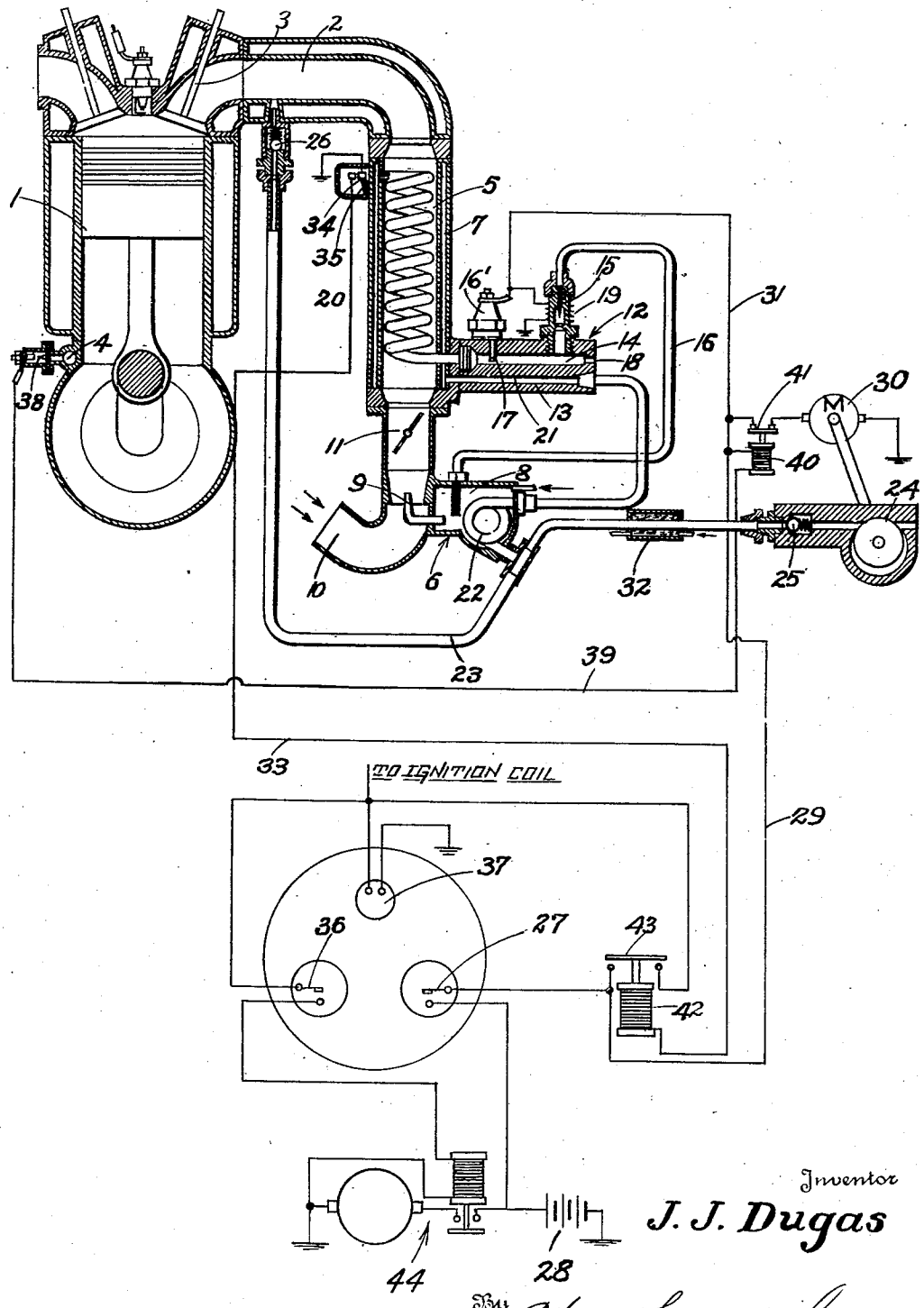
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FUEL HEATING SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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FUEL HEATING SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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This invention relates to internal combustion engines.

