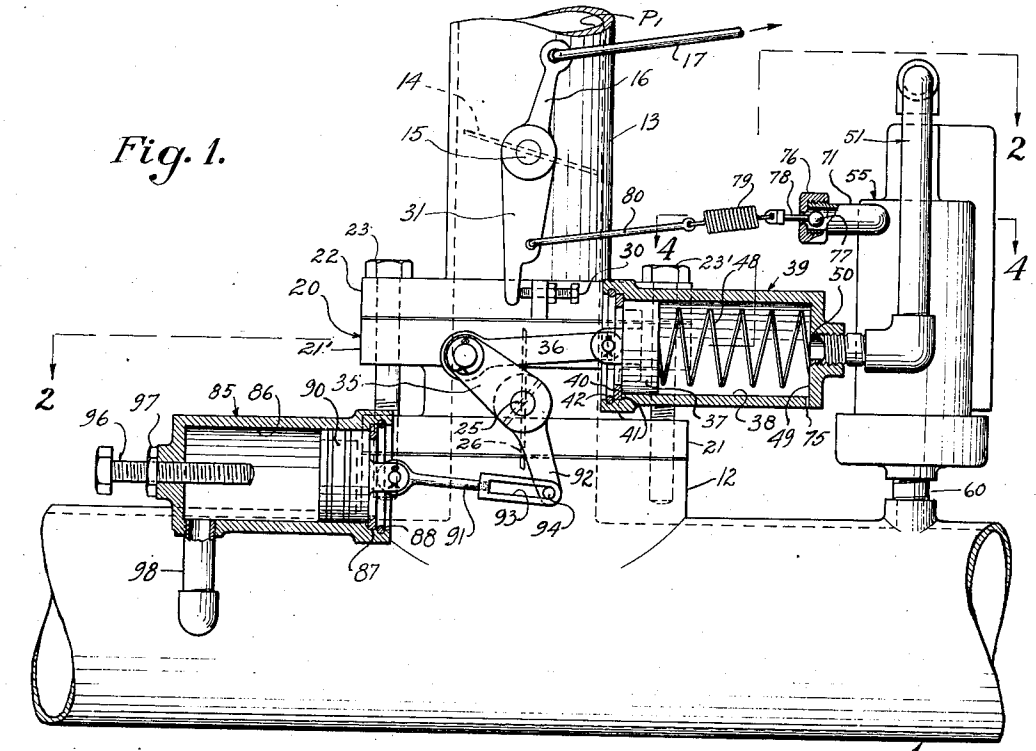
Feb. 8, 1938. A. G. H. VANDERPOEL 2,107,314

MEANS FOR AUTOMATICALLY CONTROLLING FLOW OF FUEL MIXTURE TO INTERNAL COMBUSTION ENGINES

Filed Nov. 14, 1936 2 Sheets-Sheet 1

Fig. 1.



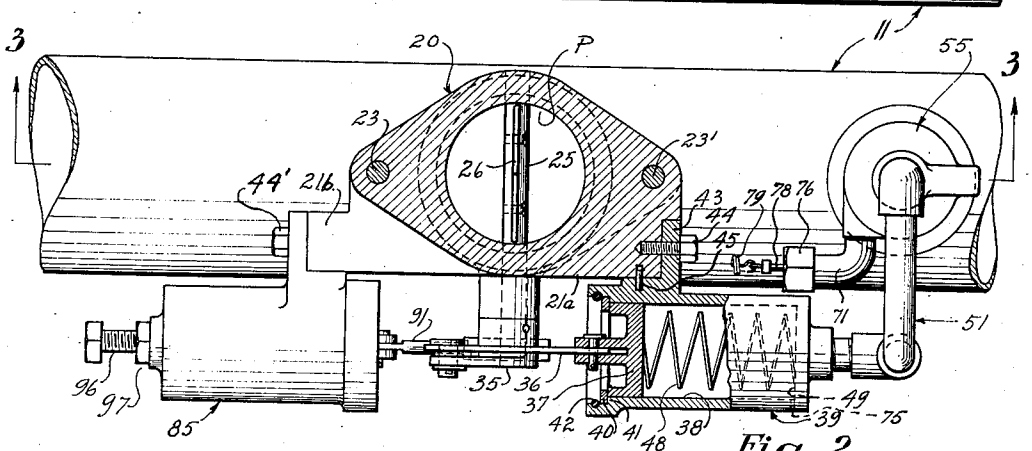


Fig. 2.

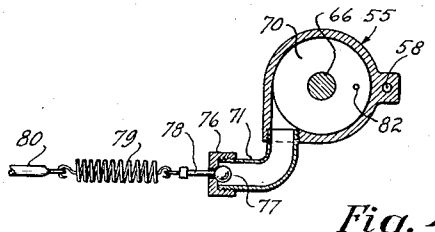


Fig. 4.

