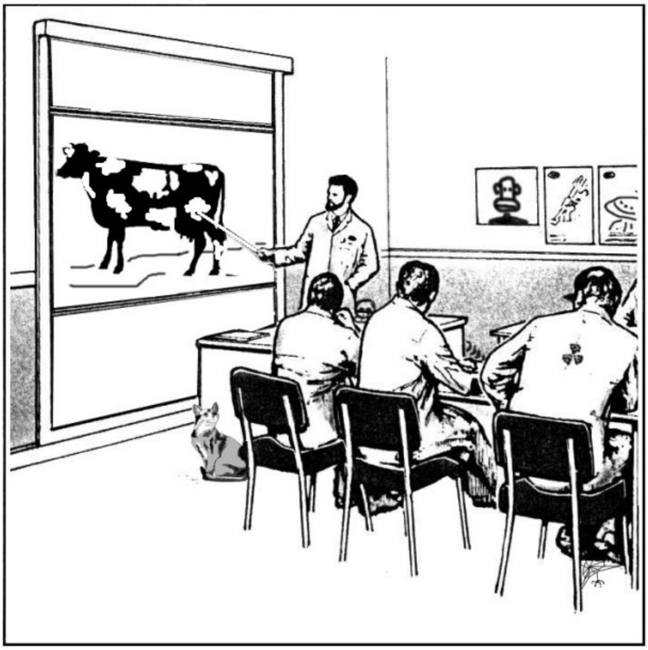
Service Training



V8 ENGINE TUNING

LSM0094 TM

LANDROVER LTD

INTRODUCTION

The contents of this Training Manual strive to clarify what the various engine associated systems are for, how they were developed and how they work, with the ultimate aim of helping you solve "tuning" problems.

In fact the main problem seems to be one of priority. In the "good old days", an engine was "tuned" – and tuning meant adjusting the carburettor ignition and tappets, for best performance and economy.

Then exhaust emission regulations were introduced with the need to set the CO levels and although the adjustments are much the same, the CO setting won priority because it is backed by the law.

Unfortunately, correct CO does not necessarily mean a good tune, especially if there is some undetected minor fault in the plumbing under the bonnet.

The CO regulations assume that all the engine systems are working 100%, and therefore good tuning and CO levels are attainable simultaneously, but this can only be true of a brand new vehicle, not one in need of service. A partially blocked air filter or worn contact breakers can soon upset the engine – and the customer.

So the following pages assume that nothing is 100%, and presents a fresh approach to the modern problem of "A" how to "tune" an engine which "B" will also pass the "CO Breathalyser" test.

V8 ENGINE TUNING

CONTENTS

PART 1 CARBURATION – IGNITION & SYSTEMS – OPERATION

PART 2 SYSTEMS – IDENTIFICATION

PART 3 CARBURATION & SYSTEMS – PREPARATION SUMMARY & CHECK LIST

PART 4 IGNITION & COOLING – PREPARATION SUMMARY & CHECK LIST

PART 5 ENGINE TUNE UP PROCEDURE – CARBURETTOR SETTING & ADJUSTMENTS
IGNITION SETTINGS & ADJUSTMENTS
CO - ADJUSTMENTS

PART 5A SU CARBURATION, SYSTEM OPERATION & ADJUSTMENTS

PART 6 ELECTRONIC IGNITION – DIAGNOSIS

PART 7 HINTS & TIPS – ITS A GOOD IDEA

Published by: **Land Rover Ltd – Service Product Training – Development**

Publication No. LSM0094 TM

Service Product Training

V8 ENGINE TUNING PART 1

OPERATION

In order that we have a thorough understanding of the "Zenith Stromberg "CD" carburettors fitted to the current Range Rovers and V8 Land Rovers and the "SU" carburettors fitted to later models, it is necessary to devote a few paragraphs to the original concept of "Variable Venturi" carburettor. Only by understanding the principals and early designs can the current improvements to both the "SU" and Stromberg carburettors be appreciated.

From Square One

Fig. 1 shows a very basic fixed choke carburettor with float control fuel level.

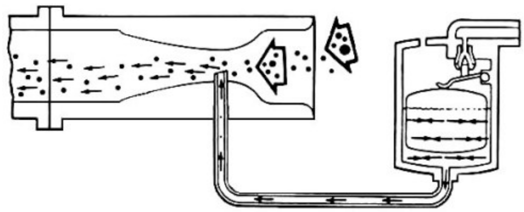


FIG. 1

This very simple device could be made to operate a constant speed engine at a fairly low fixed RPM, not at all suitable for a vehicle where a wide RPM range is necessary.

To increase the RPM range and achieve some control over the air velocity, a throttle butterfly is fitted next to the inlet manifold, as seen in **Fig. 2**.

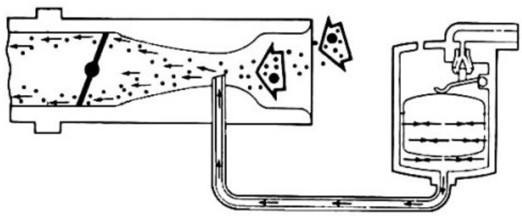


FIG. 2

By controlling the air velocity over the jet the changing depression will draw more or less fuel dependant on throttle butterfly position.

Unfortunately this system is still too crude to provide control over a wide enough RPM range to be of any use in a vehicle. It also tends to give a weak mixture at low RPM and a progressively richer mixture at the limited higher RPM.

Obtaining a rich mixture to start the engine could be achieved simply by restricting the air supply, as seen in **Fig. 3**.

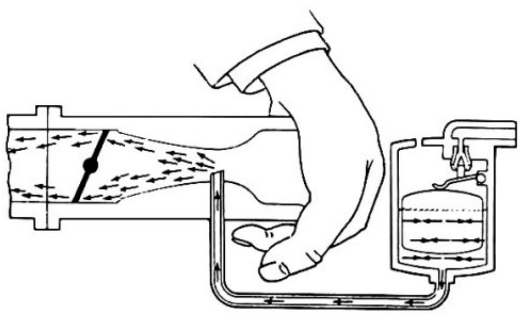


FIG. 3

TM001

Clearly, the problem with this very simple system is "control", that is, controlling the fuel output from the jet relative to the velocity and volume of air.

The Emulsion Tube

The designers overcame the problem on the fixed choke carburettor by inventing the emulsion tube "A" and placing a fuel jet "B" in the system. **Fig. 4**.

The emulsion tube has changed little since it was first invented long before the advent of the "Variable Venturi", and the way it operates is very simple.

Fig. 5. The air velocity controlled by the throttle butterfly "C" creates a depression around the outlet causing fuel to be drawn into the engine. As the depression grows stronger, the fuel is drawn from the outlet "D" thus lowering the fuel level in the tube and the mixture richens. But, as soon as the fuel level uncovers the first hole "E" in the side of the tube, extra air is admitted to provide the desired control over the mixture strength. This sequence continues automatically as each of the holes in the side of the tube is uncovered by the progressive lowering of the fuel level in the tube. Of course, the size of the carburettor, emulsion tube and jets must be correct to suit the engine, and no doubt in the very early days of development, the mixture strength varied quite a lot, but it worked and still does today in a slightly more sophisticated and refined way.

In effect, the carburettor seen in **Fig. 5** can be said to have four jets or points in the RPM range at which the mixture is controlled, i.e. three holes on the emulsion tube, E-F-G plus one fuel jet "B" for max. speed.

The practical physical size of the emulsion tube of the fixed choke carburettor limits the number of control points, which is why there are other systems used in most fixed choke carburettors, or as in the case with the Weber-DMTL 32-34, see in **Fig. 6,** where twin ventures are used with staggered throttle openings.

The primary carburettor on the left provides for cold starting, idle and engine speeds up to 2800 RPM approximately, at which point the secondary carburettor progressively supplies the extra volume of mixture necessary to reach maximum engine RPM when both throttles will be fully open.

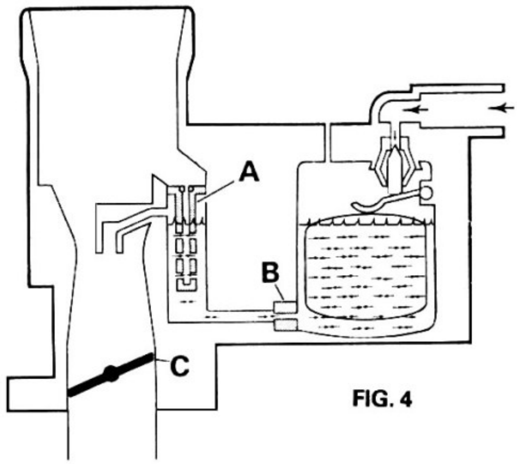


FIG. 4

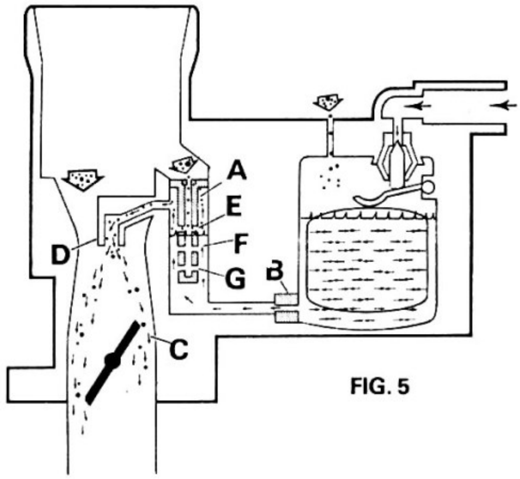


FIG. 5

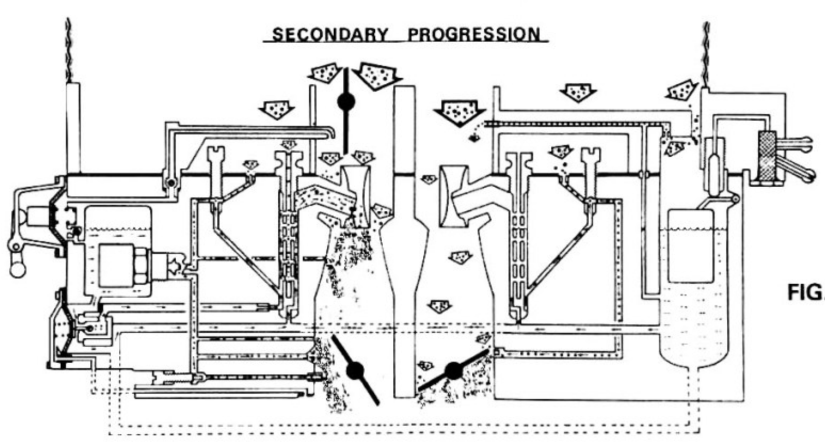


FIG. 6

The SU Concept

The principal of the SU carburettor is aimed at providing a greater number of mixture control points, in effect more jets.

The idea of placing a depression controlled sliding piston "A" in the venturi to give a constant depression over the jet "B" whilst varying the fuel output with a tapered needle "C" must have made quite an impact on the automobile designers when it first appeared.

Fig. 7 shows the basic layout of the SU Carburettor. The piston with the tapered needle controlling the size of the jet orifice is raised by the same depression which draws the fuel off. The needle which is made to very fine limits, is graduated every ⅛" along its taper so a 1" length needle has about six effective jet sizes.

Fig. 8 Some improvements were made to the design, i.e. the fitting of a spring "D" when the piston material was changed from solid brass to aluminium and a hydraulic damper "E" to slow the upward movement of the piston to provide a richer mixture during acceleration.

Fig. 9 The Zenith Stromberg of course operates on the same principal but uses a diaphragm "A" to seal the depression chamber and the jet is central to the float chamber.

The SU HIF carburettor also has the jet in the centre of the float chamber. This arrangement has obvious advantages since any change in vehicle attitude has much less effect on fuel level if the jet is central to the fuel level than if the float chamber is remote.

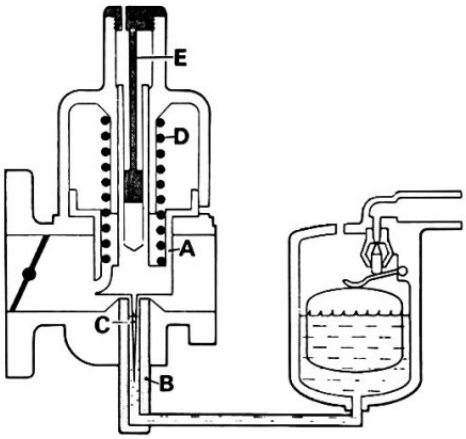


FIG. 8

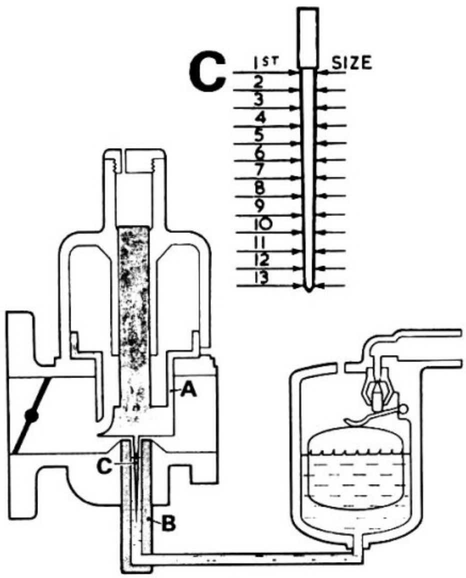


FIG. 7

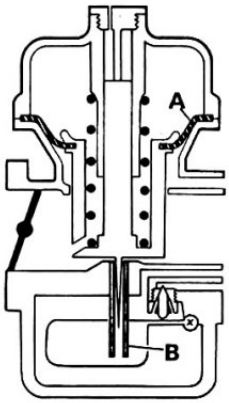


FIG. 9

Fig. 10 illustrates that the offset float chamber will allow fuel to overflow, whereas a centralised jet/ float chamber is uneffected when tilted to the same angle.

The Stromberg like the very early SU carburettor uses a diaphragm which does have the slight advantage of making the piston lighter and therefore less likely to "bounce" on a cross-country vehicle such as the Range Rover or Land Rover.

At this stage, let us summarise the operation of the carburettors seen in **Figs 11 & 12.**

Mixture

The mixture is adjusted either by moving the jet "B" up or down relative to a fixed needle or by needle adjustment "C" in the fixed jet.

With either adjustment the needle to jet orifice is altered to control the mixture.

Throttle Opening

As the throttle butterfly "D" is opened, the air speed creates a depression over the jet thus atmospheric pressure "F" on the fuel in the float chamber causes the fuel to flow into the venturi.

The air speed over the port leading to the depression chamber "E" causes a lowering of the pressure above the piston and atmospheric pressure at port "F" pushes the piston upwards as seen in **Fig. 12**.

Acceleration

The hydraulic damper "H" slows any sudden upward movement of the piston relative to throttle opening, thereby creating a momentary increase in air speed and high depression over the fuel jet, thus providing a richer mixture. The damper does not impede the downward movement of the piston.

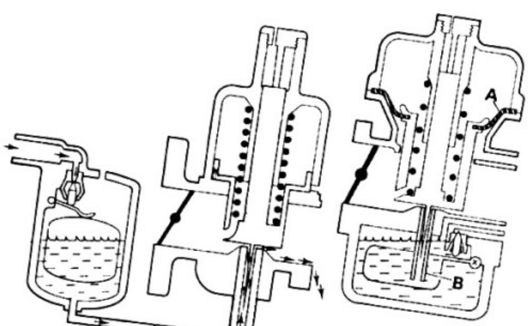


FIG. 10

Cold Start (Choke)

To obtain the rich mixture necessary to start the engine fitted with an SU carburettor, the jet is pulled down against a spring and the throttle opened, whereas in the Stromberg, the piston was raised by a cam and the throttle opened. On later versions of the Stromberg, and on the SU HIF carburettor, a separate rich mixture "disc type" of choke is used.

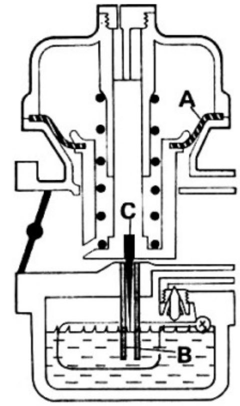


FIG. 11

The systems used in both the carburettors explained so far take no account of exhaust emission laws and there is little doubt that such comparatively simple carburettors are easier to tune (even when there is one per cylinder) than the full exhaust emissioned, temperature controlled, catalytic exhaust, pulse aired, NOX recirculated, transistorised ignitioned plumbers nightmare of today.

However, it is not quite that much of a nightmare provided we look at each system separately and understand what its function is.

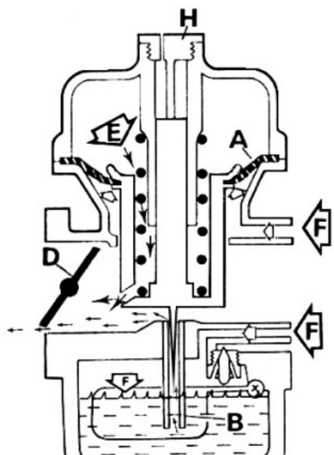


FIG. 12

The Clean Air Bill

The very first problem to be tackled in an effort to prevent pollution of the air we breathe had nothing to do with the carburation or exhaust, but was the crankcase fume emissions. Crank case fumes which used to vent direct to the atmosphere as seen in **Fig. 13** proved a simple problem to overcome – just connect the vent to the inlet manifold and the oil fumes are burned during combustion.

Simple, yes, but how to do it? A number of variations are used and each needs to be studied to determine the effect of particular faults on the mixture strength and tune of the engine.

Figs. 14 to 19 show the principal systems used on most current vehicles. Direct systems are connected to manifold depression and are usually fitted with an anti-blow back valve. Indirect systems are connected to the constant depression area of the carburettor which can only apply of course to a carburettor with a constant depression area like the SU or Stromberg, these are usually fitted with a flame trap.

A vented system means that air is admitted into the engine crankcase atmosphere usually through a filter, whereas non-vented means that no air is allowed into the crankcase.

Let us now examine each system in detail.

Fig. 14. Indirect non-vented.
This system subjects the engine gaskets and seals to moderate depression. Any oil leaks are not likely to be noticed until the engine is left to stand for some time, but damage to seals or gaskets could admit sufficient air to cause loss of engine tune due to a weak mixture.

The wire gauze flame trap "A" if blocked will cause pressure to build up in the crankcase resulting in engine oil leaks, but would not effect engine tune. However, should an engine gasket or oil seal be damaged excessive air could enter the carburettor and cause a weak mixture.

Fig. 15. Indirect vented (V8 Engine).
With this system a blocked flame trap "A" will effect the engine tune due to slightly richer mixture and blockage of the air filter "B" would have the same effect. Only if both the filter and flame trap are blocked will crankcase pressure become a problem and possibly be the cause of oil leaks.

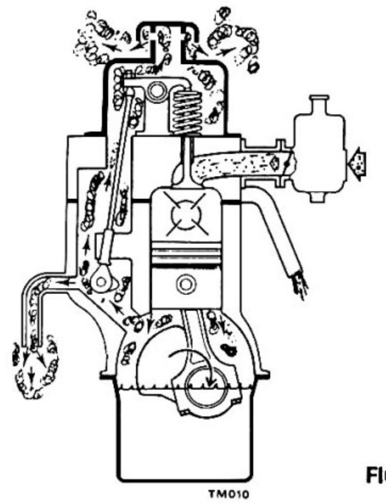


FIG. 13

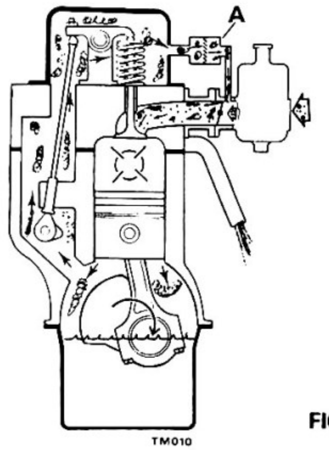


FIG. 14

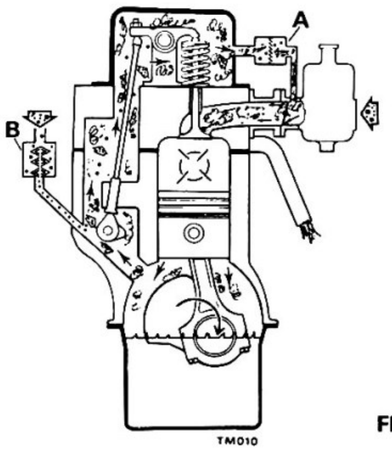


FIG. 15

Correctly maintained, the vented system has the advantage of constantly changing the crankcase atmosphere thus minimising the accumulation of moisture and sludge.

Fig. 16. Direct non-vented.
This system which usually employs an anti blowback valve "C", subjects the engine gaskets and seals to very high depression, so much so that the gaskets may need to be fixed with a strong adhesive to prevent them being sucked into the engine. Any gasket leaks have a very noticeable effect on the engine tune.

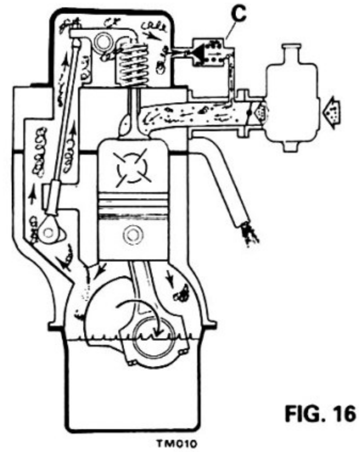


FIG. 16

Direct Vented

Two types of direct venting system are in use shown in **Figs 17 & 19.** The type seen in **Fig. 17** employ's a Smiths valve "S" which has been used extensively by many motor manufacturers including fitment to the 2¼ Land Rover engine.

The valve is designed to regulate the volume of crankcase gas entering the inlet manifold as follows:-

Operation of Smiths Valve Fig. 18

When the engine is running the inlet manifold depression begins to draw the polluted crankcase atmosphere through the valve "A", until the difference in pressure above and below the diaphragm is equal to the strength of the coil spring; at this point the valve is balanced, and when pressure below the diaphragm drops a little more, atmospheric pressure pushes the diaphragm and needle valve down, stopping the flow of gas to the manifold B. Crankcase pressure will then increase slightly and help the spring to open the valve once again. This procedure continues, with the valve fluttering on its seat maintaining a constant depression in the crankcase.

As a safety precaution, a one-way valve C is also fitted to prevent an engine backfire from igniting the gases in the crankcase.

