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AUTOMATIC CHOKE VALVE

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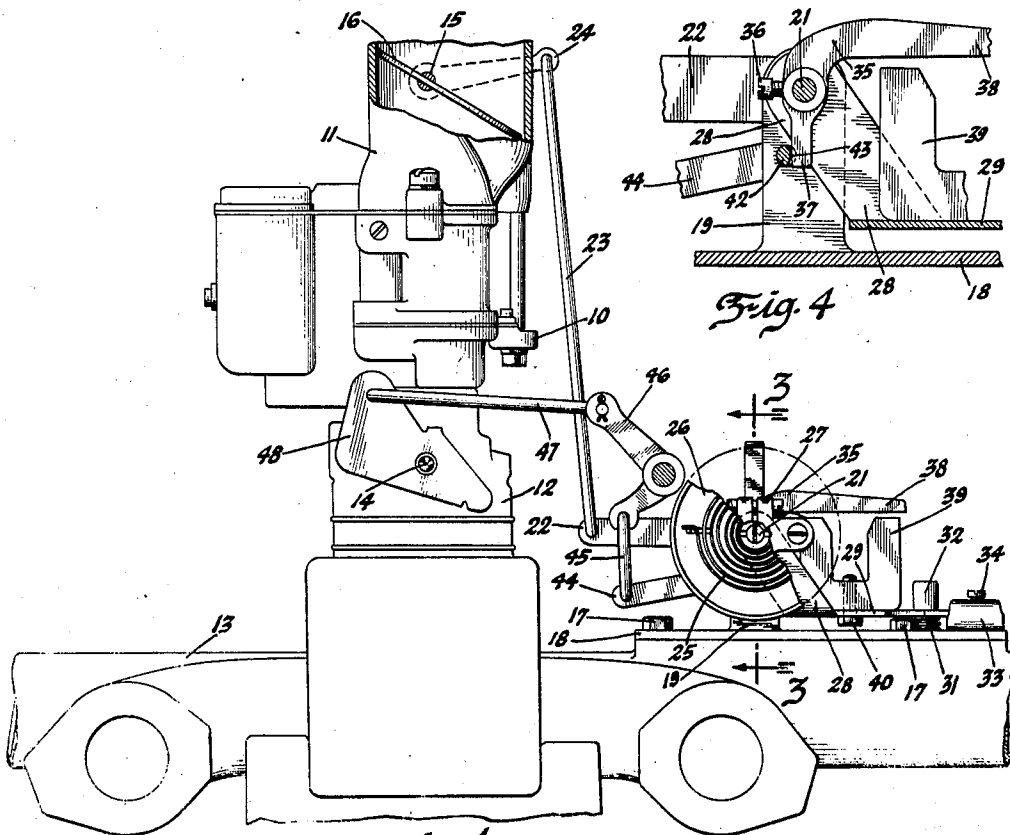


