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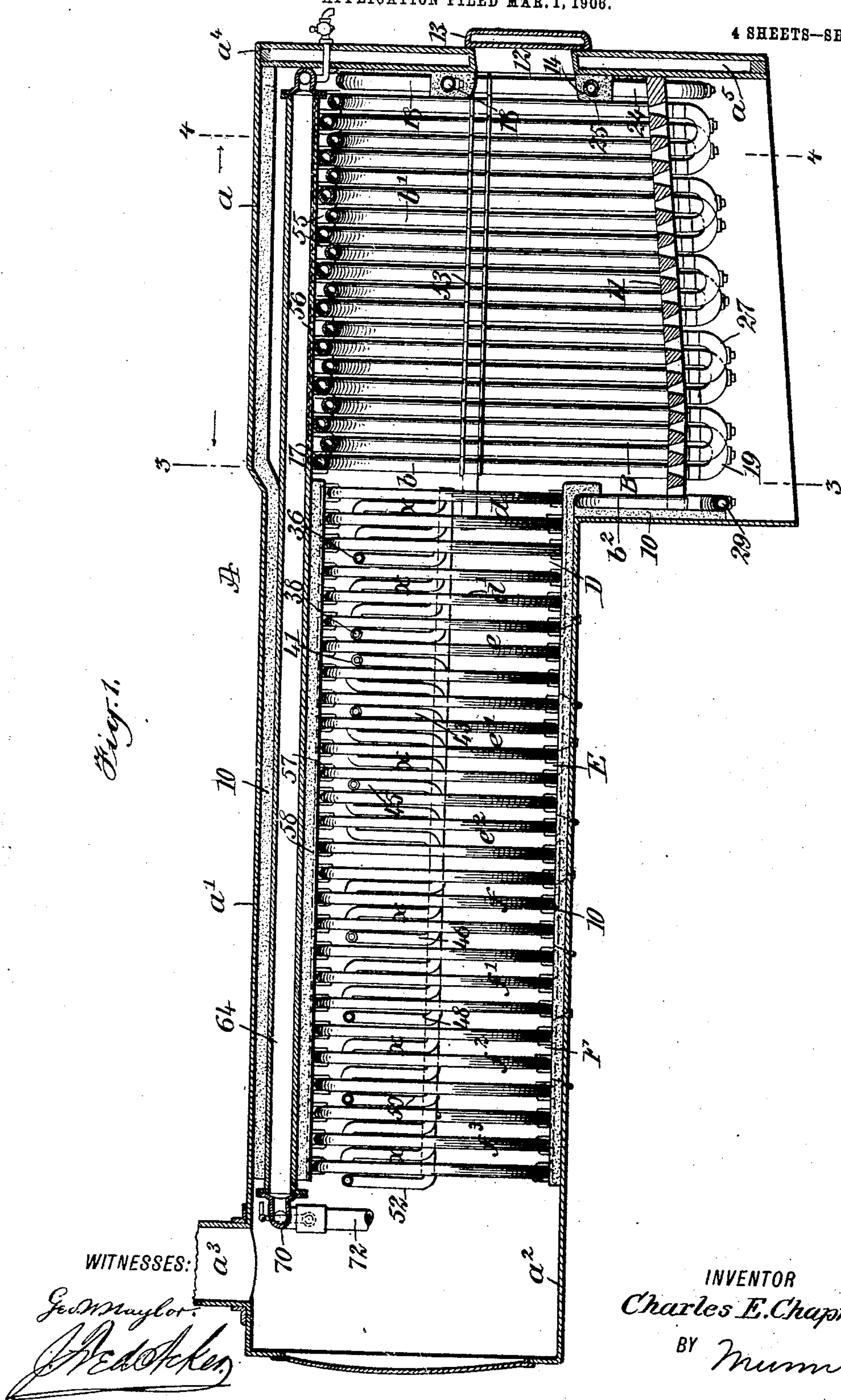
PATENTED NOV. 6, 1906.

C. E. CHAPMAN.  
STEAM BOILER.

APPLICATION FILED MAR. 1, 1906.

4 SHEETS—SHEET 1.

*Fig. 1.*



WITNESSES:

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INVENTOR

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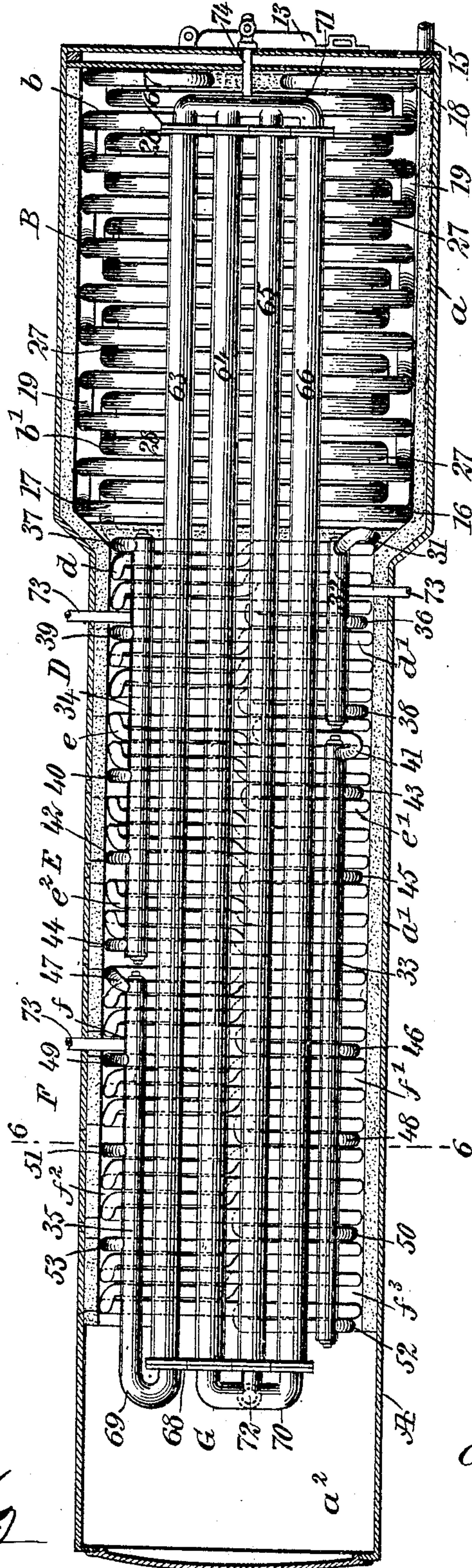
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4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 4.

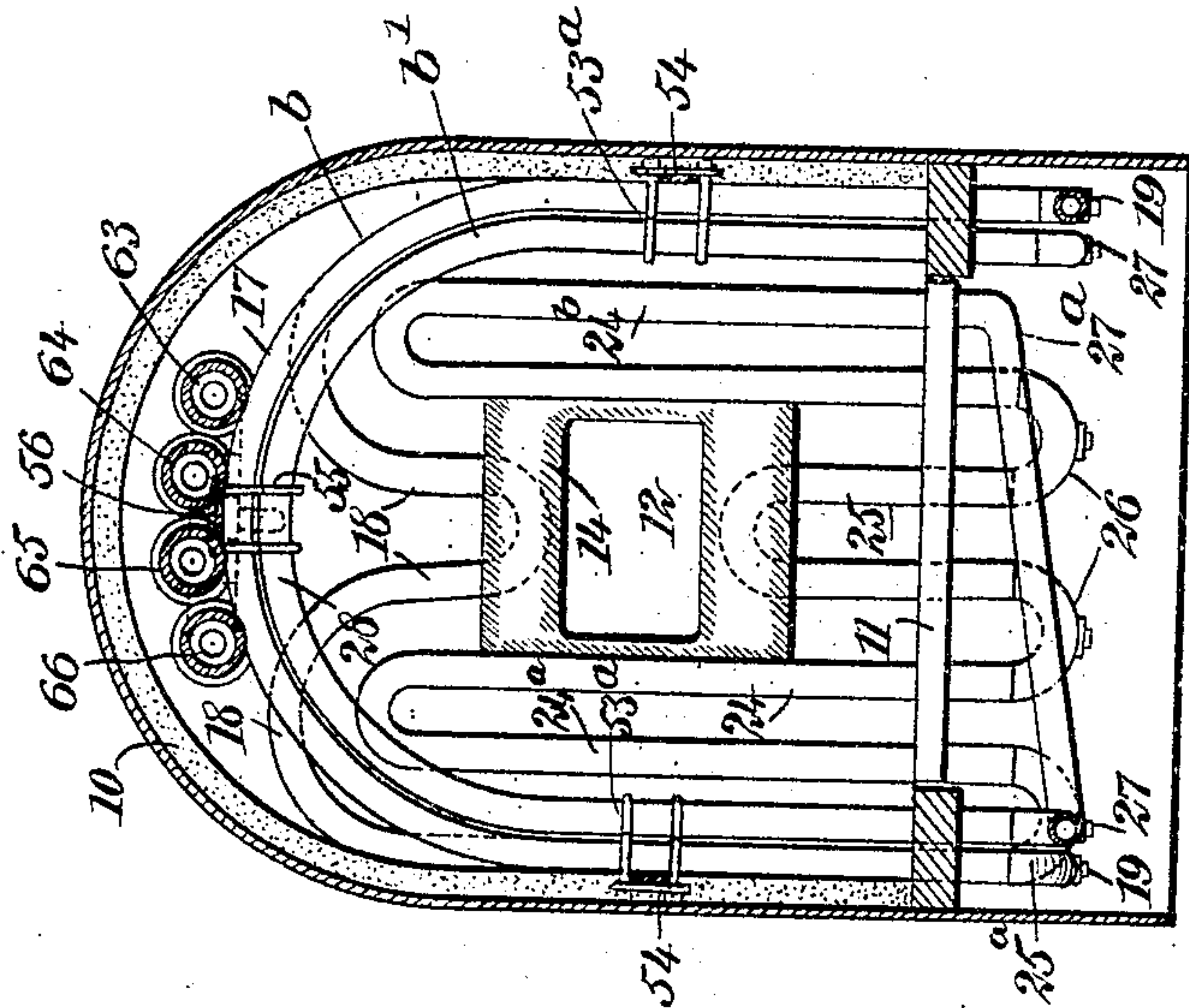


Fig. 3.