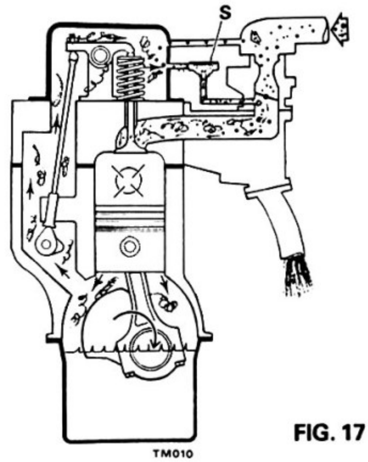


FIG. 17

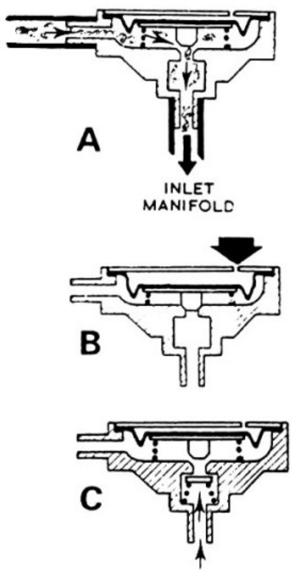


FIG. 18

Fig. 19. Direct vented (4 cylinder petrol engine)
This is the system used with a fixed choke Weber carburettor on the 4 cylinder petrol engine which, whilst it has a direct connection to the inlet manifold, is also vented to atmosphere via the carburettor air intake. The crankcase is subject to nominal depression and damaged gaskets have little effect on the engine tune.

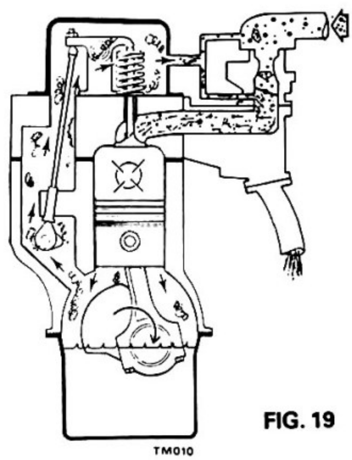


FIG. 19

When exhaust emission laws were introduced and more attention was paid to the exhaust gases, a number of problems came to light.

Poppet Valves Throttle Props & Dampers

The first problem occurred when the throttle was closed from high engine RPM (descending a hill for example). Sudden closure of the throttle caused a fluctuation of air speed and pressure in the venturi resulting in a high hydrocarbon emission due to temporary loss of control of the mixture. The cure was simple – fit a throttle damper "A" of the type seen in **Fig. 20.**

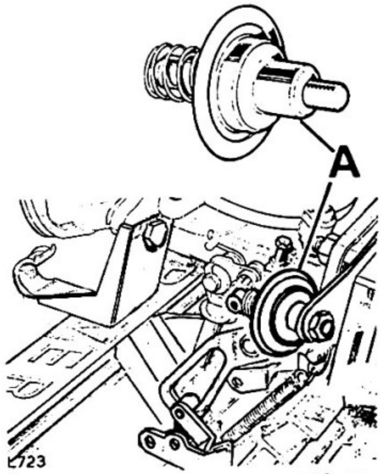


FIG. 20

This slowed down the last few degrees of throttle closure to control the air speed and therefore the fuel air ratio. The throttle damper works in exactly the same way as the dampers you see fitted to doors in the local pub or bank, which prevent the bank notes or the head on your beer from being blown about when the door is suddenly closed.

Another method of controlling gusts of wind when doors are closed is to have a smaller hinged flap in the door, a small flap to let the "cat" in for example.

The "cat flap" is called a "poppet valve" when fitted into the throttle butterfly on the SU or Stromberg carburettor **Fig. 21**. The poppet valve can give rise to one or two problems if it is not working correctly, for example, if it sticks open the engine idle increases – it is just the same as having the throttle butterfly stuck open. If it sticks closed permanently, you probably will not be aware of it, but if it sticks closed as the throttle is closed, and then opens, it will cause the engine speed to increase just as you are about to stop at the traffic lights.

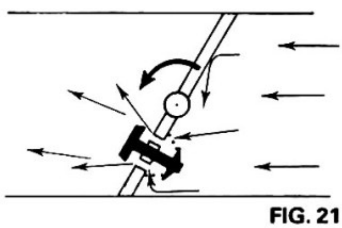


FIG. 21

Usually a thorough cleaning with a little cellulose thinners to remove the lead deposits will put it right.

As an alternative to the poppet valve some Stromberg carburettors are fitted with a throttle by-pass valve "X" **Fig. 22.**

Operation

Sudden closure of the throttle simply causes manifold depression to lift the diaphragm valve "P" against the spring to allow the mixture to by-pass the throttle butterfly "R" as shown, and has the same effect as the poppet valves and dampers. Some versions of this valve have a screw to adjust the spring tension and therefore the operating range of the valve.

On the Zenith 36 IV carburettor fitted to the Series III Land Rover, a similar problem existed which is also overcome by fitting a throttle butterfly damper or "Prop" as it is called. **Figs. 23-24.**

The system comprises a diaphragm operated, spring controlled two-way trigger valve "A", which is operated by manifold depression. This controls a distributor capsule "B" attached to the throttle lever of the carburettor.

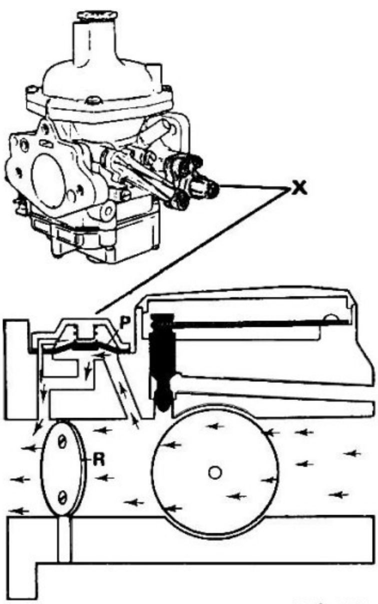


FIG. 22

When the manifold depression is low as in **Fig. 23**, the spring "C" closes the valve at "D", thus sealing off manifold depression to capsule "B", and air enters the capsule via the restrictor "F", allowing normal operation of the throttle. When the manifold depression is high, as seen in **Fig. 24**, the valve "D" and diaphragm "E" are raised by the depression, thus manifold depression is felt in the capsule "B" and momentarily the throttle is "propped open". Air enters the manifold via the restrictor "F" but not in sufficiënt volume to destroy the depression immediately.

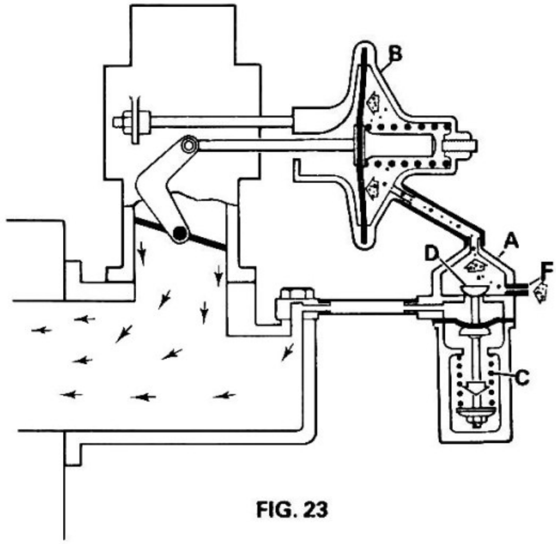


FIG. 23

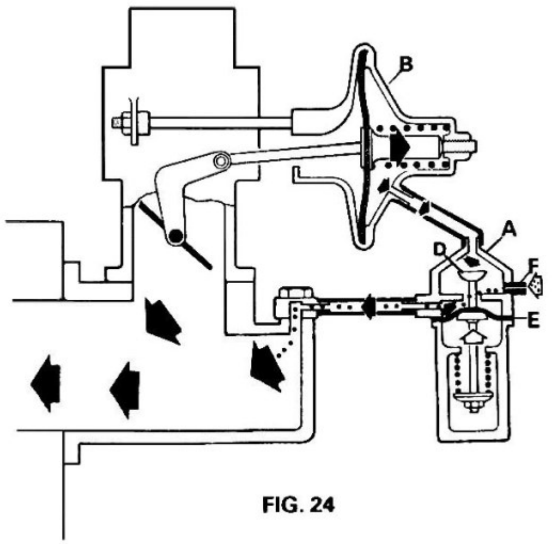


FIG. 24

Separation and Sharks Teeth

Another problem which affects horizontal or side draught carburettors is "Separation", i.e. separation of the fuel and air which becomes progressively worse as the air speed is reduced.

It is caused simply by gravity and the fact that fuel is heavier than air. As the air speed slows the heavy particles of petrol strike and run down to the lower edge of the throttle butterfly. The fuel then runs in a stream down the manifold, separated from the air. Now, to mix the fuel and air again, we either heat the fuel with a "hot spot" or find some way of lifting it into a region of higher air velocity, and the "Sharks tooth deflector" does both.

The location of the deflector and the angle of the teeth are important to its operation. Not only does it absorb some heat from the engine, which helps to vaporise the fuel, but the fuel runs from the point of each tooth into the centre of the airstream in an atomised form, as seen in **Fig. 25.** Very simple, but effective.

A fine wire screen has a similar effect.

Biased Needle

The spring loaded biased needle came about as far as I am aware, by accident, and it came about like this:

A series of emission tests revealed that some carburettors (of the same make) gave better results than others, and after tolerance checks it was discovered that the best results were obtained from a batch of carburettors which had maximum piston bearing clearance. The side movement of the piston in its bearing obviously caused the piston and needle to move towards the throttle butterfly, due to the constant depression area and air velocity, thus moving the needle off centre to the jet.
Fig. 26 illustrates the spray from a centralised and a biased needle.

The off-setting of the needle towards the throttle butterfly gives a marked improvement in the fuel spray from the jet at moderate and wide throttle openings. Most needles are biased towards the throttle butterfly, but on certain vehicles (not Rover) the needle is biased towards the air intake. This is done to prevent wear on the needle and jet but does not affect the spray since the needle will in any case move to the position seen in **Fig. 26B** due to the air velocity.

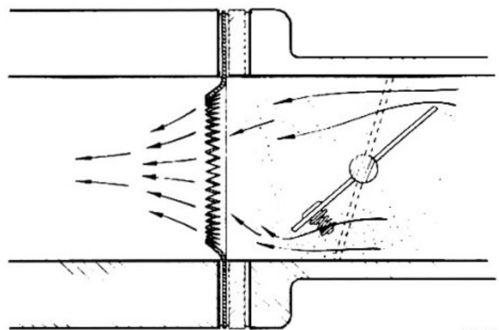


FIG. 25

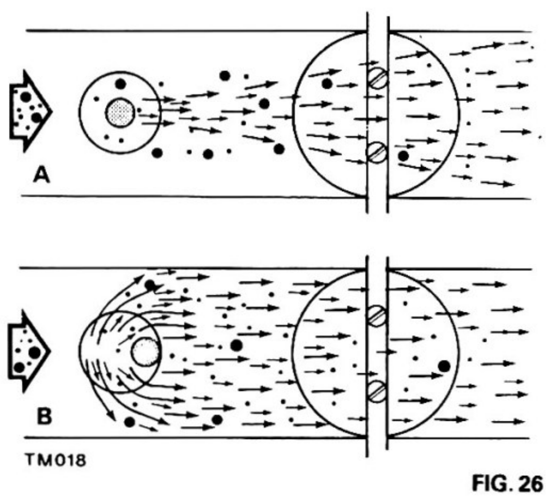


FIG. 26

Temperature and Viscosity

So far then, we have explained "Crankcase Ventilation", the "Poppet Valve", "Throttle Prop and Damper", "Sharks Teeth" and the "Biased Needle". What next? Well, emission tests also showed that even with the carburettor set exactly the mixture would not remain stable due to variations in temperature and the effect it has on the fuel viscosity. In other words, petrol when cold is reluctant to flow and when hot flows faster.

So what was needed was a "Temperature Sensitive Mixture Compensating Device" which could be bolted on to the existing SU carburettor.

The device is shown full size in **Fig. 27** and consists of a conical shaped valve "A", which is attached to a bi-metal strip "B". A very small air bleed "C" ensures that any change in air temperature is detected. One end is connected to the air intake and the other end to the constant depression area.

How it operates

As the air temperature rises and the petrol flows more easily, so the mixture will become rich. Now the simplest method of reducing the quantity of petrol drawn off the jet is to reduce the volume of air passing over it. With the engine running, but still cool, air is being drawn through the bleed "C". **Fig. 27.**

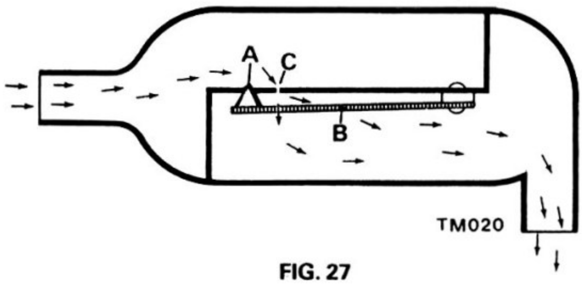


FIG. 27

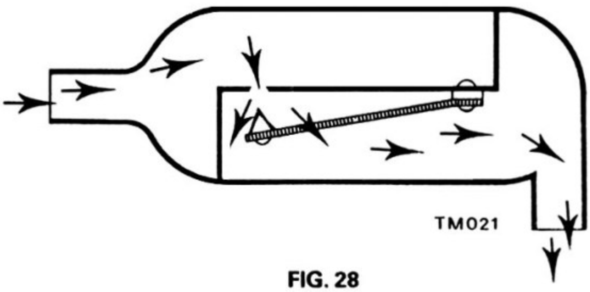


FIG. 28

As the temperature rises, the bi-metal strip "B" will cause valve "A" to open thus allowing a larger volume of air to by-pass the venturi, with a consequent reduction in petrol delivery from the jet as seen in **Fig. 28.**

Having conceived the principal of a "Temperature Sensitive Mixture Compensating Device" there are many ways in which this can be applied.

Fig. 29 shows the SU "Capstat" Controlled Jet which moves the jet up or down dependent on "under bonnet" temperature, whilst the HIF type SU carburettors with the centralised float chamber **Fig. 30**, has the bi-metal "B" immersed in the fuel to control the position of the jet.

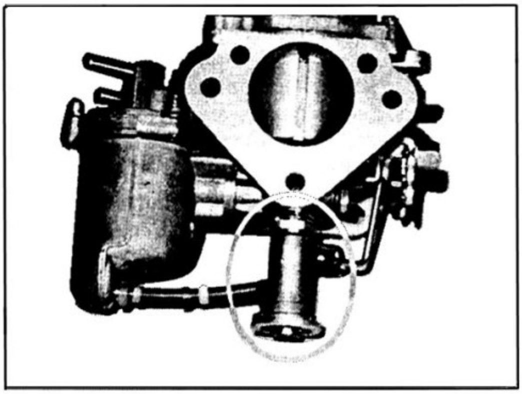


FIG. 29

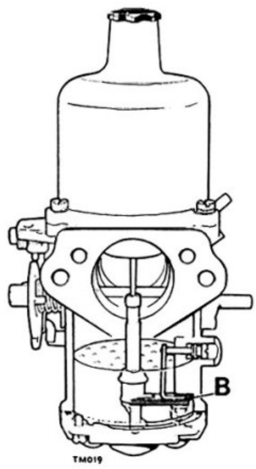


FIG. 30

The Stromberg **Figs. 31, 32** and **33** uses a bi-metal controlled valve "B" which senses the temperature of the carburettor body and is attached to the side of the carburettor with two screws. The device also allows air to by-pass the jet and venturi as shown in **Fig. 31.**

Fig. 31 shows the valve open (engine warm) and its location on the carburettor. Some carburettors are also fitted with a trim screw "T" **Figs. 32-33,** which is used to fine tune the volume of air by-passing the jet "J".

Having gone to great lengths to cater for air temperature changes, why not control the air temperature in the first instance?

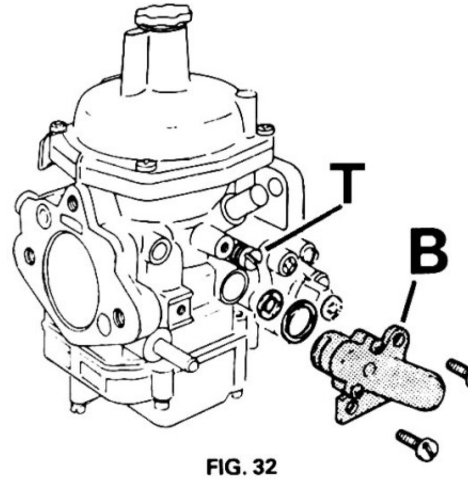


FIG. 32

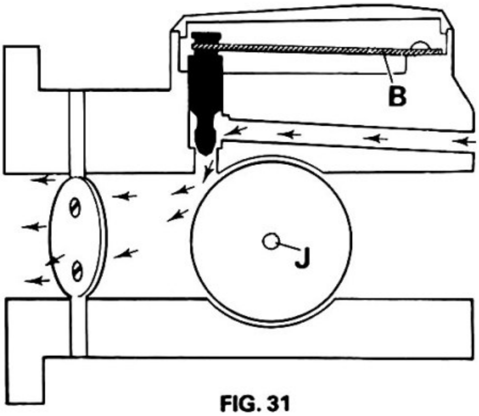


FIG. 31

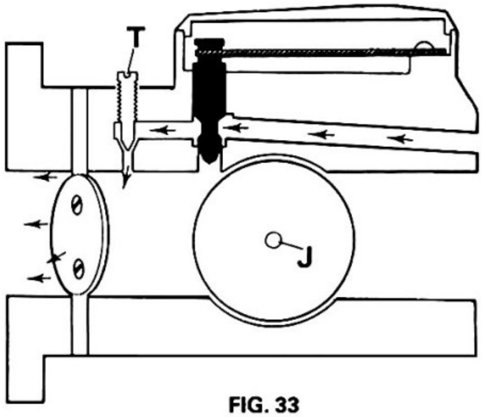


FIG. 33

Temperature Controlled Air Intake

All that is needed to control the air intake temperature is a bi-metal valve similar to the one used for mixture control.

Fig. 34 shows the system at rest.

The temperature sensing valve "B" in this system controls the position of the air intake flap "F" which is operated by manifold depression and a servo "S". Cold air is admitted through port "D" and hot air is supplied from the exhaust "Hot Box" "H". Note the small permanent air bleed "G" in the temperature sensing valve which ensures instant response to temperature variations.

The air intake flap "F" is spring loaded to the position seen in **Fig. 34** with the engine at rest.

As soon as the engine is started from cold, manifold depression is felt above the servo diaphragm "S", thus moving the flap to the position seen in **Fig. 35.**

As the engine warms, fresh air is heated in the hot box "H" and is drawn into the engine via the flap "F", and the air filter. Some of the warmed air also passes through the permanent air bleed "G" in the sensing valve "B" to enable the valve to respond to any changes in temperature.

When warm enough, the sensing valve opens to admit atmospheric pressure into the servo, thus allowing the spring to move the flap to the position seen in **Fig. 36.**

The sensing valve can control the position of the intake flap at any intermediate position, allowing a mixture of cold air via "D" and heated air via "H".

Ball valve "M" prevents any engine backfire damaging the sensing valve or servo.

The systems so far dealt with have been aimed at correcting the intake of mixture to minimise hydrocarbons at the exhaust, but there is another gas which is more toxic and is only produced under certain operating conditions – "Nitric Oxide".

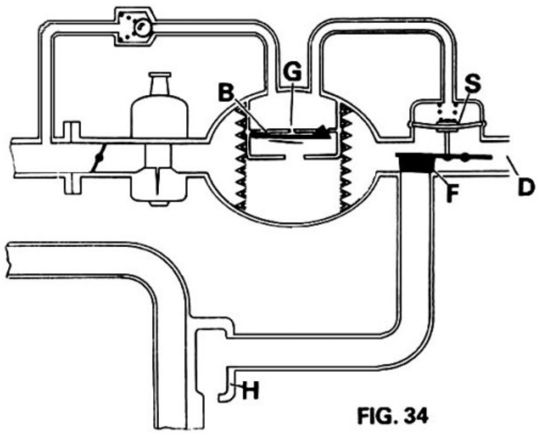


FIG. 34

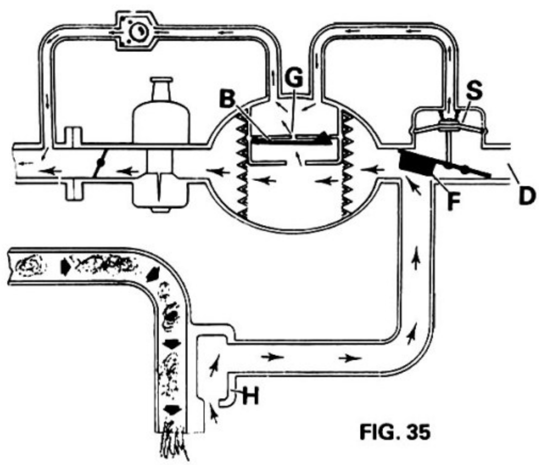


FIG. 35

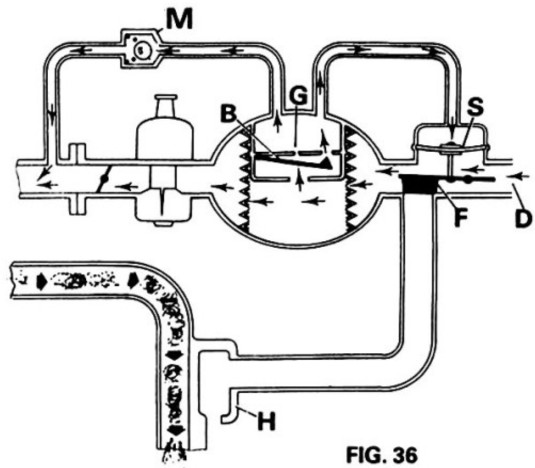


FIG. 36

Exhaust Gas Recirculation

This particularly lethal gas is produced at peak combustion temperatures and can be controlled by lowering the temperature. One way of cooling the combustion is to recirculate a quantity of burnt gas into the inlet manifold which has the effect of "smothering" the combustion.

The system is shown in **Fig. 37** which is employed on the 4 cylinder petrol engine and allows no recirculation of exhaust gas at idle or full throttle, but does allow a controlled recirculation at part throttle.

The Exhaust Gas Recirculation valve (EGR for short) consists of spring loaded rubber diaphragm "A" and valve plunger "B". At part throttle openings and under certain load conditions, the depression will raise the valve to allow exhaust gas to be drawn into the engine, as seen in **Fig. 38.**

The recirculation pipe "C" is connected to the atmospheric side of the throttle butterfly as seen in **Figs. 37 & 38** on engines fitted with fixed choke carburettors such as the Zenith 36 IV or Weber.

