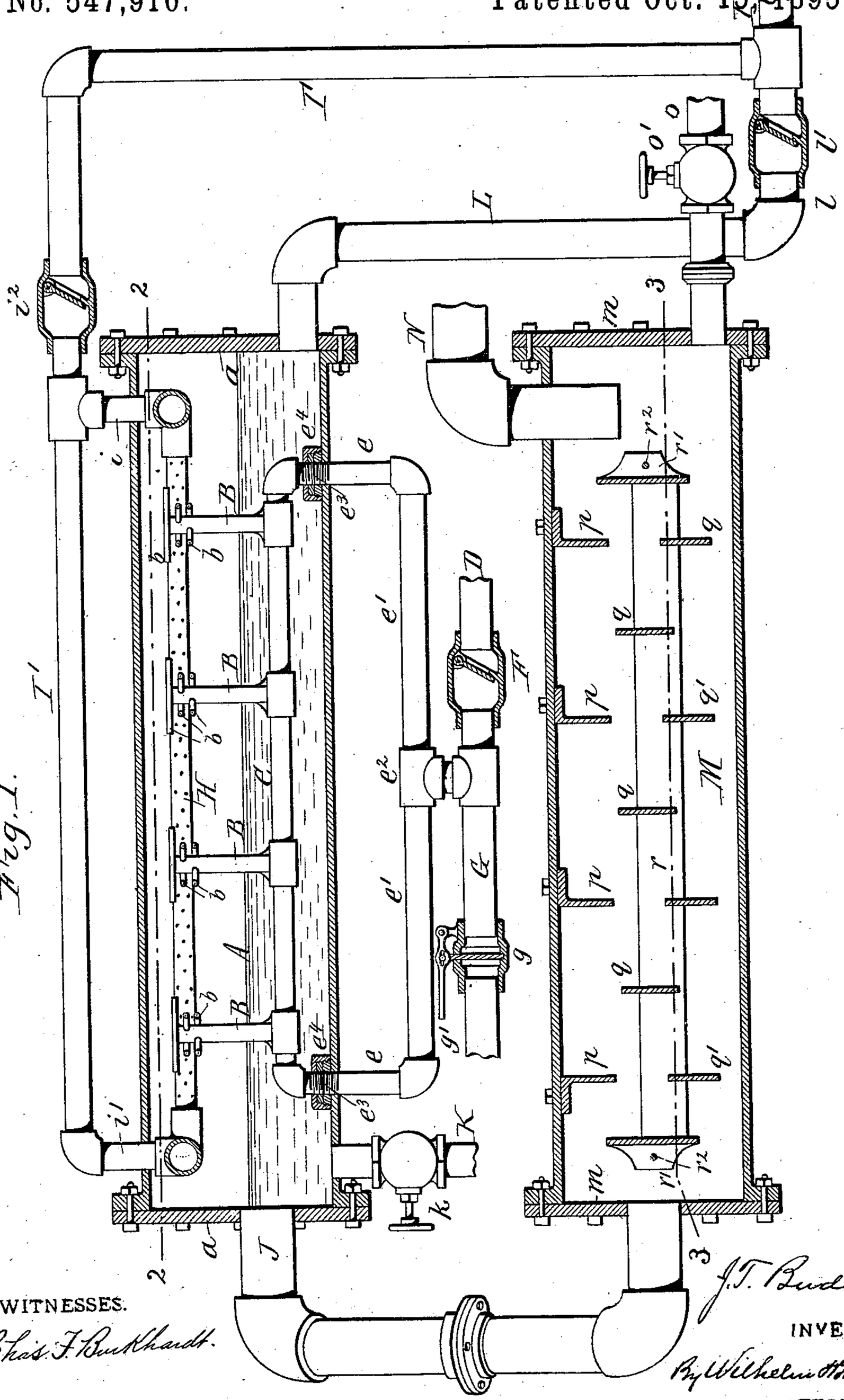
(No Model.) 4 Sheets—Sheet 1.

J. T. BUDD.

FEED WATER HEATER AND PURIFIER.

No. 547,910. Patented Oct. 15, 1895.



WITNESSES.

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J. T. Budd

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(No Model.)

4 Sheets—Sheet 2.

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FEED WATER HEATER AND PURIFIER.

No. 547,910. Patented Oct. 15, 1895.

