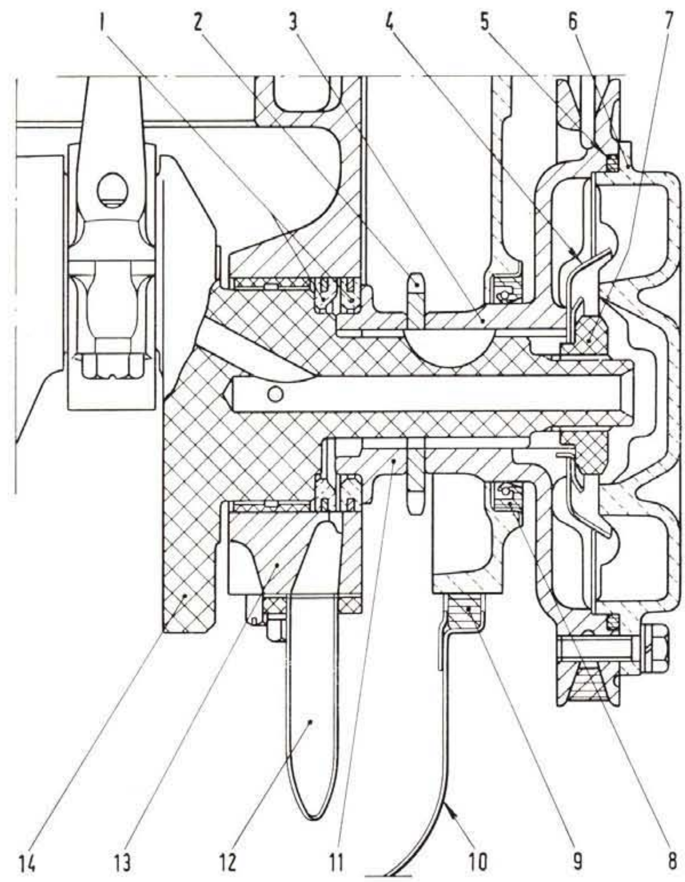


**Fig. 127 - Detail of engine side section across centrifugal oil filter.**

1. Oil seal disks. - 2. Timing drive sprocket. - 3. Centrifugal oil filter hub-pulley. - 4. Baffle ring. - 5. « O » ring. - 6. Centrifugal filter cover. - 7. Nut securing hub-pulley and baffle ring to crankshaft. - 8. Spring type oil seal. - 9. Oil pan gasket. - 10. Oil pan. - 11. Oil seal disk backing ring. - 12. Oil pump delivery pipe. - 13. Front main bearing cap. - 14. Crankshaft.

## OIL PRESSURE RELIEF VALVE

This unit is directly screwed in crankcase, on left lower end.

The valve is set as follows:

– back out the plug performing as a casing for spring;

– add or remove shims in plug as required;

– screw in plug securely.

Oil pressure, at rated speed, should be 42.7 to 56.9 psi (3 to 4 kg/cm$^2$).

To check oil pressure, insert test gauge **A. 60162** in place of low oil pressure indicator sending unit.

## CENTRIFUGAL OIL FILTER

The centrifugal oil filter consists basically of a cover, a hub-pulley and a baffle ring (see fig. 127).

The bottom bore of the baffle ring is lesser than that of the cover and hub-pulley, because the baffle ring has been designed to create a radial oil strain toward an area where centrifugal force is such as to segregate foreign matter.

Radial ribs on hub-pulley and cover inner face are to trap foreing matter and convey oil to center filter.

Oil from both sides of front crankshaft end (which bears two longitudinal machine grooves) is forced to filter outskirts by the baffle ring. Oil is so cleaned and returns to filter center whence if flows inside the crankshaft through a passage hole in shank (fig. 124).

The pulley transmits drive to generator, water pump and fan.

The nut securing the hub to the crankshaft must be drawn up with 72.3 ft.lbs (10 kgm) of torque, using a torque wrench.

### Cleaning, Inspection and Repair.

During engine overhaul, or every 30,000 miles (50,000 km), take the filter apart and thoroughly clean all components.

Check the cover and baffle ring for soundness.

If signs of crack or distortion are found, replace parts affected.

It is good practice to always renew the gasket between cover and hub.

After assembly has been completed, reset tension of generator and water pump drive belt which should show a deflection of .39″ to .59″ (10 to 15 mm) under a load of 22 lbs (10 kg).

## OIL SUMP GASKETS

In order to assure perfect oiltightness, both side gasket halves and the flywheel end and chain end gaskets must be fitted on sump as follows:

– using a paintbrush, coat the gasket seats on sump with cement;

– fit gaskets as shown in fig. 128;

– place tool **A. 60163** and secure it to the sump so that gaskets will adhere closely against seats.

It is good practice to leave gaskets under pressure of tool **A. 60163** for 45 minutes at least.

## LOW OIL PRESSURE INDICATOR SENDING UNIT

The sending unit is located on left hand side of cylinder block and wired with the low oil pressure indicator in instrument cluster.

The indicator signals with ignition on only and goes out when oil pressure is such as to assure regular lubrication of engine.

With a hot engine at low speed rate the indicator may light up even if engine is operating normally.


**Fig. 128 - Bonding oil sump gaskets.**

1. Sump. - 2. Gasket. - 3. Tool A. 60163 for compressing gaskets against seat.

## OIL PUMP FITTING DATA

| DESCRIPTION | FITS OF NEW PARTS | | WEAR LIMITS | |
|---|---|---|---|---|
| | in. | mm | in. | mm |
| Drive shaft guide bushing-to-seat in crankcase . . . . . . . . . . . . . . . . . | Pinch fit of .0010 to .0028 at all times | Pinch fit of 0.025 to 0.070 at all times | — | — |
| Drive shaft-to-crankcase bushing . . . . . | .0010 to .0024 | 0.025 to 0.062 | .006 | 0.15 |
| Driving gear shaft-to-seat in pump housing | .0005 to .0020 | 0.013 to 0.050 | .006 | 0.15 |
| Driven gear-to-its shaft . . . . . . . . . . | .0004 to .0020 | 0.010 to 0.050 | .004 | 0.10 |
| Gears-to-pump housing . . . . . . . . . . | .0004 to .0040 | 0.010 to 0.100 | .006 | 0.15 |
| Driving-to-driven gears backlash . . . . | .0031 | 0.08 | .006 | 0.15 |
| Drive shaft gear-to-camshaft gear . . . . | .0024 | 0.06 | .004 | 0.10 |

# COOLING



## GENERAL

The coolant in the cooling system is of the permanent type, its replacement being envisaged to be made only **every other year or 36,000 miles** (60,000 km) of running.

The coolant consists of a 50-50 mixture of magnesium free water and FIAT **Paraflu 11** fluid with .18 oz (5 grams) of Arexons sealing powder, having a freezing point of about $-30°$ F ($-35°$ C).

The radiator is connected, through a pipe on its filler neck, to a tank (4, fig. 130), which compensates the volume and pressure variations in coolant due to engine thermal cycling.

The FIAT **Paraflu 11** fluid is colored to facilitate visual level checks in tank, which is translucent. Fluid features anti-oxide, anti-corrosion, anti-foam and anti-scale properties.

During engine operation coolant level is apt to rise due to expansion and to the formation of vapor bubbles.

The level should then be checked only with engine stopped and cold.

Under these conditions the coolant level in tank should have a head of about **2 $^3/_4$'' (7 cm)** above the min mark. The remaining upper free space allows not only the expansion of coolant but acts also as a constrainer for the liquid that would otherwise spill away during the short periods in which, under particular conditions (sudden stops on gradients, slow column traffic, etc.), the system boils.

The liquid level in tank (4), must not show variations when checked with a cold engine.

### Directions for Use.

Check periodically coolant level in expansion tank, **with a cold engine: it must always be above the min mark.** With very hot engine the level will rise remarkably, and this may also occur immediately after stopping the engine.

Should it be found that the level has dropped below the min mark on tank wall, the system shall be closely inspected, as outlined further on, and topped up.

**Only in emergency** (severe and sudden coolant losses) refill can be made with tap water as follows:

– allow the engine to cool down;

– remove radiator and expansion tank caps;

– pour water into expansion tank until overflow is noted from radiator filler neck.

**As soon as possible** fix the fault and refill with coolant as directed hereafter.

## Directions for Service.

Check the cooling system for leakage using tester **Ap. 5066** as follows:

– fit the radiator filler cap of car under inspection to the tester **Ap. 5066** with the kit hose attached;

– operate the tester pumping air into the hose; the radiator filler cap should let air out when pressure has built up to 5.7 psi (0.4 kg/cm$^2$);

– if the cap is serviceable, affix the tester to the radiator as shown in fig. 129;

– pump air in until pressure rises to 14.2 psi (1 kg/cm$^2$); no pressure losses must be detected.

Otherwise check radiator hoses and radiator for leaks as outlined in covering chapter.

**The system must be refilled exclusively with a 50-50 mixture of magnesium free water and FIAT Paraflu 11 liquid, with no sealing powder added.**

Total capacity of the system is 6.6 G.B.qts - 7.9 U.S.qts (7.5 lts). To fill up pull the heater radiator control lever (red coloured).

Remove radiator and expansion tank caps and pour coolant into the expansion tank until it overflows from radiator neck.

Start the engine and run it at idle so to bleed the circuit.

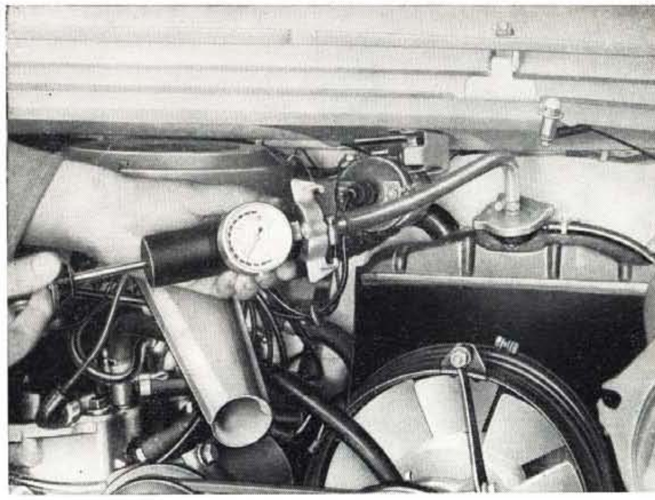

**Fig. 129 - Checking leakage of cooling system by means of tester Ap. 5066.**

Top up to 2 $^3/_4$'' (7 cm) above minimum mark and fit caps.

In case the engine radiator or the heater radiator have been taken down for service, refill the circuit with the old liquid after flushing the radiator thoroughly with a 2.5% solution of acetic acid.

On cars circulating in or for export to hot weather countries, the long lasting liquid can be safely replaced (as a result of repair jobs or after 36,000

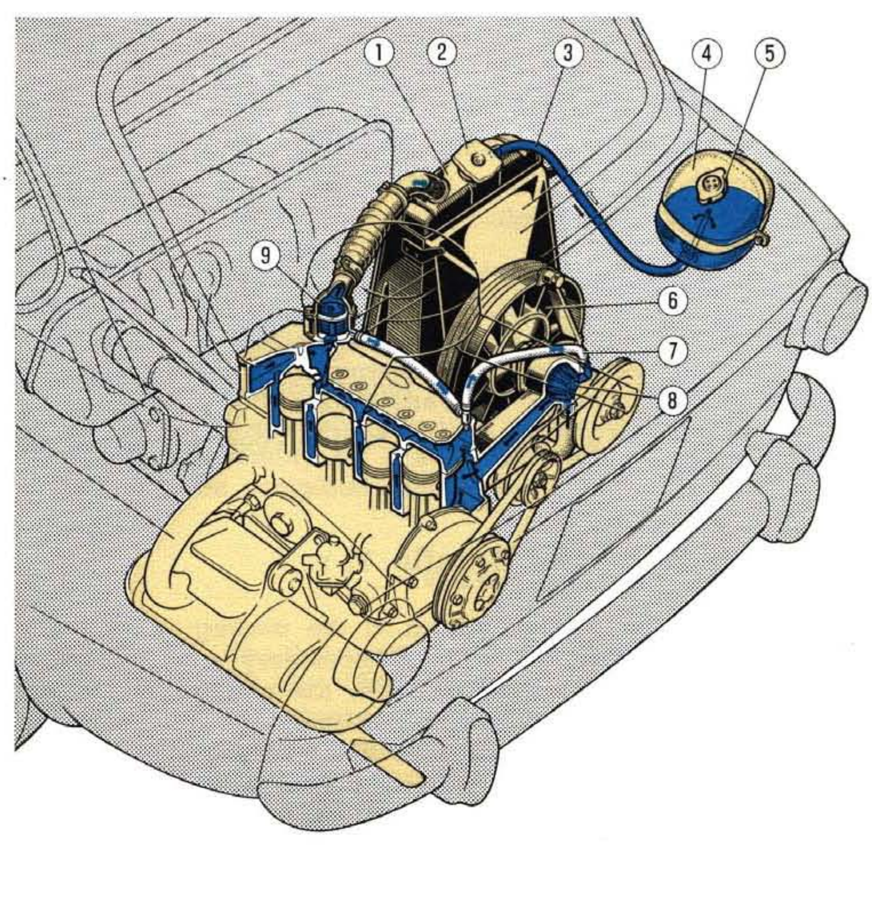


**Fig. 130.**

**Diagram of engine cooling system.**

1. Radiator. - 2. Radiator cap. - 3. Line, radiator-to-expansion tank. - 4. Translucent expansion tank. - 5. Expansion tank cap. - 6. Fan. - 7. By-pass line, cylinder head-to-pump (thermostat still closed). - 8. Coolant pump. - 9. Thermostat in engine water outlet duct.

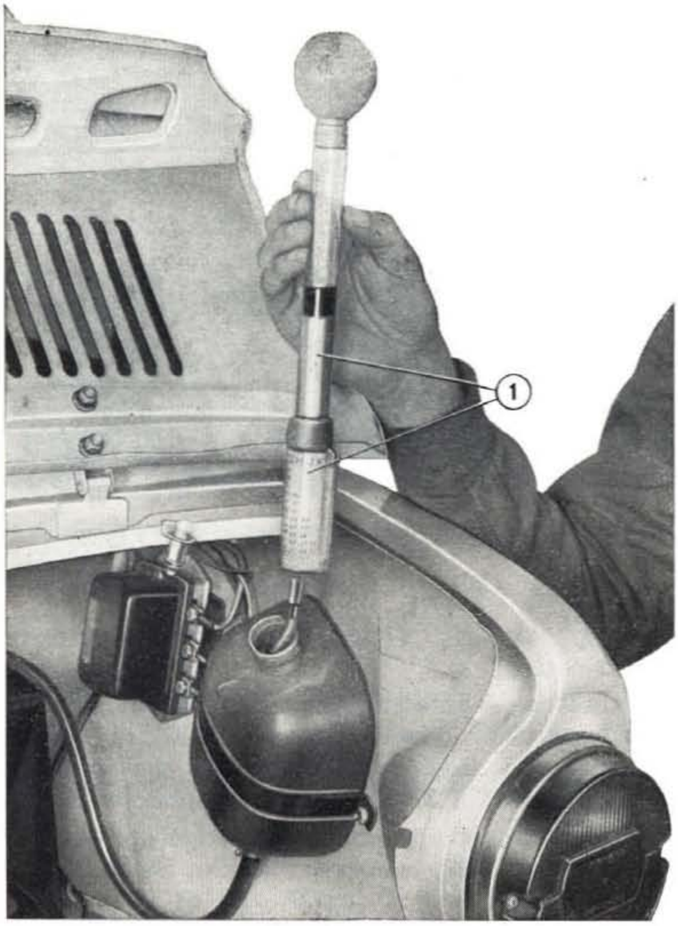


Fig. 131 - Checking rate of « Paraflu 11 » fluid in cooling system.
1. Device A. 95858 for checking « Paraflu 11 » rate.

miles - 60,000 km or two years use) by tap water with addition of bichromate base rust inhibitors.

Recommended rust inhibitors:

- potassium bi-chromate (2 to 3‰ by weight);
- Ferroxan (Bayer);
- Nalco 38 (Nalco Co.).

**NOTE** - In this event **do not** add sealing powder.

Prior to filling with inhibited water, flush the cooling system thoroughly to remove all particle of anti-freeze and sealing powder, inasmuch as the bi-chromate is incompatible with any organic body.

To check the rate of « **Paraflu 11** » fluid in coolant proceed as follows.

## Checking Rate of « Paraflu 11 ».

Should water have been added to the cooling mixture in emergency, it will be necessary to determine the rate of « **Paraflu 11** » in the circuit in order to restore coolant characteristics.

Use device **A. 95858** for this check, as follows.

Make sure that temperature of mixture ranges between 50° and 158° F (10° and 70° C) and coolant level in radiator is correct. Top up with tap water, if necessary.

Suck up enough fluid into the device to raise the float (fig. 131) and read on device tube the letter corresponding to mixture level.

For example:

- the float is at letter F;
- observe the table on bottom of device and read the actual rate of « **Paraflu 11** » present in the circuit; this rate is the number (say « 35 ») on column F lined up with the temperature reading of device thermometer;
- from the chart « amounts to be added » on top of device it may be seen that for Model 850 number « 35 » corresponds to a quantity of 1.70 liters of straight « **Paraflu 11** »; so the recommended fluid rate of 50% by volume can be restored.

---

**NOTE - If plunger rises beyond letter « A », the percentage of « Paraflu 11 » in coolant will be negligible or none.**

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# WATER PUMP

## Removal and Installation.

To remove the water pump from engine proceed as follows:

- remove engine right side apron;
- remove radiator drain plug and let all coolant out;
- remove drive belt from pulley;
- disconnect hoses at cylinder head and radiator;
- remove lock ring securing air conveyor to radiator;
- back out water pump mounting screws on crankcase;
- withdraw water pump fan and air conveyor assembly.

Install the water pump reversing above procedure and fill up the cooling system as directed in previous paragraph.

## Disassembly and Assembly.

Clamp the assembly in a vise and separate the conveyor, pulley and fan from the water pump.

Remover rear ball bearing snap ring (6, fig. 132).

Detach pump housing (2) from cover (14) by removing mounting screws.

From impeller (13) slide off: ball bearing (7), retainer (8), thrust washer (10), snap ring (11) and seal (12).

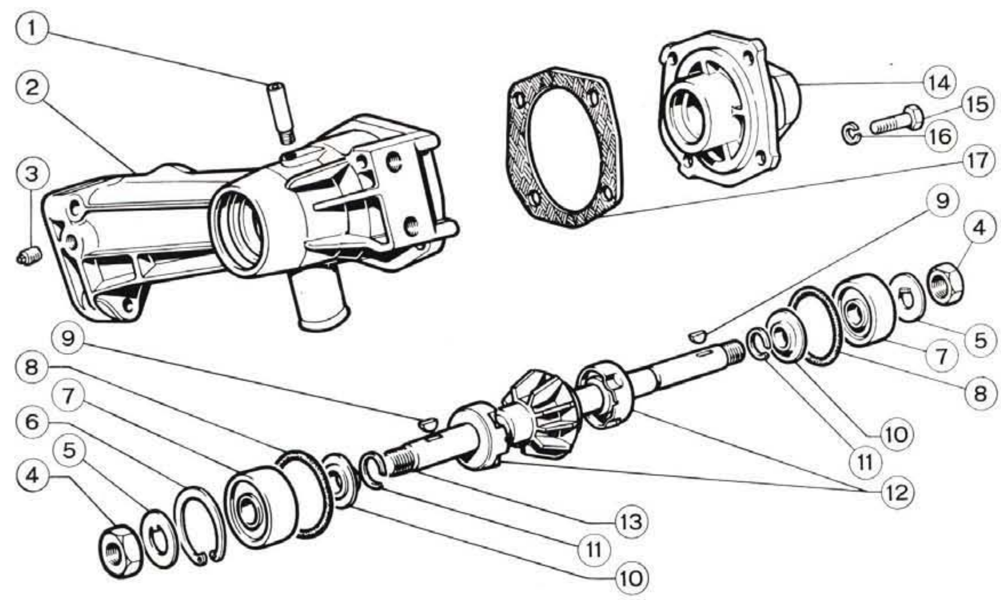



**Fig. 132.**

**Layout of water pump components.**

1. Connector. - 2. Pump housing. - 3. Plug. - 4. Pulley and fan mounting nuts. - 5. Lock plates. - 6. Bearing snap rings. - 7. Watertight ball bearings. - 8. Retainers. - 9. Woodruff keys. - 10. Thrust washers. - 11. Snap rings. - 12. Seals. - 13. Impeller. - 14. Pump housing cover. - 15. Cover mounting screw. - 16. Lock washer. - 17. Cover gasket.

Slide off cover (14) and from cover interior take out ball bearing (7), retainer (8) and thrust washer (10).

At last slide off snap ring (11) and seal (12) from impeller.

Assemble reversing disassembly procedure.

## Inspection and Repair.

With all components disassembled check that:

– ball bearings are in top condition and show no axial play; holding bearing fast with one hand no roughness should be felt if they are rocked back and forth;

– snap rings are not weak;

– the impeller shaft shows no indication of binding or runout; impeller must be tied rigidly to shaft;

– bearing thrust washers and retainers are not worn too much;

– encased seals are perfectly sound; renew seals if they proved to be most hard to pull.

In case wear or damage have been detected, replace unserviceable parts by new ones.

Pump housing-to-cover gasket should be **always** renewed.

# RADIATOR

## Removal and Installation.

Removal of radiator is made as follows:

– remove engine right side apron;

– remove radiator drain plug and let all coolant out;

– disconnect coolant inlet and outlet hoses;

– remove lock ring securing air conveyor to radiator;

– disconnect engine ground cable;

– disconnect radiator-to-expansion tank line;

– remove radiator mounting screws from body;

– lift out radiator as shown in fig. 133.

To install the radiator reverse removal steps.

## Pressure Test.

Should coolant leaks from radiator be noticed, remove the radiator as already outlined and submit it to a pressure test to locate leakage.

Fit radiator drain plug.

Plug up inlet and outlet hoses as well as the line to expansion tank.

Fill up radiator with water, attach tester **Ap. 5066** and pump air in until a pressure of 14.2 psi (1 kg/cm$^2$) is built up.

Correct minor leaks by tinning (fig. 134).

If extensive damages are detected replace radiator assembly by a new one because repair may not be completely successful.

# THERMOSTAT

The thermostat is situated at front end of cylinder head (fig. 136).

The thermostat allows of rapidly bringing up engine to rated temperature; actually it begins opening when coolant temperature is as high as 185° to 192° F (85° to 89° C).


**Fig. 133 - Lifting out radiator from underside of car.**
1. Radiator. - 2. Coolant inlet hose.

The thermostat valve should be wide open at 212° F (100° C).

The thermostat is calibrated on manufacture and needs not be further adjusted.


**Fig. 134 - Tinning the radiator.**
1. Radiator. - 2. Radiator service stand Arr. 22239.

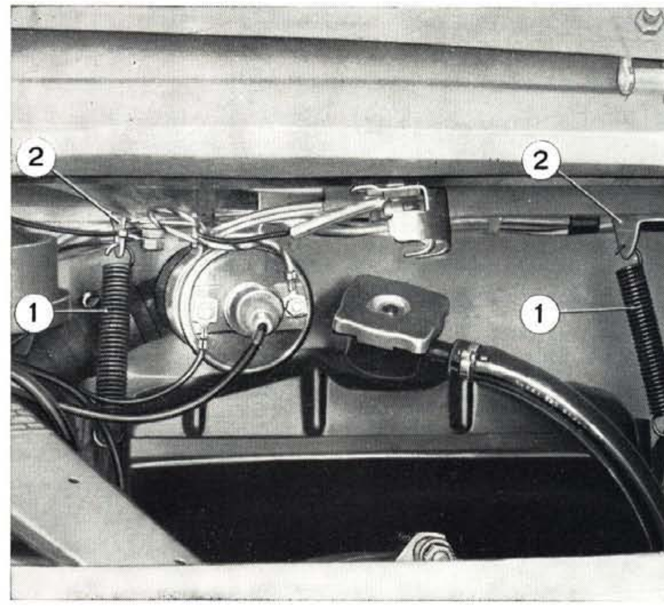



**Fig. 135 - Detail showing radiator mounting.**
1. Supporting springs. - 2. Spring hangers.

In case of damage or fissures in thermostat bellows the valve will open automatically allowing free circulation of coolant through radiator.

To remove thermostat from cylinder head use adapter socket **A. 50111** in conjunction with ratchet wrench **A. 89854.**

Check thermostat operation as follows:

– plunge thermostat deeply into a 50-50 mixture of water and FIAT «**Paraflu 11**» fluid and heat uniformly using care that temperature does not rise by more then 1.8° F (1° C) per minute beyond 140° F (60° C);

– verify that valve opening and strokes comply with the following figures:

| | | |
|---|---|---|
| Valve opening begins | 189° ±3.6° F | 87° ±2° C |
| Minimum valve stroke<br>Temperature not above | .295 in<br>212° F | 7.5 mm<br>100° C |
| Maximum valve stroke | .433 in | 11 mm |

Temperature of initial valve opening is taken to correspond to a valve stroke not in excess of .004" (0.10 mm).

Renew thermostat if it turns out to be unserviceable.

## THERMAL SWITCH

The thermal switch, which is secured to the right rear end of cylinder head, sends impulses to warn the driver of the coolant temperature

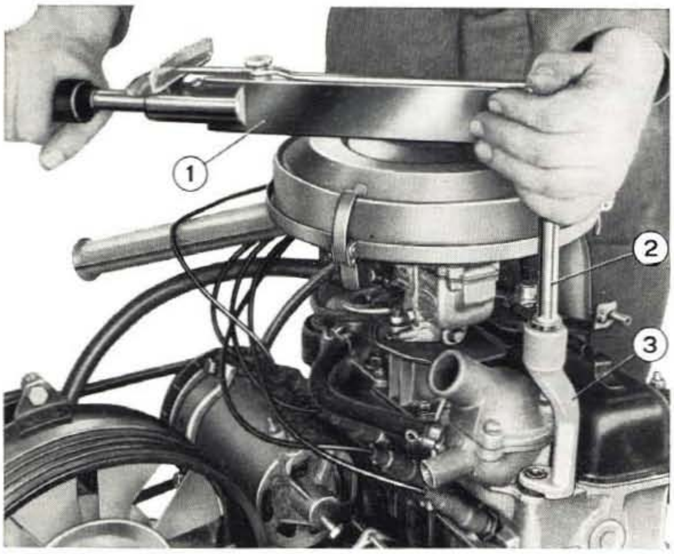



**Fig. 136 - Fitting thermostat to engine.**
1. Torque wrench. - 2. Torque wrench extension. - 3. Adapter socket A. 50111.

ranging at dangerous levels. On assembly, make sure that the seating face of switch on head is flat and smooth.

Thermal switch setting data: with temperature increments of 1.8° F (1° C) per minute the terminal contact to ground should be felt at 230° to 248° F (110° to 120° C).

Replace the switch which is inoperative or operates incorrectly, provided the trouble must not be traced to the wiring or a blown indicator bulb.

## Adjusting Generator and Water Pump Drive Belts Tension.

The generator and water pump are driven, through pulleys, by a belt each which in turn take drive from centrifugal oil filter pulley.

Incorrect tension of drive belts may adversely affect engine operation.

A slack belt tends to slip causing engine overheat due to insufficient speed of fan and water pump. Reduced belt speed causes also low generator charge.

On the other side a too taut belt will bring about excessive strain on water pump and generator shaft and, consequently, rapid bearing wear.

Correct tension of drive belts is obtained when, under a load of 22 lbs (10 kg), deflection ranges between .394" (10 mm) and .591" (15 mm) (fig. 137).

To adjust belts tension proceed as follows:

– loosen generator mounting nuts;

– correct tension of belt setting the position of generator support; tighten mounting nuts;

– remove pulley lock nuts;

– take out pulley half and shift one ore more shims outside (fig. 137);

– fit pulley half and secure with lock nuts.

This procedure is valid only **to stretch** water pump drive belt.

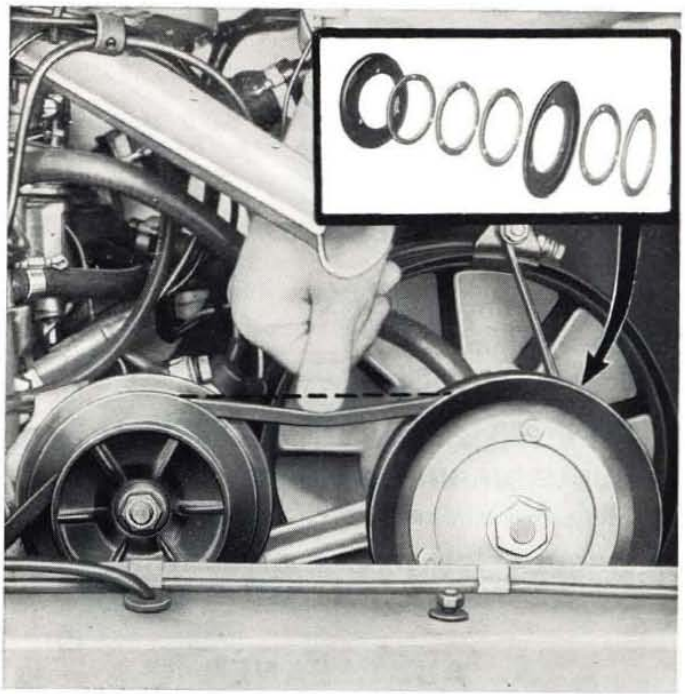


**Fig. 137 - Checking tension of generator and water pump drive belts.**
The inset shows the correct position of shims.

# FUEL SYSTEM



## AIR CLEANER

### Removal and Installation.

Take down the air cleaner from engine as follows:

– remove the spark plug cables mounting clip;

– slide off the flame trap tube connecting the air cleaner to the head cover;

– slide off the pipe connecting the air cleaner to the recirculation device of blow-by gases and oil vapours;

– remove the nuts mounting the air cleaner to exhaust manifold;

– slide off the air cleaner from carburetor.

No difficulty is encountered for air cleaner installation: just reverse the removal procedure.

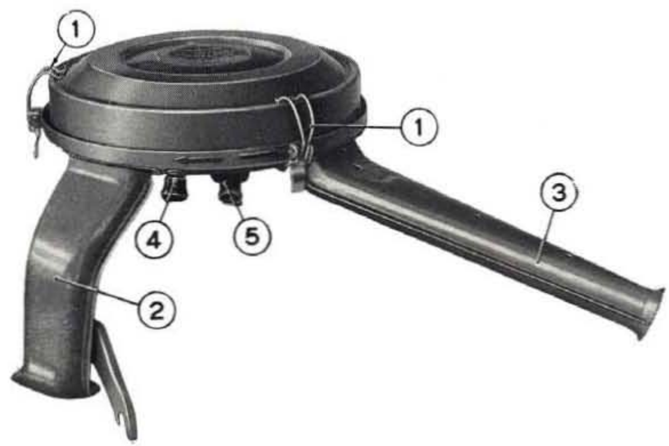



**Fig. 138 - Air cleaner assembly.**

1. Cover fasteners. - 2. Warmed air intake. - 3. Cold air intake. - 4. Warmed or cold air selector knob. - 5. Air cleaner-to-cylinder head pipe connector for blow-by gases and oil vapours recirculation.

## Replacing Cleaner Element.

For good performance of engine the air cleaner element should be renewed every 6,000 miles (10,000 km) at least.

Proceed as follows:

- unhook three fasteners (1, fig. 138);
- remove air cleaner cover;
- withdraw element and replace by a new one.

In areas where dusty roads are prevalent, renew cleaner element at shorter intervals.

## FUEL PUMP

A poor delivery of fuel to the carburetor may be due to a fault in the fuel pump or related lines.

Check:

- pump body screws (1, fig. 139) and upper cover screws (9) for a loose condition;
- fuel pump lines for restrictions, chafing or loose connectors.

Another source of fuel delivery troubles may be the breakdown of some pump components: if so disassemble the fuel pump.

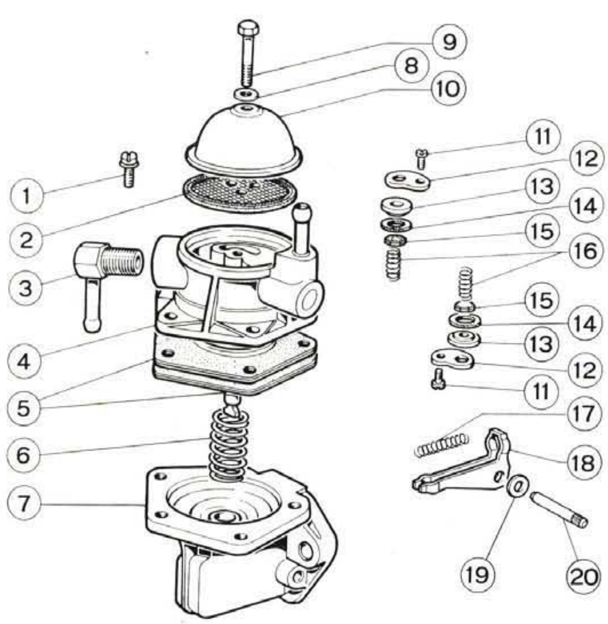



**Fig. 139 - Layout of fuel pump components.**

1. Pump bodies interlocking screws. - 2. Filter gauze. - 3. Connector. - 4. Upper body. - 5. Diaphragms. - 6. Spring. - 7. Lower body. - 8. Plain washer. - 9. Cover mounting screw. - 10. Pump cover. - 11. Valve housings locking screws. - 12. Valve housings. - 13. Valve plugs. - 14. Plug seals. - 15. Suction and delivery valves. - 16. Valve springs. - 17. Operating lever reaction spring. - 18. Yoke lever. - 19. Thrust washer. - 20. Yoke lever pin.

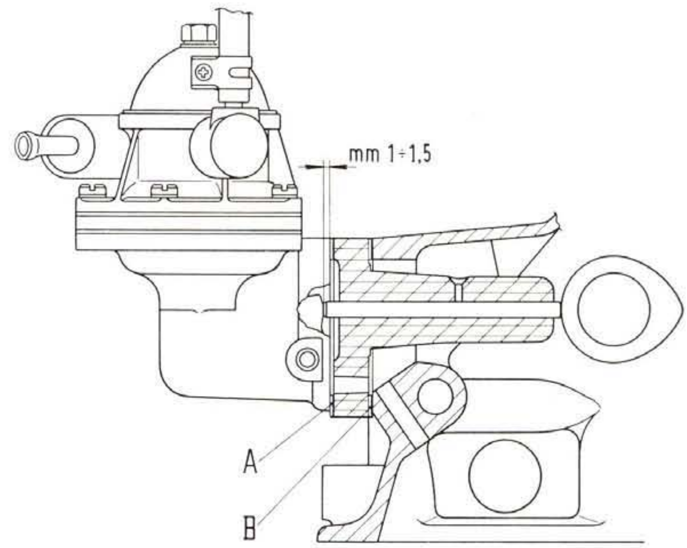



**Fig. 140 - Setting fuel pump push rod projection.**

A. Gasket .0106" to .0130" (0.27 to 0.33 mm) thick. - B. Gasket .0276" to .0315" (0.7 to 0.8 mm) thick.
Figure 1÷1,5 mm = .0394" to .0591" is jutting specified for the push rod.

## Cleaning and Inspection.

Remove the fuel pump from crankcase and take it apart.

Thoroughly wash all components in gasoline and blow them dry with compressed air.

Check valves (15, fig. 139) for evidence of damage.

Check valve springs (16) for weakness or cracks.

Check to see that the diaphragm reaction spring (6) and the operating lever spring (17) are not unserviceable or distorted.

The diaphragm (5) should show no signs of warpage or stiffness.

Wash the operating lever (18) and pin (20) in kerosene and oil them on assembly.

**Always** replace all pump seals.

Coat seals with a film of grease prior to fitting in place.

## Installation and Adjustment.

To assure the correct operation of the fuel pump, adjust the push rod projection before installing the pump on crankcase.

Proceed as follows:

- fit the insulating spacer into its seat with a gasket (B, fig. 140) in between;
- fit the gasket (A, fig. 140) and slide in the push rod;
- turn about the camshaft with the lobe positioned as shown in fig. 140;

– using a dial indicator, gauge the projection of push rod: it should be .0394" to .0591" (1 to 1.5 mm).

– if projection is less than .0394" (1 mm), replace the gasket B by another A; if projection is more than .0591" (1.5 mm), replace gasket B by another C.

Gaskets come for service in the following thicknesses:

A = . . . .0106" to .0130" (0.27 to 0.33 mm)

B = . . . .0276" to .0315" (0.7 to 0.8 mm)

C = . . . .0472" to .0512" (1.2 to 1.3 mm)

Recall that between fuel pump and insulating spacer type A gasket only should **always** be fitted.

# FUEL TANK

## Removal and Installation.

Disconnect the plus cable from battery terminal post.

Remove the drain plug from tank and let fuel out.

Disconnect: the filler neck hose at fuel tank, the fuel pump line and the tank breather tube.

Disconnect fuel gauge tank unit wires removing cover from engine compartment wall.

Disconnect accelerator and choke control cables as well as heater radiator coolant inlet and outlet pipes.

Remove transmission and clutch as directed under covering headings.

Remove left side shock absorber.

Back out fuel tank bracket screws.

Disengage brackets and lift out fuel tank.

To install the fuel tank just reverse removal procedure.

## Cleaning and Inspection.

Thoroughly check the fuel tank for leaks especially at joint seams; if necessary eliminate leakage by tinning.

To clean the tank interior, remove the drain plug and spray in a jet of gasoline so that all sediments or dirt deposits can be loosened; then shake the tank vigorously around.

Drain gasoline and blow the tank dry.

Repeat the above outlined steps and fit the drain plug.

Fig. 141 - Engine transmission and differential assembly.

# CARBURETOR

Model 850 Sedan is equipped with the following carburetor types:

- engine 100G.000 { Weber or Holley 30 ICF / Solex 30 PIB 4
- engine 100G.002 { Weber or Holley 30 ICF 7 / Solex 30 PIB 4

## WEBER OR HOLLEY CARBURETORS TYPE « 30 ICF »

Weber or Holley carburetor types **« 30 ICF »** and **« 30 ICF 7 »**, are of the single throat, downdraft type, with a barrel bore of **1.18" (30 mm)** at the throttle valve.

Both types of carburetor are fitted with:

- **mechanically controlled choke type easy starting device;**
- **leaner device;**
- **accelerator pump.**

## Operation.

From the diagram in fig. 142 it will be seen that the air from the cleaner flows down through the auxiliary Ventury (26) where it mixes with the fuel from the discharge tube (27) and then via the restriction formed by the primary Venturi (23), the air is delivered to engine cylinders after the opening of the throttle valve (21).

From the fuel line, connected to the carburetor by means of a threaded union (9), the fuel is filtered by the screen (8) and flows through the needle valve (10) into the bowl (14), where the float (13), hinged to the pivot (12), controls the opening of the needle (11) to maintain a constant fuel level.

From the bowl the fuel, controlled by the main jet (16), reaches the well (20) past the passage (18). Fuel in the well mixes with the air from the bleed jet (2) and passage (3) of the leaner device issuing from the orifices (24) of the emulsion tube (25), and then, past the discharge tube (27), it is advanced

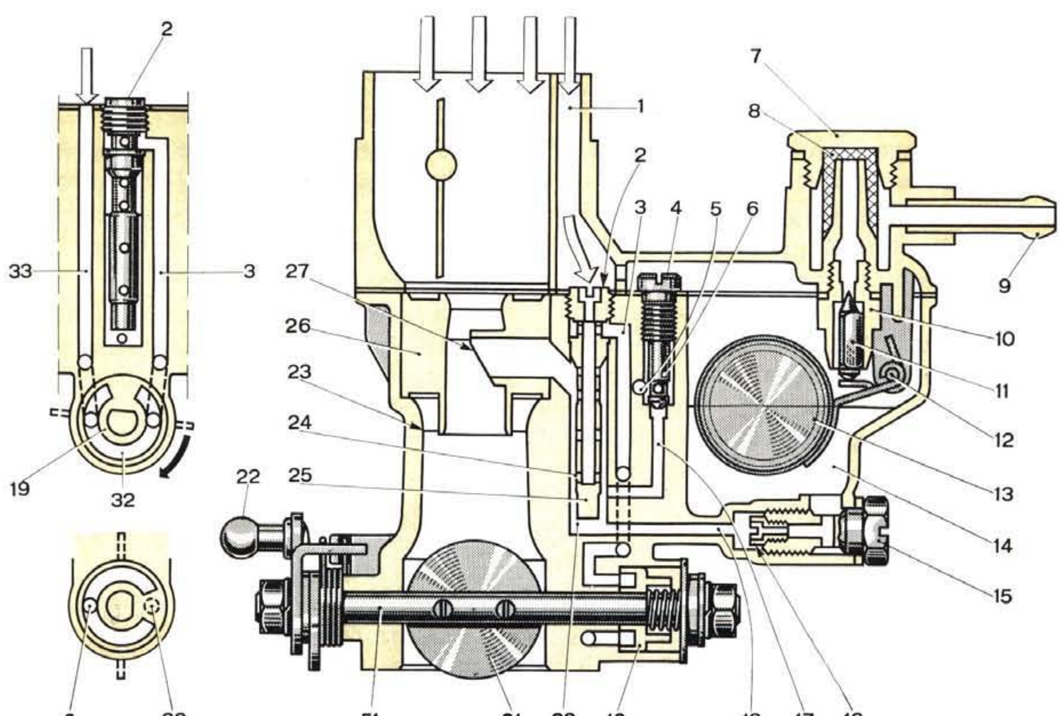



**Fig. 142 - Diagrammatic section views of Weber carburetors « 30 ICF » and « 30 ICF 7 ».**

1. Air inlet. - 2. Air bleed jet. - 3. Leaning air passage. - 4. Idling jet holder. - 5. Idling mixture passage. - 6. Idling jet. - 7. Strainer inspection plug. - 8. Strainer. - 9. Fuel inlet connector. - 10. Needle valve. - 11. Valve needle. - 12. Float pivot pin. - 13. Float. - 14. Carburetor bowl. - 15. Main jet holder. - 16. Main jet. - 17. Emulsion well-to-idling jet passage. - 18. Main jet-to-emulsion well passage. - 19. Leaner diaphragm. - 20. Emulsion tube well. - 21. Main throttle valve. - 22. Throttle control lever. - 23. Primary Venturi. - 24. Emulsion orifices. - 25. Emulsion tube. - 26. Auxiliary Venturi. - 27. Discharge tube. - 32. Diaphragm opening. - 33. Leaner air passage. - 51. Main throttle spindle.

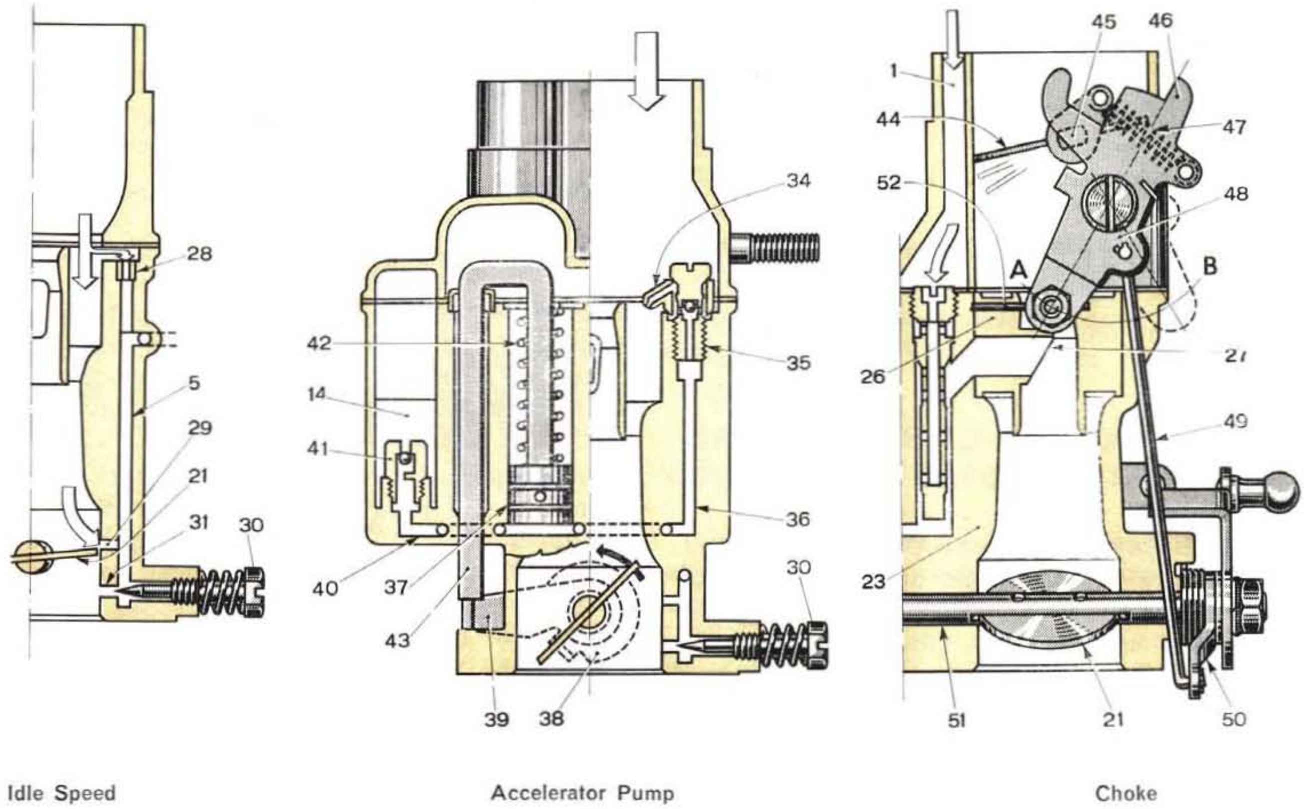



**Fig. 143 - Diagrammatic section views of Weber carburetors « 30 ICF » and « 30 ICF 7 ».**

1. Air inlet. - 5. Idling mixture passage. - 14. Carburetor bowl. - 21. Main throttle valve. - 23. Primary Venturi. - 26. Auxiliary Venturi. - 27. Discharge tube. - 28. Idling air bushing. - 29. Transfer port. - 30. Idling mixture setscrew. - 31. Idle discharge port. - 34. Pump discharge jet. - 35. Pump delivery valve. - 36. Pump delivery passage. - 37. Accelerator pump plunger. - 38. Pump control lever, stationary. - 39. Pump control lever, idler. - 40. Pump suction passage. - 41. Pump suction valve. - 42. Pump delivery extension spring. - 43. Pump control rod. - 44. Easy starting device choke throttle. - 45. Throttle spindle. - 46. Choke lever lug. - 47. Choke throttle return spring. - 48. Choke control lever. - 49. Link. - 50. Main throttle valve-to-choke device link lever. - 51. Main throttle spindle. - 52. Choke control cable.
A. Easy starting device in. - B. Easy starting device out.

to the carburetion cone consisting of the auxiliary Ventury (26) and the primary Ventury (23).

While **idling**, the fuel is passaged via (17) from the well (20) to the idle jet (6), where it blends with the air from the calibrated bushing (28, fig. 143) through the passage (5) and the idling feed orifice (31), which can be adjusted by means of the tapered screw (30). Fuel is thus discharged into the carburetor barrel below the throttle (21). Here it is further mixed with the air drawn in by engine suction through the gaps between the barrel walls and the butterfly in the idling position.

From the passage (5) the mixture can also reach the throttle chamber through the idle transfer port (29), located in exact relation to the throttle, thus enabling the engine to accelerate evenly from idling speed when the throttle is opened.

**The leaner device** (fig. 142) consists of a diaphragm (19), operated by the throttle spindle, a passage (33) in communication with the carburetor air intake, and another passage (3) to the well downstream the air bleed jet (2).

With part open throttle, the diaphragm (19) opens the way between passages (33) and (3): in these conditions the air from passages (33) and (3) adds up with the air sucked in past the air bleed jet (2) resulting in the leaning of the mixture delivered by the discharge tube (27), which means maximum fuel economy.

With throttle valve fully open, the diaphragm (19) cuts off the flow between passages (33) and (3): in these conditions the emulsion air is supplied only by the air bleed jet (2), resulting in a richer mixture to be delivered by the discharge tube (27), which means maximum engine power.

**The accelerator pump** (fig. 143) ensures smooth acceleration of the engine when the throttle is opened suddenly. It consists of a metal plunger (37) operated by the control rod (43) through the idler lever (39).

When the throttle is closed, the lever (39) under the action of the stationary lever (38), raises the plunger (37) by means of the rod (43), causing fuel to be drawn from the bowl (14) through the suction ball valve (41) and passage (40) into the pump cylinder.

When the throttle is opened, the rod (43) is released and the plunger (37) moves downward

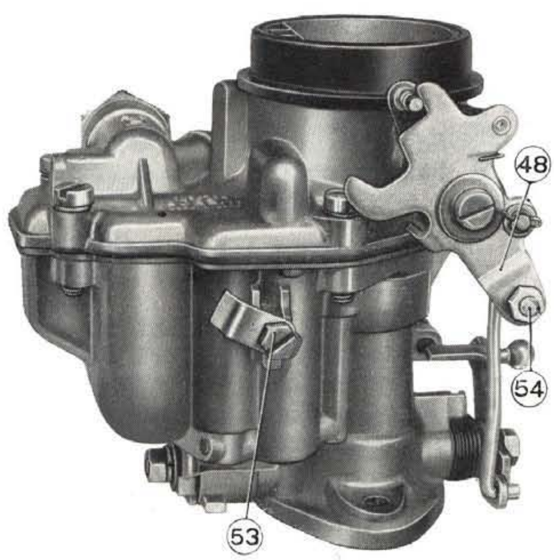



**Fig. 144 - View of Weber carburetor from choke control lever end.**

48. Choke control lever. - 53. Choke control cable guide plate screw. - 54. Choke control cable terminal.

under pressure from the spring (42), forcing fuel through the delivery ball valve (35) and via the passage (36) to the calibrated pump jet (34) where it is injected into the throttle barrel.

**The easy starting device** (fig. 143) consists of the choke valve (44) riding offset to the throttle spindle (45), which is connected to the control lever (48) through the spring (47).

When the easy starting knob on floor tunnel is pulled out to its fullest extent for cold starting, the lever (48) shifts to the position « **A** » (fig. 143) so that the throttle (44) blanks the carburetor air suction, while the main throttle (21) is set in a certain opening position through the rod (49) which connects the lever (48) and the lever (50) on the main throttle spindle (51, fig. 143).

Suction vacuum from the cranked engine rises to rather important values as a result of the throttle (44, fig. 143) restriction: the discharge tube (27) will deliver therefore a high rated mixture which enables quick starting of engine.

Once the engine has started, the suction vacuum causes the throttle (44) to open partially against the spring (47), so that the mixture delivered will be rich enough to enable the engine to run properly although cold.

When the engine begins to warm up, the choke throttle (44) should be opened gradually and the main throttle (21) closed through the rod (49); as soon as the rated temperature of the engine has been reached, the easy starting device must be cut off. The choke throttle (44) is held in the wide open position by the lug (46) of lever (48), while the main throttle (21) shifts to the idling position.

## Instructions for Using the Easy Starting Device.

The following instructions should be observed in order to obtain maximum benefit from the device:

### STARTING COLD ENGINE

Pull the easy starting knob on floor tunnel all the way out to throw in the choke device.

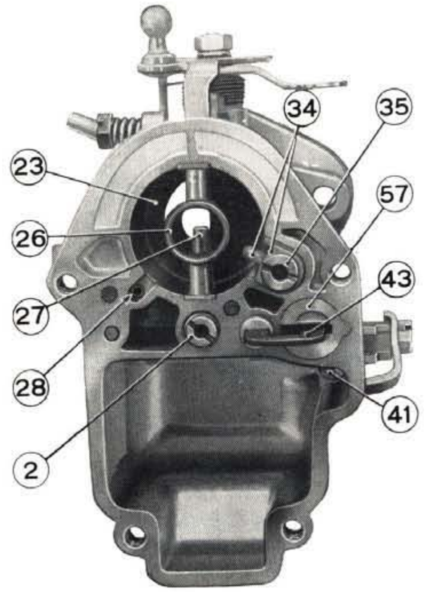
### WARMING UP ENGINE

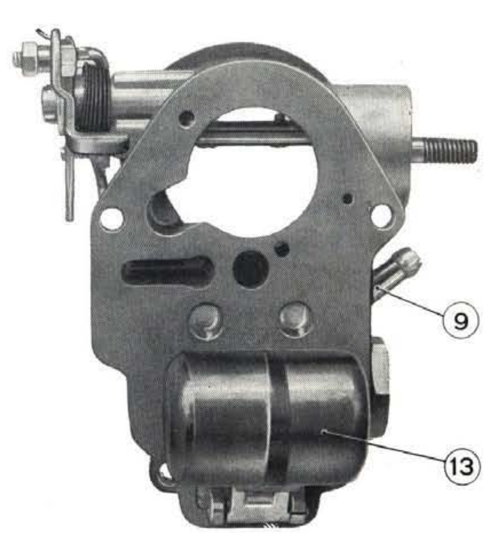
During this period, whether the vehicle is stationary or moving, the knob should be returned gradually and with short pauses to the off position,

**Fig. 145.**

**Interior view of Weber carburetor body and cover.**

2. Air bleed jet. - 9. Fuel inlet connector. - 13. Float. - 23. Primary Venturi. - 26. Auxiliary Venturi. - 27. Discharge tube. - 28. Idle air bushing. - 34. Accelerator pump jet. - 35. Pump delivery valve. - 41. Pump suction valve. - 43. Pump control rod. - 57. Pump spring retaining plate.



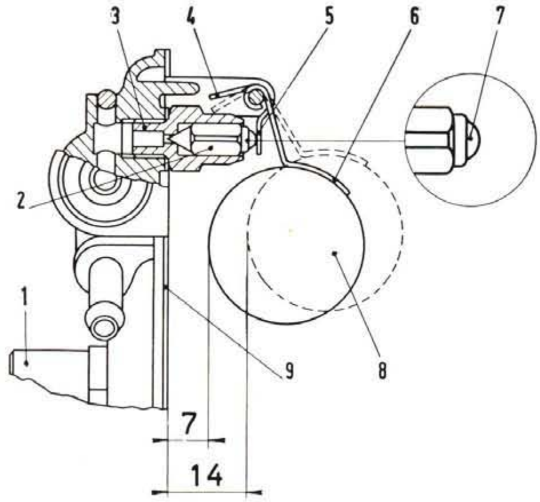



**Fig. 146 - Float level adjustment diagram. Weber carburetors « 30 ICF » and « 30 ICF 7 ».**

1. Body cover. - 2. Valve needle. - 3. Needle valve. - 4. Lug. - 5-6. Float arms. - 7. Needle valve ball. - 8. Float. - 9. Body cover gasket. 7 = .276'' - 14 = .551''

thus ensuring that the starting mixture supplied to the cylinders is never in excess of the engine's actual requirements.

### ENGINE RUNNING NORMALLY

As soon as the normal engine temperature is reached the control knob should be fully returned to the closed position, thus cutting off the choke device.

## Float Level Adjustment.

The following instructions should be observed when adjusting the level of the float:

– Ensure that the needle valve (3, fig. 146) is firmly screwed into its housing.

– Hold the body cover (1) in vertical position lest the weight of the float (8) may lower the ball (7) in valve needle (2).

– With the body cover (1) vertical and the float arm (5) just touching the ball (7), the float (8) should be **.276'' (7 mm)** from the mating face of the cover with gasket (9) properly seated thereon.

– When the level is correct check that the float (8) travel is **.276'' (7 mm)** and if necessary adjust the position of the lug (4).

– If the float (8) is not in the correct position, adjust the position of the float arms (6) to obtain the prescribed measurement. Check that the arm (5) is at right angle to the needle and free of such blemishes at the contact surface as the even movement of the valve needle might be affected.

– Make sure that the float (8) can move freely around its pivot.

**WARNING** - In case the needle valve (3) must be replaced, ensure that the new valve is screwed firmly into its housing, setting a new sealing gasket. Next repeat the float level adjustment.

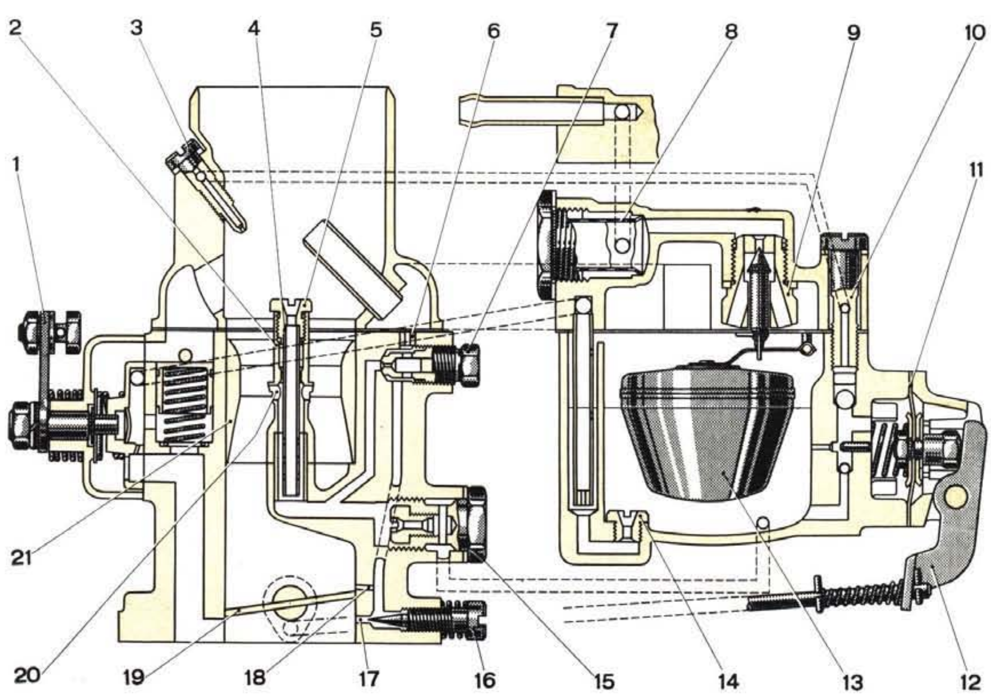



**Fig. 147 - Diagrammatic section view of Solex « 30 PIB 4 » carburetor.**

1. Choke control lever. - 2. Air correction jet seat. - 3. Nozzle. - 4. Emulsion tube. - 5. Air correction jet. - 6. Calibrated orifice. - 7. Idle jet. - 8. Filter gauze. - 9. Needle valve. - 10. Power pump delivery valve. - 11. Power pump diaphragm. - 12. Power pump lever. - 13. Float. - 14. Choke jet. - 15. Main jet. - 16. Idle adjusting screw. - 17. Idle mixture orifice. - 18. Transfer port. - 19. Throttle valve. - 20. Mixture outlet ports. - 21. Venturi.

# SOLEX CARBURETOR TYPE « 30 PIB 4 »

SOLEX 30 PIB 4 carburetor is of the single throat, downdraft type.

## Operation.

During **normal running** of engine mixture feed is obtained through the main jet (15, fig. 147) and Venturi (21).

The correct blend of mixture is automatically assured, by an air supply through a calibrated orifice (5).

During engine operation **at idle** the idle jet (7) and a calibrated orifice situated at rear of Venturi (21) provide for fuel feed.

The idle mixture setting screw (16) allows of definitely rating the grade of mixture being supplied.

## Easy Starting Device.

This device assures easy starting from cold, idle operation of a cold engine and car setout.

Use of choke is extended until engine reaches its normal running temperature.

The mixture rate (rich or weak) changes after the position of the choke control on dashboard.

With the choke control knob all the way out the fuel mixture is very rich ensuring easy starting even of a coldest engine.

The middle position of choke control is used when the engine has already warmed up somewhat after starting or it has not yet cooled off after a halt.

The choke is also equipped with a plunger valve (59, fig. 149) system. When the engine is cranked by the motor into operation, the plunger stands up clearing an additional mixture passage; as soon as the engine has been started, the speed rate increases and so does vacuum, causing the plunger to drop to the down position; as a result the additional passage is blanked off.

## Power Pump.

The power pump is of the diaphragm type and operates as follows.

At idle, with a closed throttle, the diaphragm (11, fig. 147) is caused to pulsate under spring action, filling up the pump cavity.

The diaphragm (11) is tied to the accelerator through a link fastened to the throttle shaft.

When the throttle opens, movement of shaft instantly reflects into diaphragm pulsation which forces fuel through the pump jet to the nozzle (3) discharging into the Venturi (21).

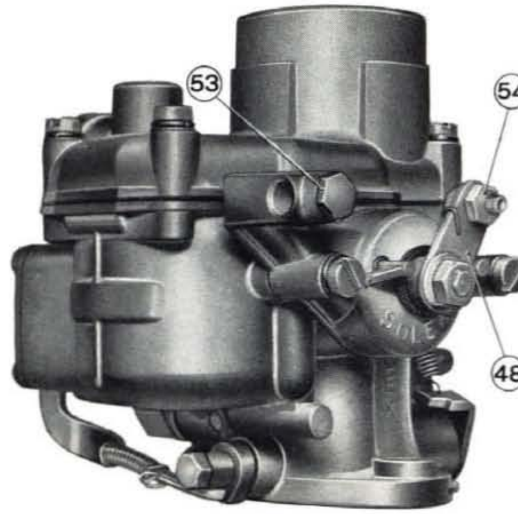



**Fig. 148 - Solex carburetor viewed from choke end.**

48. Choke control lever. - 53. Cable housing lock screw. - 54. Choke cable end clamp.

## Float Level Adjustment.

Check float level as follows:

– take down the float from carburetor and place it on gauge **A. 95126**, as shown in fig. 150;

– set the float arm (2, fig. 150) into touch with both gauge dowels; correct adjustment of float level is indicated by the absence of arm clearance at dowels.

Otherwise, bend the float arm to obtain contact conditions as above specified;

– fit gauge **A. 95126** on needle seat with dowel **A** as shown in fig. 151; in this position needle should allow the gauge to slide freely;

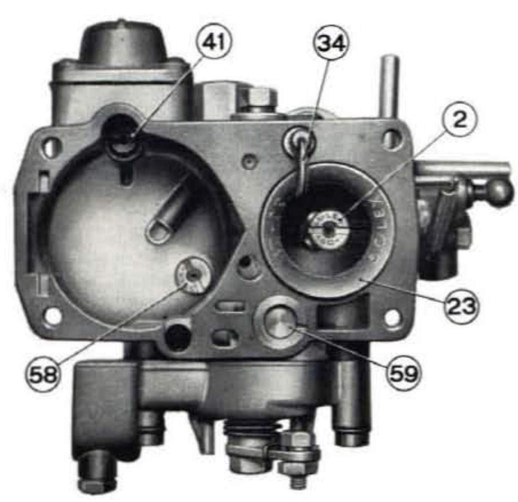



**Fig. 149 - Interior view of Solex carburetor body.**

2. Air correction jet. - 23. Venturi. - 34. Power pump nozzle. - 41. Power pump inlet valve. - 58. Choke jet. - 59. Choke plunger.

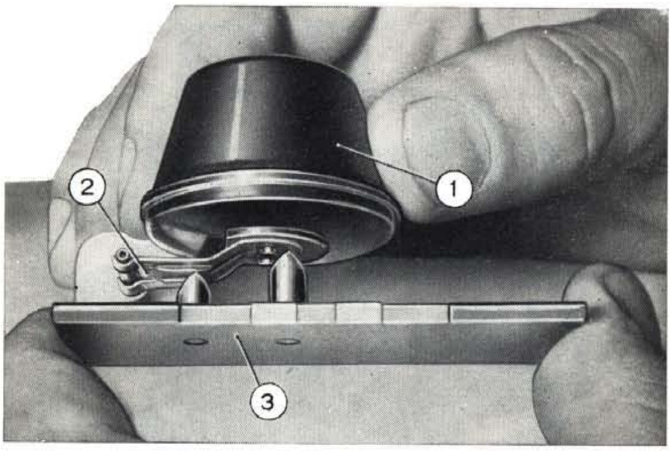



**Fig. 150 - Solex carburetor: checking float arm.**
1. Float. - 2. Float arm. - 3. Gauge A. 95126.

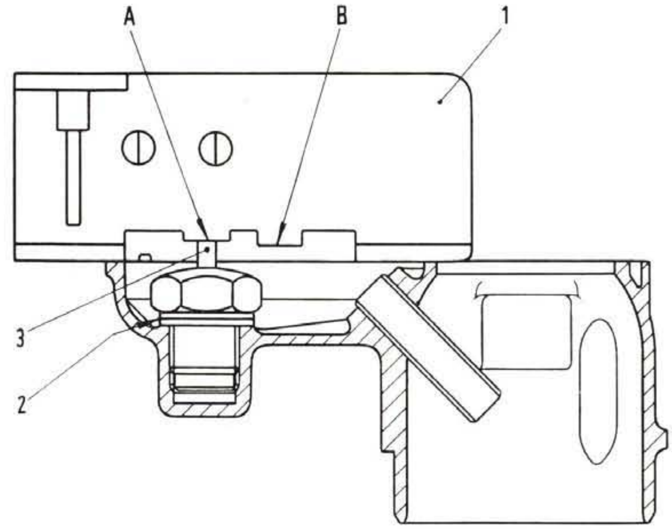



**Fig. 151 - Solex carburetor: checking float level.**
1. Gauge A. 95126. - 2. Needle valve. - 3. Valve needle. - A-B. Gauge dowels.

– set dowel **B** (fig. 151) at needle: the latter should prevent the gauge from sliding (dowel striking against needle).

In case the needle must be repositioned do so by fitting thicker or thinner shims (2, fig. 151).

## SETTING DATA OF CARBURETORS

| | Engine 100G.000 | | Engine 100G.002 | |
|---|---|---|---|---|
| | WEBER or HOLLEY 30 ICF | SOLEX 30 PIB 4 | WEBER or HOLLEY 30 ICF 7 | SOLEX 30 PIB 4 |
| Throat bore . . . . . . . | 1.181″ (30 mm) | 1.181″ (30 mm) | 1.181″ (30 mm) | 1.181″ (30 mm) |
| Primary Venturi . . . . . | .827″ (21 mm) | .827″ (21 mm) | .866″ (22 mm) | .866″ (22 mm) |
| Main jet . . . . . . . . . | .045″ (1.15 mm) | .042″ (1.07 mm) | .046″ (1.17 mm) | .043″ (1.10 mm) |
| Idling jet . . . . . . . . . | .016″ (0.40 mm) | .016″ (0.40 mm) | .016″ (0.40 mm) | .016″ (0.40 mm) |
| Easy starting device . . . | choke throttle valve | .039″ (1.00 mm) | choke throttle valve | .039″ (1.00 mm) |
| Accelerator pump jet . . . | .018″ (0.45) mm | .018″ (0.45 mm) | .020″ (0.50 mm) | .020″ (0.50 mm) |
| Air bleed jet . . . . . . . | .057″ (1.45 mm) | .065″ (1.65 mm) | .055″ (1.40 mm) | .063″ (1.60 mm) |
| Needle valve . . . . . . . | .059″ (1.50 mm) | .059″ (1.50 mm) | .059″ (1.50 mm) | .059″ (1.50 mm) |
| Float level: distance from cover, with gasket, in vertical position . . . . . . | .275″ (7.00 mm) | * | .275″ (7.00 mm) | * |

(*) See instructions page 89.

# TROUBLE DIAGNOSIS GUIDE

When the incorrect operation of engine has been definitely traced to a defective carburetion, any other possible condition having been checked and discarded, look for the origin of the trouble among the following:

— **Flooded carburetor:** valve needle seated improperly.

— **Engine will not start when cold:** clogged starting jet or shortened starting device control travel.

— **Engine will not start when warm:** clogged jets or passages, misadjusted idle speed circuit.

— **Engine will not idle:** clogged jets or passages, misadjusted idle speed circuit.

— **Engine pick up is poor:** clogged main jet or emulsion orifices.

— **Increased fuel consumption:** foreign matter in emulsion well orifices.

# IDLING ADJUSTMENT

On this carburetor the adjustment is by means of the throttle stop screw (56, figs. 152 and 153) and the volume control screw (30). Screw (56) controls the degree of opening of the throttle valve, while the tapered screw (30) regulates the volume of mixture delivered by the idling mixture passage and further mixed with the air drawn in by engine suction through the reduced gaps between the main barrel wall and the throttle valve when the latter is in the idling position, thus enabling the appropriate degree of idling richness to be obtained.

Idling adjustment should be carried out with the engine warm and running by first of all adjusting the throttle stop screw (56) to a point where the engine does not falter and then adjusting the volume control screw (30) to obtain the mixture which gives the highest regular engine speed at the selected degree of throttle restriction. Finally, further narrow the throttle opening to the best idle speed and control the rate of the mixture with the screw (30).

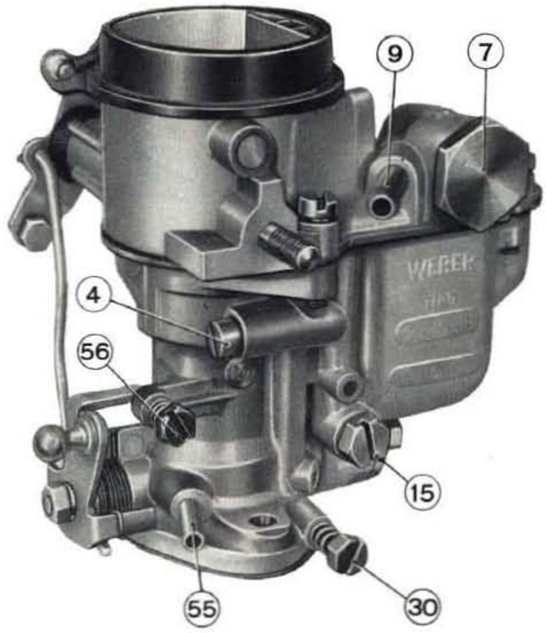



**Fig. 152 - View of Weber carburetor from idle setscrews end.**
4. Idle jet holder. - 7. Strainer inspection plug. - 9. Fuel inlet connector. - 15. Main jet holder. - 30. Volume control screw. - 55. Vacuum advance connector. - 56. Throttle stop screw.

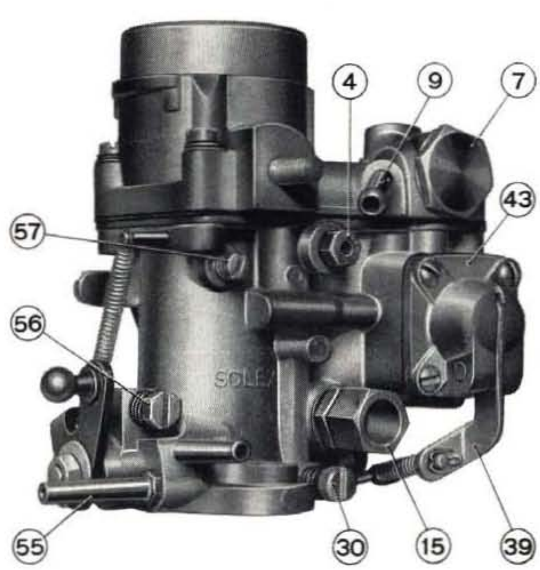



**Fig. 153 - View of Solex carburetor from idle setscrews end.**
4. Idle jet holder. - 7. Strainer inspection plug. - 9. Fuel inlet connector. - 15. Main jet holder. - 30. Volume control screw. - 39. Power pump control lever. - 43. Power pump. - 55. Vacuum advance connector. - 56. Throttle stop screw. - 57. Venturi mounting screw.

# RECIRCULATION DEVICE OF BLOW-BY GASES AND OIL VAPOURS

Thanks to this device all blow-by gases and oil vapours are conveyed into the intake manifold to be burned in cylinders.

The breather valve of device is actuated directly by throttle control lever.

When the engine is running at idle (fig. 155) all blow-by gases and oil vapours are sucked back through the line (1) which connects the engine to air cleaner and carburetor. In these conditions the breather valve (3) and the throttle valve (2) of carburetor are closed off.

When the engine is running at top speed (fig. 155) a portion of blow-by gases and oil vapours are sucked back through line (1).

As the throttle valve (4) opens, also the breather valve (6) does and most blow-by gases and oil vapours are flown directly into the intake manifold via the line (5).

During engine overhaul, check gas lines and breather valve for top efficiency. Renew damaged parts.

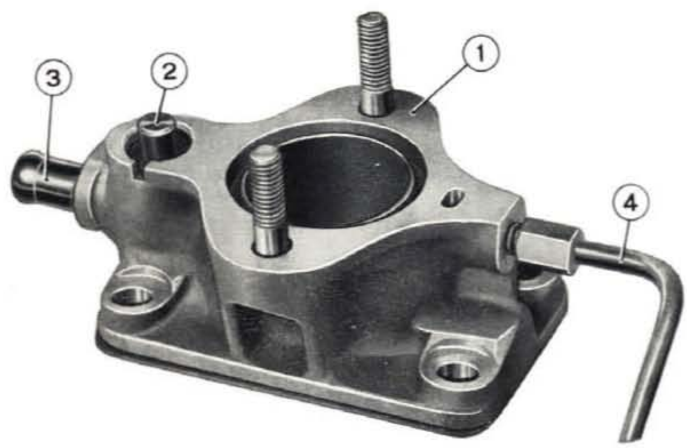
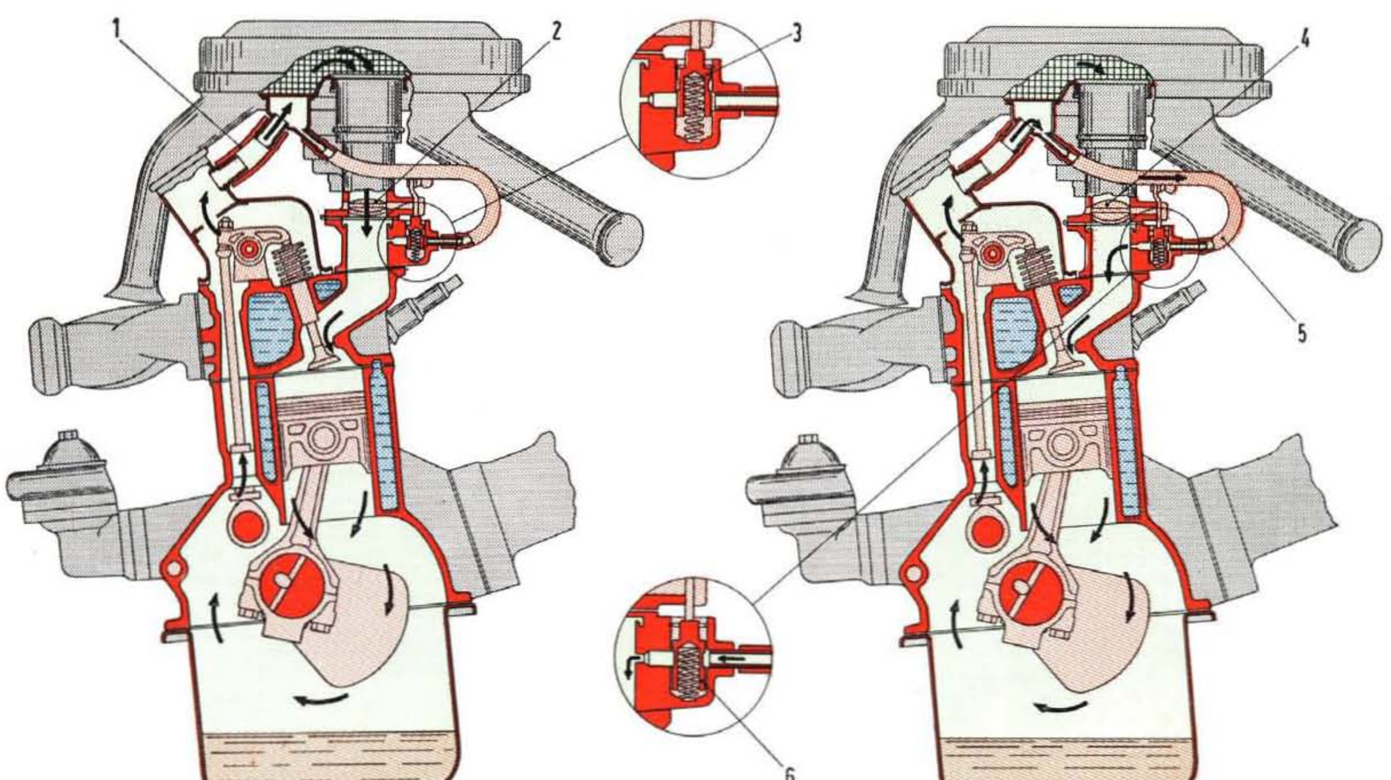



**Fig. 154 - Carburetor spacer and recirculation device of blow-by gases and oil vapours.**
1. Spacer. - 2. Breather valve. - 3. Recirculation pipe connector. - 4. Fuel overflow drain pipe.




ENGINE AT IDLE

ENGINE AT TOP SPEED

**Fig. 155 - Recirculation diagram of blow-by gases and oil vapours in engine interior.**

1. Engine-to-air cleaner pipe. - 2. Carburetor throttle valve closed. - 3. Breather valve in closed position. - 4. Carburetor throttle valve open. - 5. Engine-to-breather valve pipe. - 6. Breather valve in open position.

# Section 4

## CLUTCH
## TRANSMISSION
## DIFFERENTIAL

Fig. 156 - Running gear units.

# CLUTCH



## SPECIFICATIONS AND DATA

| | |
|---|---|
| Type | single plate, dry |
| Throwout mechanism | diaphragm spring |
| Driven plate | with friction linings |
| Lining O.D. | 6.299″ (160 mm) |
| Lining I.D. | 4.331″ (110 mm) |
| Runout of driven plate linings | .010″ to .016″ (0.25 to 0.40 mm) |
| Clutch pedal free travel, corresponding to a clearance of .079″ (2 mm) between friction ring and throwout sleeve | 29/32″ to 1″ (23 to 25 mm) |
| Clutch release flange travel, corresponding to a pressure plate distance of .071″ to .075″ (1.8 to 1.9 mm) (.055″ - 1.4 mm min.) | .315″ (8 mm) |

## Description.

Single plate, dry, with diaphragm pressure spring.

This type of clutch differs from the conventional clutch design because the pressure coil springs and all throwout mechanism components (release levers, eyebolts, struts, etc.) have been replaced by a single diaphragm spring.

The new system entails the following advantages:

– the clutch is not apt to slip, even though driven plate linings are worn extensively, thanks to the special shape and placement of the diaphragm spring, which keeps the force on pressure plate unaltered;

– the load on clutch pedal will be practically the same, whereas in the conventional coil spring clutch the load increases in proportion with the pedal travel.

Fig. 157 - Pressure plate assembly and driven plate.

# TROUBLE DIAGNOSIS AND CORRECTIONS

## Noises Audible on Pedal Depression.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Throwout bearing excessively worn, damaged or poorly lubricated. | 1) Replace the throwout sleeve assembly. |
| 2) Insufficient free travel of clutch pedal. | 2) Adjust clutch pedal travel. |
| 3) Throwout yoke lever return spring weak, snapped or unhooked. | 3) Replace the spring or hook it up correctly. |
| 4) Throwout sleeve return spring snapped or weak. | 4) Replace the spring. |
| 5) Excessive play between driven plate hub and clutch shaft, causing rattles. | 5) Replace the driven plate and the clutch shaft, if necessary. |

## The Clutch Slips.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Insufficient return travel of clutch pedal due to a bound control cable or sagged return spring. | 1) Locate the cause of failure, replace the spring or eliminate binding of control cable. |
| 2) Damaged throwout mechanism. | 2) Overhaul the mechanism. |
| 3) Oil or grease on driven plate linings. | 3) Remove cause of oil leakage and replace linings, if they cannot be reconditioned by rubbing with turpentine and metal brush. |
| 4) Driven plate linings worn or burned. | 4) Replace linings. |

## The Clutch Grabs.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Oil or grease on flywheel, pressure plate and driven plate linings. | 1) Remove cause of leakage, clean flywheel and pressure plate thoroughly, replace driven plate linings. |
| 2) Loose driven plate linings due to poor rivet tightness. | 2) If linings are not worn, replace defective rivets. Otherwise, replace linings and peen rivets securely. |
| 3) Driven plate hub does not slide freely on clutch shaft. | 3) Remove any foreign matter or dirt deposits from shaft splines. Should trouble still be present, replace damaged part. |

*(continued)*

The Clutch Grabs *(continued)*.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 4) Pressure plate deeply cracked or broken. | 4) Replace the clutch cover assembly. |
| 5) Misalignment. | 5) Locate defective point and, if possible, reset alignment or replace distorted parts. |
| 6) Stiffened throwout control mechanism. | 6) Locate cause of stiffness and lubricate or replace parts as required. |
| 7) Driven plate linings worn out. | 7) Install new linings and make sure that the driven plate, pressure plate and flywheel are not damaged. |
| 8) Cable and tube passage grommet warped. | 8) Replace grommet. |

## Abnormal Lining Wear.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Insufficient pedal free travel. | 1) Adjust clutch pedal free travel. |
| 2) Driver steps unnecessarily on pedal; this causes lining wear and damage to throwout bearing. | 2) Advise driver to discontinue wrong practice and step on clutch pedal only when necessary. |
| 3) Driven plate linings installed incorrectly. | 3) Replace linings by new ones and install them correctly. Check driven plate for misalignment. |

## Noises Audible on Pedal Release.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Misalignment of driven plate to flywheel causes slight movement of driven plate hub in respect of linings. This noise is especially audible with engine idling or at low speed. | 1) Set level of driven plate. With driven plate in place on clutch shaft, set it under slight rotation and check for no runout in excess of .016" (0.40 mm), using a dial indicator. |
| 2) Driven plate springs snapped or weak. | 2) Replace the driven plate. |
| 3) Insufficient pedal free travel. | 3) Set pedal free travel as directed on page 98. |
| 4) Throwout yoke lever return spring weak, snapped or unhooked. | 4) Replace the spring or hook it up correctly. |
| 5) Throwout sleeve return spring snapped or weak. | 5) Replace the spring. |
| 6) Clutch or direct drive shaft distorted or worn. | 6) Replace the clutch shaft and, if necessary, the driven plate. |
| 7) Excessive play between throwout sleeve and flange. | 7) Replace the worn parts and take up clearance to .079" (2 mm) as specified. |

## The Clutch Drags.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Excessive pedal free travel. | 1) Adjust. |
| 2) Driven plate warped. | 2) Set level of driven plate, if possible. Maximum plate runout: .016'' (0.40 mm). |
| 3) Roughness on driven plate linings. | 3) Rub linings with a metal brush or replace them, if necessary. |
| 4) Driven plate linings improperly fitted, loose or broken. | 4) Replace linings. Lining rivets should be peened with no protrusion, to avoid damage to pressure plate and flywheel. |
| 5) Driven plate hub dragging on clutch shaft. | 5) Locate cause of trouble and remove it, if possible. Otherwise replace the driven plate. |
| 6) Damaged clutch shaft splines prevent the driven plate from sliding. | 6) Replace the clutch shaft; also the driven plate, if required. |
| 7) Oil or grease on driven plate linings. | 7) Replace linings. |
| 8) Pressure plate warped or otherwise damaged. | 8) Replace clutch cover assembly. |
| 9) Clutch cover lamina incorrectly riveted. | 9) Replace clutch cover assembly. |
| 10) Clutch throwout control cable bound in housing or cable housing reaction points fluctuating in operation. | 10) Check and locate fluctuating points and replace defective parts. |

## Pedal Travel Adjustment.

The free travel ofclutch pedal is 29/32" to 1'' (23 to 25 mm), corresponding to a clearance of .079'' (2 mm) (fig. 160) between the throwout sleeve and ring.

Should pedal free travel be less than specified as a result of the wear of the driven plate, restore the original operating conditions (.079'' - 2 mm clearance) by working on the adjustable rod (fig. 160) of throwout yoke.

Prior to adjusting pedal travel check passage grommet of cables and tubes on dash wall for warpage.

A warped grommet prevents the clutch throwout control cable housing from reacting regularly, thus resulting in a faulty engagement of clutch.

To correct this condition renew the grommet.

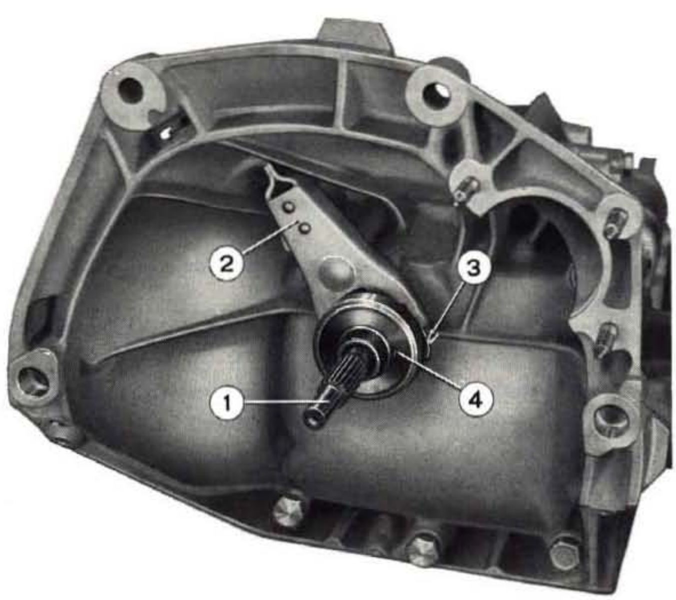



**Fig. 158 - Detail of clutch throwout control mechanism.**
1. Clutch shaft. - 2. Clutch throwout yoke. - 3. Throwout yoke-to-sleeve spring. - 4. Clutch throwout sleeve.

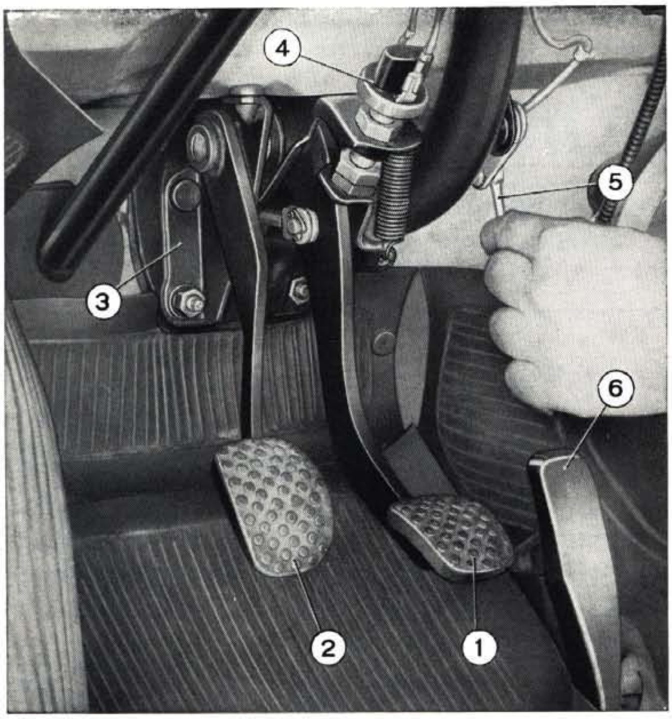



**Fig. 159 - Removing clutch throwout yoke rod.**

1. Brake pedal. - 2. Clutch pedal. - 3. Brake and clutch pedal mounting board. - 4. Stop light jam switch. - 5. Clutch throwout yoke rod. - 6. Accelerator pedal.

## Removal and Installation.

To remove the clutch proceed as follows:

– jack up the car at rear and set it on stands;

– remove the transmission as outlined under « Transmission »;

– mark the clutch position relative to the flywheel to assure correct reinstallation;

---

**WARNING**

**When removing the transmission, avoid resting the clutch shaft against the clutch release flange, lest the flange supporting plates may be cocked.**

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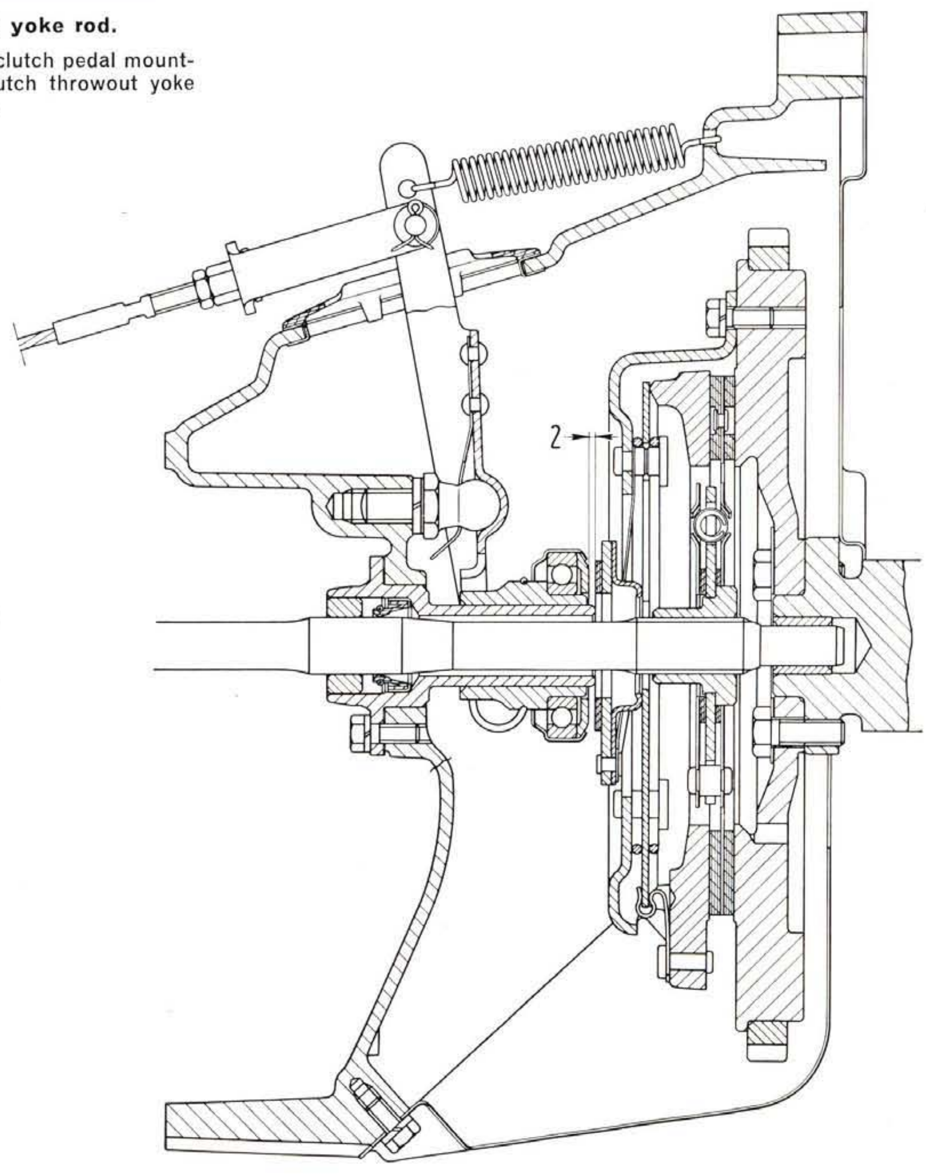


**Fig. 160.**
**Side sectional view of clutch and throwout mechanism.**

Figure .079'' (2 mm) refers to the clearance to be obtained through the adjustment of clutch throwout yoke rod.

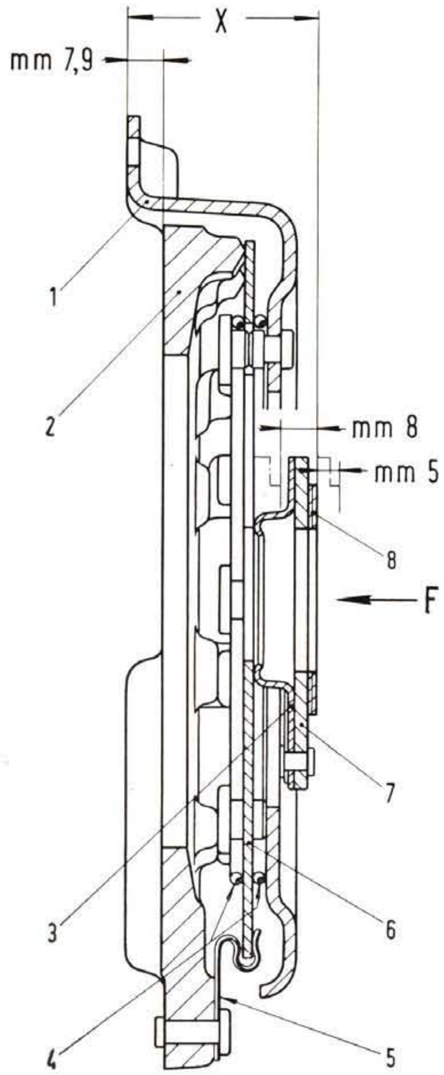


**Fig. 161 - Clutch cover assembly inspecting diagram.**

1. Clutch cover. - 2. Pressure plate. - 3. Clutch release flange plate. - 4. Diaphragm spring rings. - 5. Diaphragm spring retainer plate. - 6. Diaphragm spring. - 7. Clutch release flange. - 8. Friction ring.

X = $1.653'' {}^{+.051''}_{-.039''}$ ($42 {}^{+1.3}_{-1}$ mm).
F = direction of clutch release flange movement.
mm 8 = .315″ = release travel.
mm 5 = .197″ = maximum allowance for driven plate lining wear.
mm 7.9 = .311″

– back out clutch cover-to-flywheel mounting screws and remove the clutch cover assembly.

Install the clutch proceeding in reverse order to removal and recall the following:

– check the condition of pilot bushing; replace the bushing, if necessary, as directed on page 51;

– lubricate the pilot bushing with KG 15 grease;

– position the driven plate with the raised path of hub toward the transmission.

Prior to tightening clutch mounting screws on flywheel, center the driven plate by means of tool **A. 70085** (2, fig. 162). Clutch mounting screw torque: 5.8 to 7.2 ft.lbs (0.8 to 1 kgm).

**NOTE - While handling the clutch for service or carriage, avoid grasping at the release flange, which might be damaged.**

## Inspection.

Position the clutch cover assembly on a base plate in the place of the flywheel, with a lining .311″ (7.9 mm) thick between cover and plate. Work the clutch mechanism through four full throwout strokes by applying a load on release flange, as shown by arrow **F** (fig. 161).

In this condition, check that:

– with a withdrawal travel of .315″ (8 mm) (fig. 161), the pressure plate is .071″ to .075″ (1.8 to 1.9 mm) out (min permissible .055″ - 1.4 mm);

– the distance **X** (fig. 161) is $1.653'' {}^{+.051}_{-.039}$ ($42 {}^{+1.3}_{-1}$ mm) (for this step, allow for any wear of the friction ring [8, fig. 161], the thickness of which is, in a new condition, .075″ to .079″ - 1.9 to 2 mm).

**If distance is not within above values, replace the clutch cover assembly by a new one.**

The face of the release flange ring should be free of dents or bumps.

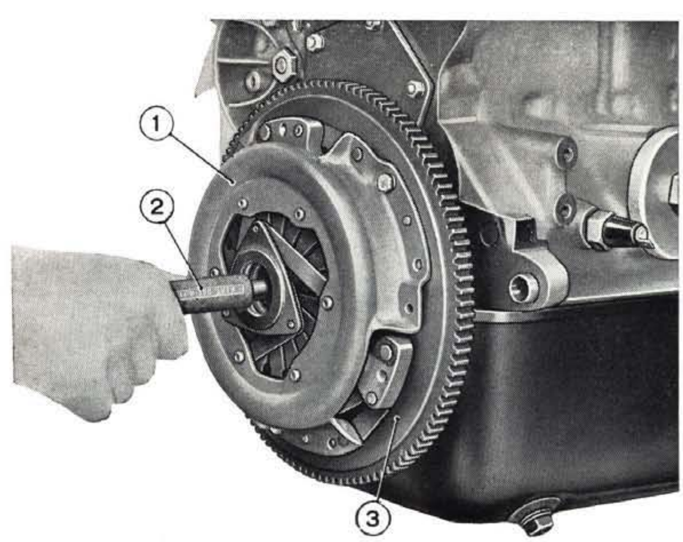


**Fig. 162 - Using tool A. 70085 to align the driven plate.**

1. Clutch assembly. - 2. Tool A. 70085. - 3. Flywheel.

# TRANSMISSION - DIFFERENTIAL



## SPECIFICATIONS AND DATA

| | |
|---|---|
| Speeds | four forward - one reverse |
| Synchromesh rings | first, second, third, fourth |
| Type of gears: | |
| first, second, third, fourth | helical, constant meshed |
| reverse | spur, sliding |
| Gear ratios: | |
| – first | 3.636 to 1 (40/11) |
| – second | 2.055 to 1 (37/18) |
| – third | 1.409 to 1 (31/22) |
| – fourth | 0.963 to 1 (26/27) |
| – reverse | 3.615 to 1 (47/13) |
| Gear backlash | .004″ (0.10 mm) |
| wear limit | .008″ (0.20 mm) |

*(continued)*

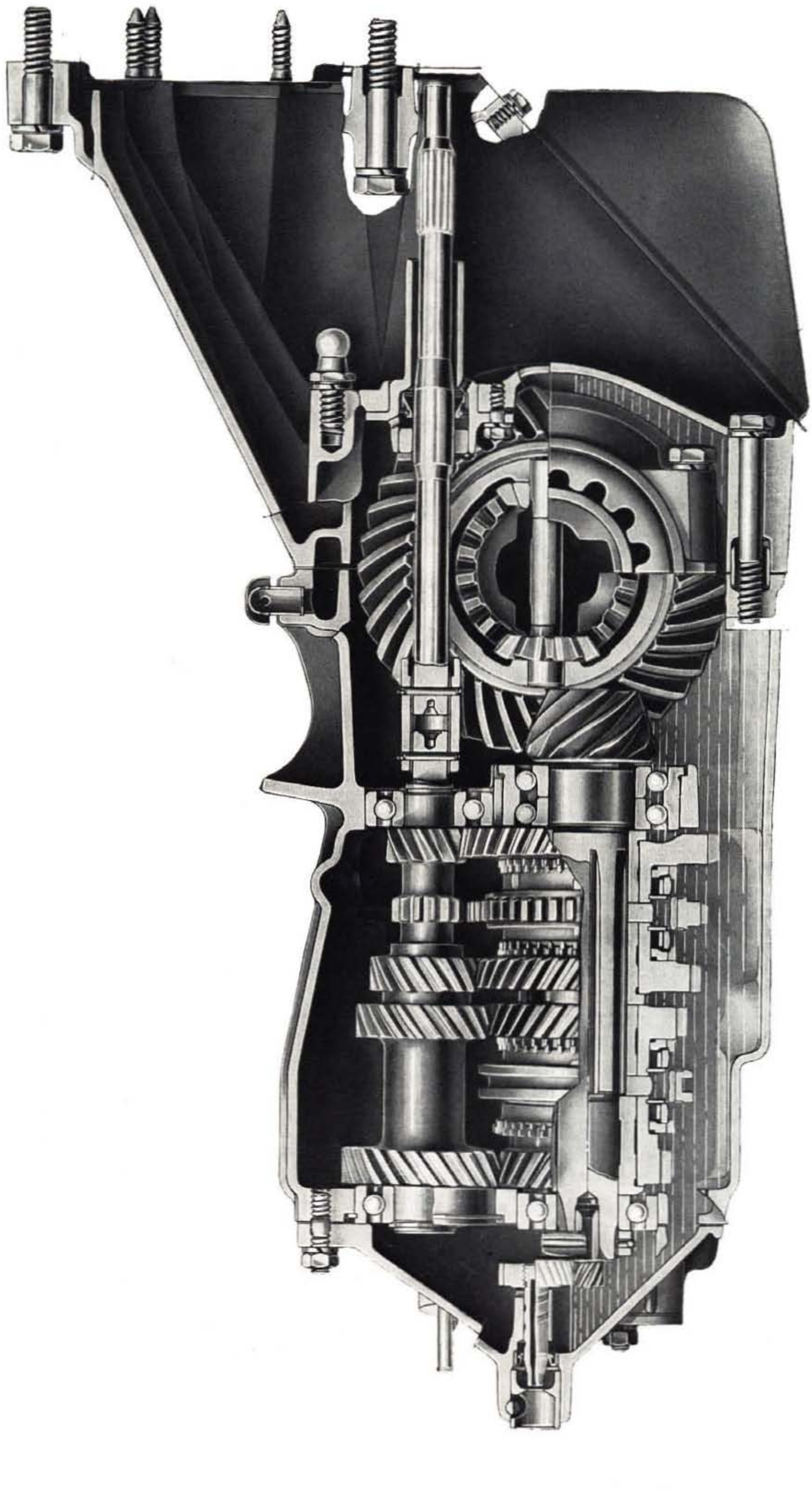

Fig. 163 - Side sectional view of transmission-differential assembly.

**Specifications and Data - Transmission - Differential** *(continued)*.

<table>
<tr><td>Radial play of ball bearings</td><td colspan="5">.002″ (0.05 mm) max.</td></tr>
<tr><td>Axial play of ball bearings</td><td colspan="5">.020″ (0.5 mm) max.</td></tr>
<tr><td>Maximum misalignment of shafts</td><td colspan="5">.0008″ (0.02 mm)<br>(at bearing seats)</td></tr>
<tr><td>Final drive gear</td><td colspan="5">hypoid</td></tr>
<tr><td>Final drive gear ratio</td><td colspan="5">4.625 to 1 (8/37)</td></tr>
<tr><td>Final ratios at wheels:<br>– Gears<br>– Reduction ratio</td><td>first<br>16.816<br>to 1</td><td>second<br>9.504<br>to 1</td><td>third<br>6.516<br>to 1</td><td>fourth<br>4.453<br>to 1</td><td>reverse<br>16.719<br>to 1</td></tr>
<tr><td>Differential cage bearings<br>– Type<br>– Setting<br>– Preload:<br>divergence { reading of dial indicators at carrier caps (fig. 198)<br>divergence { indicator reading of fixture A. 95688 (fig. 197)</td><td colspan="5">2<br>taper roller<br>adjusters<br><br>.008″ to .010″ (0.20 to 0.25 mm)<br>.006″ to .008″ (0.15 to 0.20 mm)</td></tr>
<tr><td>Final drive gear backlash</td><td colspan="5">.004″ to .006″ (0.10 to 0.15 mm)</td></tr>
<tr><td>Power drive to rear wheels</td><td colspan="5">by two axle shafts coupled with differential through slip joints</td></tr>
<tr><td>Lube oil:<br>– grade<br>– capacity</td><td colspan="5">FIAT W 90/M (SAE 90 EP)<br>3.70 G.B. pts - 4.44 U.S. pts<br>(2.10 lts - 1.90 kg)</td></tr>
</table>

# TRANSMISSION

## Description.

The transmission and differential, with final drive gears, are incorporated in a single case.

Transmission provides four forward gears (all synchromeshed) and reverse. The fourth gear is an overdrive.

Helical gears of all forward speeds are synchromeshed.

**Synchromesh rings are of the sliding type.**

Transmission is controlled manually through a gearshift lever on floor tunnel, between front seats.

The hypoid final drive set has a gear ratio of 4.625 to 1 (8/37).

Power drive to rear wheels is transmitted by means of two axle shafts, which are connected to the differential unit through slip joints and to axle shafts through flexible joints.

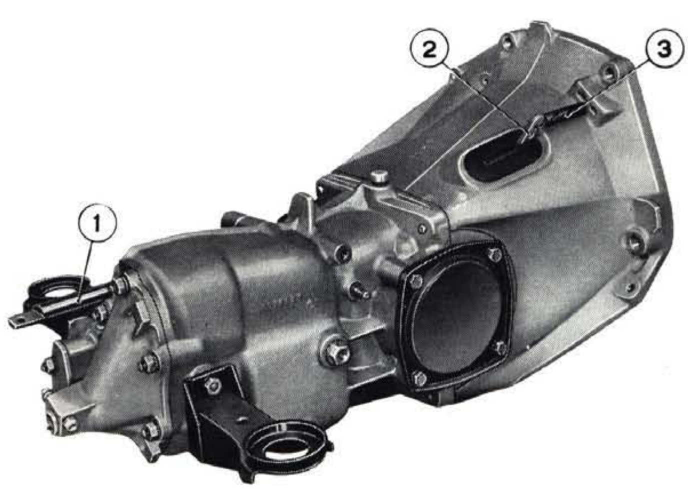


**Fig. 164 - Transmission assembly.**

1. Gear selector rod. - 2. Clutch throwout yoke. - 3. Yoke return spring.

The transmission case is fitted with rubber boots A. 70104.


**Fig. 165 - Transmission synchromesh gears.**
1. Slip sleeve hub. - 2. Third and fourth slip sleeve. - 3. Third speed gear with synchronizer.

## Engagement of 2nd, 3rd and 4th Gears.

Synchromesh of 2nd, 3rd and 4th gears is obtained thanks to the use of the items shown in figures 165, 166 and 167.

The slip sleeve (2, fig. 165) is serrated internally for proper mesh with the toothed crown of the gear (3), turning idle on the output shaft. In this way the gear will be rigidly locked with the driving hub.

As the slip sleeve is moving on, the synchromesh ring (1, fig. 167) gradually equalizes rotation speeds.

Under the action of the slip sleeve, the synchromesh ring (1, fig. 167) is dragged to abut with one end, both on acceleration and deceleration, against the thrust plate (5, fig. 166), which causes such a wrapping effect as a quick mesh is obtained.

For a better adherence of the synchromesh ring against the slip sleeve, two spreader springs (2, fig. 166) have been designed to work one on override and the other on underride.

As a matter of fact the speader spring is compressed between the thrust plate (5, fig. 166) and the stop plate (3), so that it spreads out against the synchromesh ring.

Thus the synchronizing action resulting of the tension of the ring itself is boosted gradually from the end pressure exercised by the spreader spring.

The task of the synchronizer will stop as soon as the slip sleeve and the gear affected are brought to spin at the same speed; the spreader spring relaxes and the synchromesh ring retracts itself.

This condition corresponds to the final step of the tripping movement of the slip sleeve, so that it comes into mesh with the mating teeth of the gear with minimum strain.


**Fig. 166 - Third speed gear synchronizer in place in gear.**
1. Synchromesh ring. - 2. Ring spreader springs. - 3. Stop plate. - 4. Third speed gear. - 5. Thrust plate.


**Fig. 167 - Third speed gear and synchronizer components.**
1. Synchromesh ring. - 2. Synchronizer spreader springs. - 3. Stop plate. - 4. Third speed gear with toothed crown for synchromesh. - 5. Thrust plate. - 6. Snap ring.

**NOTE - The synchromesh device shown in figs. 166 and 167 applies to the 2nd, 3rd and 4th gear, being just identical, whereas the device for the 1st gear differs in design (fig. 168).**

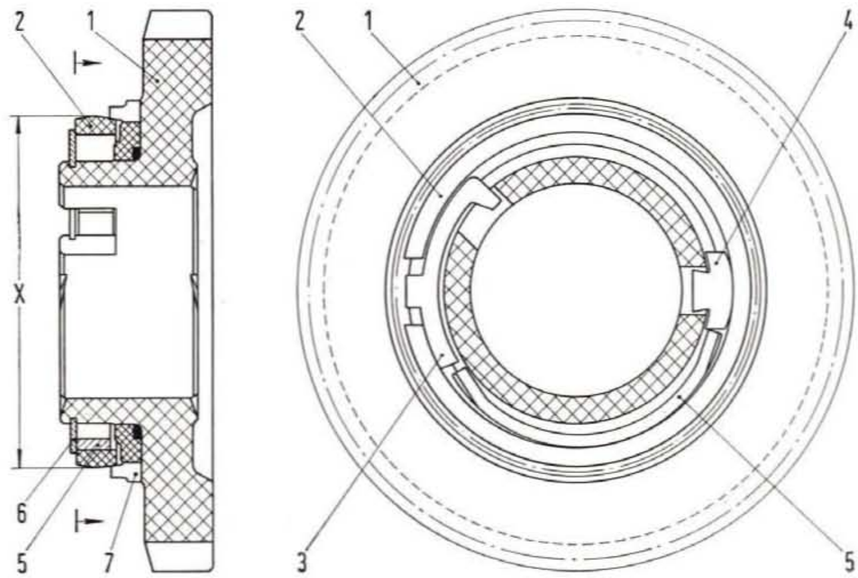


**Fig. 168.**
**First speed gear and synchronizer assembly.**

1. Gear. - 2. Synchromesh ring. - 3. Thrust plate. - 4. Stop plate. - 5. Synchronizer spreader spring. - 6. Snap ring. - 7. Gear toothed crown.

X = 2.6071″ ± .0079″ (66.22 ± 0.2 mm): overall diameter of new synchromesh ring.

When sleeve and gear teeth are in full mesh, the synchro ring settles down inside the slip sleeve, which makes for the solid engagement of the gear attached.

## Engagement of 1st Gear.

With a view to relieving to a great extent the driver of the effort involved with the engagement of the 1st gear, on starting a car at standstill, a synchromesh device has been provided which has one spreader spring (5, fig. 168) operating solely in the downshift from second to first gear.

Moreover, the thrust plate (3, fig. 168) of the 1st gear synchronizer has an end lug jutting in into a slit in the gear.

An end of the synchromesh ring (2) abuts against the thrust plate, while the plate lug sets in touch with the gear hub in the slit; thus the thrust plate is raised to increase the end thrust applied by the synchromesh ring.

When the car is started, the engine turns at low speed and therefore it will be just sufficient to control inertia of the driven plate.

For the downshift from second to first, the synchromesh of gears is made the same way as for the downshift from fourth to third.

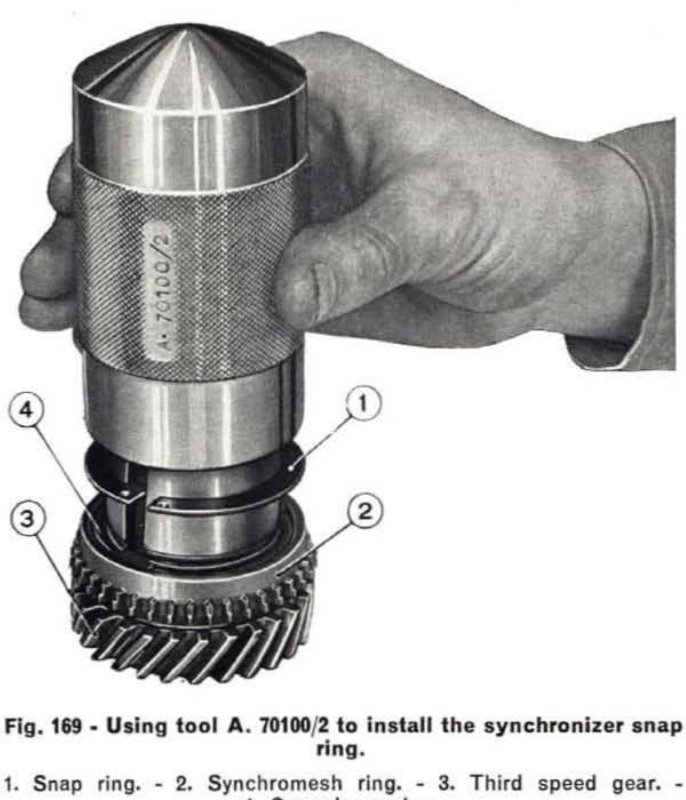


**Fig. 169 - Using tool A. 70100/2 to install the synchronizer snap ring.**

1. Snap ring. - 2. Synchromesh ring. - 3. Third speed gear. - 4. Spreader spring.

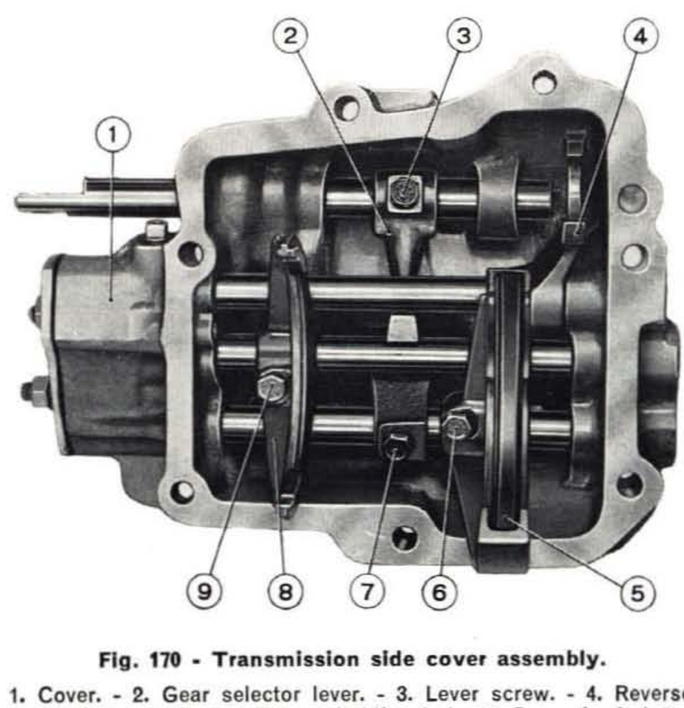


**Fig. 170 - Transmission side cover assembly.**

1. Cover. - 2. Gear selector lever. - 3. Lever screw. - 4. Reverse shifter fork. - 5. First and second shifter fork. - 6. Screw for fork 5. - 7. First and second shifter rail dog screw. - 8. Third and fourth shifter fork. - 9. Screw for fork 8.

# TRANSMISSION TROUBLE DIAGNOSIS AND CORRECTIONS

## Noisy Transmission.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Excessive backlash of gears in mesh due to gear wear. | 1) Rebuild transmission and replace worn gears. |
| 2) Gears, bearings, synchronizers or gear bushings damaged. | 2) Rebuild transmission and replace worn parts. |
| 3) Shafts misaligned or out of center due to loose mounting nuts or lock rings. | 3) Disassemble transmission and check components, repair and replace as required. |
| 4) Dirt or metal chips in the lubricant. | 4) Disassemble transmission, clean all components and make sure that they are sound. Replace lubricant. |
| 5) Insufficient oil level in transmission case. | 5) Add FIAT W 90 M (SAE 90 EP) oil up to lower brim of filler plug seat. |

## Transmission Shifts Hard.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Defective link of control rod to flexible joint. | 1) Disassemble gearshift mechanism and adjust fit between rod and joint. |
| 2) Speed selector and engagement lever control rod twisted. | 2) Remove rod and straighten. |
| 3) Control rod-to-speed selector and engagement lever joint damaged. | 3) Remove and replace flexible joint. |
| 4) Speed selector and engagement lever worn. | 4) Remove front extension and replace lever. |
| 5) Stiffened striker rods in case seats. | 5) Remove rods, locate cause of stiffening and repair as required. |
| 6) Sliding sleeves and gears bound in their seats due to the presence of dirt in splines or breakage of synchronizer springs. | 6) Locate cause of binding, clean and replace damaged parts. |
| 7) Improper quality of transmission lubricant. | 7) Drain case and clean thoroughly. Refill with FIAT W 90 M (SAE 90 EP) oil. |
| 8) Misadjusted clutch linkage and clutch make declutching impossible. | 8) Rebuild clutch throwout mechanism. Adjust as directed under « Clutch ». |

## Transmission Jumps out of Gear.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Improper shifting. | 1) Be sure the gears are completely engaged before releasing the clutch pedal. |
| 2) Gearshift actuating rod out of adjustment. | 2) Adjust as outlined on page 120. |
| 3) Incorrect assembly or wear of striker rod positioning balls and springs. | 3) Remove cover and overhaul parts. Assemble the proper way. |
| 4) Excessive end play caused by wear in the shift forks, sliding gear or sleeve grooves, or ball bearings. | 4) Rebuild transmission and replace worn parts. |
| 5) Striker rod rollers or balls worn or assembled incorrectly. | 5) Disassemble and replace worn parts and assemble the correct way as outlined on page 176. |
| 6) Worn synchronizer rings. | 6) Overhaul sliding gears and sleeves and replace bumped ones. Replace synchronizer rings. |

## Oil Leakage.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Overfilled transmission case. | 1) Check oil level for lower brim of filler plug seat. |
| 2) Front extension, side cover and bell housing mounting nuts loose. | 2) Check tension and tighten nuts to specified torques. |
| 3) Speed selector and engagement lever seal at side cover damaged. | 3) Remove cover and lever and renew seal on side cover. |
| 4) Transmission gaskets leaky. | 4) Replace gaskets which do not warrant oil tightness. |

## Removal.

Remove the transmission as follows:

Disconnect the plus cable from battery terminal post.

Remove upper rear headlining.

Remove the generator and starting motor.

Using wrench **A. 57068** disconnect shock absorbers from lower mounting.

Remove wheel shaft flexible joints.

Disconnect the control cable from clutch throwout lever and the speedo cable.

Disconnect the gear selector rod.

Support the transmission and differential assembly by means of the hydraulic jack with adapter **A. 70516** and remove transmission differential assembly mounting screws from engine using wrench **A. 55035.**

Remove the flywheel cover.

Back out the screws holding the transmission-differential assembly mounting brackets on body shell.

Properly work on hydraulic jack so to extract the clutch shaft from driven plate.

Lift out the transmission-differential assembly.

## Disassembly.

First of all remove the left side mounting bracket and tie up the axle shafts with a rope lest they may fall down on disassembly.

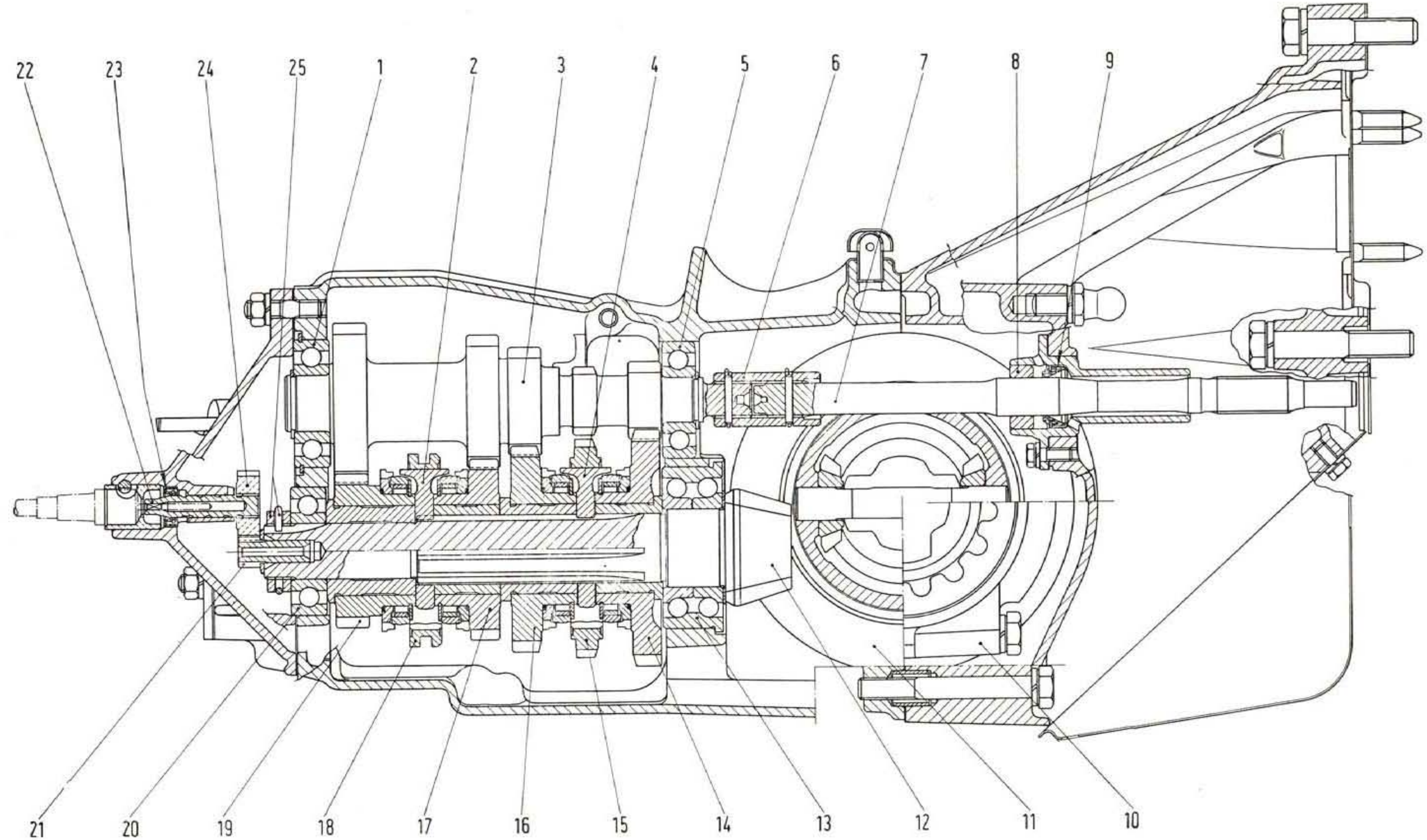


**Fig. 171 - Side sectional view of transmission-differential assembly.**

1. Front ball bearing of countershaft. - 2. Third and fourth slip sleeve hub. - 3. Countershaft with drive gears. - 4. First and second slip sleeve hub. - 5. Rear ball bearing of countershaft. - 6. Countershaft-to-input shaft sleeve. - 7. Input shaft. - 8. Input shaft bushing. - 9. Oil seal. - 10. Differential carrier cap. - 11. Ring gear. - 12. Drive pinion-output shaft. - 13. Drive pinion rear ball bearing. - 14. First driven gear. - 15. First and second slip sleeve and reverse gear. - 16. Second driven gear. - 17. Third driven gear. - 18. Third and fourth slip sleeve. - 19. Fourth driven gear. - 20. Output shaft-drive pinion front ball bearing. - 21. Speedometer drive gear. - 22. Speedometer driven shaft. - 23. Oil seal. - 24. Speedometer driven gear. - 25. Output shaft-drive pinion nut and retainer.

Now place the transmission-differential assembly on revolving stand with adapter **Arr. 22206/10** and clamp securely. Drain out oil.

Carefully dismantle the transmission and differential taking out all components.

It will be good practice, for ease on reassembly, to mark the position of differential carrier caps and bearing adjusters relative to supports in order to assure correct pairing of parts.

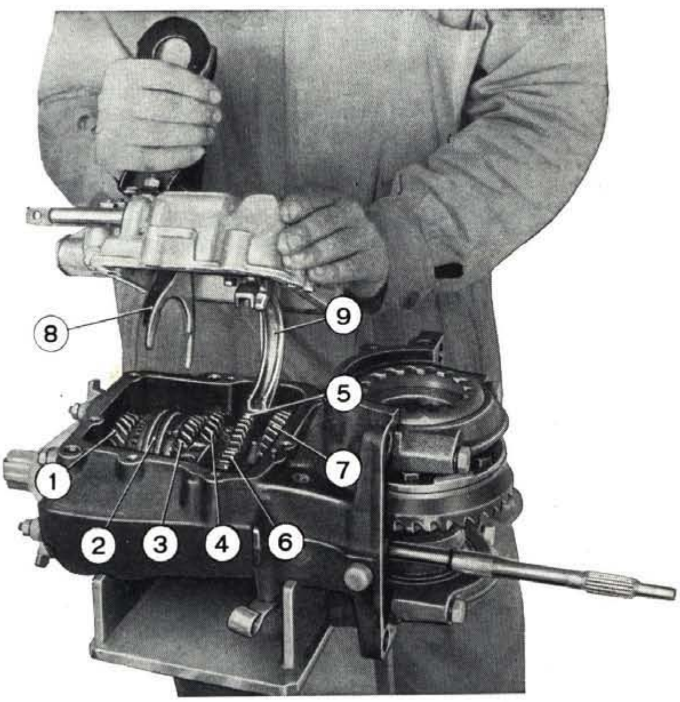


**Fig. 172 - Removing side cover, complete with shifter rails and forks.**

1. Fourth driven gear. - 2. Third and fourth slip sleeve. - 3. Third driven gear. - 4. Second driven gear. - 5. Reverse driven gear. - 6. Reverse drive gear. - 7. First driven gear. - 8. Third and fourth shifter fork. - 9. First and second shifter fork.

## Inspection and Repair.

Prior to examining all components visually, clean them thoroughly.

The case must not be cracked and bearing bores must show no sign of wear or damage, otherwise bearing cups may be turning in their seats.

Ball bearings should be in top condition and show no axial play in excess of .02" (0.5 mm), maximum limit; radial play of bearings must not be greater than .002" (0.05 mm).

Check that the inner race revolves smoothly on the outer race: hold the bearing firmly with hands and rock it back and forth; no roughness must be felt.

Replace bearings if there is even a shadow of doubt about their efficiency.

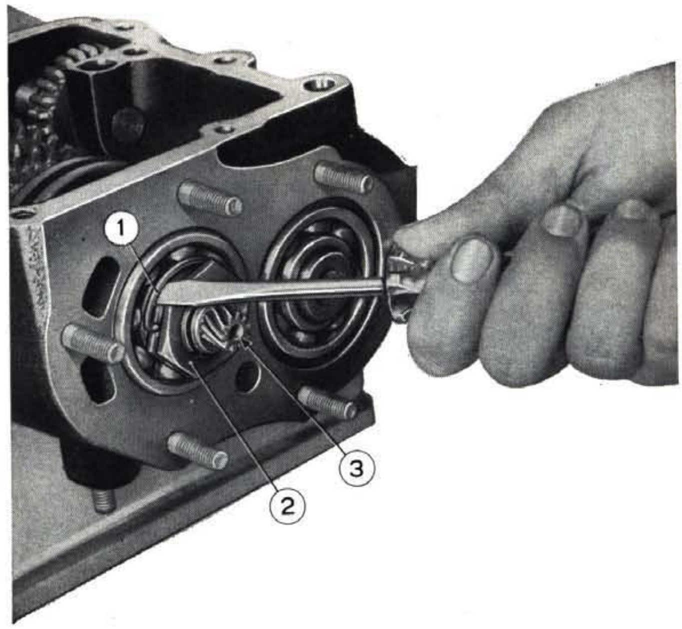


**Fig. 173 - Prying out countershaft-drive pinion nut lock ring.**

1. Lock ring. - 2. Nut. - 3. Speedo drive driving gear.

Place the mainshaft and countershaft on centers and using a dial indicator check them for misalignment in excess of .0008" (0.02 mm) to bearing bores; also check the shaft splines for absence of indentation marks.

The reverse shaft should show a very smooth surface with no sign of pitting; clearance between shaft and sliding gear bushing must be greater than .006" (0.15 mm).

All gears should not show excessive tooth wear and teeth of constant mesh gears should mate on their whole working length and depth; tooth face must be smooth and show no indication of seizure.

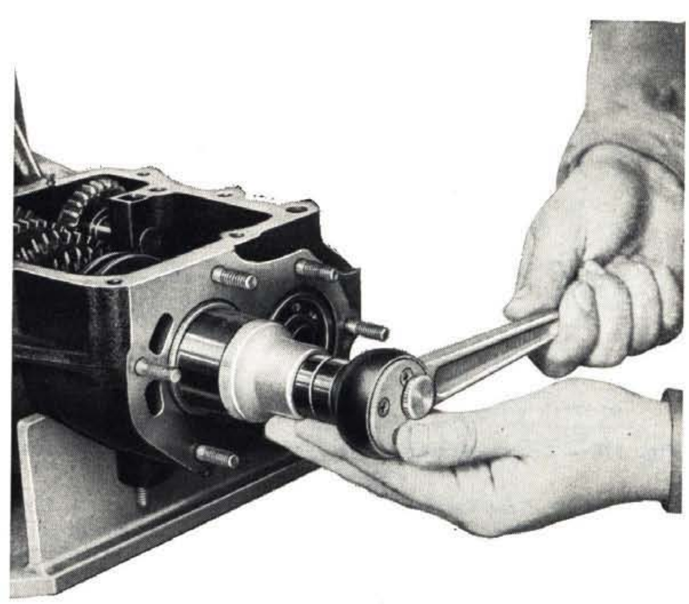

**Fig. 174 - Using ratchet wrench A. 89854 to remove countershaft nut.**

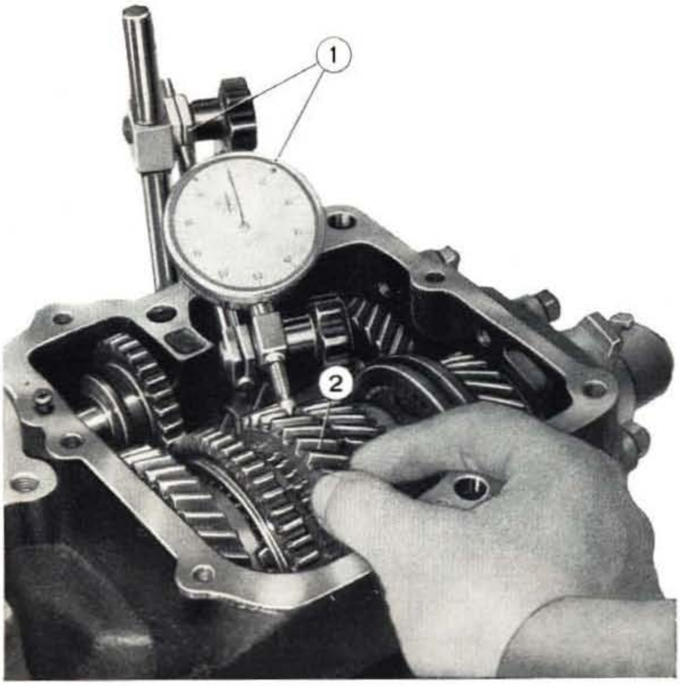


**Fig. 175 - Checking gear backlash.**
1. Magnetic dial indicator. - 2. Second driven gear.

Check gear backlash: it should be .004" (0.10 mm) with new gears; wear limit is .008" (fig. 175).

Slip sleeves and hubs should show mirror-like sliding faces.

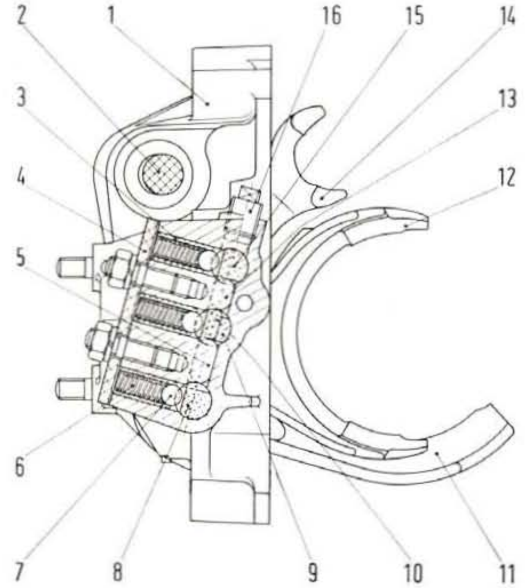


**Fig. 176 - Cross sectional view of transmission side cover assembly.**
1. Cover. - 2. Gear selector lever spindle. - 3. Bushing. - 4. Cover for shifter rail detent balls and springs. - 5. First and second shifter rail safety roller. - 6. Detent ball spring. - 7. Shifter rail detent ball. - 8. First and second shifter rail. - 9. Third and fourth shifter rail. - 10. Third and fourth shifter rail safety roller. - 11. First and second shifter fork. - 12. Third and fourth shifter fork. - 13. Reverse shifter rail safety roller. - 14. Reverse shifter fork. - 15. Reverse shifter rail. - 16. Shifter rail safety roller seating plug.

Slip sleeves should not be excessively worn either on their interior face or at serrations mating with gears; also, the synchro ring must show no undue play in its seat on gear.

The synchro ring face which contacts the slip sleeve and the toothed crown of the gear, is coated with a layer of molibdenum which confers it a high degree of wear resistance and a rather rough look.

The overall diameter of the ring **of all synchronizer units**, in place in the gear and in a new condition, is 2.6071" ± .0079" (66.22 ± 0.2 mm) (fig. 168).

After a certain number of gear shifts, during which the synchromesh ring has set by riding against the gear toothed crown and the slip sleeve, the ring diameter will change to 2.6102" ± .0079" (66.3 ± 0.2 mm), which turns out to be the best suited for a perfect synchromesh.

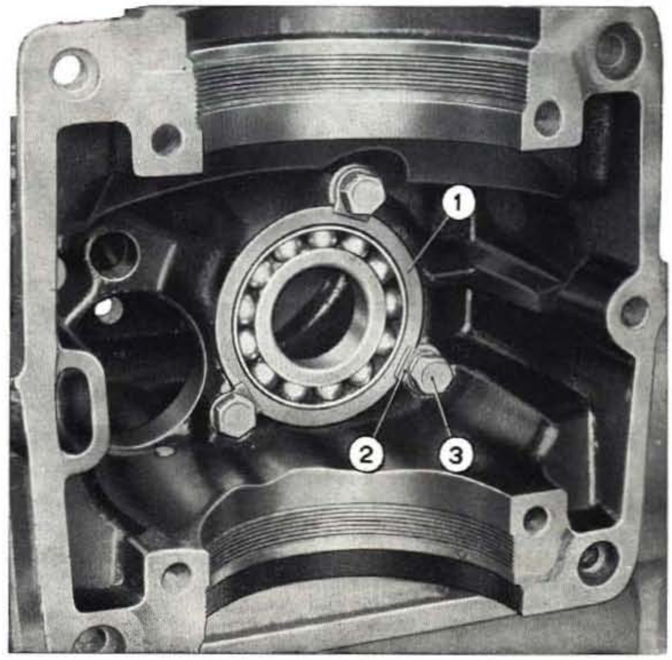


**Fig. 177 - Drive pinion bearing in place in transmission case.**
1. Ball bearing. - 2. Lock plate. - 3. Bearing screw.

If the synchro ring must be replaced, check that the overall diameter of the new ring, when seated in the gear, corresponds to specifications.

All gaskets and seals must be in top condition; renew if there is the slightest doubt as to their efficiency.

Shifter rail detent balls and safety rollers should slide freely in their seats. Bound balls or rollers may cause irregular engagement or spontaneous disengament of gears.

Shifter forks must not be distorted and rails should slide snugly in their guide bores, with no appreciable play.

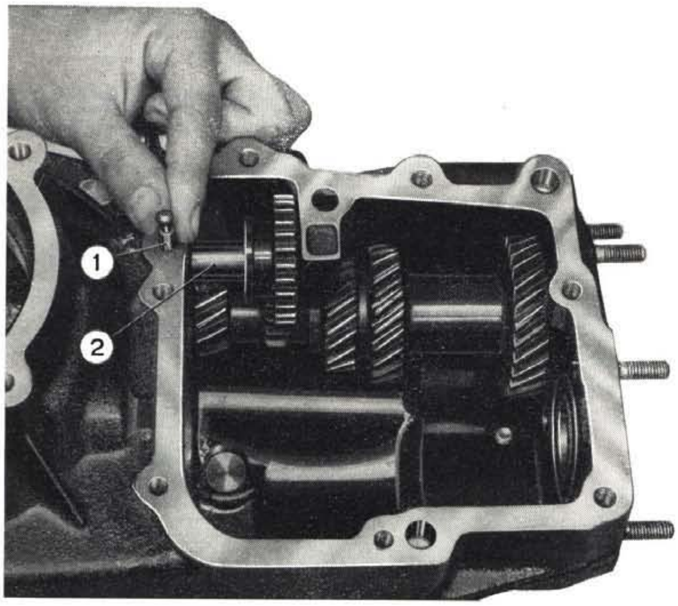


**Fig. 178 - Fitting the reverse shaft and gear lock pin.**
1. Lock pin. - 2. Reverse shaft and gear.

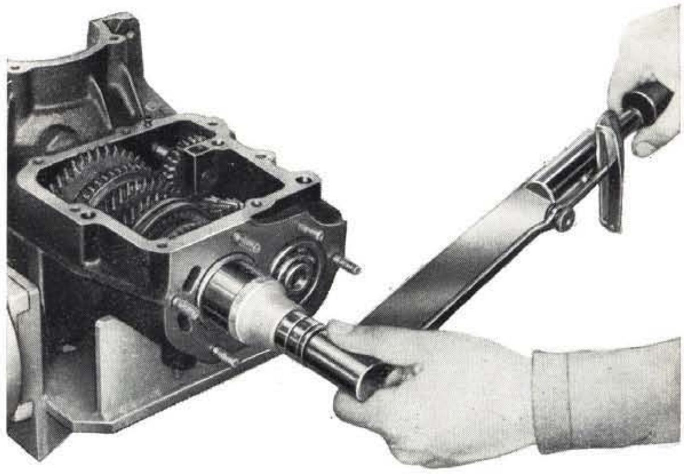

**Fig. 180 - Using torque wrench to tighten the countershaft-drive pinion nut.**

## Assembly.

Clamp transmission case to the service stand with adapter **A. 22206/10** and assemble as follows:

– slide in the mainshaft;

– fit ball bearings into bores, insert them on mainshaft and secure with snap rings;

– install the reverse shaft and gear and secure with lock pin (fig. 178);

– position the counter gear train in case and slide in the countershaft with drive pinion, on which the double race ball bearing has been pre-assembled; insert all gears into shaft (fig. 179);

– fit the front ball bearing into its bore;

– secure the drive pinion bearing with screws and lock plates (fig. 177);

– tighten the front bearing nut to 115.7 ft.lbs (16 kgm) of torque (fig. 180), using care to check that the 3rd and 4th slip sleeve is rigidly attached to the shaft;

– insert the nut retainer, using care that a hole in nut is lined up with shaft spline;

– fit the front cover and gasket and draw up cover nuts with 14.5 to 18.1 ft.lbs (2 to 2.5 kgm) of torque;

– fit the side cover with shifter rails and forks, recalling the following points.

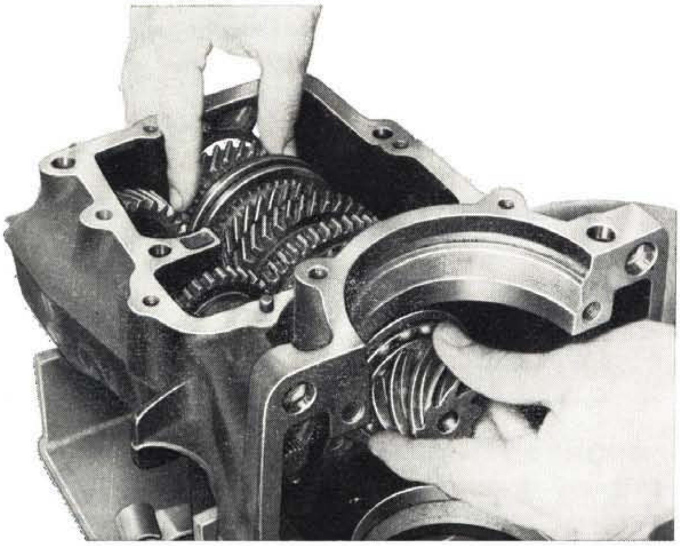

**Fig. 179 - Installing the counter gear train and the countershaft-drive pinion.**

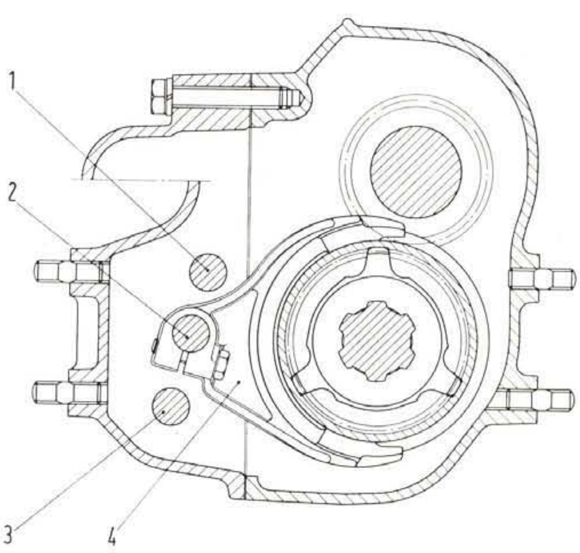


**Fig. 181 - End sectional view of transmission across shifter rails.**
1. Reverse shifter rail. - 2. Third and fourth shifter rail. - 3. First and second shifter rail. - 4. Third and fourth shifter fork.

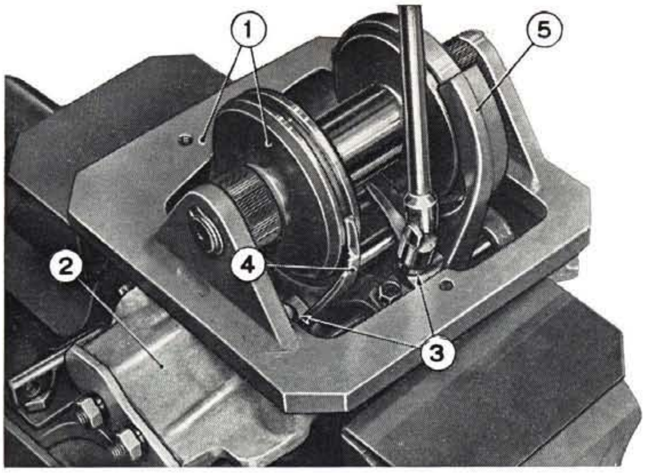


**Fig. 182 - Installing and positioning first - second and third fourth shifter forks.**

1. Tool A. 70099. - 2. Transmission case cover. - 3. Shifter fork-to-rail screws. - 4. Third and fourth shifter fork. - 5. First and second shifter fork.

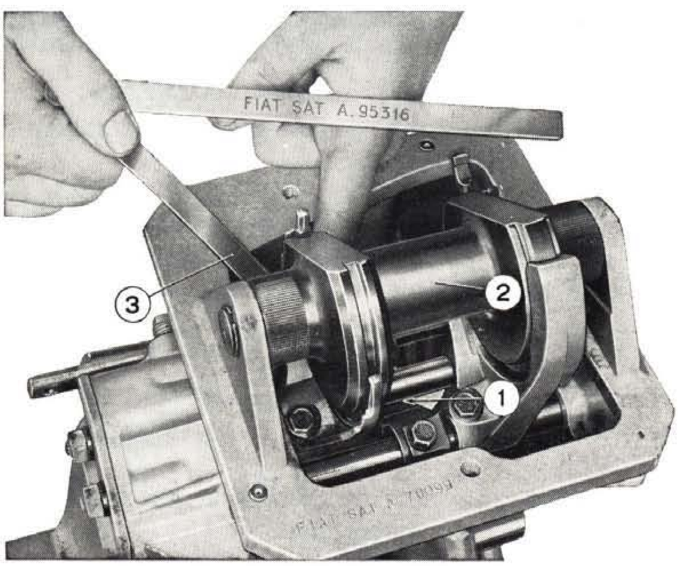


**Fig. 183 - Checking clearance between first and second shifter rail dog and third and fourth shifter rail.**

1. First and second shifter rail dog. - 2. Tool A. 70099. - 3. Feeler A. 95316.

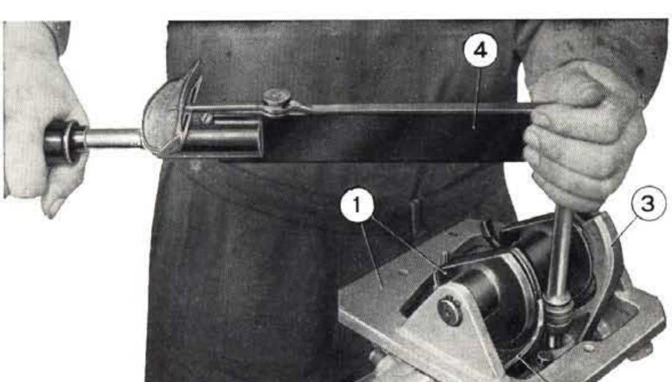


**Fig. 184 - Tightening shifter forks.**

1. Tool A. 70099. - 2. Third and fourth shifter fork. - 3. First and second shifter fork. - 4. Torque wrench.

The first and second and third and fourth shifter forks must be set in a fixed position.

