Jan. 28, 1941. E. G. REID 2,229,819

CARBURETOR

Filed Nov. 4, 1937

FIG. 1.

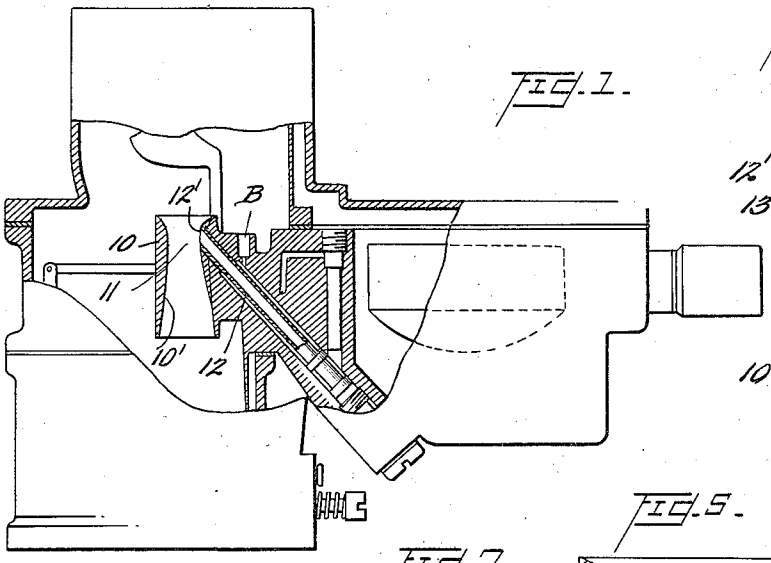


FIG. 4.

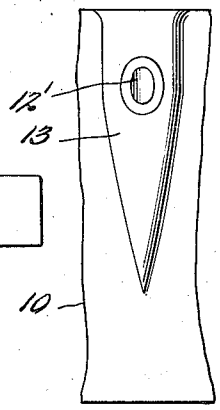


FIG. 2.

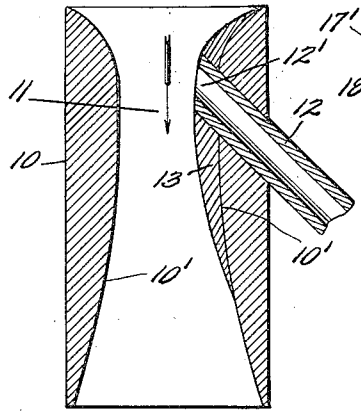


FIG. 7.

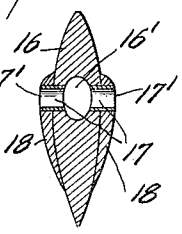


FIG. 5.

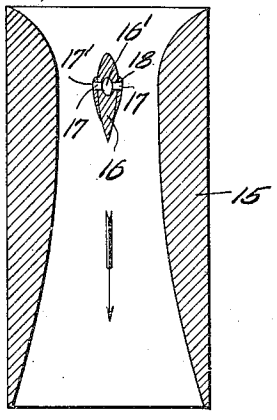


FIG. 6.

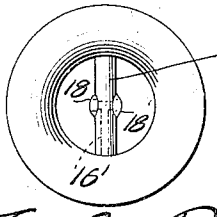
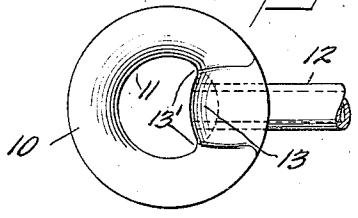


FIG. 3.



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UNITED STATES PATENT OFFICE

2,229,819

CARBURETOR

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Application November 4, 1937, Serial No. 172,788

4 Claims. (Cl. 261—76)

The present invention relates to carburetors and particularly to carburetors of the type widely made use of as charge forming devices for internal combustion engines and embodying, as essential elements, one or more fluid mixing tubes of the Venturi type.

