N. B. WALES & G. B. COLLIER.

TURBINE.

APPLICATION FILED MAY 21, 1909.

1,014,350.

Patented Jan. 9, 1912.

2 SHEETS—SHEET 1.

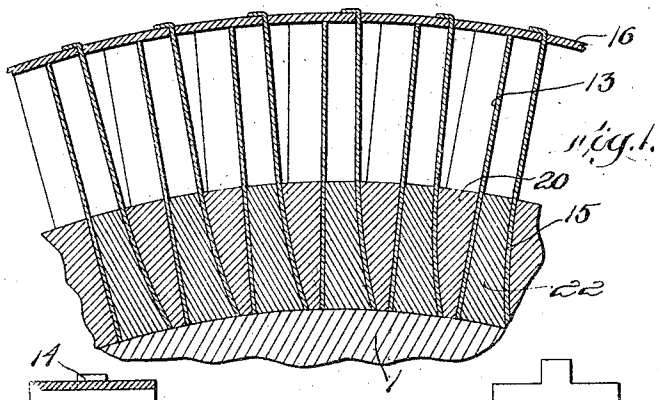


Fig. 1.

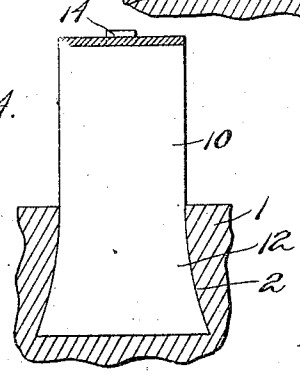
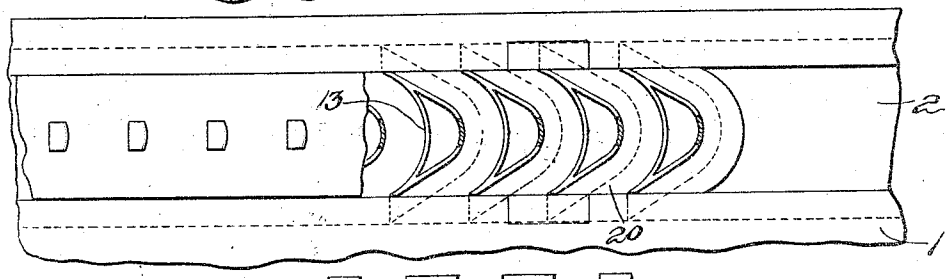


Fig. 4.

Fig. 5.

Fig. 2.



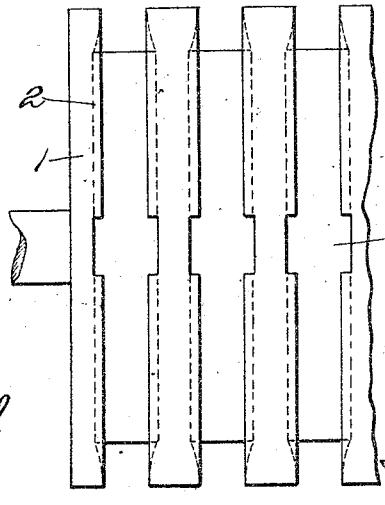


Fig. 3.

Witnesses:
Wm. L. Gilman.
H. D. McPhail

Inventors
Nathaniel B. Wales
Guy B. Collier
by Pollock Van Everen & Fish
Attys.

N. B. WALES & G. B. COLLIER.

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2 SHEETS—SHEET 2.

Fig. 11.

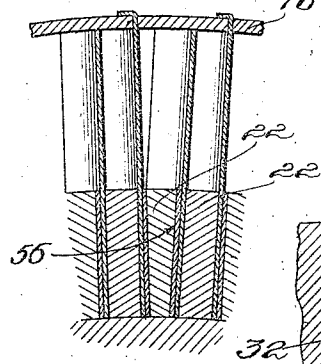


Fig. 6

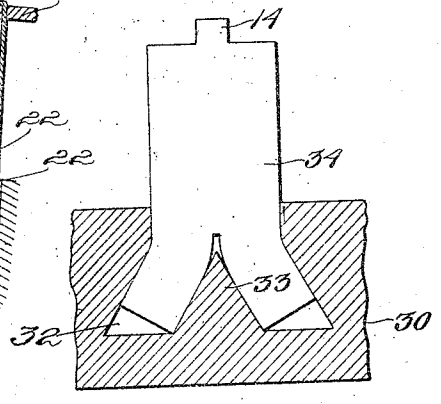


Fig. 8.

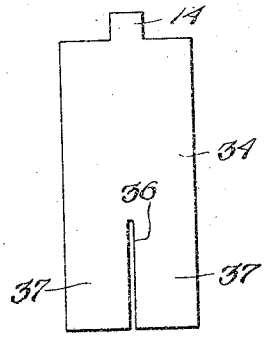


Fig. 9.

