(No Model.)

W. D. HOOKER.

CONDENSER.

No. 256,479. Patented Apr. 18, 1882.

Fig. 1.

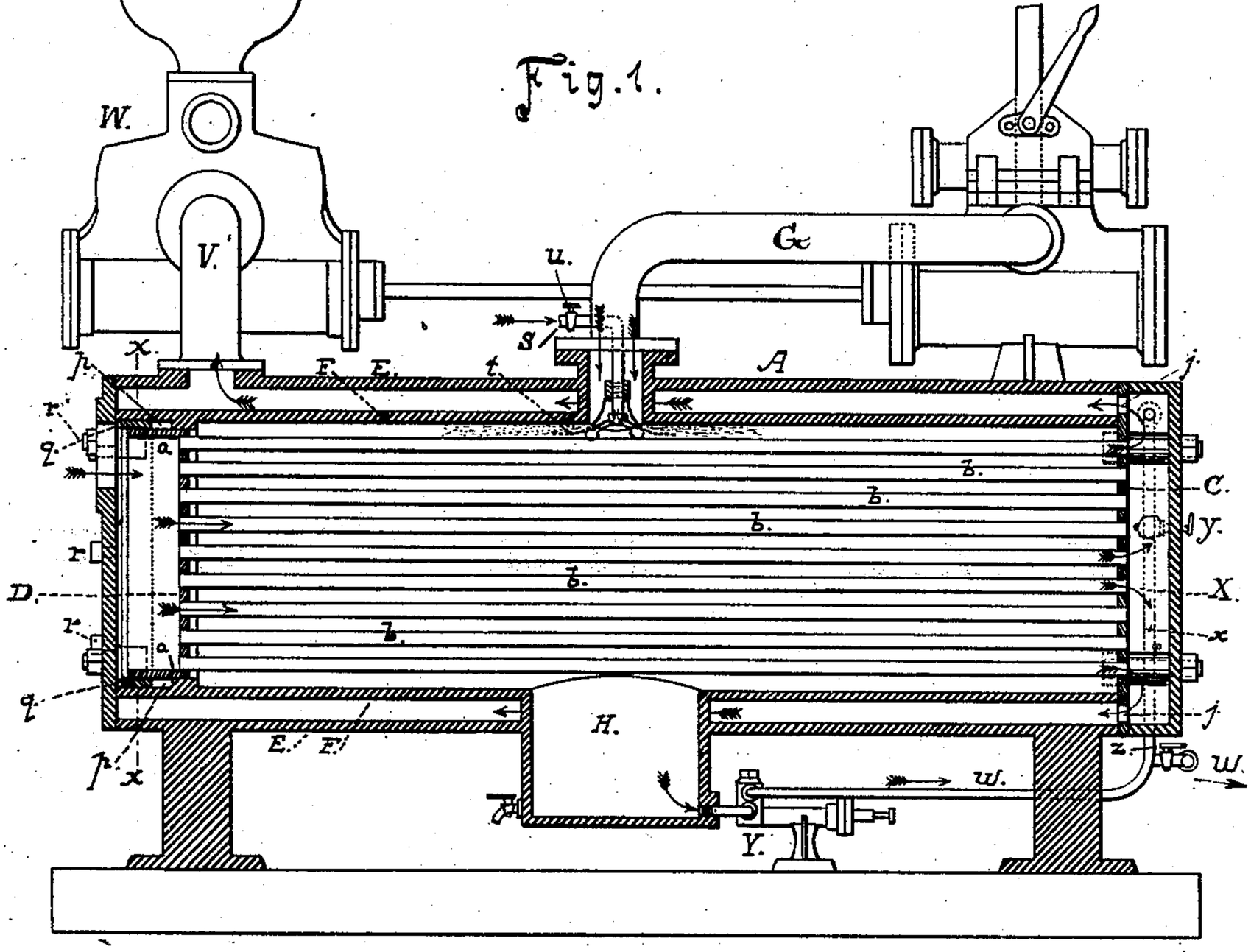


Fig. 2

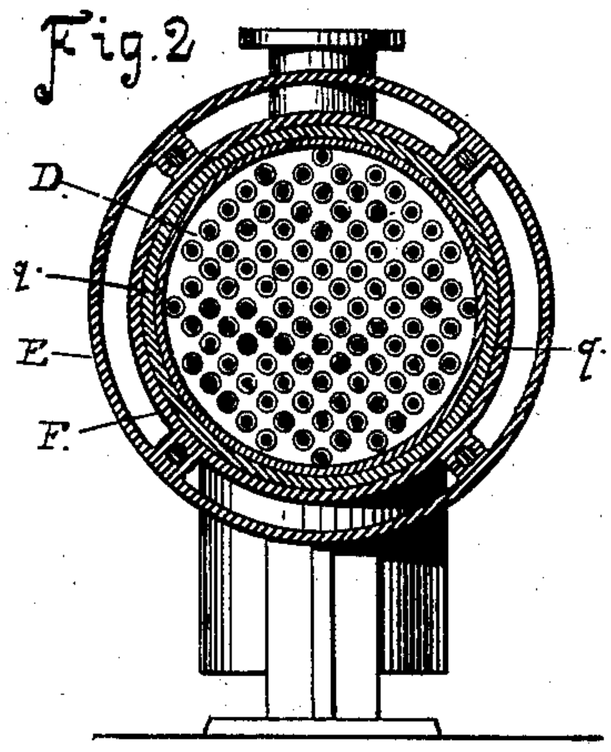


