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Gillham et al.

[11] **3,789,814**

[45] **Feb. 5, 1974**

[54] **AMBIENT TEMPERATURE REGULATED CHOKE**

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[73] Assignee: **General Motors Corporation**, Detroit, Mich.

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[52] **U.S. Cl.** ..... **123/119 F**, 261/39 B, 261/39 C

[51] **Int. Cl.** **F02m 1/10**

[58] **Field of Search** ..... 123/119 F; 261/39 C, 39 B

[56] **References Cited**

UNITED STATES PATENTS

3,396,948	8/1968	Stettner	123/119 R
2,394,665	2/1946	Christian	261/39 C

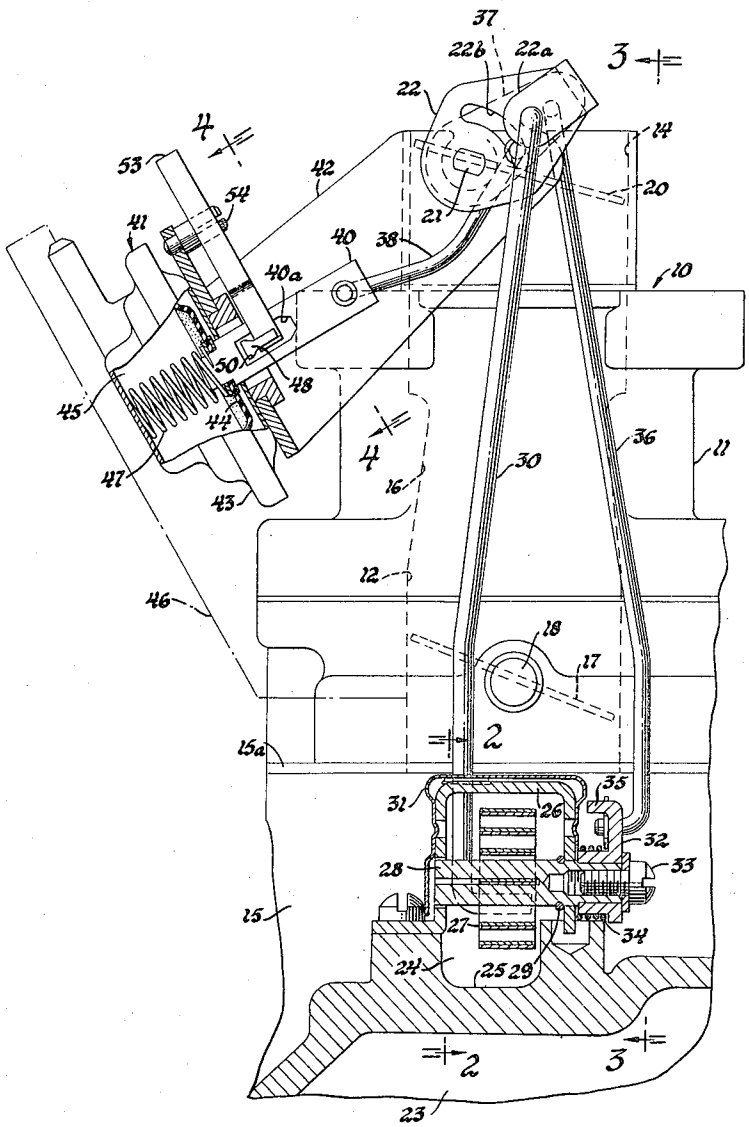
Primary Examiner—Wendell E. Burns

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[57] **ABSTRACT**

An ambient temperature regulated choke mechanism for a carburetor is provided with temperature actuated means whereby the choke pull angle, the angle the choke valve attains after the engine starts, and the time required to achieve wide open choke are modulated by ambient temperature.

