

March 1, 1966

J. T. BICKHAUS

3,237,927

CARBURETOR

Filed Aug. 13, 1962

2 Sheets-Sheet 1

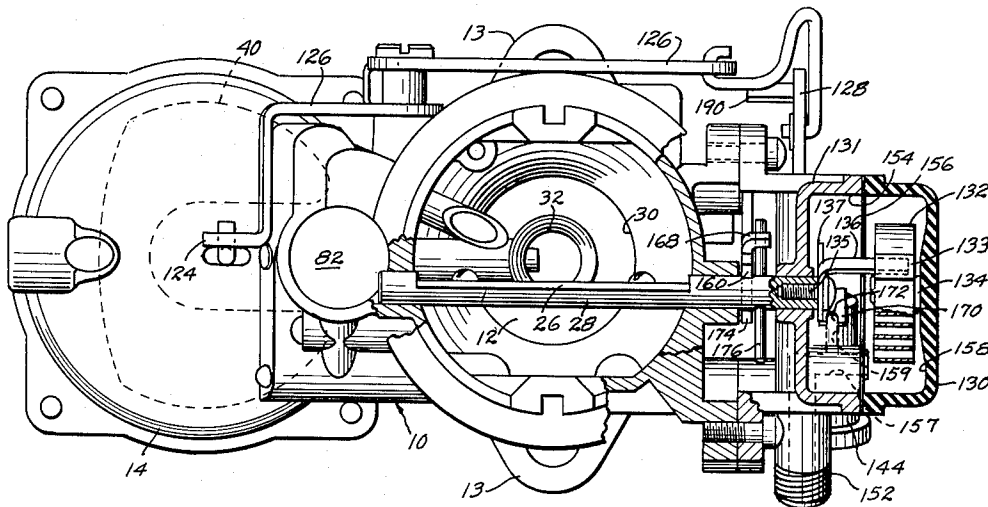


FIG. 1.

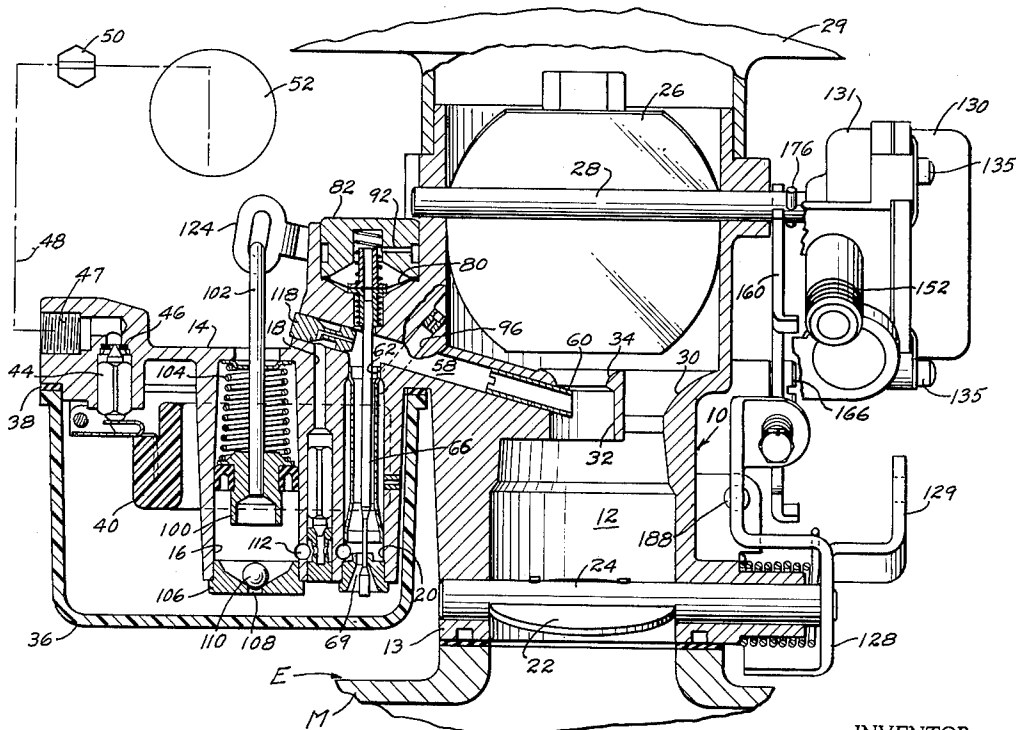


FIG. 2.

INVENTOR.
JAMES T. BICKHAUS

BY *James T. Bickhaus*

AGENT

March 1, 1966

J. T. BICKHAUS

3,237,927

CARBURETOR

Filed Aug. 13, 1962

2 Sheets-Sheet 2

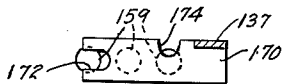


FIG. 7.

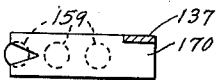


FIG. 8.

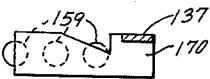


FIG. 9.

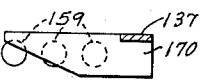


FIG. 10.

