

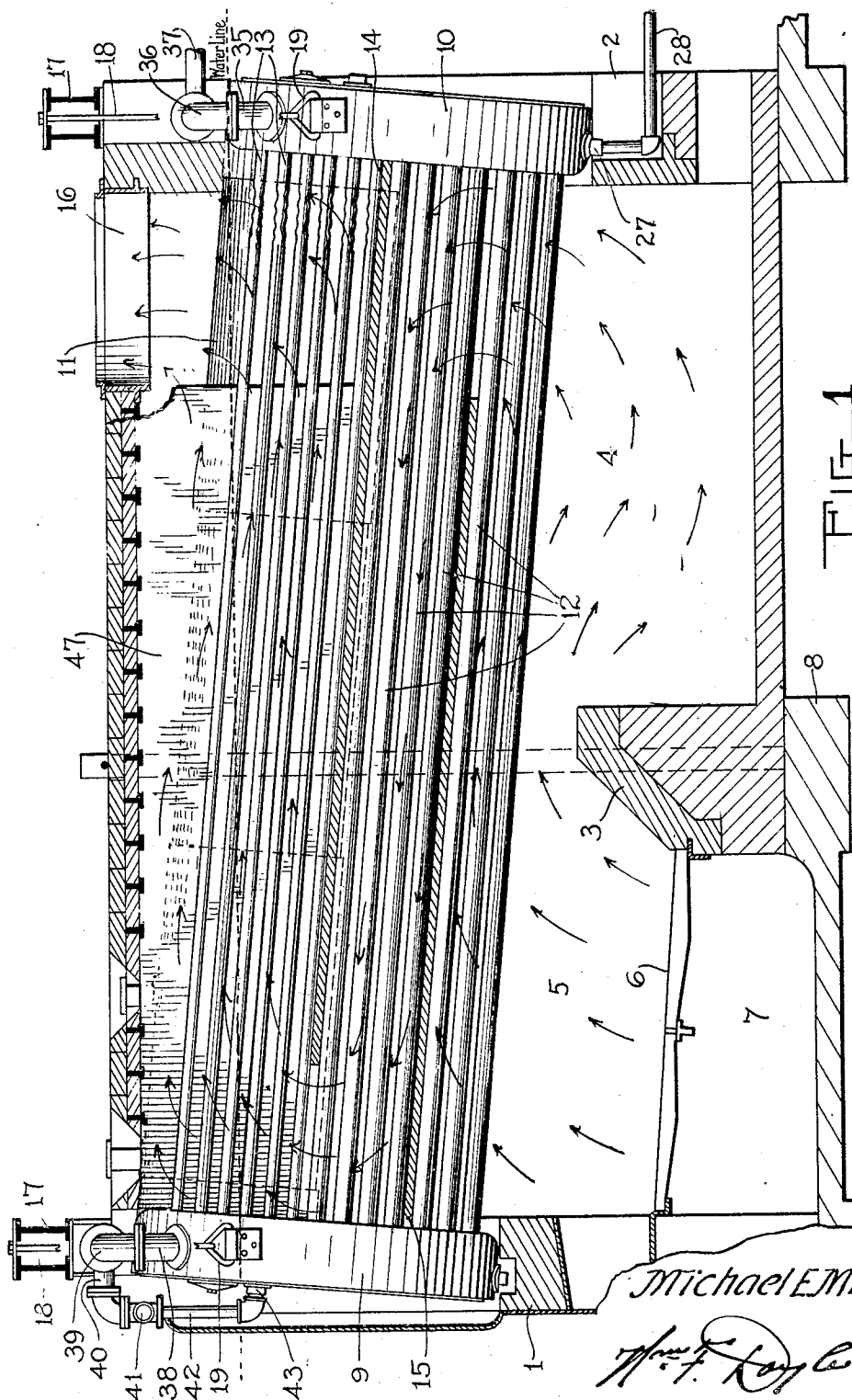
April 12, 1932.

