April 29, 1958 O. HENNING 2,832,576

TWO-STAGE CARBURETOR

Filed Aug. 1, 1955 5 Sheets-Sheet 1

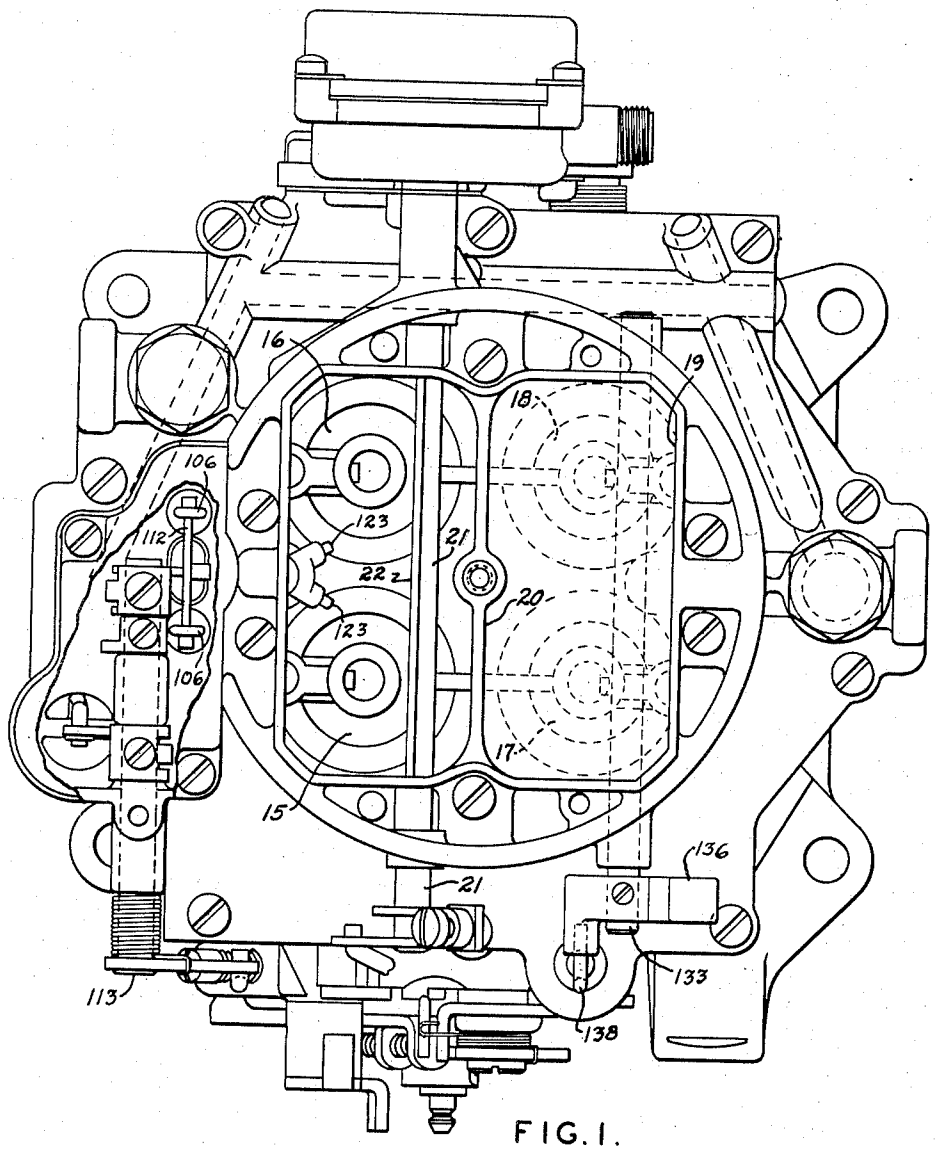


FIG. 1.

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TWO-STAGE CARBURETOR

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5 Sheets-Sheet 2

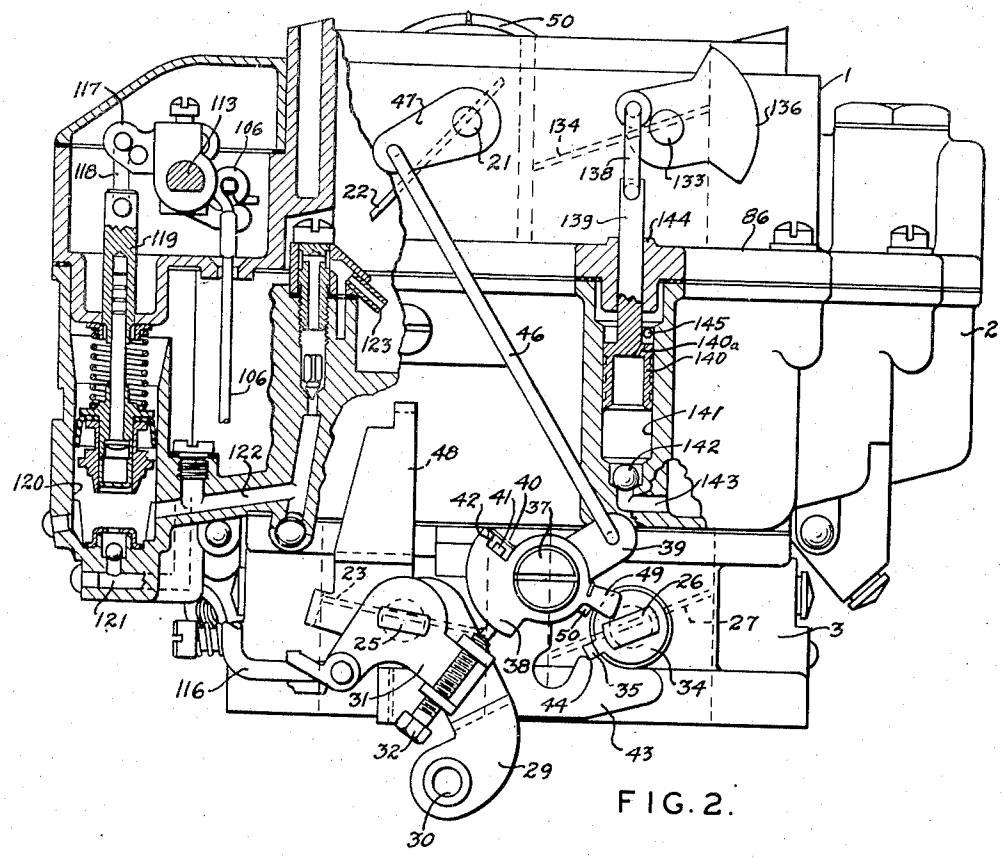


FIG. 2.