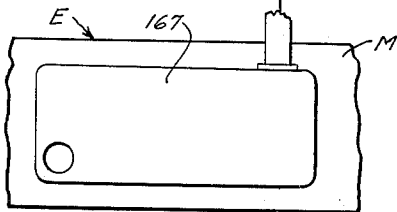


FIG. 3.

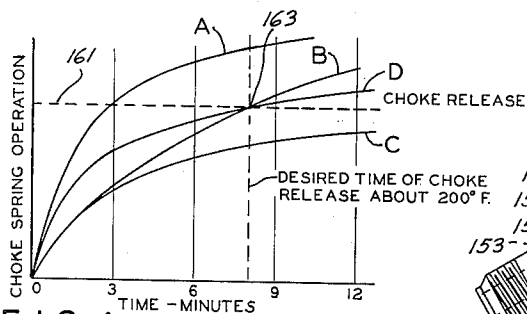


FIG. 4.

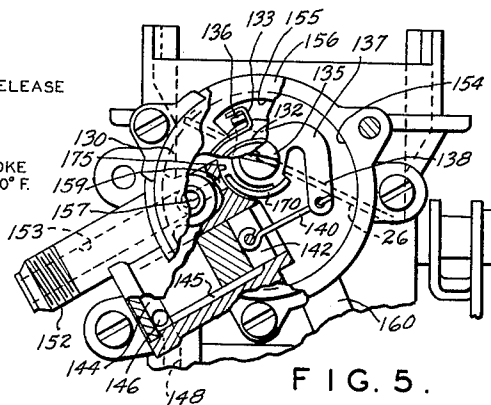


FIG. 5.

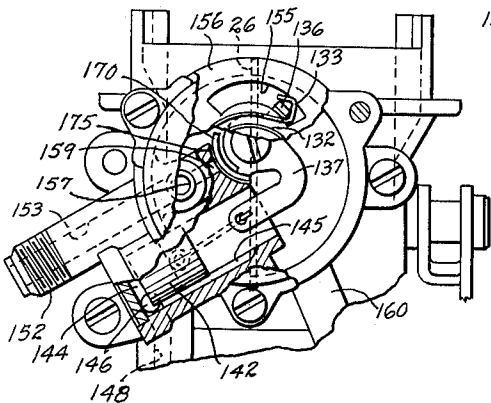


FIG. 6.

INVENTOR.
JAMES T. BICKHAUS

BY

James T. Bickhaus

AGENT

1

3,237,927

CARBURETOR

James T. Bickhaus, Granite City, Ill., assignor to ACF Industries Incorporated, New York, N.Y., a corporation of New Jersey

Filed Aug. 13, 1962, Ser. No. 216,364

4 Claims. (Cl. 261-39)

This invention is directed to a carburetor for an internal combustion engine and particularly to a novel automatic choke construction for such a carburetor.

One type of automatic choke for a carburetor consists of a coiled thermostatic spring having one end fixed to the carburetor body and the other end releasably attached to the choke valve shaft. When the engine is cold and before it has heated up to an efficient operating temperature, the thermostatic spring remains tensioned and biases the choke valve in a closed direction against air flow through the carburetor. This tends to cut down the amount of air mixing with the fuel and provides a desired richer air-fuel mixture during starting and cold running of the engine. However, as the engine gradually warms and, in a predetermined period of time, due to hot air flow over the thermostatic spring, the spring will relax and reduce its bias against the choke valve, and then at a predetermined temperature the spring releases the choke valve and permits greater air flow to provide the optimum air-fuel mixture during warm engine operation.

Internal combustion engines of different sizes and types have different operating characteristics. Normally, a bimetallic choke spring of predetermined characteristics can be chosen to match the engine so that the choke spring will release the choke valve at the proper time for proper operating efficiency, when the engine has been fully heated up. The thermostatic choke spring must retain its bias on the choke valve during the warm-up period, which can be in the order of 8 to 9 minutes.

Choke springs are normally heated during the warm-up period by a flow of air from an engine heated source through the choke spring housing and into the engine manifold. The factors which control the proper operation of the automatic choke are those of spring strength prior to warm-up, the response rate of the spring to the heated air and the rate of flow of hot air across the spring.

The rate of hot air flowing through the choke spring housing determines the speed at which the spring becomes heated. Also, it is a question of providing a thermostatic choke spring which will respond to heat at a selected rate when air flow of a fixed temperature passes over the spring so that spring will not release the choke valve too quickly resulting in an engine air-fuel mixture too lean for proper operation. Again, the choke spring must not retain too strong a bias on the choke valve and come off too late during the warm-up period resulting in an overly rich fuel-air mixture during both warm-up and after the engine has reached its efficient operating temperature.

A preferred operation of the automatic choke spring is one which is properly operative during very cold ambient temperatures around zero degrees Fahrenheit or below. A thermostatic spring under such conditions must not be so stiff as to prevent sufficient air flow through the carburetor at these low temperatures. However, providing a spring that is less stiff at such low temperatures

2

normally results in the lighter spring releasing the choke valve before the engine has fully warmed up.

