March 19, 1940. F. R. WHITCOMB 2,194,133

OIL BURNER AND CONTROL MECHANISM THEREFOR

Filed Dec. 23, 1936

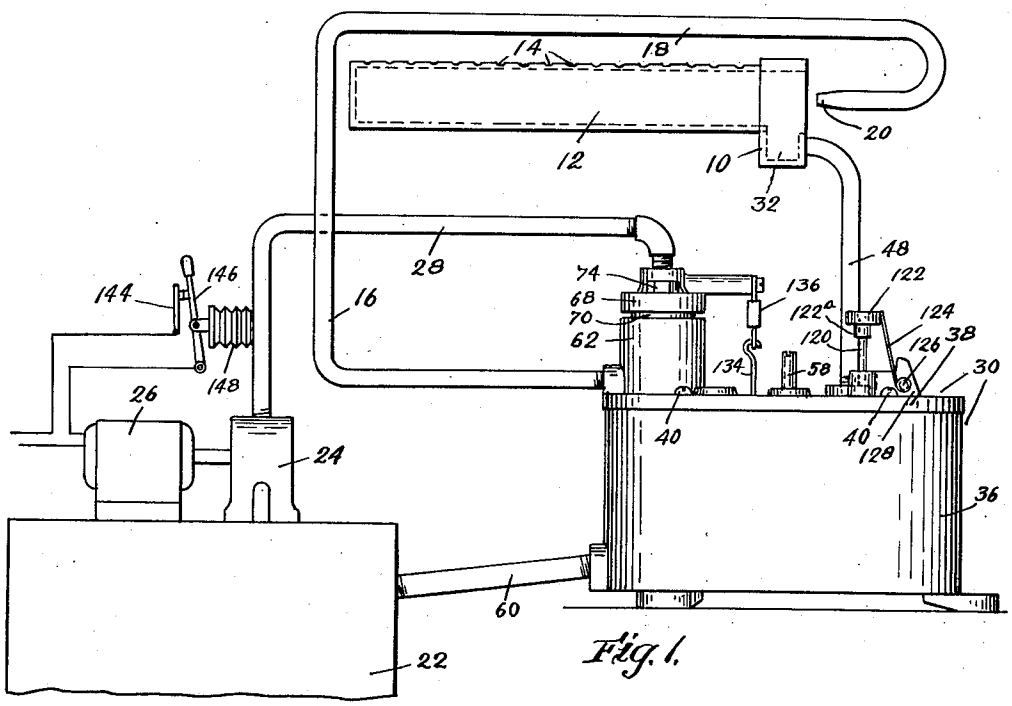

Fig. 1.

