

May 2, 1944.

C. L. RAYFIELD

2,347,843

OIL BURNER AND SYSTEM

Original Filed Sept. 27, 1939 4 Sheets-Sheet 1

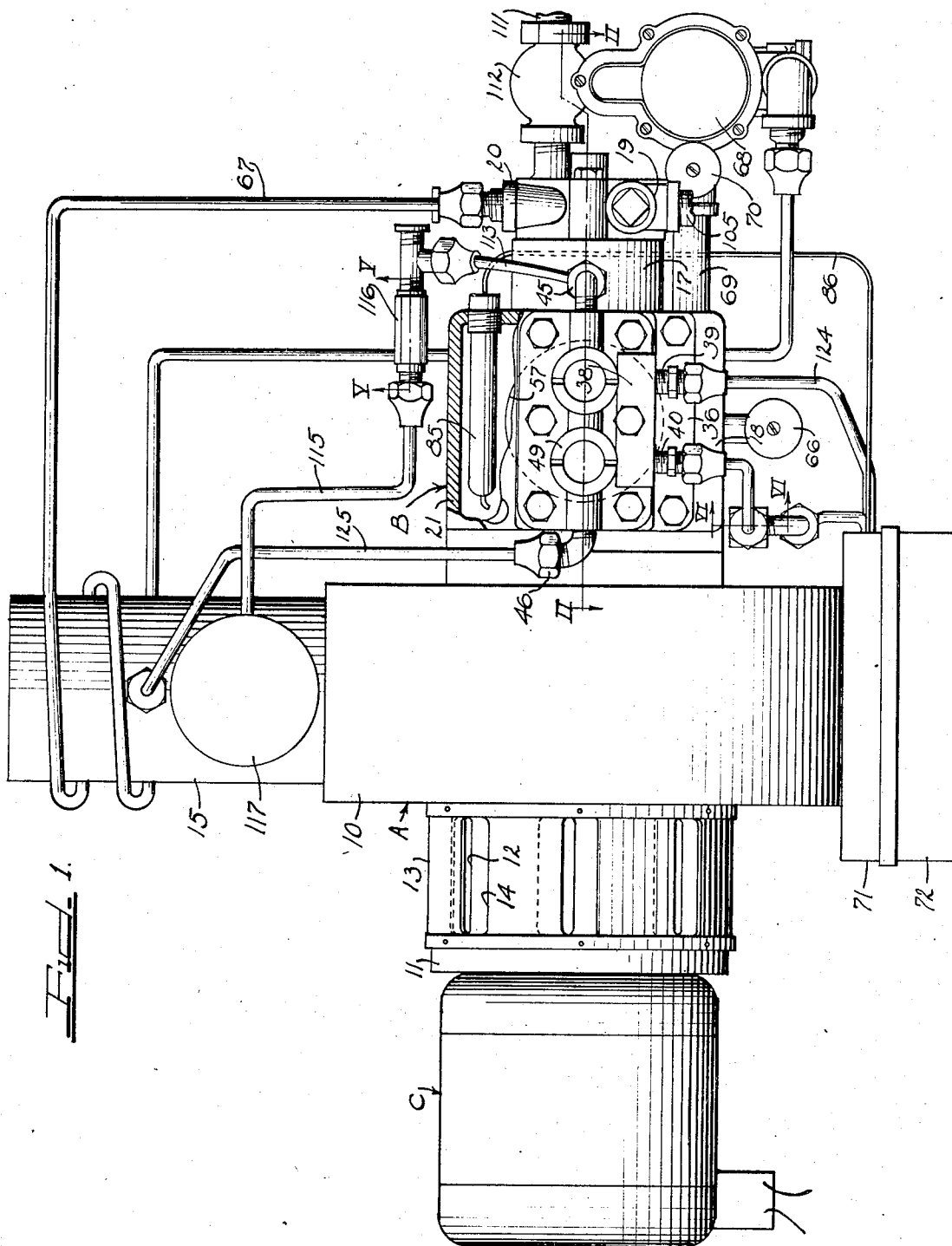


Fig. 1.

