



Direzione Assistenza

INSTRUCTION AND MAINTENANCE MANUAL
FOR ALFA ROMEO 1750
FUEL INJECTION MODELS
U.S.A. VERSION

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INSTRUCTION AND MAINTENANCE MANUAL

FOR ALFA ROMEO 1750

FUEL INJECTION MODELS

U.S.A. VERSION

This manual contains the specifications and the instructions covering the fuel injection system installed on Alfa Romeo 1750 models.

Special care should be given to the regular servicing and maintenance directions, particularly as far as the efficiency of the system is concerned.

It is important that any maintenance and repair work be entrusted only to an authorized Alfa Romeo Dealer as such Dealers are equipped with the proper tools and staffed by specially trained mechanics.

ALFA ROMEO
Direzione Assistenza

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I M P O R T A N T N O T E

The fuel injection system for the 1750 model has been designed not only to attain high performance and low fuel consumption but also to keep the exhaust emissions below the levels permitted by U.S.A. regulations.

The low exhaust emission levels have therefore been obtained by improving the distribution and the combustion. No devices to burn the unburned gases downstream of the exhaust valves are required.

Of course, even with the fuel injection system fitted to the Alfa 1750, the exhaust emissions of cars sold to Customers will not continue to meet U.S. specification unless the owner himself provides to have the prescribed servicing outlined on page 11 regularly carried out by authorized workshops and provided that, when remedying troubles or performing any maintenance work on the engine or fuel feed system, the workshops strictly follow the factory prescribed procedure.

DESCRIPTION OF FUEL INJECTION SYSTEM

GENERAL

Fuel is supplied to the engine by injection into the intake port of each cylinder by means of four pumping elements (one per cylinder) whose delivery is controlled by a "control unit". A cam in the control unit provides a "base" delivery according to the opening of throttles and to RPM range; the "base" delivery is varied by compensating devices giving proper corrections for atmospheric pressure, engine temperature, cold starting, initial running and fuel cut off on deceleration.

FUEL FEED SYSTEM

Operating diagram

Inserting the key in the ignition switch (1) and rotating clockwise to the first click will operate the electric pump (2). The gasoline flows from the tank (3) thru tank filter (4) and main filter (5) and feeds the injection pump (6).

The excess fuel, acting also as a coolant for the injection pump (6), before returning to the tank, passes thru a calibrated orifice (7) which regulates the fuel pressure within the injection pump. A pressure switch (8) inserted in the delivery pipe will switch on the warning light (10) on dashboard if a pressure drop occurs in fuel lines; the pressure should never be lower than 7.1 psi - 0.5 Kg/cm².

A pressure relief valve (9) on filter (5) limits the fuel pump outlet pressure bypassing fuel to the recovery pipe at 16 - 18 psi (1.1 - 1.3 Kg/cm²).

GENERAL ARRANGEMENT OF FUEL SYSTEM

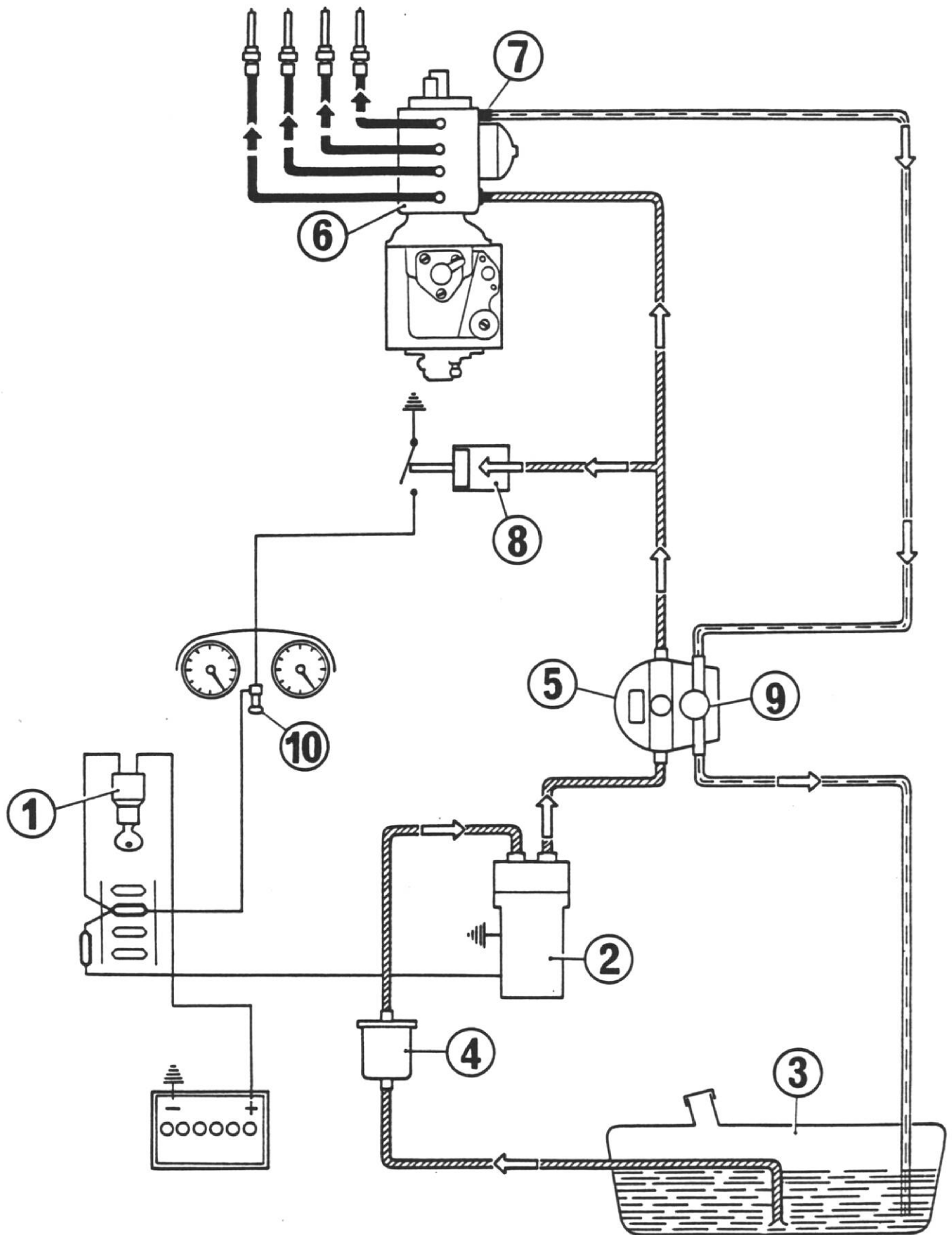


Fig. 1

AIR INDUCTION SYSTEM

The air induction system consists of a silencer (1), incorporating an air cleaner (2), directly connected to the throttle valve throats (3).

The filtered air enters the engine thru four intake ports each with a throttle valve.

The idling air (throttle valves closed) is fed thru a separate circuit which, starting from the air cleaner connects to the intake ports downstream of the throttle valves and includes the idle equalizers (9) (see fig. 2).

The accelerator pedal (5) is mechanically linked thru a relay crank to both the throttle valve lever (4) and the control unit lever (6). Therefore, any position of accelerator pedal corresponds to an exact position of throttle valve and control unit levers.

INJECTION PUMP

The injection pump, SPICA AIBB 4C.S.75, has four variable displacement plungers controlled by the control unit thru a rack. The plungers are actuated by conn.rods driven by a crankshaft revolving at half engine speed. The pump is lubricated with the engine oil drawn from the main gallery just after the main filter.

The lubricating oil, filtered further by a filter in the injection pump mount, seeps past the plungers, lubricates the various moving parts then returns to the pan thru a suitable port in the pump mount itself.

COLD START DEVICE

The cold start device incorporates a solenoid which, energized when the engine is started, enriches the mixture by increasing the injection pump delivery thru an additional movement of control unit rack. The cold start device cuts off when the ignition key is released from cranking position.

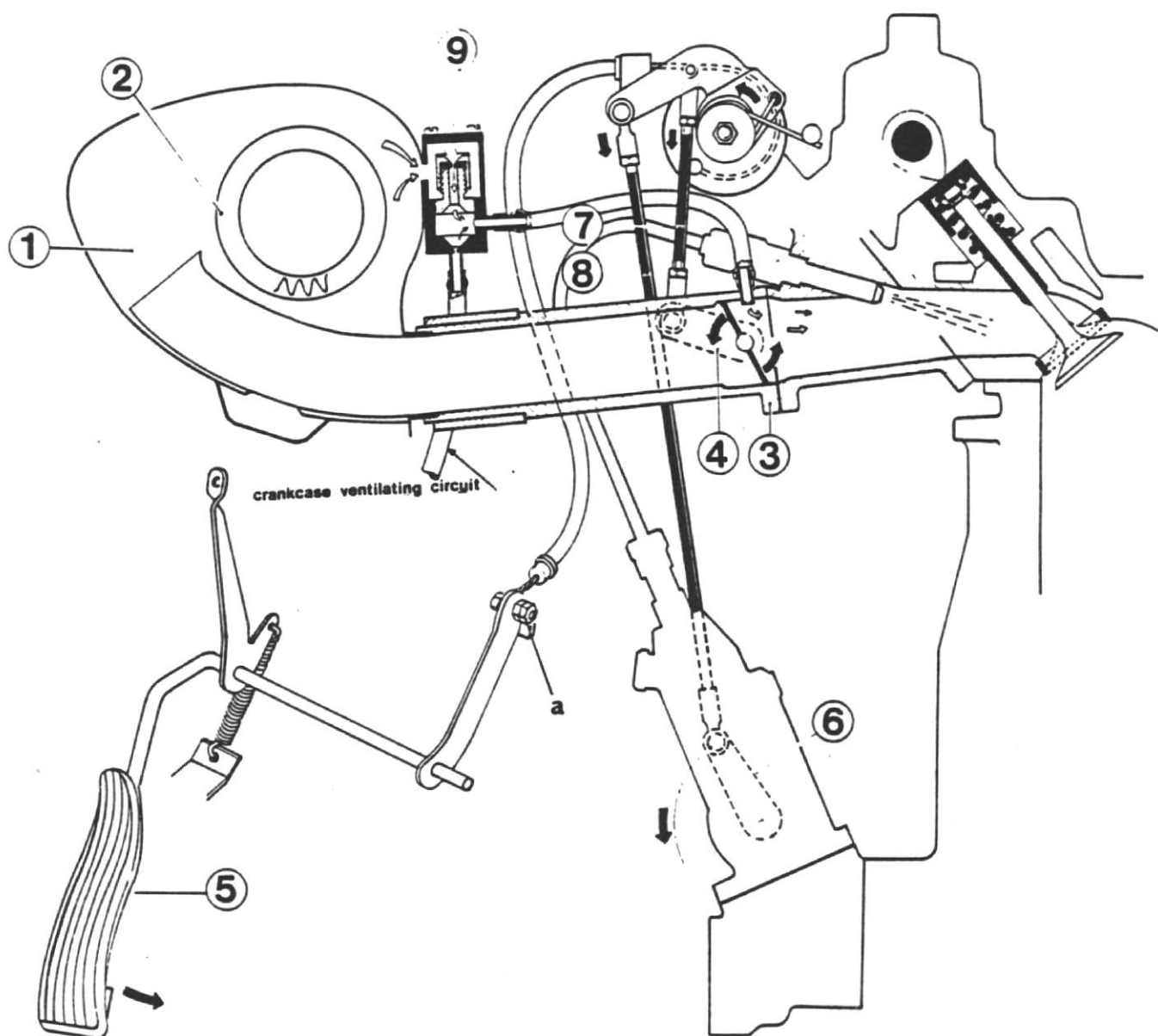


Fig. 2

INITIAL RUNNING DEVICE

This device provides for a smooth operation of the engine soon after a cold start; it consists of a thermostat which, sensing engine coolant temperatures, acts thru a linkage on the control unit rack so as to increase the injection pump delivery in accord with the decrease in temperature and at the same time, thru rods 7 and 8 outside the control unit, opens the throttles so that the engine can be properly fed.

The device cuts off automatically and progressively as the engine warms up to operating temperature thus restoring the standard idling conditions.

