May 7, 1935. E. T. AVERY 2,000,733

BURNER INSTALLATION FOR DOMESTIC BOILERS

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Fig. 1.

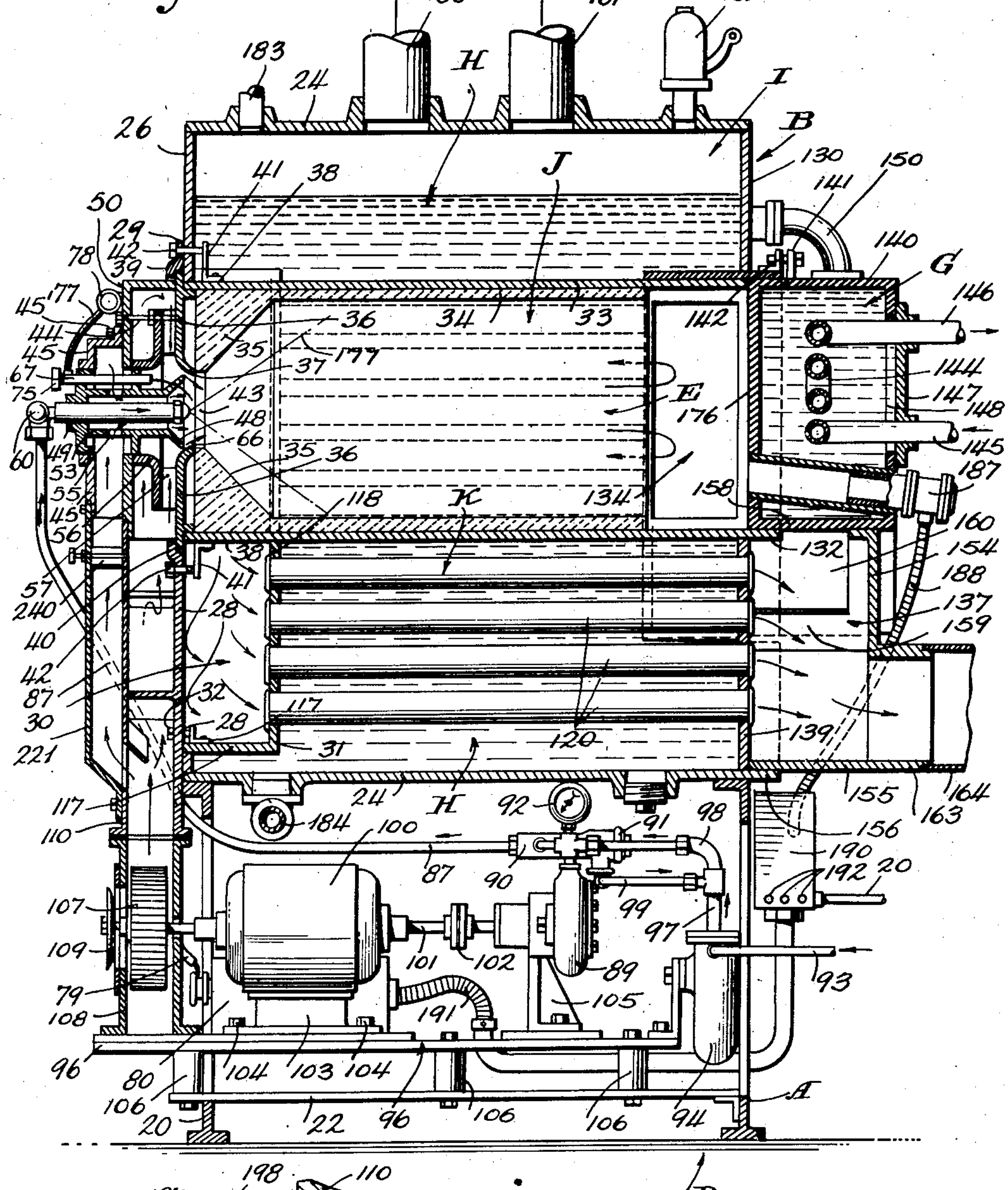
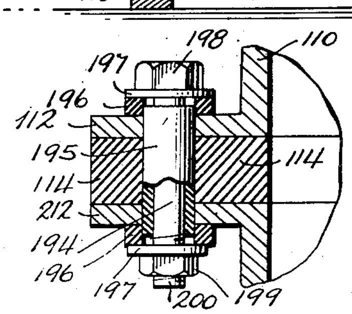


Fig. 8.



