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J. L. MOORE.

TURBINE SHAFT PACKING.

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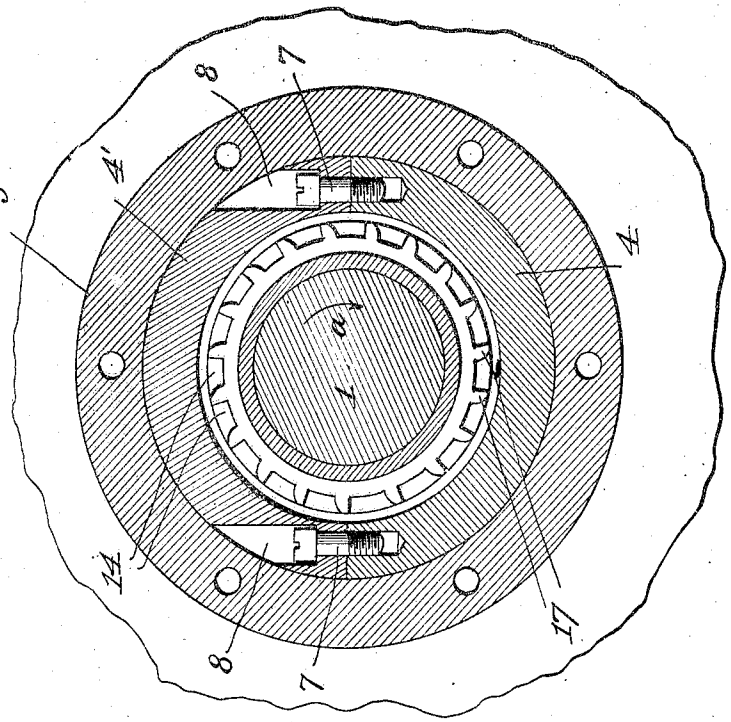

Fig. 2.

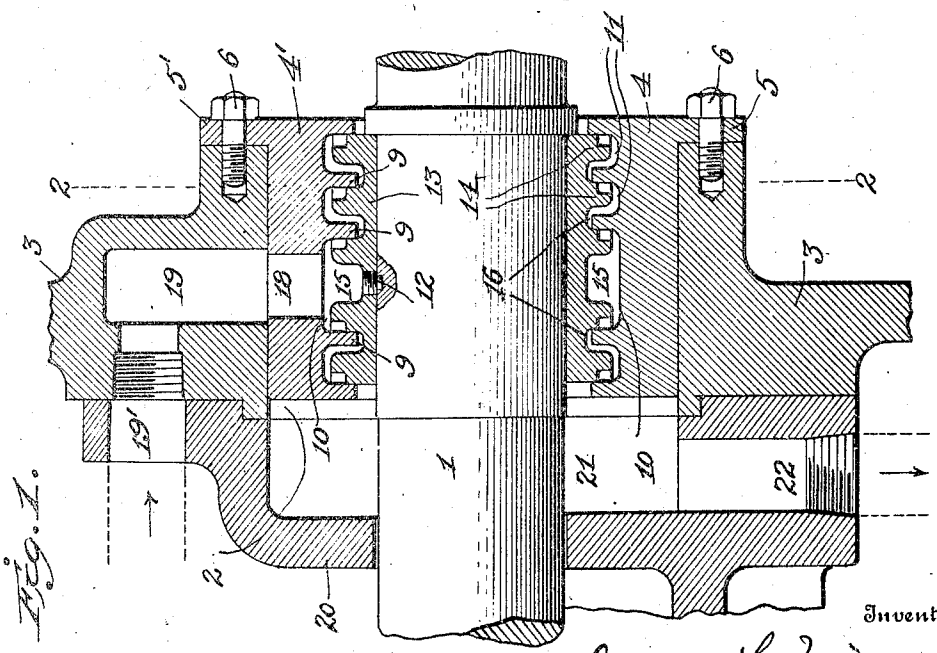

Fig. 1.

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TURBINE-SHAFT PACKING.

No. 845,701. Specification of Letters Patent. Patented Feb. 26, 1907.

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To all whom it may concern:

Be it known that I, JAMES L. MOORE, a citizen of the United States, residing at Wellsville, in the county of Allegany and State of New York, have invented certain new and useful Improvements in Shaft-Packings for Steam-Turbines or the Like, of which the following is a specification.

My invention relates to liquid-sealed packing-gland for rotary shafts or spindles, and more particularly to means for packing the shafts or spindles of elastic-fluid turbines, as shown, for example, in the Patent No. 798,105, to Charles V. Kerr, dated August 29, 1905.