CRANKCASE VENTILATING SYSTEM

The exhaust gases and the oil vapors developed during engine operation collect in the camshaft cover; from here they are sucked in the combustion chambers and burned.

The crankcase ventilating system controls gases both at high engine RPMs and at idling speed when the throttles are closed.

When the throttles are fully opened the vapors flow thru the hose (1) to the oil separator (2) and thru hose (3) into the manifold chamber (4) communicating with the intake ports (5).

When the throttles are partially closed, the secondary circuit (9) comes into operation; such a circuit starts from the oil separator and conveys unburned gases and vapors directly into the intake ports downstream of the throttles (7) by means of the equalizers (6) provided with calibrated orifices to which the hoses (10) are connected for proper distribution among cylinders. The oil collected in the separator returns to the pan via the hose (8).

CRANKCASE VENTILATING CIRCUIT

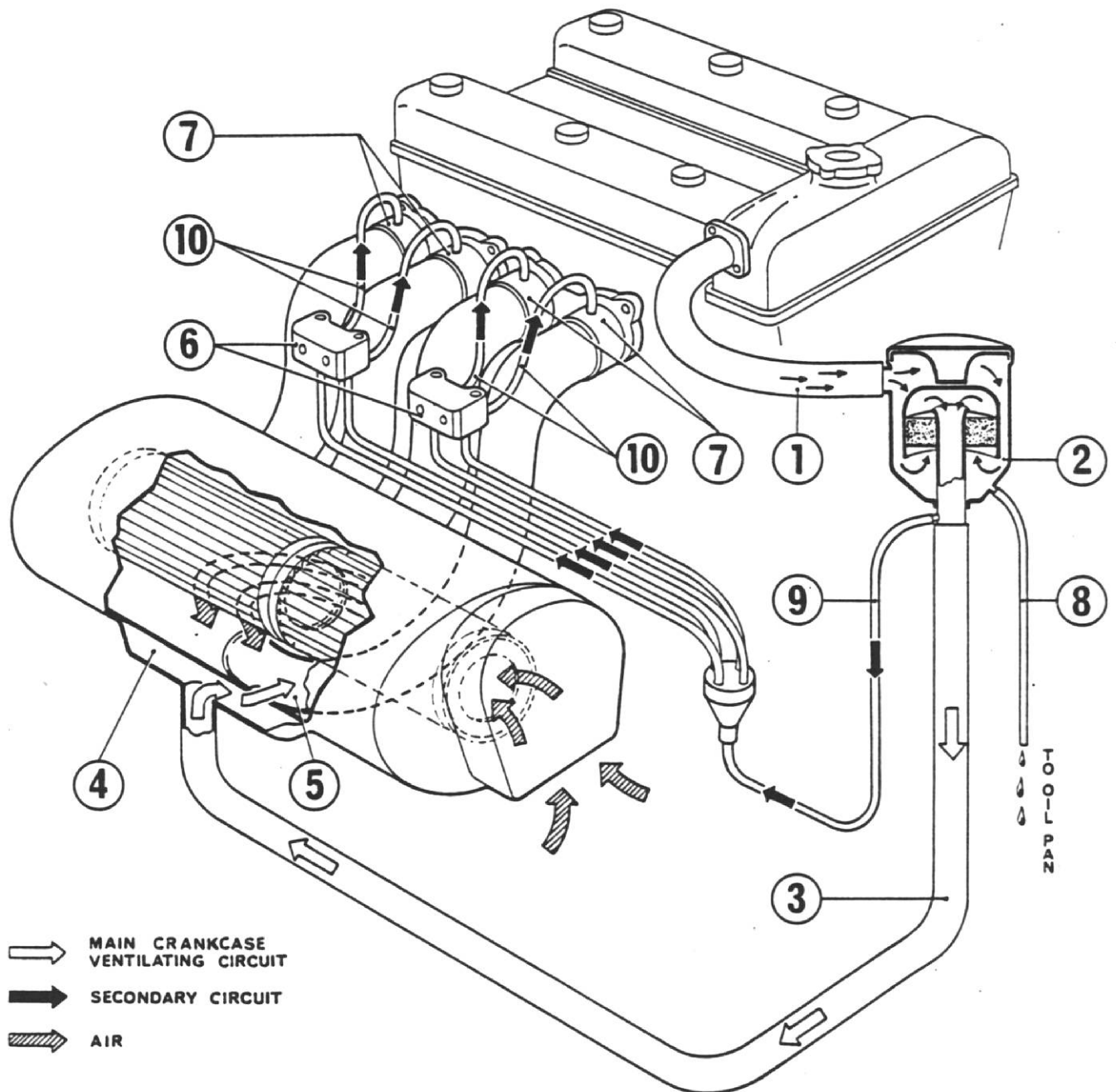


Fig. 3

RECOMMENDATIONS ON THE USE

STARTING THE ENGINE

Insert the key in the ignition switch and turn it clockwise to the first click; wait a few seconds to make sure the low fuel pressure warning light goes off.

WARNING: if the warning light does not flash on or stays on, this is an indication of failure of the indicating device or fuel feed system; therefore have them checked as soon as possible.

Turn the ignition key further clockwise to operate the starter. As soon as the engine fires release the key.

Automatic devices act as a standard choke usually does, namely, facilitate the initial running of engine after a cold start until the proper operating temperature is reached.

As an aid in starting from cold, partially depress the accelerator pedal slowly. After a cold start and particularly when the ambient temperature is below freezing point, wait a fairly long time before getting away so as to warm up properly all engine parts and allow the oil to reach all points requiring lubrication.

Top performance must never be demanded of the car until coolant temperature is about 158°F(70°C).

When the engine is already hot or with very high ambient temperatures (above 77°F-25°C) slowly depress the accelerator pedal to facilitate starting.

CAUTION: owing to the special construction of the injection pump, the pump plungers must on no account be operated directly with a lever or any other tool.

UTILIZATION DIRECTIONS

The fuel injection system allows the engine to be used in the widest RPM range; however, in gears higher than the second, the best performance and emission control as well, can only be attained by exceeding 2200 RPM. It is recommended that all driving be done above 2200 RPM, shifting to a lower gear when below this engine speed.

TEMPERATURE SETTING

To keep a constant fuel/air ratio even when the ambient temperature varies as the seasons change, the temperature compensator lever on the control unit shall be shifted to:

- N (normal) for ambient temperatures exceeding 59°F (15°C).
- C (cold) for temperatures between 59°F (15°C) and 32°F (0°C).
- F (freezing) for temperatures below 32°F (0°C).

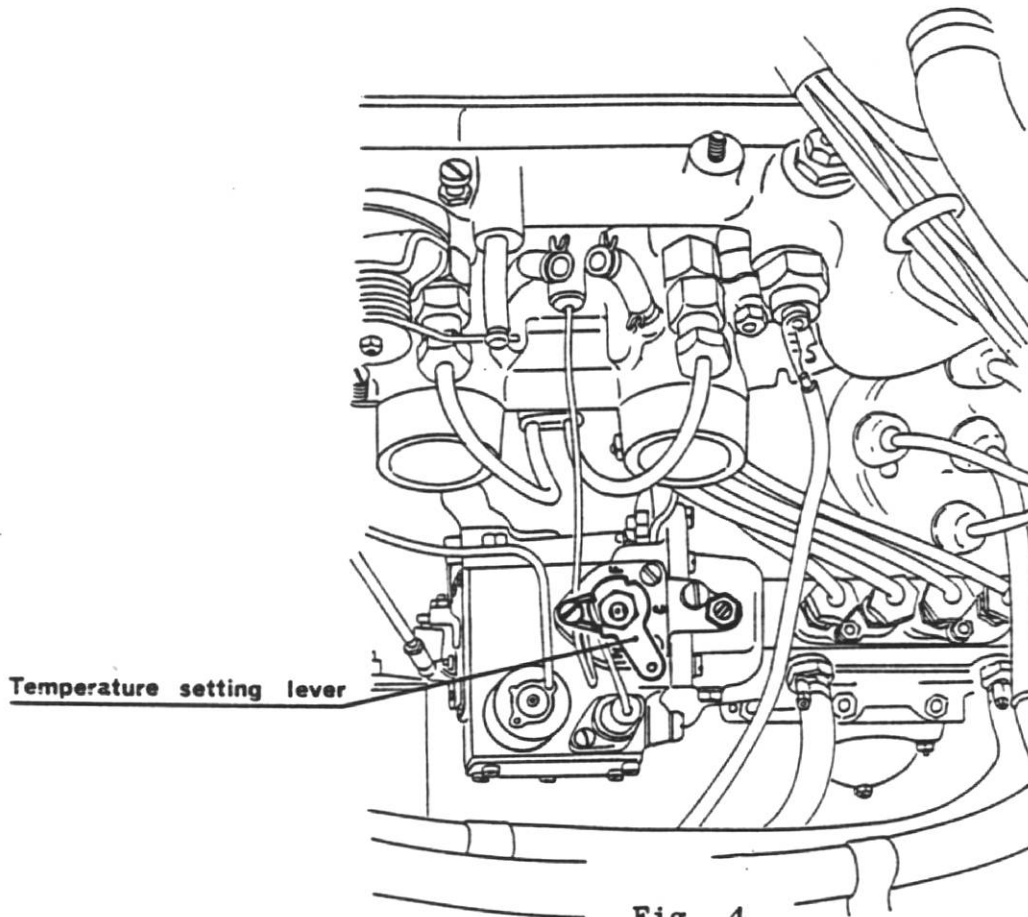


Fig. 4

DECELERATION

On deceleration, the injection pump delivery is automatically cut off; this not only eliminates the unburned gases in a condition which is critical for the emission levels, but also favorably affects the fuel consumption.

As this occurs only when the accelerator pedal is released fully, the driver should pay special attention to avoid depressing the pedal even slightly on deceleration, thus preventing detonations from taking place in the exhaust pipes.

REGULAR SERVICING

SCHEDULE OF REGULAR SERVICING REQUIRED TO KEEP THE EXHAUST EMISSION LEVEL WITHIN LIMITS PRESCRIBED BY U.S. REGULATIONS

In order to maintain the fuel injection system in good operating conditions and the exhaust emissions below the limits specified by Federal regulations, the servicing items listed below must be performed at the prescribed period; each item will be set out in details on the following pages.

Every 6,000 miles

Replace air cleaner elements	page 12
Replace main fuel filter element	" 12

Every 12,000 miles (or once a year whichever comes first)

Check spark plugs and replace, if necessary	" 13
Check the alternator and fan driving belt	" 14
Check valve timing chain tension	" 14
Check the distributor and the ignition timing	" 15
Check valve clearance and adjust, if necessary	" 17
Replace air cleaner elements	" 12
Replace main fuel filter element	" 12
Replace tank fuel filter (throw away type)	" 17
Clean throttle valve throats	" 17
Check positioning of throttle/control unit linkage	" 18
Check positioning and alignment of throttles	" 20
Check idle equalizer alignment and idle RPMs	" 21
Road test	" 23

REPLACE THE AIR CLEANER ELEMENTS

To provide room for subsequent operations, the air cleaner shall be removed as a whole; to do so, detach the two upper anchoring straps at manifold side (see fig. 3); loosen at the engine side the four clamps on the intake hoses; free the crankcase ventilation hoses (3) and (9) from the oil separator; disconnect the four idle hoses (10) from equalizers (6) on cleaner body.

Then the cover of cleaner housing can be removed and the elements replaced after having cleaned the inside of air cleaner housing. Do not reinstall the air cleaner on engine at this point.

REPLACE THE MAIN FUEL FILTER ELEMENT

Perform this operation after that mentioned above and proceed as follows:

- disconnect the battery negative terminal;
- disconnect the starter positive cable if necessary
- CAUTION: first of all clean carefully the outside of filter body to make sure no foreign matter could enter the filter on reassembly;
- slacken the bolt securing the filter to its bracket and remove the filter;
- withdraw the filter element;
- get rid of foreign matter that may have collected in the housing and fit a new element; also replace the housing gasket and the bolt washer, if damaged.

WARNING: extreme cleanliness is required in the area of the fuel filter.

