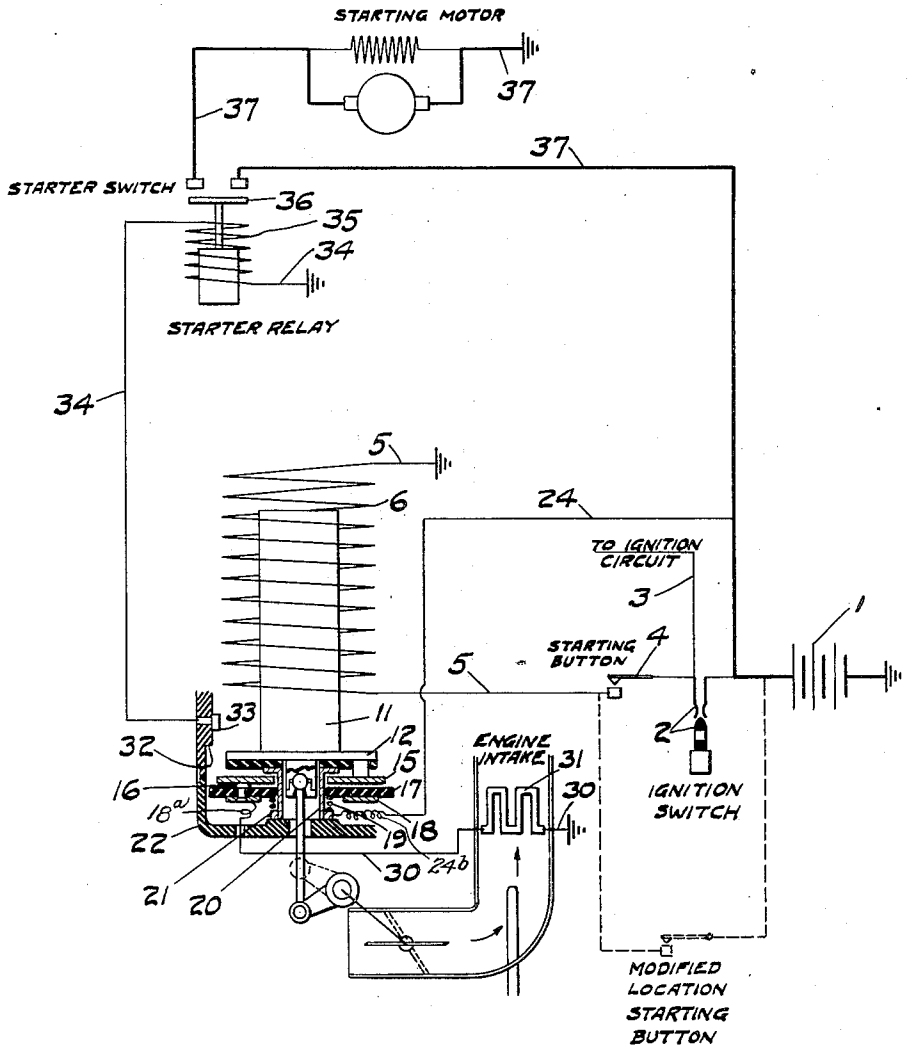
July 11, 1933. C. D. TURNER 1,917,817

ENGINE STARTER CONTROL

Filed Nov. 30, 1931 2 Sheets-Sheet 1

Fig. 1



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Fig. 3

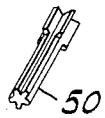


Fig. 2

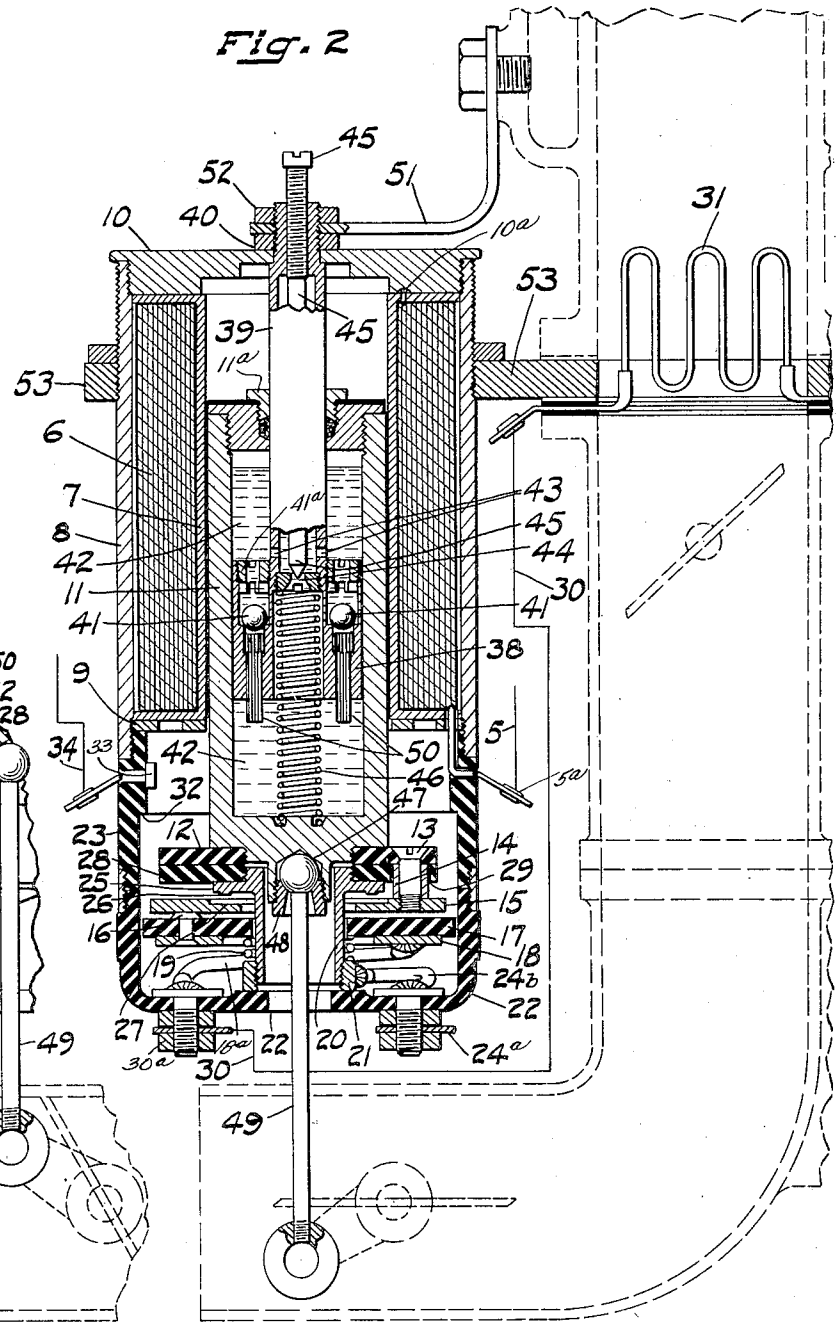
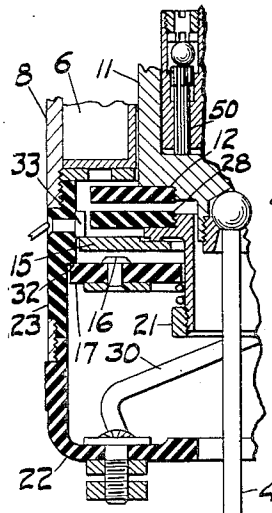


Fig. 4



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ENGINE STARTER CONTROL

Application filed November 30, 1931. Serial No. 577,984.

The fundamental object of this invention is to produce means by which the starting of internal combustion engines is effected through the proper correlation and synchronization of the three essential functions required to produce most efficient, positive and beneficial results in such an operation. These three functions are proper mixture control, proper fuel vaporization, and proper starting motor control.

A further and more specific object is to produce a means by which the choke valve of the carburetor is controlled automatically to function at the proper time, by means of which an electric heating device is operated in association with the choke control to deliver heat to the fuel mixture passing to the engine, and by means of which the starting motor circuit is controlled automatically in conjunction with the two functions just mentioned.

