

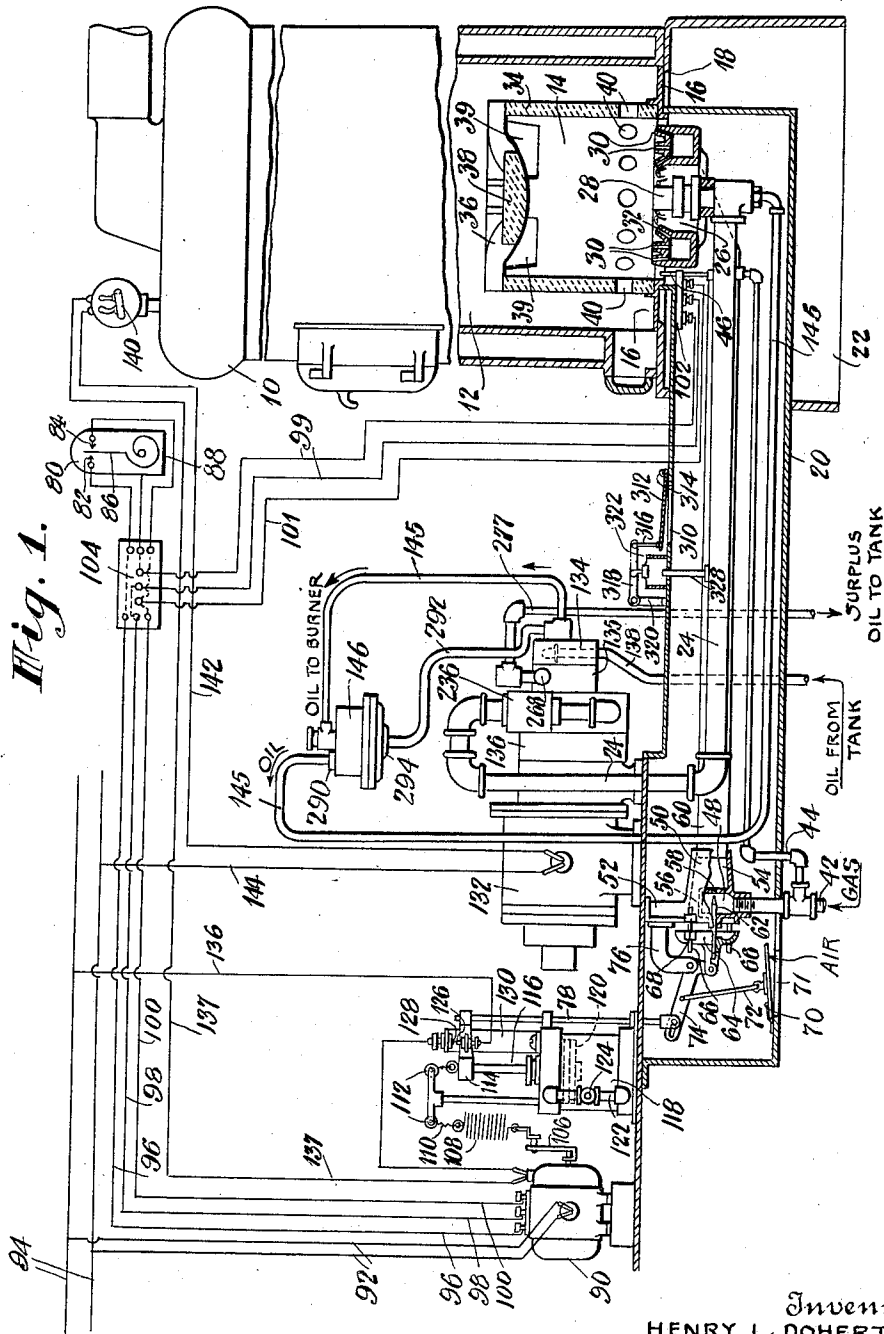
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H. L. DOHERTY

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METHOD OF BURNING FLUID FUEL

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Inventor
HENRY L. DOHERTY

By his Attorney

Edmund G. Burke

UNITED STATES PATENT OFFICE

HENRY L. DOHERTY, OF NEW YORK, N. Y., ASSIGNOR TO COMBUSTION UTILITIES CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF MAINE

METHOD OF BURNING FLUID FUEL

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The present invention relates to the combustion of fluid fuels, and more particularly to an improved method of burning liquid fuel. This invention was originally described in my application Serial No. 3,907, filed Jan. 22, 1925, of which this is a division.

The domestic oil burning systems previously developed have in general 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 burning systems and the oil burning 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 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 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.

