Feb. 11, 1958 H. A. CARLSON ET AL 2,823,019

MULTI-STAGE CARBURETOR

Filed May 13, 1955 6 Sheets-Sheet 1

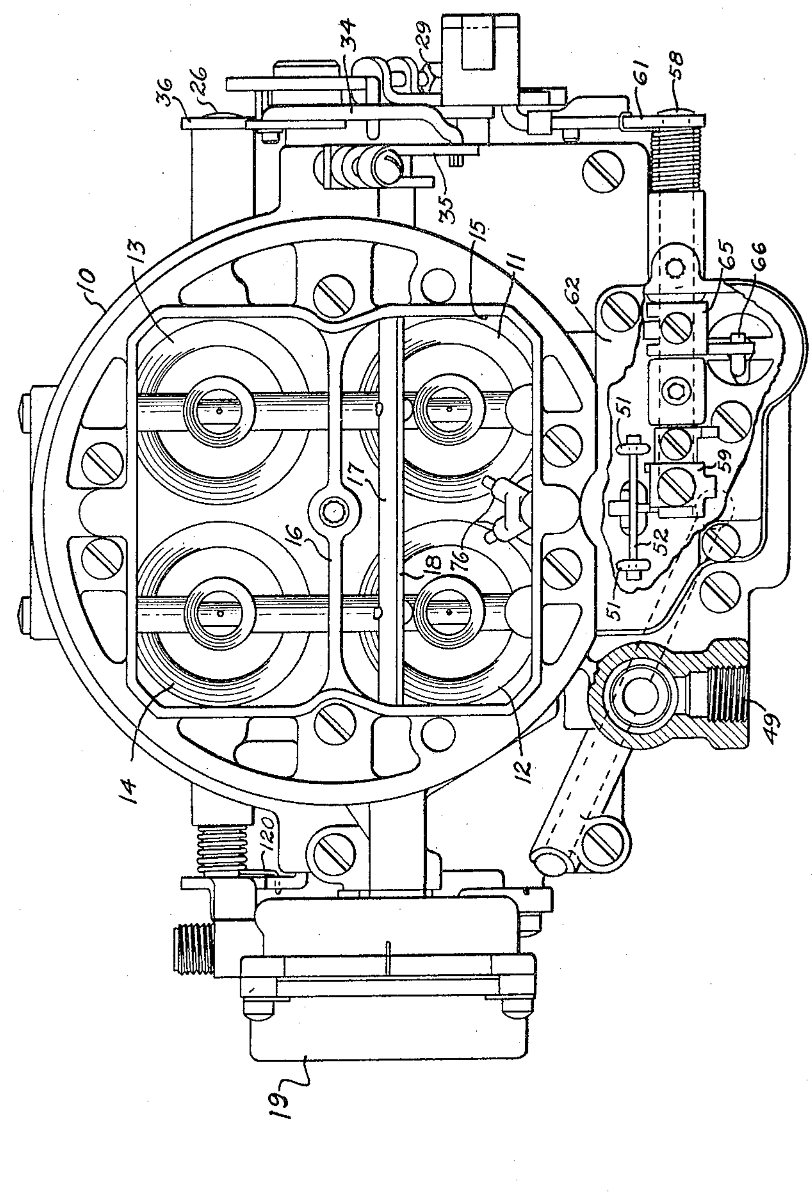

FIG. 1

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MULTI-STAGE CARBURETOR