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BURNER INSTALLATION FOR DOMESTIC BOILERS

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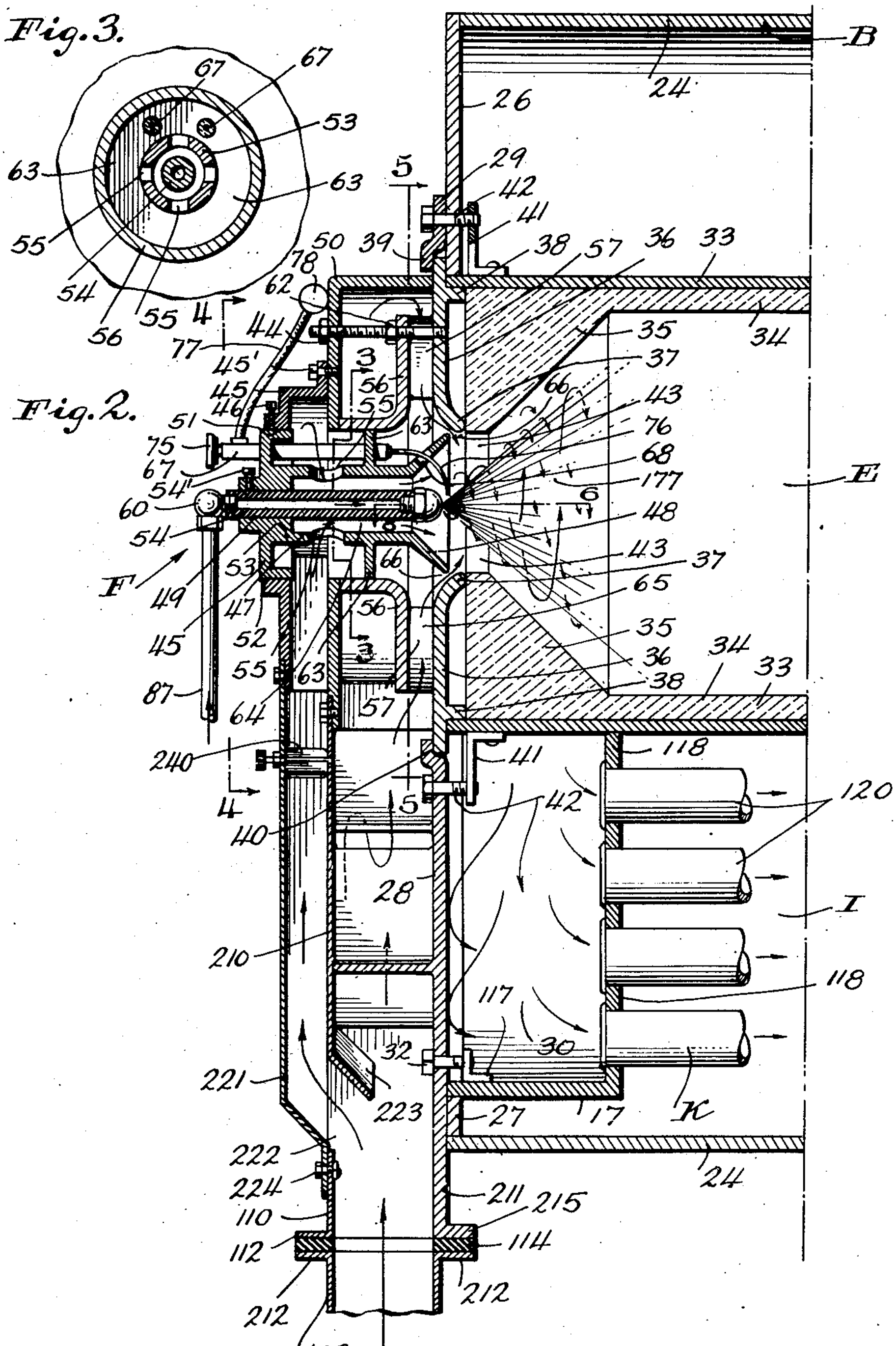

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BURNER INSTALLATION FOR DOMESTIC BOILERS

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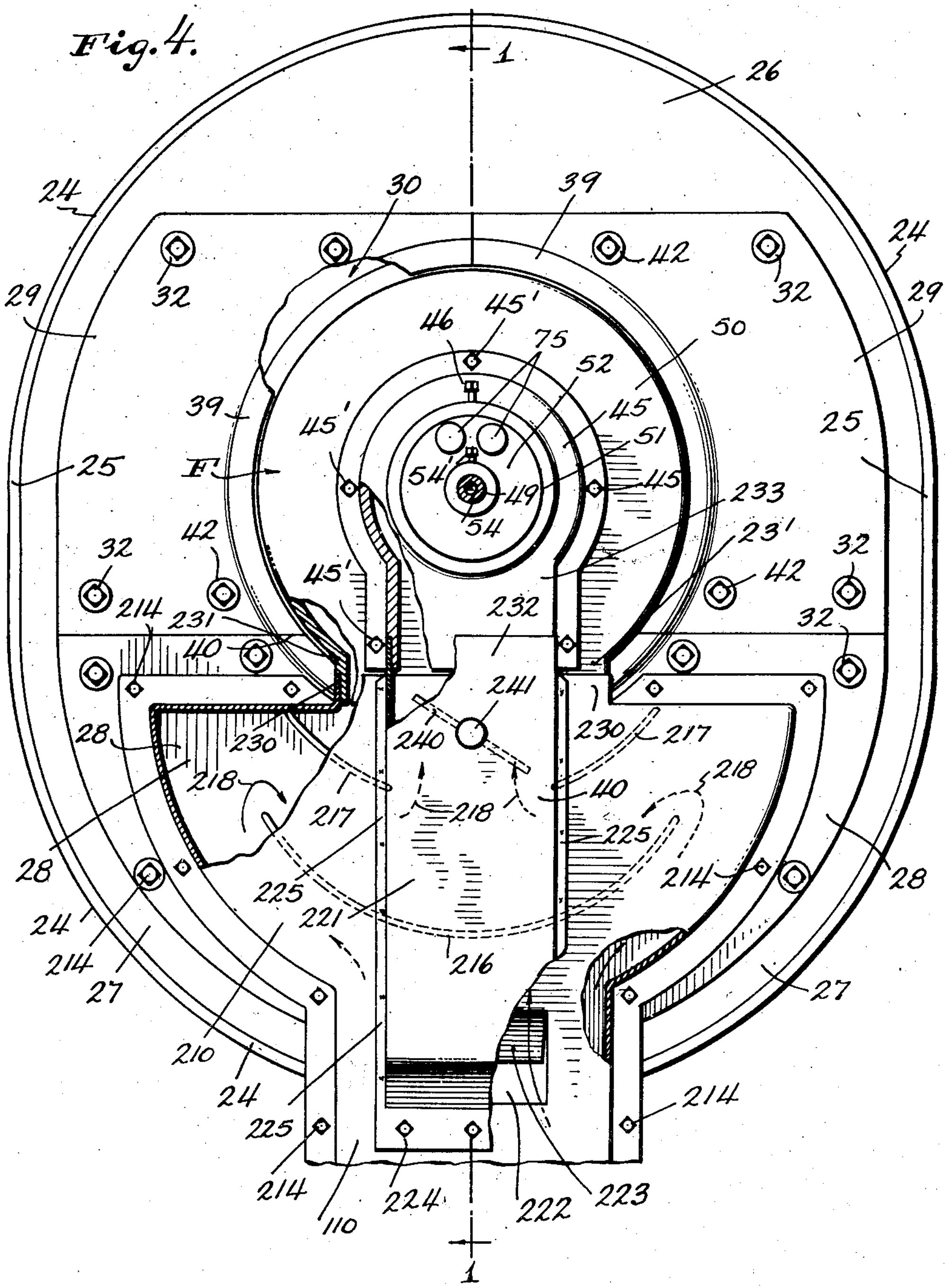
Fig. 4.



