Nov. 28, 1933. C. E. SUMMERS ET AL 1,936,694

CARBURETING APPARATUS

Filed Feb. 16, 1929 3 Sheets-Sheet 1

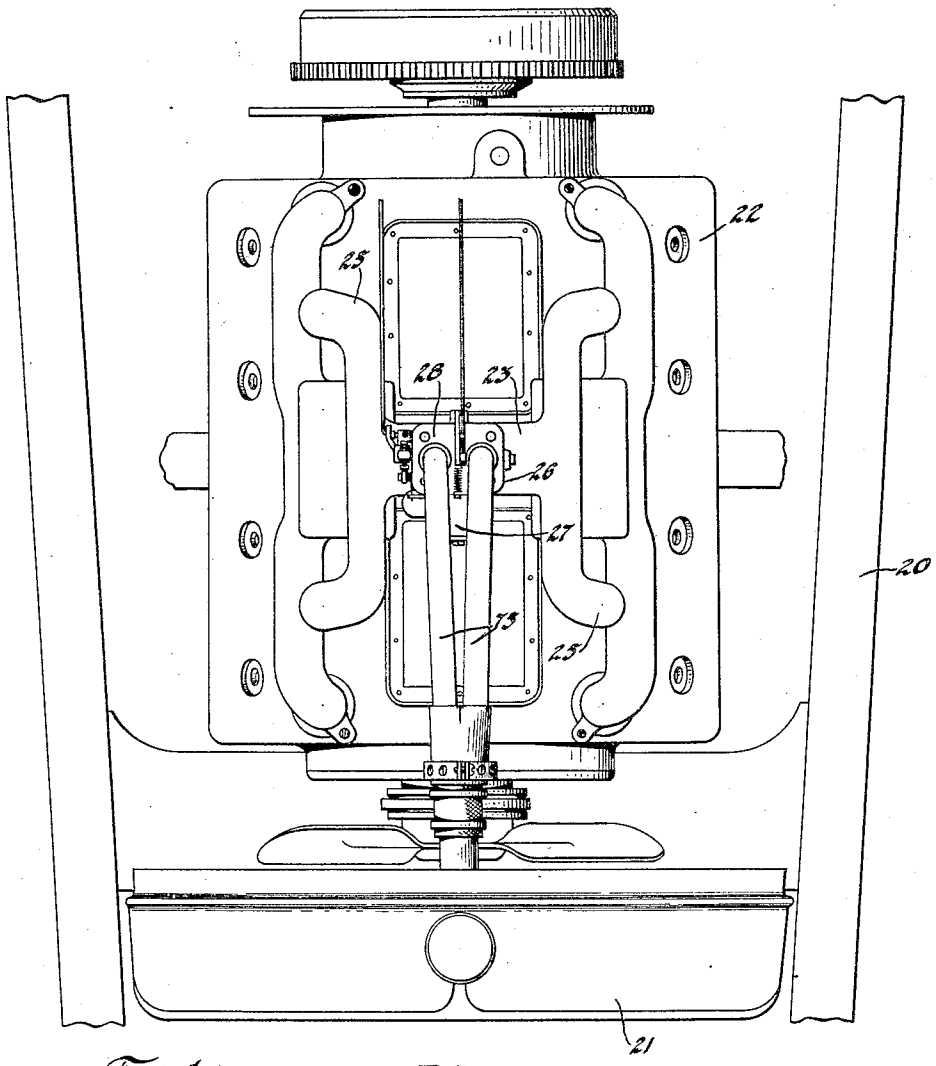


Fig. 1.

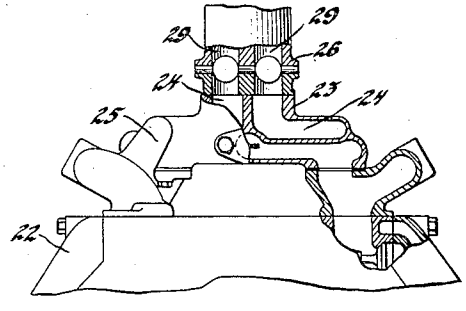


Fig. 2.

