

(No Model.)

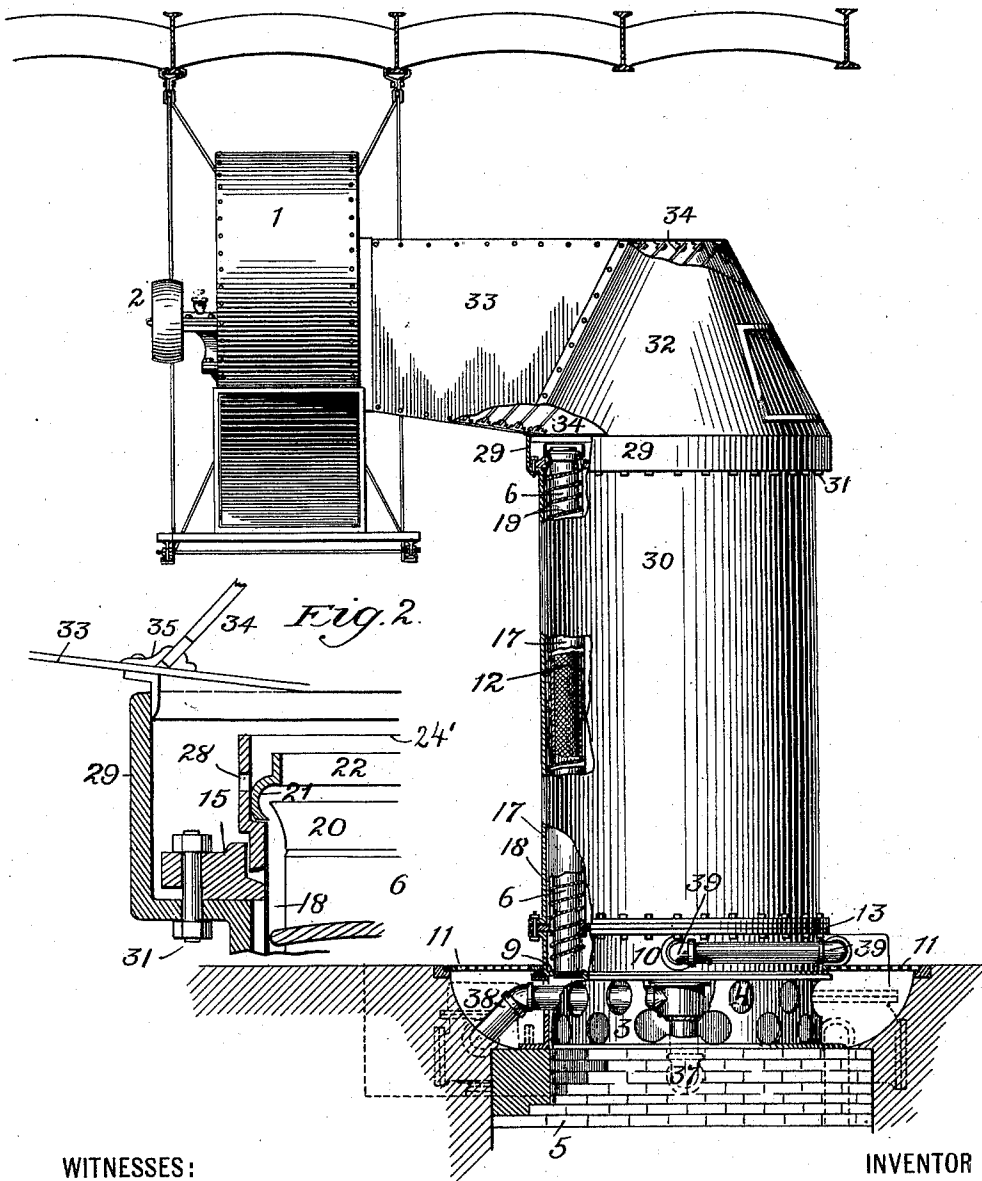
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E. F. WHITE.
EVAPORATION AND SURFACE CONDENSER.

No. 586,110.

Patented July 13, 1897.

Fig. 1.



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(No Model.)

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Fig. 4.

