Nov. 24, 1936. G. J. LEUVELINK 2,062,033

BOILER

Filed Jan. 31, 1936 2 Sheets-Sheet 1

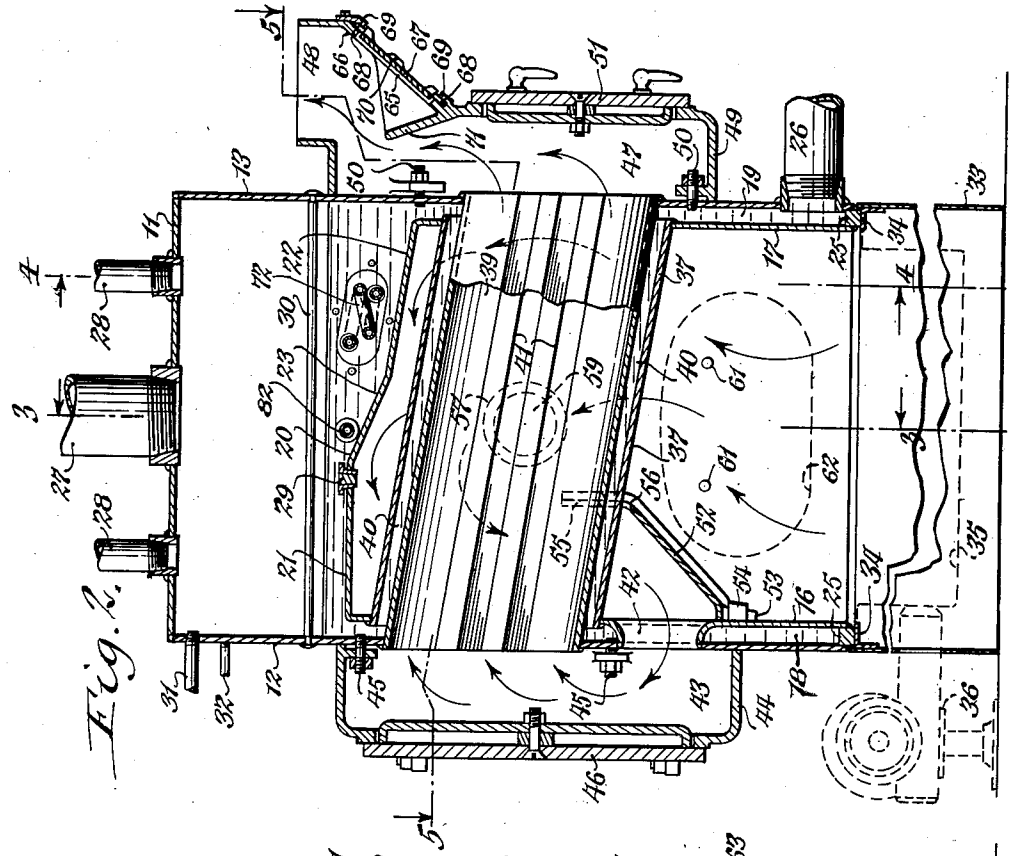

Fig. 2.

