Oct. 28, 1941. H. C. SEFFKER 2,260,408

APPARATUS FOR INCREASING ECONOMY OF CARBURETOR ENGINES

Filed Nov. 2, 1938 2 Sheets-Sheet 1

Fig:1.

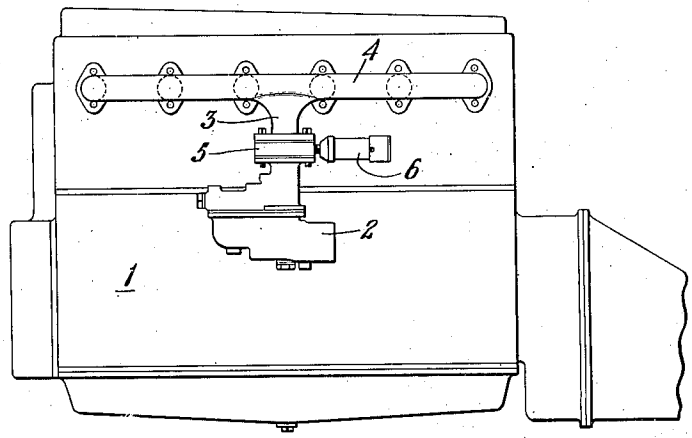



Fig:5.

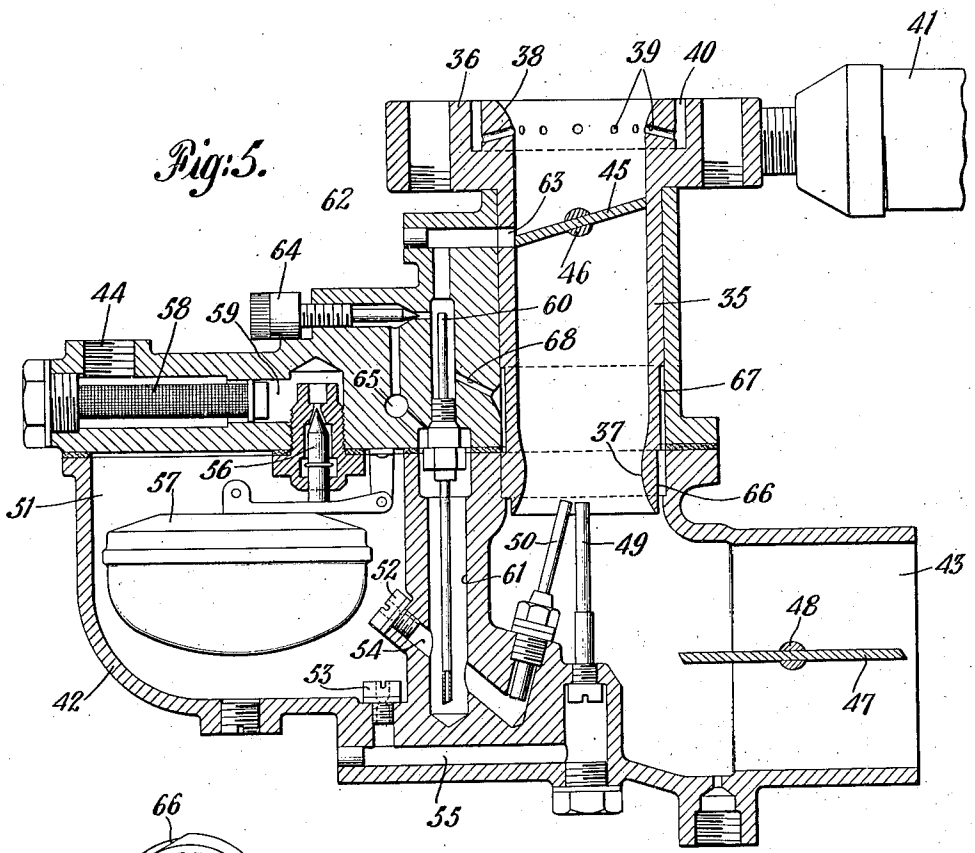
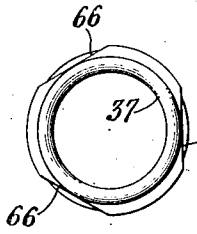



Fig:6.




