

Aug. 1, 1939.

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2,168,184

OIL BURNING FURNACE

Filed Dec. 13, 1935

4 Sheets-Sheet 1

Fig. 1.

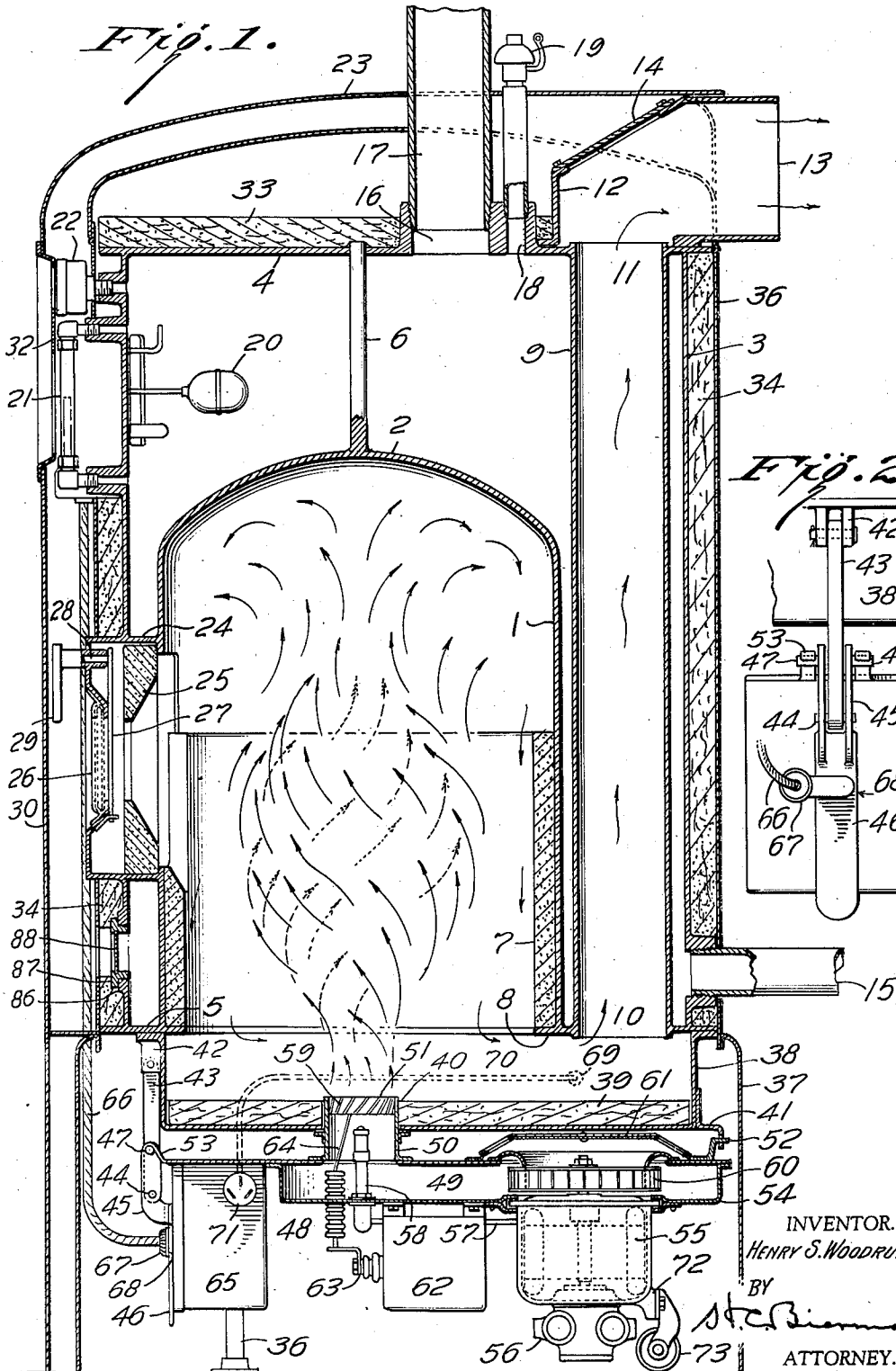
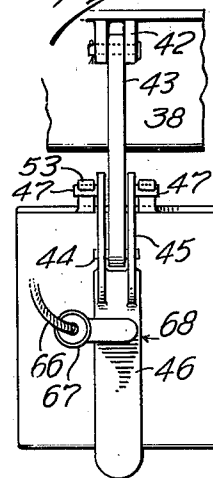


Fig. 2.