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TWO-STAGE CARBURETOR

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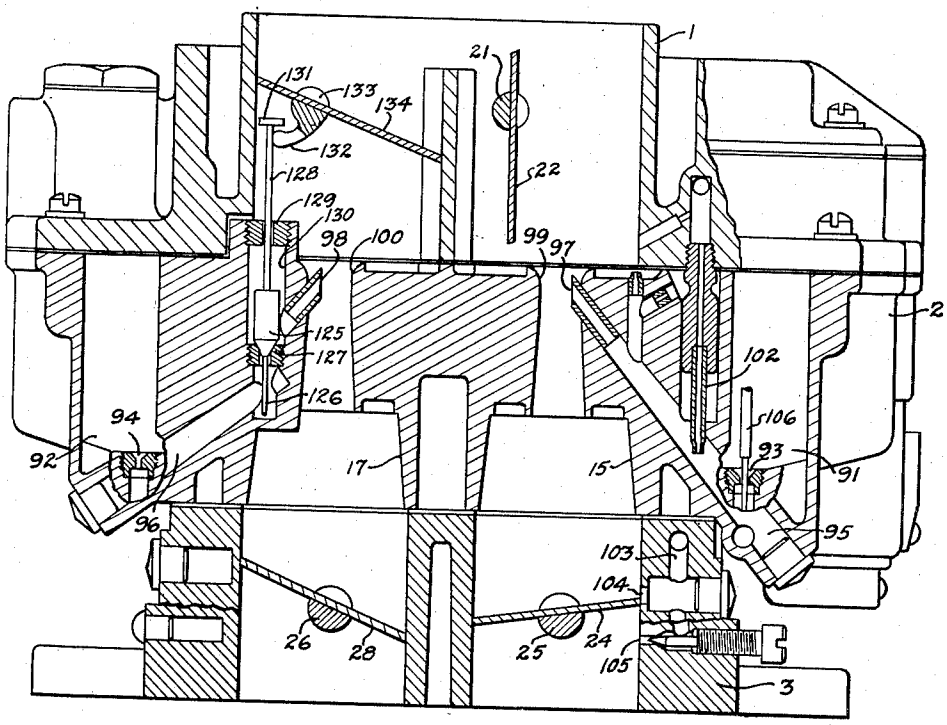


FIG. 3.

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TWO-STAGE CARBURETOR

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5 Sheets-Sheet 4

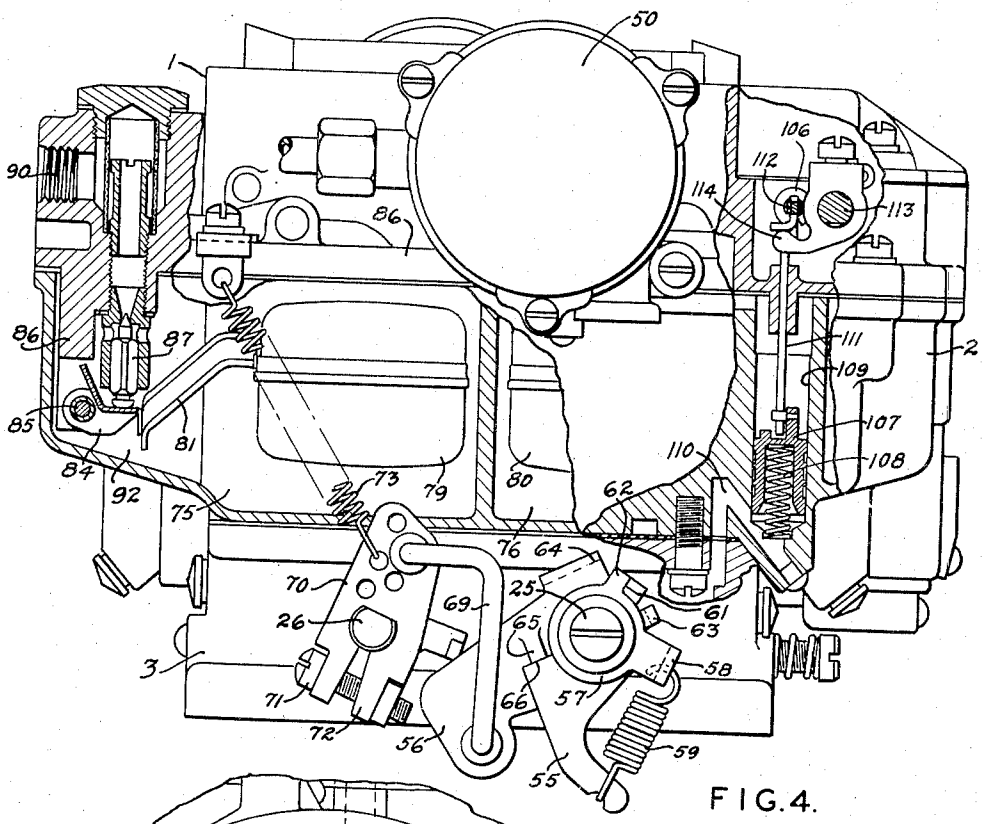


FIG.4.

