(No Model.)

T. GANNON.

SURFACE CONDENSER.

No. 320,647. Patented June 23, 1885.

Fig1.

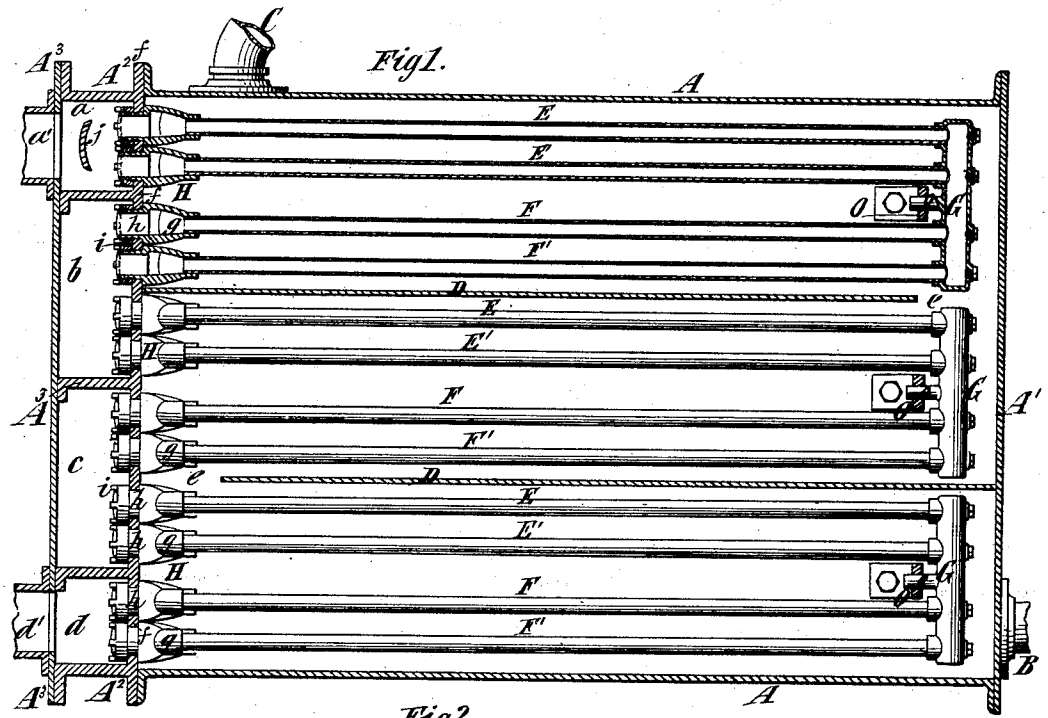


Fig2.

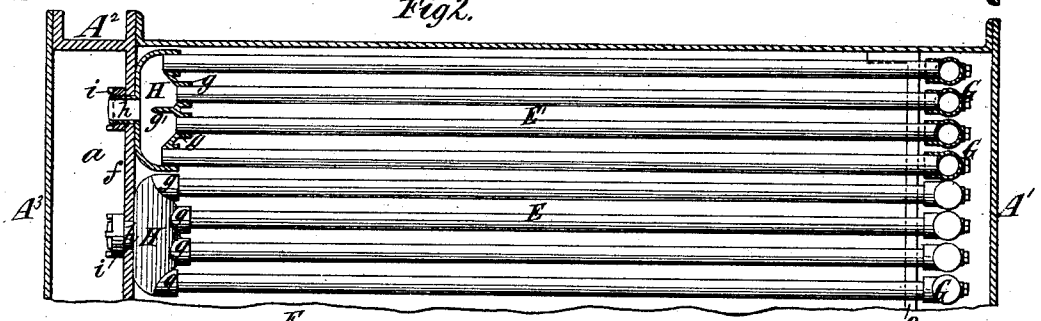


Fig5.

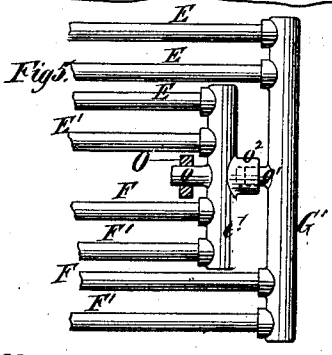


Fig3.

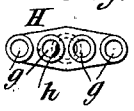
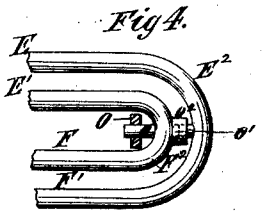


Fig4.



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UNITED STATES PATENT OFFICE.

