Flavia

Iniezione

LANCIA & C. - Fabbrica Automobili - TORINO - S.p.A.

LANCIA & C. Fabbrica Automobili Torino - S.p.A. Printed in Italy	INSTRUCTIONS FOR THE CARRYING OUT OF THE FIRST SERVICE COUPON AT 3000 to 3500 KM (1900 to 2200 MILES) AND OF THE SECOND SERVICE COUPON AT 6500 to 7000 KM (4000 to 4350 MILES) FOR THE FLAVIA WITH INJECTION ENGINE AND DERIVED MODELS	1st Coupon	2nd Coupon

1. Road test of acceptance. In addition to the normal test, check the following instruments for operation: fuel gauge, oil pressure gauge, oil low pressure warning light, fuel feed low pressure warning light (orange), water temperature gauge, ammeter, speedometer - mile recorder, revolution counter, electric clock (Coupé only), hand brake warning light, alternator warning light (which, with engine running, even at idling speed, must be off); moreover, make sure that the air conditioning system is efficient . . . .

2. Check for possible leaks. With engine running, check for possible leaks:
   - Oil: from mechanical units, from engine-to-oil cooler pipes, from oil filter, from oil pressure gauge sending unit on the filter (Coupé only), from oil pressure gauge pipe and from engine-to-injection pump oil line;
   - coolant: from radiator, from water pump and cooling system hoses;
   - petrol: from reservoir, from pump, from main filter, from fuel system pipes and connections.

   In addition, check (with engine at rest) for possible leaks:
   - brake fluid: from reservoir, from master cylinder, from servo unit, from brake system pipes and connections;
   - windscreen washing fluid: from reservoir and from windscreen washer system pipes.

3. Drain the oil from engine. Arrange a suitable container and unscrew the oil drain plug. . . . .

4. Drain the oil from gearbox-propelling unit. Arrange a suitable container and unscrew the oil drain plug . . . . NO ....

AIR CLEANER - IGNITION DISTRIBUTOR - SPARK PLUGS

5. Removal of air cleaner, ignition distributor and spark plugs. Open the bonnet, arrange protections, lift off air cleaner, remove ignition distributor and spark plugs . . . .

6. Cleaning of air cleaner filtering element. Wash with petrol and carefully dry filtering element with compressed air . . . . . NO ....

7. Cleaning, adjustment and test on bench of ignition distributor. Clean the outside of distributor body, remove the cap and clean the contact breaker assy. with petrol, remove the contact assy.; if necessary, flatten the breaker points. Reassemble; set contact breaker points gap to 0.45 ± 0.03 mm (0.0177 ± 0.0011 in.) and check for operation on test bench (as instructed in Sketch AST 655 I) . . . .

8. Testing of spark plugs on bench. As instructed in sketch AST 1091 I . . . .

OIL FILTER

9. Disassembly of oil filter body. Remove the oil filter cover, withdraw the element, drain the oil from filter body (by means of a syringe), unscrew the centre stud and remove the filter body, then, according to the case, operate as instructed under "a" or "b" . . . . . .

   a) Wash the oil filter body with petrol and dry with compressed air; blow the filtering element with compressed air. Refit, making sure that the cover gasket is in good conditions . . . . NO .....

   b) Wash the oil filter body with petrol and dry with compressed air; replace the element. Refit . NO ....

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INJECTION PUMP AND INJECTORS

10. Injection pump . Clean the pump fuel inlet filter . . . . . .

11. Injectors . Remove the injectors and, on the bench, disassemble them as instructed on page 22 of the Flavia with Injection Engine Repair Shop Manual; blow the injector bodies, the connections and the filter seats with compressed air. Reassemble and check as instructed in Sketch AST 1086 I . . . . . NO

12. Check of pump/butterfly valve synchronization . Check the synchronization between butterfly lever and injection pump control lever (as instructed on page 35 of the Flavia with Injection Engine Repair Shop Manual) . . . . . NO

13. Tightening of fuel line connections and banjo bolts . Tighten: the banjo bolt of the electro-valve fuel pipe connection, the injector fuel delivery pipe connections and the banjo bolt on the injection pump . . . . . NO

MAIN FUEL FILTER

14. Clean the main fuel filter . Remove the bowl, withdraw the filtering element and blow with low pressure compressed air. Reassemble . . . . . NO

15. Refit ignition distributor (without cap) and carry out the ignition timing. Check fan belt for tension and radiator shutter for operation. . . . . .

LUBRICANTS (Engine-Propelling Unit)

16. Engine. Refit the engine oil drain plug and replenish with fresh oil (MOBILOIL SPECIAL - ESSO EXTRA MOTOR OIL 10 W - 30 alternatively, according to which is available) . . . .

17. Gearbox-propelling unit . Refit the gearbox-propelling unit oil drain plug and replenish with fresh oil (MOBILUBE GX 90 - ESSO GEAR OIL GX 90 alternatively, according to which is available) . . . . . NO

CYLINDER HEADS

18. Check of cylinder heads for tightness. Remove the front wheels, the front mudguard skirts (5+5 bolts) and the cylinder head covers. Check cylinder heads for tightness (11 + 11 bolts) by using a torque spanner set to 6 mkg. (43 lb.ft.) . . . . . NO

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19 . Valve clearance adjustment . Remove the front wheels, the front mudguard skirts (5 + 5 bolts); set the valve clearance to 0.15 mm (0.006 ") for inlet valves and to 0.25 mm (0.010 ") for exhaust valves, with engine cold and in the compression stroke. The crankshaft rotation may be obtained by engaging a gear and then turning the wheel hub flange on the adjustment side, while locking the opposite flange . . . .

AUTOMATIC ENRICHING DEVICE

20 . Check of engine starting and of automatic enriching device operation. Refit the cap to the ignition distributor, refit spark plugs, start the engine and check the operation of the automatic enriching device, making sure that at a temperature of 60° C (140° F) the enriching device is off (see instructions given on page 40 of the Flavia with Injection Engine Repair Shop Manual) . . . .

ENGINE SLOW RUNNING

21 . Adjustment of engine slow running . With warm engine, act on the adjusting screw, screwing it out to increase the engine speed and in to decrease it (slow running speed: 800 to 900 r.p.m.) . . . .

COMPRESSIONS

22 . Check of compressions (to be carried out with warm engine) . Remove spark plugs and check compressions as instructed on page 01/5 of the Flavia Repair Shop Manual. Refit spark plugs . . . . . NO ....

ELECTROVALVE - THERMOCONTACT

23 . Check operation of engine starting electrovalve and thermocontact. Check both for operation and the electrovalve for sealing, as instructed on page 19 of the Flavia with Injection Engine Repair Shop Manual . . . . . NO ....

STEERING BOX

24 . Adjustment of backlash between steering box worm and roller. Adjust the backlash between worm and roller, as instructed on page 06/2 of the Flavia Repair Shop Manual . . . . . NO ....

25 . Check of brake circuit (in the engine compartment). Check sealing of pipes, master cylinder, connections on master and slave cylinders; check locking of master cylinder; check attachments and pipes of vacuum system . . . .

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26. Check lockings (in the engine compartment) of: subframe, front suspension leaf spring and intake manifold. Check tightness of: (2) bolts for subframe, (4) bolts for front suspension leaf spring centre mounting, (8) bolts securing intake manifolds to cylinder heads. . . . .

27. Refit air cleaner . . . .

CLUTCH PEDAL - HAND BRAKE LEVER

28. Check clutch pedal for free travel and hand brake for operation . The clutch pedal free travel must be 20 to 25 mm (0.78 to 0.98"); the adjustment is carried out by acting on the end of the control cable. Check the hand brake lever travel: it is correct when the car is braked after 3-4 teeth of the ratchet from the rest position (both for sedan and derived models) . . . .

STEERING COLUMN

29. Check fixing of steering column onto dashboard: check tightness of steering column-to- dashboard lower fixing bolts (6) . . . .

SUBFRAME

30. Check of subframe locking (bottom of car). Check tightness of: bolts (4) mounting subframe onto body, nuts (12) securing centre and rear crossmembers to subframe, gearbox-propelling unit rear mounting, screws and nuts (2 + 2) securing front stabilizer bar attachments . . . .

FRONT SUSPENSION

31. Check of front suspension unit. Make sure that there are: the cotter pins on the upper and lower arm shafts, the lock plates on the stabilizer bar end bracket nuts and on the constant velocity joint mounting screws; check locking of shock absorber attachments and inspect for possible oil leaks. . . . .

FRONT BRAKES

32. Check locking of front brake pipes (bottom of car). Check brake hydraulic circuit, with locking of connections on front brake calipers . . . .

33. Check front brake friction pads for wear (min.thickness: 8 mm = 0.314") . . . . NO .....

STEERING JOINTS

34. Check of steering rods and joints. Check tightness of steering coupling yoke clamp screw; make sure there are the cotter pins on the steering arm nuts and on the steering rod ends; also check steering shaft coupling and steering articulations . . . .

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EXHAUST PIPES

35. Check locking of exhaust manifolds and conditions of pipes . . . . . .

REAR SUSPENSION

36. Check locking of: rear suspension, stabilizer bar, reaction bar. Check locking of rear leaf springs: bolts (4 + 4) securing front support brackets, nuts (4 + 4) securing center mounting plates, bolts (4 + 4) securing rear supports; check locking of shock-absorber upper and lower attachments, of stabilizer bar and of reaction bar as instructed on page 03/001 of the Flavia Repair Shop Manual; make sure that there are the cotter pins on the leaf spring shackles and inspect shock absorbers for oil leaks . . . . . .

REAR BRAKES

37. Check fixing of rear brake pipes and of hand brake cables (bottom of car). Check locking of rear brake caliper pipe connections and inspect for possible fluid leaks from the brake system; check locking of hand brake cable anchorage fixing nuts (2+2+2). Grease cables and sheaves. . . . . .

38. Check rear brake friction pads for wear. (min. thickness: 8 mm = 0.314 ") . . . . . NO

39. Resetting of normal clearance between discs and hand brake friction pads. Remove rear wheels and reset the normal clearance (0.1 mm = 0.0039 ") between discs and hand brake friction pad braking surfaces. Refit rear wheels . . . . . .

HEADLAMP ALIGNMENT

40. Check lighting and alignment of headlamps. As instructed in Sketch AST 436 I for LUCAS or CARELLO aligning devices; as instructed on pages 07/3 and 07/1 of the Flavia Repair Shop Manual, if such devices are not available. . . . . .

LIGHTS - ACCESSORIES - INSTRUMENTS

41. Lights. Check operation of direction indicators, front and rear parking lights, back-up and number plate lights, interior lights and front open-door marker lamps. . . . . .

42. Accessories. Check operation of horns, cigarette-lighter, windscreen washer and wipers (with windscreen wet) . . . . . .

43. Instruments. Check fixing of: speedometer, revolution counter, oil pressure gauge, electric clock (Coupé only) . . . . . .

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BODY

44. Check operation of: locks, window regulators, ventilator windows and handles; lubricate door hinges . . . .

45. Check tightness of screws fixing door hinges, locks and handles . . . .

46. Check opening and safety lock of luggage compartment lid. . . . .

47. Check fixing of rear bumper, rear number plate, and rear wheel rim mouldings . . . .

48. Check operation of fuel tank filler lid lock . . . .

49. Check bonnet release linkage and safety latch; also check opening of air conditioning system front air intake . . . .

50. Check fixing of front bumper, front number plate and front wheel rim mouldings . . . .

51. Check operation of: front seat sliders, glove locker lid, sunvisors and rear-view mirror . . ..

LEVELS - GREASING

52. Check levels. - Oil: engine, injection pump (level plug), gearbox-propelling unit and steering box - Brake fluid - Engine coolant - Windscreen washer fluid - Battery electrolyte. Lubricate battery terminals with petroleum jelly. . . . .

53. Greasing . Lubricate through the grease nipples provided (5 on steering side and 6 on opposite side); care must be taken to protect the brake discs in order to avoid smearing them . . . .

54. Check, and if necessary restore, tyre inflation pressure, including the spare one. Specified pressure: 1.8 atm. (25.6 p.s.i.) front and rear, for sedan; 2 atm. (28.5 p.s.i.), for derived models . . . .

55. Road-test of resolution . . . .

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C O N T E N T S

FOREWORD

This publication aims at directing and guiding all personnel employed in overhauling and in repairing the Flavia cars equipped with injection engines.

It deals with all the variants introduced on the conventional models of the Flavia cars as a consequence of the fitting of the new fuel indirect injection system.

In order to avoid, as far as possible, consulting other publications, an appendix has been inserted at the end of the Manual, where the checkings and the operations to be carried out for the valve and the ignition timings are listed.

Still at the end of the Manual, and just after the appendix, all workshop Sketches are grouped.

All other subjects not pertaining to the fuel system, which are not stated in this Manual, are to be searched in the publications dealing with the repairs on Flavia cars, letterpress Nos. 8798769-8798780, according to whether they are sedans or derived models.

T O O L L I S T

The tools listed hereunder represent the minimum tool equipment indispensable to carry out operations of normal maintenance,tune-up and service coupons on cars equipped with injection engines.

OUTFIT 8016352

(Set of tools necessary for operations on the injection pump,fitted to the car, carried out by Selling Agencies,Foreign Concessionaires, Authorized Services):

8011354	Socket for injection pump fuel delivery valve mounting ring nut
8013030	Connector for pressure gauge 8095452
8013351	Tool to hold fuel enriching device pushrod bush
8013352	Pin to lock injection pump control lever
8015364	Pointer to set butterfly valve control lever
8015365	Tool to set butterfly valve opening
8015366	Tool to adjust the length of butterfly valve-to-injection pump lever connecting rod
8015384	Gauge to time injection pump
8095452	Pressure gauge
8095800	Thermometer (with cage) to check engine water temperature when setting the enriching device.

NOTE - For the complete set of the tools necessary for operations on car and for overhauls at the bench carried out by Lancia branches, refer to outfit No. 8016351 on page 48 bis.

F U E L S Y S T E M

DESCRIPTION OF THE SYSTEM

Figure 1 schematically shows the entire fuel system, including the relevant electrical units.

The petrol in the tank (1) is sucked by the fuel rotating pump (2), which, driven by an electric motor (M), operates with the ignition key (I) turned to the second position (vertical).

From the pump (2), the petrol is delivered at a pressure of 1.1 to 1.5 atm.(15.6 to 21.3 p.s.i.). A warning lamp (S), on the instrument panel, lights up when the pressure is too low (below 0.4 to 0.7 atm. = 5.7 to 10 p.s.i.). Through the main filter (4), the petrol is piped to the hydraulic head of the injection pump (3)in a quantity greater than required by the four plungers, which deliver the necessary petrol to the injectors (5); these will then provide to spray the petrol into the ends of the intake manifolds at a pressure ranging from 30 to 38 atmospheres (with new injectors).

A part of the excess fuel arrived at the hydraulic head is available for the operation of the electrovalve (6),while the remainder returns to the tank (1)via the proper pipe to which is connected, by means of a 3-way connector, the pipe carrying the petrol and the air vented through the connector (provided with a 0.5 mm=0.019 in. calibrated hole) fitted to the cover of the main fuel filter (4).

Besides the main filter (4), other three filters (7-8-9)provide to properly clean the petrol.

The electrovalve (6) has the function to admit petrol into the distributing chamber while the starter motor (M) is being operated; this, however, occurs only when the water temperature is below 45 to 55 deg. C (113 to 131 deg. F); in fact, at such a temperature, the thermocontact (T) will cut-off the electrovalve.

DIAGRAM

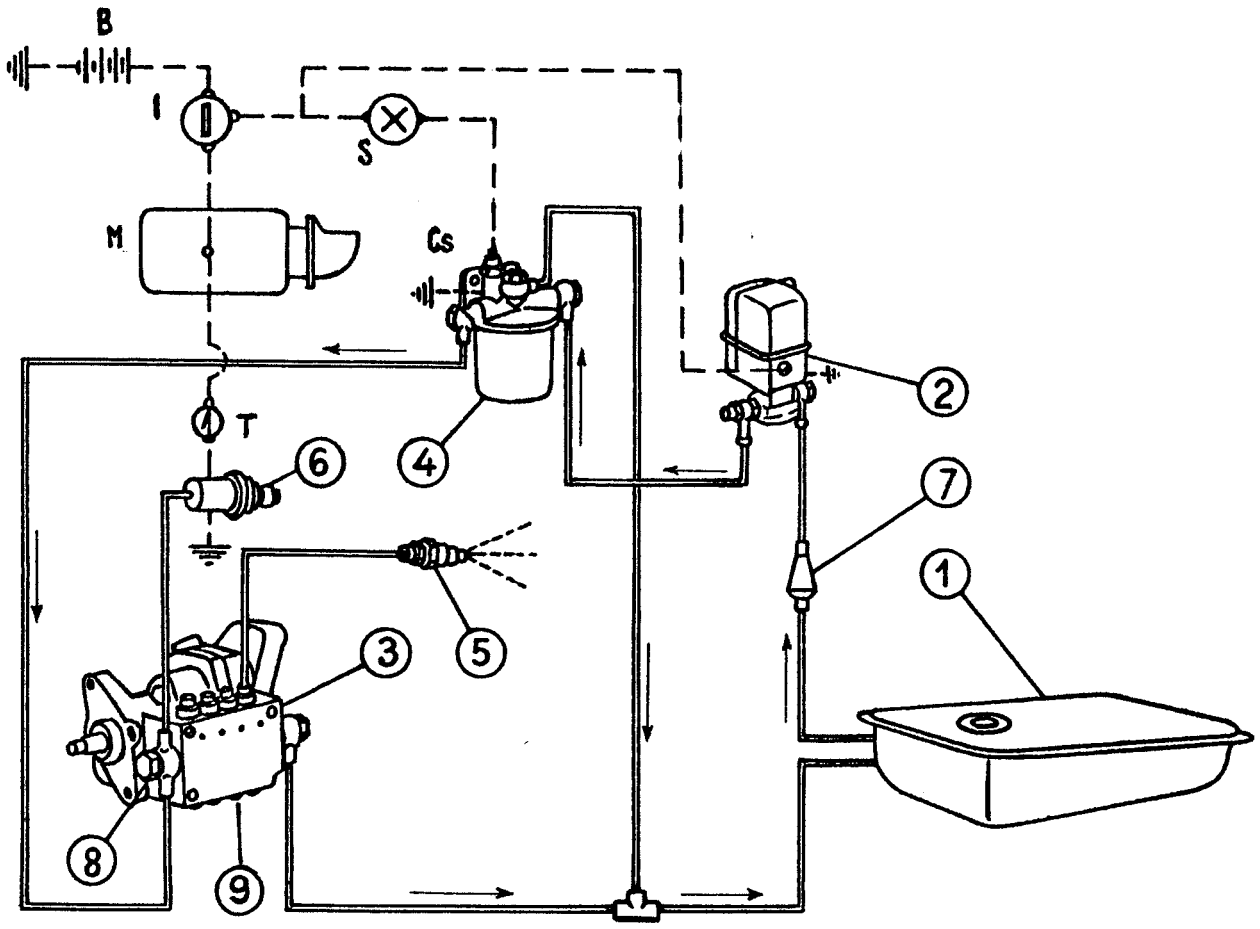


Fig. 1 - Fuel and Electric System Diagram

K E Y

1 - Fuel tank
2 - Fuel rotating pump
3 - Kugelfischer injection pump
4 - Main fuel filter
5 - Injector
6 - Electrovalve
7 - Fuel filter
8 - Fuel filter
9 - Inlet valve fuel filter

B - Battery
Cs - Fuel low pressure warning light contact
I - Ignition switch
M - Starter motor
S - Fuel low pressure warning light
T - Engine starting electrovalve cut-off thermocontact

Fuel lines

Electric connections

The enriching device, on the contrary, is on when the engine is cold; however, it reduces its operation as the cooling water temperature increases, and goes off at 60 deg. C (140 deg.F) approx.

As to the forming of the air-petrol mixture, this is properly metered by a mechanism allowing the instantaneous variation of both air and petrol amounts according to the load on the engine.

TROUBLES - PROBABLE CAUSES - REMEDIES

FAILURE TO START

Probable Causes

1) Fuel delivery pressure low or lacking
2) Electrovalve does not operate
3) Enriching device not operating with cold engine
4) Incorrect operation of the injection pump

Remedies

1) Carry out the operation "Checking the Delivery Pressure" of the fuel pump
2) Check what stated under paragraph "Electrovalve"
3) Check the enriching device push-rod return spring
4) Carry out the operation "Checking the Delivery Valves"; should this not be enough, remove the pump and test it on the bench.

IRREGULAR SLOW RUNNING

Probable Causes

1) One or more faulty injectors
2) Poor sealing of the injector delivery pipe connections
3) Enriching device operating with warm engine(or incorrectly set)
4) Incorrect operation of the injection pump
5) No setting possible through the screw provided
6) Air-locks in the pipes or in the pump

Remedies

1) Check and, if necessary, renew the faulty injector
2) Slacken, then screw them in again, without forcing excessively (not over 3.5 kgm = 25.3 lb. ft.); if necessary, replace the pipe complete with connection.
3) Check the setting and, if necessary, replace the thermocontact.

4) Carry out the operation "Checking the Delivery Valves"; should this not be enough, remove the pump and test it on the bench.
5) Clean the by-pass gallery with the proper brush.
6) Vent the system.

SLOW RUNNING TOO FAST

Probable Causes

1) Too fast adjustment
2) The butterfly valve does not return to the minimum opening position.
3) Accidental air seepages.
4) Enriching device improperly set.
5) Incorrect operation of the injection pump.
6) No setting possible through the screw provided.

Remedies

1) Repeat the slow running adjustment
2) Inspect the control linkage for binding; if necessary, check that the stop screw (5) is set as specified on page 37, paragraph C).
3) Check intake ducts for sealing downstream the butterfly valve (air hoses in particular).
4) Repeat the operation "Setting the Enriching Device".
5) Carry out the operation "Checking the Delivery Valves" ; should this not be enough, remove the pump and test it on the bench.
6) Clean the by-pass gallery with the proper brush.

ENGINE MISSING WHEN ACCELERATING WITH CAR STANDING

Probable Causes

1) Improper operation of the enriching device.
2) Air-lock in the injection pump inlet pipe, or in the pump.
3) Butterfly valve-injection pump incorrect setting.
4) Irregular increase of the air flow through the butterfly valve

owing to excessive deposits.

5) Incorrect operation of the injection pump.

Remedies

1) Carry out the operation "Setting the Enriching Device".
2) Vent the system.
3) Repeat the relevant setting.
4) Clean the butterfly valve and its seat; if necessary, repeat the minimum opening adjustment.
5) Carry out the operation "Checking the Delivery Valves"; should this not be enough, remove the pump and test it on the bench.

ENGINE MISSING UNDER LOAD (WITH CAR UNDER ACCELERATION)

Probable Causes

1) Butterfly valve/injection pump improper setting.
2) One or more faulty injectors.
3) Low pressure fuel delivery to the injection pump.
4) Improper operation of the injection pump.

Remedies

1. Repeat the relevant setting.
2. Check the operation and, if necessary, replace them.
3. Carry out the operation "Checking the Delivery Pressure" as instructed on page 10.
4. Carry out the operation "Checking the Delivery Valves"; should this not be enough, remove the pump and test it on the bench.

ENGINE WITH LOW POWER OUTPUT

Probable Causes

1. Improper butterfly valve/injection pump setting.
2. Low pressure fuel delivery to the injection pump.
3. Restrained air flow.
4. Incorrect operation of the injection pump.

Remedies

1) Repeat the relevant setting.
2) Carry out the operation "Checking the Delivery Pressure" as instructed on page 10.
3) Check the air cleaner element and, if necessary, renew it.
4) Carry out the operation "Checking the Delivery Valves"; should this not be enough, remove the pump and test it on the bench.

EXCESSIVE FUEL CONSUMPTION

Probable Causes

1) Fuel leaks from the system.
2) Enriching device operating with warm engine.
3) The electrovalve does not close completely.
4) Improper operation of the injection pump.

Remedies

1) Inspect the whole fuel system.
2) Carry out the operation "Setting the Enriching Device" and, if necessary, renew the thermocontact.
3) Check the operation and, if necessary, replace it.
4) Carry out the operation "Checking the Delivery Valves"; should this not be enough, remove the pump and test it on the bench.

F U E L P U M P

GENERAL

Driven by an electric motor, it is a Kugelfischer PLF 5A-4L type rotating pump.

It is located on the right-hand front of the engine compartment, just below the main fuel filter.

The data for the test on the bench are specified in Sketch 1086I.

As to the maintenance, it only requires the renewal of the pre-filter every 14000 km (8500 miles) and of the motor brushes every 49000 km (30000 miles).

The fuel pump pre-filter is housed in a recess inside the luggage compartment and is accessible by removing the spare wheel.

A warning lamp, on the instrument panel, lights up when the fuel feed is effected at a pressure lower than 0.4 to 0.7 atm. (5.7 to 10 p.s.i.).

O P E R A T I O N S O N C A R

CHECKING THE DELIVERY PRESSURE

The pump operates properly when the fuel delivery pressure ranges from 1.1 to 1.7 atm. (15.6 to 24.2 p.s.i.).

Should the fuel feed occur at a pressure not corresponding to the above-stated values, the proper operation of the entire fuel system would be more or less badly affected, and the well-known detrimental consequences on the engine efficiency would result. It is just when a more or less notable fall in the engine efficiency is noticed, that this checking is carried out; bear in mind, however, that not less important causes may concur in reducing the engine efficiency (see "Troubles - Probable Causes - Remedies").

To check the fuel delivery pressure on the car, a pressure gauge inserted into the circuit is used, and the procedure for the check is as follows:

- remove the low pressure warning light contact from the main fuel filter and fit, to its place, pressure gauge 8015461 complete with the connector supplied with it;
- switch the ignition on to operate the fuel pump and make sure that the pressure gauge reading is within the above-specified values.

Should the pressure reading be less than 1.1 atm. (15.6 p.s.i.), before removing the pump to test it on the bench, it is suitable to carry out the following:

Preliminary Checks

- Make sure that the pump operates; a low hum will prove this.
- Make sure that the diameter of the outlet hole of the breather and fuel return banjo union (5 - fig.4) fitted to the main filter is not greater than 0.5 mm (0.0197 ").
- Measure the quantity of fuel contained in the tank; it shall not be less than 5 litres (1.1 Imp. gall. = 1.3 U.S.A. gall.).
- Examine the pre-filter (housed in a recess under the spare wheel)
- Check that the main fuel filter element is not dirty.
- Check the charge of the battery.

If the above checks do not detect any cause for the pressure drop, it will be necessary to remove the pump and to carry out the operation "Testing the Pump at the Bench".

Note - It is advisable to carry out the above checks even when the pressure reading is very close to the limit specification of 1.1 atm. (15.6 p.s.i.).

Should the pressure reading by very close to the limit specification of 1.7 atm. (24.2 p.s.i.), it is advisable to carry out the following:

Preventive Checks

- Make sure that the main filter element is not clogged (if necessary, clean it).
- Examine the condition of the filter in the injection pump inlet connector and cleen
- Make sure that the fuel return duct in the hydraulic head of the injection pump is not clogged; it is accessible by removing the fuel return pipe banjo bolt.
- Make sure that the return pipes are not clogged.
  Conversely, should a pressure higher than 1.7 atm. (24.2 p.s.i.) be noticed, the trouble is certainly to be located in the fuel pump; then it will be necessary to carry out the operation under paragraph "Testing the Pump at the Bench" concerning the cone-shaped valve.

REMOVING AND REFITTING THE FUEL PUMP

Removing

- Disconnect the wire from the pump.
- Disconnect the fuel inlet (with union) and feed pipes.
- Remove the fuel pump

Refitting

After carrying out the checkings and the overhauls as necessary, reassemble the pump and proceed to refitting it to the car by reversing the removal procedure.

O P E R A T I O N S O N B E N C H

TESTING THE PUMP AT THE BENCH

This operation consists of two important tests:

Test No. 1 (fig. 3)

Install the pump on test bench 8016850 (see sketch 1113 I).

- Operate the pump motor.

Plug the delivery hose and, by acting on the screw (22 in figure 3), check whether the cut-out pressure may be brought to 1.5÷1.7 atm. (21.3÷24.2 p.s.i.); otherwise , proceed to removing, cleaning and if necessary renewing the cone-shaped valve and relevant spring as follows:

- unscrew the adjusting screw (22) and withdraw the seal (21), the spring (20) and the valve (19);
- clean (with air pressure) the valve seat and the valve, then make sure that the latter slides freely in its seat, otherwise replace it;
- examine the other parts, renew the inefficient ones and refit the pump components, without tightening the screw (22);
- start the motor again and, if necessary, act on the screw (22)to restore the cut-out pressure of the pump to 1.5 ÷ 1.7 atm.(21.3 ÷ 24.2 p.s.i.).

If the foregoing procedure is not sufficient to set the cut-out pressure to the desired value, carry out the checkings A)and B) detailed further on.

Test No. 2

Install the pump on test bench 8016850 (see sketch 1113 I).

- Operate the pump motor.

Check that, with a delivery pressure of 1.2 atm. (17 p.s.i.) and a 12 V current, the pump delivery is not less than 45 liters per hour (see data of sketch 1086 I).

- Check the pressure value indicated by the gauge; as it will be different from the test value (1.2 atm.= 17 p.s.i.), it will be necessary to choke the delivery pipe, downstream the pressure gauge, up to obtaining the reading required.
- Once the pressure has been brought to the desired value, collect the test fluid flowing out of the delivery pipe in a suitable container during two minutes.

After the pump has operated for the time and at the conditions specified above, at least 1.5 liters (2.64 Imp. pints - 3.16 USA pints) of fluid will have to be in the container.

If the amount of fluid collected is not as specified, it will be necessary to carry out the following checkings A) and B):

A) Checking the Electric Portion (fig. 3)

- Unhook the retainer clamp (8) and lift off the cover (9)and the seal (10).
- Check the condition of the commutator and brushes; if necessary, renew these, after cleaning the commutator.Should the commutator present burning traces, or very small and hard balls which cannot be removed, replace the electric portion complete.

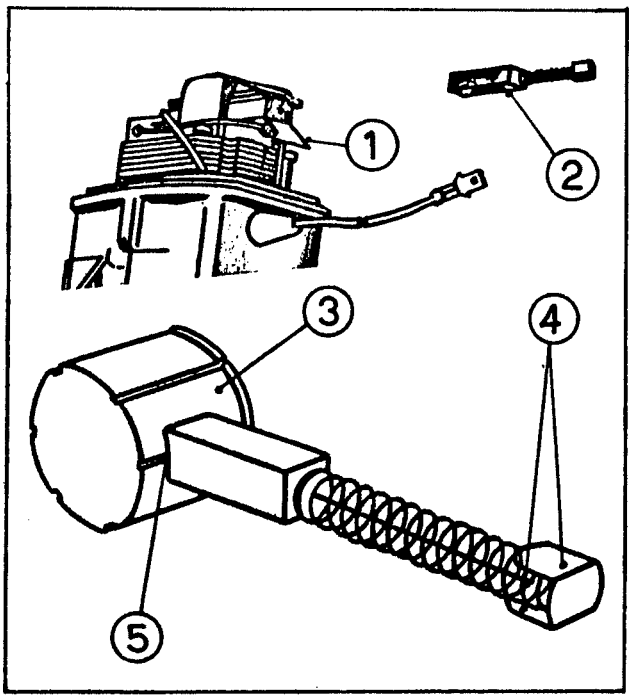


Fig. 2 - Replacing the Brushes

1. Brush retaining tab - 2. Brush - 3. Commutator - 4. Guiding sides - 5. Commutator-to-brush contact surface.

- Examine the armature; if burning traces are denoted or if, on feeding the motor with 12 volt direct current, it does not revolve at the proper speed, renew the electric portion (5) of the pump by detaching it from the mechanical one (7).
  NOTE - The three union screws (15) are not supplied as spares; however, they may be easily found on the market (5x0.8 mm - 0.197 x 0.0315 in. - with hexagon countersunk head).

B) Checking the Mechanical Portion (fig. 3)

- Unscrew the cap nuts (1) and remove the banjo unions (3-16) and the gaskets (2).
- Unscrew the screws (17), pressing the cover plate (18) against the body, so as to prevent the ball (13) and the catch (12), under the thrust of the spring (11), from falling off.

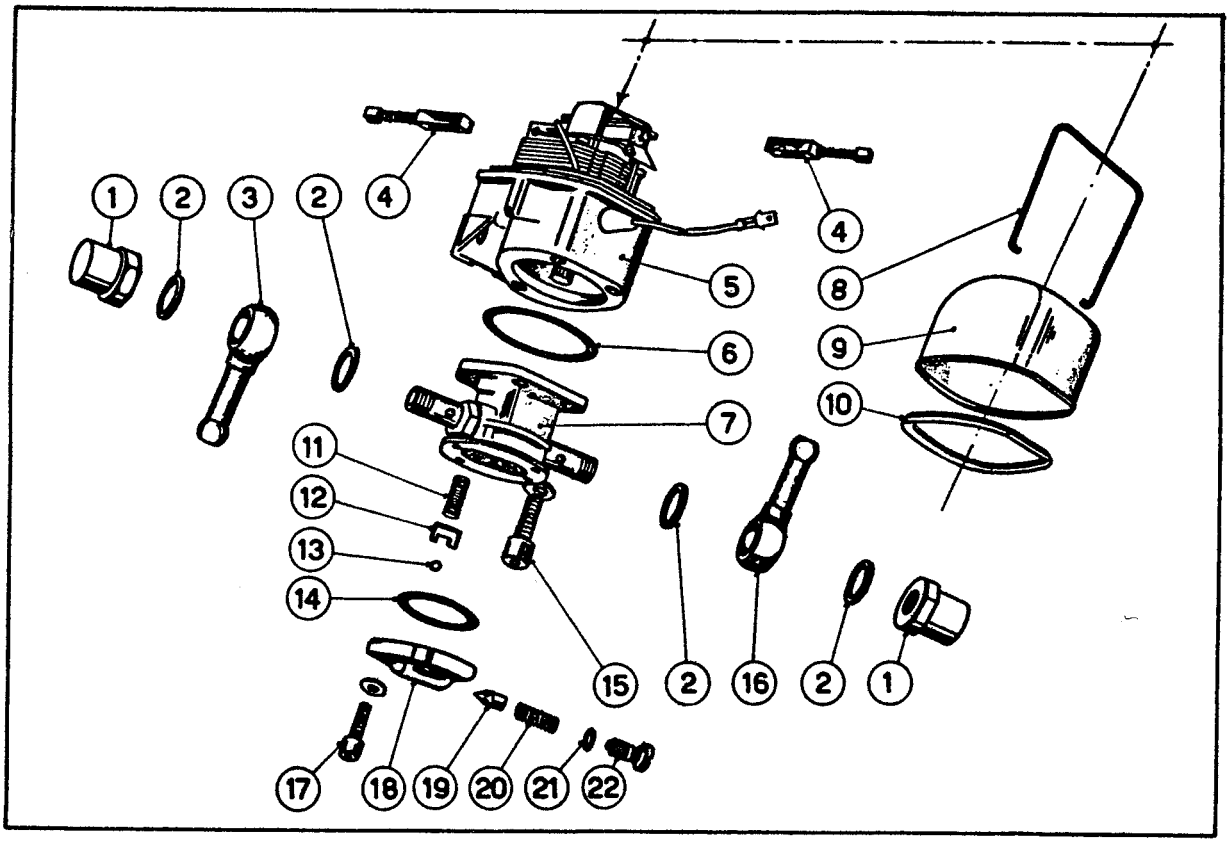


Fig. 3 - Fuel Pump

NOTE - The screws (17) are not supplied as spares (4x0.7 mm - 0.157 x 0.0275 in. hexagon countersunk head).

- Remove the cover plate (18), paying attention not to scatter the above-mentioned parts (ball, catch and spring). If the inner surface of the cover plate is excessively worn out, replace this.
- Take out the two gears, clean every part and then make sure that the clearances between gears and pins and between gears and their seats are not excessive (anyhow not so important as to impair the good operation of the pump); otherwise, the mechanical portion (7) of the pump will have to be renewed as an assembly.
- Refit the gears into their seats.
- Refit the spring (11), the catch (12) and the ball (13), then, keeping the ball pressed against its seat by means of a feeler gauge (straightedge or similar tool), fit the cover plate (18) (pay attention that the gasket (14) is not displaced from its seat), remove the feeler gauge (straightedge or similar tool) and screw in the screws (17) with the relevant washers.