On the other hand, a thermostatic spring, which releases the choke valve at the proper time when the engine has reached its operating temperature, is one which may not provide sufficient bias on the choke valve during the low temperature operations of the engine, so that, after starting of the engine at low temperatures, around zero degrees Fahrenheit and for a few minutes thereafter, the engine tends to run too lean with the resultant difficulty in maintaining engine operation.

The operation of thermostatic choke springs must be matched with the characteristics of the engine and it has been found, if the springs do not operate effectively under all conditions of engine operation, that the controlling conditions can be changed to provide the desired spring control of the choke valve.

Accordingly, it is an object of this invention to provide means for modifying the flow of heated air over the thermostatic spring of an automatic choke so as to provide for proper air and fuel mixtures during low temperature operation of an internal combustion engine.

It is another object of this invention to provide means within a carburetor for modifying the operation of the bimetallic spring of the automatic choke so as to provide efficient operation of the engine during low ambient temperatures.

It is another object of this invention to provide means within the automatic choke structure of an internal combustion engine for modifying the flow of heated air over the bimetallic coil during low ambient temperature operation of the engine so as to provide a proper mixture prior to engine warm-up.

The invention is directed to the automatic choke structure for an internal combustion engine and which consists of means for providing a flow of heated air over a bimetallic coil for varying the opening of the choke valve of the carburetor. A bypass passage portion is provided around the bimetallic coil to bypass some of the heated air around the thermostatic coil. A baffle member is attached to the choke valve shaft and rotatable therewith to vary the flow of heated air through the bypass passage. By appropriately positioning the baffle member, it is possible to direct more or less heated air over the bimetallic coil. Also, according to the invention, less air is passed over the bimetallic coil during low engine temperature operation so that the bimetallic spring holds the choke valve in a more closed position to provide a sufficiently rich air and fuel mixture to the engine during the warm-up period.

In accordance with the invention, a baffle is operably connected to a thermostatic spring which is exposed to a flow of heated air for adjusting the choke position in the carburetor. FIGURE 3 illustrates the baffle position immediately prior to the engine being started up such that piston 142 is at the uppermost end of its cylinder. FIGURE 5 represents the carburetor immediately after the engine has started, thus, the choke valve 26 is slightly opened, piston 142 is drawn sufficiently into the cylinder to communicate passage 145 with the engine intake manifold and with the thermostatic spring housing. In this instance the thermostatic spring has been slightly warmed to adjust the baffle into position with respect to passage 153. FIGURE 6 represents the device after being brought to engine operating conditions in which the choke is fully opened, and baffle 170 is at its maximum position, adjacent the opening to passage 153. It is understood with

respect to this latter position of the carburetor elements, the thermostatic spring is inoperative and has no further effect on the positioning of choke 26.

FIGURE 1 is a plan view of a carburetor embodying the novel features of this invention.

FIGURE 2 is substantially a longitudinal sectional view of the carburetor of FIGURE 1 and is shown mounted on an engine manifold and with an air filter partially in section.

FIGURE 3 is an end view of the carburetor of FIGURES 1 and 2 on looking from the right of FIGURE 1.

FIGURE 4 is a graphic representation of operating characteristics of various thermostatic springs.

FIGURES 5 and 6 are partial sectional views of the automatic choke structure of the carburetor of FIGURES 1 through 3 in different positions of operation.

FIGURE 7 is a schematic representation of the structure of the invention.

FIGURES 8, 9 and 10 are modifications of this invention structure and in accordance with the invention.

The carburetor shown in FIGURES 1 and 2 consists essentially of a single casting 10 which is formed with a fuel and air mixture conduit 12 and a fuel bowl cover portion 14 from which is integrally formed a depending accelerating pump cylinder 16, an accelerating fuel passage 18 and a fuel well structure 20. As shown, the mixture conduit 12 is arranged and aligned vertically during operation and is connected by flange 13 to the intake manifold M of an internal combustion engine E. In the lower part of the conduit 12 there is rotatably mounted a throttle valve 22 fixed to a throttle shaft 24 journaled in appropriately aligned apertures of the body casting 10. In the upper portion of the fuel-air mixture conduit 12 there is similarly mounted for rotational movement an unbalanced choke valve 26 fixed to a choke valve shaft 28, which is also journaled in aligned apertures through the body casting 10. To the top of the mixture conduit 12 is connected an air filter 29, partially shown in FIGURE 2. Between the upper and lower portions of the mixture conduit 12 is formed a venturi or air flow restricting surface portion 30. A small booster venturi 32 is formed integrally with the body casting 12 and has an inner venturi surface 34 coaxially aligned with the mixture conduit 12 and the primary venturi surface 30.

