

2,977,101

Filed March 5, 1958

2 Sheets-Sheet 1

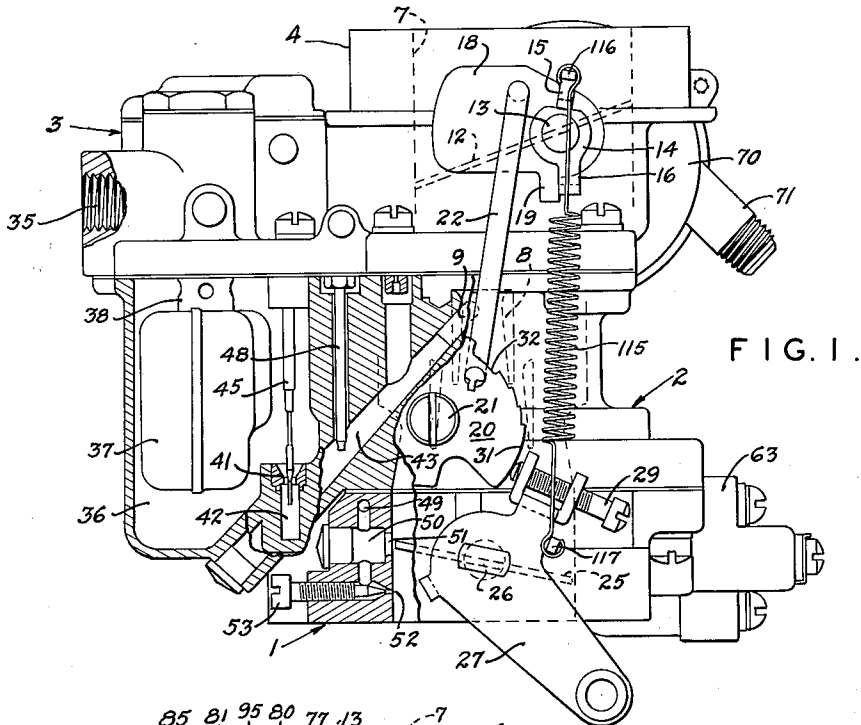


FIG. 1.

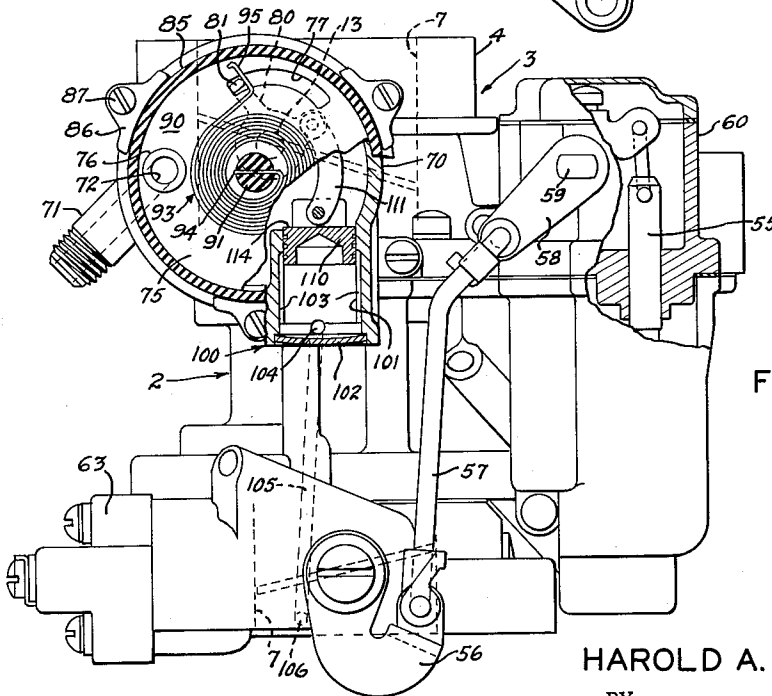


FIG. 2.

