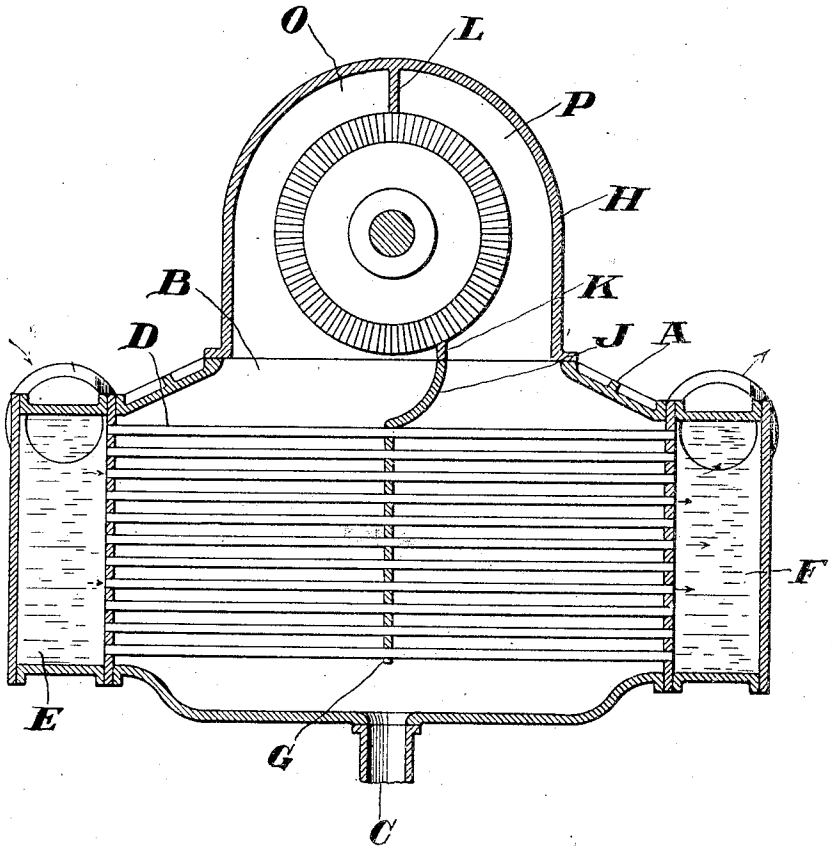
May 25, 1926. 1,585,639

P. A. BANCEL

SURFACE CONDENSER

Original Filed Oct. 15, 1924




INVENTOR.
Paul A. Bancel
BY Roland Olden
HIS ATTORNEY.

Patented May 25, 1926. 1,585,639

# UNITED STATES PATENT OFFICE.

PAUL A. BANCEL, OF NUTLEY, NEW JERSEY, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

## SURFACE CONDENSER.

Original application filed October 15, 1924, Serial No. 743,695. Divided and this application filed June 30, 1925. Serial No. 40,514.

This invention relates to surface condensers and more particularly to that type of surface condenser comprising surface cooler tubes extending longitudinally through a chamber across the path of the steam flow.

This application is a division of copending application of Paul A Bancel, Serial No. 743,695, filed October 15, 1924.

In single pass condensers having water tubes over which steam to be condensed passes or condensers so designed that all of the tubes passed over by the steam between the point of entrance of steam and the point of exit of non-condensable vapor and air have water flowing the same direction, the tubes are cooler at the inlet portions than at their outlet because in passing through the tubes, the water is warmed from the heat absorbed, and in condensing the steam the water temperature rises progressively along the length of the tubes in the direction of water flow. The effect of this temperature condition is to decrease the capacity of the water to condense steam in sections of the condenser relatively remote from the water inlet. In condensers having two or more passes the conditions are identical if the flow is toward a central air outlet, or the same general effect is observed when the air outlet is at the end of the lower pass, for the reason that a greater part of the condensation takes place in the upper tubes and the lower tubes condense a relatively small quantity of steam, their purpose being rather to cool the mixture of uncondensable air and vapor.

As steam is condensed more rapidly in the cool end of a single pass condenser than at the warm end, there must be a larger flow through that end than at the warm end in order to supply sufficient steam to the lowermost tubes. This would call for a greater loss of pressure at one end of the condenser than at the other, which is ordinarily impossible since the whole lowermost section is in free communication with the vacuum pump withdrawing the uncondensable gases. The result in an ordinary single pass condenser or any condenser to a greater or less extent is that steam does not come into contact with the lowermost tubes at the cold end and thus condensers of this type heretofore have been inefficient to a certain extent in that there is provided a certain amount of cooling surface which does not condense steam. If the vacuum pump is operated to draw steam down into the condenser into contact with all portions of the tubes, uncondensed steam will pass through the warm end and be drawn from the outlet. This is undesirable since additional means must be provided to condense the steam which has passed through the condenser.