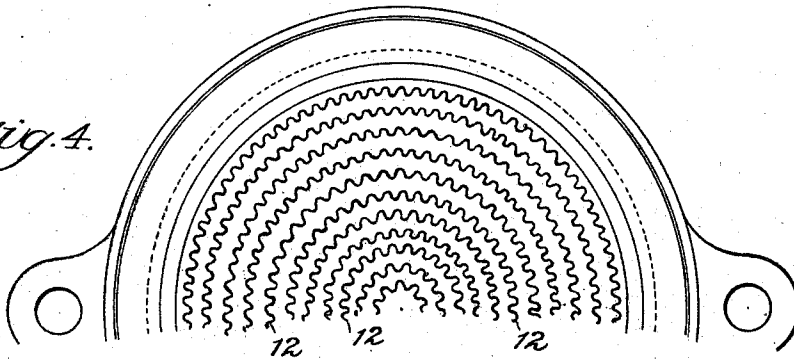
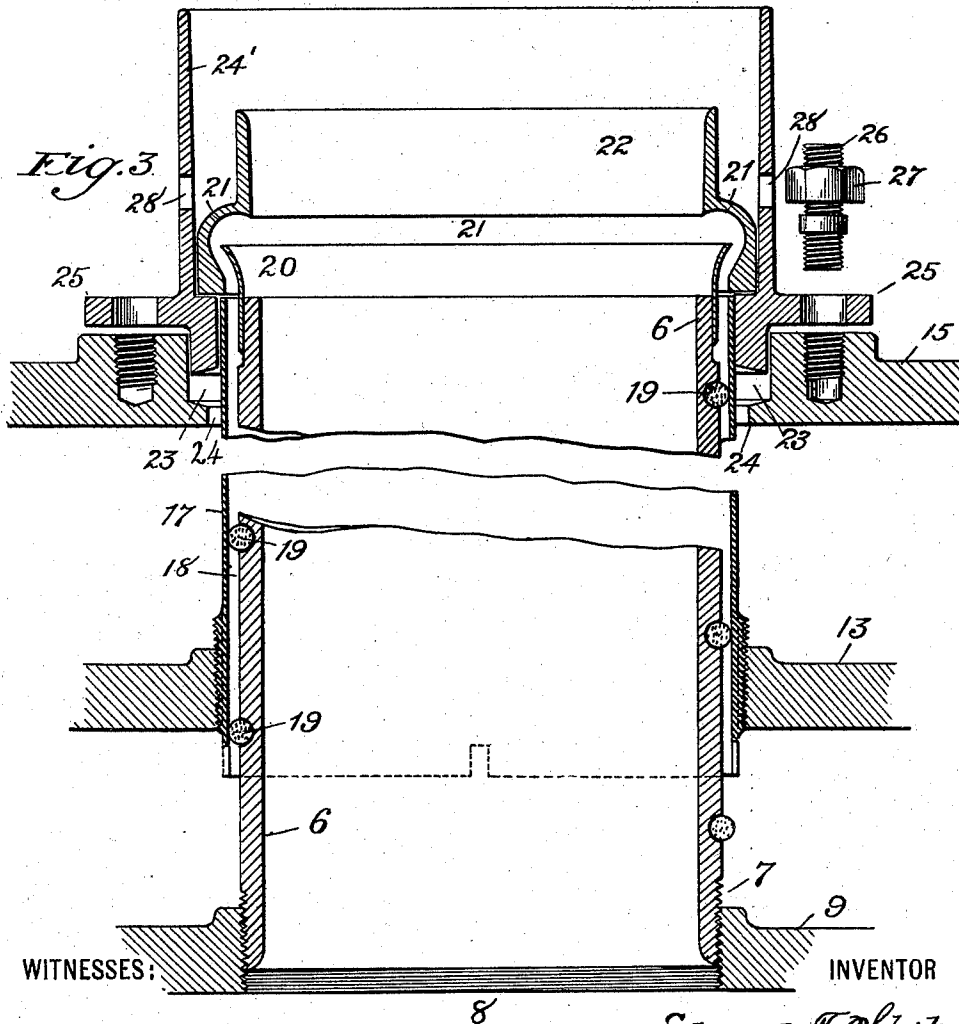


Fig. 3.



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Fig. 5.

