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CARBURETOR

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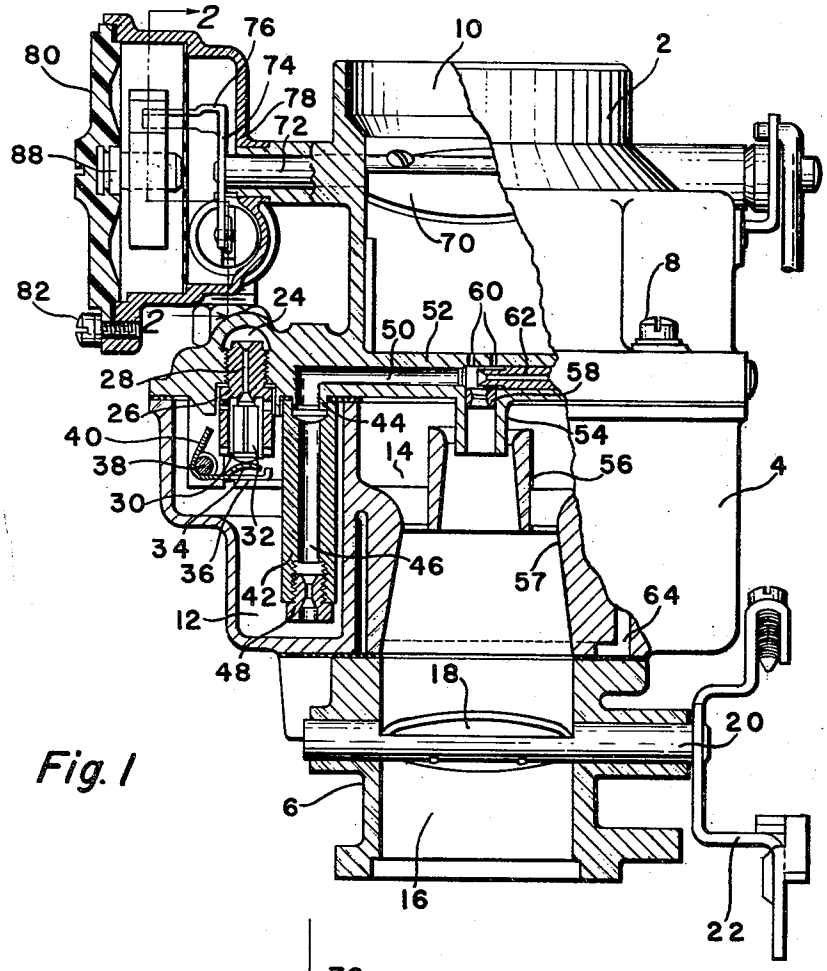


Fig. 1

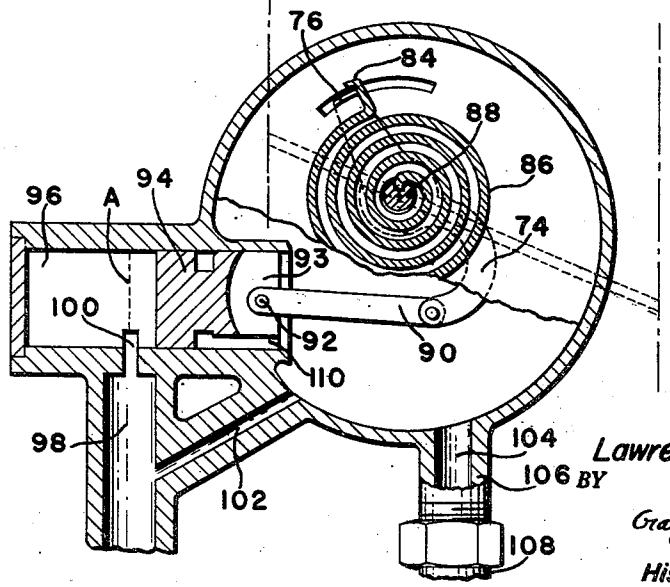


Fig. 2

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CARBURETOR

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This invention relates to carburetors for internal combustion engines, particularly engines for automotive vehicles and more specifically to automatic choke mechanism operable to automatically control the position of an air inlet valve, in order to regulate the air and fuel ratio of the combustible mixture which is supplied by the carburetor to the engine.

