

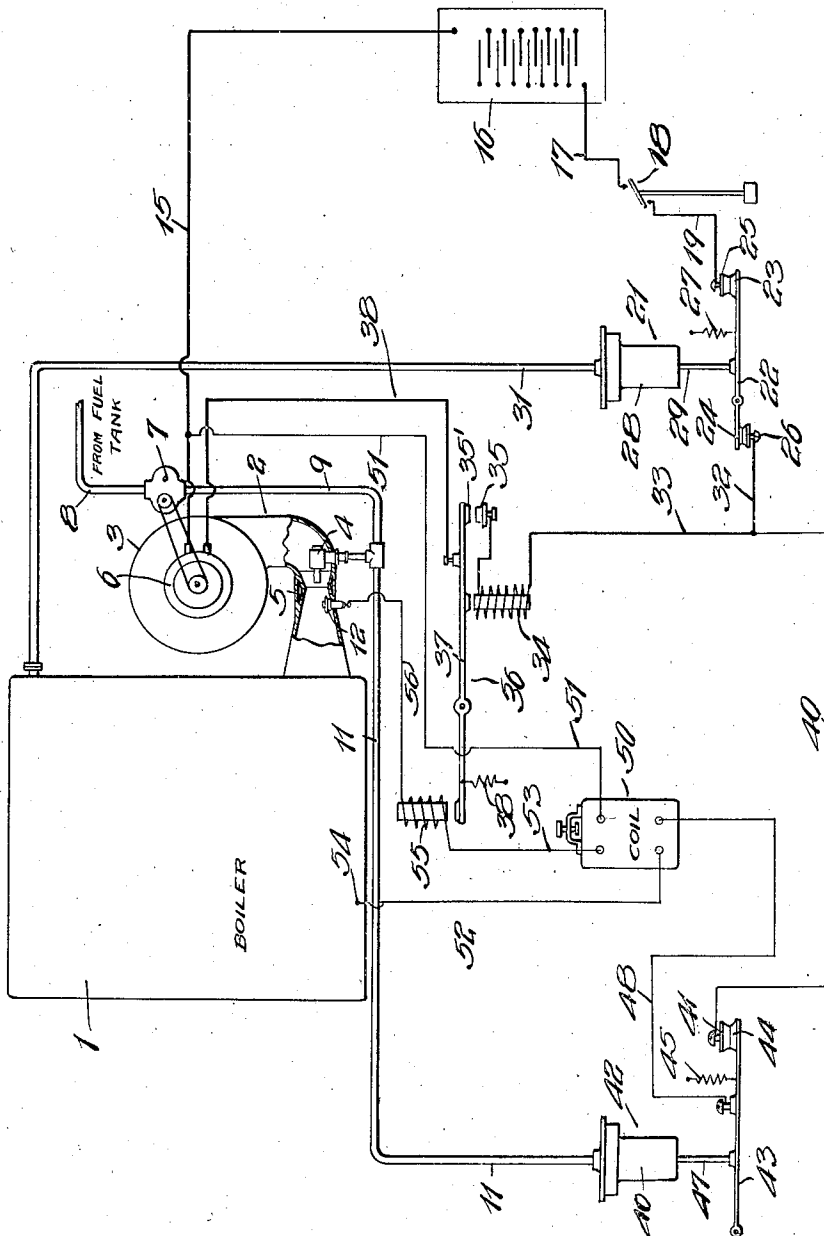
July 12, 1927.

O. F. CARLSON

1,635,809

AUTOMATIC CONTROL SYSTEM FOR BURNERS

Filed Nov. 28, 1919



Witnesses:
W. L. Kilroy
Harry R. L. White.

Inventor:
Oscar F. Carlson
By Brown Brothers and
Snyder Attys.

UNITED STATES PATENT OFFICE.

OSCAR F. CARLSON, OF CHICAGO, ILLINOIS.

AUTOMATIC CONTROL SYSTEM FOR BURNERS.

Application filed November 28, 1919. Serial No. 341,309.

My invention relates to an automatic control system for burners. The invention is particularly directed to a system of automatic control for liquid fuel burners, more specifically of the atomizing type, such as are employed in steam automobiles and in kindred practices for the heating of a portable steam generating plant.

The primary object of the invention is to provide a control system which shall efficiently control the burner operation to maintain the boiler in condition for the large and sudden load demands which are inherent in automobile practice, and which shall be entirely automatic in its operation to the end of relieving the operator of all duties concerned with the regulation and control of the burner.

