MEANS FOR STARTING AND OPERATING INTERNAL COMBUSTION ENGINES


Filed Nov. 14, 1957, Ser. No. 696,508

9 Claims. (Cl. 123—119)

This invention relates to internal combustion engines, and more particularly to means for controlling the starting and subsequent warm-up period of such engines.

Most internal combustion engines and particularly those employed to drive motor vehicles are now equipped with a so-called automatic choke, the main purpose of which is to provide a relatively rich fuel-air mixture for the engine on cold starting and until the engine has reached normal operating temperature. The most common type of automatic choke is that having an offset choke plate, a vacuum piston responsive to engine vacuum for opening the choke plate and a single thermostatic coil spring to resist such opening, with the resistance thereof decreasing with increasing engine temperature.

However, there are still some objections to the use of the above type automatic choke. In the first place, the use of a thermostatic coil spring opposing a vacuum piston tends to limit the calibration of the choke to engine requirements; that is, with any given piston and single spring combination, certain compromises have to be made which may result in departures from exact engine requirements. Secondly, the vacuum piston is a relatively expensive part of the choke assembly, and it is subject to malfunctions such as sticking.

The latter objections are related in that it is common practice to provide a predetermined bleed around the piston so that engine vacuum can also draw air heated by a stove in the exhaust manifold into the thermostatic coil spring housing as an indication of engine operating temperature. A separate clean air line must, nevertheless, be provided between the inside of the air cleaner and the stove to prevent air-borne dirt from causing the piston to stick. Also, great care must be taken to prevent and repair exhaust leaks at the stove, since this will very quickly cause the piston to stick and malfunction. This sticking sometimes occurs despite these precautions.

It is now proposed to provide an automatic choke assembly in which there is no vacuum piston and in which there is a resilient means opposing choke plate opening, one of which is a thermostatic coil spring and the other of which is a mechanical spring. With the use of the spring combinations contemplated by the invention, a choke mechanism may be provided that functions just as well as or better than a choke having a vacuum piston and without the above objections of a piston.

The invention will be best understood from the following detailed description and claims, reference being had to the accompanying drawings in which one embodiment of the invention is shown by way of example and wherein:

Fig. 1 is a side elevational view, with portions thereof cut away and in cross section, illustrating a carburetor having an automatic choke embodying the invention in its preferred form.

Fig. 2 is a fragmentary and elevational view, with portions thereof cut away and in cross-section, taken on the plane of line 2—2 of Fig. 1 and looking in the direction of the arrows.

Fig. 3 is a perspective view of a modified choke valve. Fig. 4 is an enlarged fragmentary perspective view of a portion of Fig. 2.

Figs. 5 and 6 are views similar to Fig. 4, but illustrating other embodiments of the invention.

Referring to the drawings in greater detail, Figures 1 and 2 illustrate a typical automotive carburetor 10 having an automatic choke 12 embodying the invention. This carburetor, which will be described in detail only to the extent necessary to disclose the invention, includes an upper section 14 having an air intake passage 16 to supply combustion air to the lower throttle body portion 18. The usual air cleaner would be fitted to the flange 20 so that clean air would be supplied to the engine.

A choke valve 22 for controlling the flow of air through the passage 16 is mounted on the pivot shaft 24 in a manner so that the plate is offset on the pivot, that is, the lower or downstream portion 26 of the plate, when the plate is fully closed as shown by Figures 1 and 2, is substantially longer than the upper or upstream portion 28 so that when the engine is started the flow of air through the passage 16 will tend to open the valve 22. Furthermore, the unbalance is also such that if there were nothing to restrain it, the choke valve would fully open due to gravity.

The choke valve 22 may have a secondary or a poppet valve 23 therein, as illustrated in Fig. 3. This secondary valve may comprise a plate 25 mounted on the lower surface of the valve 22 by means of two pins 27 which are biased by springs 35 away from plate 22 in such a manner so as to normally cause the plate 25 to close openings 29, 31 and 33 in valve 22. This secondary valve 23 may be used in order to obtain additional control of the fuel-air ratio once the engine is started; that is, as soon as the engine starts a pressure differential is created across the choke valve 22 and the springs 35 are overcome by this effective force acting on plate 25. In this manner, the choke 12 may allow additional air to be admitted, thereby satisfying the engine air requirements for those particular operating conditions.

The lower throttle body portion 18 contains or has mounted thereon the usual carburetor structures, such as the primary and/or the secondary induction passages each having a venturi, the associated throttle plates and throttle shafts, the float chambers, the fast idle mechanism, the accelerating pump, etc. Since these structures are not important to the invention, they need not be shown and/or described in detail.