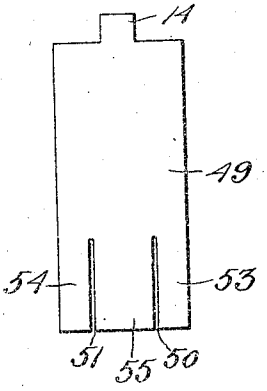


Fig. 7.

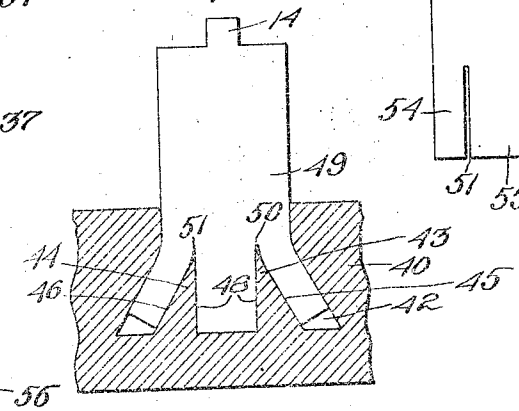
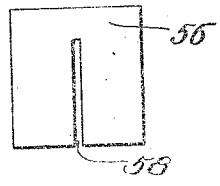


Fig. 10.



Witnesses:

M. L. Gilman.

N. D. McOhail

Inventors:

Nathaniel B. Wales

Guy B. Collier

by Phillips, Nau, Everes & Fish

Attys.

UNITED STATES PATENT OFFICE.

NATHANIEL B. WALES, OF BOSTON, MASSACHUSETTS, AND GUY B. COLLIER, OF KINDERHOOK, NEW YORK; SAID WALES ASSIGNOR TO SAID COLLIER.

TURBINE.

1,014,350 Specification of Letters Patent. Patented Jan. 9, 1912.

Application filed May 21, 1909. Serial No. 497,403.

To all whom it may concern:

Be it known that we, NATHANIEL B. WALES and GUY B. COLLIER, citizens of the United States, residing at Boston and Kinderhook, in the counties of Suffolk and Columbia and States of Massachusetts and New York, have invented certain new and useful Improvements in Turbines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to elastic-fluid turbines, and more particularly to means for securing the blades in place.

The object of the present invention is to provide an improved form of turbine construction in which the blades are securely held in place, and one which is economical in the cost of construction and maintenance.

It has been proposed to secure the blades of a turbine in place by means of a retaining band through which the blades are passed, the shanks of the blades being embedded in a mass of metal which is cast about them after the retaining band is in position on the blade support. This form of construction is comparatively expensive, and is objectionable for the reason that it does not permit repairs to be quickly and cheaply made. Accordingly, the present invention contemplates the provision of improved means for spacing and securing the blades in the support, comprising separate spacing blocks or separators located between and fitting the opposing faces of the blade shanks, said shanks and separators being received in a dove-tailed channel or groove formed in the blade support and securely held therein without the use of a retaining ring.

The invention will be readily understood from an inspection of the accompanying drawings and the following detailed description of the construction shown therein.

In the drawings, Figure 1 is a fragmentary central vertical section taken through a row of blades showing one form of construction; Fig. 2, is a fragmentary sectional plan view of the construction shown in Fig. 1 with a portion of the shroud broken away; Fig. 3 is a partial side elevation of the rotor showing one form of the channels and the openings through which the blade shanks and spacing blocks are inserted in the channels; Fig. 4 is a side elevation of a blade showing the shroud and blade support in section; Fig. 5 is a side elevation of a blade having a modified form of shank; Figs. 6 and 7 are fragmentary sectional elevations showing modified forms of channels and blades mounted therein; Figs. 8 and 9 are front elevations of the blades shown in Figs. 6 and 7 respectively before being driven into the channels; Fig. 10 is a front elevation of one form of spacing block before being driven into the channel and Fig. 11 is a view similar to Fig. 1 of the modification shown in Fig. 7.

In the drawings the blades are shown as mounted upon the rotor of a turbine, but this is merely for convenience of illustration and description, and it should be understood that the invention is equally applicable for securing the blades to the stator of the turbine.

As shown in Figs. 1 to 5 of the drawings, the blade support comprises a cylinder 1 having a series of dove-tailed peripheral channels or grooves 2 provided with openings 4, the side walls of which are spaced apart a distance substantially equal to the width of the bottom of the dove-tailed groove. It is through these openings that the blade shanks and spacing blocks or separators are inserted, as will be hereinafter explained, and any desired number of these openings may be provided to facilitate the assembling of the parts.