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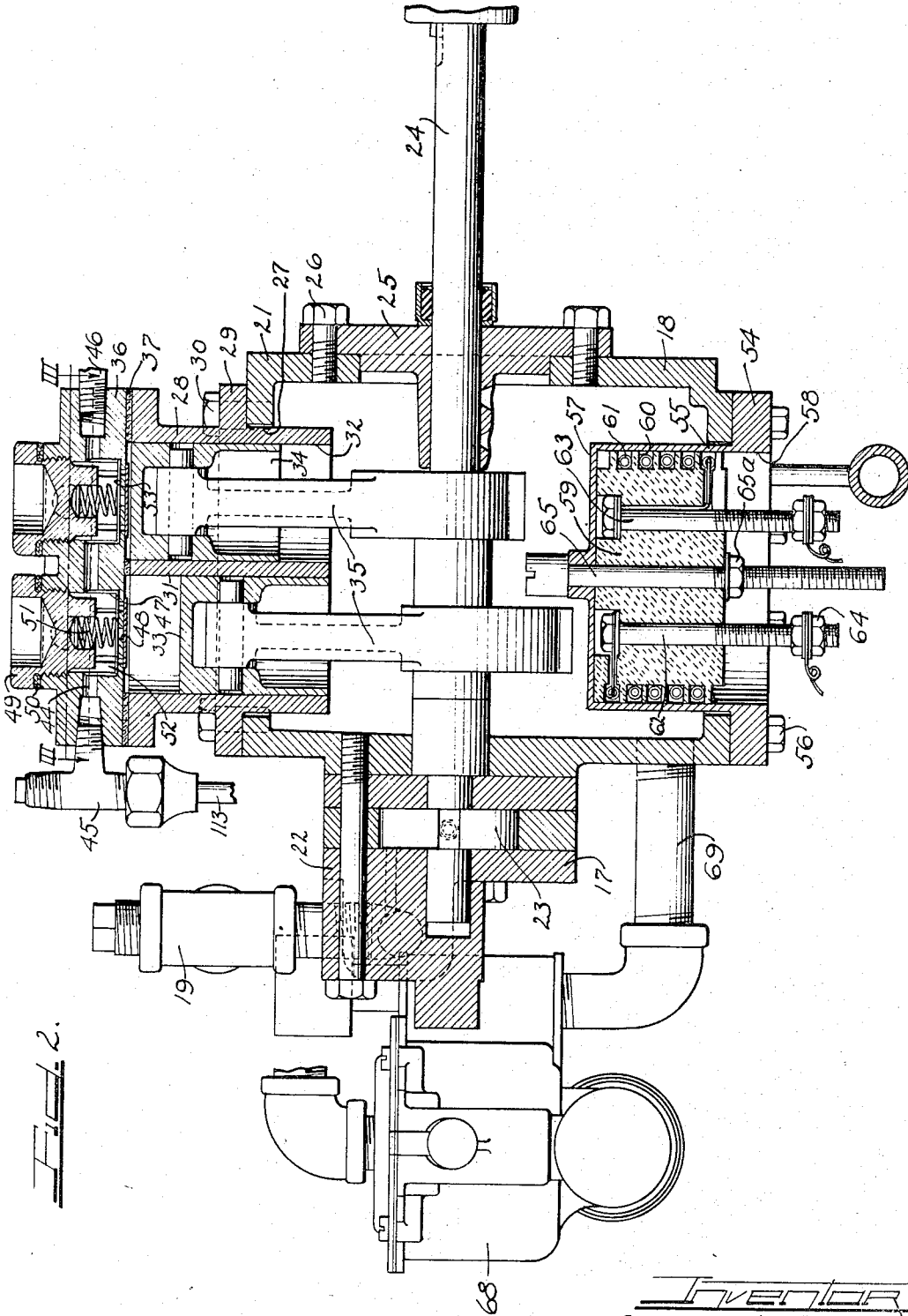


Fig. 2.

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Fig. 4.

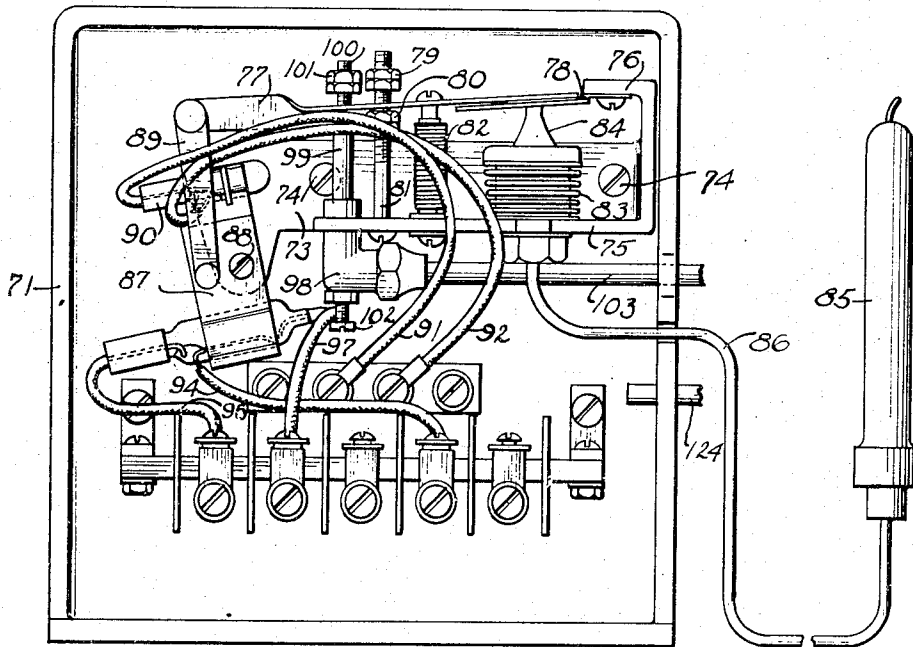


Fig. 3.

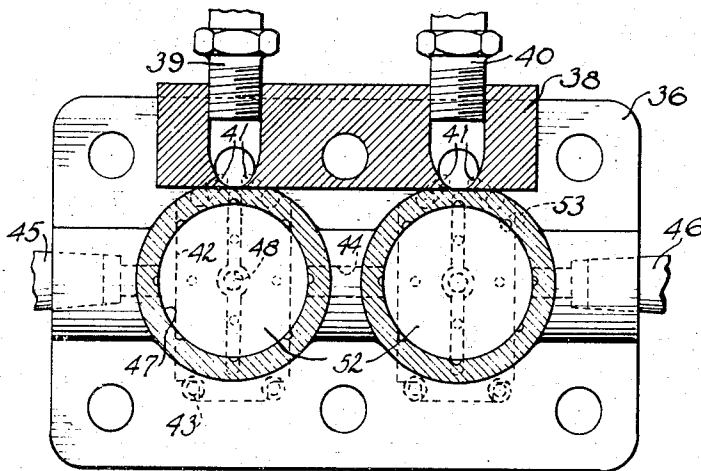


Fig. 6.

