Sept. 16, 1941. H. B. DONLEY ET AL 2,255,917

AUTOMATIC AIR SHUTTER FOR OIL BURNERS

Filed May 9, 1938 2 Sheets-Sheet 1

Fig. 1.

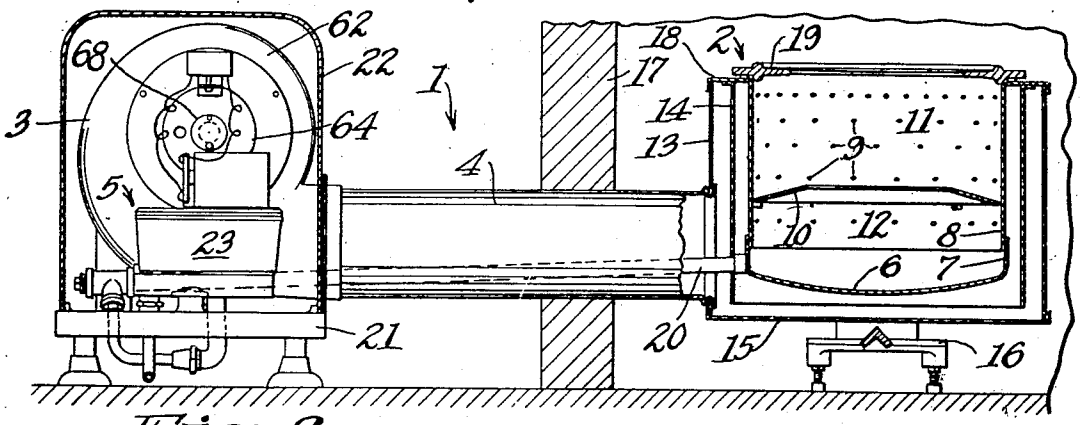


Fig. 2.

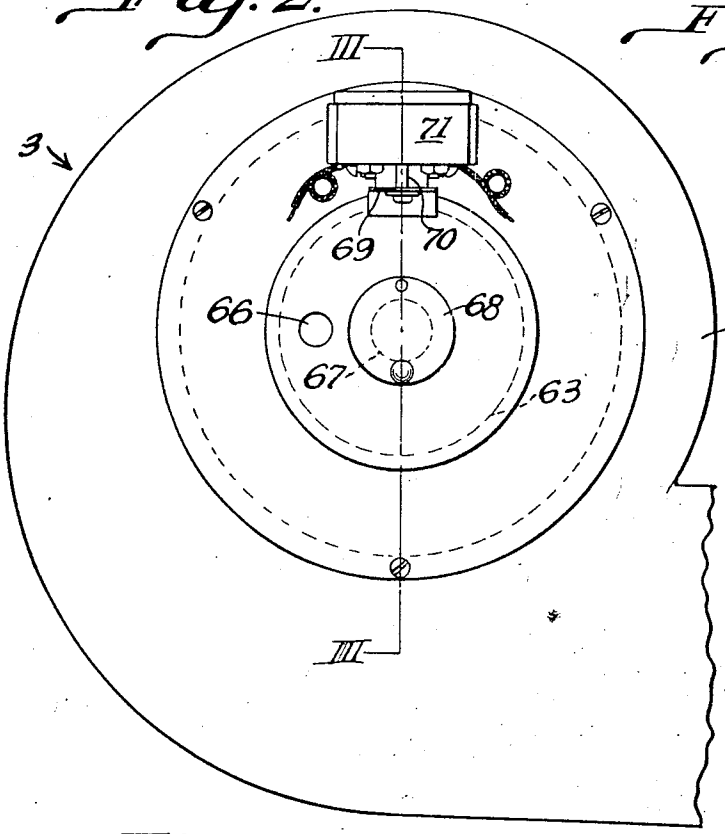


Fig. 3.

