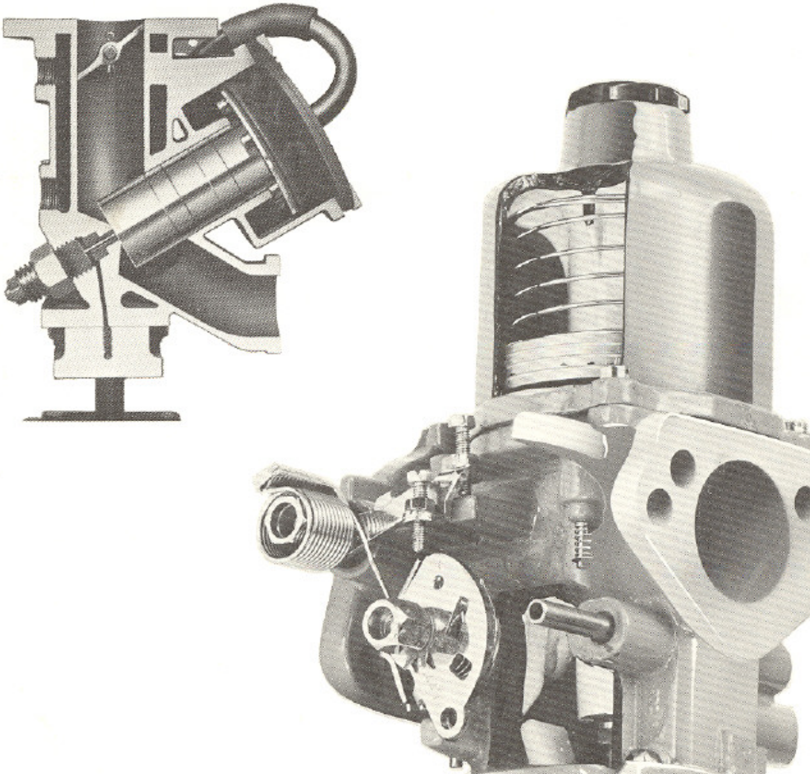
SU BUTEC
Automotive Components

Service Manual

SU FUEL SYSTEMS
HISTORY & GENERAL PRINCIPLES



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THE HISTORY OF SU FUEL SYSTEMS

The Company originated in 1905 in the name of the late Mr. George H. Skinner, a member of a family which owned the well-known shoe firm of the time, Lilley & Skinner. He evolved an idea whereby the normal fixed-choke tube and numerous jets were replaced by an expanding choke and a single jet automatically controlled by a sliding piston and a contoured needle. He and his brother, Mr. Thomas Carlyle Skinner, developed a model on these original ideas using some of their knowledge of the shoe industry by incorporating bellows in the first carburetters.

Calling their company the S U Company, the initials standing for 'Skinners Union', the two brothers set up a small workshop on the premises of George Wales & Co. in the Euston Road, London, and the machining was done for the brothers by this company. Production increased and the business was moved to 154, Prince of Wales Road, London – an old horse stable, the structure of which had to be converted to allow production to take place.

After the outbreak of the first World War in 1914, the Company virtually ceased carburetter production to work on Government contracts making machine-gun parts and tripods. There were approximately 250 employees at that time. A few years after the war ended, in 1920, because of a general recession within the motor industry, due to inefficiency and high costs, the Company had to resort to making wireless parts, windscreens, water cocks and other similar engineering products to remain in business. Having survived this depression, the Company returned to producing carburetters and these were fitted to a number of quality cars such as Bentley, Napier and Invicta.

In 1926 the S U Carburetter Company was purchased by Morris Motors Ltd. with Mr. C. Skinner as Director. The Company was transferred to Adderley Park, Birmingham, alongside the Morris Commercial Cars Ltd. factory where it rapidly expanded, and where a petrol pump was developed and introduced.

