United States Patent

[11] 3,544,085

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a corporation of Michigan

[54] **CARBURETOR HAVING AN AUTOMATIC CHOKE**
3 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **261/39**
[51] **Int. Cl.** **F02m 1/10**
[50] **Field of Search** 261/39.2

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ABSTRACT: Typically, a carburetor, having a choke valve with thermostatic means adapted to urge the choke valve in the closing direction when cold and pressure responsive means which communicates with a source of engine vacuum for moving the choke valve in a direction opposite to that of the thermostatic means upon engine starting, is provided with additional temperature responsive means for selectively introducing an abutment member into interconnecting linkages operatively connected to the pressure responsive means and choke valve whereby a first initial choke valve position is attained upon the engine being started in response to environmental temperatures less than a predetermined minimum temperature and a second initial choke valve position is attained after the engine is started in response to environmental temperatures greater than a predetermined minimum temperature.

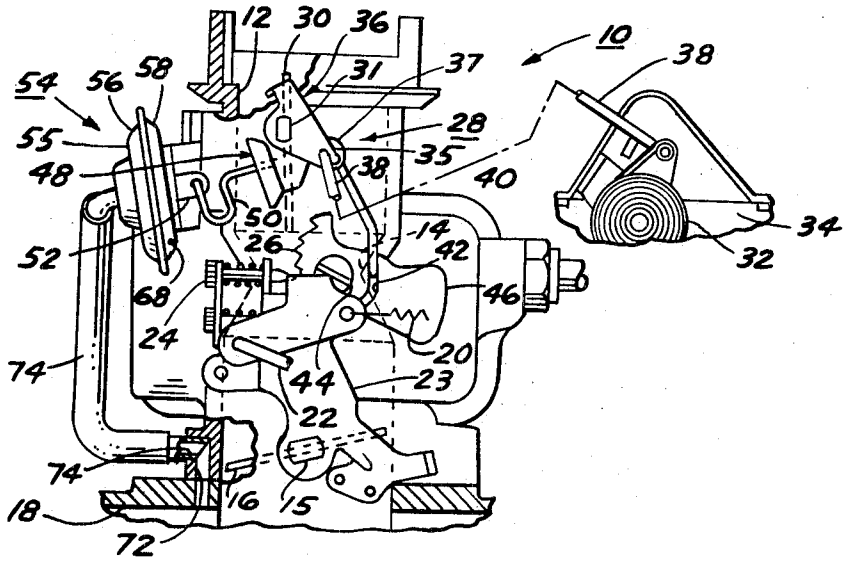


FIG. 1

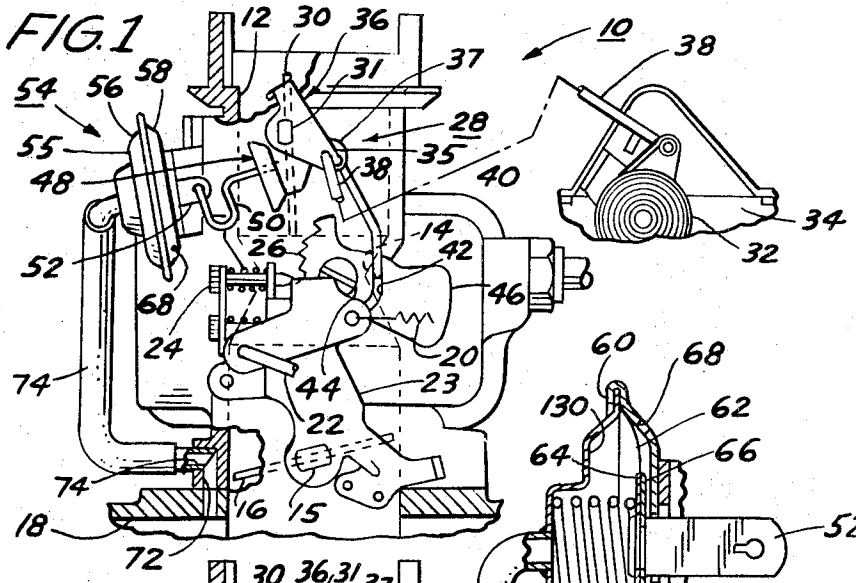


FIG. 2

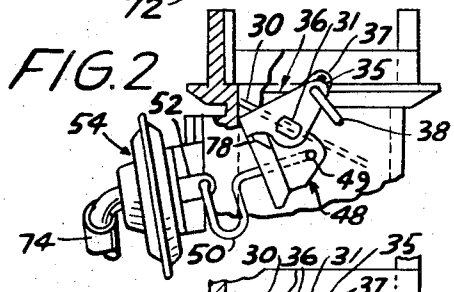


FIG. 3

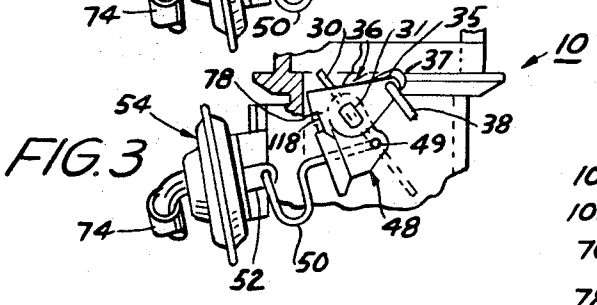


FIG. 4

FIG. 6

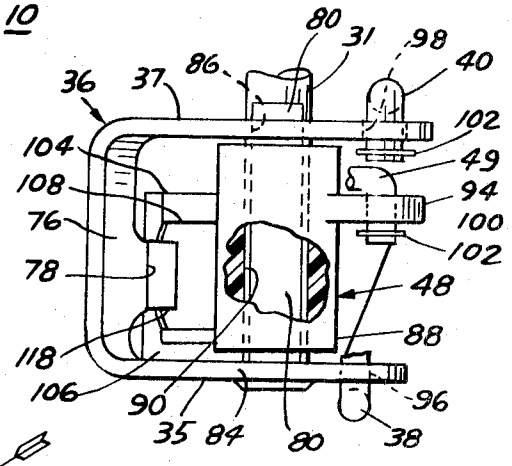
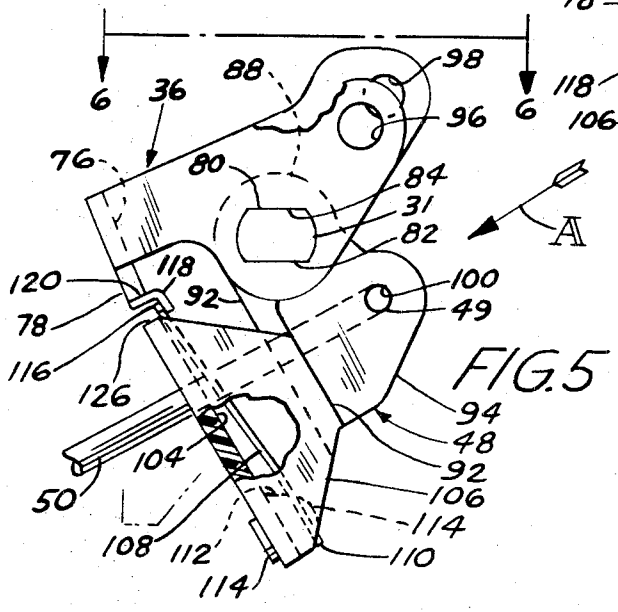


FIG. 5



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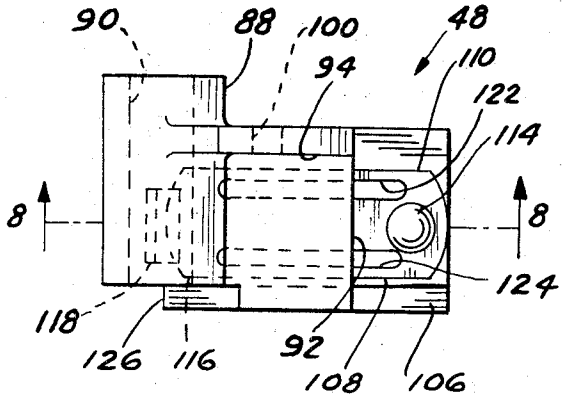


