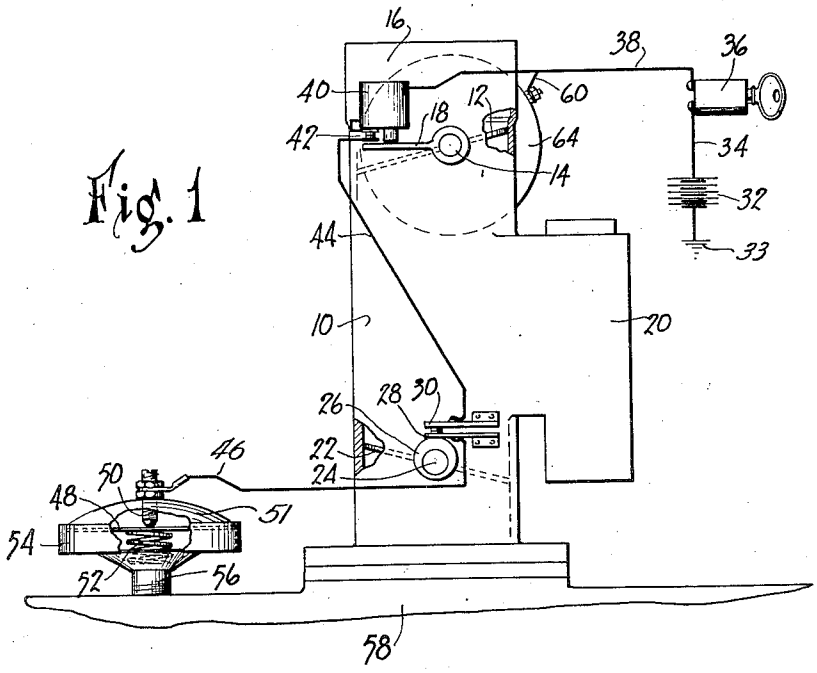
Feb. 23, 1937. S. F. HUNT 2,071,633

FUEL MIXTURE CONTROL

Filed Oct. 29, 1932

Fig. 1



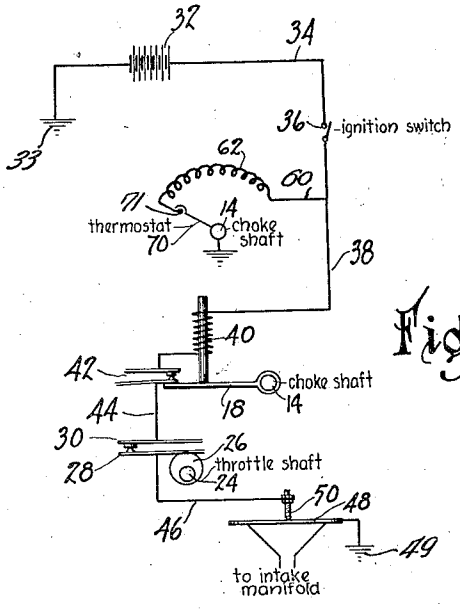


Fig. 3

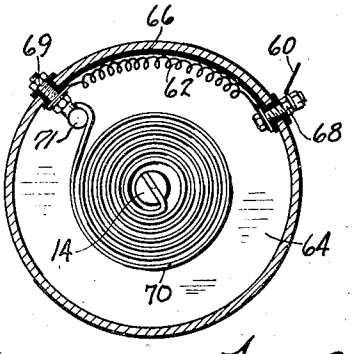


Fig. 2

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FUEL MIXTURE CONTROL

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19 Claims. (Cl. 123—119)

This invention relates to a fuel mixture control, and more particularly to a method of and mechanism for automatically controlling the richness of the fuel mixture supplied by the carburetor of an internal combustion engine.

In its preferred form the invention covers an automatic choke similar to that disclosed in the copending application of Hunt and Olson, Serial No. 575,025, filed November 14, 1931. The device hereinafter disclosed includes a carburetor having an unbalanced choke valve, the degree of opening of which governs the richness of the fuel mixture supplied to the engine. The choke valve is held yieldingly in closed position by an electromagnet and by a thermostat, the force of the latter being dependent upon a heating coil which gradually warms the thermostat and decreases its force as the engine continues to operate.

An object of the invention is to provide an improved method of and apparatus for controlling the richness of the fuel supplied to an internal combustion engine or the like.

Further objects and advantages of the invention will be apparent from the following description taken in connection with the appended drawing, in which:

Figure 1 is a view in elevation of a device embodying the invention;

Figure 2 is a sectional detail view showing the construction of the thermostat and associated parts; and

Figure 3 is a diagrammatic view of the device.

The invention is shown as applied to a carburetor 10 of the down-draft plain tube type, although obviously the invention may be applied to other types of carburetors as well. The carburetor is provided with a choke valve 12 which is preferably of the unbalanced butterfly type, being fixed to a shaft 14 which is mounted eccentrically of the air inlet 16. A crank arm 18, of magnetic metal, is fixed to shaft 14 outside of the air inlet.