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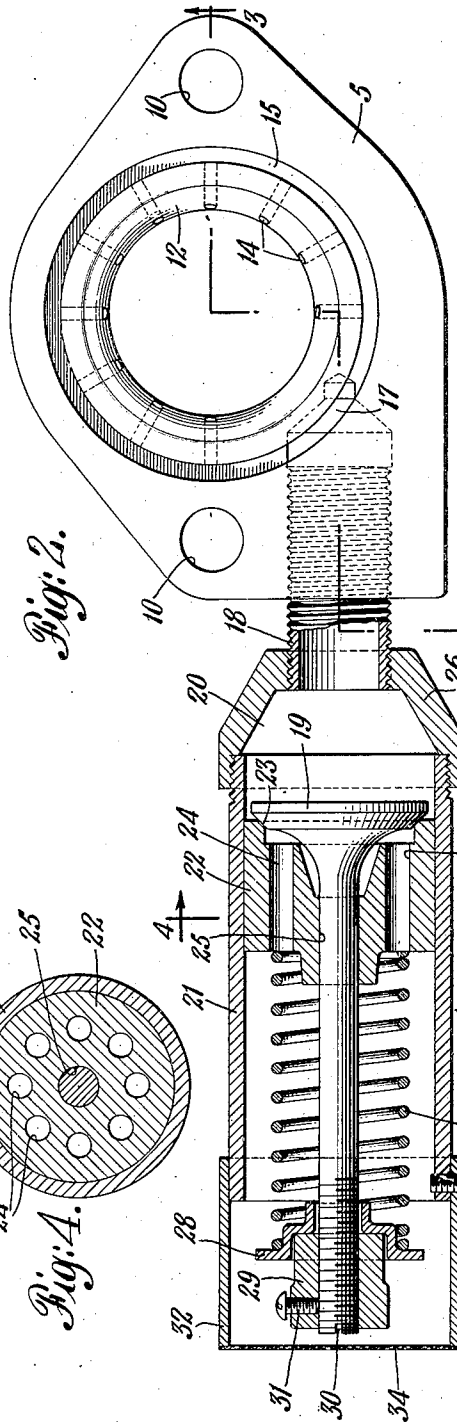


Fig. 2.



Fig. 4.

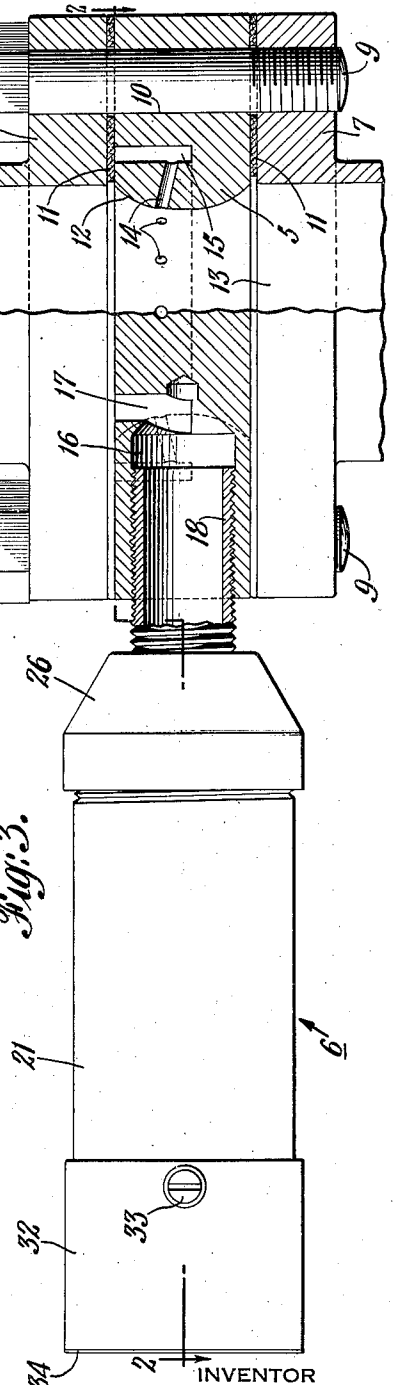


Fig. 3.

