

March 10, 1959

L. M. GOODRIDGE ET AL

2,877,003

TANGENTIAL NOZZLE TYPE CARBURETOR

Filed June 22, 1955

5 Sheets-Sheet 1

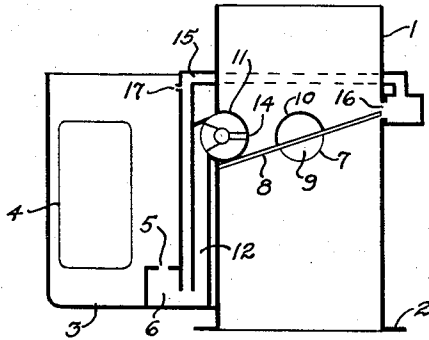


FIG. 1.

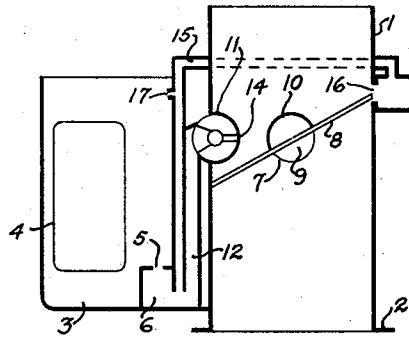


FIG. 2.

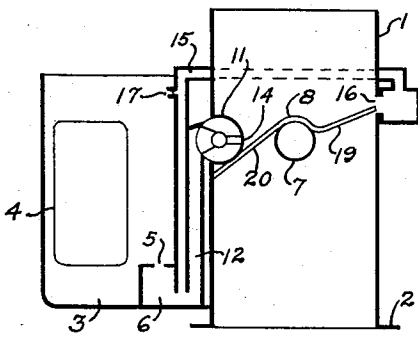


FIG. 3.

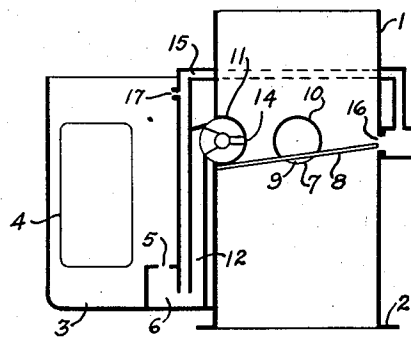


FIG. 4.

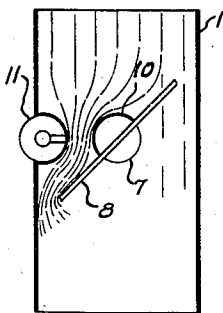


FIG. 5.

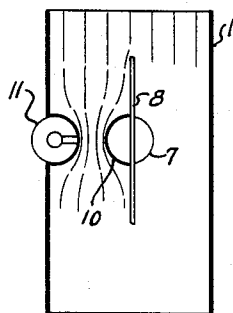


FIG. 6.

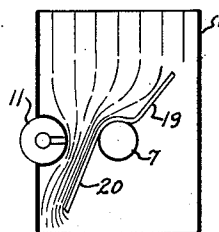


FIG. 7.

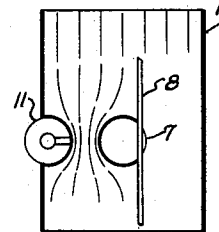


FIG. 8.

INVENTOR.  
LAURENCE M. GOODRIDGE  
CHARLES L. MARTIN

BY *George R. Evans*

ATTORNEY

March 10, 1959

L. M. GOODRIDGE ET AL

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5 Sheets-Sheet 2

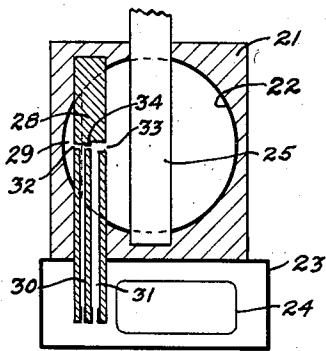


FIG. 9.

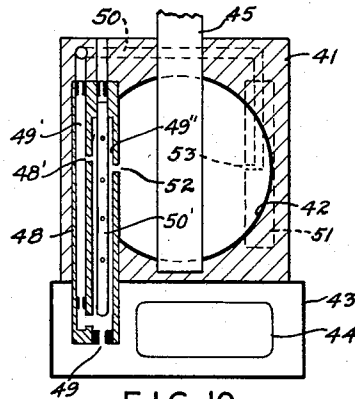


FIG. 10.

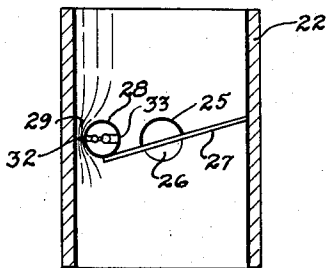


FIG. 11.

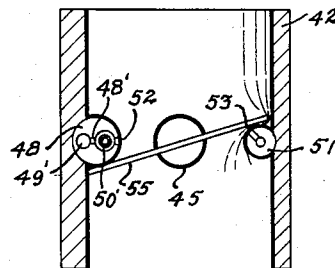


FIG. 12.

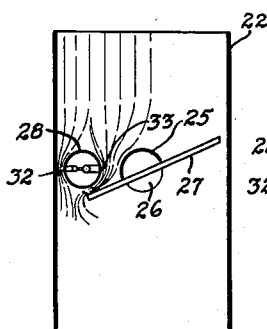


FIG. 13.

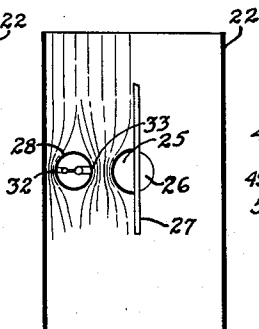


FIG. 14.

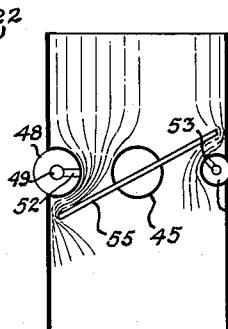


FIG. 15.

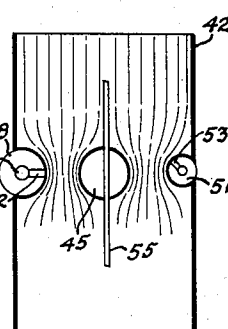


FIG. 16.

INVENTOR.  
LAURENCE M. GOODRIDGE  
BY CHARLES L. MARTIN  
*George R. Eucason*

ATTORNEY

March 10, 1959

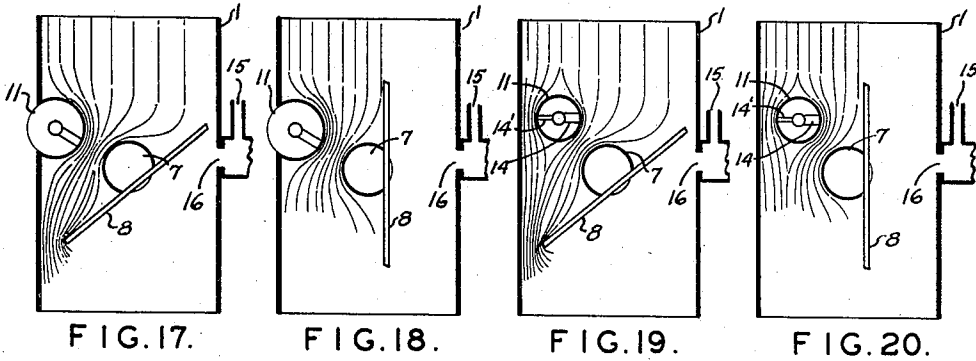
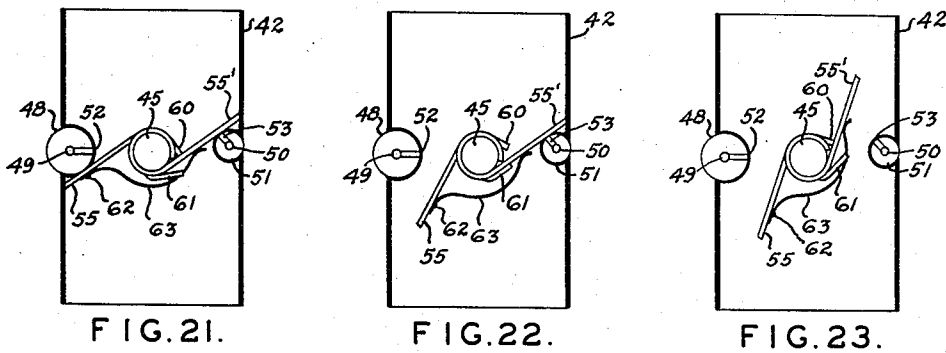
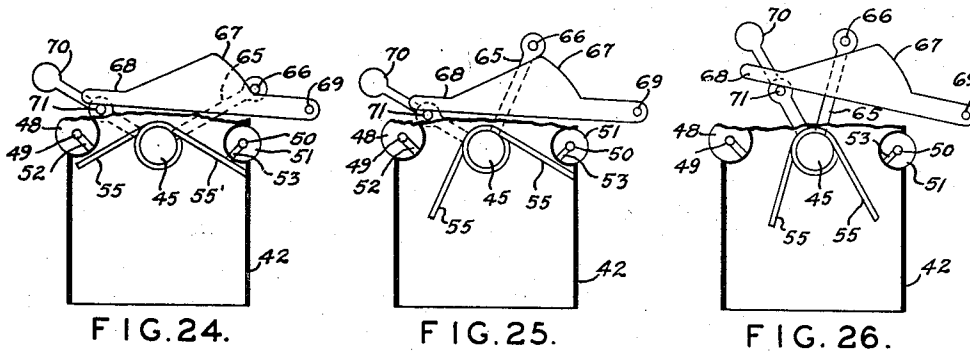
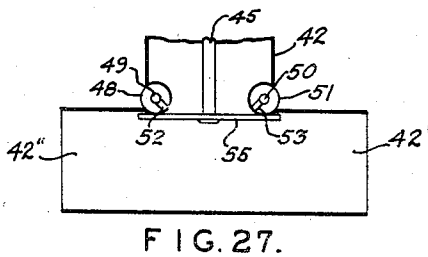
L. M. GOODRIDGE ET AL