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AUTOMATIC CHOKE

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2 Sheets-Sheet 2

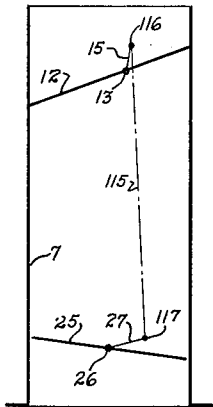


FIG. 3.

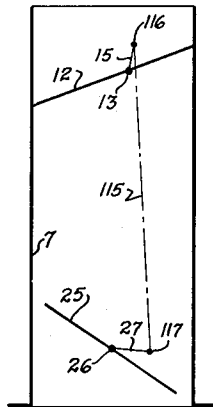


FIG. 4.

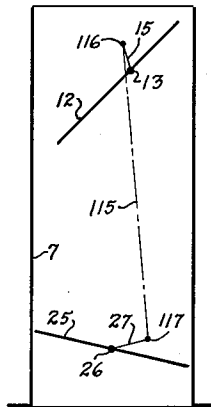


FIG. 5.

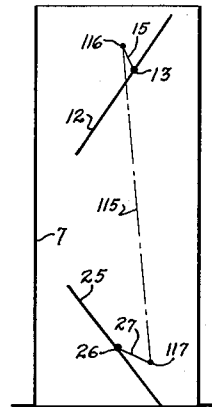


FIG. 6.

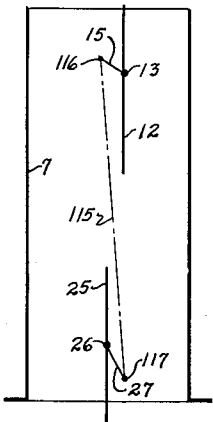


FIG. 7.

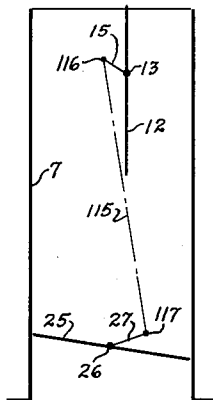


FIG. 8.

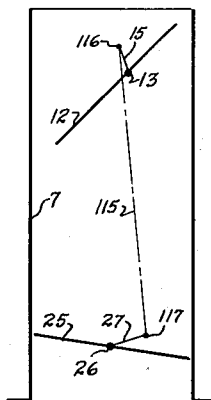


FIG. 9.

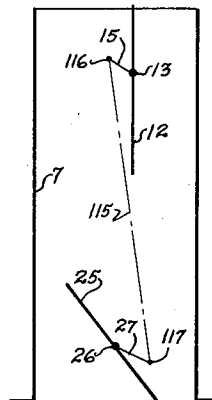


FIG. 10.

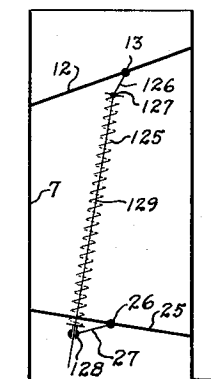


FIG. 11.

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2,977,101

AUTOMATIC CHOKE

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10 Claims. (Cl. 261—39)

This invention relates to improvements in engine fuel systems and more particularly to an improved induction system for carburetors.

A conventional carburetor includes an induction conduit containing a choke valve and a throttle valve, each pivotally mounted therein for movement between open and closed positions. The choke valve controls the richness of fuel-air mixture formed in the induction conduit, and the throttle valve controls the amount of the mixture delivered to the induction system of an engine. The fuel-air mixture becomes increasingly leaner as the choke valve is opened. The choke valve is normally provided with a temperature responsive thermostat spring for maintaining the choke valve closed when the engine is cold and for permitting the choke valve to open gradually as the engine warms up, and with a suction motor responsive to suction in the induction system of the engine tending to open the choke valve in opposition to the thermostat spring. Prior to firing during starting of the engine, it is desirable that the choke valve be maintained tightly closed by the thermostat spring when the engine is cold, to permit as much fuel as possible to be drawn into the induction system of the engine. During cranking of the engine there is a tendency for the slight suction developed in the induction system to cause the suction motor to open the choke valve slightly, and immediately upon firing of the engine it is the intended function of the suction motor to partially open the choke valve a predetermined amount. Practical limitations restrict the size of both the thermostat spring and the suction motor, and the operation of the choke valve is therefore a compromise between these various factors, which may result in the choke valve being closed with insufficient force during starting or opening insufficiently during the warm-up period, especially when the throttle is opened.