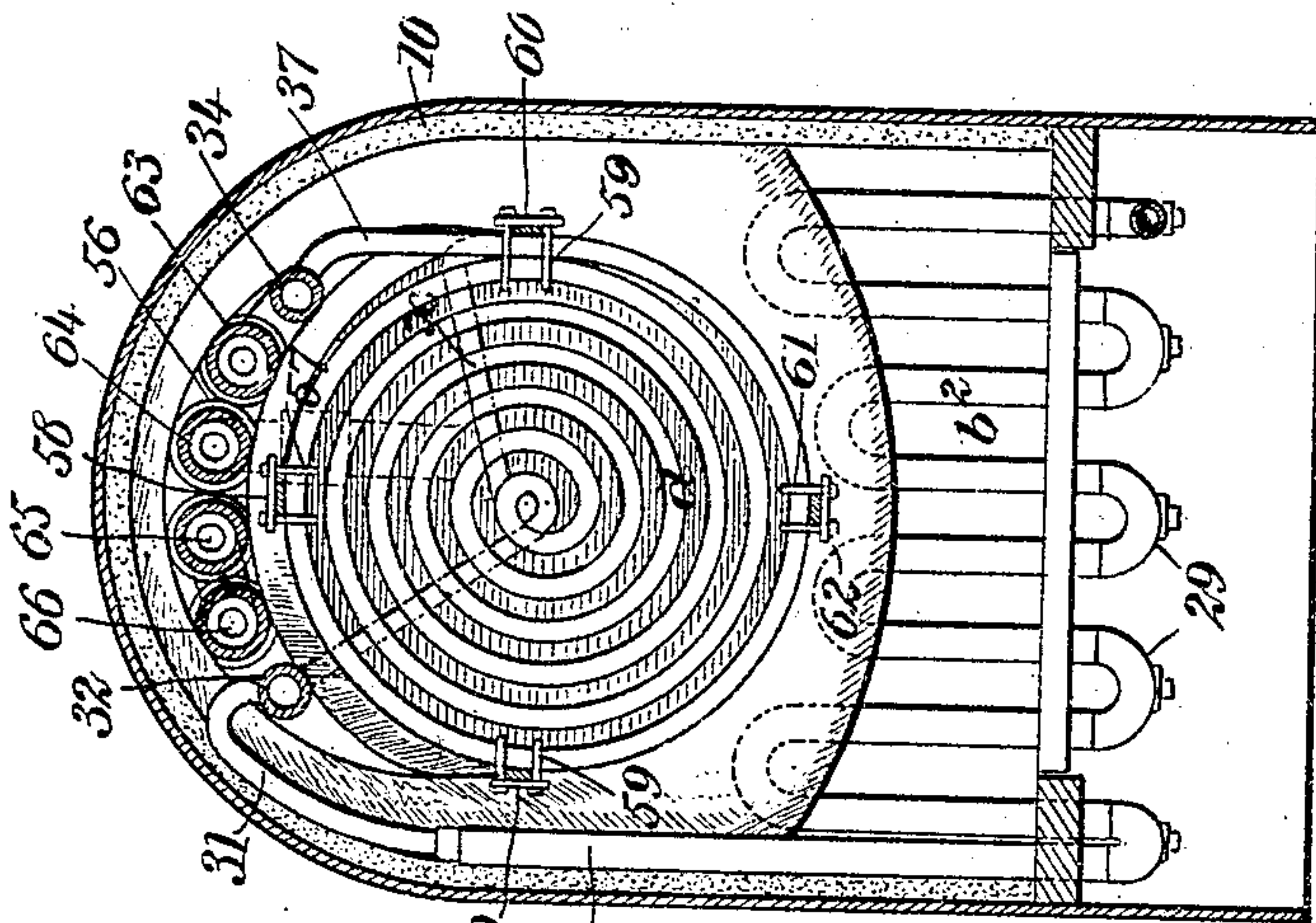
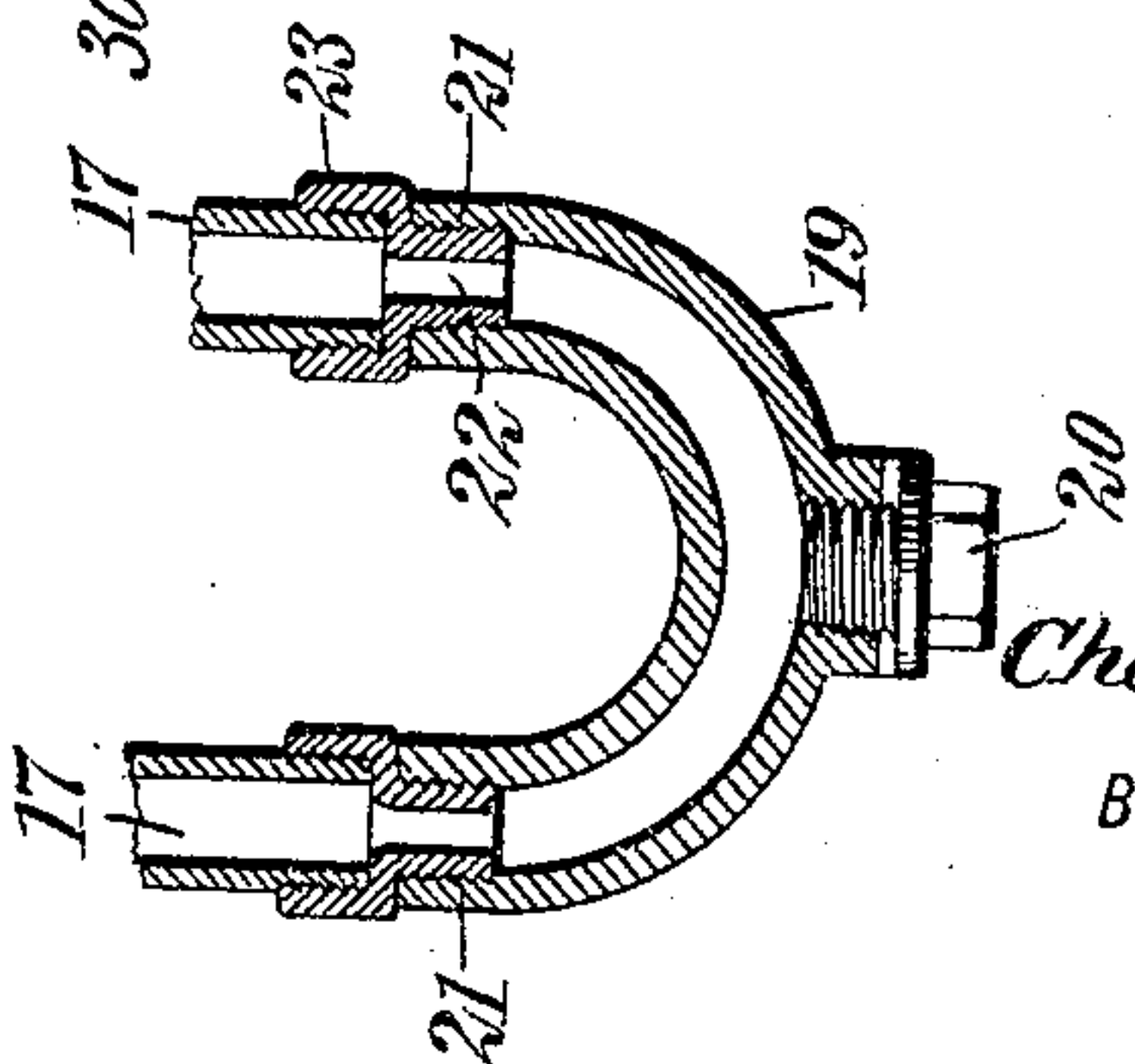


