

BEST AVAILABLE COPY

W. H. WINSLOW.

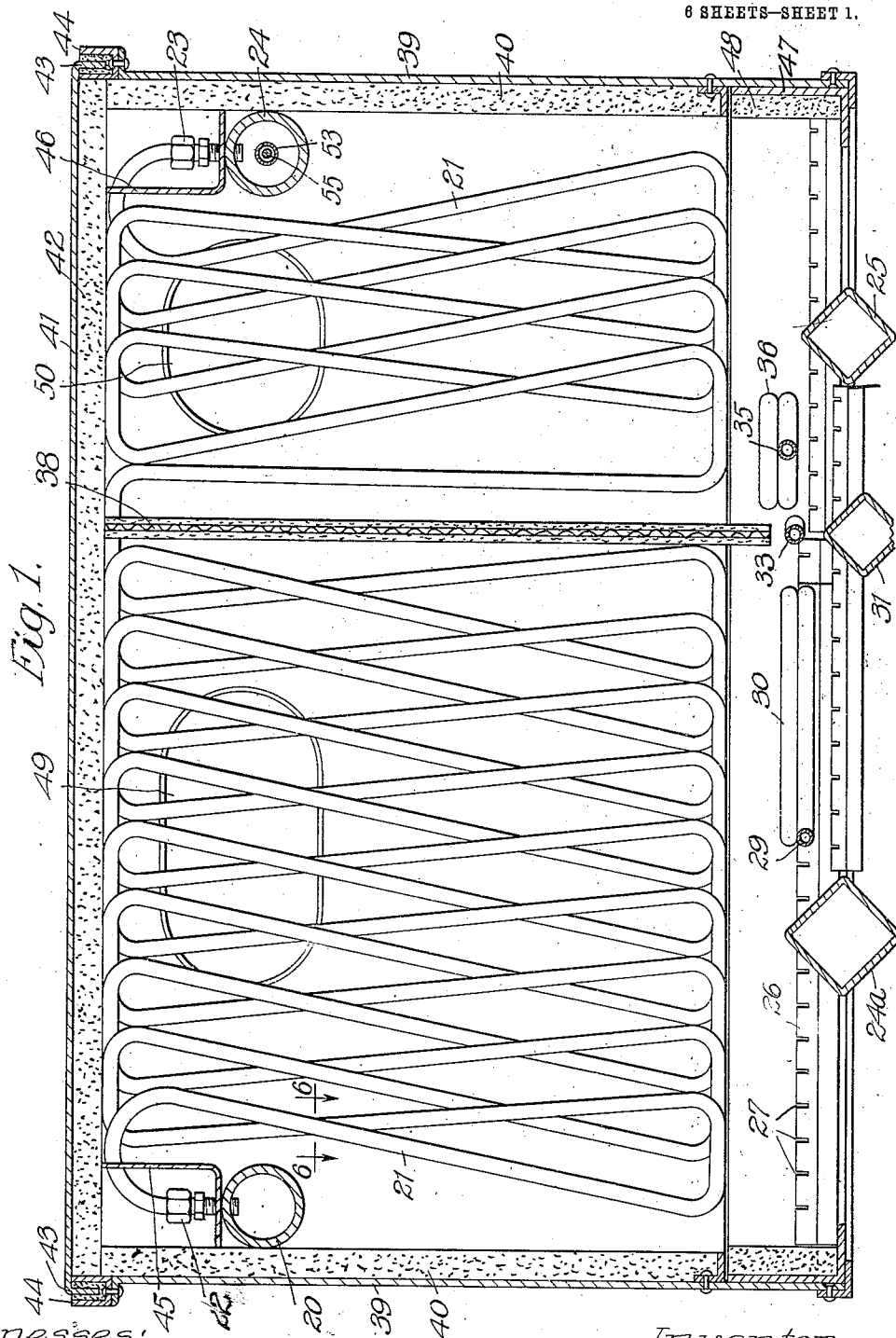
FLASH BOILER.

APPLICATION FILED JUNE 14, 1909.

1,065,418.

Patented June 24, 1913.