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CARBURETING APPARATUS

Filed Feb. 16, 1929 3 Sheets-Sheet 2

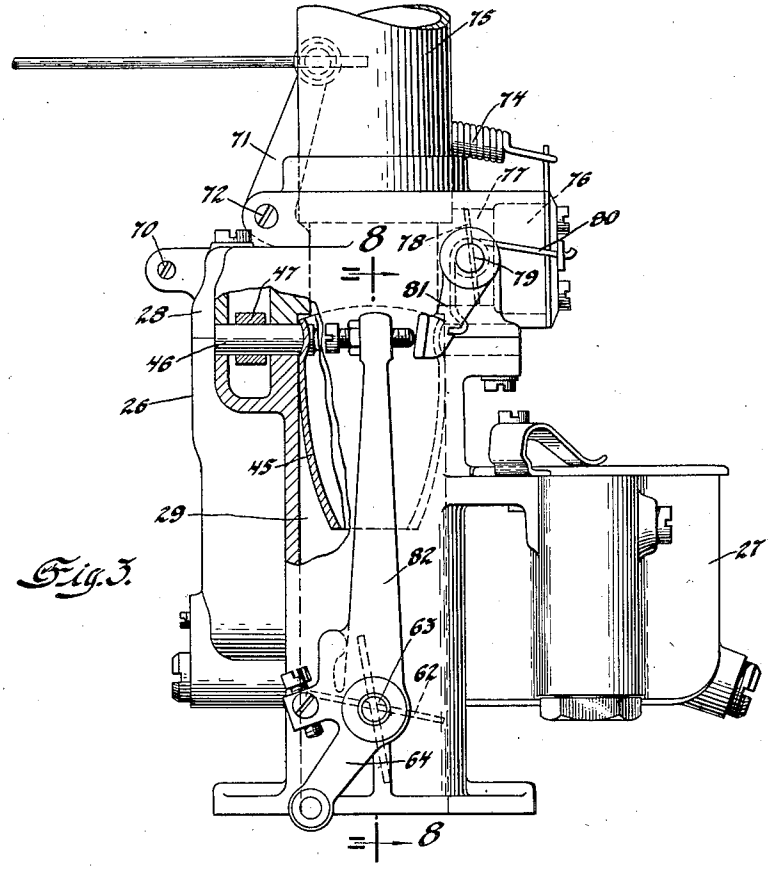


Fig. 3.

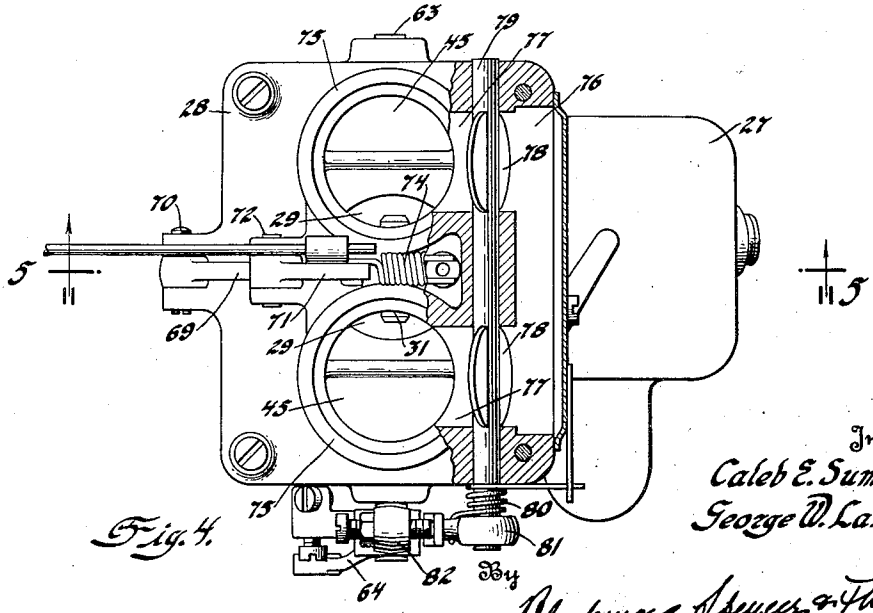


Fig. 4.

