July 21, 1936. G. M. BICKNELL 2,048,535

VENTURI STACK

Original Filed Nov. 18, 1930 3 Sheets-Sheet 1

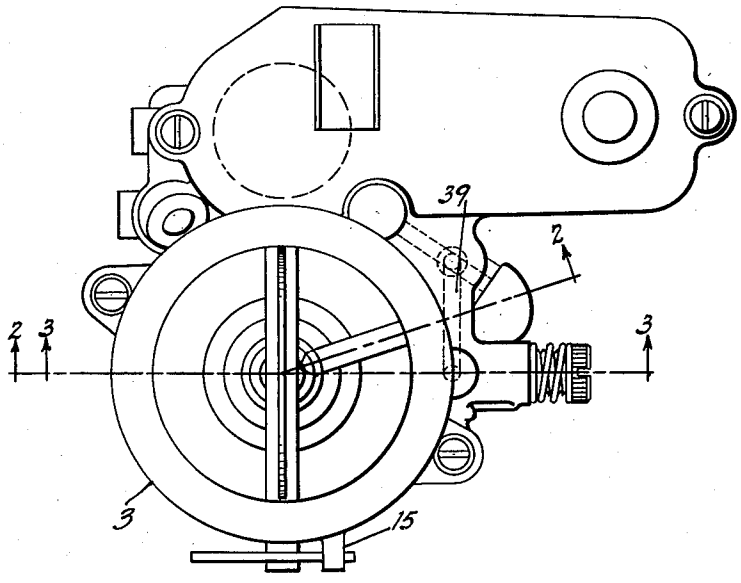


Fig. 1

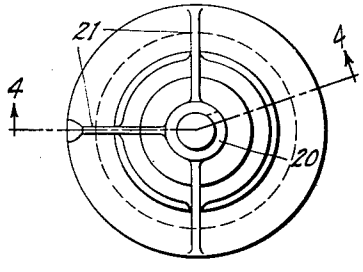


Fig. 5

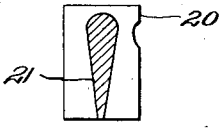


Fig. 6

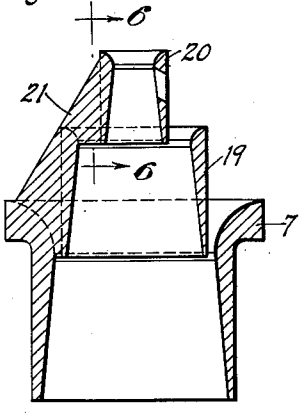


Fig. 4

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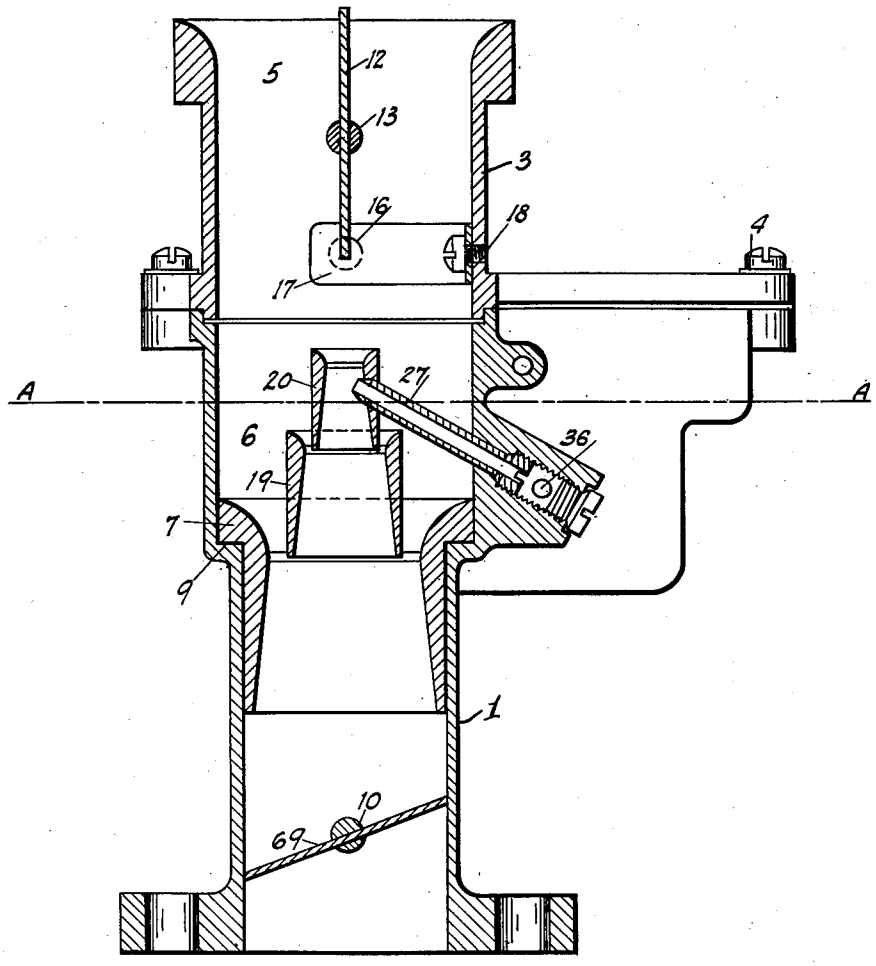