A second object of the invention is to provide a system of burner control which shall automatically safeguard the boiler and burner against explosions and the like, resulting from inoperativeness or delayed operation of the ignition apparatus. In most prior systems of burner control, failure of the ignition system to operate at the prescribed time will frequently result in the boiler furnace becoming full of combustible mixture, with the likely possibility of explosion from ignition by the boiler temperatures or by the tardy operation of the ignition apparatus. This is avoided in the present system of control by making the operation of the mixture forming apparatus positively dependent upon operation of the ignition apparatus. The dependency of operation is assured by requiring the actual discharge of sparks across the ignition terminals before a combustible mixture can be generated in the atomizing mechanism.

Another object of the invention is to provide a system of control which shall, automatically interrupt the operation of the ignition apparatus after the combustible mixture has been discharging from the atomizing mechanism for a definite time interval, of sufficient duration to insure ignition, whereby to conserve the electrical energy of the system.

In the accompanying drawing I have illustrated in diagrammatic relation a preferred adaptation of the system as applied to the steam generating plant of a steam automobile, but I wish it to be understood that the invention is not to be limited to this

particular relation, but may be extended to use with other types of burners and for other heating purposes.

Referring to the drawings the boiler 1, the particular formation of which constitutes no part of the present invention, is adapted to be heated by a liquid fuel burner, broadly designated 2. The burner 2 specifically comprises a rotary blower 3 and a fuel atomizing nozzle 4, which is arranged to discharge the kerosene or other liquid fuel for mixture with the air from the blower 3. The blower 3 is arranged to discharge into a Venturi throat or tube 5, which opens into the combustion space of the boiler and into which the combustible mixture is adapted to be projected. In the operation of the burner, this combustible mixture is formed by the atomizing action of the high velocity stream of air from the blower, pulverizing the liquid fuel as it is discharged from the nozzle 4 and intimately commingling the pulverized particles of fuel with the air.

The blower 3 is driven by an electric motor 6, which is arranged to receive current from a battery or other suitable source of current in the electrical control system, as I shall presently describe. In the preferred embodiment of the system the liquid fuel is pumped to the nozzle or jet 4 simultaneously with the operation of the blower 3, and to this end there is provided a small gear pump or other suitable type of fuel pump 7 which has suitable driving connection with the electric motor 6. This relation of air and fuel supply insures a positive and unvarying proportion of air and fuel in the mixture. The gear pump 7 has supply connection through a pipe 8 extending from the fuel tank and has discharge connection through a pipe 9 with the fuel nozzle 4. The discharge pipe 9 also has connection with a fuel pressure pipe 11, which has communication with a fuel pressure cut-out device in the control system as I shall presently describe.

It may be opportune to remark here that I also contemplate providing priming or automatic metering apparatus between the pump 7 and nozzle 4 to obtain a highly enriched mixture during a brief period in the initial operation of the burner to facilitate ignition.

The ignition of the combustible mixture is accomplished by a spark plug 12 which is threaded into the Venturi throat 5 so that

the two sparking terminals are disposed posterior to the nozzle 4 and in the path of the combustible mixture.

Referring now to the automatic control system, the control circuit for controlling the operation of the electric motor 6 is traced through the wire 15, the storage battery or other source of current 16 and the wire 17 to a snap switch or the like, illustrated diagrammatically at 18. This snap switch is preferably located on the dash of the automobile and is adapted to be closed to place the steam generating plant in condition for operation when beginning the day's run, and to be opened at the end of the run for shutting down the plant. From the snap switch 18, the motor control circuit is traced through wire 19 to a steam pressure cut-out device 21. This cut-out device comprises a pivoted switch arm 22 which carries contacts 23 and 24 adapted to engage with stationary contacts 25 and 26. The pivoted switch arm 22 is normally held in closed position by the spring 27, and is adapted to be opened by a pressure responsive element 28. This pressure responsive element preferably comprises a diaphragm or spring pressed piston having mechanical connection with the switch arms 22 through the stem 29. The diaphragm or spring pressed piston is subjected to boiler pressure through a pipe 31 which communicates with the interior of the boiler 1. Upon the development of an excessive steam pressure in the boiler, above the predetermined maximum, the cut-out device 21 functions to open the motor control circuit and stop the operation of the burner until the abnormal steam pressure subsides. From the stationary contact 26 the motor control circuit is traced through the wires 32 and 33, through the winding of an electromagnet 34 and from thence to a stationary contact 35 of the main control switch 36. The switch arm 37 of the main control switch is magnetically responsive to the electromagnet 34, this electromagnet being adapted to function as a "lock-up" magnet to retain the control switch in closer position after the initial closing by the ignition circuit, as will presently appear. The motor control circuit is completed by a wire 38 which extends from the switch arm 37 to the other terminal of the motor 6. It will be noted that this motor control circuit is normally open at the control switch 36 by reason of the separated contacts 35 and 35'.

