

[54] **THERMO SWITCH ARRANGEMENT FOR CONTROL OF AN INTERNAL COMBUSTION ENGINE**

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[58] Field of Search **123/119 F, 117 A; 261/39 E, 39 R**

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Primary Examiner—Wendell E. Burns

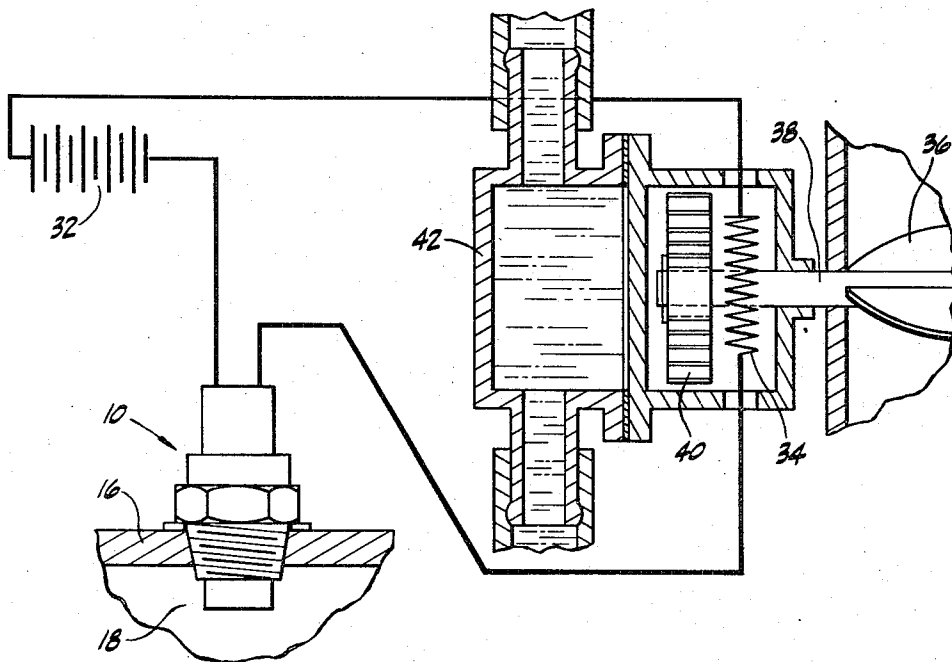
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[57]

ABSTRACT

A dual switch is mounted in the wall of the water jacket of the engine so that one thermo switch responds to the engine heat and the other thermo switch responds to the ambient temperature. The switches are connected in series with a source of current and a heater in proximity to an expansible coil controlling the choke valve. The coil is adjacent a water jacket so that it is affected by engine heat. The engine heat responsive thermo switch remains closed until the engine temperature approaches a near-normal value. At low temperatures, the ambient switch is open, and it closes only after the choke is opened following a warm-up period. During cooling of the engine, the ambient switch remains closed down to a relatively low temperature, so that if the engine is "soaked," the heater will be energized for quick opening of the choke, to relieve the "soak" condition. Another dual thermo switch may be similarly mounted in the wall of the water jacket and connected in a circuit for controlling the ignition advance means of the distributor.

6 Claims, 4 Drawing Figures



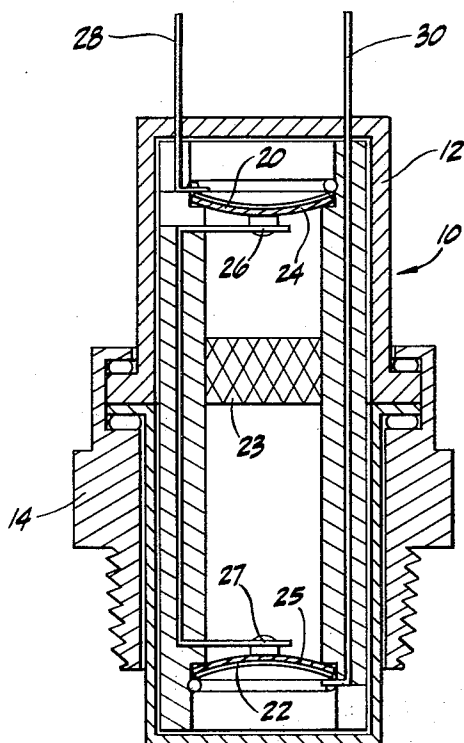


FIGURE 1.