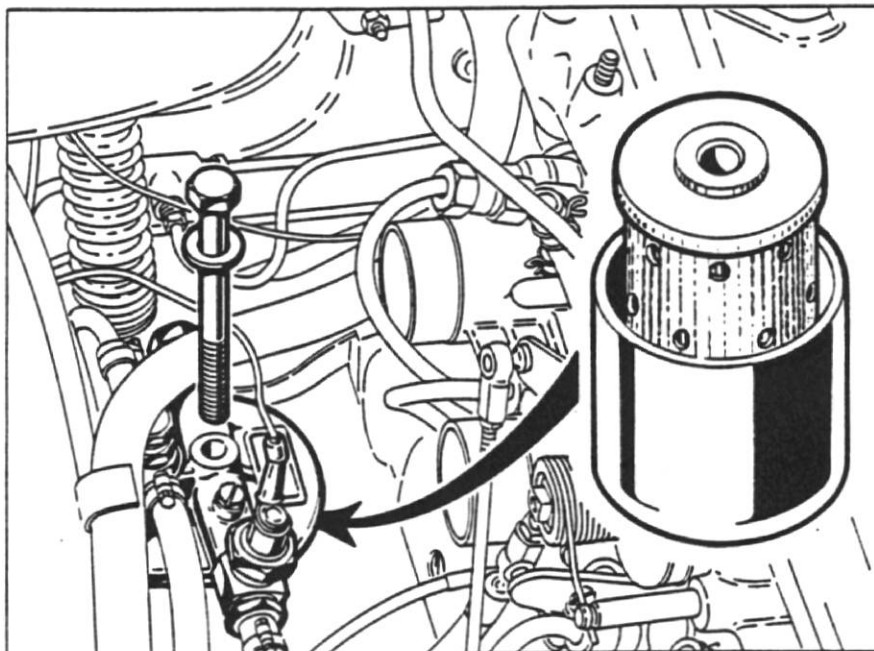


Fig. 5

CHECK SPARK PLUGS (LODGE HL) AND REPLACE, IF NECESSARY

The spark plugs are of the surface gap type with four points and a central electrode. The only maintenance required is occasional cleaning with a brush of the central electrode and points. No routine adjustment is necessary of the gap between the electrode and points.

If the ceramic insulator is cracked or the electrodes are excessively worn away, the spark plugs must be replaced.

The spark plugs should be tightened when cold to a torque of 18-25.3 lb-ft (2.5-3.5 kgm); lubricate the threads with graphite grease before fitting.

The standard plugs fitted to the engine are LODGE HL. A decal, giving the specifications for these plugs, is attached under the hood; here below, the text of the decal is repeated.

In order to comply with the Federal rule regarding the control of air pollution the engine is fitted with LODGE-HL spark plugs.

These plugs are completely adequate when the automobile is driven at speeds not exceeding the speed limiting regulations. If the automobile is driven at sustained speeds higher than the said speed limits, LODGE-2HL spark plugs must be used.

Under no condition can substitute spark plugs be used, unless they are specifically advised and approved by Alfa Romeo. Use of other plugs can promote serious engine damage, as well as alter emission levels.

CHECK THE ALTERNATOR AND FAN DRIVING BELT

The belt should be tightened enough to drive the fan and alternator pulley without slipping and without overloading the bearings.

The tension is correct when, on pressing the belt down, the sag is about 1/2" (10-15 mm).

To tighten the belt unscrew the nut on the adjusting arm and move the alternator outwards.

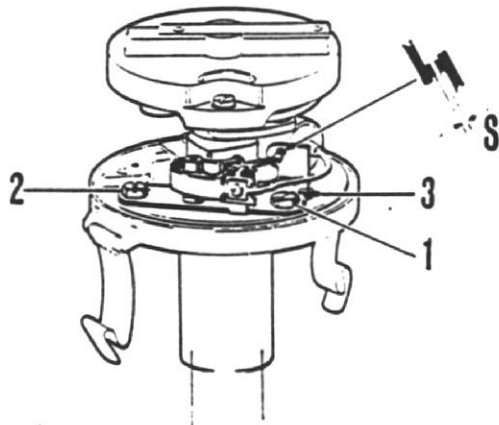
CHECK VALVE TIMING CHAIN TENSION

Unscrew the camshaft cover retaining nuts and remove the cover; slacken the chain tensioner setscrew and check that the tensioner spring is working properly; crank the engine for a few seconds to allow the tensioner to tighten the chain and then lock the tensioner setscrew firmly.

On refitting the camshaft cover, make sure the gasket is in sound conditions or replace, if necessary. Moderately tighten the cover retaining nuts in diagonal order.

CHECK THE DISTRIBUTOR (Marelli S 103 B) AND THE IGNITION TIMING

With a dwell meter check that the angle of contact-breaker points opening falls within 27 and 33 degrees; when points are new, the gap should be: .017 to .019" (.43 to .48 mm).



To adjust, loosen the screws 1 and 2, insert a screwdriver in the adjustment slot 3 and pry the stationary-point plate.

S = .017-.019 in.

Smear the distributor cam with grease. Check the inside of distributor cap for any sign of moisture, carbon deposits or cracks and the central power electrode for free movement in its seat and for effective spring action. Finally, check cap terminals for good conditions.

The ignition timing should be checked when the engine is warmed up to operating temperature (coolant exceeding 149°F - 65°C) and running at idle speed by using a timing light.

The timing should be retarded by one to three degrees ATDC (mark F cut in the pulley in line with the pointer) see fig. 6.

With the engine running with no load at 5,000 RPM, the ignition advance should be 31 to 37 degrees, that is the mark M on the pulley should be in line with the pointer or .12" (3 mm) apart either side.

Timing at idle speed must be adjusted with special care as it affects more greatly the emission levels.

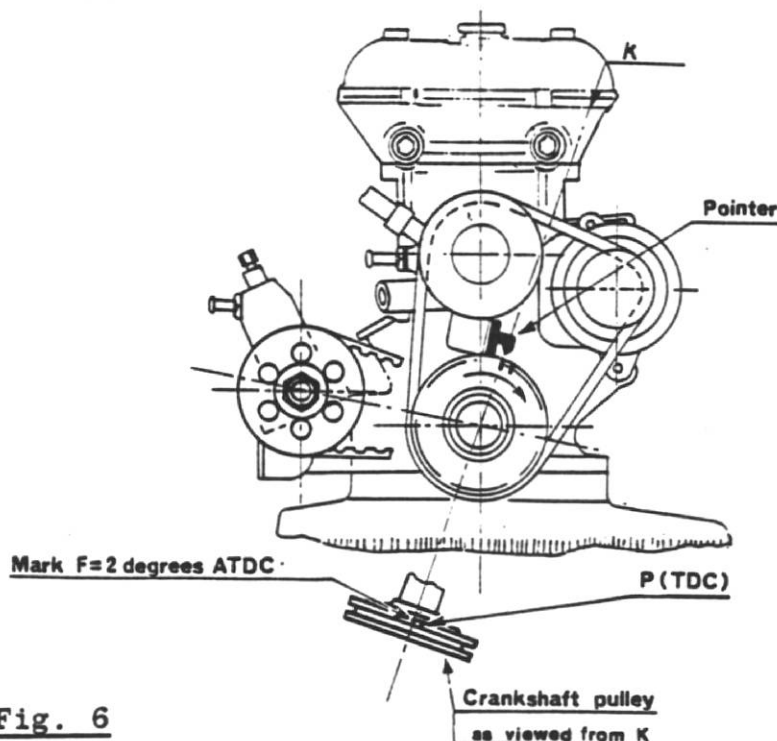
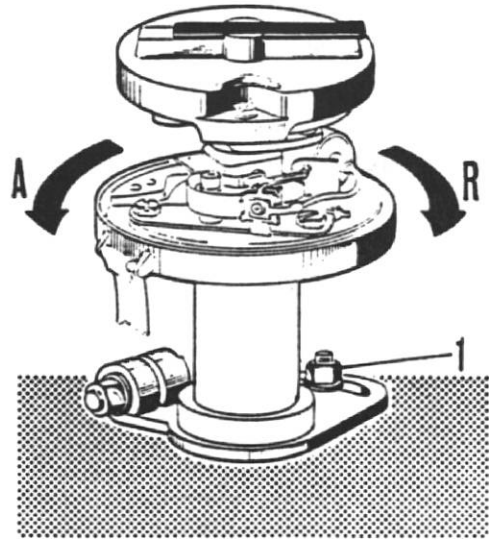


Fig. 6

Timing adjustment (maximum accuracy required)

If the timing requires adjustment, proceed as follows:

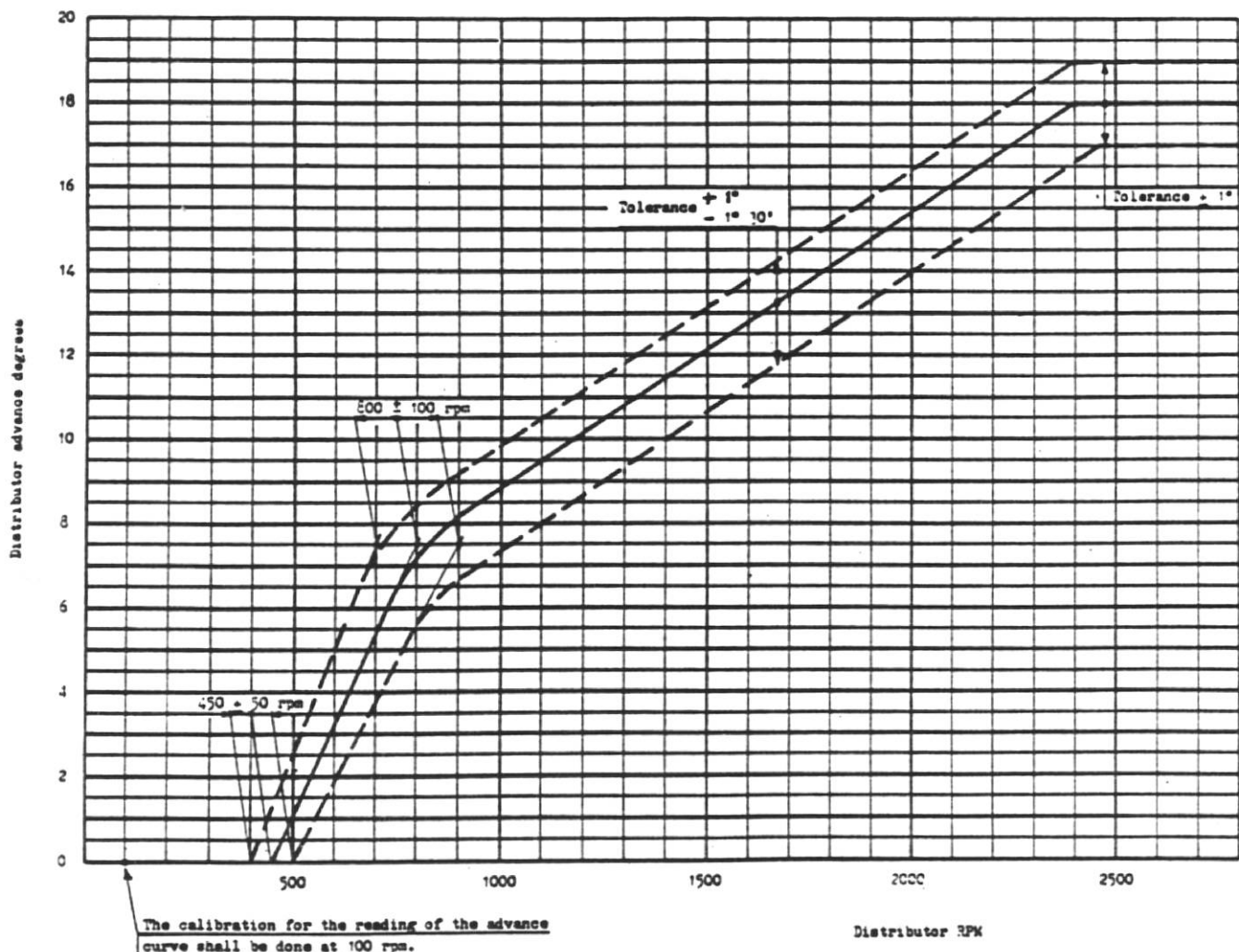
- 1 - unscrew the distributor securing nut 1 on the stud so as to allow the distributor to be rotated together with its supporting clamp;
- 2 - rotate the distributor body counterclockwise or clockwise according to whether it is necessary to respectively advance (A) or retard (R) the ignition setting;
- 3 - retighten the nut, taking care not to move the distributor body;
- 4 - recheck timing.