A further specific object of my invention is to provide heat to vaporize the fuel mixture in the manifold during the cranking operation, without taking additional energy from the battery while the starting motor is in operation, and to resume the application of heat to the fuel mixture for a predetermined period after the engine has started and the starting motor has ceased operation.

An additional and important object of my invention is to produce a device by means of which the duration of the choking operation and the fuel-air mixture ratio is controlled according to the characteristics of the engine with which the device is associated and the conditions of atmosphere at the time the device is operated, both as to the humidity of the atmosphere and temperature of both engine and atmosphere.

These and other objects are attained in the control device described in the following specification and illustrated in the accompanying drawings, in which:

Fig. 1 is a diagrammatic view showing circuits and details embodied in the construction and control of my device.

Fig. 2 is a cross-sectional view of my control device in mounted relation to associated parts of the engine and carburetor.

Fig. 3 is a perspective view of a valve-releasing plunger forming a detail of my invention.

Fig. 4 is a fragmental sectional view of the device shown in Fig. 2, but showing the parts in different positions.

Referring to the diagrammatic view shown in Fig. 1, the conventional battery 1 of the usual automobile equipment, furnishes the energy required in the operation of my device. Of course, the usual ignition switch 2 connects this battery to the ignition circuit 3. For engine starting purposes I have shown a starter switch 4 which may be manually operated if desired and which is connected in a circuit 5 adapted to energize a solenoid magnet 6.

Referring now specifically to Fig. 2, solenoid 6 is wound upon a spool 7 which is enclosed within casing 8 of magnetic material and located between a magnetic plate 9 and a magnetic cap 10. Within spool 7 is mounted a magnetic sliding core 11 which has a non-conducting plate 12 at its lower end, upon which plate a contact plate 15 is mounted by means of screws 13 and spacers 14. A non-conducting plate 17 is mounted to reciprocate on a sleeve 20, being supported by a spring 19 which surrounds the sleeve and which is held in place by a nut 21 on the lower end of sleeve 20.

A non-conducting cap 22 is attached to case 8 by means of an intervening non-conducting sleeve 23, thereby affording a normal rest for the nut 21, as shown in Fig. 2. At its upper end, a flange 25 is carried by sleeve 20, and on the sleeve, above the flange, a non-conducting disc 28 is mounted, preferably by means of screw threads as shown. This disc 28 is perforated at the proper intervals, as at 29, for guidance by the spacers 14 to permit of slight reciprocatory movement of sleeve 20 and consequent relative movement between non-conducting plates or discs 12 and 28 as shown in Figs. 2 and 4, and which movement is limited by plate 15.

On the underside of disc 17 is an annular bus plate 18 which is attached thereto by pins forming contacts 16 adapted, on the upper surface of disc 17, to engage and disengage

plate 15 as shown in Figs. 2 and 4. The plate 18 is connected with a heating element 31 located in the intake manifold of the engine by a circuit 30, through a terminal 30^a and a flexible connection 18^a. Sleeve 20 and its flange 25 and nut 21 are connected, by connection 24, with the battery 1, through terminal 24^a and flexible connection 24^b, both terminals 30^a and 24^a being located in the non-conducting cap 22 as shown.

One end of the solenoid winding connects with circuit 5 through non-conducting sleeve 23 by means of a terminal 5^a, the opposite end of the solenoid winding connecting with magnetic cap 10 at $10a$ and thence to "ground" through a connection 51 as shown.

Core 11, to which reference has been made, is made cup shaped and has a cylindrical bore within which a piston 38 is located. This piston is anchored against movement by means of its stem 39 being held in place by nuts 40 and 52. Within the piston are chambers containing check valves 41 which seat by gravity to close passages extending through the bottom of the piston and in which valve lifters 50 are located. These valve lifters are fluted, as shown in Fig. 3, and have their lower ends extending through and beyond the bottom of the piston for engagement with the inner bottom of the core at certain times, whereupon the lifters operate to push valves 41 from their seats. Apertured plugs in the upper ends of the valve chambers prevent displacement of the valves and permit passage of fluid within the core 11 from beneath the piston to above the piston, the flutes in the lifters affording passage of fluid in the operation. A stuffing box $11a$ in the upper end of core 11 permits of reciprocal movement of the core. Within the piston and located between it and the inner bottom of core 11 is a spring 46 which bears downwardly upon the core and holds it and its associated elements in the position shown in Fig. 2. Within the stem 39 of the piston is a chamber containing ports 43 and 44, the former communicating with the core interior above the piston and the latter communicating with the core interior beneath the piston by way of the central passage in which spring 46 is located. Within the piston stem is located either a jet of standard opening or a needle valve 45, which, at its upper end is screw threaded for adjustment and at its lower end is pointed for variation of opening or closing port 44 to govern the rapidity of movement. At the lower end of core 11 a ball socket 47 is located to retain, by means of a nut 48, a connecting link 49 which extends through sleeve 20 and cap 22 to connection with the arm of a carburetor choke valve, as shown.