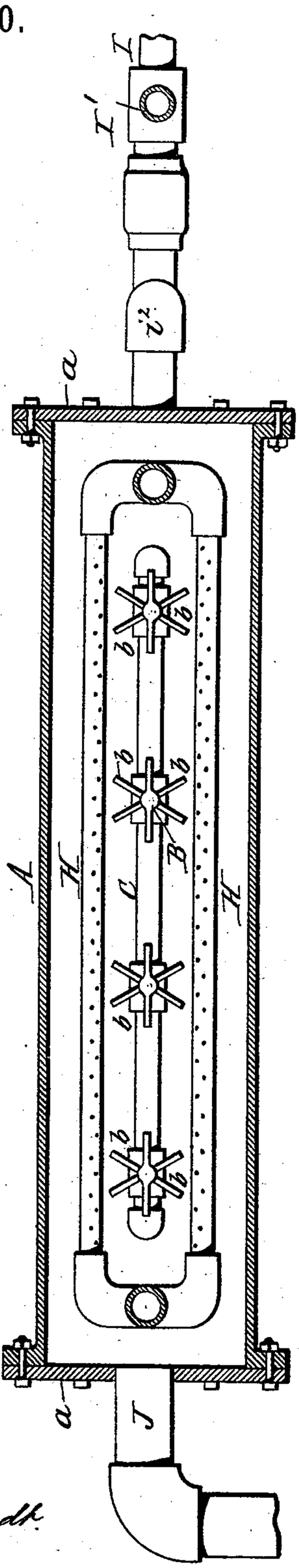

Fig. 2.

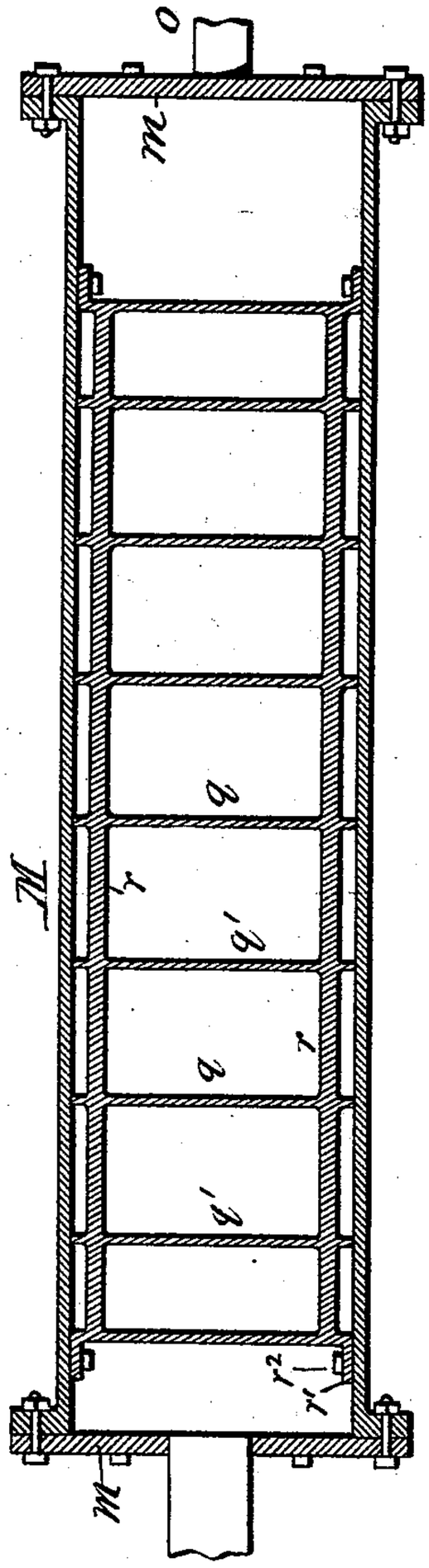

Fig. 3.

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(No Model.) 4 Sheets—Sheet 3.

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FEED WATER HEATER AND PURIFIER.

No. 547,910. Patented Oct. 15, 1895.

Fig. 5.

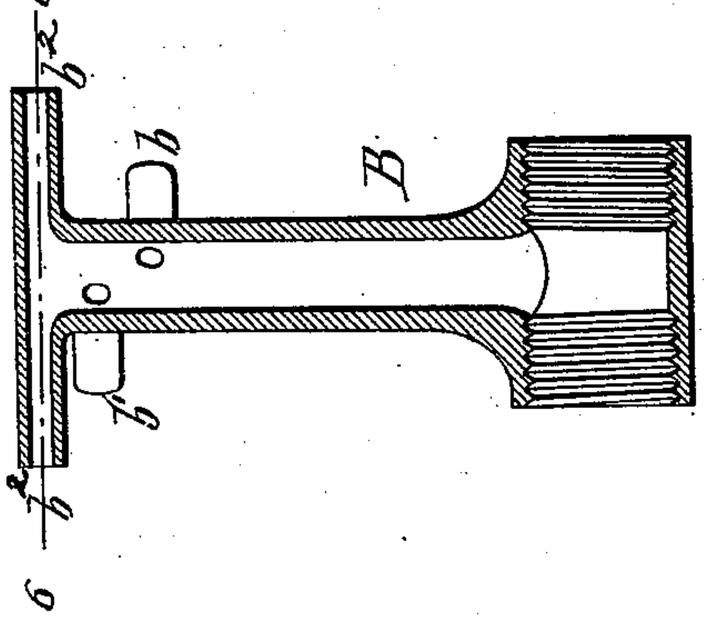


Fig. 6.