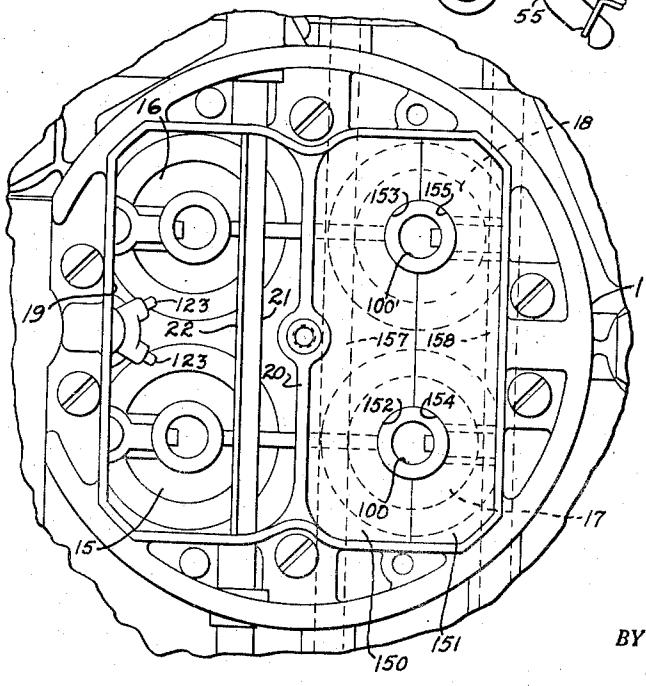


FIG.5.

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TWO-STAGE CARBURETOR

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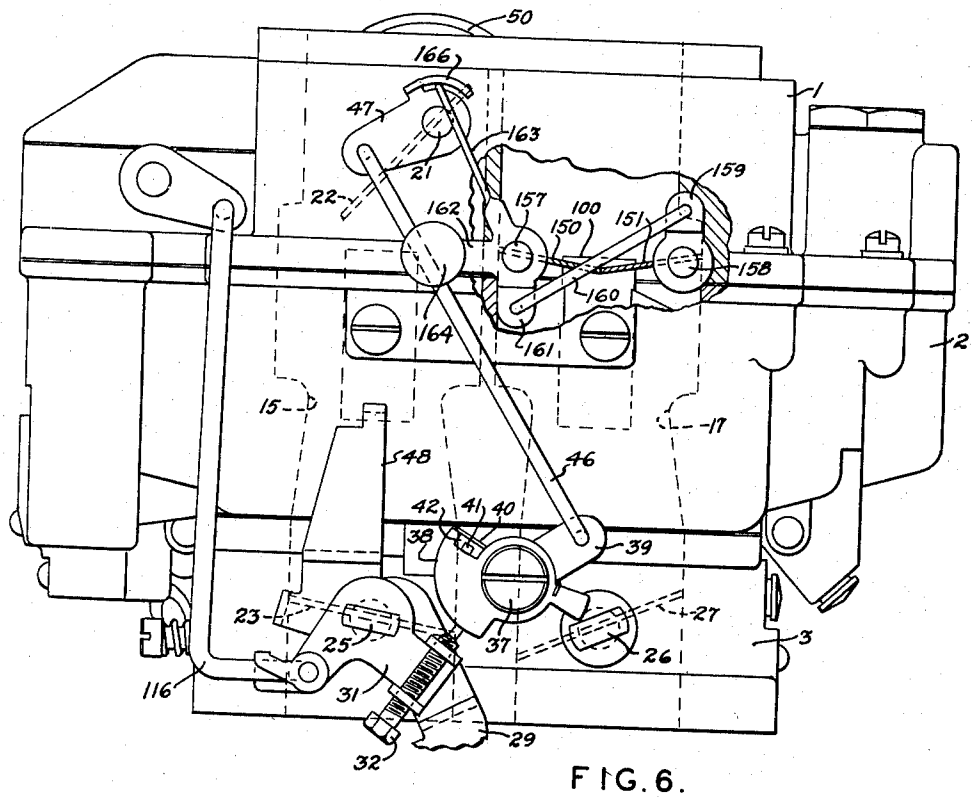


FIG. 6.

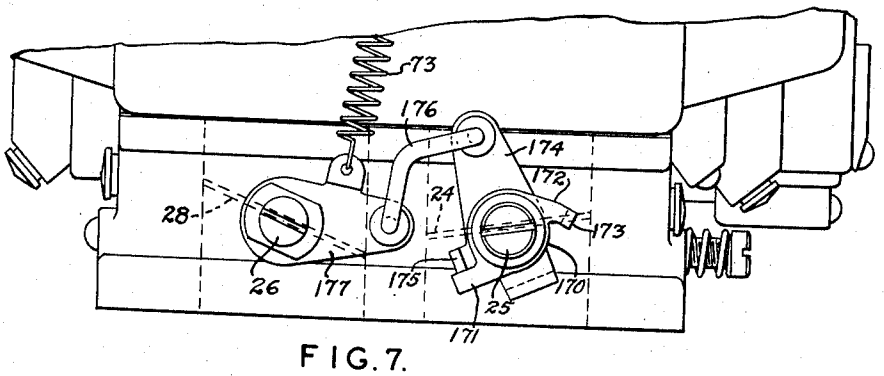


FIG. 7.

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United States Patent Office

2,832,576

Patented Apr. 29, 1958

2,832,576

TWO-STAGE CARBURETOR

Otto Henning, St. Louis, Mo., assignor, by mesne assignments, to ACF Industries, Incorporated, New York, N. Y., a corporation of New Jersey

Application August 1, 1955, Serial No. 525,522

10 Claims. (Cl. 261—23)

This invention relates to fuel systems for internal combustion engines, and more particularly to multi-stage carburetor systems in which a plurality of carburetors or a plurality of mixture conduits in a multi-barrel carburetor are connected to a single intake manifold. Since multi-cylinder engines usually have dual manifolds, this system, when applied to each manifold, requires at least four individual carburetors or what is commonly referred to as a four-barrel carburetor.