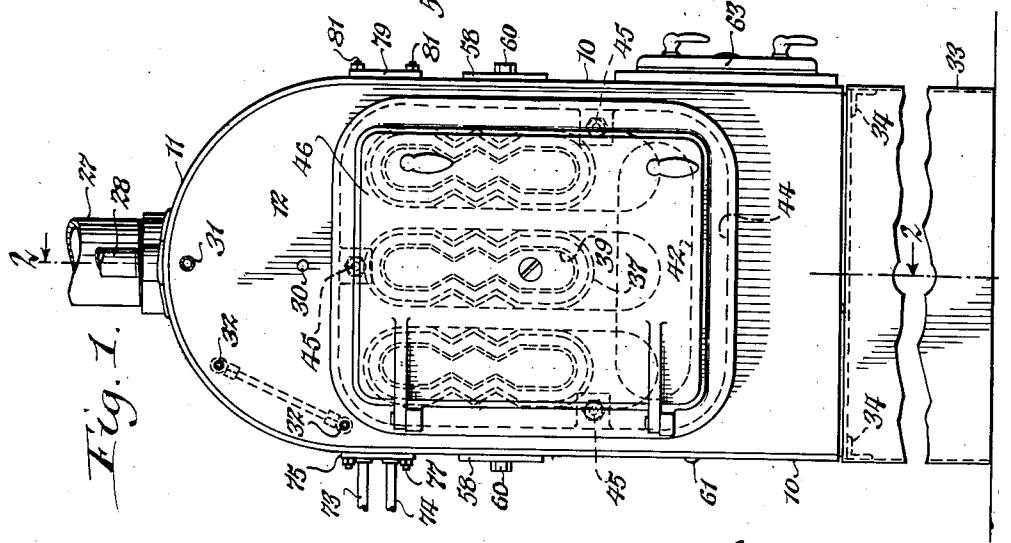

Fig. 1.

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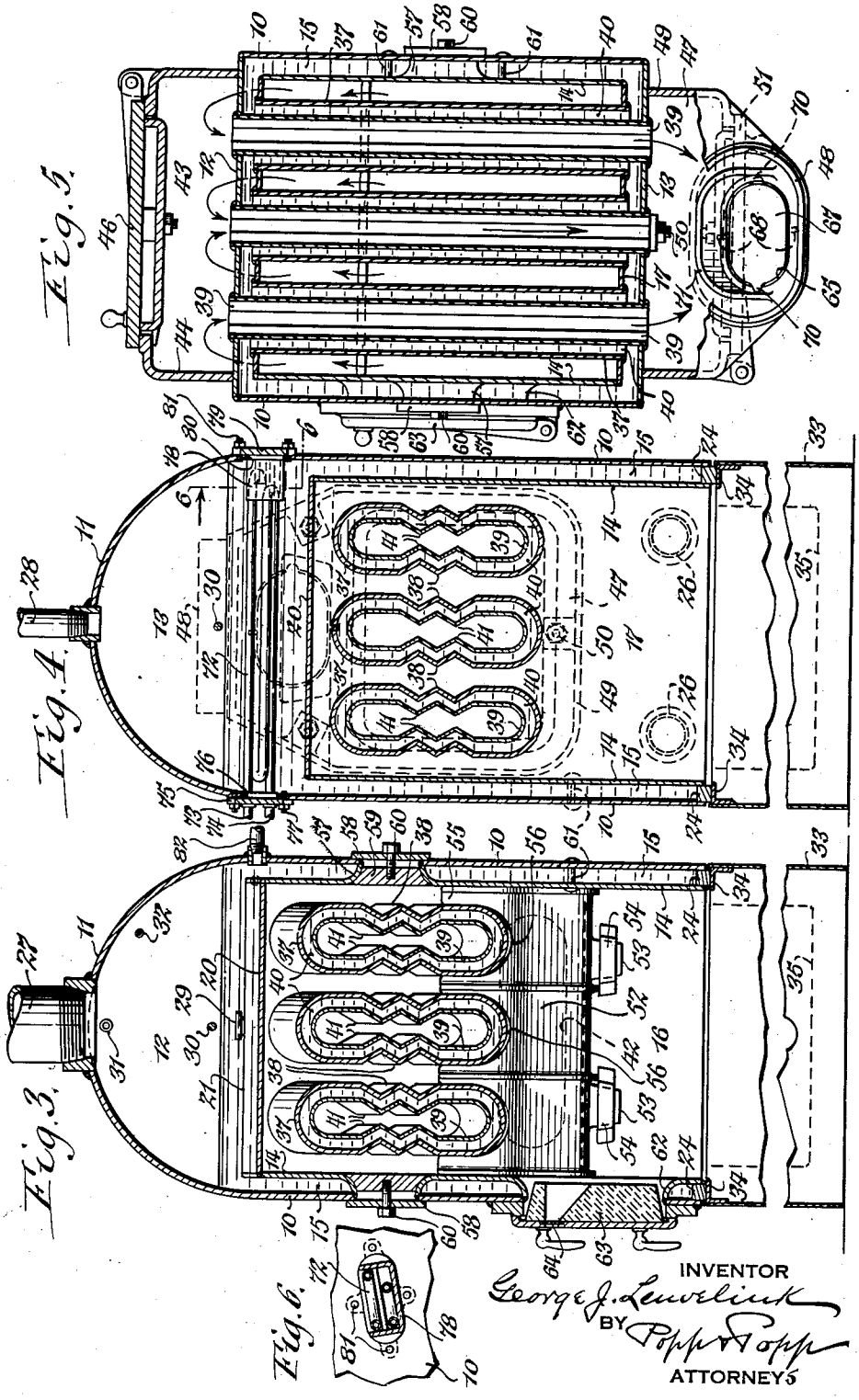

