

PETROL FUEL SYSTEM

Air-Fuel Ratio

The chemically correct air-fuel for theoretical complete combustion is 15 parts air to 1 part petrol (by mass). This ratio of 15:1 is sometimes referred to as the stoichiometric ratio. More air or less petrol gives a weak mixture (e.g. 20:1).

Less air or more petrol gives a rich mixture (e.g. 10:1)

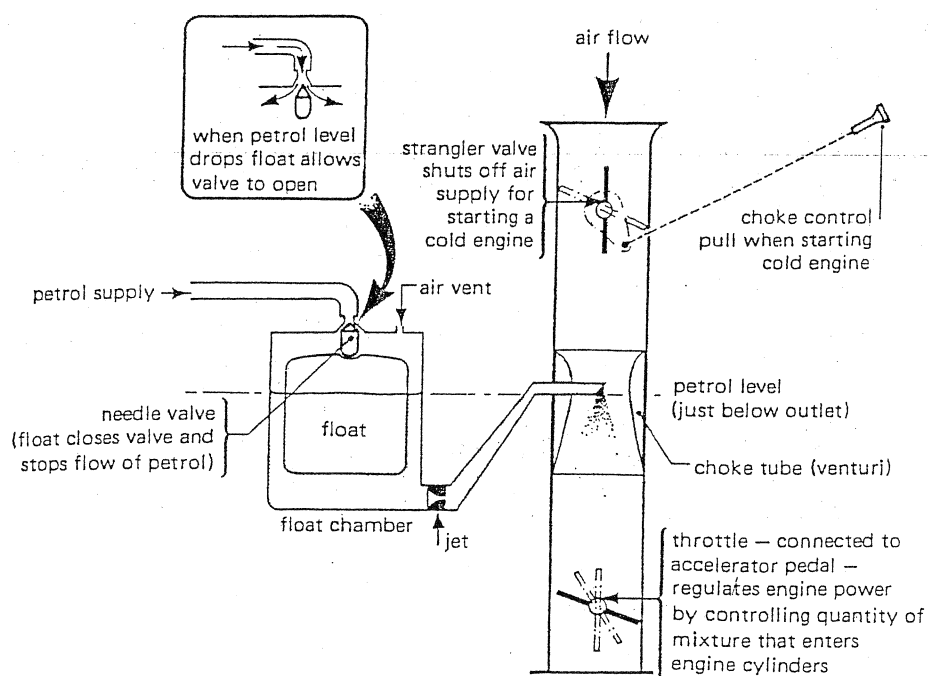
Carburettor

The function of a carburettor is to meter the correct air-fuel ratio and to atomise the fuel into fine particles to assist in combustion.

Simple Carburettor

The carburettor consists of two main points:

1. Float chamber - to regulate the flow of petrol to the carburettor and to maintain the petrol at a level just below the jet outlet.
2. Mixing chamber - to mix the fuel and air in the correct proportion and also to atomise the fuel.



Layout of simple carburettor

Opening the throttle of the carburettor causes the air flow through the carburettor to increase; this intensifies the depression in the choke tube and allows more fuel to flow from the float chamber to mix with this extra air. Unfortunately the petrol flow increases at a greater rate than the air supply.

The mixture supplied by a simple carburettor gets richer as the speed is increased.

To overcome this problem a correction or compensation system is necessary.

Cold Starting

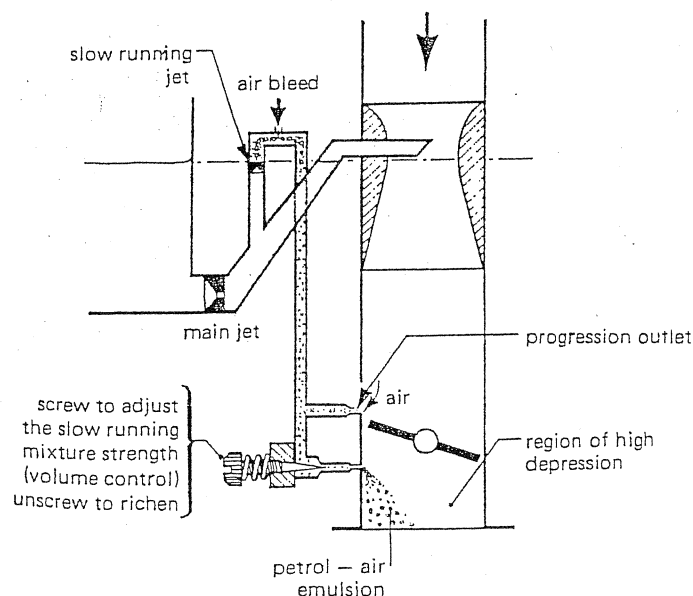
A carburettor set to give a mixture strength of 15:1 at a normal engine speed would be unsuitable for starting a cold engine. This is because:

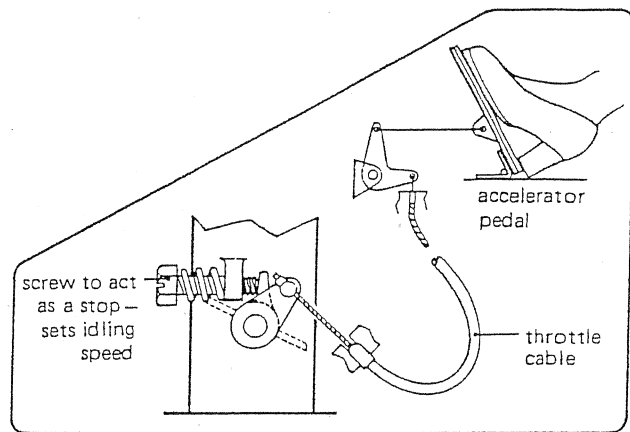
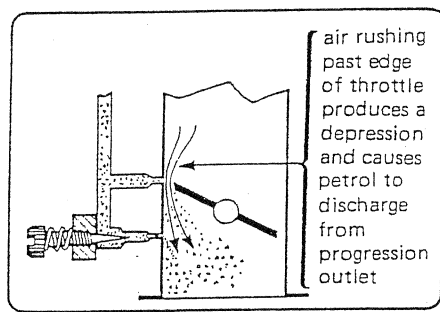
1. The cold engine will not vaporise the fuel.
2. The slow cranking speed only gives a small depression and this causes the carburettor to supply a very weak mixture.
3. Petrol falls out of the slow moving air and is deposited in the walls of the induction pipe.

Shutting off the air by means of a strangler (or choke) valve gives a rich mixture (8:1) and provides the engine with a sufficient number of fuel particles to vaporise easily.

Slow Running

The small amount of air passing through the carburettor when the engine is slow running produces a very small choke depression. This means that too little fuel will be supplied and the engine will stall.





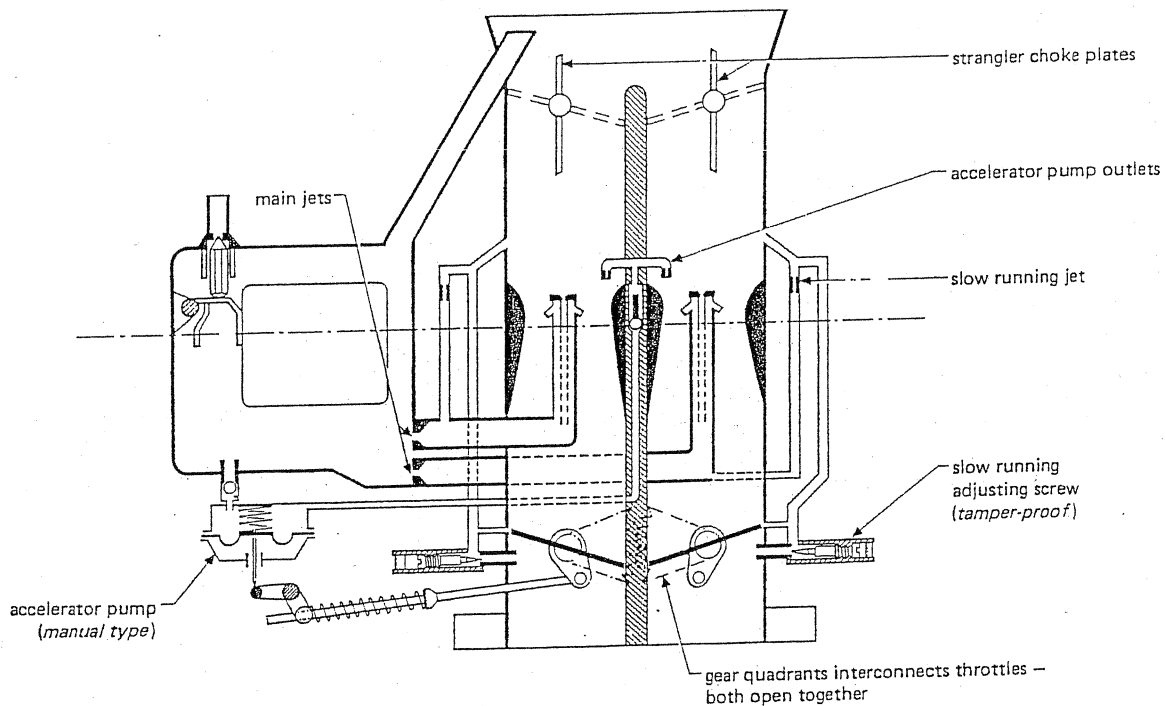
The slow running system has an outlet in a region where a high depression exists when the engine is idling.

