

P. A. BANCEL.
CASING FOR STEAM TURBINES.
APPLICATION FILED APR. 18, 1912

1,058,936.

Patented Apr. 15, 1913.

FIG. 1.

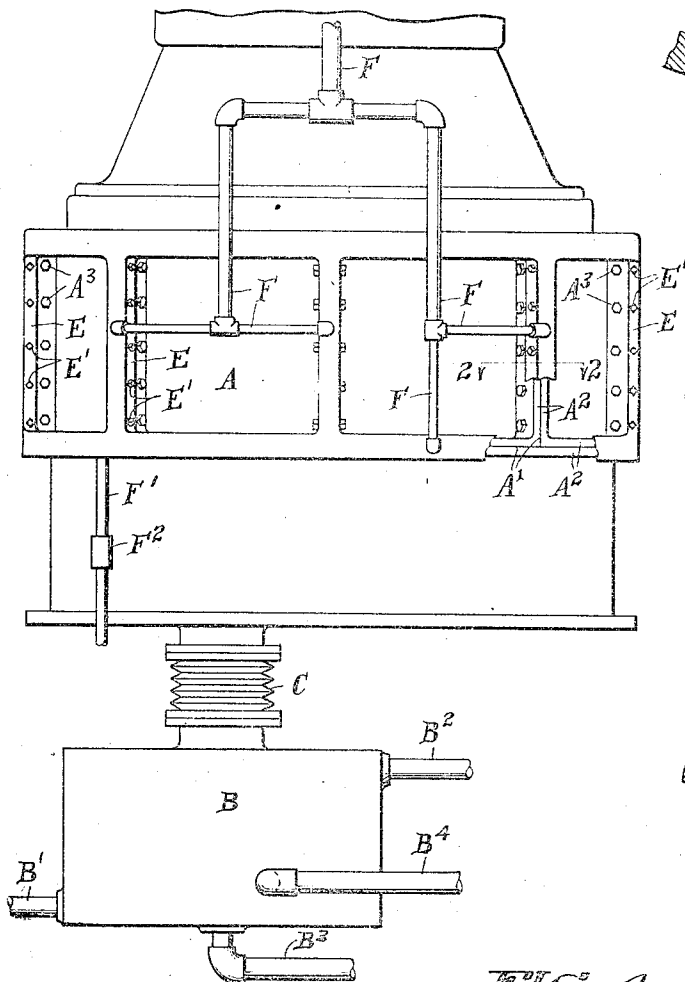


FIG. 3A.

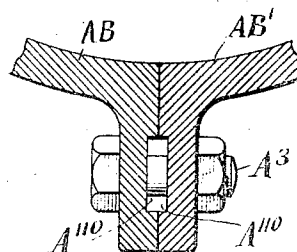


FIG. 2.

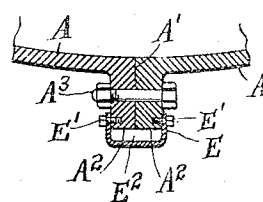


FIG. 3.

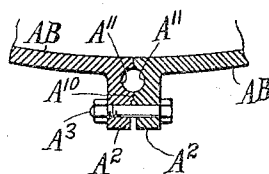
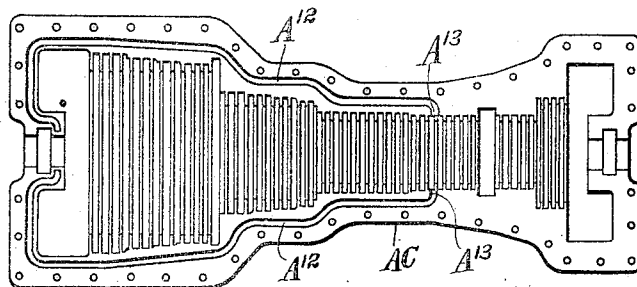


FIG. 4.



WITNESSES

Daniel Webster, Jr.
Stewart

INVENTOR

Paul A. Bancel

BY

Francis D. Chamberlain

his ATTORNEY

UNITED STATES PATENT OFFICE.

PAUL A. BANCEL, OF NEW YORK, N. Y.