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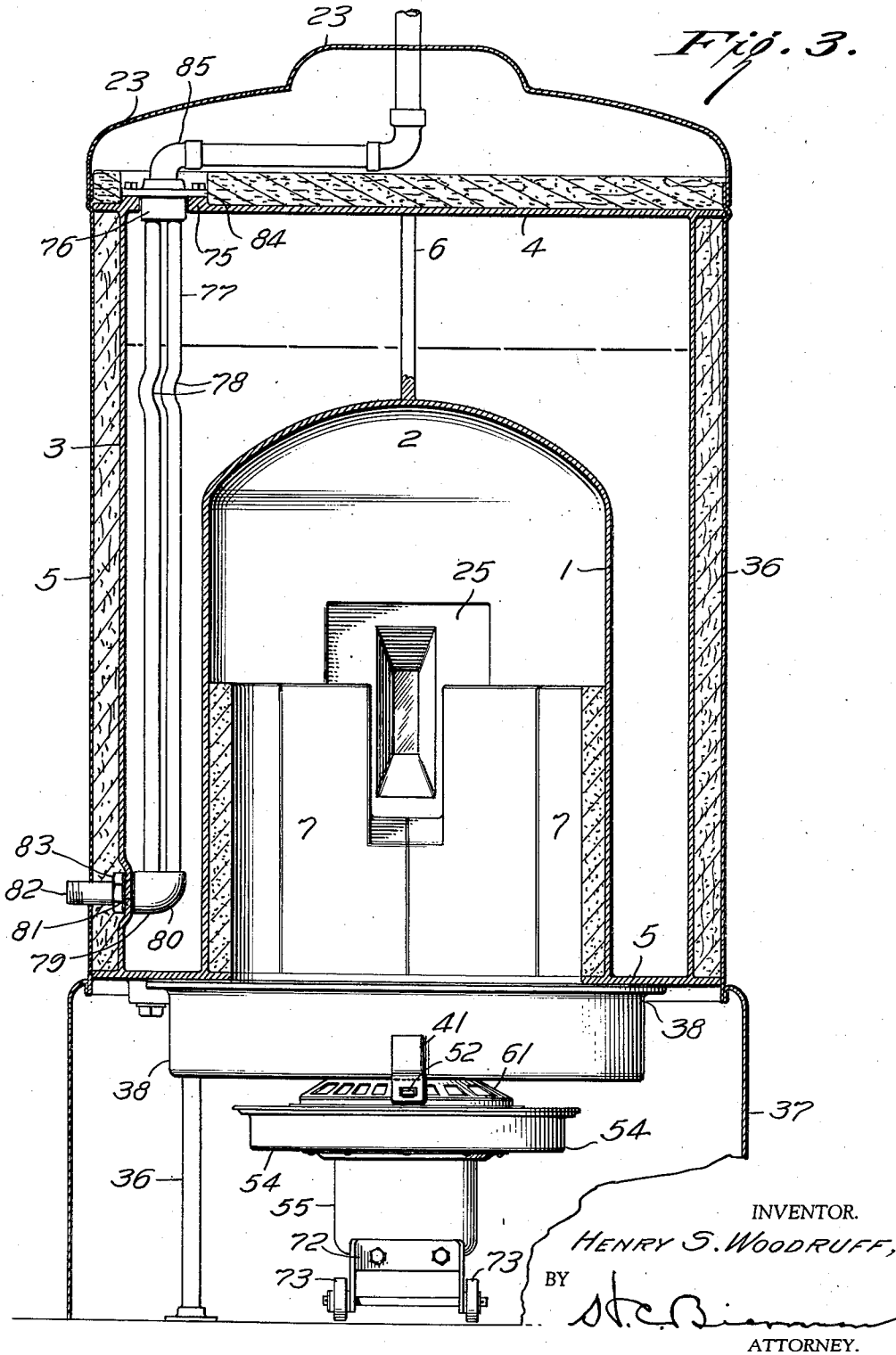
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