FIG. 7

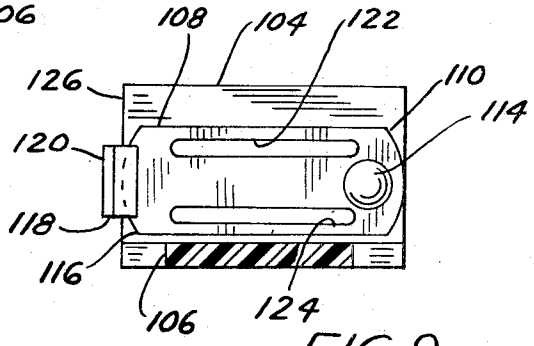


FIG. 9

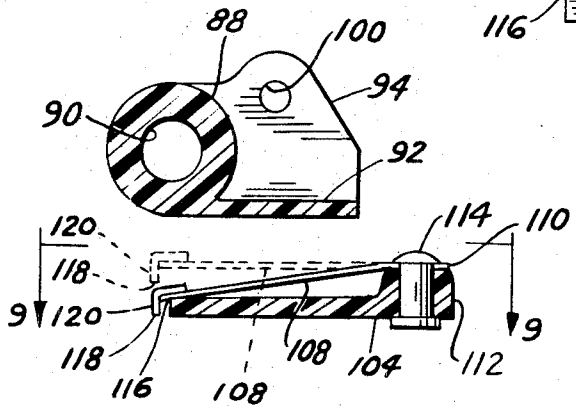


FIG. 8

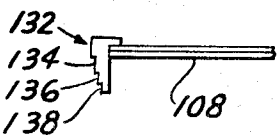


FIG. 11

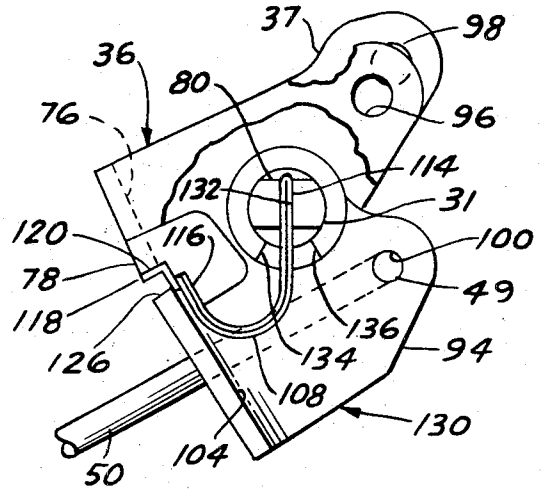


FIG. 10

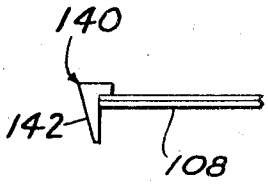


FIG. 12

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CARBURETOR HAVING AN AUTOMATIC CHOKE

BACKGROUND OF THE INVENTION

Heretofore, automatic choke mechanisms have employed either a diaphragm assembly or a pressure responsive piston in communication with a source of engine or manifold vacuum for moving the choke valve, against the resisting force of a thermostat tending to close the choke valve, to a partially open position (often referred to as the "qualifying position") after a cold or relatively cold engine has been started.

In such carburetors the qualifying position which is attained by the choke valve, after the engine is started, is determined by the point at which the opening force of the piston or diaphragm assembly equals the closing force of the choke thermostat. This balance of forces which prevails results in large hysteresis values which, of course, means that there is a large difference in the choke valve-qualifying position depending on the direction the choke valve is originally moving. Further, there tends to be substantial variations resulting from the mass production and assembling of component details comprising the choke mechanisms.

To a certain extent these problems have been overcome by the employment of either "stopped" diaphragms or pistons; in such instances the choke valve position is determined by a mechanical stop, which precludes further motion of the diaphragm or piston, rather than a zero balance of forces.

However, the disadvantages of either the stopped diaphragm or piston is that there is no modulation of the choke-qualifying position in accordance with temperature. That is, the choke-qualifying position will be the same at 70° F. as at 0° F.