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BURNER INSTALLATION FOR DOMESTIC BOILERS

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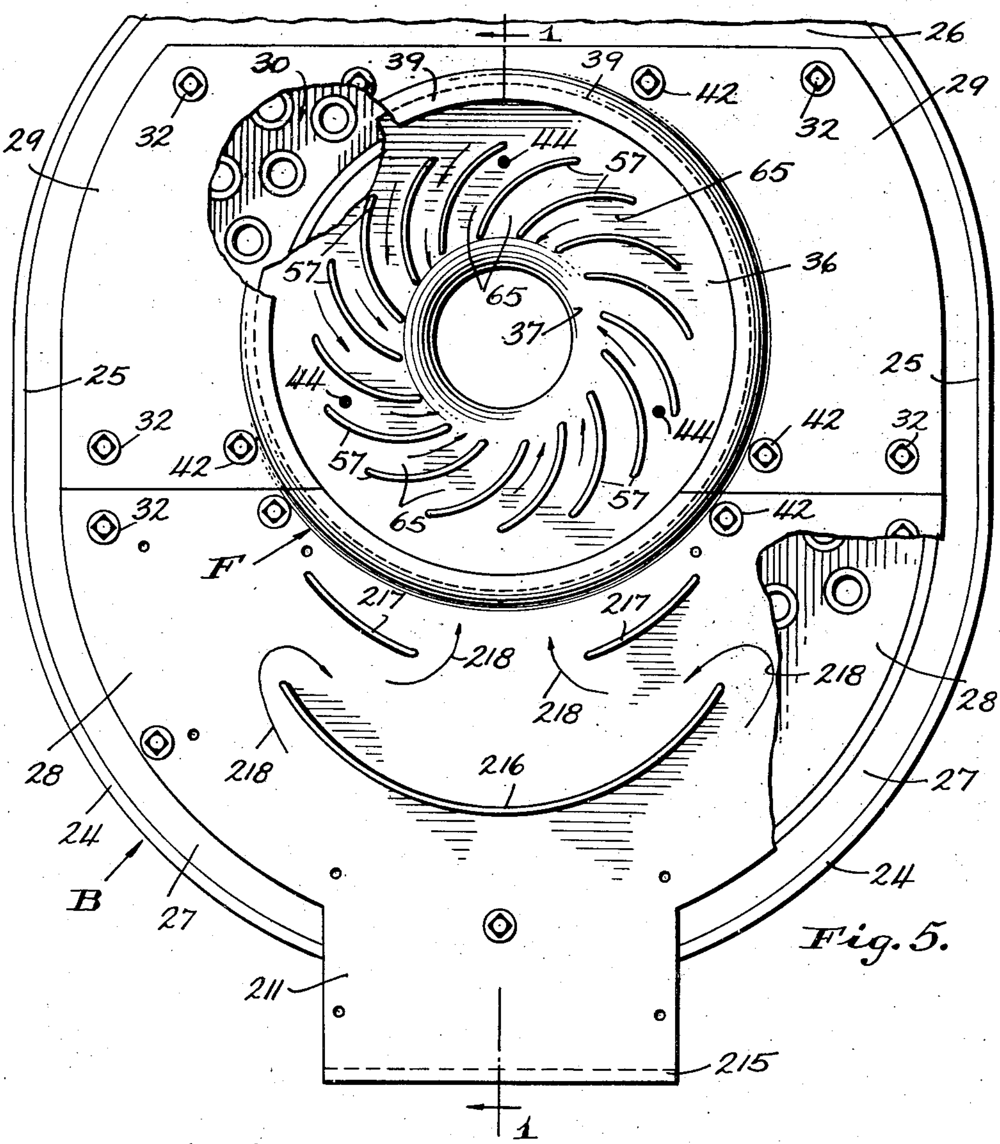


Fig. 5.

Fig. 6.