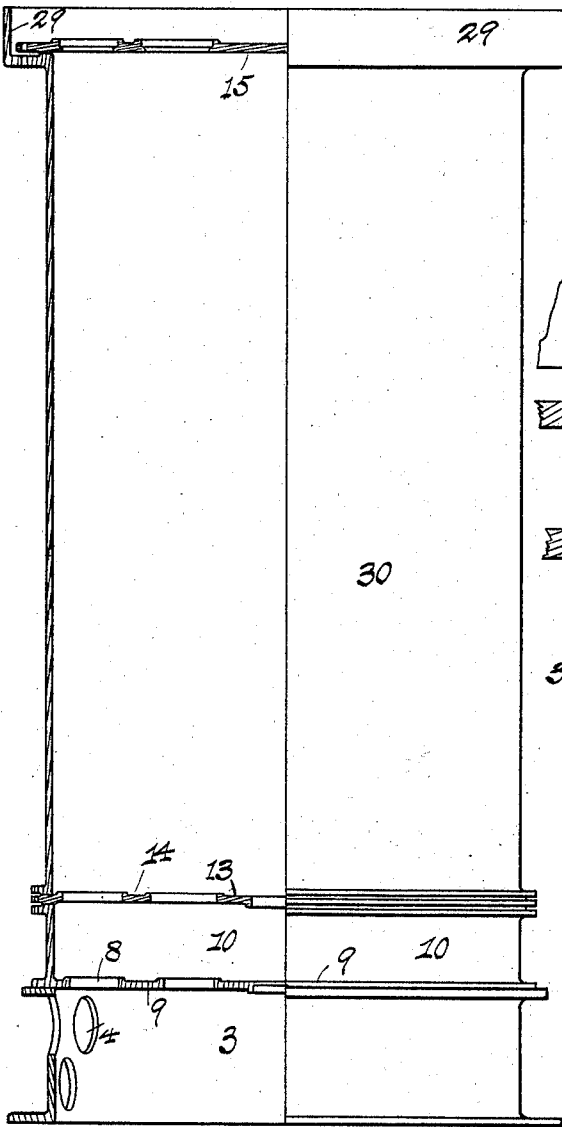


Fig. 7.

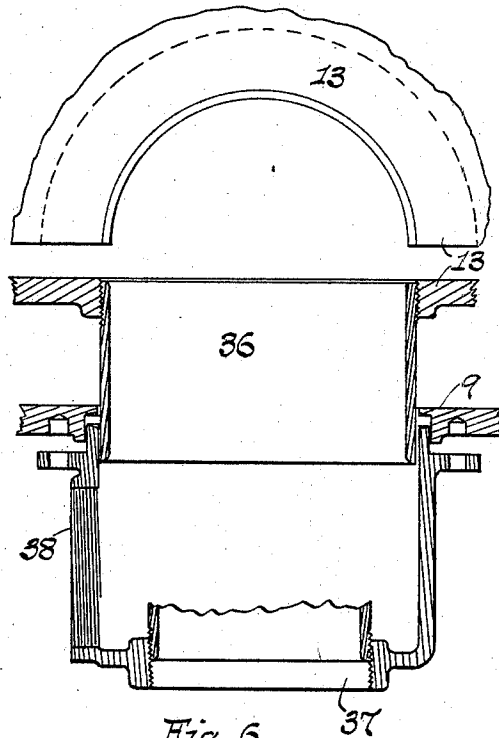


Fig. 6.

