Nov. 3, 1931. P. A. BANCEL 1,830,185

CONDENSER

Filed June 19, 1930 2 Sheets-Sheet 1

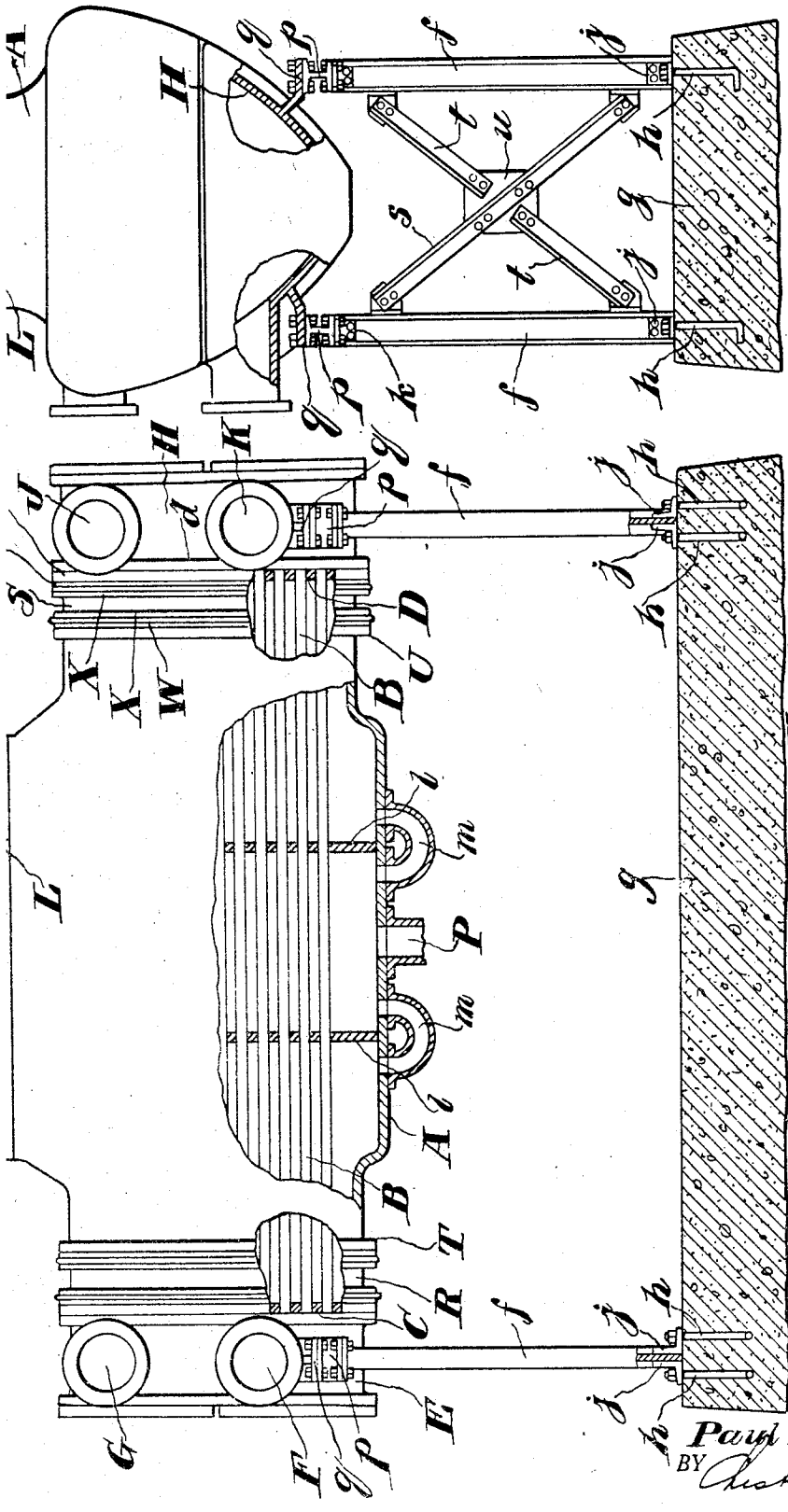


FIG.-2.

FIG.-3.

FIG.-1.

INVENTOR.
Paul A. Bancel
BY
HIS ATTORNEY.