Fig. 2

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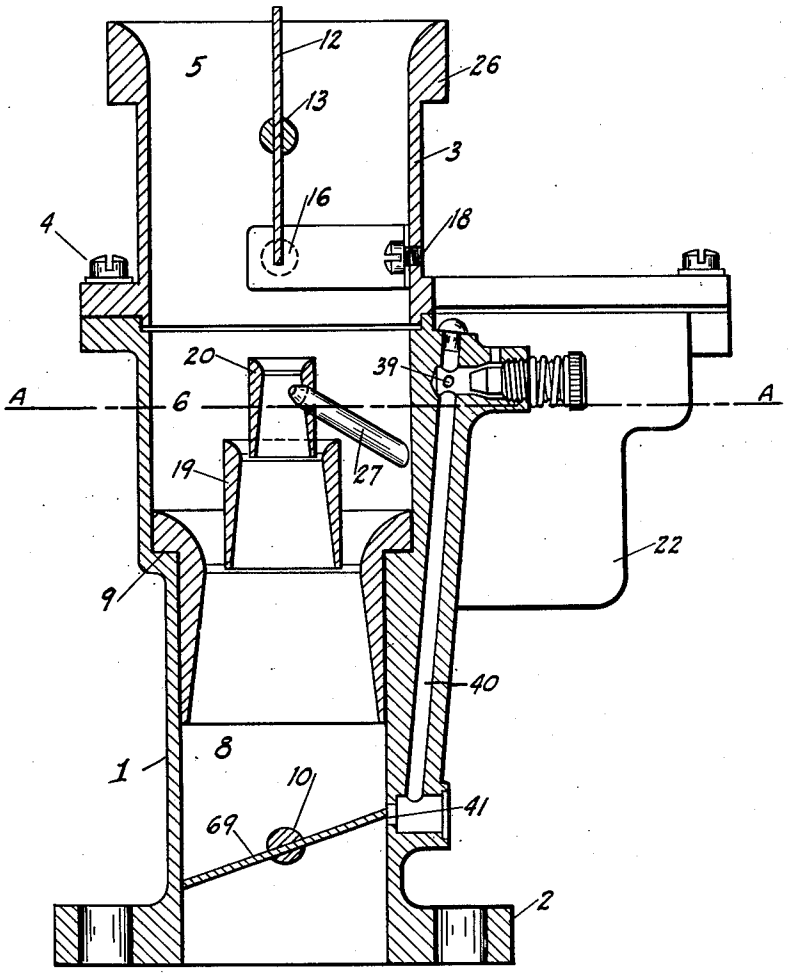


Fig. 3

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UNITED STATES PATENT OFFICE

2,048,535

VENTURI STACK

George M. Bicknell, St. Louis, Mo., assignor to Carter Carburetor Corporation, St. Louis, Mo., a corporation of Delaware

Original application November 18, 1930, Serial No. 496,396. Divided and this application April 22, 1932, Serial No. 606,803

10 Claims. (Cl. 48—180)

This application is a division of my application No. 496,396, filed November 18, 1930, for improvements in carburetors, which application has matured into Patent No. 1,858,615, granted May 17, 1932.