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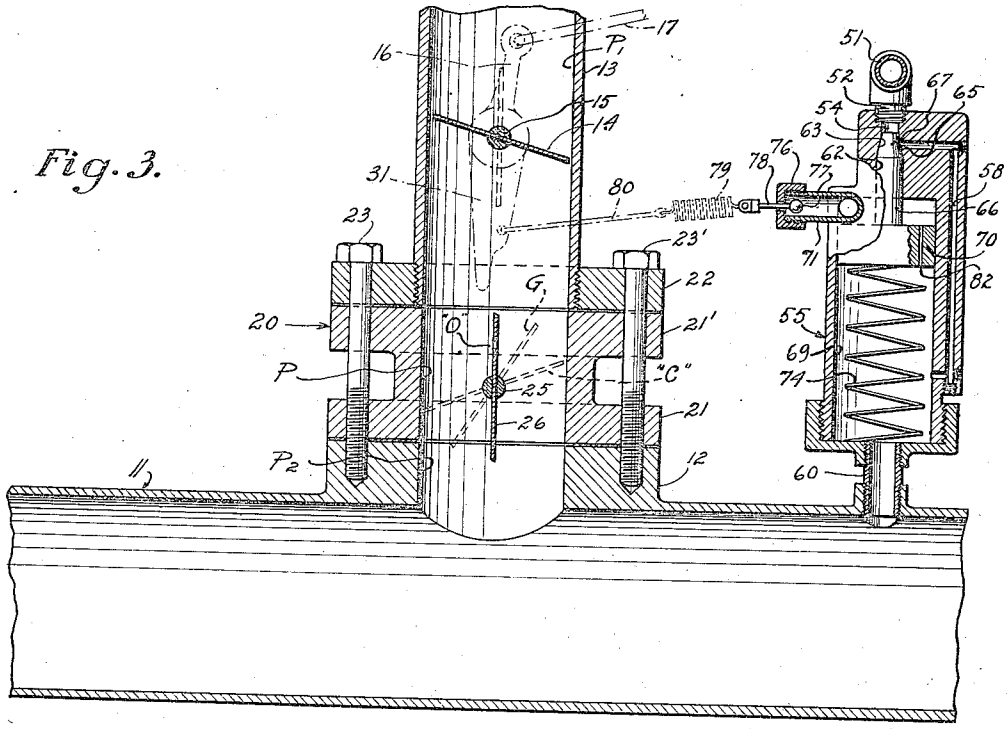
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MEANS FOR AUTOMATICALLY CONTROLLING FLOW OF FUEL MIXTURE TO INTERNAL COMBUSTION ENGINES

Filed Nov. 14, 1936 2 Sheets-Sheet 2

Fig. 3.



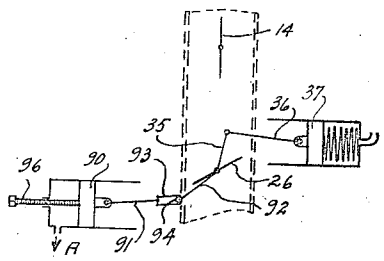


Fig. 6.

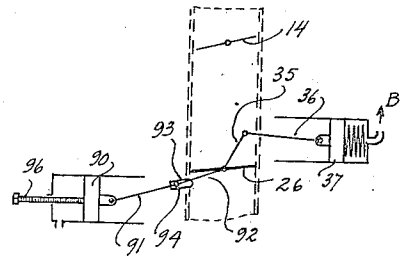


Fig. 6 A.

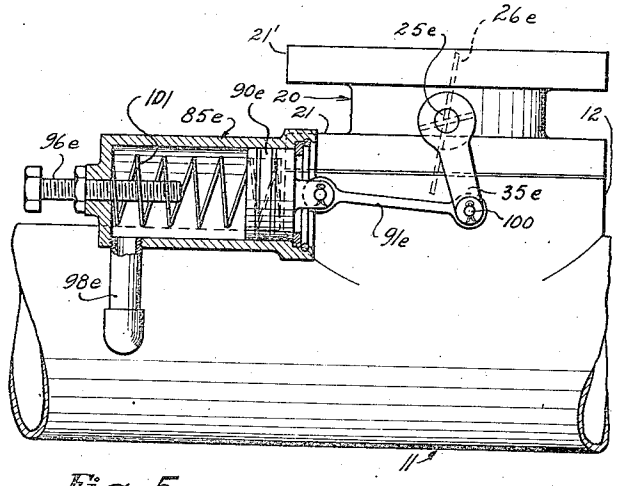


Fig. 5.

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Patented Feb. 8, 1938 2,107,314

UNITED STATES PATENT OFFICE

2,107,314

MEANS FOR AUTOMATICALLY CONTROLLING FLOW OF FUEL MIXTURE TO INTERNAL COMBUSTION ENGINES

Albert G. H. Vanderpoel, Wilmar, Calif., assignor of one-third to James O'Laverty and one-third to David E. Seward, both of Los Angeles, Calif.

Application November 14, 1936, Serial No. 110,874

23 Claims. (Cl. 123—103)

This invention has to do in a general way with devices for controlling the flow of fuel mixture from the carbureter to the intake manifold of an internal combustion engine and is more particularly related to improvements on devices of the general character shown and described in United States Letters Patent No. 2,017,878 issued to me on October 22, 1935. The present application is a substitute and continuation in part of my copending application Ser. No. 20,997 filed May 11, 1935 and the device disclosed herein is related in a general way to devices of the type shown and described in my copending applications Ser. No. 95,126, filed August 10, 1936 and Ser. No. 107,643 filed October 26, 1936.

It is a primary object of my present invention, like that disclosed in my patent referred to above, to provide means for automatically shutting off the suction passage or connection between the intake manifold and the carbureter whenever the throttle valve of the carbureter is permitted to "close" to idling position with the engine running on momentum at a speed greater than normal idling speed. The device also contemplates means for automatically opening the suction passage between the carbureter and the intake manifold, either when the engine has decelerated to normal idling speed or when the throttle valve is open from its normal idling position.

