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CHARGE FORMING DEVICE

2,600,368

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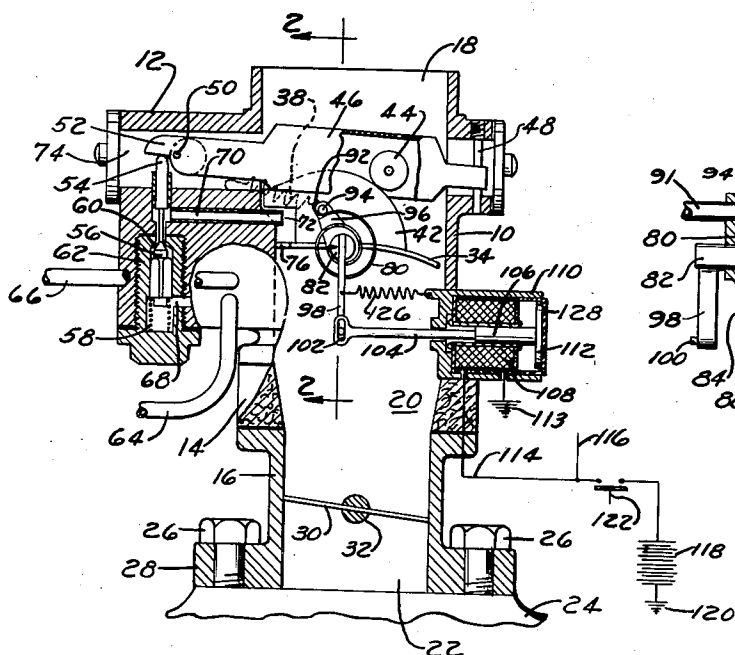


FIG. 1

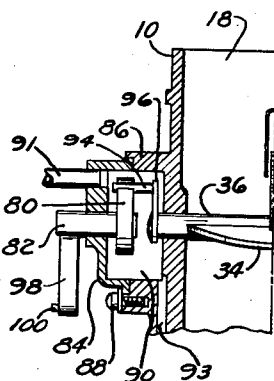


FIG. 2

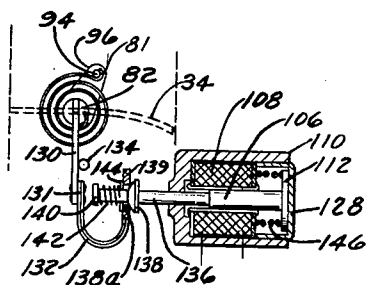


FIG. 3

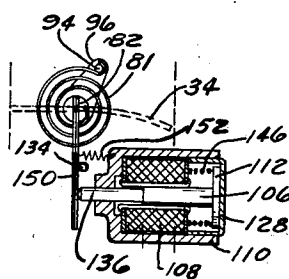


FIG. 4

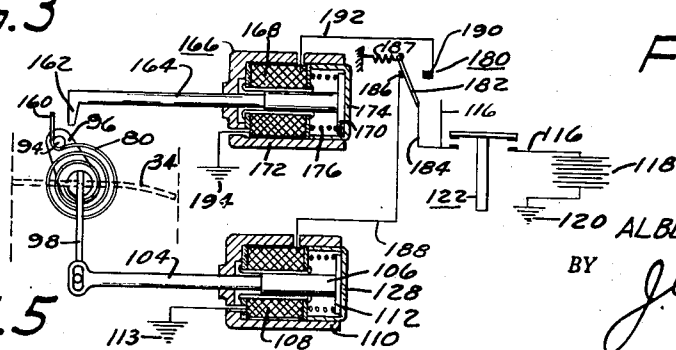


FIG. 5

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CHARGE FORMING DEVICE

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20 Claims. (Cl. 123—179)

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This invention relates to fuel systems and more particularly to charge forming devices for internal combustion engines wherein a movable flow responsive member in the induction passage controls the flow of fuel into the carburetor.

An important object of the invention is to provide an improved charge forming device having means for automatically controlling the mixture ratio under various engine operating conditions.

Another object of the invention is to provide a device of this character of simple construction and having improved performance and economy.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings which represent certain preferred embodiments and alternatives thereof. After considering these examples, skilled persons will understand that many variations may be made in the invention without departing from the principles disclosed, and I contemplate the employment of any structures, arrangements, or modes of operation that are properly within the scope of the appended claims.