THOMAS GANNON, OF JERSEY CITY, NEW JERSEY.

SURFACE-CONDENSER.

SPECIFICATION forming part of Letters Patent No. 320,647, dated June 23, 1885.

Application filed April 11, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS GANNON, of Jersey City, in the county of Hudson and State of New Jersey, have invented a new and useful Improvement in Surface-Condensers, of which the following is a specification.

My invention relates to surface-condensers of the class shown and described in my United States Letters Patent No. 263,504, dated August 29, 1882, and in which are comprised a shell or body provided with an inlet and outlet for cooling water, a head containing separate steam-chambers arranged one above another, and direct and return tubes leading from said chambers, and connected at their outer ends by bends or manifolds, which are wholly within the shell or body of the condenser.

In my former patent there were upper and lower direct tubes leading from each steam-chamber, and connected, respectively, at their outer ends by bends with upper and lower return-tubes leading to the next chamber. Consequently there was no opportunity for the separation of steam from the water of condensation at the outer ends of the tubes, and the water of condensation delivered by the bends from the upper and lower direct tubes, respectively, was returned through the upper and lower return-tubes.

My present invention consists in the combination, with a condenser shell or body and a head containing separate steam-chambers arranged one above another, of upper and lower direct tubes leading from each chamber, upper and lower return-tubes leading to the next lower chamber, and a single manifold independent of and within the shell or body, and by which the outer ends of the two direct and two return tubes in each vertical tier are connected. This construction provides for a separation in the manifold of all steam from the water of condensation received from the direct tubes, and all this water returns through the lower return-tube in the tier, while only steam enters the upper return-tube at the manifold.

The invention further consists in the combination, with the shell or body and a head comprising separate steam-chambers arranged one above another, and direct and return tubes connected by bends or manifolds, of novel connections whereby tubes in the same horizontal row may be connected with the steam-chambers, and means whereby the tubes connected by bends or manifolds at their outer ends are supported, all as more fully hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical section of a condenser embodying my invention. Fig. 2 is a horizontal section of a portion thereof. Fig. 3 is an end view of a coupling which I employ for connecting the tubes with their tube-sheet, and Figs. 4 and 5 are detail views hereinafter described.

Similar letters of reference designate corresponding parts in the several figures.

A designates the longitudinal shell or body of the condenser, and A' A^2 designate the two upright or vertical heads thereof. The head A' is simply a flat plate; but the head A^2 is a hollow casting containing a series of chambers, *a b c d*, arranged one over another, and closed by a removable bonnet, A^3.

The shell or body A has a water-inlet pipe, B, at or near the bottom, and an outlet-pipe, C, at or near the top, as shown in Fig. 1, and it contains longitudinal diaphragms D, which extend alternately from each end nearly to the other end, leaving openings *e* for the passage of water. The upper steam-chamber, *a*, is provided with a steam-inlet, *a'*, and from the lower chamber, *d*, there extends an outlet-pipe, *d'*, for the water of condensation.

From each of the chambers *a b c* there extend outward upper and lower direct tubes, E E', and to each of the chambers *b c d* there extend upper and lower return-tubes, F F'. At the outer ends of the tubes the four tubes E E' F F' in each vertical tier are connected by a manifold, G, and at their inner ends the tubes are connected by couplings H with the tube sheet or plate *f*.

Each of the couplings H has four branches, *g*, which are in the same horizontal plane, and which are connected with four tubes in any of the horizontal rows, and a single branch or screw-threaded extension, *h*, which passes through the tube plate or sheet *f*, and is secured therein by a nut, *i*. In each coupling H is a diaphragm or partition, *g'*, which is shown in Fig. 2, and which divides the enter-

ing steam, and causes it to pass equally to the tubes on each side of said diaphragm or partition.

In the chamber *a* is a baffle-plate, *j*, in front of the steam-inlet *a'*, which serves to scatter the steam, and to cause it to pass equally through all the tubes.

From the chamber *a* the steam passes outward through the direct tubes E E'; but when it reaches the manifolds G at their outer ends it separates, and the water of condensation all returns to the chamber *b* through the lower return-tubes, F', while steam only returns through the upper return-tubes, F. In the chamber *b* separation again takes place, and the water all passes outward through the lower direct tubes, E', and steam only through the upper direct tubes, E. In the manifolds G separation of the steam and water again takes place, and so on through the condenser at both ends of the tubes. The result of this separation is, that the upper direct and return tubes, E F, are given up wholly to steam and have an effective exposure throughout their entire circumference, while through the lower direct and return tubes water and steam pass.