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2,260,408

## APPARATUS FOR INCREASING ECONOMY OF CARBURETOR ENGINES

Herman C. Seffker, Freeport, N. Y.

Application November 2, 1938, Serial No. 238,475

1 Claim. (Cl. 48—180)

The invention relates to a device for regulating the vacuum applied to the fuel distributing means in an internal combustion engine, and is more particularly concerned with means for so regulating the vacuum applied to the carburetor of an internal combustion engine that an excessive injection of fuel and the attendant losses in economy are avoided. The invention is particularly described in connection with its application to bus or truck engines, where high temperatures and frequent acceleration and deceleration occur, but is also applicable to other engines in which there is a variation in the vacuum applied to the fuel controlling device.

In the operation of motor vehicles, when the motor is running at a substantially constant speed, such as when running under normal conditions or when idling, the engine applies a vacuum of about 19 inches of water to the carburetor. Under such conditions the required amount of fuel is drawn into the intake manifold and there distributed to the various cylinders.

The carburetor of an internal combustion engine normally is provided with a butterfly or other valve of such a size as to leave an opening through which a small quantity of fuel may be drawn when the motor is idling, thus avoiding stalling of the motor on deceleration.

When the motor is suddenly decelerated for example from the normal driving speed to idling speed, the vacuum builds up very rapidly to about 23 to 25 inches. It then takes an appreciable time for the vacuum to return to normal. During this period of high vacuum, an excessive amount of fuel is drawn into the intake manifold, resulting in a loss of fuel and a dilution of the crank case oils and other losses in economy. The high vacuum also tends to draw lubricating oil up into the cylinder where it combusts, causing further losses in economy and undesirable odors.

Attempts have been made heretofore to overcome this objection by the use of mechanically actuated valves operating in conjunction with the throttle. Such controls, however, are subject to the disadvantage, among others, that they are not actuated in accordance with the objectionable tendency to be overcome.

Attempts have also been made to provide for the admission of auxiliary air by valves responsive to increased vacuum occurring on deceleration. Certain arrangements heretofore devised for this purpose have been improperly located to produce the desired operating efficiency. Others are objectionable also because the air is admitted at a single point or in a manner which does not provide a smooth and responsive regulation of the vacuum. It is an object of the present invention to provide means for controlling the vacuum in an intake system for internal combustion engines, but which overcomes the disadvantages referred to.

A general object of the invention is to provide improved means for regulating the vacuum applied to the carburetor or other fuel supply. It is also an object to provide an arrangement whereby the improvement will be effective equally upon all cylinders of the motor and will be regulated in accordance with the objectionable tendency to be overcome.

A further object is to provide means for controlling the expansion of carbureted fuel before it enters the manifold to provide increased economy of operation either apart from, or in conjunction with, other means for regulating the vacuum.

Other objects and advantages of the invention will appear as the description proceeds.

I have discovered that marked operating economies can be effected, and other improvements obtained, by providing an intake system which comprises a Venturi throat designed to produce two stages of expansion. A similar result can be obtained with the use of two Venturi throats suitably positioned with respect to each other and to the carburetor jets. The distance between the centers of the two throats, or between the starting points of the two expanding stages, appears to be critical in the attainment of optimum conditions of operation. The tests which I have performed indicate that this distance should be about 4 to 5 inches in the case of gasoline engines operating normally at a vacuum of 19 inches of water. This distance appears, moreover, to remain substantially constant for a given pressure differential even with different sizes of carburetor, i. e., with carburetor venturis of different diameters. Thus it appears that the ratio between the normal vacuum in inches of water to the distance in inches between the starting points of the two expanding stages preferably should be maintained at about 4 to 1. This ratio is of course susceptible to some variation by reason of differences in carburetor design, but it will be found that best results are obtained if the aforesaid ratio be maintained at between 3.5 to 1 and 5 to 1.

I have found, moreover, that the second, or upper, expanding stage should be located beyond, or above, the throttle plate or other throttle

valve. In accordance with my invention, the auxiliary air which is admitted when the vacuum increases to a predetermined amount (as upon rapid deceleration), is drawn in at a point adjacent the second or final expanding stage. This point is above the throttle valve and preferably at—or only slightly beyond—the starting point of the expanding stage referred to, i. e., in the throat of the Venturi passage.