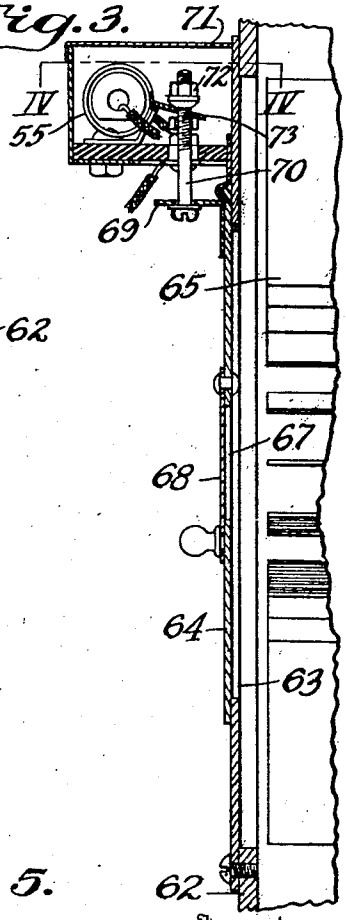


Fig. 4.

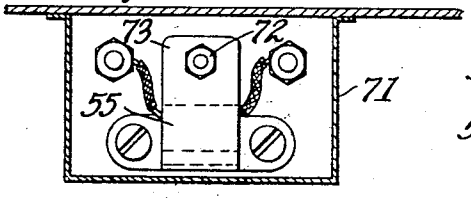
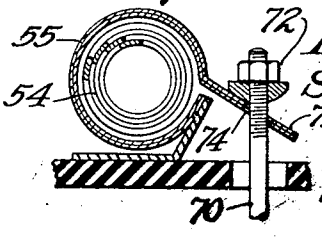


Fig. 5.



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Filed May 9, 1938 2 Sheets-Sheet 2

Fig. 6.

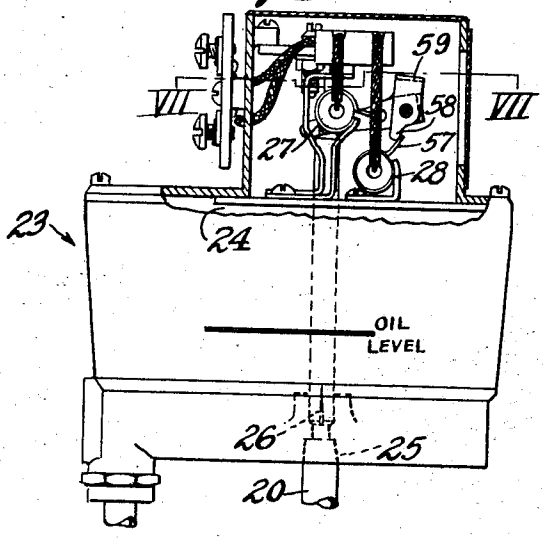


Fig. 7.

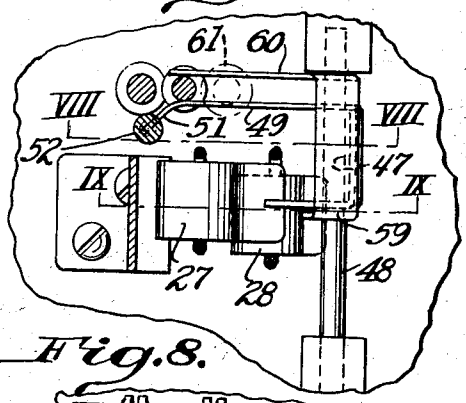


Fig. 8.

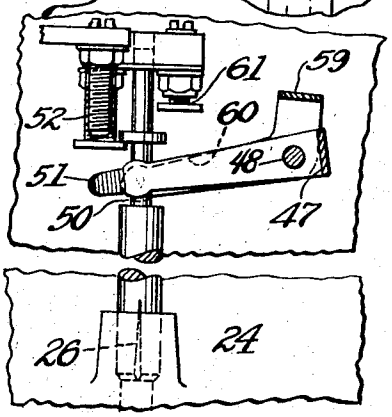


Fig. 9.

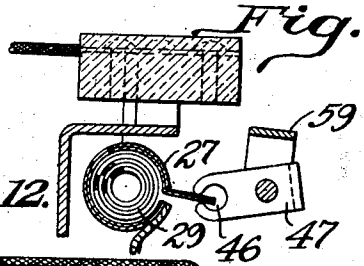


Fig. 12.

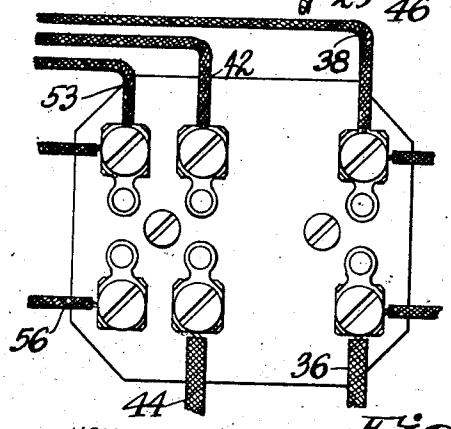


Fig. 11.

