(No Model.)

A. L. DRAPER.

FEED WATER HEATER.

No. 462,631. Patented Nov. 3, 1891.

Fig. I.

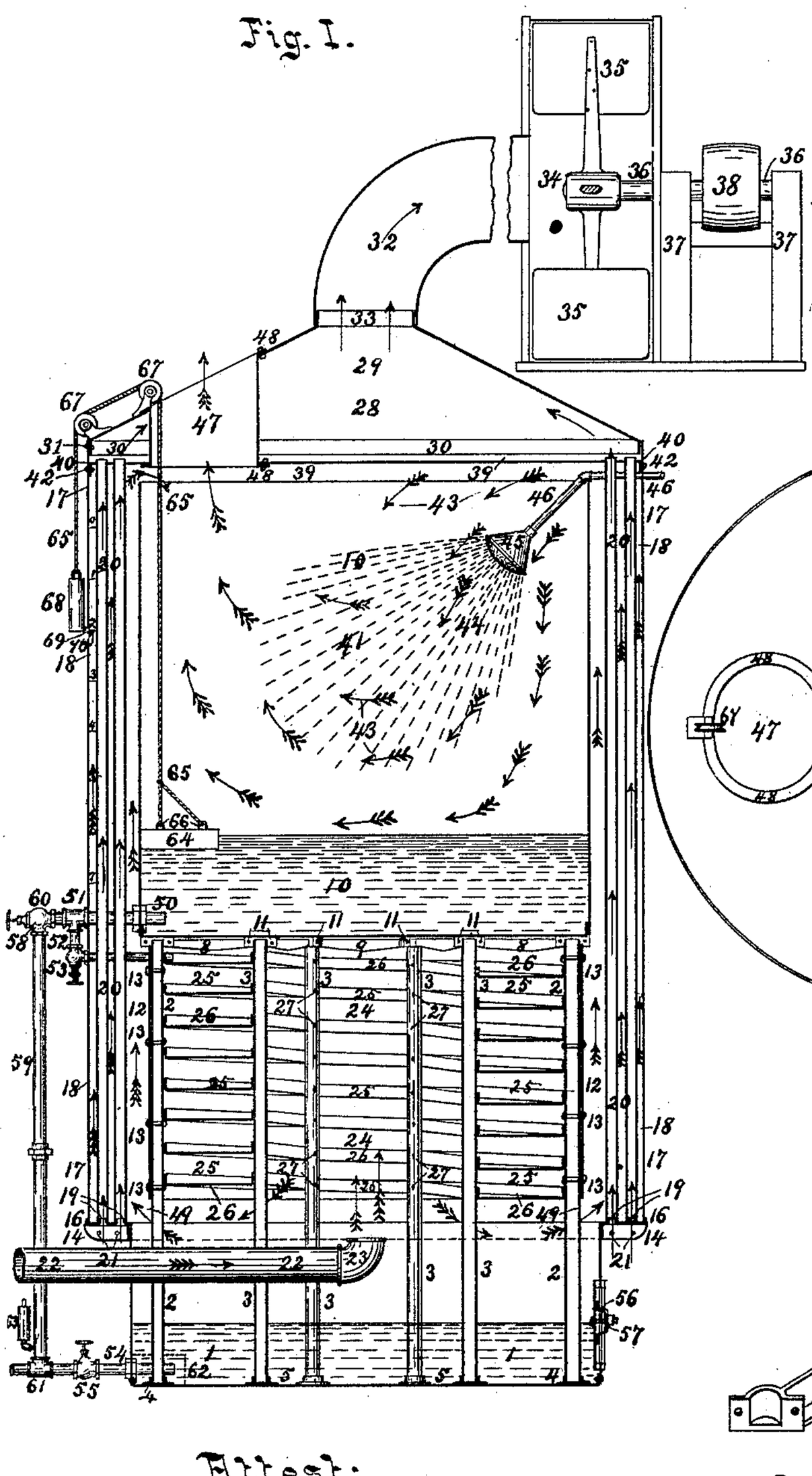


Fig. II.