A feature of the construction I have set forth is that nonconducting sleeve 23 carries a contact 33 and that the nonconducting discs 12 and 28 are small enough to move within and to pass contact 33, while contact plate 15 is larger in diameter and engages contact 33 when the core 11 rises. Also, it will be seen that disc 17 is still larger than plate 15 and engages shoulder 32 when core 11 rises.

To initiate operation of the device the starting button 4 is depressed after ignition switch 2 has been closed. This closes circuit 5 and energizes solenoid winding 6. Core 11 is thereby lifted, causing plate 12 and contact plate 15 to be lifted. This lifting of plate 15 brings it into contact with ring 26 of flange 25 of sleeve 20, thereby lifting these elements by engagement with surface 27 of plate 15. Because of spring 19, contact is maintained between plate 15 and contact 16 during this lifting movement. Therefore circuit 30 is closed to energize heater 31, thereby placing the engine intake atmosphere in condition to receive a charge of fuel for vaporization and preheating previous to delivery to the engine.

Further upward movement of the core 11 will bring insulator plate 17 into engagement with shoulder 32 in sleeve 23, thereby holding this plate against movement as the core continues upwardly toward the completion of the stroke. This results in separation between contact 16 and plate 15, thereby breaking circuit 30 and disconnecting heater 31 from its source of heating energy.

This second operation having taken place, the completion of the core movement brings plate 15 to engage contacts 33, thereby closing circuit 34, which results in energization of solenoid 35. This causes relay switch 36 to be closed, and in this manner start the starting motor through the closing of the circuit 37, whereby the engine is cranked.

It will be observed that during the time that circuits 34 and 37 are closed, circuit 30 is left open. However, after the engine has started and button 4 has been released, the contact between plate 15 and contacts 33 is broken by downward movement of core 11 after the energizing circuit is broken by release of button 4. This deenergizes the starter relay, resulting in opening the starter switch and stopping the starting motor. Following this, the contact between plate 15 and contacts 16 is reestablished and the heating circuit again closed, whereby heater 31 is again energized following its first heating. This continues during further descent of core 11, until nut 21 engages cap 22, whereupon contact is broken between sleeve 20 and plate 15, at the point of contact of ring 26 with plate 15 on surface 27, thereby shutting off the heater 31.

I will now describe the operation of the valve construction within piston 38 and its stem 39. Check valves 41 are placed in the piston so that a quick transfer of fluid 42, lo-

cated within the core, piston and stem, may be made from the lower chamber of core 11, beneath the piston, to the upper chamber of the core, above the piston, at the time the core is drawn upwardly by its solenoid energization. Assurance of complete valve opening is had through the plungers 50, which prevent any one or more of the valves sticking on their seats by contacting the bottom of the core and thereby forcing such sticking valve or valves to be lifted, but the principal function of these lifters is to cause complete opening of all the valves so that the core will drop quickly until the plungers are disengaged by the core, thereby causing a quick breaking of circuit 34 at contacts 33 with plate 15 and as quickly the reestablishment of the heater circuit 30 before its heater 31 has cooled, and simultaneously the return of the choke valve from a completely choked to such a rich running position as may be established experimentally.

The balance of the downward stroke of core 11 is accomplished at a rather slow speed because of the operation of opening or valve 45, such slow speed being desirable in order to allow a sufficient period of energization of heater 31 until normal engine heat has raised the temperature of the engine intake sufficiently to assure continuation of efficient operation. Spring 46 has been provided to assure of this downward movement of the core 11.