To obtain a smooth transfer as the engine speed is increased, extra holes are drilled adjacent to the edge of the throttle disc: these holes are the progression outlets.

The adjusting screws control the slow running system; one screw sets the idle speed the other enables the slow running mixture to be varied to give the smoothest engine speed.

Twin-choke Carburettor

Engines such as the V6 and V8 normally require two carburettors. Cost and space are saved when the two carburettors are joined together to share a common float chamber.



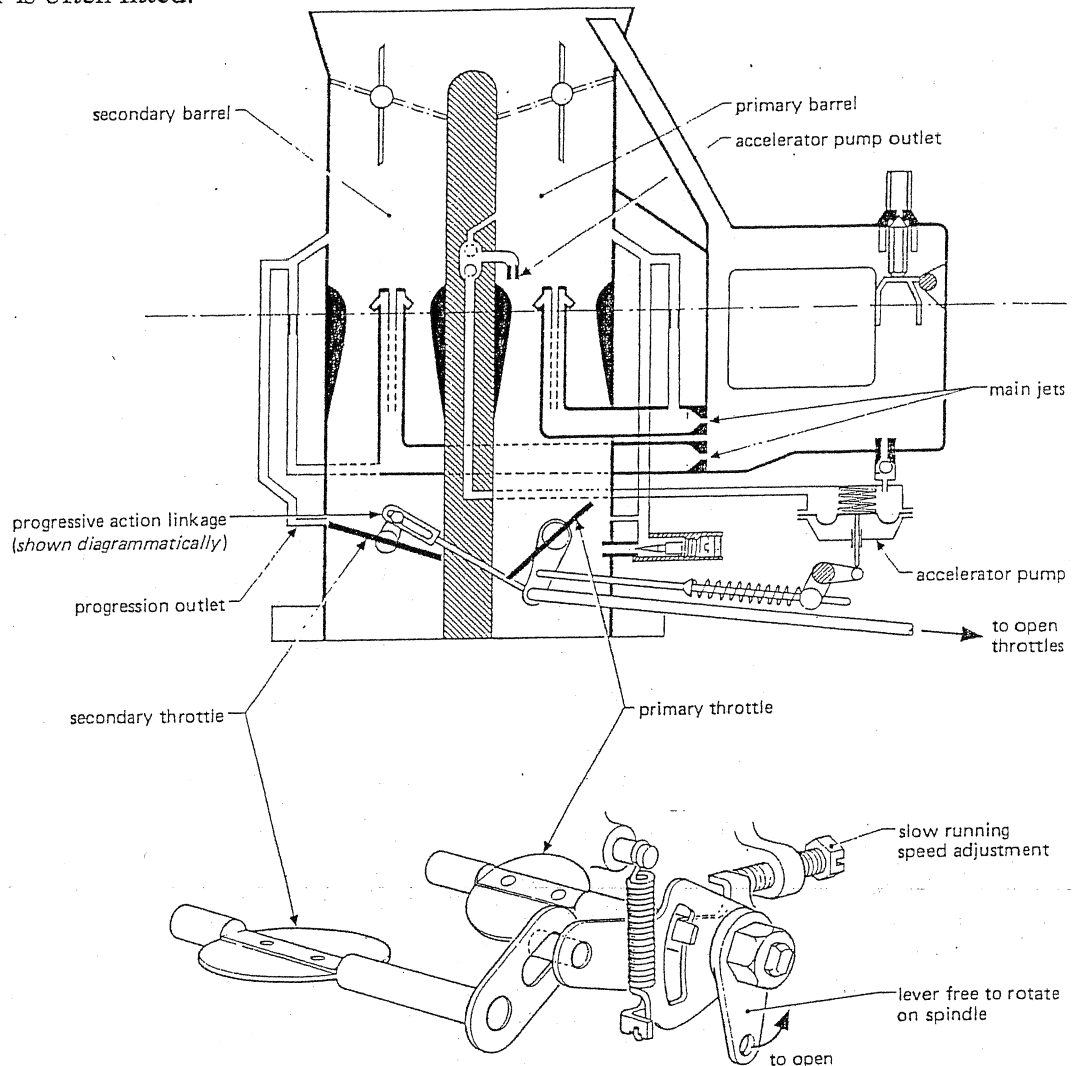
Twin-choke carburetter

The diagram shows a dual-venturi downdraught carburettor. Normal practice is to arrange the manifold so that one venturi system supplies one set of cylinders and the other venturi the remaining cylinders. This layout identifies why each venturi needs to be provided with its own system for cold starting, slow-running, cruising and power. The two throttle valves are interconnected and should be synchronised to give the same opening at all engine speeds.