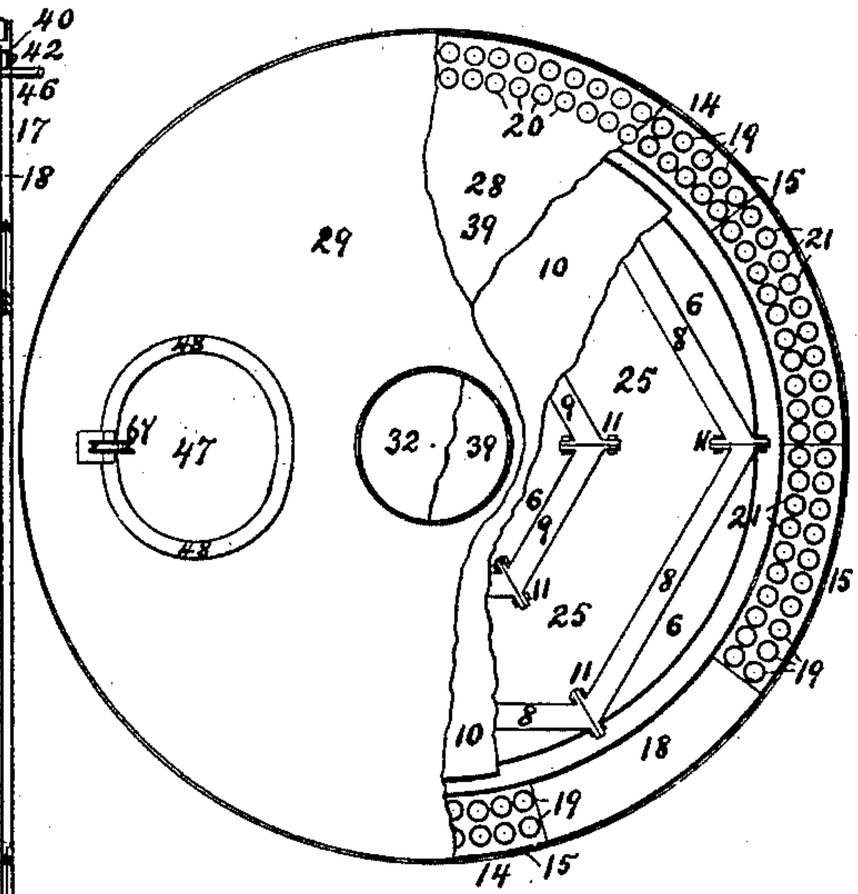
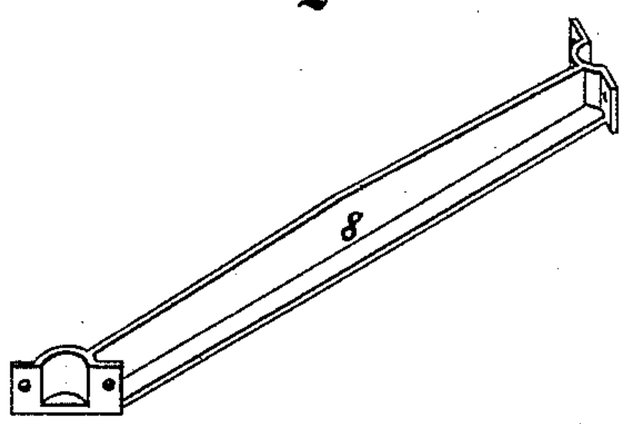


Fig. III.



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UNITED STATES PATENT OFFICE.

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FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 462,631, dated November 3, 1891.

Application filed March 28, 1891. Serial No. 386,747. (No model.)

To all whom it may concern:

Be it known that I, ALVIN L. DRAPER, of Ellsworth, in the county of Ellsworth, State of Kansas, have invented a certain new and useful Improvement in Duplex Exhaust-Steam Condenser, Purifier, and Feed-Water Heater, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

This invention relates to a compound system of coadjutant devices by which the exhaust-steam from an engine is simultaneously condensed, purified, and heated for feed-water, &c., and the hot air engendered by the operation utilized for heating purposes, &c.; and the invention consists in features of novelty, hereinafter fully described, and pointed out in the claims.

Figure I is a vertical section in elevation of the apparatus, and shows the condensing and condensed water elevated tank, the winding inclined scale and impurity extractor shelving, down which the water of condensation is carried, the pure-water tank, the annular steam-chamber, and the air-tubes in said chamber. Fig. II is a top view, part broken away to show the scale-extractor shelving, the annular steam-chamber, the air-flues in said chamber, the hot-air chambers, and the diaphragms between the compartments of the apparatus; and Fig. III is an enlarged perspective view of one of the individual sections of the hexagon bearing-ring at the summit of the tank-supporting posts.