The motor control circuit, which is in fact the main control circuit for controlling the operation of the burner, may be made subject to different boiler or burner conditions by the interposition of apparatus similar to the steam pressure cut-out device 21.

Referring now to the primary ignition circuit which controls the operation of the ignition apparatus, it will be noted that a wire

40 extends from the wire 32 to the stationary contact 41 of a fuel pressure cut-out switch 42. This switch 42 comprises a pivoted switch arm 43, carrying a contact 44 which is adapted to be held in engagement with the stationary contact 41 by a spring 45. A pressure responsive element 46, preferably consisting of a diaphragm or spring pressed piston is adapted to open the switch arm 43 through the stem 47, under the action of the pressure in the liquid fuel pipe line 11. Preferably I accomplish this by a restriction in the line to the pressure element 46 so that pressure builds up slowly therein and the opening of the switch 43 occurs after the fuel is delivered at nozzle 4. This time interval is made of sufficient duration to insure ignition of the combustible mixture, after which the primary ignition circuit is adapted to be interrupted. It will be apparent that a number of obvious expedients may be employed for obtaining this time interval, such as restricted orifice through which the liquid fuel must flow to act upon the pressure element or a suitable dash pot arrangement adapted to retard the motion of the pressure element. The primary ignition circuit continues from the switch arm 43 by way of wire 48 to the primary winding of the ignition coil 50. From the other primary terminal of the coil 50 the circuit is continued by way of wire 51 to wire 15 of the motor control circuit, which connects with the other terminal of the battery 16.

The secondary ignition circuit extends from the secondary terminals of the coil 50 through wires 52 and 53, the former of which is grounded to the metallic structure of the steam generating plant as indicated at 54. The other wire 53 has connection with an electromagnet 55 through which the high tension ignition current flows and from thence by way of wire 56 to the spark plug 12. Because of the relatively high potential, high frequency characteristic of the current in the secondary ignition circuit, it is desirable that the electro-magnet 55 be constructed with relatively small induction and high dielectric strength to adapt it to this particular current.

The electromagnet 55 is operatively associated with the main control switch 36 in such a manner as to actuate the switch arm 37 and close the contacts 35—35' in opposition to the spring 38 when the secondary ignition circuit is energized.

The operation of the control system is as follows:

Assume that the manually operated switch 18 has been closed for starting operation of the steam generating plant; the current flow from the battery 16 is then through the cut-out switch 21 to the wires 33 and 40. The main motor circuit through the wire 33 is

open at this time because of the separation of the contacts 35—35', and as a result the motor 6 does not start the instant that the switch 18 is closed. The current is free to flow, however, through the primary ignition circuit by way of the wire 40, the fuel pressure cut-out switch 42, the primary winding of the coil 50 and through the wires 51 and 15 back to battery 16. The energization of this primary ignition circuit will immediately produce a high potential in the secondary ignition circuit. The current flow in the secondary ignition circuit and consequent energization of the electromagnet 55 will be directly dependent upon the ability of this high potential to jump the terminals of the spark plug 12. Assuming that the ignition apparatus is functioning properly, the spark discharge across the terminals of the plug 12 will result in the energization of the electromagnet 55, which will instantly close the control switch 36 and complete the motor control circuit through the contacts 35—35'. The motor 6 will then begin operation and generate a combustible mixture for ignition by the plug 12, all as hereinbefore described. If, however, the potential in the secondary circuit is relatively feeble, or if there is a break in the secondary circuit or if the points of the spark plug are in bad condition there will be no spark discharge across the terminals of the spark plug, at least, no spark discharge of sufficient current value to ignite the combustible mixture, and consequently there will be little or no current flow through the electromagnet 55. As a result, the main control switch 36 will remain open and the motor 6 inert so that under no possibility will a combustible mixture be generated. It will thus be seen that the operation of the mixture forming apparatus is directly contingent upon the sparking discharge of the plug 12, and that under no other circumstances can a combustible mixture be formed.

Immediately upon operation of the motor 6, the gear pump 7 will create a pressure in the fuel line 11 which will begin operating upon the pressure element 46, and which will, after the elapsing of a predetermined time interval, actuate this element to open the cut-out switch 43. This will interrupt the primary ignition circuit, thereby interrupting the spark discharge at the plug 12 and deenergizing the electromagnet 55. The main control switch 36 will not open, however, for the reason that the "lock-up" electromagnet 34 has locked the switch arm in closed condition and will retain it so long as the motor control circuit is closed.