Twin-barrel Sequential Carburettor

To obtain fuel economy, a good atomisation of the fuel is needed. In a fixed-choke carburettor this can be achieved by using a comparatively small diameter venturi. Unfortunately the restriction to air flow of a small venturi gives poor volumetric efficiency and results in low maximum power.

When both economy and high maximum power are required, a multi-barrel sequential type carburettor is often fitted.



The two throttle valves are coupled together in such a way that the secondary throttle remains closed until the primary throttle has opened about two-thirds. When the throttle opens past this point, the linkage moves the secondary throttle so that both throttles reach the full open position together.

This sequential movement allows the primary barrel to supply all cylinders with a slightly weak, well atomised mixture for cruising conditions.

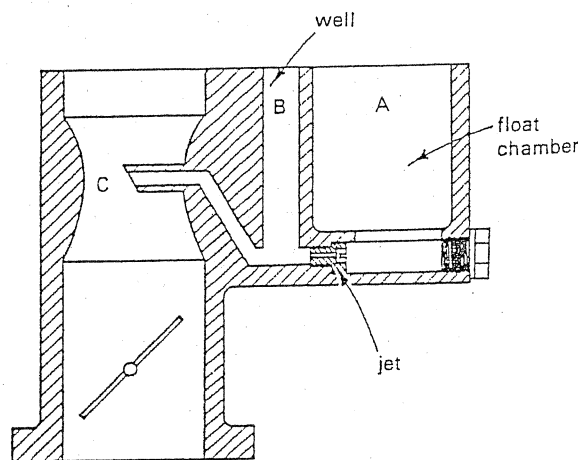
When power is required, the second barrel provides extra fuel and a good supply of air to meet power demands.

Mixture Correction

A corrected jet or carburettor is one which supplies a constant air/fuel ratio at all engine speeds. One which supplies a mixture which becomes richer as air flow increases is uncorrected or under-corrected, whilst one which supplies a mixture which becomes weaker as air flows is over-corrected.

Over-correction

In the arrangement below both sides of the jet are open to atmospheric pressure. With the engine stationary and the fuel supply turned on, fuel will fill the float chamber to a level determined by the float mechanism. It will also flow through the jet and fill both the well and the discharge tube to the same level, since when the engine is not running the pressures at A, B and C are equal (atmospheric pressure).



An over-corrected carburettor

If the engine is now started and set to run slowly, the pressure at C will fall according to the rate of flow through the choke tube. This will result in a fall in the level of the fuel in the well B proportional to the pressure difference between B and C. The fuel drawn from the well issues from the discharge tube and mixes with the air drawn through the choke tube to form the mixture delivered to the engine.

There is now a difference in level between the fuel in the well and the fuel in the float chamber; this will cause fuel to flow through the jet at a rate determined by the size of the jet and the difference in level between A and B

Fuel will be drawn away at C at the same rate as it passes through the jet, thus keeping the level B constant so long as the pressure at C remains constant.

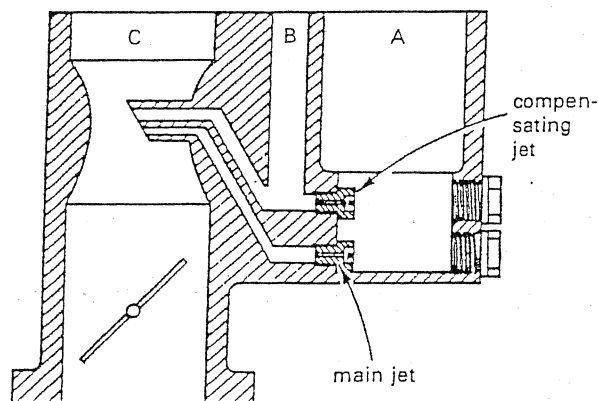
As engine speed is increased the air flow through the choke is increased, lowering the pressure at C, thus in turn lowering the level in B and consequently increasing the flow through the jet.

A very small pressure drop at C will empty the well to the level where the discharge tube leads off and thereafter the difference in level between A and B cannot be increased any more. This condition will occur at quite a low engine speed and produced the maximum possible flow of fuel through the jet, so that any further increase in engine speed, while decreasing the pressure at C, cannot increase the fuel flow.