Referring to the drawings, 1 represents the clear-water tank at the base of the apparatus, and 2 and 3 are respectively the outer and inner series of supporting-posts, of which there are preferably six in each series, whose feet 4 and 5 respectively stand within said tank 1. The said series of posts are ranged, respectively, in an outer hexagon ring 6 and inner hexagon ring 7.

8 and 9 represent, respectively, the individual sections of the outer and inner series of the hexagon bearing-bars that space and securely hold the tops of said posts, and are themselves supported by the posts and serve as bearer-joists for the support of the elevated condensed-steam water-tank 10, which, as also the clear-water tank, are preferably made of galvanized iron, and the supporting-posts of gas-pipe, but may be of any other suitable material. The angle-flanges of said outer and inner hexagon bearer-bars are secured by the screw-bolts 11 to the tops of the respective posts that they couple together.

12 represents a deflector-case around the outer series of supporting-posts, to which it is secured by the screw-bolts 13. The said deflector-case, which is also preferably of galvanized iron, extends from the bottom of the elevated tank to within six inches of the top of the clear-water tank.

14 represents an annular collar-head that extends laterally all around the outside of the top or brim of the clear-water tank, to which it is bolted or otherwise fast secured. The said collar-head is preferably cast in flanged sections 15, whose flanges are bolted together. The said collar-head has a peripherally upwardly-projecting lip 16, which holds in the base of the cylindric jacket 17, which jacket extends vertically to a somewhat higher altitude than the elevated tank 10, from the cylindric wall of which tank it extends laterally for a sufficient distance to inclose between the two walls the annular initial condensing or chilling chamber 18, through which the exhaust-steam ascends on its way to the elevated condensing-tank.

19 represent a multiple of upwardly-projecting perforate circle-flanged nipples that are cast in the sections of the collar-head and on which are fitted the two circle series of air-flues 20, into which flues the air enters freely through the open ports 21 through said circle-flanged nipples.

22 represents the exhaust-steam pipe from the engine, which exhaust-pipe extends to the center of the clear-water tank and terminates in a discharge elbow nozzle or pipe 23 that, turning upward, delivers the exhaust-steam above the water-line in said tank in the direction shown by the arrows in the center of the combined steam and purifying chamber 24, that is inclosed within the deflector-case 12, from which chamber 24 the steam escapes through the open annular port 49 all around the rim of the clear-water tank 1 into the vertical annular initial chamber 18.

25 represents the hexagon coil inclined flanged shelf, which fits between the two hexagon series of the supporting-posts, the flanged sides 26 of which inclined coil-shelves are secured, respectively, to the outer and inner series of posts on each side of said inclined coil-shelf by the screw-bolts or rivets 27, said shelf being preferably of galvanized iron. As the steam ascends through the vertical annular initial chilling-chamber 18 after its reception from the exhaust-steam pipe 22, it is chilled, preparatory to condensation, by the action of the cool air that enters through the aforesaid open ports 21 and ascends through the numerous air-flues 20, which air becomes heated in the process of chilling the steam and is discharged from the top of said flues 20 into the hot-air chamber 28 within the dome 29, whose foot-flange 30 fits tightly within the summit of the cylindric jacket 17, where it is secured by the screw-bolts or rivets 31.

32 represents a hot-air flue, that is securely fastened on the surmounting flanges 33 of the dome 29, and which flue connects with the drum-case 34, in which the rotary fan 35 works, the extension of whose drive-shaft 36, that runs in journal-bearings in the frame 37, carries the pulley 38, which pulley drives the fan by any suitable band connection with the engine, from which comes the steam-exhaust that is utilized in this apparatus.