On constant depression carburettors the recirculation pipe is connected direct to the inlet manifold. On the V8 engine, for example, pipe "C" connects to the balance drilling between the two carburettors as seen in **Fig. 39.**

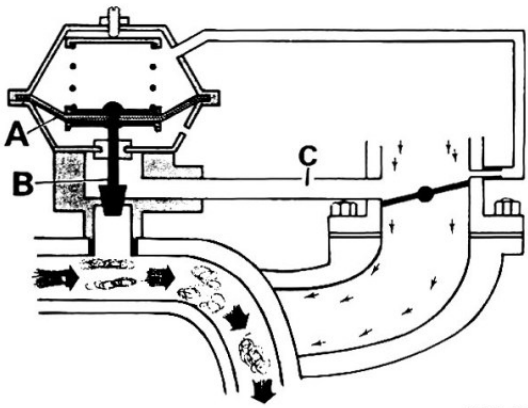


FIG. 37

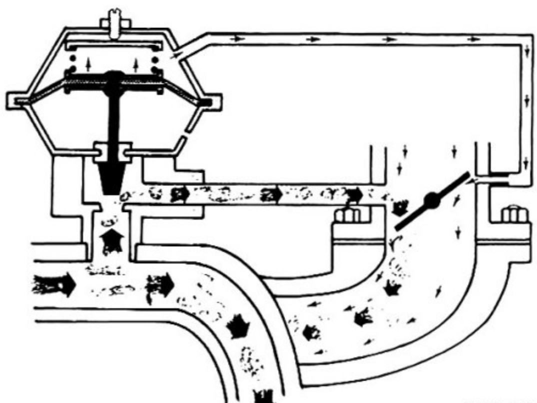


FIG. 38

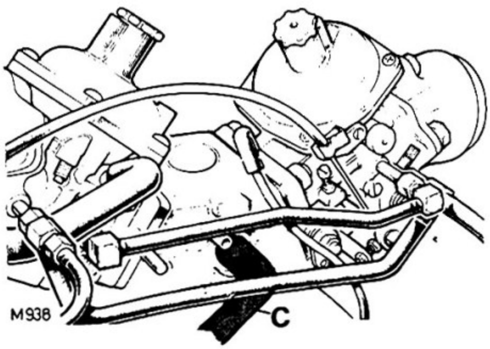


FIG. 3

Now, some engines, when fitted with all or a combination of the systems already explained, still emit more hydrocarbons than the law allows. So the designers began to look at ways of curing the problem at the exhaust pipe.

Air Injection

Pumped air injection into the exhaust manifold, as close to the exhaust valve as possible, causes an "after-burn effect" i.e., the injection of oxygen burns the residual hydrocarbons in the exhaust gas in the manifold before they are released to the atmosphere.

Fig. 40 shows the system. The check valves "N" merely prevent any backfire in the exhaust damaging the pump "K" and its inlet/outlet valves. The disadvantage of this system is that few engines require a continual supply at all engine speeds, which means that for much of the time the pump does nothing more than absorb power.

On some engines, with a suitable degree of valve overlap a system called "Pulse Air" will do the job just as well, at half the installation cost and which does not absorb engine power, as seen in **Fig. 41**.

Pulse air

In this system, the depression in the exhaust during "valve overlap", draws air through the check valves "N" into the exhaust manifold to induce the "after-burn effect".

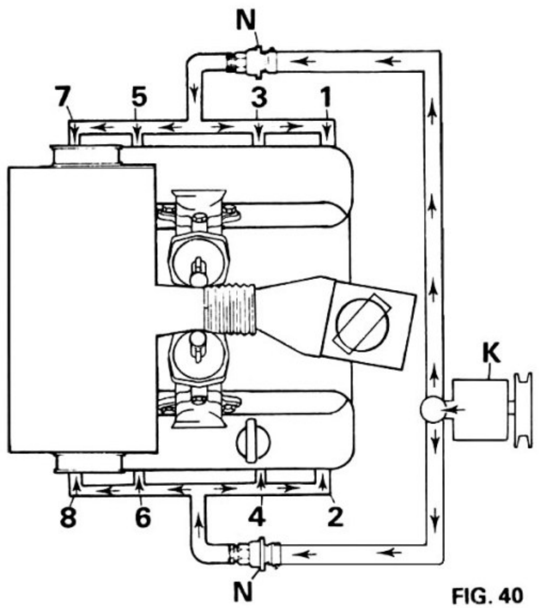


FIG. 40

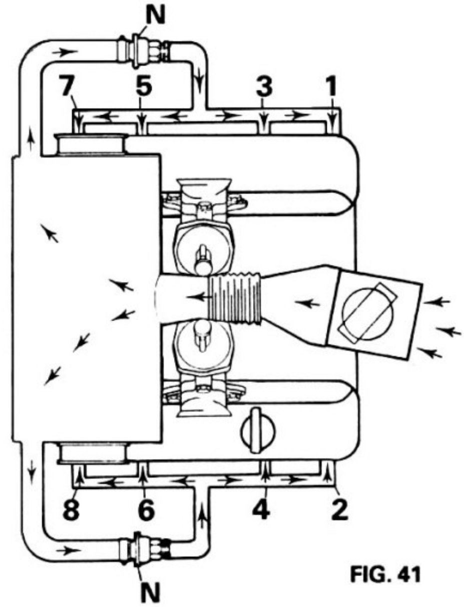


FIG. 41

Non Return Valve Fig. 42

The non return valves fitted to the pumped air and pulse air systems are basically the same, consisting of a rubber valve seal "S" and a diaphragm spring "P". The valves which allow air to pass one way only (as illustrated) are colour coded to identify the many different operating pressures, so do not imagine that because the valves are identical in size and shape that they are interchangeable. Faulty valves must only be replaced with ones of the same colour code and since only one end has a screw thread it is impossible to fit them incorrectly.

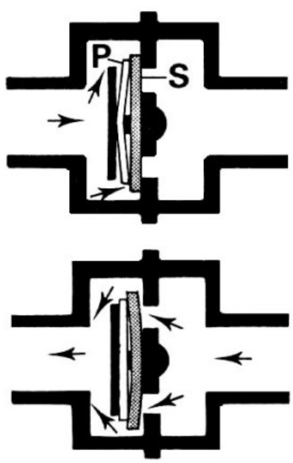


FIG. 42

At this stage, and before examining the ignition, it is perhaps a good point to summarise once again the systems covered so far.

SUMMARY

1. Crankcase ventilation, in its many forms.
2. Mixture control of the carburettor i.e. centralise float to jet location, temperature sensitive mixture controls to fuel air flow. Throttle props/ dampers and poppet valves.
3. Temperature controlled air intake (vacuum operated).
4. NOX recirculation, exhaust gas to inlet manifold.
5. Pumped or pulse air injection into the exhaust (after burning).

Now for the ignition

Ignition

Obviously, the ignition timing has a crucial effect on the combustion and the gases which make up the exhaust.

When tests were first carried out on the condition of the exhaust gas relative to the ignition timing, it was found that on many engines, if the timing was set slightly retarded at idle, the emission improved.

One very simple explanation for this, is that an engine running at idle with the ignition set BTDC produces more power than is necessary to merely turn the crankshaft and operate one or two auxiliaries, and since power usually means higher CO levels, it was logical to retard the ignition.

To achieve the desired result, a vacuum advance/ retard capsule is fitted to the distributor. The rubber diaphragm "G" has a return spring on both sides and at rest is approximately in the mid way position, as seen in **Fig. 43.**

The advance pipe "A" is connected to the atmospheric side of the throttle butterfly and the retard pipe "R" is connected to the manifold via a vacuum valve controlled by a cam on the throttle linkage, as seen in **Fig. 44.**

With the engine idling, as shown in **Fig. 44**, atmospheric pressure is admitted to the advance side of the vacuum unit and the retard side of the vacuum unit is connected to manifold depressior via the control valve, thus the ignition is retarded

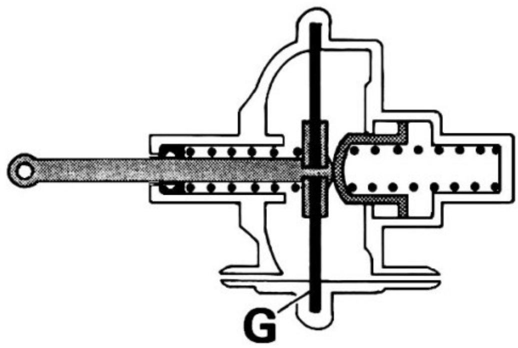


FIG. 43.

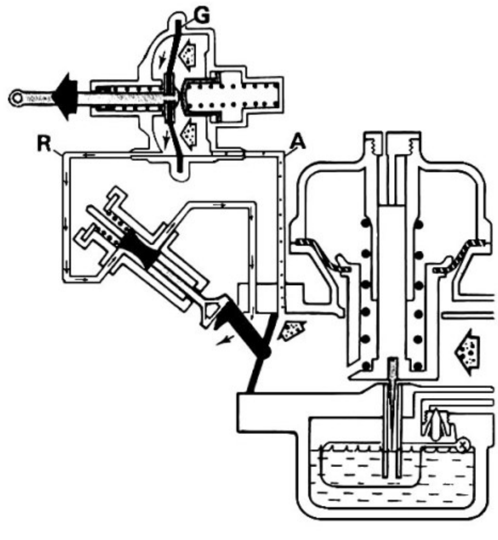


FIG. 44.

Opening of the throttle mechanically operates the control valve which is moved along the cylinder by the internal spring, thus isolating the depression and admitting atmospheric pressure to the retard side of the advance unit, as seen in **Fig. 45**.

This allows the ignition to advance to the normal static setting; further opening of the throttle allows further advance to take place in the usual way.

The control valve has been replaced on later engines requiring vacuum advance and retard, by a top and bottom vacuum connection to the carburettor, as seen in **Fig. 46**. The bottom (retard connection) is prone to filling with petrol, so it is necessary to fit a small flame trap "F". When the throttle is opened the depression at the top of the butterfly is transmitted to the advance side of the diaphragm and atmospheric pressure is admitted to the retard side of the diaphragm via the bottom connection as seen in **Fig. 47**.

The flame trap has been used for many years on engines where the distributor is mounted well below the carburettor. On one such car I once owned, the distributor cap blew off each time the engine started , this was due to ignition of petrol which had seeped through the diaphragm. The cure was to fit a flame trap.

A further improvement to the combustion can be obtained by causing the ignition advance to be slightly delayed of the throttle opening. This could be achieved by careful adjustment of the control valve, seen in **Fig. 45**, but to suit the system shown in **Figs. 46 & 47** it was necessary to introduce the "Ignition Advance Delay Capsule".

The main body of the capsule is made from black plastic, with one end a variety of colours. Each colour denotes the time delay of the unit as follows:

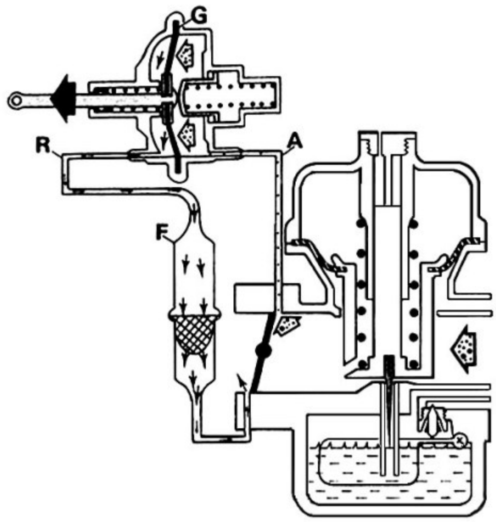


FIG. 46

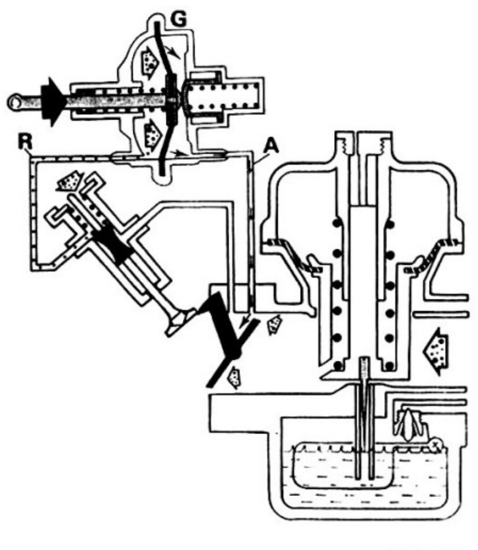


FIG. 45

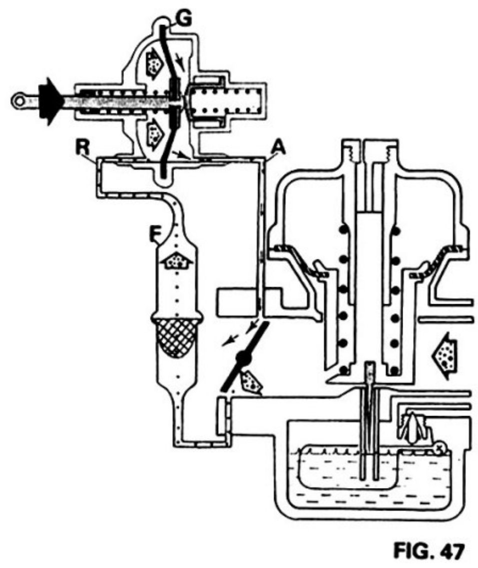


FIG. 47

Advance Delay Capsule

Colour End to Carburettor	**Delay Time In Seconds**
Blue	15 ± 3
White	6.35 ± 1.5
Green	20 ± 4
Yellow	10 ± 2
Brown	2 ± 0.5
Grey	1 ± 0.2
Red	37.5 ± 7.5
Orange	30 ± 7.5

The vacuum advance reacts too quickly in relation to engine speed and produces high emissions (HC & NOx), therefore fitting an appropriate delay valve into the advance circuit will co-ordinate the amount of advance in relation to engine speed and emission will be reduced.

The valve is designed to cause a time delay in the operation of the distributor advance unit during acceleration, by restricting the rate at which the air can be sucked out of diaphragm chamber as seen in **Fig. 48.**

When the throttle is closed, depression at the carburettor collapses and air passes freely through the centre valve into the vacuum advance unit, thus allowing the distributor to immediately retard,as seen in **Fig. 49.**

Key to Figs. 48 & 49

C = Vacuum connection to carburettor
X = Sintered steel restrictors
Y = Rubber centre valve

This is the end of Part One which hopefully has clarified how most of the current systems work and what they are designed to achieve. The next step is to identify and adjust the systems.

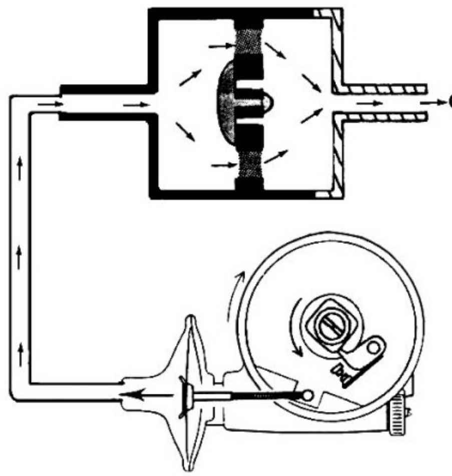


FIG. 48.

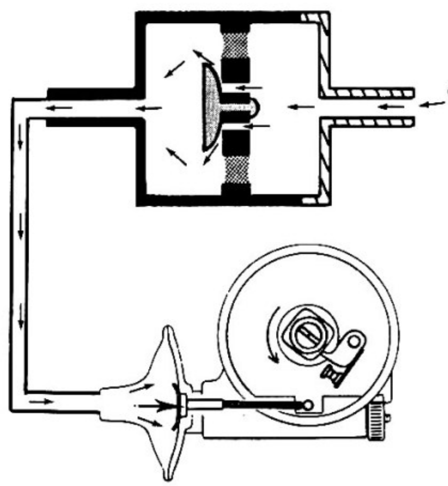


FIG. 49.

Approaching a Tune Up

There seem to be two ways in general that a tune up is approached.

Approach number 1 is to assume that plugs, points, air and fuel filters are all O.K., and all that is necessary is to connect one or two instruments, turn a few screws, adjust this that and the other and the job is done.

Approach number 2 is to clean or renew plugs, points, fuel and air filters and crankcase ventilation flame traps, connect one or two instruments, turn a few screws, adjust this that and the other and the job is done.

Approach number 1 is likely to develop into a complete fiasco as you discover one thing wrong after another, i.e. blocked filters, burned out plugs, etc.

Approach number 2 works quite well in many instances, but can still develop into a problem job, particularly if the operator has little knowledge of the systems he is dealing with.

Whichever way you decide to carry out a tune, you must first have a reasonable understanding of (a) what the vehicle specification is, (b) the service record card if available and (c) the knowledge to be able to identify what systems are under the bonnet

Back to the plumbers nightmare

Some, or all of the systems explained in the previous pages may be fitted to the vehicle you have been asked to tune, so the first thing you must be able to do is identify which systems are fitted to the engine.

Example

Let us assume a 1982 specification Range Rover with 4 speed manual LT95 transmission and visually identify each system fitted to the engine as follows:-

1ST IDENTIFY

Crankcase Ventilation System Figs. 50 & 15

Type = Indirect Vented
A = Flame Traps (Two on V8)
B = Air Filter Crank Case Vent

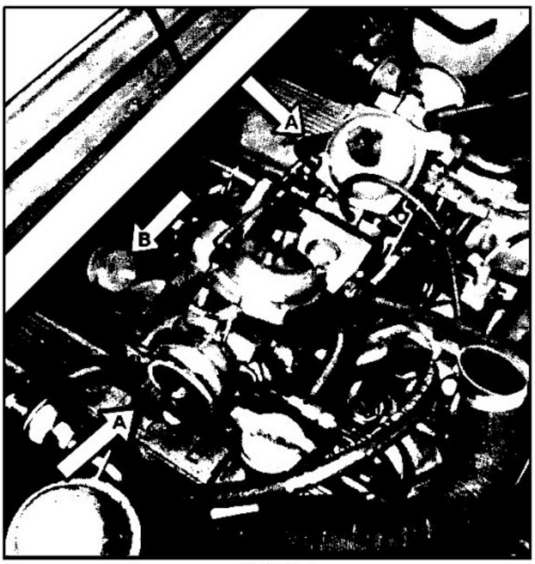


FIG. 50

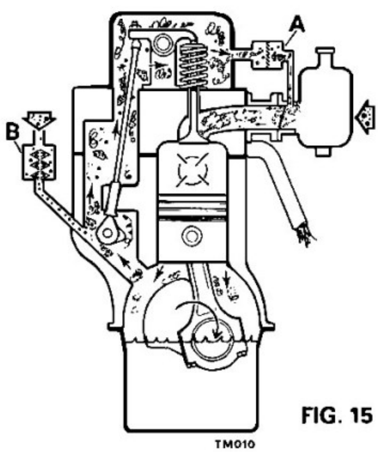


FIG. 15

2ND IDENTIFY

Carburettor Type, Stromburg

Features:
Biased Needle **Fig. 26**
Temperature compensator **Figs 31-32**
Note: Trim screw not fitted.
Poppet Valve and Sharks Teeth deflector **Fig. 25**
Needle adjustment (mixture) **Fig. 51**

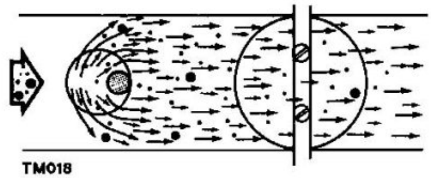


FIG. 26

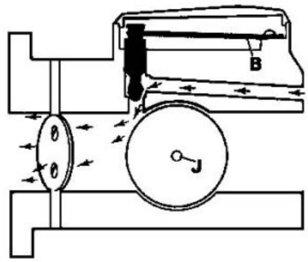


FIG. 31

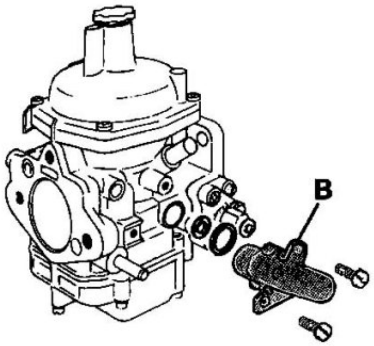


FIG. 32

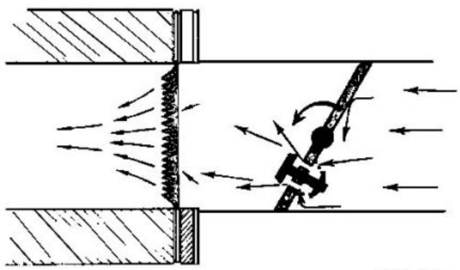


FIG. 25

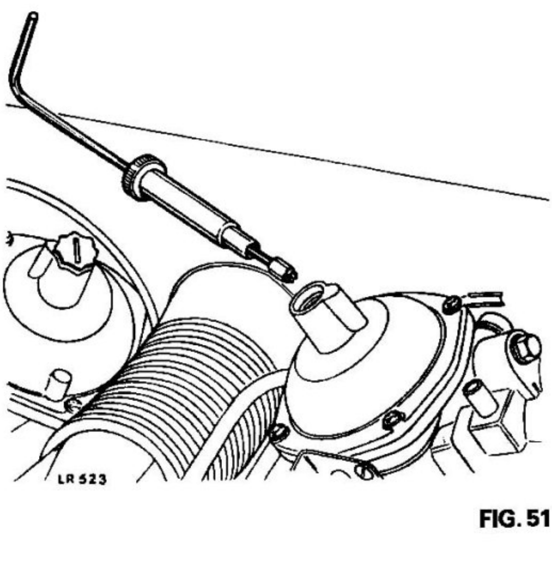


FIG. 51

3RD IDENTIFY

Temperature Controlled Air Intake System
Figs. 52 & 36

Air Intake – Servo & Flap. – D-F-S
Temperature sensitive control valve – B-G
Non Return Valve – M

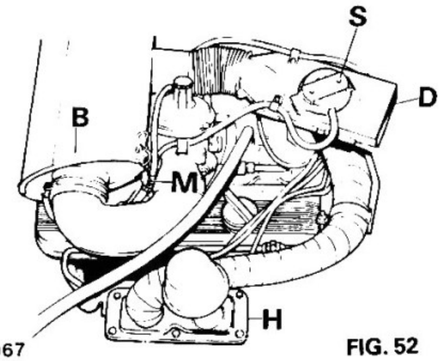


FIG. 52

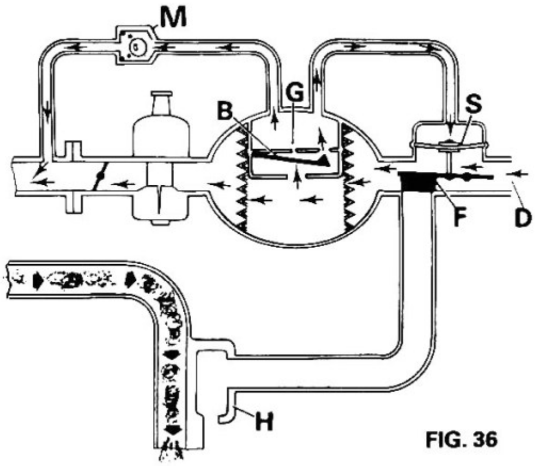


FIG. 36

4TH IDENTIFY

Exhaust Pulse Air System Figs. 53 & 41

A = Air Intake
B = Air filter
N = Pulse Air One Way Valve (Air feed into exhaust)

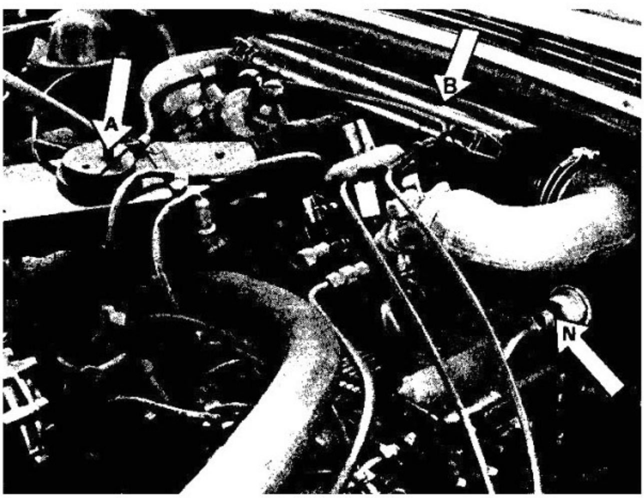


FIG. 53

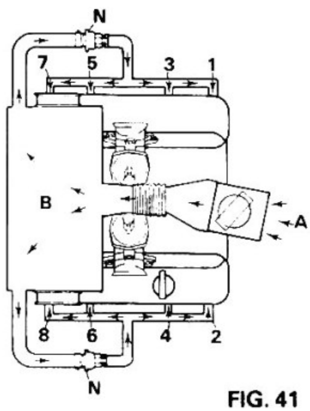


FIG. 41

5TH IDENTIFY

Ignition System. Figs. 54 & 46

Distributor Type = Sliding contact with external dwell adjuster.