The means for shutting off or closing the suction passage in the manner pointed out above, comprises a secondary or auxiliary valve positioned in the suction passage between the throttle valve or the carbureter proper and the intake manifold, and it is an important feature of my invention that the manifold depression is employed as a means for actuating this secondary valve. It is a noteworthy feature of the present invention that the secondary valve is moved to a closed position directly by the action of a suction responsive element which is under the control of the depression or vacuum in the intake manifold as distinguished from the device of my former patent in which the closure of the secondary valve was merely controlled by the depression in the intake manifold but its actual closing movement was effected through the medium of a spring.

It is a further important feature of the device contemplated by my present invention that the communication of suction from the manifold to the suction responsive element which actuates the secondary valve, is cooperatively controlled by the depression in the intake manifold, and the position of the throttle valve. In other words, my present invention contemplates the use of a pilot valve which is associated with a second suction responsive means continuously under the influence of the manifold depression, such last mentioned means being effected to open the valve only in the event the manifold depression exceeds a predetermined point. This pilot valve is adjusted so that it will be opened when the throttle valve is closed and an abnormally high depression is existent in the intake manifold, such as is occasioned when the throttle valve is closed and the engine is running on momentum.

It is a further important object of this invention to provide an auxiliary suction responsive means which is continuously under the influence of the manifold depression and is effective under normal operating conditions to partially close the secondary valve when the manifold depression reaches a predetermined value. This last mentioned means therefore cooperates with the secondary valve to act as a speed governor for the engine, and the connective relation between the auxiliary suction responsive means and the secondary valve is such that the secondary valve can be completely closed by the first suction responsive means first mentioned above, when the manifold depression becomes abnormally high, as is the case when the engine is decelerated.

It will be seen, therefore, that my invention contemplates as a further object, the provision of a secondary valve in the suction passage between the carbureter and the intake manifold which is associated with means whereby such valve will act as a governor during acceleration to limit the speed of the engine and which during deceleration, will be automatically completely closed to shut off the fuel supply from the carbureter to the intake manifold.

My invention contemplates as a still further object, the provision of a compact device in which the entire operation is isolated in the fuel supply system of the engine and which, therefore, lends itself particularly to use as an accessory attachment, which can be mounted between a standard carbureter and the intake manifold of an internal combustion engine.

The details in the construction of a preferred embodiment of my invention, together with other objects attending its production, will be best understood from the following description of the accompanying drawings, which are chosen for illustrative purposes only, and in which:

Fig. 1 is a sectional elevation illustrating a preferred embodiment of my invention associated

with a portion of the intake manifold and carbureter of an internal combustion engine;

Fig. 2 is an off-set plan section taken along the line 2—2 of Fig. 1;

Fig. 3 is a sectional elevation taken on a plane represented by the line 3—3 of Fig. 2, a portion of Fig. 3 being off-set to show the construction of the vent valve;

Fig. 4 is a plan section through the pilot cylinder used in this embodiment of my invention, and is taken along the line 4—4 of Fig. 1;

Fig. 5 is an elevational view with parts in section illustrating a modification of the invention; and

Figs. 6 and 6A are diagrammatic views illustrating respectively the relative position of the parts under the influence of the auxiliary suction responsive member or governor, and under the influence of the main suction responsive element or the deceleration control.

Referring now to the drawings for a more detailed description of the invention, reference numeral 11 indicates the intake manifold of an internal combustion engine having a carbureter supporting flange or inlet connection 12, and reference numeral 13 indicates the bottom portion of a conventional down-draft carbureter provided with a throttle valve 14 mounted on a shaft 15, the shaft being equipped with a throttle actuating lever 16, controlled by a throttle rod 17. In this latter connection, it will be understood that the showing of the carbureter is merely illustrative, since such carbureter may be either up-draft or down-draft and of any conventional design.

Interposed between the carbureter 13 and the connection 12 is what I may term an open block 20. The block 20 is shown as being provided with flanges 21 and 21' which are adapted for substantial alinement with the connection 12 and a flange 22 on the bottom portion of the carbureter. The carbureter and the block are held in assembled relation on the connection 12 through the medium of screws 23 and 23'.

The opening or passage P through the block 20 communicates between the suction passage P_1 of the carbureter 13 and the passage P_2 in the connection 12 on the intake manifold. It will be seen therefore, that this block 20, in effect, comprises a portion of the connection between the carbureter and the intake manifold. Mounted across the passage P on a shaft 25 is a butterfly valve 26, which will hereinafter be referred to as the secondary or the auxiliary valve. This secondary valve 26, it will be observed, is interposed in the connection between the carburetor proper, including the throttle valve, and the intake manifold, and it can be employed either to completely cut off or to restrict the flow of fuel mixture from the carbureter to the intake manifold.

