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F. HODGKINSON.

ROTARY PACKING FOR ELASTIC FLUID TURBINES.

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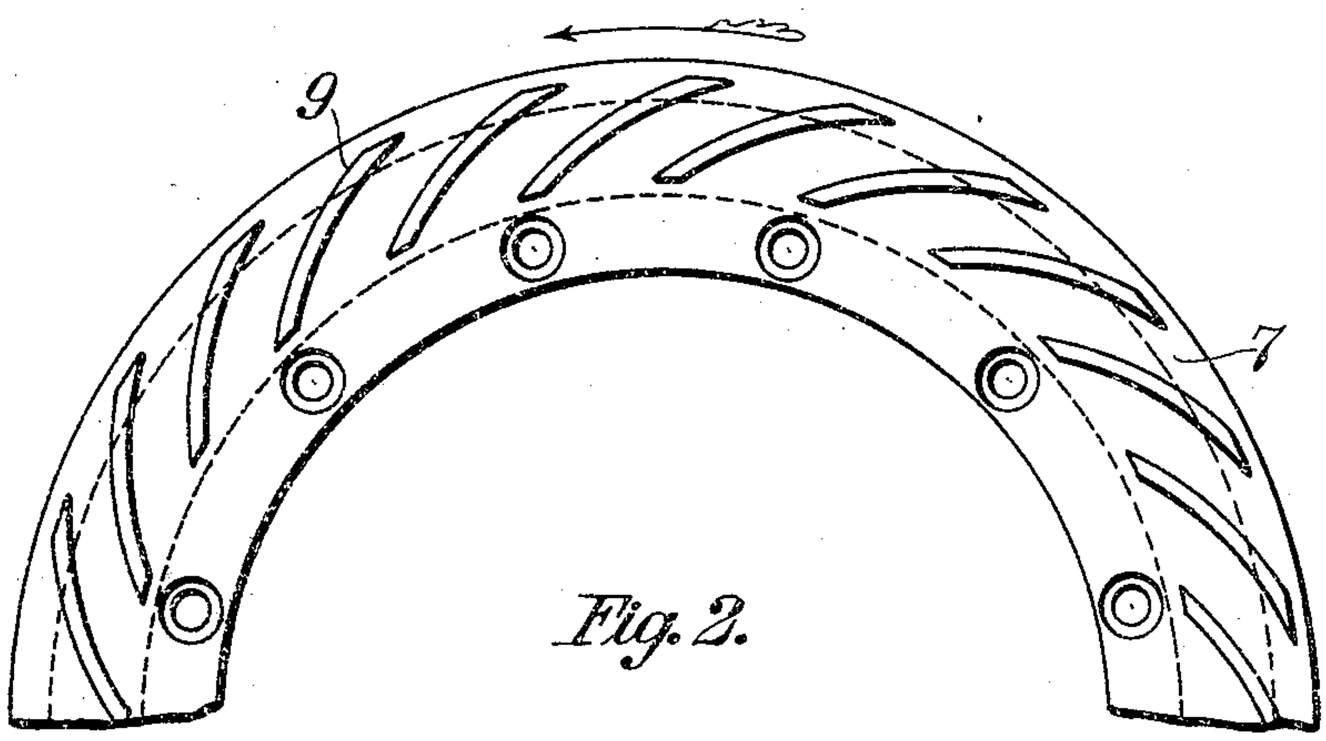

Fig. 2.