For correct positioning of forks tool **A. 70099** (fig. 182) has been designed, which should be used as follows:

— affix tool **A. 70099** on cover assembly, making sure that rails are disengaged from forks (fig. 182); locate the tool with the dowel pin;

— arrange shifter forks (4 and 5, fig. 182) at their location marks on tool;

— secure the tool with two screws, using cover screw holes;

— having thus obtained the correct position, engage the shifter forks with rails and tighten the fork fixing screws (3, fig. 182) with 5.1 to 6.1 ft.lbs (0.70 to 0.85 kgm) of torque;

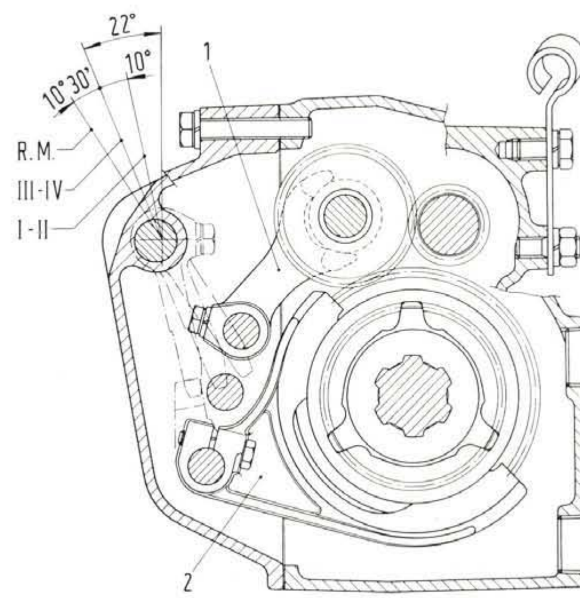


**Fig. 185 - End sectional view of transmission across shifter rail.**

1. Reverse shifter fork. - 2. First and second shifter fork.
R.M. = Reverse.

— take down tool **A. 70099** and install the cover on the transmission case;

— draw up cover mounting screws with 14.5 to 18.1 ft.lbs (2 to 2.5 kgm) of torque.

---

**IMPORTANT - After securing the first and second shifter fork on relevant rail, check the dog of this rail for $.0394''^{+.0275''}_{-.0118''}$ ($1^{+0.7}_{-0.3}$ mm) of clearance to the third and fourth shifter rail.**

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# DIFFERENTIAL

## Noise Diagnosis and Corrections.

For an easy location of differential faults proceed as follows in order to make a reliable diagnosis of the origin of differential noises experienced.

Drive the car at about 25 to 28 mph (40 to 45 km/h) until you are thoroughly familiar with all car noises.

Now gradually increase the speed until you reach 43 to 47 mph (70 to 75 km/h). As the car is gaining speed, notice any changes in the running gear noises; notice the speed at which each noise comes in and goes out.

Then release accelerator pedal and, without using the brakes, allow the car to slow down to a dead stop. Again make a note of every change in sound and the speeds at which noises are most audible.

Determine the kind of noises perceived and proceed as outlined hereafter.

**Noisiness on pull.**

Check adjustment of differential cage bearings.
Check ring gear-to-pinion backlash.
Replace the final drive gear set, if necessary.

**Noisiness on coast.**

Check meshing depth of bevel pinion teeth which may need to be moved away from or toward ring gear.

Replace the final drive gear set, if necessary.

**Thumping.**

Make sure that no gear teeth or bearing races are chipped or excessively worn.

**Noises due to excessive backlash.**

Check for too much backlash between ring gear and pinion.

Check the drive pinion for too much axial play.

**Noisiness on turns.**

Check that: pinion gears are not too tightly fitted on their shaft, pinion gear shaft surface is perfectly smooth, side gears are not bound in their supports, all gears are neither chipped nor damaged in any other way.

Check to make sure that the wear of side gears and thrust washers is not excessive.

## Disassembly.

The disassembly of differential carrier assembly does not involve any special difficulty: just remove the transmission rear cover, the carrier caps and the cage assembly.

Next take the cage assembly apart, recalling that puller **A. 40005/2** in conjunction with items **/6** and **/20 B** must be used to remove taper roller bearing cones (fig. 187).

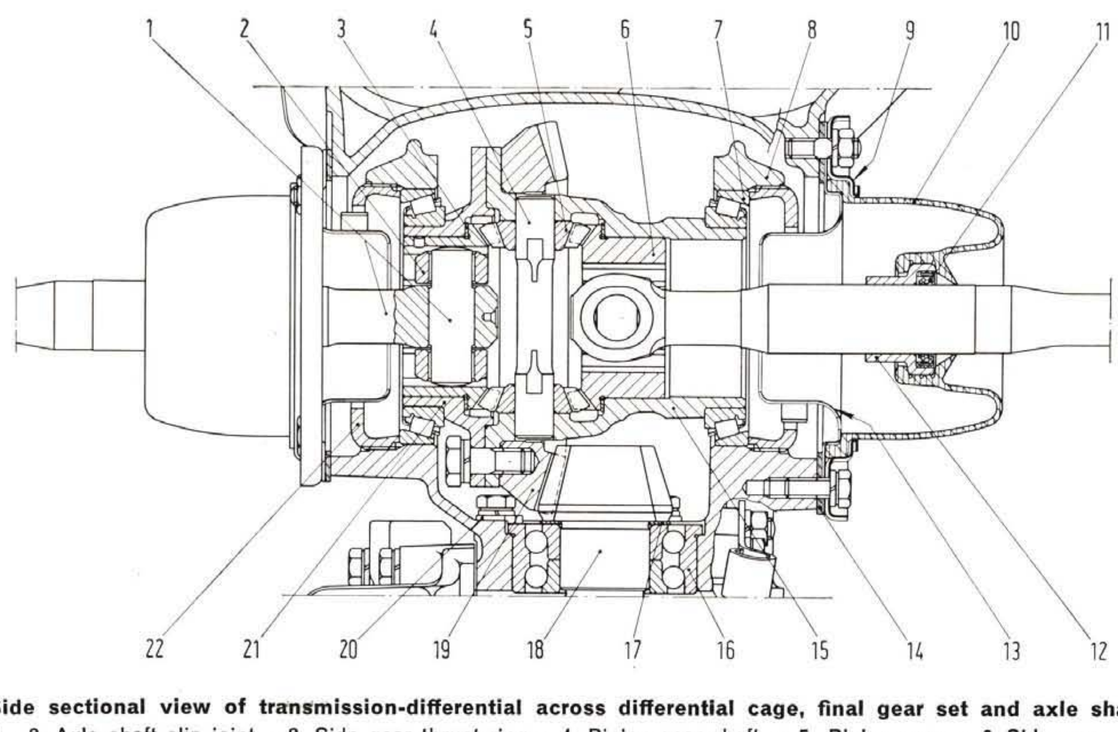



**Fig. 186 - Side sectional view of transmission-differential across differential cage, final gear set and axle shaft slip joints.**
1. Axle shaft. - 2. Axle shaft slip joint. - 3. Side gear thrust ring. - 4. Pinion gear shaft. - 5. Pinion gear. - 6. Side gear. - 7. Differential cage roller bearing. - 8. Differential cage carrier cap. - 9. Oil boot cover. - 10. Oil boot. - 11. Oil seal. - 12. Oil seal retainer. - 13. Oil boot baffle. - 14. Baffle gasket. - 15. Differential cage half. - 16. Drive pinion rear ball bearing. - 17. Drive pinion shim. - 18. Drive pinion. - 19. Ring gear. - 20. Bearing retainer plate. - 21. Differential cage half. - 22. Roller bearing adjuster.

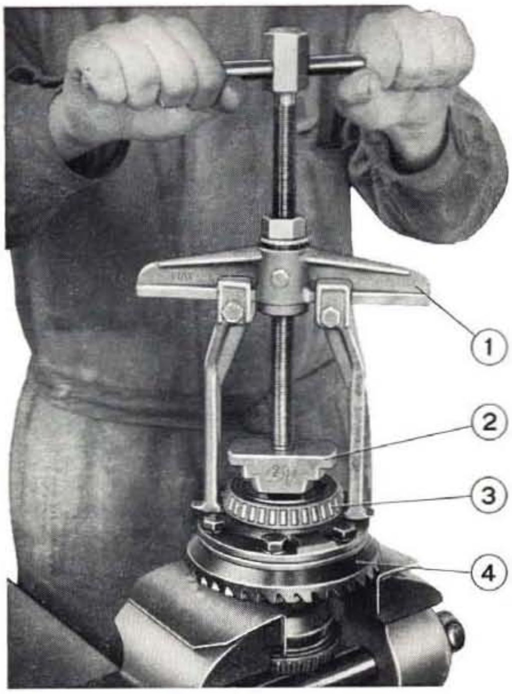



**Fig. 187 - Pulling differential cage roller bearing cones.**

1. Puller A. 40005/2/6. - 2. Puller item /20 B. - 3. Roller bearing cone. - 4. Ring gear.

## Inspection and Repair.

The components of differential carrier assembly must be painstakingly examined to check on their serviceability, state of wear as well as damages and any other irregular condition.

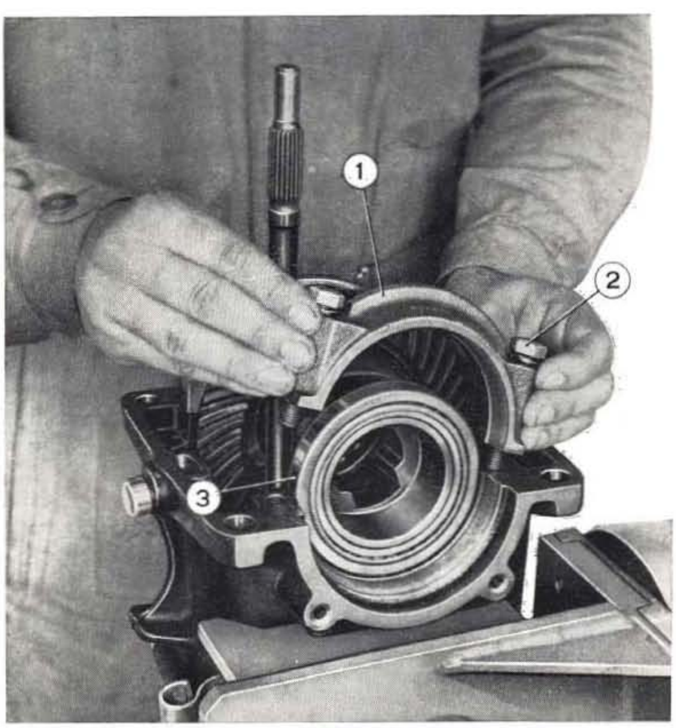



**Fig. 188 - Removing differential carrier caps.**

1. Cap. - 2. Cap screw. - 3. Roller bearing.

The pinion gear shaft should no present roughness or excessive wear; otherwise replace it by a new one.

The ring gear and pinion, the side gears and pinion gears must show no chips, cracks or excessive wear; replace as required.

Check the condition of bearings: no roughness on spinning should be felt and no damage or remarkable wear observed; renew bearings, if necessary.

If light marks or imprints are detected at contact face of pinion gear thrust washers, smooth them out, if possible, otherwise renew thrust washers.

Thrust washers come for service in the following thicknesses:

**.0275" - .0315" - .0354" - .0394"**
**.0433" - .0472" - .0512" - .0551"**
**(0.7 - 0.8 - 0.9 - 1 - 1.1 - 1.2 - 1.3 - 1.4 mm).**

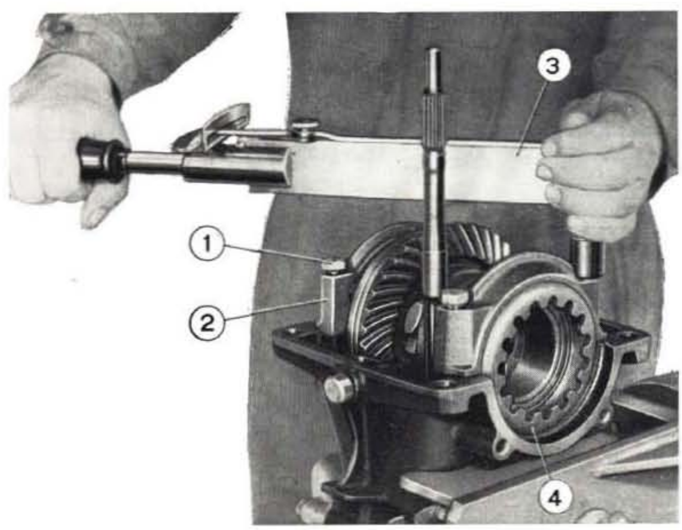



**Fig. 189 - Tightening differential carrier cap screws.**

1. Cap screw. - 2. Cap. - 3. Torque wrench. - 4. Roller bearing adjuster.

## Assembly.

For correct assembly of differential carrier, proceed as directed hereafter.

Install the clutch shaft and secure by pin and retainer.

Fit the inner cage assembly.

Install in this order: taper roller bearing cups, differential carrier caps and adjusters (fig. 189).

Draw up carrier cap screws with 36.2 to 39.8 ft.lbs (5 to 5.5 kgm) of torque.

Then adjust the mesh and backlash of the final drive gear set as outlined in next two paragraphs.

Fit the bell housing and gasket and secure by tightening mounting screws to a torque of 28.9 to 36.2 ft.lbs (4 to 5 kgm).

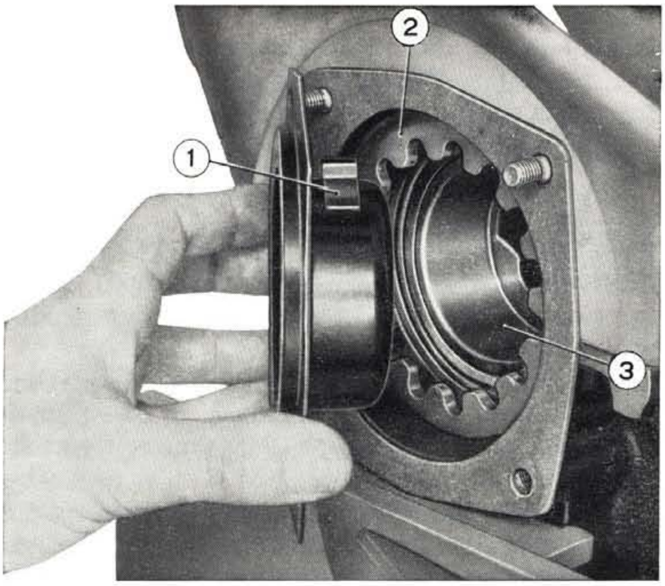



**Fig. 190 - Fitting bearing adjuster stop plate.**
1. Lug. - 2. Bearing adjuster. - 3. Roller bearing.

Fit the adjuster stop plates and gaskets (fig. 190), using care to insert the plate lug in a tooth space of adjuster.

On axle shafts, slide: oil boots with bushings (fig. 191), boot covers, caps, sleeves and slip joints; secure sleeves with snap rings.

Install the transmission and differential assembly as directed in covering paragraph; tighten mounting screws and nuts to torques tabulated on page 191.

Insert axle shafts in differential case.

Install the slip sleeve and clutch throwout yoke lever and hook up yoke lever end under the sleeve spring.

## Adjusting Final Drive Gear.

For correct meshing of the drive pinion with the ring gear, a shim of proper thickness should be placed between the pinion and the rear ball bearing (fig. 195).


**Fig. 191 - Fitting differential cage oil boot bushing.**
1. Boot bushing. - 2. Tool A. 70103.

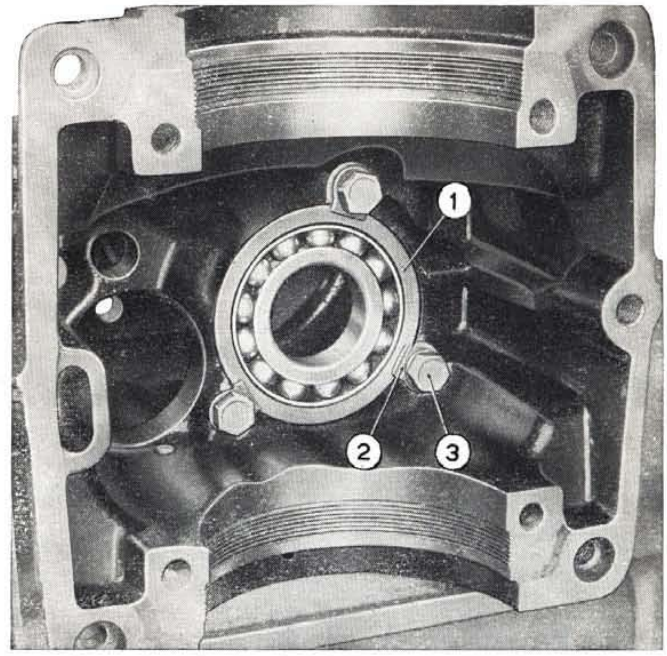



**Fig. 192 - Drive pinion ball bearing.**
1. Bearing. - 2. Bearing lock plate. - 3. Lock plate screw.

Drive pinion thrust washers for service come in the following range of thicknesses:

**.0295" - .0315" - .0335" - .0354" - .0374"**
**.0394" - .0413" - .0433" - .0453" - .0472"**
**(0.75 - 0.80 - 0.85 - 0.90 - 0.95 - 1 - 1.05 - 1.10 - 1.15 - 1.20 mm).**

Some tools have been designed to help the operator determine the thickness of pinion washer (fig. 194).

Also, the following formula should be used:

$$S = b - (+a) = b - a$$

or $S = b - (-a) = b + a$

where:

$S$ = thickness of the washer (fig. 195);
$b$ = dial indicator reading (fig. 194);
$a$ = figure stamped in production on pinion stem.

Proceed as outlined hereafter:

**How to figure « b ».**

Fit the drive pinion rear ball bearing into its bore and place the retainer plates; tighten retainer plate nuts with 14.5 to 18.1 ft.lbs (2 to 2.5 kgm) of torque (fig. 192).

Insert tool **A. 70101** (dummy pinion) (1, fig. 194) and rotate the new bearing some turns.

Draw up nut with 72.3 ft.lbs (10 kgm) of torque.

Affix fixture **A. 95690** (fig. 194) with dial indicator, the scales of which have been set at zero; make sure that the indicator plunger touches the differential cage bearing seat.

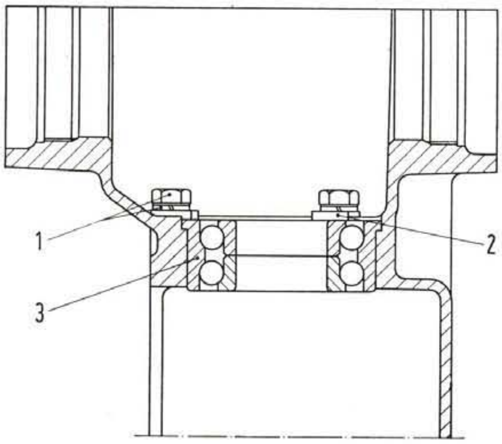



**Fig. 193 - Placing drive pinion rear bearing into transmission-differential case.**

1. Retainer plate screws and spring washers. - 2. Bearing retainer plates. - 3. Drive pinion rear ball bearing.

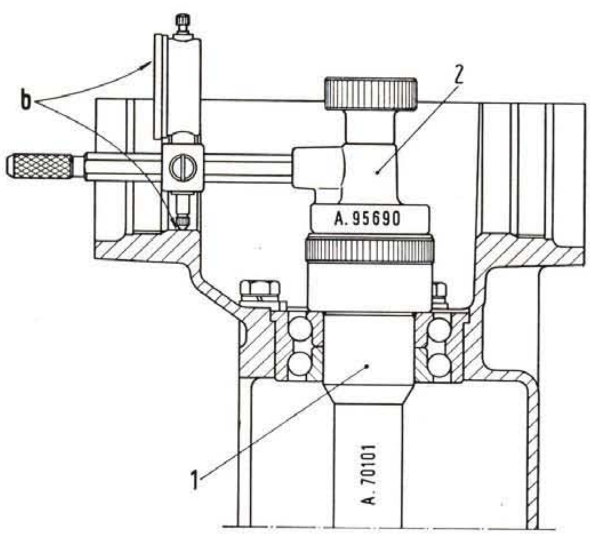



**Fig. 194 - Diagram showing use of tools for figuring pinion shim thickness.**

1. Dummy pinion A. 70101. - 2. Fixture A. 95690 with dial indicator. - b. Dial indicator reading.

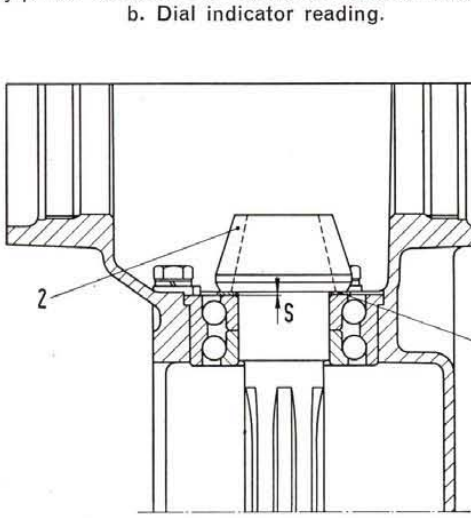



**Fig. 195 - Drive pinion and shim fitting diagram.**

1. Drive pinion shim. - 2. Drive pinion. - S. Shim thickness.

Move back and forth, horizontally, the indicator sliding support and watch fluctuations of dial pointers; block the dial indicator in the position corresponding to the minimum reading (fig. 196).

Repeat above step at the opposite bearing.

**The average of two readings obtained represents « b » (fig. 194).**

**The amount of « a »** is stamped in production on pinion stem; it may be positive, preceded by the sign plus, or negative, in which case it is preceded by the sign minus.

If the number stamped on pinion stem is preceded by the « plus » sign, the thickness of the shim is obtained by « subtracting » this figure from the indicator reading.

Conversely, if the number stamped on pinion stem is preceded by the « minus » sign, the thickness of the shim is obtained by « adding » this figure to the indicator reading.

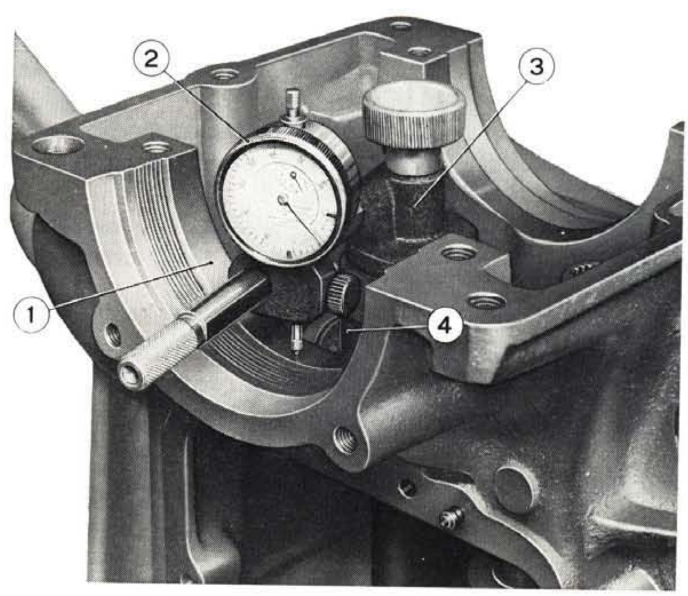



**Fig. 196 - Step for figuring the thickness of drive pinion shim.**

1. Differential cage bearing seat. - 2. Dial indicator. - 3. Fixture A. 95690 for dial indicator. - 4. Dummy pinion A. 70101.

In case there is no rate in the shim thickness range corresponding exactly to the amount of « **S** » choose the thicker shim than the amount of « **S** » next in the shim thickness range.

When assembling the differential cage, check the gear rolling torque: using tool **A. 95697/4** without threaded pivot, hold either side gear in position and with dynamometer **A. 95697**, turn over the other side gear: the gear rolling force should be 5.1 to 6.1 ft.lbs (0.2 to 0.5 kgm).

If necessary, correct the gear rolling torque by repositioning the side gears with the use of a different thrust washer.

Side gear thrust washers for service come in the following thickness range:

.0275" - .0315" - .0354" - .0394"
.0433" - .0472" - .0512" - .0551"
(0.7 - 0.8 - 0.9 - 1 - 1.1 - 1.2 - 1.3 - 1.4 mm).

## Adjusting Ring Gear-to-Pinion Backlash and Preloading Differential Bearings.

These operations should be carried out simultaneously.

Working on adjusters temporarily set final drive gear backlash at .004" to .006" (0.10 to 0.15 mm); adjusters should merely touch bearings, so not to strain them with any preload.

Tighten adjusters of the same amount in alternate fashion; differential carrier caps are thus caused to diverge slightly, increasing the distance which separates them (D, fig. 198) (axial preload of bearings).

Distance « D » between carrier caps should increase by .008" to .010" (0.20 to 0.25 mm).

If fixture **A. 95688** is used to check divergence, the reading of the dial indicator (1, fig. 197) shall be .006" to .008" (0.15 to 0.20 mm), in view of the fact that the fixture is attached to the transmission-differential case.

**NOTE** - Prior to preloading differential bearings, use care to rotate the ring gear through such a number of turns as bearings are permitted to take a snug seat.

With the ring gear bearings under the correct preload, **check the ring gear-to-pinion backlash, which should range between .004" (0.10 mm) and .006" (0.15 mm).**

Hold the drive pinion and manually move the ring gear, tripping it as much as the gear backlash may allow. Use a dial indicator (2, fig. 199) and read the amount of backlash shown.

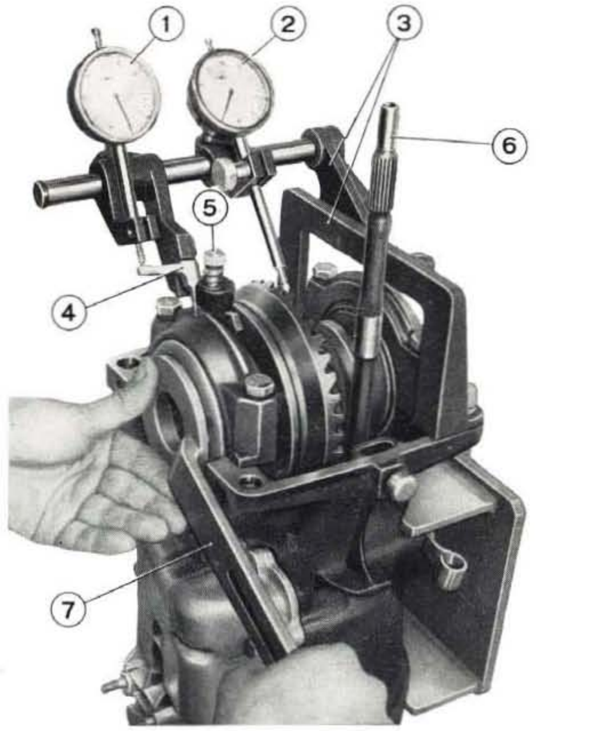



**Fig. 197 - Setting differential cage bearing preload by means of fixture A. 95688.**

1. Dial indicator for preload check. - 2. Dial indicator for gear backlash check. - 3. Fixture holder. - 4. Relay lever. - 5. Fixture positioning knob. - 6. Clutch shaft. - 7. Adjuster wrench A. 55053.

Should gear backlash be in excess or in defect of limits specified above, move the ring gear respectively toward or away from pinion, screwing out one bearing adjuster and in the other the same number of turns.

**It is mandatory that the rotation of one bearing adjuster is balanced by an even rotation of the other adjuster in the opposite direction, to avoid upsetting the preload.**

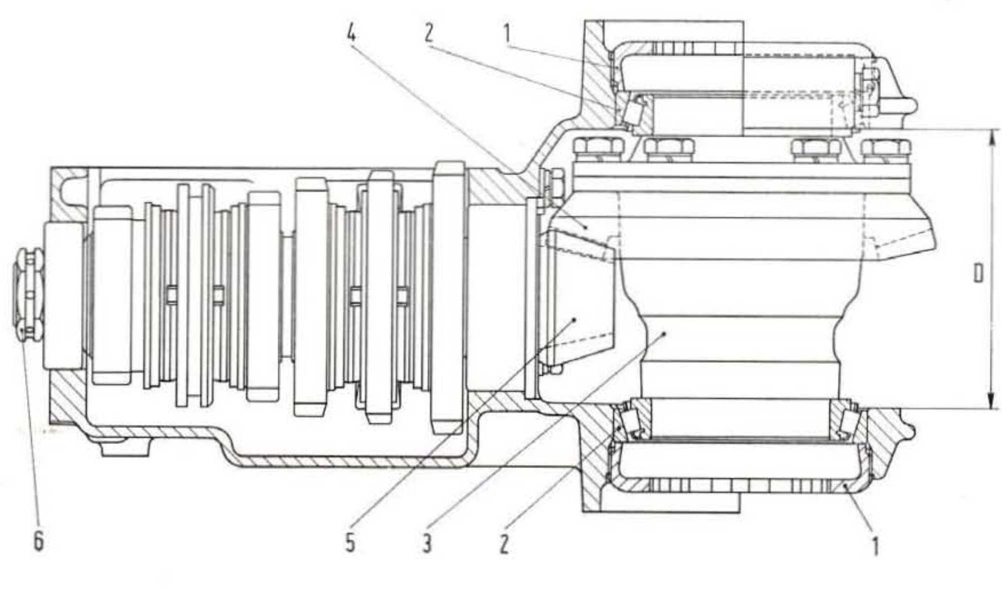



**Fig. 198.**
**Diagram for checking differential cage roller bearing preload.**

1. Bearing adjuster. - 2. Roller bearings. - 3. Differential cage. - 4. Ring gear. - 5. Drive pinion. - 6. Drive pinion nut.

D = Distance between differential carrier caps: tighten bearing adjusters until « D » increases by .008" to .010" (0.20 to 0.25 mm).

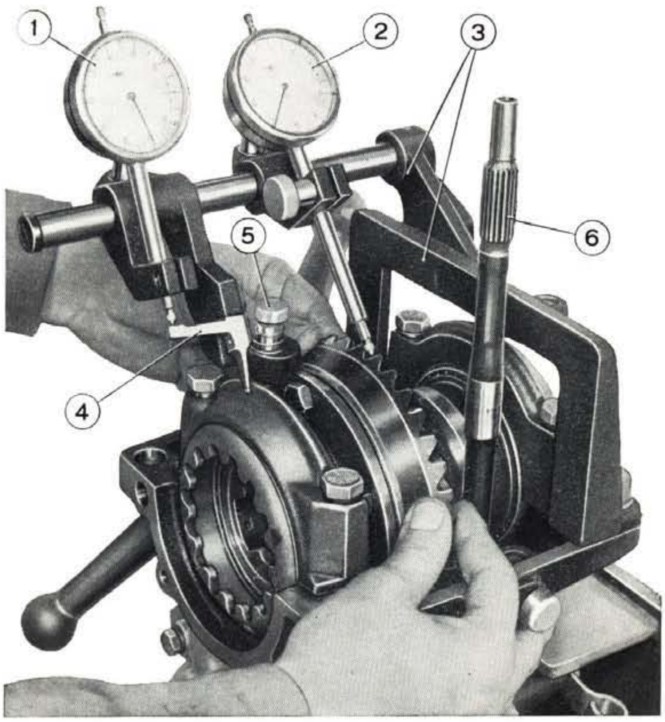



**Fig. 199 - Checking ring gear-to-pinion backlash.**

1. Dial indicator for bearing preload check. - 2. Dial indicator for final drive gear backlash check. - 3. Holder of fixture A. 95688. - 4. Relay lever. - 5. Fixture positioning knob. - 6. Clutch shaft.

## Checking Ring Gear-to-Pinion Tooth Contact.

The final inspection of tooth contact pattern must be performed with the differential unit on test bench (fig. 200).

Coat ring gear teeth with lead oxide, then rotate the differential and brake it through tester levers so that the differential works under load and a pattern is impressed on the painted section of the ring gear contacting the pinion.

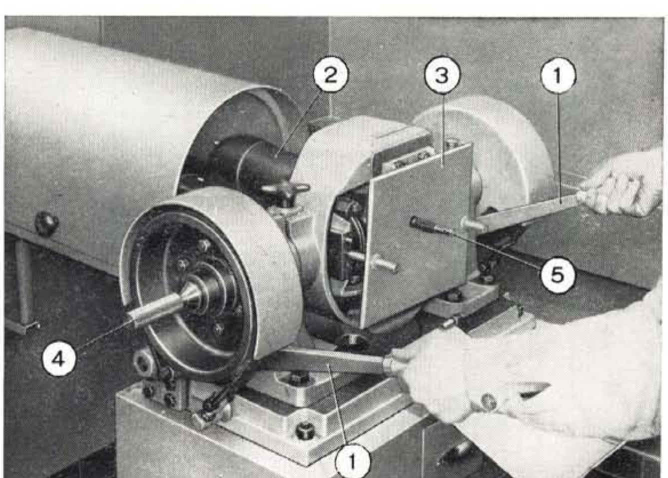



**Fig. 200 - Bench testing differential unit.**

1. Tester brake control levers. - 2. Transmission-differential assembly. - 3. Protection plate. - 4. Tester shafts. - 5. Clutch shaft.

Tooth contact will be correct when the contact pattern is evenly spread over ring gear teeth on both pull and coast sides, as shown in fig. 201.

Some instances of **wrong** tooth contact are illustrated on page 119 and necessary corrective measures are also indicated.

To obtain correct tooth contact increase or diminish the thickness of thrust washer under drive pinion head.

Thrust washers are supplied in the following thicknesses:

**.0295" - .0315" - .0335" - .0354" - .0374"**
**.0394" - .0413" - .0433" - .0453" - .0472"**
**(0.75 - 0.80 - 0.85 - 0.90 - 0.95 - 1 - 1.05 - 1.10 - 1.15 - 1.20 mm).**

The replacement of pinion shim involves the disassembly of differential unit, of course.

Consequently, on subsequent assembly, all adjusting and preloading steps, as already outlined, should be repeated.

## Installation.

No particular directions are required for installation of transmission-differential assembly.

Just reverse the removal procedure and recall the following points:

— arrange the assembly on hydraulic jack with adapter **A. 70516**;

— using tool **A. 70085** check that the hub of clutch driven plate is lined up with pilot bushing;

— jack up the assembly under the vehicle and mate it to engine observing that locating dowels are in the proper position; at the same time insert the clutch shaft in driven plate hub;

— draw up mounting screws with 54.2 to 61.5 ft.lbs (7.5 to 8.5 kgm) of torque.

# AXLE SHAFTS AND SLIP JOINTS

Axle shafts are coupled to differential through slip joints which allow shafts to slide and swing along an internal spline in side gear.

Axle shafts are tied at the opposite end to the wheel shaft flexible joint through a splined sleeve.

When overhauling the axle shaft, check the working surfaces of slip joints and those of side gears: in case the wear of parts brought about a clearance in excess of .008" (0.20 mm), replace slip joints and the side gear too, if necessary.

Check clearance between the shaft pivot and slip joints and renew the joints and/or the axle shaft, if clearance is excessive; in fact the pivot does not come separate for replacement, but only as a unit with axle shaft.

# CHECKING AND ADJUSTING RING GEAR-TO-PINION TOOTH CONTACT

**PULL SIDE** **COAST SIDE**

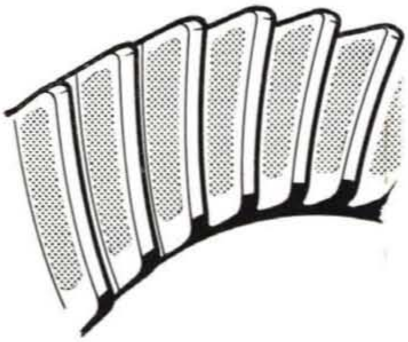
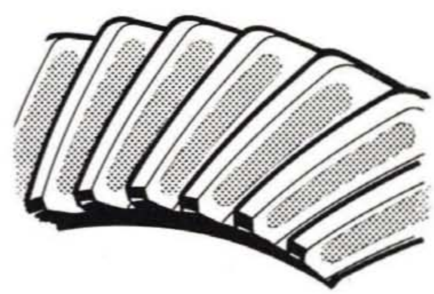


**Fig. 201.**
**Correct tooth contact.**

Contact pattern should be evenly spread over ring gear teeth, on both pull and coast sides.



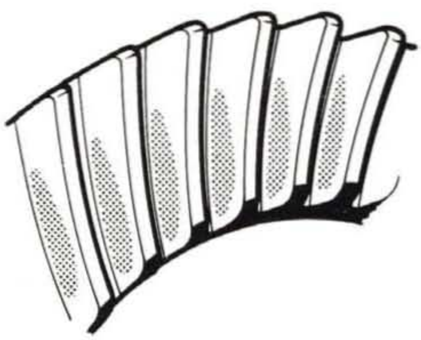
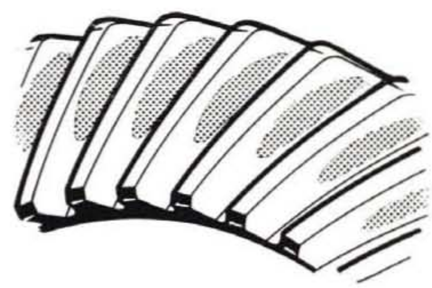


**Fig. 202.**
**Incorrect contact.**

Pull side: heavy contact at tooth toe, toward the center.

Coast side: heavy contact at tooth heel, toward the center.

Move pinion away from ring gear by reducing thrust washer thickness.



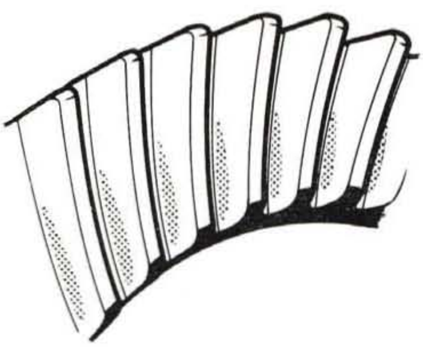
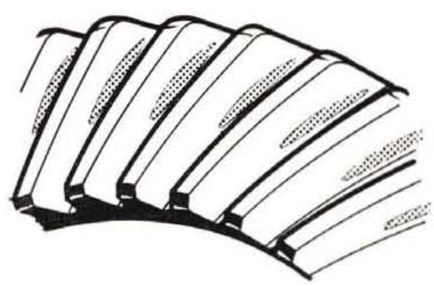


**Fig. 203.**
**Incorrect contact.**

Pull side: heavy contact on toe, at tooth flank bottom.

Coast side: heavy contact on heel, at tooth flank bottom.

Move pinion away from ring gear by reducing thrust washer thickness.



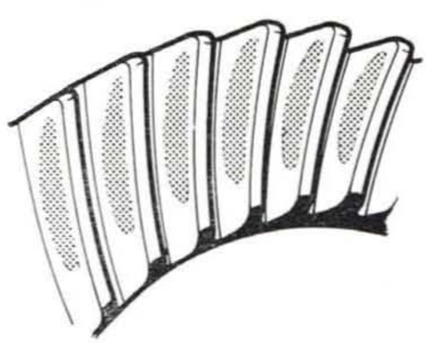


**Fig. 204.**
**Incorrect contact.**

Pull side: heavy contact at tooth heel and toward the center.

Coast side: heavy contact at tooth toe and toward the center.

Move the pinion toward ring gear by increasing thrust washer thickness.

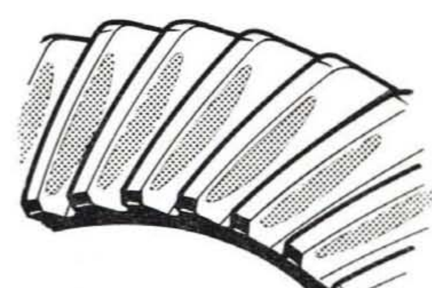
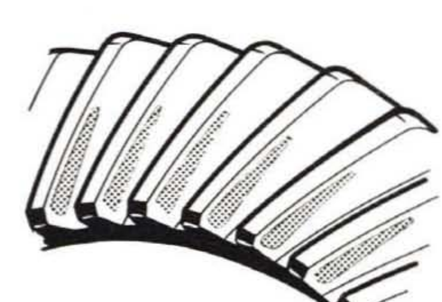


**Fig. 205.**
**Incorrect contact.**

Pull side: heavy contact on heel, at tooth face.

Coast side: heavy contact on toe, at tooth face.

Move the pinion toward ring gear by increasing thrust washer thickness.



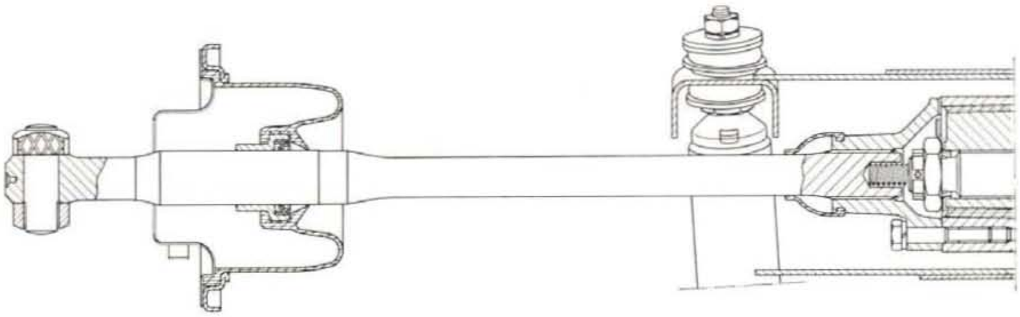


Fig. 206.

Sectional view of axle shaft as fitted to car.

Observe the slip sleeve snap ring to make sure that it fits snugly in its groove in axle shaft.

Oil boots should show no cracks or cuts, otherwise replace them.

Oil boot seals should be perfectly tight, to avoid oil leakage.

On assembly, see that gaskets are positioned correctly in bushing seats.

## GEARSHIFT MECHANISM

### Adjustment.

If an irregular engagement or spontaneous disengagement of gears are noticed, adjust the gearshift mechanism.

Proceed as follows:

– jack up the car at rear;

– loosen gear selector and actuating lever rod screws;

– position the rod as required and tighten down rod screws.

### Disassembly, Inspection and Repair.

Disassemble the gearshift mechanism as follows:

– remove the passenger's side front seat;

– remove the rubber mat from floor tunnel;

– back out gearshift lever support screws and, using flat-nose pliers, disengage the gearshift lever from pin (fig. 207);

– working from underneath the car, back out gear selector lever rod screws and remove handbrake cable stretcher;

– back out handbrake ratchet lever support screws and remove selector lever rod return spring;

– raise ratchet lever support and slide off selector lever rod (fig. 208).

After the rod has been removed, take the gearshift lever assembly apart.

Check lever assembly components and renew those damaged or unserviceable.

Assemble the gearshift mechanism by reversing the disassembly procedure.

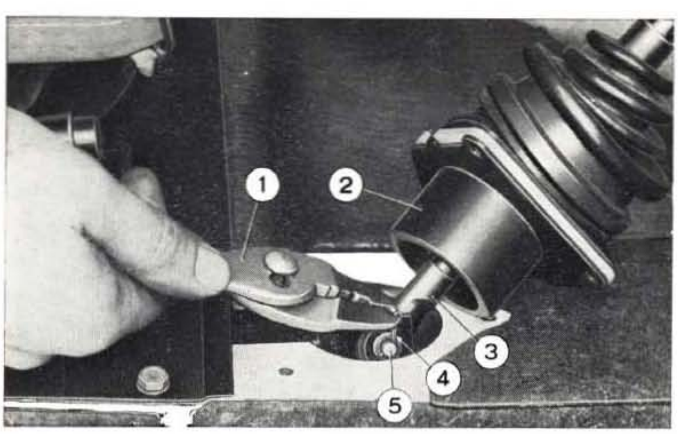



**Fig. 207 - Disassembling gearshift lever.**

1. Flat-nose pliers. - 2. Gearshift lever support. - 3. Gearshift lever. - 4. Gearshift lever pin fastener. - 5. Gearshift lever pin.

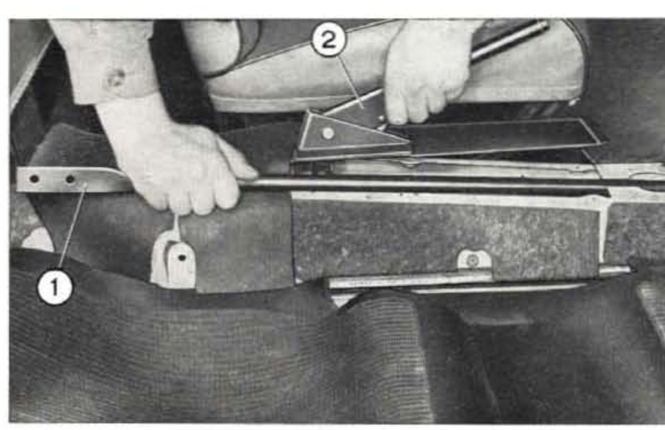



**Fig. 208 - Removing selector lever rod.**

1. Selector lever rod. - 2. Handbrake ratchet lever and support.

# Section 5

## FRONT SUSPENSION AND WHEELS

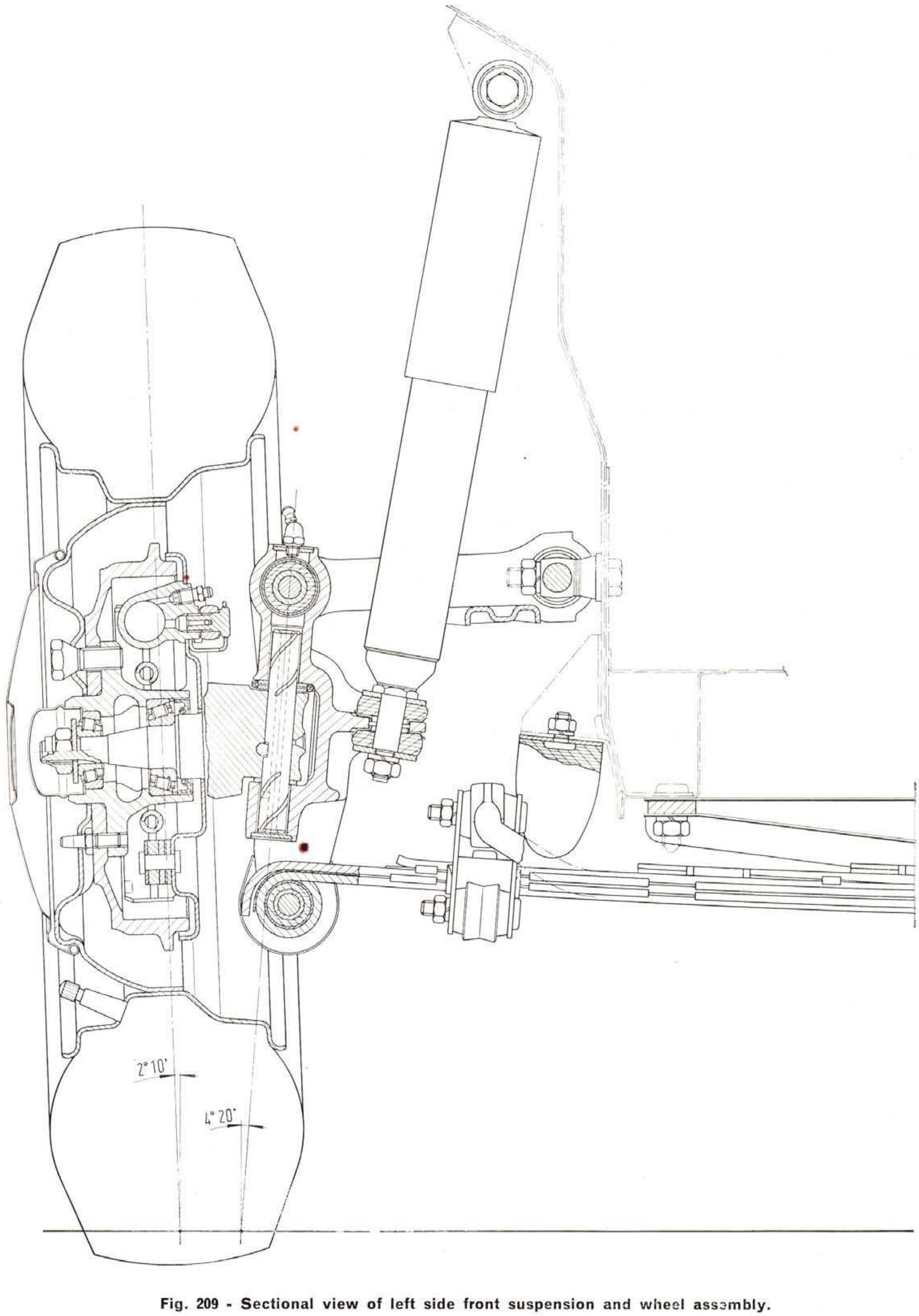



Fig. 209 - Sectional view of left side front suspension and wheel assembly.

# FRONT SUSPENSION AND WHEELS



## SPECIFICATIONS AND DATA

| | |
|---|---|
| **Semi-elliptic spring** | 1 (transversal) |
| Leaves | 1 main plus 4 |
| Camber | 1.319"±.118" (33.5±3 mm) (under a load of 242 lbs - 110 kg) |
| Bushings to kingpin housing | « silentblock » |
| Connection to underbody | press-fitted and secured centrally to a cross rail |
| Position of spring for tightening kingpin housing pin nut | static load |
| **Control arms** | 2 (upper) |
| Connection to body | pivot bar and resilient bushings |
| Arm position to pivot bar, for tightening pivot bar nuts | 2° 30′ (see fig. 223) |

*(continued)*

**Specifications and Data** *(continued)*.

| | |
|---|---|
| **Kingpin housings.** | |
| Control arm and leaf spring bushings | « silentblock » |
| Camber | 4° 20′±20″ |
| Caster | 9°±1° |
| Caster adjustment | shims (.0197″ - 0.5 mm thick) |
| Kingpin housing position to control arm, for tightening pin nut | 97° 30′ (see fig. 223) |
| **Steering knuckles.** | |
| Clearance adjustment between steering knuckle and kingpin housing | thrust washers<br>standard thickness: .0984″ (2.50 mm)<br>O.S.: .1004″-.1023″-.1063″-.1102″ (2.55-2.60-2.70-2.80 mm)<br>U.S.: .0964″-.0945″ (2.45-2.40 mm)<br>(see table on page 131) |
| **Wheels.** | |
| Camber angle — loaded | 2° 10′±15′ |
| Camber angle — no load | 1°±15′ |
| Camber, at rim (loaded) | .472″ to .512″ (12 to 13 mm) |
| Camber adjustment | (shims .0197″ - 0.5 mm thick) |
| Toe-in (see page 168) — loaded | .079″ to .157″ (2 to 4 mm) |
| Toe-in (see page 168) — no load | .236″ to .315″ (6 to 8 mm) |
| Toe-in adjustment | sleeve adjusters at tie rod ends |
| Bearing lubrication | FIAT MR 3 grease |
| **Shock absorbers** | 2 |
| Type | hydraulic, telescopic, double acting |
| Working cylinder bore | 1.063″ (27 mm) |
| Length (between upper eye center and lower mounting face): | |
| – retracted | 10.866″ (276 mm) |
| – extended — abutting begins | 16.791″ (426.5 mm) |
| – extended — maximum actual expansion (*) | 17.146″ (435.5 mm) |
| Travel (abutting begins) | 5.929″ (150.5 mm) |
| Setting — compression | .039″ to .138″ (1 to 3.5 mm) |
| Setting — rebound | .276″ to .413″ (7 to 10.5 mm) |
| Oil capacity | .299 G.B. pts - .359 U.S. pts (0.17 lt - 0.155 kg) |
| Oil grade | FIAT S.A.I. |

(*) Corresponds to the inner buffer being crushed under an axial load of 331 lbs (150 kg) approx.

# TROUBLE DIAGNOSIS AND CORRECTIONS

## Wheel Bounce.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Tire cracked. | 1) Repair tire, if possible, or replace it by a new one. |
| 2) Uneven tire pressure. | 2) Check tire pressure and inflate correctly. |
| 3) Unbalanced wheel rim or tire. | 3) Proceed as recommended under « Wheels and Tires ». |
| 4) Semi-elliptic spring mounting worn. | 4) Replace mounting and rubber pad. |
| 5) Inoperative shock absorber. | 5) Check shock absorber on test equipment and overhaul it. |
| 6) Wheel rim or tire misaligned. | 6) Proceed as recommended under « Wheels and Tires ». |

## Excessive Tire Wear.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Failure to rotate tires. | 1) For uniform tire wear, interchange tires crosswise every 3,000 miles (5.000 km). |
| 2) Incorrect camber. | 2) Check camber and adjust as recommended on pages 136 and 137. |
| 3) Incorrect toe-in. | 3) Check toe-in and adjust as recommended on page 168. |
| 4) Improper tire inflation. | 4) Proceed as directed under « Wheels and Tires ». |
| 5) Turning corners too fast. | 5) Advise owner to negotiate curves at moderate speed to reduce tire wear. |
| 6) Pick-ups too quick. | 6) Advise gradual acceleration. |
| 7) Sustained high-speed driving on gravel roads. | 7) Advise moderate speed on roads of this kind. |
| 8) Too much play at wheel bearings. | 8) Adjust clearance and lubricate bearings as outlined on pages 137, 138 and 139. |
| 9) Wheel wobble. | 9) Locate origin of failure as outlined on next page and proceed as required. |
| 10) Stiffened control arms. | 10) Disassemble control arms and replace damaged resilient bushings. |
| 11) Brakes out of adjustment. | 11) Set brake shoe-to-drum clearance as directed under « Brakes». |

## Pull to One Side.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Low or uneven tire pressure. | 1) Check tire pressure and inflate correctly. |
| 2) Incorrect front wheel alignment. | 2) Check and adjust: caster, camber and toe-in. |
| 3) Control arms distorted. | 3) Check control arms on test equipment and replace if they are distorted beyond repair. |
| 4) Inoperative shock absorbers. | 4) Disassemble, overhaul and refill with FIAT S.A.I. fluid. |
| 5) Brakes binding. | 5) Service and adjust brakes as directed in covering chapter. |

## Suspension Noise.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Lack of lubrication. | 1) Lubricate: kingpin housings, tie rods and wheel bearings, following applicable directions. |
| 2) Noisy or inoperative shock absorbers. | 2) Overhaul shock absorbers and refill with FIAT S.A.I. fluid as recommended on page 155. |
| 3) Loose sway bar at semi-elliptic spring or body mountings. | 3) Provided rubber cushions are not worn, tighten sway bar screws. |
| 4) Worn or loose wheel bearings. | 4) Remove wheels, wheel drum and hub and check bearing operation. Replace and lubricate as required and reassemble as outlined on pages 137, 138 and 139. |

## Wheel Wobble.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Uneven tire pressure. | 1) Inflate to correct pressure. |
| 2) Loose or worn wheel bearings. | 2) Remove, inspect and replace bearings as required, then lubricate and reassemble as outlined on pages 137, 138 and 139. |
| 3) Inoperative shock absorbers. | 3) Disassemble, overhaul and refill with FIAT S. A. I. fluid. |
| 4) Loose steering knuckle or kingpin housing. | 4) Remove and replace: kingpin housing bushings or control arm spider bushings, if worn, the kingpin and shims. |
| 5) Incorrect front wheel alignment. | 5) Check and adjust: caster, camber and toe-in. |
| 6) Control arm resilient bushings, or kingpin housing and semi-elliptic spring « estendblocks », worn. | 6) Check and replace bushings as directed in covering chapters. |

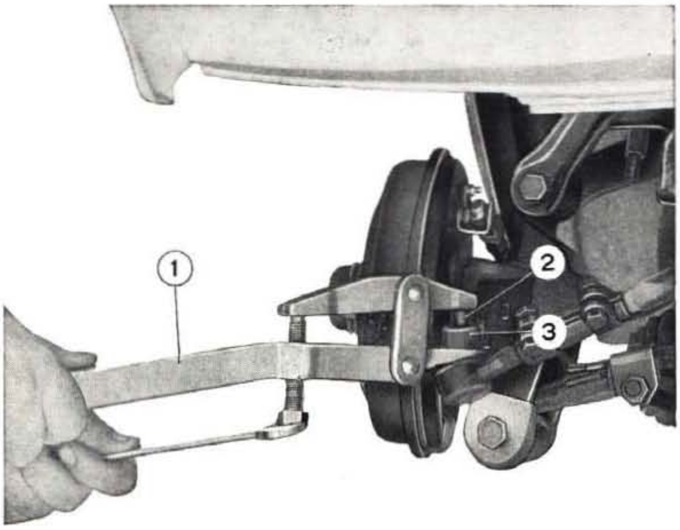



**Fig. 210 - Tying off tie rod from knuckle arm.**
1. Tool A. 47035. - 2. Rod end ball stud. - 3. Knuckle arm.

## Removal and Disassembly.

Take down the front suspension as follows.

Loosen wheel studs.

Jack up the car at front and support it on stands.

Remove wheels and disconnect shock absorbers.

Using tool **A. 47035** (fig. 210) disconnect tie rods from knuckle arms.

Separate the sway bar from semi-elliptic spring.

Plug up brake fluid reservoir outlet port and disconnect hydraulic brake lines from hoses.

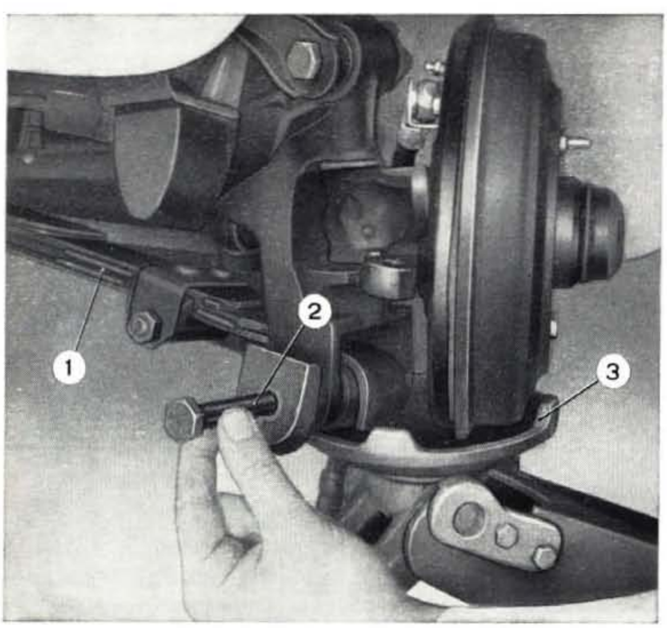



**Fig. 211 - Removing semi-elliptic spring pin.**
1. Semi-elliptic spring. - 2. Semi-elliptic spring pin. - 3. Hydraulic jack.

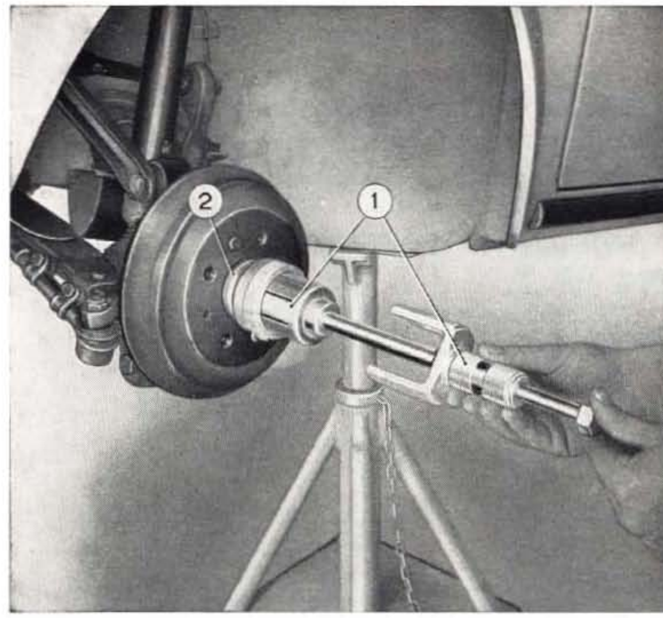



**Fig. 212 - Pulling wheel hub cap.**
1. Ram puller A. 47014. - 2. Wheel hub cap.

Support the suspension assembly with the hydraulic jack and slide off the semi-elliptic spring pin (fig. 211).

Remove the screws holding the semi-elliptic spring at center and take out the spring.

Remove upper control arm nuts from body shell and withdraw suspension assembly.

Disassembly of front suspension does not involve any special difficulty.

Pull the wheel hub cap by means of puller **A. 47014** (fig. 212).

Remove the upper bushing from kingpin housing using driver **A. 74042**.

Extract kingpin and housing bushings using driver **A. 74016**.

Pull upper control arm bushings by means of tool **A. 74116** (fig. 213).

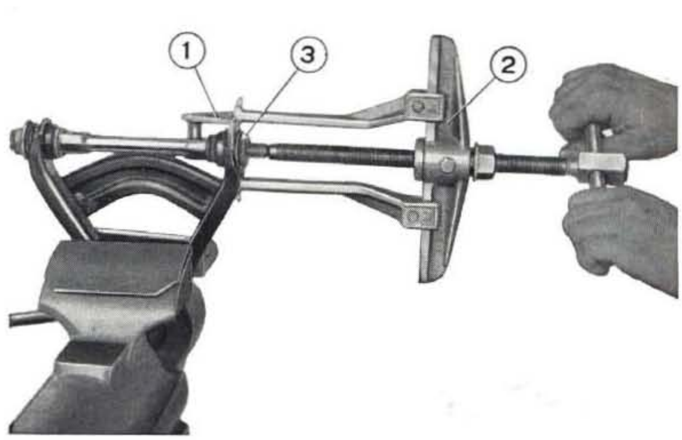



**Fig. 213 - Pulling upper control arm bushings.**
1. Tool A. 74116. - 2. All-purpose puller A. 40005. - 3. Resilient bushing.

## SEMI-ELLIPTIC SPRING

The semi-elliptic spring consists of a main leaf and four spring leaves.

The checking data of the semi-elliptic spring are tabulated on page 129.

Main leaf oscillations are shown in figures 214 and 215.

All spring leaves are supplied scraptely for service purposes.

## Inspection and Repair.

Remove spring clips at ends and center thru-bolt so that all leaves will be loose.

Inspect as follows:

— spring leaves must not be cracked or fractured, otherwise replace them;

— no paint must be present between leaves: remove any trace of paint using a scraper;

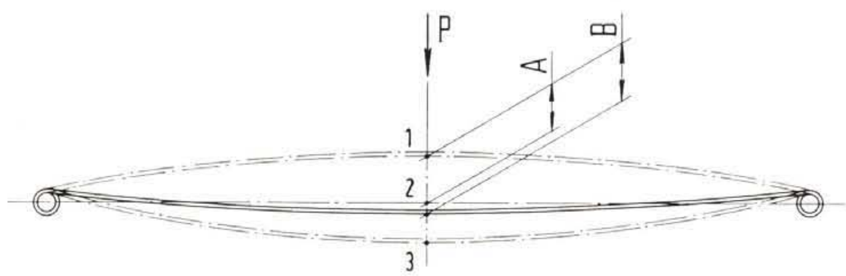



**Fig. 214.**

**Checking data of semi-elliptic spring loaded at center.**

1. Load P = 485 lbs (220 kg)
2. Load P = 705 lbs (320 kg)
3. Load P = 1,036 lbs (470 kg)

A = 1.299″±.118″ (33±3 mm)
B = 2.008″±.157″ (51±4 mm)

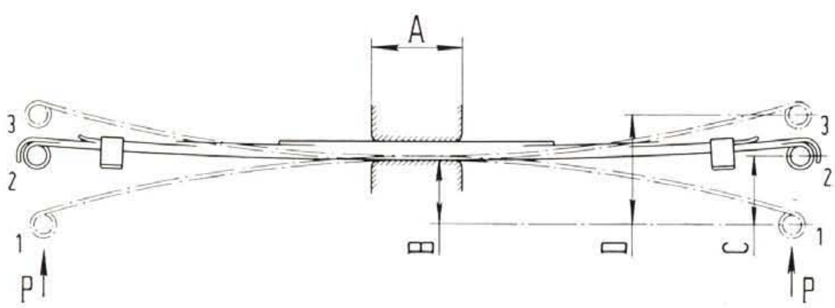



**Fig. 215.**

**Checking data of semi-elliptic spring as fitted on car.**

1. Load P = 242 lbs (110 kg)
2. Load P = 353 lbs (160 kg)
3. Load P = 573 lbs (260 kg)

A = 6.378″ (162 mm)
B = 1.319″±.118″ ( 33.5±3 mm)
C = 1.516″±.118″ ( 38.5±3 mm)
D = 4.547″±.354″ (115.5±9 mm)

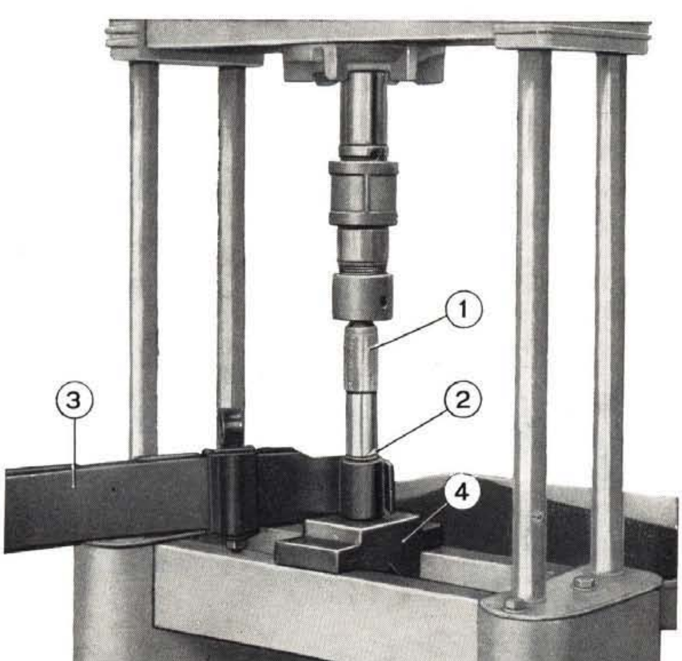



**Fig. 216 - Press fitting resilient bushing into semi-elliptic spring end eye.**

1. Driver A. 74049. - 2. « Estendblock » bushing. - 3. Semi-elliptic spring. - 4. Supporting base.

— mating surfaces of leaves should be perfectly smooth; eliminate any roughness with a file;

— check camber of leaves and re-arch them, if necessary (see table);

— in case « estendblock » bushings in main leaf eyes are damaged or worn, renew them.

---

**NOTE - The « estendblock » bushing should be driven into semi-elliptic spring eyes with such a pressure as to withstand a load of 1,100 lbs (500 kg) on its outer ring, without moving.**

---

Removal and installation of « estendblocks » is made by having recourse to an arbor press used in conjunction with driver **A. 74049** (fig. 216);

— check spring clip rubber pads and leaf interliners for a sound condition; replace damaged parts.

## CENTER LOADED SPRING

| Position | | Load P | Camber | Camber in 2nd Position | Deflection Rate |
|---|---|---|---|---|---|
| 1st | Initial load for checking deflection rate . . . | 485 lbs (220 kg) | 1.299" ±.118" (33±3 mm) | – | .910±.071 in/100 lbs (51±4 mm/100 kg) |
| 2nd | Static load . . . . . . | 705 lbs (320 kg) | – | 2.008" ±.157" (51±4 mm) | |
| 3rd | Settled load . . . . . . | 1,036 lbs (470 kg) | – | – | |

## SPRING AS FITTED ON CAR

| Position | | Load P | Camber | Camber in 2nd and 3rd Positions | Deflection Rate | NOTE |
|---|---|---|---|---|---|---|
| 1st | Initial load for checking deflection rate | 242 lbs (110 kg) | 1.319" ±.118" (33.5±3 mm) | – | 1.374±.109 in/100 lbs (77±6.1 mm/100 kg) | Specifications refer to a spring in the same conditions as on car, or anchored at center. Camber in 2nd and 3rd positions should be checked loading both end eyes of spring simultaneously. |
| 2nd | Static load . . . . . | 353 lbs (160 kg) | – | 1.516" ±.118" (38.5±3 mm) | | |
| 3rd | Settled load . . . . | 573 lbs (260 kg) | – | 4.547" ±.354" (115.5±9 mm) | | |

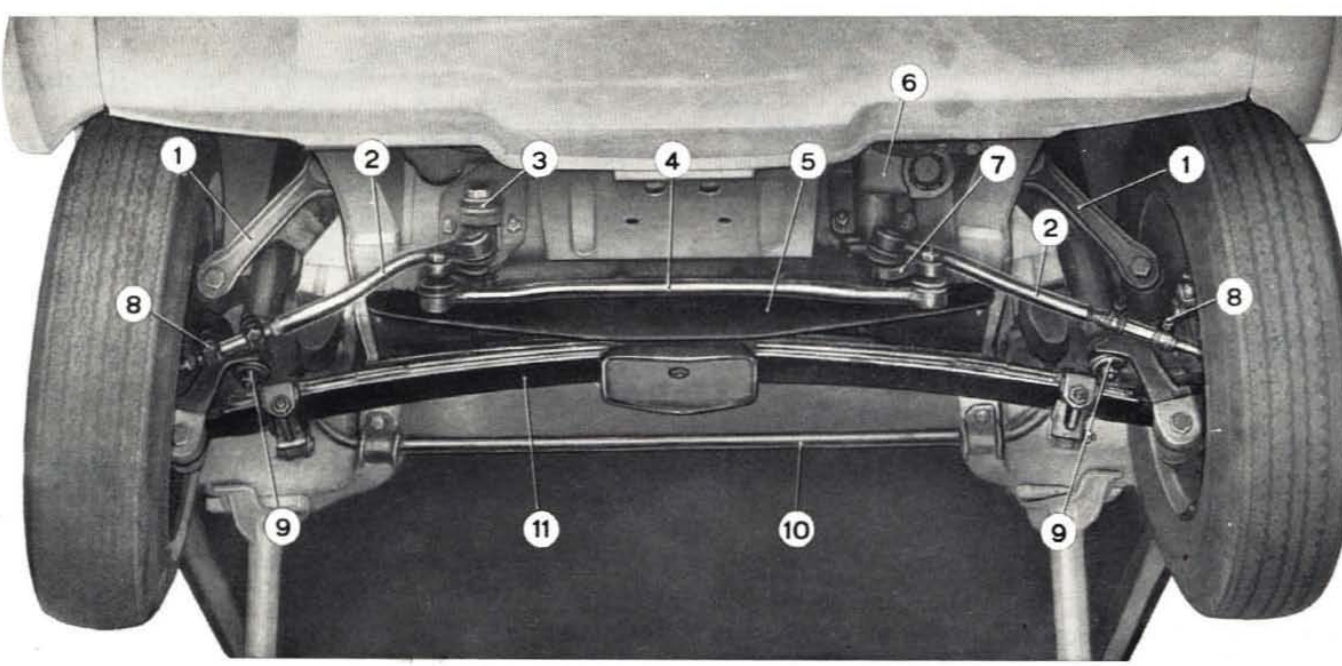



**Fig. 217 - Front suspension assembly in place on car.**

1. Upper control arms. - 2. Side tie rods. - 3. Idler arm bracket. - 4. Intermediate track rod. - 5. Semi-elliptic spring mouting rail. - 6. Steering gear. - 7. Pitman arm. - 8. Tie rod clamps. - 9. Shock absorbers. - 10. Sway eliminator. - 11. Semi-elliptic spring.

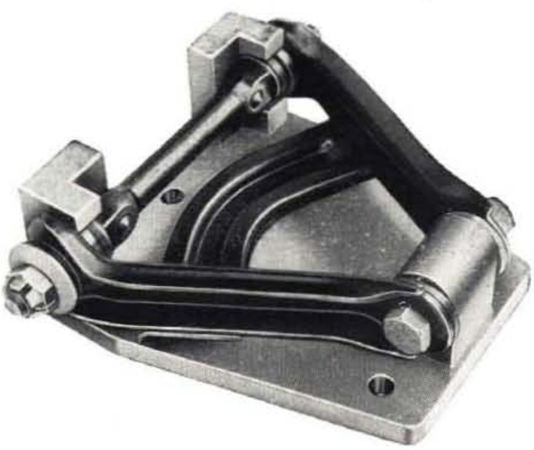


Fig. 218 - Control arm installed on fixture A. 74135.

# CONTROL ARMS

## Inspection and Repair.

Arrange the control arm on fixture **A. 74135** and check that pivot bar bores are well centered and lined up; also make sure that the arm bears against fixture shoulders. Correct any distortions which have been detected. The control arm may be also checked for misalignment as an assembly: just slide the fixture pins into pivot bar holes.

With bushings fitted in place the arm should swing freely on pivot bar without appreciable play.

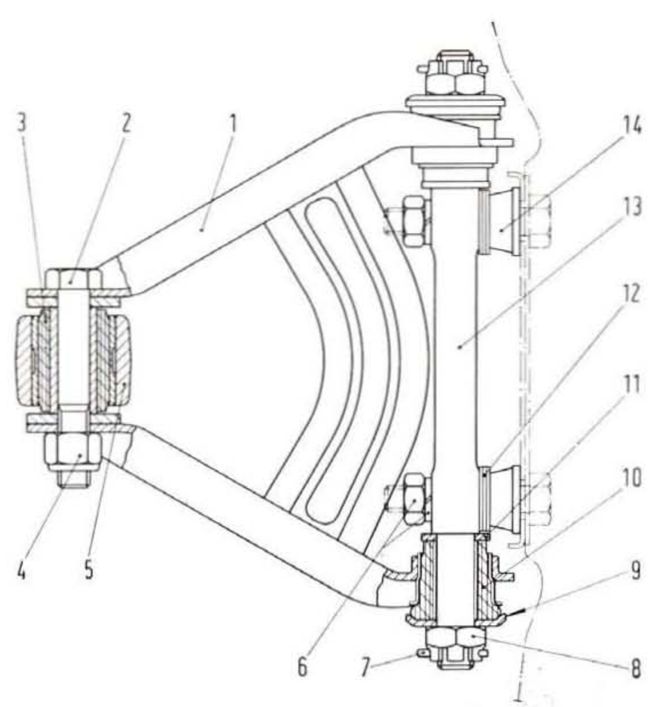



**Fig. 219 - Front suspension: sectional view across control arm.**

1. Control arm. - 2. Control arm-to-kingpin housing pin. - 3. « Silentblock » bushing. - 4. Pin nut. - 5. Kingpin housing. - 6. Pivot bar-to-body shell nut and washer. - 7-8. Pivot bar-to-control arm cotter pin and nut. - 9. Bushing cup. - 10. Resilient bushing. - 11. Inner washer. - 12. Camber and caster adjusting shims. - 13. Control arm-to-body shell pivot bar. - 14. Spacer.

The pivot bar contact face to camber and caster adjusting shims should show no such dents or scores as the accuracy of adjustment may be affected. If damage is not so serious, correct by refacing, otherwise replace the pivot bar.

Check the condition of resilient bushings press fitted in control arm.

The inside face should be thoroughly smooth and the rubber tube free from cracks or damage; otherwise replace bushings.

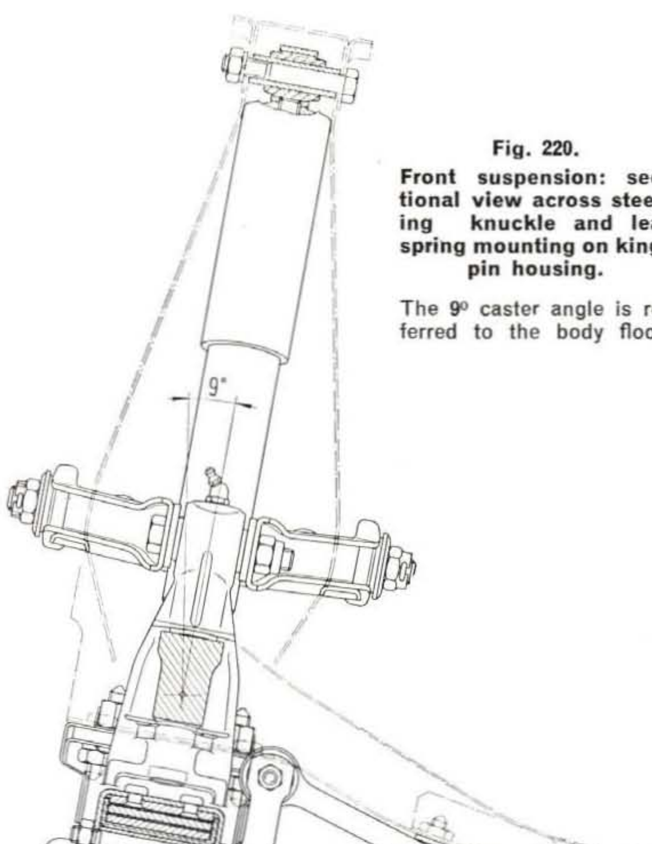



**Fig. 220.**
**Front suspension: sectional view across steering knuckle and leaf spring mounting on kingpin housing.**

The 9° caster angle is referred to the body floor.

# KINGPIN HOUSINGS

## Inspection and Repair.

Check the condition of « estendblock » bushings; the inner face should show no signs of binding and the rubber tube should not have lost elasticity.

Check that clearance between kingpin and housing bushings does not exceed .008" (0.20 mm).

Clearance of new parts is .0006" to .0021" (0.016 to 0.054 mm).

Should clearance be beyond wear limit, replace bushings and the kingpin, too, if necessary.

Use driver **A. 74016** to remove and install bushings.


**Fig. 221 - Reaming kingpin bushings.**
1. Reamer A. 90316. - 2. Reamer handle.

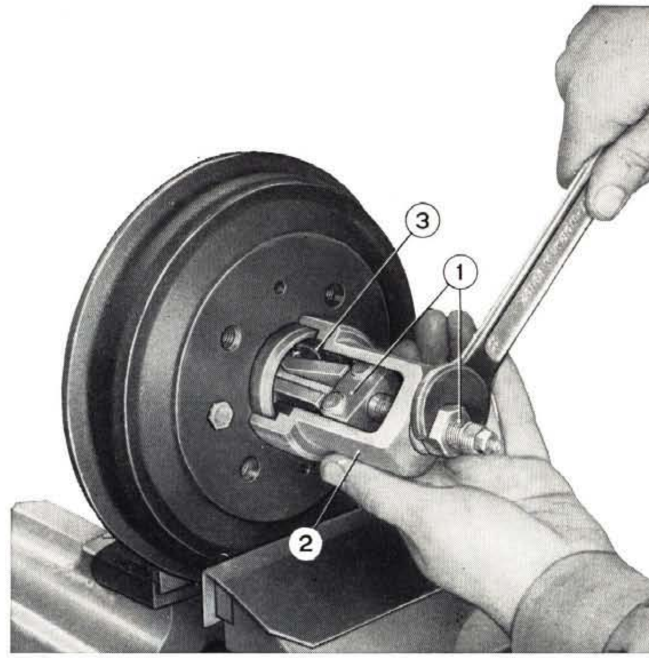



**Fig. 222 - Pulling outer bearing cup.**
1. Puller A. 47026/1. - 2. Puller bell. - 3. Bearing cup.

After installation, reface bushings by means of reamer **A. 90316** (fig. 221) to reset the specified bore of .5908" to .5922" (15.016 to 15.043 mm).

Use gauge **A. 96005** and check kingpin housing for distortion; replace the housing if distortion is evident.

## STEERING KNUCKLES AND WHEEL HUBS

### Inspection and Repair.

Thoroughly check the knuckle arm for evidence of cracks and renew it, if necessary.

Knuckle arm contact faces to bearing cones should be perfectly smooth and free from signs of seizure.

Both upper thrust washers, snap ring and lower thrust washer should not be worn, otherwise replace them.

Lower thrust washers for service come in the thicknesses tabulated on foot of page.

No appreciable clearance should be felt, on installation, between steering knuckle and kingpin housing after upper and lower thrust washers have been set.

If clearance must be corrected, replace lower thrust washer by a thinner or a thicker one.

Check the condition of roller bearings, « O » ring and hub inner faces.

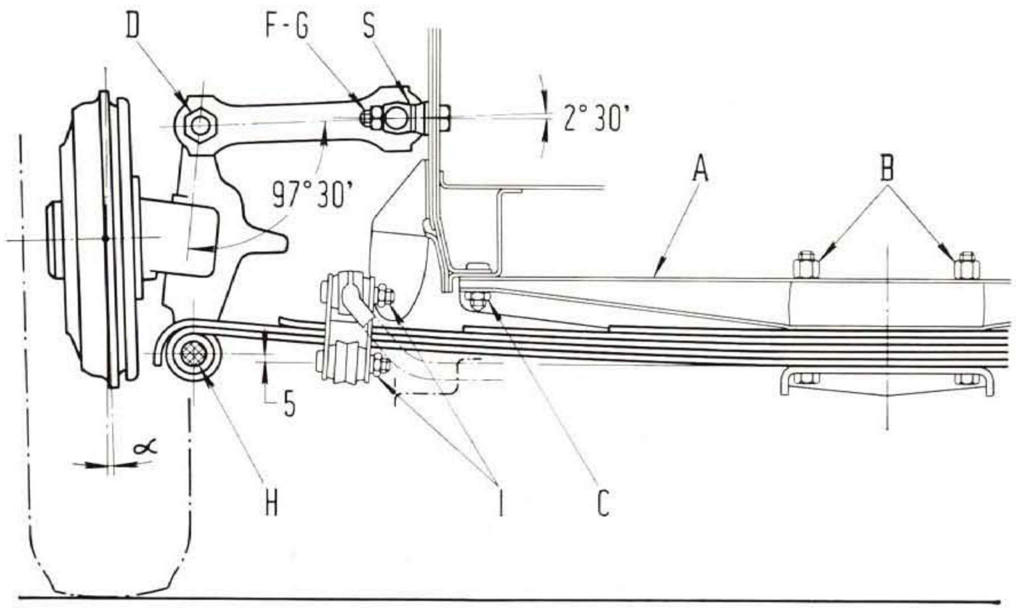
Replace damaged or otherwise unserviceable items.

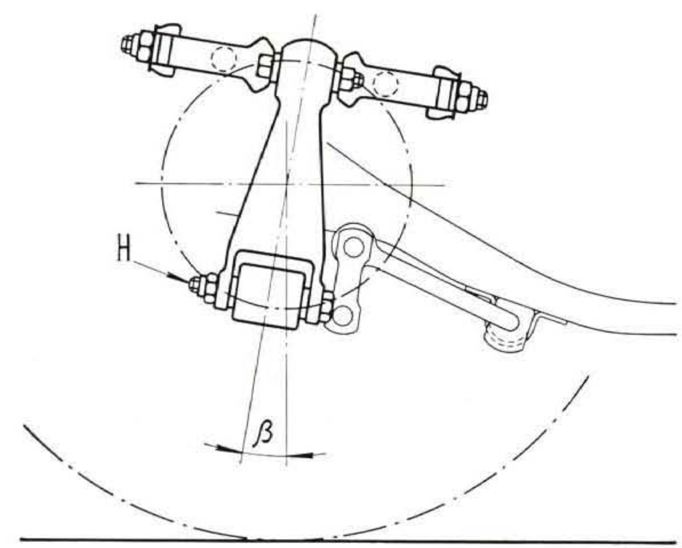
Pull outer roller bearing cup using tool **A. 47026/1** (fig. 222).

Extract inner bearing cup by means of tool **A. 47026/1** in conjunction with item **/2** (fig. 224).

## THICKNESS OF STEERING KNUCKLE LOWER THRUST WASHERS

| Washer |  | Stand. | O. S. | | | | | | U. S. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | in<br>mm | | .0020<br>0.05 | .0039<br>0.10 | .0059<br>0.15 | .0079<br>0.20 | .0098<br>0.25 | .0118<br>0.30 | .0020<br>0.05 | .0039<br>0.10 |
| Thkss | in<br>mm | .0977<br>2.482 | .0997<br>2.532 | .1016<br>2.582 | .1036<br>2.632 | .1056<br>2.682 | .1076<br>2.732 | .1095<br>2.782 | .0957<br>2.432 | .0938<br>2.382 |
| | in<br>mm | .0984<br>2.500 | .1004<br>2.550 | .1023<br>2.600 | .1043<br>2.650 | .1063<br>2.700 | .1083<br>2.750 | .1102<br>2.800 | .0964<br>2.450 | .0945<br>2.400 |



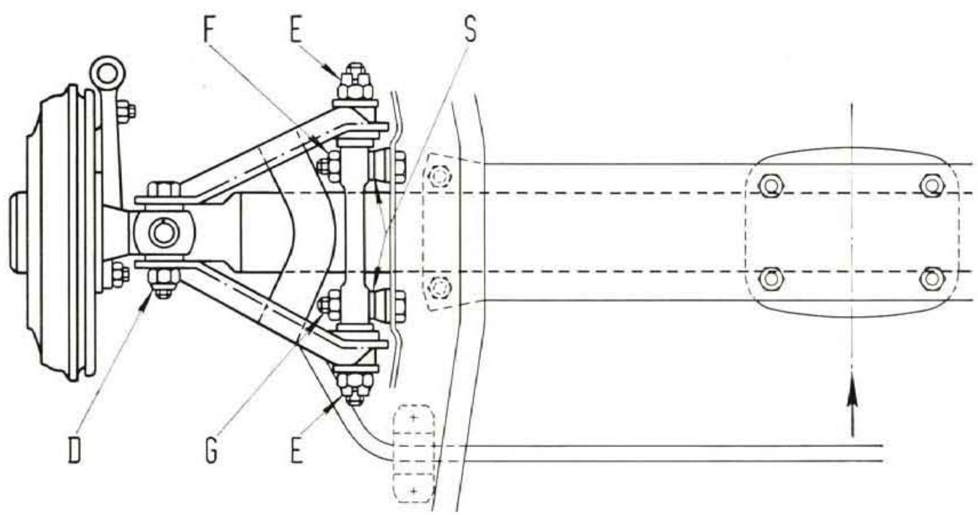




**Fig. 223 - Front end setting diagram.**

A. Semi-elliptic spring supporting rail. - B. Screws and nuts, semi-elliptic spring to cross rail. - C. Nuts, cross rail to body shell. - D. Nut, control arm to kingpin housing pin. - E. Nuts, pivot bar to control arm. - F. G. Screws and nuts, pivot bar to body shell. - H. Pin, semi-elliptic spring to kingpin housing. - I. Nuts and pins, sway bar shackle. - S. Shims, camber and caster adjustment.

5 mm = .197'' = semi-elliptic spring position under full load.

Car, under load:

$\alpha = 2^{\circ}\,10' \pm 15'$ camber.
$\beta = 9^{\circ} \pm 1^{\circ}$ caster.

Car, no load:

$\alpha = 1^{\circ} \pm 15'$ camber.
$\beta = 9^{\circ} \pm 1^{\circ}$ caster.

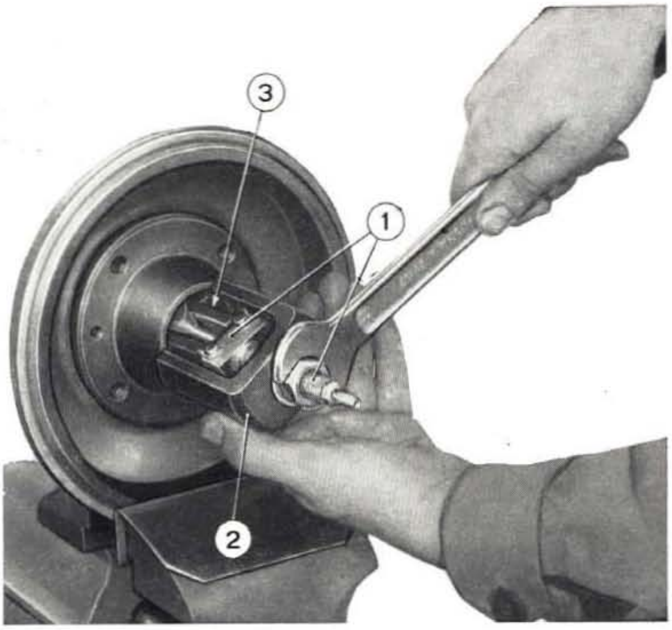



**Fig. 224 - Pulling inner bearing cup.**
1. Puller A. 47026/1. - 2. Puller bell A. 47026/2. - 3. Bearing cup.

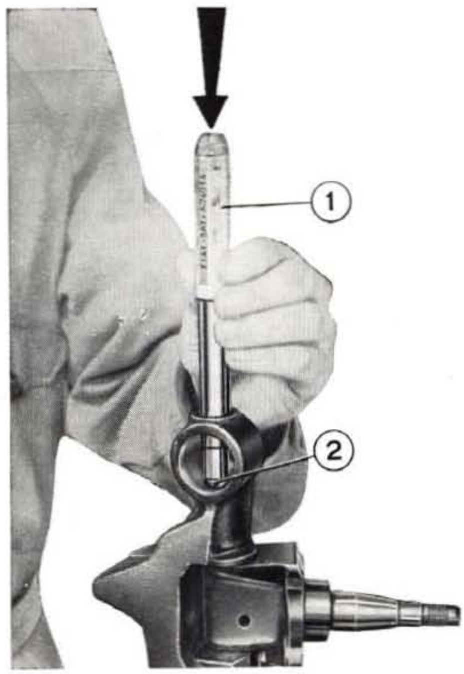



**Fig. 226 - Installing kingpin.**
1. Driver A. 74014. - 2. Kingpin.

## Assembly and Installation.

Work on a separate bench and assemble as follows:

– if « estendblock » was removed, install it into kingpin housing upper eye using driver **A. 74042** (fig. 225);

– fit the steering knuckle to the housing, setting both upper thrust washers, with snap ring, and the lower thrust washer of proper thickness, in between, so to take up any appreciable play between knuckle and pillar, though allowing free movement of the former; secure the steering knuckle pivot with the fastener;

– fit the upper control arm-to-body pin and insert relevant resilient bushings by means of driver **A. 74044** (fig. 227).

In order to avoid that rubber bushings are submitted to excessive torsional strain during oscillation of control arms, proceed as follows:

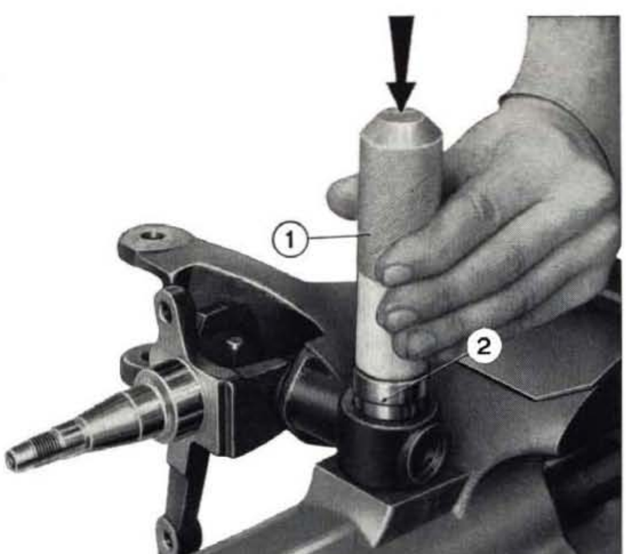



**Fig. 225 - Inserting « estendblock » bushing in kingpin housing upper eye.**
1. Driver A. 74042. - 2. « Estendblock » bushing.

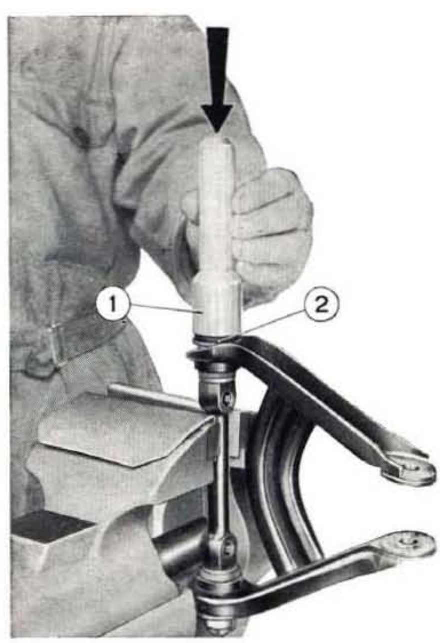



**Fig. 227 - Installing upper control arm bushings.**
1. Driver A. 74044. - 2. Resilient bushing.

**Fig. 228 - Using torque wrench to secure upper control arm to kingpin housing.**

a) tighten the nuts (E) of control arm pivot bar with the arm set at an angle of 2° 30′ to the pivot bar (fig. 223);

b) tighten the nut (D), knuckle pillar-to-control arm pin, with the arm set at an angle of some 97° 30′ to the knuckle pillar (fig. 223);

– fit the brake backing plate assembly to the steering knuckle, drawing up nuts with 14.5 ft.lbs (2 kgm) of torque;

– fit the roller bearings, the snap ring and gasket to the hub-drum;

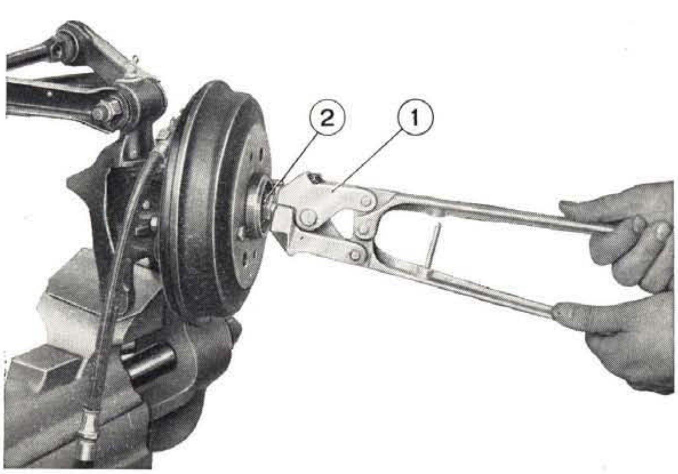



**Fig. 229 - Staking steering knuckle nut.**
1. Nut staking pliers A. 74128. - 2. Steering knuckle nut.

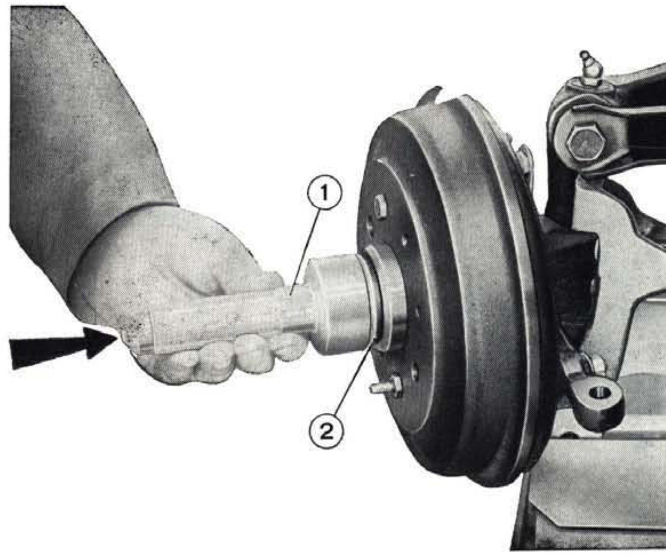



**Fig. 230 - Installing wheel hub cap.**
1. Driver A. 74088. - 2. Wheel hub cap.

– fit the hub-drum to the steering knuckle;

– fit the nut and washer securing the wheel hub to the steering knuckle;

– fit the hub cap to the hub (fig. 230).

**NOTE - For installation, adjustment and lubrication of bearings proceed as outlined on pages 137 and 138.**

Connect the control arm to the wheel assembly prepared as above, and lock it by means of a screw and nut.

Slide the control arm pin on to both studs welded to body side panels, thus supporting the suspension-wheel assembly.

Secure the semi-elliptic spring to the cross rail and the spring-rail assembly to body shell (fig. 231); tighten mounting nuts (B and C, fig. 223).

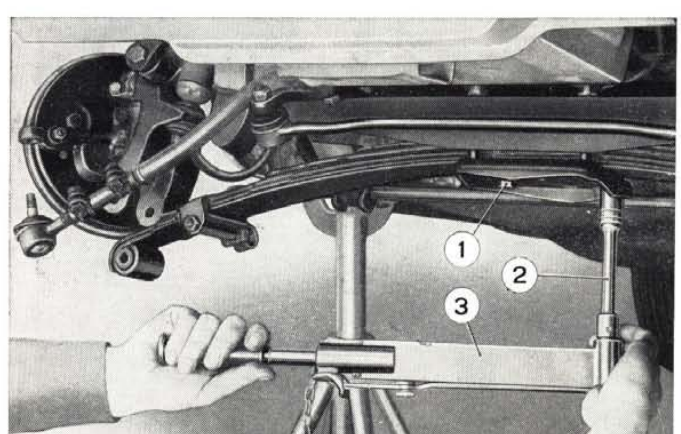



**Fig. 231 - Securing semi-elliptic spring to body shell.**
1. Semi-elliptic spring mounting screw. - 2. Torque wrench extension. - 3. Torque wrench.

Semi-elliptic spring mounting nuts to cross rail should be drawn up with 43.4 ft.lbs (6 kgm) of torque and cross rail mounting nuts to body shell should be drawn up with 32.5 to 36.2 ft.lbs (4.5 to 5 kgm) of torque.

Install the shock absorber; the mounting nut to body shell must be drawn up with 24.6 ft.lbs (3.4 kgm) of torque and the mounting nut to kingpin housing with 21.7 ft.lbs (3 kgm) of torque.

Affix tools **A. 74134**, right and left, at top of buffer mounting bracket (fig. 232).

Set the semi-elliptic spring under full static load; in these conditions the distance between the spring end eye centerline and the lower face of the spring, at rail center mounting, should be .197" (5 mm) (fig. 223).

Connect the kingpin housing to the spring end eye, inserting the pin. Draw up the pin self-locking nut with 65.1 ft.lbs (9 kgm) of torque.

Install the sway bar and tighten the bar shackle nuts (1, fig. 223) to 10.8 ft.lbs (1.5 kgm) of torque.

---

**NOTE - The semi-elliptic spring should be all the time under « static load » under the action of tools A. 74134, as outlined earlier. This point must be particularly stressed, in view of the presence of « silentblock » bushings.**

---

Slide off the control arm pivot bar and insert the spacers and shims on studs (fig. 233), in the same number as counted on disassembly.

Fit the control arm pin and tighten the pin nuts to 32.5 to 36.2 ft.lbs (4.5 to 5 kgm) of torque.

Take down tools **A. 74134**, connect the steering rods and the hydraulic lines.

Next to the suspension assembly (the procedure covers both wheel sides), check and adjust caster and camber as outlined in the paragraph hereafter.

## CHECKING AND ADJUSTING FRONT END GEOMETRY

To adjust camber ($\alpha$, fig. 223) and caster ($\beta$), set the car under load and place shims (S) between the control arm pivot bar and the spacers at body-welded studs (F and G).

Increase caster ($\beta$, fig. 223) by shifting shims from the rear screw (G) to the front screw (F, fig. 223); reverse the step to decrease caster.

Increase camber ($\alpha$, fig. 223) by adding an even number of shims at both screws F and G; reverse the step to decrease camber.

Adding or removing shims (1 and 2, fig. 233) in the same quantity allows adjustment of camber without affecting caster setting.

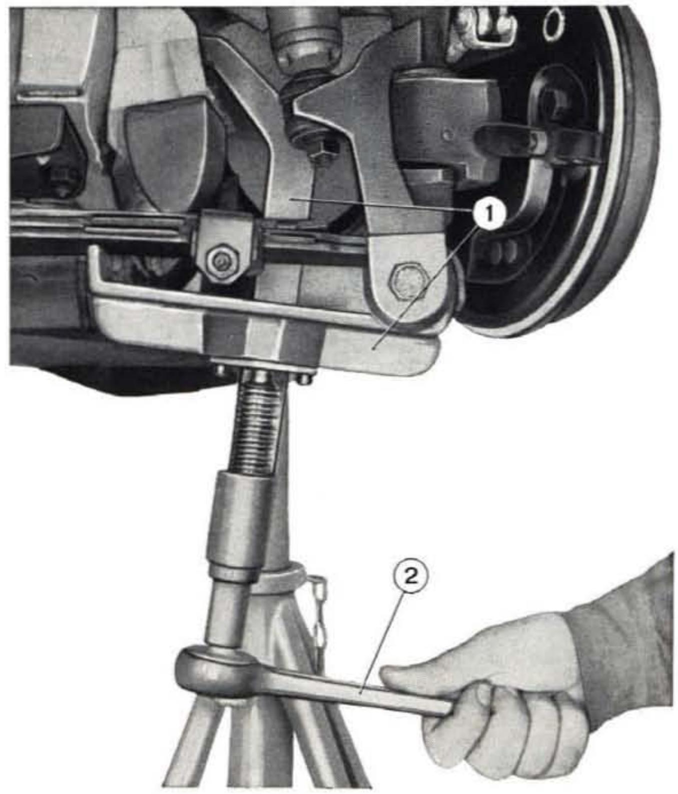



**Fig. 232 - Setting semi-elliptic spring at « static load ».**
1. Tool A. 74134 stressing semi-elliptic spring. - 2. Ratchet wrench A. 89854 for tool operation.

**Front end geometry angles are the following:**

- car loaded:
  camber $\alpha = 2^\circ 10' \pm 15'$;
  caster $\beta = 9^\circ \pm 1^\circ$;
- car unloaded:
  camber $\alpha = 1^\circ \pm 15'$;
  caster $\beta = 9^\circ \pm 1^\circ$.

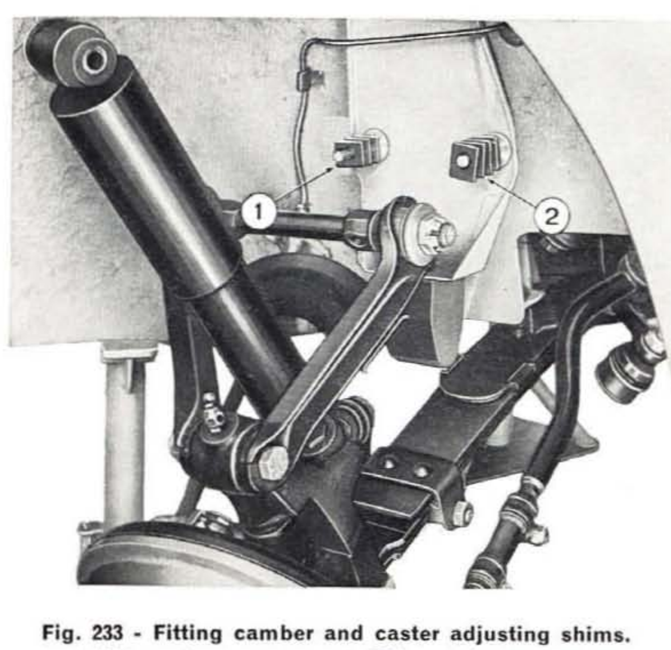



**Fig. 233 - Fitting camber and caster adjusting shims.**
1. Shims at rear screw. - 2. Shims at front screw.

**NOTE - For the check of front end geometry the car should be set in conditions shown in fig. 235. Mounting nuts D, E, H and I (fig. 223) must be tightened to specified torques (see chart) exclusively with the car in such conditions.**

Check camber and caster using fixture **Ap. 5106** as follows:

– set the car « under load » (see note hereafter);

**NOTE - Car « loaded » conditions are the following:**
**— four people;**
**— 66 lbs (30 kg) in front luggage compartment;**
**— 22 lbs (10 kg) on rear luggage floor.**

– inflate tires to recommended pressure;

– if necessary, adjust clearance of front wheel bearings and between kingpin and bushings;

– adjust clearance between steering worm and sector;

– check tie rod end ball studs for excessive play;

– replace or rebuild shock absorbers, if they are inoperative.

Next set the car on a flat surface with the steering wheel at mid-travel and road wheels for straight ahead drive.

Raise front wheels and arrange turntables of fixture **Ap. 5106** thereunder.

Set the sector scale « O » on turntable top at the pointer on base.

Affix the fixture to the wheel, as shown in fig. 234, and check camber and caster as follows.

## Checking Camber.

With the fixture clamped to the wheel and the gauge perpendicular to car centerline (fig. 234), read the value of camber angle on « Camber » scale of gauge at the gauge pointer: camber should be $2^\circ\,10' \pm 15'$.

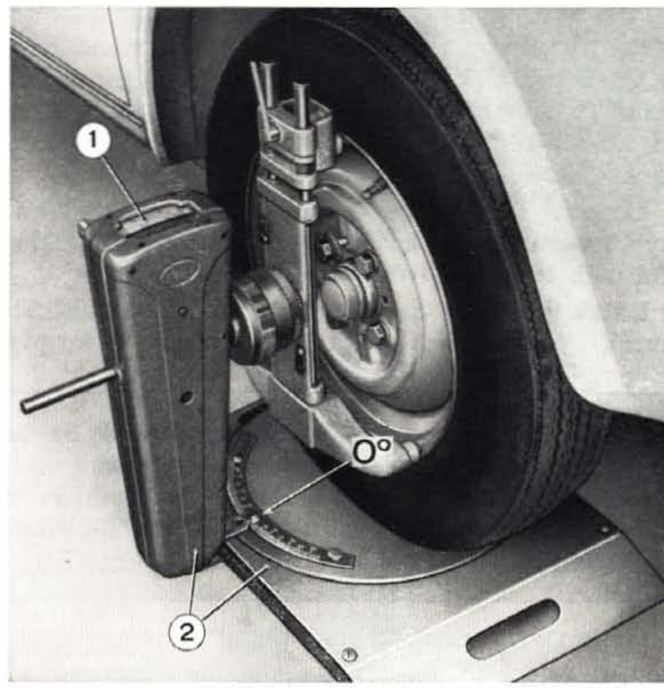



**Fig. 234 - Checking camber.**
1. « Camber » angle. - 2. Fixture Ap. 5106.
The road wheel should be set for straight-ahead drive and the turntable sector scale at zero.

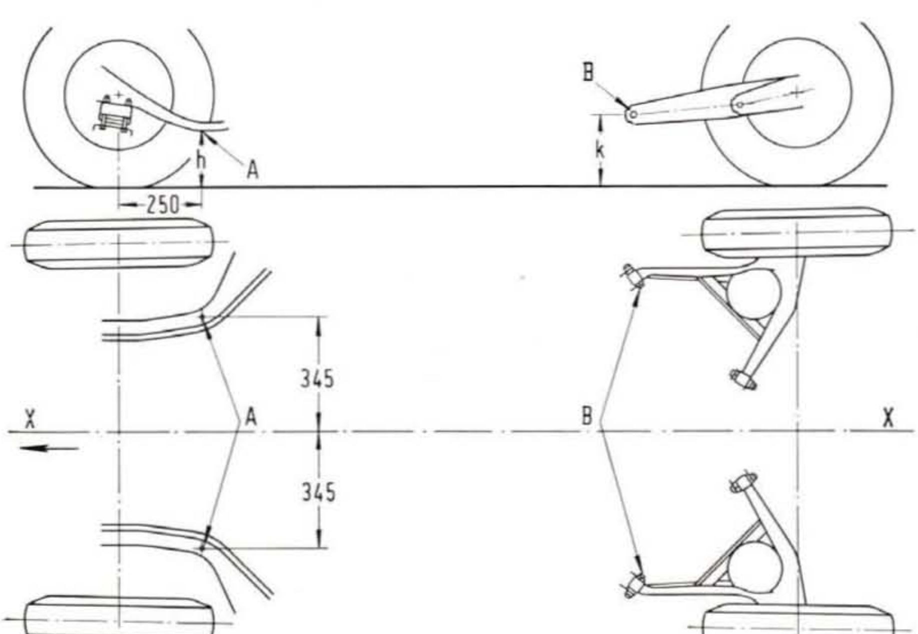



**Fig. 235.**
**Diagram showing car conditions (ground clearance) for checking and adjusting front and rear end geometry.**

A - B. Measure ground clearance at these points. - X - X. Car centerline.

Car, under load:
h = 6.102″ ± .188″ (155 ± 3 mm).
k = 7.716″ ± .188″ (196 ± 3 mm).

Car, no load:
h = 7.677″ ± .188″ (195 ± 3 mm).
k = 9.291″ ± .188″ (236 ± 3 mm).

**WARNING! - When checking camber angle, read the value as above, then steer the wheel 180° and take a new reading; figure the average of two readings to obtain the correct value. Thanks to this procedure any mistakes due to wheel misalignment are corrected.**

## Checking Caster.

Still with the fixture gauge in perpendicular position to car centerline, steer the wheel 20° out and set « O » of « Caster » (movable) scale at gauge pointer (fig. 236).

Steer the wheel 20° in and read the value of caster angle on « Caster » scale (fig. 237). Caster should be $9^\circ \pm 1^\circ$.

Should camber and caster angles not comply with specifications, adjust as outlined earlier in this chapter.

**NOTE - Check and adjustment of front wheel toe-in are covered in detail on page 168.**

# FRONT SWAY ELIMINATOR

## Description, Inspection and Repair.

The sway bar has been designed to assure better car stability, especially on turns.

No particular directions are required for service of the bar: as a matter of fact the only parts subject to wear are rubber cushions and bushings which are situated at the clamping points of the bar to the spring and body shell.

Check the wear condition of cushions and bushings and replace them by new ones, if necessary.

Also check the bar for absence of distortions, otherwise renew it.

# FRONT WHEELS

The front wheel bearings are secured to the hub by means of nuts being locked against the steering knuckle by a single staking.

When servicing the wheel hubs, free the hub nut using a punch and then undo it.

**NOTE - When reinstalling the wheel hubs, use care to always replace mounting nuts by new ones.**

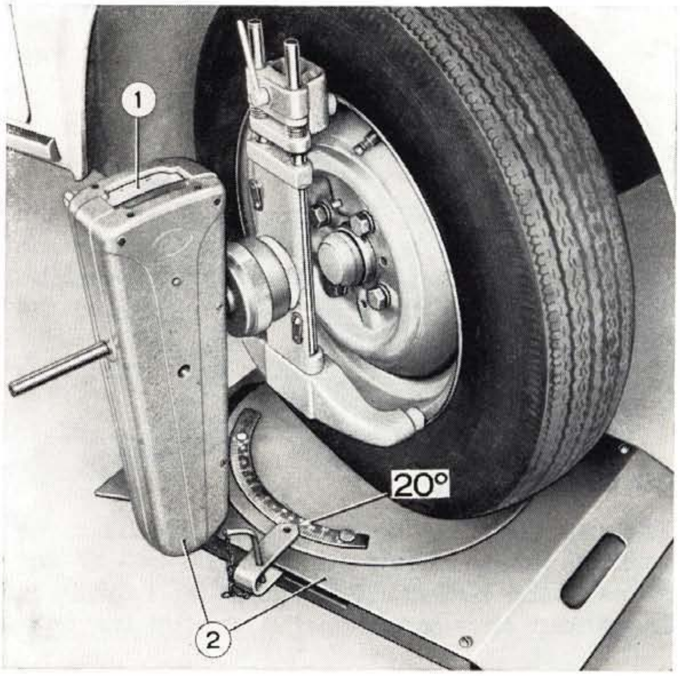



**Fig. 236 - Checking caster (first step).**
1. « Caster » scale, set at zero. - 2. Fixture Ap. 5106.
The wheel should be steered 20° out.

## Lubrication Directions.

When mounting the roller bearings, lubricate with FIAT MR 3 grease.

**BEARINGS**

The bearings must not be installed without lubricant.

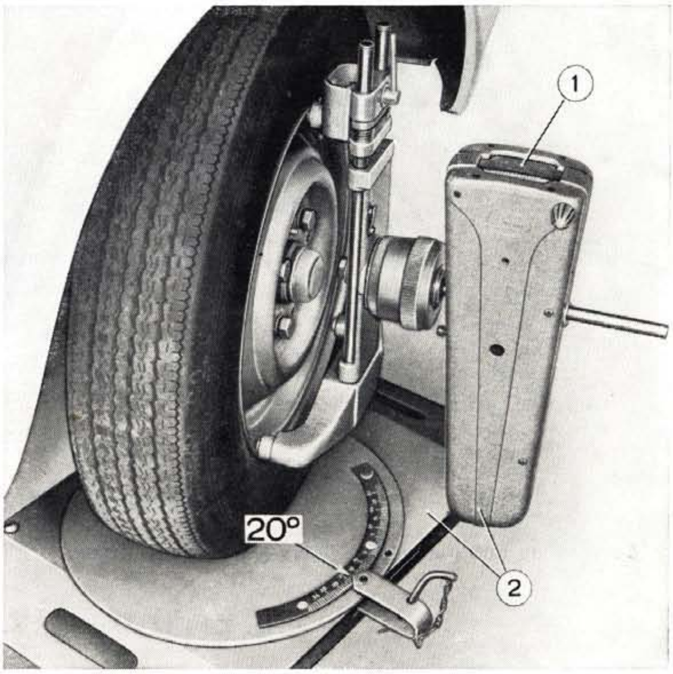



**Fig. 237 - Checking caster (second step).**
1. « Caster » angle. - 2. Fixture Ap. 5106.
The wheel should be steered 20° in.

Before installation on steering knuckles, the space between cage and bearing cone must be packed with grease.

### WHEEL HUB

The hub must not be completely filled but the amount of grease should be such as to guarantee a thorough lubrication of the outer bearing and be distributed all around in the pocket between the bearing cups.

Amount of grease specified for each hub: 1 oz (30 gr).

### HUB CAP

The cap need not be completely filled but the amount of grease should be such (7/8 oz - 25 gr) that the space between cap and outer bearing is fully packed after mounting the cap on the hub.

## Adjustment Directions.

Torque wrenches must be accurate within $\pm 5\%$.

Before securing the hub make sure the nut screws in freely, then tighten with 14.5 ft.lbs (2 kgm) of torque while rocking the wheel hub 4 or 5 times to guarantee proper setting of bearings; at this point, undo the nut all the way and finally tighten with a torque of 5.1 ft.lbs (0.7 kgm).

Next, back out the nut 30°. To do so, punch a mark (B, fig. 238) on the nut washer at a point corresponding to the center of one of the six flats of the nut, then unscrew the nut until the adjacent corner (A, fig. 238) comes in alignment with the punch mark.

Once the nut has been slackened as required, lock it in that position by staking its collar with pliers **A. 74128** (fig. 229) into the groove machined in the steering knuckle threaded end, then rock again the hub.

The hub end play should be .0010" to .0039" (0.025 to 0.100 mm).

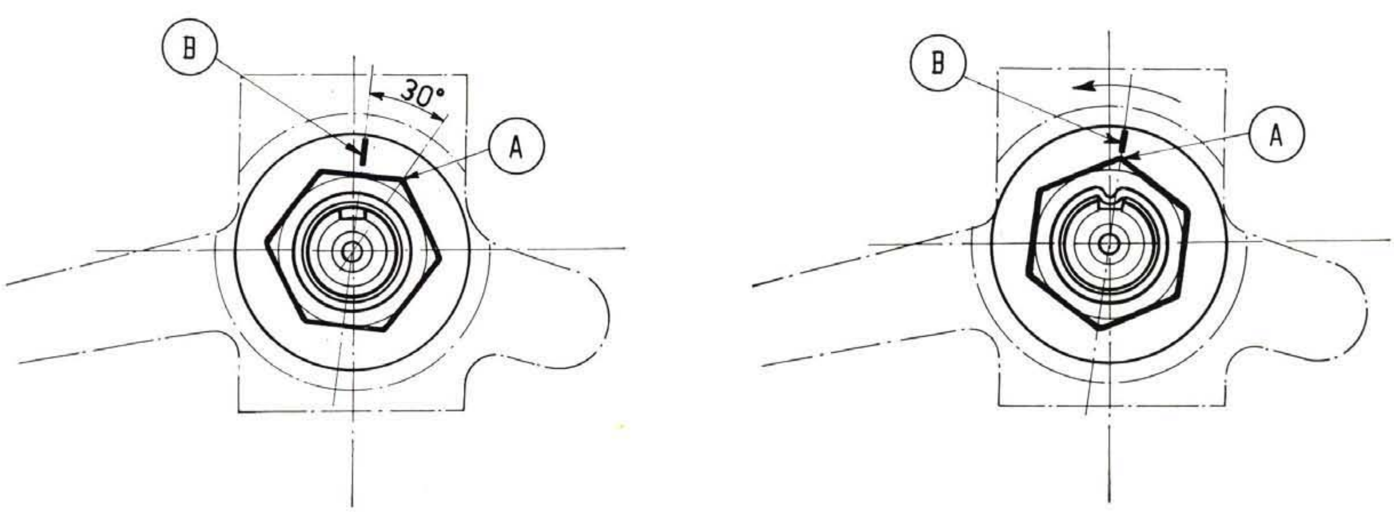
## Inspection.

The wheel hub end play can be checked with either the wheel on or down, as directed hereafter.

### CHECK WITH WHEEL OFF

After removing the hub cap, push the brake drum straight on towards car, then apply a dial indicator with magnetic base to the flat face of the drum (fig. 239).

Touch the dial indicator plunger to the end of the steering knuckle spindle and set the indicator at zero in such conditions. Pull the drum all the




Drawing up hub nut with 5.1 ft.lbs (0.7 kgm) of torque.

Backing out hub nut 30°.

**Fig. 238 - Locking and adjusting front wheel hubs.**

A. Corner of the nut. - B. Mark on nut washer.

The figure shows the adjustment of the left front hub. To adjust the right hub, the procedure should be reversed because the nut is left hand threaded.

way outward: the resulting movement, such as registered by the dial needle, will correspond to the end play of the wheel hub.

---

**WARNING - When only the hub adjustment is necessary, first replace the nut, then adjust as directed above.**

**The hub end play must be taken up only when it exceeds .0051″ (0.13 mm).**

---

## CHECK WITH WHEEL ON

After removing the wheel cover and hub cap, undo a wheel screw then affix bracket **A. 74029** to rim by said screw. Push the wheel straight on towards car then apply on bracket the dial indicator with magnetic base plate and proceed according to previous description reading the end play on the dial.

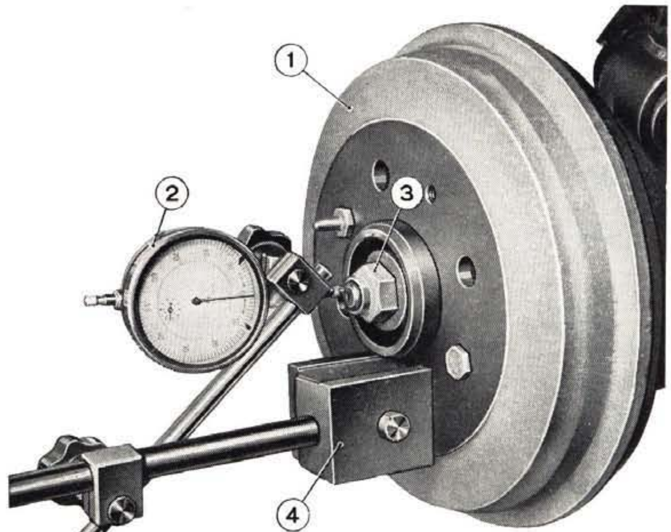



**Fig. 239 - Using dial indicator with magnetic base to check wheel hub end play.**

1. Brake drum. - 2. Dial indicator. - 3. Wheel hub nut. - 4. Magnetic base for dial indicator.

**Fig. 240 - View of mechanical units of car front end.**

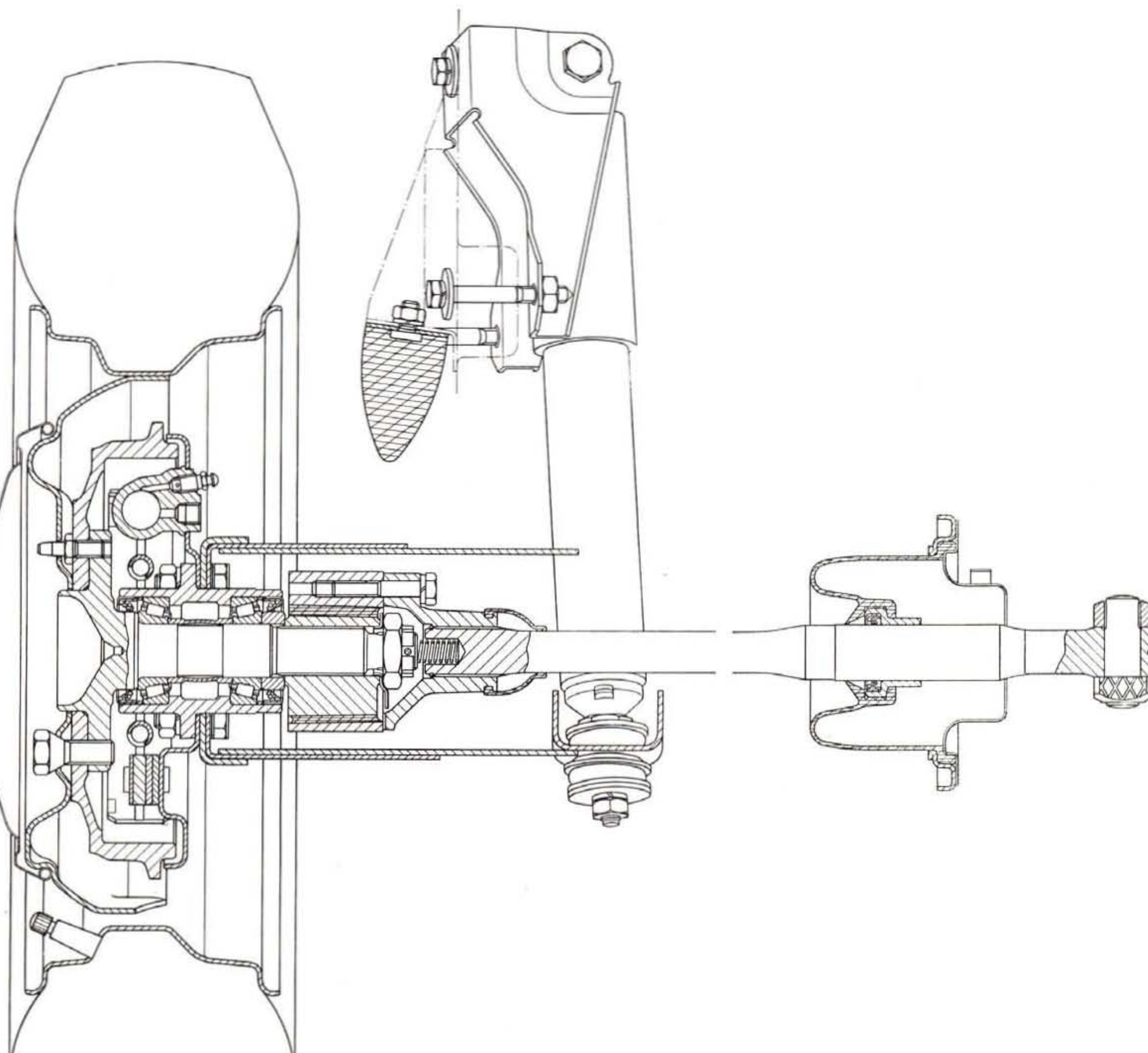


Fig. 241.

**Side sectional view of car rear end across wheel hub, drum, wheel cylinder, axle shaft, oil boot and right side rear wheel slip joint pin.**

Up to car with spare parts number **187047.**

# Section 6

## REAR SUSPENSION AND WHEELS

## SHOCK ABSORBERS



6

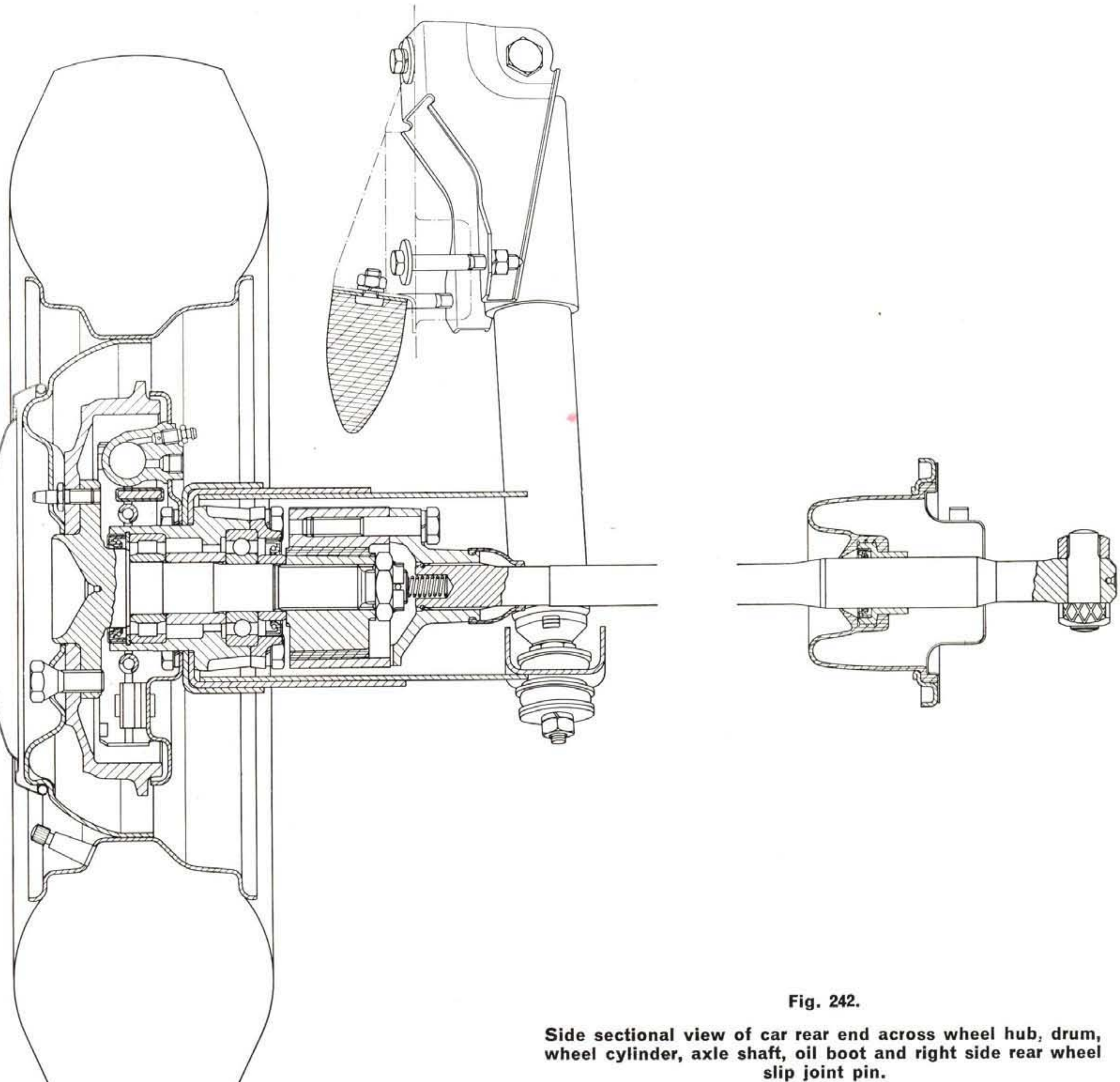


Fig. 242.

**Side sectional view of car rear end across wheel hub, drum, wheel cylinder, axle shaft, oil boot and right side rear wheel slip joint pin.**

Starting from car with spare parts number **187048.**

# REAR SUSPENSION AND WHEELS



## SPECIFICATIONS AND DATA

| | | |
|---|---|---|
| **Control arms.** | | |
| Connection to underbody | « silentblock » bushings | |
| Adjustment | shims | |
| Position for tightening: | | |
| – underbody bracket screws | wheels toed in by 0° 12′ ±6′ | |
| – arm pin nuts at underbody | car loaded | |
| | Up to car with parts serial N° 005083 | From car with parts serial N° 005084 |
| **Coil springs** | two | two |
| Free height | 9.370″ (238 mm) | 9.567″ (243 mm) |
| Height under 1257 ±55 lbs (570 ±25 kg) of load | 6.457″ (164 mm) | 6.653″ (169 mm) |
| Height under 1817 lbs (824 kg) of load | 5.157″ (131 mm) | 5.354″ (136 mm) |
| Deflection rate (between 838 and 1653 lbs - 380 and 750 kg) | .232 in/100 lbs (13 mm/100 kg) | .232 in/100 lbs (13 mm/100 kg) |

*(continued)*

**Specifications and Data** *(continued)*.

| | |
|---|---|
| **Wheels.** | |
| Roller bearing adjustment | collapsible spacer |
| Wheel bearing rolling torque, not above | .36 ft.lbs (5 kcm) |
| Toe-in (both wheels): | |
| – with wheel in vertical position | 0° 12′ ±6′ |
| – with car fully loaded | .157″ to .236″ (4 to 6 mm) |
| – with car unloaded | .000″ to .079″ (0 to 2 mm) |
| Bearing lubrication | FIAT MR 3 grease |
| **Shock absorbers** | two |
| Type | hydraulic, telescopic, double acting |
| Working cylinder bore, abt. | 1.063″ (27 mm) |
| Length (between upper end eye center and lower mounting face): | |
| – retracted | 9.921″ (252 mm) |
| – extended: abutting begins | 14.803″ (376 mm) |
| – extended: maximum actual expansion (*) | 15.197″ (386 mm) |
| Travel (abutting begins) | 4.882″ (124 mm) |
| Setting: compression | .059″ to .157″ (1.5 to 4 mm) |
| Setting: rebound | .512″ to .669″ (13 to 17 mm) |
| Oil capacity | .264 G.B. pts - .317 U.S. pts (0.15 lt - 0.135 kg) |
| Oil grade | FIAT S.A.I. |

(*) Corresponds to the inner buffer being crushed under an axial load of 661 lbs (300 kg).

# REAR SUSPENSION TROUBLE DIAGNOSIS AND CORRECTIONS

## Sag at One Wheel.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Check tires and inflate to recommended pressure. |
| 2) Weak or snapped coil spring. | 2) Check camber of loaded spring and replace spring if it is out of specifications (page 149) or snapped. |
| 3) Poor dampening action of shock absorber. | 3) Overhaul shock absorber and replace worn parts. |

## Irregular or Abnormal Tire Wear.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Tires should be inflated, front and rear, to recommended pressure. |
| 2) Wheels out of balance. | 2) Inspect and fix as directed under « Wheels and Tires ». |
| 3) Wheels off center. | 3) Inspect and fix as directed under « Wheels and Tires ». |
| 4) Misadjusted brakes. | 4) Adjust brakes as outlined under « Brakes ». |
| 5) Weak or snapped coil springs. | 5) Check camber of loaded spring and replace spring if not within specifications (page 149), or snapped. |
| 6) Excessive load. | 6) See load specifications, page 6. |
| 7) Incorrect wheel alignment. | 7) Check and adjust rear wheel toe-in as outlined on page 153. |

## Squeaks, Thumps, or Rattles.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Wheels out of balance. | 1) Inspect and fix as directed under « Wheels and Tires ». |
| 2) Wheels off center. | 2) Inspect and fix as directed under « Wheels and Tires ». |
| 3) Misadjusted brakes. | 3) Adjust brakes as outlined under « Brakes ». |
| 4) Weak or snapped coil springs or spring seats dislodged. | 4) Check camber of loaded spring and replace spring if not within specifications (page 149), or snapped. Replace upper and lower rubber seats, if damaged. |
| 5) Wear of shock absorbers causes poor dampening action. | 5) Overhaul shock absorbers. |
| 6) Worn rubber bushings in control arms. | 6) Replace bushings by new ones. |
| 7) Poor lubrication of wheel bearings. | 7) Proceed as directed on page 149. |

## Pull to One Side.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Check pressure of tires and inflate as recommended. |
| 2) Misadjusted brakes. | 2) Adjust brakes as directed under « Brakes ». |
| 3) Distorted control arm. | 3) Remove, check on test equipment (see page 148), straighten arm, if possible, and set correctly on installation. |

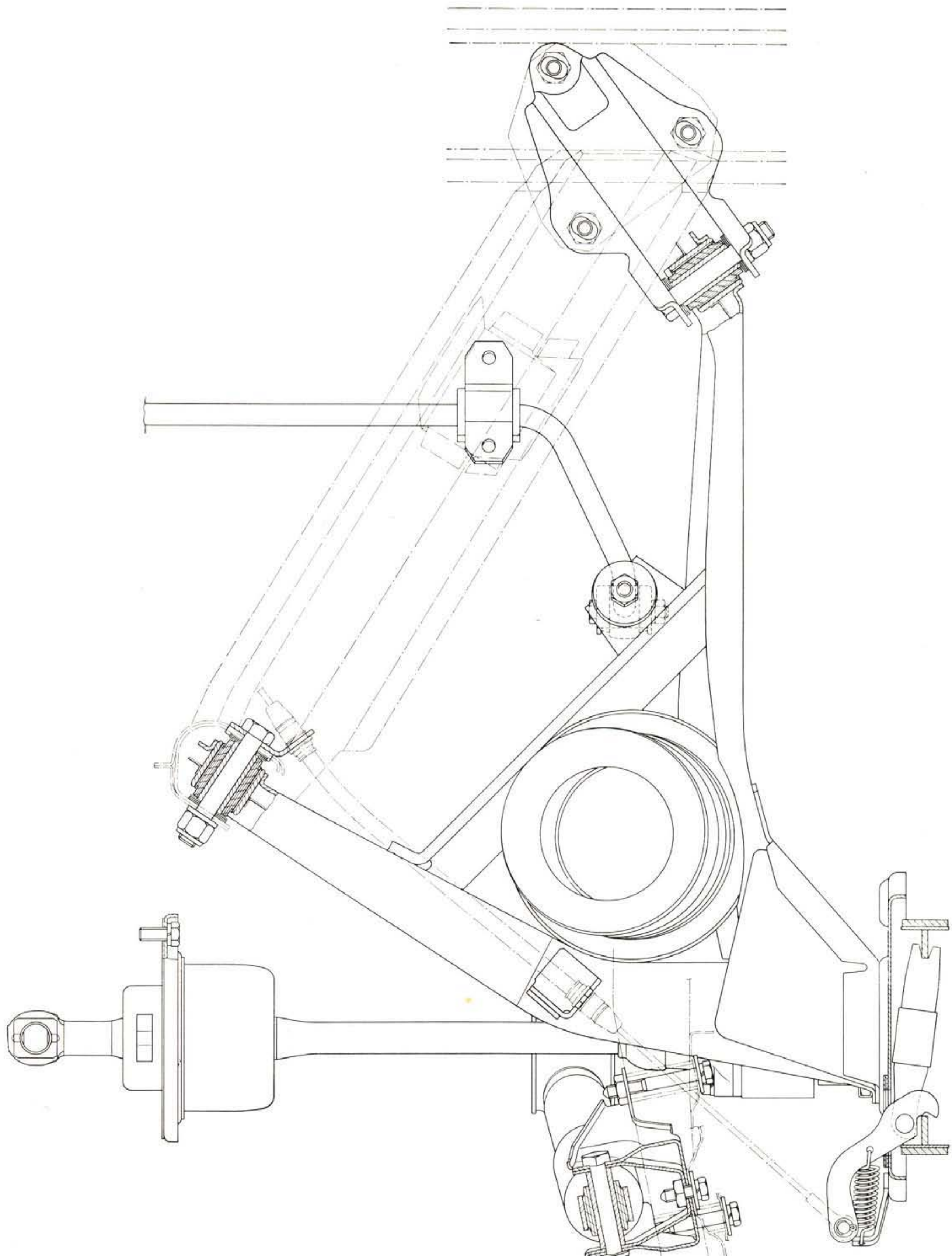


Fig. 243.

**Rear suspension: sectional views across control arm and shock absorber mounting bushings, and brake backing plate.**

## Removing Suspension.

Jack up the car at rear and set it on stands.

Take down a wheel, disconnect shock absorber at rear using wrench **A. 57068** and tie off axle shaft from wheel shaft joint.

Disconnect the handbrake control cable from brake shoe actuating lever and the hydraulic brake line from hose, after plugging up brake fluid reservoir outlet port.

Disconnect the sway bar at control arm and the transmission mounting bracket.

---

**NOTE - For inspection and repair of sway bar, refer to procedures covering front sway eliminator, page 137.**

---

Back out control arm-to-body shell mounting screws at front and rear, observe the number and arrangement of shims and, using the hydraulic jack, remove the control arm assembly and then the coil spring.

Repeat above procedure at the other arm and remove it.

## CONTROL ARMS

## Disassembly, Inspection and Repair.

Disassemble the control arm.

This operation does not involve any particular difficulty, but some suggestions are outlined hereafter for more ease of operator.

After the rear wheel hub has been pulled (fig. 245), remove the ball bearing retainer plate and, using ram puller **A. 40006/1** with tool **A. 40005/4** attached, withdraw the ball bearing (fig. 246).

Driver **A. 74034** is of use to remove the roller bearing cup (fig. 247).

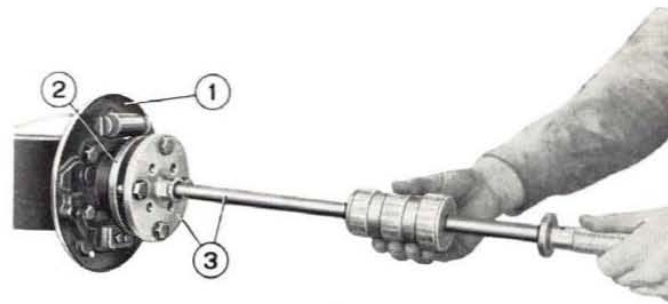



**Fig. 245 - Pulling rear wheel hub.**

1. Brake backing plate. - 2. Wheel hub. - 3. Ram puller A. 47017 for rear wheel hubs.

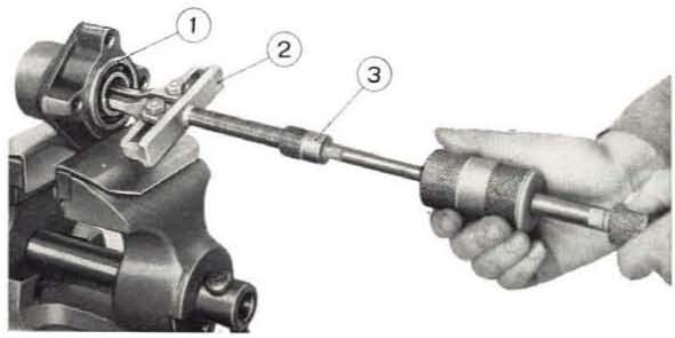



**Fig. 246 - Pulling rear wheel ball bearing.**

1. Rear wheel hub. - 2. Tool A. 40005/4. - 3. Ram puller A. 40006/1.

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**NOTE - Whenever roller bearing has been removed it must be necessarily replaced by a new one.**

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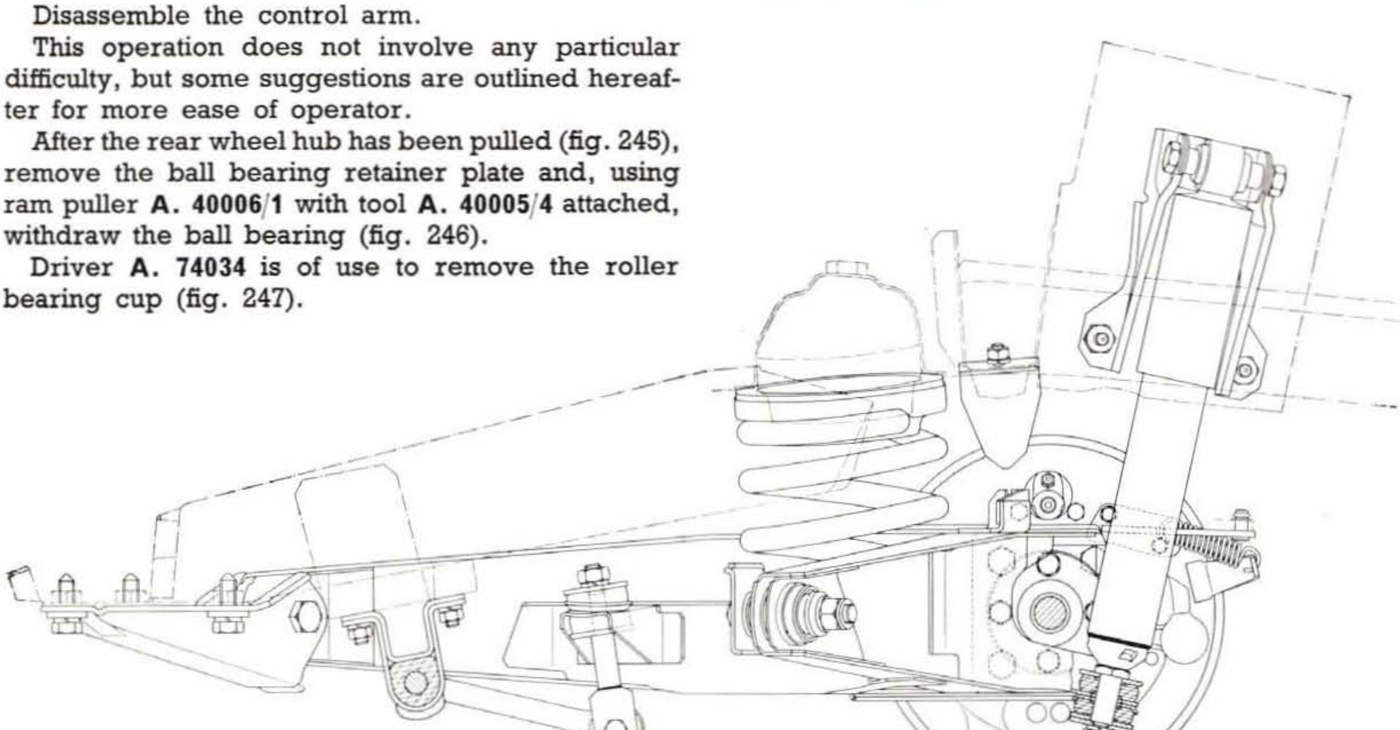

**Fig. 244.**

**Sectional view of rear end across sway bar mounting and shock absorber lower mounting.**

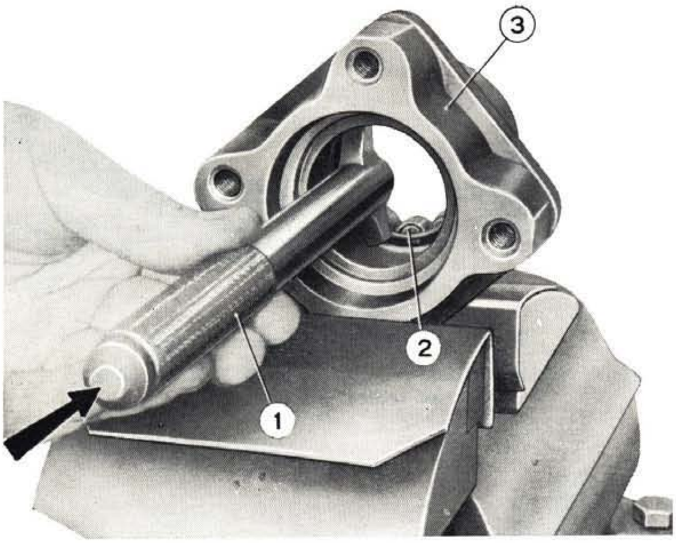


**Fig. 247 - Removing roller bearing cup.**

1. Driver A. 74034. - 2. Roller bearing cup. - 3. Rear wheel hub.

Driver **A. 74053** is of use to remove control arm bushings, as shown in fig. 248.

