May 16, 1939. S. F. HUNT 2,158,424

AUTOMATIC CHOKE

Filed Dec. 12, 1935 2 Sheets-Sheet 1

Fig. 1.

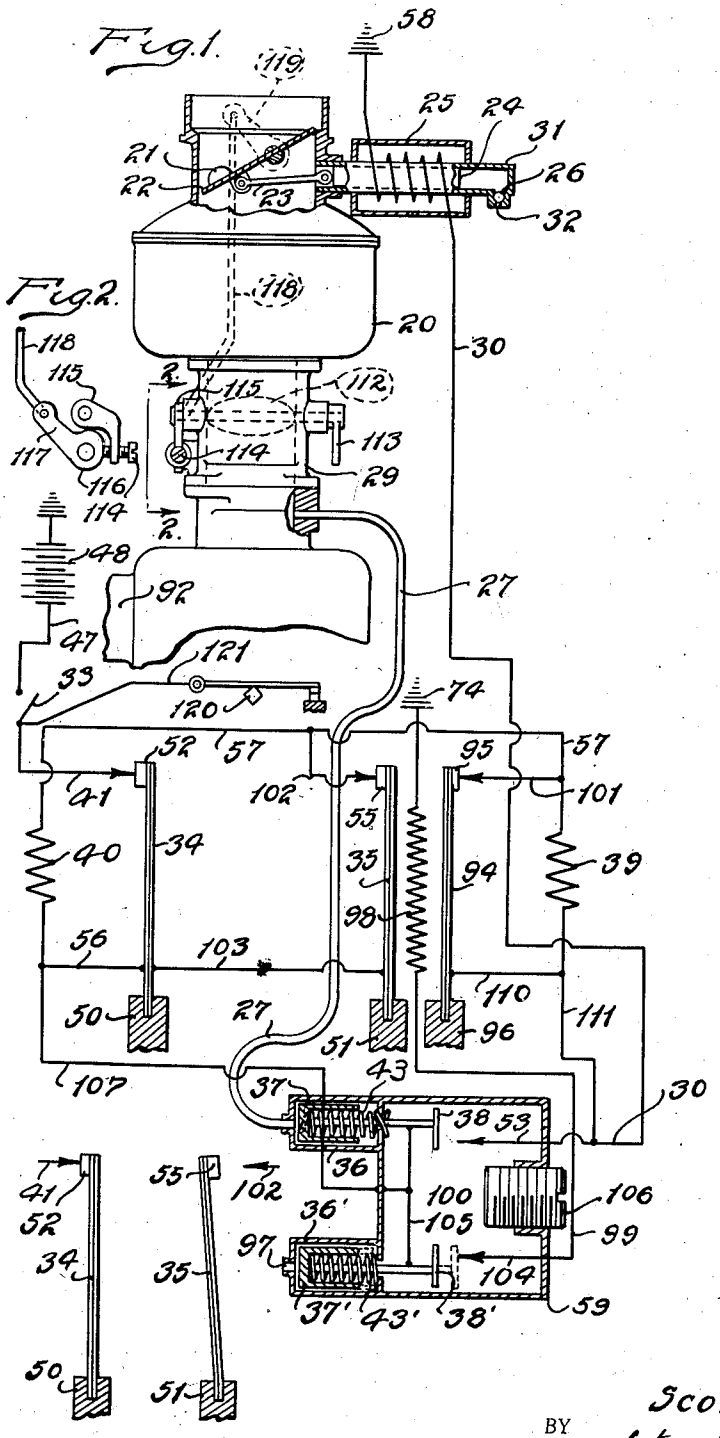


Fig. 3.

INVENTOR.
SCOTT F. HUNT,
BY J. Stanley McDade
ATTORNEY.