The carburetor is provided with the usual float chamber, indicated at 20, and with a fuel nozzle (not shown) of any suitable construction. Posterior to the fuel nozzle is a throttle valve 22 which is manually actuated in the usual manner by mechanism not shown. The throttle shaft 24 carries a cam 26 exteriorly of the carburetor designed to coact with a spring contact member 28 to move it into contact with a cooperating contact member 30, thus controlling an electrical circuit which extends from ground 33 through the storage battery 32, lead 34, ignition switch 36, lead 38, electromagnet 40 and its associated switch 42, lead 44, contacts 28 and 30, lead 46, and diaphragm 48 to ground 49, as best seen in Figure 3. It will be seen that switch 42 is controlled by crank arm 18, so that as soon as the choke valve is opened a substantial distance the crank arm permits the contacts to spring apart and thus open the switch 42. Diaphragm 48 also forms the movable member of a switch, the fixed member being a plug 50 which is carried by a supporting member 51, of insulating material, the diaphragm being normally held in contact with the plug 50 by a spring 52. The diaphragm is enclosed within a casing 54 and its upper surface is subjected to atmospheric pressure whereas its lower surface is, through a tube 56, subjected to the (usually subatmospheric) pressure within the intake manifold 58.

A shunt 60 connects lead 38 to a heating coil 62 which extends part way around the inner periphery of a casing 64, being insulated therefrom as indicated at 66. The ends of coil 62 are attached to insulated plugs 68 and 69 secured to the casing. Plug 69 has its inner end 71 formed as a stop which is designed to engage the outer end of a coiled spring thermostat 70, the inner end of which is fixed to the choke valve shaft 14 which is grounded simply by being in electrical contact with the carburetor body. It will thus be seen that, with the parts in the positions shown, current may pass from lead 38 through shunt 60, plug 68, coil 62, plug 69, stop 71, and thermostat 70 to ground.

In operation, assuming that the engine is cold and at rest, the parts will be in the positions shown in the drawing. To start the engine, the operator closes the ignition switch 36, thus causing electrical current to flow through both circuits as above described. He may also open the throttle slightly, but such slight opening will not be sufficient to separate the contacts 28 and 30. The engine crank-shaft is then turned over by the usual starting mechanism (not shown), but the resulting suction is not sufficient either to break the circuit at diaphragm 48 or to open the choke valve (against the force of electromagnet 40 and thermostat 70) sufficiently to open the switch 42. The choke valve 12 is therefore maintained in its closed position until the engine becomes self-operative.

As soon as explosions begin to occur in the cylinders, the subatmospheric pressure in the intake manifold drops sharply, which draws diaphragm 48 inwardly against the force of spring 52, breaking the circuit at 50. Electromagnet 40

then ceases to hold the choke valve closed, and it moves to a point where equilibrium is established between the force of the incoming air tending to open the valve and the force of the thermostat 70 tending to close it.

In the meantime, current has been flowing through resistance coil 62, gradually heating the interior of casing 64 and causing the thermostat 70 to exert a decreasing force on shaft 14, since the thermostat is of the type which coils more closely upon itself as it is heated. This process continues, allowing the choke valve to open more and more widely, until a point is reached where the free end of the thermostat breaks contact with stop 71, thus breaking the heating circuit. From this point on, the heat of the engine is sufficient to maintain the temperature of the thermostat at such point that the contact at plug 69 is not reestablished while the engine is running. The resistance of coil 62 and the heat capacity of casing 64 are so designed that the casing temperature rises in proportion to the engine temperature, so that the richness of the mixture, as governed by the choke valve, is at all times suited to the needs of the engine.

If the engine is cranked while the ignition switch is open, electromagnet 40 will not function and the choke valve will open partially under the suction developed in cranking. This will decrease the tendency to flood the engine. If the ignition switch is closed and the engine is cranked but fails to fire, flooding may result. In such case, the operator fully opens the throttle, breaking the circuit at 28 and releasing the choke valve from the influence of electromagnet 40, and continues cranking until the excess fuel is drawn out of the engine.

Although the invention has been described with particular reference to the embodiment illustrated in the drawing, it will be understood that it may be embodied in other forms and is not limited except by the terms of the following claims.

I claim:

1. In a carburetor for an internal combustion engine or the like, a choke valve, a throttle, and electromagnetic means operative only when the throttle is in or near its closed position to exert a closing force on the choke valve.

2. In a carburetor for an internal combustion engine or the like having an intake manifold, a choke valve, and electromagnetic means operative only when the pressure in the intake manifold of the engine is at or near atmospheric to exert a closing force on the choke valve.

3. In a carburetor for an internal combustion engine or the like, a choke valve, a throttle, and electromagnetic means operative only when the choke valve is closed and the throttle is in or near its closed position to exert a closing force on the choke valve.