Check ball and roller bearings for top efficiency and replace as required.

Sliding surfaces of wheel shaft must show no sign of binding or deep scores; replace damaged parts. The same directions apply to bearing spacers, too.

**Always** renew spring-type oil seals which have been removed.

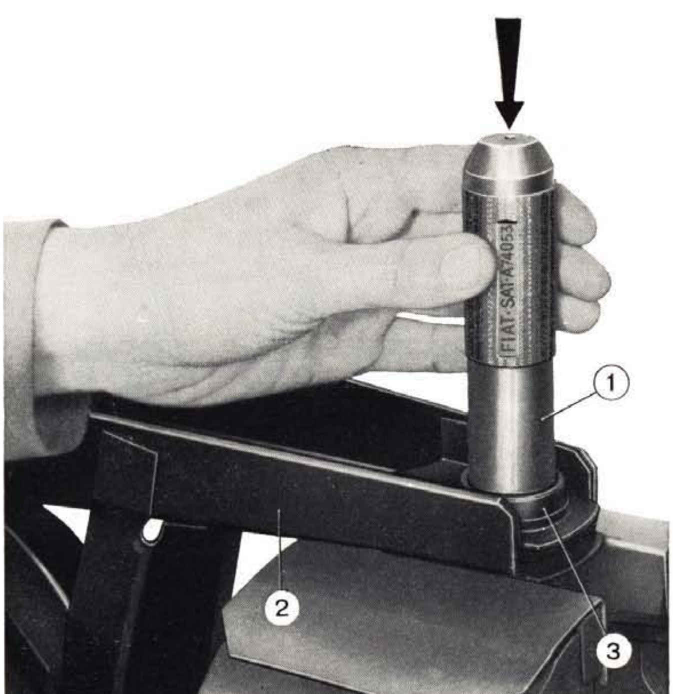


**Fig. 248 - Installing control arm bushing.**

1. Driver A. 74053. - 2. Control arm. - 3. Resilient bushing.

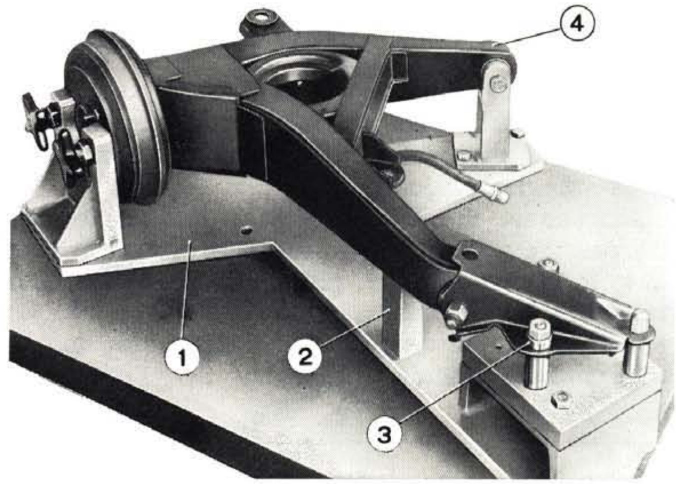


**Fig. 249 - Checking control arm and drum assembly.**

1. Fixture A. 74142. - 2. Fixture dowel. - 3. Shims, arm to fixture. - 4. Control arm.

## Adjustment.

Place the control arm, complete with bushings, on fixture **A. 74142** (fig. 249) and check it for distortions.

In case of minor distortions, correct them so that the arm is located correctly to fixture dowels; otherwise replace arm assembly.

If resilient bushings, alone, have been replaced, proceed as follows prior to removing arm from fixture:

— insert three shims between bushing and mounting plate;

— determine the number of shims required to take up clearance at (2, fig. 250), between bushing and shoulders.

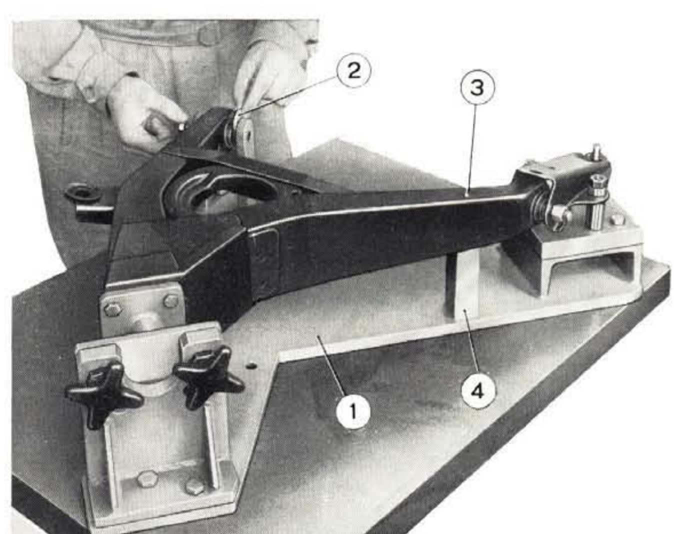


**Fig. 250 - Adjusting rear control arm.**

1. Fixture A. 74142. - 2. Shims. - 3. Control arm. - 4. Fixture dowel.

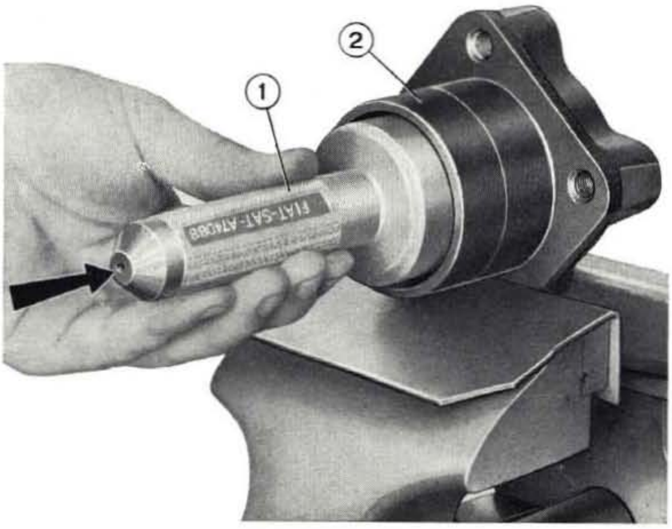


**Fig. 251 - Installing roller bearing cup.**
1. Driver A. 74088. - 2. Rear wheel hub.

## Assembly.

For the assembly of the control arm just reverse the disassembly procedure and recall the following:

– install roller bearing cup using driver **A. 74088** (fig. 251);

– install resilient bushings using driver **A. 74053**;

– lubricate bearings liberally with FIAT MR 3 grease;

– draw up all mounting nuts and screws with torques tabulated on page 193.

## COIL SPRINGS

Check to make sure that coil springs register correct deflection rate and show no cracks; otherwise replace springs.

Examine the condition of rubber seats and renew them, if damaged.

Coil spring specifications:

– wire diameter . .594" ±.002" (15.1 ±0.05 mm)
– inner diameter . . . . . . 3.976" (101 mm)
– active turns . . . . . . . . . . . 4
– total turns . . . . . . . . . . . . 6
– direction of winding . . . . . . . clockwise

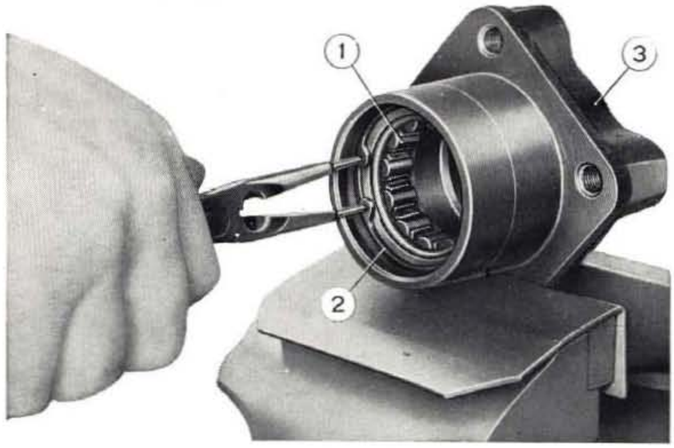


**Fig. 252 - Installing roller bearing snap ring.**
1. Bearing cup. - 2. Bearing snap ring. - 3. Rear wheel hub.

Coil springs are graded into two categories:

– a yellow paint daub on center turns identifies springs which, under a load of 1,653 lbs (750 kg), develop a length in excess of 6.457" (164 mm) (early type) or 6.653" (169 mm) (late type);

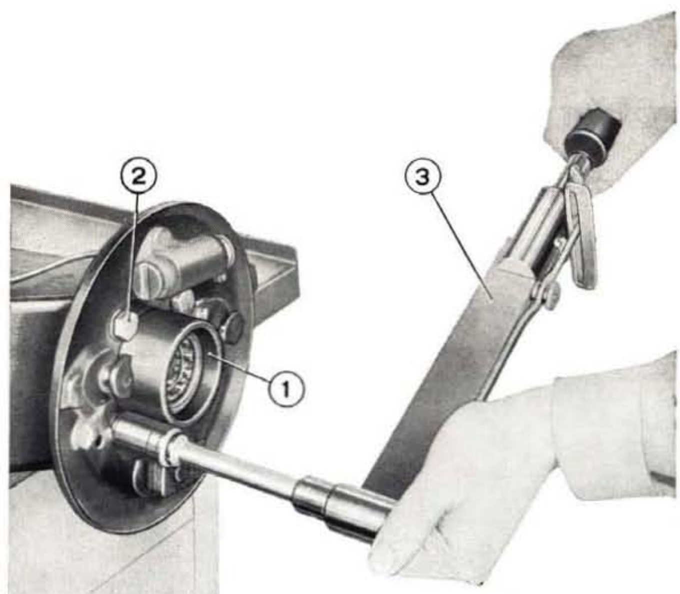


**Fig. 253 - Securing rear wheel hub and brake backing plate to control arm.**
1. Rear wheel hub. - 2. Hub and brake backing plate mounting screw. - 3. Torque wrench.

| | Up to car with parts serial No. 005083 | From car with parts serial No. 005084 |
|---|---|---|
| | two | two |
| Free height . . . . . . . . . . . . . . . . . . . . . . . . | 9.370" (238 mm) | 9.567" (243 mm) |
| Height under 1257 ±55 lbs (570 ±25 kg) of load . . . . . | 6.457" (164 mm) | 6.653" (169 mm) |
| Height under 1817 lbs (824 kg) of load . . . . . . . . . . | 5.157" (131 mm) | 5.354" (136 mm) |
| Deflection rate (between 838 and 1653 lbs - 380 and 750 kg) | .232 in/100 lbs (13 mm/100 kg) | .232 in/100 lbs (13 mm/100 kg) |

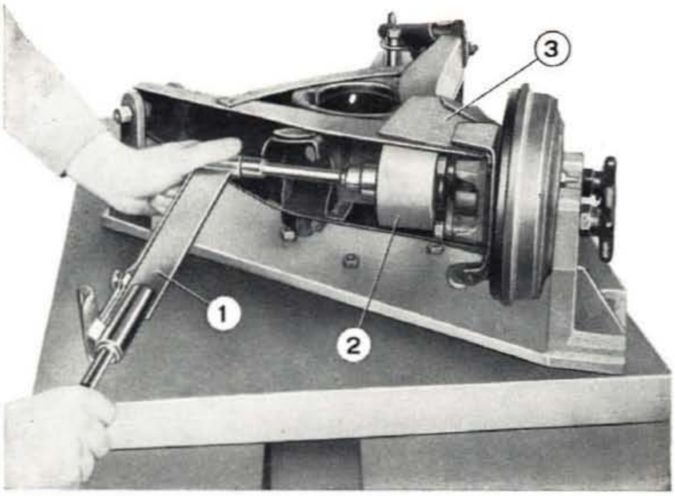


**Fig. 254 - Installing wheel shaft flexible joint on work bench.**
1. Torque wrench. - 2. Flexible joint. - 3. Rear control arm.

— a green paint daub on center turns identifies springs which, under the same load, develop a length equal to or lesser than above figures.

---

**Pairs of coil springs belonging to the same category must be fitted on car.**

---

## INSTALLING SUSPENSION

Install rear suspension as follows:

Jack up suspension assembly and set it at underbody mountings.

Temporarily tighten front mounting screws of control arm (fig. 255).

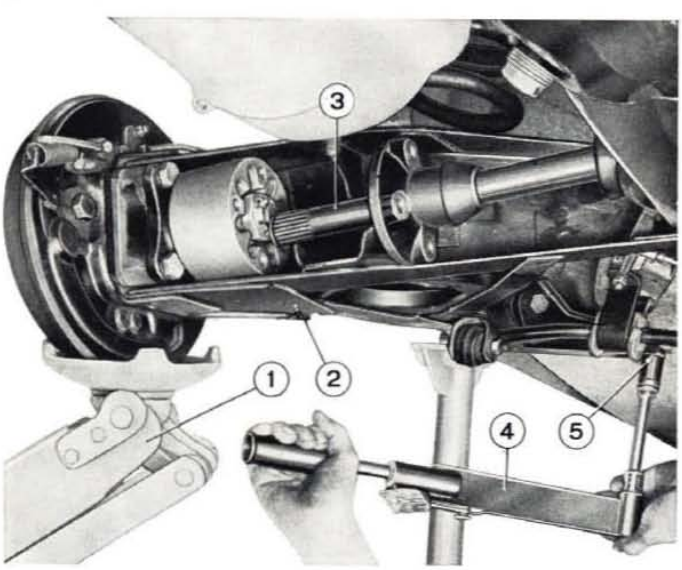


**Fig. 255 - Securing rear control arm to body shell.**
1. Hydraulic jack. - 2. Control arm. - 3. Axle shaft. - 4. Torque wrench. - 5. Control arm front mounting screw.

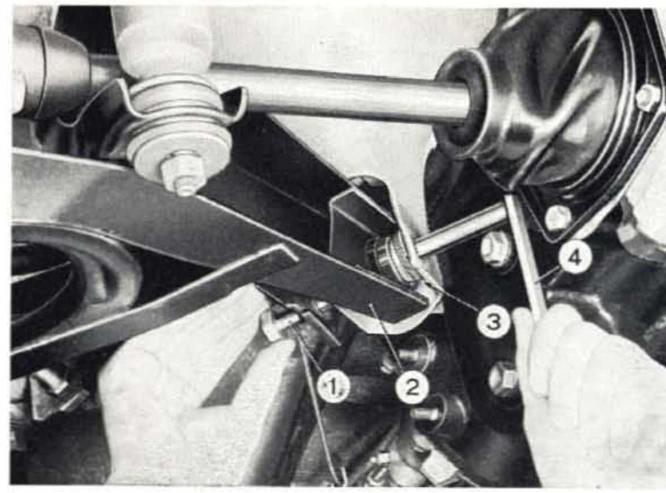


**Fig. 256 - Securing rear control arm to body shell.**
1. Control arm rear lock pin. - 2. Control arm. - 3. Shims. - 4. Tool A. 74143.

Slide the rear end of arm into body bracket.

Set the coil spring with rubber seats.

Secure the axle shaft to flexible joint and the shock absorber to control arm.

Insert shims between « estendblock » and mounting bracket, in the same amount and position as observed on fixture **A. 74142**. This step will be facilitated through the use of tool **A. 74143** (fig. 256) which should be then replaced by lock pin.

---

**NOTE - Control arm mounting screws will be turned down definitely to torque specifications tabulated on page 193 after toe-in has been adjusted.**

---

Tie up brake fluid line and handbrake control cable.

Remove plug from brake fluid reservoir to restore fluid circulation.

Install transmission mounting bracket and sway bar.

Fit the road wheel.

Bleed hydraulic lines as outlined on page 179.

Lower the rear of car.

**Fig. 257 - Left side rear suspension and wheel assembly.**

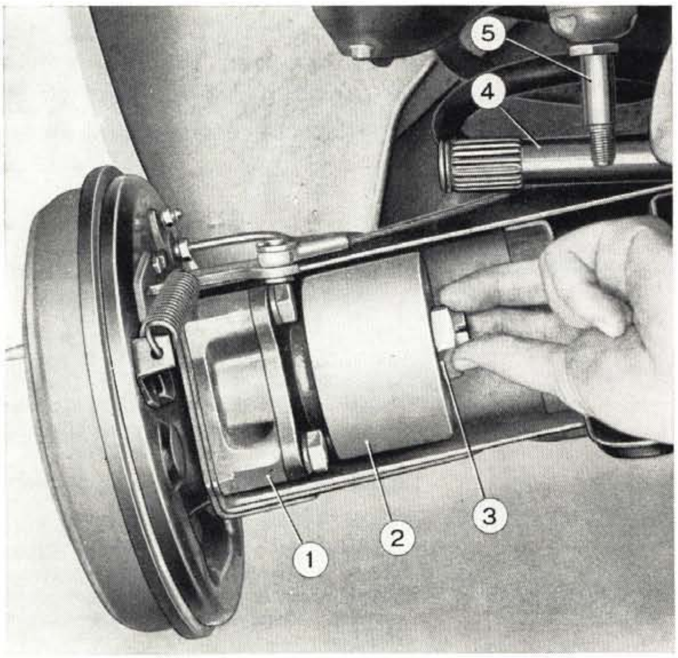


**Fig. 258 - Loosening wheel shaft flexible joint mounting nut.**
1. Wheel hub. - 2. Flexible joint. - 3. Joint mounting nut. - 4. Axle shaft. - 5. Shock absorber.

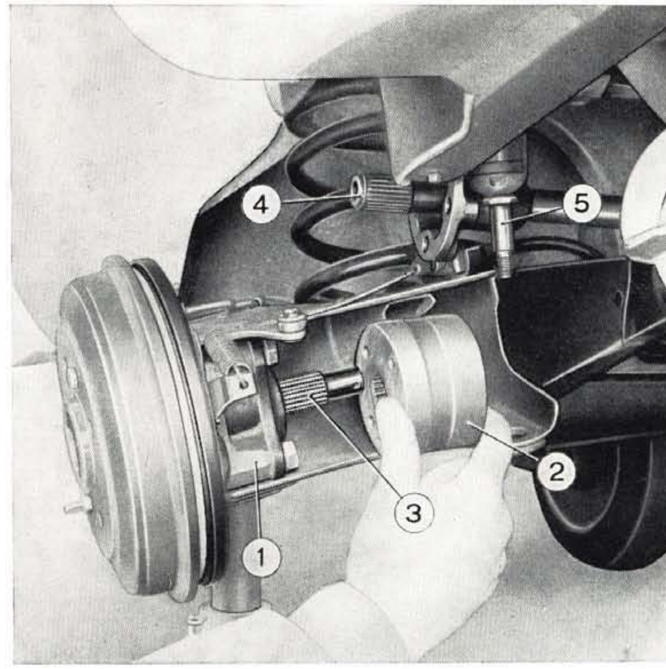


**Fig. 260 - Removing flexible joint.**
1. Wheel hub. - 2. Flexible joint. - 3. Wheel shaft. - 4. Axle shaft. - 5. Shock absorber.

## REPLACING FLEXIBLE JOINT

Starting from the car with parts serial number **187048** wheel hub bearings adopted are of the cylindrical roller and ball type instead of the taper roller type.

As a result, replacement procedure of flexible joint should be varied as follows:

– jack up the car at rear;

– remove the wheel;

– back out axle shaft-to-flexible joint sleeve screws;

– move back the sleeve on axle shaft and remove the inner spring;

– remove cotter pin and screw out the nut **four complete turns** (fig. 258);

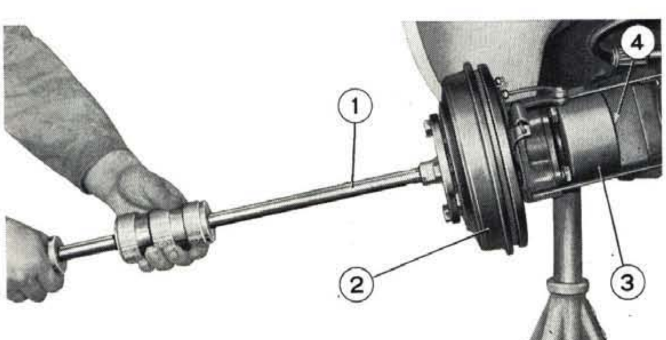


**Fig. 259 - Taking wheel shaft part way out.**
1. Ram puller A. 47017. - 2. Brake drum. - 3. Flexible joint. - 4. Flexible joint mounting nut.

– affix tool **A. 47017** to wheel hub (fig. 259) and work on the wheel hub so to take it part way out;

– turn the nut all out and replace the flexible joint by a new one (fig. 260);

– working on the mounting nut, reset the wheel shaft to the original position;

**Fig. 261 - Tightening flexible joint mounting nut.**
The wheel is on for more ease in tightening.

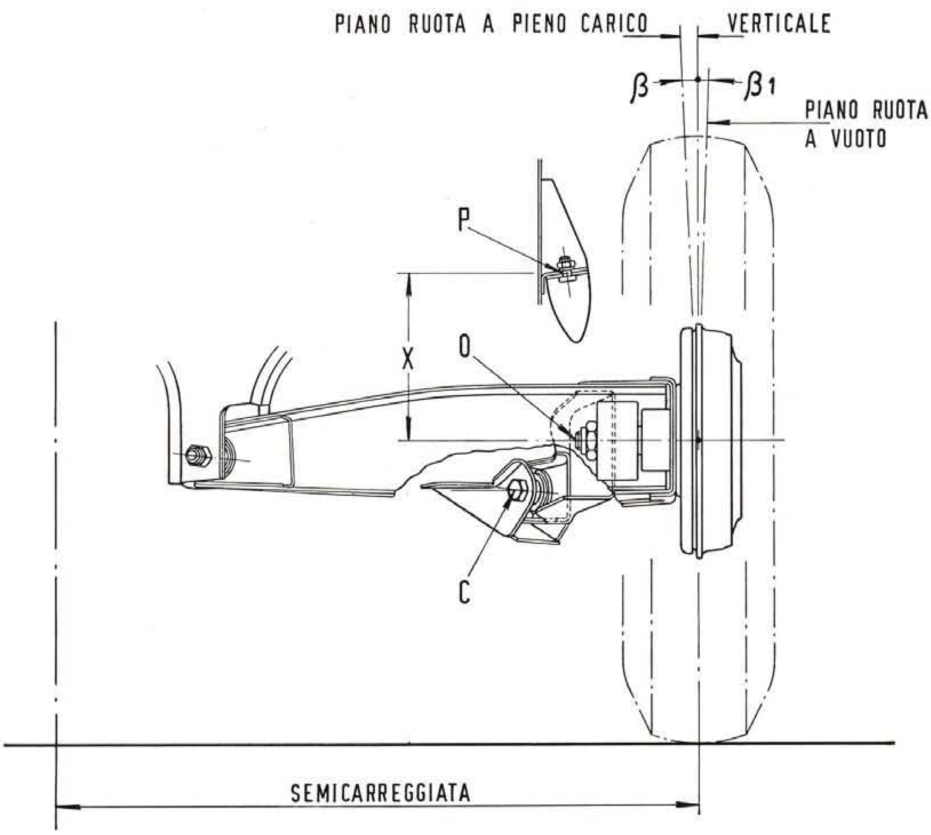


**Fig. 262.**

**Diagram for rear suspension assembly and rear end geometry check.**

C. Screw and nut, control arm to front bracket. - O. Wheel center. - P. Rubber buffer screw hole center. - X. Distance (some 6.102″ - 155 mm) of wheel center from P; in this position the wheel should be at right angle to floor.

$\beta = 2^\circ 25'$ to $2^\circ 40'$.
$\beta^1 = 1^\circ 15'$ to $1^\circ 30'$.

Piano ruota a pieno carico = Wheel plane, full load. - Verticale = Vertical. - Piano ruota a vuoto = Wheel plane, no load. - Semicarreggiata = Tread half.

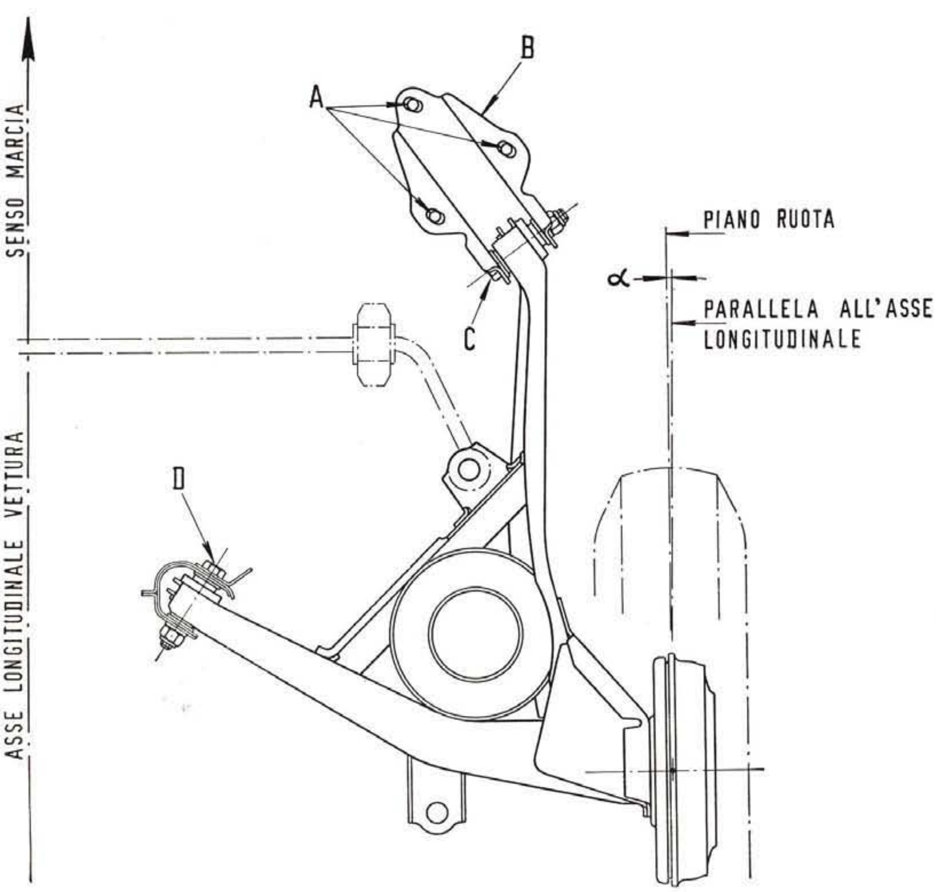


**Fig. 263.**

**Diagram for setting rear end geometry.**

A. Screws, front bracket to underbody (recommended torque 28.9 to 36.2 ft. lbs - 4 to 5 kgm). Tighten these screws after adjusting toe-in with wheel in vertical position. - B. Front bracket of control arm. - C-D. Screws and nuts, control arm to underbody. These nuts should be drawn up with 65.1 ft.lbs (9 kgm) of torque with car under full load. - $\alpha$. Toe-in angle, with wheel in vertical position: $0^\circ 12' \pm 6'$.

Senso marcia = Direction of drive. - Asse longitudinale vettura = Car centerline. - Piano ruota = Wheel plane. - Parallela all'asse longitudinale = Parallel to car centerline.

– draw up the nut with 101.3 ft.lbs (14 kgm) of torque (fig. 261) and thread in the cotter pin; to do so turn the **nut more in**, if necessary;

– complete the assembly by reversing disassembly steps.

## CHECKING AND ADJUSTING REAR WHEEL TOE-IN

After the rear suspension has been assembled, check and adjust rear wheel toe-in.

Set rear wheels as follows:

– at right angle to the floor;

– toed-in by an angle ($\alpha$, fig. 263) of $0^\circ 12' \pm 6'$ to the parallel to the car centerline;

– $23.425'' \pm .059''$ ($595 \pm 1.5$ mm) apart (tread half) to the car centerline.

To adjust toe-in angle ($\alpha$, fig. 263) use the clearance which is left between holes and screws (A, fig. 263) securing bracket (B) to body.

Recall that a linear movement of some .177" (3.5 mm) measured at a distance of some 6'8" (2.03 m) apart from the wheel center, will cause the angle $\alpha$ to vary by $0^\circ 6'$.

Check and adjust rear wheel toe-in as follows:

– take down rear wheels;

– affix the pair of tools **A. 74052** for spring

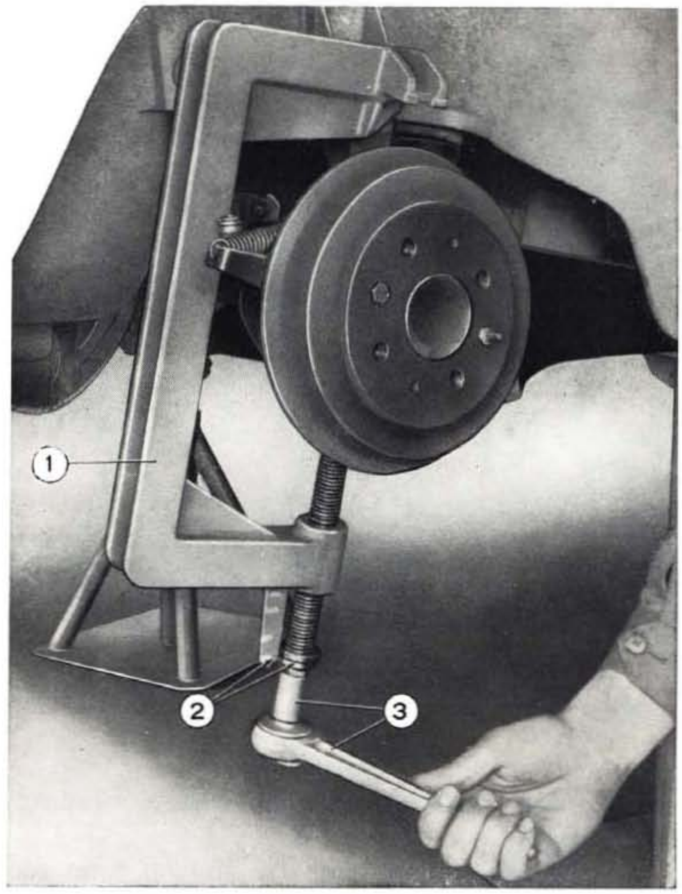


**Fig. 264 - Installing coil spring compressor.**
1. Tool A. 74052 for coil spring compression. - 2. Reference marks to be indexed. - 3. Ratchet wrench A. 89854.

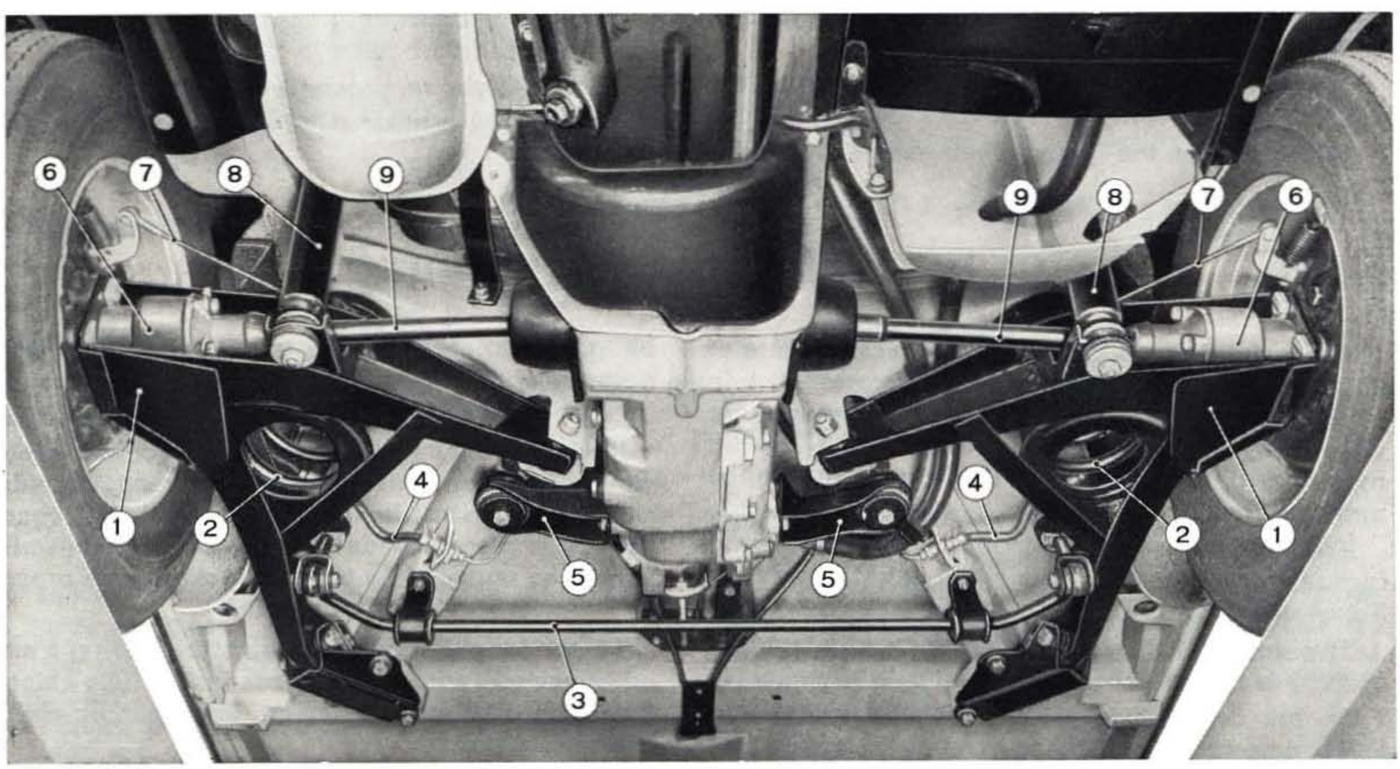


**Fig. 265 - Rear suspension assembly in place on car.**
1. Control arms. - 2. Coil springs. - 3. Sway bar. - 4. Hydraulic brake lines. - 5. Transmission mounting brackets. - 6. Flexible joints. - 7. Handbrake control cable. - 8. Shock absorbers. - 9. Axle shafts.

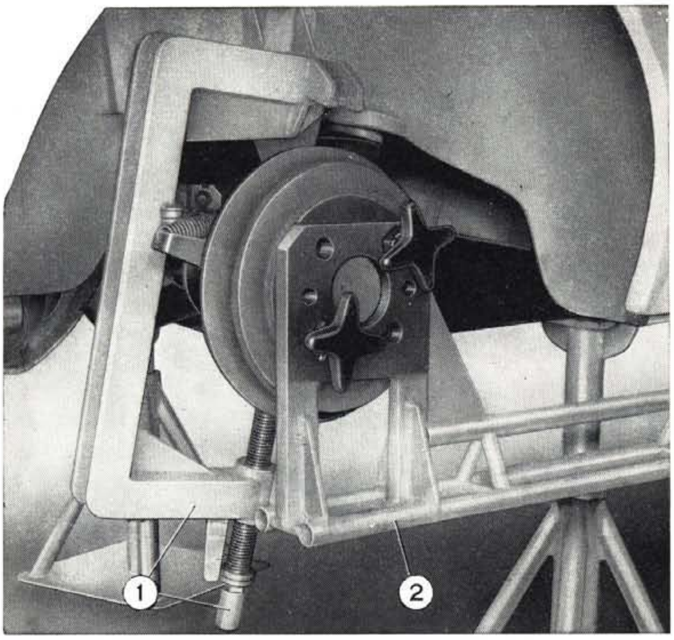


Fig. 266 - Installing rear wheel checking fixture.
1. Coil spring compressor A. 74052. - 2. Gauge Ap. 5110/1 for toe-in check.

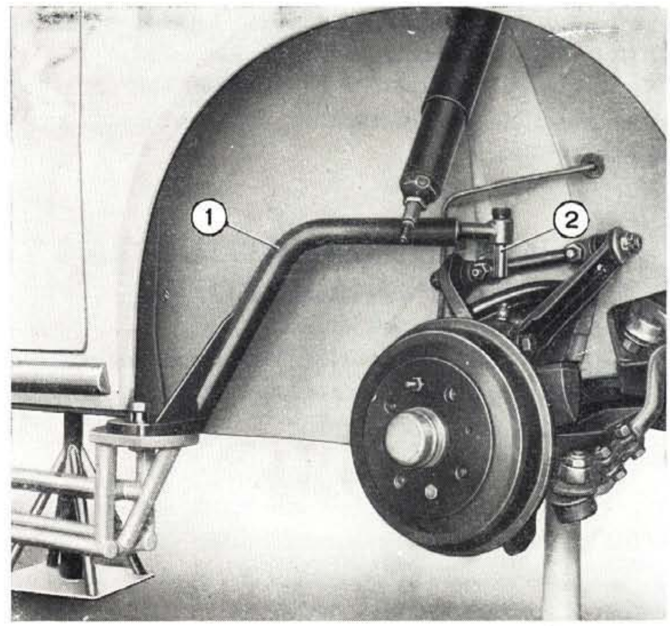


Fig. 267 - Checking rear wheel toe-in.
1. Clamp Ap. 5110/6 to be fitted to gauge Ap. 5110/1. - 2. Plunger for toe-in check.

compression and holding rear wheels vertically (fig. 264);

– compress coil springs by screwing up tool shank with ratchet wrench **A. 89854** until reference marks on tool shank and clamp are lined up (fig. 264).

In these conditions the wheel shaft center (O, fig. 262) should be at the distance « X » (corresponding to some 6.102" - 155 mm) from the center of hole « P », at rubber buffer mounting face;

– affix the gauge **Ap. 5110/1** with clamp **Ap. 5110/6** to the wheel shaft (fig. 266);

– check that the plunger at gauge front end touches upper control arm pin of front suspension (2, fig. 267);

– to correct toe-in angle, as outlined earlier, work on clearance between holes and screws (A, fig. 263) securing bracket B to body;

– next tighten screws « A » to 28.9 to 36.2 ft.lbs (4 to 5 kgm) of torque, and draw up nuts C and D (fig. 263) with 65.1 ft.lbs (9 kgm) of torque;

– repeat above procedure at the other wheel, recalling that **wheels should be toed-in by the same angle.**

## NOTE ON SELF-LOCKING NUTS

**When the threads, on which self-locking nuts of the nylon ring insert type must be screwed, are in good condition (free of burrs, rust, indents) or when they are not cross milled, the self-locking nuts may be screwed on and off more than once until practicable.**

**However, it is advisable to check the unscrewing torque and replace the nuts when said torque falls below specified limits.**

**The unscrewing torque may be rated averagely at 20 % less than the nut drawing torque.**

**On the contrary, should the above mentioned threads be cross milled, or even show burrs, rust or indents, nuts must be used once only since nylon ring is liable to be damaged with consequent loss of self-locking ability.**

**If when servicing is in progress it becomes necessary to screw and unscrew nuts on threads provided with milled slit or in the above mentioned conditions, it is recommended to use dummy nuts which should be replaced by the self-locking nuts proper, as soon as servicing terminates.**

**The self-locking nuts of the castellated type may be screwed and unscrewed indefinitely since, thanks to their special design, their locking ability is never impaired.**

# HYDRAULIC SHOCK ABSORBERS



## MAIN SPECIFICATIONS

| | Front | Rear |
|---|---|---|
| Working cylinder diameter . . . . . . . | 1.063″ (27 mm) | 1.063″ (27 mm) |
| Length (between upper eye center and lower mounting face): | | |
| – retracted . . . . . . . . . . . . . . . | 10.866″ (276 mm) | 9.921″ (252 mm) |
| – extended { abutting begins . . . . | 16.791″ (426.5 mm) | 14.803″ (376 mm) |
| – extended { max. actual expansion (*) | 17.146″ (435.5 mm) | 15.197″ (386 mm) |
| Stroke (abutting begins) . . . . . . . . . | 5.925″ (150.5 mm) | 4.882″ (124 mm) |
| Setting { compression . . . . . . . . . . | .039″ to .138″ (1 to 3.5 mm) | .059″ to .157″ (1.5 to 4 mm) |
| Setting { rebound . . . . . . . . . . . . | .276″ to .413″ (7 to 10.5 mm) | .512″ to .669″ (13 to 17 mm) |
| Fluid capacity . . . . . . . . . . . . . . | .299 G.B. pts - .359 U.S. pts (0.17 lt) | .264 G.B. pts - .317 U.S. pts (0.15 lt) |
| Fluid grade . . . . . . . . . . . . . . . | FIAT S.A.I. | |

(*) With the inner pad being crushed under an axial load of some 331 lbs (150 kg).

## Operation.

A shock absorber may be theoretically divided into three sections:

– top portion of cylinder above piston (always full of fluid);

– bottom portion of cylinder below piston (always full of fluid);

– fluid reservoir, i. e. the annular interstice between cylinders (14) and (15) (never completely full).

### REBOUND STROKE

This is the phase in which shock absorber extends. The fluid above piston finds the external row of orifices (24) closed and is forced through the internal row (25), thus acting on rebound valve (26) and passing to cylinder lower portion.

During its upward travel the piston produces a vacuum which draws fluid from the reservoir through annular passage (31) of lower plug (35) and compensating valve (30). The amount of fluid

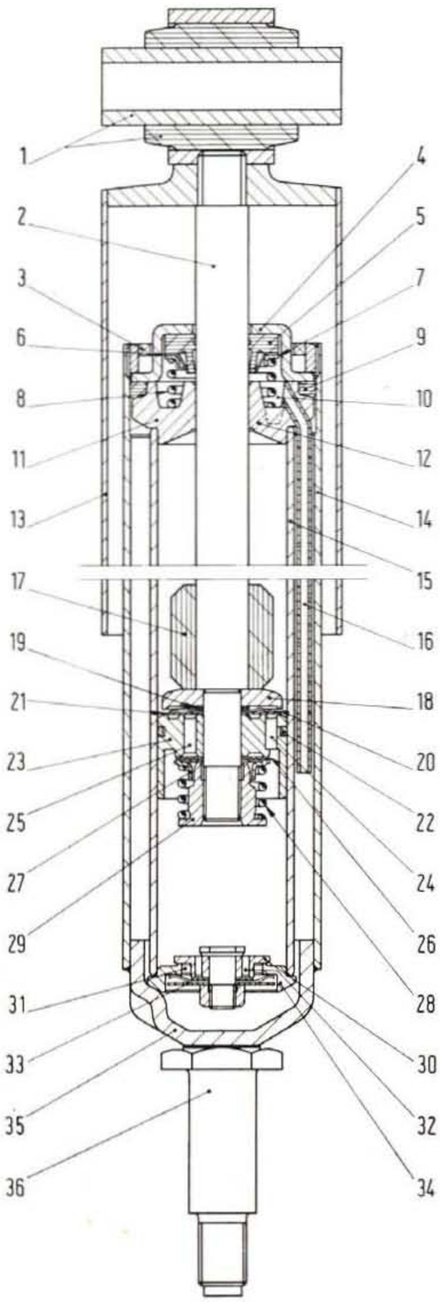


**Fig. 268 - Sectional view of shock absorber.**

1. Resilient bushing, upper mounting. - 2. Rod. - 3. Cylinder upper blanking threaded ring. - 4. Seal housing. - 5. Rod seal. - 6. Tab spring. - 7. Spring cup. - 8. Gasket packing spring. - 9. Casing gasket. - 10. Vapour pocket drain chamber. - 11. Rod guide bushing. - 12. Vapour pocket drain capillary hole. - 13. Dust shield. - 14. Casing. - 15. Working cylinder. - 16. Vapour pocket drain passage. - 17. Buffer. - 18. Inlet valve lift limiting disc. - 19. Valve lift adjustment washer. - 20. Valve star shaped spring. - 21. Inlet valve. - 22. Piston snap ring. - 23. Piston. - 24. Inlet valve holes in piston. - 25. Rebound valve holes in piston. - 26. Rebound valve. - 27. Valve guide cup. - 28. Rebound valve spring. - 29. Piston mounting plug. - 30. Compensating valve. - 31. Compensating valve annular passage. - 32. Compression valve orifices. - 33. Gradual acting compression valve. - 34. Compensating - and - compression valve carrier plug. - 35. Lower plug. - 36. Threaded shank, lower mounting.

Starting from the car with parts serial number **207742** the upper mounting has been obtained through taper resilient bushings.

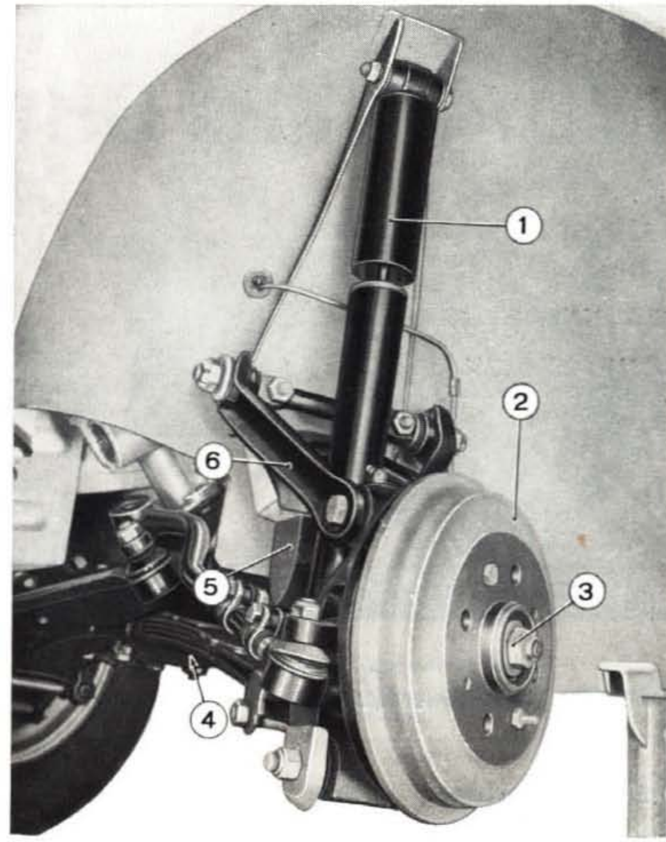


**Fig. 269 - Detail of left side front suspension and wheel.**

1. Shock absorber. - 2. Brake drum. - 3. Wheel hub mounting nut. - 4. Semi-elliptic spring. - 5. Rubber buffer. - 6. Control arm.

passing from reservoir to cylinder will be volumetrically equal to the portion of piston rod that has slid out.

Therefore in this stroke only the rebound and compensating valves are active while the compression and inlet valves keep closed.

## COMPRESSION STROKE

In this phase shock absorber retracts and the piston travels downwards.

The fluid in the lower chamber lifts inlet valve (21) and part of it passes into cylinder upper portion.

Some of the fluid, instead, rams compression valve (33), and through its orifices (32) passes into the reserve.

The dampening effect in this phase is the result of the displacement of an amount of fluid volumetrically equal to the portion of rod entering the cylinder.

During this stroke both the compensating (30) and rebound (26) valves remain closed and only the compression (33) and inlet (21) valves are operative.

# Section 7

## STEERING SYSTEM

# STEERING SYSTEM

Fig. 270 - Steering system and front running gear units.

# STEERING SYSTEM



## SPECIFICATIONS AND DATA

| | |
|---|---|
| Steering gear type | worm and sector |
| Gear ratio | 13 to 1 (2/26) |
| Worm bearings | taper roller |
| Sector shaft bushing | bronze |
| Bearing adjustment | threaded nut |
| Worm-to-sector tooth lash adjustment | turn eccentric bushing at sector shaft |
| Sector shaft bushing bore | .7874″ to .7882″ (20.000 to 20.021 mm) |
| Sector shaft diameter | .7874″ to .7865″ (20.000 to 19.979 mm) |
| Sector shaft-to-bushing fitting clearance<br>Wear limit | .0000″ to .0017″ (0.000 to 0.042 mm)<br>.004″ (0.10 mm) |
| Turning circle | 31′ 6″ (9.60 m) |
| Tie rods | with adjustable ends |
| Link rod (intermediate) | with fixed ends |

*(continued)*

**Specifications and Data** *(continued)*.

| | |
|---|---|
| Turning angle: | |
| — inner wheel . . . . . . . . . . . . . . . . . . . . | 32° |
| — outer wheel . . . . . . . . . . . . . . . . . . . . | 26° |
| Front wheel toe-in: | |
| — car loaded (see page 168) . . . . . . . . . . . . | .079″ to .157″ (2 to 4 mm) |
| — car at no load . . . . . . . . . . . . . . . . . . | .433″ to .511″ (11 to 13 mm) |
| Steering gear oil: | |
| — grade . . . . . . . . . . . . . . . . . . . . . . . | FIAT W 90/M (SAE 90 EP) |
| — capacity . . . . . . . . . . . . . . . . . . . . . | .211 G.B. pts - .254 U.S. pts (0.120 lt - 0.110 kg) |

# TROUBLE DIAGNOSIS AND CORRECTIONS

## Jerky Steering.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect front wheel alignment. | 1) Inspect and adjust as recommended on page 135. |
| 2) Incorrect front wheel bearing adjustment. | 2) Adjust as recommended on page 138. |
| 3) Wheels out of balance. | 3) Inspect and correct as recommended under « Wheels and Tires ». |
| 4) Loose steering linkage connections. | 4) Inspect, replace worn parts, if any, and tighten nuts with recommended torques. |
| 5) Loose or incorrect fitting of worm to sector. | 5) Adjust as recommended on page 165. |

## Hard Steering.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Inflate tires to correct pressures. |
| 2) Incorrect front wheel alignment. | 2) Check wheel alignment and adjust as outlined and tabulated on page 135. |
| 3) Incorrect adjustment of steering worm to sector. | 3) Adjust steering gear as recommended on page 165. |

## Front Wheel Shimmy.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Inspect tire pressure and inflate to recommended values. |
| 2) Incorrect front wheel alignment. | 2) Inspect and correct front wheel alignment as outlined on page 135. |
| 3) Loose front wheel bearings. | 3) Adjust bearings as outlined on page 138. |
| 4) Wheels out of balance. | 4) Inspect and correct as outlined on page 184. |
| 5) Loose steering linkage connections. | 5) Inspect, replace damaged parts, if any, and tighten nuts to recommended torques. |
| 6) Loose steering gear and/or idler arm support at body mountings. | 6) Check all mounting nuts for tightness with recommended torque. |
| 7) Incorrect fitting of steering worm to sector. | 7) Adjust steering gear as outlined on page 165. |

## Tire Squeal on Turns.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Check tire pressure and inflate to specified values. |
| 2) Incorrect wheel alignment. | 2) Check and correct as specified on page 135. |
| 3) Distorted kingpin housing or control arms. | 3) Check kingpin housing and control arms on test equipment as shown under « Front Suspension and Wheels »; replace kingpin housing, if distorted, and control arms which cannot be straightened correctly. |

## Rattles.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Loose steering linkage connections. | 1) Inspect, replace worn parts, if any, and tighten nuts to recommended torques. |
| 2) Loose steering gear and/or idler arm support at body mountings. | 2) Check all mounting nuts for tightness with recommended torque. |
| 3) Semi-elliptic spring weakened of broken. | 3) Check against data on page 128 and replace damaged or broken spring. |
| 4) Lack of lubricant (oil or grease). | 4) Lubricate as specified under « Maintenance ». |

## Side-to-Side Wander.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Check tire pressure and inflate to recommended values. |
| 2) Incorrect front wheel alignment. | 2) Check wheel alignment and adjust as specified on page 135. |
| 3) Loose steering linkage connections. | 3) Check, replace damaged parts and tighten nuts to recommended torques. |
| 4) Loose steering gear and/or idler arm support at body mountings. | 4) Check all mounting nuts for tightness with recommended torque. |
| 5) Incorrect fitting of steering worm to sector. | 5) Adjust steering gear as outlined on page 165. |
| 6) Distorted kingpin housing or control arms. | 6) Check kingpin housing and control arms on test equipment as shown under « Front Suspension and Wheels » and replace kingpin housing, if distorted, and control arms which cannot be straightened correctly. |
| 7) Semi-elliptic spring weakened or broken. | 7) Check spring against data on page 128, and replace if damaged or broken. |

## Loose Steering.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect front wheel bearing adjustment. | 1) Adjust as recommended on page 138. |
| 2) Loose steering linkage connections. | 2) Inspect, replace worn parts, if any, and tighten nuts to recommended torques. |
| 3) Incorrect adjustment of steering worm to sector. | 3) Adjust steering gear as recommended on page 165. |

## Hard Turning when Stationary.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Check pressure of tires and inflate to recommended values. |
| 2) Incorrect adjustment of steering worm to sector. | 2) Adjust steering gear as recommended on page 165. |

## Pull to One Side.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Incorrect tire pressure. | 1) Inspect and inflate tires to recommended pressures. |
| 2) Incorrect front wheel alignment. | 2) Inspect and adjust front wheel alignment as specified on page 135. |
| 3) Incorrect front wheel bearing adjustment. | 3) Adjust bearings as specified on page 138. |
| 4) Distorted kingpin housing or control arms. | 4) Disassemble suspensions and check kingpin housing and control arms on test equipment as outlined under « Front Suspension and Wheels ». |
| 5) Uneven brake adjustment. | 5) Adjust brakes as outlined in covering chapter. |
| 6) Semi-elliptic spring weakened or broken. | 6) Check springs against data on page 128 and replace if damaged or broken. |

## STEERING WHEEL

To remove the steering wheel proceed as follows:

– pry off horn button by inserting a screwdriver between button and wheel hub;

– disconnect horn wire at button;

– back out wheel mounting nut using ratchet wrench **A. 89854** (fig. 271);

– slide off steering wheel from shaft.

Reverse the sequence of above steps for steering wheel installation.


**Fig. 271 - Backing out steering wheel mounting nut.**
1. Ratchet wrench A. 89854. - 2. Horn button wire.

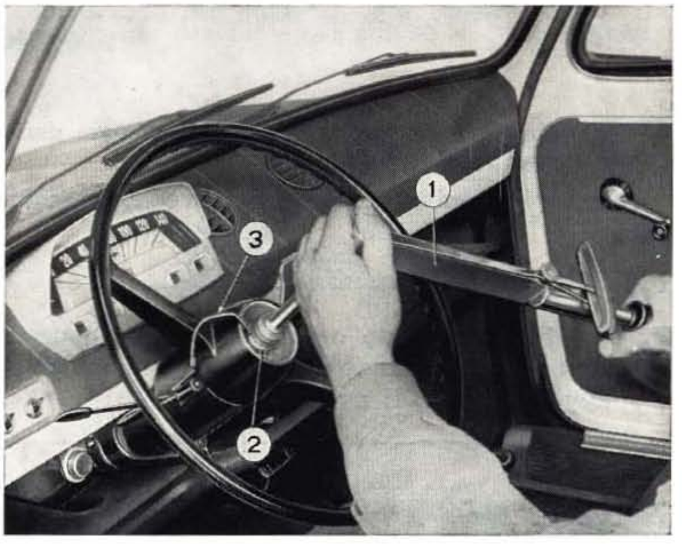


**Fig. 272 - Tightening steering wheel mounting nut.**
1. Torque wrench. - 2. Wheel mounting nut. - 3. Horn button wire.

Draw up the wheel nut with 28.9 to 36.2 ft.lbs (4 to 5 kgm) of torque (fig. 272) and stake it in position.

## STEERING GEAR

### Removal.

Working from luggage compartment loosen the steering column-to-worm screw (fig. 273).

Jack up the car at front and support it on stands.

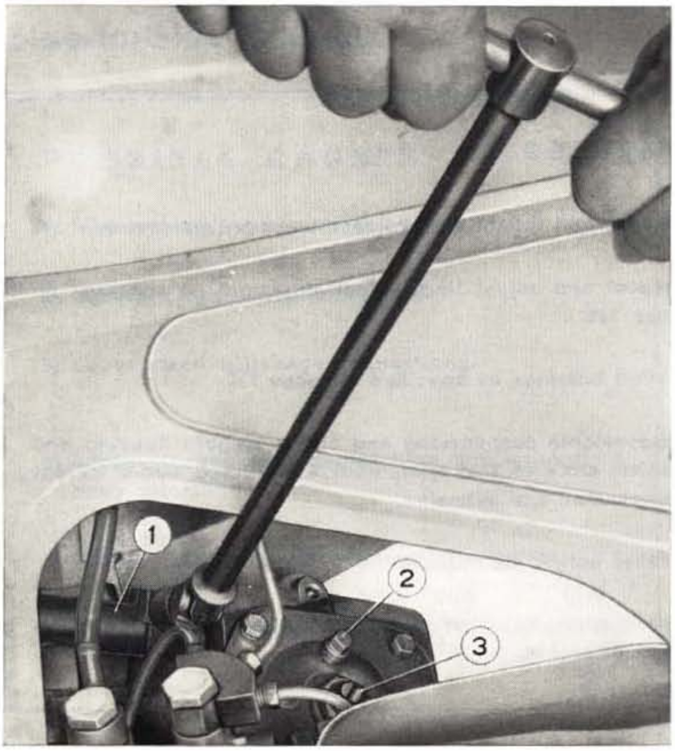


**Fig. 273 - Removing steering gear.**
1. Steering shaft. - 2. Oil filler plug. - 3. Sector adjusting screw.

Disconnect steering rods from pitman arm using tool **A. 47035** (fig. 274).

Back out mounting nuts and remove the steering gear.

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**NOTE - Prior to going over the steering gear for adjustment, make sure that the linkage is operating properly and fix it, if necessary.**

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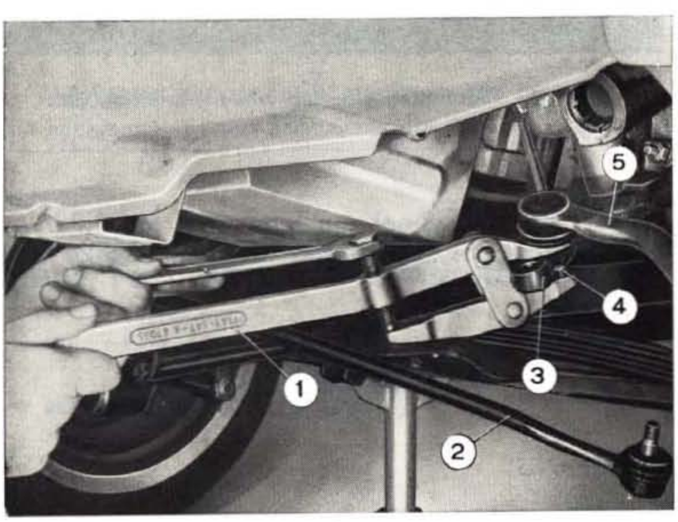



**Fig. 274 - Removing steering rods.**
1. Tool A. 47035. - 2. Link rod. - 3. Pitman arm. - 4. Rod end ball stud. - 5. Track rod.

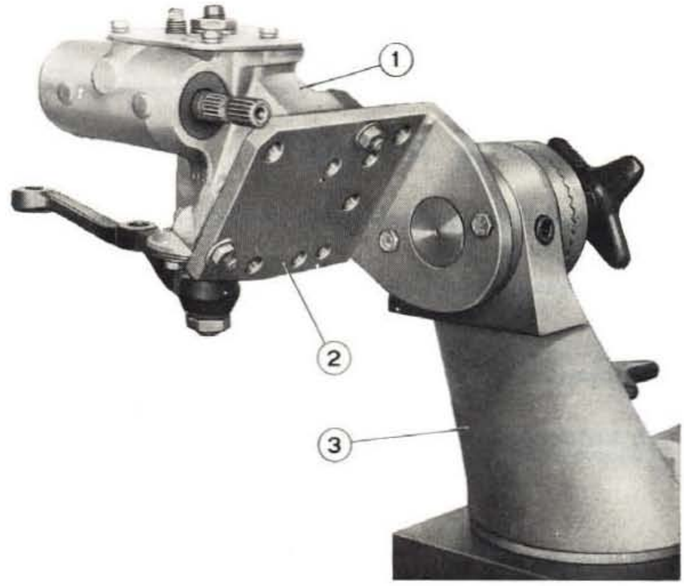



**Fig. 275 - Steering gear on service fixture.**
1. Steering gear. - 2. Adapter A. 74076/2. - 3. Service fixture A. 74076.

## Disassembly.

Clamp the steering gear to service fixture **A. 74076** equipped with adapter **A. 74076/2** (fig. 275).

Remove the drain plug and let all oil out.

Using tool **A. 47033** (fig. 276) remove the pitman arm and then the worm sector and shaft assembly.

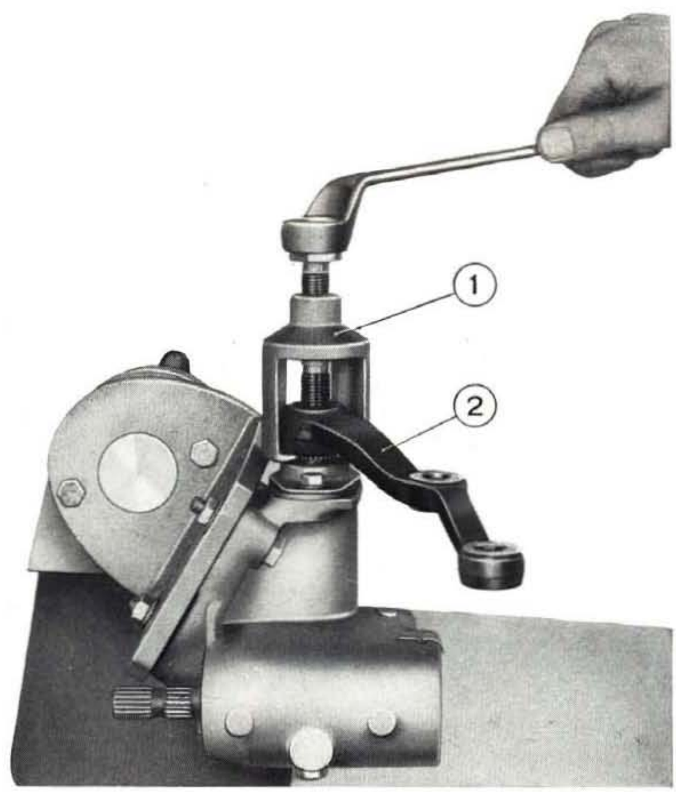



**Fig. 276 - Removing pitman arm.**
1. Tool A. 47033. - 2. Pitman arm.

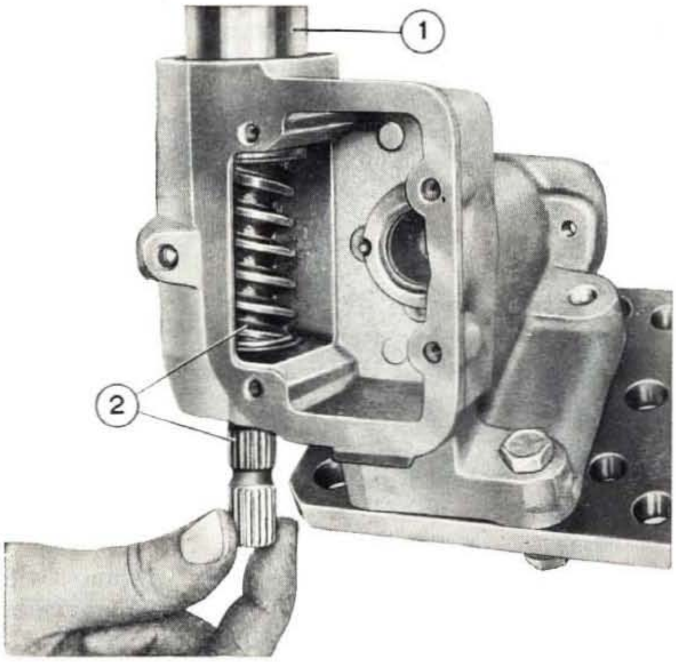



**Fig. 277 - Adjusting worm bearings.**
1. Wrench A. 57003 for bearing adjuster nut. - 2. Worm.

Back out the bearing lock and adjusting nut (5, fig. 280).

Slide off the worm (1, fig. 280) complete with roller bearing cones (3).

Tap out roller bearing cups with driver **A. 74046** and the oil seal (2, fig. 280) with driver **A.74017.**

## Inspection and Adjustment.

Check parts accurately and see that the sector and worm contact faces show no sign of seizure, indents or deep scoring.

Check clearance between eccentric bushing (6, fig. 278) and sector shaft.

The wear limit is set at .004" (0.10 mm) and clearance of new parts should be .0000" to .0016" (0 to 0.042 mm).

It is good practice to inspect the worm for meshing at center: maximum out-of-true limit is .002" (0.05 mm).

**NOTE - Steering worm and sector are assembled with a touch fit at tooth flank.**
**Adjustment is made by rotating the eccentric bushing mounting the worm sector.**

To adjust the steering gear after overhaul or just as a routine job on car, proceed as follows.

If the lash between worm and sector turns out to be excessive, work on the wormshaft bushing as outlined hereafter:

– disconnect the pitman arm;

– back out the screws (8, fig. 278) which retain the shim (7);

– turn the eccentric bushing (6) through the shim so to move the sector in toward the worm. Bushing rotation should be of such an extent as the fixing screws can enter subsequent holes in the shim.

Should the shim screws be already engaged in the last hole of the shim, remove the screws, slide off the shim from the bushing and replace the shim one serration on, then secure it.

If too much play is felt at worm bearings, take up screwing the lower adjuster nut (5, fig. 280) in; after adjustment, lock the nut in position with a cotter pin: to this purpose, see that the hole on steering housing is in line with one of the spaces between nut castellations.

The sector and worm teeth should mesh perfectly at center; if not so, move the sector back or forth, as required, by adding or removing shims (5, fig. 278) under the thrust washer (4) and against the shoulder of the eccentric bushing.

Shims are supplied in the .0039" (0.10 mm) thickness.

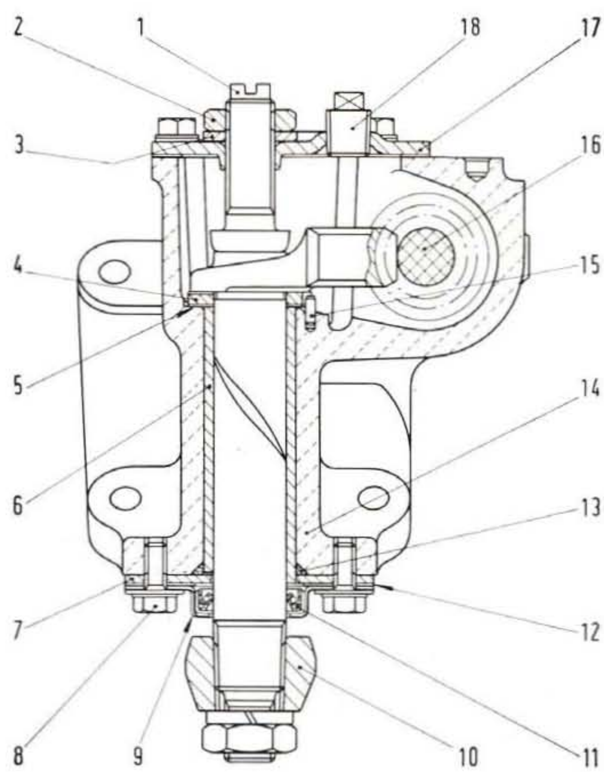



**Fig. 278 - Sectional view of the steering gear at sector.**
1. Sector adjusting screw. - 2. Lock nut. - 3. Plain washer. - 4. Thrust washer. - 5. Shims. - 6. Eccentric bushing. - 7. Bushing shim. - 8. Shim screws. - 9. Seal cover. - 10. Pitman arm. - 11. Oil seal. - 12. Shim packing. - 13. Upper oil seal. - 14. Steering housing. - 15. Washer (4) location dowel. - 16. Worm. - 17. Cover. - 18. Oil filler plug.

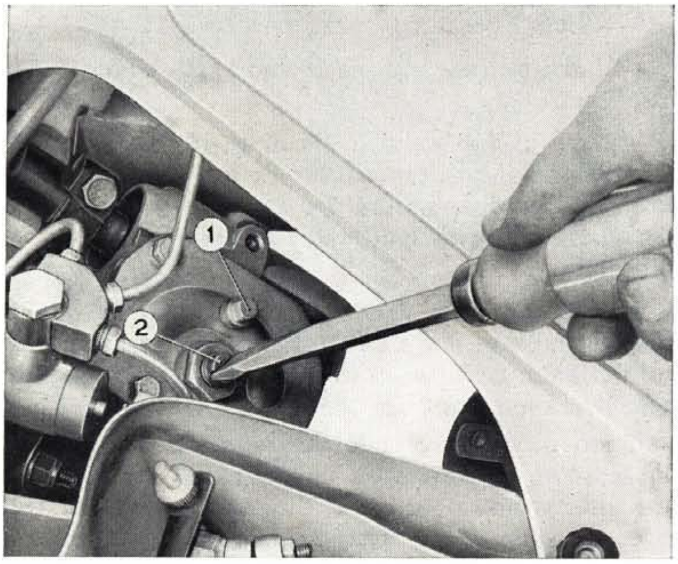
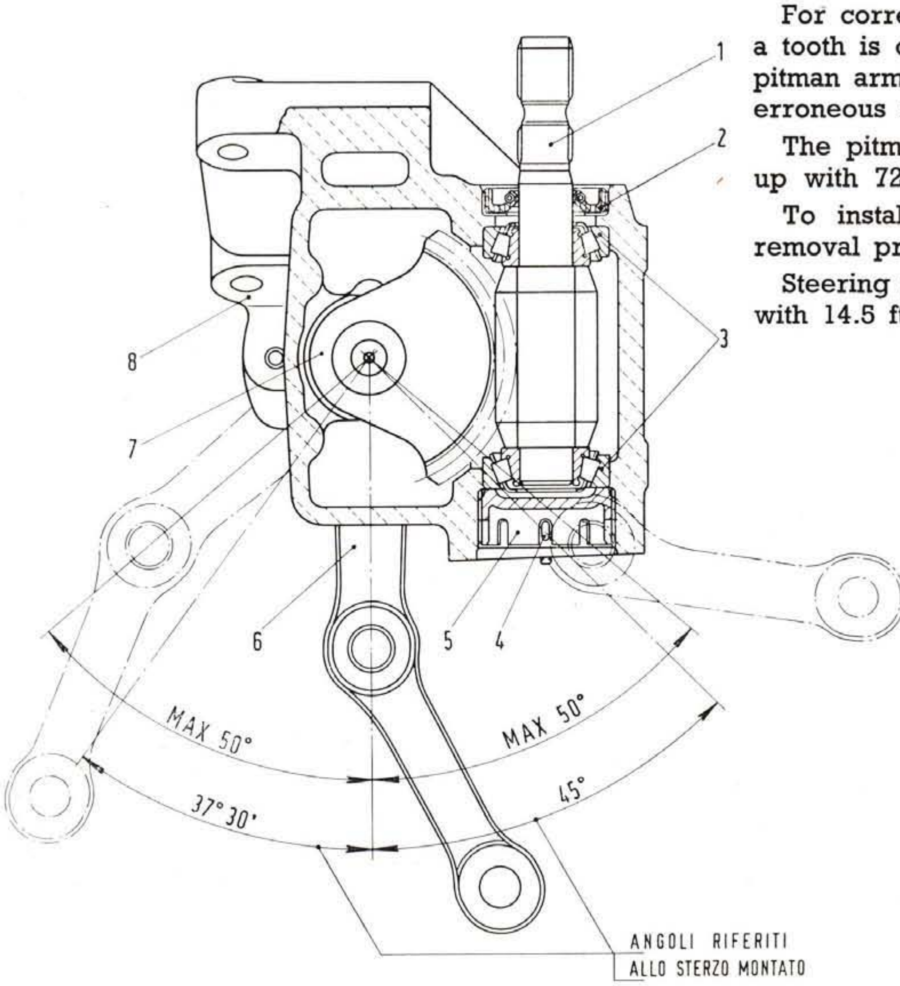



**Fig. 279 - Adjusting lash between worm and sector.**
1. Oil filler plug. - 2. Sector adjusting screw.

Next adjust the tooth lash through the adjusting screw (1, fig. 278) on cover; lock this screw with the nut (2).

Tooth lash adjustment can be also performed on car, as shown in fig. 279.




The above outlined procedures should correct any play and lash in the steering gear without causing undue stiffness on turn.

Replace any seal which turns out to be damaged.

Inspect roller bearings: roller, cages and cups should show no indication of damage or remarkable wear.

## Assembly and installation.

The steering gear is assembled by reversing the disassembly procedure. Recall the following points:

— if the eccentric bushing has been removed and discarded, install the new one using driver **A. 74043**;

— after installation, reface the bushing with reamer **A. 90360/20** (fig. 281) to obtain specified clearance between bushing and sector shaft;

— roller bearing cones and cups are fitted by means of driver **A. 74046**;

— the installation and setting of bearing adjuster nut are made using wrench **A. 57003** (fig. 277).

It is essential that before re-assembly and adjustment all components are thoroughly washed and lubricated.

For correct position of pitman arm on assembly a tooth is omitted in the sector toothing while the pitman arm shows a double tooth, which prevents erroneous mating of parts.

The pitman arm mounting nut should be drawn up with 72.3 ft.lbs (10 kgm) of torque (fig. 283).

To install the steering gear just reverse the removal procedure.

Steering gear mounting nuts should be drawn up with 14.5 ft.lbs (2 kgm) of torque.

**Fig. 280.**
**Sectional view of the steering gear across the worm.**

1. Worm. - 2. Seal. - 3. Roller bearings. - 4. Cotter pin. - 5. Bearing lock and adjusting nut. - 6. Pitman arm. - 7. Sector. - 8. Steering housing.

Angoli riferiti allo sterzo montato = Angles apply to an installed steering.

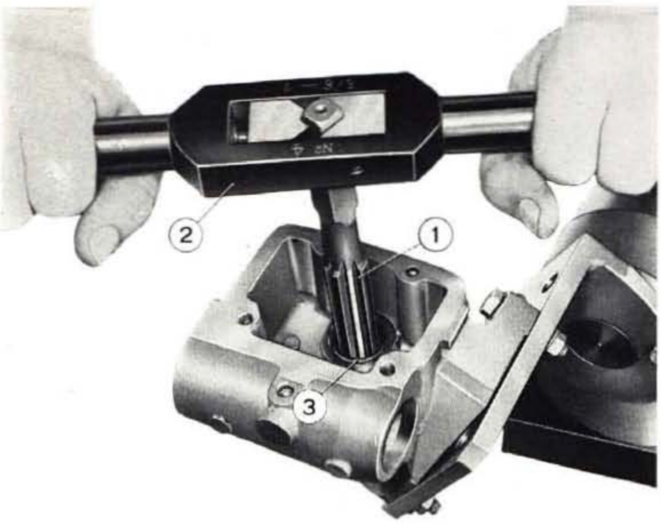



**Fig. 281 - Reaming eccentric bushing.**
1. Reamer A. 90330/20. - 2. Reamer handle. - 3. Eccentric bushing.

## IDLER ARM AND SUPPORT

The idler arm support is secured to the bulkhead, luggage compartment side, opposite the steering gear.

Remove the support as follows:

– using tool **A. 47035** remove steering rod ends from idler arm;

– back out idler arm support mounting nuts from body.

Take down the idler arm after the pin nut has been removed.

Check clearance between idler arm pin and bushings: it should not exceed .0012" (0.30 mm).

If necessary, replace the more worn part, or both.

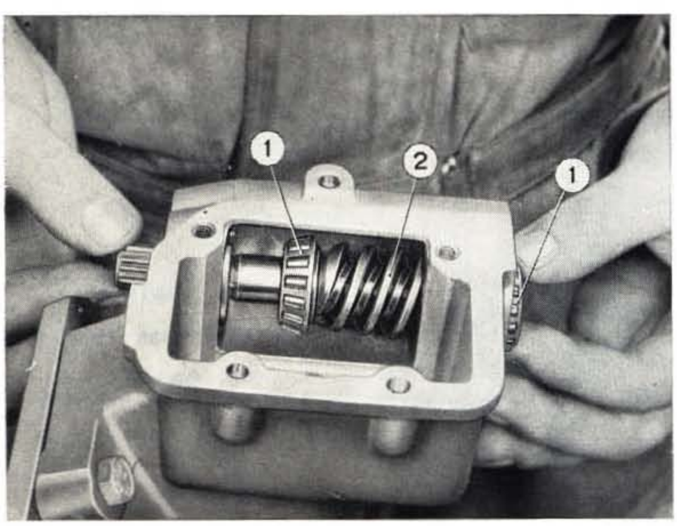



**Fig. 282 - Installing steering worm and bearings.**
1. Roller bearing cones. - 2. Worm.

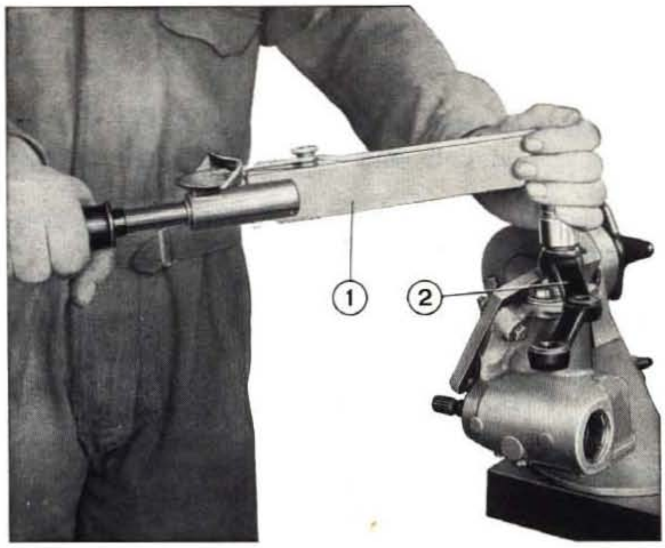



**Fig. 283 - Installing pitman arm.**
1. Torque wrench. - 2. Pitman arm.

Renew pin bushings if they show signs of binding or such damages as efficiency is impaired.

On installation, draw up idler arm pin nut with 54.2 to 57.9 ft.lbs (7.5 to 8 kgm) of torque. Use care to effect this step after front wheel toe-in has been adjusted and with front wheels set for straight forward drive.

## STEERING RODS

A center link rod, non adjustable, connects the pitman arm to the idler arm.

Two track rods, articulated to the pitman and idler arm, respectively, tie them to the knuckle arms.

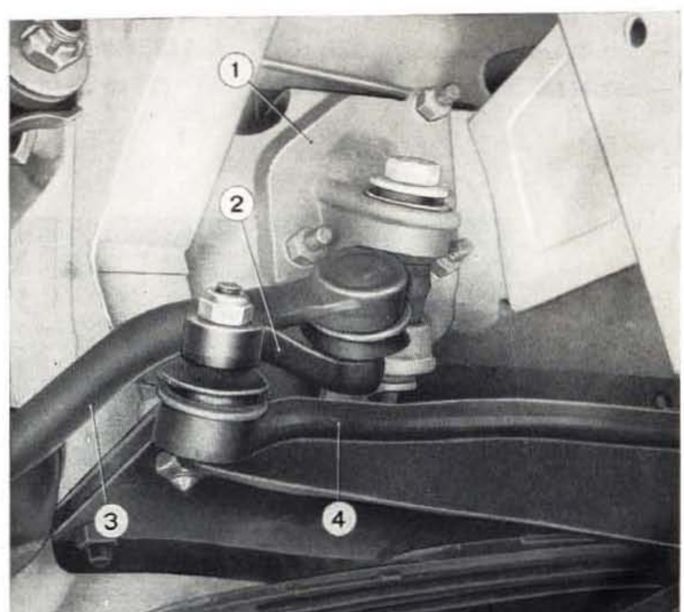



**Fig. 284 - Idler arm and support.**
1. Idler arm support. - 2. Idler arm. - 3. Track rod. - 4. Link rod.

Track rods are fitted with adjustable ends which allow of setting toe-in, as outlined on next paragraph.

In case excessive wear is detected at ball sockets, or damage at ball stud stem, renew the end assembly.

Positioning and tightening directions of steering rod clamps are given on foot of page.

Ball stud nuts should be drawn up with 21.7 to 25.3 ft.lbs (3 to 3.5 kgm) of torque.

## FRONT WHEEL TOE-IN

### Inspection and Adjustment.

Prior to going about with the check of toe-in, see that the following conditions are complied with:

- steering wheel at mid-travel with spokes horizontal;
- wheels in straight-ahead position;
- tires inflated with the correct pressure:
  - front, 15.6 psi (1.1 kg/cm$^2$);
  - rear, 25.6 psi (1.8 kg/cm$^2$).

Adjust the height of the plungers of gauge **Ap. 5107** (fig. 285), setting them at the wheel center; then touch gauge plungers against the outer edge of wheel rims at rear, zero the gauge and mark the points measured with chalk.

Jack up the car at front and rotate the wheels half a turn.

Lower the car and set the gauge plungers at chalk marks on wheels.

Observe the displacement of the gauge indicator pointer.

**Toe-in specifications:**

- car at load (see page 135) .079" to .118" (2 to 4 mm)
- car at no load . . . . . .433" to .511" (11 to 13 mm).

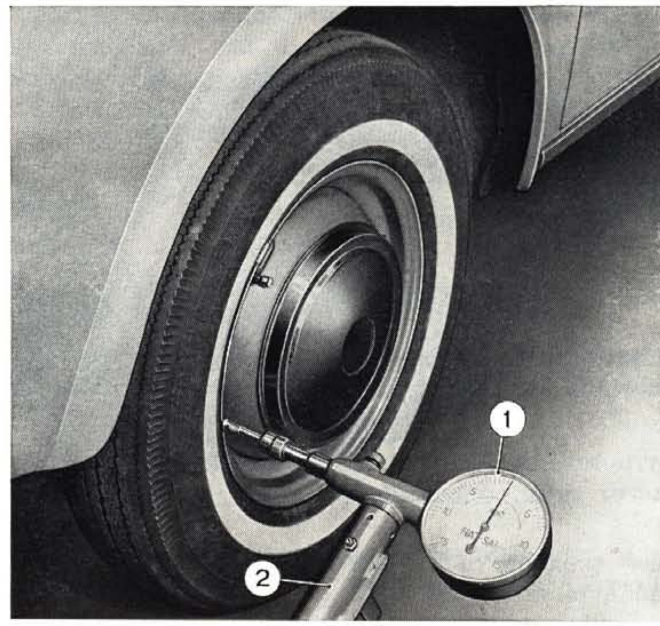



**Fig. 285 - Detail showing the arrangement of front wheel toe-in gauge.**
1. Toe-in gauge dial indicator. - 2. Gauge Ap. 5107.

**NOTE - For the check and adjustment of toe-in the car should be set as shown in fig. 235 referring to the load and no load conditions.**

If toe-in is not within above figures, loosen the clamps of tie rod sleeve adjusters; turn in or out both sleeves an equal amount so to vary the length of tie rods.

Then tighten the sleeve clamps, using care that a gap is left at clamp ends.

Also see that the gaps in sleeve adjusters and in clamps are on the same side and flush.

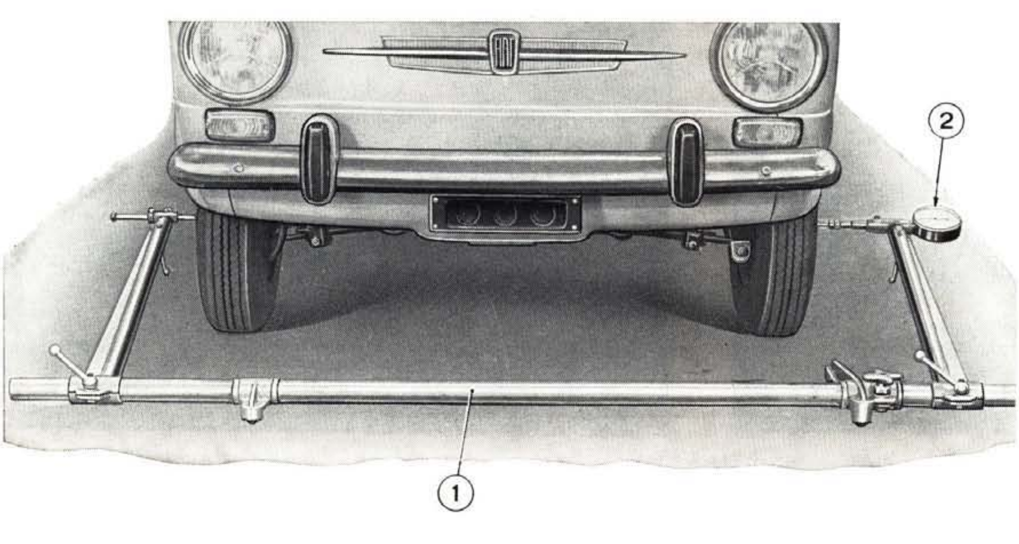



**Fig. 286.**

**Checking front wheel toe-in.**

1. Gauge Ap. 5107. - 2. Toe-in gauge dial indicator.

# Section 8

## BRAKES

## WHEELS AND TIRES



8

# BRAKES



## SPECIFICATIONS AND DATA

| | |
|---|---|
| Brake types | hydraulic, pedal-controlled with expansion shoes<br>mechanical, hand-controlled acting on rear wheel shoes |
| Drum diameter | 7.2915″ to 7.3032″ (185.24 to 185.53 mm) |
| Skimming drums: maximum allowable oversize | .315″ (0.8 mm) |
| Shoe linings — bonding | « Permafuse » process |
| Shoe linings — length (developed) | 7.086″ (180 mm) |
| Shoe linings — width | 1.181″ ( 30 mm) |
| Shoe linings — total braking area | 67 sq.in (432 sq.cm) |
| Shoe linings — thickness — new parts | .165″ to .177″ (4.2 to 4.5 mm) |
| Shoe linings — thickness — min. allowable | .059″ (1.5 mm) |
| Shoe-to-drum clearance — Up to car with n° for spare 802091 (except cars with even from 783292 to 802090) | .010″ (0.25 mm) (corresponding to an adjusting cam rotation of 20° to 25° from travel end) |
| Shoe-to-drum clearance — From car with n° for spare 802093 (including cars with even n° from 783292 to 802092) | self centering shoe |
| Master cylinder bore | 3/4″ |
| Bore of wheel cylinders — front | 7/8″ |
| Bore of wheel cylinders — rear | 3/4″ |

*(continued)*

**Specifications and Data** *(continued).*

| | | |
|---|---|---|
| Master cylinder push rod-to-piston clearance | | .0118″ (0.3 mm) |
| Free travel of clutch pedal (for master cylinder operation) | | .0630″ (1.6 mm) |
| Hydraulic system fluid | grade | FIAT special « blue label » or equivalent non-mineral type |
| | capacity | .457 G.B. pts - .549 U.S. pts (0.26 lt - 0.26 kg) |

# TROUBLE DIAGNOSIS AND CORRECTIONS

## Locked Brake Pedal.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Swollen linings because the fluid used is inadequate or contaminated by kerosene, gasoline or mineral oil. | 1) Flush the system, replace all rubber parts, refill with new fluid and air bleed the lines. |
| 2) Pistons or valve carriers locked by deposits of fluid, foreign matter, etc. | 2) Clean and bleed the system. |
| 3) Master cylinder compensating hole blanked because plunger clearance is misadjusted. | 3) Adjust the rod-to-plunger clearance by setting to .0118″ (0.3 mm). |
| 4) Clogged compensating hole. No compensation takes place. | 4) Disassemble and clean master cylinder. |
| 5) Seized master cylinder piston due to infiltrations of water through rear end because boot has failed or seals are no longer tight. | 5) Service the master cylinder, replace the piston and the boot and/or seals, to prevent water infiltrations. Check master cylinder wall face. |
| 6) Seized pedal shaft (this is also the cause for hard pedal or locked brakes). | 6) Free, smooth out the parts and lubricate. |

## Brakes Locked Even After Releasing the Pedal.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Weak or snapped return springs. | 1) Replace springs. |
| 2) Clogged master cylinder compensating hole. | 2) Clean and bleed the system. |
| 3) Rubber seals swollen or stuck because of contamination by kerosene, mineral oil, gasoline, etc. | 3) Flush the system, replace all rubber parts, refill with new brake fluid and bleed the system. |

## Spongy Pedal.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Air in brake system because of imperfect bleeding. | 1) Repeat the bleeding operation more accurately. |
| 2) Swollen hose because of deterioration. | 2) Replace the hose; bleed the system. |
| 3) Hose swollen under fluid pressure because hose used is of poor quality. | 3) Fit new hoses of a quality approved by FIAT and bleed the system. |
| 4) Air in master cylinder on account of insufficient seal tightness. | 4) Fit a new valve-ring, checking that the piston land height is less than ring thickness. Bleed the system. |
| 5) Use of a brake fluid with low boiling point. | 5) Change the fluid with the FIAT special blue label fluid (or equivalent non-mineral grade) and bleed the system. |
| 6) Reservoir filler cap vent hole clogged. This promotes a vacuum in master cylinder that sucks in air through rear seal. | 6) Clean reservoir filler cap and bleed the system. |

## Pedal Yields under Slight Pressure.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Deteriorated floating valve-ring. | 1) Fit a new valve-ring, check that there is no roughness or blow-hole in master cylinder and bleed the system. |
| 2) Chips or impurities on valve-ring sealing surfaces. | 2) Clean, replace the valve-ring if deteriorated and bleed the system. |
| 3) Fluid leaks through connections. | 3) Tighten connections and, if necessary, replace faulty parts. Bleed the system. |
| 4) Fluid leaks at wheel cylinders. | 4) Replace the deteriorated seals and packings. Dry and clean brake shoe linings. |
| 5) Fluid leaks through hoses. | 5) Replace the damaged hose, using only FIAT - approved hoses and bleed the system. |

## Excessive Effort Required on Pedal.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Swollen rubber seals because the fluid used is inadequate or contaminated by kerosene, gasoline or mineral oil (this may also cause a permanent drag of shoes on brake drum). | 1) Flush the system, replace rubber parts, refill with new brake fluid, and bleed the system. |

## Reduced Pedal Free Travel.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Master cylinder compensating hole blanked on account of misadjusted plunger rod. | 1) Adjust the rod - to - piston clearance and set to .0118" (0.3 mm). |
| 2) Master cylinder compensating hole clogged by impurities. | 2) Clean and bleed the system. |
| 3) Master cylinder compensating hole clogged by a swollen valve-ring. | 3) Flush the system, replace the valve-ring, refill with new fluid and bleed the lines. |

## Excessive Pedal Travel.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) System has not been bled. | 1) Bleed the system. |
| 2) Shoe clearance misadjusted. | 2) Adjust the brake shoe-to-drum clearance. |
| 3) Fluid level in reservoir is too low. | 3) Refill with FIAT special « Blue label » fluid (or equivalent non-mineral grade); if required, bleed the system. |
| 4) Master cylinder piston rod misadjusted. | 4) Adjust the rod-to-piston clearance at .0118" (0.3 mm). |
| 5) Deteriorated rubber seals in master cylinder or in wheel cylinders. | 5) Replace the seals and bleed the system. |
| 6) Excessive swelling of hoses because those used were of poor quality. | 6) Replace by FIAT-approved hoses and bleed the system. |
| 7) Thermal expansion of drums because of excessive overheating. | 7) Allow drums to cool off. Check brake shoe linings and drums. Replace damaged parts. |

## Shoes Drag Permanently on Drums.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Poor clearance between brake shoes and drums. | 1) Adjust clearance. |
| 2) Weak or snapped return springs. | 2) Replace the springs. |
| 3) Brake pedal has no free travel. | 3) Adjust the rod-to-piston clearance at .0118" (0.3 mm). |
| 4) Seized master cylinder piston. | 4) Service the master cylinder, replace the piston and bleed the system. |
| 5) Master cylinder flooded because compensating hole is clogged. | 5) Service the master cylinder, replace the valve-ring if swollen or deteriorated, clean the compensating hole and bleed the system. |

## Unbalanced Braking.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Fluid leaks at one wheel cylinder. | 1) Dry and clean the brake shoe linings, service the wheel cylinder and bleed the system. |
| 2) Rust corrosion on the edges of a wheel cylinder. | 2) Eliminate rust and replace the boots. |
| 3) Seized piston in one wheel cylinder. | 3) Service the wheel cylinder, replace the piston and bleed the system. |
| 4) Hose restricted from swelling or clogged (if the brakes on one axle are excluded, weak braking may result). | 4) Replace or clean the hose and bleed the system. |
| 5) Restricted flow in metal pipe which is crushed or clogged (if the brakes on one axle are excluded, weak braking may result). | 5) Replace or clean the pipe and bleed the system. |

## Weak Braking.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Fluid leakage from wheel cylinders. | 1) Dry and clean the brake shoe linings, service the wheel cylinder replacing damaged parts and bleed the system. |

# SERVICE BRAKES

## Master Cylinder.

The master cylinder operates as follows:

The brake pedal push rod directly actuates the piston (5, fig. 288). Tightness at the rear of fluid chamber is provided by rubber seal ring (8), identical to valve-ring (3).

The seal ring (8) is stretched on a raised path of the piston (5) and undergoes compression between piston shoulder and valve-ring carrier (4) from return spring (13) the radial pressure of which is such as to warrant perfect tightness.

When the master cylinder is inoperative no radial pressure is placed on valve-ring (3) which takes a position to clear by-pass port (11) whereby fluid is supplied to the master cylinder. Also valve-ring rotates in so doing, thus equalizing wear over the whole surface and reducing it to a negligible fraction.

Rubber valve-ring and seal ring (8 and 3) develop a marked toric section their overall diameter being equal to, or slightly above the cylinder bore, when free. When no hydraulic pressure impends on rubber valve-ring and seal ring, the outer mid circle only touches the cylinder wall, whereas edges keep clear.

When hydraulic pressure comes into action, radial thrust combined with axial pressure expands the valve and seal rings, making the master cylinder tight.

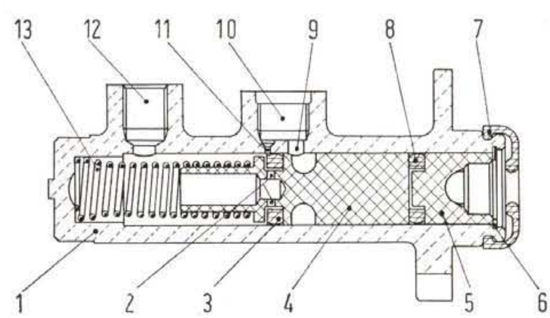



**Fig. 288 - Master cylinder.**

1. Master cylinder body. - 2. Fluid transfer holes. - 3. Floating valve-ring. - 4. Valve ring carrier. - 5. Piston. - 6. Snap ring. - 7. Rubber boot. - 8. Seal ring. - 9. Fluid inlet orifice. - 10. Fluid inlet port. - 11. Compensating orifice. - 12. Outlet line « T » connection port. - 13. Piston return spring.

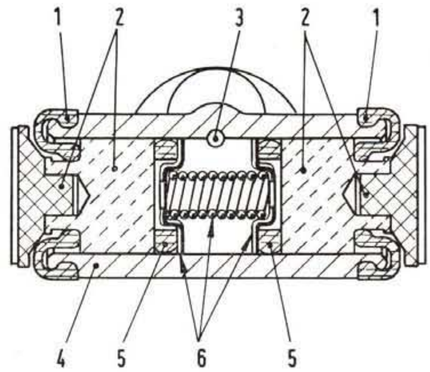



**Fig. 289 - Side section view across wheel cylinder.**

1. Rubber boots. - 2. Pistons with stems. - 3. Fluid inlet port. - 4. Cylinder body. - 5. Seal rings. - 6. Spring backing washers and piston reaction spring.

The edges of valve and seal rings (8 and 3) facing respectively piston (5) and valve carrier (4) are pushed to contact the cylinder, while the opposite edges, which are surrounded by fluid under pressure, will still have a bent shape keeping them clear of cylinder also on motion.

Valve and seal ring contact area to cylinder wall is cut to a minimum and rounded edges on the fluid side provide effective lubrication to working surfaces, taking friction drag to a very low rate. This means also a distinct advantage in the braking power, as brakes feel more responsive in the initial stage when brake shoes are seating.

The by-pass port (11, fig. 288) in master cylinder is such as to allow for quick take up in case of fluid expansion from brake drum overheating, minimize clogging possibilities as a result of foreign matter entering the lines, as well as improve the line bleeding by facilitating the expulsion of air bubbles from compression chamber.

Master cylinder bore: 3/4''.

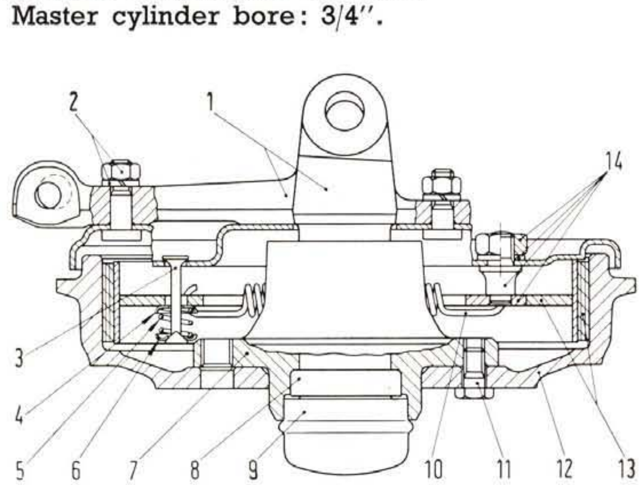



**Fig. 290 - Sectional view of left side front wheel. (Up to car with No. for spare 802091).**

1. Steering knuckle and arm. - 2. Brake backing plate lock washer and nut. - 3. Pin. - 4. Inner cup. - 5. Shoe guide spring. - 6. Outer cup. - 7. Wheel hub. - 8. Outer roller bearing. - 9. Hub cap. - 10. Shoe return spring. - 11. Drum screw. - 12. Brake drum. - 13. Brake shoe with lining. - 14. Brake backing plate with nut, pin and cam for shoe clearance adjustment.

## Wheel Cylinders.

The wheel cylinders have the following bores:

- front . . . . . . . . . . . . . . . . 7/8''
- rear . . . . . . . . . . . . . . . . 3/4''

Tightness in cylinders is obtained by means of a pair of rubber seal rings (5, fig. 289) which will stretch under impending fluid pressure. These seal rings are pressed against pistons by two backing washers to which reaction spring (6) is clenched; pistons operate brake shoes through stems.

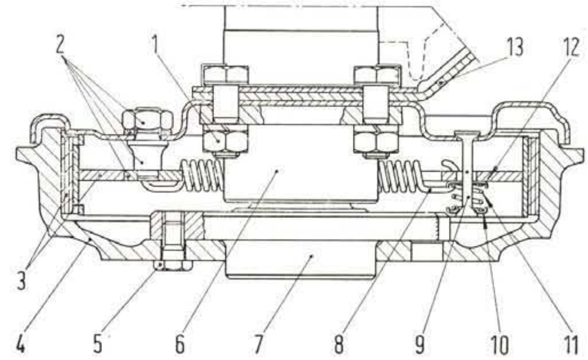



**Fig. 291 - Sectional view of right side rear wheel. (Up to car with No. for spare 802091).**

1. Nut holding hub and brake backing plate. - 2. Brake backing plate with nut, pin and cam for shoe clearance adjustment. - 3. Brake shoe with lining. - 4. Brake drum. - 5. Brake drum screw. - 6. Wheel hub and bearings. - 7. Wheel shaft. - 8. Shoe return spring. - 9. Pin. - 10. Outer cup. - 11. Shoe guide spring. - 12. Inner cup. - 13. Control arm.

## Inspection and Repair.

### FLUID RESERVOIR AND LINES

When overhauling service brakes, check for absence of foreign matter or sludge deposits in fluid reservoir and for a restricted vent hole in reservoir cap.

Correct as required or replace the fluid reservoir, if damaged.

Check hoses: if such signs of deterioration are detected as efficiency may be impaired, replace them.

Metal pipes as well as connectors should not be crushed and show no cracks; otherwise replace parts affected.

---

**NOTE - Use only FIAT special « blue label » fluid to clean brake lines and reservoir lest seals may be ruined and system operation adversely affected.**

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### MASTER CYLINDER AND WHEEL CYLINDERS

The disassembly of master cylinder does not involve any special difficulty.

Next to disassembly, check cylinder bore and piston for the presence of rust, rough faces or excessive play.

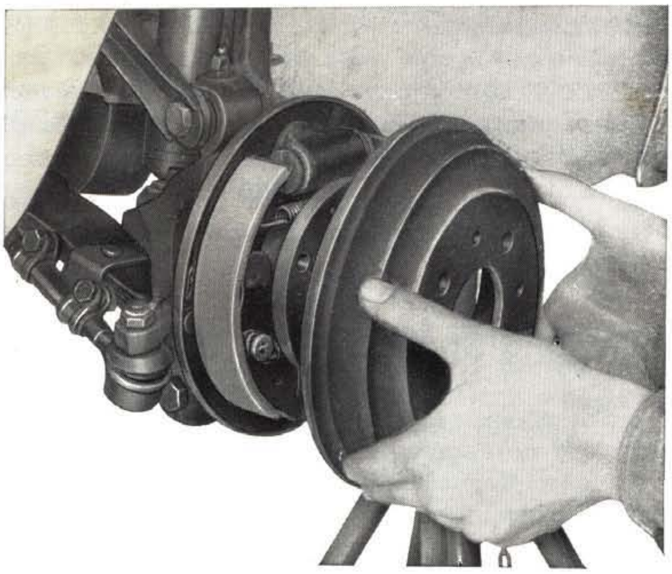

Fig. 292 - Removing brake drum.

Minor irregularities on cylinder wall may be smoothed out provided the bore size is not affected.

Replace seals.

Replace rubber boot, if damaged.

Piston return spring should not be sagged, otherwise replace it.

Prior to assembling the master cylinder, thoroughly wash all components in clean brake fluid.

For wheel cylinders, follow the same inspection and repair procedure as for the master cylinder.

## BRAKE SHOES AND LININGS

Check brake shoes for indications of crack or distortion: replace if cracks or distortions are evident.

The pin (3, fig. 290) should slide freely in its shoe seat. The guide spring (5, fig. 290) should not be sagged nor cups, outer and inner, distorted.

Replace any damaged parts.

Check to make sure that shoe return springs are quite serviceable, otherwise replace them.

Shoe linings should not be soiled or greasy, otherwise clean them thoroughly with turpentine and rub with wire brush.

Correct the cause of oil or grease leakage.

In the event that shoe linings have become thinner than .06″ (1.5 mm), replace them.

Brake linings are cemented to shoes with the « Permafuse » bonding process which is illustrated in detail in a special issue by FIAT Service Dept. Proceed as directed therein when brake linings must be replaced.

Use metal band **A. 72210** to fit and bond linings.

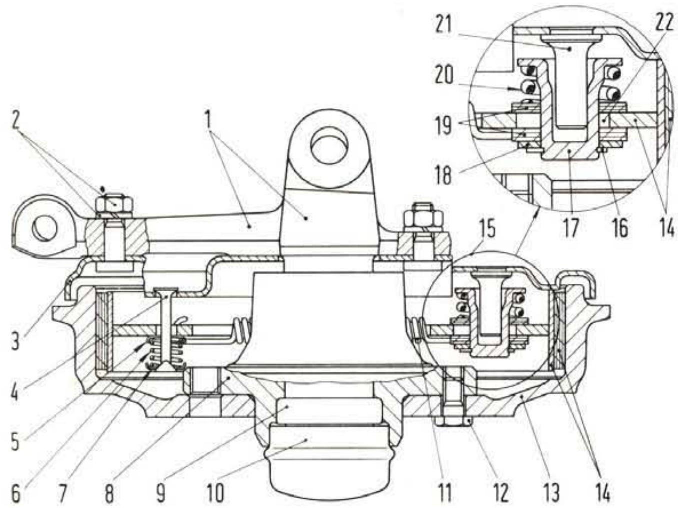


**Fig. 293 - Left front wheel sectional view from with No. for spare 802093.**

1. Steering Knuckle and arm. - 2. Backing plate lock washer and nut. - 3. Backing plate. - 4. Shoe guide pin. - 5. Inner cup. - 6. Guide pin spring. - 7. Outer cup. - 8. Wheel hub. - 9. Outer roller bearing. - 10. Hub cup. - 11. Shoe return spring. - 12. Drum-to-hub screw. - 13. Brake drum. - 14. Brake shoe with lining. - 15. Self- centering device. - 16. Lockring. - 17. Cup. - 18. Washer. - 19. Friction washer. - 20. Stop spring. - 21. Bolt. - 22. Slot for self-centering shoe.

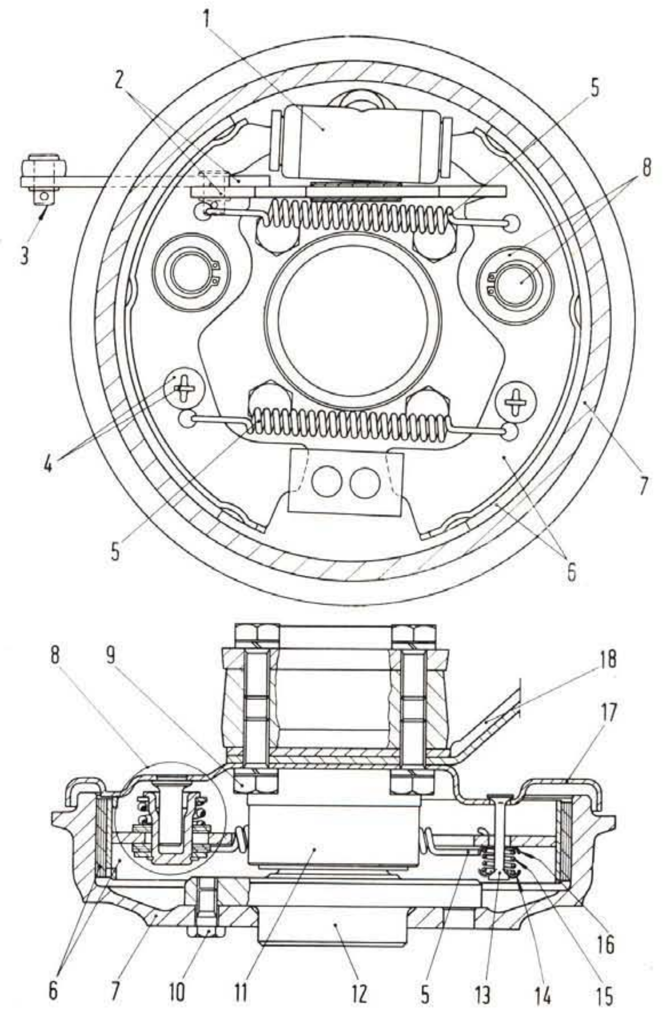


**Fig. 294 - Right rear wheel sectional views (from car with No. for spare 802093).**

1. Wheel cylinder. - 2. Hand brake operating lever and sector. - 3. Hand brake control cable hooking pin. - 4. Shoe guide device. - 5. Shoe return spring. - 6. Shoe with lining. - 7. Brake drum. - 8. Self-centering device (see fig. 293). - 9. Screw holding backing-plate and bearing housing to swingingarm. - 10. Brake drum-to-wheel shaft screw. - 11. Bearing housing. - 12. Wheel shaft. - 13. Shoe guide pin. - 14. Outer cup. - 15. Shoe guide pin spring. - 16. Inner cup. - 17. Backing plate. - 18. Swinging arm.

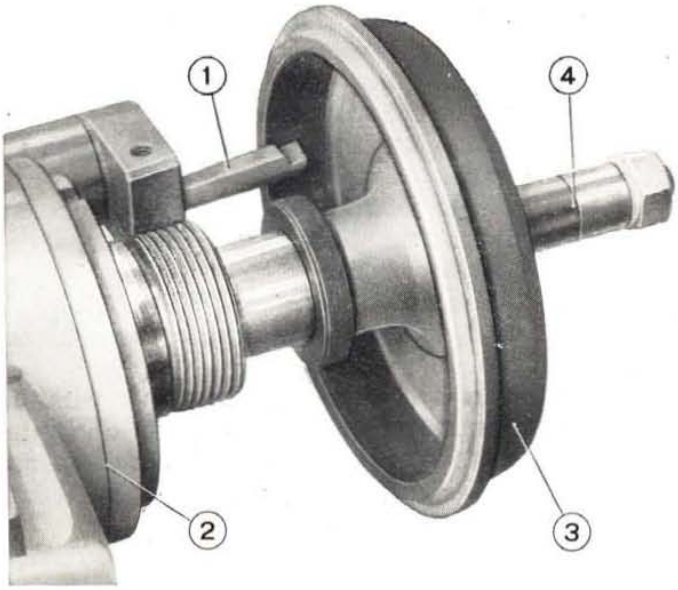


**Fig. 295 - Turning brake drum on lathe.**
1. Cutter. - 2. Lathe M. 1004. - 3. Brake drum. - 4. Drum holding spacer

Next, reface linings with refacer **Ap. 5031** as shown in fig. 297.

**BRAKE DRUMS**

Examine brake drums: if scores or out-of-round are detected turn them on lathe **M. 1004** (fig. 295).

After skimming, lap drums using lapping fixture **M. 1005** which must be inserted on lathe machine (fig. 296).

Lapping should be made with with very fine grade stones in order to eliminate any roughness left by lathe cutter during turning operation.

Maximum oversize allowed in respect of standard diameter of drums after turning and lapping:

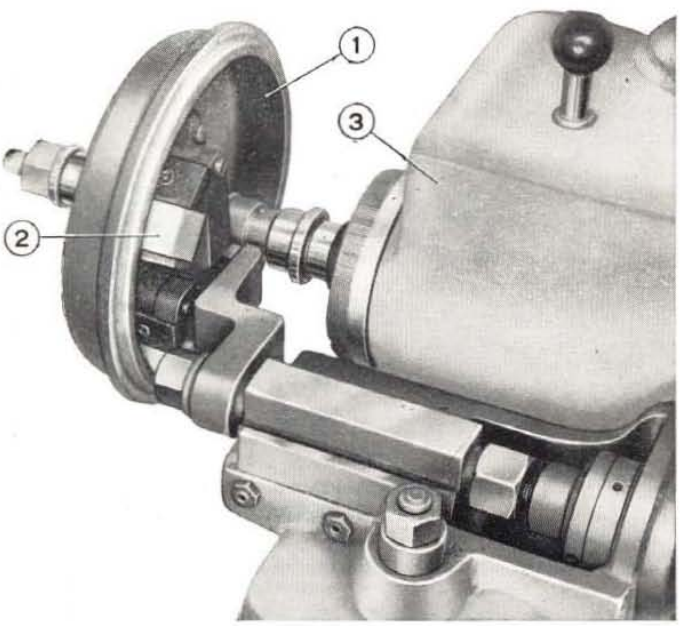


**Fig. 296 - Lapping brake drum.**
1. Brake drum. - 2. Lapping machine M. 1005. - 3. Lathe M. 1004.

— standard diameter . . . 7.2915" to 7.3032" (185.24 to 185.53 mm)
— oversize . . . . . . . . . .0315" (0.8 mm)

Drum centering and balance conditions should not be affected as a result of skimming operation.

Do not exceed drum oversize limit as otherwise both the strength and braking power of drum may be impaired.

## Adjusting Shoe-to-Drum Clearance.

Brake shoes are of the self-centering type and therefore no alignment problem is met with them.

As a matter of fact, brake shoes are setting automatically at center on pedal depression; this condition is obtained thanks to the adoption, in the place of the conventional anchor pin, of a spring guided pin (figures 290 and 291) allowing for slight side movements of shoes, which are supported on a lower plate (figures 293 and 294). Brakes shoes, under the impending hydraulic pressure from wheel

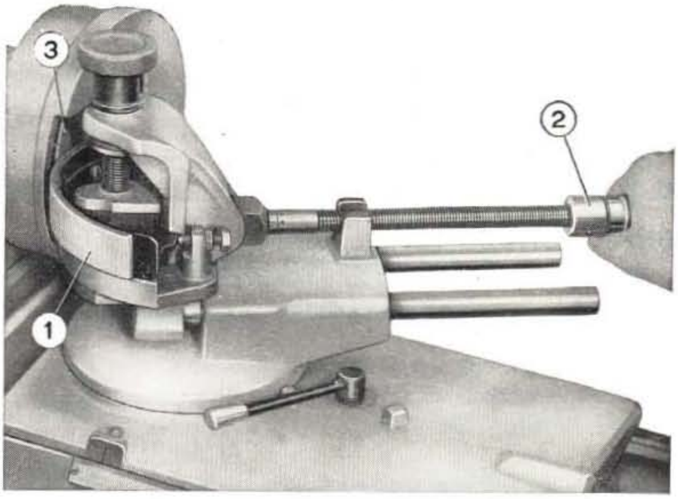


**Fig. 297 - Refacing brake shoe linings.**
1. Shoe lining. - 2. Carriage operating bar. - 3. Stone of refacer Ap. 5031.

cylinders, are caused to expand and move for such a seating as their working area will adhere to the drum face at all points.

Prior to adjusting the shoe-to-drum clearance, operate the brakes with running vehicle to ensure centering of brake shoes, especially when they have been renewed.

Then proceed as follows at each wheel:

— jack up the vehicle on the side where work is needed;

— depress the brake pedal fully to have brake shoes contact the drum;

— keep the pedal in down position and turn the nuts of adjusting cams outward to the last stop;

– turn the nuts (fig. 298) in opposite direction by some 20° for seated shoe linings and some 25° for new linings (which corresponds to a shoe clearance of .010" - 0.25 mm at cams);

– release the brake pedal and see that the wheel can rotate freely.

**NOTE**

**From car with No. for spare 802093 (including cars with even No. from 783292 to 802092) shoe-to-drum clearance of front and rear wheels is automatically adjusted by a self-centering device (figs. 293-294).**

## Bleeding Hydraulic Lines.

When brake pedal becomes spongy in operation or some connections had to be unscrewed, bleed system as follows:

1) Top up brake fluid reservoir to .39" (1 cm) from lower brim.

2) Fit one end of bleeder hose **A. 10103** on wheel cylinder bleeder screw. Immerse the other hose end in a transparent vessel partially filled with brake fluid.

3) Slacken bleeder screw a few turns and pump pedal repeatedly (depressing quickly and releasing slowly) until fluid issues in a solid stream without bubbles.

4) While keeping brake pedal depressed, tighten bleeder screw and remove bleeder hose.

5) Repeat operations 2, 3 and 4 at the other wheel cylinders. Top up fluid reservoir.

In case brake system has been completely drained, prior to bleeding, proceed as follows:

a) Slacken bleeder screws a few turns at four wheel cylinders.

b) Pump brake pedal and then tighten the screws when fluid begins to issue.

Should air bubbles continue to issue through bleeder hose ends, though bleeding operation is prolonged, check all connections for air leaks. If no leaks are found, check master cylinder and wheel cylinder seals for perfect tightness.

**WARNING**

To prevent air from being drawn in by master cylinder during the bleeding operation, the fluid level in reservoir must never be allowed to fall under the minimum mark.

If bleeding operations have not been carried out properly, with pedal fully depressed, a more or less marked sponginess will be felt, depending upon the amount of air that has remained in the system.

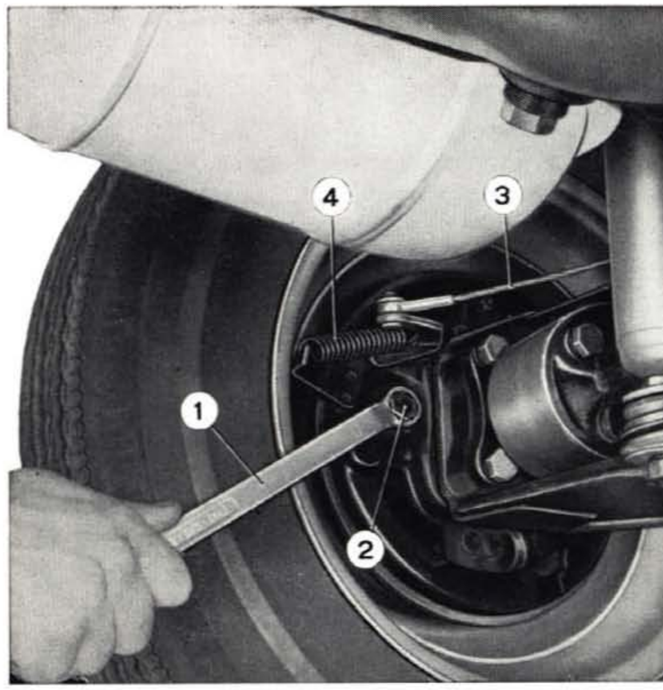


**Fig. 298 - Adjusting brake shoe-to-drum clearance at rear wheels.**

1. Wrench A. 56119. - 2. Nut, shoe actuating cam. - 3. Handbrake control cable. - 4. Spring, shoe actuating lever return.

For adjustment of brake shoe clearance at front wheels, use wrench A. 56113.

In this case, bleeding must be repeated simultaneously at the four bleeder screws.

Fluid withdrawn in the bleeding operation should not be used again if the vehicle brake system has been in service over a long period of time. Top up the reservoir with fresh fluid.

Under any circumstances, fluid should be carefully filtered prior to using it again.

## Brake and Clutch Pedal Mounting Board.

### REMOVAL AND INSTALLATION

Remove the brake and clutch pedal mounting board as follows:

– disconnect the clutch throwout control cable;

– work from engine compartment interior and back out screws and nuts from master cylinder and pedal board (1 and 2, fig. 300);

– working from passenger compartment, back out pedal board-to-body nuts and disconnect stop light swich wires;

– take out the board and pedal assembly.

Install the board by reversing the removal procedure and recall the following:

— the stop light switch pin should be set square to the welded clip at pedal stem;

— the master cylinder piston should contact the stop ring.

If so, there should be a clearance of .012″ (0.3 mm) between piston and push rod, corresponding to a pedal travel of some 1/16″ (1.6 mm).

### INSPECTION AND REPAIR

Check pedals for a complete control travel free from drags or binds.

Otherwise dismantle the assembly and remove the origin of trouble. Replace any damaged part.

Check the condition of pedal working faces, bushings and spacers, as well as return springs; replace damaged parts.

## EMERGENCY AND PARKING BRAKE

The parking brake is controlled manually through a ratchet lever and actuates rear wheel shoes.

The handbrake does not call for any special care for service. Just check the wear condition of control cable; should any plait wire be torn, renew the whole cable.

Make sure that the handlever ratchet serration and pawls are in good condition: in case of wear replace parts as required.

If the handbrake is a source of rattling noises, check the tension and arrangement of control cable and adjust it properly.

Handbrake noises may be also due to shoe segment rubber blocks being deteriorated: replace rubber blocks, if so.

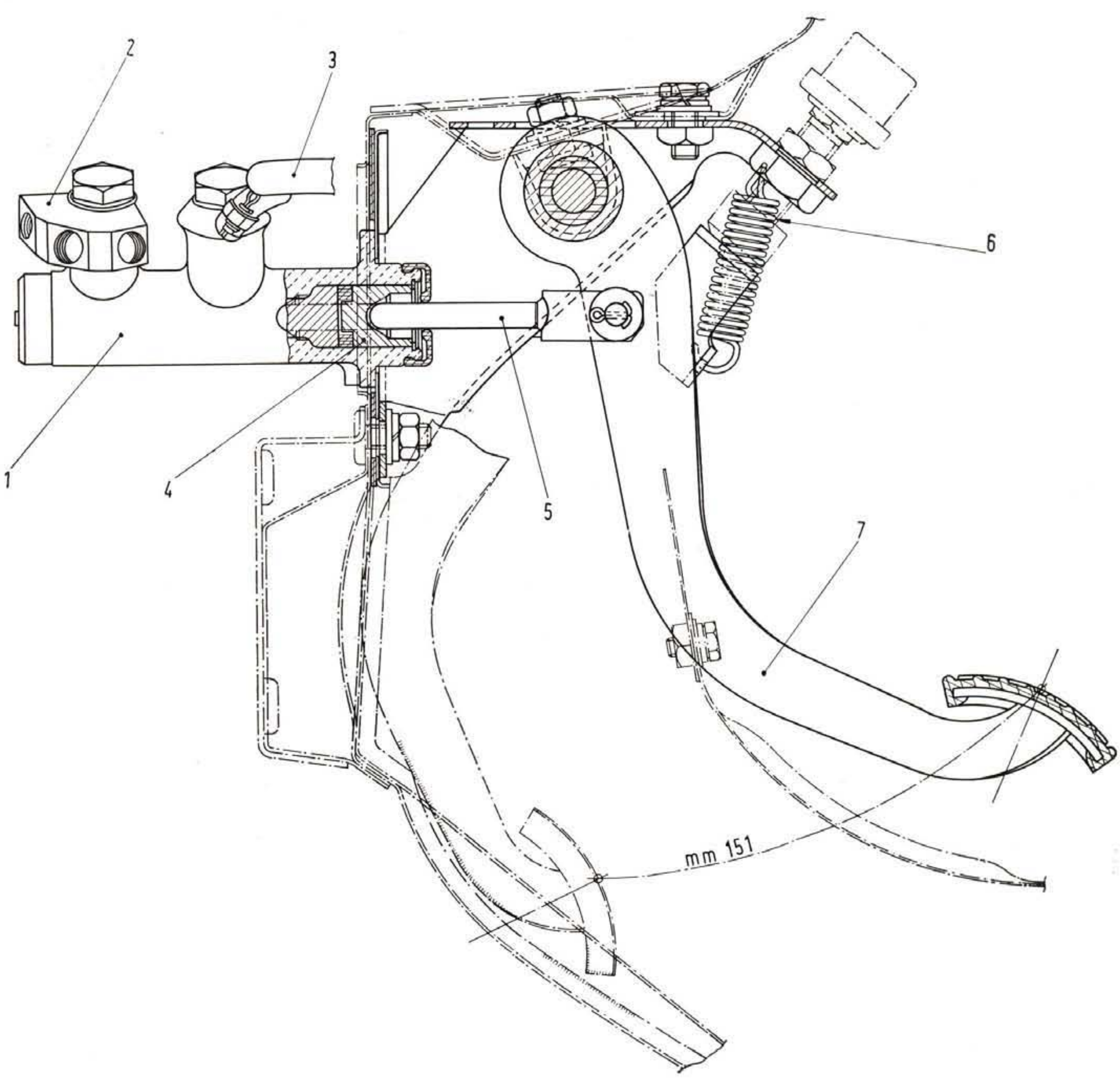


**Fig. 299 - Brake pedal and master cylinder assembly.**

1. Master cylinder. - 2. Connector, fluid delivery to wheel cylinders. - 3. Master cylinder inlet line. - 4. Master cylinder piston. - 5. Push rod, master cylinder control. - 6. Brake pedal return spring. - 7. Brake pedal.

mm 151 = 5.945″.

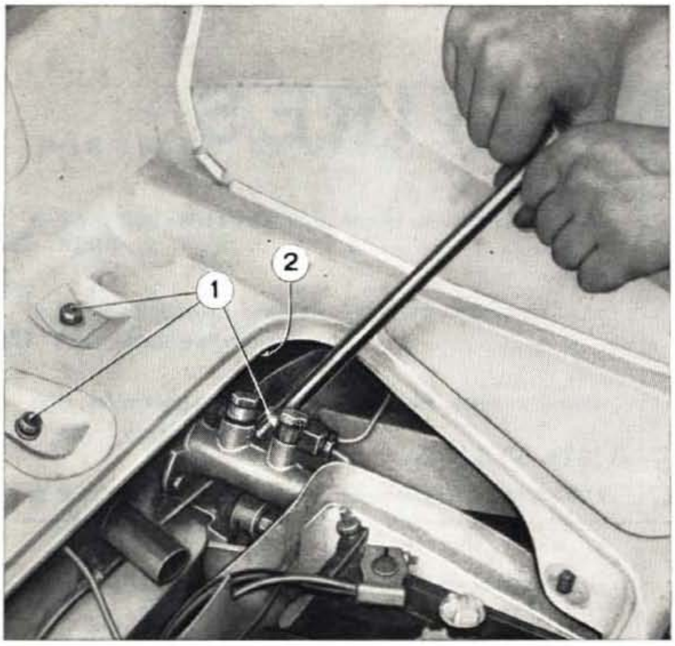


**Fig. 300 - Removing brake and clutch pedal mounting board.**

1. Screws, board to body. - 2. Brake and clutch pedal mounting board.

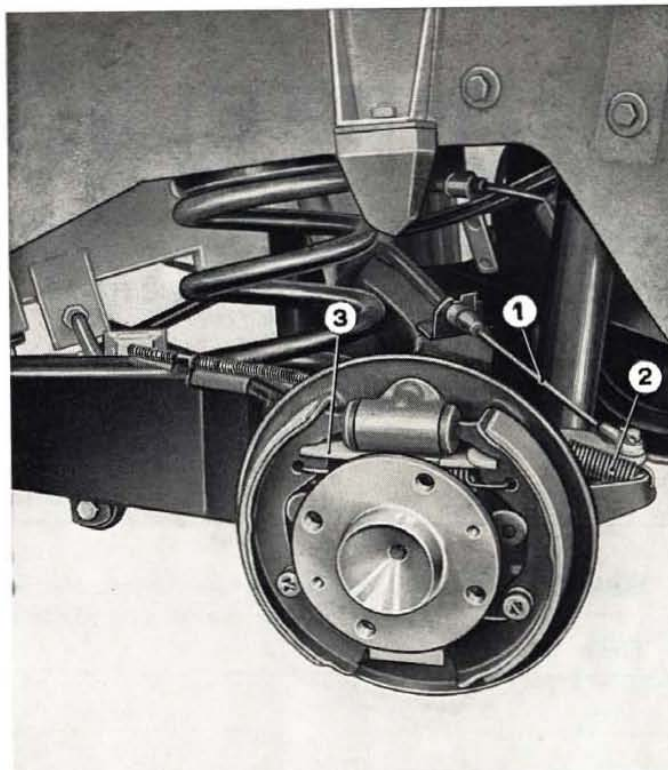


**Fig. 301 - Handbrake components at left side rear wheel.**

1. Handbrake control cable. - 2. Actuating lever return spring. - 3. Shoe actuating segment, manually controlled.

Examine all springs for a sagged or snapped condition, lest control levers fail to be returned to rest position.

At last check the cable housing to see that it is well seated in clips at control arms.

## Adjustment.

Preparatory to the adjustment of manual brake ratchet lever, set the correct clearance of brake shoes to drum, then proceed as follows:

– position the ratchet lever at rest;

– pull the lever up by two ratchet serrations;

– work on cable stretcher (4, fig. 302) so that wheels cannot be turned manually; cable should be well taut;

– lock the stretcher in position by tightening down nut and counternut.

---

**NOTE - Special care should be taken for the adjustment of the parking brake, as any abnormal tension on control cable is apt to adversely affect the operation of service brakes at rear wheels as well, the brake shoes being common to both systems.**

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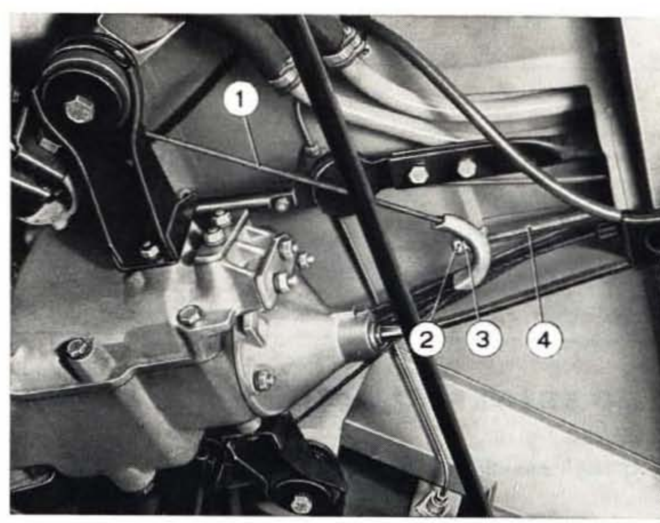



**Fig. 302 - Close-up view of manual parking brake control cable and stretcher.**

1. Handbrake control cable. - 2-3. Cable stretcher lock nut and counternut. - 4. Adjustable stretcher.

# WHEELS AND TIRES



## SPECIFICATIONS AND DATA

| | |
|---|---|
| **Wheels** | disc with rim |
| — type | 4.00 x 12 |
| **Tires** | low pressure |
| — type | 5.50 - 12 |
| **Tire Pressures:** | |
| Load not in excess of 4 people and luggage: | |
| — front | 15.6 psi (1.1 $kg/cm^2$) |
| — rear | 25.6 psi (1.8 $kg/cm^2$) |
| Long distances at maximum load (5 people and luggage): | |
| — front | 17.1 psi (1.2 $kg/cm^2$) |
| — rear | 28.4 psi (2 $kg/cm^2$) |

## TROUBLE DIAGNOSIS AND CORRECTIONS

### Excessive Tire Wear.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) High speed on very rough terrain. | 1) Reduce speed according to road conditions. |
| 2) Sudden variations of speed due to rapid accelerations or improper brake application. | 2) Avoid any unnecessary acceleration or brake application. |
| 3) High speed with underinflated tires. | 3) Check tire pressure, with cold tires, and inflate to the recommended values. |
| 4) Overinflated tires. | 4) Reduce tire pressure to the recommended values. |
| 5) Overloaded car. | 5) See load specifications on page 6. |

## Tire Damages.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Tires torn at bead bottom, due to uneven rim edges. | 1) Repair or replace wheel rim, as required; should tire be exceedingly damaged, replace it. |
| 2) Carcass threads broken at tire tread corners, due to an overloaded car. | 2) Avoid using car loaded beyond specifications. |
| 3) Overinflated tires and consequent carcass breakage from impact. | 3) Reduce tire pressure to recommended values; inspect tire and replace it, if necessary. |
| 4) Side walls damaged due to use of skid chains of improper type. | 4) Fit chains of proper type. |
| 5) Use of skid chains when driving on good roads. | 5) Use skid chains only in necessity, when particular road conditions may so demand. |

## Uneven Tire Wear.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) High speed on curves. | 1) Reduce speed. |
| 2) Side skids on curves due to defective suspensions. | 2) Rebuild suspensions. |
| 3) Wheels out of balance. | 3) Balance wheels. |
| 4) Uneven braking action on road wheels. | 4) Overhaul brake system. |
| 5) Brake drums out-of-round. | 5) Skim drums as directed under « Brakes ». |
| 6) Excessive play of wheel bearings. | 6) Proceed as required, according to directions given on page 137. |
| 7) Inoperative shock absorbers. | 7) Replace or overhaul shock absorbers. |
| 8) Incorrect setting of front end geometry. | 8) Adjust front end geometry to specifications. |
| 9) Distorted wheel rims, and consequent out-of-balance. | 9) Straighten rims, if possible; otherwise replace them. Balance wheels. |
| 10) Incorrect installation of tires on wheel rims. | 10) Fit tire correctly and balance wheel. |
| 11) Uneven tire pressure on each pair of wheels. | 11) Check tire pressure and inflate to recommended values. |
| 12) Incorrect camber: wear only on one side of front tire tread. | 12) Check camber: if correct, wear is due to curves being negotiated at high speed. |

*(continued)*

**Uneven Tire Wear** *(continued)*.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 13) Underinflated tires: wear is particularly remarkable on two sides rather than in the center of tire tread. | 13) Inflate tires to recommended values. |
| 14) Overinflated tires: excessive wear on tire tread center portion. | 14) Reduce pressure to recommended values. |
| 15) Low front wheel toe-in: excessive wear on inner sides of tire tread. | 15) Check and adjust toe-in. |
| 16) High front wheel toe-in: excessive wear on outer sides of tire tread. | 16) Check and adjust toe-in. |
| 17) Steering system out of adjustment and consequent high toe-in on one wheel and low toe-in on the other. Wear is particularly remarkable on tread inner side of one tire and outer side of the other. | 17) Set front end geometry and check steering and suspension components for distortion. |

## Pull to One Side.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Front wheels out of balance. | 1) Balance wheels. |
| 2) Uneven front tire pressure. | 2) Check pressures and set them to recommended value. |
| 3) Excessive wear difference in one pair of tires. | 3) Replace tire which is exceedingly worn. |

## Wheel Balance.

The balance of a wheel and tire assembly is an important factor which must be accurately looked after for safe and comfortable drive.

As a matter of fact unbalanced wheels may bring about abnormal wear in running gear and, mainly, in tires.

The conditions which are apt to adversely affect wheel balance are the following:

a) wheel run-out from warpage or impact;

b) wheel out-of-round caused by irregularities in the rim or tire;

c) static unbalance or uneven distribution of the weight around the axis of rotation.

Conditions a) and b) may be easily detected: first rotate the rim alone and then the wheel and tire and:

– using a scriber check wheel inside flanges retaining the tire bead and the rim well for run-out in excess of .0394" (1 mm);

– when installing tires, see to it that the red spot is situated at the valve.

To correct run-out of wheel rim take down tire and straighten wheel rim using an arbor press.

To correct the condition c), balance the wheels using electronic balancer **Ap. 5029**.

Thanks to this device best and quick results are obtained allowing to determine the amount of weights and their location on rims for correct wheel balance.

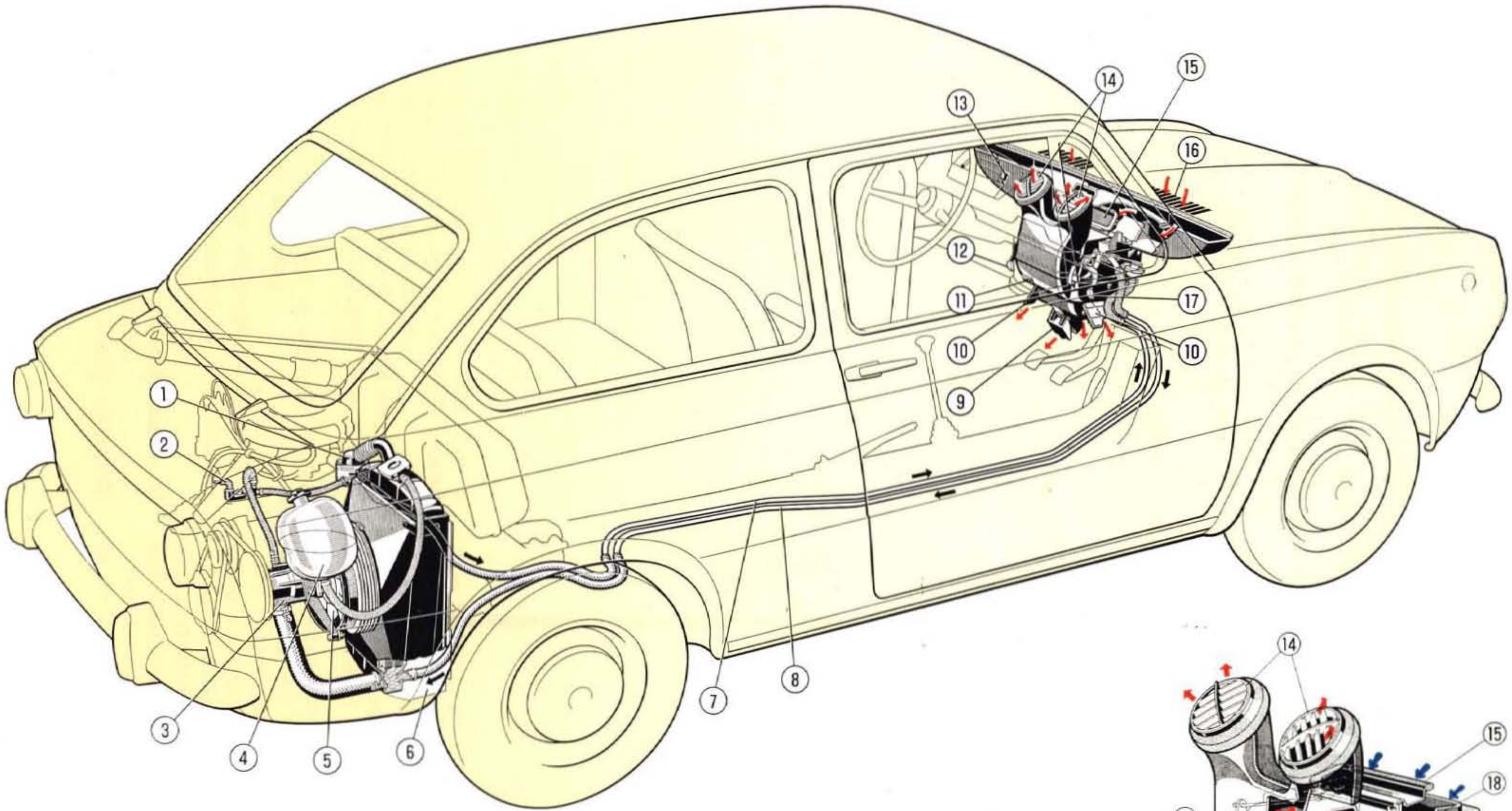
For the use of balancer, adhere to the directions in the handbook delivered with each machine.

# Section 9

## AIR CONDITIONING SYSTEM

## WINDSHIELD WASHER

## TIGHTENING REFERENCE



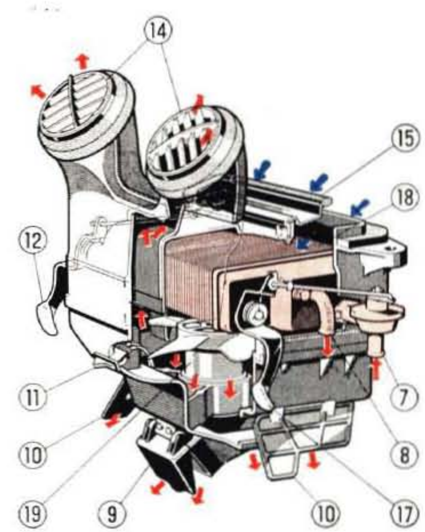




**Fig. 303 - Phantom view of air conditioning system in car interior.**

1. Thermostat at head water outlet duct to radiator. - 2. Excessive coolant temperature indicator sending unit. - 3. Coolant pump. - 4. Sealed coolant circuit expansion tank. - 5. Fan. - 6. Radiator. - 7. Coolant delivery pipe to heater radiator. - 8. Coolant return pipe to engine radiator. - 9. Air delivery shutter to rear compartment. - 10. Air delivery shutters to front compartment. - 11. Heater electro-fan switch. - 12. Heater radiator air scoop control lever. - 13. Excessive coolant temperature indicator. - 14. Adjustable air outlets for air delivery toward the windshield and/or to car interior. - 15. Heater radiator air delivery shutter. - 16. Atmosphere air intake slots. - 17. Engine-to-heater radiator water flow cock control lever. - 18. Heater radiator. - 19. Electro-fan.

# AIR CONDITIONING SYSTEM

Fresh air circulation and heating in car interior can be set at will by the driver according to weather requirements. Main operating conditions of the system are the following:

## Summer Ventilation.

To admit fresh air to car interior other than by adjusting the ventilator panes and lowering door window glasses, shift up the blue lever (A, fig. 304)

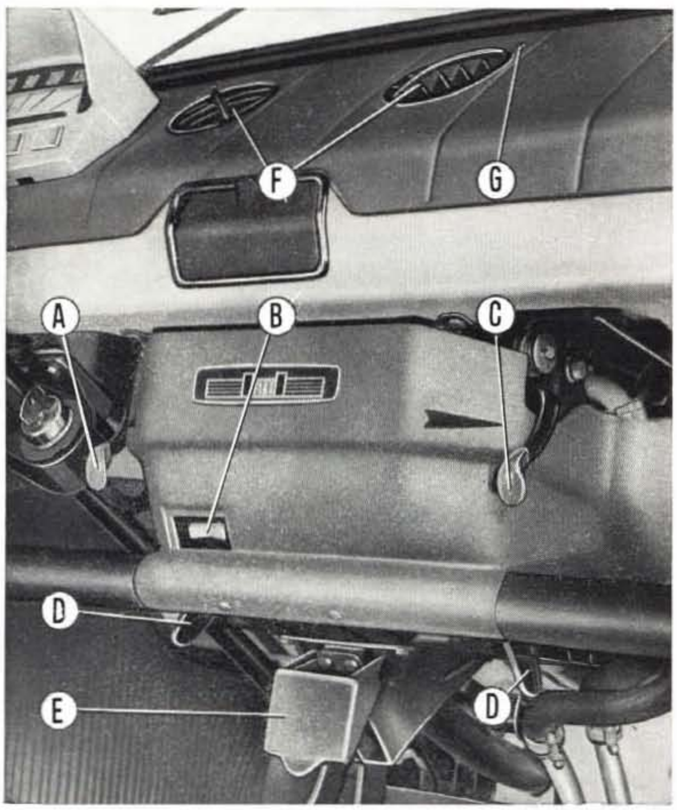



**Fig. 304 - Car air conditioner.**

A. Air scoop control lever. - B. Electro-fan switch. - C. Heater radiator coolant flow cock control lever. - D - E. Air delivery shutters. - F. Adjustable air outlets. - G. Reference mark for windshield demisting.

controlling the front air scoop shutter and open the heater shutters (D and E).

With the car at low speed, the amount of incoming air can be increased by turning on the electro-fan switch (B).

This switch is energized only with the ignition on.

To convey cool air straight toward passengers, besides pulling lever (A), shut off heater shutters (D) and (E) and position air outlets (F) properly.

**Fig. 305 - Removing utility shelf.**
Arrows point to shelf mounting screws.

## Mid-Season Ventilation.

In mid-season, to avoid the misting of the windshield, just shift the lever (A) up.

If the air must be flown exclusively toward the windshield, close the heater shutters (D and E) and position the adjustable outlets (F) with the center rib of the finning toward the reference marks (G) on the instrument panel.

In case the incoming air is desired to be slightly warmed, move the heater control lever (C) part way up.