May 16, 1939. S. F. HUNT 2,158,424

AUTOMATIC CHOKE

Filed Dec. 12, 1935 2 Sheets-Sheet 2

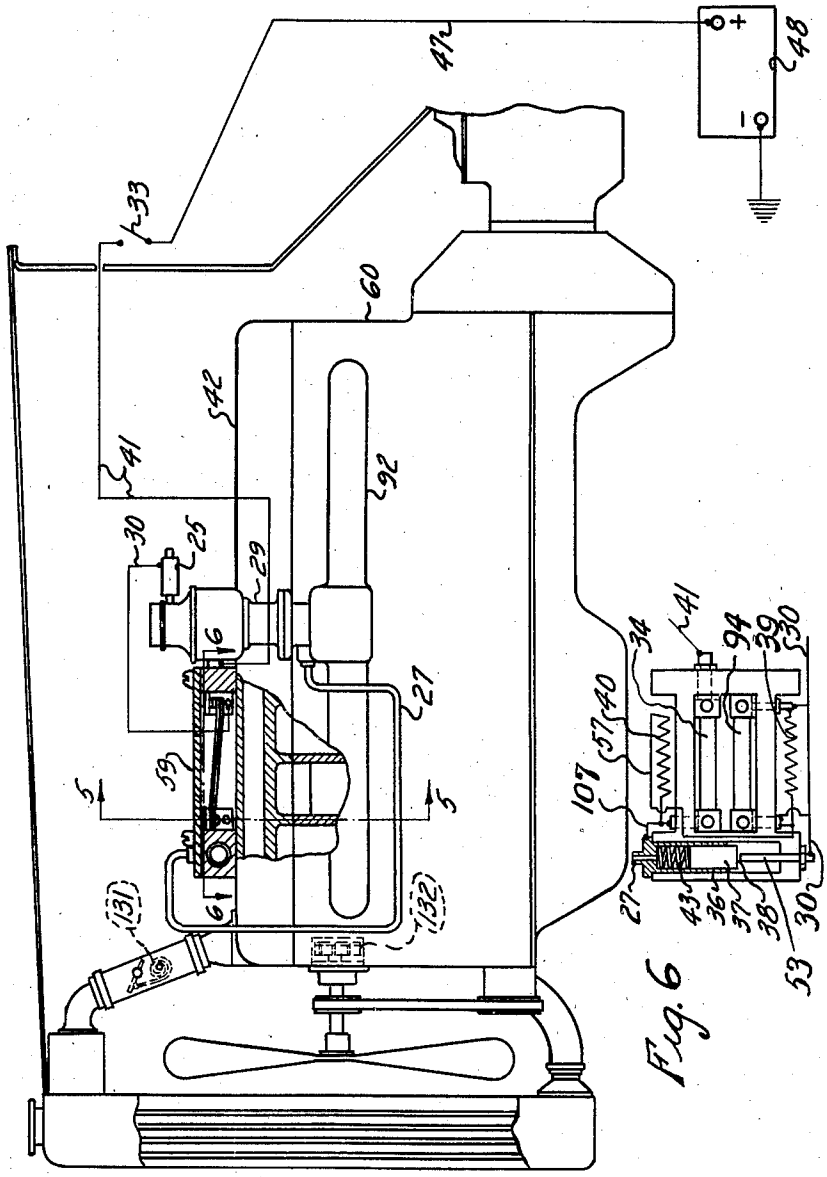


Fig. 4

Fig. 6

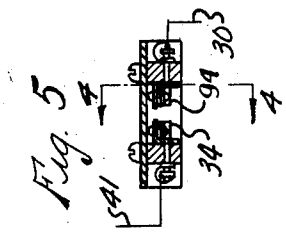


Fig. 5

INVENTOR
SCOTT F. HUNT
BY Stanley M. Udale
ATTORNEY

Patented May 16, 1939

2,158,424

UNITED STATES PATENT OFFICE

2,158,424

AUTOMATIC CHOKE

Scott F. Hunt, Detroit, Mich., assignor to Milton E. Chandler, Detroit, Mich.

Application December 12, 1935, Serial No. 54,024

7 Claims. (Cl. 123—119)

The object of this invention is to improve the starting means for automobile engines.

The method in common use heretofore has been to operate the choke valve manually, position of the choke valve being varied as the temperature of the engine varied. When starting cold more choking is required than when starting with a warm engine.

The problem is complicated by the fact that the moment the engine starts to fire it is desirable to immediately release the choke so as to admit air freely. However, if the choke is released entirely too much air is admitted and the engine stalls and must be re-started. Generally speaking, the two factors which determine starting are:

(*a*) The temperature of the air under the hood.

