

[54] SEAL MANUFACTURE AND ASSEMBLY
[75] Inventors: **Robert Stanley Sproule; Flodor Kanger**, both of Montreal, Quebec, Canada

3,332,441	7/1967	Schaale.....	415/163
1,688,736	10/1928	Moody.....	415/163
1,990,309	2/1935	Phillips.....	251/173
2,705,016	3/1955	Saar.....	251/173
3,601,497	8/1971	Mago, Jr.....	415/163

[73] Assignee: **Dominion Engineering Works, Limited**, Lachine, Quebec, Canada

[22] Filed: **Sept. 3, 1971**

[21] Appl. No.: **177,703**

Primary Examiner—C. J. Husar

Attorney—Raymond A. Eckersley et al.

[52] U.S. Cl..... **415/163, 415/170, 277/34**

[51] Int. Cl..... **B63h 1/06**

[58] Field of Search..... **415/163, 170; 277/34; 137/599; 257/173**

[56] **References Cited**

UNITED STATES PATENTS

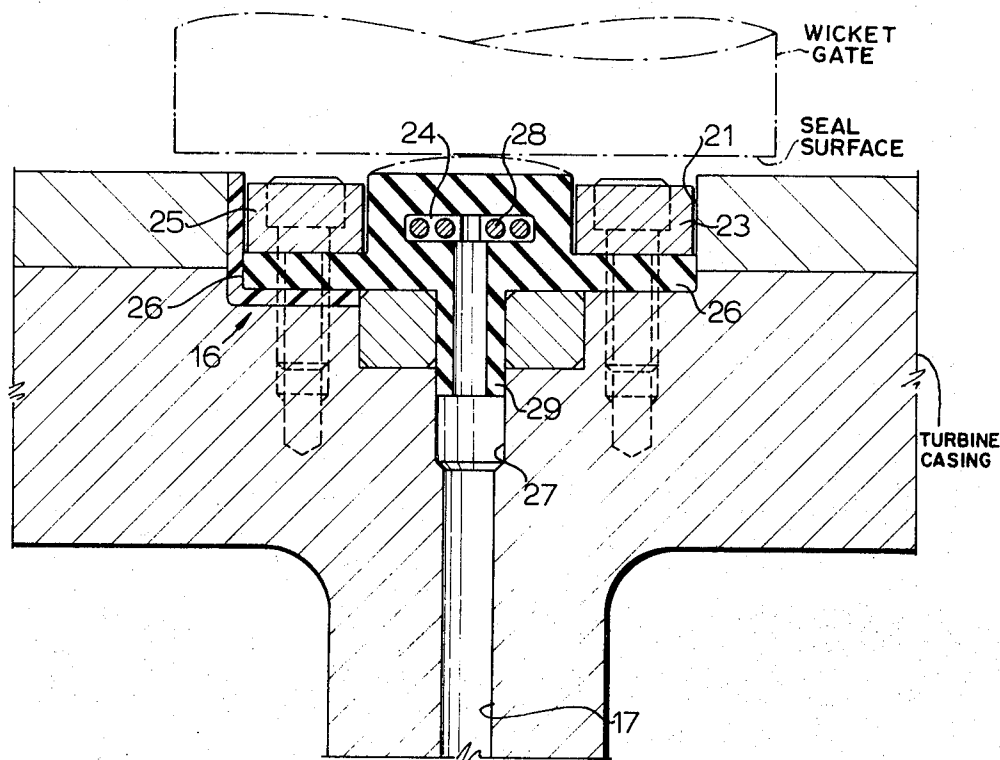
3,637,222 1/1972 Wilkinson..... 277/34

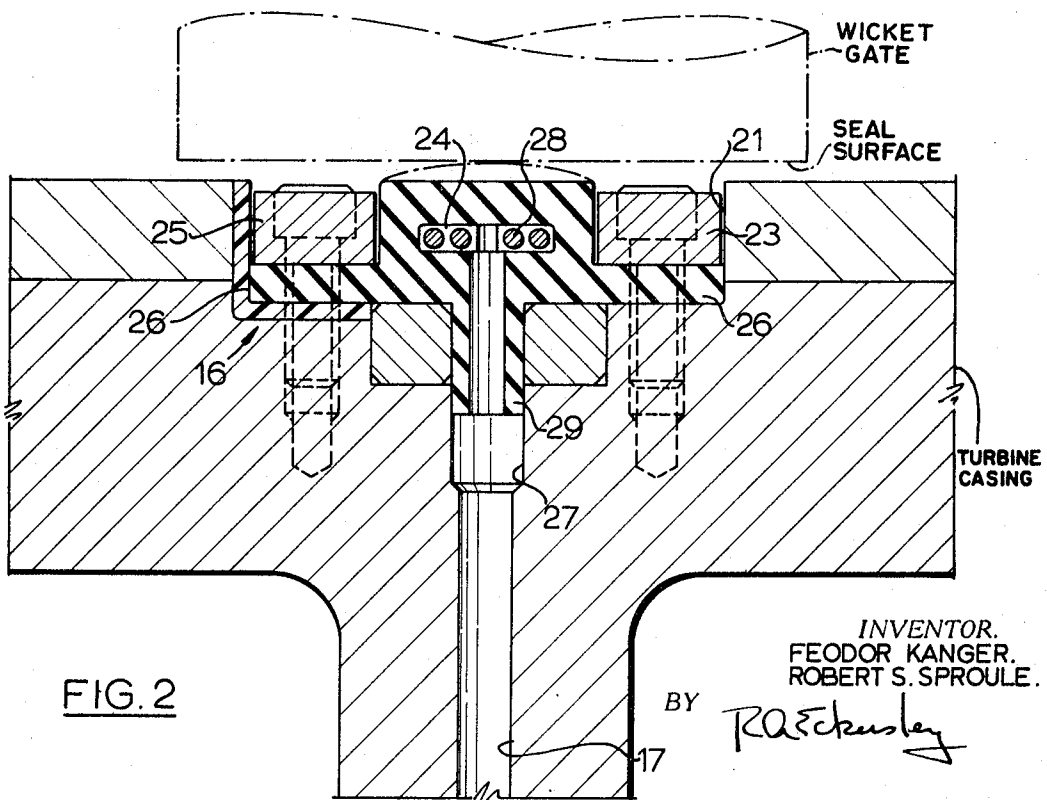
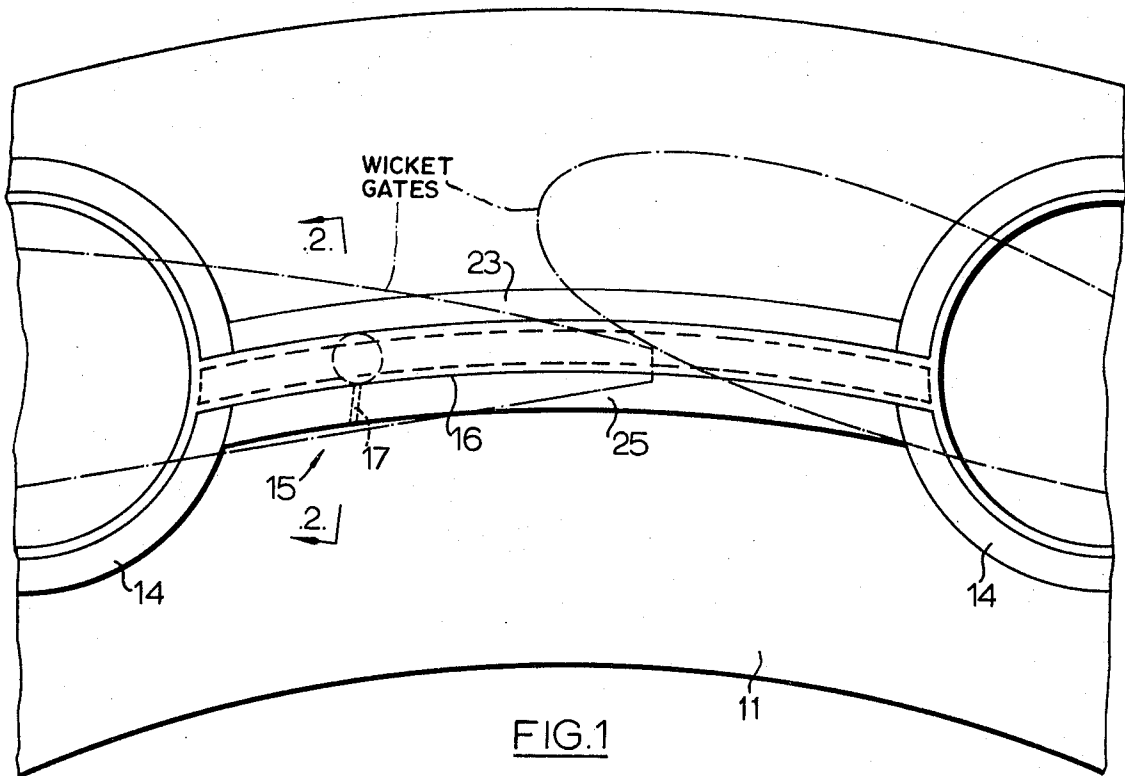
[57]