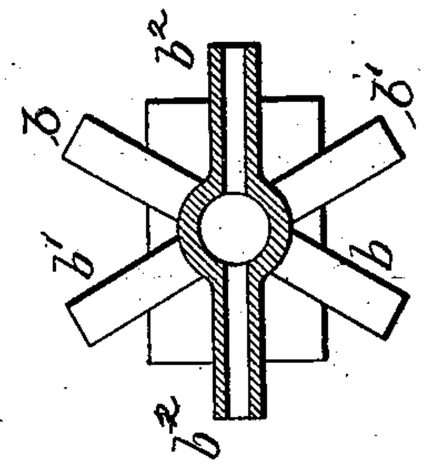
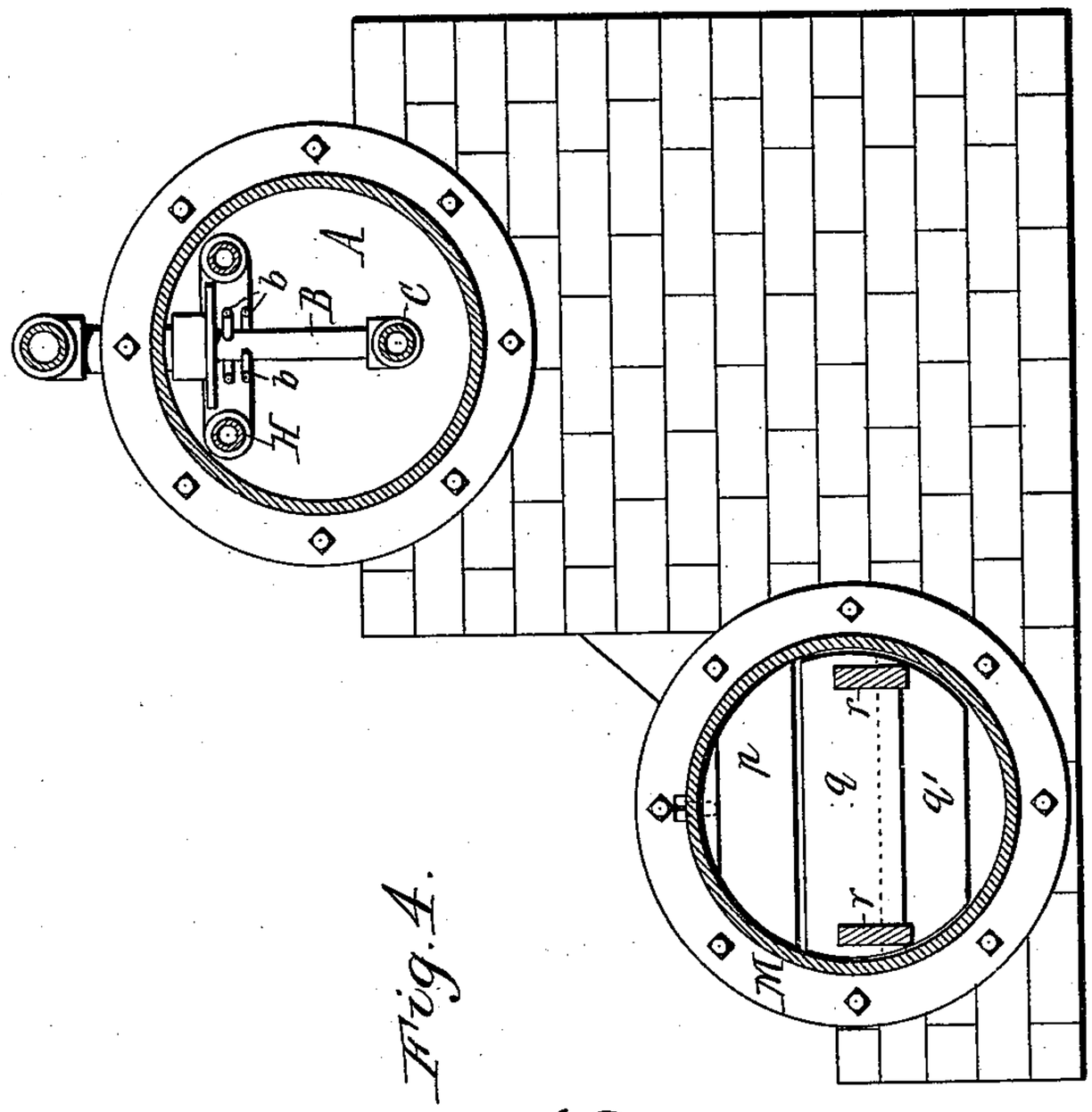


Fig. 4.