The advantages of multi-barrel, multi-stage carburetors are well understood in the art, and are generally stated in many patents such as Kishline 2,193,533; Braun 2,434,192; Ericson, et al., 2,269,930, and others. A reference to these particular patents will fully acquaint those skilled in the art with sufficient background to understood the present invention.

In some of these prior devices, the primary and secondary throttles are manually controlled in a sequential manner. In others, the secondary throttles open automatically in response to engine requirements. One of the disadvantages of all of the prior art devices is that, regardless of how the secondary throttles are controlled, their initial opening movement causes leaning out of the total mixture being supplied because there is always some lag in a plain tube type of carburetor before the fuel nozzles in the secondary carburetors begin to operate. This lag is readily detectable in many instances during rapid acceleration, and is indicated by a dip in the torque curve which is readily detectable by dynamometer tests.

The present invention solves this problem by modifications of the secondary carburetor, causing instantaneous fuel delivery on throttle opening.

In one modification an eccentrically pivoted air flow responsive valve is located in the secondary mixture barrels anterior of the fuel nozzles, rather than posterior thereof as in prior constructions such as Braun. The valve is provided with a certain degree of mechanical unbalance resisting the opening force of the air pressures imposed on opposite valve surfaces when the secondary throttles are opened.

When there is sufficient air pressure differential on the valve to overcome the degree of mechanical unbalance, the suction posterior of the valve will usually be more than enough to cause rapid fuel delivery from the main fuel nozzle. Consequently, it is desirable to have a fuel valve for the main fuel nozzles which substantially shuts off the fuel flow when the air valve is closed, but which will open proportionately as the air valve opens.

Such a means will cause the secondary barrels to function like an air valve carburetor, at least during initial operation. If desired, the degree of mechanical unbalance can be, and usually is, designed to decrease the valve closing force with valve opening, so that it becomes practically negligible when the valve reaches full open. The secondaries then function like a plain tube type of carburetor.

The results accomplished by this varied operation will eliminate the dip in the fuel ratio curve usually characteristic of multi-stage plain tube type carburetors. Before the secondary throttles open, engine suction acts directly on the fuel nozzle, and is therefore effective during initial valve opening, so that there is no lag in fuel delivery from the secondary main nozzles. Simultaneously, air velocity builds up in the secondary venturi to create the degree of suction necessary for continued fuel flow from the main nozzles as the suction producing effect of the air valve diminishes.

In another modification, the flow responsive valve is located anterior of the main throttle to initially close off all of the air flow except that through the primary venturi which encloses the outlet of the main fuel nozzle. The effect produced by this location of the valve is similar to the action which can be obtained from a carburetor with a variable venturi.

Both modifications result in structures of reduced overall height while retaining conventional throttle construction, since it is unnecessary to provide additional room for a secondary controlling valve above or below the secondary throttle, as is required by Braun.

The accompanying drawings illustrate constructions which will operate to smooth out the transition point between the primary and secondary carburetors.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a top plan view of a carburetor constructed in accordance with one modification of the instant invention.

Fig. 2 is a side elevation of the carburetor illustrated in Fig. 1, with parts broken away.

Fig. 3 is a vertical transverse sectional view of the carburetor of Fig. 1 taken on a plane through one primary and one secondary mixture conduit.

Fig. 4 is a side elevation of the carburetor in Fig. 1 illustrating the opposite side from Fig. 2, parts being broken away and sectioned.

Fig. 5 is a top plan view of the same type of carburetor illustrating a second embodiment of the invention.

Fig. 6 is a side elevation of the carburetor shown in Fig. 5, with parts broken away to illustrate the invention.

Fig. 7 is a fragmentary side elevational view of the opposite side of the carburetor from Fig. 6.

While more than one embodiment of the invention is shown in the accompanying drawings and herein described in detail, it is to be understood that his disclosure is given for the purpose of illustrating the invention, and is not intended in a limiting sense as to the precise constructions disclosed.

Throughout the drawings, similar reference characters represent similar parts, although, where such parts are modified in the structure, they may be indicated by different reference characters.

The carburetor shown in Fig. 1 has four mixture conduits or barrels which, in this case, are grouped together. These include two forward main conduits **15** and **16** and two rear secondary mixture conduits **17** and **18**. Air enters the generally rectangular air inlet portion **19** in the air horn, which is divided by a transverse partition **20** extending between the primary and secondary conduits. A shaft **21** extending transversely of the primary conduits and journaled for rotation in the side walls of the air horn mounts an unbalanced choke valve **22**, which controls the opening on the primary side of the partition **20** and the entrance of air to the forward or main mixture conduits **15** and **16**.

In this particular carburetor, the mixture conduits **15**, **16**, **17** and **18** extend from the air horn **1** downwardly through a nozzle and float bowl body portion **2** and throttle body **3**, all as shown in Fig. 2. Within the throttle body **3** are a plurality of throttle valves for controlling

the flow of mixture through the several mixture conduits. This is better shown in Figs. 2 and 3. A primary throttle shaft 25 mounts a pair of throttles 23 and 24, which will move simultaneously on operation of the throttle shaft 25. Secondary throttle shaft 26 mounts a pair of throttles 27 and 28 (Figs. 2 and 3) which separately control the secondary mixture conduits 17 and 18, respectively.

Primary throttle shaft 25 (Fig. 2) carries a double crank arm 29 rigidly fixed thereto. A suitable aperture 30 is formed in one end of the double crank arm 29 for attachment of the usual linkage extending from the accelerator pedal of the vehicle. Another lever 31, also rigidly secured to the main throttle shaft 25, carries an idle speed adjusting screw 32. Small, disc-like member 34, rigidly secured to the corresponding end of the secondary throttle shaft 26, has a radially extending lug 35. Between and above throttle shafts 25 and 26 is a stub shaft 37 carrying a fast idle cam element 38 and a freely rotatable lever 39. Lever 39 is rotatably connected to fast idle cam 38 by a lug 41 engaging within a socket 42 on one radial face of the fast idle cam 38. A torsion spring 40 on stub shaft 37 has one leg engaging arm 49 on cam 38 and the other holding lug 41 on lever 39 within notch 42.