CASING FOR STEAM-TURBINES.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, PAUL A. BANCEL, a citizen of the United States of America, residing in the city, county, and State of New York, have invented a certain new and useful Improvement in Casing Construction for Steam-Turbines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My present invention relates to steam turbine casings and consists in provisions for preventing the leakage of atmospheric air into such a casing through a joint between stationary parts of the casing and so located that the pressure at the inner edge of the joint is below that of the atmosphere.

The efficiency of operation of a steam turbine plant depends upon the extent to which the pressure of the steam is reduced as it finally leaves the rotating element of the turbine. In the practical operation of steam turbine plants it is now common to have the absolute pressure of the exhaust steam leaving the turbine as low as a pound or so, *i. e.*, the pressure of the exhaust steam is in the neighborhood of fourteen pounds below the pressure of the atmosphere, and slight decreases in this low exhaust pressure substantially and markedly increase the efficiency of operation. To obtain the desirable low exhaust pressure highly efficient steam condensing apparatus is required. The efficiency of the condensing apparatus depends in large measure upon the rate at which air enters the condenser. The presence of air in the condenser is objectionable, not only because it directly reduces the vacuum obtainable, but also because it reduces the steam condensing capacity of a surface condenser both by its volume displacement of steam and through its heat insulating property. The heat insulating capacity of air is such that in the portions of a surface condenser filled with an air and vapor mixture rich in air, the cooling effect of the condenser tubes becomes practically nil.

The presence of air in the condenser is due to a variety of causes. Some air is mixed with the high pressure steam due to the presence of air in the water supplied to the steam generating boilers. Some air may leak into the condenser through the condenser housing and turbine casing due to the porosity of the cast iron from which these parts are ordinarily made. The bulk of the

air entering the condenser, however, leaks into it through the joints of the turbine and condenser casings and the pipe connections to the latter. It is to be understood that the actual amount of air admitted to the condenser with practical apparatus under ordinary operating conditions is always small in comparison with the amount of steam condensed. Under ordinary practical operating conditions, there is seldom or ever as much as a pound of air admitted to the condenser per one thousand pounds of steam condensed therein. Heretofore it has been generally assumed that the presence of air within the condenser was due mainly to leakage into the condenser proper or the adjuncts connected thereto. I have found, however, that the leakage into the condenser through its joints and adjuncts does not account for a considerable portion of the air passing into the condenser, but that a large portion of this air leaks into the system through the supposedly tight joints of the turbine casing at portions of the casing where the internal pressure is less than that of the atmosphere. The joints of the pipe connections to the condenser proper may readily be, and usually are made tight by external bolts. Moreover the parts jointed together to form the condenser casing and pipe connections thereto are not subjected to severe warping stresses by local and rapidly changing differences in temperature, whereas in the turbine proper, portions of the casing are continually changing in temperature as the load carried by the turbine, and in consequence the steam supplied to the turbine, increases and diminishes. My investigations have shown that I can substantially increase the average efficiency of a turbine plant by effectively preventing leakage of air into the turbine through the joints located in the low pressure portions of the turbine casing. To accomplish this result I provide means for so sealing the joints with an air excluding fluid that the leakage into the turbine casing will be prevented by this air excluding fluid. The air excluding fluid which I prefer to employ is steam at a pressure above that of the atmosphere. This steam may be supplied directly from the boiler or may be drawn through suitable conduits from some portion of the turbine where the pressure is slightly above that of the atmosphere.

The various features of novelty which characterize my invention are pointed out

with particularity in the claims annexed hereto and forming a part of this specification. For a better understanding of my invention, however, and the advantages possessed by it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated various forms in which the invention may be employed.

Of the drawings, Figure 1 is an elevation of a portion of a steam turbine plant. Fig. 2 is a partial section taken on the line 2—2 of Fig. 1. Fig. 3 is a section taken similarly to Fig. 2 but showing a modified joint construction. Fig. 3^A is a view similar to Fig. 3 showing a further modification. Fig. 4 is a view of a portion of one of the casing parts in a construction in which the joint is sealed with steam taken from a high pressure portion of the turbine.