M. E. MILLER

1,853,372

BOILER

Original Filed July 26, 1927 6 Sheets-Sheet 1



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M. E. MILLER

1,853,372

BOILER

Original Filed July 26, 1927. 6 Sheets-Sheet 2

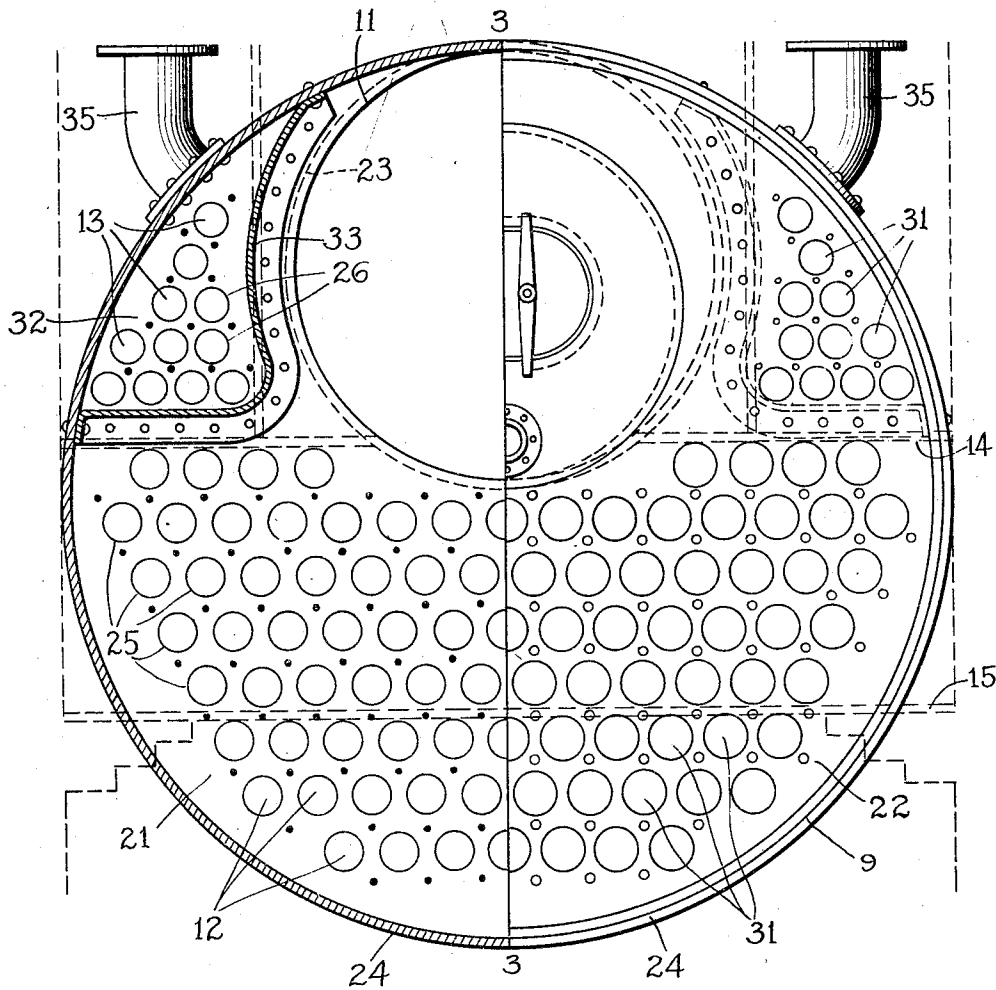


FIG. 2

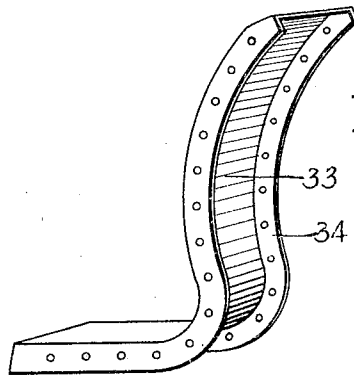


FIG. 9

Michael E. Miller,

Att'y.

April 12, 1932.

