

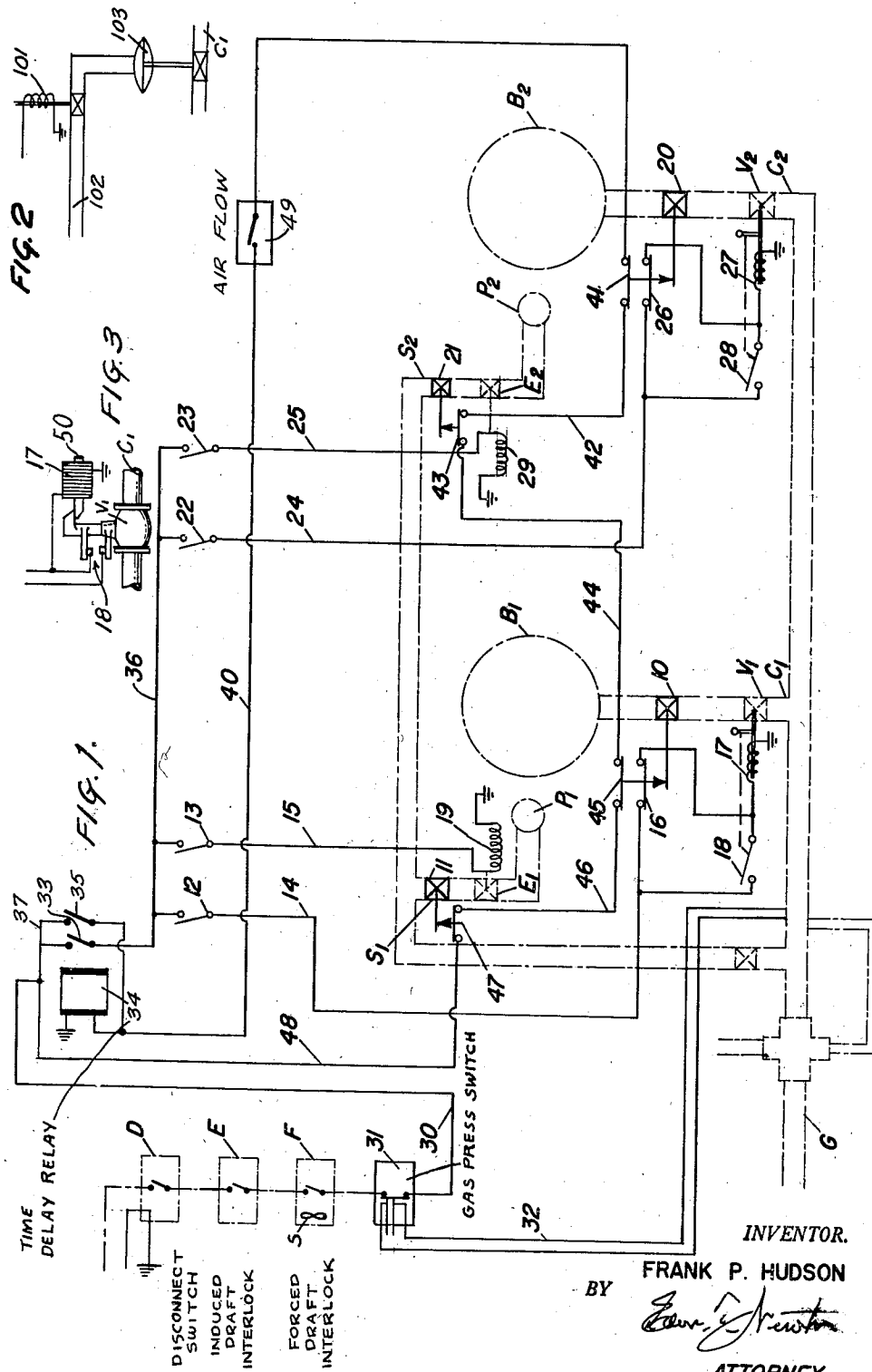
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BURNER SAFETY CONTROL SYSTEM

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BURNER SAFETY CONTROL SYSTEM

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4 Claims. (Cl. 158—28)

This invention relates to burner control systems and is particularly concerned with an electrical control system for use in connection with blower-burner combinations by which a preliminary purging of the system may be insured before fuel is supplied and the burners ignited.

