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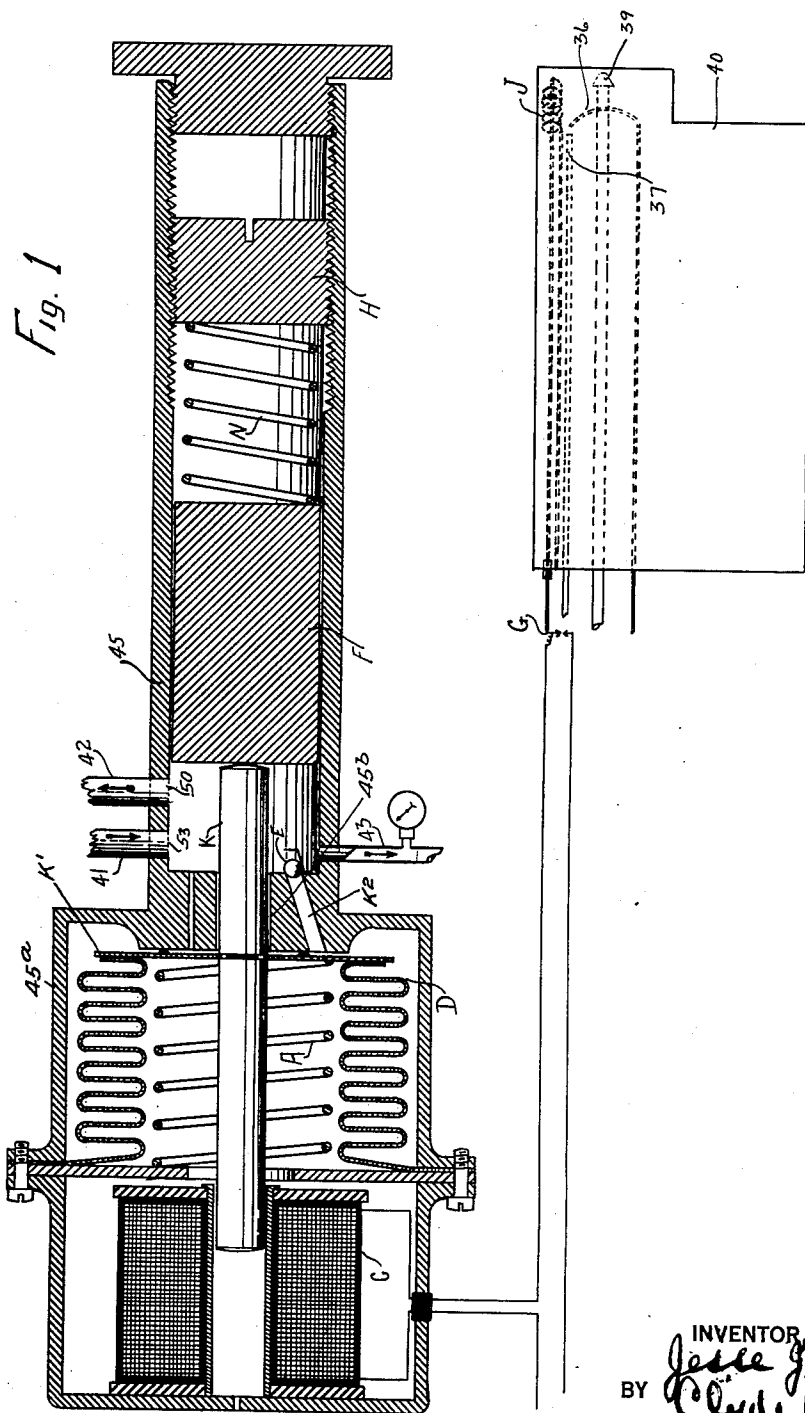
J. J. BROWN