Fig. 1

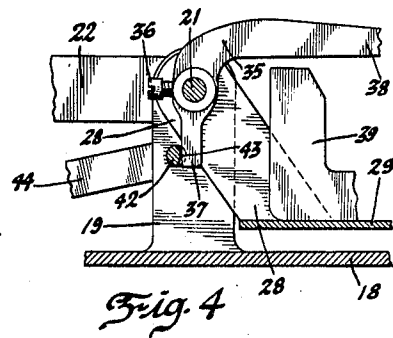


Fig. 4

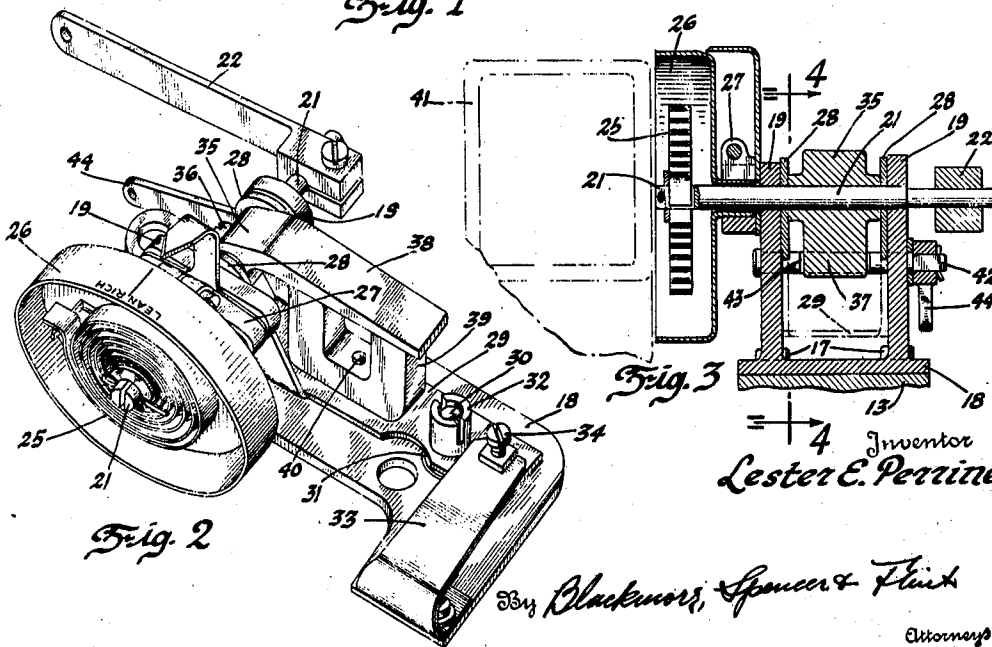


Fig. 2

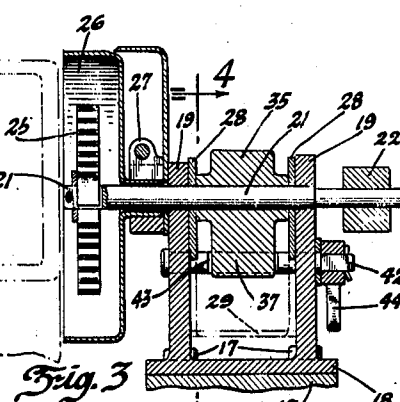


Fig. 3

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AUTOMATIC CHOKE VALVE

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24 Claims. (Cl. 123—119)

To facilitate the starting of an internal combustion engine when its temperature is lower than that at which it is designed to operate and to insure proper operation of the engine when it is operating at a temperature lower than that at which it is designed to operate, it is desirable to supply to the cylinders of the engine a combustible mixture in which the ratio of fuel to air is greater than in the combustion mixture desirable under normal operating conditions. To effect this change in the character of the combustible mixture, there is commonly provided in the air intake passage of the carburetor of an internal combustion engine a valve (commonly called a "choke valve") by which the volume of air which enters the carburetor and, consequently, the ratio of fuel to air in the combustible mixture which is supplied to the cylinders of the engine may be regulated.

Since, to maintain the choke valve of the carburetor of an internal combustion engine properly adjusted while the engine on which it is installed is being started or operated at a temperature which is lower than that at which it is designed to operate requires constant attention on the part of the most skillful operator, several mechanisms for automatically maintaining choke valves properly adjusted at all times have been suggested. Among these mechanisms is a thermostat so positioned that it is effected by the heat radiated from some part of the engine and so constructed, arranged and connected to the choke valve that it maintains the choke valve in a position determined by the temperature of the mentioned part of the engine, except when the temperature of the mentioned part is below a predetermined temperature, under which condition it tends to maintain the choke valve in fully closed position. The thermostat is so constructed, arranged and connected to the choke valve that it tends to maintain the choke valve in fully closed position when the temperature of the engine is below the mentioned predetermined temperature because when an internal combustion engine is operating under the last-mentioned condition, it is desirable to supply to the cylinders thereof a combustible mixture in which the ratio of fuel to air is greater than is desirable, and bears to the temperature a different relation than is desirable, when the temperature of the engine equals or exceeds the mentioned predetermined temperature, and because, when the thermostat is so constructed, arranged and connected it more nearly so regulates the choke valve that the carburetor supplies a combustible mixture contain-

ing the desired proportions of fuel and air when the temperature of the engine is less than the mentioned predetermined temperature, than it would if it were effective to vary the position of the choke valve under this condition.

While the mechanism referred to above functions satisfactorily when the temperature of the engine on which it is installed equals or exceeds the mentioned predetermined temperature, it is apparent that the mechanism cannot properly regulate the position of the choke valve when the temperature of the engine is less than the mentioned predetermined temperature.

My invention relates to mechanism for automatically maintaining the choke valve of an internal combustion engine properly adjusted at all times and resides, particularly, in the combination, with a thermostat for adjusting the choke valve, of an auxiliary mechanism which is capable of dominating the thermostat and maintaining the choke valve properly adjusted when the temperature of the engine is less than the mentioned predetermined temperature.

