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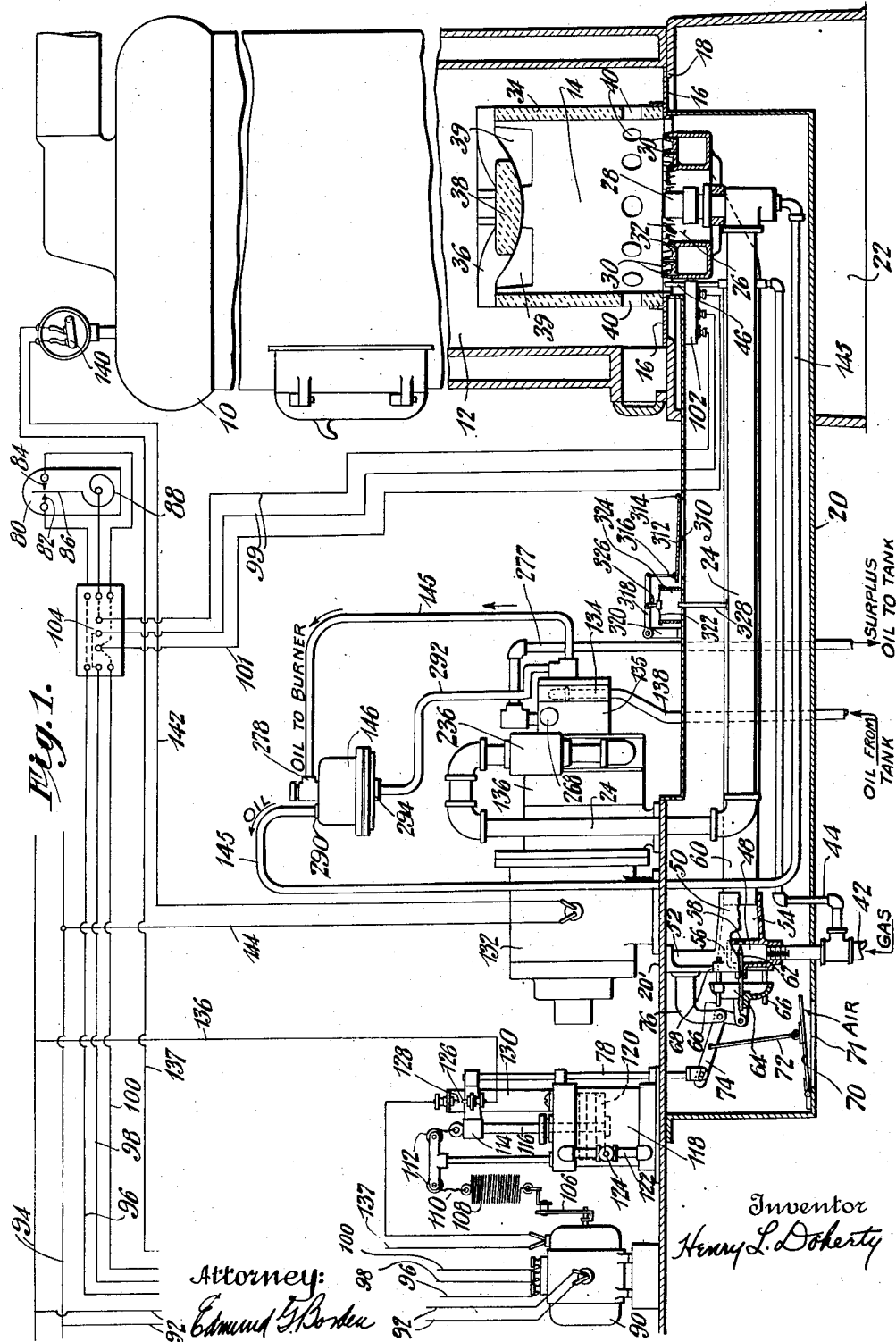
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HOUSE HEATING SYSTEM