Also loosely mounted upon the stud shaft 37 is an eccentrically weighted stop device 43, which, because of its weight distribution, normally assumes the position in which its one extreme end 44 is in the path of travel of the lug 35 on shaft 26, so as to prevent opening of the secondary throttle valves. The interaction of the finger 44 with the lug 35 provides a stable latch device which cannot be forced out of the way merely by the application of turning force to the shaft 26.

As shown in Fig. 2, lever 39 is connected by a rod 46 to an arm 47 rigid with the choke shaft 21. Accordingly, when the choke valve is closed, lever 39 is rotated from the position shown in Fig. 2 in a counter-clockwise direction, and lug 41 will move the fast idle cam 38 into a position to engage with the idle screw 32 and limit closing movement of the main throttle valves 27 and 28.

When the choke valve is open, fast idle cam 38 is urged in a clockwise direction by engagement of the lug 41 with one arm of the torsion spring 40. The reaction of the torsion spring on the fast idle cam lug 49 will tend to withdraw the fast idle cam 38 from engagement with the idle screw 32, so that, once the throttles 27 and 28 are opened, cam 38 will pull out of the way and the throttles may return to dead idle position.

Main throttle control arm 29 has an arm 48 movable with the throttle shaft 25 and so arranged that when the throttles are moved fully open, the end of this arm will engage a finger 49 on the fast idle cam 38 so as to rotate the lever 39 clockwise and thereby partially open the choke valve for unloading any excess fuel which may be in the intake manifold. When the choke valve opens under the influence of air flow and its thermostatic control mounted in housing 50, lever 39 rotates clockwise and lug 50, carried thereby, engages the eccentric weighted lever 43 so as to unlatch the secondary throttles 27 and 28. This structure is described in a co-pending application of Carlson and Moseley, Serial No. 263,291, filed December 26, 1951, for "Throttle Control for Compound Carburetors," now Patent No. 2,715,522, issued Aug. 16, 1955.

The opposite side of the throttle body 3, as shown in Fig. 4, illustrates one way of interconnecting the primary and secondary throttle shafts for sequentially operating the secondary throttle shaft during opening movement of the primary throttle shaft. A resilient lost motion mechanism permits full rotational movement of the primary throttle shaft when the secondary throttle shaft is latched.

Loosely mounted on this end of the main throttle shaft 25 are a pair of levers 55 and 56. A small, disc-like member 57 is rigidly secured to the end of the throttle shaft 25, and has an arm 58 interconnected by a coil tension spring 59 to the extremity of the lever 55. This spring normally maintains an outwardly turned finger 61 on the lever 55 in engagement with a radial finger 62 also formed integrally with the member 57. Lever 55 also has an inwardly turned peripheral finger 63 which lies in the same vertical plane as shoulder 64 on lever 56. Lever 56 has a struck-out lug 65 on its outer face for engagement with the abutment 66 on lever 55. Lever 56 is interconnected with lever 70 by a link 69. Secondary throttle shaft 26 is securely clamped to lever 70 by the bolt 71 extending through the legs of the bifurcated end 72 of the lever 70. Tension spring 73 urges the secondary throttle shaft in a counter-clockwise direction for closing the secondary throttles 23 and 24.

Rotation of the primary throttle shaft 25 counter-clockwise in order to open the primary throttles will not affect the position of the secondary throttles on the secondary throttle shaft 26 until the lug 63 on the arm 55 engages the shoulder 64. If the secondary throttle shaft is unlatched, further rotation of the primary throttle shaft to the full open position of the primary throttles will operate the levers 56 and 70 to fully open the secondary throttles. On closing of the primary throttles, abutment 66 engages lug 65 positively closing the secondary throttles.

If the secondary throttles happen to be latched during opening movement of the primary throttles, which can happen if the choke valve is not fully open, then the further movement of the primary shaft in a counter-clockwise direction subsequent to the engagement of the finger 63 with the abutment 64 merely stretches spring 59. This construction and its operation are set forth more in detail in the above-mentioned co-pending application of Carlson and Moseley.

Formed on opposite sides of the mixture conduits are constant level fuel chambers 75 and 76 within which are pairs of floats 79 and 80, only two of which are shown in Fig. 4. Each pair of floats is interconnected by a yoke such as 81, one of which is shown in Fig. 4, and these are pivotally supported on suitable pins such as 85 from suitable brackets suspended from the float bowl cover 86 by bifurcated elements such as 84. Needle valves such as 87 controlling the fuel passage 90 are engaged by the bifurcated elements 84 on movement of the pairs of floats 79 and 80 so as to maintain fuel at a substantially constant level in the fuel bowls 75 and 76, all in a well known manner.

Each pair of fuel chambers 75 and 76 is interconnected by cross-passages 91 and 92, within which are pairs of main fuel metering passages 93 and 94, one of which is shown in each of passages 91 and 92. Main fuel passages such as 95 and 96 connect with pairs of main fuel nozzles 97 and 98 within the primary venturi 99, 100 located in the primary and secondary mixture conduits 15 and 17, respectively, as shown in Fig. 3. The main mixture passages 95 on the primary side of the carburetor have wells within which are restriction tubes 102 connecting by way of passages 103 with the usual idle ports 104 and 105 located on opposite sides of the throttle valves 24.

Primary metering orifice elements 93 are controlled by suitable metering pins 106, only one of which is shown, which are actuated in accordance with manifold vacuum and throttle position by means of a suction piston and spring element 107 and 108 working in a cylinder 109 connected to the primary mixture conduits posterior of the throttle valves therein by means of a suction passage 110. A stem 111 connected with piston 107 carries a cross-bar 112 on which are supported the pair of metering rods 106. Adjacent the cross-bar 112 is a countershaft 113 with a finger 114 engaging beneath the cross-bar 112. Countershaft 113 is operated, in turn, from the primary throttle lever 27 by means of a suitable linkage 116, part of which is shown in Fig. 2.