Caution - Either in case A), or in case B), take the opportunity to check that in the seat housing the gear transmitting the motion from the electric to the mechanical portion, there is a sufficient quantity of grease KLUBER PROL 500 B.

- Re-test the pump on the bench and, if necessary, set the cone-shaped valve as described under "Test No. 1".

M A I N F U E L F I L T E R

GENERAL

Manufactured by FISPA, it is a filter of the pleated-paper element type.

It is located at the top front of the right-hand side of the engine compartment, and it houses, in its top, the low pressure warning light contact.

As to maintenance, it must be cleaned, together with the element (13), every 14000 kms (8500 miles).

After the cleaning (except for the other causes listed on page 12 under "Preventive Checks"), should it be noticed that the pressure indicated by gauge 8015461, fitted in place of the contact, always tends to the maximum value of 1.7 atm. (24.2 p.s.i.), remove and renew the element (13).

REMOVAL, OVERHAUL AND REFITTING

Removal

- Disconnect the wire from the low pressure warning light contact
- Unscrew the banjo bolts securing the fuel inlet and delivery pipes.
- Remove the breather and fuel return connector.
- Unscrew the mounting screws and lift off the filter assy.

Overhaul (fig. 4)

- Drain the fuel from the bowl
- Lock the filter in a vice
- Unscrew the low pressure warning light contact (1)
- Unscrew the centre bolt (9) and detach the bowl (14) complete with element (13)
- Withdraw the element off the bowl and clean it; should it be necessary, renew it
- Unscrew the banjo bolts (6) securing the fuel inlet and delivery pipe banjo unions (8) and remove the gaskets (7).

FUEL FILTER - ELECTROVALVE

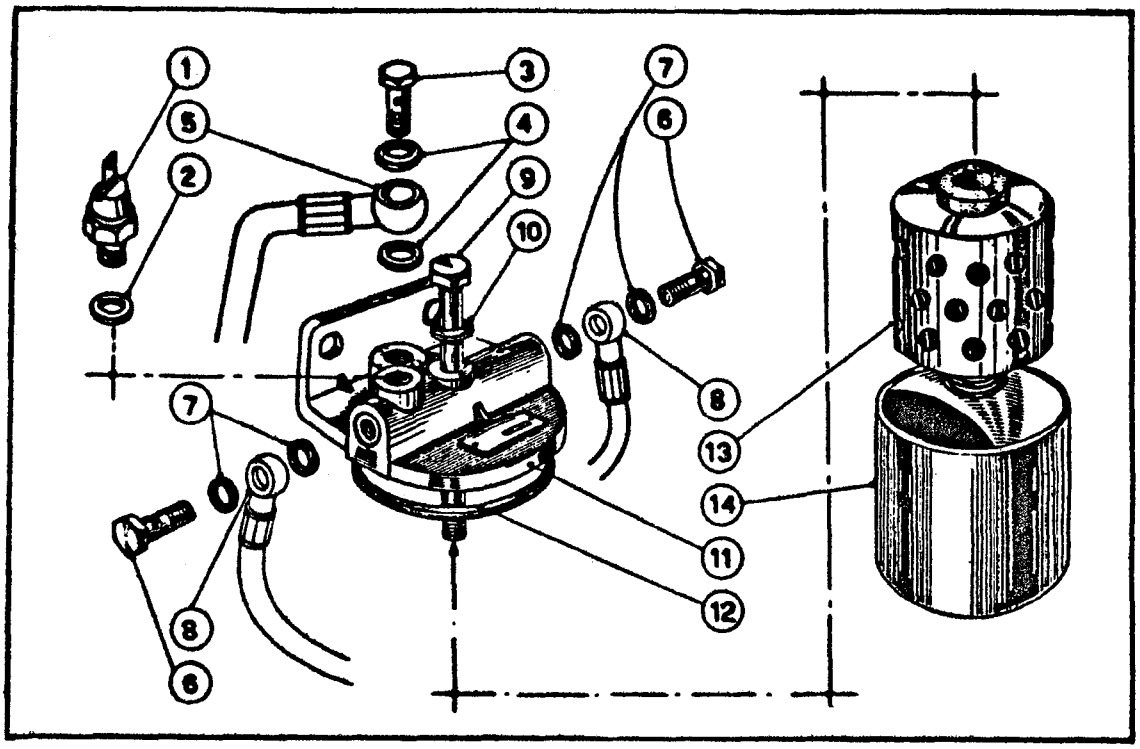


Fig. 4 - Main fuel filter

- Unscrew the banjo bolt (3) fixing the breather and fuel return connector (5) and remove the relative gaskets (4). By using flow meter 8015361, if available, check that the outlet hole of the connector has a diameter of 0.5 mm (0.019 in.), otherwise renew the connector.
- Clean the removed components, renew the inefficient ones and reassemble the filter.

Refitting

Once the above overhaul has been carried out and the necessary components renewed, refit the filter by reversing the removal order.

ELECTROVALVE (fig. 5)

GENERAL

The electrovalve (magnetic valve) has the function to spray additional fuel into the distributing chamber, while the starter motor is operated, so as to facilitate the engine starting.

Its operation, however, is only required at certain temperatures of the engine; in fact, when the temperature of the cooling water is above 45 to 55 deg.C (113 to 131 deg.F), the engine does not require

any additional fuel during its starting.

The cut-off of the electrovalve is effected by a thermocontact, which, being fitted to the enriching device body plug,is affected by the temperature of the water inside the device itself (upstream the water by-pass thermostat).

In fact, the thermocontact will open the electric circuit of the cable connecting the starter motor to the electrovalve, when the temperature of the water inside the enriching device will reach 45 to 55 deg. C (113 to 131 deg.F).

CHECKING THE OPERATION

To carry out the following operations, it is indispensable that the temperature of the cooling water inside the engine be below 45 deg. C (113 deg. F).

- Remove the low pressure warning light contact from the main filter; and fit pressure gauge 8015461 to its place.
- Turn the ignition key to operate the fuel pump;the pressure gauge will indicate a certain pressure (1.1 to 1.7 atm. - 15.6 to 2 4 . 2 p.s.i.), which corresponds to the pump delivery one.
- Push and then release the ignition key to operate the starter motor; at the moment in which this is operated,the pressure gauge w i l l have to indicate a temporary drop of pressure. Should, on the con trary, no fall in pressure be noticed, it is necessary, befo r e deciding to renew the electrovalve, to make sure that the f u e l inlet banjo bolt (1) and the relevant union (3) are not clogged, or that the inlet hose is not distorted; in case nothing irregu lar is noticed, it will he necessary to replace the electrovalve. The above check has determined the serviceability or not of the electrovalve; the following one, on the contrary, will serve to determine the serviceability of the thermocontact.
- Raise the temperature of the water inside the engine up to 55 deg. C (131 deg. F), not over.
- Stop the engine and turn the ignition key to operate the fuel pump.

- Push and release the ignition key to operate the starter motor; during this operation, check that the pressure gauge does not indicate any fall in pressure, otherwise renew the thermocontact.

CHECKING THE SEALING (for the delivery test, refer to sheet 5b/5 of Sketch 1113 I)

To carry out this check, proceed as follows:

- unscrew the banjo bolt (1) and place it temporarily aside, together with the relevant union and hose (3);
- remove the electrovalve (5) and leave the gasket (6) on its seat;
- refit the fuel inlet pipe (3) and the gaskets (2) to the electrovalve and secure them by means of the relevant banjo bolt;
- turn the ignition key to operate the fuel pump, and then examine the electrovalve for any leaks; should some leak be detected, renew the electrovalve.

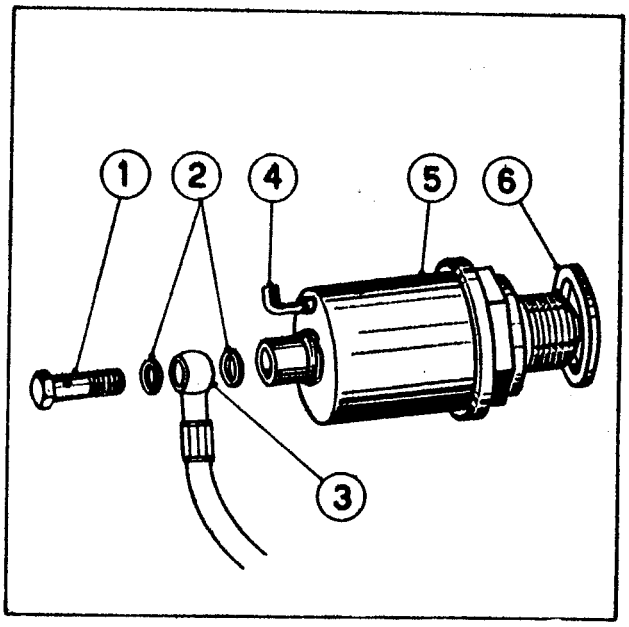


Fig. 5 - Electrovalve

REPLACING THE ELECTROVALVE

When the electrovalve has to be replaced, also the relevant gasket (6) and, if necessary the gaskets (2), will have to be renewed.

The operations for the removal and the refitting are so easy to be carried out that no particular procedure is required; bear in mind, however, that, once the refitting has been completed, the banjo bolt(1) must be tightened to a torque of 0.7 to 0.8 mkg (5.06 to 5.78 lb.ft.).

I N J E C T O R S

GENERAL

Manufactured by Kugelfischer, they are of the DLO-20B type. They only need a periodical check every 21000 km (13000 miles)to be carried out in accordance with the procedure described under the operation "Testing".

REMOVAL

- Unscrew the union securing the fuel delivery pipe to the injector to be examined,holding the injector connection with another spanner,then displace the pipe by the required amount (s e e fig. 6).
- Unscrew and remove the injector.

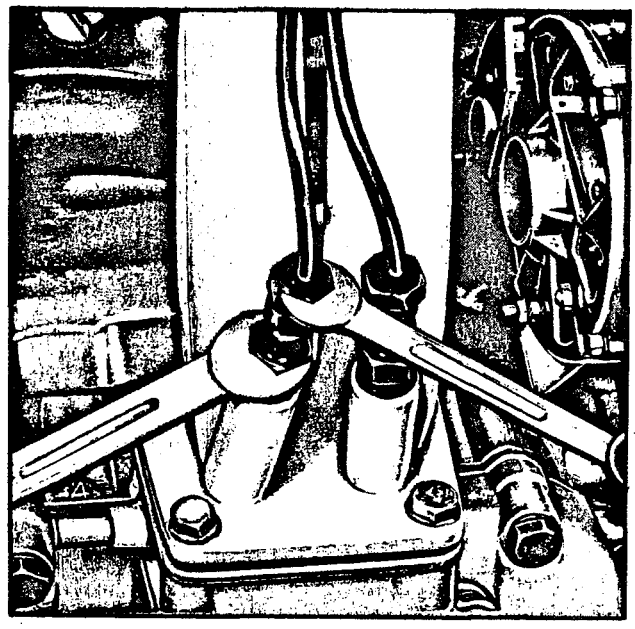


Fig. 6 - Removing the Injector

TESTING

Note - The following test has to be carried out under a hood provided with an exhauster capable of absorbing the vapours produc e d by the spraying during the test.

It must be carried out by means of a hand-testing pump equipped with a pressure gauge graduated up to 50 ÷ 60 atmospheres.

Before commencing any testing operation, give several pump shots so as to clean the injector interior thoroughly.

The new injector is set to open at a pressure of 30 to 38 atmospheres and, when testing a used injector, the delivery pressu r e must not be less than 20 atmospheres.

Subjecting the injector to a pressure of 15 atmospheres for 10 seconds, no dribble shall be detected.

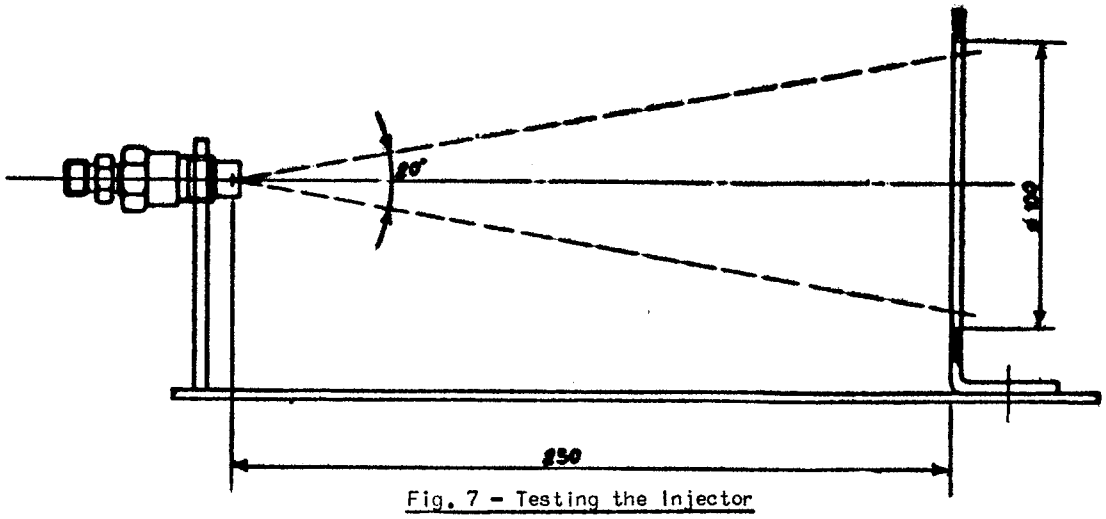


Fig. 7 - Testing the Injector

The jet given by the nozzle must be finely sprayed;in addition, it must have a conical shape (cone angle = 20 deg.) and comply with the specifications of figure 7.

The injector not complying even with one only of these specifications, requires the replacement of the nozzle (4),fig. 8.

REPLACING THE NOZZLE (Fig. 8)

- Unscrew and detach the injector holder (2)from the connection(1).
- Extract, from the injector holder, the washer (3) and the nozzle (4).
- Insert a new nozzle and also a new washer, if necessary.

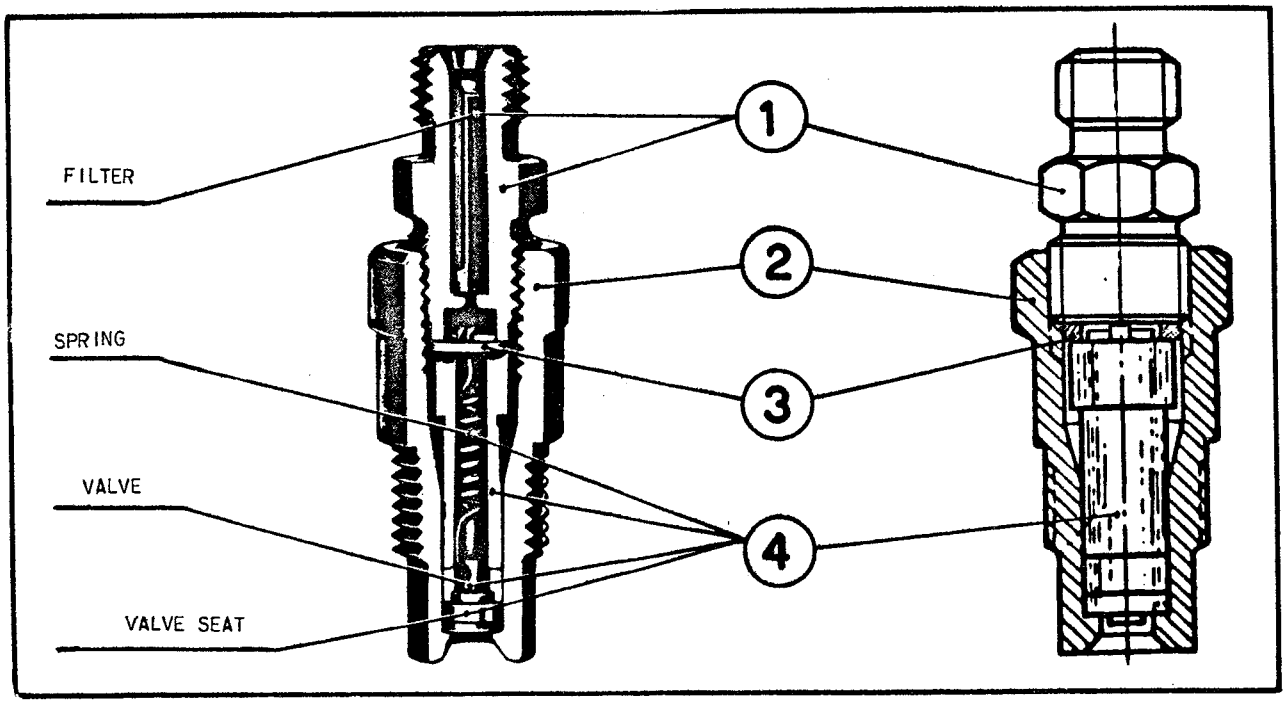


Fig. 8 - DLO-20B Type Injector Sections.

- Screw the connection into the holder (2), tightening it to a torque of 3.5 mkg (25.3 lb.ft.).
- Carry out the operation "Testing".

NOTE - The injector subjected to the above operations must have the same characteristics of a new one.

REFITTING

To be carried out in the reverse order to the "Removal", bearing in mind the following directions:
- always renew the injector washer;
- screw the injector into its seat ,by means of a torque spanner set to 2 mkg (14.47 lb.ft.);
- tighten the delivery pipe connections onto the injectors to a torque of 3.5 mkg (25.3 lb.ft.);
- start the engine and make sure that there are no fuel leaks from the connections; should some leak be noticed, do not tighten the connections further, but slacken and then screw them in again to the above torque, always with engine running.

THERMOSTATIC ELEMENT

GENERAL (fig.10 - table 3)

Of the "Behr - Thomson" type, it is contained in a suitable chamber, in the upper portion of the enriching device, through which flows the engine coolant.

The special characteristic of the element (3)is its property to expand as the hot water flows by, and consequently to force stem(A) downwards.

During its downward movement, the stem (A), after overcoming the thrust of the spring (6), will also shift the push-rod (7) and with it the bush (9) and the nuts (10-11-12), whilethe enriching device lever, which was in a raised position,will tend to lower under the action od its return spring (not shown in figure).

As a consequence of this action, the enriching device is gradually cut off and will be completely off when the water reaches a temperature of 60 ± 2 deg. C (140±3.6 deg. F).

As soon as the enriching device is off, the additional air inlet, which through the bush seating (8) and via a passage not shown in figure previously flowed into the butterfly valve housing, just past the butterfly valve, is discontinued.

Caution

Never heat the thermostatic element to the flame. Take care that the stem (A) does not slide off its seating in the element body.

TESTING ON THE CAR (fig. 9)

- With engine cold, check that the enriching device lever is in the raised position.
- Remove the water temperature gauge sending unit from the engine water outlet connector and fit thermometer 8095800 to its place.
- Check that the thermometer indicates a temperature of 20 deg. C (68 deg. F) and, by means of a sliding caliper or of a suitable tool, measure distance X.
- Heat the cooling water up to a temperature of 80 deg.C (176 deg.F) and measure distance Y.

The difference between the two distances will have to be:

Y-X=9±0.5 mm (0.354±0.02 in.) .

The result obtained corresponds to the travel covered by the thermostatic element sliding stem (A-fig.10),on raising the water temperature from 20 to 80 deg. C (68 to 176 deg. F).

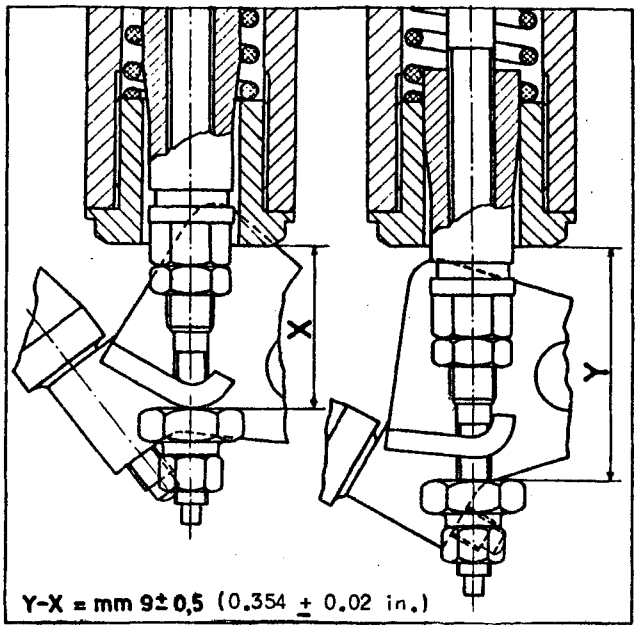


Fig. 9 - Testing the Thermostatic Element

REPLACEMENT (fig. 10)

- Drain the cooling system.
- Remove the end plug (1), complete with thermocontact, from the enriching device body and clean the interior by using air pressure.
- Extract the thermostatic element (3);should an excessive resistance be noticed, push the rod (7) upwards.
- Renew the seal (4) and insert the new thermostatic element .
- Renew the gasket (2) and fit the plug to the enriching device body.

  Should spring (6) be replaced, before fitting the seal (4)and the thermostatic element, it will be necessary:
- to unscrew the nuts (11 - 12);
- to push the rod (7) upwards and slide it off together with the

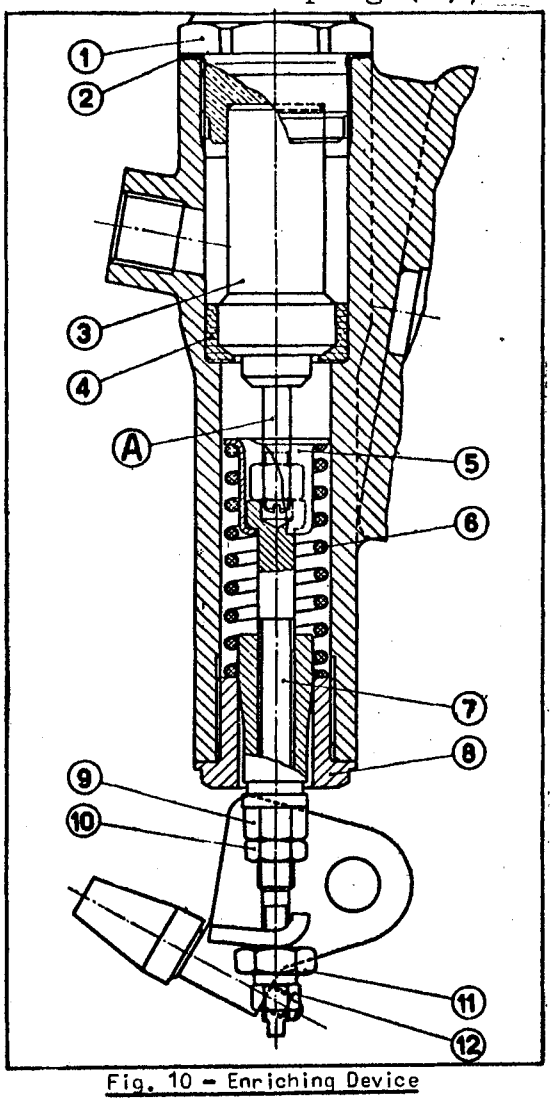


Fig. 10 - Enriching Device

bush (9), the nut (10) and the cap (5);
- to replace the spring (6).

Once the spring (6) and the other inefficient parts have been replaced, complete the reassembly.
- Replenish the cooling system.
- Start the engine and make sure that there are no water leaks due to poor tightness of the thermostatic element seal (4); such leaks may occur around the push rod (7) at the bottom of the enriching device.
- Carry out the operation "Setting the Enriching Device" described on page 40.

PETROL INJECTION PUMP

GENERAL

Manufactured by Kugelfischer, it is of the PL 004 117.01A-1 type.

It is fitted to the crankcase upper cover and carries, secured to its top, the butterfly valve housing, to which are attached: the distributing chamber in the front and the air cleaner at the rear .

As to the maintenance, it only requires the periodical checking (every 7000 km = 4300 miles) of the lubricating oil level, by removing the level plug located on the right-hand side of the governor cover plate. To restore the level, use oil of the recommended grade: ESSO UNIVIS 40. The oil capacity of the sump is 0.5 liter (0.88 Imp. pint - 1.05 U.S.A. pint).

OPERATING PRINCIPLE

In this description, reference is made to table 1, which is a schematic view of the injection pump with its main components and relevant control parts.

The driven gear (27) takes its motion from the driving gear, located inside the oil filler integral with the crankcase top cover, which is component of an inner kinematic system heading to the engine right-hand camshaft.

The pump camshaft (26) turns at the same revolutions of the engine camshaft, that is to say it revolves at half the crankshaft speed.

Each cam of the shaft controls a tappet (21), which transmits its straight-line motion to the plunger (4); the motion is transmitted in one direction only, namely for the plunger delivery stroke only.

The return stroke of the plunger is effected by a return spring, which is not shown in figure.

When the tappet (21) bears on the back of the cam, the plunger (4) is at the B.D.C., and the delivery chamber is full of fuel supplied by the pipe (1), through the valve (3).

Conversely, when the cam is at its maximum lift, the plunger is at the T.D.C. and the delivery stroke has already been effected .

From the delivery chamber, the fuel, after overcoming the thrust of the spring (6), is forced through the delivery valve (5)and,via the pipe (8), to the injector (9).

Should the plunger (4) always effect the same stroke, the quanti ty of fuel would always be the same for each delivery. Obviously, the engine fuel requirements are not always the same, as they vary according to the load and to the revolutions per minute,and moreover they are considerable in cold starting.

In order to avoid lack or useless waste of fuel, it is therefore necessary to set the fuel delivery according to said requirements, and it is just the plunger travel regulating rocker (24) which has to accomplish such task; hereinafter,we are describing how it does so.

The tappet (21) comes into contact with the plunger (4) only when its top end has passed the ball piece (10) all through its thick - ness, which results in the plunger displacement along its axis according to the amount by which the tappet protrudes from the ball piece.

The ball pieces are housed in proper seats in the rocker (24) ,

which has the function to move them in either direction along the axes of the respective plungers. From what described above, it is evident that the amount by which the end of tappet (21) protrudes from the ball piece (10) depends only upon the position taken by the rocker(24) and precisely: if the rocker is in its upper posi - tion, the tappet end will not protrude from the top edge of the ball piece (10) and, therefore, being not in a position to displace the plunger, no fuel delivery will occur; if, on the contrary, the rocker is in its lower position, the tappet upper end will protrude from the ball piece and, therefore, will displace the plunger by an amount equal to the lowering of the rocker.

The parts which govern the position of the rocker are the follower pin (23) and the eccentric shaft (11). The former varies the position of the rocker according to the position of the accelerator pedal and to the engine r.p.m., whilst the latter operates on cold startings only, and gradually reduces its action as the water temperature approaches 60 °C (140 °F), where it goes off.

Omitting the latter, which will be discussed later on, let us now deal with the follower pin and with all the regulating mechanism causing it to move along its axis.

The follower pin (23) which, as already said, may move along its axis only, is controlled by the cam (22), which has two movements : one axial and one angular (297 deg. max.).

The contact between the cam (22) and the follower pin (23) takes place on points only, and each point of contact on the cam represents a particular and instantaneous requirement of the engine; this results, therefore, in a cam shape apparently strange, but which has been actually studied in each point, in compliance with the aforesaid engine requirements. It is just this pimply shape which occasioned the name kartoffel = potato.

The movement of the cam along its axis is obtained by depressing the accelerator pedal, through the control cable (34), the connecting rod (30) and the levers (33-25), whilst the rotating movement is effected through the shaft (19), which is part of a regulating mechanism, the operation of which is detailed hereinafter.

The gear (20), fitted to the camshaft (26), transmits the motion to the governor sending unit gear (12); by revolving, such gear (12) generates, inside the sending unit, a magnetic field, the flux density of which is directly proportional to the r.p.m. of the gear (20) and therefore to the crankshaft revolutions.

As a result of such magnetic flux, the control pinion (15) begins to move and, after overcoming the resistance of the spiral spring (17) properly set, through the gears (14-18) and the pinion (16), turns the shaft (19) and the cam fitted to it.

The reverse rotation of the cam is obtained by the decrease in the crankshaft revolutions. In fact, owing to the direct proportion between the engine r.p.m. and the flux density in the sending unit, decreasing the crankshaft revolutions will result in the reduction of the flux density; as a consequence, the spiral spring (17) will overcome the reduced driving force of the pinion (15) and, on expanding, will force the gear (14) and therefore the cam to reverse their motion.

The reverse rotation of the cam continues until a balance between the flux density in the sending unit and the potential energy of spring (17) will be reached; such balance may be obtained, with the car stationary or subjected to constant load, by keeping the accelerator pedal steady for a little while.

To sum up, by depressing the accelerator pedal, two effects are obtained on the regulating cam: one direct and one as a consequence.

As a direct effect, the cam is displaced along its axis, whilst as a consequence it is partly turned.

These two movements, summed together, make the regulating cam take the specific position by which the fuel delivery necessary to the engine operating conditions in that particular moment will be obtained. The limit case of no delivery may only occur under some particular conditions, namely with accelerator pedal released and engine speed exceeding 2000 r.p.m. approx.; in fact, as long as the above conditions are combined, the regulating cam will contact the follower pin on particularly high points, which will not allow any fuel delivery.

On depressing the accelerator pedal, together with the axial displacement of the cam there will be the butterfly valve rotation so as to allow the air to be admitted to the distributing chamber, from which it will flow to the cylinders. Such regulation is effected by the butterfly valve (35) controlled by the lever (33). Since the lever (33) is connected to the injection pump control lever (25) by means of connecting rod (30), it results that the angular movements of the butterfly valve (35) are proportional to the axial displacements of the regulating cam. The two synchronized movements determine the number of the engine revolutions according to the load and therefore the angular displacement of the cam.

From the above, it is clear that the quantity of air let in by the butterfly valve is proportional to the quantity of fuel sprayed by the injectors, which ensures a correct mixture of air and fuel.

We have just described how the follower pin regulates the position of the rocker (24), and also, superficially, how the proportional mixing of air and fuel takes place. Now let us describe the operation of another device which can vary the position of the rocker.

Such part, as previously mentioned, is the enriching device eccentric shaft (11), controlled by the lever (28); turning of the shaft governs the position of the rocker (24), displacing it by an

amount equal to its eccentricity.

The lever (28) is controlled by a push-rod (29), the axial movement of which is governed by a thermostat located inside the enriching device body (31).

When the engine is cold, the push-rod (29) is forced upwards by a spring (when the lever 28 is in the up position, the enriching device is applied); as the temperature of the cooling water increases, the thermostat in the enriching device body expands more and more, until it overcomes the load of the push-rod return spring, thus forcing the push-rod downwards. When the cooling water reaches a temperature of about 60 °C (140 °F), the lever (28) will be completely lowered and the enriching device will be off.

As long as the enriching device is applied, an air passage around the push-rod bush remains open; through this passage and via a proper duct, the air flows into the butterfly valve housing(32)just past the butterfly valve (see hole in figure); also this additional air flow is cut-off gradually and this operation is completed when the enriching device goes off.

All the injection pump motive parts constantly work in an oil bath, the level of which must always be kept high and periodically checked (see " General").

Only the plungers have a different lubrication, since they are lubricated under pressure with oil coming from the engine.

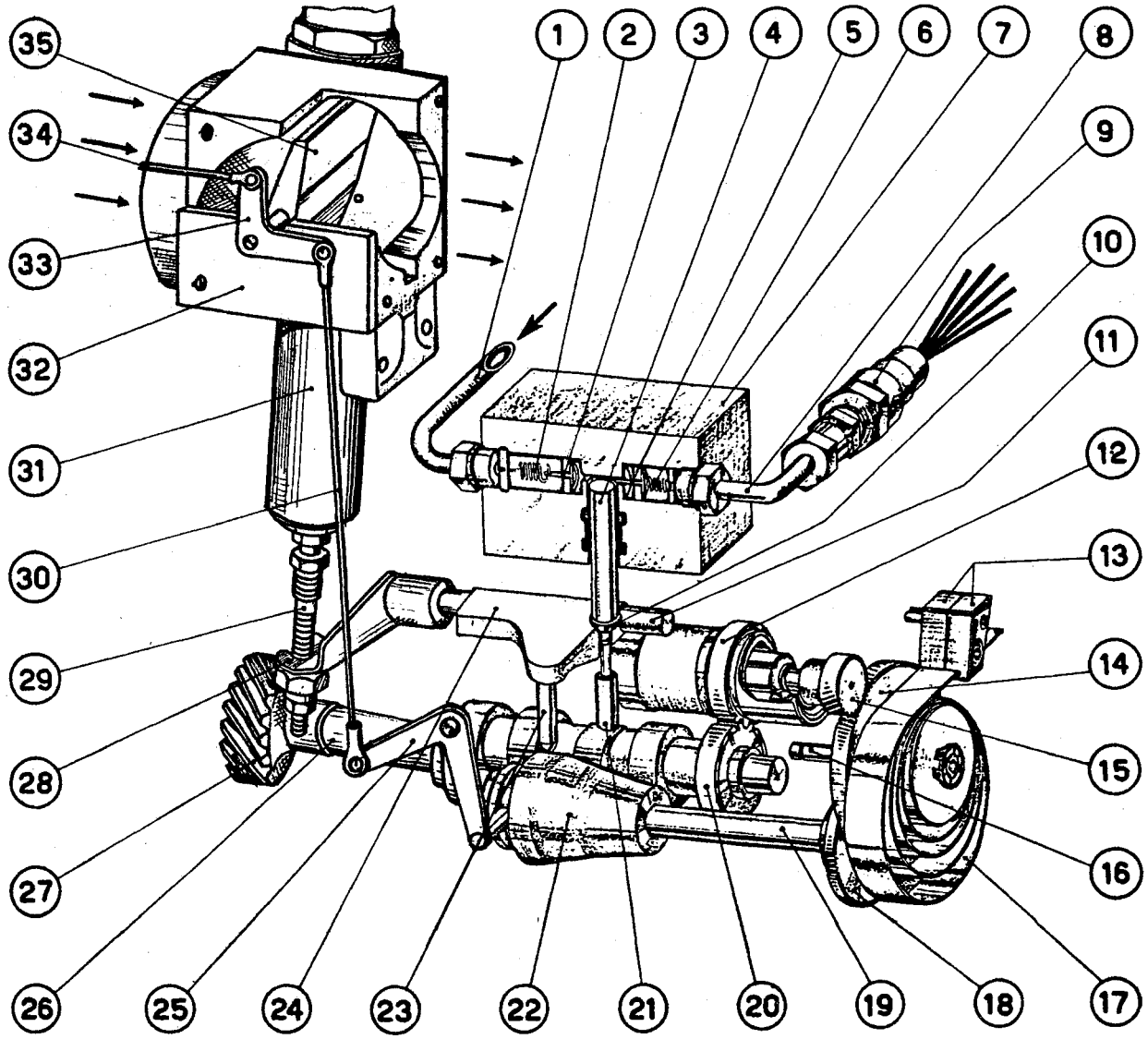


Table 1 - Petrol Injection Pump and Controls

1. Fuel inlet pipe - 2. Fuel inlet valve spring - 3. Fuel inlet valve - 4. Plunger - 5. Fuel delivery valve - 6. Fuel delivery valve spring - 7. Hydraulic head - 8. Fuel delivery pipe - 9. Injector - 10. Ball piece - 11. Enriching device eccentric shaft - 12. Governor sending unit gear - 13. Spiral spring clamps - 14. Spiral spring carrying gear - 15. Governor sending unit control pinion - 16. Governor pinion shaft - 17. Governor spiral spring - 18. Governor shaft gear - 19. Governor shaft - 20. Camshaft gear - 21. Tappet- 22. Regulating cam - 23. Follower pin - 24. Plunger travel regulating rocker - 25. Control lever - 26. Camshaft - 27. Pump driven gear - 28. Enriching device lever - 29. Enriching device push-rod - 30. Lever connecting rod- 31. Enriching device body - 32. Butterfly valve housing - 33. Butterfly valve control lever -34. Accelerator control cable - 35. Butterfly valve.

OPERATIONS ON CAR

DELIVERY VALVES

Note - Cleanliness is essential when carrying out the following operations, otherwise the good working of the delivery valves, and therefore of the injection pump, might be impaired.

Checking

- Disconnect the injector supply pipes from the delivery valves .
- Using compressed air, clean the depressions in the delivery valve connectors.
- Turn the ignition key to operate the fuel pump, and check that the above depressions are not filled with fuel in less than 30 seconds.
- Should they be filled too quickly, it is advisable, before proceeding to the renewal, to re-connect the pipes and to run the engine at high speed for a few seconds.
- If the engine continues operating irregularly, repeat the checking and, should the desired results not be obtained, proceed, without delay, to replacing the valve (or the valves) which have proved inefficient.

