No. 854,788. PATENTED MAY 28, 1907.

R. WILSON.

STEAM TURBINE.

APPLICATION FILED MAR. 15, 1904. RENEWED DEC. 6, 1905.

Fig. 1

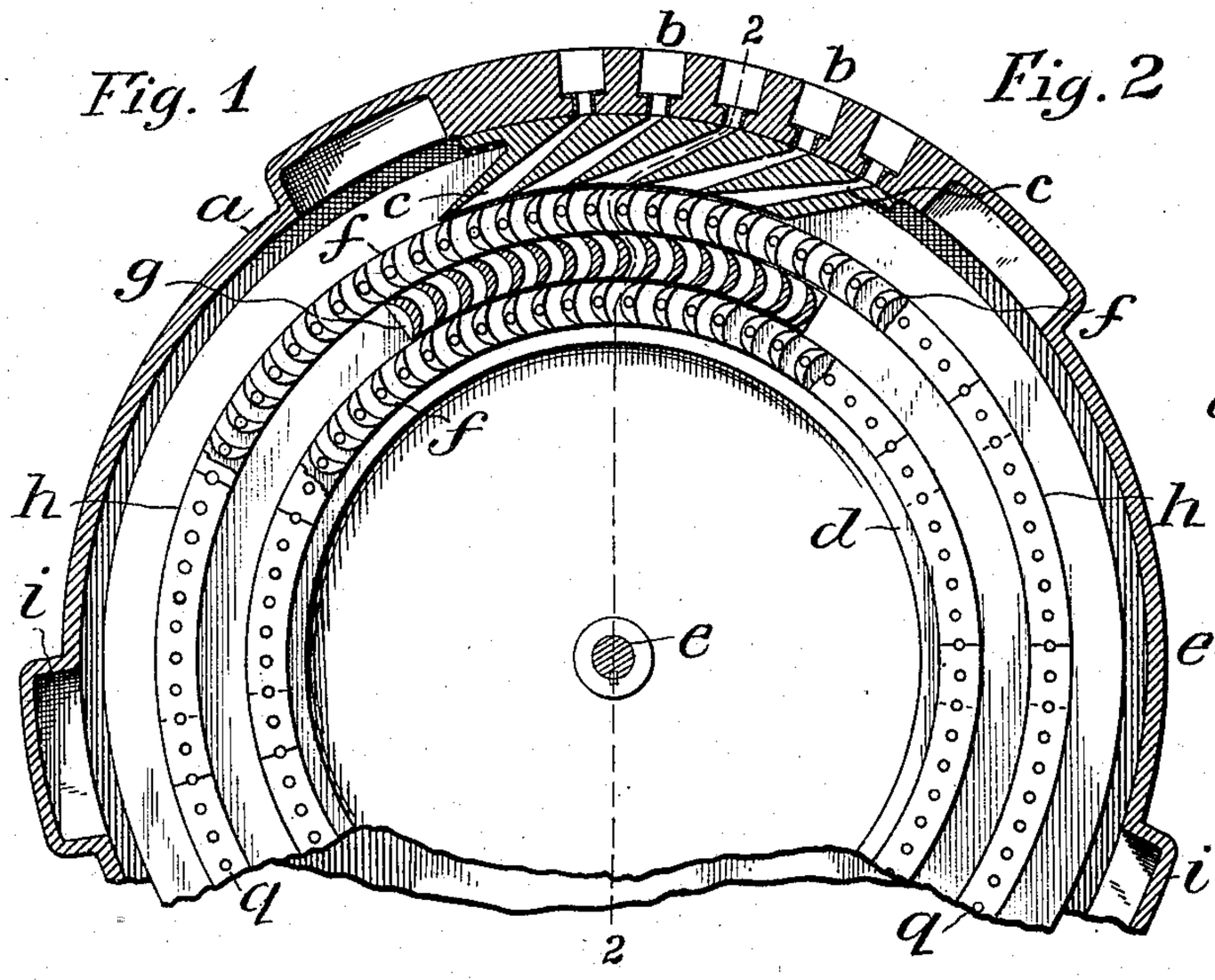


Fig. 2

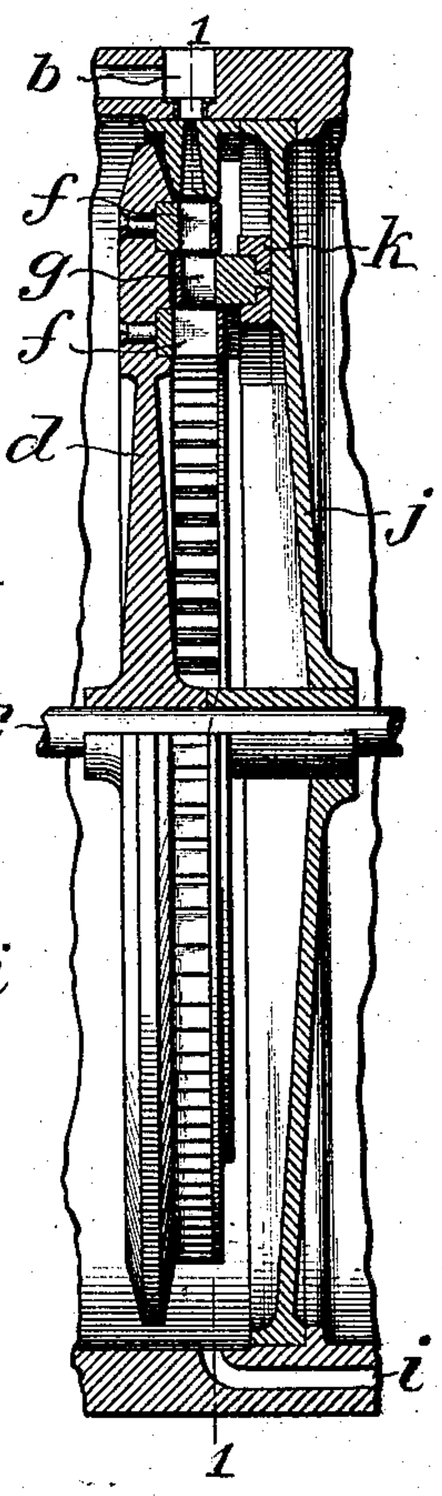


Fig. 3

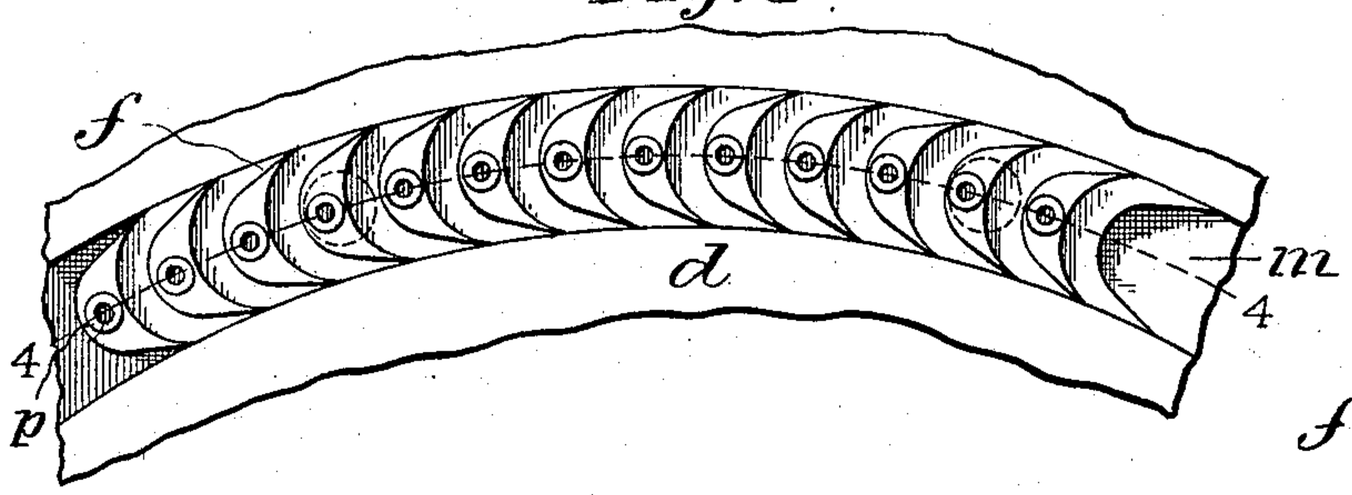


Fig. 5

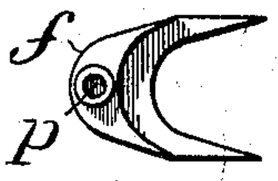
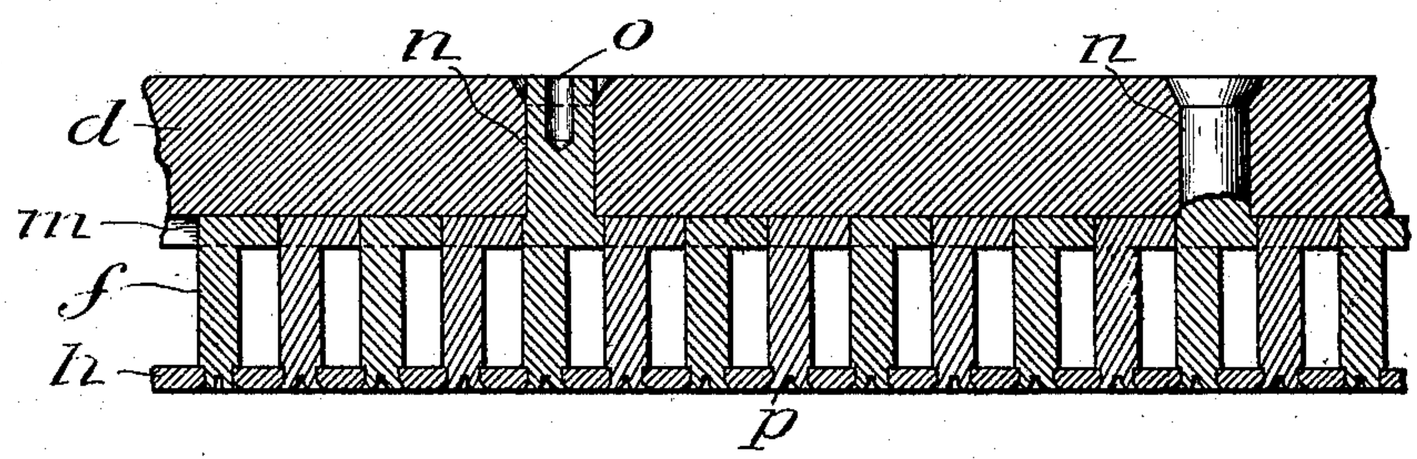


Fig. 4



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STEAM-TURBINE.

No. 854,788. Specification of Letters Patent. Patented May 28, 1907.

Application filed March 15, 1904. Renewed December 6, 1905. Serial No. 290,606.

To all whom it may concern:

Be it known that I, ROBERT WILSON, a citizen of the United States, residing at West Lynn, in the county of Essex and State of Massachusetts, have invented new and useful Improvements in Steam-Turbines, of which the following is a specification.

My invention relates to steam turbines and the vanes, blades or buckets therefor, and the invention especially consists in a new and improved means for attaching and holding said members individually in place, so that while firmly secured against detachment under the great strain of the steam impact as well as of centrifugal action, separate vanes may readily be removed and replaced without the sacrifice of the wheel or the vanes adjacent.