The Venturi tube has long been employed in the industrial arts as a means for effecting the mixture of liquid fuels with air, the air being caused to flow rapidly through the tube and the liquid being introduced laterally into the tube intermediate its ends. The liquid flow is induced, the liquid being under atmospheric pressure and the pressure within the tube being less than atmospheric pressure, the reduction in pressure within the tube resulting from the transformation of the potential or pressure energy of the air into kinetic or velocity energy, as is well-known.

In practically all types of present-day carburetors Venturi tubes are employed, and in the usual case the nozzle through which the liquid fuel is introduced is so disposed that its discharge end projects within the interior of the Venturi tube, it having been discovered that the suction at the tip of a discharge nozzle which projects either radially or obliquely some distance into the throat of a Venturi tube is greater than that which would exist if the tip of such nozzle were flush with the wall of the Venturi tube. While carburetors with discharge nozzles projecting into their Venturi tubes have been very widely used with generally satisfactory results, such arrangements have, nevertheless, certain disadvantages which, while not heretofore considered to be so serious as to outweigh the obvious advantages of this type of construction, are nevertheless substantial. Thus the inwardly projecting fuel delivery tube comprises an obstacle to the smooth flow of air through the throat, causing the flow in the vicinity of the inwardly projecting tube to be disturbed, and thus creating a turbulent wake which has the effect of decreasing the effective cross-sectional area of the expanding portion of the Venturi tube.

The present invention has for its object the provision of a carburetor of the general type just above briefly described, in which the liquid discharge nozzle projects into a Venturi throat, but which is provided with means in association with this inwardly projecting portion of the nozzle for eliminating the recited disadvantages in operation and which results in improved performance of the carburetor as a whole. Thus the invention contemplates the use, in close association with the inwardly projecting nozzle, of a "fairing" or streamlined protuberance which bears such relation to the duct and throat that not only are the objectionable turbulence and consequent effective restriction which would otherwise result from this inward projection in substance eliminated, but there are caused to exist in the immediate vicinity of the fluid discharge orifice an increased air velocity and a decreased air pressure. The augmented velocity and suction arise from the compounding of the effects of reducing the resistance to flow through the Venturi tube and of so shaping the protuberance as to further increase the velocity of the improved flow in the immediate neighborhood of the fuel orifice.

The augmented suction which results from the use of the added element, i. e., the streamlined protuberance or fairing associated with the mixing device, results in improved fuel atomization particularly when the engine with which the carburetor is associated is operating at low speed and under relatively light load. It is well known that, under these conditions, the amount of air which can be drawn in and mixed with the liquid fuel before the latter reaches the tip of the discharge nozzle determines the fineness of the resulting fuel spray and that this amount is, in turn, controlled by the amount of excess suction, over and above that required to draw in the necessary fuel, which is available for the purpose. The augmentation of the suction by this improvement thus enables a finer atomization of fuel than has heretofore been possible under comparable conditions and therefore results in improved fuel economy under this critical condition.

Likewise the creation of a greater suction at the mouth of the discharge nozzle in a venturi of given form and diameter, without restricting the air flow through the carburetor, makes it possible to use, with any given internal combustion engine, a carburetor having a throat of somewhat increased cross-sectional area without at the same time sacrificing the low speed, light load operation characteristics of the engine. The importance of this factor will be appreciated by those skilled in the art because they will realize that in the design of the modern internal combustion engine, which must function over wide ranges of speed and load, the use of a carbureting device which offers the least restriction to the flow of air to the engine is preferred if the maximum high speed torque and

power capacities are to be realized but that, in order to obtain satisfactory low speed operation of the engine, the carburetor throat construction must be smaller than that which would be most satisfactory for high speed operation.

By the use of the invention decidedly increased economies in the use of liquid fuel are realized, particularly at lower engine speeds. The invention is applicable to various types of carburetors, including both those in which the liquid component of the fuel mixture is introduced by means of a duct the discharge orifice of which is located laterally of the axis of the Venturi throat and close to the wall thereof, and those in which the fluid discharge orifices are elsewhere positioned, for instance in the approximate center of the restricted throat. In every instance, however, the invention contemplates the use of a streamlined element or fairing which extends longitudinally of the Venturi section, which fairing is closely associated with the discharge orifice of the liquid duct, added element or fairing having the effect of augmenting and increasing the suction in the vicinity of the discharge orifice of the duct while at the same time decreasing the turbulence of the outflowing gaseous fuel in the expanding portion of the Venturi mixing tube and posterior to the discharge orifice of the liquid duct.