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CARBURETING APPARATUS

Filed Feb. 16, 1929 3 Sheets-Sheet 3

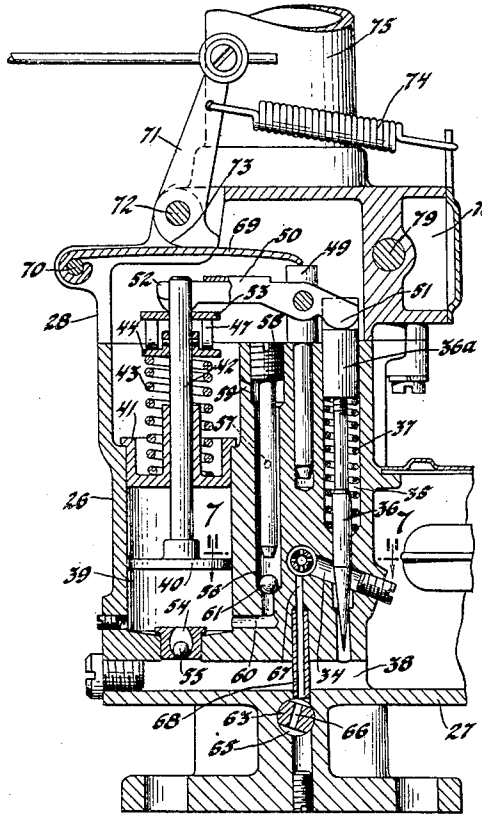


Fig. 5.

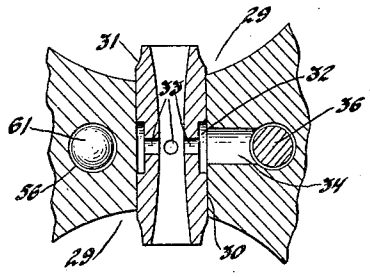


Fig. 7.

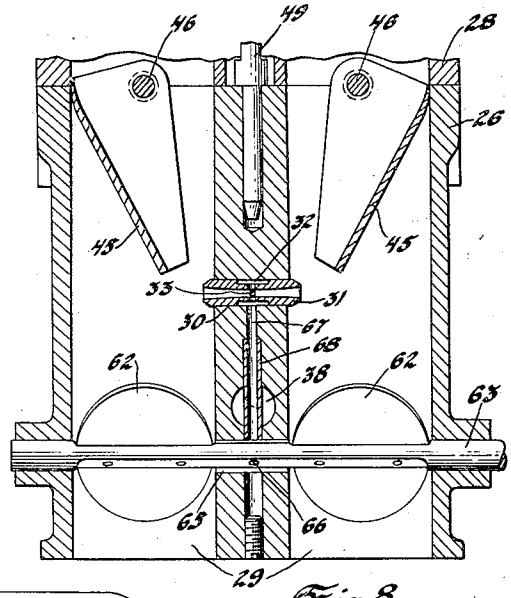


Fig. 8.

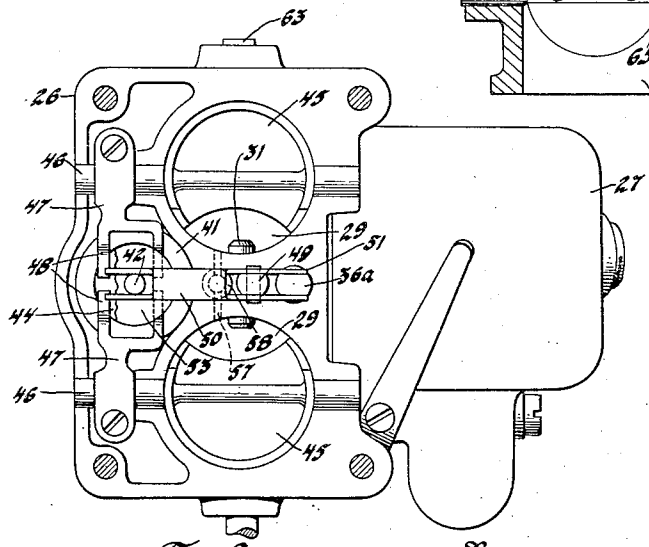


Fig. 6.

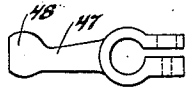


Fig. 9.

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UNITED STATES PATENT OFFICE

1,936,694

CARBURETING APPARATUS

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Application February 16, 1929. Serial No. 340,398

18 Claims. (Cl. 123—119)

This invention relates to carbureting apparatus for internal combustion engines.