In 1932 an Aero carburetter was developed and from this beginning a number were produced for Military and Civil Aircraft during the mid- to late-1930's. In 1936 the whole issued capital of the Company was acquired by Morris Motors Ltd. and the S U Carburetter Co. Ltd. was formed.

In 1939, after the outbreak of World War II, realising the importance of S U Carburetter production to the war effort, work at the Riley Plant was started to duplicate production. S U manufactured the carburetters for the Spitfires and the Hurricanes, and when the factory was damaged by two air raids on Birmingham in November 1940, the Air Ministry evacuated it to another factory at Highlands Road, Shirley. In 1941 the S U Company acquired a shadow factory in the Wharfe Valley, Yorkshire, and during these years a fuel injection pump was developed for use on Merlin aircraft.

In 1945 the production of carburetters and fuel pumps for motor vehicles was resumed and a move to the present site at Wood Lane, Erdington, Birmingham took place in July 1947. In 1952, the formation of the B.M.C. widened the market still further.

In 1965 British Motor Holdings was formed when the British Motor Corporation and Jaguar, Guy, Coventry Climax joined together.

In 1967 the S U Carburetter Co. developed and marketed a mechanical fuel pump and shortly after, an automatic enrichment device (AED).

Since then B M H and Leyland have joined forces to make the British Leyland (UK) Ltd.

During 1976 SU Carburetters' position changed and the Company became part of a division of Service & Parts known as SU/Butec, the Company title being SU Fuel Systems.

SU/Butec comprises six specialist engineering and manufacturing companies which provide a highly organised automotive components service throughout the UK, supplying carburetters and fuel pumps to many firms including Austin Morris, Triumph, Jaguar, Rolls-Royce, Rover, MG, Reliant, Volvo and Vanden Plas.

Although the basic design has altered slightly, the SU carburetter is one of the most renowned and reliable on the market.

During recent years much development has taken place in the SU carburetter design to allow vehicles to comply with even stricter exhaust emission legislation. SU Fuel Systems are continuing this development to enable vehicles to meet further tighter proposed exhaust emission legislation and also in the increasingly important field of fuel economy which has always been the forte of vehicles fitted with SU carburetters.

BASIC CARBURETTER PRINCIPLES

The majority of modern spark-ignition internal combustion engines rely on the carburetters to provide them with the finely atomized fuel/air mixture which is necessary to enable them to perform satisfactorily. It is the function of the carburetter to provide good atomization and the correct mixture strength, under all operating conditions of the engine. The method used to do this in all carburetters is to speed up the velocity of the air by means of a venturi or choke, and to use the consequent reduction of pressure in the venturi to draw fuel from the float chamber through a suitable jet orifice into the air stream. The ideal carburetter is an instrument which when correctly tuned will supply its engine with the optimum mixture for maximum power throughout the full throttle range and for minimum fuel consumption under all part-throttle conditions.

The Fixed Choke

When air is passed through a choke of fixed size its velocity and the depression over the fuel jet will vary with the demand of the engine. This varying depression makes it necessary to employ compensating devices to produce the correct fuel flow and also to impose a compromise on the choice of choke size in that, too small an orifice will produce a restriction at the top end of the output range, whilst a large orifice will lead to insensitive metering and indifferent carburation at the lower end of the range.

The Variable Choke

The principle of the variable choke carburetter is to employ a means whereby the effective choke orifice will expand as the demand increases, and contract when the demand diminishes. Such a variation in choke area will achieve a constant air velocity and depression over the jet (constant depression carburetter).