(*b*) The time the engine has been standing with the engine stopped.

A minor object of the invention is to permit the engine to be accelerated immediately after it is started. In order that a cold engine can be accelerated a considerable quantity excess fuel is required and I have invented means for supplying what I call an "accelerating shot".

In solving the many inter-related problems involved in securing the above objects I have discovered that the resistance to the opening of the choke valve should decrease as the temperature of the engine increases and also as the temperature of the air under the engine hood increases.

The resistance to the opening of the choke valve should decrease as the time in seconds during which the starting device is in operation increases. Finally, if the engine is immediately accelerated after being started, then there should be a momentary increase in resistance to the opening of the choke valve to permit what I term an "accelerating fuel shot".

In the figures:

Figure 1 shows my invention applied to a downdraft carburetor, the electrical connections being shown diagrammatically.

Figure 2 shows the choke valve control as viewed from plane 2—2 of Figure 1.

Figure 3 illustrates the action of the thermostats.

Figure 4 shows diagrammatically the installation of my invention on an automobile.

Figure 5 shows a partial cross sectional elevation taken on plane 5—5 of Figure 4.

Figure 6 shows diagrammatically a partial plan view taken on plane 6—6 of Figure 4.

In Figures 1, 2 and 3, a downdraft carburetor 20 is shown mounted on an inlet flange 29 connected to an inlet manifold 92 of an internal combustion engine which is shown at 60 in Figure 4. An electro-magnetic solenoid 25 is mounted on the air entrance to the carburetor. In the center of the solenoid is a core 24 adapted to be moved by electricity which is permitted to flow around the solenoid. This core 24 acts as a piston and slides in the cylinder 31. The flow of air into the piston is controlled by the check valve 26, which prevents the escape of air through the restricted opening 32. This air leaks out of the cylinder 31 through the clearance between the piston 24 and the cylinder 31. This piston 24 is connected through a link 23 with a choke valve 22 which controls the air entrance to the carburetor. This valve may be loaded with a weight 21, which weight will tend to open the valve.

In Figures 1 and 2 means are shown whereby when the choke valve is closed for starting, the throttle valve also is slightly open. This is known as the fast idle adjustment. The throttle is indicated by broken lines at 112, controlled by a throttle lever 113. A throttle stop 114 mounted on a throttle arm 115 engages with a cam 116. This cam is pivotally mounted on the body of the carburetor and is moved by a lever 117 which, in its turn, is connected to the choke valve 22 through the link 118. When the choke valve is closed, the throttle 112 will be opened slightly to any desired degree, as determined by the cam 116.

Three insulating blocks 50, 51 and 96 are adapted to be mounted on any convenient part of the engine. These blocks 50, 51 and 96 carry three thermostatic strips 34, 35 and 94, which are adapted to be deflected by heat. The thermostats 34, 35, carrying contacts 52 and 55, are shown in Figure 3. The contact 52 engages with another contact shown diagrammatically by an arrow and numbered 41. The contact 55 engages with a similar contact marked by an arrow and numbered 102. The third thermostat 94 mounted on an insulating block 96, carries a contact point 95, which engages with a conductor 101.

When the temperature falls below 32° F., all three contacts are closed, that is to say, the contacts 52 and 55 are moved over to the left and contact 95 mounted on thermostat 94 is moved over to the right. Electric contacts are thus maintained between the conductor 41 and the contact 52, between the conductor 102 and the contact 55, and between the conductor 101 and the contact 95. This is the cold condition existing when starting an engine which has stood outside all night.

A battery 48 is shown connected, through a conductor 47, with an ignition switch 33 which controls the flow of electricity to an ignition circuit breaker, shown diagrammatically, by the cam 120 and the conductor 121. Current also flows through the ignition switch 33 to the conductor 41 and so to the contact 52, down through the thermostatic metal 34 (which short-circuits the resistance 40).

