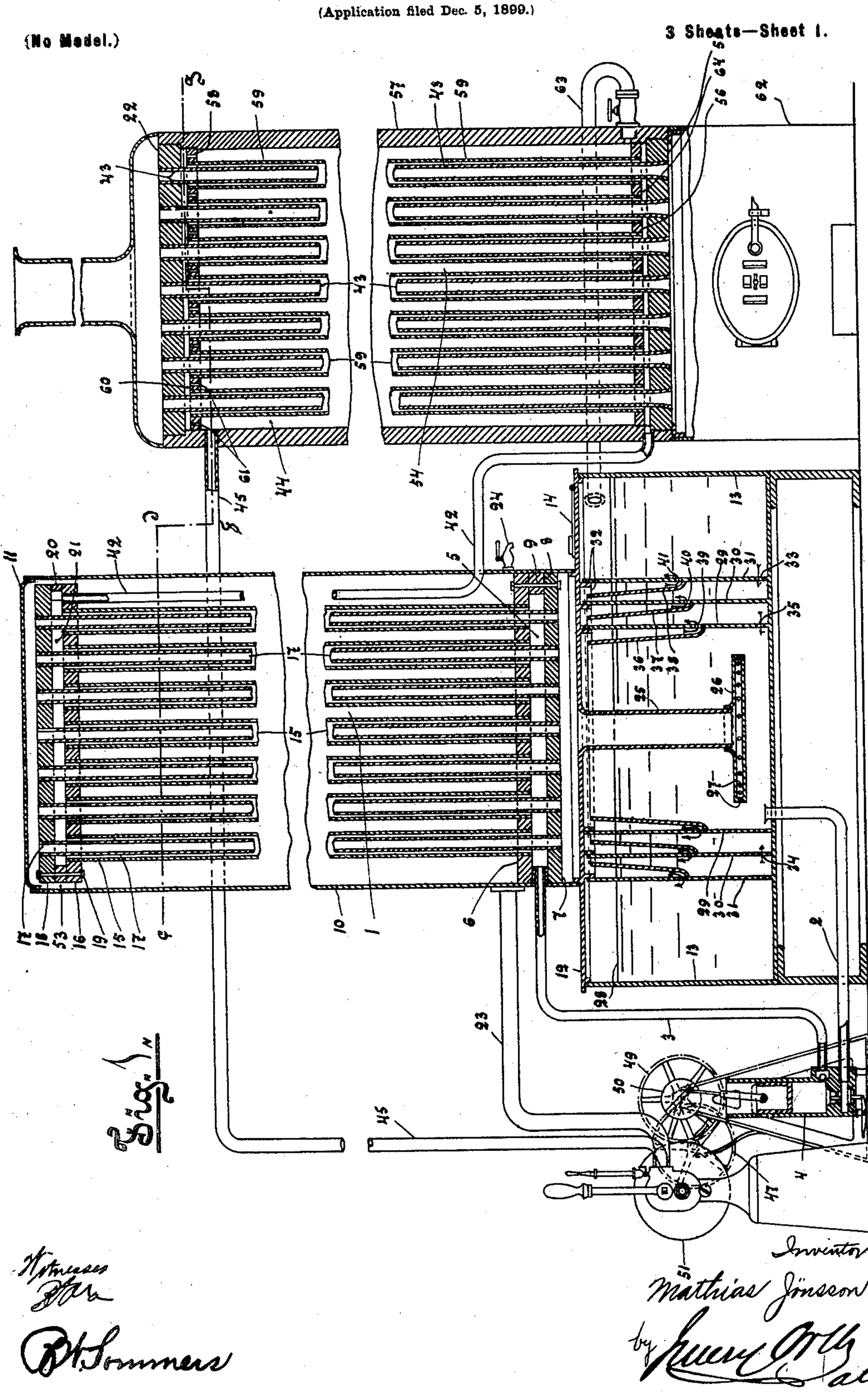
No. 673,908. Patented May 14, 1901.

M. JÖNSSON.

STEAM BOILER WITH FEED WATER HEATER.

(Application filed Dec. 5, 1899.)

(No Model.) 3 Sheets—Sheet 1.



