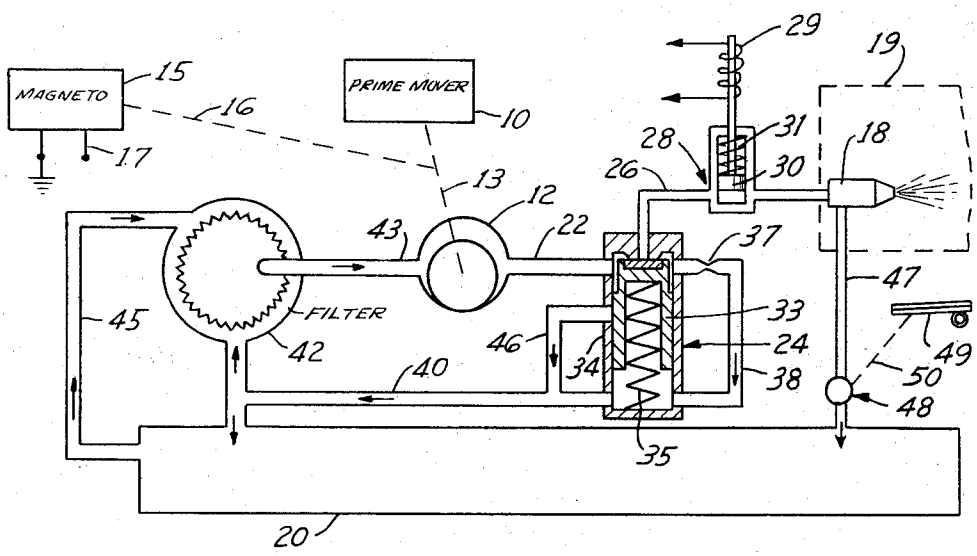
Dec. 27, 1966 R. S. DAMON 3,294,147

LIQUID FUEL BURNER CONTROL SYSTEM

Filed Nov. 15, 1965

Fig. 1.



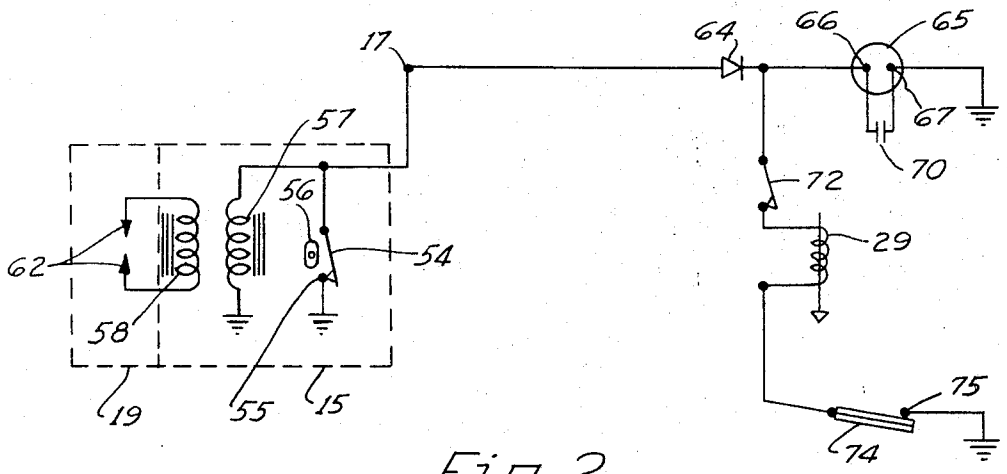


Fig. 2.

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United States Patent Office 3,294,147 Patented Dec. 27, 1966

3,294,147

LIQUID FUEL BURNER CONTROL SYSTEM

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Filed Nov. 15, 1965, Ser. No. 507,828
7 Claims. (Cl. 158—28)

This invention relates to liquid fuel burners and more particularly to a control system for controlling the operation of a liquid fuel burner.

This application is a continuation-in-part of my application, Serial No. 433,104, filed February 16, 1965, for Heating Apparatus.

Priorly numerous forms of fuel control systems have been employed to control the fuel supply for a liquid fuel burner. Generally, the prior art system are directed to shutting off the fuel supply upon an electrical power failure so that unburned fuel is not dumped into the combustion chamber. Also, certain of these embodiments of the prior art are relatively complex, expensive and fail adequately to control the fuel supply system. Further, these systems are not suitable for the control of a portable type burner unit which must be independent of an electrical power transmission system.

Accordingly, it is an object of this invention to provide an improved fuel burner control system for a liquid fuel burner.

Another object of this invention is to provide a burner fuel control system which is independent of an electrical power transmission system.

Still another object of this invention is to provide a liquid fuel burner control system which is operated from a prime mover and in which the system turns off the supply of fuel during over-heat conditions of the burner while permitting the prime mover and the prime mover driven pump to continue to operate.

