April 8, 1930. S. B. HARDING 1,754,102

BOILER

Original Filed March 9, 1927 2 Sheets-Sheet 1

Fig. 1.

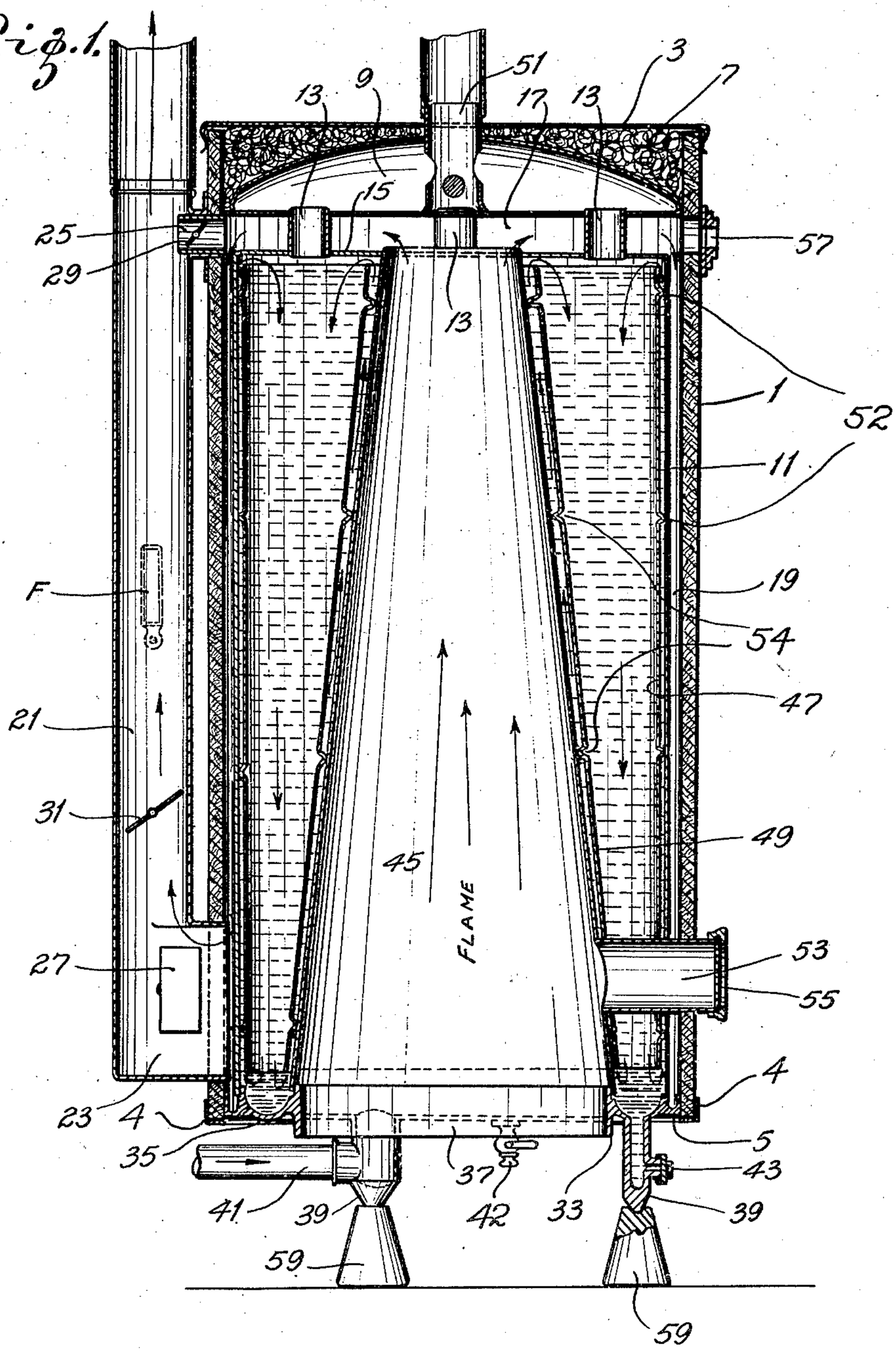

