

June 13, 1939.

O. L. BOCK

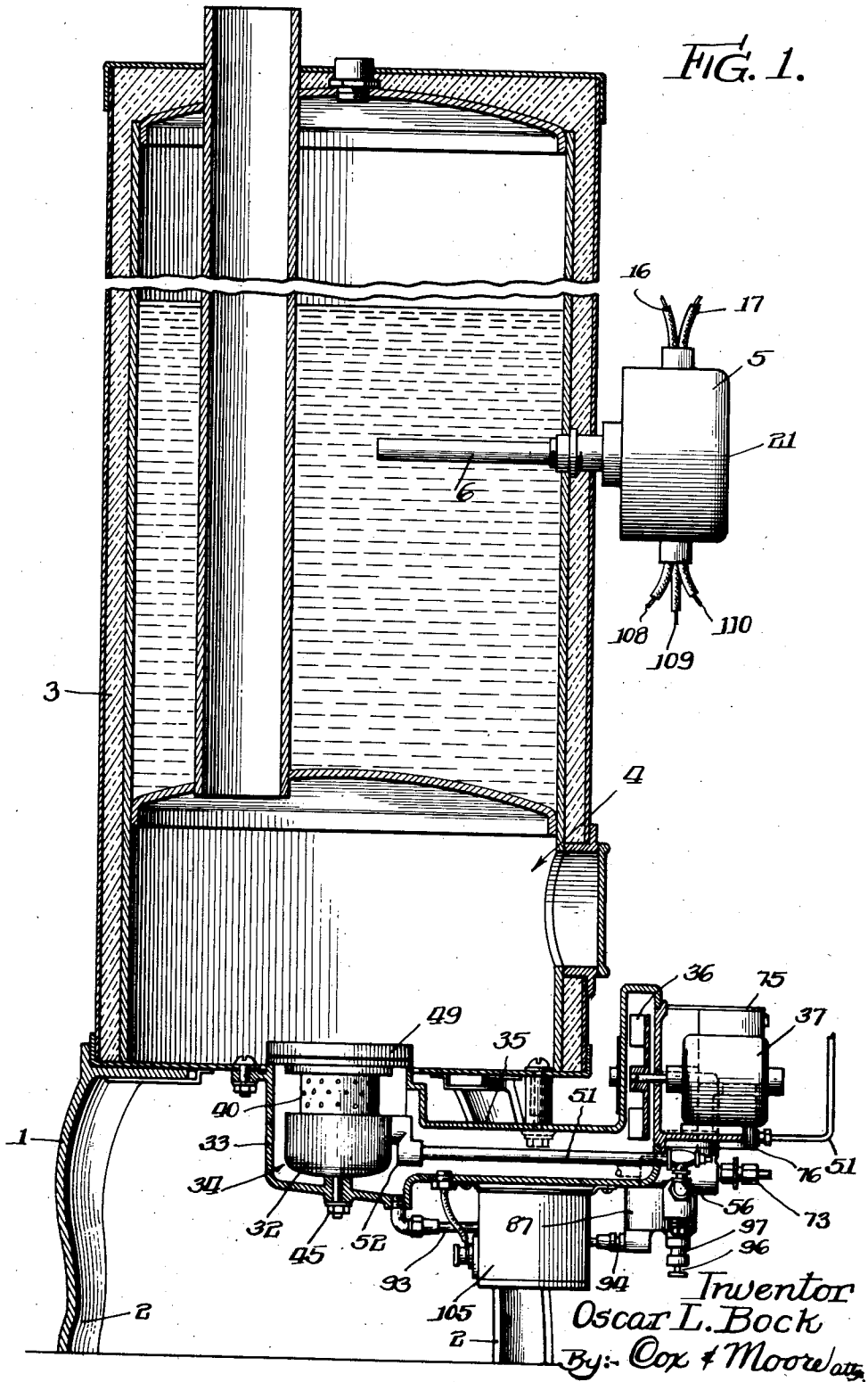
2,162,571

OIL BURNER

Filed Jan. 30, 1936

2 Sheets-Sheet 1

FIG. 1.



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FIG. 2.

