

Dec. 18, 1928.

1,696,002

H. J. HANZLIK

TURBINE

Filed Aug. 1, 1925

2 Sheets-Sheet 1

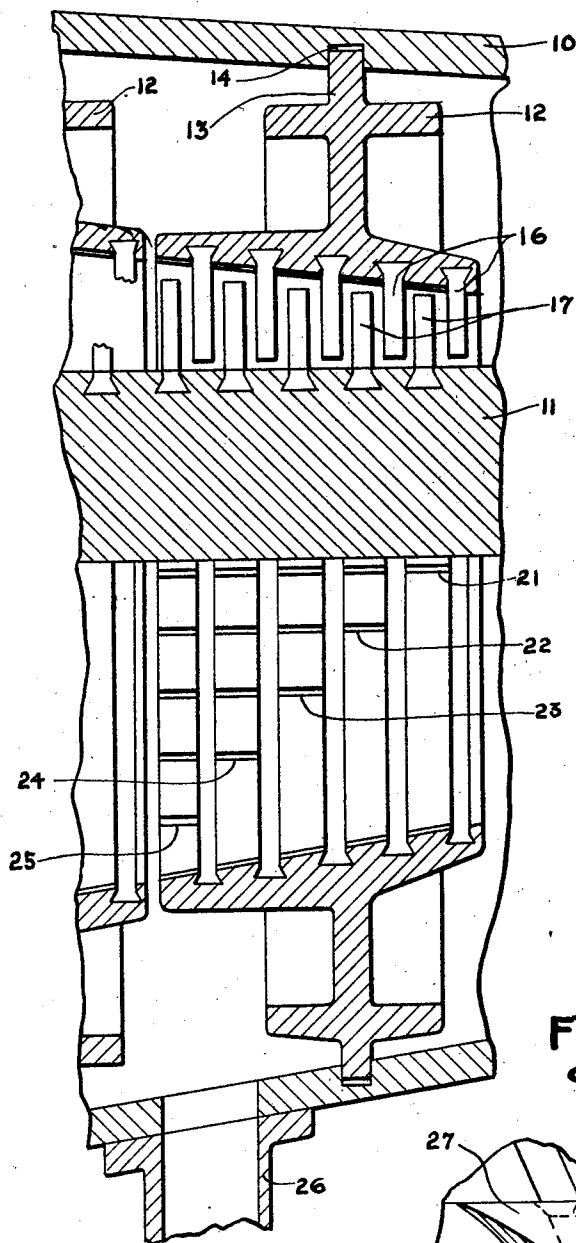


Fig. 1.

WITNESSES:

O. B. Mahaffey

Fig. 4.

Fig. 2.

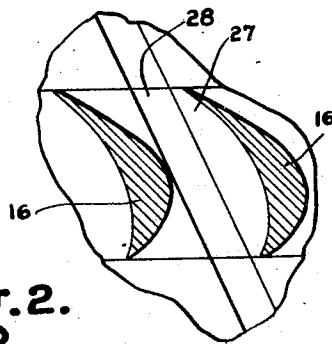
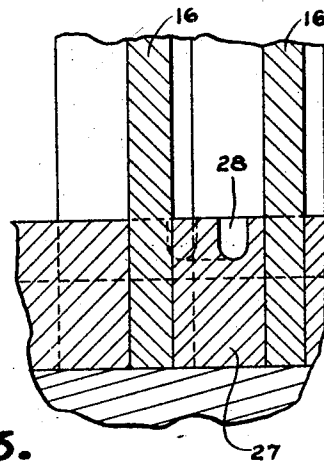
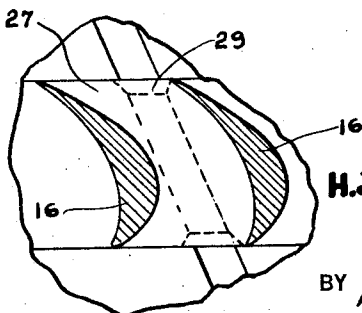


Fig. 3.