Fig. 3.

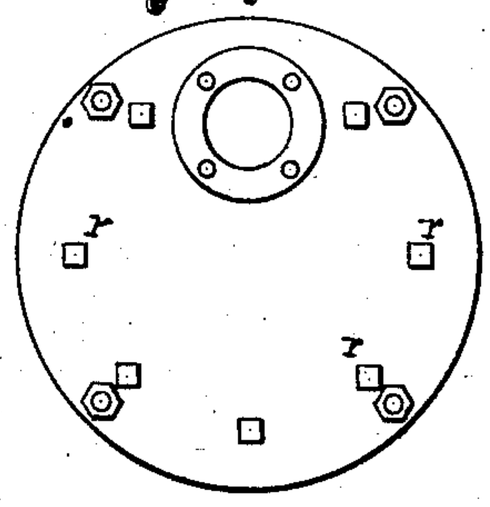


Fig. 5.

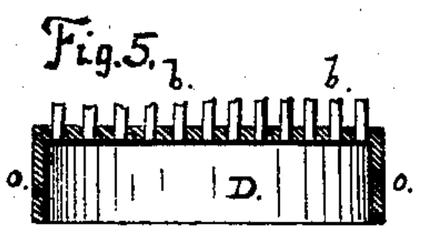
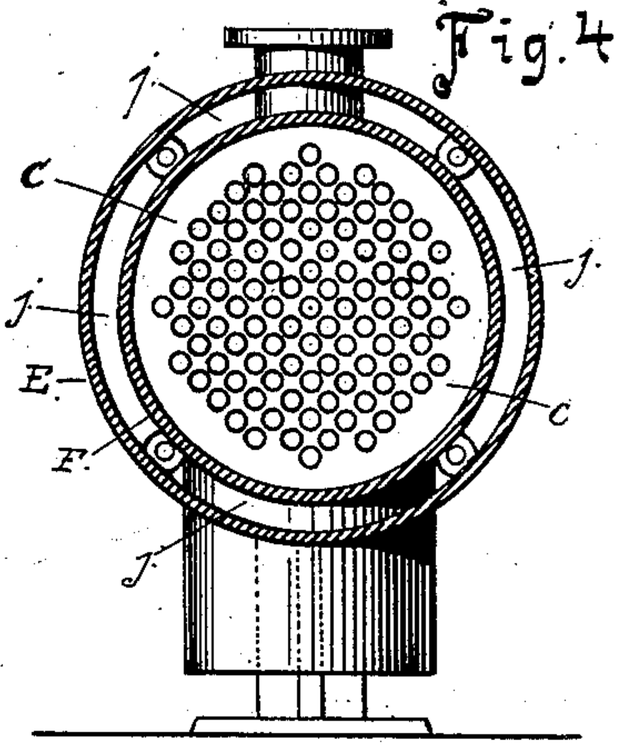


Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM D. HOOKER, OF OAKLAND, CALIFORNIA.

CONDENSER.

SPECIFICATION forming part of Letters Patent No. 256,479, dated April 18, 1882.

Application filed May 23, 1881. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. HOOKER, of Oakland, Alameda county, State of California, have invented a certain new and useful Improvement in Condensers; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings.

My invention relates to tubular condensers; and it consists, first, in means, accessible on the outside of the condenser, whereby the packing between the joint of the movable tube-sheet and the inclosing shell or cylinder can be expanded and the joint kept steam and water tight.

The invention consists, second, in the combination, with a horizontal tubular surface-condenser, of a steam-pipe and cold-water-spray inlet leading into the top of the tube-space, a hot-well communicating with said space at the bottom thereof and located below the steam-inlet, an air-pump communicating with the hot-well, pipes leading from the air-pump to the boiler and suction of the pump, and provided with valves, as will be hereinafter explained.

Referring to the accompanying drawings, Figure 1 is a longitudinal vertical section of my improved condenser, showing the combination with the pumping-engine. Fig. 2 is a cross-section through the line *x x*, Fig. 1. Fig. 3 is an end view on the left-hand side of Fig. 1. Fig. 4 is a cross-section taken through the right-hand side of Fig. 1 through the chamber X. Fig. 5 is a detail section of the movable tube-sheet.

Inside of the inner shell or wall of the condenser I arrange a series of small tubes, *b*, so as to connect two flue-sheets, C D, one near each end of the vessel or condenser. The case of the condenser I construct of an outer shell, E, and an inner shell, F, so as to leave a narrow space between the two shells. The steam-pipe G, through which the exhaust-steam is introduced into the condenser, pours through both shells, as shown, and the hot-well H, in the bottom of the condenser, is connected in a like manner. The tube-sheet C is stationary and immovable, and when the shell is made double, as above described, it extends to the outer shell, while the inner shell, F, abuts against it, leaving a chamber, X, between it and the head of the condenser. Openings *j j*, Fig. 4, are made in the rim of the tube-sheet, to connect the chamber X with the jacket or surrounding water-space. The suction V of the pump W connects with this water space or jacket, so that a continuous stream of water is drawn through the tubes, and thence through the water space or jacket to the suction-pipe of the pump, thus surrounding the condenser with a constantly-moving stream of cold water. This arrangement is admirably adapted for use in connection with a steam-pump, as the suction of the pump keeps the condenser supplied with and submerged in cold water.

The tubes *b b*, which pass through the condenser, have one end secured in the stationary or fixed tube-sheet, C, while their opposite ends are secured in a movable or sliding tube sheet or head, D, in the opposite end of the condenser. This movable tube-sheet can be made in any convenient form, so that its outer rim has a bearing against the inside of the case or shell A. In the present instance I have represented it with a projecting flange, *o*, which gives its rim a wide bearing against the interior of the shell or case. Between the flange *o* and shell I make an opening or space, *p*, in which I place any suitable packing material.

q is a gland or follower, which moves in the space *p*, so as to compress the packing and tighten it against the flange or rim *o* of the tube-sheet, and thus form a stuffing-box for the tube-sheet to move in. This gland or follower is moved by means of screws *r* or other compression device, which extends through the outer head of the vessel or shell, so that the packing can be compressed from the outside of the vessel without removing any of its parts. By this arrangement all of the tubes are secured at one end in a movable tube-sheet, while their opposite ends are secured in a fixed or stationary sheet, and it is only necessary to pack the single head or tube-sheet. The expansion and contraction of the tubes will then move the sliding tube-sheet bodily.

