O. D. H. BENTLEY.

TURBINE ROTOR.

APPLICATION FILED MAR. 8, 1910.

966,157.

Patented Aug. 2, 1910.

Fig. 1.

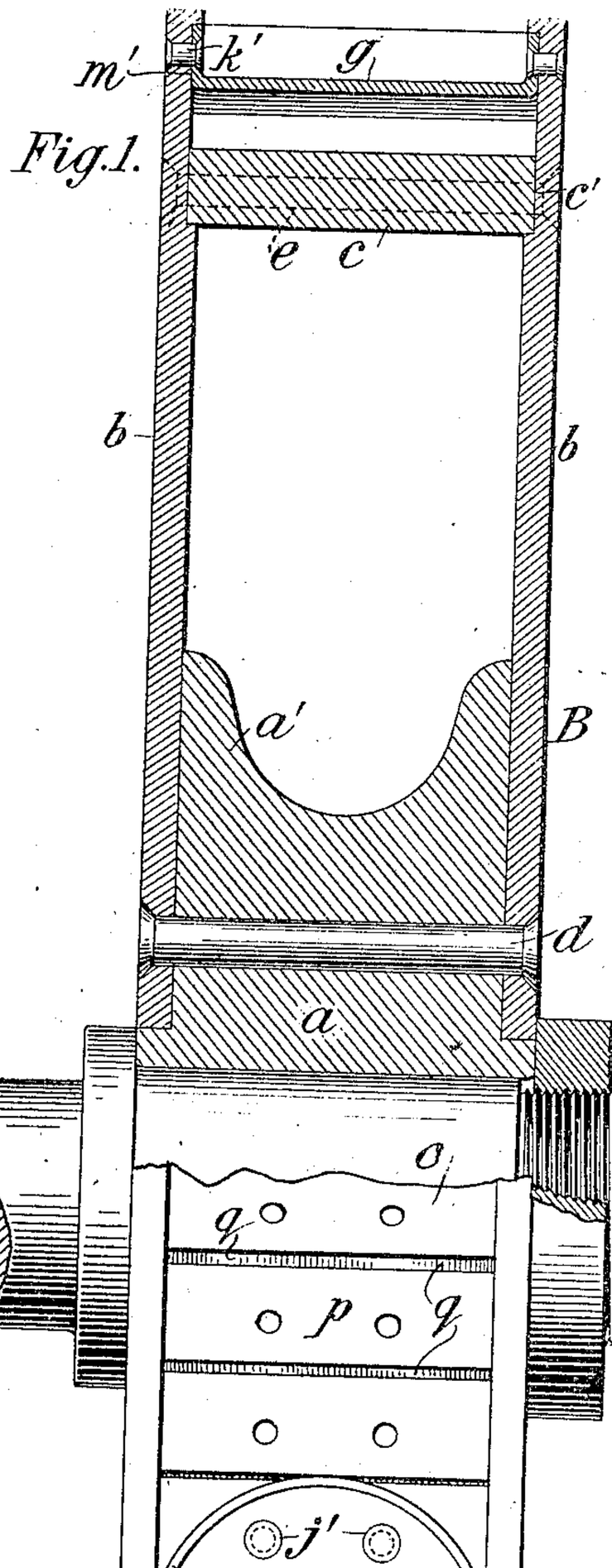


Fig. 3.

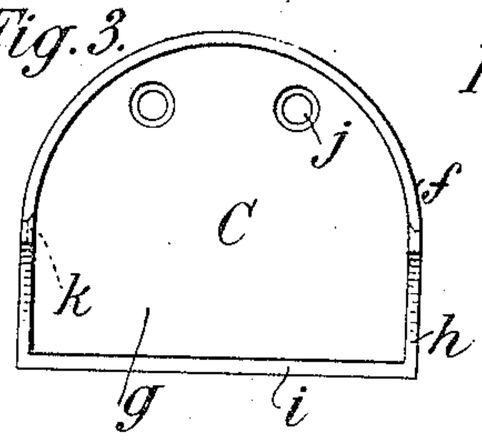


Fig. 4.