Fig. 5.

Fig. 4.

Fig. 3.

Fig. 6.

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2,062,033

BOILER

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Application January 31, 1936, Serial No. 61,769

3 Claims. (Cl. 122—174)

This invention relates to a boiler which may be used either for heating water or generating steam for household purposes and which is principally constructed of sheet steel or boiler plate.

One of the objects of this invention is to produce a boiler of this character whereby a greater heating capacity is obtained in proportion to the amount of space which is occupied and the quantity of fuel which is consumed, thereby rendering the boiler particularly well suited for heating houses in which only a comparatively small space is available for installing the heating plant.

Another object of this invention is to so construct and arrange the inner and outer shells of the boiler body and water tubes and fire tubes that the same are strong and durable, also present the maximum heating surface and cause a constant circulation of water in the boiler so that the water is heated and steam generated rapidly.

A further object of this invention is to provide improved baffle means for deflecting the hot gases in the fire box and causing the same to contact with a greater area of the water tubes whereby the efficiency of the boiler is increased and the fuel is utilized to greater advantage and more economically.

An additional object of this invention is to provide simple and efficient means for automatically cutting off the suction of the chimney from the boiler when the pressure of the fuel in the fire box ceases and thus avoids cooling the boiler.

A still further object of this invention is to provide improved means for indirectly heating water for domestic and other purposes by heat derived from the water which is heated directly in the boiler.

In the accompanying drawings:—

Fig. 1 is a front elevation of a boiler embodying my improvements.

Fig. 2 is a vertical longitudinal section of the same, taken on line 2—2, Fig. 1.

Figs. 3 and 4 are vertical transverse sections taken on the correspondingly numbered lines in Fig. 2.

Fig. 5 is a horizontal section, taken on line 5—5, Fig. 2.

Fig. 6 is a fragmentary vertical section, taken on line 6—6, Fig. 4.

In the following description similar characters of reference indicate like parts in the several figures of the drawings.

The body of this boiler includes an outer shell and an inner shell both of which are constructed mainly of sheets of steel which are cut to the required shape and connected with each other by welding so that the same practically forms an integral structure.

The outer shell comprises a sheet of steel or metal plate which is bent to form two upright longitudinal outer side walls 10, 10 and a transverse outer top 11 which curves upwardly and connects the upper ends of the side walls. The main part of the outer shell is completed by upright transverse inner walls 12, 13 which are made of sheet or plate steel and connected at their side and top edges, respectively, with the front and rear edges of the side walls 10 and top 11 by electric or gas heat welding.

The inner shell comprises two flat sheets or plates or inner side walls 14 of steel or like metal arranged upright and lengthwise along the inner side of the outer side walls 10 but spaced therefrom so as to form therebetween upright side water legs 15 which are filled with water during normal operation of the boiler. Arranged along the inner sides of the transverse outer walls are two transverse inner walls 16, 17 formed from flat inner plates or sheets of steel which are spaced from said outer transverse walls 12, 13 and produce therebetween upright front and rear water legs 18, 19 which are filled with water during use of the boiler. The opposite vertical edges of the inner transverse walls 16 and 17 are connected by welding with the corresponding front and rear vertical edges of the side walls 14. Above the inner side and transverse walls is arranged an inner top 20 of sheet steel or metal which is connected at its longitudinal and transverse edges with the respective upper edges of the inner side and end walls by welding.