As has been previously pointed out, it is one object of this invention to completely close the secondary valve 26 whenever the throttle valve 14 is permitted to "close" to normal idling position while the engine is running at a speed greater than idling speed. In this latter connection, it will be understood that when the throttle valve 14 is in its normal idling position, sufficient fuel mixture must be admitted therethrough or through a suitably provided by-pass port to run the engine at idling speed. In this form of my invention, the throttle valve 14 is shown as being held partially open for idling position by means of an adjustable stop screw 30 which engages an extension arm 31 on the throttle actuating lever 16. When the throttle valve is closed to idling position with the engine running on momentum at a speed greater than idling, the closure of the throttle valve to this position is attended by an abnormally high depression in the intake manifold, which will normally draw a large amount of raw fuel through the partially opened throttle valve, or the by-pass port into the engine where it exists as a non-combustible or partially combustible mixture, and since the engine is not furnishing power at this stage of operation, such fuel is wasted. It is the elimination of this waste and the prevention of noxious gases being formed by the partial combustion of this rich fuel mixture, which constitutes the underlying purpose of providing a valve 26 which will shut off the suction passage when the engine is running on momentum.

As has been previously pointed out, my invention contemplates the actuation of valve 26 cooperatively through the position of the throttle valve 14 and the depression or vacuum in the intake manifold 11. The mechanism contemplated by the present invention for accomplishing this objective will now be described.

Referring first to Figs. 1 and 2, it will be observed that the extending end portion of the secondary valve shaft 25 is provided with a lever member 35, which is connected through the medium of a link 36 to a piston 37 which is contained within the bore 38 of a main suction cylinder 39. The connections between the shaft 25 and the piston 37 are such that the valve 26 is normally held in its open position when the piston 37 is located in the outer open end of the bore 38. The piston 37 is held against movement from the bore 38 by means of an open retaining ring 40 which in turn is supported against a shoulder 41 in the cylinder by means of a retaining ring 42. The main suction cylinder 39 is shown as being secured to a squared extension 21*a* on the upper flange 21' of the stop 20 through the medium of a bracket piece 43, a screw 44 and a pin 45.

The piston is biased outwardly against the ring 40, where the valve 26 is held in its open position, by means of a compression spring 48 interposed between the piston and the closed end portion 49 of the main suction cylinder 39. The end portion 49 of the main suction cylinder is provided with an opening 50 which receives one portion of what I may term a main suction conduit generally indicated by reference numeral 51.

The application of suction within the bore 38 is effective to draw the piston 37 forwardly against the action of the compression spring 48 and thereby swing the valve 26 to a closed position, illustrated by dotted line "c" in Fig. 3. The cylinder 39 and the piston 37 therefor with their attending connections comprise a suction responsive element which is effective to directly act upon the valve 26 to close the passage or connection between the carbureter and the intake manifold.

Since it is important, for the proper operation of the device as a deceleration control, that the suction responsive means act to close the valve 26 only in the event the manifold depression becomes abnormally high, means must be provided for establishing communication between the cylinder 39 and the intake manifold 11 only in the event a pre-determined manifold depression is exceeded. For the purposes of accomplishing this, the main suction duct 51 is provided with a suction control valve, such control valve being associated with a pilot suction responsive means

which normally acts to hold the valve closed and is effective to open the valve only under abnormally high depression from the intake manifold.

For a more detailed description of this suction control valve and its associated actuating means, reference is now made to Figures 2 to 4, inclusive, in which it will be observed that the main suction duct 51 includes a nipple 52, a valve chamber 54 in the top of what I may term a pilot cylinder or pilot chamber 55, and a duct 58 extending from the valve chamber 54 through the wall of the cylinder member 55 and opening into the bottom portion of said cylinder member. The pilot cylinder member 55 is in open communication with the intake manifold 11 through a connection 60. The valve chamber 54 is located at the upper end of a valve stem bore 62 and is provided with a valve seat 63 through which the duct 58 opens in a port 65. Slidably mounted through the bore 62 is a stem 66 which has a valve surface 67 formed on its upper end, such surface being adapted to cooperate with the seat 63 to seal the port 65.

The length of the bore 62 and the portion of the valve stem 66 contained therein is such as will at all times effectively seal the chamber 54 from the pilot piston bore 69 which is located in the main portion of the pilot cylinder member 55. Also, the stem 66 is of a length such that a pilot piston 70 secured to the lower end thereof, will always have its upper surface positioned a substantial distance below the top of the bore 69 when the valve 63 is closed. The valve 63 is maintained in its closed position against the normal operating and the normal idling depressions in the manifold 11 by means of a compression spring 74, the compressive strength of which is such as will permit the downward movement of the pilot piston 70 only in the event the depression in the manifold 11 becomes abnormally high. This, as I have previously pointed out, occurs when the engine is operating on momentum with the throttle valve 14 closed to idling position.

Whenever an abnormally high depression is established in the intake manifold 11, it will be observed from the construction as described so far, that the pilot piston 70 will be drawn downwardly against the action of the spring 74 to open the suction control valve 63. As soon as this valve 63 is opened the manifold depression or suction is communicated from the lower end portion of bore 69 through duct 58, chamber 54 and the conduit connection 51 into the main suction cylinder 39 where it acts upon piston 37 to swing the valve 26 to its closed position.

In order to facilitate the action of the pilot piston 70 under the influence of abnormally high manifold depression to open the valve 63, the end portion of the bore 69 on the side opposite piston 70 is provided with a vent which is shown as comprising an elbow connection 71. This connection 71 also serves an additional purpose in providing means for controlling the closure of the valve 63 through the medium of throttle valve position which will be described later.