After the engine has been run for an appreciable period of time and is hot, the thermostat spring ceases to urge the choke valve closed, and the valve is then maintained fully open, either by the flow of air over an unbalanced choke valve, or by the suction motor, or both. If, under certain temperature conditions, the engine is now stopped for a short period of time, perhaps a half hour, the thermostat spring may cool off much more rapidly than the engine, closing the choke valve more than is desirable in view of the engine temperature. When an attempt is now made to start the engine, the fuel-air mixture will be entirely too rich, and the engine will be difficult to start.

It is therefore an object of this invention to provide an improved induction system for internal combustion engines.

More specifically, it is an object of this invention to provide an improved control system for the induction system of a carburetor.

Another object of this invention is to provide an improved control for the choke valve of a fuel-air mixing device.

2

Another object of this invention is to improve the starting characteristics of an internal combustion engine.

A further object of this invention is to improve the cold starting characteristics of an engine.

5 A still further object of this invention is to improve the hot starting characteristics of an engine.

Another object of this invention is to provide an improved control for maintaining a choke valve open or closed with an increasing force responsive to increased opening of the throttle valve.

10 Still another object of this invention is to control the choke valve action during warm-up of an engine to lean the fuel-air mixture relative to the amount of opening of the throttle valve.

15 Additional objects and advantages will be apparent from the following description and drawings, in which:

Fig. 1 is a fragmentary sectional elevation view of one side of a carburetor embodying features of the invention.

20 Fig. 2 is a fragmentary sectional elevation view of the opposite side of the carburetor shown in Fig. 1.

Figs. 3 through 10 are schematic elevation views of a portion of the induction system of the carburetor shown in Figs. 1 and 2 and illustrating different engine operating conditions as follows:

25 Fig. 3 illustrates an engine stopped and cold.

Fig. 4 illustrates an engine stopped and cold with the throttle open preparatory to starting.

Fig. 5 illustrates a cold engine at idle immediately after starting.

30 Fig. 6 illustrates the part throttle position of a cold engine immediately after starting.

Fig. 7 illustrates the full throttle position of an engine at least at normal operating temperatures.

35 Fig. 8 indicates the idle position of an engine at least at normal operating temperatures.

Fig. 9 illustrates a hot engine after it has been stopped for a short period of time.

Fig. 10 illustrates the same engine condition as in Fig. 9 but during starting of the engine.

40 Fig. 11 is a schematic elevation view similar to Fig. 3, but illustrating another embodiment of the invention.

A spring and lever on the choke valve shaft form an overcenter device in which the lever is overcenter in a direction to close the choke valve when the valve is nearly closed, and is overcenter in a direction to open the choke valve after the choke valve has opened slightly. One end of the spring is connected to a lever on the throttle shaft in such a manner that opening movement of the throttle valve, such as normally occurs during starting or acceleration of the engine, increases the tension of the spring and, therefore, the closing or opening force applied to the choke valve.