In the drawings:

Figure 1 is a diagrammatic sectional view of a charge forming device embodying the present invention;

Figure 2 is a view taken on line 2—2 of Figure 1;

Figure 3 shows an alternative arrangement of the invention;

Figure 4 shows still another alternative arrangement of said invention; and

Figure 5 is another alternative arrangement including means for deflooding the engine.

While the present invention is shown and described in connection with a downdraft carburetor having metering means including a movable flow responsive member in the induction passage for controlling the inflow of fuel to said passage, it is to be understood that the present invention may be used in many other fuel systems, including those having other types of metering means, one of which means may include diaphragms or the like for controlling metering of the fuel. In connection with the carburetor induction passage, it may alternatively be of the updraft or horizontal delivery type instead of the downdraft type herein shown.

Throughout the drawings similar reference characters represent similar parts, although where such parts are modified in structure and operation they are given a further differing reference character.

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The carburetor generally

The carburetor illustrated in the drawings comprises a main body section 10, which may be formed as a die casting, including a hollow integral extension 12. Below the body section 10 is mounted a gasket 14, formed of any of various well known heat insulating material, which may be internally tapered as shown. Below the gasket is a throttle body 16, preferably formed as a metal casting. The body section, gasket and throttle body are internally bored to form an induction passage comprising an air inlet 18, a mixing chamber 20, and a mixture outlet 22 which communicates with the intake manifold 24 of an engine, not shown.

The air inlet is adapted to receive an air cleaner, not shown, of known construction. The parts 10, 14 and 16 are secured together by any suitable means such as machine screws, not shown, and bolts 26 are received in holes provided therefor in the lower flange 28 of the throttle body 16 for bolting the carburetor to the intake manifold.

A butterfly throttle valve 30 is mounted in the mixture outlet 22, on a throttle shaft 32, to control the flow of fuel mixture to the engine, said throttle valve being controlled by the operator in the usual manner, by means of an accelerator pedal and/or lever or the like (not shown). Movement of the throttle in the closing direction is accomplished by means of the usual throttle return spring, not shown, and the usual throttle stops, also not shown, may be used to limit movement of the throttle in both the opening and closing directions.

An air vane 34 is mounted in the induction passage and, as shown is anterior to the throttle although it may be posterior thereto, and controls, by its movement, the rate of fuel flow to the carburetor, as hereinafter described. The air valve is fixed to an offcenter shaft 36, so that flow of the air into the carburetor tends to rotate the vane and shaft in a clockwise direction, as viewed in Figures 1, 3 and 4. Opening movement of the vane 34 is yieldably resisted by a spring of suitable character which, as shown in dotted lines in Figure 1, comprises a coil spring 38 having one end attached to a lever, not shown, secured to the shaft 36 and having its other end secured to some convenient fixed part, not shown. The vane 34 is provided with a cam 42 which engages a roller 44 mounted on a control lever 46; the right hand end (as shown in Figure 1) of said control lever is bifurcated and straddles a guide pin 48 to maintain alignment of the lever. The lever 46 is

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pivoted by means of a pin 50 adjacent the left end thereof (as shown in Figure 1), said pin 50 being mounted in the extension 12. The last mentioned end of lever 46, indicated by reference numeral 52, is adapted to engage the upper end 54 of the stem of a fuel valve 56, said valve 56 being urged in the closing direction by a spring 58. The fuel valve 56 is formed with fluted sides to permit the passage of fuel therepast, and cooperates with a valve seat 60, formed as an integral shoulder in a plug 62. Fuel is delivered to the carburetor by a conduit 64 from a pump (not shown) of any well known type adapted to supply fuel at a substantially constant pressure and a conduit 66 is provided for returning fuel and vapor to the fuel tank. The fuel system may be of the type shown in either the Leibing and Fageol application Serial No. 533,848, filed May 3, 1944, or the copending application of Emil O. Wirth, Serial No. 555,077, filed September 21, 1944, both now abandoned, and the fuel valve 56 controls the flow of fuel from a passage 68 to a transverse conduit 70 and a discharge nozzle 72. One or more air bleed passages may connect the interior recess 74 in the extension 12, with the conduit 70 to form a fuel-and-air emulsion in the usual manner, if desired, but such passages are omitted in the embodiment shown.