In many installations such as in boilers, furnaces, kilns, driers and the like, it has been deemed expedient to provide a preliminary charge or blast of air under pressure to the burners and combustion chamber to purge such chamber of present fuel and gas and thus preclude, or materially reduce in incidence and/or degree of intensity, hazardous uncontrolled combustion or explosion of residual fuel from prior operations or fuel such as may have been supplied by leakage or faulty fuel supply equipment subsequent to prior operations. While fuel systems have heretofore been proposed by which such purging air may be supplied prior to the normal firing or "light off" of the burners, such systems have not provided adequate interrelations and combinations with the fuel supply valves to positively prevent inadvertent or premature supply of fuel to the burners prior to normal light-off. Nor do present systems include adequate safety means requiring the presence of fuel pressure before "light off" or means insuring proper sequence of valve operation.

It is therefore among the primary objects of the invention to provide a new and improved fuel supply control system by which the hazards of premature fuel supply are reduced to a minimum.

More specifically it is an object of the present invention to provide a control system for a burner combination including a purging air supply in which full and adequate purging before fuel is supplied may be insured.

Another object of the invention is to provide a system of the character set forth which will be simple, effective and efficient and one having such interrelation, combination and cooperation with the conventional control elements as to insure a proper predetermined sequence of operation and which will preclude accidental or inadvertent improper operation of such instrumentalities.

A further object of the invention is to provide for the incorporation in such a system of time delay means so that by a single operation of a main control device an adequate preliminary purging is automatically insured before fuel may be supplied.

It is also among the objects of the invention to relate and combine the usual pilot burner as well as the usual main burner and its fuel supply to the control system in such manner as to insure against combustion of residual or leaked fuel prior to the normal supply of fuel initiated after the purging operation is completed.

The invention also has as an object the incorporation of pressure responsive means not only insuring a delay in fuel supply to the burner until adequate purging has been accomplished but also insuring an adequate fuel supply pressure before purging or fueling takes place and during normal firing periods therewith insuring shut down of fuel supply should such pressure be diminished below safe operating requirements.

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These and other objects, features and advantages of the invention will be apparent from a consideration of the following specification taken in conjunction with the drawing in which a diagrammatic disclosure of one preferred embodiment of the basic inventive concept is presented. In the drawing, the conventional burner arrangement and fuel and pilot system are depicted by dot and dash lines while the valves and electrical control system of the present invention are shown in full lines.

In general the system of the present invention may be broadly defined as including a time delay switch energized from a main control switch and preferably having interposed a pressure responsive device associated with the fuel supply means so as to preclude operation should the fuel supply be inadequate. The time delay switch is also preferably under the influence of another pressure responsive means associated with the operation of the fan or blower or air flow of the purging air pressure supply so as to preclude completion of its circuit in the event that the purge air flow should be inadequate. Furthermore the time delay switch is controlled by the burner and pilot valves, the arrangement being such that the control circuits may not be energized while the burner or pilot valves are open, hence there can be no possibility of fuel supply during the purging period. A further circuit supplied by the time delay switch or its interlocking relay automatically insures the opening of series arranged automatic valves in a predetermined sequence prior to the possibility of opening manual valves in the same series.

Fig. 1 is a schematic diagram of my gas burner system.

Fig. 2 is a schematic view of a detail showing a modified form of valves which may be substituted for the control valves of Fig. 1.

Fig. 3 is a side elevation of a detail showing one of the manual reset electrically latched valves.

Referring now to the diagram of the drawings, it will be seen that there is here disclosed, by way of example, a two burner gas system, the burners B1 and B2 being of conventional design and being provided with the usual igniting pilots P1 and P2. Gas is supplied from a suitable source indicated at G through conduits C1 and C2 to the burners B1 and B2, respectively. In the conduits C1 and C2 the usual manual reset electrically latched valves V1 and V2 are provided for the control of fuel to the burners. Similarly, gas is supplied to the pilots P1 and P2 through supply pipes S1 and S2, respectively, and conventional electrically controlled valves E1 and E2 are provided for the pilots.

While valves V1 and V2 are described herein as being of the manual reset electrically latched type such as shown in Fig. 3, any electrically controlled valve may be used. An electrically controlled valve is defined as a valve which may not be opened until an electric current is received by the valve. As seen in Fig. 1 the valve may be opened by the energy of the electric current on its solenoid directly, or as seen in Fig. 2, electric solenoid 101 may act as a trigger or pilot to cause the valve to be opened by the energy of air, gas, or hydraulic fluid under pressure through conduit 102 to diaphragm control mechanism 103, or the electric solenoid may latch an operating mechanism permitting the valve to be opened manually. Regardless of the source of energy used to open the valve, the valve closes automatically on loss of electric current to its solenoid.