In my preferred embodiment the auxiliary air is admitted around the periphery of a Venturi throat, as by means of a series of apertures distributed around the throat and leading to a common source of air through a vacuum-operated valve. Thus, when the vacuum reaches a predetermined amount, the auxiliary air will be drawn in adjacent the point where the carbureted fuel enters the final stage of smooth, or controlled, expansion.

I have found that in order to maintain the desired ratio of air to fuel under conditions of abnormal vacuum such as encountered upon rapid deceleration, it is important to have a particular relationship between the area of the Venturi throat and the combined areas of the auxiliary air inlet apertures. In the case of ordinary gasoline engines, the most desirable fuel ratio is recognized to be on the order of 13.5 volumes of air to one volume of fuel. However, when, upon sudden deceleration, the vacuum mounts from a normal of around 19 inches of water, to 23 or more inches, this ratio is not maintained. I have discovered that the desired fuel ratio can be more closely maintained when the combined areas of the air inlet apertures in the Venturi throat is made to equal about 1/30 of the area of the throat; that is to say, the preferred ratio of the throat area to the combined areas of the peripheral apertures is about 30 to 1.

In the drawings,

Fig. 1 is a side elevational view of an internal combustion engine, showing the carburetor and intake manifold, and illustrating the application of my invention thereto.

Fig. 2 is a plan view, partly in central horizontal section (as indicated at 2—2 in Fig. 3), illustrating an auxiliary Venturi throat and auxiliary air inlet device constructed in accordance with the invention, and adapted to the practice of my novel method. Fig. 3 is a side elevational view of the same device, showing the Venturi throat in vertical section as indicated at 3—3 in Fig. 2. Fig. 4 is a detail sectional view on the line 4—4 of Fig. 2.

Figs. 5 and 6 show another embodiment of the invention, Fig. 5 being a vertical sectional view of a conventional carburetor to which the novel Venturi throat and auxiliary air device have been applied, and Fig. 6 being a bottom plan view of the Venturi tube.

Referring to the drawings, Fig. 1 shows a general arrangement of apparatus embodying my invention as applied to an automobile engine. The engine is indicated generally by the reference numeral 1. The apparatus which will be described is used in conjunction with a carburetor 2 of conventional design and construction, arranged in communication with the riser 3 of an intake manifold 4. An auxiliary air inlet device 5 embodying a Venturi passage is arranged between the riser 3 and the throttle valve or butterfly valve of the carburetor. A vacuum-actuated air valve 6 is employed in conjunction with the auxiliary air inlet device 5.

The auxiliary Venturi air admission device 5 and cooperating vacuum valve 6 are shown in more detail in Figs. 2, 3, and 4 to which reference will now be made. In the embodiment illustrated, the device is clamped between the attaching flange 7 of the carburetor 2 and the cooperating flange 8 of the manifold riser 3 by means of stud bolts 9 passing through the flange 8 and apertures 10 in the Venturi member 5, and being threaded into the flange 7. Suitable gaskets 11 may be arranged between the cooperating faces of the Venturi member 5 and flanges 7 and 8.

The Venturi member 5 has a throat 12, the walls of which flare outwardly from a central portion thereof both toward the point where they meet the entrance to the riser 3 of the manifold and where they meet the passage 13 of the carburetor. Leading into the Venturi throat 12 are a series of air inlet passages 14 which are preferably inclined at a slight angle to a plane which is normal to the axis of the throat. These passages are distributed around the periphery of the venturi and their outlets are located in a plane which is adjacent the central portion of the throat or only slightly toward the exit side thereof, i. e., at or only slightly beyond the starting point of the outward flare of the throat 12 toward the exit side thereof. Thus air drawn in through the passages 14 enters the stream of carbureted fuel adjacent the point where the stream begins to expand into the riser 3. The passages 14 are joined by a common header 15 whcih conveniently may be formed by milling a circular groove from either the upper or the lower face of the member 5. In the embodiment illustrated, I have shown this groove as being formed from the upper face of the Venturi member. It will be observed that the header 15 is sealed off at the upper face of the member 5 by the gasket 11 which, as previously described, is clamped between this upper face of the Venturi member and the complementary face of the manifold riser flange 8. It will be understood that the header 15 can be formed in any other desired manner, although it is preferable to employ the construction just described because of its simplicity and ease of fabrication. It is particularly advantageous to have the passages 14 distributed around the periphery of the Venturi throat, and the location of these passages in the throat is important in attaining certain of the objects of the invention.