Referring now to the drawings, the carburetor includes a flange portion 1 provided with any conventional means, such as bolt holes (not shown), for attaching the carburetor to the intake manifold of an engine, a body portion 2, and a cover 3 including an air horn 4. An induction conduit 7 passes through the flange, body and cover, and includes a venturi cluster 8 receiving a main nozzle 9. In the air horn 4 is an unbalanced choke valve 12 secured to a shaft 13 pivotally mounted in the walls of the cover portion of the induction conduit. Fixed to the shaft 13 is a lever 14 having arms 15 and 16. A weighted member 18 is freely received on the shaft 13 and has an arm 19 engaging an intumed lug on the arm 16. A fast idle cam 20 is pivotally mounted on the carburetor body 2 by a stud 21 and is connected to the weighted lever 18 by a link 22. Opening movement of the choke valve 12 rotates the arm 16 counterclockwise, permitting the weighted member 18 to also rotate counterclockwise, whereupon the link 22 rotates the fast idle cam 20 clockwise. As the choke valve 12 closes the action is reversed. The induction conduit also

contains a throttle valve 25 fixed to a throttle shaft 26 pivotally mounted in the walls of the flange portion 1 of the induction conduit 7. A throttle lever 27, for opening and closing the throttle valve 25, is fixed to the throttle shaft 26 and has threadably mounted thereon an idle adjusting screw 29. An end of the idle adjustment screw 29 engages a high step 31 on the fast idle cam, which, as previously described, is responsive to opening movement of the choke valve 12 during warm up of the engine to rotate from the high step 31 to a low step 32, permitting the throttle valve to close more completely, reducing the idle speed of the engine.

The carburetor also includes a fuel inlet 35 for admitting fuel to fuel chamber 36. The level of the fuel in the chamber 36 is controlled by a conventional float 37 and a needle valve contained in cage or housing 38. Fuel passes from the chamber 36 through orifice 41, into passage 42, from which it passes into the main fuel passage 43, and is drawn out through main nozzle 9 during normal and high speed operation of the engine. The orifice 41 is provided with an adjustable metering rod 45 responsive to the position of the throttle valve 25 to permit greater quantities of fuel to flow through the orifice dependent upon the degree of opening of the throttle valve 25. The engine idle system includes an idle tube 48, which draws fuel from the main fuel passage 43, after which the fuel passes through a conventional idle system which may include a by-pass, economizer, and bleed, into passage 49, then into chamber 50, and out through idle ports 51 and 52 when the throttle valve 25 is in a substantially closed or idle position. Idle orifice 52 is provided with an adjustable needle valve 53 for regulating the quantity of fuel flowing through the port. The carburetor may also be provided with an accelerating pump system for providing additional fuel through the main nozzle 9 responsive to opening movement of the throttle valve 25. Accelerating pump shaft 55 is shown in Fig. 2.

Referring to Fig. 2, the throttle shaft 26 is also provided with a fixed lever 56 to which is attached a link 57, the opposite end of the link being attached to a lever 58 secured to shaft 59 which actuates conventional mechanism in housing 60 for operating the accelerating pump and the metering rod 45. A starter switch 63 is provided for either completing a circuit from a manual starter switch to an engine starter motor when the engine is stopped, or for completing a circuit to the starter responsive to opening movement of the throttle valve 25 when the engine is stopped.

Formed integrally with the cover 3 is a cup-shaped housing 70 having a threaded nipple 71. The nipple has a passage terminating in a port 72 projecting outwardly from the bottom of the cup 70. A plate 75 is received in the cup 70 and has an opening 76 engaging the extension of port 72, and an arcuate slot 77. Choke shaft 13 has a fixed lever 80 on an end thereof, the lever having a transverse lug 81 projecting through the slot 77 in plate 75. A cup-shaped cover 85 engages the outer edge of the cup 70 and is clamped to the cup by plates 86 and bolts 87 to form a substantially sealed chamber 90 between the base of the cup 70 and the cover 85. The cover 85 is provided with a boss 91 having a slot. A thermostat spring 93 is received in the chamber 90 between the plate 75 and the cover 85 and is provided with an inner end 94 secured in the slot in the boss 91 and a hook-shaped outer end 95 engaging lug 81 on lever 80. The thermostat spring 93 expands upon being heated.

A suction motor 100 includes a cylinder 101 formed integrally with the cover 3. The lower end of the cylinder 101 is sealed by disk 102. The walls of the cylinder are provided with longitudinally extending slots 103 and a port 104 opening into passage 105 which is connected to the induction conduit 7 by a port 106 downstream from the throttle valve 25. Slidably received in the cylin-

der 101 is a piston 110 pivotally connected to the lever 80 by a link 111.

