

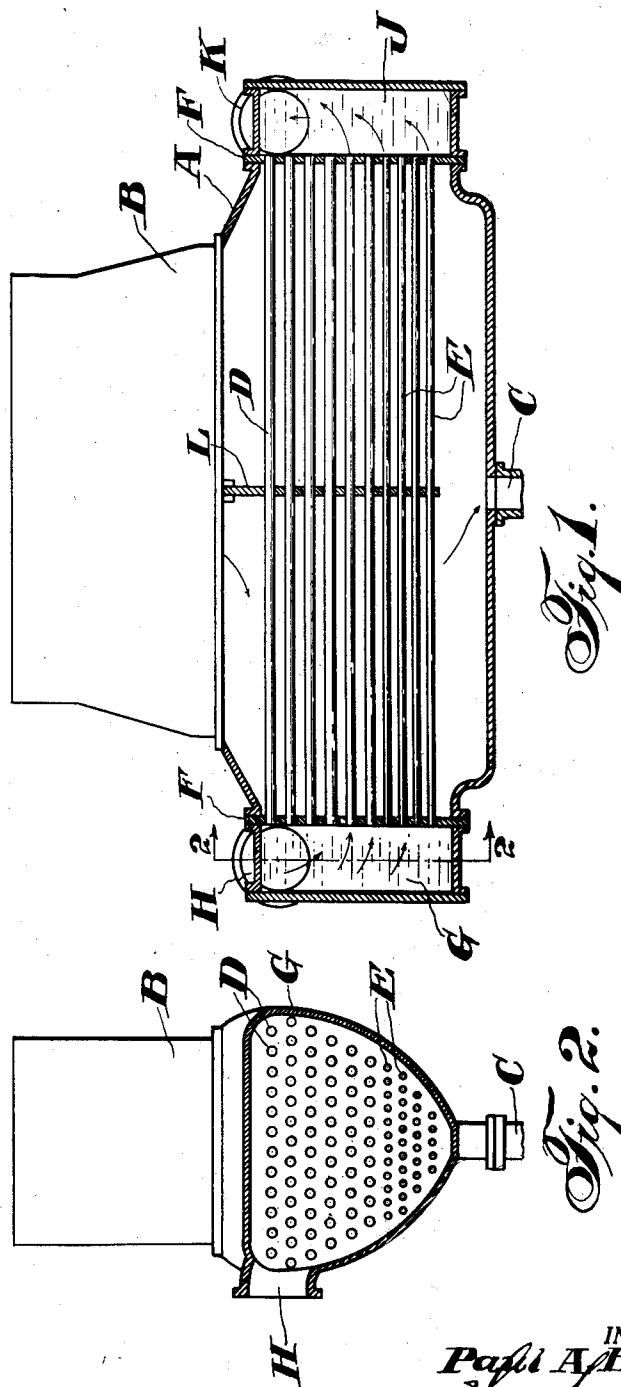
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SURFACE CONDENSER

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SURFACE CONDENSER.

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This invention relates to condensing apparatus and more particularly to surface condensers of the tubular type in which steam is adapted to contact with tubes carrying circulating cooling water.

An object of this invention is to economize as to the amount of cooling water to be used in condensing apparatus and also to economize in power expended in forcing water through the cooling tubes.

Other objects and advantages of the invention will be in part obvious and in part pointed out hereinafter.

The invention will be more clearly understood by reference to the drawings in which—

Figure 1 is a vertical longitudinal section of a condenser embodying the invention, and

Figure 2 is a cross section of the condenser along the line 2—2 looking in the direction of the arrows.

In a condenser of the tubular type the cooling surface may be said to be divided into two parts or zones. That zone near the steam inlet may properly be called the active zone, and the second or zone remote from the steam inlet and nearer the air removal outlet does less work and may be called the inactive zone. The active zone does the most work for the reason that the steam which contacts with its cooling surface is less diluted by air and uncondensable gases than the mixture which contacts with the inactive zone. Naturally, the mixture of steam and air in a properly designed condenser becomes more nearly pure air as the steam is condensed and as the mixture approaches the air outlet.