Yet a further object of this invention is to provide a liquid fuel burner with a prime mover, a magneto coupled in driven relationship to the prime mover, a pump also coupled and driven in relationship to the prime mover, and a control system for employing the electrical energy generated by the magneto to ignite the fuel from the nozzle, control the supply of fuel to the nozzle of the fuel burner and to interrupt this flow should the burner become overheated while permitting the prime mover to continue to drive the pump and magneto. Thus any fuel discharged will be ignited.

Briefly in accordance with aspects of this invention, a prime mover, such as an internal combustion engine, is coupled in driving relationship to a burner fuel pump and to a magneto for generating electrical energy for the control system as well as the fuel ignition system. The control system includes a fuel feeding and return system and an electrical system coupled to the fuel feeding system to turn the fuel fed to the burner nozzle on and off. The fuel feed system includes a pump having a pressure regulating cut-off valve in a return conduit to return fuel from the outlet of the pump to the inlet of the pump or to the reservoir if the pressure in the fuel feed line exceeds a predetermined value. The intake side of the pump is, of course, connected to the fuel reservoir. The fuel feed system further includes an electrically-operated valve such as a solenoid operated valve, connected in the fuel supply system at the inlet of the fuel burner nozzle. The fuel flow system also includes a by-pass conduit for returning the fuel from the nozzle to the fuel reservoir and a modulator valve coupled in this last-mentioned conduit and actuated by a temperature-responsive device positioned to respond to the temperature of the air passing over the burner unit accurately to control the fuel discharged from the nozzle.

The electrical system employs as a source of power the magneto coupled in driven relationship to the prime mover and the magneto is coupled to an electrical actuating member such as a solenoid for actuating the valve at the intake of the burner nozzle. Advantageously, an overheat responsive thermostat switch is coupled in the circuit of the magneto and solenoid to interrupt the flow of current through the solenoid when the burner becomes overheated and thus causes the solenoid actuated valve to release and shut off the supply of fuel to the fuel burner nozzle. The presence of the pressure responsive by-pass arrangement in the fuel supply line permits the pump to continue to operate and to return fuel from the outlet side of the pump to the inlet side of the pump for the entire period that the solenoid actuated valve is closed. Also advantageously, the circuit of the solenoid valve includes rectifier means connected between the magneto and the solenoid valve so that the alternating current from the magneto will be rectified and direct current may be employed to actuate the solenoid of the solenoid valve. Also advantageously, a capacitor is connected in parallel with the solenoid of the valve to filter the direct current pulses of the electrical current and to maintain a relatively constant D.C. potential across the solenoid thereby to maintain the solenoid valve in an open condition. The combination of the over-heat responsive thermostatic switch and solenoid positively interrupts the flow of fuel immediately upon an over-heat condition and overcomes the motor and pump inertia to prevent the supply of fuel to the burner through the nozzle.

Other objects and advantages relate to certain novel features of construction, combinations and arrangements of parts, as set forth in the following detailed description of a heating apparatus embodying the invention. This description is made in conjunction with the accompanying drawing which forms a part of the specification.

In the drawings:

FIGURE 1 is a combination pictorial and schematic representation of portions of the fuel burner control system; and

FIGURE 2 is a combined schematic and pictorial representation of the electrical system of the fuel burner control system.

A prime mover **10** such as an internal combustion engine is mechanically coupled in driving relationship to a pump **12** as indicated by the dotted line **13** by suitable means such as a belt and pulleys. The prime mover **10** is also coupled in driving relationship to a magneto **15** as indicated by the dotted line **16** and may also be coupled by belt and pulleys. The magneto **15** has an electrical output terminal **17** and a grounded terminal, not labeled. The pump is connected in a fuel supply system for controlling the supply of fuel through a burner nozzle **18** located in a combustion chamber **19** from a fuel reservoir **20**. The pump **12** is connected to the nozzle **18** by means of a first conduit **22**, a pressure regulating and cut-off valve **24**, a second fluid conduit **26** and a solenoid actuated valve **28** coupled to the inlet side of the nozzle **18**. The solenoid valve **28** includes a solenoid **29** and a solenoid-controlled valve member **30** which valve member is normally maintained in an open position by current flow through the solenoid **29** from an electrical circuit which will be subsequently described in detail.