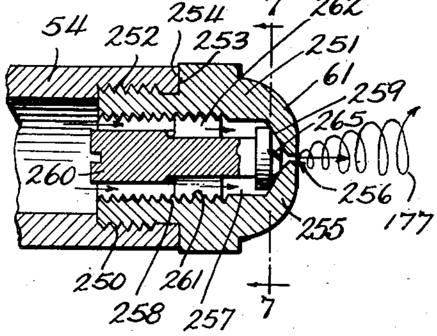
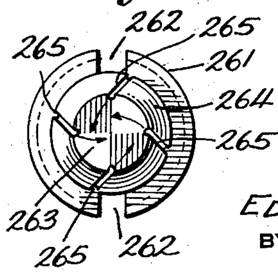


Fig. 7.



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UNITED STATES PATENT OFFICE

2,000,733

BURNER INSTALLATION FOR DOMESTIC BOILERS

Edgar T. Avery, Maplewood, N. J.

Application April 13, 1933, Serial No. 665,882

9 Claims. (Cl. 158—1)

This invention relates to burner constructions adapted to liquid fuels, such as oil, and it particularly relates to automatic heating arrangements to be combined with fire tube boilers for domestic hot water and/or steam heating systems and for domestic hot water supply for washing and similar purposes.

An object of the invention is to supply a compact, inexpensive and light weight oil burner for domestic utilization which will be substantially automatically controlled, which will at all times be most economical in fuel consumption and at the same time supply sufficient heat to fulfill all normal requirements for heating the household and for domestic and hot water washing purposes.

Another object is to provide a compact, inexpensive and relatively light weight liquid fuel burner installation for domestic utilization which may be unitarily combined with a boiler structure and which will require the minimum of adjustment and be capable of utilization over long periods of time without repair.

Another object is to provide a compact, inexpensive and light weight fuel burner installation in which the controls and supply for said burner may be compactly and conveniently included in the boiler structure proper.

Other objects will appear during the course of the following specification.

The above and other objects will appear more clearly from the following detailed description, when taken in connection with the accompanying drawings, which illustrate one embodiment of the inventive idea.

In the drawings:—

Fig. 1 is a side sectional view of an entire boiler installation with the burner and various supply and control mechanisms in position.

Fig. 2 is an enlarged fragmentary sectional view of the burner construction as shown in Fig. 1 illustrating the details thereof.

Fig. 3 is a detail transverse sectional view on the line 3—3 of Fig. 2.

Fig. 4 is a front view of the installation of Fig. 2 upon the line 4—4 showing some of the parts in fragmentary section.

Fig. 5 is a sectional view of the burner construction along the line 5—5 of Fig. 2.

Fig. 6 is a side sectional view of the spray nozzle tip construction, upon the line 6—6 of Fig. 2.

Fig. 7 is a front view of a detail of said spray nozzle tip.

Fig. 8 is a detailed sectional view illustrating one noise and vibration insulating connection.

In Fig. 1, the support A carries the boiler B. The support A is carried upon the base, floor or ground D. The boiler B is provided with a combustion chamber E with an oil burner construction F (see Fig. 2) and with water leg G for heating the domestic water supply.

The boiler is of the fire tube type and is provided with a water space H, a steam space I, two upper side groups of forward-pass fire tubes J along both sides of the chamber E, and one group of rear-pass fire tubes K along the bottom of the chamber E.

The boiler construction is more fully shown and described in my copending application Serial No. 665,881 filed April 13, 1933.

The support A which supports the boiler B upon the floor D is preferably formed by the front and rear frame members **20** (see Fig. 1) having the longitudinal bracing platform **22**, which latter serves to support the various auxiliary apparatus for supplying the air and fuel oil to the burner F.

The boiler B (see Figs. 1 to 8) is provided with an exterior shell **24** which is of ovular shape with flattened side portions **25**. The shell is provided with the front cover plate **26** and the rear cover plate **130**.

The front cover plate **26** has a relatively large opening therein so that only a thin marginal border portion **27** will extend around the lower and bottom edges of the boiler shell **24** (see Figs. 1, 2, 4 and 5). The opening in the front cover plate **26** is covered by the plates **28** and **29**, as shown best in Figs. 2, 4 and 5.

Fitting in the opening in the front cover plate **26** is the box-like front flue chamber structure **30** with a back wall **118** and the sides **17** (see Fig. 2). The sides **17** are connected to said plates **28** and **29** by the angle members **117** and the bolts **32**, as indicated in Figs. 1, 2 and 4.

The cover plates **28** and **29** are provided with a central circular opening which receives the end of the fire chamber E, said fire chamber consisting of a cylindrical sheet metal member **33** which is provided with a suitable fire brick or other refractory lining **34**, said lining having a converging section **35** of substantially increased thickness adjacent the burner F (see Fig. 2).

The front end of the combustion chamber shell **33** is covered by the plate **36** (see Figs. 1 to 5). The plate **36** is provided with a central inwardly lipped opening **37** which provides for the burner inlet and is also provided with a flange 38 which fits inside of the end of the fire box shell 33.

The lip 37 closely contacts with the edge of the opening 43 of the fire brick lining 35. The edge of the cover 36 is covered by the lips ?9 on the plate 29 and the lip 40 on the plate 28. The angle members 41 attached to the shell 33 of the combustion chamber E, together with the bolts 42, clamp the lips 39 and 40 to the edges of the cover 36.