The problems presented in the proper functioning of the two zones of the condenser are quite different. In the active zone, there is a small percentage of air in the mixture and the problem is rather to transfer the heat from the tube walls to the cooling water and to remove the cooling water from the tubes rapidly before it becomes heated to a temperature at which no condensation will take place. When the mixture of air and steam reaches the inactive zone, there is no problem of overheating the water since there is relatively little heat to be absorbed through the tubes. Here the problem is to cool and devaporize the air so that its volume will be as small as possible on reaching the air removal pump. Relatively

little cooling water is needed, therefore, in the inactive zone. Furthermore, the velocity of the mixture of air and steam is naturally much greater in the active zone since the quantity of fluid to be acted upon is much greater than in the inactive zone where the velocity is relatively slow after the active zone has performed its functions properly and has condensed the greater part of the steam. Since the greater part of the work is done in the active zone, the energy expended per unit of tube area in forcing the water through the tubes should be greater in this zone. In the inactive zone a relatively small amount of energy per unit of tube area need be expended in comparison with that expended in the active zone. This makes for the maximum economy in operation since less water is thus used in the inactive zone and less energy is used in forcing it through the tubes.

It is understood that the inactive zone may be in the same condenser shell with the active zone or in a separate shell forming part of the same system of condensing apparatus.

In the embodiment shown in the drawings, the condenser comprises a shell A provided with a steam inlet B which may be at the upper side of the shell and an outlet C relatively remote from the inlet which may conduct the condensate from the shell A. The outlet C may also be used to remove the air and uncondensable gases, ordinarily called "stuff," from the casing A, although, if desired, a separate outlet may be provided for this purpose. For convenience the outlet C is shown adapted to remove both condensate and stuff. Within the condenser shell A there is provided a plurality of tubes D which may be arranged transverse to the inlet B. A second group of tubes E of smaller diameter and preferably parallel to the larger tubes D is also provided within the casing A and interposed between the tubes D and the stuff outlet C. The tubes D and E are sealed in tube sheets F at either end of the shell A and are supplied with water from an inlet water head G having a suitable inlet H for attachment to a suitable or well-known type of pump. The water issues from the tubes D and E into a discharge water head J attached to the shell A and thence to a water outlet K into a suitable storage tank (not shown). Near the middle of their length, the tubes D and

E are supported by a plate L attached to the casing A in any suitable manner.

The larger tubes D form the active zone of the condenser and the smaller tubes E form the inactive zone. The tubes E being smaller than the tubes D, less water is supplied to each individual tube than to any one of the tubes D. Furthermore, the friction head loss in the tubes D is less than in the smaller tubes E and the velocity will be greater in the tubes D. Water may, therefore, pass from the inlet head G to the outlet head J without being excessively heated before reaching its destination. There is no difficulty in the heating of the water in the smaller tubes E and, therefore, its low velocity is not disadvantageous. On the contrary, the advantage in economy of power in forcing the water through the entire system of tubes D and E is much greater and also the amount of water utilized is much less. The advantages of operation may be understood also if viewed from the point of a given quantity of water passing through the tubes D and E. The flow of water through the tubes E is choked on account of their small size and accordingly the greater amount of water passes through the tubes D which, being in the active zone, assures that the cooling water will be present where needed most.

Preferably the shell A is heart-shaped. The reason for the adoption of this shape is that the cross section of the path of the steam past the tubes D and E should become less as it approaches the outlet C. As the steam condenses, its volume is reduced but its velocity should remain substantially con-

stant in order to prevent pressure drop. Pressure drop between the inlet B and the outlet C means a loss in vacuum available at the stuff outlet C. A slight pressure drop cannot be avoided since there must be some pressure to force the steam from the inlet to the outlet, but any unnecessary loss of pressure such as would be due to changes in velocity of the steam passing from the inlet B to the outlet C is a waste of capacity at the air removal pump (not shown), which might be valuable to produce a greater vacuum at the steam inlet B.

Thus by the above construction are accomplished, among others, the objects hereinbefore referred to.

I claim:

1. A surface condenser comprising a steam inlet and an air outlet, and cooling tubes arranged in active and inactive zones for steam condensation, the tubes in the inactive zone being of smaller diameter and adapted to conduct water at lower velocity than the tubes in the active zone.

2. A surface condenser comprising a shell having a steam inlet and an air outlet, steam condensing water conducting tubes interposed between said steam inlet and air outlet and arranged in active and inactive zones, the inactive zone being relatively remote from the steam inlet and having tubes of lesser diameter than the tubes of the active zone, and water heads for supplying water to and receiving water from said tubes.

In testimony whereof I have signed this specification.

PAUL A. BANCEL.