Assuming for the present that the suction control valve 63 has been opened by the abnormally high manifold depression occasioned as pointed out above, and through such opening movement has brought about the closure of the secondary valve 26, it will be seen that as the engine decelerates and the manifold depression returns to normal idling depression, the action of the spring 74 will operate to raise the pilot piston 70 and close the valve 63, thereby cutting off the bore 38 and the piston 37 from the direct action of the manifold depression. In order that the piston 37 may be moved to open the valve 26 whenever this condition is established, it is important that atmospheric air be bled into the bore 38 behind the piston 37 and this may be done either by forming the piston 37 with a relatively loose fit in the bore or preferably, by providing the cylinder 39 with a small bleeding orifice 75. The size of this orifice is such that it will not interfere with the action of the relatively high suction applied, as described above, to close the valve 26, but will permit the ingress of atmospheric air at a sufficiently high rate to permit the rapid opening of this valve under the action of the spring 48 when the suction is cut off by the valve 63.

It frequently happens during deceleration of the engine that the operator wishes to again accelerate the engine before it has decelerated to normal idling speed. In order to accomplish this it will be seen that some means must be provided for effecting the closure of the valve 63 whenever the throttle valve 14 is moved from its idling position toward an open position. In this embodiment of my invention this is accomplished by providing the vent member 71 with a ported cover 76 within which a valve 77 is adapted to seat. This valve 77 is shown as having a stem 78 connected through a spring 79 and a rod 80 with the extension 31 on the throttle actuating lever 16. The length of the parts last described is such that when the throttle valve 14 is in its normal idling position the valve 77 is open so that the upper portion of the bore 69 is in open communication with the atmosphere to facilitate the downward movement of the piston 70 in the manner described above. Whenever the lever 16 is actuated to move the throttle valve 14 to an open position, the vent valve 77 is drawn into engagement with its seat thereby sealing the upper portion of the bore 69 from the atmosphere. When this is done, the suction applied within the bottom portion of the bore 69 from the intake manifold is bled either around the piston 70 (in the event of a relatively loose fit) or preferably through a bleeding orifice 82 in the piston so that the pressure differential between the opposite sides of the piston 70 in the bore 69 is destroyed, and the compressive action of the spring 74 is thereby effective to raise the piston 70 and close the suction control valve 63. The area of the bleeding passage between the end portions of the bore 69 is of course sufficiently restricted that the piston 70 will be immediately drawn down by an abnormally high depression in the intake manifold when the vent valve 77 is open. The spring 79 permits free opening movement of the throttle valve from its normal idling position to full open position and is adjusted so that the vent valve 77 will open just as the throttle valve 14 is closed to its normal idling position.

It will thus be seen from the foregoing description that when the throttle valve 14 returns to idling position with the engine running at above idling speed the following operation takes place: The vent valve 77 is opened simultaneously with the "closure" of the throttle valve, and also simultaneously with the closure of the throttle valve an abnormally high depression is established in the intake manifold which acts upon the pilot piston 70 to open the valve 63, thereby communicating this depression or suction to the main suction cylinder 39 where it operates upon the piston therein to close the sec-

ondary valve 26. The secondary valve will be subsequently opened either by imparting opening movement to the throttle valve, which closes the vent valve 77, or by a continued deceleration of the engine until normal idling depression is established in the manifold.

In addition to the "deceleration control" function of the valve 26, my invention contemplates the further utilization of this valve as a means for governing or limiting the speed of the engine at any pre-determined point. For the accomplishment of this additional object, I provide what may be termed an auxiliary suction cylinder 85, somewhat similar in construction to the cylinder 39, having a bore 86, a stop ring 87 held in place within the bore by means of a retaining ring 88. The bore 86 contains a suction responsive piston 90 which is connected through the medium of a link 91 to an extending arm 92 on the lever member 35. The cylinder member 85 is shown as being mounted on a squared portion 21b on the bottom flange 21 of block 20, and is held in place thereon by screw 44'.

It will be observed that the end of the link 91, whereby it is connected to the arm 92, is slotted as indicated at 93 to receive a connecting pin 94, and that the length of this link is such that the pin 94 is in the forward end of the slot 93 when the valve 26 is in its full open position and the piston 90 is in the end of the bore 86 against the stop ring 87.

The bore of the cylinder 85 is in constant communication with the interior of the intake manifold through a connection 98 so that the suction of the intake manifold is constantly acting upon the piston 90 to impart valve closing movement to the valve 26 through the arm 92. Such movement however, is opposed, in this form of my invention, by the spring 48 acting upon the piston 37. The strength of the spring 48 which resists the suction responsive movement of the piston 90 (as well as the movement of piston 37) is chosen so as to permit a complete retractive movement of the piston 90 under a pre-determined uniform load depression in the intake manifold. In order to limit the closing movement of the secondary valve 26 by such retractive movement of piston 90 to a point corresponding to a pre-determined engine speed, I provide the cylinder 85 with an adjustable stop member shown as comprising a screw 96 which is adapted to be locked in its position of adjustment by means of a lock nut 97.