The burner construction F (see Fig. 2) to which the present application is particularly directed, is connected to the plate 36. The burner construction F includes a main cylindrical cup casing 50 which is connected to the plate 36 by the bolts 44 which extend transversely across the burner construction and are arranged symmetrically around the entire burner constuction. The subsidiary cylindrical cup shaped casing 45 is attached to the base of the cup casing 50 by the screws 45′.

The base of the casing 45 is provided with a central opening 51 into which the enlarged cylindrical flanged section 52 of the cylindrical burner section 53 extends. The cylindrical section 52 of the central burner member 53 is held in position and adjustment is permitted by the set screw 46.

The central cylindrical section 53 has a conically diverging end portion 48 which extends toward and terminates closely adjacent to the lip 37 of the cover plate 36. The cylindrical burner section 53 is also provided with the air inlet ports 55.

The base 52 of the cylinder 53 is provided with a central opening 49, which receives the cylindrical annular nozzle member 54 (see Fig. 2).

To the inlet end of the annular cylindrical nozzle 54 is connected the inlet fitting 60 (see Fig. 2) while at the outlet end is connected the spray nozzle tip 61 (see also Fig. 6).

The cover plate 36 (see Fig. 2) carries the curved fins 57, which may be cast integrally therewith. The circular angle plate 56 is clamped on top of these fins 57 by the bolts 44 and the nuts 62 to cover the passages between the fins. The plate 56 is centered by the outwardly projecting lip 63 extending peripherally away from the tubular section 53.

In the burner construction F, it is thus evident that there will be a central inner annular stream of air which will be admitted through the inlet ports 55 and will pass through the annular passage 64 (see Fig. 2) and outwardly into the space inside of the conical extension 48, while there will be an additional outer annular supply of air which upon passing through the parallel spiral passages 65 between the fins 57 will then pass through the adjustable annular space 66 between the end of the conical section 48 and the lip 37 with a whirling motion.

The ignition members 75 (see Figs 1 to 4) are provided with shanks 67 which extend through the cylindrical centering section 52 of the burner section 53 and through the flange or fin 63. From the front ends of the shanks 67 extend the ignition wires 76, (see Figs 1 and 2) which converge together so that there will be a small gap between them in front of the burner spray nozzle tip 61 so that a spark may be generated between them to ignite the oil spray. These wires extend through the openings 68 in the conical flange 48 of the burner section 53.

The ignition members 75 are provided with the cables 77 (see Figs. 1, 2 and 4) which are connected to the junction box 78. The main conduit 79 extends from the junction box 78 to the transformer box 80 (see at the lower left hand portion of Fig. 1) to supply the tension necessary for sparking.

The fuel oil is supplied to the burner F by the conduit 87 (see Fig. 1) which conduit 87 is fed by the oil pump 89 through the pressure regulating valve 90. The pressure controlling valve 91 relieves the liquid fuel pressure if it exceeds a predetermined value. The gauge 92 indicates the pressure of the liquid fuel.

The fuel oil is supplied from a tank (not shown) through a pipe 93, to the filter 94 which is supported by the bracket 95 upon the platform 96 (see Fig. 1). From the filter the liquid fuel flows through the conduits 97 and 98 to the pump 89. The conduit 99 serves to permit recirculation of the fuel oil upon opening of the pressure limiting valve 91. The pump 89 is driven from the motor 100 and through the shaft 101 having the coupling 102.

Both the motor 100 and the pump 89 are supported upon the platform 96 (see Fig. 1). The motor is supported by the foot 103 and the bolts 104 while the pump is supported by the bracket member 105. The structure 96 which supports the motor 100, the pump 89 and the filter 94 is supported by the sound and vibration insulating connections 106 upon the structural member 22 connected between the side frames 20 of the support A.

The motor 100 (see Fig. 1) also drives the fan 107 which is enclosed in the casing 108 and is provided with a central air inlet valve 109. The casing of the motor is provided with an outlet conduit section 110 which extends upwardly and expands at the front of the boiler into the semi-circular section 210.

The conduit section 110 and the semi-cylindrical portion 210, constituting an extension thereof, are attached by means of the screws 214 to the plate 28 (see particularly Fig. 4). The plate 28 (see Figs. 4 and 5) is provided with a downward extension 211 which is provided with a flange 215 which is connected to the flange 212 of the fan casing 108, as shown in Fig. 8. The extension 211 of the front plate 28 serves as a means of attachment for the conduit section 110.

As shown in Figs. 1, 2 4 and 5 the air on passing up through the conduit 110 and into the semi-cylindrical chamber 210 will strike the baffles 216 and 217, which will cause the gases to take a tortuous path as illustrated by the arrows 218. The air in passing upwardly through the conduit section 110 and the semi-cylindrical section 210 and past the baffles 216 and 217 will be in heat exchange contact with the hot combustion gases in the front flue chamber 30 through the front cover plate 28 of the boiler shell. As a result, air upon flowing out of the semi-cylindrical chamber 210 and then through the spiral air passages 65 between the fins 57 to flow through the narrow annular space 66 around the conical burner section 48 will be highly heated and will greatly assist combustion and the economic utilization of the fuel. In addition, the stream of air being heated in the chamber 210 will substantially insulate the front of the boiler shell.

To the front of the semi-cylindrical casing 210, (see Figs. 1, 4 and 5) is connected the longitudinal casing 221 which opens into the upper portion of the conduit section 110 as indicated at 222.