Increase in engine speed now results in a weakening of the mixture, since air-flow increases without corresponding increase in fuel flow, giving the characteristics of an over-corrected jet.

Compound Jet

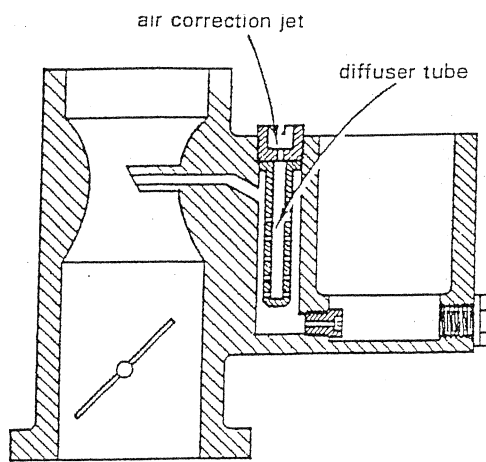
The diagram below shows a carburettor using two jets. The main jet is a simple uncorrected jet, whilst the compensating jet is of the over corrected type. Selection of the main and compensating jet sizes can match up in such way that the richening mixture delivered by the main jet is exactly balanced by the weakening mixture supplied by the compensation jet.



The compound jet arrangement

Air Bleed

The air correction jet forms the opening of the well to atmosphere and is screwed into the top of a diffuser tube dipping into the fuel in the well. The lower end of this tube is drilled with a number of small holes through which air is bled into the fuel. The air forms an emulsion of tiny bubbles of air in the liquid fuel, so assisting with the atomisation of the fuel when it enters the mixing chamber.



An air-bleed system

Economisers

Motor vehicle engines spend little of their lives at full throttle. Generally low fuel consumption is considered of great importance. It is therefore necessary to set the carburettor to provide the best mixture for economy when the throttle is not fully opened, but to richen the mixture, for maximum power, for full-throttle operation.

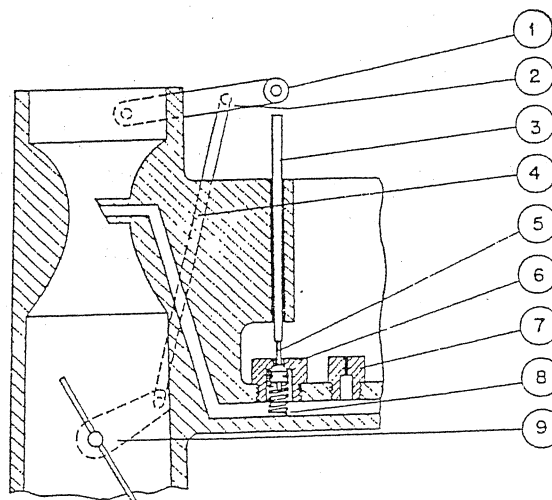
Many carburettor are fitted with means for enriching the mixture when the throttle approaches the fully open position, thus permitting the use of economy mixture at part throttle. Arrangement of this kind are called economisers, enrichment devices or power jets.

The diagram below shows an enrichment jet which is brought into operation by a mechanical connection to the throttle. The mixture for part throttle is supplied by the main jet (7).

Alongside this is the enrichment jet (6) which is closed by the valve (5) being pushed by the spring (8) so that the coned head of the valve seats in the orifice of the jet.

A lever (9) attached to the throttle spindle is connected by a link (4) to a second lever (2) on the end of which is a roller (1).

As the throttle approaches the fully open position, the link (4) pulls down lever (2) until the roller (1) touches the end of the rod (3), after which further opening of the throttle opens the enrichment jet.



Enrichment jet operated by throttle linkage

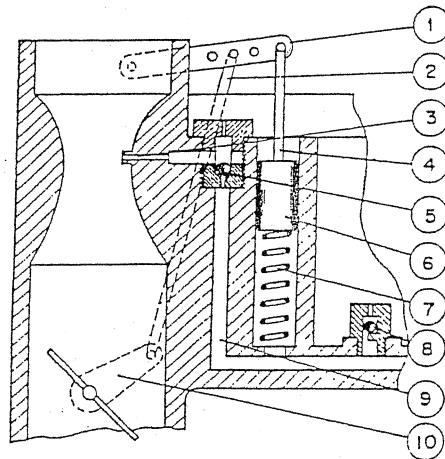
Acceleration

For best acceleration the mixture which reaches the cylinders should be slightly rich which gives maximum power. Whatever mixture the carburettor is adjusted to deliver under steady conditions, the effect of suddenly opening the throttle is an immediate weakening of the mixture reaching the cylinders.