Fig. 5.



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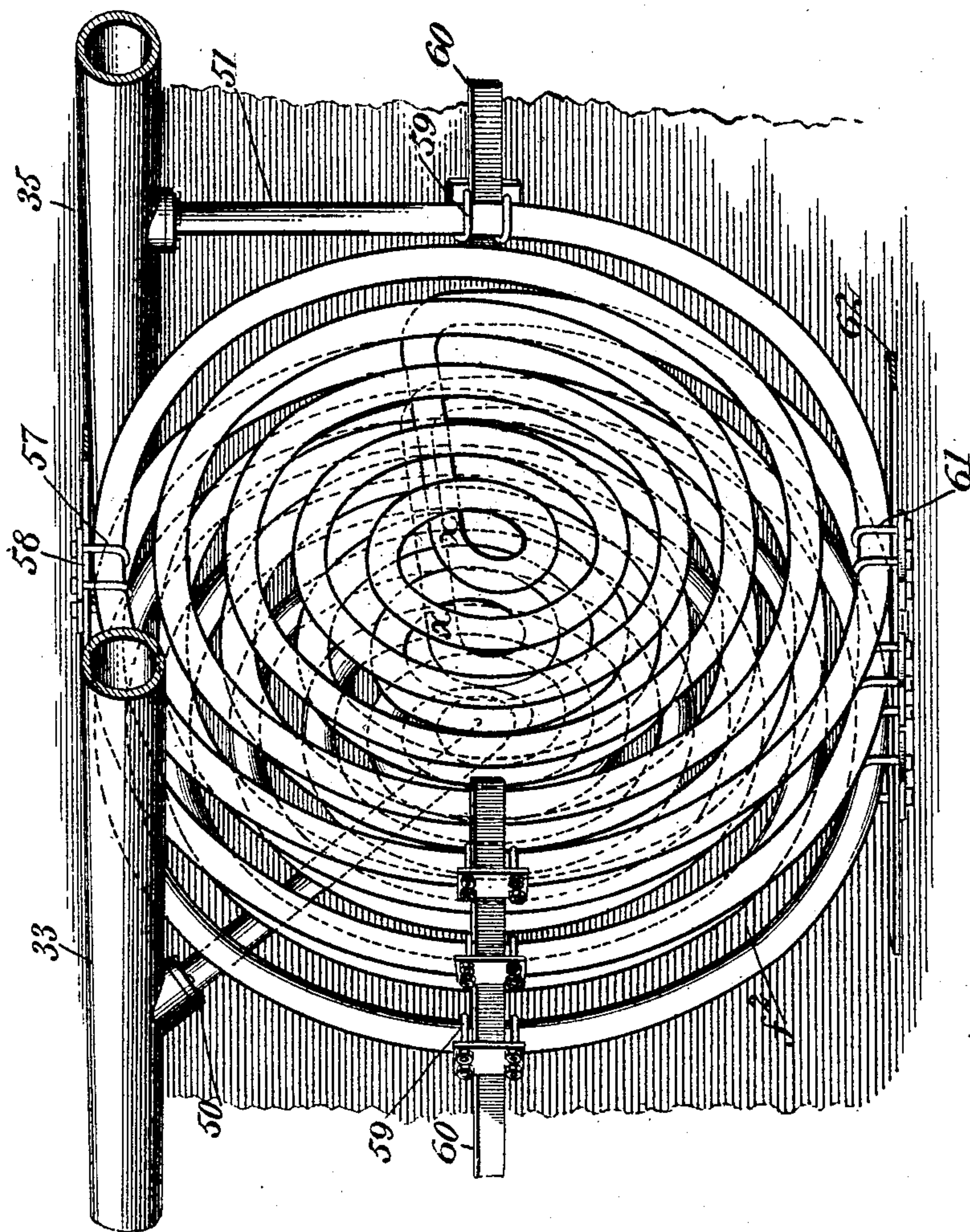
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4 SHEETS—SHEET 4.