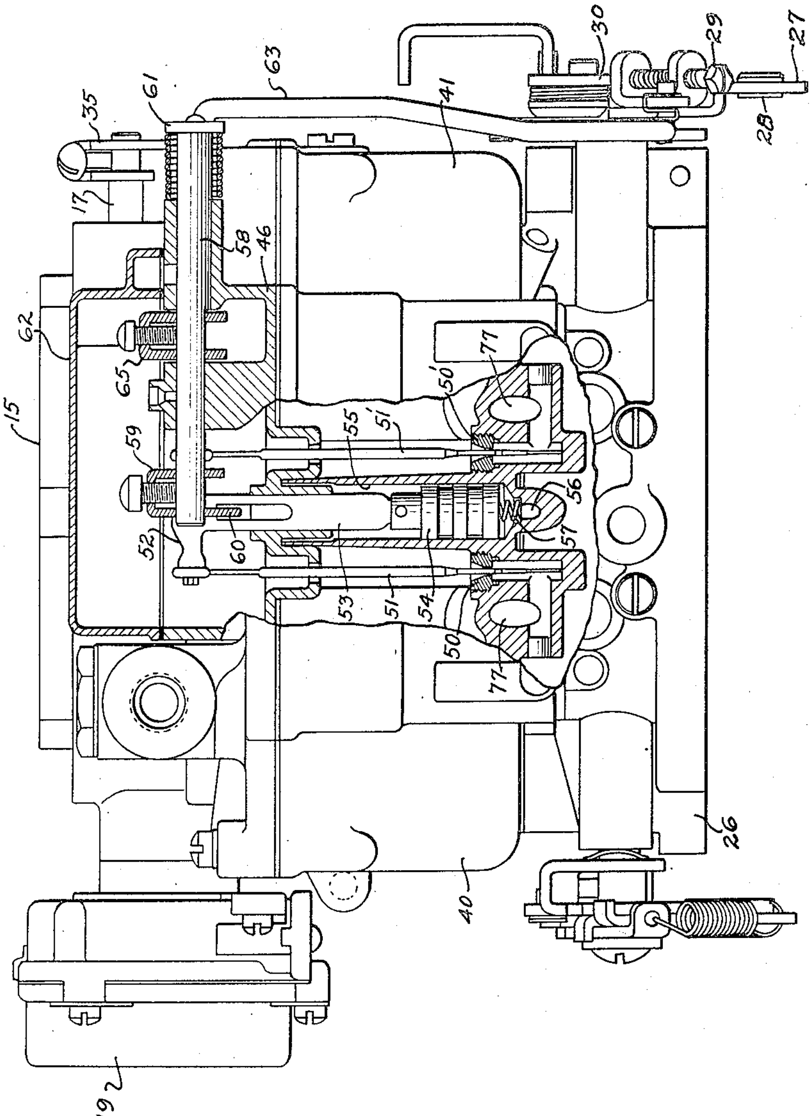

FIG. 2.

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MULTI-STAGE CARBURETOR

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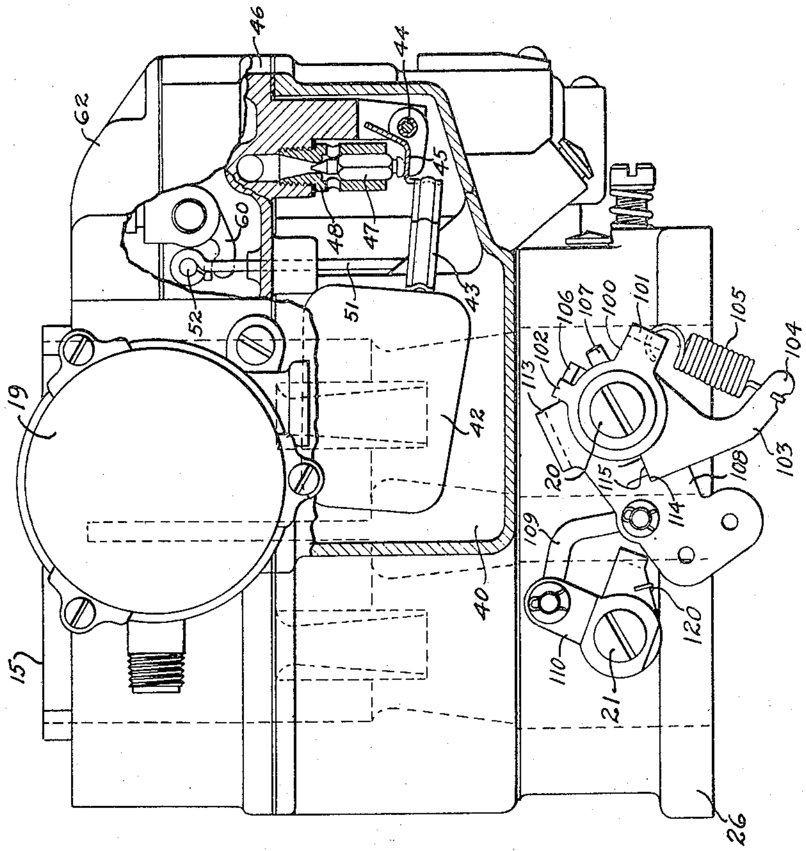