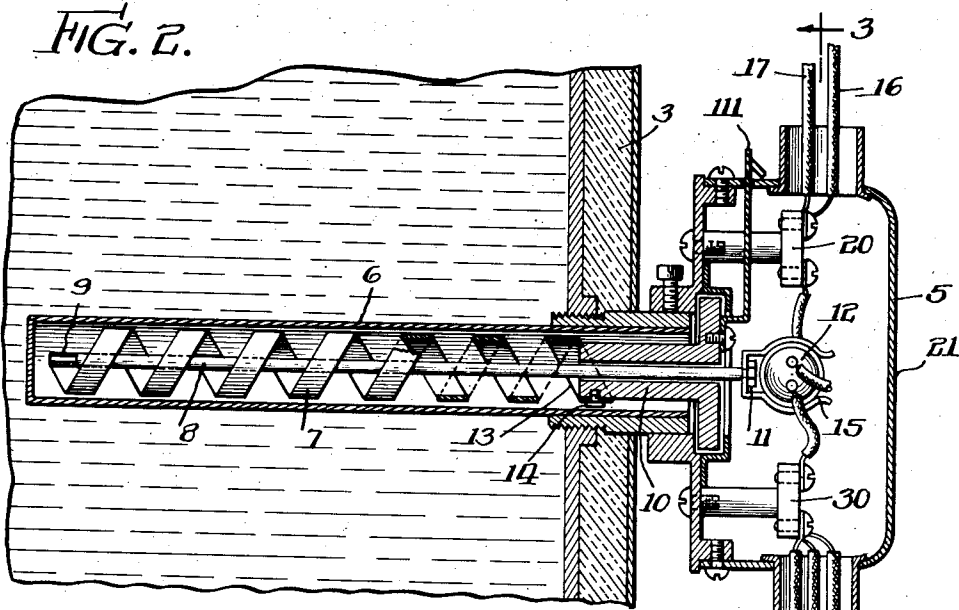


FIG. 3.

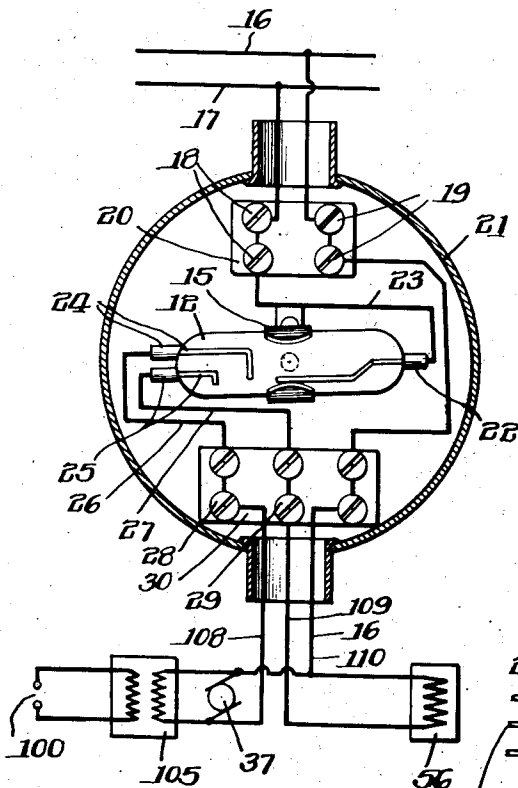


FIG. 4.

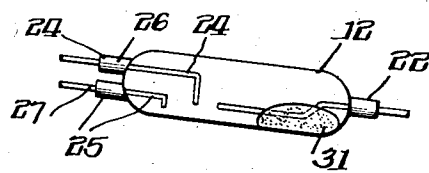


FIG. 5.

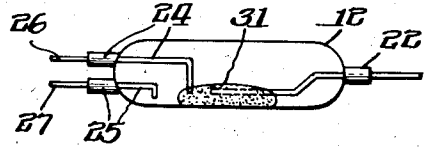


FIG. 6.

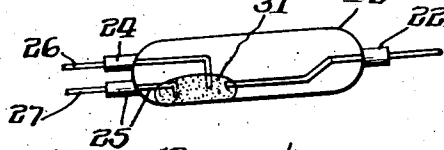


FIG. 7.

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UNITED STATES PATENT OFFICE

2,162,571

OIL BURNER

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9 Claims. (Cl. 158—28)

This invention relates to oil burners, and in particular to oil burners of the type having control mechanism operated by temperature mechanism, such as a thermostat or an aquastat.

5 The primary object of the present invention is to provide new and improved means for operating the burner mechanism when the temperature of the room, or water, reaches predetermined degrees.