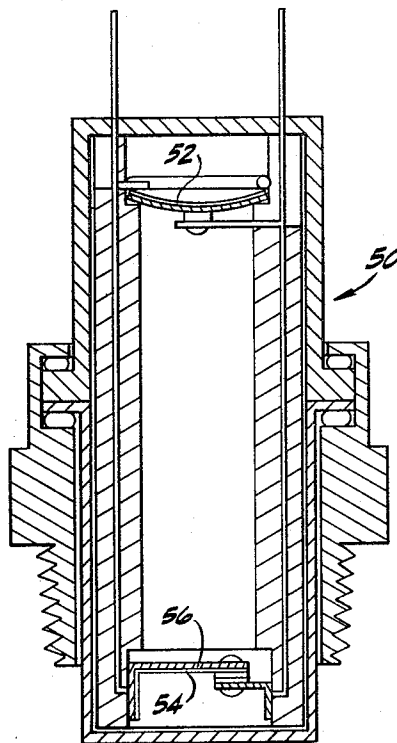


FIGURE 2.

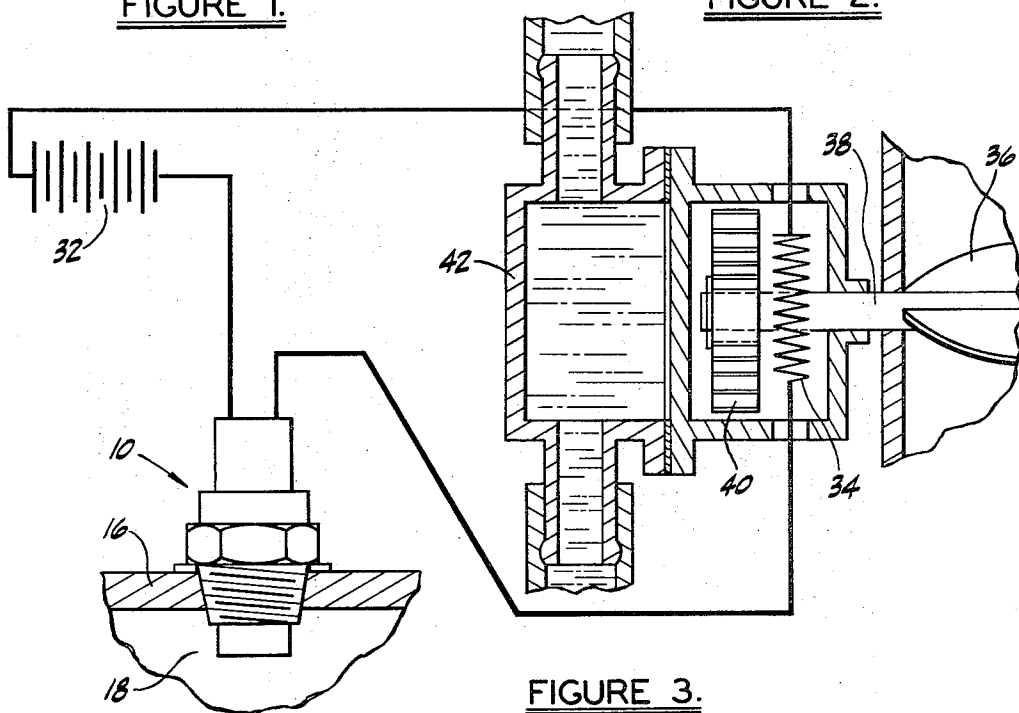


FIGURE 3.