This opening 222 is formed by bending inwardly the section 223 of the conduit section. The longitudinal casing 221 which is bolted as indicated at 224 to the conduit section 110 and is attached, as by spot welding, along its flanges 225 to the central wall of the semi-cylindrical casing 210. It will be noted in Figs. 2 and 4, that the semi-cylindrical casing 210 is provided with an upstanding flange 230 which fits in a recess in the downward extension 231 of the burner casing 50. The longitudinal casing 221 has a similar connection by the flange 232 (see Figs. 2 and 4) to the downward extension 233 of the smaller burner casing 45.

The casing 221 will permit an outer column of air to flow from the conduit 110 into the extension 233 and through the ports 55, see also Fig. 3. This air which will not be in heat exchange contact with the boiler plate 28 will be at a relatively lower temperature than the air passing through the semi-cylindrical casing 210. This air will then pass through the annular passage 64 between the cylindrical section 47 and the nozzle 54 and will mix with the oil spray adjacent the front portion of the conical member 48. The damper butterfly valve 240 provided with the manual handle 241 located in the casing 221 will enable ready regulation of the amount of air passing up through the casing 221 and through the ports 55 and the annular space 64 to mix with the flame 177.

The oil as previously described will pass up through the conduit 87 through the angle 60, through the nozzle 54 and it will then be sprayed out through the spray tip 61, (see Fig. 6).

Although many different spray nozzles are satisfactory, one which has been found particularly satisfactory is shown in Figs. 6 and 7.

In this construction the outer portion of the cylindrical nozzle section 54, is internally threaded as indicated at 250 and receives the nipple 251 having the corresponding threaded portion 252. The nipple 251 is provided with a shoulder 253 which contacts with the end 254 of the sleeve 54. The front end of the nipple 251 is rounded as indicated at 255 and is provided with an opening 256 which emits the spray of oil to form the flame 177. The nipple 251 is provided with an internal cavity 257 which is threaded as indicated at 258 and has a conical socket portion 259 converging down to the outlet 256. The insert 260 has a threaded portion 261 which screws into the threaded portion 258 and is provided with the slots 262 to permit ready flow of the fuel oil. The end of the insert member is provided with a mushroom disc-like member 263 which has a conical portion 264 to be closely pressed against the conical socket 259. The conical surface 264 is provided with the spiral slots 265 which give the oil a whirling motion as it passes through the outlet 256.

As shown in Figs. 1, 2 and 5, the back wall 118 of the front flue box is provided with a plurality of openings receiving the fire tubes 120 in the banks J (see Fig. 1) and in the bank K (see Figs. 1 and 2). The fire tubes 120 in the banks J provide for flow of hot gases from the rear of the boiler into the upper part of front flue chamber 30, while the tubes 120 provide for flow of hot gases from the lower part of the front flue chamber 30 to the rear of the boiler.

The construction of the rear end of the boiler is fully described in my application Serial No. 665,881 filed April 13, 1933, but will be briefly described here.

The rear of the boiler shell 24 is covered by the plate 130 (see Fig. 1). The shell 33 extends rearwardly to be substantially flush with the rear cover 130 and has a rearwardly extending lip 132.

The upper rear flue box 134 receives the hot gases from the combustion chamber E and conducts the hot gases from such combustion chamber E to the upper tube banks J. The hot gases will pass through these banks J on both sides of the boiler to the front flue chamber 30.

The upper rear flue chamber 134 is covered by the water back G, as is indicated in Fig. 1. The water back G includes a casing 140 with flanges 141 which enable its attachment to the angles 142 on the side walls of the upper rear flue chamber 134. The lip 132 of the box shell 33 supports the bottom 158 of said water back 140.

The water back is provided with a hot water coil 144 (see Fig. 1) having an inlet at 145 and an outlet at 146, which supplies hot water for washing and other domestic purposes. The outlet and inlet portions 145 and 146 of the coil 144 are held in the plate 147. The plate 147 is bolted to an opening 148 in the rear of the casing 140 of the water back G.

The water back G communicates through the connections 150 with the upper portion of the water space H of the boiler B.

The lower rear flue chamber 137 receives gases from the lower bank K of the fire tubes 120 and from this flue chamber 137, the hot gases are permitted to pass to the chimney.

The lower flue chamber 137 (see Fig. 1) is covered by the flue casing 154, the lower wall 155 of which rests on the rearwardly projecting lip 156 of the boiler shell 24 while its upper sides 159 contact with the bottom portion 158 of the water back G. The top of the flue chamber 137 is open at 160 and closed by the bottom part 158 of the water back G.

The lower rear flue chamber 137 is provided with the back plate 139 receiving the rear ends of the fire tubes 120.

It will be noticed that the fire tubes 120 are expanded over the openings in the rear plate 118 of the front flue chamber 30 (see Figs. 2 and 5) and also over the back plate 139 of the lower rear flue chamber 137.

The open portion 160 in the lower flue chamber 137 permits better heat exchange contact between the bottom 158 of the water back casing 140 and the hot gases passing through the flue chamber 137.

The outlet connection 163 from the flue chamber 137 is connected to a flue or chimney 164 for drawing off the hot gases after they have passed through said flue chamber.

In operation water is fed to the bottom of the water space H of the boiler. An additional supply will pass up through the water back casing 140, heating the water passing through the coil 144. The water passing through the water back G, will be heated due to the heat exchange of its lower wall 158 with the hot gases in the lower flue chamber 137 and also due to the heat exchange between its inside wall 176 (see Fig. 1), and the hot gases in the upper rear flue chamber 134. The hottest water will ascend through the pipes 150, into the upper portion of the water space H of the boiler.