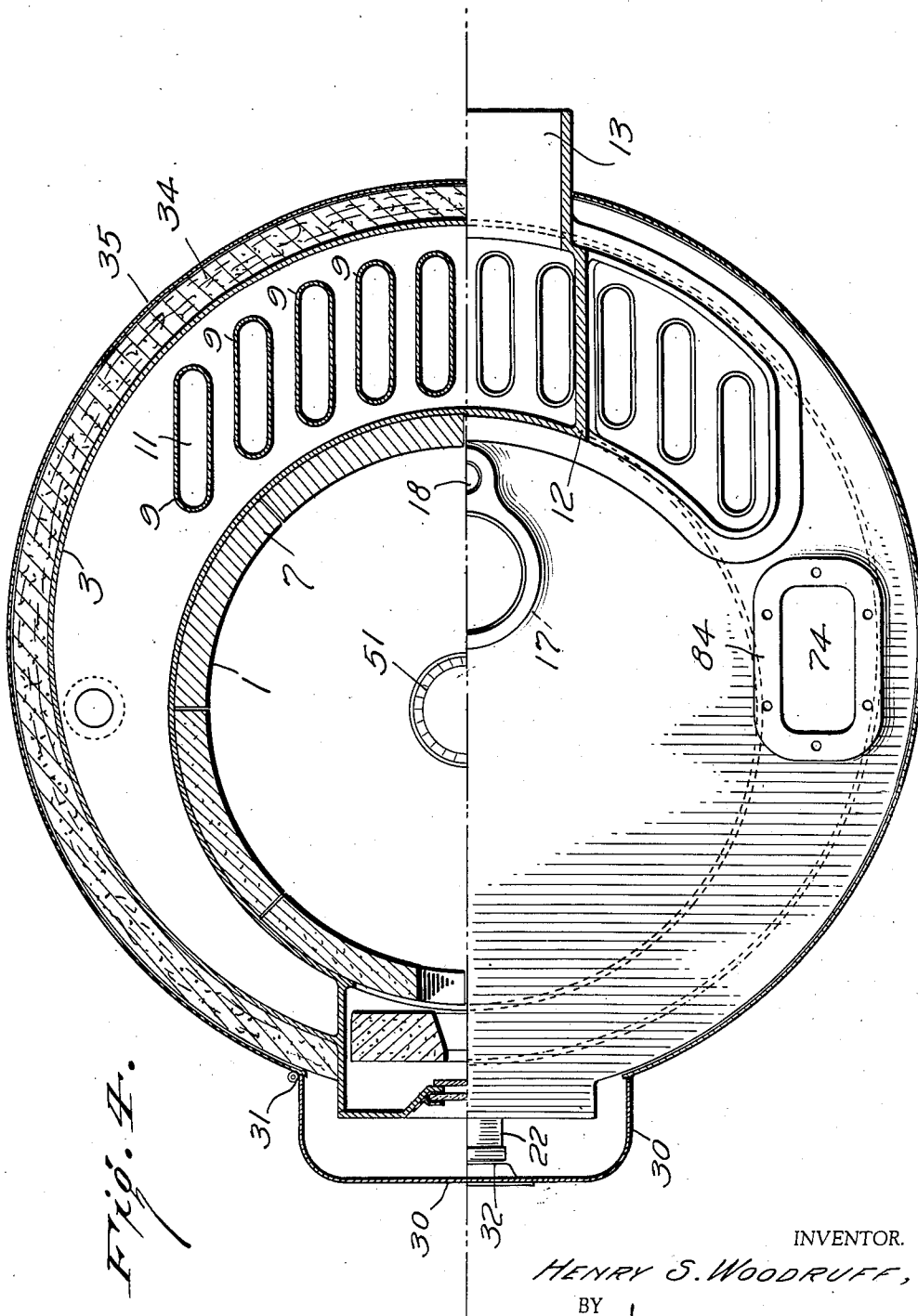
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

