Jan. 29, 1924. 1,482,031

C. A. PARSONS ET AL

PACKING FOR ROTATING BODIES

Filed Jan. 18, 1923 2 Sheets-Sheet 1

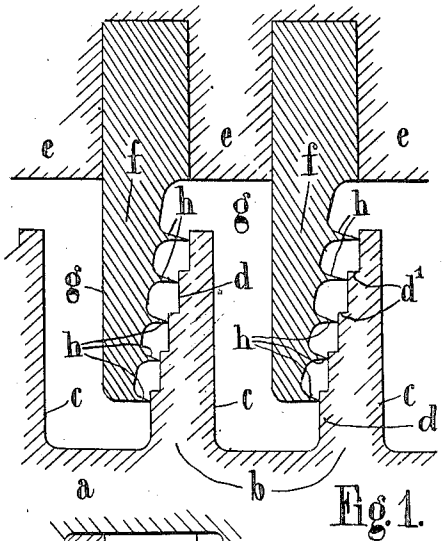


Fig. 1.

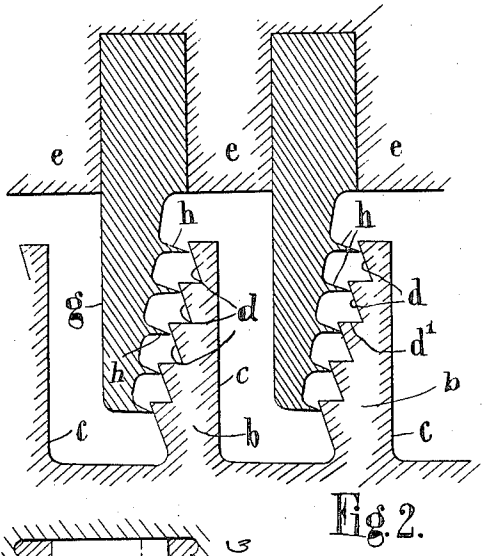


Fig. 2.

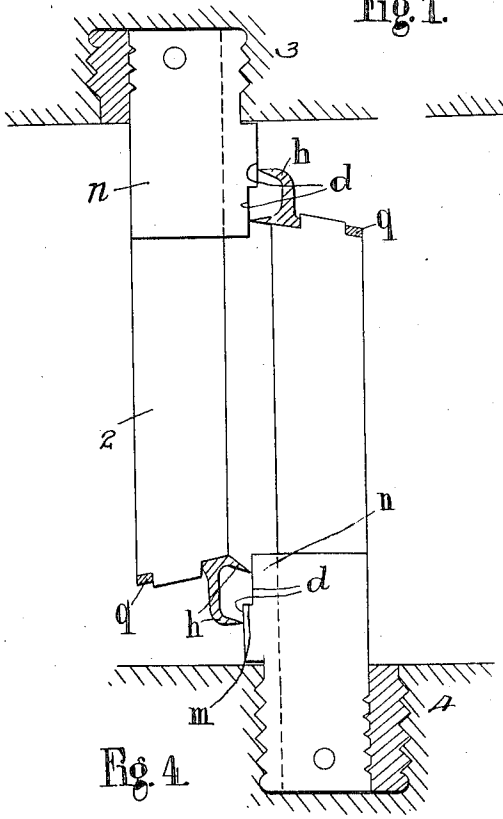


Fig. 4.

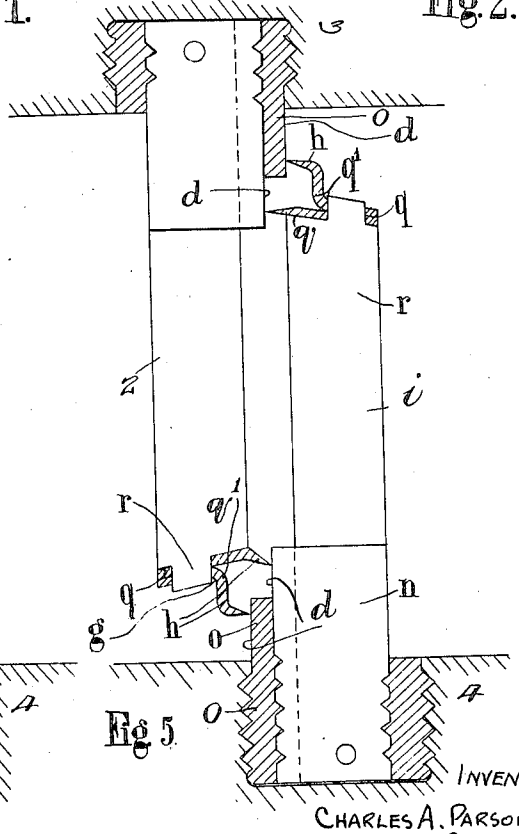


Fig 5.