Replacement

- Disconnect the injector supply pipes from the delivery valves.
- Clean the hydraulic head carefully.
- By means of socket 8011354, unscrew the mounting ring nut and extract the delivery valve.
- Clean the hydraulic head by temporarily operating the fuel pump.
- Fit the new valve so that its slot engages with the locating pin of the seating (fig. 11).

- Fill with oil the valve seating in the hydraulic head.
- Using socket 8011354, screw in the valve securing ring nut, remembering to insert also the washer under the ring nut.
- Tighten definitively by means of a torque spanner set to 5mkg (36.17 lb/ft).
- Complete the reassembly by reversing the disassembly procedure.

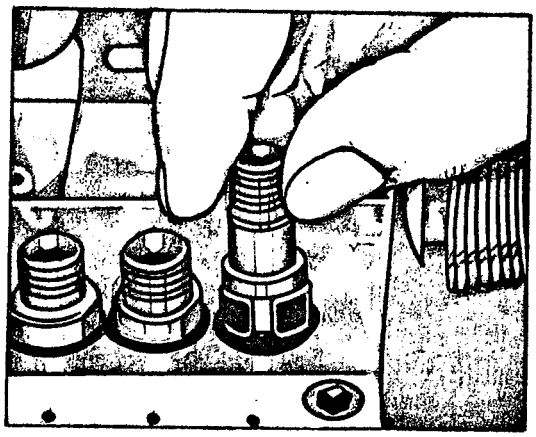


Fig. 11 - Fitting the Delivery Valve.

VENTING THE PUMP

- Disconnect the injector supply pipes from the delivery valves
- Turn the ignition key to operate the fuel pump only.
- Act on each delivery valve securing ring nut as follows: by means of socket 8011354, slacken it, let some fuel seep out together with the air trapped in the hydraulic head, then re-tighten the ring nut.
- Re-connect the injector fuel supply pipes.

CHECKING THE SEALING OIL DELIVERY TO THE HYDRAULIC HEAD

This checking must be carried out when the oil level in the pump has risen.

In this case, the petrol leakage into the pump oil sump is due to the lack of the sealing oil around the plungers owing to the clogging of the oil delivery pipe to the pump hydraulic head or owing to air-lock in the pipe.

The checking must be carried out as follows:

- disconnect the pipe from the hydraulic head;
- make sure that the banjo bolt is not clogged;
- push the ignition key to operate the starter motor and then release it immediately; should no oil flow out of the pipe, remove and check it.

  If, after the above checking, the pipe is found to be efficient, the cause of the trouble will have to be traced somewhere else, and in particular the operations "Sealing Test of the Hydraulic Head" and "Testing the Sealing Oil Ducts in the Hydraulic Head " will have to be carried out; both operations are described under "Operations on Bench" of the injection pump.

SYNCHRONIZING THE BUTTERFLY VALVE/INJECTION PUMP OPERATION.
(Figs. 12 - 13).

As already said during the description of the "Operating Principle" of the injection pump, in order that a predetermined proportion between air and fuel may be obtained, it is necessary that the displacements of the regulating cam along its axis be proportional to the angular movements of the butterfly valve.

The following operations aim just at obtaining the synchronization of such movements; to this end, the two levers controlling the butterfly valve and the injection pump are rigidly connected by proceeding as follows:

- remove the air cleaner;
- unhook the butterfly valve control lever return springs;
- remove the connecting rod (6) and check its length by means of tool 8015366; if necessary, adjust it by loosening the lock nuts and turning the rod. The rod has two opposite threads,i.e. right

and left-hand (the latter is identified by a groove), so as to facilitate the length adjustment;
- re-tighten the lock nuts;
- insert pin 8013352 (7), through the hole in the lever (8), into the proper slot in the pump housing;
- fit the connecting rod (6);
- slacken the screw locking the butterfly valve control lever;
- insert tool 8015365 (1) into the spline inside the butterfly valve housing and rest the butterfly valve on the tool end;
- re-tighten the butterfly valve control lever locking screw.

Once the two control levers have been connected as previously described, it will be necessary to carry out the following operation:

Setting the Butterfly Valve

a) Basic adjustment, with lever in the "intermediate" position ;

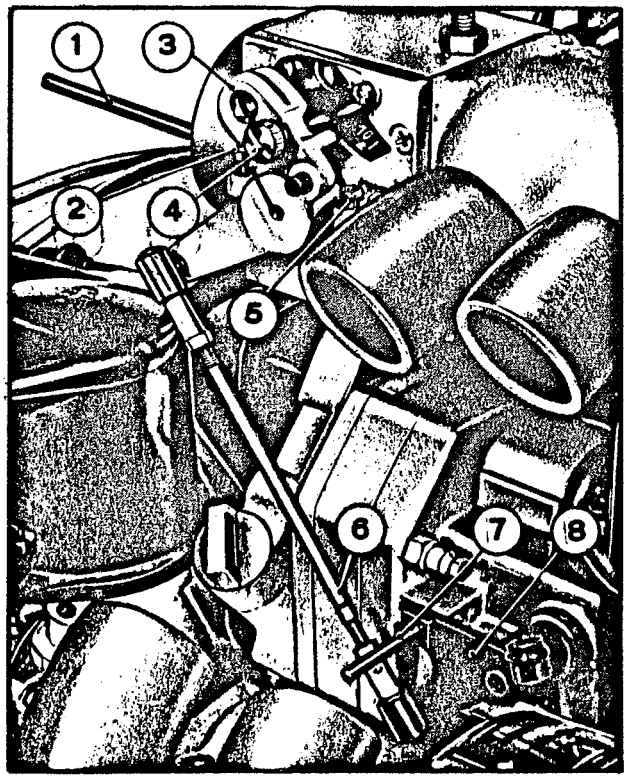


Fig. 12 - Synchronizing the Butterfly Valve / Injection Pump Operation.

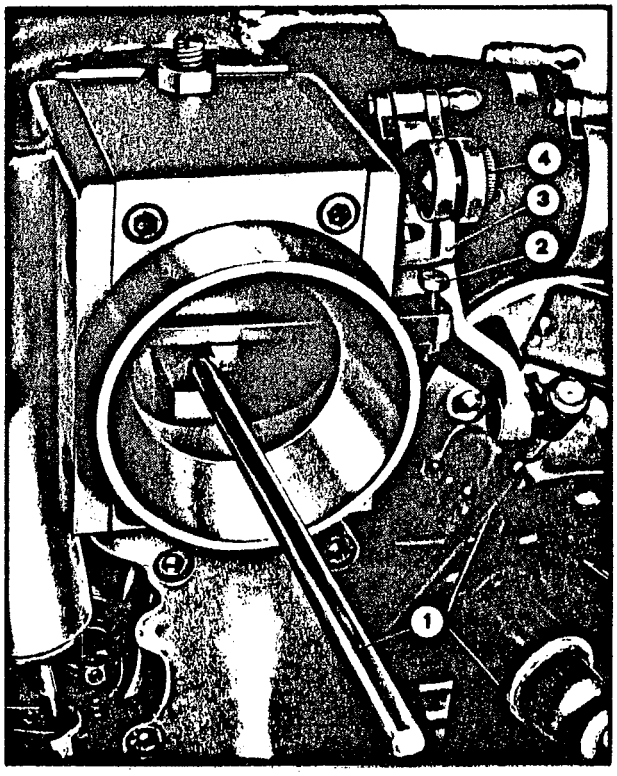


Fig. 13 - Use of Tool 8015365.

proceed as follows:

1. screw-in pointer 8015364 (4) and check that its conical end lines up with the intermediate mark (46 deg.) on the calibrated sector;
2. if not so, slacken the mounting screws and move the calibrated sector until the desired lining up has been obtained;
3. re-tighten the sector mounting screws;
4. remove the pin (7) and the tool (1);

b) Lever in the "maximum" position; proceed as follows:

1. rest the lever (3) against the butterfly valve max. opening (87°) stop screw (2);
2. make sure that the conical end of the pointer (4)lines up with the sector mark corresponding to such opening; if not so, have it line up by acting on the stop screw (4);
3. lock the screw (2) by means of the relevant locknut;

c) Lever in the "minimum" position; proceed as follows:

1. hook the butterfly valve control lever return springs again; if required, act on the stop screw (5) until the conical end of the pointer (4) lines up with mark 10 deg. on the calibrated sector;
2. lock the stop screw by means of the relevant locknut;
3. unscrew and remove the pointer 8015364 (4).

Once the adjustments have been completed, refit the parts in the reverse order to the removal.

CHECKING THE INJECTION TIMING

- Detach the alternator belt tension adjusting arm from the oil filler extension.
- Remove the oil filler extension
- Remove the ignition distributor cap.

- Turn the engine flywheel until mark "0", stamped on a tooth, is two teeth after mark 1/2 on the flywheel housing (fig. 14), paying attention that the ignition distributor rotor arm is aligned with the cable to cylinder No. 2. Should it not be so, turn the crank shaft a full turn until mark "0" is again two teeth after mark 1/2.

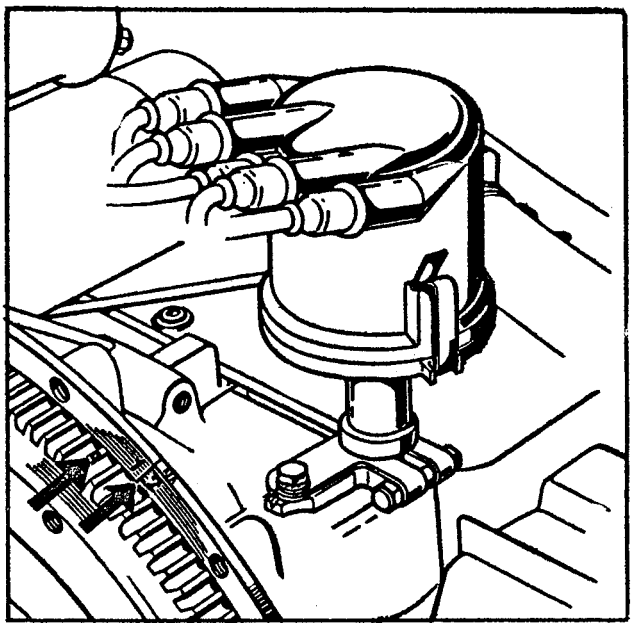


Fig. 14 - Flywheel Position for Timing the Injection.

- Check that the centerline of a tooth of the injection pump driving gear is in line with the timing mark stamped inside the oil filler integral with the crankcase top cover (2 - fig. 15), and that the marks stamped on the pump boss and on the driven gear hub are aligned (fig. 16).
  If the above does not occur , then it will be necessary to carry out the operation "Timing the Injection", as instructed hereinafter.

TIMING THE INJECTION

This operation must be carried out after making sure that both the ignition and the valve timings are correct (see the appendix at the end of the manual).

- Carry out the operation "Checking the Injection Timing".
- By means of suitable pliers, withdraw the injection pump drive shaft spring snap ring and remove the spring.
- Using tool 8012514 (1), partly extract the shaft (4 - fig. 15) .

- Turn the driving gear (3) by one tooth at a time, searching (by trial and error) the position in which, with drive shaft lower end engaging into its seat, the centerline of a tooth whatever of the driving gear is in line with the timing mark (2) located inside the oil filler (fig. 15).
- Remove puller-installer 8012514
- Refit the spring and secure it by means of the relevant snap ring.

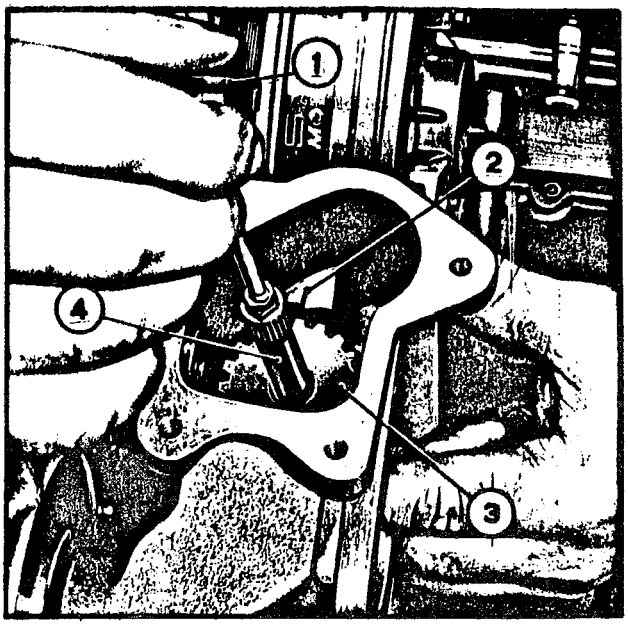


Fig. 15 - Position of the Driving Gear.

- Install the injection pump and, before locking it definitively, check that the timing marks located on the pump boss and on the driven gear hub are aligned.

Note - Starting from a certain engine serial number, the timing mark on the pump boss has been replaced by a hole.

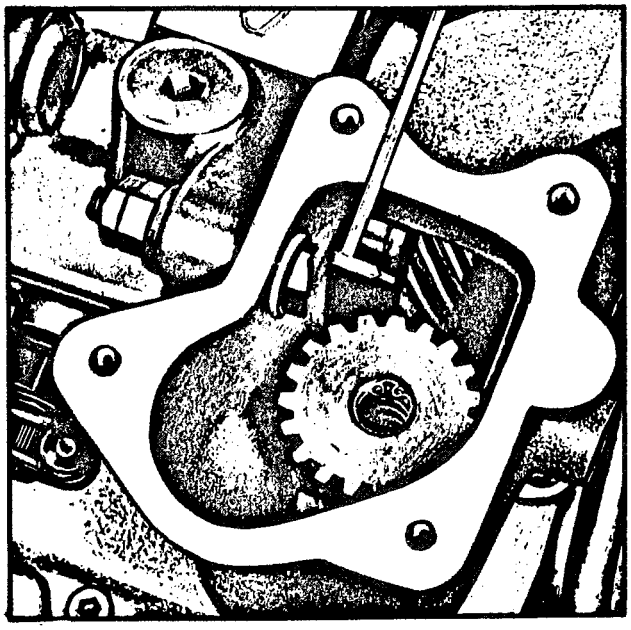


Fig. 16 - Timing the Injection Pump.

Such hole is used to insert tool 8015384, as shown in figure 16, which makes the checking considerably easier.

- Complete the reassembly by reversing the disassembly procedure.

SETTING THE ENRICHING DEVICE (Fig. 17)

- Remove the air cleaner.
- Disconnect the electric cable and remove the water temperatu r e gauge sending unit from the engine water outlet connector.
- Fit thermometer 8095800 (T) to its place. The thermometer c a g e is provided with a slightly tapered mounting thread ensuring a proper sealing, so that no gasket is required.
- See that the thermometer does not show a temperature in excess of 50 deg. C (122 deg. F); if not so, stop the engine until the level of the mercury drops below 50 deg.C (122 deg. F).
- Slacken the nut (3) locking the bush (4).
- Unscrew, as much as possible, the lock nut (7) and the enriching device lever (5) adjusting nut (6).
- Start the engine and heat the water up to a temperature of about 80 deg. C (176 deg.F); let it cool down to about 50 deg. C (122 deg.F) and then heat it again up to a temperature of 60 deg. C (140 deg. F.)

Note - During the subsequent operations, the water must remain at a steady temperature of 60 $\pm$ 2 deg.C (140 $\pm$ 3.6 deg. F).

- Using a spanner (1), unscrew the bush (4)by the amount required to uncover the groove.
- Fit tool 8013351 (2) into the groove.
- Screw-in the bush until the tool (2) contacts the enriching device body and, in this position, tighten the nut (3).
- Stop the engine and let the temperature of the water cool down a little. Owing to the cooling, the bush is forced by the spring to withdraw, but is held by the tool (2) fitted into the groove.
- With the bush in such position, screw-in the adjusting nut (6) until it just contacts the enriching device lever (5), t h e n

tighten the lock nut (7).

- Start the engine and heat the water up to a temperature of 60 deg. C. (140 deg.F) again.
- Remove tool 8013351 (2).

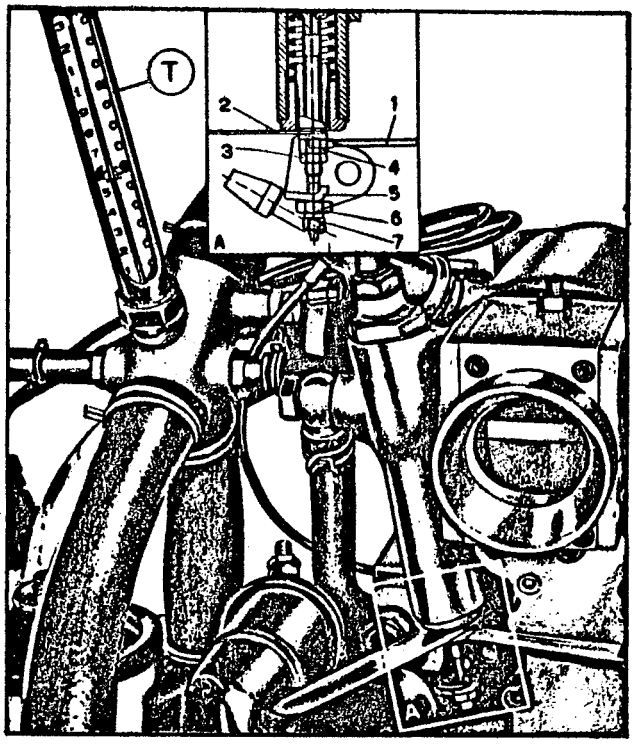


Fig. 17 - Setting the Enriching Device

- Raise the temperature of the water and make sure that the adjusting nut (6) moves away from the lever (5).
- When the water has reached a temperature of 80° deg.C. (176 deg.F), check that the distance between the lever and the adjusting nut is 3 mm (0.118 in.) approx.
- Stop the engine, unscrew the radiator filler cap and remove the thermometer (T).
- Refit the water temperature gauge sending unit and connect the electric cable.
- Refit the air cleaner.

PETROL INJECTION PUMP

SLOW-RUNNING ADJUSTMENT (fig. 18)

- This operation must be carried out with hot engine (80 deg. C - 176 deg. F approx.)
- Slacken off the locknut of the slow-running adjusting screw located on the butterfly valve housing top surface.
- By acting on the above screw, set the engine speed to 800 ÷ 900 r.p.m.
- Check that, after depressing the accelerator pedal one or more times, the engine does not revolve at a speed higher than the specified one; if necessary, screw-in the screw until the speed is restored to the proper value.
  (Screwing-in the adjusting screw will decrease the speed, whilst unscrewing will increase it).
- Tighten the locknut.

Note - If, on acting on the adjusting screw, poor or no effect on the engine revolving speed is noticed, it will be necessary to stop the engine, to remove the air cleaner and clean the by-pass duct by means of a brush, as shown in figure 19.

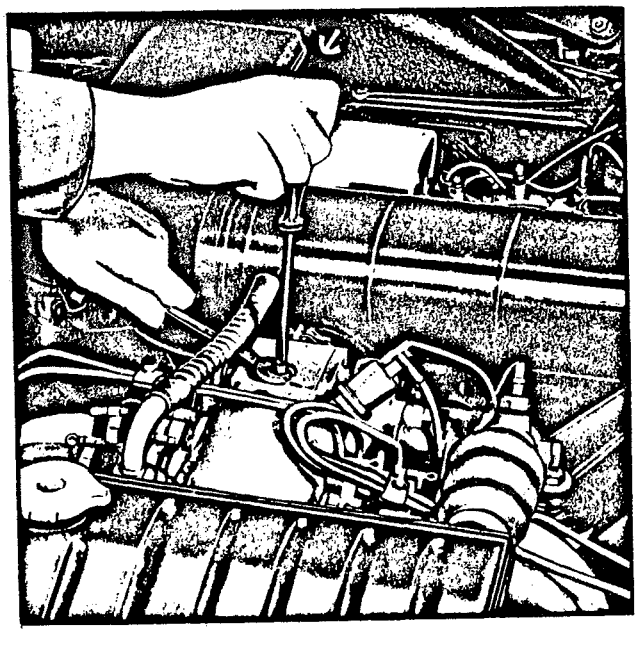


Fig.18 - Slow-Running Adjustment

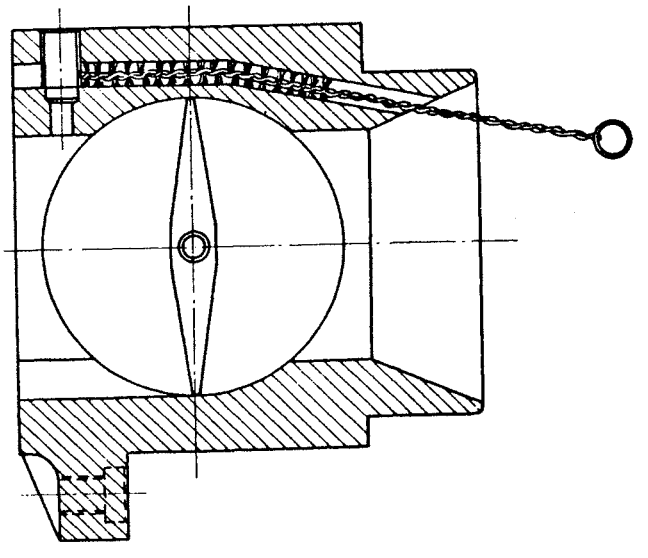


Fig. 19 - Cleaning the By-Pass Duct

REMOVAL AND REFITTING OF INJECTION PUMP

Removal

- Drain the cooling system.
- Lift off the air cleaner.
- Disconnect the fuel supply hose and the electric cable from the electrovalve.
- Disconnect the cables from the water temperature gauge sending unit and from the thermocontact.
- Disconnect the cable from the butterfly valve control lever.
- Remove the screw securing the engine water outlet connector to the left intake manifold.
- Disconnect the inlet and outlet hoses from the engine water outlet connector.
- Unscrew, from the enriching device, the banjo bolt securing the water outlet hose.
- Unscrew, from the injection pump hydraulic head, the connectors of the injector supply pipes.
- Unscrew the screws fixing the distributing chamber front end to the support bracket and the rear end to the butterfly valve housing.
- Loosen the intake manifold-to-cylinder head mounting screws and lift off the intake manifolds and the distributing chamber together.
- Unscrew, from the engine crankcase, the banjo bolt securing the engine -to-pump oil flexible hose.
- Detach the alternator mounting bracket from the oil filler extension.
- Remove the oil filler extension.
- Disconnect the fuel inlet and return pipes from the pump.
- Take out the engine oil level dipstick.
- Lift off the injection pump complete with butterfly valve housing.

Note - The butterfly valve/injection pump synchronization may be carried out either on the bench, or with the pump installed on the engine.

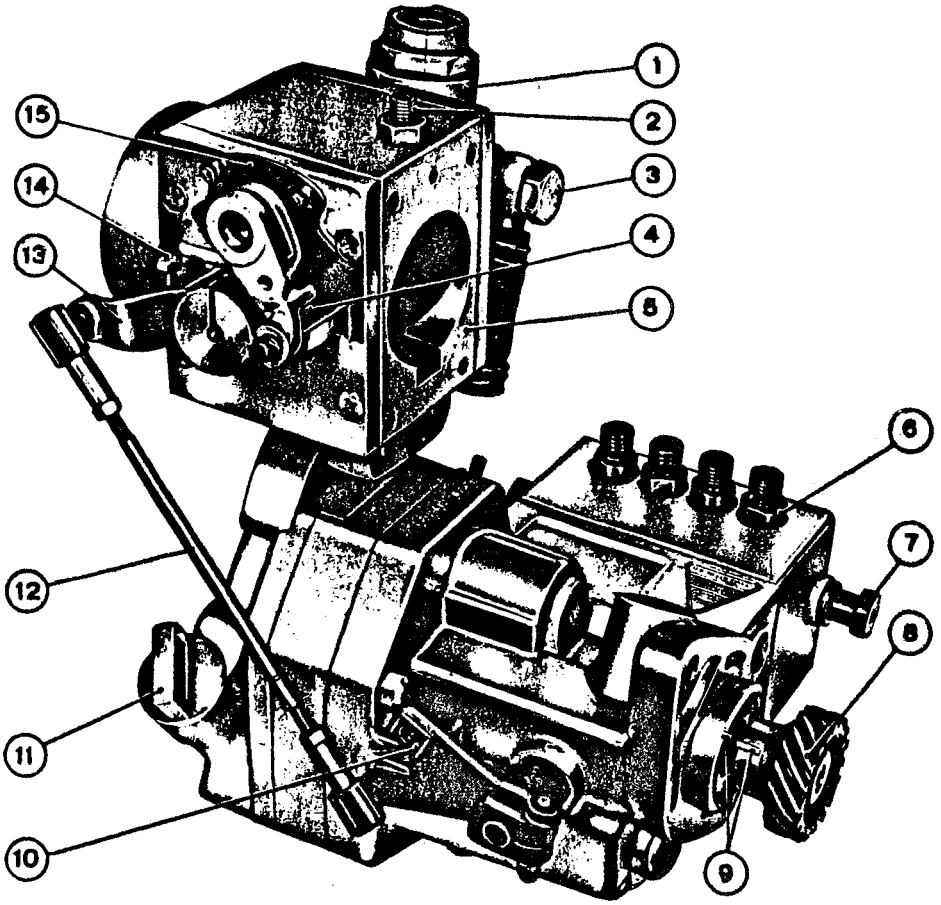


Fig. 20 - Injection Pump and Butterfly Valve Housing Assy.

1. Enriching device body - 2. Slow-running adjusting screw - 3. Water inlet hose banjo bolt - 4. Butterfly valve control lever stop screw - 5. Butterfly valve housing - 6. Fuel delivery valve locking ring nut - 7. Injection pump fuel inlet and electrovalve delivery connector - 8. Driven gear - 9. Injection timing marks - 10. Injection pump control lever - 11. Oil filler plug - 12. Butterfly valve and injection pump control lever connecting rod - 13. Butterfly valve control lever - 14. Butterfly valve control lever stop screw - 15. Calibrated sector.

Refitting

Before refitting the pump to the engine, it is necessaryto carry out the operation "Checking the Injection Timing" as instructed on page 37, then proceed as follows:

- Install the pump, positioning it suitably between starter motor

and ignition distributor and, before locking it, make sure that the timing marks stamped on the driven gear hub and on the injection pump boss are aligned.

Note - Starting from a certain engine serial number, the timing mark stamped on the pump boss has been replaced by a hole. Such hole is used to insert tool 8015384, as shown in fig.16, which considerably facilitates the checking.

- Fit the oil filler extension.
- Secure the alternator mounting bracket and check the drive belt for tension.
- Screw-in the banjo bolt securing the injection pump oil supply flexible hose onto the crankcase.
- Connect the fuel inlet and return hoses to the pump hydraulic head (tighten the banjo bolts to 0.8 ÷ 1 mkg - 5.78 ÷ 7.23 lb.ft.).
- Fit the intake manifolds together with the distributing chamber, then secure the distributing chamber front end to the support bracket and the rear end to the butterfly valve housing.

Caution - When refitting the intake manifolds to the cylinderheads, pay attention not to interchange gaskets 2136138 (to be inserted between manifold supports and cylinder heads) with gaskets 2219345 (to be fitted between manifold supports and manifolds). Such mistake would result in the stopping of the water circulation in the engine.

- Connect the fuel inlet hose to the electrovalve and carry out the operation "Venting the Pump" as instructed on page 34.
- Connect the injector supply pipes to the injection pump.
- Screw-in the banjo bolt securing the water outlet hose to the enriching device.
- Fit the engine water outlet connector and connect the water circulation hoses to it.
- Connect the electric cables to the water temperature gauge sending unit on the engine water outlet connector and to the thermo-

contact on the enriching device body.

- Connect the wire to the electrovalve.
- Re-connect the control cable to the butterfly valve controllever.
- Refit the oil filler and breather cap.
- Refit the air cleaner.
- Replenish the cooling system.
- Start the engine and check all connectors for sealing.
- With engine running, slacken the oil supply flexible hose to pump hydraulic head securing banjo bolt, let some oil seep out, then screw it in again.
- Carry out the operations "Setting the Enriching Device" and "Slow Running Adjustment", as instructed under the relevant paragraphs.

I M P O R T A N T

1) All the operations specified hereinafter may be carried out by our Branches and by the Manufacturer, or his Authorized Workshops provided with proper test benches. To this end, Lancia h a v e provided a special additional equipment for the normal D i esel engine injection pump test benches.

2) In order to ensure a perfect operation of the pump, it is imperative that the specifications and the directions detailed in the following pages be observed.
This Kugelfischer petrol injection pump has high-precision technical and manufacturing features, which require special accuracy and cleanliness in carrying out the various overhaul operations described hereinafter.

Note - Non-complying with the above directions will result in the cancellation of the guarantee; this will also be no longer applicable if we ascertain that the relevant seals have been removed or even only tampered with.

PETROL INJECTION PUMP

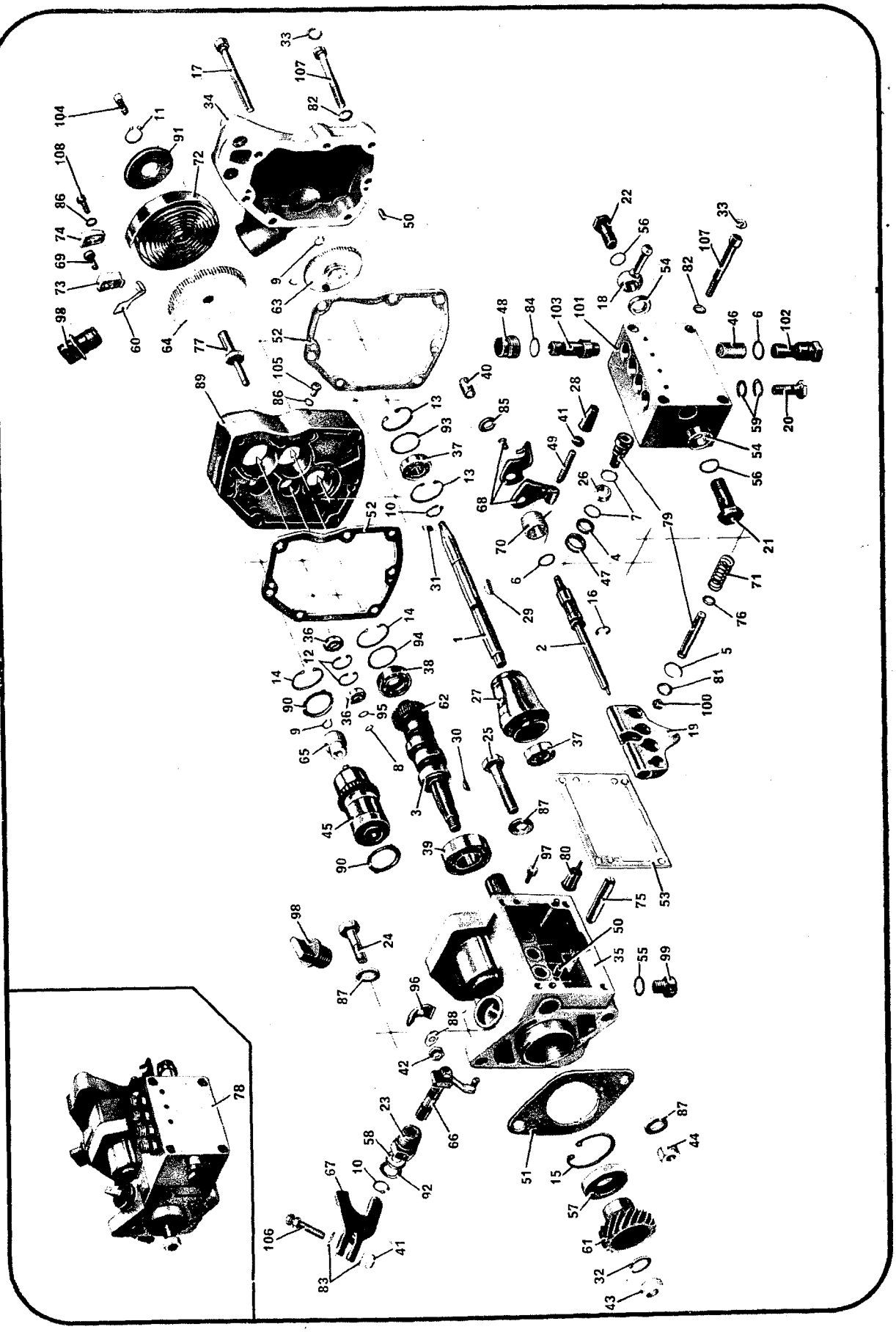


Table 2 - Injection Pump Components (from Spare Parts Catalogue)

T O O L L I S T

The additional equipment 8016350 described in sketch 1113 I (to be used with test bench 8016850) and outfit 8016351, detailed hereinafter, form the complete set of equipments and tools necessary to carry out any operation of normal maintenance, tune-up, service coupons, setting check and overhaul (on car or at the bench) of the petrol injection system.

OUTFIT 8016351

(Complete set of tools necessary for operations on car and for overhaul at the bench of the injection pump carried out by Lancia Branches):

8011354		Socket for injection pump fuel delivery valve mounting ring nut.
8011355		Double hexagon socket for injection pump plunger mounting ring nut.
8012351		Puller for governor support flange (to be used with 8022912).
8012514	*	Puller-installer for injection pump drive shaft.
8012854	*	Puller for injection pump plunger.
8012868	*	Universal puller for injection pump driven gear.
8013030		Connector for pressure gauge 8095452.
8013351		Tool to hold fuel enriching device pushrod bush.
8013352		Pin to lock the injection pump control lever.
8013353		Fixture to locate the injection pump control lever to the cam control lever.
8015364		Pointer to set the butterfly valve control lever.
8015365		Tool for setting the butterfly valve opening .
8015366		Tool for adjusting the length of the butterfly valve-to-injection pump lever connecting rod .
8015377		Gauge to set the injection pump at the test bench.
8015378		Fixture to check travel of injection pump plungers.
8015384		Gauge to time the injection pump.
8015392		Tool to check position of injection pump governor gear.
8017350		Support plate for injection pump overhaul.
8095452		Pressure gauge.
8095800		Thermometer with cage to check the engine water temperature when setting the enriching device.

Note - For the tool set necessary only for operations on car carried out by selling agencies, foreign concessionaires and authorized services, see outfit No.8016352 on page 2.

* Already existing for previous use.

PRECAUTIONS TO BE TAKEN ON DISMANTLING AND REASSEMBLING THE INJECTION PUMP

During the injection pump reassembly operations, it is advisable to arrange on the bench a proper container filled with trichloroethylene where every pump component will have to be dipped and shaken before being refitted to its place.

Should foreign matter be noticed in the trichloroethylene, this will have to be filtered with blotting paper.

The trichloroethylene will also do to facilitate the removal of special gaskets (52-53 - Table 2) from the relevant mounting surfaces.

Obviously, when using the trichloroethylene, care must be taken that it does not remain in touch with the skin for a long time.

OPERATIONS ON BENCH

Note - All the parts composing the injection pump referred to in this chapter may be identified by the reference numbers given in table 2, which is taken from the Spare Parts Catalogue.

CHECKING THE DELIVERY AND THE HYSTERESIS

The operation of the pump may be considered satisfactory, when the delivery and hysteresis specifications (with lever in all positions and at all testing speeds) comply with those of Sketch 1086 I. The delivery checkings are carried out with pump control lever (67) in three different positions: "minimum", "intermediate","maximum ".

To secure the lever in the three positions, it is necessary to use gauge 8015377 and pin 8013352. The former has to be fitted to the pump by inserting the register lip into the slot machined in the housing, whilst the latter has to be inserted into one of the three holes in the gauge (for the "minimum" position, insert pin 8013352, through the hole in lever (67), into the upper hole in gauge 8015377, whilst for the "maximum" position insert it into the lower hole).

With lever in the "minimum" position, the checkings are carried out at one pump speed only: 350 r.p.m.

With lever in the "intermediate" position, the checkings are carried out at the following pump speeds: 350-1400-2800 r.p.m.

With lever in the "maximum" position, the checkings are carried out at the following pump speeds: 1400-2800 r.p.m.

When carrying out any checking under the various testing conditions, it is necessary to make sure that the difference between the maximum and minimum deliveries measured by the four test tubes is not in excess of 1 c.c.