The general object of the invention is to adapt a carburetor to use heavy fuel. The carburetor may be of ordinary construction, having a float chamber supplying fuel to a nozzle, and a riser from the nozzle taking vaporized fuel to the intake manifold. The invention places a coil of tubing in the float chamber and a similar coil in the riser. These coils are connected in series. Hot combustion gases are drawn through these coils for heating them, the combustion gases being generated in a small external heater. The idea in heating the float chamber is to reduce the viscosity of the heavy fuel so that it will atomize in the nozzle. The purpose of heating the riser is to vaporize the atomized fuel. Since it takes higher temperature to vaporize than it does to reduce vsicosity, the hot gases are drawn serially from the heater, first through the riser coil, and then through the float chamber coil.

Another object of the invention is to heat the fuel prior to the starting of the engine, as well as while it is running. Consequently, means are provided for sucking the combustion products from the external heater through the coils, before the engine starts, this means being a vacuum pump. The vacuum in the engine is relied upon after the engine starts. The intake manifold of the engine and the vacuum pump are therefore connected by a tube, and a branch from this tube is connected to the coil in the float chamber.

Still another object of the invention is the provision of a control system whereby the engine cannot be started or attempted to be started until the fuel is preheated, the control means being as follows. In the preliminary heating period, the starting circuit and the ignition circuit are rendered inoperative. When the heater has run long enough to produce the desired temperature in the riser, a thermostat closes a gap, which renders the the starting and ignition circuits potentially operative, then upon pressing the starting button, the engine is turned over and ignition takes place.

Still another object of the invention is to provide means whereby the vacuum pump will not be supplanted by the intake suction of the engine as a means for circulating the heating medium immediately upon the turning over of the engine by the starter, but not until the engine has started under its own power. Therefore, some function of the engine, such as the development of oil pressure in the lubrication system, is utilized for stopping the vacuum pump.

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Another object of the invention resides in the construction and arrangement of the external heater, which in its preferred embodiment draws heavy fuel from the float chamber of the carburetor, and which is therefore provided with electrical heating means energized concurrently with the starting of the vacuum pump for heating the cold fuel in advance of its introduction to the combustion chamber of the heater.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawing which accompanies and forms a part of the following specification, the sole figure is a longitudinal sectional view, largely diagrammatic, showing an internal combustion engine with the carburetor connected thereto, and embodying the features of the present invention, including the electrical control.

Referring now in detail to the drawing, the numeral 1 represents an internal combustion engine having the intake manifold 2, intake valve 3, and a conduit 4, forming part of the pressure lubrication system.

The intake manifold 2 is connected to the upper end of a riser 5, the lower end of which is connected to the carburetor 6. The riser is provided with a jacket 7.

The carburetor comprises a float chamber 8, atomizing nozzle 9, air intake 10, and mixing chamber 11.

The above described parts may be, but are not necessarily, of conventional construction and design.

An external heater 12 is provided, consisting of a casing 13, which houses a tube 14, constituting a combustion chamber. This has a nozzle 15, opening thereinto, which is connected by a pick-up tube 16 with the float chamber of the carburetor, an igniting device, which as shown, is a glow igniter 16', which is mounted on the casing 12 and has an incandescent tip 17 exposed within the combustion tube 14. The latter has an air inlet 18, communicating with atmosphere. The nozzle 15 is surrounded by an electric heater 19, which is in parallel circuit with the igniter 16, so that both the igniter and heater are simultaneously energized.

A heating coil 20 is arranged longitudinally within the riser 5, having its lower end connected to the combustion tube 14, and its upper end opening into the upper end of the jacket 7. The lower end of the jacket is connected by a tube 21, which preferably passes through the casing 13 and is connected to one end of a heating coil 22, located

within the float chamber 6. Thus, the heater 12 is the anterior element of serially connected members including in sequence coil 20, jacket 7 and coil 22, and is therefore subject to suction imposed upon the coil 22, by which suction air and fuel are drawn into the combustion tube 14.