Figure 46:

G = Vacuum Advance Retard Unit

F = Flame Trap in Retard Pipe

A = Advance Connection to top of Carburettor

Note:- Later models are fitted with the delay unit seen in **Figs. 48 & 49.**

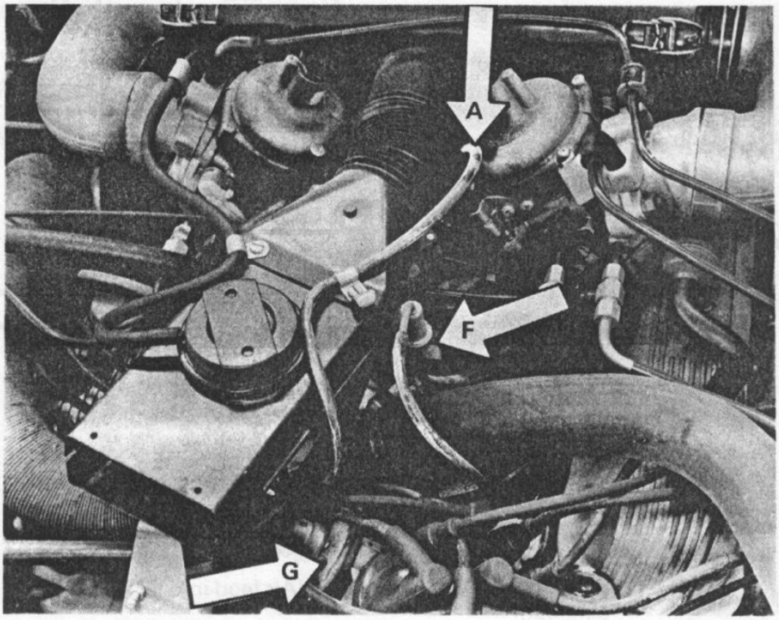


FIG. 54

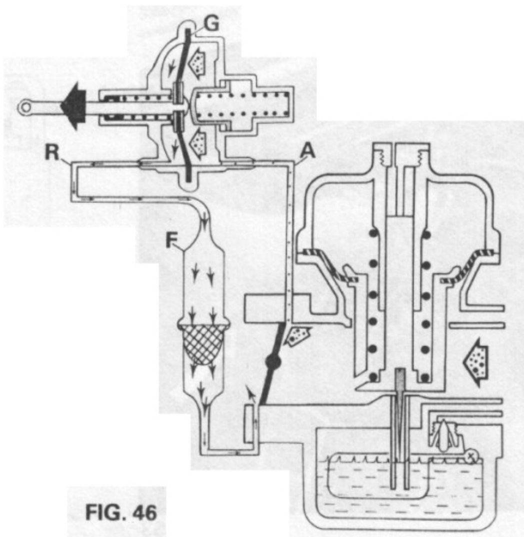


FIG. 46

Next, ask yourself the question:-
What other systems are fitted to the engine which might affect the tune and performance?

Three systems spring to mind which could drastically affect the carburettion and tuneability.

First the brake servo and its vacuum connection to the manifold **Fig. 55.**

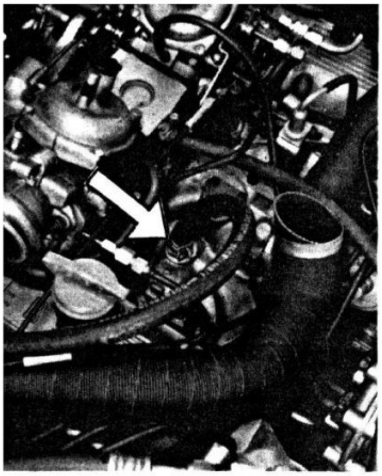


FIG. 55

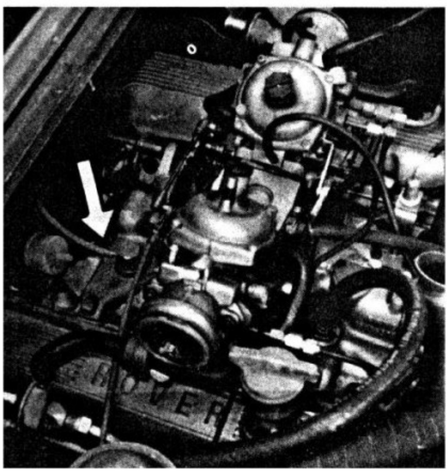


FIG. 56

Second the differential lock control and vacuum connections to the manifold. **Fig. 56.**

Third – the carburettor float chamber ventilation pipes, seen in **Fig. 57.** These pipes terminate near the chassis where they have on occasions been blocked with underseal. Blocking of these vents will of course prevent fuel being drawn off the jets.

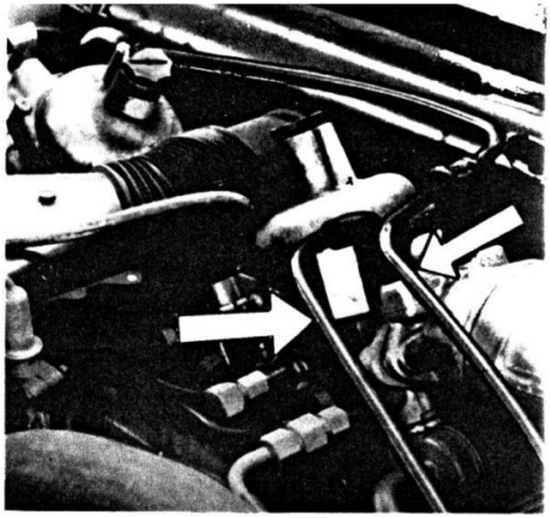


FIG. 57

Now one final look around the engine compartment inlet manifold and ignition system for spurious gadgets that might have been fitted by the owner – anti-theft devices, vacuum operated horns, etc. If any such gadgets are fitted they should, if possible, be disconnected and the manifold connections sealed.

Now, at this stage, we should have a fairly good idea of the engine systems involved in the tune up, but of course we will have no idea of their condition.

A general guide to the condition may be gleaned from the year, mileage and general state of the vehicle. A service record sheet would enlighten us even more, but whatever we decide about the condition of the engine from the available evidence, our conclusion will be pure assumption.

Bearing this in mind, the procedure suggested in Part 3 is aimed at avoiding the most disastrous/ obvious mistakes whilst making you aware of the possible faults and effects.

Engine Tuning Preparation Procedure Including:-
Preliminary Checks and Adjustments

Note: This procedure does not form any part of any published timed operation for engine tuning.

Air cleaner

1. Remove air cleaner, clean canister, if necessary renew element.

   Ensure that the ball check valve "M" **Fig. 35** is operating. If necessary, it may be dismantled and cleaned.

Crankcase Ventilation

2. With the air cleaner removed, check/renew the crankcase ventilation filter and its connections, ensure it is fitted with "IN" towards the air cleaner connection. **Figs. 58-59**

FIG. 59

3. Renew both flame traps then disconnect and seal both flame trap carburettor connections as shown "G" in **Fig. 60.** Blocked flame traps or air filter fitted upside down can cause a rich mixture, whereas poor connections or cracked rubber hoses will cause a weak mixture. Make a mental note of any such faults at each stage.

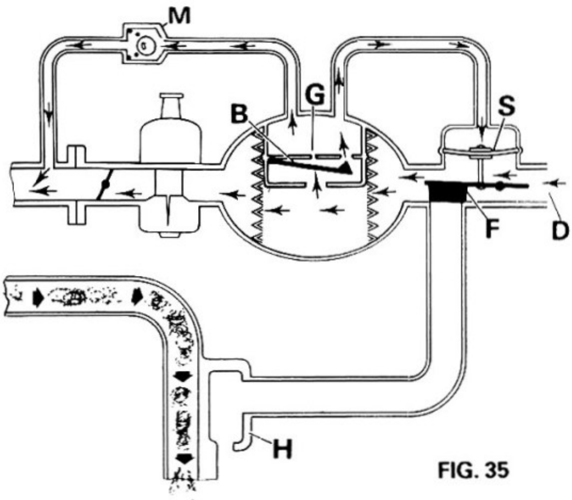


FIG. 35

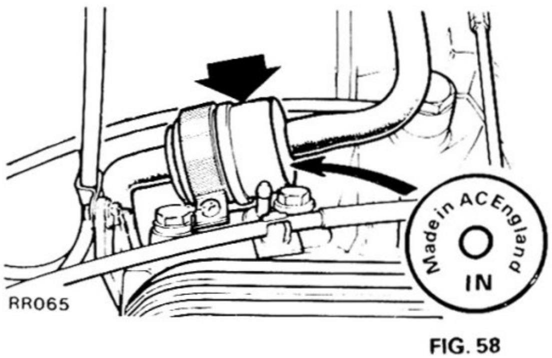


FIG. 58

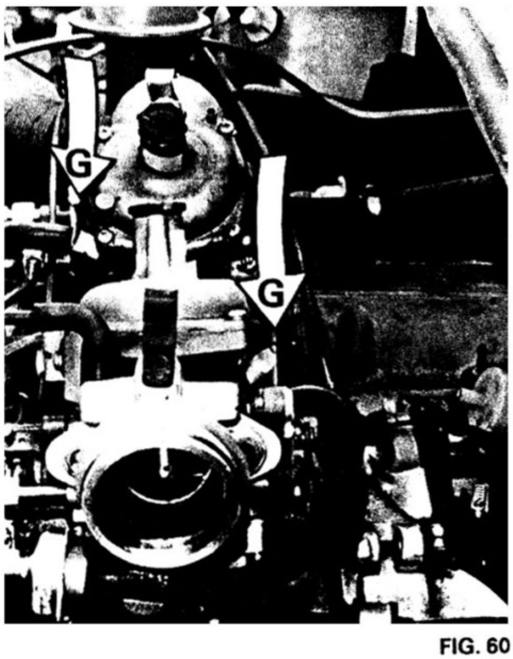


FIG. 60

Brake Servo Connection

4. Now disconnect the brake servo pipe and seal the manifold connection which communicates with No. 2 cylinder inlet port and the right hand carburettor as seen in **Figs. 61 & 62 "H".**

Differential Lock Connection

5. Next, disconnect the transmission differential lock control valve vacuum pipe "J", at the manifold which communicate with No. 8 cylinder and again the right hand carburettor. Any air leaking into either of these connections will effect the mixture settings of the right hand carburettor, the CO levels and colour of the spark plugs on 2·3·5 & 8 cylinders.
   Seal the Diff Lock connection at the manifold as seen in **Fig. 63.**

Carburettors

6. Now check the damper oil and make a mental note of the level and viscosity. Low oil level will cause poor acceleration. Too thicker oil (EP90 for example) will cause heavy petrol consumption.

7. Remove both carburettor diaphragm chambers with piston, ensuring that one is marked for correct original re-assembly. **Fig. 64.**

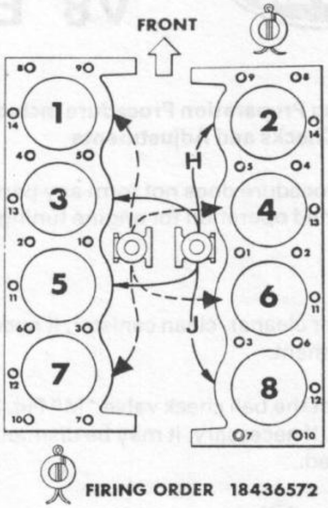


FIG. 62

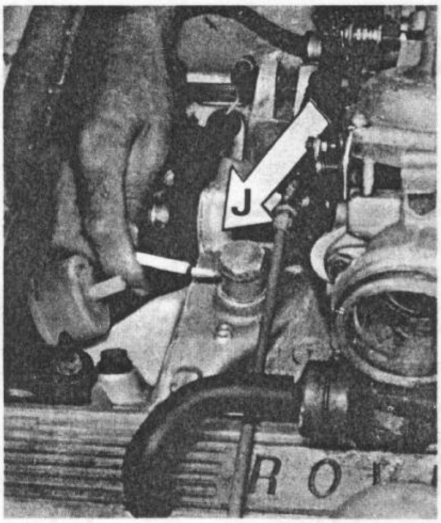


FIG. 63

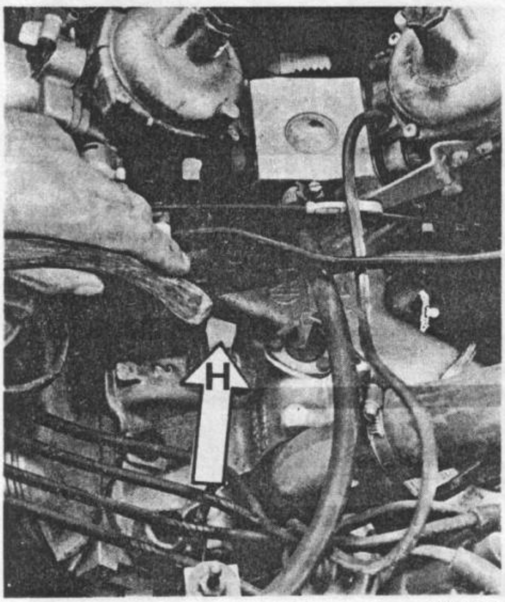


FIG. 61

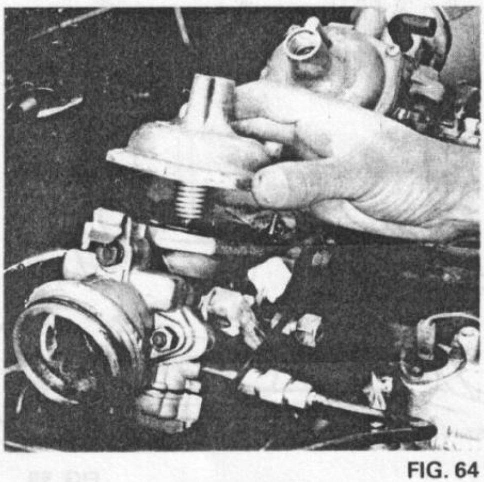


FIG. 64

8. With the carburettor pistons removed, ask an assistant to depress the throttle pedal fully, check for full travel of the pedal down to the original thickness of carpet and that at full depression, **both** throttle butterflies are in fact at "full throttle". Note that some carburettors have adjustable stop screws at full throttle, and if incorrectly adjusted can allow the throttle butterfly to go past "fully open position" and begin to close again.

9. Make sure the throttle butterflies are also fully closed, it may be necessary to release both idle screws "L" using special tool MS.86 and fast idle screw "S" as seen in **Fig. 65** to allow full closure.

10. Now adjust both the idle screws using MS.86 so that the butterflies are open 1½ complete turns on each screw and temporarily secure the setting as illustrated in **Fig. 66.**

11. Slacken the screws "N" securing the throttle levers on both carburettors, **Fig. 67.**

Poppet Valves

12. Check that both poppet valves do not stick open and will open and close easily. This can only be done by pressing open with your finger and is by no means a guarantee that they will function correctly with the engine running, **Fig. 68.**

If necessary clean the poppet valve with little cellulose thinners to remove the lead deposits.

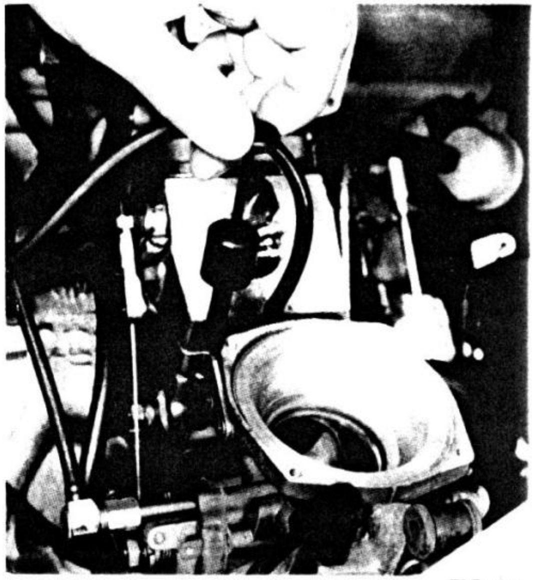


FIG. 66

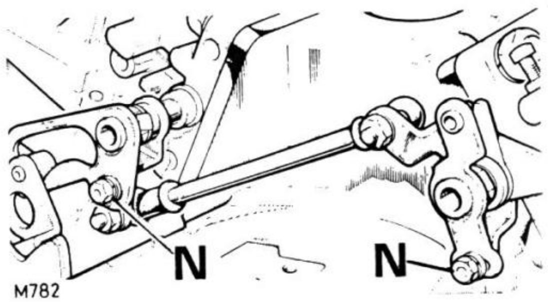


FIG. 67

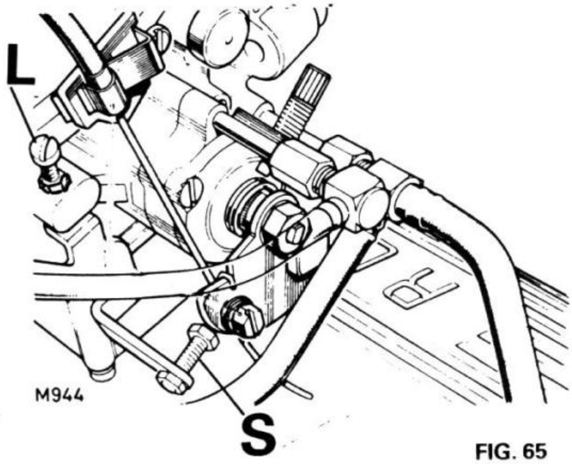


FIG. 65

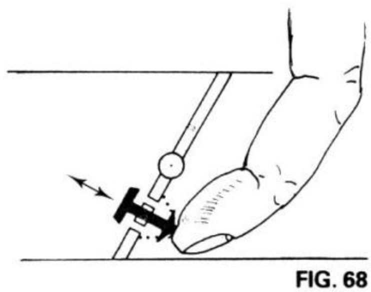


FIG. 68

Diaphragms, Needles and Jets

13. Check the condition of the piston and diaphragm ensuring that the diaphragm location tabs locate correctly in the piston recess, as seen in **Fig. 69**.

    Also ensure that both diaphragm retaining rings "T" are the same thickness. Note the retaining rings are manufactured in differing thickness material to vary the weight of the piston. The springs also vary in strength and are colour coded for identification – ensure that both are the same colour.

14. Check that the pistons are free in the bearings and that both needles are adjusted using special tool 8353 - early models or MS80 - later types, so that the small plastic washer "W" is flush with the piston face, as seen in **Fig. 70**.

15. Check the position of both jets in the carburettor bodies, with a tyre tread depth gauge.

    Both jets should be recessed into the same distance as seen in **Fig. 71** where "J" = the jet "K" = the depth of recession into the body. Recession on 110 models = 2.4mm ± 0.3mm Range Rover = 2.6mm ± 0.3mm.

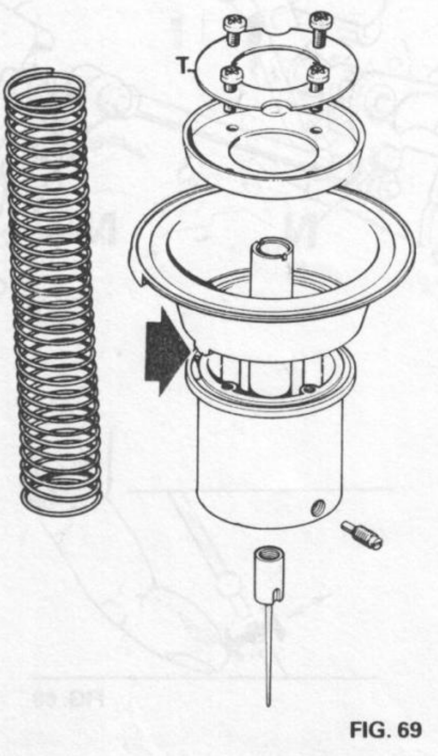


FIG. 69

If the carburettor is an early type with adjustable jets, then measuring the depth that each jet is recessed, clearly shows how they have been set previously. Inaccurate adjustment of the jets or needles is usually made to compensate for inaccurate fuel level. If the float chamber fuel level is excessively high you can expect to find the needle or jet adjusted to the weak position, and if low, the jet or needle will be set rich.

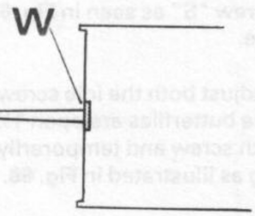


FIG. 70

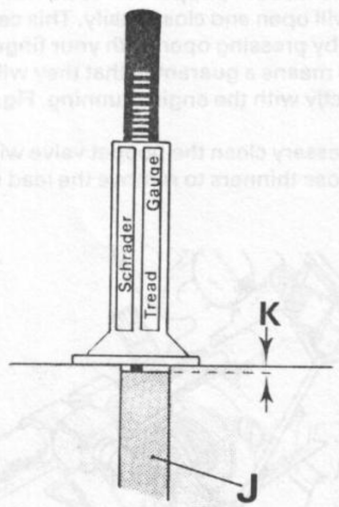


FIG. 71

Another possible reason for one jet being adjusted very low or the needle high is to compensate for air leakage into the inlet manifold and if one considers which carburettor on the V8 is most likely to be affected by air leaks, the answer must be the right hand carburettor.

Look again at **Fig. 62** and you will see why.

As you will perhaps have realised this suggested method of tuning does not merely state how to set and adjust the carburettors and systems, but strives to make you aware and take note of the adjustment and settings on the vehicle **before you begin to tune it.**

A criminal investigator does not disturb the scene before making a thorough study of it, likewise the setting and adjustments on the vehicle as received can indicate where the fault lies.