## Winter Heating.

To admit warmed air to car interior for heating purposes and against the windshield to avoid misting and prevent frost and ice from building up on windshield exterior, proceed as follows:

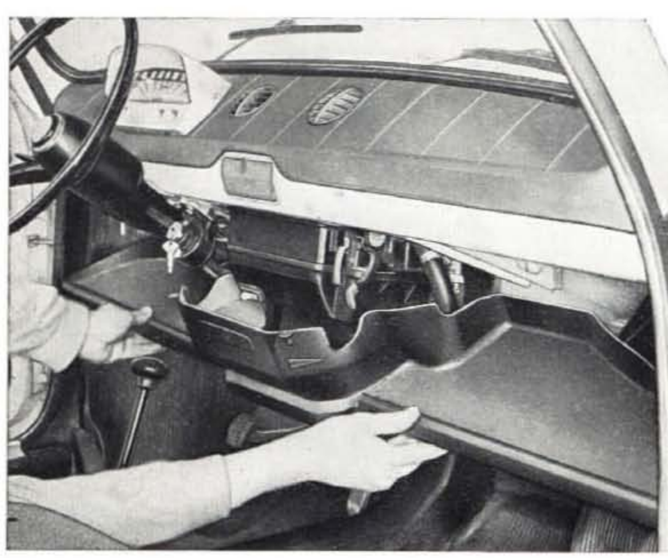


**Fig. 306 - Withdrawing utility shelf.**

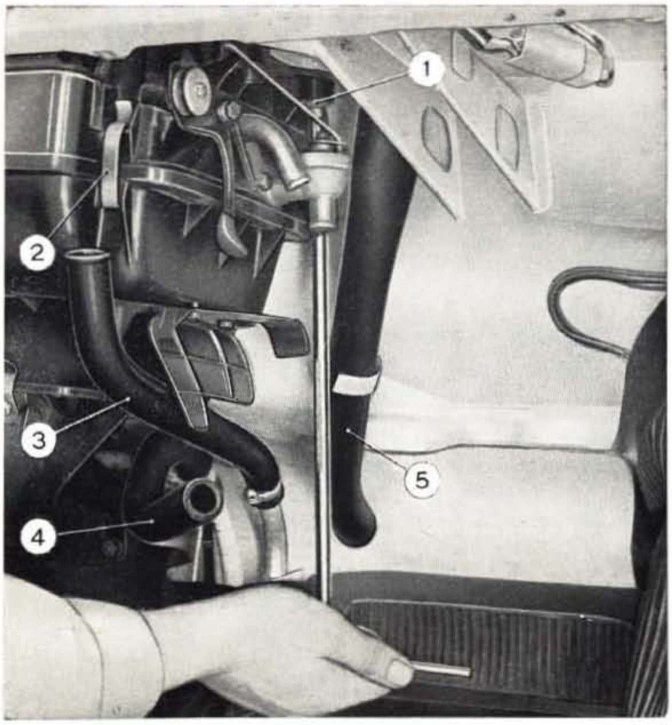



**Fig. 307 - Removing air conditioner.**

1. Conditioner mounting screw. - 2. Conditioner case fastener. - 3. Heater radiator inlet hose. - 4. Heater radiator outlet hose. - 5. Air intake water drain hose.

– shift up the lever (A) controlling the air scoop shutter;

– shift up the red lever (C) controlling the coolant flow from engine to heater radiator;

– if necessary, turn on the electro-fan switch (B).

**Fig. 308 - Withdrawing air conditioner.**

Next:

a) adjust the air outlets (F) so that air is sent both against the windshield and up into the passenger compartment;

b) open the shutters (D) for air delivery to the front compartment;

c) open the shutter (E) if heating of the rear compartment, too, is desired.

In case of very cold climate conditions, move the lever (A) part way up only in order to reduce the quantity of incoming air.

For better air circulation in car interior, it is good practice opening either ventilator pane.

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**NOTE - Should the car heater efficiency be rather poor, check the thermostat in the head-to-radiator duct for correct operation.**

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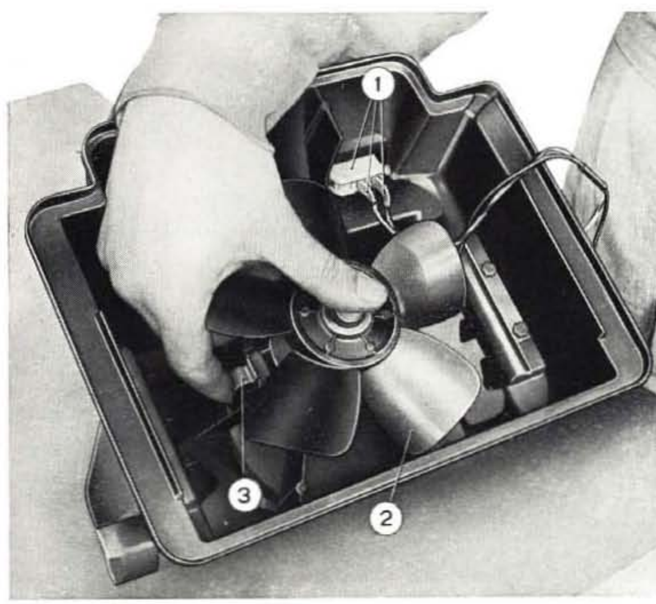


**Fig. 309 - Fitting electrofan.**

1. Electrofan junctions and switch. - 2. Blower fan. - 3. Electrofan fastener.

## Repair.

If the air conditioner must be overhauled, proceed as outlined hereafter.

To remove:

– drain the cooling circuit thoroughly;

– back out utility shelf mounting screws (fig. 305) and remove the utility shelf (fig. 306);

– detach heater radiator inlet and outlet hoses and electrofan switch wires;

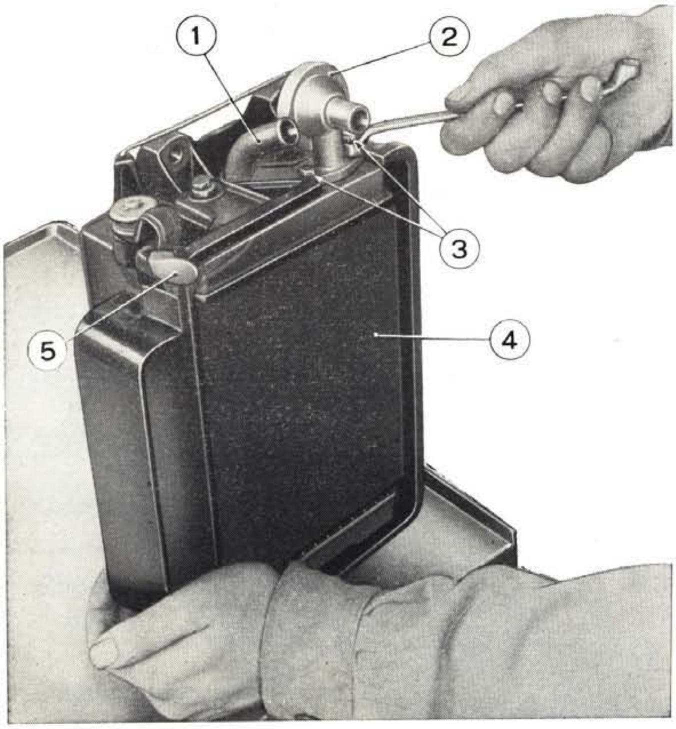


**Fig. 310 - Removing heater radiator cock.**

1. Radiator coolant outlet tube. - 2. Cock. - 3. Cock mounting screws. - 4. Heater radiator. - 5. Cock control lever.

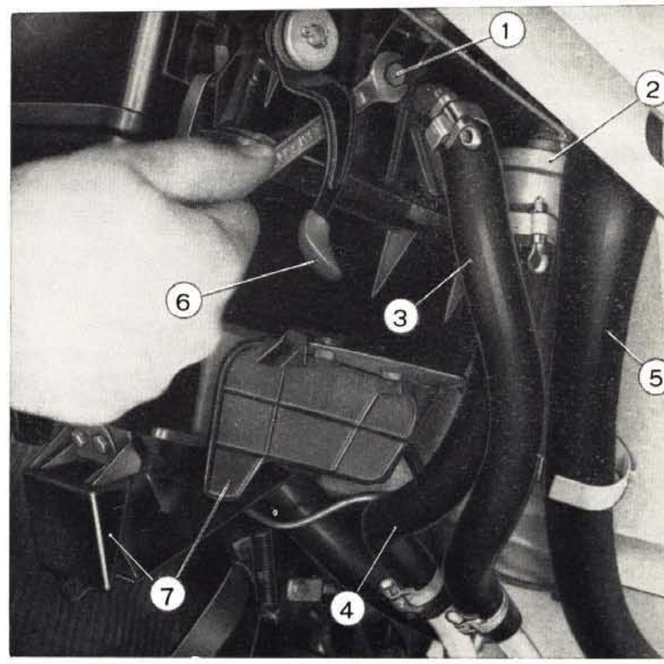


**Fig. 311 - Bleeding cooling system.**

1. Bleeder screw. - 2. Cock. - 3. Heater radiator outlet hose. - 4. Heater radiator inlet hose. - 5. Air intake water drain hose. - 6. Cock control lever. - 7. Air delivery shutters.

– back out air conditioner mounting screws from body (fig. 307);

– withdraw the conditioner assembly as shown in fig. 308.

Disassembling air conditioner does not involve special difficulties, just pry out case clips and separate case halves. The electrofan assembly, too, is fastened to the case through clips (fig. 309).

Check the efficiency of electrofan, heater radiator, cock and gaskets; replace any damaged parts.

The heater radiator can be repaired for leaks by tinning.

Renew any hoses and clamps which do not warrant perfect tightness.

For assembly and installation of air conditioner just reverse disassembly and removal procedures.

With an open heater cock, refill the cooling circuit as directed in covering chapter.

At last bleed the heater radiator through the proper screw (1, fig. 311).

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**NOTE - In the event that pure water has been added in the cooling system, check the rate of « Paraflu » fluid in coolant mixture as outlined on page 78.**

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# WINDSHIELD WASHER

The windshield washer consists of a container arranged on left side wall of front compartment, two jets mounted on cowling at bottom of windshield, and a pump, located under the instrument panel to the left of steering column, sending the cleaner solution to the jets.

To clean the windshield glass just press on the pump repeatedly and operate the wiper.

Maintenance of washer should be performed as follows:

**Positioning jets.** - Loosen the screw on jet head and adjust the jets so as to direct the liquid squirt to top of sweep arc.

Retighten the jet head screw.

**Cleaning jets and container gauze.** - If the liquid spray is defective, remove the jet hex. retainer nut and clean jet hole accurately.

Every four or five refills it is advisable to clean also the filtering gauze on outlet pipe suction end.

The washer container capacity is .66 G.B. qts - .79 U.S. qts (0.75 kg) pure water plus .6 oz (17 gr) - 2.28% in weight (Summer) or 1.2 oz (34 gr) - 4.56% in weight (Winter) of FIAT D.P./1 liquid (concentrated solution).

Check pipings and container bag for leakage.

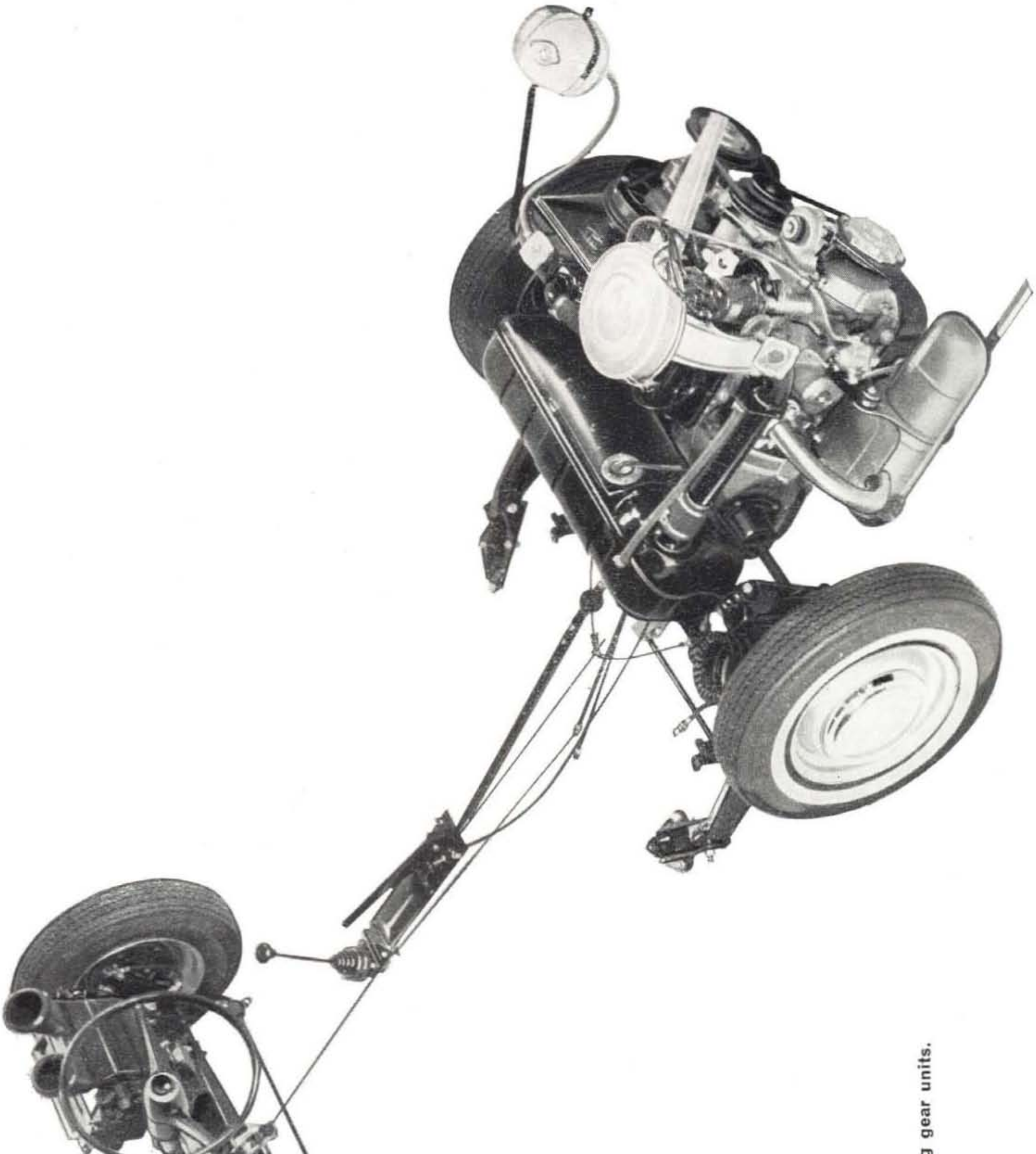

Fig. 312 - Running gear units.

# CHASSIS TIGHTENING REFERENCE

| DESCRIPTION | Part No. | Thread Diameter and Pitch | Material | Recommended Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| **CLUTCH** | | | | | |
| Clutch mounting screws . . . . . | 1/38243/21 | M 6 x 1 | R 80 Znt | 5.8 to 7.2 | 0.8 to 1 |
| **TRANSMISSION - DIFFERENTIAL** | | | | | |
| Clutch housing-to-engine screw . | 870059<br>1/59743/21 | M 12 x 1.5 | R 80 Znt | 54.2 to 61.5 | 7.5 to 8.5 |
| Clutch housing - to - transmission screw . . . . . . . . . . . . | 1/59714/21 | M 10 x 1.25 | R 80 Znt | 28.9 to 36.2 | 4 to 5 |
| Transmission side cover screws . | 1/60443/21<br>1/38265/21 | M 8 x 1.25 | R 80 Znt | 14.5 to 18.1 | 2 to 2.5 |
| Transmission front cover stud nut | 1/61008/11 | M 8 x 1.25 | R 50 Znt (Stud R 80 Znt) | 14.5 to 18.1 | 2 to 2.5 |
| Speedo cable sheath-to-front cover screw . . . . . . . . . . . . | 1/25742/11 | M 6 x 1 | R 50 Znt (Screw R 50 Znt) | 1.8 to 2.2 | 0.25 to 0.30 |
| Axle shaft oil boot-to-transmission screws and nuts . . . . . . . | 1/38258/21<br>1/61008/11 | M 8 x 1.25 | R 80 Znt<br>R 50 Znt (Stud R 80 Znt) | 14.5 to 18.1 | 2 to 2.5 |
| Drive pinion bearing retainer plate screw . . . . . . . . . . . . | 1/60432/21 | M 8 x 1.25 | R 80 Znt | 14.5 to 18.1 | 2 to 2.5 |
| Drive pinion front bearing and gear nut . . . . . . . . . . . . . . | 4092101 | M 25 x 1.5 | C 4 MF Fosf (Pinion 14 CN 5 Cmt 8 Fosf) | 115.7 to 144.7 | 16 to 20 |
| Clutch throwout sleeve support screw . . . . . . . . . . . . | 1/38243/21 | M 6 x 1 | R 80 Znt | 5.8 to 7.2 | 0.8 to 1 |
| Clutch throwout yoke ball pin . . | 835389 | M 10 x 1.25 | C 10 Ind Znt | 25.3 | 3.5 |
| Differential carrier cap screw . . | 1/12880/21 | M 10 x 1.25 | R 80 Znt | 36.2 to 39.8 | 5 to 5.5 |
| Gear selector fork and lever screws | 813149<br>1/09026/21 | M 6 x 1 | R 80 | 5.8 to 8.7 | 1 to 1.2 |
| Ring gear-to-differential cage screw | 4073923 | M 10 x 1.25 | R 100 | 43.4 to 54.2 | 6 to 7.5 |
| Flexible joint-to-gearshift control rod screw . . . . . . . . . . | 1/38258/21 | M 8 x 1.25 | R 80 Znt | 16.6 | 2.3 |

*(continued)*

**Chassis Tightening Reference** *(continued)*.

| DESCRIPTION | Part No. | Thread Diameter and Pitch | Material | Recommended Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| **POWER PLANT MOUNTINGS** | | | | | |
| Mounting bracket-to-transmission stud nut . . . . . . . . . . . | 1/61008/11 | M 8 x 1.25 | R 50 Znt (Stud R 80 Znt) | 18.1 | 2.5 |
| Transmission mounting bracket-to-body screw . . . . . . . . . | 4122373 | M 10 x 1.25 | R 80 Znt | 21.7 to 25.3 | 3 to 3.5 |
| Engine rear mounting bracket-to-body screw nut . . . . . . . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screw 12 NC 3 Znt) | 27.5 | 3.8 |
| Side link-to-engine-and-body screw nut . . . . . . . . . . . . . . . | 1/61041/11 | M 8 x 1.25 | R 50 Znt (Screw R 80 Znt) | 16.6 | 2.3 |
| **FRONT SUSPENSION** | | | | | |
| Semi-elliptic spring cross rail-to-body screw nut . . . . . . . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screw R 80) | 32.5 | 4.5 to 5 |
| Semi-elliptic spring-to-cross rail screw nut . . . . . . . . . . | 735802 | M 10 x 1.25 | R 50 Znt (Screw R 100 Fosf) | 43.4 | 6 |
| Semi-elliptic spring-to-kingpin housing screw nut . . . . . . . . | 1/61050/11 | M 12 x 1.25 | R 50 Znt (Screw R 80 Znt) | 65.1 | 9 |
| Kingpin housing-to-control arm screw nut . . . . . . . . . . | 1/61050/11 | M 12 x 1.25 | R 50 Znt (Screw R 80 Znt) | 65.1 | 9 |
| Control arm-to-body screw nut . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screw R 80) | 32.5 to 36.2 | 4.5 to 5 |
| Control arm pivot bar rubber bushing nut . . . . . . . . . . . . . | 1/07934/11 | M 14 x 1.5 | R 50 Znt (Bar C 40 Bon) | 43.4 (minimum, prior to inserting cotter pin) | 6 |
| Brake backing plate-to-steering knuckle screw nut . . . . . . | 1/61008/11 | M 8 x 1.25 | R 50 Znt (Screw R 50) | 14.5 | 2 |
| Wheel bearing nuts at steering knuckles . . . . . . . . . . . . | 1/40439/71<br>1/40446/71 | M 14 x 1.5 | C 40 Rct (Knuckle 38 NCD 4 Bon) | see page 137 | |
| Wheel and brake drum-to-hub stud | 4080533 | M 12 x 1.5 | C 35 Bon Cdt | 43.4 to 50.6 | 6 to 7 |

*(continued)*

**Chassis Tightening Reference** *(continued)*.

| DESCRIPTION | Part No. | Thread Diameter and Pitch | Material | Recommended Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| Wheel cylinder-to-brake backing plate screw . . . . . . . . . . | 1/38240/11 | M 6 x 1 | R 50 Znt | 7.2 | 1 |
| Shock absorber-to-body shell screw nut . . . . . . . . . . . . . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screw R 50 Znt) | 24.6 | 3.4 |
| Shock absorber-to-kingpin housing screw nut . . . . . . . . . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screw R 50) | 21.7 | 3 |
| Sway bar shackle screw nut . . . | 1/61008/11 | M 8 x 1.25 | R 50 Znt (Screw R 50) | 10.8 | 1.5 |
| **REAR SUSPENSION** | | | | | |
| Control arm pin nut . . . . . . | 1/61050/11 | M 12 x 1.25 | R 50 Znt (Pin R 80 Znt) | 65.1 | 9 |
| Control arm front bracket-to-body shell screw . . . . . . . . . . | 1/61389/21 | M 10 x 1.25 | R 80 Znt | 28.9 to 36.2 | 4 to 5 |
| Wheel hub and brake backing plate-to-control arm screw . . . . . | 4108912 | M 10 x 1.25 | R 80 Znt | 43.4 | 6 |
| Wheel hub inner bearing plate screw . . . . . . . . . . . . . | 4108912 | M 10 x 1.25 | R 80 Znt | 43.4 | 6 |
| Flexible joint-to-wheel shaft nut . | 4037820 | M 18 x 1.5 | R 80 Znt (Shaft 38 NCD 4 Bon) | 101.3 (minimum, prior to inserting cotter pin) | 14 |
| Axle shaft sleeve-to-flexible joint screw . . . . . . . . . . . . . | 4124424 | M 10 x 1.25 | R 80 Znt | 28.9 to 36.2 | 4 to 5 |
| Wheel-to-brake drum stud . . . . | 4080533 | M 12 x 1.5 | C 35 Bon Cdt | 43.4 to 50.6 | 6 to 7 |
| Shock absorber mounting bracket-to-body screw . . . . . . . . | 1/61357/21 | M 8 x 1.25 | R 80 Znt | 14.5 to 18.1 | 2 to 2.5 |
| Shock absorber mounting bracket-to-body screw nut . . . . . . | 1/61008/11 | M 8 x 1.25 | R 50 Znt (Screw R 80 Znt) | 14.5 to 18.1 | 2 to 2.5 |
| Shock absorber-to-upper mounting bracket screw nut . . . . . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screw R 50 Znt) | 24.6 | 3.4 |
| Shock absorber - to - control arm screw nut . . . . . . . . . . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screw R 50) | 21.7 | 3 |

*(continued)*

**Chassis Tightening Reference** *(continued)*.

| DESCRIPTION | Part No. | Thread Diameter and Pitch | Material | Recommended Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| Sway bar-to-control arm link screw nut . . . . . . . . . . . . . . | 1/61008/11 | M 8 x 1.25 | R 50 Znt (Screw R 80 Znt) | 14.5 to 18.1 | 2 to 2.5 |
| Wheel cylinder-to-brake backing plate screw . . . . . . . . . . | 1/38240/11 | M 6 x 1 | R 50 Znt | 7.2 | 1 |
| **STEERING** | | | | | |
| Steering wheel-to-column nut . . | 1/07914/11 | M 16 x 1.5 | R 50 Znt (Column C 10 Trf) | 28.9 to 36.2 | 4 to 5 |
| Steering column jacket support-to-instrument panel screw . . . . | 1/09022/20 | M 6 x 1 | R 80 | 7.2 | 1 |
| Steering gear-to-body screw nut . | 1/61041/11 | M 8 x 1.25 | R 50 Znt (Screw R 50 Sd Stab) | 14.5 | 2 |
| Idler arm mounting-to-body screw nut . . . . . . . . . . . . . . | 1/61041/11 | M 8 x 1.25 | R 50 Znt (Screw R 50 Sd Stab) | 14.5 | 2 |
| Tie rod end ball stud nut . . . . | 1/25756/11 | M 10 x 1.25 | R 50 Znt (Stud C 21 R Cdt) | 21.7 to 25.3 | 3 to 3.5 |
| Pitman arm-to-sector nut . . . . . | 1/07913/21 | M 14 x 1.5 | R 80 Znt (Sector 19 CN 5 Cmt 5) | 72.3 | 10 |
| Idler arm pin nut . . . . . . . . | 1/25747/11 | M 12 x 1.5 | R 50 Znt (Pin R 80 Znt) | 54.2 to 57.9 | 7.5 to 8 |

## IMPORTANT NOTICE ON USE OF TORQUE WRENCHES

**Never forget that tightening of screws and nuts with torque wrenches to the recommended torques, must always be performed with threads and seating faces (screw or nut head seating faces, lockplates, washers, etc.) absolutely dry, perfectly free from any trace of rust, grease, dirt, etc.**

**NOTE - Tightening directions for self-locking nuts are outlined on page 154.**

# Section 10

# ELECTRICAL

# BATTERY



## SPECIFICATIONS

| | |
|---|---|
| Voltage | 12 |
| Capacity (at 20 hr discharge rate) | 36 Amp/h |
| Length | 8.976″ (228 mm) |
| Width | 6.772″ (172 mm) |
| Height, overall | 8.858″ (225 mm) |
| Weight — with electrolyte | 36.4 lbs (16.5 kg) |
| Weight — without electrolyte | 27.6 lbs (12.5 kg) |

The battery is located in a housing in front compartment.

Cell connectors are sunk in sealant. This design feature improves battery insulation and cuts down intercell and ground current leakages. Moreover the corrosion of cell connectors and terminal posts is tapered down remarkably.

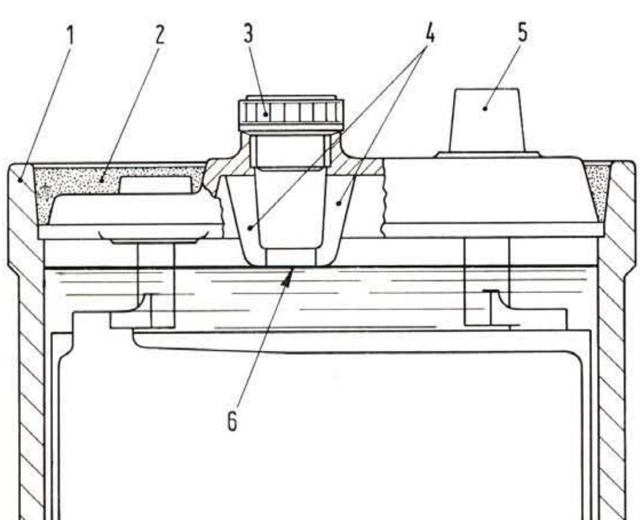


**Fig. 313 - Side sectional view of battery at filler neck with electrolyte level sight.**

1. Battery case. - 2. Sealant. - 3. Cover. - 4. Filler neck with vent slots. - 5. Terminal post. - 6. Electrolyte level sight on filler neck.

## INSPECTION AND UPKEEP

To gain access to battery raise front compartment lid and rubber mat, then back out recess cover hold-down nuts (fig. 314).

**NOTE - To remove battery grab the two insulating bands, after disconnecting negative and positive terminal clamps, and lift up.**

The battery must always be clean and dry, especially its top.

Use a hard brush and keep out dust or other foreign matter from cells.

Check that sealing compound around battery cell covers has not cracked (with consequent electrolyte leaks). Electrolyte should never spill over battery because it is highly corrosive. In case leaks have already occurred and some parts are corroded, clean and coat with acidproof paint all parts which can still be used and replace the unserviceable ones.

To unscrew or tighten terminal clamp nuts, do not use pliers but the specially provided wrenches.

Never tap on terminal clamps in an attempt to insert on or disinsert from posts.

To free clamp, do not grab around the cable but use a proper tool.

Jerking the cable entails stresses which may crack the ebonite cell cover or tear cable off clamp, thus causing electrolyte dispersion paths, with consequent damages.

Terminal posts and clamps should be coated exclusively with pure ropy vaseline.

## Electrolyte Level.

During battery operation, water is the only element that, due to evaporation, must be periodically added to top up battery.

Therefore it will be necessary to add **distilled water** periodically (so that separators do not emerge from electrolyte), but **never acid.**

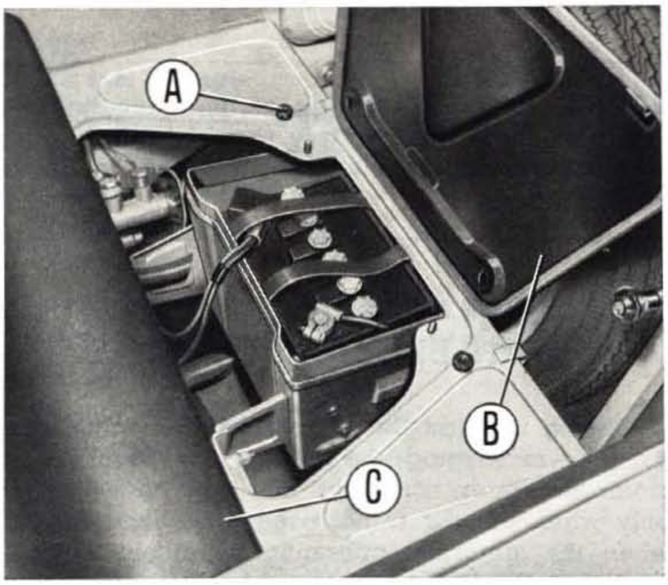


**Fig. 314 - Arrangement of battery in car.**
A. Battery recess cover hold-down nut. - B. Battery recess cover. - C. Front compartment floor mat.

Electrolyte level must be kept constantly above separators but not above a given height.

Cell filler necks are fitted with an opening for « level sight ». This opening (fig. 313) is situated at the bottom of the filler neck well and can be reached by unscrewing the filler cover.

Such new design makes for an easier check of battery electrolyte level and quicker topping up operation.

**The cell is correctly filled when the electrolyte level is flush with the « level sight » opening.**

The filler neck has also two vertical vent slots for vapour dissipation.

**NOTE - Electrolyte level must never be higher than recommended. When level is too high, gases developed cause the spraying of the electrolyte on battery top, with consequent corrosion of clamps, terminals and battery case.**

Electrolyte level must be checked at 1,500-mile (2,500 km) intervals or every 15 days if car is laid up.

## Checking State of Charge.

The state of charge is determined by measuring the electrolyte specific gravity. Never use the high-discharge method (voltmeter individual cell tester), since cells thus tested may be seriously damaged with considerable current consumption.

The electrolyte gravity is proportional to the state of charge. Relationships:

| Specific gravity | State of charge |
|---|---|
| 1.28 | 100% |
| 1.25 | 75% |
| 1.22 | 50% |
| 1.19 | 25% |
| 1.16 | barely operative |
| 1.11 | completely discharged |

To check specific gravity use the hydrometer **A. 95852.**

Readings should be taken at eye level on float graduated stem, the float being free and tube vertical.

Once reading has been taken, return the electrolyte to the cell from which it was sucked.

**IMPORTANT - When reading the hydrometer take care to avoid the dripping of the tube: actually the electrolyte contains sulphuric acid which causes corrosions, current dispersion, etc., to whatever it contacts.**

Specific gravity readings should never be taken under these conditions:

a) Incorrect electrolyte level.

b) Too warm or too cold electrolyte: temperature should be 59° to 77° F (15° to 25° C).

c) Soon after topping up: uniform acid solution in electrolyte must be waited for; flat batteries may require even some hours.

d) Soon after repeated engine starts: also in this case the uniform acid solution is to be waited for.

e) Bubbling electrolyte: wait until all bubbles sucked in hydrometer with the solution have come up into empty portion of tube.

Should the following conditions occur:

– cell gravity readings more than 0.2 apart from each other;

– excessively high specific gravity: 1.30;

– low specific gravity: 1.22;

and, at the same time, an excessive battery overheating in operation (more than 18°F - 10°C) above room temperature, apply to a service shop of battery manufacturer's.

If car has been laid up for a long time, recharge the battery periodically once a month.

Recharging must be carried out at low current rate (3 Amps max) till all cells are boiling briskly.

## Conditions Entailing Battery Rundown.

If battery becomes flat in operation (obviously any long standing periods of the car, during which the battery is self-discharging should be eliminated), this indicates abnormal operating conditions.

The most frequent causes of battery rundown are the following:

a) **Improper recharging system operation** (generator-regulator). - Refer to the instructions outlined for generator and regulator assembly in the next chapters.

b) **Current dispersions caused by defective insulation in car wiring system.** - This is a rather frequent case, especially when the car owner adds, on his own initiative, some new users (special horns, fog lamps, etc.), in which case he tampers with the electric system and faulty insulations are very likely to occur.

If a megohmmeter is available, check insulation by placing the instrument between the disconnected battery positive cable and ground (all users totally excluded). Even in the worst test conditions (wet car, etc.) an insulating resistance reading of less than 10,000 Ohms should not be recorded.

A quick check can be carried out using a milliammeter: just connect it serially between battery positive cable clamp and terminal, and make sure that the current registered (without any users in the circuit) is not greater than 1 milliampere.

c) **Addition of users by the car owner.** - A given proportionate margin is possible with the charging system. Therefore, provided certain limits are not exceeded, the addition of a few users can be tolerated.

d) **Use of car on short runs, with many halts and extended use of 4th gear at very low speed.** - Because of frequent use of starter, battery discharges quickly. Generator supplies no output or develops only a part of the power it should, because its r.p.m. rate is too low.

It will suffice to advise the car owner to run car in lower gear when travelling at reduced speeds: the generator will then operate at normal recharging rate.

e) **Sulphated battery with shorted or «open» cells.**

---

**NOTE - Before connecting or disconnecting the positive clamp from battery terminal, always disconnect the negative cable (grounded on frame) from battery.**

---

## RECHARGING BATTERY WITH EXTERNAL MEANS

Bearing in mind the aforementioned recommendations, recharging the battery by rectifiers or motor-generator converter unit will be necessary only when the car is not used for a long time or when the abnormal operating conditions outlined at a), b), c), d), have occurred.

Remember the following:

a) after removal from car, carefully clean the battery, especially its top;

b) check electrolyte level;

c) insert battery in the charging circuit and during the recharging operation methodically check, at intervals, the state of charge using a hydrometer;

d) clean battery once more, before installation on car.

# GENERATOR



## SERVICE DATA

| | |
|---|---|
| Type | D 90/12/16/3 CS |
| Nominal voltage | 12 |
| Continuous peak amperage (ammeter limit) | 16 |
| Temporary peak amperage | 22 |
| Continuous peak wattage | 230 |
| Temporary peak wattage | 320 |
| Cut-in speed (12 V at 68° F - 20° C) | 1,710 to 1,790 r.p.m. |
| Speed for maximum continuous amperage (16 at 68° F - 20° C) | 2,550 to 2,700 r.p.m. |
| Speed for maximum peak amperage (22 at 68° F - 20° C) | 3,050 to 3,200 r.p.m. |
| Maximum speed, steady | 9,000 r.p.m. |
| Rotation direction (drive end) | counterclockwise |
| Pole shoes | 2 |
| Field winding | shunted |
| Regulator, separate | FIAT GN 2/12/16 |
| Engine-to-generator drive ratio (new belt) | 1.8 to 1 (*) |
| Pole shoe inner diameter | 2.295" to 2.301" (58.3 to 58.45 mm) |
| Brush Part No. | 4110851 or 4110852 |
| **Bench Testing Data.** | |
| – Testing generator as a motor (at 68° F - 20° C): | |
| Feed voltage | 12 |
| Current draw | 4.5 to 5.5 Amps |
| Speed | 1,400 to 1,600 r.p.m. |
| – Output test (at 68° F - 20° C): | |
| Steady voltage | 12 |
| Speed for abt. 1 hour and 45 min. | 4,500 r.p.m. |
| Current delivery to resistor (at 14 Volts) | 15.5 to 16.5 Amps |

*(continued)*

(*) New drive ratio from engine No. 549463: 2 to 1.

## FIAT D 90/12/16/3 CS GENERATOR ASSEMBLY

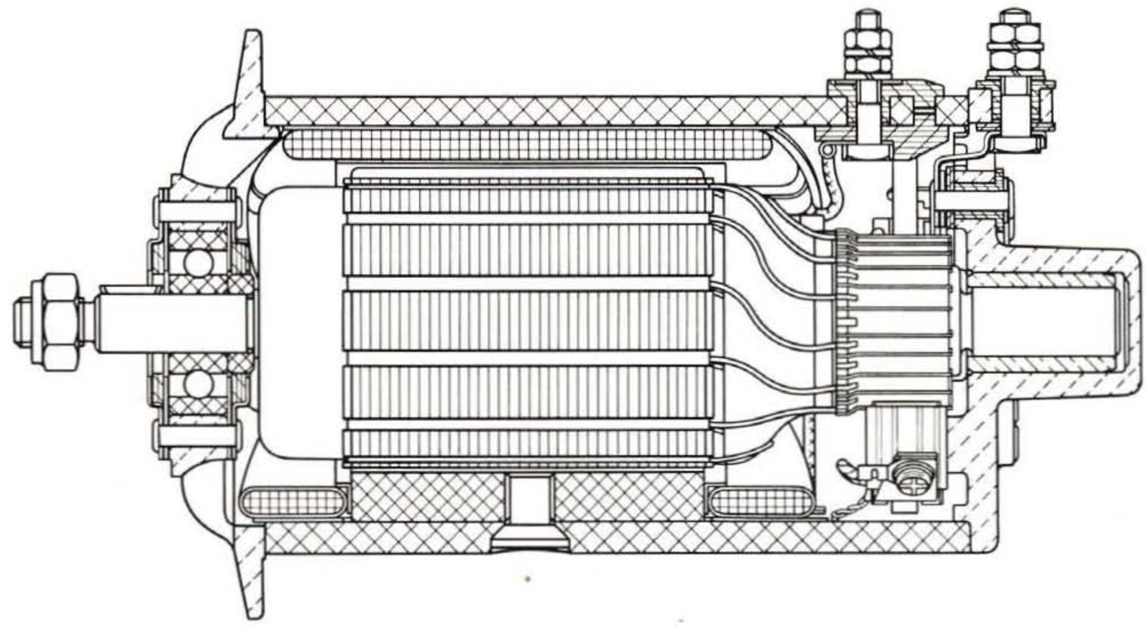

Fig. 315 - Side sectional view of generator.

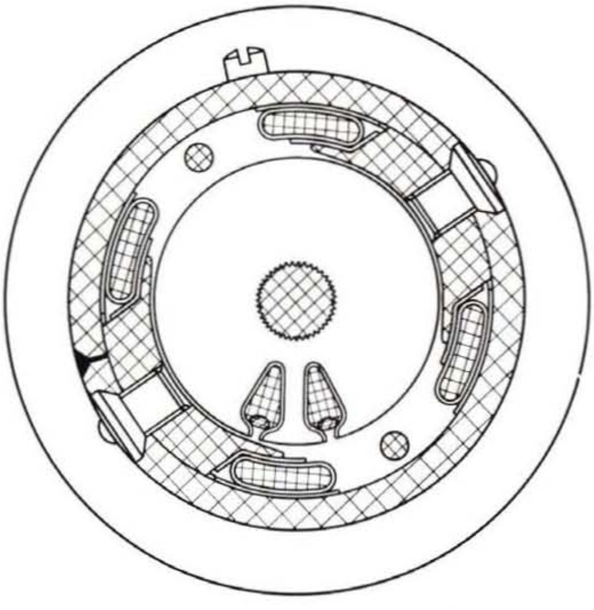

Fig. 316 - End sectional view of generator across field frame, pole shoes and windings.

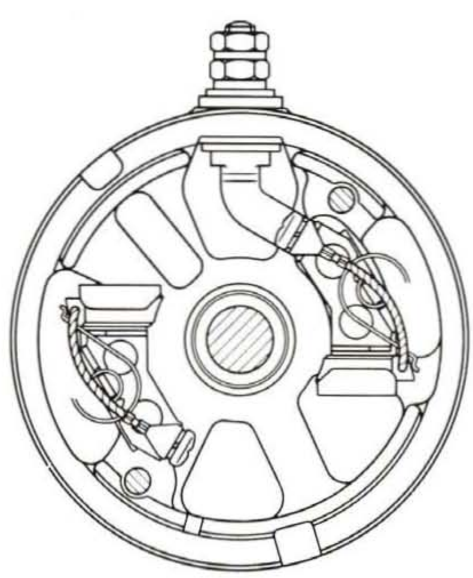

Fig. 317 - End sectional view of generator across armature shaft and view of commutator end head.

**Service Data** *(continued)*.

| | |
|---|---|
| After generator has been raised to operation temperature by running it at the above specified speed and time rates, at steady 12 voltage, read the amperage at every generator speed increment: each reading will represent a point of the output curve of the generator as shown in fig. 321. | |
| – Heating test: | |
| Speed, for abt. 1 hour and 45 min. | 4,500 r.p.m. |
| Current delivery to resistor (at 14 Volts) | 15.5 to 16.5 Amps |
| Overheating – field frame, not above | 86° F (30° C) |
| Overheating – commutator, not above | 149° F (65° C) |
| – Ohmic resistance test (at 68° F - 20° C): | |
| Armature resistance | 0.135 to 0.155 ohms |
| Field winding resistance | 7.70 to 8.10 ohms |
| – Mechanical characteristics test: | |
| Load of springs on new brushes | 1.3 to 1.6 lbs (0.60 to 0.72 kg) |
| Maximum commutator out-of-round | .0004″ (0.01 mm) |
| Mica undercut depth | .0236″ to .0275″ (0.6 to 0.7 mm) |
| **Lubrication.** | |
| Drive end ball bearing | FIAT MR 3 grease |
| Commutator end head oiler | FIAT engine oil |

## BENCH TESTING

To check the generator efficiency, carry out operation tests, as well as electrical and mechanical characteristics tests according to the following directions.

### Operation Tests.

Before starting any test, it is advisable to have all test equipment and gauges ready for use.

It is recommended to strictly follow the directions given for each test.

**Motoring test (at 68° F - 20° C).**

This is the first and simplest test for a quick generator check.

Wire up according to diagram fig. 319.

Feed generator with a 12 V d.c. supply and check that current draw is 4.5 to 5.5 A at 1,400 to 1,600 r.p.m.

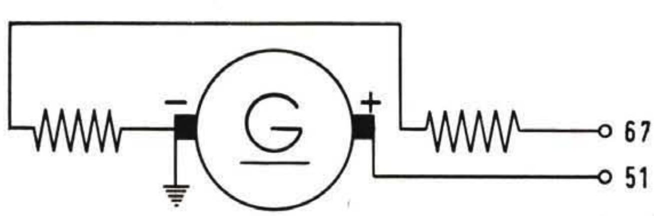


**Fig. 318 - Generator wiring diagram.**

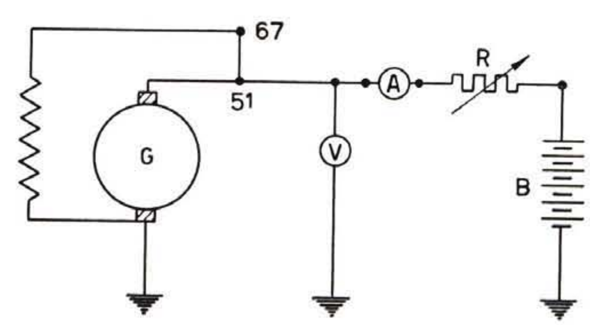


**Fig. 319 - Wiring diagram for motoring test.**

G. Generator. - V. Voltmeter, 15 V scale. - A. Ammeter, 10 A scale. - B. Battery capable of supplying a voltage slightly above 12 V during a discharge of 5 A. - R. Plate type rheostat for regulating the battery voltage, 100 A capacity, variable resistance of 0.2 to 20 Ω.

**Output test at 12 V steady tension (at 68° F - 20° C).**
**NOTICE - Prior to plotting the output curve, make sure that brushes are thoroughly seated in commutator bore.**

Install generator on test bench and couple it with a motor, whose speed may be varied at will by small degrees.

Wire up according to diagram fig. 320.

Before starting the test, run generator for 1 hour and 45 min. at 4,500 r.p.m., delivering a 15.5 to 16.5 A - 14 V current to a resistor. Stop motor.

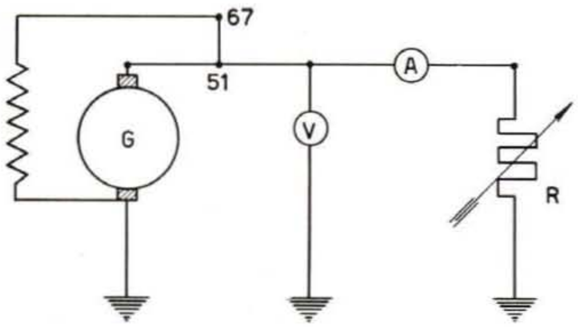


**Fig. 320 - Wiring diagram for plotting the ampere-revolution output curve at a steady 12 V voltage (68° F - 20° C).**
G. Generator. - V. Voltmeter, 15 V scale. - A. Ammeter, 25 A scale. - R. Plate type rheostat, 100 A capacity, variable resistance of 0.20 to 20 Ω.

Disconnect load rheostat.

Start generator and speed up gradually until voltmeter reading is 12 Volts; at this point, determine generator speed by a revolution counter, the voltage remaining steady.

This represents the « cut-in speed » at 12 Volt output (origin of curve on abscissa axis).

Stop generator and connect load rheostat.

While driving generator at steady speed in different increments, adjust load rheostat to ensure a constant 12 V output at each given r.p.m. rate; at the same time, read the value of current supplied.

Each reading will give a point of the output curve.

Note that readings must be taken in a very short while, since the curve extends beyond generator nominal power and currents higher than those of the nominal output range impose an overload that generator cannot withstand for long without overheating, with consequent failure of insulations.

The curve plotted by points must lie within the limits of the shaded area shown in fig. 321.

## Heating Test.

Wire up the generator complete with fan pulley, according to diagram fig. 322.

Run generator for one hour and 45 minutes at 4,500 r.p.m., delivering 15.5 to 16.5 Amperes at 14 Volts to a resistor.

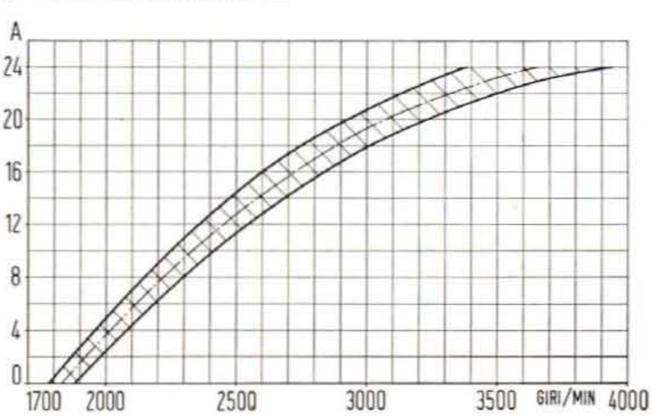


**Fig. 321 - Output curve of warm D 90/12/16/3 CS generator.**
Steady 12 V Voltage.
GIRI/MIN = R. P. M.

Check that temperatures of frame and commutator do not exceed respectively 86° F (30° C) and 149° F (65° C).

## Ohmic Resistance Test.

Field winding ohmic resistance may be determined with assembled generator, by simply measuring the resistance between terminal 67 and ground.

The recommended measurement method is that of the Volt/Ampere ratio in which a sufficiently high voltage is applied and measured, together with the current drawn by the winding. The ratio of applied voltage to drawn current gives the ohmic resistance, according to the formula: $\frac{V}{I} = R$.

Alternatively, a Wheatstone bridge may be used, provided it is sufficiently accurate.

Determining armature winding resistance is more difficult on account of the low value involved and, therefore, must be made only in exceptional cases, provided proper equipment is available.

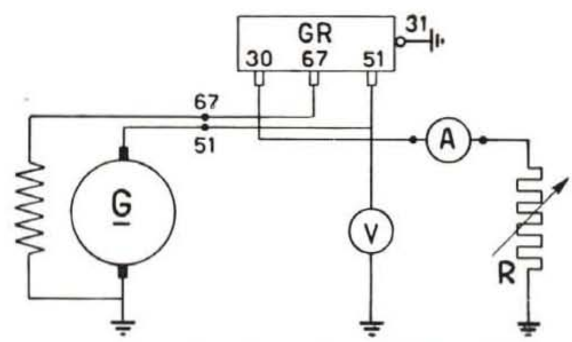


**Fig. 322 - Wiring diagram for the generator heating test.**
G. Generator. - GR. Regulator. - V. Voltmeter, 15 V scale. - A. Ammeter, 20 A scale. - R. Carbon plate type rheostat, 100 A capacity, 0.2 to 20 Ω variable resistance.

In this case proceed as follows:

– solder two wire lengths on the faces of two commutator segments 180° apart;

– apply 2 to 2.5 Volts and measure with accuracy the current drawn (Volt and Ampere readings).

Resistance R (in Ohms) is still given by $\frac{V}{I}$.

## Mechanical Characteristics Check Data.

Brush hold-down springs load must be 1.3 to 1.6 lbs (0.60 to 0.72 kg).

Maximum commutator out-of-round (on rubbing surface): not more than .0004" (0.01 mm).

Commutator mica must be undercut at least .04" (1 mm) throughout its entire length and width.

# SERVICE PROCEDURES

To correct generator troubles, proceed as outlined hereafter.

The only repairs that may be carried out by Service Station personnel are:

- commutator re-turning;
- repairs of field winding connections being broken, unsoldered or with damaged insulation.

Any other defective part must be replaced.

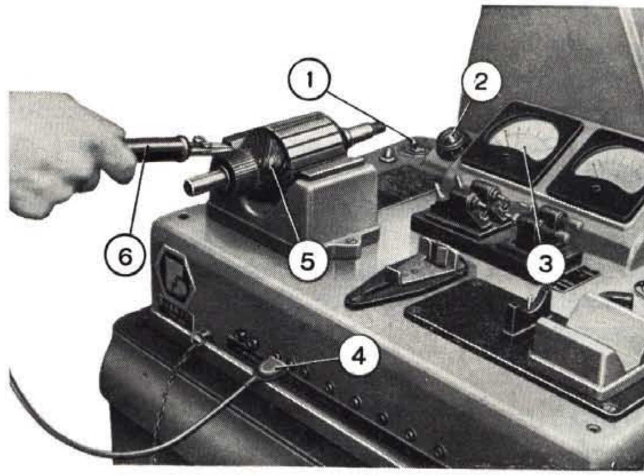


**Fig. 324 - Testing generator armature for open coils.**
1. Armature tester throw-in switch. - 2. Tester warning light. - 3. Ammeter. - 4. Ammeter plug. - 5. Armature. - 6. Twin contact insulated grip.
In correspondence with an open coil the ammeter reading will be zero.

## Commutator Re-Turning.

Disassemble generator.

The armature assembly must be placed on a lathe and suitably centered, as it is not possible to hold the armature shaft between lathe centers.

This centering must be perfect because commutator out-of-round must not exceed .0004" (0.01 mm).

After re-turning, undercut the mica using cutter **Ap. 5015** (fig. 323).

## Broken Field Winding, with Shorted or Grounded Coils.

Repair only if trouble consists in unsoldered or broken connections. In all other cases replace winding by a genuine one.

Do not attempt to build a new winding locally.

Field winding inspection may be carried out using the bench for current feed and instrument reading.

Heat new winding to 122° F (50° C) before installation, to render it slightly flexible, thus facilitating its seating under pole shoes.

Pole shoes must be well set against frame and their screws fully tightened, so as to restore original air gap.

After reassembly, check that pole shoe inner diameter is 2.2952" to 2.3012" (58.3 to 58.45 mm).

If diameter departs from above figures, it is an indication that assembly is incorrect.

In this case, the whole procedure must be repeated. **Never ream pole shoes.**

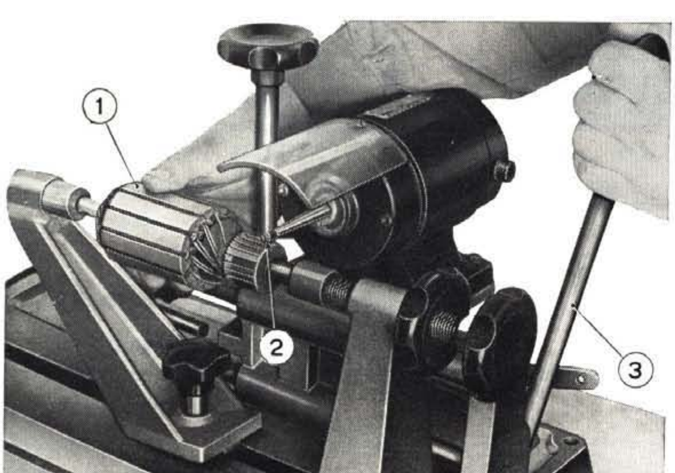


**Fig. 323 - Undercutting mica between commutator bars using fixture Ap. 5015.**
1. Armature. - 2. Cutter. - 3. Cutter arm actuating lever.

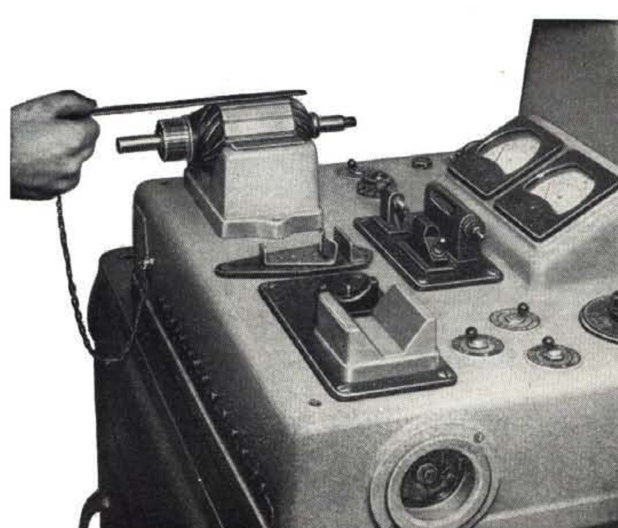

**Fig. 325 - Testing the armature on bench, using a lamina.**
In correspondence with short-circuited coils the lamina will vibrate.

## Shorted, Grounded or Open Armature Coil.

If the armature winding is damaged, it cannot be repaired through replacement of shorted, broken or grounded turns.

As a matter of fact coils are made of a copper wire coated with special insulating material (vinyl acetate) and require, for winding, soldering, impregnation, etc., a special treatment and equipment covered by suitable Process Standards, which are only available at specialized workshops.

Therefore, the armature should be renewed as an assembly.

## Replacing Brushes.

Only genuine FIAT brushes must be used for replacement. Brushes with different hardness or composition characteristics would impair commutator life and affect generator and regulator operation adversely.

The use of unsuitable brushes determines poor commutation, followed by accelerated wear rate of commutator segments and brushes, remarkable voltage drops between commutator and brushes and a marked excitation current increase.

## Overhaul.

Irrespective of the repair or replacements effected, before reassembling the generator:

a) blow all carbon dust from components;

b) with a dry rag, clean brush holders and commutator end head from all grease and carbon dust;

c) with a dry rag, clean commutator, especially between segments.

**Do not use** emery cloth or sand paper, or even cloths soaked in oil, gasoline or solvents of any kind;

d) with FIAT Jota 3 grease, pack ball bearing and pocket at the end of commutator end head bushing and, with FIAT VE oil, fill up the commutator end head oiler.

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**NOTE - Do not lubricate generator bearings with greases of any different kind.**

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Assemble generator by reversing disassembly procedure.

Repeat operation checks as per « Bench Testing ».

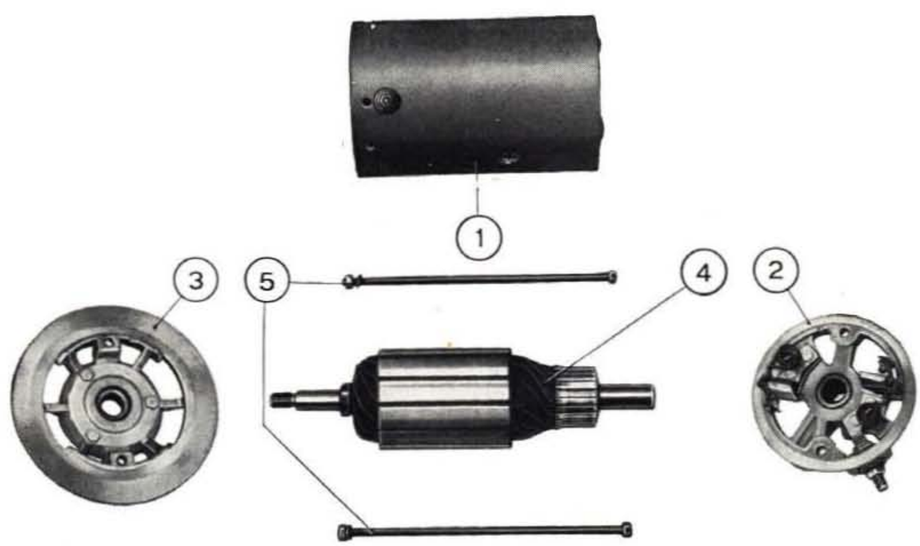


**Fig. 326 - Components of D 90/12/16/3 CS generator.**

1. Field frame. - 2. Commutator end head. - 3. Drive end head. - 4. Armature. - 5. Thru-bolts.

# GENERATOR REGULATOR



## SERVICE DATA

| | |
|---|---|
| **Cutout Relay.** | |
| Feed voltage for temperature stabilization: | |
| – regulator initial operating temperature 59°-68° F (15°-20° C) | 16.5 |
| – regulator initial operating temperature 68°-95° F (20°-35° C) | 15 |
| Closing voltage | 12.4 to 12.8 |
| Voltage-contact stroke variation, below | 1 V/mm |
| Reverse current, not above | 16 Amps |
| Air gap (closed contacts) | .0138″ (0.35 mm) |
| Point gap | .0154″ to .0201″ (0.39 to 0.51 mm) |
| **Voltage Regulator.** | |
| Battery | 50 Ah |
| Half-load current | 7.5 to 8.5 Amps |
| Setting voltage after temperature stabilization in oven at 122° ± 5° F (50° ± 3° C) for 30 minutes, half-load, on battery | 13.9 to 14.5 |
| Feed voltage for temperature stabilization | 15 |
| Air gap | .0391″ to .0437″ (0.99 to 1.11 mm) |
| **Current Regulator.** | |
| Regulated current on battery | 15 to 17 Amps |
| Voltage for regulated current inspection | 13 |
| Air gap | .0391″ to .0437″ (0.99 to 1.11 mm) |
| **Regulating Resistor** | 80 to 90 Ohms |
| Voltage regulator additional resistor | 16 to 18 Ohms |

# BENCH TESTING

To check the efficiency of GN 2/12/16 regulator, proceed as follows:

a) On a test bench, install a FIAT D 90/12/16/3 CS generator.

b) Couple this generator to a motor whose speed may be varied at will in small increments.

c) Prepare all instruments and devices required to test cutout, voltage and current regulators in accordance with the diagrams and instructions given hereunder.

**NOTE - Due to the fact that test bench gauges are subject to being upset from vibrations and the difficulty of detecting any fault in bench circuits, it is good practice to use portable gauges to check the generator regulator, by setting the generator-regulator-gauges wiring circuit through outside electrical connections, which can be inspected more easily.**

**All checks must be accomplished without removing the seals from the regulator unit.**

## Checking Cutout Relay.

1. - **Closing voltage** (room temperature: 59° to 95° F - 15° to 35° C).

Wire as shown in diagram (fig. 329).

Initially the unit must be at room temperature of 59° to 95° F (15° to 35° C).

Operate the unit with no load, at room temperature of 59° to 95° F (15° to 35° C) for 15-18 minutes, with cover installed and with voltage of:

— 16.5 V for initial temperatures of 59° to 68° F (15° to 20° C);

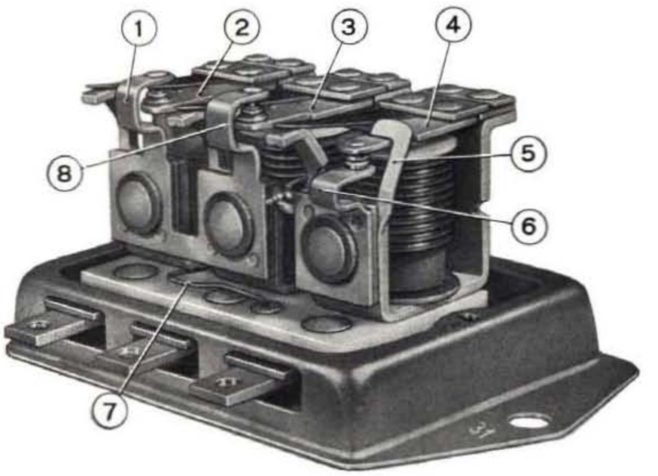


**Fig. 327 - Generator regulator GN 2/12/16.**
View from the cutout relay end.
1. Voltage regulator stationary contact bridge. - 2. Voltage regulator armature. - 3. Current regulator armature. - 4. Cutout relay armature. - 5. Cutout relay armature stop. - 6. Cutout relay stationary contact bridge. - 7. Voltage regulator resistor cable. - 8. Current regulator stationary contact bridge.

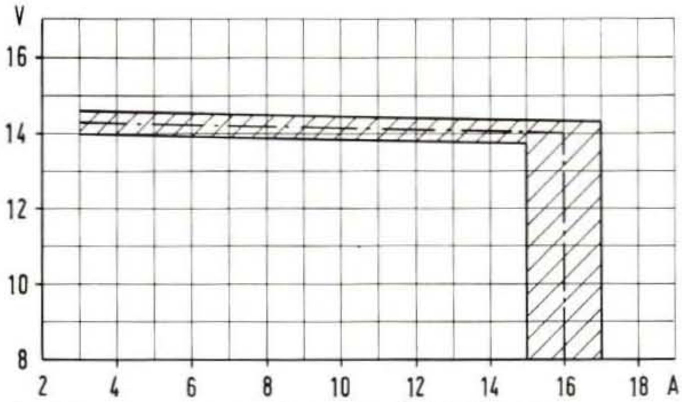


**Fig. 328 - Generator regulator GN 2/12/16: Volt-Ampere curve on battery at 122°±5° F (50°±3° C). - Generator speed 4,500 rpm.**

— 15 V for initial temperatures of 68° to 95° F (20° to 35° C).

This way, the **temperature stabilization** of the unit is obtained, i.e., the temperature of both the cutout shunt windings and bi-metallic springs increases due to heat developed by the windings and reaches the « operative rate ».

Temperature stabilization is necessary because initially there is a « transient voltage » of some minutes before the setting voltage stabilizes on a steady rate, and if this condition is not observed **results are liable to be erroneous.**

**Soon after** reaching **temperature stabilization,** start the generator, increase its speed gradually and check on voltmeter the value of cutout contact closing voltage. Take reading at the instant at which test lamp glows. Closing contact voltage should be 12.4 to 12.8 V.

**IMPORTANT**

**Reliable results can be obtained only if tests are run under the exact conditions specified for each of them.**

**Reserve current** (room temperature: 59° to 95° F - 15° to 35° C).

This check must be performed soon after the closing voltage test, so that temperature stabilization remains unaltered.

Wire as shown in diagram (fig. 330).

Speed up generator to 4500 r.p.m. for 5 minutes, making sure voltmeter reads at least 14.5 V, then gradually reduce generator r.p.m.

The ammeter needle, at first indicating a given charging current, will gradually move to zero and then shift to the other side of the scale to indicate reverse current value. By still reducing generator speed, the reverse current reading will increase to a given value and then abruptly fall to zero (cutout contacts have opened).

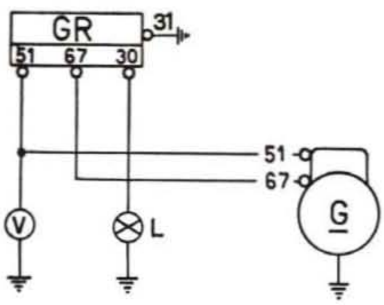


**Fig. 329 - Wiring diagram for checking the cutout closing voltage.**
GR. Regulator GN 2/12/16. - G. Generator FIAT D 90/12/16/3 CS. - V. Voltmeter, 20 V scale (0.5% accuracy). - L. Bulb (12 V, 3 to 5 W).

**NOTE - To obtain the max. reverse current possible, the reduction in generator speed must be so quick as not to give battery voltage sufficient time to drop excessively (10 seconds). Should it be desired to repeat the test, to avoid erroneous readings which may result from residual magnetism in cutout, wait until generator stops and then re-start.**

This limit indicates max. reverse current value which must not exceed 16 Amp.

## Checking Voltage Regulator.

**Regulating voltage, with half load, on battery** (room temperature: 117° to 127° F - 47° to 53° C).

Wire as shown in diagram (fig. 331).

**Operate regulator in room temperature of 117° to 127° F (47° to 53° C) for 30 minutes,** by supplying a current half that of regulated current, namely 7.5 to 8.5 Amps.

For this test, the thermostat oven **Ap. 5014** should be available, so that regulator can be maintained at the above specified temperature.

Soon after this test, keeping regulator always at 117° to 127° F (47° to 53° C), stop generator and start it again, increasing its speed gradually up to 4,500 r.p.m.

Adjust rheostat R for a generator output corresponding to half-load current, that is 7.5 to 8.5 Amps.

With this generator output, voltage should be 13.9 to 14.5 V.

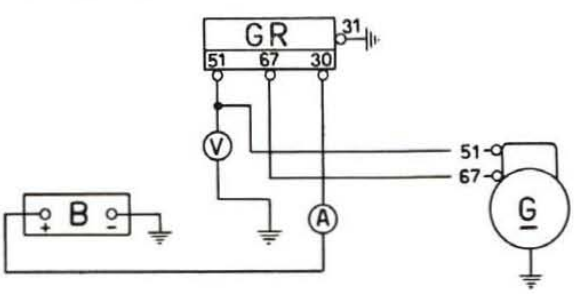


**Fig. 330 - Wiring diagram for checking the reverse current of cutout.**
GR. Regulator GN 2/12/16. - G. Generator FIAT D 90/12/16/3 CS. - B. Battery, 50 Ah, fully charged. - A. Ammeter, asymmetrical scale 10-0-15 A. - V. Voltmeter, 20 V scale (0.5 % accuracy).

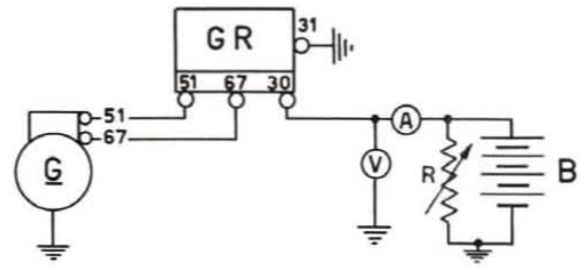


**Fig. 331 - Wiring diagram for checking the current and voltage regulators.**
GR. Regulator GN 2/12/16. - G. Generator FIAT D 90/12/16/3 CS. - V. Voltmeter, 20 V scale (0.5% accuracy). - A. Ammeter, 20 A scale. - R. Rheostat, 25 A - 3 Ω. - B. Battery, 50 Ah, fully charged.

## Checking Current Regulator.

**Regulated current on battery.**

Wire in accordance with the same diagram as for voltage regulator.

The regulated current on battery must be checked immediately after testing the half-load regulated voltage (on battery) of the voltage regulator.

Instruments are the same as used in determining half-load regulated voltage, excepting the ammeter which must have a 25 Amp scale.

Insert maximum rheostat resistance.

Operate the regulator at 117° to 127° F (47° to 53° C) for 30 minutes with regulator-controlled current **(reduce resistor R of rheostat until current is steady** and voltage drops) and 13 Volt tension.

After this operating period, check current for a steady delivery (that is rated operation temperature).

Stop the generator, restart and speed it up to 4,500 r.p.m. Check that the regulated current rate corresponds to specified 15 to 17 Amperes.

By still reducing the resistance, the current shall remain constant. The voltage, instead, with the decrease in resistance should drop to as low as 12 V.

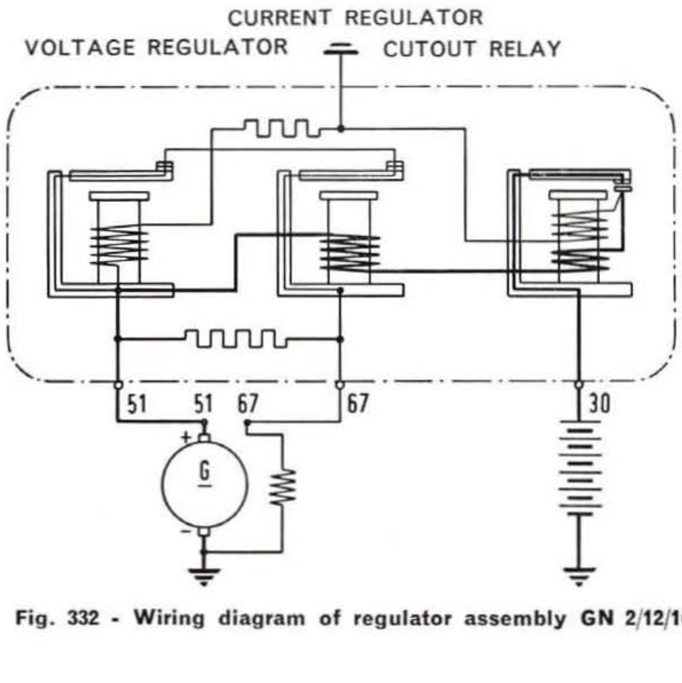


**Fig. 332 - Wiring diagram of regulator assembly GN 2/12/16.**

# SERVICE PROCEDURES

**All repairs are to be limited to exceptional cases, since, as a general rule, it is preferable to replace a defective regulator unit rather than repair and reset the same.**

In case service operations are to be made, **strictly** adhere to the following directions.

Before starting the regulator repairs, the serviceman must have performed all checks mentioned above, thus being sure that defects are really present and repairs necessary.

Except for setting and replacement of regulating resistor, which will be outlined further on, any disassembly, replacement, or repair of parts in the remaining components must be absolutely avoided.

The regulating resistor is supplied adequately packed in **special containers** protecting them from damage, distortion, grease soiling or other foreign matter, etc.

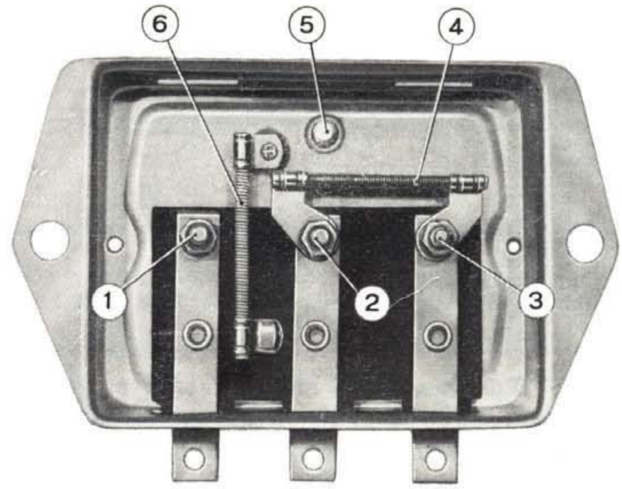


**Fig. 334 - Generator regulator GN 2/12/16.**
Bottom view.
1. Cutout relay nut. - 2. Current regulator and resistor nut. - 3. Voltage regulator and resistor nut. - 4. Regulator resistor. - 5. Soldering on base for cutout relay and voltage regulator windings. - 6. Voltage regulator series resistor.

## Opening the Regulator.

Loosen both cover-to-base screws and remove the cover and gasket.

### WARNING

Always bear in mind that most troubles, especially the serious ones, like:

– excessive wear or welding of cutout contacts;
– oxidation of voltage and current regulator contacts;
– contact pitting and build-up in voltage regulator and current regulator;
– contact welding in voltage regulator and current regulator;
– short-circuited coils;
– burnt windings;

are often due to causes not ascribable to regulator and which generally originate from troubles in the generator, such as alteration of field winding resistance, use of improper brushes, damaged circuits (wires, etc.).

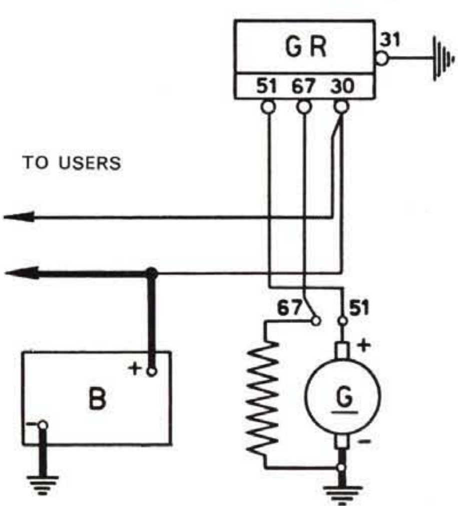


**Fig. 333 - Wiring diagram of regulator assembly GN 2/12/16.**
GR. Regulator. - B. Battery. - G. Generator.

Especially use of improper brushes brings about a poor commutation, with rapid wear of commutator segments and brushes themselves, high voltage drop between commutator and brushes and remarkable increase of field current.

In such conditions voltage regulator and current regulator contacts are affected by a current which is above the standard value.

As the bracket is of iron, sparkling at the contact area will cause local oxidation.

So both above contacts are isolated and the regulating resistance of the unit is all the time in the field winding of the generator, which delivers no output.

As a rule, regulator operation and life are most satisfactory. **For this reason, the serviceman must not simply restore the unit to efficiency but should also test the generator and the entire recharging system.**

## Replacing Regulating Resistor.

If it has been found that the voltage and/or current regulator settings have been altered, namely:

– regulated voltage is low or reduced to negligible values;
– voltage is no longer under control, but rises to high values;
– regulated current no longer ranges within rated limits but rises excessively;

the trouble may be ascribed to an open regulating resistor or to an alteration in resistor value.

In such a case some damage to the contacts may, in fact, take place, such as:

– oxidation of voltage or current regulator contacts (low or very low no-load voltage);

– welded voltage regulator contacts (uncontrolled voltage reaching very high values);

– welded current regulator contacts (uncontrolled current reaches very high values).

Inspect the resistor and make sure that the wire is not broken at some point and that no coils are shorted.

In doubtful cases, remove the resistor and test at 68° F (20° C); resistance must be 80 to 90 Ohms.

This operation can be performed without taking off resistor from regulator. Just insert a lintless paper between current and voltage regulator contacts and take reading across terminals 51 and 67.

If a different value is found, replace resistor by taking off nuts (2 and 3, fig. 334) with lock washers.

The resistor **must not be repaired.** A repair is never satisfactory since special methods and equipment are required. **Replace by a new resistor.**

**Caution.** - If the resistor is found to be damaged, remember that to restore regulator efficiency it will not suffice to simply replace the resistor, but it is **indispensable** to inspect the whole regulator.

Should further damages be detected (such as oxidized contacts, overheated wirings, etc.) the regulator unit must be replaced.

To reassemble resistor on regulator refit nuts (2 and 3, fig. 334), being careful not to forget lock washers, which should be replaced in their original position.

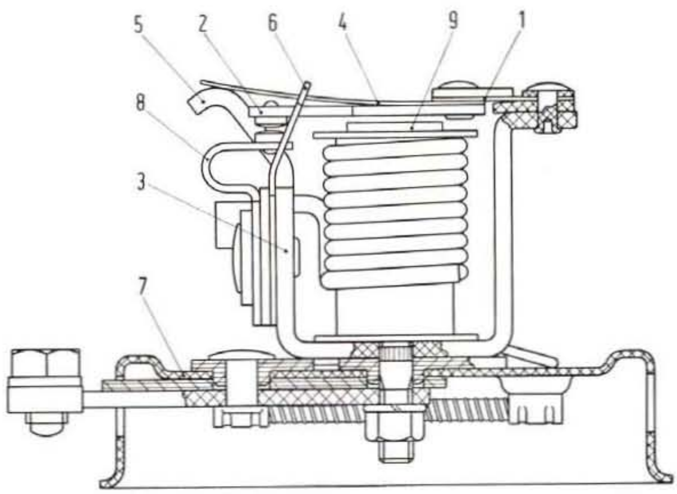


**Fig. 335 - Cutout relay for regulator assembly GN 2/12/16.**

1. Bi-metallic hinge-spring. - 2. Armature. - 3. Body. - 4. Adjusting spring. - 5. Setting arm. - 6. Armature stop. - 7. Base. - 8. Stationary contact blade spring. - 9. Core.

When rescrewing the resistor attaching nuts be also careful not to damage the resistor wire while handling the wrench.

Subsequently, check armature-to-core air gap of current and voltage regulators, taking the measurement on core edge towards contacts. Gap should equal .0391" to .0437" (0.99 to 1.11 mm).

Finally check regulator setting in accordance with the instructions given under « Adjustments ».

The above checks are indispensable since the voltage and current regulator cores, and relevant frames, are interconnected and mounted on base by the same nuts that secure the regulating resistor.

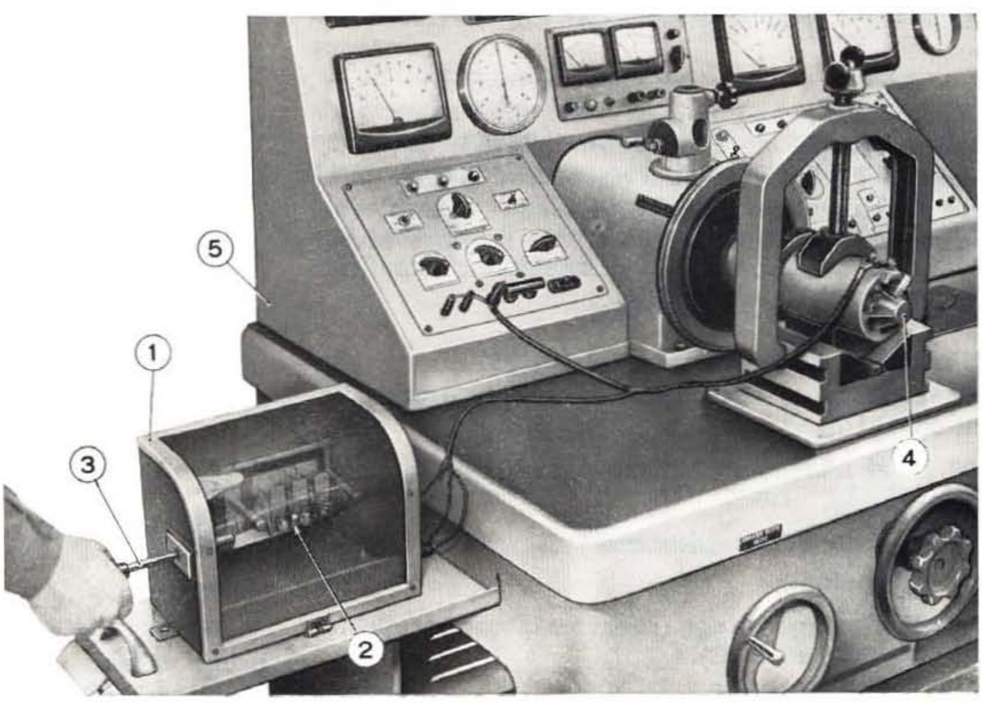


**Fig. 336.**
**Adjusting generator regulator in thermostat oven Ap. 5014 for temperature stabilization.**

1. Oven Ap. 5014. - 2. Stationary contact blade spring. - 3. Blade spring adjusting fork. - 4. Generator. - 5. Test bench.

Therefore, when handling the unit to replace regulating resistor, the arrangement of relays may be altered. For this reason, make sure that, after tightening the nuts, no asymmetry, if any, is left. In any case, the operation should be performed with maximum care and **regulating resistor mounting nuts should be tightened securely.**

If, after adjustment, armature-to-core air gaps are not within specified tolerance, it will be necessary to bend blade spring (8, fig. 335) carrying the stationary contact so as to bring air gap again within recommended limits. During this operation, it is essential to maintain the **parallelism of both the movable and stationary contacts,** that is to say, the two contacts should touch each other at their centers. This condition should be checked using a magnifying glass.

---

**NOTE - Even if cutout is not disturbed by removal of regulating resistor, it is always advisable to inspect cutout just the same, checking that:**

— armature-to-core air gap, **with contacts closed,** measured at core edge towards contacts (fig. 335) is .0138″ (0.35 mm);

— point gap, **with open contacts,** is .0153″ to .0201″ (0.39 to 0.51 mm).

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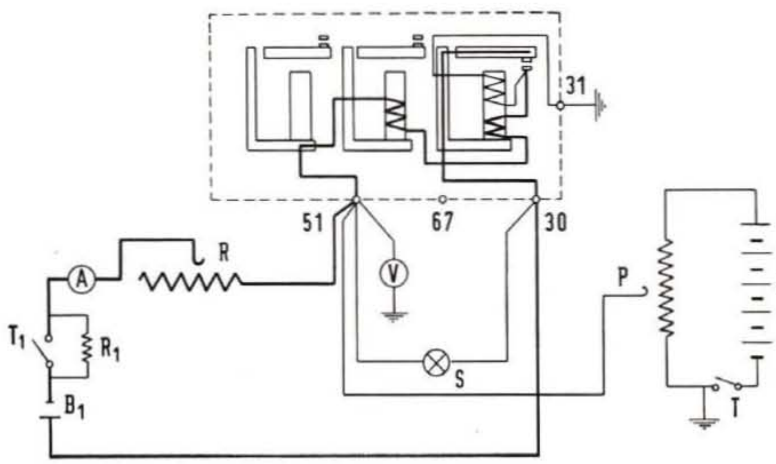


**Fig. 337.**
**Wiring diagram for setting the cutout relay.**
(Generator regulator 2/12/16).

$B_1$. 2-V battery. - $B_2$. 20-V battery. - A. Ammeter, 20 A scale (1% accuracy). - V. Voltmeter, 20 V scale (0.5% accuracy), directly connected to terminals 31 - 51. - P. Potentiometer for voltage adjustment, having such a capacity that the current draw of the cutout shunt winding does not cause sensible variations in the voltage readings (voltmeter under no load). - S. Test lamp, with 2 V, 3 W bulb, to signal opening and closing of contacts. - R. Rheostat, 4 Ω, 12 A. - $R_1$. Voltage drop rheostat, suitable to allow turning on of S, with $T_1$ open and cutout contacts open.

Setting of instruments before inserting the unit:
- — P. At minimum (voltmeter reads zero).
- — T. Open.
- — R. All in (max. resistance).
- — $T_1$. Open.

# ADJUSTMENTS

The adjustment of generator regulator must be carried out by placing the assembly **without cover** upright on bench with terminals lowermost.

---

**WARNING - If the regulator assembly has remained for a certain while in a room below 59° F (15° C) or above 95° F (35° C), before proceeding as outlined hereafter, keep the regulator for at least one hour at 59° to 95° F (15° to 35° C) room temperature.**

---

## Adjusting Cutout Relay.

Wire as shown in diagram of fig. 337.

The setting of instruments before inserting the unit should be:

- — P at minimum (voltmeter reads zero);
- — T open;
- — R all in (max. resistance);
- — $T_1$ open.

**Contact closing voltage** (room temperature: 59° to 95° F - 15° to 35° C).

a) Close switch T.

b) **Stabilize regulator temperature** with cover on, by feeding current for 15 to 18 minutes at 16.5 V (obtained by suitably adjusting P) for initial regulator operating temperatures of 59° to 68° F (15° to 20° C), or at 15 V for initial operating temperatures of 68° to 95° F (20° to 35° C).

c) Immediately after stabilizing the regulator, bring voltage to 12.4 to 12.8 V by adjusting P.

d) Remove cover and adjust load on setting spring by bending the relevant arm, until pilot lamp S goes out.

e) Reset P to minimum value.

f) Again increase voltage by working on P and check that pilot lamp goes out at the specified voltage.

**Reverse current** (room temperature: 59° to 95°F - 15° to 35° C).

This test must be run soon after the closing voltage test, so as to maintain regulator temperature stabilization.

a) With switch T closed, by working on P bring voltage to 14.5 V. Cutout contacts should be closed, pilot lamp S off.

b) Close $T_1$.

c) Increase reverse current by means of rheostat R, and check that pilot lamp S glows as contacts open. This opening may also be unsteady: such condition is evidenced by a slight buzz.

d) Check on ammeter the value of the reverse current causing the opening of contacts: it should not exceed 16 Amps.

e) If reading is unstable, or S lights up at tolerance limit, reset reverse current to the minimum value and repeat operation c).

f) Open switches T and $T_1$ and again adjust rheostat R and potentiometer P to minimum settings.

## Adjusting Voltage Regulator.

(Room temperature: 117° to 127° F - 47° to 53° C).

**NOTE** - Regulator must be placed in oven **Ap. 5014** where it can be maintained at above specified temperature.

a) Wire as shown in diagram (fig. 338).

b) Load voltage regulator setting springs by suitably bending the relevant arm.

c) With the unit in thermostat oven at 117° to 127° F (47° to 53° C) close I, start generator and stabilize regulator temperature by feeding current for 30 minutes at 15 V (obtained by suitably adjusting generator speed).

d) With unit still at 122° F (50° C), stop generator, open I, start generator again and speed it up to 4,500 r.p.m.

e) Adjust voltage regulator setting spring load by suitably bending the relevant setting arm and by rheostat R, so as to have a voltage of 13.9 to 14.5 V and half-load current of 7.5 to 8.5 Amps.

f) Check steadiness and accuracy of voltage regulator adjustment by stopping the generator and starting it again after a short while; then speed it up to 4,500 r.p.m.

## Adjusting Current Regulator.

(Room temperature: 117° to 127° F - 47° to 53° C).

To be performed immediately after adjusting voltage regulator, using the same wire diagram (fig. 338) and instruments, except ammeter, which should have a 40 A scale.

a) With the regulator in thermostat oven at 117° to 127° F (47° to 53° C), close I, start the generator and set its speed and rheostat R for a 13 Volt tension and 15 to 17 Ampere output.

b) Operate in above conditions for 30 minutes with the regulator at 117° to 127° F (47° to 53° C), stop the generator and open I. Again run the generator at 4,500 r.p.m.

c) Adjust the load of current regulator setting spring by bending the spring arm, and rheostat R, in order that regulated current and voltage are respectively 15 to 17 Amperes and 13 Volts.

d) Check regulated current for stability and precision by stopping generator and running it again as hinted at b).

# OPERATION TEST AND SEALING

After the regulator has been set, close the assembly in a warm condition (see « Warning » here below) by fitting cover and gasket, and check as outlined under « Bench Testing ». Next apply the paint seals.

---

**WARNING**

**Whenever the unit has been opened and kept open for servicing, it must be operated for a while and the cover fitted only after a suitable warm up period.**

---

Close cover carefully on warm unit with fixing screws and check that rubber gasket between cover and base is properly seated and ensures adequate sealing.

This eliminates the moisture usually deposited on windings and prevents the formation of moisture occurring when cover is applied on a cold unit. If any moisture is trapped in the unit, during operation when the unit is warm moisture will evaporate and deposit on armatures, thus causing highly detrimental oxidation of contacts.

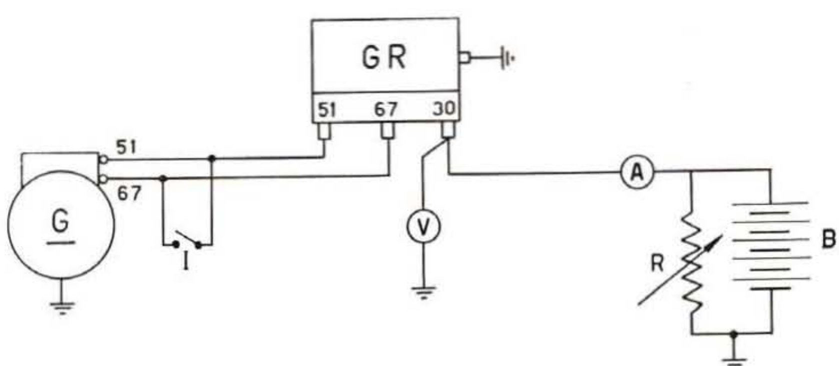


**Fig. 338.**
**Wiring diagram for adjusting voltage and current regulators.**

GR. Regulator assembly GN 2/12/16. - G. Generator D 90/12/16/3 CS - V. Voltmeter, 20 V scale (0.5% accuracy). - A. Ammeter, 15 Amp. scale (for voltage regulator), or 40 Amp. scale (for current regulator). - R. Rheostat, 25 Amps., 3 Ohms. - B. 50 Amp/hr battery, fully charged. - I. Switch.

# TROUBLE DIAGNOSIS OF RECHARGING SYSTEM

## Indicator Light Fails to Go out.

DISCHARGED BATTERY AND NO RECHARGE AT ALL

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Voltage regulator or current regulator contacts strongly oxidized or dirty. | 1) Check regulator:<br>— clean points with a proper file;<br>— replace unit if points cannot be reconditioned. |
| 2) Windings (« 67 » and « 51 ») of regulator unsoldered or broken. | 2) Check and replace regulator by a new one. |
| 3) Cutout relay fails to close. | 3) Check and replace regulator by a new one. |
| 4) Open wire between terminals « 67 » of generator and regulator. | 4) Check and replace wire by a new one. |
| 5) Loose wire at terminal « 51 » of regulator. | 5) Check wire fastening at terminal « 51 » and tighten lock screw. |
| 6) Open field winding. | 6) Locate « open » in field winding:<br>— if fault is in connections, repair;<br>— if winding is faulty, replace by a new one. |
| 7) Field winding grounded out. | 7) Check field winding on test bench and replace it by a new one. |
| 8) Armature winding grounded or inner paths open. | 8) Check armature on test bench and renew it. |
| 9) Armature commutator coated with an insulating film (grease, oxide, etc.). | 9) Examine commutator:<br>— with a clean rag, clean commutator face;<br>— remove brush carbon dust from commutator bars. |
| 10) Brushes worn or hardly bearing on commutator. | 10) Check brushes and replace by genuine ones. |
| 11) Faulty battery. | 11) Using an efficient battery, check whether the indicator light goes out regularly and in the affirmative:<br>— renew the battery. |
| 12) Voltage regulator adjusted low. | 12) Check and readjust voltage regulator. |

## No-Charge Indicator Fails to Light up.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Inoperative indicator lamp. | 1) Check lamp and lamp holder:<br>— replace lamp by a new one;<br>— repair or renew lamp holder. |
| 2) « Open » between terminal « 51 » of generator and lamp holder of indicator. | 2) Check circuit (wire and junction) for an « open »:<br>— renew wire or recondition junction. |
| 3) « Open » between indicator junction and plug-in insert « 15-54 » of ignition switch. | 3) Check circuit (cable, insert, junction and fuse) for an «open»:<br>— renew wire of fuse or recondition junction or insert. |
| 4) « Open » in ignition switch circuit. | 4) Check for an « open » between terminals 30 and 15/54:<br>— renew ignition switch. |
| 5) « Open » between plug-in insert « 30 » of ignition switch and plus terminal clamp of battery. | 5) Check circuit (in case of an « open », engine cannot be started):<br>— renew wire or recondition insert or clamp. |

## No-Charge Indicator Goes out but then Glows Feebly.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Indicator lamp faulty from low lighting voltage. | 1) Check lighting voltage of indicator lamp:<br>— replace lamp by another having a lighting voltage of 1.1 to 1.5. |
| 2) Voltage regulator points slightly oxidized or dirty, or else cutout relay points worn. | 2) Check voltage regulator points:<br>— clean points with a proper file;<br>— replace regulator unit by a new one. |
| 3) Cutout relay shunt winding broken. | 3) Replace regulator unit by a new one. |

NOTE - After the trouble has been detected, check:

- wires for a secure fastening at terminals « 30 » and « 51 » of regulator and at terminal « 51 » of generator;
- plug-in inserts in circuit between terminal « 30 » of regulator and socket « 30 » of ignition switch for a secure coupling.

**WARNING** - **Whenever it is necessary to go over the generator regulator for point cleaning, readjustment is required as outlined on page 210.**

## No-Charge Indicator Goes out at High Speed.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Field winding coils shorted.<br><br>2) Field winding grounded. | 1) - 2) Check ohmic resistor (page 202):<br>— renew winding;<br>— check points of voltage regulator and current regulator:<br>- if points are oxidized or dirty, clean with a proper file;<br>- if points are deteriorated, renew regulator unit. |
| 3) Number of field winding coils shorted. | 3) On test bench, ascertain the presence of shorted coils:<br>— renew armature;<br>— check efficiency of regulator, as directed above;<br>— if necessary, renew brushes. |
| 4) Insulating film (grease, etc.) between voltage regulator or current regulator points. | 4) Examine points and clean, if necessary. |
| 5) Generator drive belt loose. | 5) Check belt tension:<br>— adjust, or<br>— renew belt, as required. |

## No-Charge Indicator Lights up and Goes out Regularly.

LOW CHARGING RATE WITH DISCHARGED BATTERY

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Loose terminals, faulty wires. | 1) Check junction and continuity of wires:<br>— tighten terminal clamps;<br>— renew wires. |
| 2) Faulty battery. | 2) Test with battery discharged but serviceable:<br>— renew battery. |
| 3) Voltage regulator or current regulator adjusted low.<br><br>4) Voltage regulator or current regulator points oxidized or dirty.<br><br>5) Incidental resistor in circuit and windings of regulator. | 3) - 4) - 5) Temporarily short circuit terminal « 67 » of regulator with « 51 » and raise generator speed:<br>— if output increases, trouble is due to one of conditions 3) - 4) - 5):<br>3) Revise adjustment of voltage regulator and current regulator.<br>4) Clean points by filing them with a proper file:<br>— renew regulator if points cannot be reconditioned.<br>5) Locate the cause in the regulator:<br>— correct, if possible;<br>— renew the unit. |

## No-Charge Indicator Lights up and Goes out Regularly.

HIGH CHARGING RATE WITH FULLY CHARGED BATTERY

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| | 1) - 2) - 3) - 4) - 5) Disconnect wire from terminal « 67 » of regulator and keep generator at average speed.<br>— If output stops at all, fault lies in regulator and is due to one of conditions 1) - 2) - 3) - 4) - 5 a). |
| 1) Voltage regulator adjusted high. | 1) Readjust voltage regulator. |
| 2) Voltage regulator winding or additional resistor at fault. | 2) Renew regulator unit. |
| 3) Voltage regulator or current regulator points stuck. | 3) Renew regulator unit. |
| 4) Faulty ground of voltage regulator. | 4) Improve ground connection. |
| 5) Direct short circuit between plus terminal « 51 » of generator and field circuit.<br>— a) in regulator interior;<br>— b) in generator interior. | 5) Check points of voltage regulator, if not clean there is a short:<br>— renew regulator unit;<br>— if output is high, fault lies in generator from condition 5b); check for undue contacts between terminal « 51 » and terminal « 67 » or between plus brush holder and field winding:<br>- remove cause of contact;<br>- renew commutator end head;<br>- renew field winding. |
| 6) High temperature in battery tapering down reactive e.m.f. of battery to charge input. | 6) Overhaul charging system. |

**NOTE** - If generator output keeps at top level even after a long recharging period and no overheating or other fault in regulator or generator are detected, the trouble is to be traced to the battery which has grown « aged ».

## Uneven Wear of Commutator Bars in Generator.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Some coils shorted in field winding. | 1) On test bench, prove the presence of shorted coils: renew armature. |
| 2) Improper brushes. | 2) Bars stained unevenly from irregular sparkling:<br>— return commutator on lathe;<br>— replace brushes by genuine ones. |
| 3) Commutator coated with a insulating film (grease, oxide, etc.). | 3) Examine commutator:<br>— return on lathe, if necessary. |
| 4) Commutator bars out of place. | 4) Check commutator with dial indicator:<br>— renew armature and brushes. |

## Rapid Wear of Generator Brushes.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Commutator out-of-round. | 1) Check that maximum out-of-round of commutator does not exceed .0004″ (0.01 mm):<br>— return commutator on lathe and renew brushes. |
| 2) Commutator bars out of place. | 2) Check commutator with dial indicator:<br>— renew armature and brushes. |
| 3) Brushes of improper grade. | 3) Check that brushes are the genuine FIAT type:<br>— replace by FIAT brushes. |

**NOTE** - Life of brushes, with generator operating regularly, should range between 25,000 and 37,000 miles (40,000 and 60,000 km).

### IMPORTANT

**Never insert radio interference suppression condensers of any capacity between:**

- **terminal 67 and ground;**
- **terminals 67 and 51, both on generator and on regulator.**

**If condensers are inserted between said terminals, regulator points will be damaged in a very short time.**

**Should interferences occur from regulator, a shielded cable can be used for « 67 » connection, otherwise replace regulator by a new one.**

Normally, regulators do not cause radio interference.

If this recommendation is disregarded, the regulator will be damaged, as explained above.

# STARTING MOTOR



## SERVICE DATA

| | |
|---|---|
| Type | E 76-0,5/12 S Var. 9 |
| Voltage | 12 |
| Nominal power | 0.5 kW |
| Rotation (pinion end) | counterclockwise |
| Pole shoes | 4 |
| Field winding | series |
| Drive | overrunning clutch |
| Pole shoes I.D. | 2.0697 to 2.0768 in. (52.57 to 52.75 mm) |
| Armature diameter | 2.0394 to 2.0413 in. (51.80 to 51.85 mm) |
| Part No. of brushes | 805581 |
| Drive control | solenoid |
| **Bench Test Data.** | |
| – Operation test at 68° F (20° C): | |
| Amperage | 130 |
| Torque developed | 1.88 to 2.17 ft.lbs (0.26 to 0.30 kgm) |
| Speed | 2,150 to 2,350 r.p.m. |
| Voltage | 10 |
| – Stall torque at 68° F (20° C): | |
| Amperage | 258 |
| Voltage | 7.4 to 8 |
| Torque developed | 4.92 to 5.64 ft.lbs (0.68 to 0.78 kgm) |
| – No-load test: | |
| Amperage, not above | 30 |
| Voltage | 12 |
| Speed | 7,500 to 9,500 r.p.m. |

*(continued)*

## STARTING MOTOR ASSEMBLY FIAT E 70-0,5/12 S VAR. 9

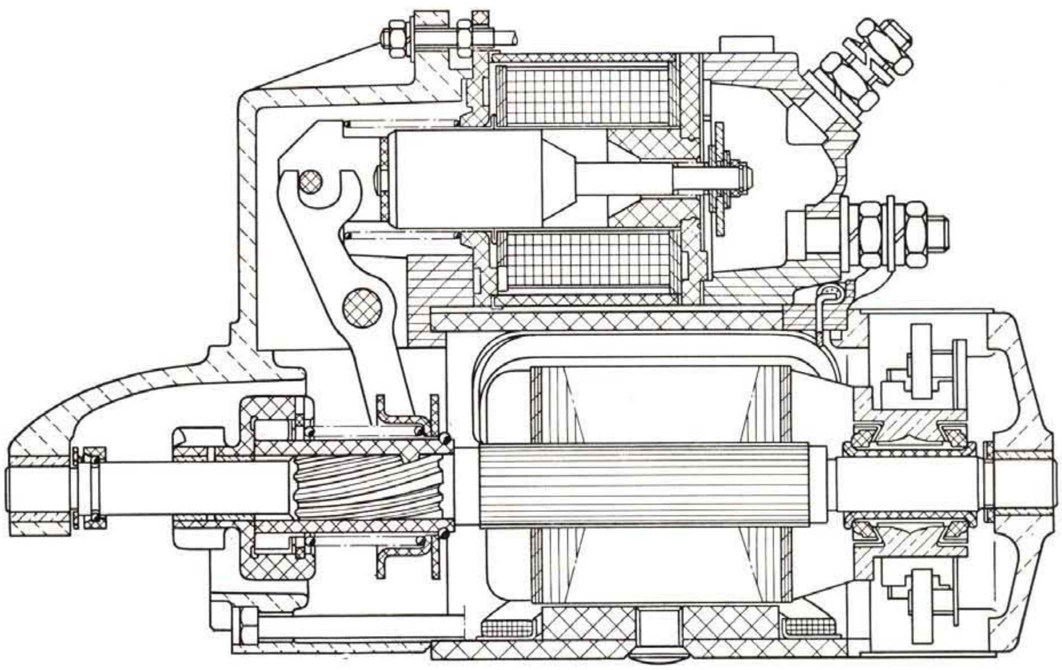

**Fig. 339 - Side section view of starting motor.**

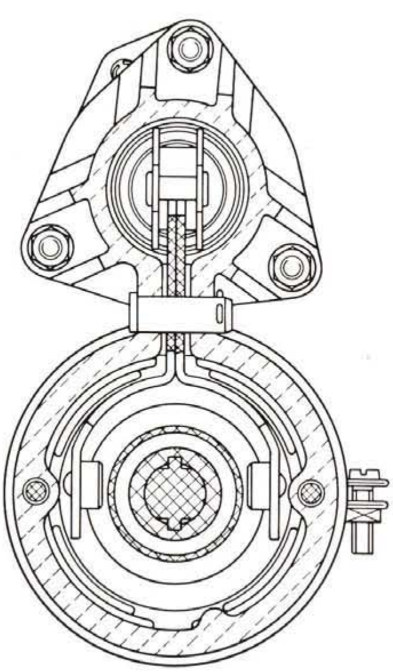

**Fig. 340 - End section view of starting motor across pinion drive.**

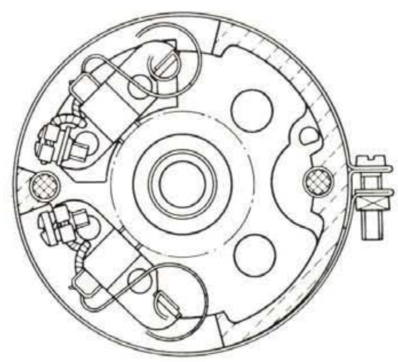

**Fig. 341 - End section view across commutator end head and view of brushes.**

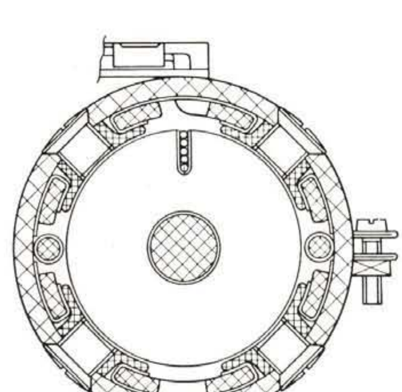

**Fig. 342 - Transverse section view across pole shoes and field winding.**

**Service Data** *(continued).*

| | |
|---|---|
| – Solenoid winding resistance at 68° F (20° C) | 0.354 to 0.454 Ohms |
| – Ohmic resistance during stall torque test at 68° F (20° C) | 0.029 to 0.034 Ohms |
| – Field winding resistance at 68° F (20° C) | 0.0137 to 0.0167 Ohms |
| **Mechanical Characteristics Test Data.** | |
| – Load of springs on new brushes | 2.5 to 2.9 lbs (1.15 to 1.30 kg) |
| – Armature shaft end play | .0059″ to .0256″ (0.15 to 0.65 mm) |
| – Mica undercut depth | .04″ (1 mm) |
| – Drive unit free wheel efficiency: static torque required to rotate pinion, not above | .35 in.lbs (0.4 kgcm) |
| – Solenoid contact stroke | .450″ to .582″ (12.44 to 14.79 mm) |
| – Solenoid armature stroke | .408″ to .513″ (10.36 to 13.02 mm) |
| **Lubrication.** | |
| – Drive unit splines | FIAT VS 10 W oil (SAE 10 W) |

# TROUBLE DIAGNOSIS AND CORRECTIONS

## Motor Fails to Operate.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Battery posts and clamps oxidized. | 1) Remove clamps, thoroughly clean posts and clamps, refit and coat with pure ropy vaseline. |
| 2) Terminal clamps of starter switch or battery loose. | 2) Inspect and tighten down terminal clamps, if necessary. |
| 3) Battery thoroughly flat. | 3) Check state of charge as outlined under « Battery ». Locate any possible point of leakage (battery, wires, instruments). |
| 4) No contact on commutator from worn brushes. | 4) Replace brushes by genuine ones. |
| 5) Starter switch points pitted, worn or insulated from foreign matter. | 5) Check and clean points; pitting may be the result of shorted coils from excessive current draw. |
| 6) Armature or field winding grounded. | 6) Insulator blackened, commutator bars deteriorated. Renew damaged parts. |
| 7) Armature or commutator thrown out. | 7) Renew armature or the motor assembly, if necessary. |

## Motor Operates but Very Slowly.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Worn brushes. | 1) Replace brushes by genuine ones. |
| 2) Number of armature or field winding coils shorted. | 2) Detect shorted coils by a high frequency short circuit detector and proceed as required. |

*(continued)*

**Motor Operates but Very Slowly** *(continued)*.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 3) Battery posts and clamps oxidized. | 3) Remove clamps, thoroughly clean posts and clamps, refit and coat with pure ropy vaseline. |
| 4) Terminal clamps of starter switch or battery loose. | 4) Inspect and tighten down terminal clamps, if necessary. |
| 5) Very low state of charge of battery, or one or more cells damaged. | 5) Check state of charge of battery or renew it, if necessary. |

## Motor Noisy in Operation.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Oilless bushings too much worn. | 1) Renew bushings. |
| 2) Drive pinion tardy to disengage from flywheel ring gear. | 2) Faulty operation of drive mechanism from a dragging or jammed lever, weak springs, dragging hub sleeve or solenoid core.<br>Disassemble motor and renew defective parts. |

# BENCH TESTING

To check the efficiency of starting motor B 76-0,5/12-S Var. 9 the operation tests and electrical and mechanical characteristics tests outlined hereunder, should be carried out.

## Operation Tests.

Before any testing is carried out, it is advisable to prepare all instruments and gauges required. Strictly follow the procedure outlined for each single test.

1) **Operation test** (room temperature 68° F - 20° C).

Connect starter to a high capacity battery, so as to avoid current fluctuations during the test.

Adjust rheostat so that to prescribed current absorption the exact voltage specified below corresponds at starter terminals. This is an essential condition to obtain reliable results which, otherwise, would be true only for the torque (and even thus only approximately).

Wire up as per diagram fig. 343.

Install starter on a bench provided with a ring gear (whose ratio to pinion is not less than 10 to 1), and a dynamometric brake; then operate the starter

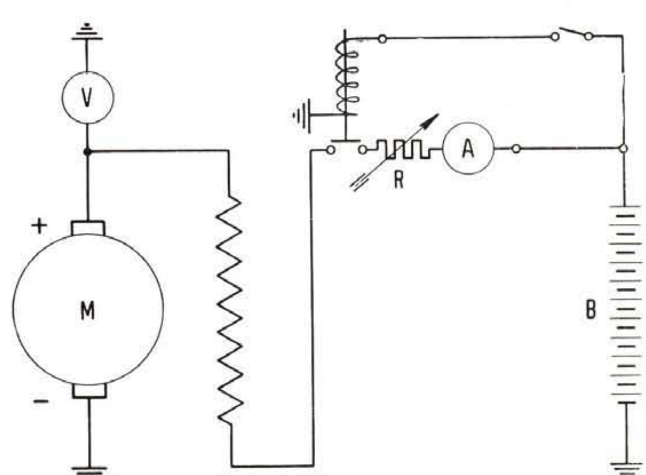


**Fig. 343 - Wiring diagram for starting motor operation test.**
M. Starting motor. - V. Voltmeter, 15 V scale. - A. Ammeter, 1,000 A scale. - B. Battery, 50 A/h - 12 V. - R. Rheostat, 800 A capacity.

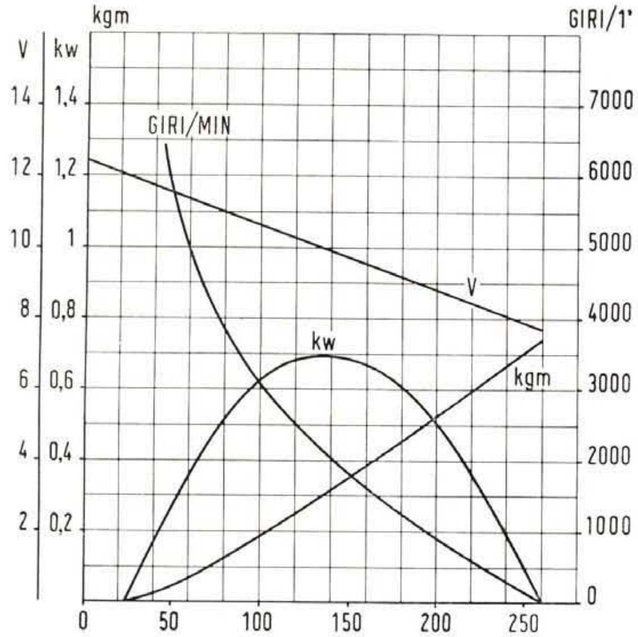


**Fig. 344 - E 76-0,5/12 S Var. 9 starting motor curves.**
GIRI/MIN - GIRI/1' = R. P. M.

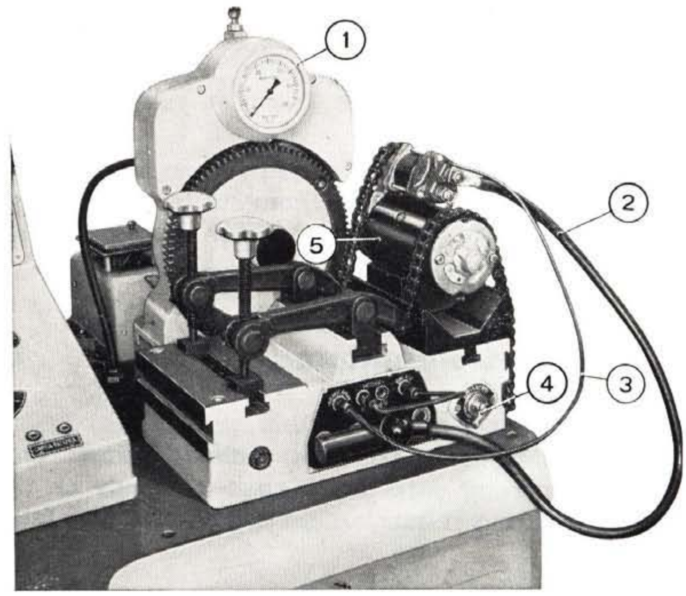


**Fig. 345 - Operation test of starting motor, loaded and at no-load.**
1. Drag torque dial indicator. - 2-3. Power cords. - 4. Starter switch. - 5. Starting motor.

switch, by carrying out ten starts of 4 seconds each, at 30 second intervals.

Braking the starter with a 130 A current, the delivered torque should be 1.88 to 2.17 ft.lbs (0.26 to 0.30 kgm) at 2,150 to 2,350 r.p.m., tension 10 V.

2) **Stall torque** (room temperature 68° F - 20° C).

With the same wiring layout as above, adjust the voltage at the starter terminals so that starter is delivered a 258 A current, at 7.4 to 8 V, lock the ring gear and actuate the starter control lever to stroke end.

The delivered torque should be 4.92 to 5.64 ft.lbs (0.68 to 0.78 kgm).

3) **No load test** (room temperature 68° F - 20° C).

On the test bench move the starter out from ring gear so that pinion cannot mesh even when travelling its full forward stroke.

The wiring layout remains the same as described above and the tension should be 12 V at the starter terminals.

The starter should draw a current not exceeding 30 A, at 12 V, and turn at 7,500 to 9,500 r.p.m.

## Ohmic Resistance Test.

From the data obtained during the **stall torque test** and by figuring the ratio of voltage to drawn current, the starter internal resistance may be directly determined.

The resistance for the E 76-0,5/12-S Var. 9 starter, at 68° F - 20° C, should be 0.029 to 0.031 Ohms.

## Mechanical Characteristics Check Data.

Brush hold down springs load must be (with new brushes) 2.5 to 2.9 lbs (1.15 to 1.3 kg).

Armature shaft end play must be .0059" to .0256" (0.15 to 0.65 mm).

Commutator mica must be undercut .04" (1 mm) at least.

The efficiency of drive unit free wheel must be such that the static torque required to rotate the pinion slowly is not greater than .35 in.lbs (0.4 kgcm).

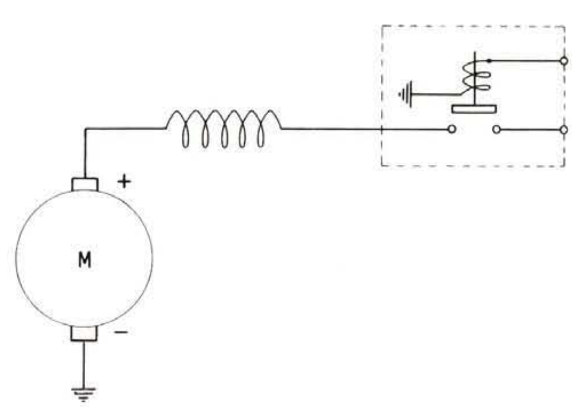


**Fig. 346 - Starting motor wiring diagram.**

# SERVICE PROCEDURES

To correct starter faults, keep in mind the following directions:

1) The only repair that can be carried out by Service Station personnel is: commutator re-turning.

2) Any other damage or defect must be eliminated by replacing defective parts.

## Returning Commutator.

Place the armature assembly, which has been removed from the starter as outlined further on, on a lathe, using care that it rotates exactly on its shaft axis during re-turning, so that no runout is felt.

## Replacing Brushes.

Remove cover band, raise brush springs and replace worn brushes by new ones, which must be exclusively of the genuine type supplied by FIAT - Spare Parts Dept.

## Armature Disassembly and Assembly.

Remove cover band. Lift brush hold-down springs and take off commutator end head. Slide off armature assembly from drive unit and shoe poles.

Before reassembly blow clean the armature, the frame and the drive end head; lubricate the armature shaft splined end with FIAT VS 10 W oil.

If armature is sound and can still be used, blow it clean; polish the commutator with a clean cloth, free from grease, gasoline, etc.

To assemble the motor, just reverse the disassembly procedure.

## Replacing Starter Drive Mechanism.

Take down armature assembly, slide off drive end head and remove drive mechanism.

Prior to replacing or fitting drive mechanism, lubricate inner splined face with FIAT VS 10 W oil and contact face of lever sheave to rollers with FIAT Jota 2/M grease.

## Replacing Starter Switch.

Remove both switch mounting screws, take down starter switch and replace it by a new one, using care that field winding terminal nuts are screwed well home.

## Replacing Field Winding.

Remove field coil from armature as directed above and take down pole shoes by removing mounting screws.


**Fig. 347 - Armature assembly with overrunning clutch drive mechanism.**

1. Washer. - 2. Stop ring. - 3. Drive pinion. - 4. Sheave spring. - 5. Overrunning clutch hub. - 6. Drive sheave. - 7. Armature winding. - 8. Commutator.

Prior to installing, heat the new winding to 122° F (50° C), in order to render it slightly flexible and facilitate its seating under the pole shoes.

The winding must be fully tightened, so that the original air gap is restored. After reassembly, check that the pole shoe inner diameter is within the following specifications:

2.0697" to 2.0768" (52.57 to 52.75 mm).

Should it depart from above limits, this indicates that the assembly has been performed incorrectly.

Under any circumstances, revise the assembly work. Never ream the pole shoes.

Also check that the armature outer diameter is correct, namely: 2.0394" to 2.0413" (51.80 to 51.85 mm).

# IGNITION SYSTEM



## SERVICE DATA

| | | |
|---|---|---|
| **Ignition Distributor.** | | |
| Maker's No. | engine 100G.000 | S 110 B |
| | engine 100G.002 | S 110 C |
| Vacuum advance (*) | | $10^{\circ}$ to $16^{\circ}$ |
| Static advance | engine 100G.000 | $11^{\circ}$ |
| | engine 100G.002 | $10^{\circ}$ |
| Automatic centrifugal advance (to engine) | engine 100G.000 | $26^{\circ}$ to $30^{\circ}$ |
| | engine 100G.002 | $23^{\circ}$ to $27^{\circ}$ |
| Breaker point pressure | | 17.6 to 21.2 oz (500 to 600 gr) |
| Point gap | | .0165″ to .0189″ (0.42 to 0.48 mm) |
| Insulating resistance between terminals and ground at 500 Volts d.c., above | | 10 MΩ |
| Condenser capacity at 50 to 100 Hz | | 0.20 to 0.25 μF |
| Condenser insulating resistance at 212° F (100° C) and 100 Volts d.c., above | | 1 MΩ/μF |
| Drive shaft bushing lubricant | | FIAT engine oil |

*(continued)*

(*) Vacuum advance has been suppressed starting from following engine numbers:
— 850 Standard Sedan 573196,
— 850 Super Sedan 515049

**Service Data** *(continued)*.

| **Ignition Coil.** | MARELLI | BOSCH | O.E.M. |
|---|---|---|---|
| Maker's No. | BE 200 B | TK 12 A 17 | G 52 S |
| Primary winding resistance at 68° ± 9° F (20° ± 5° C) | 3.1 to 3.4 Ohms | 3.1 to 3.4 Ohms | 3 to 3.3 Ohms |
| Secondary winding resistance at 68° ± 9° F (20° ± 5° C) | 6,700 to 8,300 Ohms | 7,200 to 8,000 Ohms | 6,500 to 8,000 Ohms |
| Ground insulating resistance at 500 Volts d.c., not below | 50 MΩ | 50 MΩ | 50 MΩ |

| **Spark Plugs.** | MARELLI | CHAMPION |
|---|---|---|
| Maker's No. | M 14-19 (CW 240 L) | M 14-19 (N 4) |
| Thread diam. and pitch, metric | M 14 x 1.25 | M 14 x 1.25 |
| Point gap | .0236″ to .0276″ (0.6 to 0.7 mm) | .0236″ to .0276″ (0.6 to 0.7 mm) |

## General.

The ignition system consists of:

– ignition coil;

– ignition distributor with breaker, centrifugal automatic advance and condenser;

– vacuum advance;

– low and high tension wiring and spark plugs;

– a power supply provided by generator-and-battery.

The system is subdivided into two circuits (fig. 348), namely:

– the low tension circuit or primary circuit, which includes: the power supply, breaker, condenser and ignition coil primary winding;

– the high tension circuit or secondary circuit, which includes: the ignition coil secondary winding, distributor rotor, distributor cap with terminals and central brush, high tension cables and spark plugs.

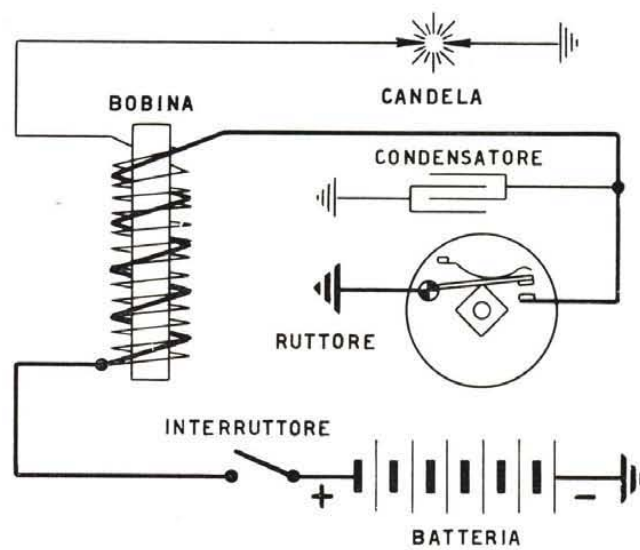


**Fig. 348 - Ignition system wiring diagram.**
Bobina = Coil. - Candela = Spark plug. - Condensatore = Condenser. - Ruttore = Breaker. - Interrutore = Switch. - Batteria = Battery.

# IGNITION DISTRIBUTOR

This unit includes:

– the centrifugal automatic advance;

– the low tension circuit breaker;

– the condenser;

– the high tension distributor rotor.

## Vacuum Advance.

Vacuum advance device allows of increasing ignition advance angle against vacuum rate in a part of carburetor.

## Checking Distributor on Test Bench.

### Operation test.

Install distributor on tester and connect it to the variable-speed motor. Wire to an ignition coil and battery, and connect the four outside cap terminals to four terminals of an adjustable point gap spark tester.

Rotate distributor for some minutes in the prescribed direction at a speed of about 2,000 r.p.m., keeping the spark tester point gap at some 3/16″ (5 mm).

Then, widen gap to 3/8″ (10 mm) and check if any sparking takes place in distributor. Aside from the particular noise produced, such sparks are revealed either by a drop in intensity or a total lack of one or more sparks at the tester.

### Checking the automatic advance curve.

Install distributor on tester and connect terminal D of an ignition coil to the ignition distributor low tension terminal; next, connect the coil H.T. terminal to the graduated disc of tester.

Operate distributor at a speed of 300 to 400 r.p.m., and on the graduated disc, record the value in degrees at which one of the four sparks is produced. Increase distributor speed; if the increase is very slight in comparison to the speed of the preceding test, the same reading should be recorded.

Continue to rise the rotational speed: by taking readings at every 200 to 300 r.p.m. increment, it will be possible to record the new values in degrees of spark advance (referred to distributor), with respect to initial advance setting and as a function of distributor rotational speed.

Since the distributor speed is half that of engine, the figures obtained must be doubled (both the r.p.m. and advance in degrees) to properly plot the distributor automatic advance versus-engine diagram and compare it with figs 349, 350, 351.

The automatic advance range of distributor to engine is as wide as 30°.

### Checking the vacuum-operated advance device.

Check that distributor is free to rotate in its support because if rotation is hindered from binding of the distributor-support assembly or from the cables to

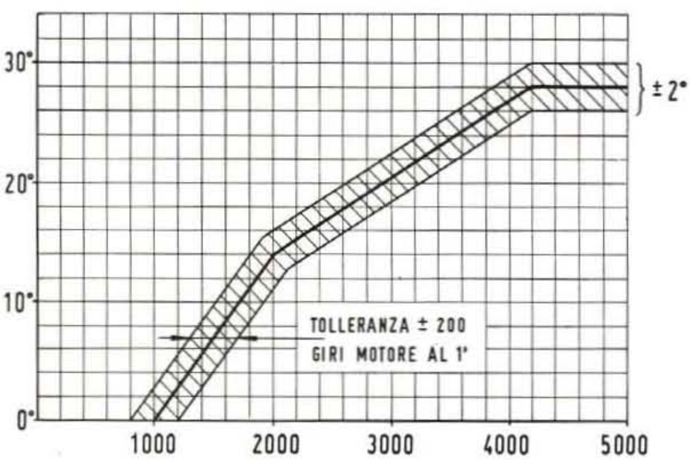


**Fig. 349 - Diagram showing automatic advance of ignition distributor to engine 100 G.000.**

Covers distributors fitted with or without vacuum advance.
Tolleranza ± 200 giri motore al 1' = Tolerance ± 200 r.p.m.

spark plugs, the advance device will not operate properly.

The above troubles, besides hindering the advance device, may also cause knocking of the engine in case the distributor remains blocked in the position corresponding to the maximum advance angle with the engine at maximum r.p.m. rate.

On the contrary, if the distributor remains blocked in the position corresponding to the minimum advance angle, the trouble is not so serious, since the engine performs as if it were not provided with vacuum operated advance device.

The ground cable must be firmly fastened so as to ensure a good grounding because, otherwise, ignition would be defective.

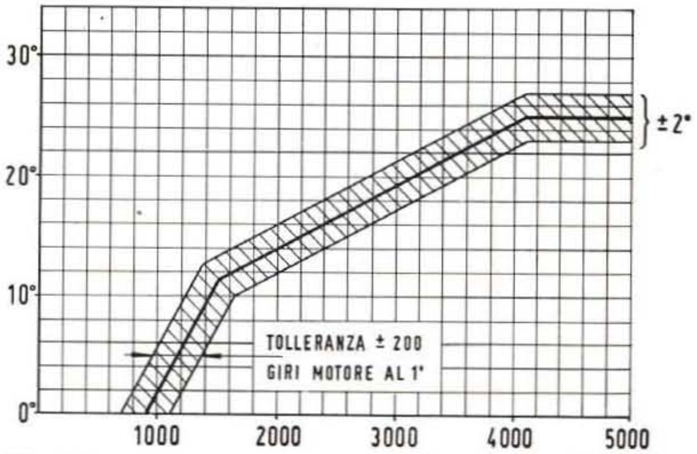


**Fig. 350 - Diagram showing automatic advance of ignition distributor to engine 100 G.002.**

Up to engine N° 515048.
Tolleranza ± 200 giri motore al 1' = Tolerance ± 200 r.p.m.

Also, the cable must not impede the free rotation of distributor.

Check for tightness also the connections of hose (2, fig. 353) to carburetor and vacuum advance.

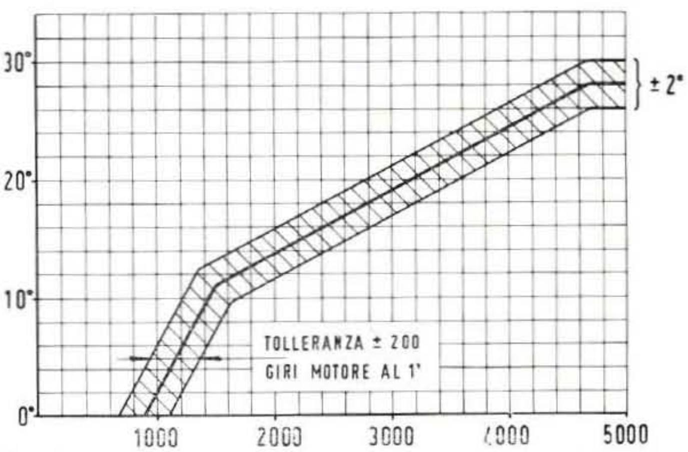


**Fig. 351 - Diagram showing automatic advance of ignition distributor to engine 100 G.002.**

Starting from engine N° 515049.
Tolleranza ± 200 giri motore al 1' = Tolerance ± 200 r.p.m.

### Checking timing.

With distributor mounted on test bench as outlined under «Checking the automatic advance curve», operate it at approximately 400 r.p.m.

By properly adjusting the distributor on the bench support, align one of the four sparks occurring between the rotating point and the graduated disc with the 0° mark.

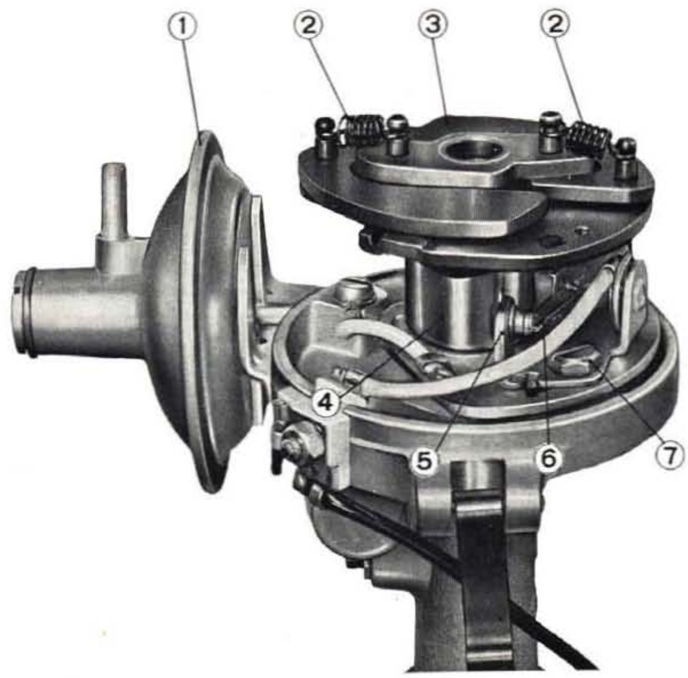


**Fig. 352 - Ignition distributor with cover removed.**
1. Vacuum advance. - 2. Weight springs. - 3. Centrifugal weights. - 4. Cam lobe. - 5. Stationary contact bracket. - 6. Breaker arm. - 7. Stationary contact bracket lock and set screw.

The four sparks should thus correspond to 0°, 90°, 180° and 270° on the disc with a $\pm 1°$ tolerance.

### Checking breaker contact points opening-closing rate.

Install distributor on test bench and connect primary circuit with a battery and a test lamp.
Rotate distributor by hand in the prescribed direction and read on the graduated disc, at the reference index, the value in degrees corresponding to the instant at which contacts begin to part.
This instant is indicated by the lamp going out. Continue to rotate distributor until the lamp lights up again meaning that contacts have closed. Record at this instant the degrees read on the graduated disc.
Still rotate distributor until contacts open (lamp going out). The difference between the second and the first figure recorded gives the opening angle; the difference between the third value (corresponding to the last lighting up of the lamp) and the second value recorded, indicates the closing angle.

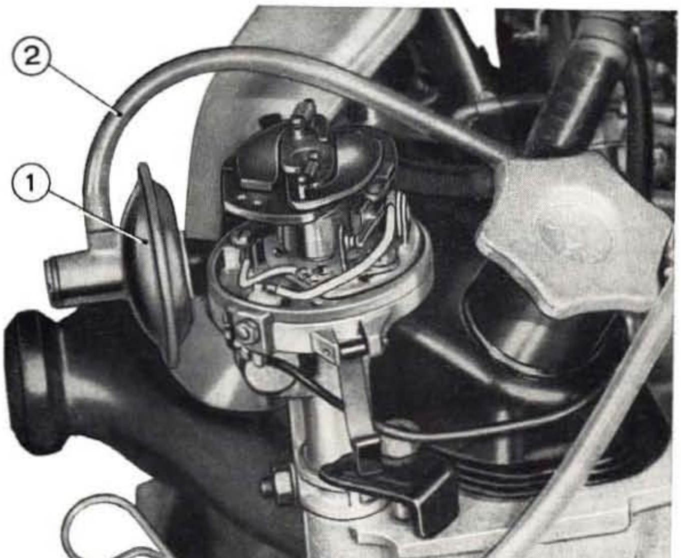


**Fig. 353 - Ignition distributor in place on engine, with cover removed.**
1. Vacuum advance device. - 2. Vacuum advance to-carburetor hose.

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**NOTE - Starting from engine 100 G.000 No. 573196 and 100 G.002 No. 515049, the ignition distributor is no longer fitted with vacuum advance.**
**To check the new design distributor refer to diagrams figs. 349 and 351.**

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Check the recorded opening and closing angles taking the average of several readings.
The ratio between closing angle and opening angle must be about 1.3 to 1:
- closing angle magnitude: 48° to 54°;
- opening angle magnitude: 36° to 42°.

### Checking distributor noises.

No matter at what speed the car is driven, the distributor should not be noisy.
Generally, the presence of marked noises can be attributed to the following sources:
- contact points pressure lower than 17.6 to 21.2 oz (500 to 600 gr);
- shaft bushings worn out;
- weight pivots worn out;
- weight springs weakened.

Trouble listed first will also account for a difficult ignition at high speeds.
Instead, higher contact point pressure will result in a marked wear of contacts, cam and movable contact rubbing block.
In case listed last also a consequent alteration in automatic advance will be experienced as well as ignition advance to specified r.p.m. rate.

### Checking mechanical components.

Contacts should be checked for pitting, oxidation and charring.
Ascertain that rotor, cap stationary contacts, H.T. central brush are not worn by more than .0118" (0.3 mm).
Check breaker arm rubbing block. Its wear must not be such as to upset breaker timing by more than 2° with respect to ignition distributor setting.

Check also that contact gap is .0165" to .0189" (0.42 to 0.48 mm) and contact points pressure 17.6 to 21.2 oz (500 to 600 gr.).

**Checking insulation resistances.**

The insulating resistance between different terminals and ground must exceed 10 MΩ at 500 Volt d.c., and can be controlled with a megohmmeter.

The measurement between breaker terminal and ground must be taken while breaker contact points are kept open.

**Checking condenser.**

Condenser capacity - measured at a frequency ranging from 50 to 100 Hz. - should be from 0.20 to 0.25 μF.

Insulating resistance at 212° F (100° C), measured with a 100 Volt d.c., should be greater than 1 MΩ/μF.

# IGNITION COIL

## Bench Testing.

Check ignition coil efficiency as follows:

**Ohmic resistances.**

Ohmic resistance of primary circuit at 59° to 77° F (15° to 25° C) should be lower than 3.4 Ohms.

Secondary circuit resistance should be as follows:

| | |
|---|---|
| – Marelli . . . . . . . . . | 6,700 to 8,300 Ohms |
| – Bosch . . . . . . . . . . | 7,200 to 8,000 Ohms |
| – O.E.M. . . . . . . . . . | 6,500 to 8,000 Ohms |

**Grounding insulation.**

Ignition coil must withstand, without any sparking, an alternate tension of 500 V. r.m.s., 50 Hz, applied for three minutes between one end of the primary winding and the metal casing. Insulation resistance, with respect to ground, must be greater than 50 MΩ at 500 V. d.c. This can be measured with a megohmmeter.

**Measuring spark length.**

Run the ignition coil with the distributor without using H. T. distribution, and send all sparks to a standard ionising point spark tester for measurement of maximum spark length.

After the coil has been operating for approximately two hours at a rate of 50 sparks per second and has warmed up, spark length at 12 Volts should be at least .47" (12 mm).

**Test with shunted spark tester.**

Insert a 1 MΩ resistor in parallel with spark tester. Under these conditions, the spark length should not be lesser than $^3/_4$ the length of the spark obtained in previous test.

**Over-voltage test.**

Feed the ignition coil with a 17 V. battery at 60 sparks per second, connecting the H.T. lead directly to spark tester with .315" (8 mm) spark gap adjustment. The coil must withstand this test for 15 minutes.

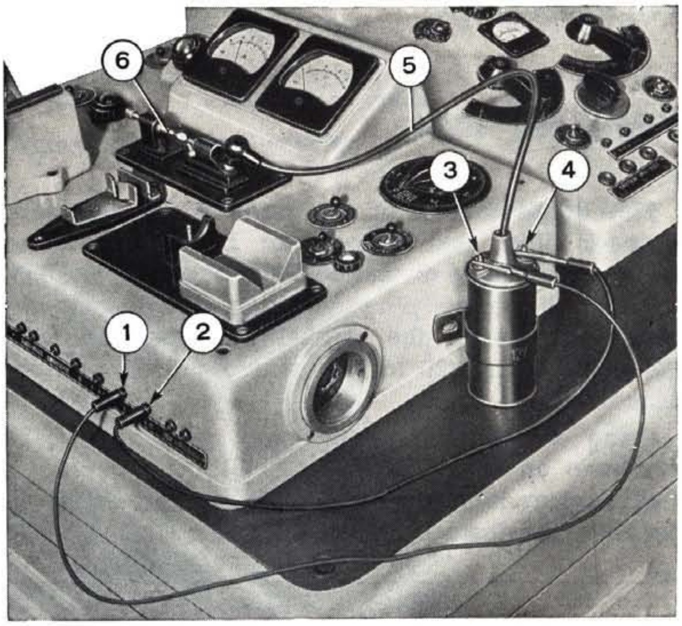



**Fig. 354 - Checking ignition coil on test bench.**

1. Breaker. - 2. 12 Volt power socket. - 3. Low tension cable terminal. - 4. Power cord terminal. - 5. High tension cable. - 6. Spark issuing between tester points.

# SPARK PLUGS

## Inspection and Repair.

Should ignition troubles and misfiring occur in one or more cylinders check spark plug condition.

For a perfect cleaning and electric test of spark plugs, use the proper Service Center where fouled spark plug is first sanded then washed by gasoline under pressure and, finally, blown dry (fig. 356).

Check electrode gap and adjust to .024 to .028" (0.6 to 0.7 mm).

To adjust the gap, bend the outer electrode towards the central one; never try to move the central

Fig. 355 - Testing a spark plug for gas tightness.

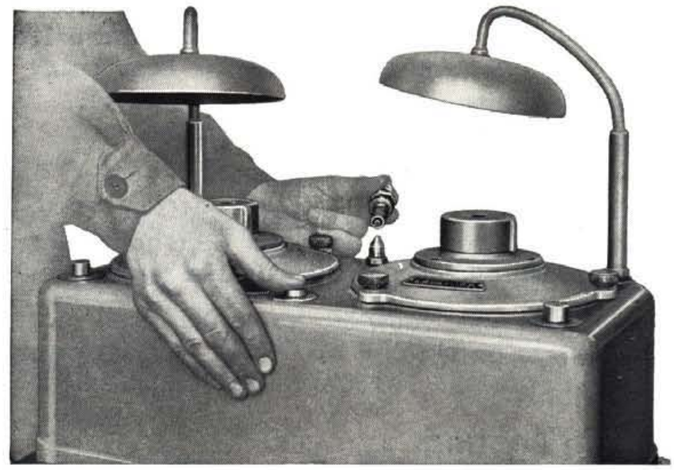


Fig. 356 - Blowing a spark plug after sanding and washing.

electrode, since this would break the porcelain insulator.

If the porcelain appears black and coated with carbon deposits, pour some alcohol or gasoline in the capsized spark plug and after a while scrub with a wire brush.

## Tightness Test.

The tightness test of the parts which compose a spark plug, that is insulator body and center electrode, is made on test bench as shown in fig. 355.

Screw the spark plug on to the Service Center seat, then operate the manual pump lever until a 284 to 356 p.s.i. (20 to 25 kg/cm$^2$) pressure is obtained.

Using an oil can, pour some drops of oil or kerosene on spark plug (fig. 355). If the plug is leaky, oil or kerosene will bubble out, most likely between the insulator and metal body.

**NOTE - Spark plugs should be tightened with a torque of 18.1 to 21.7 ft.lbs (2.5 to 3 kgm) using a torque wrench.**

## Electric Test.

Screw the spark plug on to the Service Center seat; tightness is assured by the connector seal on seat.

Adjust the tester spark meter point gap at .315″ (8 mm), then operate the manual pump lever. Take care to push the lever all the way down each time, so that the pressure gauge reads as tabulated hereafter:

| Tester spark meter point gap | | Spark plug gap | | Tester cell pressure reading | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Very good plug | | Good plug | | Faulty plug | |
| in | mm | in | mm | p.s.i. | kg/cm$^2$ | p.s.i. | kg/cm$^2$ | p.s.i. | kg/cm$^2$ |
| .315 | 8 | .024 | 0.6 | 85 | 6 | 71 | 5 | 57 | 4 |
| | | .028 | 0.7 | 71 | 5 | 57 | 4 | 50 | 3.5 |

**NOTE - Some sparks at meter points can be tolerated.**

**Should no spark be seen either at the plug or at the meter, this is an indication that the plug insulator is cracked and the spark takes place internally between ground and electrode. As a result, the spark plug is unserviceable.**

Place the **high tension** cable socket on the spark plug and depress the switch button.

The following conditions may be experienced:

1) Looking through the eye piece, a vivid spark is seen to issue through the plug electrodes; if so, the plug is serviceable.

2) Spark occurs at the meter points. Decrease the tester pressure and see at what pressure spark issues through plug electrodes. To judge on the efficiency of the spark plug under test, compare data with those shown in the table.

# IGNITION TIMING

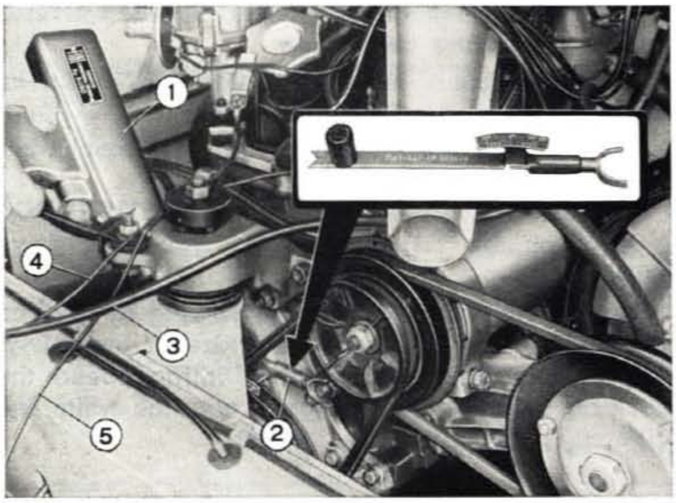



**Fig. 357 - Checking ignition timing.**
1. Strobe lamp. - 2. Plate Ap. 5030/9. - 3. Lamp power cord. - 4. Spark plug cable. - 5. Ground cable.

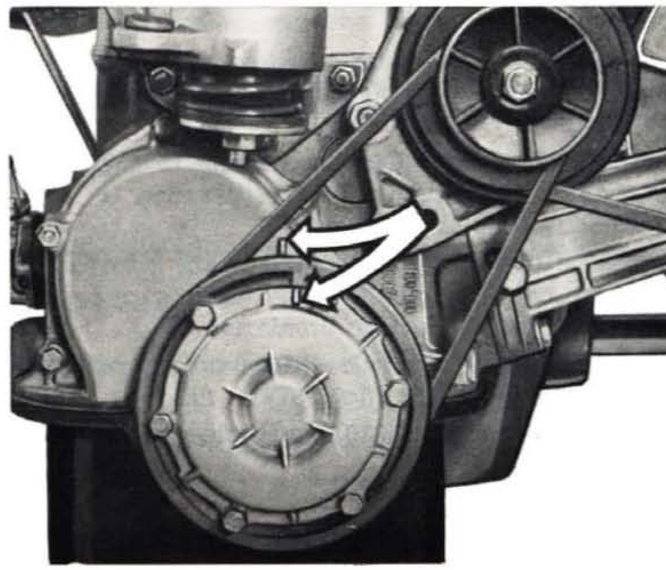


**Fig. 358 - Ignition timing.**
Arrows show the position of timing marks for correct setting of ignition distributor. The mark on centrifugal filter cover should be ahead of timing gear cover mark, namely:
- engine 100 G.000: 9/16" to 19/32" (14 to 15 mm) (11° B.T.D.C. in cylinder No. 1, compression stroke);
- engine 100 G.002: 1/2" to 9/16" (13 to 14 mm) (10° B.T.D.C. in cylinder No. 1, compression stroke).

**Engine turns counterclockwise.**

Ignition timing is required whenever the distributor drive shaft or camshaft have been taken down.