10 Another object of the invention is the provision of a new and improved mechanism for operating a burner, which comprises an aquastat operable by the temperature of the water in a storage tank, whereby the mechanism is operated
15 according to the position or operation of the aquastat.

A further object of the invention is the provision of new and improved means for operating various elements of a burner control mechanism, to create a lag or interval of time to occur between the operation or shut-off of various devices so as to effect the operation and the shut-off of certain of the elements in proper sequence and time interval.

25 A further object of the invention is the provision of an oil burner which is provided with temperature regulating mechanism for controlling the operation of the burner mechanism, which is provided with a mercury switch control element so as to cause operation or cease operation of some of the instrumentalities and which is provided with means whereby some of the elements and operating mechanism have delayed operation or shut-off as regards other elements
30 or mechanism of the burner.

Numerous other objects and advantages will be apparent throughout the progress of the following specifications.

40 The accompanying drawings illustrate a select embodiment of the invention and the views therein are as follows:

Fig. 1 is a vertical, longitudinal sectional view taken through a hot water heater and embodying the invention;

45 Fig. 2 is a vertical, sectional view taken through the aquastat control mechanism;

Fig. 3 is a detail vertical, sectional view on the line 3—3 of Fig. 2;

50 Fig. 4 is a detail view of a mercury switch showing the same in a predetermined position;

Fig. 5 is a view similar to Fig. 4, showing the mercury tube in another position;

Fig. 6 is a similar view showing the mercury tube in still another position, with all electrodes
55 connected; and

Fig. 7 is a view similar to Figs. 4 to 6, but showing a modified form of mercury tube with an additional electrode.

The particular burner, herein shown for the purpose of illustration, comprises a base 1, having supporting legs 2, upon which there is mounted an upright storage tank 3 having a heating chamber 4, Fig. 1.

An aquastat 5 is mounted on the tank 3 and has an extension 6 in the form of a tube which extends interiorally of the tank.

Bimetallic material in the form of a coil 7, Fig. 2, is arranged within the tube 6 and is controlled by the temperature of the water in the tank 3. The bimetallic material 7 is in the form of a coil and surrounds a longitudinal rod 8, having one of its ends connected thereto as indicated at 9, Fig. 2.

The other end of the rod 8 passes through a friction bushing 10 and has connected thereto, as indicated at 11, a mercury tube 12.

The end 13 of the bimetallic material 7 is connected to the bushing 10 as indicated at 14. This bimetallic material is such that it will cause the coil to wind or unwind in accordance with the temperature of the water in the tank. When the temperature within the tank 3 reaches a predetermined degree it will tend to expand, and being coiled will cause the rod 8 to rotate in a predetermined direction.

When the water in the tank 3 attains a predetermined minimum temperature the bimetallic material will contract and turn the rod 8 in an opposite direction. The turning movement of the rod 8 will cause rotation of the frame 15, to which the mercury tube 12 is operatively connected.

Electric conductors 16 and 17 lead from a source of electrical supply and are electrically connected to contacts 18 and 19, respectively, on a panel 20, Fig. 3, which is arranged and supported within the casing 21. The conductor 17 is operatively connected to the electrode 22 of the mercury switch 12 by means of a connector 23. Electrodes 24 and 25 are connected to the opposite end of the mercury switch 12, Fig. 3, and connectors 26 and 27 electrically connect the electrodes 24 and 25, respectively, to contacts 28 and 29 on a panel 30, which panel is likewise arranged within the casing 21.

The conductor 16, which is the ground of the electrical circuit, is also operatively connected to the panels 20 and 30, as clearly shown diagrammatically in Fig. 3.

Mercury 31, Figs. 4 to 6, is arranged within the

tube 12 and is adapted to complete and break the electrical circuit between the electrode 22 and the electrodes 24 and 25.

Thus, depending upon the temperature of the water inside of the storage tank 3, the bimetallic element 7 will cause the mercury tube 12 to be rotated in either a clockwise or counter-clockwise direction, and make and break circuit between the electrodes 22, 24, and 25 because the mercury in the tube 12 will flow from one end of the tube to the other, depending upon the movement transmitted to the tube, as clearly shown in Figs. 4 to 6.

A burner 32, Fig. 1, is positioned centrally of the storage tank 3 and in communication with the chamber 4. This burner 32 is operatively surrounded and fastened to a surrounding wall or jacket 33, which is rigidly carried by part of the tank supporting structure, as clearly shown in Fig. 1.