*Fig. 6.*



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# UNITED STATES PATENT OFFICE.

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## STEAM-BOILER.

No. 835,400.

Specification of Letters Patent.

Patented Nov. 6, 1906.

Application filed March 1, 1906. Serial No. 303,662.

*To all whom it may concern:*

Be it known that I, CHARLES EDWARD CHAPMAN, a citizen of the United States, and a resident of Fort Edward, in the county of Washington and State of New York, have  
5 invented a new and Improved Steam-Boiler, of which the following is a full, clear, and exact description.

The purpose of the invention is to provide  
10 a quick-steaming purely coil-boiler in which the coils are continuous from around the fire-box throughout the body and the header in the dome from which the live steam is taken, the water being forced under pressure in the  
15 fire-box coils, passing thence in the form of vapor to the body-coils, which are in connected series, the vapor entering the headers of the said series of body-coils farthest away from the fire-box and then entering the headers of the next series at a point close to the  
20 fire-box, so that the vapor travels from any series to the other in the direction of the fire-box and contrary to the direction of travel of the products of combustion.

25 The invention consists in the novel construction and combination of the several parts, as will be hereinafter fully set forth, and pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference  
30 indicate corresponding parts in all the figures.

Figure 1 is a vertical longitudinal section through the entire boiler. Fig. 2 is a horizontal section through the boiler, taken just  
35 above the steam-coils, which appear in plan. Fig. 3 is a transverse section taken practically on the lines 3 3 of Fig. 1. Fig. 4 is a transverse section taken substantially on the  
40 line 4 4 of Fig. 1. Fig. 5 is a detail sectional view through a return connection for the coils; and Fig. 6 is a perspective view of one series of body-coils and a section through the headers for the same, the section being taken  
45 practically on the line 6 6 of Fig. 2.

In carrying out the invention I aim particularly to provide a boiler in which is employed a fire-box of coils of pipe in a continuous coil, which coils are generators, since  
50 water is forced into one end of said coil and leaves the other end in the form of vapor or spray, which vapor or spray is then blown, for example, through two body-coils connected with each other and with the fire-box

coil, which two coils are composed of three  
55 coils each. The vapor from the said two body-coils is then blown through three body-coils of three coils each and from the three coils of three coils each into four coils of three coils each, and from the end of the last  
60 group of coils the vapor in the form of superheated steam passes into the steam-dome, composed of a number of tubes connected at their ends to equalize the pressure.

A represents the shell of the boiler comprising a fire-box section  $a$ , a body-section  $a'$ , and a rear box-section  $a^2$ , which receives the products of combustion after they have passed the water-tubes, which box-section  $a^2$   
65 is provided with a stack  $a^3$ . The upper and lower portions of the shell are provided with an asbestos lining 10, as is likewise the rear lower portion of the fire-box, as is shown in  
70 Fig. 1, and the front  $a^4$  of the shell is double to provide a water-chamber  $a^5$ .

A grate 11 is suitably supported in the bottom of the fire-box, and the front of the shell has a firing-opening 12 made therein, normally closed by a door 13. Around the inside of the said opening an asbestos packing  
80 14 is laid, as is shown in Figs. 1 and 4. The water is received under pressure first in coils B within the fire-box, the vapor passing from thence to body and dome coils in the form of steam, which dome and body coils  
85 will be hereinafter particularly described.

The fire-box coils are in two series, an outer and an inner series, (designated, respectively, as  $b$  and  $b'$ ), the two series being continuous. Each coil of both the inner and the outer series of fire-box coils B is arched over the top of the fire-box, extending as near as may be desired to the roof of the fire-box section of the casing, which roof is arched, as is shown in Figs. 3 and 4. Each coil  $b$  and  $b'$  is provided with legs extending down from their upper arched portions to a point approximately below the side portions of the grate 11, as is especially shown in Fig. 1.