Filed Jan. 22, 1925

2 Sheets-Sheet 1



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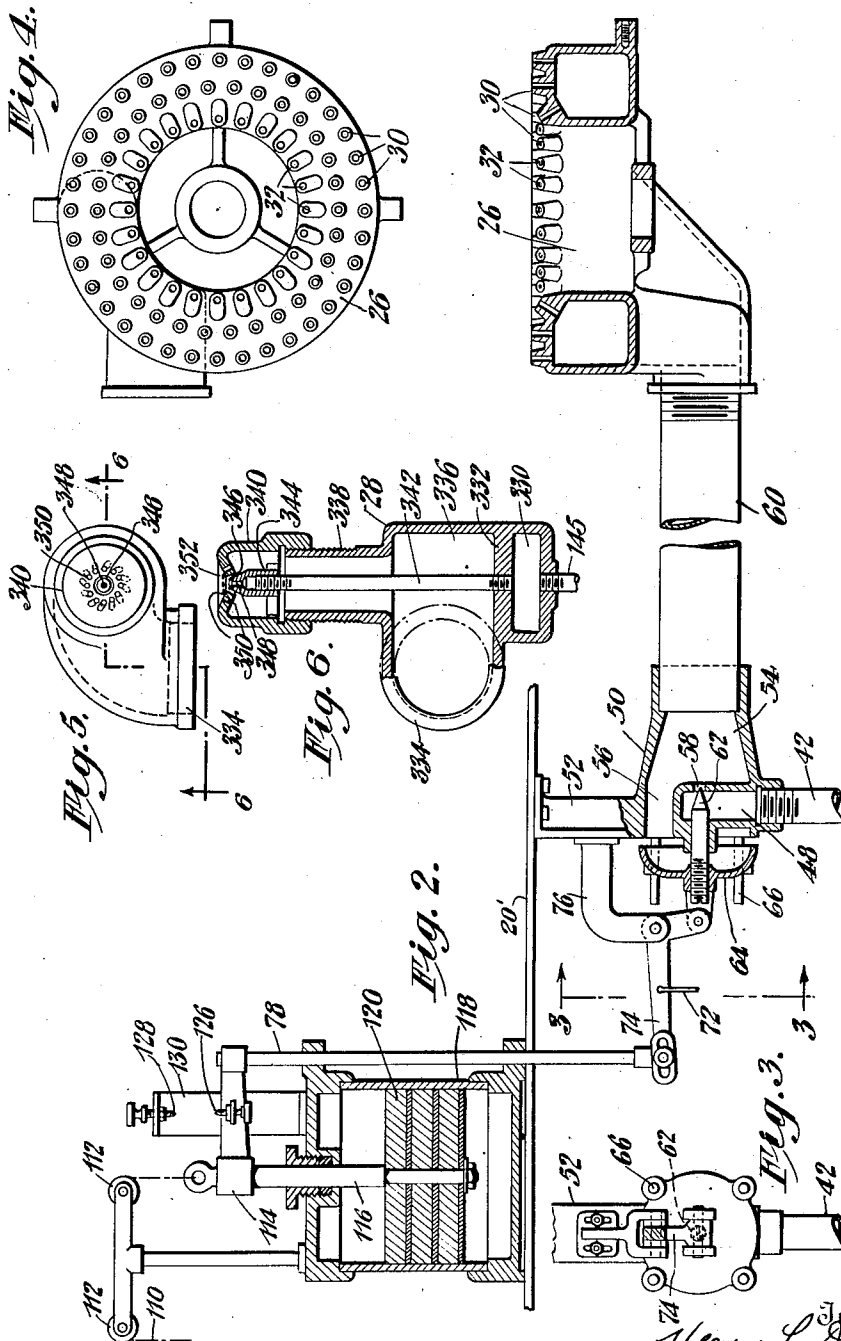
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

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HOUSE HEATING SYSTEM

Application filed January 22, 1925. Serial No. 3,907.

The present invention relates to fluid fuel heating systems. More particularly the invention relates to domestic furnace burners and combustion controlling apparatus.

It has been proposed to operate systems for heating houses, raising steam, and like purposes, automatically, the fire under the boiler being controlled automatically by a thermostat or by means responsive to the pressure in the boiler, or in other ways in order that the furnace, or furnace and boiler, should require a minimum of attention. Certain of the automatic systems just referred to burn gas, oil or coal, but the majority of the features of the present invention have to do with the use of gas or oil separately and jointly.

The automatic gas heating systems have been handicapped by the high cost of furnishing gas for domestic heating. Such a system must be designed to furnish enough heat for the coldest days of the year. The gas company must therefore provide equipment including gas generating plant and auxiliaries as well as distributing mains, regulators, meters and the like, for supplying the large occasional demand for heating gas and then permit the equipment for this purpose to be idle most of the time. Therefore if the gas for house heating and the like is charged its proper part of the fixed charges incurred in its manufacture, the cost of heating entirely by gas becomes too high to be considered except by those having unusually large incomes.