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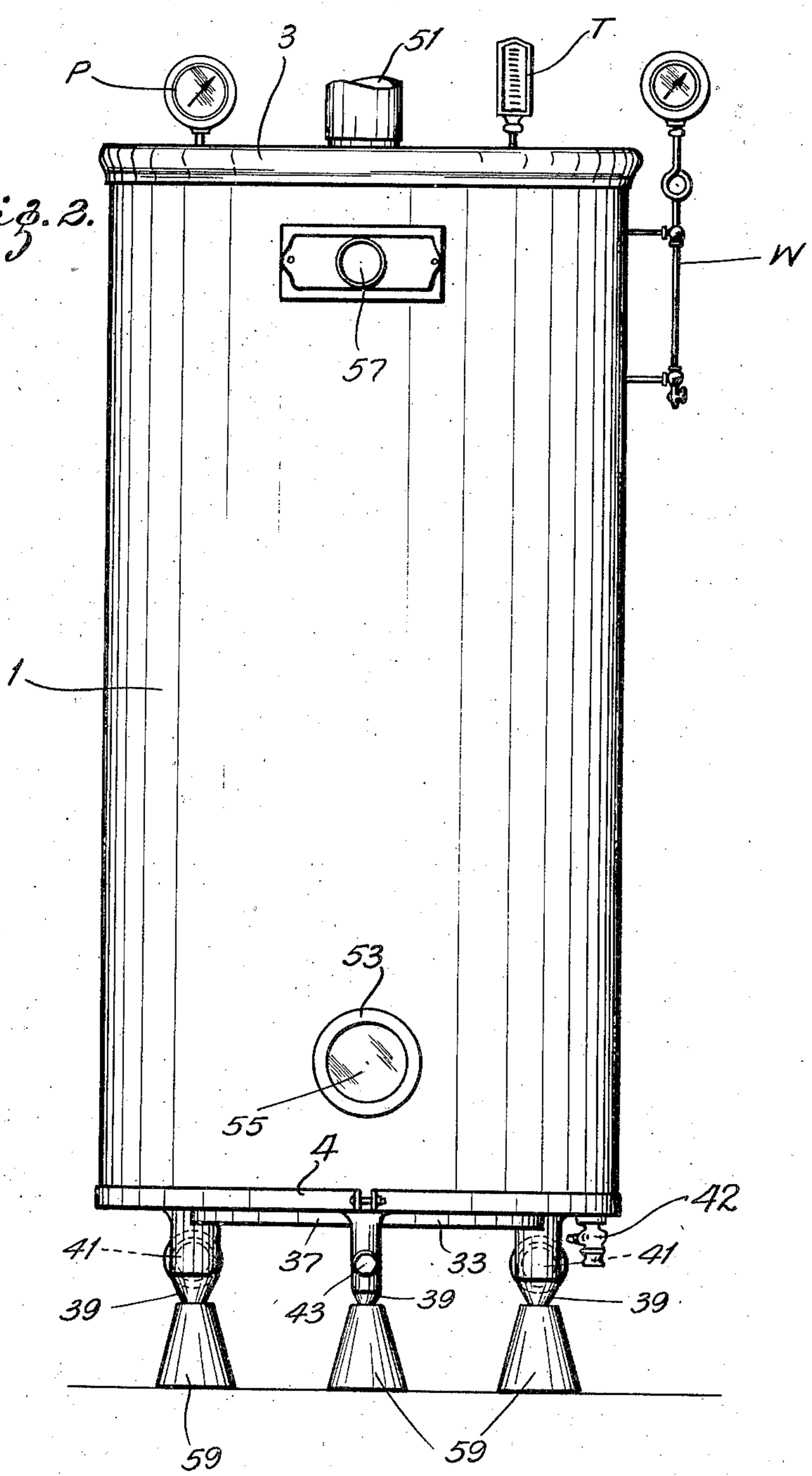
Fig. 2.