The water in the boiler shell 24 will be heated from the shell **33** of the combustion box E, by the fire tubes **120**, by the heated side and back walls of the front flue chamber **30**, the upper rear flue chamber **134**, and the lower rear flue chamber **137**. The hot water will ascend past the shell **33** and the tubes **120** to the upper portions of the boiler where it will give off steam to the space I of the boiler.

The hot gases are generated by the burner F in the front end of the combustion chamber E, as indicated in Fig. 1, the nozzle tip **61** spraying liquid fuel to form a diverging flame.

The burner F is supplied with fuel oil through the conduit **93**, the filter **94**, the pump **89**, the valve **90**, and the conduit **87**, as shown in Fig. 1. This fuel is forced through the nozzle **54** and is sprayed into the combustion box E as indicated at **177** in Fig. 1.

As previously indicated, the oil will be forced in a spiral spray outwardly from the tip **61** (see Fig. 6) of the burner F (see Fig. 2) and it will be mixed with a relatively cool central annular stream of air flowing through the passage **64** and through a whirling highly heated stream of air passing through the annular space **66** around the conical lip **48**. The inner annular film of air and the outer whirling stream will assure perfect intermixture between the air and the oil and most satisfactory combustion.

The hot combustion gases will flow to the rear of the boiler into the upper rear flue chamber **134**, and then will flow forwardly through the fire tubes **119** to the front flue chamber **130**. The hot flue gases from the front flue chamber **130** will then flow rearwardly through the fire tubes **120** to the rear flue chamber **137** and then to the stack **164**.

The steam generated in the space I may be taken off by the outlets **180** and **181** (see Fig. 1) and be supplied to the heating system of the household or building, in the desired manner, the water returning through a suitable return conduit (not shown).

The blow-off valve **182** will prevent excessive pressure from being generated in the boiler B.

The pipes **183** and **184** may be connected, respectively, from the top and bottom of the boiler shell **24** to an automatic level control (not shown). If the level is too low an electrical control **190** will cut off the burner F and give a signal.

The burner F is provided with an electrical eye control **187** (see Fig. 1) which is directed toward the flame **177** and is provided with an electrical conduit **188** leading to the main control box **190**. It will be noted that the motor **100** is also connected by means of the electrical conduit **191** to the main control box **190**. If the electrical eye **187** does not register sufficient light and/or heat intensity, due to the fact that the flame **177** has gone out or due to the fact that the interior of the combustion chamber E has become full of soot and smoke, it will immediately cause the main control **190** to cut out the motor **100**, extinguishing the flame **177** and giving an alarm.

When the trouble has been remedied the operation of the motor will be initiated and the conduit **79** leading to the sparking device **75** will be effective to reignite the flame **177** within the fire combustion chamber E.

The burner and boiler are also controlled by means of the thermostat connections **192** (see Fig. 1) on the main control box **190**, which may be connected to various rooms of the house or building of which the temperature is to be regulated. If the temperature rises to too high a level, the boiler is cut out, while if it drops the burner F is again cut in by cutting off or starting the motor **100**.

It is thus evident that the present boiler construction is most efficaciously controlled by the water level and by the condition of the flame through the electric eye **187**, and by the temperature of the building or rooms, by the thermostat controls **192**. If the water level falls too low or if the flame is out and combustion conditions are improper, the control box will function to stop the motor **100**, cutting off the supply of air and fuel to the burner F. When this happens a suitable alarm will be given to the householder, advising him the boiler needs attention.

On the other hand the thermostat connection **192** to the control box **190** will effectively shut off and turn on the boiler by controlling the motor **100** to regulate the temperature within the building or house.

It will be noted that the boiler arrangement of the present invention is most compact, with the various conduits both for the hot gases and for the incoming gases arranged for most effective heat exchange, and so as to give a compact heating installation.

The position of the motor **100**, the oil pump **89** and the oil filter **84** within the supporting framework of the boiler enhances the compactness and inexpensiveness of the entire installation.

Fig. 9 shows the vibration and noise insulation connection for the conduit section **110** to prevent the vibration from being transmitted to the boiler B and to the house or building in which the heating insulation may be installed.

In Fig. 9 the flanges **112** and **212** are separated by the annular rubber pad **114**. These flanges are respectively connected to the conduit member **110** and the blower casing **108**. The bolt **194** extends entirely through the flanges and the rubber pad **114**, is encircled by the rubber annulus **195** and is separated from the flanges by the annular rubber pads **196**. The washers **197** contact respectively with the head of the bolt **198** and the nut **199**, which is screwed onto the lower threaded end **200** of said bolt.

It will be noted that the casing **108** and the conduit casing **110** are fully insulated from each other by the rubber members **114**, **195**, **196**, so that no sound or vibration will be transmitted through the pipe **110** to the boiler. The bolt **194**, although it rigidly connects the flanges **112** and **212** nevertheless is devoid of metallic contact with either flange, such metallic contact being prevented by the annular rubber sleeve **195** and the rubber members **196**.

In operation, the air admitted to the fan **107** will be at about room temperature, between 70° and 80° while the air passing through the semicylindrical casing **210** and through the spiral or curved passages **65** will be heated up to about 400° F. The utilization of a stream of relatively cool air around the nozzle **54** gives assurance that the oil or liquid fuel will not be cracked while passing through said nozzle, and will assure most efficient operation.