The jacket 33 is spaced from the burner 32 to provide a surrounding air space or chamber 34. This space 34 has communication with a passage 35 leading to a blower 36, which is operated by an electric motor 37. Operation of the motor 37, therefore, supplies draft to the air chamber 34 which surrounds the pot or bowl 32. The lower part of the pot or bowl is operatively connected to the lower part of the jacket by means of fastening members indicated generally by the numeral 45.

Suitable openings in the wall of the pot supply air to the vaporizing area of the pot in sufficient quantities so as to initiate combustion at the bottom of the pot where the fuel is vaporized.

The area where vaporization occurs is therefore kept at a temperature which is beyond the end point of the fuel being supplied, actual burning being initiated in this area. As the burning mixture rises in the center of the pot, additional air is supplied progressively by the spaced rows of openings, formed in the side wall 40 of the upper portion of the pot. The method of burning oil as embodied in this case is clearly disclosed and claimed in applicant's copending application Serial No. 752,035, filed November 8, 1934. A ceramic choke ring 49 rests on the upper flange of the pot.

Fuel is supplied to the burner through a fuel supply line 51, which is arranged within the air conduit or duct 35. The supply of fuel to the burner passes through a fitting 52 and includes an upwardly inclined drilled passage, which communicates with the interior of the burner pot.

Oil coming through the line 51 drops from the nozzle or fitting 52 into the space directly below the outlet and causes a thin film of oil to be spread over the side wall and the bottom of the pot.

The oil line 51 leads to a source of fuel supply and has interposed between its inlet and its outlet a magnetically controlled valve 56.

Also interposed in the fuel supply line 51, preferably between the valve 56 and the source of supply, is an oil control device 75. The device 75 is to maintain a constant head of oil and cause a uniform flow of fuel at desired intervals. The fuel coming from the source of supply 74 passes through a strainer element 76 and then through a supply passage into a receiving tank. The device 75 is further provided with a sump 87 for receiving excess oil from the burner and is adapted to shut off the oil supply when an abnormal accumulation of oil occurs in the sump.

The bottom of the jacket 33 inclines in the di-

rection shown in Fig. 7 and has an outlet formed therein at its lowest level, through which any excess oil delivered to the burner will pass into the line 93 and then into the sump. The line 93 is connected to the bottom of the sump as indicated at 94. Thus, should oil continue to flow to the burner and the same not be burned, it will flow through the openings in the burner pot and into the jacket and then through the pipe line 93 into the sump.

A valve, for the purpose of draining the sump 87, is arranged at the bottom of the bottom of the sump, and this valve includes a plunger valve 96 which is urged by a spring 97 against a valve seat. Therefore, when it is desired to empty the sump the plunger 96 is pulled downwardly, permitting oil to flow out through the valve outlet. The arrangement of this valve is such that it cannot be opened except when it is intentionally desired so to do, and by making a pull-out valve instead of a push-in valve articles placed or pushed under the sump will not cause the oil in the sump to flow out but—to the contrary—will only cause the valve to be seated more tightly.

An electrode 100, Fig. 3, is provided for effecting ignition of the oil which enters through the fitting or nozzle 52. This electrode comprises an electrode holder or fitting, which surrounds the body of the electrode and threadedly engages an opening in the wall of the burner pot. This electrode holder has its lower end spaced from an anode and from a porcelain insulator which surrounds the anode.

The electrode 100 is operatively and electrically connected to a transformer 105 which receives current through connectors leading from the mercury switch 12.

The electrical connections from the mercury switch 12 to the various operating elements of the burner comprise a connector 108, which is connected in parallel to the motor 37 and also to the electrode 100 through the transformer 105. Another connector 109 leads from the electrode 25 to the solenoid 56. The connector 110 is electrically connected to the ground conductor 16 and is electrically connected to the solenoid valve 56, the motor 37, and the electrode 100. Thus, during operation of the device the electrode, motor, and solenoid valve 56 are controlled by the position of the mercury tube 12, Fig. 3.