Fig. 6.

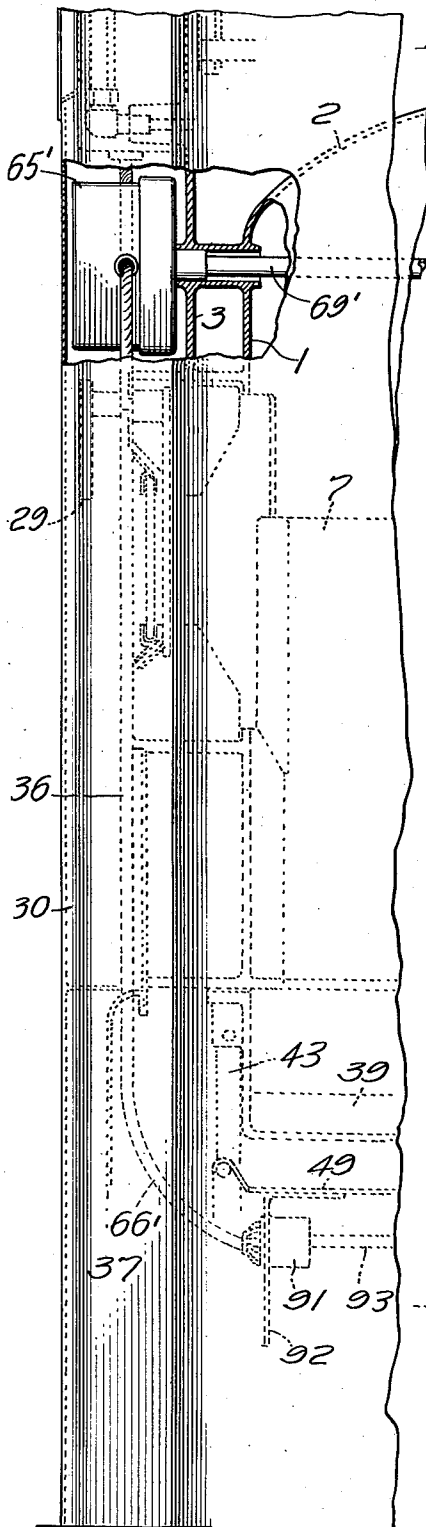
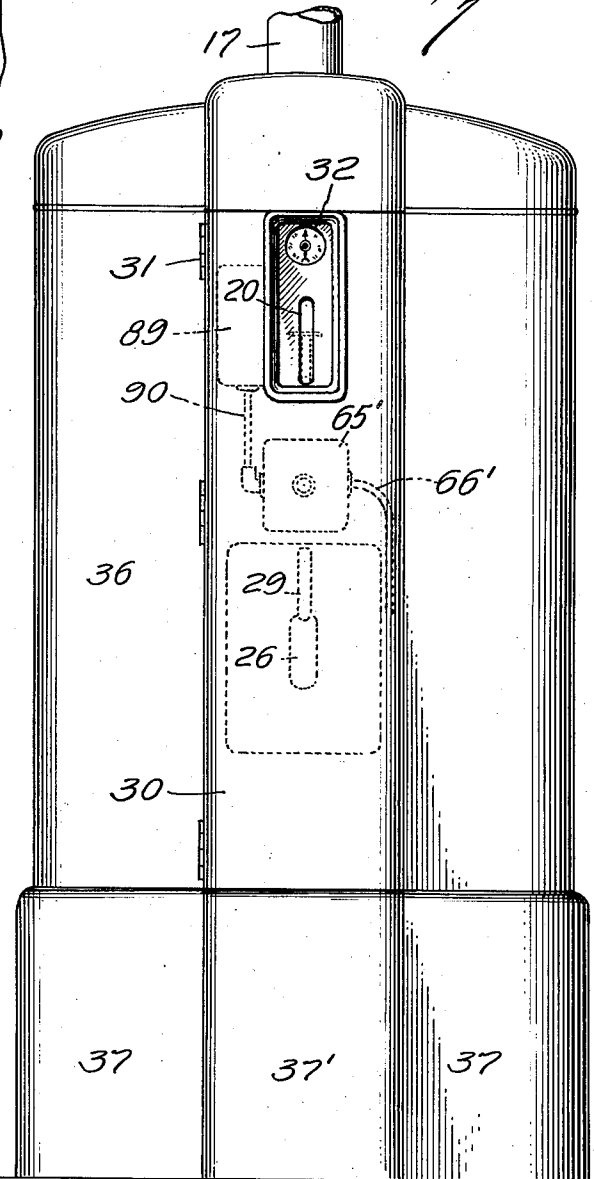


Fig. 5.