Nov. 3, 1931. P. A. BANCEL 1,830,185

CONDENSER

Filed June 19, 1930 2 Sheets-Sheet 2

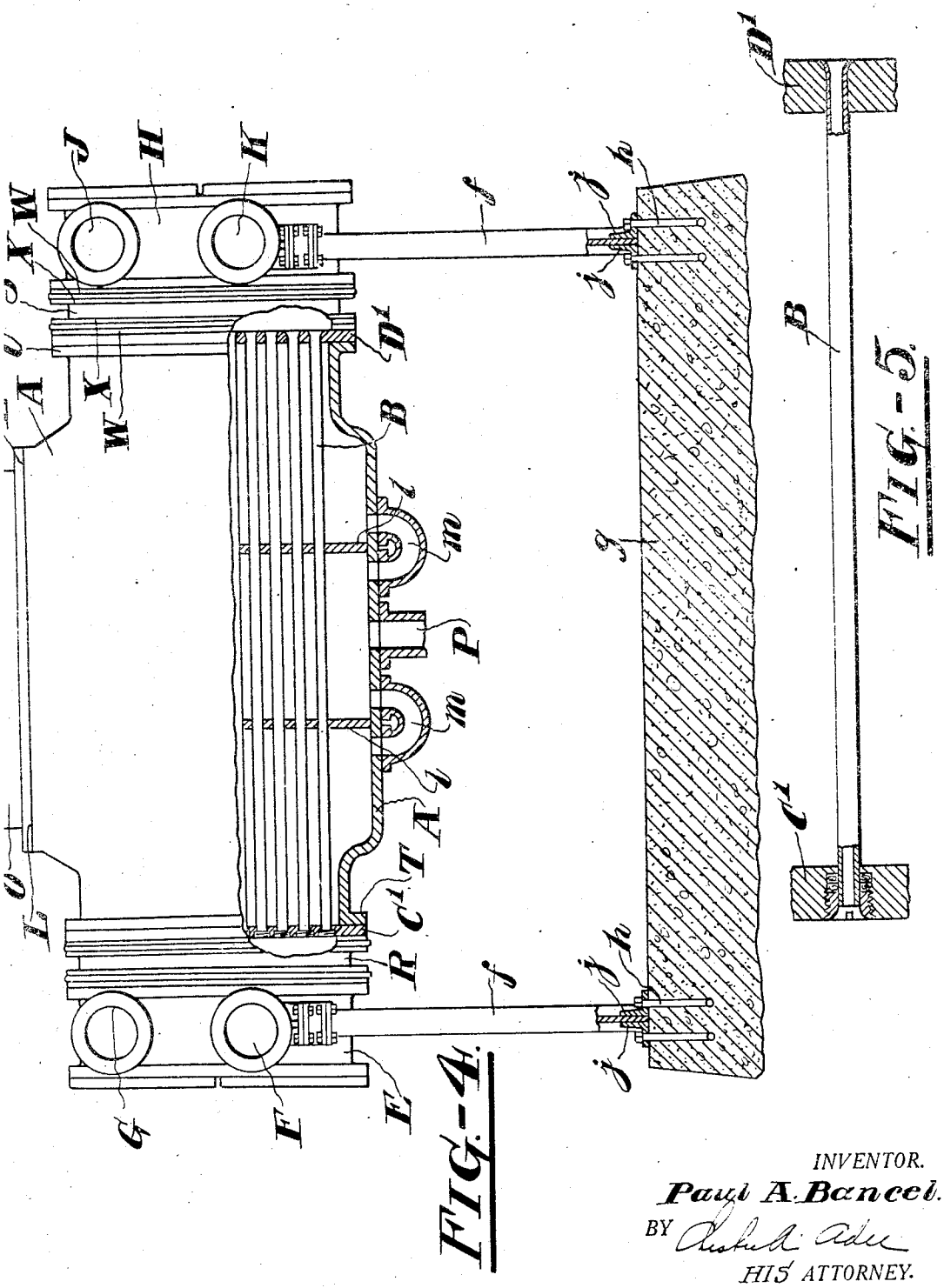


FIG.-4.

FIG.-5.

INVENTOR.
Paul A. Bancel.
BY Robert C. Adee
HIS ATTORNEY.

Patented Nov. 3, 1931 1,830,185

UNITED STATES PATENT OFFICE

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

CONDENSER

Application filed June 19, 1930. Serial No. 462,320.

This invention relates to condensers and more particularly to constructions for supporting the various component parts of the assembly. This application is a continuation in part of my co-pending application, Serial No. 393,436 filed September 18th, 1929. One of the objects of the invention is to relieve the turbine of the weight of the water boxes. Another object is to provide flexibility between the condenser casing and the water boxes in order to permit expansion of the circulating water tubes without setting up strains on the tube sheet or the condenser shell and without buckling the tubes, and to permit relative movement of the water boxes and the condenser shell. Other objects and advantages of the invention will be in part obvious and in part pointed out hereinafter.

In the drawings in which similar reference characters refer to similar parts,

Figure 1 is a side elevation of a condenser constructed in accordance with the practice of the invention and its supporting means, portions of the condenser being broken away to show the internal construction,

Figure 2 is an end view of the condenser and its supporting means, portions being broken away to show the method of supporting the water boxes,

Figure 3 is a detailed sectional view of the connection between a water box and the condenser casing,

Figure 4 is a side view partly in section showing a modification of the invention in which all parts of the condenser except the water boxes are supported by the turbine, and

Figure 5 is an enlarged view of a water tube showing its connections to the tube sheets when the invention is applied as in Figure 4.