A plastic fuel bowl 36 is fixed beneath the fuel bowl cover 14 and is held with its rim tightly against a gasket 38 fitted between the rim of the fuel bowl 36 and matching portions of the fuel bowl cover 14. A float 40 is pivotally mounted from a depending portion of fuel bowl cover 14. An arm of a float lever fixed to float 40 abuts the lower end of a needle valve 44 having an upper tapered end extending into a valve seat 46 of the inlet 47 to the fuel bowl 36. A fitting may be threaded into inlet 47 to connect the carburetor to a fuel line 48. Fuel is forced under pressure by a pump 50 from a fuel tank 52, both schematically shown, through the fuel line 48 and into the carburetor inlet 47. With the fuel level in bowl 36 low, the float 40 is lowered and allows valve 44 to be pressed by fuel pressure and gravity to an open position. Fuel flows into the bowl 36 and when it reaches a predetermined level, the float raises lever 43 upwardly against the needle valve 44 to close the inlet to the fuel bowl.

The lower end of the fuel well 20 is closed by a threaded fitting having a central orifice 69 therethrough which is carefully formed to provide a metering jet for the flow of fuel from the fuel bowl 36 to the mixture conduit 12. The upper end of the fuel well 20 intercepts a cross fuel passage 58 directly downwardly into the secondary venturi structure 32. A nozzle fitting 60 is press-fitted into the end of passage 58 and has one end thereof extending into the center of the secondary venturi surface 34. Press-fitted within the well 20 is a fuel emulsion tube 62 having apertures therethrough along its length.

A metering rod 66 is suspended within the fuel well 20. The lower end of rod 66 is formed with varying thicknesses and is positioned within the main fuel jet orifice 69 for operation in response to engine requirements. Flow of fuel is controlled by that portion of the formed end of rod 66 which is positioned within the orifice 69.

A diaphragm 80 is sealed in an air tight manner at its peripheral edge between a shoulder of the body casting 10 and a fitting 82 pressed into a matching bore of the body casting. Diaphragm 80 is connected to metering rod 66 for its operation. The space above diaphragm 80 is connected by a cross passage 92 to an annular passage formed in the peripheral surface of the fitting 82. A passage (not shown) is formed through the body casting 10 to the flange portion 13 of the carburetor and opens into the mixing conduit below or downstream of the throttle 22. In this manner, the portion of the space above the diaphragm 80 is connected to manifold pressure of the engine for operation of metering rod 66.

Mounted within the cylindrical recess 16 formed into body casting 10 is a pump piston 100 (FIGURE 2), which is connected to a pump piston rod 102. A spring 104 is fitted between the upper end of the pump cylinder 16 and the piston 100. The lower end of the pump cylinder 16 is closed by a fitting 106 having a central aperture 108 therethrough above which, biased by gravity, is a ball valve 110. A fuel passage 112 extends between the pump cylinder 16 and the cylindrical passage 18 formed in the body casting 10. The cylindrical passage 18 extends upwardly and connects with the main fuel passage 58 through a fitting 118 through which fuel can be ejected from the cylindrical passage 18 into the main fuel nozzle 60 under pressure from the pump piston 100.

The operation of the structures described is as follows: Fuel from the fuel bowl 36 flows into both the pump cylinder 16 and the well structure 20, to fill these recesses to the level of the fuel in the bowl. Upon the turning over of the engine, air is sucked through the air filter 29 into the mixture conduit 12 and the intake manifold M. The flow of air through the booster venturi 32 provides a sub-atmospheric pressure within the venturi surface 34 which extends back through the fuel passage 58 to the upper end of fuel well 20. The atmospheric pressure on the surface of the fuel within bowl 36 raises the fuel within the well 20 and simultaneously air is sucked through a bleed passage 96 into the upper portion of the fuel well. This air passes around and through the apertures in the emulsion tube 62 to mix with the fuel and its vapor and to form an air-fuel emulsion. The emulsion is carried upwardly from the fuel well into the main fuel passage 58 and out the nozzle 60 to form a fuel and air mixture with the air passing through the mixture conduit 12.

At low engine speeds, the throttle 22 is partially closed so that the manifold vacuum in the intake manifold M below the throttle 22 is relatively high. This vacuum is effective upon the upper surface of diaphragm 80 so that atmospheric pressure will press the diaphragm upwardly and permit the metering rod and its retainer to be carried by spring 78 in an upward direction. This brings the thicker portion of the lower end of metering rod 66 into the main jet orifice 69 to cut down the flow of fuel through this orifice in accordance with the lower engine speed. As the throttle 22 is opened progressively from low speed to high speed, the vacuum pressure in the manifold drops and diaphragm 80 and the metering rod 66 are spring biased downwardly until a thinner portion of the lower end of rod 66 enters the jet orifice to provide a greater flow of fuel into the mixing conduit 12.

The accelerating pump rod 102 is connected with a lost motion connection 124 (FIGURES 1 and 2) by a linkage 126 to the throttle lever 128 which is fixed for simultaneous movement with the throttle shaft 24. Throttle lever 128 has an arm 129 adapted to be connected to any means for manual operation of the throttle 22. Any

5

opening of the throttle by lever 128 will allow spring 104 through the lost motion connection 124 to press accelerating pump piston 100 downwardly and force fuel out the nozzle structure 60 to provide additional fuel for the increased air flow due to the opening of the throttle 22. This provides rapid response of the engine upon opening of the throttle.