This inner top 20 spaced from the outer top 11 and in the preferred form is transversely bent or corrugated so that one part thereof is off-set vertically relatively to another in a direction lengthwise of the boiler for the purpose of strengthening the same and enabling it to withstand the pressure to which the same is subjected. The off-setting or corrugating is preferably effected by bending the top 20 so that the front part 21 of the same is elevated, the rear part 22 depressed, and the intermediate part 23 inclined downwardly from the front part 21 to the rear part, as best shown in Fig. 2.

A mud ring or filler closes the water legs between the inner and outer shells of the boiler body which ring comprises two side bar sections 24 arranged between the lower edge portions of the side walls 10, 14 respectively, and two end bar sections 25 arranged between the correspond-

ing lower edge portions of the transverse end walls of the shells and said walls and mud ring sections being connected by welding.

The water to be heated may be introduced into the water space between the inner and outer shells of the body in any suitable manner, for example, through one or more feed pipes **26** connected with the lower rear part of the rear transverse wall **13** of the outer shell, as shown in Fig. 2, which pipes may also be used as water return pipes when this boiler is used in a hot water building heating system. The steam or hot water may be conducted from the interior of the body to the radiators of the building or other place where the heat is to be used by pipes **27**, **28** connected with the top **11** of the outer shell which piping may be organized to either return to the boiling water which has been utilized for heating in a hot water heating system, or to return the water of condensation to the boiler in case the boiler is used for generating and heating by steam.

The top **20** of the inner shell may be provided with a fusible plug **29** which is adapted to melt and let off steam in case the water in the boiler gets below the top of the inner shell and thus relieves the pressure in the boiler for safety.

In order to prevent the upper parts of the transverse end walls **12**, **13** of the outer shell from being pressed outwardly by the internal pressure of the steam within the boiler body these parts are connected by longitudinal tie rod or brace **30** arranged above the top plate of the inner shell, as best shown in Fig. 2. The upper parts of the front wall **12** of the outer shell are also provided with outlets **31**, **32** for connection with pressure and water gages of usual construction.

The body of the boiler may be supported in any suitable manner but this is preferably accomplished in the present case by means of a hollow base having an outer rectangular casing **33** of sheet metal, such as steel, which rests on a foundation and is provided at its upper end with an internal angle iron **34** forming a shoulder upon which the mud ring at the lower marginal part of the boiler body rests, as shown in Figs. 1–4.

The space within the inner shell of the boiler body and the space within the base together form a fire box in which the heat is generated for heating the water in the water space of the boiler. Although the means for heating the water may be organized for utilizing various kinds of fuels the present installation purposes the use of fuel oil and for this purpose the inner side and bottom of the base is provided with a refractory lining, as shown by dotted lines **35** in Figs. 2, 3, and 4 and a fuel oil burner is provided, as shown by dotted lines **36** in Fig. 2, whereby fuel oil and air is projected in the form of a combustible mixture into the lower part of the fire box and burned as a flame in the latter. Part of the heat resulting from the burning of the fuel in the fire box acts upon the inner shell of the boiler body and effects heating of the water in the space between the inner and outer shells of the body.

For the purpose of increasing the area of the surface which is contacted by the hot gases and produce the greatest transference of heat to the water before these gases escape to the chimney leading to the outer atmosphere additional radiating means are provided which embody some features of the present improvement and which are constructed as follows:—

The numeral **37** represents a plurality of water tubes which are arranged lengthwise and side by side in a transverse row in the upper part of the fire box so as to be exposed to the hot gases therein and each of these tubes inclining from its front end toward its rear end. Each of these water tubes is of oval form in cross section and so arranged that the opposite wide areas or walls thereof are arranged vertically, thereby enabling a large number of water tubes of extensive area to be employed in a given space. Each of the water tubes is provided on its opposite upright sides with a plurality of longitudinal corrugations **38** arranged in vertical rows, thereby increasing the strength of these tubes and also increasing the radiating area of the same. At its front and rear ends each of the water tubes extends through correspondingly shaped openings in the front and rear transverse walls of the inner shell and is integrally connected therewith by welding.