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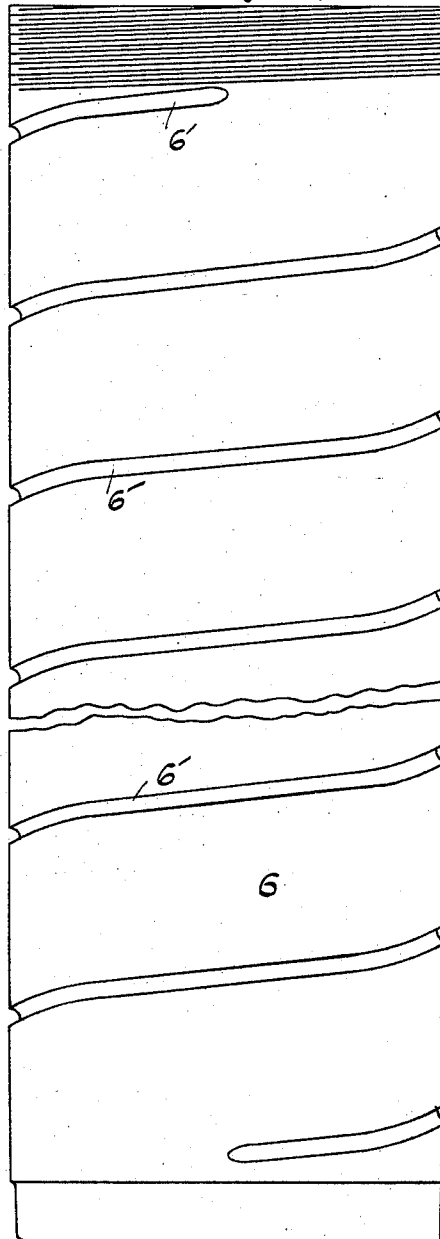
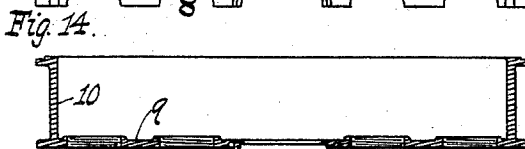
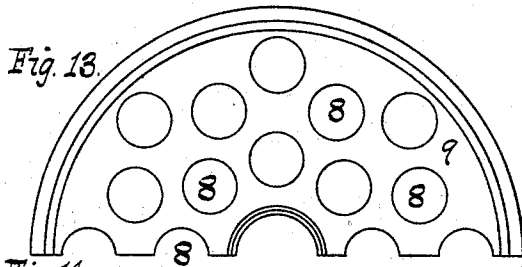
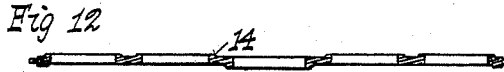
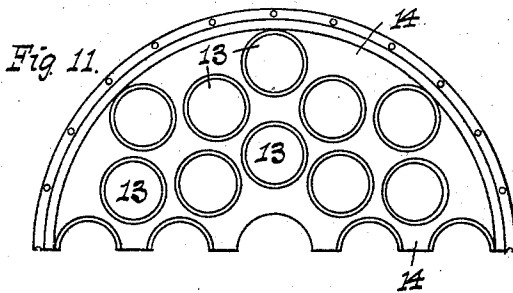
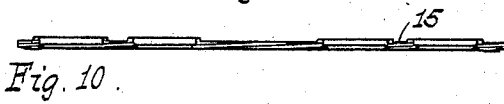
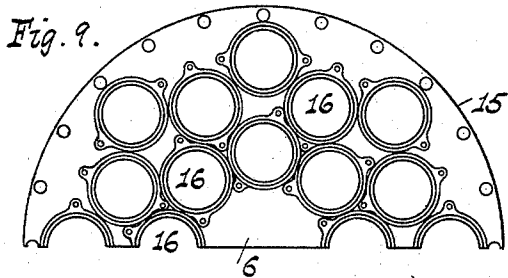


Fig. 8.

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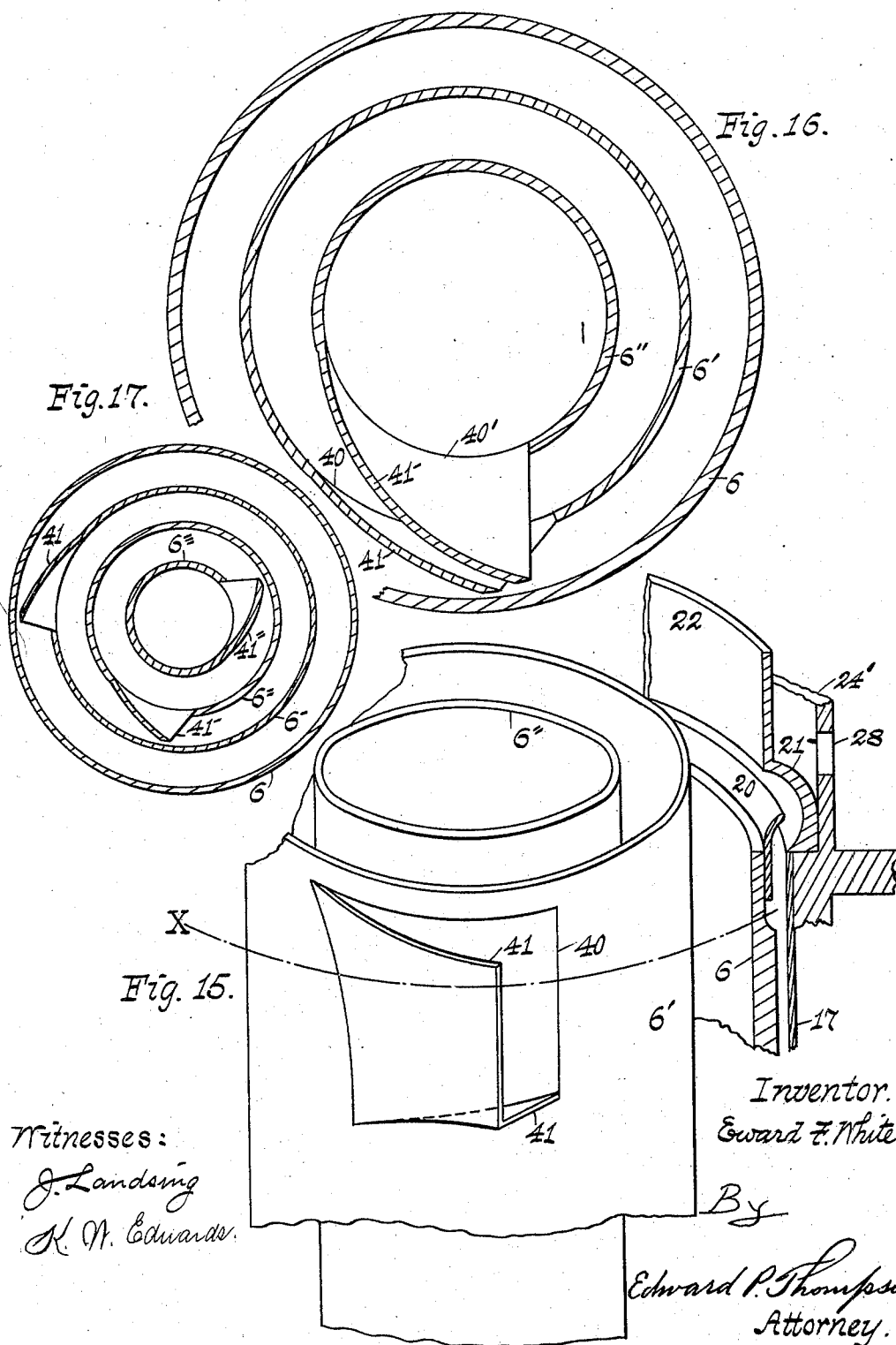
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EVAPORATION AND SURFACE CONDENSER.