THE SU PRINCIPLE (CONSTANT DEPRESSION)

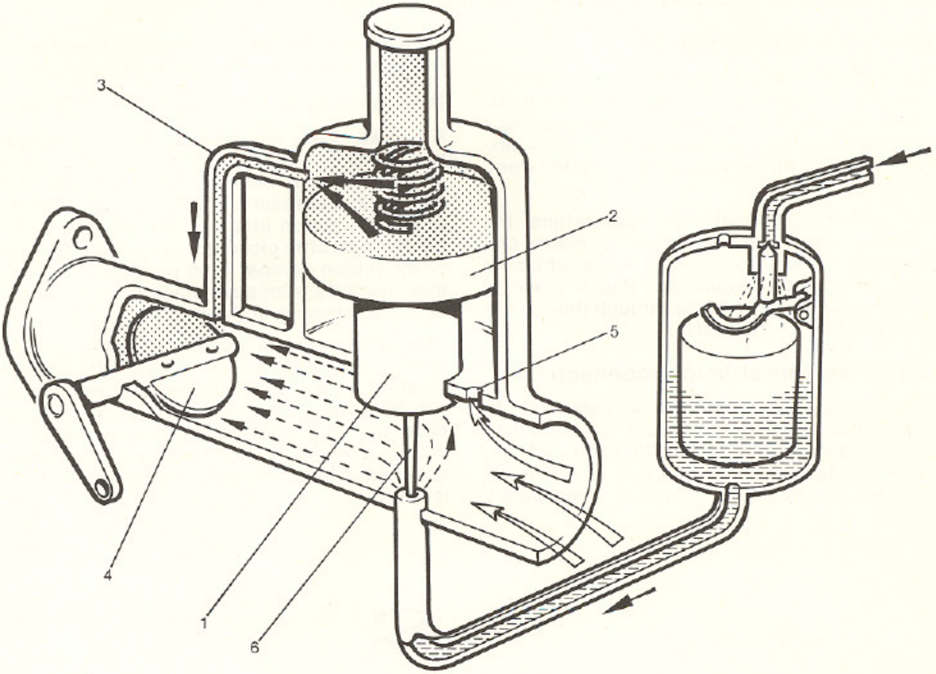

Fig 1. The SU carburetter – basic construction (theoretical)

The SU Carburetter – Basic Construction (Theoretical)

Choke

A variable choke orifice is obtained in the SU carburetter by the vertical movement of a close-fitting piston (1) (Fig. 1) positioned above the fuel jet in the centre of the body casting. A suction disc (2) is integral with the piston and works in a concentric chamber bolted to the top of the body casing.

Drillings in the under face or side of the piston, shown for simplicity as an external duct (3), communicate any depression existing in the space between the piston (1) and the throttle disc (4), to the chamber above the suction disc (2). The under side of the suction disc is vented to atmosphere or to the air cleaner by transfer holes located in the inlet flange shown simply by the drilling (5).

Jet

As the choke orifice is varied over wide limits by the movement of the piston throughout the speed range, the fuel jet orifice must also be varied. This is achieved by means of a tapered needle (6) attached to the piston and projecting into the jet. Correct discharge areas are obtained by the accurate dimensioning of this needle.

Operation

Opening the throttle disc (4) allows the manifold depression to be communicated to the body of the carburetter and also to the chamber above the suction disc. The piston will rise, allowing a mixture of air and fuel to pass underneath it to relieve the depression. The piston will continue to rise until the depression has reached a value which is just sufficient to balance the weight of the piston, together with the load exerted by the piston spring.

It will be appreciated that approximately the same depression can be obtained whatever the demand and that the piston height will be governed by the mass of mixture flowing beneath it. This depression is arranged to be of sufficient value to ensure that good atomization is obtained, but small enough to ensure adequate engine filling at high speeds.

Additions to the Basic Design (Theoretical)

Cold start mixture control

Operation of the cold start mixture control (7) (Fig. 2) will lower the jet down the needle (maximum movement 11.112 mm (7/16 in)) exposing a large annulus and so providing the rich mixtures required for the cold start and initial warm up period.

On later integral float (HIF) carburetters, the cold start enrichment is provided by means of a separate fuel path between the float chamber and the constant depression region close to the jet orifice. The fuel flow through this path is controlled by a rotary valve.

Enrichment/throttle interconnection

In all SU carburetters, as the cold start enrichment (7) is operated this in turn rotates a cam which slightly opens the throttle to give what is known as fast idle. The first part of the movement of the enrichment control gives purely movement of the throttle. Further movement of the control then provides enrichment.