Two checkings must be carried out at every pump speed and with control lever in any position: one by increasing the delivery, that is by reaching the testing speed starting from a slower one; and one by decreasing the delivery, that is by attaining the testing speed from a faster one; the hysteresis is obtained by subtracting the smaller value from the greater one.

The procedures to install the pump on test bench 8016850 (with additional equipment 8016350) and to make the relevant connections are given in Sketch 1113 I.

Hereinafter, we are giving an example of the delivery checking of a pump revolving at a specified speed (1400 r.p.m.) and with control lever in a determined position (intermediate).

ALL READINGS ARE TAKEN AT 1000 PUMP SHOTS

CONTROL LEVER POSITION	PUMP SPEED r.p.m.		READINGS-ERRORS-HYSTERESIS (c.c.) 1 reading	1 E Hy.	2 reading	2 E Hy.	3 reading	3 E Hy.	4 reading	4 E Hy.	DIFFERENCES BETWEEN TEST TUBES Acceptable YES-NOT	HYSTERESIS Acceptable YES-NOT	NOTES
Intermediate	1400	incr. speed	27	-	26.5	-	27.3	-	26.8	-	YES		
		decr. speed											

From the above table (taken from the card for the test at the bench of the injection pump), it can be noted that, with pump in the above testing conditions, the values read, on increasing the speed, for all the four plungers (79) are within the specified limits (26 to 29 c.c.) and that the difference between the max.value (27.3 c.c.) and the minimum one (26.5 c.c.) does not exceed 1 c.c. and therefore it can be accepted (see Sketch 1086 I).

The same example given above is resumed and completed in the

following table stating the values found on decreasing the speed and, beside them, the hysteresis (Hy.) found.

ALL READINGS ARE TAKEN AT 1000 PUMP SHOTS														
CONTROL LEVER POSITION	PUMP SPEED r.p.m.		READINGS-ERRORS-HYSTERESIS (c.c.)								DIFFERENCES BETWEEN TEST TUBES	HYSTERESIS	NOTES
			1		2		3		4				
			Reading	E / Hy.	Reading	E / Hy.	Reading	E / Hy.	Reading	E / Hy.	Acceptable YES-NO	Acceptable YES-NO	
Intermediate	1400	incr. speed	27	-	26.5	-	27.3	-	26.8	-	YES	YES	
		decr. speed	27.3	0.3	27	0.5	27.6	0.3	27.2	0.4			

Should the values found on checking the delivery and the hysteresis differ from the specifications given in Sketch 1086 I, the possible causes of defects existing in the pump may be deduced.

Hereinafter, we are giving the main cases of troubles which may be detected on checking the delivery and the hysteresis, and each case is followed by the description of the probable causes which have originated it.

1. Under one or more testing conditions, the deliveries of the four plungers are greater or smaller than the normal ones.

Probable causes: improperly set or binding governor, weak magnetic device (45), spring (72) weak or even slipped off the clamps (73-74).

2. Under all testing conditions, the deliveries of the four plungers are all increased or decreased by the same amount.

Probable causes: improper setting of adjusting pin (49) for enriching device control lever (68), which results in lowering or lifting of the plunger travel regulating rocker (19) by the eccentric

shaft (2).
Lowering of the ball piece seats (100) owing to wear (deliveries increased).
Wear of the follower pin ball surface (75)(deliveries increased), or of the steel pad fitted to the regulating rocker (19).

3. Under one or more testing conditions, the deliveries of one or more plungers are lower than the specified ones.

Probable causes: plungers sliding with difficulty in the relevant barrels (slight seizure).
Plunger returning springs weak or broken; camshaft (3) cams or tappets (80) worn out, depressions in the surfaces of plungers (79) caused by the action of tappets (80).
Inlet and delivery valves improperly sealed.

4. Under one or more testing conditions, hysteresis exceeds 1 c.c.

Probable causes: improper governor setting. Bearings of shaft (1), or bearings (36) binding. Teeth of gears (63)(77)(64) and (65) with burrs, or broken in some places. Surface of regulating cam (27) with scorings or hard spots preventing the proper sliding on the ball surface of the follower pin (75). Ball surface of follower pin (75) in touch with the regulating cam, which presents hard spots hindering the free sliding of the cam (27). Follower pin (75) with foreign matters or slight seizure in its seat, which prevent a free axial movement.
Roughness on the steel pad fitted to the regulating rocker (19), or on the ball surface of the follower pin (75), with consequent poor sliding. Eccentric shaft (2) binding in the regulating rocker (19), with consequent poor rotation of the rocker itself.

CHECKING THE GOVERNOR

This operation must be carried out whenever the check of the delivery and hysteresis has given results not complying with the specifications of Sketch 1086 I and denoting a faulty operation of the governor (see "Troubles and Probable Causes" described under the preceding paragraph).

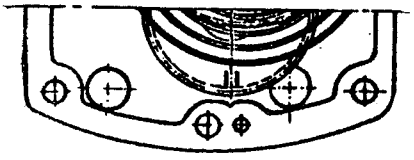
Preliminary Operations

- Drain the oil from the pump.
- Secure the pump onto support plate 8017350 and lock this in a vice.
- Carry out the operation "Removing the Hydraulic Head" following the procedure described on page 66; lift off the plunger travel regulating rocker (19) and withdraw the cam follower pin (75) and the tappets (80).
- Remove the governor cover plate (34) from the pump.
- Secure the governor support flange (89) to the pump housing by using two screws of suitable length and two washers.
- Remove the pump from the support plate and install it on the test bench.
- Start the motor of the test bench and let it operate for a few minutes.

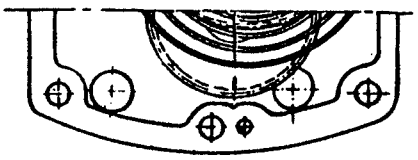
Specifications and Checkings

Three reference marks can be noticed on the gear (63) fitted to the governor shaft (1) of the regulating cam (27); such marks correspond to three different pump speeds and precisely: 200 r.p.m. = two marks; 1400 r.p.m. = one mark; 2800 r.p.m. = two marks. When the pump camshaft (3) revolves at the speeds specified above, the following conditions must occur:

1. at 200 r.p.m., the reference mark on the governor support flange (or gauge 8015392) will have to be midway between the two marks on the gear;
2. at 1400 r.p.m., the mark on the gear will have to be aligned with the one on the governor support flange;

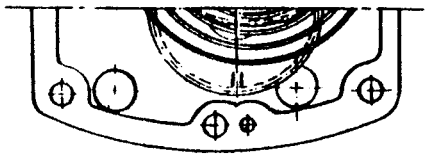


for 200 r.p.m.



for 1400 r.p.m.

3. at 2800 r.p.m., the reference mark on the governor support flange will have to be midway between the other two marks on the gear.



for 2800 r.p.m.

Checking the Hysteresis (referred to the governor only).

In this case there will be hysteresis when one of the reference marks, stamped on the governor gear, stops in two different positions (for the engine speed considered), according to whether such speed has been attained on increasing or decreasing the revolutions per minute.

The hysteresis value, therefore, is given by the angle included between these two positions.

The hysteresis of the governor is to be considered satisfactory when, on carrying out the test at the three different speeds (200, 1400, 2800 r.p.m.), the following conditions are observed:

- at 200 r.p.m., the maximum admitted hysteresis value is the one corresponding to an angle, the width of which does not exceed that of the two marks on the governor gear relative to such speed. In other words, during the two checkings carried out by increasing and by decreasing the speed, the reference mark located on the governor support flange must remain within the two marks on the gear;
- at 1400 r.p.m., the hysteresis value shall be "0". That is to say, the mark on the governor gear must be in line with the reference mark on the governor support flange, whether the test is carried out on attaining the speed of 1400 r.p.m. by increasing or by decreasing the revolutions per minute;
- at 2800 r.p.m., for the maximum admitted hysteresis value, follow the directions given for the test at 200 r.p.m., obviously with the only variation that in this case it is necessary to consider the two marks on the governor gear, corresponding to the speed of 2800 r.p.m. As admitted hysteresis applies again the width of

these two marks.

Should all the above conditions, or some of them, not be observed, the reason for such possible troubles is due to:

1. Axial forcing of governor shaft bearings (37); in this case, proceed as follows:
   - slacken the governor support flange mounting screws;
   - if the hysteresis disappears, re-tighten the mounting screws and slightly tap on the governor shaft with a light hammer.
2. Wear of the gears (64)(65)(77) and (63); in such a case, proceed as follows:
   - gradually vary the pump speed and make sure that the governor gradually follows the speed variations;
   - should the governor jam in some point, check that the gear teeth, meshing in that moment, are not excessively worn out or damaged; if necessary, renew the gears.

SETTING THE GOVERNOR (fig. 21)

To be carried out if, while "Checking the Governor", the conditions under points 1.2.3. do not occur.

- Set the test bench motor speed to 1400 r.p.m.
- Hold the spiral spring carrying gear (64) and loosen the relevant locking screw (104).
- Still holding the spiral spring carrying gear and with bench motor running, turn the governor shaft gear (63) until the reference mark corresponding to 1400 r.p.m. (one mark) is aligned with that on the governor support flange (89) and, in such position, temporarily lock the spiral spring carrying gear (64) by slightly tightening the screw (104).
- After locking the gear, make sure that the marks are still aligned.
- Change the test bench motor speed down to 200 r.p.m.
- Should the reference mark on the governor support flange not be within the tolerance limits corresponding to 200 r.p.m., hold the governor shaft gear (63) and turn the spiral spring carrying gear

in the suitable direction and by the amount deemed sufficient to correct the misalignment.

- Release the spiral spring carrying gear and make sure that the difference has disappeared, otherwise repeat the operation described above.
- Reset the test bench motor speed to 1400 r.p.m.
- Make sure that the initial setting has not been altered;if necessary, proceed as follows: by means of suitable pliers, hold the end of spring (72), slacken the screw securing the clamp (74) and load or release the spring by the amount required to correct the misalignment.
- At this stage, it will be necessary to carry out the checking at 2800 r.p.m. by proceeding as follows:
- set the motor speed to 2800 r.p.m;
- make sure that the reference mark on the governor support flange is midway between the two marks (on the governor shaft gear)corresponding to the test speed; possible adjustments may be carried out by slackening the screw securing the clamp (74) and varying the load of the spring (72).

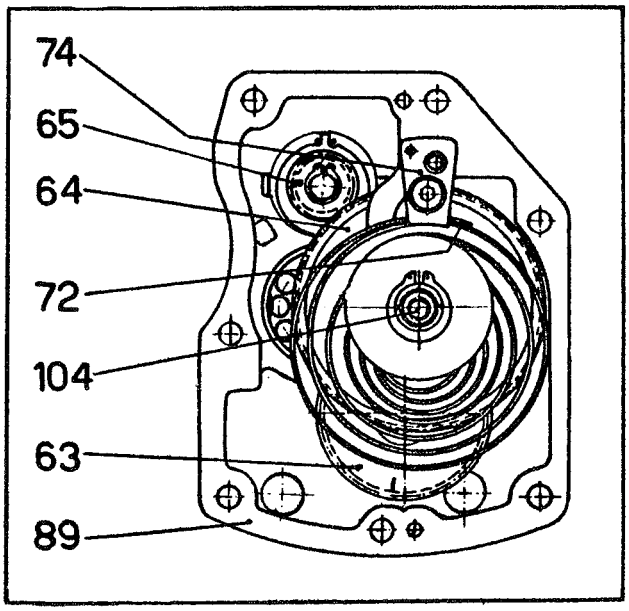


Fig. 21 - Governor Spiral Spring and Gear

Once the last setting has been completed, it will be necessary to repeat the checkings at the other two speeds and to make sure that the previous settings have not been disturbed; if required, repeat the settings and should it be impossible renew the spring (72).

These alternate settings will have to be effected until at all three testing speeds the reference marks on the governor shaft gear (63) are in the correct position as compared with the mark

on the governor support flange (89).

When the setting operations have been completed, it will be necessary to definitively tighten the screw (104) securing the spiral spring carrying gear (64) and the screw securing the clamp(74), but without tightening the latter excessively.

CHECKING THE PLUNGER TRAVEL

It has already been said that the deliveries of all four plungers must be equal one another or, at the maximum, may differ by 1 c.c. every 1000 pump shots; in addition, it has also been specified that the deliveries at the various pump speeds must be within the values given in Sketch 1086 I.

If, when checking the delivery, this results poor or excessive for all or for some plungers, it will be necessary to proceed as follows:

Preliminary Operations

- Carry out the operation "Removing the Hydraulic Head", following the procedure described on page 66.
- By means of pin 8013352, lock the pump control lever in the intermediate position.
- Zero-reset the dial gauge of fixture 8015378 (fig.22) by proceeding as follows: rest the gauge sleeve against the fixture body and align the pointer with mark "0".
- Arrange the plate of fixture 8015378 on the pump housing.

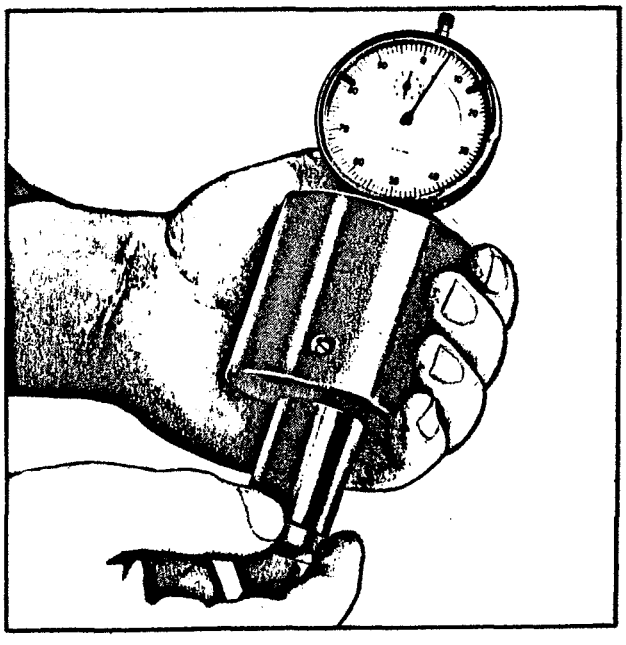


Fig. 22 - Zero-resetting the Dial Gauge

- Fit the dial gauge, already zero-reset, to the plate by inserting its stem into one of the holes.

Checking

- Turn the camshaft (3) and make sure that, with the tappet to be checked at its T.D.C., the gauge pointer lines up with mark "0" (maximum allowed tolerance: ± 0.005 mm = 0.0002 ").
- Zero-reset the gauge after each checking and repeat the test on the other tappets.

If, during the above checkings, the gauge pointer shifts beyond the tolerance limits, two cases may occur:

a) in all measurements, the gauge pointer always shifts from mark "0" by the same amount and in the same rotation direction:
   - carry out the basic adjustment of the plunger travel by acting on the adjusting pin (49) of the enriching device lever (68)(refer to fig. 24).

b) in one or more measurements, the gauge pointer shifts from "0" by different amounts:
   - replace the ball pieces concerned by following the procedure described under operation "Setting the Plunger Travel".

SETTING THE PLUNGER TRAVEL

Foreword

In describing the "Operating Principle" of the injection pump, we stated that the travel of each plunger (79) is exactly equal to the amount by which the end of tappet (80) protrudes from the relevant ball piece (100), and is also directly proportional to the fuel delivery; it follows that the fuel deliveries are also directly proportional to the protrusion of tappet ends from the relevant ball pieces.

Should the tappet end protrusions differ one another, the fuel deliveries would also differ;this results in the necessity for all the tappet ends to protrude by an equal amount, with a maximum allowed difference of ± 0.005 mm(0.0002 in.). It is just by fitting ball pieces of specific thickness, that this uniformity is obtained.

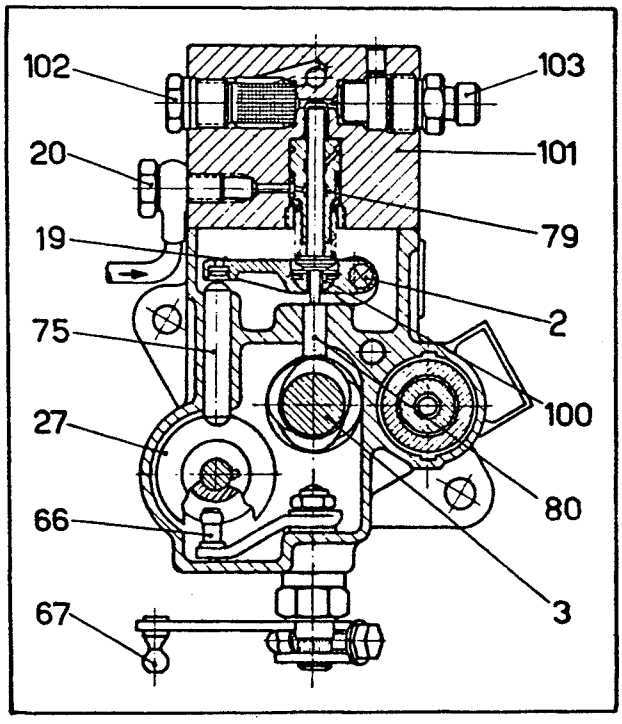


Fig. 23 - Injection Pump Section

For this adjustment, it is necessary to set the regulating cam (27) in such a position that the cam follower pin (75) will make the plunger travel regulating rocker (19) take a determined position, which will allow the tappet end to protrude from the ball piece by a given amount.

The position which the regulating cam will take is that corresponding to the intermediate one of the pump control lever (67) .

For such position of the cam, the tappet end, when at the T.D.C., will protrude from the relevant ball piece by 1.255±0.005 mm(0.0494 ± 0.0002").

Such protrusion is reproduced inside the gauge sleeve of fixture 8015378; it is just by means of such sleeve that the dial gauge of the fixture is set to zero (refer to the operation "Checking the Plunger Travel").

Basic Adjustment

Once the preliminary operations described under paragraph "Checking the Plunger Travel" have been completed and before fitting the plate of fixture 8015378, replace one ball piece with another, the thickness of which is already known (for example; 4.00 mm - 0.1574"), then proceed as follows:

- fit the plate of fixture 8015378 to the pump housing;
- fit the dial gauge to the plate by inserting its stem into the hole corresponding to the ball piece replaced;
- turn the camshaft; the pointer of the dial gauge will move, following the rotation of the shaft; when the pointer will commence reversing its motion, stop turning the camshaft; this being in such position, the cam controlling the tappet of the ball piece under measurement is at its T.D.C., and the end of the tappet in question will have to protrude from the relevant ball piece by 1.255±0.005 mm(0.0494 ± 0.0002 ");
- make sure that the gauge pointer is aligned with mark "0"; possible corrections may be carried out by screwing in or out the adjusting pin (49) of the enriching device lever(68) (see fig. 24).

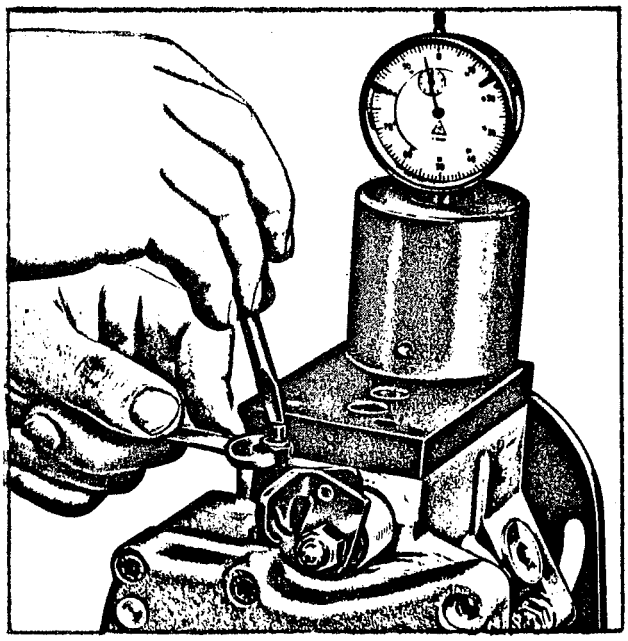


Fig. 24 - Plunger Travel Basic Adjustment

With the above operations, the travel adjustment of one plunger

has been carried out; repeat it now to adjust the travel of the other plungers.

In order not to alter the basic adjustment just carried out, it is necessary to protect the adjusting pin (49) by fitting a cap(28), which, once the pump has been re-assembled, must not be disturbed. Important. Do not disturb the zero-resetting of the dial gauge during the measurement. After each measurement, check the zero-resetting and, if necessary, zero-reset.

- Insert the stem of the dial gauge,duly zero-reset, into the hole of the next ball piece.
- Turn the camshaft and make sure that, when the cam corresponding to the ball piece under checking is at its T.D.C., the pointerof the dial gauge is in line with mark "0".
- Should this not occur, it will be necessary to renew the ball piece (100) with a new one of different thickness.
- Follow the same procedure for the remaining ball pieces.

Renewing the Ball Pieces

The available ball pieces are of various thicknesses ranging from a minimum of 3.88 mm(0.1527") to a maximum of 4.11 mm(0.1618 "),and the intermediate ones present a progression of 0.01 mm (0.0004 "): 3.88 (0.1527") - 3.89 (0.1531") - 3.90 (0.1535")....4.09 (0.1610") 4.10 (0.1614") - 4.11 (0.1618").

The procedure for determining the thickness of the new ball piece is as follows:

- replace the ball piece with a master one of a given thickness,for inst. 4.00 mm (0.1574"). The 4.00 mm thick master ball piece is chosen for calculation convenience;a mark whatever (e.g. a paint touch) is then made on it, so as to distinguish it from the others,

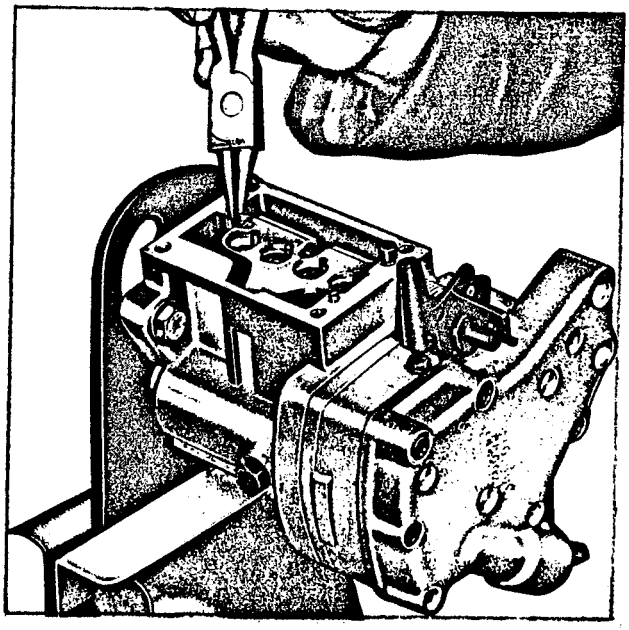


Fig. 25 - Renewing a Ball Piece

for example: 

- take the reading on the dial gauge.

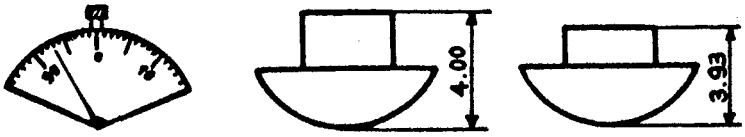
Three readings may be observed:

1. <u>The pointer of the dial gauge does not reach "0".</u>

This occurs when, the master ball piece (4.00 mm - 0.1574 ") being thicker than required, the end of tappet (80),at its T.D.C., protrudes from the ball piece (100) less than necessary.

To correct such protrusion,it will be necessary to replace the master ball piece (4.00 mm-0.1574") with a thinner one,the thickness of which is reckoned by making the following subtraction :

master ball piece	4.00 mm
reading taken	- 0.07 mm
NEW BALL PIECE	3.93 mm

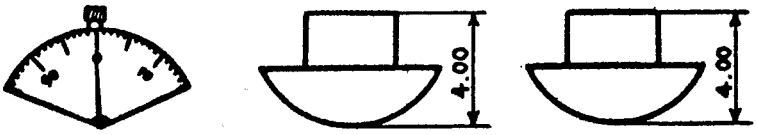


Reading Master ball piece NEW BALL PIECE

2. <u>The pointer of the dial gauge lines up with "0".</u>

This takes place when the thickness of the master ball piece (4.00 mm-0.1574 ")is just the right one to make the tappet(80), at its T.D.C.,protrude from the ball piece (100)by the proper amount.

In such a case,just to recover the master ball piece,it will be necessary to replace it with another one having the same thickness.



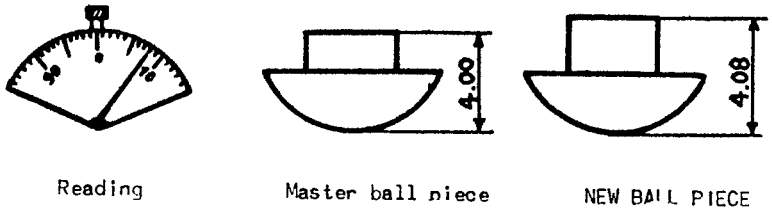
Reading Master ball piece NEW BALL PIECE

3. <u>The pointer of the dial gauge goes beyond mark "0".</u>

This occurs when, the master ball piece (4.00 mm-0.1574") being thinner than required,the end of tappet (80),at its T.D.C., protrudes from the ball piece (100) more than necessary.

To correct such protrusion, it will be necessary to replace the master ball piece (4.00mm-0.1574") with a thicker one, the thickness of which is reckoned by making the following addition :

master ball piece	4.00 mm
reading taken	+ 0.08 mm
NEW BALL PIECE	4.08 mm



Reading — Master ball piece — NEW BALL PIECE

After setting the travel of all plungers, secure the ball pieces by fitting washer (81) and circlip (5).

Note - Small corrections of the ball piece thickness may be obtained by rubbing the top face with very fine emery cloth.

SEALING TEST OF HYDRAULIC HEAD

Foreword

This operation has to be carried out during the general overhaul and anyhow whenever fuel leakages into the pump oil sump have been noticed.

Such leakages might be caused by:

1. Poor sealing of "O" rings fitted to the plungers: in such a case the fuel leakage (with plunger fitted) may occur through the ring nut (47), or through the fuel return port.

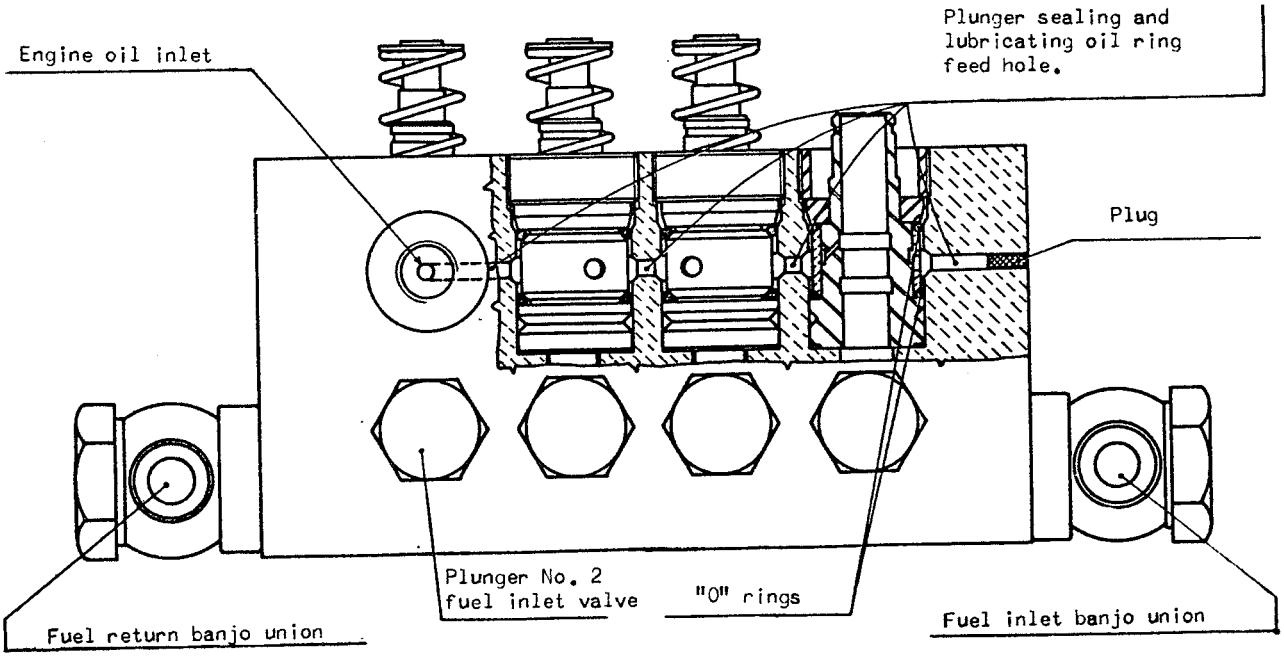


Fig. 25 bis - Hydraulic Head: Section through Oilways

2. Lack of sealing oil ring between plunger and barrel (79)(on one or more plungers) owing to the oilway being clogged (see figure 25 bis).

Preliminary Operations

If the pump is completely assembled, proceed as follows:

- drain the oil from the pump;
- secure the pump to support plate 8017350 and grip the latter in a vice;
- untighten the four hydraulic head mounting screws (107)(one of them is covered by a seal bearing the Kugelfischer stamp, or the Lancia one, if the pump has already been overhauled at a Lancia Branch);
- completely unscrew three of such screws, and then , applying a certain pressure on the hydraulic head, unscrew the last screw and remove the hydraulic head with relevant gasket,taking care that the plungers do not slide off the relevant barrels;
- take out the plungers one by one,remove the return springs and then refit the plungers to the bottom of their seats, paying attention not to interchange them;
- connect the injector hand-testing pump to the oil inlet port on the hydraulic head.

1st Test : (relevant to the trouble specified under point 1).

By means of the injector hand-testing pump,force testing fluid into the hydraulic head up to building up a pressure of 10 atm.;at this moment, two cases may occur:

- the pressure stays on for some time, after giving up operating the hand-testing pump, and no testing fluid leakages are noticed, either from the plunger mounting ring nuts (47) or from the fuel return port.

In such a case, it must be concluded that the oil "O" rings fitted to the plungers seal perfectly.

- The pressure drops more or less rapidly and leakages are noticed from the ring nuts (47) or from the fuel return port.

In this case, the "O" rings (all or some of them) do not seal properly and they will have to be renewed (it is advisable to renew all the eight "O" rings fitted to the four plungers). After completing this test, repeat it and proceed to carrying out the second test.

2nd Test:

- take out one plunger, hold the other three, and force testing fluid in by means of hand-testing pump 8015853;
- if the testing fluid flows freely and the gauge does not indicate a pressure above 1 to 1.5 atmospheres, it means that the inlet gallery of this plunger is clear;
- if the testing fluid pumped at this pressure does not flow freely, try to unclog the ducts by raising the pressure up to 10 atm.;
- repeat the foregoing procedure on the other three plungers.

If the increase of the fluid pressure has not sufficed to unclog the duct concerned, it will be necessary to remove all plungers, to clean the circular grooves machined in the plunger seats one by one, and then, after dipping the head in trichloroethylene, to make sure that all the ducts concerned are clear by applying air pressure.

INJECTION PUMP GENERAL OVERHAUL

Note - Before disassembling the injection pump, carry out the following operations:

- clean it carefully;
- make sure that the guarantee seals bearing the Lancia or Kugelfischer stamps have not been removed or damaged;
- check the conditions of the pump housing;
- drain the lubricating oil.

HYDRAULIC HEAD

Removing the Hydraulic Head from the Injection Pump (table 2)

- Install the pump on support plate 8017350 (fig.26) and lock the latter in a vice.
- Unscrew the mounting screws (107- one of them bears a guarantee seal with the Kugelfischer stamp or the Lancia one, if the pump has already been disassembled at a Lancia Branch), then remove the hydraulic head (101) and the relevant gasket (53)(to facilitate the removal, moisten it with a brush dipped in trichloroethylene); during this operation, apply a slight pressure on the head against the thrust of the inner springs, so as to prevent the plungers (79) from sliding off.

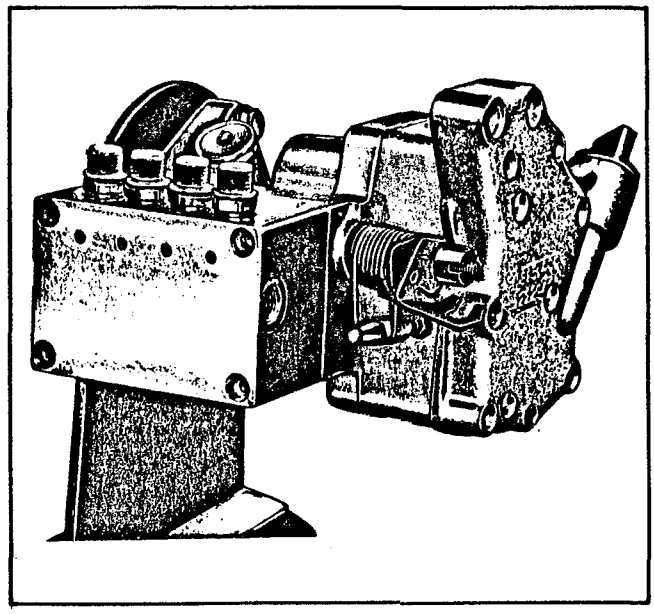


Fig. 26 - Injection Pump on Support Plate 8017350

Dismantling and Overhauling the Hydraulic Head (table 2)

- Grip the hydraulic head in a vice provided with lead jaws;
- for each plunger, proceed as follows: withdraw the plunger (79),

complete with spring (71) and spring cap (76), slip off the spring and the cap, then refit the plunger;

- by means of socket 8011355, unscrew the plunger mounting ring nuts (47);
- using puller 8012854, remove the barrels (79), complete with the relevant parts: plungers, thrust rings (4), "O" rings (7) and rings (26).

Note - The "O" rings (6-7) must always be renewed on reassembling.

- by means of socket 8011354, unscrew the mounting ring nuts (48) and withdraw the delivery valves (103), paying attention not to scatter the washers (84);
- using a suitable spanner, unscrew the inlet valves (102) and extract them together with the filters (46) and the "O" rings (6);
- unscrew the fuel inlet and return hose banjo bolts (21-22), then remove the banjo union (18) and the sealing rings (54-56) ; the banjo bolt (21) is provided with an inner filter, which is not supplied loose as spare;
- dip the hydraulic head in a bath of trichloroethylene and let it remain for some time, then clean the various passages, using air pressure;
- check the various components for conditions; the ground working surfaces of plungers and barrels must be perfectly polished and without signs of wear and seizure, so as to allow the plungers to slide freely. If not so, renew the plunger assemblies (79);
- check the spring caps for conditions;
- check and clean the banjo union, the banjo bolts and the filters; anyhow, renew any part which is worn or damaged.

Reassembling the Hydraulic Head (fig. 27)

Caution - During the reassembly of the hydraulic head, it is imperative that the utmost cleanliness be observed, since even a small foreign particle could affect the normal operation of the valves and plungers.

- fit the filters (46) and the "O" rings (6) to the inlet valves (102); renew the "O" rings (6) whenever the inlet valves are re - fitted;
- slightly oil the "O" rings (6) and the threads of the inlet valves and screw the inlet valves into the hydraulic head (101), using a torque spanner set to 3 mkg (21.7 lb/ft.).