For a better understanding of the nature and objects of the present invention, reference is made to the following specification, in which there is described the preferred embodiment of my invention which is illustrated in the accompanying drawing.

In the accompanying drawing:

Figure 1 is a view of choke valve adjusting mechanism in which is embodied my invention installed on an internal combustion engine.

Figure 2 is an enlarged perspective view of the choke valve adjusting mechanism shown in Figure 1.

Figure 3 is an enlarged section taken on the line 3—3 of Figure 1.

Figure 4 is a fragmentary section taken on the line 4—4 of Figure 3.

In the drawing, there is shown part of the induction system of an internal combustion engine which includes a carburetor 10 into which air is drawn through the conduit 11 and from which combustible mixture is discharged through the conduit 12, and a manifold 13 through which the combustible mixture discharged from the conduit 12 is conducted to the intake ports of the cylinders of the engine. Within the conduit 12 on the shaft 14, there is mounted a throttle valve (not shown) of the butterfly type, and within the conduit 11 on the shaft 15, there is mounted a choke valve 16 of the butterfly type which is notable only in this, that, as shown in the drawing, the portion thereof which moves inwardly as the

valve opens is of greater area than the portion on the opposite side of the shaft 15, and, consequently, that the flow of air into the carburetor will tend to open it.

On the intake manifold 13 adjacent the carburetor 10, there is secured, by means of screws 17, my choke valve adjusting mechanism which includes a base 18, which is preferably made of brass or some other non-magnetic material, and on which there are provided two laterally spaced, upstanding ears 19. In the outer ends of the ears 19, there are provided aligned bores through which there extends and in which there is journaled a shaft 21. To one end of the shaft 21, there is fixed a crank arm 22 which is connected by a link 23 to an operating arm 24 which is fixed to the shaft 15 on which the choke valve 16 is mounted. To the opposite end of the shaft 21, there is secured the inner end of a bi-metallic thermo-sensitive coil spring 25 which is located within and whose outer end is secured to a cup-shaped housing 26 which is adjustably secured to the base 18 by means of a clamping element 27 which is carried by the adjacent ear 19.

The portion of the shaft 21 intermediate the ears 19 passes through openings formed in ears 28 which are formed on one end of a platform 29 which is preferably made of brass or some other non-magnetic material and serves to support and pivotally connect one end of the platform to the base 18. To the base 18 at a distance from the ears 19, there is secured a stud 30 which extends through an opening in the adjacent end of the platform 29. The portion of the stud 30 below the platform is surrounded by a coil spring 31 which urges the upper surface of the platform into contact with the lower side of a nut 32 which is threaded on the portion of the stud above the platform. To a lateral extension which is formed on the side of the base 18 on which the housing 26 is located at the end thereof distant from the housing, there is secured one end of a bi-metallic thermo-sensitive strip 33 through whose free end which over-lies the adjacent end of the platform 29 there extends a set screw 34.

The portion of the shaft 21 between the ears 28 of the platform 29 passes through the intermediate portion of an L-shaped keeper 35 which is preferably made of a ferrous metal and fixed to the shaft by a set screw 36. When the choke valve 16 is in fully closed position, as shown in the drawing, the shorter arm 37 of the keeper 35 extends substantially vertically downwardly between the ears 19 and the longer arm 38 thereof extends substantially horizontally and overlies the poles of a U-shaped permanent magnet 39 whose bight is secured to the platform 29 between the shaft 21 and the stud 30 by means of a screw 40.

In the installation illustrated in the drawing, the mechanism for automatically maintaining the choke valve 16 properly adjusted is mounted on the intake manifold 13 of the engine, because, when it is so mounted, the thermo-sensitive elements 25 and 33 are located in such close juxtaposition to the exhaust manifold 41 of the engine that they are affected by the heat radiated therefrom, as shown in Figure 3 of the drawing. It will, of course, be understood that in engines in which the relative positions of the intake and exhaust manifolds differ from that illustrated in the drawing, it may be found desirable, in order so to locate the thermo-sensitive elements that they will be affected by the heat radiated from the exhaust manifolds, to mount the mechanisms

on parts of the engine other than the intake manifolds, and, moreover, if it is so desired, the mechanisms may be so mounted that the thermo-sensitive elements will be affected by the heat radiated from parts of the engines other than the exhaust manifolds.