The blades 10 are made from tubing drawn through a suitably formed die, one end of each blade being flared or expanded to form a shank 12 which fits the dove-tailed groove 2. In the form of construction shown in Figs. 1 and 2 one face 13 of the blade is straight longitudinally its entire length and the other face is curved at the shank as shown at 15. These shanks may be formed by means of a punch and die, so that they will all be uniform in size and shape. The other end of each blade is formed with one or more projections 14 which pass through holes in a shroud 16 and are bent over to secure the shroud in place. If desired, the shank of the blade may be split as at 17 to facilitate the expanding or flaring operation. Alternating

with the blades are tapered spacing blocks or separators 20 having their front and rear faces shaped to fit the opposing faces of the blade shanks, and their edges fitting the sides of the dove-tailed groove. These blocks may be machined the desired shape to insure the accurate location of the blades around the periphery of the support.

In assembling the blades to be secured in place, the shanks are inserted through the openings 4 and then pushed into the dove-tailed groove with their inner ends resting on the bottom of the groove. Alternating with the blades are the spacing blocks or separators which are similarly introduced into the groove through the openings. When the channel has been filled with blades and blocks, a suitable molten metal 22 such as brass or lead, is poured into each opening to fill the space surrounding each block or blade shank which is at the opening, in order to retain it in place in the support. Obviously other means for securing the last block or blade to be entered may be employed. After the blades are thus secured in place in the support, molten metal is poured into each blade to fill its shank, and if desired, the entire blade may be filled to the shroud to keep out water. This metal may afterward be tamped to spread the shanks to insure intimate contact with the sides of the retaining groove and the spacing blocks. Thus it will be noted that the shanks are firmly locked in the support by engagement with the inclined sides of the dove-tailed groove and the tapered surfaces of the spacing blocks. After the blades have been thus secured to the support, the shroud 16 is placed around the outside, and the projections 14 are bent or headed over so that the blades will be secured at their outer ends to the shroud.

The above method of construction insures accurate and uniform spacing of the blades about the periphery of the support, in addition to firmly securing them in the support.

In case it becomes necessary to repair or replace a blade, the members occupying the nearest opening may readily be taken out after chipping or otherwise removing the metal cast into the opening, and then the intervening blades and spacing blocks may be taken out through this opening. A new blade is then substituted, and the blades and spacing blocks which were removed are replaced as above described.

In the modification shown in Fig. 6 the blade support 30 is provided with dove-tailed channels 32 having a central ridge 33 which is triangular in cross section. The blade 34 is tubular and may have the same cross section as the blades 10 shown in Fig. 2. It is slotted at 36 and is secured in the dove-tailed channel 32 by being driven against the ridge 33 which spreads the lower portions 37 of the blade apart to fill the channel.

In the modification shown in Fig. 7 the blade support 40 is provided with a dove-tailed channel 42 having a pair of ridges 43 and 44 formed with outer oblique faces 45 and 46 and opposing substantially parallel faces 48. The blade 49 is slotted at 50 and 51 to correspond to the vertices of the ridges 43 and 44 respectively. The blade 49 is driven into the channel against the ridges 43 and 44 which spread the portions 53 and 54 outwardly to fit the sides of the channel 42 while the central portion 55 is held between the faces 48 of the ridges.

Alternating with the blades 34 and 49 are tubular separators or spacing blocks 56. These spacing blocks are slotted at 58 similarly to the blades 34 and 49 according to the form of blade with which they are to be used and are driven into the dove-tailed channels in the same manner as the blades. They are shaped to fit the opposing faces of the blade shanks and when driven into position they correctly space apart and firmly secure the blades in place in the support. Molten metal 22 as above described may be poured into the blades and spacing blocks and tamped to insure intimate contact between all the parts. The blades may be filled to the shroud with the molten metal to keep out water. After the blades are thus secured in place the shroud 16 is attached as above described.

In the modifications shown in Figs. 6 and 7 the dove-tailed channels are continuous and the openings 4 are omitted, since the shanks of the blades in these modifications are straight until spread apart by being driven against the ridges in the bottoms of the channels.

Having set forth the nature and object of the invention, and specifically described one form of turbine in which the invention may be embodied, what we claim is:—

1. A turbine, having, in combination, a blade support provided with a groove, hollow blades having their shanks received within the groove, spacing blocks mounted within the groove between each pair of blades engaging the opposing faces of the blade shanks to retain them within the groove, and a mass of cast metal within each blade, substantially as described.

2. A turbine, having, in combination, a blade support provided with a dove-tailed groove, hollow blades having their shanks spread to fit the dove-tailed groove, a spacing block between each pair of blades fitting the groove and the opposing faces of the blade shanks, and a mass of cast metal within each blade shank, substantially as described.

3. A turbine, having, in combination, a blade support provided with a dove-tailed

groove, hollow blades having their shanks spread to fit the sides of the groove and engaging the bottom of the groove, a spacing block mounted within the groove between each pair of blades fitting the groove and the opposing faces of the blade shanks, and a mass of cast metal within each blade, substantially as described.

In testimony whereof we affix our signatures, in presence of two witnesses.

NATHANIEL B. WALES.
GUY B. COLLIER.

Witnesses:
WARREN G. OGDEN,
N. D. MCPHAIL.