For use on certain internal combustion engines, particularly those of the V-type, a carburetor of the down-draft type is particularly desirable for the reason, among others, that such a carburetor may be connected to the intake ports of the engine by means of a manifold having a minimum number of bends as is desirable in order to obtain equal and efficient distribution of the fuel charges to the several cylinders of the engine.

In order to obtain high volumetric efficiency, it is desirable that not more than four cylinders of an internal combustion engine be supplied with fuel charges from a single carbureting chamber. However, it is obviously not desirable that the carbureting apparatus for some of the cylinders of an internal combustion engine having more than four cylinders should be entirely independent of that for the others for, under such conditions, there is likely to be a disparity in the fuel charges supplied to the cylinders of the two groups.

Our invention resides in the provision of a carburetor of the down-draft type in which there are provided a plurality of carbureting chambers, each of which is adapted to supply fuel charges to a plurality of the cylinders of an internal combustion engine, and which are so functionally and structurally interrelated that the fuel charges supplied to each of the several groups of cylinders are substantially equal in quantity and quality.

Our invention further comprehends the provision, in a carburetor, of means whereby, in passing from fully closed throttle to fully opened throttle, the point of delivery of the fuel into the carbureting chamber is gradually changed from a point on the engine side of the throttle to a point on the outside of the throttle in such a manner as to prevent "breaks" or "spots" in the combustible mixture. As applied, in the embodiment of our invention hereinafter described, to a carburetor of the type described the means has the additional function of maintaining equal and efficient distribution of combustible mixture to the cylinders of the several groups under all conditions of speed and load.

Our invention further comprehends the provision, in a carburetor, of means for increasing the supply of fuel during the periods of acceleration, and the provision of means for enriching the fuel mixture when starting and running the engine when it is cold.

Our invention further comprehends the provision, in combination with an engine and a carburetor of the type described, of means functioning to provide pneumatic rams which are adapted to exert a supercharging effect on the engine throughout a portion of its speed range, and means whereby, when the rams become ineffective or a hindrance to the proper operation of the engine, their effect may be eliminated.

Other features of the invention reside in the construction, arrangement and combination of elements hereinafter described whereby the hereinbefore mentioned and other features of the invention are incorporated in a simple and efficiently operating structure.

In the drawings:

Figure 1 is a fragmentary plan view of an automotive vehicle in which is installed an internal combustion engine to which is connected a carburetor in which is embodied our invention.

Figure 2 is a fragmentary end elevation, with parts removed, broken away, and in section, of the installation shown in Figure 1.

Figure 3 is a side elevation, with parts broken away and in section, of the carburetor shown in the preceding figures.

Figure 4 is a plan view, with parts broken away and in section, of the carburetor shown in the preceding figures.

Figure 5 is a section taken on the line 5—5 of Figure 4.

Figure 6 is a plan view of the body portion of the carburetor after the cap portion has been removed therefrom.

Figure 7 is a fragmentary section taken on the line 7—7 of Figure 5.

Figure 8 is a fragmentary section taken on the line 8—8 of Figure 3.

Figure 9 is a side elevation of one of the air resistance valve shaft arms.

In the drawings, the reference character 20 indicates an automotive vehicle on which there is installed a cooling radiator 21 and an internal combustion engine 22 of the eight-cylinder V-type. The reference character 23 indicates an intake cross header having therein a pair of independent and entirely separated passages 24, each of which is connected to the intake ports of one of the cylinder blocks by means of a runner 25.

Our carburetor, as shown in the drawings, includes a body portion 26, on which there is formed a float bowl 27, and a cap portion 28 which s suitably secured to the body portion. Through the body portion and the cap portion extend parallel vertical passage 29, each of which, when the body portion of the carburetor is secured to the

intake cross header 23, as shown in Figures 1 and 2 of the drawings, communicates with one of the passages 24 in the header.

Between and connecting the two passages 29 extends a bore 30 in which is located a small Venturi tube 31, each extremity of which extends into one of the passages 29. In the outer wall of the Venturi tube, at substantially its mid-point, there is provided a circumferential groove 32 which communicates with the interior of the Venturi tube through a plurality of bores 33. Into the groove 32 opens an inclined bore 34 which communicates with a vertical bore 35 in which is located a metering pin 36, which is adapted to control the flow of fuel from the bore 35 to the bore 34 and a portion of which is surrounded by a coiled spring 37 which constantly urges the metering pin to position to allow the passage of fuel from the bore 35 to the bore 34. At its lower end, the bore 35 communicates with the interior of the float bowl 27 through a horizontal bore 38.