Certain proposals have been made in the past for employing thermostatic means for modifying the choke-qualifying position when a ported vacuum bypass type of piston (one whose initial position is to some degree influenced by the position of said vacuum bypass ports) is employed. For example, U.S. Pat. No. 3,006,617 issued to J. T. W. Moseley, teaches the use of a thermostatic element as a force-transmitting member generally between the piston and choke valve. However, the various forms of this concept disclosed, have the difficulty of a varying spring constant or spring force being introduced into the system because of the characteristics of the bimetal and the manner in which it is employed as a force-transmitting member.

Another proposal shown by U. S. Pat. No. 2,970,825 issued to M. L. Smitley, discloses a piston with a positive stop which is thermostatically adjusted to provide for some degree of variation in the position at which the piston is stopped. However, there are practical problems in the manufacture and calibration of the device as specifically taught by Smitley. Further, as disclosed, the abutment's rate of response to temperature variations is relatively slow.

SUMMARY OF THE INVENTION

The present invention comprises a carburetor for an internal combustion engine, having a choke valve, thermostatic means adapted to urge said choke valve in the closing direction when cold, pressure responsive means adapted to communicate with a source of engine vacuum and operatively connected to said choke valve so as to move said choke valve against the urging of said thermostatic means to a partially open position upon said engine being started, and abutting interconnecting linkage means operatively interposed between said choke valve and said pressure responsive means for varying the position to which said choke valve is opened by said pressure responsive means, said abutting interconnecting linkage means including temperature responsive means effective for selectively placing abutment means between first and second linkage members comprising said linkage means in response to environmental temperatures in order to establish a first position to which said choke valve is opened by said pressure responsive means when said environmental temperature is below a predetermined temperature value and also effective to establish at least a second position to which said choke valve is opened by said pressure responsive means when said environmental temperature is above a predetermined temperature value.

Accordingly, a general object of this invention is to provide, in a carburetor having a choke valve thermostatically closed and pressure responsive means moving the choke valve open against the thermostat upon the engine being started, additional temperature responsive means responsive to environmental temperatures for modifying the degree to which the choke valve is opened by the pressure responsive means in order to provide for sufficiently rich fuel-air mixtures during cold temperature operation and to lean-out the fuel-air mixture during warm or hot temperature operation in order to provide for smooth driveaway operation immediately following initial engine starting.

Other more specific objects and advantages of this invention will become apparent when reference is made to the following description considered in conjunction with the drawings.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, wherein certain details may be omitted from one or more views for purposes of clarity;

FIG. **1** is an elevational view, with portions thereof cut away and in cross section, of a carburetor embodying the invention;

FIGS. **2** and **3** are fragmentary portions of FIG. **1** illustration the positions of the choke elements at various other operating conditions;

FIG. **4** is a cross-sectional view of the diaphragm assembly shown in the upper left-hand portion of FIG. **1**;

FIG. **5** is an enlarged elevational view of some of the elements shown in each of FIGS. **1**, **2** and **3** illustrating an operating condition generally similar to that depicted by FIG. **3**;

FIG. **6** is a view taken generally on the plane of line **6–6** of FIG. **5** and looking in the direction of the arrows;

FIG. **7** is a top plan view of one of the elements shown in FIGS. **5** and **6**, taken generally in the direction of arrow A of FIG. **5**;

FIG. **8** is a cross-sectional view taken generally on the plane of line **8–8** of FIG. **7** and looking in the direction of the arrows; and

FIG. **9** is a cross-sectional view taken generally on the plane of line **9–9** of FIG. **8**;

FIG. **10** is a view similar to FIG. **5** but illustrating another embodiment of the invention; and

FIGS. **11** and **12** are each views fragmentarily illustrating modifications of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in greater detail to the drawings, FIG. **1** illustrates a carburetor **10** formed to provide an induction passage **12** having the usual venturi restriction **14** and a throttle valve **16** pivotably mounted downstream of the venturi, on a shaft **15**, the carburetor being mounted on an engine intake manifold **18**. The throttle valve is opened, against the force of a spring **20** urging it closed, in the usual manner as by means of a linkage **22** connected between the throttle lever **23** and the operator's foot pedal (not shown). As is customary, closure of the throttle **16** is limited by an adjustable stop **24** adapted to engage one of the steps on a fast idle cam **26**, the latter being positioned by the choke mechanism **28**.