Obviously there might be six or more tubes connected with each manifold instead of four, as here shown; but in all cases there should be at least four tubes, so that there may always be upper and lower tubes, both direct and return.

The horizontal arrangement of the condenser-tubes and the vertical arrangement of the steam-chambers is imperative, because the water of condensation will then drain readily from each chamber to the chamber next lower, and by connecting an air-pump with the pipe *d'* an effective vacuum may be maintained. This could not be done if the tubes were vertical, as the hot water of condensation would remain in the steam-chambers, and as soon as the pressure was reduced below that of the atmosphere would give off vapor, which would prevent the formation of a vacuum.

Instead of connecting the outer ends of the tubes by manifolds the direct and return tubes might be connected by return-bends E^2 F^2, as shown in Fig. 4; but in that case there would be a separation of the water of condensation from the steam at the steam-chambers only.

In Fig. 5 I have represented another arrangement of tubes in which four direct tubes, E E E E', are intended to lead from each chamber, and four return-tubes, F F' F F', to lead to the next lower chamber. The two upper direct tubes, E E, and the two lower return tubes, F F', are connected by one manifold, G', and the two lower direct tubes, E E', and the two upper return tubes, F F', are connected by a manifold, G. In this case the manifold G' is long enough to straddle the manifold G. The separation of steam and water would take place in the two manifolds, and water will flow outward through the single direct tube E', but will flow back or return through the lower tubes, F' F', leading from both manifolds. It is necessary that the tubes should be supported at their outer ends, and I provide for this in Figs. 1 and 2 by providing the manifolds G with inwardly-projecting studs or pins *o*, which enter holes or guides in supports or bars O. This is more advantageous than if the studs or pins projected outward and engaged with supports behind or outside the manifolds. If it is desired to remove any one group of tubes, I simply disconnect their ends from the tube-plate *f*, and when the head A' is removed they may be drawn out without disturbing any other of the tubes.

Where two return bends or manifolds are employed, as shown in Figs. 4 and 5, the inner bend or manifold has a pin or stud, *o*, which enters a cross-bar, O; but the outer bend or manifold has a similar pin or stud, *o'*, which enters a socket, o^2, in the back of the inner bend or manifold. The outer bend or manifold and its attached tubes can then be drawn out, and afterward the inner bend or manifold and its attached tubes.

I do not claim, broadly, the connection of the tubes of a condenser with the tube plate or sheet by couplings each having branches for a number of tubes, and a single externally-threaded extension passing through the tube plate or sheet. I only seek to cover such a coupling when the branches for the tubes are all in the same horizontal plane.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, with a condenser shell or body and a head containing separate steam-chambers arranged one above another, of upper and lower direct tubes leading from each chamber, upper and lower return-tubes leading to the next lower chamber, and a single manifold independent of and within the shell or body, whereby the outer ends of the two direct and two return tubes in each vertical tier are connected, substantially as described.

2. The combination, with the shell or body A and the head A^2, containing separate steam-chambers arranged one above another, of the direct and return tubes arranged in vertical tiers, the tubes in each tier being connected by bends or manifolds independent of and within the shell or body, and the couplings H, each comprising a number of branches, *g*, with which the tubes are connected, and which are all arranged in one horizontal plane, and a single branch or extension, *h*, externally screw-threaded, and provided with a nut, *i*, substantially as described.

3. The combination, with the direct and return tubes of a condenser, and a bend or manifold connecting them, of a stud or pin, *o*, projecting inwardly from the bend or manifold, and a bar or support, O, with which it engages, extending across the shell or body on the inner side of the bend or manifold, substantially as and for the purpose specified.

4. The combination, with the direct and return tubes of a condenser and bends or mani-

folds arranged one within the other, and connecting said tubes, of a stud or pin, *o*, projecting inward from the inner bend or manifold, and a bar or support, O, with which it engages, and which extends across the shell or body inside the inner bend or manifold, and a stud or pin, *o'*, projecting inward from the outer bend or manifold, and engaging with a socket, o^2, on the inner bend or manifold, substantially as and for the purpose described.

5. The combination, with the shell or body A and the head A^2, containing separate steam-chambers arranged one above another, of the direct and return tubes, and the couplings H, each comprising a number of branches, *g*, with which the tubes are connected, and which are in the same horizontal plane, and a single branch or extension, *h*, externally screw-threaded, and provided with a nut, *i*, and each having the diaphragm or partition *g'*, substantially as described.

THOS. GANNON.

Witnesses:
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ED. L. MORAN.