The present invention relates to a gas operated automatic heater for use in conjunction with a liquid cooled internal combustion engine in order to maintain the engine in a warm condition when the engine is not operating and when located in a cold ambient temperature.

Various means have been devised to maintain an internal combustion engine, such as of an automobile, truck, bus or the like motor vehicle, in a warm condition when this engine is not operating so as to facilitate subsequent starting of the engine in cold weather.

One known system provides for automatic intermittent starting and stopping of the engine of the stationary vehicle. This system entails the consumption of a substantial amount of gasoline and causes undue wear and tear on the engine and, moreover, may be dangerous if the system operates with the transmission of the engine out of neutral position. Moreover, this system is complicated and is not proof against faulty operation.

Another known very simple system consists of an electric heater inserted directly into the liquid cooling circuit of the engine, but this electric heater requires an outside supply of electricity and, therefore, the motor vehicle has to be parked in the vicinity of an electric outlet. Therefore, the general object of the present invention is the provision of an engine heater of the character described which will obviate the above noted disadvantages.

The main object of the present invention is the provision of an engine heater which is operated by a gaseous fuel such as a fuel of the alkane and alkene families of hydrocarbons.

Yet another important object of the present invention is the provision of an engine heater of the character described which is completely automatic in its operation and which maintains the temperature of the cooling liquid of the internal combustion engine within an adjustable range of temperature thus permitting easy starting and perfect lubrication of the mechanical parts of the internal combustion engine independently of the outside temperature.

Yet another important object of the present invention is the provision of an engine heater of the character described which is provided with safety means to shut off the burner completely and instantly in case of failure to start, and also to provide an adequate fire trap to prevent the flame from protruding from the enclosed unit, whereby the heater is safe for location adjacent the engine of a motor vehicle such as under the hood of a car or truck.

Yet another important object of the present invention is the provision of an electrically operated control circuit for the engine heater which requires a minimum supply of electrical energy and, therefore, can be directly connected to the conventional battery of the motor vehicle.

Still another important object of the present invention is the provision of a heater of the character described in which all the control elements are failure safe, that is, the supply of the fuel is shut off completely if a failure to start occurs or any control element fails to function properly.

Yet another important object of the present invention is the provision of a heater of the character described which can be supplied with a gaseous fuel under pressure, such as propane or propylene, contained in a pressure bottle of conventional type made in a size easily carried by the motor vehicle.

The foregoing and other important objects of the present invention will become more apparent during the following disclosure and by referring to the drawings in which:

Figure 1 is a perspective view of the engine heater in accordance with the first embodiment of the invention;

Figure 2 is an elevation, partly in section, of the first embodiment;

Figure 3 is a plan section of the bottom part of the combustion chamber;

Figure 4 is a complete schematic representation of the heater and control circuit in accordance with the first embodiment of the invention;

Figure 5 is an enlarged detail schematic view of the thermostatic switch at the top of the heater.

Referring now more particularly to the drawings in which like reference characters indicate like elements throughout, the engine heater comprises a container 1 preferably of cylindrical shape, having a bottom wall 2 and a top wall 3. A liquid inlet pipe 4 and an outlet pipe 5 are in communication with the container 1 adjacent the bottom wall 2 and top wall 3 respectively. The pipes 4 and 5 are adapted to be connected to the liquid coolant circuit of an internal combustion engine, generally indicated at E in Figure 4, by means of conduits 6 and 7 respectively. Upright heat exchange tubes 8 extend through the container 1 and are secured to the bottom and top walls 2 and 3 and open at the exterior of the container 1. The lower end of the heat exchange tubes 8 open within a combustion chamber 9 which is secured to the container 1 underneath the same. The upper ends or outlets of the heat exchange tubes 8 open within a discharge chamber 10 for the combustion gases, said discharge chamber 10 having a top wall 11 and an open side wall which is provided with a screening 12 made of fine wire mesh, similar to the screening used in miner’s lamps, to act as a fire trap to positively prevent escape of flame from the heater while allowing the escape of the combustion gases. The bottom wall 13 of the combustion chamber 9 is provided with a plurality of openings 14, which are screened similarly to the outlet of the discharge chamber, for the admission of ambient air.

A nozzle 15 for the gaseous fuel is mounted within the combustion chamber 9 at the centre thereof and is connected to a pressure bottle 16 by means of piping 17. The pressure bottle 16 which contains propane, propylene or the like gaseous fuel under pressure, can be located anywhere in the motor vehicle and preferably in the rear trunk. This pressure bottle is of a practical size permitting several weeks of operation.