6 SHEETS-SHEET 1.



Witnesses:
Leonard W. Novander
George E. Higham

Inventor
William H. Winslow
By *Brown & Williams*
Attorneys

W. H. WINSLOW.

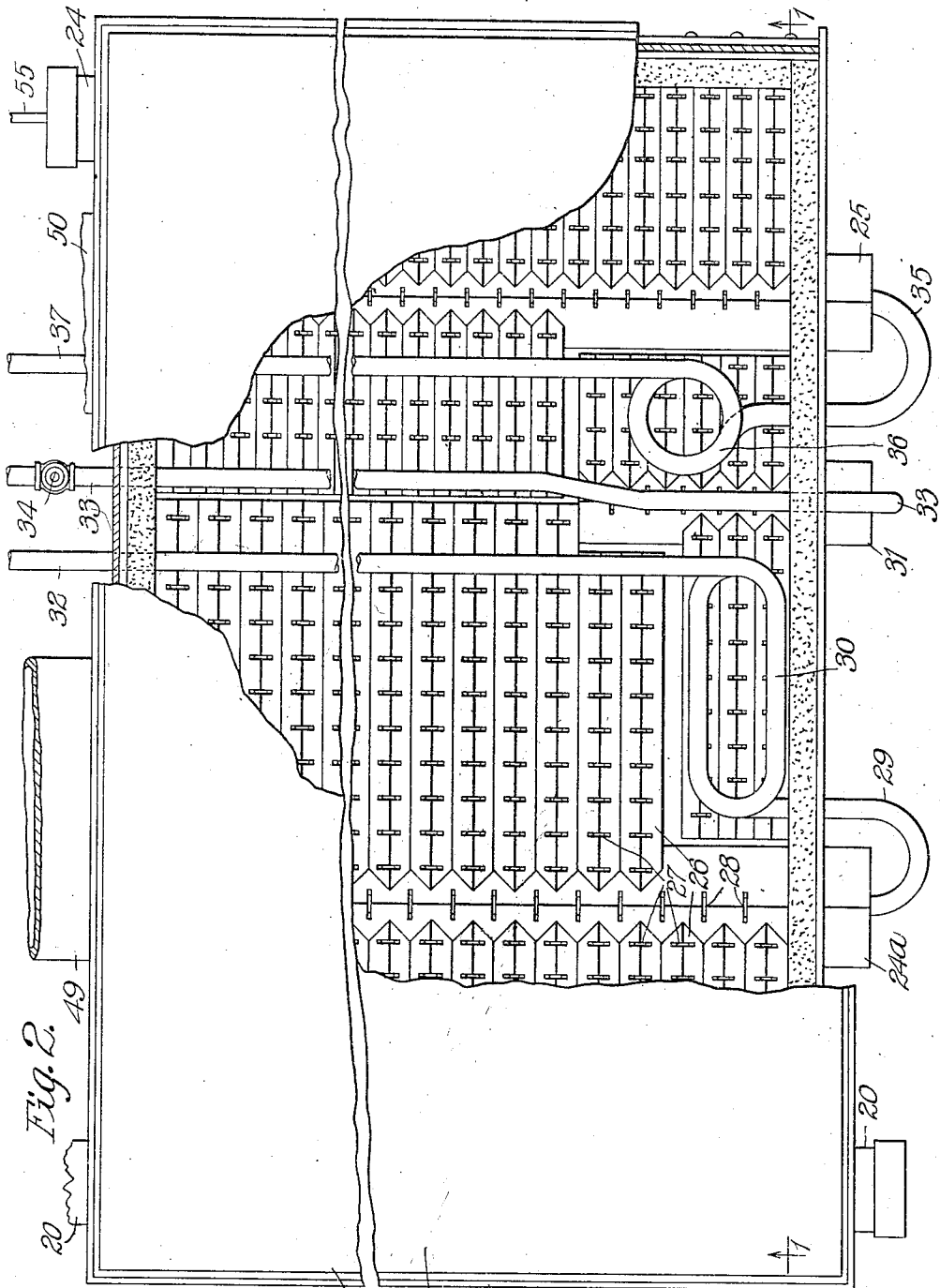
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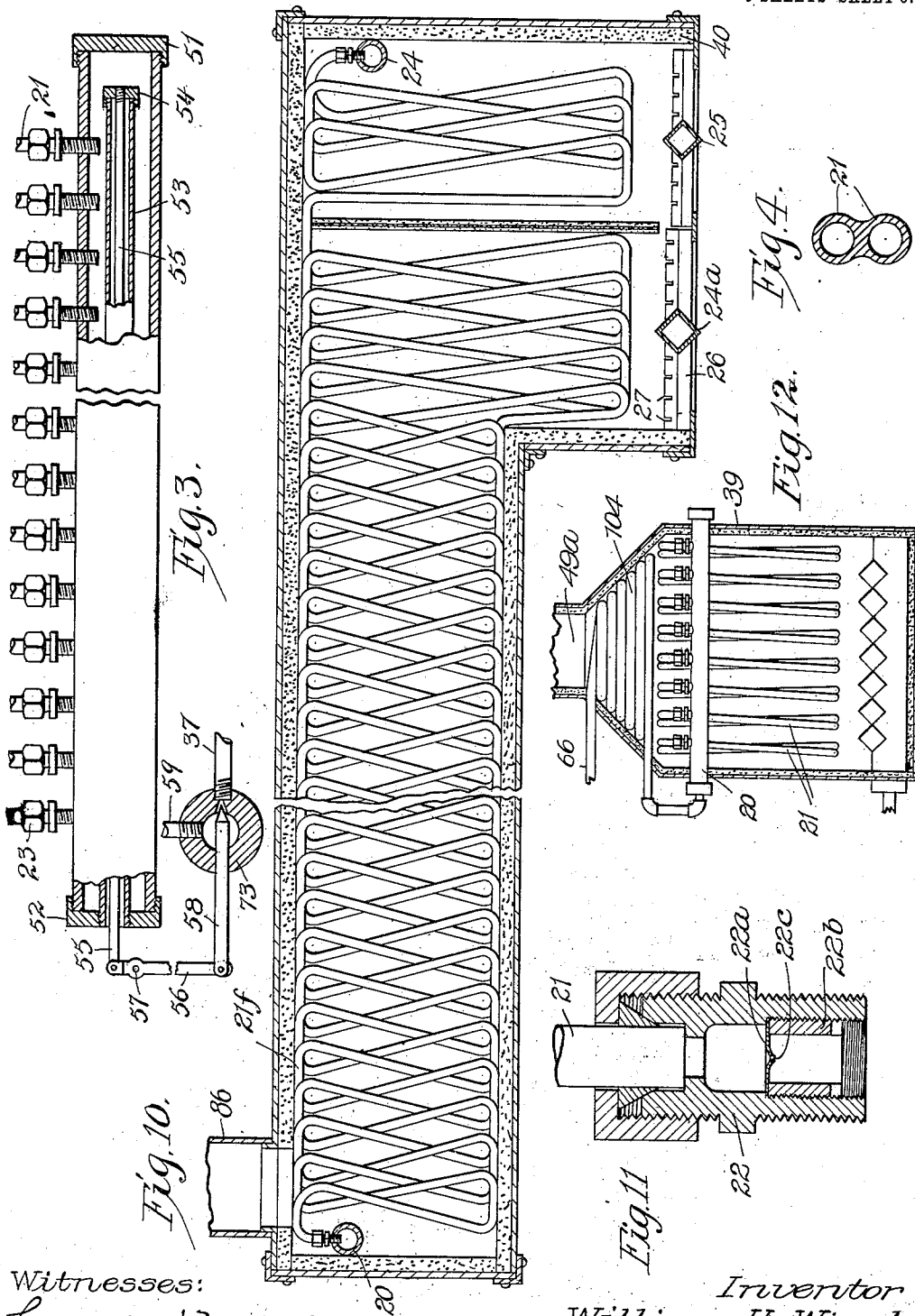
Inventor
William H. Winslow
By *Ground William*
Attorneys

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Inventor
William H. Winslow
By *Brown & Williams*
Attorneys