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(No Model.) 3 Sheets—Sheet 2.

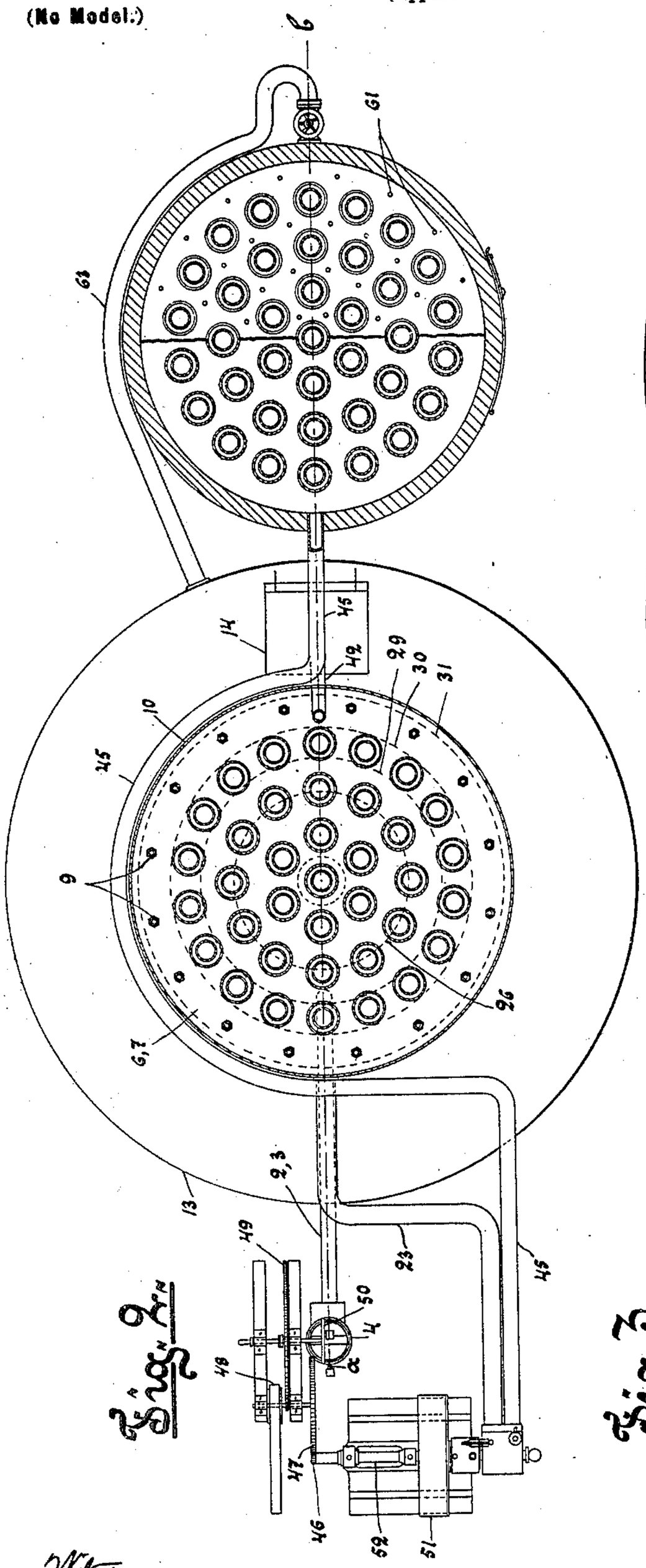

Fig. 2.