The choke mechanism **28** comprises a choke plate **30** mounted on shaft **31** for pivotal rotation within the air induction passage **12** upstream of the venturi. It will be noted that the choke plate is unbalanced, as is often the case, to open by gravity and in response to airflow through the induction passage. The force of the air tending to open the choke plate is opposed by the coiled thermostatic spring **32**, which in this case is mounted on the engine exhaust manifold **34** and operatively pivotally connected to an arm portion **35** of a lever **36**

(secured to choke shaft 31) by a link 38. The opposing force of the thermostat is at a maximum when the engine is cold and is progressively relaxed as the engine warms up. The choke lever 36 is in turn operatively connected to the fast idle cam by a link 40 having one end pivotally connected to an arm portion 37 of lever 36 and its other end positioned in a slot 42 formed in the fast idle cam 26. The fast idle cam 26, pivoted at 44 and weighted as at 46, is thus moved by gravity in the clockwise direction until restrained by the link 40. In other words, the choke position determines the step on the fast idle cam to which the throttle is permitted to close.

The choke lever 36, suitably secured to choke shaft 31 for rotation therewith, contains, generally between the arms 35 and 37, a second lever member 48 which is freely pivotally mounted on choke shaft 31. The lever member 48 receives one end 49 of a link 50 which has its other end pivotally secured to a stem 52 of a vacuum diaphragm assembly 54. The vacuum diaphragm housing 55 may be formed from a pair of stamped members 56 and 58 secured together in any suitable manner, as by rolling the flange 60, so as to secure the peripheral edge of the diaphragm 62 therebetween. The stem 52 is secured to the center of the diaphragm by the use of conventional diaphragm washers 64 and 66. The right-hand chamber of the housing is vented to atmosphere through ports 68, while the left-hand chamber 69 of the housing, containing a return spring 70 urging the diaphragm to the right, is in communication with manifold vacuum by means of passageway 72 and conduit 74.

The cooperative action of levers 36 and 38 is illustrated in FIGS. 5 and 6 wherein lever 36 can be seen as comprised of generally parallel extending arms 35 and 37 joined to each other as by a transversely directed bight portion 76 having an integrally formed tablike striker or abutment 78 formed thereon. As shown in each of FIGS. 1, 2, 3, 5 and 6, the choke shaft 31 is provided with flatted surfaces 80 and 82 which are engaged by complementary surfaces in apertures 84 and 86 respectively formed in arms 35 and 37.

Lever member 48, contained generally between arms 35 and 37 of lever 36, is comprised of a generally tubular bearing portion 88, having a cylindrical bearing surface 90 formed therethrough, which may be integrally formed with a platelike portion 92 and a transversely directed wall 94 which serves as a gusset between the plate 92 and bearing 88. Apertures 96 and 98 respectively formed in lever arms 35 and 37 pivotally receive the ends of linkages 38 and 40 while an aperture 100 in wall 94 pivotally receives end 49 of linkage 50. Such pivotally received ends may be retained therein as by a snap ring 102 received within a cooperating groove formed in the end of the linkage member.

A platform support 104 may be integrally formed with and secured to plate 92 as by means of a depending wall 106. In FIG. 5, a portion of the wall 106 is broken away exposing a portion of a thermostatic element 108, which may be a bimetallic element, secured at one end 110 to a raised portion 112 of the support 104 as by a rivet 114. The other end 116 of element 108, free to move in accordance with the dictates of temperature, is provided with an abutment member 118 which, at times, is adapted to have its surface 120 abuttingly engage the protruding stop or abutment 78 of lever 36. Abutment member 118 and end 116 of bimetallic element 108 may be secured to each other in any suitable manner as, for example, by soldering.