The casing 6 projects into the water in the storage tank 3, whereby temperature of the water will be transmitted to the bimetallic coil 7 arranged within the casing 6. The inner end of the coil 7 is mounted on a frictionally held member 10 to which is fastened a lever 111, which protrudes through the control casing 21, Fig. 2. The lever 111 can be moved through an arc to change the temperature at which the controls will act. The other end of the coil is fastened to the shaft 8, which extends through the center of the coil, Fig. 2. The opposite end of the shaft 8 carries the mercury tube or switch 12. As the bimetallic coil 7 winds and unwinds it tilts the mercury tube 12 through an arc, making or breaking the electrical circuits.

The type of mercury switch herein embodied consists of separate electrodes or switches 24 and 25, acting in consecutive order and having a definite time interval between the operation of each. One side of the electrical circuit comprises the ground wire 16 which is electrically connected at one side of the oil valve 56, the motor 37, and the transformer 105. The other side of the circuit, comprising the conductor 17 goes to the end of

the switch comprising the common electrode 22. Current passes through the conductor 17, the electrode 22, the mercury 31, and then through the two separate and independent electrodes 24 and 25. The electrode 24 leads to the motor and transformer while the electrode 25 leads to the oil valve 56.

When the tube 12 is tilted to the extreme left as shown in Fig. 6, current will flow to all three devices—viz., the motor, electrode 100, and oil valve. Under these conditions the oil valve is open and fuel is flowing to the burner pot. The motor is operating and the fan is delivering air to the pot. The transformer is furnishing high tension current to the electrode 100, causing ignition and burning to occur.

As heat is generated and imparted to the water this heat in turn will pass through the tube or casing 6 of the aquastat and affect the bimetallic element 7, causing this element to rotate the shaft 8 and mercury tube 12 in a clockwise direction. This movement of the tube 12 causes the mercury 31 to spread or stretch out as the tube 12 approaches a level position. In so doing the electrode farthest to the left, electrode 25, is broken, causing the oil valve to close and shut off further flow of oil.

At this point part of the mercury 31 has passed over to the right of the center of the tube, making it lighter; or in other words it requires less torque to continue its further movement, as the mercury approaches a dead center position, at which time it is equally divided to the right and left of center as shown in Fig. 5.

In the process of transferring heat from the water to the bimetallic element a certain lag occurs, in that the water is slightly hotter than the element 7 as the temperature of both rises. This lag is taken advantage of in that it supplies the necessary final increment of heat to the bimetallic element required to roll the tube over dead center after the flow of oil, and consequently the fire, has ceased. In this latter movement the second electrode, or electrode 24, is broken, Fig. 4, stopping the motor and ignition, but the action has supplied the necessary overrun of the motor and ignition so vital to proper operation because of the time interval which is allowed between the two breaks.

After the first break, which shuts off further oil flow, the main body of fire in the pot rapidly drops and is out in a few seconds. However, a small fire may continue to burn about the nozzle 52 until it is burned dry. As it is essential in order to prevent smudging or fouling of the nozzle, the air pressure is continued until all of the fire is extinguished.

It has been found that by constructing the mercury tube 12 with a wider gap between the two electrodes 24 and 25, a time interval between the two breaks can be had ranging from a few seconds to as long as nine minutes. The present burner, however, requires approximately one minute overrun of the fan, which is readily obtained from the construction herein disclosed and described.

During the burning process when there is a heavy flow of oil passing through the nozzle, it is possible for the oil to wet the end of the anode 102 and form carbon between the end of the anode and the balance of the spark gap. Were this carbon allowed to remain, ignition failure would occur the next time the burner is put into action because no spark would occur, the electricity following the carbon to the wall of the burner instead of making a spark.

By continuing the spark during the interval that the blower is allowed to overrun, the particle of carbon reaches a glowing white heat and with a blast of air against it it is consumed in a few seconds and normal sparking follows. Consequently it is important that the motor and spark operate for a short interval after cessation of oil flow to prevent fouling of these parts.

If desired the mercury tube can be provided with an additional electrode 112 in addition to the electrodes 24 and 25 and the common electrode 22, Fig. 7. Instead of having the motor and spark operating from one electrode as previously described, the motor and spark can each have its individual electrode, Fig. 7, thereby allowing a time interval between the operation of the motor, the operation of the electrode 100 and the operation of the oil valve. This same result can also be obtained by attaching a plurality of mercury tubes side by side on the same shaft. Each of these mercury tubes could have but a single electrode, and if each tube were tilted a few degrees apart the electrical circuits would be made and broken, one ahead of the other in the proper time interval.