If for any reason the current flow through the solenoid **29** is interrupted, the solenoid valve **30** will be released and will close under the influence of a helical spring **31** which encircles valve member **30** and normally biases the valve member **30** into a closed position. If at anytime during the operation of the prime mover **10** the valve member **30** is closed, the pump **12** develops pressure in the conduits **22, 26** which pressure actuates a pressure

and regulating cut-off valve 24 to return the fuel from the outlet side of the pump to the inlet side of the pump in a manner which will be subsequently described. Pump 12 can continue to operate without possible damage to the pump or the fuel supply system while maintaining sufficient pressure in the conduit 22 to immediately supply the nozzle 18 if the solenoid valve is again opened. The pressure regulating and cut-off valve includes a valve member 33 slidably mounted in a suitable valve chamber 34 and biased in a direction to close the communication between conduits 22 and 26 by means of a helical spring indicated 35. A suitable bleed orifice 37 is also connected to the pressure regulating and cut-off valve 24 adjacent the entrance to the second conduit 26 and is connected by means of a conduit 38 to the opposite end of the valve chamber 34. The opposite end of the valve chamber 34 is also connected by means of a conduit 40 to the fuel reservoir 20 and to a filter 42. The bleed orifice 37 and the return conduits 38, 40 cooperate to maintain a constant fuel pressure in the conduit 26 during the operation of the pump 12. The filter 42 is connected to the inlet side of the pump 12 by means of a suitable conduit 43. The filter 42 is connected to the fuel reservoir 20 by means of a suitable conduit 45.

The previously described pressure regulating and cut-off valve includes a conduit 46 which communicates with the intermediate portion of the chamber 34 and the previously described conduit 40. Valve 24 by-passes fuel from the first conduit 22 to the fuel reservoir 20 and to the filter 42 in response to the build up or pressure at the upper side of the pressure regulating and cut-off valve 24, as viewed in FIGURE 1, when the pressure is sufficient to overcome the bias of spring 35 and move the valve member 33 downwardly to open the communicating passage between conduit 22 and conduit 46. If at anytime the pressure in conduit 22 reaches a value sufficient for the pressure upon the upper portion of the sliding valve member 33 to overcome the bias of the spring 35, the sliding valve member 33 moves downwardly and opens the passage between the conduit 22 and the conduit 46 to permit the fuel delivered from the pump 12 to be returned through conduit 40, the filter 42 and the inlet conduit 43 to the intake side of the pump. When the flow of fuel to the nozzle is interrupted by the solenoid valve 28, the prime mover can continue to operate the pump and the pump continues to circulate liquid fuel without danger of damage to the fuel supply system while nevertheless maintaining sufficient pressure at the conduit 26 to immediately continue supplying fuel to the nozzle upon the actuation of the solenoid operated valve 28.

The fuel supply system also includes a return conduit 47 connected to the burner 18 and to the fuel reservoir 20 to return oil not projected into a spray by the nozzle 18. A modulator valve 48 is connected in conduit 47 and is coupled to a temperature responsive means 49 by means of a mechanical link 50 such that the temperature of the air passing around the combustion chamber 19 causes the temperature responsive elements to closely control the pressure in the conduit 47 by closely controlling the opening of the modulator 48 in a manner similar to the operation of the modulator valve 90 in the above-mentioned patent application.

The electrical system of the fuel burner control system is shown in detail in FIGURE 2 in which the magneto 15, shown in dotted outline, includes a breaker contact 54 which is normally connected to ground through a contact 55 and a contact interrupter cam 56 positioned to open the contact 54 during rotation of the magneto 15 in a manner well known in the art. The interrupter contact 54 is connected to a primary winding 57 of the magneto 15, which primary winding 15 is coupled to a secondary winding 58 by means of a suitable magnetic core 60. The secondary winding 58 is connected to the fuel burner igniter electrodes 62 which may be any convenient form of fuel igniter electrodes such as those disclosed in the above-mentioned patent application, which electrodes are positioned within combustion chamber 19 and preferably in the path of the spray from nozzle 18.

The primary winding 57 is connected to the output terminal 17 of the magneto 15 and this output terminal is connected to the anode of a rectifier 64. The cathode of rectifier 64 is connected to a suitable direct current operated clock 65 by means of a terminal 66 and the clock 65 includes a second terminal 67 which is connected to ground. A suitable capacitor 70 is connected in parallel with the clock 64 by connecting the capacitor 70 to the terminals 66 and 67. This clock indicates the elapsed operating time of the heating apparatus. The cathode of the rectifier 64 is also connected to a series circuit including a manual on-off switch 72, the solenoid 29 and an over-heat thermostat 74, the opposite terminal of which is connected to ground at 75. Because the circuit including on-off switch 72, solenoid 29 and over-heat thermostat 74 is a series circuit, the current flow through the solenoid 29 will be interrupted when either the manual on-off switch 72 or the over-heat thermostat 74 is opened. The solenoid valve member 30 is normally biased in a closed position by spring 31, and valve member 30 is opened in response to current flow through the solenoid 29. The valve member 30 is returned to its closed position by spring 31 when an over-heat condition causes the thermostat 74 to open or when the on-off switch 72 is manually opened. The capacitor 70 is effectively connected in parallel with the series circuit which includes the on-off switch 72, solenoid 29 and the over-heat thermostat 74. Thus the capacitor filters the output of the rectifier 64 and maintains a substantially constant potential across the series circuit which includes the solenoid 29.