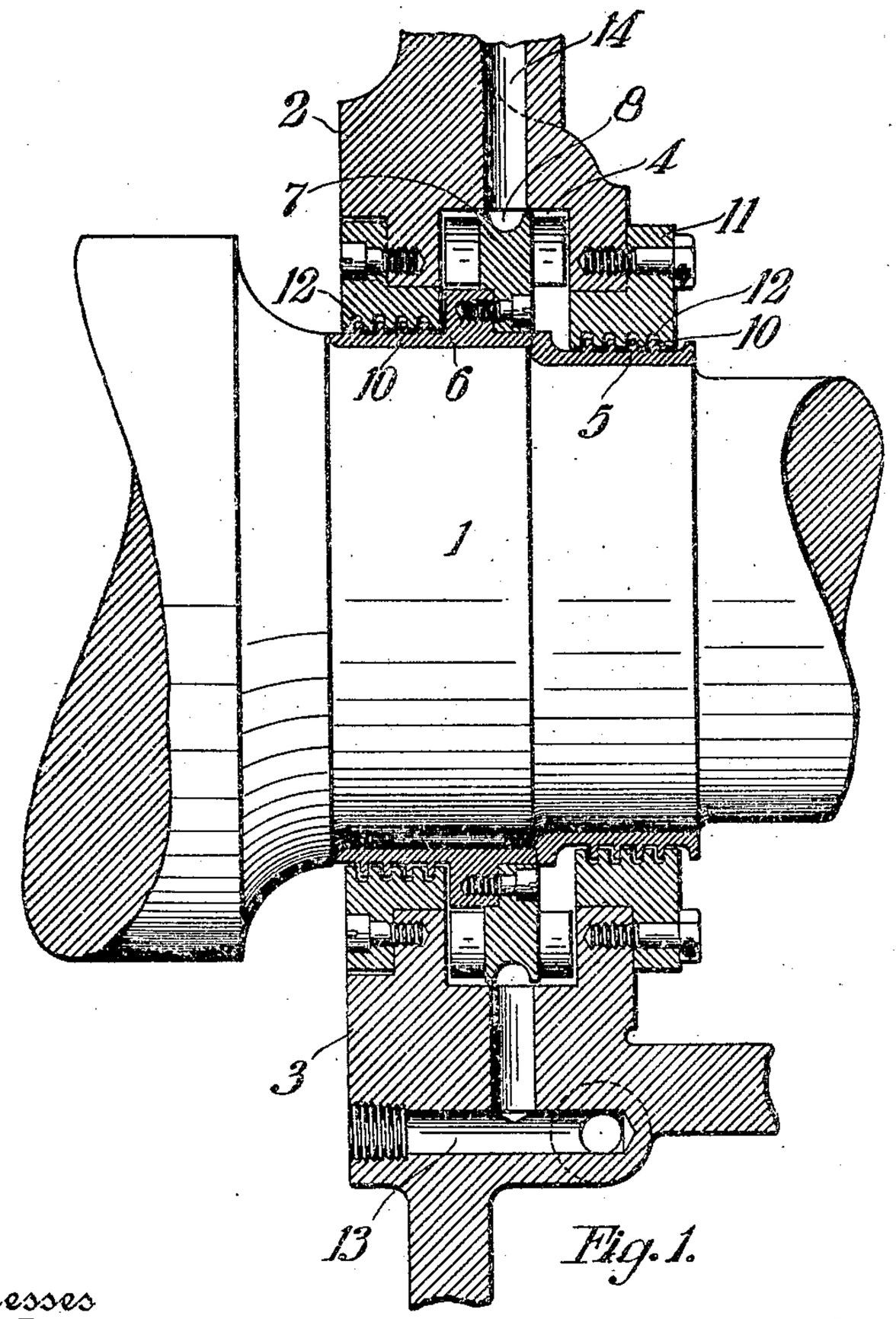

Fig. 1.

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UNITED STATES PATENT OFFICE.

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ROTARY PACKING FOR ELASTIC-FLUID TURBINES.

SPECIFICATION forming part of Letters Patent No. 792,131, dated June 13, 1905.

Application filed February 10, 1905. Serial No. 245,167.

To all whom it may concern:

Be it known that I, FRANCIS HODGKINSON, a subject of the King of Great Britain and Ireland, residing at Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Rotary Packing for Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to packing for rotary shafts or spindles, and more particularly to means for packing the shafts or spindles of elastic-fluid turbines or compressors.