The series of outer coils  $b$  commence at the rear end of the fire-box and extend a predetermined distance apart to the forward end of the fire-box. All of the coils of the outer series  $b$  are alike and are designated as 17 with the exception of the coil which is close  
100 to the firing end of the said box, which coil is designated as 18. As is particularly shown in Figs. 2 and 4, this forward end coil 18 is



made to dip or curve downward at its center, and, as is illustrated in Figs. 1 and 4, the dipping portion of the coil 18 is carried through the upper portion of the asbestos packing 14 at the firing-opening 12. This forward coil 18 is given the said particular formation since it must stop at its central portion short of the fire-opening, and it is desired to carry this portion down as close as possible to the bed of fire.

The coils of the series *b* in the fire-box are connected at their lower ends at alternate sides by means of return-fittings 19, one of which is particularly shown in Fig. 5, and each return-fitting is provided with a threaded aperture at its central bottom portion, normally closed by a screw-plug 20, so that any sediment may be discharged from the coils. The preferred manner of connecting the legs of the said outer coils 17 with the return-fittings 19 is also shown in Fig. 5 and consists in providing the fitting 19 with interior threads 21 at its ends, into which threaded portions of the fitting the contracted exteriorly-threaded tubular shank 22 of a thimble 23 is screwed, and the said thimbles are interiorly threaded to receive the lower ends of the legs of the said coils 17, which are exteriorly threaded. Under this construction it is obvious that the coils can be connected conveniently and expeditiously and as conveniently disconnected when desired and that the flow of water from these coils is serpentine, entering one coil at one end and passing into the next coil at the opposite end, and so on. Water is forced into the said outer series of coils *b* through a feed-pipe 15, entering the front portion of the boiler at a point near the bottom, being connected with the lower end of the left-hand leg of the rearmost coil 17 of the said series *b*, as is shown by dotted lines in Fig. 2. It will be observed that the water is introduced into the fire-box coils at the extreme rear end of the fire-box and travels through said coils in direction of the front of the fire-box or in an opposite direction to the direction of travel of the products of combustion.

After leaving the foremost coil 18 of the series *b* the water passes into the foremost coil 24 of the inner series *b'*, as is shown at 25<sup>a</sup> in Fig. 4. This foremost coil 24 is immediately below the foremost coil 18 of the outer series *b*, as is shown in Fig. 4, and said coil 24 of the inner series *b'* comprises two parallel legs 24<sup>a</sup> and 24<sup>b</sup>, as is shown in said Fig. 4, having returns at their upper ends, and the innermost of the said parallel legs of the coil 24 pass through the side portions of the asbestos packing at the firing-opening. Further, in the formation of this forward coil 24 of the inner series *b'* an upwardly-extending loop-section 25 is provided, having a curved upper end, which extends into the lower portion of the said asbestos packing 14, as is shown in

Fig. 4. The legs of the central section 25 are connected at their lower ends with the lower ends of the innermost legs of the parallel set of legs 24<sup>a</sup> and 24<sup>b</sup> by means of return-fittings 26, which are of the same character as the fittings which have been described and which are shown in detail in Fig. 5.

The water already heated in the outer series of coils enters the outermost of the left-hand set of legs 24<sup>a</sup> and passes through all the members of the forward coil 24 of the inner series *b'* and passes out from said coil at the right-hand side of the boiler. A pipe 27<sup>a</sup> extends from the outermost of the right-hand set of legs 24<sup>b</sup> of this coil, downward to the opposite or left-hand side of the boiler, where, by means of a return-fitting 27 of the character heretofore described, connection is made with the foremost arched coil 28 of the inner series *b'*, all of the remaining coils in the said inner series being similar to the coil 28, which is plainly shown in Fig. 4. The arched portions of these inner coils 28 are opposite the spaces between the arched portions of the outer series of coils *b*, as is shown in Fig. 2. The legs of the various coils 28 of the inner series *b'* are connected alternately at opposite sides of the fire-box by the fitting 27, heretofore referred to.

The fire-box coils *B* are completed by the addition of a series of vertical coils *b*<sup>2</sup>, transversely arranged at the lower rear portion of the fire-box, as is shown particularly in Figs. 1 and 3, and these coils *b*<sup>2</sup> extend from a point below the rear end of the grate 11 up to a point where the fire-box connects with the lower portion of the body of the shell. These coils *b*<sup>2</sup> are connected at their lower ends by fittings 29 of the same type as the fittings 19. (Shown in Fig. 5.)

The water which was introduced into the outer set of coils *b* and which was in turn delivered to the inner series or set of coils *b'* is delivered in substantially the form of spray to the rear transverse series of coils *b*<sup>2</sup> at the lower right-hand end of the said transverse coils. The spray after passing through the transverse coils *b*<sup>2</sup> is delivered to a stand-pipe 30 at the left-hand side of the fire-box, as is shown in Fig. 3, which is connected by a suitable coupling-pipe 31 with a header 32 at the upper portion of the left-hand side of the body *a'* of the shell, as is shown in both Figs. 2 and 3, and the said header 32 receives the water in the form of a highly-heated spray.