M. E. MILLER

1,853,372

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FIG. 3

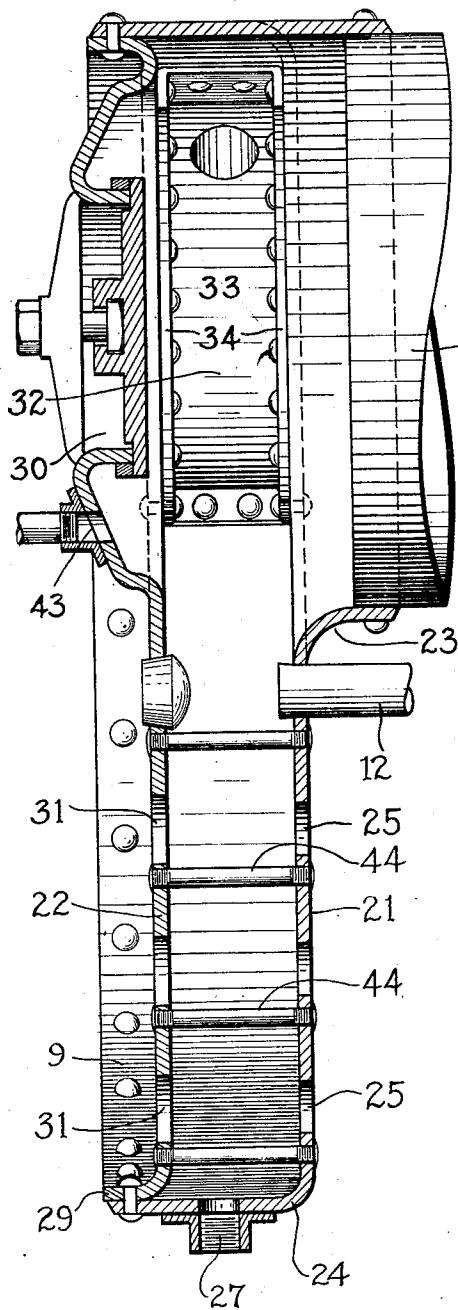
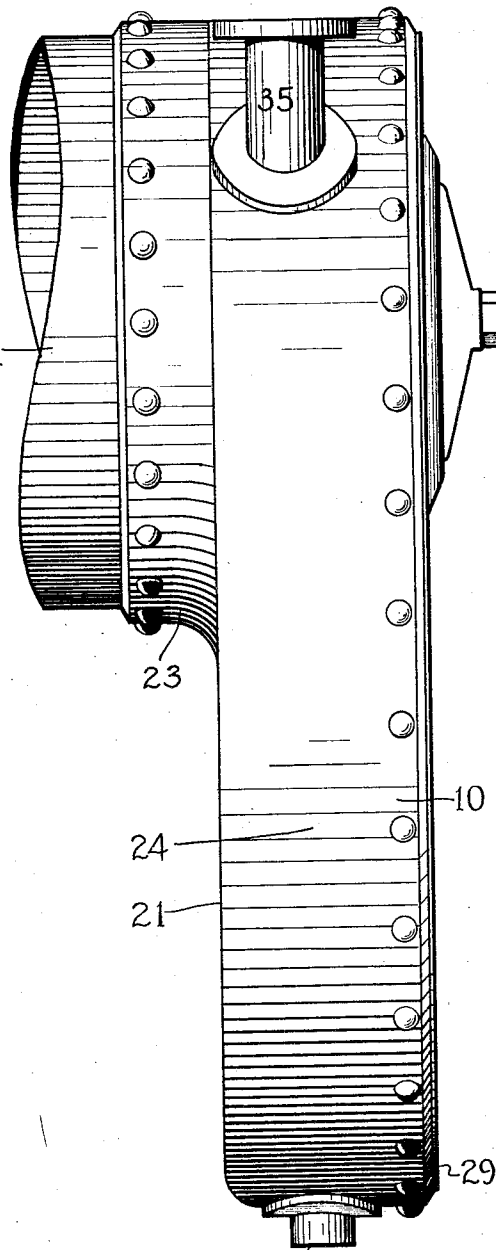


FIG. 4



Michael E. Miller,

Wm. F. Doyle.

Atty.