On the other hand, the domestic oil burning systems have been limited to the use of a relatively high priced quality of oil. Also, they often give off an unpleasant odor. Moreover, both the gas systems and the oil systems have been relatively expensive to operate and complicated in construction as compared with coal burning systems.

One object of the invention is to provide a method of and apparatus for burning fuel in a domestic furnace by which a relatively expensive and readily inflammable fuel such as gas is used for the normal load heating purposes of the furnace with the supply of gas being limited to a fixed amount and

when the demand for more heat is required than will be provided by the fixed amount of gas, it will be supplemented by a relatively cheap and not easily inflammable fuel such as the cheaper grades of oil.

A second object of the present invention is to improve the performance of automatic house heating systems and steam raising systems from the standpoint of the householder, or person in charge of the apparatus.

A third object of the present invention is to provide a combined gas and oil burning system having high efficiency and reliability.

Another object of the present invention is to provide an odorless method of and apparatus for burning oil in domestic heating systems.

A further object of the present invention is to provide a method and apparatus capable of satisfactorily burning heavier, and therefore cheaper oil, than is now commonly used in automatic house heating systems.

The novel features of the present invention are pointed out with particularity in the appended claims.

The invention, together with further objects and advantages, will best be understood from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a view of an apparatus adapted to operate in accordance with the method of the present invention; the view being partly diagrammatic, parts shown in section, and parts in elevation for purposes of illustration.

Fig. 2 is an elevation on a larger scale of the gas burner and gas controlling portion of the apparatus illustrated in Fig. 1, parts being shown in section.

Fig. 3 is a section of the gas controller taken on the line 3—3 of Fig. 2, looking in the direction of the arrows.

Fig. 4 is a plan of a portion of the gas burner illustrated in Fig. 2.

Fig. 5 is a plan of the oil burner illustrated in Fig. 1.

Fig. 6 is a section of the oil burner taken

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on the line 6—6 of Fig. 5, looking in the direction of the arrows.

In the drawing, 10 is a boiler, illustrated as being one of an ordinary house heating type, and having a furnace 12 within which is a burner apparatus 14. In installing an apparatus such as 14 in a furnace in accordance with the present invention, the ordinary coal burning grates are removed and a sheet metal plate 16 placed in the lower portion of the furnace 12 and resting on the lugs 18 ordinarily used to support the grates. The sheet 16 is centrally apertured to receive the burner apparatus 14 which projects up into the lower portion of the furnace 12. Apparatus 14 is mounted at one end of an air conduit 20 which extends into the ash pit 22 of the furnace 12 through the ordinary doorway for removing the ashes.

The burner apparatus 14 comprises a gas burner 26 and an oil burner 28, burner 26 being of annular or ringlike form having a central opening through which burner 28 projects. Gas burner 26, Figs. 2 and 4, includes a considerable number of individual burner tips 30 extending in a ring around its upper edge and has also a number of tips 32, adjacent the upwardly projecting tips 30, but inclined inwardly somewhat toward the center of the burner 26, so that flames from the tips 32 will strike the edge of and be drawn into a stream of atomized oil issuing from the centrally positioned oil burner 28. Surrounding the tips 30 and 32 and extending upwardly above the level of the same is a bell or cylinder 34. Bell 34 may be of cast iron or of fire brick or like refractory material, or it may be cast iron lined with refractory. Resting on the upper edge of cylinder 34 is a spider 36 supporting a central plate or button 38, which is made of cast iron, or fireclay, and so positioned as to contact with and spread oil flame issuing from the oil burner 28 and insure the thorough mingling of the oil and oil flame from burner 28 with the gas and gas flame from burner 26. The upper edge of cylinder 34, moreover, is notched as illustrated at 39, Fig. 1, so that flame from burners 26 and 28 may spread and issue from the cylinder 34 somewhat laterally as well as upwardly.