2,098,951

DUAL SAFETY DEVICE FOR OIL BURNERS

Filed Nov. 6, 1935

3 Sheets-Sheet 1



INVENTOR
Jesse J. Brown
BY Clyde R. Rogers
his ATTORNEY

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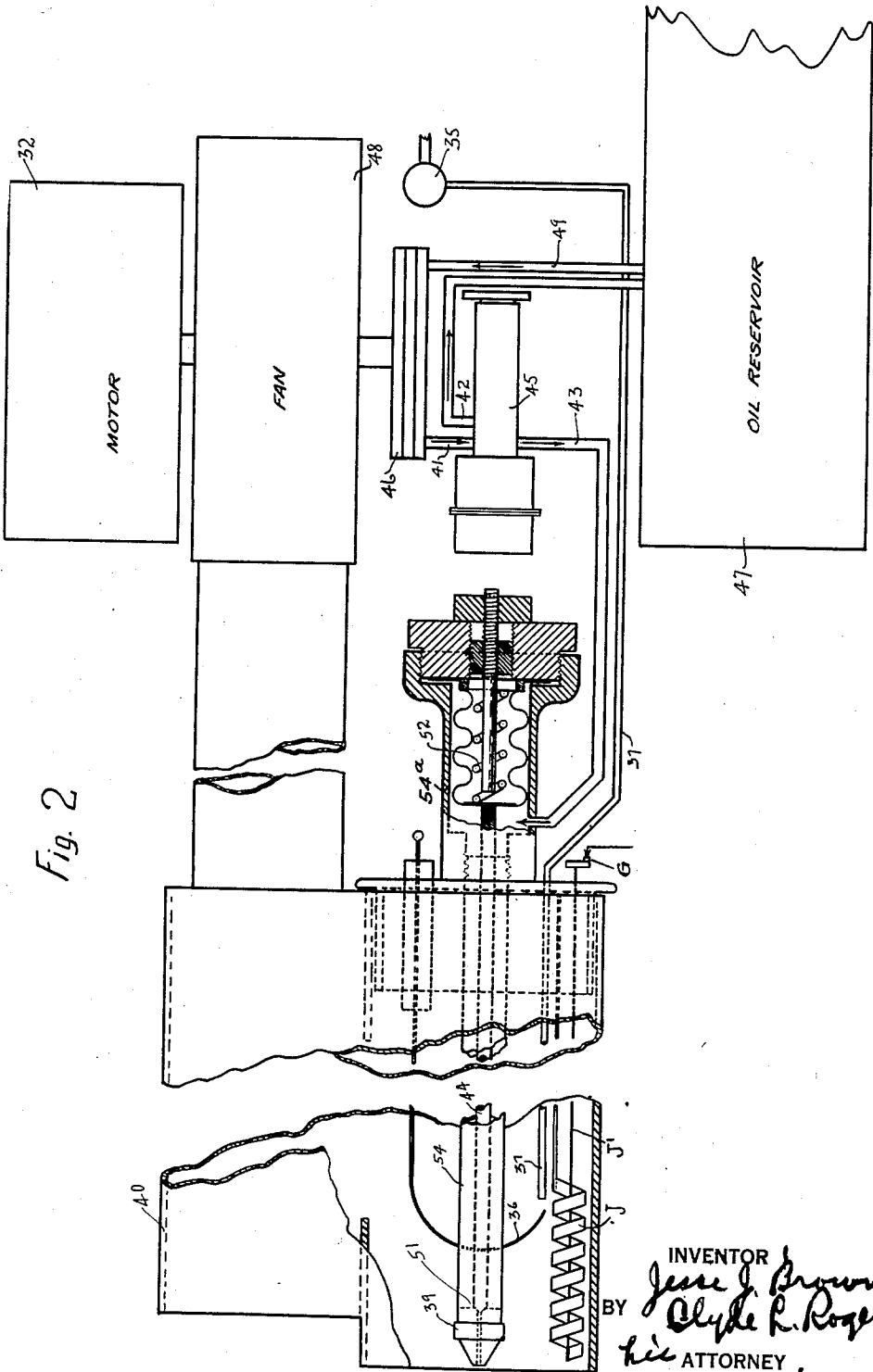
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3 Sheets-Sheet 2



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Jesse J. Brown,
BY Clyde R. Rogers,
his ATTORNEY,