The admission of the fuel gas to the nozzle 15 is controlled by the following elements which are mounted in series in the piping 17: a manually operated stopcock 18 adjacent the pressure bottle 16, a pressure regulator 20 of conventional type, a safety low pressure cut-off switch 19 which cuts off the whole system if the cylinder is empty of gas and a low pressure electromagnetic or solenoid gas valve 21, commonly called “gas valve.” Furthermore, a gas bleed off tube 17 is connected to gas valve 21 and discharges a bleed gas jet adjacent the ignition means immediately upon opening of gas valve 21. Ignition means, generally indicated at 22, are mounted within the combustion chamber 9 adjacent the outlet of bleed off tube 17. The container 1 is provided with bracket means 23 for mounting said container in any
3 suitable location adjacent the internal combustion engine E. A box 24 is mounted on the top wall 11 of the discharge chamber 10. The box 24 contains a heat responsive element sensitive to the heat within the discharge chamber 10, the operation and object of said heat responsive element will be described hereinafter.

In accordance with the present invention, the ignition means 22 consists of a resistance wire 25 which is adapted to be heated until red to ignite the gas discharging from the bleed off jet in bleed off tube 17 providing positive ignition of nozzle 15.

The resistance element 25 is wound around a thermocouple assembly 26 which is connected in series with the low pressure solenoid gas valve 21 and with the main contacts of a relay 27 (see Figure 4) through wires 28, 29 and 30. The thermocouple assembly 26 generates sufficient power output to directly energize the low pressure solenoid gas valve 21. The solenoid gas valve 21 is a valve which is electromagnetically operated and is normally closed when de-energized, and is of the positive shut off type; thus it is failure safe and the thermocouple assembly 26 has to provide constant electric power to the solenoid gas valve 21 in order to maintain the supply of gas to the combustion chamber 9 through pipe 17 or nozzle 15.

There presently exists on the market solenoid valves of the differential type which require a very low amount of power, and thermocouple assemblies which provide sufficient power for directly actuating such valves.

Referring again to Figure 4, the electrical control circuit comprises the following elements which are connected in series: ground 32, the conventional battery 31 of the motor vehicle, a main switch 33 mounted on the dashboard of the motor vehicle, a fuse 34, the low pressure switch 19, contacts 35 of a cut-off relay 36, a thermostat 37 which is mounted on the liquid inlet tubing 6, main contacts 90 of a manual reset delay relay 91, terminal A, bimetal switch 38 (Fig. 5) in box 24, terminal C, resistance element 25 and ground 44.

The thermostat 37 closes the circuit when the temperature drops below an adjustable minimum temperature and opens the circuit when the temperature rises above an adjustable maximum temperature. The differential between the high and low temperatures can be adjusted if desired.

The bimetal switch 38 located in the box 24 normally closes the circuit below a predetermined temperature and opens the circuit above said temperature.

Terminal A of the box 24 is also connected to the solenoid 40 of the relay 27, the other terminal of said solenoid being connected to ground. The resistance element 25 is connected to ground by being directly connected to the metallic combustion chamber 9 at 43, as shown in Figure 3, and said chamber 9 is connected to ground, as shown at 44 in Figure 2.

The solenoid 92 of delay relay 91 is connected to wire 42. The relay 91 opens contacts 90 only after a predetermined time delay.

Assuming that the temperature of the cooling liquid of the internal combustion engine E is below the adjusted minimum temperature of the thermostat 37, the heater operates as follows: referring to Figure 4, upon closing of the main switch 33, the following circuit is closed: battery 31, switch 33, fuse 34, pressure switch 19, contacts 35 of cut-off relay 36, thermostat 37, contacts 90 of delay relay 91, terminal A of box 24 and solenoid 40 of relay 27, and also bimetal switch 38, terminal C and resistance element 25. Upon closing of this first circuit, the relay 27 is energized, thereby closing the contacts 41, and therefore, the secondary circuit, consisting of thermocouple assembly 26 and low pressure solenoid gas valve 21 is closed, but the latter does not open until the thermocouple is sufficiently heated by the resistance element 25 which is then hot enough to instantly ignite the gas discharged from the bleeding off tube jet and passing through the red hot wires, thus producing immediate ignition of bleed off gas and also of the main burner.