WITNESSES:

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(No Model.) 4 Sheets—Sheet 4.

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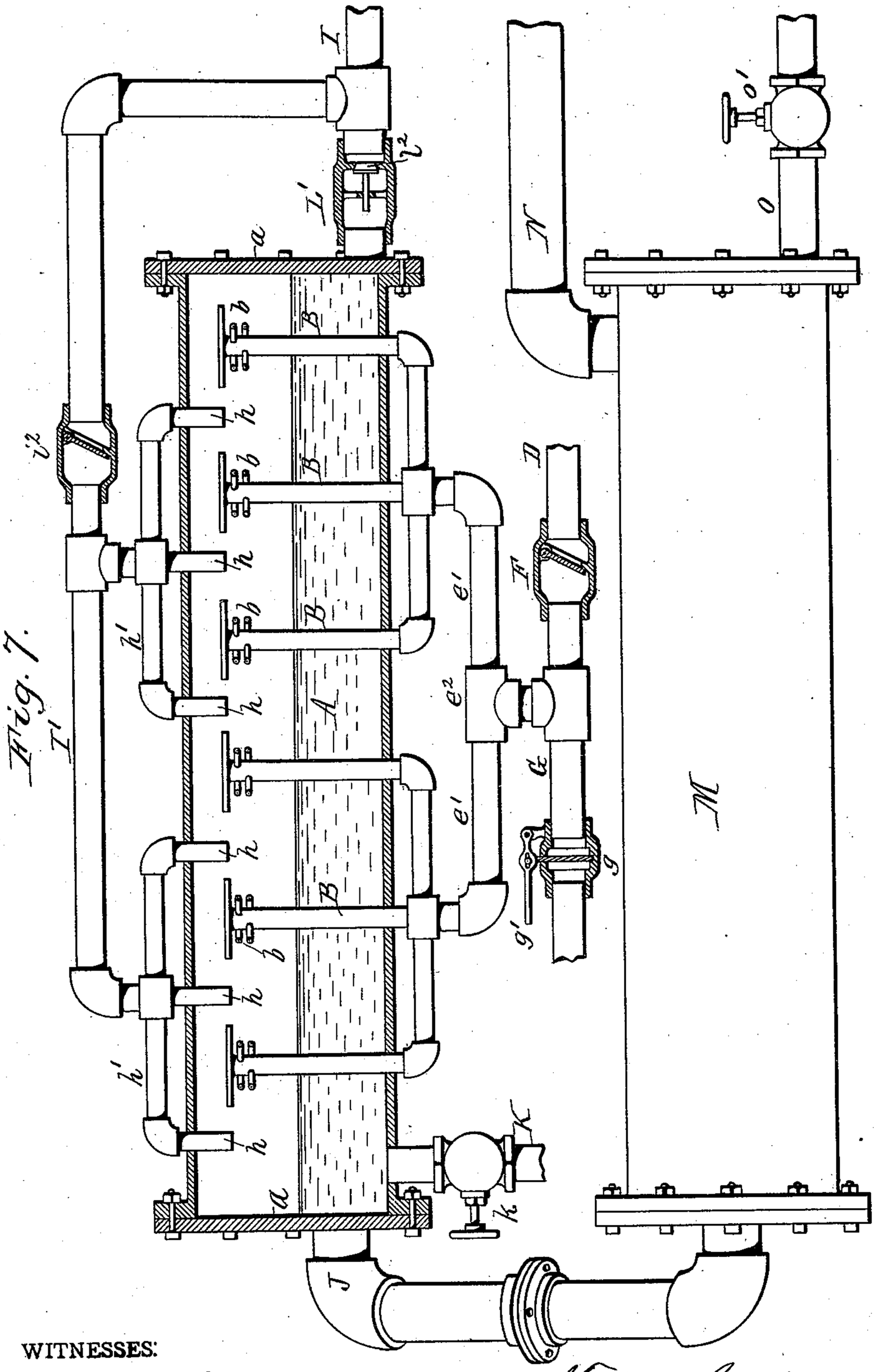
FEED WATER HEATER AND PURIFIER.