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J. J. BROWN

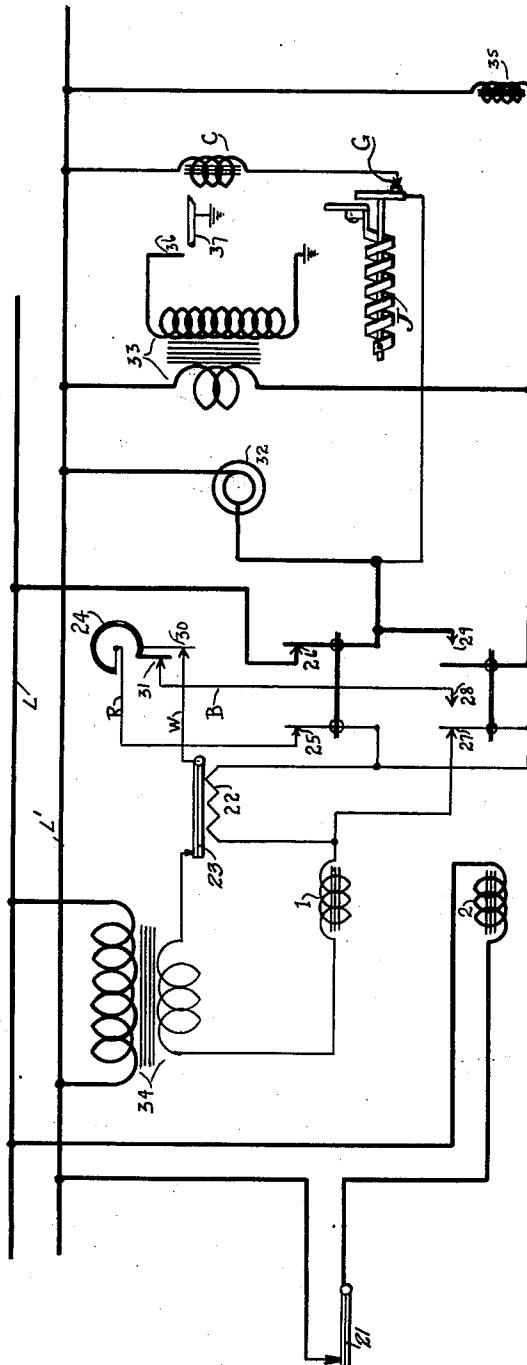
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DUAL SAFETY DEVICE FOR OIL BURNERS

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3 Sheets-Sheet 3

Fig. 3



INVENTOR
Jesse J. Brown
BY Clyde H. Rogers
his ATTORNEY

UNITED STATES PATENT OFFICE

2,098,951

DUAL SAFETY DEVICE FOR OIL BURNERS

Jesse J. Brown, Syracuse, N. Y.

Application November 6, 1935, Serial No. 48,590

12 Claims. (Cl. 158—28)

This invention relates to safety device for oil burners and more particularly to a safety device for fully automatic machines of the "gun" or oil pressure type. A principal object of the invention is to prevent positively the spraying of any oil into the fire box when the burner mechanism is set in operation unless the proper ignition means is present to ignite such oil. A further object is to prevent positively the spraying or feeding of any oil into the fire box without the presence of proper ignition after oil combustion in the fire box has ceased from any cause either from failure of oil pressure or from failure of requisite current voltage in the system, or otherwise. A still further object is to provide means for preventing positively the oil pressure in the system from rising again, once it has fallen to a pre-determined point, my improved means for this purpose providing in such case for the release of all oil pressure and the restarting of the burner in normal manner with the proper ignition. Among the advantages of my invention is that it eliminates the ever-present hazard of "puff-backs" caused by the burner starting without proper ignition means being present. This has heretofore been a very prevalent cause of serious trouble in all prior automatic oil burners known to me, the spraying of oil into a fire box without proper ignition means being present, constituting as is well known, a source of great danger especially if the fire box is hot, with many resulting serious explosions. A further important object and feature of the invention are to provide a system and arrangement whereby when the room thermostat calls for heat, the blower and ignition of the burner are first started into operation to scavenge the fire-box of dead gases with a dwell after the blower starts, before any oil feed can take place, whereby puff-outs of smoke and malodorous gases are substantially eliminated.