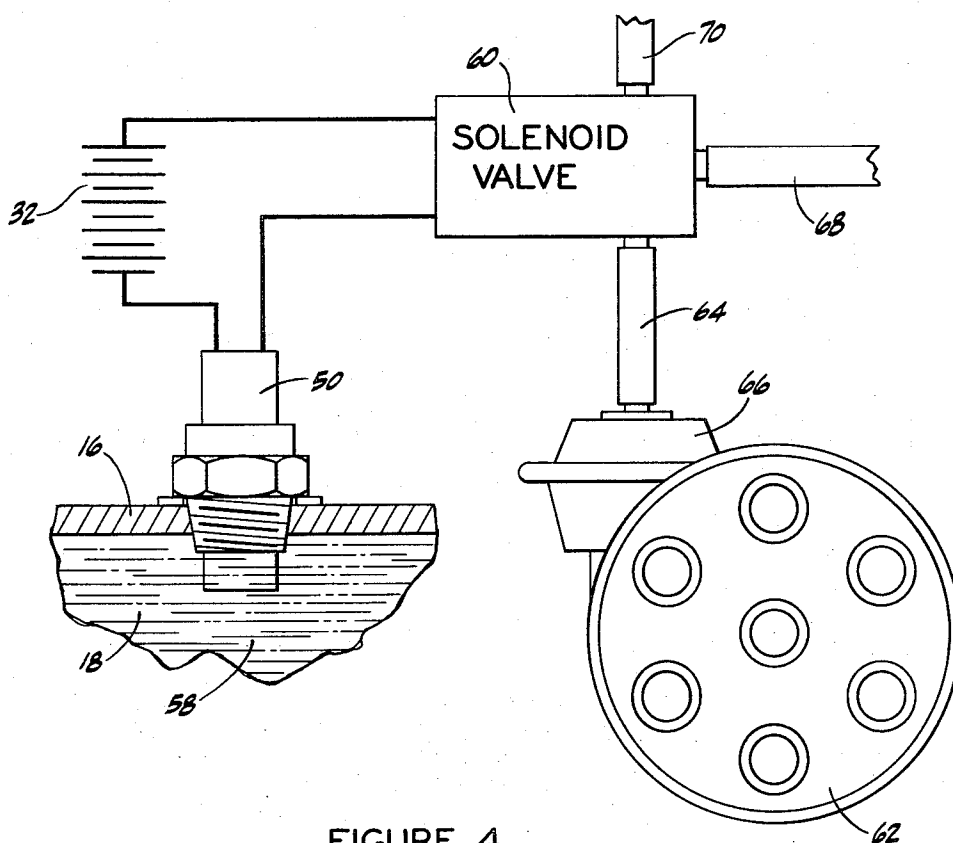


FIGURE 4.

THERMO SWITCH ARRANGEMENT FOR CONTROL OF AN INTERNAL COMBUSTION ENGINE

BACKGROUND OF THE INVENTION

A carburetor choke valve is adapted to close at low temperatures and open after a suitable warm-up period. For this purpose, the choke valve may be controlled by an expansible spiral coil adapted to be heated by the engine coolant or by heated air. To aid in heating the coil, an electric heater is placed in proximity thereto. Difficulties are often encountered when an engine is restarted a short time after it has been shut off, because a condition called "soaking" occurs, in which a considerable amount of fuel may condense and accumulate in the intake manifold and the carburetor mixture chamber. The air fuel mixture may then be so rich that starting is very difficult, and if the choke is closed, the excess fuel is not readily removed.

To lower exhaust emissions, it has been found that at ambient temperatures (say, above about 65° F), the ignition should be retarded when the engine is idling. At lower temperatures, it is desirable to advance the ignition for better engine operation. Accordingly, an object of the invention is to achieve desirable operation of the choke valve and of the ignition advance mechanism by means of dual thermo switches responsive to ambient and engine temperatures.

SUMMARY OF THE INVENTION

A dual purpose switch includes an insulated casing having two widely separated series connected thermo switches therein. The casing is adapted to be mounted in a wall of the water jacket of an internal combustion engine so that a part of the casing is in and a part is outside the water jacket. The lower or inner thermo switch responds to the engine coolant to control a heater for the automatic choke valve, and its function is to turn the heater off after the engine warms up. The other thermo switch is subject to ambient temperature, and is designed to remain open until choke begins to open. During cooling, after engine shut-down, the ambient switch remains closed down to approximately 60° to 66° F. If the engine is "soaked" above 66° F, the heater is energized for quick opening of the choke during starting. Below about 60° F, the ambient switch is open, and it does not close until the temperature rises to about 85° F. Thus, when starting at a low temperature, the heater is energized only after the choke is opened. Hence, the heater has no effect on the warm-up period, but relieves a "soak" condition by opening the choke valve.

Another similar dual purpose switch may be mounted in the water jacket to retard the ignition above ambient temperatures of about 65° F and advance the ignition at lower temperatures during engine idling. The thermo switch in the water jacket senses any overheating of the engine that might develop due to prolonged idling with loads such as air conditioning applied to the engine. Under such a condition, the second thermo switch will close to advance the spark and speed up the engine and thereby increase its cooling.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view of a switching device having a pair of thermo switches connected in series.

