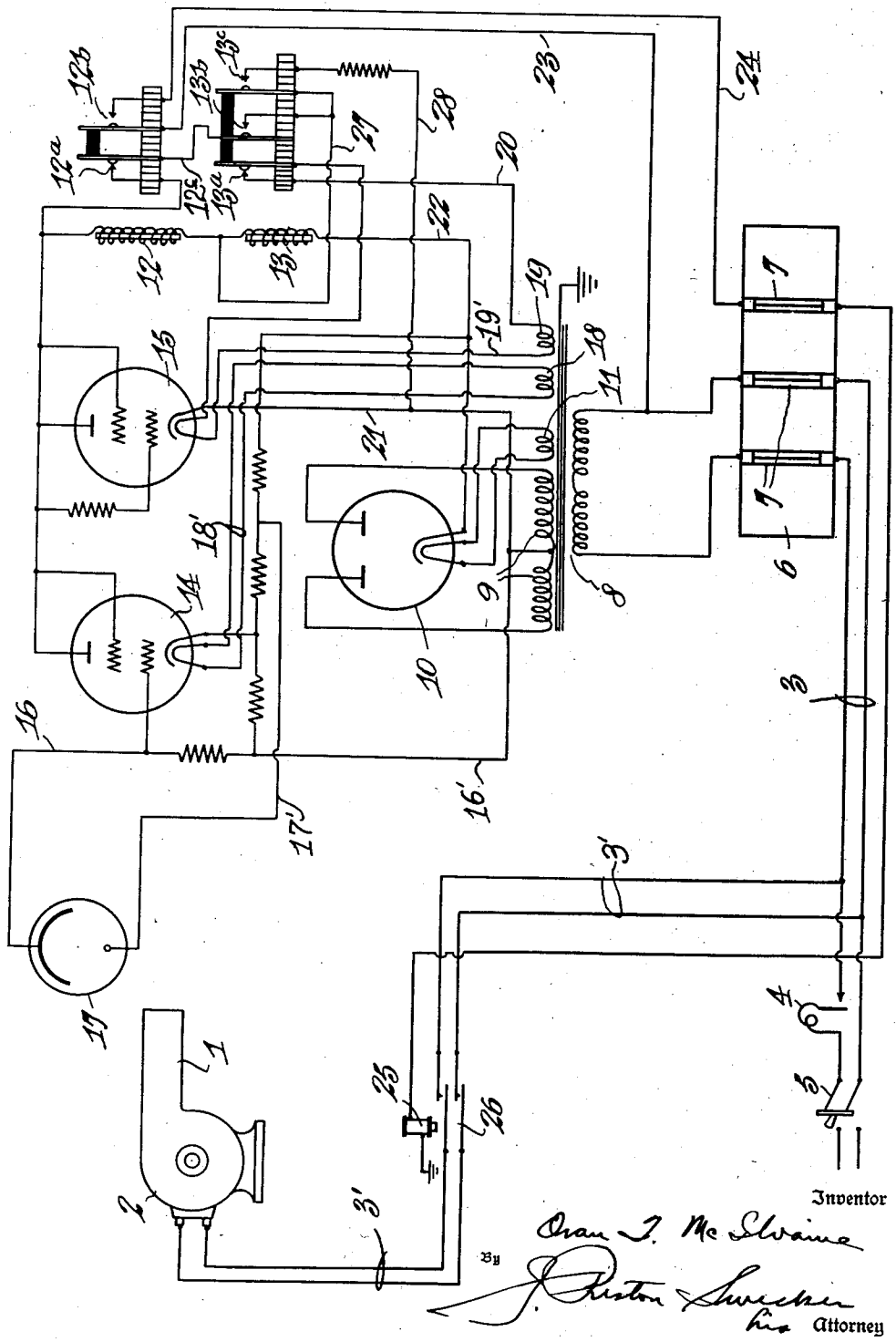
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BURNER CONTROL SYSTEM

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BURNER CONTROL SYSTEM

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6 Claims. (Cl. 158—28)

This invention relates to an improvement in burner control systems, and more particularly for use as a safety system for oil or gas burners, to discontinue the operation thereof, if the flame becomes extinguished.

Various attempts have been made heretofore to provide for the automatic control of the fuel to an oil or other burner in response to the operation thereof, and to some extent these have proposed the operation of the control system in response to a photo-electric cell or other light sensitive device, but such systems have not been entirely satisfactory for use.

The object of this invention is to improve the operation of the control system for a burner, whereby the operation of the burner will be responsive to the flame thereof, and yet provision is made for a definite time interval for starting and for automatically shutting off the burner if its flame does not start and continue operation during this time interval, the system being entirely fool-proof in its operation and performance.

In carrying out this object, I have provided a pair of electronic discharge tubes connected in parallel and arranged to control a pair of relays, one of the tubes functioning in response to the energizing of a photo-electric tube, and one of the relays controlling the operation of the burner, while the other relay has as one of its functions, actuation at a delayed time interval after the operation of the first relay, to prevent operation of the burner in the event that the flame thereof becomes extinguished or the burner does not function. This delayed time interval is governed by the heating or cooling intervals of the second tube, which may be varied by the substitution of different tubes, so as to change the starting interval as may be desired.