On the countershaft 113 and extending in the opposite direction from the finger 114 is a short lever 117 con-

nected by means of a link **118** with an accelerating pump **119** within the well **120**. Fuel from the fuel bowl enters the well **120** through passage **121** and leaves by way of passage **122** which interconnects by way of suitable valves and passages with nozzles **123**, only one of which is shown, but both of which are located in separate primary mixture conduits **15** and **16**.

So far, the description has been confined to the features shown and described in the aforementioned copending application of Carlson and Moseley.

The present invention contemplates a modification of the multi-stage carburetor, which is more specifically shown in Fig. 3 and Fig. 4.

As shown in Fig. 3, the main fuel supply passages **96** leading to the fuel nozzles **98** in the secondary barrels **17** and **18** have valves provided with weighted bodies **125** and metering stems **126** projecting into and through a valve seat **127**. An actuating stem **128** for each valve projects through a guide **129** screwed into the upper end of a well **130** in which the valve **125** is adapted to move. The upper ends of the stems **128** are joined by a transverse bar **131** which overlies a pair of fingers **132** rigid with a shaft **133** carrying the suction and velocity operated valve **134**. The stem **128** may be shaped to control the air bleed **129**. Shaft **133** is journaled in bearings in opposite sides of the air horn body **1**, and has a projecting end to which is rigidly fixed an eccentric weight **136** mounted on the shaft **133** so as to urge the valve **134** towards closed position. A lever **137** formed integrally with the counterweight **136** is connected by means of a link **138** to a rod **139** on piston **140**. A dashpot cylinder **141** containing the piston **140** has an inlet check **142** controlilng the bowl inlet passage **143**. Piston rod **139** is slidably mounted in the bearing **144** in the float bowl cover **86** which is formed as an integral part of the air horn **1**. Piston **140** has metered orifice **140***a* and overflow passage **145** leads from the port of cylinder **141** to the fuel bowl.

As can be seen, the parts are so interconnected that when the secondary barrels **17** and **18** are not in operation and throttles **27** and **28** are closed, velocity valve or throttle **134** will be held in closed position by the counterweight **136**. A slight clearance will then exist between the finger **132** and the bar **131**, so that valve **125** will remain seated by its own weight on seat **127**, thereby preventing any spillage or leakage of liquid fuel from the main secondary fuel nozzles **98**.

During operation of the engine with the throttles **27** and **28** partially open or full open, unless sufficient suction exists in the secondary mixture conduits, valve **134** will remain closed. When engine speed increases, suction will increase to a degree necessary to open valve **134**.

Upon opening movement of valve **134**, finger **132** engages bar **131** to lift valves **125**, so that fuel may flow through the main nozzles **98** to the secondary mixture conduits under control of metering rod **126**. Weight **136** and dashpot **140**, **141** will both resist opening movement of the valve **134** by engine suction, because the movement of the valve will force the piston **140** downwardly in the cylinder **141**, compressing fuel beneath the piston **140** and retarding the progress of movement of the valve to a rate proportional to the leakage of fuel through the metered port **140***a* in the top of piston **140**.

It will be apparent that, because of the mechanical connection controlling the operation of the valve **125** by the suction velocity valve **134**, a difference in pressure must necessarily exist above and below the valve **134** to cause its operation in the opening direction. This difference in pressure can be predetermined by the degree of mechanical unbalance of the weight **136**. It will be equally apparent that the rate of opening of the valve **134** due to this difference in pressure on its opposite sides can be likewise controlled by the dashpot action of the piston **140** in the cylinder **141**, so that both the force

necessary for initial opening and the difference in pressure necessary to produce a certain rate of opening will be required. Both differences in pressure, however, are subject to be determined by proper calibration and testing of the individual carburetor.

During operation, when the secondary throttle valves **27** and **28** open, a certain amount of suction will exist beneath the valve **134**, and this suction will be applied to main secondary fuel nozzles **98**, but, since the valves **125** are closed, no fuel will be discharged until there is some movement of the suction velocity valve **134**. Upon opening movement of valves **125**, however, fuel issues immediately from nozzles **98**. The amount of flow will initially depend upon the degree of suction necessary to move the valve **134**, rather than upon the velocity of air passing the main secondary fuel nozzles **98** through the venturis **100**. As the valve **134** moves toward its open position, its throttling action on the flow from the main nozzles decreases, and at some point during opening of the valve **134** may cease altogether.

At least initial operation of the secondary mixture conduits will resemble that of an anterior throttle type carburetor, but during final opening movement of the valve **134** the operation changes to resemble that of a plain tube type of carburetor.

Figs. 5 to 7 show another form of the invention applied to the same basic carburetor above described. The detailed description will therefore be limited to the modifications necessary in this basic structure. Like reference characters indicate parts corresponding to those already described.

Primary mixture conduits **15** and **16** have a common air entrance in the air horn **19** divided by a partition **20** from the common air entrance to the secondary mixture conduits **17** and **18**. The air horn entrance to the primary mixture conduits is controlled by a choke valve **22** mounted on rotatable shaft **21** and operated by the choke mechanism in the housing **50**, all as above described.

The common air entrance to the secondary mixture conduits **17** and **18** mounts a pair of air valves **150** and **151** which, when closed, confine the air flow to the inner venturi tubes **100** and **100'** in the secondary mixture conduits **17** and **18**, respectively. The inner free edge of the valve **150** has semicircular notches **152** and **153** which register with like notches **154** and **155** in valve **151** so as to accommodate or clear the inner venturi tubes while yieldingly closing the remainder of the secondary mixture conduits **17** and **18** to the passage of air when the valves are in the positions shown, except as above mentioned.