Many difficulties have been encountered in producing packings for shafts or spindles of elastic-fluid turbines and compressors, as the conditions are somewhat peculiar. The rapidly-rotating 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 shaft and the casing at that point where the shaft extends through the casing necessary, and the high speed of rotation required for the economic running make it impossible to satisfactorily pack the shaft, as heretofore done when relatively low speeds are encountered.

An object of this invention is to provide a packing applicable to this class of machines which will effectually pack against considerable differences of pressure between the interior and exterior of the casing—that is, a packing which will effectually prevent the escape of the motive 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 exhaust end of the casing is less than atmospheric pressure, as where the turbine is connected to a condenser approaching a vacuum.

A further object is to make an air-tight seal around the shaft at the exhaust end of the turbine, so as to completely exclude the air from the turbine where a high vacuum is employed, and at the same time provide a packing in which the friction is reduced to a minimum in order to maintain a uniform high rotary speed and perfect alinement of the shaft, so as to develop the highest efficiency of the turbine.

My invention consists of structural features and relative arrangement of elements, which will be hereinafter more fully and clearly described, and pointed out in the appended claims.

Referring to the one sheet of drawing, in which similar reference characters indicate the same parts throughout the figures, Figure 1 is a longitudinal section of the packing, showing only a fragment of the exhaust end of the turbine-casing immediately surrounding that end of the shaft. Fig. 2 is a transverse section on line 2 2 of Fig. 1.

As the invention is equally applicable to turbines or compressors or any other similar machines in which like conditions exist, 1 may represent the rotary shaft of any such machine, which extends through any suitable opening 2 in the usual casing 3, of which only the adjoining section is indicated. Inserted in said shaft-opening 2 are two fixed and separable semi-annular tightly-fitting gland-sections 4 4′, which may be made of bronze or other suitable metal and are provided with outer flanges 5 5′ for the purpose of holding them to the inner side of the casing by means of suitable bolts 6 6.

7 7 are small bolts for securing the two semi-annular gland-sections 4 4′ together and, as indicated in Fig. 2, are made to pass down into pockets 8 8, one on either side of the upper section 4′. On the inner surface of each of the gland-sections 4 4′ are formed a series of semi-annular ridges 9 9, which are separated by a channel 10 and smaller channels 11 11 and so arranged and proportioned that the ridges and channels of section 4 are in the same transverse vertical planes and register with those of the section 4′.

Surrounding the shaft 1 and attached thereto by any suitable fastening means 12 is an annular runner 13, which rotates in the direction of the arrow *a* in Fig. 2 and is provided on its outer surface adjacent to the inner semi-annular surfaces of the gland-sections 4 4′ with a series of annular ridges 14 14, which are separated by the channel 15 and the smaller channels 16 16. On one of the upright faces of the ridges 14 14 are formed a series of separated lateral vanes or projections 17 17, (see Fig. 2,) each of which has one of its faces radial or straight and the

other face on a curve for reasons to be hereinafter described. The gland-sections 4 4′ and rotary runner 13 are so arranged and relation maintained that the ridges of one fit into the channels of the other with a small clearance between them, as shown in Fig. 1, and the lateral vanes or projections 17 17 on the ridges 14 14 form with the adjacent side walls of the ridges on gland-sections 4 4′ a series of equally-spaced pockets for purposes to be hereinafter described.

18 indicates a passage in the upper gland-section 4, one end of which connects with the channels 10 and the other end to passage-ways 19 19′ in the turbine-casing 3. These passage-ways are arranged so as to be connected with any suitable supply of fluid under pressure which is capable of being regulated or controlled.

20 is a cap secured in any manner to the exterior of the casing and loosely fitted about the shaft 1.

21 is a chamber formed between the outside of the casing 1 and the inner side of the cap 20 and communicates with the interior of the shaft-packing and receives any leakage of fluid which may pass through the clearance formed between the fixed gland-sections 4 4′ and the rotary runner 13.

22 is an outlet in the cap 20, hrough which the leakage passing into chamber 21 may freely pass out into a suitable receptacle or forced under pressure through suitable piping back into the passage-ways 19 19′ to be again used to maintain the air-tight seal.