SPECIFICATION forming part of Letters Patent No. 586,110, dated July 13, 1897.

Application filed October 28, 1896. Serial No. 610,288. (No model.)

To all whom it may concern:

Be it known that I, EDWARD F. WHITE, a citizen of the United States, and a resident of Bayonne, county of Hudson, and State of New Jersey, have invented certain new and useful Improvements in Evaporation and Surface Condensers, of which the following is a specification.

My invention relates to means for condensing steam derived from the exhaust of a steam-engine or from any other source.

The organization involves an aspirator for drawing air from the lower to the upper ends of pipes provided internally with material having the largest possible cooling-surface, like a net, other larger pipes located concentrically with respect to the first-named pipes, so as to leave a passage-way for the forced circulation of water upward, the space around the larger pipes being the steam-space, and all the pipes being surrounded as a whole by a cylinder for containing said steam.

Figure 1 is an elevation showing the general appearance of all of the apparatus which has anything to do directly or indirectly with the invention. Here and there parts of the construction are broken away so as to give some idea as to the internal arrangements. Some parts are shown in section. Fig. 2 is a vertical section of a small portion of that which is shown in Fig. 1, and it is drawn on a much larger scale, so that the details may be positively understood. Fig. 3 is a vertical section of one of the internal elements of the construction of the condenser shown in Fig. 1. The section is shown in a different plane from that at the section in Fig. 2. The central portions of the pipes are broken away and the end portions brought thereby within the scope of the sheet of drawings. Fig. 4 is a plan of most of that which is shown in Fig. 3, and in addition the edges of the corrugated net, which is not represented in Fig. 3, are visible. Fig. 5 is a view of the principal condensing-cylinder, shown half in elevation and half in vertical section. Fig. 6 is a vertical section of that which forms a construction below the main part of the condenser. Some of the portions are broken off. Fig. 7 is a plan of that which is shown in Fig. 6, intended to bring out principally that the elements are generally circular in Fig. 6. Fig. 8 is a

vertical elevation, with the central portion broken away, of one of the inner pipes involved in the construction. Figs. 9 and 10 are respectively a half-plan and a section of the uppermost horizontal division-plate for holding the ends of certain pipes. Figs. 11 and 12 are similar views of similar plates in order measured from the top. Figs. 13 and 14 are similar views of the next similar plate measured from the top, which is provided with an upwardly-projecting cylindrical flange forming a water-holder. These three plates are shown partially in their order in Fig. 5. Fig. 15 is a perspective of a portion of the whole condenser, representing especially that part which is modified over the former constructions. Enough of the former construction is repeated to assist in identifying the part of the condenser alluded to. Fig. 16 is a cross-section of a part of that which is shown in Fig. 15 at about the line X. Fig. 17 is a similar view to that shown in Fig. 16 of a modification of the same.

By referring to Fig. 1 the combination of the elements brought out in the other figures may be comprehended, especially as to their relative locations, while the exact mechanical construction may be known by referring to the individual remaining figures.