8 Claims, 5 Drawing Figures



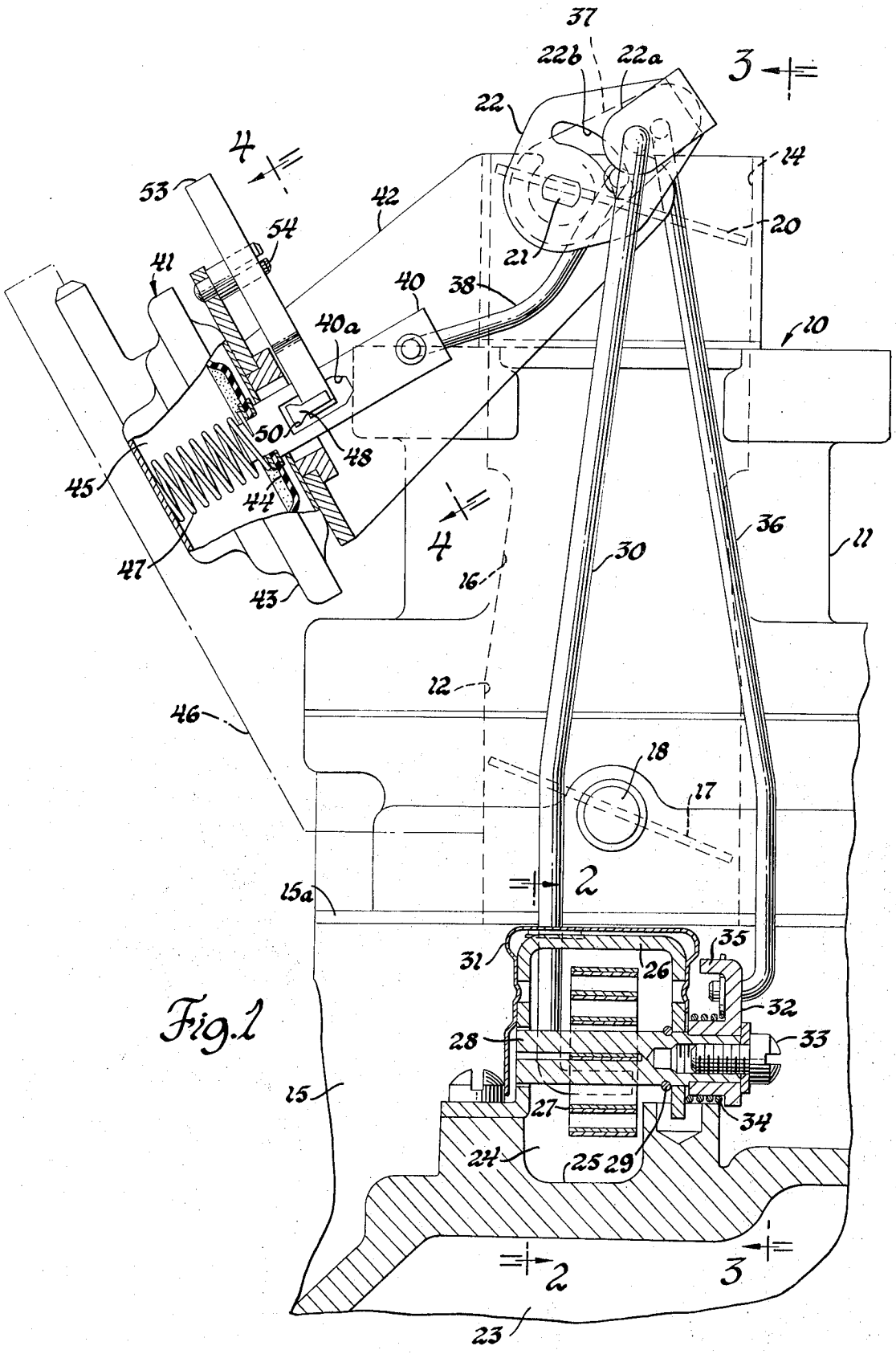

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Fig. 1

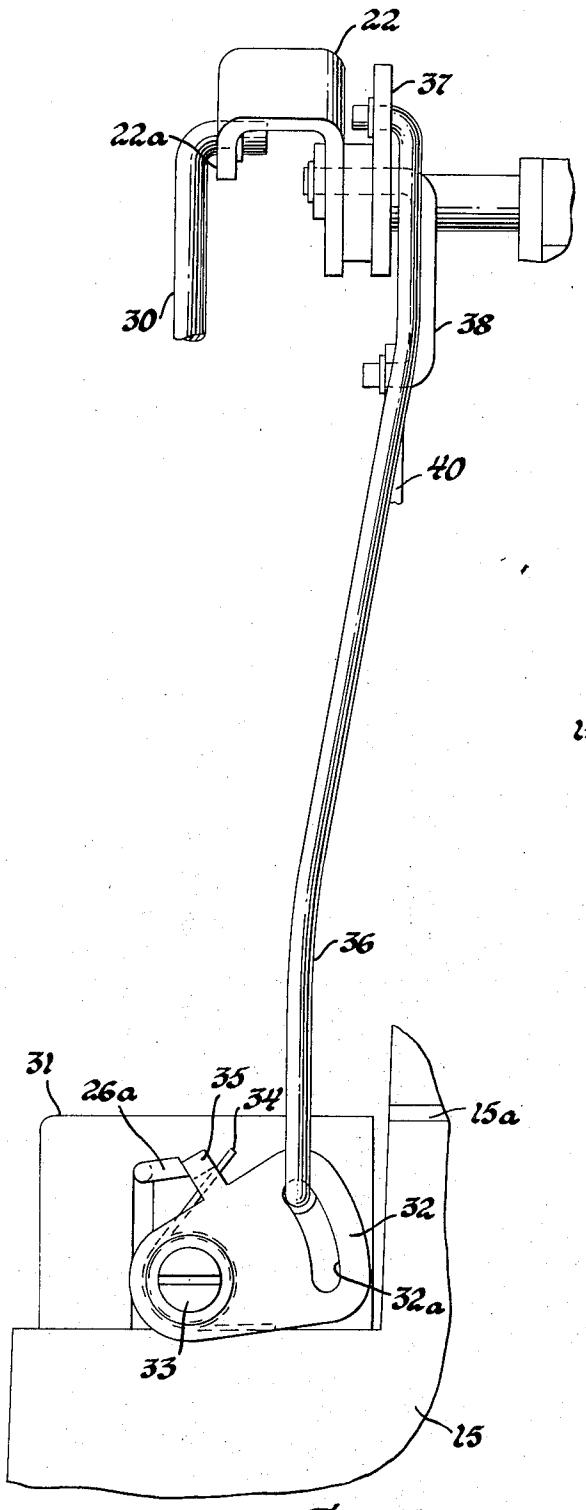


Fig. 3

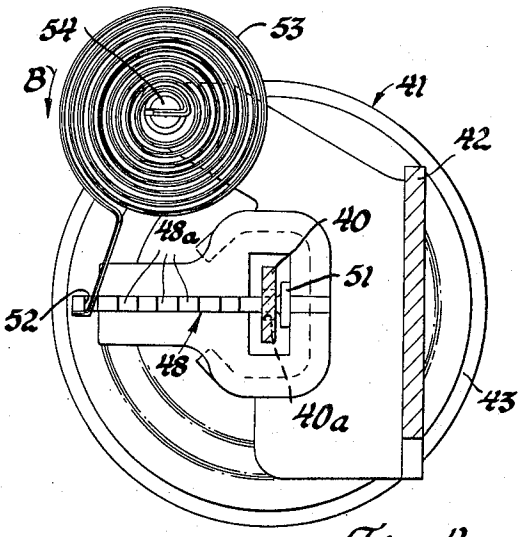


Fig. 4

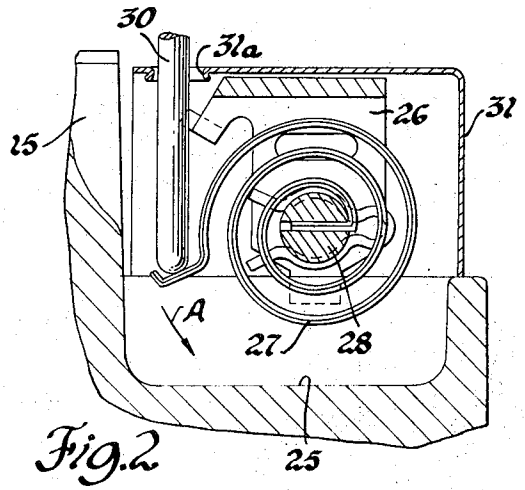


Fig. 2

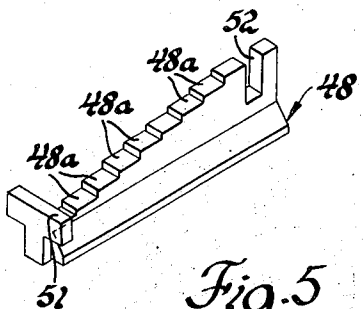


Fig. 5

AMBIENT TEMPERATURE REGULATED CHOKE

This invention relates generally to carburetors and, in particular, to an ambient temperature regulated choke mechanism of a carburetor. More specifically, the invention pertains to an automatic choke mechanism which responds more accurately to engine operating temperatures.

