Sept. 15, 1931. J. J. RING 1,823,702

HYDRAULIC MACHINE

Filed May 24, 1928

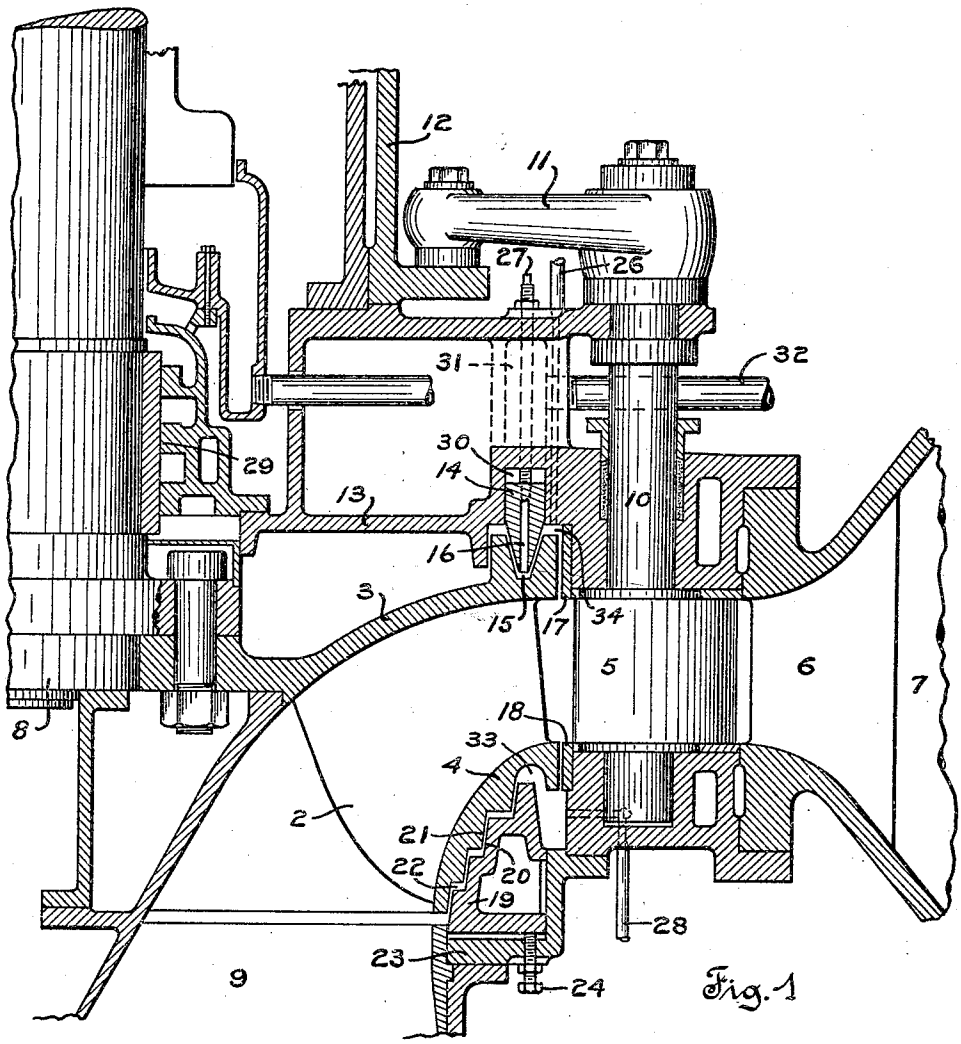

Fig. 1

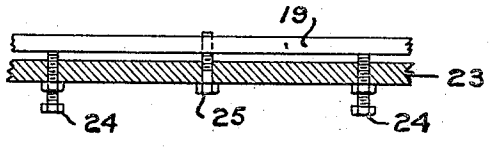

Fig. 2

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UNITED STATES PATENT OFFICE

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HYDRAULIC MACHINE

Application filed May 24, 1928. Serial No. 280,174.

The present invention relates generally to improvements in the construction of packings or sealing devices for rotary machines such as reaction hydraulic turbines or the like.

An object of the invention is to provide an improved sealing device for preventing objectionable escape of liquid under relatively high pressure, from a conduit having relatively movable sections forming a liquid conducting passage. Another object of the invention is to provide simple and effective means for eliminating excessive leakage of fluid in rotary hydraulic machines. A further object of the invention is to provide a new and useful packing which is especially applicable to the inlet portions of the rotors of reaction hydraulic turbines or the like. These and other objects and advantages will be apparent from the following detailed description.