Many difficulties have been encountered in producing packings for the shafts or spindles of elastic-fluid turbines and compressors, as the conditions are somewhat peculiar. The shafts or spindles of this class of machines are liable to and do distort, and for this reason a perfect alinement cannot be maintained. The differences in pressure between the interior and exterior of the casings of these machines make a tight joint between the shafts and the casing at that point where the shafts extend through the casing necessary, and the high speeds of rotation encountered make it impossible to pack the shaft as heretofore done where relatively low speeds are encountered.

An object of this invention is to provide a packing applicable to this class of machine which will effectually pack against considerable differences in pressures between the opposite sides of the machine-casing—*i. e.*, a packing which will prevent the escape of fluid from the interior of the casing if the pressure on the interior is greater than atmospheric pressure and will pack against atmospheric pressure if the pressure at the interior of the casing is less than atmospheric pressure, as where a turbine is running condensing and the interior is connected to a condenser.

A further object is to provide such a packing as above outlined in which the friction is negligible.

These and other objects I attain by means of the device illustrated in the single sheet of drawings accompanying this application and forming a part thereof and throughout the two views of which similar elements are denoted by like characters.

As the invention is equally applicable to turbines or compressors or to any other machines in which like conditions are met, shaft 1 may represent the shaft of any such machine. The shaft extends through the exterior casing, which in turbines, as is now common, is divided on the horizontal plane through its axis. The fragment shown of the upper half of the casing is numbered 2 and the fragment of the lower half 3. The two halves of the casing meet in a finished joint, and the end wall of the casing thus formed by the two halves is provided with a channel or cylindrical chamber 4, concentric with the geometric axis of the shaft 1. A collar 5, preferably formed of non-rusting metal, such as bronze, is shrunk on or otherwise secured to that portion of shaft 1 lying between the opposite sides of the end wall of the casing. Collar 5 is provided with an annular flange 6, to which a runner 7 is bolted or otherwise rigidly secured. The outer periphery of the runner 7 is provided with a circumferential groove or recess 8, which in cross-section is preferably half-round, and the opposite faces of the runner are provided with blades or paddles 9, preferably disposed as illustrated in Fig. 2. Clearance is left beyond the periphery of the runner and the outer ends of the blades or paddles and the inner peripheral wall of the annular chamber 4, which surrounds the runner. Sufficient clearance is left between the sides of the blades or paddles and the side walls of the chamber 4 to allow for longitudinal adjustment of the shaft or slight longitudinal play.

Collar 5 on each side of the runner is provided with a multiple number or series of annular flanges or ridges 10, and each of the halves of the casing is provided with a semicircular member 11, bolted or otherwise secured to the casing and provided with grooves or depressions 12, which span the annular ridges 10. When the two halves of the casing are in position, as shown in Fig. 1, these an-

nular ridges 10 and the depressions 12, which become annular when the halves of the casing are together, form an interleaving gland or packing, which hereinafter will be referred to as the "supplemental" or "auxiliary" packing.

A duct or passage 13, formed in any suitable manner, leads into the lower part of the chamber 4, preferably in line with the groove 8 of the runner, and through this duct or passage the chamber 4 is supplied with suitable sealing liquid, such as water, from any suitable source of supply. A passage 14 leads away from chamber 4 at its top, and preferably in line with passage 13.

If the packing device is applied to a steam-turbine running non-condensing, then the gland is liable to become so hot that the water used for the seal will boil, and passage 14 is utilized for the escape of the steam generated, as well as for the passage of water, as it has been found advisable when running non-condensing to maintain a continuous flow of water through the passages 13 and 14 and the chamber 4.

As ordinarily employed for use in turbines and compressors passage 14 will be connected with a pipe suitable for maintaining a constant head, and this head, which it may be desirable to have adjustable, will determine the resistance to the pressure created by the runner. The runner rotating in the direction indicated by the arrow in Fig. 2 will maintain an annulus of sealing liquid in the outer portion of chamber 4, which annulus, of course, will extend farther down on the side of the runner nearest the side of lowest pressure—*i. e.*, if the pressure within the machine is greater than the pressure outside of the machine the annulus will be deeper on the outside of the runner, and vice versa.