The choke valve 26 is controlled during cold weather and during cold starts by a thermostatic choke control device enclosed in a housing structure 130. The choke control consists of a thermostatic coiled bimetallic spring 132 having one end 133 fixed to a stationary stud 134 mounted on the housing 130. The other end of the thermostatic spring rests against one arm 136 of a lever 137 fixed to the choke shaft 28 by a screw 135 to rotate therewith. Lever 137 has an extension 138 connected by a wire linkage 140 (FIGURE 3) to a piston 142 positioned for sliding motion in the air motor cylinder 144. The lower end of cylinder 144 is closed and is connected through an aperture 146 to a passage 148 leading therefrom to the flange 13 of the carburetor where the lower end of passage 148 connects with an annular groove forming a passage with a gasket 151 between the flange 13 and the manifold M. Passage 149 opens into a chamber 153 on the opposite side of the carburetor. A directional port 155 extends through the carburetor wall from the chamber 153 into the mixture passage below the throttle valve 22. Port 155 is directed upwardly against the edge of throttle 22 to provide a flow of heated air against the under side of the throttle to prevent the formation of ice at this edge of the throttle adjacent to the idle port 157.

When the engine is cold the bimetallic thermostatic spring 132 is unwound and tensioned in one direction to press against the end of the lever 136 and bias the choke valve 26 into a closed position. The flow of air through the mixing conduit 12 against the unbalanced choke valve 26 and the action of manifold vacuum through passage 148 on piston 142 connected to the choke shaft will partially open the choke valve 26 against the bias of thermostatic spring 132 to permit only sufficient air to pass into the mixing conduit 12 to provide an enriched mixture with the available fuel.

As seen in FIGURE 1, the cup-shaped choke spring housing 130 and the choke lever housing 131 are assembled together, as shown in FIGURE 1, by means of screws 135, for example, indicated in FIGURE 3, fixing the flanges of the housings together. A separating plate 156 divides the interior of the choke housings into two chambers 158 and 154. An arcuate slot 155 is formed in the divider plate 156 through which the lever arm 136 extends into the chamber 158 and into the path of movement of the thermostatic spring end 133. The arcuate slot 155, as shown more specifically in FIGURE 6, provides freedom of movement of the lever arm 136 during all positions of movement of the choke valve 26.

Integral with the choke lever housing 131 is a threaded nipple 152 through which is formed a passage 153. As shown specifically in FIGURE 1, a portion 157 of the air passage 153 extends at right angles and into the spring housing chamber 158. A bypass groove 145 in the lower end of cylinder wall permits the passage of air around the piston 142, when it is in the lower portion of cylinder 144. The passage 148 exposes the chamber 154 to manifold vacuum and enables the warm air from a stove 167 to pass through a conduit 150 into passages 153 and 157 into the chamber 158. The warm air in the thermostatic spring chamber 158 passes through arcuate slot 155 into chamber 154 and then through bypass groove 145 in response to manifold vacuum.

As the spring 132 becomes heated it relaxes and after a predetermined temperature has been reached it releases the end of lever 136 and the thermostatic coil 132 has no further effect on the choke 26, which now remains open by gravity and air flow due to its unbalanced construction.

6

A cam slide 160 (FIGURES 1 and 3) supported by a stud 166 is biased downwardly by gravity so that a lug 168 of slide 160 rides on the upper surface of a rod 176 fixed to the choke shaft 28. Thus, the position of the choke valve 26 will control the position of the cam slide 160. In cold weather starting, the choke valve 26 is pulled open, as described above, by the flow of air through the mixture conduit 12 acting against the unbalanced valve portions, as well as the manifold vacuum exerting itself against the choke piston 142. The choke valve 26, however, is prevented from opening to its full extent because of the tension of the cold thermostatic spring 132, which through shaft 28 and rod 176 holds slide 160 in an upper position. In this position one of the steps 180 of slide 160 is in the path of the throttle stop screw 184 fixed to the throttle lever 128 to hold the throttle 22 in a partially open position necessary for cold engine idling conditions. As the engine warms up during idling, the thermostatic spring 132 releases the choke shaft 28 and the choke valve 26 opens up fully because of air flow and gravity bias. Cam slide 160 is released by rod 176 and biased downwardly by gravity until it reaches a position indicated in FIGURE 3 and in which the steps 180 are out of the path of rotation of the throttle adjustment screw 184 and the throttle 22 can close for normal idle operation.