Referring again to Figures 1 and 2, an automatic choke housing assembly 30 may be secured to the side of the throttle body portion 18, preferably adjacent the end 32 of the primary throttle shaft. The assembly 30 may include a cast or other hollow housing 34 secured to the choke body 18 by any suitable means such as screws 36, a plastic or other insulating type cover 38 secured by screws 40 and a clamping ring 41 and a separating gasket 42 constructed from a material having heat insulating properties.

The housing 34 may be provided with a journal 44 and bearing 46 adapted to receive the shaft 48 which is free to rotate within the bearing 46. A lever 50 having a laterally extending portion 52 is secured for rotation with the shaft 48 and within the housing 34 and the cover 38, with the portion 52 being adapted to move an arcuate slot 54 in the gasket 42. The other end of the shaft 48 is provided with a lever 56 which is also secured for rotation with the shaft 48, and a suitable link 58 is pivoted at the ends thereof between the lever 56 and the lever 60 which is secured for rotation with the choke
The link 58 may extend through a suitable opening 62 in the air cleaner flange 20.

The cover 38, which is preferably constructed from a heat insulating material, comprises a hollow body of suitable proportions to house the structure to be described and includes a stem 64 rigidly secured to the center of the end wall 66. The stem 64 is of sufficient length to accommodate the thermostatic coil spring 68 and the mechanical spring 70. One end of thermostat 68 is received and anchored in slot 72 in the stem 64.

Figure 1 illustrates the arrangement of the thermostatic and mechanical springs within the choke assembly 12. The mechanical spring 70 is generally of a torsional form having any desired number of coils 71 wound loosely about the rod 64 to permit rotation of the entire spring 70 about the pivot 64. The two arms extending from the coiled sections have portions 74 and 88 which are formed so as to pass over the outer coil of thermostatic spring 68. In conjunction with portion 88, an abutment 76 that may be of generally loop shape is formed within the spring; this abutment 76, in turn, has another segment 97 which extends in a generally arcuate manner about thermostat 68 and passes through an opening 90 formed in the end 86 of the thermostat. The end 92 of spring 70 may be bent so as to prevent its slipping out of the hole 92.

Portion 74 and end 92 of spring 70 are positioned in a manner to contain end 86 of the thermostatic constant between them. The abutment 96 is placed between end 86 of the thermostat and portion 52 of arm 50 so as to contact said arm and offer initial resistance to the opening of the choke valve.

Provision may be made to heat the thermostatic coil spring 68 by air heated in any suitable manner, as by the exhaust manifold, as an indication of engine operating temperature. For instance, the heated air may be drawn from a stove in the exhaust manifold through passage 78 and into the thermostatic spring chamber 80 defined by the insulating gasket 42 and cover 38 at a predetermined rate by means of a passage 82 having a restriction 83 and leading from the chamber 84 to the engine intake manifold; communication between chamber 80 and the chamber 84 may be provided by the arcuate slot 54 in the insulating gasket 42. This structure is well known in the art and need not be described in great detail.

In Figs. 1 and 2, the choke plate 22, the choke housing assembly 30 and the connecting linkage 58 are shown in the position they would be when the engine is cold and not operating; that is, the thermostatic coil spring 68 is unwound to load the mechanical spring 70 so that the abutment 76 thereof engages the portion 52 of lever 50 and urges the lever 50 to the left, as shown in Fig. 2, to raise the link 58 and close the off-choke plate 22 against the force of gravity tending to open it. The thermostatic coil spring 68 is prevented from completely unwinding by the engagement of portion 74 of spring 70 with end 86 of thermostat 68.

As soon as the cold engine starts after cranking, the flow of air to the engine past the throttle valve, which may be held in the partially opened position by any suitable fast idle mechanism, exerts an additional opening force on the unbalanced choke plate 22. This additional opening force overcomes the force of spring 70, causing it to unwind clockwise until portion 52 approaches or actually comes into contact with the end 86 of thermostat 68 depending upon the force of the intermediate spring 70. As the engine temperature increases, the thermostat 68 will wind in the clockwise direction, thereby permitting the choke valve to open according to temperature. It is evident that the degree of choke opening is dependent on only temperature but also on the air loading of or the pressure differential existing across the choke valve. Therefore, as the thermostat continues to wind, the loading on the choke decreases and as it decreases the effective force acting against the mechanical spring 70 diminishes thereby causing the end 86 of the thermostat to "walk" away from the arm 50. This insures that the richness of the fuel air mixture is dependent only on the temperature but also on the air requirements of the engine. This "walking away" action of the end 86 of the thermostat 68 continues until the choke valve 22 is fully opened, at which time further movement of arm 50 is arrested while further movement of thermostat 68 and spring 70 may continue, since the thermostat 68 reaches its point of maximum travel depending on temperature, a substantial angular displacement may result between abutment 76 and portion 52 of arm 50.