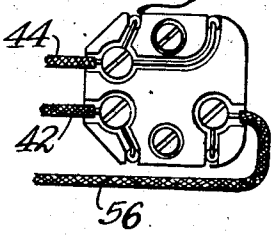


Fig. 10.

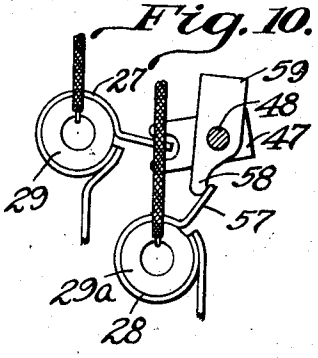
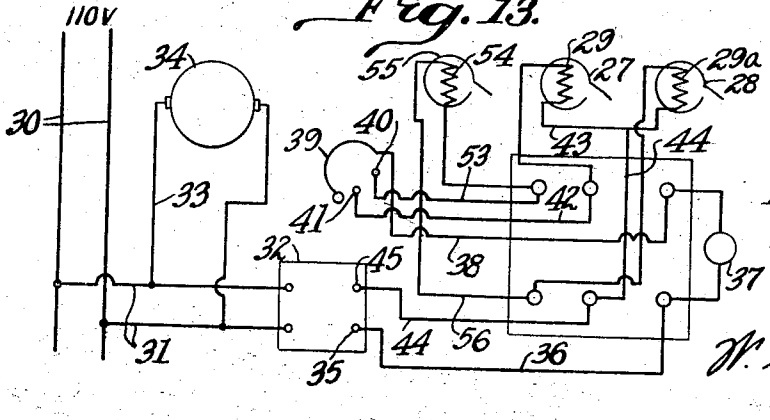


Fig. 13.



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2,255,917

UNITED STATES PATENT OFFICE

2,255,917

AUTOMATIC AIR SHUTTER FOR OIL BURNERS

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Application May 9, 1938, Serial No. 206,800

8 Claims. (Cl. 236—1)

This invention relates to oil burning apparatus of the automatically controlled type, such as is used in connection with house heating systems and the like. In its more specific aspects, the invention has particular reference to oil burning apparatus utilizing a hydroxylating combustion vessel in association with thermostatically governed means for delivering oil at various rates of flow to the burner vessel to provide for low, intermediate and high stages of combustion, together with cooperative means for delivering air to the vessel at differing flow rates in accordance with said stages in order to effect carburetion and combustion of the oil supplied to the vessel.

In automatically controlled oil burning apparatus of this character, considerable difficulty has been encountered in the matter of securing reliable and efficient means for obtaining the proper volume of air delivery under forced flow conditions to the oil vaporizing and combustion vessel in such quantities as to secure proper burning of the oil during the different stages of combustion. In the hydroxylating type of burner, to which the present invention is particularly applicable, critical relationships obtain in the relative proportions of the oil and air supplied to the vessel. That is, if the amount of air supplied to the vessel for a given rate of combustion is deficient, smoke and carbon producing combustion takes place with inefficient combustion and if an excess quantity of air is supplied, there is a tendency to curtail combustion and to interfere with flame propagation.

It is, therefore, an object of the present invention to provide novel means for supplying the burner vessel with correctly proportioned quantities of oil and forced air through the several combustion stages of the burner so that efficient combustion of the hydroxylated fuel mixture will be obtained in accordance with each of said stages.

Another object of the invention resides in the provision of a motor driven fan or blower for delivering air under forced flow to the burner vessel and to provide the casing of the fan or blower with an air inlet equipped with a movable shutter device adapted to vary the effective area of the inlet in a manner automatically proportioned to the flow of oil to the burner vessel.