In the drawings the condenser is shown comprising a shell A housing a plurality of circulating water tubes B extending lengthwise of the casing A and suitably sealed at their ends in tube sheets C and D, and C′ and D′. In Figure 1 the ends of the tubes are expanded in tube sheets C and D but in Figures 4 and 5 the tubes are expanded in tube sheet D′ and packed in tube sheet C′. In the former construction expansion of the tubes is permitted by the yieldable nature of the water box supports hereinafer more specifically described, which yield to the extension of the tubes. In the latter structure expansion of the tubes is permitted by the packing at one end thereof.

In Figures 1 and 3 tube sheet C is suitably attached to an inlet water box E having inlet openings F and G adapted to be connected to a suitable source of circulating water (not shown). Likewise a discharge water box H is attached to the tube sheet D and is provided with discharge openings J and K for connection to suitable pipes, not shown, to carry away the circulating water. In Figure 4 the tube sheets C′ and D′ are attached to the end of the shell A instead of to the water boxes so that no part of the weight of the tube sheets or of the water tubes is supported by the water box supports.

The casing A is provided with a steam inlet flange L which is adapted to be rigidly connected to a turbine exhaust hood O. Remote from the steam inlet flange L with respect to the path of the steam through the condenser shell A there is provided an outlet P through which condensate may be withdrawn.

Intermediate of the length of the tubes B are support sheets 1 tightly fitted in the condenser shell A through which the tubes B are passed and by which they are supported in their intermediate portions. In Figure 1, by this construction, the major portion of the weight of the water tubes is supported by the condenser shell and consequently upon the turbine outlet O. In the form of the invention illustrated in Figure 4 the entire weight of the tubes and tube sheets is supported upon the turbine outlet O.

Because of the tight fit of the tube support sheets *l* within the casing A it is necessary to make provision for the removal of condensate from the compartments created by said support sheets. For this purpose inverted siphons *m* are provided which connect the end compartments to the center compartment from which the condensate outlet leads. Uncondensible gas and air are with-

drawn from the casing by suitable means, not shown.

In accordance with this invention the condenser shell A is arranged to be supported independently of the water boxes E and H. To this end the casing A is rigidly attached to the steam turbine exhaust hood or conduit O at the flange L. The water boxes E and H are free to move with respect to the casing A, being connected thereto by means of connections R and S preferably of some flexible material such as rubber.

In Figure 1 the connection R is interposed between an end flange T of the casing A and the tube sheet C and may be bolted thereto or attached in any suitable manner. Similarly the connection S as is shown in detail in Figure 3 is interposed between an end flange U of the shell A and the tube sheet D. The connection S is reinforced on the inside by means of rings W having outwardly extending flanges. Similar rings X having upturned flanges conforming to the U-shape of the connection reinforce it on the outside. The flange U of the casing A is attached to connection S by bolts Y passing through the flange U, the rings W and X and the connection S to make a tight joint. Similar bolts Z pass through the water box flange *d* of the water box H, the tube sheet D, rings W and X and the connection S also to make a tight joint. The connection R is similarly attached to the flange T of the casing A and the water box E and tube sheet C.

In Figure 4 the flexible connections R and S are similarly made, the difference being that the tube sheets C′ and D′ come between the flexible connections R and S and the flanges T and U of the casing A instead of between the flexible connections and the flanges of the respective water boxes.

Referring particularly to Figure 2 the water boxes E and H are each supported on separate frameworks each comprising upright posts *f* suitably anchored to a base *g* by bolts *h* anchored into the the base *g* and passing through foot pieces *j* attached to the base end of the posts *f*. At their upper ends the posts *f* are provided with angles *k* upon which are bolted short sections of I-beams *p* by means of outwardly extending brackets *q* which may be formed integrally with the water boxes. Diagonal bracing for the posts *f* is provided in the form of angles *s* and *t* attached at the center by a gusset plate. Each support thus provided for the water boxes E and H is independent of the other and permits movement of the water boxes with respect to each other upon expansion of the tubes B within the condenser due to a change of temperature.

In a condenser 20 feet long the maximum tube expansion between temperatures of 32° and 212° would hardly equal one-half inch and in ordinary practice expansion of more than one-quarter inch would be unlikely. Thus the movement of each water box would seldom exceed one-eighth inch and the framework described will permit of this distortion without exceeding its elastic limits.

It will be apparent from the method of suspension adopted in Figure 4 that flexible mounting of the water boxes in that particular construction will not be necessary as the expansion of the tubes will not have any effect upon the position of the water boxes.