With reference to the body-coils they may be in any desired number of sections; but in the drawings three sections are illustrated—namely, a forward section *D* in two groups *d* and *d'* of three coils each, an intermediate section *E* in three groups of three coils each, (designated, respectively, as *e*, *e'*, and *e*<sup>2</sup>,) and a rear section *F* in four groups, (designated, respectively, as *f*, *f'*, *f*<sup>2</sup>, and *f*<sup>3</sup>,) of three coils each. In connection with the said body-



coils I employ four headers—the header 32 at the left-hand side of the boiler and above referred to, which is connected with the fire-box coils B, a second header 33 at the same side of the boiler, and a third and a fourth header 34 and 35 at the right-hand side of the boiler. The short header 32 is connected with the section D only; but the header 33 at the same side of the boiler is in connection with all the groups of coils of the two sections E and F. The header 34 at the right-hand side of the boiler is in connection with all the groups of coils of the sections D and E, while the header 35, also at the right of the boiler, is connected with the groups of coils of the section F; but such communication is established by said headers between all of the coils as to render them as a whole continuous. All the coils in the body of the boiler are spiral coils, as shown in Figs. 3 and 6. The connections between the coils of a group are from the center of one coil to the outer member of the next, as is also shown in Figs. 3 and 6, and in order to prevent the confusion of a multiplicity of reference characters such connections are uniformly designated  $x$ ; but the connections between the sections of coils and the headers will be individually designated, and such connections as is evident from Fig. 6 may be from the center of a coil of a section or from the outer end of a coil of the section, or it may be possible that in making such connections with the headers that both connections will be from the center of the end coils or from the ends of the end coils of a section. Each group of coils in each section is formed and connected as is indicated in Fig. 6.

With reference to the coils in the group  $d$  of the section D an extension 36 from the forward coil of the group is carried up and connects with the header 32, and another connection 37 is carried up from the forward coil of a group and connected with the right-hand header 34. The rear coil of the group  $d'$  of the same section is provided with an extension member 38, which connects likewise with the left-hand header 32, and the forward coil of this group is provided with an extension 39, which connects with the header 34 at the right-hand side of the boiler, as is shown best in Fig. 2.

With reference to the section E the rear coil of the group  $e$  is provided with an extension 40, which likewise connects with the header 34, and the forward coil of the same group is provided with an extension 41, connected with the left-hand header 33. The intermediate group  $e'$  of the section E at its rear end has an extension 42, connected with the right-hand header 34, and the forward coil of this group has an extension 43, which connects with the left-hand header 33. The rear coil of the group  $e^2$  of the section E has an extension 44, which connects with the right-

hand header 34, and the forward coil of the same group has an extension 45, which connects with the left-hand header 33.

The rear coil of the group  $f$  of the section F has an extension 46, which connects with the left-hand header 33, and the forward coil of the same group has an extension 47, which connects with the right-hand header 35. The group  $f'$  of the section F is provided with an extension 48, which connects with the left-hand header 33, and the forward coil of the same group is provided with an extension 49, which connects with the right-hand header 35. With reference to the group  $f^2$  of the section F the rear coil is provided with an extension 50, which connects with the header 33, and the forward coil of this group is provided with an extension 51, which connects with the header 35. The rear coil of the last group  $f^3$  of the section F has an extension 52, which connects with the left-hand header 33, and the forward coil of this group has an extension 53, which connects with the right-hand header 35, all of which connections are best shown and can be best traced in Fig. 2.

The coils in the fire-box are all held in place by clips 53<sup>a</sup>, engaging with their legs and attached to straps 54, attached to the shell A in any suitable or approved manner, as is shown in Figs. 1 and 4, and by means of clips 55, engaging with the coils at the top and attached to straps 56, suitably secured. The coils in the body of the shell are held in place by upper clips 57, attached to straps 58, suitably secured in the shell, and by clips 59, which engage with the side portions of the coils, the clips 59 being secured to straps 60, which in their turn may be secured to the shell A, as may be found desirable. Also, preferably, bottom clips 61 are provided for the body-coils attached to straps 62, also suitably secured to the shell, as is best shown in Fig. 6.

In connection with the coils above enumerated and constituting continuations thereof crown-headers G are employed. These headers are preferably four in number and are best shown in Fig. 2, being designated, respectively, as 63, 64, 65, and 66. These headers are parallel and extend from a point beyond the rearmost body-coil to a point quite adjacent to the front of the shell and are supported by suitable brackets 67 and 68, located at the front and at the rear. The crown-header 63 at the right-hand side of the boiler is connected by a return 69 with the right-hand header 35 for the body-coils, and the rear ends of the remaining crown-headers 64, 65, and 66 are connected by a suitable return 70, while a return 71 connects all of the crown-headers at their forward ends. An offtake-pipe 72 for the steam extends downward, preferably, from the return-fitting 70 at the rear of the boiler. Tubes 73 lead out from all of the headers connected with the



body-coils adapted to have test-cocks connected therewith, and the crown-headers are provided with a test-tube 74, which extends from the forward return-fitting 71.