Fuel Level Setting

Should it be necessary, set the fuel level as follows:-

16. With the needle valve on its seating and the tab on the float carrier contacting the needle valve, measure the distance "X" between the carburettor flange face and the highest point on the floats. **Fig. 72.**

    The dimension required for correct float lever is 17 to 18 mm (.67 to .71 in). Adjust by bending the tab "Y" on the float carrier.

    In this position it should not be possible to blow air past the valve.

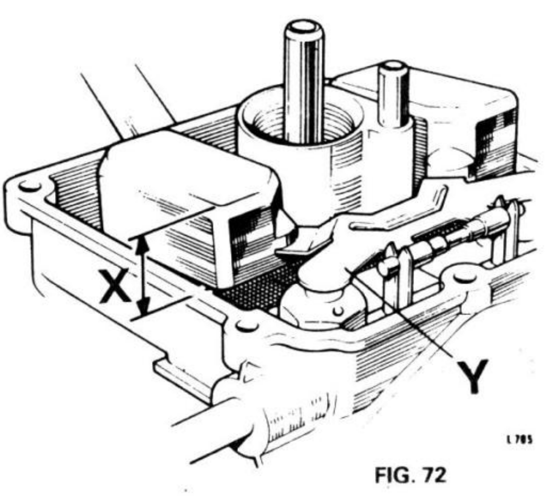


FIG. 72

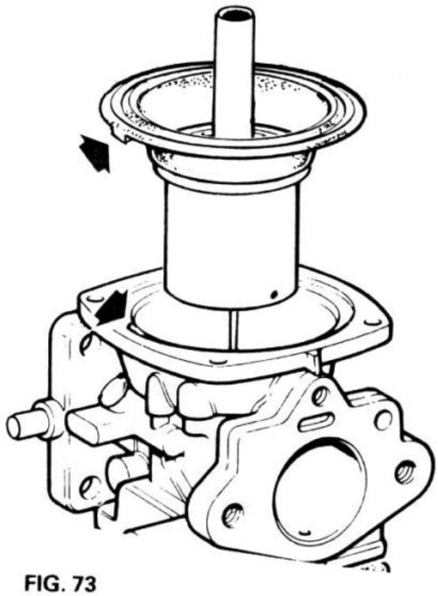


FIG. 73

17. Now, with the jets/needles and fuel level set correctly refit the pistons and diaphragm assemblies, springs and vacuum chambers to their original location ensuring that the tag on the diaphragm locates in the recess as seen in **Fig. 73** and the pistons move freely when the screws are tightened **equally. Fig. 74.**

18. Ensure the identification tags are refitted but do not fit the piston dampers at this stage.

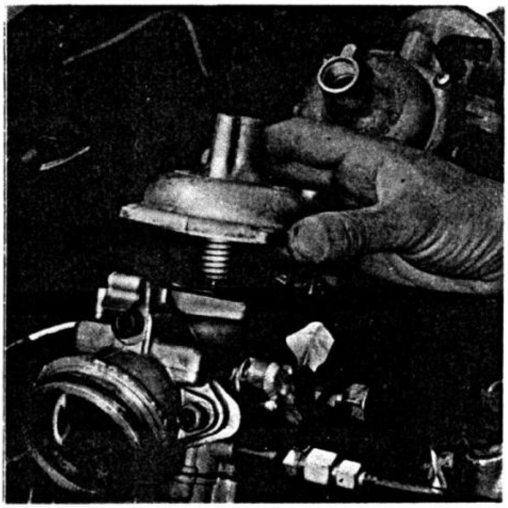


FIG. 74

Mixture Compensator

19. Since we cannot be sure if the "Mixture Temperature Compensators" are working correctly or not, remove both air intake adaptors and seal off air passage to the compensator with tape "K". **Fig. 75.**

Choke Cable (cold start control)

20. Check the operation of the choke and cable, i.e. that full choke on the hand control coincides with full choke at the carburettor and when the hand control is fully **IN** the choke at the carburrettor is fully **OFF**. Ensure that the fast idle screw "S" is fully released at this stage. **Fig. 76.**

Pulse Air System

21. Though the pulse air system has no actual effect on engine tuning it is necessary in preparation for checking emissions, to ensure that there are no air leaks into the pipe system and that the check valves open in one direction and do not allow exhaust gas to leak back into the carburettor air filter. Having checked the pipe system, seal both valves with tape, as seen in **Fig. 77.**

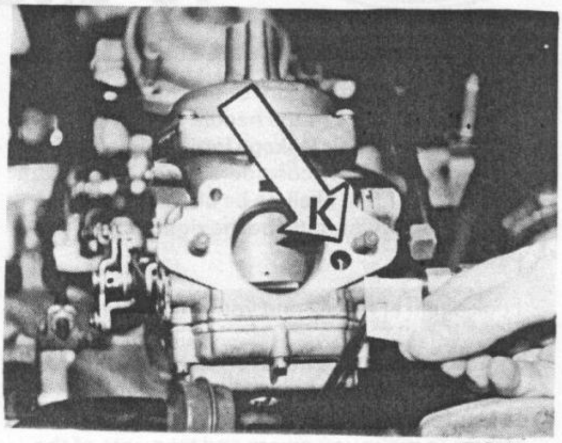


FIG. 75

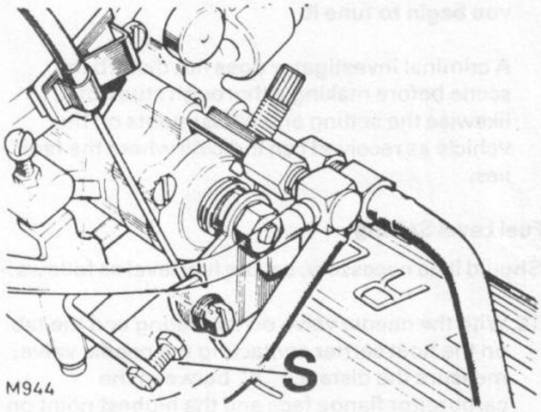


FIG. 76

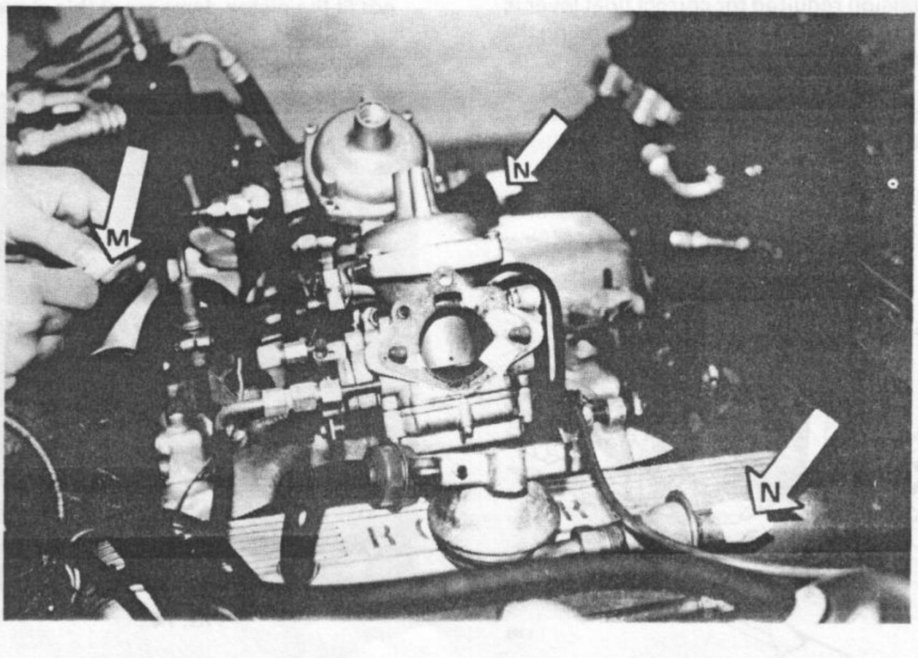


FIG. 77

V8 ENGINE TUNING PART 3

Finally seal off the manifold vacuum connection to the hot air intake with tape "M" **Fig. 77** and ensure that the flame trap in the distributor retard pipe seen in **Fig. 54** Part 2 is clean and connected.

Before delving into the ignition system and its preparation let us summarise the actions taken so far:-

Carburettors

A Poppet valve cleaned and operating.

B Both throttle butterfly screws adjusted open 1½ turns of each screw, i.e. both **the same.**

C Both needles/jets set **the same.**

D Both fuel levels set **the same**.

E Piston diaphragms are in sound condition and both springs are **the same.**

F Throttle interconnecting links are released and the choke cable is correctly adjusted. The fast idle screw is released.

Vents Which Are Sealed Fig. 78.
Using linen tape or suitable plugs.

G Crankcase ventilation pipes at both carburettors.

H Brake servo connection at manifold (No. 2 cylinder, visible below the flame trap).

J Gearbox differential lock connection at manifold (No. 8 cylinder).

K Temperature mixture compensator air passage on front joint face of both carburettors.
Note: If this unit is doubtfull it may be removed completely and any vents in the carburettor body temporarily sealed.

M Hot air intake vacuum pipe sealed.

N Pulse air valves sealed.

Other Items

O Crankcase ventilation flame traps and air filter, renewed.

P Piston dampers are removed.

R Float chamber ventilation pipes are not blocked and are disconnected.

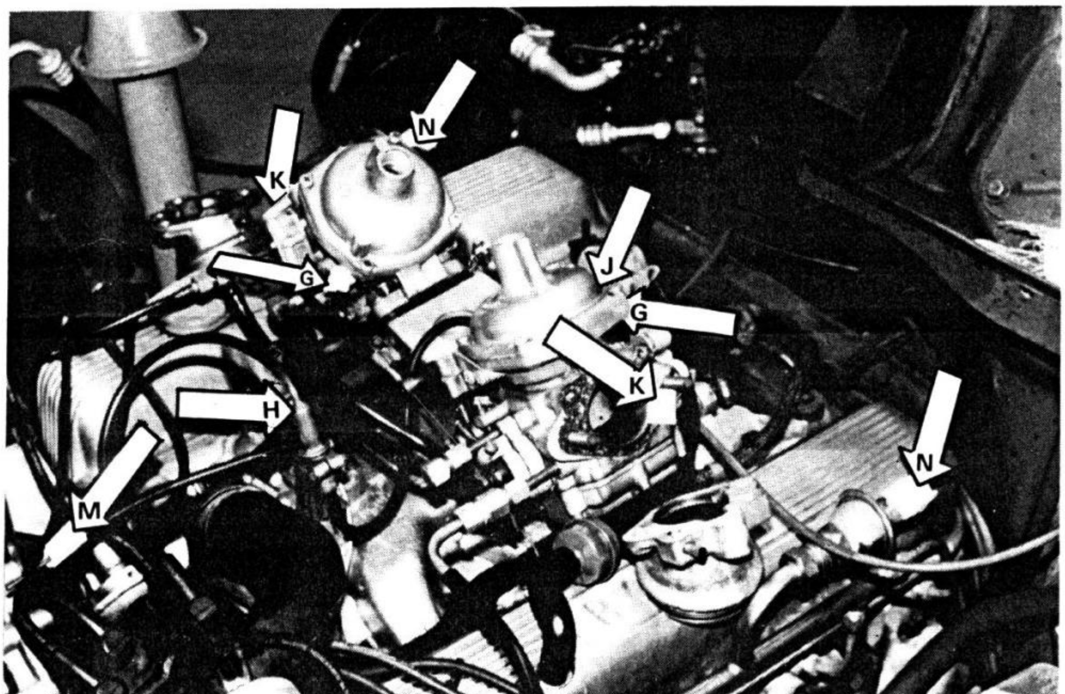
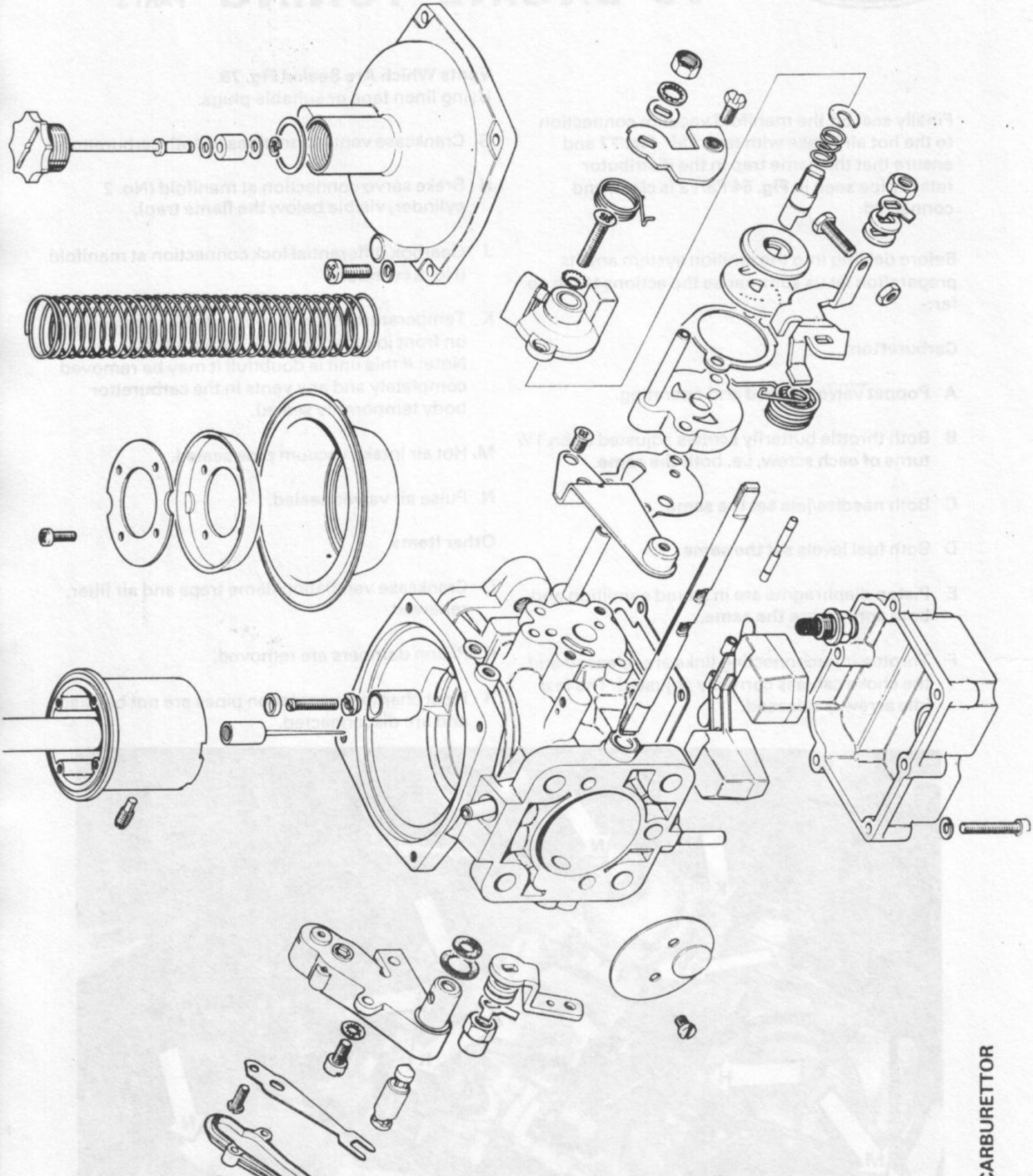


FIG. 78



STROMBERG CARBURETTOR

Now for the Ignition System Preparation Preliminary Checks and Adjustments

22. Remove the sparking plugs, keeping them in the original sequence so that they may be examined in relation to the inlet manifold layout **Fig. 80**.

    If plugs 2, 3, 5 & 8 are white, indicating a weak mixture, this may confirm evidence of weak mixture adjustment of right hand carburettor or an air leak into the inlet manifold discovered during the first stage of preparation.

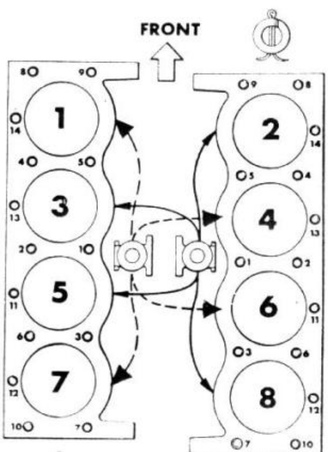
    Note: At this stage you may wish to carry out a compression test.

23. Fit a new set of spark plugs.

24. Renew the contact breakers, ensuring they are the correct type, and adjusted initially to 0,35 to 0,40 mm (0.014 to 0.016 in) as shown in **Fig. 81**.

25. Check the operation of the vacuum advance/ retard unit by connecting a vacuum pump to each side of the unit, to ensure the diaphragm is not punctured or leaking, as seen in **Fig. 82**. Ensure that the contact breaker base plate moves with depression and is returned by the spring inside the vacuum unit, in both directions.

26. Thoroughly examine and check the condition of the rubber pipes. Ensure the flame trap is clean and that the distributor vacuum unit and vacuum delay unit operate correctly.



FIRING ORDER 18436572 FIG. 80

27. When you are absolutely sure that the ignition advance retard vacuum system is sound, reconnect the advance side to the delay unit and top connection on the carburettor. The retard pipe connects to the flame trap and the bottom of the carburettor.

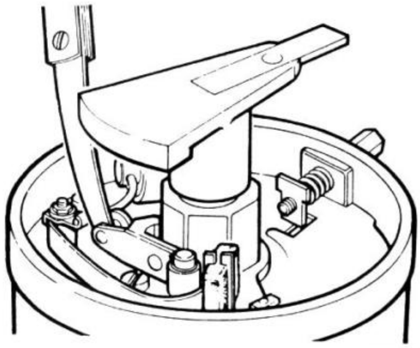


FIG. 81

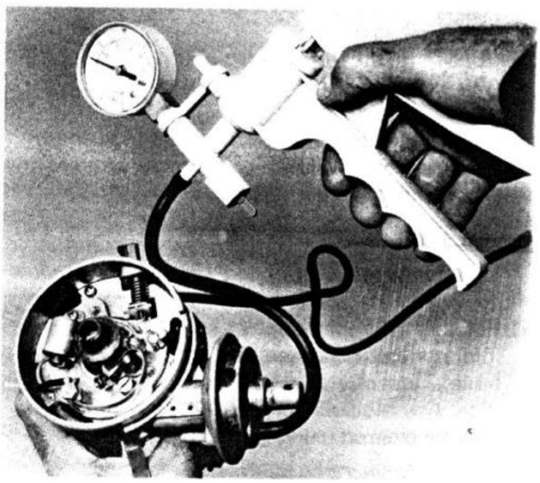


FIG. 82

28. Check the condition of the HT leads and reconnect to the plugs, ensuring that the cables are correctly routed, as seen in **Fig. 83**. Pay particular attention to the routing of numbers 5 and 7 plug leads, as simultaneous firing can occur due to electrical inductance if the leads run parallel, so make sure they are crossed. Note the firing order: 18436572 and the cylinder location. Numbers 5 and 7 cylinders are located next to one another, and also fire one after the other with only a 90° interval.

This completes the preparation of the ignition system, the remaining electrical checks which may be necessary are best carried out with the engine running.

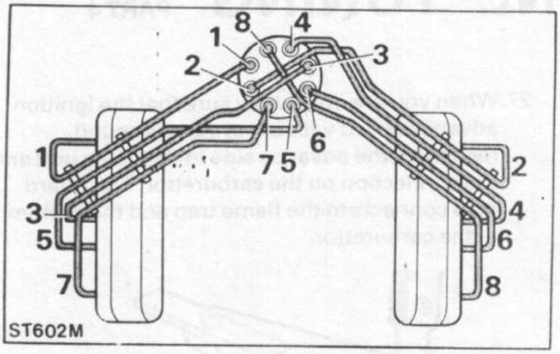


FIG. 83

And now to the final stage of preparation, the cooling system. After all it would be foolish not to check it over before starting the engine.

Cooling System Preparation

Obviously the operating temperature of the engine will effect our attempts at tuning, so at least we should check the following points.

29. Check that the fan blades are fitted the correct way round as shown in **Fig. 84.**

Fitted the wrong way round and the running temperature will rise by about 20% above norm on most vehicles.

30. Check the fan belt tension and the condition of all the hoses.

31. Release the vent hose "V" at the centre of the inlet manifold, as seen in **Fig. 85,** blow down the hose, water should flow freely from the manifold pipe. Any blockage is usually in the pipe and may be cleared using a 3 mm (⅛ in) drill.

Blockage of the vent pipe will cause overheating and loss of coolant due to an air lock in the top of the inlet manifold, which incidentally is the highest point in the cooling system.

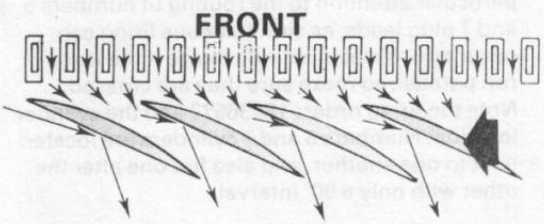


FIG. 84

32. If in doubt the thermostat "V" **Fig. 85** should be checked for operation and correct installation. The vent hole in the thermostat flange must be at the top to ensure air locks do not develop.

33. Rectify any water leaks.

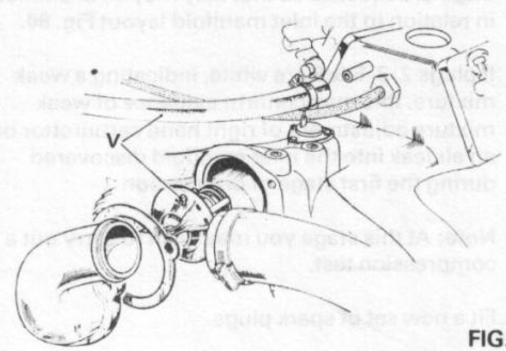


FIG. 85

Now for a final summary on the ignition and cooling preparations.

Ignition

A New spark plugs fitted.

B Contact breaker renewed and adjusted to correct gap.

C Vacuum unit check for operation and condition of pipes checked.

D If necessary renew the flame trap and delay unit.

E Renew any suspect plug leads and ensure correct routing (Ref. 5 & 7 leads).

Cooling

F Check vent pipe to top of inlet manifold.

G Check operation and installation of thermostat.

H Ensure fan blades are fitted correctly.

J Check fan belt condition and tension.

K Renew any defective hose and check for leaks.

L Top up system.

With all preparation completed the engine is ready to "tune".

Tuning Procedure

Essential Tools

Tachometer
Strobescopic timing light
Dwell meter
Air flow meter

Special tools for carburettor adjustment – kit, part no. MS95.

To tune the engine using the following procedure, the preliminary checks and adjustments **MUST** have been carried out as described previously.

1. Connect the tachometer, timing light and dwell meter.

2. Start the engine and bring to normal operating temperature. It may be necessary to temporarily adjust the fast idle screw to obtain satisfactory engine speed for warming up. Release the screw before setting the idle speed.

Idle Speed

3. If necessary, adjust the idle screws an **equal** amount to obtain an idle speed of 600-650 rpm (with distributor advance and retard vacuum pipe **connected**).