FIG. 3

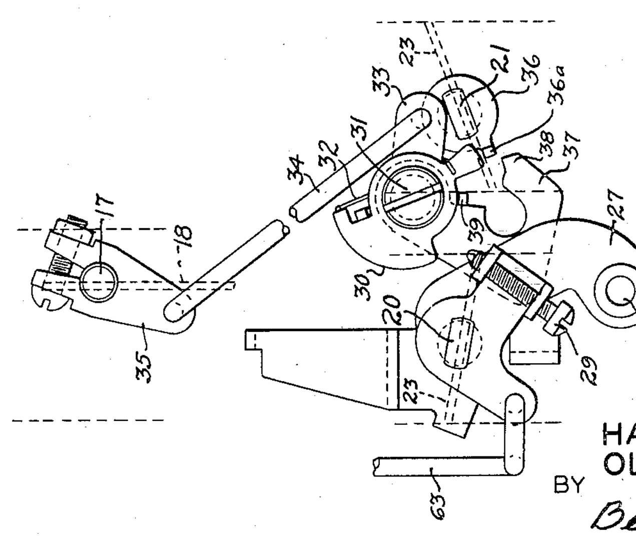

FIG. 5

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MULTI-STAGE CARBURETOR

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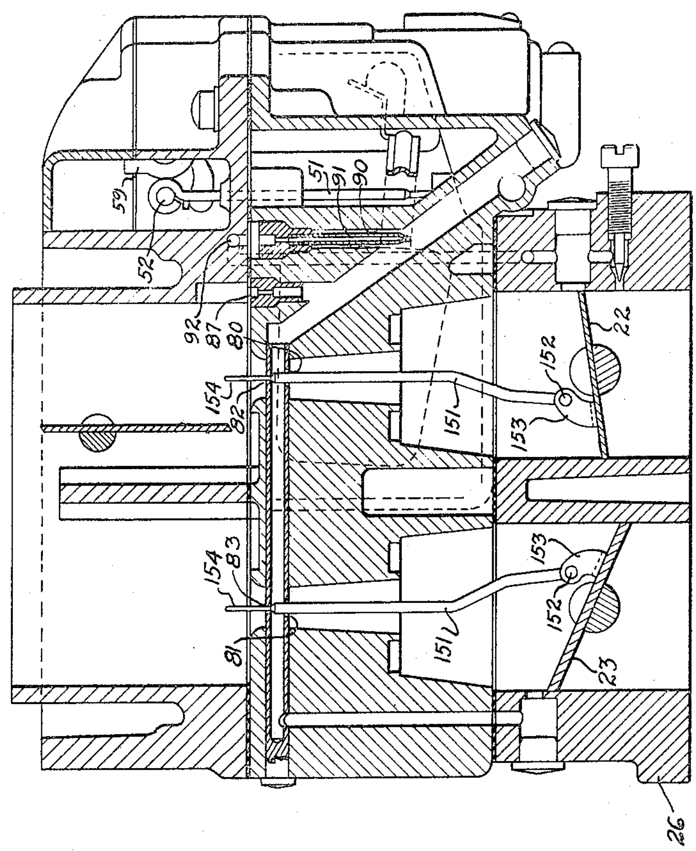

FIG. 6.

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Feb. 11, 1958 H. A. CARLSON ET AL 2,823,019

MULTI-STAGE CARBURETOR

Filed May 13, 1955 6 Sheets-Sheet 5

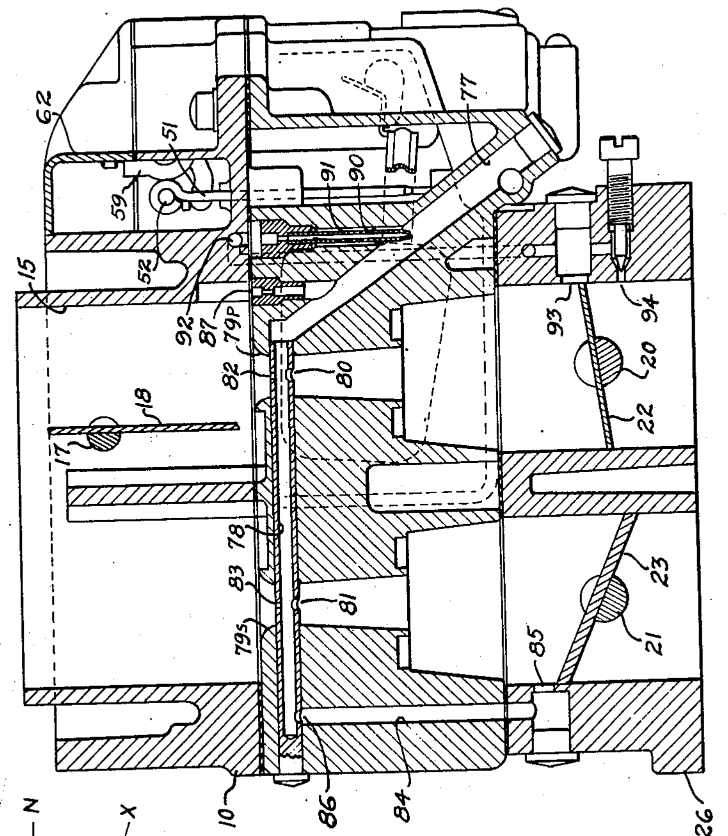

FIG. 4.

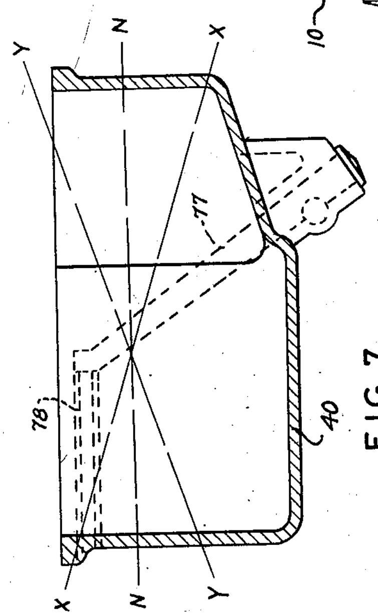

FIG. 7.

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MULTI-STAGE CARBURETOR

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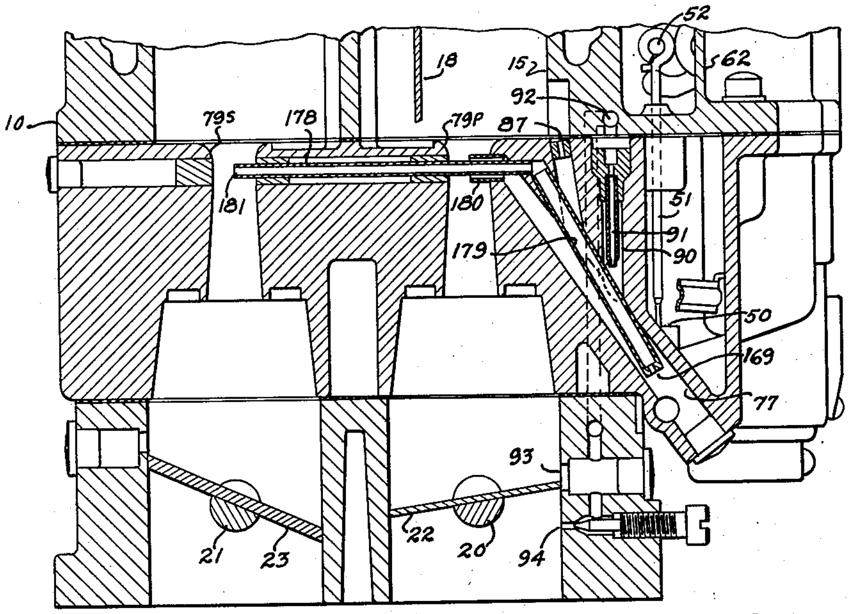

FIG. 8.