Automatic choke devices operable to move the choke or air inlet valve to different positions in response to variations in engine temperature and suction are old and well known. Such devices generally are provided with an unbalanced valve in the carburetor air inlet which is subject to a pressure differential created by the air entering the carburetor and which is also controlled by a thermostat which exerts a force to hold the valve closed at low temperatures, and by a suction operated piston responsive to variations in suction posterior to the throttle and exerting a force tending to open the valve as the suction increases.

Devices of this kind are also old in which a given change in temperature or engine suction does not produce the same movement of the choke valve throughout the entire range of movement of said valve. In other words, if the temperature increases a given number of degrees and the suction increases a given number of inches of mercury, the movement of the valve effected by such changes is different if the changes occur when the valve is in one part of its range of movement than if the valve is in a different part of its range of movement when such changes occur.

Devices of this kind are provided because characteristics of different engines vary and with some engines, for example, it is desirable to move the choke valve more rapidly toward open position upon a given increase in temperature and suction, when the valve is in a certain part of its operating range than it is with other engines. For example, it may be desirable, with some engines, to move the valve more slowly toward open position immediately after the engine has been started and is warming up than with other engines because some engines require a richer mixture for best operation under such conditions than do other engines.

It is the primary object or purpose of this invention to provide in a carburetor an automatic choke valve which is controlled by variations in temperature and engine suction and novel means for moving such choke valve in response to variations in these factors at such different rates per unit of change therein that its movement throughout its operating range will be such as to obtain the mixture ratio best suited for operation of a particular engine.

More particularly, it is an object of the invention to provide a carburetor having an automatic choke valve of the character described, the movement of which toward open position will be relatively retarded immediately after its initial movement which occurs when the engine starts to run under its own power, and which will subsequently be moved more rapidly after the valve is opened

to a predetermined extent, and novel means for effecting these movements of the valve.

According to the present invention, the objects thereof are accomplished by the provision of a suction operated piston connected to the choke valve and subject to the effect of suction in the engine intake passage posterior to the throttle when the valve is in closed position, so that immediately after the engine starts to run under its own power the valve is moved, by suction effective on such piston, toward open position until it reaches a certain desired position. At this position, the suction passage which communicates suction to the end of the piston is substantially closed so that the effect of suction thereon is substantially nullified and further movement of the choke valve toward open position is not effected by the piston, but is controlled by the reduction in closing force of the thermostat which enables the suction or pressure differential across the unbalanced choke valve produced by the ingoing air to move the valve further toward open position.

The suction of the intake passage is communicated to the thermostat housing through a constantly open passage and draws heated air through said housing to heat up the thermostat and bring about the above-described motion of the valve during the engine warm-up period. As the choke valve opens the suction operated piston, which is connected to said valve and moves with it, first substantially blocks the passage through which suction is communicated to the end of the piston, to render the piston ineffective to move the valve. Then as the choke valve moves on further toward open position, a second passage leading to the thermostat housing is placed in communication with the suction passage at a predetermined open position of the choke valve.

After the choke valve reaches this position, the heating of the thermostat is much more rapid than previously, so that the final movement of the choke valve to full open position is considerably faster than the movement of such valve during the intermediate portion of its range of movement, after the effect of suction on the piston has become substantially ineffective and before the second passage to the thermostat housing is opened.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Figure 1 is a vertical section, partly in elevation, of a conventional down-draft carburetor embodying the present invention; and

Figure 2 is a detail section on the line 2—2 of Figure 1.

The carburetor shown in the drawings is, in general, of conventional construction and substantially the same as that shown in the copending application of Elmer Olson, S. N. 192,035, filed October 25, 1950, now Patent No. 2,698,168 dated Dec. 28, 1954, and comprises three castings 2, 4 and 6 suitably secured together by screws 8, or in any suitable way. The casting 2 is the air inlet casting having a passage 10 for admission of air. The casting 4 is the fuel chamber casting and has a constant level fuel chamber 12 therein, in which fuel is maintained at a substantially constant level by mechanism which will be very briefly described later. The passage 10 communicates with a chamber or passage 14 centrally located in the casting 4 into which fuel is introduced and which forms the mixing chamber of the carburetor.

The casting 4 is immediately above and secured to the casting 6 which is the outlet casting and is secured in any suitable way to the intake manifold of the engine. An outlet passage 16 is formed in the casting 6 and connects with the passage 14, the passages 10, 14 and 16,

forming a continuous intake passage through the carburetor through which air entering the inlet flows and is mixed with fuel to form a combustible mixture which flows through the outlet passage **16** to the engine.