Each of the valves is mounted on a rotatable shaft such as **157** and **158** journaled in the walls of the air horn **1**. Shaft **158** carries at one end a fixed arm **159**, the upper end of which has a pivoted connection with link **160**. Shaft **157** carries a compound lever fixed thereto, which has a plurality of arms **161**, **162**, and **163**. Link **160** has a pivotal connection at its opposite end with the depending arm **161**. With this construction, valves **150** and **151** will move together or, when one is locked against movement, both will be held closed. Also, since the valves are eccentrically mounted with respect to their shafts **157** and **158**, both will be responsive to suction when unlocked. The effect of suction in the secondary mixture conduits **17** and **18** is resisted by mechanical unbalance tending to hold the valves closed against the action of a difference in pressure tending to open them. Arm **162** has a weight **164** for this purpose. Thus, as in the first form, the air valves constantly control the admission of air to the zone of the secondary mixture conduits into which inner venturi tubes **100** and **100'** discharge fuel from the secondary main nozzles.

VALVE LOCK

The lock for holding the valve against suction is operated by the automatic choke. Thus, in Fig. 6 choke arm **47** carries an arcuate latch member **166** which engages with a finger on arm **163** when the choke valve is closed. Release of this latch occurs when choke valve **22** reaches full open position, which, in turn, frees the two valves **150** and **151** to respond to differences in pressure on their opposite sides.

It will be noted that, because of this locking function performed by the choke valve, as above described, it is unnecessary in this modification of the carburetor to use a latch member such as **43** in Fig. 2 for holding the secondary throttles closed during operation of the choke valve. Furthermore, because of the omission of this particular latch mechanism, the linkage for sequentially operating the throttle shaft shown in Fig. 4 may be considerably simplified. A resilient interconnection between the primary throttle shaft **25** and the linkage for operating the secondary throttle shaft **26** may be omitted and, as will be noted in the description of Fig. 7 to follow, there is a total absence of a mechanism corresponding to arms **55** and **58** and their connecting spring **59**.

In Fig. 7, primary throttle shaft **25** carries fixed thereto a disc-like member **170** having oppositely extending arms **171** and **172**. An inwardly offset lug **173** on arm **172** lies in the plane of lever **174**, which is rotatably journaled on the throttle shaft **25**. An outwardly extending lug **175** on the lever **174** is positioned to be engaged by the arm **171** when primary throttles **24** and **25** are in the closed position. Secondary throttle shaft **26** has fixed thereto an arm **177**, and link **176** has a pivotal connection with both arms **174** and **177**. A spring **73** connects with arm **177** and the carburetor body to retain or urge the valve **27** in a closing direction.

With this mechanism, opening movement of the primary throttles **25** and **26** rotates lug **173** until it engages the edge of arm **174**. At this point, throttles **23** and **24** will be open approximately 60 degrees. Further rotation of the primary throttle shaft in the throttle opening direction is transmitted to the secondary throttles **27** and **28** through the link **176** and arm **177** in such a manner that the throttles **27** and **28** reach their full-open position simultaneously with throttles **23** and **24**.

Rotation of the primary throttle shaft **25** from the full open position of the primary throttles in the closing direction permits spring **73** to move secondary throttles **27** and **28** to their closed position. This will occur when the primary throttles are still open about 60 degrees. Operation of the primary throttles to the dead idle position engages arm **171** with lug **175** so as to tightly close the secondary throttles **27** and **28**.

Operation

Generally speaking, the modification described in Figs. 5 to 7 operates like a variable venturi carburetor when the air valves are unlatched by opening of the choke valve **22**, and when latched closed there will be no interference with the normal carburetor operation during starting or warm-up.

During engine cold starting, choke valve **22** will be closed, and the carburetor will function normally on the mixture supplied entirely by the primary mixture conduits. Movement of the primary throttles to operate the unloader **48** may open the secondary throttles to some extent, but, although valves **150** and **151** remain latched, the cranking speed is slow, relatively speaking, and no fuel will be drawn from the secondary mixture conduits.

When the engine is operating during the warm-up, both primary and secondary throttles can be fully opened without having the mixture lean out, because air flow is concentrated in the inner venturi tubes **100** and **100'** in the secondary mixture conduits. A mixture-enriching effect will occur in the secondary mixture conduits suitable for warm-up.

During operation with the choke fully open, valves **150** and **151** are unlatched, but a certain degree of suction is required to cause them to open, which is determined by the degree of mechanical unbalance. This can be so chosen that all of the suction is concentrated on the primary venturi tubes **100** and **100'** on initial secondary throttle operation. This brings the secondary fuel nozzles into operation immediately on secondary throttle opening, and delivers a mixture suitable to eliminate any dip in the fuel ratio curve during the transition.

As the flow through the secondaries increases with engine speed and throttle opening, valves **150** and **151** respond accordingly, increasing the size of the venturi nozzles. Preferably, valves **150**, **151** will reach full open position before maximum engine power output is reached.

The modifications above described and explained operate on a generally similar principle. During initial opening of the secondary throttles, the air valves throttle the flow of air to the zones of the secondary mixture conduits into which the secondary main fuel nozzles discharge, the air valves in both cases being located anterior to these zones, and, in so doing, create a substantial drop in static pressure, causing immediate fuel flow from the nozzles in the secondary mixture conduits which will be richer than otherwise.

In the first modification, the metering rod and valve **125**, **126** and **127** may be properly shaped to give the normal mixture ratio after initial opening of the air valve **134**. This may be controlled by the shape of the metering rod **126** or by opening of an air bleed for the secondary nozzles such as **129** by the valve **125**.

In the second modification, the same control is effected by opening of the air valves **150** and **151**, allowing the air to pass around rather than through the primary venturis **100** and **100'**. The additional air reduces the mixture ratio to normal at any desired point in the opening.

As explained above, the mechanical unbalance for these valves in the form of weights **136** and **164** decreases in effectiveness as the valve opens, which also tends to reduce the throttling effect and thereby lean out the fuel mixture.