The nipple 71 is connected to a stove on the exhaust manifold, directly into the exhaust manifold, or any other appropriate source of engine heat. When the engine is cold, the thermostat spring 93, through engagement of hook 95 with lug 81 on lever 80, urges the choke valve 12 to the closed position. As soon as the engine is started, a suction is impressed in cylinder 101 drawing piston 110 downwardly against the force of spring 93 until a shoulder 114 on the piston passes the top end of grooves 103 providing the required pull-off or initial opening of the choke valve. At the same time the suction in cylinder 101 draws warm air through the passage in nipple 71, into the chamber 90 between the plate 75 and the base of the cover 85, and the warm air circulates around the spring 93 and is drawn through the arcuate slot 77 and the grooves 103 into the cylinder 101 and out through port 104 into the induction system of the engine. The piston 110 constantly exerts an opening force on the choke valve 12 against the closing force of the thermostat spring 93. As the spring 93 is heated, it expands and loses tension, and the suction piston 110 and, in the event an unbalanced choke valve is utilized, the air flowing through induction conduit 7 and against the unbalanced choke valve 12 acts to progressively open the choke valve as the spring 93 is heated.

A tension spring 115 is attached at one end to a lug 116 on the arm 15 of lever 14 which is fixed to the choke shaft 13. The other end of the spring 115 is secured to a lug 117 on the throttle lever 27 which is fixed to the throttle shaft 26. Lug 117 is so located that opening movement of the throttle valve 25 increases the tension in spring 115. The longitudinal axis of the spring 115 defines a line of force acting on the lug 116. The relationship between the lug 116, choke valve 12, and the line of force established by spring 115 is such that the lug 116 passes over dead center between its position at the fully closed position of the choke valve 12 and the pull-off or the partially open position established by suction motor piston shoulder 114 passing the top ends of grooves 103 immediately upon starting the engine when cold.

Briefly, the operation of the device is as follows: With the choke valve 12 closed, as with a cold engine prior to starting, the spring 115 is additive to the force of thermostat spring 93 in closing the choke valve. In this position, when the throttle valve 25 is opened, as during starting, the spring 115 is additionally tensioned so that the choke valve 12 is held more firmly closed. Immediately after the engine starts, as the suction motor 100 effects the choke valve pull-off, the lug 116 passes top dead center and the closing action of thermostat spring 93 is then modified by spring 115 acting to open the choke valve 12. When the throttle valve 25 is opened, the spring 115 is additionally tensioned, exerting a greater force tending to additionally open choke valve 12. The operation will be more fully described with reference to Figs. 3-10.

Figs. 3 through 10 are schematic illustrations of the previously described induction conduit 7, choke valve 12, choke shaft 13, lug 116 on lever arm 15 fixed to shaft 13, throttle valve 25, throttle shaft 26, lug 117 on throttle lever 27 fixed to throttle shaft 26, and tension spring 115 having opposite ends attached to lugs 116 and 117.

Referring to Figs. 3-6, Fig. 3 schematically illustrates the parts in the positions shown in Figs. 1 and 2, or, in other words, as they would be with a cold stopped engine. The choke valve 12 is fully closed, the throttle valve 25 is in the fast idle position (adjusting screw 29 on the fast idle cam high step 31), and spring 115 is additive to the force of thermostat spring 93 in closing the choke valve 12. Fig. 4 illustrates the carburetor with the throttle valve open preparatory to starting the cold engine, or