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TANGENTIAL NOZZLE TYPE CARBURETOR

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INVENTOR.  
LAURENCE M. GOODRIDGE  
CHARLES L. MARTIN  
BY *George R. Everson*

ATTORNEY

March 10, 1959

L. M. GOODRIDGE ET AL

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TANGENTIAL NOZZLE TYPE CARBURETOR

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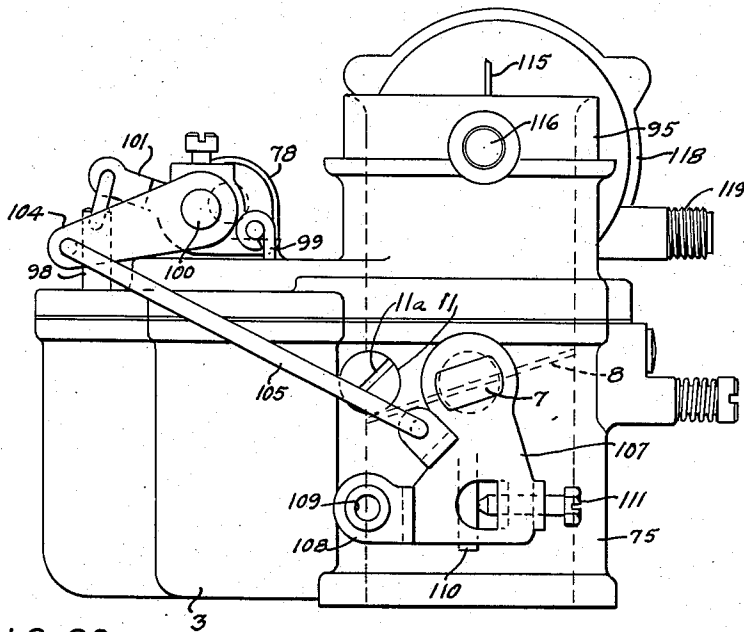


FIG. 28.

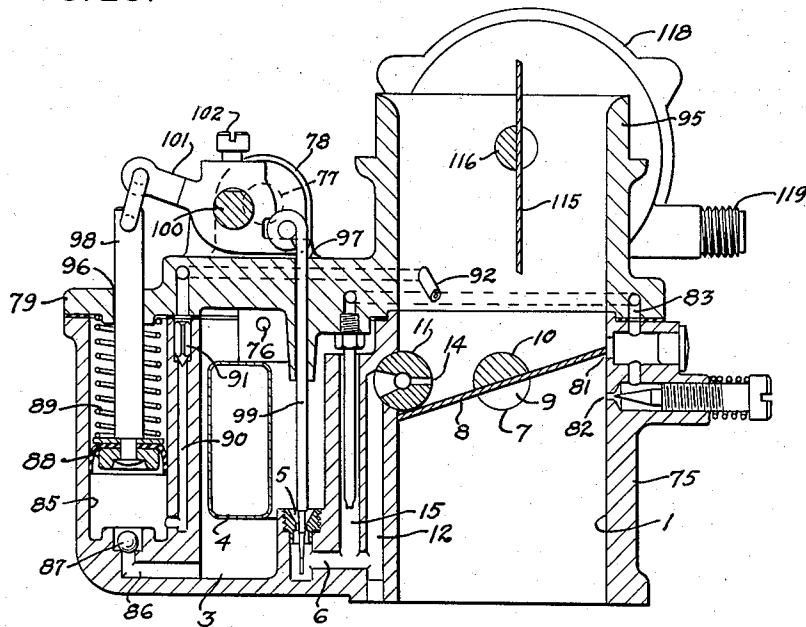


FIG. 29.

INVENTOR.  
LAURENCE M. GOODRIDGE  
CHARLES L. MARTIN  
BY *George R. Eucom*  
ATTORNEY

March 10, 1959

L. M. GOODRIDGE ET AL

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TANGENTIAL NOZZLE TYPE CARBURETOR

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5 Sheets-Sheet 5

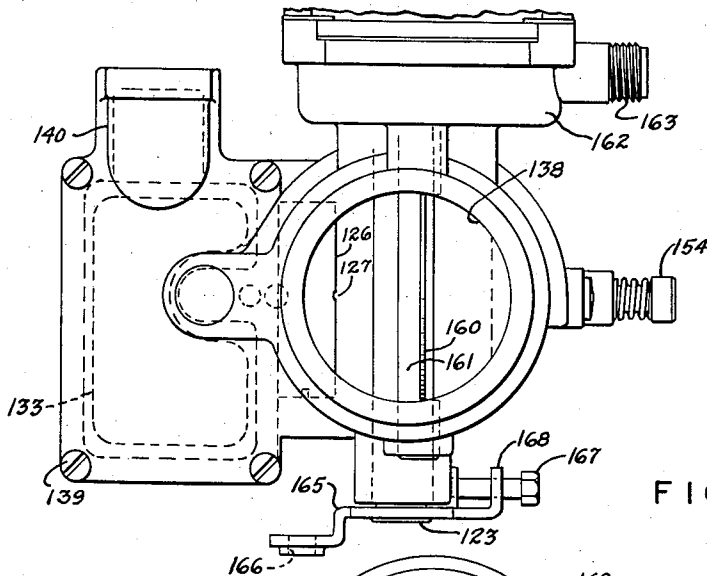


FIG. 30.

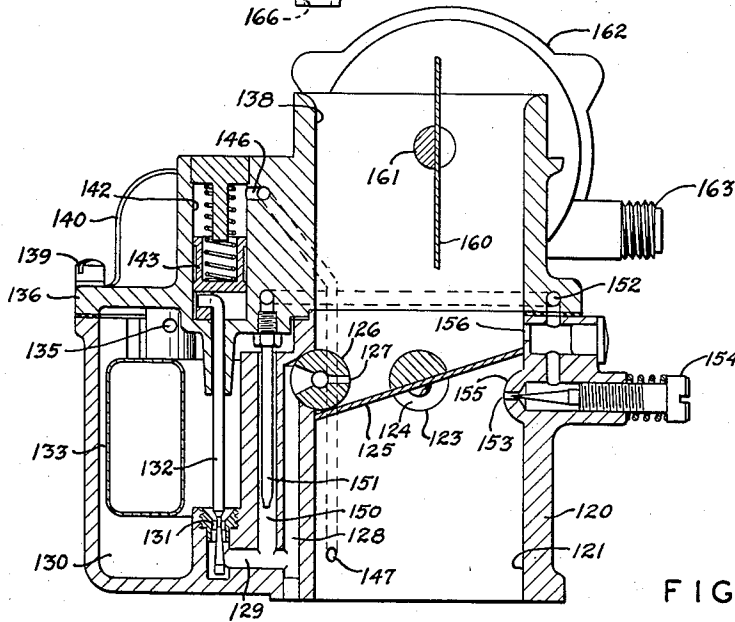


FIG. 31.