W. H. WINSLOW.

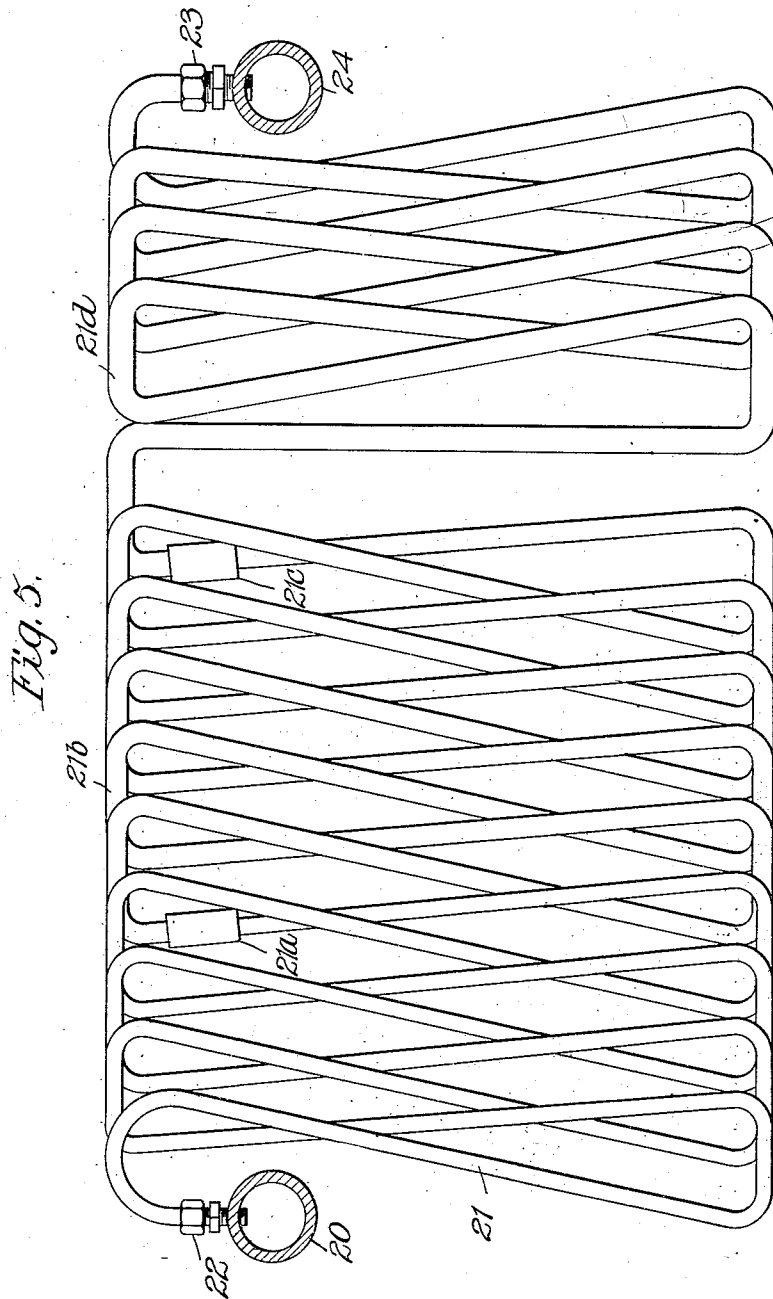
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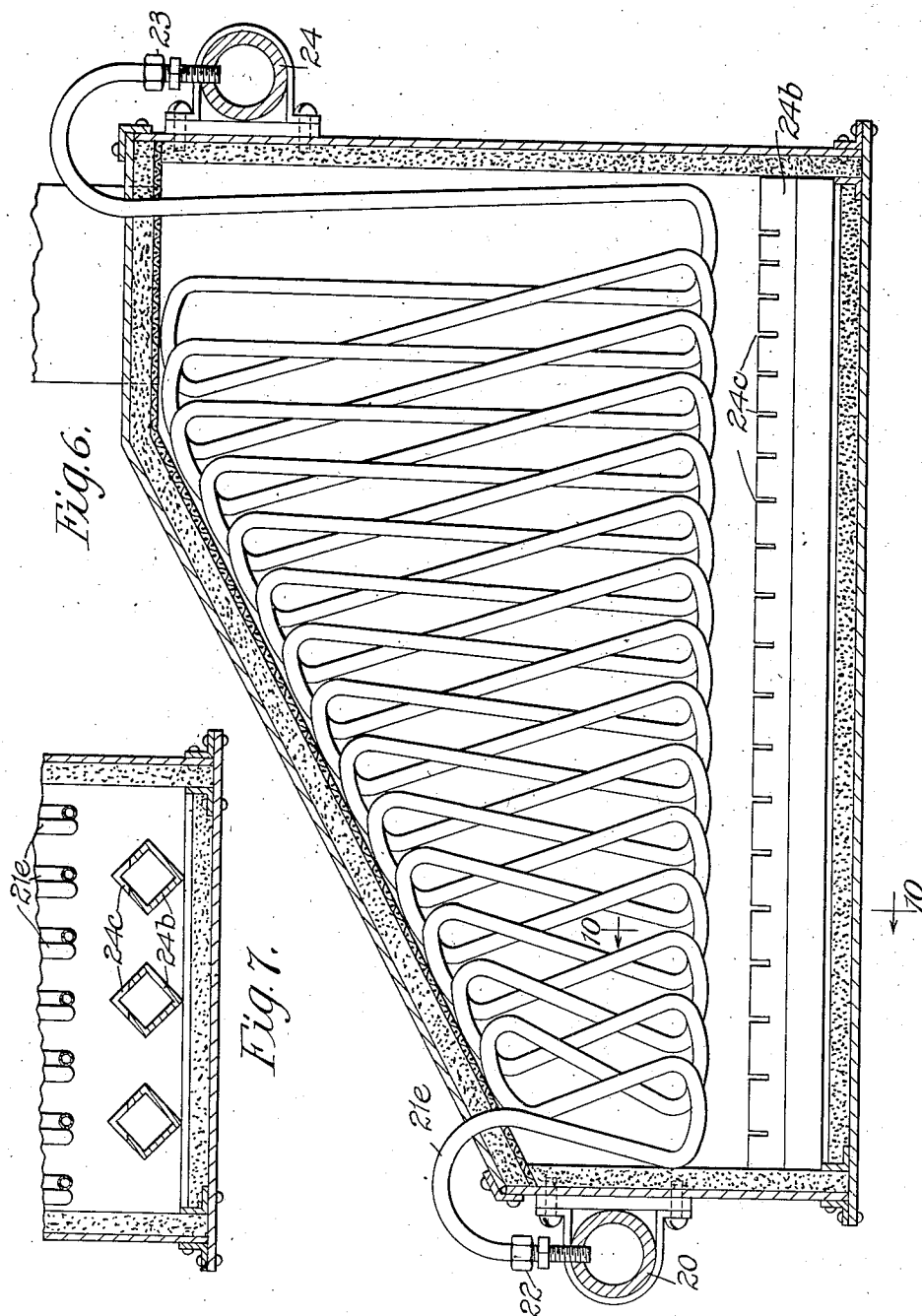
Inventor
William H. Winslow
By *George W. Williams*
Attorneys