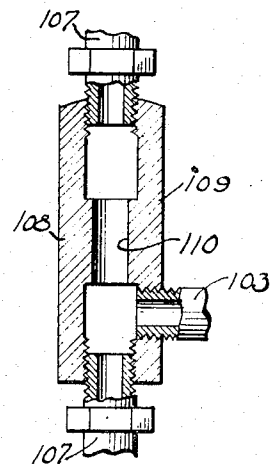
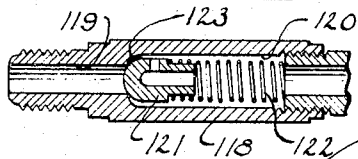


Fig. 5.



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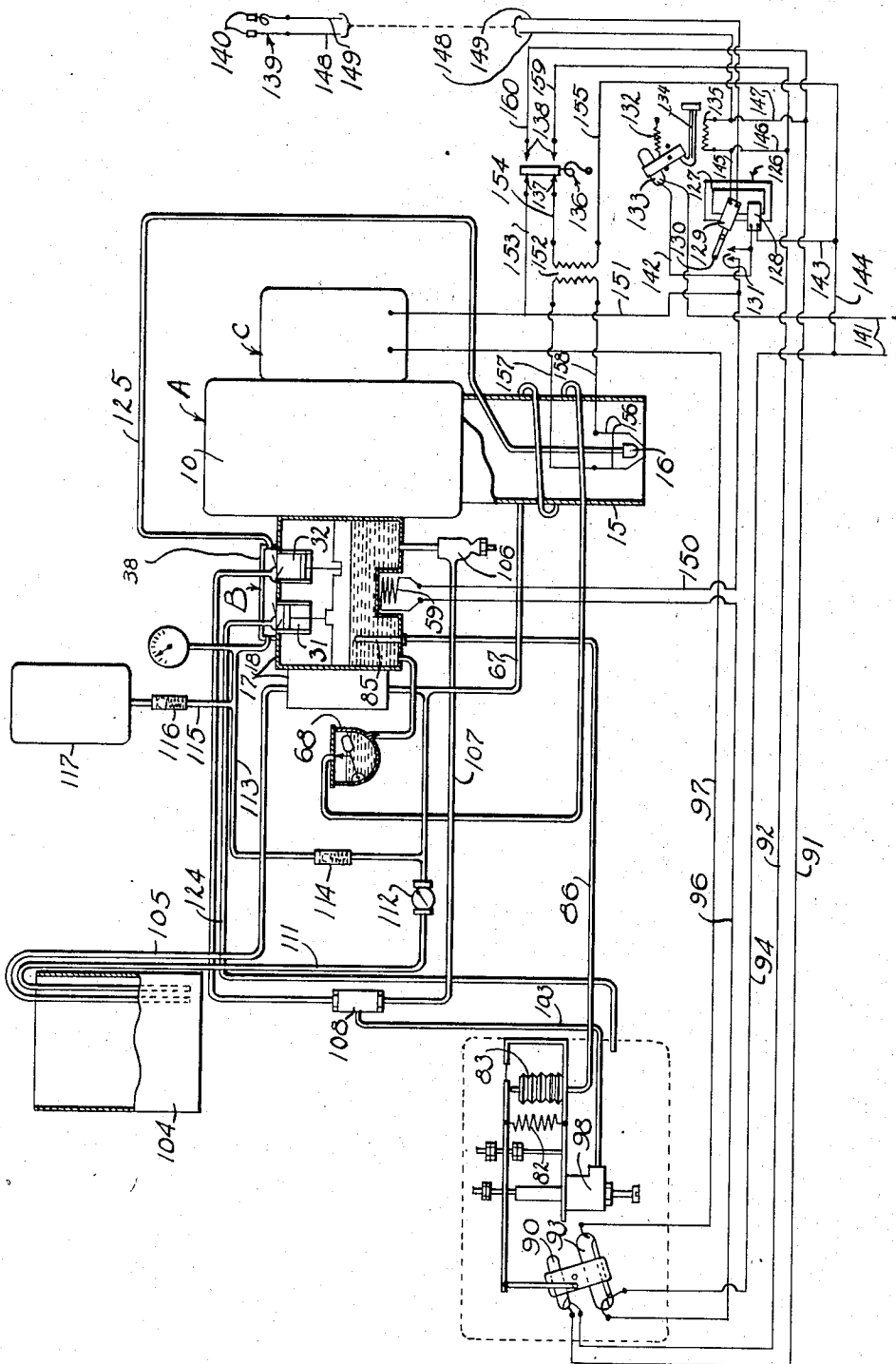
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2,347,843

OIL BURNER AND SYSTEM

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Original application September 27, 1939, Serial No. 296,718. Divided and this application November 10, 1941, Serial No. 418,531

3 Claims. (Cl. 158—36.3)

The present invention is a division of my co-pending application entitled "Oil burner and system" filed September 27, 1939, U. S. Serial No. 296,718 and relates in general to improved means for the burning of oil for heating purposes. More particularly, my invention is concerned with improvements in such apparatus to the end that the less expensive, more viscous oils containing a greater number of heat units may be efficiently utilized for heating purposes and to the end that purging and flushing the apparatus when not in use may be accomplished.

Heretofore, oil burners for domestic heating, such as utilized for the heating of homes, apartment buildings, and the like, have been limited almost entirely to the use of the more highly refined and lighter oils which not only contain a less number of heat units, but are more expensive than the heavier and more viscous oils.

This limitation has resulted to a large extent from the apparent inability of manufacturers to heretofore build suitable apparatus for efficiently burning the heavier grades of oil, which could be assembled into a compact unit suitable for domestic installations. Where attempts were made to use the heavier oils, the installed apparatus usually entailed a complicated arrangement of piping between widely spaced parts of the apparatus and required considerable space for installation, all of which was objectionable and unsightly, especially in cases where the spaces containing the burner apparatus were to be utilized for game and play rooms, and the like.