Most modern day carburetors include an automatic choke device, with which the present invention is concerned, of the type disclosed, for example, in U. S. Pat. No. 2,705,484 issued Apr. 5, 1955 to P. J. Jorgensen et al. In this type of automatic choke device, a temperature responsive element, usually a coiled bi-metal, is operatively connected to the choke valve and is attached to urge the same in a closing direction with a force dependent upon ambient operating temperatures. With such a device, the choke valve opening force is supplied by making the valve of unbalanced construction whereby air flow through the carburetor will tend to open the choke valve. In addition, a manifold vacuum responsive member is also utilized to modify the action of the coiled bi-metal during the starting and warm-up periods of engine operation.

Although automatic choke devices of the above type have proved satisfactory as far as general engine operation is concerned, variations in the air-fuel mixture delivered to the engine occur, for a given calibration and setting of the carburetor, due to the wide range of ambient temperatures during certain seasons of the year which affect engine operation.

It is therefore an object of this invention to provide an automatic choke mechanism whereby to vary the choke pull angle and come-off rate as a function of ambient temperature.

Another object of this invention is to provide an automatic choke mechanism for a carburetor adapted to compensate choke opening for ambient operating conditions, particularly those reflecting seasonal changes.

These and other objects of the invention are attained in the above type automatic choke mechanism by means of a thermostat responsive to ambient temperature to vary the amount of vacuum break by positioning a stepped cam to control the operation of the vacuum responsive member and by varying the rate at which the choke is actuated through a temperature responsive element by unloading this element.

For a better understanding of the invention, as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 is a view of a carburetor embodying the invention which is mounted on an internal combustion engine;

FIG. 2 is a view taken along line 2—2 of FIG. 1;

FIG. 3 is a view taken along line 3—3 of FIG. 1;

FIG. 4 is a view taken along lines 4—4 of FIG. 1; and,

FIG. 5 is a perspective view of the stepped cam of the structure illustrated in FIG. 4.

Referring to FIG. 1, there is illustrated a carburetor 10 of the downdraft type having a body 11 with an air-fuel induction passage 12 with an air intake 14 at one end and connected to the carburetor pad 15*a* on the intake manifold 15 of an internal combustion engine at the opposite end. Passage 12 contains a conventional fixed area venturi 16, a throttle valve 17 fixed to a rotatable throttle shaft 18 and upstream thereof a choke valve 20 fixed off-center to a choke shaft 21 journalled in the body and carrying a lever arm 22 which is operatively connected in a manner to be described to a thermostatic coil unit and a vacuum break diaphragm unit. As shown in FIG. 1, the inlet manifold 15 is provided with an exhaust crossover passage 23. Formed in the upper surface of the manifold adjacent to the carburetor pad 15*a* is an upwardly opening cavity or receptacle 24 having lower wall 25 in common with the exhaust crossover passage and in heat exchange relation with it to provide a choke stove.

A choke coil housing 26, which may be formed as part of the carburetor as disclosed in U. S. Pat. No. 2,837,071 issued on June 3, 1958 to Clarence J. Eckert and Elmer Olson or, as shown, formed as a separate element is mounted to the intake manifold over the receptacle to house the thermostat bi-metal coil 27. The housing 26, substantially of inverted U-shape, has a shaft 28 rotatively mounted therein. The thermostat also referred to as a choke thermostat is a conventional bi-metallic coiled thermostat, one end of which is fixed to the shaft 28 and the other end of which is free and engages one end of a choke rod 30 with the other end of the choke rod being engaged in an aperture in the downturned arm 22*a* of the lever arm 22 fixed to the throttle shaft to effect positioning of the choke shaft as a function of engine temperature. As shown, a portion of the thermostat is disposed within the receptacle and it and the housing are partly enclosed by a sheet metal cover 31 having an aperture 31*a* therein through which the choke rod extends. This last described structure is well known in the art as part of a standard automatic choke system for carburetors. Other features, such as a fast idle cam arrangement, are normally associated therewith, but are not illustrated or described since they form no part of the subject invention.

