

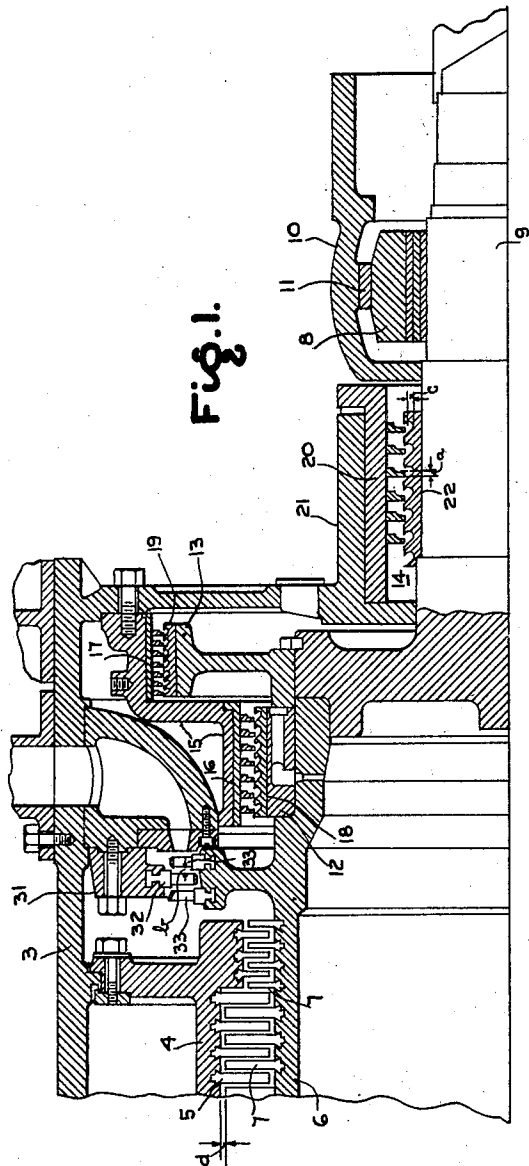
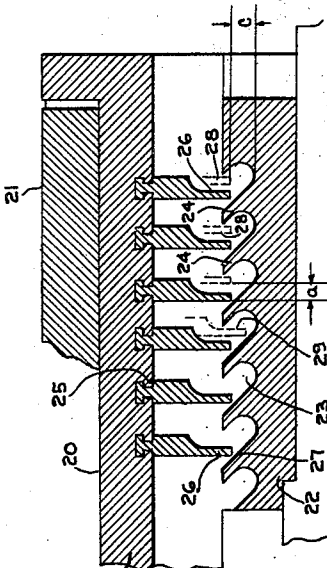
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ELASTIC FLUID TURBINE

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ELASTIC-FLUID TURBINE

Continuation of application Serial No. 362,773, filed March 2, 1920. This application filed October 3, 1928. Serial No. 310,123.

This application is a continuation of my application for packing No. 362,773, filed March 2, 1920.

My invention relates to an elastic fluid turbine, and it has for its object to provide a construction and an arrangement of the parts of the turbine to facilitate the centering or positioning of the rotor in the casing or stator.

More specifically it is an object of my invention to provide a construction of packing, for the gland and the dummy, or either, and its arrangement in the turbine, whereby the radial packing clearances may be increased by axial movement of the rotor.

The usual form of packing employed hitherto comprises a plurality of overlapping flanges mounted on the stator and rotor in such a manner that the tip of a flange on the stator projects into the groove formed between two flanges on the rotor, the flanges and grooves being of such depth that the radial clearance between the tip of the flange and the bottom of a groove is but a few hundredths of an inch.

The permissible end or radial clearance of the blading of the turbine is considerably greater than that permissible between the packing elements, and heretofore when it was desired to center the rotor with respect to the blade clearance between the tips thereof and the casing or stator, it was necessary to first remove the rings containing the packing flanges carried by the stator, so as to permit of greater radial movement of the rotor with respect to the stator than would be permitted were the packing flanges in place.

The rotor is centered with respect to the stator by first moving it laterally or radially until the blade tips on the rotor engage the shell of the stator. The position of the rotor is noted and the rotor is then moved horizontally in the opposite radial direction until the tips of the rotor blades on the opposite side of the rotor engage the stator shell. The total movement of the rotor from one extreme position to the other is then measured and the rotor is moved horizontally to a position midway between the extreme limits of movement in the horizontal plane. The rotor is next moved vertically downward

until the blade tips of the rotor engage the bottom of the stator shell. The extreme lower position is noted after which the rotor is raised vertically until the blade tips of the rotor engage the upper stator shell. The rotor is finally moved to a position midway between the extreme limits of vertical movement. In this position, the radial blade clearances are substantially uniform throughout the entire circumference of the blading.

An object of this invention is to provide and arrange a packing having adjustable radial clearances whereby the radial clearance may be increased at will, so that the rotor may be centered in the manner above described without necessitating the removal of the packing rings carrying the flanges, and thereby greatly reduce the time and expense usually involved in centering the rotor with respect to the stator.