The foregoing and other objects and advantages of the invention will be better understood from the following detailed description taken in connection with the accompanying drawings, and the distinctive features of novelty will be thereafter pointed out in the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal sectional view of a pressure regulator valve for an oil burner equipped with the improvements of my invention, the burner itself and associated parts being shown diagrammatically.

Figure 2 is a diagrammatic elevation showing the mechanical features of the apparatus with a

portion of the firing head and gun assembly of the burner broken away in vertical section, and

Figure 3 is a diagrammatic view of an electrical wiring system for a pressure oil burner showing my invention incorporated therewith.

Referring to Figure 2, 39 denotes a firing head or burner nozzle of a type of burner in common use to which air is blown from a hollow casing 40 connected with a fan 48, there being a suitable electrode 36 in position to supply a spark to ignite the gas from gas pilot tube 37, the passage of gas through which is controlled by a solenoid 35. 54 denotes the oil tube leading to the spray nozzle 39 at its extremity, and 51 denotes a shut off valve for controlling the passage through nozzle 39, this valve 51 being borne at the end of a rod 44 extending through the oil tube 54 into an enlargement 54a at the rear thereof where it is acted on by a spring 52 tending normally to close the valve, there being, as shown, a metal bellows surrounding this spring in the housing 54a and responsive to oil pressure to hold the valve 51 open, all this being usual construction.

My invention is centered primarily in the embodiment shown, in improvements in, and additions to the pressure regulator valve designated generally 45, from which the oil line 43 leads to the oil tube 54. The oil supply to this pressure regulator valve is shown as through passage 41 from the pump 46 which draws the oil through a pipe 49 from the reservoir tank 47, while 42 denotes a by-pass or return pipe for returning to the reservoir 47 oil supplied by the pump and not delivered to the burner. In its more comprehensive embodiment, my invention comprises thermo-responsive means associated with the ignition device at 37, i. e. at the discharge end of gas pipe 37, in combination with improvements to be now described in the pressure regulator valve, whereby upon failure for any reason of oil combustion in the burner chamber, the oil supply is cut off immediately and may not be again restored until proper ignition is again operative in the fire box. Referring more particularly to Figure 1, pressure regulator valves as heretofore known to me have embodied only the smaller right-hand portion as shown in said Figure 1, i. e. with the oil supply pipe 41 leading into a cylindrical chamber in which a piston F is slidingly fitted, the by-pass or return pipe 42 and the pipe 43 to the burner head also communicating with this chamber. The piston F is acted on by a compression spring N, the tension of which may be adjusted by a threaded follower block H, the inward pressure thus exerted on the piston F being

such that under normal working oil pressure, the end of the piston covers the return pipe 42 permitting the oil to be delivered from pipe 41 to pipe 43, but upon any excessive pressure the piston being pressed back so as to uncover enough of the opening 50 to pipe 42 so as to keep the pressure delivered to the pipe 43 down to normal. In accordance with my invention the housing of pressure regulator valve 45 is formed with an inner enlarged portion 45a in the end of which is fixed a solenoid C. A plunger K extending into this solenoid and under the control thereof extends through an intermediate guide neck 45b of the housing so that when in outer position its end engages the piston F and holds it so as to uncover the by-pass port 50. A disk K' is secured to the plunger K and this is acted on by a compression coil spring A to normally hold the plunger K outward while permitting it to be drawn in by the energizing of the solenoid C. The solenoid C is in an electric circuit which includes the contacts G and these contacts are under the control of a thermo-responsive device, shown as the helix J, which upon being heated by the ignition from pipe 37 closes said contacts and energizes the solenoid C. Thus when there is no ignition, i. e. when the helix J is cold, the contacts G open, the solenoid C de-energized, and the plunger K held outward by the spring A, the piston F will be held outward by said plunger so as to open the by-pass port 50 as shown in Figure 1, this being the condition when the burner is not working. D denotes a metal bellows secured in the housing 45a at one end thereof and having its other end secured to the disk K'. This metal bellows is made to collapse by the energization of solenoid C as later more fully explained, and during the operation of the burner it is acted on by the oil under pressure delivered from the regulator chamber through passage K² to the chamber 45a, to keep it collapsed. Thus the plunger K is kept in its inward position permitting the piston F to move to close the by-pass 50, this being the condition when the burner is working and normal oil pressure is being supplied to the burner 39. A ball check valve E may if desired be employed to retard the passage of oil through the port K² so that the inward movement of the piston F will be made slower and thus pressure will tend to build up gradually.