FIGS. 7, 8 and 9 illustrate, in greater detail, the configuration of lever 48 and the thermostatic element 108 carried thereby. As shown in FIGS. 7 and 9, the element 108 is preferably provided with longitudinally extending slots 122 and 124 which aid the bimetal 108 in operating as a "snap-acting" lever. That is, with reference to FIG. 8, bimetal 108 and spacer or abutment 118 would assume the position illustrated at predetermined environmental or ambient temperatures of, for example, 60° F. or greater while at temperatures less than the predetermined temperature the thermostatic element 108 and spacer 118 would assume a position relative to support 104 as generally indicated in phantom line. Accordingly, in view of the above, it can be seen that in FIGS. 3 and 5, the levers 36 and 48 are in a relationship wherein the abutment 78 of lever is engaging surface 120 of spacer or abutment member 118 which, of course, indicates that the environmental temperature is at or in excess of a predetermined minimum temperature. However, in comparison it can be seen that the abutment 78 of lever 36 is in abutting engagement with end surface 126 of the platform support 104 of lever 48 (also see FIG. 5). This, of course, can only be attained when the thermostatic element 108 and abutment member 118 are moved to a position wherein the abutment 118 will not be in the path of movement generally described by the abutment 78 of lever 36. As previously explained, this will happen, as illustrated in FIG. 8, when the ambient temperature is less than the predetermined minimum temperature.

When the engine is cold and the throttle 16 is opened (prior to cranking) so as to release the choke 30 and fast idle cam 26 from their FIG. 1 positions, the thermostatic coil 32 unwinds so as to close the choke plate 30, through link 38 and the lever 36. Since the engine is not operating spring 70 in chamber 69 of the diaphragm assembly 54 urges the diaphragm 62, stem 52 and the link 50 to the right thereby rotating lever 48 counterclockwise about choke shaft 31.

During engine cranking, the manifold vacuum is insufficient to actuate diaphragm 62; however, when the engine is started, with the thermostatic coil 32 still in its cold condition urging the choke closed, the increased manifold vacuum supplied to chamber 69 of the diaphragm housing becomes sufficient to pull diaphragm 62 to the left against the force of the spring 70, causing the link 50 to rotate the lever 48 clockwise and initially open the choke valve 30 some predetermined amount as shown, for example, by either FIGS. 2 or 3.

Since any engine vacuum after starting is sufficient to fully actuate the diaphragm 62, spring 70 being only a return spring, the extent to which the choke is initially opened is determined by the location of the positive stop 130. In the embodiment shown, the stop 130 is part of the housing member 56, and its exact location may be varied to suit the requirements of the particular engine-carburetor combination. Alternatively, the housing 55 could be of a standard design having an equivalent separate abutment such as shown by U. S. Pat. No. 2,970,825 issued to M. Smitley.

The position of the choke 30 and associated elements in FIG. 2 is that as would occur when the environmental or "underhood" temperature is relatively cold while FIG. 3 illustrates the same initial engine-started condition with the environmental temperature being relatively hot. That is, as can be seen from FIGS. 2 and 3, when the environmental temperature is relatively cold (a temperature below a predetermined minimum) the choke plate or valve 30 is initially opened a lesser degree, as compared to the choke valve position shown in FIG. 3, thereby providing for a richer fuel-air ratio in order to aid in engine operation. This is, of course, necessary at colder temperatures because the degree of vaporization of the fuel is less at colder temperatures; therefore, greater quantities of fuel are required in order to achieve the proper combustible mixture of vaporized fuel and air.

The difference in choke valve positions as comparatively illustrated by FIGS. 2 and 3 is accomplished by the difference in degree to which lever 36 is rotated by the lever 48. That is, since the stroke of diaphragm linkage 52 is the same for both "cold" and "hot" underhood temperatures, it follows that if bimetal 108 and associated spacer 118 are situated, as generally shown by either FIG. 5 or FIG. 8, the lever 36 will be rotated clockwise to a position (as depicted by FIG. 3) further than if the element 108 and spacer 118 were in the raised position, as shown in phantom line in FIG. 8, which would result in lever abutment 78 engaging the end surface 126 of lever 48 (as depicted by FIG. 2).

Accordingly, it can be seen that the provision of bimetallic element 108 and associated spacer abutment 118 enables the positioning of the choke valve to either of two positions in ac-

cordance with the dictates of temperature even though the pressure responsive diaphragm **62** and linkage **52** are caused to move to substantially the same position once the engine has become started.