5

while the engine is being cranked. It is customary to open the throttle valve about 25° to 30° during cranking, and if a starter switch 63, responsive to opening movement of the throttle valve is utilized, a throttle position as indicated in Fig. 4 is mandatory upon starting. In Fig. 4 the opening movement of the throttle valve 25 has rotated the lug 117 downwardly, increasing the tension in spring 115 and, therefore, the closing force on choke valve 12. In both Figs. 3 and 4, the arm 15 and lug 116 are over dead center with respect to the line of force established by the longitudinal axis of the spring 115 in a direction to close the choke valve 12. Fig. 5 represents the carburetor upon firing of the engine. Suction applied to the suction motor 100 has effected the initial pull-off or opening of the choke valve 12, and the throttle valve 25 is in the fast idle position. It will be noted that the arm 15 and lug 116 have now passed over dead center in a direction such that the force of spring 115 urges the choke valve 12 open, modifying the action of thermostat spring 93. Fig. 6 represents the carburetor immediately after starting a cold engine, as in Fig. 5, but at part throttle. Opening of throttle valve 25 moves lug 117 downwardly, increasing the tension in spring 115 to rotate the lug 116 counterclockwise and open the choke valve additionally, which has the desirable effect of leaning the fuel-air mixture responsive to advanced throttle position. Additional air flowing through the induction conduit 7 and over the unbalanced choke valve 12 also opens the choke valve. As the engine warms up, the tension in thermostat spring 93 will be reduced, and the choke valve 12 will tend to open the choke valve additionally in the normal manner. Suction motor 100 also works to open the choke valve as the thermostat spring 93 heats and its tension is reduced.

Referring to Figs. 7 and 8, Fig. 7 represents the carburetor after the engine is fully heated to at least its normal operating temperature, and at full throttle. In this position, the spring 115 acts to prevent undue fluttering of the choke valve 12 during acceleration and deceleration by providing a slight tension tending to hold the choke valve open. The choke valve will, of course, assume the position shown in Fig. 7, when hot, irrespective of the spring 115. Fig. 8 illustrates the carburetor in the hot idle position. The choke valve 12 remains wide open, but the throttle valve 25 is closed. It should be noted that the throttle valve 25 is closed more completely than during the hot condition shown in Fig. 8, because the adjusting screw 29 is now bearing against the fast idle cam's lowest step 32. With the choke valve 12 wide open and the throttle valve 25 closed, the spring 115 will have the least tension possible in any operative position and, therefore, the spring 115 may be calibrated to have no tension or any desired amount of tension in the position shown in Fig. 8. If the spring is set to have no tension in any other position of the choke and throttle valves, it will be necessary to provide lost motion connections for the spring, such as a loose lever on the throttle, or a free sliding connection on one end of the spring 115, or else to permit the spring to buckle, for example, when in the position shown in Fig. 8.

With reference to Figs. 9 and 10, Fig. 9 shows the carburetor after a hot engine has been stopped for a short period of time, for example, five minutes to a half hour. Under some atmospheric temperature conditions, the thermostat spring 93 cools more rapidly than is dictated by the engine temperature. Under such conditions, the choke valve 12 will be partially closed by the thermostat spring 93. Attempting to start a conventional engine under such conditions results in an unduly rich fuel-air mixture which may prevent the engine from starting. As shown in Fig. 10, upon attempting to restart the engine under such conditions, opening movement of the throttle valve 12 provides additional tension in spring 115 modifying the action of the thermostat spring 93, and opening the choke valve 12 sufficiently to

6

lean the starting fuel mixture. Under these operating conditions, it is conventional practice to open the throttle valve 25 somewhat more than under normal starting conditions, as illustrated in Fig. 4. In fact, the throttle valve may be fully opened if necessary.

Fig. 11 schematically illustrates another embodiment of the invention in which the same reference numerals are used to indicate parts similar to those in Figs. 1-10. In this embodiment, a compression spring 125 replaces tension spring 115 and choke lever arm 15 is replaced by a diametrically oppositely projecting fixed arm 126 having a suitable pivoted compression spring seat 127. The throttle lever lug 117 is replaced in this embodiment by a diametrically opposite pivoted compression spring seat 128. A rod 129 may pass through the center of spring 125 to maintain the spring in proper alignment. The rod must not restrict movement of the parts and to this end may be provided with a pivot or universal connection at one seat, as 127, and a free sliding connection at the other seat, as 128. The functioning of this embodiment is the same as that previously described except for the inherent difference in the compression spring 125 pushing seats 127 and 128 apart.