Make sure that piston of cylinder No. 1 is in the compression stroke, with both valves closed. Turn about the crankshaft until ignition timing **mark** on

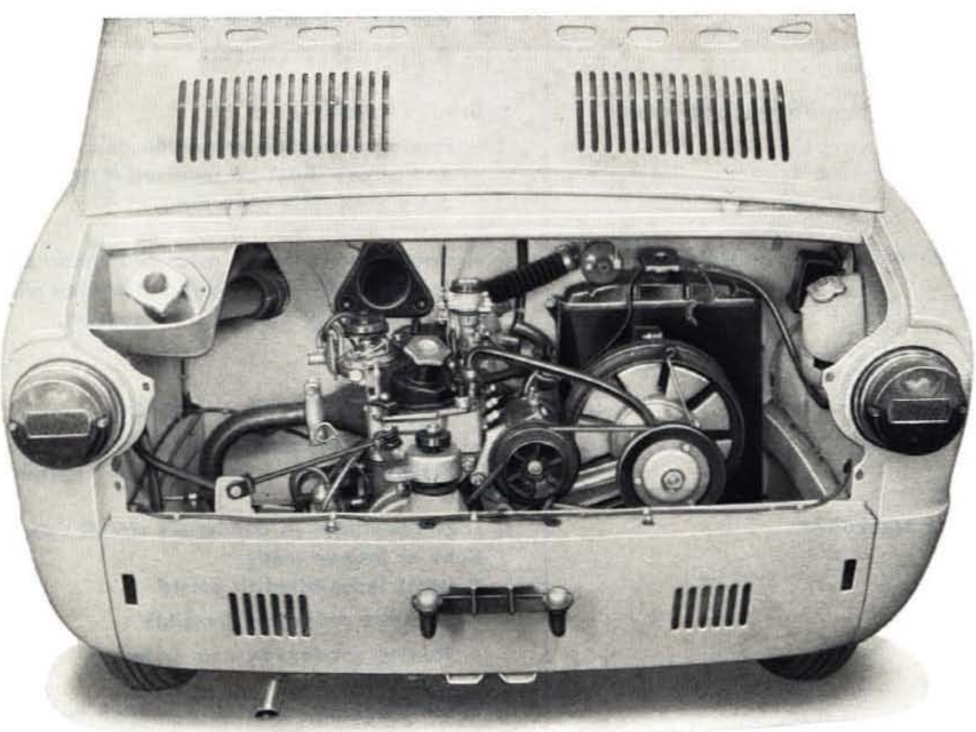


**Fig. 359 - View of engine compartment with disassembly in progress.**

drive pulley is at 9/16" to 19/32" (14 to 15 mm) (engine 100G.000) or 1/2" to 9/16" (13 to 14 mm) (engine 100G.002) ahead of the mark on timing gear cover (fig. 358); this corresponds to the position specified for the static advance before t.d.c.

Remove the distributor cap and rotate the drive shaft with insert by hand until rotor points to contact for firing in cylinder No. 1.

In this position contacts are about to snap open (check first if maximum contact distance is .0165" to .0189" - 0.42 to 0.48 mm).

Without disturbing distributor shaft, insert lower coupling on its toothed end, install support and tighten the lock screw on crankcase.

Ignition timing may be checked more easily using tester **Ap. 5030** (fig. 357) as follows.

Connect tester **Ap. 5030** to a single-phase 220 Volt power outlet, fitted with grounding insert. The grounding of the tester must be made positively, before or when plugging in the tester service cord. **Under no circumstances** the tester must be operated without grounding connection.

Connect ground terminal (5, fig. 357) with an unpainted metal portion of car under test.

Set the cable (4) for strobe lamp (1) control between the spark plug No. 1 and its wire.

Fit graduated plate **Ap. 5030/9** (fig. 357).

Chalk off the T.D.C. mark on generator drive pulley.

Start the engine and aim the winking light beam of tester (1) on the chalk mark drawn on pulley. If ignition is timed correctly, **at idling speed** the mark on pulley must be aligned with the white line (10° or 11°) on plate **Ap. 5030/9.**

# IGNITION SYSTEM TROUBLE DIAGNOSIS

## Ignition Faulty or Completely Absent.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Condenser shorted or with low insulation resistance. | 1) Low voltage in secondary circuit; poor sparking.<br>— Renew condenser. |
| 2) Cap cracked or showing signs of carbon on inner face; moisture deposits. | 2) Current leakage to ground along cracks, burned paths or moisture.<br>— Remove moisture or carbon deposits.<br>— Renew cap, if cracked. |
| 3) Cracks, carbon or moisture deposits on rotor. | 3) Ground leakage as at 2).<br>— Remove moisture or carbon deposits. Recall that rotor and/or cap must be renewed if their terminals are worn more than .0118" (0.3 mm). |
| 4) Center brush worn or broken, brush spring deformed. | 4) Arcing occurs between rotor and center brush causing corrosion and oxidation. Spring distortion and brush breakage can be detected by visual inspection.<br>— Renew cap. |
| 5) Build-up and pitting on points. | 5) Point gap lesser than specified.<br>— Adjust point gap to .0165" to .0189" (0.42 to 0.48 mm). Renew points, if necessary, or camshaft if worn. |
| 6) Points oxidized or blackened. | 6) High resistance in condenser circuit due to faulty connections or broken leads.<br>Contact faces oiled or soiled.<br>— Remove oxidation, possibly.<br>— Renew condenser, cap or brush, if necessary. |
| 7) Excessive point gap. | 7) Weak sparking, especially at high speed.<br>— Adjust point gap to .0165" to .0189" (0.42 to 0.48 mm), as specified. |

## Ignition Extremely Advanced.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Centrifugal weight springs weakened. | 1) Replace springs by genuine ones. |

## Ignition Coil Unserviceable.

| POSSIBLE CAUSES | REMEDIES |
|---|---|
| 1) Connections loose or soiled. | 1) Clean connections and tighten down. |
| Any different trouble of ignition coil will involve its renewal. | |

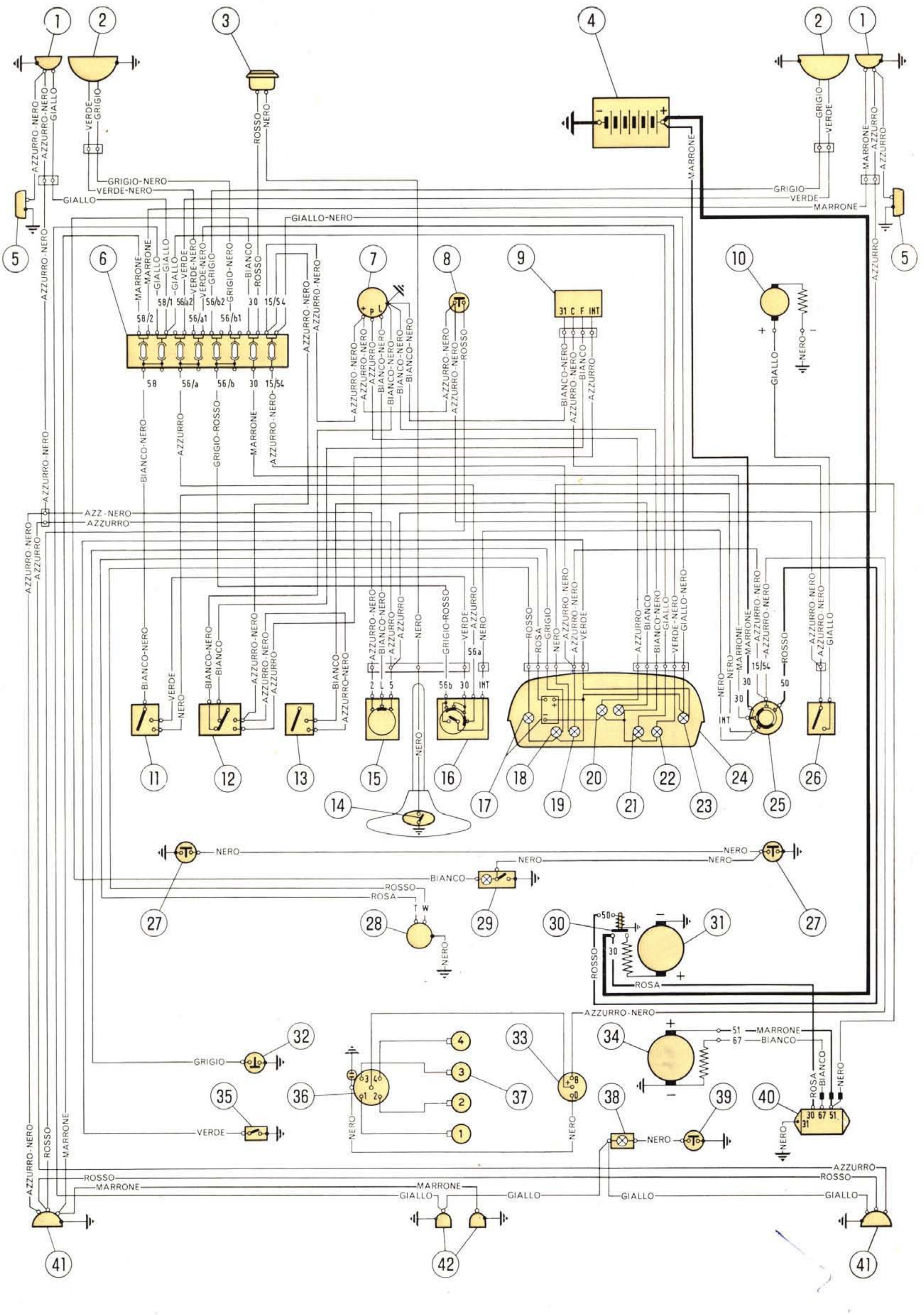
# LIGHTING SYSTEM



## SPECIFICATIONS AND DATA

| | |
|---|---|
| **Headlamps** | two |
| Double filament bulb: | |
| – high beam | 45 - Watt |
| – low beam | 40 - Watt |
| **Front parking and direction signal lamps** | two |
| Double filament bulb: | |
| – parking | 5 - Watt |
| – direction signal | 20 - Watt |
| **Side direction signal lamps** | two |
| Tubular bulb | 3 - Watt |
| **Rear parking, direction signal and stop lamps (with reflector lens)** | two |
| Direction signal bulb | 20 - Watt |
| Double filament bulb: | |
| – parking | 5 - Watt |
| – stop | 20 - Watt |
| **License plate lamp** | one |
| No. 2 globular bulbs | 5 - Watt |
| **Outer lighting control** | master switch on instrument panel |
| **Outer lighting shifting control** | lever switch under steering wheel |

*(continued)*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56/a2
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56b
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INT
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**Fig. 360 - Wiring diagram.**

1. Front parking and direction signal lights.
2. High and low beam headlights.
3. Horn.
4. Battery.
5. Side direction signal lights.
6. 8-Ampere fuses.
7. Flasher unit.
8. Stop light jam switch.
9. Windshield wiper motor.
10. Electro-fan motor.
11. Outer lighting master switch.
12. Windshield wiper switch.
13. Instrument cluster light switch.
14. Horn button.
15. Direction signal lever switch.
16. Selector switch for outer lighting and light flashes.
17. Fuel gauge, with reserve supply indicator.
18. Low oil pressure indicator.
19. No-charge indicator.
20. Direction signal indicator.
21. Parking light indicator.
22. High beam indicator.
23. Excessive coolant temperatuie indicator.
24. Instrument cluster light.
25. Key-type ignition switch, also energizing warning lights and starting circuits.
26. Electro-fan motor switch.
27. Jam-switches, on door pillars, for courtesy light.
28. Fuel gauge tank unit.
29. Rear view mirror map light with toggle switch.
30. Starting motor solenoid switch.
31. Starting motor.
32. Low oil pressure indicator sending unit.
33. Ignition coil.
34. Generator.
35. Excessive coolant temperature indicator thermal switch.
36. Ignition distributor.
37. Spark plugs.
38. Engine compartment light.
39. Engine compartment light jam switch.
40. Generator regulator.
41. Rear parking, stop and direction signal lights.
42. License plate lights.

NOTE - The mark — means that the cable is fitted with numbered strip or ferrule.

CABLE COLOUR CODE

| | | | |
|---|---|---|---|
| Nero | = **Black** | Azzurro-nero | = **Black and blue** |
| Marrone | = **Brown** | Bianco-nero | = **Black and white** |
| Giallo | = **Yellow** | Giallo-nero | = **Black and yellow** |
| Azzurro | = **Blue** | Verde-nero | = **Black and green** |
| Grigio | = **Grey** | Grigio-nero | = **Black and grey** |
| Verde | = **Green** | Grigio-rosso | = **Red and grey** |
| Rosa | = **Pink** | Bianco | = **White** |

**Specification and Data** *(continued)*.

| | |
|---|---|
| **Flashing direction signal control** | lever switch under steering wheel |
| **Inner lighting.** | |
| Bulb incorporated in rear view mirror | 3 - Watt |
| Control switch: | |
| – toggle type | on mirror frame |
| – jam type, actuated by doors | on door pillars |
| **Instrument cluster light.** | |
| No. 1 lamp with toggle switch on instrument panel | 3 - Watt |
| **Engine compartment light.** | |
| No. 1 lamp, with jam switch actuated by lid | 5 - Watt |
| **Instrument cluster indicators.** | |
| No. 8 bulbs in instrument cluster, each | 3 - Watt |
| **Fuses** | 8, 8-Ampere |

# HEADLIGHTS

## Removal.

To remove the headlamp proceed as follows:

– Using a screwdriver, pry out the headlamp rim which is hooked up by spring retainers (4, fig. 361).

– Depress clips (1) so that the lamp unit will come out.

To replace the bulb, snap out spring retainers and remove the bulb, which is fitted with a flange coupling to lamp unit.

**NOTE - Bulbs must not be replaced by others of different type or wattage, lest troubles to the electric system may result.**

## Aiming.

Headlights are of asymmetrical low beam type.

Headlights should be focussed in a **no-load** condition, as follows.

Check that tires are inflated with the recommended pressure (front, 16.6 psi - 1.1 kg/cm$^2$; rear, 25.6 psi - 1.8 kg/cm$^2$).

Locate the car on a level floor, 16′ 5″ (5 m) apart from an opaque, white screen vertically in the shade and make sure that the car centerline it at right angle to the screen face.

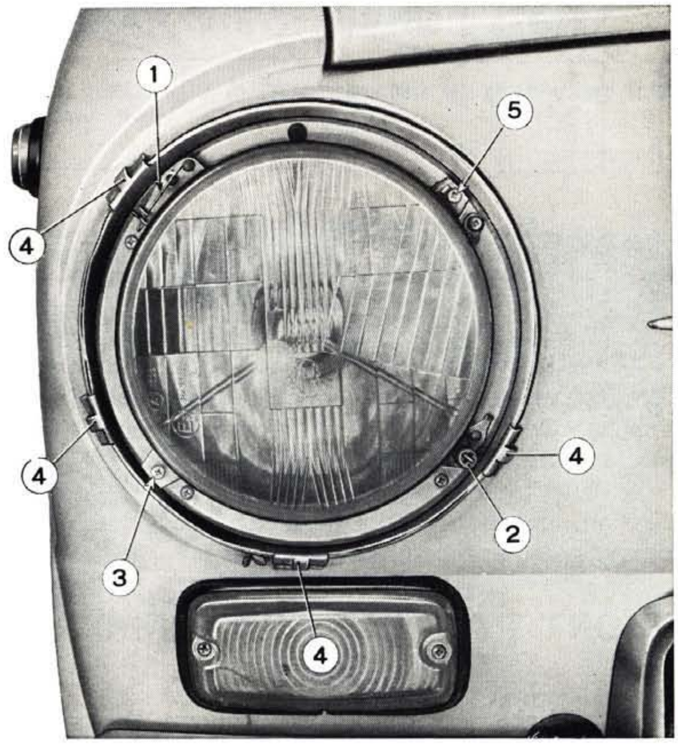



**Fig. 361 - Headlamp without rim.**

1. Clip, lamp unit. - 2. Hook pin, lamp unit. - 3. Screw, vertical beam adjustment. - 4. Spring retainers, headlamp rim. - 5. Screw, horizontal beam adjustment.

Jounce the car both sides to set suspensions.

Draw two vertical lines a-a on the screen (fig. 362). These lines should be equally spaced from the perpendicular to the car longitudinal axis and $38\ ^{13}/_{16}''$ (986 mm) apart (A), which corresponds to the headlight center - to - center distance.

Draw a horizontal line b-b on the screen, at the following distance from ground:

– B = C – $1\ ^{25}/_{32}''$ (45 mm), new vehicles or vehicles with suspensions renewed;

– B = C – $1\ ^{9}/_{16}''$ (40 mm), settled vehicles; where **C corresponds to the ground clearance of headlight center, measured on aiming.**

---

**NOTE - A vehicle is settled in practice when it has run the mileage specified for the first free voucher service.**

---

To aim headlights, switch on the low beam and work on the screw (3, fig. 361) for vertical adjustments, and on the screw (5) for horizontal adjustments, until the following conditions are obtained:

– the horizontal separation line between the unlit and lit areas should be on line b-b (fig. 362);

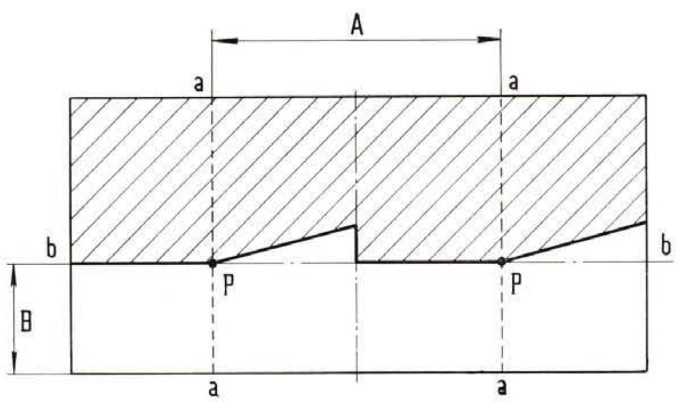



**Fig. 362 - Headlight aiming diagram.**
A = $38\ ^{13}/_{16}''$ (986). - B = C – $1\ ^{25}/_{32}''$ (45 mm), new vehicles. - B = C – $1\ ^{9}/_{16}''$ (40 mm), settled vehicles. - C = Ground clearance of headlight center.

– the upward slanting (some 15°) separation lines should start from the meeting points **P** of vertical lines a-a with the horizontal line b-b or just outside of them.

A $10\ ^{1}/_{4}''$ (260 mm) increase in distance **A** specification, corresponding to a 3° aggregate beam divergence, is permissible.

## FRONT PARKING AND DIRECTION SIGNAL LIGHTS

To replace the bulb, just remove the screws securing the lamp to the body and take out the bulb holder (1, fig. 363).

Both bulb and bulb holder are inserted by bayonet coupling.

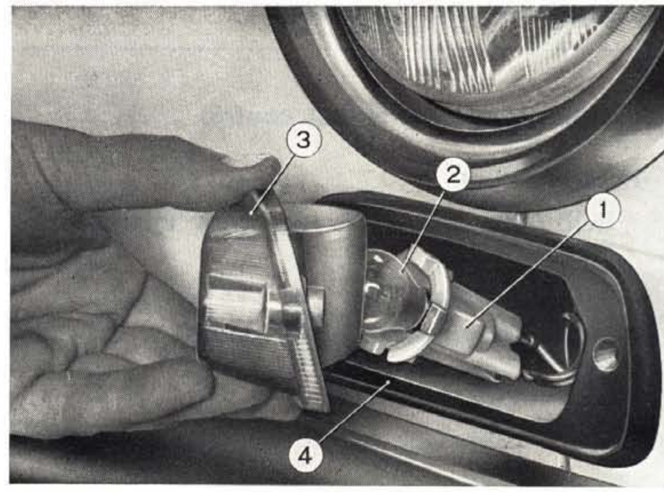



**Fig. 363 - Opening front parking lamp.**
1. Bulb holder. - 2. Bulb. - 3. Lens. - 4. Gasket.

## SIDE DIRECTION SIGNAL LIGHTS

To open the lamp screw out mounting nuts from inside the fender.

To replace the bulb work from fender interior and remove the rubber boot as well as the bulb holder with bulb; bulb is inserted by bayonet coupling (fig. 364).

## REAR PARKING STOP AND DIRECTION SIGNAL LIGHTS WITH REFLECTOR LENS

To take down the lamp just remove mounting screws from body.

Bulb holders (2, fig. 365) and bulbs (3) are inserted by bayonet coupling.

When fitting tail lamps, use care that they are not interchanged in error.

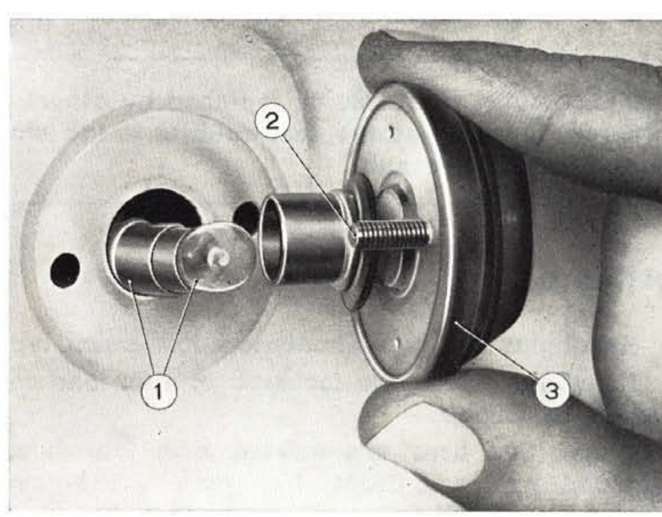



**Fig. 364 - Removing side direction signal lamps.**
1. Bulb and bulb holder. - 2. Lamp mounting studs. - 3. Lamp.

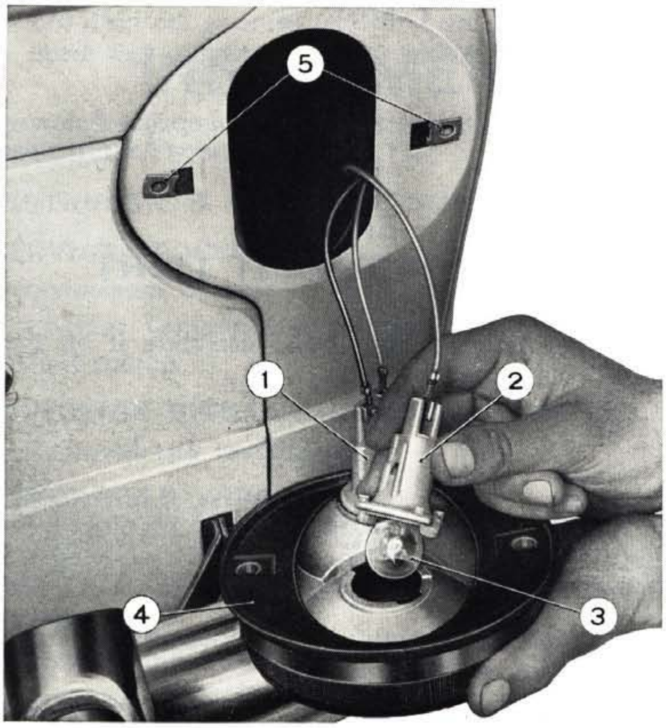



**Fig. 365 - Removing tail light.**
1. Stop light bulb holder. - 2. Direction signal light bulb holder. - 3. Direction signal light bulb. - 4. Lamp complete with gasket. - 5. Lamp locking plates to body.

## LICENSE PLATE LIGHT

The license plate lamp is incorporated in the rear bumper.

To replace the bulb, remove lens screws and slide off the bulb, which is inserted by bayonet coupling (fig. 366).

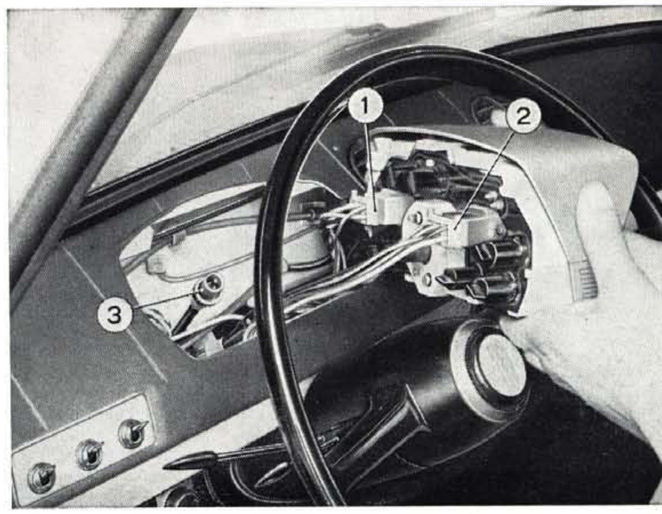



**Fig. 367 - Removing instrument cluster for replacement of bulbs.**
1. Six-insert insulated junction block (white). - 2. Six-insert insulated junction block (red). - 3. Speedo cable.

## INSTRUMENT CLUSTER LIGHTS

To replace instrument cluster light bulbs the cluster must be partially removed by inserting a screwdriver at its base; then slide off the bulb holder.

Bulb holders and bulbs are inserted by bayonet coupling (fig. 367).

## REAR VIEW MIRROR LIGHT

The map light is incorporated in rear view mirror (fig. 368).

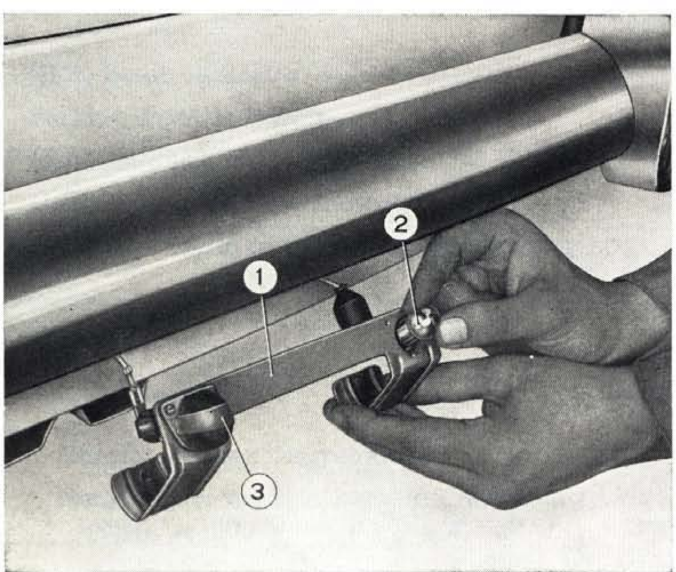



**Fig. 366 - Removing license plate lamp.**
1. Lamp frame. - 2. Bulb. - 3. Bulb holder.

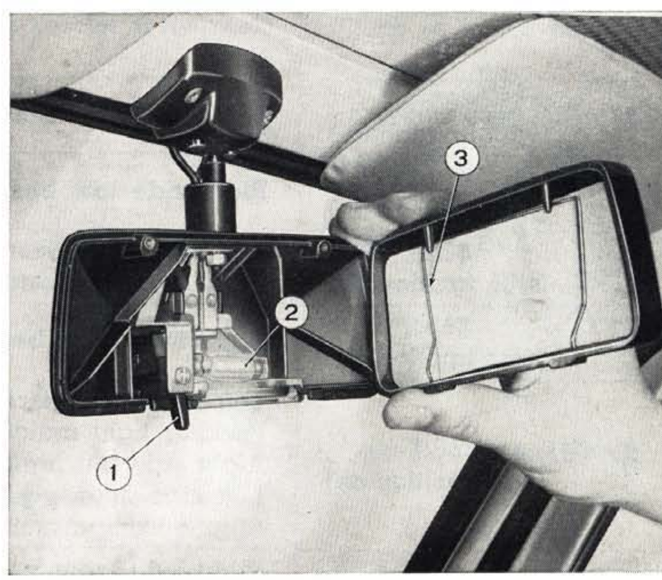



**Fig. 368 - Removing map light bulb.**
1. Toggle switch. - 2. Bulb. - 3. Mirror clip.

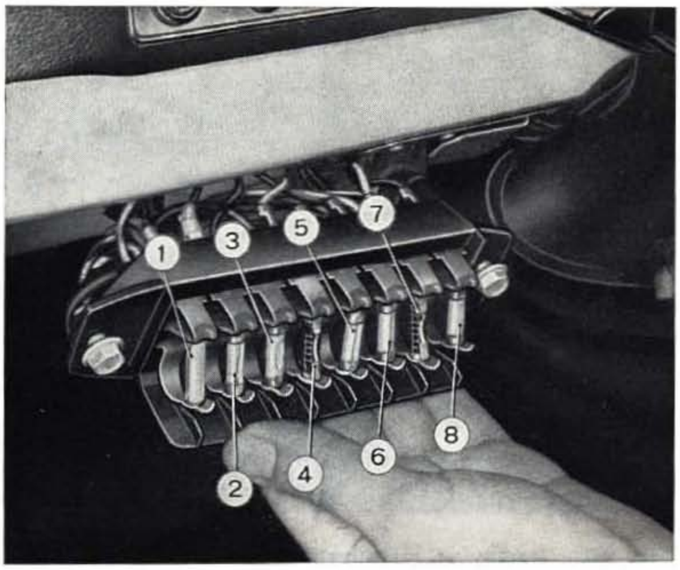



**Fig. 369 - Electrical system fuses.**
1. Fuse No. 15/54. - 2. Fuse No. 30. - 3. Fuse No. 56/b 1. - 4. Fuse No. 56/b 2. - 5. Fuse No. 56/a 1. - 6. Fuse No. 56/a 2. - 7. Fuse No. 58/1. - 8. Fuse No. 58/2.

To replace the bulb just remove the bulb holder from mirror frame by overcoming the force of fasteners.

The bulb is secured by means of spring fasteners.

## ENGINE COMPARTMENT LIGHT

To replace the light bulb just slide it off from spring holders.

## FUSES

The electrical system is protected by eight 8-Ampere fuses, which are located on the left-hand side of the dash wall below the instrument panel (fig. 369).

**Unprotected circuits:** battery charge with indicator, ignition and starting.

**NOTE - Prior to replacing a blown fuse by a new one, locate and remove the source of the trouble which brought about the blowing, to avoid any recurrence.**

| Fig. 369 | Fuses | PROTECTED CIRCUITS |
|---|---|---|
| **1** | 15/54 (with ignition on) | Low oil pressure indicator.<br>Coolant temperature indicator.<br>Fuel gauge with reserve supply indicator.<br>Wiper motor.<br>Instrument cluster light.<br>Electro-fan motor.<br>Direction signal lights and indicator.<br>Stop lights. |
| **2** | 30 | Rear view mirror map light.<br>Horn. |
| **3** | 56/b1 (with ignition on) | Left side low beam. |
| **4** | 56/b2 (with ignition on) | Right side low beam. |
| **5** | 56/a1 (with ignition on) | Left side high beam.<br>High beam indicator. |
| **6** | 56/a2 (with ignition on) | Right side high beam. |
| **7** | 58/1 (with ignition on) | Left side front parking light.<br>Parking light indicator.<br>Right side tail light.<br>Left side license plate light.<br>Engine compartment light. |
| **8** | 58/2 (with ignition on) | Right side front parking light.<br>Left side tail light.<br>Right side license plate light. |

# INSTRUMENTS AND ACCESSORIES



## SPECIFICATIONS AND DATA

| | |
|---|---|
| Low oil pressure indicator | red light |
| Indicator lighting pressure | 3.6 to 10.7 psi (0.25 to 0.75 kg/cm²) |
| No-charge indicator | red light |
| Initial speed for battery charge — engine | 1,000 r.p.m. (*) |
| Initial speed for battery charge — car in top gear | 14 mph (22.5 km/h) (*) |
| Fuel reserve supply indicator | red light |
| Fuel reserve supply | 3.5 to 4.8 G.B. qts - 4.2 to 5.8 U.S. qts (4 to 5.5 lts) |
| High beam indicator | blue light |
| Parking light indicator | green light |
| Right and left turn indicator | green blinking light |
| Coolant temperature indicator | red light |
| Signals when coolant temperature exceeds | 230° F (110° C) |
| **Thermal switch.** | |
| Contact closing temperature | 230° to 248° F (110° to 120° C) |
| Insulating resistance between terminal and ground (open contacts), at 500 Volts d.c., not below | 20 MΩ |

*(continued)*

(*) Starting from engine N° 549463 engine to generator ratio is 2 to 1 and battery charge data are: engine 915 r. p. m. - car speed 12.4 m. p. h. (20 km/h).

**Specifications and Data** *(continued).*

| | |
|---|---|
| **Blinking direction signals.** | |
| Number of cycles per minute of flasher unit with a nominal load of 43 W: | |
| – at a nominal tension of 12 V and 68° F (20° C) . . . . . | 77 to 93 |
| – at a tension 1.25 times the nominal one (15 V) and 104° F (40° C) . . . . . . . . . . . . . . . . . . . . . not above | 120 |
| – at a tension 0.8 times the nominal one (9.5 V) and – 4° F (– 20° C) . . . . . . . . . . . . . . . . . . . . not below | 60 |
| **Windshield wiper** . . . . . . . . . . . . . . . . . . . . | crank gear type |
| Sweeps per minute on dry glass, at 14 V . . . . . . . . . . | 52 to 66 |
| Motor unit bench test data: | |
| – Feed voltage . . . . . . . . . . . . . . . . . . . . | 14 |
| – Stall torque . . . . . . . . . . . . . . . . . . . . | .43 ft.lbs (6 kgcm) |
| – Stator overheating temperature . . . . . . . . . not above | 140° F (60° C) |
| – Speed . . . . . . . . . . . . . . . . . . . . . . . | 52 to 66 r.p.m. |
| – Current draw . . . . . . . . . . . . . . . . . not above | 2.1 Amps |
| – Starting torque (with locked shaft), warm, at 14 V not below | 5 ft.lbs (70 kgcm) |
| Wiper blade pressure on windshield . . . . . . . . . . . . | 10.6 to 14.1 oz (300 to 400 gr) |
| Wiper arm tilting angle . . . . . . . . . . . . . . . . . . | 100° |
| **Air conditioner electrofan.** | |
| Nominal speed with fan, at 12 Volts and 77° F (25° C) . . . | 2,600 to 2,800 r.p.m. |
| Corresponding current draw . . . . . . . . . . . . . . . | 3 Amps |
| Drive shaft output, at 12 Volts and 77° F (25° C) . . . . . . | 13.4 to 13.6 Watts |
| Stall torque draw . . . . . . . . . . . . . . . . . . . . | 5.4 to 6.5 Amps |

# INSTRUMENTS AND ACCESSORIES

Instruments and accessories consist of the following:

**Instrument cluster** (5, fig. 370), incorporating (fig. 371):

1) **Fuel gauge.**

2) **Speedometer:** red marks on dial indicate maximum speed limits for the first 3 gears (after running-in).

3) **Direction signal arrow tell-tale** (green): flashes when lever 11 (fig. 370) is moved down or up.

4) **Mileage recorder** (totalizer).

5) **Coolant temperature indicator** (red): lights up when engine overheats.

6) **High beam indicator** (blue).

7) **Parking lights indicator** (green).

8) **No-charge indicator** (red): goes out when engine exceeds 1,000 rpm (car at 14 mph - 22.5 km/h in 4th gear).

9) **Low oil pressure indicator** (red): goes out when oil pressure is high enough to ensure good engine lubrication.

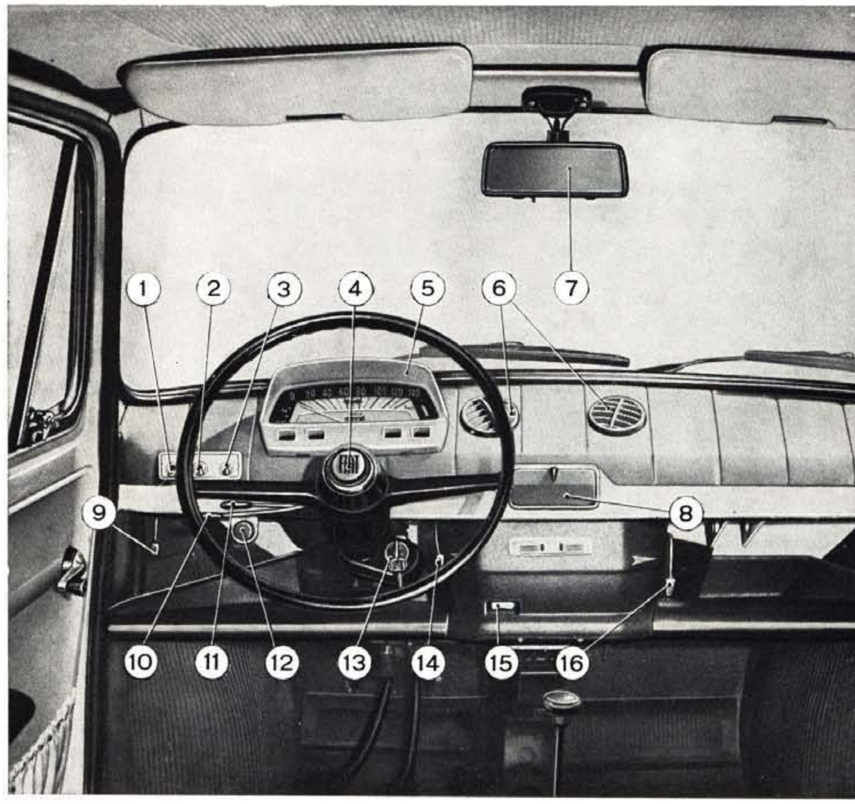



**Fig. 370.**
**Instruments and accessories.**

1. Outer lighting master switch. - 2. Windshield wiper switch. - 3. Instrument cluster light switch. - 4. Horn button. - 5. Instrument cluster. - 6. Adjustable outlets, ventilation and heating. - 7. Rear view mirror with courtesy light. - 8. Ash receiver. - 9. Front compartment release handle. - 10. Outer lighting selector switch. - 11. Direction signal switch. - 12. Windshield washer pump control. - 13. Lock switch, also energizing starting and warning lights circuits. - 14. Air scoop control lever. - 15. Electrofan switch. - 16. Heater radiator water cock lever.

With hot engine and low rpm, the indicator may turn ON even if performance is normal.

10) **Fuel reserve supply indicator** (red): lights up when less than 1-1 ½ U.S. or .9-1.2 G.B. Gals (4 to 5.5 liters) of fuel remain in tank.

1) **Outer lighting selector switch** (fig. 370): turns ON the parking lights, the license plate lights and energizes the switch controlled by lever 10.

2) **Instrument cluster light switch.**

3) **Windshield wiper switch:** with blades parking off automatically.

4) **Horn button.**

6) **Adjustable outlets for air admission into car:** see page 187 for use.

7) **Rear view mirror:** with courtesy light controlled by side doors and a toggle switch incorporated in mirror frame.

8) **Ash receiver.**

9) **Front compartment lid release lever.**

10) **Outer lighting selector switch** (with switch 1 on).

11) **Direction signal switch** (with automatic return to off position).

12) **Windshield washer pump control:** to clean the windshield depress the rubber bulb repeatedly and at the same time tun on the wiper switch 3.

13) **Key-type ignition switch, also energizing warning lights and starting circuits;** a switch with anti-theft device incorporated is supplied optionally.

14) **Air scoop control lever.**

15) **Air conditioner electrofan switch.**

16) **Heater radiator water cock lever.**

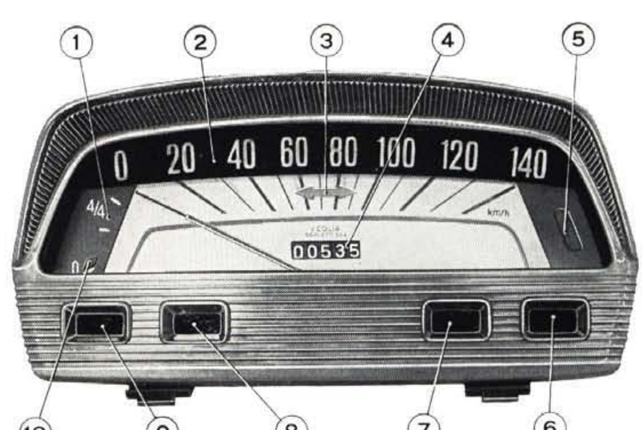



**Fig. 371 - Close-up view of the instrument cluster.**

1. Fuel gauge. - 2. Speedometer. - 3. Direction signal arrow telltale. - 4. Mileage recorder. - 5. Coolant temperature warning light. - 6. High beam indicator. - 7. Parking light indicator. - 8. No-charge indicator. - 9. Low oil pressure indicator. - 10. Fuel reserve supply indicator.

# SERVICE PROCEDURES

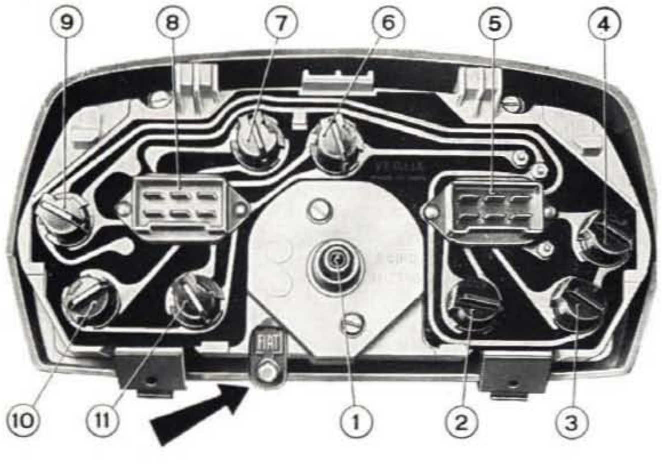



**Fig. 372 - Rear view of the instrument cluster.**

1. Speedometer-odometer cable attachment. - 2. No-charge indicator. - 3. Low oil pressure indicator. - 4. Fuel reserve supply indicator. - 5. Six-insert junction block (red). - 6. Direction signal arrow tell-tale. - 7. Instrument cluster light. - 8. Six-insert junction block (white). - 9. Coolant temperature warning light. - 10. High beam indicator. - 11. Parking light indicator.

Arrow points to the brass seal which is applied to one of three instrument frame-to-surround screws.

The instrument is sealed to avoid meddling of odometer.

## Instrument Cluster.

Any faults in the instrument cluster can be easily located.

In case one or more indicators fail to operate, make sure that bulb, fuse, contacts and connections are in good order, then check units with which unserviceable indicators are wired.

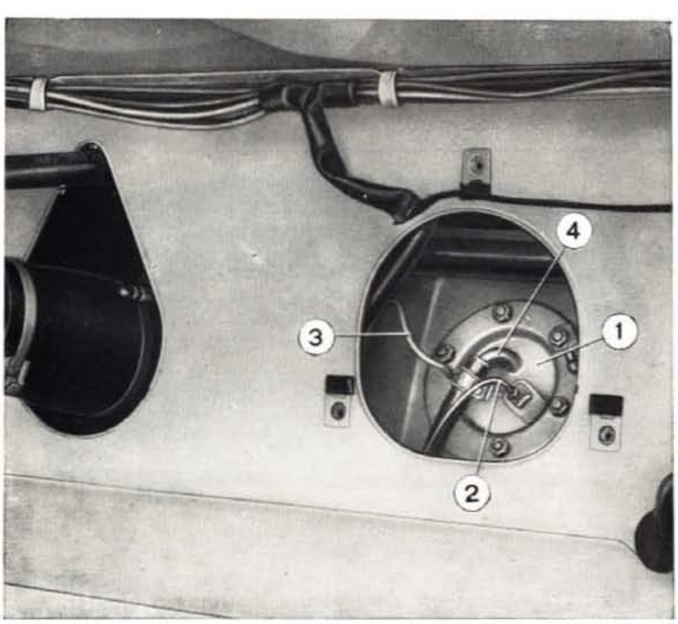



**Fig. 373 - Fuel gauge.**

1. Sending unit. - 2. Sending unit ground cable. - 3. Sending unit lead. - 4. Connector for fuel pump line.

## Coolant Temperature Warning Light.

The glowing of the warning light indicates irregular operation of engine.

Possible causes:

– thermal switch points bound;

– incorrect tension of generator, water pump and fan drive belts;

– fluid leakage from cooling system;

– faulty thermostat in cylinder head;

– poor performance of lubrication system.

Locate the source of trouble among the above and correct as required.

## Fuel Gauge.

Fuel gauge defects are mainly attributable to the tank unit.

To replace the unit proceed as follows:

– disconnect the plus cable from battery terminal post;

– remove the cover of the unit from engine compartment partition wall;

– disconnect cables (2 and 3, fig. 373) and line (4);

– remove mounting nuts and lift out the unit.

# DIRECTION SIGNAL AND OUTER LIGHTING SELECTOR SWITCH

The unit consists of two lever switches:

– direction signal switch which returns automatically to off position when the turn has been negotiated;

– selector switch controlling outer lights and low beam flashes.

Above two switches form a centralized control unit located under the steering wheel.

In case of irregular operation of either switch, renew the whole device.

## Removal and Installation.

Proceed as follows:

- pry off horn button;
- withdraw steering wheel;
- disconnect wires;
- loosen the clamp which secures to the switch to the steering column and slide off the whole switch as shown in fig. 374.

To install the switch just reverse the steps for removal.

# WINDSHIELD WIPER

Consists of a motor which drives wiper arms back and forth through a linkage.

The unit is fitted with an automatic parking device of wiper arms for best vision of driver through the windshield.

The wiper motor is controlled through a toggle switch (2, fig. 370).

## Trouble Diagnosis.

If the wiper operates incorrectly or it does not at all, the origin may be located as follows:

- improper installation on body;
- irregularities of motor unit.

In the first instance, check for distortion of wiper mounting bracket, linkake or pivots.

If necessary, revise the unit installation on body.

As for the second case, check the motor on bench against data tabulated on page 238 and renew the unit if some specifications are not met.

## Removal and Installation.

Take down the windshield wiper assembly as follows:

- remove instrument cluster;
- remove lock rings of control switches and ornamental plate;
- pull instrument panel lining, overcoming the force of fasteners.

Thus the wiper assembly can be easily removed through the opening in instrument panel (fig. 375).

For installation reverse removal procedure.

# HORN

The horn circuit includes:

- horn;
- control button;
- ground, made up by body shell.

**Fig. 374 - Removing direction signal and outer lighting selector switch.**

## Trouble Diagnosis.

Failure of the horn to operate may be due to:

- horn button unserviceable or stuck;
- horn damaged.

Check connections, cables and button contact ring for full efficiency and no sign of oxidation.

In case the trouble is due to button mechanism, renew it.

Any faults in the horn involve replacement of horn assembly.

To adjust horn sound just work on adjusting screw (2, fig. 376), with horn on car.

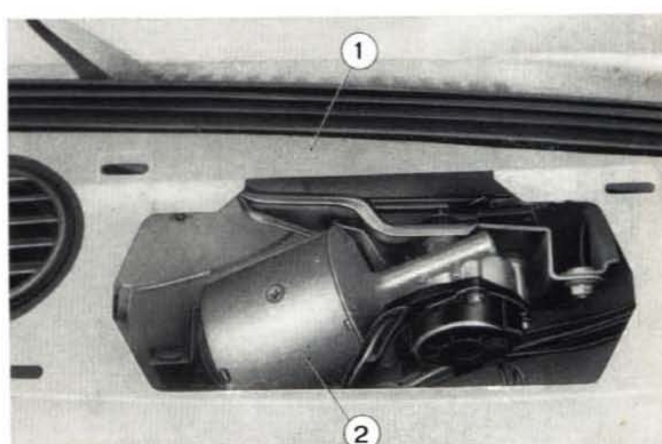
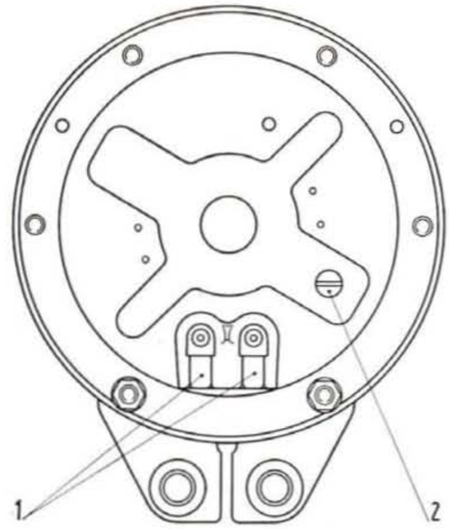



**Fig. 375 - Arrangement of windshield wiper.**

1. Instrument panel. - 2. Wiper motor.




Turning the screw **clockwise** makes the sound louder through diaphragm pulsation; turning the screw **counterclockwise** the horn sound becomes feebler.

It will be necessary, however, to check with an ammeter that current absorbed by horn does not exceed 3.5 Amperes; otherwise reposition adjusting screw.

**Fig. 376 - Horn diagram.**

1. Horn terminals. - 2. Horn pitch adjusting screw.

# RADIO RECEIVER

## General.

The « 850 » passenger car can be optionally equipped with an all-transistor radio receiver, Autovox series 440; the set is made up of two parts of minimum bulk (fig. 378).

The tuning scale of stations is built in the control knob. A fixed tell-tale light indicates at all times the position of the tuning scale.

**Fig. 377 - Front view of the car with the radio antenna fitted in place.**

The volume control knob works also as on-off power switch.

Depressing this double-purpose knob energizes the receiver; turning the knob counterclockwise adjusts the volume.

The antenna trimmer is located on the antenna cable (2, fig. 382) to the set for an easier aligning of the antenna circuit.

The set (1, fig. 378) is attached to the instrument panel while the loudspeaker (2, fig. 378) is arranged on the right-hand side of the utility shelf.

The SA 91 type antenna is designed for installation on top corner of the left-hand side front fender, as shown in fig. 377.

### INSTALLATION

## Antenna.

Install the antenna as follows:

– fit the drilling templet (2, fig. 379) on the left side front fender;

– drill a .669″ (17 mm) opening (1, fig. 379) at the point shown by the templet;

– detach a length of the left-side wheelhousing rubber mat at the upper end and drill a .591″ (15 mm) opening (1, fig. 382) 1 $^{3}/_{16}$″ (3 cm) above the hood catch cable square plate;

– separately, set the collar clamp and the antenna mounting bracket (3, fig. 381) on the antenna screen;

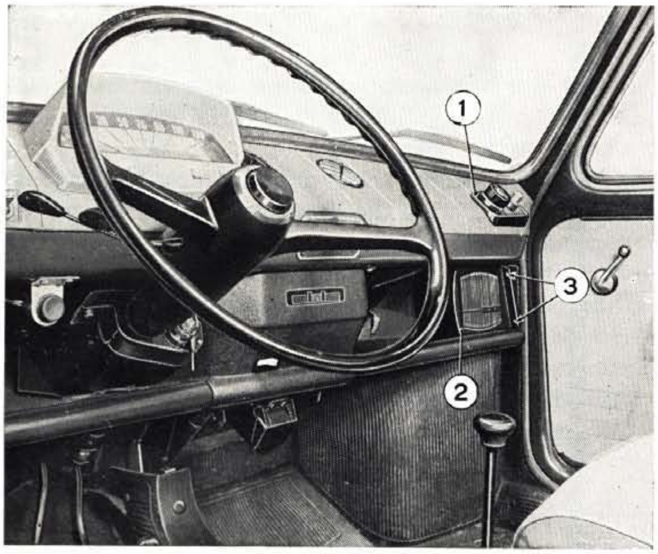



**Fig. 378 - Detail showing the location of the radio receiver on car.**

1. Radio set. - 2. Loudspeaker. - 3. Loudspeaker mounting screws.

— slide in the antenna assembly through the fender opening drilled previously and secure it by means of lock ring;

— position the mounting bracket at right angle to the antenna; drill the opening on the body panel and secure the bracket as shown in fig. 381;

— thread the antenna cable through the opening (1, fig. 381) and place the protection grommet tightly on to the opening.

Next again lay the rubber mat on the wheel-housing.

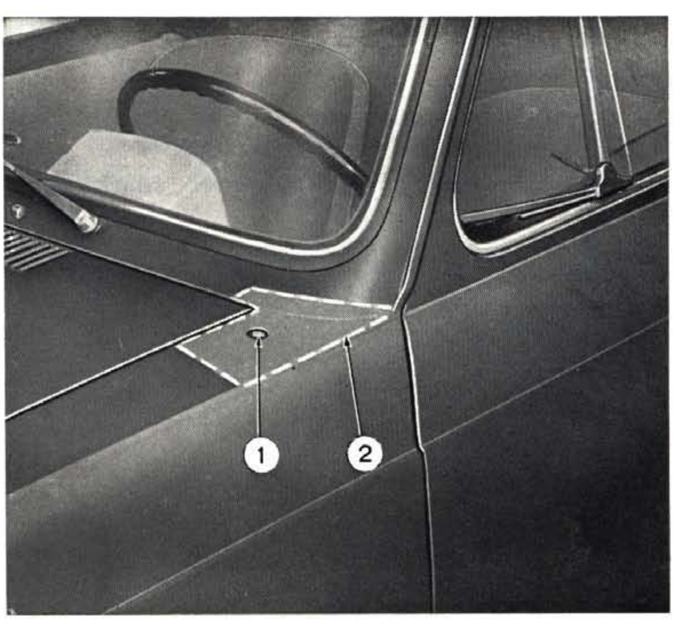



**Fig. 379 - Fitting the templet for drilling the antenna rod passage opening.**

1. Drilling point. - 2. Templet on fender top corner.

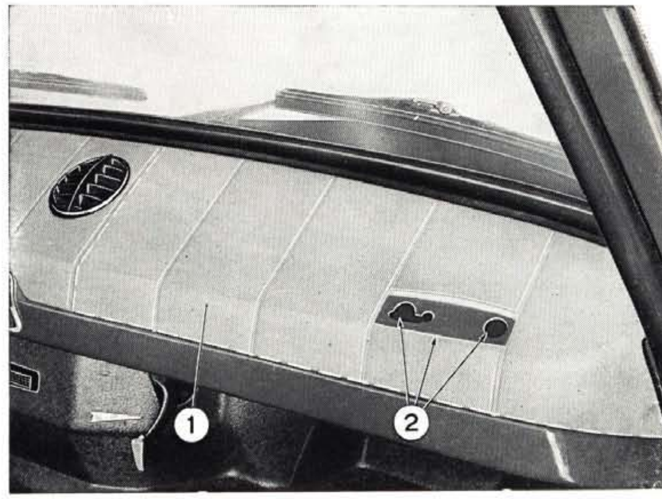



**Fig. 380 - Fitting the templet for cutting out the instrument panel lining and fashioning the panel holes, preparatory to the radio set installation.**

1. Templet. - 2. Lining slot and instrument panel holes.

## Radio Set.

Prior to installing the set, disconnect the positive cable from the battery to avoid possible short circuits during subsequent steps as follows:

— fit the templet (1, fig. 380) on the instrument panel lining and cut out the lining following the slot in the templet;

— fashion out the holes in the panel as shown in fig. 380;

— working from the bottom, locate the radio set in place, having the control knob threaded shanks jut out from their holes;

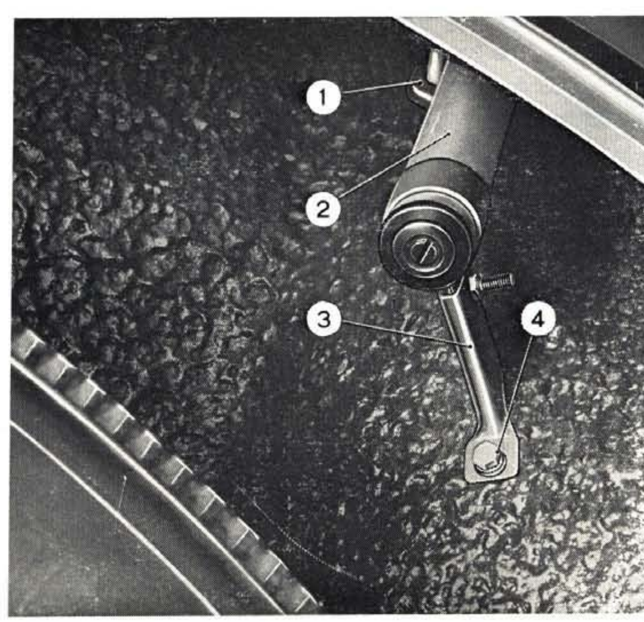



**Fig. 381 - Detail of antenna mounting.**

1. Cable, antenna to radio set. - 2. Antenna. - 3. Antenna mounting bracket. - 4. Bracket screw.

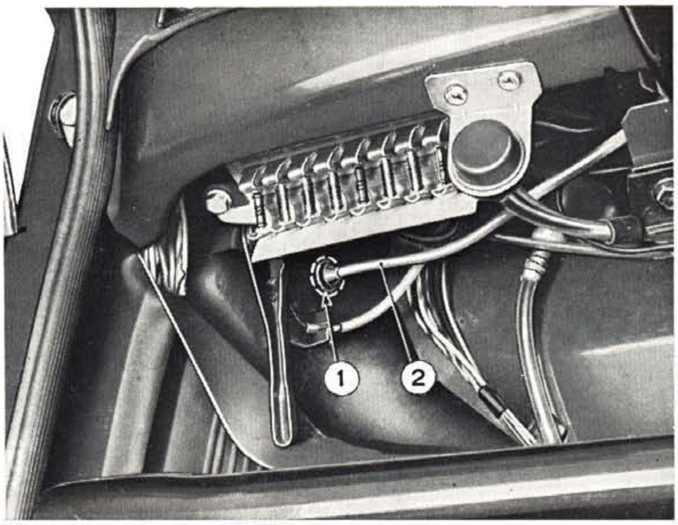



Fig. 382 - Detail showing the arrangement of the antenna cable in car interior.

1. Cable passage opening. - 2. Cable, antenna to radio set.

– fit on to the shanks, in this order:

a) the flat washers (with the chamfered edge toward the body);

b) the plastic panel;

c) the spring washers and nuts;

– tighten the nuts on set shanks;

– secure the set at the rear, using a self-threading screw and a special retainer plate;

– wire up as follows:

a) the loudspeaker cable to lamina inserts 3 and 4 of the set;

b) the service cord to the socket No. 1 of the set and to the junction of the cable to the lamina insert « INT » of the ignition switch (using the two-way connection supplied with the radio kit);

c) the antenna cable to the jack-type socket in the set.

### Loudspeaker.

Locate the loudspeaker to the far right-hand side of the utility shelf, with the mounting end positioned as shown in fig. 378.

Slide in the utility shelf drilling templet between the utility shelf and the loudspeaker; remove the loudspeaker, holding the templet in its place. Drill the opening (.216″ - 5.5 mm) as the templet indicates.

After connecting the loudspeaker cables, secure the loudspeaker to the utility shelf by means of a self-threading screw and lock plate.

Drill the loudspeaker side mounting holes and fit the mounting screws (3, fig. 378).

---

**NOTE - The drilling templets are contained in the radio receiver carton.**

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## SETTING ANTENNA TRIMMER

For best performance of the radio receiver, operate as follows:

– pull the antenna all the way out;

– switch on the receiver and tune it to a weak station between 1,400 and 1,600 kHz;

– work on the knob on bottom of the antenna until maximum output is obtained.

## INTERFERENCE SUPPRESSION DEVICES

Affix:

– a non-inductive condenser between the positive terminal of the generator (No. 51) and ground;

– a non-inductive condenser between the positive terminal of the ignition coil and ground;

– a resistive suppressor on coil high tension cable, adjacent to the ignition distributor;

– a resistive suppressor on each spark plug.

# Section 11

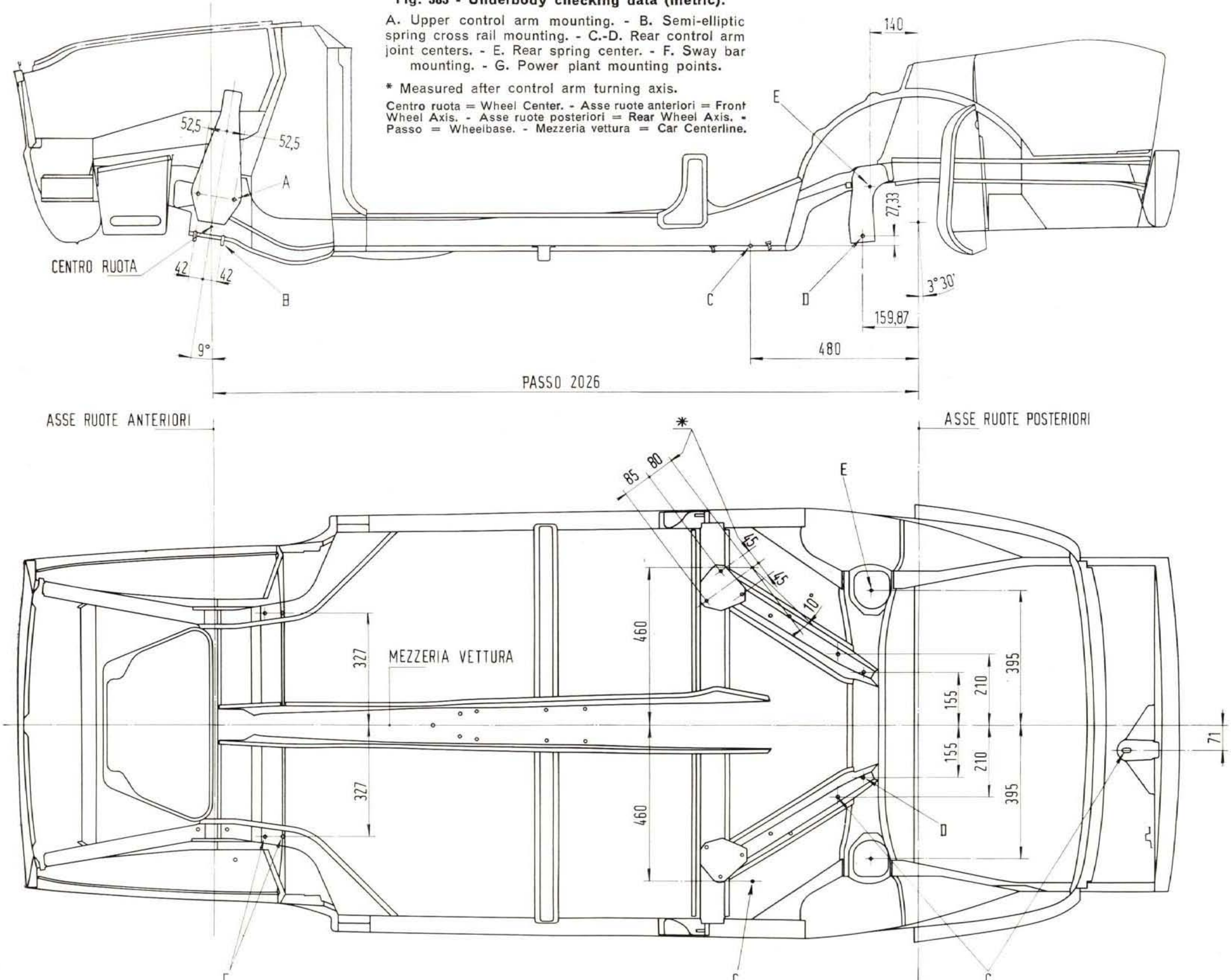
## BODY

**Fig. 383 - Underbody checking data (metric).**

A. Upper control arm mounting. - B. Semi-elliptic spring cross rail mounting. - C.-D. Rear control arm joint centers. - E. Rear spring center. - F. Sway bar mounting. - G. Power plant mounting points.

* Measured after control arm turning axis.

Centro ruota = Wheel Center. - Asse ruote anteriori = Front Wheel Axis. - Asse ruote posteriori = Rear Wheel Axis. - Passo = Wheelbase. - Mezzeria vettura = Car Centerline.



# BODY



## GENERAL

**Sedan,** integral construction, four-five seater.

**Two doors,** front-hinged, each with two window glasses: the front one swivelling, the rear one of the drop-type with cranking regulator; key-type door locks with safety catch; door control handles of the linear type.

**Rear quarter windows and back window** of the stationary type with safety glass.

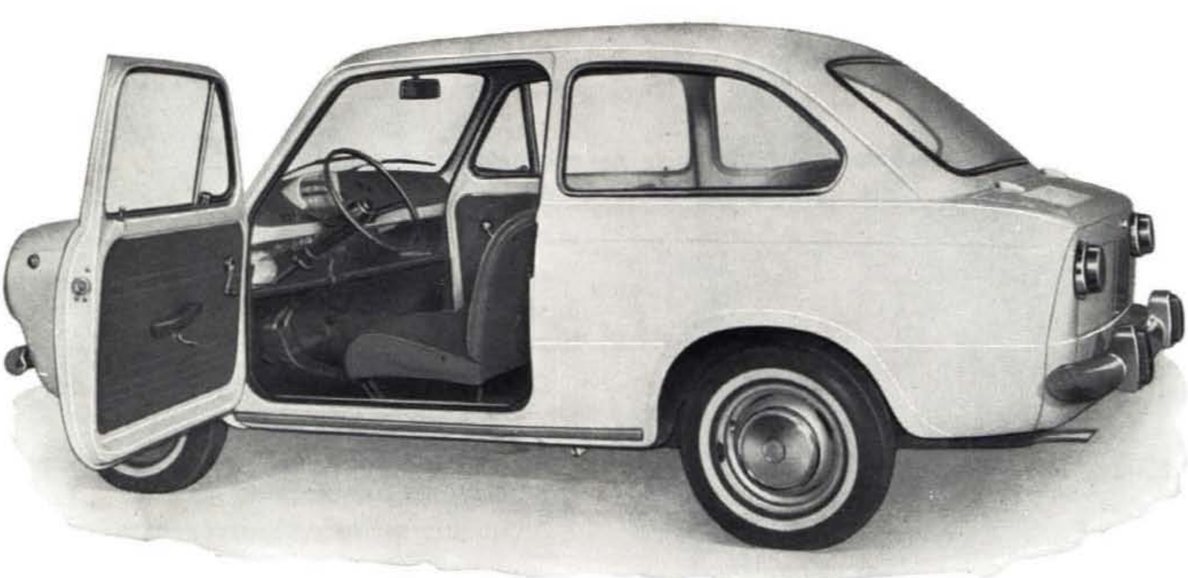


Fig. 384 - Left side view of car with door opened.

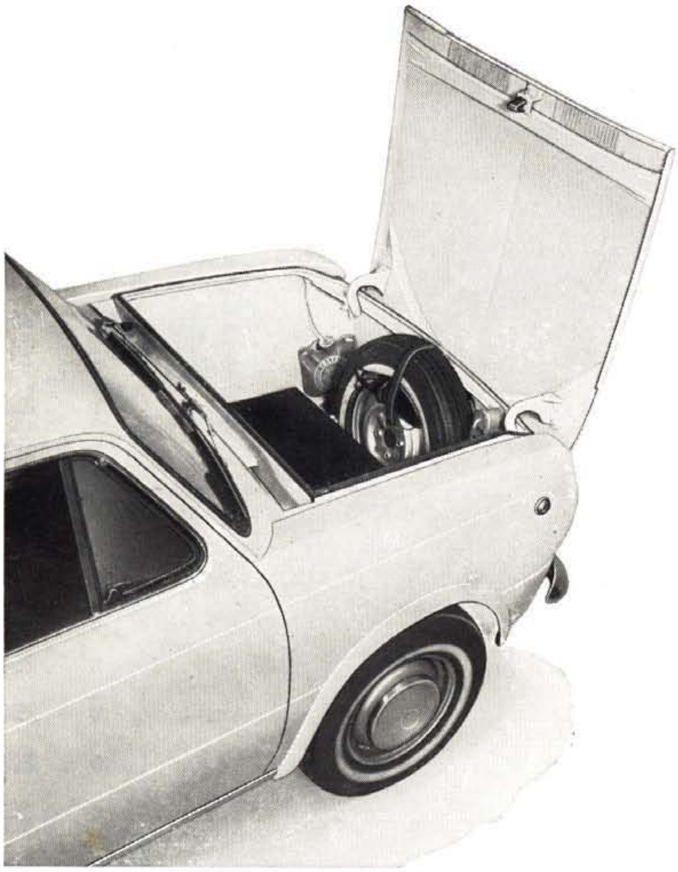


Fig. 385 - View of front luggage compartment.

**Windshield** of the stationary type with curved safety glass.

**Black rubber weatherstrips** around the windshield and back window, rubber weatherstrip with bright metal moulding at rear quarter windows.

Fig. 386 - Rear view of car.

**Hood lid,** front-hinged, with ventilation louvers.

**Rear compartment lid** for access to the power plant, has a partly louvered design for air circulation purposes.

**License plates** are located: the rear plate, at center of upper body liner, and the front plate under the bumper.

**Bumpers,** front and rear, with rubber padded, chrome plated steel overriders.

**Front seats** of the bucket type, adjustable and forward-folding, are made with cloth and imitation leather lining or all-imitation leather lining.

**Rear seat** of the bench type with reclining back. Additional luggage room behind the rear seat back.

Fig. 387 - Front view of car.

The rear seat can be lined with cloth and imitation leather or with imitation leather only.

**Garnish moulding** of doors and side panels of plastic material.

**Roof center section** lined with insulating plastic material.

**Plastic material linings:** on rear wall, additional luggage compartment, rear seat back reverse, and front luggage compartment.

**Black fluted rubber mats** on body floor and front wheelhouses.

**Instrument panel** of sheet metal, painted in the car tone and plastic lined on top.

At center an ash receiver has been arranged.

A utility shelf lined on the outer edge and shockproof material stuffed, extends itself on both sides of the heater unit, below the instrument panel.

**Padded armrests** on door trim panels.

**Two sun visors,** padded and adjustable, are fitted on windshield header panel.

**Hanger straps,** for passengers, are attached to center pillar posts of body and above the door window at front, side opposite the driver's. Dress hook on hanger straps.

**Rear view mirror,** with courtesy light built in.

**Windshield washer pump** under the instrument panel.

**Two ash receivers** to suit rear passengers, are fitted on side panel trimming.


**Fig. 388 - Inside view of car door.**

1. Inner safety lock knob. - 2. Door lock. - 3. Door handle. - 4. Window regulator crank. - 5. Ventilator window stop handle. - 6. Ventilator window. - 7. Drop glass pane.

On cars manufactured starting from the second fortnight of April 1966, the ventilator window stop handle is fitted with a safety push button.

# DOORS

## Disassembly.

To disassemble the door proceed as follows:

Remove the arm rest, the window regulator crank (4, fig. 388) and the door latch handle (3).

Remove the door trim panel, overcoming the force of retaining clips.

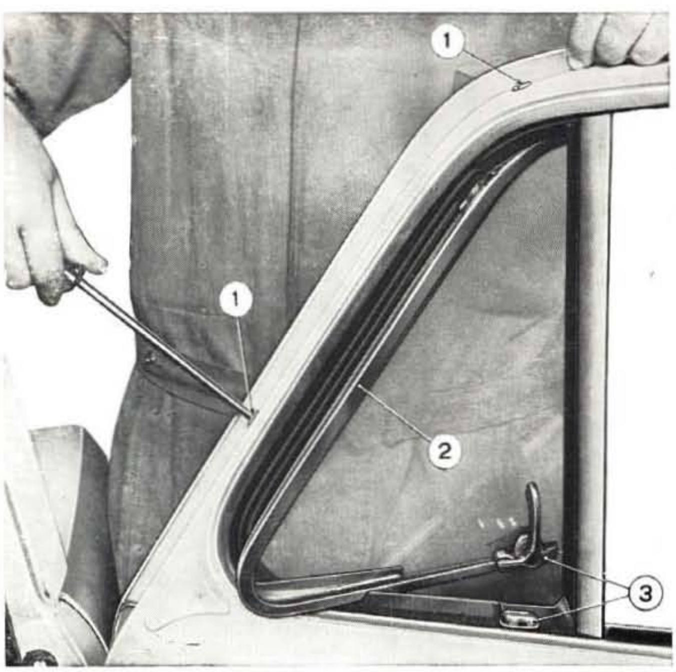



**Fig. 389 - Removing ventilator window.**

1. Ventilator window frame screws. - 2. Ventilator window frame. - 3. Ventilator stop handle and striker plate.

Take down the water shield from inside the door framing.

Remove the lower front drop glass channel (5, fig. 392).

Back out ventilator window frame screws (1, fig. 389).

Crank down the drop glass and remove the ventilator window, positioning it as shown in fig. 390.

Remove the door lock and remote control (fig. 391).

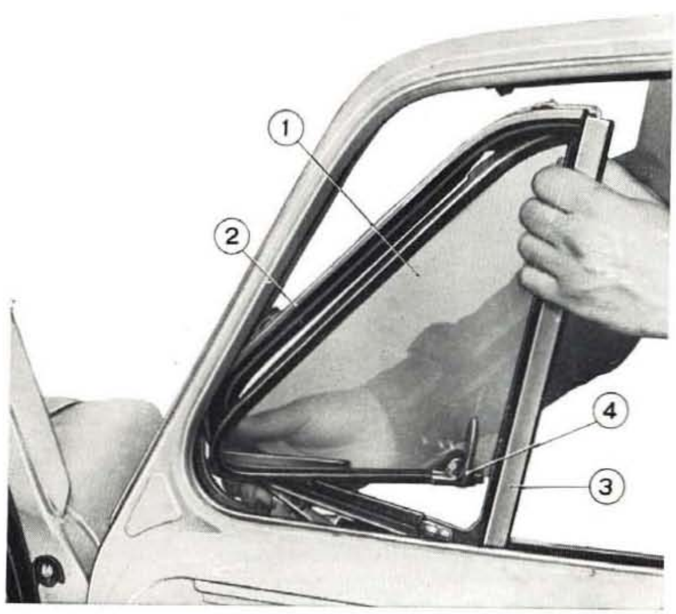



**Fig. 390 - Withdrawing ventilator window assembly.**

1. Ventilator window pane. - 2. Ventilator window frame. - 3. Division bar. - 4. Ventilator stop handle.

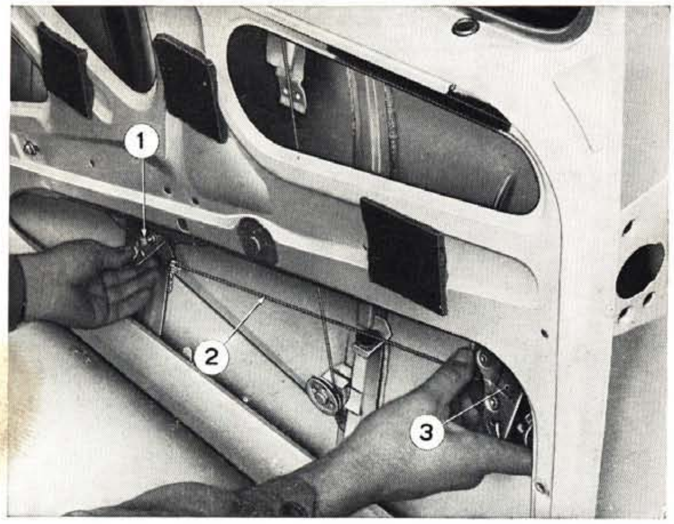



**Fig. 391 - Taking down door lock and control.**

1. Door remote control. - 2. Control link. - 3. Lock assembly.

Loosen the screw (6, fig. 392) and remove the screws which secure the glass to the control cable (fig. 395).

Disengage window regulator cable from sheaves.

Back out window regulator screws and remove regulator as shown in fig. 392.

Slide off the drop glass as shown in fig. 393.

Remove handle lock screws and lift out outer door handle (fig. 394).

## Assembly.

Assemble the door in reverse order to disassembly and recall the following:

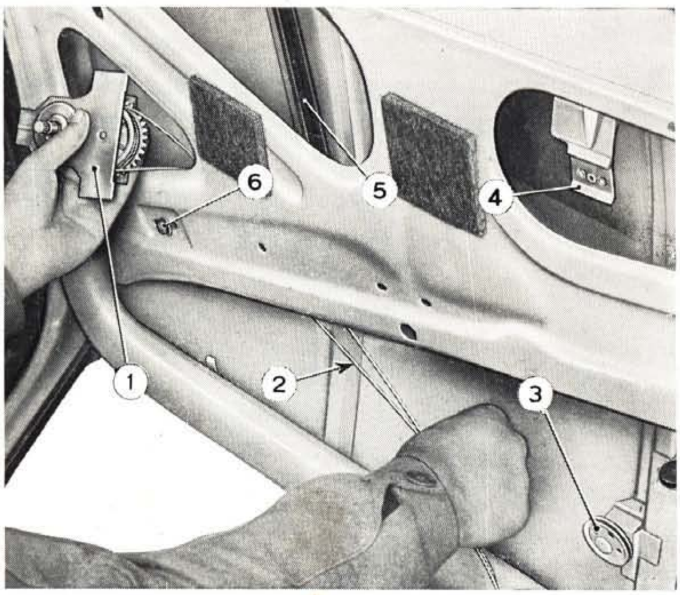



**Fig. 392 - Taking down window regulator assembly.**

1. Regulator assembly. - 2. Regulator control cable. - 3. Cable sheave. - 4. Cable clip. - 5. Drop glass run channel. - 6. Window regulator cable tensioner screw.

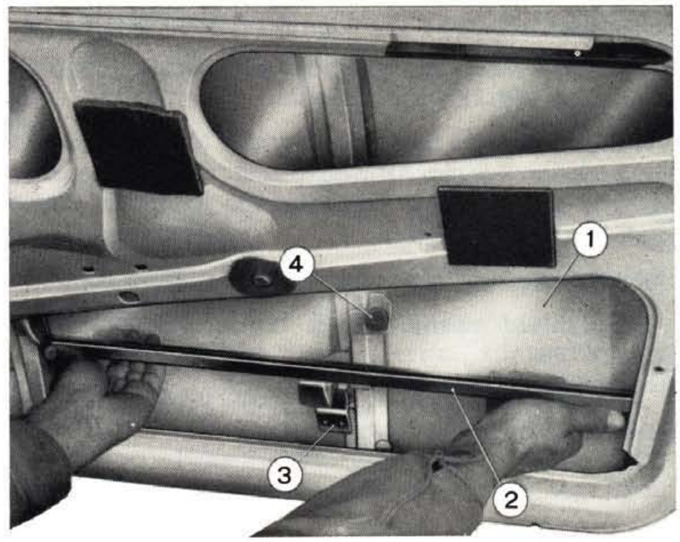



**Fig. 393 - Removing drop glass.**

1. Glass pane. - 2. Glass bottom channel. - 3. Regulator cable clip. - 4. Buffer.

– wind the control cable on window regulator grooves, using care that turns do not interfere with each other;

– set the drop glass pane in position, then fit the window regulator with cable and adjust the cable tension by moving the screw (6, fig. 392) in or out;

– work on the window regulator so that the glass can be cranked all the way down;

– lower the glass to abut against the buffer and, without moving the cable, secure the glass to the cable by means of the lock plate (fig. 395).

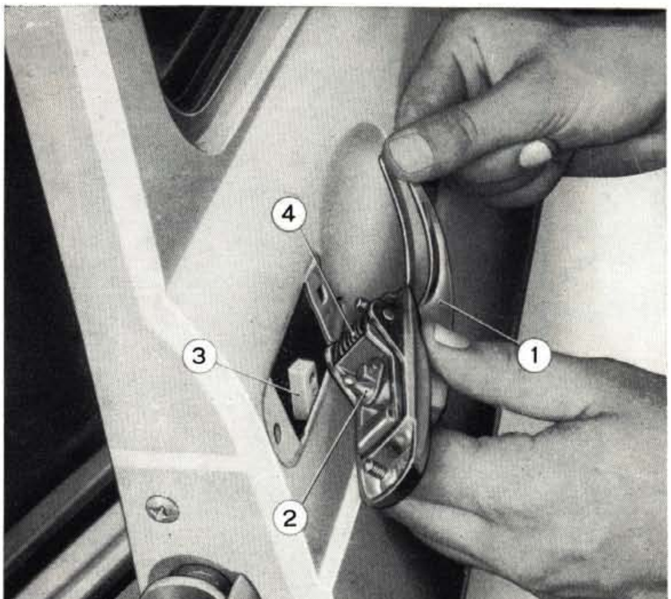



**Fig. 394 - Removing door handle.**

1. Handle. - 2. Control cable ball pin. - 3. Control cable adjustable end. - 4. Handle return spring.

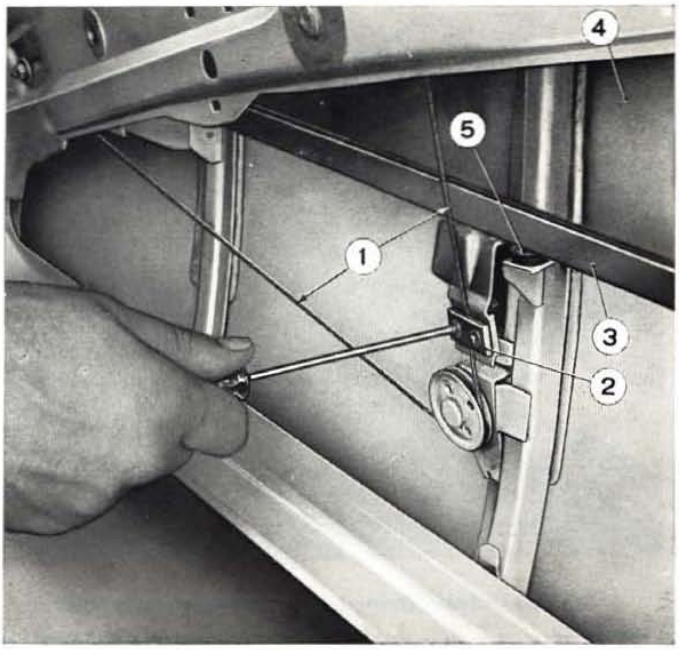



Fig. 395 - **Adjusting drop glass travel.**

1. Window regulator cable. - 2. Cable stop plate. - 3. Glass bottom channel. - 4. Glass pane. - 5. Buffer.

Thanks to this adjustment the drop glass can be correctly cranked from the « closed » to the « wide open » position.

Check for the absence of drags from a tight front run channel.

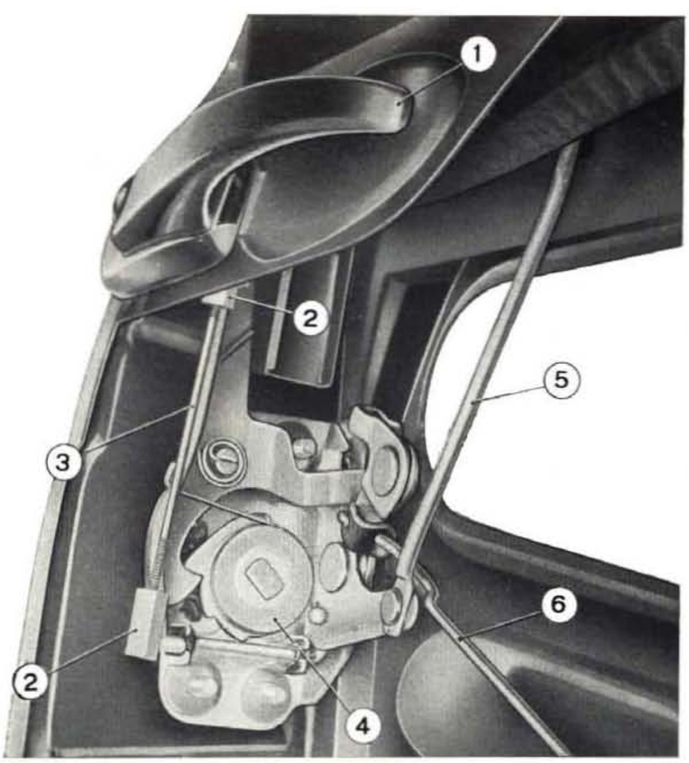



Fig. 396 - **Interior view of door latch.**

1. Door handle. - 2. Ends of rod 3. - 3. Latch control rod. - 4. Lock assembly. - 5. Door lock link. - 6. Remote control link.

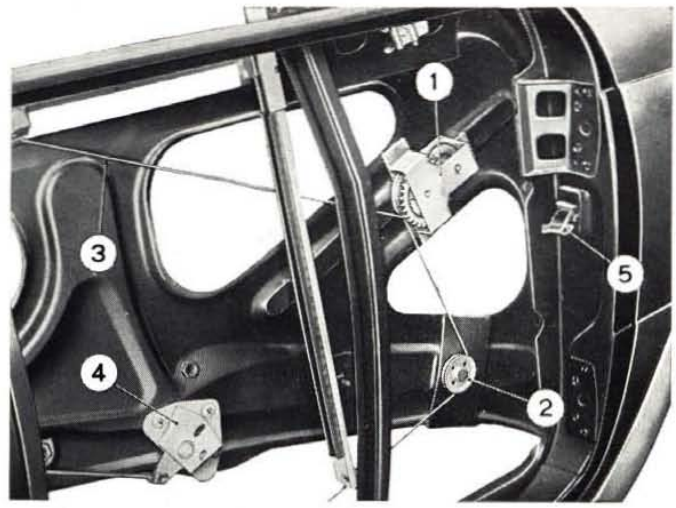



Fig. 397 - **Door and window controls.**

1. Regulator. - 2. Regulator cable sheave. - 3. Regulator cable. - 4. Remote control. - 5. Door check strap.

## Adjustment.

After the door has been assembled, adjust it as follows.

The door must be perfectly aligned in door opening, otherwise:

– scribe the outline of the hinge plates which are secured to door pillar posts;

– using ram puller **A. 81011** (fig. 398), loosen hinge screws;

– reposition door as required; necessary movement can be easily determined by comparing the new position of hinges to scribe lines.

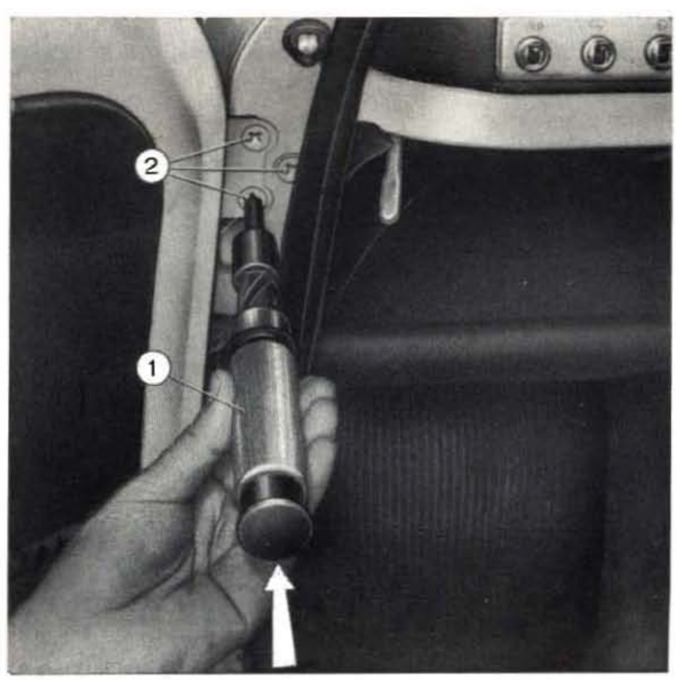



Fig. 398 - **Door alignment.**

1. Ram screwdriver A. 81011. - 2. Door hinge screws.

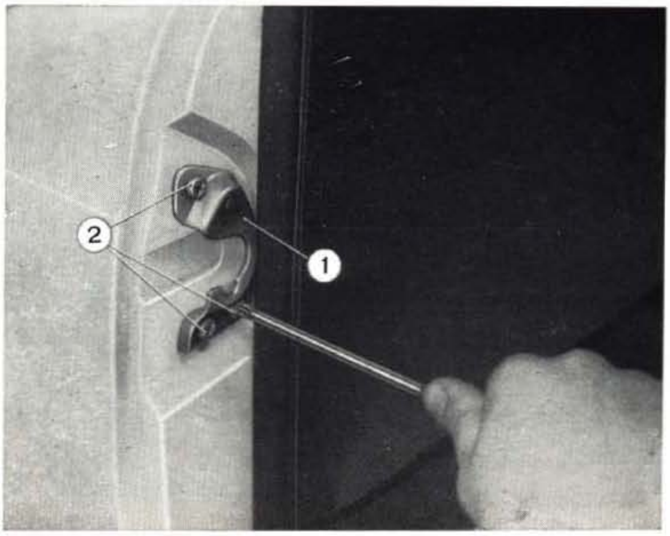



**Fig. 399 - Adjusting door lock striker plate.**
1. Striker plate. - 2. Striker plate mounting screws.

The door should open and close correctly; door lock should hold positively when push button is depressed.

For any necessary adjustment, mark the outline of striker plate, then loosen screws (2, fig. 399).

Reposition the striker plate as required.

## FRONT COMPARTMENT LID

The luggage compartment lid is hinged at front and a hook catch (3, fig. 400) locks it in position.

The lid release mechanism consists of a control cable operated through a handle on left-hand side of the steering column.

If the lid must be replaced, just back out relevant hinge stud nuts (1, fig. 401).

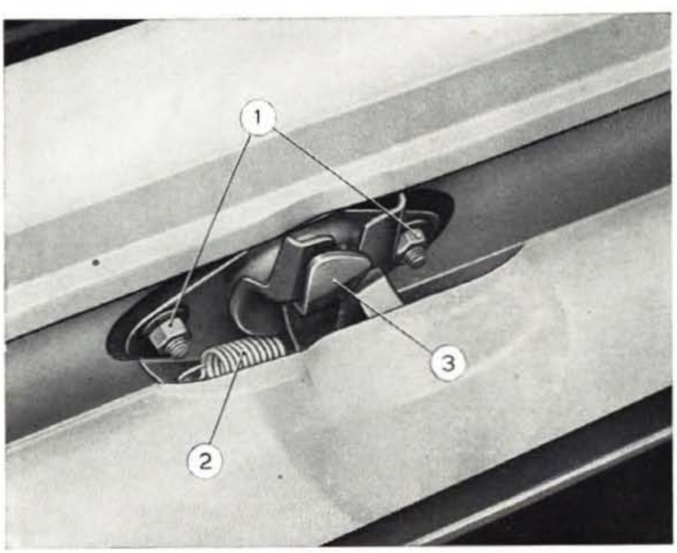



**Fig. 400 - Front compartment lid catch.**
1. Catch mounting nuts. - 2. Catch hook return spring. - 3. Catch hook.

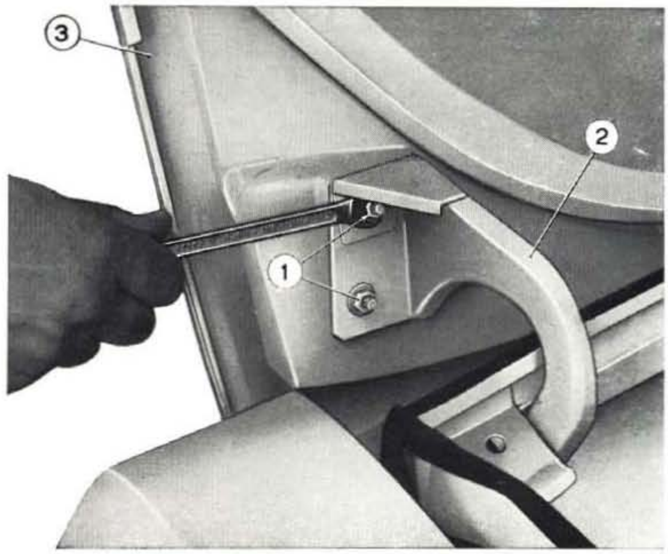



**Fig. 401 - Repositioning front compartment lid.**
1. Lid hinge stud nuts. - 2. Lid hinge. - 3. Front compartment lid.

On installation, see to it that the lid is perfectly seated and free to open and close without strain.

To reposition the lid in its opening use elongated holes which are cut on hinges.

If excessive stiffening is felt on opening and closing of front compartment lid, reposition the catch to the striker: therefor hinge stud holes are drilled with a larger diameter than that of studs.


**Fig. 402 - Engine compartment lid catch.**
1. Striker mounting screws. - 2. Striker. - 3. Catch hook. - 4. Catch hook mounting screw.

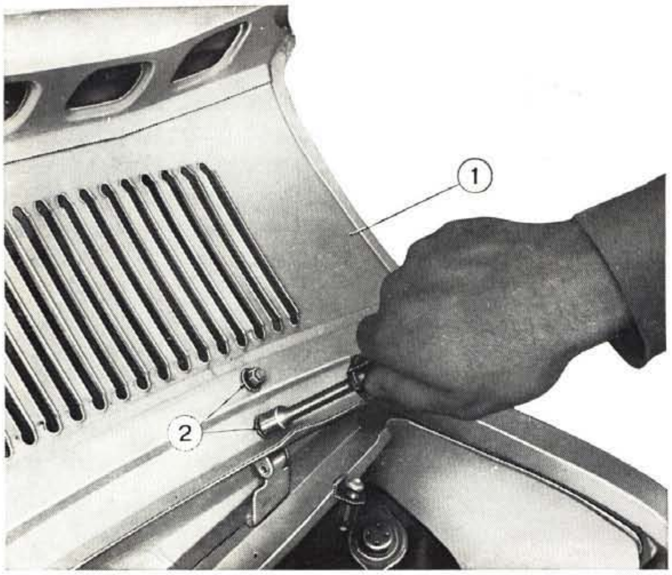



**Fig. 403 - Repositioning engine compartment lid.**
1. Lid. - 2. Lid hinge nuts.

## ENGINE COMPARTMENT LID

To open and close the engine compartment lid actuate the catch hook (3, fig. 402) situated at center of lid.

The lid can be repositioned in its opening by means of elongated holes on lid panel.

To adjust the lid catch back out the striker mounting screws (1, fig. 402) and move the striker in or out, as required.

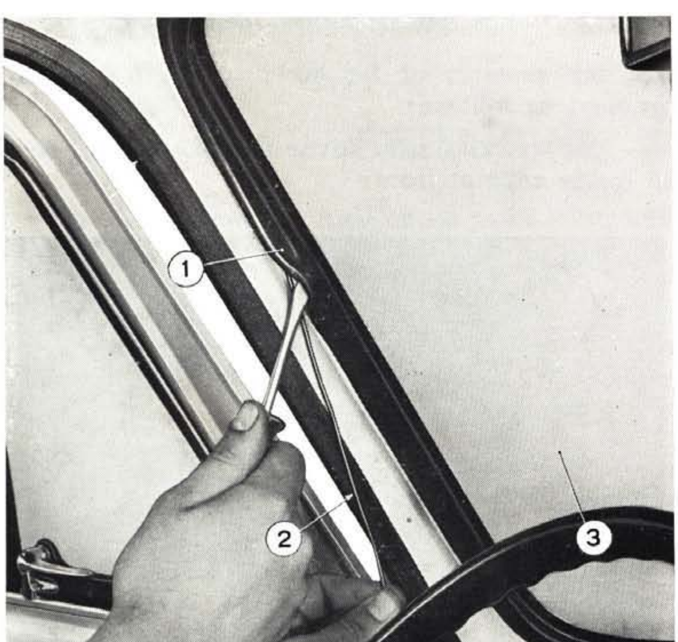



**Fig. 404 - Installing windshield glass.**
1. Rubber weatherstrip. - 2. Weatherstrip draw cord. - 3. Windshield glass.

**Fig. 405 - Removing windshield glass.**

## GLAZING

### Removing and Installing Windshield Glass.

To remove the windshield glass proceed as follows:

– tilt wiper arms;

– with both arms apply pressure on upper corners of windshield (fig. 405).

The rubber weatherstrip will thus snap out from body opening lip, allowing removal of the glass pane.

Install the windshield glass as follows:

– fit the rubber weatherstrip on glass pane contour;

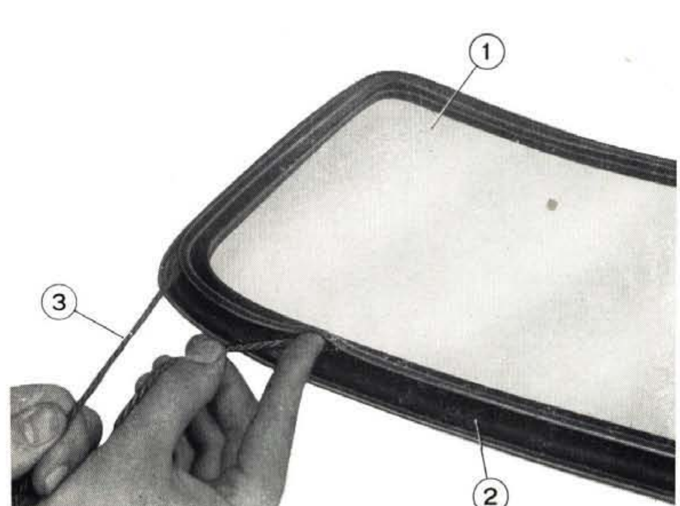



**Fig. 406 - Arranging draw cord, preparatory to windshield glass installation.**
1. Windshield glass. - 2. Rubber weatherstrip. - 3. Draw cord for glass installation.

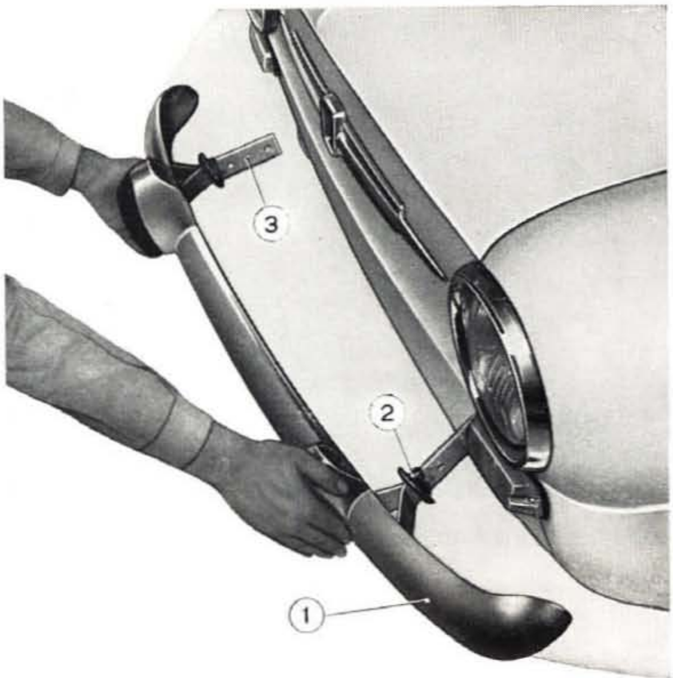



**Fig. 407 - Removing front bumper.**
1. Bumper. - 2. Bracket gasket. - 3. Bumper bracket.

– insert a draw cord in the weatherstrip groove as shown in fig. 406;
– clean the windshield contour flange painstakingly with gasoline;
– start the glass with weatherstrip into the windshield opening and working from car interior pull the ends of the draw cord so that the weatherstrip is seated snugly, overlapping from opening lip.
To facilitate this step, use a screwdriver (see fig. 404).

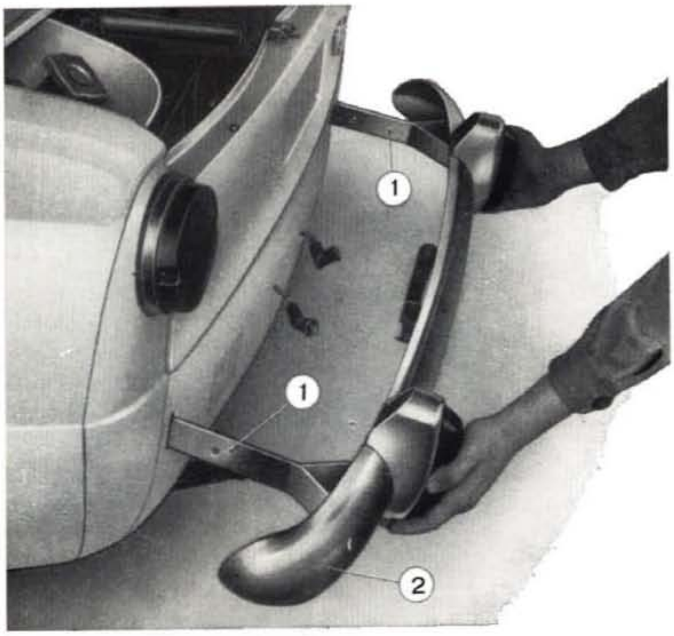



**Fig. 408 - Removing rear bumper.**
1. Bumper brackets. - 2. Bumper.

## Back Window Glass.

The removal procedure of the back window glass is the same as for the windshield glass in preceding paragraph. The only difference is that to push the glass out from window opening pressure must be exercised at the base rather than at top corners of pane.

## Rear Quarter Window Glasses.

For removal and installation of these glasses, too, refer to above paragraphs. The trim moulding is fitted by just inserting in the proper slot in rubber weatherstrip.

**NOTE - It is unnecessary to apply sealing compound when glass panes are installed. Lay sealant just in case of water leakage.**

## BUMPERS

Removal and installation of bumpers do not involve special difficulties.
Bumper brackets are mounted in luggage compartment at front and in engine compartment at rear.
When fitting the front bumper it is good practice to insert brackets in body slots alternately, for easy performance of this step (fig. 407).

## SEATS

If car seats must be taken down for repair, proceed as follows:

– pull seat adjuster lever and slide front seats off guide rails at front;

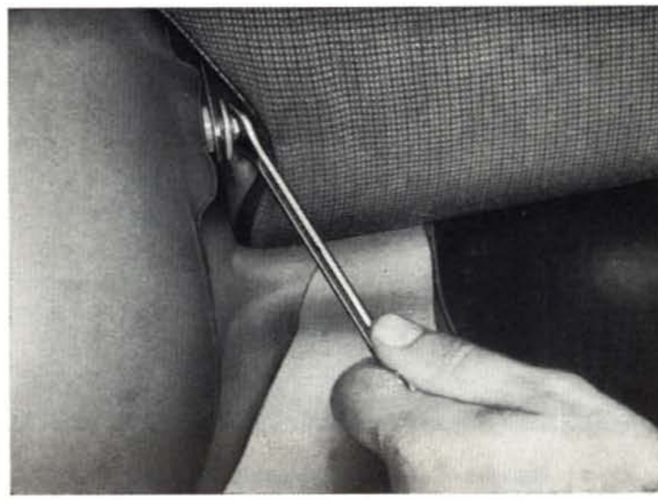


**Fig. 409 - Removing rear seat back rest.**

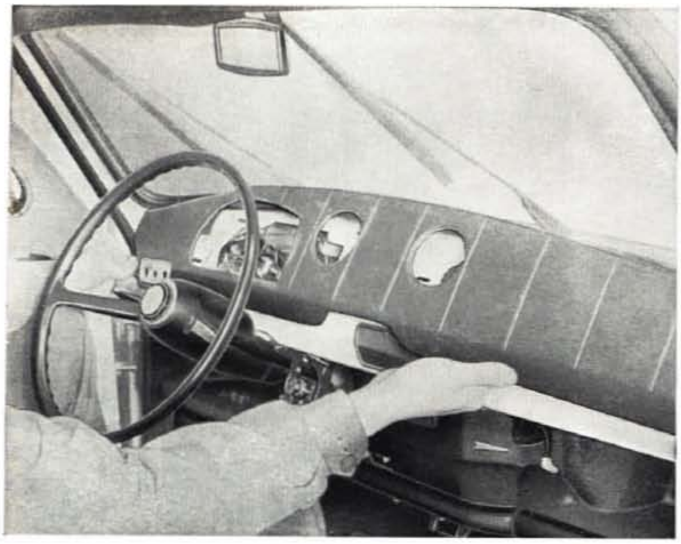


Fig. 410 - Removing instrument panel lining.

– the rear seat cushion is held in place on body floor by two dowel pins and therefore its removal will be an easy matter;

– to remove the rear seat back rest, back out the screws securing articulation joints to wheelhousings (fig. 409).

Next check guide rails on front seats and body floor for distortion and repair if necessary.

Wipe off any dirt or sludge deposits from guide rails and lubricate with grease on installation.

## INSTRUMENT PANEL LINING

Renew the instrument panel lining as follows:

– remove instrument cluster;

– pull adjustable air outlets (which are held in place by means of spring fasteners);

– remove control switches along with ornamental plate;

– withdraw instrument panel lining overcoming the force of clips (fig. 410).

To install the instrument panel lining just proceed in reverse order.

## STRAP HANGERS

In case strap hangers must be replaced by new ones, pull screw caps (2, fig. 411) which are press fitted in place and remove screws (3) from strap hanger (1).

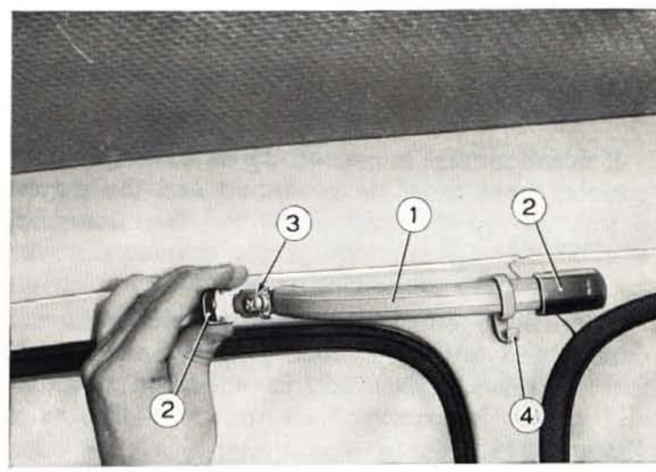



Fig. 411 - Removing strap hanger.
1. Strap hanger. - 2. Screw cap. - 3. Hanger mounting screw. - 4. Dress hook.

# REPAIRING ACCIDENTED CARS

The damages a car may undergo in an accident may be different in nature and severity.

For this reason it is rather difficult to give specific and detailed instructions on body repair, covering the many possible cases, as each blow and/or bump may entail given deformations which must be eliminated in accordance with the best method suggested by the type of damage.

A thorough knowledge of body construction and welding seams is however an essential condition before any repair of body parts is attempted.

In most of such cases it will be necessary to remove some parts in order to gain access to the distorted items for straightening and aligning operations.

If body is very badly damaged, it will be advisable to take off all easily removable inner panellings.

This will provide a clearer vision of parts during repair and alignment operations at the same time facilitating measurements, checks and the application of the hydraulic jack for panel straightening and squaring.

## Alignment.

The car is of the intregral construction type and, therefore, the floor is in a single unit with body.

On a bumped car first check the alignment of front and rear wheels. Possible misalignment will be evidenced by lack of parallelism between front and rear wheel axes or between front and rear wheel track widths.

It is essential to check that the misalignment is not due to distortion of front and rear control arms, track rods, etc.

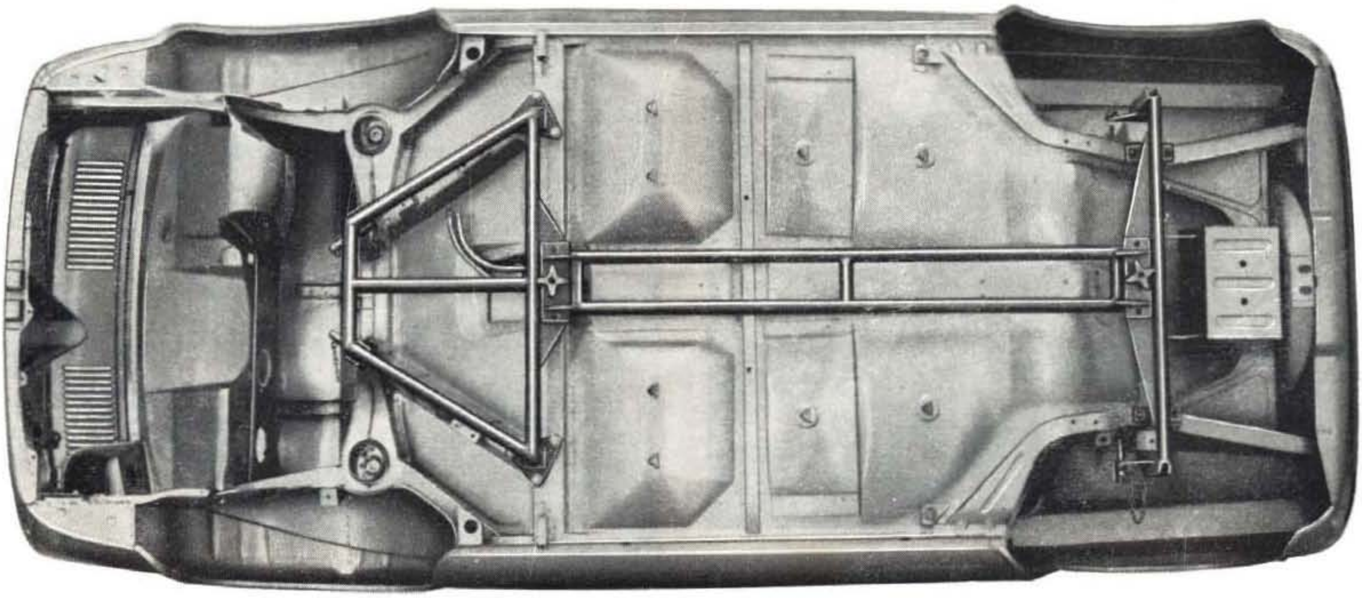


Fig. 412 - Checking underbody with gauge A. 74141.

If misalignment is caused by deformation of body panels, these must be reshaped and the mounting points of mechanical units on floor rechecked against data in fig. 383 or using gauge **A. 74141** for underbody inspection (fig. 412).

Underbody should be checked with utmost accuracy and any distortions perfectly corrected so that underbody data are as specified in fig. 383 and gauge is arranged as shown in figures 412, 413 and 414.

## Leakage Check.

After the body has been fixed, thoroughly check all points which may give the way to water or dust infiltrations, prior to fitting trim panels.

In case leaky areas are detected, tighten them as well as welding seams affected by means of «sealing compound».

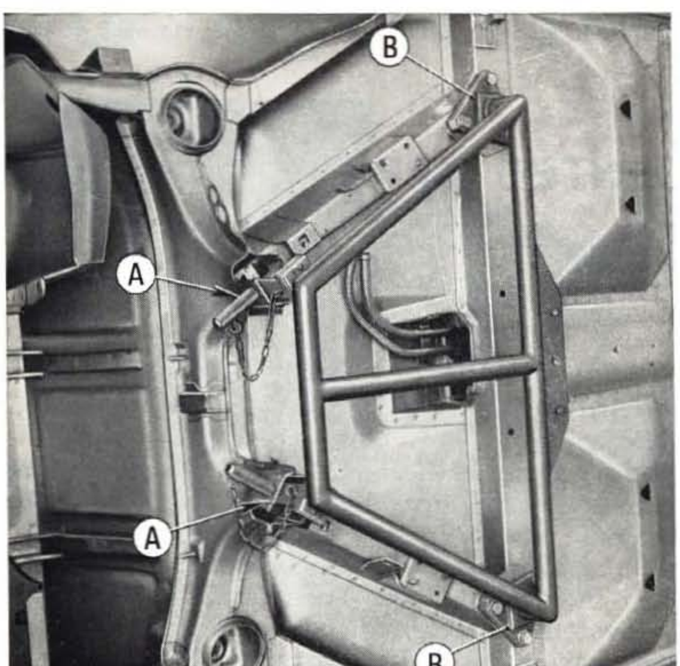



**Fig. 413 - Detail showing use of gauge A. 74141 for checking underbody rear.**

A. Gauge dowel pins to be engaged into control arm mounting brackets. - B. Gauge feet.

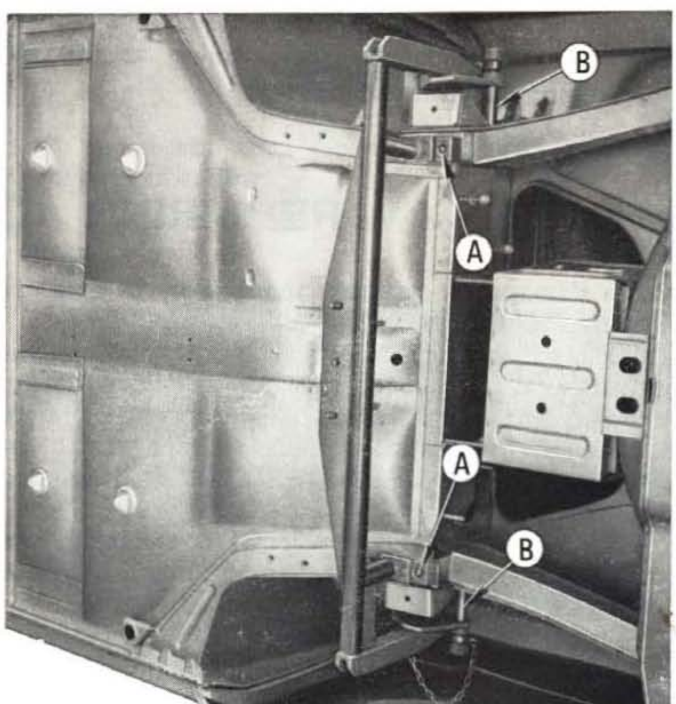



**Fig. 414 - Detail showing use of gauge A. 74141 for checking underbody front.**

A. Semi-elliptic spring mounting cross rail studs. - B. Hollow pins to be engaged into upper control arm mounting studs.

# BODY UPKEEP

## Cleaning Upholstery Cloth.

A periodical cleaning based on specially devised methods is a « must » to ensure long life and preserve the attractive appearance of upholstery cloth.

Dust and dirt blown into the car when windows are open settle on the upholstery and tend to wear the cloth causing an unsightly appearance.

For this reason, it is extremely important to do some rather frequent cleaning (about every 15 days) shortening this interval as the car accumulates mileage.

Wipe off dust using a brush or better still, use the household vacuum cleaner, if available.

To remove ordinary soiling of the upholstery cloth, proceed as follows:

– lukewarm water and a neutral soap should be used, applying to surface on a piece of clean cloth or brush, wiping in the direction of upholstery nap rather than against it;

– repeat the operation using only a clean damp cloth and no soap;

– when upholstery cloth is dry, brush back against nap to restore a « fresh », fluffy look.

To obtain good results, stains must be removed in the least possible time after they are made because spots that are allowed to remain for long on cloth will set and their removal will be very difficult if not impossible.

Some types of stains call for specific spot removers.

## Cleaning Imitation Leather.

Never use oil, dyes or ammonia solutions.

The cause for any alteration or loss of imitation leather softness or luster, should generally be ascribed to the use of unsuitable or harmful cleaners.

To keep imitation leather clean, simply wash with a soap-sudded moist cloth.

Then, wipe clean with a moist cloth and no soap.

Finally, rub with a clean dry cloth and stop when original luster is restored.

## Chrome Parts.

To preserve the enduring finish of chrome parts, wash periodically using a cloth dampened with kerosene, dry, and rub with a cloth moistened in fluid oil. Next, remove any trace of oil using a clean woolen cloth.

This procedure will not alter the brilliancy of chromium-plated parts and will preserve them from the detrimental action of atmospheric agents like climate dampness or saline air.

## Glass Panes.

Glass panes must be cleaned with a chamois or rag: in either case utmost cleanliness is an essential condition, inasmuch as if already used to clean the car they might be soiled with dust or contain sand. This foreign matter is abrasive and will eventually scratch glass panes to the point where perfect vision is impaired.

## Washing the Car.

Body will call for washing at variable intervals depending on driving conditions. If a car washing tunnel is not available, proceed as follows.

Using an ordinary garden hose (with nozzle) wash first the bottom of car, including the wheels. If required, caked road grime should be softened with a sponge.

Wash all body panels with running water, moderating the pressure of the water spout. Complete the washing with a sponge, rubbing gently at first to prevent scratching the finish with the entrained dirt (rinse sponge often) and then more vigorously, using plenty of running water all the time.

Dry car thoroughly with a clean chamois. No trace of water must remain on the finish.

To prevent damages to windshield wiper during the washing operation, pass the sponge or chamois under wiper blades which must be lifted and tilted towards cowl: never displace blades angularly.

If after washing and drying with chamois the original luster of the finish is not restored, use one of the many polishing compounds of good commercial grade. A slight amount of color showing up on the cloth while polishing should not be cause for alarm as this is a natural condition having no consequence on the luster and life of the finish.

Grease, oil and tar stains on the body finish may be removed with some gasoline followed by an immediate wiping with a dry cloth.

# Section 12

## MAINTENANCE
## TOOL EQUIPMENT

# MAINTENANCE

| OPERATIONS | Miles | 6,000 | 12,000 | 18,000 | 25,000 | 31,000 | 37,000 | 44,000 | 50,000 |
|---|---|---|---|---|---|---|---|---|---|
| | Kms. | 10,000 | 20,000 | 30,000 | 40,000 | 50,000 | 60,000 | 70,000 | 80,000 |

## LUBRICATION

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. Lubricate ignition distributor . . . . . . | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 2. Check transmission and rear axle oil level | ★ | ★ | | ★ | ★ | | ★ | ★ |
| 3. Replace oil in transmission and rear axle | | | ★ | | | ★ | | |
| 4. Lubricate front wheel bearings . . . . . | | ★ | | ★ | | ★ | | ★ |
| 5. Lubricate rear wheel bearings . . . . . | | | ★ | | | ★ | | |
| 6. Lubricate generator ball bearings . . . . | | | ★ | | | ★ | | |
| 7. Lubricate starter free wheel and electro-magnet plunger . . . . . . . . . . . . | | | ★ | | | ★ | | |
| 8. Lubricate door hinges . . . . . . . . . | | ★ | | ★ | | ★ | | ★ |

**Every 300 miles** ( 500 km): Check oil level in sump.

**Every 1,500 miles** ( 2,500 km): Inject grease in lubricators.

**Every 6,000 miles** (10,000 km): Replace oil in sump.

## CHECKS AND INSPECTIONS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. Replace air cleaner element . . . . . . | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 2. Check ignition distributor breaker contacts | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 3. Clean spark plugs and check gap . . . | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 4. Clean carburetor filter . . . . . . . . . . | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 5. Check brake fluid level . . . . . . . . | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 6. Check tappet clearance . . . . . . . . | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 7. Adjust front wheel bearing play . . . . | | ★ | | ★ | | ★ | | ★ |
| 8. Check rear wheel bearings . . . . . . | | | ★ | | | ★ | | |
| 9. Clean and lubricate battery terminals and clamps and check battery charge . . . . | ★ | ★ | ★ | ★ | ★ | ★ | ★ | ★ |
| 10. Check generator and starter brushes for wear . . . . . . . . . . . . . . . | | | ★ | | | ★ | | |
| 11. Tighten all mounting bolts and nuts of units to body . . . . . . . . . . . . . . . | | ★ | | ★ | | ★ | | ★ |
| 12. Renew cooling mixture . . . . . . . . . | | | | | | ★ | | |

**Every 300 miles** ( 500 km): Check coolant level in expansion tank and tire pressure.

**Every 1,500 miles** ( 2,500 km): Check electrolyte level in battery.

**Every 6,000 miles** (10,000 km): **Road test car.**

# LUBRICANT SPECIFICATIONS

| | | |
|---|---|---|
| FIAT VS 40 Oil, for engine<br>(above 86° F - 30° C, average)<br>(SAE 40) | Flash point (in open cup)<br>Pour point<br>Viscosity at 122° F ( 50° C) } Engler units<br>Kinematic cSt<br>Viscosity at 212° F (100° C) } Engler units<br>Kinematic cSt | not below 464° F (240° C)<br>not below 18.4° F (—8° C)<br>11.4 to 12.6<br>86.6 to 95.6<br>not below 2.22<br>not below 14 |
| FIAT VS 30 Oil, for engine<br>(above 32° F - 0° C, minimum)<br>(SAE 30) | Flash point (in open cup)<br>Pour point<br>Viscosity at 122° F ( 50° C) } Engler units<br>Kinematic cSt<br>Viscosity at 212° F (100° C) } Engler units<br>Kinematic cSt | not below 428° F (220° C)<br>not above —.4° F (—18° C)<br>8 to 9<br>60.8 to 68.4<br>not below 1.92<br>not below 10.90 |
| FIAT VS 20 Oil, for engine<br>(32° to 5° F - 0° to —15° C, minimum)<br>(SAE 20) | Flash point (in open cup)<br>Pour point<br>Viscosity at 122° F ( 50° C) } Engler units<br>Kinematic cSt<br>Viscosity at 212° F (100° C) } Engler units<br>Kinematic cSt | not below 428° F (220° C)<br>not above —.4° F (—18° C)<br>4.7 to 5.5<br>35 to 41.3<br>not below 1.58<br>not below 7.20 |
| FIAT VS 10 W Oil, for engine<br>(below 5° F - —15° C, minimum)<br>(SAE 10 W) | Flash point (in open cup)<br>Pour point<br>Viscosity at 122° F ( 50° C) } Engler units<br>Kinematic cSt<br>Viscosity at 212° F (100° C) } Engler units<br>Kinematic cSt<br>Viscosity at —4° F (—18° C) } Engler units<br>Kinematic cSt | not below 404° F (200° C)<br>not above —13° F (—25° C)<br>2.7 to 3.3<br>18.5 to 23.7<br>not below 1.38<br>not below 4.80<br>not above 330<br>not above 2500 |
| FIAT W 90 Oil<br>(SAE 90 EP) | Flash point (in open cup)<br>Viscosity at 122° F ( 50° C) } Engler units<br>Kinematic cSt | not below 374° F (190° C)<br>14.5 to 15.5<br>110.2 to 118 |
| FIAT Jota 1 Grease | Drop point (Ubbelhode)<br>Worked penetration (after 60 strokes)<br>Type of soap | not below 284° F (140° C)<br>310 to 340 mm/10<br>Lithium |
| FIAT Jota 2/M Grease | Drop point (Ubbelhode)<br>Worked penetration (after 60 strokes)<br>Type of soap | not below 356° F (180° C)<br>265 to 295 mm/10<br>Lithium with molybdenum sulfur |
| FIAT Jota 3 Grease | Drop point (Ubbelhode)<br>Worked penetration (after 60 strokes)<br>Type of soap | not below 374° F (190° C)<br>220 to 250 mm/10<br>Lithium |
| FIAT MR 3 Grease | Drop point (Ubbelhode)<br>Worked penetration (after 60 strokes)<br>Type of soap | not below 356° F (180° C)<br>235 to 250 mm/10<br>Lithium |
| FIAT special fluid<br>(blue label) | Heavy Duty non-mineral grade (SAE 70 R 3) | — |

# SPECIAL SERVICE TOOLS

**In the following list are not quoted fixtures and equipments of general use, but solely special tools, some of which are common to other car models.**

**For better knowledge of the whole range of tools devised for correct performance of service operations, see the « Service Tool Catalogue » issued by FIAT Service Dept.**

| FIAT Number | DESCRIPTION |
|---|---|
| | **ENGINE** |
| A. 60534 | Adapter, engine removal (use with hydraulic jack). |
| A. 60511/1/2 | Hook, engine hoist. |
| Arr. 22205/9 | Clamps, engine service stand. |
| A. 50088 | Wrench, exhaust manifold nut. |
| A. 89854 | Wrench, ratchet. |
| A. 40005 | Puller, all-purpose. |
| A. 60292 | Installer, camshaft intermediate bushing. |
| A. 90326 | Refacer, camshaft bushing. |
| A. 60281 | Installer, crankshaft rear gasket and cover. |
| A. 60273 | Set of installers, piston. |
| A. 95694 | Sector scale, engine timing. |
| A. 60186 | Crank, engine timing. |
| A. 95647 | Master gauge, indicator A. 95687. |
| A. 90318/1/2 | Reamers, tappet seat. |
| A. 60182 | Installer, piston ring. |
| A. 95605 | Tester, piston pin drag (serves also as holder for piston - con rod disassembly). |
| A. 60275 | Installer, piston pin. |
| A. 60285 | Remover, piston pin (use with arbor press). |
| A. 60080 | Flange and bushings, crankshaft installation on grinding machine. |
| A. 94016/10/14 | Reamers, crankshaft plug seat. |
| A. 94016 | Chuck, reamer. |
| A. 86014 | Installer, crankshaft plug. |
| A. 40006/2 | Adapter, clutch shaft pilot bushing pulling (use with ram puller A. 40006/1). |
| A. 60283 | Table, head support during valve removal and installation. |
| A. 60084 | Remover and installer, engine valve. |
| A. 60041 | Holder, cylinder head during valve reconditioning. |
| A. 95650 | Gauge, combustion chamber depth. |
| A. 60081 | Tester, head leakage. |
| A. 94015 | Pilot, valve seat grinding. |
| A. 94084 | Taper grinder, 45°, valve seat (use with spindle A. 94069). |
| A. 94083 | Cutter, 20°, valve seat grinding. |
| A. 94030 | Cutter, 75°, valve seat grinding. |
| A. 60041/2 | Holder, valve seal tester (use with tester A. 60148). |
| A. 60018 | Plug, spark plug orifice blanking during valve leakage test. |
| A. 60059 | Remover and installer, valve guide. |
| A. 90313 | Reamer, valve guide bore. |

(continued)

**Special Service Tools** *(continued)*.

| FIAT Number | DESCRIPTION |
|---|---|
| A. 60282 | Holder, flywheel. |
| A. 50006 | Wrench, valve tappet adjusting. |
| A. 95111 | Feeler gauge, valve tappet adjusting. |
| I. 35100G/3/4 | Clamps, engine test rig. |
| A. 60163 | Installer, sump gasket. |
| Ap. 5066 | Tester, cooling system leakage. |
| A. 95858 | Rating device, « Paraflu 11 » in cooling system. |
| A. 50111 | Remover, engine thermostat. |
| A. 95126 | Gauge, float level adjustment, Solex carburetor. |
| | **CLUTCH** |
| A. 70085 | Pilot pin, driven plate alignment. |
| | **TRANSMISSION - DIFFERENTIAL** |
| A. 70516 | Holder, transmission-differential assembly during removal and installation. |
| A. 55035 | Remover and installer, transmission, engine on car. |
| Arr. 22206/10 | Adapter, transmission - differential assembly support (use with service stand Arr. 22204). |
| A. 70099 | Tool, shifter fork adjusting. |
| A. 95690 | Dial indicator with base, to be used with drive pinion shim thickness gauges. |
| A. 70101 | Gauge, drive pinion shim thickness (use with A. 95690). |
| A. 95697/4 | Adapter, differential rolling torque inspection (to be used with dynamometer A. 95697). |
| A. 95688 | Tool, final drive backlash adjusting and adjuster nut tightening. |
| A. 55053 | Wrench, differential adjuster nut setting. |
| | **FRONT SUSPENSION AND WHEELS** |
| A. 47014 | Puller, ram, wheel hub cap. |
| A. 74042 | Remover and installer, kingpin housing « estendbloc » bushing. |
| A. 74016 | Remover and installer, kingpin housing bushing. |
| A. 74116 | Holder, control arm, during bushing removal (use with A. 40005/1/5). |
| A. 74049 | Remover and installer, semi-elliptic spring bushings. |
| A. 74135 | Gauge, control arm inspection. |
| A. 90316 | Reamer, kingpin housing bushing. |
| A. 96005 | Gauge, kingpin housing inspection. |
| A. 47026/1 | Puller, wheel outer bearing cup. |
| A. 47026/2 | Puller (item), wheel inner bearing cup (use with A. 47026/1). |
| A. 74044 | Installer, upper control arm bushing. |
| A. 74088 | Installer, wheel hub cap. |
| A. 74134 | Pair of tools, semi-elliptic spring load during « silentbloc » bushing installation. |
| A. 74128 | Staking tool, steering knuckle nut. |
| A. 74029 | Support, magnetic base indicator, wheel hub play check. |

*(continued)*

**Special Service Tools** *(continued)*.

| FIAT Number | DESCRIPTION |
|---|---|
| | **REAR SUSPENSION AND WHEELS** |
| A. 74034 | Remover, wheel bearing cups. |
| A. 74053 | Remover and installer, control arm bushings. |
| A. 74142 | Tool, control arm check and adjustment. |
| A. 74143 | Pilot pin, control arm shim installation. |
| A. 47017 | Puller, ram, wheel hub. |
| A. 74052 | Pair of tools, coil spring compression. |
| Ap. 5110/1/6 | Gauge and clamp, rear wheel toe-in check. |
| | **STEERING** |
| A. 47035 | Puller, tie rod end ball stud. |
| A. 47033 | Puller, pitman arm. |
| A. 74046 | Installer, worm rear bearing. |
| A. 74017 | Installer, steering housing oil seal. |
| A. 74043 | Remover and installer, steering shaft bushing. |
| A. 90360/20 | Reamer, steering housing bushing. |
| A. 57003 | Wrench, worm thrust sleeve. |
| Ap. 5107 | Gauge, front wheel toe-in. |
| | **BRAKES** |
| A. 72210 | Band, brake shoe lining bonding. |
| A. 56113 | Wrench, front wheel brake shoe adjusting. |
| A. 56119 | Wrench, rear wheel brake shoe adjusting. |
| | **BODY** |
| A. 74141 | Gauge, underbody checking. |

# Section 13

## COUPE
## ROADSTER
## FAMILY
## IDROCONVERT

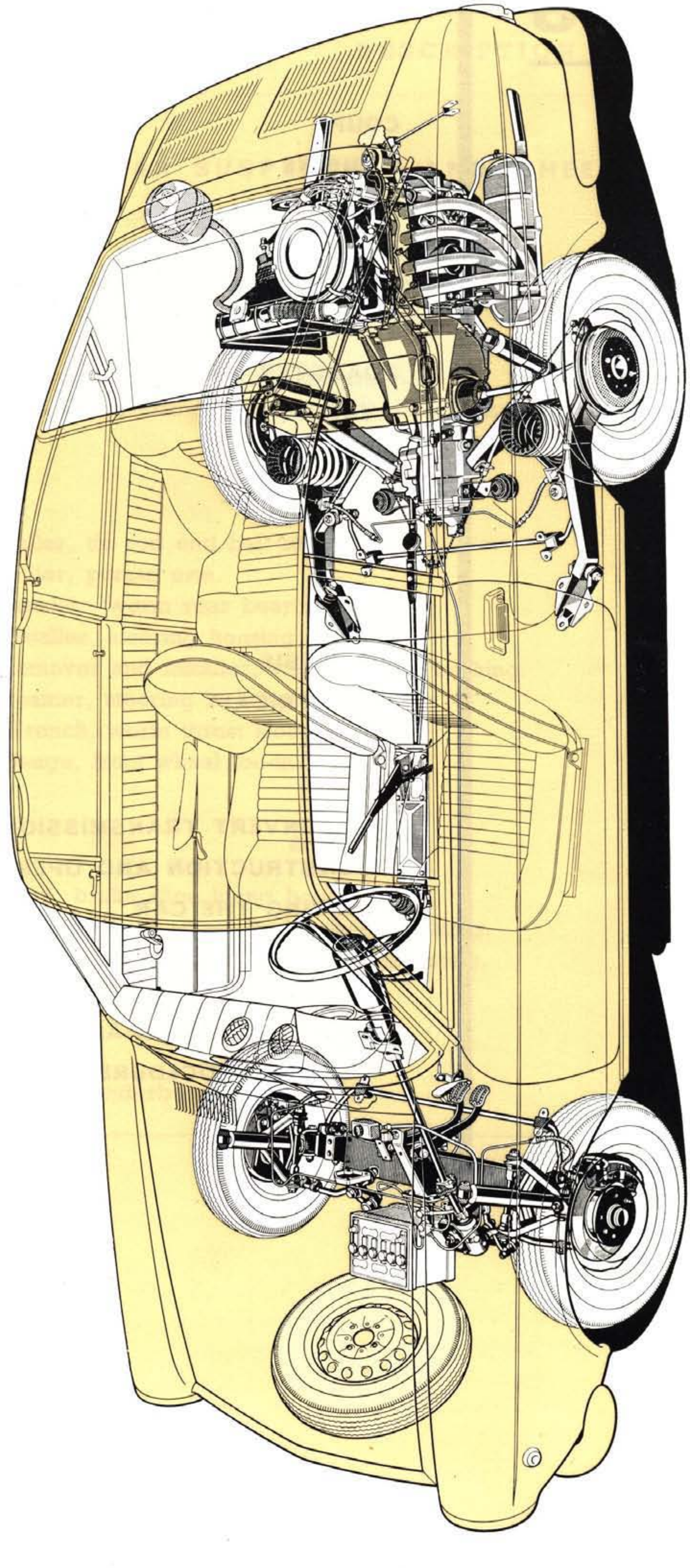


Fig. 415 - Phantom view of running gear units.

# COUPE

# DIFFERENCES FROM SEDAN VERSION

## ENGINE

Cylinder head: valves, valve guides and intake and exhaust valve seats of increased diameter.

Intake manifold: mounting to suit new carburetor.

Exhaust manifold: eliminated; exhaust gases are conveyed to the muffler via four separate ducts.

Pistons: crown shape (higher compression ratio); first compression ring of special cast iron.

Valve gear: timing, lift and cam contour; drive sprocket with damper ring; double tracked chain.

Carburetor: Weber type 30 DIC 1, dual throat with super-feeder device.

Air cleaner: warmed air scoop has been eliminated, cleaner redesigned to suit new carburetor.

Ignition distributor: vacuum advance corrector has been eliminated.

Spark plugs: of new type.

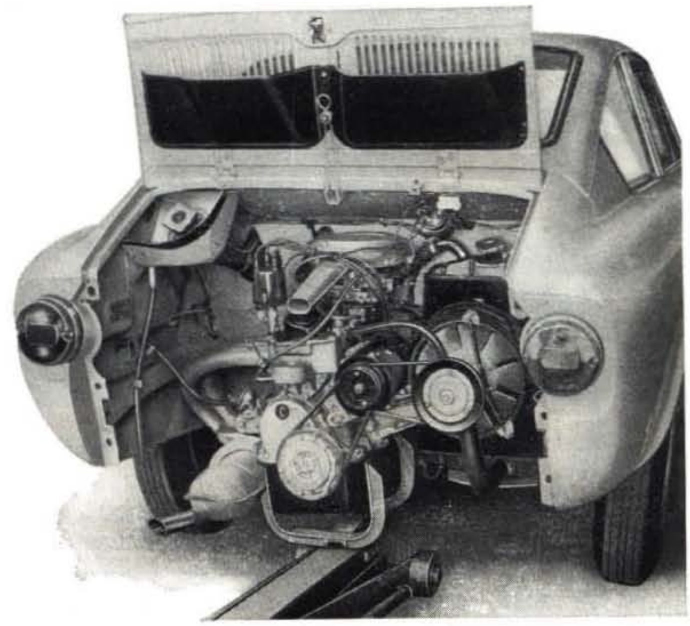


Fig. 416 - Using hydraulic jack and adapter A. 60534 to remove engine.

## CHASSIS

Leading dimensions of car.

Transmission: shorter gearshift lever.

Differential: final drive ratio.

Front suspension: semi-elliptic springs; steering knuckles, due to the adoption of disc brakes; hydraulic shock absorbers.

Rear suspension: coil springs.

Fig. 417 - Fiat 850 Coupe.

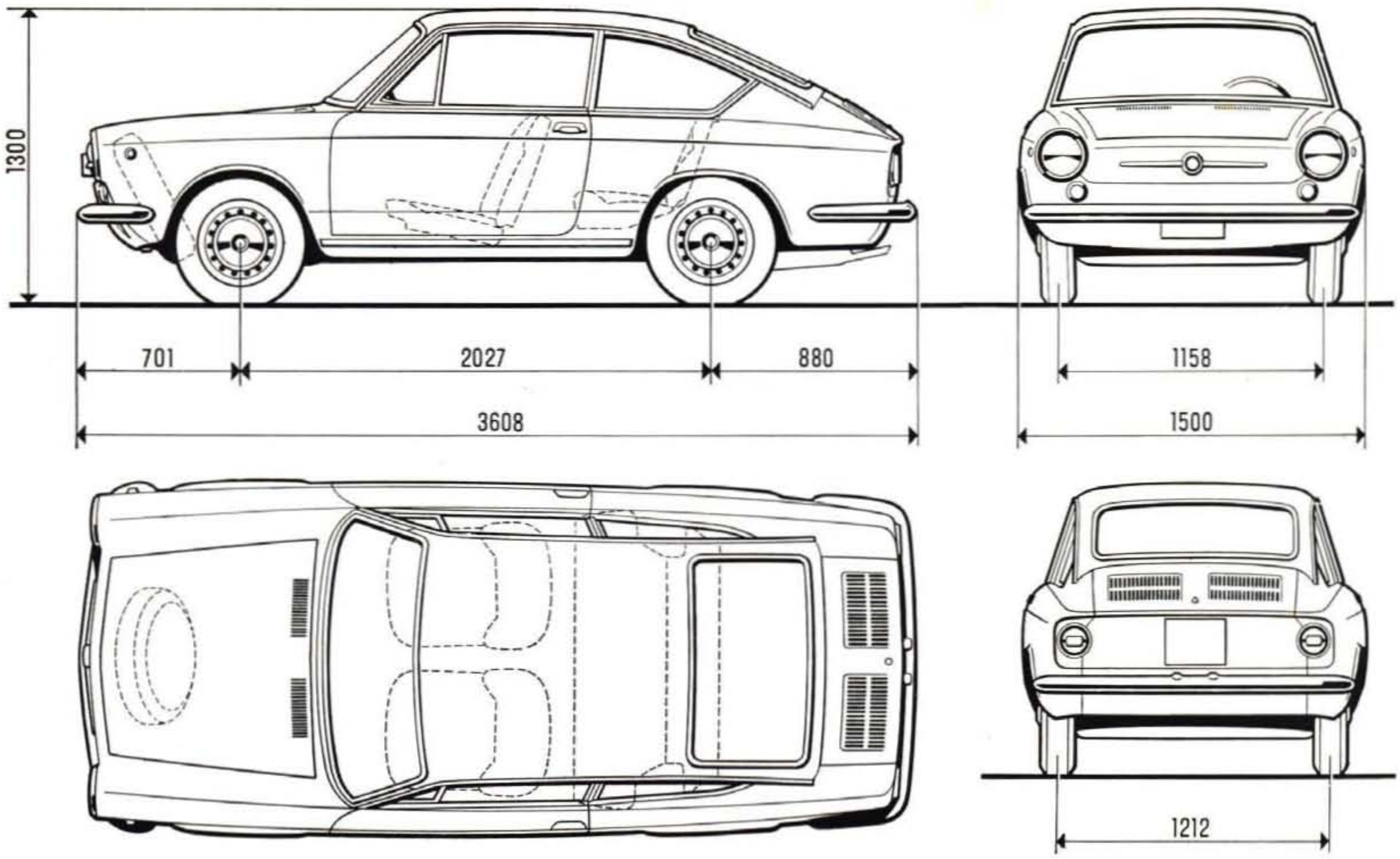



**Fig. 418 - Leading dimensions (in mm).**
Overall height applies to an unloaded vehicle.

# CAPACITIES

| UNIT | QUANTITY Imp. units | U.S. units | lt | kg | FILL-IN |
|---|---|---|---|---|---|
| Fuel tank . . . . . . . . . . | 6.60 gals | 7.93 gals | 30 | — | 98 octane gasoline (R.M.) |
| | pints | pints | | | |
| Radiator, engine and heating system . . . . . . . . . . | 13.20 | 15.85 | 7.5 | — | Mixture of water and FIAT Paraflu 11 fluid (50% by volume) (1) |
| Sump and filter (*) . . . . | 5.68 | 6.86 | 3.25 | 2.90 | FIAT oil (3) |
| Transmission and differential | 3.70 | 4.44 | 2.10 | 1.90 | FIAT W 90/M oil (SAE 90 EP) |
| Steering gear . . . . . . . . | 0.211 | 0.254 | 0.12 | 0.11 | FIAT W 90/M oil (SAE 90 EP) |
| Braking system . . . . . . . | 0.493 | 0.592 | 0.28 | 0.28 | FIAT special « blue label » fluid |
| Front shock absorbers (each) | 0.299 | 0.359 | 0.170 | 0.155 | FIAT S.A.I. fluid |
| Rear shock absorbers (each) | 0.264 | 0.317 | 0.150 | 0.135 | FIAT S.A.I. fluid |
| Windshield washer reservoir | (2) | (2) | — | (2) | Water and FIAT D.P./1 fluid mixture (concentrated solution). |

(*) The total capacity of sump, oil filter, pipings and crankshaft is 6.48 G.B. pts - 7.80 U.S. pts (3.3 kg). The quantity shown in the table applies to routine oil changes.

(1) The coolant has non-oxidizing, non-corrosive, non-foamy, non-scaling properties and will not freeze up to $-31°$ F ($-35°$ C).

(2) Pure water .66 G.B. qts - .79 U.S. qts (0.75 kilos) plus .6 oz (17 gr) solution in summer or 1.20 oz (34 gr) solution in winter.

(3) Use oil grades as tabulated on page 7.

Steering: wheel of new design; column fitted with flexible joint.

Brakes: disc type at front; master cylinder with longer body casting; chrome plated manual brake ratchet lever.

Wheels and tires: diameter and section; slotted type wheel rims.

## ELECTRICAL

Battery: nominal capacity 48 Amp/hr.

Generator: type D 90/12/16/3 DS with thicker commutator end bushing.

Temperature gauge sending unit on cylinder head.

Front parking and direction signal lamps: of new design.

License plate lamps: of new design.

Horns: dual chime; horn button of new design.

Windshield wiper: with new motor, arms and crank gear.

Interior illumination: light has been arranged centrally on instrument panel, with switch built in.

Instrument cluster: with two separate dials; temperature gauge has been added. Tachometer comes as optional equipment.

Control switches: of new design.

## BODY

Coupe: integral construction, two-plus-two seater, two-door.

Rear side windows: part-way swiveling outward.

Bright metal outer trim mouldings: around side windows, windshield and rear window.

Engine compartment lid: with inner water shields and pushbutton catch control.

Bumpers: of new design, without rubber pads.

Bright metal step moulding below doors.

Bright metal moulding on drip channels.

Ventilator pane lock handle fitted with safety pushbutton.

Front bucket seats: of new design with back rest catching device.

Rear bench seat: with fixed-type back rest.

Imitation leather headlining.

Trim panel underwaist: of new design.

Plastic garnish mouldings below side windows.

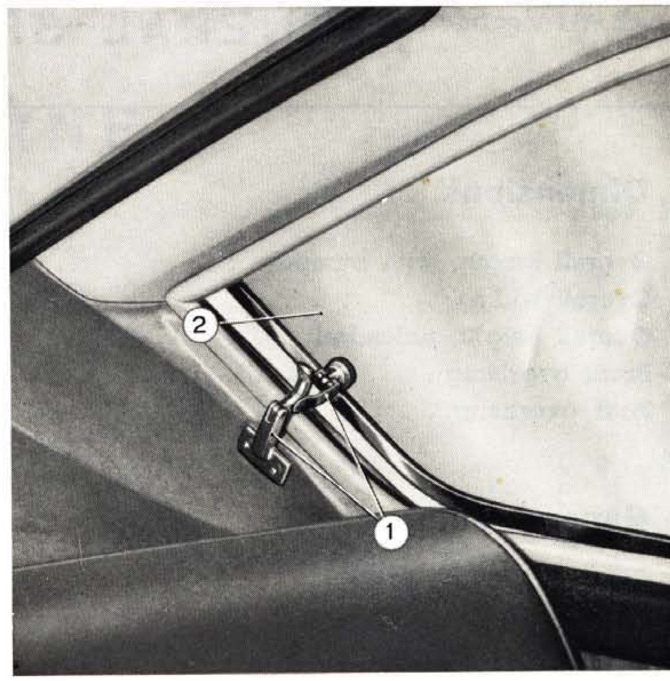



**Fig. 419 - Detail of rear quarter door window adjuster.**
1. Adjuster. - 2. Rear quarter door window.

Instrument panel: of new design, with imitation wood plastic laminate linings throughout the mid-strip.

Foot rest: beside clutch pedal.

Ash receiver: on floor tunnel, for use of rear passengers.

Outer door handles: of new design (snap type).

Ornament and name plate on front end: of new design.