The flow of mixture from the carburetor is controlled by a suitable throttle valve **18** secured to a shaft **20** suitably journalled for rotation in the walls of casting **6**. This throttle is manually operated in the usual manner by means of an arm **22** secured to one end of the shaft **20** and is variably positioned to control the volume of mixture supplied to the engine and the speed thereof.

Fuel is supplied to the fuel chamber **12** through a passage **24** formed in the wall of casting **2** and communicating with this passage is a nipple **26** threaded in the wall of casting **2** and having a passage **28** which conveys fuel from passage **24** to chamber **12**. The nipple **26** is enlarged at its lower end to form a cylindrical chamber **30** in which is received a valve **32** which controls flow through passage **28**. This valve is freely movable and its lower end rests on a tang **34** cut out from and integral with a plate or bracket **36** which is secured to a float (not shown), and is pivoted on a pin **38** mounted in lugs **40** which are integral with and depend from the casting **2** into the chamber **12**. When the fuel reaches a predetermined level, the float is raised enough to move the valve **32** against its seat to close passage **28**. This is a conventional float valve construction and forms no part of the present invention.

A tube **42** is secured at its upper end in any suitable way to an annular rib **44** projecting from the casting **2** and has a fuel passage **46** formed therein to convey fuel from the chamber **12** to the carburetor mixing chamber. A calibrated plug **48** is screwed into the lower end of tube **42** and meters the fuel supplied to the mixing chamber. The passage **46**, at its upper end, connects with a cross passage **50** formed in a bridge member **52** which extends across the mixing chamber and is integral with the casting **2**. The passage **50** supplies fuel to the main nozzle **54** which extends into a small venturi tube **56** positioned in the mixing chamber and extending into a large venturi **57** which forms the wall of the mixing chamber. A plug **58** having a restricted orifice therein is positioned in the main nozzle to aid in atomizing the fuel. Air is admitted to the passage **50** through two small passages **60** to mix with the fuel flowing therethrough.

Positioned in the bridge piece **52** at the right of the main nozzle is a sleeve **62** having a passage therethrough for idling fuel and at its right end this sleeve is somewhat reduced in size so that it is spaced from the wall of the passage **50**, as shown in Fig. 1. The fuel which flows through the sleeve **62** ultimately reaches the passage **64** which supplies fuel to idling fuel supply inlets (not shown), which deliver fuel adjacent the edge of the throttle valve **18**.

The admission of air to the passage **10** is controlled by an automatically operated choke valve **70**, secured to a shaft **72** suitably journalled for rotation in the wall of the casting **2**. This shaft has secured to the left end thereof, as seen in Fig. 1, an arm **74** which has a horizontally extending portion **76**. The shaft **72** extends into a housing **78** which is a part of casting **2** and is provided with a removable and adjustable cover-plate **80** which may be either metal or a suitable plastic and is held in any adjusted position by screws **82**. The arm **76** at the end of the choke shaft and cooperating parts, about to be described, are positioned in this housing.

The arm **76** is engageable by the hooked end **84** of a thermostat **86** the other end of which is secured to a pin **88** which is fixed in the cover-plate **80**, as shown in Fig. 1. Upon reduction of temperature, the hooked end **84** moves counter-clockwise to engage the extension **76** of arm **74** and exerts a pressure thereon to hold the choke valve in closed position, as shown in Fig. 2. By adjustment of plate **80**, the pin **88** is rotated and changes the pressure exerted by the thermostat at any given temperature to hold the choke valve closed.

The lower end of the arm **74**, as seen in Fig. 2, is pivotally connected to a link **90** which is pivotally connected to a cross-pin **92** extending across a slot **93** in the right end of a piston **94** slidable in a horizontal cylinder **96** integral with the housing **78** and to which the suction maintained in the intake passage posterior to the throttle **18** is communicated through a passage **98**. The passage **98** may connect with the carburetor outlet between the throttle and the manifold or with the intake passage in the manifold itself. The particular position of this connection is not material as long as it is on the engine side of the throttle.

The mechanism so far described is substantially the same as that shown and described in the co-pending application previously referred to.

In the device disclosed in such application the suction passage comparable to the passage **98** connects with the cylinder in which the suction operated piston slides substantially at the end of such cylinder, so that the suction, which is communicated through such passage, is effective on the piston throughout the whole range of movement of the choke valve and exerts a pulling force on the piston until the valve reaches fully open position.