In the event of reinstallation or renewal of the distributor, refer to the directions given on page 25.

Automatic advance graph and specifications of Marelli S 103 B distributor

Contact gap017 - .019"
Contact opening angle	$30^{\circ} \pm 3^{\circ}$
Dwell angle	$70^{\circ} \pm 3^{\circ}$
Contact pressure	18 - 21 oz

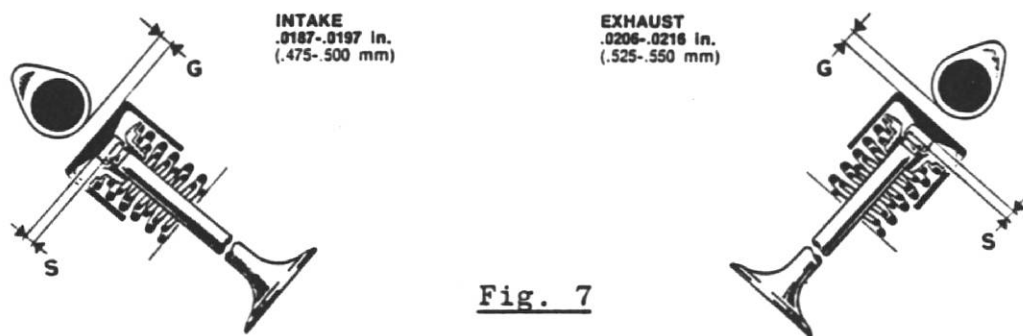


VALVE CLEARANCE CHECKING AND ADJUSTMENT

The V-mounted overhead valves are directly operated by two camshafts acting thru oil bath cups.

When the engine is cold, carefully measure the clearance "G" with a feeler gage. If the clearance is not as specified, remove camshafts and valve cups; measure the thickness "S" of the adjusting pad on each valve stem and replace it with another of proper thickness so that the clearance is the correct one shown in the diagram.

To facilitate this adjustment the pads are made available in a series of thicknesses ranging from .05 to .014" (1.3 to 3.5 mm) in increments of .001" (.025 mm).



REPLACE THE TANK FUEL FILTER

To replace the tank fuel filter (throw-away type) (see 4, fig. 1), located on the rear underbody of car, proceed as follows:

- slacken the bolt on the clamp securing the filter to the underbody.
- loosen the clamps securing the hoses to the filter inlet and outlet adapters; it is advisable to stop the pipe from fuel tank provisionally.

Remove the filter and replace it with a new one by proceeding in reverse order of removal. Make sure the hoses are properly positioned.

CLEAN THE THROTTLE VALVE THROATS

Clean the valve throats especially at the areas of contact of throttle valve edges and throat by holding the throttles in full open position and using a brush soaked in gasoline; the cleaning can be completed by rubbing repeatedly the affected areas with a lint-free cloth.

Then, clean in a similar way the throttle valve edges taking care not to strain the spindles.

CHECK THE POSITIONING OF THROTTLE/CONTROL UNIT LINKAGE

This check has to be performed with the air cleaner taken off the engine (see paragraph "Replace the air cleaner elements").

With hot engine (over 158°F - 70°C) and the standard thermostat fitted, check with a feeler gauge that clearance between the control unit input lever and its reference screw is .012 to .024" (.3 to .6 mm) (the nearer to .019" the better) when the relay crank is resting against the idle limit stop; if this is not the case, let the engine cool down then proceed as follows: first disconnect the push-pull rods (7) and (8) (see fig. 2), the cable from the relay crank sheave and the battery negative terminal; remove the cable clamps and fit the tool no. A.4.0121 (fig. 8) onto the studs. Adjust the idle stop screw until the ball joint just touches the reference plane of the tool and lock in this position.

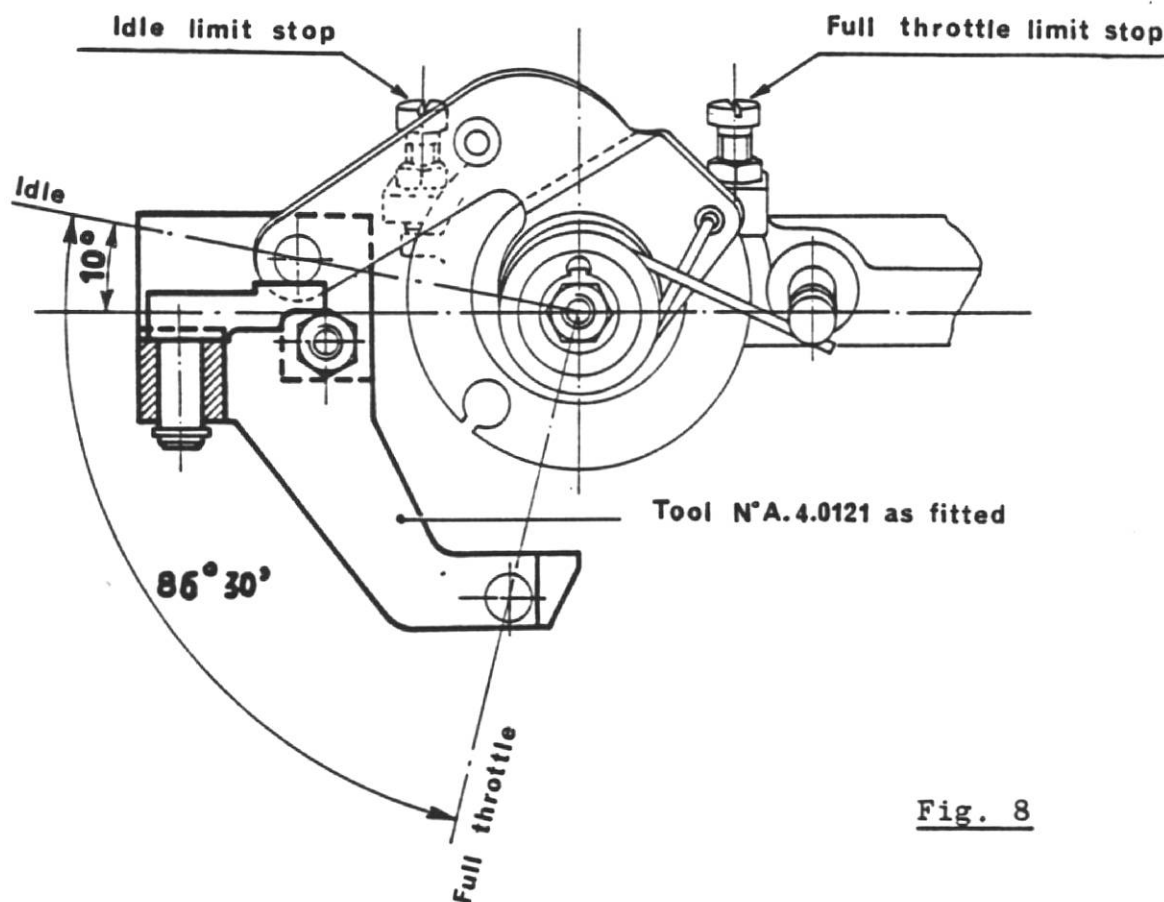


Fig. 8

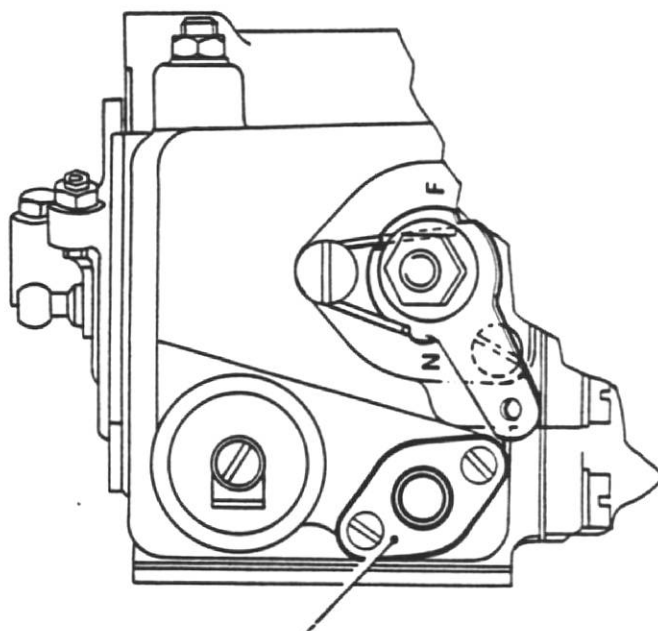
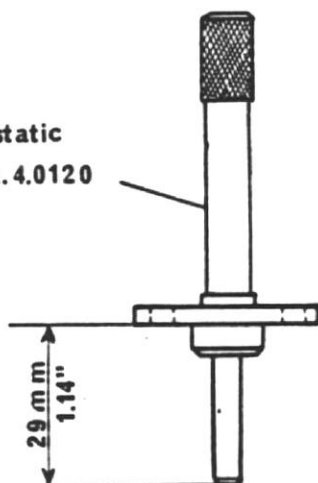
CAUTION - If the linkage assembly has been removed or if doubts of distortion or straining exist, it is advisable to check also the "full throttle" setting as follows: with the above mentioned tool fitted, rotate the relay crank to bring the ball joint in contact with the "full throttle" reference plane and lock in place the respective limit stop screw.

Now the "actuator" section of the thermostatic control can be removed from the control unit; to do so, remove the two screws retaining the actuator mounting flange and the two screws clamping the actuator pipe anchoring grommet (do not remove the thermostat bulb); then withdraw the actuator taking care not to distort excessively the pipe.

Fit the "dummy actuator" (tool no. A.4.0120 - fig. 9) in place of the standard one just removed. At this point, refit the relay crank/control unit lever rod (8) and, if necessary, adjust the rod length so that the linkage is at rest against the idle limit stop, when, between control unit lever and its reference screw, there is a clearance of .035 - .051" (0.9 - 1.3 mm).

WARNING
Never disturb the reference screw of control unit input lever.

Dummy thermostatic actuator Tool N° A.4.0120



Dummy thermostatic actuator as fitted

Fig. 9

When the above adjustment is over, reconnect the relay crank-to-throttle rod (7) and, if necessary, adjust the rod length so that the throttle valves are just closed when the linkage rest against the idle limit stop ("just closed" means such a position that, when slightly opening the throttle valves and then releasing them, a definite hit of the linkage against the idle limit stop is felt).

Remove the dummy actuator, reinstall the standard one carefully and tighten it in place.

Again check that - with hot engine- the clearance between the control unit input lever and its reference screw is .012 to .024" (the nearer to .019" the better).

If the injection pump has been removed from engine or any doubt exists that the system setting has been disturbed or any component distorted for a collision, etc., an additional adjustment of throttle angles in relation to control unit lever angles, described on page 25, should be performed.

NOTE: to obtain the specified clearance, a twisting within $\pm 30^\circ$ from the in-line-position of the plastic sockets of each rod is allowed.

CHECK THE POSITIONING AND ALIGNMENT OF THROTTLES

To perform this check, the air cleaner body and hoses shall be removed from the engine and the four adapters of tool no. C.2.0012 connected to the idle fittings on the throttle valve throats; the other end of these adapters shall be connected to the four columns of mercury gage (tool no. C.2.0011) see fig. 10.