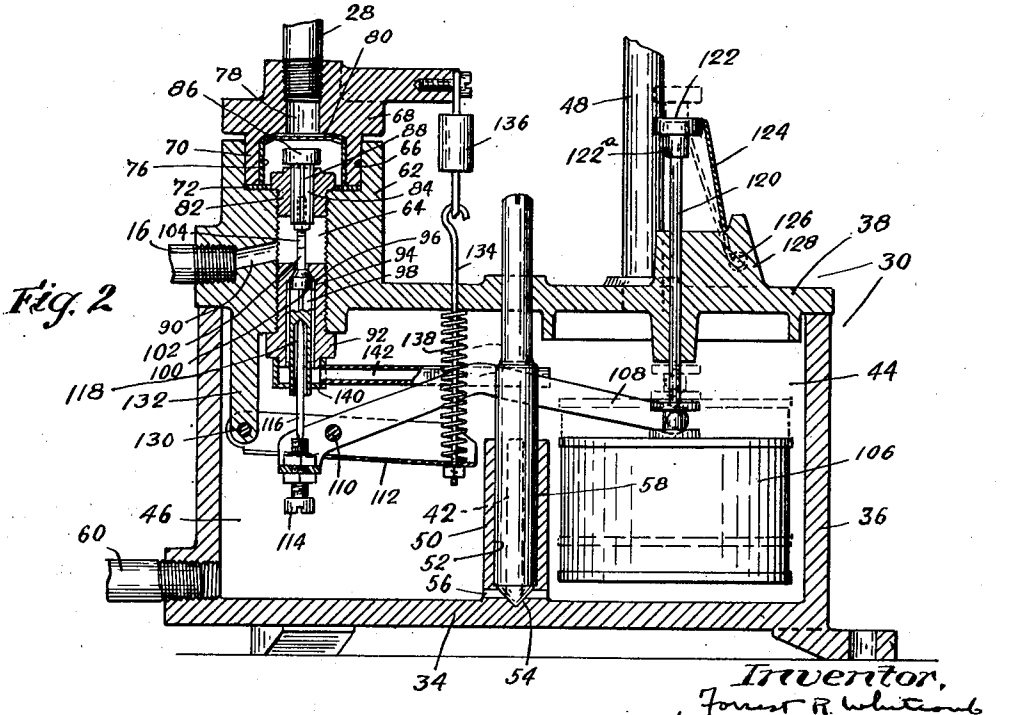

Fig. 2.

Inventor,
Forrest R. Whitcomb
by T. T. Drummond atty

Patented Mar. 19, 1940 2,194,133

UNITED STATES PATENT OFFICE

2,194,133

OIL BURNER AND CONTROL MECHANISM THEREFOR

Forrest R. Whitcomb, Winchendon, Mass.

Application December 23, 1936, Serial No. 117,313

25 Claims. (Cl. 158—42.3)

This invention relates to liquid fuel burners and to protective devices therefor arranged to shut down the burner when it is operating improperly and particularly when an excessive amount of liquid oil has escaped therefrom.

The invention is concerned particularly with liquid fuel burners, as oil burners, of the vaporizing type, although it is not necessarily restricted to such type of burners.

In an oil burner of the vaporizing type the oil is vaporized in a heated generator and the vapor is discharged usually under substantial pressure into a mixing tube where it draws in sufficient air for combustion and the combustible mixture passes into the burner body and issues from the burner orifices where it burns. If the generator is insufficiently heated at the time of starting the burner in operation the vaporization of the oil is not complete and raw oil can flow into the burner body. The presence of substantial amounts of raw oil in the burner body interferes with the proper operation of the burner since it tends to become gradually vaporized and thus unduly enrich the vapor mixture.

Raw oil is also introduced into the burner if for some reason the flame becomes extinguished and the generator becomes cool. The collection of raw oil may constitute a fire hazard in addition to hindering the proper operation of the burner when it is again started in service.

Hence an object of the present invention is the provision of means for collecting the raw oil that may be discharged into the burner and for stopping the flow of oil to the burner when the accumulation is excessive.

A further object is the provision of an improved form of mechanism for stopping the flow of oil to the burner, the mechanism being operated by the discharge of a predetermined amount of raw oil into the burner and being self-locking in an operated condition so that it must be manually unlocked and reset before fuel can again be supplied to the burner and generator for further operation thereof.

The protective mechanism includes a float operated by the raw oil discharged into the burner to cut off the supply of oil to the burner. It is a further object of the invention to provide means for delivering additional oil to the float chamber at the time the float is about in a flow-stopping position, so as to insure a positive and quick movement of the float to an operated position thereof.

Another object of the invention is the provision of protective apparatus as above described having means by which it is operated to shut off the supply of oil to the burner in the event of a dangerous rise of temperature in the vicinity of the apparatus and the burner.

Another object of the invention is the provision of protective apparatus as above outlined having means which effects its operation to shut off the flow of oil to the burner when the pressure in the supply line becomes unduly high, as occasioned by the partial or complete clogging of the oil vapor orifice.