In the device disclosed herein the passage **98** connects with the cylinder **96** by means of an orifice **100** in the wall of the cylinder. This orifice is of rectangular shape, as shown, but may be triangular or of any other shape desired, but this orifice is positioned relatively close to the end of the piston when the valve is in closed position so that the valve cannot open very far before the orifice is completely blocked by the side wall of the piston. As illustrated, the piston reaches approximately the position designated by the dotted line A when the choke valve is about 20° open. The piston **94** is slightly loose in the cylinder in which it slides so as to permit leakage of air past the piston and when the piston reaches the dotted-line position, the area of the orifice **100** not covered by the piston is very little greater than this leakage space. When the parts are in such position, air can enter the cylinder at almost the same rate as it is withdrawn therefrom, by action of the suction passage **98**. Hence, there is very little partial vacuum maintained in the cylinder **96** when the piston reaches line A and the suction communicated through the passage is ineffective to move the choke valve further toward position.

The choke valve will be moved to this position by suction almost immediately after the engine starts to run under its own power, and this position of the valve is that which has been found most desirable for the beginning of the warm-up operation of some particular engine. It might be desirable to secure a greater or less substantially immediate opening of the choke valve for some other engine and this could be accomplished by appropriate positioning of the orifice **100**.

It also should be apparent that there may be some slight difference in the position assumed by the valve when it first is moved by engine suction when the engine starts to run under its own power, due to the difference in force exerted by the thermostat at different temperatures. This difference will be very slight, however, as the valve will move immediately to a position where the opening and closing forces are balanced and this will be very close to the line A with the piston end somewhere opposite the orifice **100**, and very quickly the thermostat will warm up enough for the piston to move to line A. Obviously, in view of the foregoing, the choke valve will move, almost immediately and quite rapidly after the engine starts, to a position about 20° open, which has been found desirable for some particular engines.

If the suction which is communicated through the passage **98** continued to be effective on the piston so that the valve would continue to be moved by the effect of suction during the warm-up period, it has been found for

some engines that the movement would be too rapid and the mixture would become too lean for entirely satisfactory operation. It is, therefore, desirable to retard the further opening movement of the valve relative to its rate of movement at the beginning of such movement, so that its opening from 20° to some predetermined position, more than 20° open, is relatively slow. Therefore, the orifice **100** is so positioned that after the valve opens about 20° the suction becomes substantially ineffective and the subsequent movement of the valve is controlled by the rate at which the thermostat is heated.

To this end, the passage **98** connects with a passage **102** formed in the casting **2** which leads to the interior of the housing **78** and also a passage **104** formed in a threaded nipple **106** extending from the housing **78** communicates with the interior thereof. This nipple may be positioned at any point on the housing where it gives the best results. Connected to the nipple **106** is a conduit **108** leading to a source of hot air (not shown), for example, a stove on the exhaust manifold.

The engine suction is communicated through passage **102** to the interior of housing **78** and draws heated air through passage **104** through the housing to heat the thermostat. During the warm-up period, after the piston has reached line A, the heated air passing through housing **78** progressively heats the thermostat so that the hooked end **84** moves clockwise and away from the extension **76** of arm **74**. As the end of the thermostat so moves, the choke valve is moved toward open position, at a rate which is determined by the thermostat, by the force exerted by the entering air directly on the choke valve **70**. This movement is relatively slow until the choke valve reaches a predetermined open position when the rate of movement of the choke valve is considerably increased and the valve continues to move at the increased rate until it reaches full open position.

To effect this increased rate of movement, the piston **94** is cut away on the lower side thereof, as indicated at **110** and this cut-away portion of the piston is brought into registry with the orifice **100** when the choke valve is about 55° open. As soon as this occurs, the effect of suction communicated to the interior of the housing **78** is much increased and much larger quantities of heated air per unit of time are drawn through housing **78**. This effects heating of the thermostat more rapidly after the choke valve is opened to the extent referred to and more rapid opening movement of the choke valve is effected from that point to its full open position, than its movement from 20° open to the position at which the cut-away portion **110** becomes effective.

It will be apparent from the foregoing that in the device disclosed the choke valve is moved very rapidly by the effect of engine suction, when the engine starts to run under its own power, to a position about 20° open, the effect of engine suction is then substantially eliminated, the valve is then moved more slowly at a rate controlled primarily by the thermostat to a position about 55° open, and finally is moved more rapidly from 55° open to full open position, this being effected by more rapid heating of the thermostat after the valve is opened to that extent. These movements of the valve could be brought about at different points in its operating range by changing the position of the orifice **100** or changing the length of the cut-away part **110** of the piston. By suitable dimensioning of the parts, substantially any desired rate of movement of the choke valve can be obtained at different parts of its operating range.