In the accompanying drawings forming a part of this specification, Figure 1 is a view, mainly in section, taken transversely to the axis of rotation, on line 1—1 of Fig. 2, of a steam turbine of that type of flow in which the steam acts on vanes movable and fixed in alternate series, the movable vanes not being in section, but shown in plan with the outer supporting band removed. Fig. 2 is a longitudinal section, mainly in the plane of the axis of rotation of the wheel, but passing through the steam nozzles, and also not cutting the vanes, but for better illustration following the steam channels between the vanes, on line 2—2, Fig. 1. Said sectional plane cuts the bases of the vanes centrally to show the mode of insertion and fastening. Fig. 3 is an enlarged plan view of the vanes in their channel with supporting band removed. Fig. 4 is a sectional view of the vanes on line 4—4, Fig. 3, passing through the shanks of the vanes, to show the mode of securing them to wheel and band. Fig. 5 is a plan view of an individual vane.

Referring to Figs. 1 and 2, *a* is the casing or shell.

b, *b*, are the openings in the casing through which steam is admitted to the nozzles.

c, *c*, are the nozzles, of the usual divergent type, for delivering the steam to the rotatory system of impulsion vanes. In this instance they are shown secured to the interior of the casing.

d is the rotatory wheel which carries the movable vanes, mounted on central shaft *e*.

f, *f*, are the movable reaction vanes mounted in circular channels on the wheel *d* in one or more series concentric with the axis of rotation.

g, *g*, are the stationary abutment vanes, fixed in circular series intermediate and concentric with the movable vanes.

h is the band, secured on the outside of the vanes to each vane at its extremity, to give support to the series.

i, *i*, are passage ways in the casing for exhaust steam.

j is a fixed supporting disk for the stationary vanes.

k is the holder for stationary vanes, secured to disk *j*.

Other wheels with vanes may be mounted on the same shaft, but for present purposes the illustration is sufficient.