A clear conception of an embodiment of the invention and of the operation of devices having the improved packing applied thereto, may be had by referring to the drawings accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the several views.

Fig. 1 is a fragmentary central vertical section through a Francis type hydraulic turbine having the improved sealing device applied therein.

Fig. 2 is a fragmentary development of a portion of the sealing device showing the mechanism for effecting adjustment thereof.

The Francis type hydraulic turbine to which the improvement has been applied herein by way of illustration, comprises a rotor consisting of an annular series of vanes 2 having fluid passages therebetween and confined between end walls 3, 4 the former of which is formed integral with the rotor supporting hub and the latter of which provides a shroud ring for attachment to the flanged end of a main shaft 8 which is supported in a guide bearing 29 in a well known manner.

The hydraulic turbine rotor which is of the radial inlet axial discharge flow type, is housed within a casing consisting of upper and lower portions 13, 23, and has its axial discharge in open communication with a draft tube 9 extending axially away from the end of the shaft 8. The inlet opening of the rotor is surrounded by an annular series of flow controlling guide vanes 5 mounted upon pivot stems 10 rotatably supported in the turbine casing. The inlet guide vanes 5 are simultaneously adjustable to vary the quantity of liquid admitted to the rotor, by means of a rotary shifting ring 12 which is supported on the casing and is connected by means of linkage to actuating arms 11 secured to the pivot stems 10. The annulus of inlet guide vanes 5 is surrounded by a speed ring having an annular series of fixed vanes 6, the spaces between the speed ring vanes 6 being in open communication with a liquid supply conduit 7. The outermost portions of the rotor end walls 3, 4 are provided with cylindrical peripheral surfaces located closely adjacent to and cooperating with renewable wearing rings 17, 18 which are secured to the rotor housing.

The hub end wall 3 of the rotor is provided with an annular V-shaped groove 15 of less diameter than the peripheral surface of the wall, and the open end of the groove 15 faces an annular recess 30 of like diameter formed in the upper casing portion 13. Slidably adjustably disposed within the casing recess 30, is a sealing ring 14, the lower portion of which is provided with tapered side surfaces located within and cooperating with the tapered sides of the V-groove 15 through variable clearance. The ring 14 is provided with a series of through openings 16 connecting the groove 15 with the recess 30, and the ring is adjustable to vary the clearance, by means of a series of adjusting screws 27. The recess 30 is in open communication with a chamber 31 formed in the casing portion 13, and this chamber may be provided with a drain pipe 32. The annular space 34 beyond the sealing ring 14, is in communication with a fluid pressure supply pipe 26 for admitting air or water under pressure to said space.

The shroud end wall 4 of the rotor is provided with a stepped series of tapered annular surfaces 21 of less diameter than the pe-

ripheral surface of the said wall, and an annular sealing member 19 is provided with a similar stepped series of tapered surfaces 20 cooperating with the surfaces 21 through variable clearances. The member 19 is slidably adjustable within a bore of the lower casing portion 23 to vary the clearances between the surfaces 20, 21, by means of jack screws 24 and cap screws 25 as shown in Fig. 2. The several sets of cooperating tapered surfaces 20, 21 are separated by annular spaces 22, and a pressure chamber 33 is disposed between the member 19 and the wearing ring 18. The pressure chamber 33 is in communication with a pressure supply pipe 28 through which air or water under pressure may be admitted to the said chamber.

During normal operation of the turbine, water under pressure is delivered to the rotor from the supply conduit 7 past the vanes 6, 5, and is delivered from the rotor to the draft tube 9. The quantity of water thus delivered to the rotor is controllable by adjustment of the inlet guide vanes 5 with the aid of the shifting ring 12. While the clearance between the peripheral surfaces of the rotor end walls 3, 4 and the adjacent stationary wearing rings 17, 18, is reduced to a minimum, there is still considerable tendency for the high pressure fluid to leak through these clearances. In order to avoid objectionable leakage through the peripheral clearances, the sealing ring 14 and the sealing member 19 may be adjusted so as to closely approach the adjacent tapered surfaces. Fluid under pressure such as air or water may then be admitted in regulated quantities, into the annular chambers 33, 34 thus preventing escape of water through the peripheral clearances. Any slight amounts of sealing liquid which may leak past the outer inclined surface of the ring 14 will pass through the holes 16 to the chamber 31 and from thence through the drain pipe 32, thus preventing water from entering the turbine pit. Slight amounts of sealing fluid may also leak past the surfaces 20, 21 and through the spaces 22 to the draft tube 9, but the leakage past the ring 14 and the member 19 may obviously be reduced to a minimum by adjustment of these parts.