FIG. 2 is a sectional view of a switching device having a pair of thermo switches connected in parallel.

FIG. 3 shows the switching device of FIG. 1 in an arrangement for controlling a choke valve.

FIG. 4 shows an arrangement utilizing the switching device of FIG. 2 for controlling the ignition advance and retard mechanism of a distributor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, FIG. 1 shows a dual purpose switch 10 including an insulated casing 12 having a threaded member 14 for mounting switch 10 in wall 16 of a water jacket or casing 18 in which the coolant of the internal combustion engine is adapted to flow. The purpose of this arrangement is to convey the heat of the engine to switch 10 so that the lower portion thereof within casing 18 responds to engine temperature. It is evident, of course, that switch 10 may also be heated by the exhaust or by hot air from the engine. Casing 12 contains a pair of widely spaced thermo switches 20 and 22 separated by insulator 23, when necessary. Each thermo switch has an arched disc 24 or 25, and a fixed contact 26 or 27. The bimetallic discs are designed so that they will snap from one arched condition to the opposite arched condition at predetermined temperatures. For example, disc 24 may be designed so that it will snap to its open position at about 65° F, and will snap closed at about 85° F. Thermo switch 22 may be designed so that it will snap open at about 160° F. As is evident from FIG. 1, switches 20 and 22 are connected in series between leads 28 and 30.

Referring now to FIG. 3, switch 10 is connected in series with the battery 32 and heater 34. Choke valve 36 is fixed to shaft 38, which is connected to an expansible spiral coil or spring 40 in a well-known manner. Spiral coil 40 is subjected to engine heat and, for this purpose, may be mounted adjacent conduit 42 through which the engine coolant flows. Normally, the opening and closing of choke valve 36, which may be of the unbalanced type, is controlled by spiral coil 40 in response to engine temperature. In the present arrangement, auxiliary heater 34 is also placed in close proximity to spiral coil 40.

The arrangement described above functions as follows: If the ambient temperature is below about 65° F, thermo switch 20 is open and no current is supplied to heater 34. When the engine is started at such temperatures, choke valve 36 is substantially closed and remains in that condition until the engine warms up sufficiently to enable spiral coil 40 to open or permit opening of choke valve 36, in a manner well understood in the art. Choke valve 36 is adapted generally to open at engine temperatures corresponding to ambient temperatures somewhat below 85° F and switch 20 remains open until about that temperature is reached, so that the warm-up period of the engine is not affected by heater 34. When switch 20 closes, heater 34 is turned on. The heater remains energized, however, only until the temperature in water jacket 18 increases to approximately 20° below the normal operating value thereof, and then switch 22 opens to break the circuit of heater 34. In other words, if the normal operating temperature in water jacket 18 is about 180° F, switch 22 will open at about 160° F. Thus, heater 34 is cut off during normal engine running.

When the engine is cooling down after being shut-off, switch 20 remains closed at ambient temperatures down to approximately 60°-66° F, and switch 22 closes when it is subjected to a temperature below about 160° F. Hence, if the engine is "soaked" at ambient temperatures above 66° F, the heater will be energized for quick opening of choke 36 during engine starting. Opening of the choke wall, of course, increase the flow of air and help to relieve the "soaked" condition of the engine to permit starting.

Referring now to FIGS. 2 and 4, switch 50 is similar to switch 10 of FIG. 1 except that thermo switches 52 and 54 are connected to parallel rather than in series. Also, the thermo switches may include a flat bimetallic strip 56 instead of a bimetallic arched disc. Switch 50 is adapted to be mounted in wall 16 of water jacket 18 in the same manner as is the switch of FIG. 3, and thermo switch 54 is subjected to the engine coolant 58 while thermo switch 52 responds to the ambient temperature. Switch 50 is connected in series with battery 32 and a solenoid valve 60. Solenoid valve 60 is adapted to control the ignition advance mechanism of a conventional distributor 62. For this purpose, solenoid valve 60 has an outlet comprising conduit 64 connected to air motor 66. The latter may be of a conventional type adapted to advance the spark of distributor 62. As is well-known, the timing of the ignition is adapted to be responsive to the vacuum in the intake manifold, and this vacuum may be conveyed to motor 66 through solenoid valve 60 by conduit 68. Atmospheric pressure may be supplied to solenoid valve 60 by conduit 70. The purpose of solenoid valve 60 is to apply or remove the intake manifold vacuum from the ignition advance motor 66. In order to improve exhaust emissions, it has been determined that above ambient temperatures of about 65° F, the ignition should be retarded at engine idle conditions. At lower temperatures, it is desirable to advance the spark for better engine operation. Hence, thermo switch 52 is designed to close at all temperatures below approximately 65° F, and open at temperatures somewhat above that value. The closing of switch 52 energizes the solenoid of valve 60 to permit the vacuum supplied by conduit 68 to be conveyed to motor 66 for advancing the spark. At temperatures somewhat above 65° F, thermo switch 52 opens and solenoid valve 60 operates to connect to conduit 70 and remove the vacuum from motor 66, permitting the ignition to be retarded. Switch 56 senses any engine overheating condition that might develop due to prolonged idling with heavy loads such as that of air conditioning. In response to such overheating, switch 56 will close and will operate solenoid valve 60 to permit the vacuum from conduit 68 to be applied to motor 66. Motor 66 will then be actuated to advance the spark, which will speed up the engine somewhat and thereby provide increased cooling of the engine to remedy the overheating condition.