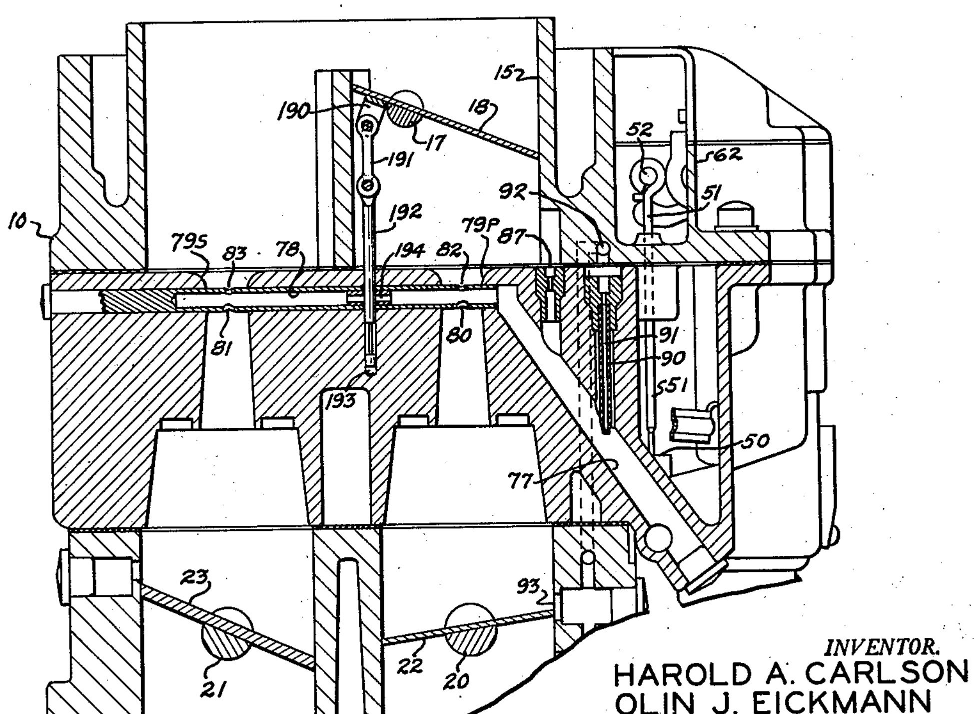

FIG. 9.

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United States Patent Office

2,823,019

Patented Feb. 11, 1958

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2,823,019

MULTI-STAGE CARBURETOR

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Application May 13, 1955, Serial No. 508,039

7 Claims. (Cl. 261—23)

This invention relates to multi-barrel or multi-stage carburetor systems for internal combustion engines. More particularly, the invention relates to a novel combination of a fuel supply and a new fuel nozzle system for such carburetors which eliminates the necessity of two separate fuel bowsl and of four separate nozzle systems.

The invention is shown applied to the type of carburetor disclosed in Patent No. 2,715,522, issued August 16, 1955, to Carlson and Moseley. Briefly, this prior application shows a multi-barrel, multi-stage carburetor with four barrels and four separate float chambers, which chambers are connected in pairs to form two fuel bowls, each supplying fuel to two individual fuel nozzle systems.

The performance of carburetors with multiple fuel bowls and nozzle systems is not wholly satisfactory because they cannot be readily calibrated for changes in acceleration, cornering, braking, or inclination of the vehicle. Such changes can produce an uneven distribution of fuel with its accompanying disadvantages in engine performance. Furthermore, the transition point which occurs when the secondary stages go into action is very pronounced, and is regarded, for that reason, as undesirable.

In the present invention, two float chambers are interconnected by a restricted passage to form a single fuel bowl. This bowl supplies fuel to two separate fuel nozzle systems of novel design—one for each pair of primary and secondary stages of the multi-barrel, multi-stage carburetor. The location of the point of supply for each nozzle system is adjacent one side of the fuel bowl, preferably from a zone located in the restricted passage connecting the float chambers. Each fuel system has a conventionally arranged low-speed nozzle or idling ports supplied with fuel through passages connecting with a main inclined fuel passage from the point of supply within the fuel bowl. The main or high-speed primary and secondary nozzles are in a tube extending transversely of the primary and secondary stage barrels. This tube, in turn, connects with the inclined main fuel passage from the fuel bowl. The junction between the tube and the passage forms a single control point for both primary and secondary stage fuel nozzles, and this control point is purposely located adjacent the volumetric center of the fuel bowl above the liquid level. Each fuel nozzle has one or more air bleeds at a point in a zone pressure-sensitive to throttle positions.

The combination of a single fuel bowl with two fuel nozzle systems has been found to avoid unequal distribution of fuel, and its disadvantages. This is due to the proximity of the fuel supply for each fuel nozzle system, and to the feature of having a single control point for each pair of main or high-speed nozzles. Because of the single control point, the amount of lift from the fuel bowl to each primary and secondary stage main nozzle is identical under the conditions above mentioned which occur due to accelerations or inclination of the vehicle.