Other objects will hereinafter appear throughout the further description of the apparatus embodying my invention and illustrated in the accompanying drawing wherein: Fig. 1 is a vertical section of a portion of the upper half of a steam turbine having packing arranged in accordance with my invention.

Fig. 2 is a vertical section on enlarged scale of a detail of the packing.

Referring to the drawing, the packing is shown applied to the dummies and gland of a steam turbine of the combined impulse and full peripheral admission reaction type. As shown, the turbine includes a casing or stator 3, provided with a stationary blade ring 4 upon which the stationary reaction blades 5 of the turbine are mounted, and with a second blade ring 31 carrying impulse blades 32. The rotor 6 carries the moving reaction blades 7 and moving impulse blades 33.

The rotor is supported at each end in concentric relation with the blade rings 4 and 31 by means of suitable adjustable bearings 8 (only one of which is shown) which receive and support the shaft of the rotor. The bearing 8 is adapted for universal radial adjustment within a pedestal 10 and is retained in adjusted position by means of the usual

liners 11, four of which may be provided to hold the bearing in the desired position.

In reaction turbines, or turbines including a section of reaction blading, it is desirable that the end clearance of the blading, that is, the space between the blade tips and the stator shell or rotor body, be as small as is practicable, and for this reason it is desirable that the rotor be accurately centered so that the clearance is uniform throughout the entire circumference of the blading. As practiced in the construction of large turbines, the permissible clearance is about one-eighth of an inch, while the clearance permissible between the flanges or the rings of the packing elements is but a few hundredths of an inch. It is apparent that the radial movement of the rotor provided with the usual form of packing is therefore limited by the radial clearance of the packing flanges and that in order to center the rotor, certain packing elements must first be removed.

It is the object of this invention to provide the turbine with efficient packing for the dummies and the glands, that will permit of the centering of the rotor with respect to the stator in the manner previously described, while the packing remains in the turbine casing. The packing employed is shown applied to the dummies 12 and 13 carried by the rotor and to the gland 14. Surrounding the dummies is a stationary ring 15 provided with two separate packing rings 16 and 17, the former cooperating with a packing ring 18 mounted on the dummy 12 and the latter cooperating with the packing ring 19 mounted on the periphery of the dummy 13. The packing ring 20, forming a part of the gland packing, is shown mounted in the gland housing 21 of the casing 3 and cooperates with the packing ring 22 mounted upon the shaft 9.

In Fig. 2 I show a longitudinal section illustrating on an enlarged scale, a fragment of the packing such as is used in the gland. The details of the packing elements used on the dummies are substantially the same as those employed in the gland. Referring to Fig. 2, the packing comprises a ring or blade 22 carried by the rotor and provided with a series of annular, obliquely undercut grooves 23, separated by annular webs 24 which terminate in thin knife-edged wearing tips. A plurality of annular packing flanges 25 are mounted in the packing ring 20 in such manner that a packing flange 25 is disposed opposite each groove 23. The exposed edge of each flange is cut away so as to leave a thin wearing tip 26 which extends into the groove 23 and slightly overlaps the web 24. The flanges 25 are made in segments placed end to end so as to form a continuous annular flange and the sleeve 20 may be made in halves adapted to separate on the horizontal plane so that the upper half may be removed

when the upper half of the stator casing is lifted.

When the packing elements are in their operative relation as indicated in Fig. 2, the extreme edges of the flanges 26 just clear the inclined walls 27 of the grooves and form a seal preventing the escape of fluid past them. It will be observed that the direction of flow of fluid tending to pass through the gland will be reversed in each groove with the result that the gland is more effectually sealed than is the case where the walls of the grooves are normal to the axis of the rotor. The wearing tips 26 are reduced in thickness so that in the event that they accidentally come in rubbing contact with the walls of the grooves they will bend or yield without causing serious injury to the gland elements.

When it is desired to center the rotor with respect to the stator, the rotor is first moved longitudinally to the left until the flange tips 26 and the webs 24 almost engage one another, as indicated by the position of the tips shown in dotted lines at 28 in Fig. 2. This movement causes sufficient separation of the inclined groove walls 27 and the flange tips 26 to permit of radial displacement of the rotor to the position indicated by the tip shown in dotted lines at 29 in Fig. 2. The clearance of the packing elements when the rotor has been moved longitudinally, as above indicated, is greater than the permissible end clearance of the turbine blading and, therefore, the rotor may be moved radially in all directions to its extreme limits of radial movement without interfering with the packing elements. After the rotor has been centered in the manner previously described, it is moved longitudinally to the right until the desired clearance is again obtained between the flange tips 26 and the inclined walls 27 of the grooves. There is always sufficient longitudinal clearance between the moving and stationary blading of the turbine to permit of sufficient axial movement to effect the desired longitudinal adjustment of the rotor with respect to the stator.