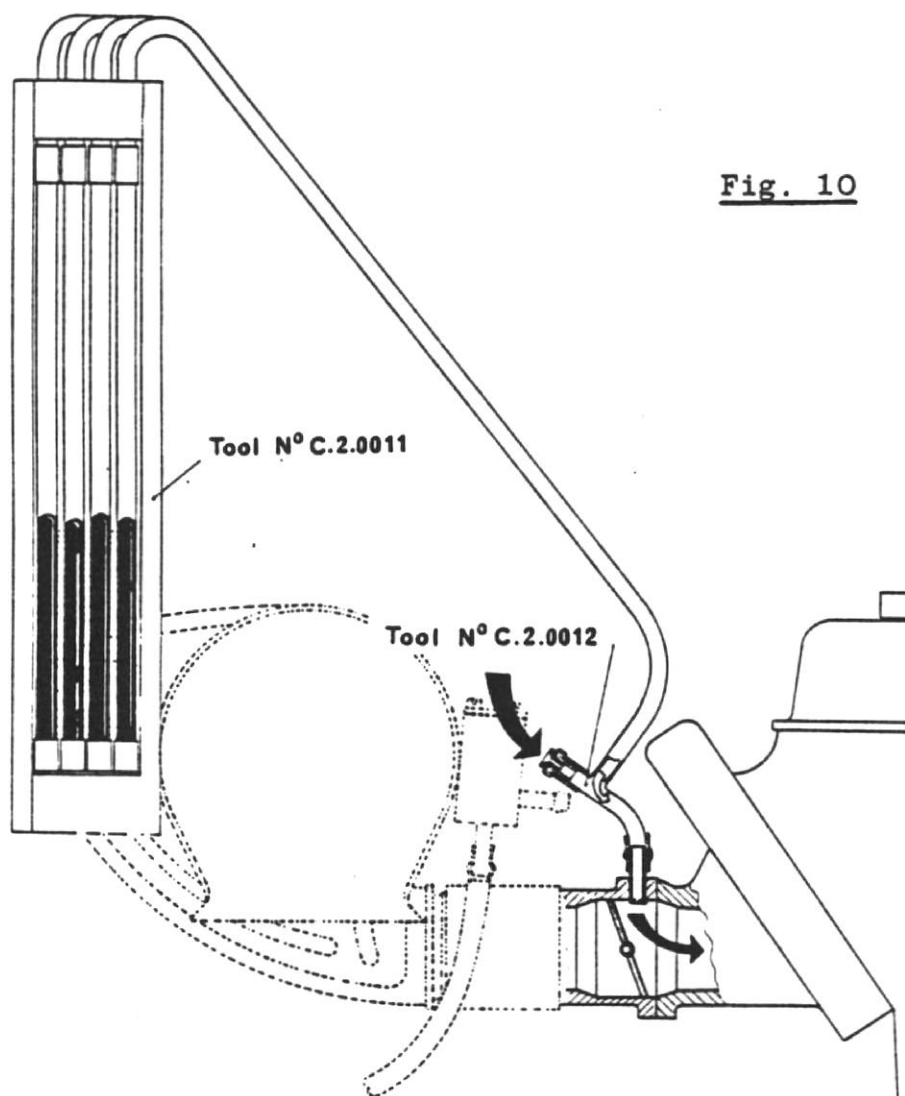


Fig. 10

Start the engine and warm it up until the coolant temperature is at least 158°F (70°C); first check that the clearance between control unit lever and its reference screw is .012 to .024" (the nearer to .019" the better) with hot engine and thermostat actuator fitted.

Now, check that readings on mercury gage columns are much the same (maximum difference: .4"-10 mm); if this is not the case, proceed as follows:

- if readings show that vacuum in front pair of cylinders is higher than in the rear, unscrew the throttle coupling adjusting screw so as to close the rear pair of throttles;

- if vacuum in front pair of cylinders is lower than that in rear pair, disconnect the relay crank-to-throttle rod and set the throttle coupling adjusting screw in such a way as to close the front pair of throttles (screw in the adjusting screw); then, reconnect the relay crank-to-throttle rod and adjust its length so that the throttle valves are in the "just closed" condition as outlined in the paragraph: "Check the positioning of throttle/control unit linkage".

If, before commencing the above adjustments, the engine would run unevenly (lean mixture), make sure the throttle valves are in the "just closed" position; if not the relay crank-to-throttle rod must be shortened.

CAUTION: avoid sudden revving up of the engine or too great a vacuum could take place and the mercury might be sucked out of gage columns.

CHECK IDLE EQUALIZER ALIGNMENT AND IDLE RPMs

Reinstall the air cleaner, clamping in place the hoses and attaching the two upper anchoring straps; also reconnect the crankcase ventilation hoses.

Remove the calibrated restrictors from the adapters (tool no. C.2.0012) and connect the ways from mercury gage columns to the fittings of idle equalizers on air cleaner and to idle fittings on throttle valve throats.

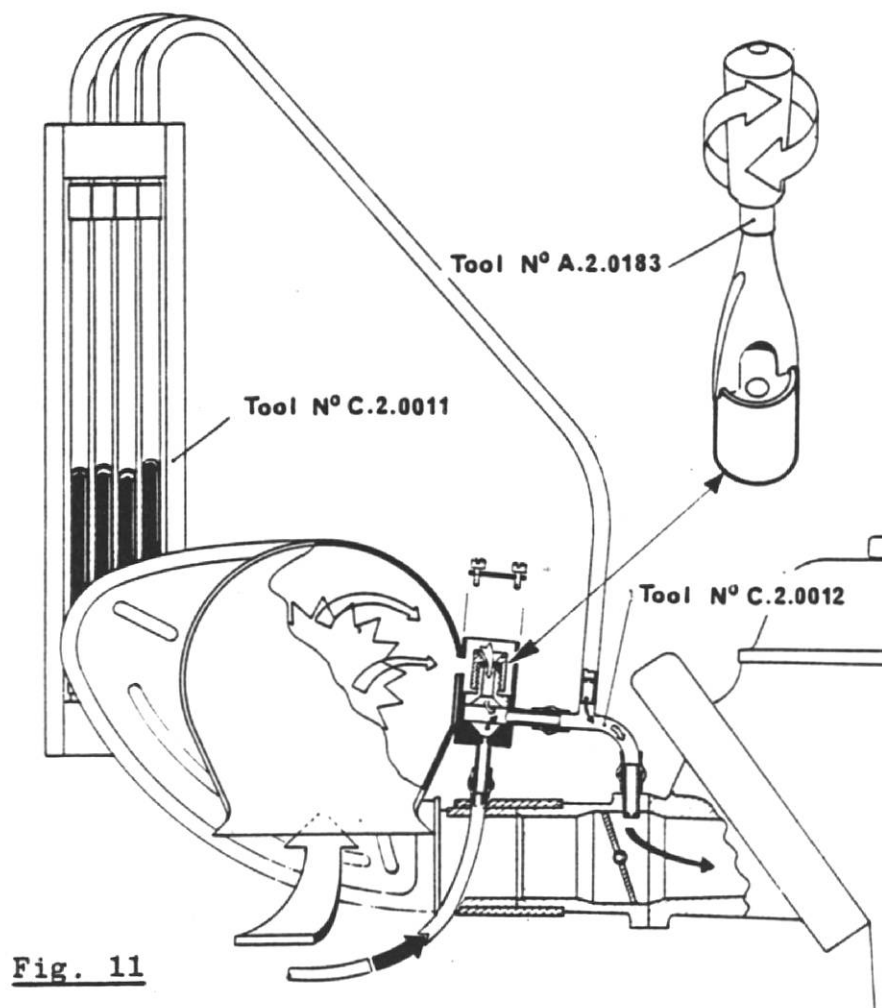


Fig. 11

Start the engine and, when coolant temperature is at 158°F (70°C) as specified, check vacuum in all cylinders for the same reading; if not, bring them to the same level by acting with a screwdriver on the adjusters which, inside the equalizers, calibrate the flow of air; after each adjustment, take care to refit the cover plates to the equalizers before taking readings.

While leveling the readings on mercury gage columns, check at the same time that the engine is running smoothly at an idle speed of at least 720 RPM using an electronic tachometer of proven accuracy.

If too lean a mixture takes place because of increasing the adjuster orifice and the engine thus begins to hunt, screw in at the same time the injection pump delivery adjusting screw, located on control unit (see fig. 12). Repeat the procedure until the engine is idling at the said RPM. (The same "Caution" as given on page 21 applies).

ROAD TEST

With a hot engine drive the car hard for a few miles, using high revs and low gears in order to burn off any deposit from the spark plugs; then drive the car at a constant speed of 30 mph in third gear to see whether the engine operates smoothly, without any hesitation; otherwise, screw in the injection pump delivery adjusting screw by half a turn and repeat the test. If, after that, possible malfunctions are not yet remedied, screw in the injection pump delivery adjusting screw by a further half turn (see fig. 12).

NOTE: to act on the adjusting screw, first loosen the locknut with the wrench tool no. A.5.0168 then turn the screw with the screw-driver tool no. A.2.0185.

This screw is not to be adjusted before all previous steps are completed. It will not correct for inaccurate ignition timing or maladjusted throttles.

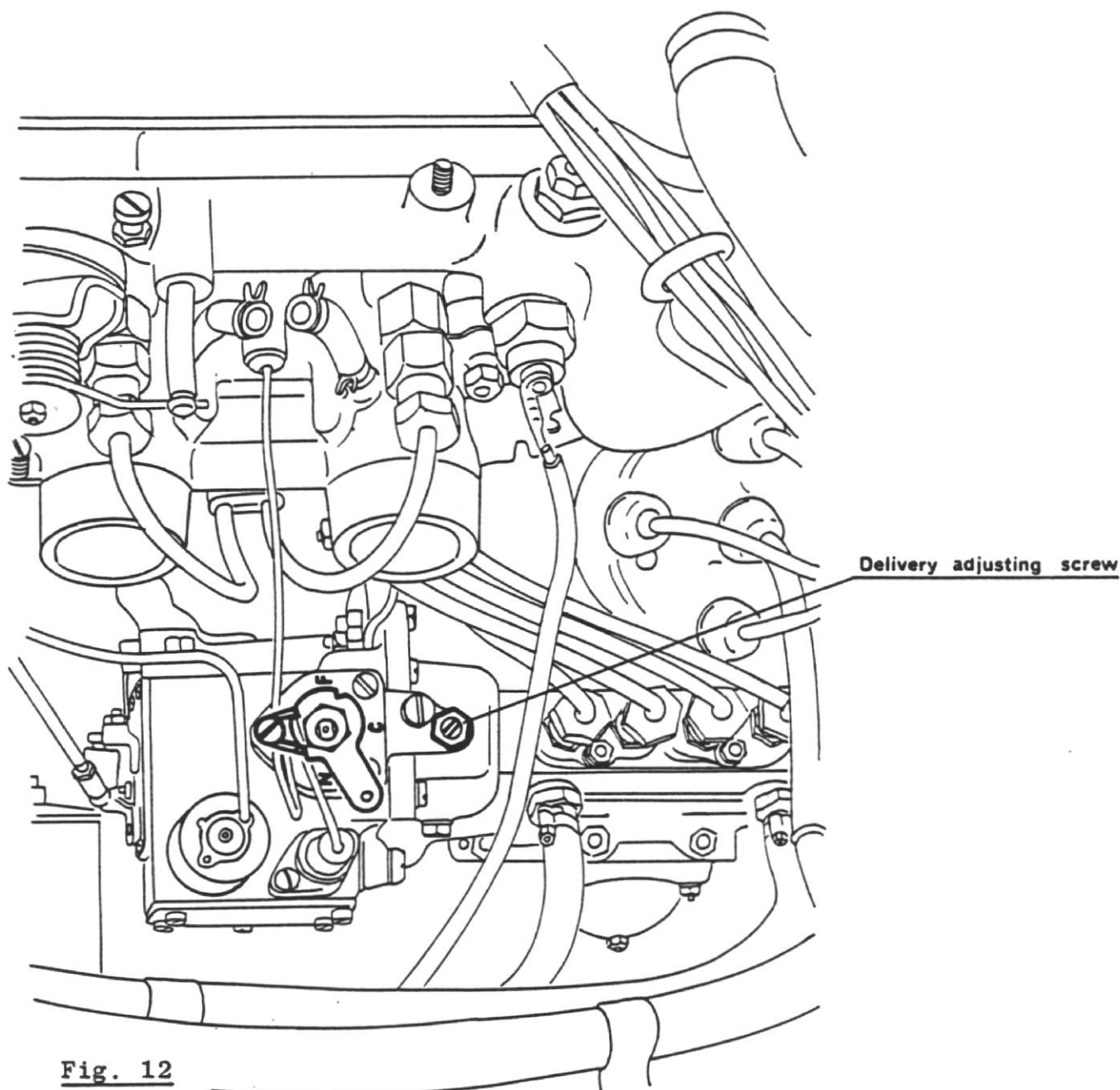


Fig. 12

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SPECIFIC ADJUSTMENTS

INSTALLING THE IGNITION DISTRIBUTOR

When reinstalling or renewing the distributor, perform the following procedure:

- rotate the crankshaft to bring no. 1 cylinder piston to the compression stroke that is with both valves closed;
- by slightly rotating the crankshaft bring the fixed advance mark F on pulley into line with the reference pointer;
- fit the supporting clamp onto the distributor body and tighten the clamp just snug;
- remove distributor cap and rotate the drive shaft by hand to bring the rotor arm in line with the contact for no. 1 cylinder;
- as a trial installation place the distributor on engine and move the supporting clamp so that the stud is centered in the clamp slot when the contact-breaker points are about to open for no.1 cylinder
- then, remove the distributor with its supporting clamp, taking care not to disturb the distributor body/clamp setting and lock the clamp in place;
- reinstall the distributor and adjust timing as directed on page 16.