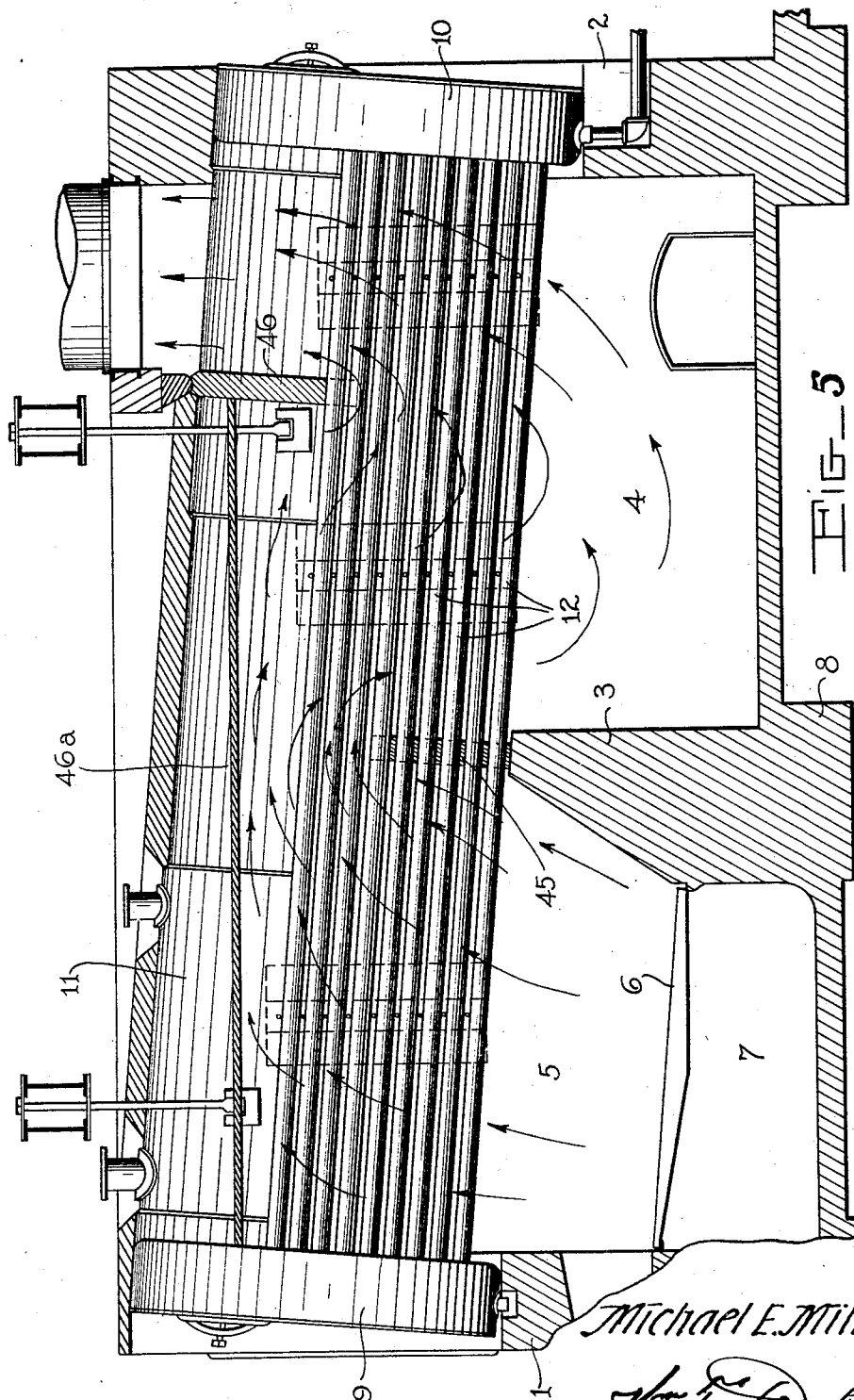
April 12, 1932.

M. E. MILLER

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BOILER

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Michael E. Miller,

Wm. F. Roy atty.

April 12, 1932.

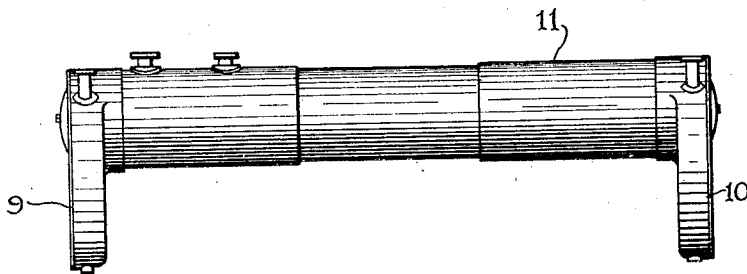
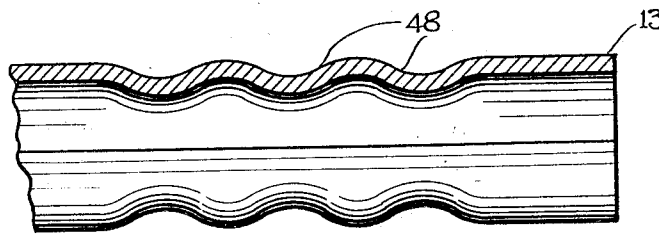
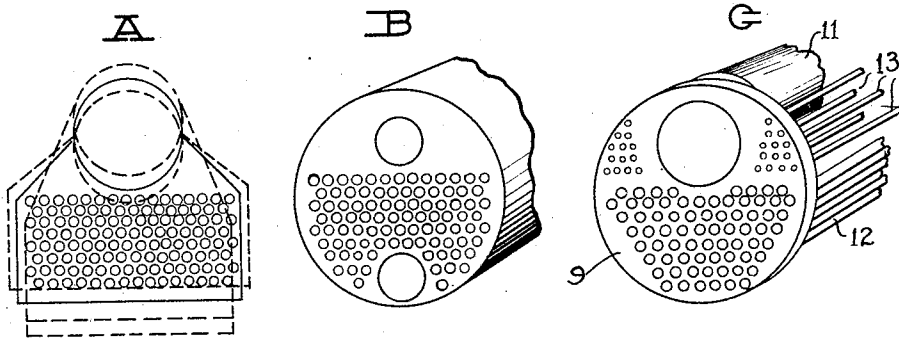
M. E. MILLER