Although various sizes of oil pumps **89** and air blowers **109** may be utilized, an oil pump having a capacity of thirty gallons per hour and an air blower having a capacity of 150 to 200 cubic feet per minute, have been found to be satisfactory. The air driven upwardly through the air blower will be ordinarily divided, about 10%

passing through the annular chamber 64 around the nozzle 54 and about nine-tenths passing through the opening 66 after having been relatively highly heated in the semi-cylindrical chamber 210.

In certain cases the oil flowing through the line 87 from the pump 89 may be preheated if desired to a temperature for example, of 180° C.

Although the apparatus may be of many varying dimensions the casing 50 may conveniently have a diameter of 12'', the plate element 56 may have a diameter of about 4'' with an inlet opening in the end of the combustion chamber of about 3½'', the other dimensions being approximately in proportion.

What is claimed is:

1. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with said flue chamber, for feeding heated air, a longitudinally extending cylindrical oil spray device passing through said casing, a substantially cylindrical air-directing shell encircling said device extending across said casing from front to back and having inlet openings from said primary compartment at its end away from the furnace, the other end of said shell being provided with an outwardly diverging mouth, the secondary air passing around the periphery of said mouth.

2. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with said flue chamber, for feeding heated air, a longitudinally extending cylindrical oil spray device passing through said casing, a substantially cylindrical burner-encircling and air-directing shell extending across said casing and having inlet openings from said primary compartment at its end away from the furnace, the primary air passing inside of said shell and around said burner to said furnace and the secondary air passing around the exterior of said shell to said opening.

3. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with said flue chamber, for feeding heated air, a longitudinally extending cylindrical oil spray device passing through said casing, a substantially cylindrical burner-encircling and air-directing shell extending across said casing and having inlet openings from said primary compartment at its front end, said secondary air compartment being provided with a plurality of baffles extending thereacross to assure a thorough heat exchange.

4. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with said flue chamber, for feeding heated air, a longitudinally extending cylindrical oil spray device passing through said casing, a substantially cylindrical burner-encircling and air-directing shell extending across said casing and having inlet openings from said primary compartment, said secondary air chamber being provided with an annular inlet area encircling said shell provided with a plurality of spirally curved air whirling vanes, which set up a whirling movement of the air in a plane perpendicular to the burner and the shell, said air being caused to undergo a change in direction of ninety degress to mix with primary air at the furnace end of the burner.

5. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with said flue chamber, for feeding heated air, a longitudinally extending cylindrical oil spray device passing through said casing, a substantially cylindrical burner-encircling and air-directing shell extending across said casing and having inlet openings from said primary compartment, said primary and secondary conduit compartments being superimposed upon one another, with the primary conduit being separated from the furnace front by said secondary air conduit compartment and both of said compartments conducting the air in planes perpendicular to the axis of said burner and said shell, the primary and secondary air being caused to undergo a change of ninety degrees in direction and to flow parallelly to the axis of said burner before it mixes with said spray.

6. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with said flue chamber, for feeding heated air, a longitudinally extending cylindrical oil spray device passing through said casing, a substantially cylindrical burner-encircling and air-directing shell extending across said casing and having inlet openings from said primary compartment, said secondary air conduit compartment being provided with a plurality of transverse baffles through which the secondary air is first passed to assure thorough heat exchange contact and being also thereafter provided with a plurality of spiral vanes for giving a whirling motion to the air before admission to said spray.

7. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising a plurality of air boxes, one for supplying secondary heated air and the other for supplying relatively cool primary air, said air boxes being provided with a cylindrical burner structure projecting therethrough to an opening in the furnace front and with a cylindrical shell enclosing said burner structure, said cylindrical shell interiorly receiving the cool primary air and exteriorly guiding the heated secondary air, said shell extending to said opening in said front and separating said primary air and said secondary air until they substantially enter said front opening and constructing the flow of the secondary air into said opening.

8. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with the boiler, for feeding heated air, said furnace being formed with an opening, a longitudinally extending cylindrical oil burner passing through said casing and projecting into said opening, a substantially cylindrical burner-encircling and air-directing shell extending across said casing and having inlet openings from said primary compartment, said compartments being separated by an intermediate plate within the casing, baffles in the lower part of said secondary compartment for assuring thorough heat exchange relationship between the furnace front and the secondary air, said baffles extending between said intermediate plate and said furnace front, said shell being provided with a conical diverging portion adjacent to the furnace opening adjustable to control the flow area for the secondary air into the furnace opening.

9. A furnace front construction for a furnace of the type having a combustion chamber, a plurality of conduits receiving the hot combustion gases from said combustion chamber, the heat in the combustion gases being extracted in large part during the passage through said conduits and a flue chamber at the front of the furnace to receive the combustion gases from said conduits after considerable heat has been extracted from them, said construction comprising an air receiving casing with an outside primary air conduit compartment for receiving and feeding cool air and an inside secondary air conduit compartment, in heat exchange relationship with said flue chamber, for feeding heated air, said casing having a front plate and a back plate with an opening into the furnace, a longitudinally extending cylindrical oil burner passing through said casing, a substantially cylindrical burner-encircling and air-directing shell extending across said casing and having inlet openings from said primary compartment, said primary and secondary compartments being superimposed with the primary compartment being insulated from the boiler by said secondary compartment, said secondary compartment being provided with an annular flow area encircling said shell provided with spiral baffles to set up a whirling motion of the air and said shell being provided with a diverging portion adjacent the opening into the furnace for regulating the flow area for said air after said whirling motion has been set up through said opening, said secondary compartment being provided with an intermediate annular mixer chamber between said spiral vanes and said furnace opening.

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