As an added feature of my invention I draw attention to the character of the fluid 42 in core 11. This is of such a nature that during warm weather or when the motor is warm, the viscosity of the fluid permits the core to drop at a higher rate of speed than when the weather or motor is cool. In this manner the fluid itself performs the function of governing the speed of movement of the core for the purposes and conditions under which the device is designed to function. It is interesting to note that I have provided a second function for connector 51 to perform, which is, to conduct heat directly from the exhaust manifold, intake manifold or the water jacket to the piston 38 and its stem 39 so that the fluid 42 may be warmed quickly and kept warm, thereby assuring of efficient functioning of the device. Any suitable mounting, such as plate 53 may be provided for supporting the device in proper location.

Having thus described my invention what I claim is:

1. An electro mechanical hydraulic control device for internal combustion engines, comprising a movable switch operating element, an electrical means for moving the switch operating element, a circuit including a fuel heater, a circuit including an engine starter, a switch in the heater circuit, and a switch in the starter circuit, said switch operating element functioning the switch operation in the sequence of closing the heater circuit, opening the heater circuit, closing the starter circuit, opening the starter circuit, closing the heater circuit and opening the heater circuit.

2. In combination with an electro mechanical hydraulic control device for internal combustion engines, a fuel heater circuit, an engine starter circuit, a switch in the heater circuit, a switch in the starter circuit, comprising a movable switch operating element, an electric means for moving the switch operating element in one direction in sequence to close the heater circuit, open the heater circuit, and close the starter circuit, and a mechanical means for moving the switch operating element in the opposite direction in sequence to open the starter circuit, close the heater circuit, and open the heater circuit.

3. In combination with an internal combustion engine, a carburetor, an engine starter circuit, a fuel heater circuit, a starter circuit switch, a heater circuit switch, a movable control element, an electric means for moving the switch and carburetor control element in sequence to close the heater circuit, control the carburetor, open the heater circuit, and close the starter circuit and mechanical means to restore the control device to normal condition, whereby, in sequence, the starter circuit is opened, the heater circuit is closed, the carburetor restored to normal conditions, and the heater circuit is opened.

4. In combination with an electro mechanical hydraulic control device for internal combustion engines and their carburetors, a fuel heater circuit, an engine starter circuit, a switch in the heater circuit, a switch in the starter circuit, said device comprising a movable switch and carburetor operating element, an electric means for moving the element in one direction in sequence to close the heater circuit, cause the carburetor to deliver a starting fuel mixture, open the heater circuit, and close the starter circuit, and a mechanical means for moving the switch operating element in the opposite direction in sequence to open the starter circuit, close the heater circuit, gradually return the carburetor to normal fuel mixture condition, and open the heater circuit.

5. An electromechanical hydraulic control device for internal combustion engines comprising a switch operating element consisting of a cylinder and a piston in the cylinder, an electric device for moving the cylinder and piston relatively to each other in one direction, a fuel heater circuit, a fuel heater circuit, a fuel heater in the circuit, a circuit including an engine starter, a switch in each of the circuits, said switches having connection with the relatively movable members of the switch operating element, whereby when

the electric is functioned, switch operation will be performed in sequence to close the heater circuit, to open the heater circuit, and close the starter circuit, and a mechanical device for moving the cylinder and piston relatively to each other in the opposite direction, whereby switch operation will be performed in sequence to open the starter circuit, close the heater circuit, and open the heater circuit.

6. In combination, an internal combustion engine, an engine carburetor, an engine starter circuit, a fuel heater circuit, a switch in the starter circuit, a switch in the heater circuit, a switch and carburetor control element consisting of a cylinder and a piston in the cylinder, and an electric device controlling movement of the cylinder and piston relatively to each other in one direction in sequence to close the heater circuit, to cause the carburetor to deliver a starting fuel mixture to open the heater circuit, to close the starter circuit, and a mechanical device controlling relative movement of the cylinder and piston in the opposite direction, whereby in sequence to open the starter circuit, close the heater circuit, restore the carburetor to normal fuel delivery condition, and open the heater circuit.

In testimony whereof I have hereunto affixed my signature.

CARL D. TURNER.