CHECK THE RELATIONSHIP BETWEEN THROTTLE ANGLES AND CONTROL UNIT LEVER ANGLES

Perform this check when the engine is cold; the air cleaner must then be removed from engine (see under "Replace the air cleaner elements"), the procedure for disconnecting the rods (7) and (8) (see fig. 2) must be repeated as well as the removal of thermostatic actuator (taking care not to distort excessively the small pipe).

At this point check the positioning of linkage at idle and full throttle setting with the special tool no. A.4.0121 and fit the dummy actuator, tool no. A.4.0120. Reconnect the rod and check for a clearance of .012 to .024" (the nearer to .019" the better) between the control unit lever and its reference screw (if necessary, adjust the rod length by acting on the threaded clevis).

WARNING

Never disturb the reference screw
of control unit input lever.

Fit the fixed protractor (tool no. C.6.0140) onto rear end of control unit, using the cover attaching screws, and the pointer (tool no. C.6.0141) aligned with the zero on the scale (see fig. 13); to take readings use the suitable built-in light mirror.

Reconnect the rod (7) and check for a proper closure of throttles as directed under "Check the positioning of throttle/control unit linkage!"

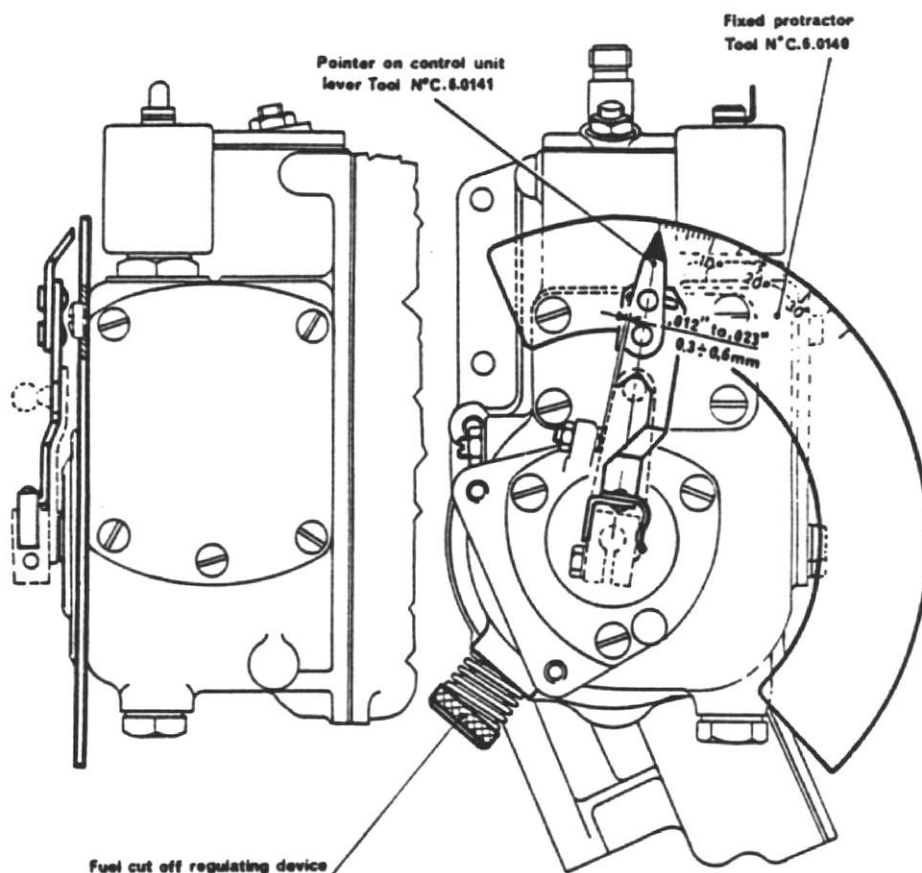


Fig. 13

Place the movable protractor (tool no. C.6.0142) on the spindle of rear throttle valve pair and set to zero in correspondence of the pointer (tool no. C.6.0143) see fig. 14.

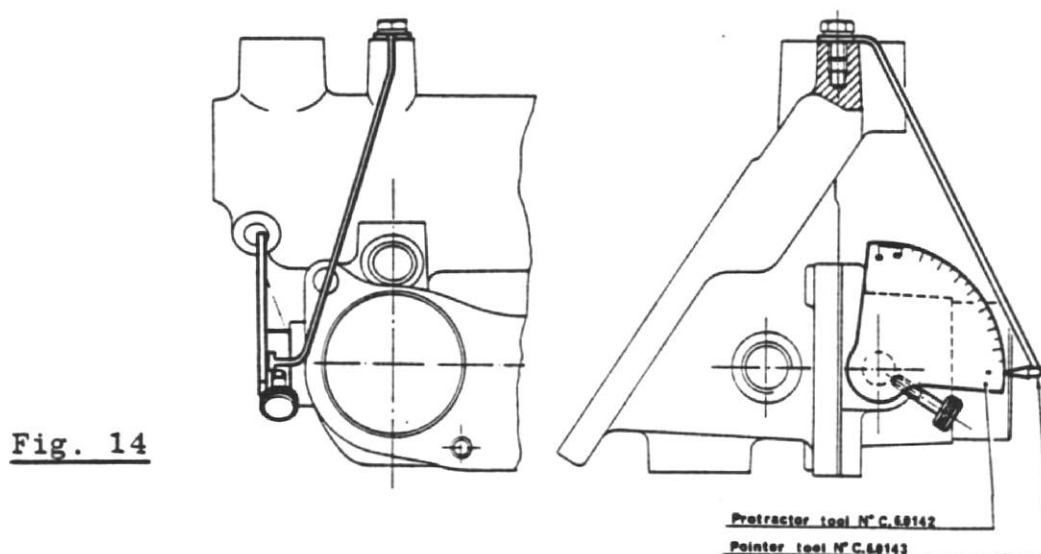


Fig. 14

Install the tool no. A.2.0181 using the cable sheath clips and gradually rotate the relay crank by acting on the adjuster (See fig. 15).

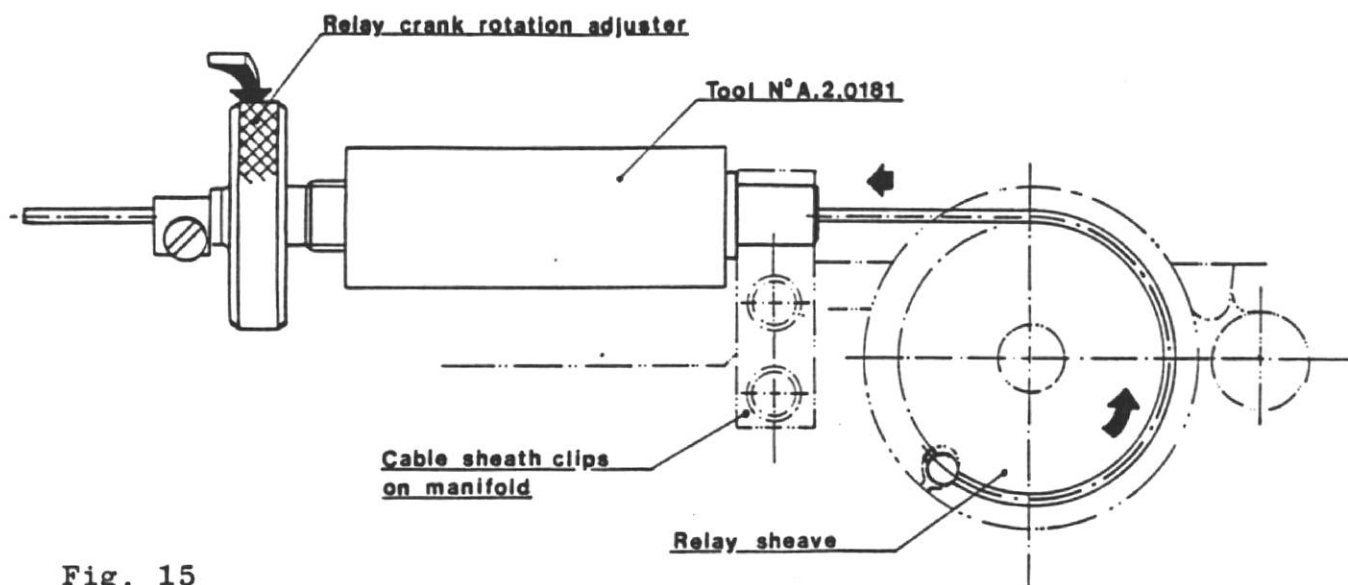


Fig. 15

Open the throttle valves to predetermined angles (2, 4, 6 degrees - see table) and read the corresponding rotations of control unit lever.

THROTTLE ANGLES/CONTROL UNIT LEVER ANGLES RELATIONSHIP TABLE

α	β	Tolerance on β
0°	0°	} $\pm 20'$
2°	8° 13'	
4°	14° 40'	
6°	20° 09'	} $\pm 1^\circ$
10°	29° 30'	
15°	39° 20'	
20°	47° 54'	} $\pm 2^\circ$
25°	55° 33'	
30°	62° 30'	
35°	68° 51'	
40°	74° 41'	
50°	84° 55'	
60°	93° 25'	
70°	100° 12'	
82°	106° 08°	

α = throttle rotation angle

β = control unit lever rotation angle

In the event the throttle angles and control unit lever angles are out of the specified relation, it is likely that checking procedure has not been perfectly accomplished; therefore, try once more; if again it will not satisfy, inspect carefully any component of control linkage, or parts directly affecting it, replace any defective part and repeat the procedure.

When the above checks are over, lengthen the rod (8) until there is a clearance of .035 to .051" (0.9 - 1.3 mm) or 1° to 1° 30' between the control unit lever and the reference screw.

On completion of adjustments, reinstall the standard thermostatic actuator and check for a clearance of .012 to .024" (.3 to .6 mm) with a hot engine (coolant temperature above 158°F - 70°C) between the control unit lever and its reference screw; if necessary, adjust the length of rod (8) by acting on the clevis thread. (the same footnote as given on page 19 applies).

INSTALLING THE THERMOSTATIC ACTUATOR ON CONTROL UNIT

If the engine shows too fast an idle and black smoke at the exhaust or stalls easily at idle while emitting black smoke or if an excessive fuel consumption is experienced, the cause is probably a malfunction of the thermostatic actuator on the injection pump control unit.

To replace the thermostatic actuator, proceed as follows:

- remove the air cleaner as outlined under "Replace the air cleaner elements";
- drain about one gallon of coolant from cooling system and remove the defective thermostat assembly;
- install the new thermostat assembly by fitting first the bulb on manifold, then the actuator pipe anchoring grommet and finally the actuator on control unit taking care not to distort excessively the small pipe. Replace the "O"ring on thermostat bulb, if necessary;
- check that clearance between control unit lever and the reference screw is .146 to .165" (3.7 to 4.2 mm) when the coolant temperature is about 68°F (20°C). Should this clearance not fall in the above specified limits, screw in or unscrew the adjuster in the control unit (to gain access to adjuster, take the actuator off) to respectively increase or diminish the clearance;
- on completion of thermostat installation, replenish the cooling system.