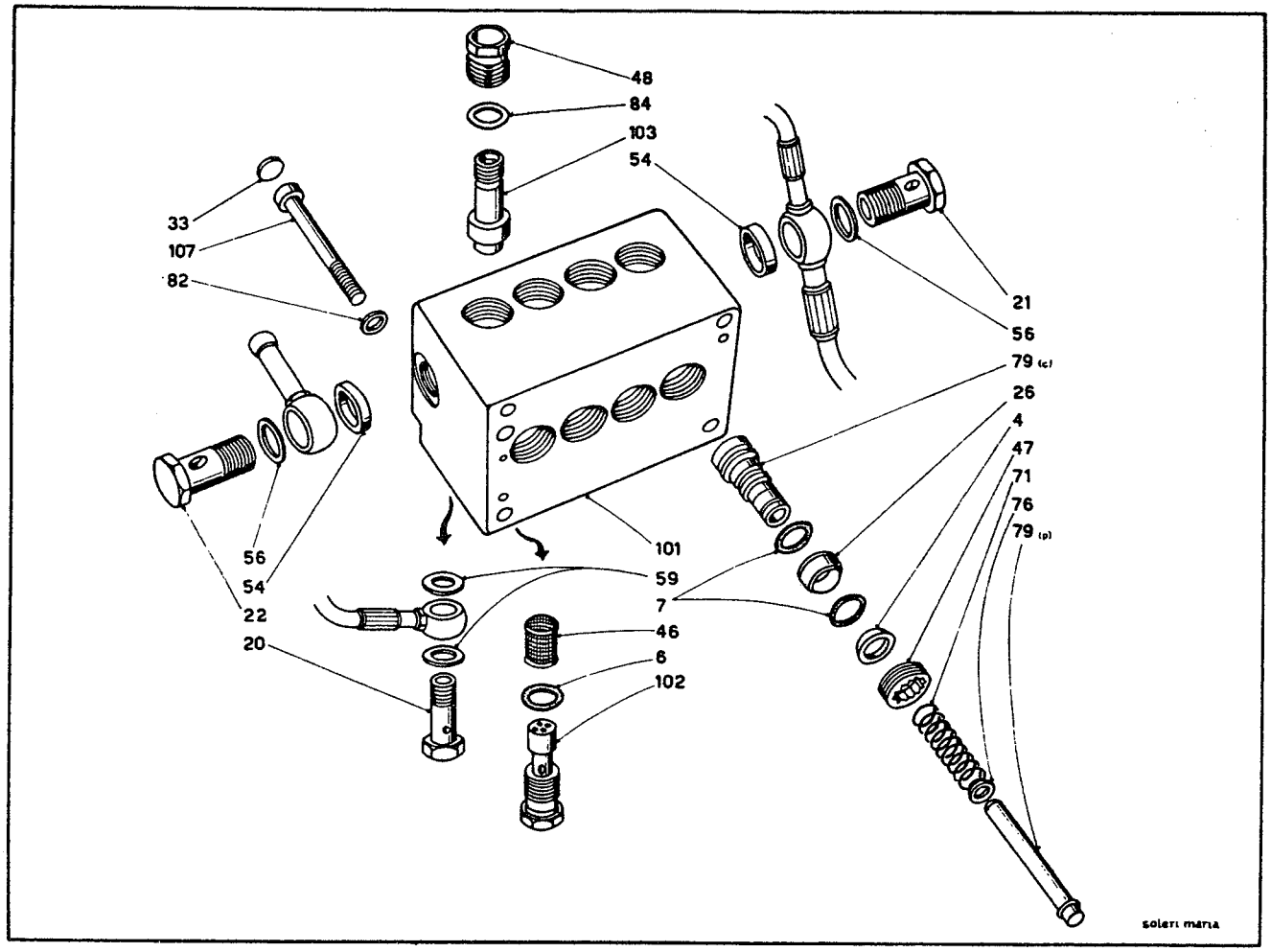


Fig. 27 - Hydraulic Head Components

- fit the delivery valves (103), so that the slots engage the locating pins of the seats in the hydraulic head;
- fit the shims (84), then, by means of socket 8011354 with a torque spanner set to 5 mkg (36.17 lb./ft.), screw in the delivery valve mounting ring nuts (48);
- make sure that the holes in the barrels (79 c) are not clogged ;

- lubricate the plungers (79 p) and insert them into the barrels ;
- to each barrel (79 c) fit: the first "O" ring(7), then the thrust ring (26) and the other "O" ring (7);
- fit the thrust rings (4) with the larger diameter facing outwards;
- slightly oil the barrels and "O" rings, then insert the plunger assemblies into the hydraulic head;
- fit the plunger mounting ring nuts (47) and screw them in by hand, so as not to distort the "O" rings (7), and make sure that, without much effort, they are driven almost flush with the hydraulic head surface;
- once such condition is obtained, tighten the plunger mounting ring nuts (47), using socket 8011355 and a torque spanner set to 3.5 mkg; during this operation, the plungers must be left in the barrels;
- make sure that the plungers slide freely in the relevant barrels; should an excessive resistance of a plunger be noticed, unscrew the relevant ring nut and re-tighten it (if necessary, turn the barrel in its seating);

After fitting the plungers, as detailed above, it is necessary to make sure that the "O" rings (7) have not been damaged; to this end, carry out the operations described under paragraph "Sealing Test of Hydraulic Head" (1st and 2nd tests);

- for each plunger, proceed as follows: extract the plunger from the relevant barrel, fit the spring cap (76) and the spring (71) to the plunger, then re-insert it, so prepared, into the barrel.

Refitting the Hydraulic Head to the Injection Pump (Table 2)

- Oil the gasket (53) and fit it to the pump housing;
- keeping the hydraulic head slightly slanting, so as to prevent the plungers and the springs from sliding off, fit it to the pump housing, so that the dowel pins engage with the mating holes in the hydraulic head (fig.28);
- screw in the screws (107), provided with washers (82), tightening them with a torque spanner set to 0.8÷1 mkg(5.78 to 7.23 lb/ft.);
- after the tightening, insert the seal disc (33) into the seat of one of the mounting screw heads (107)(see figure 39), so as to cover the head itself, then stamp the Lancia mark on it by means of the punch provided.

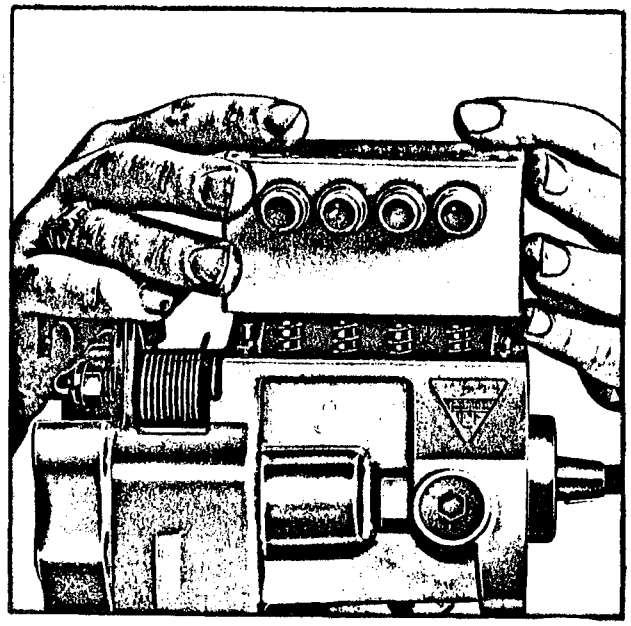


Fig. 28 - Fitting the Hydraulic Head

P U M P H O U S I N G

Disassembly (Table 2)

- Carry out the operation "Removing the Hydraulic Head from the Injection Pump" as instructed on page 66, then:
- remove the pin (97) retaining the enriching device eccentric shaft (2);
- using a pair of pliers, withdraw the retainer (16) of the plunger travel regulating rocker (19);
- unscrew the cylindrical nut (40) locking the enriching device lever (68);
- unhook the return spring (70) from the enriching device lever(68), and remove the lever;
- withdraw the eccentric shaft (2) and lift off the plunger travel regulating rocker (19);
- slide off the cam follower pin (75) and the tappets (80) (if the camshaft (3) has not to be renewed, notice the mounting position of the tappets, so as to refit them in their original positions);
- remove the seal disc (33) bearing the guarantee stamp,unscrew the mounting screws (17-107) and remove the governor cover plate(34), together with the gasket (52); to facilitate the removal of this, moisten it with a brush dipped in trichloroethylene;
- slacken the screw (108) of the clamp (74) locking the spiral spring (72) and release the spring;
- unscrew the screw (108) and remove the clamp (74);
- withdraw the snap ring (11),take off the thrust washer (91) and extract the spring from the slot on the hub of gear (64);
- unscrew the mounting screw (69), then remove the clamp(73)and the spring guide (60);
- unscrew the fixing screw (104) and lift off the spiral spring carrying gear (64);
- withdraw the snap ring (9), remove the gear (63) and take out the

key (31) from the governor shaft (1);
- using puller 8012351, detach the governor support flange(89)complete with governor shaft;
- withdraw the snap ring (8), remove the shim (95)and take out the gear shaft (77);
- extract the two bearings (36) and, if necessary,remove the snap rings (12);
- by means of a drift, drive off the governor shaft assy. (1);
- from the shaft, remove the snap ring (10),the regulating cam(27), the key (29) and the bearing (37);
- withdraw the two snap rings (13) and take off the bearing (37), with adjusting shim (93), from the governor support flange;
- from the governor support flange, remove the thrust ring(90)and, if required, the snap ring (14) of the governor sending unit(45);
- from the pump housing, remove the governor sending unit assy. (45) and relevant thrust ring (90).

Caution. The governor sending unit must not be dismantled;should it be necessary, the gear (65) only may be renewed; in case of inner binding, wear of the gear teeth, or improper operation detected on checking the governor setting,the sending unit will have to be renewed as an assembly.
- unscrew the nut (43) and take off the lock washer (32);
- using universal puller 8012868, remove the driven gear(61)and withdraw the key (30);
- remove the pump housing from support plate 8017350,place it under a press (see figure 29) and drive out the camshaft(3) complete with gear (62) and bearing (38);

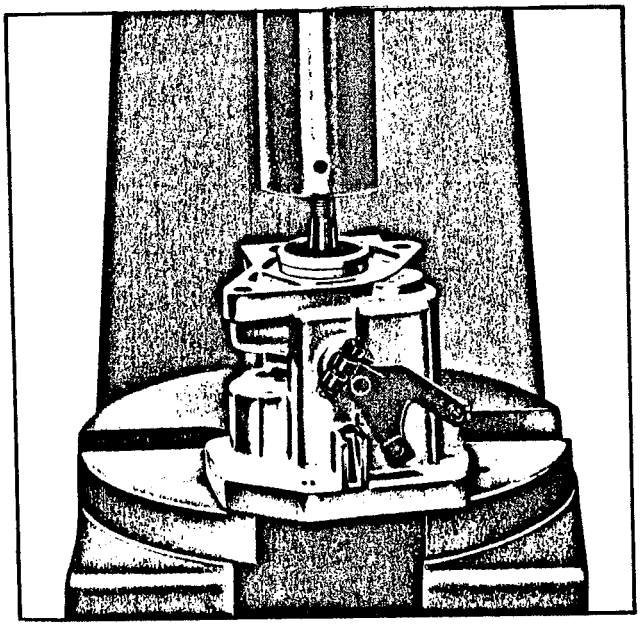


Fig. 29 - Driving out the Camshaft

- remove the seal (57), withdraw the snap ring (15) and extract the bearing (39) from the pump housing;
- unscrew the safety screw (106) and remove the pump control lever (67);
- remove the snap ring (10) and the shim (92) from the lever pin (66);
- unscrew the guide bush (23) together with seal (58), push the cam control lever (66) inwards and remove it from the pump housing.

Overhaul and Reassembly (Table 2)

- Carefully wash the removed components, check them for conditions, renew as necessary and refit them.
- Dip the pump housing in a bath of trichloroethylene, then blow off any possible deposits.
- Install the pump housing on support plate 8017350.
- Check that the seats, in the pump housing, for enriching device eccentric shaft (2) and for cam follower pin (75) are not so worn as to cause excessive clearance, so that even the renewal of the eccentric shaft (2) and of the follower pin (75) is not sufficient to restore the proper clearance; if this occurs, renew the housing.
- Check the cam control lever pin (66) and the bush (23) for wear and make sure that the relevant clearance is not so eccessive as to affect the necessary precise connection between the movements of the butterfly valve and of the regulating cam; if this is the case, renew the parts.
- From inside the pump housing, insert the cam control lever (66) into the threaded hole.
- Holding the cam control lever, fit the guide bush (23), complete with seal (58), to the cam control lever pin, and screw the bush into the pump housing.
- Fit the shim (92) and secure it with the snap ring (10).

PETROL INJECTION PUMP-PUMP HOUSING

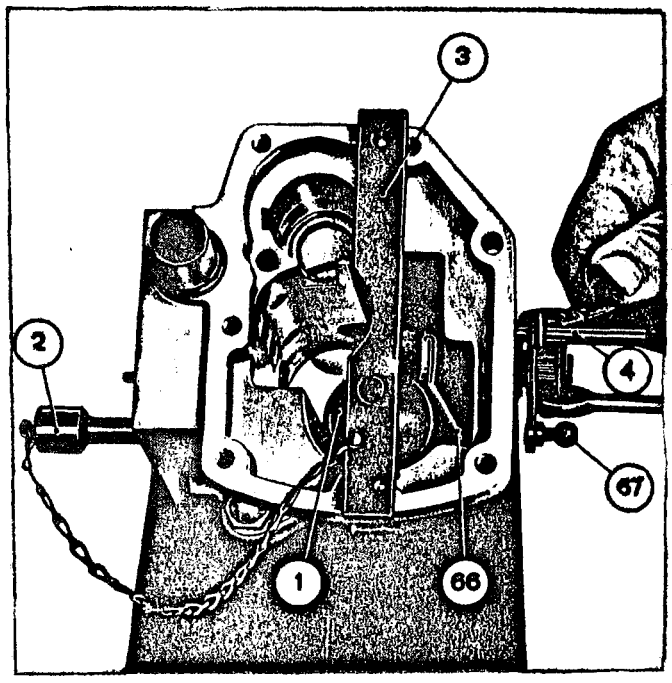


Fig. 30 - Using Fixture 8013353

- To position and then secure the pump control lever(67)onto the cam control lever pin, it is necessary to use fixture 8013353 by proceeding as follows (see figure 30):
- fit fixture 8013353 into the pump housing, so that:the shaft cylindrical head seats in the housing of the governor shaft end bearing(37), the ball pin of the cam control lever (66) is inserted into the first groove of the dummy cam (1),the holes in the plate (3) engage with the dowels of the pump housing;
- fit the pin (2) into the hole of the cam follower pin, until it is inserted into the second groove of the dummy cam(1),locking it;
- fit the pump control lever (67) to the cam control lever(66)pin;
- insert pin 8013352 (4),through the hole in the lever (67), into the proper slot machined in the pump housing;
- after positioning the lever (67) as previously described,lock it by screwing in the bolt (106),provided with the washers(83),until the spigot between the hexagon head and the cylindrical one breaks; obviously,during such operation, it will ne necessary to hold the nut (41) with another spanner;
- remove fixture 8013352 and the pin (4 - fig. 30);
- after tightening the holt, check that the lever is securely fitted to the cam control lever pin;
- check the camshaft bearings (38-39) for conditions and,if required, renew them;
- make sure that the ground surfaces of lobes of the camshaft (3) are not excessively worn out or scored and do not present signs

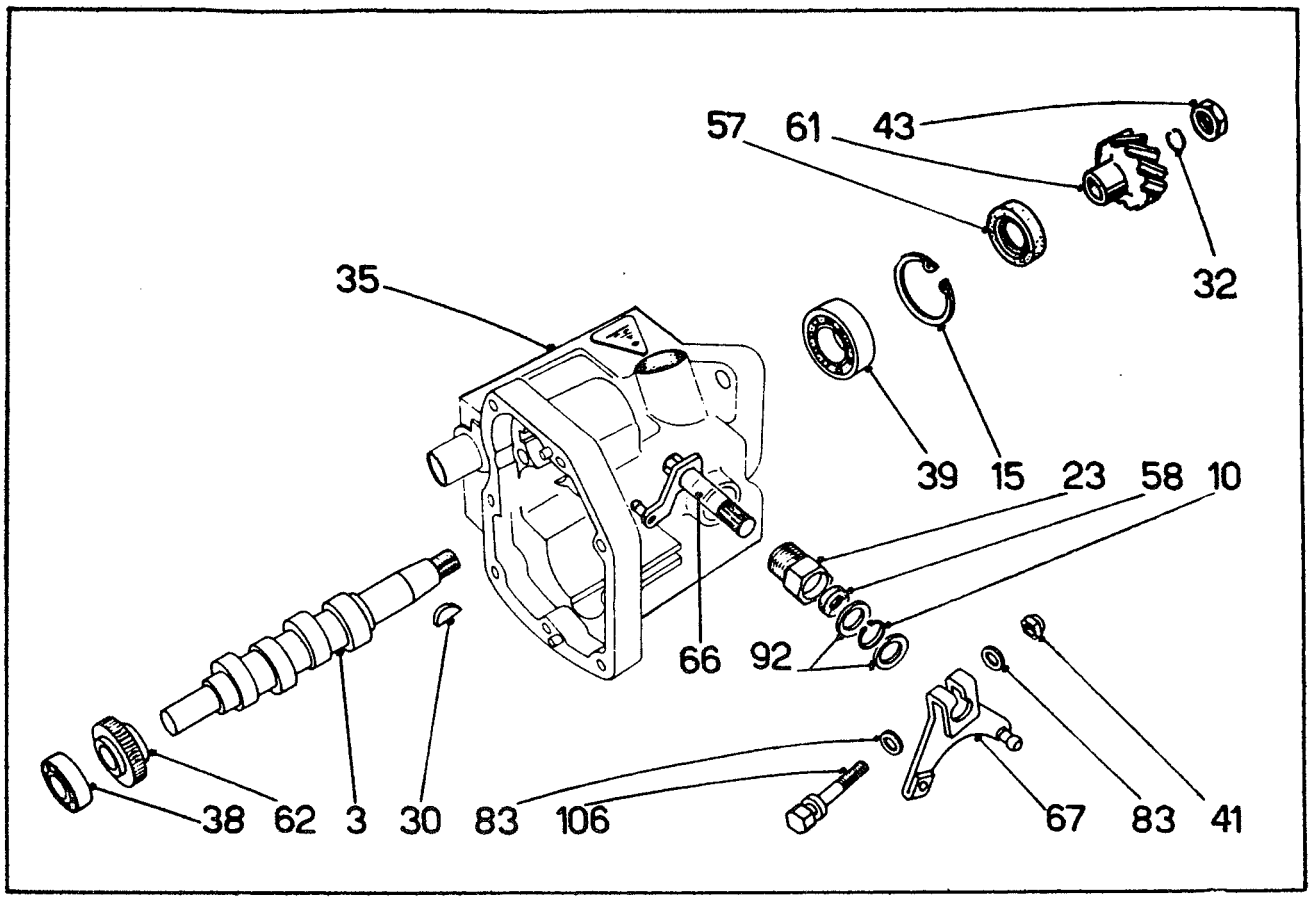


Fig. 31 - Camshaft and Control Levers

of seizure; if necessary, renew the camshaft;
- check the teeth of gear (62) for wear; if necessary, replace the gear;
- insert the bearing (39) into the relevant seat in the pump housing;
- by means of a press (fig. 32), drive the camshaft (3), complete with the gear (62) and bearing (38), into the bearing already fitted, having care to hold the latter with a suitable tool.
- secure the bearing (39) by fitting the snap ring (15);
- fit the seal (57), using a suitable installer;

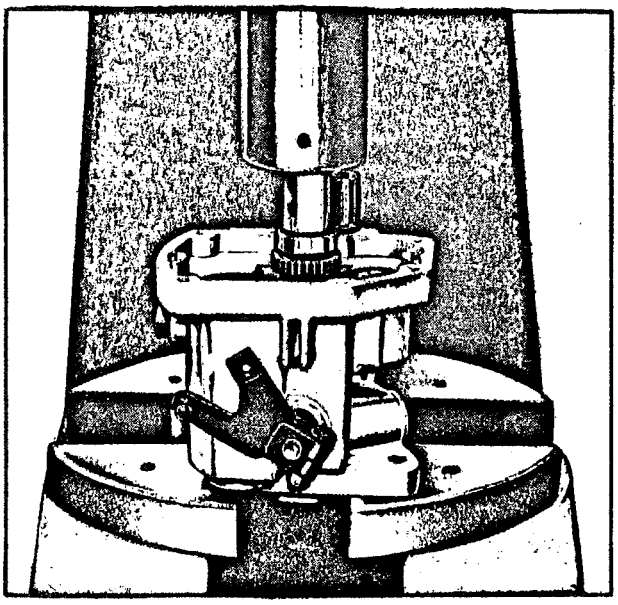


Fig. 32 - Driving-in the Camshaft

- make sure that the regulating cam(27)slides freely on the governor shaft (1) and that the relevant clearance is not excessive owing to wear of the shaft or of the cam hole;if necessary,renew the parts;
- check the bearings(36-37) and the gear shaft(77) for conditions; if required, renew them;
- fit the bearing(37)to the governor shaft left end(1)(as shown in table 2);
- insert the key (29) into the keyway in the governor shaft (1);
- fit the regulating cam (27) into the shaft,with the groove facing the bearing just fitted;
- fit the snap ring (10) into the groove in the shaft;
- make sure that the regulating cam slides freely on the governor shaft;
- from the governor shaft right end (1-table 2), insert snap ring (13) and then fit the other bearing (37);
- on the governor support flange (89), fit the snap rings (13-14), retaining the bearing (38), into the seats nearest the cover plate (34);
- fit the two snap rings (12) into the relevant seats in the governor support flange (89) and then fit the two bearings(36)on either side;
- insert the gear shaft (77) in the bearings (36), fitting it with the gear facing the governor cover plate;
- fit shim (95) to the opposite end of gear shaft (77) and secure the whole by means of snap ring (8);
- fit shim (93),if any,then insert the bearing (37), with governor shaft (1) and snap ring (13),in the proper seat in the governor support flange (89);
- secure all these parts by fitting snap ring (13);
- make sure that the end play of the bearing (37) in its housing in the governor support flange is not excessive; if required,fit

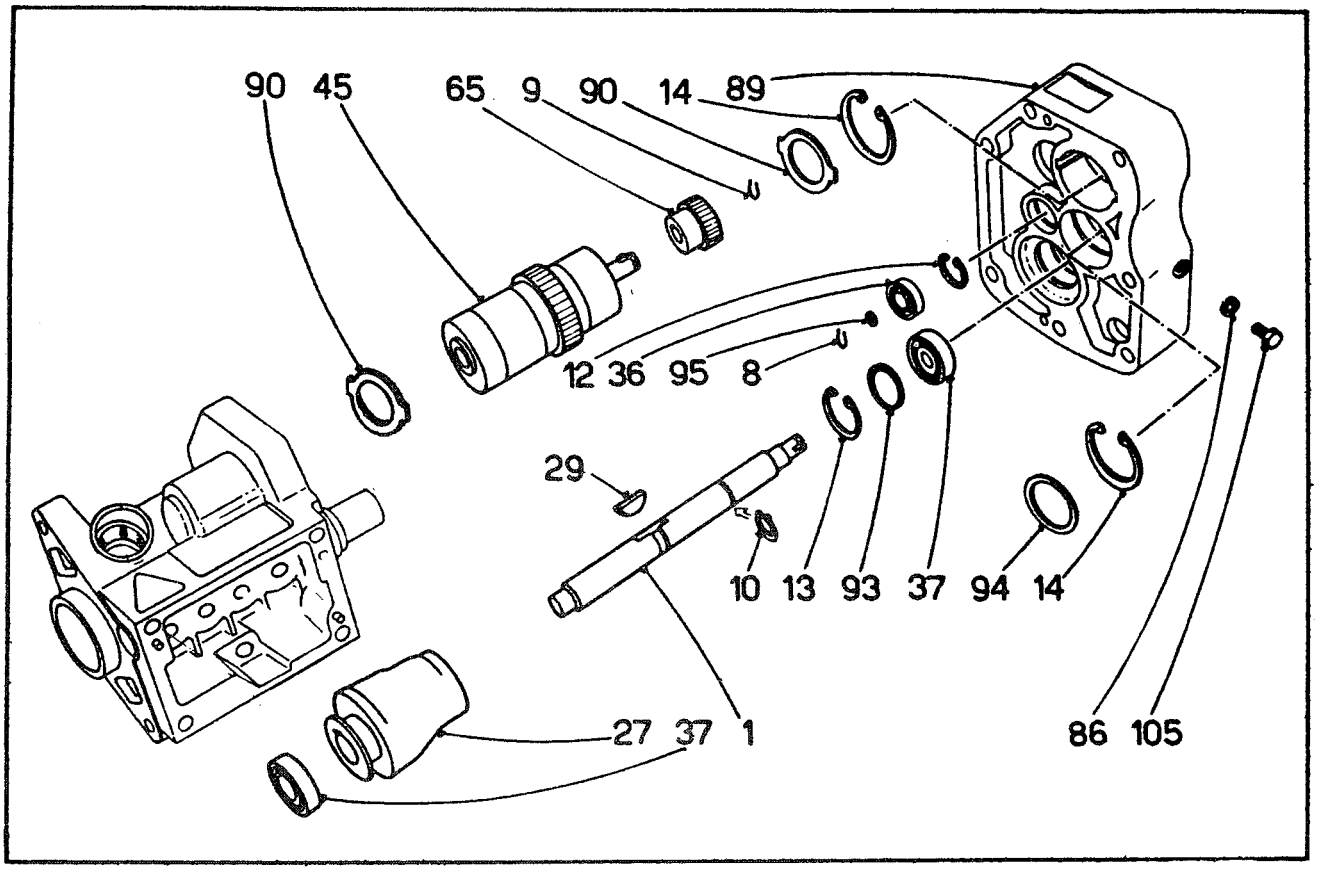


Fig. 33 - Regulating Cam and Governor Sending Unit

adjusting shim (93), or increase its thickness;

- fit one of the two thrust rings (90) into the governor sending unit seat in the pump housing (35);
- fit the sending unit (45), complete with ring gear (65)and snap ring (9), into the relevant seat in the pump housing;
- fit the snap ring (14) into the groove machined in the seat on the governor support flange (89), then fit the other thrust ring (90);
- oil either side of the gasket (52) and fit it to the pump housing;
- fit two 0.1 mm (0.0039 in.)adjusting shims (94-table 2) into the seat of the camshaft bearing (38) in the governor support flange,in addition to those already fitted, if any;
- temporarily fit the governor support flange and the cover plate onto the pump housing,by cautiously screwing-in some mounting screws and checking,at the same time,that the camshaft may still be turned;

- should it be noticed, on tightening the cover plate mounting screws, that the camshaft tends to lock, unscrew the mounting screws and remove one adjusting shim (94);
- repeat this procedure until, with governor support flange and cover plate secured to the pump housing, the camshaft may be turned without excessive effort (i.e. with end play $\cong 0$);
- remove one 0.1 mm (0.0039 in.) adjusting shim and refit the governor support flange only, securing it with two or more screws provided with suitable spacers. By so acting, the specified 0.1 ÷ 0.2 mm (0.0039 ÷ 0.0078 in.) end play will be obtained.

NOTE - The camshaft end play adjustment must be effected only when one of the following parts has been renewed: camshaft, pump housing, or governor support flange.

- arrange the pump as if it were mounted on the car, then check the regulating cam control for smoothness, by acting on the control lever (67) as follows:
- move the lever (67) to the minimum position, apply a 50 grams (1.76 oz.) weight to the ball pin, then make sure that this weight is sufficient to lower the lever to the maximum position;
- turn the governor shaft until the regulating cam key (29) faces the hydraulic head;
- check the gears (63-64) for wear and the teeth for burrs or breaks capable of causing improper friction on meshing with the teeth of the mating gears (77-65);
- fit the gear (63) to the governor shaft and, while holding the regulating cam, turn it anticlockwise until it abuts against

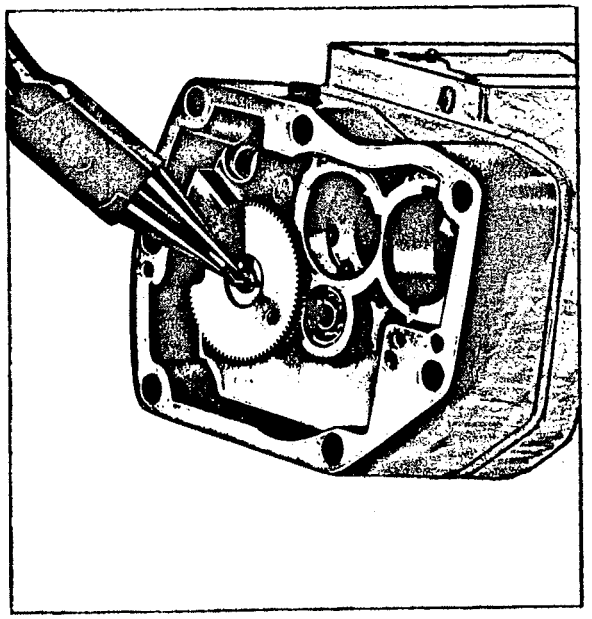


Fig. 34 - Mounting Position of Governor Shaft Gear

its stop (gear pin positioned as shown in figure 34);
- secure the shaft and the gear in this position, by fitting key (31) and snap ring (9);
- fit the spiral spring carrying gear (64) to the gear shaft(77);
- turn the gear (63) or (64) and make sure that it revolves completely without binding or excessive effort, otherwise renew all or some of the gears concerned;
- keeping the spiral spring (72) in the position shown in fig.35, insert its inner end into the slot provided in the hub of gear (64);
- fit the thrust washer (91) with its convex side facing the spring and secure it by fitting the snap ring (11);

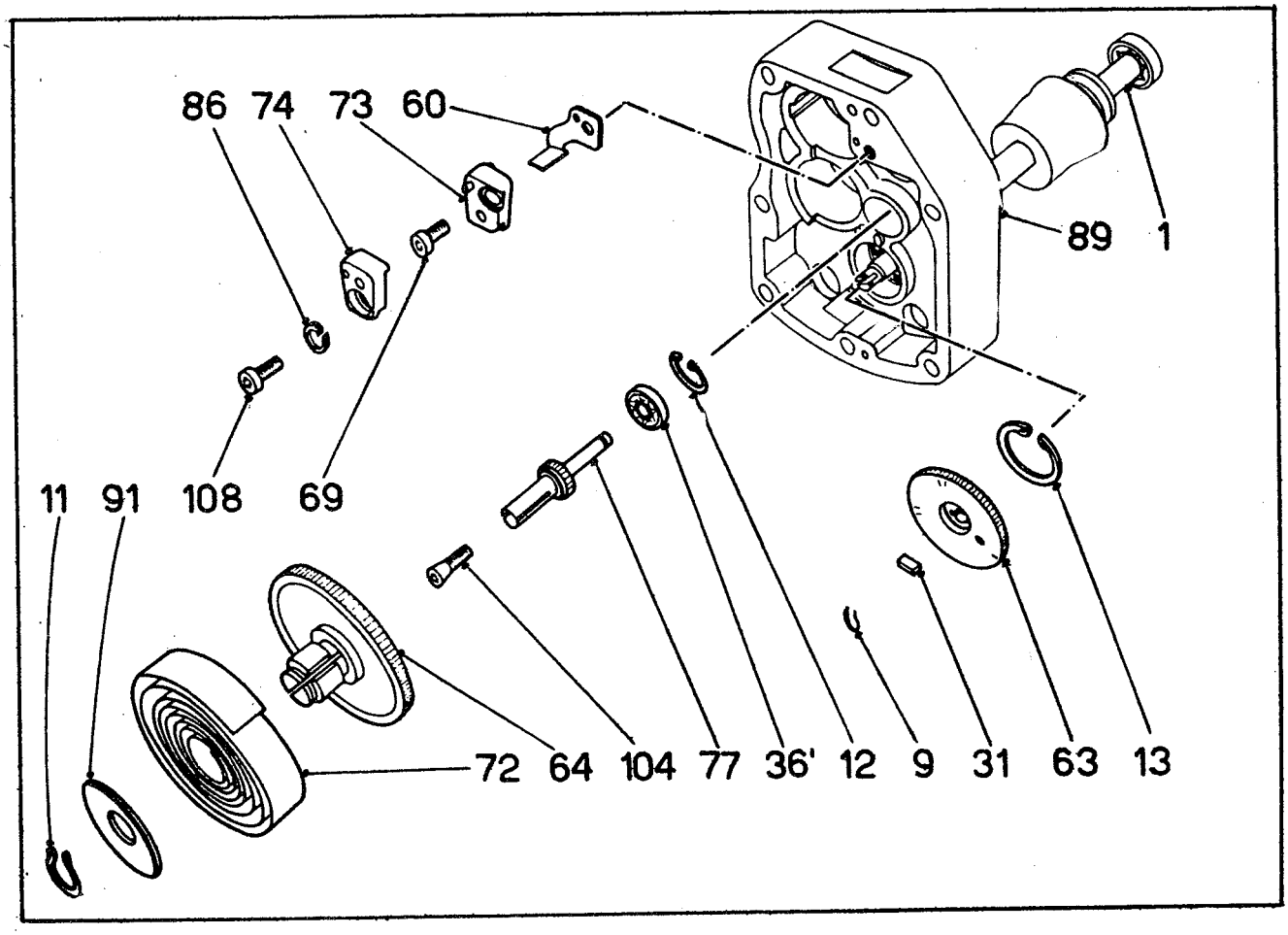


Fig. 35 - Governor Gears and Spiral Spring

- start the screw (104) into the relevant seat in the hub of gear (64);
- fit the spring guide (60), inserting the guiding end under the last outer coil of the spring itself;
- secure the spring guide (60) with the clamp (73) and screw (69);
- secure the spring outer end (72) by fitting the clamp (74) and cautiously screwing in the screw (108) provided with lock washer (86).

NOTE - The spring end must be locked in the proper transversal steps machined in the mating surfaces of clamps (73 - 74).