When a vaporizing type of oil burner has the oil supply leading to its generator shut off for the purpose of shutting down the burner at the time the generator is hot there is a considerable amount of oil in the hot generator. The oil continues to be vaporized and the vapor to discharge into the burner for some time after the oil has been shut off. This means that the flame is not extinguished immediately or, if the oil supply has been shut off due to improper operation of the burner, such as caused the flame to be extinguished, for instance, the unconsumed oil vapor will collect in the gas passages leading from the burner and flow into the surrounding atmosphere, not only producing an objectionable odor but also a fire hazard.

Hence another object of the present invention is the provision of means for interrupting the flow of fuel to the burner and also for venting the oil supply line so as to relieve the pressure on the line and to discharge oil from the generator and thereby to immediately extinguish the fire and to prevent the discharge of material amount of obnoxious and combustible gases, and also liquid fuel, from the generator nozzle.

Another object of the invention is the provision of manual means by which the flow of fuel to the generator can be interrupted and the pressure in the generator relieved and the oil therein withdrawn.

A further object of the invention is the provision of protective apparatus for an oil burner receiving pressure oil from a motor driven pump, the protective apparatus being arranged to shut off delivery of oil through the line connecting the pump with the burner and to change the oil pressure in a part of the line sufficiently to effect the interruption of the motor circuit and thereby to stop the operation of the pump.

Another object is generally to improve the construction and operation of oil burners and protective and control apparatus therefor.

Fig. 1 is a diagrammatic view of an oil burner system with which the present invention is associated.

Fig. 2 is a longitudinal sectional elevation through the float controlled protective apparatus of Fig. 1.

The oil burner with which the present invention is associated comprises an entrance casing 10 for the combustible mixture of oil and vapor, and the burner tube 12 into which the combustible mixture flows and discharges through orifices 14. The incoming oil is supplied under suitably high pressure through a pipe 16 and passes into a generator 18 which is herein shown as a continuation of the pipe 16. The generator 18 passes above the burner tube 12 and in sufficiently close relation with the flame or heated gases from the burner orifices so that it is heated sufficiently highly to vaporize the oil in the generator before the oil arrives at the front end of the generator.

The oil vapor is discharged through the orifice of a burner tip or nozzle 20 into the inlet of the burner casing 10 where it entrains a sufficient volume of air to form with the oil vapor a combustible mixture.

The oil for the burner is contained in a suitable tank 22 and is drawn from the tank and is pumped under pressure by a suitable pump 24 operated by the electric motor 26. The oil from the pump passes through a pipe 28 and thence into the pipe 16 through the protective or control apparatus generally indicated at 30.

When the heat of the generator is insufficiently high to properly vaporize all of the oil, as when the generator is not heated enough prior to starting the burner in operation, or has cooled down after the generator flame has been accidentally extinguished, or is cool for other reasons, raw oil will be discharged into the burner. The entrance casing 10 is provided with a cup or reservoir 32 in which the raw oil is collected. The cup is below the inner face of the bottom wall of the burner tube and the tube preferably is inclined toward said cup so that the raw oil and the condensed oil vapor can flow into the cup and thence into the protective apparatus 30 to operate said apparatus to shut off the supply of oil to the burner when the collection of raw oil becomes excessive.

The protective apparatus 30, illustrated in cross section in Fig. 2, comprises a casing having a bottom wall 34 and the generally elliptically shaped upstanding side wall 36. The casing is open at the top and is closed by a cover 38 secured removably in position by screws 40, see Fig. 1. The casing is traversed in approximately the middle thereof by a partition wall 42, thereby separating the casing into two compartments 44 and 46. Oil from the burner cup 32 flows by gravity through a pipe 48 and through the cover 38 into the compartment 44 where it collects.