A further object of the invention rests in a motor driven fan or blower for oil burning apparatus wherein the adjustable shutter for controlling the effective area of the air inlet for said fan or blower is pivotally mounted on the casing and wherein electrically heated thermostatic means is provided for effecting the opening and closing of the shutter by swinging movement thereof about its pivotal mounting.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawings, wherein:

Fig. 1 is a view partly in vertical section and side elevation of oil burning apparatus embodying the features of the present invention;

Fig. 2 is a side elevation of the air inlet side of the casing of the fan or blower used in connection with the oil burning apparatus and disclosing the automatically controlled shutter mechanism for varying the effective area of the air inlet;

Fig. 3 is a vertical sectional view taken through the fan or blower casing, disclosing the air inlet, the pivoted shutter device and the thermostatic means for automatically controlling the operation of said shutter device;

Fig. 4 is a horizontal sectional view on the line IV—IV of Fig. 3;

Fig. 5 is a detail vertical sectional view on an enlarged scale of the electrically heated thermostatic element employed for controlling the operation of the air inlet shutter;

Fig. 6 is a view in side elevation, with parts being broken away and shown in section, of the thermostatically operated metering valve, and its associated elements, used for varying the rate of oil flow to the burner vessel of the apparatus;

Fig. 7 is a horizontal sectional view on the plane indicated by the line VII—VII of Fig. 6, disclosing the electrically heated thermostat elements for controlling the operation of the metering valve;

Fig. 8 is a detail vertical sectional view on the plane indicated by the line VIII—VIII of Fig. 7 and disclosing the yoke members and associated movement limiting stops for governing the operation of the metering valve;

Fig. 9 is a similar view taken on the plane disclosed by the line IX—IX of Fig. 7 and illustrating one of the electrically heated thermostats for operating one of the yoke members of the metering valve;

Fig. 10 is a diagrammatic view disclosing in side elevation both of the electrically operated thermostatic strips used in controlling the operation of the oil metering valve;

Fig. 11 is a detail front elevational view of one of the lead wire connecting plates;

Fig. 12 is a view in front elevation of the electrical terminals and associated conductors used

in supplying the thermostatic strips of the oil metering valve with electric current;

Fig. 13 is a diagrammatic view of the circuits utilized by the apparatus.

In the drawings, the numeral 1 designates the oil burning apparatus in its entirety. Essentially, this apparatus comprises a burner vessel 2, a motor driven fan or blower 3, an air conducting conduit 4 between the outlet of the fan or blower and the air inlet of the burner vessel 2, a metering valve 5 for governing the flow of oil at different rates to the bottom of the burner vessel 2, and associated automatic control devices for use in connection with the fan or blower and the valve 5, as will be hereinafter described.

In the practical embodiment of the invention illustrated, the vessel 2 is formed from sheet metal and includes a concave bottom wall 6 which terminates in an upstanding peripheral flange 7, the latter cooperating with an annular side wall 8 in which is formed rows of spaced air-admitting apertures 9 of restricted size. A frusto-conical baffle 10 is positioned on supporting pins extending inwardly from the wall 8 and divides the interior of the vessel into upper and lower chambers 11 and 12 respectively. The burner vessel is arranged concentrically within an outer casing 13 and a cylindrical partition wall 14 is arranged between the walls of the casing 13 and the side wall 8 of the vessel 2, the lower edge of the wall 14 being spaced from the closed bottom wall 15 of the casing 13.

The discharge end of the conduit 4 is connected with the edges of an opening produced in the casing 13. A frame 16 is arranged below the casing 13 to effect the support of the latter within the confines of a furnace or other heat confining structure 17. The upper edge of the casing 13 terminates in an inwardly and horizontally extending flange 18 to which is secured the upper portions of the walls 8 and 14. A deflector ring 19 rests on the upper portion of the wall 8 and projects inwardly a limited distance over the open top of the burner vessel.

An oil supply pipe 20, leading from a suitable source of oil supply, passes through the conduit 4 and enters the lower portion of the vessel 2 in order to produce a pool of liquid oil of variable area on the concave bottom 6 of said vessel.

The burner vessel described is of the well-known hydroxylating type. Air constantly supplied under the forced draft of the fan or blower 3, passes through the conduit 4 and is deflected by the partition wall 14 so that it circulates around the burner vessel, passing downwardly between the lower edge of the partition wall 14 and the bottom wall 15 of the casing 13. The air then flows in an upward direction, sweeping across the bottom 6 of the burner vessel 2 and flowing upwardly into the annular space formed between the side wall 8 of the burner vessel and the partition wall 14. The air enters the interior of the burner vessel in accurately metered quantities through the small ports or apertures 9 provided in the side wall 8. The air thus entering the burner vessel is mixed with the oil vapors arising from the pool of oil maintained in the bottom of the vessel, producing a carbureted or hydroxylated mixture which is burned either within the confines of the vessel or exteriorly thereof. Through the operation of the metering valve 5, oil is delivered to the bottom of the vessel 2, and in the present embodiment of the invention, at three different rates of flow. During low stage operation, when the minimum amount of oil is supplied to said vessel, vaporized oil is admixed with sufficient air so that active flame-producing combustion takes place within the upper chamber 11 of said vessel immediately over the baffle 10.