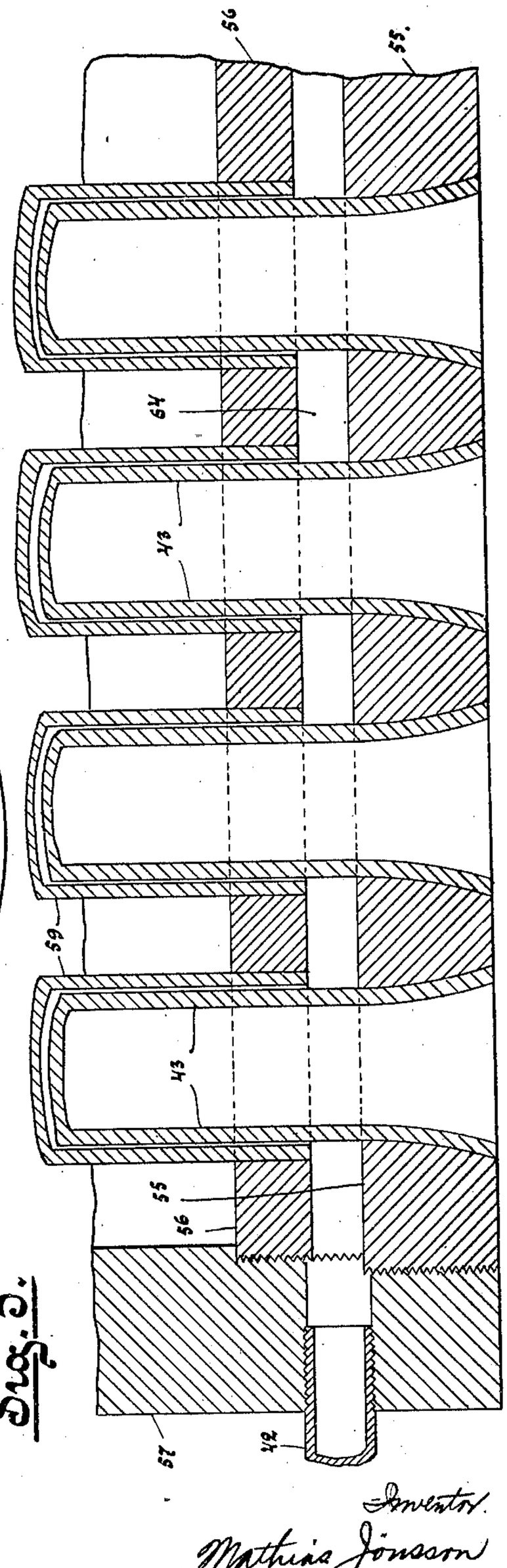

Fig. 3.

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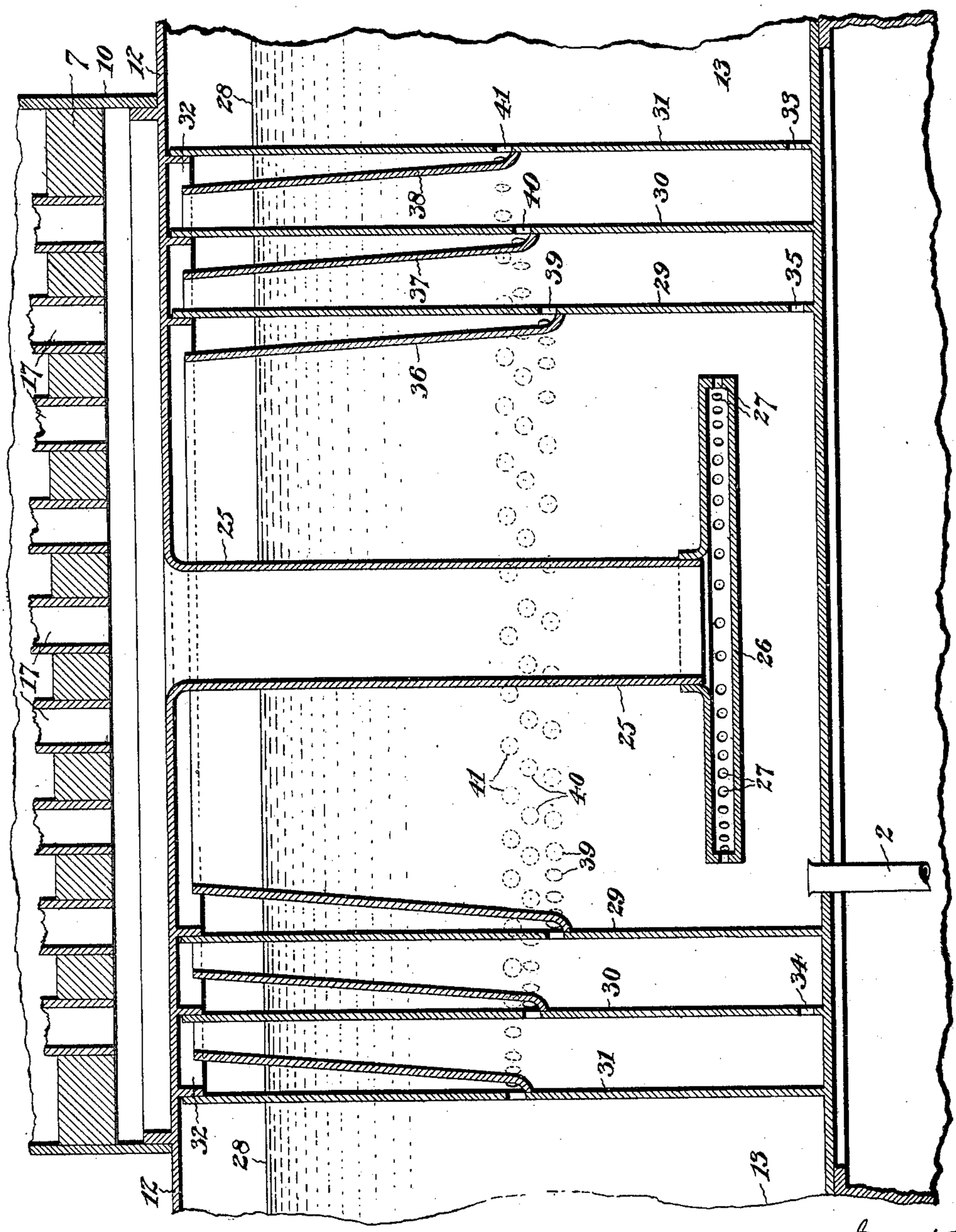