It is well known that not all types of boilers are equally efficient when fired by gas. When the amount of hot gases passing through the boiler is small as compared to the size of the passages of the boiler, the efficiency often suffers unless the heating surfaces receive heat by radiation. The apparatus according to the present invention is therefore so designed that the flame produced in the firebox when using gas only may be made either luminous or non-luminous as required in order to obtain

best efficiency with the particular type of boiler with which a given burner apparatus is to be used. According to the present invention, a high heat efficiency is obtained from the gaseous fuel used by burning the gas, when so desired, as a luminous flame in a position from which it radiates to a relatively large amount of heating surface. Burner 26 can be readily arranged to radiate to a large heating surface in comparison to the energy of the gas being burned when the burner is installed in an ordinary domestic type of coal burning boiler furnace, such boilers having ordinarily a considerable percentage of their heating surface in position to receive radiation from a coal fire on the grate. Moreover, when the system according to the present invention is applied to a domestic type boiler, the space designed to be occupied by coal and ashes is available to receive heat by radiation from burner 26. It will be clear from the drawing that the active surface of the boiler is not reduced according to the present invention by refractory material placed against it to promote the combustion of the oil. Therefore, when the apparatus is adjusted to give a luminous flame, the flame issuing from cylinder 34 radiates directly to all parts of the boiler surface which would receive direct heat or radiation from a coal fire. As it is good practice to burn fuel oil with a luminous flame, no attempt is made to provide means for adjusting the apparatus to a non-luminous flame when the oil is being burned.

According to the present invention, moreover, the cylinder 34 has a ring of apertures 40 therein at a level slightly above the ends of the burner tips 30 whereby products of combustion may be drawn into the flame within the cylinder 34 to lengthen the flame and assist in improving efficient combustion of the oil.

Great difficulty has been experienced heretofore in using fuel oil for domestic boiler furnaces because the amount of oil burned is comparatively small, the fuel often has a very high viscosity, and is quite dirty. Accordingly, the oil does not feed uniformly to the burners and there is not sufficient combustion to maintain sufficiently high temperatures for proper combustion. In accordance with the present invention an ideal condition for burning heavy fuel oils is provided by burning gas within a refractory chamber to maintain a radiating surface which will readily ignite fuel oil. To this end the gas is used as the normal load fuel and is burned within the cylinder 34 in maintaining normal heat requirements of the boiler. When the requirement of heat from the boiler increases above normal, the oil is introduced through the burner 28. At this time the gas is burning at its maximum

amount. Therefore the oil is introduced into a heated chamber and into a burning gas flame. When the combined combustion of the oil and gas has supplied the heat requirements of the boiler the oil will be cut off from the burner 28 before the gas is turned down in the burner 26, and accordingly the amount of oil being burned is substantially uniform and is in sufficient amount to maintain an efficient and ideally burning luminous oil flame.

The means for supplying gas and air to burner 26 and for regulating a flow of the same as above described and according to the present invention will now be described in detail.

42 indicates a pipe which leads from a source of gas supply and which delivers into a gas chamber 48 of a gas and air mixing device 50 within the air conduit 20, said chamber being provided with a jet orifice 58 controlled by a needle valve 62 slidably mounted in the outer wall of said chamber. As clearly shown in Fig. 2, said orifice 58 discharges into a chamber 54 where into primary air may enter through a passage 56 controlled by a damper 64, said damper being mounted on the outer end of the needle valve 62 for movement therewith. The needle valve and damper are simultaneously actuated by an elbow lever 74 mounted on an arm 76 projecting from a bracket 52 which extends upwardly from the device 50 and which is secured to a top plate 20' of the air conduit 20.

It will of course be understood that by adjusting the damper 64 simultaneously with the needle valve 62, the amount of primary air entering the mixing device will be controlled in accordance with the amount of gas discharged from jet orifice 58. As shown, the damper is guided in its movement by pins 66. 46 indicates a pilot adjacent the gas burner 26, gas being supplied to the pilot by a pipe 44 leading from the main gas pipe 42. Connecting the gas burner 26 and the mixing device 50 is a pipe 60.

In order that the amount of secondary air supplied to the gas burner may be controlled in accordance with the amount of gas supplied thereto, the air inlet 71 of air conduit 20 is controlled by a damper 70 connected to the elbow lever 74 by a link 72. It will therefore be seen that the lever 74 actuates three elements—namely the needle valve 62, the primary air damper 64 and the secondary air damper 70. When the needle valve 62 is closed the secondary air damper 70 will also be closed. The lever 74 is connected to rod 78 and automatic means is provided for operating the rod 78 in accordance with the need for heat to be delivered by the system of which the burner apparatus 14 is a part.