Depending on engine temperature, which may be ambient room temperature if the engine is cold, or some other temperature if the engine has been operated, the choke rod 30 is biased upward by a force dependent on engine temperature to urge the choke valve in a closing direction, counterclockwise as seen in FIG. 1. The coils of the thermostat 27 would rotate in a counterclockwise direction from the position shown in FIG. 2 with increase in engine temperature.

In accordance with a feature of the subject invention, means are provided to unload a portion of this choke thermostat preload as the choke is pulled open at engine start-up. As shown in FIGS. 1 and 3, the shaft 28 journalled in the housing 26 is retained axially in one direction by retainer spring 29 positioned in a suitable groove provided in the shaft for this purpose and in the opposite directing by a lever 32 fixed for movement with the shaft and retained thereon by a screw 33, the retainer spring being positioned on the opposite side of the wall of the housing from lever 32. A spring 34 encircles the boss of the lever 32 and the shaft 28 with one end of the spring abutting against the intake manifold 15 and the opposite end abutting against a stop arm 35 of the lever to normally bias the lever in a counterclockwise direction, as seen in FIG. 3, to a position whereat the stop on the lever engages a stop 26*a* on the housing 26. The lever 32 is provided with an arcuate slot 32*a* to slidably receive one end of link 36, the other end of this link being engaged in a suitable aperture in the lever 37. Lever 37 is rotatably mounted on the

choke shaft 21 inboard of the lever arm 22 which is fixed to this shaft for rotation therewith.

However, lever 37 is connected to lever arm 22 by a lost motion device. Lever arm 22 has an arcuate slot 22*b* in which an end of a link 38 is received, this end of the link 38 first passing through a round aperture in lever 37 whereby the lever 37 and the lever arm 22 are interconnected. Movement of the link 38, in a manner to be described, results in rotation of lever 37 and movement of link 36, but motion of the lever arm 22 occurs only when the free play, if any, is used.

With this arrangement, the choke rod 30 is effectively connected to the outer or free end of the bi-metal thermostat 27, as is commonly done, but in addition with the arrangement disclosed, it is also connected through a lost motion device, including the lever arm 22, lever 37, link 36 and lever 32 to the shaft 28 which is normally stationary. At low ambient temperature, the lost motion in this arrangement, would permit the shaft 28 to remain stationary. At a higher ambient temperature, the increased motion of the choke rod would exceed the lost motion in this arrangement and the shaft would be rotated in the "unloading" direction by an amount proportional to the choke pull angle. When the engine is stopped, with the engine returning to normal ambient temperature, the spring 34 will return the shaft 28 to the "normal" stationary position, the force of this spring being greater than the maximum force being exerted by the bi-metal thermostat 27 so that the choke will be firmly closed for cold starting.

As shown in FIG. 1, link 38 is secured at its other end to the plunger 40 of the vacuum break diaphragm unit 41 mounted on the bracket 42 fixed to the body 11 of the carburetor. This unit 41 includes a housing 43 with a diaphragm 44 therein to form a chamber 45. The plunger 40 is suitably secured to the diaphragm 44 for movement therewith. A conduit 46 extends from the housing 43 to the intake manifold 15 or to the air-fuel induction passage downstream of the throttle valve to thereby subject one side of the diaphragm 44 in chamber 45 to the manifold or induction pressure. A spring 47 biases the diaphragm 44 against this induction pressure. The vacuum break diaphragm unit 41 thus far described is of the type disclosed in U. S. Pat. No. 3,396,948 issued Aug. 13, 1968 to Ernest R. Stettner.

Now, in accordance with the invention, the effective movement of the plunger 40 and therefore diaphragm 44 is limited as a function of ambient temperature. This is done by providing the plunger 40 with a slot 40*a* intermediate its ends to receive a stepped cam 48 slidably positioned in a groove 50 provided for this purpose in the attaching cover flange of the housing 43. The groove 50 is shown as being in the form of a dovetail slot to slidably receive the corresponding shaped slide portion of the stepped cam 48. As seen in FIG. 5, the stepped cam is provided at one end with a T-shaped tnag 51 of a width greater than the width of slot 40*a* to limit movement of the cam in one direction. At its other end, the cam is provided with a notch 52 to receive the end extension of an ambient air temperature responsive coiled bi-metal thermostat 53 fixed to the post 54 extending outward from the bracket. Winding of this thermostat coil will move the stepped cam at right angle to the movement of plunger 40.