These and other features will be evident from a full description of the invention as illustrated in the accompanying drawing, which is a diagrammatic view showing an embodiment of this invention in a burner control system.

I have shown the invention applied to a conventional form of oil burner designated generally by the numeral 1, and having a compressor or blower shown at 2, which is adapted to receive operating current from a power line 3 through a branch 3'. Also connected in the power line 3 is a thermostatic control switch 4 and a main power switch 5, of the usual construction. The power line 3 extends to a control board 6 having fuses 7, and through which the power line extends to a transformer 8, with the primary of which it is connected.

The transformer 8 has a secondary winding 9, the opposite sides of which are connected with a pair of anodes in a double rectifier tube 10, while the cathode thereof is indirectly heated from a winding 11 of the transformer 8.

A pair of relays are shown at 13 and 12 which are connected in series with each other and respectively with the cathode of the rectifier tube 10 and with the anodes of a pair of amplifier electronic discharge tubes 14 and 15 which tubes are connected in parallel with each other. The grid of the tube 14 is connected through a line 16 with the cathode of a photo-electric cell 17 that is arranged to receive light from the flame of the burner 1 when the latter is operating.

The cathodes of the tubes 14 and 15 are indirectly heated, the heaters thereof being connected through circuits 18' and 19' respectively with secondary coils 18 and 19 of the transformer 8. The coil 19 having one side connected with the heater of the tube 15, has its opposite side in a circuit 20 that includes a contact switch 13*a* of the relay 13.

When the main power line switch 5 is closed, as well as the thermostatic switch 4, or other control provided in the power line, current will be supplied to the transformer 8. The secondary coils 11, 18 and 19 will then cause heating up of all of the tubes 10, 14 and 15, the heater of the tube 15 being energized through the circuit 19', 20 that is initially closed at the contact switch 13*a*.

When the tube 15 heats up and starts electronic emission, it causes current to flow from the secondary 9 of the transformer, through the rectifier tube 10, the line 22, the anode and cathode of the tube 15, and the line 21. The line 22 includes the windings of both relays 12 and 13, and the closing of this circuit upon the energizing of the tube 15, thereby energizes both relays 12 and 13.

The energizing of the relay 12 breaks a circuit at 12*a* and closes a circuit at 12*b* which latter switch connects a line 23 leading from one side of the power line 3 with a line 24 that extends to an electro-magnet 25 which controls a power line switch 26 in the line 3' leading to the compressor or other operating part of the burner to actuate the burner, it being ignited either automatically or manually in the usual way. The light from the burner 1 which would thus fall on the photo-electric tube 17, causes current to flow through said tube between the line 16', 16, ex-

tending from the transformer secondary 9, and a line 17' connected with the cathode of the tube 14, which circuit thereby starts an electronic emission in the tube 14, completing the circuit through the line 22 and the rectifier tube 10 to the transformer secondary 9. This closed circuit will continue to hold the relay 12 energized and to maintain the control circuit 24 closed at the switch 12b for the operation of the oil burner. This will continue as long as the light from the burner is maintained on the photo-electric cell 17. However, if the flame from the burner is interrupted or extinguished, the described circuit through the photocell 17 and the tube 14 is broken and the relay 12 becomes deenergized, opening the circuit 24 at 12b and disconnecting the power circuit to the burner motor 2, thereby stopping the operation of the burner. The closing of the contact switch 12a upon deenergizing of the relay 12, while the relay 13 remains energized, causes a short circuit around the coil of the relay 12 through the switch 12a, one side of which is connected through a line 12c with a contact of the switch 13b and which switch has the other contact thereof connected with a line 27 that extends to the line 22 between the coils of the relays 12 and 13. This short circuit prevents the energizing of the relay 12 again until after the relay 13 has been deenergized and the operation repeated.

When the burner was started as described above, if it did not become ignited and thus produced no flame on the photo-electric cell 17, the tube 14 would not function to hold the relays energized. When the relay 13 was energized initially, its actuation opened the contact switch 13a, thus breaking the circuit 19', 20 that supplied current to the heater of the tube 15, allowing the cathode thereof to cool. When it has cooled to a predetermined extent, its emission stops, breaking the circuit through the relay 12. The deenergizing of the relay 12 after this delayed time interval, opens the control circuit 24 to the burner by opening the contact switch 12b, the relay 12 being deenergized, since the tube 14 was not operated because of the failure of the burner to supply light to the photo-electric cell 17.

The relay 13 has not become deenergized however, because when it was operated initially, it closed a contact switch 13c, having a line 28 leading to one side thereof from the secondary coil 9, while the opposite side of the switch 13c is connected with the line 27 leading to the line 22 between the relays 12 and 13. Thus the initial energizing of the relay 13 completed a locking circuit through 27 and 28 and the switch 13c, thence through the winding of the relay 13 and the line 22, thereby maintaining the coil of said relay energized until the main power line circuit 3 is opened. To restart the burner, it is only necessary to open the main line switch 5 again and then to close it, which repeats the cycle of operation as described above.