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2 Sheets-Sheet 2

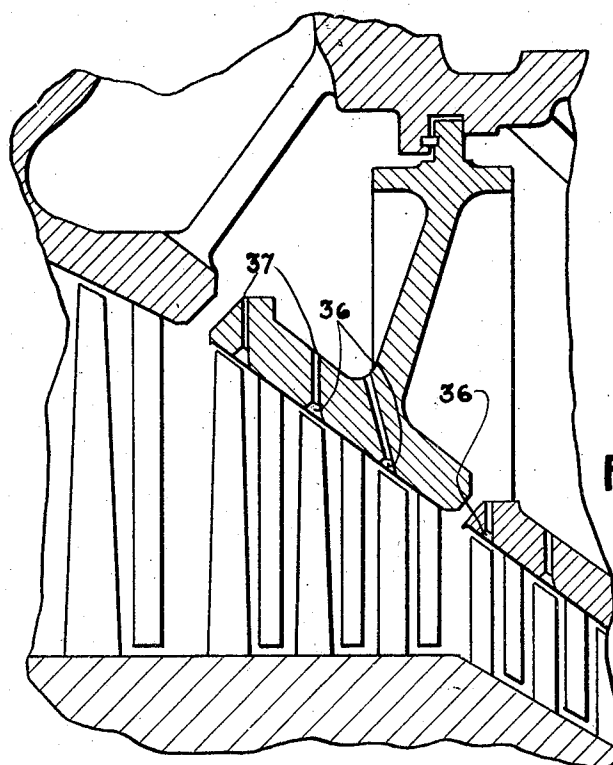


Fig. 7.

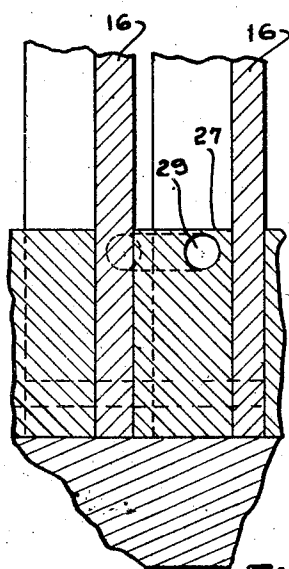


Fig. 5.

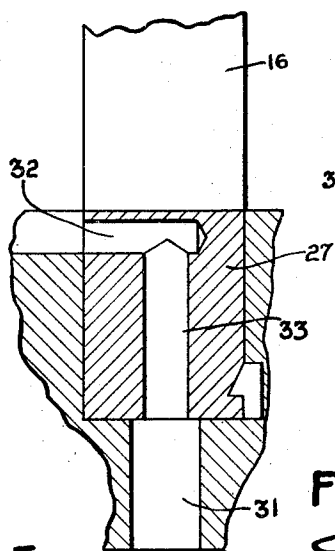


Fig. 6.

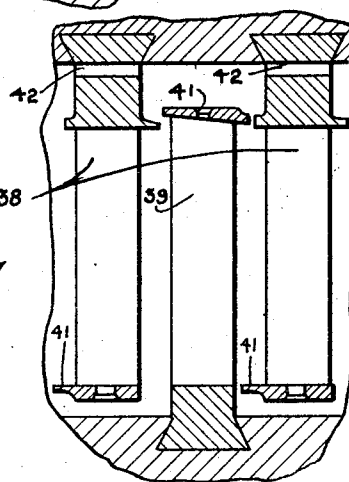


Fig. 8.

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UNITED STATES PATENT OFFICE.

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TURBINE.

Application filed August 1, 1925. Serial No. 47,578.

My invention relates to elastic fluid turbines, more particularly to multi-stage turbines, and it has for its object the provision of means for extracting moisture from the partially expanded motive fluid in its passage through the turbine.