A diaphragm 39 is provided with a pendent-flange collar 40, and makes a tight partition between the aforesaid hot-air chamber 28 above and the annular initial chilling-chamber 18 and the condensing-chamber 41 beneath, and said pendent flange of said diaphragm is secured near the top of and to the said cylindric jacket by the bolts or rivets 42. The air-flues 20 pass through said diaphragm, so as to effect their discharge into said hot-air chamber within the dome. A steam-tight partition is thus provided and secured between the condensing steam-chamber 41, that is inclosed within the condensed-steam water-tank 10 and the surmounting hot-air chamber 28 within the dome 29. Now it will be seen that the upper edge or brim of the condensed-water tank 10 lacks a sufficient distance from reaching to the diaphragm 39 to allow the steam 43 from the annular initial chilling-chamber 18 (which steam has been chilled by the air-pipes 20 in said chamber) to roll over the brim of the tank 10 into the condensing-chamber 41 in said tank. The already-chilled steam after it reaches said chamber 41 rapidly condenses under the influence of the cold-water spray 44 from the spray-nozzle 45, which nozzle is fed by the pipe 46, which pipe may connect with the hydrant or any other cold or iced water supply, and said spray may be forced by the usual hydrant-head, or by a force-pump or other suitable means, or spray by its own gravity. The small residue, if any, of uncondensed steam escapes through the vertical outlet-pipe 47, which passes through apertures and is seated in the diaphragm 39 and dome 29, where said pipe is retained by its upper and lower flanges 48. The opening through said escape-steam pipe also provides a convenient man-hole for the entrance of the workman who cleans out the condensed-water tank 10 and its inclosed condensing-chamber 41. The soft scale in the water of condensation is deposited during the condensing process in the bottom of said tank 10, from which it may be cleaned out, as occasion requires. The rotary fan 35, that is driven by the pulley 38 through its band connection with the engine, produces a suction-draft *via* the hot-air chamber 28, through the air-flues 20, so as to draw said air on its passage through said flues, in which operation it chills the steam in the annular chamber 18 and becomes heated itself and still further heated on its passage through the hot-air chamber 28, and said rotary fan forces said hot air by the usual flues to the various rooms of any building, where it may be utilized for heating purposes, or forces it, if required, as a hot draft to the furnace of the engine from whence comes the exhaust-steam to aid the combustion within the furnace.

50 represents the discharge-pipe from the condensed-water tank 10, which water passes through the T-pipe 51 and coupling-pipe 52 to the globe feed-valve 53, and from said check-valve it is carried to the top of the hexagon coil inclined flanged shelf 25. The discharge of the water of condensation from the upper tank is regulated by said check-valve 53, so as to allow a gentle stream to run down said inclined coil-shelf while it is subjected to the purifying influence of the heated temperature of the exhaust-steam in the purifying-chamber 24, in which said coil-shelving is located. The effect is to extract the remaining hard scale from said water of condensation and deposit it on said shelves, the soft scale, as previously stated, being more easily extracted, having been deposited as sediment in the upper tank 10. The resultant pure water runs from the bottom of the coil-shelf into the clear-water lower tank 1.

54 represents the suction or discharge pipe, which taps the clear-water tank and communicates with the boiler of the engine or with a pure-water reservoir for ice-making or any other purpose for which pure water is required that is clear of scale and all other impurities. 55 is a globe feed-valve in said pipe to regulate the discharge from the tank.

56 represents a man-hole into the clear-water tank 1, through which the man who cleans the tank and inclined coil-shelving finds entrance and through which he throws out the hard scale that he cleans off the shelving and any sediment that in course of time may gather in said tank. 57 is the usual screw-bolted trap that makes a steam and water tight stopper to said man-hole when the same is closed.

58 represents a globe-valve at the outer end of the discharge-pipe 50, that taps the upper

tank 10, and 59 is a vertical pipe that hangs pendent from the globe-joint 60, in which said valve works. The said vertical pipe is connected at its base with the three-way joint-pipe 61 in the discharge-pipe 54. Now it will be seen that if at any time it is desired to feed direct from the upper tank 10 to the boiler, &c., when, for instance, the coil-shelving and lower tank are being cleaned, the supply and outlet also can be cut off from said shelving and lower tank by the closure of the globe-valves 53 and 55, after which the globe-valve 58 is opened, which takes the water of condensation *via* the pipe 59 direct to the discharge-pipe 54, that supplies the boiler, or any other objective point.

62 represents a screen-trap over the reception end of the discharge-pipe 54 within the clear-water tank, which screen filters the water previous to its entrance to said pipe and is a still further guaranty of its purity; also, if any stray hard scale should be washed from the coil-shelving in consequence of the cleansing of said shelves having been too long delayed the said screen will arrest it before reaching the entrance to said pipe.

63 represents a float-indicator, whose attachment tube taps the vertical pipe 59 near its base, and when the globe-valve 59 is closed, as it always is when the clear-water tank 1 is in use and the globe-valve 55 of the discharge-pipe 54 is open, then said indicator shows the height of the water in said clear-water tank and the working of the boiler feed-pump.