Under this condition of operation, the primary air for producing vaporization or hydroxylation enters the vessel through the apertures formed in the side wall 8 below the baffle 10, and secondary air for completing combustion enters the vessel through the apertures of the side wall above the baffle 10.

When the supply of the oil to the burner vessel through the operation of the metering valve has been sufficiently increased to produce an intermediate stage of combustion, a portion of the active flame producing combustion actually occurs in the upper portions of the chamber 11 and above the burner vessel, so that the rows of apertures 9 above the baffle 10 may be used for supplying both primary and secondary air.

When the burner apparatus is operating on high-stage combustion conditions, with a maximum supply of oil being delivered to the bottom of the burner vessel, the apertures 9 serve to admit primary air into said vessel for the carburetion or hydroxylation of the oil and oil vapors so that the observable flame during this stage of operation is disposed above the deflector ring 19, the flame possessing a bush-like outline.

The successful operation of a burner of this character depends upon the properly proportioned flow of air and oil for each combustion stage to the vessel 2. These proportions are quite sensitive and if disturbed materially, undesired combustion of fuel mixture results. It is also a practical necessity to provide these different combustion rates through the use of automatic controls, since manual operation and adjustment are not feasible. It is to the attention of such automatic control and proportioned blending of the air and oil supplies that the present invention is particularly addressed.

At the outer end of the conduit 4, there is disposed a base 21, surmounted by a removable casing 22. Arranged on the base, within the confines of the casing 22, is a supplemental oil receptacle 23. Oil obtained from a supply tank, or other source of supply, enters a chamber 24 formed in the receptacle 23 and a constant level of the oil thus delivered to the chamber 24 is maintained in the chamber by the operation of a float valve mechanism, not shown. A sufficient head of oil is maintained within the chamber 24 to provide for its gravitational flow through the pipe 20 to the bottom of the vessel 2. In the event of non-combustion of the oil within said vessel, the float valve mechanism operates as a safety measure to arrest further inflow of oil from the source into the chamber 24 after a predetermined level of oil has been reached in the bottom of the burner vessel.

The pipe 20 enters the bottom of the receptacle 23 as indicated at 25 in Fig. 6, and the metering valve 5 regulates the rate of oil flow from the chamber 24 into the pipe 20 in accordance with fuel demands. The metering valve 5 comprises a cylindrical body slidably mounted for vertical movement in guides formed in connection with the receptacle 23. The lower portion, at least, of the valve is tubular and the side walls thereof are provided with one or more substantially inverted V-shaped slits 26. When the valve 5 is positioned to provide for minimum flow of oil from the float chamber 24 to the bottom of the

burner vessel, only the restricted upper end or ends of the slits 26 are arranged above the bottom of the receptacle 23 to permit of the flow of oil from said float chamber into the oil supply line 20.

When a larger amount of oil is required to provide for an intermediate stage of combustion, wherein a larger amount of heat is developed, the present invention includes automatic means for raising the valve 5 a limited distance so that a still greater area of the slit or slits 26 will be disposed above the bottom of the receptacle 23 to admit of a greater outflow of oil from the chamber 24 into the oil line 20. When a high stage rate of combustion is desired, further elevation of the valve 5 is secured so that the wider lower portions of the slit or slits 26 will be exposed to the interior of the float chamber 24, thereby producing a maximum flow of oil to the burner vessel.

While but one intermediate stage of operation has been described, it is, of course, within the range of the invention to employ one or more of such intermediate stages.