1 is a blower or fan adapted to be driven through the agency of a pulley 2 for the purpose of producing a vaporous current through certain passage-ways in the condenser from the lower part to the uppermost part. The specification need not be burdened by a detail description of this blower, for it is a device well known in the art, and in fact any aspirator whatever will do as far as the principle of the invention is concerned, but of course it is well to chose the most efficient for economical results.

Now passing to the lower part of the condenser the passage-way for the gaseous current may be set forth.

3 is a perforated cylinder having plenty of holes 4, acting as an intermediate foundation between the condenser and the usual masonry work 5. These holes are for the free entrance of air.

6 stands for numerous pipes having external threads at the lower ends and screwed into holes 8 in the lowest head-plate 9, a base

for the water-holder 10, in an air-tight manner, so that air which is drawn by the blower 1 may enter the hole 4 and then the pipes 6, first coming in of course through the perforated platform 11. Within the pipes 6 I provide means to act in the way of a maximum water-cooling surface. In the construction shown this means consists of corrugated netting 12, arranged in convolutions at small distances—for example, three-sixteenths of an inch or so—apart, but the question of distance is only a matter of efficiency and not of invention. The netting is so arranged, preferably as indicated, that the surface stands vertically. The pipes 6 are continued through the holes 14 in the division-plate 13 upward to a point above the head-plate 15, through holes 16, and terminate above the said plate 15, but larger concentric pipes 17, surrounding the pipes 6, surround the respective pipe 6' from a point at the top of the water-holder 10 to a point within the head-plate 15, and within the space 18, between each pipe 6 and each pipe 17, is a spirally-wound cable 19, of yielding and waterproof material, wound in a spiral groove 6', cut upon each pipe 6, and compressed therein by the surface of the pipes 17, so that the space 18 may be called a "spiral" passage-way for the water from the water-reservoir 10 between the division-plate 13 and around the lip 20, secured to the top of each pipe 6 and flaring upward. Around this lip is a water-deflecting surface 21, formed upon an enlarged portion of a short section of a pipe 22, which is located just above the lip 20. The inner deflecting-surface 21 curves around the lip 20, so that water which comes with considerable velocity up the passage-way 18 is thrown toward the center of the pipe 6 through the medium of the deflecting-surface 21, and then may travel in a manner more particularly described hereinafter. The said pipe 17 is held by a screw-joint within the plate 13 and by a packing-ring 23, held down against the flange 24, formed around the edge of each hole 16 in the head-plate 15 by means of a reduced extension of a pipe 24', which has lugs 25 fastened upon a plate 15 by means of screws 26 and nuts 27.

It is important for reasons hereinafter stated that the pipes 24' should extend at least above the pipes 22 and that there should be holes 28 through the side of the pipe 24' at points lower than the top edges of the pipe 24, so as to form an important part of the water-trap of which the retaining-wall is made by an enlarged top 29 of the outside condenser 30.

The plate 15 is bolted by means of bolts 31 to the base of the enlarged portion 29 of the condenser-body 30. Resting upon the top edge of the enlarged portion 29 of the condenser-body 30 is a conical dome 32, tapering upward and secured to and communicating with a conduit 33, which enters the blower 1. The conduit 33 is provided with numerous perforated partitions 34, made, for example, of wire-netting and held to the conduit 33 by

lugs 35. The screens 34 slope upward through the dome 32.

The diameter of the condenser-body 30 is large enough to leave a space between its inner surface and the outer surfaces of the pipes 17, and, furthermore, spaces should be left, as they naturally will, between the pipes 17. These spaces form passage-ways for the steam, which is consequently in contact with the outside surfaces of the pipes 17. These spaces—that is, constituting the unoccupied portions of the interior of the condenser-body 30—communicate with a central opening through a central pipe 36, which connects the middle division-plate with the lower head-plate 9, and which thereby passes in a water-tight manner through the reservoir 10 and also communicates with the pipe 37, which leads to the engine. The pipe 38 leads to the air-pump.