Dwell

4. Check and adjust the dwell angle in accordance with specification.

Dwell Variation

5. Raise the engine speed to 2000 rpm and check that dwell variation is within 3° of specification.

   Note: On models fitted with electronic ignition the dwell is electronically set and can not be adjusted. It is only necessary to accurately set the timing which is adjusted to the same setting as a normal ignition system.

Timing Check

6. Disconnect the retard pipe, which will cause the engine speed to gradually increase.

   To carry our an accurate timing check, the engine speed must not be above 750 rpm, so limit the engine speed by lifting the piston on one carburettor to weaken the mixture, then if necessary adjust the timing to 6° BTDC or as specified.

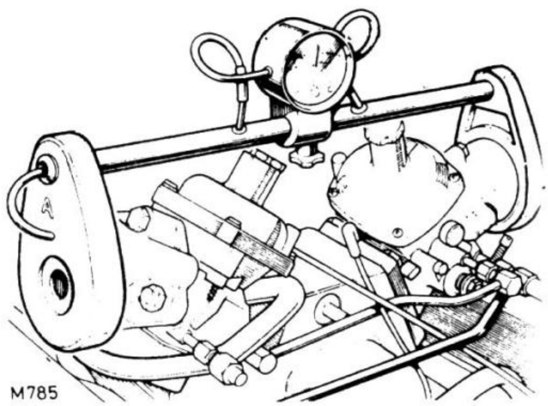
7. Reconnect the retard pipe and release the carburettor piston, the timing should now be 4° to 8° ATDC or as specified.

Note with suitable equipment a full ignition electrical diagnostic check may be carried out at this stage.

Carburettor balance (air flow)

8. Check the air flow through each carburettor and adjust the idle screws as necessary to ensure that the meter reads the same for both carburettors, (note the reading for later reference) and that the idle speed is 600-650 rpm.

9. If the air flow meter shown in **Fig. 86** is used it is necessary to:



M785

FIG. 86

   Temporarily refit the air intake adaptors leaving the temperature compensators sealed off.

10. When the idle speed is adjusted remove the intakes.

Note:- A higher idle speed may be specified on vehicles fitted with airconditioning or optional equipment.

Adjust the interconnecting throttle linkage as follows:-

11. On the left hand carburettor, manual transmission only, place a 0,15 mm (.006 in.) feeler between the underside of the roller, as shown in **Fig. 87.**

12. Apply pressure to the throttle lever in the direction indicated to hold the feeler gauge, then tighten screw to secure the setting.

13. On the right hand carburettor, manual and automatic transmissions, place a 0.05 mm (.002 in.) feeler in the position shown in **Fig. 88.** Note the feeler gauge as shown is to the left of pin "C".

14. Apply light pressure to the linkage to hold the feeler, then tighten the screw to secure the setting.

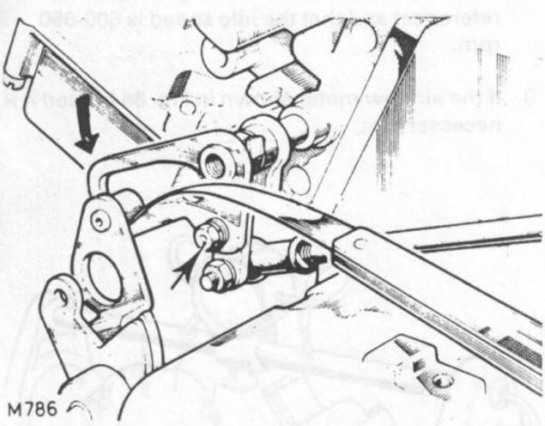


FIG. 87

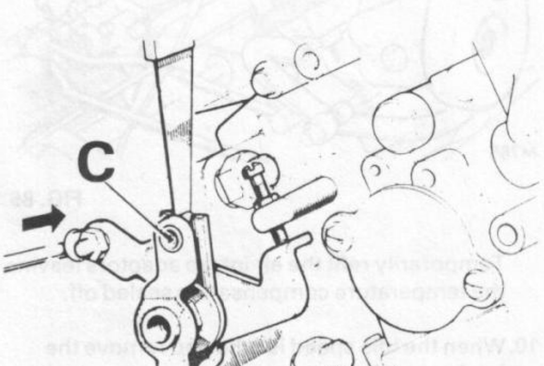


FIG. 88

Mixture Adjustment

15. Observe the tachometer and lift the piston on one carburettor, not more than 1 mm.

    An increase in engine speed indicates a need to weaken the mixture by turning the needle adjuster anti clockwise by not more than ¼ turn at a time.

    A decrease in engine speed indicates a need to richen the mixture by turning the needle adjuster clockwise by not more than ¼ turn at a time.

    The lift of the piston is best judged by using two short and equal lengths of 16 gauge wire for an indicator as seen in **Fig. 89.**

    Concentrate on adjusting the mixture on one carburettor before adjusting the other one.

    The mixture is correct when, as the piston is lifted, the engine speed momentarily increases then decreases, but continues to run slightly rough.

16. The adjusting tool is quite heavy and will itself affect the position of the piston, so between each adjustment to the needle the engine must be revved up a little to allow the carburettor piston to settle.

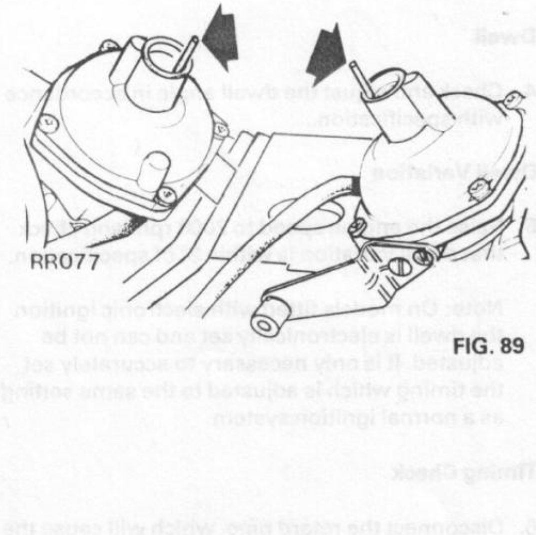


FIG. 89

Connections to inlet manifold

Brake Servo

17. Unseal and refit the brake servo pipe to the manifold. **Fig. 90.**

    Provided the servo and hose connections are sound, reconnection should have no effect on the **air flow reading**, engine speed or mixture setting.

    If in doubt, re-check the **air flow using the meter.** It should still be **the same as noted in item 8.**

    A permanent change in the engine speed indicates an air leak in the servo unit or connections which must be investigated and rectified.

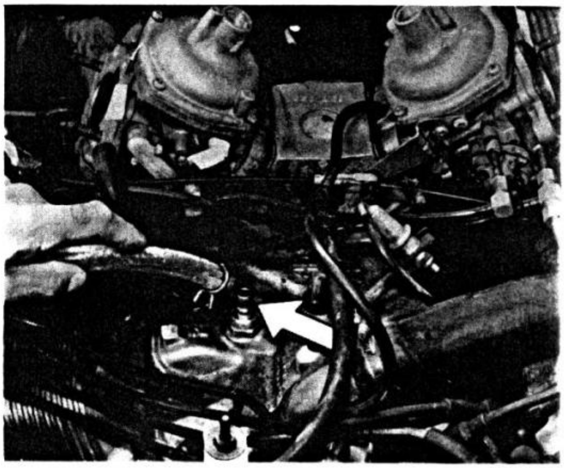


FIG. 90

Temperature Compensation

18. Unseal both temperature compensator passages **Fig. 91** unsealing should have no effect on the **air flow reading**, engine speed or mixture setting.

    If unsealing of the air passages to the compensators affects the engine tune, renew one compensator; if the tune is still affected, renew the other compensator.

    Refit air intake elbows using new gaskets.

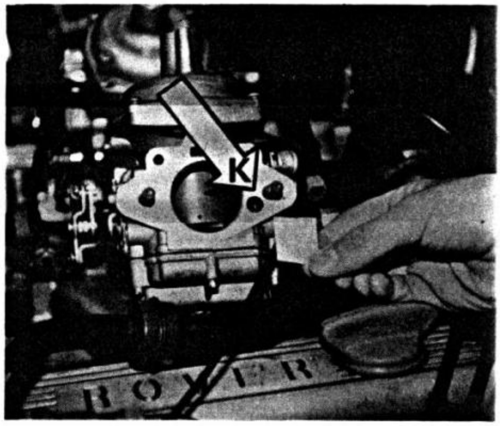


FIG. 91

Differential lock vacuum connection 4 speed transmission only

Unseal and reconnect the differential lock control vacuum connection as seen in **Fig. 92.** Reconnection should have no effect on the engine tune. Any change in engine speed or air flow indicates a faulty differential lock control valve, servo or interconnecting pipes on the transfer gearbox. Check with the control in the locked and unlocked position.

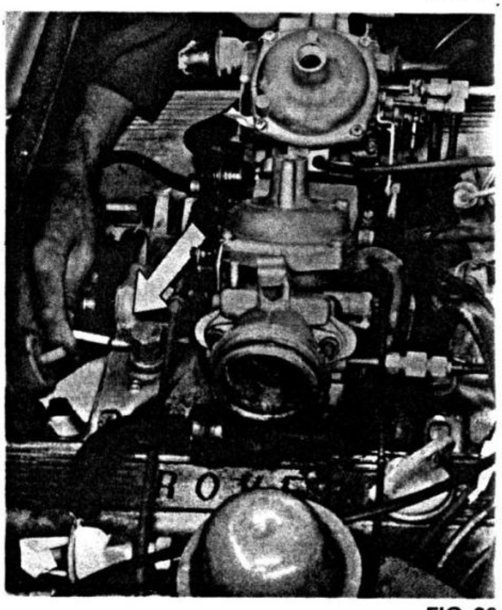


FIG. 92

Crankcase ventilation system Fig. 93

19. Unseal and reconnect both crankcase vent systems. This action will disturb the carburettor pistons, so rev the engine a little to resettle the piston positions.

The engine idle speed should not be affected by more than 50 rpm, but the air flow through the carburettor will be reduced, however, the reduction should be the **same** for each carburettor.

If the carburettor air flow balance or engine idle speed is affected by more than 50 rpm, this indicates either an excessive air leak into or partial blockage of the crankcase ventilation system.

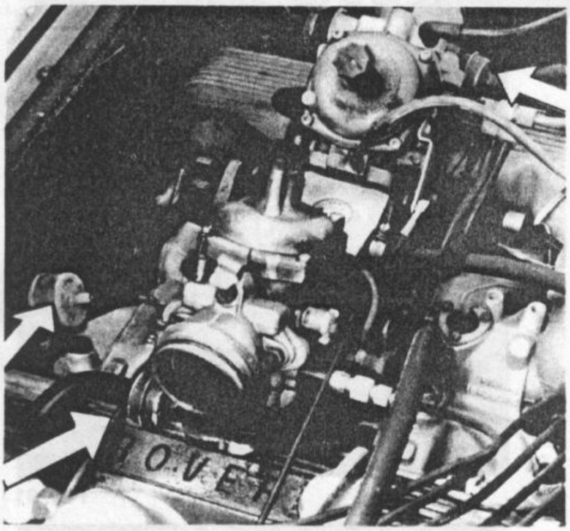


FIG. 93

Air leaks into this system may occur through the following.
Front or rear crankshaft oil seals.
Inlet manifold gasket or front and rear rubber seals.
Sump, rocker covers, distributor body "O" ring in front cover.
Dipstick or tube into cylinder block or crankcase ventilation air filter pipe into rear of cylinder block. Blockages usually occur in the air filter at the rear of the cylinder block, particularly if fitted upside down. The flame traps or rubber hoses may also be causing restriction.

20. The mixture setting may require very slight adjustment to compensate for the extra air flow through the crankcase ventilation system.

Finally top up with engine oil and refit both carburetter dampers.

The engine is now tuned but not adjusted for CO.

CO Adjustments

Additional essential tools – Exhaust gas analyser.

21. First rev the engine to 2000-3000 rpm for 30 seconds to clear the combustion chambers and exhaust system of accumulative gases.

22. Connect the CO meter. After about 30 seconds with the engine idling the CO should read not more than 3%, provided of course you have carried out the previous operations correctly and there are no items which have been glossed over, or undiscovered faults.

Pulse Air

23. Unseal and refit the rubber hoses to the pulse air system **Fig. 94** and the CO reading should fall to between 1 and 1½%.

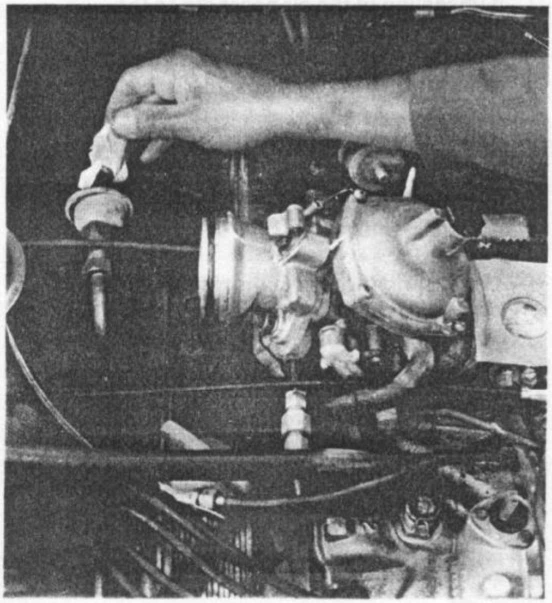


FIG. 94

Fast Idle Setting

24. Pull out the choke control so that the warning light comes on, then carefully push it in until the light just goes out. At this point the control knob should be 14 to 16 mm 9/16 to 5/8 in. out. With the control in this position, the scribe line on the fast idle cam should be central to the head of the adjustment bolt as seen in **Fig. 95**. Adjust the screw to give a fast idle speed of 1000-1200 rpm and secure the setting. Push the control fully in.

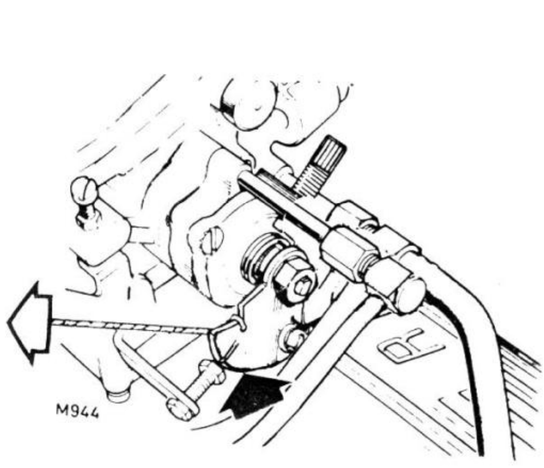


FIG. 95

Hot Air Intake

25. Unseal the hot air intake connections **Fig. 96** and refit the carburettor air filter. The intake flap should close when the vacuum pipes are first connected but will open when the control valve senses the intake temperature.

If the hot air intake flap fails to operate as described, check the system shown in **Figs. 52 & 35 Part 2.**

Re-check the CO reading, which should remain unchanged at between 1 and 1½%.

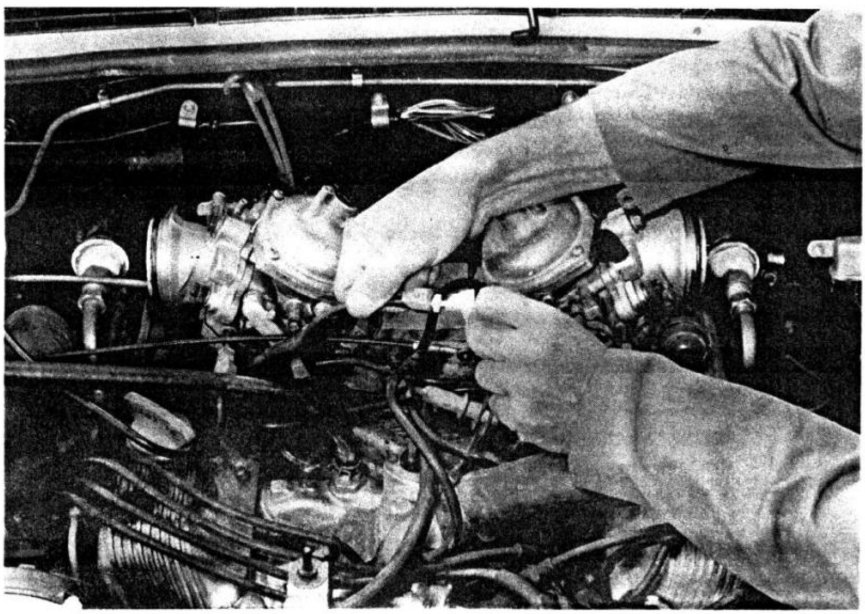


FIG. 96

SU CARBURATION, SYSTEM OPERATION AND ADJUSTMENTS.

Since this training manual was first published Stromberg Carburettors have ceased to manufacture the "CD" constant depression carburettor and since the "SU" carburettors have previously been fitted to the V8 engine in the Rover car, they were the obvious choice as a replacement.
The latest "SU HIF" carburettor refered to in Part 1 and again shown here, has undergone progressive development over the years and has therefore required only minor modifications to improve sealing against water ingress to make it more suited to cross country operation in the Land Rover and Range Rover.

Many of the features, systems and procedures explained in part 1 to 7 of this manual apply to the "SU" equipped V8 engine unit, so it is only necessary to summarise the similarities.
Major differences are of course explained in the following paragraphs.

SUMMARY OF SIMILAR FEATURES

Fuel jet central to float chamber.

Poppet valve in throttle butterfly.

Spring loaded "Biased Needle".

"Sharks Teeth" deflector.

Temperature sensitive "Mixture Control" jet moved by bi-metal immersed in float chamber, externally adjustable.

Idle speed adjustment screw on throttle butterfly.

SUMMARY OF SIMILAR SYSTEMS

Crankcase ventilation.

Temperature controlled air intake.

Distributor vacuum advance only, with delay unit.

Exhaust gas "Pulse Air", into three cylinders on each bank only.

Recirculation fuel system.

Although there are other systems that could be described as similar they are sufficiently different to require a full explaination.
First, let us look at the carburettor features which have not previously been explained in detail.

TEMPERATURE SENSITIVE MIXTURE CONTROL

The position of the temperature sensitive jet seen in **Fig. 1**, may be adjusted by means of screw "M" to allow the mixture and co level to be set.
The jet and bi-metal assembly is pivoted at "B", thus the jet is moved up the needle to weaken the mixture, or down the needle to richen the mixture, dependent on which way the screw is turned.
The bi-metal which de-forms according to the fuel temperature, moves the jet up or down as necessary to maintain the correct mixture and CO level after the initial manual setting.
This device is similar to the Stromberg except of course the Stromberg adjusts the volume of air by passing the jet to control the mixture and the "SU" controls the fuel flow from the jet.

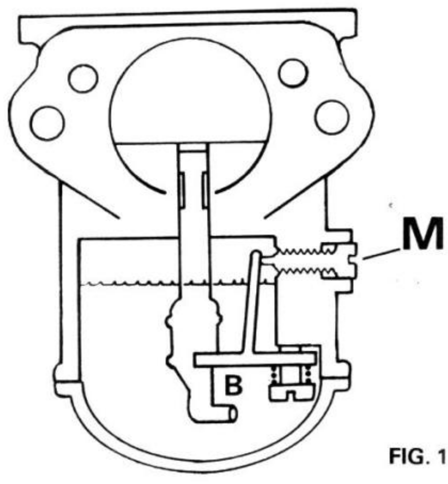


FIG. 1

IDLE SYSTEM

When an engine is operating at idle, the air speed over the jet is relatively slow and this tends to cause separation of the fuel from the air as shown in **Fig. 2.** Here it can be seen that the fuel runs under the throttle blade whilst the air flows over the top. In order to improve atomisation at idle speed the "SU" carburettor employs a by-pass port seen in **Fig. 3.** As the fuel leaves the jet it flows into a trough and then through the by-pass port which emerges very close to the bottom edge of the throttle butterfly, where the high air speed lifts and atomises the fuel. With the throttle fully closed the by-pass port provides a nominal volume of mixture, but to obtain fine adjustment of the idle speed the throttle butterfly is opened slightly with an external adjustment screw. The sharks tooth deflector further assists atomisation at low air speeds.
With the carburettor piston removed it can be seen in **Fig. 4,** that there are two ports in the bottom of the trough "T" one is the idle by-pass "IB" and the other is used for cold start which is explained next.

COLD START

The cold start system on the "SU HIF" is similar to the last of the "CD" Stromberg's, in that rich mixture is drawn through the choke unit direct from the float chamber and is discharged into the constant depression area thus by-passing the needle and jet. The Stromberg employs a rotary "Disc" with various size holes in it to provide the enrichment for cold start and the "SU HIF" a rotary sleeve with an elongated window, shown in **Fig. 5.**
On both types of carburettors the cold start is manually operated by a cable, which also opens the throttle butterfly to provide a fast idle condition.
Having explained the principal differences between the Stromberg and SU carburettors we should next look at the pulse air system.

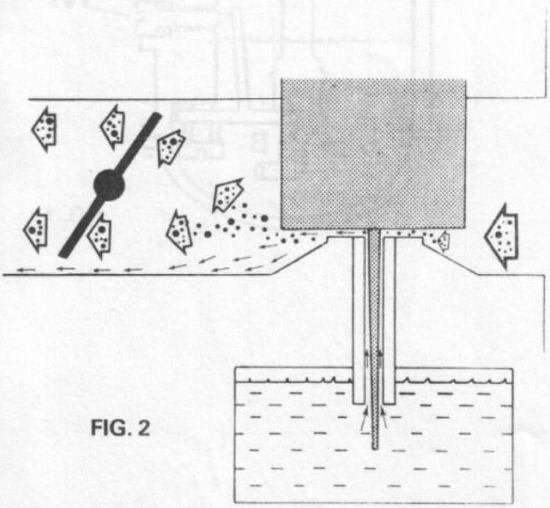


FIG. 2

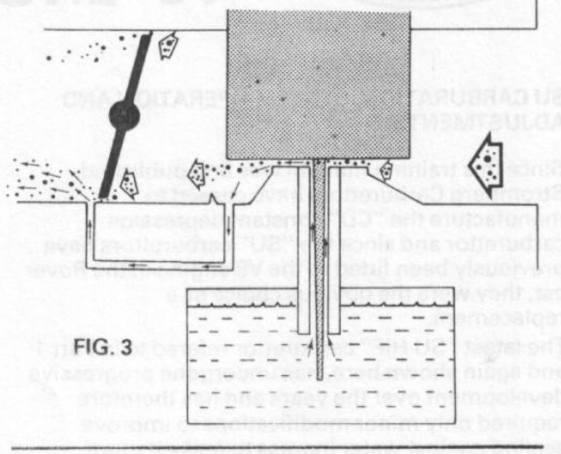


FIG. 3

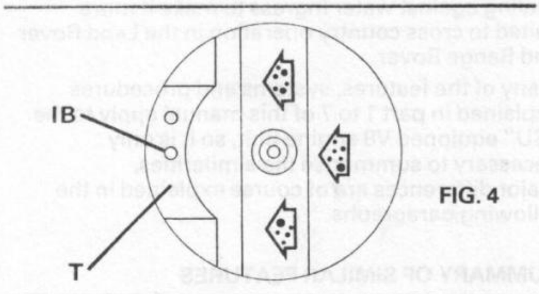


FIG. 4

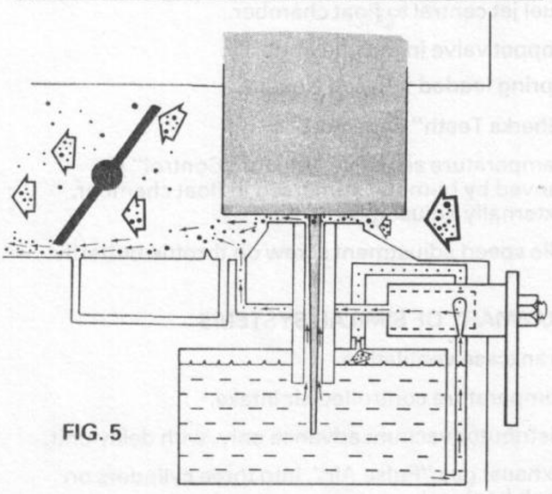


FIG. 5

PULSE AIR SYSTEM

As can be seen by comparing **Fig. 6,** with **(Fig 41, Part 1)** the pulse air system fitted with "SU" carburettors, employs three valves "N" which are an integral part of the pulse air manifold assembly. It can also be seen that air is supplied to only three cylinders on each bank.
With "SU" carburettors fitted it has been found that pulse air into just three combustion chambers is sufficient to satisfy emission regulations and, with continued research it is very possible that pulse air will become redundant in the near future.
Pulse air valves in the canister can not be renewed individually, but only as a complete assembly.