**Fig. 420 - Detail of front seat back rest catch.**
1. Catch release utton. - 2. Striker plate.

# GENERAL SPECIFICATIONS

## Dimensions.

| | |
|---|---|
| Overall length, with bumpers | 142.05″ (3,608 mm) |
| Overall width | 59.05″ (1,500 mm) |
| Overall height, unloaded | 51.18″ (1,300 mm) |
| Front overhang | 27.60″ ( 701 mm) |
| Rear overhang | 34.64″ ( 880 mm) |

## General Data.

| | |
|---|---|
| Wheelbase | 79.80″ (2,027 mm) |
| Front tread, on ground | 45.59″ (1,158 mm) |
| Rear tread | 47.72″ (1,212 mm) |
| Minimum ground clearance, loaded | 5.31″ ( 135 mm) |
| Turning circle diameter | 31 ½ ft (9,600 mm) |

## Weights.

| | |
|---|---|
| Curb weight (with water, oil, petrol, spare wheel, tool kit and accessories) | 1,587 lbs ( 720 kg) |
| Carrying capacity | two plus two people |
| Payload | 705 lbs ( 320 kg) |
| Loaded weight (passengers plus 88 lbs - 40 kg luggage) | 2,293 lbs (1,040 kg) |
| Distribution of loaded weight: | |
| – front axle | 904 lbs ( 410 kg) |
| – rear axle | 1,389 lbs ( 630 kg) |

## Performance.

| | |
|---|---|
| **Speeds**, maximum, on flat road (run-in and fully loaded): | |
| first gear | 22 mph ( 35 km/h) |
| second gear | 40 mph ( 65 km/h) |
| third gear | 59 mph ( 95 km/h) |
| fourth gear, over | 84 mph (135 km/h) |
| reverse | 22 mph ( 35 km/h) |
| **Gradients**, maximum climbable (run-in and fully loaded): | |
| first gear | 36% |
| second gear | 19% |
| third gear | 11.5% |
| fourth gear | 6.5% |
| reverse | 36% |

In this section are outlined exclusively service data and procedures of units differing from Sedan Version.

# ENGINE



## PISTONS

The shape of piston crown and the machining allowance of skirt are shown in fig. 421.

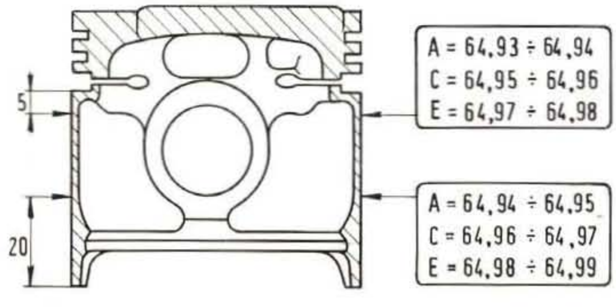



Fig. 421 - Skirt diameter (metric) of 100GC.000 engine measured at class grading points.
5 = .197" - 20 = .787"

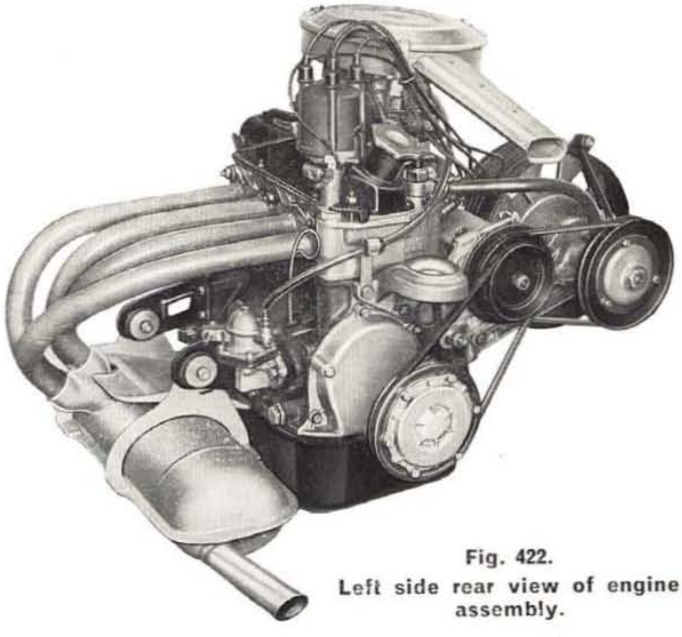


Fig. 422.
Left side rear view of engine assembly.

## MAIN SPECIFICATIONS OF ENGINE

| | |
|---|---|
| Engine type | 100 GC.000 |
| Cycle and strokes | Otto, four-stroke |
| Number of cylinders, in-line | 4 |
| Bore | 2.559" (65 mm) |
| Stroke | 2.500" (63.5 mm) |
| Displacement | 51.44 cu.in (843 cc) |
| Compression ratio | 9.3 |
| Maximum horsepower, DIN standards | 47 |
| at | 6,200 rpm |
| Maximum horsepower, SAE standards | 52 |
| at | 6,400 rpm |
| Maximum torque, DIN standards | 44.1 ft.lbs (610 kgcm) |
| at | 3,600 rpm |
| Maximum torque, SAE standards | 45.6 ft.lbs (630 kgcm) |
| at | 4,000 rpm |
| Taxable horsepower (Italy) | 11 |
| Timing | valves-in-head |
| Weber dual throat carburetor, type | 30 DIC 1 |

## CON RODS

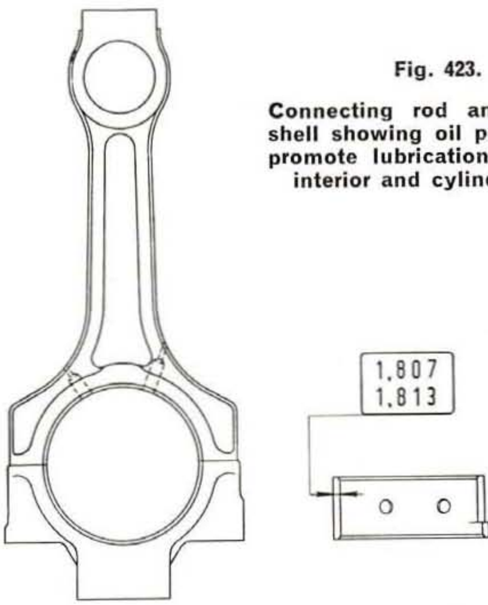



**Fig. 423.**

**Connecting rod and bearing shell showing oil passages to promote lubrication of piston interior and cylinder walt.**

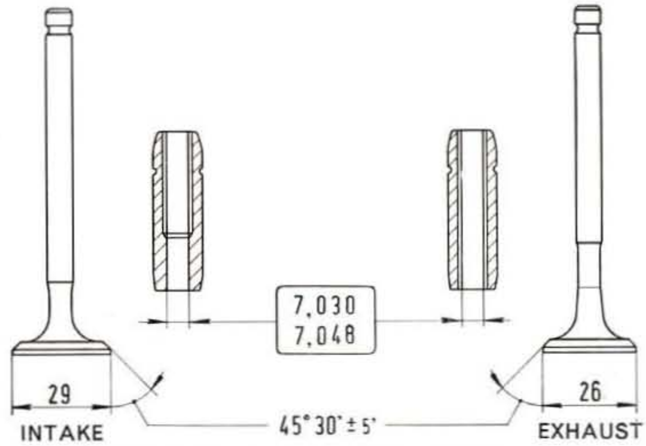



**Fig. 425 - Critical dimensions (metric) of intake and exhaust valves and valve guides.**

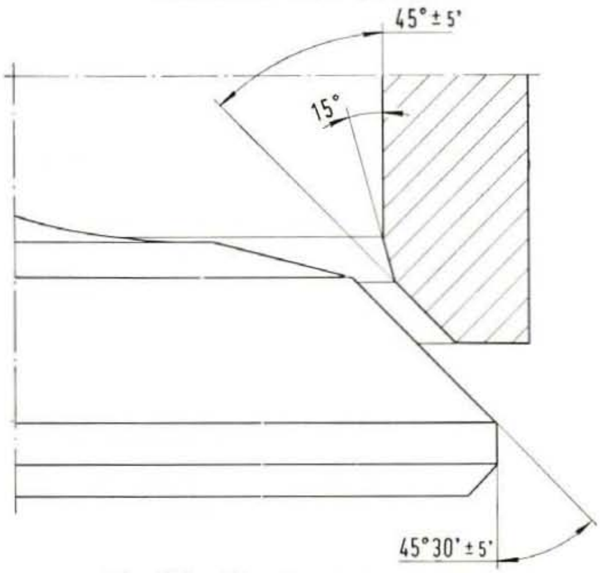



**Fig. 426 - Fits of valves to seats.**

## VALVES - VALVE SEATS - SPRINGS

**Intake:**

- valve head diameter . . . . . 1.142" (29 mm)
- valve seat diameter . . . . . 1.024" (26 mm)

**Exhaust:**

- valve head diameter . . . . . 1.024" (26 mm)
- valve seat diameter . . . . . .905" (23 mm)

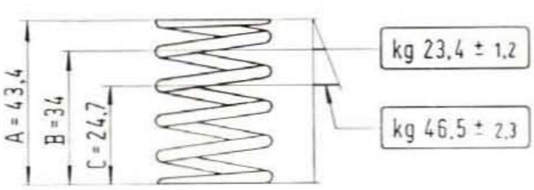



**Fig. 424 - Outer valve spring specifications.**

43,4 = 1.709" - 34 = 1.339" - 24,7 = .972" - kg 23,4±1,2 = 51.6±2.6 lbs
kg 46,5±2,3 = 102.5±5.1 lbs.

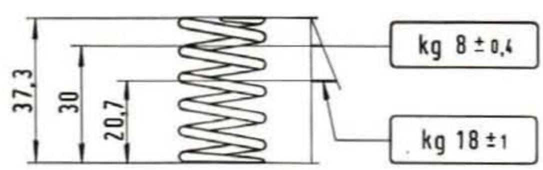



**Fig. 427 - Inner valve spring specifications.**

Up to engine No. 425696.

37,3 = 1.468" - 30 = 1.181" - 20,7 = .815" - kg 8±0,4 = 17.6±.9 lbs
kg 18±1 = 39.7±2.2 lbs.

### VALVE SPRING SPECIFICATIONS

| Description | Part Number | Working Turns | Total Turns | Inside Diam. | Wire Diam. | A | B | | C | | Minimum Load Referred to B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Outer Spring | 4127537 (1) 4139657 (2) | 4 5 | 5½ 6½ | .823" (20.9 mm) | .142" (3.6 mm) | 1.709" (43.4 mm) | 1.339" (34 mm) | 51.6 lbs (23.4 kg) | .972" (24.7 mm) | 102.5 lbs (46.5 kg) | 46.3 lbs (21 kg) |
| Inner Spring | 4127538 (3) 4139658 (4) | 6¾ | 8¼ | .539" (13.7 mm) | .091" (2.3 mm) | 1.468" (37.3 mm) | 1.181" (30 mm) | 17.6 lbs (8 kg) | .815" (20.7 mm) | 39.7 lbs (18 kg) | 15.4 lbs (7 kg) |
| | 4159353 (5) | 7½ | 9 | .555 (14.1 mm) | .088" (2.1 mm) | 1.563" (39.7 mm) | 1.181" (30 mm) | 14.1 lbs (6.4 kg.) | .815" (20.7 mm) | 27.5 lbs (12.5 kg.) | 12.3 lbs (5.6 kg.) |

A = Free length. B - C = Length and load for spring check.

(1) Up to engine N°. 425696. (2) Starting from engine N°. 425697. (3) Up to engine N°. 425696. (4) Starting from engine N°. 739352 and up to No. 865939. (5) From engine No. 865940.

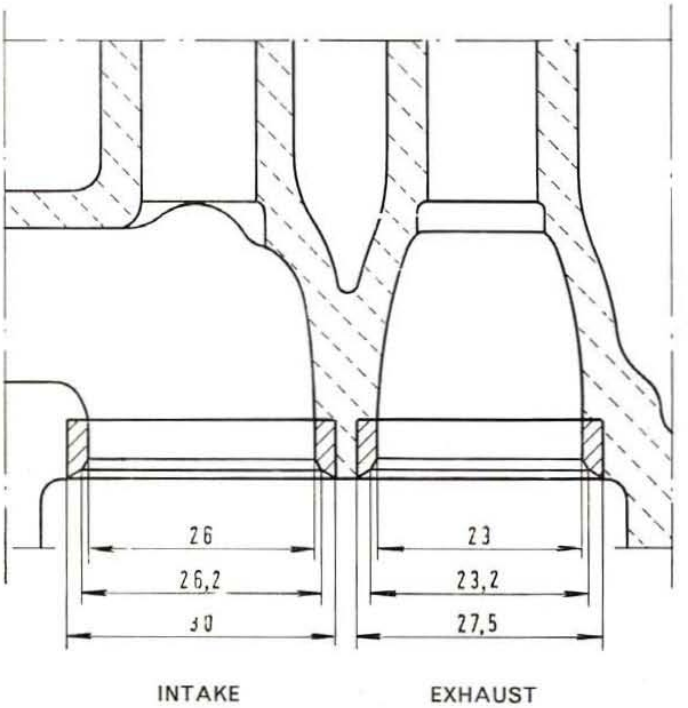



**Fig. 428 - Diameters of intake and exhaust valve seats in head.**
26 = 1.024" - 26,2 = 1.031" - 30 = 1.181" - 23 = .905" - 23,2 = .913" - 27,5 = 1.083".

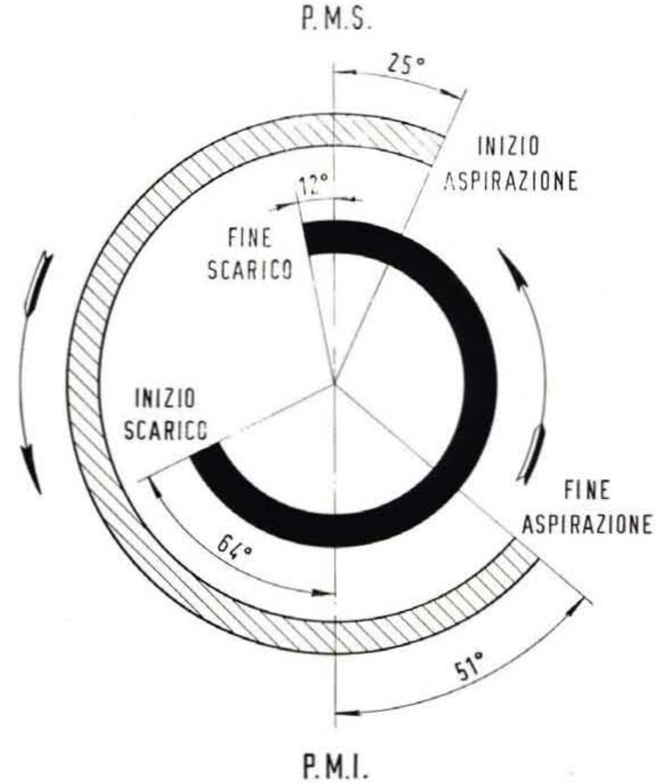



**Fig. 429 - Valve timing diagram at increased tappet clearance of .0148" (0.375 mm).**

Inizio scarico = Exhaust opens
Fine scarico = Exhaust closes
Inizio aspirazione = Intake opens
Fine aspirazione = Intake closes
P.M.S. = T.D.C.
P.M.I. = B.D.C.

## VALVE GEAR

**Intake:**

- opens, B.T.D.C. . . . . . . . . . . . . . 25°
- closes, A.B.D.C. . . . . . . . . . . . . . 51°

**Exhaust:**

- opens, B.B.D.C. . . . . . . . . . . . . 64°
- closes, A.T.D.C. . . . . . . . . . . . . 12°

Tappet clearance for timing check .0148" (0.375 mm)
Tappet clearance, **cold:**

- intake . . . . . . . . . . . . .006" (0.15 mm)
- exhaust . . . . . . . . . . . .008" (0.20 mm)

**NOTE - Rocker shaft stud nuts must be drawn up with 36.2 ft.lbs (5 kgm) of torque.**

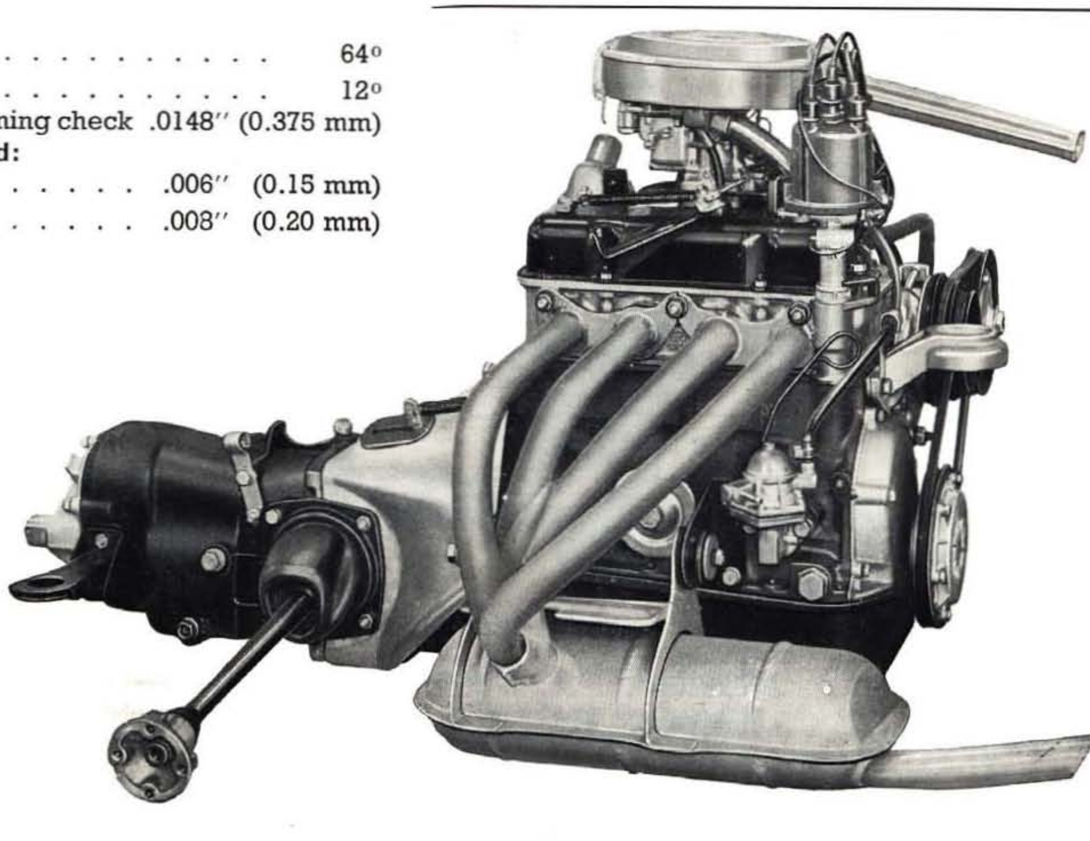


**Fig. 430.**

**Power plant and differential unit.**

# SPECIFICATIONS AND FITS OF NEW PARTS

## CONNECTING RODS - BEARING INSERTS

| DESCRIPTION | in | mm |
|---|---|---|
| Thickness of standard con rod shells | .0711 to .0713 | 1.807 to 1.813 |
| Connecting rod bearing shell-to-journal: | | |
| – clearance of new parts | .0010 to .0028 | 0.026 to 0.071 |

## PISTONS

| DESCRIPTION | | in | mm |
|---|---|---|---|
| Standard piston diameter, at right angle to pin: | | | |
| – .197″ (5 mm) apart from skirt top | Class A | 2.5563 to 2.5567 | 64.930 to 64.940 |
| | Class C | 2.5571 to 2.5575 | 64.950 to 64.960 |
| | Class E | 2.5579 to 2.5583 | 64.970 to 64.980 |
| – .787″ (20 mm) apart from skirt bottom | Class A | 2.5567 to 2.5571 | 64.940 to 64.950 |
| | Class C | 2.5575 to 2.5579 | 64.960 to 64.970 |
| | Class E | 2.5583 to 2.5587 | 64.980 to 64.990 |
| Width of piston ring grooves | first groove | .0703 to .0709 | 1.785 to 1.800 |
| | second groove | .0793 to .0799 | 2.015 to 2.030 |
| | third groove | .1558 to .1564 | 3.957 to 3.972 |
| Piston fit in cylinder, at right angle to pin: | | | |
| – .197″ (5 mm) apart from skirt top | | .0024 to .0031 | 0.060 to 0.080 |
| – .787″ (20 mm) apart from skirt bottom | | .0020 to .0028 | 0.050 to 0.070 |
| Piston ring fit to groove land (vertically): | | | |
| – first compression ring: clearance of new parts | | .0018 to .0028 | 0.045 to 0.072 |
| – second step-cut oil ring: clearance of new parts | | .0010 to .0020 | 0.025 to 0.052 |
| – third radial-slotted oil ring: clearance of new parts | | .0011 to .0028 | 0.027 to 0.072 |

## CYLINDER HEAD - VALVES - GUIDES - SPRINGS

| DESCRIPTION | | in | mm |
|---|---|---|---|
| Bore of valve guides fitted in head | | .2768 to .2775 | 7.030 to 7.048 |
| Valve stem-to guide fit: | | | |
| – clearance of new parts | | .0012 to .0025 | 0.030 to 0.063 |
| Valve head diameter | intake | 1.142 | 29 |
| | exhaust | 1.024 | 26 |
| Valve seat I. D. | intake | 1.024 | 26 |
| | exhaust | .905 | 23 |

*(continued)*

**Cylinder Head - Valves - Guides - Springs** *(continued).*

| | | | |
|---|---|---|---|
| Valve spring I. D. | inner spring (*) | .539 | 13.7 |
| | outer spring | .823 | 20.9 |
| Free length | inner spring (*) | 1.468 | 37.3 |
| | outer spring | 1.709 | 43.4 |
| Seated length, valve closed: | | | |
| – inner spring, under 17.6±.9 lbs (8±0.4 kg) of load (*) | | 1.181 | 30 |
| – outer spring, under 51.6±2.6 lbs (23.4±1.2 kg) of load | | 1.339 | 34 |
| Seated length, valve open: | | | |
| – inner spring, under 39.7±2.2 lbs (18±1 kg) of load (*) | | .815 | 20.7 |
| – outer spring, under 102.5±5.1 lbs (46.5±2.3 kg) of load | | .972 | 24.7 |
| Minimum permissible load with seated springs: | | | |
| – inner spring (length 1.181" - 30 mm) (*) | | 15.4 lbs | 7 kg |
| – outer spring (length 1.339" - 34 mm) | | 46.3 lbs | 21 kg |
| Valve lift (touch fit) | | .346 | 8.8 |

(*) The inner spring has been suppressed starting from engine No. 425697 and reinstated from engine N° 739352 (see page 272).

# FUEL SYSTEM

## CARBURETOR

The Weber carburetor type 30 DIC 1 is of the dual throat design with a barrel bore of 1.181" (30 mm).

This carburetor is equipped with:

– mechanically controlled choke type easy starting device;

– super-feeder device;

– accelerator pump.

## Operation.

From the diagram in figure 431 it will be seen that the fuel flows past the needle valve (1) into the bowl (17), where the float controls the opening of the needle (2) and maintains a constant fuel level: the needle (2) is attached to the arm of the float (19) by means of the return hook (20).

From the bowl (17) fuel, controlled by the main jets (18), reaches the well (15) past the ducts (16).

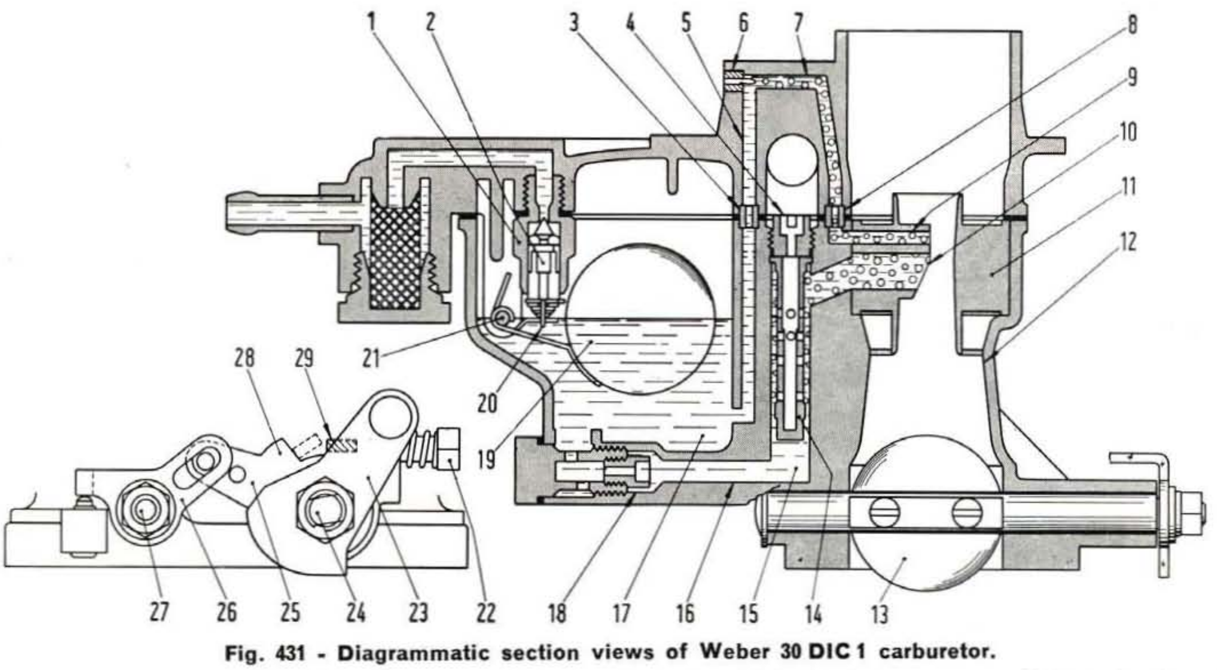



**Fig. 431 - Diagrammatic section views of Weber 30 DIC 1 carburetor.**

1. Needle valve. - 2. Needle. - 3. Calibrated bushing. - 4. Air bleed jet. - 5. Super-feeder device passage. - 6. Calibrated orifice. - 7. Superfeeder mixture delivery passage. - 8. Calibrated bushing. - 9. Super-feeder nozzle. - 10. Discharge tube. - 11. Auxiliary Venturi. - 12. Primary Venturi. - 13. Secondary throttle valve. - 14. Emulsion tube. - 15. Well. - 16. Main jet duct. - 17. Bowl. - 18. Main jet. - 19. Float. - 20. Float return hook. - 21. Float pivot pin. - 22. Throttle stop screw. - 23. Throttles control lever. - 24. Primary shaft. - 25. Idler lever. - 26. Secondary shaft control lever. - 27. Secondary shaft. - 28. Idler lever lug. - 29. Throttles control lever lug.

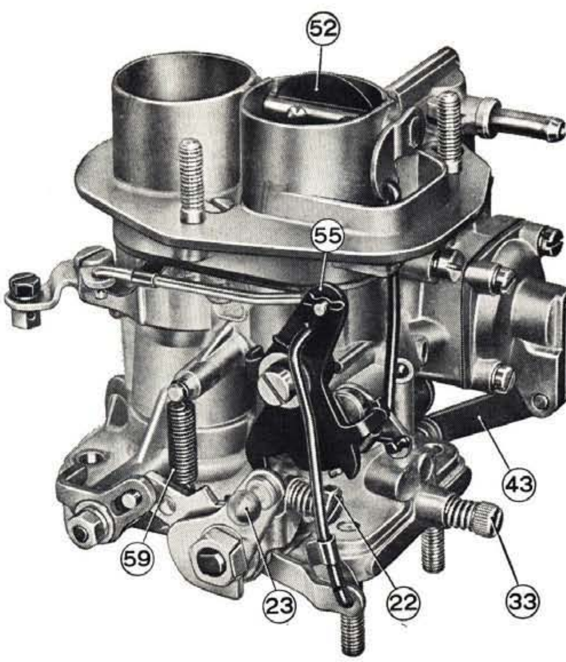



**Fig. 432 - Carburetor viewed from the throttles control end.**

22. Throttle stop screw. - 23. Throttles control lever. - 33. Idle volume control screw. - 43. Accelerator pump control lever. - 52. Choke throttle valve. - 55. Choke control lever. - 59. Primary sector return spring.

Fuel in the wells mixes with the air from the bleed jets (4) issuing from the opening in the emulsion tubes (14), then, past the discharge tubes (10), it is advanced to the carburetion cone consisting of the auxiliary Venturis (11) and the primary Venturis (12).

The secondary throat includes the **super-feeder device:** the fuel from the bowl (17) is metered by the calibrated bushing (3) and blends with the air from the calibrated orifice (6).

During high speed operation with wide open throttles, the mixture streaming past the passage (7) and calibrated bushing (8) is drawn into the secondary throat through the super-feeder nozzle (9).

Fig. 431 illustrates also the differential opening device of throttle valves.

When the throttles control lever (23) is actuated, the lug (29) of the sector attached solidly to the primary shaft (24) at first rides free and the primary throttle opens through a corresponding angle, whereas the secondary throttle working on shaft (27), remains closed.

Subsequently the lug (29) abuts against the lug (28) of the idler lever (25) which will cause the lever (26) to rotate the secondary shaft (27) until both throttle valves are simultaneously wide open.

The primary throttle stop screw (22) is situated on the idler lever (25).

While **idling,** the fuel is passaged from the primary well (15, fig. 431) to the idling jet (31, fig. 435) where it blends with the air from the calibrated bushing. Hence, through the idling feed passage and orifice which can be adjusted by means of the screw (33), fuel reaches the primary throat downstream of the throttle (35, fig. 433) where mixture is also conveyed from the idle transfer port located in exact relation to the primary throttle, thus enabling the engine to accelerate evenly from the idling speed.

When the secondary throttle (13, fig. 431) is opened, the fuel flows from the secondary well (15) to the idling jet (31, fig. 435) where it blends with the air from the calibrated bushing and eventually

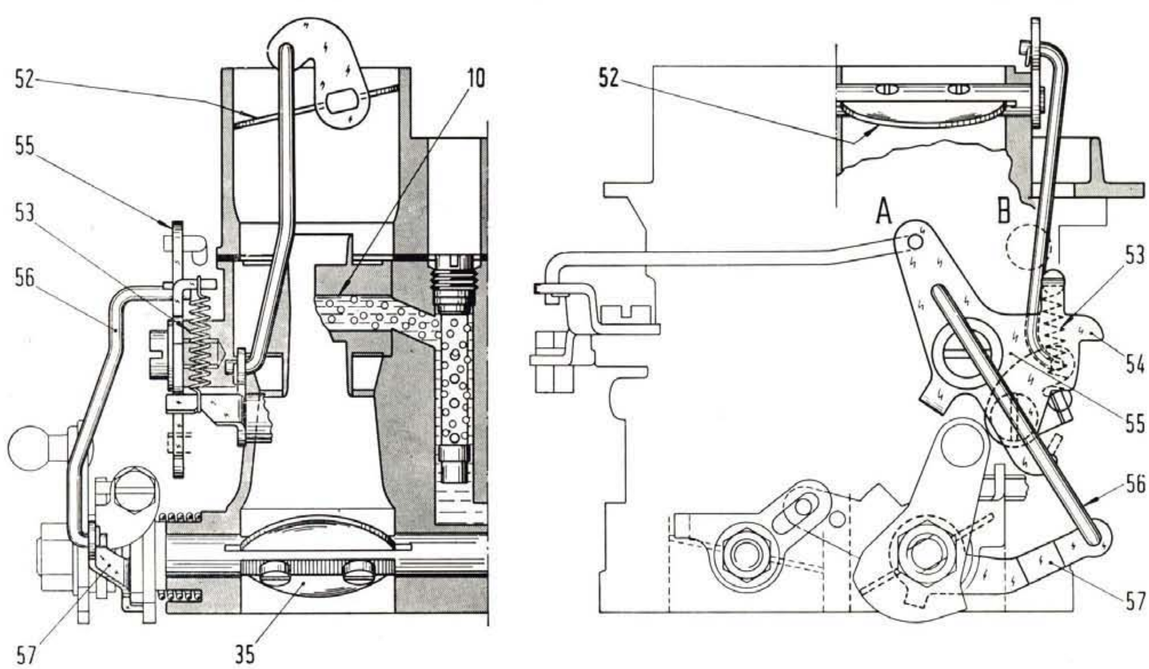



**Fig. 433 - Diagrammatic section views of Weber 30 DIC 1 carburetor.**

10. Discharge tube. - 35. Primary throttle valve. - 52. Choke throttle valve. - 53. Choke return spring. - 54. Choke control lever lug. - 55. Choke control lever. - 56. Primary throttle control lever rod. - 57. Primary throttle control lever.
A. Easy starting device (choke) in. - B. Easy starting device (choke) out.

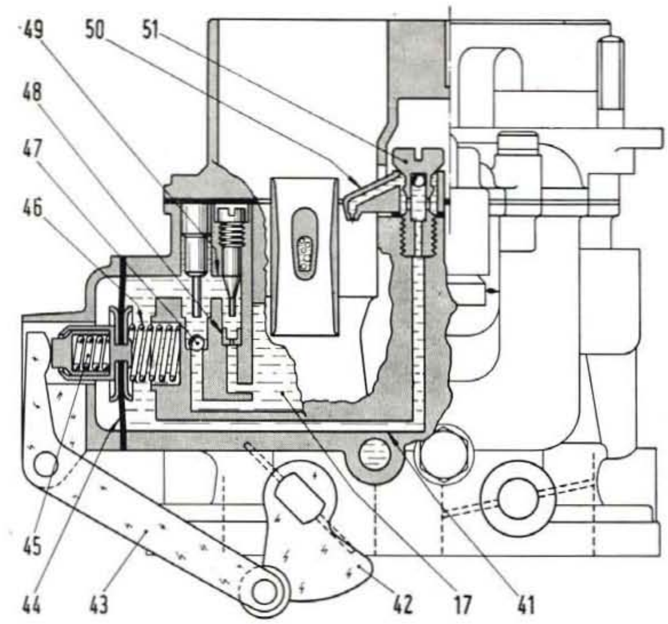



**Fig. 434 - Diagrammatic sections of Weber 30 DIC 1 carburetor.**

17. Bowl. - 41. Primary throat fuel delivery passage. - 42. Primary throttle shaft cam. - 43. Accelerator pump control lever. - 44. Accelerator pump diaphragm. - 45-46. Diaphragm springs (outer and inner). - 47. Ball valve. - 48. Calibrated bushing. - 49. Pump fuel recirculation passage. - 50. Pump jet. - 51. Delivery valve.

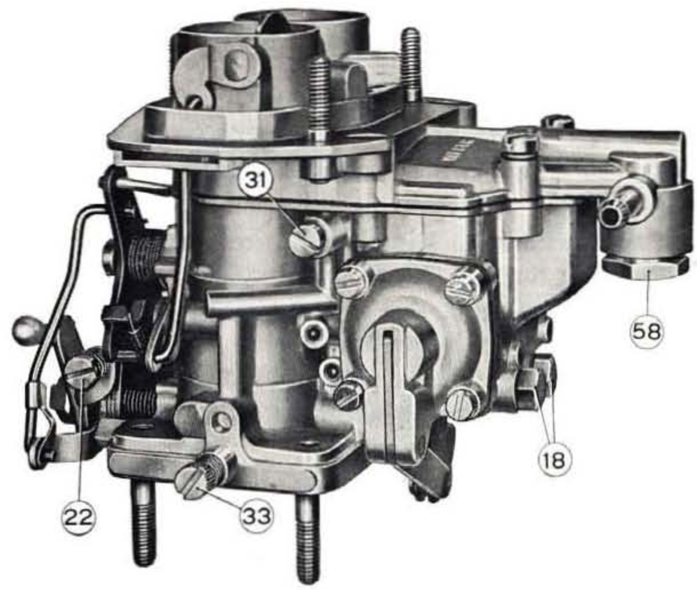



**Fig. 435 - Carburetor viewed from the volume control screw end.**

18. Main jets. - 22. Throttle stop screw. - 31. Idle jet. - 33. Volume control screw. - 58. Strainer inspection plug.

is passaged to discharge into the secondary throat through idle transfer orifices.

**The accelerator pump** (fig. 434) ensures smooth acceleration of the engine when the throttles are opened suddenly.

When the throttles are closed, the lever (43) is released and the diaphragm (44) actuated by the spring (46) causes fuel to be drawn from the bowl (17) through the suction ball valve (47). When the throttles are opened, the combined action of the cam (42) and lever (43) urges the diaphragm (44) to inject fuel into the primary throat of the carburetor via the passage (41), the delivery valve (51) and the pump jet (50). With wide open throttles, the spring (45) will move the diaphragm (44) further on, thus obtaining an additional amount of fuel to be discharged into the primary throat.

Fuel delivered in excess by the accelerator pump is recirculated to the bowl (17) through the passage (49) and the calibrated bushing (48).

**The easy starting device** is controlled by a knob on floor tunnel.

When the control knob is pulled out to its fullest extent, the lever (55, fig. 433) shifts to the position

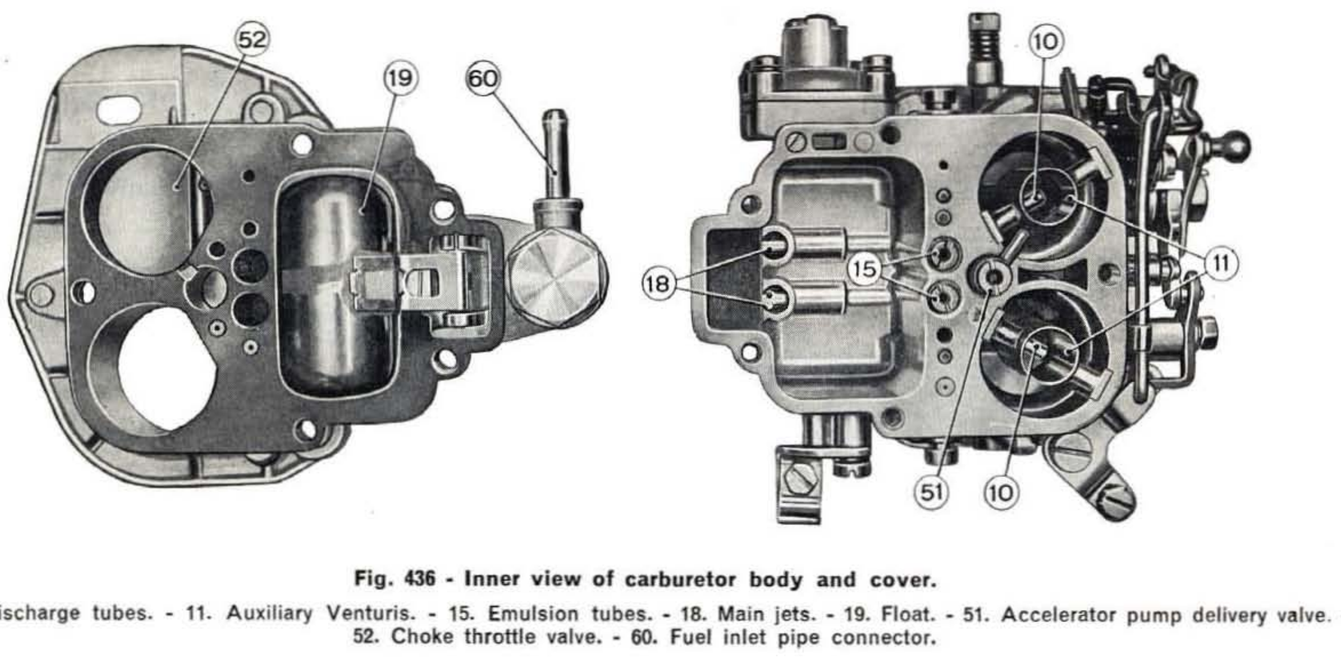



**Fig. 436 - Inner view of carburetor body and cover.**

10. Discharge tubes. - 11. Auxiliary Venturis. - 15. Emulsion tubes. - 18. Main jets. - 19. Float. - 51. Accelerator pump delivery valve. - 52. Choke throttle valve. - 60. Fuel inlet pipe connector.

« **A** » and the throttle (52) blocks the air suction to the primary throat while the throttle (35) is brought ajar by the rod (56) and lever (57).

The discharge tube (10) is thus delivering a high rated mixture which enables quick starting of engine.

Once the engine has started, the suction vacuum causes the throttle (52) to open partially against the spring (53) so that the mixture delivered will be reach enough to enable the engine to run properly although cold. When the engine begins to warm up, the choke throttle (52) should be opened gradually.

As soon as the rated temperature of the engine has been reached the easy starting device must be cut off (position « **B** »). The choke throttle (52) is held in the wide open position by the lever lug (54), while the throttle (35) returns to idle.

## Instructions for Using the Easy Starting Device.

### STARTING COLD ENGINE

Pull the easy starting knob on floor tunnel all the way out to throw in the choke device (position « **A** », fig. 433).

### WARMING UP ENGINE

During this period, whether the vehicle is stationary or moving, the knob should be returned gradually and with short pauses to the off position, thus ensuring that the starting mixture supplied to the cylinders is never in excess of the engine's actual requirements.

### ENGINE RUNNING NORMALLY

As soon as the normal engine temperature is reached the control knob should be fully returned to the closed position (« **B** ») thus cutting off the choke device.

## CARBURETOR SETTING DATA

| | Primary Throat | Secondary Throat |
|---|---|---|
| Type | Weber 30 DIC 1, dual barrel | |
| Throat bore | 1.181″ ( 30 mm) | 1.181″ ( 30 mm) |
| Primary Venturi | .827″ ( 21 mm) | .905″ ( 23 mm) |
| Main jet | .045″ (1.15 mm) | .045″ (1.15 mm) |
| Idling jet | .018″ (0.45 mm) | .020″ (0.50 mm) |
| Air bleed jet | .073″ (1.85 mm) | .073″ (1.85 mm) |
| Accelerator pump jet | .016″ (0.40 mm) | |
| Pump recirculation orifice | .016″ (0.40 mm) | |
| Needle valve | .059″ (1.50 mm) | |
| Super-feeder device | .043″ (1.10 mm) | |
| Easy starting device | choke throttle valve | |
| Float level (with gasket) | .236″ ( 6 mm) | |

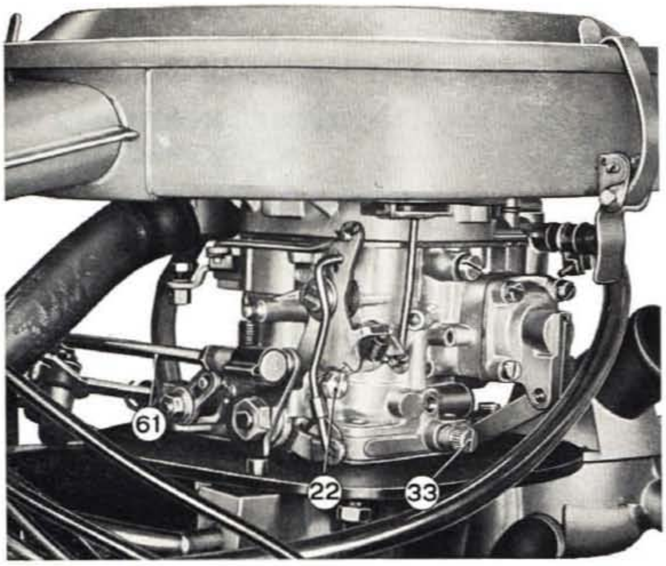



**Fig. 437 - Carburetor in place on engine.**

22. Throttle stop screw. - 33. Volume control screw. - 61. Throttles control rod.

## Idling Adjustment.

Idling adjustment should be carried out with the engine warm and running by first of all adjusting the throttle stop screw (22, fig. 437) to a point where the engine does not falter and then adjusting the volume control screw (33) to obtain the mixture which gives the highest regular engine speed at the selected degree of throttle restriction. Finally, further narrow the throttle opening to the best idle speed and control the rate of the mixture with the screw (33).

## ENGINE BENCH TEST

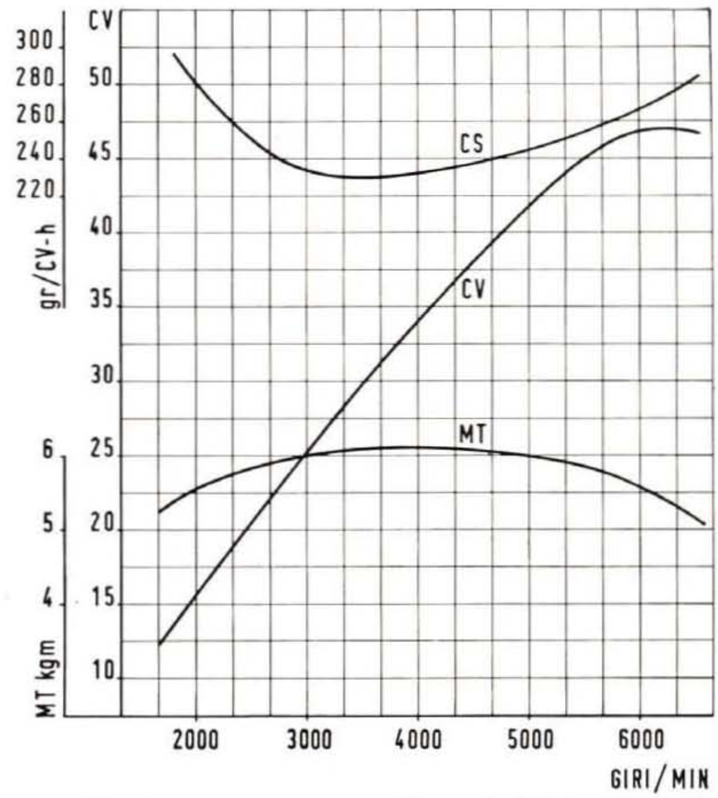



**Fig. 438 - Horsepower, consumption and torque curves of 100 GC.000 engine.**

Corrected horsepower curve shown in figure refers to a rebuilt and run-in engine with fan, air cleaner and muffler.

CS = Consumption - CV = H.P. - MT = Torque - GIRI/MIN = r.p.m.

**When bench testing a rebuilt engine, avoid revving it up but comply with data tabulated on page 70.**

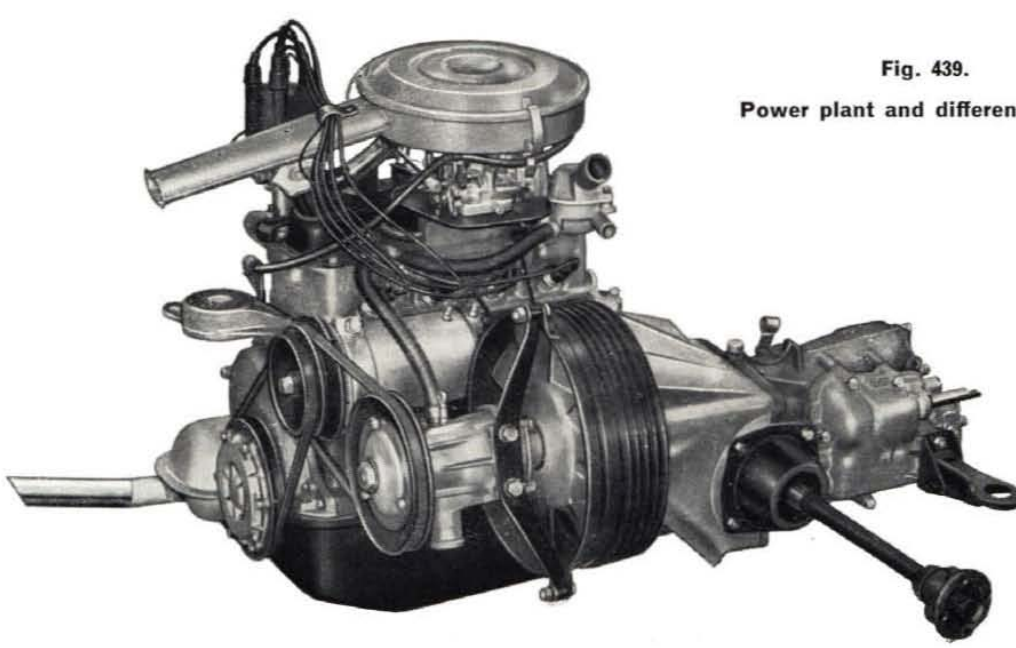


**Fig. 439.**

**Power plant and differential unit.**

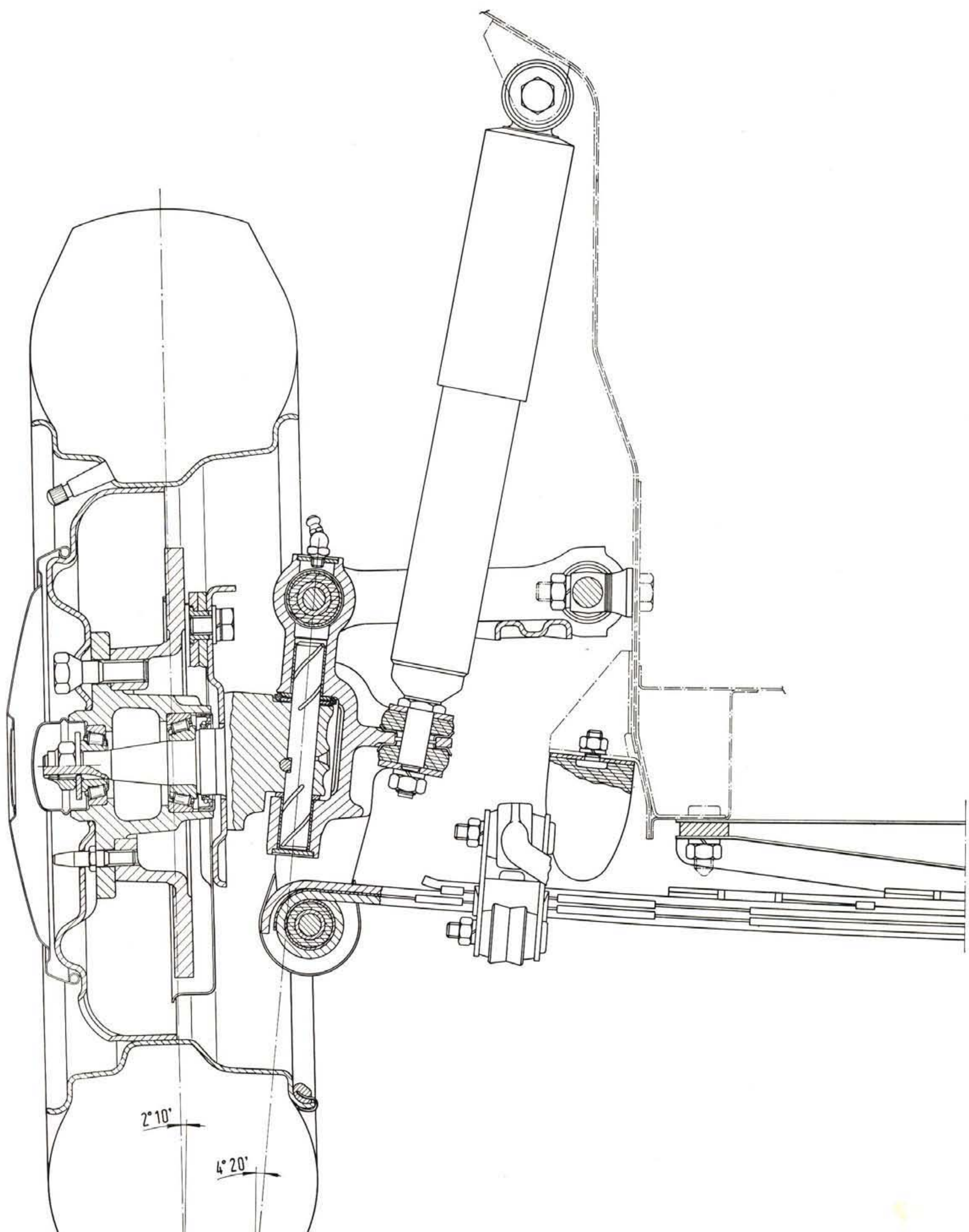



**Fig. 440 - Sectional view of left side front suspension and wheel assembly.**

Front wheel camber is $2^{\circ}10' \pm 20'$ with fully loaded car and $1^{\circ} \pm 15'$ with unloaded car. The kingpin angle is $4^{\circ}20' \pm 20'$ and caster $9^{\circ} \pm 1^{\circ}$.

# CHASSIS



## TRANSMISSION - DIFFERENTIAL

| | | | | | |
|---|---|---|---|---|---|
| Final drive gear ratio 4.875 to 1 (8/39) . | | | | | |
| Final ratios at wheels: | | | | | |
| — Gears | first | second | third | fourth | reverse |
| — Reduction ratio | 17.720 to 1 | 10.020 to 1 | 6.870 to 1 | 4.690 to 1 | 17.620 to 1 |

## FRONT SUSPENSION

### SPECIFICATIONS OF CENTER LOADED SPRING

| ITEM | | Load P | Camber | Camber in 2nd Position | Deflection Rate |
|---|---|---|---|---|---|
| 1st | Initial load for checking deflection rate . . . | 441 lbs (200 kg) | 1.063″ ±.118″ (27 ±3 mm) | — | |
| 2nd | Static load . . . . . . | 661 lbs (300 kg) | — | 2.008″ ±.157″ (51 ±4 mm) | .910 ±.071 in/100 lbs (51 ±4 mm/100 kg) |
| 3rd | Settled load . . . . . . | 1,036 lbs (470 kg) | — | — | |

NOTE - This spring is identified by a white paint daub to avoid that it may be mixed in error with the Sedan front suspension spring.

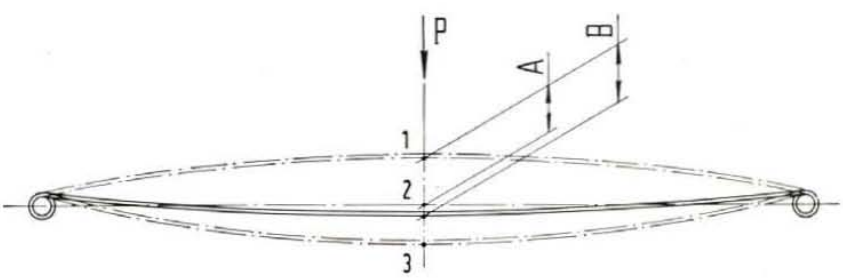



**Fig. 441.**

**Checking data of semi-elliptic spring loaded at center.**

1. Load P = 441 lbs (200 kg)
2. Load P = 661 lbs (300 kg)
3. Load P = 1,036 lbs (470 kg)

A = 1.063″ ±.118″ (27 ±3 mm)
B = 2.008″ ±.157″ (51 ±4 mm)

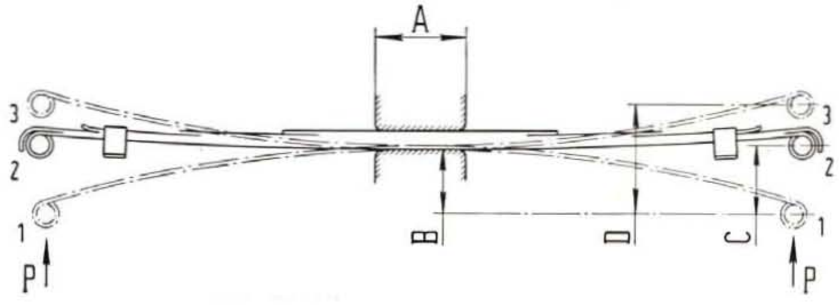



**Fig. 442.**

**Checking data of semi-elliptic spring as fitted on car.**

1. Load P = 220 lbs (100 kg)
2. Load P = 331 lbs (150 kg)
3. Load P = 573 lbs (260 kg)

A = 6.378″ (162 mm)
B = 1.063″ ±.118″ ( 27 ±3 mm)
C = 1.516″ ±.118″ ( 38.5 ±3 mm)
D = 4.850″ ±.394″ (123.2 ±10 mm)

## SPECIFICATIONS OF SPRING AS FITTED ON CAR

| ITEM | | Load P | Camber | Camber in 2nd and 3rd Positions | Deflection Rate | NOTE |
|---|---|---|---|---|---|---|
| 1st | Initial load for checking deflection rate | 220 lbs (100 kg) | 1.063" ±.118" (27 ±3 mm) | — | 1.374 ±.109 in/100 lbs (77 ±6.1 mm/100 kg) | Specifications refer to a spring in the same conditions as on car, or anchored at center. Camber in 2nd and 3rd positions should be checked loading both end eyes of spring simultaneously |
| 2nd | Static load . . . . | 331 lbs (150 kg) | — | 1.516" ±.118" (38.5 ±3 mm) | | |
| 3rd | Settled load . . . | 573 lbs (260 kg) | — | 4.850" ±.394" (123.2 ±10 mm) | | |

## FRONT SHOCK ABSORBERS

Hydraulic shock absorbers at front differ only in the setting as follows:

| SETTING DATA | |
|---|---|
| — Compression | .118" ±.039" (3 ±1 mm) |
| — Rebound . . | .413" ±.059" (10.5 ±1.5 mm) |

# REAR SUSPENSION

## COIL SPRINGS

Coil spring specifications:

- Free height . . . . . . . . . . 9.291" (236 mm)
- Height under 1,135 lbs (515 kg) of load . . . . . . . . . . . 6.653" (169 mm)
- Height under 1,695 lbs (769 kg) of load . . . . . . . . . . . 5.354" (136 mm)
- Deflection rate (between 705 and 1,499 lbs - 320 and 680 kg) .232 in/100 lbs (13 mm/100 kg).

**NOTE - These springs are identified by a white paint daub to avoid that they may be mixed in error with Sedan rear springs.**

**Moreover, coil springs are marked in production with a daub of green or yellow paint and colours should be paired on assembly.**

# STEERING

In figures 443 and 444 is shown the flexible joint as fitted to the steering column.

## Replacing Steering Column Flexible Joint.

To replace the steering column flexible joint proceed as follows:

- remove the joint shield (fig. 445);

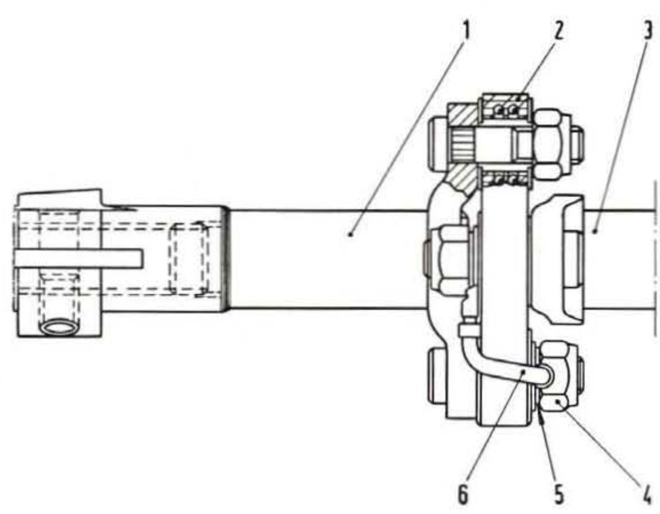



**Fig. 443 - Sectional view of the steering column flexible joint.**

1. Steering column lower section. - 2. Flexible joint. - 3. Steering column upper section. - 4. Nut. - 5. Washer. - 6. Horn ground connection.

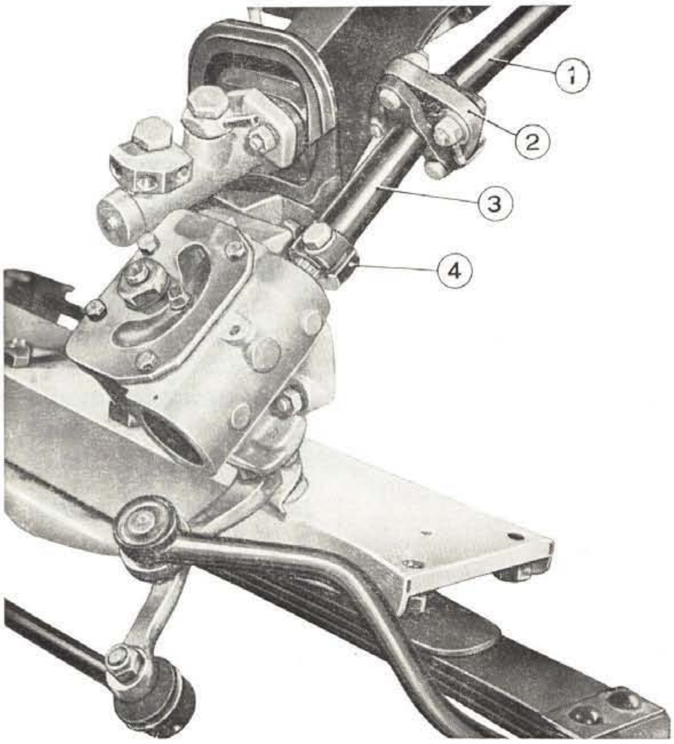



Fig. 444 - Scrap view of the steering system showing the column flexible joint.

1. Steering column upper section. - 2. Flexible joint. - 3. Steering column lower section. - 4. Clamp securing the lower section of column.

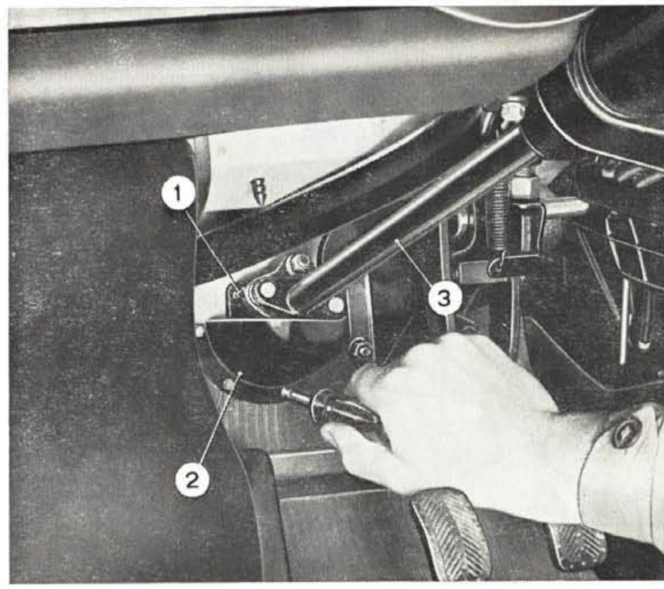



Fig. 445 - Removing steering column joint shield.

1. Steering column flexible joint. - 2. Joint shield. - 3. Upper steering shaft.

– remove both screws which secure the joint and horn ground cable to steering housing sleeve;

– loosen steering column bracket mounting screws to instrument panel;

– working on steering wheel back up the column so that the flexible joint may be slid out easily;

– remove remaining mounting screws and lift out the joint as shown in fig. 445.

**NOTE - In case the steering wheel must be removed from column, see covering procedure on page 301 for the Roadster Version.**

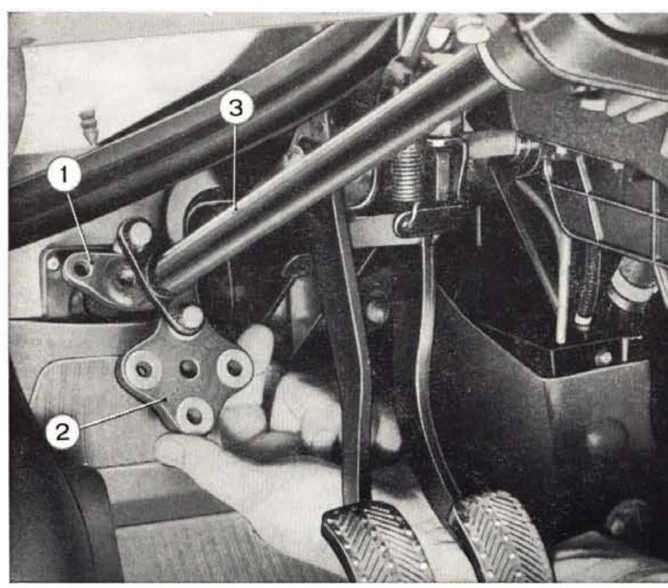



Fig. 446 - Removing steering column joint.

1. Lower steering shaft. - 2. Flexible joint. - 3. Upper steering shaft.

# BRAKES

The calipers of the front disc brakes are of the single cylinder, floating type; in fact they are free to move axially assuring the constant alignment of linings to the brake disc.

Moreover, a special device takes up automatically the lining wear so that the clearance between the disc and linings is kept on a steady level at all times.

**NOTE - Calipers are marked in production with a daub of black paint to avoid that they may be exchanged in error with similar calipers of other Models.**

## NOTE

**From car with No. for spare 801773, shoe-to-drum clearance of rear wheels is automatically adjusted by a self-centering device (as shown in figs. 293 and 294 covering the Sedan version).**

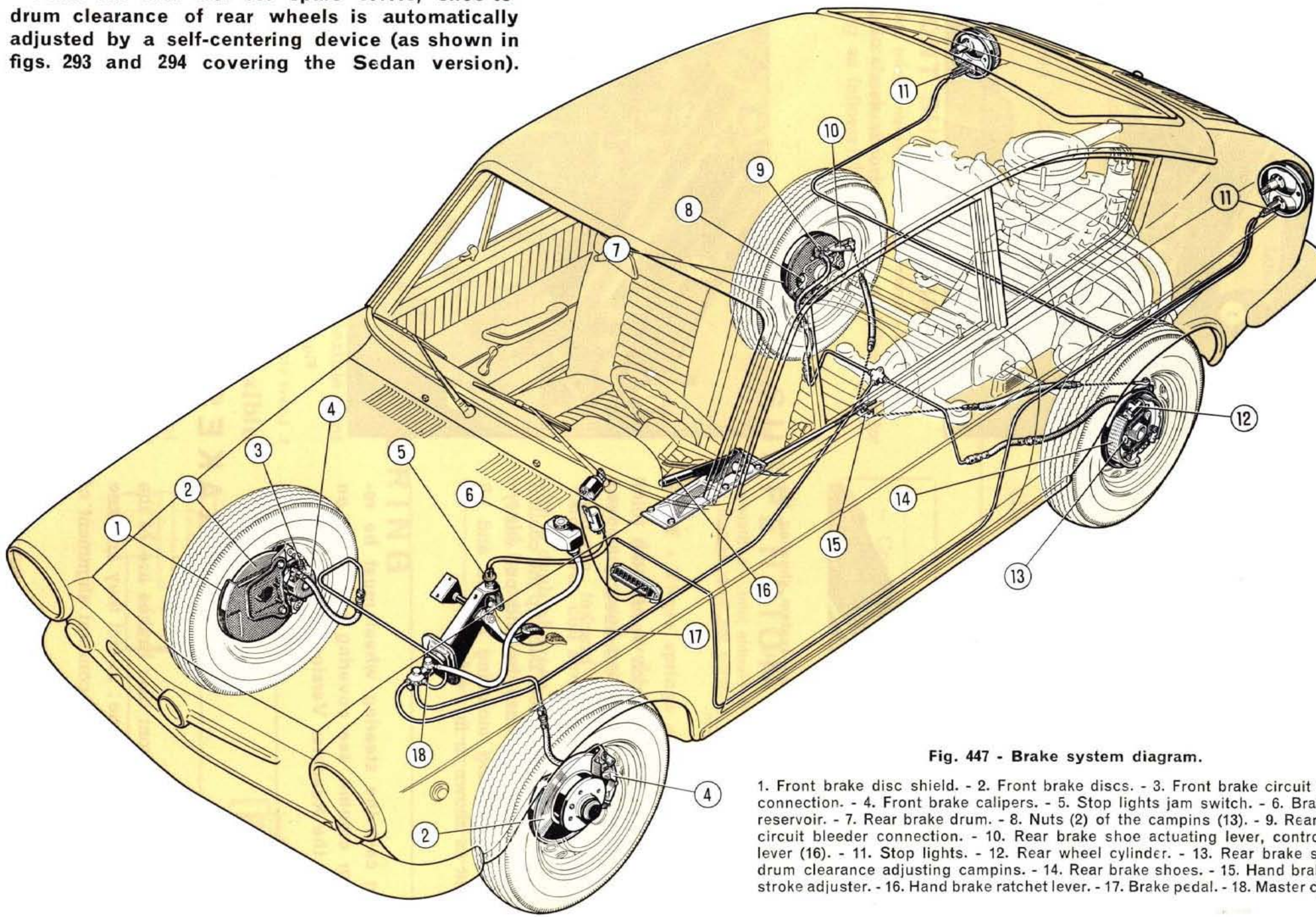



**Fig. 447 - Brake system diagram.**

1. Front brake disc shield. - 2. Front brake discs. - 3. Front brake circuit bleeder connection. - 4. Front brake calipers. - 5. Stop lights jam switch. - 6. Brake fluid reservoir. - 7. Rear brake drum. - 8. Nuts (2) of the campins (13). - 9. Rear brakes circuit bleeder connection. - 10. Rear brake shoe actuating lever, controlled by lever (16). - 11. Stop lights. - 12. Rear wheel cylinder. - 13. Rear brake shoe-to-drum clearance adjusting campins. - 14. Rear brake shoes. - 15. Hand brake lever stroke adjuster. - 16. Hand brake ratchet lever. - 17. Brake pedal. - 18. Master cylinder.

# FRONT BRAKE SPECIFICATIONS

| | |
|---|---|
| Front wheel brakes | disc type with lining pads controlled by a wheel cylinder |
| Disc diameter | 8.898" (226 mm) |
| Working area | 20.46 sq.in (132 $cm^2$) |
| Caliper piston diameter | 1.772" (45 mm) |
| Working clearance of self-adjuster friction ring | .0236" to .0285" (0.600 to 0.725 mm) |
| Minimum thickness of disc after grinding | .374" (9.5 mm) |
| Minimum permissible thickness of disc from wear | .354" (9 mm) |
| Minimum thickness of lining pads | .079" (2 mm) |
| Free travel of brake pedal (for master cylinder operation) | .063" (1.6 mm) |
| Total travel of brake pedal | 5.945" (151 mm) |
| Hydraulic brake fluid — grade | FIAT special « blue label » fluid |
| Hydraulic brake fluid — circuit capacity | .493 pts (G.B.) - .592 pts (U.S.) (0.28 lt) |

## Description.

The disc brake of each front wheel consists of:

– a **disc** rigidly mounted to the wheel hub;

– a **plate** rigidly mounted to the steering knuckle, for anchor of caliper mounting bracket;

– a **caliper mounting bracket** equipped with two clamps retaining the bracket laterally and pivoted to it by pins;

– a **one-piece caliper** which houses the wheel cylinder piston and two lining pads; in caliper interior is also inclosed the automatic adjusting device;

– a **splash shield** protecting the disc side opposite the wheel from foreign material.

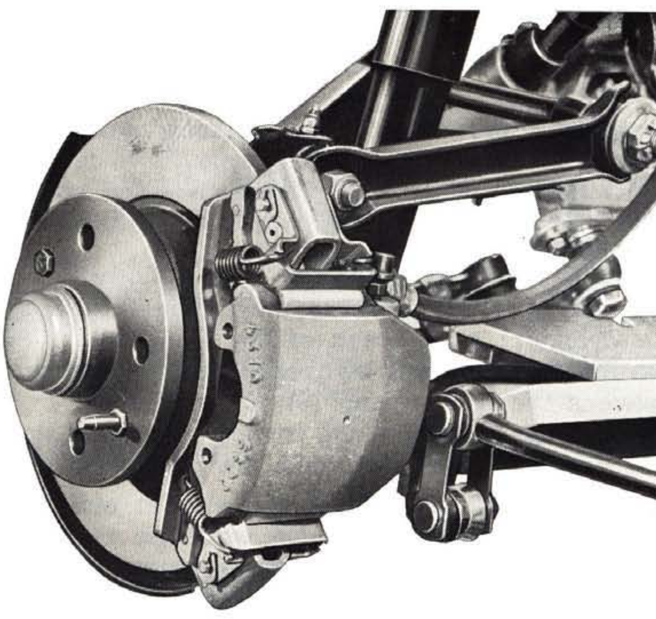


Fig. 448 - Left side front wheel disc brake assembly.

## Operation.

When the hydraulic pressure is established by depressing the brake pedal, the wheel cylinder piston moves on and causes the adjacent lining to come in contact with the disc. Simultaneously with the above described functions, reaction creates an even and opposite force which moves the caliper axially on the bracket and the outer lining comes into contact with the disc.

Now, as the hydraulic pressure increases, the braking action will take place and the effort is shared by both linings, resulting in equal wear and effective braking.

Upon release of the brake pedal hydraulic pressure is annulled and the piston is apt to return to rest position. However, piston back travel is restrained by the automatic adjusting device as outlined hereafter.

## Brake Lining-to-Disc Clearance Self-Adjusting Device.

This device assures good braking under all conditions by maintaining a constant clearance between the linings and disc. It ensues that, as the front brakes are set by themselves, action must be made solely on rear brakes when the brake pedal travel needs adjustment.

The self-adjuster is assembled into piston (4, fig. 451) and works in fluid bath. It consists of a steel ring (9) which is sliding with a certain friction in piston interior.

The friction ring (9) is tied to the pin (6) rigidly mounted to the caliper body (1) by means of two washers (8-10) which are secured to the pin through a spacer (11).

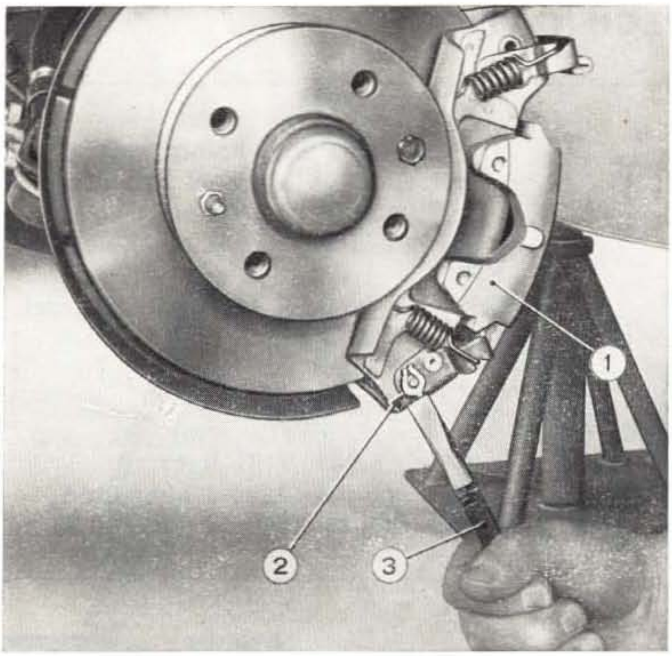



Fig. 449 - Removing bracket clamp pin lock plate.
1. Brake caliper. - 2. Lock plate. - 3. All-purpose plier.

A clearance of .0236" to .0285" (0.600 to 0.725) should be allowed between the working friction ring (9) and washers.

The self-adjuster operation is as follows: when applying hydraulic pressure, the piston (4) moves in the cylinder; as a result of the lining wear, the travel of the piston will be greater than the clearance between the friction ring (9) and washers.

Under this condition, the friction ring (9) is stopped by the washer (10) while the piston continues to move.

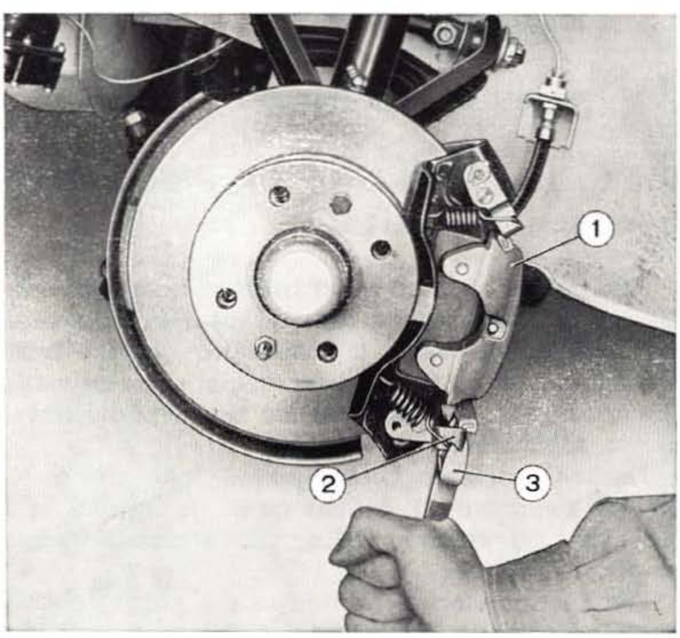



Fig. 450 - Tipping caliper mounting bracket clamps.
1. Brake caliper. - 2. Caliper mounting bracket. - 3. Tool A. 72238.

**NOTE - On assembly, recall that outer lining pads of calipers are fitted with two holes whereas inner pads have one hole.**

Upon release of the hydraulic pressure, the piston has a tendency to return to its original position, but the friction ring (9) will be stopped against the washer (8), thus limiting the back travel of the piston.

The net result is that the lining wear is eliminated and the correct clearance between linings and disc restored.

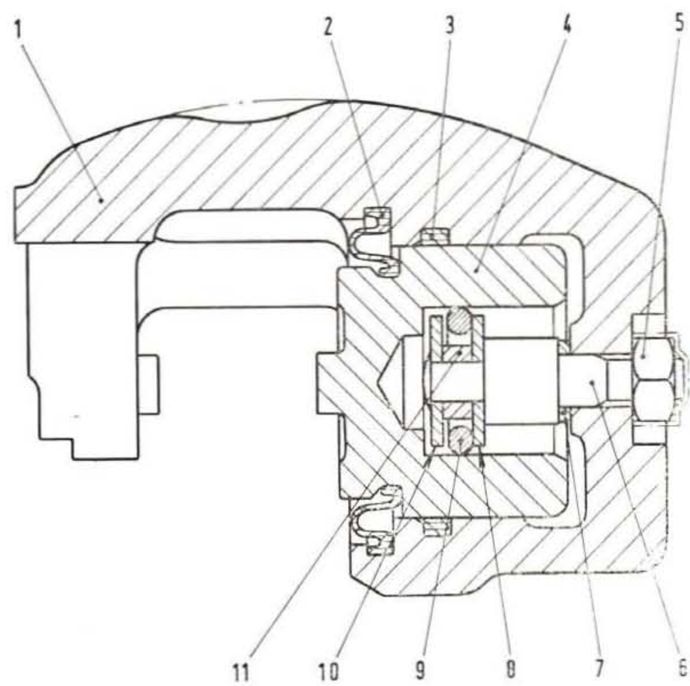



Fig. 451 - Side sectional view of the disc brake caliper.
1. Caliper body. - 2. Piston rubber boot. - 3. « O » ring seal. - 4. Piston. - 5. Pin lock nut - 6. Piston adjusting pin. - 7. Pin lock washer. - 8-10. Friction ring washers. - 9. Friction ring. - 11. Spacer for washers.

## Replacing Lining Pads.

Brake linings should be renewed whenever they are no thicker than .079" (2 mm).

To replace the linings, take down the caliper from the mounting brackets: slide off the pins (after removing the retaining plates) and tip the clamps. The caliper can be thus lifted out from the bracket (fig. 453).

Remove the worn linings and, before placing the new ones, proceed as follows:

– push the piston to the bottom of the cylinder bore (force required, 121 lbs - 55 kg) and check that the datum mark (A, fig. 452) on the piston is facing the bleeder screw.

After the new lining pads have been set into place in the caliper, see that the distance between their inner faces is not lesser than .417" (10.6 mm).

**NOTE - The datum « A » must necessarily be located so as to be in line with the bleeder screw (as shown in figure 452).**

**Failure to meet with this condition will bring about braking troubles through an incorrect bleeding of the system.**

## Disassembling and Assembling Disc Brakes.

To dismantle the disc brake assembly at either front wheel proceed as follows:

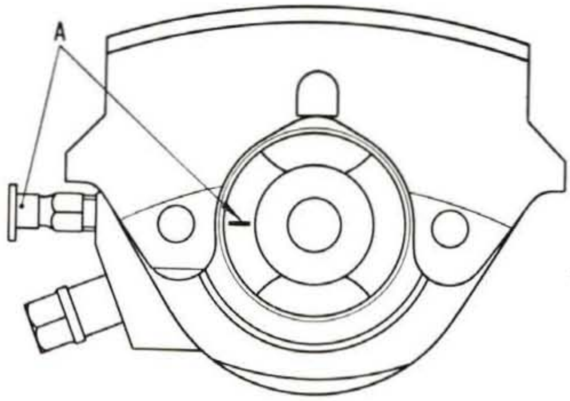



**Fig. 452 - Disc brake caliper diagram.**
A. Datum mark in piston to be positioned toward the bleeder screw as shown.

- remove the wheel;
- disconnect the brake fluid hose at caliper and plug up the fluid outlet port;
- remove caliper bracket clamp pin clips (fig. 449) and withdraw clamp pins;
- using tool **A. 72238**, tip caliper bracket and remove the caliper (fig. 450);
- with tool **A. 47014** pull the wheel hub cap and remove both wheel hub screws from brake disc;
- remove the staked nut, the backing washer and slide off the wheel hub assembly;
- withdraw the brake disc as shown in fig. 454.
- at last back out caliper bracket-to-disc shield screws and withdraw caliper mounting bracket (fig. 457).

Assemble reversing disassembly procedure. Make sure that bracket clamp pin clips are well positioned in seating grooves.

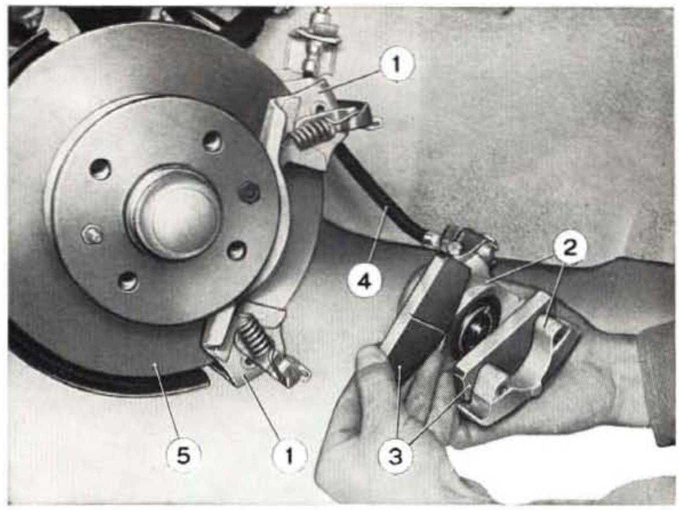



**Fig. 453 - Replacing lining pads.**
1. Caliper bracket clamps. - 2. Brake caliper. - 8. Lining pads. - 4. Brake fluid hose. - 5. Brake disc.

## Inspection and Repair.

Whenever going over the brake system for service, first of all clean front brakes thoroughly with warmed water and FIAT LDC detergent and wipe immediately with a compressed air hose.

Never use gasoline, diesel fuel or mineral solvents of any kind for cleaning lest piston seals are definitely ruined.

Also, the following points should be observed on overhaul of front brakes.

### BRAKE CALIPERS

Possible repairs are confined to the renewal of pistons or seals; in fact pistons are one unit with

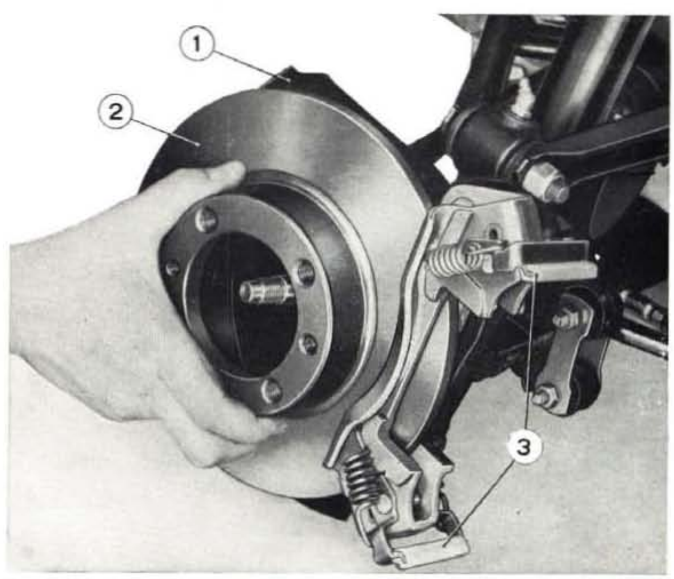



**Fig. 454 - Removing brake disc.**
1. Brake disc splash shield. - 2. Brake disc. - 3. Caliper bracket clamps.

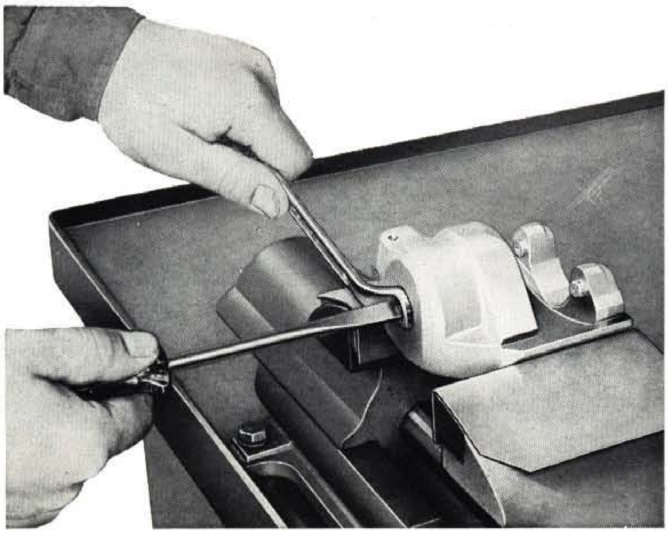


**Fig. 455 - Removing brake caliper self-adjusting pin nut.**

self-adjusting devices, no components of which are supplied for service.

To remove pistons from front calipers, back out the nut (5, fig. 451) and depress pin (6) at end.

Special care should be exercised for removal and replacement of lining pads lest piston and cylinder faces may be scored.

In case the pump body turns out to be damaged or unserviceable, renew the caliper assembly.

When fitting pistons into calipers, make sure that datum A (fig. 452) faces the bleeder screw and the gap between opposite lining pads is not lesser than .429″ (10.9 mm).

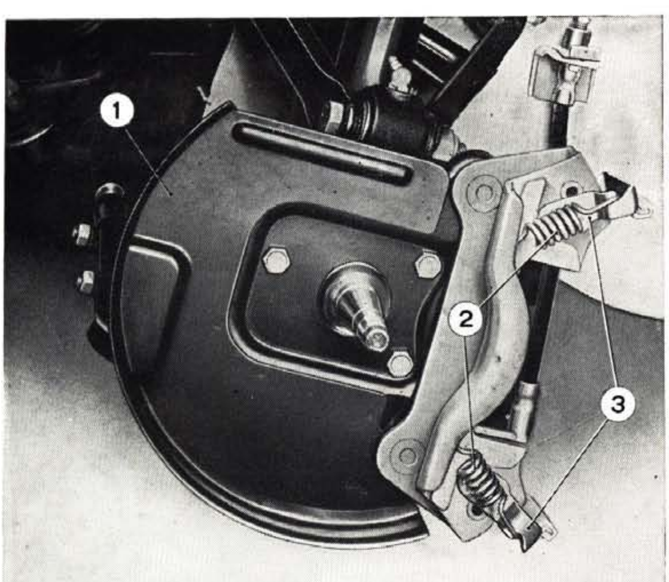



**Fig. 456 - Detail showing caliper mounting bracket and disc splash shield.**

1. Brake disc splash shield. - 2. Caliper bracket clamp springs. - 3. Caliper bracket clamps.

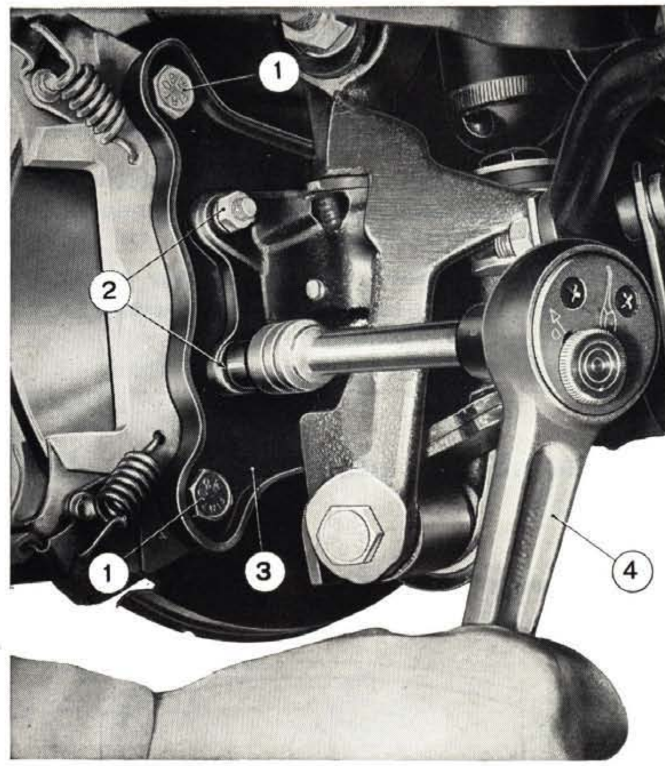



**Fig. 457 - Fitting brake caliper.**

1. Caliper bracket-to-plate screws. - 2. Nuts, splash shield and plate to kingpin housing. - 3. Plate. - 4. Ratchet wrench.

**NOTE - On assembly, use care to fill up each caliper with brake fluid prior to fitting in place for ease in further bleeding operation. Remove the bleeder connector and pour in fluid through the threaded port for bleeder hose insert with the caliper in tilted position.**

**Next replace the bleeder connector.**

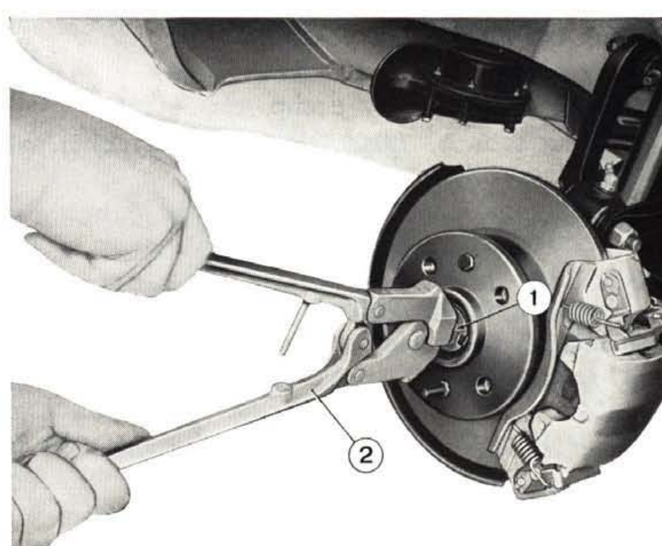



**Fig. 458 - Staking wheel hub nut.**

1. Hub nut. - 2. Nut staking tool.

### BRAKE DISCS

Make sure disc working faces are not damaged. Otherwise grind disc recalling that minimum permissible thickness, after refacing, is .374" (9.5 mm).

Renew discs which have been ground beyond above limit. Renewal of brake disc is demanded when worn to .354" (9 mm). Using a dial indicator check brake disc for runout in excess of .0047" (0.12 mm).

## WHEELS AND TIRES

| | | |
|---|---|---|
| Disc wheels with rim type . . . . . . . . . . . . . . .<br>Tire size . . . . . . . . . . . . . . . . . . . . . . . . . | 4½ J x 13"<br>5.50 — 13" (4 p.r.) | |
| | front | rear |
| Tire inflating pressure . . . . . . . . . . . . . . . . . | 15.6 psi (1.1 kg/cm²) | 25.6 psi (1.8 kg/cm²) |

## TIGHTENING REFERENCE

| ITEM | Part No. | Thread Diameter and Pitch | Material | Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| Nut, caliper carrier plate - to - steering knuckle screw . . . | 1/610008/11 | M 8 x 1.25 | R 50 Znt (Screw R 80) | 14.5 to 18.1 | 2 to 2.5 |
| Screw, brake caliper-to-caliper carrier plate . . . . . . . . | 1/59703/21 | M 10 x 1.25 | R 80 Znt | 39.8 | 5.5 |
| Stud, road wheel and brake disc-to-hub . . . . . . . . . . . | 4077152 | M 12 x 1.25 | C 35 Bon Cdt | 43.4 to 50.6 | 6 to 7 |

# ELECTRICAL



## IGNITION DISTRIBUTOR

The setting data of the ignition distributor fitted to engine 100 GC.000 are the following:

– Static advance . . . . . . . . . . . . . . . 10°
– Centrifugal automatic advance (to engine) 28°

As shown in fig. 459, this distributor has no vacuum advance.

For the ignition timing, proceed as outlined in fig. 460.

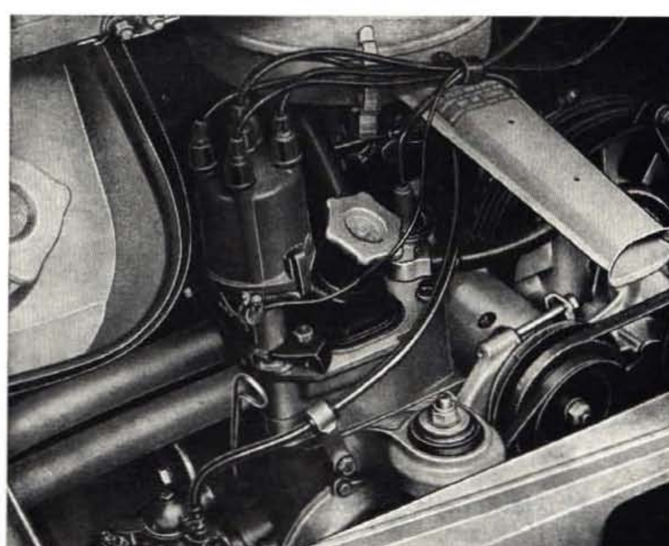


**Fig. 459 - Scrap view of engine compartment.**
In foreground, the ignition distributor without vacuum advance corrector.

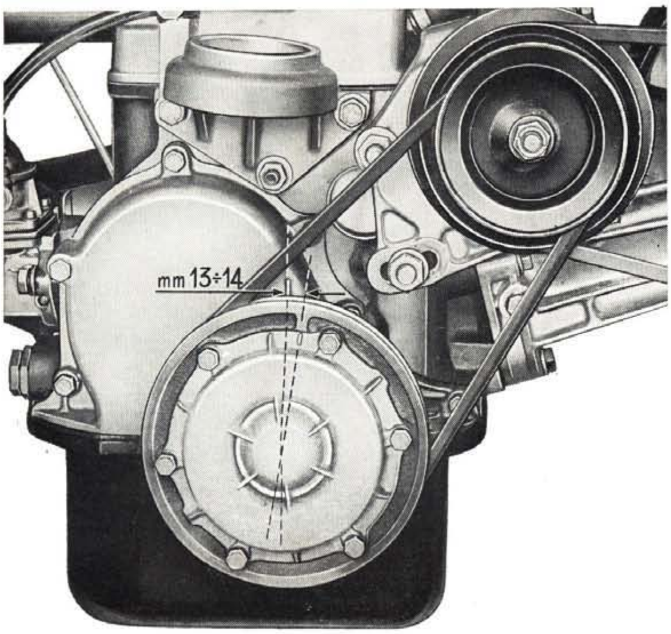



**Fig. 460 - Ignition timing.**

Arrows show the position of timing marks for correct setting of ignition distributor. The mark on centrifugal filter cover should be ahead of timing gear cover mark, namely:

— 1/2″ to 9/16″ (13 to 14 mm) (10° B.T.D.C. in cylinder No. 1, compression stroke).

**Engine turns counterclockwise.**

## SPARK PLUGS

| | | |
|---|---|---|
| Type | Marelli | CW 260 L |
| | Champion | N 3 |
| Gap | | .0197″ to .0237″ (0.5 to 0.6 mm) |

## HEADLIGHTS

Headlights are of asymmetrical low beam type.

Headlights should be focussed in a **no-load** condition, as follows.

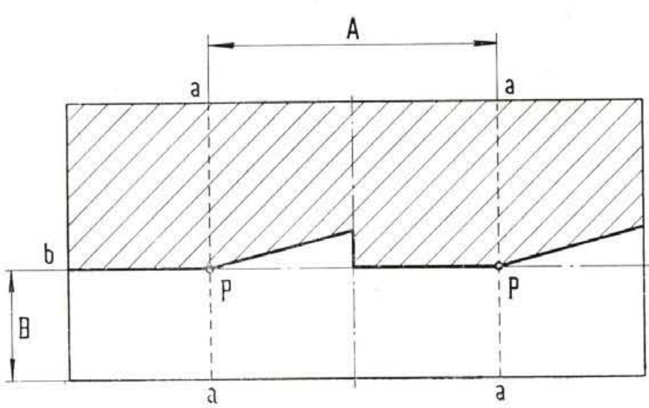



**Fig. 461 - Headlight aiming diagram.**

A = $44^{23}/_{32}$″ (1,136 mm). - B = C $-^{25}/_{32}$″ (20 mm). - C = Ground clearance of headlight center.

Check that tires are inflated with the recommended pressure (front, 15.6 psi - 1.1 kg/cm$^2$; rear, 25.6 psi - 1.8 kg/cm$^2$).

Locate the car on a level floor, 16′5″ (5 m) apart from an opaque, white screen vertically in the shade and make sure that the car centerline it at right angle to the screen face.

Jounce the car both sides to set suspensions.

Draw two vertical lines a-a on the screen (fig. 461).

These lines should be equally spaced from the perpendicular to the car longitudinal axis and 44 $^{23}/_{32}$″ (1,136 mm) apart (A), which corresponds to the headlight center-to-center distance.

Draw a horizontal line b-b on the screen, at the following distance from ground: B = C $-$ $^{25}/_{32}$″ (20 mm), where **C corresponds to the ground clearance of headlight center, measured on aiming.**

To aim headlights, switch on the low beam and work on the screw (4, fig. 462) for vertical adjustments, and on the screw (2) for horizontal adjustments, until the following conditions are obtained:

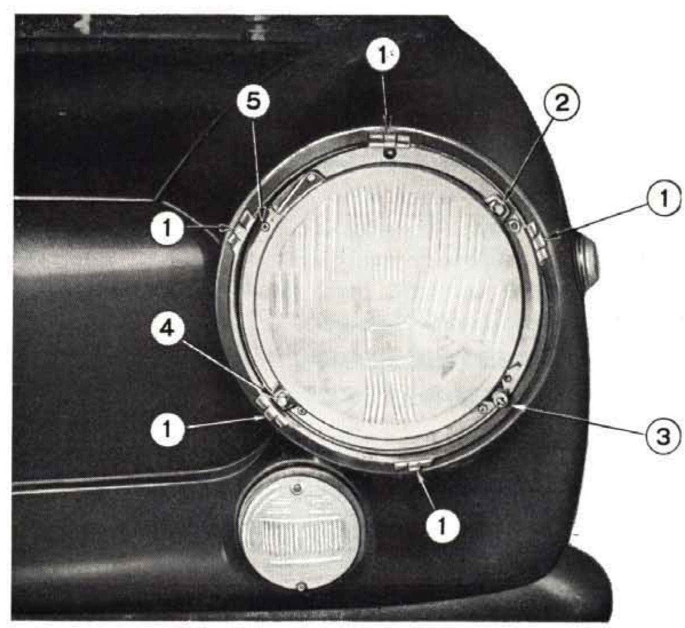



**Fig. 462 - Left side headlight, without rim.**

1. Rim spring fasteners. - 2. Screw for horizontal beam adjustment. - 3. Lamp unit hooking pin. - 4. Screw for vertical beam adjustment. - 5. Lamp unit hooking spring.

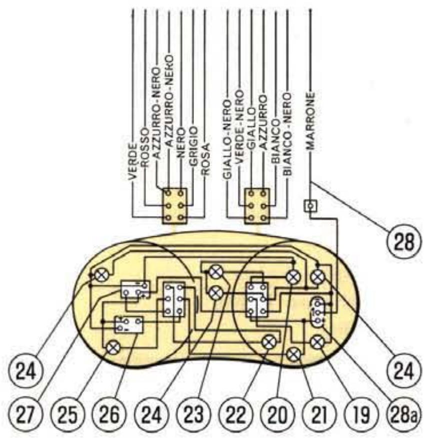
— the horizontal separation line between the unlit and lit areas is on line b-b (fig. 461);

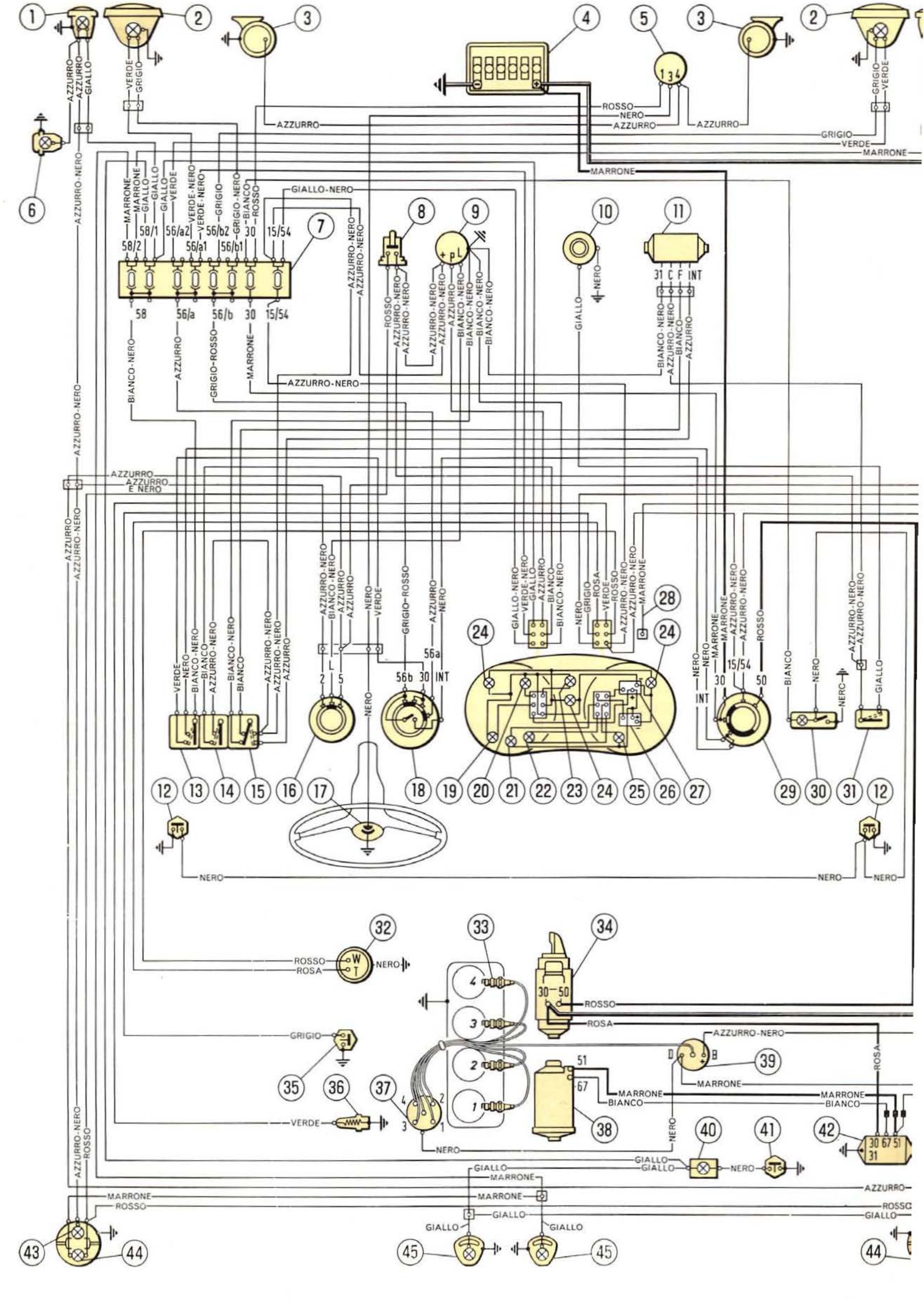
— the upward slanting (some 15°) separation lines start from the meeting points **P** of verticals a-a with the horizontal line b-b (fig. 461) or just outside of them.

A maximum outward shift of the meeting point **P** (fig. 461) of 1° 30′ (= $5^1/_8$″ - 130 mm), is permitted.

## Wiring diagram modification for cars equipped with tachometer (optional).

**19.** High beam indicator (blue light).
**20.** Parking light indicator (green light).
**21.** Low oil pressure indicator (red light).
**22.** No-charge indicator (red light).
**23.** Direction signal indicator (green light).
**24.** Instrument cluster lights.
**25.** Reserve supply indicator (red light).
**26.** Fuel gauge.
**27.** Temperature gauge.
**28.** Tachometer wire.
**28a.** Electronic tachometer.





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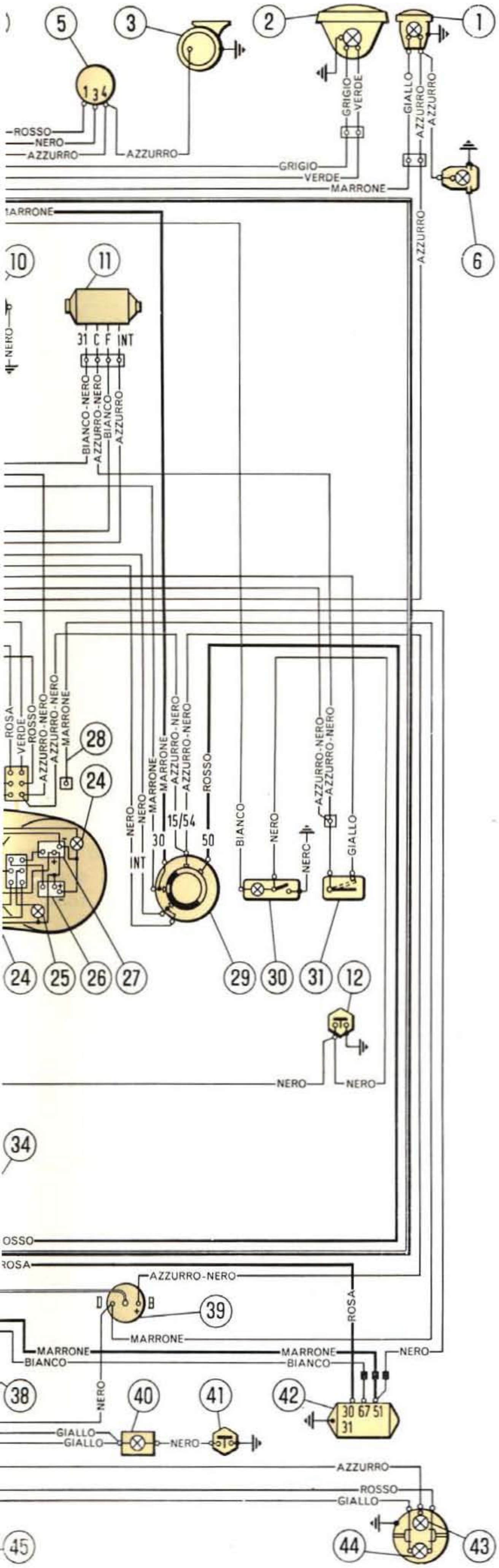



**Fig. 463 - Wiring diagram.**

1. Front parking and direction signal lights.
2. High and low beam headlights.
3. Horn.
4. Battery.
5. Horn relay switch.
6. Side direction signal lights.
7. Fuses.
8. Stop light jam switch.
9. Direction signal flasher unit.
10. Electro-fan motor.
11. Wiper motor.
12. Courtesy light jam switch.
13. Outer lighting master switch.
14. Instrument cluster light switch.
15. Windshield wiper switch.
16. Direction signal light switch.
17. Horn button.
18. Selector switch for outer lighting and light flashes.
19. High beam indicator (blue light).
20. Parking light indicator (green light).
21. Low oil pressure indicator (red light).
22. No-charge indicator (red light).
23. Direction signal indicator (green light).
24. Instrument cluster lights.
25. Reserve supply indicator (red light).
26. Fuel gauge.
27. Temperature gauge.
28. Circuit wire for tachometer (extra).
29. Key-type ignition switch, also energizing warning lights and starting circuits.
30. Map light, with toggle switch incorporated.
31. Electro-fan motor switch.
32. Fuel gauge tank unit.
33. Spark plugs.
34. Starting motor, with solenoid switch.
35. Low oil pressure indicator sending unit.
36. Temperature gauge sending unit.
37. Ignition distributor.
38. Generator.
39. Ignition coil.
40. Engine compartment light.
41. Engine compartment light jam switch.
42. Generator regulator.
43. Rear direction signal lights.
44. Rear parking and stop lights.
45. License plate lights.

All fuses are 8 - Ampere fuses, except No. 30 which is a 16 - Ampere fuse.

**NOTE** - The mark **—** means that the cable is fitted with numbered strip or ferrule.

## CABLE COLOUR CODE

| | | | |
|---|---|---|---|
| Azzurro | = **Blue** | Verde | = **Green** |
| Bianco | = **White** | Azzurro-nero | = **Black and blue** |
| Giallo | = **Yellow** | Bianco-nero | = **Black and white** |
| Grigio | = **Grey** | Giallo-nero | = **Black and yellow** |
| Marrone | = **Brown** | Grigio-nero | = **Black and grey** |
| Nero | = **Black** | Grigio-rosso | = **Red and grey** |
| Rosa | = **Pink** | Verde-nero | = **Black and green** |
| Rosso | = **Red** | INT | = **Switch** |

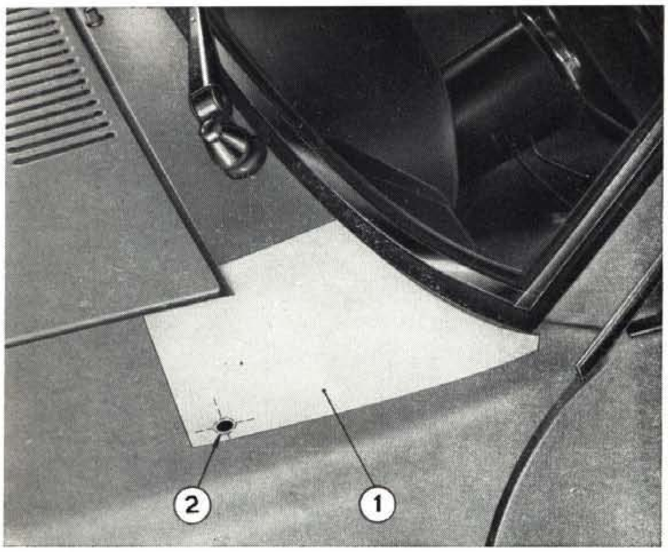



**Fig. 464 - Fitting templet to drill antenna rod passage opening.**

1. Templet. - 2. Antenna rod passage opening.

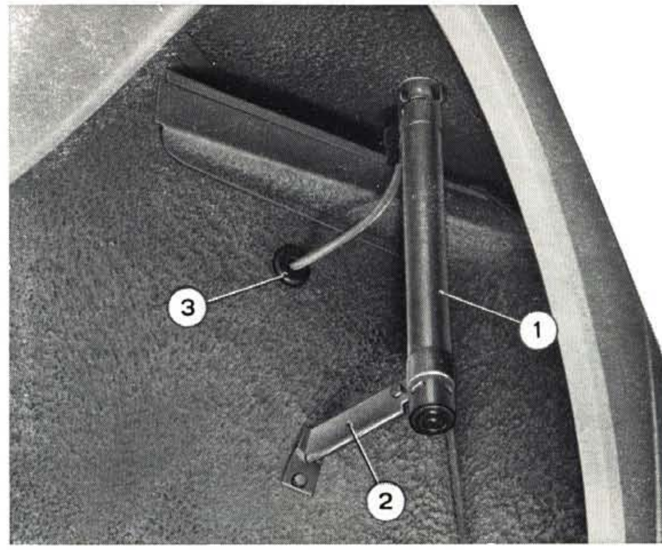



**Fig. 466 - Detail showing antenna mounting.**

1. Antenna. - 2. Antenna mounting bracket. - 3. Antenna-to-radio receiver cable.

# RADIO RECEIVER

The same radio receiver equipping 850 Sedan is fitted to the Coupe Version.

See page 242 for the installing procedure of the radio receiver and recall the following additional points:

– drillings: on upper corner for installation of aerial (fig. 464), on the instrument panel for installation of receiver (fig. 465), should be made using templets included in the radio kit;

– position the antenna assembly with mounting bracket and tilting it 15° toward the windshield drill the bracket screw and secure the bracket in place (fig. 466);

– as clearly shown in fig. 467, the loudspeaker is arranged in the space between the instrument panel and the utility floor.

Noise suppression devices should be fitted by closely adhering to the directions outlined on page 244.

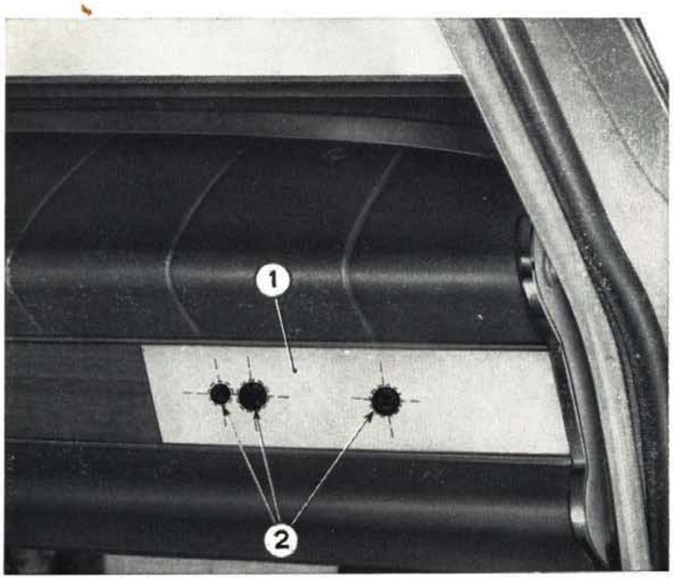



**Fig. 465 - Fitting templet to drill radio receiver mounting holes.**

1. Templet. - 2. Radio receiver mounting holes on instrument panel.

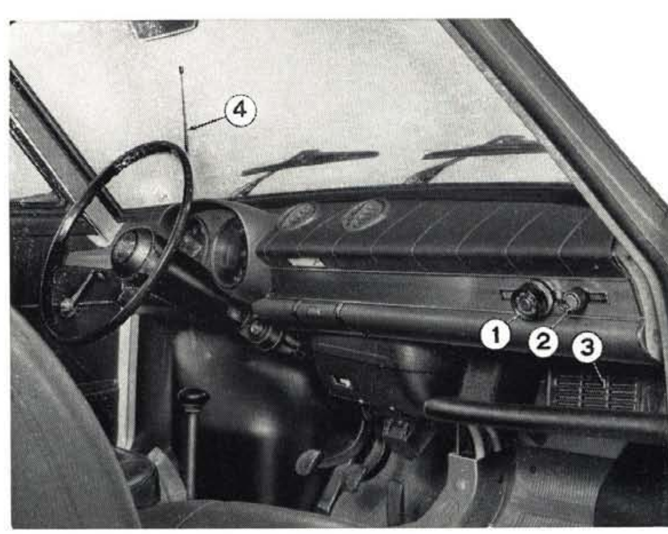



**Fig. 467 - Radio assembly installed on car.**

1. Tuning control knob. - On-off and volume control knob. - 3. Loudspeaker. - 4. Antenna.

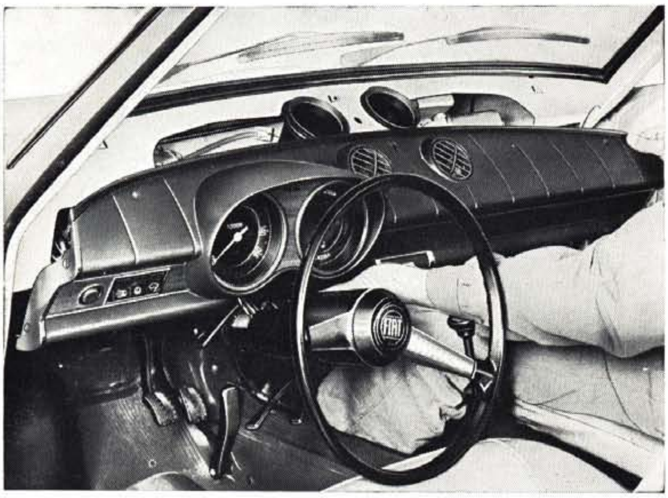



**Fig. 468 - Removing instrument panel lining and cluster assembly.**

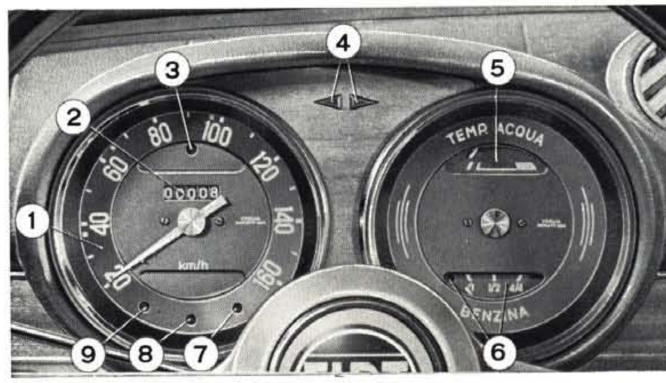



**Fig. 470 - Close-up view of instrument cluster.**

1. Speedometer. - 2. Odometer. - 3. Parking light indicator. - 4. Direction signal arrow tell-tale. - 5. Temperature gauge. - 6. Fuel gauge and reserve supply indicator. - 7. No-charge indicator. - 8. Low oil pressure indicator. - 9. High beam indicator.

# INSTRUMENTS AND ACCESSORIES

## Remove and Install Instrument Cluster.

Remove the instrument cluster as follows:

— disconnect the steering column mounting from instrument panel and lay the wheel on seat;

— back out instrument panel lining screws and remove the lining as shown in fig. 468;

— untie the speedo cable and both multiple connectors;

— back out the instrument panel holding nuts (fig. 469);

— then slide off the cluster from panel lining (fig. 471).

For cluster installation proceed in reverse order to removal.

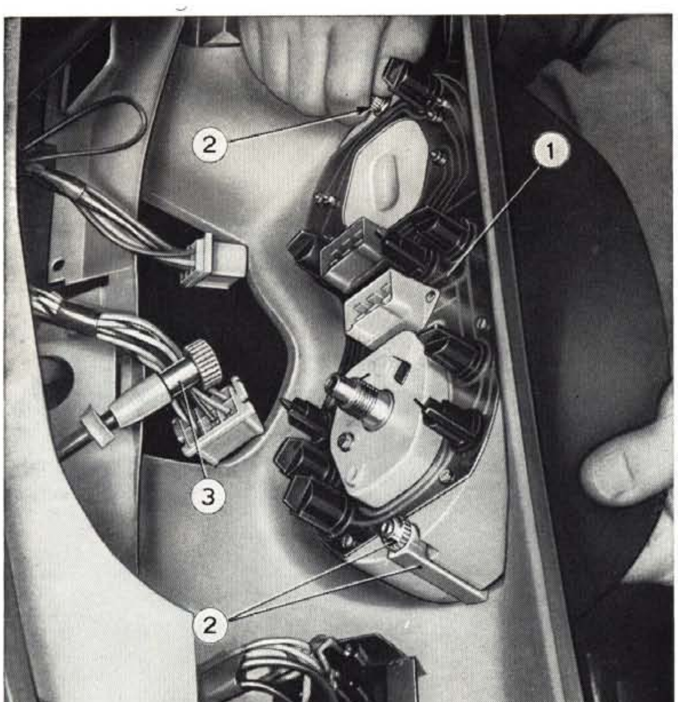



**Fig. 469 - Removing instrument cluster.**

1. Instrument cluster. - 2. Cluster holding nuts and clamps. - 3. Speedo cable.


**Fig. 471 - Withdrawing instrument cluster from panel lining.**

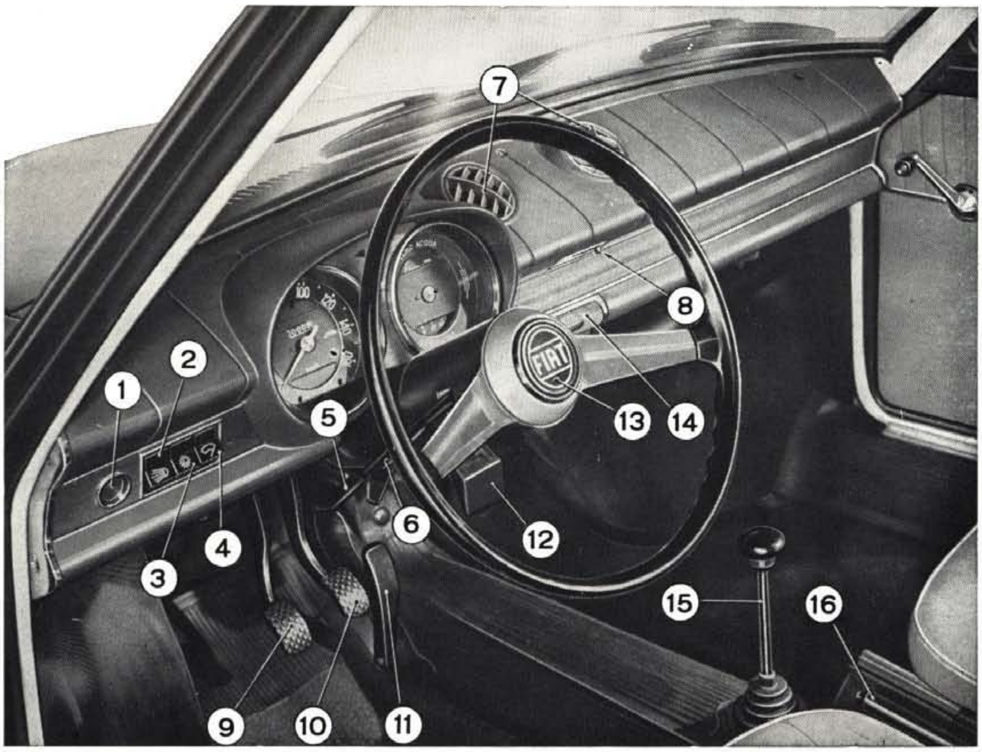



**Fig. 472.**

**Arrangement of controls.**

1. Windshield washer pump control. - 2. Outer lighting master switch. - 3. Windshield wiper switch. - 4. Instrument cluster light switch. - 5. Outer lighting change-over switch (with master switch 2 on). - 6. Direction signal light switch. - 7. Adjustable air outlets, ventilation and heating. - 8. Map light, with toggle switch incorporated. - 9. Clutch pedal. - 10. Brake pedal. - 11. Accelerator pedal. - 12. Shutter, warmed air admission to car interior. - 13. Horn button. - 14. Ash receiver. - 15. Gearshift lever. - 16. Parking brake ratchet lever.

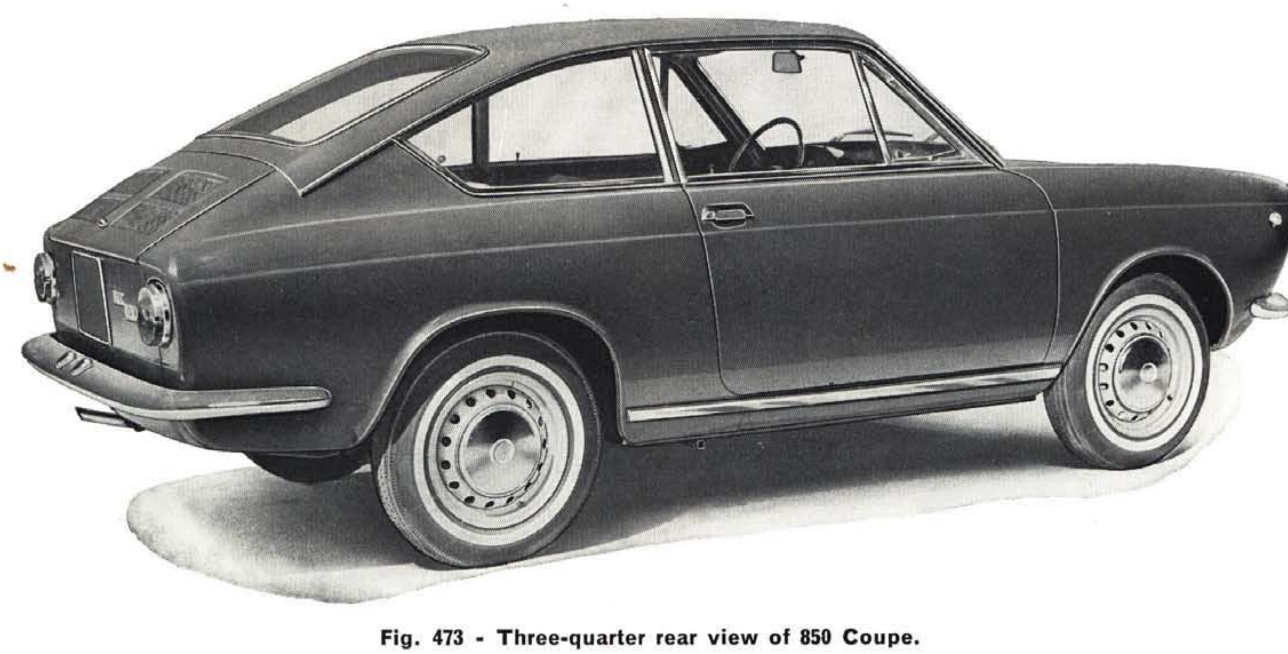


**Fig. 473 - Three-quarter rear view of 850 Coupe.**

# BODY



Body differences from Sedan version are itemized on page 269.

In this chapter are solely dealt with units involving particular directions for service.

For check of underbody use the same gauge **A. 74141** as recommended for the Sedan version.

## SEATS

Remove seats as follows:

– pull front seat adjuster lever, unhook return spring and slide off seats at front;

**Fig. 474 - Removing rear seat cushion.**

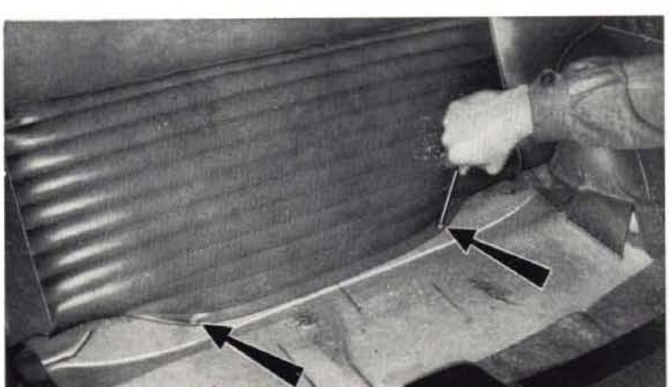


**Fig. 475 - Removing rear seat back rest. Arrows point to back rest holding screws.**

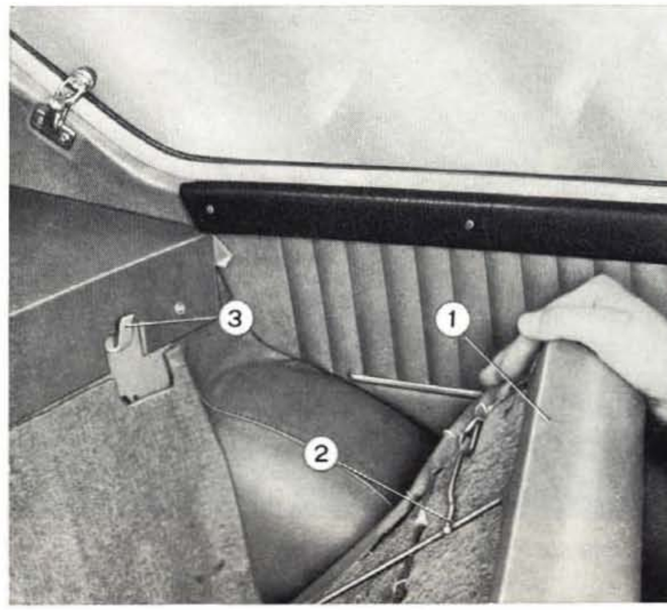



**Fig. 476 - Removing rear seat back rest.**
1. Back rest. - 2. Back rest hooking strut. - 3. Back rest clamp.

– remove rear seat cushion seats (fig. 474) and disengage the cushion from dowel pins on body floor;

– remove rear seat back rest lock screws at bottom (fig. 475) and disengage the back rest from hooking clamps welded to rear wall (fig. 476).

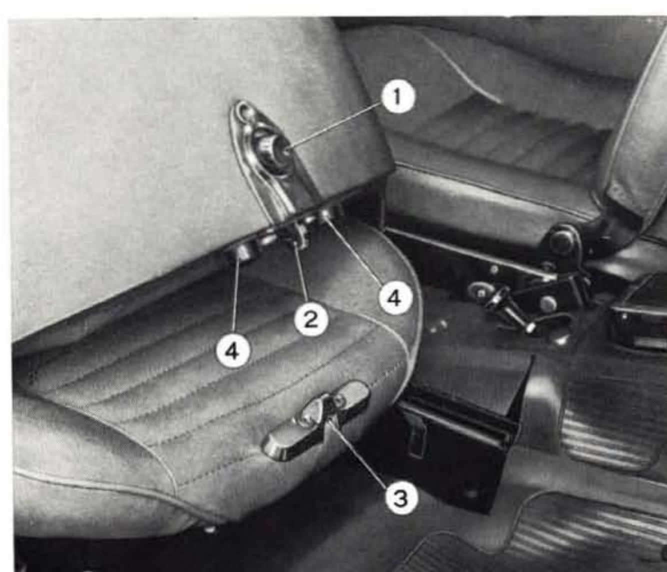



**Fig. 477 - Front seat back rest catch device.**
1. Catch release button. - 2. Catch hook. - 3. Catch striker. - 4. Catch mounting screws.

Fig. 478.

Interior view of 850 Coupe.

In foreground the ash receiver on floor tunnel behind handbrake ratchet lever, for use of rear passengers.

## ENGINE COMPARTMENT LID

The engine compartment lid is fitted with a catch device operated through a push button (fig. 479).

To adjust the catch for correct opening and closing of lid just reposition the striker (1) to the catch hook (3) as required.

To do so use the slots which are cut on the striker plate.

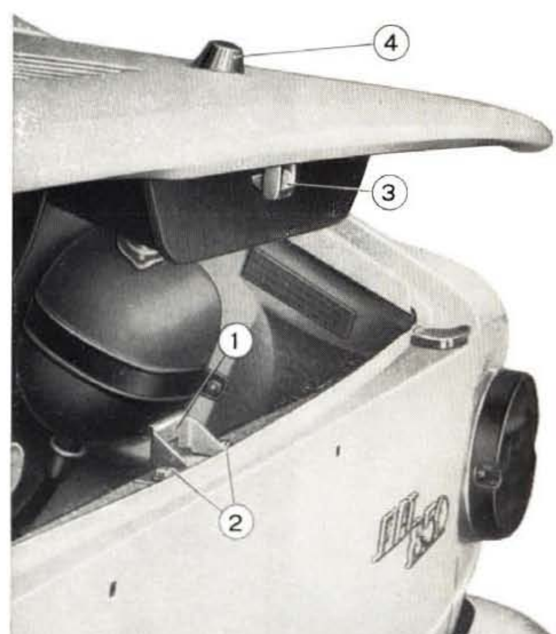



Fig. 479 - Detail of rear compartment lid catch.

1. Catch striker. - 2. Striker mounting screws. - 3. Catch hook. - 4. Catch release button.

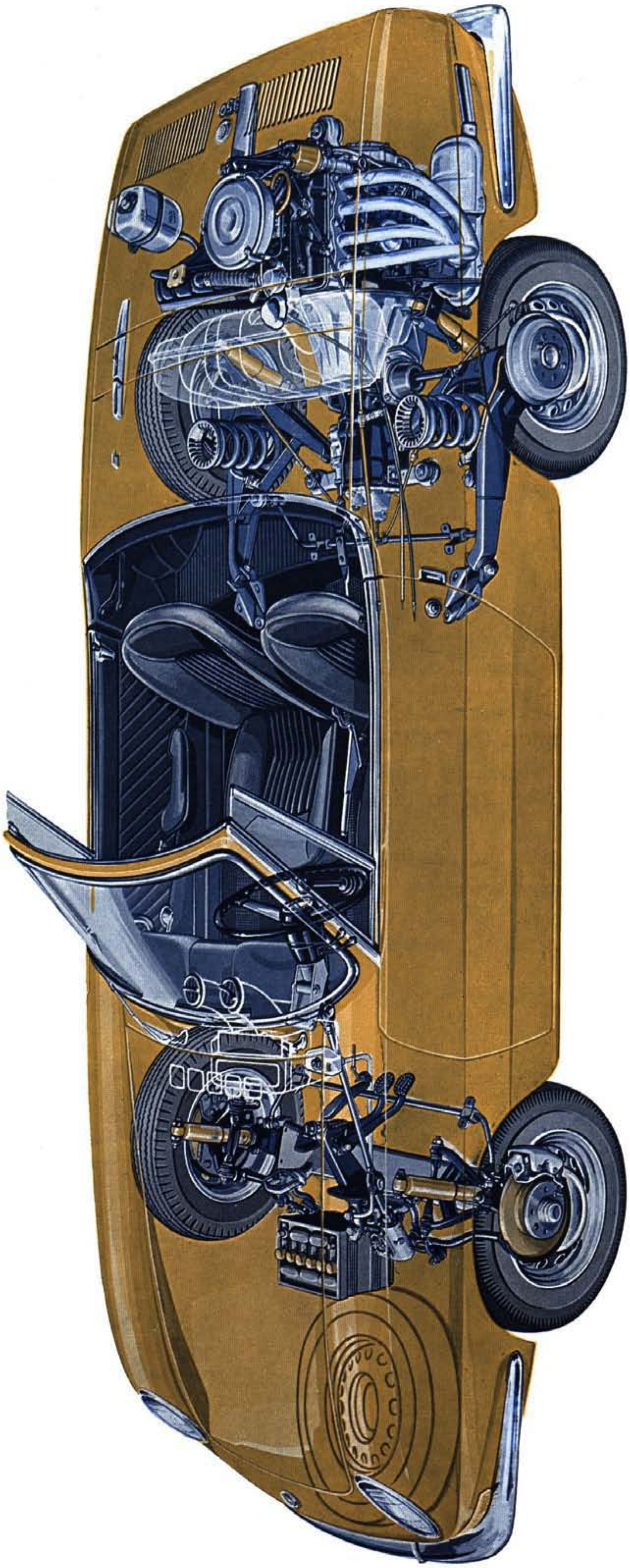


Fig. 480 - Phantom view of 850 Roadster running gear units.

# ROADSTER

# DIFFERENCES FROM COUPE VERSION

## ENGINE

Type: 100 GS.000.

## CHASSIS

Fuel tank: filler neck aiming; filler cap chromium plated and fitted outside.

Steering: column mounted on a pair of ball bearings and articulated on two universal joints.

Rear suspension: coil springs.

## ELECTRICAL EQUIPMENT

Oil gauge: electric sending unit on crankcase.

Headlights: of new design, rearranged.

Front corner parking and direction signal lights: of new design.

Rear tail, direction signal and stop lights with reflector lens: of new design.

License plate lights: of new design, rearranged.

Windshield wiper: new motor, arms and crank gear.

Inner lighting: two lamps at opposite ends of instrument panel.

Two rheostats: one single for setting strokes of wiper arms and one double for adjusting glow of panel light and outer light indicator.

Set of dashboard instruments: with five separate dials (tachometer and oil gauge added).

Control switches: of new design; inner light switch added.

Electric cigar lighter.

Key-type ignition switch, also energizing warning lights and starting circuits: fitted with anti-theft device blocking the steering column.

Windshield washer: controlled by a pedal pump; single spray nozzle, located at center.

## BODY

Roadster: integral construction, two-seater, two-door; waterproof fabric top, collapsible into car interior.

Extra: hard top, with sun visors incorporated.

Additional rear view mirror: mounted on fender.

Door windows: with fixed front pane.

Door control: push-button latch and key lock.

Bumpers: of new design.

Seats: without squab release catch; fitted with squab adjusting device.

Trim panel: of new design.

Fig. 481 - Fiat 850 Roadster.

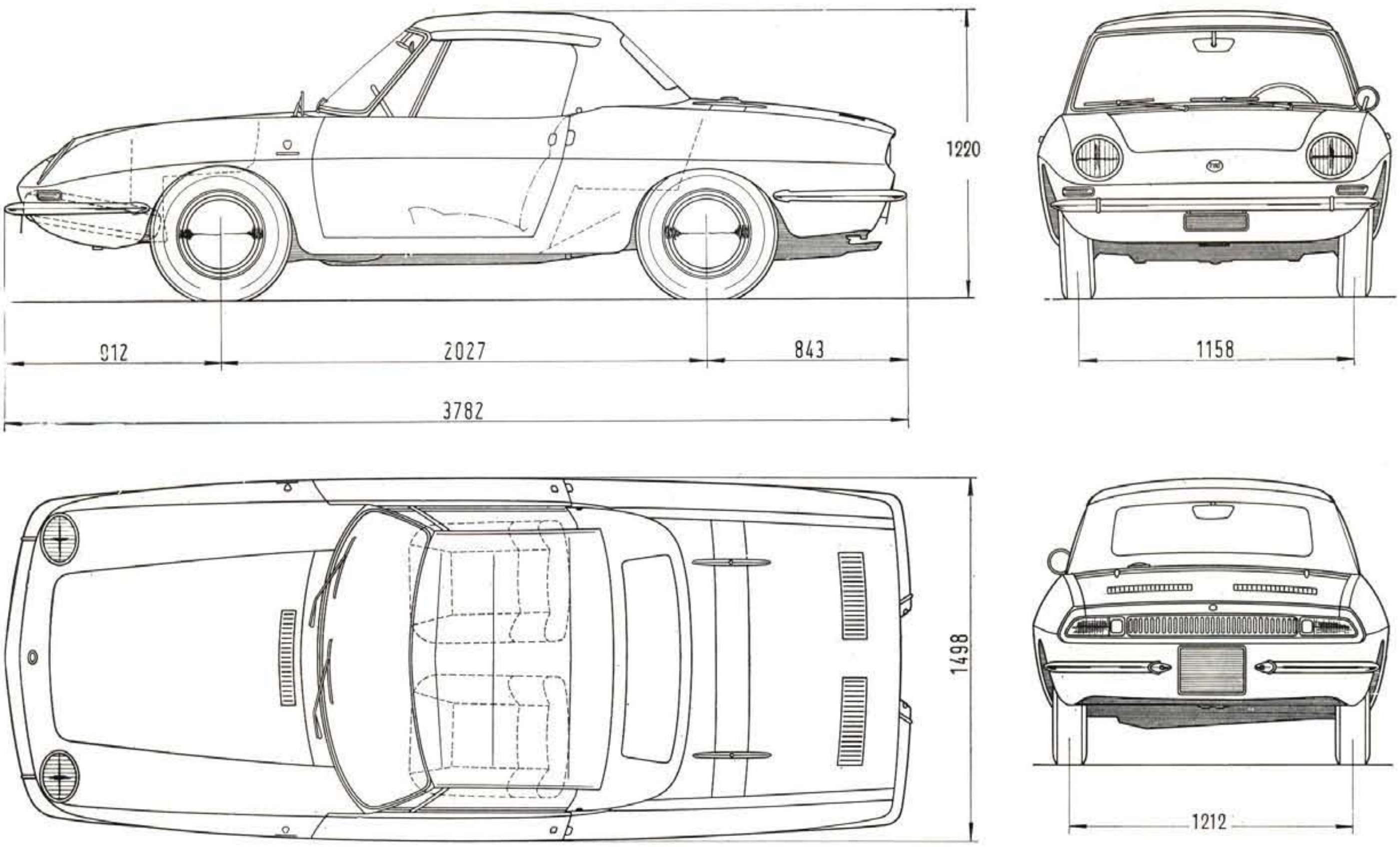



**Fig. 482 - Leading dimensions (metric).**

Overall height applies to an unloaded car. Overall height for cars fitted with hard top is 47.44'' (1,205 mm).

Instrument panel: of new design.

Grab handle: on instrument panel, passenger's side.

Utility compartment: under the instrument panel, with key lock and pushbutton latch.

Front end: without ornament (name plate only).

**Fig. 483 - Fiat 850 Roadster.**

# GENERAL SPECIFICATIONS

## Dimensions.

| | |
|---|---|
| Overall length, with bumpers | 148.90″ (3,782 mm) |
| Overall width | 58.98″ (1,498 mm) |
| Overall height, unloaded — with folding top | 48.03″ (1,220 mm) |
| Overall height, unloaded — with hard top | 47.44″ (1,205 mm) |
| Front overhang | 35.90″ ( 912 mm) |
| Rear overhang | 33.15″ ( 843 mm) |

## General Data.

| | |
|---|---|
| Wheelbase | 79.80″ (2,027 mm) |
| Front tread, on ground | 45.59″ (1,158 mm) |
| Rear tread, on ground | 47.72″ (1,212 mm) |
| Minimum ground clearance, loaded | 5.31″ ( 135 mm) |
| Turning circle diameter | 31 ½ ft (9,600 mm) |

## Weights.

| | with folding top | with hard top |
|---|---|---|
| Curb weight (with water, oil, petrol, spare wheel, tool kit and accessories) | 1,598 lbs (725 kg) | 1,620 lbs (735 kg) |
| Carrying capacity | 2 people | 2 people |
| Payload (two people plus 132 lbs - 60 kg luggage) | 441 lbs (200 kg) | 441 lbs (200 kg) |
| Loaded weight (passengers plus luggage) | 2,039 lbs (925 kg) | 2,061 lbs (935 kg) |
| Distribution of loaded weight: | | |
| – front axle | 871 lbs (395 kg) | 882 lbs (400 kg) |
| – rear axle | 1,168 lbs (530 kg) | 1,179 lbs (535 kg) |

## Performance.

**Speeds,** maximum, on flat road (run-in and fully loaded):

| | |
|---|---|
| first gear | 22 mph ( 35 km/h) |
| second gear | 40 mph ( 65 km/h) |
| third gear | 59 mph ( 95 km/h) |
| fourth gear, abt | 90 mph (145 km/h) |
| reverse | 22 mph ( 35 km/h) |

**Gradients,** maximum climbable, (run-in and fully loaded):

| | |
|---|---|
| first gear | 36% |
| second gear | 19% |
| third gear | 11.5% |
| fourth gear | 6.5% |
| reverse | 36% |

**The following procedures, data and specifications solely cover units and items which are differing from Coupe Version.**

# ENGINE

## Removal.

Engine removing procedure is the same as for the Sedan Version with the following exceptions.

Remove rear parking and stop lamps (with reflector lens).

Disconnect ignition coil cables.

Remove rear bumper mounting screws, side and rear, from body.

Support the engine by means of the hydraulic jack (fig. 484) with adapter **A. 60534**.

Tie off the engine from rear mounting and remove the rear end liner, bumper and lamp assembly.