In the drawings, and referring first to Figs. 1 and 2, A represents the turbines, B the condenser connected to the turbine by the expansible joint member C, B' and B² represent the cooling water inlet and outlet connections respectively to the condenser. B³ represents the water of condensation and B⁴ the air outlet connections, each pipe running to a suitable pump (not shown), for withdrawing water or air from the condensing chamber. As shown, A' represents joints in the turbine casing between adjacent casing parts, the latter being formed with flanges A² connected by the bolts A³. To prevent air from leaking into the interior of the turbine through the joints A', or such portions of them as are so located that the steam pressure at their interior edges is less than that of the atmosphere, I secure to the flanges A² a sheet metal casing or casings E as by the bolts E' tapped into the flanges A². With this arrangement a channel or space E² is formed by the casing E and the flanges A² which runs longitudinally of each joint A' and is open to the outer edge of the joint. Into this channel or space E² I supply a sealing fluid, preferably steam, at a pressure above that of the atmosphere. In consequence any fluid leaking into the interior of the turbine through the joint A' will be steam or other sealing fluid and not air. As shown, I supply steam to the space E² by the piping F which may lead from any suitable source of steam under pressure exceeding that of the atmosphere. F' represents a pipe connected to a suitable trap F² which may be employed for disposing of water of condensation formed in the space E². It will be obvious however, that the outlet pipe is not essential in all cases as the water of condensation accumulating in the space E² forms of itself a sealing fluid effective to prevent the leakage of air through the joint A' when the water is under a pressure exceeding that of the atmosphere. The

water leaking through the joint will be so small in amount with any practical apparatus as not to appreciably affect the operation of the turbine.

In the modified apparatus shown in Fig. 3 the casing parts AB meeting at the joint A¹⁰ are formed with registering grooves A¹¹ in the adjacent faces of the flanges A². These unite to form a channel located between the inner and outer edges of the joint and adapted to receive the sealing fluid. As shown in Fig. 3, the bolts A³ lie on the outer side of the channel for the sealing fluid. An advantageous modification of this arrangement is shown in Fig. 3^A, in which the abutting flanges of the casing parts AB' are formed with opposed relatively wide and shallow grooves A¹¹⁰ which unite to form a channel for the sealing fluid through which pass the bolts A³ securing the flanges together.

In the arrangement shown in Fig. 4 the channel A¹² formed in the casing part AC opens at A¹³ into the interior of the turbine at a point where the steam pressure is above that of the atmosphere.

It is of course apparent that the joints of the condenser B and the joints between the expansion joint member C and the turbine body proper and the condenser may be sealed by an air excluding fluid in a manner similar to that in which the joints A' and A¹⁰ are sealed.

While in accordance with the provisions of the statutes I have illustrated and described the best forms of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of apparatus disclosed without departing from the spirit of my invention.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a turbine casing the combination with stationary casing parts meeting at a joint in a portion of the casing at which the internal pressure is less than that of the atmosphere, of means local to said joint for sealing the latter with an air excluding fluid at a pressure above that of the atmosphere.

2. In a turbine casing, the combination with stationary casing parts meeting at a joint at a portion of the casing at which the internal pressure is less than that of the atmosphere, of means providing a channel running along said joint and opening to said joint at a distance from its inner edge, and means for supplying an air excluding sealing fluid to said channel at a pressure exceeding that of the atmosphere.

3. In a turbine casing, the combination with stationary casing parts meeting at a joint at a portion of the casing at which the internal pressure is less than that of the atmosphere and having a channel formed

in the joint forming surfaces extending longitudinally thereof and means for supplying an air excluding sealing fluid to said channel at a pressure above that of the atmosphere.

4. In a turbine casing the combination with stationary casing parts meeting at a joint in a portion of the casing at which the internal pressure is less than that of the atmosphere, of means local to said joint for sealing the latter with steam at a pressure above that of the atmosphere.

5. In a turbine casing, the combination with stationary casing parts meeting at a joint at a portion of the casing at which the internal pressure is less than that of the atmosphere, of means providing a channel running along said joint and opening to the latter at a dis-

tance from its internal edge and means for supplying steam to said channel at a pressure exceeding that of the atmosphere.

6. In a turbine casing, the combination with the stationary casing parts meeting at a joint which extends along a portion of the casing at which the internal pressure is less than that of the atmosphere, of means providing a channel running along said joint and opening to the latter at a distance from the internal edge and communicating with the interior of the turbine casing at a point where the internal pressure is above that of the atmosphere.

PAUL A. BANCEL.

Witnesses:

GEO. F. FENNO,
EUGENE L. LARKIN.