The partition wall 42 is provided with an upstanding cylindrical enlargement 50 having a cylindrical bore 52 which extends substantially to the bottom wall 34 and has a conical seat 54 at its bottom end, which seat, and the cylindrical enlargement, is traversed by an oil passage 56 that establishes communication between the two chambers 44 and 46. Such communication is normally interrupted by a valve stem 58 disposed loosely in said bore 52 and having a conical seat that normally interrupts the continuity of the passage 56. The valve stem projects loosely through the cover 38 and can be engaged manually and raised to permit oil to flow from the chamber 44 into the chamber 46. Oil escapes from the chamber 46 through a pipe 60 and back into the supply tank 22.

The cover 38 above the chamber 46 is provided with an upstanding valve-enclosing boss 62 having a vertical cylindrical passage 64 therethrough which is internally screw-threaded at least at its upper and lower ends. The upper end of the boss, and said passages, is provided with an enlarged recess 66 surrounding the upper end of the passage 64.

A cap 68 has an annular rib 70 located in said passage and seated upon a packing ring 72 against which it is held firmly but removably by a pair of bolts 74, one of which is shown in Fig. 1. The cap 70 has an annular recess 76 in its lower end which surrounds the upper end of the passage 64. The cap has a fuel passage 78 therethrough which conducts fuel to the recess 76 and into which the high pressure pipe 28 from the oil pump 24 is connected. A strainer 80 is interposed between the passage 78 and the recess or chamber 76 for the purpose of filtering the oil flowing from the pipe 28.

An upper valve bushing 82 is screw-threaded in the upper end of the passage 64 and is provided with a valve stem 84 which is vertically movable therein. The stem is provided with an enlarged head 86 at its upper end which overlies the bushing and when seated thereupon shuts off the flow of oil through the valve stem passage in the bushing. The valve stem is provided with flutes or longitudinal oil passages 88 in its side wall through which oil can flow when the head 86 is elevated above the top of the bushing.

Under normal conditions of operation the valve is maintained in elevated position so that oil can flow through the bushing and into the intermediate part of the passage 64 and thence into a passage 90 that opens into the passage 64 and thence into the pipe 16 screw-threaded into the discharge end of said passage 90 and leading to the generator and burner.

A second, or lower, valve bushing 92 is screw-threaded into the lower end of the passage 64 and has a valve stem passage 94 therethrough provided with a reduced conically shaped upper end 96. A fluted valve stem 98 is reciprocable in said passage and has a conical end 100 which under normal conditions is seated on the conical end 96 of the valve passage to prevent flow of oil through the bushing. The valve stem 98 is provided with an extension 102 that projects above the bushing and engages a depending projection 104 which is adjustably screw-threaded into the bottom end of the stem 84 of the upper valve. The arrangement is such that when the lower valve is closed the upper valve is open and vice versa. The amount of elevation of the head 86 of the upper valve above its seat on its bushing is relatively slight, being only a few thousandths of an inch, which amount is sufficient to pass the requisite amount of oil. The upper valve is normally held open and the lower valve held closed by the float controlled mechanism associated therewith.

The float controlled mechanism includes a float member 106 disposed in the float chamber 44 and pivotally connected to the ends of a pair of lever arms 108 which are located above and traverse the partition wall 42 and are pivoted close to their other ends at 110 to a supporting frame 112 located beneath the valves. Said lever arms 108

are interconnected on the other side of the pivotal support 110 and carry a vertically adjustable screw 114 which has a conical recess in its upper end in which the lower end of a valve-operating strut rod 116 is pivoted. Said rod is extended loosely through an enlarged passage 118 of the valve stem 98 of the lower valve and is pivotally seated in the bottom, or upper end, of said passsage. With this arrangement the connection between the valve stem and the strut rod is in the middle of the bearing surfaces of the valve so that the side thrust on the valve is minimized when operating it and hence there is little danger of the valve cramping or sticking.

The weight of the float, when there is little oil in the float chamber 44, is sufficient to maintain the lower valve 98 in closed position and the upper valve 86 in open position so that oil can flow freely from the oil pump to the burner. If, however, there is a flow of raw oil into the burner or a condensation of oil vapor therein the oil flows into and accumulates in the float chamber 44 and ultimately raises the float sufficiently to effect the opening of the lower valve and the closing of the upper valve. As a consequence the oil flow from the pump to the burner is cut off so that further discharge of raw oil into the burner is prevented.