64 represents a swimming float that floats on the surface of the water of condensation in the tank 10, and 65 is a cord or chain which is secured to the staples 66 on the top of said float and passes up through the vertical outlet-pipe 47 and over the pulley-wheels 67, from the last of which it hangs pendent and holds the indicating suspension-weight 68, whose position indicates the depth of water in said tank 10. The outer side of the cylindric jacket 17 on line with the pendent weight is graduated, so that the pointer 69 on the bottom of the weight indicates the measurement of the water at the time being in the tank 10 by the graduated table 70, to which it points.

The operation of the apparatus has been in a measure pointed out in the description of its combined elements. This apparatus can be set anywhere within connecting distance of the engine feed-pump and fan. The exhaust-steam is discharged upward from the pipe 22 in the middle of the clear-water tank above the water-level, and passing upward in the center of the purifying-chamber it strikes the bottom of the elevated tank 10, from which the current is rebuffed and circles downward and inclines around over the running water on the coil-shelving 25, until having reached the bottom of the deflector-case said exhaust-steam passes through the annular port 49 into the annular steam-chamber 18, in which it is chilled by the air-tubes 20, the air in which is by the same process heated, and is drawn by a suction rotary fan through the hot-air chamber 28 and forced through flues to any point where it is required for heating or for force hot draft for the furnace, as before described. To return to the exhaust-steam on its passage through the annular steam-chamber 18, it beats against the air-pipes 20 and becomes chilled, and if sufficiently chilled for the process of condensation to have commmenced the product thereof runs down into the clear-water tank 1; but the chief process of condensation takes place after the steam in said annular chamber, having been chilled to a temperature prepared for rapid condensation, rolls over the rim of the elevated tank 10 into the condensing-chamber 41, where it is exposed to the cold-water spray 44 from the perforated rose-nozzle 45. The steam rapidly condenses under the influence of said spray, and the still warm water of condensation settles in the bottom of the tank 10, the continuous influx of steam above the water, as also of that below the bottom of the tank, keeping the water at a high temperature at the boiling-point in the most favorable condition for sedimentation. The soft scale soon settles in the bottom of the tank, and the depth of water of condensation in said tank is pointed by the float-indicator attached thereto. The water is drawn in a regulated current by the globe-valve 53 and discharged on the inclined coil-shelves within the purifying-chamber, and as it slowly runs around on the coil-shelves and under the influence of the hot exhaust-steam that has just rebounded from the bottom of the tank 10 and accompanies the water in its descent, the remaining hard scale in the water, which is the most difficult to extract, remains behind on the gently-inclined shelving, and the now pure water is deposited in the clear-water tank 1, from which, after passing through the screen 62, it is drawn through the suction-pipe 54 when the globe-valve 55 is opened and passes to the boiler or other required destination.

Experience with this apparatus demonstrates the fact that it condenses enough of the exhaust-steam from an engine to more than half supply the boilers with distilled water from which all scale impurities have been taken; also, it is seen that the feed-water is both pure and pumped into the boilers at about the boiling-point, so that the rapid deterioration of the iron caused by incrustation and the great danger incurred from cold-water feeds from the sudden contraction and expansion of the plates are avoided.

All natural waters used for generating steam hold in solution or suspension scale-forming impurities. Among the important elements of the invention are its quick and economic means for the condensation of the exhaust-steam and the simultaneous removal of all the aforesaid impurities from the water of condensation, which is returned to the boiler at about the boiling-point. The slight

wastage may be compensated by the cold-water spray in the condensing-chamber from the perforated rose-nozzle 45.

Experience with this apparatus has demonstrated the fact that it condenses enough of the exhaust-steam to more than half supply the boilers with pure soft distilled water. The residue, as stated, may be provided by the cold spray that hastens the condensation; also, it is seen that the latent heat given out by the steam in the reduction of its temperature consequent on its condensation is utilized for purposes described above. It will also be seen that the purifying functions of the invention are cumulative, for as more than half the exhaust-steam is again utilized when condensed as feed-water it follows that as the operation continuously progresses the feed-water continuously becomes softer and purer; also, the feed-water being supplied continuously to the boiler at about the boiling-point there is no perceptible alternate contraction and expansion of the boiler-metal, with its consequent disintegration and cutting of the rivets and the danger of explosions resulting therefrom. It also reduces to a minimum the rapid disintegration of the metal caused by the incrustation of scale and other deposits.