If the burner apparatus is part of a house heating system, the automatic means just mentioned includes a thermostat 80 placed in the room whose temperature it is desired to control. Thermostat 80 includes two fixed contacts 82 and 84, respectively. It also includes a movable contact arm 86, the position of which is controlled by the temperature of the room on account of the expansion and contraction of the curved metal portion 88. 90 is an electric motor supplied with current through wires 92 from the power line 94. The circuit of motor 90 is extended through wires 96, 98 and 100 to thermostat 80, wire 96 being normally connected to fixed contact 82, wire 98 being normally connected to the arm 86 and wire 100 being normally connected to fixed contact 84. Wire 100 is also connected to an automatic thermostat or circuit closing device 102 by means of a branch 101 while wire 98 is interrupted at point 104 and connected to the arm 86 through the loop 99 running through the device 102.

The parts of the fuel controlling devices are illustrated in Fig. 1 in the position assumed by them when the burner 28 is inactive. The room whose temperature is controlled by thermostat 80 will therefore be cooling off. Assuming that the temperature of the room has declined to the lower limit desired, the arm 86 of the thermostat 80 therefore strikes the contact 82. The motor 90 is so constructed that each time its circuit is closed, it turns its driving shaft 180 degrees and then stops. The circuit of motor 90 having been closed as just mentioned, the motor thereupon rotates its shaft 180 degrees from the position illustrated in Fig. 1. The motor 90 and thermostat control therefor are well known in the art and form no part of the present invention. The details of motor 90 are therefore neither disclosed nor claimed herein.

The crank or arm 106 fixed to the shaft of motor 90 is thrown down by the movement of the motor just mentioned and the spring 108 placed in tension. Spring 108 connects the arm 106 with cord 110, cord 110 running over pulleys 112, 112 and connecting to a cross head 114 carrying the rod 78, previously mentioned. The downward pull on the spring 108 tends to lift the cross head 114 by virtue of the pulleys 112 and with consequent actuation of the lever 74 which controls the admission of gas and air to the burner 26. When, however, the temperature of the room is at the upper desired limit, arm 86 of the thermostat 80 strikes the fixed contact 84 again closing the circuit of motor 90 and causing said motor shaft to execute another half turn or rotary movement of 180°. The arm 106 is thereby again brought upward into the position illustrated in Fig. 1, the tension of spring 108 being

relaxed and the arm 78 permitted to drop to close off the flow of gas to burner 26.

However, according to the present invention it is preferred that the gas flame be increased gradually and turned off gradually, and for this purpose a retarding means is connected to the cross head 114, said retarding means comprising a rod 116 fixed to cross head 114 and extending into a dash pot cylinder 118. Within the dash pot 118, rod 116 is connected to a weighted piston 120, (Fig. 2), the dash pot 118 being filled with light oil, preferably a mixture of kerosene and light lubricating oil, and the ends of the dash pot above and below the piston 120 connected by pipe 122 (Fig. 1), having a retarding valve 124 therein. When the spring 108 has been tensioned by the motor 90 as above described, the tension of the spring is resisted by the weight of piston 120 and the motion of the weight of piston 120 and the motion of the weight is moreover retarded by the oil in the dash pot so that the cross head 114 carrying the operating rod 78 can rise only gradually and the fuel to burner 26 is turned on gradually. Similarly, when the motor 90 is turned into the position illustrated in Fig. 1 so that the spring 108 is relaxed, the weighted piston 120 gradually carries the rod 78 downwardly and the movement of rod 78 correspondingly shuts off the flow of gas to burner 26, the movement of the piston being resisted by oil flowing through the valve 124. It will be seen that the parts of the gas controlling apparatus just described are illustrated in Fig. 1 in the position assumed by them shortly after the motor 94 has turned the arm 106 to the uppermost position, thereby relaxing spring 108.

The means for supplying oil to burner 28 and for starting and stopping the flow of the same according to the present invention will now be described.