Fig. 1.

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UNITED STATES PATENT OFFICE.

MATHIAS JÖNSSON, OF WISBY, SWEDEN.

STEAM-BOILER WITH FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 673,908, dated May 14, 1901.

Application filed December 5, 1899. Serial No. 739,309. (No model.)

To all whom it may concern:

Be it known that I, MATHIAS JÖNSSON, a subject of the King of Sweden and Norway, residing at Wisby, Sweden, have invented certain new and useful Improvements in Steam-Boilers with Feed-Water Heaters; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form a part of this specification.

My invention has relation to water heaters or boilers, and more particularly to heaters for heating the water supplied to steam-boilers; and it has for its object a construction whereby such water may be more rapidly and effectually heated and the exhaust-steam of an engine utilized as a heating medium.

The invention is shown in the accompanying drawings, wherein—

Figure 1 shows the apparatus in a front view, partly in section, on line *a b* of Fig. 2. Fig. 2 shows the invention in a plan view, partly in section, on line *c d f g* of Fig. 1. Fig. 3 shows a full-size section of a portion of the boiler. Fig. 4 is an enlarged fragmentary sectional view of the lower part of the feed-water heater.

The feed-water heater 1 is in communication with the suction-pipe 2 and force-pipe 3 of an ordinary force-pump. The water from the pump is forced into the space or intermediate chamber 5 between the partitions 6 and 7, which are connected by screws 9 and a ring 8 water-tightly with one another at some distance apart and also are fitted tightly in the cylinder 10. This cylinder is covered at the top with a covering 11 and below is attached to a bottom plate 12, which also serves simultaneously as cover or lid of a water-reservoir 13. On this latter the cover 12 is placed and provided with a valve 14; but said cover is not fixed firmly, but may be removed. On the bottom 6 outer tubes 15 are fixed, which are also fixed at the top to another bottom plate 16. Inner tubes 17 are fixed at the lower end on the bottom plates 7 and at the upper end on a bottom plate 18. Between the plates, which are screwed together by means of screws 19, a ring 20 is placed on the outer edges, so that between the partitions an intermediate chamber or space 21 is formed. Between these outer and inner tubes the water rises in a layer of the thickness of half a millimeter into the intermediate chamber 21, from whence it reaches by means of a pipe 42 the steam-boiler 54, and here comes between the partitions 55 and 56, which are held some distance apart by means of threads or in other suitable manner on the outer casing 57. On the upper end of the casing partitions 22 and 58 are also fixed apart at some distance from one another. Between the outer partitions 55 and 22 inner tubes 43 extend, which are steam-tightly fixed in said partitions. The outer tubes 59 are also fixed steam-tight in the inner partitions 56 and 58. The distance between the inner and the outer tubes 43 59 amounts only to half a millimeter, and between these tubes the water and eventually the resulting steam passes upward into the intermediate chamber 60 between the floors 22 and 58. The steam flows, therefore, afterward in the steam-chamber 44 of the boiler, around the outer tubes 59, and through numerous small openings 61 in the partition 58. From here the steam passes through the steam-pipe 45 to the steam-engine.