INVENTOR.  
LAURENCE M. GOODRIDGE  
BY CHARLES L. MARTIN

*George R. Encarn*

ATTORNEY

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2,877,003

## TANGENTIAL NOZZLE TYPE CARBURETOR

Laurence M. Goodridge, Clayton, and Charles L. Martin, Berkeley, Mo., assignors, by mesne assignments, to ACF Industries, Incorporated, New York, N. Y., a corporation of New Jersey

Application June 22, 1955, Serial No. 517,262

22 Claims. (Cl. 261—62)

This invention relates to carburetors for internal combustion engines and, more specifically, to a new type having a compact and simple construction and operating on the principle of both the fixed venturi type and variable venturi type of carburetor.

Carburetors now used on motor vehicles are usually of the down-draft type and comprise three parts or sections such as a throttle body with a mixture conduit containing the throttle valve, a main body containing the fuel bowl and including another part of the mixture conduit with the venturi and main fuel nozzle, and an extension for the mixture conduit in the form of an air horn containing the choke valve. These parts or sections are serially arranged and, when superimposed, occupy a considerable space.

The present trend in motor car engines is toward engines with increased displacement, higher engine top speeds, and increased torque throughout the engine speed range. This trend has resulted from a popular demand for better motor car performance within the useful range of operating speeds, and, as will be explained, has a distinct effect on carburetor design.

Increases in displacement mean larger engines, but space limitations require a compact power package. This has been a deciding factor in the adoption of V-8 engines. Larger engines with higher top speed and engine requirements for better aspiration to increase torque throughout the speed range dictate the use of carburetors with greater capacity and multi-barrel, multi-stage design for better performance over the full range of engine speeds. Both greater carburetor capacity and multi-barrel arrangement mean larger carburetors.

The V-8 engine requires the location of the carburetor on top of the engine in the space available between engine and hood. This space has been reduced by style changes lowering the hood line, so that the space available has become smaller as both engines and carburetors have become larger.

These changes in motor cars make compactness in carburetor design imperative, but there are certain limits in compactness which cannot be reached or exceeded with present carburetor assemblies.

The present invention solves the problem of compactness by utilizing the throttle valve to perform the function of the venturi in prior constructions, thereby eliminating the section of the carburetor containing the venturi and main fuel nozzle. According to this invention, a convex, cambered surface containing a fuel nozzle or discharge port is disposed transversely of the mixture conduit adjacent a pivoted butterfly type of throttle valve, so that air flow past the fuel nozzle will be modified by both the cambered surface and the position of the throttle valve plate itself and/or the throttle shaft upon which that plate is mounted. In its simplest form, the cambered surface referred to can be a round, hollow tube disposed tangentially of the mixture conduit opposite the usual type of pivoted butterfly throttle valve, and so spaced with respect to the throttle plate or valve

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as to form therewith an orifice or throat for constricting the lines of air flow to form, in effect, a variable type of venturi between the valve or its shaft and the peripheral surface of the tube in any partially open position of the valve. In the full open position of the valve, the venturi-like orifice is formed between the throttle valve or the throttle valve shaft and the tubular surface. The tube referred to is supplied with fuel and is apertured to form a fuel nozzle facing the throttle valve or shaft.

There are certain advantages besides compactness to be found in a fuel-air mixing device constructed along these lines. All the advantages of the fixed type and the variable venturi type of carburetor are obtained without an increase in mechanical complexity. In fact, the carburetor is much simpler, having fewer mechanical parts, than any now known of the fixed venturi type. Like the variable venturi type of carburetor, as the throttle opens, the size of the orifice or throat of the venturi increases until near wide-open throttle position is reached. In the later stages of throttle opening, the orifice or throat size becomes fixed, causing air velocity to increase directly with engine speed and corresponding decreases in static pressure adjacent the fuel discharge port to enrich the mixture.

This invention is capable of many variations and modifications. In one of these modifications, a pair of tangentially arranged fuel nozzles in the form of hollow tubes can be used in conjunction with a manually controlled throttle valve to obtain all of the advantages of a dual carburetor arrangement within a single mixture conduit. The throttle valve in such a modification may be so arranged in the mixture conduit as to place one of the tubular nozzles anterior, and the other posterior, of the throttle. The two tubes may be interconnected to form a single fuel supply system for idle and high speed. With this system, at least one of the nozzles functions continuously, thereby eliminating the effect of transfer points on engine operation.

Other modifications of this invention contemplate other arrangements of the tubular nozzle or nozzles spaced in other ways from the throttle valve or the wall of the mixture conduit.

In addition, this invention contemplates other modifications involving changes in the shape or mounting of the throttle valve so as to obtain different flow characteristics in both open and closed positions of the throttle valve due to its changing relationship with tangentially located fuel nozzles.

Further modifications of this invention are contemplated in which multiple throttle valves operate in cooperation with multiple fuel nozzles to obtain the functions and characteristics of a multi-stage carburetor.

The accompanying drawings illustrate the construction and operation of devices which operate according to the invention above described.

In the drawings,

Fig. 1 is a diagrammatic view showing a down-draft type of carburetor constructed according to this invention.

Fig. 2 is a similar view of a modification of the device shown in Fig. 1.

Fig. 3 is a similar view of another modification of the device in Fig. 1.

Fig. 4 is a similar view of still another form of the invention.

Figs. 5 and 6 illustrate the air flow in a device such as that disclosed in Fig. 1 at part throttle and full throttle, respectively.

Fig. 7 is a schematic representation illustrating the air flow through the modification illustrated in Fig. 3.

Fig. 8 is a schematic representation illustrating the air flow in the modification shown in Fig. 4.

Fig. 9 is an end view of a carburetor constructed according to the present invention having a horizontally arranged mixture conduit.

Fig. 10 is a view similar to Fig. 9 showing another modification.

Fig. 11 is a schematic representation of the air flow through the mixture conduit in Fig. 9.

Fig. 12 is a schematic representation of the air flow through the mixture conduit of the carburetor of Fig. 10 in the idle position of the throttle.

Fig. 13 is a view similar to Fig. 11 showing the throttle valve partially open.

Fig. 14 is a view similar to Fig. 11 showing the throttle valve fully open.

Fig. 15 is a view similar to Fig. 12 showing the throttle valve partially open.

Fig. 16 is a view similar to Fig. 12 showing the throttle valve fully open.

Figs. 17 and 18 are schematic representations illustrating the air flow in another modification.

Figs. 19 and 20 are schematic representations illustrating the air flow in still another modification.

Figs. 21 to 23 diagrammatically illustrate a modified form of throttle valve.

Figs. 24 to 26 illustrate still another modified form of throttle valve and its operation.

Fig. 27 illustrates a modification using another type of throttle.

Figs. 28 and 29 illustrate a carburetor constructed according to the modification shown in Fig. 1.

Figs. 30 and 31 illustrate a carburetor with a modified form of fuel system.

In order to convey an understanding of the principle of operation involved in this invention, reference is made first to Figs. 1, 5 and 6, which illustrate diagrammatically one basic arrangement of structural elements functioning according to these principles.

In Fig. 1 is shown a carburetor having a cylindrical mixture conduit 1 provided with a flange 2 for securing the carburetor to the engine or to the intake manifold of the engine, as the case may be. Formed integral with the mixture conduit is a fuel bowl 3 within which is pivotally mounted a float 4 for controlling the usual needle valve in the fuel supply line connection to the fuel bowl 3. The action of the float 4 and its valve (not shown) is to maintain a substantially constant fuel level within the fuel bowl 3, all as well understood in the art of carburetors. (See patent to Eberhardt, 2,668,696, of February 9, 1954.)

Adjacent the bottom wall of the fuel bowl 3 is a main fuel metering orifice 5 which controls the rate of flow of fuel from the fuel bowl 3 to a well 6, which supplies the fuel nozzles.

Within the mixture conduit 1 is a throttle shaft 7 to which is secured a throttle valve or plate 8. Attention is particularly called to the fact that part of the shaft 7 is cut away at 9 to accommodate the valve plate 8, which leaves the half-round portion 10 of the shaft exposed on the upper side of the throttle plate 8.