The thermo-sensitive element 25 is so constructed and arranged that, as its temperature rises, it tends to rotate the shaft 21 in a counter-clockwise direction, as viewed in Figure 1, and to open the choke valve 16, that, as its temperature falls, it tends to rotate the shaft 21 in a clockwise direction and to close the choke valve, and that, when its temperature falls below a predetermined minimum (e. g. 70° F. to 80° F), if unresisted, it will maintain the choke valve in fully closed position. From what was said in the preceding sentence, it will be apparent that the thermo-sensitive element 25, when its temperature is below the mentioned predetermined minimum, tends to maintain the choke valve in fully closed position, and, when its temperature equals or exceeds the mentioned predetermined minimum, tends to regulate the position of the choke valve in accordance with its temperature, and, since the thermo-sensitive element 25 is affected by the temperature of the exhaust manifold 41, in accordance with the temperature of the exhaust manifold. Moreover, it will be noted that the attraction of the magnet 39 for the arm 38 of the keeper 35 tends to prevent rotation of the shaft 21 in a counter-clockwise direction, and, therefore, to maintain the choke valve in a closed position.

When the engine on which the mechanism described and illustrated in the drawing is installed is not operating, the positions of the parts of the mechanism will depend upon the temperature of the exhaust manifold of the engine. If the engine is sufficiently heated, the thermo-sensitive element 25 will maintain the choke valve partially or fully open and the arm 38 of the keeper 35 out of the effective field of attraction of the magnet 39. Under such conditions, the position of the choke valve during starting of the engine will be controlled entirely by the thermo-sensitive element 25 and the volume of air which is flowing through the conduit 11.

If, however, when the engine is not operating, it becomes sufficiently cold, the thermo-sensitive element 25 will move the choke valve sufficiently toward closed position to bring the arm 38 of the keeper 35 into the effective field of attraction of the magnet 39 which will tend to move the keeper further in a clockwise direction, and, consequently, completely to close the choke valve. Since the force exerted by a permanent magnet on an object varies inversely as the square of the distance separating the magnet and the object, the strength of the closing force exerted by the magnet 39 will depend upon the position of the magnet which is urged toward the arm 38 of the keeper by the spring 31 but limited in its movement by the nut 30 or by the set screw 34 which is moved toward the platform 29 when the temperature of the thermo-sensitive element 33 rises and away from the platform when the temperature thereof falls. Under the conditions described in the preceding portion of this paragraph, it is obvious that the position of the choke valve 16 will depend partly upon the temperature of the thermo-sensitive element 25 and partly upon the position of the magnet 39 which is affected by the temperature of the thermo-sensitive element 33. If, under these conditions, the engine is cranked, the tendency of the air flowing

through the conduit 11 to open the choke valve will be resisted by the attractive force of the magnet 39 for the arm 38 of the keeper 35 and the tendency of the thermo-sensitive element 25 to maintain the choke valve in closed position and, consequently, since under the conditions in which the arm 38 of the keeper 35 is located within the effective field of the magnet, the latter dominates the thermo-sensitive element 25 in determining the position of the choke valve, the position of the choke valve will be determined by the magnet until such time as the flow of air through the conduit becomes sufficient to overcome the attractive force of the magnet for the arm 38 of the keeper 35 plus the tendency, if any, of the thermo-sensitive element 25 to maintain the arm 38 of the keeper 35 in the effective field of attraction of the magnet. The air flow necessary to overcome the attractive force of the magnet for the arm 38 of the keeper 35 plus the tendency, if any, of the thermo-sensitive element 25 to maintain the arm 38 of the keeper 35 in the effective field of attraction of the magnet is obviously dependent upon the effective strength of the attractive force, which is dependent upon the distance which separates the magnet and the arm 38 of the keeper 35 and is at its maximum when the thermo-sensitive element 33 is so cold that the set screw 34 is out of contact with the platform 29, and decreases rapidly with a rise in temperature of the thermo-sensitive element 33, which as its temperature increases, through the set screw 34, moves the platform and the magnet away from the arm 38 of the keeper against the resistance of the spring 31. From what has been said, it will be apparent that the length of time during which the choke valve and, consequently, the ratio of fuel to air in the combustible mixture discharged from the carburetor through the conduit 12 will remain under the control of the magnet will be greater when the engine is relatively cold than when it is relatively warm. When the flow of air through the conduit 11 becomes sufficient to overcome the attractive forces of the magnet for the arm 38 of the keeper 35 plus the tendency, if any, of the thermo-sensitive element 25 to maintain the arm 38 of the keeper 35 in the effective field of attraction of the magnet, the arm will be moved out of the effective field of attraction of the magnet and, thereafter, until conditions again become such as to bring the keeper back into the effective field of attraction of the magnet, the position of the choke valve will depend entirely upon the temperature of the thermo-sensitive element 25 and the flow of air through the conduit.