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OIL BURNING FURNACE

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Application December 13, 1935, Serial No. 54,156

3 Claims. (Cl. 122—156)

5 This invention is directed to furnaces, more particularly to small size furnaces including mechanism for burning oil as the fuel and intended for use for household and similar purposes.

10 This invention is directed to a combined furnace and oil burning unit wherein all of the mechanism necessary for the operation is contained in a single shell. Furnaces of this type have been used heretofore and have functioned with reasonable efficiency. However, the construction of such furnaces has in general been complicated and has required expensive construction by reason of considerable hand labor and close fitting of numerous parts of irregular design and shape. Many of the parts have been inaccessible and the cost of repairs has, therefore, been unnecessarily high.

20 The present invention is intended and adapted to overcome the disadvantages and difficulties of prior furnaces of this type, it being among the objects of this invention to provide a furnace structure which is simple and compact, which may be readily made in quantity production, which does not require special parts or highly skilled labor, in which the various elements are readily accessible for replacement or repair and which is efficient in the utilization of fuel.

30 In practicing my invention, I provide a furnace of sheet metal usually of steel and consisting essentially of substantially flat, horizontal top and bottom boiler sheets between which are welded inner and outer shells of substantially circular, cross-section, and offset with respect to each other. In the widest portion of the space between said sheets there are welded a series of flat flues designed to facilitate the extraction of heat from the gases. The burner unit is below the inner shell and the mixture of air and oil under combustion passes upwardly with a rotating motion into the inner shell where combustion takes place and the hot gases of combustion pass to the dome of said shell, then outwardly and downwardly along the sides thereof and then into said flues and upwardly through the same and out of the furnace.

40 Various other novel and important features of my invention are described and claimed herein and such features will be apparent from the description given below.

50 One embodiment of my invention is shown in the accompanying drawings constituting a part hereof, and in which like reference characters indicate like parts.

55 Fig. 1 is a vertical, cross-sectional view of a

furnace made in accordance with the present invention, some parts being shown in elevation for clearness;

Fig. 2 is a fragmentary, front elevational view of the burner unit showing particularly the means for locking the unit in place for operation;

Fig. 3 is a vertical, cross-sectional view of the furnace taken at right angles to the section of Fig. 1, some parts being shown in elevation for clearness;

Fig. 4 is a top view partly in section and partly in plan of said furnace;

Fig. 5 is a front view of a furnace showing a slightly modified form of construction; and

Fig. 6 is a fragmentary side view of the furnace shown in Fig. 5, some parts being shown in section.

There is provided a substantially cylindrical vertical shell 1, open at the bottom and having a dome shaped top 2. A cylindrical vertically placed outer shell 3 surrounds the inner shell, the said shells being eccentric with respect to each other, as most clearly shown in Fig. 4, and circular horizontally placed top and bottom boiler sheets 4 and 5 are welded to said sheets. A stay rod 6 is welded to dome 2 and sheet 4 to strengthen the structure. Fire brick, or similar heat insulation, 7 lines the lower portion of shell 1 and rests upon a ledge 8 constituting an extension of sheet 5. A series of vertically placed oval or flattened flues 9 is also welded into sheets 4 and 5. Said flues are placed in the wider portion of the space between the two shells, as shown in Fig. 4, and they are substantially in parallel relation to obtain a maximum amount of heat transfer surfaces in the minimum of space available. The lower ends 10 of said flues communicate with the combustion chamber of the furnace and the upper ends 11 lead into a casing 12, the open end 13 of which leads to a chimney. A plate 14 bolted to said casing provides ready access to the flues for cleaning purposes.