This device limits the travel of the diaphragm mechanism 41, including the plunger 40, which would otherwise normally pull the choke to a "pull" position as determined solely by manifold pressure. Movement of the plunger 40 and therefore the diaphragm 44 is limited by the position of the steps 48*a* of the stepped cam relative to the line of travel of the plunger so as to limit the length of travel of the plunger. The stepped cam 48 is positioned by the thermostat 53 and thus it is positioned directly as a function of the ambient temperature.

The steps 48*a* of the stepped cam are designed to limit diaphragm 44 travel by engagement of a step on this cam with the end of the notch 40*a* in the plunger 40 to limit the degree of choke opening as desired as function of ambient temperature as sensed by the thermostat. As shown in FIG. 4, the thermostat is fully extended at high ambient temperature positioning the step 48*a* of lowest height to engage the plunger, the coils of thermostat 53 rotating in the direction of arrow B in FIG. 4 upon decrease in ambient temperature.

With the structure just described, it is possible to achieve a desired choke pull angle and engine temperature choke thermostat unloading with ambient temperature at the time of engine start-up to effectively reduce exhaust emissions from a cold start.

In operation, the choke valve is moved toward a closed position for cold engine starting. The choke valve is closed, in the position as shown in FIG. 1, through the tension of the coil of the thermostat 27 acting through the choke rod 30 to move the lever arm 22 in a counterclockwise direction to the position as shown. When the engine is starting, intake manifold vacuum pressure is applied to the choke vacuum diaphragm 44 which opens the choke valve against the tension of the coil of the thermostat 27 to a point as determined by the movement of the plunger 40 into engagement with the stepped cam 48 positioned by thermostat 53 as a function of the ambient temperature to which this thermostat is exposed. This permits the engine to operate without loading or stalling lean.

The choke valve remains in this position until the engine begins to warm up and exhaust gas heat is drawn into the choke coil housing 26 from the choke stove and begins to relax tension of the coil of the choke thermostat 27. This allows the choke valve 20 to open gradually through air flow against the offset choke valve and exhaust heat acting on the thermostat 27. This action continues until the engine is warm and the choke valve 20 is fully opened.

However, depending upon the temperature conditions, unloading of the choke thermostat 27 may be affected. In the embodiment illustrated, there is no unloading of the choke thermostat 27 until the choke angle of choke valve 20, as established by the vacuum break diaphragm exceeds, for example, 22°. Therefore, at low ambient temperature, when the choke vacuum break angle is 22° or less, there is no unloading. This is possible due to the free travel of the link 36 permitted by the slot 32*a* in the lever 32. When the choke vacuum break angle is greater than, for example, 22° (up to a maximum of 45°, for example) the degree of unloading is increased as the vacuum break increases to a maximum of 25° rotation, for example, of the choke thermostat shaft 28. The reduction in time to wide open choke as a result of the 25° unloading depends upon the temperature characteristics and heat rating of the bi-metal thermostat 27 which are selected as desired.

What is claimed is:

1. A carburetor for an internal combustion engine comprising a carburetor body having an induction passage for delivery of an air fuel mixture to the intake manifold of the engine as controlled by a throttle valve, a choke shaft journalled in said body, a choke valve secured off-center on said choke shaft and disposed in said induction passage, a first lever means fixed to said choke shaft for rotation therewith, a second lever means rotatably supported on said choke shaft, a choke coil housing positioned in thermal relation to the engine, a shaft journalled in said choke coil housing, a temperature responsive bi-metal choke coil fixed at one end to said shaft and at its other end operatively connected to said first lever means to urge said choke valve in a closing direction with a force related to engine temperature, spring means positioned to normally rotatively bias said shaft in a direction to load said choke coil, a first lost motion connection between said shaft and said second lever means and, a second lost motion connection between said second lever means and said first lever means to effect rotation of said shaft in a direction to unload said choke coil as a function of choke valve opening.

2. A carburetor according to claim 1 including a control means responsive to intake manifold pressure downstream of said throttle valve and having a linearly moving plunger movable as a function of intake manifold pressure, said second lost motion connection including a link connected to said plunger and pivotably connected to said second lever means.

3. A carburetor according to claim 2 wherein said control means comprises a housing, a diaphragm in said housing to form therewith an expansible chamber, said plunger being connected at one end to said diaphragm and a conduit connecting said expansible chamber to said induction passage downstream of said throttle valve and spring means positioned to bias said diaphragm against said intake manifold pressure.