The construction above described provides support for the casing A entirely independent of the water boxes E and H. The steam inlet opening at the flange L may be designed to provide an area of opening which at the vacuum within the shell A provides an upward force sufficient to carry the entire weight of the condenser shell A together with all of the weight of the tube support sheets and all or a major portion of the weight of the tubes, and also, in the construction shown in Figure 4, the weight of the tube sheets C′ and D′.

It has been found in the past that the upward force produced by the vacuum due to the size of the steam inlet openings into the condenser tends to lift the condenser from its supports, whereby the greater part of the weight is carried by the turbine instead of by the condenser supports. With the construction above described the casing and its contents are suspended from the turbine while the water boxes are supported by their own proper base *g*.

I claim:

1. A surface condenser comprising a shell, inlet and outlet water boxes, separate supporting means for said water boxes and flexible U-shaped connecting members having annular reinforcements between said shell and each of said water boxes and attached thereto and adapted to permit relative movement between said water boxes and said shell.

2. In combination with a turbine exhaust conduit, a condenser comprising a shell supported wholly by said conduit, water boxes supported independently of said shell by a framework and flexible connecting members between said shell and each of said water boxes.

3. In combination with a turbine exhaust conduit a surface condenser comprising a shell wholly supported by said turbine exhaust conduit, inlet and outlet water boxes, tubes within said shell terminating in said water boxes, flexible members between and attached to said shell and each of said water boxes permitting relative movement between said shell and said water boxes and a yieldable supporting framework for each of said water boxes independent of said shell.

4. A surface condenser comprising a rigid unified shell, water boxes at the ends of said shell attached thereto by flexible members,

ube sheets in the water boxes, water tubes herebetween and separate frame-works for ·ieldably supporting said water boxes.

5. In combination with a turbine exhaust ·utlet, a surface condenser comprising a rigid ınified shell supported by said outlet, water ›oxes at the ends of said shell attached there-o by flexible members, tube sheets in the vater boxes, water tubes therebetween, and ı framework independent of the shell for ;upporting said water boxes and permitting ·elative movement therebetween.

6. In a condenser, a rigid unified shell at-;ached to a steam conduit outlet, water boxes ıt each end of the shell, tube sheets in each water box, tubes for cooling water therebe-;ween, support plates for the tubes support-ed by the shell intermediate the water boxes, flexible connections between the shell and the water boxes and separate laterally yieldable supports for each water box.

7. In a condenser, a rigid unified shell at-;ached to a steam conduit outlet, water boxes ıt each end of the shell, tube sheets in each water box, tubes for cooling water between said tube sheets and rigidly affixed thereto, support plates for the tubes supported by the shell intermediate the water boxes, flexible connections between the shell and the water boxes and separate yieldable supports for each water box.

8. In a condenser, a rigid unified shell attached to a steam conduit outlet, tube sheets attached to the shell at each end thereof, tubes for cooling water therebetween. support sheets for the tubes supported by the shell intermediate the tube sheets, water boxes at each end of the shell flexibly connected thereto, and separate supports for each of said water boxes.

9. In a condenser, a rigid unified shell attached to a steam conduit outlet, tube sheets attached to the shell at each end thereof, tubes for cooling water therebetween, said tubes being rigidly affixed to one tube sheet and slidably mounted in the opposite tube sheet, support sheets for the tubes supported in the shell intermediate the tube sheets, water boxes at each end of the shell flexibly connected thereto and separate supports for each of said water boxes.

10. A condenser comprising a shell, means for suspending the same, water boxes at each end thereof, flexible connections to the ends of said shell and to the water boxes, and a yieldable framework for supporting said water boxes.

11. In combination, a turbine outlet, a condenser shell suspended therefrom, a tube support sheet supported by the shell, cooling tubes supported therein extending lengthwise of the shell and terminating in tube sheets, flexible extensions attached to the ends of the shell and to the tube sheets, and yieldable supporting means for the tube sheets.

12. In a condenser, a shell suspended from a steam conduit outlet, tube sheets attached to the shell at each end thereof, cooling tubes therebetween, water boxes at each end of the shell supported independently thereof, and flexible connections between the tube sheets and the water boxes.

13. In a condenser, a shell suspended from a turbine exhaust outlet, reinforced flexible members at each end of the shell, tube sheets attached to the outer edges thereof, cooling tubes therebetween, an intermediate tube support plate in the shell and supported thereby, and water boxes separately supported connected to the tube sheets.

14. In a condenser, a shell suspended from a steam exhaust outlet, flexible end sections at each end of the shell, tube sheets attached thereto, cooling tubes therebetween having their ends rigidly affixed therein, water boxes attached to the tube sheets and separate yieldable supports for the water boxes.

In testimony whereof I have signed this specification.

PAUL A. BANCEL.