Piston damper assembly

A one-way valve is incorporated in the damper plunger (11) and this is fitted in an oil-filled reservoir in the hollow piston rod (12). The piston damper assembly will restrict the rate by which the piston lifts, but will allow it to fall freely on throttle closure. The primary purpose of the piston damper is to provide the enrichment necessary for a satisfactory 'pick-up' during rapid opening of the throttle.

This enrichment is achieved by the damper retarding the speed of piston lift, thereby creating an additonal depression over the jet which increases the amount of fuel discharged. When the engine is cold, the viscosity of the oil in the damper is high and the enrichment obtained is therefore greater than when the oil is warm.

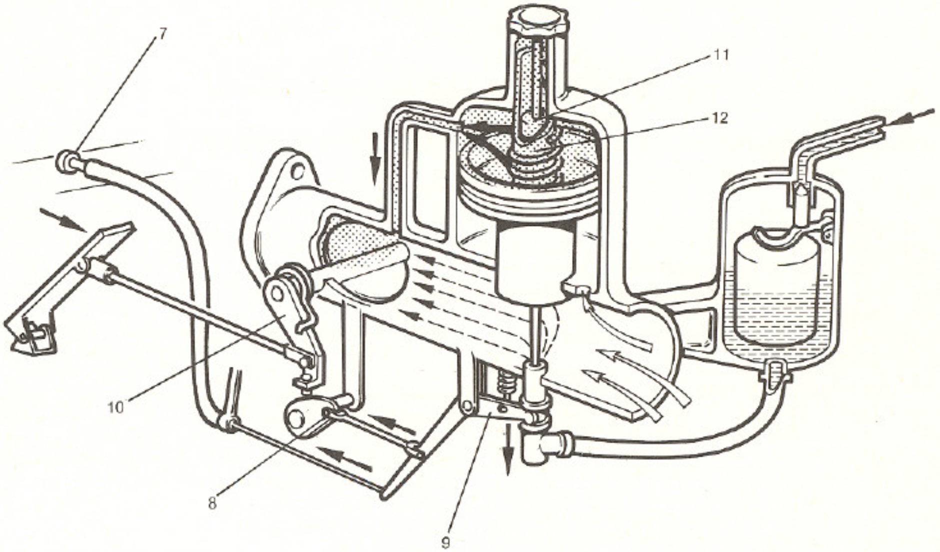

Fig 2. Additions to the basic design (theoretical)

The SU Carburetter Principle (Practical Application)

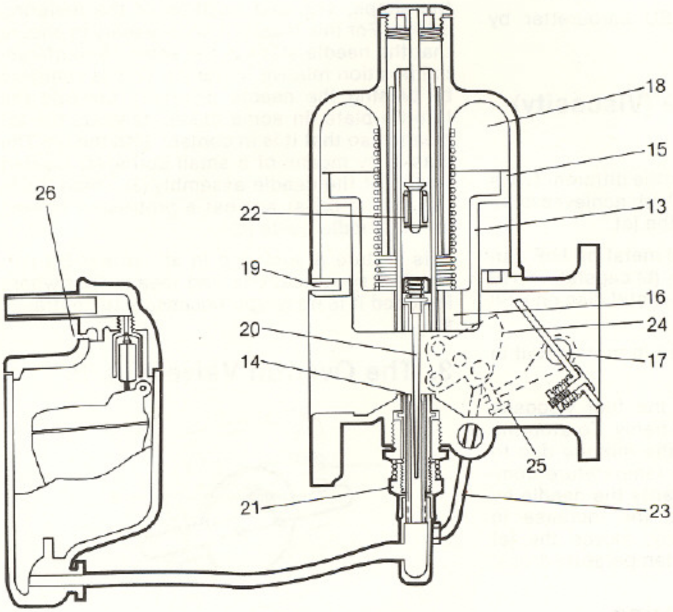

Fig 3. A section through an SU Type HS carburetter (float chamber shown out of position.)