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George C. Hggham.

Inventor
William H. Winslow
By *Brown & Williams*
Attorneys

W. H. WINSLOW.

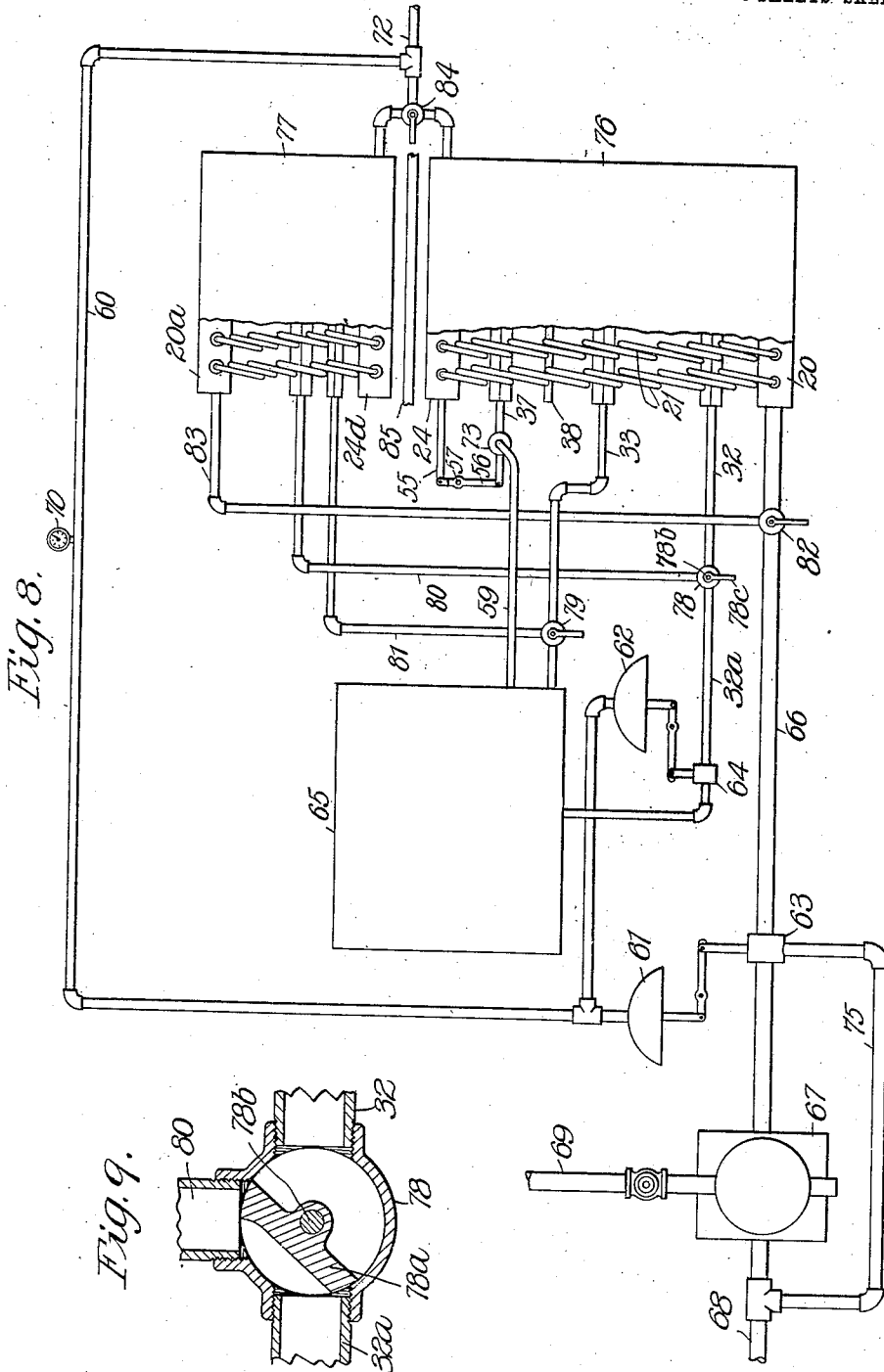
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6 SHEETS-SHEET 6.



Witnesses:
Leonard W. Novander
George C. Hyman.

By

Inventor
William H. Winslow
Brown & Williams
Attorneys

UNITED STATES PATENT OFFICE.

WILLIAM H. WINSLOW, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE STEAM POWER DEVICES COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

FLASH-BOILER.

1,065,418.

Specification of Letters Patent.

Patented June 24, 1913.

Application filed June 14, 1909. Serial No. 501,980.

To all whom it may concern:

Be it known that I, WILLIAM H. WINSLOW, a citizen of the United States, and resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Flash-Boilers, of which the following is a specification, and which is illustrated in the accompanying drawings, forming a part thereof.