FIG. **10** illustrates another embodiment of the invention, Elements which are like or similar to those of the preceding FIGS. are identified with like reference numbers. In FIG. **10**, a portion of arm **35** is broken away to more clearly illustrate the bearing portion **88** of the lever **130** which is mounted on the choke shaft **31** for relative movement therebetween. The lever **130** may have a generally downwardly depending wall **94** which in turn carries a transversely extending platform or abutment wall **104**. In contrast to the embodiment of FIGS. **1** through **9**, end **114** of the thermostatic element **108** is secured to choke shaft **31** as by being tightly received within a groove **132** formed therein. In order to accommodate the thermostatic element, a slot or opening, defined generally by surfaces **134** and **136**, may be formed in the bearing portion **88**. The thermostatic element **108** and abutment **118** continue to function as previously described; that is, upon attainment of sufficiently high environmental temperatures, element **108** causes the abutment **118** to assume a position as illustrated in FIG. **10** whereas if the environmental temperatures are not sufficiently high, element **108** causes abutment **118** to to move generally to the right so as not to be in the path of movement of end **126** and abutment **78**. Accordingly, it can be seen that in this instance an operative connection between the lever **37** and bimetal **108** of FIG. **10** is achieved by virtue of each being secured to the choke shaft **31** for rotation therewith.

FIGS. **11** and **12** illustrate modifications of the invention wherein, instead of the abutment member **118** of FIGS. **1—10**, either a stepped abutment **132** or a wedgelike or tapered abutment **140** is employed in combination with the cooperating thermostatic element. In FIG. **11**, it can be seen that a plurality of discrete steplike surfaces **134**, **136** and **138** are provided for selectively engaging the abutment **78** of lever **36** while abutment **140** of FIG. **12** is provided with an inclined surface **142**. In the modifications of FIGS. **11** and **12**, the thermostatic elements **108** would be calibrated so that at a first predetermined temperature the abutments, either **132** or **140**, would be at a first specific position and that for subsequent specific temperatures such abutments would attain specific positions corresponding to such temperatures. This, of course, would mean that, if such modifications as contemplated by FIGS. **11** and **12** were employed, the degree to which the choke valve **30** is initially opened will vary in a manner closely approximating the changes in environmental temperature.

In view of the preceding, it can be seen that the invention provides, in a carburetor having a choke valve and thermostatic means adapted to resist opening of the choke valve when the engine is cold and vacuum responsive means for opening said choke valve against the closing force of the thermostatic means, additional temperature responsive means responsive to environmental temperatures for modifying the degree to which the choke is opened by the vacuum responsive means in order to provide for sufficiently rich fuel-air mixtures during cold temperature operation and to lean-out the fuel-air mixture during warm or hot temperature operation in order to provide for smooth driveway operation immediately following initial engine starting. The provision of such additional temperature responsive means permits the attainment to of such characteristics without the necessity of having to in any way alter or modify the otherwise normal operating characteristics of the thermostatic means adapted to resist opening of the choke valve.

Although only two basic embodiments and two modifications of the invention have been disclosed and described, it is apparent that other embodiments and modifications of the invention are possible within the scope of the appended claims.

I claim:

1. A carburetor for an internal combustion engine comprising a choke valve; means including a heat responsive device to close said choke valve at low temperatures; a device responsive to engine vacuum for partially opening said choke valve against the tension of said heat responsive device upon starting of the engine; abutment means associated with said vacuum responsive device adapted to limit the amount of choke opening due to said vacuum responsive device; and linkage means operatively interconnecting said pressure responsive device and said choke valve; said linkage means comprising a first linkage member, a second linkage member and temperature responsive means operatively connected to one of said linkage members, said first and second linkage members being effective for at times positively engaging each other when said vacuum responsive device is opening said choke valve in order that the opening force of said vacuum responsive device is transmitted directly through said first and second linkage members; and said temperature responsive means, responsive to environmental temperature, being effective to operatively engage the other of said linkage members in order to change the relationship between said first and second linkage members when said environmental temperature exceeds a predetermined minimum temperature value so as to enable said vacuum responsive device to open said choke valve to a more nearly completely open position, said first linkage member being operatively connected to said device responsive to engine vacuum for movement in unison therewith, said second linkage member being operatively connected to said choke valve for movement in unison therewith, said first linkage member comprising a first lever pivotally supported by a choke shaft connected to said choke valve, said first lever being freely pivotally supported so as to have freedom of rotational movement relative to said choke shaft and connected to said vacuum responsive device for rotational actuation thereby, a first abutment portion formed on said first lever, said second linkage member comprising a second lever secured to said choke shaft for rotation therewith, a second abutment portion carried by said second lever, said first abutment being effective whenever said choke valve is closed and said first lever is actuated by said vacuum responsive device to abuttingly engage said second abutment portion and rotate said second lever and choke valve toward a first partially open position, said temperature responsive means comprising a thermostatic element secure to said first lever and to a third variably positioned spacer carried thereby, said thermostatic element being responsive to environmental temperature and effective to provide a snap action whereby said spacer is moved to a first position in response to environmental temperatures less than a predetermined minimum temperature and whereby said spacer is moved to a second position in response to the attainment of environmental temperatures at least equal to said predetermined minimum temperature, said spacer when moved to said second position being effective whenever said choke valve is closed and said first lever is actuated by said vacuum responsive device to abuttingly engage said second abutment and move said second lever and choke to a second partially open position which is more nearly fully open than said first partially open position, said spacer being effective when moved to said first position for permitting direct abutting engagement between said first and second abutments in order to effect said first partially open position, said device responsive to engine vacuum comprising a pressure responsive member operatively connected to said first lever and having one side thereof exposed to substantially ambient atmosphere and another side thereof exposed to a source of engine vacuum, said second lever comprising generally U-shaped lever having first and second arm portions connected to said choke shaft and a bight portion interconnecting said arm portions, wherein said second abutment is carried by said bight portion, and wherein said first lever is pivotally mounted on said choke shaft in a manner so as to be generally axially confined by said arm portions.

2. A carburetor according to claim **1**, wherein said vacuum responsive device is a pressure responsive diaphragm.

3. A carburetor for an internal combustion engine comprising a choke valve; means including a heat responsive device to

close said choke valve at low temperatures; a device responsive to engine vacuum for partially opening said choke valve against the tension of said heat responsive device upon starting of the engine, abutment means associated with said vacuum responsive device adapted to limit the amount of choke opening due to said vacuum responsive device; and linkage means operatively interconnecting said pressure responsive device and said choke valve; said linkage means comprising a first linkage member, a second linkage member and temperature responsive means operatively connected to one of said linkage members, said first and second linkage members being effective for at times positively engaging each other when said vacuum responsive device is opening said choke valve in order that the opening force of said vacuum responsive device is transmitted directly through said first and second linkage members; and said temperature responsive means, responsive to environmental temperature, being effective to operatively engage the other of said linkage members in order to change the relationship between said first and second linkage members when said environmental temperature exceeds a predetermined minimum temperature value so as to enable said vacuum responsive device to open said choke valve to a more nearly completely open position, said first linkage member being operatively connected to said device responsive to engine vacuum for movement in unison therewith, said second linkage member being operatively connected to said choke valve for movement in unison therewith, said first linkage member comprising a first lever pivotally supported by said carburetor and connected to said vacuum responsive device for angular actuation thereby, said second linkage member comprising a second lever secured to a pivotally mounted choke shaft for rotation therewith, said temperature responsive means comprising a thermostatic element secured to said choke shaft and to a variably positioned abutment member, said thermostatic element being responsive to environmental temperature and effective whenever said choke valve is closed and said first lever is actuated by said vacuum responsive device and said and said environmental temperature is greater than a predetermined minimum for causing said abutment member to move generally in the path between said first and second abutments in order to cause said first lever to abuttingly engage and rotate said second lever and said choke valve to a partially open position reflective of environmental temperature, said abutment member comprising a stepped or inclined abutment surface adapted to be contacted by said second lever at a point along said surface which is reflective of said environmental temperature.