The thermostat 34 is connected to the electric conductors 56 and 103. The contacts 41, 52 are adapted to be opened at 130° F. Current flows from the thermostat 34 through the conductor 56 which leads to the terminal conductor 107, which engages with the movable contact 38 mounted on the piston 37. There is an additional conductor 103 which connects the thermostat 34 with the thermostat 35 which, in its turn, is connected through the conductors 102 and 57 with a conductor 101 which engages with the movable contact 95 mounted on the thermostat 94. The resistance 39 is interposed in the connection between the conductor 57 and the conductor 111 and is short-circuited by the thermostat 94 when the contact 95 engages with the conductor 101, when the current flows across a conductor 110, which leads through a conductor 111 to the conductor 30. When the contact 95 is opened, however, a small quantity of current can still flow from the conductor 57 to the conductor 111, through the resistance 39. The conductor 111 connects with the conductor 30 which leads back to the solenoid 25, and thus operates the piston 24, as described above.

In the box 59 mounted on the engine, there are two stationary terminals 53 and 104. The terminal 53 is connected with the conductor 30 and the terminal 104 is connected, through the conductor 99 and a heating coil 98, with the ground 74. The movable contact 38 is held in engagement with the stationary terminal 53 by a tension spring 43. In Figure 6, an alternative construction using a compression spring 43, is shown. This contact 38 is connected to a piston 37 which is loosely mounted in a cylinder 36, the cylinder being connected to the vacuum in the inlet manifold through the pipe 27. The other movable contact 38' is connected with a loosely fitting piston 37' which reciprocates in a cylinder 36' and is moved by a compression spring 43'. This cylinder is in communication with the atmosphere through an opening 97. The chamber 100 within the housing 59 contains the contacts 38, 38' and has an adjustable volume determined by the plug 106. When there is a vacuum in the mixture outlet, the pipe 27 communicates this vacuum to the cylinder 36. Then the contact 38 is drawn over to the left by the vacuum so communicated, which vacuum acts on the piston 37 and stretches the spring 43, and the circuit through 53, 38 is broken.

At the same time, owing to the clearance between the piston 37 and the cylinder 36, a vacuum is created in the chamber 100 which, in its turn, draws the contact 38' over to the right, the piston 37' compressing the spring 43' under the influence of the atmospheric pressure admitted through 97. Thereupon a circuit is established between 38' and the terminal 104. This produces a flow of current from the battery 48 through the conductor 47, the switch 33, the terminal 41, the conductor 52, thermostat 34, conductor 56, conductor 107, conductor 105, movable contact 38', stationary terminal 104, heating coil 98, to ground 74.

The circuit through the contact 41 and the thermostats 34, 35, and 95, and the conductors 111 and 30, permits a certain amount of current to flow through the solenoid 25 to maintain the choke valve in closed position after the circuit 38, 53 has been broken. The period of time that the current continues to flow freely through the circuit including the three thermostats, depends on the time it takes for the heating coil 98 to deflect the two thermostats 35 and 94 and to open the contacts 55, 102, and the contacts 95, 101. When these contacts open, the current is then forced to take another path and flows from the battery 48 through the switch 33 to the terminal 41, the contact 52, through the thermostat 34, through the conductor 56, through the resistance 40, the conductor 57, and the second resistance 39, to the conductor 111, and then to the conductor 30, back to the solenoid 25. Naturally this current is reduced by the two resistances 39 and 40 through which it is forced to flow.

The first pair of contacts to open is the pair of contacts 95, 101 which introduces the resistance 39 into the circuit. The second pair of contacts to open is 55, 102, which forces the resistance 40 into the circuit and this increases the resistance and decreases the current. The choke valve 22 is thus progressively permitted to open by the effect of the successive reductions in the flow of current. When the contact 52 moves to the right and opens the contacts 41, 52, then the entire mechanism is disconnected and the choke valve 22 is free to open without any resistance from the solenoid. If, before the contacts 41, 52 open, that is, during the starting operation, the engine begins to stall and the vacuum in pipe 27 is destroyed, then some vacuum will linger in the chamber 100. The effect of this vacuum is to maintain connection between the contact 38' and the terminal 104, and to momentarily engage the contact 38 with the stationary terminal 53. This short-circuits the resistances 39 and 40, and thus sends a powerful current through the solenoid 25 and momentarily closes the choke valve 22 and thus checks the tendency of the engine to stall. The same effect results from a sudden opening of the throttle 102, destroying the vacuum in the chamber 100 located in the housing 59.