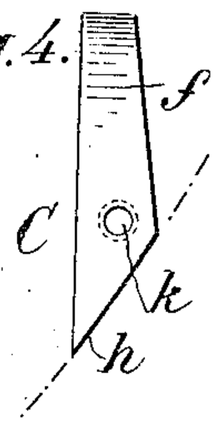
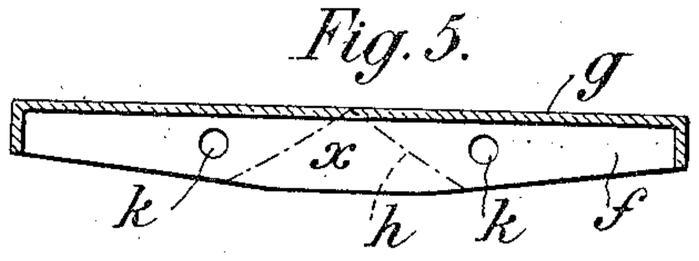


Fig. 5.



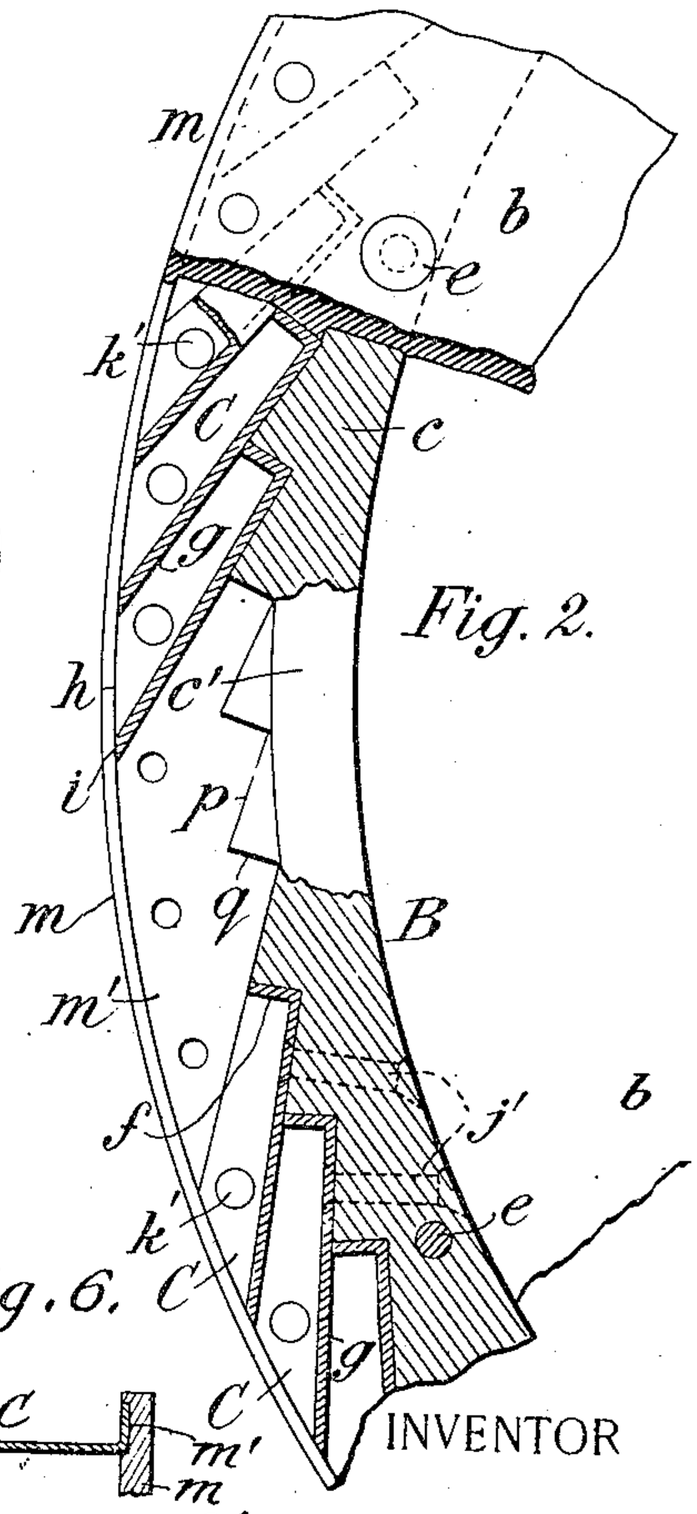


Fig. 2.