Due to the opening of the lower valve the pipe 16 is permitted to vent immediately through said valve into the interior of the casing 36 and particularly into the chamber 46 thereof, the interior of the casing being at atmospheric pressure. As a consequence the oil in the generator 18 is immediately forced out of the generator by the pressure of vapor therein and the pressure of the vapor is reduced to atmospheric pressure and so has no tendency to flow out of the nozzle 20. If there is a sufficient amount of vapor all of the oil of the pipe and also the vapor will pass into the casing 36 and the vapor will ultimately condense therein. With this arrangement discharge of gas from the burner nozzle ceases immediately the float operates and hence there can be no liberation of obnoxious and combustible gases. If the flame is burning at the time the device operates the flame is immediately extinguished.

Means are provided which locks the mechanism in an operated position so that the burner cannot be restarted without first resetting the mechanism. For this purpose the float 106 is provided with a stem 120 which is freely vertically movable in the cover 38. The upper end of the stem is provided with a manually-engageable knob 122. A latch 124 is loosely pivoted at 126 to an upstanding boss 128 of the cover and has its upper end inclined toward and normally bearing against the knob 122. When the float is raised to an operated position by reason of an accumulation of oil in the float chamber the knob 122 passes above the upper end of the latch so that the latch falls by gravity under the knob, or the hub 122a thereof, thereby holding the float in an elevated position and the upper valve 86 closed and the lower valve 98 open until the latch is restored manually to its original position and the float permitted to fall after the chamber 44 has been drained of oil by raising the valve 58.

The float can be raised manually at any time by engagement of the knob 122 and will be locked automatically in an operated position by said latch. The manual raising of the float effects the venting of the generator and the immediate extinguishment of the burner flame in the manner above described.

The valve mechanism is also adapted to be operated automatically in the event of a dangerous elevation of temperature of the ambient atmosphere, such as may result from burning oil outside the burner. To this end the frame 112 that supports the valve operating lever 108 is pivotally mounted at 130 to a depending lug 132 of the cover on the side of the axes of the valves opposite the pivot 110 for the valve operating lever. The free end of the frame is connected to a rod 134 which passes loosely through the cover 38 and is hooked to the lower end of a fusible link member 136, the upper end of which is suitably anchored removably to a part of the cap 68. A compression spring 138 encircles the rod 134 and bears against the cover and against the frame 112 in a direction to force the frame downwardly. When the link melts due to excessive heat the spring forces the frame downwardly and consequently operates to open the lower valve and close the upper valve and shut off the supply of oil to the burner and to relieve the generator of oil. The device can be reset by installing a new link 136. The device is operative by gravity and the pressure of oil on the valves without the spring 138. Said spring is useful, however, in holding the parts stationary while in shipment and also for facilitating assembly and adjustment of the float mechanism.

Means are provided to effect the rapid operation of the float controlled mechanism at the time the float is about to operate, thereby to obtain a positive quick action of the valves. To this end the valve bushing 92 has a cup 140 thereon which surrounds the lower end of the valve stem 98 and receives oil that is discharged from the flutes thereof. The oil is conducted through a duct 142 into the float chamber 44. The arrangement is such that when the float has been raised high enough to slightly open the lower valve oil discharged therethrough flows into the float chamber and rapidly raises the oil level therein to cause the float to move rapidly and positively up into its fully operated position.