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Furthermore, the interconnecting air bleeds provide a smooth transition from primary to secondary stage by enriching the mixture in the primary stage to compensate for the additional air admitted through the secondary stage before the secondary stage fuel nozzle begins to function.

This application is a continuation-in-part of an allowed application of Carlson and Eickmann, Serial No. 345,048, filed March 27, 1953, for Multi-Stage Carburetor, now Patent No. 2,718,387, issued September 20, 1955.

The accompanying drawings illustrate several forms of the instant invention.

Fig. 1 is a top plan view of a carburetor according to the present invention.

Fig. 2 is a vertical front elevational view of the carburetor with parts broken away to show the adjacent points of fuel supply to the fuel nozzle systems within the fuel bowl.

Fig. 3 is a side elevational view of the carburetor with parts broken away to illustrate a float chamber and its float control mechanism.

Fig. 4 is a vertical longitudinal section through the carburetor.

Fig. 5 is a detail view of the choke valve-operated mechanism for locking out the action of the throttles for the secondary stages.

Fig. 6 is a longitudinal section illustrating a modification of the present invention.

Fig. 7 is a diagrammatic view illustrating the lack of effect of changes in inclination of the vehicle on the relation between the fuel level in the fuel bowl and the control point for the fuel nozzle.

Fig. 8 is a longitudinal section illustrating a modification of the nozzle shown in Fig. 4.

Fig. 9 is a longitudinal section through a carburetor illustrating still another modification of the invention.

The drawings illustrate a four-barrel downdraft carburetor with a body **10**. As shown in Fig. 1, this body includes two forward or primary stage mixture conduits **11** and **12**, and two rear or secondary stage mixture conduits **13** and **14**. These conduits are arranged in symmetrical relation in a compact group, and are supplied with air through a rectangular-shaped air horn structure **15** provided with a transverse partition **16**. At the forward side of the partition is journaled a chokeshaft **17** mounting an unbalanced choke valve **18** (see Fig. 4). The chokeshaft is controlled by any suitable automatic choke control mechanism within the housing **19** in Fig. 2. Extending across both primary and secondary mixture conduits are throttle shafts **20** and **21** mounting throttle valves **22** and **23**. Each pair of primary throttles **22** moves as a unit. Likewise, each pair of secondary throttles **23** moves as a unit. The primary conduits may be connected by pressure-equalizing passages, and the secondary conduits may be likewise connected, if desired. A flange **26** surrounding the lower end of the conduits is provided for attaching the carburetor to the usual engine intake manifold.

Referring to Figs. 2 and 5, the primary throttle shaft **20** has a projection on which is rigidly mounted a throttle operating arm **27** having a hole **28** for attachment to the usual accelerator linkage. The throttle arm carries an adjusting screw **29** for engaging a fast idle cam **30** pivoted as at **31** to the carburetor body. The cam is connected by a torsion spring **32** to a concentrically pivoted loose lever **33**, which, in turn, is connected by means of a link **34** to an arm **35** rigid with the projecting extremity of choke valve shaft **17**, which is located opposite said housing **19**. A small disk **36** is rigid with the adjacent projecting extremity of a secondary throttle shaft **21**, and has a radial lug **36*a***. Also loosely mounted with respect to the pivot element **31** is an eccentrically weighted stop lever **37** provided with a finger **38** which is normally maintained by its own weight in position to interfere and engage with lug **36*a*** on the secondary throttle shaft **21** when the choke valve is closed. This lock mechanism is the same as that shown in Patent No. 2,715,522, issued August 16, 1955, to Carlson and Moseley. It is explained therein that lug **39**, which is integral with lever **33**, will engage eccentrically weighted lever **37** as the choke valve moves toward opening position, thereby shifting the lever **37** to unlock the secondary throttles **23** by its disengagement with the lug **36*a***.

The mechanism for operating the primary and secondary throttles in a sequential manner is shown in Fig. 3, and this mechanism comprises a small lever **100** fixed with primary throttle shaft **20**, which lever is formed with radial and angularly extending lugs **101** and **102**. A lever **103** is rotatably mounted on throttle shaft **20** inward of lever **100**, and has a finger **104** connected by a coil tension spring **105** to the finger **101** of the operating lever **100**. Spring **105** normally maintains a second integral finger **102** in engagement with lug **106**. Lever **103** has a second angular lug **107** mounted thereon for a purpose to be later described. Also rotatably mounted on the throttle shaft is a third lever **108** inwardly of fixed lever **100** and lever **103**. This lever is connected by a link **109** to an arm **110** rigidly secured with the adjacent projecting extremity of secondary throttle shaft **21**. Arm **110** may be biased in a counterclockwise direction by a suitable torsion spring **120** or the like. In operation, counter-clockwise movement of the shaft **20** to open the primary throttles **22** moves lever **100**, and lever **103** is likewise rotated through spring connection **105** until radial lug **107** engages a shoulder **113** on third lever **108**, whereupon the three levers rotate as a unit, causing opening of the secondary throttles **23** by link **109** and arm **110**. Because of the lost motion connection between lug **107** and shoulder **113**, primary throttles **22** are in a partially opened position before engagement between lug **107** and shoulder **113** causes initial movement of the secondary throttles. The linkage is such, however, that movement of the primary throttles from this partially open position to wide open causes full opening of the secondary throttles. Upon closing of the primary throttles, the aforementioned spring which may be used on the secondary throttles causes the secondary throttles to follow the movement of the primary throttles. Full closing of the primary throttles engages shoulder **114** with lug **115** to lock the secondary throttles in a closed position.