In addition to the conventional burner and pilot valves V1, V2, P1 and P2, the present invention provides additional manual burner control valves 10 and 20 and manual pilot control valves 11 and 21, which as hereinafter set forth are effective in the control of the electrical system of the present invention. In the drawing, the conventional burners, pilots, valves, fuel supply pipes and wiring are shown in broken lines while the elements

of the present invention are shown in full lines. In considering the above outlined arrangement it will of course be understood that the showing is diagrammatic and is not intended as a disclosure of any particular burner and pilot combination or the fuel supply and wiring therefor. While the present showing contemplates a gas burning arrangement, it will be understood that the invention is in no way limited to such fuel and that powdered or liquid fuel may be supplied and controlled in like manner within the scope of the present inventive concept.

The present presentation of connected parts further includes a current supply C, a fused disconnect switch D, induced draft fan interlock E and forced draft fan interlock F having blower means S, all of which are conventional and customary in the type of arrangement here shown and form no part of the present invention except as to their combination and interrelation with respect to the control system. In this respect, it is also to be understood that different kinds, numbers and arrangements of blowers or natural draft ports may be incorporated in the system without departure from the arrangement and operation of the present invention.

The conventional circuit here shown includes the series connection of the fused disconnect switch D, the induced draft fan interlock E, the forced draft fan interlock F, or an operating differential air flow switch performing the same purpose as E and F with the source of current C. In series there is also provided a low gas pressure switch connected by tubing 32 from the gas header G, and/or any other safety interlock desired in the fuel system. From the series connected low pressure switch 31, a conductor 30 leads to a time delay switch 33 of the present system. For actuating time delay switch 33, I have provided a slow acting coil 34 which is connected to conductor 30 through the circuit traceable from conductor 40 and 48. The other side of coil 34 leads to ground. The relay thus formed by coil 34 and switch 33 is of the hold down type and includes a second switch 35 connected through conductor 37 to conductor 30. The other side of switch 35 is connected to coil 34 so that once coil 34 is energized it receives current from conductor 30 and remains energized so long as current is supplied to conductor 30. From the time delay switch 33, a conductor 36 extends to individual switches 12, 13, 22 and 23 connecting respectively through conductors 14, 15, 24 and 25 leading to switch 16, solenoid 19, switch 26, and solenoid 29 of valves 10, E1, 20 and E2, respectively. Switches 12, 13, 22 and 23 may be manually controlled disconnect switches or may be contacts on individual burner flame failure safeguard relays.

Switches 16 and 26 are coupled with valves 10 and 20 in such manner as to be closed when the valves are closed. From these switches the circuits extend to solenoid coils 17 and 27 which operate to disengage a latch such as latch 50 on valves V1 and V2 to permit manual opening of these valves when their coils are energized. A shunting or holding circuit is also provided for the valves V1 and V2 including switches 18 and 28 which are closed when the valves V1 and V2 are manually opened after engagement of the latch, thus shunting out the switches 16 and 26 once the valves V1 and V2 are opened. The conductors 15 and 25 lead to the conventional electrical actuators 19 and 29 of the conventional pilot valves E1 and E2, and thus when these circuits are energized such pilot valves will be opened.

From the foregoing, it will be seen that, without regard for the master time delay switch circuit hereinafter discussed, the foregoing circuit, upon energization, provides for opening of pilot valves E1 and E2 and the unlatching of burner valves V1 and V2, permitting the latter to be opened manually, and further provides for the retention of valves V1 and V2 in open position. Such operation, when current is supplied through the time delay switch, assumes the switches 12, 13, 22 and 23 to be closed. It will of course be noted that the provision

of such switches provides individual overriding manual control or unmonitored control by flame failure safeguard relays of either pilot or main burner. It will also be understood that the opening of valves E1, E2, V1 or V2 will not result in the supply of fuel to the pilots or burners because of the provision of the valves of 10, 20, 11 and 21 of the present system. These latter valves being manually controlled.

In conjunction with the valves 10, 11, 20 and 21 there is provided a master or control circuit for the time delay switch which precludes actuation of the time delay switch to energize the circuits of conductor 36 should one of such valves 10, 11, 20 or 21 be left open. This master circuit includes a conductor 40 extending from one connector of the time delay switch 33 to a switch 41 which is closed when and if the manually operable burner valve 20 of the burner B2 is closed and is opened when the valve 20 is opened. Switch 41 is a companion switch to switch 26 and is operable therewith. From the switch 41, conductor 42 leads to a second series connected switch 43 operable by the valve 21 and closed and opened with the closing and opening of the valve 21. From the switch 43, a conductor 44 leads to a third series connected switch 45 associated with valve 10 as in the manner of switch 41 associated with valve 20. From switch 45, conductor 46 leads to a fourth switch 47 connected with valve 11 in the manner of the connection of switch 43 to valve 21; and from switch 47, a conductor 48 returns to the time delay switch 33 completing the circuit therefor.