The object of this invention is to produce a mixing conduit for a carburetor or gas mixer having accurately formed venturis and passageways therein, and to provide a new and improved means to form said passageways, so that the carburetor or gas mixer may be manufactured in large quantities without substantial variations in the flow capacities thereof.

It is a further object of this invention to produce a new and generally improved air horn and Venturi construction for plain tube carburetors or gas mixers.

Other objects of the invention will appear from the following description and accompanying drawings, referring to which:

Figure 1 shows a plan view of a carburetor or gas mixer constructed according to my invention.

Figure 2 shows a vertical sectional view of the carburetor or gas mixer shown in Figure 1, the section being taken along the line 2—2 of Figure 1.

Figure 3 is a vertical sectional view of a carburetor or gas mixer shown in Figure 1, the section being taken along the line 3—3 of Figure 1.

Figure 4 is a vertical sectional view of the Venturi construction used in the carburetor or gas mixer which is shown in the preceding paragraphs.

Figure 5 is a plan view of the Venturi construction shown in Figure 4.

Figure 6 is a fragmentary, vertical, sectional view taken along the line 6—6 of Figure 4 looking in the direction of the arrows.

The main body member of the carburetor or gas mixer is formed as a casting 1 which has a flange 2 formed on its lower end for attachment to the intake manifold of an internal combustion engine, not shown. An upper body member 3 is attached to the member 1 by any suitable means, such as screws 4. An air inlet 5 is formed in the upper body member and registers with an air chamber 6 which forms the upper end of the main air passageway through the lower body member 1.

A venturi 7 is fitted into the air chamber 6 and extends downwardly into a bore 8 which forms the mixing chamber of the carburetor or gas mixer. It will be understood that the bore 6 is larger in diameter than the bore 8, and that the two portions are joined by a shoulder or tapered portion 9 to provide means for locating the venturi 7 with respect to the length of the carburetor or gas mixer.

The lower end of the bore 8 is controlled by a throttle valve 69 mounted on a shaft 10 which is journaled in the casting 1 as shown. Any suitable operating lever (not shown) may be attached to the shaft 10 for operation by any suitable means.

An air inlet valve 12 is mounted on a shaft 13 in the upper body member 3, and any suitable operating lever (not shown) may be attached. A stop 15 is formed integral with the casting 3 and may be provided with an adjustment, if desired.

One or more openings 16 are formed in the upper body member 3 to communicate with the atmosphere, and these openings are controlled by a spring or valve member 17 which is attached to the inner wall of the air inlet 5 by any suitable means, such as a screw or rivet 18. It will be understood that the member 17 acts as a valve which may be opened by suction to permit the admission of air through the port 16.

The tension of the spring 17 is calibrated with respect to the size of the port 16 and the leakage which may occur past the valve 12, in such a way that the valve 17 will remain in closed position when the valve 12 is closed during cranking speeds of the engine, but when the suction of the engine is increased by its beginning to run under its own power, the valve 17 will be unseated and air may flow in through the port 16. Obviously, the tension required in the spring 17 will vary with different installations, but, as an illustration, the valve 17 should ordinarily remain closed at speeds below one hundred revolutions per minute of the motor, and it should begin to open at speeds in excess of that figure.

In this installation, three venturis are provided, the largest venturi 7 fitting the outer wall of the carburetor or gas mixer as shown. The second venturi 19 terminates at the throat or at the most restricted portion of the venturi 7, and the third venturi 20 terminates at the throat of the most restricted portion of the venturi 19.

To prevent eddy currents being formed in the venturis, I provide one or more vanes or straighteners 21 which extend parallel to the lines of flow and which are preferably made thicker at the inlet end then at the end adjacent the outlet of the carburetor or gas mixer. The shape of the longitudinal section of the vane is indicated in Figure 6. These vanes are mainly for the purpose of preventing the rotation of the air currents in the carburetor or gas mixer, or checking

any rotation which may have been set up in the inlet, but they are also highly useful as devices for locating the venturis with respect to each other. It will be understood that where many thousands of carburetors or gas mixers are to be produced, it is essential that the air flow characteristics in each be substantially the same. By forming the venturis and the vanes as a single die casting, I am able to secure absolute uniformity so that there is no need of separately adjusting the venturis in each carburetor or gas mixer.