Although this invention has been illustrated and described with reference to particular embodiments, interrelationship of parts, and particular functional environments, various modifications will be apparent to one skilled in the art, and the invention is therefore not to be limited to the particular embodiments, interrelationship of parts, or particular functional relationships, except as set forth in the appended claims.

I claim:

1. A carburetor for an internal combustion engine comprising a mixture conduit, a choke shaft pivotally mounted therein, a throttle shaft pivotally mounted in said mixture conduit, a choke valve and a throttle valve mounted on said shafts respectively for regulating fluid flow through said conduit, venturi means in said mixture conduit, a main fuel supply system and an idle fuel supply system for supplying fuel to said mixture conduit, a thermostatic device responsive to engine temperature operatively connected to said choke valve and tending to close said choke valve with a force that decreases with increase in engine temperature, a suction device responsive to engine vacuum operatively connected to said choke valve tending to open said choke valve when said engine is running, a tension spring operatively connected to said choke shaft and defining a line of force with respect to said choke shaft, said choke shaft being over dead center with respect to said line of force in a direction to urge said choke valve closed when said choke valve is substantially closed and being over dead center with respect to said line of force in a direction to open said choke valve when said choke valve is substantially opened.

2. A carburetor for an internal combustion engine comprising a mixture conduit, a choke shaft pivotally mounted therein, a throttle shaft pivotally mounted in said mixture conduit, a choke valve and a throttle valve mounted on said shafts respectively for regulating fluid flow through said conduit, venturi means in said mixture conduit, a main fuel supply system and an idle fuel supply system for supplying fuel to said mixture conduit, a thermostatic device responsive to engine temperature operatively connected to said choke valve and tending to close said choke valve with a force that decreases with increase in engine temperature, a suction device responsive to engine vacuum operatively connected to said choke valve tending to open said choke valve when said engine is running, an arm fixed on said choke shaft, a tension spring operatively connected to said choke shaft arm and said throttle shaft tending to close said choke valve when said choke arm is moved in one direction past a dead center position and tending to open said choke valve when said choke shaft arm is moved in the opposite direction past said dead center position.

3. A carburetor for an internal combustion engine comprising a mixture conduit, a choke shaft pivotally mounted therein, a throttle shaft pivotally mounted in said mixture conduit, a choke valve and a throttle valve mounted on said shafts respectively for regulating fluid flow through said conduit, venturi means in said mixture conduit, a main fuel supply system and an idle fuel supply system for supplying fuel to said mixture conduit, a thermostatic device responsive to engine temperature operatively connected to said choke valve and tending to close said choke valve with a force that decreases with increase in engine temperature, a suction device responsive to engine vacuum operatively connected to said choke valve tending to open said choke valve when said engine is running, a resilient biasing member operatively connected to said choke shaft and said throttle shaft and movable past a dead center position to yieldably resist movement of said choke valve from either its closed or full open positions.

4. A carburetor for an internal combustion engine comprising a mixture conduit, a choke shaft pivotally mounted therein, a throttle shaft pivotally mounted in said mixture conduit, a choke valve and a throttle valve mounted on said shafts respectively for regulating fluid flow through said conduit, venturi means in said mixture conduit, a main fuel supply system and an idle fuel supply system for supplying fuel to said mixture conduit, a thermostatic device responsive to engine temperature operatively connected to said choke valve and tending to close said choke valve with a force that decreases with increase in engine temperature, a suction device responsive to engine vacuum operatively connected to said choke valve tending to open said choke valve when said engine is running, a first member affixed to said choke shaft, a second member affixed to said throttle shaft, a tension spring operatively connected to said first and second members urging said choke valve closed when said first member is moved in one direction past a dead center position and urging said choke valve open when said first member is moved in the opposite direction past said dead center position.