Fig. 6.

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TURBINE-ROTOR.

966,157. Specification of Letters Patent. Patented Aug. 2, 1910.

Application filed March 8, 1910. Serial No. 547,982.

To all whom it may concern:

Be it known that I, OLIVER D. H. BENTLEY, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Turbine-Rotors, of which the following is a specification.

This invention relates to the construction of rotors for turbine engines driven by steam or other fluid, and particularly to those having tangential peripheral buckets. Such rotors have been made by milling out recesses to form the buckets from the solid metal of the wheel; also and more commonly by milling stepped recesses in the wheel and fastening thereto flat plates forming the partitions between successive buckets; also by forming the wheel of a central spider and opposite parallel side flanges, fastening flat partition plates between these flanges to separate the buckets, and fastening a curved or semicircular strip or punching of metal plate between said flanges to form the parallel sides and semicircular bottoms of the buckets.

The present invention aims to improve upon these several constructions, and to cheapen the rotor without any sacrifice of strength or accuracy.

Figure 1 of the accompanying drawings is partly an elevation and partly a diametrical section of a rotor embodying the present invention. Fig. 2 is a side elevation of a part thereof, the view being partly in mid-section and some of the parts removed. Fig. 3 is a plan of one of the buckets detached. Fig. 4 is a side elevation thereof; Fig. 5 is a longitudinal section of the punched and drawn shell from which the buckets are made. Fig. 6 is a fragmentary sectional view, showing in reduced size a modified construction of wheel.

In Fig. 1, A is the shaft, and in Figs. 1 and 2, B is as a whole the wheel, C C being the buckets. In this specification the term "wheel" will be used to indicate that part of the rotor which supports the buckets and through which they are connected to the shaft.

The wheel B may be variously constructed, but in the construction shown in Figs. 1 and 2 it is made up of a hub *a*, which may or may not have flanges *a'*, two disks *b b* on opposite sides, and an intervening ring or rim *c*. The disks *b b* are shown as united to the hub *a* by rivets *d d* at suitable intervals. The rim *c* is shown as having annular projections *c'* on opposite sides which enter slightly into shallow grooves formed in the disks *b b*, as shown in the sectional part of Fig. 1, whereby the rim is accurately centered with respect to the disks and hub. The rim and disks are preferably united by rivets *e e* at intervals which, like the rivets *d d*, pass entirely through from side to side and are headed against the exteriors of both disks. A wheel thus constructed is very light, stiff and strong, its lightness being of especial advantage in the minimizing of centrifugal stress due to the high speed of rotation in many such turbines.

The buckets C C, one of which is shown detached in Figs. 3 and 4, are made of metal plate by the drawing or punching process whereby the upturned flange *f* is formed integrally with the partition plate *g*. This flange *f* is semi-circular at its middle portion to form the bottom of the bucket, and straight on its opposite sides, and is of varying height, so that the successive buckets will fit properly together, the outer ends *h* of the flange being tapered off in the arc of a circle of which the axis of rotation forms the center. The front edge *i* of the partition plate is also preferably formed as a bevel coinciding with the same circular arc. The bucket has one or more, preferably two holes *j j* through its bottom, and has opposite side holes *k k*, through which holes rivets *j' k'* are passed for attaching the buckets to the wheel.