Within each water tube is arranged a longitudinal rearwardly inclined fire tube **39** which is of smaller diameter so as to form a water space **40** between these tubes which communicates at its opposite ends with the front and rear transverse water legs **18**, **19** and in which water in the form of a comparatively thin film is exposed to the heating effect of the hot gases and thus utilize the fuel more advantageously. Each of the fire tubes is of oval form in cross section and arranged with its wide sides vertically and each of these vertical sides is provided with longitudinal corrugations **41** which are arranged in a vertical row and thus increase the strength of this tube and also the area of its radiation surface so as to facilitate the heating of the water in the space between the respective outer water and inner fire tubes.

At its opposite ends each of the fire tubes extends through correspondingly shaped openings in the front and rear transverse walls of the outer shell and is secured to the same by welding. By inclining both the water tubes and the fire tubes a more rapid circulation of the water in the boiler is obtained.

Extending across the water space of the front water leg **18** below the water and fire tubes is a transfer flue **42** which communicates with the fire box and which has its inner end formed integrally with the front transverse wall **16** of the inner shell and has its front end connected with the front transverse wall **12** of the outer shell by welding.

On the front side of the boiler is arranged a flame chamber **43** for connecting the flue **42** with the front ends of the fire tubes **39** which chamber preferably comprises a marginal flange **44** connected at its rear edge by bolts **45** with the front wall **12** of the outer body shell and a clean-out door **46** movably mounted on the front side of said flame chamber. Normally this door is closed so that the flame chamber only communicates with the tranfer flue and the fire tubes but when this door is opened the fire tubes are accessible at their front ends for repairing, cleaning or inspection.

In rear of the boiler is arranged a smoke box **47** which communicates with the rear ends of the fire tubes and is provided at its top with an outlet flue **48** adapted to be connected with the chimney of the building in which the boiler is installed so as to conduct the spent heating gases and smoke to the outer atmosphere. This smoke box is provided with a marginal flange **49** which is secured by bolts **50** to the rear end wall **13** of the outer shell and the rear side of this smoke box is provided with a movable door **51** which may be

opened when access is required at the rear ends of the fire tubes for inspection, cleaning or repairing purposes.

The hot gases resulting from the burning of the fuel in the lower part of the fire box pass upwardly in the fire box and around the water tubes, thence forwardly through the transfer flue **42**, thence upwardly through the flame chamber **43**, thence rearwardly through the fire tubes and into the smoke box, and thence upwardly through the outlet flue **48** to the chimney, thereby heating the water lying against the exposed surfaces which are contacted by the hot gases for either heating the water at a relatively low temperature or at a higher temperature if steam is desired.

By inclining the water tubes and fire tubes from their front ends toward their rear ends the flow of hot gases through the fire tubes is retarded and a greater amount of heat is transferred to the water before the gases escape to the smoke box.

Baffling or deflecting means are provided for preventing the hot gases from passing directly from the lower part of the fire box to the transfer flue and instead compelling these gases to first pass upwardly in the fire box and around the rear parts of the water tubes, thence downwardly around the front parts of the water tubes and then to the transfer flue and thus obtaining a more extended contact of the hot gases with the water tubes and increasing the efficiency of the boiler for the amount of fuel consumed.

These baffle means preferably comprise a baffle plate having a rearwardly inclined main part **52** extending across the inner end of the transfer flue **42**, a pair of supporting tongues or lugs **53** projecting downwardly from the lower edge of this main part and removably seated in sockets **54** arranged on the inner side of the front wall of the inner shell below the transfer flue **42**, and an upright plate portion **55** projecting upwardly from the upper edge of the main part **52** and transversely across the lower part of the water tubes **37** and provided in its upper edge with a plurality of notches **56** each of which receives the lower part of one of said water tubes between the front and rear ends of the same.

It follows from this form of baffle that the latter causes the hot gases rising from the lower part of the fire box to first pass upwardly around the rear parts of the water tubes and then over the top of the baffle and downwardly around the front parts of the water tubes to the transfer flue, thus lengthening the path of the hot gases and retaining the same for a longer time in contact with the water tubes and increasing the heating effect on the water accordingly.