It can readily be seen that this choke mechanism would also act somewhat as an anti-stall device. That is, if during the warm-up period the engine began to stall, the air loading would diminish on the choke valve, thereby allowing spring 70 to rotate the choke valve 22 in the closing direction to provide a richer fuel-air ratio.

When the engine is shut down and thermostat 68 begins to cool, it unwinds in the counter-clockwise direction, moving spring 70 with it. When the thermostat and spring 70 have moved sufficiently, abutment 76 contacts portion 52 of arm 50 and forcibly moves arm 50 to the left; this, in turn, causes the choke valve 22 to move towards the closed position.

Figures 5 and 6 are modifications of the invention, also employing combinations of thermostatic and mechanical springs. The mechanical springs 94 of both Figures 5 and 6 are identical in shape, that is, they are of generally torsional form, being coiled about extension 64, and they have arms 96 and 98 and a portion 100 bent over so as to contact the end 86 of thermostat 68.

When the choke valve 22 is closed, the embodiment of Figure 5 will act in the same manner as that of Figures 1, 2 and 4; that is, the unwinding of thermostat 68 will cease when an equilibrium of forces is obtained between the mechanical spring 94 and thermostatic spring 68. However, there is a slight difference in the operation at the time that the choke valve 22 is in its fully opened position.

When the arm 50 has moved so as to reach its fully opened position, the spring 94, since it has a tendency to move to its free state, will continue to exert some force upon arm 50 in a decreasing manner in accordance with engine temperature because of the winding action of the thermostat.

The modification of Figure 6 has a step pin 102 fixed at one end within the choke assembly housing 34 and projecting into the path of end 86 of the thermostat when it is unwinding. This is used so as to limit the initial stress applied to the mechanical spring 94 in the closed choke position. Otherwise the operation is the same as that of Figure 5 and generally the same as that of both Figures 4 and 5.

The modifications of the invention shown and described herein are for the purposes of illustration, and no limitations are intended, except as set forth in the appended claims.

We claim:

1. A carburetor or other fuel control for an internal combustion engine, comprising a body having an air intake passage, a pivoted choke valve in said passage to control the flow of air therethrough, said choke valve being offset so that the flow of air through said passage tends to open said valve, suitable linkage connected to said choke valve and terminating at the opposite end thereof in a pivoted lever having a laterally extending arm movable with said choke valve, a thermostatic element having a stem extending from said arm and the free end thereof positioned in the path of travel of said arm, and mechanical spring means interposed between said arm and the free end of said thermostatic element.

2. A carburetor or other fuel control for an internal combustion engine, comprising a body having an air in-
take passage, a pivoted choke valve in said passage to control the flow of air therethrough, said choke valve being offset so that the flow of air through said passage tends to scald said valve, said valve being connected to said choke valve and terminating at the opposite end thereof in a pivoted lever having a laterally extending arm movable with said choke valve, a thermostatic element having one end secured to said body and the free end thereof positioned in the path of travel of said arm, and mechanical spring means interposed between said arm and the free end of said thermostatic element when cold urging said arm through said mechanical spring to close said choke valve and initial opening of said choke valve compressing said mechanical spring to an extent dependent upon temperature.

3. A carburetor or other fuel control for an internal combustion engine, comprising a body having an air intake passage, a pivoted choke valve in said intake passage to control the flow of air therethrough, said choke valve being offset so that the flow of air through said passage provides a force to open said valve, linkage connected to said choke valve and movable with said choke valve, a thermostatic element having a portion thereof positioned in the path of travel of said linkage, and mechanical spring means interposed between said linkage and said portion of said thermostatic element, said thermostatic element on decreasing temperature urging said linkage to close said choke valve through said mechanical spring and initial opening of said choke valve compressing said mechanical spring to an extent dependent upon temperature, and the connection between said thermostatic element and said mechanical spring being such that said element moves said spring bodily on increasing temperature.