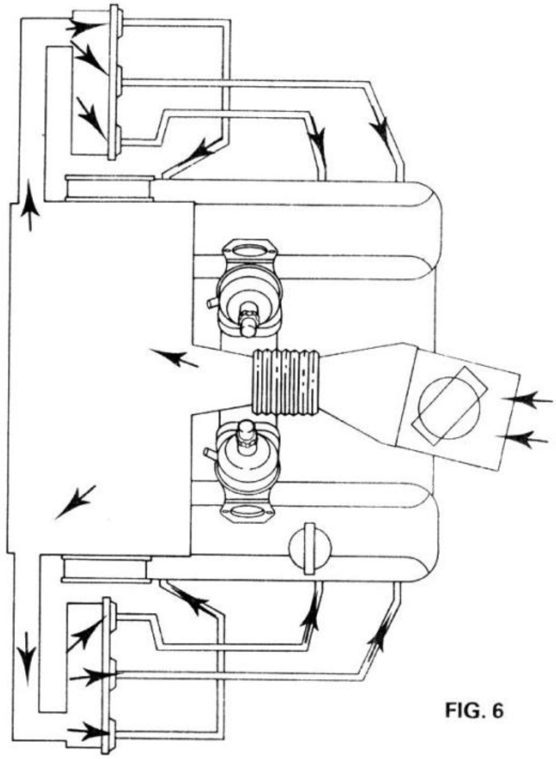


FIG. 6

The reason for this vent valve, is that under certain conditions of humidity and temperature the moisture in the crankcase fumes being drawn into the carburettors at "C" is liable to iceing up, thus preventing the crankcase from breathing. When this occurs crankcase pressure is relieved via the vent valve to the air intake system. **Fig. 7** shows normal venting and **Fig. 8** alternative venting.

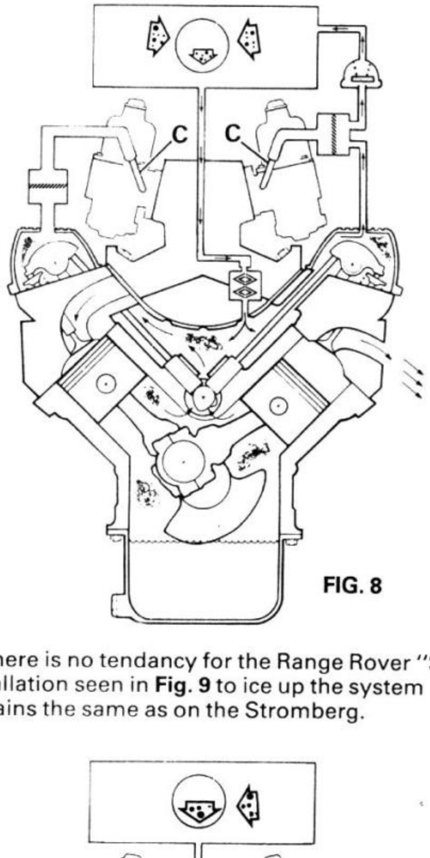


FIG. 8

CRANKCASE VENTILATION.

One final point in need of explanation is the minor modifications specific to the V8 Land Rover crankcase ventilation system (viewed from the rear in **Fig. 7**), which with "SU" carburettors has an additional one way vent valve "VV" and a modified flame trap "FT" to the left rocker cover only.

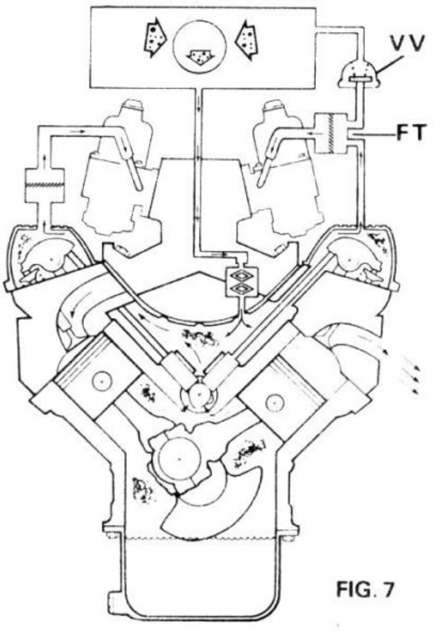


FIG. 7

As there is no tendancy for the Range Rover "SU" installation seen in **Fig. 9** to ice up the system remains the same as on the Stromberg.

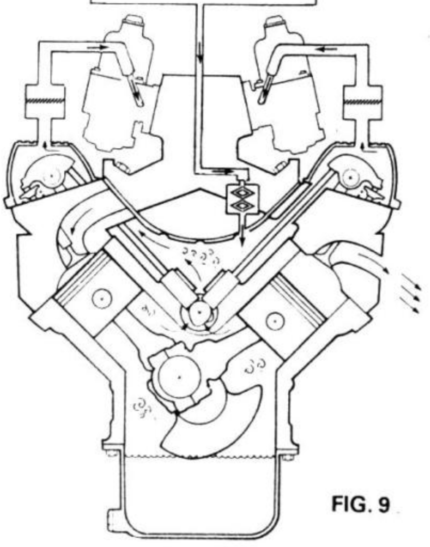


FIG. 9

APPROACHING A TUNE UP

The technique of tuning the V8 engine fitted with the "SU HIF" carburettor is virtually identical to the methods described in for tuning the Stromberg carburettors in Part 2, therefore it is very important that all sections of this manual are studied and fully understood before attempting to tune the "SU" installation.
Once confident that you are able to identify the various systems and connections on the particular vehicle to be tuned then the first task is to disconnect and seal all the manifold connections described in Part 2. Next, carry out the engine tuning preparation procedure described in Part 3 including the following procedures which are particular to the "SU" system.

First remove both carburettor vacuum chambers and pistons and check the position of the jets, obviously both should be recessed the same amount.
As mentioned previously in Part 3, a difference in jet recession between a pair of carbuettors fitted to the same engine can indicate that:-

A The bi-metal, controlling the jet is distorted.

B Some person has adjusted the position of the jets in an attempt to compensate for an incorrect fuel level.

C The fuel level is correct, but the person who has tuned the carburettors has no idea how the job should be carried out.
If necessary the fuel level should be checked next, which necessitates removal of the complete carburettor.

FUEL LEVEL SETTING

Remove the float chamber bottom cover to gain access to the float, needle valve and jet unit, as seen in **Fig. 10**.

Check the condition of the needle valve and filter and check that the float is not punctured. Renew any parts which are doubtful, then set the level. With the carburettor inverted so that only the weight of the float is closing the valve, measure the float level shown in **Fig. 11** which should be 1.0 to 1.5mm (0.04 to 0.062). Bend the brass tongue on the float as necessary to achieve the correct setting. Note in this position it should not be possible to blow air past the valve through the fuel inlet connection.

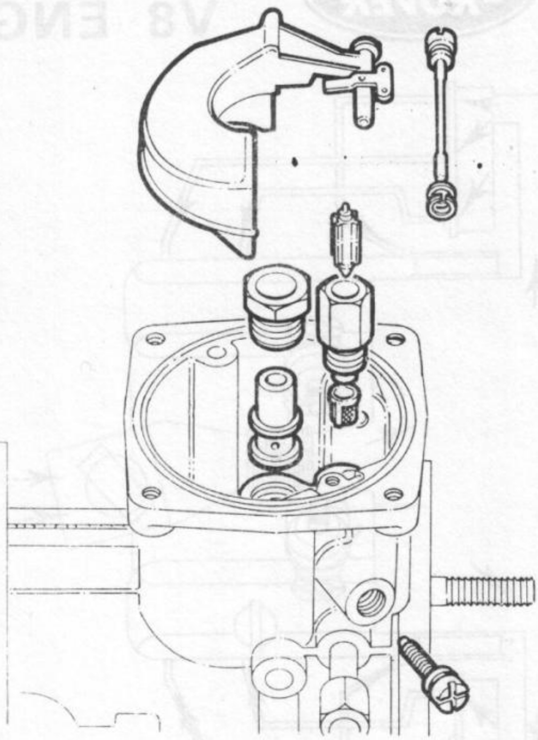


FIG. 10

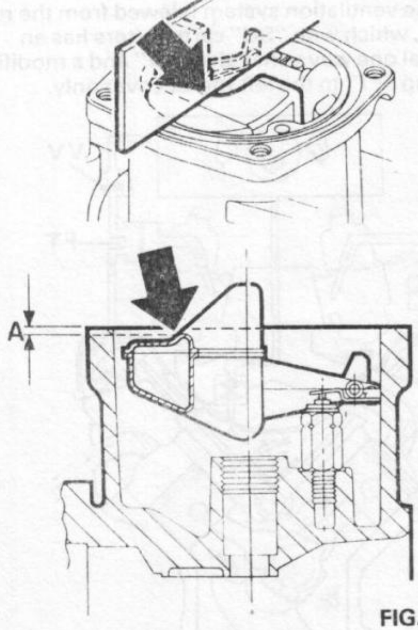


FIG. 11

FUEL JET BI-METAL ASSEMBLY

There is no absolute certain method of checking the condition or performance of the jet bi-metal, unless of course it is visibly damaged or cracked. However as a rough guide both jets should protrude between 0.25 and 0.50mm (.010 and .020in) above the bridge when both mixture screws are fully released and the jet lever is resting against the inside of the float chamber as shown in **Fig. 12**. Obviously if either jet is outside the above measurement the bi-metal is faulty and should be renewed. If in any doubt, renew the bi-metal in both carbuettors.

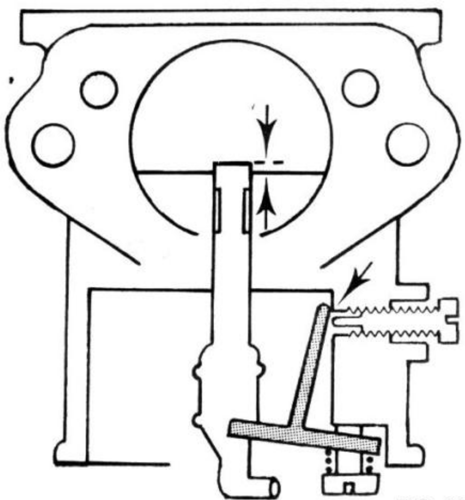


FIG. 12

PROVISIONAL MIXTURE SETTING

Having determined the condition of the jet assemblies, set the mixture initially as follows:-

First adjust both jets so that they are level with the bridge, then turn each mixture screw clockwise 2¾ turns. This should recess the jets 2.54mm (0.100in) below the bridge to provide a starting point ready for final adjustment of the mixture and CO level when the engine is running.

PISTON AND NEEDLE

If necessary check the needle specification and that it is correctly clamped in the piston as shown in **Fig. 13**.

Check that both needles protrude the same amount.

Model	Carb Part No	SU Spec No	Needle ID
H/C comp engine	ETC7122 ETC7123	FZX2006	BGD
L/C comp engine	ETC7124 ETC7125	FZX2005	BGC

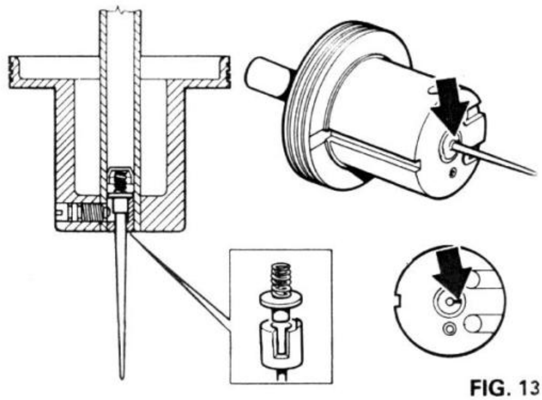


FIG. 13

Before refitting the piston and vacuum chamber se the idle speed (throttle butterfly) as follows.

PROVISIONAL IDLE SPEED AND THROTTLE LINKAGE SETTING

When carrying out the following adjustments the carburettors must be in situ with the adjustable enc of the interconnecting throttle link rod released at the ball socket. Also the ball securing nut and the lost motion adjustment screw must be released as seen in **Fig. 14**.

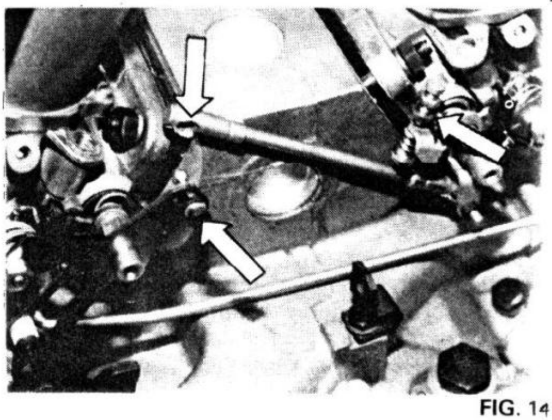


FIG. 14

This is to ensure that any adjustment made to the one carburettor does not effect the oposite carburettor.
Note:- On automatic models the adjustable end of the internnecting throttle link rod is on the "right" carburettor, see **Fig. 21**.

Next release each idle screw so that it is clear of the throttle lever seen in **Fig. 15** then screw it in again until it just makes contact with the lever, from this point turn the screw a further two turns to open the butterfly.

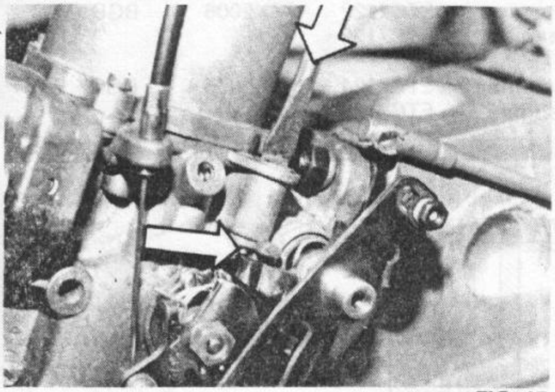


FIG. 15

Alternatively adjust the idle screw on each carburettor so that both throttle blades are open 0.10mm (.004), this particular adjustment can be carried out prior to fitting the carburettors or in situ with the vacuum chambers and pistons removed, as seen in **Fig. 16**.

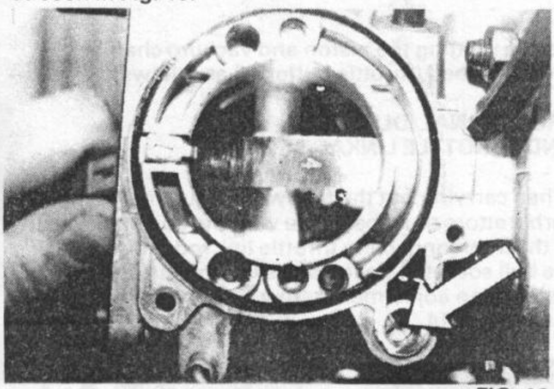


FIG. 16

Ensure that both throttles are set open the same amount.

THROTTLE LINK AND LOST MOTION ADJUSTMENT

Check that both throttle butterfly's are fully closed against the idle screws, then with the lost motion adjustment screw released ensure that the nylon roller is seated in the bottom of the lever slot as shown in **Fig. 17** and tighten the throttle rod ball securing nut indicated. At this stage reconnect the interconnecting throttle link rod.

Note:- On automatic models, ensure that the kick down cable linkage is firmly on its idle stop. If necessary adjust the length of the coupling rod to achieve this condition before tightening the ball end securing nut on the right carburettor.

Now carefully adjust the lost motion screw so that the throttle lever on the right carburettor is just clamped between the screw and the spring loaded plunger seen in **Fig. 18**.

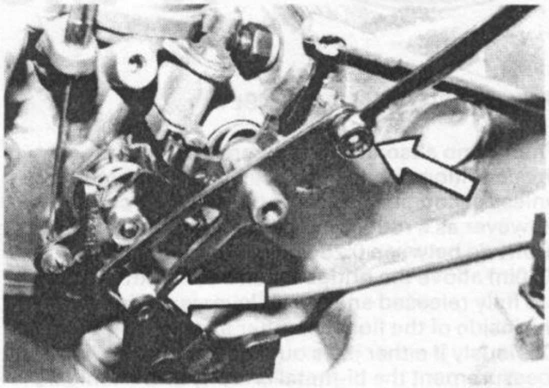


FIG. 17

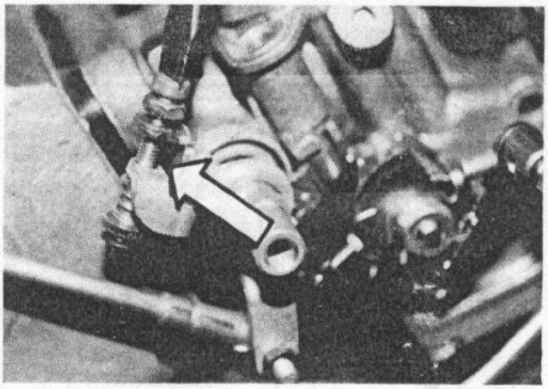


FIG. 18

FAST IDLE ADJUSTMENT

First, ensure that the choke interconnecting rod clamping bolt is released (on the right carburettor) and that the fast idle screw indicted in **Fig. 19** is screwed well into the throttle lever, clear of the cam.

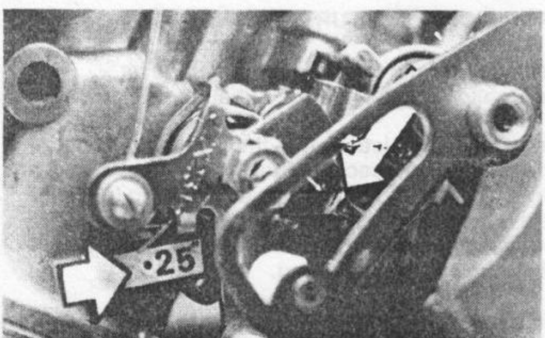


FIG. 19

Next, insert a 6.35mm (¼') spacer between the operating lever and the stop on both carburettors. This will correctly align the arrow on each fast idle cam with the heads of the adjusting screws as seen in **Fig. 19.** Now adjust the screws so that they just make contact with the cams, then turn both a further 1¼ turns and secure the setting. This will provide a fast idle speed of 1100 to 1150 RPM when the chokes are in operation.
With both spacers still in position and the fast idle screws correctly set, adjust the interconnecting link, as seen in **Figs. 21 & 22,** so that no freeplay is present between the choke units on each carburettor. Remove the spacers prior to adjusting the choke cable.

CHOKE CABLE ADJUSTMENT

First push the cable control knob fully in then release the inner cable **clamp screw** on the left carburettor seen in **Fig. 20.**
Next pull the choke control out approximately 2mm, check that the choke lever on the left carburettor is fully anti-clockwise (against the stop) and tighten the cable clamp screw.

Now continue with Parts 4-5 & 6, ignoring any reference to the temperature compensators.