A liquid fuel bowl 22 is cast integrally with the lower body member 1 and conventional mechanism, not shown, is located in this bowl for maintaining the fuel at a constant level substantially as indicated by the line A—A. The fuel is supplied to the bowl by any suitable means which, being entirely conventional, is not shown.

The fuel is supplied from the bowl to a nozzle 27 by means of a passageway 36 in the usual manner, and the passage 36 is also connected to the idling conduit 40 by means of a cross bore 39 and other connecting passages which, being unrelated to the present invention and covered in the divisional application and patent above referred to, are not shown. It may be noted, however, that the idling conduit 40 terminates in the usual idling port 41 adjacent the edge of the throttle when it is in closed position, as indicated in Figure 3.

The Venturi stack shown in Figures 4 and 5 is formed as a die casting with the vanes 21 cast integral with the venturis. This integral construction provides for extremely accurate dimensioning of the venturis with respect to each other. Accuracy in this is highly important on account of the multiplying effect of the venturis on the suction. If the venturis were made separate, what is known as the limit stack in manufacturing tolerances would cause such variations in the relation of the venturis with respect to each other in large quantity production as to make the use of multiple venturis very undesirable. It may be noted that the advantages of two and three Venturi constructions have been known for over twenty years, but the three-Venturi construction has been entirely impractical on account of difficulties in maintaining the relative sizes and relations of the parts which, in previous constructions, were made separately. This new construction has resulted in a practical construction which has been used in approximately a million installations within less than two years after it was put on the market and its success is chiefly due to the fact that the venturis were made in an integral die casting, so that the shapes and sizes of the parts in large quantity production did not vary to any great extent.

The operation of the device is as follows:

The carburetor or gas mixer is attached to the intake manifold of an engine, and fuel is supplied to the float chamber 22 by any suitable means. Assuming that the engine is to be started cold, the choke valve 12 is closed for starting purposes and the throttle valve 69 is preferably slightly open. It will be understood that linkage may be provided for causing the throttle to be slightly open when the choke valve is closed, but said linkage is not a part of this invention and need not be further described.

Upon operation of the engine at cranking speeds, say, fifty revolutions per minute, a strong suction acts on the nozzle 27, causing a very rich fuel mixture to be supplied to the engine. When the engine begins to fire, and run under is own power, its speed will substantially increase, and the increased suction will cause the opening of the valve 17 to permit the admission of sufficient air through the port 16 to supply the requirements of the engine and to prevent the engine being stalled by too rich a mixture, which would probably occur if all the suction caused by the engine operating under its own power were permitted to act on the nozzle 27. After the engine is started, the valve 12 is gradually opened, and the free admission of air to the air inlet 5 is permitted.

Assuming that the throttle 69 is in open position, air flows through the venturis 20, 19, and 7, and the most rapidly moving part of the air stream flows through the venturi 20. The speed of this rapidly moving air being increased by the restriction at the throat of the venturi 20, a strong suction on the end of the nozzle 27 is caused, serving to draw fuel out of that nozzle in proportion to the speed of the air stream at low speeds, and at high speeds the normal tendency of the fuel nozzle to over-richness is overcome in two ways. First, the increasing impact of the air against the fuel issuing from the nozzle and the partial reversal of the flow of fuel which is caused to occur in the venturi 20 partially corrects the normal tendency of this nozzle to increase the richness of the mixture as a whole at high speeds. The tendency toward increasing richness at high speeds is further counteracted by the fact that the flow ratios between the venturis 20 and 19 and 7 tend to change, as the speed increases, in favor of the larger venturis.

In modern carburetors or gas mixers, the high capacity which is so greatly desired necessarily involves comparatively large venturis and air passageways and correspondingly low suctions available to draw fuel from the nozzle during low speed operation with wide open throttle. With this construction, the difficulty of getting enough fuel at low speeds when the throttle is open is overcome, to a great extent, by the fact that the impact of air against the outlet of the nozzle 27 at low speeds is very much less than at high speeds and, accordingly, I am able to use a comparatively large metering jet which permits the free flow of fuel at the low speeds and yet does not give too much fuel at high speeds on account of the economizing action of the impact of the air stream against the fuel which is discharged from the nozzle 27. It will be understood that it is not only the impact of the air striking against the fuel which retards it, but also the suction is lowered by the fact that the velocity of the air is slightly reduced by the inertia of the fuel which it must overcome.