More specifically, most oil burners are arranged to burn the so-called "Light oil No. 3," and it has heretofore been difficult to provide satisfactory apparatus for domestic heating which could be efficiently utilized to burn oils as heavy as the so-called "No. 5" or "No. 6."

Having the foregoing in mind, the present invention contemplates as a primary object the provision of an improved oil burner and system which will efficiently and economically burn the heavier, more viscous oils.

A further object of the invention is to provide improved means in an oil burner and system for purging and flushing the oil nozzle, when the burner is shut down.

Another object of the invention is to provide an improved relief arrangement in the oil path of the burner, whereby oil may be returned to a source of supply, whenever the burner nozzle becomes clogged.

A still further object of the herein described invention is to provide an improved oil burner in which metered quantities of oil are burned, and any surplus pumped oil is automatically by-passed back to a supply source.

Other objects and Features of the invention will more fully appear from the following detailed description taken in connection with the accompanying drawings, which illustrate a single embodiment thereof, and in which:

Figure 1 is a plan view of oil burner apparatus embodying the features of the present invention;

Figure 2 is a longitudinal sectional view taken through the pumping part of the apparatus to show the details of the construction thereof, taken substantially on line II—II of Figure 1;

Figure 3 is a detailed view, partly in section, showing the valving arrangement of the pumping parts, taken substantially on line III—III of Figure 2;

Figure 4 is a view looking into the housing for certain of the control equipment mounted on the burner, the cover of the housing being removed to show the control elements therein;

Figure 5 is an enlarged fragmentary sectional view showing the details of construction of the bleeder valve as utilized in the present invention; taken substantially on line V—V of Figure 1;

Figure 6 is an enlarged fragmentary sectional view of the carburetor construction utilized in the present invention, taken substantially on line VI—VI of Figure 1; and

Figure 7 is a schematic view of the oil burner and diagrammatically disclosing the piping systems for oil and air, and also diagrammatically showing the control equipment and the electrical connections thereof.

As shown on the drawings:

From a consideration of the apparatus illustrated in Figure 1 of the drawings, it will be apparent that the oil burner and system of the present invention provides a compact unit assembly which may be readily applied to already installed or existing furnaces and boilers for heating purposes.

Burner apparatus in general

As shown in Figure 1, the burner unit comprises in general an air blower A, fuel pumping mechanism B, and a main driving motor C for actuating the blower and pumping mechanism.

The blower A is of conventional construction

and comprises a main housing portion 10 for enclosing the blower blades or impeller (not shown) which is connected to the driving shaft of the motor. This housing terminates at one end in a tubular extension 11 which forms an air inlet to the center of the housing 10, the extension being circumferentially provided with a plurality of spaced air inlet openings 12. Control of the inlet openings 12 is accomplished by means of a slide plate 13 which is suitably supported on the outer surface of the extension 11 for sliding movement thereover. This plate is provided with spaced openings 14 which are adapted to cooperate with the openings 12 and vary the effective air inlet openings so as to vary the amount of inlet air taken in by the blower.

The housing 10 is provided with a tubular extension 15 on its forward side, this extension defining an air nozzle for supplying the main combustion air to a fuel atomizing nozzle 16 mounted therein, as shown in Figure 7.

Returning again to Figure 1, the pumping mechanism B comprises a rotary type of pump 17 for the pumping of oil only, and a second pump 18 of the reciprocable type for the pumping of air and oil for a purpose which will hereafter be more fully explained.

The rotary pump 17 is provided with a suitable pipe connection fitting 19 at its inlet, and a suitable pipe connection fitting 20 at its outlet.

The reciprocating pump 18, as more specifically shown in Figure 2, comprises a housing or casing 21 which serves at one side as a support for the rotary pump housing structure 22 which encloses the rotary pump rotor 23, this rotor being mounted at one end of a shaft 24 which also serves as the shaft for the pumping elements of the reciprocating pump. The shaft 24 and the opposite wall of the housing 21 from that to which the rotary pump housing is secured is provided with a suitable shaft bearing 25 that is secured to the pump housing by means of suitable bolts 26.

The top wall of the housing 21 is provided with an opening 27 for receiving the lowermost end of a cylinder defining block 28 having a peripheral flanged portion 29 for receiving holding down screws or bolts 30 by means of which the block is secured to the housing 21.

The block 28 defines a pair of aligned cylinders 31 and 32 for reciprocally and operatively receiving the pistons 33 and 34. Each of the pistons is connected by means of a connecting link 35 to an eccentric on the shaft 24, the eccentrics for actuating the two pistons being in 180° relation. That is, when one piston is at the bottom of its stroke, the other piston will be at the top of its stroke.

It will be noted that the cylinder bores extend entirely through the cylinder block and are covered by a cap member 36 which defines the outlet manifold from the cylinders, a suitable gasket 37 preferably being provided at the joint between the cap and the uppermost end of the cylinder block.

As shown in Figure 3, a common inlet manifold 38 is suitably secured at one side of the cap member, this manifold having separate inlet connections 39 and 40 respectively communicating through ducts 41 with the interior of the cylinders, the ducts terminating in the undersurface of the cap 36 in each cylinder. The ducts 41 in each cylinder are respectively controlled by a downwardly opening member or flap

valve 42 which is anchored at one end as at 43 to the undersurface of the cap 36 with its free end overlying the entrance openings of the ducts 41 into the cylinder.