The mechanism is also arranged to shut off the flow of oil to the burner if the oil pressure in the generator becomes unduly high as may be occasioned by a partial or complete stoppage of the burner orifice, or by unauthorized tampering with the pressure regulating devices. This result is secured by a proper adjustment of the weights of the parts. It will be appreciated that the oil pressure in the pipe 16 acts upon the lower valve 98 in a direction to open it and that this valve is held closed by the weight of the float and the associated mechanism. When the oil pressure becomes sufficiently high the valve 98 is moved downwardly thereby, and caused to open. The downward movement of the valve 98 effects the closing of the upper valve 84, thereby shutting off the oil supply. Oil from the pipe 16 flows through the open valve 98 and into the float chamber, thereby filling the chamber and causing the float to be elevated into a lock-out position.

The control mechanism, when it operates, is also operative to interrupt the pump motor circuit and shut down the pump. To this end the motor circuit is provided with a circuit controller comprising cooperating stationary and movable contact members 144 and 146, respectively. Said movable contact member 146 is moved into and out of engagement with the stationary contact member 144 by an expansible bellows 148 or equivalent operated by the pressure of oil in the

pipe line 28 connected to the pump. When the oil pressure is sufficiently high the bellows maintains the motor circuit closed. When the pressure drops below a predetermined minimum value as determined by the adjustment of the bellows, the bellows contracts and thereby opens the motor circuit and stops the pump and motor.

The drop of pressure necessary to effect sufficient contraction of the bellows to open the circuit controller occurs immediately both the upper and lower valves are open at which time the pump discharges at substantially atmospheric pressure into the casing and into the float chamber thereof. Thus the operation of the control mechanism, either automatically or manually, effects the stoppage of the motor and pump.

After the control apparatus has been reset the motor can be restarted by manually moving the movable contact member into engagement with the stationary contact member against the elasticity of the bellows and holding the movable contact member in such position until sufficient oil pressure has again been built up in the bellows.

In the claims the term "oil" comprehends any liquid fuel.

I claim:

1. The combination of an oil burner, a source of liquid oil, a pipe conducting oil from said source to said burner, a shut-off valve in said pipe, a vent valve opening into said pipe between said shut-off valve and said burner, and means responsive to the flow of liquid oil from said burner operative to close said shut-off valve and open said vent valve to stop the flow of oil through said pipe and to immediately relieve the pressure at said burner.

2. The combination of a vaporizing type of oil burner having a vapor generator, means for supplying oil to said generator, and means for cutting off the supply of oil to said generator and means independent of the oil supply means and automatically responsive to a condition of the burner for venting the vapor pressure in said generator.

3. The combination of a vaporizing type oil burner having a vapor generator, means for supplying liquid oil to said generator, and means responsive to an abnormal condition of said burner for shutting off the supply of oil to said generator and for immediately venting oil and vapor from said generator between the generator and the oil supply means.

4. The combination of a vaporizing type oil burner having a vapor generator, a source of pressure oil, a pipe for conducting oil from said source to said generator, means for controlling the supply of oil to said generator, and automatic means responsive to a condition of the burner for venting said pipe between said source and said generator for relieving oil from said generator.

5. The combination of a vaporizing type oil burner having a vapor generator, a source of pressure oil, a pipe for conducting oil from said source of said generator, and means responsive both to an abnormal operating condition of said burner and to manual control for shutting off the supply of oil to said generator and for venting said pipe between said source and said generator for relieving said generator of oil.

6. The combination of a vaporizing type oil burner having a vapor generator, a pressure oil supply, a pipe line for conducting oil from said supply to said vaporizer, valve mechanism in said pipe line operative to prevent the flow of oil through that portion of the pipe leading from said valve mechanism to said generator and to vent the oil in said portion of the pipe, and means for operating said valve mechanisms concurrently.

7. The combination of a vaporizing type oil burner having a vapor generator, a pressure oil supply, a pipe line for conducting oil from said supply to said vaporizer, valve mechanism in said pipe line operative to prevent the flow of oil through that portion of the pipe leading from said valve mechanism to said generator and to vent the oil in said portion of the pipe, and operating means for both said valve mechanisms concurrently responsive to an abnormal condition of the burner.