13 Close fitting piston
14 Fuel jet
15 Suction disc
16 Depression transfer drillings
17 Throttle disc
18 Suction chamber
19 Atmospheric vent passage
20 Jet needle
21 Mixture adjusting nut
22 Hydraulic damper
23 Jet drop link
24 Fast-idle cam
25 Fast-idle screw
26 Float chamber vent

General Principle of Operation

Fig. 3 is a sectional representation of a type HS carburetter which shows how the operation of the SU carburetter is achieved in practice.

The depression is communicated to the depression chamber (18) by means of the depression transfer drillings (16) in the bottom of the piston (13).

Cold start enrichment is provided by clockwise rotation of the fast-idle cam (24), this is usually effected by a Bowden-type flexible cable which is operated from a position convenient to the driver. Initial rotation of the cam takes up lost motion built into the jet drop link and brings the cam into contact with the fast-idle screw (25). This causes the throttle to start opening. Further rotation of the cam increases the throttle opening still further and also pushes the link (23) which lowers the jet, thus providing enrichment.

Adjustment

The basic means of adjusting the carburetters are:

(a) Jet adjustment for mixture strength
(b) Slow run screw adjustment (not shown) for engine idling speed
(c) Fast-idle speed adjustment by means of fast-idle screw.

Each of these adjustments is covered in detail in the relevant servicing instruction.

EMISSION CONTROL FEATURES

As emission legislation is introduced in all parts of the world it is necessary to introduce features into the carburetter which enable the vehicle to run at lower emission levels. Also, it is most important that once a satisfactory level is reached this level will remain constant.

This is achieved on the SU carburetter by means of the following:

1. Fuel Temperature (Viscosity) Compensation

Various systems are used on the different types of SU carburetter, each of which achieves compensation by movement of the jet.

The systems used are: (a) bi-metal on HIF carburetters (standard feature); (b) capstat on HS carburetters (optional); (c) bi-metal disc on HS8 carburetters (optional).

These systems are described in more detail in the relevant literature.

As the temperature rises, the fuel viscosity lowers and fuel flows more freely. To stop the consequent enrichment of the mixture due to this characteristic, the fuel temperature compensator moves the jet towards the needle by an amount proportional to the increase in temperature, and, conversely, moves the jet away from the needle as the temperature drops.

2. Spring-loaded Metering Needle (Fig. 4)

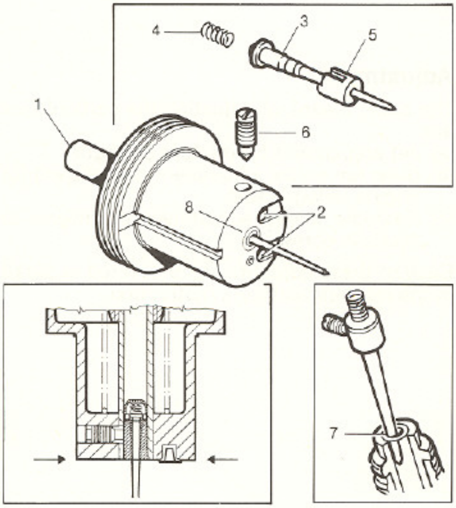

Fig 4. The spring-loaded jet needle

Fig. 4. (continued)

1 Piston rod
2 Transfer holes
3 Jet needle
4 Needle spring
5 Needle guide
6 Needle locking screw
7 Needle biased in jet
8 Etch mark

The quantity of fuel metered can be affected by the shape, size and position of the metering orifice. For this reason it is necessary to ensure that the needle stays in the same circumferential position relative to the jet. This is achieved by biasing the needle generally towards the throttle plate (in some cases, towards the air cleaner) so that it is in contact with the jet. The bias is by means of a small spring (4) located on top of the needle assembly (3) which loads the needle collar against a protrusion formed on the needle guide (5).