As shown in Figure 2, the cap 36 has a longitudinally extending bore 44 having one end connected with a pipe connection fitting 45 and its other end connected with a pipe connection fitting 46. Intermediate the ends of the bore 44, the cap is provided with portions defining a valve socket 47 axially aligned and above each of the cylinders. This socket is closed at its bottom, except for one or more outlet ports 48.

The upper end of each socket is arranged to be closed by a suitable plug 49 which may be screwed into the upper end of a socket against a suitable gasket 50. This plug is recessed at its innermost end to receive one end of an expansion spring 51 which acts to bias a valve disk 52 into seated position over the outlet port from the associated cylinder.

In addition to the valving arrangement of ports as described above, the outlet valve for cylinder 32 is additionally provided with a small by-pass port 53 which enables a small amount of the fluid being pumped in cylinder 32 to be bypassed around its associated outlet valve disk 52.

The bottom wall of the housing 21 of the reciprocating pump structure is provided with a removable closure member 54, as shown in Figure 2, this member being secured over an opening 55 in the housing by means of suitable securing screws or bolts 56. This closure member is constructed of a metal which preferably has a high heat conducting characteristic, such as aluminum. The member 54 is constructed with a relatively thin shelled integrally formed capped portion 57 which extends upwardly through the opening 55 into the housing 21 and provides a downwardly opening recess 58 adapted to axially receive therein an electric heating unit 59. This heating unit comprises a body portion of insulating material, such as an asbestos composition, which is provided with a helically extending groove 60 in which a suitable heating element or resistance wire 61 is disposed. The ends of the heating element are connected to suitable terminal studs 62 and 63 which are mounted in the body of the heating element and have threaded ends projecting from the recess or socket 58, these threaded ends being provided with suitable nuts 64 for making connection to energy supplying conductors.

The heating element is retained within the socket 58 by means of a retaining bolt 65 extending through the bottom of the cupped portion and a suitable bore in the body portion of the heater body, a nut 65a being threaded onto the bolt 65 to cooperate with the head of the bolt for clamping the body portion of the heater against the bottom of the cupped portion.

With the construction just described, the heater may be easily removed from its position in the socket 58 simply by removing the nut 65a, whereupon the heater may be taken out as a unit. Such an arrangement is particularly advantageous as it enables ready replacement of a heater should it become burned out, or in the event that it is desired to install heaters for operation on different voltages which may be available in different installations of the oil burner equipment.

As shown in Figure 1, the interior of the housing 21 is maintained open to atmosphere through a suitable breather 66.

The housing 21 of the reciprocating pumping mechanism comprises a reservoir for receiving oil which is supplied from the outlet connection of the rotary pump through a pipe connection 67, as shown in Figure 1, this pipe being provided with a number of turns which encircle the extension 15 of the blower, these turns being in heat receiving relation with the burner nozzle and the fuel which is being atomized and burned. After encircling the extension 15, the pipe 67 is carried to the inlet of a float valve 68 having an outlet which is connected by a suitable pipe connection 69 to the interior of the housing 21.

The float valve 68 operates to maintain a predetermined supply of oil within the housing 21. Normally this oil level is approximately at the shaft 24 so that the operation of the driving eccentrics for the links 35 will act to churn and agitate the oil and enable its being more readily heated by the electric heater in the bottom of the pump housing 21 and by the heat generated by friction during operation of the pump parts.

By conducting the oil through pipe 67 through the turns around extension 15, the heating of the oil is augmented. In fact, after the burner has started to operate, the electric heater is de-energized and the oil is sufficiently heated by its being passed around the extension 15.

The float valve 68 is also vented to atmosphere through a suitable breather 70.

On the opposite side of the blower casing 10 from the extension 15, there is supported a housing 71 for the local control mechanism, the housing 71 having a removable cover 72.

Referring to Figure 4, the local control mechanism will now be described. Within the housing, there is provided a supporting bracket 73 which is secured to the rear wall of the housing by means of suitable screws 74. This bracket has a forwardly projecting L-shaped flange portion defining a long leg 75 and an uppermost shorter leg 76.

Associated with the uppermost leg 76 of the bracket is an elongate arm 77 which is flexibly connected to the leg 76 of the bracket by means of a leaf spring as shown at 78. This spring permits vertical swinging movement of the arm 77, this swinging movement being adjustable between abutment nuts 79 and 80 threaded on a stud bolt 81, these nuts being adjustably positionable on either side of the arm 77 to limit its swinging movement.

The arm 77 is normally biased in a downward direction by a tensioned spring 82 having one end anchored to the leg 75 of the bracket, and its other end anchored to the arm 77.

The arm 77 is moved upwardly in response to the action of the thermal responsive closed system. This system comprises a bellows 83 which is rigidly secured at one end to the leg 75 of the bracket and has its uppermost end provided with a head member 84 which bears against the underside of the arm 77 adjacent its connection to the leg 76 of the bracket. Connecting the interior of the bellows 83 with a bulb 85 is a hollow conductor 86. The bulb, bellows, and conductor are filled with a thermal responsive medium, so that as the temperature to which the bulb 85 is subjected is varied, the bellows 83 will be caused to expand or contract depending upon whether the temperature is increased or decreased. Expansion of the bellows moves the arm 77 upwardly against the tension of spring 82, whereas contraction of the bellows

permits the spring 82 to move the arm 77 in the opposite direction.

The bulb 85 in the present instance is mounted within the pumping housing 21 previously described, and as shown in Figure 1. Thus, the bellows 83 and consequently the arm 77 will be moved up and down in response to variations in temperature of the oil within the housing 21.