The movable cross head 114 carries an insulated contact 126. A co-operating contact 128 is mounted on and insulated from the fixed standard 130, the latter mounted on dash pot cylinder 118. Contact 126 strikes contact 128 at the upper limit of travel of cross-head 114 as it moves upward under the influence of spring 108 as previously described. Also, the contacts 126 and 128 separate as soon as cross head 114 starts downwardly when the tension on spring 108 has been relaxed. Contacts 126 and 128 are inserted in the circuit of motor 132 which drives a pump 134 furnishing oil to oil burner 28. The circuit of motor 132 is taken off the power line or circuit 94 through lead 136, passing through contacts 126 and 128 to the casing of motor 90 and thence through lead 137 to an emergency circuit opening device 140 and thence by lead 142 to the casing of motor 132 itself from which it re-

turns to the other side of power circuit 94 by lead 144. From the foregoing, it will be seen that the oil pump 134, and hence the oil burner 28, is thrown into operation only after the operating rod 78 has reached the upper limit of its travel and hence after the gas to gas burner 26 has been turned on full. It will be seen also that oil pump motor 132 and pump 134 will be stopped by breaking the circuit of motor 132 at contacts 126, 128 as soon as the rod 78 controlling gas valve 62 starts downward to shut off gas to burner 26.

The casing of oil pump 134 is supported from that of oil pump motor 132 and the shafts of the motor and pump are directly coupled in alinement. Also intermediate oil pump 134 and motor 132 is an air pump 136 furnishing air for atomizing oil from pump 134 in burner 28. The casing of air pump 136 is fixed to the casings of motor 132 and pump 134 and its shaft is in alinement with those of the motor and oil pump, motor 132 and pumps 134 and 136 forming a unitary structure. Oil flows to pump 134 through pipe 138 and is forced to burner 28 through pipe 145. Air pump 136 delivers air for atomizing the oil through pipe 24 previously mentioned, pipe 24 running between pump 136 and burner 28.

When pump 134 has been operating to force oil to burner 28 and is then shut down by one of the automatic controls previously described, unless means were provided to prevent it, oil would stand in the upper part of the burner 28 when not operating. As the upper part of burner 28 is surrounded by a ring of gas jets from burner tips 30 and 32, oil so standing in burner 28 would be carbonized by the heat of flames and would soon clog burner 28. To prevent carbonizing of oil in burner 28, a drawback device 146 is provided in pipe 145 intermediate pump 134 and burner 28. Device 146 acts automatically to cut-off pump 134 from burner 28 as soon as the pressure of oil in pipe 145 drops upon shutting down of pump 134 and device 146 then acts to suck back into its own casing some of the oil in pipe 145, so that the oil in burner 28 is drawn down below the level at which it can be carbonized by heat from burner 26.

The two thermostatic devices 102 and 140 at the burners and on the boilers, respectively, previously mentioned as forming part of the system according to the present invention operate only under abnormal conditions. Thermostat device 102 comes into operation upon the extinction of pilot light 46. When the thermostat in device 102 is maintained at normal temperature by the heat from pilot light 46 contacts are made to connect the two halves of loop 99 so that wire 98 acts as a continuous wire leading to ther-

mostat arm 86 as previously described. When, however, device 102 cools below a certain temperature it connects wire 101 with the part of loop 99 running to point 104. The action of device 102 when it cools down therefore is the same as that of thermostat 80 when the thermostat is heated up and upon the connection of wire 101 with point 104 by device 102, motor 90 if not already in that position turns arm 106 to point upward, thereby first cutting off the oil, if the pump is in operation and then gradually cutting off the gas.

Device 140 controls only the oil-pump motor 132. When the temperature or pressure within the boiler 10 exceeds certain desired limits, device 140 disconnects wire 142 from wire 137, thereby interrupting the circuit of motor 132 and shutting down this motor and oil-pump 134. The oil to burner 28 is thereby shut off.

Secondary air as well as primary air for the gas flame is furnished through opening 71, as previously mentioned. However, damper 70 governing opening 71 is opened substantially as far as the apparatus can do so before the oil pump 134 is started, a very small movement of contacts 126 and 128 one way or the other being sufficient to start or stop oil-pump motor 132. Since damper 70 is adjusted to give the proper supply of air for the maximum flow of gas to burner 26, while primary air for oil burner 28 is supplied through pipe 24, it is clear an additional supply of air is needed to furnish secondary air to burner 14 when oil as well as gas is being burned. For the purpose just mentioned there is provided a second air inlet aperture 310 in air duct 20, aperture 310 being closed by damper 312 except when oil is being burned. Damper 312 is illustrated as hinged at 314 to the outside of the top surface of duct 20 whereby this damper closes by its own weight. Of course, if the damper 312 were so placed that it did not close by its own weight some means would need to be provided to hold it normally closed. In order to open damper 312 when needed, a link 316 is connected to the unhinged end of the damper, link 316 being pivoted in turn to arm or lever 318. Lever 318 is pivoted at the end removed from link 316 to a fixed standard 320. Lever 318 lies above and is connected to a flexible operating diaphragm 322, diaphragm 322 being attached so as to close the upper end of cylinder 324 which is mounted on the duct 20. A pipe 328 connects the interior of air pipe 24 with the interior of cylinder 324 beneath diaphragm 322. With this arrangement the same air pressure is maintained in the cylinder 324 which exists in the pipe 24. Therefore when the air pump 136 is put into operation the diaphragm 322 will be actuated to

open the damper 310 to admit secondary air.