The main reason for this is the greater inertia of petrol compared with air, which prevents the flow of fuel increasing as rapidly as the air flow increases, so that the mixture is weaker than that normally provided until steady conditions are again reached.

This is overcome by fitting an acceleration pump which delivers an additional controlled amount of fuel to the mixing chamber when the throttle is opened.

The diagram below illustrates an acceleration pump mechanically linked to the throttle. When the throttle is opened, the lever (10) pulls down the link (2) and lever (1), thus causing the pump rod (4) to push down the plunger (6).



Mechanically operated acceleration pump

The reverse action takes place as the throttle is closed, the fuel plunger being pushed up by the spring (7), causing fuel to enter the pump cylinder from the float chamber through the non-return valve (8), the ball-valve (5) closing onto its lower seat.

Gradual opening of the throttle causes the plunger (6) to be moved slowly down the cylinder and the non-return valve (8) closes to prevent the return of fuel to the float chamber.

During slow downward movement of the plunger, a large proportion of the fuel will leak past the plunger back to the float chamber and the fuel which is pumped up the passage (9) is moving so slowly that it merely lifts the ball-valve (5) off its lower seating, leaving the upper hole open. This allows a good deal of the fuel passing the ball-valve (5) to

return to the float chamber through the upper hole and very little fuel is ejected from the pump jet.

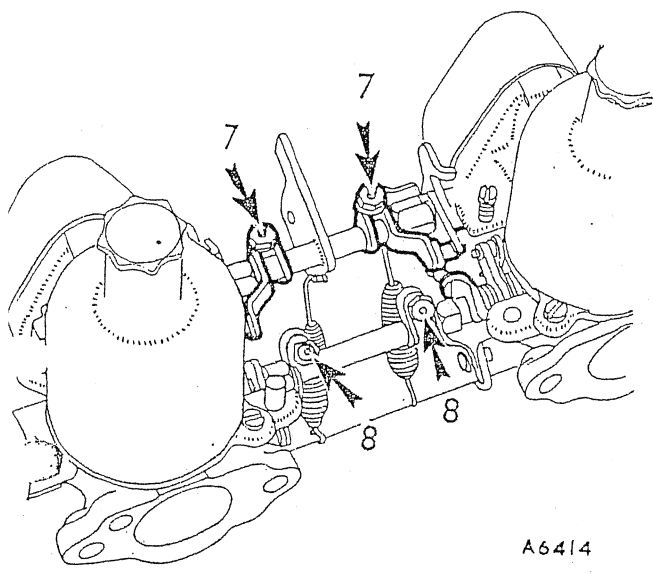
Rapid opening of the throttle displaces fuel from the pump more quickly so that less fuel leaks past the plunger in the shorter time available. More fuel is pumped more quickly up the passage (9) causing the ball-valve (5) to be lifted to its upper seating where it closes the hole at the top of the valve body, preventing the return of fuel to the float chamber. Thus nearly all the fuel displaced by the pump is ejected into the air stream

The main function of the hole at the top of the valve body is to vent the pump jet to the top of the float chamber when the pump is not being operated, thus preventing the fuel being drawn through the accelerating pump by the depression in the choke tube at steady speeds.

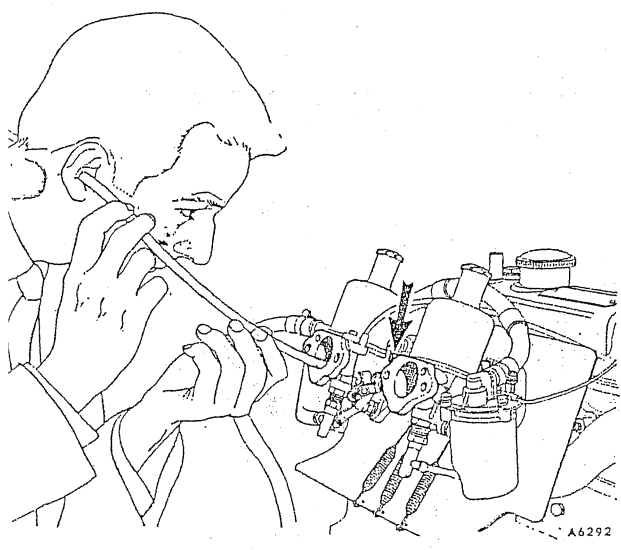
The quantity of fuel delivered can be varied by fitting the upper end of the link (2) into a different hole in the lever (1), thus altering the plunger stroke.