In the accompanying drawing two arrangements are illustrated by way of example and will be hereinafter more particularly described.

In the drawing:

Figure 1 is a side elevation of a complete carburetor of a type with which the invention may advantageously be employed, portion of the wall of the carburetor being broken away in order that its interior construction may be more clearly perceived;

Figure 2 is a longitudinal section through the small or secondary Venturi tube of Figure 1;

Figure 3 is an end view of the same;

Figure 4 is an elevation of portion of the inner wall surface of the same Venturi tube, showing the fairing and discharge orifice;

Figure 5 is a longitudinal section through a second type of carburetor embodying the invention;

Figure 6 is an end view of the same; and

Figure 7 is an enlarged sectional view through the liquid discharge ducts of the mixing device shown in Figures 5 and 6.

The invention may be made use of as an element of any carbureting device in which an air and liquid mixing tube of the Venturi type is employed and it is deemed unnecessary to illustrate and describe all features of a carburetor in order that a full understanding of its construction, manner of use, and advantages, may be obtained. The carburetor may include one, two, or more Venturi tubes or it may perform the same function by the use of an obstruction in a passage of arbitrary form and its other elements may be modified in design and arrangement as may be desired. The carburetor which is rather diagrammatically illustrated in Figure 1 is of the well-known Stromberg type now widely used as a carbureting device for automobile engines, including that manufactured by the Packard Motor Car Company and employed as a power plant for its Model 120 motor vehicle. The carburetor shown is of the downdraft type, the air stream flowing downwardly through the same after passing through an air cleaning device positioned above the carburetor (not illustrated) and from the lower end of the carburetor passing to the intake manifold of an engine (also not shown). In this type of carburetor, air is drawn in through the "bleeder" orifice B and mixed with the liquid fuel in the discharge tube **12**.

The secondary Venturi tube is indicated generally at **10** and the contour of its inner surface is such that its zone of least air pressure is adjacent its upper end, or slightly in advance of its section of greatest restriction, which section is indicated at **11**. The discharge tube is indicated at **12** and is shown to extend upwardly and inwardly toward the axis of the throat and to project into the throat for a short distance beyond the curved inner wall surface of the throat, which surface is indicated at **10'**, the discharge orifice of the nozzle or discharge tube **12**, which orifice is indicated at **12'**, being in the zone of least air pressure. The flow of air downwardly through the Venturi tube will result in the upward flow of liquid through the tube **12** in well-known manner and this stream of fuel will entrain the air which enters through the orifice B. Associated with the duct **12** is the fairing **13** comprising a longitudinally extending rib-like protuberance, projecting into the throat of the Venturi tube and extending from the leading or inlet end of this tube to a point well toward its discharge end. This fairing is a streamlined member which increases in depth or thickness, measured radially of the tube, from its leading end to the vicinity of the discharge orifice **12'** of tube **12**, and thereafter decreases gradually in thickness toward its trailing end. In Figure 3 the fairing is shown in profile being gently curved or bowed inwardly toward the axis of the tube, smooth reverse fillets **13'** merging the surface of the fairing and the inner wall surface **10'** of the tube. In side elevation the fairing is as shown in Figure 4, being of approximately uniform width from its leading end to the vicinity of the fuel outlet port and thereafter tapering to a point. The fairing may comprise an integral portion of the tube or may be formed elsewhere and applied to the tube in the position shown.