The operation of the invention is as follows: Assuming the turbine to be in operation and the shaft 1 and runner 13 rotating in the direction of the arrow *a*, the sealing fluid is supplied and maintained under such pressure in passage ways 19 19′ and channels 10 as to have a tendency to pass between the clearance-spaces between the gland-sections 4 4′ and the runner 13. The sealing fluid being forced into the channels 10 and 11 11, the vanes or projections 17 17 act like the blades of a centrifugal pump to throw or beat the sealing fluid back against the constant head of pressure. By this arrangement it will be seen that there is constantly maintained a film of sealing fluid under pressure in the clearance-spaces between the runner 13, securely fixed to the shaft, and gland-sections 4 4′, thereby effectually forming an air-tight seal at all times between the inner and outer sections of the turbine-casing. As will be seen by reference to Fig. 1, I have placed three sets of vanes or projections on the end of the runner 13 next to the condensing or vacuum end of the turbine-casing, and this is for the purpose of overcoming the greater difference of pressure between the sealing fluid and that at the vacuum end of the turbine, and therefore the increased tendency of the sealing fluid from being drawn or sucked into the turbine-casing. The end of the packing which is next to the exterior of the casing or air is only provided with two sets of vanes or projections, since the difference of the pressure is not so great as at the end near the vacuum, and consequently not so much effort or force is required to push back the sealing fluid. The pressure or head of the sealing fluid that is maintained against the air side during the operation of the runner is just sufficient to force the sealing fluid through and show in the air side. Should any leakage of the sealing fluid take place on the vacuum side of the runner, it would be readily carried off by and mingle with the exhaust-steam, and while I have shown two and three sets of vanes or projections on the runner this number and ratio may be readily varied to suit each particular case and forms no essential part of my invention.

The manner of assembling and arranging the packing to the casing and shaft can be readily understood and will not need further description, and while I have shown and described my preferred form I do not wish to limit myself to these specific constructions and arrangements, as they could be modified in many ways without departing from the spirit of my invention and accomplish the same results.

Having now fully described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. A turbine-shaft packing comprising a turbine-casing provided with a shaft-opening and a rotary shaft extending through said opening, an annular runner surrounding the shaft and rotating therewith and provided with channels and two distinct sets of ridges, each set of ridges having vanes oppositely arranged with respect to those of the other set, an annular channel interposed between the two sets of ridges, two stationary semicircular gland-sections inserted in the shaft-opening of the turbine-casing and surrounding the runner and having inner annular channels and ridges adapted to register respectively with the ridges and channels of the runner, a passage-way in one of said gland-sections adapted to communicate with the annular channel in the runner separating the two sets of ridges, and means for connecting the said annular channel and channels of the gland-sections with a source of fluid-pressure.

2. A turbine-shaft packing comprising a turbine-casing provided with a shaft-opening and a rotary shaft extending through said opening, an annular runner surrounding the shaft and rotating therewith and provided with channels and two sets of ridges, each set of ridges having vanes oppositely disposed with respect to those of the other set, an annular channel interposed between the two sets of ridges, an annular stationary gland

inserted in the shaft-opening of the turbine-casing and surrounding the runner and having inner annular channels and ridges adapted to register respectively with the ridges and channels of the runner, a passage-way in the gland adapted to communicate with the annular channel in the runner separating the two sets of ridges, and means for connecting the said annular channel and channels of the gland-sections with a source of fluid-pressure.

3. A turbine-shaft packing comprising a turbine-casing provided with a shaft-opening and a rotary shaft extending through said opening, an annular runner surrounding the shaft and rotating therewith and provided with channels and two distinct sets of ridges, each set of ridges having vanes oppositely arranged with respect to those of the other set, an annular channel interposed between the two sets of ridges, an annular stationary gland inserted in the shaft-opening of the turbine-casing and surrounding the runner and having inner annular channels and ridges adapted to register respectively with the ridges and channels of the runner, a passage-way in the gland adapted to communicate with the annular channel in the runner separating the two sets of ridges and connect the same with a source of fluid-pressure, and a cap attached to the exterior of the turbine-casing about the shaft-opening and forming a chamber adapted to receive the leakage from the shaft-packing.

4. A turbine-shaft packing comprising a turbine-casing provided with a shaft-opening and a rotary shaft extending through said opening, an annular stationary gland inserted in the shaft-opening of the turbine-casing, having inner annular channels and ridges, an annular runner surrounding the shaft and rotating herewith and provided with channels and two sets of ridges, each set of ridges having vanes oppositely disposed with respect to those of the other set, said vanes being of such length radially as to be completely overlapped by the ridges of the annular stationary gland, an annular channel interposed between the two sets of ridges, and means for connecting the said annular channels of the gland-sections with a source of fluid-pressure.

5. A turbine-shaft packing comprising a turbine-casing provided with a shaft-opening and a rotary shaft extending through said opening, an annular stationary gland inserted in the shaft-opening of the turbine-casing, having inner annular channels and ridges, an annular runner surrounding the shaft and rotating herewith and provided with channels and two sets of ridges having vanes oppositely disposed with respect to those of the other set, means for preventing the escape of the sealing fluid when the runner is not in motion, an annular channel interposed between the two sets of ridges, and means for connecting the said annular channels of the gland-sections with a source of fluid-pressure.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES L. MOORE.

Witnesses:
E. A. RATHBONE,
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