1,853,372

BOILER

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6 Sheets-Sheet 5



Michael E. Miller,

H. F. Hoyle
att'y.

April 12, 1932

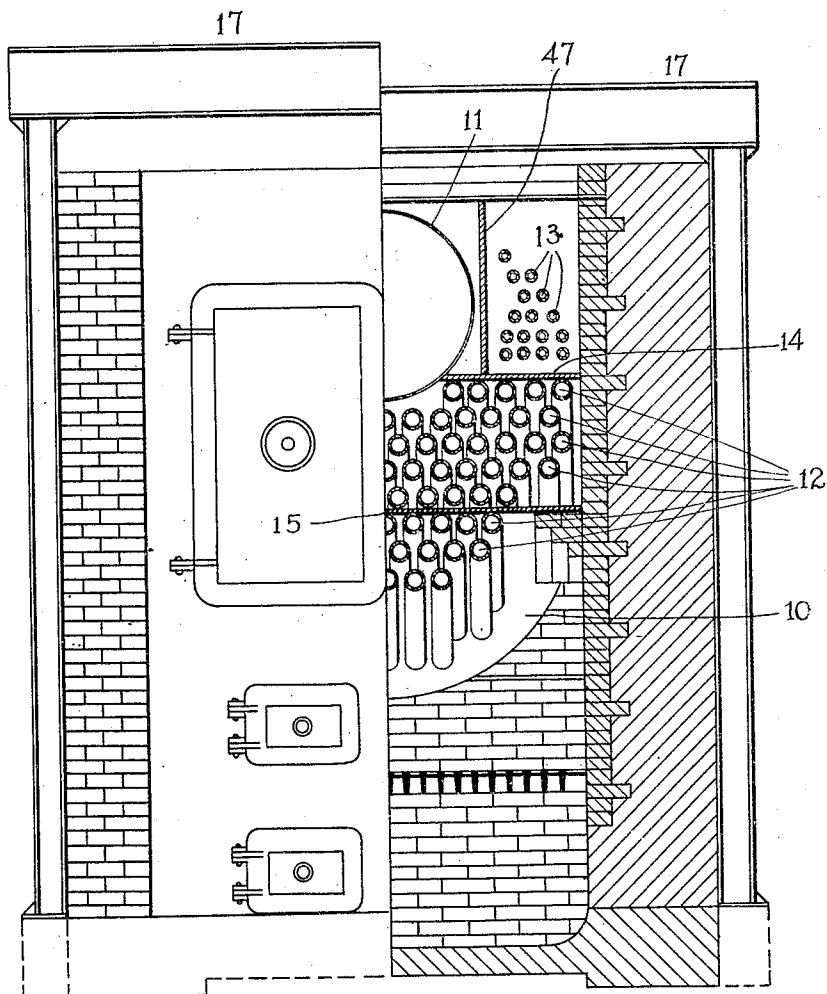
M. E. MILLER

1,853,372

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FIG. 10



Michael E. Miller,

M. E. Miller
ATTY.

UNITED STATES PATENT OFFICE

MICHAEL E. MILLER, OF WASHINGTON, DISTRICT OF COLUMBIA

BOILER

Application filed July 26, 1927, Serial No. 208,573. Renewed January 5, 1932.

(GRANTED UNDER THE ACT OF MARCH 3, 1883, AS AMENDED APRIL 30, 1928; 370 O. G. 757)

The invention described herein, if patented, may be manufactured and used by or for the Government for governmental purposes without payment of any royalty thereon.

This invention relates to improvements in boilers and more particularly to a water tube boiler having circular heads forming its water legs, said legs being connected by a steam drum beneath which are arranged the water tubes, the drum being flanked on both sides with nests of preheating water tubes connecting segregated compartments formed in the water legs on opposite sides of the ends of the drum, said preheating tubes being located in the last passes of the gases to the stack, the water in said tubes absorbing heat that would otherwise be wasted.

The objects of this invention are:

To utilize a greater portion of the heat units in the gases, and reducing the gases to the temperature of the steam or below this temperature. The heat units of the flue gases that would otherwise pass up the stack are absorbed by the nests of water preheating tubes arranged beneath the steam level.

To provide economically for expansion and contraction in the tubes by corrugating the ends of the preheating tubes only, wherein the water is brought to such a temperature, that when admitted to the water tubes it will not materially change in temperature.

To provide a boiler having self contained preheating means, that will eliminate the necessity of using live steam in feed water heaters (now in general practice), to bring the feed water to the proper temperature for admission into the boiler. The feed water in the preheating tubes being under the same pressure as that carried on the boiler permits of said feed water being heated beyond the boiling point before entering the steam generating space.