The action of the auxiliary piston 90 and its associated parts which I have termed an auxiliary suction responsive means, upon the secondary valve 26 as a speed governor is substantially as follows:

Assuming that the engine is running at normal idling speed, the parts will occupy the position shown in Fig. 1, except that the piston 90 may be drawn rearwardly into engagement with the stop screw 96 or to some intermediate point depending upon the normal idling depression of engine and the secondary valve 26 will be correspondingly moved away from its full open position. As the throttle is opened to accelerate the engine, the manifold depression, of course, drops and the piston 90 will be moved to or toward the full line position shown in Fig. 1 by the action of compression spring 48. As the speed of the engine increases with the throttle open or being opened, the manifold depression gradually builds up, drawing the piston 90 rearwardly toward the stop 96, and, assuming, for example, that the throttle valve 14 has been moved to wide open position, the increase in engine speed and the attending increase in manifold depression will continue until the piston 90 has been drawn back into engagement with the stop 96 (see Fig. 6), at which time the secondary valve 26 has been closed to an intermediate position (indicated by the dotted line position G in Fig. 3). At this position the suction passage between the carbureter and the intake manifold is restricted to a point corresponding to a throttle position for that particular speed and the fuel mixture which can pass through the suction passage therefore, with the engine operating at uniform load, cannot exceed that which will drive the engine at a speed corresponding to a depression which will draw the piston into engagement with the stop 96, irrespective of the degree to which the main throttle valve 14 is opened.

Assuming then that the engine is operating, with the throttle valve wide open, at the maximum speed set for the "governor" or the auxiliary suction responsive control, the secondary valve 26 and the pistons 90 and 37 will occupy the relative positions shown in Fig. 6, suction being applied within the cylinder 85 only as indicated by the arrow A of Fig. 6.

When the throttle valve is released from its open position shown in Fig. 6, and returns to its closed or idling position as shown in Fig. 6A, the "deceleration control unit" is brought into play in the manner described above, so that the abnormally high manifold depression attending this closure of the throttle valve 14 is communicated to the main suction cylinder 39 to apply suction therein in the direction of the arrow B of Fig. 6A. The application of this suction is operative to move the main suction responsive piston 37 to completely close the secondary valve 26, the pin and slot connection 94—93 permitting this last mentioned full closure of the secondary valve irrespective of the position of the piston 90 for which the stop 96 has been set.

Fig. 5 shows a modification in the governor or speed control unit and illustrates the manner in which the governor unit may be employed as a separate accessory without depending on the cooperative action of the spring 48 in the cylinder 39, as was described in connection with Fig. 1. In Fig. 5, the secondary valve is indicated by reference numeral 26e, such valve being mounted on a shaft 25e, and having a lever arm 35e, to which the link 91e has a direct pivotal connection, indicated at 100. The suction cylinder 85e and the piston 90e therein are the same in all essential respects as was described in connection with Fig. 1, the cylinder being connected to the intake manifold through a connection 98e and having a stop screw indicated by reference numeral 96e. In this form of my invention, the suction responsive movement of the piston 90e is opposed by a compression spring 101, which is contained within the cylinder 85e itself. The operation of the device shown in Fig. 5, is a means for governing the speed of the engine, and is the same as was described above in connection with Figs. 1, 2 and 6.

In some types of carbureters, some difficulty is experienced in maintaining the carbureter chambers and passages filled with vaporized fuel unless a small depression is maintained therein, and for the purpose of maintaining a small depression in the carbureter during such time as the secondary valve is completely closed, I provide the valve 26

with a small bleeding orifice "O", the size of which is preferably just sufficient to keep the carbureter passages filled with vapor, and may be in the neighborhood of .050 inch in diameter.

It will be understood that while I have herein described and illustrated certain preferred forms of my invention and one particular combination embodying the same, that the invention is not in any way limited to the precise details or the specific combinations described above, but includes within its scope such changes or modifications as fairly come within the spirit of the appended claims.

I claim:

1. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between said throttle valve and the intake manifold; suction responsive means actuated by the abnormally high depression in the intake manifold which attends closure of the throttle valve with the engine running at above idling speed to move said secondary valve to closed position; yieldable means associated with said suction responsive means for automatically opening said secondary valve when the manifold depression returns to normal; governor means operable to actuate said secondary valve only to a partially closed position when said throttle valve is open, and means limiting the range of actuation of said secondary valve by said governor means.

2. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between said throttle valve and the intake manifold; suction responsive means actuated by the abnormally high depression in the intake manifold which attends closure of the throttle valve with the engine running at above idling speed to move said secondary valve to closed position; means operatively associated with said throttle valve for controlling the operation of said suction responsive means; governor means operable when both said throttle valve and said secondary valve are open to partially close said secondary valve, and means limiting the range of actuation of said secondary valve by said governor means.

3. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between the carbureter and the intake manifold; suction responsive means attached to said secondary valve and operable under the application of suction to close said secondary valve; yieldable means normally holding said secondary valve in open position; means including a suction duct communicating with said manifold for applying manifold suction to said suction responsive means; a normally closed valve in said suction duct; a pilot suction chamber communicating with said manifold; a second suction responsive member in said pilot suction chamber; means connecting said second suction responsive member to said suction duct valve whereby suction responsive movement thereof opens said duct valve; and yieldable means opposing the valve opening movement of said second suction responsive member, a vent in the portion of said pilot suction chamber opposite the connection to the manifold; a valve in said vent; and means interconnecting said vent valve and said throttle valve whereby said vent valve is opened when the throttle valve is closed to idling position.

4. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between the carbureter and the intake manifold; suction responsive means attached to said secondary valve and operable under the application of suction to close said secondary valve; yieldable means normally holding said secondary valve in open position; means including a suction duct communicating with said manifold for applying manifold suction to said suction responsive means; a normally closed valve in said suction duct; a pilot suction chamber communicating with said manifold; a second suction responsive member in said pilot suction chamber; means connecting said second suction responsive member to said suction duct valve whereby suction responsive movement thereof opens said duct valve; and yieldable means opposing the valve opening movement of said second suction responsive member, a vent in the portion of said pilot suction chamber opposite the connection to the manifold; a valve in said vent; and means interconnecting said vent valve and said throttle valve whereby said vent valve is opened when the throttle valve is closed to idling position, and means for bleeding manifold suction to the portion of said chamber opposite said manifold connection.

5. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between said throttle valve and the intake manifold; suction responsive means actuated by the abnormally high depression in the intake manifold which attends closure of the throttle valve with the engine running at above idling speed to close said secondary valve; yieldable means associated with said suction responsive means for biasing said secondary valve to open position; and a second suction responsive means associated with said secondary valve and in continuous communication with said intake manifold, said first suction responsive means being operable independently of said second suction responsive means and the latter being operable under normal manifold depressions to partially close said secondary valve.

6. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between said throttle valve and the intake manifold; suction responsive means actuated by the abnormally high depression in the intake manifold which attends closure of the throttle valve with the engine running at above idling speed to close said secondary valve; yieldable means associated with said suction responsive means for biasing said secondary valve to open position; a second suction responsive means associated with said secondary valve and in continuous communication with said intake manifold, said second suction responsive means being operable under normal operating manifold depression to impart closing movement to said secondary valve and the first suction responsive means being operable independently of the second; and stop means associated with said second suction responsive means for limiting the

closing movement of said secondary valve by said second suction responsive means.

7. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between the carbureter and the intake manifold; a main suction cylinder; a main suction conduit communicating between said main suction cylinder and the intake manifold; a piston in said main suction cylinder; means operatively connecting said piston and said secondary valve whereby suction responsive movement of said piston closes said secondary valve; yieldable means biasing said secondary valve to open position; a pilot suction cylinder in direct communication with said manifold; a pilot piston in said pilot suction cylinder; a suction control valve in said main suction conduit; means operatively connecting said suction control valve with said pilot piston whereby suction responsive movement of said pilot piston opens said suction control valve; yieldable means resisting suction responsive movement of said pilot piston until a predetermined suction is applied thereto from said manifold; a vent in the end portion of said pilot cylinder opposite the manifold connection; a valve in said vent; and means operatively associated with said throttle valve for closing said vent valve when opening movement is imparted to said throttle valve; said pilot piston being formed so as to provide a bleed between the opposite ends of said pilot cylinder.

8. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between the carbureter and the intake manifold; a main suction cylinder; a main suction conduit communicating between said main suction cylinder and the intake manifold; a piston in said main suction cylinder; means operatively connecting said piston and said secondary valve whereby suction responsive movement of said piston closes said secondary valve; yieldable means biasing said secondary valve to open position; a pilot suction cylinder in direct communication with said manifold; a pilot piston in said pilot suction cylinder; a suction control valve in said main suction conduit; means operatively connecting said suction control valve with said pilot piston whereby suction responsive movement of said pilot piston opens said suction control valve; yieldable means resisting suction responsive movement of said pilot piston until a predetermined suction is applied thereto from said manifold; a vent in the end portion of said pilot cylinder opposite the manifold connection; a valve in said vent; means operatively associated with said throttle valve for closing said vent valve when opening movement is imparted to said throttle valve, said pilot piston being formed so as to provide a bleed between the opposite ends of said pilot cylinder, an auxiliary suction cylinder in constant communication with said intake manifold; an auxiliary piston in said auxiliary suction cylinder; means operatively connecting said auxiliary piston with said secondary valve whereby suction responsive movement of said auxiliary piston imparts closing movement to said secondary valve; and a stop in said auxiliary cylinder for limiting the valve closing movement of the piston therein, the connection between said auxiliary piston and said secondary valve being adapted to permit a complete closing movement of the secondary valve by the piston in said main suction cylinder.

9. For use in combination with the carbureter and intake manifold of an internal combustion engine, a fuel mixture control attachment embodying: an open block adapted to be interposed between the carbureter and the intake manifold; a valve in the opening through said block; main suction responsive means operatively connected with said valve and adapted to close said valve under the application of suction; yieldable means normally biasing said valve to open position, conduit means adapted for communication with the engine manifold for applying suction to said suction responsive means; a suction control valve in said conduit means; yieldable means normally holding said suction control valve closed; suction responsive pilot means operable under the influence of a predetermined suction for opening said suction control valve, and auxiliary suction responsive means operatively connected with the valve in said block opening for partially closing said valve.

10. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between the carbureter and the intake manifold; suction responsive governor means in continuous communication with said intake manifold for imparting closing movement to said secondary valve under normal operating manifold depressions when said throttle valve is open, yieldable means biasing said secondary valve toward open position; means associated with said suction responsive governor means for limiting the closing movement imparted to said secondary valve; a second suction responsive means operable by abnormally high manifold depression to fully close said secondary valve independently of said suction responsive governor means; and means under control of throttle position and manifold depression for establishing communication to said second suction responsive means.

11. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between the carbureter and the intake manifold; suction responsive governor means in continuous communication with said intake manifold for imparting closing movement to said secondary valve under normal operating manifold depressions when said throttle valve is open; yieldable means for biasing said secondary valve to open position; means for limiting the closing movement imparted to said secondary valve by said governor means, to a point where the fuel mixture delivered from the carbureter to the manifold cannot exceed the mixture required for a predetermined engine speed; and automatic means operating independently of said governor means for completely closing said secondary valve when said throttle valve is closed to idling position with the engine operating at above idling speed.

12. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween; a valve in the suction passage, governor means under control of engine speed acting to partially close said valve and thereby to govern the engine speed, means limiting the range of actuation of said valve by said governor means, and means, actuated by virtue of engine

operation under sub-normal load at above idling speed, to fully close said valve.

13. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween; a valve in the suction passage, governor means actuated by the depression obtaining in the suction passage to partially close said valve and thereby to govern the engine speed, means limiting the range of actuation of said valve by said governor means, and means, actuated by virtue of engine operation under sub-normal load at above idling speed, to fully close said valve.

14. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween having a control throttle; an auxiliary valve in the suction passage, governor means under control of engine speed acting to partially close said auxiliary valve independently of throttle operation and thereby to govern the engine speed, means limiting the range of actuation of said valve by said governor means, and means, actuated by virtue of depression in the suction passage greater than normal idling with the throttle in idling position, to fully close said auxiliary valve.

15. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween having a manually controlled throttle; an auxiliary valve in the suction passage, governor means actuated by virtue of normal operating depressions in the suction passage and acting to partially close the auxiliary valve independently of throttle operation and thereby to govern the engine speed, means limiting the range of actuation of said valve by said governor means, and other means, actuated by virtue of the throttle being in idling position and the presence of depression in the suction passage greater than normal idling, to fully close said auxiliary valve.

16. In combination with an internal combustion engine carbureter having a throttle valve, and the intake manifold to which said carbureter is connected: a secondary valve located in the connection between said throttle valve and the intake manifold; suction responsive means actuated by the abnormally high depression in the intake manifold which attends closure of the throttle valve with the engine running at above idling speed to close said secondary valve; yieldable means associated with said suction responsive means for biasing said secondary valve to open position; a speed governor mechanism controlled by engine speed, connection between said mechanism and the secondary valve including a lost motion whereby said mechanism may act to move said valve toward closed position but the valve may close independently of said mechanism, and adjustable means limiting the valve closing action of the governor mechanism.

17. For use in combination with the carbureter and intake manifold of an internal combustion engine, a speed governor attachment embodying: a governor suction cylinder adapted to have continuous communication with the intake manifold; a governor piston in said suction cylinder; a valve in the suction passage between the carbureter and the manifold; means operatively connecting said piston and said valve whereby suction responsive movement of said piston imparts closing movement to said valve; yieldable means opposing suction responsive movement of said piston; means for limiting the suction responsive movement of said governor piston whereby said valve cannot be closed thereby beyond a predetermined point; and a second suction responsive means attached to said valve and operable independently of said governor piston for completely closing said valve.

18. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween; a valve in the suction passage, governor means under control of engine speed acting to partially close said valve and thereby to govern the engine speed, and means, actuated by virtue of engine operation under sub-normal load at above idling speed, to fully close said valve, said last-named means being adapted to act independently of said governor means.

19. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween; a valve in the suction passage, governor means actuated by the depression obtaining in the suction passage to partially close said valve and thereby to govern the engine speed, and means, actuated by virtue of engine operation under sub-normal load at above idling speed, to fully close said valve, said last-named means being adapted to act independently of said governor means.

20. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween having a control throttle; an auxiliary valve in the suction passage, governor means under control of engine speed acting to partially close said auxiliary valve independently of throttle operation and thereby to govern the engine speed, and means, actuated by virtue of depression in the suction passage greater than normal idling with the throttle in idling position, to fully close said auxiliary valve, said last-named means being adapted to act independently of said governor means.

21. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween having a manually controlled throttle; an auxiliary valve in the suction passage, governor means actuated by virtue of normal operating depressions in the suction passage and acting to partially close the auxiliary valve independently of throttle operation and thereby to govern the engine speed, and other means, actuated by virtue of the throttle being in idling position and the presence of depression in the suction passage greater than normal idling, to fully close said auxiliary valve, said last-named means being adapted to act independently of said governor means.

22. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween, a valve in the suction passage, governor means under control of engine speed acting to partially close said valve and thereby to govern the engine speed, and means, actuated by virtue of engine operation under sub-normal load at above idling speed, to fully close said valve, said last mentioned means embodying a movable valve actuating element acting directly on the valve to close it when the element is energized, and means for supplying valve closing energy to said element only when the engine is operating under sub-normal load at above idling speed.

23. In combination with an internal combustion engine, a carbureter, and a suction passage therebetween having a control throttle; an auxiliary valve in the suction passage, governor means under control of engine speed acting to partially close said auxiliary valve independently of throttle operation and thereby to govern the

engine speed, and means, actuated by virtue of depression in the suction passage greater than normal idling with the throttle in idling position, to fully close said auxiliary valve, said last mentioned means embodying a depression actuated element acting directly on the valve to close it, and means for applying depression to said element only when the depression in the suction passage is greater than normal idling with the throttle in idling position.

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