At the bottom of the furnace is an opening into which is fitted a pipe 15 for return or supply water to the furnace. In the sheet 4 is an opening 16 into which is fitted a pipe 17 for steam to be distributed to the heating system. An opening 18 in said sheet 4 is fitted with a pressure release or safety valve 19. A float 20 operates a switch to cut off the burner if the water level gets too low. A gauge glass 21 of usual construction is provided at the front of the furnace and a pressure gauge 22 is inserted at a point just above the water gauge. A cap or

cover 23 fits over the top of the furnace enclosing the casing 12.

A rectangular member 24 is welded into the shells 1 and 3 and provides a rectangular opening 5 which is protected by an insulating member 25 having a central opening. A sight glass 26 is fitted opposite said opening and a disk or other protective member 27 is interposed between the combustion chamber and said glass 26. An operating lever 28 secured to the upper end of disk 27 is provided with an operating handle 29 on the outside of the furnace. A cover 30, U-shaped in cross-section, is hinged at 31 to the furnace jacket and extends from substantially the top thereof to the top of the lower band or skirt and serves as a means for protecting the gauge 22, glass 21 and sight 26 from dust or injury. Said cover is provided with a glass 32 to enable the inspection of gauge 22 and glass 21 without opening said cover.

Insulation 33 of the cellular type is placed on sheet 4 and similar insulation 34 is placed around shell 3 and a metal jacket 35 surrounds the same and holds it in place. The furnace is supported on a plurality of legs 36 which are suitably secured to sheet 5. The space below sheet 5 is surrounded by a skirt 37 secured to the furnace in such a manner as to be readily removable at least in part. For this purpose, the sheet is usually made in two parts 37 and 37'.

Secured to the bottom of the furnace is a pan 38 having in the bottom thereof heat insulating material 39 and having an opening 40 therein in line with the axis of shell 1. At the rear of the pan is secured an eye 41. At the opposite or front end of the pan is a boss 42 having pivoted therein a downwardly extending lever 43. The lower end of the lever is provided with a pin 44 on which is pivoted forked member 45 having a flat extension or handle 46. At an intermediate portion of lever 44 is a pair of pins 47 as most clearly shown in Fig. 2.

To the pan is removably secured an oil burner unit designated generally as 48. It comprises a support or base consisting of a flat member 49 having an opening to which is secured a flat cylindrical upwardly extending member 50 terminating in a member 51 having diagonal waves along the inner periphery thereof. A hook 52 at the rear of the plate 49 is adapted to fit into the eye 41. At the opposite end of plate 49 is a pair of hook members 53 adapted to fit over pins 47.

Secured to plate 49 is a pan-shaped member 54 on the lower side of which is secured motor 55 to which in turn is secured oil pump 56 connected with oil feed pipe 57 which terminates in burner 58, having atomizing nozzle 59 extending into cylinder 50. The shaft of motor 55 extends through an opening in pan 54 and there is secured thereto a blower 60 provided with a perforated cover 61. Also secured to pan 54 and below the same, is ignition unit 62, the high tension terminals 63 of which are connected to spark discharge members or plugs 64 terminating in proximity to nozzle 59. To plate 49 are attached control unit 65 for the usual relays and other controls for the burner mechanism. A source of power or cable 66 terminates in a plug 67 fitting into a socket in control unit 65, said plug having a flat lateral extension 68 adapted to overlies handle 46 when the burner unit 48 is in position.

A fire detector 69 extends through the wall of pan 38 to the flue and has a cable 70 extending from the outside of pan 38 to socket 71 of control unit 65. The cord 70 is so fixed or is of such

length that the plug attached thereto can reach socket 71 and be inserted therein only when burner unit 48 is in its proper locked position. Formed on motor 55 is a boss 72 carrying a pair of casters 73 on which the burner unit 48 is adapted to be rolled.

At a point 74 in a space between shells 1 and 3 at a point intermediate to the flues 9 and the narrowed portion of the space between said shells, is inserted a unit for the heating of domestic hot water. In sheet 4 is a boss 75 into which is fitted a header 76 into which is inserted a series of pipes 77 usually of copper, bronze, brass, or the like. Any number of such pipes may be utilized, and I have found that two rows of four pipes each form a unit which is usually adequate and which will readily fit into the available space. Said pipes have one or more offset portions 78 to allow for unequal expansion of the furnace and said pipes. The lower end of said pipes fit into a header 79 one side 80 of which is rounded as shown in Fig. 3. An opening 81 opposite header 79 allows the introduction of pipe 82 and a nut 83 is fitted thereover to make a water-tight joint, as is usual. The header 76 is secured in place by flange member 84 which is bolted onto sheet 4. A pipe 85 is fitted thereto and pipes 82 and 85 are fitted to the hot water tank or the like.