These and other objects will appear in the following description and be finally pointed out in the appended claims, it being understood that slight changes in form and minor details of construction may be resorted to without departing from the spirit of the invention.

Similar numerals indicate corresponding

parts in all the figures of the drawings, in which:

Fig. 1 is a side elevation of my improved water tube boiler showing the near wall of the furnace removed.

Fig. 2 is an enlarged end elevation of the boiler showing one-half of same in section on line taken between the sheets of the near water leg.

Fig. 3 is a vertical section taken on line 3—3 of Fig. 2.

Fig. 4 is a side elevation of the parts shown in Fig. 2.

Fig. 5 is a vertical sectional view similar to Fig. 1, of a modified form of boiler wherein the superheater tubes are omitted; vertical or horizontal baffle plates may be used and an upper plate arranged at the water level to prevent the gases coming into contact with the drum above the level of the water.

Fig. 6 shows diagrammatically different types of boilers, to assist in the understanding and arrangement of parts of this invention, as compared to other forms of boilers now in general use.

Fig. 7 is a detail of one end of one of the preheating tubes showing the expansion corrugations.

Fig. 8 is a side elevation on a reduced scale of the steam drum and circular water legs assembled, with the water tubes and preheating tubes omitted.

Fig. 9 is a detail perspective view of one of the partition plates adapted to be mounted in the water leg to provide the segregated portion thereof with which the preheating tubes are in communication.

Fig. 10 is a front view, one half section showing the improved boiler mounting.

Reference now being had to the drawings by numerals and to make clear the relative arrangements of parts of the improved boiler as compared to boilers now on the market, special reference is made to Fig. 6 in which the view marked "A" represents the form of boiler of the usual construction and referred to as a water tube boiler. The view marked "B" is a fragment of a fire tube boiler partly in perspective to show the shell. The view marked "C" is the improved type of water

tube boiler shown in perspective, to indicate the absence of the shell, the location of the water tubes, the preheating tubes, and the steam drum.

5 This invention is intended to provide a water tube boiler that will require little or no more head room than the ordinary fire tube boilers, will have the efficiency of the water
10 tube boiler, which at present exceeds that of the fire tube boiler and can be standardized with horizontal fire tube boilers for diameter, length of tubes and corresponding horse
15 powers, also to provide a boiler having a self-contained preheater whereby the waste gases can be utilized to heat the feed water or the preheating tubes used to superheat the steam.

The circular form of water leg shown in this invention eliminates difficulties experienced in the use of the present water tube
20 boilers, which are partly illustrated in Fig. 6, view "A" wherein is shown in dotted lines in a diagrammatical manner, the variations that exist in the forms of boilers legs now in
25 general use. The dotted lines indicate the variations in the lower rectangular portion of the water legs as put out by different manufacturers for a given horsepower, the angle or taper of the upper portion of the water
30 legs and the relative position of the steam drum.

With the present construction of the smaller sized tube boilers, additional head room is required, which results in increased building costs which in many instances become
35 prohibitive and necessitates the installation of the fire tube type of boiler, which again requires special large openings be left in walls for their admission or their installation before the walls are completed, both of these
40 objections are overcome by the improved round leg water tube boiler which can be assembled on the job and boilers up to 200 horse power can be taken through the ordinary 3 feet 6 inches by 7 feet door opening, and the
45 head room will not exceed that of the ordinary fire tube boiler. If a standard round leg water tube boiler such as herein submitted is adopted, no provision for special shape of water leg will be necessary, since standard
50 sizes of circular flanged heads suitable for forming the improved round water legs for different horse powers, are a standard product of the steel mills.

In illustrating this invention, the ordinary
55 form of furnaces as seen in Fig. 1 is used, wherein the front wall 1, the rear wall 2, the fire wall 3, the combustion chamber 4, the fire chamber 5, the fire grates 6, the ash pit 7, and cement foundation 8 are all of standard construction.
60

The boiler which is of the water tube type consists of circular water legs 9 and 10, said water legs being of a corresponding construction and are interchangeable, facilitating assembling and laying out. The water legs are

connected by a steam drum 11, arranged between the upper portions of the circular legs. Water tubes are arranged beneath the steam drum as shown at 12 and nests of preheating tubes flank the steam drum on both sides as shown at 13.

In the arrangement of the parts shown, horizontal upper and lower baffle plates 14 and 15 respectively are provided. A flue leading to the stack as indicated at 16 is provided for the passage of the gases from the combustion chamber beneath the lower baffle plate 15 rearwardly and then upwardly around the end of the same, forwardly between the baffle plates 14 and 15, around the forward end of baffle plate 14 and back on itself in a rearwardly direction to the flue 16, it being noted in the arrangement of baffle plates shown that the gases turn over three times which may be increased by a re-arrangement of baffle plates in either case insuring a perfect mixture of the gases, preventing stratification thereof and producing more complete combustion.