Fuel tube 11 is mounted transversely of the mixture conduit 1 with its center line or axis parallel to the throttle shaft 7 or valve 8 and tangentially located with respect to the inner wall of the mixture conduit 1. It may be well to point out in passing that the spacing between the fuel tube 11 and the throttle shaft 7, and the size of each, directly affect carburetor calibration, and must be determined by the usual test procedure for a particular size of engine.

Extending from the well 6 is a main mixture passage 12 which connects with the interior of the fuel tube 11. One or more fuel discharge ports 14 are formed in the exposed surface of the fuel tube 11. These can be arranged in any desired position by so constructing the

device that the fuel tube 11 is rotatable. Thus it is possible to have the discharge ports face downwardly, so that, when the throttle valve is slightly open, one or more will be subject to the velocity of air between the surface of the fuel tube and the upper surface of the plate 8, and thereby furnish the mixture for engine idling conditions. Since the tube 11 may be rotated, it is possible to interconnect the tube and the throttle shaft 7 so that, as the throttle 7 is opened, the position of the fuel discharge ports 14 can be adjusted to take maximum advantage of the flow characteristics for any throttle opening. However, in the particular modification illustrated, a separate idle system is shown which comprises a tube 15 extending into the fuel well 6 and around the mixture conduit to an idle port 16 adjacent the opposite edge of the throttle 8. The idle tube may have an air bleed or bleeds such as illustrated at 17.

Fig. 5 is a schematic representation illustrating the effect on the stream lines of air flow produced by the construction in Fig. 1 when the throttle is partially open. The air flow entering the mixture conduit 1, presumably in parallel lines, is split by the upper edge of the throttle plate 8. Some of the flow will pass through the crescent-shaped opening formed by the upper edge of the throttle plate 8 with the interior of the mixture conduit wall, and thereby by-pass the nozzle throat during its passage through the mixture conduit 1 to the engine. Most of the flow lines, however, will be deflected by the upper edge of the throttle plate 8 in a direction towards the half-round exposed area 10 of the throttle shaft 7, and the similarly shaped outer surface of the fuel tube 11. The throat formed between the throttle shaft and the fuel tube causes the flow lines to converge as they pass through this opening or throat so that the flow is restrained to follow the cambered surfaces on the throttle shaft 10 and on the fuel tube 11. Below the throttle shaft and tube, the flow lines are restrained and held in compressed relation by the upper surface of the throttle plate 8 and the lower surface of the fuel tube 11, and, as can be seen, the flow lines are bent around the fuel tube 11 by the action of the throttle plate 8. The flow lines turn again as they exit through the discharge passages formed between the lower edge of the throttle plate 8 and the conduit wall 1. The mixture conduit may take any desired form, but, where the conduit 1 is round, this exit will be a crescent-shaped opening.

This type of flow will have a marked effect upon velocity of the stream and, of course, likewise upon static pressure. Thus, where the stream lines begin to converge above the fuel tube and throttle shaft 7, the flow is gradually accelerated until it passes through the first throat formed between the fuel tube 11 and the throttle shaft 10. Depending upon the degree of throttle opening, if the second throat between throttle plate 8 and the fuel tube 11 is smaller than the first throat, the flow will continue to accelerate. Fig. 5 shows the throats approximately the same size, but at smaller throttle openings the second throat would be of less area. Since the flow lines are held converged until they pass the lower edge of the throttle plate 8, the velocity will remain high throughout the passage of air past the throttle plate 8, and, as will be pointed out later, this has a novel effect upon the feeding of fuel from the tube 11.

Where the flow lines are converged, the velocities will be high and the static pressure will be low. In addition to this effect, the throttle plate 8 has an additional function augmenting the first. As will be noted from a close consideration of Fig. 5, the flow lines are bent during their travel generally about the surface of the fuel tube 11. This function is, of course, produced by the underlying or lower edge of the throttle plate 8, which deflects the flow lines from right to left. When the stream lines of flow converge and at the same time are bent over a

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cambered surface, then the maximum obtainable drop in static pressure will occur, for this is exactly what happens to the stream lines of flow in passing over the upper surface of an airplane wing.

Fig. 6 is a schematic representation of the flow lines through the mixture conduit 1 when the throttle plate 8 is wide open. This view illustrates the simple convergence of the flow lines as they pass between the throttle shaft 7 and the fuel tube 11. As therein illustrated, the flow lines entering the mixture conduit 1 split, some passing through the unrestricted side on the righthand side of the throttle plate 8, and others passing down through the throat formed between the fuel tube and the throttle shaft. At high engine speeds, the static drop in pressure is adequate to provide sufficient fuel and, at the same time, the maximum capacity of pounds of air delivered per instant of time for a given pressure drop between the entrance and exit of the mixture conduit 1 is increased some 15 to 20 percent over the fixed venturi type of nozzle now used.

Flow tests run on the construction shown in Fig. 1 have revealed some unusual characteristics of this device. In the first place, the fuel leaving the discharge port 14 spreads laterally along the entire length of the fuel tube 11, and flows from the tube in the manner of a cascade. Of course, the spreading of the fuel in this manner forms a very thin liquid, increasing the exposure to air flow so that the fuel is readily atomized as it reaches the turbulent area of flow about the lower edge of the throttle plate. The fuel becomes so finely divided that it is very difficult to see when mixed with the flow beyond the throttle plate. There is a very marked difference between this action and that of the venturi type of carburetor, where the fuel, after it passes the throttle, is readily apparent, and resembles large drops of rain. In the second place, the construction in Fig. 1 has been found to give a static pressure curve, measured at the fuel nozzle, which climbs extremely rapidly in the part-throttle range. The full-throttle range, on the other hand, is a curve of relatively gradual slope.

In order to flatten the static suction curve for the part-throttle range, it was discovered that only a slight change was necessary in the construction. This modification is shown in Fig. 2. The corresponding parts in Fig. 2 are indicated by the same reference characters. The construction in Fig. 2 is the same as that described above for Fig. 1, except that a larger throttle plate 8 is substituted. This will have a larger inclination in the closed position, and the upper surface of plate 8 will be initially spaced from the outer peripheral surface of the fuel tube 11. This modification will produce no change in the static suction curve for the full-throttle condition, but it will produce a more gradual slope in the static suction curve for operation in the part-throttle range. It is believed that the change in the area of the throat formed between the fuel tube 11 and the upper surface of the throttle plate 8, for each part-throttle condition, from that shown in the modification of Fig. 1 is responsible for the above results. This discovery is deemed useful for calibration purposes where the particular engine requires a different mixture ratio curve, because the inclination or slope in the static suction curve can directly affect the slope of the mixture ratio curve.

In Fig. 3 is shown another manner of changing the shape of the static suction curve throughout the part-throttle range of operation. This modification is the same as that shown in Fig. 1 except for the change in the shape of the throttle plate 8 and its throttle shaft. The throttle shaft 7 in Fig. 3 is not recessed to receive the throttle plate 8, as in the prior constructions. Instead, throttle shaft 7 is solid, and the throttle plate 8 attached thereto in any suitable manner on its outer surface. The throttle plate in Fig. 3 has an upper half 19 which extends substantially radially with respect to the center of the shaft 7. The lower half of the throttle

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plate 8 indicated as 20 extends substantially tangentially with respect to the outer surface of the throttle shaft 7, and at a slight angle to the part 19 thereof.

Fig. 7 indicates schematically the nature of the air flow through the mixture conduit 1 of Fig. 3 in the part-throttle range. As will be noted from a comparison between Fig. 5 and Fig. 7, the throat in Fig. 7 is always formed between the upper surface of the throttle plate 8, that is, the portion 20 thereof, and the outer peripheral surface of the fuel tube 11. As the throttle opens, the position of this throat gradually rises until, at the wide-open position, it is located substantially at the same point as shown in Fig. 6. However, the transition is a gradual and progressive one in Fig. 7, in contradistinction to the functioning of Figs. 5 and 6.

In Fig. 4 is shown a modification of the throttle plate mounting which produces little change in the shape of the suction curve through the part-throttle range, but effects a distinct change in the full-throttle curve throughout the range of carburetor operation. The same reference characters are used in Fig. 4 as in Fig. 1, because the two are substantially identical devices except for the mounting of the throttle plate 8, which is eccentric with respect to the center of the throttle shaft 7.