The steam-boiler is arranged above the fireplace 62 and has a discharge-pipe 63, fitted with a tap and leading to the water-reservoir 13 in order to run off any water which at the commencement of the formation of steam before the boiler is thoroughly warmed through may possibly have accumulated in the steam-chamber. Over the uppermost partition 22 a cover is provided for the gaseous products of combustion, which are conveyed to the chimney. The exhaust-steam from the engine flows through a pipe 23 to the feed-heater 1. Here the steam warms the outer tube 15 and then flows through an annular chamber 53, between the cylinder 10 and the upper partitions 16 and 18, around the inner tubes 17 into the same, so that these latter also are warmed. A tap 24 serves for drawing off the residual water condensed from the exhaust-steam and is so placed that when the valve 14 is opened water flows into the reservoir 13. The surplus exhaust-steam flows out of the inner tubes 17 into the cylinder 25 and the receiver 26 and then through a series of fine

holes 27, formed in the wall of the said receiver, and rises through the water in the reservoir, where it then accumulates over the upper surface of the water 28, so far as any steam still remains uncondensed. Three cylinders 29, 30, and 31 are inserted on the floor of the reservoir, which fit steam-tightly on the short cylinder 32, fixed in the cover 12 of the reservoir. The water flows out of the uppermost chamber of the reservoir through the opening 33 in the cylinder 31 into the space between said cylinder and the cylinder 30 and then through an opening 34, arranged diametrically to the above-mentioned opening, and finally through the opening 35, also arranged diametrically to the opening 34, into the innermost part of the reservoir, from whence water flows to the pump through pipe 2. The upper part of the feed-heater may thus be lifted off with the lids 12 of the cylinder 32 and again replaced and that so tightly that no waste steam can escape through the joints. At the inner sides of the cylinders 29 30 31 slightly-tapering casings 36 37 38 are fixed, which project upward somewhat over the upper surface of the water in the reservoir. Numerous holes 39 40 41 are also provided above the respective points of projection between the cylinderf 29 30 31 and the casings 36, 37, and 38. The waste steam still remaining above the water inside cylinder 29 passes between the casing 36 and the said cylinder downward, driving the water in front of it, and escapes through holes 39. Steam then again rises upward through the water and then passes downward between the casing 37 and the cylinder 30 through holes 40. In a similar manner it passes over the casing 38 and escapes upward through holes 41 to the outer chamber of the reservoir and then upward through the water.

When the boiler is to generate steam, water is first pumped into the feed-heater by hand-power, of which water a portion reaches the boiler through the pipe 42. The fire is then lighted under the boiler and its products of combustion pass through the inner tubes 43 and then escape through the chimney. Owing to the boiler and also the feed-heater being placed very high, all the heat which is to be obtained from the products of combustion is given off to the said tubes 43 and a thin layer of water surrounding them, so that steam is rapidly formed, which flows into the steam-chamber 44 and further through steam-pipe 45 to the engine.

46 47 48 49 50 represent the gearing connecting the shaft 52 of the engine 51 with the pump 4. The exhaust-steam which has passed into the feed-heater through the pipe 23 first warms the outer tubes 15 and then enters the inner tubes and warms them also, so that the thin layer of water between the tubes 15 and 17 is rapidly heated. As, therefore, the water reaches the boiler considerably heated steam is very easily raised, which then is superheated in the upper part of the boiler before it flows to the engine, thus affording an economical advantage. As the exhaust-steam which is not condensed in the tubes enters the cylinder 25 and further flows along the casings 36, 37, and 38 through the holes 27, the water is heated up to 100°, or nearly to this temperature, and therefore the pump must be placed so low that the water from the reservoir runs into the same, or else otherwise the formation of steam would take place in the pump. The motor-water thus reaches the feed-heater boiling hot.