When steam-turbines are running condensing, it is sometimes desirable to maintain the vacuum within the casing while the turbine is at rest, and therefore the supplemental or auxiliary packings formed by the interleaving glands are utilized.

It is evident that if the collar and casing on each side of the runner were of smooth bore and the flow of water or other sealing liquid into the gland were maintained while the turbine was at rest the interior of the turbine would be flooded. The water under the influence of its static head and the suction caused by the partial vacuum would flow unrestricted through the shaft clearance-space.

It is known that the energy of a static head is partially and sometimes wholly consumed by friction introduced by turns and twists in and the size and length of passages designed for its conveyance from one place to another, and I have applied this in reducing to a minimum the amount of sealing fluid necessary when the turbine is at rest.

On the rotating shaft, at either side of the centrifugal sealing or packing device, I have introduced the annular collars, consisting, as outlined, of a number of alternate grooves and ridges which interleave with reversely-formed grooves and ridges formed in the member 11, and the water or fluid entering the annular chamber 4 must pass through the circuitous route in order to leak therefrom into the turbine-casing or out into the air.

The clearance between the interleaving collars is small, and the introduction of the grooves and ridges considerably multiplies the surface and increases the length of passage through which the water must flow, thus producing additional resistance to such flow and considerably decreasing, if not wholly restricting, it.

Even in the absence of liquid packing fluid the interleaving serrations of the auxiliary packing-collars by the circuitous or tortuous path presented and the friction thus introduced materially resist and throttle the flow of motive or other fluid through said packing.

The details of construction of this packing device can of course be varied to suit the case in hand. The runner 7 may have vanes of any desired shape on one or both sides. It might also be found advisable to use more than one of such runners in packing a joint. The auxiliary packing-collars can of course be varied in their details and mounting. The grooves and ridges 10 and 12 can be of any desired shape or of any desired number.

Having thus described my invention, I claim—

1. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and an interleaving gland on each side of said chamber between said casing and said shaft.

2. In combination with a turbine-casing and a rotatable shaft extending therethrough, two separated interleaving glands between said casing and said shaft, and a rotatable liquid sealing device between said interleaving glands.

3. In combination with a casing and a shaft extending therethrough, two interleaving glands between said casing and said shaft, a chamber in said casing between said interleaving glands, a runner mounted on said shaft within said chamber and sealing liquid retained in the outer portion of said chamber by the rotation of said runner.

4. In combination with a casing and a rotatable shaft extending therethrough, a serrated gland between said casing and said shaft, a chamber in said casing surrounding said shaft, a source of supply of sealing liquid in communication with said chamber, and a run-

ner carried by said shaft within said chamber whereby during the rotation of said shaft said liquid is caused to rotate.

5. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and a packing-gland between said casing and said shaft.

6. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and an interleaving packing-gland between said casing and said shaft.

7. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and an interleaving liquid packing-gland between said casing and said shaft.

8. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and a tortuous passage between said casing and said shaft.

9. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and an interleaving packing-gland on each side of said chamber between said casing and said shaft.

10. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and a tortuous-passage water-gland on each side of said chamber between said casing and said shaft.

11. In combination with a rotatable shaft provided with a bladed runner, a casing provided with a cylindrical chamber for said runner, sealing liquid retained in the outer portion of said chamber by the rotation of said runner, and a tortuous-passage packing-gland on each side of said chamber between said casing and said shaft.

12. In combination with a turbine-casing and a rotatable shaft extending therethrough, two separated packing-glands between said casing and said shaft, and a rotatable liquid packing device between said two packing-glands.

13. In combination with a turbine-casing and a rotatable shaft extending through one end thereof, two separated tortuous-passage packing-glands between said casing and said shaft, and a rotatable liquid packing device between said packing-glands.

In testimony whereof I have hereunto subscribed my name this 7th day of February, 1905.

FRANCIS HODGKINSON.

Witnesses:

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