4. A carburetor according to claim 2 further including an ambient temperature responsive element mounted adjacent said control means, and a cam means connected to said temperature responsive element for movement thereby and positioned to engage said plunger to limit its linear movement as a function of ambient temperature as sensed by said temperature responsive element.

5. A carburetor according to claim 4 wherin said temperature responsive element is a bi-metal coil fixed at one end relative to said control means and having its other end engaging said cam means, said cam means being slidably mounted on said control means for movement at a right angle to said plunger, said cam means having cam steps of stepped incremental heights thereon, the cam step of lowest height engaging the plunger at high ambient temperature while the cam step of greatest height engaging the plunger at low ambient temperature.

6. A charge forming device for an internal combustion engine of the type having a body with an induction passage connected to the intake manifold of the engine and having a choke valve secured on a choke shaft and rotatably disposed in the induction passage, means for automatically controlling the operation of the choke valve as a function of engine temperature and ambient air temperature, said means including a first lever means, having an arcuate slot therein, fixed to said choke shaft for rotation therewith, a second lever means rotatably mounted on said choke shaft adjacent said first lever means, a choke coil housing positioned in thermal relation to the engine, a shaft journalled in said choke coil housing, a termperature responsive choke coil in said choke coil housing fixed at one end to said shaft and at its other end operatively connected to said first lever means to urge said choke valve in a closing direction, a third lever means, having an arcuate slot therein, fixed to said shaft for rotation therewith, spring means positioned to normally rotate said shaft in a direction to load said choke coil, a first link pivotally connected at one end to said second lever means and at its other end extending through said arcuate slot in siad third lever means, a control means responsive to intake manifold pressure and having a diaphragm movable as a function of intake manifold pressure, a plunger connected at one end to said diaphragm, a second link pivotally connected to the opposite end of said plunger with its opposite end of said second link pivotally connected to said second lever and extending into the arcuate slot of said first lever means, a temperature responsive element mounted adjacent said control means and, a cam means connected to said ambient temperature responsive element for movement thereby in position to engage said plunger to limit its linear movement.

7. In a carburetor for an internal combustion engine, the carburetor including a body having an induction passage controlled by a choke valve mounted on a choke shaft journalled in the body, a first lever means fixed to said choke shaft, a second lever means rotatively mounted on said choke shaft, a lost motion connection between said first lever means and said second lever means, a thermostat choke coil operatively connected at one end to said first lever and positioned in thermal relation to the engine to move the choke valve toward a closed position at low engine temperatures, means pivotally connected at one end to said second lever and connected at its opposite end through a lost motion connection to said thermostat choke coil to vary the rate at which said choke valve is actuated by said thermostat choke coil by unloading said thermostat choke coil as a function of choke valve opening angle, a vacuum break means operative as a function of engine intake vacuum operatively connected to said second lever means to effect opening of said choke valve upon increase in engine intake vacuum and an ambient temperature actuated stepped cam operatively connected to said vacuum break means to limit opening of said choke valve by said vacuum break means as a function of ambient temperatures.

8. A carburetor for an internal combustion engine comprising a carburetor body having an induction passage connected to the intake manifold of the engine, a choke shaft journalled in said body, a choke valve secured to said choke shaft and disposed in said induction passage, a thermostat choke coil positioned in thermal relation to the engine and operatively connected at one end to said choke shaft to move said choke valve toward a closed position at low engine temperatures, a vacuum break control means responsive to intake manifold pressure operatively connected to the intake manifold of the engine, a plunger secured at one end for movement by said control means, link means including a lost motion connection connecting said plunger to said choke shaft to effect opening of said choke valve upon increase in engine intake vacuum against the bias-

ing action of said thermostat choke coil, and an ambient temperature actuated stepped cam operatively connected to said plunger to limit movement of said plunger to thereby limit opening of said choke valve as a function of ambient temperature, said thermostat choke coil being operatively connected at its other end to a rotatable shaft, spring means operatively connected to said shaft to rotate said shaft in one direction to effect loading of said thermostat choke coil and link means including a lost motion connection connected at one end to said shaft and at its other end through said lost motion connection to said choke shaft to effect unloading of said thermostat choke coil as a function of choke valve opening angle.

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