As shown, the peripheral portion of the wheel is constructed to fit the buckets and form a suitable seat and housing for them. For this purpose the wheel is formed with side flanges *m m*, which in the construction shown are constituted by the marginal portions of the disks *b b* which project beyond the rim *c*. The rim has its outer surface or perimeter stepped, so as to form a series of tangential steps or planes *p p* for supporting the buckets, and intervening perpendicular faces *q q* which form seats for the rounded bottoms of the buckets. The rim is formed at each of the steps *p* with holes coinciding with the holes *j j* in the buckets, and through these coinciding holes are passed rivets *j'* for attaching the buckets to the rim. The side flanges *m* are also pierced with holes at intervals which coincide with the rivet holes *k* in the buckets, and through these coinciding

holes are passed rivets k' which secure the side flanges of the buckets to the side flanges of the wheel. The rims m are best formed with annular grooves m' which receive the buckets, so that the outer margins of these grooves form a shoulder to resist the outer or centrifugal thrust of the buckets. When the buckets are thus assembled and riveted in place, the marginal portion of the flange f of each bucket forms an accurate seat for receiving the partition plate g of the next bucket. Thus each bucket is held not only by the rivets, but by its partition plate being seated against the step p and against the flange of the next bucket beneath, and by the side portions of its flange being held against and confined between the side flanges m of the wheel, and within the grooves m' thereof.

The construction of the wheel with the rim c having steps p p forms no part of the present invention.

In constructing the buckets, it is preferable to draw or punch them in pairs, which are afterward cut apart. This is shown in Fig. 5, which is a mid-section of the punching after having been flanged in a suitable drawing press and before being cut in two. Thus the drawing operation is performed upon a complete cup, whereby this operation is facilitated. The rivet holes j j may be punched at the same time that the plate is struck out. By preferably a subsequent punching operation, the waste piece x on each side is cut out, and at the same time, or by a different operation the side rivet holes k are punched. After the buckets are thus severed, the upper edge or margin of the flange f may be trued off if necessary, which can be done to gage in a milling machine. The truing of the arc-shaped edge h may be done as the last operation after the buckets are riveted in place, for which purpose the entire rotor may be put in a lathe and its peripheral face turned off true. Or, if it is desired to make the buckets interchangeable, they may be clamped in a suitable jig, and this arc-shaped face h dressed off in a milling machine. By either method the buckets are finished with great accuracy and at very trifling expense.

The present invention is not necessarily limited to the precise details of construction shown. For example the wheel built up of hub and disks may be substituted by any ordinary cast or turned wheel having its peripheral portion adapted to receive the punchings. The punched or drawn buckets may also be varied in shape, provided only the partition plate and flange are integral instead of being separately made and fitted together as heretofore. The shape and arrangement of the buckets will depend upon the type of rotor under construction. The invention is shown as applied to a rotor having a single series of reversing buckets opening peripherally. An example of a rotor of this type may be found in my Letters Patent No. 944,839, granted December 28, 1909.

A modified construction is shown in Fig. 6, where the rim c is omitted, the buckets alone being sunk into the grooves m' in the flanges m. The provision of such grooves forms outer annular shoulders which encircle the sides of the buckets and hold them against centrifugal stress.

I claim as my invention the following defined novel features substantially as hereinbefore specified, namely:—

1. A turbine rotor comprising a wheel and buckets, the wheel having side flanges with annular grooves, and the buckets formed of metal plate with integral flanges fitting between the wheel flanges and within said annular grooves, and fastened to the wheel.

2. A turbine rotor comprising a wheel and buckets, the wheel having side flanges and an intervening rim, and the buckets formed of metal plate with integral flanges fitting between the wheel flanges and against said rim, and fastened to the wheel.

3. A turbine rotor comprising a wheel and buckets, the wheel having side flanges and an intervening rim formed as a ring fastened between said flanges, and the buckets formed of metal plate with integral flanges fitting between the wheel flanges and fastened to said flanges and rim.

4. A turbine rotor comprising a wheel and buckets, the wheel comprising a rim having tangential steps and the buckets formed of metal plate with integral flanges and seated against and fastened to the tangential faces of said rim.

5. A turbine rotor comprising a wheel and buckets, the wheel having side flanges and an intervening rim, and the buckets formed of metal plate with integral flanges, and rivets uniting said buckets at their rear portions to said rim and at their sides to said wheel flanges.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

OLIVER D. H. BENTLEY.

Witnesses:

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PHILIP L. ROSS.