It is an object of this invention to apportion the steam in the various parts of the condenser so as to produce substantially the same depth of penetration throughout and to utilize the entire available cooling surface of the condenser. This object is accomplished by dividing the condenser into sections utilizing for this purpose partitions which may be the usual tube supporting plates and directing the steam toward the cooler section of the condenser by suitably apportioning the steam in accordance with the steam condensing capacities of the vertical sections along the length of the condenser at the source from which the steam is drawn as for instance in the turbine casing.

The invention will be more clearly understood by reference to the accompanying drawing forming part of the specification in which is illustrated a diagrammatic representation of a condenser and a turbine associated therewith in which the discharge chamber of the turbine is arranged to deliver to the compartments of the condenser quantities of steam proportionate to their steam condensing capacities.

Referring to the drawing, the condenser consists of an outer shell A having an outlet C for the withdrawal of condensate and uncondensable gases. The shell A is preferably along and is traversed by a plurality of tubes D with water from the water head E and discharging into a head F at the opposite end of the condenser. A tube support in the form of a drilled plate G divides the space within the shell into two compartments, one being comparatively cool as it includes that portion of the water tubes D nearer the water head E and a warmer compartment nearer the discharge head F containing water which has already absorbed heat in condensing steam.

A source of steam, such as a turbine H, is adapted to be connected at the steam inlet B of the condenser and to discharge its steam in a direction substantially at right angles to the tubes D. An extension J of the tube sheet G curves upwardly to the casing of the turbine H and connects at the turbine with a lower partition K which with an upper partition L divides the discharge chamber of the turbine H which is the source of steam into two compartments O and P. The compartments O and P are unequal in size, one of the partitions K or L being situated so that the quantity of steam discharged into the compartments O and P is proportionate to the steam condensing capacities of the cool and warm ends of the condenser respectively. Equal depth of steam penetration is thereby assured independently of any other means since steam delivered to the two sections O and P will be at different pressures or vacuums. Since the vacuum at the bottom of the condenser is maintained by a pump connected at the outlet C, the pressure is substantially the same over the entire length of the condenser below the last bank of tubes D. The greater quantity of steam being delivered to the cooler section of the condenser, the pressure drop through this end will be slightly greater than that at the warmer end. The absolute pressures in the compartments O and P of the turbine casing H differs by the difference in pressure losses in the cooler and warmer ends of the condenser.

I claim:

1. In combination with a source of steam to be condensed, a condenser having tubes with different temperatures along their length resulting in unequal capacities for condensing steam in vertical sections along their length, and means in said source for obtaining substantially equal depth of penetration of steam in said sections along the length of the condenser.

2. In combination with a steam turbine, a condenser having tubes with different temperatures along their length resulting in unequal capacities for condensing steam in vertical sections along their length, and means at the discharge end of said turbine for obtaining substantially equal depth of penetration of steam in said sections along the length of the condenser.

3. In combination with a steam turbine, a condenser having tubes with different temperatures along their length resulting in unequal capacities for condensing steam in vertical sections along their length, and means including partitions at the discharge end of said turbine for delivering quantities of steam to the vertical sections of the condenser proportionate to their steam condensing capacities.

4. In combination with a source of steam to be condensed, a condenser having tubes with different temperatures along their length resulting in unequal capacities for condensing steam in vertical sections along their length, a partition extending vertically from the top toward the bottom of the condenser and means in said source cooperative with said partition independently adapted to produce substantially equal depth of penetration of steam in said sections along the length of the condenser.

5. In combination with a source of steam to be condensed, a condenser having tubes with different temperatures along their length resulting in unequal capacities for condensing steam in vertical sections, a partition extending vertically from the top toward the bottom of the condenser, a single outlet for air and uncondensable gases and means in said source cooperative with said partition independently adapted to produce substantially equal depth of penetration of steam in said sections along the length of the condenser.

6. In combination with a source of steam to be condensed, a condenser having tubes with different temperatures along their length resulting in unequal capacities for condensing steam in vertical sections along their length, a partition extending vertically from the top toward the bottom of the condenser, and means in said source for producing a higher pressure at the top of the condenser adjacent the cooler end of the condenser to provide substantially equal depth of penetration of steam in said sections along the length of the condenser.

7. In combination with a source of steam to be condensed, a condenser having tubes with different temperatures along their length resulting in unequal capacities for condensing steam in vertical sections along their length, having a partition extending from the top to the bottom of the condenser and a central outlet for air and uncondensable gases and means in said source for producing a higher pressure at the top of the condenser adjacent the cooler end to provide substantially equal depth of penetration of steam in said sections along the length of the condenser.

In testimony whereof I have signed this specification.

PAUL A. BANCEL.