This boiler possesses many advantages. It is of small size in proportion to its steam production and may be rapidly heated in consequence of there being no great quantity of water contained therein. The steam which passes to the engine is superheated, or so-called "dry-steamed," and the water in the feed-heater is raised by the waste steam to the same temperature. The consumption of fuel is therefore considerably less than in ordinary boilers.

I claim—

1. A steam-heated feed-water heater and means for taking water therefrom to a boiler, in combination with a water-reservoir, means causing the waste steam from the heater to circulate through the water in said reservoir in alternate upward and downward directions and means for feeding water from the reservoir to the heater, for the purpose set forth.

2. A steam-heated feed-water heater and means for taking water therefrom to a boiler, in combination with a water-reservoir supporting said heater, means causing the waste steam from the heater to circulate through the water in the reservoir in alternate upward and downward directions and means for feeding water from said reservoir to the heater, for the purpose set forth.

3. A steam-heated feed-water heater, means for taking water therefrom to a boiler, in combination with a water-reservoir divided into a plurality of intercommunicating chambers, means causing the waste steam from the heater to circulate through said chambers in alternate upward and downward directions and means for feeding water from the reservoir to the heater, for the purpose set forth.

4. A steam-heated feed-water heater and means for taking water therefrom to a boiler, in combination with a water-reservoir divided into intercommunicating concentric chambers, means causing the waste steam from the heater to flow successively through said chambers from the central to the outer one in an alternate upward and downward direction and means for feeding water from said central chamber to the heater, for the purpose set forth.

5. A steam-heated feed-water heater and means for taking water therefrom to a boiler, in combination with a water-reservoir, means for dividing the waste steam from the heater and distributing the same in the form of jets near the bottom of the reservoir and means

for feeding water from said reservoir to the heater, for the purpose set forth.

6. A multitubular feed-water heater, comprising a shell closed at top and bottom, chambered flue-sheets near said top and bottom, open-ended circulating-tubes connecting the chambers in said flue-sheets, similar heating-tubes extending through said circulating-tubes and connecting the shell-spaces above and below the flue-sheets, means for taking water from the upper flue-sheet chamber to a boiler, and a connection between the heater-shell and the exhaust-port of an engine; in combination with a feed-water reservoir, means for conveying the waste exhaust-steam from the heater below the lower flue-sheet into the body of water in the reservoir, and means for forcing water from said reservoir to the chamber in the lower flue-sheet, for the purpose set forth.

7. A multitubular feed-water heater, comprising a shell closed at top and bottom, chambered flue-sheets near said top and bottom, open-ended circulating-tubes connecting the chambers in said flue-sheets, similar heating-tubes extending through said circulating-tubes and connecting the shell-spaces above and below the flue-sheets, means for taking water from the upper flue-sheet chamber to a boiler, and a connection between the heater-shell and the exhaust-port of an engine; in combination with a feed-water reservoir, means for draining water of condensation from above the lower flue-sheet into the reservoir, means for conveying waste exhaust-steam from below said lower flue-sheet into the body of water in the reservoir, and means for feeding water from the reservoir to the lower flue-sheet chamber, for the purpose set forth.

8. A multitubular water-heater, comprising a shell closed at top and having an encompassing flange at its bottom and a pipe depending from said bottom and terminating in a perforated head, chambered flue-sheets near the upper closed end and above the bottom of the shell respectively, the upper flue-sheet arranged to connect the shell-space above and below said sheet, circulating-tubes connecting the flue-sheet chambers, and heating-tubes in said circulating-tubes connecting the shell-spaces above the upper and below the lower flue-sheet respectively; in combination with a water-reservoir on which the heater is mounted and into which the aforesaid pipe dips, means for forcing water from the reservoir into the chamber of the lower flue-sheet, means for taking water from the chamber in the upper flue-sheet, and means for supplying steam to the heater-shell, substantially as and for the purposes set forth.