The effect upon the stream line flow at full throttle produced by the modification in Fig. 4 is schematically illustrated in Fig. 8. In this view it is apparent that far more of the air flow is deflected into the throat formed between the fuel tube and the throttle shaft than is the case in Fig. 6. This has very little effect upon the slope of the static suction curve throughout the full throttle range, but has a distinct effect upon the degree of suction produced at the nozzle throughout the full throttle range. The reason for this is fairly apparent from a comparison of Figs. 6 and 8, as it will appear from this comparison that more of the stream line flow in Fig. 8 is deflected into the throat area adjacent the fuel nozzles, and less is allowed to by-pass down the righthand side of the throttle plate 8.

In Figs. 1 to 4 some of the variations in the throttle shape and mounting have been described which can be used with this basic combination of fuel tube with the mixture conduit. Still others are possible which combine two or more of the types disclosed.

Fig. 9 is a diagrammatic view of a side-draft carburetor. In this device, the mixture conduit 22 is horizontal, and has a flange 21 for securing the carburetor to the engine or engine intake manifold. Integral with the flange 21 is a fuel bowl 23 containing a float 24 for operating the needle valve (not shown) controlling the supply of fuel to the fuel bowl 23 from the usual fuel line connection, all in a manner well understood in the carburetor art. Journaled in the walls of the mixture conduit 22 is a vertically arranged throttle shaft 25. As shown in Fig. 11, throttle shaft 25 is recessed at 26 for receiving a throttle valve or plate 27 secured to the throttle shaft 25. A fuel tube 28 is mounted in the wall of the mixture conduit 22 so that its axis is parallel with the axis of the throttle shaft 25. In this modification, the fuel tube is not tangentially arranged as in prior modifications, but is spaced between the mixture conduit wall and the throttle shaft, so that a throat 29 is formed between one surface of the fuel tube 28 and the wall of the mixture conduit. Within the fuel tube are formed two fuel passages 30 and 31 which extend from ports 32 and 33, respectively, to the end of the fuel tube 28, which is submerged within the fuel in the fuel bowl 23. A bleed passage 34 connects the ports 32 and 33.

In Fig. 11 the throttle plate is shown in the closed position, where it engages the walls of the mixture conduit 22 and extends into closing contact with the bottom of the fuel tube 28. This arrangement of the parts leaves a throat 29 constantly open. The schematic representation of the air flow in Fig. 11 illustrates the operation with the throttle plate 27 closed. In this view

the stream lines of flow entering the mixture conduit 22 pass through the throat 29, where they are bent and converge to produce the static drop in suction necessary to pull the fuel from the idle nozzle or discharge port 32 by way of the passage 30 from the fuel bowl 23. The passage 34 functions as an air bleed for the idle discharge port 32. During the idle, air continually enters the main nozzle port 33 and discharges at high velocity through the port 34 into the throat 29, carrying with it the necessary fuel to furnish the idle mixture necessary to keep the engine running at low speed. The idle port continues to function as the throttle opens, and this operation is schematically illustrated in Figs. 13 and 14.

In Fig. 13, as the throttle 27 is opened, the high-speed discharge port 33 is brought into operation by the action of the stream lines which converge and bend around the outer periphery of the fuel tube 28 in the same manner as explained in Fig. 1. This will result in a drop in static suction on both sides of the fuel tube 28, and raise the fuel in the fuel passage 31 to the port 33. At the same time, the air bleeding through port 34 is gradually reduced, so that, when the throttle is appreciably open as in Fig. 13, fuel will be flowing from both the discharge ports 32 and 33. If necessary, the fuel tube 28 may be provided with metered openings to bleed air into both passages 30 and 31.

The modification shown in Fig. 9 differs primarily from that in Fig. 1 in this respect: That the idle will function continuously during operation, regardless of throttle opening. This eliminates any transition between the operation of the nozzles and its adverse effect upon engine operation.

In Fig. 10 we have shown a modified form of the device in Fig. 9. The side-draft type of carburetor shown in Fig. 10 has a horizontally arranged mixture conduit 42 provided with a flange 41 for securing the carburetor to the engine or engine manifold. Integrally formed with the flange 41 is a fuel bowl 43. Within the fuel bowl is a float 44 for operation of the usual needle valve for controlling the fuel supply to the fuel bowl 43 from the usual fuel line connection. This structure is not shown because it forms no part of the present invention, and its construction and operation are well understood in the carburetor art.

A fuel tube 48, tangentially arranged with respect to the mixture conduit 42, has a metered inlet 49 for fuel passages 49' and 49''. Tube 48 extends into and is submerged in the fuel within fuel bowl 43. Passage 49' connects by way of passage 50 with discharge port 53 in fuel tube 51 tangentially arranged in mixture conduit 42 posterior of throttle 55. Fuel passage 49'' has a discharge port 52 anterior of the throttle and may be connected with port 53 by a cross passage 48'. It is desirable also to bleed air to the nozzle or discharge port 52, and a suitable metered air bleed is provided for the perforated tube 50' within passage 49''.

Fig. 12 is a schematic representation of the arrangement of the fuel tube and throttle valve, and illustrates the flow through the mixture conduit at closed throttle. As will be apparent from inspection, the throttle valve 55 is cracked slightly with respect to the fuel tube 51. Consequently, the lines representing the air flow pass into the mixture conduit and downwardly, around the right-hand edge of the throttle plate 55, through the narrow throat formed between the lower surface of the plate 55 and the upper peripheral surface of the fuel tube 51. Under such conditions a static drop in pressure will occur at the fuel nozzle 53, causing fuel to be drawn through the passages 49 and 50. Air will enter the discharge port 52 and mix with the fuel in the passage 50, so that a mixture of fuel and air will be discharged at the discharge port 53 during the idle. The action of the air flow is such that the fuel spreads out the length of the tube.

Fig. 15 is a schematic representation of the air flow when the throttle plate 55 is partly open. In this position of the throttle valve 55, flow lines indicating the passage of air down the mixture conduit will pass around the righthand edge of the throttle and over the surface of the fuel tube 51. This convergence of the flow lines during this passage will produce the static pressure drop necessary to continue the operation of the fuel discharge port 53. A similar operation will be performed on the opposite side of the throttle valve 55 where the flow lines converge and bend around the outer periphery of the fuel tube 48. This action will produce a drop in pressure in the locality of the discharge port 52, decreasing its air bleeding effect and drawing fuel from this port, so as to gradually increase the fuel discharged into the mixture conduit, with throttle opening enriching the mixture delivered from the fuel port 53 by decreasing the air bleed function of the fuel port 52.

At full throttle, in Fig. 16, the flow lines representing the air flow entering the mixture conduit will pass on opposite sides of the throttle, converging on opposite sides of the throttle shaft 45 to form, in effect, two venturi throats, so that a static suction drop will occur on both sides of the throttle shaft 45. The effect will be similar to that produced by a dual carburetor.

Fig. 17 is a schematic representation of the lines of flow through a device which is a modification of the construction illustrated in Fig. 4. Corresponding parts have been given the same reference characters. In this modification, the relationship between the fuel tube 11 and the throttle shaft 7 has been altered in such a way that the throat is always formed between the throttle shaft 7 and the fuel tube 11. It will be apparent from this illustration that the flow lines entering mixture conduit 1 converge in order to pass around, or between, the throttle shaft 7 and the fuel tube 11. At the same time, the flow lines wrap around the fuel tube 11 due to the proximate effect of the throttle shaft 7 on the lines of flow below the fuel tube. In the part-throttle condition indicated in Fig. 17, the throttle plate 8 aids to some extent in obtaining this wrap-around effect.

Fig. 18 illustrates the effect produced with the throttle plate wide open, and, as can be seen, the lines of flow converge and are wrapped around the fuel tube 11 by the proximity of the throttle shaft 7, thus bending the stream around the corner, so to speak, to obtain the benefits due to the acceleration of the flow in this manner on the drop in static suction about the discharge port in the fuel tube 11.

Fig. 19 is still another modification of the structure in Fig. 4, and is a schematic representation of the effect on the lines of flow due to moving the fuel tube inside the mixture conduit 1. The same reference characters are used to indicate like parts. In this modification, the fuel tube 11 may be provided with discharge ports 14 and 14' in opposite sides thereof. As represented in Fig. 19, the stream lines of the air flow entering the conduit 1 are caused to closely conform to the peripheral surface of the mixture tube 11 by the proximity of the mixture conduit 1 on one side, and the action of the throttle plate and throttle shaft 7 on the opposite side. In the part-throttle position in Fig. 19, the stream lines of flow about the fuel tube 11 are caused to converge and to be bent or wrapped around the fuel tube. This effect is accentuated in Fig. 20 for the wide-open throttle condition, where the upper edge of the throttle plate becomes effective.