The flame produced by the ignited gas rises through tubes 8 and heats the liquid within the container 1 which circulates in a closed circuit through the engine E. The heated gas then heats up the bimetal switch 38 located in the box 24 on top of the discharge chamber 10 for the combustion gases. Thus, the switch 38 opens the electrical circuit to the resistance element 25, but the thermocouple assembly 26, which is now heated directly by the flame produced by the fuel gas, continues to energize the low pressure solenoid gas valve 21.

When the temperature of the cooling liquid of the engine E has risen to the adjusted high temperature set in the thermostat 37, the latter opens the main circuit to the heater, thereby instantly opening the relay 27 which, therefore, immediately opens the thermocouple circuit thereby causing closing movement of the solenoid gas valve 21. Then the flame at burner 15 and also at bleed off tube 17 is extinguished until the temperature of the liquid coolant again drops to the minimum temperature. It will be noted that relay 27 acts as a safety means should the battery 31 of the motor vehicle be too weak for proper operation of the heater. In this case, the relay 27 will fail to close the circuit through the thermocouple assembly 26 and solenoid gas valve 21 if the voltage drops below a preset minimum.

It will be noted also that the thermocouple assembly 26 acts as delay means to provide for the full energization to gas igniting temperature of the resistance element 25 before the secondary solenoid gas valve 21 is actually opened to admit fuel gas within the combustion chamber 9 through bleed-off tube 17 and main burner 15. The thermocouple 26 also acts as an additional safety means because it will cut off the supply of fuel gas when there is no flame. In other words, should, for any reason whatsoever, the flame from the nozzle 15 becomes extinguished, the thermocouple assembly 26 will become cold and quickly de-energize the solenoid valve 21 which will, in turn, cut off the supply of fuel gas to the heater both through bleed-off tube 17 and burner 15.

Should the burner fail to ignite, the manual reset delay relay 91 will open the main circuit after a predetermined time interval to prevent undue drain on the battery. However, the relay 91 is not essential because it has been found in practice that the jet of gas from bleed off tube 17 provides positive ignition means for the main gas stream.

The electrical circuit just described may be further completed with an additional circuit operated by the conventional ignition key of the engine E. In accordance with the invention, an additional wire is connected on the existing engine ignition system which includes barrel 45, ignition key 46, terminal 47 and wire 47' to engine ignition coil. Turning movement of the key 46 for closing the conventional ignition circuit also closes the circuit to the solenoid 48 which is connected to ground, as shown at 49.

Thus, when the driver starts the engine, the solenoid 48 automatically opens the circuit to the heater by opening the main contacts 24, thereby energizing the heater and maintaining it in an energized state. The relays require very little electrical power for their operation and consume electrical energy only when the heater is operating, therefore, the drain on the conventional battery 31 will be very little. Moreover, it has been found that, for average winter temperatures of say 10 to 30° F., the heater, in accordance with the present invention, very quickly heats the cooling liquid within the engine E to a temperature of say 60 to 70° F. and,
therefore, will remain in operation a relatively short time as compared to its off periods.

While a preferred embodiment in accordance with the present invention has been illustrated and described, it is understood that various modifications may be resorted to without departing from the spirit and scope of the appended claim.

We claim:

A heater for the liquid coolant of an internal combustion engine, comprising a gas burner adapted to be arranged in heat exchanging relation with the coolant, a pipe feeding said burner, a normally closed valve in said pipe, a bleed-off tube downstream of said valve, said bleed-off tube having an outlet end formed to supply a gas jet on said burner, a first circuit including a source of electricity, a thermostatic switch adapted to be located in said coolant and adapted to close said first circuit if the temperature of said coolant falls below a predetermined minimum, and to open said first circuit if said coolant temperature rises above a predetermined maximum, said first circuit further including the winding of a relay having normally open contacts, and an ignition element constituted by an electrical resistance, said resistance being located in the path of the gas jet issuing from said bleed-off tube, a second circuit including electromagnet means for opening said valve, the contacts of said relay, and a thermocouple assembly adjacent to and adapted to be heated by said resistance, and when heated, adapted to energize said electromagnetic means to open said valve to feed gas to said burner and to said bleed-off tube, the jet from said bleed-off tube being ignited by said resistance and in turn, igniting said burner, said relay being adapted to open said second circuit to close said valve immediately upon opening of said first circuit by said thermostatic switch.

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