There is formed in the body portion of the carburetor a vertically arranged dashpot 39, in which is located a piston 40, and which is closed at its upper end by means of a head 41 through which extends the piston rod 42. A coiled spring 43, which surrounds the piston rod and bears at its lower end against the head 41 and its upper end against a washer 44 which is secured to the piston rod 42, constantly urges the piston to its uppermost position in the dashpot.

In an intermediate portion of each of the passages 29, there is located a scoop-shaped air resistance valve 45 whose smaller, free end is positioned adjacent the end of the Venturi tube 31 which projects into that passage. Secured to or integral with each of the resistance valves is a shaft 46, which is journalled in suitable bearings formed between the cap portion and the body portion of the carburetor. Clamped to each of the shafts 46 is an arm 47, on the free end of which is provided a transversely extending, cylindrical, bearing portion 48 whose lower surface is seated on the upper surface of the washer 44.

To a pin 49, which is slidably mounted in a vertical bore in the body of the carburetor and which is normally maintained in its lowermost position in the bore by means of the levers 69 and 71 and the spring 74 to which further reference is hereinafter made, is pivoted a lever 50 which is provided on its opposite ends with parti-cylindrical bearing portions 51 and 52 seated, respectively, on a cap member 36*a* which is threaded on the metering pin 36, and on the upper surface of a washer 53 which surrounds the piston rod 42 and is seated on the upper sides of the cylindrical bearing portions of the arms 47.

Through the bottom of the dashpot, there extends a passage 54 which opens into the bore 38 and which is controlled by a ball valve 55. There is provided in the body portion of the carburetor a well 56 which communicates with the passages 29 through bores 57. The upper end of the well 56 is closed by a screw plug 58 on which is provided an extension of smaller diameter than the well which extends into the well to a point below the bores 57. Into the upper end of the well 56 opens a vent 59 and into the lower end of the well a passage 60 which is controlled by a ball valve 61 and which communicates with the interior of the dashpot.

In the lower end of each of the passages 29, there is located a butterfly throttle valve 62. Both of the throttle valves are secured to a shaft 63 which is journalled in bearings in the body portion of the carburetor and to which is secured an operating arm 64.

It will be obvious that, as the spring 43 urges the piston 40 to its uppermost position in the dashpot 39, it will tend to close the air resistance valves 45 and to maintain the metering pin 36 in its lowermost position in the bore 35. The spring 43 is made of such strength that it keeps the air resistance valves "closed" when the engine is operating at idle speeds so that all of the air flowing through the passages 29 at this time passes through the relatively restricted orifices between the tips of the valves and the walls of the passages 29 so that a substantial velocity of air flow and a substantial vacuum is provided in order to obtain positive metering at this time. It will be obvious that the position of the metering pin 36, which is set so that, when the air resistance valves are "closed", it is off its seat the proper distance to allow a sufficient quantity of fuel to pass from the float bowl to the passages 29 to form with the air which passes the air resistance valves the desired fuel and air mixture, is controlled by the position of the air resistance valves so that the desired mixture of fuel and air will be maintained at all times.

During the operation of the engine, fuel is maintained in the float bowl at a level just below that of the Venturi tube 31. By means of this head, fuel is forced into the dashpot 39, through the bore 38 and the passage 54, and into the bore 34 to a level just below that of the Venturi tube, through the bores 38 and 35. When the engine is running at speeds appreciably above idle, the suction applied to one of the passages 29 will be alternately greater and less than that applied to the other and, as a consequence of this difference in pressure in the two passages, air will constantly surge back and forth from one of the passages to the other through the Venturi tube 31. The flow of air through the Venturi tube withdraws fuel from the float bowl through the bores 38, 35 and 34, the groove 32 and the bores 33 and discharges it into each of the passages 29, alternately, whence it passes with the proper amount of air into the engine cylinders.