Apparatus made in accordance with my invention is illustrated in the accompanying drawings forming a part of this specification in which Fig. 1 is a fragmentary view showing, in section, a turbine made in accordance with my invention; Fig. 2 is an enlarged plan view of two stationary blades in a row and arranged in accordance with Fig. 1; Fig. 3 is a longitudinal sectional view of the blades and spacing pieces shown in Fig. 2; Fig. 4 is a view similar to Fig. 2 showing a modified form of my invention; Fig. 5 is a longitudinal sectional view of the blades shown in Fig. 4; Fig. 6 is a view of a blade and spacing piece illustrating another modified form of my invention; and Figs. 7 and 8 are sectional views illustrating still other modifications of my invention.

In the operation of steam turbines difficulties have been encountered, especially in the low pressure sections thereof, due to moisture in the partially expanded motive fluid. The moisture entrained with the motive fluid and travelling at a high velocity through the blades exerts a serious braking effect on the turbine and causes erosion of the blading. Due to the relative density of steam and entrained moisture, the moisture is carried by centrifugal force along the outer ends of the moving blade rows and along the bases of the stationary blade rows. The greatest damage by erosion is accordingly found along the outer ends of the moving blades and the bases of the stationary blade rows.

I overcome the aforementioned difficulties by providing drainage grooves in the stationary blade carrying element and arranging the grooves to discharge the collected moisture without the stationary blade carrying element. My invention is especially applicable to turbines wherein the stationary blades are carried by rings mounted within the casing and forming with the casing bleeder chambers from which partially expanded motive fluid is extracted. In such installations, the bleeder connection furnishes a ready means for withdrawing the moisture

collected by the grooves from the turbine casing.

Referring to the drawings for a better understanding of my invention, I show in Fig. 1, at 10, a fragment of a turbine casing having a rotor 11 disposed therein. For the sake of clearness of illustration I have only shown the upper half of the turbine rotor. Mounted within the casing 10 is a stationary blade carrying ring 12 having a flange portion 13 carried in a groove 14 formed in the turbine casing. In the ring 12 are mounted a plurality of rows of stationary blades 16—16 which interleave with a like number of rows of moving blades 17—17 carried by the rotor 11. In the illustration, Fig. 1, I show the lower half of the ring 12 below the half of the rotor 11, as having the stationary blades 16—16 removed in order that the relation of the grooves, the blades and the blade ring may be more clearly understood.

Formed in the inner periphery of the blade ring 12 and extending transversely thereof between the blade rows are a series of grooves 21, 22, 23, 24 and 25 decreasing in length in the order named. In the illustration the direction of motive fluid flow is assumed to be from right to left and I accordingly increase the number of grooves across the blade ring 12 toward the leaving side of the blade ring. The effect of this is to increase the added, or total, cross sectional area of the grooves toward the low pressure side of the blade ring and consequently in the zone of increased moisture within the steam. The grooves 21, 22, 23, 24 and 25 all extend entirely to the leaving edge of the blade ring 12 so that any moisture collected therein passes to the leaving edge and thence outwardly of the blade ring 12 in the space between said blade ring and the next adjacent blade ring. At 26, I show a bleeder connection communicating with the interior of the casing 10 from which moisture extracted from the steam by means of the drainage grooves may be readily removed from the interior of the casing.

Between adjacent blades in the row 16—16 is a spacing member 27, (See Figs. 2 to 5.) In order that moisture collected within the drainage grooves may cross the stationary blade rows 16—16, I provide a groove 28 in the required number of spacing

pieces, and arrange the grooves 28 to come opposite cooperating drainage grooves in the blade ring.

Instead of a groove 28 as shown in Figs. 2 and 3, I may provide a hole through the spacing member 27 as shown at 29 in Figs. 4 and 5, and arrange the spacing members with the holes 29 provided therein opposite the grooves in the blade ring.

It may be desirable in certain designs to remove the moisture from the steam without requiring it to travel across several blade rows in grooves such as illustrated in Fig. 1. I accordingly may provide holes extending through the blade ring as shown at 31 in Fig. 6 and provide holes 32 in the spacing members 27 cooperating with grooves in the blade ring 12 as before illustrated and provide in the member 27, a second hole 33 joining the hole 32 and coming opposite the hole 31 formed in the blade ring. In accordance with this modification the moisture entrained from the steam is not required to cross the stationary blade rows but is extracted directly to the exterior of the stationary blade carrying ring through the holes 32, 33 and 31.