It will, of course, be understood that, a balanced, instead of an unbalanced, choke valve may be employed in conjunction with the mechanism herein disclosed, if there is provided some mechanism by which the arm 38 of the keeper 35 will be moved out of the effective field of attraction of the magnet when the ratio of the rate at which air flows through the conduit 11 or the pressure within the intake manifold 13 to the attractive force of the magnet for the arm 38 of the keeper 35 plus the tendency, if any, of the thermosensitive element 25 to maintain the arm 38 of the keeper 35 in the effective field of attraction of the magnet exceeds a predetermined value.

To insure that the choke valve will be open when the throttle valve is open to a predetermined extent, there is preferably provided in conjunction with the mechanism hereinbefore described, means by which the arm 38 of the

keeper will be moved out of the effective field of attraction of the magnet when the throttle valve has been opened to a predetermined extent. To this end, I provide, as shown in the drawing, a shaft 42 which is journaled in bores which extend through the ears 19 of the base 18 and has formed on a portion thereof between the ears 19 a cam surface 43 which is adapted to be brought into engagement with the arm 37 of the keeper 35 to open the choke valve to a predetermined extent when the shaft has been rotated through a predetermined angle. To interconnect the shaft 42 with the throttle valve so that the angular position of the shaft will be determined by the position of the throttle valve, there is fixed to one end of the shaft 42 an arm 44 which is interconnected, through a link 45, a bell crank 46 and a link 47, to an arm 48 which is fixed to the shaft 14 on which the throttle valve is mounted. It will be apparent from a consideration of the structure described in the preceding portion of this paragraph that when the throttle valve is opened to a predetermined extent, the cam surface 43 on the shaft 42 will engage the arm 37 of the keeper 35, rotate it in a counter-clockwise direction and positively partially open the choke valve.

While, in connection with certain engines, it is desirable to provide a thermo-sensitive element, such as 33, which renders the effective strength of the attractive force of the magnet 39 for the arm 38 of the keeper 35 greater at relatively low temperatures than at relatively high temperatures, my experiments indicate that, in connection with other engines, it may be desirable to maintain the effective strength of the attractive force constant at all temperatures, and, in connection with still other engines, to render the effective strength of the attractive force greater at relatively high temperatures than at relatively low temperatures. In the former case, the magnet 39 may be fixed to the base 18. In the latter case, the spring 31 may be disposed between the nut 32 and the upper surface of the platform 29 and the thermo-sensitive element 33 arranged so that its free end engages the lower surface of the platform and it tends to move the magnet toward the arm 38 of the keeper 35 when its temperature rises.

Although I have shown and described a preferred embodiment of my invention, it is to be understood that this has been done by way of example and not by way of limitation, and, consequently, that the scope of my invention is to be determined only by the appended claims.

I claim:

1. In mechanism for regulating the position of the choke valve of a carburetor, a magnetic body associated with the choke valve, and a permanent magnet which is so arranged that the force exerted thereby tends to maintain the body in a position in which the choke valve is closed.

2. The invention claimed in claim 1, plus a thermo-sensitive element so arranged that the effective force exerted by the magnet on the magnetic body increases with a decrease in temperature.

3. In an internal combustion engine, a carburetor in which there is incorporated a choke valve which is so arranged that its position is affected by pressure variations in the induction system of the engine, an armature associated with the choke valve, and a magnetic body which is effective while the engine is operating and is so arranged that the force exerted thereby

tends to maintain the armature in a position in which the choke valve is closed.

4. In an internal combustion engine, a carburetor in which there is incorporated a choke valve which is so arranged that its position is affected by pressure conditions in the induction system of the engine, a thermostat arranged to regulate the position of the choke valve in accordance with the temperature of the engine, a magnetic body associated with the choke valve, and a permanent magnet which is so arranged that the force exerted thereby tends to maintain the body in a position in which the choke valve is closed and dominates the thermo-sensitive element at temperatures below a predetermined temperature and the effect of the pressure conditions in the induction system on the position of the valve when the pressure is less than a predetermined value.