Of course, if the choke valve-operated lock-out mechanism previously described is in operation, the secondary throttle cannot be opened, and spring **105** will allow for movement of the primary throttles in an opening direction after engagement of lug **107** with shoulder **113**.

As shown in Figs. 2 and 3, the carburetor is provided with a fuel bowl having two identical float chambers **40** and **41**. (A description of one will suffice for both.) These chambers are interconnected by a restricted passage in which is located the supply point for two fuel nozzle systems.

Float chamber **40** contains a float **42** mounted on a float control arm **43** pivoted on a shaft **44** supported by structure depending from float bowl cover **46**. Finger **45** on arm **43** engages and actuates a needle valve **47**, which, in turn, controls the supply of fuel past valve seat **48** from a common inlet **49** for both chambers **40** and **41** shown in Fig. 1. Float **42** and needle valve **47** maintain a substantially constant fuel level within the fuel bowl **40—41**.

The passage between the float chambers **40** and **41** has two metering orifices **50** and **50'** located in the lower portion thereof. Each is, in turn, controlled by metering pins **51** and **51'** carried at the upper end by a cross-bar **52** shown clearly in Figs. 1 and 2. This cross-bar is formed as an integral part of a stem **53** projecting upwardly from a piston **54**, which works in a cylinder **55** connected by means of a passage **56** to the primary mixture conduit posterior of the throttle **22**. A coil spring **57** constantly urges the piston and metering pins upwardly against the force of suction acting downwardly on the piston.

Journaled in the fuel bowl cover **46** is a countershaft **58** which mounts an actuating lever **59** having a finger **60** underlying the cross-bar **52** so as to lift the cross-bar and metering pins when the countershaft is rotated. The countershaft, in turn, is connected to the primary throttle valves by an actuating arm **61** rigid with the projecting end of the countershaft **58** and a link **63** connected to throttle lever actuating arm **27**.

Also attached to the countershaft is a lever **65** which is connected by a small link **66** to an accelerating pump piston not shown. This piston works in the usual cylinder and draws fuel into that cylinder on upward movement of the piston. Upon opening movement of the accelerator, the fuel is discharged from the cylinder of the pump past suitable check valves and into the primary mixture conduit through pump jets **76**, all in a well known manner, as shown in the co-pending application to Otto Henning, Serial No. 268,811, filed January 29, 1952, now Pat. No. 2,728,563, dated Dec. 27, 1955. The mechanism just described is mounted under a dust cap **62** as shown in Figs. 1 and 2.

The main fuel supply from each fuel bowl to adjacent primary and secondary mixture conduits is through individual fuel nozzle systems which are identical. Consequential, only one fuel nozzle ssytem will be described. In Fig. 2, fuel through the metering orifice **50** is supplied to a main fuel passage **77** through a connecting passageway. Passage **77** is inclined upwardly as shown in Fig. 4, and connects with a fuel tube **78** extending across and between inner venturi tubes **79P** and **79S** in the primary and secondary conduits. Tube **78** has fuel ports **80** and **81** in these venturi tubes, respectively, and air bleed openings **82** and **83** more or less in alignment therewith. A vertical passage **84** connects between a port **85** adjacent the secondary throttle and a restriction **86** in the fuel tube **78**. The main fuel system also includes a combination air bleed and vapor vent orifice **87** connecting with the inclined fuel passage **77**.

Idling fuel nozzles are provided for each primary mixture conduit. These are identical, and a description of one will suffice for both. This idling system has a vertical well **90** containing an idling tube **91** which connects through a series of passages **92** with idling ports **93** and **94** adjacent the primary throttle **22**.

Operation

With the primary throttle **22** in idle position and the secondary throttles **23** closed, fuel is supplied to the separate idle nozzles in the separate primary mixture conduits from the fuel bowl **40**, **41** through the metering orifices **50**, **50'**, inclined passages **77**, and idle tubes **91**, to the idle ports **93** and **94**. As the primary throttles are opened, suction gradually increases in the inner venturi tubes **79P**, which produces a flow of fuel through the fuel tubes **78** and then to and through discharge nozzles **80**. Simultaneously, suction decreases at the idle ports and a gradual transition takes place until nozzles **80** supply all of the fuel. The action of suction on the fuel nozzles **80** is somewhat modulated by the leakage of air at atmospheric pressure through the ports **81**, **82**, **83** and **85** into the fuel tubes **78** when the throttles in the secondary mixture conduits are closed. This modulating effect of the air bleeds reduces the discharge from nozzles **80** to give a proper mixture for part-throttle operation.

When the primary throttles are opened far enough to begin opening the secondary throttles **23**, then suction will exist in both the primary and secondary inner venturis **79P** and **79S**, which will reduce the amount of air bleed through ports **81** and **83**, and thereby increase the rate of fuel flow into the fuel tubes 78 in order to initially increase the amount of fuel to the fuel nozzles 80. Further opening of the secondary throttles increases the suction at ports 81 and 83 to further increase the flow through tubes 78 to supply sufficient fuel for both the primary and secondary nozzles. During the initial opening of the secondary throttles 23, ports 85, initially wholly anterior thereto, will be gradually exposed to manifold suction, which, in turn, will decrease the effectiveness of these air bleeds and increase the amount of fuel delivered to enrich the mixture in the primary stages. But this invention contemplates the use of the device with or without the ports 85. The function would be the same regardless of their presence or absence.