The movements of the arm 77 are utilized for the opening and closing of switches (preferably of the mercury type) as will be explained presently. For this purpose a switch supporting bracket 87 is pivoted as at 88 for swinging movement, and this bracket is pivotally connected to one end of a link 89, the other end of this link being pivotally connected to the free end of arm 77.

One end of the bracket 87 carries a two-electrode type mercury switch 90 which is adapted in the down position of arm 77 to interconnect a pair of circuit conductors 91 and 92. The other end of the bracket 87 carries a three-electrode mercury type of switch 93 which is arranged in the closed position of switch 90 to interconnect conductors 94 and 96. However, when the arm 77 is raised, the bracket 87 will be rotated clockwise and carry the switches to such position that the switch 90 will open its contact and switch 93 will disconnect the conductors 94 and 96 and connect conductor 94 with a conductor 97. The conductors connected with the switch may be brought out to suitable terminal blocks within the housing 71.

There is also associated with the control mechanism, just described, an adjustable air intake valve 98 which is also supported upon the leg 75 of bracket 73. This valve is provided with a stem 99 having a threaded extension 100 at its uppermost end for receiving suitable nuts 101, the threaded extension extending through a suitable opening in the arm 77. By adjusting the nuts 101, the amount of opening of the air valve may be determined in relation to the movement of arm 77. Moreover, regulation of the valve opening is attained by means of an adjusting screw 102. The air valve is connected to and controls the inlet of an air pipe 103.

Oil system

Referring now to Figure 7, the oil system will now be described. The oil is taken from a suitable source of supply such as a tank 104, which might be placed in any suitable location. Oil is drawn from the supply tank through an oil pipe 105 by the action of the rotary pump 17. From the outlet of this pump, the oil travels through the pipe 67 and traverses the coil portion surrounding the extension 15, where during normal operation of the burner the oil will be heated. This pipe delivers the oil into the float valve 68 which is, in turn, connected with the interior of the casing 21 of the reciprocating pump mechanism. In other words, the float valve maintains a substantially constant oil level within the casing 21 at all times.

From the casing 21 the oil is drawn through a metering valve 106 of conventional construction by the action of the piston associated with cylinder 32 of the reciprocating pumping mechanism.

After the oil passes through the metering valve, it is carried through a pipe 107 and carburetor 108 to the intake of cylinder 32.

This carburetor is constructed as specifically shown in Figure 6, and comprises an elongate

body portion 109 having a longitudinally extending bore 110 enlarged at its ends for receiving pipe connections. At its lowermost end, the bore 110 is tapped by the connection of pipe 103 which extends laterally from the body. The body 109 is so positioned in relation to the float valve 68 that the oil level in the float valve will also maintain an oil level in the body 109 which is above the entrance of the air pipe 103. It will therefore be evident that as the oil flows through the body 109 from the bottom towards the top thereof, as shown in Figure 6, air will be drawn into the oil stream. The air and oil will thus become mixed and an attenuated mixture of air and oil formed. It will thus be apparent that the piston acting in cylinder 32 will pump an attenuated mixture of air and oil and discharge it into the outlet manifold of the reciprocating pump mechanism.

The rotary pump 17 is arranged to pump a greater amount of oil than will be required to be delivered through the metering valve. The surplus oil, particularly when the float valve is closed, will be delivered through a return pipe 111 back to the supply source in tank 104. The pipe 111 contains a relief valve 112, which is set to open at approximately one to two pounds oil pressure acting in the direction of flow of oil in its return to the supply tank.

The attenuated mixture of air and oil, the oil having been carbureted in the carburetor 108 and further mixed under pressure in the cylinder 32 and discharged into the outlet manifold of the reciprocating pump mechanism, will build up a pressure in a pipe line 113 which connects the outlet manifold through a ball relief valve 114 with the pipe 111 just ahead of relief valve 112. The relief valve 114 is of the ball type and is set to open at substantially 90 pounds pressure.

Connected ahead of the relief valve 114 is a pipe 115 which connects through a bleeder valve 116 to a closed tank or container 117.

The construction of this bleeder valve is disclosed in detail in Figure 5. As will be noted, the bleeder valve comprises an elongate casing 118 having a longitudinally extending bore 119 which communicates at its innermost end with an expanded bore portion 120 to form a valve seat. The valve mechanism is housed within the portion 120 and comprises a valve member 121 having a rounded nose portion adapted to seat upon the innermost end of the bore 119, the valve member being resiliently actuated to seated position by means of an expansion spring 122.

The rounded seating end of the valve member is provided with a small surface groove 123 which permits bleeding of air from the pipe 113 into the tank 117. During normal operation of the burner, the bleeding of air into the tank 117 will build up an air pressure in the tank to the operating pressure at the nozzle. This tank obviates surges and the air therein is used for purging and cleaning as described hereinafter. During normal operation, the valve member 121 will remain in closed position as shown in Figure 5.

Air system

As previously described, air is taken in through the pipe 103 by the carburetor 108 and mixed with the pumped oil to form an attenuated mixture of air and oil. The piston of the reciprocating pump mechanism which is associated with cylinder 31 is utilized for the pumping of air only, the inlet to this cylinder being supplied

through an air pipe 124 which is carried to and has its inlet end disposed within the control housing 71, this housing protecting the air inlet against the entrance of dirt and other objectionable materials. Operation of the piston in cylinder 31 compresses the air and discharges it into the manifold of the reciprocating pumping mechanism where it combines and is further mixed with the attenuated mixture discharged from pumping cylinder 32. The manifold from the reciprocating pumping mechanism is connected to a pipe 125 which conducts the air and oil as they are mixed to the atomizing nozzle 16, where the mixture is discharged at pressures ranging from substantially 40 to 150 pounds. The atomized fuel, when ignited, is burned in the combustion supporting air delivered from the blower through the tubular extension 15.