REMOVAL AND REINSTALLATION OF THE INJECTION PUMP

After having removed the air cleaner (see relevant directions) perform the following steps:

- disconnect the negative battery terminal;
- disconnect the lead from cold starting device solenoid;
- remove the two screws on the thermostat actuator mounting flange and the two screws clamping the actuator pipe anchoring grommet (do not remove the thermostat bulb); then withdraw the actuator from the control unit, taking care not to distort excessively the pipe;
- disconnect the fuel hoses from injection pump;
- detach the push-pull rod from the control unit.

Proceed by timing the injection pump with the engine (instant in which fuel injection starts); to do this, bring the no. 1 piston on induction stroke by aligning the mark "I" (80° ATDC) cut in the crankshaft pulley with the pointer on crankcase front cover (doing so will facilitate the reinstallation on the injection pump to the engine).

Finally, unscrew the three attaching nuts and remove the drive belt cover; then take the drive belt off the injection pump pulley.

Now, perform the removal of the injection pump proper as follows:

- fully slacken the injection pipe nuts on pump outlet fittings (use the wrench tool no. A.5.0164), without removing the pipes;
- unscrew the nuts on the two bolts attaching the pipe cluster plate and the injection pump slanting bracket;
- loosen the two screws attaching the control unit to its bracket at the engine mount;
- unscrew, from the underside of car, the four nuts (use tool A.5.0167 for the front ones) attaching the injection pump support to the engine front cover.

Withdraw the injection pump and its support as a unit by tilting it suitably.

To reinstall the injection pump, reverse the removal procedure.

In case of injection pump renewal, the new injectors, supplied with the new pump, must be installed on the engine in place of the old ones. The new injectors bring a location number and must be installed accordingly.

CAUTION: owing to the special construction of the injection pump, the pump plungers must on no account be operated directly with a lever or any other tool.

WARNING: on reinstallation, align the reference marks on the injection pump and the drive pulley (with the engine previously timed for injection in no.1 cylinder), then fit the drive belt onto the pulley avoiding the use of tools that might damage the belt.

TIMING THE INJECTION PUMP

The injection pump timing is correct when:

no. 1 piston on induction stroke (thru the spark plug seat the intake valve opened can be seen) and aligning the mark "I" (80° ATDC) cut in the crankshaft pulley with the pointer on crankcase front cover, the mark on the injection pump pulley is aligned with the reference on the injection pump itself (to gain access to the reference on the injection pump remove the protective cover).

N.B. - The reference marks can be out of alignment within a tolerance of about $\pm .2"$ (5 mm) corresponding to half pitch of pulley splines.

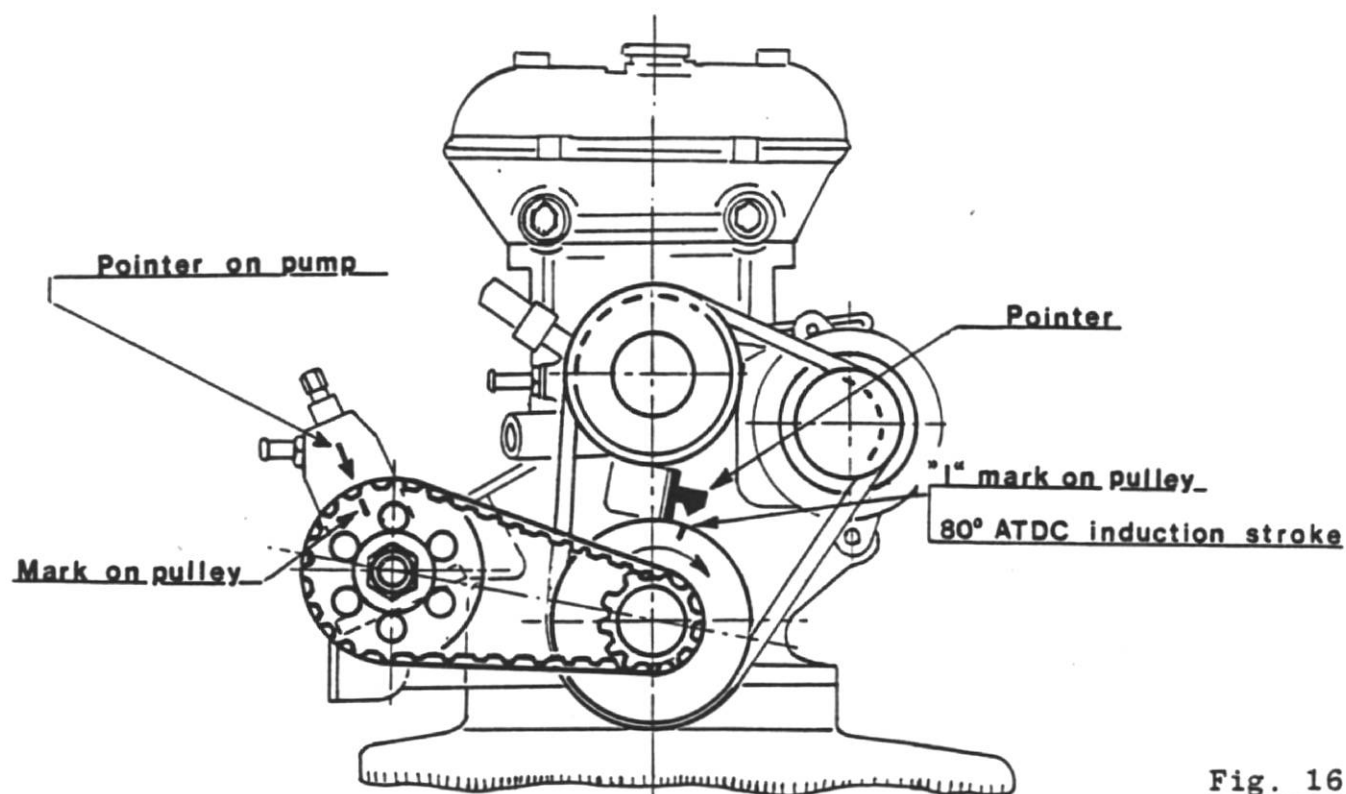


Fig. 16

If the pump is out of timing:

- remove the drive belt;
- line up the reference marks of the injection pump and refit the drive belt by rotating the pulley in either direction to engage the nearest spline.

On completion of the alignment, refit the protective cover.

ADJUSTING THE FUEL CUT OFF REGULATING DEVICE

The injection pump control unit is provided with a device, located at the bottom of unit (see fig. 13), that regulates the rate at which fuel cut off ceases on decelerations with a fully released accelerator pedal, thus preventing exhaust emissions and detonations from taking place due to incomplete combustion.

If, when releasing the accelerator pedal fully with the engine either under load or in neutral, exhaust detonations occur, the cause may be an improper adjustment of the fuel cut off device.

In this event, progressively screw in the knurled knob until the trouble is remedied, taking care that the engine does not stop when, hot and in neutral, is decelerated from about 4000 RPM.

If, on the contrary, the engine stops when the accelerator pedal is released fully in neutral, then progressively unscrew the knurled knob until the engine keeps running when it is decelerated, again hot and in neutral, from about 4000 RPM taking care, however, not to give rise to detonations.

NOTE: to adjust this device gain access from the underside of car.

TESTING THE INJECTORS

Since the operating conditions of the injectors are not so heavy (being located in the air intake ports and therefore not subject to the high pressures and temperatures of the combustion chamber) and since the life of the injectors is expected to be the same as that of the car, they should undergo a test only when the cause for malfunctions is unquestionably attributed to the injectors themselves.

To test the injectors use a handpump like that for testing Diesel injectors but supplied with gasoline and provided with a pressure gage whose top dial reading is 700-1000 psi (50-70 Kg/cm²).

The procedure for checking the spray shape, injection pressure and leaks is as follows:

- connect the test pump pipe to the injector inlet fitting which has a 12 x 1.5 mm metric thread;
- pump quickly to prime pump and injector;
- pump slowly until injector nozzle opens; this must take place at 360-400 psi (25-28 Kg/cm²) for new injectors and at no less than 260 psi (18 Kg/cm²) for used injectors;
- again pumping slowly, bring the pressure to 15-30 psi (1-2 Kg/cm²) below the rating pressure taken as directed above and make sure that there is no drip from the nozzle within five seconds;
- pump quickly and check that the spray is narrow, deeply plunging and has good vaporization even at minimum delivery. At a distance of 4" (100 mm) from the nozzle orifice the spray cone diameter should be about .8" (20 mm). If the injector does not meet these requirements, replace it with a new one;
- The injectors must be tightened in place with a torque of 20.2-23.1 lb-ft (2.8 - 3.2 Kgm).

N.B. - To remove the injectors use the wrench tool no. A.5.0165.

REPLACING THE ALTITUDE COMPENSATOR (in-car)

If the engine runs at idle but stops as soon as it is accelerated the cause of that is lean mixture due to a failure in the altitude compensator which must therefore be replaced.

The replacement procedure is the following:

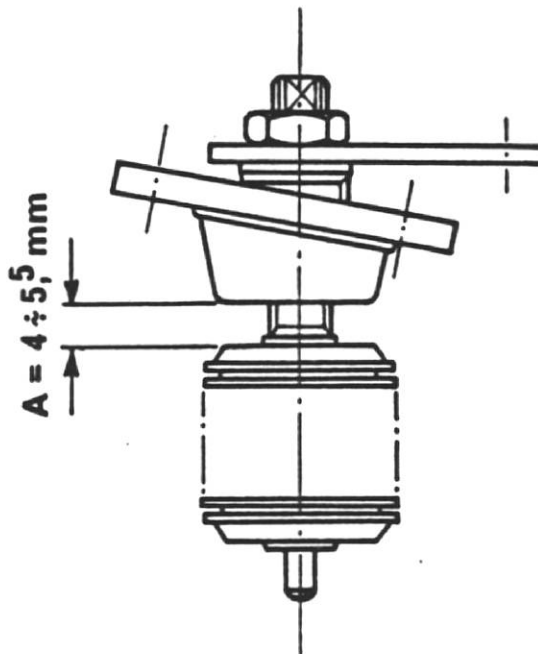
- remove the air cleaner;
- bring the temperature setting lever to N position.

Then remove in this sequence:

- the relay crank-to-control unit rod;
- the rear inspection cover from the control unit;
- the altitude compensator with its mounting flange, taking care not to disturb the position of the setting lever (N position).

CAUTION: do not move the control unit input lever (even better tape it in place) nor disturb the inside devices of control unit or serious damage and out-of-adjustment may result.

Measure the dimension A between the bottom face of compensator mounting flange and the top of bellows: such a dimension should fall between .16 and .21" (4 - 5.5 mm).



Loosen the locknut and unscrew the capsule taking care not to rotate the setting lever with respect to the mounting flange.

Screw in the new capsule until the dimension previously taken is obtained; then slightly tighten the locknut.

NOTE: if, because of any reason, the dimension A does not fall within the specified limits, screw in the new capsule to a dimension of 5 mm irrespective of the dimension previously read.

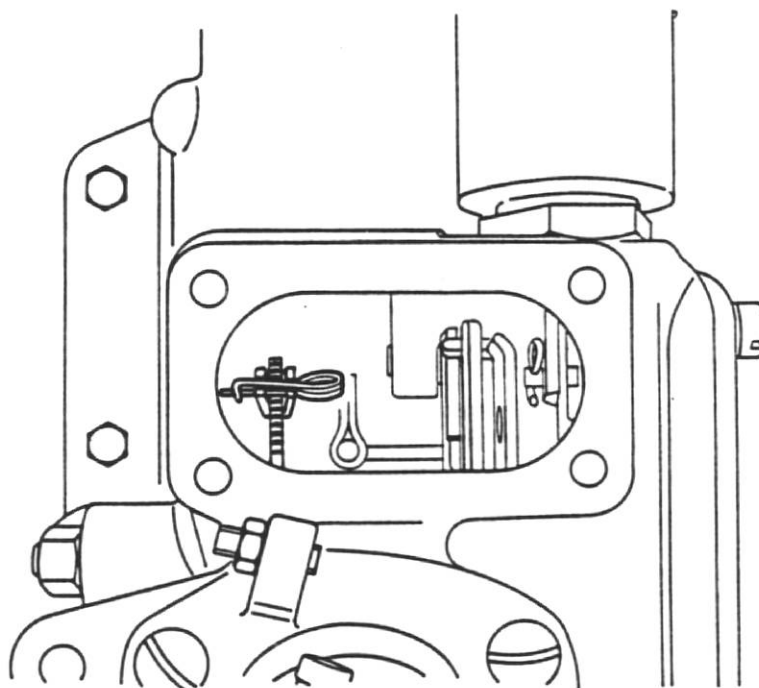
Install capsule, and mounting flange assembly on the control unit making sure the setting lever spring is properly positioned and the setting lever itself is in "N" position.