So far this description has been confined to modifications in throttle mounting, fuel tube location, and changes in their arrangement affecting the manner of flow so as to obtain variations in the manner in which the air passes the fuel nozzle. These variations will produce different suction effects which can be utilized to obtain the desired flexibility useful in calibrating for the desired mixture ratio curve. Modifications have also been described in which the idle nozzle functions con-

tinuously, and these modifications apply to either single or double fuel tube arrangement.

All this is by way of illustrating the extremely flexible nature and adaptability of the nozzle-throttle arrangements. It is also possible, however, to combine the dual fuel nozzles with throttle valves of still different constructions in order to obtain results similar to those obtained by multi-stage carburetion.

Figs. 21 to 23, inclusive, are diagrammatic representations of a modification of the dual nozzle type shown in Fig. 10. The same reference characters will be used to indicate like parts. Mixture conduit 42 has tangentially arranged fuel tubes 48 and 51 with interconnected fuel passages 49 and 50 and suitable discharge ports 52 and 53. Rotatably mounted within the mixture conduit 42 is a throttle shaft 45 which can be manually controlled. Fixed to the throttle shaft 45 is one half of a throttle plate 55. The other half of the throttle plate 55' is rotatably mounted on the throttle shaft within limited distances, controlled by an abutment 60 fixed to the throttle shaft 45 which, in turn, is spaced from a second abutment 61, also secured to the throttle shaft 45. A leaf spring 63 is secured to the throttle plate 55 by rivet 62, and has its free end engaging the underside of throttle plate 55' urging it in a direction against the abutment 60.

Figs. 22 and 23 illustrate the operation of this particular throttle valve. Counter-clockwise rotation of throttle shaft 45 will partially open the throttle plate 55, but throttle plate 55' will be held closed against the pressure of spring 63 by manifold suction produced by operation of the engine until abutment 61 contacts the underside of the throttle plate 55 or the tension of spring 63 overcomes the force of suction on plate 55'. At this point in its operation the halves of the throttle 55 and 55' move in unison towards the open position, thereby bringing both nozzles 48 and 51 into operation. After both halves of the throttle have opened substantially, the spring 63 is properly calibrated so as to overcome the effects of velocity through the mixture conduit 42, tending to hold the throttle half 55' against the abutment 61, so that both halves of the throttle will open fully. The abutment 60 functions during closing of throttle 55 to insure positive closing of throttle 55'. It is probable that the throttle 55' will be closed first by the action of manifold suction. The effect of this throttle on the lines of flow through the carburetor will be substantially that shown in Fig. 7.

Figs. 24, 25 and 26 show a second modification of throttle for use in the carburetor having fuel tubes diagrammatically shown according to Fig. 10. The same reference characters will be used to indicate like parts. In this modification, the mixture conduit 42 has two tangentially arranged fuel tubes 48 and 51 interconnected by a single fuel passage 49 and 50 extending to the discharge ports 52 and 53 and into the fuel bowl. A throttle shaft 45, which may be manually controlled, is journaled in the walls of the mixture conduit 42 and carries a fixed throttle 55 and a rotatably mounted throttle 55'. Secured to the throttle shaft 45 is a suitable lever 65 having a pin 66 traveling on the cam surface 67 of a lever 68 pivoted at a fixed point 69. A weighted lever 70 is rotatable on the throttle shaft 45, and fixed to the throttle valve 55' this lever carries a suitable pin 71 riding on the undersurface of the lever 68.

The operation of this modification is illustrated in Figs. 25 and 26. Opening movement of the throttle 55 by the shaft 45 produces rotation of the lever 65. As the lever 65 moves, the pin 66 travels up the cam surface 67, and during this portion of its travel prevents rotation of the lever 68 and any movement of the lever 70 or throttle 55'. After the pin 66 reaches the position in Fig. 25, throttle valve 55' is free to open in response to suction within the mixture conduit 42 against the resistance of weight 70 and the weight of lever 68. Once the effect of the weights is overcome by the suction in the mixture conduit 42, valve 55' will be forced open by

velocity of the gases passing its upper surface. From this point on, the two throttles can open together. This modification differs from the one in Figs. 21 to 23 in that the secondary valve 55' is held closed mechanically and opened by suction. Both modifications combine the multi-stage type of operation in a single mixture conduit of a carburetor.

Fig. 27 shows a modification of throttle arrangement for use in a carburetor of the type having two fuel tubes broadly disclosed in Fig. 10. The same reference characters will be used to indicate like parts.

Mixture conduit 42 in Fig. 27 discharges into a chamber which may have one or more outlets 42' and 42''. The fuel tubes 48 and 51 are located at the point of junction between the mixture conduit 42 and the chamber, and are generally tangentially located with respect to both the walls of the mixture conduit 42 and the upper wall of the chamber. Within the fuel tubes 48 and 51 are fuel passages 49 and 50 interconnected with each other and extending from the source of fuel as shown in Fig. 10. Each discharge tube has a port 52 and 53 facing in a direction toward the throttle valve 55.

Throttle valve 55 is movable vertically by means of a throttle shaft 45. The air flow entering the mixture conduit 42 will pass downwardly and be turned abruptly around the outer periphery of the fuel tubes 49 and 50, and then pass through the throat formed between the upper surface of the throttle plate 55 and the peripheries of the fuel tubes 49 and 50.

With this construction a similar flow pattern will be established as in the preceding modifications in that a pair of throats will be formed by the position of the throttle plate 55 with respect to the lower surface of the fuel tubes, and the flow lines will converge as they pass through this passage or throat. Likewise, the throttle plate 55 will act as a guide or deflecting surface to cause the flow of air to bend and follow around the outer periphery of the fuel tube.

Figs. 28 and 29 illustrate a carburetor constructed according to the teaching of Fig. 1. Similar reference characters will be used to those in Fig. 1 where possible. As Fig. 28 clearly illustrates, the unit is extremely compact, and this is achieved by the elimination of the main fuel nozzle section, including the venturi and nozzles. In Fig. 28 the throttle body 75 has a mixture conduit 1 in which is journaled a throttle shaft 7. This shaft is recessed at 9 to receive the throttle plate 8 secured thereto in any suitable manner. In mixture conduit 1 is fuel tube 11 disposed with its axis substantially tangentially located with respect to the inner wall of the mixture conduit 1. In the fuel tube 11 is a discharge port 14 adjacent throttle plate 8, and this, in turn, is connected by way of a passage 12 with a fuel well 6 supplied by way of the metering orifice 5 from the fuel bowl 3. The position of this fuel discharge port 14 is adjustable by rotating tube 11. A screw driver slot 11a is provided for this purpose. Within the fuel bowl is a float 4 controlling a float valve (not shown) in the supply passage 76 which, in turn, is connected with a supply connection 77 in boss 78 on the fuel bowl cover 79.

Also connected with the well 6 is an idle tube passage 15 containing the idle tube which supplies the idle fuel ports 81 and 82 formed in the wall of the mixture conduit 1 adjacent the opposite edge of the throttle plate 8 by way of a passage 83 formed in the float bowl cover 79.

In one side of the fuel bowl 3 is a cylinder 85 which is supplied with fuel from the fuel bowl 3 by way of the passage 86 containing the ball check valve 87. Within the cylinder 85 is a piston 88 operated in one direction by a spring 89 to discharge fuel by way of the passage 90 containing the check valve 91 to the nozzle 92 located in a continuation of the mixture conduit 1 formed in the air horn 95 integral with the float bowl cover 79. Cover 79 is secured on the float bowl by any suitable means

(not shown), and is apertured at 96 and 97 to pass the piston rod 98 and the metering rod 99. A countershaft 100 journaled in the float bowl cover carries a rocker arm 101 secured to the countershaft 100 by the set screw 102. Piston rod 98 and metering rod 99 are connected to the rocker arm 101 to be operated thereby.

On the end of the countershaft 100 is an arm 104 operated by a rod 105 from a lever 107 secured to the end of the throttle shaft 7. An arm 108 on lever 107 is apertured at 109 for connection with a manual or automatic control. On the outside of the throttle body 75 is a lug 110 engaged by a throttle stop screw 111 threadedly engaged in a suitable lug formed integral with the lever 107.