A governing effect is provided by mid-point positioning of the valve 98 which is determined by the temperature of the compressor as this temperature determines the condition within the bulb 85. Thus where there is a high boiler room temperature the compressor chamber temperature will be higher, causing the bellows 83 to expand and push its head member 84 against the bar 77, thus opening the valve to admit additional air and maintain the desired even flame.

Control mechanism

In addition to the control previously described as being contained in the housing 71, additional control devices are utilized in order that the burner may be automatically started and stopped according to the heating requirements.

As further shown in Figure 7, the control mechanism in the casing 71 may be coordinated with additional control relays, etc., which may be variously constructed to accomplish the desired control of the burner. In the present instance, I have shown schematically a repulsion type relay as generally indicated at 126. This relay comprises a magnetic yoke 127 with which there is associated a fixedly mounted primary coil 128 and a movably mounted secondary coil 129 which is supported on a pivotally mounted arm 130. With this type of relay, when the primary coil 128 is energized, the secondary coil is energized due to the transformer effect between the coils. At the same time, magnetic repulsion between the primary and secondary coils causes the secondary coil to swing away from the primary coil. This action brings the arm 130 to a position in which it will close a pair of contacts 131. The connection to this relay will later be described.

Another device which is desirable in oil burner control is a safety switch such as diagrammatically shown at 132. This switch may constitute a two-electrode mercury switch 133 carried on a swingable bracket and normally biased to open position. The bracket is arranged to be latched by a suitable latch member 134 of bi-metallic material. The safety switch is moved to normally closed position in which it is latched by the bi-metallic member 134, but upon the temperature of the bi-metallic metal of the latch reaching a predetermined amount, the latch member will release the safety switch and permit it to be biased to open position. The temperature of the bi-metallic latch member is controlled by means of a heating coil 135.

Also included in the control diagrammatically represented herein is a flue thermostat relay 136 which is responsive to flue temperatures, when cold, to interconnect a pair of contacts 137, but,

when heated, to open the contacts 137 and close another pair of contacts 138.

As in most control systems for oil burners, the present system includes a room thermostat as generally indicated at 139 having a pair of normally opened contacts 140, which are adapted to close upon a rise of room temperature.

Operation

Let it be assumed that the oil burner has been standing idle and that the oil in the casing 21 is cold. The control devices will then be in their normal positions as shown in Figure 7.

Under such conditions, it will be noted that the primary coil of the repulsion relay will be connected to a source of current supply 141 through the following circuit: from the side of the current supply through the closed contacts of safety switch 132, conductor 142 to one side of primary coil 128, conductor 143, and thence through conductor 144 to the other side of the main current supply. Thus the primary coil is across the line and will be energized. However, the primary coil will not repulse the secondary coil 129, since it is open-circuited as the result of the contacts 140 of the room thermostat in the secondary coil circuit being in open position.

Let it now be assumed that the thermostat calls for heat, and that this thermostat closes its contacts 140 due to fall of room temperature. Closing of the thermostat contacts 140 operates to close the secondary coil circuit as follows: from one terminal of coil 129 through conductor 145, conductor 146, conductor 92, the contacts of switch 90, conductor 91, conductor 147, conductor 148, contacts 140, conductor 149, and thence back to the other terminal of coil 129. The secondary coil circuit thus being completed, current will flow in the secondary coil with the result that the secondary coil will be repulsed from the primary coil, and the relay will operate to close contacts 131.

Closing of contacts 131 energizes the heater 59 in the bottom of casing 21 through the following circuit: from one side of the current supply 141, through the contacts of the safety switch 132, conductor 142, contacts 131, conductor 150 to one side of the heating element of the heater 59, and the other side of this heating element through conductor 96, the closed contact switch 93, and thence through conductor 94 to the other side of the current supply.

The heater 59 continues to pre-heat the oil in the casing 21. This heating of the oil continues until it reaches substantially a temperature of 105° F. As the temperature of the oil continues to increase, the closed thermal responsive system expands the bellows 83 and causes switches 90 and 93 to move to a position wherein they tilt downwardly to the right instead of downwardly to the left. In this changed position, the contacts of switch 90 are opened, and conductor 94 is disconnected relative to conductor 96, whereupon the circuit through the heater 59 is opened. At the same time, conductor 94 is connected with conductor 97 and the motor C of the oil burner becomes energized through the following circuit: from one side of the electric supply circuit, through the contacts of safety switch 132, conductor 142, contacts 131, thence through conductor 151 to one terminal of the motor, from the other terminal of the motor through conductor 97, the right hand contact of switch 93, and thence through conductor 94 75

back to the other side of the main current supply.

The motor now being energized starts to operate the blower and pumping mechanisms. The action of cylinder 32 draws heated oil through the metering valve, and the carburetor 108 where air is combined with the oil as previously described, it being understood that the valve 98 is so regulated that when the switches 90 and 93 are actuated as just described, the valve 98 will also be opened to admit air to the carburetor.

At the same time, cylinder 31 starts drawing in air which is compressed and combined with the attenuated mixture discharged from cylinder 32. The mixed oil and air is then conducted through pipe 125 to the nozzle 16, where it is atomized into a combustion supporting atmosphere produced by the air issuing from the blower A through the extension 15.