No. 547,910. Patented Oct. 15, 1895.



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UNITED STATES PATENT OFFICE.

J. TALMAN BUDD, OF BUFFALO, NEW YORK.

FEED-WATER HEATER AND PURIFIER.

SPECIFICATION forming part of Letters Patent No. 547,910, dated October 15, 1895.

Application filed February 1, 1895. Serial No. 536,937. (No model.)

To all whom it may concern:

Be it known that I, J. TALMAN BUDD, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Feed-Water Heaters and Purifiers, of which the following is a specification.

This invention relates more particularly to that class of feed-water heaters and purifiers in which the water is delivered into the heater in a finely-divided condition and in which the sprayed water is heated by steam issuing from orifices arranged in close proximity to the water-inlets.

One of the objects of my invention is to deliver the water and steam into the heating-chamber in such a manner as to avoid the disagreeable and destructive hammering which takes place when the steam becomes commingled with the water in the heater and the water-pipes.

The invention has the further objects to provide the purifier with effectual blow-offs of simple construction for dislodging and discharging the impurities which settle in the same or which obstruct the feed-water pipes and orifices and to provide an efficient settling-chamber whereby any impurities remaining in the water after leaving the heater are intercepted and separated from the water.

In the accompanying drawings, consisting of four sheets, Figure 1 is a longitudinal sectional elevation of my improved apparatus. Fig. 2 is a horizontal section of the heating-chamber in line 2 2, Fig. 1. Fig. 3 is a similar section of the settling-chamber in line 3 3, Fig. 1. Fig. 4 is a cross-section of the apparatus. Fig. 5 is a vertical central section of one of the water-delivery pipes on an enlarged scale. Fig. 6 is a horizontal section thereof in line 6 6, Fig. 5. Fig. 7 is a longitudinal sectional elevation of a modified construction of the apparatus.

Like letters of reference refer to like parts in the several figures.

A is the heating or separating chamber, into which the water is delivered and which preferably consists of a tube arranged horizontally above the boiler to be fed and having its ends closed by heads *a*.

B represents a longitudinal series of upright water-delivery pipes arranged at intervals within the heating-chamber, and C is a horizontal supply device or water-distributing pipe which is arranged in the lower portion of the heating-chamber and with which the lower ends of the water-delivery pipes are connected.

D is the main water-supply pipe, which is connected with opposite ends of the supply device C, preferably by vertical branch pipes *e*, horizontal branch pipes *e'*, and a short vertical pipe e^2. The upright branch pipes *e* are preferably divided within the heating-chamber, as shown at e^3 in Fig. 1, and their lower sections pass through openings formed in the under side of the heating-chamber, the two sections of each of said pipes being coupled together by a union e^4, of any suitable or ordinary construction, arranged within the heating-chamber.

F is a check-valve arranged in the main water-supply pipe adjacent to the short pipe e^2 and permitting the water to pass into the branch pipes *e* and *e'*, but preventing its return into the supply-pipe.

The water-delivery pipes B extend nearly to the top of the heater, and each of these pipes is provided above the level of the water in the heater with several horizontal rows or tiers of discharge-nozzles *b b' b²*, which radiate in different directions and from which the water issues in minute streams or jets.

These nozzles or orifices are arranged at different levels, as clearly shown in Figs. 5 and 6, the orifices *b'* being arranged higher than the orifices *b*, and the orifices b^2 higher than the orifices *b'*. When the pump supplies sufficient water to discharge through all of these orifices, no steam can enter the pipe. When the water-supply decreases and the upper orifices are not supplied with water, the steam enters the pipe through the idle orifices and fills the space in the pipe above the water-level therein. When the water-supply increases again, the steam is expelled through the upper orifices and water takes its place. By this means free egress and ingress for the steam from and to the space in the pipe above the water-level therein is provided under all conditions of feed, and the steam is at all times kept above the water-level in the pipe and prevented from becoming commingled with the water or separating the water in the

pipe into different bodies or particles, and the pounding resulting therefrom is avoided.

G is a blow-off pipe for the water-delivery pipes, which is connected with the lower coupling of the short pipe e^2, and g is a hand-valve of any suitable construction arranged in said pipe. In the drawings is shown a sliding valve, which is operated by a hand lever g'. Upon opening this valve the steam in the heating-chamber above the body of water enters the water-delivery pipes through their discharge-nozzles and passes through said pipes and the branch pipes, and finally escapes through the blow-off pipe, thus clearing the orifices of these nozzles and the various water-pipes of any impurities or scale.