When the throttle valves are opened farther, in order to increase the speed of the engine, a greater volume of air seeks to enter the carburetor and the pressure drop across the resistance valves 45 increases and causes a further opening of these valves. The movement of the resistance valves is transmitted to the piston 40 through the arms 47, the washer 44, and the piston rod 42, and the piston is thereby moved downwardly in the dashpot and, the passage 54 being sealed by the ball valve 55, forces a quantity of fuel through the passage 60, past the ball valve 61, into the well 56 and from the well into the passages 29 through the bores 57, thus supplying the extra volume of fuel desired during acceleration periods. When the piston 40 moves downwardly, the pressure of the spring 37 raises the metering pin 36 until the forces applied to the opposite ends of the lever 50 are again balanced and thus an increased amount of fuel is supplied to the passages 29 through the Venturi tube so as to maintain the desired mixture of fuel and air.

When the engine is running at speeds appreciably above idle, the currents of air surging back and forth through the Venturi tube cause equal quantities of fuel to be delivered to the two passages 29. However, when the throttle is closed, at

idle speed or at speeds only slightly above idle, there is very little pulsation of air in the passages 29 on the outside of the throttle and, consequently, very little movement of air through the Venturi tube. When this condition exist, minor errors in the fit of the resistance valves may cause a poor distribution of fuel between the two passages. To eliminate this possibility, the portion of the shaft 63 between the end bearings thereof and which is located in the bore 65 is made flat on its upper and lower sides and there are provided a bore 66 extending through the central portion of the shaft from one flat face thereof to the other, and a passage 67 in the same plane as the axis of the shaft 63 and formed in part by a tube 68, extending from the groove 32 in the outer wall of the Venturi tube to the bore 65.

It will be obvious that the portion of the bore 65 on the engine side of the throttle is at all times subjected to the high manifold vacuum. During the time that the engine is operating at idle speed or speeds only slightly above idle, i. e. when the throttle valves are substantially closed, air will surge from one of the passages 29 to the other through the portion of the bore 65 on the engine side of the throttle. And since the suction applied to this portion of the bore 65 is so much greater than that applied to the Venturi tube at this time practically all of the fuel will be withdrawn from the groove 32 by the suction applied to the passage 67 and will pass therefrom into the bore 66 and the portion of the bore 65 on the engine side of the throttle whence it will be discharged into the passages 29. It will be obvious that, due to the currents of air which are surging back and forth through the portion of the bore 65 on the engine side of the throttle when the throttle is closed, proper distribution will be maintained at this time.

The cross-sectional area of the passage 67, the areas of the flat surfaces of the shaft 63, and the cross-sectional area of the bore 66 are, preferably, so chosen that at closed, or nearly closed, throttle practically all of the fuel is delivered to the passages 29 through the portion of the bore 65 on the engine side of the throttle and yet should not be so great as appreciably to increase the vacuum applied to the throat of the Venturi tube and increase the rate of fuel metering beyond that desired under these light load conditions.

It will now be apparent that when the throttle occupies a position intermediate fully closed, when all of the fuel is delivered to the passages 29 through the portion of the bore 65 on the engine side of the throttle, and fully opened, when all of the fuel is delivered to the passages 29 through the Venturi tube, a portion of the fuel will be delivered to the passages 29 through each of these means. As the throttle is moved from fully closed to fully opened position, there is no change in the source of the fuel but merely in its point of delivery, and since the point of delivery is changed gradually, and not abruptly, there will be none of the "spots" in the mixture which are characteristic of multi-jet carburetors.

When an internal combusion engine is cold, a much richer mixture is necessary to start it and run it than is desirable after the engine has become warmed up. The ordinary butterfly choke valve is not a satisfactory device for enriching the mixture when the engine is cold for, when the engine is idling, practically no beneficial results are obtained by partially closing the choke valve, and yet, if the vehicle is driven away with the choke valve in the same position, the mixture will become too rich. In order to eliminate the objectionable features of a choke valve mechanism and to provide means whereby the fuel mixture may be enriched when desired, there is incorporated in our carburetor the following mechanism:

There is provided a lever 69 which is pivoted at 70 to the cap portion of the carburetor and rests, at its free end, on the upper end of the pin 49. A second lever 71 is pivoted to the cap portion of the carburetor, as indicated at 72, and is provided, on one end, with a cam surface 73 bearing against an intermediate portion of the lever 69. The lever 71 is normally maintained in the position, in which it is shown in Figure 5 of the drawings and in which, through the lever 69, it holds the pin 49 in its lowermost position, by means of a coiled spring 74.