In the modified form of the invention disclosed in Figures 5, 6 and 7 the Venturi tube **15** is provided with a transversely extending member **16** which bridges the tube in the zone of least air pressure or greatest suction. In transverse section the bridging member **16** is effectively streamlined in order to offer the least resistance to the air which flows through the tube from top to bottom. A liquid conducting conduit or bore is indicated at **16'** and this bore communicates with short tubes **17** which extend horizontally in diametrically opposite directions, the ends of these tubes being open and comprising discharge orifices spaced outwardly from the surface of member **16** from which a mixture of liquid fuel and air may issue. Associated with the projecting portion of each of these tubes is a fairing **18** which is generally similar to the fairing **13** described in connection with the form of the invention first referred to, each fairing **18** extending longitudinally of the tube from a point in advance of the discharge orifice of such tube, gradually increasing in thickness until the vicinity of discharge port **17'** is reached, and thereafter gradually decreasing in thickness until merging with the surface of cross member **16**. In horizontal profile each fairing is substantially as shown in Figure 6, being joined to the side surfaces of cross members **16** by gently curved fillets.

In each of the embodiments of the invention

which have been disclosed by way of example the fairing envelops that portion of the liquid discharge duct which would otherwise project into the Venturi tube and the discharge orifice of the liquid duct in each case may be said to be in the surface of the associated fairing. Air flow through each (Venturi) tube is unimpeded by the addition of the fairing and in fact is facilitated because of the elimination of the turbulent wake which would otherwise be present. Again the presence of the fairing actually results in an augmented suction in the tube in the zone in which the fuel discharge orifice is located.

While it is preferred that the streamlined fairing, when applied to a Venturi tube, shall bear a relationship to the tube substantially as shown in the drawing, minor variations are permissible. In each case, however, the cross-sectional area of the fairing should not exceed one fourth of the cross-sectional area of the throat of the venturi and its length should be not less than twice its maximum thickness, the thickness being measured normally to the surface to which the fairing is attached or from which it may be said to spring. In the general case the effect of the fairing is to produce a zone of lowest pressure anterior to the point of greatest throat restriction and the mouth of the fuel nozzle is most advantageously located at this point.

The invention may be adapted to still other forms and types of carburetors which employ the Venturi principle of air and liquid mixing, as will be apparent to one skilled in the art.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A carburetor including a mixing tube of Venturi form, a liquid discharge nozzle projecting into the throat of said tube, and means for decreasing the air pressure at the orifice of said nozzle without materially restricting the air flow through the tube, comprising an elongated protuberance on the wall of said tube and surrounding the projecting part of said nozzle, said protuberance extending longitudinally of the tube and being streamlined on the downstream side of said orifice, and the orifice of said nozzle being flush with the surface of said protuberance.

2. A carburetor including a mixing tube of Venturi form, a liquid discharge nozzle projecting into the throat of said tube, and means for decreasing the air pressure at the orifice of said nozzle without materially restricting the air flow through the tube, comprising an elongated protuberance on the wall of said tube and surrounding the projecting part of said nozzle, said protuberance extending longitudinally of the tube and being streamlined on the downstream side of said orifice, and the cross-sectional area of said protuberance being, in any given cross-section through the tube, a minor fraction of the cross-sectional area of the throat, the orifice of said nozzle being flush with the surface of said protuberance.

3. A carburetor comprising a Venturi tube, a discharge tube for leading liquid fuel from a source without the Venturi tube to a discharge orifice within the same and located substantially in the zone of lowest air pressure, and a member in which is located that portion of the discharge tube which is immediately adjacent the liquid fuel discharge orifice, for reducing turbulence on the downstream side of the discharge tube and locally augmenting the suction in the vicinity of the fuel discharge orifice, said member constituting a protuberance from a wall of the Venturi tube, being elongated longitudinally thereof, and being streamlined on the downstream side of said orifice, the orifice being in the surface of and flush with said member.

4. A carburetor comprising a Venturi tube, a liquid fuel supply means for delivering liquid fuel to said Venturi tube and comprising a discharge tube having an outlet orifice substantially in the zone of lowest pressure in said Venturi tube, and an elongated member extending from the wall of said Venturi tube and a portion of which surrounds said orifice and which member extends longitudinally of the Venturi tube and is streamlined on the downstream side of said orifice, the cross-sectional area of said member being, in any given cross-section through the Venturi tube, not greater than one-fourth of the area of the throat, measured in the same cross-section, and the length of said member being not less than twice its thickness, said orifice being flush with the surface of said member.

ELLIOTT G. REID.