These several positions of the oil metering valve are automatically obtained in the present instance by the inclusion of electrically heated thermostats, indicated at 27 and 28 in Figs. 6 and 10. These thermostats each comprise substantially circular bimetallic strips, wherein one end of each strip is stationarily mounted on a convenient support, while the other or free end is able to flex or move in response to temperature variations. Within each thermostat, there is arranged a resistor coil 29, which is adapted to be heated by the passage of electric current therethrough in order to produce the requisite temperature variations to effect the required expansion and contraction movements of the thermostats. To control the passage of current through the coils 29 of said thermostats, reference is to be had to the diagrammatic view, Fig. 13, of the drawings. In this figure, the leads 30 of a commercial 110 volt house circuit are connected with conductors 31 which lead to the primary side of a voltage reducing transformer 32. Also connected with the conductors 31 is a shunt circuit 33, in which is positioned the electric motor 34, employed for effecting the operation of the fan or blower 3.

From the secondary terminal 35 of the transformer, a conductor 36 extends through a voltage limiting switch 37 and a conductor 38 to one terminal of a room thermostat 39. It will be understood, of course, that the thermostat 39 may be placed in any location where regulated heating is desired. The free end of the thermostat 39 is disposed for consecutive engagement with the spaced contacts 40 and 41. If the thermostat 39 should respond for a slight added need for heat, the free end thereof will engage with the contact 41 so that current will pass from the thermostat 39 through the contact 41, thence by way of a wire 42 to the electric resistor coil 29 arranged in the intermediate thermostat 27. Following passage through the resistor coil of the thermostat 27, current travels by way of the conductors 43 and 44 to the second terminal 45 on the secondary side of the transformer 32.

The heating of the coil 29 causes flexure of the thermostat 27 so that the free end thereof, by being positioned in a recess 46 (Fig. 9) causes the oscillation of a yoke 47 which is freely supported for pivotal movement on a stationary rod 48. The yoke 47 includes an arm 49, which is positioned within an annular groove 50, formed in the upper end of the metering valve 5, which projects through an opening formed in the top wall of the chamber 24. The flexure of the thermostat 27 in response to the heating of its coil is continued until the movement imparted to the yoke 47 by the thermostat 27, causes the arm 49 to elevate the metering valve to its intermediate position. The stoppage of the valve in this intermediate position is secured by providing the outer end of the arm 49 with an offset portion 51 which is arranged in the plane of the lower end of an adjustable stop in the form of a set screw 52.

If the demand for heat should be greater than that which intermediate stage combustion will supply, the free end of the room thermostat 39 engages with the contact 40. Current then flows from the thermostat 39 through a conductor 53, which leads to a resistor 54 provided in a fan shutter thermostat 55, to be hereinafter more particularly described. From the resistor 54, current passes by way of a conductor 56 to a resistor coil 29a arranged in the thermostat 28, and after passage through the coil 29, current is returned to the secondary terminal 45 by way of the conductor 44.

The heating of the coil 29a flexes the thermostat 28 so that the lip 57 formed at its free end engages the lower reduced end 58 of a second yoke 59 pivotally mounted on the rod 48. This yoke is formed with an arm 60 which extends parallel with the arm 49 of the yoke 47, but is somewhat shorter in length, the free end of the arm 60 being disposed in the annular groove 50 in the upper end of the valve 5, but on the opposite side of the latter as regards the arm 49 (Fig. 7). Due to the position of the arm 60, the upward movement thereof is not influenced by the set screw 52, so that greater movement may be imparted to the valve 5 by the arm 60 than can be imparted to said valve by the arm 49, thus enabling the metering valve to be elevated to its maximum extent when under the influence of the operation of the thermostat 28. When the arm 60 contacts with an adjustable stop in the form of a set screw 61, the metering valve will have been elevated to its maximum point in order to provide for the maximum outflow of oil from the float chamber 24 to the vaporizing burner.

By means of these themostat devices, accurate metering of the oil flow to the burner vessel is obtainable for establishing the different stages of combustion. As previously pointed out, it is also important, particularly with the use of a hydroxylating burner, to vary the amount of volume of air delivered to the burner vessel in proportion to the oil supplied thereto. This is secured by the apparatus disclosed in Figs. 2 to 5 of the drawings. In these figures, the casing 62 of the fan or blower has one of its vertical side walls provided with an air inlet opening 63 of fixed area. Normally covering this opening is a pivotally movable shutter device 64 which is so mounted that it may swing outwardly from the side wall of the casing 62 to uncover the opening 63 so as to provide for free air flow into the interior of the fan or blower in response to the operation of the impeller 65 of the latter. In this embodiment of the invention, the shutter device 64 is provided at one side with a constantly open port 66 of relatively small diameter which, even when the shutter is in closed position, admits of limited air inflow into the fan or blower. If this limited inflow of air should be insufficient, the shutter device 64 includes a somewhat larger axially disposed port

67, which may be opened or closed by a pivoted disk 68, the latter retaining its adjusted positions through frictional contact with the outer surface of the shutter 64.