It will thus be seen that when atmospheric pressure exists in the pipe 27, a very powerful current flows through the thermostatic metal 34, down through the conductor 56, through the conductor 107, and through the contact 38, and the stationary terminal 53. The moment the engine fires, the contact 38, 53 is opened. This current is successively weakened by the successive openings of the contacts first 95, 101, then 55, 102, and finally, 52, 41.

The thermostatic metal 94 is set to open its contact 95 at 40° F.

The thermostatic metal 35 is set to open its contact 55 at 85° F.

The thermostatic metal 34 is set to open its contact 52 at 130° F.

The resistances 39, 40 are adjusted to give the necessary reduction in current for these temperature increases. The heating coil 98 is set to give the correct time effect.

I claim:

1. Automatic starting means for an internal combustion engine having an electric circuit, external carbureting means, a mixture outlet leading therefrom and an air entrance leading thereto comprising a valve mounted in said air entrance, means responsive to the air flow

through said entrance for opening said valve, a solenoid electrically connected to said circuit and having a core mechanically connected to said valve so as to close the same when said solenoid is energized by said circuit, a temperature responsive switch mounted on said engine for opening said circuit when the engine reaches a predetermined temperature, a resistance in said circuit between said switch and said solenoid, a second switch in said circuit located between the first switch and the solenoid so as to short-circuit said resistance when closed, a vacuum chamber having a passage connected to said mixture outlet, a restriction therein, means responsive to the temporary difference of pressure in said chamber and said mixture outlet for holding said second switch closed until the pressure in the chamber becomes substantially equal to that in the mixture outlet, resilient means for opening said second switch at all times except when the vacuum in the mixture outlet is less than that in the chamber.

2. Automatic starting means as described in claim 1 together with a second temperature responsive switch mounted on said engine and located in said electrical circuit so as to short-circuit said resistance when cold, a second resistance in said circuit, a third temperature responsive switch mounted on said engine and located in said circuit so as to short-circuit said second resistance when cold, a heating coil located between the second and third temperature responsive switches and grounded at one end and connected to the circuit through a fourth switch at the other, means for applying mixture outlet vacuum to operate said fourth switch so that the heating coil is in operation so long as there is vacuum in the mixture outlet.

3. Automatic starting means as described in claim 1 together with a second temperature responsive switch mounted on said engine and located in said electrical circuit so as to short-circuit said resistance when cold.

4. Automatic starting means as described in claim 1 together with a second temperature responsive switch mounted on said engine and located in said electrical circuit so as to short-circuit said resistance when cold, a second resistance in said circuit, a third temperature responsive switch mounted on said engine and located in said circuit so as to short-circuit said second resistance when cold.

5. Automatic starting means for an internal combustion engine having a source of electricity, an electric circuit connected thereto, external carbureting means, a mixture outlet leading therefrom and an air entrance leading thereto comprising a valve mounted in said air entrance, means responsive to the air flow through said entrance for opening said valve, a solenoid electrically connected in said circuit and having a movable core mechanically connected to said valve so as to close the same when said solenoid is energized by said circuit, a plurality of temperature responsive switches mounted in said engine, a plurality of resistances in said circuit, each of said switches being adapted to short-circuit one of said resistances at different temperatures whereby the flow of current permitted to flow to said solenoid is reduced step by step as the temperature increases.

6. Automatic starting means as described in claim 5 in which a heating coil is located adjacent to one of said temperature responsive switches and connected to said circuit through a switch, means responsive to an increase of vacuum in said mixture outlet for moving said switch to render said heating coil operative.

7. Automatic starting means as described in claim 5 in which an additional switch is provided adapted to short-circuit at least one of said resistances, a vacuum chamber communicating with said mixture outlet through a restricted passage, means responsive to the temporary difference of pressure between said outlet and said chamber for operating said switch whereby the current flow is increased temporarily during the acceleration of said engine.

SCOTT F. HUNT.