In one illustrative embodiment the output voltage of the magneto 15 as measured across terminal 17 and ground was 85 volts A.C., open circuit. The output at the rectifier 64 was between 12 and 13½ volts D.C. with an alternating current component of 9½–10 volts. The capacitor 70 is preferably an electrolytic capacitor having a rating of approximately 50 volts and a capacity of the order of 100 mf. With this combination of capacitor and rectifier, the potential available to maintain the solenoid 29 energized is substantially constant in the previously mentioned range of 12–13½ volts of direct current. The electrical coupling of the solenoid valve 28 to the magneto 15 assures that the solenoid interrupts the fuel supply to the nozzle 18 positively and immediately and overcomes any problems of the pump inertia and permits the pump 12 to continue to operate until the fuel burner has cooled to a point to permit the over-heat thermostat 74 to close its circuit. As soon as the thermostat 74 closes the circuit of solenoid valve 28, the valve member 30 is attracted by the magnetic flux of solenoid 30 to an open position and fuel flows, through nozzle 18 and is ignited by electrodes 62.

From the foregoing explanation, it is apparent that the liquid fuel burner control system comprising the fuel supply system and the electrical control system constitutes a relatively simple combination for quickly responding to an over-heat condition and terminating fuel flow and for closely controlling the supply of liquid fuel to the nozzle of a liquid fuel burner while the fuel burner and the entire system is operated by an independent prime mover and for continuing to supply fuel to the burner nozzle after the over-heat condition is terminated.

In accordance with provisions of the patent statutes, the principles of operation of the above invention have been described together with the apparatus now believed to represent the best embodiment thereof, but it is to be understood that the apparatus shown and described is only illustrative and that the invention may be carried out by other arrangements.

I claim:

1. A liquid fuel burner control system comprising:
a prime mover;

a combustion chamber having a fuel nozzle communicating therewith;

a fuel supply system including a fuel reservoir;

a pump connected to said reservoir and coupled in driven relationship to said prime mover, a conduit coupling said burner fuel nozzle to said pump;

an electrical system including an electrically-operated normally closed valve in said conduit, a magneto coupled in driven relationship to said prime mover and having a secondary winding and having a primary winding electrically coupled in controlling relationship to said electrically-operated valve, and normally closed interrupter contact means connected to said primary winding, thermostat switch means positioned to respond to the temperature of said burner and electrically coupled in circuit with said electrically-operated valve to interrupt the electrical current to said valve when said thermostat switch means is heated to a predetermined temperature thereby causing said valve to close, said system further comprising rectifier means electrically coupled between said magneto primary winding and said electrically operated valve, a capacitor means connected to the output of said rectifier means to store current pulsations whereby direct current is supplied to said electrically operated valve.

2. The control system according to claim **1** wherein said prime mover is an internal combustion engine having its fuel input coupled to said fuel reservoir.

3. The combination according to claim **2** wherein said control system further includes a pressure responsive by-pass system for returning fuel to the intake side of said pump during the period in which said electrically-operated valve is closed.

4. The control system according to claim **1** further comprising pressure responsive by-pass means for returning fuel from the high pressure side of said pump to the intake side of said pump during the period that said electrically-operated valve is closed, wherein said electrically-operated valve remains in the open condition in response to the supply of electrical energy thereto from said magneto, wherein said electrically-operated valve closes when said thermostat means opens the circuit of said electrically-operated valve in response to elevated burner temperatures, and wherein said pressure responsive means connects the output of said pump to the inlet of said pump to permit said pump to continue to operate while preventing the build-up of fuel pressure in the pump outlet.

5. In a hydrocarbon burning heating apparatus, the combination comprising:

a prime mover;

a combustion chamber;

a heat exchanger cooperating with said combustion chamber;

means including a fuel pump coupled in driven relationship to said prime mover for supplying fuel to said combustion chamber;

igniting means including a magneto coupled in driven relationship to said prime mover, said magneto including a primary winding having normally closed interrupter contacts connected in parallel therewith and a secondary winding for igniting said fuel within said combustion chamber; rectifier means connected to said primary winding;

electric timing means connected to said rectifier means for indicating the elapsed operating time of said heating apparatus; and, capacitor means connected in parallel with said timing means.

6. The combination according to claim **5** wherein said timing means includes an electric direct current operated clock coupled to the primary winding of said magneto.

7. The combination according to claim **5** wherein said igniting means includes a pair of electrodes defining a fuel igniter, said secondary winding being connected to said electrodes, said timing means including an electric clock having one terminal coupled to said rectifier means and a second terminal coupled to said magneto.

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