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

A further object of the present invention is to provide a method 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 sections, 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 plan of a portion of the gas burner illustrated in Fig. 2.

Fig. 4 is a vertical, central section of the oil drawback device illustrated in Fig. 1.

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

Fig. 6 is a section of the oil burner taken on the line 6—6 of Fig. 5, looking in the direction of the arrows.

In the drawings, 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 coal burning furnace in accordance with the present invention, the ordinary coal burning grates are removed and a sheet metal plate 16 is placed in the lower portion of the furnace 12, said plate 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 a flue or air box 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 entirely surround and project across the path of a jet 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 flues of the boiler, the efficiency often suffers unless the heating surfaces receive heat by radiation. The apparatus according to the present invention is therefore designed so 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 drawings 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 circulated by induced draft from the furnace firebox 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 the ignition is not regular nor the combustion sufficiently uniform and complete to maintain in the furnace the high temperatures necessary 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 amount sufficient to meet the 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:

Pipe 42 (Fig. 1) is connected to a gas supply which may be the ordinary city gas. Pipe 44 is taken off from pipe 42 and leads through the flue 20 to a pilot burner 46 adjacent the gas burner 26. Pipe 42 is extended within the flue 20 and connected to deliver into a chamber 48 of an air and gas proportioning and mixing device 50 suspended within flue 20 by a bracket 52. The device 50 has a mixing chamber 54 which opens into the flue 20 by way of passage 56 and which connects with the gas chamber 48 by an aperture or passage 58. The gas flowing through aperture 58 draws air through passage 56 and the air and gas after mixing in chamber 54 pass through the pipe 60 within flue 20 to the gas burner 26. In order that the flame of the burner 26 may be regulated as desired, a needle valve 62 is arranged to govern the passage 58, valve 62 being projected as a pin or like form backwards through the wall of chamber 48 opposite passage 58 and being slidably mounted in the wall of the chamber 48. The outer end of the valve 62 is fixed to a cap 64 slidably

mounted on pins 66 fixed in lugs 68 on the exterior of the device 50. The cap 64 when moved up against the end of the device 50 covers the air passage 56 and shuts off the flow of air to the mixing chamber 54. At the same time cap 64 carries the valve 62 into such a position that it closes the gas aperture 58. Therefore by moving the cap 64 in one direction or the other on pins 66, the flow of air and gas to the burner 26 may be regulated as desired and the cap 64 is so arranged with respect to the valve 62 and the intake end of the air passage 56 that a desired percentage mixture of gas and air is maintained in the pipe 60 and burner 26. The air admitted to mixing chamber 54 through passage 56 is primary air in accordance with the ordinary nomenclature of the art. A damper 70 is arranged to control the admission of air into the flue 20 through opening 71, damper 70 being operated through link 72 connected to a bell lever 74 which operates the cap 64 and needle valve 62, bell lever 74 being pivoted to a bracket 76 fixed to the part 52. One end of bell 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 by 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 and air 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 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 hav-

ing 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 just described are similar to those used in the known Honeywell house heating system 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 or 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 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 and thereby open the gas valve 62 and passage 56 to bring up the gas flame of 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 thrown 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 the 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 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 returns 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 burner 26 is operating at maximum rate. 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 and would soon clog burner 28. To prevent carbonizing of oil in burner 28, a draw-back device 146 is provided in pipe 145 intermediate pump 134 and burner 28. Device 146, details of which are set out below, 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 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 thermostat arm 86 as previously described. When, however, device 102 cools below a certain temperature it connects wire 101 with loop 99. 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 loop 99 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 fully 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. The 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, so that 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 as in the pipe 24. Therefore when the air pump 136 is put into operation the diaphragm 322 will be actuated to open the damper 312 to admit secondary air.

At the instant the motor 132, pumps 134 and 136 have been shut off by the automatic controls, the burner 28 is still full of oil and, being surrounded by a ring of gas flame, oil in the upper part of burner 28 would soon carbonize and prevent the operation of the burner when the oil is next pumped into it. To prevent the carbonizing of the oil in burner 28 an automatic means is provided for drawing down the level of oil in this burner as soon as the pressure is taken off of the oil in pipe 145. The means for accomplishing this result has been referred to previously in connection with Fig. 1 and designated by numeral 146. The details of device 146 are illustrated in Fig. 4. Oil from pump 134 is delivered to the device 146 through a port 278 in its upper portion. Port 278 leads into a valve chamber 280 in the bottom of which is a ball valve 282 carried on spindle 284 and controlling an outlet port 286. Port 286 leads into chamber 288 from which, when the pump 134 is delivered oil under pressure, the oil passes to port 290 thence through pipe 145 to the oil burner. The valve 282 is held open so long as the pump is in operation, by the pressure of oil introduced into the pressure chamber 296 in the lower part of the casing of device 146. The upper side of chamber 296 is closed by a diaphragm 298 whose edges are clamped between portions of the casing of device 146 as indicated at 300. The lower side of chamber 288 is formed by a plate 302 fixed within device 146 by screws 304. Fixed to diaphragm 298 at one end and plate 302 at the other is a resilient plaited cylinder 306 which tends to thrust the diaphragm 298 downwardly. The spindle 284 of valve 282 is connected to diaphragm 298 by a lost motion connection comprising a head 308 on the lower end of spindle 284 and a cage 311 in which head 308 is loosely encased. The parts are illustrated in Fig. 4 in the position which they assume when the oil