Another advantage besides those which are obvious and flow directly from the simplification of the mechanism, resides primarily in the feature of providing a carburetor of this type wherein the fuel is lifted a constant amount regardless of tip angle. In Fig. 7, for example, if the carburetor is tipped backwards due to a steep ascent, the amount of lift necessary to get the fuel to both the primary and secondary nozzles remains the same, as illustrated by intersection of lines *x—x* and *n—n*, the latter being the normal fuel level. This is fixed by the fact that the distance from the fuel levels *n—n* and *x—x* to the intersection of passage 77 with the fuel tube 78 remains substantially constant because the control point at the intersection is located vertically above and substantially centrally of the fuel chamber 40. Consequently, the amount of lift due to tip angle is unchanged. Because of this, the carburetor will operate as satisfactorily at an inclination as at a level position. If the carburetor is tilted the other way (or forward, as illustrated by line *y—y*), the lift also remains unchanged. The secondary fuel nozzle will be above the primary, but this would only be in descending a steep grade, when it is very unlikely that the secondary throttle would be held wide open and when a leaner mixture in the secondary stages is desirable anyway.

Fig. 6 shows a modification of the invention described above in which metering rods are provided in each of the mixture conduits for operation with the fuel ports in the fuel tubes. In this modification, four metering rods 151 are received in the fuel ports 80, 81, respectively. The rods are pivotally connected at 152 with arms 153 mounted on the throttles 22 and 23, respectively. Metering rods 151 are provided with stepped ends 154 received in the fuel ports 80, 81, and air bleed orifices 82, 83.

In this modification, with only the primary throttles open, flow from the ports 80, 81 is controlled by the metering rods received therein. Because suction will exist only at the primary nozzle, the mixture is also controlled by the amount of air admitted by the metering rods 151 in the secondary nozzles through the ports 81, 83, 85. After the secondary throttles open, suction will exist in both the primary and secondary nozzles, and port 85 will aid in lifting the fuel from the bowl. This will increase flow sufficiently to provide adequate fuel in both the primary and secondary nozzles. However, this invention contemplates the omission of port 85. Of course, the metering rod for the secondary cannot open until secondary throttle 23 is unlocked by opening of choke valve 18.

Fig. 8 shows a modified form of the invention illustrated in Fig. 4. The main fuel supply from each fuel bowl to adjacent primary and adjacent secondary mixture conduits is through individual fuel nozzle systems which are identical. Consequently, only one fuel nozzle system will be described. The same reference characters will be used to indicate corresponding parts. As described heretofore in Fig. 2, the fuel entering through the metering orifice 50 under control of the metering rod 51 supplies the main fuel passage 77 through a connecting passageway. Passage 77 is inclined upwardly as shown in Fig. 8, and connects with a short fuel tube or nozzle 180 discharging in the primary venturi 79P of the primary barrel 15. Concentrically arranged within the primary nozzle 180 is a fuel tube 178 which discharges in a fuel nozzle 181 within primary venturi 79S of the secondary barrel. Fuel is supplied to the secondary nozzle 181 from the inclined passage 77 by a tube 179 connected with the opposite end of the fuel tube 178.

The fuel flow to the secondary fuel nozzle 181 is controlled by metered orifices 169 at the lower end of inclined fuel tubes 179.

In this arrangement of parts, the fuel supply to both the primary nozzle 180 and the secondary nozzle 181 is metered at a common point by a single metering orifice 50 controlled by the metering rod 51. This is a distinct advantage, due to the obvious simplification and elimination of parts.

During operation of the primary stage, when the throttle 22 is open, fuel will be supplied from the fuel bowls through the metered orifice 50 to the main fuel nozzle 180 in the primary side of the carburetor. The operation of the primary main nozzle will be bled out through two sources, 87 and 181. Atmospheric pressures entering at these points will mix with the fuel within the main fuel supply passage 77 so as to lean out the mixture to the proper proportions for operation on the primary barrels of the carburetor.

As the secondary throttles 23 begin to open in the final range of movement of the throttles 22, the first effect is to enrich the mixture from the primary nozzles 180 due to the drop in pressure created in the secondary venturi 79S at the openings 181 of the fuel tubes 178. This action will compensate for the immediate lack of fuel in the nozzles 181 and the leaning out effect caused at this time by the passage of air through the secondary barrels of the carburetor. When the nozzles 181 begin to deliver fuel, which they will in due course if the throttles 23 are held open, the supply of fuel to the primary nozzles 180 through the metering orifices 50 will be decreased by an amount equal to that delivered by the secondary nozzles 181. This will automatically compensate for the temporarily rich condition in the primary nozzles 180.

Fig. 9 shows another modification of the invention illustrated in Fig. 4. As in the above-described illustrations, the main fuel supply from each fuel bowl to adjacent primary and adjacent secondary mixture conduits is through individual fuel nozzle systems which are identical. Consequently, only one fuel nozzle will be described, and the same reference characters will be used, where possible, to indicate like parts. As stated in the description of Fig. 4, the bleed 85 and its connecting passage 84 may be omitted if desired. Fig. 9 shows a modification omitting this construction. Since the nozzle arrangement of Fig. 9 is identical with that of Fig. 4 in other respects, the description thereof will not be repeated.