5. A carburetor for an internal combustion engine comprising a mixture conduit, a choke shaft pivotally mounted therein, a throttle shaft pivotally mounted in said mixture conduit, a choke valve and a throttle valve mounted on said shafts respectively for regulating fluid flow through said conduit, venturi means in said mixture conduit, a main fuel supply system and an idle fuel supply system for supplying fuel to said mixture conduit, a thermostatic device responsive to engine temperature operatively connected to said choke valve and tending to close said choke valve with a force that decreases with increase in engine temperature, a suction device responsive to engine vacuum operatively connected to said choke valve tending to open said choke valve when said engine is running, a first member affixed to said choke shaft, a second member affixed to said throttle shaft, a tension spring operatively connected to said first and second members urging said choke valve closed when said first member is moved in one direction past a dead center position and urging said choke valve open when said first member is moved in the opposite direction past said dead center position, said second member being arranged to move away from said first member responsive to movement of said throttle valve from its closed position toward its open position to stress said spring in tension.

6. A carburetor for an internal combustion engine comprising a mixture conduit, a choke shaft pivotally mounted therein, a throttle shaft pivotally mounted in said mixture conduit, a choke valve and a throttle valve mounted on said shafts respectively for regulating fluid flow through said conduit, venturi means in said mixture conduit,

a main fuel supply system and an idle fuel supply system for supplying fuel to said mixture conduit, a thermostatic device responsive to engine temperature operatively connected to said choke valve and tending to close said choke valve with a force that decreases with increase in engine temperature, a suction device responsive to engine vacuum operatively connected to said choke valve tending to open said choke valve when said engine is running, rotating members rigidly affixed to said choke shaft and said throttle shaft respectively, radially disposed lugs on each of said rotating members, a biasing spring operatively connected to said lugs, the lug on said choke shaft member being movable across a dead center position whereby said spring acts to yieldably resist movement of said choke valve from either its closed or full open positions.

7. A carburetor for an internal combustion engine comprising a mixture conduit, a choke shaft pivotally mounted therein, a throttle shaft pivotally mounted in said mixture conduit, a choke valve and a throttle valve mounted on said shafts respectively for regulating fluid flow through said conduit, venturi means in said mixture conduit, a main fuel supply system and an idle fuel system for supplying fuel to said mixture conduit, a thermostatic device responsive to engine temperature operatively connected to said choke valve and tending to close said choke valve with a force that decreases with increase in engine temperature, a suction device responsive to engine vacuum operatively connected to said choke valve tending to open said choke valve when said engine is running, rotating members rigidly affixed to said choke shaft and said throttle shaft respectively, radially disposed lugs on each of said rotating members, a biasing spring operatively connected to said lugs, the lug on said choke shaft member being movable across a dead center position whereby said spring acts to yieldably resist movement of said choke valve from either its closed or full open positions, said other lug being movable away from said choke shaft lug responsive to opening movement of said throttle valve.

8. In an internal combustion engine carburetor having an air inlet and a mixture outlet, a choke valve controlling the air inlet, a throttle valve controlling the mixture outlet, means responsive to suction and temperature for controlling said choke valve, and a resilient spring connected to said choke valve to yieldably resist movement of the latter from either its closed position or its fully open position toward a predetermined intermediate position.

9. In an internal combustion engine carburetor having an air inlet and a mixture outlet, a choke valve controlling the air inlet, a throttle valve controlling the mixture outlet, means responsive to suction and temperature for controlling said choke valve, and a resilient spring interconnecting said choke valve and throttle valve to yieldably resist movement of the choke valve from either its closed position or its fully open position toward a predetermined intermediate position.

10. In an internal combustion engine carburetor having an air inlet and a mixture outlet, a choke valve controlling the air inlet, a throttle valve controlling the mixture outlet, means responsive to suction and temperature for controlling said choke valve, and a resilient spring interconnecting said choke valve and throttle valve to yieldably resist movement of the choke valve from either its closed position or its fully open position toward a predetermined intermediate position, said spring acting to bias said throttle valve toward its closed position.

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