The *modus operandi* consists in feeding water into the reservoir 10 under pressure, whereby the water rises in the several spiral spaces surrounding the pipes 6 and repeatedly climbs up the pipes to the top at the lip 20, when it rushes over the surface 21 and becomes deflected toward the center of the pipes 6 and meets the opposition of the blast of air which is drawn through the pipes 6 from the lower ends by means of the aspirator 1. As a result of this opposition and the presence of the corrugated netting the water as a whole is divided into two parts. One consists of some spray produced by the deflecting-surface 21, trickling down the netting at all points toward the base of the condenser and ultimately into the cistern and the other part being carried along by the gaseous current through the nettings 34, where the spray is again separated into two parts, one proceeding through the blower and the other dropping downward to the lowest side of the conduit 31 into the trap, whence it continues through the holes 28, while the oil and grease stand above the hole 28. This portion thus escaping from the trap enters again the pipe 22, where it is again influenced by the gaseous current in a similar manner. The ultimate aim of this circulation of water and water-spray, as is now probably evident, is, first, the maintaining as cool as possible the material of the pipes 17, in contact with which is the steam at all points, and consequently the latter is very effectually condensed and flows out at the pipe 36. A second important result of the circulation is the cooling of the water which has become heated by the steam, for upon being exposed in the thin film and dropped upon the netting 12 it is quickly reduced in temperature by any action of the current, and consequently the heat which is given by the steam to the water is mostly transferred from the water to the air, and the operation is kept up for any length of time with the loss of but little water—namely, that which escapes at the aspirator 1.

The resistance to the air offered by the netting and the water clinging to it is the only

work that the blower is obliged to perform besides that of setting the air in motion, and therefore, as blowers are common in many machinery plants, it may be made use of in conjunction with my condenser at places where it is already found.

An important construction is represented in Figs. 15, 16, and 17. Inside the cylinder 6 is a concentric cylinder 6', within which is another concentric cylinder 6". The cylinder 6' has a lateral opening 40, and from its lateral and lower edges extends a scraper or water-deflector 41, which all but touches the inner surface of the cylinder 6. The cylinder 6" has an opening 40', and a similar water-deflector 41' extends from the lateral and lower edges of the hole 40' and all but touches the inner surface of the cylinder 6 and passes through the opening 40.

Instead of having the water-deflector 41 extending through the hole 40 and deflect the water from the inner surface of the cylinder 6 it may be placed, as in Fig. 17, so as to deflect the water from the cylinder 6'. Other cylinders may be provided concentrically—as, for example, 6"', which is provided with a deflector 41'', extending to thus escape the inner surface of the cylinder 6".

The operation of the construction shown in Figs. 15, 16, and 17 is as follows: The water which rises within the passage-way between the pipes 17 and 6 under great elevating force is turned by the deflector 1, passes over the lip 20 at the top of the pipe 6, and whirls around in a layer about an inch thick or so—that is, of considerable thickness—and at the same time slightly downward by the action of gravitation and by the direction imparted to it by the deflector 21. As it touches the deflector 41 much of it is scooped up and while still in concentric force partly clings to the inner surface of the pipe 6', while some of it remains within the pipe 6. Some more is picked up by the deflector 41' and flows downward along the inner surface of the pipe 6". By this means, therefore, the thick layer of water on the inner surface of the pipe 6 becomes subdivided into three layers, very thin, one being on each of the pipes 6, 6', and 6". As regards the construction in Fig. 17 the principle is the same, but the deflector 41 is so close to the cylinder 6 that all but a slight film is picked up and introduced into the pipe 6', from which the deflector 41' turns aside a portion of the water that flows within the pipe 6", and in like manner the deflector 41'' introduces some of the water from the pipe 6" to the inner surface of the pipe 6".

In both constructions the operation is substantially the same in principle, for the water which has thus been subdivided into films is very rapidly cooled by the flow of the air upward against the film. The water in evaporating in order to go with the air is a source of lowering the temperature of the water, not only mechanically in this cooling process, but

being an absorber of water causes some of this evaporation by absorption.

Among the details of my invention attention is especially invited to the aspirator at the top, whereby the water is evaporated and cooled by the reduction of pressure of the air upon its surface, a result not easily accomplished by means of a blower, which increases the pressure upon the water. I have already made tests of this apparatus and find that this feature is an important one and that the reduction of pressure which I have obtained is equal to one to three inches of water in a column.

I claim as my invention—

1. An evaporation and surface condenser, consisting of the combination of a compartment for receiving steam, concentric pipes passing through said compartment, means for forcing water upwardly between the pipes, and into the inner pipe, and an aspirator for drawing air upwardly through the inner pipe and into the outside atmosphere.

2. An evaporation and surface condenser, consisting of the combination of a compartment for receiving steam, concentric pipes passing through said compartment, means for forcing water upwardly between the pipes, and into the inner pipe, an aspirator for drawing air upwardly through the inner pipe and into the outside atmosphere, and a water-deflector for causing the water to whirl around the inner surface of the inner pipe.