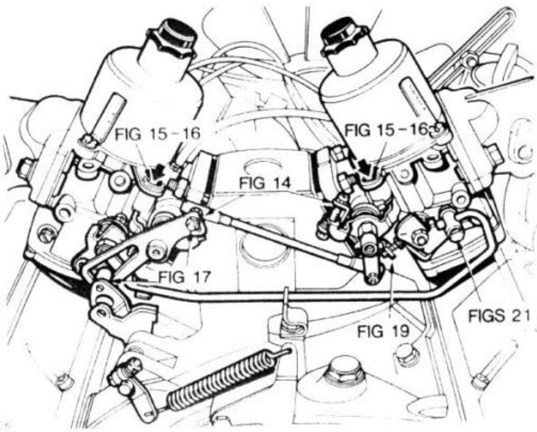


FIG. 21 MANUAL TRANSMISSION

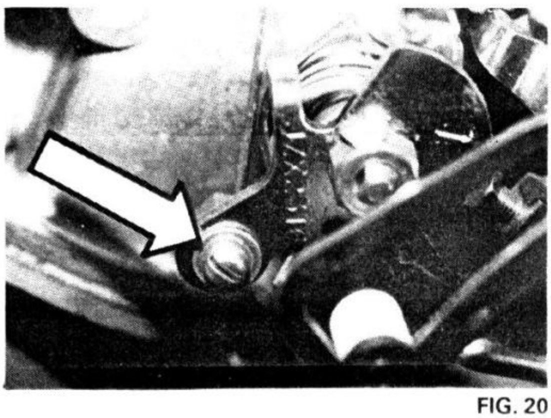


FIG. 20

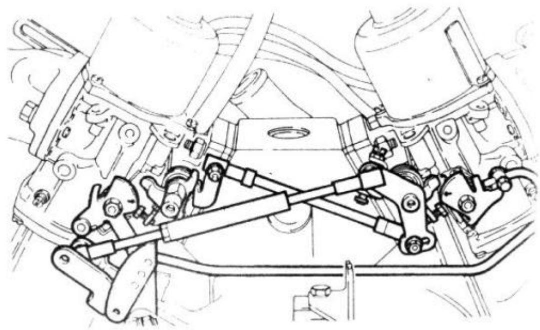


FIG. 22 AUTOMATIC TRANSMISSION

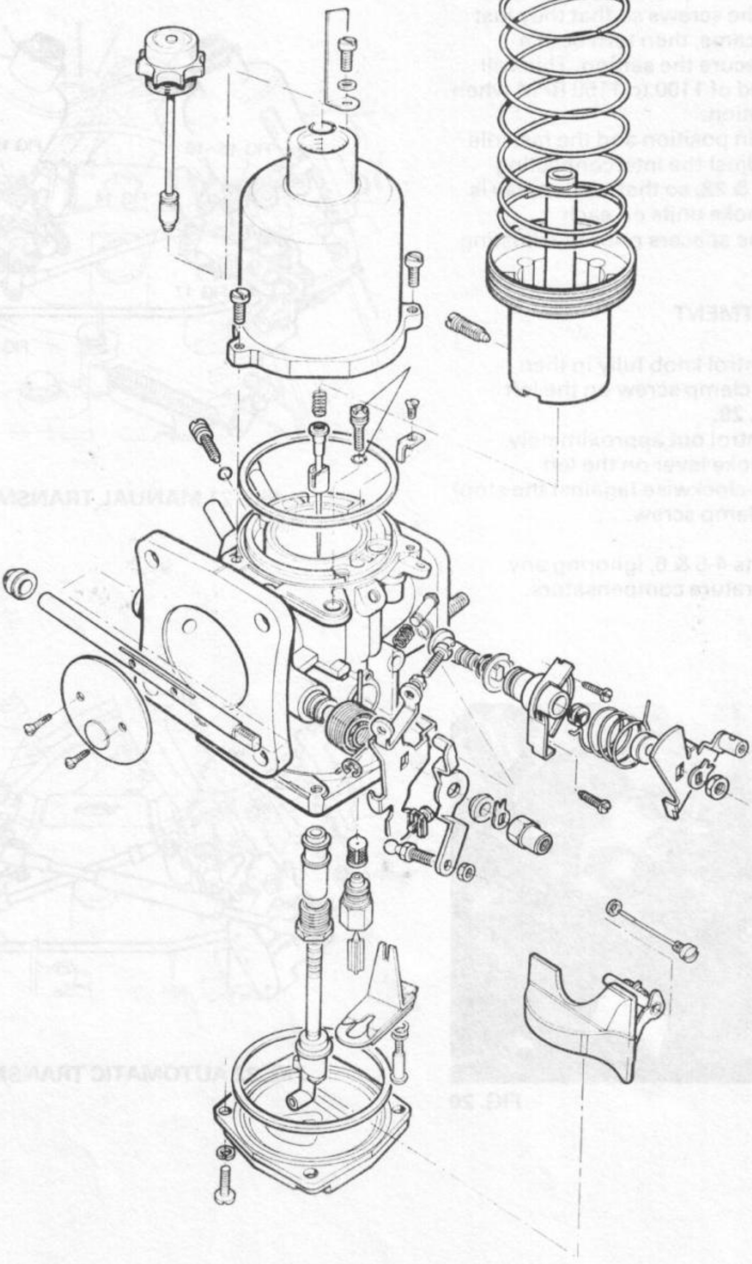


FIG. 23

Electronic Ignition

A Lucas model 35DM8 distributor which is fitted to the latest Range Rover has a conventional advance/retard vacuum unit and centrifugal automatic advance mechanism.

A pick-up module, in conjunction with a rotating timing reluctor inside the distributor body, generates timing signals. These are applied to an electronic ignition amplifier unit fitted under the ignition coil mounted on top of the left front wing valance.

Key to Fig. 1

1. Cover.
2. HT Brush & spring.
3. Rotor arm.
4. Insulation cover (Flash shield).
5. Reluctor.
6. Barrel nuts securing base plate –3.
7. Barrel nuts securing module – 2.
8. Reluctor drive coupling (nylon).

Maintenance

80,000 km (48,000 miles)
Remove the distributor cap and rotor arm and wipe inside with a nap-free cloth.

DO NOT DISTURB the clear plastic insulating cover which protects the magnetic pick up module.

Overhaul

1. Remove the cap and HT leads complete.
2. Pull the rotor arm off the spindle and release the three screws retaining the cover.
3. Release the two screws securing the vacuum unit, disengage the connecting rod from the base plate engagement peg and withdraw the unit.
4. Remove the circlip to release the flat washer, rubber "O" ring and prise the reluctor gently with a small screwdriver to release.

Note:- The nylon coupling (8) which must not be removed, has four driving lugs one of which is a "master" and is wider than the remaining three.

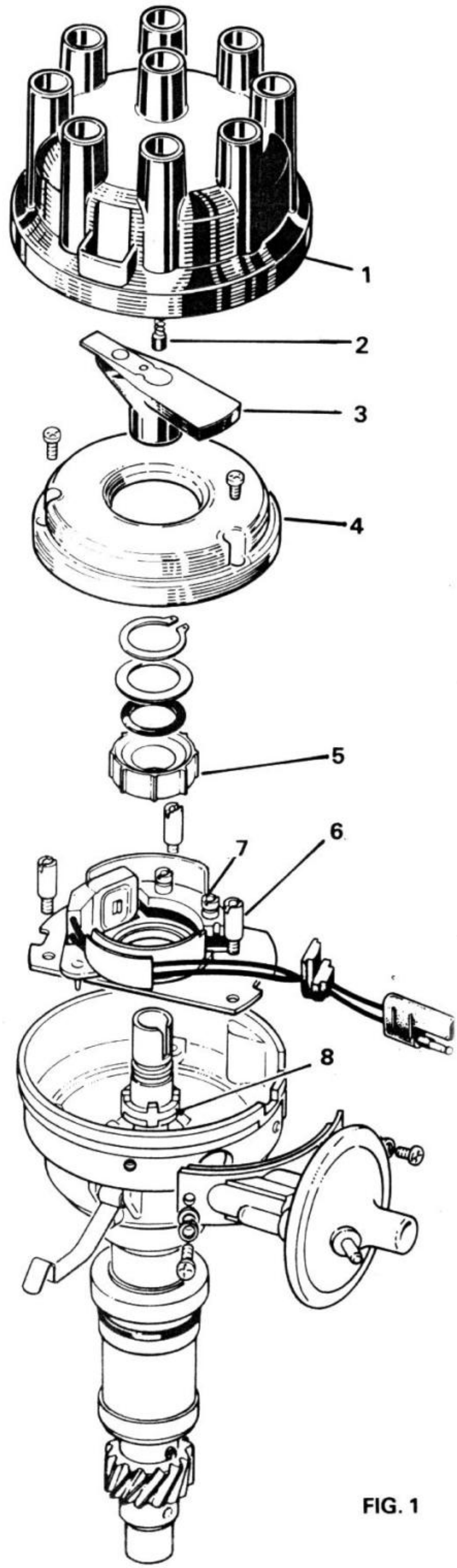


FIG. 1

5. Remove the three slotted pillar screws (9) to release the base plate assembly.

   Note:- do not disturb the two barrel nuts X securing the module to the base plate, otherwise the air gap will need re-adjustment.

   Check the module winding resistance which should be (2K to 5K ohms) and renew if necessary.

6. Lubricate the rotor shaft with 3 drops of clean engine oil and the remaining working part with Chevron SRI grease (or equivalent).

7. During assembly ensure that the module leads are located in plastic carrier to prevent them fouling the reluctor and that the reluctor engages onto the master driving lug.

8. If necessary re-set the air gap to 0.20 mm - 0.35 mm (0.008"-0.014" inch). A none-ferrous gauge must be used to set the gap.

   Note:- The base plate and module are supplied only as an assembly.

Technical Data

Pick up air gap adjustment (Pick up limb/reluctor tooth)	0.20mm - 0.35mm (0.008" - 0.014")

NOTE 1: Use non-ferrous feeler gauge and check on all reluctor teeth

NOTE 2: The pick up air gap is factory set. **Do not** adjust unless pick up is being changed or bearing plate has been removed.

Pick up module winding resistance	2k - 5k ohms
TIGHTENING TORQUES	
Pick up bearing plate support pillars	1.0 - 1.2 Nm (9-11 lb in)
Pick up barrel nuts	1.1 - 1.5 Nm (10-12 lb in)
Firing order	1, 8, 4, 3, 6, 5, 7, 2,
Sparking plug	Unipart GSP131 or Champion N12Y 14mm with suppressed leads.
Sparking plug point gap	0,80mm (0.03in)

Ignition timing	**9.35:1 compression ratio**	**8.13:1 compression ratio**
Static (Datum only - ignition timing must be set dynamically	6° B.T.D.C.	6° B.T.D.C.
Dynamic at 700 rev/min maximium (engine with emission control)	6° B.T.D.C. (vacuum pipes disconnected) using 97 octane fuel - 4 star rating in UK.	6° B.T.D.C. (vacuum pipes disconnected) using 90 octane fuel.
Engine idle speed	Idle speed rev/min	Fast idle rev/min
Manual gearbox models	700 to 750	1100 ± 50
Automatic gearbox models	650 to 750	
Non emission models .... (8.13: compression ratio except Saudi Arabia).	550 to 650	

LUCAS CONSTANT ENERGY IGNITION SYSTEM 35DM8 PRELIMINARY CHECKS

Inspect battery cables and connections to ensure they are clean and tight. Check battery state of charge if in doubt as to its condition.

Inspect all LT connections to ensure that they are clean and tight. Check the HT leads are correctly positioned and not shorting to earth against any engine components. The wiring harness and individual cables should be firmly fastened to prevent chafing.

Test Notes

(i) The ignition must be switched on for all checks.

(ii) Key to symbols used in the charts for Tests 2.

✓	Correct Reading	H	High Reading	L	Low Reading

(iii) Use feeler guages manufactured from a non-magnetic material when setting air gaps.

PICK-UP MODULE AIR GAP SETTINGS

Air gap settings vary according to vehicle application.

NOTE: The gap is set initially at the factory and will only require adjusting if tampered with or when the pick-up module is replaced.

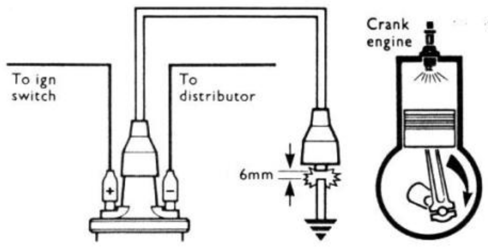
TEST 1:

Check HT Sparking

Remove coil/distributor HT lead from distributor cover and hold approximately 6 mm (0·25") from the engine block. Switch the ignition 'on' and operate the starter.

If regular sparking occurs, proceed to Test 6. If no sparking proceed to Test 2.

Test 1



TEST 2:

Amplifier Static Checks with Ignition Switched On

(a) Connect voltmeter to points in the circuit indicated by the arrow heads and make a note of the voltage readings.

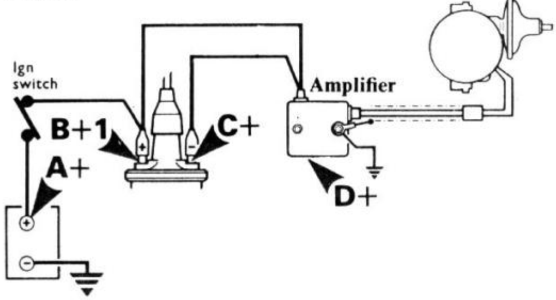
(b) Compare voltages obtained with the specified values listed below:-

(c) If all readings are correct proceed to Test 3.

(d) Check incorrect reading(s) with chart to identify area of possible faults, i.e. faults listed under heading "Suspect".

Note:- Move only the + lead of volt meter for checks B – C & D.

Test 2



EXPECTED READINGS

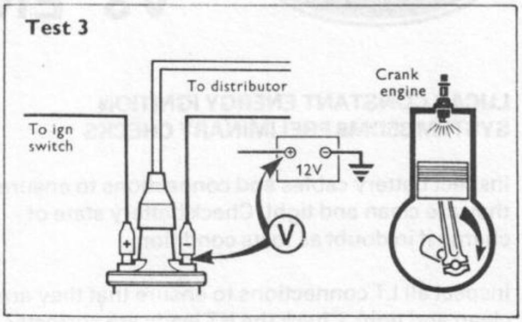
A	More than 11.5 volts
B	Not more than 1 volt below volts at A
C	Not more than 1 volt below volts at A
D	0 volt – 0.1 volt

A	B	C	D	SUSPECT
L	✓	✓	✓	Discharged battery
✓	L	L	✓	Ign. switch and/or wiring.
✓	✓	L	✓	Coil or amplifier
✓	✓	✓	H	Amplifier earth

TEST 3:
Check Amplifier Switching

With ignition switched off disconnect HT lead at coil. Connect the voltmeter between battery positive (+ve) terminal and HT coil negative (–ve) terminal. Voltmeter will register zero. Switch the ignition 'on' then crank the engine and the voltmeter reading should increase above zero, in which case proceed with Test 5.

If there is no increase in voltage during cranking proceed to Test 4.

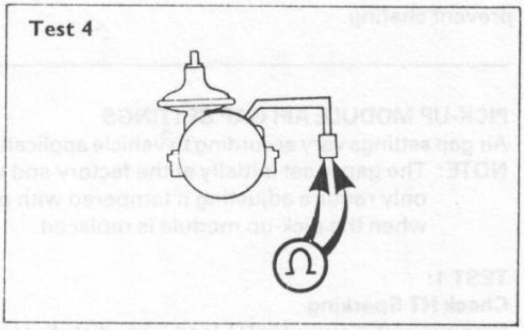


TEST 4:
Pick-Up Coil Resistance
Applications with Separate Amplifier

Disconnect the pick-up leads at the harness connector. Connect the ohmmeter leads to the two pick-up leads in the plug.

The ohmmeter should register between 2k and 5k ohms if pick-up is satisfactory. Change the amplifier if ohmmeter reading is correct. If the engine still does not start carry out Test 5.

Change the pick-up if ohmmeter reading is incorrect. If the engine still does not start proceed to Test 5.



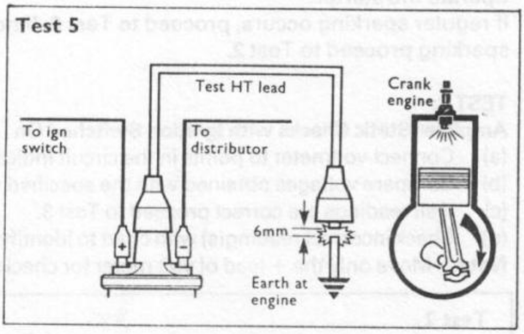
TEST 5:
Check HT Sparking

Remove existing coil/distributor HT lead and fit test HT lead to coil chimney. Hold free end about 6 mm (0·25") from the engine block and crank the engine.

HT sparking good, repeat test with original HT lead, if then no sparking, change HT lead. If sparking is good but engine will not start, proceed to Test 6.

If no sparking, replace coil.

If engine will not start carry out Test 6.

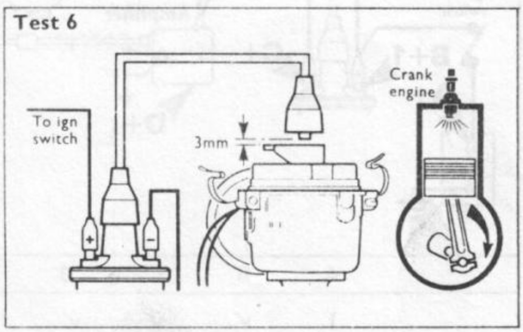


TEST 6:
Check Rotor Arm

Remove distributor cover. Disconnect coil HT lead from cover and hold about 3 mm (0·13") above rotor arm electrode and crank the engine. There should be no HT sparking between rotor and HT lead. If satisfactory carry out Test 7.

HT sparking, replace rotor arm.

If engine will not start carry out Test 7.



TEST 7:
Visual and HT Cable Checks

Examine:	Should be:
1. Distributor Cover	Clean, dry, no tracking marks.
2. Coil Top	Clean, dry, no tracking marks.
3. HT Cable Insulation	Must not be cracked chafed or perished.
4. HT Cable Continuity	Must not be open circuit.
5. Sparking Plugs	Clean, dry, and set to correct gap.

NOTE:

1. Reluctor	Must not foul pick-up or leads.
2. Rotor and Flash Shield	Must not be cracked or show signs of tracking marks.

COIL/AMPLIFIER LOCATION
LH FRONT WING VALANCE

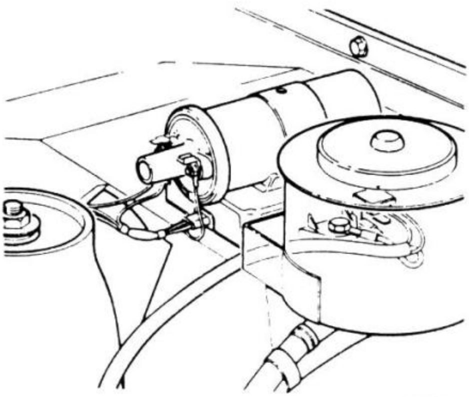
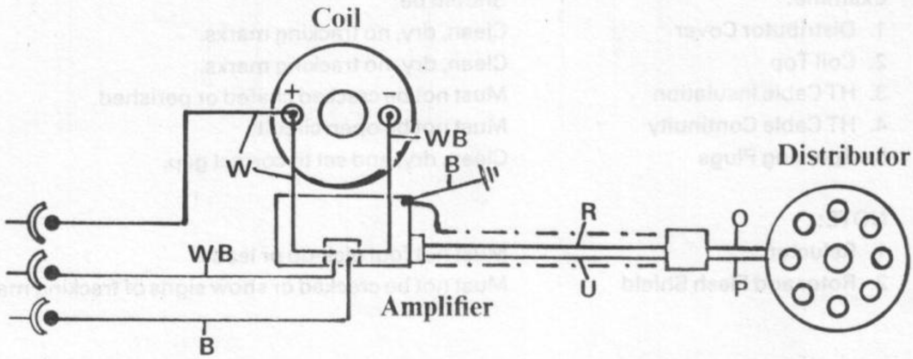


FIG. 2

Wiring diagram
Model 35DM8 distributor.

FIG. 3



NOTE: When cables have two colour code letters, the first denotes the main and the latter the tracer.

- Snap Connectors
- Connections via Plug & Socket
- Permanent In-line Connections
- Earth Connections via Fixing Bolts
- Earth Connections via Cables
- Eureka Resistance Wire

CABLE COLOUR CODE

G	=	Green	U	=	Blue
P	=	Purple	N	=	Brown
L	=	Light	Y	=	Yellow
O	=	Orange	B	=	Black
S	=	Slate	R	=	Red
K	=	Pink	W	=	White

ITS A GOOD IDEA

This is the hints and tips page, if you have a good idea which will help us to help you service our products better, please let us know.

Carburettors

This suggested method of checking the mixture setting/piston lift, is also a useful way of checking for a sticking piston, punctured diaphragm, unequal or incorrectly set throttle linkage or blocked vents to the underside of the diaphragm.

With the engine running, simply remove the dampers, install the two equal lengths of aluminium wire as shown here and rev the engine. Obviously if the pistons do not rise an equal distance as indicated by the wires, a fault exists. The most common fault of those mentioned is "unequal adjustment of the throttle blades" with "a blocked vent to the underside of one diaphragm" a close second. A blocked vent is usually caused by incorrect fitting of the gasket between the "air intake elbow" and the carburettor.

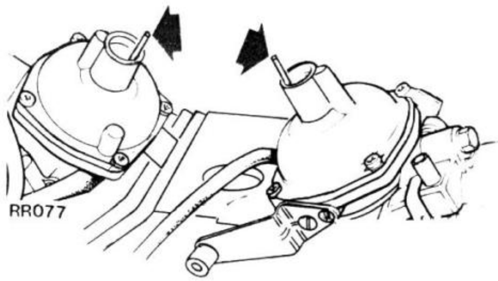


FIG. 89

Air Filters

Make sure the air filter elements are genuine parts as spurious filters with silicon rubber bonded elements restrict the air flow resulting in limited maximum speed and excessive fuel consumption.

High Engine Oil Pressure

If you have "done everything possible" and the engine performance is still down, its a good idea to check the engine oil pressure. Excessive pressure can cause the hydraulic tappets to hold the valves open.

High Altitude Operation (Stromberg Carburetter)

When operating at altitudes up to 12,000 ft. (3657 mtrs) it is only necessary to readjust the carburetter mixture. However above 12,000 ft. (3657 mtrs) the carburetter needles should be changed to the following,
TYPE B 28759 PART NUMBER B 28760 which are suitable up to 15,000 ft. (3572 mtrs).

TEACHING AIDS & TRAINING LITERATURE

TRAINING MANUALS

Each training manual provides detailed information based on practical experience of the subject covered and is intended to assist an instructor formulate training courses or further the knowledge of the individual student.

VIDEO LINK

Certain new subjects available on Video under the 'Video Link' logo, are designed specifically for use in the classroom, however the manuals which support these programmes are equally as informative to the instructor and student.

MANUALS

LRTL 32	-	A727 Automatic Transmission.
LRTL 34	-	Land Rover series II & III Main & Transfer Gearbox.
LRTL 35	-	Early Range Rover, Series III V8 Land Rover & early V8 110 models Transmission.
LSM 0045 TM	-	LT230 & Transfer Gearbox.
LSM 0060 TM	-	2¼ Petrol & Deisel and, 2½ Deisel Including: Fuel Systems Carburettor & Injector Pump.
LSM 0094 TM	-	V8 Engine Tuning, (REVISED) SU Carburettors included.
LSM 0140 TM	-	LT85mm Gearbox (EARLY TWO PIECE CASING).
LSM 0236 TM	-	ZF Automatic Transmission.
SMR 677 TM	-	LT77mm Gearbox, (REVISED).
SMR 678 TM	-	V8 Engine Overhaul.
SMR 679 TM	-	V8 Engine EFI 'L' System, Manual & Diagnostic card. (VIDEO LINK).

VIDEO Service Training LINK

VIDEO PROGRAMMES

SMR 730ENVR — Electronic Fuel Injection 'L' System programme.
This is the first of a new series of video programmes to PAL VHS format launched under the "Video Link" logo.
Each programme comprises one video in library case, three manuals and diagnostic cards. Extra manuals complete with diagnostic card are available under separate part number shown above.

WALL CHARTS

SMR 726WC - Range Rover (EFI Automatic wallchart, set of five.
Each of the wall charts comprising the set show a sectioned view of the:- Vehicle V8 EFI Engine, Front Axle, Rear Axle and the Chain Drive 1989, Transfer Gearbox.

SMR 716WC - LT 230'T" Transfer Gearbox which is applicable to 90.110 Land Rovers and pre 1989 Range Rover.

SMR 728WC - Land Rover 110 County wallchart set of six.
Each of the wall charts comprising the set show a sectioned view of the:- Vehicle, 110 County with 4 cylinder petrol engine, 4 cylinder turbo diesel engine, Front Axle, Rear Axle, LT 77mm Gearbox, LT85mm Gearbox.
The charts which measure 58mm x 84mm are printed in landscape format and four colours.

ENQUIRIES TO: –

LAND ROVER MERCHANDISING SERVICES.

P.O. BOX 534, CHESTER ROAD,
ERDINGTON,
BIRMINGHAM B24 0QS.

TEL: (021) 377 6544

Printed by Dial House Press Ltd., Coventry, England.