H is a steam-delivery pipe arranged in the heating-chamber and constructed, preferably, in the form of an elongated horizontal loop surrounding the series of water-delivery pipes B about on a level with their discharge nozzles or orifices b. The members of this loop are provided with perforations or orifices through which the steam issues into the heating-chamber in numerous jets from end to end of the loop. The steam-jets meet the small streams of water issuing from the water-delivery pipes, whereby all the particles of water are effectually exposed to the heating action of the steam.

I is the main steam-supply pipe, preferably connected with the boiler to be fed, and I′ is a branch pipe extending from the main supply pipe to the upper side of the heater and preferably connected with both ends of the loop-shaped steam-delivery pipe by vertical branch pipes ii', extending through the upper side of the heating-chamber.

i^2 is a check-valve, which is arranged in the branch pipe i' between the main steam-supply-pipe and the front branch pipe i, and which prevents the steam from returning into the main steam-pipe I.

J is the feed-water outlet or discharge pipe leading from the rear end of the heating-chamber, and K is a blow-off pipe connected with the bottom of said chamber at or near its end and having a hand-valve k.

L is an upright cleaning or flushing pipe connected at its upper end with the front end of the heating-chamber, at or near the bottom thereof, and communicating at its lower end with the main steam-supply pipe I by a branch pipe l. In this branch pipe is arranged an automatic or check valve l', which closes toward the main steam-supply pipe. The flushing-pipe, by reason of its connection with the water-space of the heating-chamber, becomes filled with water, and the weight of this water column tends to close the automatic valve in the flushing-pipe. The pressure exerted against the front side of this valve by the weight of the water column, in addition to the equalized steam-pressure in the heating-chamber, exceeds the steam-pressure against the rear side of the valve, and the steam in normal condition of the apparatus thus encounters less resistance in the branch pipe I′, and passes through the latter into the heating-chamber. Upon opening the valve of the blow-off pipe K the pressure in the heating-chamber is reduced sufficiently to allow the steam-pressure in the main supply-pipe to overcome the resistance against the front side of the automatic valve and open the same. The steam, seeking the shortest course, enters the flushing-pipe, expels the water from the latter, and passes through the heating-chamber. In sweeping over the bottom of the chamber the steam effectually dislodges the deposited mud or other impurities and discharges the same through the blow-off pipe.

M is a settling or purifying chamber, which receives the heated feed-water from the heating-chamber and in which any remaining impurities are separated from the feed-water before its passage into the boiler. This settling-chamber preferably consists of a horizontal tube of about the same dimensions as the heating-chamber, having its ends closed by heads m. The feed-water is delivered into the settling-chamber by the outlet-pipe of the heating-chamber, which connects with the adjacent head of the same.

N is the outlet-pipe of the settling-chamber, which extends into the top of the latter and whereby the purified feed-water is delivered into the boiler.

o is a blow-off pipe connected with the rear end of the settling-chamber and having a hand-valve o'.

p represents a series of transverse skimming-plates or diaphragms arrranged within the settling-chamber and depending from the upper side thereof, whereby any floating substances or impurities are intercepted and prevented from passing with the feed-water into the boiler. The skimming-plates extend across the upper portion of the settling-chamber and are preferably provided with flanges for securing them to the chamber, as shown.

q represents a longitudinal series of upright diaphragms arranged transversely in the central portion of the settling-chamber, and q' represents a similar series of diaphragms arranged in the lower portion of the settling-chamber.

The diaphragms q of the central series preferably alternate with those of the lower series, and the lower edges of the diaphragms of the upper series extend a short distance below the upper edges of the lower series, whereby the water is caused to flow through the settling-chamber in a sinuous or serpentine course. These diaphragms, while retarding the flow of the water and thereby promoting the precipitation of the impurities, serve to arrest the impurities, causing the same to be deposited on the top and bottom of the chamber. The diaphragms of the lower series terminate above the bottom of the settling-chamber, so as to leave a narrow space for the passage of the sediment in blowing off the

same through the pipe *o*. In or order to permit the two series of settling-diaphrams to be readily placed in the settling-chamber and removed therefrom, they are formed on or secured to upright longitudinal bars *r*, and the end diaphragms of the series are formed with lugs or ears *r'*, which are secured to the inner surface of the settling-chamber by bolts r^2. Upon removing the heads of the settling-chamber and the fastening-bolts r^2 the two groups of diaphragms may be withdrawn from the settling-chamber.