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UNITED STATES PATENT OFFICE

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BOILER

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This invention relates to water heaters or boilers, and with regard to certain more specific features, to boilers for use primarily with domestic steam and hot water heating plants, but applicable to produce steam or hot water for any purpose, such as for power generation or process work.

Among the several objects of the invention may be noted the provision of an improved, compact boiler construction, having a flue adapted to make more efficient use of the available heat in a given fuel; the provision of a boiler requiring only a small amount of water which circulates rapidly; the provision of a boiler having thin sheet-like but unrestricted waterways, adapted to promote rapid circulation, whereby heat economies are increased and clogging and deterioration reduced; the provision of a boiler of the class described having long heating passages adapted to extract a maximum amount of heat from the gases passing therethrough; and the provision of a boiler of the class described which is compact in shape, light in weight and economical of manufacture. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structure hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which is illustrated one of various possible embodiments of the invention,

Fig. 1 is a cross section taken vertically through the boiler; and

Fig. 2 is a front elevation thereof.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Fig. 1, there is illustrated at numeral 1 an outside smoke jacket which is mounted on and around the boiler proper and which comprises suitable heat insulating material. This jacket 1 is closed in at its upper end by means of a flanged cap 3 and at its lower end by means of a condensation drain 5, forming part of a mud ring 35, an angle iron 4 being clamped around the lower end of said jacket 1 in order to hold it in place. The cap 3 is provided therebeneath with a mass 7 of mineral wool separating said cap 3 from an upper, preferably superheating head drum 9.

The head drum 9 is joined to the main shell 11 by means of a plurality of tubes 13 (four tubes in the present embodiment). The tubes 13 are welded or otherwise made fast to the bottom plate of the drum 9 and the head 15 of said main shell 11. They serve to connect the interior of the drum 9 with the water or steam supply in the interior of the main shell 11, and also to separate the exterior portions of said head 9 and said shell 11, whereby a horizontal or lateral flue portion 17 is left for flue purposes. It may be seen from Fig. 1 that the jacket 1 has an annular spaced relationship with respect to said shell 11, whereby a vertical outer flue portion 19 is left to connect with said portion 17, also for flue purposes. The drum 9, as stated, serves as a superheating element.

In order to carry off the flue gases, a suitable breeching 21 is provided, having a lower connection 23 with said vertical flue portion 19 and a by-pass connection 25 to said horizontal flue portion 17. A check draft door 27 is placed at the lower connection 23 and a direct-draft damper 29 in said by-pass connection 25. Another main direct-draft damper 31 is placed in the breeching between said damper 29 and the check draft door 27.

The water drum or shell 11 is enclosed at its lower end by means of the one-piece, preferably cast-steel bottom head or boiler base 33, with which is integrally formed a mud ring 35, said condensation drain 5, a burner ring 37 and suitable legs 39. The double U shape of the described casting lends itself to keeping the castings straight as they come from the molding sand. Two of the three legs 39 are provided with inlet passages 41 to which the condensate-return connections are made. The remaining leg is provided with a drain or blow-off port 43. The smoke jacket 1 engages said condensation drain 5 to close in the vertical flue portion 19, as described. The con-

densation drain 5 is provided with a suitable outlet 42 adapted to drip into a waste pipe.

It may be seen from said Fig. 1 that the burner ring 37 is annular in shape and supports a conical inner flue 45, which flue 45 has a water-tight welded connection with the burner ring 37 and also a water-tight connection with said upper head 15 of the shell 11. Welded to the inner rim of the condensation drain 5 is said main shell 11, the drain 5 forming a spacer between said shell 11 and the jacket 1. The burner ring 37 is of such dimensions that suitable coal grates or gas, oil or like burners may be placed therein to supply a suitable heating flame in the flue 45. Inasmuch as the exact type of heating element to be used is conventional, it is not shown nor described herein.

In annular spaced relationship with respect to the shell 11 is placed a shell skirt 47. This skirt is open at the top and bottom and is held in suitable annular or other spaced relationship by means of dented impressions 52. The skirt is held in position by an inspection tube 53.