Since all of the series connected switches 41, 43, 45 and 47 are associated with these valves in such manner as to be closed to complete the circuit only when the valves are closed, it will be seen that the open position of any of the valves will preclude completion of the circuit. The internal circuit arrangement of the time delay switch is such that power may not pass to coil 34 from the elements, D, E, F, and 31 when the master control circuit is open, nor can current pass therethrough for the conductor 36 and its dependent circuits.

Incorporated with the foregoing circuit in series with switches 41, 43, 45 and 47 may be a differential air flow responsive switch 49 which may be a manometer or diaphragm type switch connected to the boiler to determine whether a draft is flowing through the boiler. This air flow switch of course is optional; when located in the circuit, it remains open until a draft through the boiler causes it to close.

From the foregoing, it will be seen that in the operation of the present apparatus the coil 34 for the time delay switch 33 may not be energized unless all of the valves 10, 11, 20 and 21 are closed. When such valves are closed, the switch 33 may be energized through the series connected devices D, E, F and 31. Such energization will not however immediately energize the circuit of conductor 36 since such energization is delayed by the switch 33 until a predetermined lapse of time sufficient to complete the purging of the system. After such purging, the switch 33 will energize the circuits of conductor 36 opening the pilot valves E1 and E2 and unlatching for manual operation the valves V1 and V2. With such valves open, the manual valves 10, 11, 20 and 21 may then be opened to supply the pilots and the burners with fuel for normal operation. It will thus be seen that the present system precludes opening of any of the electrically controlled valves during purging of the system should any of the manual valves be opened. The low pressure switch also precludes operation of any of the equipment should the fuel supply fail, and the interlock circuit arrangement insures a proper sequence of valve opening. As hereinbefore indicated, the invention is not limited or restricted to any particular structural features of the individual components, and it will be understood that numerous changes, modifications, and the full use of equivalents may be resorted to in the

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practice of the invention without departure from the spirit or scope thereof as set forth in the following claims.

I claim:

1. A control system for fuel burners having in combination, blower means, a source of current, a first circuit from said source of current, a switch actuatable by air from said blower means and connected to said circuit for supplying current from said source of current through said circuit upon actuation of said switch, a time delay switch connected to said circuit and actuatable upon the flow of current in said circuit, a second circuit connected to said time delay switch to receive current from said source of current upon the lapse of sufficient time after said actuation of said time delay switch, a solenoid connected to said second circuit and actuatable by current flowing therein, a fuel valve of a fuel burner connected to said solenoid, said solenoid permitting opening of said fuel valve upon actuation of said solenoid, a valve connected in series with said fuel valve, said last mentioned valve being constructed and arranged to prevent fuel from entering said fuel burner when closed, a pair of switches connected to said last mentioned valve and openable thereby, said switches being constructed and arranged to close upon closing of said last mentioned valve and to open upon opening of the same, a third circuit connected between one of said pairs of switches and said time delay switch, said time delay switch being constructed and arranged to remain open as long as said one of said pairs of switches is open, the other of said pairs of switches being interposed in said second circuit between said time delay switch and said solenoid, a normally open switch connected in parallel with said other of said switches, and means operably associated with said solenoid and operable to close said normally open switch upon energization of said solenoid.

2. The control system as set forth in claim 1 includ-

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ing a pilot fuel burner, a pilot valve and a safety valve in series with said pilot valve to prevent fuel from entering said pilot fuel burner when closed, a switch connected to said safety valve, said last mentioned switch being constructed and arranged to be opened when said safety valve is open and closed when said safety valve is closed, said last mentioned switch being connected in series in said first circuit.

3. The control system set forth in claim 1 including an air flow switch connected to said fuel burner and in series with said one of said pairs of switches, said air flow switch being constructed and arranged to be closed when sufficient air is passing through said fuel burner and to be open when insufficient air is passing through said burner.

4. The control system set forth in claim 1 including a pilot fuel burner, a pilot valve, a safety valve in series with said pilot valve to prevent fuel from entering said pilot fuel burner when closed, a switch connected to said safety valve, said last mentioned switch being constructed and arranged to be opened when said safety valve is opened and closed when said safety valve is closed, said last mentioned switch being connected in series in said first circuit and an air flow switch connected to said fuel burner in series in said first circuit, said air flow valve being constructed and arranged to be closed when sufficient air is passing through said fuel burner and to be open when insufficient air is passing through said burner.

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