In carburetors of the type described above, it is preferable that the thermostatic choke coil control the choke valve for a sufficiently long time until the engine arrives at an efficient operating temperature. In engine operation in which the ambient temperature is in the order of zero degrees Fahrenheit, it is essential that the choke coil not become heated too quickly as to release the choke valve prematurely. It is preferable that the choke coil control be retained for a period of time in the order of eight minutes, for example, in which the engine becomes heated to the desired operating temperature. These requirements obviously vary from engine to engine and it has been found that a coil that may operate effectively on one type of engine will not operate well on another type. Furthermore, it has also been found that a thermostatic coil which is sufficiently stiff so that the release of the choke valve by the coil is delayed the desired time, is one which may not provide a sufficient closing of the choke valve in the early stages of warm-up when the engine is still cold. Also, coils which provide a strong enough bias on the choke valve during early stages of warm-up, may not release the choke valve at the desired time. FIGURE 4, for example, shows schematically the operating characteristics of various coils. The graph, in FIGURE 4, is a showing of choke spring operation with respect to the time to which the coil is exposed to hot air flow. Line 161 represents the point at which the coil upon being heated releases the choke valve shaft. Curve A represents the operation of a choke coil which provides a relatively light spring bias on the choke shaft. At low temperatures the coil of curve A relaxes quickly indicated by the steepness of the curve. This causes the bias on the choke valve to open more than the desired amount and the air-fuel mixture passing through the carburetor becomes too lean for proper low temperature operation of the engine. Curve A crosses line 161 at a point representing substantially 2.8 minutes of time, which indicates that in this period of time, the choke spring 132 releases the choke lever and ceases to bias the choke valve in a closing direction. This is normally an insufficient time for the engine to become heated to an efficient operating temperature, particularly during very cold weather around zero degrees. The spring represented by curve A is one that, in a particular carburetor of the type described, exerts a biasing force of substantially seven ounces on the choke lever portion 136.

Curve C at the other extreme represents the operation of a choke coil having relatively stiff spring action and may, for example, exert a force in the order of nine ounces on the choke valve of the carburetor. However, this particular coil is one which does not react sufficiently fast

to the increase in temperature provided by the heated air flow through the coil chamber 158. The fact that curve C extends below the line 161 indicates that it never fully releases the choke lever 137 and always exerts a spring closing bias on the choke valve 26. This results in a rich operation of the engine at all times. Insufficient air is allowed to flow through the carburetor to provide the optimum mixture at any temperature.

Curve B shows a coil having intermediate characteristics between those represented by curves A and C. This curve passes through a point 163 which represents a time of substantially eight minutes at which the choke lever is released by the thermostatic coil. For very cold temperatures this period of time is a desirable one to enable the engine to become effectively warm for efficient operation. However, it is also noted that the coil of curve B is too flat in its lower portion and follows somewhat the behavior of the coil represented by curve C. Thus the coil of curve B is one which at low temperatures provides too rich a mixture for engine operation and for this reason is not desirable. A possible remedy is to provide in the air passage 148 between the stove 167 and the engine manifold M a restriction 165, as shown in FIGURE 3. Such a restriction is one which reduces the rate of air flow through the coil chamber 158 and consequently increases the time in which the thermostatic coil is heated to its choke release temperature. However, this is not the entire solution. The coils represented by the characteristic curves A and B of FIGURE 4 utilized the same air passage restriction 165, which was in the order of 0.089 inch in diameter. A study of FIGURE 4 would indicate that changing the opening in either direction of the passage restriction 165 would not provide a desired characteristic curve such as one which would have a steepness approaching curve A in its lower portion and one which would pass through the point 163 of optimum engine operating time.

In accordance with the invention it has been found that the hot air passage between the stove 167 and through the thermostatic coil chamber 158 can be further modified during the low temperature operation of the thermostatic coil to provide a desired rapid coil response at very cold ambient temperature during early engine warm-up and also in the later stages of engine warm-up when the coil response would be delayed and the time for engine warm-up would be extended. The novel structure provided by this invention includes the use of a bypass warm air passage 159 extending from the air passage 153 directly into the choke lever housing chamber 154, as indicated in FIGURES 1 and 3, for example. The warm air from stove 167 flowing through this bypass passage 159 does not pass into the thermostatic coil chamber 158 but directly into the piston cylinder 144 on its way to the engine manifold. Furthermore, in accordance with the invention, the choke valve lever 137 carries a shoe structure 170 (attached to lever 137) which during the rotation of lever 137 passes over the opening of passage 159 into the chamber 154. The shoe 170 is of an arcuate configuration and may be concentric with the axis of rotation of choke lever 137, as shown in FIGURES 3, 5 and 6, or may be eccentric thereto. The shoe 170 furthermore is shaped, as shown schematically in FIGURE 7, with a slot 172 formed at one end thereof between a solid central portion and a formed edge portion 174. Furthermore, the portion of the nipple 152 extending into the lever chamber 154 may have an arcuate surface 175 coaxial with the shoe 170 so as to provide a constant spacing, as the shoe passes over the arcuate surface 175.

Upon the starting of the engine in cold weather, the static suction in manifold M extends into passage 148 and the choke piston cylinder 144 to exert a suction on the piston 142. The suction is sufficiently great to pull the piston downwardly into the cylinder to a position substantially shown in FIGURE 5 and against the bias of the cold thermostatic spring 132. In this position, the solid portion of piston 142 is below the top opening of

the bypass groove 145 so that the vacuum in passage 148 is broken to an extent as to not force the piston to a lower position than that shown. This position opens the choke valve 26 an amount to permit sufficient air to flow into the carburetor and to the engine to provide an optimum enriched mixture for cold engine operation. During this period of operation, the low manifold pressure in passage 148 is sufficient to suck air from the choke cylinder 144 and the choke lever housing chamber 154 and thus to cause heated air to flow from the stove 161 up into the air passage 153. Most of the air is sucked through the thermostatic spring housing chamber 158. However, to prevent the thermostat from becoming heated too quickly and thus prematurely release the choke valve during cold weather operation, the bypass 159 around the choke coil is partially opened by the slot 172 of the baffle 170.