My improved device is adapted for use with any standard system of control for oil pressure burners, and in Figure 3 I show its application to a well known and standard control panel arrangement of electrical connections, the only change necessary as will more fully appear, being the introduction of the solenoid coil C with the contacts G into the system in parallel with the motor 32 as shown in Figure 3. In the diagram of said figure the circuit of room thermostat 24 is low voltage, e. g. 20 volts which is derived from a transformer 34 from the line wires L—L'. In this circuit the connection W is common to the starting circuit and the running circuit. W and B constitute the starting circuit and W and R the running circuit. 21 indicates any suitable form of combustion safety device now in common use and as shown includes a thermal warp element which is operated by the heat from the burner flame which closes the circuit when heated. The combination 22 and 23 comprises a thermal cut-out used to shut the burner down on "safety" if 21 is not by any chance operated by the heat from the flame. This cut-out usually operates in about fifty seconds and mechanically latches in the

"safety position", requiring it to be reset manually. In this device, 22 is a heating element and 23 the usual bi-metallic thermostat. In normal operation, 22 is short-circuited at 27 when 21 operates to close the relay 2, before 22, 23 has had time to open. The burner motor 32 and ignition means 33 and 35 controlling the ignition gas supply are fed through 26 controlled by relay 1, but the ignition means is also controlled through 29 by relay 2, so that the ignition means may be cut off when relay 2 is closed by operation of 21.

In normal operation, when the room thermostat 24 is not calling for heat the contacts 30 and 31 at the thermostat are open, relays 1 and 2 are open and the burner is not in operation. As the room containing the thermostat cools, the contacts gradually close, 30 first against a flexible blade. This does not start the burner because the starting circuit is still open at 31. As the thermostat cools and warps more, the contact 31 is also made, and the starting circuit is completed through 24, 30, W, 23, transformer 34, coil of relay 1, 22, 28, and B, back to 31. This energizes the coil and closes relay 1 completing the R circuit through 25 and also closes contacts 26, starting the motor 32, driving the fan 48 and pump 46 and energizing the ignition means 33 and 35. It is to be noted that the thermal element 22 is now in the circuit. The pump produces no oil pressure,—with the use of my device,—because the spring A in Figure 1 causes the plunger K to keep the return port 50 open and oil from the pump flows freely back to the tank. The gas pilot flame heats the helix J which operates to close contacts G, energizes coil C, which pulls plunger K to the left allowing piston F to cover the return port 50 and thus permit oil pressure to be built up in the usual manner. With the oil pressure built up, oil is sprayed into the fire box and ignited by the gas flame at 37, the heat of the flame operates 21 to close relay 2 which short circuits thermostat element 22 at 27, opens starting circuit B at 28 and opens the ignition circuit at 29, thus producing normal running conditions. In the normal shutting down of the burner when the room temperature rises enough to warp the bi-metallic element of the room thermostat and open contacts 30 and 31, 31 opens first but this has no effect as this circuit is already open at 28, the opening of 30, however, will de-energize relay 1 which instantly stops the burner by opening contacts 26. This opening of relay 1 also opens circuit R at 25. Relay 2 will remain closed until 21 cools off and opens. It is to be noted that until 21 does open relay 2, the starting circuit is also open at 28, and the burner cannot restart with the ignition circuit open at 29. The burner is then ready to start normally whenever the contacts 30 and 31 of circuit B—W at the thermostat close.