- remove the assembly just completed, and install it on test bench 8016850 (see sketch 1113I);
- pre-load the spring (72) by proceeding as follows: turn the gear (63) fully anti-clockwise, turn the spring carrying gear (64) by half a turn clockwise and temporarily tighten the screw (104);
- carry out the operation "Checking the Governor" as instructed on page 53;
- remove the assembly from the test bench and fit it to support plate 8017350;
- oil either side of the gasket (52) and fit it to the governor support flange (89);
- fit the governor cover plate (34) and secure it by means of the screws (17-107) tightened with a torque spanner set to 0.8 mkg (5.78 lb.ft.);
- make sure that the cylindrical surface of the tappets(80)and the plane surface contacting the cams do not show signs of seizure and that the tappets slide freely in their seats; if required, renew some or all of them;
- make sure that the clearance between the regulating rocker (19) and the enriching device eccentric shaft(2) is not excessive; if necessary, renew. Such a clearance could affect the regular variation of the plunger travel effected by the cam follower pin;
- fit the tappets (80) into the relevant seats in the pump housing;

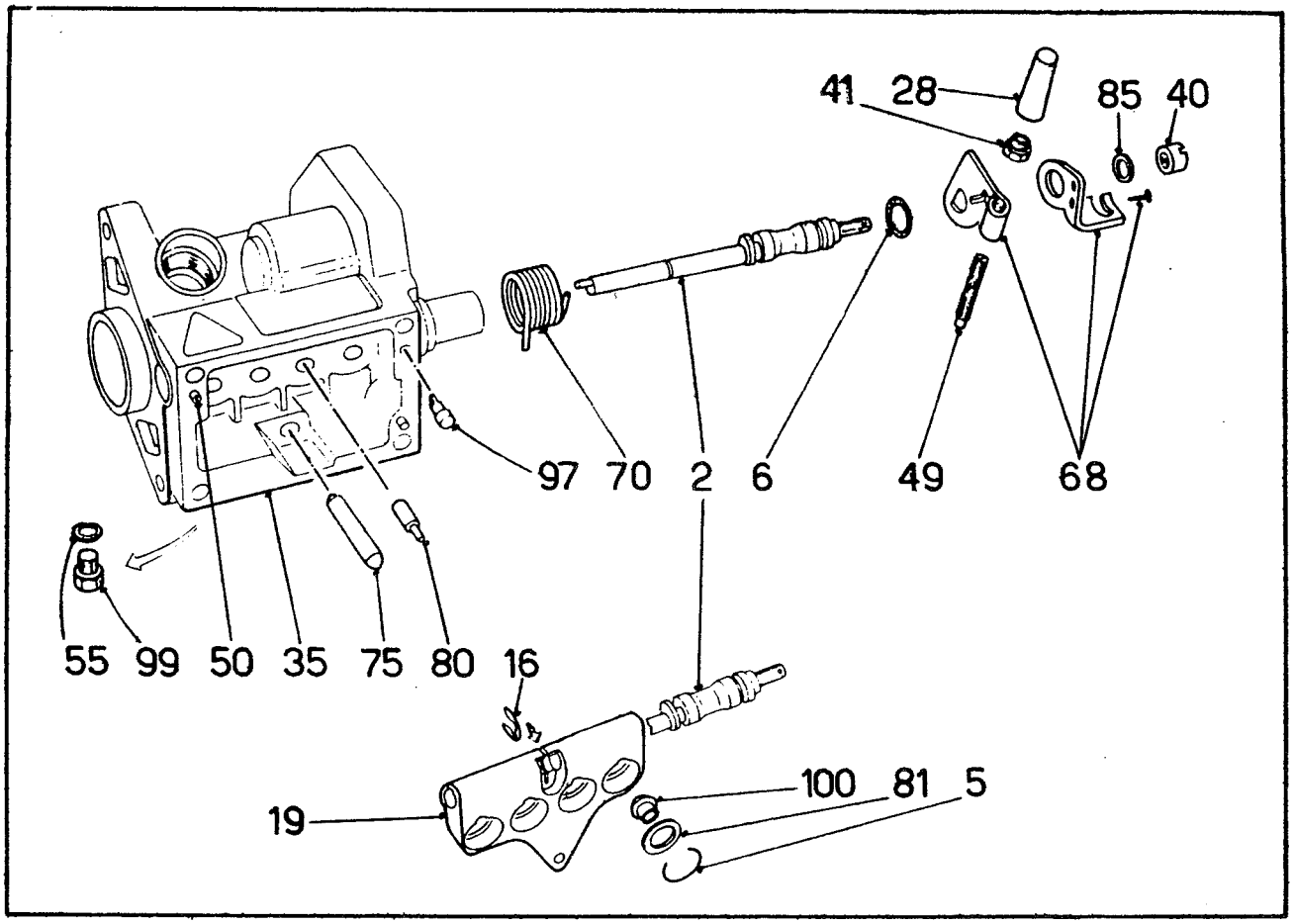


Fig. 36 - Eccentric Shaft, Regulating Rocker, Tappets and Cam Follower Pin

- renew the "O" ring (6) and fit the eccentric shaft (2) to the regulating rocker (19) by keeping this in the pump housing recess, as shown in figure 37, and turning the shaft in either direction up to inserting it completely;
- fit ring (16) securing the regulating rocker to the eccentric shaft;
- fit the retaining pin (97) into the relevant seat in the pump housing and turn it slowly until its front end engages the groove provided on the excentric shaft, thus securing the shaft in the proper position as compared with the pump housing;
- make sure that the ball and cylindrical surfaces of the cam follower pin are not worn, seized, or show defects;if required,renew it;
- fit the cam follower pin (75) into its seat(figure 38)and check

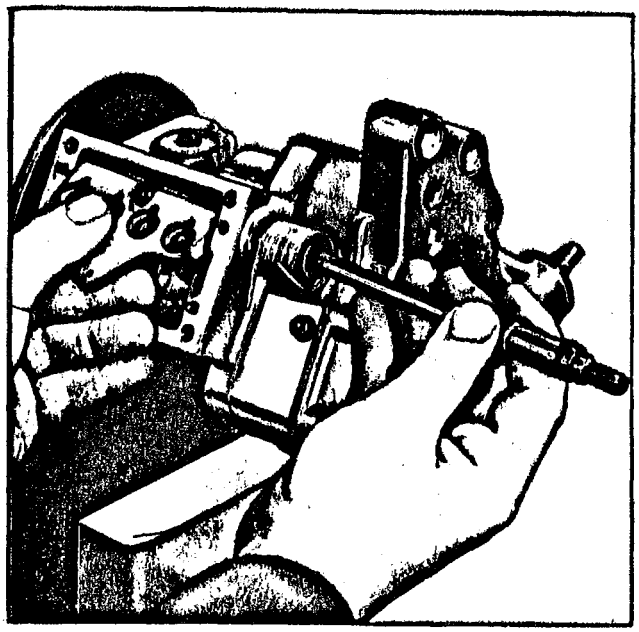


Fig. 37 - Fitting the Eccentric Shaft

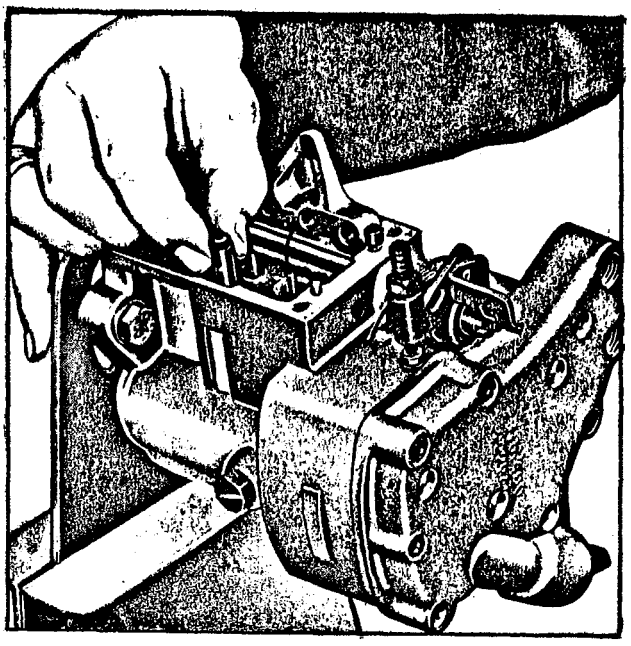


Fig. 38 - Fitting the Cam Follower Pin

that, on operating the cam control lever (66), the pin slides freely upwards and drops by itself;

- suitably turn the enriching device eccentric shaft (2) and the camshaft (3) until the regulating rocker (19) rests on the cam follower pin (75). Make sure that, on the whole, the various parts operate well;
- fit the enriching device lever return spring(70)into its seating on the pump housing, load it suitably and fit the control lever (68),with screw (49) and nut (41), to the end of eccentric shaft (2),paying attention that it is inserted in the correct position;
- release the end of spring (70),so far held,so that it rests against the lug of the control lever;
- fit lock washer(85) and secure the whole by tightening nut(40);
- carry out the operation "Setting the Plunger Travel"as instructed on page 59;
- oil the gasket (53) and fit it to the pump housing;
- complete the reassembly as instructed under operation "Reassembling the Hydraulic Head" on page 68;
- fill the pump sump with 0.5 litre (0.87 Imp. pts - 1.05 U.S.A.

pts) of oil ESSO UNIVIS 40;

- at the bench, carry out the operation "Checking the Delivery and the Hysteresis", as instructed on page 49;
- should all the values found, or some of them, differ from the specifications given in sketch 10861, follow the instructions described case by case on page 51 and act accordingly, as specified in the overhaul operations relevant to the trouble detected.

NOTE - Should poor deliveries be detected in one or more testing tubes, it is good practice to renew, at first the inlet and delivery valves relevant to the plunger concerned.

- fit the guarantee seals to the pump, as shown in figure 39, then by using the proper punch, stamp the LANCIA mark on seals(1) and (3).

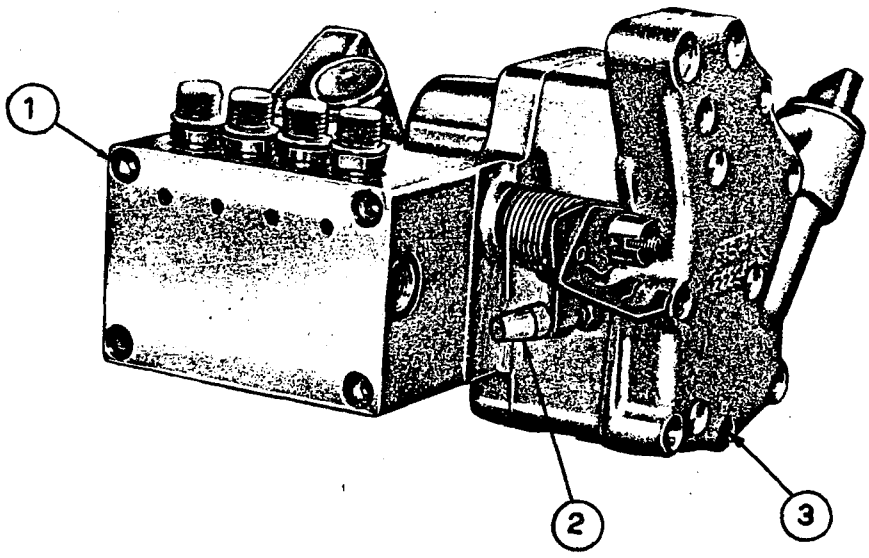
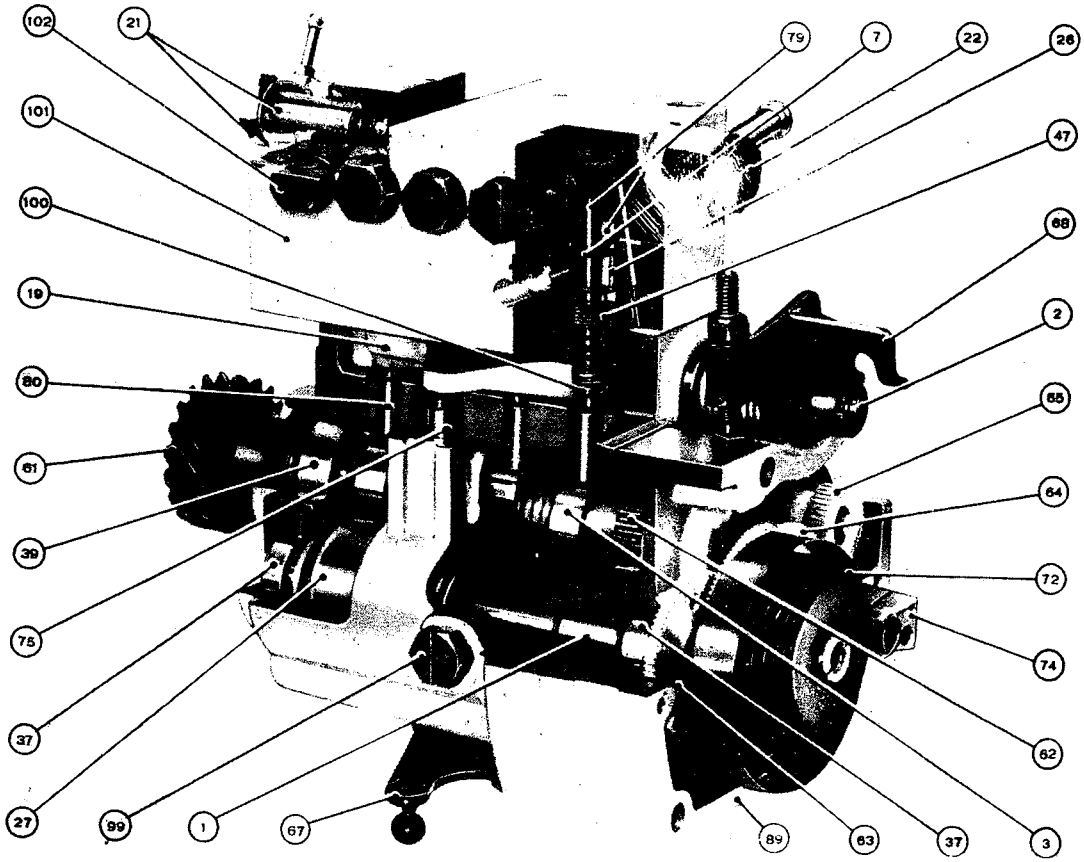


Fig. 39 - Location of Guarantee Seals

1. Seal disc on hydraulic head - 2. Seal cap on enriching device lever adjusting pin - 3. Seal disc on governor cover plate



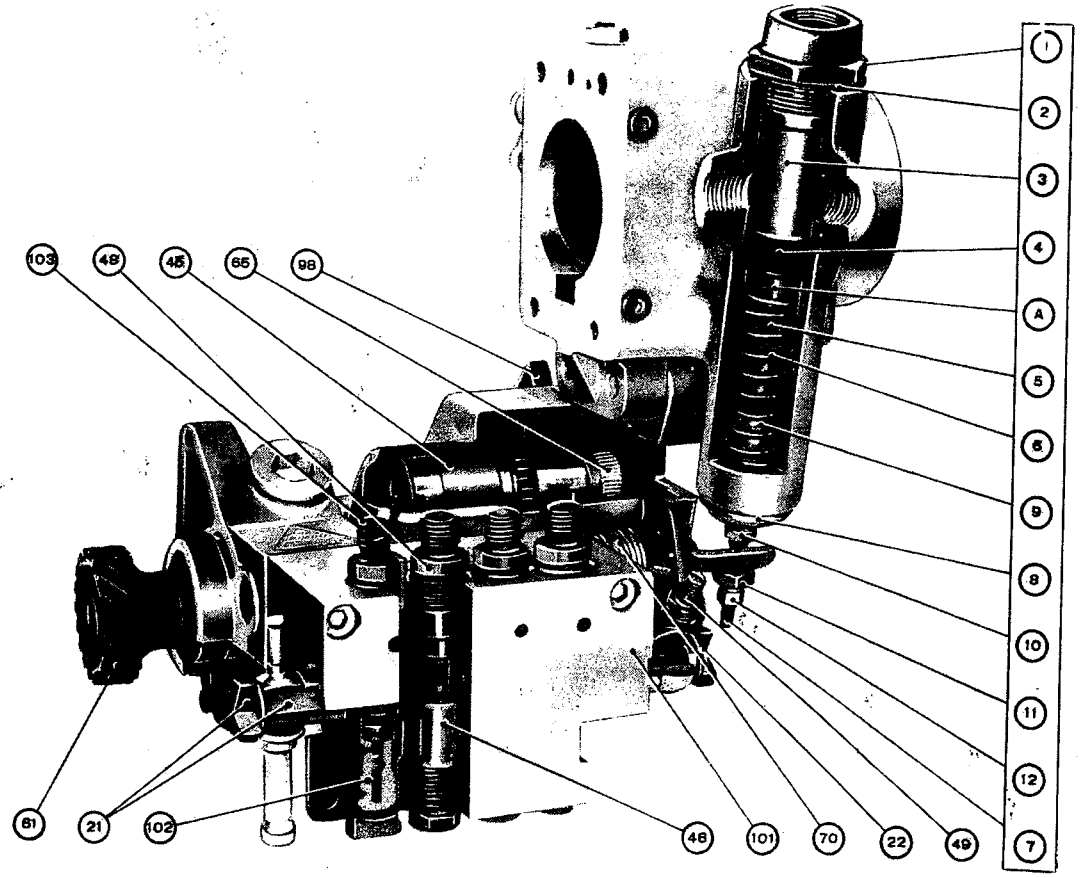


Table 3 - Injection Pump and Enriching Device Sections

E N G I N E U N I T

GENERAL

There is only one type of engine fitted to all cars equipped with the indirect injection fuel system and it is identified by prefix 815.400 stamped on the right-hand rear of the crankcase.

The maximum power developed is 102 HP at 5200 r.p.m., whilst the maximum r.p.m. is 5800.

At 3500 r.p.m., corresponding to the max. torque of 15.6 mkg (112.8 lb./ft.), the power developed is 76.2 HP.

The normal valve clearance with cold engine must be: 0.15 mm (0.006 in.) for the intake valves and 0.25 mm (0.010 in.) for the exhaust ones.

As the operating cycle has not changed, the ignition in the cylinders is always by spark; the spark plugs used are of the LODGE HL type (LODGE 2HL for engines fitted to Sport cars).

NOTES ON THE VARIANTS TO THE CONVENTIONAL TYPES TO FIT THE INDIRECT INJECTION FUEL SYSTEM.

The Flavia injection engine may be substantially considered derived from the engine 815.300, of which it keeps in fact the piston displacement (1800 cc - 109.84 in.) and almost all the mechanical components, obviously with the exception of those directly or indirectly concerning the fuel system. It is just with these components that the following chapter will deal.

The conventional intake manifolds are replaced by pipes which provide to separately feed the various cylinders. As it may be clearly seen in figure 40, through the intake pipes flows only air evenly metered by the distributing chamber, which air mixes up with the fuel sprayed by the injectors at the end of each pipe, near the intake valves. The only fuel which flows inside the intake pipes is that sprayed by the electrovalve during the engine starting (see

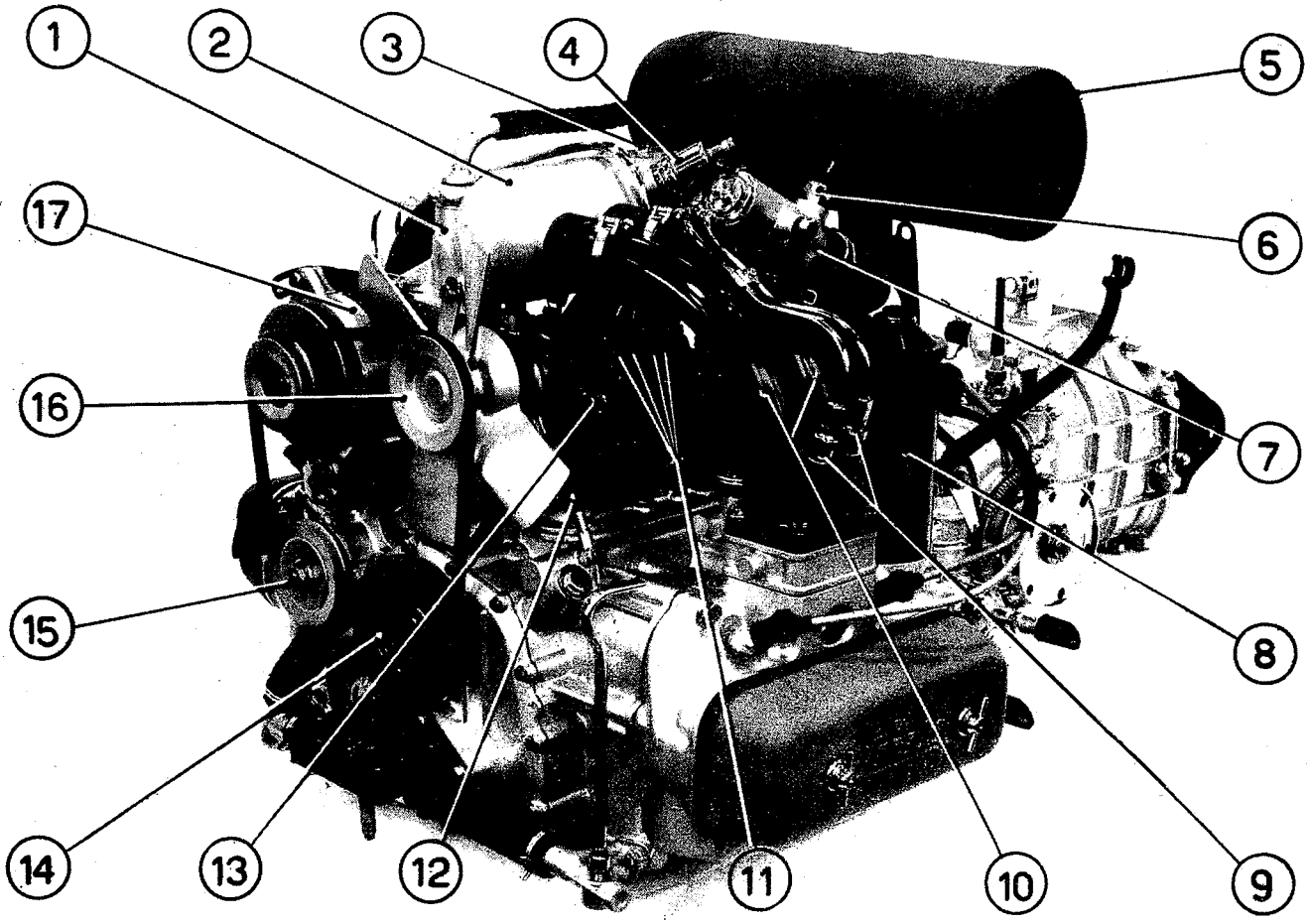


Fig. 40 - Engine-Gearbox-Propelling Unit

1. Engine oil filler - 2. Distributing chamber - 3. Slow-running adjusting screw - 4. Electrovalve - 5. Air cleaner - 6. Water temperature gauge sending unit - 7. Engine water outlet connector - 8. Engine oil filter - 9. Injectors - 10. Air intake pipes - 11. Delivery valves - 12. Oil supply pipe to injection pump hydraulic head - 13. Hydraulic head fuel inlet and electrovalve fuel supply 2-way connector - 14. Crankshaft pulley - 15. Water pump pulley - 16. Fan - 17. Alternator.

chapter "Electrovalve").

From the figure, it may be noticed that the intake pipes are not heated; the hot water coming from the engine provides to heat only the pipe supports and obviously the cylinder heads as well; it heats up, therefore, all the area where the mixing of the air with the fuel occurs.

The injection pump has been fitted onto the crankcase upper cover and carries, secured to its top, the butterfly valve housing, to which are attached the distributing chamber at the front and the air cleaner at the rear.

On the right-hand side of the crankcase upper cover and integral with it, there is the oil filler, into which is located one of the injection pump driving gears and precisely the one which meshes with the injection pump driven gear.

The other driving gear is mounted on the lower end of a shaft carrying the driving gear mentioned above, and runs in a support secured to the crankcase.

Both driving gears are provided with splined holes into which engage the splined ends of a shaft, which at the bottom rests on an abutment and at the top is secured by a snap ring; for the removal, use the proper puller 8012514, which has to be inserted into the shaft hole, after removing a snap ring and a retaining spring; the function of the shaft is to provide a steady motion between the two driving gears.

The shaft lower end gear is driven by another gear integral with the right-hand camshaft.

All the other variations concerning clearances, wear limits, data and various tolerances are specified in the relevant sketches grouped at the end of the manual.

A P P E N D I X

EXTRACT FROM " FLAVIA REPAIR SHOP MANUAL"

All the following operations are entirely drawn from the "Flavia Repair Shop Manual",letter-press No.8798769,and the only variants concern the Flavia cars provided with indirect injection fuel system.

CHECKING THE IGNITION TIMING

Check the ignition timing with a 12 Volt test lamp connected to the distributor side terminal and to the ground.

The lamp lights up at the same instant the contacts open.The lighting of the lamp must occur for cylinder No.1(distributor rotor arm aligned with the cable to such cylinder),when mark "0",stamped on a tooth of the flywheel, lines up with mark A/A beside the flywheel housing inspection aperture and the cylinder valves are closed. Possible slight corrections may be obtained by acting on the screw fixing the distributor collar to the crankcase; for greater corrections,slacken the nut locking the collar and turn the distributor body anti-clockwise to increase the advance(fig.41-2)and clockwise to reduce it(1).

The checking of the ignition timing may be facilitated by using a stroboscopic lamp and following the instructions supplied with the device.

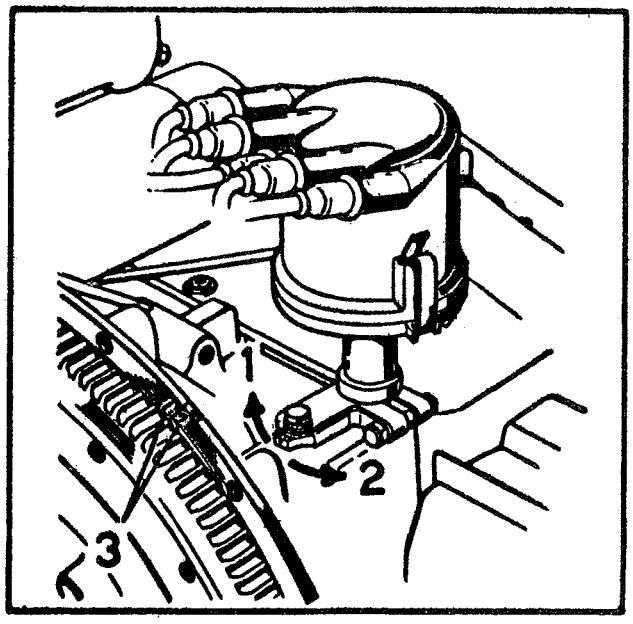


Fig. 41 - Adjusting the Ignition Advance

ADJUSTING THE CLEARANCE BETWEEN VALVES AND ROCKERS

Valves and rockers are accessible from inside the front mudguards and the procedure for the adjustment is the following:

- completely turn the front wheels to the side where the adjustment has to be carried out or, better yet, lift the car and remove the wheel;
- remove the front mudguard skirt secured with screws;
- remove the spark plugs;
- remove the cylinder head cover and the relevant gasket.

The valve clearance adjustment must be effected with engine cold, both valves closed and rockers at rest(compression stroke).

Such conditions can be obtained by engaging a gear and turning a wheel, or the relevant hub, and keeping the other one stationary, or by slight movements of the car with a gear engaged, and by checking the position with a test lamp inserted between the distributor and the ground, as described in the foregoing operation "Checking the Ignition Timing".

The clearance between valves and rockers must be 0.15 mm(0.006 in.) for intake valves and 0.25mm(0.010 in.)for the exhaust ones.

The adjustment must be carried out using spanner 8011022 and feeler gauge 1810390.

Whenever the cylinder head covers are removed, it is good practice to examine the gaskets and to renew them if necessary.

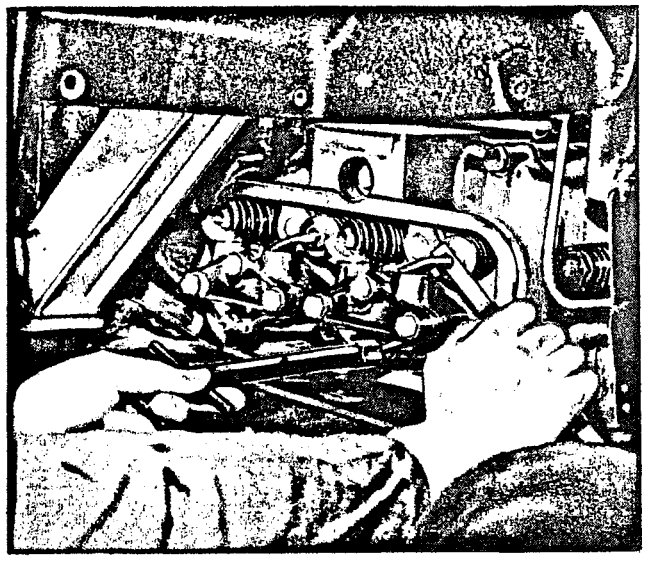


Fig. 42 - Adjusting the Clearance between Valves and Rockers

VALVE TIMING

Checking

It is normally carried out on cylinder No.1, after removing the left-hand cylinder head cover, as specified under operation"Adjusting the Clearance between Valves and Rockers".

With 1 mm (0.0394 in.) special valve clearance for timing inspection, the intake valve of cylinder No.1 must begin opening when mark "0" on the flywheel is half a tooth(1° 30') before mark 1/2 (3-figure 41),and the exhaust valve of the same cylinder must close when mark "0" is half a tooth (1° 30') after mark 1/2 stamped beside the flywheel housing aperture.

A similar checking may be carried out on cylinder No.2,by operating on the right-hand side and following the same procedure. The difference between the two checkings consists in the fact that,when carrying out the checking on cylinder No.1,the ignition distributor rotor arm must be aligned with the cable to cylinder No.2, while, when carrying out the checking on cylinder No.2,the rotor arm must line up with the cable to cylinder No.1.

Should the valves do not open and close as specified above, it will be necessary to reset the valve timing,operating as instructed hereinafter.

Once the checking has been completed,it will be necessary to restore the working clearance between valves and rockers with engine cold,that is:intake:0.15 mm (0.006 in.) - exhaust :0.25 mm (0.010 in.).

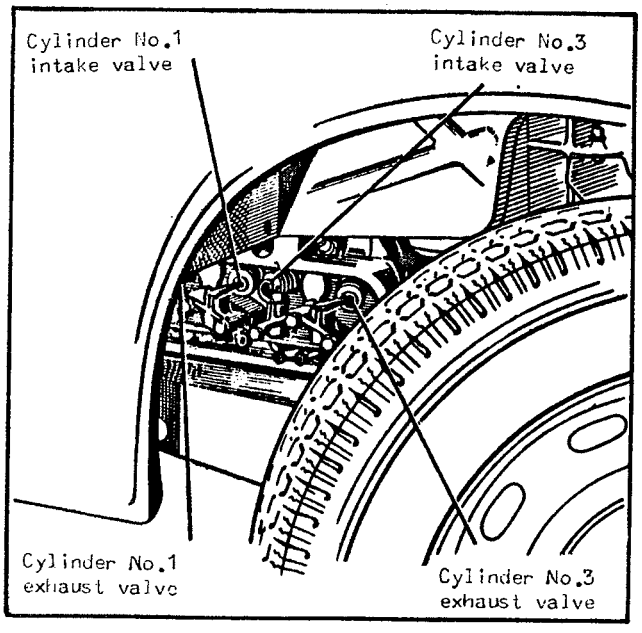


Fig. 43 - Valve Positions

Timing the Engine

The timing has to be carried out whenever the engine has been overhauled. In addition, it is also to be carried out whenever the camshafts are replaced on the car, or the timing chain is inadvertently removed without taking care in advantage that the correct angular positions of crankshaft and camshafts are maintained on re assembling.

For this operation, it is necessary to remove the radiator, the engine front support bracket, the water pipes, the crankshaft pulley, the timing gear cover and the cylinder head cover.

- By applying a box spanner to the crankshaft pulley mounting screw, rotate the crankshaft until the valves of cylinder No.1 are in rest position (both closed).
- Temporarily set the clearance of the cylinder No.1 intake valve to 1.03 mm (0.040 in.) using a feeler of 1 mm (0.039 in.)together with one of 0.03 mm (0.0011 in.).
- Crank the engine in the operating direction, until the above clearance is reduced to 0.03 mm (0.0011 in.)
- Remove the bolt mounting the left camshaft sprocket (cylinders No.1 and 3), remove the dowel and refit the bolt without tightening it, so that the sprocket can rotate without dragging the camshaft.
- Crank the engine until mark "0" on the flywheel is at halftooth before mark 1/2 on the inspection opening , and the distributor rotor arm is aligned with the lead to cylinder No. 2.

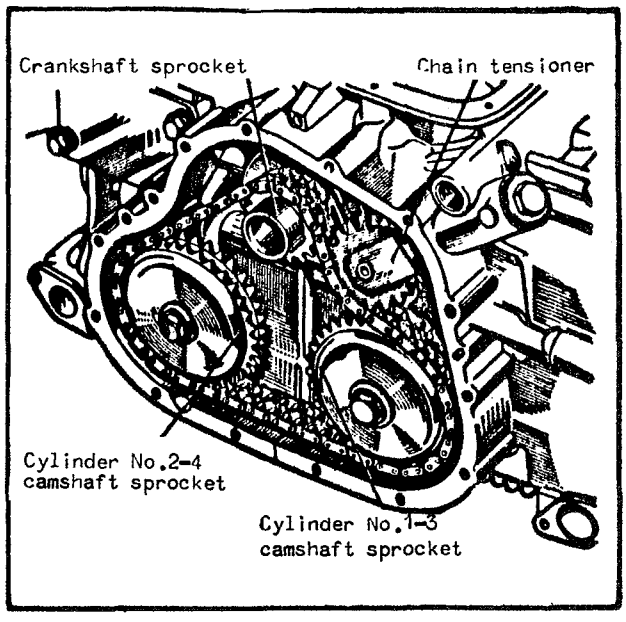


Fig. 44 - Timing Sprockets

Should this not happen, remove the distributor, pull out the drive shaft by means of round nose pliers, then rotate it by half a turn (180°).

- Fit the sprocket to the left camshaft, insert the dowel and tighten the bolt.
- Crank the engine until both valves of cylinder No.2 are closed.
- Set the clearance of cylinder No. 2 intake valve to 1.03 mm (0.040 in.).

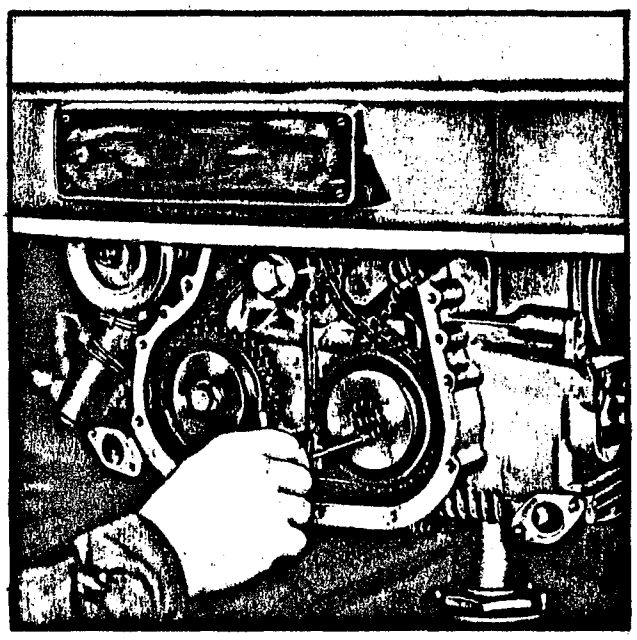


Fig. 45 - Timing the Valve System

- Crank the engine in the operating direction, until the above clearance is reduced to 0.03 mm. (0.0011 in.).
- Remove the bolt mounting the right camshaft sprocket (cylinders Nos.2 and 4), remove the dowel and refit the bolt without tightening it.
- Crank the engine until the mark "0" on the flywheel is at halftooth before mark 1/2 on the inspection opening, and the distributor rotor arm is aligned with the lead to cylinder No. 1.
- Fit the sprocket to the right camshaft, insert the dowel and tighten the bolt.
- Set the clearance of all valves to their operating values, i.e.0.15 mm (0.006 in.) for intake valves and 0.25 mm (0.010 in.) for exhaust valves.
- If the ignition distributor has been removed, or its position tampered with, check the ignition timing as described under paragraph "Checking the Ignition Timing".

SKETCH LIST

510 I - Setting the Timing (sheet 1/3 - 3/3).

650 I - Clearances, Wear Limits and Undersizes for Crankshaft Journals, Crankpins, Main and Conrod Bearings.

655 I - Automatic Advance Diagram.

865 I - Clearances and Wear Limits for Liners, Pistons, Rings and Pins.

1086 I - Specifications for Injection Pump, Injectors and Fuel Pump.

1107 I - Power Curve

1113 I - Installing Injection and Fuel Pumps of Engine 815.400 on Test Bench 8016850 and Additional Equipment 8016350.

1114 I
1115 I
1116 I
1117 I
- Wiring Diagrams.

1124 I - Test Data and Circuit Diagram of S.E.V. Motorola type Alternator and Electronic Regulator.

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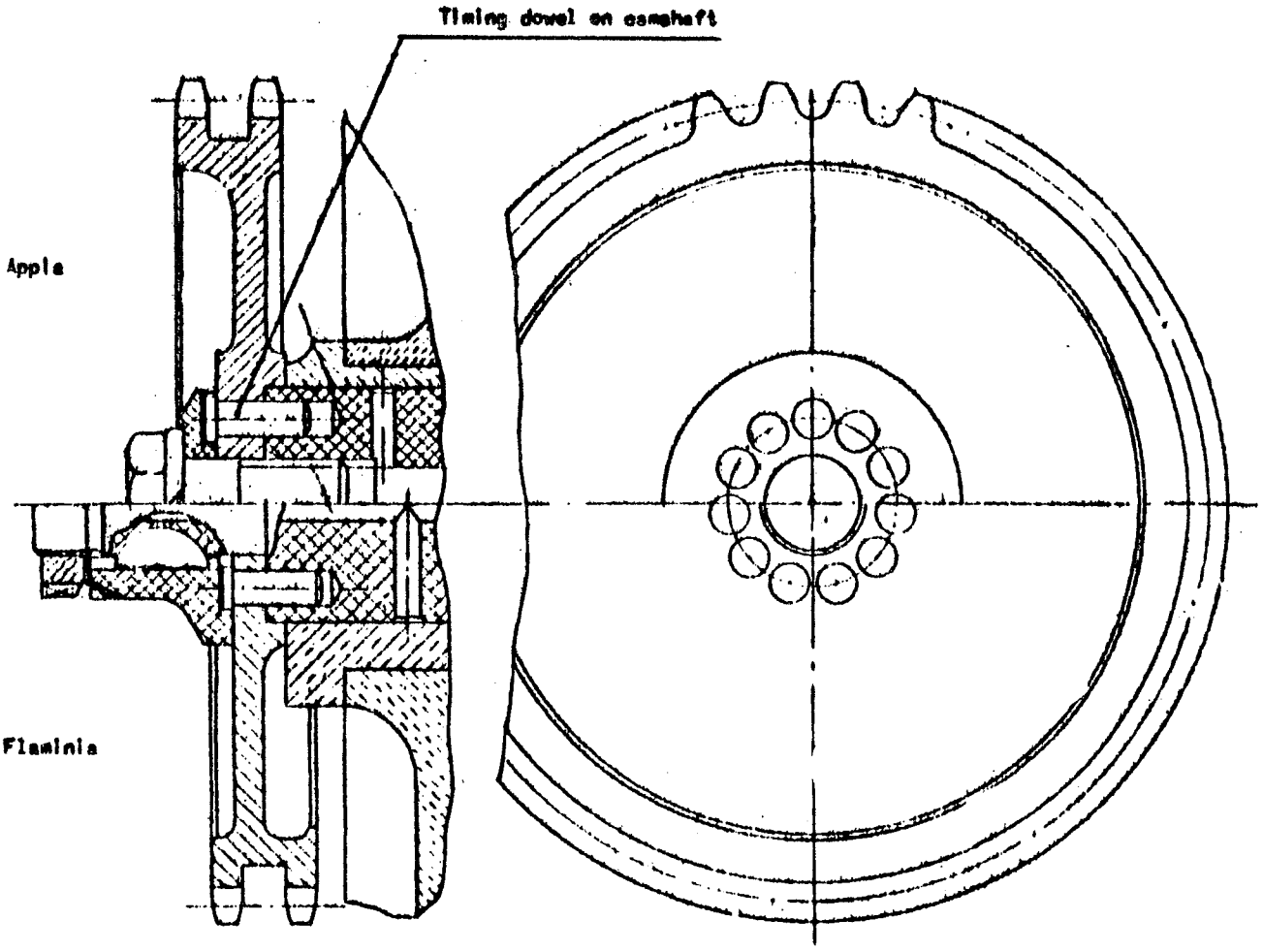
CAR ENGINES

Setting the Timing

A S T
Sketch 510J
5/2/59
Sheet 1/3



To set the timing of car engines, proceed as follows:

- Adjust clearance between intake valve of cylinder No.1 (closed) and rocker arm with a feeler gauge equal to the clearance given on sheet 2/3 plus another feeler gauge 0.03 mm. thick, by acting on the adjusting screw and nut.
- Turn camshaft by hand, cranking the engine in its running direction until clearance is reduced to 0.03 mm. when checking with the above mentioned feeler.
- Set camshaft timing gear free by removing timing dowel and refitting screw or ring nut, so that the timing gear , driven by the timing chain, may rotate without turning the camshaft, then rotate the flywheel until mark "0" stamped on a tooth of the flywheel ring gear is in line with mark 1/4 on flywheel casing. From this point, corresponding to the TDC, bring the mark "0" in opening position of intake valve, as indicated on sheet 2/3, and check that the ignition distributor rotor lines up with the spark plug cable to cylinder No.4 for a 4-cylinder engine and to cylinder No.6 for a 6-cylinder engine. Fit the timing gear onto camshaft, refitting timing dowel, and finally lock the timing gear.
- For the Appia engine having a camshaft for the intake valves and a second one for the exhaust valves, the above mentioned procedures must be repeated for the exhaust valve of cylinder No.1. Lock the timing gear onto its camshaft, after turning mark "0" of the flywheel in the closing position of exhaust as indicated on sheet 2/3.
- Adjust valve clearance to its normal value with cold engine; when this operation is completed, the engine is ready for use.