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Filed Jan. 18, 1923 2 Sheets-Sheet 2

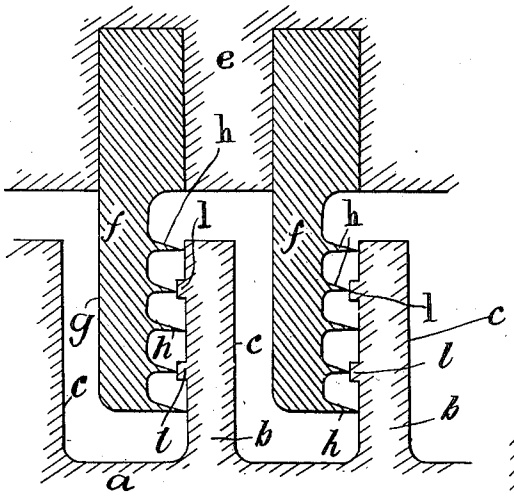


Fig. 3.

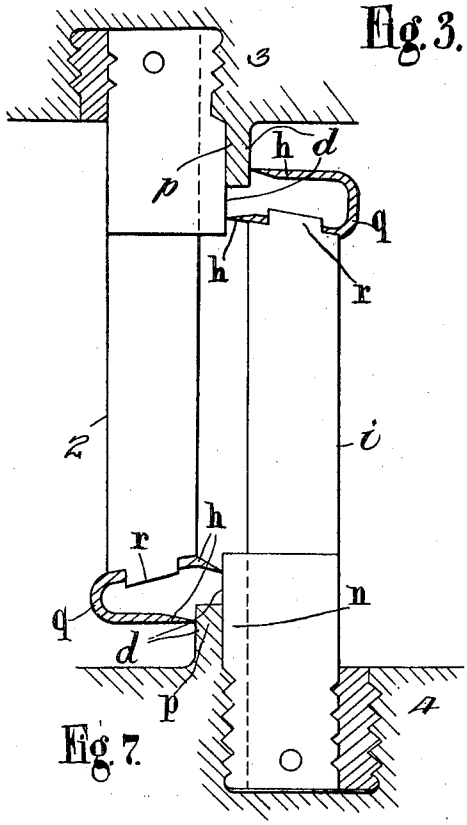


Fig. 7.

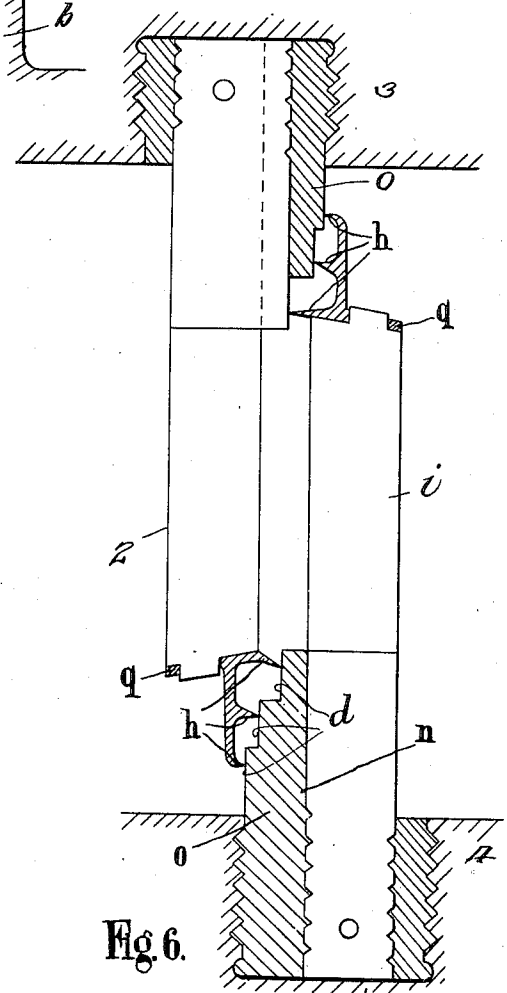


Fig. 6.

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UNITED STATES PATENT OFFICE.

CHARLES ALGERNON PARSONS AND ALFRED QUINTIN CARNEGIE, OF NEWCASTLE-ON-TYNE, ENGLAND; SAID CARNEGIE ASSIGNOR TO SAID PARSONS.

PACKING FOR ROTATING BODIES.

Application filed January 18, 1923. Serial No. 613,516.