The details of oil burner 28 are illustrated in Figs. 5 and 6. The oil or other liquid fuel enters burner 28 at the bottom through pipe 145; and passes into a chamber 330, the top of which is formed by an internal horizontal web 332. The air for burner 28 is pumped therein from the pump 136 through the pipe 24, pipe 24 connecting with the burner through threaded offset 334 connecting with the air chamber 336 lying within the burner 28 above the web 332. From the chamber 336 the air is conducted upwardly through a nipple 338 leading out of the chamber 336 into a burner cap 340. A pipe 342 extends through the web 332 and runs centrally through chamber 336 and nipple 338 to conduct oil to within the burner cap 340. At the upper end of pipe 342 is a nozzle 344 co-operating with the cap 340 and producing the oil flame. Cap 340 has a central upwardly tapering opening 346 therein and the upper end of nozzle 344 tapers upwardly on the line parallel to the taper of the aperture 346 and projects within this aperture, but nozzle 344 is spaced from the cap 340 so that air may pass up around the nozzle through the aperture 346. Nozzle 344 has a central aperture 348 leading upwardly and delivering oil within the aperture 346 so that air and oil are thoroughly commingled in passing through the upper portion of aperture 346. In order to further atomize the oil and thoroughly mix it with the air, the upper end of the opening 348 in the oil nozzle 344 is enlarged and cap 340 has also a series of air jet apertures 350 arranged around the central aperture 346 and so inclined as to deliver fine jets of air under pressure to the stream of mixed oil and air issuing from aperture 346. In order to promote the ease of drilling the apertures 350 the upper end of the cap 340 around the aperture 346 is indented or countersunk to form a depression 352. Moreover, in order to produce a large volume of flame and also to assist in mixing the oil thoroughly with air the apertures 350 are placed at inclination to the radii from the centre of cap 340 so that the air jets from the apertures 350 produce a swirling action of the flame.

The operation of the apparatus disclosed herein will be obvious to those skilled in the art from the foregoing description. For convenience of reference however the operation of the apparatus according to the present invention will be summarized as follows:

The fuel burning and combustion regulating apparatus of the present invention is applied specifically to a domestic heating furnace of the type usually employed for burning coal. The burners and the controlling apparatus are preferably built up in a unit construction and located immediately

adjacent the furnace. The automatic control for the burners and the regulating apparatus consist of a thermostat which should be placed in a room of the house whereby the temperature of this room will be used for controlling the heating of the house. If the room in which the thermostat is located has the normal temperature desired, say, for example, 70° F., the burners will be turned off and nothing but the pilot burner 46 will be burning. When the temperature falls below 70° the thermostat 80 will operate to close the power circuit in the motor 90 whereupon the dash pot mechanism 118 will be operated by the motor to adjust the needle valve 62 and air valve 64 so that the gas will be introduced into the mixing pipe 60 and flow to the gas burner 26. The dash pot mechanism is so arranged that the gas will be gradually increased until a predetermined maximum or fixed demand of gas has been reached. When the maximum has been reached, electric contacts 126 and 128 mounted on the dash pot mechanism will be made and the air and oil pump motor 132 will be set in operation to supply oil and air to the oil burner 28. By the time the gas burner is burning the maximum amount of gas, the refractory chamber surrounding the gas burner will be highly heated and therefore when the oil is introduced into the burner 28, it will be atomized into the gas flame from the burner 26 and into the heated refractory chamber 34. At the time the motor 132 is set into operation the oil will be supplied to the regulating mechanism 146 in a fixed amount, and the amount of oil flowing to the burner will be uniform as long as the oil burner continues to operate. The oil is supplied to the burner 28 in a measured quantity, the measuring being accomplished by the pump 134, so that the oil flows through a comparatively large pipe to a burner having a comparatively large discharge orifice. When the gas is turned on by the motor 90, the air valve 70 in the duct 20 is gradually opened as the supply of gas increases. This furnishes the primary and secondary air for the gas burner 26. When the oil is turned on, primary air is introduced to the oil burner 28 by the pump 136 and the secondary air is introduced into the air conduit 20 through the damper 310 by the regulating diaphragm 322 which is operated by the air pressure used in the oil burner. While the oil is burning the gas is burning at its maximum demand and the oil burns at the predetermined fixed quantity which is normally used when burning oil. These two combined fuels then continue to burn until the heat supplied by the boiler is sufficient to raise the room temperature of the house to normal temperature. When such normal temperature is reached, the thermostat 80 will make such electrical con-