The air vane 34 is formed with a slot 76 which receives or registers with the fuel nozzle 72 when the air vane has moved a predetermined distance away from its closed position. The operating surface of cam 42 may be empirically designed to give any desired ratio between the rate of air flow and the rate of fuel flow at different engine speeds and the vane 34, as it is moved in the clockwise direction by air flow through the induction passage, effects opening of the fuel valve 56. For a further description of the operation of the above described carburetor reference is made to the above noted Leibing and Fageol application, Serial No. 533,848, filed May 3, 1944.

Automatic control for the vane

The present invention deals more particularly with the automatic means for modifying the action of the above described fuel metering means under abnormal engine operating conditions such as when starting the engine cold or when the engine is running at subnormal temperatures.

This automatic means, as shown in Figures 1 and 2, includes temperature responsive means which comprises a bimetallic thermostat 80 having its inner end attached to a stub shaft 82 rotatable in an orifice of the wall of a cover 84 attached to a hollow extension 86 by means of screws 88, the extension 86 and cover 84 forming a chamber 90 in which the thermostat 80 is housed. The free end of the thermostat 80 is provided with a hooklike part 92 which is adapted to engage a pin 94 mounted adjacent the free end of a lever 96 secured to the adjacent end of the shaft 36 which extends into the chamber 90. The outer end of shaft 82 carries a lever 98 which, as shown, depends from said shaft 82 and the free end of lever 98 is provided with a pin 100 which is received in the elongated slot 102 of a rod 104 which is integral with or attached to a plunger 106 slidably disposed within a solenoid coil 108. The solenoid coil 108 is mounted in a casing 110 which may be either attached to the body of the carburetor or otherwise conveniently positioned, and the plunger 106 carries a disk 112 of soft iron or the like adapted to be attracted toward the coil 108 when energized. The coil is

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grounded at 113 and the solenoid circuit includes a wire 114 connected to a wire 116 of the starter circuit, said starter circuit wire 116 being attached to one pole of a storage battery 118, the other pole of which is grounded at 120. A normally open starter switch 122 is interposed in said starter circuit.

If desired, warm air may be circulated through the chamber 90, there being a conduit 91 connected at one end to a stove, not shown, on the engine exhaust manifold and the other end connected with said chamber. A conduit 93 leads from said chamber 90 to the induction passage, preferably posterior to the throttle. Thus air drawn from chamber 90 through conduit 93 is replaced by heated air delivered by conduit 91 from said stove.

Operation

Normally the vane 34 is urged in the closing direction only by the spring 38 which is so calibrated that the proper proportion of fuel will be delivered to the induction passage for a given air flow. However when the engine is running cold, an enriched mixture is desired and such enriched mixture is provided by reason of the thermostat 80 which when cold exerts an effective pressure such as will tend to open the vane 34 against the closing force of the spring 38. Thus the effective force urging the vanes 34 in the closing direction is reduced and for a given air flow the valve 56 will be opened to a greater extent than under normal temperature conditions. It is to be noted that the lever 98 is urged in a counterclockwise direction, as shown in Figure 1, by a spring 126 but this movement of lever 98 is limited by the abutment of the disk 112 against the adjacent end 128 of the casing 110.

Generally when starting an engine cold it is desirable to provide a fuel mixture richer than that required for cold running of the engine. This enriched mixture is automatically provided when the starter switch 122 is closed for cranking the engine at which time current is also supplied to the solenoid coil 108 to energize same and attract the disk 112. The disk 112 thereby effects clockwise movement of the lever 98, limited by abutment of disk 112 against the adjacent end of the solenoid coil 108, to increase the force tending to open the vane 34 so that said vane will open to an extreme extent by said given air flow, resulting in a corresponding opening of the valve 56 to provide the enriched starting mixture. When the engine starts to fire the starter switch 122 is opened and the spring 126 moves the lever 98 to its normal position. Thereafter, as the engine warms up the thermostat 80 coils upon itself and when normal operating temperature is reached the hooked end 92 of said thermostat will move away from the pin 94 so that only the spring 38 will urge the vane 34 in the closing direction for normal operation.