The end of the coil 22 is connected to a tube 23, which has a vacuum pump 24 connected to one end, the other end communicating with the intake manifold 2 of the engine. A check valve 25 in said tube is open while the vacuum pump 24 is running, and at this time a check valve 26 adjacent the intake manifold 2 is closed. When the engine is running and the vacuum pump has stopped, the check valve 26 is open and the check valve 25 closed. When either the vacuum pump 24 or the engine has control of the suction within the tube 23, air and fuel are drawn into the combustion tube 14 of the heater, ignited by the igniter 16' and circulated serially through the coil 6, jacket 7 of the riser and the coil 22 in the float chamber.

The operation of the invention is controlled in the following manner. Prior to starting the engine, the ignition switch 27 is closed. This closes a circuit from the battery 28, through the wire 29, through the motor 30 of the vacuum pump, to ground. A circuit is likewise closed through the wire 31, igniter 16' and electric heater 19, to ground. This causes cold, heavy fuel to be picked up by the pick-up tube 16, which is heated and atomized at the nozzle 15, mixed with air drawn in through the inlet 18 of the heater, ignited by the incandescent tip 17 of the igniter, and circulated through the coil 6 and jacket 7 of the riser and through the coil 22 in the float chamber of the carburetor. Since the coil 6 is the first of the serially connected heat dissipating elements, the combustion products are hotter at this point than in the coil 22. This is as it should be, since as has been suggested, it requires more heat to vaporize the atomized fuel particles than to reduce the viscosity of the liquid fuel in the float chamber. A little heat may be picked up by the passage of the tube 21 through the casing 12 of the heater. In the event that the combustion gases should still retain an appreciable amount of heat after passing through the coil 22, a cooler 32 may be intercalated in the tube 23 between the coil 22 and the vacuum pump.

At the time the vacuum pump is started, it is desirable to make it impossible to try to start the engine on the cold heavy fuel. Therefore, a relay circuit 33 is provided, which is normally open at a thermostatically controlled switch 34, the thermostat 35 of which is responsive to the temperature of the riser. When the temperature of the riser has risen sufficiently to produce a vaporized fuel, the thermostat 35 closes the circuit through the wire 33, energizing the relay 42, which pulls down the solenoid switch 43, making the starter switch 36 potentially active, and at the same time, energizing a pilot light 37, which when lit indicates that the fuel mixture is in condition to permit starting of the engine. The starting switch 36 is then closed and a current passes through the starter 44, turning over the engine.

When the starter switch 36 is closed, the vacuum pump is not immediately cut out, for the degree of vacuum created by the mere turning over of the engine by the starter may not be sufficient to open the check valve 26 and pick up the circulation of the heating medium without interruption. Therefore, it is preferred to open

the vacuum pump motor circuit and discontinue the action of the vacuum pump responsive to some engine function which comes into being when the engine has started under its own power. In the disclosed embodiment of the invention, the pressure of the lubricating oil built up through operation of the engine is utilized for this purpose. A normally open diaphragm switch 38 has its diaphragm chamber in communication with the lubricating oil conduit 4. When the pressure in this conduit has built up, the diaphragm switch closes, establishing a circuit through the wire 39, which energizes a solenoid 40, opening a normally closed switch 41 in the vacuum pump motor circuit and stopping the vacuum pump. When the vacuum pump ceases to operate, the check valve 25 closes, so that the suction of the engine intake is imposed solely upon the coil 22.

While I have in the above description disclosed what I believe to be a preferred and practical embodiment of the invention, it will be understood to those skilled in the art that the specific details of construction and the arrangement of parts and circuits, as disclosed, are by way of example and not to be construed as limiting the scope of the invention.

What I claim as my invention is:

1. In combination, an internal combustion engine, a conduit for conducting a flow of heated medium in heat exchanging relation to fuel supplied to said engine, alternatively operable vacuum means connected to said conduit for inducing a flow of heated medium therethrough, one means being the engine, the other a vacuum pump operated independently of the engine prior to starting of the engine.