From the foregoing description, it will be apparent that the present invention provides simple and effective means for preventing excessive leakage of fluid, especially when the turbine is operating under high pressure. The use of a stepped series of cooperating annular surfaces and intervening spaces 22 between the end wall 4 and the sealing member, is especially effective in avoiding leakage from the high pressure inlet to the low pressure draft tube 9. The tapered formation of the clearance varying surfaces, enables sensitive adjustment of the ring 14 and of the member 19 to effect the desired results.

It should be understood that it is not desired to limit the invention to the exact details of construction herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In combination, a casing, a rotor having an end wall the periphery of which is formed to revolve in close proximity to said casing and the side of which is provided with an annular groove, a sealing ring adjustably associated with said casing and cooperating with the sides of said groove, and means for effecting drainage of fluid directly from within said groove through said casing to the exterior.

2. In combination, a casing, a rotor having an end wall the periphery of which is formed to revolve in close proximity to said casing and the side of which is provided with an annular V-groove, a sealing ring adjustably associated with said casing and having tapered surfaces cooperable with the tapered sides of said groove, and means for effecting drainage of fluid directly from within said groove through said ring and said casing.

3. In combination, a casing, a rotor having an end wall the periphery of which is formed to revolve in close proximity to said casing and the side of which is provided with a stepped series of annular tapered surfaces of different maximum diameters, and an annular member adjustably associated with said casing and having a stepped series of annular tapered surfaces directly with said rotor wall surfaces in throttling cooperation.

4. In combination, a casing, a rotor having an end wall the cylindrical peripheral surface of which is adapted to revolve in close proximity to said casing and the side of which is provided with a stepped series of annular tapered surfaces, an annular member having a stepped series of tapered surfaces of different maximum diameters cooperable with said rotor wall surfaces, and means for shifting said member axially of said rotor to vary the clearances between said tapered surfaces.

5. In combination, a casing having an inlet and an outlet, a rotor having an end wall the peripheral surface of which is formed to revolve in close proximity to said casing to provide an annular gap communicating with said inlet, said end wall being provided with a groove of less diameter than said peripheral surface, said casing being provided with a chamber forming an annular space between said groove and said peripheral surface, means for maintaining said chamber filled with fluid at a greater pressure than the pressure of the fluid flowing in said inlet and a sealing ring adjustably associated with said casing and cooperating with said groove.

6. In combination, a casing having an inlet and an outlet, a rotor having an end wall the peripheral surface of which is formed to revolve in close proximity to said casing to provide an annular gap communicating with said inlet, said end wall being provided with an annular V-groove of less diameter than said peripheral surface, said casing being provided with a chamber forming an annular space between said V-groove and said peripheral surface, means for maintaining said chamber filled with fluid at a greater pressure than the pressure of the fluid flowing in said inlet and a sealing ring adjustably associated with said casing and having tapered surfaces cooperable with the tapered sides of said groove.

7. In combination, a casing having an inlet and an outlet, a rotor having opposite end walls the peripheral portions of which are formed to revolve in close proximity to said casing to provide annular gaps communicating with said inlet, said end walls being each provided with an annular tapered surface of less diameter than the corresponding peripheral portion, said casing cooperating with said rotor end walls to provide annular pressure chambers adjoining said rotor between said surfaces and said portions and means for maintaining said chambers filled with fluid at a greater pressure than the pressure of the fluid flowing in said inlet.

8. In combination, a casing having an inlet and an outlet, a rotor having opposite end walls the peripheral portions of which are formed to revolve in close proximity to said casing to provide annular gaps communicating with said inlet, said end walls being each provided with an annular tapered surface of less diameter than the corresponding peripheral portion, an adjustable element carried by said casing adjacent to each of said surfaces and cooperating therewith to provide annular chambers near said peripheral wall portions and means for maintaining said chambers filled with fluid at a greater pressure than the pressure of the fluid flowing in said inlet.

In testimony whereof, the signature of the inventor is affixed hereto.

JOSEPH J. RING.

CERTIFICATE OF CORRECTION.

Patent No. 1,823,702. Granted September 15, 1931, to

JOSEPH J. RING.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 103, claim 3, strike out the words "in throttling cooperation" and insert the same to follow the word "surfaces" in line 102, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of November, A. D. 1931.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)