My invention relates to that class of boilers known as flash boilers, in which one of the essential features is that water supplied to the boiler shall be converted instantly into steam: In boilers of this type practically no water supply is maintained in the boiler; but on the other hand the water is supplied to the boiler in a quantity corresponding to the amount of steam to be produced. In the past it has been proposed to accomplish the instantaneous conversion of water into steam by constructing boilers in which a water tube is so formed as to extend for a considerable length through a highly heated zone, the length of the tube or pipe being sufficient to so heat the water as to convert it into steam. For boilers of any considerable capacity this has necessarily resulted in the use of a tube of such a diameter that the water flowing therein could not at once be raised by the heat applied outside of the tube to a sufficient temperature to convert it into steam, and as a result the tube has necessarily been constructed of great length to give the necessary heating surface. Boilers constructed in this manner are comparatively heavy and difficult to make and repair; also on account of the large volume of water flowing through the tube it is a very difficult matter to properly regulate the amount of water supplied to the boiler to meet the varying demands placed upon it during actual use.

By my invention I conduct the water to be heated in a plurality of parallel paths from the water supply to the steam receptacle. Each of these paths consists of a tube of comparatively small bore, formed preferably in a plurality of vertically disposed loops to contain the necessary length of tube in small compass. Since these tubes are of small bore it is not necessary that they be of great length, as the heating surface is much larger in comparison to the volume of water flowing through the tube than is the case when tubes of comparatively large di-

ameter are used. By my construction I am able to reduce the size of the tubes to such an extent that material such as copper or brass, which has heretofore been considered too weak to use for this purpose, may be employed with safety and the desirable results of non-corrosion, ease of working and high heat conductivity may be secured.

My invention further consists in so arranging the parallel looped tubes that the water from the water connection or receptacle is introduced gradually into the heating zone. This may be accomplished in a number of ways, as I have shown in this application—for instance, the fire may be graduated so as to be of less intensity at the end of the tubes connected to the water receptacle and increased in intensity toward the steam receptacle, or again, loops in the tubes may be shorter at the ends connected to the water receptacle and gradually increased in length toward the steam receptacle, or a similar result may be accomplished by causing the heat from the fire to pass horizontally through the looped tubes, beginning at the ends of the tubes connected to the steam receptacle, as a result of which the heat is absorbed in a large part before it reaches the ends of the tubes connected to the water receptacle. Another way in which this result may be accomplished is by constructing the tubes of smaller diameter at the ends connected to the water receptacle and gradually increasing the diameter toward the ends connected to the steam receptacle.

My invention further consists in the arrangement of an emergency section of tubes that may be used temporarily in case of overload or in case the main section of the boiler is disabled. Means are employed with this construction to operatively connect either the main section or the emergency section, or both, as desired.

My invention further consists in providing means for equalizing the water distribution from the water receptacle to the plurality of tubes connected therewith, in order that each tube may perform its proper share of the work and that at no time any of the tubes may be filled with water.

In carrying out my invention I employ an improved form of burner which I have found to be cheap to manufacture and very effective in operation.

My invention also consists in housing all of the portions of the boiler and burners in

such a manner that their operation may be effective and that the parts may be readily removed for inspection or repair.

The several drawings illustrating my invention are as follows:—

Figure 1 is a vertical sectional view through my boiler, taken along the line 1—1 in Fig. 2; Fig. 2 is a plan view of the boiler with a portion of the top and tubes removed to show the arrangement of the burners; Fig. 3 is a detail view of the steam header or receptacle and shows the thermostatic means employed for controlling a portion of the fire by means of the temperature of the steam produced; Fig. 4 is a sectional view taken through the joint formed between two of the loops of the tube shown in Fig. 1 and is taken along the line 6—6; Fig. 5 is a detail view of a looped tube of the conformation shown in Fig. 1, the tube shown in this figure being of increasing diameter from the water receptacle to the steam receptacle; Fig. 6 shows a modified form of tube construction, in which the loops are gradually increasing in length from the water receptacle to the steam receptacle; Fig. 7 is a sectional view of the parts shown in Fig. 6, taken along the line 10—10; Fig. 8 shows a boiler consisting of a main and emergency portions; Fig. 9 is a detail sectional view of the valves used in the connections indicated in Fig. 8; Fig. 10 is a view showing in vertical section taken longitudinally of the boiler a modified form in which the heat from the burner is caused to pass horizontally through the loops of the tubes from the steam receptacle toward the water receptacle; Fig. 11 is a sectional view through a union used to connect one of the tubes to the water receptacle. In this union there is shown the means employed to equalize the water distribution to the several parallel tubes connected to the water header or receptacle; Fig. 12 shows an arrangement of boiler casing in which a feed water heater is located above the tubes of the boiler.

Similar letters refer to similar parts throughout the several views.

As shown in Figs. 1 to 4 inclusive, my boiler consists essentially of a water header or receptacle 20, to which a plurality of tubes 21 are connected by means of unions 22. The tubes 21 are bent into overlapping loops as indicated, which loops are disposed in substantially vertical planes and extend from one end to the other of the tubes. At their right hand ends, as shown in Fig. 1, the tubes are connected by means of unions 23 with a steam header or receptacle 24. The relation of the unions 23 to each other is shown in detail in Fig. 3. Each of the tubes 21 is secured together at its points of overlapping, as indicated in Fig. 4, by means of brazing or welding, which latter may be

accomplished by the oxy-acetylene flame, or they may be secured together at these points by means of suitable clamps. As thus secured together, each tube constitutes practically a truss and results in a very rigid construction requiring no particular support other than that naturally received from the casing of the boiler. Each tube thus formed is substantially vertically disposed in a continuous plane and all of the tubes together, located side by side between the water receptacle and the steam receptacle, practically fill the space indicated. As a result the fire passing upward from the burners 24^a and 25 is very effective in heating the water contained in the tubes. These tubes, it is to be noted, may be of very small inside diameter, as for example an eighth of an inch, on account of the large number of tubes that may be used in parallel arrangement. While the capacity of each tube is small, the combined capacity of all the tubes may be as large as desired.

A partition 38 is disposed vertically in the boiler casing between the main burner and the burner 25 which is thermally controlled by the temperature in the steam receptacle 24. The partition 38 consists of a reinforcing central portion of metal, as steel, upon either side of which insulating material is secured to prevent the ready transfer of heat from one portion of the boiler to the other.