4. In an engine carburetor or other fuel control, a body having an air intake passage, a pivoted choke valve in said intake passage to control the flow of air therethrough, said choke valve being offset on its pivot so that the flow of air through said passage and gravity provide forces to open said choke valve, a lever having a laterally extending arm and being pivoted on said body, linkage between said choke valve and said pivoted lever, means adapted to oppose the opening of said choke valve including a thermostatic coil spring subjected to engine temperature and having its inner end secured to a shaft secured to said body, said thermostatic spring being adapted to unwind with decreasing temperature and to wind up with increasing temperature, said thermostatic spring being formed to provide an abutment variably positioned in the path of travel of said arm in accordance with engine temperature, and a mechanical spring formed intermediate its ends to be pivotally anchored on said shaft and having the free ends thereof positioned between said arm and said abutment to spread the same, said mechanical and said coil springs being arranged such that initial opening of said choke valve is accomplished by compressing said mechanical spring against the tension of said coil spring regardless of engine temperature, and subsequent opening of said choke valve being dependent upon the extent of windup of said coil spring with increasing engine temperature.

5. In an engine carburetor or other fuel control, a body having an air intake passage, a pivoted choke valve in said intake passage to control the flow of air therethrough, said choke valve being offset on its pivot so that the flow of air through said passage provides a force to open said choke valve and said choke valve being opened by the flow of air to said engine at times when said choke valve is not fully open, a lever having a laterally extending arm and being pivoted on said body, linkage between said choke valve and said pivoted lever, means adapted to regulate the opening of said choke valve including a thermostatic spring subjected to engine temperature and having one end secured to a shaft secured to said body, the other end of said thermostatic spring being formed to provide an abutment variably positioned in the path of travel of said arm in accordance with engine temperature, and a mechanical spring formed intermediate its ends to be pivotally anchored on said shaft and having the free ends thereof positioned between said arm and said abutment, the arrangement of said mechanical and said coil springs being such that initial opening of said choke valve compresses said mechanical spring and subsequent opening of said choke valve is dependent upon the relaxing of said coil spring with increasing engine temperature.

6. In an internal combustion engine, a carburetor or other fuel control comprising a body having an air intake passage, a pivoted choke valve in said intake passage to control the flow of air therethrough, said choke valve being offset on its pivot so that the flow of air through said passage provides a force to open said choke valve, a lever having a laterally extending arm and being pivoted on said body, linkage between said choke valve and said lever, means adapted to regulate the opening of said choke valve, said means including a thermostatic spring subjected to engine temperature and having one end secured to a shaft secured to said body, the other end of said thermostatic spring being variably positioned in the path of travel of said arm in accordance with engine temperature, and a mechanical spring pivotally anchored on said shaft and having portions thereof positioned between said arm and said abutment, the arrangement of said mechanical and said thermostatic springs being such that initial opening of said choke valve is substantially controlled by said mechanical spring and subsequent opening of said choke valve is substantially controlled by said thermostatic spring.

7. In an internal combustion engine, a carburetor or other fuel control comprising a body having an air intake passage, a pivoted choke valve in said intake passage to control the flow of air therethrough, said choke valve being offset on its pivot so that the flow of air through said passage provides a force to open said choke valve, a lever having an extending arm portion, said arm portion being adapted to rotate in accordance with a choke valve movement and having a path of travel substantially co-planer with the path of travel of said free end of said thermostatic element, and a mechanical compression spring placed in series between said arm portion and said free end of said thermostatic element, said spring being formed so as to have one or more portions engageable with said free end of said thermostatic element in such a manner as to prevent said spring from ever attaining its free length regardless of the respective positions of said choke valve and said free end of said thermostatic element.

8. A carburetor or other fuel control for an internal combustion engine, comprising a body having an air intake passage, a pivoted choke valve in said passage to
control the flow of air therethrough, said choke valve being offset so that the flow of air through said passage tends to open said valve, linkage means connected to said choke valve and terminating at the opposite end thereof in a pivoted lever having a laterally extending arm movable with said choke valve, a thermostatic element having one end secured to said body and the free end thereof positioned in the path of travel of said arm, mechanical spring means interposed between said arm and the free end of said thermostatic element, and a rigid stop member positioned in the path of travel of said free end of said thermostatic element when said free end is moving in the choke closing direction so as to provide a maximum limit on the choke closing force regardless of the temperature effect on said thermostatic element.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor(s)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,336,810</td>
<td>Smith</td>
<td>Dec. 14, 1943</td>
</tr>
<tr>
<td>2,420,917</td>
<td>Sutton et al.</td>
<td>May 20, 1947</td>
</tr>
<tr>
<td>2,421,733</td>
<td>Henning</td>
<td>June 3, 1947</td>
</tr>
<tr>
<td>2,423,059</td>
<td>Winkler</td>
<td>June 24, 1947</td>
</tr>
</tbody>
</table>