In order to provide a safety device to prevent accidental rupture of the boiler under unusual conditions, there is provided an opening 86 in shell 3 into which is fitted a plug 87 having secured therein a disk 88 of metal or other material. The strength of said disk is substantially lower than the calculated strength of the boiler shell, but is greater in strength than the maximum pressure for which the boiler is designed. Therefore, under unusual conditions of pressure, disk 88 will blow out and thus prevent explosions. A new disk or a new plug can be placed into position very readily, particularly if the arrangement is placed underneath cover 30. Such an arrangement is desirable when using boiler shells of extreme thinness where fire regulations may require safety devices.

In the operation of the furnace, unit 48 is rolled into place on casters 73 and hook 52 is inserted in eye 41. Handle 56 is manipulated so that pins 47 fit into hooks 53 and a downward movement of the handle will raise unit 48 into position, and when handle 56 touches unit 65 the burner unit 48 is locked into proper position. By this movement the shell 50 is caused to rise into opening 40. When the unit 48 is properly locked in place, pins 49 are in such a position that the axis thereof is to the left of pin 44, as shown in Fig. 1. Plug 67 is fitted into its socket and extension 68 will lie over handle 46. If the handle is not in proper position, the socket 67 will not fit sufficiently into its socket to make proper contact. The plug of cable 70 is fitted into socket 71 and this can be done only when unit 48 is in proper position.

Upon the starting of the burner, oil and air are mixed and they flow upwardly with a swirling motion approximately as shown by the arrows in Fig. 1, in a fan-shape and spread out until the flame almost touches insulation 7. The gases of combustion hit the dome 2 and are deflected outwardly and downwardly along the sides of shell 1 and insulation 7, then upwardly through flues 9 and out through casing 12 and into the chimney. The gases take the form shown by the arrows in Figure 1, having a constricted area at the lower end. The gases of combustion passing downwardly along the sides of shell 1 are sub-

stantially in contact with the burning mixture of fuel and air. By reason thereof and also by reason of the low pressure at the base of the flame, some of the combustion gases will become entrained in the burning mixture. The proportion of such gases varies with a number of factors and is controllable. This is of considerable importance in that the presence of the proper amount of combustion gases in the flame tends to make the flame less noisy. An inspection of the boiler pressure and the water level is made through window 32 and inspection of the combustion chamber may be obtained by opening cover 30 and rotating handle 29 a distance of about 45°, which allows a view of the combustion chamber through sight 26.

In the modification shown in Figs. 5 and 6, the primary control box is located in a different and more readily accessible position and it is combined with the flame detector. The flame detector 69' is situated in shell 1 near the dome 2 thereof and passes through the outer shell 3 into control box 65', which is located above the sight opening 26 and under the door 30. Limit control box 89 is placed in proximity to the limit controls, such as the water level control, aquastat, etc., and also under door 30. A cable 90 connects the same to box 65' and cable 66' extends downwardly under the door 30 and skirt 37 and is just long enough to fit into socket 91 on bracket 92 fixed on plate 49, when the burner unit is in its proper position. A cable 93 is adapted to energize motor 55.

Efficient performance of a small oil burning heating unit such as used for domestic heating, depends on two factors. First, complete and efficient burning of the oil with the minimum amount of excess air, and second, the efficient transfer of heat from the flame and burned gases or products of combustion by radiation and convection.

The first factor is by far the most important, since in oil heating units of the size under discussion from 70% to 80% of the total heat of combustion should be transferred to the water through the walls of the combustion chamber, depending on the rate or amount per hour of oil burned. The percentage decreases as the rate and size of boiler increase. This is partially due to the relations of volumes to areas in objects of similar shape but varying in size. As the size of the combustion chamber is reduced, the unit area becomes larger in proportion to unit volume and, since the rate and amount of heat transferred is governed by unit area, as well as relative temperature, the smaller units transfer a larger percentage of the total heat in the combustion chamber.

