Nov. 4, 1930. R. N. EHRHART 1,780,781

CONDENSER

Filed April 28, 1926

Fig. 1.

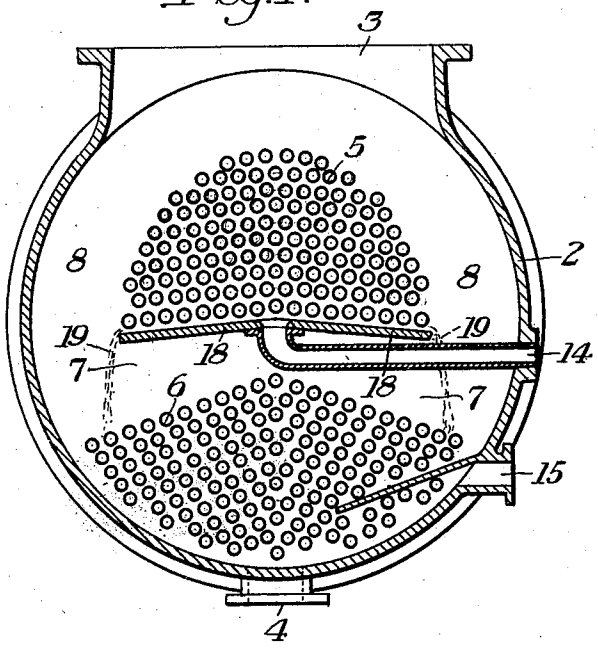


Fig. 2.

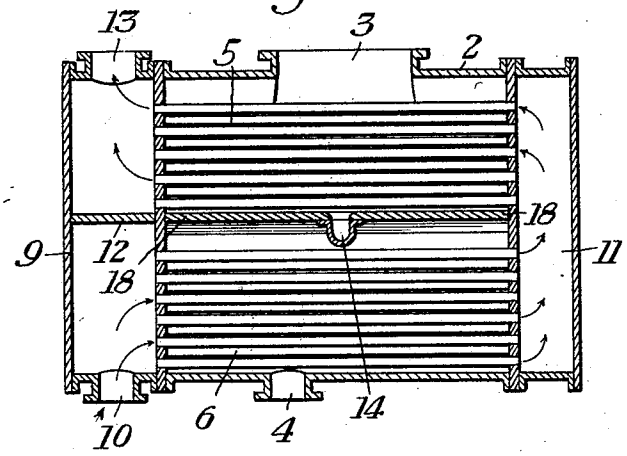
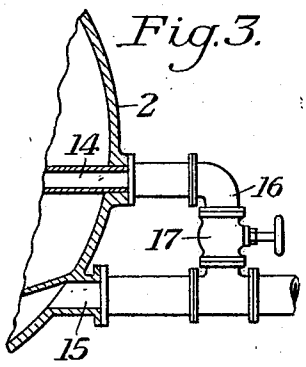


Fig. 3.



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UNITED STATES PATENT OFFICE

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CONDENSER

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The present invention relates broadly to the art of heat exchangers and more particularly to heat exchangers of the character ordinarily referred to as surface condensers and especially applicable to the condensation of steam.

It has heretofore been proposed in the art to which the present invention relates to construct condensers having a plurality of tube nests through which the steam has been adapted to pass. The present invention relates broadly to condensers of this type, and has for one of its objects to provide a series of tube nests receiving cooling water in series and steam flow in parallel.

Another object of the invention is to provide tube nests of the general character referred to adapted to not only receive steam in parallel but in different amounts.

Still another object of the invention is to provide improved means in a condenser having a plurality of tube nests for effecting the offtake of the non-condensible gases. In the accompanying drawings there are shown more or less diagrammatically, condensers embodying the present invention, it being understood that the drawings do not define the limits of my invention as changes in the construction and operation disclosed therein may be made without departing either from the spirit of the invention or the scope of my broader claims.

In the drawings,

Figure 1 is a transverse sectional view through a condenser constructed in accordance with the present invention,

Figure 2 is a longitudinal sectional view through the condenser of Figure 1 illustrating the matter of supplying cooling water to the tube nests, and

Figure 3 is a view similar to Figure 1 illustrating a modified embodiment of the present invention.

A condenser constructed in accordance with the present invention may comprise a shell 2 of any usual construction having a vapor inlet 3 and a condensate outlet 4.

Arranged within the condenser shell is an upper tube nest 5 preferably spaced from the shell in such manner that both the top and sides of the tube nest are adapted to receive steam directly from the steam inlet. Located below the tube nest 5 is a second tube nest 6, the tube nest preferably being located in such manner that a substantial space 7 is provided therebetween. By reason of this construction it will be apparent that vapor from the inlet 3 may pass directly to the tubes of the nest 5 throughout substantially the whole of that portion of the perimeter of the tube nest facing the inlet and at the same time, vapor may likewise pass, by reason of the side passages 8 and the space 7, to the tubes of the nest 6. This provides a construction in which there may be a steam flow in parallel through the different nests.

The construction is preferably such that while the nests receive steam in parallel, they receive cooling water in series. This may be accomplished by providing a header 9 at one end of the condenser having a water inlet 10 supplying cooling water to the tubes of the lower nest. The water, after passing through the tubes of the lower nest enters the header 11 at the opposite end of the condenser by means of which it is returned through the tubes of the upper nest, the header 9 having a partition 12 insuring a flow in series through the tube nests as set forth. The cooling water may then be removed from the header 9 through the outlet 13.