To enrich the mixture, the upper end of the lever 71 is moved to the left (as the parts are shown in Figure 5) against the resistance of the spring 74. As the upper end of the lever 71 is moved to the left, due to the shape of the cam surface 73, the free end of the lever 69 is permitted to rise and relieves the downward pressure on the pin 49 and the metering pin 36 so that both are permitted to rise by reason of the force exerted on the metering pin by the spring 37. The upward movement of the metering pin will, of course, increase the richness of the mixture to any desired extent and, since the metering pin is at all times under the control of the resistance valves, the enriching will be proportional throughout the speed range of the engine.

Experiments have proven that where four or fewer cylinders are supplied by one mixture passage a supercharging effect throughout a considerable range of the engine speed may be obtained by making the passage of sufficient length and the proper size so that the air column which surges into a cylinder in response to the suction produced therein on the intake stroke of the piston will continue with a ram effect, after the suction is discontinued, with the result that the pressure in the cylinder at the time the intake valve closes will be actually super-atmospheric. Theoretically, it is preferable to position the ram passage between the carburetor and the engine since the heavier and colder fluid which passes from the carburetor to the engine will be more effective as a ram than atmospheric air and, moreover, ram pressure between the carburetor and the engine will not affect fuel metering. However, in practice, it is for well known reasons not desirable to have a long mixture passage between the carburetor and the engine.

As shown in Figure 1 of the drawings, the ram passages are provided by a pair of pipes 75 each of which communicates at one end with the upper end of one of the passages 29 in the carburetor and at its other end with the upper tank of the radiator 21. The pipes 75 are connected to the radiator, as described in the patent to C. E. Summers, No. 1,846,283, issued Feb. 23, 1932, so that the installation functions as an air cleaner, to provide a source of cold air, and as a muffler for the carburetor noises, as well as a supercharger.

As we have intimated, a ram passage of any given length and cross-sectional area will be effective throughout only a part of the range of speed of the engine. It is preferred to select a size of ram passage which will give a maximum

supercharging effect when the engine is operating at ordinary running speeds. At high engine speeds, such a ram passage becomes entirely ineffective and actually hinders the flow of air into the carburetor and it is, therefore, desirable to eliminate it at high engine speeds. For this purpose there is provided the following mechanism:

In the cap portion of the carburetor there is provided a passage 76 which communicates with the passages 29 through ports 77 which are controlled by butterfly valves 78 which are carried by an operating shaft 79 and which are biased to position to close the ports by a spring 80. To operate the valves 78, there is provided on the shaft 79 an operating arm 81 adapted to be contacted by an extension 82 carried by the throttle valve operating arm 64 when the throttle valves become opened to such an extent that the ram passages become ineffective. The contact of the extension 82 with the operating arm 81 causes the valves 78 to open against the resistance of the spring 80. When the valves 78 are opened communication is established between the two passages 29, and the surging effect of the rams thereby eliminated so that the ram passages function solely as air inlet passages.

It is to be understood that although the several features of our invention, as shown and described, are so related that they function to effect a unitary result and are, to some extent, at least, interdependent they are capable of independent use.

We claim:

1. In a carburetor, an air passage, a throttle valve for controlling the flow of air through the air passage, a fuel reservoir, a passage for conducting fuel from the reservoir to the air passage, means for controlling the flow of fuel through the fuel passage, means including a valve in the air passage for operating the first-mentioned means, and means for operating the first-mentioned means independently of the second-mentioned means.

2. In a carburetor, an air passage, a throttle valve for controlling the flow of air through the air passage, a fuel reservoir, a passage for conducting fuel from the reservoir to the air passage, an air resistance valve in the air passage, a valve in the fuel passage, means interconnecting said air resistance valve and the third-mentioned valve so as normally to control the flow of fuel through the fuel passage by the flow of air through the air passage, and means for operating the third-mentioned valve, independently of the air resistance valve.

3. In a carburetor, a pair of air passages, a throttle valve in each of the air passages, means for introducing fuel into the air passages including a passage interconnecting said air passages on the engine side of the throttle, a second passage interconnecting said air passages on the outside of the throttle and means for supplying fuel in connection with each of said interconnecting passages.