MODIFICATIONS: 1) 10/12/63 Re-made and modified

MODIFICATIONS: 1) 10/3/1966 - Remade and modified

ENGINE TYPE	TIMING DATA (cylinder No. 1 at T.D.C.)			NORMAL OPERATING VALVE CLEARANCE AND TIMING CYCLES					
				INTAKE			EXHAUST		
	VALVE CLEAR. mm	INTAKE OPENS	EXHAUST CLOSES	CLEARANCE (COLD ENGINE) mm	OPENS	CLOSES	CLEARANCE (COLD ENGINE) mm	OPENS	CLOSES
825.10 - 826.100	1	8° before TDC	8° after TDC	0.20	22° before TDC (3)	60° after BDC(3)	0.30	60° before BDC (3)	22° after TDC(3)
815.100 - 815.500	1.3	opens at TDC	closes at TDC	0.20	19° before TDC (3)	57° after BDC(3)	0.30	57° before BDC (3)	19° after TDC (3)
818.000	1	opens at TDC	closes at TDC	0.15	17° before TDC (3)	54° after BDC(3)	0.25	54° before BDC (3)	17° after TDC(3)
315.000 - 815.400	1	1°30' before TDC	1°30' afterTDC	0.15	14°before TDC (3)	58° after BDC(3)	0.25	58°before BDC (3)	14° after TDC(3)
818.100 - 818.130 818.132	1	opens at TDC	closes at TDC	0.15	17°before TDC (3)	65° after BDC(3)	0.25	65°before BDC (3)	17° after TDC(3)
818.140	1.8	opens at TDC	closes at TDC	0.20	24°before TDC (3)	72° after BDC(3)	0.30	72°before BDC (3)	24° after TDC(3)

(3) - Timing considering a clearance of 0.4 mm.

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CAR ENGINES
Setting the Timing

A S T
Sketch510I
5/2/1959
Sheet 3/3

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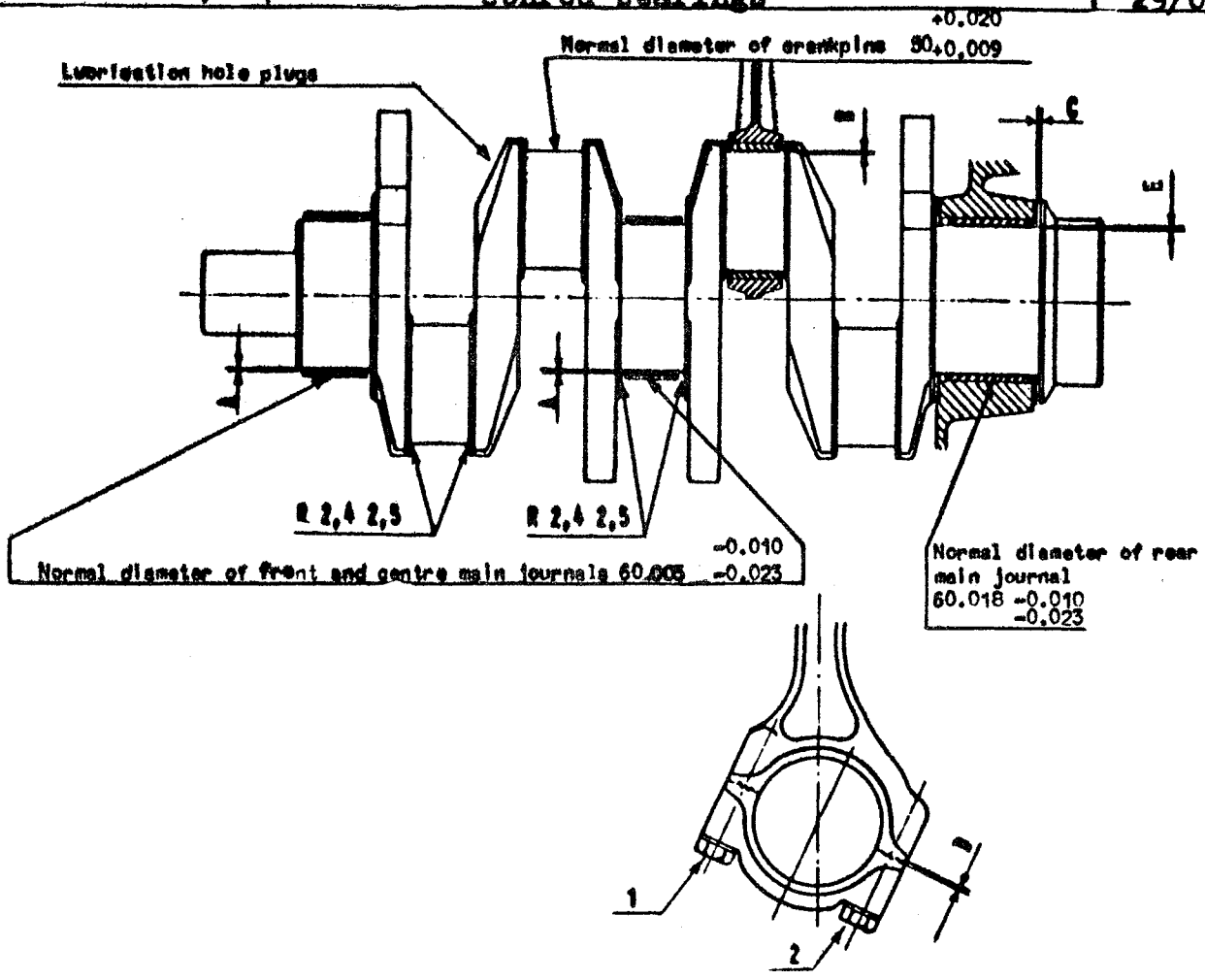
FLAVIA-ENGINES 815.00-815.100-815.200-815.400 815.300-815.500-315.000

Clearances, wear limits and undersizes for crankshaft journals, crankpins, main and conrod bearings

A S T
Sketch 650 I
29/8/63



NOTE: While overhauling crankshaft, remove plugs and clean lubrication holes

	ASSEMBLY CLEARANCES AND WEAR LIMITS OF CRANKSHAFT JOURNALS AND CRANKPINS, MAIN AND CONROD BEARINGS	Assembly clearances mm	Wear limits mm
A	Diametral clearance between front and centre main bearings and journals	0.020÷0.047	0.065
B	Diametral clearance between conrod bearings and crankpins	0.018÷0.056	0.070
C	Axial clearance between rear support thrust surface and crankshaft	0.080÷0.150	0.200
D	Conrod bearing cap pull: 1) tightened nut - 2) slackened nut	0.080÷0.150	—
E	Diametral clearance between rear main bearing and journal	0.020÷0.055	0.050

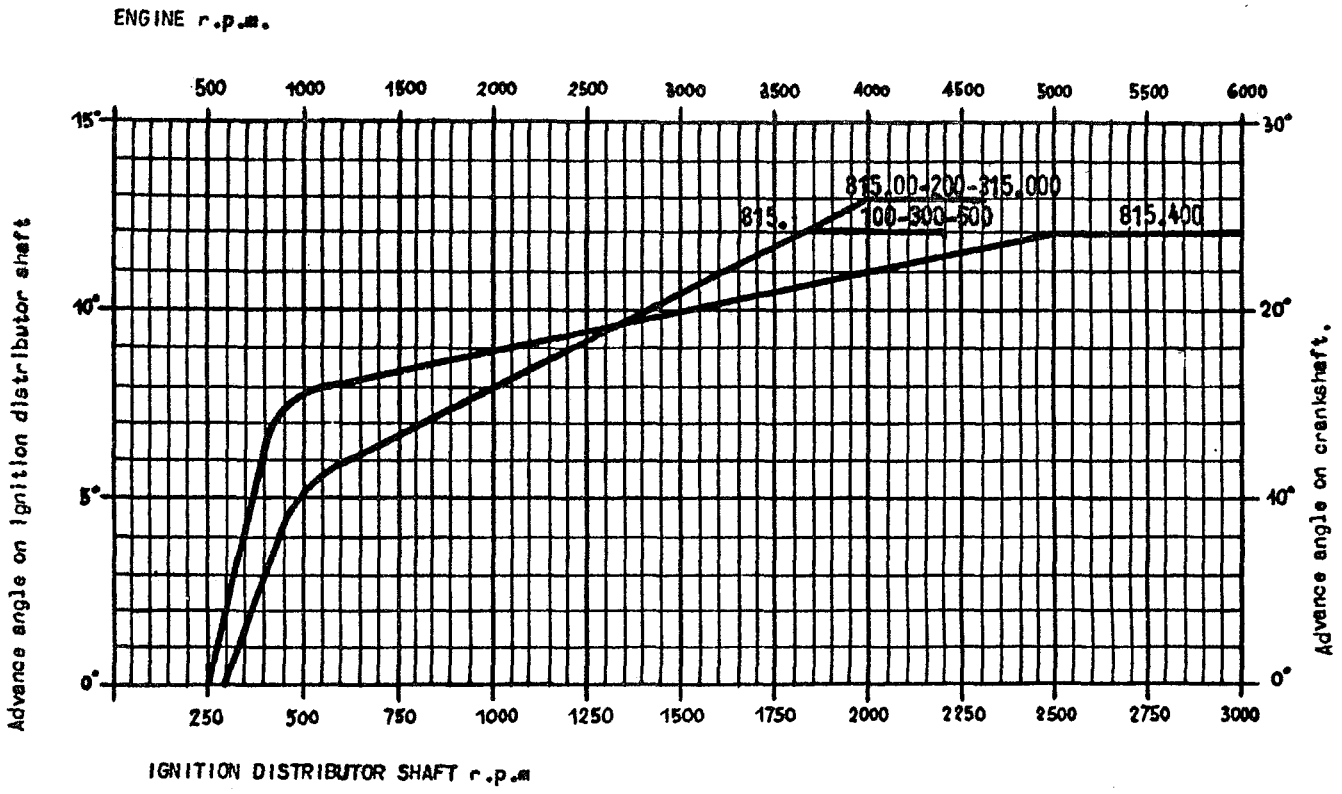
UNDERSIZES OF MAIN JOURNALS AND CRANKPINS TO FIT UNDERSIZED BEARINGS		mm
Front and centre main journal dia. to fit 1st undersize bearings	*	59.726÷59.741
Front and centre main journal dia. to fit 2nd undersize bearings	*	59.474÷59.487
Rear main journal dia. to fit 1st undersize bearings	*	59.741÷59.754
Rear main journal dia. to fit 2nd undersize bearings	*	59.487÷59.500
Crankpin dia. to fit 1st undersize bearings	*	49.755÷49.766
Crankpin dia. to fit 2nd undersize bearings	*	49.501÷49.512

* Compulsory dimensions of main journals and crankpins
Bearings are delivered full precisiob bored and are not adaptable

MODIFICATIONS: 3) 29/8/63 - Remade and added new engines - 4) 10/1/64 Added clearance E - 5) 15/6/64 Corrected dia. for 1st-undersize crankpin - 6) 25/11/65 - Added engine 815.400 and modified clearances A-B-E

LANCIA & C. FABBRICA AUTOMOBILI TORINO S.p.A. Printed in Italy	815.00-100-200-300-400-500-315.000 FLAVIA AND SUPERJOLLY ENGINES Automatic Advance Diagram	A S.T Sketch 655I 17/11/60

TOLERANCE: ± 1° REFERRED TO THE IGNITION DISTRIBUTOR SHAFT



815.00-815.200-315.000 = Fixed advance 2° on crankshaft

815.100-815.300-815.500-815.400 = Fixed advance 2° to 3° on crankshaft

MODIFICATIONS: 3) 27/12/65 = Added engine 815.400 =
LANCIA 8790656 (12-58) MULTI 3567

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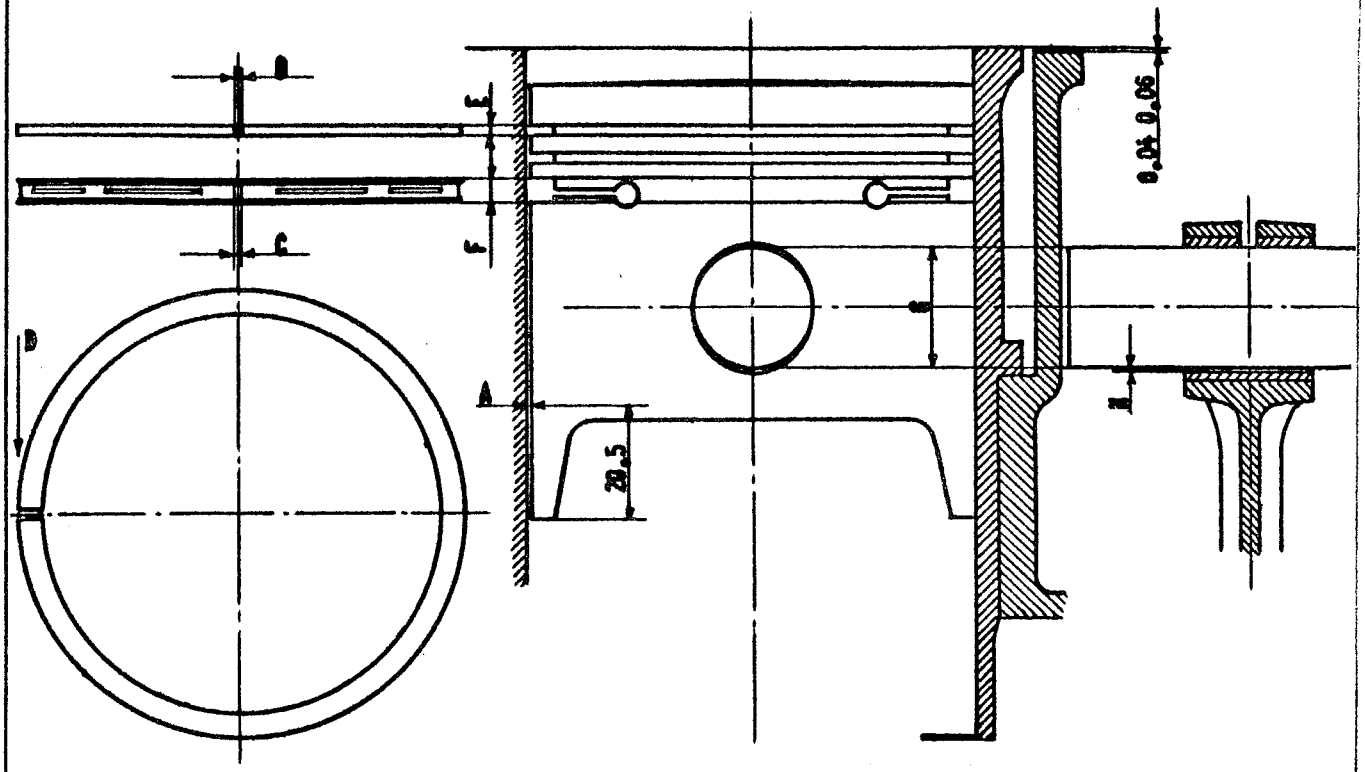
FLAVIA-ENGINES 815.300-815.400-500
Clearances and wear limits for liners, pistons, rings and pins

A S T
Sketch 8651
29/8/63



	ASSEMBLY CLEARANCES AND WEAR LIMITS FOR LINERS, PISTONS, RINGS, PINS AND CONNECTING ROD SMALL END BUSHINGS		Assembly clearances mm	Wear limits mm
A	Clearance between liner and piston (piston measured at 20.5mm from the lower edge at 90° from the pin hole axis);		0.064 to 0.090	0.200
B	Gap for fitted compression rings		0.300÷0.450	1.000
C	Gap for fitted oil scraper ring		0.250÷0.400	1.000
D *	Wall pressure of top compression ring	815.300-500 815.400	1.170÷1.550 kg 1.404÷2.028 kg	1.070 kg 1.304 kg
	Wall pressure of lower compression ring		1.305÷1.740kg	1.205 kg
	Wall pressure of oil scraper ring		1.710÷2.280kg	1.610 kg
E	Groove clearance of compression rings		0.047÷0.076	0.090
F	Groove clearance of oil scraper ring		0.030÷0.062	0.080
G	Clearance of pin in piston bosses		0.002 interf. 0.010 clear.	0.020
H	Clearance of pin in connecting rod bushing		0.005÷0.016	0.030

* To be measured by means of tool 8015225 or similar

OVERSIZES OF CYLINDER LINERS TO FIT OVERSIZED PISTONS	mm
Cylinder diameter for 1st oversize piston (NOTE: through honing only)	88.05 $^{-0}_{+0.039}$ (x)
Cylinder diameter for 2nd oversize piston	88.20 $^{-0}_{+0.039}$ (x)
Cylinder diameter for 3rd oversize piston	88.40 $^{-0}_{+0.039}$ (x)
Cylinder diameter for 4th oversize piston	88.60 $^{-0}_{+0.039}$ (x)

(x) To be fitted to piston dimensions, according to the assembly clearance

1) = 25/11/65 = Added engine 815.400 = 2) 27/4/1966 = Brought up-to-date clearance A

LANCIA & C. FABBRICA AUTOMOBILI TORINO - S.p.A. Printed in Italy	FLAVIA GAR - 815.400 ENGINE Specifications for Injection Pump, Injectors and Fuel Pump	A S T Sketch 1086I 7/10/65

KUGELFISCHER PL 004-117.01A-1 TYPE PETROL INJECTION PUMP
(Order No. 815.400-2229453)

DELIVERY CHECKING DATA *

(obtained with the following testing fluid: 2/3 - by volume - of JP4 and 1/3 of Shell Fusus A oil)

Control lever position	Pump r.p.m.	Allowed deliveries c.c.	Maximum hysteresis c.c.	No. of pump Strokes
Minimum	350	13,0 to 15,0	0,8	1,000
Intermed.	350	33,0 to 36,0	0,8	1,000
	1,400	26,0 to 29,0		
	2,800	17,5 to 20,0		
Maximum	1,400	52,0 to 55,0	0,8	1,000
	2,800	49,5 to 52,0		

KUGELFISCHER DLO-20B TYPE INJECTORS

MAIN FEATURES

Order No. (injector assy.)	Spray angle	Setting pressure kg/sq.cm	
		new	used
815.400 - 2229455	20°	30 to 38	≥ 20
At a pressure of 15 kg/sq.cm for 10 sec., no dribble should occur.			

KUGELFISCHER PLF 5A - 4L TYPE FUEL PUMP
(Order No. 815.400-2229502)

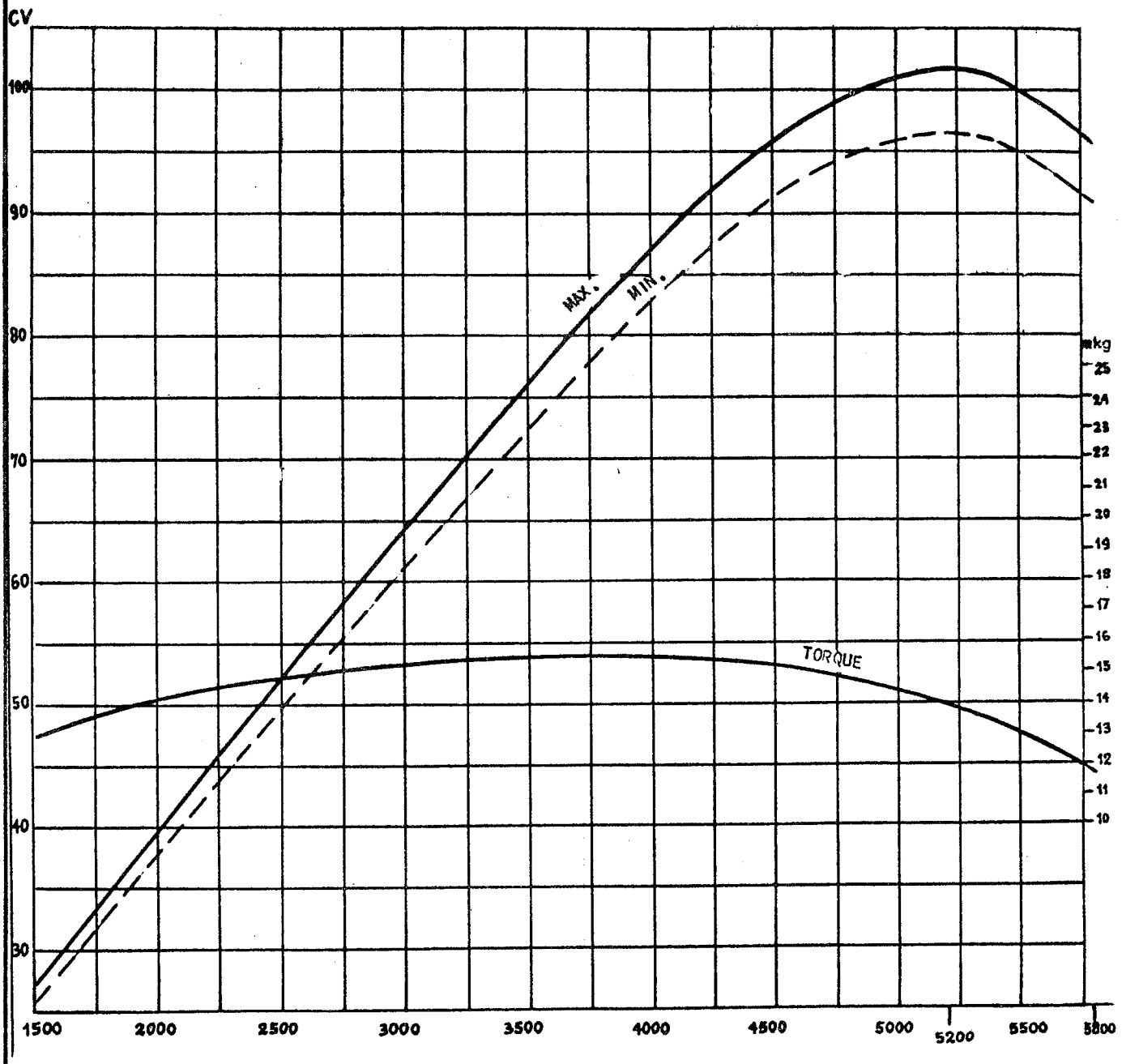
TESTING DATA

D A T A	Unit of measure	Specifications
Delivery at a pressure of 12 kg/sq.cm/12V	litres/hour	≥ 45
Self-adjusting pressure	kg/sq.cm	1,5 to 1,7
Operating voltage	Volt	12
Current draw	Amp	≤ 2,5
Electric resistance	Ω	2 to 3

* For all positions of the control lever and for any r.p.m. of the pump, the max. allowed difference between test tubes must be ≤ 1 c.c.

LANCIA & C. FABBRICA AUTOMOBILI TORINO S.p.A. Printed in Italy	FLAVIA - INJECTION ENGINE 815.400 Power Curve	A S T Sketch 1107I 19/10/965

Barometric pressure: 760 mm Hg - temperature: 15 °C (59 °F)



R.P.M.

Formula to calculate the engine power with the following data:

P = weight in kg. at the end of the brake arm

CV = Engine power

N = r.p.m.

0,001 = fixed coefficient for 716 mm long brake arm.

$$CV = 0.001 \times P \times N$$

LANCIA 8790656 (12-58) MULTI 3567

INSTALLING THE INJECTION PUMP

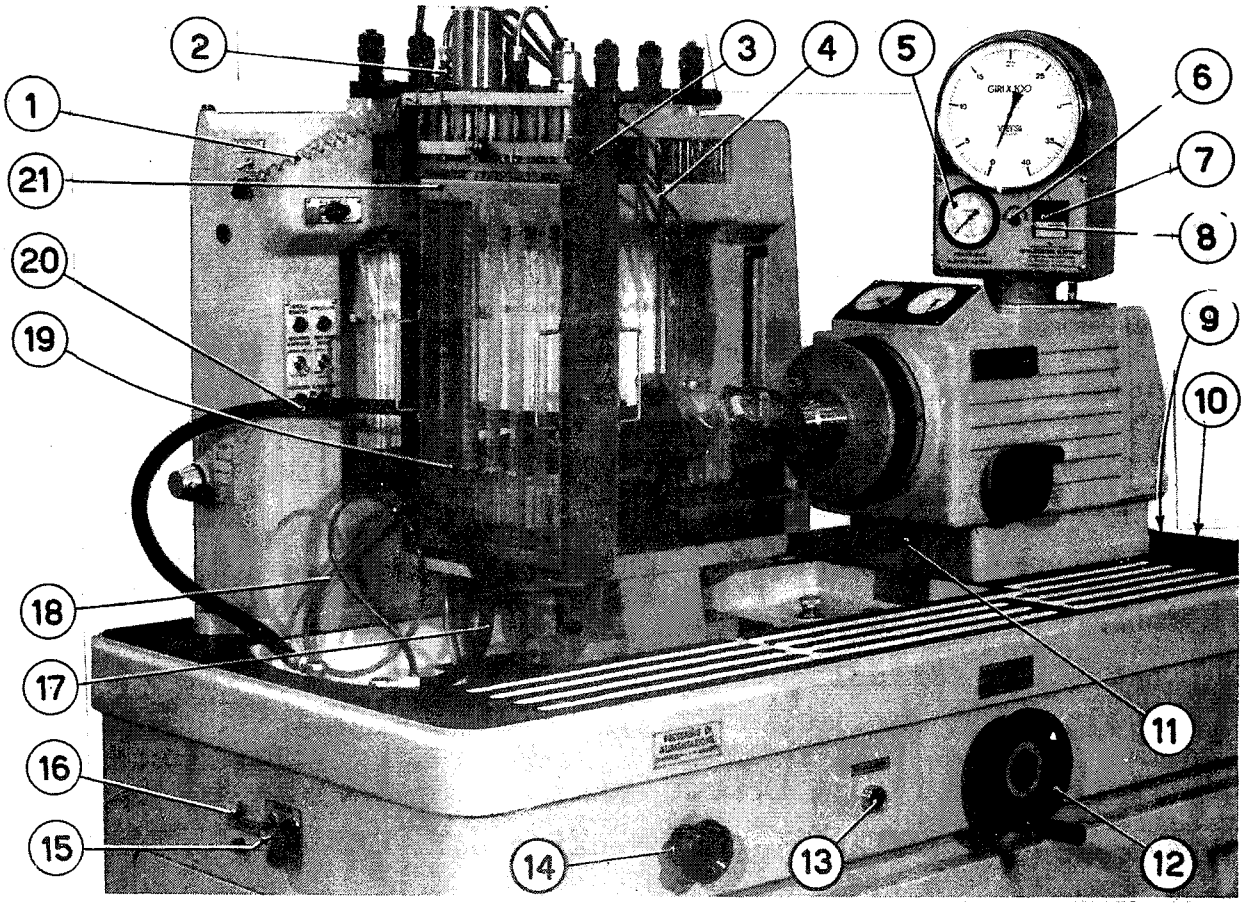


Fig. 1-Injection Pump on Test Bench

1. Additional spray diverting device connecting cable - 2. Injector - 3. Support frame - 4. Delivery valve-to-injector pipes - 5. Test fluid pressure gauge - 6. Pre-selector warning light - 7. Pre-selector cover - 8. Pump shot counter - 9. Test fluid lift pump switch - 10. Rotating direction pre-selecting handwheel - 11. Test bench motor switch - 12. Speed governing handwheel - 13. Spray diverting device push-button - 14. Test fluid delivery pressure regulating handwheel - 15. Lift pump test plug-in socket - 16. Oil pump switch - 17. Hydraulic head fluid inlet hose - 18. Hydraulic head oil feed hose - 19. Test tube with bulb - 20. Fluid return hose - 21. Test tube carrier.

The above figure shows the injection pump installed on the test bench and ready to undergo the delivery and hysteresis tests.

Note: The test fluid to be used is the same for both the petrol injection pumps and the diesel engine injection pumps, and is a compound of:

2/3 (by volume) of JP4 and 1/3 of Fusus A Shell oil.

The connections are the same as for the pump fitted to the car, that is: four pipes (4) connecting the delivery valves to the injectors (2); one fluid inlet hose (17) and one fluid return hose (20); another hose (18) which supplies the lubricating and sealing oil to the hydraulic head.

The drive connection to the bench head is provided by a coupling

(3 in fig. 2), after removal, however, of the drive gear from the pump. Moreover, the pump is secured to a support (2 in fig. 2) which slides longitudinally on tracks.

Figure 2 shows, in particular, the pump mounting onto the support and the drive connection to the bench head. Figure 2 also shows gauge 8015377 (6), for setting the pump, fitted into the pump housing slot, and pin 8013352 (4) by which the pump control lever (5) is held in the desired position (in the figure, the lever is in the minimum position).

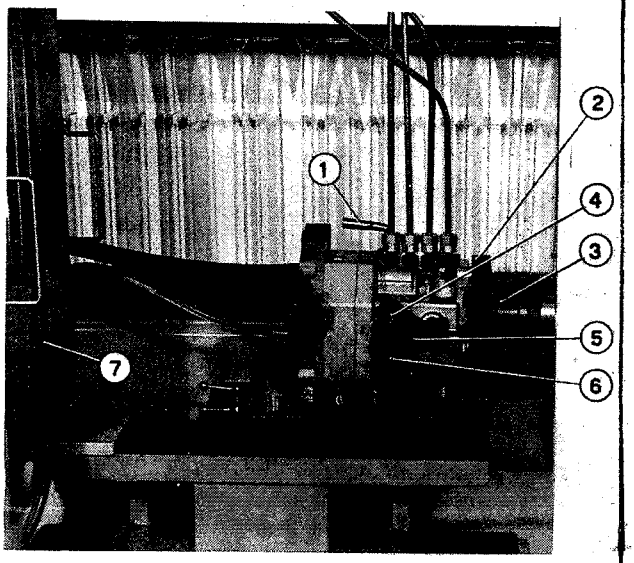


Fig. 2 – Detail View of the Injection Pump on Test Bench.

The test tubes for collecting the fluid are of two types:

- one type (7 in figure 2,), with even section, suitable for checking deliveries of up to 40 cu. cm. (2.44 cu. in.);
- one type (19), with uneven section, suitable for checking deliveries from 40 to 70 cu.cm.(2.44 to 4.27 cu.in.).

The even section test tubes are used when testing with pump control lever in the "Minimum" and "Intermediate" positions, whilst the other test tubes are used when carrying out tests with pump control lever in the "Maximum" position.

All eight test tubes are secured, by clamps, to a metallic carrier (21), which may be easily removed from its support frame (3).

Notice also that the mouths of the even section test tubes are in the opposite position as compared with those of the test tubes provided with bulbs; therefore, should it be necessary to invert their position, proceed as follows:

- remove the carrier, turn it by 180° on the horizontal plane, and by 180° on the vertical plane and then refit it.

Indispensable Precautions

- Never set the pump shot counter (8) to zero while the bench

motor is running;

- Before starting the bench motor, switch on the lift pump (9) and the oil pump (16). Once the oil pump has been set in motion, it will be necessary to vent the feed hose (18) by unscrewing and immediately screwing - in again the banjo bolt fitted to the pump hydraulic head;
- When fitting the cable (1) which connects the additional spray diverting device, it is necessary to disconnect the bench diverting device;
- The shaft of the pump, seen from the drive side, must rotate in a clockwise direction; to this end, properly set the pre-selector knob;
- Before starting the motor, check that the speed governor is set to zero, which is obtained with control handwheel (12) fully turned to the left;
- The preselection, for the pumps of the 815.400 type engine, must be set to 1000 shots (as also specified on the test chart); to this end lift the cover (7) and set the selector to "100" (in fact, the counter trips every 10 pump shots);
- Before commencing the test, it will be necessary to operate the pump for some time at the various speeds.
  On starting the motor set the pressure on gauge (5) to 1.3 atm. (18.5 p.s.i.)approx.;
- To operate the spray diverting device , it will be necessary to depress the relevant push-button (13), releasing it only after the preselector red warning light (6) lights up.
  Conversely, should it be necessary to Test the Governor, with pump, complete with hydraulic head, fitted to the bench, proceed as follows:
- Switch-off the test fluid feed pump and the oil pump, then disconnect the pump hoses;
- Slacken, as far as possible, the nut securing the support (2 in fig. 2) to the bench;
- Move back the support and pump assy., as far as possible;
- Lift the support, turn it and place it in the most convenient

position (see fig. 3);

- Remove the pump hydraulic head and cover, following the procedure described in the operation "Disassembly" of the manual "Flavia with injection engine";
- Lift the plunger travel regulating rocker and withdraw the tappets and the cam follower pin;
- Reconnect the pump to the bench head and tighten the nut securing the support to the bench;
- Remove the test tube carrier (21) and place it in a safe place.

INSTALLING THE LIFT PUMP

The lift pump is fitted to the outer side of the test tube carrier support frame (see fig. 3), to which it is secured with two nuts.