In steam turbines of this type, whether of radial or axial flow, the energy of the inflowing steam is imparted to the rotatory portion by reaction against the movable vanes of a series, and by change of direction of motion caused by the adjacent series of fixed or abutment vanes on which the steam current impinges after deflection by the movable vanes, a second reaction takes place upon the second series of movable vanes, and so on throughout the successive series until the energy of the steam is exhausted. Great strain necessarily occurs upon the vanes of each series, whether movable or fixed, and this is enhanced in the movable vanes by the great velocity attained, adding centrifugal strain to that of the direct impact of the steam current. The making of the vane rings in one solid piece is costly, and great additional expense is entailed when breakage occurs. Vanes have also been made removable, but it is the object of the present invention to improve the mode of setting and securing the individual vanes so that they shall have all the required strength and power of resistance against steam impact and centrifugal action, while being separately removable and replaceable without impairment of the remainder of the series. To this end I provide in the rotatory wheel *d* and also in the stationary annular vane holder *k*, circular grooves or channels *m*, rectangular in section, in which the bases of the vanes are inserted. These channels contain the heaviest portion

of the vanes, and take the centrifugal strain in case of the movable vanes and transfer it to the solid wheel.

The vanes are made of the form shown in section in Fig. 5. They may be drop forged, milled, or otherwise formed to uniform shape and size by any of the well known mechanical processes. Certain ones of the series have shanks *n* at the rear of the base, which pass through apertures made for the purpose at intervals in the wheel; also in the stationary vane holders. These shanks are firmly upset on the rear of said apertures by any of the well known processes of riveting, or they may be screw-threaded and held by nuts on projecting portions at the rear. A secure mode of riveting is to drill the shank lengthwise as shown at *o*, Fig. 4, and expand the tubular end when in place by a proper tool.

It is not necessary that every one of the vanes in the series shall be secured to the wheel by the riveted shank. The bases of all the vanes are formed to accurately fit the channels and also each other, as shown in Fig. 4, so that there is no lost space to cause looseness. Each vane is also provided at its extremity with a projection *p*, and perforations *q* are provided in the band *h* to fit all the projections, which are firmly secured to said band by upsetting or otherwise, the entire series being thus supported and tied together at their outer ends. The riveting, upsetting or other mode of fastening is accomplished in the same manner as that employed on the rear shanks. The band may be entire, or for greater convenience, in sections, as shown in Fig. 1, but should extend at least over two of the shanked vanes, if sectional, with overlapping joints. This means of securing in place the separate vanes is applicable to any type of steam turbine using vanes, the essentials being the rectangular groove or channel for receiving the bases, and the means described for firmly securing the bases in the channel and tying the vanes by their outer extremities.

I claim, and desire to secure by Letters Patent:

1. In an elastic-fluid turbine, a support having a circular groove or channel formed therein, a series of vanes having bases accurately fitting said channel, shanks on the rear of said bases, perforations in said support into which said shanks are fitted, means for securing said shanks firmly in place in said support, projections on the outer extremities of said vanes, and a band, perforated at intervals to correspond to said projections, into which said projections are firmly secured, substantially as specified.

2. In an elastic-fluid turbine, a rotatory member having circular grooves or channels formed therein, a fixed member having a circular groove or channel, vanes having bases accurately fitting said grooves or channels, integral shanks on said bases, perforations in said grooved members corresponding to said shanks and their position, in which the latter are securely fastened, projections on the outer extremities of said vanes, and bands perforated at intervals to correspond to said projections and their position, into which the latter are securely fastened, substantially as specified.

3. In an elastic-fluid turbine, the combination of a support, a plurality of vanes mounted thereon, other vanes having shanks which are secured to the support, and a cover for securing the first-mentioned vanes in place, that is attached to those vanes having shanks.

4. In an elastic-fluid turbine, the combination of a support, a plurality of vanes carried thereby, retaining shanks for a portion only of the vanes, a cover for the ends of the vanes, and projections on all of the vanes that enter openings in the cover and are riveted over to unite the cover and buckets.

5. In an elastic-fluid turbine, the combination of a support, a plurality of vanes, each having a base that engages the adjacent vane and forms a spacing device, shanks on a portion only of the vanes which enter the support and are secured thereto, a cover for the vanes having openings therein, and projections on the vanes that enter the openings and are riveted over to secure the parts.

6. In an elastic-fluid turbine, the combination of a carrying member, a grooved support mounted thereon, a plurality of vanes mounted in the groove, a cover secured to and covering the ends of the vanes, and shanks for the vanes that pass through and are secured to the support.

7. In an elastic-fluid turbine, the combination of a support, a plurality of vanes mounted thereon, projections on the vanes, shanks for a portion only of the vanes, and a segmental cover that is secured to all of the vanes, each of said segments being secured to at least two of the vanes having shanks.

8. In an elastic-fluid turbine, the combination of a grooved support, a plurality of vanes, bases for the vanes which are located in the groove and act as separators for the vanes and also as means to keep them from twisting, shanks for a portion only of the vanes, which enter the support and are secured thereto, and means for securing the vanes which are not provided with shanks to those that are.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT WILSON.

Witnesses:
WILLIAM E. REID,
TIMOTHY C. FARRELL.