Operation

A drop in temperature in the water in the storage tank 3, due to cooling or drawing out hot water and admitting cold, is transferred to the bimetallic element 7 of the aquastat. This change in temperature tilts the mercury tube 12 in a counter-clockwise direction, causing the mercury to close electrodes 22 and 24. This causes the motor and fan to operate and supplies current to the transformer, which causes a high tension current to flow from the transformer to the electrode 100, causing a spark to jump the gap from the end of the anode to the wall of the pot. The continued operation of the tube 12 causes electrodes 22 and 25 to close, whereby the oil valve 56 will be operated, allowing oil to be fed to the burner.

Ignition of the oil now occurs at the point of the spark gap, and the flame is propagated throughout the pot by the blast of air discharged down the lower side walls and across the bottom of the pot. Normal burning then follows and heat is transferred to the water with a consequent rise in its temperature. This rise in temperature affects the bimetallic element 7, causing it to reverse its movement and now rotate the mercury tube in a clockwise direction. As this latter movement proceeds and as the temperature reaches that at which the instrument is set, the electrode farthest to the left, electrode 25, is broken causing the oil valve to shut off further flow. The motor and spark will continue until the bimetallic coil picks up additional heat, which causes a further movement of the tube and the breaking of the connection between electrode 24 and electrode 22, which stops both the motor and the spark, completing the cycle.

While the apparatus, elements, and controls herein mentioned have been described in connection with a hot water heater, they are readily adaptable for use on furnaces or other heaters for heating dwellings. The control in these latter cases would be a thermostat instead of the aquastat herein described. However, the action and the control of the various parts and the operating principles herein mentioned would be identical.

The present invention provides a complete automatically operating device used in connection

with storage water heaters and provides for the continued operation of the fan 36 and electrode 100 after the oil supply has been cut off.

A particular burner herein described produces a very hot fire without the formation of carbon and causes complete consumption of the fuel. The electrical controls provide a positive and inexpensive means for positively and readily controlling the operation of the various devices upon which the success of the device depends.

Furthermore the arrangement of the parts herein disclosed causes the necessary time interval between the operation of the parts to positively and effectually perform the functions intended.

Changes may be made in the form, construction and arrangements of the parts without departing from the spirit of the invention or sacrificing any of its advantages, and the right is hereby reserved to make all such changes as fairly fall within the scope of the following claims.

The invention is hereby claimed as follows:

1. The combination with a water tank and means to heat the water in the tank including a burner, means controlled by the temperature of the water in the tank to control the heating means, of an aquastat extending into the body of the water tank, a thermostatic control element arranged in the aquastat, a switch connected to said element, a fuel line leading to the burner, a valve for controlling the fuel passing through the fuel line, a motor for supplying air to the burner, ignition means for causing the fuel oil to become ignited, and electrical connections from said mercury switch to said motor, ignition means, and valve, to control the starting and shutting off of said last three elements, said control means including an electric circuit whereby the motor and ignition are caused to operate prior to the operation of the oil valve and to continue operation of the draft and ignition means after shutting off the oil valve.

2. In an oil burner, a control device, a mercury switch operated by the control device, a common electrode in said switch, an electrical connection to said electrode, spaced electrodes in said mercury switch and adapted to make electrical connection with the first-named electrode by the mercury contained in the mercury switch, a burner, an oil supply line to the burner, an oil valve in the said line, draft means for furnishing air to the burner, ignition means for causing ignition of the fuel supply to the burner, one of said electrodes being electrically connected to the oil valve, and another being electrically connected to the draft and ignition means, and means for stopping and starting the motor and ignition means and for opening and closing the valve, said oil valve being opened after the starting of the motor and closed before the stopping of the motor and ignition means.

3. In an oil burner, a control device, a mercury switch having an electrode and operated by the control device, an electrical connection to said electrode, spaced electrodes in said mercury switch and adapted to make electrical connection with the first-named electrode by the mercury contained in the mercury switch, one of said spaced electrodes making electrical connection with the first-named electrode in timed relationship with respect to the other said spaced electrode, a burner, an oil supply line to the burner, an oil valve in the said line, draft means for furnishing air to the burner, and ignition means for

causing ignition of the fuel supply to the burner, said first-named electrode and said second-named spaced electrode being electrically connected to the oil valve, said first-named electrode and the other of said spaced electrodes being electrically connected to the draft and ignition means.