5. The invention claimed in claim 4, plus a thermo-sensitive element so arranged that the effective force of the magnet on the body increases with a decrease in temperature.

6. In a carburetor, a throttle valve, a choke valve, a magnet which tends to hold the choke valve in closed position, and mechanism interconnected with the throttle valve for moving the choke valve toward open position after the throttle valve has been opened to a predetermined extent.

7. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, and an armature and a magnetic member which is effective while the engine is operating under its own power to affect the position of the choke valve.

8. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, a member responsive to an engine operating condition to regulate the position of the choke valve, and an armature and a magnetic member which is effective while the engine is operating under its own power to hold the choke valve in a predetermined position.

9. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, and a magnet and an armature which is effective while the engine is operating under its own power and whose effectiveness varies with an engine operating condition to affect the position of the choke valve.

10. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, and a permanent magnet and an armature which tends to hold the choke valve in a predetermined position.

11. In internal combustion engine carburetor choke valve operating mechanism, a body, a choke valve actuating shaft journaled in the body, a magnetic member carried by the body, a two-armed armature carried by the shaft so that one of its arms may move toward and away from the field of attraction of the magnet, and a shaft which is journaled in the body and may be actuated to move the last-mentioned arm of the armature away from the field of attraction of the magnetic member through the intermediary of the other arm.

12. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, a thermally actuated element to regulate the position of the choke valve, and an armature and a magnetic member which is effective while the engine is operating under its own power to

hold the choke valve in a predetermined position.

13. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, and means which is effective while the engine is operating under its own power and whose effectiveness varies with an engine operating condition for releasably holding the choke valve in a predetermined position.

14. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, a magnetic body and an armature which tends to hold the choke valve in a predetermined position, and means for changing the relative positions of the magnetic body and the armature without affecting the position of the choke valve.

15. In internal combustion engine carburetor choke valve operating mechanism, a body, a choke valve actuating shaft journaled in the body, a magnetic member carried by the body, an armature carried by the shaft so that it may move toward and away from the field of attraction of the magnetic member, and means for moving the magnetic member toward and away from the armature in accordance with temperature variations.

16. In an internal combustion engine, a carburetor in which there is incorporated a choke valve, a member responsive to an engine operating condition to regulate the position of the choke valve, a magnetic body and an armature which is effective while the engine is operating under its own power to tend to hold the choke valve in a predetermined position, and means which renders the effectiveness of the magnet and magnetic body dependent on an engine operating condition.

17. In internal combustion engine choke valve operating mechanism, a body, a choke valve actuating shaft journaled in the body, a magnetic member carried by the body, a thermally actuated element to regulate the position of the choke valve connected to the shaft, an armature carried by the shaft so that it may move toward and away from the field of attraction of the magnetic member, and means for moving the magnetic member toward and away from the armature in accordance with temperature variations.

18. In internal combustion engine carburetor choke valve operating mechanism, a body, a choke valve actuating shaft journaled in the body, a member mounted so that it may rock on the shaft, a magnetic member mounted on the first-specified member, an armature carried by the shaft so that it may move toward and away from the field of attraction of the magnetic member, and means for rocking the first-specified member on the shaft so as to move the magnetic body toward and away from the armature in accordance with temperature variations.

19. Control mechanism for a carburetor comprising a pressure responsive air inlet valve, and magnetic means constantly opposing opening movement of the valve with a force varying with the position of the valve.

20. Control mechanism for a carburetor for use in automotive vehicles, comprising a pressure responsive air inlet valve, a thermostat influencing the movement of the valve, and magnetic means constantly opposing opening movement of the valve during operation of the vehicle with a force varying with the position of the valve.

21. Control mechanism for a carburetor comprising a pressure responsive air inlet valve, and a permanent magnet opposing opening movement

of the valve only when the valve is near its closed position.

22. In an internal combustion engine, a carburetor in which there is incorporated a choke valve which includes a permanent magnet and an armature of which one is fixed and the other is movable with respect thereto, and means for varying the resistive effect of the specified means in accordance with changes in temperature.

23. In an internal combustion engine, a carburetor which includes a choke valve, and means

which is effective while the engine is operating under its own power and whose effectiveness varies with the temperature for releasably holding the choke valve in a predetermined position.

24. In an internal combustion engine, a carburetor which includes a choke valve, and a magnet and an armature which is effective while the engine is operating under its own power and whose effectiveness varies with the temperature to affect the position of the choke valve.

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