5 In the operation of this boiler water is forced through the tube 15 into the rearmost coil 17 of the outer group or series of coils *b* in the fire-box and circulates through these coils in the direction of the front of the fire-  
10 box and then finds its way into the coils of the inner group or series *b'* and works back to the pipe 21, connected with the header 32, delivering the water in the form of a highly-heated spray to this header. The spray then  
15 enters the extension 36 of the group *d* of the section D and passes through all the coils of that group to the extension 37, where the spray enters the header 34, traveling, as will be observed, in direction of the front of the  
20 boiler, or contrary to the direction of travel of the products of combustion. The spray also passes from the left-hand header 32 through the extension 38 at the rear portion of the second group *d'* of the section D and  
25 travels through the coil of that group forwardly, entering the header 34 at the connection 39. The spray also passes through the extension 40 from the group *e* of the section E from the header 34, moving forwardly  
30 through all of the coils of that group and entering the header 33 through the extension 41 at the forward end of this group. The spray also passes from the header 34 through the connection 42 at the rear of the second  
35 group *e'* of the coil and travels forwardly through all the coils of that group, entering the opposing header 33 through the connection 43 from the forward coil of that group. With reference to the group *e''* of the section  
40 E the steam enters the connection 44 from the rear coil of that group and travels forward through all of the coils of said group and passes out from said group of coils through the extension 45 from the forward  
45 coil of said group into the left-hand header 33. With reference to the circulation in the group *f* of the section F the spray, which is now practically converted into steam, enters the rear coil of this group through the extension  
50 46, supplied from the left-hand header 33 and passes through all of the coils of that group and empties into the right-hand header 35 through the extension 47 from the forward coil of that group. With reference to  
55 the group *f'* the steam passes from the left-hand header 33 into the extension 48 from the rear coil of that group and travels through all of the coils of said group to the extension 49 from the forward coil which connects  
60 with the right-hand header 35. With regard to the group *f''* the steam passes from the header 33 into the extension 50 of the rear coil of the group and forward through all of the coils of that group to the extension 51  
65 from the forward coil of the group which con-

nects with the right-hand header 35. Then the steam passes from the left-hand header 33 into the extension 52 from the rear coil of the group *f''* and passes through all of these coils into the right-hand header 35 through  
70 the extension 53 from the forward coil of the said group *f''*. The superheated steam then finds its way through the return 69 from the header 35 and circulates through all of the crown-headers 63, 64, 65, and 66,  
75 finally passing out where it is to be used through the offtake-pipe 72. It will be observed that the coils are continuous throughout and that the feed of the water to the coils where it is to be converted into steam  
80 is invariably from the rear in direction of the front, or directly opposite to the direction of travel of the products of combustion.

Having thus described my invention, I claim as new and desire to secure by Letters  
85 Patent—

1. In boilers, a shell, series of connected water-tubes within the shell, including coils of arched fire-box tubes, spiral tubes for the  
90 body, and a coil of crown header-tubes.

2. In boilers, a shell, a series of water-tubes including coils of arched fire-box tubes, spiral tubes for the body, coils of crown-header tubes, and connections between said  
95 tubes, whereby the water-vapor or steam has first a movement in opposite directions to the direction of the products of combustion, and then a return movement.

3. In boilers, a shell, continuous coils of fire-box tubes which receive water under  
100 pressure at the rear, conducting it toward the front of the boiler and returning the water to the rear, coils of spiral tubes in the body of the shell, arranged in connected groups, headers at the right and left of the  
105 shell, a header at one side being connected with the fire-box coils, opposite ends of each group of the body-coils being in communication with opposite headers, each group of body-coils receiving vapor or steam from a  
110 header at its rear and delivering it to an opposing header at its front end, said headers being connected through said body-coils, and a coil crown-header connected with the discharge body-header, whereby the flow of  
115 liquid through the body-coils is in an opposite direction to the direction of travel of the products of combustion.

4. In boilers, a shell, continuous coils of fire-box tubes which receive water under  
120 pressure at the rear and conduct it toward the front of the boiler, returning it to the rear, headers at the right and left of the boiler, a header at one side being connected with the fire-box coils, spiral body-coils ar-  
125 ranged in sections, each section consisting of groups of connected coils, the number of groups in the sections being progressive in direction of the rear, opposite ends of each group of body-coils being in communication  
130



with opposite headers, the inlet of each coil being at the rear and the outlet at the front, said headers serving as supply and return mediums for the body-coils, and a coil of crown-header tubes extending over the body and fire-box coils, being in communication with the discharge-header of the body.

5. In boilers, a shell, continuous coils of fire-box tubes which receive water under pressure at the rear and conduct it toward the front of the boiler, returning it to the rear, headers at the right and at the left of the boiler, a header at one side being connected with the fire-box coils, spiral body-coils arranged in sections, each section consisting of groups of connected coils, each group of coils containing the same number of individual coils and the number of groups in the sections being progressive in direction of the rear, opposite ends of each group of body-coils being in communication with opposite headers, the inlet of each coil being at the rear and the outlet at the front, and a coil of crown-headers overlying the body and fire-box coils, being in communication with the discharge-header of the body.

6. In a boiler, a fire-box consisting of a

continuous coil adapted to receive water under pressure at its rear end, conducting the water to the front and returning it again to the rear in the form of vapor or spray, a series of body-coils arranged in sections, which sections are subdivided into groups of connected coils, headers at opposite sides of the boiler, opposite ends of the groups of coils being connected with opposite headers, and one header being in communication with the fire-box coils, said series of body-coils comprising a forward series consisting of two groups of three coils each, an intermediate series consisting of three groups of three coils each, and a rear series consisting of four groups of three coils each, and a steam-dome consisting of a number of tubes having return connection at their ends and also having connection with a rear end header in the body.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES EDWARD CHAPMAN.

Witnesses:

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