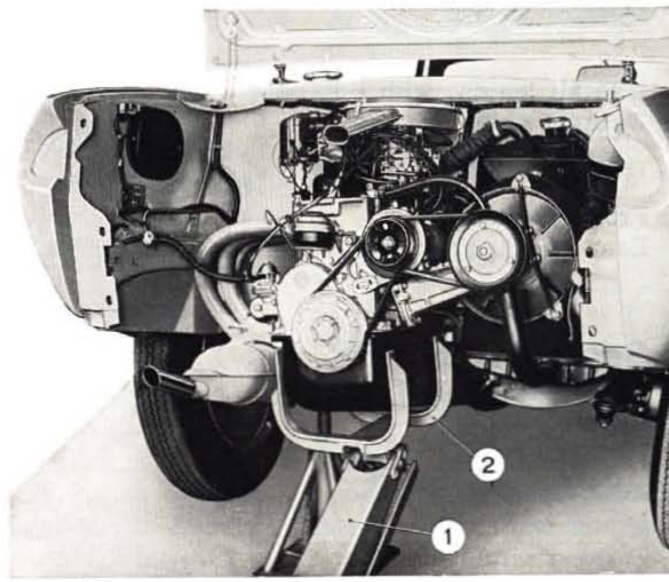



**Fig. 484 - Engine removal.**
1. Hydraulic jack. - 2. Adapter A. 60534.

# CHASSIS



# REAR SUSPENSION

Rear coil spring specifications:

| | |
|---|---|
| – Free height . . . . . . . . . | 8.976″ (228 mm) |
| – Height under 1,003±51 lbs (455±23 kg) of load . . . . | 6.653″ (169 mm) |
| – Height under 1,563 lbs (709 kg) of load . . . . . . . . | 5.354″ (136 mm) |
| – Deflection rate (between 573 and 1,433 lbs - 260 and 650 kg) | .232 in/100 lbs (13 mm/100 kg) |

**NOTE - These springs are identified by a daub of brown paint to avoid that they may be mixed in error with Sedan rear springs.**

**Moreover, coil springs are marked in production with a daub of green or yellow paint and colours should be paired on assembly.**

# STEERING

The steering column is mounted on a pair of ball bearings (2, fig. 485) and articulated on two universal joints (fig. 493).

The mounting of the upper universal joint (4, fig. 485) is clearly shown in figure; the yoke is attached to the upper groove of the steering column.

Thanks to this design feature the steering wheel may be moved, at the Owner's will, more apart from the instrument panel by some 5/8″ (15 mm).

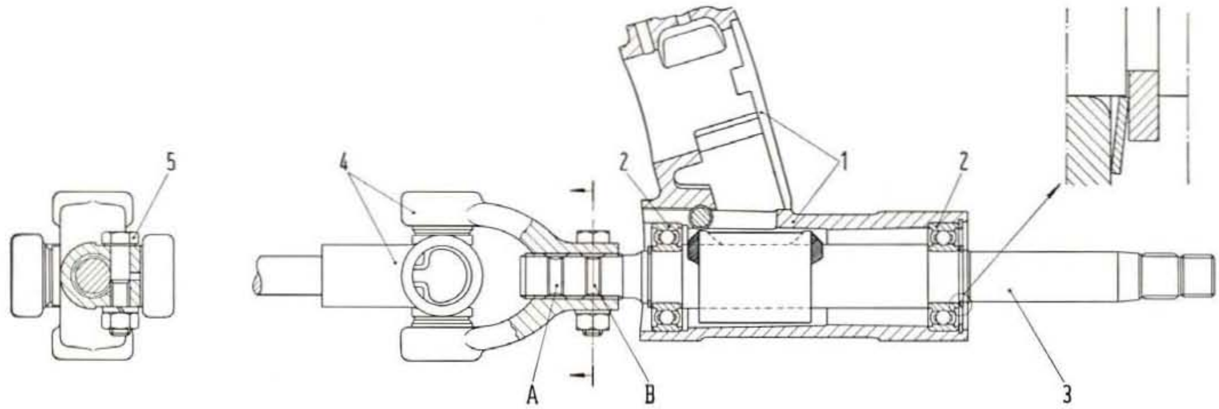



**Fig. 485 - Section view of the steering column and mounting bracket.**

1. Steering column mounting bracket. - 2. Ball bearings. - 3. Steering column. - 4. Upper universal joint. - 5. Universal joint-to-column screw and nut. - A. Lower groove. - B. Upper groove.

**The section detail on the far right evidenced by arrow illustrates the locking device of the steering column upper ball bearing cone by snap ring and spring plate. Up to car with parts serial N° 7211.**

To do so just loosen the column mounting bracket screws at the body shell as well as the nut and screw (5) securing the upper yoke of the joint (4).

Next work on the steering wheel so to set the joint yoke into the lower groove.

Secure the yoke and the bracket in place, tightening down on the screws and nut.

## Pulling Wheel.

In case the steering wheel must be removed proceed as follows:

- using a screwdriver, pry out the horn button;
- affix puller **A. 47039** as shown in fig. 486;
- operate the puller and extract the wheel.


**Fig. 486 - Pulling the steering wheel.**

1. Puller A. 47039. - 2. Open-end wrench actuating puller.

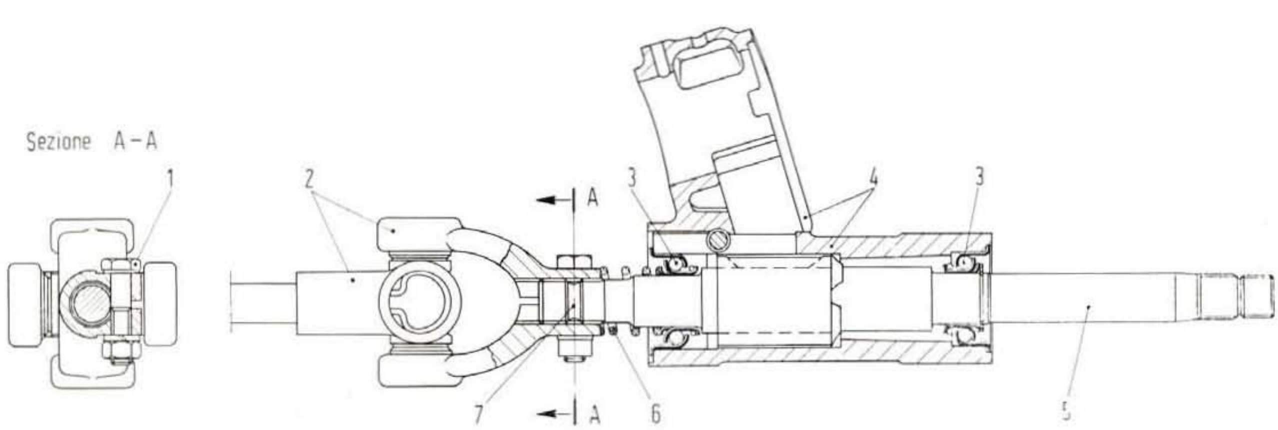



**Fig. 487 - Section view of the steering column and mounting bracket.**

1. Universal joint-to-column screw and nut. - 2. Upper universal joint. - 3. Ball bearings. - 4. Steering column mounting bracket. - 5. Steering column. - 6. Ball bearing stop spring. - 7. Universal joint locking groove.

**Starting from car with parts serial N° 7212.**

Sezione = Section.

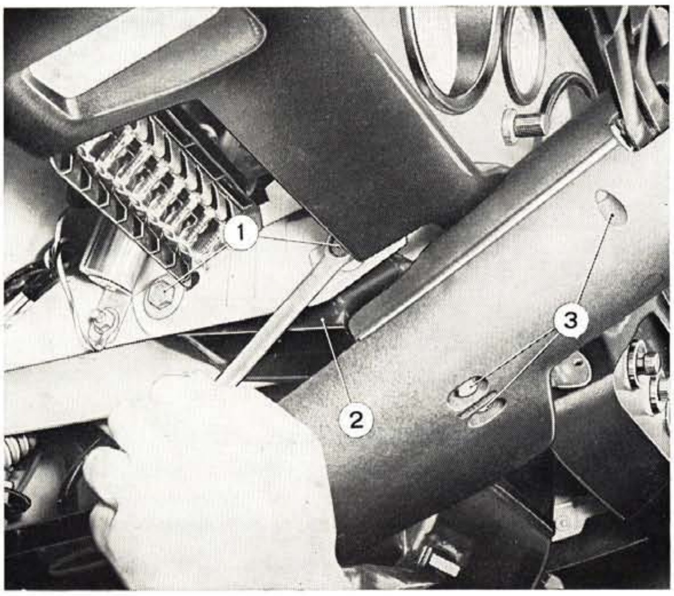



**Fig. 488 - Removing steering column mounting bracket from instrument panel.**

1. Steering column mounting bracket-to-instrument panel screws. - 2. Steering column mounting bracket. - 3. Steering column jacket screws.

## Removing and Disassembling Steering Column Bracket.

Disconnect steering column jackets removing screws (3, fig. 488) from lower jacket.

Disconnect ignition switch cables and both junction blocks for outer light and direction signal selector switch cables.

Remove steering column bracket screws (1, fig. 488) from instrument panel.

Lay the steering column, bracket and wheel assembly down on seat cushion.

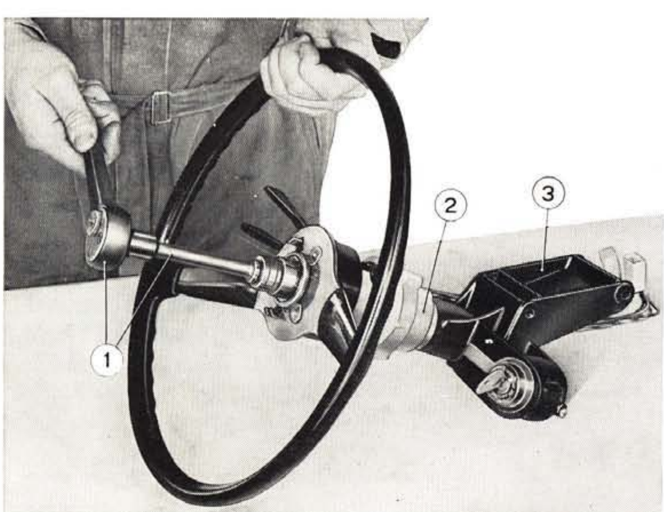



**Fig. 489 - Removing steering wheel on work bench.**

1. Ratchet wrench and extension for steering wheel nut. - 2. Outer light and direction signal selector switch. - 3. Steering column mounting bracket.

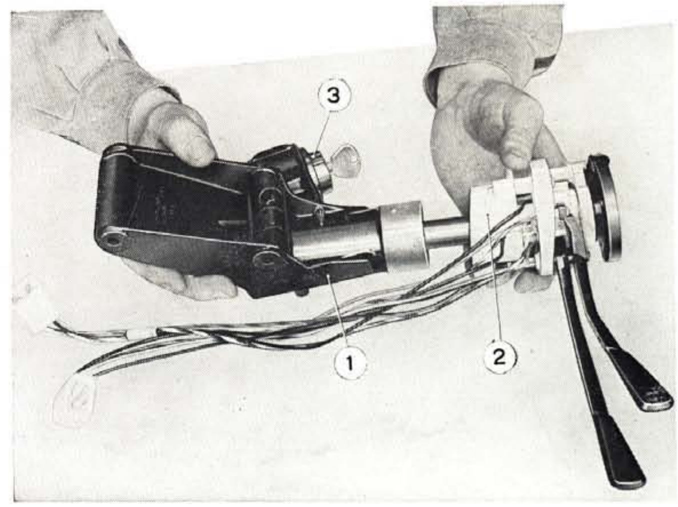



**Fig. 490 - Removing outer light and direction signal selector switch from steering column.**

1. Steering column mounting bracket. - 2. Outer light and direction signal selector switch. - 3. Key-type ignition switch, also energizing warning lights and starting circuits.

Remove the universal joint upper screw from steering column and slide off the steering column, bracket, gear and wheel assembly.

## Replacing Steering Column Bearings.

With the steering assembly in above outlined conditions, renew column bearings as follows:

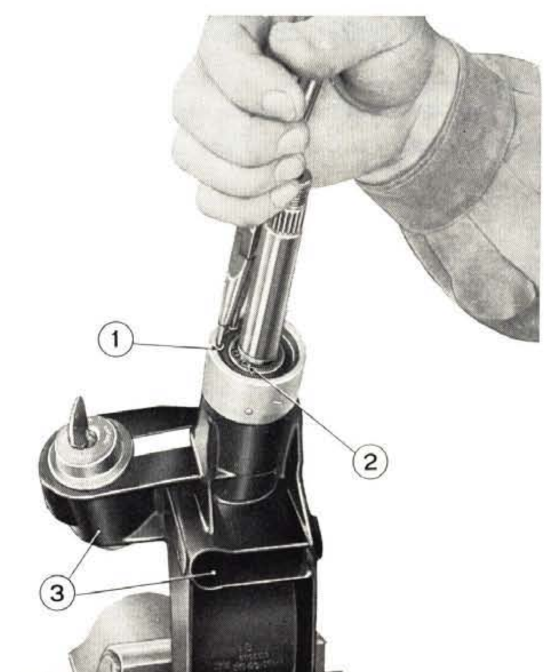



**Fig. 491 - Removing steering column bracket bearing snap rings.**

1. Outer snap ring. - 2. Inner snap ring. - 3. Steering column mounting bracket.

– working on bench, take down the wheel (fig. 489) using puller **A. 47039**;

– loosen the screw which secures the outer light and direction signal selector switch to steering column bracket;

– slide off the selector switch (fig. 490);

– remove both upper ball bearing snap rings and cupped washer (fig. 491);

– remove the lower snap ring and working on top end of shaft have the shaft and the first bearing slide out (fig. 492); the other bearing can be easily withdrawn from the bracket without use of tools;

– renew parts as required and reverse the above outlined procedure to reassemble;

– check ball bearings for perfect efficiency and replace one or both, if showing signs of damage.

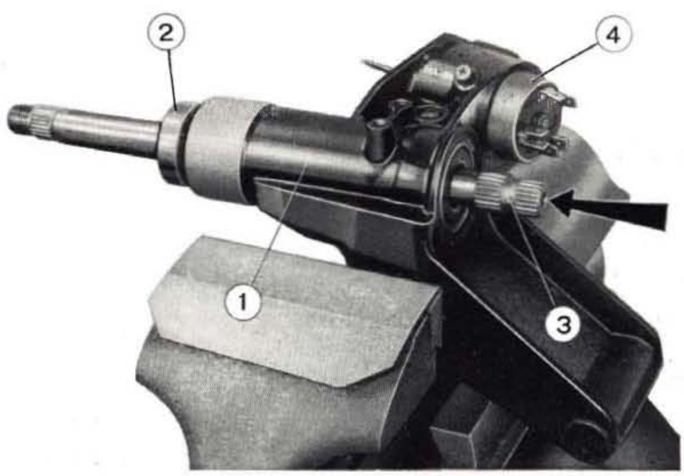



**Fig. 492 - Removing steering column.**

1. Steering column mounting bracket. - 2. Rear ball bearing. - 3. Steering column. - 4. Key-type ignition switch, also energizing warning lights and starting circuits.

**Fig. 493**

**Steering system and front end mechanical units of car.**

**NOTE - From car with No. for spare 801773, shoe-to-drum clearance of rear wheels is automatically adjusted by a self-centering device (as shown in figs. 293 and 294 covering the Sedan version).**

# ELECTRICAL



## HEADLAMPS

### Removal.

To remove headlamps proceed as follows:

– back out headlamp mounting nut (5, fig. 494) from body;

– disengage spring fasteners (7) and take out the unit.

For replacement of bulb just relase both retainers and take out the bulb holder (3).

The bulb is fitted with flange-type mounting.

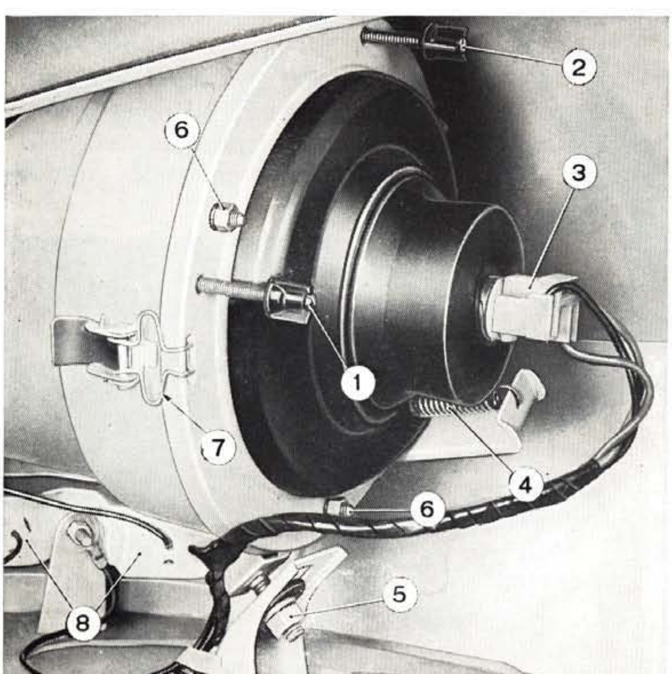



**Fig. 494 - Interior view of right side headlamp.**

1. Screw for horizontal adjustment of light beam. - 2. Screw for vertical adjustment of light beam. - 3. Bulb holder with plug-in insert. - 4. Reflector support retaining spring. - 5. Headlamp mounting screw to body. - 6. Nuts and studs, reflector support rings. - 7. Lamp unit spring fasteners. - 8. Corner direction signal lamp shell.

### Aiming Headlights.

Set the car in conditions outlined on page 233 for aiming operation and proceed as follows.

Draw a pair of vertical lines a-a on the screen (fig. 495). These lines should be equally spaced from the perpendicular to the car longitudinal axis and $38\,^{7}/_{32}''$ (971 mm) apart (A), which corresponds to the headlight center-to-center distance.

Draw a horizontal line b-b on the screen at the following distance from ground: $B = C - {}^{25}/_{32}''$ (20 mm), where **C corresponds to the ground clearance of headlight center, measured on aiming.**

To aim headlights, switch on the low beam and work on the screw (2, fig. 494) for vertical adjustments, and on the screw (1) for horizontal adjustments, until the following conditions are obtained:

– the horizontal separation line between the lit and unlit areas is on line b-b (fig. 495);

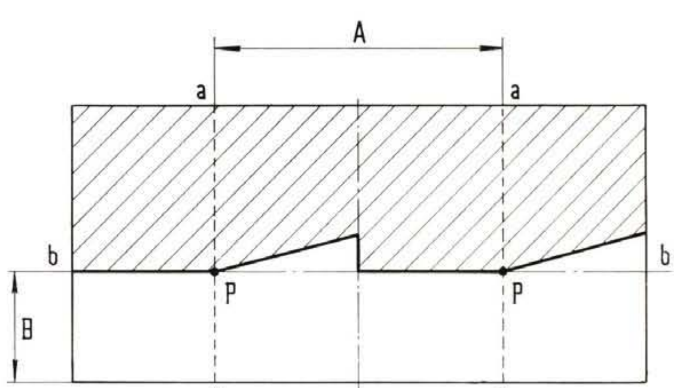



**Fig. 495 - Headlight aiming diagram.**

$A = 38\,^{7}/_{32}''$ (971 mm) - $B = C - {}^{25}/_{32}''$ (20 mm) - C = Ground clearance of headlight center.

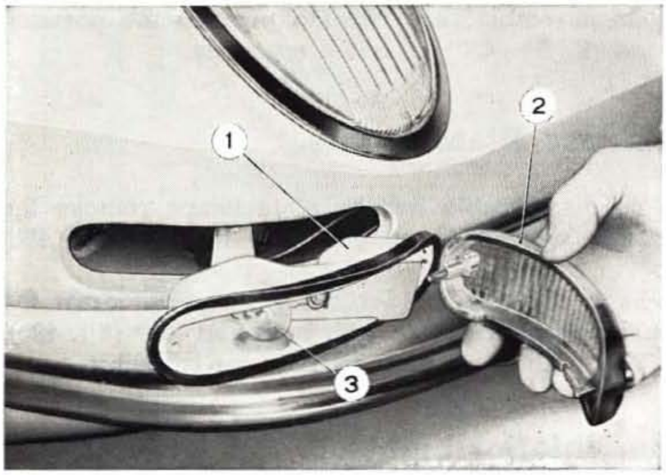



**Fig. 496 - Disassembling front corner parking and direction signal lamp.**

1. Lamp shell. - 2. Lamp lens. - 3. Front corner direction signal light bulb.

– the upward slanting (some 15°) separation lines start from the meeting points **P** of verticals a-a with the horizontal line b-b (fig. 495) or just outside of them.

A maximum outward shift of the meeting point **P** (fig. 495) of 1° 30′ (= $5^1/_8$″ - 130 mm), is permitted.

## Front Corner Parking and Direction Signal Lights.

To disassemble the front corner parking and direction signal lamps just back out the screws which secure the lens (2, fig. 496) and the lamp shell (1) to the body.

Bulbs (3) are inserted by bayonet coupling.

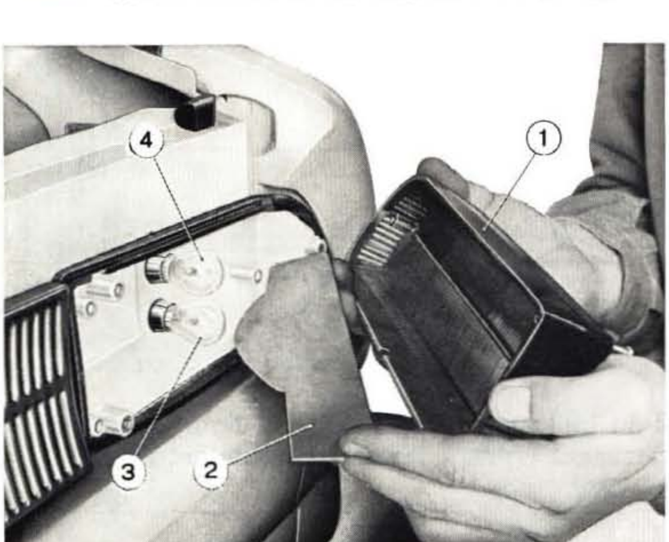



**Fig. 497 - Disassembling rear parking stop and direction signal lamp.**

1. Lamp lens. - 2. Partition plate. - 3. Direction signal light bulb. - 4. Parking and stop light bulb.

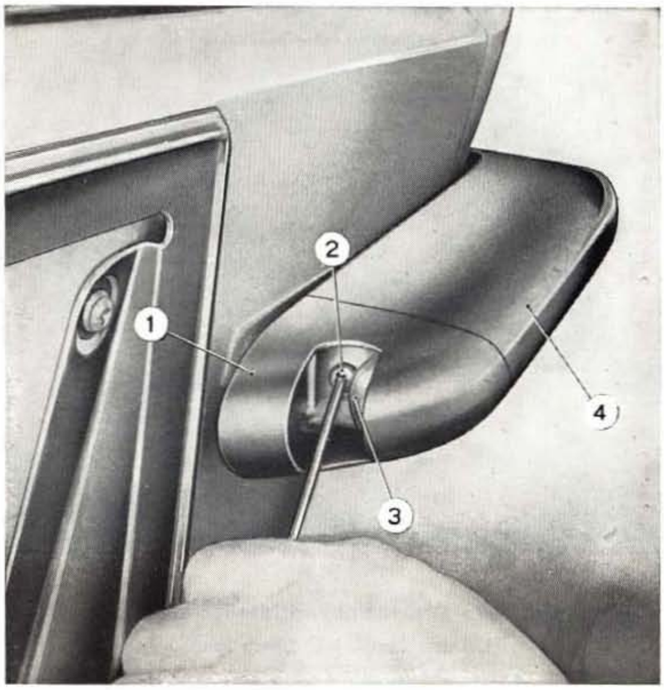



**Fig. 498 - Disassembling license plate lamp.**

1. Lamp shell. - 2. Screw, lamp shell-to-bumper. - 3. License plate light bulb. - 4. Bumper.

## Rear Parking, Direction Signal and Stop Lights with Reflector Lens.

The lamp is disassembled by removing the screws securing the lens (1, fig. 497) and the screws securing the lamp shell to the body.

Bulbs (3-4) are inserted by bayonet coupling.

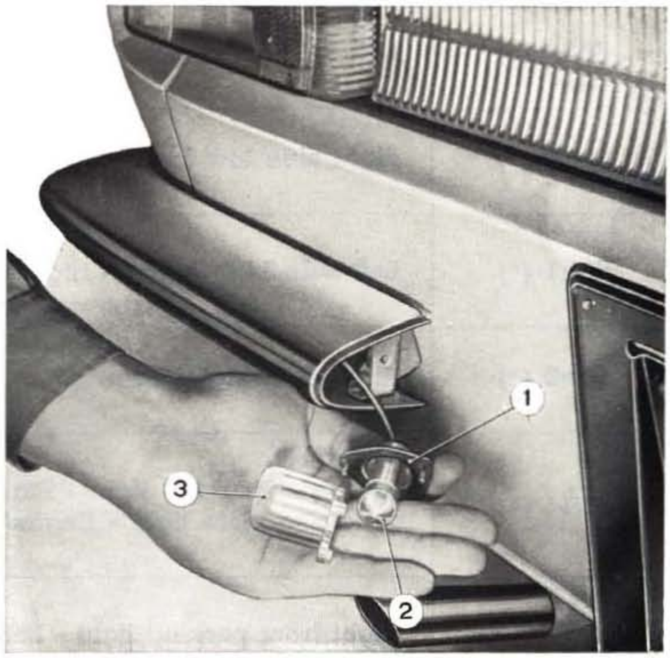



**Fig. 499 - License plate lamp components.**

1. License plate lamp bulb holder. - 2. License plate lamp bulb. - 3. Lamp lens.

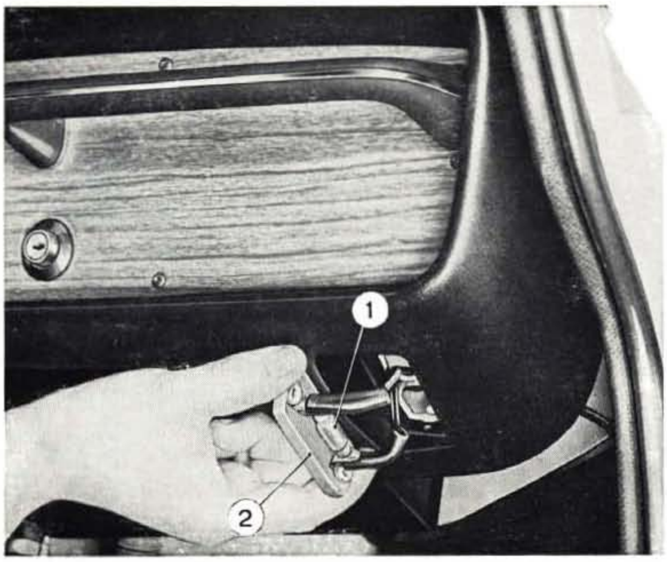



Fig. 500 - Disassembling interior lamps.
1. Inner lamp. - 2. Lamp lens.

On assembly, use care to position the partition plate (2, fig. 497) of bulbs correctly.

### License Plate Lights.

To disassemble license plate lamps remove the screws which secure the lamp lens (2, fig. 498) to the bumper.

Back out bulb holder screws and withdraw the bulb holder complete with bulb and lens (fig. 499).

The bulb is inserted by bayonet coupling.

### Car Interior Lights.

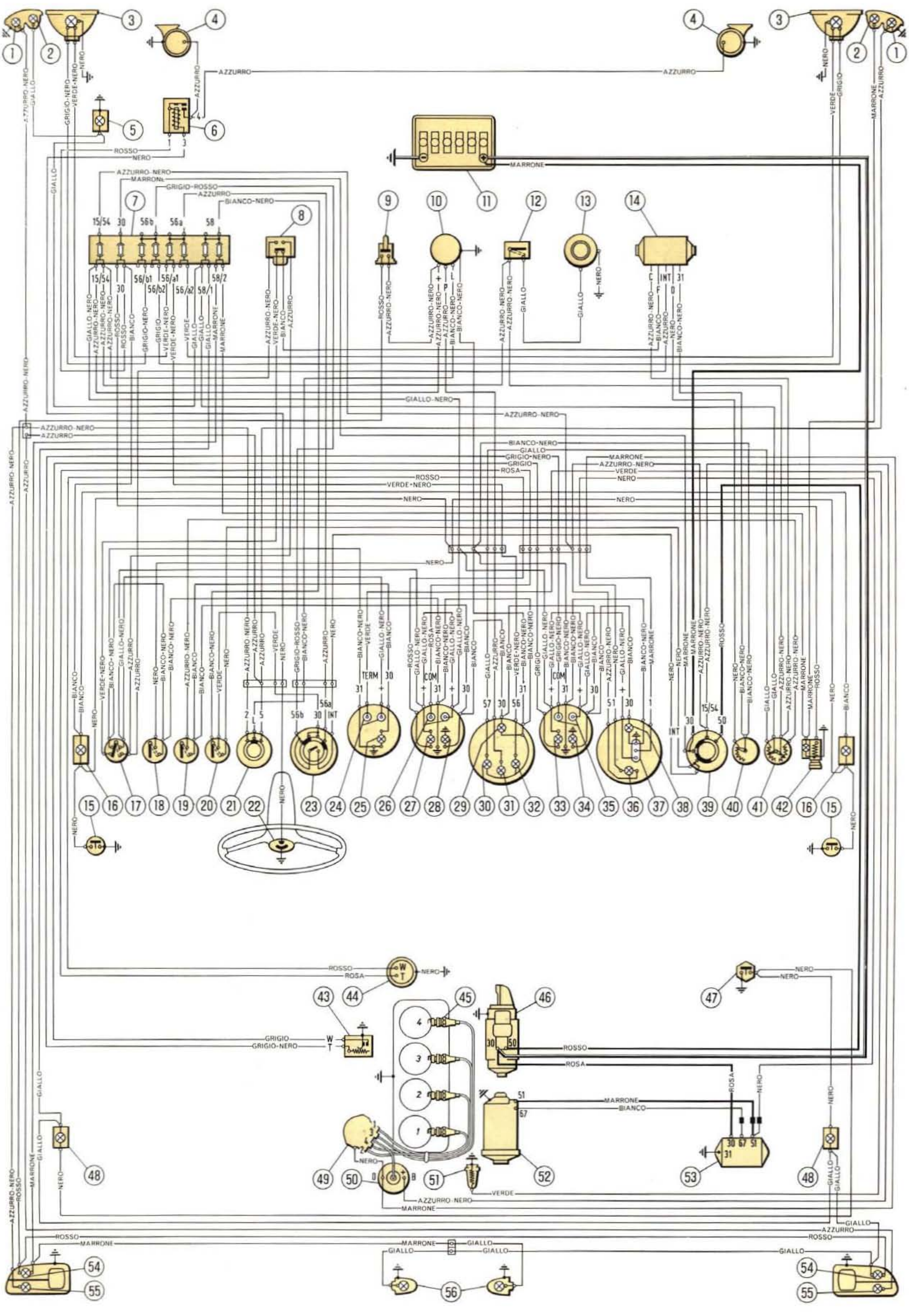
To replace car interior light bulbs just remove the screws securing the lens (2, fig. 500) which serves also as a bulb holder.

The cylindrical bulb is held by means of spring fasteners.

## FUSES

| | |
|---|---|
| 15/54 (*) | Oil pressure gauge - Low oil pressure indicator - Temperature gauge - Fuel gauge and reserve supply indicator - Wiper motor - Panel light - Electro-fan motor - Direction signal lights and indicator - Stop lights - Tachometer. |
| 30 | Car interior lights - Horns - Cigar lighter. |
| 56/b1 (*) | Left side low beam. |
| 56/b2 (*) | Right side low beam. |
| 56/a1 (*) | Left side high beam - High beam indicator. |
| 56/a2 (*) | Right side high beam. |
| 58/1 (*) | Left front parking light - Parking light indicator - Right side tail light - Left side license plate light - Engine compartment lights - Trunk compartment light. |
| 58/2 (*) | Right front parking light - Left side tail light - Right side license plate light - Cigar lighter spot light. |

(*) With ignition on.



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### Fig. 501 - Wiring diagram.

. Front corner direction signal lamps.
2. Front parking lamps.
3. Headlamps (high and low beams).
4. Horns.
5. Luggage compartment light.
6. Horn relay switch.
7. Fuses.
8. Windshield washer and wiper foot control.
9. Stop lights jam switch.
10. Flasher unit, direction signal lights.
11. Battery.
12. Electrofan switch.
13. Electrofan motor.
14. Windshield wiper motor.
15. Jam switches, between doors and pillars, for courtesy light.
16. Interior lights under instrument panel.
17. Windshield wiper switch.
18. Interior lights toggle switch.
19. Instrument panel light switch.
20. Outer lighting master switch.
21. Direction signal lights switch.
22. Horn button.
23. Selector switch for outer lighting and light flashes.
24. Temperature gauge.
25. Temperature gauge light.
26. Fuel gauge.
27. Fuel reserve supply indicator.
28. Fuel gauge light.
29. Speedometer light.
30. Parking lights indicator (green).
31. Direction signal light tell-tale (green).
32. High beam indicator (blue).
33. Low oil pressure indicator (red).
34. Oil gauge light.
35. Oil gauge.
36. No-charge indicator (red).
37. Engine tachometer.
38. Engine tachometer light.
39. Key-type ignition switch, also energizing warning lights and starting circuits.
40. Rheostat for windshield wiper sweep rate adjustment.
41. Rheostats for dimming instrument and parking light indicator lights.
42. Cigar lighter (w/ spot light).
43. Sending unit, oil pressure gauge and low oil pressure indicator.
44. Fuel gauge sending unit.
45. Spark plugs.
46. Starting motor.
47. Engine compartment lights jam switch.
48. Engine compartment lights.
49. Ignition distributor.
50. Ignition coil.
51. Sending unit, temperature gauge.
52. Generator.
53. Generator regulator.
54. Rear parking and stop lights.
55. Rear direction signal lights.
56. License plate lights.

**NOTE** - Mark — means that cable is provided with numbered strip or ferrule.

### CABLE COLOR CODE

| | | |
|---|---|---|
| Azzurro = **Blue** | Grigio = **Grey** | Rosa = **Pink** |
| Bianco = **White** | Marrone = **Brown** | Rosso = **Red** |
| Giallo = **Yellow** | Nero = **Black** | Verde = **Green** |
| INT - COM = **Switch** | TERM = **Temperature gauge** | |

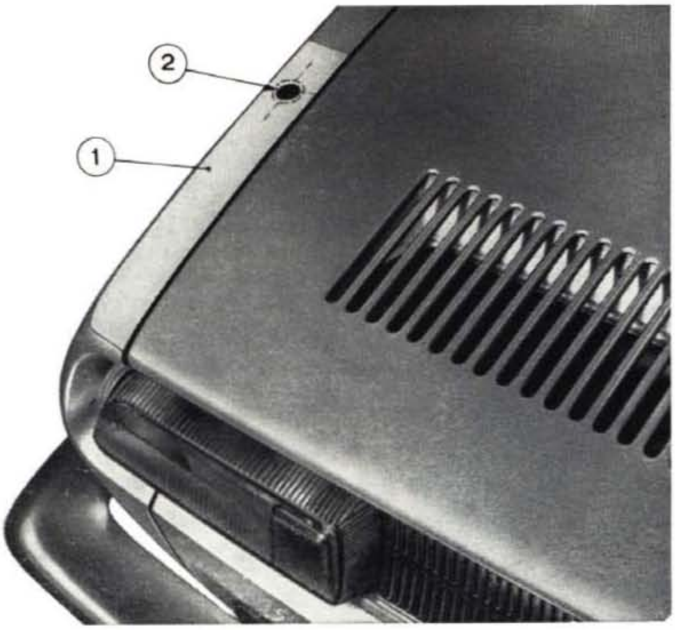



**Fig. 502 - Fitting templet for drilling antenna rod passage opening.**

1. Templet. - 2. Opening on rear fender for antenna rod passage.

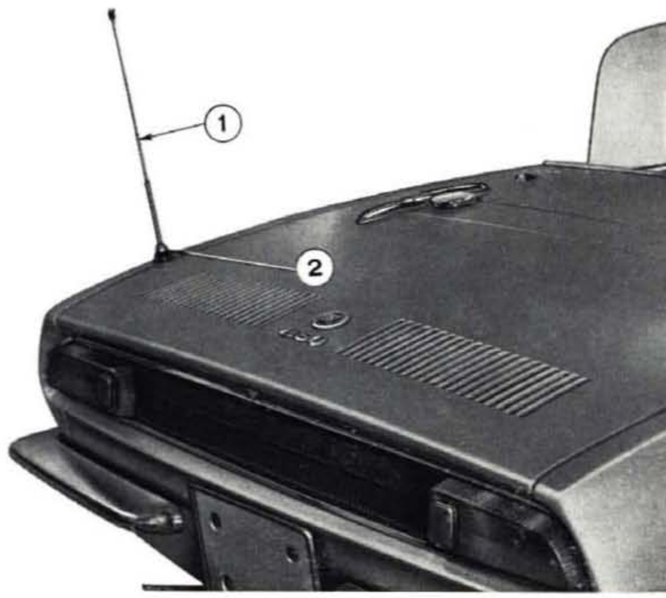



**Fig. 504 - Antenna installed on rear fender.**

1. Antenna. - 2. Nut, antenna trimmer setting.

# RADIO RECEIVER

The 850 Roadster may be optionally fitted with the same radio receiver as for the Coupe version.

For radio installation proceed as outlined on page 291 and recall the following additional points.

Using radio kit templet drill antenna rod passage opening (fig. 502) and arrange the antenna and mounting bracket in position.

To secure the antenna assembly to rear wheel-housing remove the lid from engine compartment interior and work through the opening in the wall.

The antenna bracket mounting holes must be drilled and the bracket mounted with the antenna tilted at an angle of 110° toward the rear of the car (fig. 504).

To install the radio receiver, remove the ornamental plate from the right side of instrument panel and drill necessary mounting holes using marks stamped on panel lid as a guide (fig. 503).

The loudspeaker (3, fig. 505) is mounted behind the utility drawer.

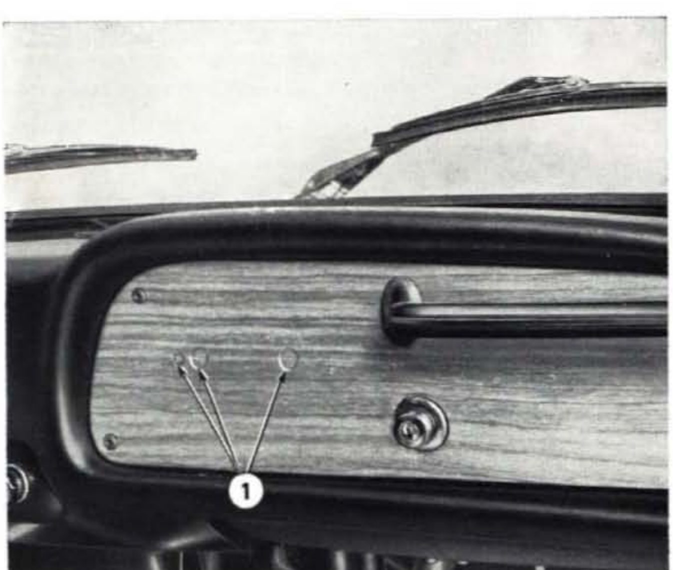



**Fig. 503 - Instrument panel with location marks for drilling radio receiver mounting holes.**

1. Location marks for drilling receiver mounting holes.

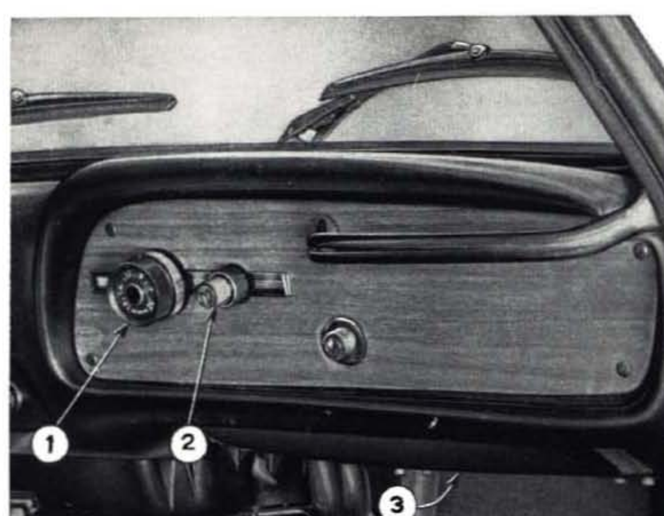



**Fig. 505 - Radio receiver installed on car.**

1. Tuning control knob. - 2. On-off and volume control knob. - 3. Loudspeaker.

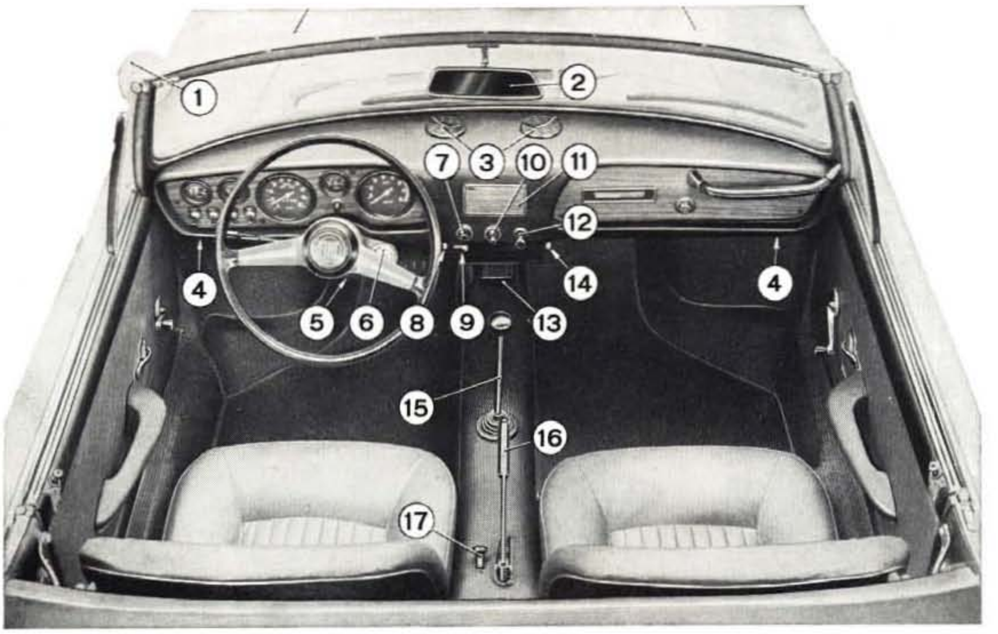



**Fig. 506.**

**Instruments and accessories.**

1. Outer rear view mirror. - 2. Inner rear view mirror. - 3. Adjustable air outlets, ventilation and heating. - 4. Car interior lights. - 5. Windshield washer foot control. - 6. Key-type ignition switch, also energizing warning lights and starting circuits. - 7. Rheostat, wiper arm stroke adjustment. - 8. Front air scoop control lever. - 9. Air conditioning electrofan switch. - 10. Rheostat, glow adjustment of panel light and outer light indicator. - 11. Ash receiver. - 12. Cigar lighter. - 13. Shutter, air admission to car interior. - 14. Heater cock control lever. - 15. Gearshift lever. - 16. Parking brake ratchet lever. - 17. Easy starting device control knob.

# INSTRUMENTS AND ACCESSORIES

## Removal and Installation of Dashboard Instruments.

Remove the steering column mounting bracket and lower the wheel as outlined on page 302.

Remove lock nuts from dashboard control switches and the trip odometer zero setting knob.

Disconnect the speedo drive cable from speedometer.

Back out instrument panel imitation wood lining mounting screws.

Withdraw the instrument assembly (fig. 507).

For installation of instruments, just reverse above removal procedure.

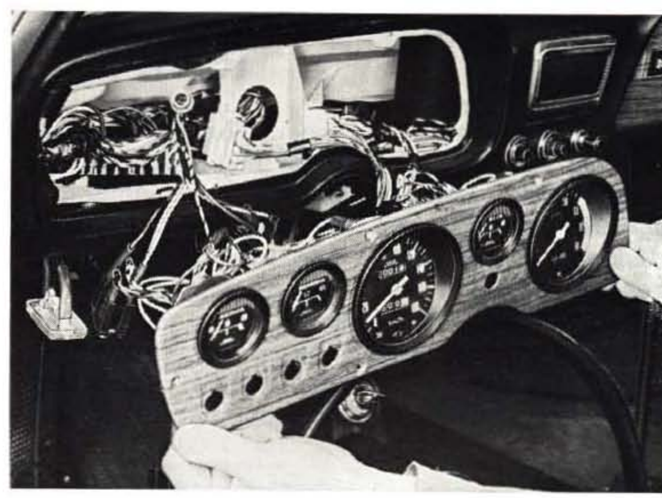


**Fig. 507 - Removing instrument assembly from dashboard.**

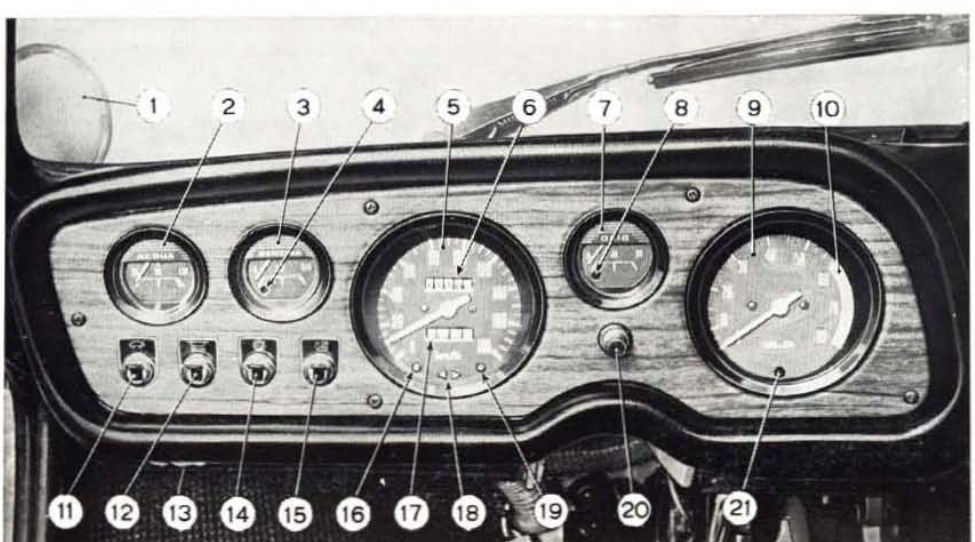



**Fig. 508.**

**Detail of instrument panel.**

1. Rear view mirror. - 2. Temperature gauge. - 3. Fuel gauge. - 4. Reserve supply indicator. - 5. Speedometer. - 6. Total odometer. - 7. Oil gauge. - 8. Low oil pressure indicator. - 9. Tachometer. - 10. Dangerous r.p.m. rates of engine. - 11. Windshield wiper switch. - 12. Interior light switch. - 13. Car interior lights. - 14. Panel light switch. - 15. Outer lighting master switch. - 16. Parking light indicator. - 17. Trip odometer. - 18. Direction signal arrow tell-tale light. - 19. High beam indicator. - 20. Trip odometer zero-setting knob. - 21. No-charge indicator.

## WINDSHIELD WASHER

The windshield washer is controlled by a pedal pump (1, fig. 510).

To clean the windshield glass, apply foot pressure several times on the button controlling the pump.

This way the cleaning liquid in the bag is flown to the single spray nozzle at center of windshield base, while the wiper starts stroking.

The wiper is set into operation synchronously and automatically thanks to a switch in the foot control shunt connected to the wiper toggle switch in the instrument panel.

As pressure on pedal button releases, the wiper motor will continue to operate till arms are parked off.

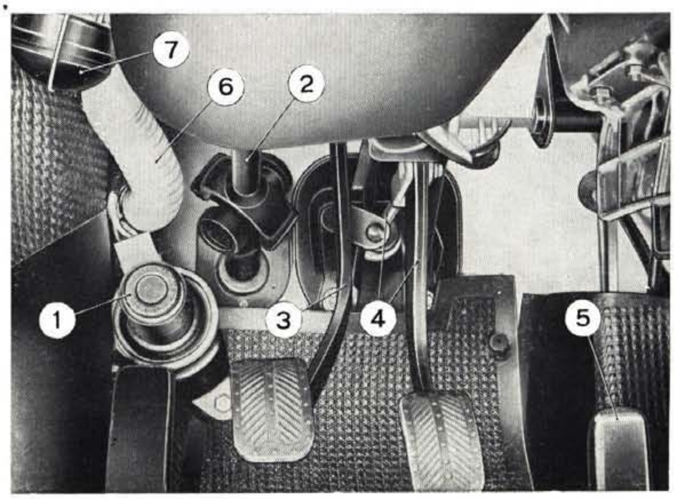



**Fig. 510 - Detail showing car interior, driver's side.**

1. Windshield washer foot control. - 2. Steering column. - 3. Clutch pedal. - 4. Brake pedal with master cylinder control rod. - 5. Accelerator pedal. - 6. Air intake water drain hose. - 7. Horn relay.

# BODY



Body differences are outlined on page 297.

Body units involving particular directions for service are dealt with in this section.

Some differences from Coupe version being self-evident as far as service is concerned, have been solely illustrated in picture.

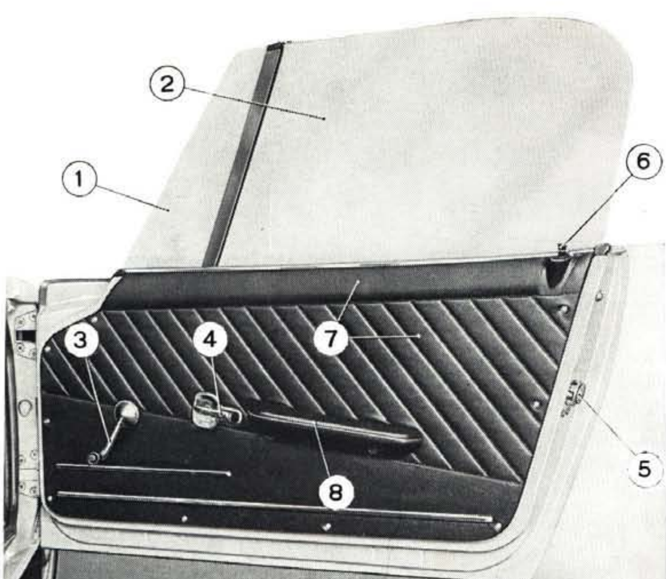



**Fig. 509 - Door interior view.**

1. Stationary pane. - 2. Drop window. - 3. Window regulator crank. - 4. Door remote control. - 5. Door lock. - 6. Door locking knob. - 7. Trim panel. - 8. Arm rest.


**Fig. 511 - Detail showing seat squab adjusting device.**

1. Squab adjuster push rod and nut. - 2. Push rod backing plate.

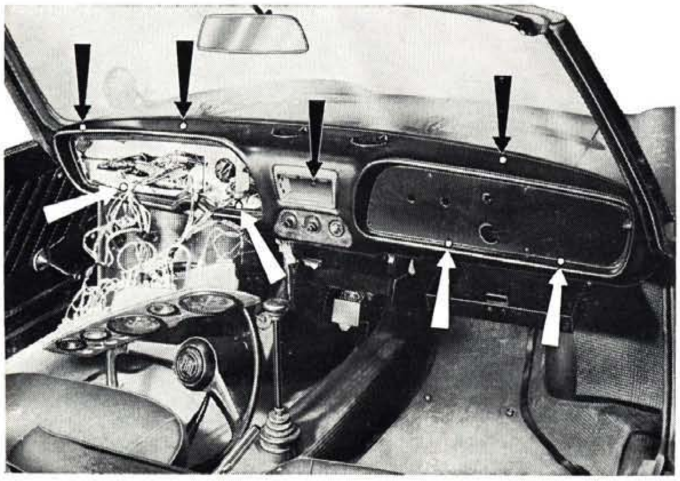


**Fig. 512 - Layout of instrument panel lining holding points. Arrows evidence location of lining holding screws, nuts and lugs.**

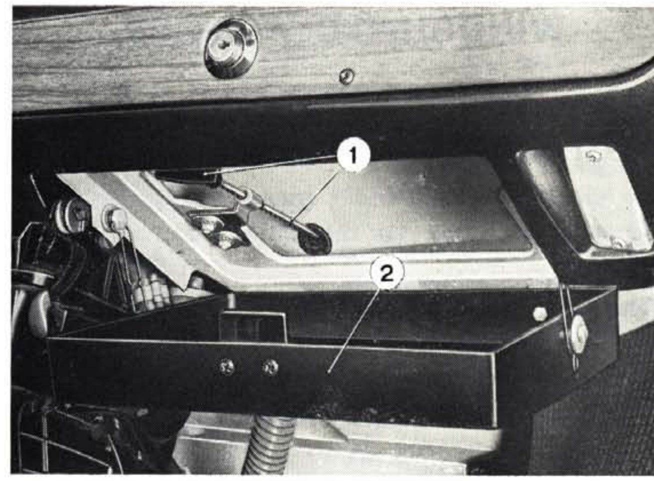


**Fig. 514 - Close-up view of utility compartment.**

1. Engine compartment lid release control. - 2. Utility drawer, drop type.

## Removing Instrument Panel Lining.

Take down instrument assembly as outlined on page 308.

Remove lock nuts from wiper arm stroke adjusting knob and instrument light dimming knob. Remove cigar lighter.

Withdraw air outlets (3, fig. 506) from instrument panel.

Remove ash receiver and instrument panel rim screw (fig. 512).

Remove utility drawer release pushbutton (1, fig. 513).

Remove the passenger grab handle (2, fig. 513) as well as imitation wood lining screws. Withdraw imitation wood lining.

Take out both interior lamps under instrument panel.

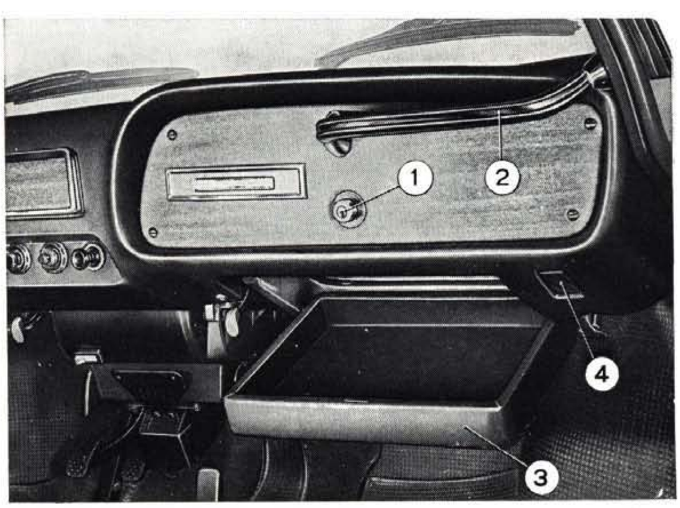


**Fig. 513 - Detail showing the utility compartment in instrument panel.**

1. Release pushbutton with key lock. - 2. Grab handle. - 3. Utility drawer. - 4. Interior light.

**Utility compartment and articulation system shown in figure are the early design.**

Back out instrument panel lining lock nuts and screws (fig. 512) and pry up lining lugs.

Withdraw imitation leather lining assembly.

For installation, just reverse above outlined steps using care to bend down imitation leather lining lugs.

## Luggage Compartment Lid Release Control.

The front compartment lid release control (1, fig. 514) is arranged in utility compartment interior.

For replacement of control cable just remove the cable holding screws and disengage the lid catch actuating rod (fig. 514).

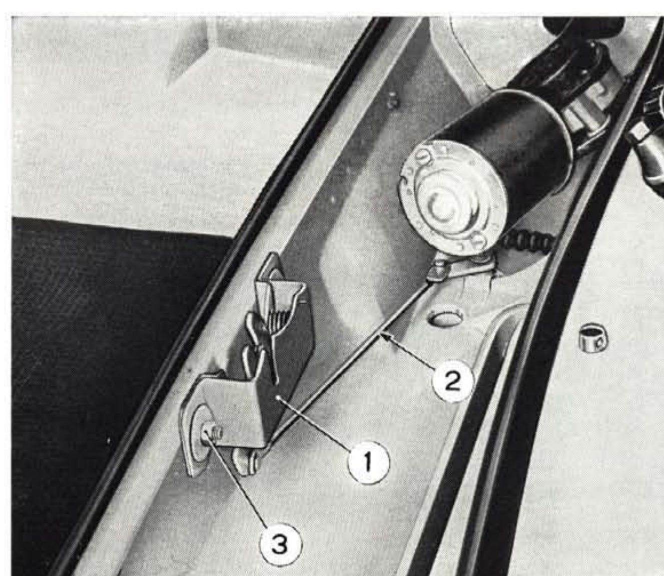


**Fig. 515 - Close-up view of engine compartment lid catch and release control.**

1. Catch. - 2. Release rod. - 3. Catch mounting screw.

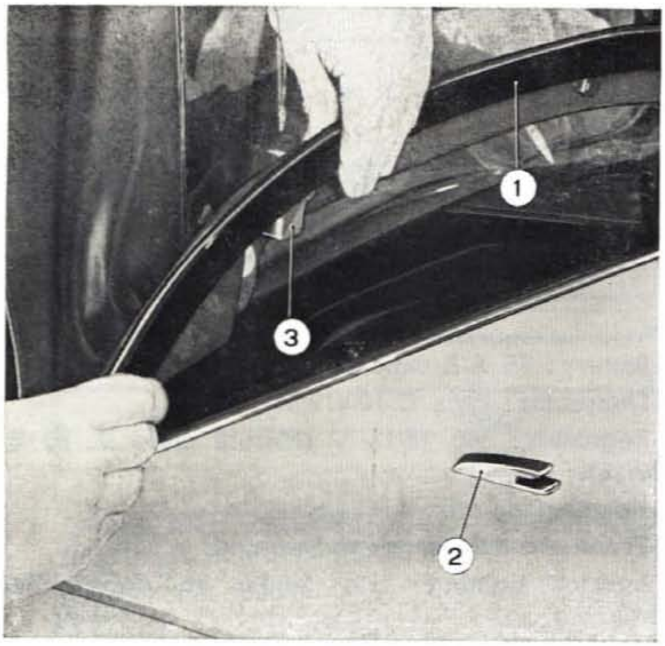



**Fig. 516 - Hooking up canvas at rear.**

1. Top rear cross rail. - 2. Cross rail hook. - 3. Hook seat.

## Folding Top.

The canvas to should be unfolded with much care because rattles and water leakage may result if the top is closed incorrectly.

Proceed as follows.

Raise top recess lid.

Unhook the top fastening strap.

Pull up the top from its stow recess.

Lower the recess lid and hook up the top at rear (fig. 516).

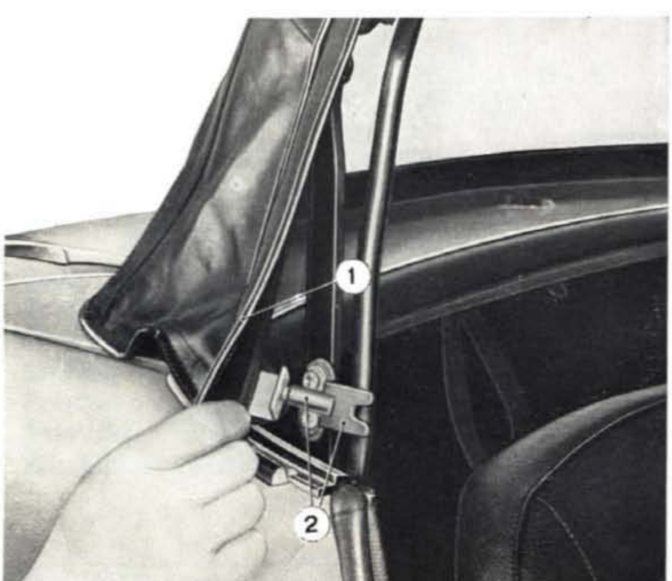



**Fig. 517 - Securing canvas top on sides.**

1. Top. - 2. Lock pin and plate holding top side.

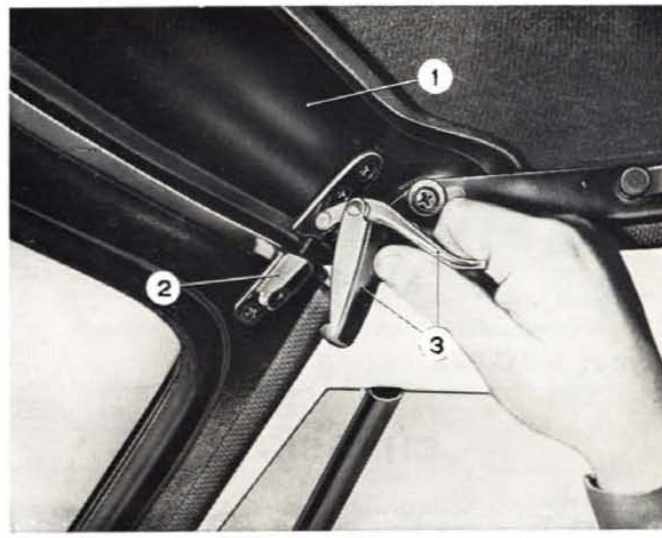



**Fig. 518 - Fastening top at front.**

1. Top front cross rail. - 2. Top front catch. - 3. Top front catch clamp and lever.

Insert side flap lock pins into lock plates (fig. 517).

Secure the top to windshield frame by actuating catch levers (fig. 518).

At last check to see that drip flaps on top sides are placed outside door window panes.

## Rear Lid for Folded Top.

The top stow recess lid is locked by means of a pair of latches (1, fig. 519) controlled from a turn handle on lid panel framework.

If the lid latch link (5, fig. 519) must be replaced remove the center turn handle and disconnect link ends from latches.

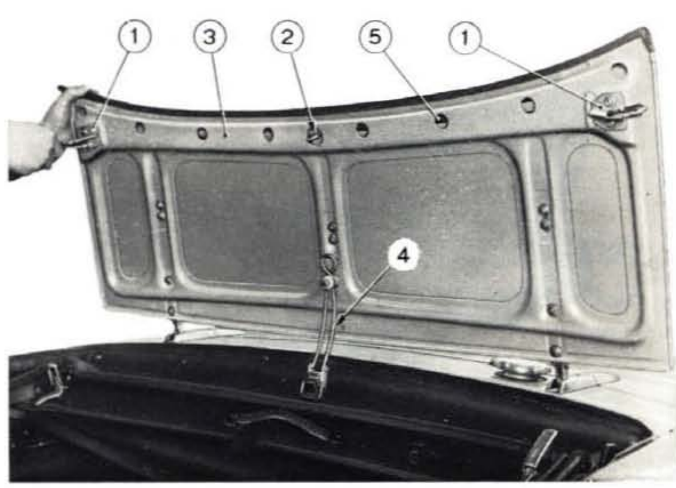



**Fig. 519 - Removing folded top recess lid latch link.**

1. Lid latches. - 2. Cam pin for latch control. - 3. Top recess lid. - 4. Lid spring strut. - 5. Lid latch link.

# FAMILY

# DIFFERENCES FROM SEDAN VERSION

## ENGINE

Type: 100 G.000.

## CHASSIS

Capacities.

Leading dimensions of car.

Differential: reduction ratio.

Front suspension: assembly design.

Rear suspension: coil springs; without sway eliminator.

Steering: worm and roller, ratio 16.4 to 1, steering column with flexible joint.

Brakes: hydraulic circuit design.

Wheels and tires: tire type and pressure, location of spare wheel.

Air conditioning: conditioner design.

Chassis tightening torques.

## ELECTRICAL

Battery: 48 A/h capacity.

Generator: type D 100/12/25/4 SB.

Regulator: 360 W/12 V (Marelli code IR 50 H/360/12).

Headlamps: twin.

Front and tail lamps: redesigned.

Interior lighting: two lamps on door pillar posts.

Fuses: arrangement of protected circuits.

Instrument cluster: redesigned, different arrangement of indicators.

Dashboard switches: different arrangement.

## BODY

Body differences are outlined and illustrated on page 340.

Fig. 520 - Fiat 850 Family.

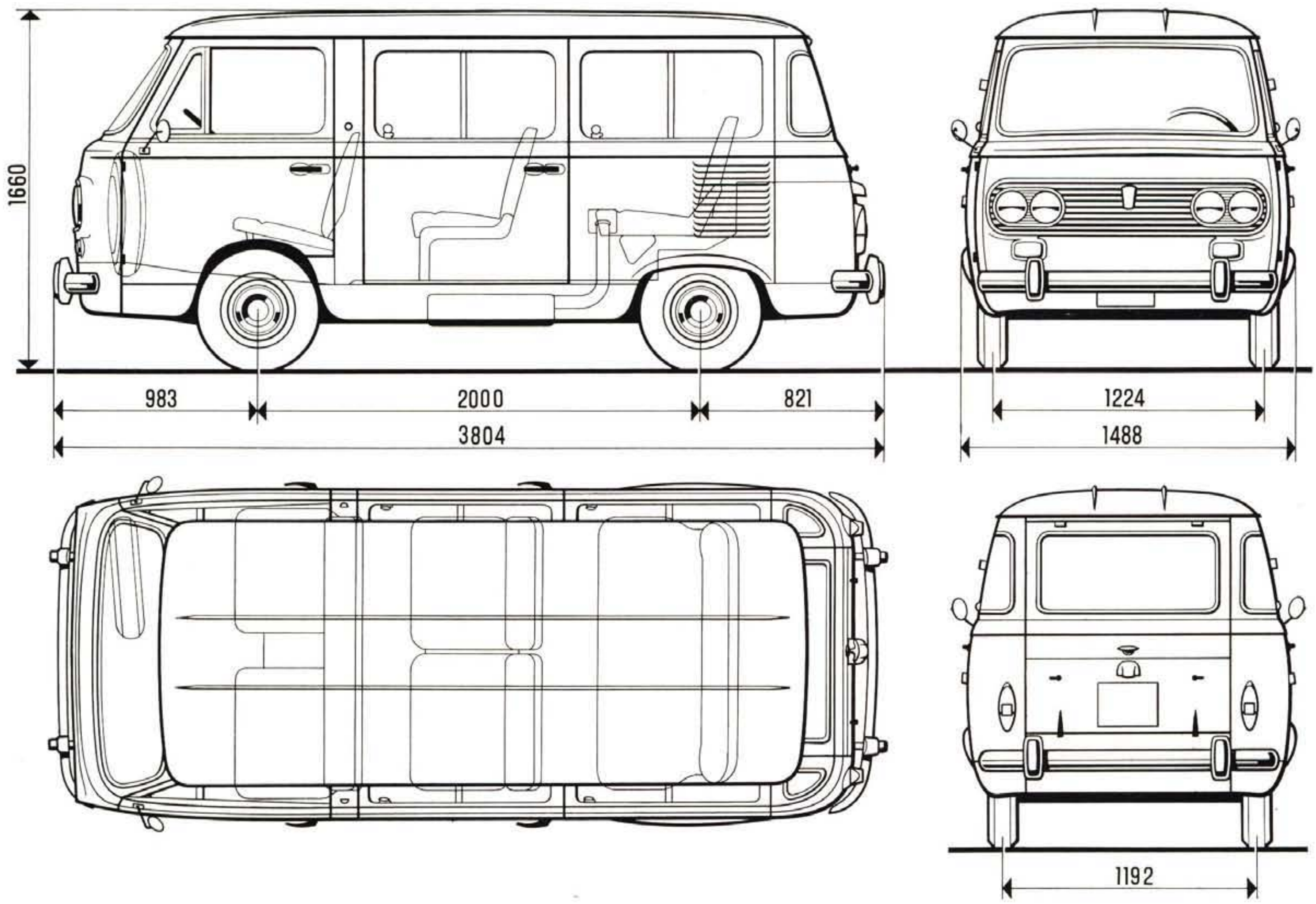



**Fig. 521 - Leading dimensions.**
Overall height applies to an unloaded vehicle.

## CAPACITIES

| UNIT | QUANTITY | | | | FILL-IN |
|---|---|---|---|---|---|
| | Imp. units | U.S. units | lt | kg | |
| Fuel tank | 7.04 gals | 8.45 gals | 32 | — | 83 octane gasoline (R.M.), min. |
| Radiator, engine and heating system | 1.65 | 1.98 | 7.5 | — | Mixture of water and FIAT Paraflu 11 fluid (50% by volume) (¹) |
| | pints | pints | | | |
| Sump and filter (*) | 5.72 | 6.87 | 3.25 | 2.90 | FIAT oil (³) |
| Transmission and differential | 3.70 | 4.44 | 2.10 | 1.90 | FIAT W 90/M oil (SAE 90 EP) |
| Steering gear | 0.422 | 0.507 | 0.24 | 0.22 | FIAT W 90/M oil (SAE 90 EP) |
| Braking system | 0.651 | 0.782 | 0.37 | 0.37 | FIAT special « blue label » fluid |
| Front shock absorbers (each) | 0.290 | 0.349 | 0.165 | 0.150 | FIAT S.A.I. fluid |
| Rear shock absorbers (each) | 0.264 | 0.317 | 0.150 | 0.135 | FIAT S.A.I. fluid |
| Windshield washer bag | (²) | (²) | — | (²) | Water and FIAT D.P./1 fluid mixture (concentrated solution). |

(*) The total capacity of sump, pipings and crankshaft is 6.48 G.B. pts - 7.80 U.S. pts (3.3 kg). The quantity shown in the table applies to routine oil changes, which should be made every 6,000 miles (10,000 km) or six months. Every 300 miles (500 km), check oil level.
(¹) The coolant has non-oxidizing, non-corrosive, non-foamy, non-scaling properties and will not freeze up to —31° F (—35° C).
(²) Pure water .66 G.B. qts - .79 U.S. qts (0.75 kilos) plus .6 oz (17 gr) solution in summer and 1.20 oz (34 gr) solution in winter.
(³) Use the oil grades recommended on page 7.

# LEADING DIMENSIONS

## Overall Dimensions.

| | |
|---|---|
| Length, with bumpers | 149.764″ (3,804 mm) |
| Width | 58.582″ (1,488 mm) |
| Height, no load | 65.354″ (1,660 mm) |
| Overhang, front | 38.700″ ( 983 mm) |
| Overhang, rear | 32.322″ ( 821 mm) |

## General Specifications.

| | |
|---|---|
| Wheelbase | 78.739″ (2,000 mm) |
| Tread, front, on ground | 48.031″ (1,224 mm) |
| Tread, rear | 46.928″ (1,192 mm) |
| Minimum ground clearance, loaded | 5.315″ ( 135 mm) |
| Turning circle | 28′ 10 ½″ (8,800 mm) |

## Weights.

| | |
|---|---|
| Curb weight of car with fuel, oil, coolant, spare wheel, tool kit and accessories | 1,984 lbs (900 kg) |
| Accomodation | 7 |
| Payload | 7 people plus 154 lbs (70 kg) or 1 person plus 1,080 lbs (490 kg) (*) |
| Gross weight | 3,219 lbs (1,460 kg) |
| Distribution of gross weight on axles: | |
| – front | 1,356 lbs (615 kg) |
| – rear | 1,863 lbs (845 kg) |

## Performances.

**Speed,** maximum, at full load, with level road in good condition and run-in engine:

| | |
|---|---|
| first gear | 15 1/2 mph ( 25 km/h) |
| second gear | 28 mph ( 45 km/h) |
| third gear | 43 1/2 mph ( 70 km/h) |
| fourth gear, over | 62 mph (100 km/h) |
| reverse | 15 1/2 mph ( 25 km/h) |

**Gradeability** at full load, with level road in good condition and run-in engine:

| | |
|---|---|
| first gear | 23% |
| second gear | 12% |
| third gear | 7.5% |
| fourth gear | 4.5% |
| reverse | 23% |

(*) Orderly load on the whole loading platform (intermediate and rear seats folded down).

**In the following text are outlined exclusively the units, service procedures and data differing from Sedan version.**

# CHASSIS



## TRANSMISSION - DIFFERENTIAL

| | | | | | |
|---|---|---|---|---|---|
| Gear ratio . . . 5.571 to 1 (7/39) | | | | | |
| Final drive ratio: | | | | | |
| – Gears . . . | first | second | third | fourth | reverse |
| – Ratio . . . | 20.256 to 1 | 11.448 to 1 | 7.850 to 1 | 5.393 to 1 | 20.139 to 1 |

**NOTE** - To figure thickness of bevel pinion shim adhere to the procedure outlined on page 115 and use the following formula:

$$S = b - (+ a) + 2 = b - a + 2$$
$$\text{or } S = b - (- a) + 2 = b + a + 2$$

## FRONT SUSPENSION

The front suspension consists of control arms, upper and lower, which are connected to wheels through kingpin and counteracted by coil springs and hydraulic double acting telescope shock absorbers (fig. 522).

# FRONT SUSPENSION ASSEMBLY

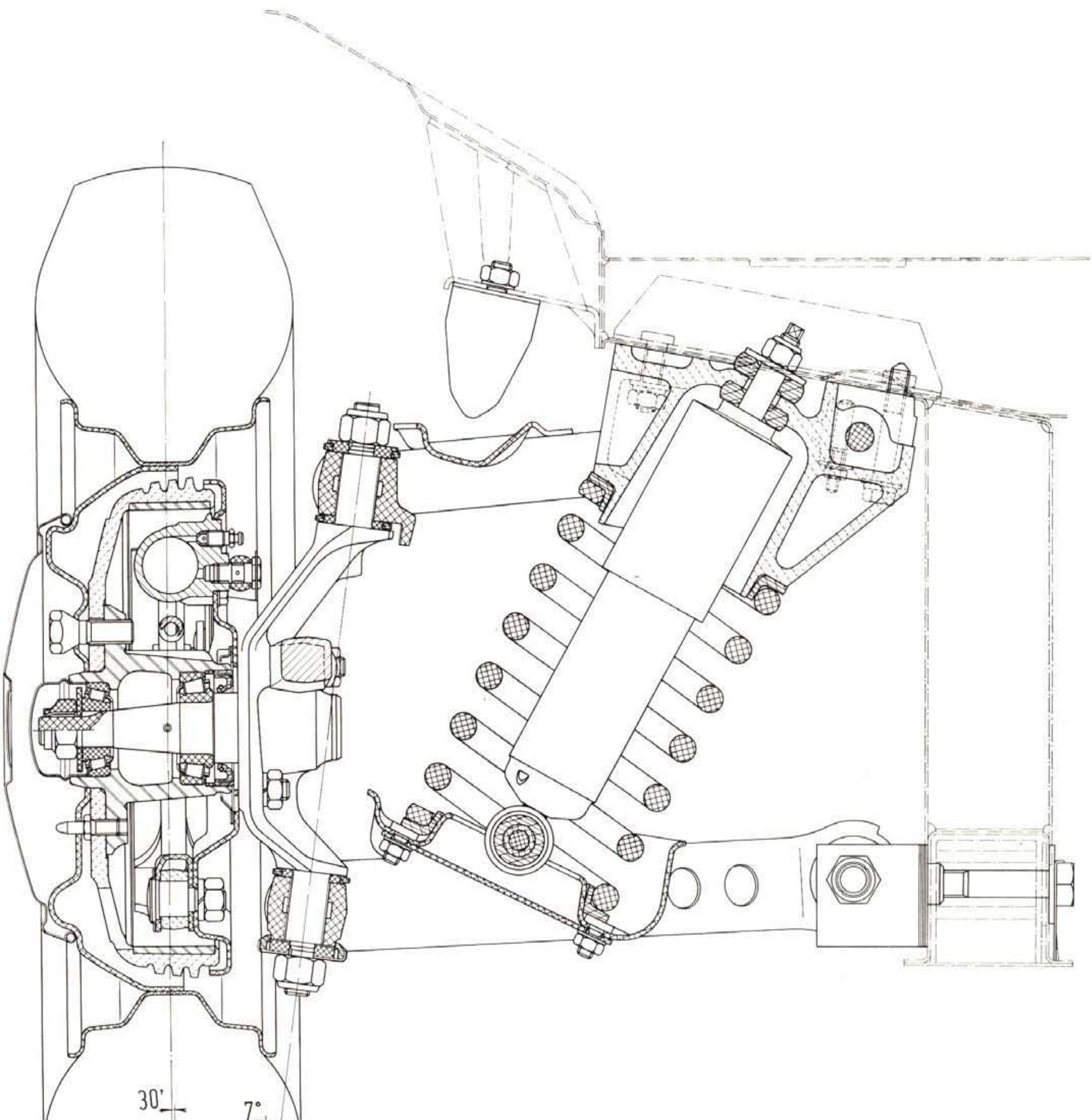



Fig. 522 - Sectional view of left side front suspension and wheel assembly.

# SPECIFICATIONS AND DATA

| | | |
|---|---|---|
| Front suspension type | independent wheel with hydraulic shock absorbers and coil springs | |
| Sway eliminator | cross bar mounted on resilient bushings | |
| Camber | 0°30′ ±20′ | With vehicle in « loaded » condition (7 people plus 154 lbs) (70 kg) |
| Caster | 4°55′ ±30′ | |
| Kingpin inclination | 7° ±20′ | |
| Toe-out | .079″ to .157″ (2 to 4 mm) | |
| Tread, front (on ground) | 48.031″ (1,224 mm) | |
| Wheelbase | 78.739″ (2,000 mm) | |
| Shock absorbers | 2 | |
| Type | hydraulic, telescoping, double acting | |
| Working cylinder bore | 1.26″ (32 mm) | |
| Fluid grade | FIAT S.A.I. | |
| Fluid capacity | .290 ± .009 Imp.pts - .349 ± .011 U.S.pts (165 ± 5 cm³) | |

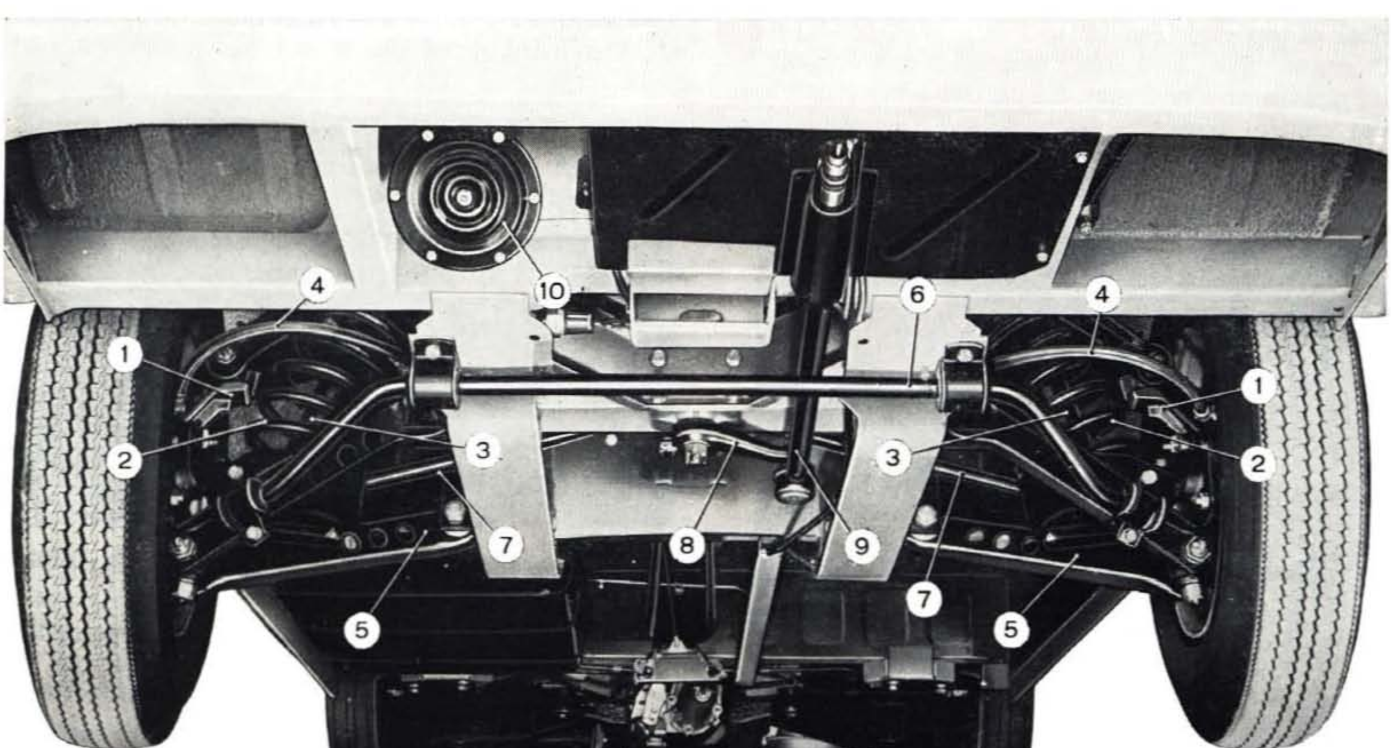



**Fig. 523 - Bottom view of front suspension in place on car.**

1. Kingpins. - 2. Coil springs. - 3. Shock absorbers. - 4. Front brake hoses. - 5. Lower control arms. - 6. Front sway bar. - 7. Tie rods. - 8. Idler arm. - 9. Drag link. - 10. Horn.


**Fig. 524 - Disconnecting shock absorber at top end.**
1. Shock absorber. - 2. Wrench A. 57035.

## Removal and Disassembly.

Jack up the car at front and set it on stands.

Remove either front wheel and disconnect related shock absorber at bottom end.

Remove front seat cushion from car interior and using wrench **A. 57035** disconnect the shock absorber at top end (fig. 524).

Using wrench **A. 47035** disconnect the drag link from pitman arm and then tie off the sway bar from lower control arm.

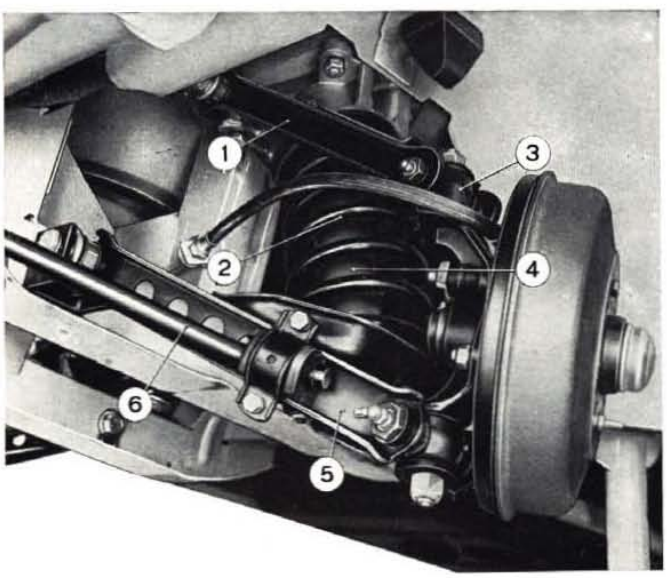



**Fig. 525 - Detail of left side front suspension.**
1. Upper control arm. - 2. Coil spring. - 3. Kingpin. - 4. Shock absorber. - 5. Lower control arm. - 6. Sway bar.

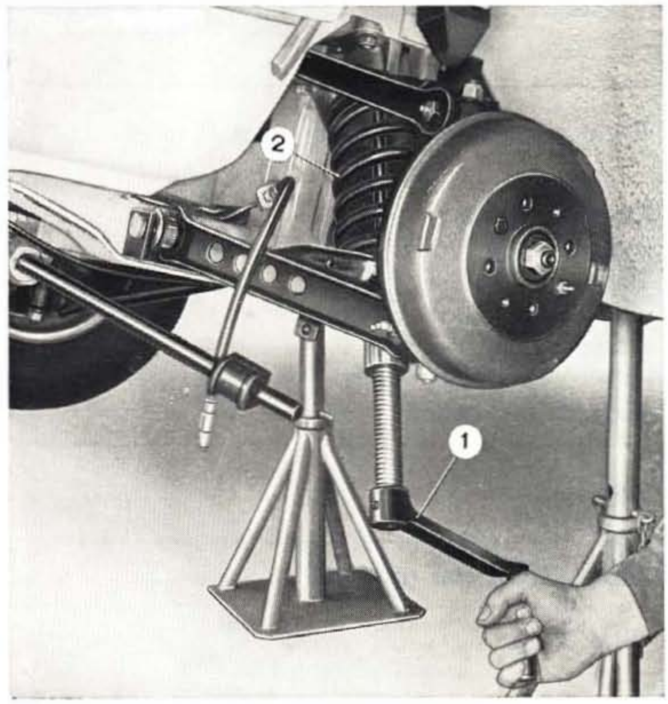



**Fig. 526 - Compressing coil spring as a preparatory step to suspension removal.**
1. Spring compressor A. 74083. - 2. Coil spring.

Affix tool **A. 74083** (fig. 526) and actuate it to compress the coil spring.

Disconnect the hydraulic brake fluid hose.

Untie lower control arm from underbody observing the number of shims set between arm and body metal.

Again work on tool and release the coil spring.

Slide off the coil spring and disconnect the body mounting bracket.

Mount the arm and bracket assembly on tool **A. 22229** and strip it into components.

For removal of bearings and overhaul of front wheel hub follow the procedure covering the Sedan version, page 137.

## Inspection and Repair.

Affix the upper control arm on tool **A. 74023** (fig. 527) and check:

— The arm for a squared condition to mounting planes: in case of difficulties to secure the arm to the tool, correct distortion.

Should arm be deformed beyond repair, replace the arm assembly by a new one.

— Resilient bushings for absence of binding signs and no clearance to arm pivot bars in excess of .0157" (0.4 mm). Otherwise renew bushings.

Clearance specification of new resilient bushings is .0002″ to .010″ (0.005 to 0.250 mm).

— Self-threading bushings for any clearance; in case clearance is observed at these bushings, replace by oversizes. Self-threading bushings for service come in the standard size as well as oversized by .01″ and .02″ (0.25 and 0.50 mm) at outside diameter.

Should clearance not be thoroughly taken up through fitting of largest bushing in the service range, renew the control arm assembly.

— Kingpin pivots for excessive clearance to control arm spiders; to take up too much clearance replace spider inner bushings by new ones and ream them by means of reamer **A. 90361**.

Upper and lower thrust washers should not be worn; replace them, if necessary, by others of proper thickness.

Thrust washers for service come in the following thicknesses: .1555″ - .1575″ - .1594″ - .1614″ (3.95 - 4.00 - 4.05 - 4.10 mm).

The same procedure must be performed at lower control arm (fig. 528).

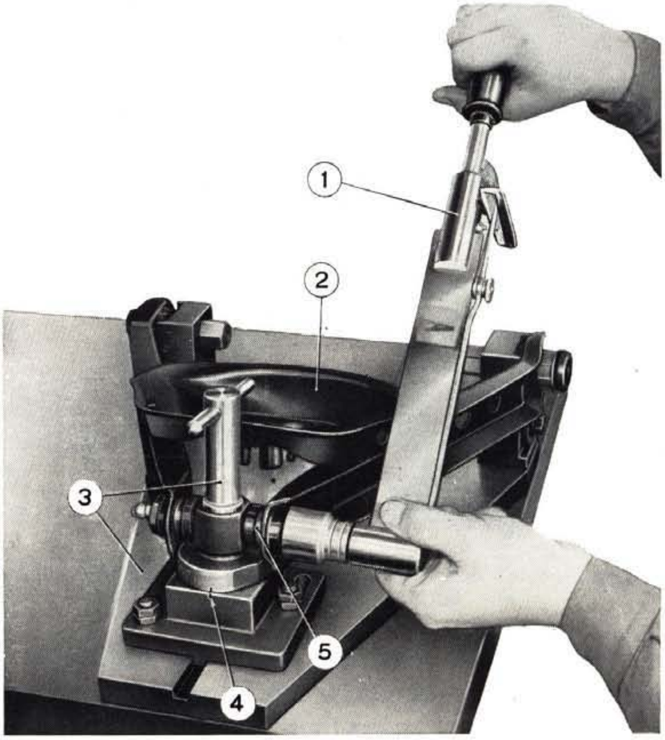



**Fig. 528 - Installing lower control arm self-threading bushings.**
1. Torque wrench. - 2. Coil spring housing. - 3. Fixture A. 74023. - 4. Location marks to be indexed. - 5. Self-threading bushings.

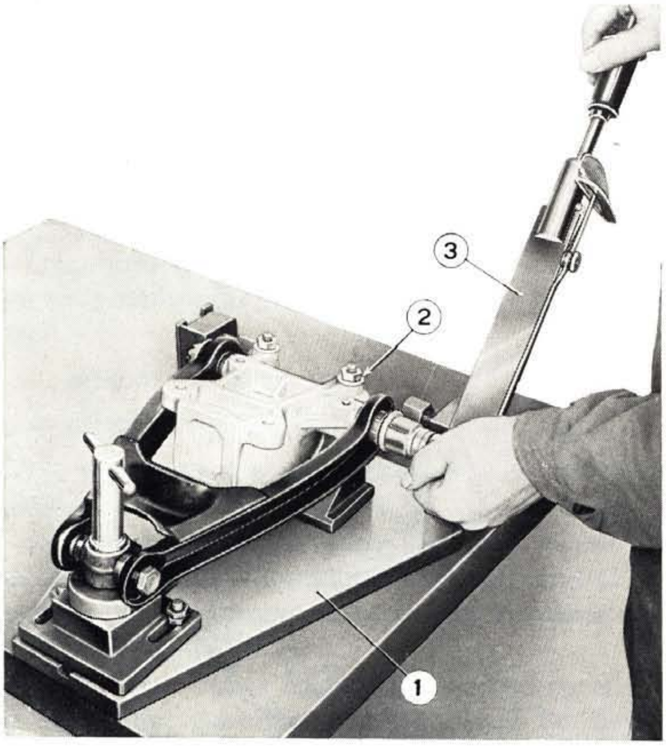



**Fig. 527 - Tightening upper control arm pivot bar nuts.**
1. Fixture A. 74023. - 2. Coil spring mounting bracket. - 3. Torque wrench.

## Assembly and Installation.

Clamp control arm assemblies to fixture **A. 22229** (fig. 529).

Tie control arms to kingpin and brake drum assembly and draw up kingpin pivot nuts with 86.8 to 94.0 ft.lbs (12 to 13 kgm) of torque (fig. 531) setting thrust washers and snap ring in between.

Next install the assembly on car as follows:

— secure upper bracket to underbody;

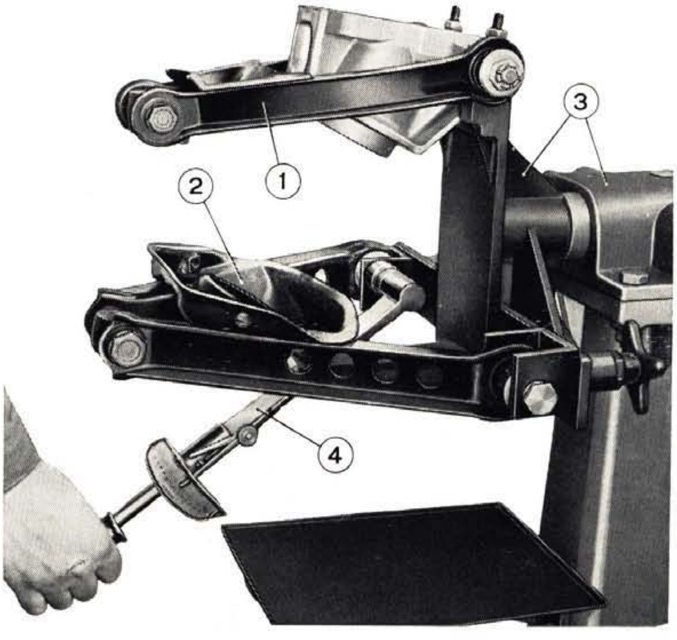
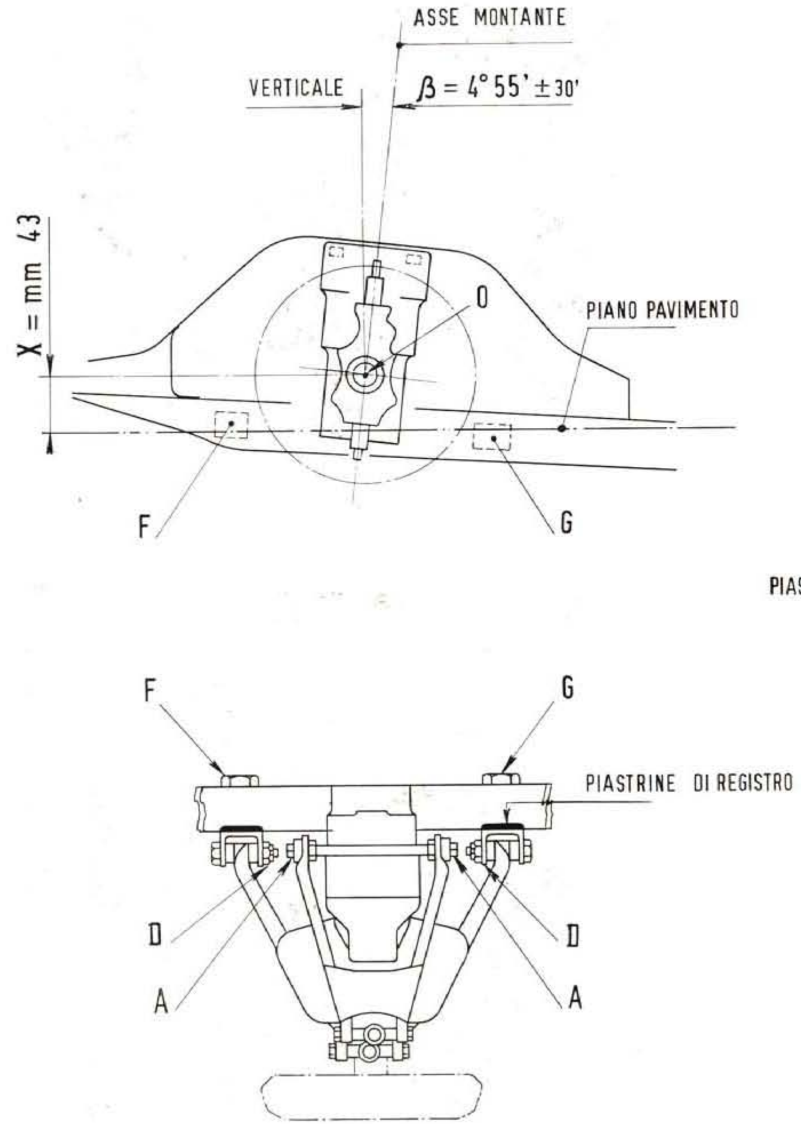



**Fig. 529 - Securing lower control arm to fixture A. 22229.**
1. Upper control arm. - 2. Coil spring housing. - 3. Fixture A. 22229. - 4. Torque wrench.



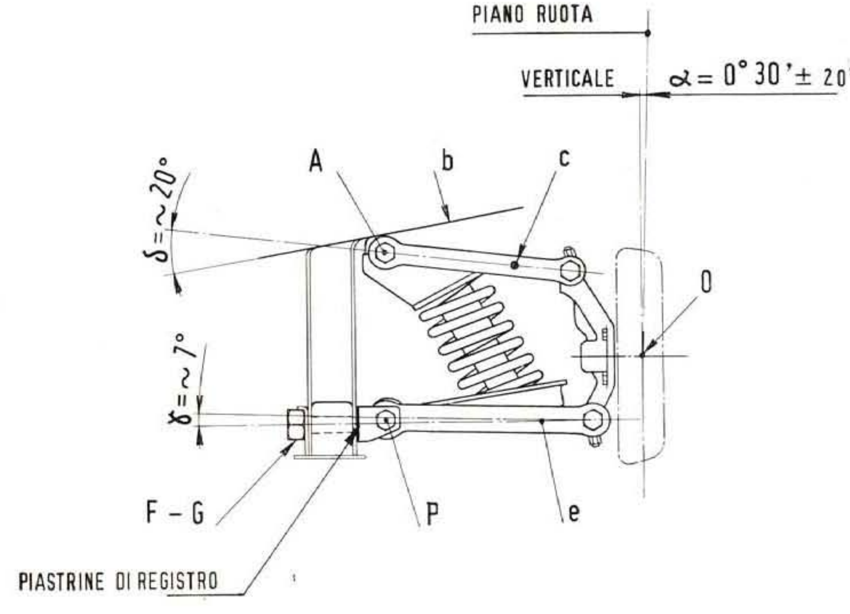




**Fig. 530 - Front suspension inspection, assembly and setting diagram.**

A. Upper control arm pivot bar nuts. - D. Lower control arm pivot bar nuts. - F - G. Control arm-to-underbody screws. - O. Wheel center. - P. Lower control arm pivot centerline. - b - c. Planes meeting at angle $\delta$. - e. Lower control arm plane meeting at angle $\gamma$ with centerline of screws F - G.

**NOTE - Nuts A should be tightened down when angle $\delta$ is some 20°. Nuts D should be tightened down when angle $\gamma$ is some 7°.**

Asse montante = Kingpin axis. - Verticale = Vertical. - Piano pavimento = Floor plane. - Piastrine di registro = Shims. - Piano ruota = Wheel plane. - X = mm 43 - 1.693″.

– fit coil spring rubber seats;

– insert tool **A. 74083** and compress coil spring so that control arm mounting bracket location dowels engage into seats in underbody;

– fit the same shim pack as noted on disassembly and secure lower control arm with screws torqued to 86.8 to 94.0 ft.lbs (12 to 13 kgm); bend down screw lock plates;

– slide off tool **A. 74083**;

– place shock absorber in extended position and jack up suspension assembly;

– secure shock absorber at top by means of wrench **A. 57035**;

– secure shock absorber at bottom and tighten down mounting nuts;

– tie up brake fluid hose, sway bar and drag link;

– install road wheel and bleed hydraulic circuit;

– fit front seat cushion.

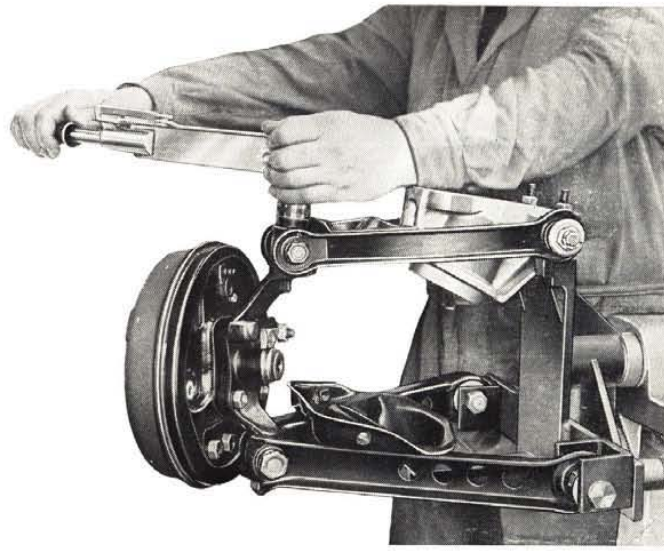


**Fig. 531 - Tightening kingpin screw to upper control arm with unit on fixture A. 22229.**

When the procedure has been completed lower the car and check front wheel toe-out for specified .079″ to .157″ (2 to 4 mm).

# CHECKING AND ADJUSTING FRONT END CAMBER AND CASTER

Front end geometry angles with a loaded car (seven people plus 154 lbs - 70 kg) are the following:

– camber: $0^\circ 30' \pm 20'$;

– caster: $4^\circ 55' \pm 30'$.

For **front wheel toe-out**, see covering specifications on page 326.

To adjust camber ($\alpha$, fig. 530) and caster ($\beta$, fig. 530) set shims (fig. 530) at screws F and G between lower control arm mounting brackets and front underframe.

Camber and caster angles are checked by means of the gauge described on page 136 for Sedan version.

Preparatory inspections to geometry measurements are the same as for the Sedan version (see page 136), except for tire pressures which should be as follows:

– front . . . . . . . . . 24.2 psi (1.7 kg/cm²)

– rear { medium load . 31.3 psi (2.2 kg/cm²)
full load . . . . 39.8 psi (2.8 kg/cm²) }

Checking procedures for camber and caster angles are as outlined on page 136 for Sedan version: note the points hereafter:

– To widen angle $\alpha$ (fig. 530) decrease the number of shims at both screws F and G; reverse this step if angle must be narrowed.

– To widen angle $\beta$ (fig. 530) shift some shims from screw F to screw G; reverse this step if angle must be narrowed.

**NOTE - With car in « loaded » conditions or seven people plus 154 lbs (70 kg):**

**– distance (x, fig. 530) between wheel center (0) and floor plane should be 1.693″ (43 mm).**

## COIL SPRINGS

### SPECIFICATIONS

| | |
|---|---|
| Wire diameter . . . . . . . . . . . . . . . . . . . . . . . . | .5709" ±.0020" (14.5±0.05 mm) |
| Inside diameter . . . . . . . . . . . . . . . . . . . . . . . | 3.5630" ±.0354" (90.5±0.9 mm) |
| Total number of coils . . . . . . . . . . . . . . . . . . . . | 8 |
| Number of active coils . . . . . . . . . . . . . . . . . . . | 6 ½ |
| Direction of winding . . . . . . . . . . . . . . . . . . . . | clockwise |
| Free height, abt . . . . . . . . . . . . . . . . . . . . . . | 11.024" (280 mm) |
| Height under 1,069±55 lbs (485±25 kg) of load . . . . . | 7.874" (200 mm) |
| Deflection rate (between 860 and 1,411 lbs - 390 and 640 kg) | .892 in/100 lbs (50 mm/100 kg) |

# REAR SUSPENSION

## SETTING

To check rear suspension for setting refer to figures 262 and 263 recalling that with car at load (7 people plus 154 lbs - 70 kg):

– angle β must be 1° ± 30′;
– angle α must be 0° 12′ ± 12′ (wheels toeing-in by .079" to .091" - 2 to 2.3 mm).

## COIL SPRINGS

### SPECIFICATIONS

| | |
|---|---|
| Wire diameter . . . . . . . . . . . . . . . . . . . . . . . . | .7283" ±.0020" (18.5±0.05 mm) |
| Inside diameter . . . . . . . . . . . . . . . . . . . . . . . | 3.9370" (100 mm) |
| Total number of coils . . . . . . . . . . . . . . . . . . . . | 6 |
| Number of active coils . . . . . . . . . . . . . . . . . . . | 4 ¾ |
| Direction of winding . . . . . . . . . . . . . . . . . . . . | clockwise |
| Free height . . . . . . . . . . . . . . . . . . . . . . . . . | 10.374" (263.5 mm) |
| Height under 1,962±99 lbs (890±45 kg) of load . . . . . | 7.854" (199.5 mm) |
| Deflection rate (between 1,213 and 2,645 lbs - 550 and 1,200 kg) . . . . . . . . . . . . . . . . . . . . . . . . . . | .536 in/100 lbs (30 mm/100 kg) |

NOTE - Starting from chassis N° 075327 coil springs with foregoing specifications have been adopted. For early-type coil springs same as for Sedan) see specifications on page 149.

# STEERING

## SPECIFICATIONS AND DATA

| | |
|---|---|
| Gear type | worm and roller |
| Gear ratio | 16.4 to 1 |
| Worm bearings | taper roller |
| Roller shaft bushings | two, bronze |
| Bearing adjustment | ring shims, top; plate shims, bottom |
| Worm-to-roller lash adjustment | screw and shim on roller shaft |
| Roller shaft bushing bore | 1.1298″ to 1.1307″ (28.698 to 28.720 mm) |
| Roller shaft diameter | 1.1295″ to 1.1287″ (28.690 to 28.669 mm) |
| Fitting clearance, roller shaft-to-bushing | .0003″ to .0020″ (0.008 to 0.051 mm) |
| Fitting clearance, idler arm pin-to-bracket bushing | .0005″ to .0021″ (0.012 to 0.054 mm) |
| Turning circle | 28′ 10 ½″ (8.80 m) |
| Steering column | mounted on flexible joint |
| Tie rods | with adjustable ends |
| Drag link | with non-adjustable ends |
| Turning angles:<br>– inner wheel<br>– outer wheel | <br>32°30′ ± 1° 30′<br>26° 30′ |
| Front wheel toe-out | .079″ to .157″ (2 to 4 mm) |
| Steering gear oil:<br>– grade<br>– capacity | <br>FIAT W 90 oil (SAE 90 EP)<br>.422 G.B.pts - .507 U.S.pts (0.24 lts) |

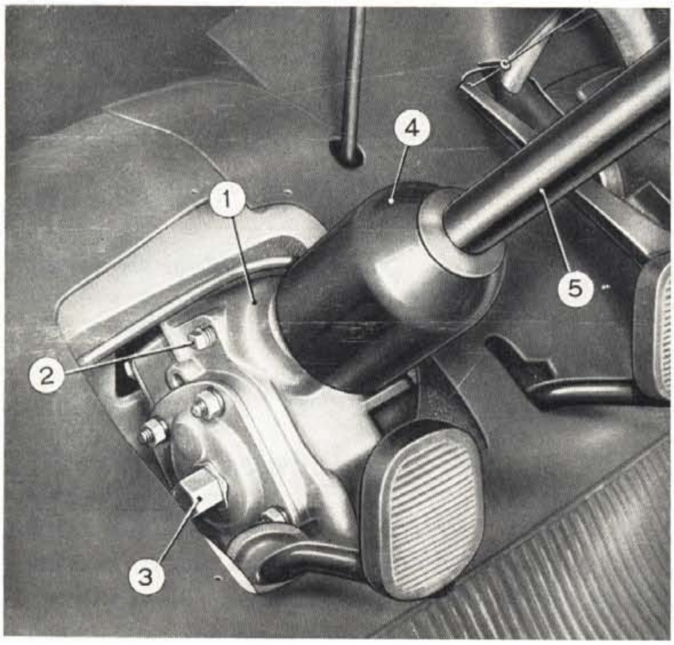



**Fig. 532 - Steering gear viewed from car interior.**
1. Steering gear. - 2. Oil filler plug. - 3. Roller shaft adjusting screw nut. - 4. Steering column flexible joint boot. - 5. Steering column.

## Removal and Disassembly of Steering Gear.

Remove the steering wheel.

Disconnect the steering column bracket from instrument panel.

Remove floor linings at steering column.

Slide away the steering column flexible joint boot (4, fig. 532) and disconnect the column from steering gear.

Using tool **A. 47035** untie the drag link (3, fig. 533) from pitman arm (2).

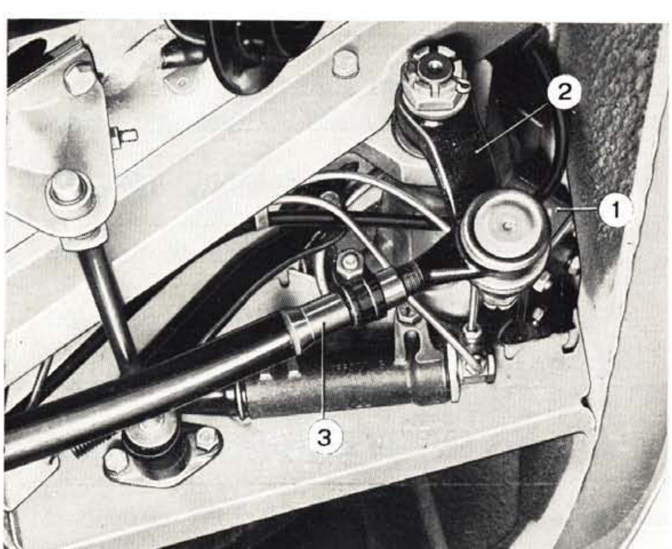



**Fig. 533 - Detail of steering linkage.**
1. Steering gear. - 2. Pitman arm. - 3. Drag link.

Back out gear mounting nuts (2, fig. 534) from body shell and remove the steering gear.

Disassemble the steering gear.

---

**NOTE - Prior to going about with the adjustment of the steering gear, check to see whether the trouble must be traced to the linkage being at fault; in the affirmative fix the steering linkage.**

---

## Inspection and Repair.

Carefully examine working faces of worm and roller to detect any signs of binding, scuffing or deep scores.

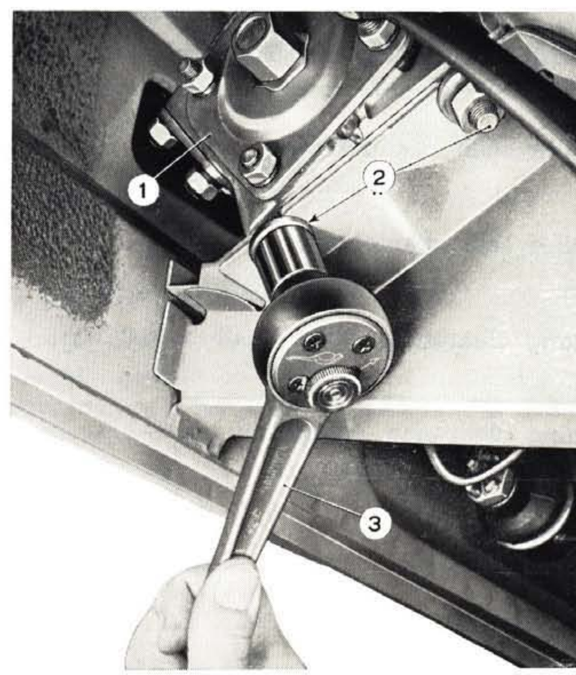



**Fig. 534 - Removing steering gear.**
1. Steering gear. - 2. Steering gear mounting studs and nuts on body shell. - 3. Ratchet wrench.

At the same time also check that the worm and roller are meshing perfectly at center; as a matter of fact this is a basic condition for correct arrangement of shims on assembly.

Check clearance between bushings (6, fig. 536) and roller shaft. Maximum permissible play is .004″ (0.10 mm); in case this limit is exceeded, replace bushings by new ones.

Insert bushings and then rebore them to 1.1298″ to 1.1307″ (28.698 to 28.720 mm) as specified, using reamer **A. 90336**. Fitting clearance between roller shaft and bushings is .0003″ to .0020″ (0.008 to 0.051 mm).

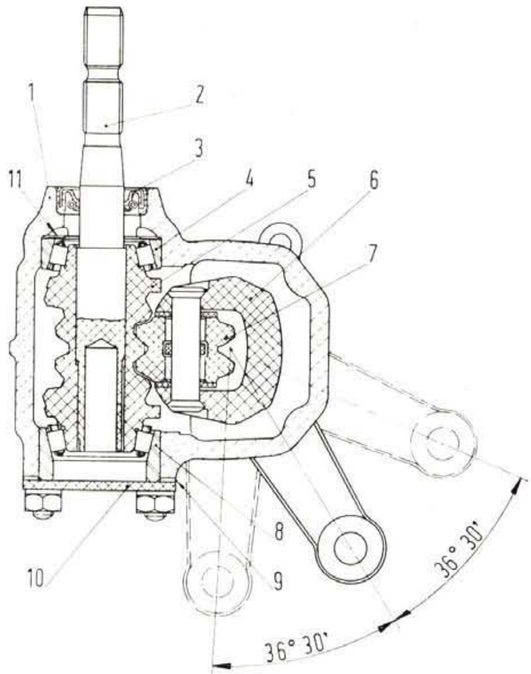



**Fig. 535 - Sectional view of steering gear at worm-to-roller shaft meshing plane.**

1. Steering housing. - 2. Wormshaft. - 3. Oil seal. - 4. Upper roller bearing. - 5. Worm. - 6. Roller shaft. - 7. Roller. - 8. Lower bearing. - 9. Lower bearing shims. - 10. Thrust cover. - 11. Upper bearing shims.

The roller shaft diameter is 1.1295″ to 1.1287″ (28.690 to 28.669 mm).

Check the worm for misalignment: the worm out-ot-true limit is .002″ (0.05 mm).

Both roller bearings should not feel rough on spinning or show play at races.

Examine gaskets at worm and roller shaft for first class condition.

Renew any damaged parts.

## Assembly.

Fit ring shims and worm upper roller bearing cup; the number of ring shims should be the same as counted on disassembly, if roller and worm meshed perfectly at center.

Position roller bearing cones on worm.

Install: the worm and lower bearing cup, then the thrust cover, setting plate shims between cover and housing.

**Plate shims for service come in the thicknesses of .0039″ and .0059″ (0.10 and 0.15 mm).**

Check clearance of worm bearings: reduce thickness of shim pack if clearance is excessive and increase thickness if clearance is too little.

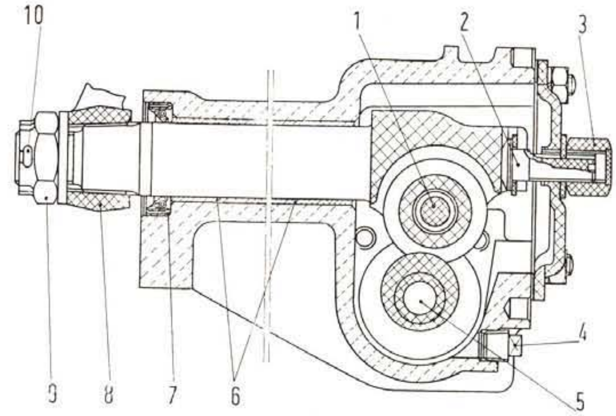



**Fig. 536 - Sectional view of steering gear across roller shaft and pitman arm.**

1. Roller. - 2-3. Roller shaft adjusting screw and nut. - 4. Oil filler plug. - 5. Worm. - 6. Roller shaft bushings. - 7. Oil seal. - 8. Pitman arm. - 9. Pitman arm nut. - 10. Nut cotter pin.

Install the roller shaft and fit the upper cover along with the adjusting screw and shim.

Check clearance between worm and roller: work on adjusting screw (2, fig. 536) so as to take up all clearance. Next turn the screw lock nut (3) all the way in.

Adjustment should be made when the roller is meshed well at center with the worm.

In case the worm and roller turn out to be meshed incorrectly, action should be made on ring shims (11) and plate shims (9, fig. 535) for worm bearing adjustment, so to align the worm centrally to the roller.

Next again adjust lash between worm and roller and fit the roller shaft seal and the worm seal.

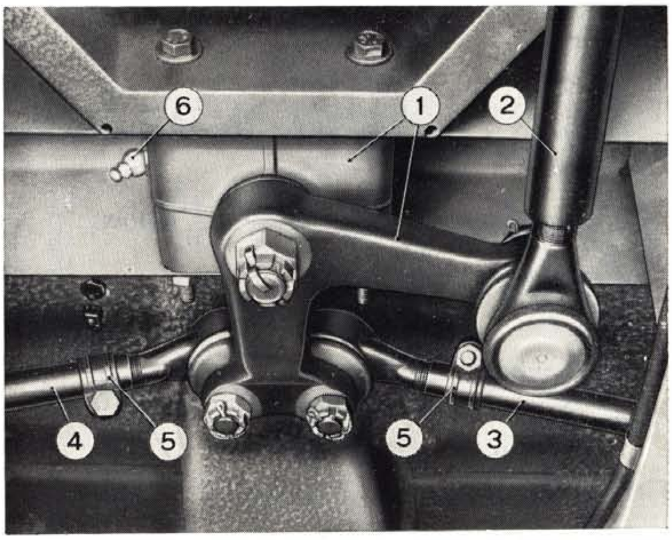



**Fig. 537 - Detail of idler arm and support.**

1. Idler arm and support. - 2. Drag link. - 3. Left side tie rod. - 4. Right side tie rod. - 5. Tie rod clamps. - 6. Lubrication fitting.

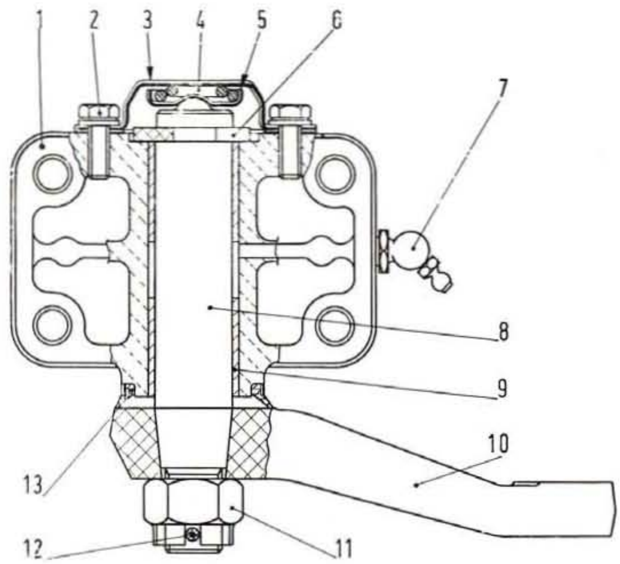



**Fig. 538 - Sectional view of idler arm and support assembly.**
1. Support. - 2. Cover screw. - 3. Cover. - 4. Pivot pin spring. - 5. Spring cup. - 6. Pivot pin lock plate. - 7. Lubrication fitting. - 8. Idler arm pivot pin. - 9. Pivot pin bushings. - 10. Idler arm. - 11. Idler arm-to-pivot pin nut. - 12. Nut cotter pin. - 13. Rubber dust shield.

## Idler Arm and Support.

The idler arm support is secured to a cross rail in underbody (fig. 537).

To remove the idler arm support, just slide off the drag link ball stud and tie rod ball studs, back out four self-locking nuts mounting the support and withdraw nut screws from the cross rail.

To strip the arm and support assembly proceed as follows:

– clamp the support (1, fig. 538) in a vise;

– slide off the cotter pin (12) and back out the idler arm mounting nut (11);

– withdraw the idler arm (10) and slide off the rubber dust shield (13);

– take down the upper cover (3), cover gasket, spring (4) and lower cup (5);

– remove the pin lock plate (6), then slide off pivot pin (8).

Next to disassembly, inspect as follows.

Examine the pressure spring (4, fig. 538): if the spring is sagged or bent, replace by a new one otherwise end play of pivot pin in arm support may result.

Check bushings (9, fig. 538) for taper and too much play to pivot pin; in the affirmative, take down bushings and replace by new ones; fitting clearance between pivot pin and bushings is .0005" to .0021" (0.012 to 0.054 mm).

After they have been press fitted in place, bushings must be reamed to the specified bore of .8666" to .8674" (22.012 to 22.033 mm).

Bushing insertion is not a difficult matter: do not forget, however, that the idler arm-to-pivot pin nut must be drawn up with a torque of 54.2 to 57.9 ft.lbs (7.5 to 8 kgm).

---

**NOTE - For check-up and adjustment of front wheel toe-out adhere to directions covering the Sedan version and recall the following:**

**– inflate tires to recommended pressure;**

**– set the car « at load » (7 people plus 154 lbs - 70 kg);**

**– final toe-out (toe-in negative) must be set at .079" to .157" (2 to 4 mm).**

---

# WHEELS AND TIRES

Specifications only are varied as follows:

| | |
|---|---|
| – disc wheels, size | 4.00 x 12" |
| – tires, type | Pirelli 5.60-12 (6 p.r.) Trasporto<br>Ceat 5.60-12 DR 163 (6 p.r.) Trasporto<br>Michelin 5.60-12 C. |

**Tire pressures:**

| | | |
|---|---|---|
| – Front | | 24.2 psi (1.7 kg/cm²) |
| – Rear | medium load | 31.3 psi (2.2 kg/cm²) |
| | full load | 39.8 psi (2.8 kg/cm²) |

# BRAKES

## HYDRAULIC BRAKES SPECIFICATIONS AND DATA

| | |
|---|---|
| Type | expanding shoe |
| Brake and clutch pedal board | secured to underbody |
| Front and rear drum diameter | .8672" to .8683" (220.26 to 220.55 mm) |
| Maximum allowable oversize on drum diameter | .0394" (1 mm) |
| Brake linings — length (developed) | 8.189" (208 mm) |
| Brake linings — width | 1.575" ( 40 mm) |
| Brake linings — thickness — new | .157" ( 4 mm) |
| Brake linings — thickness — min. permissible, not below | .059" (1.5 mm) |
| Brake-to-drum clearance: — at upper cams | .01 " (0.25 mm) |
| Brake-to-drum clearance: — at lower campins | .004" (0.10 mm) |
| Master cylinder bore | 1" |
| Bore of wheel cylinders — front | 1 1/8" |
| Bore of wheel cylinders — rear | 3/4" |
| Master cylinder push rod-to-piston clearance | .0394" (1 mm) |
| Brake pedal free travel | 1/4" (6 mm) |
| Hydraulic circuit fluid — grade | FIAT special blue label |
| Hydraulic circuit fluid — capacity | .651 G.B.pts - .782 U.S.pts (0.37 lt) |

## Adjusting Shoe-to-Drum Clearance.

The brake shoes should be adjusted for the following clearance:

- .004" (0.10 mm) at lower campins;
- .010" (0.25 mm) at upper cams.

To do so proceed as outlined hereafter (the drum shows openings for passage of feeler gauge and for access to lower cams for turning purposes).

1) Insert the .010" (0.25 mm) stock of feeler gauge **A. 95316** across drum openings and between shoe and drum at upper cams (fig. 541).

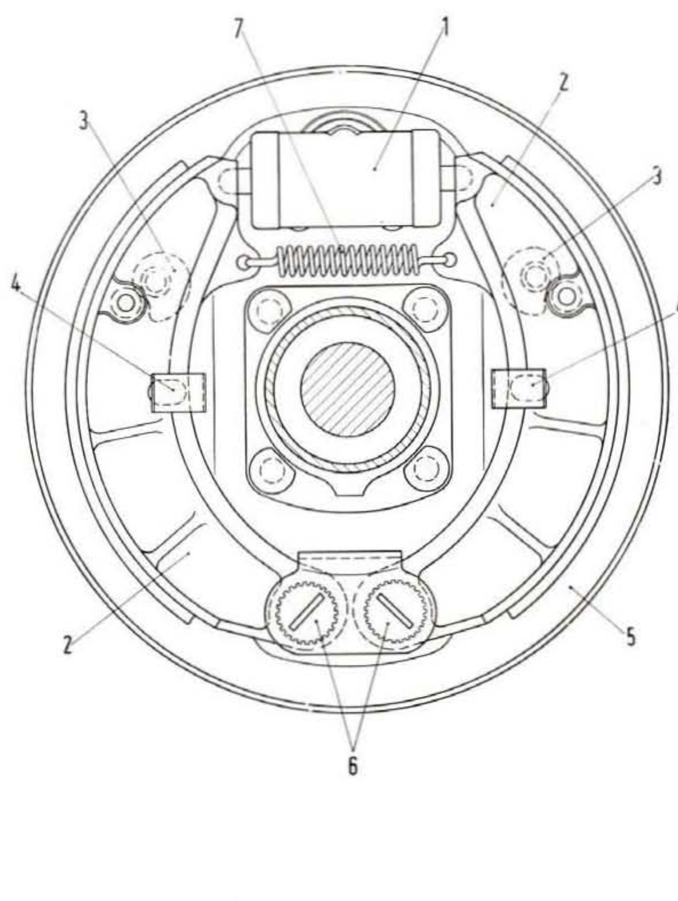



**Fig. 539 - Front wheel brake assembly.**

1. Wheel cylinder. - 2. Brake shoes with linings. - 3. Upper cams for shoe-to-drum clearance adjustment. - 4. Shoe guide springs. - 5. Brake backing plate. - 6. Lower campins for shoe-to-drum clearance adjustment. - 7. Shoe return spring.

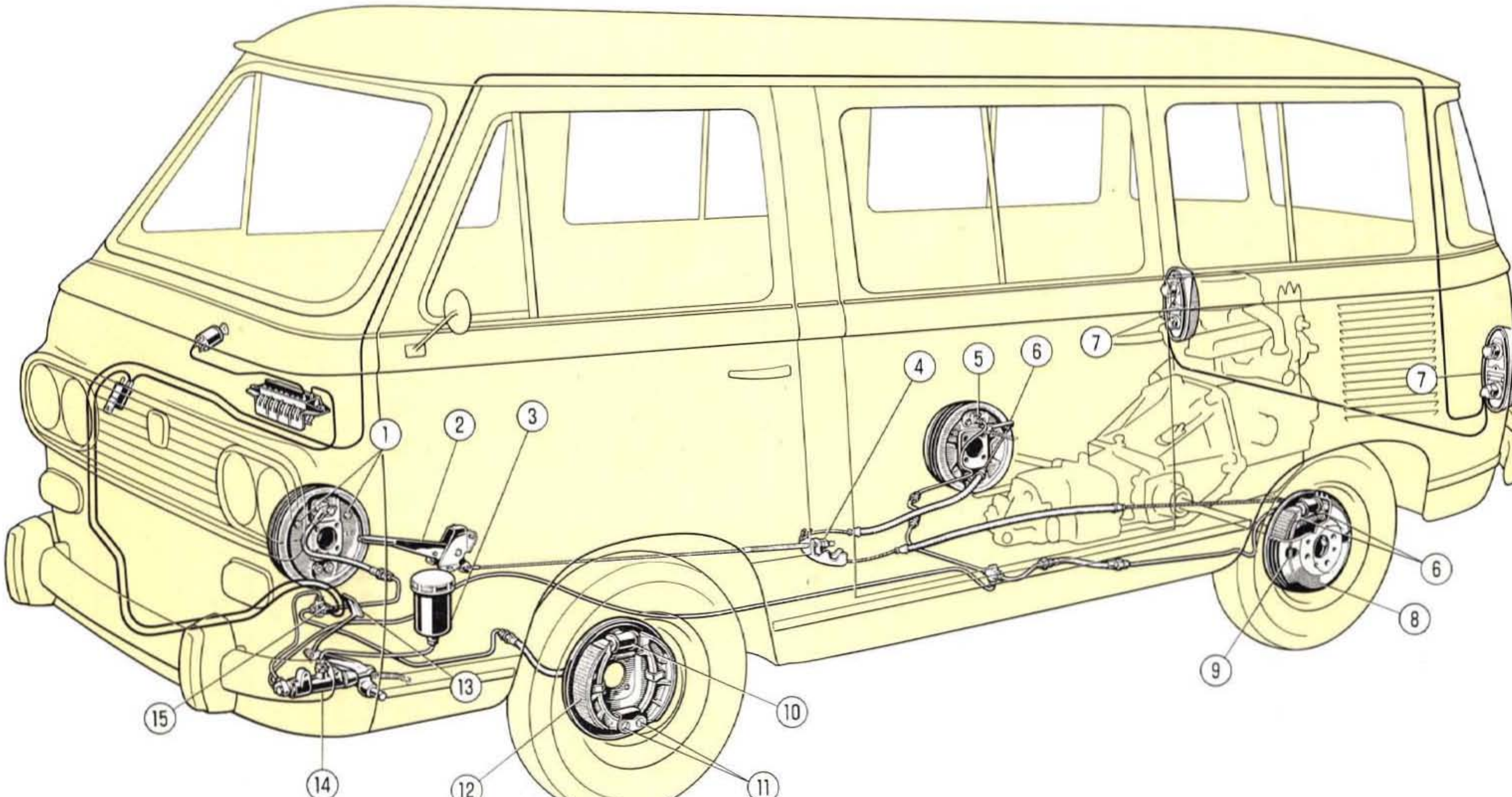



**Fig. 540 - Diagram of hydraulic service brakes and emergency and parking brake.**

1. Upper cams for shoe clearance adjustment. - 2. Emergency and parking brake control ratchet lever. - 3. Brake fluid reservoir. - 4. Parking brake ratchet lever stretcher. - 5. Hydraulic circuit bleeder connector. - 6. Rear brake shoe actuating levers, controlled by ratchet lever. - 7. Rear stop lights. - 8. Brake drum. - 9. Drum openings, shoe clearance check. - 10. Wheel cylinder. - 11. Shoe anchor campins. - 12. Brake shoes. - 13. Service brake pedal. - 14. Master cylinder. - 15. Stop light jam switch.

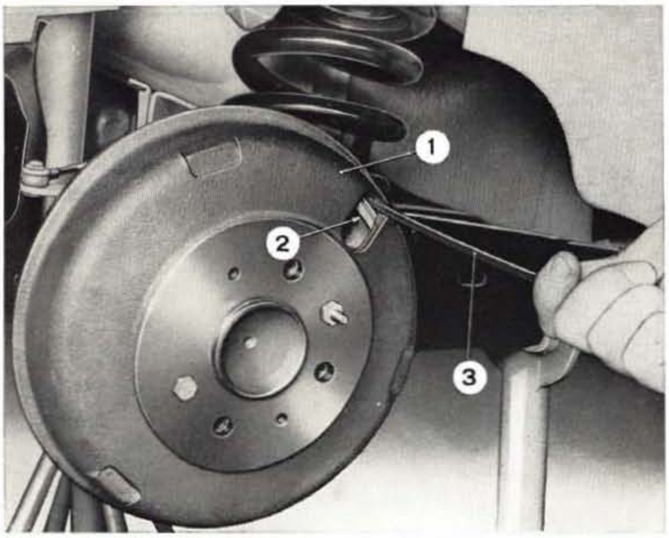



**Fig. 541 - Checking shoe-to-drum clearance at right side rear wheel.**
1. Brake drum. - 2. Brake shoe with lining. - 3. Feeler gauge A. 95316.

2) Working on upper cam hex. nut (3, fig. 539) spread the shoe to take up clearance to .010" (0.25 mm); check clearance with feeler **A. 95316.**

3) Insert the .004" (0.10 mm) stock between shoe and drum at lower campins; screw out the campin nut (1, fig. 542), back up the campin (fig. 543) to disengage it from the stop plate and replace the campin one or two serrations on, so to approach the shoe to the drum for a clearance of .004" (0.10 mm).

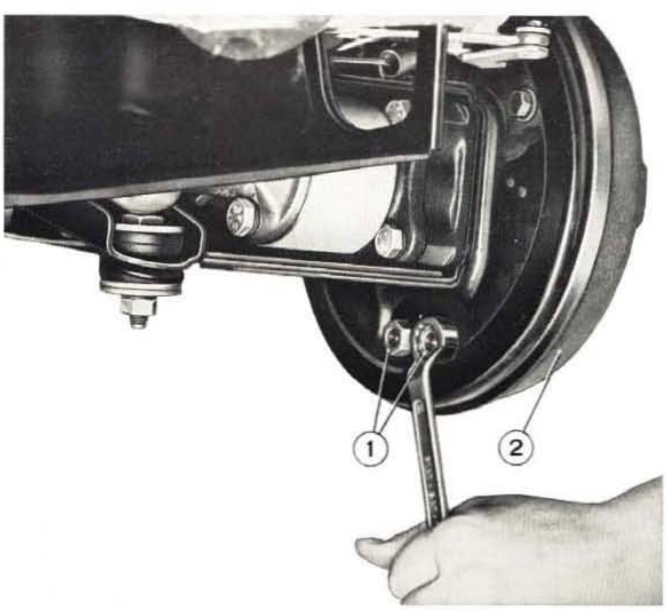



**Fig. 542 - Loosening lower anchor campin nuts.**
1. Campin nuts. - 2. Brake drum.

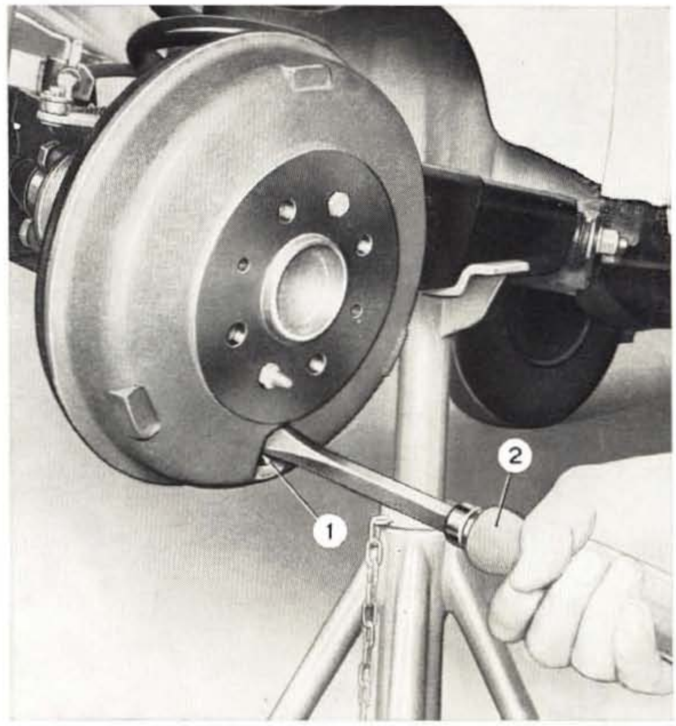



**Fig. 543 - Repositioning lower anchor campins for shoe clearance adjustment.**
1. Anchor campins. - 2. Screwdriver for campin lock.

If necessary, again turn the upper cam in or out to obtain the recommended clearance both at top and bottom.

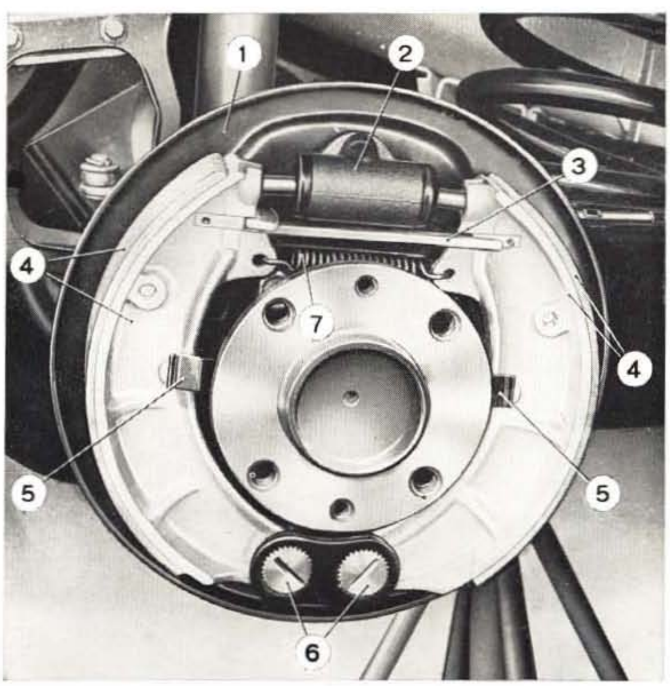



**Fig. 544 - Right side rear wheel brake assembly.**
1. Brake backing plate. - 2. Wheel cylinder. - 3. Shoe actuating segment for manual brake. - 4. Brake shoes with linings. - 5. Shoe guide springs. - 6. Anchor campins. - 7. Shoe return spring.

# AIR CONDITIONING

**(Up to chassis N° 69715)**

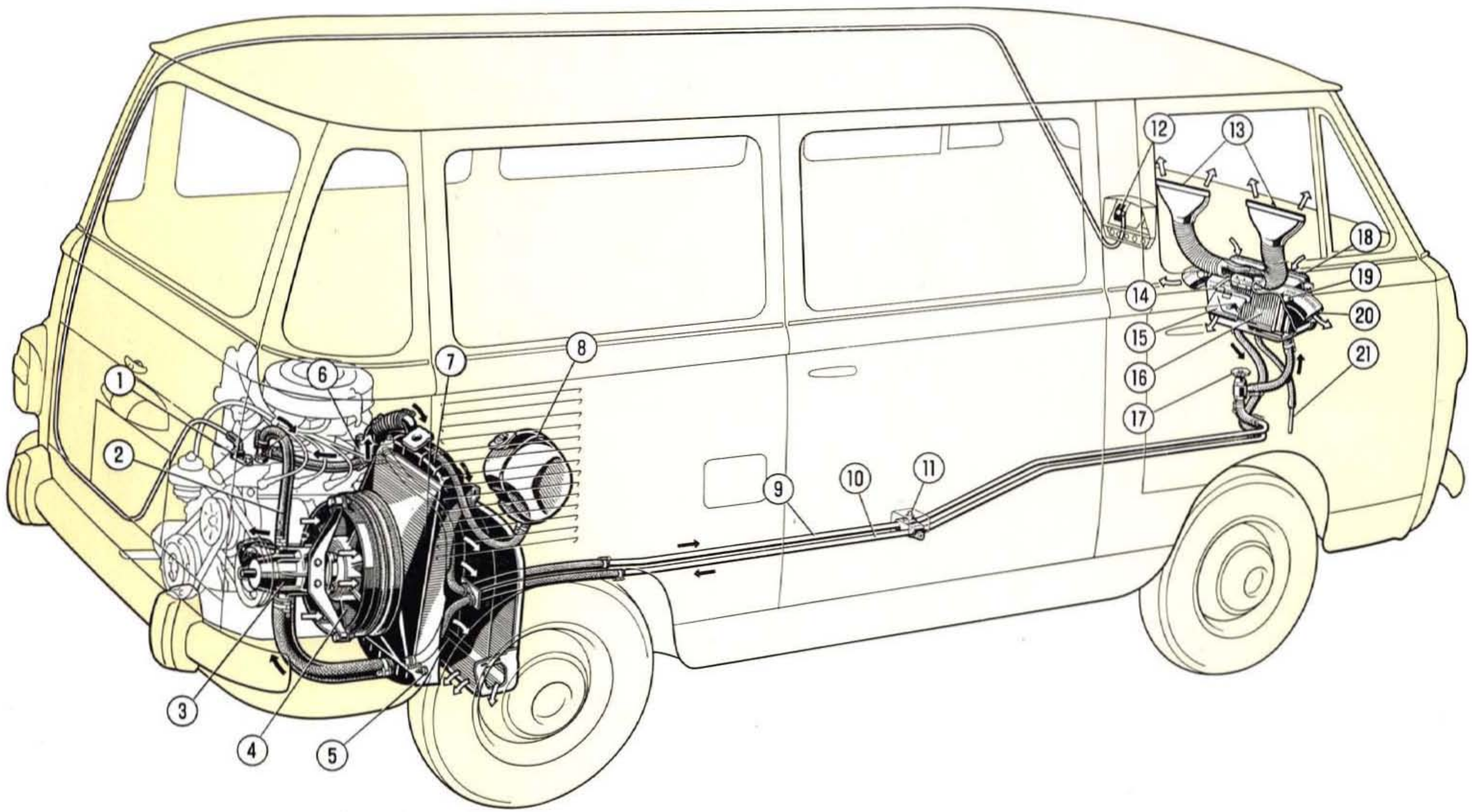



**Fig. 545 - Engine cooling and car heating system.**

1. Heat indicator thermal switch. - 2. Engine-to-coolant pump hose (cold engine). - 3. Coolant pump. - 4. Fan. - 5. Coolant drain plug. - 6. Thermostat. - 7. Radiator. - 8. Coolant expansion tank. - 9. Heater radiator coolant delivery line. - 10. Heater radiator coolant outlet line. - 11. Radiator coolant drain cock. - 12. Heat indicator. - 13. Windshield air outlets. - 14. Shifter lever for air delivery toward windshield or car interior. - 15. Shutter for air admission to car interior. - 16. Heater radiator. - 17. Cock, coolant delivery control in heater radiator. - 18. Grille, front air scoop. - 19. Knob (two), air throttle control to car interior. - 20. Air outlet (two) to car interior. - 21. Heater radiator case water drain hose.

# AIR CONDITIONING

**(Starting from chassis N° 69716)**

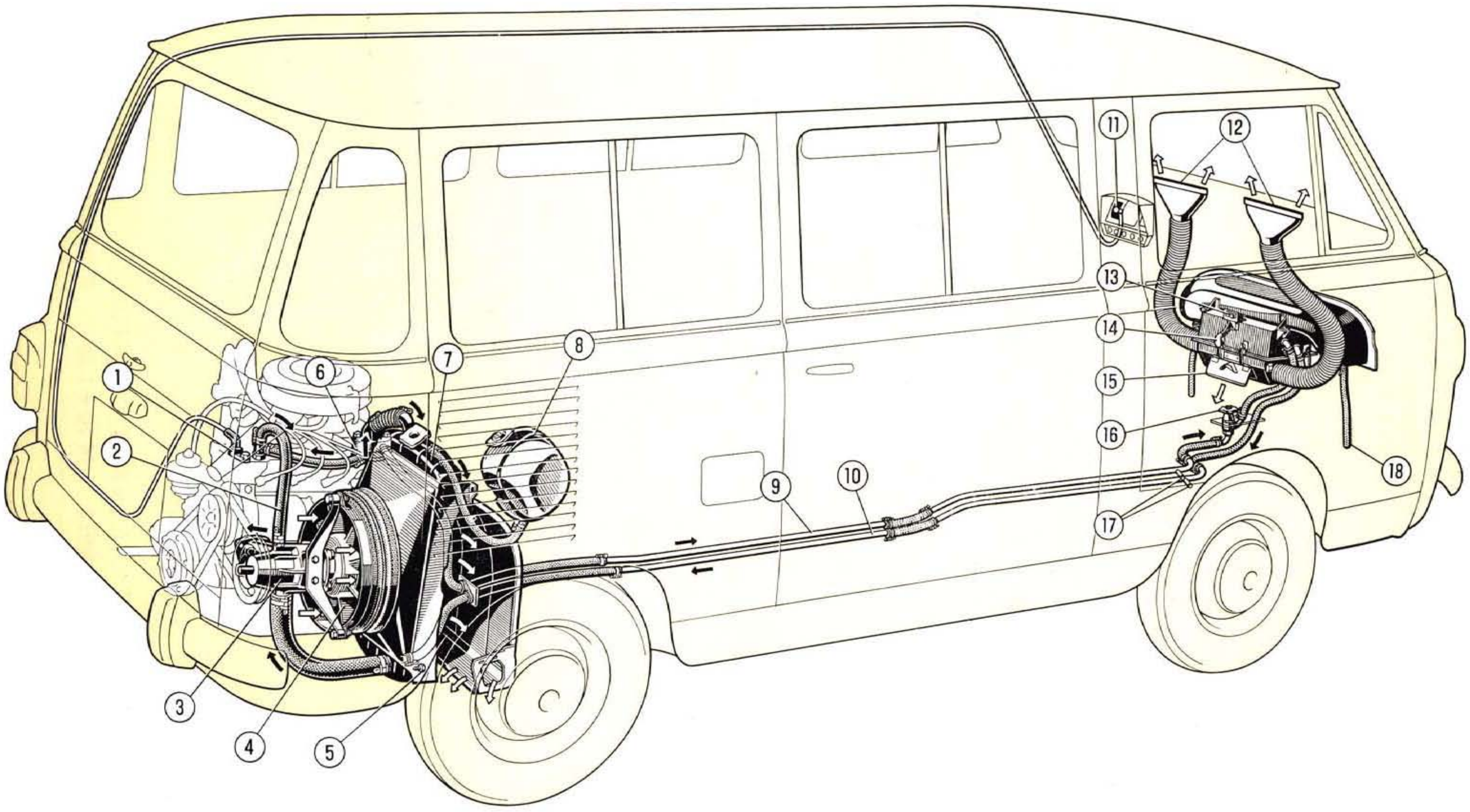



**Fig. 546 - Engine cooling and car heating system.**

1. Heat indicator thermal switch. - 2. Engine-to-coolant pump hose (cold engine). - 3. Coolant pump. - 4. Fan. - 5. Radiator coolant drain plug. - 6. Thermostat. - 7. Radiator. - 8. Expansion tank. - 9. Heater radiator coolant delivery line. - 10. Heater radiator coolant outlet line. - 11. Heat indicator. - 12. Windshield air outlets. - 13. Electrofan switch. - 14. Air shutter control lever. - 15. Shutter for air admission to car interior. - 16. Cock, coolant delivery control in heater radiator. - 17. Threaded plugs, heating system coolant drain. - 18. Air scoop water drain hose.