In the normal condition of the apparatus the valves in the blow-off pipes of the heating-chamber, the water-delivery pipes, and the settling-chamber are closed, and the check-valve of the flushing-pipe L is held in its closed position by the steam-pressure in the heating-chamber and the weight of the water column in the flushing-pipe. The water sprayed into the heating-chamber by the nozzles of the upright pipes is met by the steam-jets issuing from the steam-delivery pipe, as hereinbefore described, whereby it is quickly heated to the necessary degree for liberating the lime and other impurities, which latter settle to the bottom of the heating-chamber. From the latter the heated feed-water flows through the outlet-pipe J into the settling-chamber, and in passing through this chamber the impurities floating upon the surface of the water are arrested by the skimming-plates *p*, while the heavier impurities still remaining in the water are intercepted and caused to settle by the middle and lower series of diaphragms *q* and *q'*, the water freed from impurities being finally discharged from the settling-chamber into the boiler. In order to keep the settling-chamber full of water, its outlet-pipe is connected with the top thereof, as shown.

When it is desired to blow off the accumulated sediment from the heating-chamber, the valve of its blow-off pipe is opened, which causes the steam-supply to be diverted through the flushing-pipe owing to the reduction of pressure in the heating-chamber, as hereinbefore described, thereby flushing the bottom of the heating-chamber and expelling the sediment through the blow-off pipe. After blowing off this chamber, the blow-off valve is closed, when the valve in the flushing-pipe is again closed automatically by the weight of the water column and the increase of the pressure in the heating-chamber, thereby again directing the steam through the branch pipe I', leading to the heating-chamber. The settling-chamber is readily cleared of sediment by opening its blow-off valve, whereupon the steam-pressure in the heating-chamber discharges the contents of the settling-chamber through the blow-off pipe of the latter, and thus flushes its bottom and cleans the diaphragms.

The system of water-delivery pipes and their orifices are readily cleansed by opening the blow-off valve, as hereinbefore described.

By dividing the vertical branch pipes *e* and connecting the sections thereof by unions, as shown, the system of water-delivery pipes can be withdrawn from the heating-chamber for making repairs or other purposes upon removing the heads of said chamber and unscrewing the unions to disconnect the pipe-sections, the delivery-pipes being for this purpose made sufficiently short to clear the steam-delivery pipe H when the vertical branches *e* are disconnected.

By the thorough distribution of steam and water within the heating-chamber the dangerous hammering and jarring are avoided.

By supplying the water to the heating-chamber from a rising discharge-pipe, as shown in the drawings, the steam cannot enter below the water in the pipes connected with the heater, as the water always remains below the steam by gravity, thus avoiding the annoying hammering which occurs in the water-pipes of feed-water heaters in which the water-supply is delivered from above through a pipe or pipes entering at or near the top of the heating-chamber.

In the modified construction of the apparatus shown in Fig. 7 the automatic action of the valve in the flushing-pipe is effected by constructing the valve of different areas on opposite sides, the side of the valve which faces the main steam-supply pipe being of smaller area than the side subjected to the pressure in the heating-chamber. In the ordinary condition of this apparatus the pressure which tends to close the automatic valve overbalances the pressure against the rear side of the valve, thus diverting the steam through the branch pipe I', except when the pressure is reduced in the heating-chamber by opening its blow-off valve, in which case the automatic valve is opened and the steam allowed to pass into the heating-chamber through the flushing-pipe, as in the first-described apparatus. In Fig. 7 of the drawings an ordinary conical check-valve l^2, of different areas, is shown in a horizontal flushing-pipe L'; but any other suitable automatic valve presenting different areas on opposite sides may be substituted for the conical valve.

It will be observed that in the first-described apparatus the automatic valve is kept closed by differential pressures operating against substantially like areas thereof, while in the last-described apparatus this is effected by like pressures operating against differential areas of the valve. In both cases the reduction of pressure in the heating-chamber by the opening of the blow-off valve causes a diminished pressure on the side of the valve facing the heating-chamber, which decrease in pressure is sufficient to open the valve and keep it open until the normal pressure is restored in the heating-chamber.

If desired, the supply device or horizontal distributing-pipes of the water-delivery pipes B may be arranged outside of the heating-chamber and the delivery pipes extended

through the bottom of the latter, as shown in Fig. 7, and, if preferred, a series of separate steam-delivery nozzles or short pipes *h* may be employed instead of the perforated steam-delivery pipe or loop H. These nozzles extend through the top of the heating-chamber and terminate in close proximity to the nozzles or orifices of the water-delivery pipes, and they are preferably supplied in groups from manifold pipes *h'*, arranged on the outer side of the heating-chamber and connected with the branch pipe I'.