Refit the rear inspection cover and the rod.

Start the engine and warm it up until the coolant has reached a temperature of no less than 158° F (70°C) then race the engine a few times up to 4000 rpm and fully release the throttle pedal each time.

Stop the engine, again remove the rear inspection cover and (with the aid of a suitable mirror and a lamp to light the inside of control unit) see whether the wire at the end of link engages the notch corresponding to the actual atmospheric pressure as listed below (notches to be counted starting from the top of the notched lever):

- atmospheric pressure falling between 29.9 - 30.7 in Hg: the wire should engage the 3rd notch.
- pressure falling between 29.1 - 29.9 in Hg: the wire should engage the 4th notch.
- pressure between 28.3 - 29.1 in Hg: the wire should engage the 5th notch.
- pressure between 27.6 - 28.3 in Hg: the wire should engage the 6th notch.



If the above conditions are not fulfilled, adjust the position of the capsule so that, when the engine is started again (before that refit the rear inspection cover on control unit) and the warming up procedure (racing the engine followed by a complete release of accelerator) is repeated, the wire positions itself correctly: screw in the capsule to cause the wire to engage notches of higher numbers and unscrew the capsule to engage notches of lower numbers. Keep in mind that a rotation of about 150 degrees corresponds to one notch.

Tighten securely the locknut on the capsule, place the temperature setting lever in the position corresponding to the ambient conditions and reinstall the air cleaner.

REPLACING THE OIL FILTER IN THE INJECTION PUMP

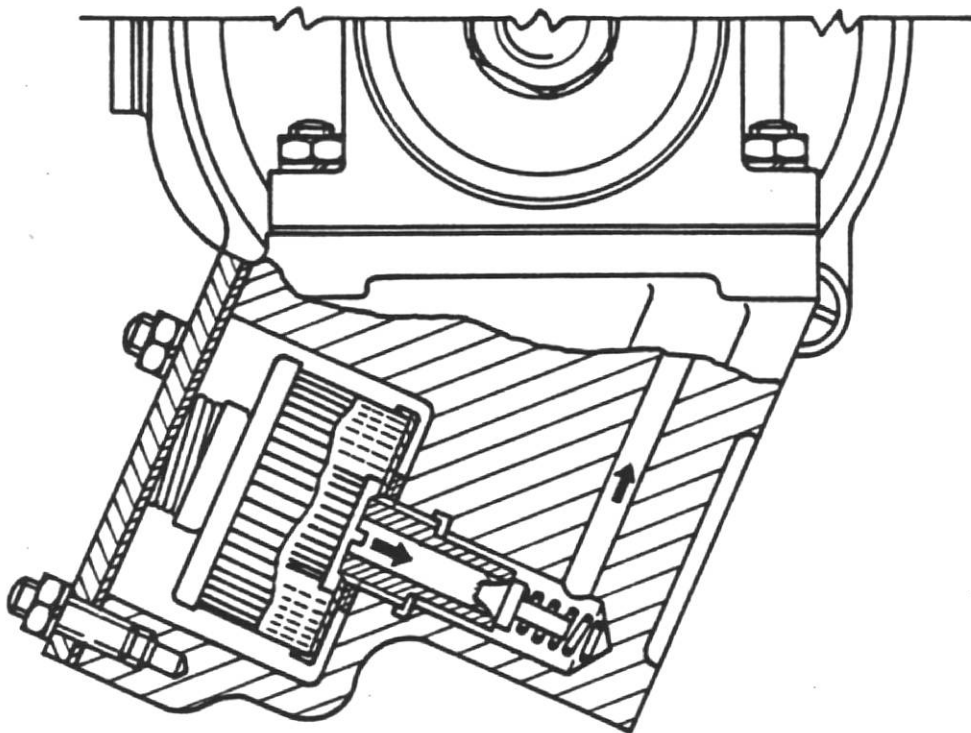
On performing the engine major overhaul, on removing the injection pump (or after 50000 miles whichever occurs first) or on replacing the engine oil in case of contamination by water or similar, the additional oil filter located in the injection pump support must be renewed.

To do so, proceed as follows:

clean very carefully the filter housing cover and the surrounding areas to prevent any foreign matter from entering the filter housing.

remove the cover and withdraw the element; wash thoroughly the filter housing with gasoline, then insert the new element in such a way that the spring faces the cover; renew the cover gasket, if necessary.

To facilitate the air bleed and the quick filling up of filter housing with oil, slightly tighten the two upper cover retaining nuts, crank the engine a few seconds (even by means of the starter) until the oil just oozes out; then lock the nuts fully.



CHECKING AND ADJUSTING THE THROTTLE CONTROL LINKAGE

Engine cold.

Disconnect the relay crank-to-control unit rod 8 (see fig. 2) at the crank-side joint.

When the relay crank is at rest against the idle limit stop, there should be a .04 - .06" (1-1.5 mm) free travel at the pedal lever (see page 5, point "a") in the engine compartment with respect to the reference screw on the cable anchoring bracket; if not so, adjust the reference screw until the specified free travel is obtained.

Depress the accelerator pedal to the floor and check that the clearance between relay crank lug and full throttle limit stop is .08" (2 mm): if not so, adjust the pedal stop on floor until the specified clearance is obtained.

Reconnect the rod 8.

Engine hot (coolant temperature higher than 158°F - 70°C).

With the accelerator pedal fully released, check that the free travel at the pedal lever (see page 5, point "a") is .04 - .06" (1- 1.5 mm).

NOTE: if the adjustments of the reference screw are not enough to obtain the correct free travel of pedal lever, loosen the cable setscrew and tighten it again on the cable at a more suitable position.

TROUBLE SHOOTING

The following chart lists several malfunctions, possible cause for each of them and remedies.

If deficiencies or malfunctions are experienced in the fuel system, it is absolutely essential to make sure they are not caused nor affected by the incorrect operation of the ignition system: in fact it is impossible to distinguish "a priori" whether a failure of fuel or ignition system is the cause for the deficiencies; therefore, first inspect the ignition system for the following and remedy, if necessary

- spark plugs for proper operation and type;
- contact-breaker points conditions and gap.
- ignition coil for continuity or leakage;
- ignition distributor for correct timing using a timing light; adjust timing or replace the ignition distributor, if necessary.

Should any of the troubles listed below be experienced, it is recommended to clean thoroughly the affected areas of both engine and engine compartment with a suitable solvent; this to the purpose of preventing any foreign matter from entering, on removal or reinstallation, the mechanical components and specifically the fuel feed circuit.

Soon after cleaning, inspect the mechanical units for loose attaching or joining parts, the pipes for loose fittings and the brackets for sound conditions.

TROUBLE	POSSIBLE CAUSE	REMEDY
Low fuel pressure warning light does not flash on when ignition key is turned	Fuse no. 6 blown Warning light bulb burnt out Pressure switch faulty (jammed open)	Replace fuse Replace bulb Check switch and replace, necessary

TROUBLE	POSSIBLE CAUSE	REMEDY
Low fuel pressure warning light stays on (fuel pump operates properly)	Pressure switch faulty (jammed closed) Low fuel pump outlet pressure due to: - tank to pump lines clogged or air seeping thru them - tank fuel filter clogged - main fuel filter clogged - main filter pressure relief valve defective or stuck open Fuel pump delivery too low	Replace switch - Inspect fuel lines - Remove and clean filter - Clean filter and replace element (see page 12) - Check relief valve and replace, if necessary Have fuel pump checked or replaced.
Low fuel pressure warning light stays on (fuel pump fails to operate)	Fuse blown (in the additional fuse box) Electric wires to pump disconnected Fuel pump faulty	Replace fuse Check and reconnect Have the pump checked or replaced
Engine will not start from cold	Solenoid-actuated cold start device fails to operate	- check electric connections - Have the device checked or replaced
Engine misfires; rough idle	One injector defective Injection pipe fittings leaking Injection pipes cracked	Trace the cylinder by grounding each spark plug and replace the injector, if necessary Tighten fittings Check and replace, if necessary
Rough idle (hunting)	Lean mixture	Remedy possible air seepage downstream throttles. Refer to page 21
Too fast an idle and smoky exhaust	Faulty thermostatic actuator	Replace thermostatic actuator
Engine keeps running at idle but stops on accelerating	Altitude compensator faulty	Replace altitude compensator (see page 32)

TROUBLE	POSSIBLE CAUSE	REMEDY
Idle too fast	Accelerator linkage fails to return fully	<p>Check:</p> <ul style="list-style-type: none"> - flexible cable - linkage joints and pivot pins for free movement - pedal return spring for sound conditions - pedal and linkage limit stop for proper adjustment <p>Clean linkage joints and pack with grease</p>
Unsatisfactory driveability and road performance; hesitations	<p>Control linkage out of adjustment</p> <p>Fuel pump outlet pressure too low (warning light comes on while running at high rpm.)</p> <p>Air induction clogged</p> <p>Injector defective</p> <p>Injection pump or control unit/defective</p>	<p>Check throttle/control unit linkage (see page 18)</p> <p>Refer to remedies as under "Low fuel pressure warning light stays on"</p> <p>Check and replace air cleaner elements, if necessary</p> <p>Refer to remedies as under "Engine misfires; rough idle"</p> <p>Have them checked and replaced, if necessary, by an authorized workshop</p>
Excessive fuel consumption	<p>Fuel feed circuit leaks</p> <p>Thermostatic actuator defective; also refer to causes as under "Too fast an idle"</p> <p>Defective carburation</p>	<p>Check pipes, fittings, seals and replace defective parts</p> <p>Have the thermostatic actuator checked and replaced, if necessary, by an authorized workshop</p> <p>Have the injection pump adjusted by an authorized workshop</p>
Engine stalls in positions other than idle	Defective altitude compensator or excessive vibrations of injection pump and control unit	Have the altitude compensator checked (see page 32); also check injection pump and control unit brackets for sound conditions and firm attachment
Engine stalls flat	Injection pump driving belt defective	Replace belt

TROUBLE	POSSIBLE CAUSE	REMEDY
Detonations in the exhaust pipe on deceleration	Both throttles and control unit lever fail to return fully on deceleration Control unit lever out of adjustment does not return fully on deceleration Fuel cut off regulator device out of adjustment	Check: - flexible cable - linkage joints and pivot pins for free movement - pedal and linkage return springs for sound conditions - pedal and linkage limit stops for proper adjustment - clean linkage joints and pack them with grease suitable for low temperatures Check throttle/control unit linkage (see page 18) Screw in knurled knob on control unit bottom (see fig. 13) until no more detonations occur; take care that engine does not stop when, hot and unloaded, is decelerated from about 4,000 rpm
Engine stops frequently on deceleration	Fuel cut off regulator device out of adjustment	Unscrew knurled knob (see fig. 13) so as to remedy the trouble without giving rise to detonations on deceleration
Noisy electric fuel pump	Line between pump and main filter distorted or forced in the rubber mountings or against the recovery pipe Tank filter and hoses improperly fitted	Reset the line making certain it is centered in the rubber mountings without forcing against the recovery pipe Check that the filter is properly fitted and that hoses have a correct run

A.R. PUMP POLICY

Injection pumps are not to be opened for any reason. An exchange pump service is available for complete pump units. Pumps that have been tampered with will forfeit any core value.

Always before removing a pump consult your Alfa Romeo representative or zone office.

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