4. In an oil burner, a control device, a mercury switch having an electrode and operated by the control device, an electrical connection to said electrode, spaced electrodes in said mercury switch and adapted to make electrical connection with the first-named electrode by the mercury contained in the mercury switch, one of said spaced electrodes making electrical connection with the first-named electrode in timed relationship with respect to the other said spaced electrode, a burner, an oil supply line to the burner, an oil valve in the said line, draft means for furnishing air to the burner, ignition means for causing ignition of the fuel supply to the burner, said first-named electrode and said second-named spaced electrode being electrically connected to the oil valve, said first-named electrode and the other of said spaced electrodes being electrically connected to the draft and ignition means, and means for operating and stopping the draft and ignition means and for opening and closing the valve, said valve being closed prior to the stopping of the motor and ignition means.

5. A burner construction including a zone to be heated, a burner for heating said zone, a draft means for supplying air to the burner, fuel supply means for supplying fuel to the burner, ignition means for causing primary ignition of the fuel to be burned in the burner, an aquastat comprising coiled bimetallic material adapted to be further coiled or uncoiled depending on the temperature surrounding the coil, a shaft rotated by the coiling action of the coil, and a mercury switch fixed to the shaft and adapted to be operated thereby, said mercury switch having a plurality of electrodes, the electrodes being connected to said draft and fuel supply means and to said ignition means to form a temperature control means, the mercury in the tube breaking the electrical connection between the electrodes in such order upon actuation of the switch by the bimetallic element as to cause continued operation of the draft and ignition means for a predetermined length of time after discontinued operation of the supply means.

6. The combination with a water tank and means to heat the water in the tank including a burner, means controlled by the temperature of the water in the tank to control the heating means, said last named control means comprising means responsive to the temperature of the water in the tank, a switch connected to said temperature-responsive means for actuation in accordance with the temperature of the water in the tank, a fuel line leading to the burner, a valve for controlling the flow of fuel through the fuel line, a motor for supplying air to the burner, ignition means for causing the fuel oil to become ignited, and electrical connections from said switch to said motor, ignition means, and valve, to control the starting and shutting off of said last three elements, said control means including an electric circuit operable to continue operation of the draft and ignition means after shutting off of the oil valve, the ignition means and air draft being available to assure the combustion of all residual oil in the burner.

7. In an oil burner, a control device, a switch operated by the control device, a common elec-

trode in said switch, an electrical connection to said electrode, spaced electrodes in said switch and adapted to be electrically connected for making electrical connection with said first named electrode upon actuation of the switch by the control device, a burner, an oil supply line to the burner, an oil valve in the said line, draft means for furnishing air to the burner, ignition means for causing ignition of the fuel supply to the burner, one of said electrodes being electrically connected to the oil valve, and another being electrically connected to the draft and ignition means, and means for stopping and starting the motor and ignition means and for opening and closing the valve, said oil valve being closed before the stopping of the motor and ignition means.

8. In an oil burner, a control device, a switch having an electrode and operated by the control device, an electrical connection to said electrode, spaced electrodes in said switch and adapted to make electrical connection with the first named electrode when the switch is operated by the said control device to operative position, one of said spaced electrodes making electrical connection with the first named electrode in timed relationship with the other of said spaced electrodes, a burner, an oil supply line to the burner, an oil valve in said line, draft means for furnishing air to the burner, and ignition means for causing ignition of the fuel supply to the burner, said first named electrode and said second named

spaced electrode being electrically connected to the oil valve, said first named electrode and the other of said spaced electrodes being electrically connected to the draft and ignition means whereby, upon actuation of the switch to operative position, said draft and ignition means are caused to continue operation in timed relationship after shutting off of the oil valve.

9. A burner construction including a zone to be heated, a burner for heating said zone, a draft means for supplying air to the burner, fuel supply means for supplying fuel to the burner, ignition means for causing primary ignition of the fuel to be burned in the burner, a control device comprising coiled bimetallic material adapted to be further coiled or uncoiled depending on the temperature surrounding the coil, a shaft rotated by the coiling action of the coil, and a mercury switch fixed to the shaft and adapted to be operated thereby, said mercury switch having a plurality of electrodes, the electrodes being connected to said draft and fuel supply means and to said ignition means to form a temperature control means, the mercury in the tube breaking the electrical connection between the electrodes in such order upon actuation of the switch by the bimetallic element as to cause continued operation of the draft and ignition means for a predetermined length of time after discontinued operation of the supply means.

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