The air horn 95 contains a choke valve 115 suitably secured to the choke shaft 116 journaled in the walls of the mixture conduit. Shaft 116 is, in turn, controlled by an automatic choke mechanism contained within the housing 118 and having a connection 119 to receive heated air from the stove, or like, on the exhaust manifold of the engine. Any suitable automatic choke mechanism may be used, but it is contemplated that the housing 118 contain a mechanism such as shown in the Coffey Patent 2,085,351.

In Figs. 30 and 31 is shown a down-draft type of carburetor incorporating the throttle and nozzle arrangement such as shown in Figs. 15 and 16.

In Fig. 31 a throttle body 120 contains a mixture conduit 121 in which is rotatably mounted a throttle shaft 123. Recess 124 in shaft 123 receives the throttle valve plate 125. Tangentially arranged in one wall of the mixture conduit 121 is a fuel tube 126 having a discharge port 127 supplied with fuel by way of a passage 128 leading to the fuel well 129. Fuel is supplied to the well 129 from a fuel bowl 130 by way of a metering jet 131 controlled by a tapered metering rod 132. Within the fuel bowl 130 is a float 133 for operating a needle valve (not shown) controlling the entrance of fuel to the fuel bowl 130 through the inlet 135. A boss 140 integral with the cover contains a connection for the fuel supply line.

Secured to the top of the fuel bowl 130 is a cover 136 which contains an air horn forming a continuation 138 of the mixture conduit 121. The float bowl cover 136 can be secured in place by screws, or the like, 139.

Within the cover 136 is a cylinder 142 containing a spring-pressed piston 143. The piston is, in turn, connected to the hooked end of the metering rod 132. A suction passage for operating the piston indicated as 146 leads to a port 147 posterior of the throttle 125.

An idle passage 150 connects with the well 129 and contains an idle tube 151 in turn connecting with the passage 152 leading to the fuel nozzle 153 controlled by the fuel needle 154. The nozzle 153 may be an aperture or discharge port in the usual tangentially located fuel tube or, as shown here, in a cambered surface 155 of similar shape. The fuel passage 152 may have an air bleed 156 located adjacent one edge of the throttle plate or valve 125.

In the air horn 138 is a choke valve 160 mounted on the pivoted choke shaft 161 controlled by an automatic choke mechanism located within the housing 162. A connection 163 is formed on the housing 162, which connection may be supplied with hot air from a stove on the exhaust manifold of the engine. The automatic choke mechanism contemplated may be any of the well known types or such as in the prior patent to Coffey, above mentioned.

Fixed on the outer end of the throttle shaft 123 is a lever 165 apertured at 166 for connection with the usual manual control. A set screw 167 threadedly engages an integral lug 168 on the arm 165 and abuts a fixed lug (not shown) on the throttle body 120. The screw 167 may be adjusted to set the closed position of the throttle 125.

The combination of either one tubular fuel nozzle or two with a throttle valve provides a very simple arrangement of basic parts which may be adjusted angularly and in spacing to give an extremely flexible fuel metering device. Furthermore, still other characteristics may be incorporated in the carburetor by the proposed changes in throttle valve mounting and design, all of which give marked variations in the calibration to suit the particular engine requirements.

The systems described above make possible a multiplicity of combinations, but most of these will have some of the characteristics of a variable air orifice type of carburetor. In calibrating such a carburetor for use with a particular engine, there are various approaches to the problem, only one of which is described here.

Generally speaking, the weight of fuel (rate) required is a function of several variables such as the weight of air (rate), the rate of throttle operation, and the engine load. The weight of air per instant of time is a function of several variables such as the degree of throttle opening, engine speed, and engine load. (Engine load has to be considered because the engine may be accelerating or decelerating.)

A good choice as to size of carburetor would be one in which the velocity of air through the throat remains a constant at engine speeds under normal load when the throttle is moved through a substantial range. With such a choice, one variable (air velocity) becomes a constant, and the weight of air per instant of time is a direct function of throttle opening. When this system is followed, the throttle can be directly connected to change the fuel metering at any throttle setting (as in Fig. 29), and a simple metering rod step-up can be used (as in Fig. 31) to compensate for load. The usual accelerating pump will compensate for the rate of throttle opening. Calibration of each may be separately obtained independent of the other. The shape and slope of the mixture ratio curve is primarily a function of throttle controlled metering, which is readily variable by the shape of the metering rod or rods operated by the throttle. Other variables such as variations in air velocity which affect the flow of fuel in carburetors with fixed venturi do not enter into the problem of calibration to any great extent.

A carburetor constructed along the above described lines lends itself to an extremely compact design resulting in reduction in height by an amount equal to the third section generally present in conventional designs. Two examples so constructed have been shown and described, but other modifications embodying some or all of the arrangements of parts disclosed are contemplated as within the scope of this invention as defined by the appended claims.

We claim:

1. In a plain tube type of carburetor having an open tube forming a mixture conduit, the combination of means forming an air nozzle in said conduit, comprising a member having a convexly cambered surface disposed transversely of the direction of air flow in said conduit, and a second member having a surface similarly disposed, and spaced transversely of said conduit with respect to said first member to form a throat for said nozzle constricting the lines of air flow between said members, and displaced with respect to said first member in the direction of air flow to bend the air flow as it passes said first member, to cause the flow to wrap around said first member for increasing the velocity of air flow locally thereof, and means for discharging fuel into the zone of high velocity air flow.

2. In a plain tube type of carburetor having an open tube forming a mixture conduit, the combination of means forming a venturi device in said conduit for constricting the lines of air flow in varying degrees comprising a fuel tube tangentially arranged with respect to a wall of said mixture conduit, a throttle valve mounted for

movement from closed positions in which it forms a restricted throat with said fuel tube to an open position in spaced relation thereto, and a mounting for said throttle valve spaced with respect to said fuel tube and located opposite said fuel tube to form therewith a restricted throat for said venturi device when said throttle valve moves to an open position in spaced relation to said fuel tube.

3. In a plain tube type of carburetor having an open tube forming a mixture conduit, the combination of means forming a plurality of orifices in said conduit for constricting the lines of air flow in varying degrees, comprising a fuel tube disposed transversely of said conduit adjacent one wall thereof and transversely of the direction of air flow therethrough, forming a first orifice, fuel discharge ports in opposite sides of said fuel tube, a throttle shaft spaced with respect to said fuel tube and forming a second orifice with said fuel tube, and a throttle valve on said shaft for controlling the flow past said shaft and said tube.

4. In a plain tube type of carburetor, the combination of means forming a fixed and variable size orifice in said conduit for constricting the lines of air flow in varying degrees comprising a convexly cambered surface disposed transversely of said conduit adjacent to and spaced from one wall thereof and transversely of the direction of air flow therethrough, a throttle shaft in said conduit spaced from said cambered surface for forming therewith the fixed size orifice, and a throttle valve on said throttle shaft arranged for movement on said throttle shaft from a closed position adjacent said cambered surface to an open position displaced from said surface and forming with said surface the variable size orifice increasing in size during an initial range of throttle opening, and means for discharging fuel into the zone of high velocity air flow through said orifice.

5. In a plain tube type of carburetor, the combination of a body, a mixture conduit in said body, a source of fuel, a convexly cambered surface eccentrically arranged in said mixture conduit, disposed transversely of said mixture conduit and transversely of the direction of air flow therethrough, a fuel port in said surface communicating with said source, an air deflecting surface in said mixture conduit parallelly arranged with respect to said cambered surface and forming therewith an elongated slot of varying width in the direction of air flow to cause a constriction in the lines of flow between said surfaces, said surfaces being relatively displaced in the direction of air flow, whereby said deflecting surface delays separation of air flow over said cambered surface to bend the stream and thereby increase air velocity and create a zone of low static pressure lengthwise of said cambered surface into which said port discharges whereby to disperse fuel discharged from said port lengthwise of said cambered surface.

6. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a plurality of variable size orifices in said conduit for constricting the lines of air flow in varying degrees comprising, convexly cambered surfaces disposed transversely of said conduit adjacent opposite walls thereof and transversely of the direction of air flow therethrough, a valve means in said conduit, and means mounting said valve means for movement from a closed position adjacent said surfaces to an open position displaced from said surfaces and forming with said surfaces orifices increasing in size with throttle opening.

7. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a plurality of variable size orifices in said conduit for constricting the lines of air flow in varying degrees comprising a throttle valve means rotatably supported in said mixture conduit, a pair of fuel tubes in said mixture conduit arranged on opposite sides of said mixture conduit and on opposite sides of said throttle valve means when said

valve is closed, and fuel nozzles in said tubes exposed to the air flow on opposite sides of said throttle valve means.

8. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a plurality of variable size orifices in said conduit for constricting the lines of air flow in varying degrees comprising a throttle shaft in said mixture conduit, a throttle valve means rotatably supported by said throttle shaft, a pair of fuel tubes in said mixture conduit arranged on opposite sides of said throttle shaft, a source of fuel, and fuel nozzles in said tubes communicating with said source and exposed to the air flow passing between said shaft and said fuel tubes on opposite sides of said throttle shaft.

9. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a plurality of variable size orifices in said conduit for constricting the lines of air flow in varying degrees comprising a throttle shaft in said mixture conduit, a throttle valve inclined in its closed position and rotatably supported by said throttle shaft, a pair of fuel tubes in said mixture conduit on opposite sides of said throttle shaft and located adjacent and anterior to, and posterior of, said throttle valve, and fuel nozzles in said tubes exposed to the air stream on opposite sides of said throttle shaft.

10. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a plurality of variable size orifices in said conduit for constricting the lines of air flow in varying degrees comprising a throttle extending transversely of said mixture conduit in the closed position thereof and means mounting said throttle for movement to wide-open position, a pair of fuel tubes in said mixture conduit adjacent opposite edges of said throttle, and fuel nozzles in said tubes exposed to the air stream through said mixture conduit and past the edges of said throttle.

11. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a venturi device in said conduit for constricting the lines of air flow in varying degrees comprising a fuel tube tangentially arranged with respect to the wall of said mixture conduit, a throttle valve means having a first part arranged for movement from closed positions in which it forms a restricted throat with said fuel tube to an open position in spaced relation thereto, and a second part movable with said first part disposed in offset relation with respect to said first part, and a mounting for said throttle valve means located between said parts and movably supporting said valve means in said mixture conduit.

12. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a venturi device in said conduit for constricting the lines of air flow in varying degrees comprising a fuel tube tangentially arranged with respect to the wall of said mixture conduit, a throttle valve mounted for movement from closed positions in which it forms a restricted throat with said fuel tube to an open position in spaced relation thereto, and a throttle shaft eccentrically supporting said valve and spaced with respect to said fuel tube to form a restricted throat for said venturi device when said throttle valve is open.

13. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a venturi device in said conduit for constricting the lines of air flow in varying degrees comprising a fuel tube tangentially arranged with respect to the wall of said mixture conduit, a throttle shaft in said mixture conduit mounted in spaced relation with respect to said fuel tube, a throttle valve having a first part supported eccentrically on said throttle shaft for movement from closed positions in which it forms a restricted throat with said fuel tube to an open position in spaced relation thereto, and a second part on said shaft disposed in offset relation with respect to and movable with said first part.

14. In a carburetor having a mixture conduit, the com-

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bination of a pair of fuel nozzles in opposite sides of said conduit, throttle valves in said mixture conduit adjacent each fuel nozzle, means for positively operating one of said throttle valves to and from closed position, means for holding the other said throttle valve closed by suction posterior of the throttle, and means interconnecting said valves for overriding the effect of suction on said second valve during opening movement of said first valve.

15. In a carburetor having a mixture conduit, the combination of a pair of fuel nozzles in opposite sides of said mixture conduit, a pair of throttle valves adjacent said fuel nozzles, positively acting means for controlling one of said valves, suction operated means for opening the other of said valves, and means responsive to closing movement of said first valve for moving said second valve to closed position.

16. In a carburetor having a mixture conduit, the combination of a pair of throttles movably mounted in said mixture conduit, positively acting means for controlling one of said valves, suction operated means for opening the other of said valves, a fuel tube in said mixture conduit adjacent the opening edge of said suction operated throttle valve, and means responsive to closing movement of said positive actuated valve for moving said suction operated valve to closed position.

17. In a plain tube type of carburetor having a mixture conduit, the combination of a pair of throttle valves movably mounted within said mixture conduit, positively acting means for controlling the position of one of said valves, suction operated means for opening the other of said valves, a fuel tube in said mixture conduit having a fuel discharge port located adjacent the opening edge of said positively actuated valve, and means responsive to closing movement of said positively actuated valve for moving said suction operated valve to closed position.

18. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a plurality of variable size orifices in said conduit for constricting the lines of airflow in varying degrees, comprising a throttle valve rotatably supported in said mixture conduit, a pair of fuel tubes in said mixture conduit arranged on opposite sides of said mixture conduit and adjacent opposite sides of said throttle valve when said valve is closed, fuel nozzles in said tubes exposed to the airflow on opposite sides of said throttle, a fuel supply connected with both of said fuel tubes, and a connection between said tubes permitting a cross-flow of air between the same during operation of the carburetor.

19. In a plain tube type of carburetor having a mixture conduit, the combination of means forming a plurality of variable size orifices in said conduit for constricting the lines of airflow in varying degrees, comprising a throttle valve rotatably supported in said mixture conduit, a pair of fuel tubes in said mixture conduit arranged on opposite sides of said mixture conduit and adjacent opposite sides of said throttle valve when said valve is closed, fuel nozzles in said tubes exposed to the airflow on opposite sides of said throttle, a fuel supply connected to said tubes, and means for metering the fuel flow from said supply to said fuel nozzles.

20. In a plain tube type of carburetor having an open tube forming a mixture conduit, the combination of means forming a venturi device in said conduit for constricting the lines of airflow in varying degrees, comprising a fuel tube disposed transversely of said conduit adjacent one wall thereof, and transversely of the direction of airflow therethrough, a fuel discharge port in

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said fuel tube exposed to the passage of air through said mixture conduit, means for supplying fuel to said tube, a throttle shaft spaced with respect to said fuel tube and forming a fixed orifice with said fuel tube, and an unbalanced throttle valve eccentrically mounted with respect to said throttle shaft and movable to and from contact with said fuel tube for forming a variable restriction in said mixture conduit.

21. A plain tube type of carburetor having an open tube forming a mixture conduit, and means in said mixture conduit forming an orifice for constricting the lines of air flow in varying degrees, comprising a convexly cambered surface and a throttle valve means, said convexly cambered surface being disposed transversely of said conduit and transversely of the direction of air flow through said conduit, and said throttle valve means in said conduit including a pivoted mounting and a disk valve on said mounting located by said mounting to move from a position in which one edge of said disk valve lies adjacent said convexly cambered surface, through intermediate positions in which it varies the size of said orifice, to a wide-open position spaced from said surface in which said valve is substantially parallel to the direction of the air stream passing on opposite sides, a second convexly cambered surface on the upstream side of said throttle valve means when closed and arranged to move into opposed relation to said first convexly cambered surface to form an orifice therewith when said throttle means is opened, a source of fuel for said carburetor, and fuel discharge means in said orifice connected to said source of fuel.

22. In a plain tube type of carburetor having a mixture conduit, the combination of a low-speed fuel nozzle in said conduit, a fuel nozzle tube disposed transversely of the direction of air flow through said mixture conduit, a throttle valve in said conduit, and a shaft extending transversely of said mixture conduit adjacent said fuel tube and forming means for pivotally locating said throttle valve abreast of said nozzles to swing from a nearly closed position in said mixture conduit in which the air flow is minimum and confined to said low-speed nozzle, through intermediate positions in which a portion of the air flow is confined between one surface of said valve and said fuel nozzle tube, to a wide-open position spaced from said fuel nozzle tube in which said valve is substantially parallel to the direction of the air stream passing on its opposite sides.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |                |                |
|-----------|----------------|----------------|
| 1,080,118 | Monosmith      | Dec. 2, 1913   |
| 1,204,901 | Plant          | Nov. 14, 1916  |
| 1,261,756 | Britton        | Apr. 9, 1918   |
| 1,429,534 | Renner         | Sept. 19, 1922 |
| 1,547,296 | Bullard        | July 28, 1925  |
| 1,555,489 | Spencer et al. | Sept. 29, 1925 |
| 1,780,522 | Hammer et al.  | Nov. 4, 1930   |
| 2,097,409 | Wertz          | Oct. 26, 1937  |
| 2,102,846 | Hunt           | Dec. 21, 1937  |
| 2,194,783 | Ball et al.    | Mar. 26, 1940  |
| 2,252,955 | Woods          | Aug. 19, 1941  |
| 2,375,160 | Woods          | May 1, 1945    |

##### FOREIGN PATENTS

|           |               |               |
|-----------|---------------|---------------|
| 448,741   | Great Britain | June 15, 1936 |
| 1,050,545 | France        | Sept. 2, 1953 |