9. A water-heater, comprising a shell, closed at top and having an encompassing flange on its bottom provided with a depending pipe terminating in a perforated circular head, chambered flue-sheets near the upper and lower ends of the shell respectively, the upper flue-sheet arranged to connect the shell-spaces above and below it, circulating-tubes connecting the chambers in the flue-sheets, and heating-tubes in said circulating-tubes connecting the shell-spaces above the upper flue-sheet and below the lower flue-sheet respectively; in combination with a water-reservoir on which said heater is mounted and for which its bottom forms a cover, concentric circular partitions dividing the water-reservoir into chambers, into the central one of which projects the aforementioned pipe depending from the heater-bottom, ports at the foot of the partitions placing the reservoir and the aforesaid chambers in communication with one another, means causing the water under the pressure of the steam entering the central chamber to flow through the several chambers in an upward and downward direction alternately, and from the outer chamber into the space surrounding the same, means for forcing the water from the inner chamber into the chamber of the lower flue-sheet, means for taking water from the chamber in the upper flue-sheet and means for supplying steam to the heater-shell, substantially as set forth.

10. A water-heater, comprising a shell, closed at top and having an encompassing flange on its bottom provided with a depending pipe terminating in a perforated circular head, chambered flue-sheets near the upper and lower ends of the shell respectively, the upper flue-sheet arranged to connect the shell-spaces above and below it, circulating-tubes connecting the chambers in the flue-sheets, and heating-tubes in said circulating-tubes connecting the shell-spaces above the upper flue-sheet and below the lower flue-sheet respectively; in combination with a water-reservoir on which said heater is mounted and for which its bottom forms a cover, concentric circular partitions dividing the water-reservoir into chambers, into the central one of which projects the aforementioned pipe depending from the heater-bottom, ports at the foot of the partitions placing the reservoir and the aforesaid chambers in communication with one another, means causing the water under the pressure of the steam entering the central chamber to flow from chamber to chamber into the space surrounding the outer chamber at different elevations and alternately in an upward and downward direction, means for forcing the water from the inner chamber into the chamber of the lower flue-sheet, means for taking water from the chamber in the upper flue-sheet, and means for supplying steam to the heater-shell, substantially as and for the purpose set forth.

11. A water-heater, a water-reservoir, a steam-collecting chamber between the two, steam-heating tubes in said heater opening into said chamber, means for supplying steam under pressure to said heating-tubes, concentric chambers in the water-reservoir, means for conducting the steam from the collecting-

chamber into the body of water in the central chamber of the water-reservoir, means causing the water in said reservoir to circulate under steam-pressure from the central chamber through the others successively, means for feeding water from said central chamber to the heater, and means for supplying cold water to the outer chamber in said reservoir, substantially as and for the purposes set forth.

12. A water-heater consisting of a heater proper and a water-reservoir separated therefrom by a partition having a pipe terminating in a perforated head and projecting into said reservoir, concentric chambers in the water-reservoir, the central chamber surrounding the aforesaid pipe, said chambers in communication alternately at top and bottom; said heater comprising a fluid-tight shell, water-circulating tubes connected with feed and delivery chambers, steam-heating tubes opening into a chamber above the aforesaid partition whereby the circulation of the water in the reservoir is induced by waste-steam pressure and said water preheated and the steam condensed; in combination with means for forcing water from the central chamber of the reservoir into the receiving-chamber for the circulating-tubes, and means for supplying steam to the heating-tubes, substantially as and for the purpose set forth.

13. The combination with the tubular heater constructed as described and whose bottom is provided with an encompassing flange, with concentric flanges 32 on its under side and with the steam-distributing pipe 25 terminating in the circular head 26 having perforations 27 in its periphery; of the water-reservoir, the concentric partitions 29, 30 and 31 whose upper edges form joint with the flanges 32, ports, 33, 34, 35, in said partitions near the foot thereof, the upwardly-tapering casings 36, 37 and 38 respectively secured at their lower edges to partitions 29, 30 and 31 at different elevations, and ports in said partitions above their point of junction with their respective casings, and means for taking water from the chamber encompassed by the partition 29, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

MATHIAS JÖNSSON.

Witnesses:
O. E. JAKOBSSON,
J. VESTERGREN.