Assume now that the steam pressure in the boiler has risen to the predetermined maximum at which the cut-out switch 21 is set. The operation of this pressure cut-out switch will immediately interrupt the motor

control circuit, thereby restoring the control switch 36 to open position and stopping further generation of combustible mixture. Simultaneously with the stopping of the electric motor 6, the pressure on the fuel line 11 will cease and the pressure element 46 and the switch arm 43 will be returned to normal, thereby closing the primary ignition circuit, preparatory to beginning operation of the burner again. Upon the fall of the steam pressure in the boiler to the predetermined minimum the cut-out switch 21 will close the motor control circuit and the burner will resume operation in the manner hereinbefore described.

I do not intend to be limited to the precise details and arrangement herein disclosed, but intend to include all equivalent embodiments of the invention as defined in the appended claims.

I claim:

1. In combination, a burner, electrically operated means for forming a combustible mixture for said burner, and ignition means for igniting said combustible mixture, the setting into operation of the electrically operated means being dependent upon the prior operation of the ignition means for igniting the initial charge of the combustible mixture in the burner.

2. In an automatic control system for liquid fuel burners, means for atomizing the liquid fuel and forming a combustible mixture, an electric motor for operating said atomizing means, ignition means for igniting the combustible mixture, and control means for said electric motor, the operation of said control means being dependent upon the existence of a current at said ignition means.

3. In combination, a burner, apparatus for forming a combustible mixture, a pair of sparking terminals and control means for making the setting into operation of said mixture forming apparatus dependent upon the existence of a current at said terminals.

4. In an automatic control system for liquid fuel burner, a blower, an atomizing nozzle cooperating with said blower to form a combustible mixture, an electric motor for driving said blower, a motor control circuit including a source of current for said motor, an ignition plug for igniting said combustible mixture, an ignition circuit, a control switch in said motor control circuit, actuating means operative upon the energization of said ignition circuit for actuating said control switch, and an electromagnet in said motor control circuit for locking said control switch in closed position.

5. In combination, a burner, electrically operated means for generating a combustible mixture including a fuel pump, ignition means for igniting said mixture, control means for making the setting into operation

of said electrically operated means dependent upon the operation of said ignition means, and means utilizing the pressure of the fuel pump for interrupting the operation of said ignition means at a predetermined period after the operation of said electrically operated means.

6. In combination, a burner, electrically operated means for forming a combustible mixture, ignition means dependent upon a flow of current therethrough for igniting said mixture, and control means operable to begin operation of said electrically operated means only upon a flow of current through said ignition means and to interrupt the operation of said ignition means after a predetermined interval of operation of said electrically operated means.

7. In combination, a burner, fuel atomizing apparatus for forming a combustible mixture, an electric motor for operating said fuel atomizing apparatus, ignition terminals, a control switch for said motor, said control switch adapted to be closed upon the existence of a current at said terminals, and means for interrupting the spark discharge between said terminals caused by said current after a predetermined interval of operation of said fuel atomizing apparatus.

8. In combination, a burner, fuel atomizing apparatus for forming a combustible mixture, an electric motor for operating said fuel atomizing apparatus, ignition terminals, a motor control circuit including a source of current for said motor, an ignition circuit for said ignition terminals, a control switch in said motor control circuit, means controlled by the energization of said ignition circuit for operating said control switch, and means for interrupting the spark discharge between said ignition terminals after a predetermined interval of operation of said fuel atomizing apparatus.

9. In combination, a fuel feeding device, an electric circuit for said device, an ignition device, an electric circuit for said ignition device, a switch for said first circuit controlled by energization of said second cir-

cuit to cause operation of the fuel feeding device.

10. In combination, a fuel feeding device, an electric circuit for said device, an ignition device, an electric circuit for said ignition device, a switch for said first circuit controlled by energization of said second circuit to cause operation of the fuel feeding device, and means controlled by energization of said first circuit for holding said switch closed.

11. In combination, a fuel feeding device, an electric circuit for said device, an ignition device, an electric circuit for said ignition device, a switch for said first circuit controlled by energization of said second circuit to cause operation of the fuel feeding device, means controlled by energization of said first circuit for holding said switch closed, and means operated by the fuel feeding device for opening the second circuit.

12. In a device of the class described, a fuel feeding device, an electric circuit for operating said device, an ignition device, an electric circuit for operating said ignition device, a switch for said first circuit dependent upon energization of said second circuit, and means controlled by said fuel feeding device for interrupting said ignition circuit.

13. In combination, a burner, apparatus for forming a combustible mixture, a plurality of sparking terminals, and control means for making the starting of said mixture forming apparatus dependent upon the existence of a current at said terminals.

14. In combination, a burner, means for supplying a combustible mixture to said burner, and ignition means for igniting said combustible mixture, the means for supplying the combustible mixture being set into operation by the operation of the ignition means for igniting the initial charge of the combustible mixture in the burner.

In witness whereof, I hereunto subscribe my name this 25 day of November, A. D. 1919.

OSCAR F. CARLSON.