In annular spaced relationship with respect to the flue 45 is placed an internal cone skirt 49. This skirt is also open at the top and bottom and is held in annular spaced relationship by means of dented impressions 54. The cone skirt is not positioned parallel to the flue wall 45 but is separated therefrom a greater distance at the top than at the bottom. The purpose of this will appear hereinafter. The spacing of both skirts 47, 49 is as close as is practicable.

It is to be understood that the skirts 47 and 49 each extend substantially the whole length of the respective contiguous wall, by which is meant that they are long enough to effect a rapid circulation of water in the boiler.

An outlet 51 is provided for the boiler; and a peep hole 53 having a heat resistant glass 55 is connected with the flue 45 for purposes of viewing combustion conditions. A suitable flame inspection member and cleanout 57, also provided with heat resistant glass, is used.

The boiler carries the ordinary operating appurtenances, such as a pressure gage P, themometer T, water gage W and flue gas thermometer F. The legs 39 are ordinarily mounted on suitable blocks 59.

The operation of the boiler is as follows:

Water is led into the shell 11 through the return pipe 41, up to a suitable level, the exact level depending upon whether the boiler is being used for steaming or hot water purposes. A burner or the like is located in the burner ring 37 and the flame thereof permitted to effect a passage through the inner flue 45. The inner flue 45 is of a tapering shape, because as the flame travels upwardly it is cooled and the volume diminished. If a straight flue were used the diminishing volume would result in the hot gases withdrawing more or less from the heating surfaces. By using a tapered flue, a longer period of contact is maintained.

The cone expands at one temperature and the shell at another and the head 15 functions as a diaphragm take-up.

From the flue 45 the products of combustion pass into the horizontal flue passage 17, around the water or steam tubes 13 and thence down through the vertical flue passage 19 (around the shell 11) and normally to the breeching 21 by way of the lower connection 23. In starting a fire, when there is a defective draft, some of the products of combustion, may be by-passed directly to the breeching 21 by opening the damper 29. The said by-passed products do not go through the flue portion 19.

It is evident that the water within the shell 11 receives heat internally from the flue 45 and externally from the flue passages 17, 19. The result is that heated water is formed on the flue water surfaces and the external shell surfaces. When the heat is great enough steam bubbles are also generated, especially on the flue wall. The heated fluids rise near the surfaces on which they are generated and the purpose of the skirts 47 and 49 is to prevent the heating water and steam from leaving the heating surfaces too quickly. When they are permitted to leave quickly, colder water takes their place and the rate of circulation is impaired.

With the present invention, the heated fluids are held to their heating surfaces by the skirts 47, 49 and the thermo-siphon circulating effect is augmented. The result is that less water is needed for a given heating requirement, because the same water is used again and again at a much more rapid rate. The rate of heat transmission is also increased because the temperature difference or head between fuel and water is increased, due to the rapid circulation. Both of these results increase the operating economy.

Another advantage of the present construction is that, if the feed water has scale forming properties, its tendency to deposit scale on the inside of the heating walls is decreased, because of the scrubbing action of the rapidly moving water and steam bubbles over the heating walls. Scale ordinarily does most damage at the heating walls, because it lowers the capacity of the plate constituting the walls to transmit heat, whereby the efficiency of the boiler is lowered and the possibility of burning out the plate is increased. This invention, by reason of the closeness of skirts to heating surfaces, eliminates all of said disadvantages.

The purpose of increasing the distance between the cone skirt 49 and the flue 45 at their upper portions is to counteract the re-

duction in area of circulation which the cone construction would otherwise effect.

It may be seen that this invention also provides the maximum length of hot water film (between skirt and heating plate), as well as a maximum of flue passage for a minimum amount of water carried. The insulation about the boiler prevents or reduces loss of heat by radiation.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense, the scope of the invention being indicated in the following claims.