We have found, as a practical matter, that through the use of the ports 66 and 67, a sufficient amount of air will be admitted into the fan or blower to produce efficient combustion of the oil during both low and intermediate stages of burner operation. However, for high stage operation, it is essential that the air inlet 63 be fully opened, and in view of the nature of the apparatus, it is also necessary that such opening should take place automatically, together with the closure of the inlet following the termination of the high stage period of combustion.

This can be simply accomplished by providing the shutter device 64 with a flange 69. Passing through this flange is the shank of a headed bolt 70, which projects upwardly into a small casing 71, connected with the side of the blower or fan. The upper threaded end of the bolt 70 is equipped with an adjusting nut 72. As shown more particularly in Fig. 5, the lip 73 of the thermostat 55 is provided with an opening 74 for the reception of the shank of the bolt 70 so that the lip will engage with the rounded lower surface of the nut or washer 72.

Since the resistor 54 of the thermostat 55 is wired in series with the resistor 29*a* of the thermostat 28, it follows that both of these resistors will be simultaneously energized. This results, as previously explained, in the full opening of the metering valve 5, and in sufficient flexure on the part of the thermostat 55 to cause the elevation of the bolt 70 to such extent as to swing the shutter device 64 about its pivotal mounting and cause the required full opening of the air inlet 63. When the high stage period of operation is terminated by the operation of the room thermostat 39, the resistor 54 cools and the strips 55 returns to its normal position, thus lowering the shutter device and again closing the fan inlet 63 to the position shown in Fig. 3.

It is believed, in view of the foregoing description, when taken in connection with the accompanying drawings, that the construction, operation and advantages of the automatic oil burner control mechanism forming the present invention will be readily understood by those versed in the art. The apparatus is essentially simple and fully automatic so that when once adjusted for efficient operation, reliable performance will be assured. The construction enables vaporizing or hydroxylating oil burners to operate efficiently with minimum soot and carbon formation through several stages of combustion, enabling clean combustion to be produced at each stage well adapted for the heat demands present.

While the apparatus in its preferred and commercial form has been set forth, it will be understood that the same is subject to certain variation or modification without departing from the scope of the invention as the latter has been defined in the following claims.

What is claimed is:

1. In automatically controlled oil burning apparatus of the type having a burner vessel and a fuel line communicating therewith, valve means disposed in said fuel line, said valve means being capable of movement between closed and open positions, motor driven means for supplying air to said burner vessel, electrically actuated thermo-responsive means for controlling the volume of air delivered to said burner by said air supplying means, a pair of electrically actuated thermo-responsive members cooperating with said valve means to open the same to provide for fuel flow to said burner, stop means engaging the first thermo-responsive member of said pair to limit the degree of opening movement of the valve means in response thereto, and thermostatic switch means having a pair of spaced contacts, the first contact of said pair being connected with the first thermo-responsive valve actuating member, the second contact being connected with the second thermo-responsive valve actuating member and air controlling member whereby maximum air flow will be provided when the fuel valve means is fully opened.

2. In automatically controlled oil burning apparatus of the type having a burner vessel and a fuel line communicating therewith, valve means disposed in said fuel line, said valve means being capable of movement between closed and open positions, motor driven means for supplying air to said burner vessel, electrically actuated thermo-responsive means for controlling the volume of air delivered to said burner by said air supplying means, a pair of electrically actuated thermo-responsive members cooperating with said valve means to open the same to provide for fuel flow to said burner, adjustable stop means engaging the first thermo-responsive member of said pair to limit the degree of opening movement of the valve means in response thereto, and thermostatic switch means having a pair of spaced contacts, the first contact of said pair being connected with the first thermo-responsive valve actuating member, the second contact being connected with the second thermo-responsive valve actuating member and air controlling member whereby maximum air flow will be provided when the fuel valve means is fully opened.