If in starting no flame is obtained for any reason, combustion safety switch 21 will not be closed by the heat of combustion and will not in turn close relay 2. This allows thermal element 22 to remain in circuit and in about fifty seconds will warp the bi-metallic blades of thermostat 23 open, shutting the burner down on safety. If this happens due to loss of ignition means for any reason, no hazard exists with the use of my invention because no oil can be sprayed into the fire box without the ignition flame to heat the helix J, while with ordinary burners previously in use, oil will be sprayed into the fire box until the cut-out 23 opens. This is a serious hazard and the cause of much trouble. Now to

consider what happens if the burner flame goes out due to any of the causes before mentioned while the burner is in otherwise normal running condition, let it be supposed contacts 30 and 31

5 at the thermostat are closed and the burner running with flame present in the fire box, both relays being closed and the ignition cut off at 29. Should the voltage of the supply line now drop to, say, 55 volts or fifty per cent of normal the
10 motor 32 will slow down and probably stop; this causes the oil pressure to drop, possibly to zero, the shut-off valve 51 at the burner nozzle to close and the flame goes out. Then presume that the voltage comes back to normal, i. e. 110 volts.—
15 both relays 1 and 2 have remained closed on the reduced voltage so the motor starts again with the rise of voltage to near normal and sprays oil into the fire box, assuming the burner is not equipped with the present invention. With the
20 relay 2 closed there is no ignition means present and an explosion is apt to result. However, if the burner is equipped with the present invention, no hazard results, as when the motor 32 re-starts, no oil pressure can be obtained because
25 the plunger K is now holding the return port 50 open. Then when 21 cools and opens relay 2, ignition is brought on and through the operation of helix J oil pressure is allowed to build up and be ignited by the ignition gas flame.

30 In present day practice it will be understood that since there is no plunger K or solenoid to cooperate in control of the piston F that this piston F when at rest is held to the left by spring N covering return port 50 and pressure will build
35 up immediately when the burner motor 32 starts. Also if when the burner is running normally the pressure should go down to, or nearly to, zero temporarily, the regulator valve is free to respond to the pump and allow pressure to build up again
40 immediately. With the device of my invention as described and by the cooperative action of the plunger K, this is impossible until proper ignition is assured. The bi-metallic helix J which typifies any suitable type of heat responsive element for controlling the contacts G is adapted
45 to cause a rod J' extending from the free end thereof to turn when the helix is heated by the ignition gas flame, this rod bearing a movable contact which meets with a stationary contact, these contacts being electrically in series with the
50 coil C and as stated the coil and contacts being connected in parallel with the motor 32.

With the added equipment of my invention the operation will be as follows.—When burner starts
55 the piston F will be in right hand position as shown in Figure 1, being held clear of return port 50 by plunger K actuated by spring A which is stronger than spring N. Oil from pump 46 enters at 53 as before but is free to flow back to tank
60 47 through return port 50 which is now wide open and therefore no pressure can be built up. The burner motor 32, fan 48, pump 46, spark at 36, and gas at 37 are in operation as in the previous case, but no oil is sprayed into firebox as no pressure has been raised.

65 The spark lights the gas at the pilot tube 37, the air from the fan 48 gives this flame a clean blue blow-torch effect, and this hot blast quickly heats helix J closing contacts G, energizing coil
70 C, pulling plunger K to left allowing spring N to push piston F to left covering return port 50 and allowing pump 46 to raise pressure. With K held clear of F, F is free to regulate pressure as in first case.

75 As stated in description of controls, as burner

flame heats combustion safety switch 21, Figure 3, relay 2 closes and cuts off ignition at 29. This allows helix J to be quickly cooled by the fan air and contacts G open, deenergizing coil C. But with normal oil pressure being maintained, plunger K will remain at the left because bellows D
5 is now compressed by this pressure, the surface of D exposed to the oil pressure being sufficiently great to permit this pressure to hold against the relatively strong spring A.

Thus, after the coil C is de-energized by the controls transferring from the starting circuit to the running circuit, and cutting off the ignition means, the only thing preventing the plunger K and the spring A from releasing all the oil pressure, is the oil pressure itself.

With any reduction in pressure, K will move to the right, and if this reduction is continued, K will eventually come in contact with F and uncover the return port 50, allowing all pressure to release to tank. Once the return port is uncovered, it is evident that pressure cannot again be built up except through action of the gas pilot on starting cycle. Spring A and the plunger K act with the return port 50 as an unloading valve,
25 once the pressure has dropped to a certain point.