TUNING Multi-carburettors

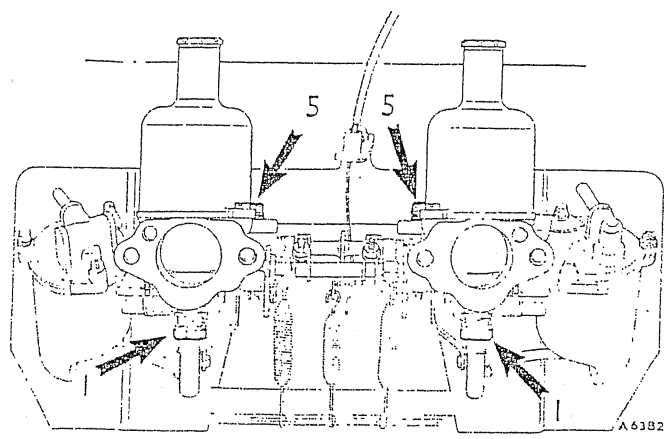
Remove the air cleaners and carry out item 1 as for single carburetters then:



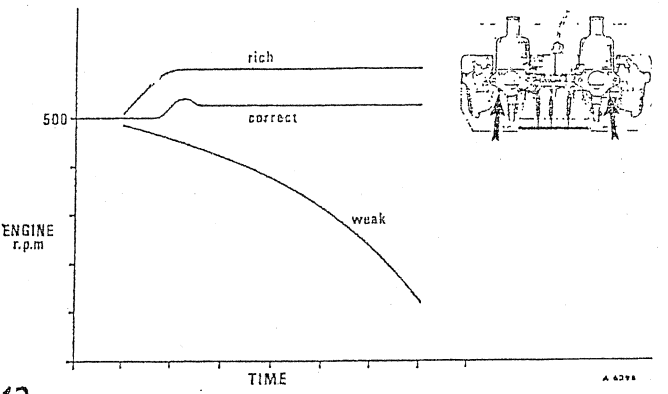
Slacken both of the clamping bolts (7) on the throttle spindle interconnections.
Disconnect the jet control interconnection by slackening the clamping bolts (8).
Carry out items 2 and 3 as for single carburetters, then additionally:



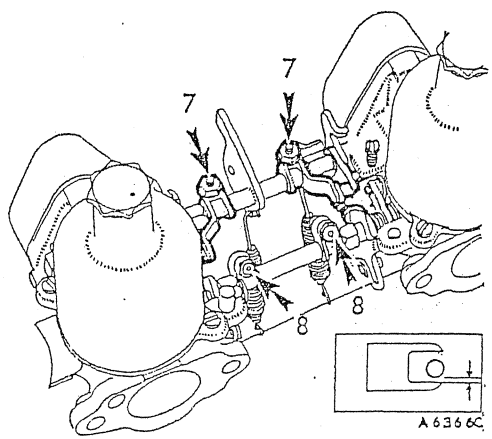
Restart the engine and adjust the throttle adjusting screws on each carburettor to give the desired idling speed as indicated by the glow of the ignition warning light.
Compare the intensity of the intake 'hiss' on all carburetters and alter the throttle adjusting screws until the 'hiss' is the same.



- 11
- A. Turn the jet adjusting nuts (1) on all carburetters up to weaken or down to richen the same amount until the fastest idling speed consistent with even running is obtained.
- B. Readjust the throttle adjusting screws (5) to give correct idling if necessary.

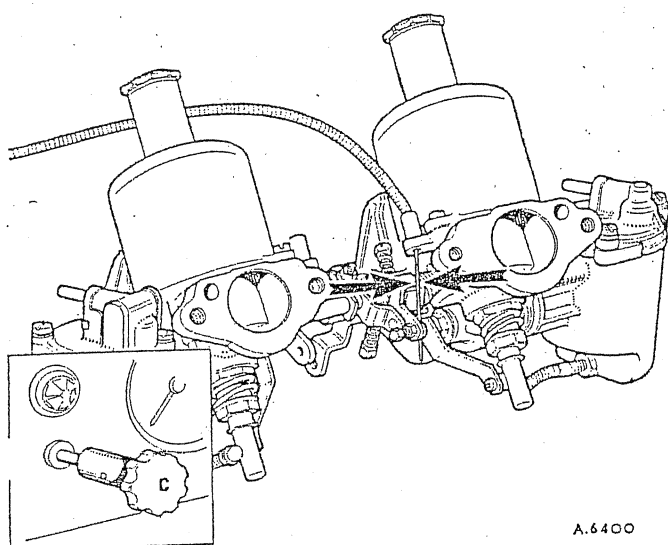


- 12
- A. Check for correct mixture by gently pushing the lifting pin of the front carburettor up $\frac{1}{8}$ in. (1.8 mm.) after free movement has been taken up. The graph illustrates the possible effect on engine r.p.m. Readjust the mixture strength if necessary.
- B. Repeat the operation on the other carburetters and after adjustment re-check since they are all inter-dependent.
- C. Item 5 shows the correct type of exhaust smoke.