To all whom it may concern:

Be it known that we, CHARLES ALGERNON PARSONS and ALFRED QUINTIN CARNEGIE, both subjects of the King of Great Britain and Ireland, and both residing at Heaton Works, Newcastle-on-Tyne, in the county of Northumberland, England, have invented certain new and useful Improvements in and Relating to Packings for Rotating Bodies, for which we have filed application in Great Britain, No. 193, dated 3rd January, 1922, of which the following is a specification.

The present invention relates to improvements in packings of the fine-clearance or throttling type and though applicable to rotating bodies in general is specially intended for use in conjunction with the dummy pistons, shaft glands and the so-called "end-tightened" blading of turbines, as described in the British patent specification No. 12347 of 1901, in the name of one of the present applicants.

In the specific form of turbine blade packing referred to, the shrouding strip on the ends of the blades is formed with an edge to act as a baffle which is arranged with a small axial clearance in relation to a barrier member disposed at the root of an adjacent ring of blades.

The main object of the present invention is to increase the baffling effect of packings of the kind in question without undue increase in dimensions.

In particular as applied to end-tightened blading, the object of the invention is to obtain an increase in the number of throttlings without any increase in the axial length of the turbine while at the same time retaining the present advantages of easy assembly, especially as regards shaft alignment, and large radial clearances of the blade tips.

With such objects, the invention consists in the devices hereinafter described and particularly pointed out in the claims.

In order that the carrying of the invention into effect may be understood, reference will now be made to the accompanying drawings, in which:—

Figure 1 shows one form of the invention in which the faces of the shaft collars are all perpendicular to the axis of rotation;

Figure 2 shows a modification of the form of the invention illustrated by Figure 1, in which the faces of the shaft collar are slightly undercut;

Figure 3 shows a form of the invention in which the contact faces instead of forming a succession of steps are in the form of annular projections of rectangular cross-section;

Figures 4, 5, 6 and 7 illustrate the invention as applied to improvements in the shrouding and blading of the axial clearance or end-tightened type of turbines.

In carrying the invention into effect according to one form as illustrated in Figure 1 and as applied to the general case of a shaft or the like rotating within a housing, the shaft a is provided with a series of spaced collars forming the barrier members b, one face c of each of which is arranged in a plane perpendicular to the axis of the shaft a while the other takes the form of a series of steps, the rises d of which lie in planes perpendicular to the axis of rotation and are so arranged as to increase the thickness of the collar b from the tip towards the root. The housing e on the other hand is provided with a corresponding series of internal collars or annular projections f, one for each of the barrier members, fixed in place by any convenient means and formed with one face g perpendicular to the axis of rotation and the other substantially conical, the slope of the cone corresponding substantially with the general slope of the steps. On this conical surface a series of annular knife-edges h are provided, the pitch of which is equal to that of the steps, the knife-edges h projecting in an axial direction with their fine edges in close proximity respectively to the rises d of the steps described above. If desired, the length of the annular knife-edges may decrease slightly as shown in a direction towards the axis of the shaft, the axial relation, however, between their fine edges and the steps being of the same order of magnitude throughout.

According to another form of the invention as illustrated in Figure 2, the barrier member b is modified by making the steps slightly undercut as shown that is to say, the steps form portions of conical surfaces. Owing to the undercutting, the steam or other fluid passes obliquely through the space between the knife-edge h and the rise d into the angle of the step so as to cause the maximum interference in its path to

the next knife-edge. This effect can readily be obtained with a degree of undercutting insufficient to interfere with the radial freedom of the shaft.

According to another form of the invention as illustrated in Figure 3, the stepped face of the barrier member *b* is modified so as to take the form of annular projections *l* of rectangular cross-section projecting from a plane perpendicular to the axis of rotation, or in other words, while the fundamental principle of eddy-making formations is still retained, the steps are alternately up and down instead of all in the same direction. In this case, as before, a knife-edge *h* coacts with a face of each projection.

In packings according to this invention, any steam or other fluid leaking past one of the annular barrier members strikes a step and is thrown into the turbulent motion characteristic of labyrinth packings; the major part of the kinetic energy of the fluid, and therefore also its forward velocity, is destroyed in causing such turbulence, a like action occuring at each successive baffle and step.

By arranging all the knife edges to face in the same direction as shown, the clearance of all may be simultaneously adjusted.