FIGURE 7 shows schematically the position of the baffle 170 during the early stages of choke warm-up in which the bypass 159 is retained open by reason of the slot 172 being positioned over the opening of bypass passage 159 into the lever chamber 154. The flow of warm air through the bypass 159 under cold engine operating conditions, reduces the amount of warm air flowing directly into the coil chamber 158. This delays the heating up of the coil and produces an effect represented by the lower portion of curve D, which is not as steep as curve A.

The baffle 170 does not have a close spacing with the arcuate surface 175. In one carburetor of the type described, the spacing was in the order of 0.015 inch. Thus, with the slot 172 there is a sufficient bleeding of air through the bypass for the desired delay in heating the coil 132. As the temperature of spring 132 increases, it relaxes and the choke valve 28 slowly moves in an opening direction under the action of air flow through the mixture conduit 12. Choke lever 137 also rotates in a clockwise direction to bring the more solid central portion of baffle 170 over the passage 159. This closes off more of the bypass air and forces it through the coil chamber 158. Even with greater flow of air through coil chamber 158, the greater temperature differential between the coil housing and low ambient temperature further delays the release of the choke valve by coil 132. Curve D represents a coil successfully operated with a baffle 170 of the type described.

The delay in the heating of coil 132 in the early stages of engine heat-up is sufficient to extend the time for choke release to a period in the order of eight to nine minutes, as indicated by curve D in FIGURE 4. This period of time of engine warm-up is within an optimum time for efficient operation of the engine. When the coil 132 releases the choke lever 136, the choke valve 26 opens to a full position, as indicated in FIGURE 6, and the choke piston 142 is at the bottom of the cylinder 144. To prevent the choke spring 132 from becoming overheated during hot weather, a cutout portion 174 may be formed in the edge of baffle 170 to permit air to bypass through the passage portion 159. This eliminates some of the hot air passing through the coil chamber and prevents it from becoming excessively heated.

As indicated in FIGURES 8, 9 and 10, the shape of the baffle 170 may be varied with many possibilities to provide different operating characteristics of the choke coil. Also, as pointed out above, the arcuate baffle 170 may be eccentric to the axis of shaft 28 so that the spacing between the baffle 170 and the passage surface 175 may vary to either increase or decrease the spacing, as the baffle is turned upon heating up of the thermostatic coil. This spacing between the baffle and the surface 175 is necessary to provide the proper amount of leakage of bypass air past the baffle under all conditions. The baffle never fully closes the passage 159 because of this spacing. Furthermore, the shape of the surface 175 can be varied so as to control in different ways the spacing between surface 175 and shoe 170 and thus the flow of bypass air between the baffle and the surface. It is thus

recognized that many variations are possible to provide in these ways the characteristic curve desired.

The bypass passage 159 enables a more effective use of the choke air for deicing purposes. Some carburetors in the past have been designed to utilize air flowing through the choke coil housing as means for preventing icing conditions around the edge of the carburetor throttle during idling or low speed operation of the engine. Carburetors of this design, however, of necessity must use a small flow of heated air through the coil housing to prevent the thermostatic coil from releasing the choke too quickly. Thus, restrictions such as 165 in FIG. 3, of necessity have been made small with the result that insufficient heat is provided adjacent to the throttle to prevent icing conditions. With the bypass 159, the controlling restriction 165 can be made large or even eliminated and the amount of warm air passing through the choke coil housing 158 can be controlled entirely by the baffle construction 170 as described above. Thus, a larger amount of warm air from the stove 165 can be passed through the bypass 159 to provide a sufficient amount of hot air for icing conditions. This heated air is aimed by the directional port 155 so that it strikes the edge of throttle 22 adjacent to the idle port 157. In this manner, then, the bypass passage 159 provides enough warm air for eliminating icing conditions and yet the control by the baffle 170 can be adjusted to provide the desired amount of hot air flow through the choke coil housing 158 to provide for optimum choking operation.

I claim:

1. A carburetor for an internal combustion engine, said carburetor comprising a body formed with an air and fuel mixture conduit adapted to be connected to the intake manifold of said engine, a throttle valve mounted in said conduit for movement from an open to a closed position, an unbalanced choke valve mounted within said mixture conduit for movement from an open to a closed position in response to air flow through said mixture conduit, a choke operating lever fixed to said choke valve, said body having an open passageway adapted to be connected at one end to a source of engine heated air and having the other end opening into said mixture conduit downstream of said throttle valve, said passageway including a thermostatic spring housing, a thermostatic spring in said housing and releasably connected to said lever to resist opening of said choke valve during a predetermined range of cold ambient temperatures in said housing, said passageway including a bypass portion extending around said thermionic spring housing, a baffle fixed to said choke lever and having a first portion positioned across said bypass during a range of cold ambient temperatures for decreasing the air flow therethrough to thereby increase heated air flow through said spring housing, said baffle including a second reduced portion movable across said bypass to increase air flow through said bypass and thereby decrease heated air flow through said spring housing, and a manifold vacuum responsive means in said passageway and connected to said choke lever to move said reduced baffle portion across said passageway when ambient temperature in said choke housing is in a predetermined temperature range.