I claim as my invention—

1. The combination with a horizontal heating chamber, of a steam distributing device extending throughout the length of the heating chamber in the upper portion thereof, and ascending water delivery pipes arranged in the heating chamber below the steam distributing device and provided with discharge orifices at their upper ends, which discharge orifices are arranged in close proximity to the orifices of the steam distributing device, substantially as set forth.

2. The combination with a horizontal heating chamber, of a perforated steam distributing pipe arranged horizontally in the upper portion of the heating chamber, and ascending water delivery pipes arranged in the heating chamber below the perforated steam distributing pipe and provided at their upper ends with discharge orifices which are arranged in close proximity to the perforated steam distributing pipe, substantially as set forth.

3. The combination with a heating chamber having a water outlet and a perforated steam distributing device, arranged in its upper portion, of a water supply pipe, and a water delivery pipe connected with said supply pipe, extending upward from the lower portion of the heating chamber and provided with laterally extending discharge nozzles arranged in close proximity to said steam distributing device, substantially as set forth.

4. The combination with a heating chamber having a water outlet, of a series of water delivery pipes extending upward in the heating chamber and provided with discharge nozzles or orifices, and a perforated horizontal steam delivery loop arranged within the heating chamber and surrounding said delivery pipes opposite their discharge nozzles or orifices, substantially as set forth.

5. The combination with a heating chamber having steam inlet and water outlet pipes, of a water distributing device having orifices for delivering the water into the steam space of the heating chamber in small streams, a water supply pipe connected with the distributing device, and a blow off pipe leading from said supply pipe and provided with a blow off valve, substantially as set forth.

6. The combination with a heating chamber having a water inlet, a water outlet and a blow off pipe having a valve, of a steam supply pipe connected with said heating chamber, a cleaning or flushing pipe leading from said steam supply pipe to the heating chamber, and an automatic valve arranged in said cleaning pipe, substantially as set forth.

7. The combination with a heating chamber having water inlet and outlet pipes, a steam distributing device for heating the water and a steam supply pipe, of a blow off pipe and valve arranged at one end of the heating chamber, and a steam cleaning or flushing pipe connected with the opposite end of the heating chamber and provided with a check valve arranged to open and close automatically as the blow off valve is open or closed, whereby the steam is diverted from the steam distributing device when the blow off valve is opened for cleansing the heating chamber, substantially as set forth.

8. The combination with a heating chamber having water inlet and outlet pipes, a steam delivery or distributing device for heating the water and a blow off pipe and valve, of a steam supply pipe connected with said delivery or distributing device, an upright flushing or stand pipe leading from said steam supply pipe to the heating chamber, and a check valve arranged in said flushing or stand pipe, the water in the latter and the equalized steam pressure in the heating chamber keeping the check valve closed, except when the blow-off valve is opened, substantially as set forth.

9. The combination with a settling chamber having a water inlet and outlet and a blow-off, of a series of upright transverse diaphragms arranged in the lower portion of the settling chamber and all terminating at a distance from the bottom of the chamber, whereby an unobstructed blow off passage is formed between said diaphragms and the bottom of the chamber, substantially as set forth.

10. The combination with a settling chamber having a water inlet and outlet and a blow off, of a series of internal transverse skimming plates depending from the top of the chamber, an upper series of upright transverse diaphragms arranged in the central portion of the settling chamber and separated from said skimming plates by intervening water spaces, and a lower series of diaphragms arranged in the lower portion of the said chamber and all terminating at a distance from the bottom of the chamber, whereby an unobstructed blow off passage is formed between said diaphragms and the bottom of the chamber, substantially as set forth.

11. In a feed water heater and purifier, the combination with a settling chamber having a water inlet and an outlet, of a series of transverse diaphragms arranged in the settling chamber and separated from the bottom thereof by an intervening water space, and longitudinal bars connecting said diaphragms, substantially as set forth.

12. In a feed water heater and purifier, the combination with a settling chamber having a water inlet and an outlet at opposite ends, of a series of transverse diaphragms arranged

in the central portion of the settling chamber, a series of transverse diaphragms arranged in the lower portion of said chamber, alternately with the central series and separated from the same and the bottom of the chamber by intervening water spaces, and longitudinal bars connecting the diaphragms of the two series together, substantially as set forth.

13. In a feed water heater and purifier, the combination with a settling chamber having a water inlet at one end and a water outlet and a blow off pipe at its opposite end, of internal transverse skimming plates depending from the top of the settling chamber, and transverse diaphragms arranged in said chamber below the skimming plates and separated from the bottom of the chamber by a water space, substantially as set forth.

Witness my hand this 29th day of January, 1895.

J. TALMAN BUDD.

Witnesses:
CARL F. GEYER,
KATHRYN ELMORE.