In accordance with the modification of my invention shown in Fig. 7 the grooves in the stationary blade carrying ring 12, instead of extending transversely of the blade ring, may extend circumferentially around the inner periphery of the ring as indicated at 36—36. Connecting the grooves 36—36 with the outer portion of the ring 12 are a plurality of series of holes 37—37 formed in the blade ring 12. The grooves 36—36 are formed in the blade ring 12 directly opposite the tips of the moving blades so that the moisture is urged into the grooves by centrifugal force.

In Fig. 8 I illustrate a modification of my invention adapted for use with shrouded blades. In this figure, I show two rows of stationary blades 38—38 and a row of moving blades 39, both the stationary and moving blades being provided with a well-known form of shrouding 41 adapted to minimize leakage of motive fluid over the tips of said blades and permitting relatively large radial clearances. With this type of blading the moisture in the partially expanded steam is carried out past the shrouding 41 of the moving blades into the space between the roots of the stationary blade rows 38. Holes 42—42 are provided through the spacing members between the stationary blades which permit moisture to pass in the direction of motive fluid flow toward the turbine exhaust.

From the foregoing, it will be apparent that I have provided, in an elastic fluid turbine, means for separating moisture from motive fluid in its passage through the turbine.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is sus-

ceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a turbine, the combination with a casing, of a blade-carrying element having an inner axially-extending blade-carrying portion and an outer radially extending portion detachably connected to the casing, a plurality of rows of blades carried by the blade-carrying portion, and drainage means for each annular space between rows of blades and for the space at the leaving side of the last row of blades.

2. In a turbine, a stationary blade carrying element having a plurality of rows of blades mounted thereon and provided with grooves extending transversely of the blade rows, the added cross section of the areas of said grooves increasing in the direction of motive fluid flow.

3. In a turbine, a casing, a stationary blade carrying ring mounted within the casing and having a series of grooves around its inner periphery extending in the direction of motive fluid flow to the leaving side thereof, a second stationary blade carrying ring disposed within the casing and closely spaced from the first-mentioned ring and forming, together with the first-mentioned ring and the casing, a chamber into which said grooves discharge the condensed moisture collecting therein.

4. In a turbine, a stationary blade carrying ring having a series of grooves around its inner periphery extending in the direction of motive fluid flow to the leaving side thereof and increasing in number toward the leaving side of the blade carrying element.

5. In a turbine, the combination of a casing, a bleeder connection communicating with the casing for extracting partially expanded motive fluid therefrom, a stationary blade carrying ring mounted within the casing and forming therewith a chamber communicating with the conduit means, and a series of grooves provided in the blade carrying ring around its inner periphery and communicating with the chamber.

6. In a turbine, a stationary blade carrying element provided with drainage grooves therein extending in the direction of motive fluid flow, a plurality of rows of stationary blades mounted on said element transversely of the grooves, spacing members between blades in a row, and means provided in the spacing members opposite the grooves permitting moisture in the grooves to pass said spacing members.

7. In a turbine, a stationary blade carrying element provided with drainage grooves therein extending in the direction of motive

fluid flow, a plurality of rows of stationary blades mounted on said element transversely of the grooves, spacing members between blades in a row, and grooves provided in the
5 spacing members opposite the grooves in the ring permitting moisture in the grooves in the ring to pass said spacing members.

8. In a turbine, a stationary blade-carrying element provided with drainage grooves
10 therein extending in the direction of motive fluid flow, a plurality of rows of stationary blades mounted on said element transversely of the grooves, spacing members

between the blades in a row, and grooves provided in the spacing members opposite
15 the grooves in the blade carrying element permitting moisture in the grooves in the blade-carrying element to pass said spacing members, the added cross section of the areas of
20 said grooves increasing in the direction of motive fluid flow.

In testimony whereof, I have hereunto subscribed my name this twentieth day of July, 1925.

HENRY J. HANZLIK.