The looped tubes, the water and steam receptacles and the several burners are all inclosed in a common casing 39 of sheet metal, which is lined with heat insulating material 40. A cover 41 is provided, which has secured to its under side a layer of similar insulating material 42. The edges of the cover 41 are bent down as indicated at 43 to enter a groove or channel 44 formed around the upper edge of the side walls of the boiler casing. The groove or channel 44 is filled with insulating material after the cover is put in place, such material being in the form of paste preferably, which in drying out forms a seal and yet does not prevent the ready lifting of the cover in case of accidental explosion of the boiler. The unions 22 are surrounded by a wall 45 to protect them from the action of the heat. The unions 23 are similarly surrounded by a protecting wall 46. The casing 39 carries in its lower portion a drawer or tray 47 which is arranged to support the several burners 24^a, 25 and 31 in such a manner that all of these burners and the fuel heat coils disposed above them may be removed from the casing when desired without disarrangement of the burners and fuel coils. The drawer or tray 47 is lined with a heat insulating material 48 to protect the casing and drawer and to also prevent undue radiation of heat from the boiler. The water

and steam receptacles 20 and 24 are supported at their ends by the casing 39 and the tubes where they pass over the partition 38 rest in notches formed therein, as a result of which by removing the cover 41 all of the tubes and the water and steam headers, together with the partitions 45 and 46, may be removed in their assembled condition for purpose of inspection or repair. Furthermore, without removing all of the tubes and the water and steam headers, any tube may be removed by undoing its unions 22 and 23 and lifting such tube from the boiler.

Flues for receiving the products of combustion are indicated at 49 and 50 in Fig. 1. The connection of the several tubes 21 to the steam receptacle 24 is indicated in Fig. 3.

In Fig. 5 there is shown the manner of constructing the tubes 21 by which these tubes may consist of a plurality of sections of different diameters. As shown in this construction a portion of the tube 21 connected to the water receptacle 20 is of comparatively small diameter and is connected by the coupling 21^a to a second section of the tube 21^b of larger diameter than the section indicated at 21. Section 21^b is in turn connected by a coupling 21^c with a third section 21^d of larger diameter than the section 21^b. The section 21^d is connected to the steam header or receptacle 24. This construction provides an increasing cross section for the accommodation of the steam produced as the water progresses from the water receptacle to the steam receptacle. This is as it should be, since the water occupies very much less space in that portion of the tube adjoining the water receptacle from what it does in the portion of the tube nearer the steam receptacle after having been converted into steam. By the construction indicated it is possible to proportion the tubes for any particular operation found in practice and to provide a cross section sufficient in every case to take care of the steam produced without offering serious resistance to the flow of the steam through the tube. The operation described is further provided for by means of mechanism I prefer to use in connection with the unions 22 used for connecting the tubes 21 to the water receptacle. This mechanism is shown in detail in Fig. 11 and consists in a disk 22^a of thin non-corrosive material, as nickel, which is held in place in the body of the union 22 by means of a hollow nut 22^b screwed into the end of the union 22. The disk 22^a is provided with a small perforation 22^c at its center, which perforation is so formed that the central portion of the disk projects toward the lower end of the union 22, as shown in Fig. 11. The perforated disk 22^a serves to restrict the amount

of water which may pass through it for any given pressure in the water receptacle 20 and thus serves to provide a correspondingly large volume in the tube 21 relatively to the volume of water delivered to the tube for the production and accommodation of steam in the tube. The perforated disks 22^a also serve to equalize the water flow from the water receptacle 20 to the tubes 21, especially in starting the boiler, since these disks at once by limiting the flow of the water, serve to establish a back pressure in the water receptacle and thus to cause a practically uniform flow of water through all of the apertures 22^c. It has been found, however, that while it is desirable to use a restricted opening as provided by these disks at the ends of the tubes 21 connected to the water receptacle, that such restricting disks or diaphragms are not absolutely necessary, since during the operation of the boiler the pressure generated in each tube will automatically control the amount of water supplied to the tube and the resultant operation of all of the tubes is to equalize the amount of water supplied to the several tubes and to therefore equalize the amount of steam produced by the tubes. As pointed out, however, the restricted openings referred to have a decided value in equalizing the water flow into the several tubes when the operation of the boiler is begun and they assist in the efficient operation of the boiler while it is in use. The gradual introduction of the water into the heating zone may also be accomplished by means of a construction shown in Fig. 6. In this arrangement the looped tubes 21^e extending between the water receptacle 20 and the steam receptacle 24 are formed so that the lower ends of the loops are practically in line, as in the modifications described above, but the loops adjacent to the water receptacle 20 are comparatively short and increase in length toward the steam receptacle 24, as a result of which the fire is not afforded as great heating surface on the loops near the water receptacle as it is on the loops near the steam receptacle, and thus the water is not introduced at once to the point of maximum heating but is gradually heated and is thus more certain to approach the middle portion of the tube before being converted into steam. This operation may be further accomplished by means of the construction of the burner, as indicated in Figs. 6 and 7. The burner used in this modification consists in several square tubes 24^b placed on edge and extending in a direction under the tubes 21^e parallel with the planes of such tubes. The tubes are supported on their corners, and the upper corners are slotted, as indicated at 24^c, such slots being closer together under the portion of the tubes 21^e connected to

the steam receptacle than they are under the portion of the tubes connected to the water receptacle, as a result of which the intensity of the fire is less under the latter portion of the tubes than what it is under the former portion of the tubes.