It will be apparent to those skilled in the art that in a construction in which the number of tubes in the respective nests is substantially equal, as indicated generally, for example, in the accompanying drawings, and with a water flow through the tubes in series, the average water temperature in the lower tube nest will be lower than the average water temperature in the upper tube nest due to the heat abstracted from the vapor in the lower nest. Under these conditions, more steam will be condensed by the colder tube nest than by the warmer tube nest. Inasmuch as the length of the flow path for both nests of tubes is substantially the same, and inasmuch as the introductory area for the steam is substantially the same for both nests, there must necessarily be a greater loss of pressure through the nest 6 than

through the nest 5 due to their different steam condensing capacities. The loss of pressure, due to steam flow, varies approximately as the square of the amount of steam. Under these circumstances, assuming a condition of operation, for example, in which the nest 6 handles approximately twice as much steam as the nest 5, there will be a loss of pressure through the nest 6 which is approximately four times greater than the corresponding pressure drop through the nest 5.

If a condenser is constructed properly along the general lines referred to, that is with the passages 7 and 8 of sufficient size, it may be assumed that the pressure of the steam in the space 7 will be substantially the same as the steam pressure in the inlet, although necessarily some slight difference in pressure between these two points must exist. Under these conditions, if each of the tube nests is allowed to develop its own natural condensing capacity, the natural condition of pressure at the flow termini of the respective nests will be materially different if each nest accomplishes its full share of condensing capacity incident to water temperatures. Since it is desirable to effect the offtake of non-condensible gases from both of the tube nests, and since these non-condensible gases must be taken off under the conditions referred to from points adjacent the flow termini through the nests which points are at different pressures, it will be obvious that in condensers as heretofore constructed having a single air offtake, undesirable conditions are encountered. According to the present invention, there is provided an air offtake 14 for the nest 5 and a second air offtake 15 for the nest 6. These offtakes, as indicated in Figure 1, may be connected to separate ejecting means, not shown, having characteristics suitable to the pressures which exist at the respective flow termini of the tube nests.

If desired, the offtakes 14 and 15 may be interconnected as by a pipe 16 having a throttling valve 17 therein effective for dissipating the pressure difference at the respective flow termini, or maintaining this difference, whereby a common ejecting means may be utilized.

The nests of tubes in addition to having the space 7 between them, are preferably further separated by downwardly and outwardly inclined baffles 18 connected at their inner edges and constructed to cooperate with the offtake 14. Such baffles will be effective for directing condensate as indicated at 19 across the space 7 in direct contact with live steam whereby not only will the temperature of the condensate be increased, but effective jet condensing action on the steam will be obtained.

The advantages of the present invention arise from the provision of a surface condenser in which steam is fed to different portions separated by means constituting a wall, and in which cooling water temperatures in the respective portions are different.

Other advantages of the invention arise from the provision of a condenser having condensing portions separated by a wall, and having separate offtakes communicating with said portions, and preferably with the flow termini therethrough.

Still other advantages arise from the provision of a surface condenser in which a plurality of portions receive steam in parallel and of differing amounts, this condition preferably being accompanied by a flow of cooling water at different temperatures through the respective portions.

Still further advantages arise from the provision of a condenser having a plurality of tube nests having different condensing capacities with means for maintaining different pressures at the points of non-condensible gas offtake from the respective portions.

I claim:

1. In a surface condenser, a shell having a steam inlet, a wall in said shell providing free steam flow spaces between at least two of its edges and the shell and providing a free steam space therebelow, a tube nest on each side of said wall, means for passing cooling water through said tube nests in series, and means for subjecting the respective tube nests at substantially their steam flow termini to different pressure conditions.

2. In a surface condenser, a shell having a steam inlet, a wall in said shell providing free steam flow spaces between at least two of its edges and the shell and providing a free steam space therebelow, a tube nest on each side of said wall, means for passing cooling water through said tube nests in series, and means for taking off non-condensible gases from each of said nests under different pressure conditions.

3. In a condenser, superimposed tube nests, a common steam inlet for both of said nests, there being a flow passage surrounding one nest for supplying steam to the other nest, and a condensate collecting baffle intermediate said nests, there being a separate air offtake under different pressure conditions for each of said nests.

4. In a condenser, superimposed tube nests, a common steam inlet for both of said nests, there being a flow passage surrounding one nest for supplying steam to the other nest, and a condensate collecting baffle intermediate said nests, there being a separate air offtake for each of said nests, one of said offtakes extending through said baffle.

5. In a condenser, superimposed tube nests each providing a steam flow zone having its area decreasing in the direction of steam flow, a common steam inlet for both of said nests, and a separate air offtake operable un-

der respectively different pressures for each of said nests.

6. In a condenser, superimposed tube nests each providing a steam flow zone having its area decreasing in the direction of steam flow, a common steam inlet for both of said nests, and a separate air offtake for each of said nests, there being a baffle intermediate said nests through which one of said air offtakes communicates.

7. In a condenser, an inlet, superimposed tube nests each having a steam receiving portion facing said inlet, the condenser being formed with a free steam receiving space above each tube nest, connections for individually withdrawing noncondensable gases from said nests, and means for maintaining different pressure conditions in each of said connections.

8. In a condenser, an inlet, superimposed tube nests each having a steam receiving portion facing said inlet, the condenser being formed with a free steam receiving space above each tube nest, connections for individually withdrawing noncondensable gases from said nests, each of said tube nests providing a steam flow space decreasing in area in the direction of gas offtake, and means for maintaining different pressure conditions in each of said connections.

9. In a condenser, an inlet, superimposed tube nests each having a steam receiving portion facing said inlet, the condenser being formed with a free steam receiving space above each tube nest, and means for separately withdrawing noncondensable gases from said nests, there being a baffle intermediate said nests around which the steam passes to one of the nests and through which air from the other nest is taken off.

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