tact that the motor 90 will be operated to set the dash pot mechanism in a position for turning off the oil and gas. Immediately upon the operation of the motor for turning off the oil and gas the electrical contact for controlling the circuit of the oil and air pump will be broken, and the motor will stop. As soon as the oil pressure in the feed line and the air pressure in the air line have been decreased the suck-back device 146 will act to draw back the oil from the burner 28 and the damper 310 will be closed. The gas however will not be cut off immediately, but the supply of gas will be gradually reduced by the dash pot until it will be entirely cut off unless in the meantime the room temperature has fallen so that the thermostat 80 will be operated to actuate the motor for again turning on the gas. In this way the gas is used as the normal load fuel to be gradually increased and decreased as the heat demands require. When however the temperature in the house is such as to require more heat than can be supplied by the burning of the gas alone, then the oil will be turned on to supplement the gas in supplying the heat demands. The temperature and pressure controlling device 140 is used to prevent the development of an excess temperature in a water boiler or an excess steam pressure in a steam boiler whereby the burning of fuel may be checked rather than injuring the boiler. The safety device 102 which is connected with the pilot flame is arranged to operate at the time the pilot flame is extinguished in order to cut off both the oil and gas to prevent them from being supplied to the furnace when the fuel is not ignited or burning.

It will be seen that the present invention provides a heating system particularly adapted although not limited to household heating purposes in that it is fully automatic, but safe and rugged in operation.

Moreover, the system operating according to the present invention burns fuel oil without odor and with little noise.

While the foregoing disclosure is specific in character the appended claims are not to be construed as limited to details of said disclosure except as to details positively included in the claims.

Having thus described my invention, I claim:

1. A heating system including a gas burner, an oil burner, automatic means associated with said burners for turning on the gas to said gas burner to full extent and then turning on the oil to said oil burner when a greater heat output is required of the system, said means operating automatically to first turn off the oil to said oil burner and thereafter to decrease the gas to said gas burner

when a lessened heat output is required of the system.

2. A heating system including a gas burner, an oil burner, a thermostat, a motor controlled by said thermostat having means associated therewith for turning on the gas to said gas burner to full extent and then turning on the oil to said oil burner when said thermostat operates under a condition requiring more heat, said means first turning off the oil completely before reducing the gas flow when the thermostat operates under a condition requiring less heat.

3. A heating system including a gas burner, an oil burner arranged to be ignited by said gas burner, thermostat means having high and low temperature and neutral positions, and means associated with said thermostat means for turning on and increasing the flow of gas to said gas burner and then turning on the oil to said oil burner when said thermostat means is in the high temperature position, and for turning off the oil and for gradually decreasing the gas flow when said thermostat is in a low temperature position.

4. A heating system comprising a gas burner, means for regulating the flow of gas to said burner, an oil burner, a pump for pumping oil to said oil burner, an electric motor for operating said pump, a thermostat and a thermostat motor controlled thereby, means whereby said thermostat motor gradually turns on the gas to said gas burner and gradually turns it off depending on the position of said thermostat, said last mentioned means acting at times also to close the circuit of said pump motor.

5. A heating system comprising a heater, a furnace for said heater, a burner for said furnace, automatic means for regulating the fire from said burner in accordance with the temperature at a point remote from said heater, and automatic means for reducing the fire from said burner irrespective of the condition of said first mentioned means when the temperature of the heater exceeds a given degree.

6. The combination with a heating system including a gas burner, of temperature responsive mechanism operable to gradually vary the volume of gas flow to said burner in accordance with variations in heat demand within normal ranges of heat demand, and temperature responsive means for supplementing the heat from said gas burner by an oil flame when the amount of heat required exceeds normal.

In testimony whereof I affix my signature.

HENRY L. DOHERTY.