According to another form of the invention as illustrated in Figures 4, 5, 6 and 7 and as applied to the case of end-tightening turbine blading, the stepped barrier member is formed at the root end of the blading 2, on appropriate members which project above the surface of one of the blade-carrying members, 3, while the free ends of the blades 2, are provided with shrouding strips *q* secured in position by any convenient means, each such strip *q* being provided with a plurality of knife-edge baffles *h* coacting with the rises *d* of the adjacent barrier steps. In a similar manner, the blading, *i*, on the other blade-carrying member, 4, is associated with a stepped barrier member and knife-edged baffles.

The constructional form of the details of this part of the invention may take different forms. For example, Figure 4 shows the steps of the barrier member integral with the spacing pieces *n* between the blades; while, as shown in Figures 5 and 6, one or more of the steps may be formed by an independent strip *o* inserted in the grooves carrying the blades and preferably serrated on each side to lock with corresponding serrations in adjacent members; or again, as shown in Figure 7, one or more of the steps may be formed by a collar *p* or the like projecting from the rotor or stator, as the case may be.

As regards the form of the baffles, where two sharp edges *h* are provided, the shrouding strip *q* may as shown in Figure 4 be drawn in the form of a T, the cross of which forms the shrouding strip proper and has one sharp edge to form the knife-edge while the stem, the main portion of which runs in a radial direction, is turned over at right angles near its sharp tip so as to lie in a substantially axial direction.

According to another form as illustrated in Figure 5, two separate shrouding strips *q*, *q'* may be used in connection with each ring of blading, the first of these being a plain strip with one sharp edge while the other strip as seen in cross-section is of cranked form with a sharp edge to form the second knife-edge, the two strips being secured in place by silver-soldering to a common tenon *r* on the blades or by any other suitable means.

According to another convenient form as illustrated in Figure 7, the shrouding strip *q* may take the form of a U in cross-section, one limb of which having a sharp edge is secured to the ring of blades in any convenient manner while the other, the edge of which is likewise sharp, lies parallel to the first at an appropriate distance therefrom. The strip is preferably bent into U-form by the use of a suitable former after the shroud has been secured in place.

By an obvious extension of certain of the specific forms above described in relation to end-tightened blading, three or more knife-edges may be provided as shown in Figure 6, co-acting with a corresponding number of steps. Thus, for example, one or more additional axially disposed knife edges, *h*, may be formed on the stem of the T.

Any of the specific forms of barrier member described above may be used as convenient with any of the specific forms of shrouding.

The general baffling action of the shrouds described is similar to that already explained above in relation to the general case of the rotating shaft; it will be seen that several throttlings can be obtained in little more space than has hitherto been required for one throttling, resistance to leakage being increased, and the total quantity of leakage steam thereby appreciably reduced.

Although a number of specific forms of the invention have been described above in order to make clear its nature, such forms are to be regarded only as examples illustrating the underlying principles, and without restrictive effect on the scope of the invention.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:—

1. In combination a pair of relatively rotatable coaxial bodies, barrier means associated with one of said bodies, said barriers

consisting of steps having rises and treads, a plurality of knife edges all disposed par allel to the axis of rotation of said bodies, carried by the other body and engaging the rises of said steps, the points of contact between adjacent knife edges and rises lying in a line at an angle other than a right angle to the axis of rotation of the bodies.

2. In combination, a pair of relatively rotatable coaxial bodies, barrier means associated with one of said bodies, said barriers consisting of steps having rises and treads, a radially disposed insert member carried by the other body having walls perpendicular to the axis of rotation of said bodies, knife edges on said member all disposed parallel to the axis of rotation and engaging the rises of said barrier steps, all of said knife edges being included between the planes of said walls of said insert member, the points of contact of adjacent knife edges and rises lying in a line at an angle to the axis of rotation of said bodies.

3. In combination, a pair of relatively rotatable coaxial bodies, barrier means associated with one of said bodies, said barriers consisting of steps having rises and treads, a plurality of knife edges all disposed parallel to the axis of rotation of said bodies, carried by the other body and engaging the rises of said steps, the points of contact between adjacent knife edges and rises lying in a line at an angle other than a right angle to the axis of rotation of the bodies, the rises of said steps lying in successive planes each transverse to the axis of rotation.

4. In combination, a pair of relatively rotatable coaxial bodies, barrier means associated with one of said bodies, said barriers consisting of steps having rises and treads, a plurality of knife edges all disposed parallel to the axis of rotation of said bodies, carried by the other body and engaging the rises of said steps, the points of contact between adjacent knife edges and rises lying in a line at an angle other than a right angle to the axis of rotation, said steps being under-cut so that the rises thereof are at an angle other than a right angle to the axis of rotation of said bodies.

In testimony whereof we have signed our names to this specification.

CHARLES ALGERNON PARSONS.
ALFRED QUINTIN CARNEGIE.