2. A carburetor for an internal combustion engine, said carburetor comprising a body formed with an air and fuel mixture conduit adapted to be connected to the intake manifold of said engine, a throttle valve mounted in said conduit for movement from an open to a closed position, an unbalanced choke valve mounted within said mixture conduit for movement from an open to a closed position in response to air flow through said mixture conduit, a choke operating lever fixed to said choke valve, said body having a passage adapted to be connected at one end to a source of engine heated air and having the other end opening into said mixture conduit downstream of said throttle valve, said passage including a thermostatic spring

housing, a thermostatic spring in said housing and releasably connected to said lever to regulate opening of said choke valve during a predetermined range of cold ambient temperatures in said housing, said passage including a bypass portion for directing heated air away from said thermostatic spring housing to avoid heating said thermostatic spring, an arcuate baffle carried on said choke operating lever and having a first portion movable across said bypass when said choke is in substantially closed position at initial start up of the internal combustion engine, to substantially cover said bypass, for introducing a heated air flow through said spring housing to contact said thermostatic spring, said baffle including a second portion having a lesser area than said first portion, being movable across said bypass to cover a lesser area thereof than is covered by said first portion, to decrease heated air flow through said spring housing and reduce the rate at which said thermostatic spring is heated, said body forming said bypass having a surface adjacent to and spaced from said baffle a predetermined distance to provide a controlled bleeding of air between said baffle and said surface, and a manifold vacuum responsive means in said passage being connected to said choke operating lever to move said reduced baffle portion across said bypass to gradually open the latter when ambient temperature in said choke housing is within said predetermined temperature range, whereby said choke valve will be adjusted from a substantially closed position to an open position at a slower rate after being subjected to a heating at initial engine start-up.

3. A carburetor for an internal combustion engine, said carburetor comprising a body formed with an air and fuel mixture conduit adapted to be connected to the intake manifold of said engine, a throttle valve mounted in said conduit for movement from an open to a closed position, a choke valve mounted within said mixture conduit for movement from an open to a closed position, a choke operating lever fixed to said choke valve, said body having a passage adapted to be connected at one end to a source of engine heated air and having the other end opening into said mixture conduit downstream of said throttle valve, a thermostatic spring within said passage and operatively connected to said choke lever to regulate opening of said choke valve during cold ambient conditions, said passage including a bypass portion for directing heated air away from said spring, said passage other end opening into said mixture conduit adjacent one edge of said throttle when the latter is in closed position, and a baffle connected to said choke lever and being movable across said bypass passage for regulating air flow leaving said bypass passage as said choke move from a closed to an open position, said baffle including a reduced portion movable across said bypass and having means therein to increase air flow through said bypass passage under cold ambient temperature conditions to minimize icing conditions adjacent said throttle to reduce the flow of heated air to said thermostatic spring for reducing the rate at which said choke opens from a closed position as the latter moves to said open position.

4. A carburetor for an internal combustion engine, said carburetor comprising a body formed with an air and fuel mixture conduit adapted to be connected to the intake manifold of said engine, a throttle valve mounted in said conduit for movement from an open to a closed position, a choke valve mounted within said mixture conduit for movement from an open to a closed position, a choke operating lever fixed to said choke valve, said body having a passage adapted to be connected at one end to a source of engine heated air and having the other end opening into said mixture conduit downstream of said throttle valve, a thermostatic spring within said passage and operatively connected to said choke lever to resist opening of said choke valve during cold ambient conditions, said passage including a bypass portion for directing heated air away from said spring, said passage other end including a passage portion terminating at and hav-

11

ing an opening adjacent to said throttle and being directed at one edge thereof when said throttle is in its closed position, and a baffle connected to said choke lever and movable across said bypass passage for regulating air flow through said bypass passage as said choke moves from a closed to an open position, said baffle including a reduced portion movable across said bypass having opening means formed therein to form a partial closure to said bypass and increase air flow through said bypass passage and said directed passage portion under cold ambient temperature conditions to minimize icing conditions adjacent to said throttle.

12

References Cited by the Examiner

UNITED STATES PATENTS

2,818,239	12/1957	Eickmeier et al.	261—39
2,840,065	6/1958	Brown	261—39
2,989,293	6/1961	Marsee	261—39
3,133,977	5/1964	Szwargalski	261—39

FOREIGN PATENTS

798,720	7/1958	Great Britain.
---------	--------	----------------

HARRY B. THORNTON, *Primary Examiner*.
HERBERT L. MARTIN, *Examiner*.