Numerous forms of boiler suspension are used in boiler setting and simply as a means of illustration, the improved boiler as shown is supported on pairs of I-beams 17—17, arranged across the front and rear walls of the furnace, from which depend links 18—18 connected at their lower ends to loops 19—19, secured to the water legs of the boiler.

The circular water legs 9 and 10 at the ends of the boiler, are identical in construction and a description of only one will be given. The water leg consists of a tube sheet 21 (see Figs. 2 and 3) and a hand hole sheet 22. The tube sheet is preferably provided with flanges 23 and 24, and also with openings 25 and 26 in which the ends of water tubes 12 and preheating tubes 13 respectively, are secured in the usual manner. An end of the steam drum 11 snugly fits flange 23 of the tube sheet and is secured thereto by rivets or other preferred means.

Drain or blow-off pipe opening 27 is provided at the lower portion of the water leg, from which pipe 28 (see Fig. 1) may extend to any desired point, it being noted that said drain or blow-off pipe is fully protected throughout its entire length, from the direct heat of the furnace. Hand hole sheet 22 is preferably shaped steel as is the tube sheet and is provided with a flange 29, adapted to fit within flange 23 of the tube sheet 21 and be secured therein in any preferred manner, to provide the hollow water leg. Said hand hole sheet has a large man hole 30 near its upper portion and tube replacing or clean-out openings 31 in line with each tube opening 25 in the tube sheet, said openings 30 and 31 being closed by plate and yoke, and key plugs respectively, in the usual manner.

Arranged in the water leg on each side of its connection with the steam drum, are segregated chambers 32 formed by plates 33 adapt-

ed to be secured by flanges 34 to the inner faces of the tube sheet and the hand hole sheet, to provide a space separate from the remainder of the space between said tube sheet and hand hole sheet.

As stated above the baffles can be changed so that the flue gases may be taken off at either end of the boiler, in which case the inlet and outlet openings to the preheating tubes would be reversed from that shown so as to produce a counter flow of the liquid in the tubes and the gases.

Communicating with the segregated chambers 32 at the lower end of the boiler are inlet pipes 35 as shown in Figs. 1 and 2 and connecting said inlet pipes is a yoke 36 adapted to receive and to supply water to the segregated chambers simultaneously, from the supply pipe 37. At the opposite or upper ends of the boiler are outlet pipes 38 in connection with the segregated chambers at the upper end of the boiler, said pipes 38 being connected by a T 39, which through pipe connection 40, valve 41 and pipe 42 conveys preheated water from the segregated chambers at the upper end of the boiler down to the water leg beneath the man hole opening 30 as shown at 43, Fig. 3. Said opening 43, (not shown) at the opposite or lower end of the boiler is provided with a removable plug (not shown).

Stay bolts 44 of the usual construction, either hollow, drilled ends or solid as shown are provided, having sufficient cross section and spacing for the required working pressure.

In Fig. 5 is shown a slightly modified form of the application of my improved boiler wherein the currents of the products of combustion follow different courses from that shown in Fig. 1. The baffle plates are arranged in a vertical position instead of in horizontal positions as shown in the preferred form.

It will be noted that baffle plates 45 cause the products of combustion to follow an up and down direction through the water tubes and that there are plates 46a arranged on opposite sides of the steam drum to prevent any contact between the products of combustion, and the steam drum above the water line.

For the same reason as described in the preceding paragraph vertical plates 47 as seen in Figs. 1 and 10 are provided on either side of the steam drum to prevent contact between the cooled gases of combustion and the steam drum above the water line. It will be understood that by the time the products of combustion have circulated about the water tubes and the preheating tubes and rise to the upper and rearward passages to the flue if the temperature therein has been reduced below that of steam, contact with the steam drum above the water line would be objectionable.

The operation of the structure shown in Fig. 1 provides for the flow of the products of combustion from the fire chamber, rearwardly under the lower baffle plate 15, then forwardly between baffle plates 15 and 14 and then again rearwardly to the flue. The plates 47 prevent contact between the products of combustion on their final rearward movement with the steam drum. It will be noted that the preheating tubes are arranged above the baffle plate 14 and are in what is termed the last gas pass on its passage to the flue and that during the passage of the gases or the products of combustion through said last gas pass the remaining heat therein or a large portion of it is taken up by the contents of the preheating tubes.