The choke valve 18 in the primary barrels of the carburetor 10 carries a bracket 190 which, in turn, is pivotally connected to a metering rod 192 by a link 191. The rod 192 is received within a well 193 in the carburetor body and passes through a metering jet 194 in the fuel tube 78. It will be apparent that, with this construction, when the choke valve 18 is in operation, metering rod 192 will be positioned to cut off the air-bleeding effect produced through the ports 81 and 83 in the secondary stage. Consequently, the primary stage can be separately calibrated for proper operation of the choke valve 18. The final opening movement of the choke valve 18 will withdraw the metering rod 192 so as to open communication between the nozzles 81, 83 and the fuel passage 77. Under these conditions, the carburetor action will be similar to that described for Fig. 4.

This invention may be modified as will occur to those skilled in the art, and the exclusive use of all modifications as come within the scope of the appended claims is contemplated.

We claim:

1. In a multi-stage carburetor, primary and secondary mixture conduits, primary and secondary throttles, respectively, controlling said conduits, a fuel bowl, a float-operated valve for controlling the fuel supply to said bowl, a fuel metering orifice adjacent one side of said bowl, a main fuel passage from said orifice to a control point above the fuel level and adjacent the center of said fuel bowl, a fuel tube connecting with said passage at said control point and extending transversely through said primary and secondary mixture conduits, and a fuel nozzle in said tube for each mixture conduit, whereby a substantially constant relation is maintained between the fuel level and said control point to supply each said nozzle uniformly on inclination of said carburetor, and valve means provided in said tube between said nozzles to control the flow of fuel to said secondary conduit.

2. The combination defined in claim 1 in which said valve means is moved from closed to open position responsive to movement of a choke valve from closed to open position.

3. In a multi-stage carburetor, primary and secondary mixture conduits, sequentially operated primary and secondary throttles in said primary and secondary mixture conduits, primary and secondary fuel nozzles in said primary and secondary mixture conduits, a choke valve anterior of said primary nozzle, means for restricting secondary throttle opening movement when said choke valve is closed, and a fuel supply system for said nozzles comprising, a constant level fuel chamber, a main fuel passage, a fuel metering device between said chamber and said passage, a connection between said passage and said nozzles, a metering device for said secondary nozzle, and means for maintaining said metering device in flow restricting position when said choke valve is in closed position and for moving said device to decrease the restricting effect.

4. In a multi-stage carburetor, primary and secondary mixture conduits, sequentially operated primary and secondary throttles in said primary and secondary mixture conduits, primary and secondary fuel nozzles in said primary and secondary mixture conduits, a choke valve anterior of said primary nozzle, and a fuel supply system for said nozzles comprising, a constant level fuel chamber, a main fuel passage, a fuel metering device between said chamber and said passage, a connection between said passage and said nozzles, a metering device for said secondary nozzle, and means for moving said device to flow restricting position in response to closing movement of said choke valve for lessening the effect of back-bleed from said secondary nozzle so as to increase the fuel delivery rate from said primary nozzle when said choke valve is closed.

5. In a multi-stage carburetor, primary and secondary mixture conduits, sequentially operated primary and secondary throttles in said primary and secondary mixture conduits, primary and secondary fuel nozzles in said primary and secondary mixture conduits, a choke valve anterior of said primary nozzle, and a fuel supply system for said nozzles comprising, a constant level fuel chamber, a main fuel passage, a fuel metering device between said chamber and said passage, a connection between said passage and said nozzles, and a metering device for said secondary nozzle operated in response to closing movement of said choke valve for lessening the effect of back-bleed from said secondary nozzle so as to increase the fuel delivery rate from said primary nozzle.

6. In a multi-stage carburetor, primary and secondary mixture conduits, sequentially operated primary and secondary throttles in said primary and secondary mixture conduits, primary and secondary fuel nozzles in said primary and secondary mixture conduits, a choke valve anterior of said primary nozzle and a fuel supply system for said nozzles comprising, a constant level fuel chamber, a main fuel passage, a fuel metering device between said chamber and said passage, a connection between said passage and said nozzles, a metering device in said connection to said secondary nozzle, and means for maintaining said metering device in a flow restricting position when said choke valve is closed for lessening the effect of back-bleed from said secondary nozzle so as to increase the fuel delivery rate from said primary nozzle

7. In a multi-stage carburetor, primary and secondary mixture conduits, primary and secondary throttles, respectively, controlling said conduits, a fuel bowl, a float-operated valve for controlling the fuel supply to said bowl, a fuel metering orifice in the lower part of said bowl, a main fuel passage from said orifice to a control point above the fuel level and adjacent the middle of said fuel bowl, a fuel tube connecting with said passage at said control point and extending transversely through said primary and secondary mixture conduits, and primary and secondary fuel nozzles in said tube for the respective mixture conduits, whereby a substantially constant relationship is maintained between the fuel level and said control point to supply each said nozzle uniformly on inclination of said carburetor, and means including an orifice, a choke valve, and a metering rod operatively connected to said choke valve and movable within said orifice for restricting the flow of fuel to said secondary nozzle.

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