3. An evaporation and surface condenser, consisting of the combination of a compartment for receiving steam, concentric pipes passing through said compartment, means for forcing water upwardly between the pipes and into the inner pipe, an aspirator for drawing air upwardly through the inner pipe and into the outside atmosphere, a water-deflector for causing the water to whirl around the inner surface of the inner pipe, and other concentric pipes communicating with said aspirator, and provided with lateral openings, at which are deflectors for feeding some of the whirling water in the said first-named inner pipe into the other said inner pipes.

4. The combination with means for causing water to whirl around and down the inner surface of a pipe, of other pipes located concentrically therewith and with one another, and provided with lateral openings, sheets extending from the lateral and lower edges of said openings to within almost touching distances of the next larger respective pipes, and an aspirator communicating with the edges of the pipes, which at their lower ends, open into a supply of air, a surrounding casing for the steam being provided.

5. The combination with means for causing water to whirl around and down the inner surface of a pipe, of other pipes located concentrically therewith and with one another, and provided with lateral openings, sheets extending from the lateral and lower edges

of said openings to within almost touching distances of the next larger respective pipes, and an aspirator communicating with the edges of the pipes, which at their lower ends
5 open into a supply of air, the outside pipe passing through a steam-compartment.

6. An evaporation and surface condenser, consisting of the combination of pairs of concentric pipes, located in a cylinder, adapted
10 to contain an atmosphere of steam or vapor, or both, means for forcing water upwardly through the spaces between the inner and outer concentric pipes, and over and into the inner pipes, whereby water is thrown into
15 the inner pipes, and means for producing a blast of gas upwardly against the water, which tends to fall downward by the action of gravitation.

7. An evaporation and surface condenser, consisting of the combination of a steam-containing cylinder, provided with given heads, at the respective ends, a water-holder below
20 said cylinder, and communicating with a given force-pump, a hood above the said cylinder, and communicating with a given
25 aspirator, water-pipes passing through said steam-condenser, and forming a communication between the water-holder and the hood, and having inwardly-projecting water-deflectors at their upper ends, and air-pipes
30 passing through said steam-containing cylinder, and said water-holder, concentrically with, and located within said water-pipes, and communicating at the lower ends with
35 the outside atmosphere and at the upper ends, with said hood.

8. An evaporation and surface condenser, consisting of the combination of a steam-containing cylinder provided with given heads
40 at the respective ends, a water-holder below said cylinder, and communicating with a given force-pump, a hood above said cylinder, and communicating with a given aspirator, water-pipes passing through said steam-condenser, and forming a communication
45 between the water-holder and the hood and having inwardly-projecting water-deflectors, at their upper ends, air-pipes, a netting throughout the air-pipes, and within a conduit which
50 connects the said hood with the said aspirator, and a water-trap communicating between the lower edge of the said conduit, and the upper edge of said air-pipes.

9. An evaporation and surface condenser consisting of the combination of a cylinder 55 30, hood 32 therefor, a blower 1, a conduit between the blower and the hood, a water-holder underneath the cylinder 30, air-pipes 6 communicating with the hood, and extending along the interior of the cylinder 30, 60 through the lowest head 9 of the whole device, up and opening to the outside atmosphere, concentric pipes 17 surrounding the respective air-pipe 6, and of sufficient size to permit a passage-way, and communicating 65 between the hood and a given water-reservoir, and a pipe for admitting steam and entering the space bounded by the nearest surface of the cylinder 30, and the outer surfaces of the pipes 17, means being provided 70 for forcing water from the water-tank through said passage-ways between the pipes 6 and 17 over and into the pipes 6, which are provided with material adapted to expose a large condensing-surface. 75

10. An evaporation and surface condenser consisting of the combination of a cylinder 30, hood 32 therefor, a blower 1, a conduit between the blower and hood, a water-holder underneath the cylinder 30, air-pipes 6 communicating with the hood, and extending along the interior of the cylinder 30, through the lowest head of the whole device, up and opening to the outside atmosphere, concentric pipes 17 surrounding the respective air-pipes 85 6, and of sufficient size to permit a passage-way and communicating between the hood and a given water-reservoir, a pipe for admitting steam and entering the space bounded by the inner surface of the cylinder 30, and 90 the outer surfaces of the pipes 17, means being provided for forcing the water from the water-tank through said passage-ways, between the pipes 6 and 17, over and into the pipes 6, which are provided with a helical partition 19, 95 arranged so as to make said passage-ways, helical passage-ways, between the water-holder and the hood.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 20th day of October, 1896. 100

EDWARD F. WHITE. [L. S.]

Witnesses:

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KATHARINE W. EDWARDS.