This provides for a fool-proof control of the burner, with a definite starting time interval which functions to discontinue the operation of the burner, or the supply of power thereto automatically in the event that its flame is not ignited or becomes extinguished. Different starting time intervals may be obtained, as desired, merely by changing the tube 15 and replacing it with a tube of a different heating time. Thus, a tube requiring fifteen seconds for heating or cooling may be replaced by one requiring thirty seconds or even a minute, which will thereby vary the starting time during which the system will function before discontinuing the operation of the burner if no flame has been produced.

The relays 12 and 13 preferably are set at different tensions, the relay 12 having the contact springs thereof of a lighter tension than those of the relay 13 so they will yield before those of the relay 13, whereby the relays will function in the proper order. This is also provided by the connection between the switches 12a and 13b of the relays.

Another feature of this system, as distinguished from a thermo controlled system as frequently employed heretofore, is that regardless of an increased heating of the cathode of the tube 15, it merely delivers an increased emission as a result thereof until the relay 13 is energized to break the heater circuit of said tube 15 at 13a, and thereby discontinuing the operation of this tube. Thus the relay of this tube functions to interrupt its own heater, as described.

I claim:

1. In a burner control system, the combination with a burner, of an electrical circuit for controlling the operation of the burner, a relay having a contact switch for controlling said circuit, a second relay having a contact switch adapted to be opened upon energization of said second relay, an electronic discharge device including an anode and a time-delay cathode of appreciable heat capacity, a source of power, a second circuit connecting in series said relays, anode, cathode and source of power, a third circuit controlling the energization of said cathode and including said second relay contact switch, a fourth circuit including said relays and source of power, and means responsive to combustion at the burner for energizing said fourth circuit, thereby normally maintaining said relays energized when the cathode of said discharge device, after a predetermined time delay, has cooled to a non-emitting temperature.

2. In a burner control system, the combination with a burner, of an electrical circuit for controlling the operation of the burner, a relay having a contact switch for controlling said circuit, a second relay having a contact switch adapted to be opened upon energization of said second relay, an electronic discharge device including an anode and a time-delay cathode of appreciable heat capacity, a source of power, a second circuit connecting in series said relays, anode, cathode and source of power, a third circuit controlling the energization of said cathode and including said second relay contact switch, a fourth circuit including said relays and source of power, and means responsive to combustion at the burner for energizing said fourth circuit, thereby normally maintaining said relays energized when the cathode of said discharge device, after a predetermined time delay, has cooled to a non-emitting temperature, and a fifth circuit including the second relay and having a contact switch arranged to hold the second relay energized upon deenergizing of the first relay.

3. In a burner control system, the combination of an electrical circuit for controlling the operation of a burner, a relay having a contact switch for controlling said circuit, a second relay having a contact switch responsive to energization of said second relay, an electronic discharge device including an anode and a time-delay cathode of an appreciable heat capacity, a source of power, a second circuit connected in series

with said relays, anode, cathode and source of power, a third circuit controlling the energization of said cathode and including said second relay contact switch, a fourth circuit including said relays and source of power, and means constructed for operation in response to combustion at the burner for energizing said fourth circuit, thereby normally maintaining said relays energized when the cathode of said discharge device, after a predetermined time-delay, has cooled to a non-emitting temperature.

4. In a burner control system, the combination of an electrical circuit for controlling the operation of a burner, electrical means for controlling the operation of said circuit, an electronic discharge device including an anode and a time-delay cathode of appreciable heat capacity, a source of power, a second circuit connected in series with said control means, anode, cathode and source of power, a third circuit for controlling the energization of said cathode and including means for deenergizing the cathode, and means responsive to combustion at the burner for controlling said circuits to normally maintain said first-mentioned control means energized when the cathode of said discharge device, after a predetermined time-delay, has cooled to a non-emitting temperature.

5. In a burner control, electrical means for controlling the operation of a burner circuit, an electronic discharge device including an anode and a time-delay cathode of appreciable heat capacity, means adapted to be connected with a source of power for connecting said electrical controlling means in a circuit with the anode and cathode, means for controlling the energizing of the cathode and including means for deenergizing the cathode, and means responsive to combustion at the burner for controlling the several aforesaid means normally to maintain the first-mentioned control means energized when the cathode of said discharge device, after a predetermined time delay, has cooled to a non-emitting temperature.

6. In a burner control, the combination of a relay having a contact switch adapted for controlling an electric circuit of a burner, a second relay having a contact switch responsive to energizing of said second relay, an electronic discharge device including an anode and a time-delay cathode of appreciable heat capacity, means adapted to be connected with a source of electrical power for connecting said anode and cathode in series with said relays, means for controlling the energizing of said cathode and including said second relay contact switch, and means constructed for operation in response to combustion at the burner for energizing said relays, thereby normally maintaining said relays energized when the cathode of said discharge device, after a predetermined time delay, has cooled to a non-emitting temperature.

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