pump 134 is stopped, the port 286 being closed by the valve 282. If now the pump is started, oil pressure is transmitted to the chamber 296 through pipe 292 and lifts the diaphragm 298. At first, the movement of the diaphragm 298 does not disturb the valve 282 on account of the lost motion connection between the diaphragm and the valve spindle 284. Further upward movement of the diaphragm 298, however, brings the diaphragm into contact with the head 308 of spindle 284 and the movement of the diaphragm thereupon lifts valve 282 and permits oil to flow through device 146 on its way to the oil burner 28. As soon as oil has filled the chamber 288, it passes from chamber 288 around the valve stem 284 at the point 310 so as to fill the interior of cylinder 306. The pressure within the cylinder 306, however, does not affect the position of the diaphragm 298 so long as the pressure is maintained in the chamber 296, since the area of diaphragm 298 exposed to the oil on its under-surface is greater than that exposed to the oil within the cylinder 306, the diaphragm therefore continuing to hold valve 282 open. As soon as the pump is shut down, pressure is taken off of the under-side of diaphragm 298 and the resiliency of cylinder 306 forces the diaphragm downwardly. The first effect of the downward movement of the diaphragm 298 and cylinder 306 is to permit the valve 282 to close. After valve 282 has closed, diaphragm 298 may move further downwardly due to lost motion connection between the head 308 of the valve spindle 284 and the cage 311 fixed to the diaphragm. The diaphragm 298 is accordingly moved further downwardly by the resilient cylinder 306 and this further movement of the diaphragm 298 serves as a pump to draw in oil from chamber 288 through the aperture at 310 and into the interior of cylinder 306. Valve 282 being closed, oil will therefore be drawn into the chamber 288 from the portion of pipe 145 between the device 146 and burner 28, thereby lowering the level of the oil in burner 28 below the influence of the gas flame from burner 26 and preventing the carbonization of oil while standing in burner 28.

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, 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 the burner

cap 340. At the upper end of pipe 342 is a nozzle 344 co-operating with the cap 340 and producing oil flame. Cap 340 has a central upwardly tapering opening 346 therein and the upper end of nozzle 344 tapers upwardly 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 disposed in helically inclined relation 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 consists 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. At the time the temperature falls below 70° F. the thermostat 80 will operate to close the power circuit to the motor 90 and at this time 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 supply 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 supply has gradually increased to its maximum, 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 flame. When the oil is turned on primary air is introduced by the pump 136 and the secondary air is introduced into the duct 20 through the opening 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 rate and the oil burns at a predetermined fixed rate. These two combined fuels then continue to burn until the heat supplied by the boiler is sufficient to raise the temperature in the room of the house in which the thermostat is situated to normal temperature, when the thermostat 80 will make such an electrical contact 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 312 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 before injury occurs to 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 fluid fuel combustion method 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 described my invention, I claim:

1. A method of burning oil comprising atomizing the oil with air in ignitable relation to a surrounding ring of gas flame.

2. In burning oil the step comprising atomizing the oil with air in ignitable relation to a surrounding ring of luminous gas flame.

3. The method of burning oil, which comprises atomizing oil with a fluid atomizing agent supplied under pressure and burning the atomized oil in ignitable relation to a gas flame and supplying air for combustion in controlled amount to produce a luminous flame from the burning oil and gas.

4. The method of burning oil and gas which comprises atomizing oil with air and jetting the atomized oil into ignitable contact with a surrounding ring of gas flame.

5. In burning oil and gas the steps comprising atomizing oil with air, jetting the atomized oil into ignitable contact with a surrounding ring of gas flame, and introducing products of combustion into the gas and oil flames.

6. The method of burning oil which comprises, projecting a gas flame of substantial heating capacity across the discharge orifice of an oil burner, and jetting atomized oil from said orifice through the center of said gas flame in ignitable relation therewith.

In testimony whereof I affix my signature.

HENRY L. DOHERTY.