8. The combination of a vaporizing type oil burner having a vapor generator, a pressure oil supply, a pipe line for conducting oil from said supply to said vaporizer, valve mechanism in said pipe line operative to prevent the flow of oil through that portion of the pipe leading from said valve mechanism to said generator and to vent the oil in said portion of the pipe, and operating means for both said valve mechanisms concurrently responsive to an abnormal condition of the burner and also to manual control.

9. The combination of a vaporizing type oil burner having a vapor generator, a pressure oil supply, a pipe line for conducting oil from said supply to said vaporizer, valve mechanism in said pipe line operative to prevent the flow of oil through that portion of the pipe leading from said valve mechanism to said generator and at the same time to vent the oil in said portion of the pipe, operating means for said valve mechanism responsive to an abnormal burner condition, said valve mechanism including a valve for closing that portion of the pipe between it and said oil supply, and another valve for opening that portion of the pipe between it and said generator to a lower pressure.

10. Control mechanism for oil burners comprising means providing an inlet for pressure oil, an outlet for the oil to the burner, and oil-level-responsive mechanism common to both said inlet and outlet for closing said inlet and concurrently therewith for venting said outlet.

11. Control mechanism for oil burners comprising means providing an inlet for pressure oil, an outlet for oil to the burner, a valve for closing said inlet, a second valve for opening said outlet to the atmosphere, and valve operating means for both valves normally holding said first valve open and said second valve closed and operative into a position to close said first valve and open said second valve.

12. Control mechanism for oil burners comprising means providing an inlet for pressure oil, an outlet for oil to the burner, a valve for closing said inlet, a second valve for opening said outlet to the atmosphere, valve operating means for both valves normally holding said first valve open and said second valve closed and operative into a position to close said first valve and open said second valve, and oil level responsive means for operating said valve operating mechanism.

13. Control apparatus for oil burners comprising means providing an inlet for pressure oil, an outlet for oil to the burner, a passage connecting said inlet and outlet, a valve for closing said inlet, a second valve for opening said passage to the atmosphere, valve operating mechanism controlling said valves and normally biased

in a direction to open said first valve and to close said second valve, means providing a float chamber adapted to receive oil from the burner, a float in said chamber in control of said valve operating mechanism and movable in response to a sufficient elevation of oil in said float chamber into a position to close said first valve and to open said second valve, and means for releasably locking said valve operating mechanism in the operated position thereof.

14. Control apparatus for oil burners comprising means providing an inlet for pressure oil, an outlet for oil to the burner, valve mechanism for closing said inlet and for opening said outlet to the atmosphere, fluid level responsive means for operating said valve mechanism, and latch means for releasably locking said operating means and valve mechanism in the operated position thereof.

15. Control apparatus for oil burners comprising means providing an inlet for pressure oil, an outlet for oil to the burner, a passage connecting said inlet and outlet, a valve for closing said inlet, a second valve for connecting said passage to the atmosphere, operating mechanism for said valve mechanism normally biased toward a position wherein said first valve is open and said second valve is closed, means providing an oil chamber in which oil from the burner can accumulate, a float in said chamber controlling the operation of said operating mechanism, and means responsive to the opening of said second valve for discharging oil from said passage into said float chamber.

16. Control apparatus for oil burners comprising a float chamber in which oil from the burner can accumulate, a float in said chamber, a pipe line supplying oil to the burner, valve mechanism controlled by said float for controlling the supply of oil in said line to said burner, and means responsive to the operation of said valve mechanism for venting oil from said pipe line into said chamber.

17. Control apparatus for oil burners comprising a pipe line supplying oil to the burner, valve mechanism in said line controlling the supply of oil to said burner, a float chamber in which oil escaping from said burner can accumulate, a float in said chamber for operating said valve mechanism, and means responsive to the operation of said valve mechanism for venting oil from said pipe line between the burner and valve mechanism into said float chamber.