In the boiler and system of control, shown in Fig. 8, I have provided a main section of boiler 76 and an emergency section 77, each similar in its construction to the boiler shown and described in Figs. 1 to 4 inclusive. In this boiler arrangement the pipes 32, 33 and 37 supply fuel from the fuel tank 65, to the main, the pilot and the thermally controlled section of the burner of the main section 76 of the boiler. The pipes 32 and 33 are connected by means of three-way valves 78 and 79 through pipes 80 and 81 with the main and pilot sections respectively of the emergency section 77 of the boiler. The amount of fuel supplied through the pipes 32 and 37 is controlled by means of the mechanism 62 and the valve 73 respectively, as described above, the controlling mechanism 62 being connected through the pipe 60 with the steam header 24, as indicated. The pipe 60 also connects with the controlling mechanism 61 for regulating the amount of water supplied through the pipe 66 to the water receptacle 20, as above described. The pipe 66 is provided with a three-way valve 82 connected to the water receptacle 20 of the main section 76 of the boiler and by means of pipe 83 to the water receptacle 20^a of the emergency section 77 of the boiler. The emergency section 77 is provided with a steam header 24^a connected with the steam header 24 and with the pipe 60 through a three-way valve 84. The emergency and main sections of the boiler are preferably separated by an insulating partition 85. Each of the three-way valves 78, 79, 82 and 84 is constructed preferably, as indicated in detail sectional view in Fig. 9, for the valve 78. As shown in this figure a movable vane 78^a is disposed in the casing in such a manner as to be turned by the stem 78^b when such stem is rotated by the handle 78^c shown in Fig. 8. When the vane 78^a occupies the position indicated in Fig. 9 the tank 65 is in communication through the valve 64 with the pipe 80. When the vane 78^a is moved from the position indicated in Fig. 9 around to the right a sufficient amount for its lower edge to enter the opening connected with the valve 64 by the pipe 32^a, fuel is communicated by the pipe 32^a to both of the pipes 32 and 80 and thus to the burners of the main and emergency sections of the boiler. Further motion of the vane 78^a serves to move the lower left hand edge of the vane beyond the opening connected with the pipe 32^a without, however, causing the upper right hand edge of the vane to enter the

opening connected with the pipe 32, for which position communication with the pipe 80 is cut off and the fuel supplied by the pipe 32^a is delivered only to the pipe 32. By means of the relation described between the main and emergency sections of the boiler, the valves 78, 79, 82 and 84 may be caused to normally occupy a position such that communication with the pipes 80, 81, 83 and the steam header 24^a is cut off. Under conditions requiring the development of an unusual amount of power by the boiler, the valves mentioned are turned to a position such that each valve communicates with both of its delivery pipes, that is, that the fuel supplied by the pipe 32^a is delivered to both of the pipes 32 and 80; that the fuel supply through the valve 79 is delivered to both of the pipes 33 and 81; that the pipe 60 is connected through the valve 84 with both of the steam headers 24 and 24^a and that the water headers 20 and 20^a are both connected through the valve 82 with the pipe 66. For this position of the valves an amount of steam is developed that is in excess of that normally contemplated in the operation of the boiler, thus permitting a large percentage of overload when desired. A further function of the emergency section is that by moving the valves referred to to a position to cut off communication with the pipes 32, 33, the water header 20 and the steam header 24, the emergency section 77 may be used alone and is designed to be capable of supplying enough power to drive the engine or other motor temporarily.

The arrangement of boilers described is particularly valuable for use on automobiles, since in the event of conditions arising that call for an abnormal amount of power, both sections of the boiler may be used together, and again if for some reason defects develop in the main section of the boiler at such a time that it is desirable to run the automobile to return home or to a repair shop, the emergency section may be used alone. Furthermore, by separating the two sections it is possible in the event of defects developing in some one of the tubes of the main section, to run a short time on the emergency section while the main section is cooling, so that it may be inspected and if possible repaired on the road. Defects that may arise in connection with any individual tube of either section may readily be overcome by removing the defective tube and inserting a new tube, since extra tubes may readily be carried for this purpose.

In Fig. 10 a construction of boiler is shown in which the tubes 21¹ extend for a considerable distance horizontally between the water header 20 and the steam header 24. The depth of the loops vertically is comparatively small, as is also the number

of tubes employed, as a result of which a boiler of small vertical cross section and relatively great length is produced. In this modification the burners are arranged under the right hand end of the tubes 21', as shown in Fig. 10, at which end such tubes are conformed in longer loops than at the other portion of the tubes. This is for the purpose of increasing the heating surface immediately over the burners. The fire after passing from the burners is caused to pass horizontally through the loops of the different tubes toward the water receptacle 20 before it can pass out through the flue 86. In this way the temperature of the gases resulting from the combustion decreases as they pass to the left, as shown in Fig. 10, through the loops of the tubes 21' and the water entering from the water header is therefore gradually introduced into the heating zone and each loop is therefore caused to operate in a relatively effective manner. This construction of boiler is particularly adapted for use upon automobiles, since in such connections a comparatively small cross section vertically is available while a considerable length is at the disposal of the designer for the motive apparatus.

As shown in Fig. 12 the casing 39 of the boiler may be extended upward to a centrally disposed delivery flue 49^a and in the space thus left within the casing over the tubes 21, a coil 104 is placed, which is connected between the water supply pipe 66 and the water header 20. In this manner the heat remaining in the gases resulting from the combustion of the fuel after passing through the tubes 21, may be in part utilized to heat the feed water before it is supplied to the water receptacle 20.

Attention is called to the fact that in any modification of my boiler the heating tubes are so looped that the loops of each tube lie in practically a vertical plane and that the planes of the several tubes used are substantially parallel. Also, that the spacing of the tubes from each other is such that the adjacent tubes are nearly in contact with each other. This arrangement serves to completely fill the space above the burner with heating loops and to thus effectively utilize the fire produced by the burner. I have found it desirable to arrange the looped tubes in vertical planes, in order to prevent a free and uninterrupted flow of water from the water header to the steam header. Such an arrangement would be undesirable, since in the early stages of the transformation of the water into steam, only a portion of the water is so transformed and the steam produced at this time is relatively wet. As a result, a considerable amount of moisture must still be evaporated from the steam to de-

liver only steam that is dry and efficient to the steam receptacle. If the loops of the tubes were arranged in horizontal planes without the use of vertical risers, the water carried by the steam in its wet condition would pass with comparative freedom through the remaining length of the heating tubes and there would be considerable danger of delivering steam in wet condition. By disposing the loops of the tubes in vertical planes, this danger is entirely eliminated, since any water carried by the wet steam at its initial production is trapped by the lower portions of the loops and must be lifted against the action of gravity to pass into succeeding loops. The water, therefore, has a tendency to remain in the lower ends of the loops where it is effectively acted upon by fire from the burner. In this way I prevent the production and delivery to the steam receptacle of wet steam.