3. In oil burning apparatus of the type having a burner vessel, valve means for supplying liquid fuel to the burner vessel and motor operated means for supplying air to said vessel, control mechanism for said apparatus comprising electrically heated thermo-responsive members connected with said fuel valve means and air supply means to control the quantity of each supplied to said burner vessel, one of said thermo-responsive members serving to actuate said fuel valve means to provide for partial flow of fuel, another serving to actuate said valve means to provide for full flow of fuel and a third thermo-responsive member providing for a maximum flow of air, thermostatic switch means for controlling the flow of electric energy to said thermo-responsive members, said switch means having a pair of stationary contacts and a movable contact, and circuit means connecting said switch means and thermo-responsive members with a current source, the first thermo-responsive member being connected with the first stationary contact of said switch, the other contact being connected with the second and third thermo-responsive members to provide for their operation in unison.

4. In oil burning apparatus of the type having a burner vessel, valve means for supplying liquid fuel to the burner vessel and motor operated means for supplying air to said vessel, control mechanism for said apparatus comprising thermo-responsive members for controlling the operation of the fuel valve means and the quantity of air delivered by said air supplying means, a pair of said members being associated with said fuel valve means, one of said pair providing for

partial opening of said valve means, a resistance coil disposed adjacent each thermo-responsive member, thermostatic switch means having movable contact means connected with a source of electric current, a pair of stationary contacts successively engaged by said movable contact means, the resistance coil adjacent said thermo-responsive member which partially opens the fuel valve being connected with the stationary switch contact first engaged by the movable contact, the other stationary contact being connected with the remaining resistance coils.

5. In automatically controlled oil burning apparatus of the type having a burner vessel and means for conducting liquid fuel thereto, valve means for controlling the flow of fuel to said burner vessel comprising a casing, a valve member disposed in said casing for movement between open and closed positions, a pair of valve actuating lever elements engaging said valve member to impart opening movement thereto, means in said casing for limiting the degree of movement of one of said lever elements toward a valve opening position, and thermo-responsive means engaging said lever members and imparting movement thereto.

6 In automatically controlled oil burning apparatus of the type having a burner vessel and means for conducting liquid fuel thereto, valve means for controlling the flow of fuel to said burner vessel comprising a casing, a valve member disposed in said casing for movement between open and closed positions, a pair of valve actuating lever elements engaging said valve member to impart opening movement thereto, means in said casing for limiting the degree of movement of one of said lever elements toward a valve opening position, thermo-responsive means engaging said lever members, and electric resistance coils disposed adjacent said thermo-responsive means, the introduction of electric current to said resistance coils serving to heat said thermo-responsive means to cause movement of said lever elements and said valve.

7. In oil burning apparatus of the type having a combustion vessel, means for feeding liquid fuel to said vessel, continuously operated means for delivering air to said vessel, valve means for controlling the flow of fuel through said feeding means, said valve means normally permitting sufficient fuel flow to operate said apparatus at a low stage, means for governing the quantity of air delivered to said vessel, said means normally providing sufficient air flow to convert the normal fuel flow to a combustible mixture, thermo-responsive means connected with said valve to move the same to open positions to increase the flow of fuel to said vessel, additional thermo-responsive means connected with said air flow governing means, and thermostatic switch means connected in circuit with said thermo-responsive members, said switch means being operable to effect the opening of said valve independently of and simultaneously with the opening of said air flow governing means.

8. In oil burning apparatus of the type having a combustion vessel, means for feeding liquid fuel to said vessel, continuously operated means for delivering air to said vessel, valve means for controlling the flow of fuel through said feeding means, said valve means normally permitting sufficient fuel flow to operate said apparatus at a low stage, means for governing the quantity of air delivered to said vessel, said means normally providing sufficient air flow to convert the normal fuel flow to a combustible mixture, thermo-responsive means connected with said valve to move the same to an open position to provide for sufficient fuel flow to sustain said apparatus at a high stage of operation, a second thermo-responsive device connected with said air flow governing means, and thermostatic switch means connected in circuit with said thermo-responsive members to cause simultaneous operation thereof.

HAROLD B. DONLEY.
SAMUEL JOHNSON.

DISCLAIMER

2,255,917.—*Harold B. Donley* and *Samuel Johnson*, Columbus, Ohio. AUTOMATIC AIR SHUTTER FOR OIL BURNERS. Patent dated September 16, 1941. Disclaimer filed March 12, 1942, by the inventors; the assignee, *Columbus Metal Products, Inc.*, consenting.

Hereby enter this disclaimer to claims 5 and 6 of said Letters Patent.

[*Official Gazette April 7, 1942.*]