Simultaneously with the starting of the motor, energization of the motor completes a circuit through the primary of an ignition transformer as follows: from one side of the main current supply 141, through the contacts of the safety switch, conductor 142, contacts 131, conductor 151, conductor 153, contacts 137, conductor 154 to one terminal of the primary of the ignition transformer, from the other primary terminal through conductor 155, and thence through conductor 144 back to the other side of the supply circuit. The ignition transformer thus being energized, an ignition spark is emitted adjacent the nozzle 16 between a pair of electrodes 156 which are respectively connected by conductors 157 and 158 to the respective ends of the secondary winding of the ignition transformer.

Assuming now that the atomized fuel issuing from the nozzle 16 is ignited, the hot gases passing out the flue of the furnace will actuate the flue thermostat to such position that it will open its contacts 137 and disconnect the ignition transformer. At the same time it will close its contacts 138 which operate to short circuit the heater 135 of the safety switch through the following circuit: from one terminal of the heater, through conductor 146, conductor 159, contacts 138, conductor 160, and thence through conductor 147 to the other terminal of the heater coil 135.

The burner will now continue to operate until sufficient heat is furnished to the room containing the room thermostat. When the temperature has reached the amount for which the room thermostat is set, it will open its contacts 140 and thereupon open-circuit the secondary coil 129 of the repulsion relay. The secondary coil then moves towards the primary coil and opens the contacts 131, whereupon the motor circuit is deenergized and the burner discontinues its operation.

In the event that the ignition spark does not ignite the atomized fuel issuing from the nozzle 16, then the flue thermostat continues to retain contacts 137 closed. Since the contacts of switch 90 are at this time opened, the heating coil 135 will be in the room thermostat circuit of the secondary coil 129. The heating coil 135 is thus energized from the secondary coil 129, and due to its heating effect upon the thermostatic strip of bi-metal 134, this latch will be deflected after a predetermined interval of time to a position wherein it will release the safety switch 132, so that the mercury switch 133 will be moved under the action of its biasing spring to a position wherein it will open its contacts and shut down

the motor driving the burner. The burner will then be cut out until such time as the safety switch is manually reset.

When the burner shuts down, the air which has become stored in the tank 117 will open the bleeder valve 116 and be discharged through the pipe 125 and nozzle 16, thus purging and cleaning out the system.

If, for any reason during the operation of the oil burner, the nozzle 16 should become clogged so as to prevent the atomization of the attenuated fluid thereby, a pressure will build up behind the nozzle. In my improved system, this pressure is relieved by the opening of relief valve 114 which permits the passage of fluid from the outlet manifold of the reciprocating pump mechanism through the by-pass valve 112 back to the supply tank.

If the burner has been operating continuously or at sufficiently close intervals to have kept the oil in the casing 21 of the reciprocating pumping mechanism at a sufficiently high temperature, the burner will start up immediately upon a call for heat by the room thermostat and there will not be instituted the time delay previously described for energizing the heater 59 for preheating the oil.

From the foregoing description, it will be apparent that the present invention provides an improved oil burner and system which will efficiently and economically burn the heavier and more viscous oil; which includes improved means for pre-heating the oil; which is so arranged that air may be mixed with the oil under pressure to form a combustible mixture, before the mixture is atomized in the burner nozzle, the amount of air being automatically controlled; which embodies improved means for carbureting the oil by the injection of air before the oil reaches the burner nozzle; which includes novel pumping mechanism in which the oil may be pre-heated and mixed with air under pressure; which is provided with improved means for purging and flushing the oil nozzle, when the burner is shut down; which has an improved relief arrangement in the oil path, whereby oil may be returned to a source of supply whenever the burner nozzle becomes clogged; a burner arranged to utilize metered quantities of oil and by-pass surplus pumped oil back to a supply source; and which utilizes improved control means for delaying starting of the burner, when cold, until the oil has been pre-heated to a predetermined temperature.

Now, it is, of course, to be understood that although I have described in detail the preferred embodiment of my invention, the invention is not to be thus limited, but only insofar as defined by the scope and spirit of the appended claims.

I claim as my invention:

1. In an oil burner having a nozzle, a conduit to said nozzle, means for mixing air and oil and delivering the mixture under pressure through said conduit, driving means for said first means, and a thermally actuated mechanism responsive to the temperature of space to be heated by said burner for starting and stopping said driving means, the improvements comprising means driven by said driving means for compressing air, a storage tank, a conduit for receiving compressed air from said means during operation of said driving means and conducting the same to said tank, said last named conduit connecting with said first named conduit, and valve means for releasing said compressed air from said tank when said driving means is out of operation to flush said first conduit and said nozzle.

2. In an oil burning apparatus in which mixed air and oil are supplied through a conduit to a fuel nozzle, means for pumping air, means for storing said pumped air during operation of the burner, a conduit for connecting the means for storing air and said first named conduit and a valve for releasing said stored air through said last named conduit when the burner is shut down to flush said first named conduit and said fuel nozzle, said valve including means defining a small inlet opening for flow of air into said storage means during operation of said burner, and being constructed and arranged to shift in response to pressure in said storage means to define a large outlet opening for flow of air out of said storage means when said burner is shut down.

3. In an oil burning apparatus in which mixed air and oil are supplied through a conduit to a fuel nozzle, means for pumping air, means for storing said pumped air during operation of the burner, a conduit for connecting said storage and pumping means, said last named conduit connecting with said first named conduit and a valve for releasing said stored air when the burner is shut down to flush said first conduit and said fuel nozzle, said valve including a tubular casing having different sized bores therethrough defining inlet and outlet openings, a seat between said bores, a valve member, and spring means normally maintaining said valve member against said seat, said valve member having a small surface groove permitting bleeding of air from said air pumping means into said storage means during operation of said air pumping means, said valve member being moved away from said seat when said air pumping means is out of operation to permit air to flow through said bores to flush said first named conduit and said fuel nozzle.

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