18. Control mechanism for oil burners comprising valve mechanism for controlling the supply of oil to the burner, operating mechanism for said valve mechanism including a pivoted frame, thermo-responsive means for holding said frame in a predetermined position and for permitting said frame to move to a second position when said thermo-responsive means operates, a lever pivoted upon said frame engageable with said valve mechanism, and fluid level control means for actuating said lever to operate said valve mechanism, said pivoted frame being also constructed and arranged to move said lever and effect the operation of said valve mechanism independently of said fluid level responsive means.

19. Control apparatus for oil burners comprising a casing having an oil chamber in which escaping oil from the burner can accumulate and a cover, said cover having means providing an inlet for pressure oil and an outlet for oil to the burner, valve mechanism carried by said cover including a valve for closing said inlet, and a second valve for opening said outlet to the interior of the casing, a lever carried by said cover for operating said valve mechanism, and a float carried by said lever and located in said float chamber for operating said lever.

20. Control mechanism for oil burners comprising a casing having an oil chamber in which escaping oil from the burner can accumulate, and a cover, said cover having means providing an inlet for pressure oil, and an outlet for oil to the burner, a valve for closing said inlet, a second valve for opening said outlet to the interior of the casing, a lever supporting frame pivotally carried by said cover, a thermo-responsive member normally holding said frame in an inoperative position and operating to permit said frame to move to an operated position, a valve operating lever pivoted on said frame and having an operative connection with said valve, and a float carried by said lever in said float chamber.

21. Control mechanism for oil burners comprising a casing having an oil chamber in which escaping oil from the burner can accumulate, and a cover, said cover having means providing an inlet for pressure oil, and an outlet for oil to the burner, a valve for closing said inlet, a second valve for opening said outlet to the interior of the casing, a lever supporting frame pivotally carried by said cover, a thermo-responsive member normally holding said frame in an inoperative position and operating to permit said frame to move to an operated position, a valve operating lever pivoted on said frame and having an operative connection with said valve, a float carried by said lever in said float chamber, and valve means for withdrawing the oil in said chamber.

22. Control mechanism for oil burners comprising a casing having an oil chamber in which escaping oil from the burner can accumulate, and a cover, said cover having means providing an inlet for pressure oil, and an outlet for oil to the burner, a valve for closing said inlet, a second valve for opening said outlet to the interior of the casing, a lever supporting frame pivotally carried by said cover, a thermo-responsive member normally holding said frame in an inoperative position and operating to permit said frame to move to an operated position, a valve operating lever pivoted on said frame and having an operative connection with said valve, a float carried by said lever in said chamber, valve means for withdrawing oil from said chamber, and means responsive to the operation of said valves for rapidly introducing oil into said float chamber.

23. The combination of an oil burner, a pump for supplying oil under pressure to the burner, a motor for operating said pump, a pipe line conducting oil from said pump to said burner, means responsive to a predetermined reduction of pressure of oil in said pipe line for effecting the stoppage of said motor, and means responsive to an abnormal discharge of oil from the burner for venting said pipe line and effecting a reduction of oil pressure in said pipe line sufficient to operate said pressure-responsive means.

24. The combination of an oil burner, a pump for supplying oil under pressure to the burner, a motor for operating said pump, a pipe line conducting oil from said pump to said burner, means responsive to a predetermined reduction of pressure of oil in said pipe line for effecting the stoppage of said motor, and means responsive to an abnormal ambient temperature for effecting a

reduction of oil pressure in said pipe line sufficient to operate said pressure-responsive means.

25. The combination of an oil burner, a pump for supplying oil under pressure to the burner, a motor for operating said pump, a pipe line conducting oil from said pump to said burner, means responsive to a predetermined reduction of pressure of oil in said pipe line for effecting the stoppage of said motor, and burner-controlled means operative to vent said pipe line and effect a reduction of oil pressure in said pipe line sufficient to operate said pressure-responsive means.

FORREST R. WHITCOMB.