The arrangement of the parts here shown, provides for the circulation of the products of combustion about the water tubes in a direction opposite to the flow of water therein and further provides for the absorption of the heat left in the products of combustion when they have been reduced to such a degree as to be useless for steam generation and at the same time prevent contact of said gases of reduced temperature with the steam drum. The gases that are usually discharged direct to the flue are in this invention circulated through the preheating tubes.

This invention therefore provides for a combined boiler and preheater in a single unit, wherein water supplied through pipe 37 and T 36 enters the segregated chambers of the lower water leg, passes from said segregated chambers through the preheating tubes to the segregated chambers in the upper water leg, from thence, to the upper water leg, from which it enters the water tubes and is converted into steam, the latter collecting in the upper portion of the steam drum. The temperature of the water in its passage through the preheating tubes is brought to such a sufficiently high degree, as to avoid the necessity for providing for expansion in other than the preheating tubes as shown.

It is further noted that there is an unrestricted communication between the steam drum and the water legs, this as in numerous other particulars is different from the usual practice wherein the communication between the steam drum and the water leg is through slits arranged around a portion of the circumference of the steam drum. The construction here shown provides for free circulation and more rapid generation.

The construction shown provides for boilers of uniform shape for all horse powers, having the efficiency of the usual fire tube boiler, the minimum in volume of water required to be carried by the boiler, the minimum amount of metal required in its construction, diminishes the explosion hazard and includes in a single unit within said uniform shape a steam generator and a pre-

heater and utilization of heat ordinarily wasted.

In the construction shown, wherein all of the tubes including the water tubes and the preheating tubes are directly connected to the water legs, there is provided a structure wherein different temperatures are applied to the different tubes at different elevations, thus producing a greater expansion of the lower tubes as compared to those nearer the top of the generator, which may be provided with corrugations to compensate for the movement of the water legs due to irregular expansion of the tubes. It will also be understood that the inflow of cold water into the preheating tubes varies to a considerable degree, while the lower steam generating tubes remain at practically a uniform temperature, said corrugations provide for the movement of the water legs due to the irregular expansion of the tubes.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A water tube boiler having circular water legs, a steam drum connecting the water legs, segregated chambers arranged in the water legs at opposite sides of the steam drum connections, water tubes connecting the water legs, preheating tubes connecting the segregated chambers and means for supplying water to the segregated chambers of one water leg and from the segregated chambers of the other leg to the last named water leg of the boiler.

2. A water tube boiler having circular water legs, a steam drum, water tubes and preheating tubes arranged between the water legs within the diameter of the circular water legs and means for supplying water to the preheating tubes and means for conveying water from the preheating tubes to the water tubes.

3. A water tube boiler having circular water legs, segregated chambers arranged in the water legs, a steam drum and water tubes connecting the water legs within the diameter of said water legs, preheating tubes connecting the segregated chambers and means for supplying water to the segregated chambers of one water leg and from the segregated chambers of the other leg to the last named water leg of the boiler.

4. A water tube boiler having circular water legs, pairs of segregated chambers arranged in said legs, a steam drum and water tubes in communication with the water legs and preheating tubes connecting said segregated chambers of the water legs all within the diameter of said legs, means for supplying water to the segregated chambers of one water leg and means for conveying water from the segregated chambers to the water legs.

5. A water tube boiler having circular

water legs, a steam drum connecting the upper portion of the water legs, segregated portions in the water legs on opposite sides of the drum connections, water tubes connecting the lower portion of the water legs, corrugated preheating tubes arranged on either side of the steam drum connecting the segregated portions of the water legs, means for supplying the preheating tubes with water and means for conveying preheated water from the preheating tubes to a water leg.

6. A water tube boiler having circular water legs, a steam drum connecting the upper portions of the water legs, segregated chambers arranged in the water legs on opposite sides of the steam drum connections, preheating tubes arranged on each side of the drum and connecting the segregated chambers on corresponding sides of the steam drum, water tubes arranged below said steam drum and preheating tubes, connecting the water legs, means for supplying water to the segregated chambers of one leg and means for conveying water from the segregated chambers of the other leg, to the last named water leg of the boiler.

7. The combination with a furnace having a fire chamber, a flue and means adapted to form circuitous gas passes between the fire chamber and the flue, of a tilted water tube boiler having circular water legs, segregated chambers within the water legs, a steam drum and water tubes connecting the water legs, corrugated preheating tubes connecting the segregated chambers in the water legs and arranged in the last gas pass, said tubes and drum being all arranged within the diameter of the water legs, means for supplying water to said segregated chambers at the lower end of the boiler, means for conveying water from said segregated chambers at the upper end of the boiler to the water leg and a baffle arranged to prevent the gases coming into contact with the steam drum above the water line.

MICHAEL E. MILLER.