My boiler construction is particularly well adapted for repair in case of accident, since if one of the heating tubes is disabled for any reason, it may readily be removed from the boiler without taking the boiler apart and the unions may either be plugged or a new tube may be inserted. Either of these operations is readily accomplished and the plugging of the unions particularly constitutes a convenient means for temporarily repairing the boiler, in order that an automobile upon which it may be in use may reach its destination. The use of copper tubes in this connection is also particularly advantageous in that in the event of difficulty in any of the heating tubes as a result of which any of the tubes may burst, the material being comparatively soft and fibrous will yield with little or no damage to other parts of the boiler, whereas, the use of other stronger materials of greater hardness, such as steel, might result in an explosion under similar circumstances, that would seriously disable some of the rest of the mechanism. If an explosion should occur with my construction it can only be comparatively small, on account of the small size of the tubes used and therefore the danger of injury, either to the apparatus or to the occupants of an automobile or persons near the boiler when it is in operation, is reduced to a minimum.

While I have shown my invention in the particular modifications shown and described above, I do not wish to limit myself to these constructions, but desire to claim broadly any equivalents that may suggest themselves to those skilled in the art.

What I claim is—

1. In a boiler, the combination of a water supply connection, a steam connection, and a plurality of looped tubes extending between such water and steam connections, the loops of each tube formed in substantially

the same plane in the shape of a figure 8, and similarly disposed loops overlapping each other and fused together at points of crossing.

2. In a boiler, the combination of a water receptacle, and a tube of small bore connected therewith and bent into vertically extending overlapping loops, such tube having sections of larger internal diameter as the distance from the water receptacle increases.

3. In a boiler, the combination of a water receptacle, and a tube of small bore connected therewith and bent into vertically extending overlapping loops, such tube consisting of a plurality of sections of different internal diameters, and diameters increasing for successive sections.

4. In a boiler, the combination of a water receptacle, and a plurality of tubes of small bore connected therewith and extending to a separate steam receptacle and bent into vertically extending overlapping loops, one or more of such tubes consisting of a plurality of sections of different internal diameters.

5. In a boiler, the combination of a water supply connection, a steam connection, and a plurality of looped tubes extending in substantially vertical planes between such water and steam connections, the loops of each tube formed in the shape of a figure 8, and similar loops overlapping each other and fused together at points of crossing, such loops increasing in capacity as the distance from the water connection increases.

6. In a boiler, the combination of a water receptacle, a separate steam receptacle, a plurality of parallel tubes formed in vertically extending overlapping loops from the water receptacle to the steam receptacle, the loops of each tube fused together at points of crossing, such tubes being removable and insertible without disturbing the remaining tubes.

7. In a boiler, the combination of a water receptacle, a separate steam receptacle, a plurality of parallel tubes formed in overlapping loops extending from the water receptacle to the steam receptacle, the loops of each tube secured together at points of crossing, union connectors for connecting such tubes to such receptacles, and heat resisting walls inclosing such union connectors to protect the same from the fire under the tubes.

8. In a boiler, the combination of a water header, a steam header, a plurality of tubes of comparatively small bore extending in vertical loops from the water header to the steam header, and restricting diaphragms associated with the tubes at the water header for equalizing the distribution of the water to such tubes.

9. In a boiler, the combination of a water header, a steam header, a plurality of tubes

of comparatively small bore bent into vertical overlapping loops between the water header and the steam header, and a casing surrounding such headers and tubes, such headers and tubes together removable from the casing without disconnection from each other.

10. In a boiler, the combination of a steam connection, a water connection, two water headers connected with the water connection, two steam headers connected with the steam connection, a main set of tubes extending from one of the water headers to one of the steam headers, an auxiliary set of tubes extending from the other water header to the other steam header, and valves for operatively connecting either set of tubes as desired.

11. In a boiler, the combination of a steam connection, a water connection, two water headers connected with the water connection, two steam headers connected with the steam connection, a main set of looped tubes extending in substantially vertical planes from one of the water headers to one of the steam headers, an auxiliary set of looped tubes extending in substantially vertical planes from the other water header to the other steam header, a common casing for the connections and tubes, and valves for operatively connecting either or both of such sets of tubes as desired.

12. A water coil for a boiler, comprising a tube of comparatively small bore formed in overlapping loops sufficiently close to the plane of the coil so that such coil at no point is more than twice the thickness of the outside diameter of the tube.

13. In a boiler, the combination of a water header, a separate steam header at substantially the same level as the water header, and a plurality of tubes of comparatively small bore extending between the water header and the steam header to afford a plurality of parallel passages for the flow of water from the supply connection to the steam header, such tubes formed in loops to trap the water as it passes from the water header to the steam header after it has been partially converted into steam.

14. In a boiler, the combination of a water header, a separate steam header at substantially the same level as the water header, and a plurality of tubes of comparatively small bore extending between the water header and the steam header to afford a plurality of parallel passages for the flow of water from the supply connection to the steam header, such tubes formed in vertical loops to require pressure upon the water in the water header to force the water through such loops.

15. In a boiler, the combination of a water header, a separate steam header, and a plurality of tubes of comparatively small bore extending between the water header and the

steam header to afford a plurality of parallel passages for the flow of water from the supply connection to the steam header, such tubes each formed in vertical overlapping loops to prevent the flow of water from the water header to the steam header under the action of gravity.

16. In a boiler, the combination of a water header, a separate steam header, and a plurality of tubes extending from the water

header to the steam header, such tubes each formed in overlapping vertical loops and each constituting a flat coil insertible and removable without disturbing the other coils.

In witness whereof, I hereunto subscribe my name this 11th day of June, A. D. 1909.

WILLIAM H. WINSLOW.

Witnesses:

ALBERT C. BELL,

LEONARD W. NOVANDER.