# CHASSIS TIGHTENING REFERENCE

| DESCRIPTION | Part Number | Thread Diameter and Pitch | Material | Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| **Front Suspension.** | | | | | |
| Lower control arm mounting bracket-to-underbody screw | 1/59777/21 | M 14 x 1.5 | R 80 Znt | 86.8 to 94 | 12 to 13 |
| Lower control arm pivot bar-to-arm mounting bracket nut . . | 1/25749/11 | M 16 x 1.5 | R 50 Znt (Bar R 80 Znt) | 130.2 to 144.7 | 18 to 20 |
| Kingpin mounting nut to control arms . . . . . . . . . . . . | 1/25748/11 | M 14 x 1.5 | R 50 Znt (Kingpin 38 NCD 4 Bon) | 86.8 to 94 | 12 to 13 |
| Upper control arm pivot bar bushing nut . . . . . . . . | 1/07934/11 | M 14 x 1.5 | R 50 Znt (Bar R 80) | 43.4 (minimum, before inserting cotter pin) | 6 |
| Brake backing plate and knuckle arm-to-kingpin screw nut . . | 1/21647/11 | M 10 x 1.25 | R 50 Znt (Screws R 50 & R 80 Znt) | 25.3 to 28.9 | 3.5 to 4 |
| Wheel bearing lock nuts at steering knuckle . . . . . . . . | 1/40441-48/71 | M 18 x 1.5 | C 40 Rct Znt (Knuckle 38 CD 4 Bon) | See page 137 | |
| Wheel and brake drum-to-hub stud . . . . . . . . . . . . | 4080533 | M 12 x 1.5 | C 35 R Bon Cdt | 43.4 to 50.6 | 6 to 7 |
| Wheel cylinder-to-brake backing plate screw . . . . . . | 1/09020/11 | M 6 x 1 | R 50 Znt | 7.2 | 1 |
| Shock absorber mounting nut to upper bracket . . . . . . . | 1/25745/11 | M 10 x 1.25 | R 50 Znt | 21.7 to 25.3 | 3 to 3.5 |
| Shock absorber mounting screw nut to lower control arm . . | 1/25756/11 | M 10 x 1.25 | R 50 Znt (Screw R 80 Znt) | 28.9 to 36.2 | 4 to 5 |
| **Rear Suspension.** | | | | | |
| Shock absorber pivot bar nut . | 1/61050/11 | M 12 x 1.25 | R 50 Znt (Bar R 80 Znt) | 65.1 | 9 |
| Control arm mounting bracket-to-underbody screw . . . . | 1/61389/21 | M 10 x 1.25 | R 80 Znt | 28.9 to 36.2 | 4 to 5 |
| Hub and brake backing plate-to-control arm screw . . . . . | 4108912 | M 10 x 1.25 | R 80 Znt | 43.4 | 6 |
| Wheel hub inner bearing plate screw . . . . . . . . . . . | 1/59705/21 | M 10 x 1.25 | R 80 Znt | 43.4 | 6 |

*(continued)*

Chassis Tightening Reference *(continued)*.

| DESCRIPTION | Part Number | Thread Diameter and Pitch | Material | Torque | |
|---|---|---|---|---|---|
| | | | | ft.lbs | kgm |
| Wheel shaft flexible joint nut . | 4037820 | M 18 x 1.5 | R 80 Znt (Shaft 38 NCD 4 Bon) | 101.3 (minimum, before inserting cotter pin) | 14 |
| Axle shaft sleeve-to-flexible joint screw . . . . . . . . . . . | 4124424 | M 10 x 1.25 | R 80 Znt | 36.2 | 5 |
| Shock absorber mounting nut to upper bracket . . . . . . . | 1/25745/11 | M 10 x 1.25 | R 80 Znt | 21.7 to 25.3 | 3 to 3.5 |
| Shock absorber mounting nut to lower control arm . . . . . | 1/25756/11 | M 10 x 1.25 | R 50 Znt (Screw R 80 Znt) | 28.9 to 36.2 | 4 to 5 |
| Wheel cylinder-to-brake backing plate screw . . . . . . | 1/38241/11 | M 6 x 1 | R 50 Znt | 7.2 | 1 |
| **Steering.** | | | | | |
| Steering wheel-to-column nut . | 743601 | M 18 x 1.5 | R 50 Znt (Column C 12 Tube) | 28.9 to 36.2 | 4 to 5 |
| Steering column-to-instrument panel screw nut . . . . . . | 1/61096/11 | M 8 x 1.25 | R 50 Znt (Screw R 50) | 10.8 | 1.5 |
| Steering gear-to-subframe lower stud nut . . . . . . . . . . | 1/21647/11 | M 10 x 1.25 | R 80 Znt (Stud R 80 Znt) | 28.9 | 4 |
| Steering gear-to-subframe side screw nut . . . . . . . . . | 1/61008/11 | M 8 x 1.25 | R 50 Znt (Screw R 80 Znt) | 14.5 to 18.1 | 2 to 2.5 |
| Idler arm support-to-underbody screw nut . . . . . . . . . | 1/61041/11 | M 8 x 1.25 | R 50 Znt (Screw R 80 Znt) | 18.1 to 21.7 | 2.5 to 3 |
| Steering rod ball stud nut . . . | 1/07934/11 | M 14 x 1.5 | R 50 Znt (Stud 12 NC 3 Ind) | 36.2 (minimum, before inserting cotter pin) | 5 |
| Pitman arm-to-roller shaft nut . | 1/07913/21 | M 14 x 1.5 | R 80 Znt (Shaft 19 CN 5 Cmt 3) | 72.3 | 10 |
| Idler arm ball stud nut . . . . | 1/25747/11 | M 12 x 1.5 | R 50 Znt (Stud R 80 Znt) | 54.2 to 57.9 | 7.5 to 8 |

# ELECTRICAL



## BATTERY

### SPECIFICATIONS

| | | |
|---|---|---|
| – Voltage | | 12 |
| – Capacity (20-hr discharge rate) | | 48 Amp/hr |
| – Length | | 10.236″ (260 mm) |
| – Width | | 6.772″ (172 mm) |
| – Height | | 8.858″ (225 mm) |
| – Weight | with electrolyte | 40.8 lbs (18.5 kg) |
| | without electrolyte | 29.8 lbs (13.5 kg) |

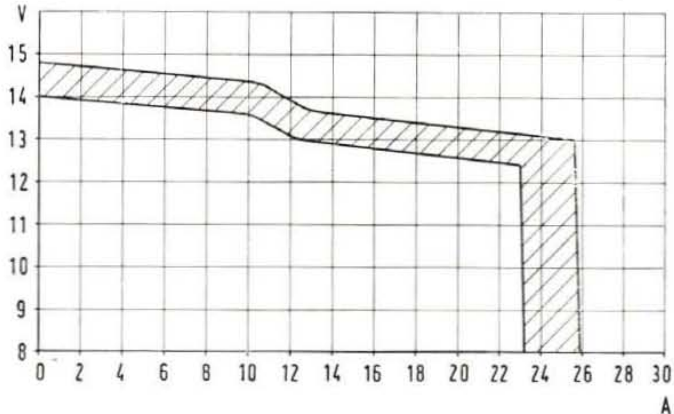
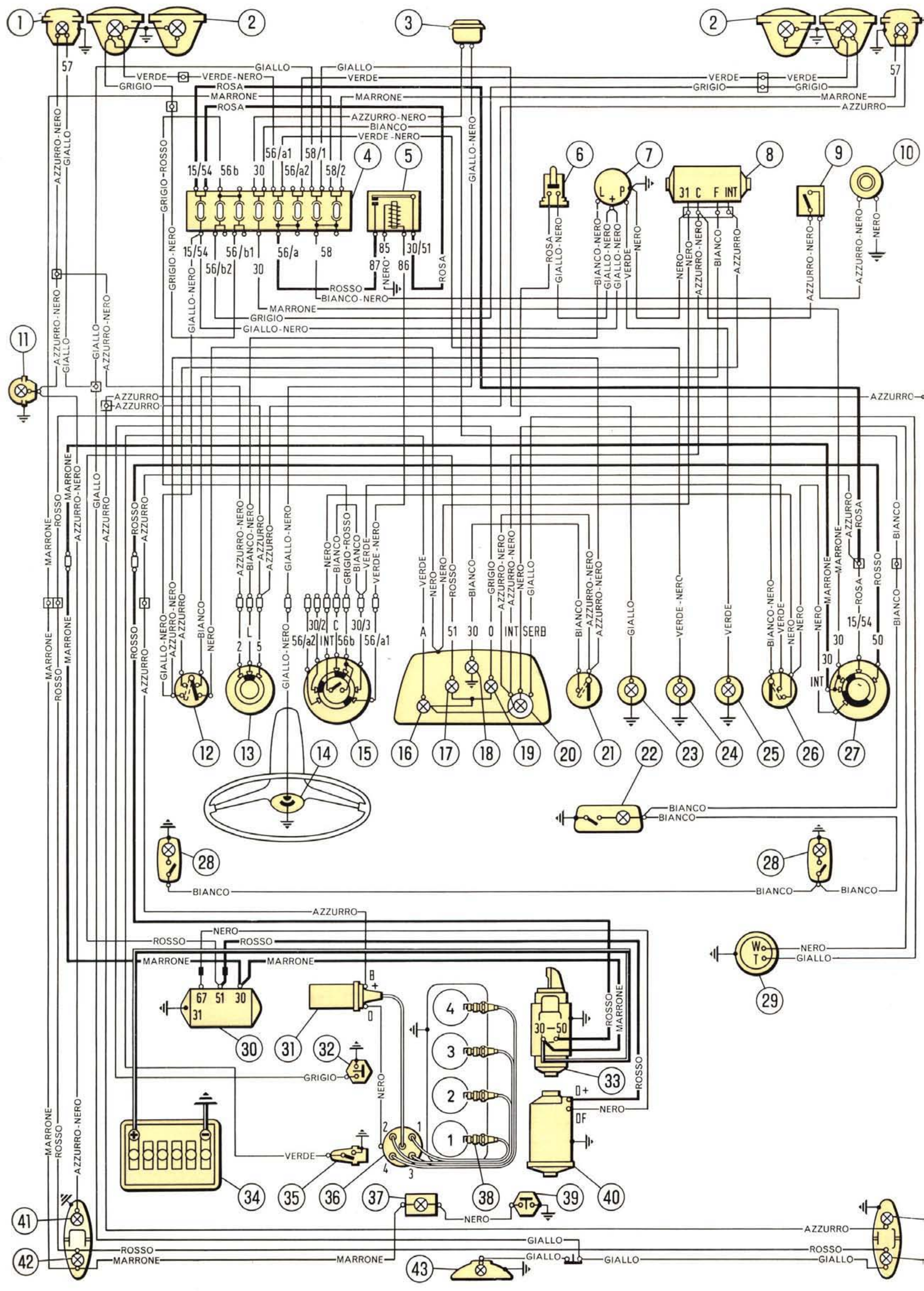



**Fig. 547 - Generator regulator type IR 50 H.**
Volt/Amp regulating pattern at 122° ± 5° F (50° ± 3° C).
Generator speed: 5,000 r. p. m.

## GENERATOR REGULATOR
### SERVICE DATA

| | |
|---|---|
| Type (Marelli) . . . . . . | IR 50 H |
| **Cutout Relay.** | |
| Feed voltage for temperature stabilization: | |
| – initial operating temperature 59° to 68° F (15° to 20° C) . . . . | 16.5 |
| – initial operating temperature 68° to 95° F (20° to 35° C) . . . . | 15 |
| Closing voltage . . . . . . | 11.5 to 13 |
| Reverse amperage . . . . . . | 2.5 to 7.5 |
| Point gap . . . . . . | .0177″ ±.0039″ (0.45±0.1 mm) |
| **Voltage Regulator.** | |
| Battery . . . . . . | 50 |
| « Half-load » amperage . . . . . . | 12 |
| Setting voltage after temperature stabilization in oven at 122°±5° F (50°±3° C) for 30 minutes, half-load, on battery . . . . . . | 14 to 14.8 |
| Feed voltage for temperature stabilization . . . . . . | 15 |
| **Current Regulator.** | |
| Setting amperage on battery: cold . . . . . . | 28.5 to 30.5 |
| Setting amperage on battery: warm . . . . . . | 23 to 25.5 |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GRIGIO
ROSA
MARRONE
AZZURRO-NERO
BIANCO
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GRIGIO-ROSSO
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AZZURRO
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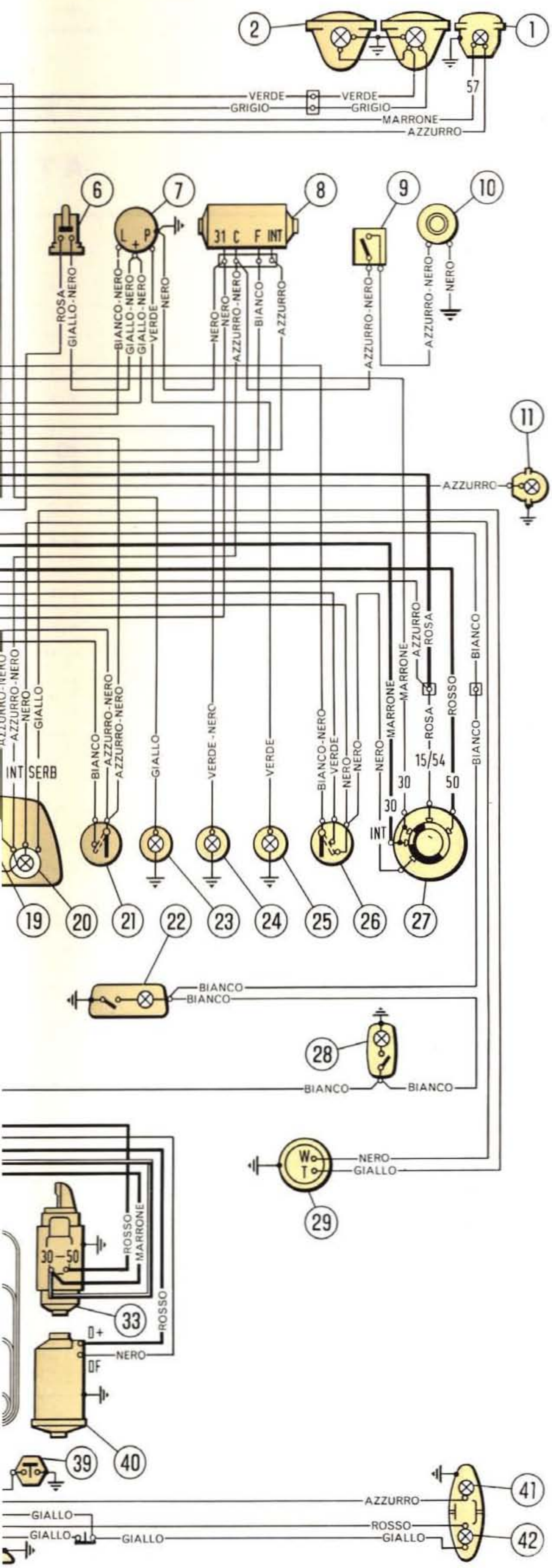


## Fig. 548 - Wiring diagram.

1. Front parking and direction signal lights.
2. High and low beam twin headlights.
3. Horn.
4. 8-Ampere fuses.
5. High beam relay switch.
6. Stop light jam switch.
7. Direction signal flasher unit.
8. Wiper motor.
9. Electrofan switch.
10. Electrofan motor.
11. Side direction signal lights.
12. Windshield wiper switch.
13. Direction signal lever switch.
14. Horn button.
15. Selector switch for outer lighting and low beam flashes.
16. Excessive coolant temperature indicator.
17. No-charge indicator.
18. Instrument cluster light.
19. Low oil pressure indicator.
20. Fuel gauge with reserve supply indicator.
21. Instrument cluster light switch.
22. Rear view mirror map light with toggle switch.
23. Parking light indicator (green light).
24. High beam indicator (blue light).
25. Direction signal indicator (green light).
26. Outer lighting master switch.
27. Key-type ignition switch, also energizing warning lights and starting circuits.
28. Dome lights with toggle switch built in.
29. Fuel gauge tank unit.
30. Generator regulator.
31. Ignition coil.
32. Low oil pressure indicator sending unit.
33. Starting motor.
34. Battery.
35. Excessive coolant temperature indicator thermal switch.
36. Ignition distributor.
37. Engine compartment light.
38. Spark plugs.
39. Jam switch for light 37.
40. Generator.
41. Rear direction signal lights.
42. Rear parking and stop lights.
43. License plate light.

**NOTE** - The mark ▬ means that the cable is provided with numbered strip or ferrule.

CABLE COLOUR CODE

| | | | |
|---|---|---|---|
| Nero | = **Black** | Bianco | = **White** |
| Marrone | = **Brown** | Azzurro-nero | = **Black and blue** |
| Giallo | = **Yellow** | Bianco-nero | = **Black and white** |
| Azzurro | = **Blue** | Giallo-nero | = **Black and yellow** |
| Grigio | = **Grey** | Verde-nero | = **Black and green** |
| Verde | = **Green** | Grigio-nero | = **Black and grey** |
| Rosa | = **Pink** | Grigio-rosso | = **Red and grey** |

# GENERATOR

## SERVICE DATA

| | |
|---|---|
| Type | DN 62 L |
| Nominal voltage | 12 |
| Continuous peak amperage (ammeter limit) | 25 |
| Temporary peak amperage | 30 |
| Continuous peak wattage | 360 |
| Temporary peak wattage | 420 |
| Cut-in speed (12 V at 68° F - 20° C) | 1,580 to 1,740 r.p.m. |
| Speed for maximum continuous amperage (25 at 68° F - 20° C) | 2,250 to 2,640 r.p.m. |
| Speed for maximum peak amperage (30 at 68° F - 20° C) | 2,400 to 2,800 r.p.m. |
| Maximum speed, steady | 10,000 r.p.m. |
| Rotation direction (drive end) | counterclockwise |
| Pole shoes | 2 |
| Field winding | shunted |
| Regulator, separate | IR 50 H |
| Engine-to-generator drive ratio (new belt) | 2 to 1 |
| Pole shoe inner diameter | $2.5955''^{+0}_{-.0059''}$ ($65.926^{+0}_{-0.150}$ mm) |
| Brush Part No. | 9914450 |
| **Bench Testing Data.** | |
| – Output test (at 68° F - 20° C): | |
| Steady voltage | 12 |
| Speed for abt. 1 hour and 45 min. | 5,000 r.p.m. |
| Current delivery to resistor (at 14 Volts) | 25 ± 0.5 Amps |
| After generator has been raised to operation temperature by running it at the above specified speed and time rates, at steady 12 voltage, read the amperage at every generator speed increment: each reading will represent a point of the output curve of the generator as shown in fig. 551. | |
| – Heating test: | |
| Speed, for abt. 1 hour and 45 min. | 5,000 r.p.m. |
| Current delivery to resistor (at 14 Volts) | 25 ± 0.5 Amps |
| Overheating – field frame, not above | 176° F (80° C) |
| Overheating – commutator, not above | 230° F (110° C) |
| – Ohmic resistance test (at 68° F - 20° C): | |
| Armature resistance (bar-to-bar: 15 to 1) | 0.115 ± 0.008 ohms |
| Field winding resistance | 4.5 ± 0.2 ohms |
| – Mechanical characteristics test: | |
| Load of springs on new brushes | 2.315 ± .110 lbs (1.050 ± 0.050 kg) |
| Maximum commutator out-of-round | .0012″ (0.03 mm) |
| Mica undercut depth | .0236″ to .0275″ (0.6 to 0.7 mm) |
| **Lubrication.** | |
| Drive end ball bearing | FIAT MR 3 grease |
| Commutator end head oiler | FIAT engine oil |

# DN 62 L GENERATOR ASSEMBLY

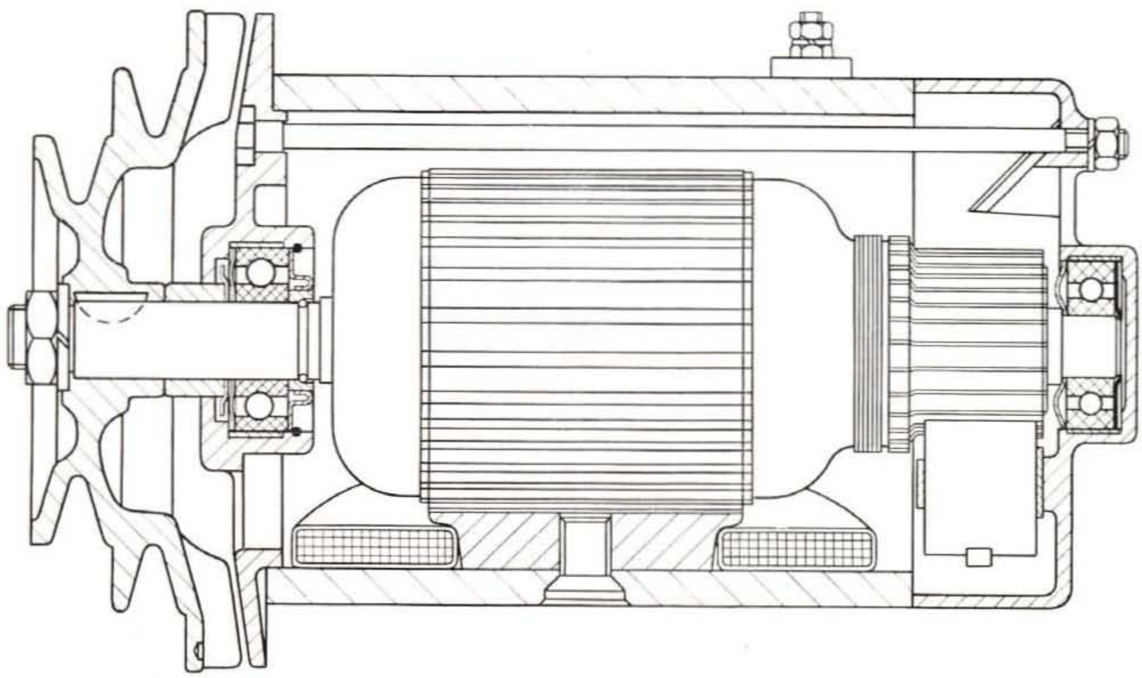

Fig. 549 - Side sectional view of generator.

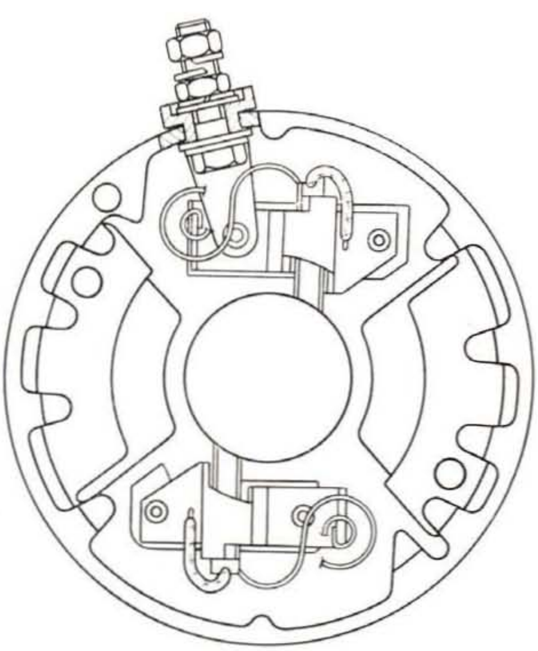

Fig. 550 - End sectional view of generator across commutator end head.

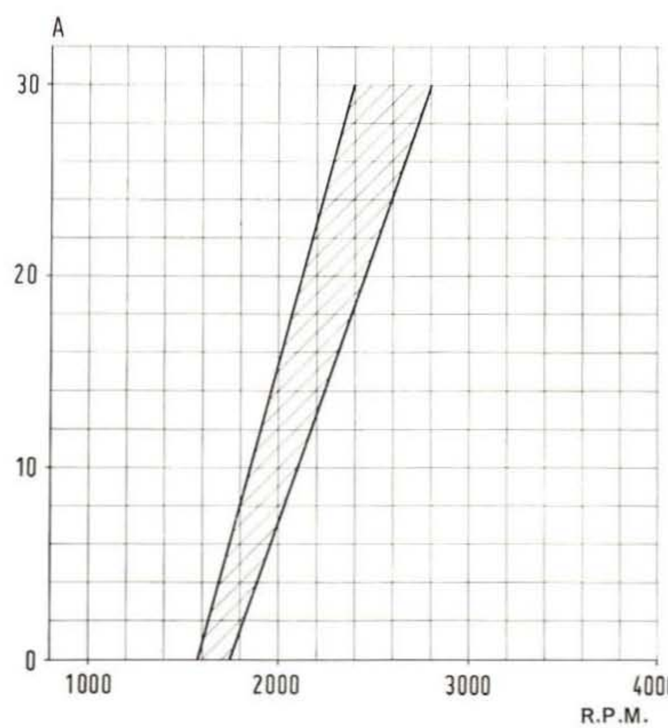


Fig. 551 - Output curve, warm, of **DN 62 L** generator. Steady voltage: 12.

## LIGHTING SYSTEM SPECIFICATIONS AND DATA

| | |
|---|---|
| **Twin headlamps** | two |
| Double filament bulb: | |
| – high beam filament | 45 - Watt |
| – asymmetric low beam filament | 40 - Watt |
| **License plate lamp** | one |
| Globular bulb | 5 - Watt |
| **Inner lighting.** | |
| Bulb incorporated in rear view mirror | 5 - Watt |
| Control switch: | |
| – toggle type | on mirror frame |
| N° 2 lamps on pillar posts | 5 - Watt |
| Control switch: | |
| – toggle type | on lamp shell |

# HEADLAMPS

## Removal.

To take down headlamps proceed as follows:

– back out rim lock screws (3, fig. 552) and remove the rim;

– work on lamp unit ring retainer screws (1, fig. 552) and remove complete headlamp.

To replace bulbs, snap out spring retainers and remove the bulb, which is inserted by a flange coupling.

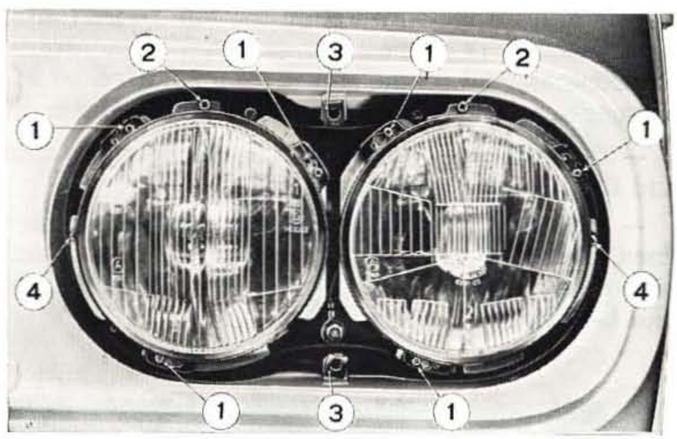


**Fig. 552 - Headlamps without rim.**

1. Lamp unit ring retainer screws. - 2. Screws, vertical adjustment of light beam. - 3. Rim screw holes. - 4. Screws, horizontal adjustment of light beam.

## Aiming.

If headlamps have been removed, aiming is required after installation.

Set the car in the following conditions:

– at no load;

– with tires inflated to recommended pressure;

– on a level surface, 16′ 5″ (5 m) apart from an opaque white screen; make sure that car centerline is square to screen face.

Draw two pairs of vertical lines a-a and a′-a′ on the screen (fig. 553). These lines should be equally spaced from the perpendicular to car longitudinal axis and respectively 29 $^{1}/_{16}$″ (738 mm) and 41 $^{3}/_{16}$″ (1,046 mm) apart (A and A′), which correspond to the center-to-center distance of inner and outer headlights.

Draw two horizontal lines b-b and b′ - b′ on the screen at the following distance from ground:

– B = C – 1 $^{9}/_{16}$″ (4 cm), new vehicles or vehicles with suspensions renewed; B = C – 1 $^{3}/_{8}$″ (3.5 cm), settled vehicles;

– B′ = C – $^{19}/_{32}$″ (1.5 cm), new vehicles, vehicles with suspensions renewed and settled vehicles;

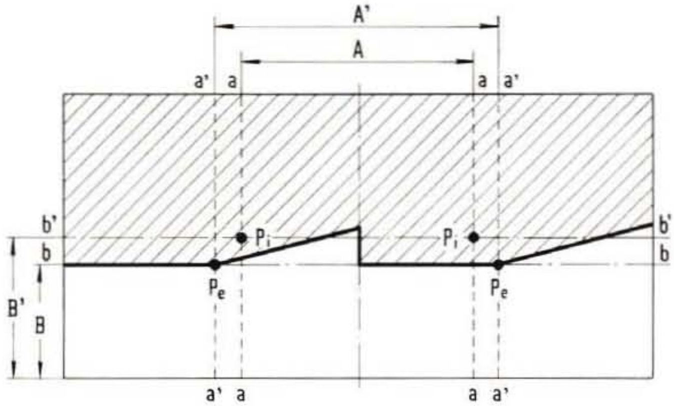


**Fig. 553 - Headlight aiming diagram.**

A = 29 1/16'' (738 mm). - A' = 41 3/16'' (1,046 mm). - B = C − 1 9/16'' (4 cm), new vehicle. - B = C − 1 3/8'' (3.5 cm), settled vehicle. - B' = C − 19/32'' (1.5 cm), new vehicle and settled vehicle. - C = ground clearance of headlight center.

where **C corresponds to the ground clearance of headlight center, measured on aiming.**

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**NOTE - A vehicle is settled in practice when it has run the mileage specified for the first free voucher service.**

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To aim headlights switch on the low beam **(outer lamps)** and work on the screw (2, fig. 552) for vertical adjustments, and on the screw (4) for horizontal adjustments, until the following conditions are obtained:

— the horizontal separation line between the unlit and lit areas lies on line b-b;

— the upward slanting (some 15°) separation lines start from the meeting points **Pe** (or just outside them) of vertical lines a'-a' with the horizontal line b-b (fig. 553).

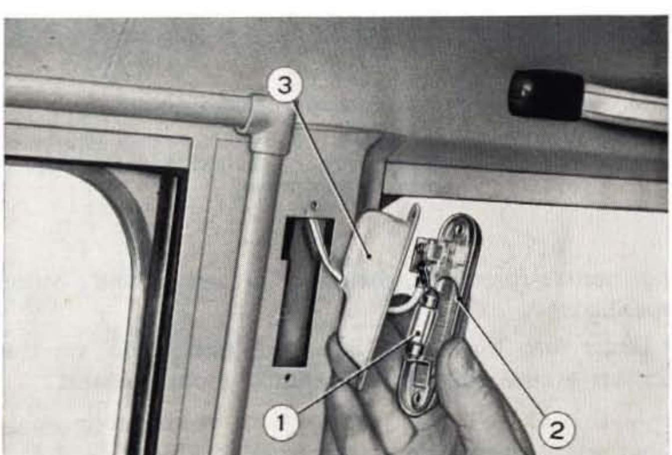


**Fig. 554 - Removing dome light.**

1. Cylindrical bulb. - 2. Lens. - 3. Lamp shield.

To aim the high beam of **inner headlamps** turn on the high beam and work: on screw (2, fig. 552) for vertical adjustments and on screw (4) for horizontal adjustments.

The center of the zone of highest intensity (hot spot) should thus fall on intersection **Pi** between the horizontal line b'-b' and two vertical lines a-a (figure 553).

A 10 1/4'' (260 mm) increase in distance A and A' specifications, corresponding to a 3° aggregate beam divergence, is tolerated.

---

**NOTE - Recall that headlamps should be aimed as follows:**

**— low beam, by working solely on outer headlight screws;**

**— high beam, by working solely on inner headlight screws.**

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## INNER LIGHTING

Two dome lamps fitted to side pillar posts provide car interior illumination.

For replacement of dome lamp bulb just remove lamp mounting screws and pull to overcome the force of bulb spring retainers (fig. 554).

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**NOTE - Prior to removal of dome lamp, take off fuse N° 30 (fig. 555).**

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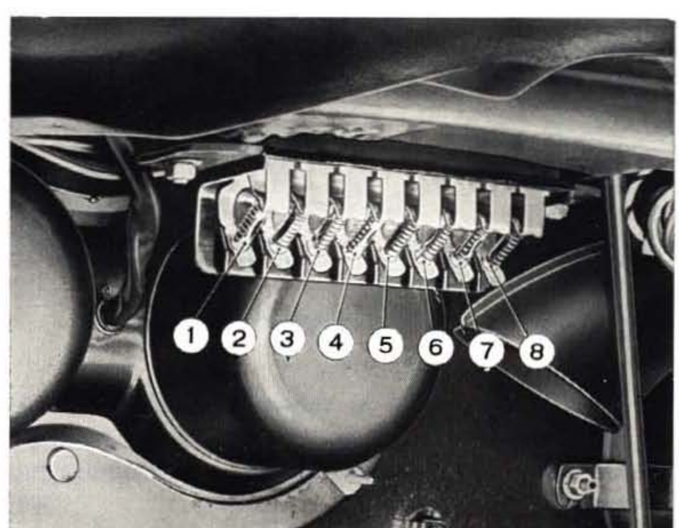


**Fig. 555 - Fuses.**

1. Fuse No. 15/54. - 2. Fuse No. 30. - 3. Fuse No. 56/b1. - 4. Fuse No. 56/b2. - 5. Fuse No. 56/a1. - 6. Fuse No. 56/a2. - 7. Fuse No. 58/1. - 8. Fuse No. 58/2.

## FUSES

Eight 8-Ampere are situated below instrument panel. Prior to replacing a blown fuse by a new one, locate and remove the source of the trouble which brought about the blowing.

**Unprotected circuits:** ignition, starting and battery charge (no-charge indicator excepted).

| Fig. 555 | Fuses | PROTECTED CIRCUITS |
|---|---|---|
| 1 | 15/54 (with ignition on) | No-charge indicator.<br>Low oil pressure indicator.<br>Heat indicator.<br>Fuel gauge with reserve supply indicator.<br>Wiper motor.<br>Instrument cluster light.<br>Electrofan motor.<br>Direction signal lights and indicator.<br>Stop lights. |
| 2 | 30 | Dome lights.<br>Rear view mirror map light.<br>Horn. |
| 3 | 56/b1 (with ignition on) | Left side low beam. |
| 4 | 56/b2 (with ignition on) | Right side low beam. |
| 5 | 56/a1 (with ignition on) | Left side high beam.<br>High beam indicator. |
| 6 | 56/a2 (with ignition on) | Right side high beam. |
| 7 | 58/1 (with ignition on) | Left side front parking light.<br>Parking light indicator.<br>Right side rear parking light.<br>License plate light. |
| 8 | 58/2 (with ignition on) | Right side front parking light.<br>Left side rear parking light.<br>Engine compartment light. |

# INSTRUMENTS AND ACCESSORIES

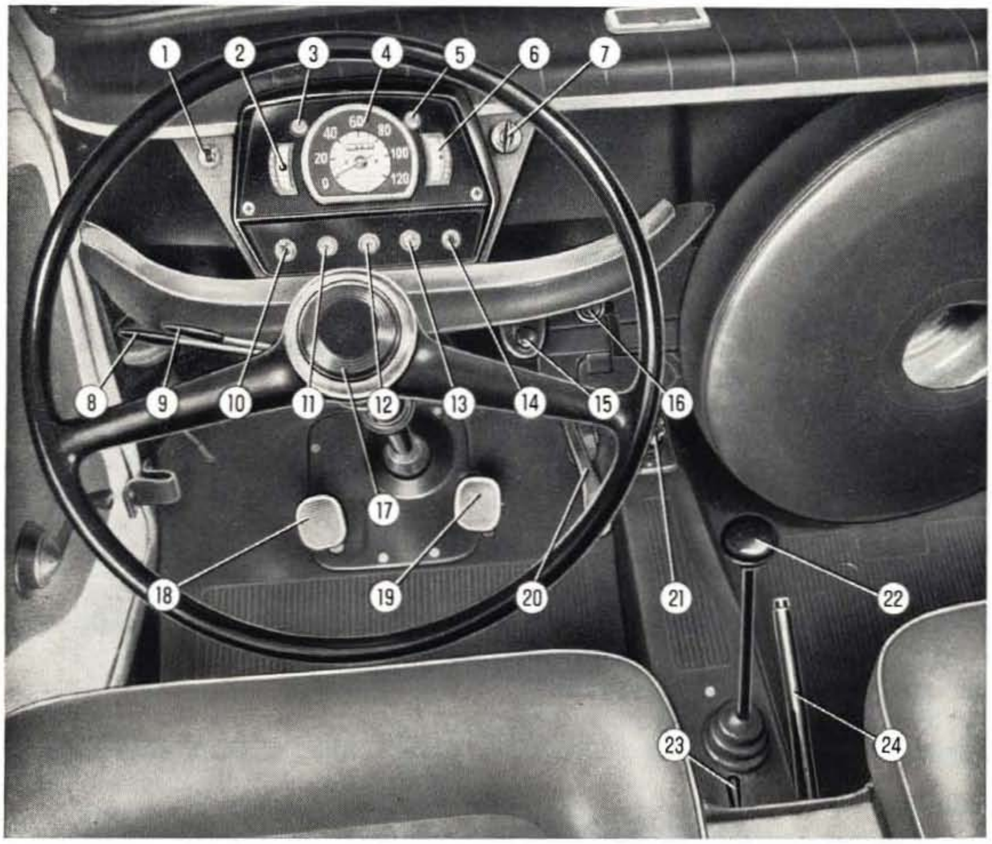


**Fig. 556 - Instruments and accessories.**

1. Windshield wiper switch. - 2. Heat indicator (red). - 3. No-charge indicator (red). - 4. Speedometer and mileage recorder. - 5. Low oil pressure indicator (red). - 6. Fuel gauge with reserve supply indicator (red). - 7. Key-type ignition switch, also energizing warning lights and starting circuits. - 8. Selector switch for outer lighting (with master switch 14 on). - 9. Direction signal lever switch. - 10. Instrument cluster light switch. - 11. Parking light indicator (green). - 12. High beam indicator (blue). - 13. Direction signal indicator (green). - 14. Outer lighting master switch. - 15. Manual accelerator control. - 16. Windshield washer pump. - 17. Horn button. - 18. Clutch pedal. - 19. Service brake pedal. - 20. Accelerator pedal. - 21. Heater radiator coolant flow cock. - 22. Gearshift lever. - 23. Easy starting device (choke) control. - 24. Manual brake ratchet lever.

# BODY

Integral construction, seven seater, four door.

Body shell with inner framework; longitudinal-ribbed roof panel; air intake louvers at rear of side panels for engine cooling.

Sheet metal body floor with reinforcing ribs.

Front end with four recessed headlamps and iron bar grille for heating air scoop.

Front quarter doors: two, front-hinged, each with two window glasses: the front one swivelling, the rear one of the drop type with cranking regulator. Driver's side door with key-type lock. Map pouches in door trim panel.

Rear quarter doors: two, front-hinged, each with two window sliding glasses, provide access to intermediate and rear seat rows. Doors are fitted with key-type locks and inner safety catch. Door opening from intermediate range seats is assured through a remote control handle and from rear range seats through a control lever actuating the latch directly.

Rear engine compartment lid bottom hinged and with two catch levers at top. Right side lid catch with key-type lock.

Rear luggage compartment lid, top hinged, is provided with handle control and key-type lock.

A prop holds lid in open position. Fixed-pane type rear window with black rubber weatherstrip and bright metal trim moulding.

Power plant recess with rear inspection lid fitted with two catches and a prop holding the lid in open position.

Sheet metal instrument panel lined with non-reflective imitation leather lining; plastic support for instruments; utility shelf under the instrument panel, driver's side, lined with plastic material.

Adjustable sun visors, plastic laminate lined.

Tool kit and jack arranged behind spare wheel.

Front seat for two features separate cushions and a single back rest; seat is imitation leather lined.

Intermediate seat for two is imitation leather lined and metal framed. Bench-type seat is divided into two sections, each reclinable forward.

Bench-type rear seat, accomodating three, is imitation leather lined and metal framed. Seat can be collapsed on floor above engine compartment.

Black fluted rubber mats on floor and front wheehouses.

Imitation leather lined masonite trim panels for doors and body sides; imitation leather headlining.

Rear view mirrors: two outer on front quarter doors and one inner, above windshield, with courtesy light.

Fuel filler neck lid on right side panel, fitted with key-type lock.

Fig. 557 - Front view of 850 Family.

Grabbing bar for intermediate row seat passengers arranged behind front seat back rest.

Four ash receivers are located as follows: one at center of dashboard, one on front seat back rest, two on side panels at rear seat ends.

Fig. 558 - Interior view of 850 Family with one intermediate seat section in collapsed position.

Fig. 559 - Side view of 850 Family

# IDROCONVERT TRANSMISSION

# CONSTRUCTION AND OPERATION

## GENERAL

The Idroconvert transmission, available as an optional extra on the **850 model**, consists mainly of:

1) A torque converter, inclusive of:

– a hydrokinetic coupling comprising an impeller, a turbine and stator used to transmit power and give torque multiplication from 2-1 to 1-1;

– a release mechanism fixed to the turbine, controlled by the oil pressure;

– a uni-directional clutch which, when coasting cuts off the torque converter positively interconnecting the flywheel, the release mechanism and the torque converter output shaft.

2) A transmission casing, in replacement of the conventional clutch bell housing, enclosing the following equipment:

– a gear type oil pump, fitted with a special regulating valve to ensure constant feed and lubrication of torque converter, uni-directional clutch and release mechanism;

– a main oil reservoir with strainer;

– a solenoid-operated flow control valve. The valve is connected hydraulically to the release mechanism and monitors its operation.

3) An auxiliary, compensating oil reservoir connected to the main reservoir by means of a flexible hose.

4) A floor-mounted selector lever fitted with a knob switch which closes the electrical circuit at any movement of the lever.

5) A neutral switch, situated on transmission cover, which closes the electrical circuit when selector lever is in neutral position.

6) A relay for the solenoid-operated flow control valve and a starter motor inhibitor switch.

The IDROCONVERT transmission eliminates the need for a conventional clutch and allied control.

The IDROCONVERT transmission is fitted between engine and gearbox in place of the clutch.

The conventional gearbox has been retained and a small friction-ring brake has been added to facilitate engagement of reverse gear (not synchronised).

## DESCRIPTION

The use of a hydrokinetic torque converter coupled to the input shaft of a conventional gearbox gives exceptionally smooth and progressive vehicle operation. In fact, because of the torque multiplication given by the torque converter and then by the gearbox, extreme flexibility and optimum pick-up are readily available at all speeds.

The torque converter consists of:

– an impeller, fixed to the crankshaft;

– a turbine, connected to the release mechanism which, in turn, is connected to the torque converter output shaft;

– a stator, fitted with a uni-directional clutch.

Both impeller and turbine are made of pressed sheet metal with inserted vanes (peened on assembly). The stator is a light alloy casting.

The torque converter sleeve bearing, which is fixed to the outer casing, carries a race for the uni-directional clutch.

A second uni-directional clutch, fitted between release mechanism and torque converter casing, causes these to lock together when coasting so as to give an uninterrupted drive from road wheels to engine, thus by-passing the torque converter. Such a design ensures positive engine braking and facilitates engine starting by towing at low speed, as well as parking on a gradient with the car in gear (1st gear downhill and reverse gear uphill).

The release mechanism consists of a single, wet plate clutch (oil bath) which is used to disconnect the engine from the transmission during gear shifts, and whenever the hand lever is moved to the neutral position (with engine running).

This clutch consists of a bell housing, a pressure plate and a driven plate. Both bell housing and pressure plate rotate together with the turbine and, during coasting, are made to engage the converter casing (and therefore, the impeller) via the uni-directional clutch.

The driven plate, placed between bell housing and pressure plate, is free to move axially on its hub which, in turn, is fixed to the converter output shaft.

Oil pressure is brought to bear on either side of the pressure plate to engage and release the clutch.

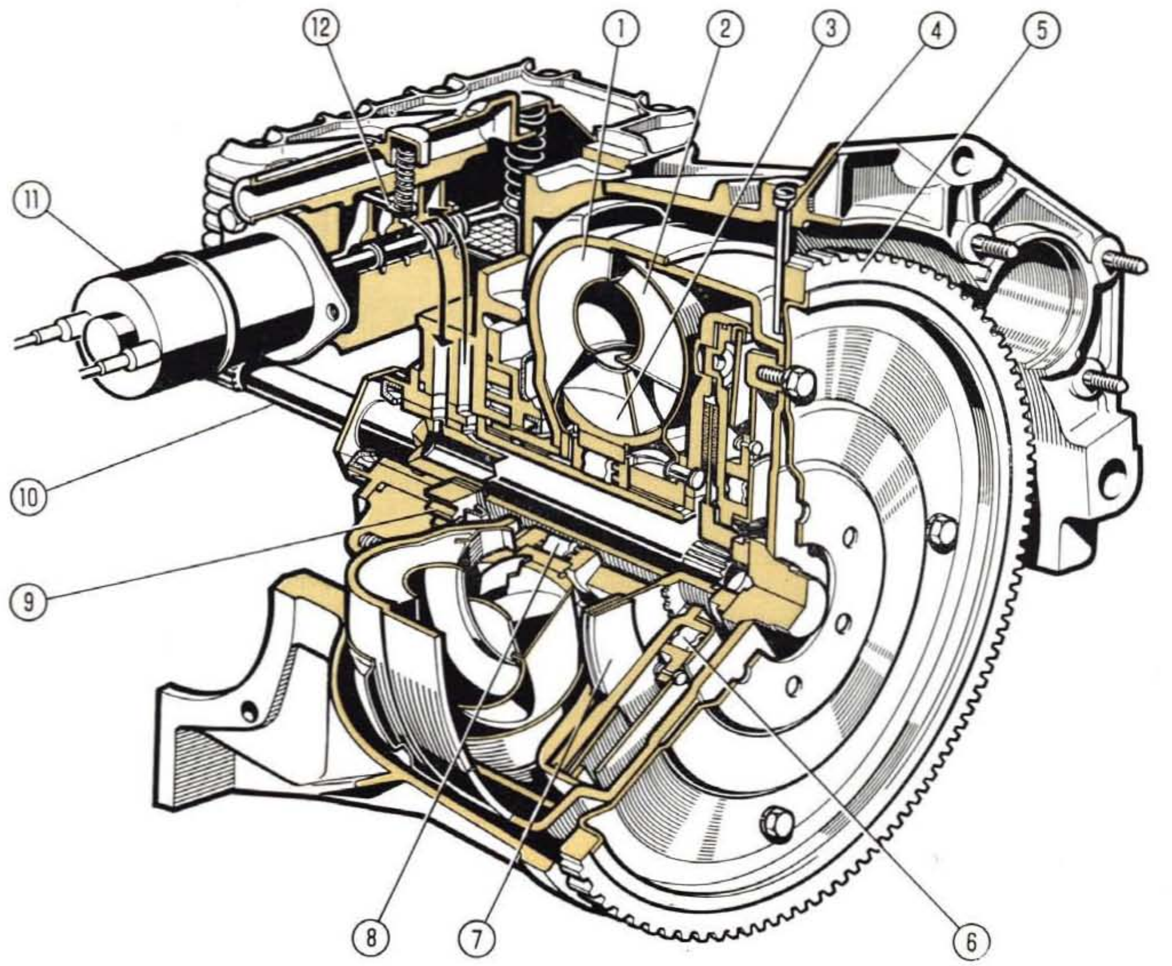


**Fig. 560 - Sectional view of Idroconvert transmission.**

1. Impeller. - 2. Turbine. - 3. Stator. - 4. Torque converter guarantee seal. - 5. Engine flywheel and starter ring gear. - 6. Uni-directional clutch for torque converter by-pass. - 7. Clutch driven plate. - 8. Stator uni-directional clutch. - 9. Oil pump. - 10. Torque converter output shaft. - 11. Solenoid. - 12. Pressure regulating valve.

A disc type return spring is used to exert a constant pressure in the direction of engagement, so as to obtain the torque transfer necessary for engine starting by towing or pushing.

The torque converter unit is enclosed in a pressed sheet-metal casing consisting of two halves welded on assembly to ensure perfect sealing. The casing outer surface is finned to facilitate oil cooling.

Clutch engagement and release are obtained by reversing the direction of oil pressure within the hydraulic circuit inside the converter. Flow reversal is achieved by means of a plunger type valve enclosed in a valve body and operated by a solenoid which is, in turn, controlled by the knob switch in selector lever (signalling the driver's intention to change gear) as well as by the neutral switch situated in the gearbox cover and operated via a gear selector rod.

A constant supply of oil under pressure is maintained by the gear type oil pump situated in the transmission outer casing.

Two dog teeth on the impeller are used to drive the pump.

It should be noted that this pump is used to maintain oil circulation under pressure and not to supply oil to the torque converter. Indeed, the converter must at all times be full of fluid both during operation and when stationary.

A pressure regulating valve with return to supply reservoir maintains the oil pressure within the specified limits: 71-85 psi (5-6 kg/cm$^2$) maximum.

The main oil reservoir is situated in the torque converter outer casing, in proximity of the plunger valve, and is closed at the top by a cover (3, fig. 562).

Its outer surface is finned for faster cooling and a strainer inside the reservoir provides adequate filtration of the oil coming from the secondary reservoir.

The secondary reservoir is situated above the transmission and carries a dip-stick (1, fig. 573) in the filler neck.

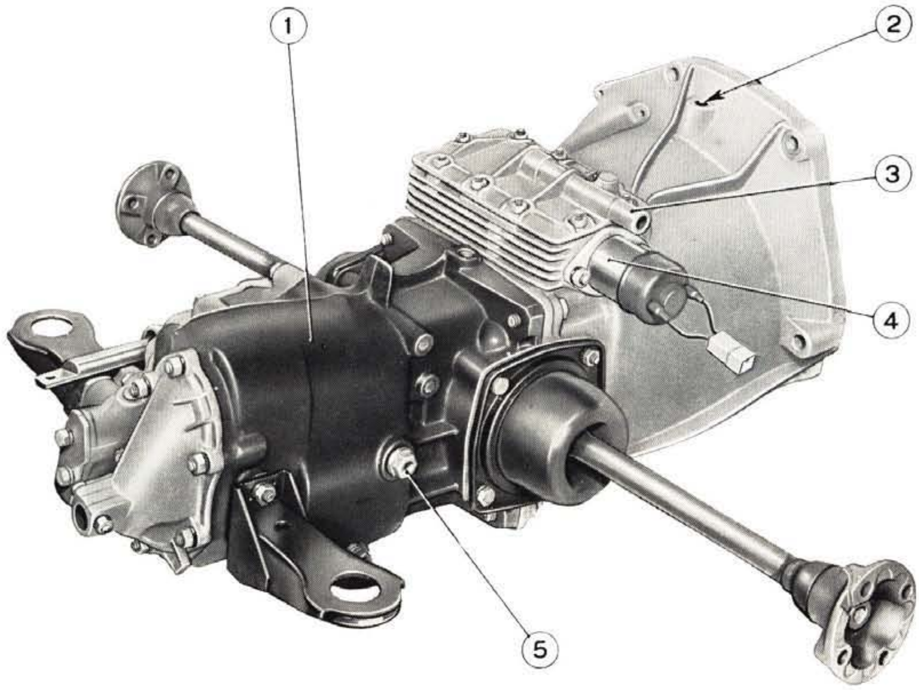


**Fig. 561 - Transmission unit with hydraulic torque converter - left hand view.**

1. Gearbox. - 2. Seat of guarantee seal. - 3. Oil inlet. - 4. Solenoid. - 5. Gearbox oil level indicator plug.

## TORQUE CONVERTER OPERATION

The impeller, driven by the engine crankshaft, transforms engine power into hydrokinetic energy.

Thus, centrifugal force flings the oil within the torque converter from the impeller to the turbine vanes then back to the impeller via the stator vanes.

Turbine vanes are concave to absorb the maximum amount of energy. Such a profile, however, results in the inversion of the oil flow. Consequently, should there be no stator, soon after leaving the turbine oil would tend to strike the impeller vanes in the direction of rotation opposite to that imparted by the engine.

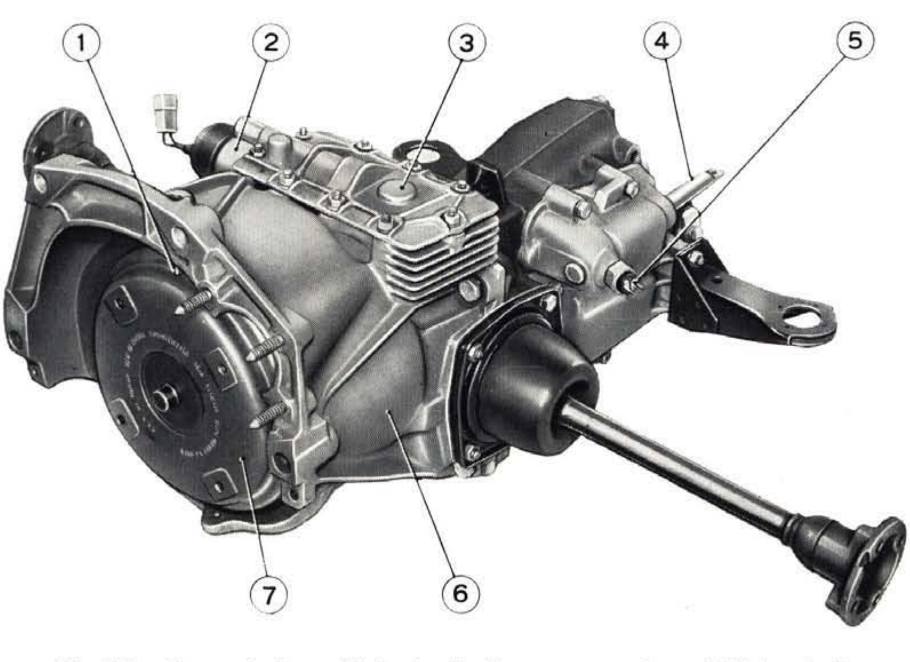


**Fig. 562 - Transmission with hydraulic torque converter - right hand view.**

1. Guarantee seal. - 2. Plunger valve solenoid. - 3. Outer casing cover. - 4. Gear selector and engagement rod. - 5. Neutral switch. - 6. Transmission outer casing. - 7. Hydraulic torque converter.

# HYDRAULIC TORQUE CONVERTER

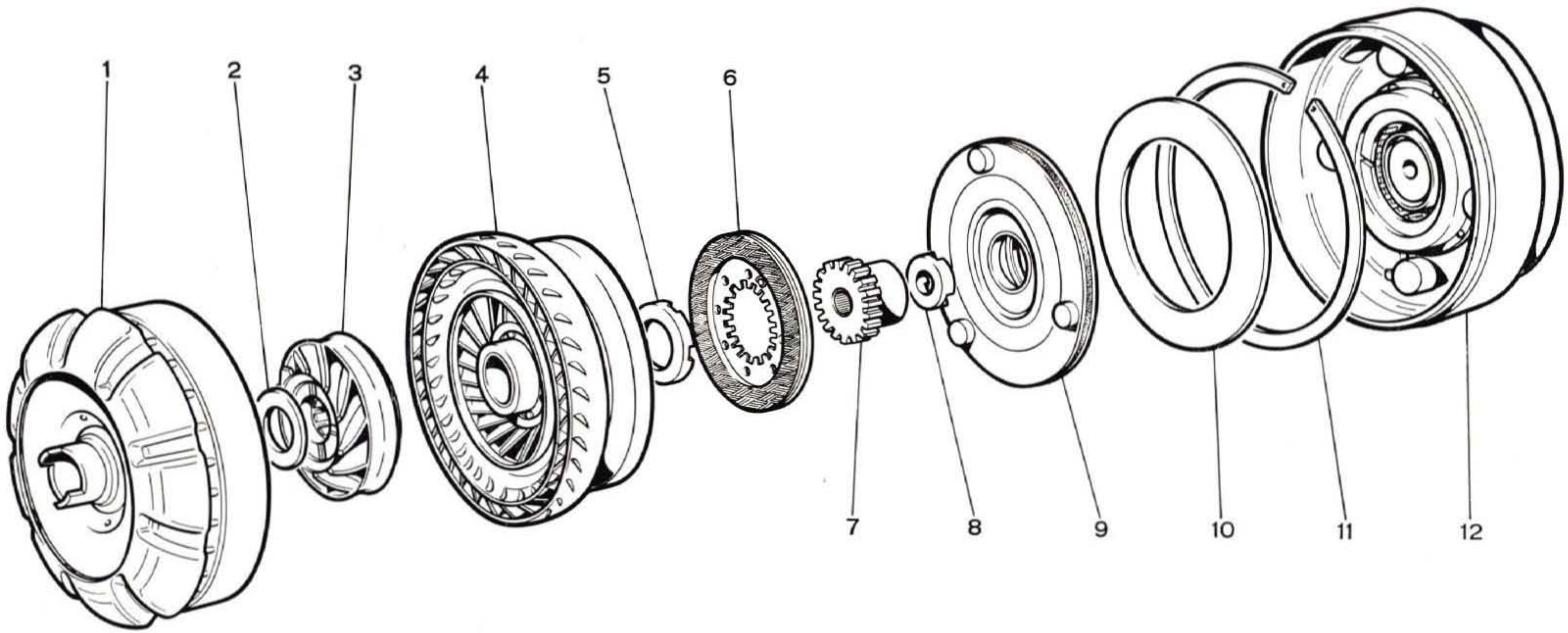


**Fig. 563 - Exploded view of torque converter.**

1. Impeller. - 2. Spacer ring. - 3. Stator. - 4. Turbine. - 5. Spacer ring. - 6. Driven plate. - 7. Driven plate hub. - 8. Spacer ring. - 9. Pressure plate oil seal. - 10. Disc type spring. - 11. Snap ring. - 12. Torque converter casing.

Should oil flow re-enter the impeller vanes in this unfavourable direction, an opposing torque would counteract the engine torque thereby causing a reduction in engine speed.

In such a situation the advantage gained by suitably shaping the turbine vanes would be completely lost.

To obviate this, a stator is inserted between impeller and turbine to reverse the direction of oil flow leaving the turbine in order to facilitate impeller rotation thus increasing the torque. The period during which this torque increase occurs is known as the conversion phase.

The torque multiplication obtained is proportional to the speed differential existing between impeller and turbine, reaching a maximum of 2 to 1 during starting (turbine stationary).

During the conversion phase, the stator, under the thrust exerted by the oil, tends to rotate in the opposite direction to that of the impeller. If such a tendency were not controlled the torque multiplication effect would be destroyed with ensuing further loss of power. In practice this does not happen as stator rotation is prevented by a unidirectional clutch.

As the speed differential between impeller and turbine decreases, a variation occurs in the angle at which the oil acts on stator vanes causing a reduction in torque multiplication.

Fig. 564 - Hydraulic torque converter unit.

When the speed differential between impeller and turbine is down to a minimum the oil flow becomes almost parallel to the torque converter centre line.

So the stator, no longer restrained by the unidirectional clutch, is made to rotate in the same direction as impeller and turbine. In this condition there is no torque multiplication and the converter acts as an ordinary fluid coupling.

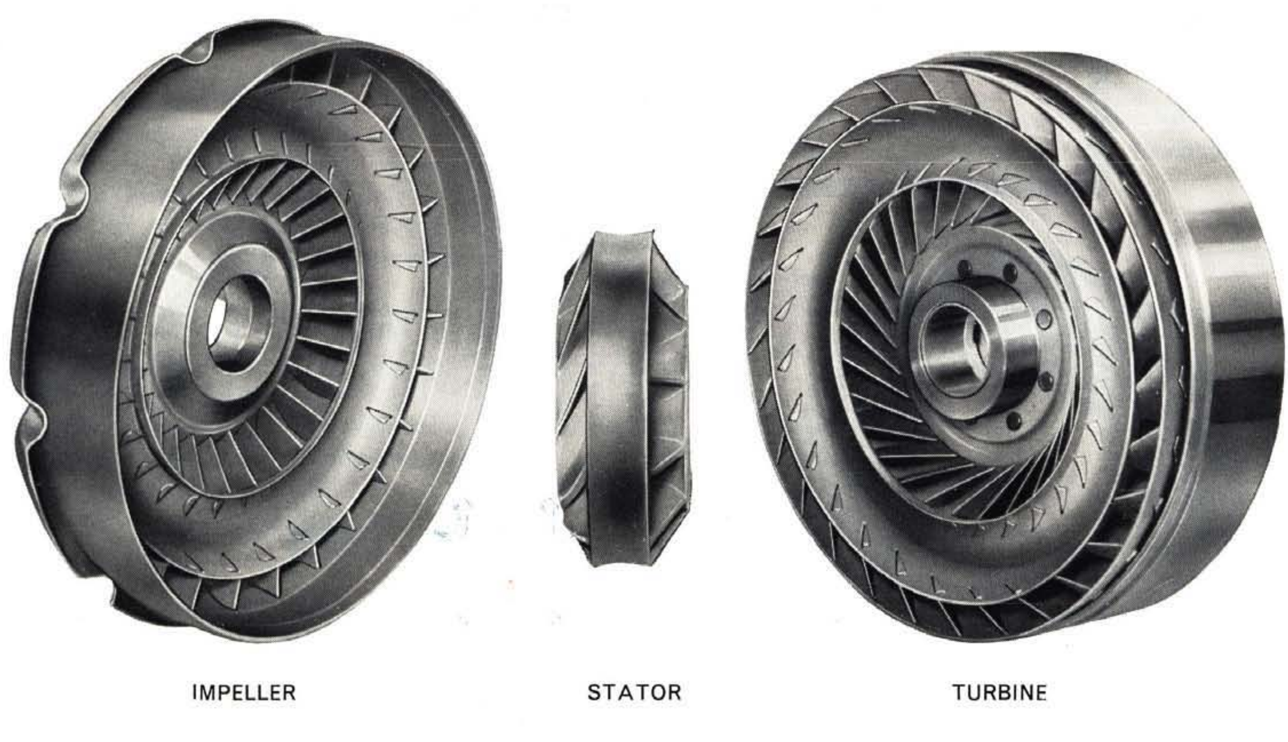


Fig. 565 - Internal view of the hydraulic torque converter.

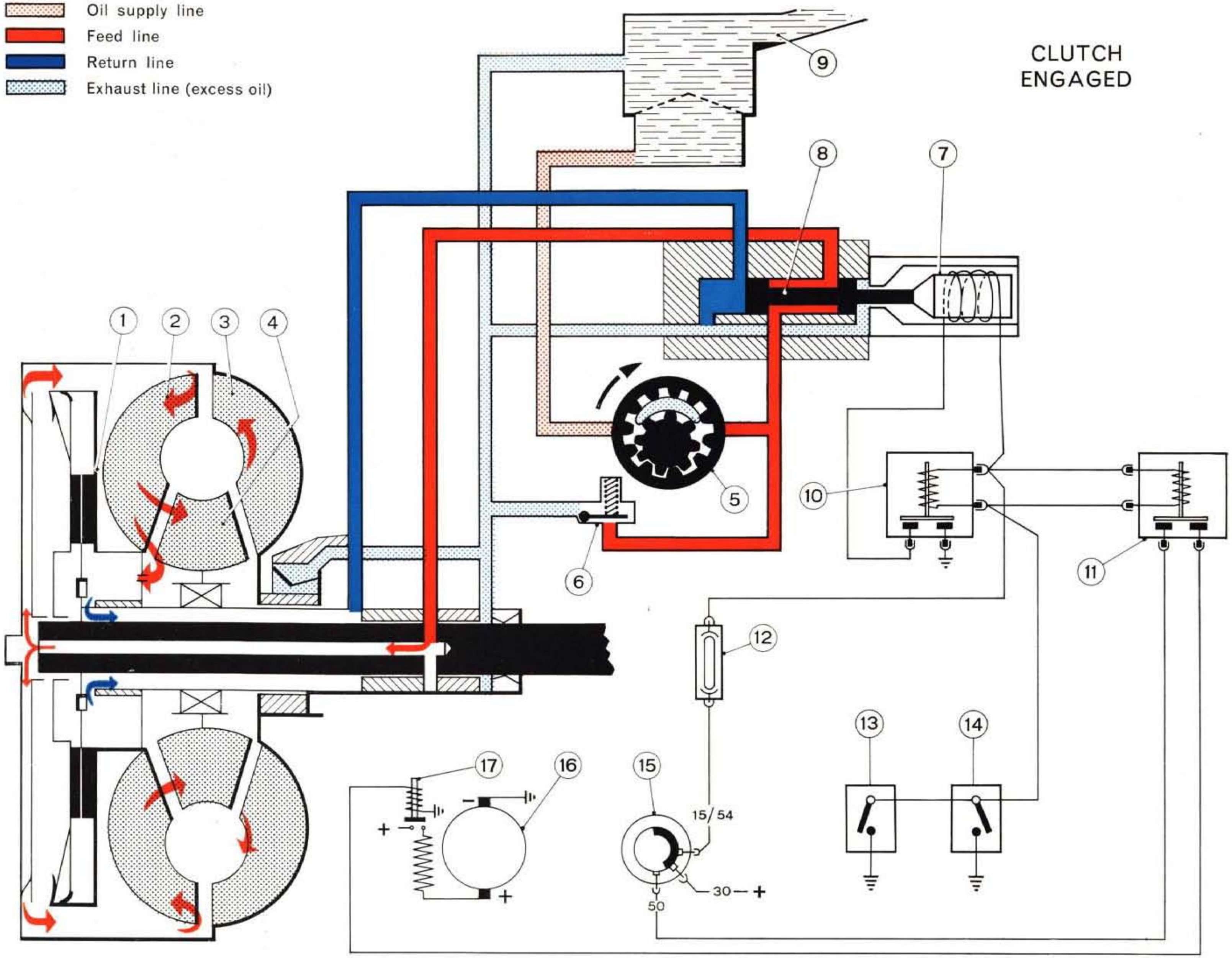


**Fig. 566 - Operating diagram of Idroconvert transmission with clutch engaged.**

1. Release mechanism (clutch). - 2. Turbine. - 3. Impeller. - 4. Stator. - 5. Oil pump. - 6. Oil pressure regulating valve. - 7. Valve solenoid. - 8. Plunger valve. - 9. Main oil reservoir. - 10. Solenoid relay. - 11. Starter inhibitor switch. - 12. Fuse. - 13. Knob switch on selector lever. - 14. Neutral switch. - 15. Selector switch. - 16. Starter motor. - 17. Starter motor relay.

# OPERATION OF THE HYDRAULIC SYSTEM

## Clutch Engaged (see fig. 566).

Oil is drawn by gear pump (5) from oil reservoir (9) via an interconnecting suction duct. Oil under pressure is then fed from the pump to pressure regulating valve (6) where a maximum pressure of 71-85 psi (5-6 kg/cm$^2$) is constantly maintained, excess oil being exhausted to reservoir (9).

A second oil feed from the pump reaches plunger valve (8) which, when clutch is engaged directs oil pressure into the hollow converter output shaft.

From the hollow shaft oil is fed to the pressure plate, so as to exert pressure in the same direction as that of the disc spring, and to the torque converter where a build-up in pressure occurs. From the converter, oil passes through the bell housing and returns to reservoir via the annular chamber formed around the output shaft.

This interconnection between torque converter and bell housing is designed to permit oil circulation but must at all times prevent the formation of a back pressure on the pressure plate - against the disc spring - to avoid any risk of clutch disengagement. To avoid any such risk, interconnection is achieved by a small orifice allowing a limited amount of oil to pass through.

## Clutch Disengaged (see fig. 568).

In this position oil reaches pump (5), pressure regulating valve (6) and plunger valve (8) in the same manner as that shown for clutch engaged.

However, the solenoid (7) operated plunger valve is moved to the rear causing the oil flow to be reversed, i.e., from plunger valve through the annular chamber over output shaft to the bell housing where, by acting on the pressure plate, causes the clutch to disengage thus discontinuing torque transfer.

Torque converter pressure will subside as the return line is connected to reservoir via output shaft and plunger valve.

Although oil will pass from bell housing to torque converter through the orifice, the oil pump succeeds in compensating this loss to prevent any pressure drop within the bell housing.

# OPERATION OF RELEASE MECHANISM (CLUTCH)

The release mechanism, situated between torque converter and engine flywheel, is a wet clutch (oil bath) of the bell housing type.

The bell housing is fixed to the turbine; the driven plate, designed to ensure a positive transmission, is pressed between bell housing and pressure plate, though free to slide within the bell housing itself.

Oil pressure may be applied from **B** or **A** (see fig. 569). Oil pressure from **B** causes the pressure plate to exert a thrust on the driven plate, thereby coupling torque converter to gearbox, whereas oil pressure from **A** will cause the pressure plate to move away from the driven plate, thus discontinuing torque transfer.

Also acting in the direction of arrow **B** is a disc type spring which is pre-loaded to 14.5-21.7 ft.lbs (2 to 3 kgm), this value being sufficient to push (or tow) start the vehicle as in this condition there is no oil pressure.

Oil pressure acts from **A** or **B** according to the position of the solenoid operated plunger valve; moreover, oil pressure is not modulated, i.e., it is either absent or acting to the maximum value permitted by the pressure regulating valve (71 to 85 psi = 5 to 6 kg/cm$^2$).

During disengagement, oil pressure acting in **A** flows from **D** to chamber **C** through a passage in the driven plate. Oil flow through this passage is controlled by an orifice and a valve which may take two positions according to whether the car is pulling or coasting. This double positioning is automatic and governed by the amount of backlash existing between the driven plate and hub splines.

The orifice is uncovered by the valve during normal driving and closed when coasting.

With an uncovered orifice, i.e. under pull, a considerable amount of oil passes between chambers **C** and **D** to obtain rapid clutch engagement and disengagement.

When the orifice is closed, i.e. during coasting, oil pressure will overcome the resistance of the

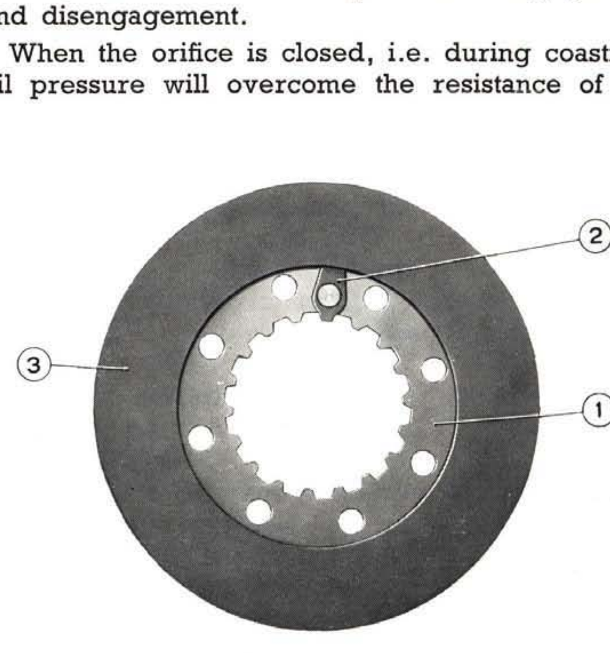


**Fig. 567 - Clutch driven plate.**

1. Driven plate. - 2. Partialising valve. - 3. Friction lining.

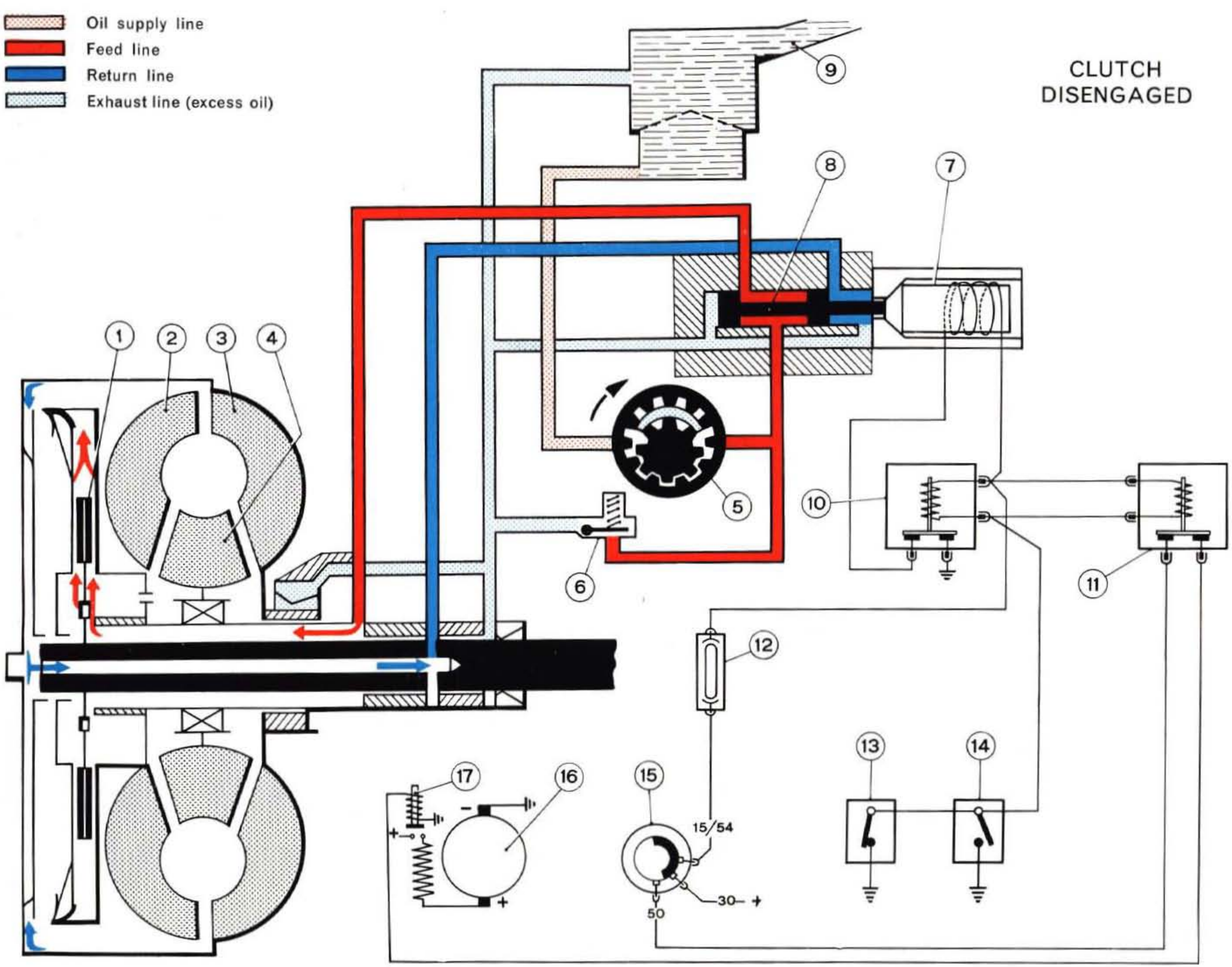


**Fig. 568 Operating diagram of Idroconvert transmission with clutch disengaged.**

1. Release mechanism (clutch). - 2. Turbine. - 3. Impeller. - 4. Stator. - 5. Oil pump. - 6. Oil pressure regulating valve. - 7. Plunger valve solenoid. - 8. Plunger valve. - 9. Main oil reservoir. - 10. Solenoid relay. - 11. Starter inhibitor switch. - 12. Fuse. - 13. Knob switch on selector lever. - 14. Neutral switch. - 15. Selector switch. - 16. Starter motor. - 17. Starter motor relay.

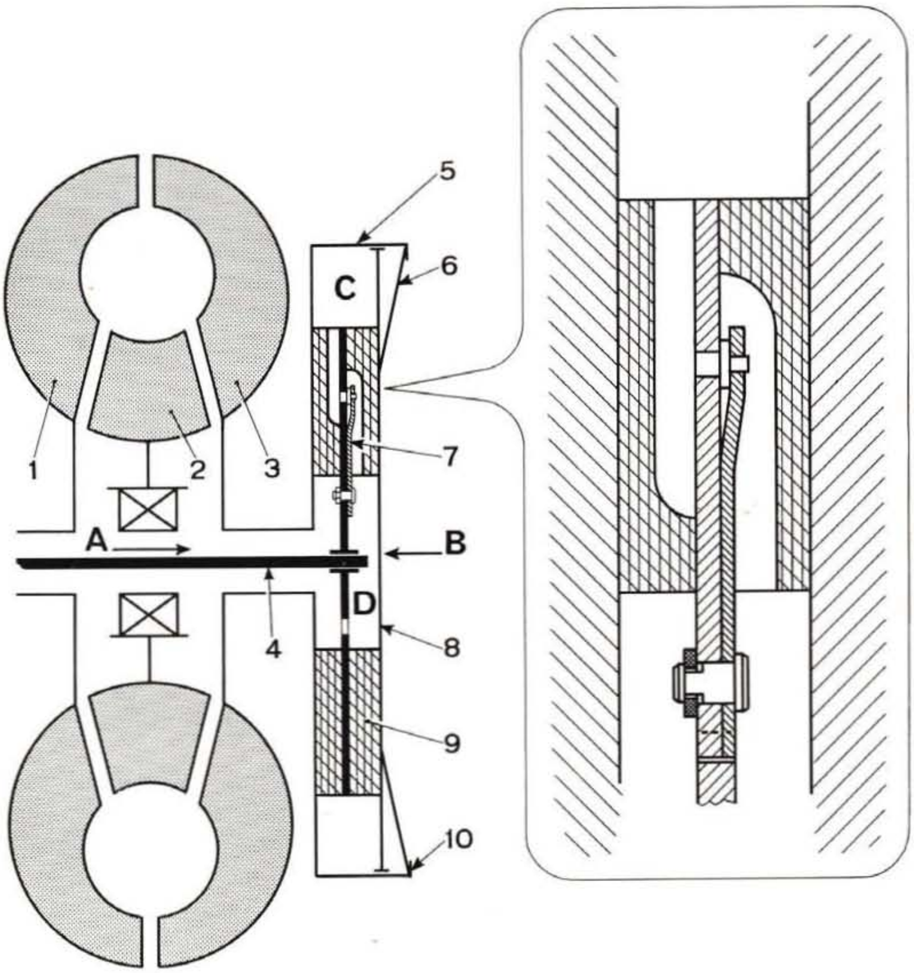


**Fig. 569 - Operating diagram of release mechanism.**

1. Impeller. - 2. Stator. - 3. Turbine. - 4. Torque converter output shaft. - 5. Bell housing. - 6. Disc type spring. - 7. Partialising valve. - 8. Pressure plate. - 9. Driven plate. - 10. Snap ring.

disc spring and cause the pressure plate to move back. However, the subsequent clutch engagement will be slightly retarded as, in order to pass from chamber **C** to **D**, the oil must overcome the resistance of the valve which is lifted in the process - the pressure plate is pushed rapidly towards the driven plate by a spring and oil pressure acting from **B** whilst the oil is simultaneously compressed within chamber **C** and forced through into chamber **D** to give a gradual engagement.

It should also be noted that the driven plate is compressed between bell housing and pressure plate. At the moment of engagement the driven plate is subjected to an elastic deformation which facilitates separation during subsequent disengagement to avoid sticking.

On the other hand, the engagement phase must adjust itself to the speed of bell housing/pressure plate assembly (turbine speed) and that of the driven plate (gearbox input speed) as it is these factors which determine its duration.

In fact, so far we have been dealing with static pressures only whereas, to obtain a clear understanding of the system, one must also consider the dynamic pressures at work within the system.

Under certain conditions, bell housing/pressure plate on the one hand, and driven plate on the other, rotate at different speeds acting as separate turbines. Consequently, the dynamic pressures generated during rotation must be added to the static pressures.

Such dynamic pressures are directly proportional to the rotational speeds, and oil transfer from chamber **C** to chamber **D** and vice-versa is governed by the pressure differential between them.

From this it may easily be inferred that the pressure-plate-to-driven-plate approach speed varies according to whether the dynamic pressures prevail over the static pressures and vice-versa.

This adjustment in the speed of engagement occurs quite automatically thanks to careful dimensioning of the components. Its purpose is to give

Fig. 570 - Plunger valve solenoid.

a progressive clutch operation and to act as a safety device when changing down at excessively high road speeds.

In fact, during downshifts the clutch is disengaged; the driven plate rotates faster than the bell housing, thereby causing a pressure increase within chamber **C** which opposes pressure in **B** and the action of the disc spring.

The higher the driven plate speed, with respect to the bell housing, the greater will be the pressure build-up within chamber **C** and the increase in differential between higher pressure in **C** and static pressure in **B** which tends to engage the clutch. Consequently, a longer delay will occur on engagement.

Naturally, this delay will be just about noticeable when, after engaging a lower gear, the speed (r.p.m.) at which the engine is driven by the road wheels is within the specified limits.

Also to be borne in mind is the fact that the above delay occurs during coasting only. In fact, under pull the depression of the accelerator on the part of the driver soon after change-down has occurred, causes the valve on the driven plate to move, thereby uncovering the partialiser orifice and at the same time reducing or eliminating the speed differential between bell housing and driven plate, i.e., the dynamic pressure.

At this point the static pressure immediately overcomes the dynamic pressure thus enabling the clutch to engage. This is particularly useful when changing down in order to obtain a brisker pick-up for overtaking.

## OPERATION OF ELECTRICAL SYSTEM

The electrical system consists of a relay, an inhibitor switch, a solenoid, a neutral switch and a knob switch fitted at the top of the gear selector lever.

Relay (3, fig. 571), controls solenoid (5) which, in turn, operates plunger valve; switch (4) acts as an inhibitor monitoring starter motor relay (9).

Neutral switch (6) is closed when selector lever is in neutral position and open with the transmission in gear. Knob switch (7) is normally open and closes when the driver grips the selector lever knob.

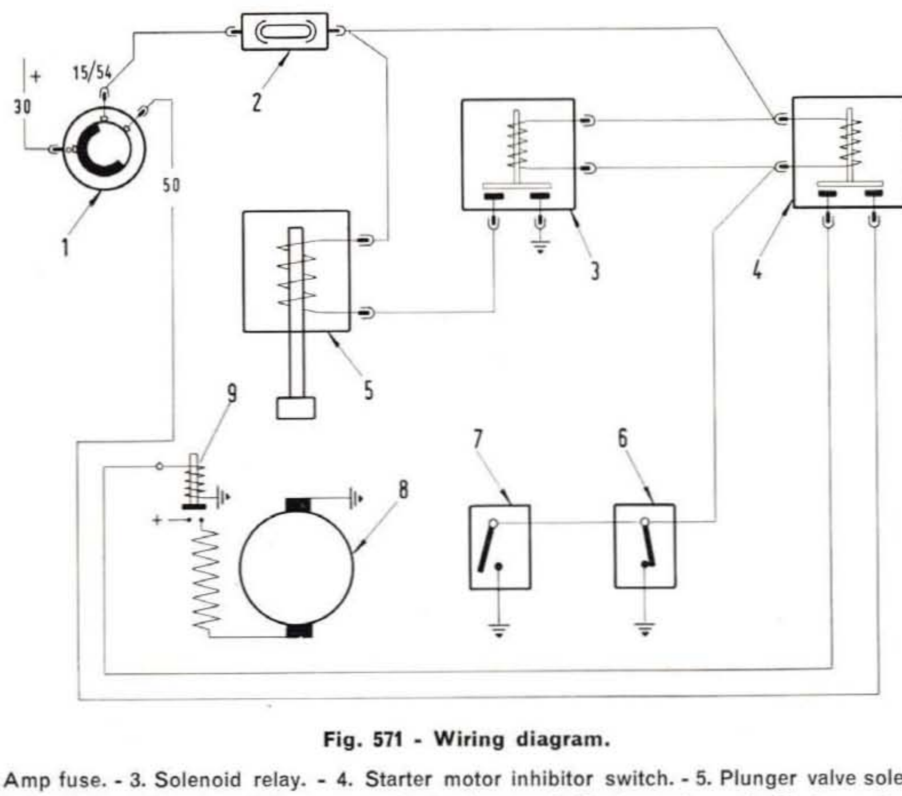


Fig. 571 - Wiring diagram.

1. Selector switch. - 2. 8-Amp fuse. - 3. Solenoid relay. - 4. Starter motor inhibitor switch. - 5. Plunger valve solenoid for clutch control - 6. Neutral switch. - 7. Knob switch on gear selector lever. - 8. Starter motor. - 9. Starter motor relay.

With selector lever in neutral position (or in gear with knob switch closed) and selector switch turned to connect terminals 30 and 15/54, current energises relay (3) and switch (4) and is connected to earth via neutral switch (6) or knob switch (7).

When energised, relay (3) and switch (4) close the circuit.

More specifically, when relay (3) contacts « make » the solenoid circuit is closed. Operation of the solenoid will cause the plunger valve to move and bring about clutch disengagement.

Moreover, when switch (4) contacts « make » current flows to starter relay (9); to achieve this it will be sufficient to connect terminal (30) to terminal (50).

Upon selection of any gear, switch (6) opens and switch (7) closes. In this condition the current flow remains unaltered so long as the driver clasps the selector lever knob.

As soon as the driver withdraws his hand from the selector lever, switch (7) will open; the current is cut-off and both relay and switch, as well as the solenoid, are de-energised. As it moves back, the solenoid operates the plunger valve and brings about clutch engagement.

# DRIVING THE CAR

Starting is only possible if the engine is disconnected from the transmission. To achieve this move selector lever to neutral position.

**N. B. - To start the engine with the transmission in gear slightly depress the knob switch on selector lever.**

## Traditional Driving.

The driver acts as with a conventional transmission - take-off in 1st or 2nd gear and subsequent up-shifting according to road profile and conditions. During traditional driving the Idroconvert transmission enables the driver to obtain the same performance as with a conventional gearbox.

The one difference is that gear changing only requires the movement of the gear selector lever.

**Never allow the hand to rest on the selector lever knob while driving.**

## Automatic Driving.

During automatic driving it is possible to obtain the most suitable gear ratio at all times without having to intervene manually.

If the driver decides to accelerate, the increase in engine r.p.m. will bring about a speed differential between impeller and turbine; consequently, the resulting torque increase is proportional to the speed differential between turbine and impeller. The transmission ratio will, therefore, be automatically determined by the speed differential between the two rotating members.

When the vehicle slows down owing to road gradient, etc., the resulting deceleration brings about a speed differential, and the degree of torque multiplication will be directly proportional to the reduction of vehicle speed, i.e. turbine speed.

The greater the speed differential between impeller and turbine the greater will be torque multiplication.

However, torque multiplication does not increase above a certain limit; the torque converter is designed to give a 2 to 1 limit above which it will be necessary to use a gearbox.

The Idroconvert transmission is therefore coupled to a conventional 4-speed gearbox which should be used according to the instructions given below. Upon selection of the most suitable gear demanded

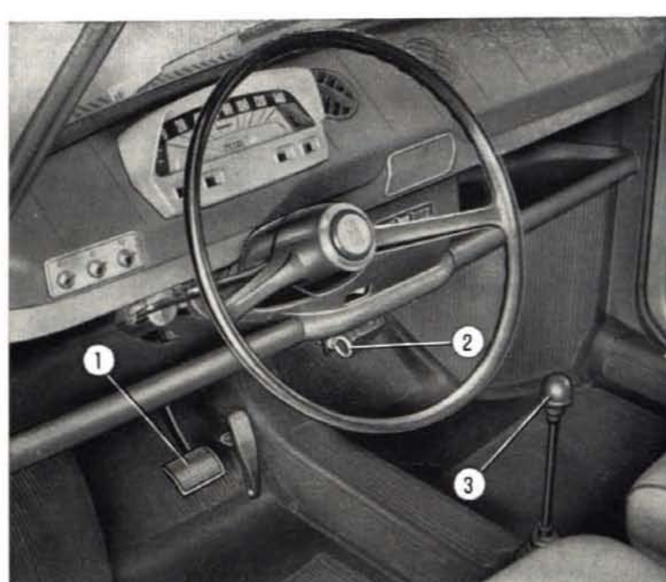


**Fig. 572 - Car controls.**

1. Brake pedal. - 2. Accelerator hand control. - 3. Gear selector lever with integral knob switch.

by road conditions, the vehicle takes over control and no further action on gearshift lever is needed until the car has reached the maximum speed obtainable with the chosen gear, unless road or traffic conditions become such as to require a different gear ratio to obtain faster pick-up.

– 4th gear (top): the vehicle may be started in 4th gear to reach maximum speed gradually. This gear is ideally suited to level road and highway driving but may also be used for climbing.

– 3rd gear: 3rd is particularly useful in urban traffic when signal lights, crossroads and heavy traffic call for frequent stop-and-go driving. With respect to 4th gear it offers brisker pick-up.

3rd speed may be used also for hard climbing.

– 2nd gear: giving a lively acceleration and maximum pick-up at all times. It is suitable for very hard climbing.

– 1st gear: to be used as an emergency measure only or when climbing on exceptionally steep hills.

## To Stop the Car.

To stop the vehicle momentarily it is sufficient to release the accelerator pedal completely and depress the brake pedal without acting on the gearshift lever. However, if the car is to remain stationary for a long period of time, it is advisable to move the gearshift lever to the neutral position.

## Emergency Starting.

Should the starter motor fail to operate, owing to a discharged battery or any other reason, the vehicle may be push-started as the action of the torque converter is excluded by the uni-directional clutch. The gear to be inserted with a stationary vehicle depends on road conditions as well as on the power available to ensure sufficient vehicle movement.

To start a vehicle parked up-hill with stationary engine and gear inserted, it will be necessary to close the starter motor inhibitor switch circuit i.e., move selector lever to neutral position.

As gear disengagement may be difficult owing to the fact that the transmission is under pull, it is preferable to leave the gear engaged and close the starter motor inhibitor circuit by depressing selector lever knob downwards slightly.

## Parking on Gradients.

Pull handbrake fully upwards and **select 1st gear if vehicle is facing downhill, or reverse if uphill.**

## Engine Braking.

Engine braking is the same as on conventional transmissions thanks to the torque converter uni-directional clutch which cuts off the converter when coasting.

# MAINTENANCE

The only servicing operation required is that of checking the oil level in the reservoir at every 6,000 miles (10,000 km) using dip-stick (1, fig. 573).

FIAT GI/M automatic transmission fluid (Type A, Suffix A) is used. Total transmission oil capacity is approx. .88 Imp. gals - 1.06 U.S. gals (4 litres). Oil level must always lie between « Min » and « Max » marks on dipstick.

**Caution** - Oil level should always be checked with a cold and stationary engine.

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**N. B. - As lack of oil seriously lowers the efficiency and shortens the life of the transmission, extreme care should be taken to refit filler plug very accurately to prevent leakage.**

---

## Refilling the Transmission.

Should the transmission have been emptied for any reason, when refilling proceed as follows:

– fill the reservoir up to maximum level;

– move gear selector lever to neutral position and apply the handbrake;

– start the engine allowing it to idle for about 10 minutes topping-up as oil level decreases;

– with engine running at idling speed, select 4th gear and cause the clutch to disengage several times by gripping the lever knob;

– finally, top-up if necessary and repeat the above operation.

**Caution** - The above procedure must be carried out in the given order. The car may only be used after the hydraulic circuit has been correctly filled.

## Adjustment.

Idling speed is the only item requiring adjustment. Adjustment of idling speed must be performed with a warm engine in the normal manner.

To check whether idling speed adjustment is correct apply the handbrake and engage 4th gear; if the engine tends to stall increase the throttle opening slightly by suitably turning the relevant adjusting screw.


**Fig. 573 - Transmission oil filler neck.**
1. Transmission dip-stick.

# CHECKS TO BE PERFORMED ON THE VEHICLE

1) **Checking the Operation of Knob Switch on Selector Lever.**

Clutch disengagement may be felt when, inserting 4th gear (with engine running and brake on) and accelerating slightly, engine speed increases as soon as selector lever knob is touched, i.e., knob switch closes the electrical circuit causing clutch disengagement.

2) **Checking the Starter Inhibitor Circuit.**

With a stationary car in gear it should not be possible to start the engine.

Starting should only be possible with selector lever in neutral position or in gear but with knob switch depressed.

3) **Checking the Operation of Clutch Free-wheel.**

With the car stationary on a level surface and engine switched off, select any forward gear; in this condition the car should be free to move backwards offering no resistance at all when pushed, as if it were in neutral.

On the contrary, when pushed forward, the car should offer more or less resistance according to the gear engaged and behave in exactly the same manner as a car fitted with conventional transmission having both gear and clutch engaged.

If no resistance at all is encountered when the car is pushed forward, this is indicative of faulty freewheel operation.

# FAULT - FINDING CHART

| | |
|---|---|
| Poor pick-up | Assess engine conditions and carry out adjustments as required and tune-up. |
| | Using a revolution counter, check engine stall speed. If below 1,400 r.p.m. or above 2,000 r.p.m. replace the transmission (see page 366). |
| Transmission does not engage | Check selector lever contacts and cables. |
| | Ensure that neutral switch is not permanently connected to earth; to do this remove switch from transmission and check on test bench. |
| | Inspect solenoid operation. |
| | Plunger valve stuck in « disengaged » position. |
| | Faulty solenoid relay. |
| Transmission will not disengage | Check for faulty operation of selector lever contacts and leads. |
| | Check solenoid operation. |
| | Plunger valve stuck in « engaged » position. |
| | Faulty solenoid relay. |
| Starter motor will not operate | Faulty neutral switch (no connection to earth); in this case engine starting may be obtained by depressing selector lever knob. |
| | Faulty starter inhibitor switch, current supply lead loose or broken; engine starting by means of starter motor is impossible. |
| Abnormally low transmission oil level | Oil leakage through transmission cover revealed by the presence of oil on cover periphery and on transmission case fins. |
| | Oil leakage through gear pump seal revealed by the presence of oil on flywheel cover. |
| | Increase in gearbox oil level: oil leakage through seal on torque converter support. |
| Noisy operation | Rocker-like noise present at all times during operation.<br>Hissing noise audible at 2,500 to 3,000 r.p.m. reaching maximum intensity at 4,500 to 5,000 r.p.m., less audible at lower speeds.<br>In both cases the noise is due faulty gear pump. |
| | Rattling and considerable vibration is due to an internal fault of the torque converter. |

# SERVICE PROCEDURES

## To Remove.

The removal procedure for the Idroconvert transmission is the same as that adopted for the conventional clutch-gearbox unit.

Firstly, it will be necessary to remove torque converter and gearbox as a single unit; then torque converter and gearbox may be separated as required. Proceed as follows:

– disconnect negative terminal from battery;

– remove upper rear cross-member, generator and starter motor;

– remove bottom cover from car;

– free lower end of rear shock absorbers and compress them upwards;

– remove flywheel cover and, through the resulting opening, remove the four flywheel-to-torque converter screws rotating the torque converter as required;

– disconnect speedometer cable and sheath, gear shift control rod from its linkage, solenoid connection and neutral switch leads;

– disconnect half shafts from rear wheel hubs;

– support gearbox by means of a suitable jack and remove the two screws holding gearbox cross member to body shell;

– lower jack slightly so that the gearbox slopes down towards the front of the car;

– remove retainer ring holding auxiliary oil reservoir rubber hose in position on converter cover oil inlet connection;

– disconnect rubber hose and drain the oil in a clean vessel;

– close the oil inlet connection by means of a rubber plug;

– remove four screws holding transmission casing to engine;

– disconnect torque converter-gearbox assembly and lower the jack.

To separate Idroconvert transmission from gearbox proceed as follows:

– drain gearbox oil into a clean vessel;

– remove two side rubber boots with their respective half-shafts;

– remove five screws holding Idroconvert transmission to gearbox;

– separate torque converter and clutch assembly from gearbox.

## To Refit.

To refit the transmission carry out the following operations in the order given.

Fit Idroconvert assembly to gearbox in the following manner:

– apply a film of sealing compound on contact faces of both Idroconvert unit and gearbox casings;

– couple torque converter output shaft to gearbox input shaft by means of inter-connecting sleeve;

– tighten five retaining screws on both casings;

– refit both half shafts together with the two side rubber boots;

– fill gearbox with fresh oil up to prescribed level.

Place transmission assembly on a garage jack and offer-up to engine flywheel.

Position torque converter spigot in its recess on the flywheel and three starter motor retaining studs in the three corresponding holes in Idroconvert unit casing.

Then, complete refitting as follows:

– tighten four screws holding transmission casing to engine;

– remove plug from transmission oil inlet, connect rubber hose and reposition retaining collar;

– lift gearbox and fix cross-member to body;

– fix torque converter to engine flywheel;

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**N. B. - The torque converter is a statically and dynamically balanced unit. It may, therefore, be fitted on the flywheel in any position.**

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– refit flywheel cover;

– connect half-shaft to rear wheel hub;

– reconnect revolution counter cable sheath, solenoid lead and neutral switch leads;

– connect gearshift rod to its linkage;

– re-anchor lower end of rear shock absorbers and replace bottom cover in position;

– fit starter motor, generator and rear upper cross member;

– reconnect negative battery terminal;

– fill transmission with fresh oil and check oil level as described on page 354.

## To Dismantle.

The following pages contain a description of the correct sequence of transmission dismantling and reassembling; servicing of individual units and the most important details are dealt with from page 363 to page 367.

For correct dismantling proceed as follows:

– remove plug (8, fig. 586) and pin (1, fig. 575), from guarantee seal seating;

– lift outer casing so as to free it from torque converter (2, fig. 575);

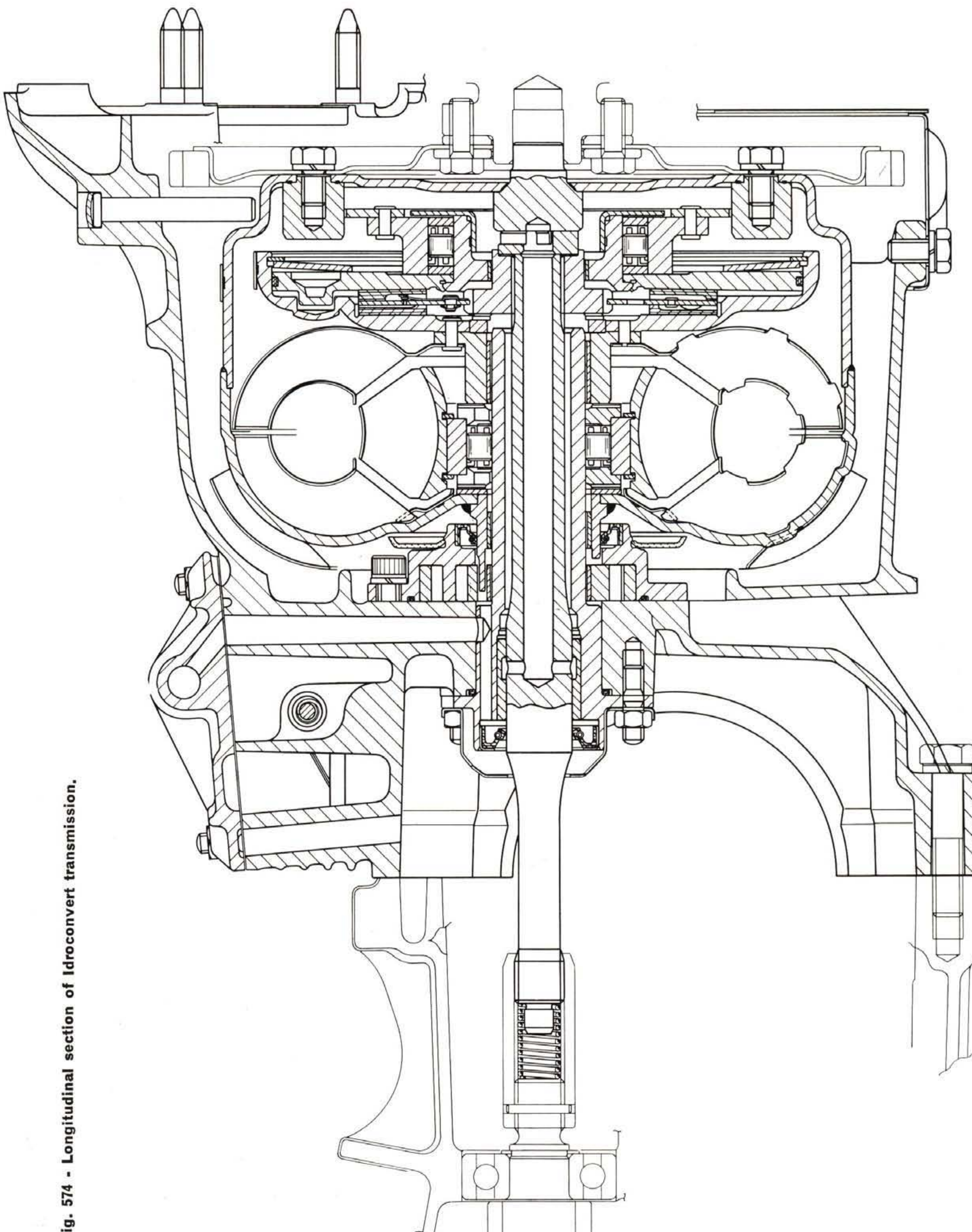

Fig. 574 - Longitudinal section of Idroconvert transmission.


Fig. 575 - Transmission unit viewed from engine side.
1. Guarantee seal. - 2. Torque converter.

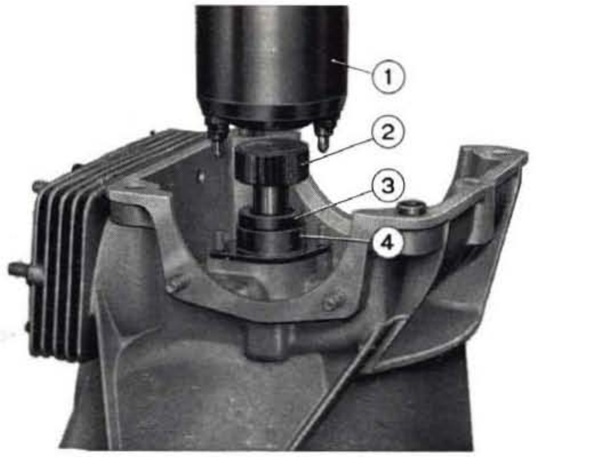


Fig. 577 - Fitting the seal on torque converter support.
1. Press. - 2. Seal centraliser. - 3. Seal. - 4. Torque converter support.

– withdraw torque converter output shaft;

– plug torque converter center opening to prevent the entrance of any foreign matter;

– remove transmission cover, complete with oil pressure regulating valve and return spring (3 and 4, fig. 587);

– withdraw gasket (2, fig. 586) interposed between cover and transmission unit;

– remove strainer (1, fig. 586) with spring;

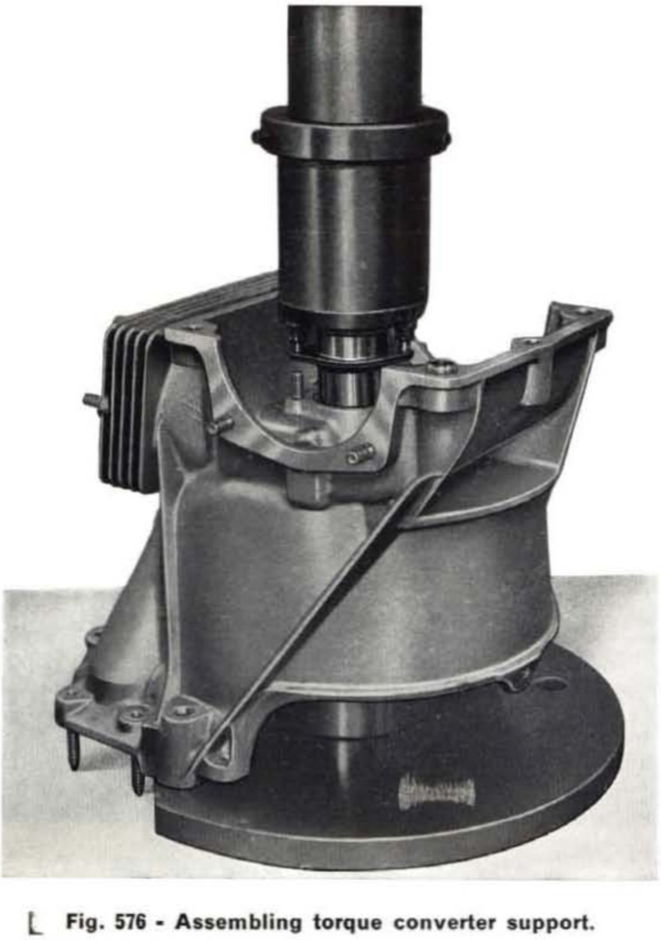

Fig. 576 - Assembling torque converter support.

– remove solenoid (1, fig. 585) and, if necessary, the plug covering pressure point (2);

– slide out plunger valve (2, fig. 583) together with its return spring;

– remove dustcover (2, fig. 582) from the inside of the casing;

– remove gear pump retaining screws and withdraw pump complete;

– remove retainer plate (4, fig. 585) from gearbox side of transmission casing and remove torque converter support (1, fig. 582) using a press.

## To Reassemble.

It should be remembered that the reassembly operation must be carried out in conditions of utmost cleanliness. Wipe carefully each component before reassembly and ensure that the oil passages are not obstructed in any way; moreover, renew all worn or seized gaskets, seals, etc.

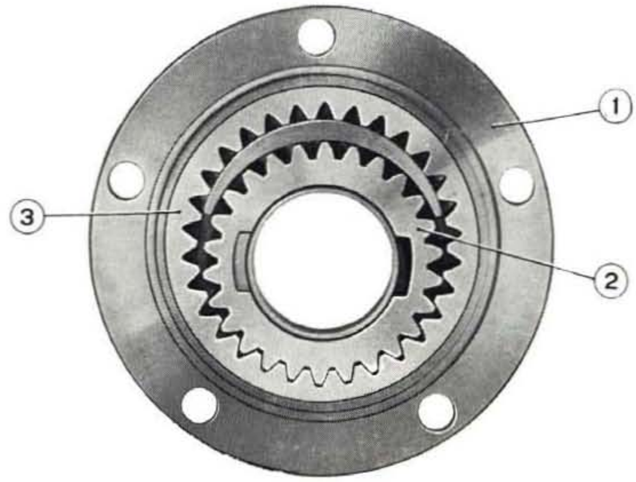


Fig. 578 - Gear type oil pump.
1. Pump body. - 2. Drive gear. - 3. Driven gear.

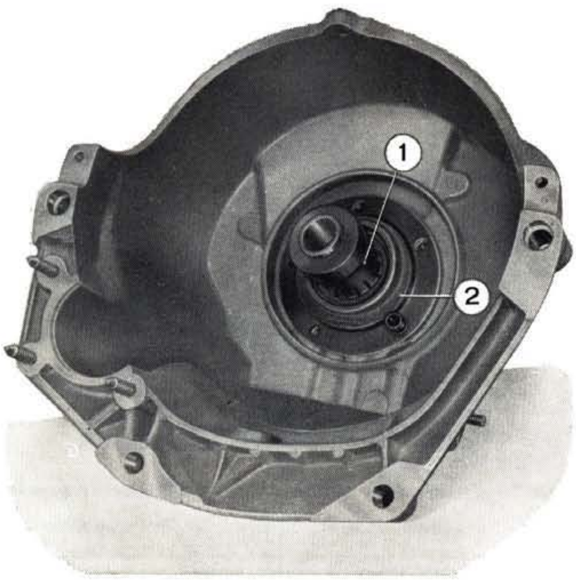


**Fig. 579 - Centralising the oil pump.**

1. Oil pump centraliser tool A. 70145. - 2. Pump body.

Place transmission outer casing as shown in fig. 576 and proceed as follows:

– lubricate ring seal for torque converter support with GI/M oil and slide it onto the support;

– replace torque converter support on transmission casing using a suitable press (fig. 576);

– lubricate seal (3, fig. 577) with engine oil and slide in position on torque converter support;

– fit retainer plate (4, fig. 585), tightening the two nuts to 10.85±1.08 ft.lbs. (1.5±0.15 kgm) folding plate tabs upwards.

Then assemble the gear pump as described below:

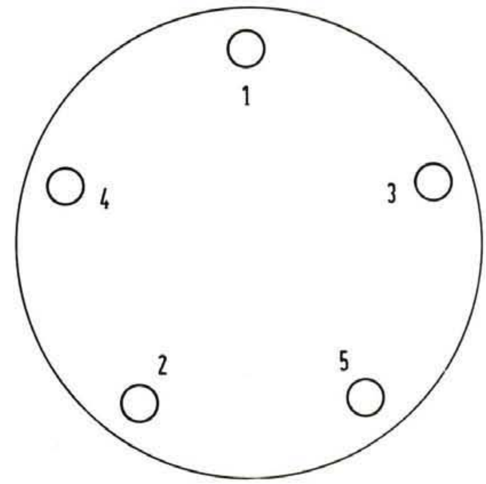


**Fig. 581 - Tightening diagram for pump body retaining screws.**

– place transmission casing with torque converter side facing upwards;

– thoroughly clean pump seating, pump body and the two gears;

– oil the two gears and position them in pump body (fig. 578);

– check gear rotation using special tool **A. 70144**;

– lubricate and fit ring seal on pump body;

– place transmission casing horizontally (cover facing upwards) making sure that the ring seal is not unseated during assembly;

– as soon as the pump is in contact with the casing, return the latter in its original position and drive in two screws, together with new lock washers, without tightening them;

– insert service tool **A. 70105** (fig. 579) to centralise the pump and fit the three remaining screws with new lock-washers;

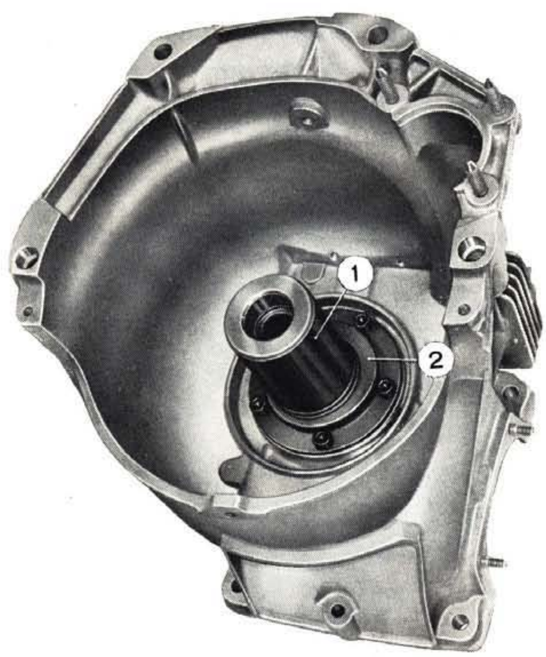


**Fig. 580 - Fitting pump oil seal.**

1. Service tool A. 70142 for pump seal fitting. - 2. Pump body.

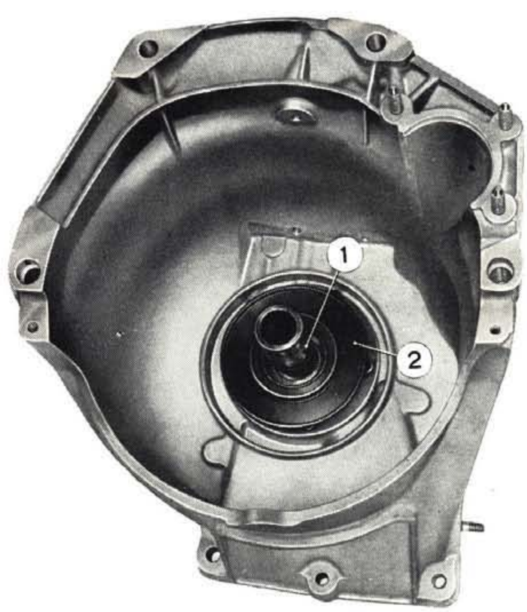


**Fig. 582 - Fitting the dust cover.**

1. Torque converter support. - 2. Dust cover.

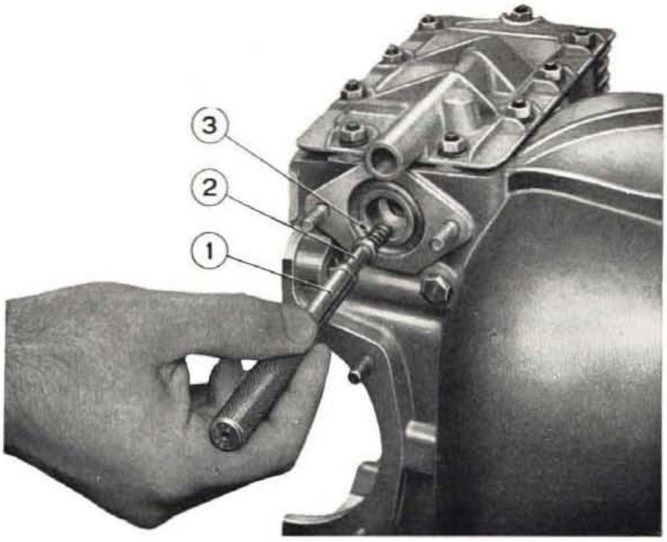


**Fig. 583 - Introducing plunger valve into valve body.**

1. Service tool A. 70146/1 for plunger valve assembly and dismantling. - 2. Plunger valve. - 3. Return spring.

– tighten the five pump body retaining screws to $10.85 \pm 1.08$ ft.lbs. ($1.5 \pm 0.15$ kgm) as shown in diagram of fig. 581, remove service tool **A. 70145** and re-check gear rotation (service tool **A. 70144**);

– lubricate and insert pump seal in its seat on the pump body (fig. 580) using service tool **A. 70142**;

– fit dust cover (2, fig. 582) using service tool **A. 70143.**

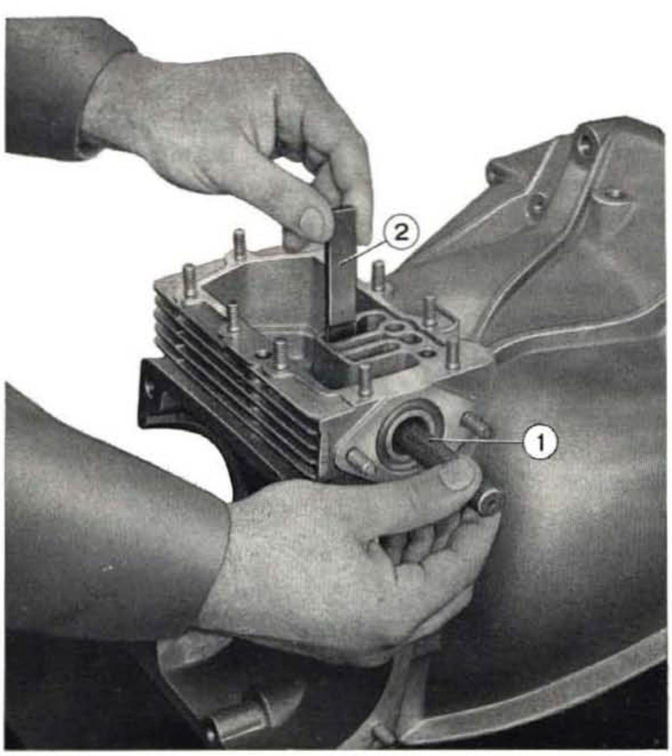


**Fig. 584 - Reassembling plunger valve.**

1. Service tool A. 70146/1. - 2. Spacer A. 70146/2 for plunger valve assembly.

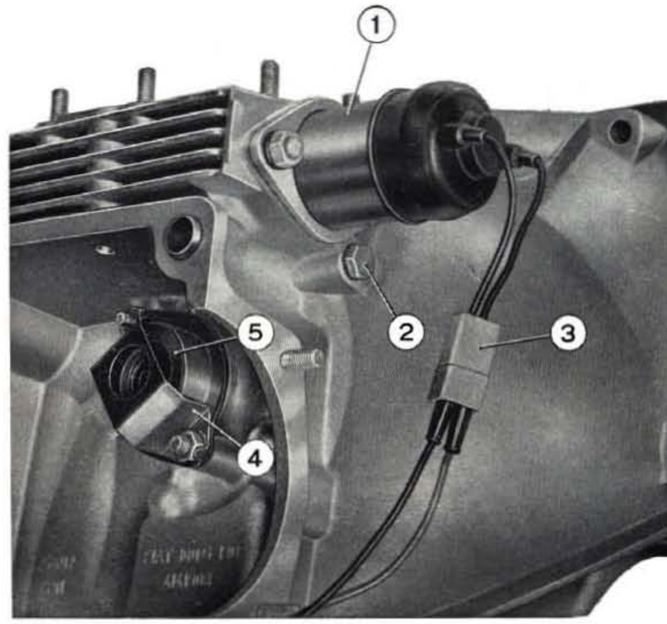


**Fig. 585 - Checking solenoid operation.**

1. Solenoid. - 2. Pressure point plug. - 3. Solenoid lead connector. - 4. Retaining plate for torque converter output shaft. - 5. Torque converter support seal.

Ensure that the oil ways in the casing upper section are free from foreign matter by blowing with a compressed air line.

Moreover, make sure that casing top surface which is to receive the plunger valve cover, is not scratched or scored. Then:

– hook return spring to plunger valve;

– introduce valve assembly, complete with spring, in valve recess using service tool **A. 70146/1**


**Fig. 586 - Main oil reservoir viewed from the top.**

1. Oil strainer with spring. - 2. Gasket. - 3. Oil feed to pump. - 4. Oil bleeder. - 5. Oil return to reservoir. - 6. Plunger valve. - 7. Solenoid. - 8. Guarantee seal seat.


**Fig. 587 - Underside view of valve cover.**
1. Cover. - 2. Plate for pressure regulating valve. - 3. Oil pressure regulating valve. - 4. Return spring.

(fig. 583); slightly press the plunger to position return spring correctly and hold in position by means of service tool **A. 70146/2** (fig. 584), bearing in mind that the return spring must be introduced ahead of the plunger valve;

– lubricate solenoid sealing ring with oil and place in position on the solenoid;

– place solenoid in its seat taking care not to displace the sealing ring and tighten the two solenoid retaining nuts to 15.9 ±1.08 ft.lbs. (2.1 ±0.15 kgm);

– remove service tool **A. 70146/2** and check operation of solenoid-valve assembly and wiring connector (3) to the terminals of a 12 V battery (fig. 585);

– close oil pressure point by refitting plug (2, fig. 585) together with sealing washer.

Make sure that the contact face on plunger valve cover (1, fig. 587) is perfectly clean and free from scratches. Check the gasket for wear or damage and steel backing plate for distortion; if any damage is found, replace cover.

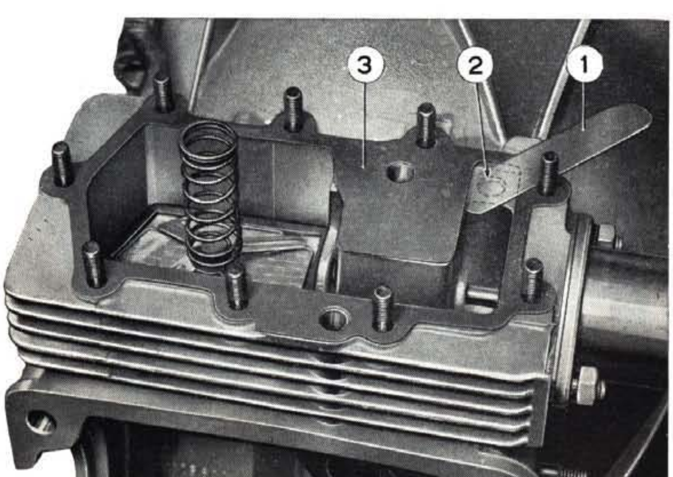


**Fig. 588 - Assembling the valve cover.**
1. Feeler gauge. - 2. Oil return to reservoir and seat for pressure regulating valve. - 3. Gasket.

Next:

– position return spring (4, fig. 587) onto oil pressure regulating valve (3) in the recess;

– lubricate gasket (2, fig. 586) with oil and place it with care on the cover making sure that it is not bent or torn;

– clean strainer (1, fig. 586), checking for damage of the gauze and seal, and replace in its proper position;

– insert .020″ (0.5 mm) feeler gauge (1, fig.588) under gasket (3) to cover recess (2) to prevent the pressure regulating valve from damaging the gasket during assembly of cover;

– fit the cover making sure that the valve does act on the feeler gauge also ensuring that the spring on the strainer is properly fitted on the recess of the cover;

– hold the cover with one hand and screw-in the retaining nuts with the other using new lock-washers. Do not tighten retaining nuts to avoid damaging the gasket upon withdrawal of feeler gauge;

– withdraw feeler gauge;

– tighten the nine retaining nuts to 13 ±1.08 ft.lbs. (1.8 ±0.15 kgm) according to tightening reference shown in fig. 589;

– close cover oil inlet by means of plug (4, fig. 592).

Finally, to complete transmission reassembly, proceed as follows:

– remove plug from central opening of torque converter (which was inserted during dismantling);

– insert output shaft (2, fig. 590) into the torque converter and ensure that the clutch freewheel is working properly - while holding the shaft stationary, the torque converter must be able to rotate in the same direction as that of the engine and lock in the opposite direction;

– place service tool **A. 70147** (1, fig. 590) on spring (1, fig. 592) so that the latter does not damage the converter support seal and the pump seal during the subsequent operation;

– lift the casing above the torque converter unit; then, lower and turn slightly in an anti-clockwise direction (fig. 591);

– check correctness of assembly by rotating torque converter a few turns;

– insert pin (5, fig. 592);

– remove service tool **A. 70147**;

– place casing flat and refit plug to guarantee seal pin.

The Idroconvert transmission is thus ready to be attached to the gearbox and then fitted to the vehicle; when in position, proceed to fill the unit with oil as described on page 355.

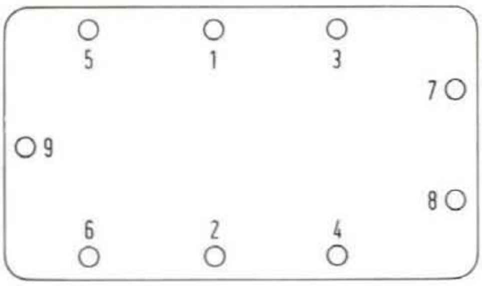


Fig. 589 - Tightening reference for cover retaining nuts.

# SERVICING OF MAIN UNITS

## Solenoid and Plunger Valve.

The following operations may be carried out without removing the Idroconvert transmission from the car:

– carefully clean the solenoid outer surfaces and the surrounding area;

– remove solenoid and ensure that it is working properly by wiring connector (3, fig. 585) to the terminal of a 12 V battery; check that the plunger moves freely and that the plunger stroke is .0295" (7.5 mm);

– remove plunger valve using service tool **A. 70146/1** (1, fig. 583); the return spring must come off with the valve;

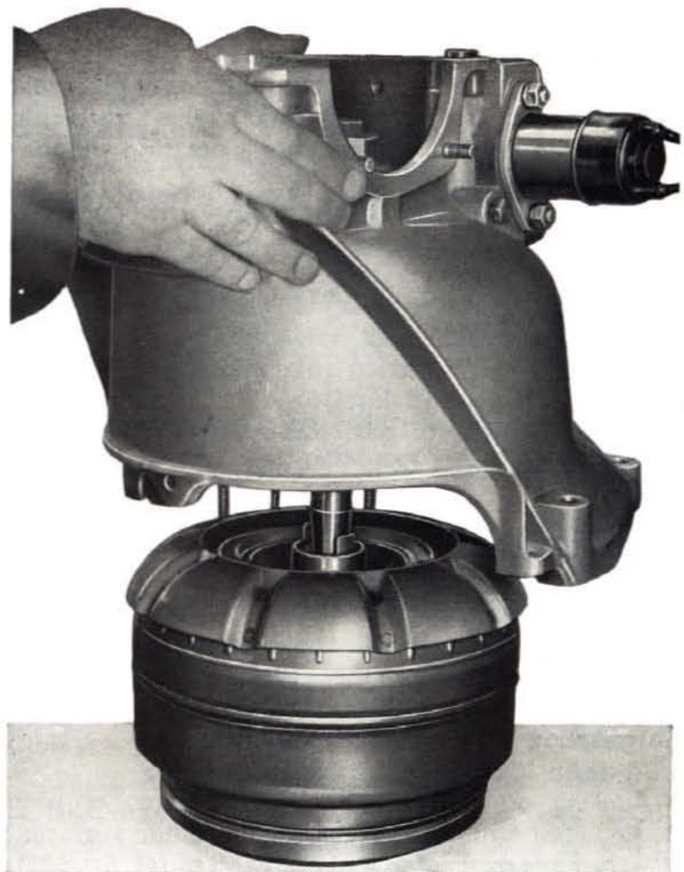

Fig. 591 - Fitting Idroconvert transmission casing onto torque converter.


Fig. 590 - Torque converter assembly.

1. Service tool A. 70147 for protection of seals. - 2. Torque converter output shaft. - 3. Torque converter.

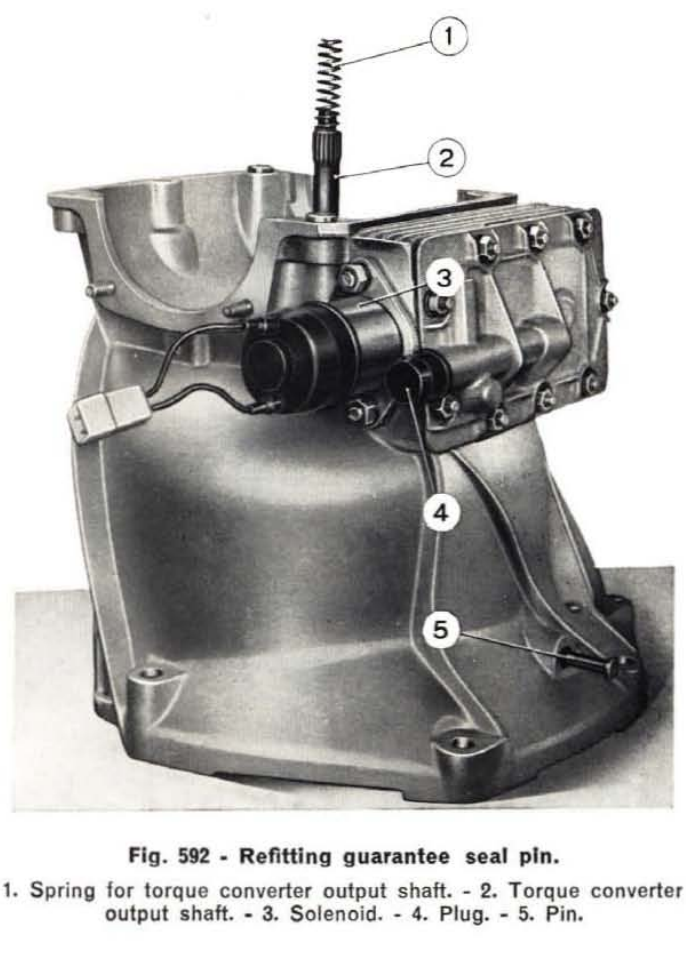


Fig. 592 - Refitting guarantee seal pin.

1. Spring for torque converter output shaft. - 2. Torque converter output shaft. - 3. Solenoid. - 4. Plug. - 5. Pin.

– check for seized valve sealing surfaces and, if necessary, renew valve plunger;

– operate starter motor several times to eliminate any air locks from the plunger valve: **to avoid starting the engine during this operation disconnect ignition coil;**

– ensure that the return spring is correctly positioned in the plunger valve unit and refit valve plunger using service tool **A. 70146/1**;

– ensure that the solenoid sealing ring is in good condition and refit solenoid;

– tighten two solenoid retaining nuts to 15.19 ± 1.08 ft.lbs (2.1 ± 0.15 kgm);

– check oil level and top-up if necessary, as described on page 354.

## Oil Pump.

### TO RENEW OIL PUMP SEAL

This operation may be carried out without removing the pump; remove the gearbox complete from the vehicle, remove Idroconvert transmission from the gearbox and proceed as follows:

– drain Idroconvert transmission oil;

– close oil inlet on cover by means of plug (4, fig. 592) and clean transmission outer surfaces;

– remove guarantee seal plug and pin (1, fig. 592);

– place Idroconvert transmission on the bench with output shaft turned upwards;

– lift casing upwards to separate it from the torque converter;

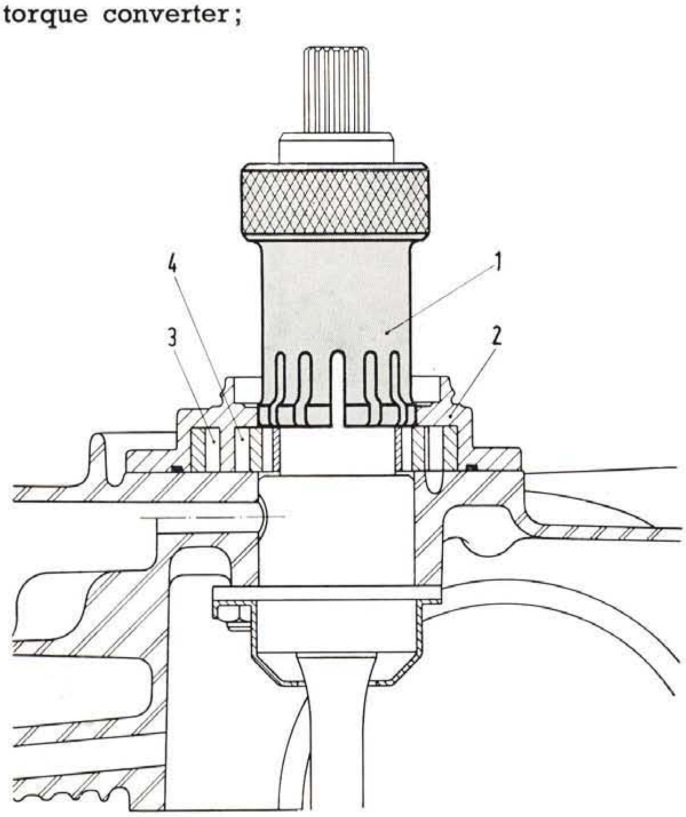


**Fig. 593 - Centralising the oil pump.**

1. Service tool A. 70145 for pump body centralisation. - 2. Pump body. - 3. Driven gear. - 4. Drive gear.

– check conditions of torque converter hub at the point of contact with pump seal - the hub should be clean and free from wear, scoring and burrs; should any of the above defects be found the converter must be renewed;

– rotate outer casing to uncover the pump body (torque converter end facing upwards);

– remove dust cover (2, fig. 582);

– remove seal using service tool **A. 45023**;

– lubricate a replacement seal with GI/M oil exercising the utmost care to avoid damaging the sealing lips;

– offer the seal onto its seat in pump body and centralise very carefully (making sure that it is fitted correctly);

– drive seal in position using service tool **A. 70142** (1, fig. 580) - when fully home the seal **must be flush with the pump body;**

– fit dust cover (2, fig. 582) using service tool **A. 70143**. Refit torque converter - see page 365.

### TO CENTRALISE THE OIL PUMP

This servicing operation is necessary when noisy pump operation is detected.

Repeat the same sequence as that described in previous chapter up to removal of seal by means of service tool **A. 45023**. Then:

– slacken five pump retaining screws;

– insert pump centraliser tool **A. 70145** very gently (fig. 593);

– tighten five pump retaining screws to 10.85 ± 1.08 ft.lbs. (1.5 ± 0.15 kgm), as indicated in tightening reference shown in fig. 581;

– withdraw service tool **A. 70145**;

– insert service tool **A. 70144** (fig. 594) and check for noisy gear operation and roughness during running;

– fit a new seal and complete refitting procedure as described above.

Should roughness be experienced during running, repeat centralising operation; if the defect cannot be remedied, renew the pump following the procedure described below.

### TO RENEW OIL PUMP

Carry out the same procedure as described under « To Renew Oil Pump Seal » up to removal of dust cover. Then:

– remove five pump retaining screws and withdraw pump complete;

– obtain a new pump (pump body plus gears), lubricate gears with GI/M oil and assemble the pump;

– check gear rotation using service tool **A. 70144** (fig. 594);

– lubricate and fix sealing ring on pump body;

– place the casing horizontally (with cover facing upwards) to prevent the sealing ring from becoming displaced during assembly;

– as soon as the pump is in contact with the casing, return the latter in its original position and drive in two screws, together with new lock-washers, without tightening them;

– insert service tool **A. 70145** (fig. 579) to centralise the pump and fit the three remaining screws with new lock washers;

– tighten the five pump body retaining screws to 10.85 ± 1.08 ft.lbs (1.5 ± 0.15 kgm) as shown in diagram of fig. 581, remove service tool **A. 70145** and re-check gear rotation (service tool **A. 70144**).

If the pump is perfectly centralised, fit new seal (see page 364). Then complete assembly operation as described below.

## To Refit Torque Converter Unit to Idroconvert Transmission Casing.

Proceed as follows:

– fit service tool **A. 70147** (1, fig. 590);

– lift the casing above the torque converter unit; then, lower and turn slightly in an anti-clockwise direction (fig. 591); this operation must be performed without excessive effort on the part of the fitter; if any resistance is encountered, slightly lift the casing and repeat the operation so that the two converter drive teeth may correctly engage the pump drive gear;

– check correctenss of assembly by rotating torque converter a few times;

– insert pin (5, fig. 592);

– remove service tool **A. 70147** (1, fig. 590);

– place casing flat and refit plug to guarantee seal.

The Idroconvert transmission is thus ready to be fitted to the gearbox on the vehicle; the considerable amount of play between torque converter and casing is quite normal. When the transmission has been fitted to the vehicle, fill with new oil as described on page 354.

## To Remove and Refit Valve Cover.

Removal of valve cover entails the removal of the transmission from the vehicle; therefore, remove gearbox from the vehicle and separate Idroconvert transmission from the latter.

Thoroughly clean Idroconvert transmission casing and cooling fins, then:

– plug oil inlet on cover;

– place casing flat with cover facing upwards;

– remove cover and gasket;

– withdraw the strainer: make sure that its gasket is in good condition and check for gauze damage - replace if necessary;

– drain oil reservoir;

– make sure that mating surfaces on cover and casing are in perfect condition; renew cover if distorted or in any way defective;

– check for damaged pressure regulating valve seal and distorted support steel plate. Renew cover if necessary;

– position return spring (4, fig. 587) onto oil pressure regulating valve (3);

– lubricate gasket (2, fig. 586) with oil and place it with care on the cover making sure that it is not bent or torn;

– clean strainer (1, fig. 586), checking for damage of the gauze and seal, and replace in its proper position;

– insert .020″ (0.5 mm) feeler gauge (1, fig. 588) under gasket (3) to cover recess (2) to prevent the pressure regulating valve from damaging the gasket during assembly of cover;

– fit the cover making sure that the valve does act on the feeler gauge, also ensuring that the spring on the filter is properly fitted on the recess of the cover;

– hold the cover with one hand and screw in the retaining nuts with the other using new lock-washers. Do not tighten retaining nuts to avoid damaging the gasket upon withdrawal of feeler gauge;

– tighten the nine retaining nuts to 13 ± 1.08 ft.lbs. (1.8 ± 0.15 kgm) according to tightening reference shown in fig. 589;

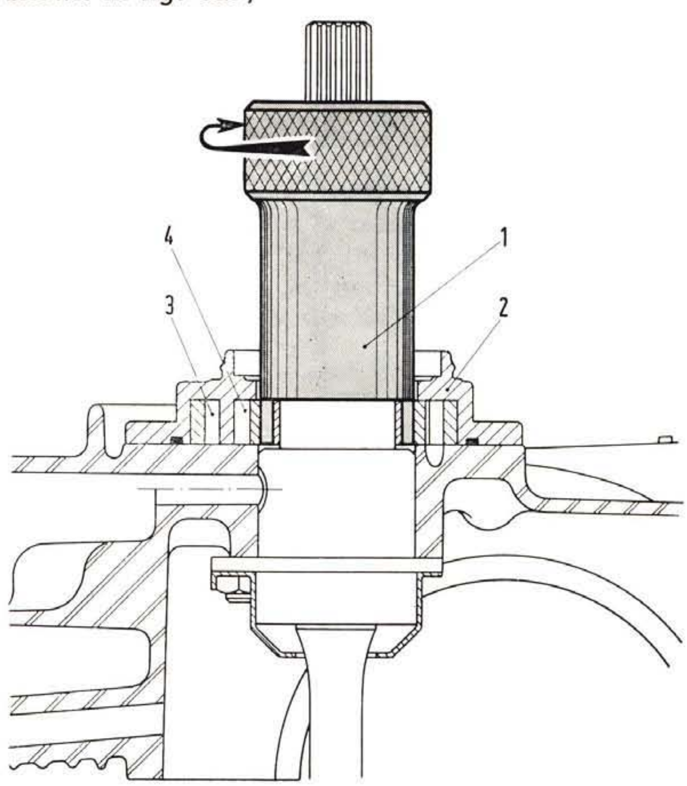


**Fig. 594 - Checking pump gear rotation.**

1. Service tool A. 70144 for gear rotation check. - 2. Pump body. - 3. Driven gear. - 4. Drive gear.

– wipe off any oil from the casing cooling fins;

– reset the transmission on the vehicle and fill with oil as described on page 354.

## Torque Converter Support.

### TO RENEW OIL SEAL

Remove gearbox from vehicle and separate Idroconvert transmission from gearbox.

Close oil inlet on cover by means of plug (4, fig. 592) and place the Idroconvert transmission on the bench with the converter output shaft facing upwards.

Then, proceed as follows:

– remove retainer plate (4, fig. 585);

– withdraw output shaft;

– remove oil seal (2, fig. 595) using a screwdriver. Take care not to score the support;

– refit output shaft, complete with spring;

– lubricate a new seal with oil. Insert oil seal in position on torque converter support using service tool **A. 70141** (1, fig. 595);

– refit retainer plate tightening the two nuts to 10.85 ± 1.08 ft.lbs. (1.5 ± 0.15 kgm);

– bend both ends of retainer plate onto the nuts;

– fit Idroconvert transmission to gearbox and replace the unit in position on the car;

– check oil level and top-up, if necessary, as described on page 354.

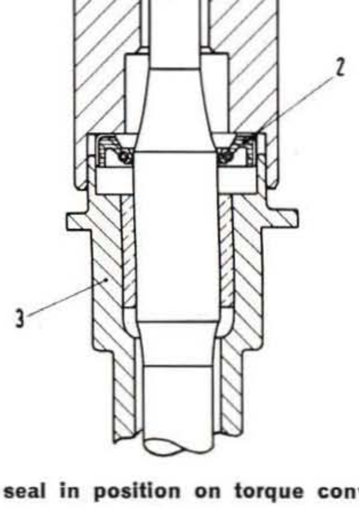


**Fig. 595 - Oil seal in position on torque converter support.**

1. Service tool A. 70141. - 2. Oil seal. - 3. Torque converter support. - 4. Torque converter output shaft. - 5. Spring.

### TO RENEW SUPPORT

To renew torque converter support separate transmission casing from torque converter, remove oil pump, retainer plate (4, fig. 585) and support using a press.

For dismantling, reassembly and adjustments see page 357 to page 362.

## Torque Converter.

The torque converter cannot be interfered with as it consists of an enclosed welded unit.

If the engine runs efficiently but performance is poor, the transmission overheats and pick-up is inadequate at take-off - transmission oil level being normal - perform stall test as described below:

– couple a revolution counter to the engine so that readings may be taken from the driver's seat;

– bring engine and transmission temperature up to normal operating temperature;

– apply hand brake, anchor the front wheels with chocks and depress brake pedal;

– insert top gear and depress accelerator pedal fully;

– take an r.p.m. reading.

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**NOTE - To prevent overheating of the transmission, the stall test must not exceed 10 seconds.**

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If stall speed is found to be lower than 1400 r.p.m. or higher than 2000 r.p.m. renew the torque converter.

## Gear Selector Lever.

Prior to interfering with the lever, check for loose connections, broken leads and wrong connections.

Connect a test bulb in series between one lead of the gearshift lever and the positive terminal of a battery. Connect the other gearshift lever lead to the negative battery terminal. Then, observe the test bulb which should remain on when gearshift lever knob is gripped and go off upon releasing the lever.

Carry out the above test in all positions of the gearshift lever.

If the bulb stays on at all times, it means that the lead is earthed to some metal part or that the lever knob is stuck in the closed position; should the lamp not light at all, the fault could be due to a defective contact within the lever knob.

In both cases repair or renew selector lever.

## Neutral Switch.

Check firstly with neutral switch fitted in position and then with switch removed from the gearbox.

### NEUTRAL SWITCH ON GEARBOX

Connect a test bulb in series between one neutral switch lead and the positive terminal of a battery; connect the other neutral switch lead to the negative battery terminal. The test bulb should stay on when selector lever is in neutral position and until gearshift control rod has moved about 1/4" (6 mm) towards the engagement position of any gear, and go off in any other position of selector lever.

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**N. B. - During this test the selector lever knob must not be interfered with.**

---

### NEUTRAL SWITCH REMOVED FROM GEARBOX

Establish the same connections as those described above. Then, check that the test bulb stays on when the plunger is free and off when the plunger is depressed.

If the neutral switch operates properly when tested away from the car but is faulty when fitted on the gearbox, check for worn plunger and gearshift control rod. Renew any worn parts.

## Relays.

Before interfering with the relays, check for loose or wrong connections and broken leads.

### SOLENOID CONTROL RELAY

The faulty operation of this relay causes the solenoid plunger valve assembly to be stuck in one position. Consequently, the transmission remains constantly engaged or disengaged according to the position of the valve plunger. However, this defect may also be due to plunger valve sticking or faulty solenoid operation, as well as to defective neutral switch or knob switch on selector lever. Carry out a check by elimination, inspecting each component separately.

### STARTER INHIBITOR SWITCH

If the engine cannot be started by means of the starter motor either with gear selector lever in neutral, or when selector lever knob is gripped - it is possible that the starter inhibitor switch is faulty.

Renew any relay or inhibitor switch found to be defective.

# PRESSURE CHECKS

Should the Idroconvert transmission still be defective in operation after overhauling has been completed, carry out the pressure checks described below.

Couple a revolution counter to the engine and a pressure gauge to the oil pressure point situated below the solenoid [in fig. 585 the pressure point is closed by plug (2)].

Run the engine and transmission until the normal operating temperature is reached. Then, perform the three checks listed in the table below with **gear selector lever in neutral position.** Finally, compare the readings with the values given in the table.

| Check No. | Engine r.p.m. | Oil Pressures | | | |
|---|---|---|---|---|---|
| | | Min. | | Max. | |
| | | p.s.i. | kg/cm$^2$ | p.s.i. | kg/cm$^2$ |
| 1 | 750 | 39.8 | 2.8 | 59.7 | 4.2 |
| 2 | 2000 | 49.8 | 3.5 | 76.8 | 5.4 |
| 3 | 5000 | 64 | 4.5 | 83.9 | 5.9 |

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