A passage 16 joins the header 15 at 17, this passage extending outwardly through the side walls of the member 5. This passage 16 preferably is tapped to receive a threaded nipple 18 or other suitable connection for the vacuum controlled valve 6 which now will be described.

In accordance with my preferred construction, the vacuum operated air inlet comprises a poppet-valve 19 arranged to resiliently seal the chamber 20 from the atmosphere. The poppet-valve 19 may conveniently be enclosed in a cylinder 21 having a partition member 22 secured therein. The partition 22 is milled or otherwise formed to provide a valve seat 23; drilled or otherwise formed to provide air inlet passages 24; and drilled or otherwise formed to provide a valve stem hole or guide 25. The end of the cylinder 21 may be provided with a threaded connection to the head 26 which in turn may be threaded to receive the nipple or other connection 18. Surrounding the stem of the valve 19 is a coil spring 27 seating at one end against the partition 22 and at the other end against the spring seat 28 which loosely surrounds the stem of the valve.

The position of the spring seat **28** is adjustable by means of the sleeve or nut **29** which has a threaded engagement with the end of the valve stem. If desired, the end of the valve stem may be slotted at **30** for engagement by a screw-driver to facilitate adjustment of the compression of the spring **27**. A set screw **31** may be provided to maintain the sleeve **27** in its adjusted position. In my preferred construction, the cylinder **21** is of such a length as to permit the spring seat **28** and sleeve **29** to project beyond the end thereof to facilitate the adjustment of the compression of the spring. A cap **32** is arranged to be slipped over the end of the cylinder to completely enclose the valve mechanism once the adjustment has been made. The cap may be retained in place by means of the screw **33**. The top of the cap **32** is formed by a screen **34**, or other air filtering means may be attached at this point if desired.

In the embodiment illustrated in Figs. 5 and 6, the invention is shown as applied to a typical carburetor for an automotive engine. In this construction, the carburetor venturi is replaced by a Venturi sleeve **35** formed as an integral part of the auxiliary Venturi air admission device **36**. The sleeve **35** is provided at or near its lower end with a constricted throat portion **37** forming the main carburetor venturi. At its upper end, the sleeve is flared outwardly as at **38**, which in effect forms an extension of the throat **37** providing a second stage of expansion for the carbureted fuel. The auxiliary air admission device **36** may be similar in construction to the member **5** described in connection with Figs. 2 and 3, embodying inlet passages **39** and a header **40** communicating with a vacuum actuated valve mechanism of which only a portion of the casing is shown at **41**. The construction of this valve may be the same as has been described with reference to Figs. 2, 3 and 4.

In order that the invention may be more fully understood, I shall describe briefly the cooperating elements of the particular carburetor construction selected for illustration. It consists generally of a housing **42** provided with an air intake passage **43** and a fuel intake passage **44**. The valve plate of the throttle is shown at **45**, being mounted on a shaft **46** connected to the manual and foot controls. The air shutter plate **47** operated by the shaft **48** provides the usual strangler valve or "choke." When the throttle plate is turned to open position, the vacuum created in the engine draws air in through the passage **43** and gasoline through the main jet **49** and cap jet **50**. The gasoline supply is drawn from the reservoir **51** through the compensating jet **52**, main jet regulator **53** and the communicaating passages **54** and **55**. The fuel supply in the reservoir **51** is controlled by the valve **56** and cooperating float **57**, the construction and operation of which is well known to those familiar with the art to which the present invention pertains. Fuel entering the carburetor at **44** passes through a cylindrical screen **58**, discharging from the interior thereof to the passage **59**.