It will be seen from this that the proportions, volume and temperature of the combustion chamber are of paramount importance and all bear a fixed relation to the rate of oil burned.

As the proportion of heat transferred in the secondary surface or flue passes increases, the area of secondary surface necessary goes up rapidly, since the transfer is almost entirely by convection with practically no radiation and the temperature of the gases drops rapidly as they enter the flues. This results in a rapidly decreasing rate of transfer per unit of area.

The use of true cylinders for combustion chamber and outer shell of a domestic heating boiler is very desirable, since it avoids the expensive construction involved in staying flat surfaces.

Another very desirable feature of domestic heating boilers of cylindrical, welded steel, one piece construction is that the largest diameter shall be something less than 30" so that the boiler may be moved through doorways of minimum standard width.

The design of this boiler combines a 1¾ gal. of oil or its equivalent in other fuels per hour capacity and the related combustion chamber dimensions, with the low cost cylindrical construction and an outside diameter of less than thirty inches. The diameter of the inner shell should be not less than about 19" and its length 30" to 31". When burning its rated capacity of oil, the efficiency of heat transfer to the water is not less than 78% and may be as high as 80% or 81%. This is believed to represent the best combination of features, namely, maximum capacity with minimum cost.

Although I have described my invention setting forth a single specific embodiment thereof, it will be apparent that my invention is not limited to the details described herein and that wide variations in construction may be made within the scope of my invention. For example, the invention is applicable not only to a steam heating system, but also to hot water and vapor systems. It is also applicable to gas fired furnaces, as well as those using powdered coal. Various changes in the materials used, the details of construction, the form and arrangement of various parts, etc., may be made as will be apparent to the individual skilled in the art. These and other changes may be made in my invention which is to be broadly construed and is to be limited only by the scope of the claims appended hereto.

What I claim is—

1. A furnace comprising an inner vertically extending elongated shell closed at the top and constituting a combustion chamber, an enclosing vertically extending outer shell, said shells being spaced from each other to form a water compartment between them, a flue, the lower end of which is in communication with the lower end of said inner shell, said flue extending vertically of said water compartment and through the upper end thereof adjacent the upper end of said outer shell, a pressure type burner so constructed and arranged as to project a column of flame upwardly into said elongated shell, said flame being immediately surrounded by said inner shell thereby exposing the inner shell directly to the radiant energy from said flame, the closed top of said inner shell effecting deflection of the combustion products into contact with the inner surface of the inner shell and their passage downwardly along the same and into said flue, and the upwardly projected flame effecting entrainment of some of the downwardly moving combustion products into the flame.

2. A furnace comprising in combination an inner vertically extending elongated shell closed at its upper end and constituting a combustion chamber, an enclosing vertically extending outer shell out of communication with the inner shell, said shells being spaced from each other in eccentric relation to provide a water compartment between them, flues extending vertically of said water compartment from top to bottom thereof, the lower ends of said flues being in direct communication with the interior of said inner shell, the upper ends of said flues projecting through the upper end of the water compartment, a pressure type burner so constructed and arranged as to project a column of flame upwardly into said

elongated shell, said flame being immediately surrounded by the inner shell, the closed upper end of the inner shell effecting deflection of combustion products into contact with the inner surface of the inner shell and their passage downwardly along the same and into said flues and the upwardly projected flame effecting entrainment of some of the downwardly moving combustion products into the flame.

3. A furnace comprising an inner vertically extending elongated shell closed at its upper end and constituting a combustion chamber, an enclosing vertically extending outer shell, said shells being spaced from each other to form a water compartment between them, a flue, the lower end of which is in communication with the lower end of said inner shell, said flue extending vertically

of said water compartment and through the upper end thereof adjacent the upper end of said outer shell, a pressure type burner disposed concentrically with respect to said inner shell and so constructed and arranged as to project a column of flame upwardly into said elongated shell, said flame being immediately surrounded by the inner shell, the closed upper end of the inner shell deflecting combustion products into contact with the inner surface of the inner shell and their passage downwardly along the same and into said flue, and the upwardly projected flame effecting entrainment of some of the downwardly moving combustion products into the flame.

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