It is to be noted that when the room thermostat 24 calls for heat, the described connections immediately start the ignition and also start the blower motor into operation after which there is then an appreciable dwell or interval as required for the heating of the thermoresponsive device J before the solenoid C is energized to close the by-pass 42 and permit feeding of the oil. This feature is of value and importance because it
35 provides for adequately scavenging the fire-box of dead gases or partly burned or unburned gases before any fresh fuel is injected into the fire-box. In pressure oil burners of the present type, as heretofore constructed, when the burner starts, the first rush of air from the fan blower combined with the expansion of the oil gas at first ignition causes a sudden pressure in the fire box, which is largely relieved as soon as the burned gases get into normal motion up the stack and chimney.
45 However, during the brief interval until such gases do get into motion up the stack, the pressure causes the incompletely ignited gases to pass out through any crack or opening of the fire box resulting in a puff of smoke in the cellar or hot air chamber or both, which is very objectionable and has been a source of much service complaint. Of course if there should be any unburned gases in the fire-box from a previous operation, the
55 "puff-out" of smoke and gases would be much more violent even when the burner started normally. This objection is substantially eliminated in the present device by the described provision for first starting the ignition and blower of the burner and as already described providing for a dwell before the start of the oil feed, thus scavenging the fire-box and starting the air and dead gases in motion up the stack before combustion begins. In a normal starting of the burner action,
65 this relieves the fire-box of most of the "ignition pressure" when combustion starts and practically eliminates the "starting smell" of which so many users complain.

I am aware that the invention may be embodied
70 in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire the present embodiment to be considered in all respects as illustrative and not restrictive, reference being had to the appended
75

claims rather than to the foregoing description to indicate the scope of the invention.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a pressure oil burner equipped with an oil spraying nozzle and blower, with means for supplying oil under pressure to said nozzle, and with a pressure responsive valve adapted to open at a pre-determined oil pressure, an oil burner safety control including an ignition means, a thermostatic element adjacent thereto and adapted to be heated thereby, and an electric circuit responsive to the action of the said thermostatic element having means associated therewith to control the supply of oil fuel to the burner independently of the energization of said blower motor, said means as controlled by said thermostatic element normally rendering said oil fuel supply operative with a time dwell after the blower operation is started.

2. In a pressure oil burner equipped with an oil spraying nozzle, with means embodied in a fuel pump for supplying oil under pressure to said nozzle, and with a pressure responsive valve adapted to open at a pre-determined oil pressure, an oil burner safety control including an ignition means, a thermostatic element adjacent thereto and adapted to be heated thereby, and an electric circuit responsive to the action of the said thermostatic element having means associated therewith to control the building up of the atomizing oil pressure subsequent to the normal operation of the fuel pump.

3. In a pressure oil burner equipped with an oil spraying nozzle, with means for supplying oil under pressure to said nozzle, and with a pressure responsive valve adapted to open at a pre-determined oil pressure, an oil burner safety control including an ignition means, a thermostatic element adjacent thereto, an oil-pressure regulator of the by-pass type, and a solenoid and plunger connected to be controlled by said thermostatic element; said plunger adapted to hold open the by-pass of the pressure regulator while the burner is idle and to allow by-pass to close only when the solenoid is energized by action of the thermostatic element when said thermostatic element is heated by the ignition means.

4. In a pressure oil burner equipped with an oil spraying nozzle, with means for supplying oil under pressure to said nozzle, and with a pressure responsive valve adapted to open at a pre-determined oil pressure, an oil burner safety control including an ignition means, a thermostatic element adjacent thereto and adapted to be heated thereby, an oil-pressure regulator of the by-pass type for controlling the atomizing oil pressure, a solenoid and plunger connected to be controlled by said thermostatic element; said plunger adapted to hold open the by-pass of the pressure regulator while the burner is idle and to allow the by-pass to close only when the solenoid is energized by action of the thermostatic element when said thermostatic element is heated by the ignition means, a diaphragm or bellows attached to said plunger and forming an oil seal, a spring on one side of said bellows to actuate the plunger to open the by-pass of the regulator, said spring adapted to be compressed by action of the solenoid and plunger and to be held in compressed position by action of said oil-pressure on the opposite side of the bellows when the solenoid becomes de-energized through normal operation of the burner control system.