4. In a carburetor, two air passages, a throttle valve in each air passage, means for introducing fuel into the air passages on the engine side of the throttle, means for introducing fuel into the air passages on the outside of the throttle, said means being so constructed and arranged that the first is effective at closed throttle and the second at open throttle and each means connecting the two passages so as to equalize the fuel distribution between said passages.

5. In a carburetor which is adapted to be used on an internal combustion engine in which there are provided a plurality of groups of cylinders and a conduit for conducting combustible mixture from the carburetor to the cylinders of each group, a plurality of air passages of which each is adapted to communicate with one of the conduits, a conduit communicating with the intake end of each of the passages and of such length and cross-sectional area as to be effective to produce a pneumatic ram for supercharging the engine throughout a part of its speed range, and means whereby the rams may be rendered ineffective.

6. In a carburetor, an air passage, a throttle valve for controlling the flow of air through the air passage, means to introduce fuel into the air passage, and means including a resistance valve in the air passage for controlling the volume of fuel supplied to the air passage said resistance valve arranged to direct air toward the fuel introducing means.

7. The invention claimed in claim 5 in which the last-mentioned means includes means whereby the ram passages may be interconnected adjacent the carburetor.

8. In a carburetor, an air passage, a passage through which fuel is conducted to the air passage, and means to control the volume of fuel supplied to the air passage including scoop-shaped resistance valves in the air passage.

9. In a carburetor, a pair of air passages, a Venturi tube interconnecting said air passages, means to supply fuel to the Venturi tube, and a scoop-shaped valve pivotally mounted in each of the air passages and having its free end located adjacent one end of the Venturi tube so that when the valves are closed, substantially all of the air which passes through the passage is caused to flow between the scoop-shaped valves and the walls of the passages through which the Venturi tube projects so as to effect positive metering of fuel when the engine is idling.

10. In a carburetor for supplying combustible mixture to independent mixture conduits, air passages, one arranged to deliver mixture to each of said conduits, fuel supply means comprising a double venturi connecting said passages so as to permit air to flow from either passage into the other, and means for supplying fuel to said venturi intermediate of said passages.

11. Structure as in claim 10, including air directing means in each passage positioned to deflect entering air toward the discharge ends of said venturi.

12. In a carbureting apparatus for internal combustion engines, the combination with a carburetor having a throttle valve and an air intake of means constructed and arranged to produce a pneumatic ram effect to supercharge the engine over a portion of the speed range and means responsive to throttle position for rendering said ram ineffective over another portion of the speed range.

13. Structure as in claim 12, said last-mentioned means including additional air inlets controllable by throttle movement.

14. The combination in a carburetor of a pair of air conduits, a throttle valve in each of said conduits, a common shaft on which said valves are supported, a passage between said conduits in which said shaft lies, means for supplying fuel to said passage, and means, including said shaft, for distributing said fuel to said conduits.

15. In a duplex carburetor, a pair of air con-

duits, a throttle valve in each conduit, means connecting the conduits for supplying fuel on the engine side of the throttle valves, and means connecting the conduits for supplying fuel anterior to the throttle valves, each fuel supplying means including a passage through which air may flow from either conduit to the other.

16. In a carburetor, the combination with an air conduit, an air-resistance valve therein, fuel supply means, a valve for controlling the supply of fuel, means connecting said valves to control the flow of fuel by the position of the air valve and means for varying the connecting means at will to enrich the mixture, said last-mentioned means including a lever connecting the air-resistance valve to the fuel valve and having its fulcrum on a slidable support, and manually operable means to vary the position of said support.

17. In a carburetor which is adapted to be used on an internal combustion engine in which there is provided a conduit for conducting combustible mixture from the carburetor to the cylinders of the engine, an air passage which is adapted to communicate with the conduit, a conduit communicating with the intake end of the passage and of such length and cross sectional area as to be effective to produce a pneumatic ram for supercharging the engine throughout a part of its speed range, and means whereby the ram may be rendered ineffective.

18. In a carburetor, a pair of air passages, an air-resistance valve in each of the passages, a passage for conducting fuel to each of the air passages, and one valve for controlling the supply of fuel to both air passages so connected to the air-resistance valves that its position is affected by the positions of the air-resistance valves.

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