Figure 3

In Figure 3 there is shown an alternative form of the invention. The lever depending from the shaft 82 is somewhat modified, being given the reference numeral 130. The free end of said lever 130 has an arm 131 of a substantially U-shaped thermostat 132 attached thereto and the counterclockwise movement of lever 130 is limited by a pin 134 which may be suitably attached to some convenient fixed support, the lever then being in its normal position. The rod attached to the plunger 106 is also modified, being designated by the reference numeral 136, said

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rod having a hemispherically shaped washer or the like 138 secured thereto adjacent the free end thereof which is adapted to normally engage the arm 139 of the thermostat. The adjacent end of the rod 136 extends through an opening 138a in the arm 139 of the thermostat and is provided with an enlarged head 140 adjacent said free end, there being a spring 142 disposed between said head and a washer 144 abutting against the thermostat arm 139 on the side opposite the washer 138. A spring 146 within the casing 110 is adapted to react between the disk 112 and the adjacent end of the solenoid coil 108 for urging said disk to the right, as shown in Figure 3, against the wall 128 of the solenoid housing.

A spring 81 is provided between the stub shaft 82 and the pin 94 of lever 96. This spring 81 is nonresponsive to temperature changes. It provides a yielding connection between the thermostat and valve, and is so constructed and arranged as to urge the vane toward the no-flow position to provide the normal yielding resistance to the opening of the vane. With this arrangement spring 38 may be dispensed with if desired.

The thermostat 132 is so constructed and arranged that the arms thereof tend to separate when cold and to draw together when heated. When the engine is cold the arms of the thermostat separate, moving the lever 130 in a clockwise direction to decrease the effective force of spring 81 urging the vane 34 in the closing direction to provide the proper enriched mixture for cold operation of the engine. For starting the engine cold the mixture is further enriched by the movement of the rod 136 to the left, as shown in Figure 3, due to the energization of the solenoid when the starter switch is closed. Such movement of the rod 136 effects further clockwise rotation of the lever 130 thus further decreasing the effective force of spring 81.

When the member warms up to normal temperature the free ends of the arms of the thermostat 132 move toward each other and when the thermostat reaches normal temperatures the arm 139, shown in the drawing as being in engagement with the washer 138, moves to the left against the force of spring 142 to a position out of engagement with said washer 138 so that should the engine be started when warm and the solenoid 108 energized the washer 138 will not engage the adjacent arm of the thermostat to effect a decrease in the force of spring 81 in the vane closing direction. No enrichment of the fuel mixture will therefore be effected for warm starting.

Figure 4

In this arrangement of the invention a straight strip thermostat 150 is provided, one end of which is attached to the outer end of the shaft 82, said thermostat depending from said shaft. The spring 81 is of the same general character as that of Figure 3 while a spring 152 is adapted to urge the thermostat in a counterclockwise direction. The free end of the rod 136 may be rounded and abuts against the thermostat 150 adjacent its free or lower end which is adapted to move toward the right, as shown in Figure 4, when cold and to the left when heated. As said thermostat cools it effects a decrease in the force of spring 81 urging the vane 34 toward the no-flow. At normal engine operating temperatures spring 81 provides the normal force for urging the vane toward the no-flow position. Cold starting, and cold operation of the engine are effected

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in a manner similar to that previously described in connection with the arrangements of the invention, shown in Figure 3.

If desired, a Bowden wire or like arrangement may be used for varying the effective force of the yielding means urging the vane toward the no-flow position.