Strengthening of the longitudinal side walls of the inner and outer shells is effected by means of reinforcing tubes **57** each of which is formed integrally at its inner end with the respective inner side wall **14** and connected at its outer end with the companion outer side wall **10** by welding, as best shown in Fig. 3. Normally each of these reinforcing tubes is closed by a cover plate **58** extending across the outer end of the reinforcing tube and engaging the outer side of the respective side wall **10**, a conical plug **59** fitting the conical inner end part of this reinforcing tube, and a bolt **60** detachably connecting said plate **58** and plug **59**. When these reinforcing tubes are open the same may be utilized for cleaning, repairing and inspecting the adjacent internal parts of the boiler. Reinforcing of the side walls of the inner and outer shells may also be effected by stay bolts **61** connecting these parts, as shown in Figs. 3, 4 and 5.

For the purpose of readily gaining access to the interior of the fire box a manhole **62** having the form of a tube is extended across the water space between one pair of outer and inner side walls of the outer and inner shells, which tube is formed integrally at its inner end with the respective inner side wall **14** and connected by welding at its outer end with the respective outer side wall **10**, as best shown on the left side of Fig. 3. The manhole is normally closed by a movable door **63** mounted on the adjacent wall **19** and this door is provided with a window **64** to permit of observing the burning operation within the fire box. This tubular manhole also reinforces the side walls on this side of the boiler and stay bolts are not needed.

Means are provided for automatically checking the draft through the boiler when the generation of heat in the fire box ceases or is materially reduced and thus prevents cooling of the water in the boiler at such times. The preferred means for this purpose comprise a check passage **65** formed in the upper inclined part **66** of the rear wall of the smoke box between the clean-out door **51** and the smoke outlet **48**, and an unbalanced check valve **67** of the butterfly type adapted to open and close said check passage and pivotally mounted about midway of its length on the smoke box so that the same is normally moved into a closed position by gravity in which it is parallel with the plane of the check passage, but when the pressure in the smoke box ceases, due to stopping or slowing down of the burner, then the suction of the chimney is concentrated on the check valve and causes the same to be turned into an open position in which it stands at right angles to the plane of the check passage so that air is now drawn from the exterior of the boiler instead of through the fire box and fire tubes and cooling the water. The unbalanced condition of the check valve is preferably effected by means of pivot pins or pintles **68** arranged at the upper lower edges of the check valve and in a slightly inclined position relative to a vertical line and journalling these pins in correspondingly inclined bearings **69** on the smoke box, as shown in Figs. 2 and 5. When the heat generating means in the fire box are in operation, particularly an oil burner supplying air under pressure, then the demands of the suction of the chimney are supplied by this burner and only a slight suction effect is produced on the check valve which is sufficient to permit the same to remain in a closed position and thereby prevent the entrance of air in any substantial amount from the atmosphere through the check passage and into the chimney and thus maintain a good draft on the fire box. The movement of the check valve upon reaching its closed position is arrested by stop means consisting preferably of stop lugs **70** arranged at opposite ends of the check valve and adapted to engage with adjacent parts of the smoke box.

When the pressure in the fire box is materially reduced or arrested and no longer supplies the demands of the suction of the chimney then the continuance of the strong suction in the latter will be exerted more effectively on the check valve and cause the same to be turned into an open position, thereby permitting external air to be drawn into the chimney and avoiding a strong draft through the heat conduits of the boiler which otherwise would operate to cool the water and effect a loss in heat and waste of fuel.

In the preferred construction a baffle 71 projects upwardly and forwardly from the inner side of the smoke box and partly across the check passage so as to prevent any air coming into the smoke box through the check box from cooling the water in the boiler and also to prevent the pressure of the oil burner and the suction of the chimney from producing a suction effect on the check valve which would tend to open the same.