In order to test the tightness of the stuffing-box and tubes, I can place a small petcock at the bottom of the hot-well, and then, by drawing the water from the condenser and applying a pressure of water in the water ways and

chambers of the condenser, if there is any leakage, it will be shown by water flowing through the cock. If there should be a leak, I first tighten the packing in the stuffing-box around the movable head; but if water should still continue to flow from the cock, I then know that the leak is in the tubes.

Another improvement which I have added to the condenser is a spray-pipe, *s*, which leads from a cold-water supply, and is introduced into the condenser at the point where the exhaust-steam enters it. This pipe is connected with a suitable pump, and terminates inside of the condenser in a sprinkler or rose, over which I arrange a deflector, *t*. A cock, *u*, on this pipe serves to regulate the amount of water it supplies to the condenser. The object of this pipe is to supply the wastage which occurs from leakage, evaporation, blowing off, &c. The cock is to be set to admit the desired quantity of water. The steam in entering the condenser strikes the deflectors *t*, and is spread so as to meet the spray of cold water, thus combining the spray and surface principles in one condenser. The cold water is heated by its contact with the steam and falls into the hot-well, where it mingles with the water of condensation, and thence is pumped along with the water of condensation into the boiler.

Y is the air-pump, through which the air in the condenser is exhausted, and by which the water of condensation in the hot-well is forced into the boiler. *w* is the pipe which leads from the pump to the boiler. This pipe I connect by a branch pipe, *x*, with the water-passage in the condenser which leads to the pump, and in the length of this branch pipe I place a cock, *y*, and another, *z*, on the pipe *w*, between the pipe *x* and boiler, so that I can shut off the passage in either of the pipes. When the cock *y* is closed and the cock *z* is open the air-pump will force the hot water into the boiler; but in case it should not be desired to pump the hot water into the boiler, I can close the cock *z* and open the cock *y*, so that when the vacuum in the pump exceeds the vacuum in the condenser the pump will draw the hot water up the pipe *x* and cause it to mingle with the supply which passes through the pump; and even when the vacuum in the pump is less than that in the condenser, the pump *v* will supply the additional power required to send the hot water into the pump-supply.

The arrangement of stationary and movable tube-sheets herein described for connecting the tubes in the condenser can be used in a refrigerator or other vessel in which the tubes require to be subjected to varying degrees of temperature.

By my new arrangement of the flues the surrounding water-space, the chambers at the ends of the tube-sheets, the openings *j* through the stationary tube-sheet, and the suction-pump, I not only maintain a continuous flow of cold water through the apparatus, but I cause the water to pass through the flues and then return through the water-space between the jacket and inner shell, which incloses the tubes, to the suction-pump, which is arranged at the same end of the apparatus into which the cold water is introduced.

The arrangement of the air-pump pipe and its branch and cocks in connection with the hot-well is a valuable improvement in condensers of the kind described, for the reasons given.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, in a condenser, of a series of tubes supported at one or both ends in a tube-sheet movable in a stuffing-box inside of the case or shell, the adjusting-screws connected with the gland or follower and extended through the outer head of the condenser, whereby the packing in the stuffing-box may be compressed from the outside of the condenser without removing any of its parts, substantially as described.

2. The combination, in a horizontal tube surface-condenser, of the steam and cold spray inlets leading through the outlet water-space into the tube-space, the hot-well located below the said inlets, the air-pump, the pipe leading from this pump to the boiler, the branch pipe leading to the cold-water space of the condenser, and the cocks applied to said pipes, substantially as described.

Witness my hand and seal.

WILLIAM DAVIS HOOKER. [L. S.]

Witnesses:

EDWARD E. OSBORN,

W. F. CLARK.