It may be said that, upon acceleration during the warm-up period, the operation of the device disclosed herein is somewhat different from the conventional automatic choke. In the latter, when the throttle is opened to effect acceleration, the choke moves somewhat toward closed position, due to the drop in suction effective on the piston corresponding to piston **94**. In this device, since the suction is substantially ineffective on the piston after the valve is 20° open, the drop in suction in passage **98** when the throttle is opened is substantially without effect and the valve will probably be opened slightly due to the increase in pressure differential across the valve **70** itself. Therefore, the desired mixture ratio for acceleration must be effected by the accelerator pump which is probably beneficial because the pump is more easily and accurately controllable.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a charge forming device for an internal combustion engine having a constant level fuel supply chamber, an intake passage having fuel and air inlets and a mixture outlet for supplying a combustible mixture to said engine, a throttle valve for controlling the flow of said mixture, an unbalanced choke valve operable in response to variations in the intake passage for controlling the admission of air through said inlet; mechanism for automatically controlling the operation of said choke valve comprising a thermostat operable to exert a force tending to hold said valve closed upon a reduction in temperature, a suction operated member connected to said valve and operable to move said valve toward open position upon an increase in suction, a conduit to communicate the engine suction to said member, said conduit being so positioned that it is blocked by said member when the valve reaches a partially open position, a housing in which the thermostat is positioned, a source of heated air, a suction passage communicating with said housing and effective to draw heated air from said heat source through said housing to progressively heat the thermostat whereby the valve closing force of the thermostat is progressively reduced and the choke valve is moved further toward open position only by the suction effective on the valve itself after said conduit is blocked by said suction operated member, and a second means for drawing heated air through said housing which is rendered effective when the choke valve reaches a predetermined open position to effect more rapid heating of the thermostat so as to bring about more rapid movement of the valve toward open position after it has been opened to a predetermined extent.

2. In a charge forming device for an internal combustion engine having a constant level fuel supply chamber, an intake passage having fuel and air inlets and a mixture outlet for supplying a combustible mixture to said engine, a throttle valve for controlling the flow of said mixture, an unbalanced choke valve operable in response to variations in the intake passage for controlling the admission of air through said inlet; mechanism for automatically controlling the operation of said choke valve comprising a thermostat operable to exert a force tending to hold said valve closed upon a reduction in temperature, a suction operated piston slidable in a cylinder and operatively connected to the valve so as to move the valve toward open position upon an increase of suction, a suction conduit connected to said cylinder intermediate its ends and adapted to be blocked by said piston when the valve is moved to partially open position so that the piston is rendered ineffective to move the valve further toward open position, a housing surrounding the thermostat, a source of heated air, a constantly open passage connecting said conduit with the housing and effective to draw heated air from the heat source through the housing to heat the thermostat and reduce its valve closing force so as to permit further opening of the valve by the suction effective on the valve itself, and a second normally closed passage connecting said conduit with the housing, said last named means being rendered effective after the choke valve reaches a predetermined open position.

3. In a charge forming device for an internal combustion engine having a constant level fuel supply chamber, an intake passage having fuel and air inlets and a mixture

outlet for supplying a combustible mixture to said engine, a throttle valve for controlling the flow of said mixture, an unbalanced choke valve operable in response to variations in the intake passage for controlling the admission of air through said inlet; mechanism for automatically controlling the operation of said choke valve comprising a thermostat operable to exert a force tending to hold said valve closed upon a reduction in temperature, a suction operated piston slidable in a cylinder and operatively connected to the valve so as to move the valve toward open position upon an increase of suction, a suction conduit connected to said cylinder intermediate its ends and adapted to be blocked by said piston when the valve is moved to partially open position so that the piston is rendered ineffective to move the valve further toward open position, a housing surrounding the thermostat, a source of heated air, a constantly open passage connecting

said conduit with the housing and effective to draw heated air from said heat source through the housing to heat the thermostat and reduce its valve closing force so as to permit further opening of the valve by the suction effective on the valve itself, said piston having a passage in the wall thereof adapted to connect said conduit with the thermostat housing after the valve has reached a predetermined open position, so that the thermostat is heated more rapidly and the valve is moved more rapidly toward open position as the valve approaches its fully open position.

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