- 13
- A. Set the throttle interconnection clamping levers (7) so that the link pin is .006 in. (1.5 mm.) away from the lower edge of the fork (see inset). Tighten the clamp bolts.
- B. With both jet levers at their lowest position, set the jet interconnection lever clamp bolts (8) so that both jets commence to move simultaneously.

TUNING Multi-carburettors (continued)



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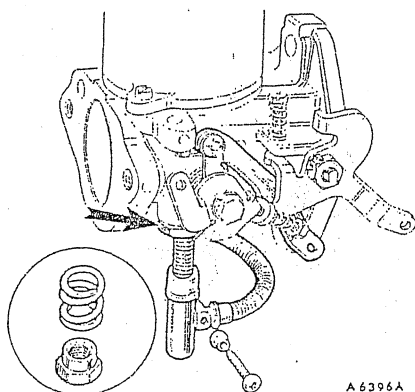
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- Reconnect the mixture control wire with about $\frac{1}{8}$ in. (1.6 mm.) free movement before it starts to pull on the jet levers.
- Pull the mixture control knob until the linkage is about to move the carburettor jets, and adjust the fast idle screws, comparing the intensity of the air intake 'hiss' to give an engine speed of about 1,000 r.p.m. when hot.
- Refit the air cleaners and re-check for correct mixture as described in item 12.

ADJUSTING AND SERVICING Jet Centring

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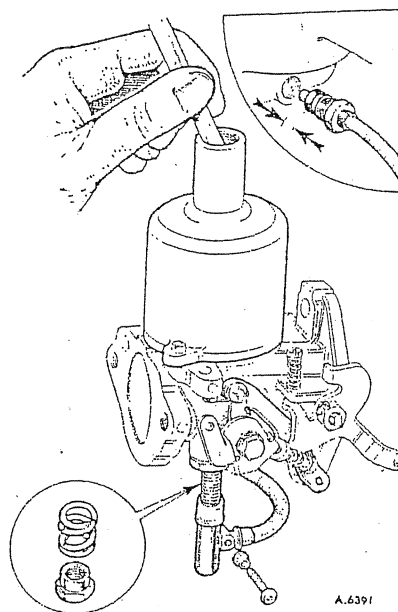
The piston should fall freely onto the carburettor bridge with a click when the lifting pin is released with the jet in the fully up position. If it will only do this with the jet lowered then the jet unit requires re-centring. This is done as follows:



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- Remove the jet head screw to release the control linkage.
- Withdraw the jet, disconnecting the fuel feed pipe union in the float-chamber, and removing the rubber sealing washer. Remove the jet locking spring and adjusting nut.
- Replace the jet and insert the fuel feed pipe connection into the float-chamber.
- Slacken the jet locking nut until the assembly is free to rotate.

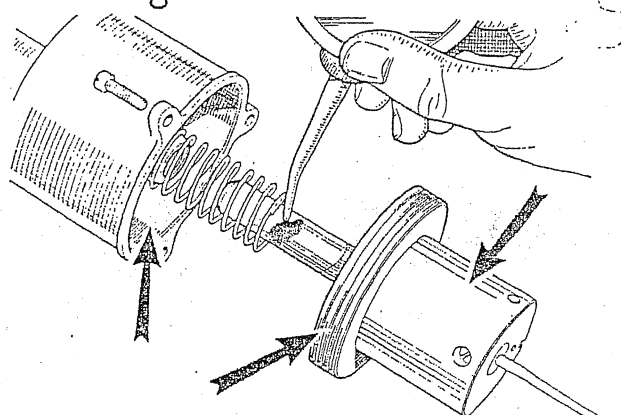


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- Remove the piston damper and apply pressure to the top of the piston rod with a pencil.
- Tighten the jet locking nut keeping the jet hard up against the jet bearing.
- Finally check again as in item 15.
- Re-fit the jet locking spring and adjusting nut. Before replacing the fuel feed pipe into the float-chamber, fit the rubber sealing washer over the end of the plastic pipe so that at least $\frac{3}{8}$ in. (4.8 mm.) of pipe protrudes (see inset). Reassemble the controls.
- Refill the piston dampers with the recommended engine oil (see item 8).

Cleaning



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- At the recommended intervals mark for reassembly and carefully remove the piston/suction chamber unit.
- Using a petrol-moistened cloth, clean the inside bore of the suction chamber and the two diameters of the piston.
- Lightly oil the piston rod only and reassemble as marked.
- Refill piston damper (see item 8).