An idling jet **60** may be provided, being arranged to draw fuel from the well **61** and to discharge it through the passages **62** communicating with the Venturi sleeve **35** through an aperture **63** therein. The aperture **63** may be so designed and placed with reference to the throttle plate **45** as to permit fuel to be drawn in from the idling jet above the plate when the latter is in the closed position shown in Fig. 5. The idling mixture is controlled by a suitable needle valve **64** arranged in communication with an air passage **65** communicating with the atmosphere. The passage **65** also communicates with the well **61** so that fuel in this well will be open to the atmosphere.

The lower end of the sleeve **35** is cut away at **66, 66, 66** (see Fig. 5 and particularly Fig. 6), providing air passages between the lower carburetor body and the annular depression **67** in the sleeve, which in turn communicates with a passage **68** leading to the chamber for the idling valve **60**.

As an example of the application of the invention to a particular size of carburetor, I shall refer to the use of a normal 2 inch carburetor wherein the throttle plate shaft is positioned 3⅜ inches above the lower end of the venturi. This venturi is first removed and the diameter of the throttle plate passage in the upper carburetor body is enlarged sufficiently to receive the sleeve **35**. For this particular carburetor, this sleeve will be provided with a Venturi throat 1½ inches in diameter which at the exit side joins smoothly with a throttle plate passage 1⅝ inches in diameter. The auxiliary air is admitted through ten radial passages arranged as indicated in Fig. 2 each having a diameter of $\frac{3}{32}$ inch. It will be understood that the diameter of these passages is subject to variation; also that a greater number of passages of smaller diameter may be employed, or a lesser number of larger diameter. These radial passages intersect the throttle plate passage adjacent the start of the final stage of smooth expansion which, in this specific example, is located 4 inches above the center of the lower Venturi throat. Beyond this point the passage flares outwardly to a diameter of 2¼ inches. It will be observed that in accordance with this specific example, a nominal 2 inch carburetor actually employs a 1⅝ inch throttle plate and would nominally be described as a 1⅝ inch carburetor. This means that an engine employing a nominal 2 inch carburetor of conventional construction would, in accordance with the present invention, employ a nominal 1⅝ inch carburetor. It is essential that the admission of auxiliary air and the second expanding stage be located above the throttle plate.

Extensive tests of the invention described, as applied to automotive busses, have been made under my supervision and these tests indicate that the invention is capable of effecting an improvement in fuel economy of from 8% to %, with a substantial decrease in the quantity of obnoxious fumes discharged. The improvements which are obtained in accordance with the invention are particularly apparent as applied to street car busses or other vehicles where frequent acceleration and deceleration are encountered.

Those skilled in the art will understand that my invention can be employed in conjunction with carburetors and manifolds of widely varying design and construction. The auxiliary venturi and air admission device described in connection with Figs. 1 to 4 inclusive can be employed without making any changes in the carburetor or manifold, it being merely necessary to insert the device between the connecting flanges of the carburetor and manifold. The form illustrated in Figs. 5 and 6 may require some minor changes in the carburetor in order to maintain the desired distance between the carburetor venturi and the point of admission of the auxiliary air, or between the two stages of expansion. Thus the carburetor attaching flange may be removed or cut down to a certain extent, and, if

necessary, the throttle plate passage in the upper carburetor body may be machined to enlarge the diameter thereof. The usual carburetor venturi is removed in order to permit insertion of the sleeve **35** with its Venturi throat **37**.

It will also be understood that the auxiliary venturi and air admission device shown in Figs. 5 and 6 may be built into carburetors as manufactured, in which case the sleeve **35** might be formed as an integral part of the upper carburetor body if so desired. Other modifications will suggest themselves to carburetor specialists and I do not wish to be limited to the particular constructions shown in the drawings.

The terms and expressions which I have employed are used as terms of description and not of limitation, and I have no intention of excluding such equivalents of the invention set forth, or of portions thereof, as fall within the purview of the claim.

I claim:

An attachment for internal combustion engines which comprises a sleeve for insertion between the carburetor and manifold, said sleeve having a Venturi passage at its lower end and an outwardly flared portion at its upper end, apertures arranged in communication with the interior of the sleeve near its upper end, an air inlet valve, and a header connecting said apertures to the air inlet valve, the sleeve having substantially cylindrical smooth inner walls throughout the distance between the Venturi passage and the outwardly flared portion.

HERMAN C. SEFFKER.