The rings 20 and 22 are axially positioned on the stationary and rotating parts, respectively, so that the relative movement of the flange tips 26 from the full line position to the dotted line position at 28 takes place within the limited axial movement of the rotor. Referring specifically to the arrangement shown, the axial movement of the rotor changing the relative position of the flange tips 26 from full line position to dotted line position at 28 is indicated by the reference character a . Now the rings 20 and 22 must be positioned to provide the minimum or working clearance with the rotor in a position in which there is an axial clearance between the left-hand side of the rotor blades and the right-hand side of the stationary

blades, indicated at b in Fig. 1 (on a smaller scale than Fig. 2), so that sufficient movement of the rotor to the left may be permitted, in other words, the clearance b must be equal to or greater than the distance a .

The inclined surfaces or walls 27 are of sufficient inclination to increase the radial clearance between the flange tips 26 and the surfaces 27 to an amount, indicated by the reference character c , which is greater than the radial blade or end clearance d .

I am aware that packing elements having inclined surfaces have been heretofore proposed, but I am not aware of any arrangement of such packing, or any other kind of packing, whereby sufficient radial clearance for centering the rotor may be obtained by axial movement.

It is obvious that the contours and shapes of the grooves and flanges of the packing may be varied through a wide range and that the modified packing will still fulfill in every respect the functions of the packing illustrated. The construction illustrated is but one of a number of simple forms of packing which may be devised to permit of adjustment of the radial clearance to suit the conditions and the invention is, therefore, not limited to the single specific construction illustrated in the drawings.

While the packing has been described as being applied to a rotor element and a stator element, it is obvious that the packing will be equally effective when used in turbines wherein the casing revolves in one direction and the rotor revolves in the opposite direction, or in any apparatus having two rotative elements wherein it is desired to pack the space between the relatively moving parts against the passage of fluid therethrough.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible 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 an elastic fluid turbine, the combination of a casing, an axially movable spindle within the casing and carrying radially-extending blades whose outer ends are disposed in close proximity to a part carried by said casing, cooperating packing elements carried by said casing and said spindle and, in one axial position of the rotor relative to the casing, providing normal radial packing clearances less than those between the outer ends of said blades and the adjacent part of the casing and in another axial position of the spindle providing a clearance greater than that between the outer ends of said blades and the adjacent part of said casing.

2. In an elastic fluid turbine, the combination of a casing, a rotor therein, interleaving rows of radial blades carried by the casing and the rotor and certain of said blades being disposed to provide radial clearances at the outer ends thereof with the rotor and the casing, respectively, cooperating packing elements carried by the casing and the rotor and normally providing radial clearances less than the blade clearances, said cooperating packing elements being so formed as to increase the radial clearances therebetween to an amount greater than the blade clearances upon axial movement of the rotor to an extent not more than the axial clearances between blades.

3. In an elastic fluid turbine, the combination of a casing, a rotor therein, interleaving cooperating parts carried by said casing and said rotor and certain of said parts being disposed to provide axial and radial clearances between the casing and rotor parts to permit limited axial and transverse movement of the rotor, and cooperating packing elements carried by said casing and said rotor, said packing elements being so constructed and arranged that, in one axial position of said rotor within the limited axial movement, the packing elements have radial clearances less than the radial clearances provided by said cooperating parts and, in another axial position within said limited axial movement, the packing elements have radial clearances greater than the radial clearances provided by said cooperating parts.

4. In an elastic fluid turbine, the combination of a casing, a rotor therein capable of limited axial movement, cooperating blades carried by the casing and the rotor and having close end clearances with the adjacent parts, cooperating packing elements carried by the casing and the rotor, the packing elements carried by one member having thin-edged portions extending radially toward the packing elements carried by the other member, said latter packing elements having frusto-conical surfaces cooperating with the thin-edged portions, said frusto-conical surfaces being of such extent and inclination that, within the limited axial movement of the rotor, the packing elements of the rotor may move relative to the packing elements of the casing from a position in which the thin-edged portions pack closely to the frusto-conical surfaces with close normal working clearances to a position in which the radial clearances between the thin-edged portions and the frusto-conical surfaces are greater than said blade end clearances.

5. In a steam turbine, the combination of a casing, an axially movable spindle within the housing and carrying radially-extending blades whose outer ends are disposed in close proximity to a part carried by said casing, packing members carried by said spindle and

having outer frusto-conical surfaces, radially-extending thin-edged packing members carried by said housing and cooperating with said frusto-conical surfaces, the inner edges of said last-mentioned packing members being intermediate the radial extent of said frusto-conical surfaces, and said frusto-conical surfaces being of sufficient radial extent to provide, when the spindle is moved in clearance-increasing direction, a clearance at least as great as that between the ends of said blades and the casing.

In testimony whereof, I have hereunto subscribed my name this 28th day of September, 1928.

HENRY F. SCHMIDT.