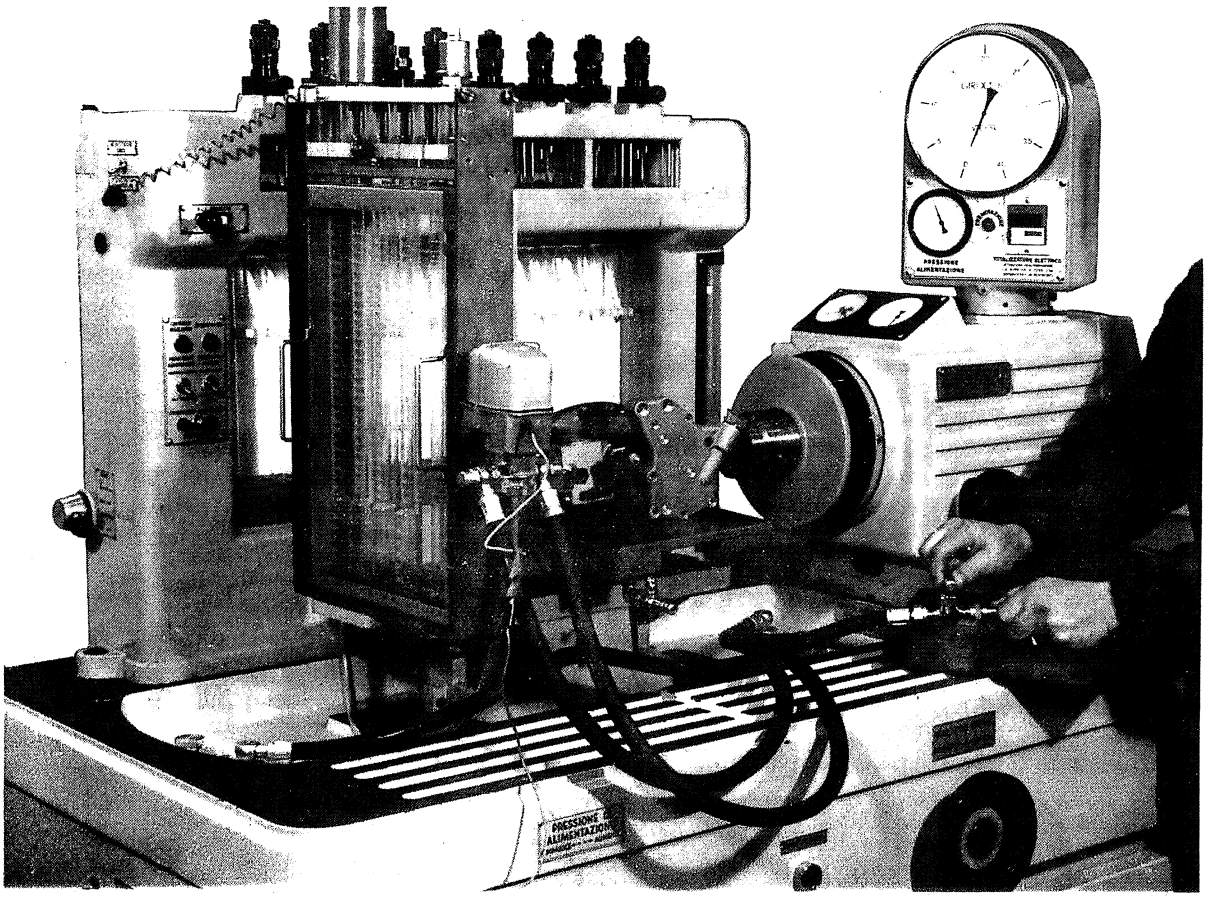


Fig. 3 – Lift Pump on Test Bench

Connections

- Unscrew the plugs from the bench (just below the head overhang) and screw-in the banjo bolts of the hoses to be used for the lift pump test.
- The banjo bolts on the other two hose ends are to be screwed respectively into the lift pump inlet and outlet ports. Do not interchange them; the inlet and outlet indications are located under the bench head, near the ports;
- Make sure that the oil pump and the test fluid pump are switched-off.
- Check that the reservoir contains enough fluid; if necessary, top up.
- Leave the cock (1 in fig.2) on the delivery line slightly open (the same cock used for the injection pump test).
  With the foregoing operations, the bench pump has been cut-off and has been replaced by the one to be tested; the delivery pressure readings, therefore, will have to be taken on the bench pressure gauge. The pressure has to be regulated by acting on the cock located at the end of the delivery line (see fig.3).
- Connect the pump to the 12 V electric system; to this end, use the proper bridge cable by inserting the plug into the socket (15 in fig. 1) and locking the other end in the pump clamp (see fig.3).
- The pump will begin operating and, after expelling the air contained in the lines, the fluid will flow out the delivery line cock.
- When the pressure has become stable, the tests may begin.
  Figure 3 shows the delivery test, for which the delivery pressure has been set to 1.2 kg./sq.cm ≈ 17.07 p.s.i. (see Sketch 1086I); on the contrary, should the cone-shaped valve setting be carried out, it will be necessary to close the clock completely and to follow the procedure described in the relevant operation of the manual "Flavia with Injection Engine".

CHECKING THE ELECTRO-VALVE

Check Data

Fuel delivery	≥ 0.04 l.p.m.
Power input	1 A at 12 Volt
Feed voltage	12 V d.c.
Electro-valve inlet pressure	1.2 kg/sq.cm.(17 p.s.i.)

Checking Operations

- Fit the electro-valve into the proper threaded seat (first threaded hole towards operator when the support frame is in the position shown in fig.3) obtained in the top plate of the support frame (which is part of additional equipment 8016350).
- Arrange the test tube carrier so that the 70 cu.cm.(4.27 cu.in.) single tube, fitted unmatched, is in correspondence with the electro-valve.
- Electrically connect the electro-valve; to this end, use the proper jumper cable (provided with plug and jack), connecting the electro-valve to the 12 V d.c.socket (15 in fig.1) of the test bench.
- Make the hydraulic connection by screwing in one end of the proper pipe (which is part of additional equipment 8016350) into the delivery connection located in the test bench collecting tank, at the operator's left, and connecting the other end to the electro-valve.
- Set the pressure on the gauge to 1.2 kg/sq.cm. (17 p.s.i. approx.).

Since the delivery test is referred to one minute's time, should a chronometer not be available, proceed as follows:

- set the pre-selector to 1000 pump shots;
- start the bench and set its speed to 1000 r.p.m.
- set the electro-valve operation electric contact by acting on the proper switch (beside socket 15 in figure 1).
- press the spray-diverting device push-button and release it as soon as the warning light goes on.
  At this point, the fluid fed by the electro-valve begins being collected in the test tube provided and, thanks to the spray-diverting device, as soon as the minute is elapsed, the collecting will immediately stop.
  The collected quantity will have to be less than 0.04 lt. per minute.

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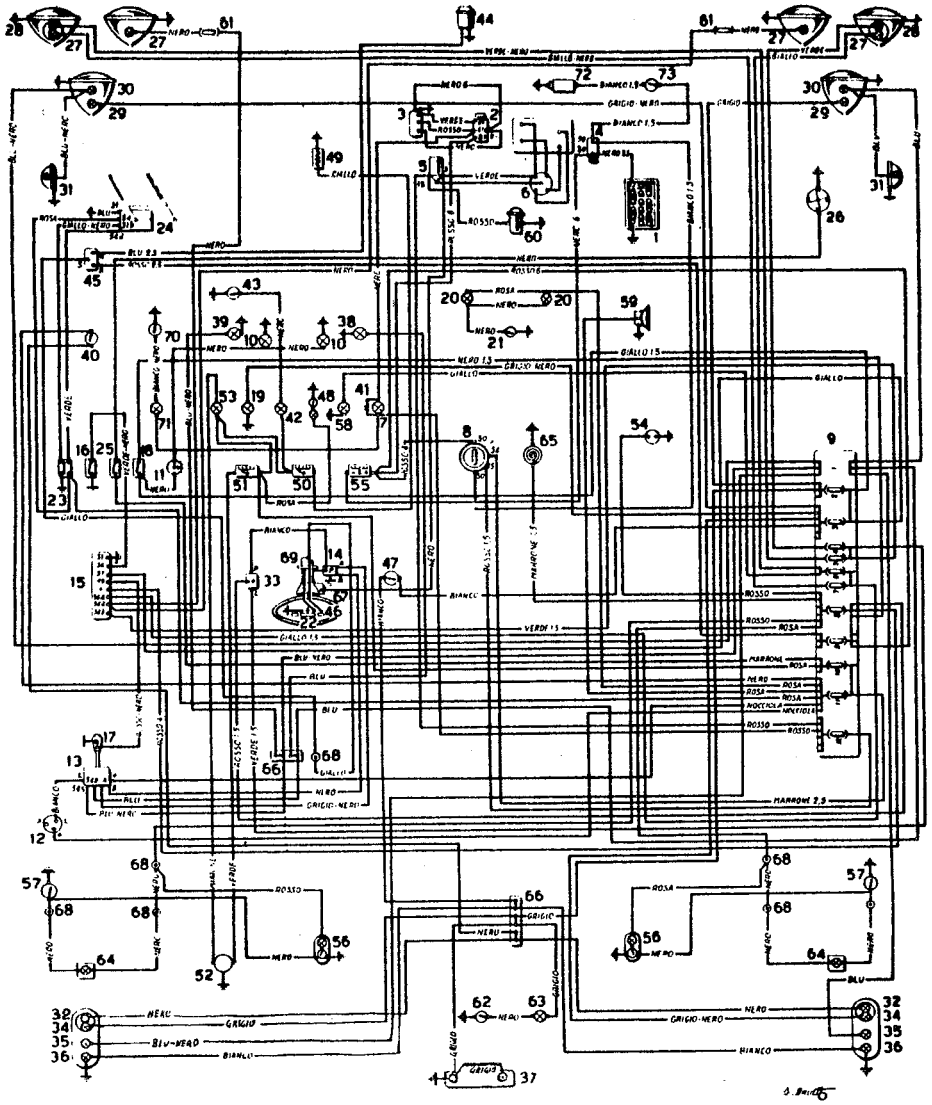
815.400 FLAVIA CAR

Wiring diagram

A S T
Sketch 1114 I

29/12/1965



Bianco = White
Blu = Blue
Giallo = Yellow
Grigio = Gray
Marrone = Brown
Nocciola = Hazel
Nero = Black
Rosa = Pink
Rosso = Red
Verde = Green

1. Battery
2. Alternator
3. Electronic voltage regulator
4. Starter motor
5. Ignition coil
6. Ignition distributor
7. Alternator warning light
8. Key switch for ignition, starting and services
9. Fuse box
10. Instrument panel lights
11. Instrument panel light switch, with rheostat
12. Direction indicator flasher
13. Direction indicator control
14. Direction indicator self-cancellation switch
15. Headlamp control relay
16. Low beam switch
17. Dipper switch push-button
18. Parking lamp switch
19. Parking lamp warning light
20. Engine compartment lights
21. Engine compartment light automatic switch
22. Headlamp flashing control
23. Windscreen wiper switch
24. Windscreen wiper motor
25. Air conditioning fan switch
26. Air conditioning fan motor
27. Main beam
28. Low beam
29. Front parking lamps
30. Front direction indicators
31. Direction indicator repeaters
32. Stop lights
33. Headlamp flashing relay
34. Rear parking lamps
35. Rear direction indicators
36. Back-up lights
37. Number plate lights
38. Right direction indicator warning light
39. Left direction indicator warning light
40. Stop light switch
41. Resistor for alternator excitation circuit (80 Ω - 4 W)
42. Hand brake warning light
43. Hand brake warning light switch
44. Horn electro-compressor
45. Horn relay
46. Horn control
47. Back-up light switch
48. Oil low pressure warning light, with switch
49. Coolant temperature gauge sending unit
50. Coolant temperature gauge
51. Fuel gauge
52. Fuel gauge sending unit
53. Fuel reserve warning light
54. Plug-in socket
55. Ammeter
56. Interior light, with switch
57. Interior light door-operated switch
58. Main beam warning light
59. Radio
60. Fuel pump
61. Main beam circuit fuses
62. Engine compartment light automatic switch
63. Luggage compartment light
64. Front open door marker lamp
65. Cigar-lighter
66. Shunt block
67. Blaster anti-theft
68. Plug-in junction
69. Headlamp flashing and dir. indicator self-cancellation breaker contact assembly
70. Fuel feed low pressure warning light switch
71. Fuel feed low pressure warning light
72. Engine starting electro-valve
73. Engine starting electro-valve cut-off thermo-contact.

MODIFICATIONS: 1) 9/3/1966 - Remade and modified.

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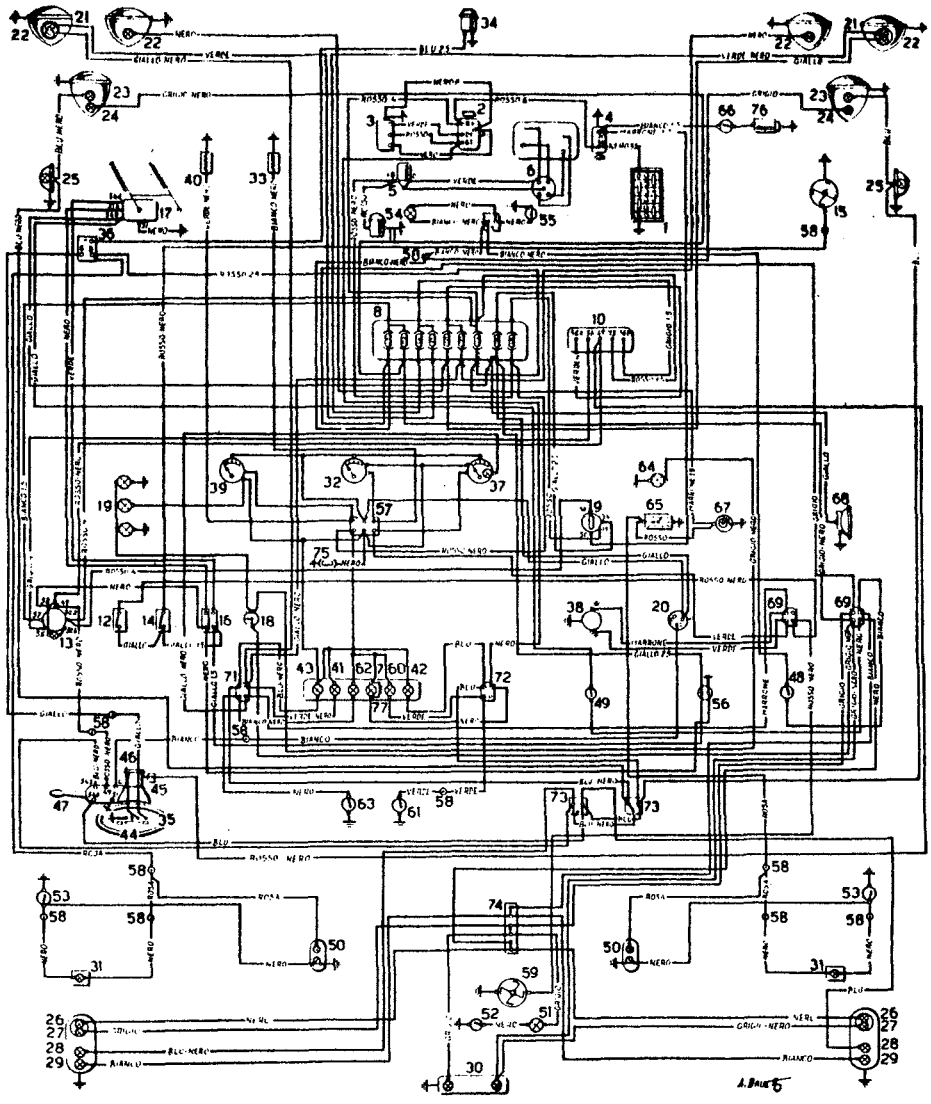
815.430 FLAVIA COUPE CAR

Wiring diagram

A S T
Sketch1115I

28/10/65



Bianco = White
Blu = Blue
Giallo = Yellow
Grigio = Gray
Marrone = Brown
Nero = Black
Rosa = Pink
Rosso = Red
Verde = Green

1. Battery
2. Alternator
3. Electronic voltage regulator
4. Starter motor
5. Ignition distributor
6. Ignition coil
7. Alternator warning light
8. Fuse box
9. Key switch for ignition, starting and services
10. Headlamp control relay
11. Fuel pump
12. Rear window defroster fan switch
13. Exterior light switch, with parking lamp warning light
14. Air conditioning fan switch
15. Air conditioning fan motor
16. Windscreen wiper switch
17. Windscreen wiper motor
18. Instrument panel light switch, with rheostat
19. Instrument panel lights
20. Direction indicator flasher
21. Low beam
22. Main beam
23. Front direction indicators
24. Front parking lamps
25. Direction indicator repeaters
26. Stop lights
27. Rear parking lamps
28. Rear direction indicators
29. Back-up lights
30. Number plate lights
31. Open door marker lamps
32. Coolant temperature gauge
33. Coolant temperature gauge sending unit
34. Horn electro-compressor
35. Horn control
36. Horn relay
37. Fuel gauge, with reserve warning light
38. Fuel gauge sending unit
39. Oil pressure gauge
40. Oil pressure gauge sending unit
41. Main beam warning light
42. Right direction indicator warning light
43. Left direction indicator warning light
44. Headlamp flashing control
45. Headlamp flashing contact
46. Headlamp flashing control contact assembly
47. Direction indicator and dipper switch control
48. Back-up light switch
49. Stop light switch
50. Interior light with switch
51. Luggage compartment light
52. Luggage compartment light, automatic switch
53. Interior light door-operated switch
54. Engine compartment light
55. Engine compartment light automatic switch
56. Plug-in socket
57. Instrument junction block
58. Plug-in junction
59. Rear window defroster fan motor
60. Handbrake warning light
61. Hand brake warning light switch
62. Fuel feed low pressure warning light
63. Fuel feed low pressure warning light switch
64. Clock lamp
65. Clock
66. Engine starting electro-valve cut-off thermo-contact
67. Cigar-lighter
68. Radio
69. 4-way front junction block
70. Alternator excitation circuit resistor (80 Ω - 4 W)
71. Instrument 4-way junction block (red)
72. Instrument 4-way junction block (White)
73. Direction indicator 2-way junction block
74. Shunt block
75. Instrument cluster circuit protection fuse (3A)
76. Engine starting electro-valve.

MODIFICATIONS: 1) 9/3/1966 - Remade and modified.

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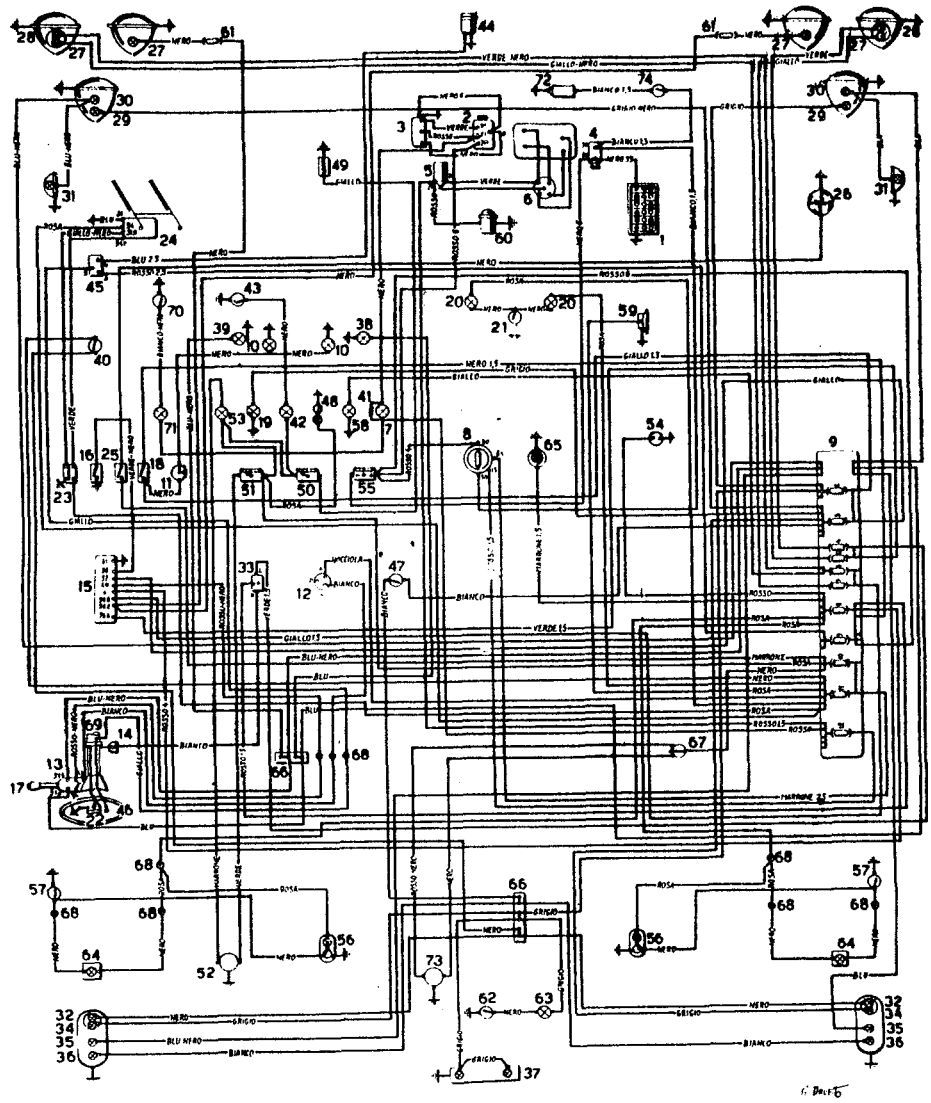
815.432 FLAVIA SPORT CAR

Wiring diagram

A S T
Sketch1116I

29/12/65

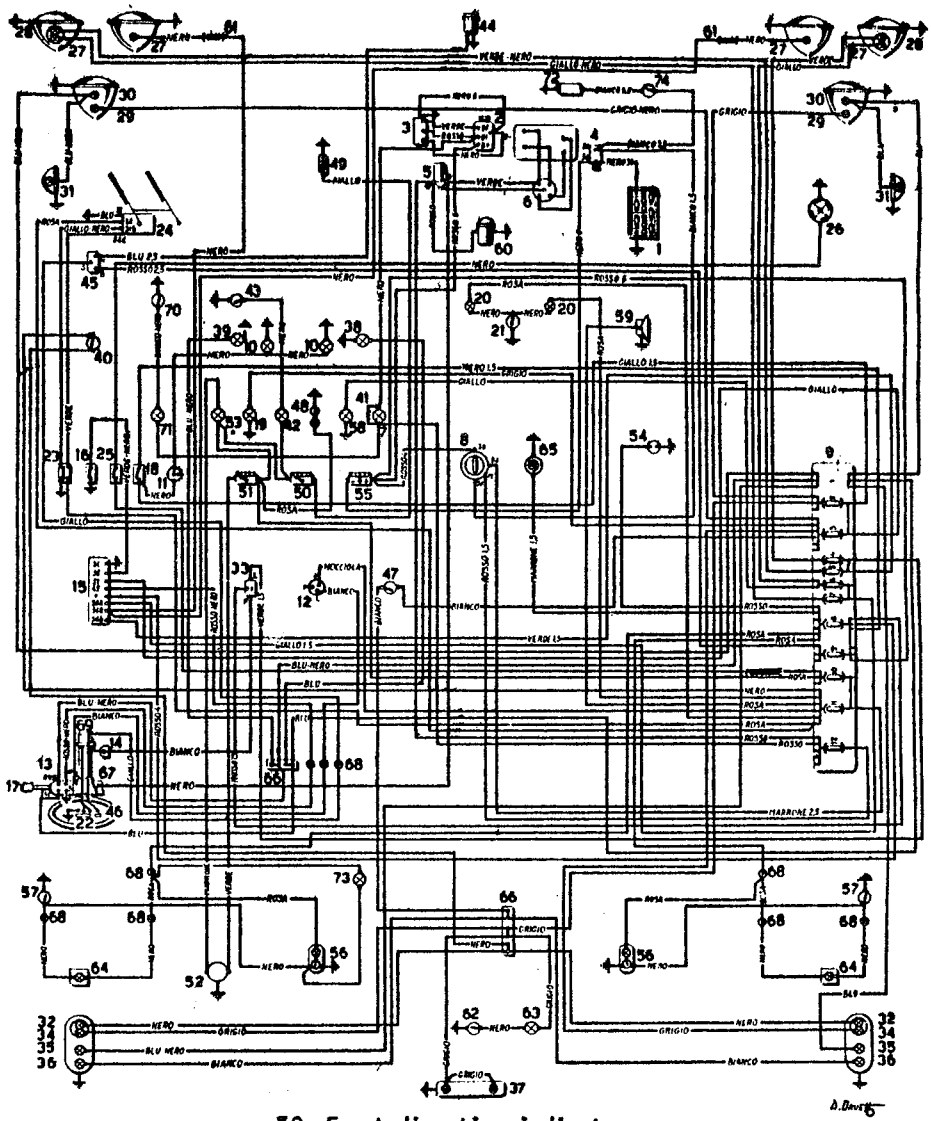


Bianco	= White
Blu	= Blue
Giallo	= Yellow
Grigio	= Gray
Marrone	= Brown
Nero	= Black
Rosa	= Pink
Rosso	= Red
Verde	= Green
Nocciola	= Hazel

1. Battery
2. Alternator
3. Electronic voltage regulator
4. Starter motor
5. Ignition coil
6. Ignition distributor
7. Alternator warning light
8. Key switch for ignition,starting
9. and services
9. Fuse box
10. Instrument panel lights
11. Instrument panel light switch, with rheostat
12. Direction indicator flasher
13. Direction indicator control
14. Headlamp flashing contact assembly
15. Headlamp control relay
16. Low beam switch
17. Dipper switch push-button
18. Parking lamp switch
19. Parking lamp warning light
20. Engine compartment lights
21. Engine compartment light automatic switch
22. Headlamp flashing control
23. Windscreen wiper switch
24. Windscreen wiper motor
25. Air conditioning fan switch
26. Air conditioning fan motor
27. Main beam
28. Low beam
29. Front parking lamps
30. Front direction indicators
31. Direction indicator repeaters
32. Stop lights
33. Headlamp flashing relay
34. Rear parking lamps
35. Rear direction indicators
36. Back-up lights
37. Number plate lights
38. Right direction indicator warning light
39. Left direction indicator warning light
40. Stop light switch
41. Alternator excitation circuit resistor (80 Ω - 4 W)
42. Hand brake warning light
43. Hand brake warning light switch
44. Horn electro-compressor
45. Horn relay
46. Horn control
47. Back-up light switch
48. Oil low pressure warning light, with switch
49. Coolant temperature gauge sending unit
50. Coolant temperature gauge
51. Fuel gauge
52. Fuel gauge sending unit
53. Fuel reserve warning light
54. Plug-in socket
55. Ammeter
56. Interior light with switch
57. Interior light door-operated switch
58. Main beam warning light
59. Radio
60. Fuel pump
61. Main beam circuit protection fuses
62. Luggage compartment light automatic switch
63. Luggage compartment light
64. Open door marker lamps
65. Cigar-lighter
66. Shunt block
67. Rear window regulator motor switch
68. Plug-in junction
69. Headlamp flashing control contact assembly
70. Fuel feed low pressure warning light switch
71. Fuel feed low pressure warning light
72. Engine starter electro-valve
73. Rear window regulator motor
74. Engine starting electro-valve cut-off thermocontact.

MODIFICATIONS: 1) 9/3/1966 - Remade and modified.

LANCIA & C. FABBRICA AUTOMOBILI TORINO S.p.A. Printed in Italy	815.434 FLAVIA CONVERTIBLE CAR Wiring diagram	A S T Sketch1117I 29/12/65



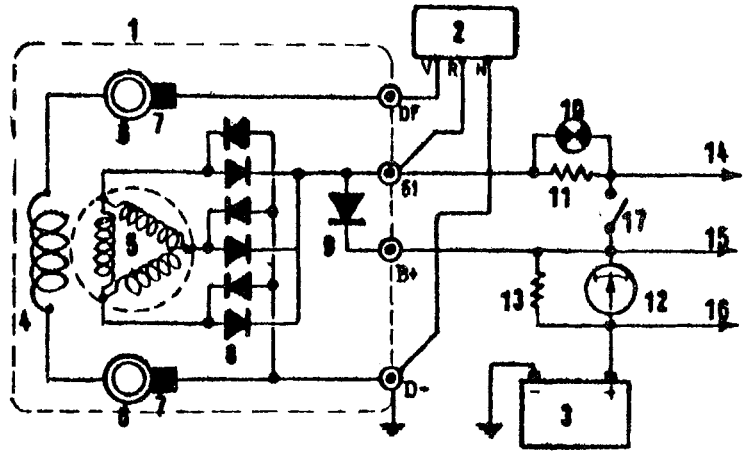
Bianco = White
Blu = Blue
Giallo = Yellow
Grigio = Gray
Nocciola = Hazel
Nero = Black
Rosa = Pink
Rosso = Red
Verde = Green
Marrone = Brown

1. Battery
2. Alternator
3. Electronic voltage regulator
4. Starter motor
5. Ignition coil
6. Ignition distributor
7. Alternator warning light
8. Key switch for ignition, starting and services
9. Fuse box
10. Instrument panel lights
11. Instrument panel light switch, with rheostat
12. Direction indicator flasher
13. Direction indicator control
14. Headlamp flashing contact assembly
15. Headlamp control relay
16. Low beam switch
17. Dipper switch push-button
18. Parking lamp switch
19. Parking lamp warning light
20. Engine compartment lights
21. Engine compartment light automatic switch
22. Headlamp flashing control
23. Windscreen wiper switch
24. Windscreen wiper motor
25. Air conditioning fan switch
26. Air conditioning fan motor
27. Main beam
28. Low beam
29. Front parking lamps
30. Front direction indicators
31. Direction indicator repeaters
32. Stop lights
33. Headlamp flashing relay
34. Rear parking lamps
35. Rear direction indicators
36. Back-up lights
37. Number plate lights
38. Right direction indicator warning light
39. Left direction indicator warning light
40. Stop light switch
41. Alternator excitation circuit resistor (80Ω - 4 W)
42. Hand brake warning light
43. Hand brake warning light switch
44. Horn electro-compressor
45. Horn relay
46. Horn control
47. Back-up light switch
48. Oil low pressure warning light, with switch
49. Coolant temperature gauge sending unit
50. Coolant temperature gauge
51. Fuel gauge
52. Fuel gauge sending unit
53. Fuel reserve warning light
54. Plug-in socket
55. Ammeter
56. Interior light, with switch
57. Interior light door-operated switch
58. Main beam warning light
59. Radio
60. Fuel pump
61. Main beam circuit protection fuses
62. Luggage compartment light automatic switch
63. Luggage compartment light
64. Open door marker lamps
65. Cigar-lighter
66. Shunt block
67. Bloster anti-theft
68. Plug-in junction
69. Headlamp flashing control contact assembly
70. Fuel feed low pressure warning light switch
71. Fuel feed low pressure warning light
72. Engine starting electro-valve
73. Interior light (in the rear-view mirror)
74. Engine starting electro-valve cut-off thermo-contact.

MODIFICATIONS: 1) 9/3/1966 - Remade and modified.

LANCIA & C. FABBRICA AUTOMOBILI TORINO S.p.A. Printed in Italy	815.400 FLAVIA CAR TEST DATA AND CIRCUIT DIAGRAM OF S.E.V. MOTOROLA TYPE ALTERNATOR 14/30 - 33505 AND ELECTRONIC REGULATOR 33069.	A S T Sketch 1124I 17/2/66 sheet 1/2

ALTERNATOR AND REGULATOR CIRCUIT DIAGRAM



1. Alternator
2. Regulator
3. Battery
4. Excitation coil (rotor)
5. Field coil (stator)
6. Slip rings
7. Brushes
8. Rectifier diodes
9. Insulation diode
10. Warning light
11. Excitation resistor
12. Ammeter
13. Ammeter shunt
14. To the ignition coil
15. To the using devices
16. To the starter motor
17. Ignition switch

ALTERNATOR WITH REGULATOR TEST DATA

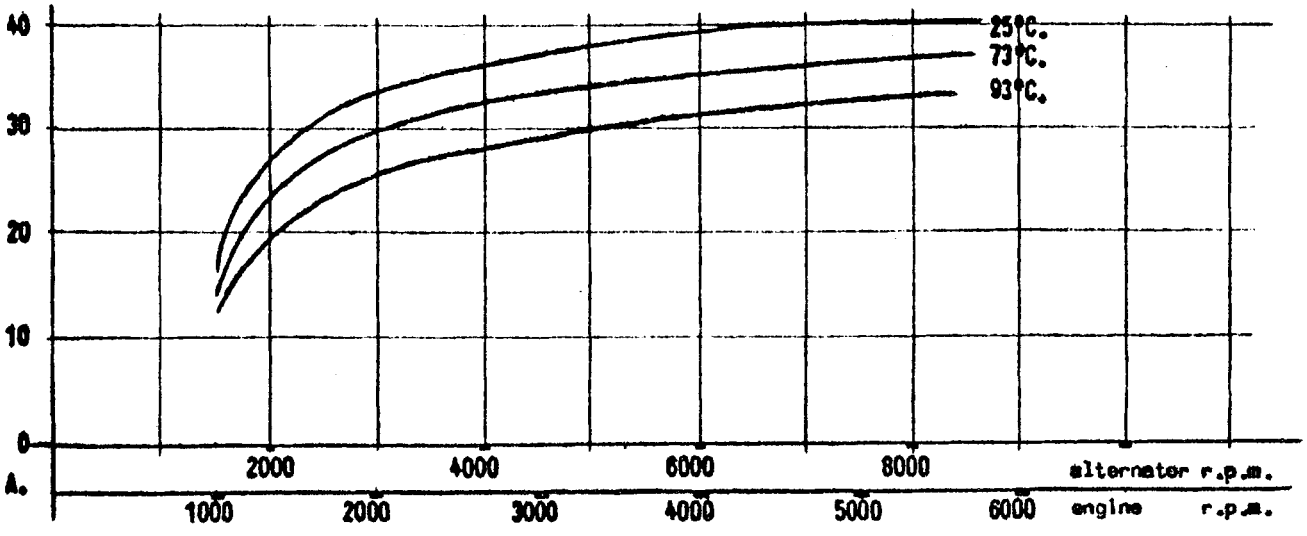
The alternator being connected to a battery, with parallel charge resistance set so that the supplied current is 10 A approx., after 30 minutes of stabilization at a room temperature of 25 °C (77 °F), the voltage measured between the alternator terminals B+ and D- must be 14.4 ± 0.2 V.

OUTPUT DATA

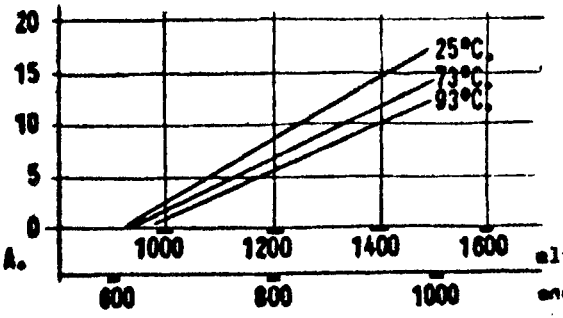
Taken after 45 minutes of stabilization at 3000 r.p.m. with output of 30 A and constant voltage of 14.4 V.

Rated performances: 14V - 30A

Output curve under power



Output curve at slow running speed



In examining the output curve at slow running speed, it may be noted that, already at a very low engine rotation speed, the alternator supplies a few ampere current which is sufficient to cause the warning light to go off.

MODIFICATIONS: 1) 23/3/66 - Changed sheet number and added sheet 2 -

CAUTION - The SEV MOTOROLA alternator-voltage regolator uses semi-conductor devices (diodes and transistors) which might be damaged beyond repair, if subjected to accidental short-circuits or over-voltage. Therefore, it will be necessary to scrupulously comply with the under-listed rules, parts of which have already been specified with a preceding circular letter of ours and also stated on the plate fitted to the battery cover of the cars equipped with the above alternator :

1) for any intervention on the electric system of the car, always disconnect one of the battery terminals;
2) when re-charging the battery, this must be disconnected from the electric system of the car;
3) should the engine be started when the battery is dead, it will be possible to connect to this an outside battery without however disconnecting the terminals of the car battery;
4) when the alternator is charging, that is when the engine is running, even at idling speed, never disconnect the battery terminals, nor disconnect any connection of the alternator and regulator;
5) for any possible intervention on the alternator or on the regulator, the utmost care must be taken not to transpose their connections;
6) when testing the alternator and the regulator on the bench, never disconnect any connection between them; in addition, for the connections, do not use crocodile-type clips, which might get disconnected or effect a poor contact; preferably use terminals with locking by screw;
7) on the test bench, the battery must always be connected to the alternator, in parallel with the charge resistance.

Bear in mind, moreover, that, in order to avoid distortions or breakages in the aluminium frame, the alternator will never have to be secured onto the test bench with the mountings normally used for the generator, but will have to be secured, through the mounting bosses (as on the car), by means of a suitable bracket.

L A N C I A & C.

FABBRICA AUTOMOBILI - TORINO - S. p. A.

Fully paid-up capital: 10,800,000,000 lire

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TECHNICAL ASSISTANCE DPT.

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