During low speed closed throttle operation, the carburetor or gas mixer obtains its fuel through the port 41 in a well known manner, and as the throttle is gradually opened, the nozzle 27 is kept from coming into operation until the port 41 begins to go out of operation by reason of the fact that the suction from the port 41 is communicated to the nozzle 27 through passages 36, 39, etc. By this arrangement, the nozzle 27 is permitted to come in only gradually as the idling supply goes out gradually.

The invention is not limited in details to the structure shown but may be modified in various respects as will occur to those skilled in the art and the exclusive use of all such modifications that come within the scope of the appended claims is contemplated.

I claim:

1. In a device of the class described, means forming a mixing conduit, a plurality of co-axial venturis mounted in said conduit, and means for preventing the rotation of the air stream as it passes through said venturis, comprising one or more longitudinally extending vanes adjacent said venturis.

2. In a device of the class described, means forming a mixing conduit, a plurality of co-axial venturis mounted in said conduit, and means for preventing the rotation of the air stream as it passes through said venturis comprising one or more longitudinally extending vanes adjacent said venturis, said vane or vanes being formed integral with at least one of said venturis.

3. In a device of the class described, means forming a mixing conduit, a plurality of co-axial venturis mounted in said conduit, and means for preventing the rotation of the air stream as it passes through said venturis comprising one or more longitudinally extending vanes adjacent said venturis, said venturis being formed as an integral casting.

4. In a device of the class described, means forming a mixing conduit, a plurality of co-axial venturis mounted in said conduit, and means for preventing the rotation of the air stream as it passes through said venturis comprising one or more longitudinally extending vanes adjacent said venturis, said vane or vanes and said venturis being formed as an integral casting, and said vane or vanes being of substantially greater thickness at the end adjacent the inlet of the mixing conduit than at the opposite end.

5. A nest of venturis comprising a unitary die casting, the outlet end of one of said venturis terminating near the most restricted portion of the next venturi, and an air straightener comprising a vane extending longitudinally with respect to said venturis and integral therewith.

6. A fluid conduit having an inlet of comparatively large diameter and an outlet of comparatively smaller diameter, a plurality of co-axial venturis in said conduit, said venturis being connected by one or more vanes, said vane or vanes and venturis being formed integrally with each other.

7. A nest of venturis comprising a main venturi, a secondary venturi having an outlet extending to and terminating at a point near the throat of said main venturi, the inlet of said secondary venturi being substantially anterior to the inlet of said main venturi, a plurality of vanes formed integrally with said venturis and holding them in fixed relation with respect to each other, said vanes being of great length and comparatively little thickness, the leading edge of said vanes extending from the inlet end of the secondary venturi to the inlet end of the primary venturi and the trailing edge of said vanes terminating substantially at the throat of the main venturi.

8. In a device of the class described, a primary venturi, a larger venturi, said venturis being co-axial with each other and said primary venturi being mounted anterior to the larger venturi so that the outlet of the primary venturi extends to and terminates in the throat of the larger venturi, one side of the primary venturi having a nozzle-receiving opening therein, a plurality of vanes connecting said primary venturi with said larger venturi, said vanes being of comparatively great length in comparison with their thickness, the leading edge of said vanes connecting the entrances of said venturis, and the trailing edge of said vanes extending from the outlet of the primary venturi to the throat of the larger venturi.

9. A device of the class described in claim 8 and further characterized by the provision of three vanes, said nozzle opening being located between two of said vanes and the third vane being substantially diametrically opposed to the nozzle opening.

10. A nest of venturis comprising a main venturi having a flange surrounding its inlet end, a secondary venturi extending into the inlet end of said main venturi and terminating substantially at the throat thereof, a primary venturi extending into said secondary venturi and terminating substantially at the throat thereof, said venturis being co-axial, a plurality of vanes connecting said venturi and forming straightening devices to prevent the rotation of the stream of fluid flowing thru said venturis, said vanes being of great length compared with their thickness, the leading edges of said vanes connecting the inlet ends of said venturis, the trailing edges of said vanes connecting the outlet end of the primary venturi with the throat of the secondary venturi and connecting the outlet end of the secondary venturi with the throat of the main venturi, and a nozzle opening formed in said primary venturi.

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