Figure 5

Should the engine become flooded when the thermostat is cold it is desirable to have means for deflooding same, such an arrangement being best shown in Figure 5 wherein the thermostat 80 is shown as having an upturned end portion 160 which is adapted to be engaged by a depending lug 162 of a plunger or armature 164 of a solenoid, indicated generally at 166. The lug 162 is normally spaced from the end portion 160 of the thermostat to allow vane action under the control of the thermostat. The plunger 164 extends through the core of coil 168 of the solenoid and is provided with a disk 170, which may be of soft iron, or the like. The coil 168 is disposed in a housing 172 having an end wall 174 toward which the disk 170 is normally urged by a spring 176, said end wall serving to limit the spring urged movement of the plunger. Electric power for energizing the solenoid coils 108 and 168 is provided by connecting the solenoid circuits to wire 116 of the starter circuit, there being a two-way switch, indicated generally at 180, provided for controlling the solenoid circuits. The switch includes a movable member 182 connected with the wire 116 by means of a wire 184 and the free end of said switch member 182 is adapted to be actuated for engagement with a contact member 186 having a connection 188 with the solenoid coil 108. The member 182 is normally urged against the contact member 186 by a spring 187. A second contact member 190 is provided and has a connection 192 with the solenoid coil 168, the former coil being grounded at 113 and the latter at 194.

The starter switch 122 is so located in the starter circuit wire as to control the flow of current to the starter and to both the solenoids. When the starter switch is closed the solenoid coil 108 is energized to effect mixture enrichment for cold starting as hereinabove described. Should the engine become flooded the switch member 182 is moved into engagement with the contact member 190 whereupon solenoid 108 will become deenergized, the solenoid coil 168 becoming energized. The arm 98 will return to its normal position and the plunger 164 will be actuated to the left, as shown in Figure 5, causing the lug 162 to engage the extension 160 of the thermostat and will move the free end of the thermostat out of engagement with the pin 94. Thus only the normal vane closing force will be present and cranking of the engine by the starter will effect deflooding of said engine. As soon as the engine is deflooded the switch member 182 is permitted to return to its normal position in engagement with the contact 186 so that the engine may be started in the usual manner under the prevailing conditions.

I claim:

1. In a charge forming device having an induction passage: a movable member therein responsive to air flow and having a substantially closed no-flow position; a fuel supply conduit communicating with the induction passage anterior to said member; a fuel regulating valve in said conduit controlled by movement of the member; yielding means urging the member to-

ward the no-flow position; temperature responsive means adapted when cold to urge the member in the opening direction; and means for varying the effective force of said temperature responsive means on said member for a given temperature.

2. The invention defined by claim 1 wherein the last mentioned means is a mechanism including an electrical device.

3. The invention defined by claim 1 wherein the temperature responsive mean, in combination with a one-way connection, becomes ineffective at normal engine operating temperatures to urge the member toward the flow position.

4. In a charge forming device for an internal combustion engine having an electrical starter, and an electric circuit therefor including a normally open starter switch: an induction passage; a member therein responsive to air flow and having a substantially closed no-flow position; a fuel supply conduit communicating with the induction passage anterior to said member; a fuel regulating valve in said conduit controlled by movement of the member and adapted to control the flow of fuel for the fuel mixture; yielding means urging the member toward the no-flow position; temperature responsive means adapted, when at subnormal engine operating temperatures, to urge the member toward the flow position; and electrical means, connected with the starter circuit, for increasing the effective force of the temperature responsive means on said member, for a given temperature when the starter switch is closed.

5. The invention defined by claim 4 wherein the temperature responsive means has a one way connection with the member and said means is adapted to be functionally disengaged from the member when the engine operating temperature is at or above normal.

6. The invention defined by claim 4 and including means whereby the temperature responsive means is rendered functionally inoperative at normal engine operating temperatures; and yielding means for reestablishing the normal effective force of the temperature responsive means for a given subnormal engine temperature when the starter switch is open.

7. In a charge forming device comprising an induction passage having an air inlet and a mixture outlet controlled by a throttle: an unbalanced air vane in the induction passage anterior to the throttle, said vane having a no-flow position; a fuel supply conduit communicating with the induction passage anterior to said vane; a fuel regulating valve in said conduit controlled by movement of the vane; yielding means urging the vane toward the no-flow position; a movable member; and a thermostat operatively disposed between said member and vane and so constructed and arranged as to exert vane opening force when cold, the effective force of said thermostat being variable by movement of said member.

8. In a charge forming device for an internal combustion engine having an electric starter circuit including a normally open starter switch: an induction passage; an unbalanced air vane in the induction passage, said vane having a no-flow position; a fuel supply conduit communicating with the induction passage anterior to said vane; a fuel regulating valve in said conduit controlled by movement of the vane; yielding means urging the vane toward the no-flow position; a movable member; a thermostat operatively disposed between the member and vane and so constructed and arranged as to exert vane opening force

when cold; and electrical means adapted to be connected into said circuit for actuating said member, said electrical means being adapted to become energized when the starter switch is closed.