2. In combination, an internal combustion engine, a conduit for conducting a flow of heated medium in heat exchanging relation to fuel supplied to said engine, alternatively operable vacuum means connected to said conduit for inducing a flow of heated medium therethrough, one means being the engine, the other a vacuum pump operated independently of the engine, means for operating said vacuum pump before the engine starts, and means responsive to a function of the engine while running for discontinuing the operation of the vacuum pump.

3. In combination, an internal combustion engine, including an intake, a conduit supplying fuel to said intake, a second conduit for conducting a flow of heated medium in heat exchanging relation to the fuel in said supply conduit, said second conduit having branches, one connected to said intake, a vacuum pump operating independently of the engine connected to the other, said intake and said vacuum pump alternatively functioning to induce a flow of heated medium through said second conduit, means for operating said vacuum pump before the engine starts, means responsive to a funtion of the engine while running for discontinuing the operation of the vacuum pump, and means responsive to the temperature of the fuel within said first mentioned conduit to prevent the engine from being started until a predetermined high temperature of said fuel has been attained.

4. In combination, an internal combustion engine including a fuel intake, and fuel conditioning means connected to said intake from which fuel is supplied to the engine through suction of the intake, said conditioning means including a fuel reservoir, a generator of hot combustion products, heat exchanging means connected thereto for bringing said combustion products

into heat exchanging relation to the fuel in said conditioning means, means connecting said generator to said reservoir, a vacuum pump driven independently of said engine, a connection from said heat exchanging means to said engine intake and to said vacuum pump, means for operating the vacuum pump before the engine starts and means responsive to a function of the engine when running for stopping the vacuum pump, whereby the engine and vacuum pump constitute alternative means for drawing fuel from said reservoir to said generator and combustion products from said generator through said heat exchanging means.

5. The combination as claimed in claim 4, including means responsive to predetermined high temperature of said conditioning means created by said heat exchanging means, to prevent the engine being started until high temperature has been attained.

6. In combination, an internal combustion engine including an intake, a carburetor including a vaporizing chamber supplying fuel to said intake, said carburetor having a float chamber, a heater for generating hot combustion products having a fuel nozzle driving liquid fuel from said float chamber, having an air inlet and an igniter, a heat exchanging conduit from said heater positioned in heat exchanging relation to said vaporizing chamber, said conduit being connected to the engine intake, a vacuum pump driven independently of the engine connected to said conduit, said intake and vacuum pump functioning alternatively to impose suction upon the combustion chamber of said heater by drawing combustion products through said heat exchanging conduit.

7. In combination, an internal combustion engine including a fuel intake, a carburetor including a float chamber and an atomizing nozzle, a vaporizing riser connecting said carburetor to said intake, in which the atomized fuel is vaporized, a generator of hot combustion products, means connecting said generator to said float

chamber, a heat exchanging conduit connected to said generator and serially associated with said riser and said float chamber, a vacuum pump driven independently of the engine, a connection from said heat exchanging conduit to said engine intake and to said vacuum pump, means for operating said vacuum pump before the engine starts, and means responsive to a function of the engine when running for stopping the vacuum pump whereby the engine and vacuum pump constitute alternative means for drawing fuel from said float chamber to said generator and combustion products from said generator through said heat exchanging conduit.

8. The combination as claimed in claim 7, said means responsive to a function of the engine for stopping the vacuum pump comprising an element responsive to build-up of lubricating oil pressure incident to the running of the engine.

9. In combination, an internal combustion engine including a fuel intake, a carburetor including a float chamber and an atomizing nozzle, means forming a vaporizing chamber connecting said carburetor to said intake in which the atomizing fuel is vaporized, a heat exchanging conduit for bringing a heated medium into heat exchanging relation first with said vaporizing chamber, then with said float chamber, means for supplying heated medium, connected to one end of said heat exchanging conduit, the other end of said heat exchanging conduit being connected to said engine intake whereby said engine draws heated medium through said heat exchanging conduit.

10. The combination as claimed in claim 9, including a vacuum pump connected to the said other end of said heat exchanging conduit operating independently of the engine, for drawing heated medium through said heat exchanging conduit before the engine starts, and means responsive to a function of the engine when running for stopping said vacuum pump.

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