5. In a pressure oil burner equipped with an oil spraying nozzle, with means for supplying oil under pressure to said nozzle, and with a pressure responsive valve adapted to open at a pre-determined oil pressure, an oil burner safety control including an ignition means, a thermostatic element adjacent thereto and adapted to be heated thereby, a pressure regulator equipped with a by-pass in the oil line between the source of oil supply and the nozzle, a spring pressed device adapted to hold open said by-pass yieldingly, and a solenoid connected to be controlled by said thermostatic element responsive to the heating of the said thermostatic element by the ignition means to compress the said spring and permit closing of said by-pass.

6. In a pressure oil burner equipped with a pressure opened nozzle valve adapted to open at a predetermined oil pressure, means for supplying oil under pressure to said valve, an ignition means, a thermostatic element associated with said ignition means and responsive thereto, an oil pressure regulator of the by-pass type to control the oil supply to said nozzle valve, having associated therewith means operative upon failure of oil pressure to by-pass all the oil supplied to the pressure regulator, and means controlled by said thermostatic element for rendering said by-pass means inoperative when the ignition means is operating.

7. An oil burner safety control device as set forth in claim 6 wherein the by-passing means of the pressure regulator is constructed and arranged to be rendered inoperative by normal oil pressure but to become operative upon failure of oil pressure.

8. In combination with an atomizing oil burner having a pressure opened nozzle valve, an electrically controlled pressure fuel feeding means including an oil-pressure regulator of the pressure actuated by-pass type, and an igniter; a control system comprising in circuit a main switch, the electrical means controlling fuel feed, said igniter, means operable when deenergized to hold said by-pass valve open and a thermal switch which closes when hot operatively associated with said igniter and controlling energization of said last named means, whereby said nozzle valve is opened only after the igniter is functioning properly.

9. In a pressure-type oil burner equipped with a spray nozzle and with a pressure-opened nozzle-valve for controlling the flow of oil to the nozzle, a pump for supplying oil under pressure to said nozzle, ignition means for igniting the oil sprayed from said nozzle, and a pressure-actuated by-pass valve for regulating the pressure of the oil delivered by the pump; a control system comprising said ignition means, a thermal switch adapted to close when heated by the ignition means, and means having an electrical component controlled by said thermal switch which when said electrical component is deenergized, is adapted to hold said by-pass valve open thereby preventing the building up of sufficient oil pressure to open said nozzle-valve.

10. A pressure oil burner system comprising an oil spraying nozzle with means for supplying oil under pressure to said nozzle equipped with a pressure responsive valve adapted to open at a predetermined oil pressure, a blower, ignition means, a thermostatic element adjacent to said ignition means adapted to be heated thereby, an oil pressure regulator of the pressure-actuated by-pass type having means tending to keep a

- by-pass connection opened and equipped with an element to cause closing of such by-pass connected to be responsive to said thermostatic element, and a room-condition responsive circuit
5 arranged when heat is called for to instantly activate said blower and said ignition means and to activate said pressure regulator to build up oil feeding pressure with a time dwell after the activation of the blower and ignition means.
- 10 11. A pressure oil burner system comprising a pressure spray nozzle with means for supplying oil under pressure thereto, a blower, an oil pressure regulator of the pressure-actuated-by-pass type having an electrical control device to control the building up of pressure to said nozzle,
15 ignition means, a room-condition-responsive electrical circuit embracing said blower and ignition means to cause instant activation thereof when

heat is called for, a thermo-responsive device associated with said ignition means, a circuit including said control device and ignition means; said circuit, control device and said thermo-responsive device constructed and arranged to produce normal oil feeding pressure to said nozzle at a substantial and predetermined interval after the activation of said blower and ignition means and to prevent the building up of such pressure until such interval has elapsed.

10 12. A pressure oil burner system as set forth in claim 11, wherein the pressure regulator is biased to an oil by-passing setting, and said electrical control device therefor embodies a solenoid adapted to overcome such bias and cause a
15 setting of the regulator in pressure building relation.

JESSE J. BROWN.