If desired, means may be used in connection with this boiler for supplying indirectly heated water for domestic and other purposes independently of the water which is heated directly by the fuel in the boiler. The preferred construction of the means for this purpose shown in Figs. 2, 4 and 6 are constructed as follows:—

The numeral 72 represents a coil of piping having one or more loops which are arranged horizontally and transversely in the space within the outer body shell above the depressed rear part 22 of the top of the inner shell and having its opposite ends 73, 74 extending to the outside of the outer shell. Water admitted to the coil at one end and discharged at its opposite end will be heated indirectly by the hot water in which the coil is submerged and which is contained between the boiler shells. The ends of the coil are supported by a plate 75 which closes an opening 76 in the respective side wall of the outer shell through which the coil is introduced into the water space of the boiler, this plate being removably secured to the outer shell by bolts 77 or other suitable means. The inner end of the coil is supported in a trough-shaped bracket 78 which permits the coil to expand and contract freely in response to variations in temperature of the water in the boiler. The bracket is mounted on the inner side of a closure plate 79 which covers an opening 80 in the adjacent part of the outer shell and which is detachably secured to this shell by bolts 81, as shown in Fig. 4. Upon removing the plates 75 and 79 the indirect water heating coil can be easily removed from the boiler for inspection, cleaning and renewal if necessary. The plates 75 and 79 of the coil 72 and bracket 78 are identical and may be bolted on either side of the boiler thus permitting the coil to be placed with its inlet and outlet on the side of the boiler nearest the piping to which it will be connected. A further advantage derived from depressing the rear part 22 of the top of the inner shell is that it provides a pocket for the reception of the indirect water heating coil and thus permits the latter to be properly submerged without unduly raising the water level or reducing the steam space in the body.

If desired the upper part of the outer shell may be provided with a pipe 82 for connection with a thermostat, aquastat, vacuum gage or other instrument to be used in connection with the boiler.

For the purpose of conserving heat the exterior of the boiler may be provided with any suitable insulating covering.

I claim as my invention:

1. A boiler comprising a body having an outer shell and an inner shell arranged within the outer shell and forming a front vertical water leg between the front parts of these shells, a rear vertical water leg between the rear parts of these shells, and a fire box within the inner shell, an outer longitudinal water tube arranged within the fire box and having its front and rear ends connected with the front and rear parts of the inner shell and communicating at its opposite ends with the front and rear water legs, an inner longitudinal fire tube arranged within the water tube and separated therefrom by an intervening water jacket and having its front and rear ends connected with the front and rear parts of the outer shell, a flue arranged below the water tube and fire tube and extending across the front water leg and connected at its opposite ends with the front parts of the inner and outer shells, a flame chamber communicating with said flue and the front end of said fire tube, a vertical socket arranged on the inner side of the front part of said inner shell, and a baffle arranged below the front part of said water tube and across said flue and provided with a tongue engaging said socket.

2. A boiler comprising a body having an outer shell and an inner shell arranged within the outer shell and forming a front vertical water leg between the front parts of these shells, a rear vertical water leg between the rear parts of these shells, and a fire box within the inner shell, a plurality of longitudinal water tubes arranged horizontally side by side in said fire box and communicating at their opposite ends with said front and rear water legs, a plurality of longitudinal fire tubes each arranged in one of said water tubes and connected at its opposite ends with the front and rear parts of said outer shell, a flue arranged below said water tubes and connected with the front parts of said inner and outer shells, a flame chamber communicating with said flue and said fire tubes, a plurality of vertical sockets arranged on the inner side of the front part of said inner shell below said flame tube, and a baffle having a rearwardly inclined main part arranged below the front parts of said water tubes and across the inner end of said flue, a vertical upper part having a plurality of upwardly opening notches each of which receives the lower part of one of the water tubes, and attaching tongues projecting downwardly from the lower edge of the baffle body and each engaging with one of said sockets.

3. A boiler comprising an outer shell having upright longitudinal side walls, upright transverse end walls and a top, an inner shell arranged within said outer shell and having upright longitudinal side walls, upright transverse end walls and a top of which the front part is elevated, the rear part depressed and the intermediate part inclined rearwardly, water tubes connected at their opposite ends with the transverse walls of said inner shell, and fire tubes arranged in the water tubes and connected at their opposite ends with the transverse end walls of the outer shell.

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