I claim as my invention—

1. In an exhaust-steam condenser, the combination of the clear-water tank 1, the annular collar-head 14 around the brim of said tank, the perforate circle-flanges integral with said collar-head, the cylindric jacket 17, that rests on said collar-head, the elevated condensed-water tank 10, provided with the condensing-chamber 41, the pillars that support said tank, and the deflector-case 12, there being provided an open annular port 49 between the brim of said clear-water tank and the deflector-case, and the annular chilling steam-chamber 18 between said deflector-case and the tank 10, through which the exhaust-steam passes to said condensing-chamber, substantially as and for the purpose set forth.

2. In an exhaust-steam condenser, the combination of the clear-water tank 1, the posts 2 and 3, standing in said tank, the elevated condensed-water tank 10, supported by said posts, the annular collar-head 14 around the brim of said tank, the perforate circle-flanges 19, integral with said collar-head, the cylindric jacket 17, the deflector-case, there being provided an annular steam-chamber 18 between said jacket, said elevated tank, and said deflector-case, with the open annular exhaust-steam port 49 into said chamber, the air-flues 20, seated on said circle-flanges, the diaphragm 39, secured to near the top of said jacket and pierced by said air-flues, and the dome 29, that surmounts said diaphragm and incloses the hot-air chamber 28, substantially as and for the purpose set forth.

3. In an exhaust-steam condenser, the combination of the clear-water tank, the posts 2 and 3 in said tank, the elevated condensed-water tank 10, that rests on said posts, the deflector-case 12, the cylindric jacket 17, which incloses the steam-chamber 18, the inclined coil-shelving 25, the transfer-pipe that conveys water from the elevated tank to said coil-shelving, and the globe-valve 53, that regulates said transfer, substantially as and for the purpose set forth.

4. In an exhaust-steam condenser, the combination of the clear-water tank 1, the discharge or suction pipe 54, the globe feed-valve 55 in said pipe, the screen-trap 62, that covers the inlet to said pipe, the float-gage or indicator 63, the man-hole trap 57, the steam-exhaust pipe 22, the posts 2 and 3, the elevated tank 10, supported on said posts, the coil inclined shelving 25, the transfer-pipe and valve that commands it that conveys water from the elevated tank to said inclined shelving, the deflector-case 12, the perforate annular collar-head 14, the cylindric jacket 17, and the air-flues 20, substantially as and for the purpose set forth.

5. In an exhaust-steam condenser, the combination of the clear-water tank 1, the posts 2 and 3, that stand in said tank, the elevated tank 10, supported on said posts, the spray-rose 45, the pipe that feeds said rose, the cold-water condensing-spray 44, the deflector-case 12, the cylindric jacket 17, the diaphragm that surmounts the elevated tank, the combined steam-escape pipe and man-hole 47, the float 64, the suspension cord or chain 65, the pulley-wheels 67, the pendent indicator-weight 68, and the graduated table 70, substantially as and for the purpose set forth.

6. In an exhaust-steam condenser, the combination of the clear-water tank 1, the posts that stand in said tank, the elevated tank 10, that rests on said posts, the steam-exhaust pipe 22, the deflector-case 12, the inclined coil flanged shelving 25, the purifying-chamber 24, the perforated annular collar-head 14, the cylindric jacket 17 and air-flues 20, supported on said collar-head, the condensing-chamber 41, the spray-rose and cold-water spray that plays in said chamber, the hexagonal series of bearing-bars 8 and 9, the transfer-pipe that conveys water of condensation from the elevated tank to the inclined shelving, the valve 53, that regulates said transfer, the vertical direct carrier-pipe 59, and the valve 58, that opens and closes its surmounting port, substantially as and for the purpose set forth.

7. In an exhaust-steam condenser, the combination of the clear-water tank 1, the posts that stand in said tank, the elevated condensed-water tank supported by said posts, the inclined coil flanged shelving carried by said posts, the transfer-pipe that conveys water from said elevated tank to said shelving, the valve that regulates said transfer, the exhaust-steam pipe 22, the deflector-case 12, the perforated collar-head 14, the cylindric jacket 17 and air-flues 20, supported by said collar-head, the condensing-chamber 41, the spray-rose and cold-water spray that plays in said condensing-chamber, the diaphragm

39, through which said air-flues 20 discharge hot air, the hot-air chamber 28, the dome 29, that incloses said hot-air chamber, the hot-air pipe 32, the drum-fan case 34, that is connected to said hot-air chamber by said pipe 32, the rotary fan 35, that draws and forces the hot air from said hot-air chamber and to its destination, and the pulley 38, that drives said fan, substantially as and for the purpose set forth.

ALVIN L. DRAPER.

In presence of—
LEWIS H. SEAVER,
H. S. DAVIS.