I claim:

1. A boiler comprising a shell containing water, an inner flue passing from end to end through said shell, a spaced skirt in annular relationship with respect to the water side of the outer wall of said shell and a spaced inner skirt in annular relationship with respect to the water side of the inner wall thereof, said skirts extending substantially the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, the space between skirts being open and free, and a heating flue spacedly surrounding the outer wall of the shell.

2. A boiler comprising a shell containing water, an inner flue tapering upwardly and passing through said shell, a spaced skirt within and in annular relationship with respect to the outer wall of said shell and a spaced inner skirt in annular relationship with respect to the inner wall thereof, said skirts extending substantially the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, and a heating flue spacedly surrounding the outer wall of the shell.

3. A boiler comprising a shell containing water, an inner flue tapering upwardly and passing from end to end through said shell, a spaced skirt in annular relationship with respect to the water side of the outer wall of said shell and a spaced inner skirt in annular relationship with respect to the water side of the inner wall thereof, said skirts extending substantially the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, said spaced inner skirt progressively receding from the upper portions of said inner wall, the space between skirts being open and free and a heating flue spaced from and surrounding said outer wall.

4. A boiler comprising a shell containing water, an inner flue passing from end to end through said shell, a spaced skirt in annular relationship with respect to the water side of the outer wall of said shell and a spaced inner skirt with an annular relationship with respect to the water side of the inner wall thereof, said skirts extending substantially the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, means for providing a flue passage around the outer wall of the shell connecting with th inner flue at the upper end of said inner flue and with a breeching at the lower end of the shell.

5. A boiler comprising a shell containing water, an inner flue passing from end to end through said shell, a spaced skirt in annular relationship with respect to the water side of the outer wall of said shell and a spaced inner skirt with an annular relationship with respect to the water side of the inner wall thereof, said skirts extending substantially the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, means for providing a flue passage around the outer wall of the shell connecting with the inner flue at the upper end of said inner flue, a breeching connected to the lower end of the shell and a by-pass damper connecting said breeching with the upper end of the flue passage around the outer end of the wall.

6. A boiler comprising a shell containing water, an inner flue passing from end to end through said shell, a spaced skirt in annular relationship with respect to the water side of the outer wall of said shell and a spaced inner skirt with an annular relationship with respect to the water side of the inner wall thereof, said skirts extending substantially the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, means for providing a flue passage around the outer wall of the shell connecting with the inner flue at the upper end of said inner flue and with a breeching at the lower end of the shell, and an upper drum, passages connecting said drum with the interior of said shell, said drum being in line with and spaced from said shell to form the connection between the outside flue passage and the inner flue.

7. A boiler comprising a shell containing water, an upwardly tapering inner flue passing from end to end through said shell, a skirt positioned in spaced relationship with respect to the water side of the outer wall of said shell, an inner skirt positioned in spaced and upwardly receding relationship with respect to the water side of the inner wall, said skirts extending the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, an upper drum, restricted passages connecting said drum with the interior of the shell, said drum being in line with and spaced from said shell, whereby a lateral flue passage is formed connecting with the inner flue, and a jacket forming a flue passage around the outer wall of the shell, said

last-named flue passage connecting with the lateral flue passage and a breeching connected to the lower end of the jacket.

8. A boiler comprising a shell containing water, an upwardly tapering inner flue passing from end to end through said shell, a skirt positioned in spaced relationship with respect to the water side of the outer wall of said shell, an inner skirt positioned in spaced and upwardly receding relationship with respect to the water side of the inner wall said skirts extending the greater parts of the wall lengths, said inner wall forming the wall of said inner flue, an upper drum, restricted passages connecting the drum with the interior of the shell, said drum being in line with and spaced from said shell, whereby a lateral flue passage is formed connecting with the inner flue, a jacket forming a flue passage around the outer wall of the shell, said last-named flue passage connecting with the lateral flue passage, a breeching connected to the lower end of the jacket and a by-pass connection between said lateral flue passage and said breeching.

In testimony whereof, I have signed my name to this specification this 8th day of March, 1927.

SAMUEL B. HARDING.