A structure has been described which will fulfill all the objects of the present invention, but it is contemplated that still other modifications will occur to those skilled in the art which come within the scope of this invention as defined by the appended claims.

I claim:

1. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said primary and secondary mixture conduits, primary and secondary fuel nozzles opening in said venturi tubes, and primary and secondary throttle valves in said mixture conduits posterior of said fuel nozzles, the combination of, a flow responsive member in said secondary mixture conduit anterior of said secondary fuel nozzle, a fuel valve controlling the supply of fuel to said secondary fuel nozzle, and a connection between said member and said fuel valve.

2. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles opening in said venturi tubes, and primary and secondary throttle valves in said mixture conduits posterior of said fuel nozzles, the combination of, a flow responsive valve in said secondary mixture conduit anterior of said secondary fuel nozzle, a fuel metering device controlling said secondary fuel nozzle, and means interconnecting said flow responsive valve and said metering device for proportioning the fuel flow from said secondary nozzle in response to displacements of said flow responsive valve.

3. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said primary and secondary mixture conduits, primary and secondary fuel nozzles opening in said venturi tubes and primary and secondary throttle valves in said mixture conduits

posterior of said fuel nozzles, the combination of, an air flow responsive valve in said secondary mixture conduit anterior of said secondary fuel nozzle, fuel and air metering means for said secondary fuel nozzle, and a connection between said flow responsive valve and said air and fuel metering means controlling the delivery of fuel from said secondary fuel nozzle in response to movement of said flow responsive valve.

4. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles discharging into their respective venturi tubes, a choke valve and a primary throttle valve in said primary conduit, a secondary throttle valve means and an air flow responsive valve means in said secondary conduit on opposite sides of said secondary fuel nozzle and coacting to vary the fuel mixture, and means for locking one of said valve means in closed position, said locking means being unlocked responsive to opening movement of said choke valve, whereby air flow through said secondary conduit is variably controlled by said valve means.

5. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles discharging into their respective venturi tubes, a choke valve and a primary throttle valve in said primary conduit, a secondary throttle valve means and an air flow responsive valve means in said secondary conduit on opposite sides of said secondary fuel nozzle and coacting to vary the fuel mixture, and means for locking one of said valve means in closed position, said locking means being unlocked responsive to opening movement of said choke valve, whereby air flow through said secondary conduit is variably controlled by said valve means, said air flow responsive valve means being anterior to said secondary fuel nozzle for throttling the flow of air entering said secondary conduit on initial opening of said secondary throttle valve means to enrich the fuel mixture.

6. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles discharging into their respective venturi tubes, a choke valve and a primary throttle valve in said primary conduit, a secondary throttle valve means and an air flow responsive valve means in said secondary conduit on opposite sides of said secondary fuel nozzle and coacting to vary the fuel mixture, and means for locking said secondary throttle valve means in closed position, said locking means being unlocked responsive to opening movement of said choke valve, whereby air flow through said secondary conduit is variably controlled by said valve means, said air flow responsive valve means being anterior to said secondary fuel nozzle for throttling the flow of air entering said secondary conduit on initial opening of said secondary throttle valve means to enrich the fuel mixture.

7. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles discharging into their respective venturi tubes, a choke valve and a primary throttle valve in said primary conduit, a secondary throttle valve means and an air flow responsive valve means in said secondary conduit on opposite sides of said secondary fuel nozzle and coacting to vary the fuel mixture, and means for locking said air flow responsive valve means in closed position, said locking means being unlocked responsive to opening movement of said choke valve, whereby air flow through said secondary conduit is variably controlled by said valve means, said air flow responsive valve means being anterior to said secondary fuel nozzle for throttling the flow of air entering said secondary conduit on initial opening of said secondary throttle valve means to enrich the fuel mixture.

8. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles discharging into their respective venturi tubes, a choke valve and a primary throttle valve in said primary conduit, a secondary throttle valve means and an air flow responsive valve means in said secondary conduit on opposite sides of said secondary fuel nozzle and coacting to vary the fuel mixture, and means for locking one of said valve means in closed position, said locking means being unlocked responsive to opening movement of said choke valve, whereby air flow through said secondary conduit is variably controlled by said valve means, said air flow responsive valve means being anterior to said secondary fuel nozzle for throttling the flow of air entering said secondary conduit on initial opening of said secondary throttle valve means to enrich the fuel mixture and comprising a pair of pivotally mounted coacting valves.

9. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles discharging into their respective venturi tubes, a choke valve and a primary throttle valve in said primary conduit, a secondary throttle valve means and an air flow responsive valve means in said secondary conduit on opposite sides of said secondary fuel nozzle and coacting to vary the fuel mixture, and means for locking one of said valve means in closed position, said locking means being unlocked responsive to opening movement of said choke valve, whereby air flow through said secondary conduit is variably controlled by said valve means, said air flow responsive valve means being anterior to said secondary fuel nozzle for throttling the flow of air entering said secondary conduit on initial opening of said secondary throttle valve means to enrich the fuel mixture and comprising a pair of pivotally mounted coacting valves interconnected by a linkage for common opening movement.

10. In a multi-stage carburetor having primary and secondary mixture conduits, venturi tubes in said conduits, primary and secondary fuel nozzles discharging into their respective venturi tubes, a choke valve and a primary throttle valve in said primary conduit, a secondary throttle valve means and an air flow responsive valve means in said secondary conduit on opposite sides of said secondary fuel nozzle and coacting to vary the fuel mixture, and means for locking one of said valve means in closed position, said locking means being unlocked responsive to opening movement of said choke valve, whereby air flow through said secondary conduit is variably controlled by said valve means, said air flow responsive valve means being anterior to said secondary fuel nozzle for throttling the flow of air entering said secondary conduit on initial opening of said secondary throttle valve means to enrich the fuel mixture and comprising a pair of pivotally mounted coacting valves interconnected by a linkage for common opening movement, and having recesses therein to receive their related venturi tube.

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