This feature is included in all current SU carburetter specifications and means that where included it is no longer necessary to centralize the jet.

3. The Overrun Valve (Fig. 5)

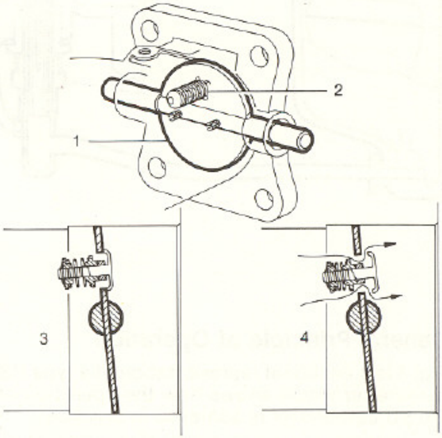

Fig 5. The overrun valve

1 Throttle butterfly disc
2 Overrun valve
3 Overrun valve closed
4 Overrun valve open

The valve consists of a precisely set, spring-loaded plate valve located in the throttle disc.

It improves combustion at high manifold depression (closed throttle overrun) conditions where the mixture might normally be too weak for complete combustion. The valve opens slightly against its spring under high manifold depression and allows a quantity of correct fuel/air mixture into the combustion chamber. This action helps to maintain correct combustion and prevents the emission of high levels of unburnt hydrocarbons.

4. Crank Case Emission Control (Fig. 6)

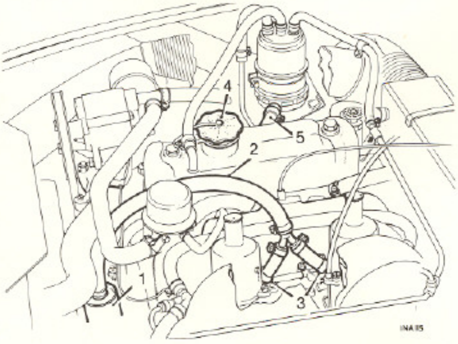

Fig 6. Crankcase emission control

1 Oil separator
2 Breather hose
3 Carburetter chamber connection
4 Filtered filler cap
5 Absorption canister breather hose

With this system the engine breather outlet is connected by hoses to the constant depression area between the piston and the throttle disc valve of the carburetter(s). Engine fumes and blow-by gases are drawn from the crankcase by the depression in this area, through an oil separator incorporated in the engine outlet connection, and from there on to the inlet manifold. Fresh air is supplied to the engine through the combined oil filler cap and filter, or, on cars fitted with fuel evaporative loss control systems, through the breather hose of the absorption canister.

5. Ball Bearing Suction Chambers (Fig. 7)

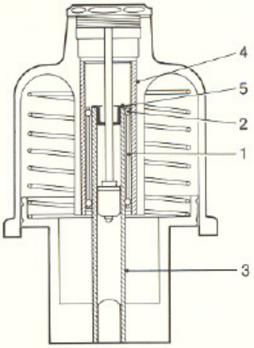

Fig 7. Ball bearing suction chamber

1 Bearing cage
2 Ball bearing
3 Piston rod
4 Piston guide
5 Bearing retention clip (early models only)

The ball bearing suction chamber is a feature which improves carburetter consistency. By introducing a nylon cage (1) with two rows of ball bearings (2) between the piston rod (3) and the suction chamber piston guide (4) the hysterisis in the piston movement is reduced. This leads to greater repeatability of emissions and engine speed especially when returning to an idling condition.

6. Tamperproofing

With the increase in emission legislation, some legislative bodies have also insisted that it should not be possible for the emission-sensitive carburetter settings to be adjusted once they have been correctly set.
With this in mind, tamperproofing has been devised for mixture adjustment and idle speed adjustment. The types of tamperproofing used are described in the relevant carburetter literature.

NOTE: It may under certain circumstances be illegal for non-qualified personnel to adjust tamperproofed settings.