9. The invention defined by claim 8 wherein there is means to render the thermostat inoperative at or above normal engine operating temperatures.

10. In a charge forming device for an internal combustion engine having an electrical starter and electric circuit therefor including a normally open starter switch: an induction passage; an unbalanced air vane in the induction passage, said vane having a no-flow position; a fuel supply conduit communicating with the induction passage; a fuel valve in said conduit controlled by movement of the vane and controlling the flow of fuel for the fuel mixture; yielding means urging the vane toward the no-flow position; a movable arm; a thermostat operatively disposed between the arm and vane and so constructed and arranged as to exert vane opening force when the engine is at subnormal temperatures, the effective force of the thermostat being variable by movement of said arm; a solenoid adapted to actuate said arm and to increase the effective force of the thermostat, when energized; yielding means urging the arm in the opposite direction; stop means for maintaining the arm in a normal position; a solenoid circuit connected with the starter circuit; and means for relieving the vane of the force of the thermostat when cold.

11. In a charge forming device for an internal combustion engine: an induction passage; a member therein responsive to air flow and having a no-flow position; a fuel supply conduit communicating with the induction passage; a fuel valve in said conduit controlled by movement of the member and controlling the flow of fuel for the fuel mixture; yielding means urging the member toward the no-flow position; an arm adapted to vary the effective force of the yielding means; a stop for said arm; means for moving said arm in a direction to decrease the effective force of said yielding means.

12. The invention defined by claim 11 wherein the last mentioned means comprises an electrical device.

13. The invention defined by claim 11 wherein there is a thermostat between the last mentioned means and the arm.

14. The invention defined by claim 11 wherein the last mentioned means comprises a solenoid; and there is a thermostat operatively disposed between the solenoid and arm; and a one way connection between said thermostat and solenoid.

15. In a charge forming device for an internal combustion engine: an induction passage; a fuel supply conduit communicating with the induction passage; a fuel valve in said conduit; a member responsive to air flow in said induction passage and having a no-flow position, said member being adapted to regulate the flow of fuel for the fuel mixture by actuating said valve; yielding means urging the member toward the no-flow position; a thermostat adapted to vary the effective force of the yielding means; and a solenoid having a plunger operably connected to the thermostat for varying the effective position thereof.

16. The invention defined by claim 15 and including a stop effective to limit the movement of the thermostat in one direction; and yielding

means for urging the thermostat in said direction.

17. In a charge forming device: an induction passage; a fuel supply conduit communicating with the induction passage; a fuel valve in said conduit; a fuel valve control member in said induction passage responsive to air flow and having a substantially closed no-flow position; yielding means urging the member in the no-flow direction; temperature responsive means tending, at subnormal engine operating temperatures, to decrease the force of the yielding means urging the member toward the no-flow position; and electrical means adapted to decrease the effective force of the yielding means when energized; said yielding means, temperature responsive means and electrical means being arranged in series.

18. In a charge forming device for an internal combustion engine having an electric starter, and an electric circuit therefor including a normally open starter switch: an induction passage; a member therein responsive to air flow and having a substantially closed no-flow position; a fuel supply conduit communicating with the induction passage; a fuel valve in said conduit controlled by movement of the member and adapted to control the flow of fuel for the fuel mixture; yielding means urging the member toward the no-flow position; temperature responsive means adapted, when at subnormal engine operating temperatures to urge the member toward the flow position; electrical means, including an electric circuit, for increasing the effective force of the temperature responsive means on said member for a given temperature when the starter switch is closed; other electrical means, includ-

ing an electrical circuit, for negating the force of the thermostat on said member; and switch means for controlling the circuits of said electrical means including a connection with the starter switch, the flow of current to said electric circuits being controlled by said starter switch.

19. The invention defined by claim 18 wherein the switch means is adapted to alternately connect the circuits of said electrical means with the starter circuit.

20. The invention defined by claim 18 wherein the switch means normally directs current to the first mentioned electrical means, and said switch means is adapted to alternately provide current to either of said electrical means.

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