4. In a carburetor for an internal combustion engine or the like having an intake manifold, a choke valve, and electromagnetic means operative only when the choke valve is closed and the pressure in the intake manifold of the engine is at or near atmospheric to exert a closing force on the choke valve.

5. In a carburetor for an internal combustion engine or the like having an intake manifold, a choke valve, a throttle, and electromagnetic means operative only when the throttle is in or near its closed position and the pressure in the intake manifold of the engine is at or near atmospheric to exert a closing force on the choke valve.

6. In a carburetor for an internal combustion engine having an intake manifold, a choke valve, a throttle, and electromagnetic means operative only when the choke valve is closed, the throttle is in or near its closed position, and the pressure in the intake manifold of the engine is at or near atmospheric to exert a closing force on the choke valve.

7. In a carburetor having a choke valve and a throttle, an electromagnet operative to yieldingly retain the choke valve in its closed position, and a second means responsive respectively to the position of the choke valve and of the throttle for rendering the electromagnet inoperative.

8. In a carburetor having a choke valve and a throttle and adapted to be connected to the intake manifold of an internal combustion engine, an electromagnet operative to retain the choke valve in its closed position, and means independent of said electromagnet responsive respectively to the position of the choke valve and to the pressure in said manifold for rendering the electromagnet inoperative.

9. In a carburetor having a choke valve and a throttle and adapted to be connected to the intake manifold of an internal combustion engine, an electromagnet operative to retain the choke valve in its closed position, and a second means responsive respectively to the position of the choke valve and of the throttle and pressure in said manifold for rendering the electromagnet inoperative.

10. In a carburetor for an internal combustion engine, a choke valve, a thermostat influencing the operation of the choke valve, an electrical circuit, a switch in said circuit normally closed only during the operation of the engine to which the carburetor is connected, said circuit including a heating element positioned to influence the thermostat and a second switch actuated by the thermostat.

11. In a carburetor for an internal combustion engine, a choke valve, an electrical circuit including a thermostat influencing the operation of the choke valve, a switch in said circuit normally closed only during the operation of the engine to which the carburetor is connected, said circuit including a heating element positioned to influence the thermostat and a second switch which opens in response to temperatures developed by the heating element.

12. In an internal combustion engine, an ignition circuit, an intake manifold, a carburetor connected thereto and having a pressure-responsive choke valve and a throttle, an electromagnet urging said choke valve toward its closed position, an electrical circuit including said electromagnet and supplied from said ignition circuit, and a plurality of switches controlling said electrical circuit, one of said switches being controlled by the position of the choke valve, another of said switches being controlled by the position of the throttle valve, and another of said switches being controlled by the pressure in the intake manifold.

13. A device as defined in claim 12, wherein another of said switches is manually controlled from the ignition circuit.

14. In combination with an internal combustion engine carburetor having a choke valve, a thermostat influencing the operation of the choke valve, an electric circuit, a switch in said circuit normally closed only during operation of the engine and including heating means for the thermostat, a second electric circuit including electro-

magnetic means operable to influence the operation of the choke valve, and common means for making and breaking both of said circuits.

15. In combination with an internal combustion engine carburetor having a choke valve, a thermostat influencing the operation of the choke valve, an electric circuit including heating means for the thermostat, a second electric circuit including electromagnetic means operable to influence the operation of the choke valve, common means for simultaneously breaking both circuits, and means responsive to the position of the choke valve for controlling the second mentioned circuit.

16. In combination with an internal combustion engine carburetor having a choke valve and a throttle valve, a thermostat influencing the operation of the choke valve, an electric circuit including heating means for the thermostat, a second electric circuit including electromagnetic means operable to influence the operation of the choke valve, common means for controlling both circuits, and means responsive to the suction posterior to the throttle valve for controlling the second mentioned circuit.

17. In a carburetor for an internal combustion engine having an ignition switch; a mixing chamber having a main air inlet, a pressure responsive choke valve controlling said air inlet, a thermostatic spring mechanically connected to the choke valve to yieldingly urge it toward closed position when cold, a heat-retaining casing enclosing said thermostat, an electric resistance element within the casing in heat-exchange relation to the thermostat, and a circuit including said ignition switch and said resistance element.

18. In a carburetor for an internal combustion engine having an ignition switch; a mixing chamber having an air inlet, a pressure responsive butterfly choke valve mounted off-center on a shaft and controlling the air inlet, a coiled bimetallic temperature-responsive spring positioned adjacent said shaft and mechanically connected thereto to yieldingly urge it toward closed position when cold, a casing enclosing said thermostat, an electric resistance element within the casing in heat-exchange relation to the thermostat, and a circuit including said ignition switch and said resistance element.

19. The invention defined in claim 18, wherein the circuit also includes a storage battery, so that current flows through the resistance element continuously while the ignition switch is closed.

SCOTT F. HUNT.