It will be apparent from the foregoing that the invention provides dual bimetallic switch arrangements which facilitate starting a "soaked" engine and which advantageously control the vacuum operated ignition advance mechanism of a distributor.

What is claimed is:

1. Apparatus for controlling an internal combustion engine including a carburetor having a control device for opening and closing the carburetor choke valve in response to engine temperature, comprising a circuit

including an electric auxiliary heater in proximity to said control device, said circuit including a source of current and a dual switch device, said switch device having an elongated casing and means for mounting said casing in a wall of a container subjected to the heat of the engine so that one end of said casing is within said container and the other end of said casing is outside said container, a pair of series connected temperature responsive switches located at opposite ends of said casing, so that one of said switches is opened by engine temperatures above a given level and the other switch is closed by ambient temperatures above a given level, whereby said auxiliary heater is energized to enable the control device to open the choke valve in response to predetermined ambient and engine temperatures.

2. Apparatus according to claim 1, wherein each switch includes a bimetallic member constituting the movable contact of the switch.

3. Apparatus according to claim 2 wherein said bimetallic members are in the form of arched discs.

4. Apparatus according to claim 1 wherein said engine has a distributor having spark advance and retard means, comprising a circuit including a source of current and switch means connected in series with a solenoid for actuating said spark advance and retard means, said switch means having an elongated casing and means for mounting said casing in a wall on a container subjected to the heat of the engine, so that one end of said casing is within said container and the other end of said casing is outside said container, said switch means further including a pair of parallel connected temperature responsive switches located at opposite ends of said casing so that one of said switches is opened by ambient temperatures above a given level to retard the spark and the other switch is closed by engine temperatures above another level to advance the spark, and thereby reduce engine overheating, said first switch being closed by ambient temperatures below a given level to advance the spark.

5. A carburetor having an automatic choke valve operated by an engine heated control device, comprising a circuit including an electric auxiliary heater in proximity to said control device, said circuit including a source of current and a dual switch device, said switch device having an elongated insulated casing and means for mounting said casing in a wall of the water jacket of the engine so that one end of said casing is within the water jacket and the other end of said casing is outside of the water jacket, a pair of series connected bimetallic temperature responsive switches located at opposite ends of said casing, so that when the engine is cut off, one of said switches is closed when the engine temperature falls below a given level, and the other switch remains closed at ambient temperatures above a given level, whereby said auxiliary heater is energized to cause the control device to accelerate opening of the choke valve during engine restarting.

6. An internal combustion engine including a control device for controlling the operation of the engine in response to ambient and engine temperatures comprising a circuit including an electric actuator for said control device, said circuit further including a source of current and a dual switch device, said switch device having an elongated insulated casing and means for mounting said casing in a wall of a container subjected to the heat of the engine so that one end of said casing is within

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said container and the other end of said casing is outside said container, a pair of interconnected bimetallic temperature responsive switches located at opposite ends of said casing, so that one of said switches is operated by engine temperatures and the other switch is operated by ambient temperatures for energizing said actuator in response to predetermined ambient and en-

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gine temperatures, said control device including a carburetor choke valve and a means for controlling the opening and closing thereof, said actuator being an electric heater adjacent to said last mentioned means so that energizing said heater actuates said means for controlling so as to tend to open said choke valve.

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