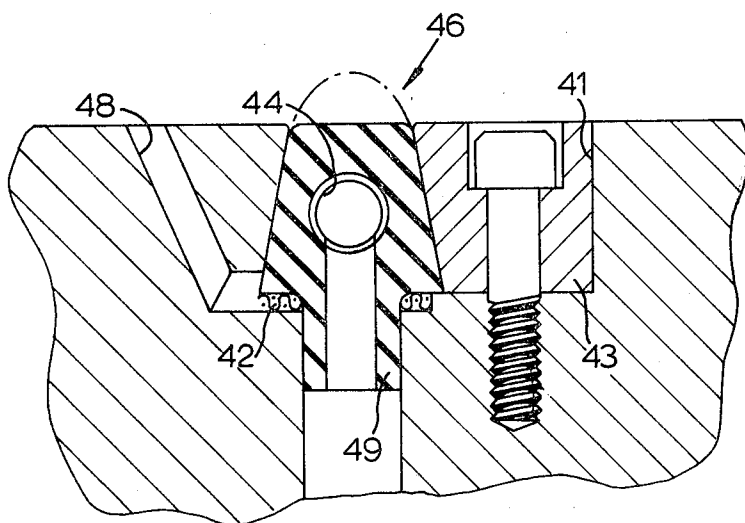
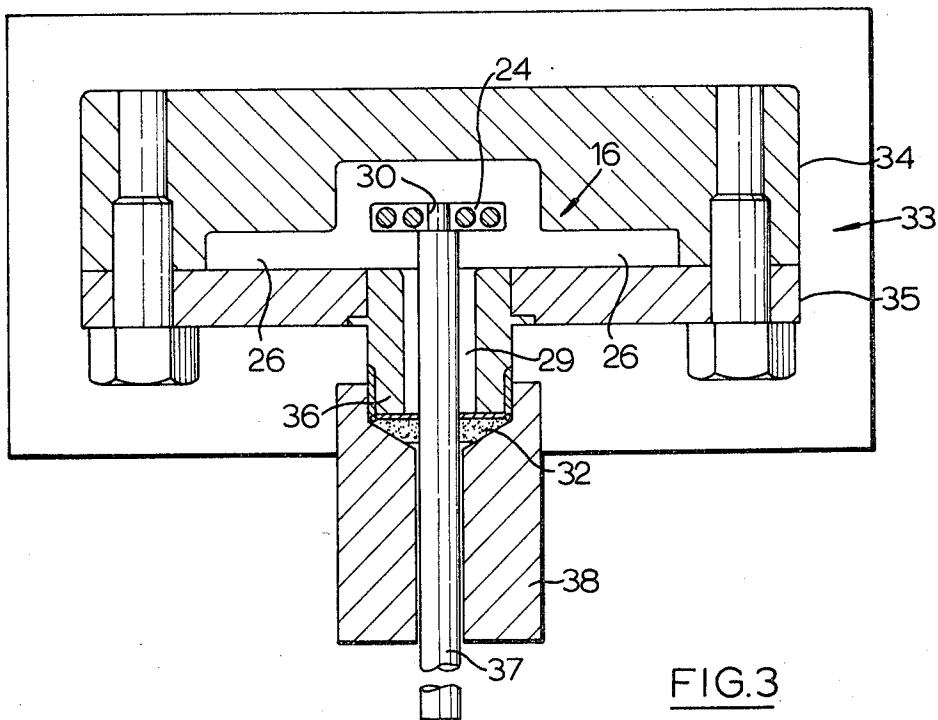
ABSTRACT

The inlet to a hydraulic turbine having variable wicket gates arranged to completely close-off the inlet when fully closed, is provided with seals set in the housing for expansion into sealing contact with the ends of the gates. The seal housings are self draining, to preclude extrusion of and damage to the seals.

1 Claim, 4 Drawing Figures







INVENTOR.
FEODOR KANGER.
ROBERT S. SPROULE.

BY

RA Eckenroby

SEAL MANUFACTURE AND ASSEMBLY

This invention is directed to an improved seal formulation and to a method of sealing the ends of movable gates.

In the construction of water turbines having wicket gates arranged in annular array to provide control of working liquid entering the runner of the machine a number of problems have been encountered in providing satisfactory seals for the gate ends, when in the closed position.

In order to effectively dewater such a machine, it is usual to close the gates into abutting sealing relation. In order to prevent significant leakage past the gate end edge clearances different types of seals such as retractable seals, and including inflatable seals have been provided. However, such seals have a tendency to remain in an extended position and become damaged by the gates, or to become damaged due to interaction of the seal component parts.

The present invention provides an improved inflatable seal structure having a slender filler piece for use within an elongated inflatable fissure extending for substantially the full length of the seal, the filler piece having a cross section devoid of external cutting edges and having a recess therein to receive a mould locating spigot, the material of the filler piece being non-adherent to the material of the moulded seal and providing a non-blocking deflation flow path at all times for seal pressurizing fluid.

Various hydraulic seal structures may be seen, as illustrated in U.S. Pat. Nos. 3,387,544 Mac Lellan et al., June 11, 1968; 3,394,914 Nagasato, July 30, 1968; and Canadian Pat. 788,258 Schaale, June 25, 1968, which however fail to teach or foreshadow the present invention.

The provision of the subject filler piece within the seal fissure extending in overlying non-blocking relation with the inflation aperture of the seal permits the seal to be substantially totally deflated, so that on the removal of fluid pressure from the seal entry the seal is free to collapse to a substantially totally deflated condition. By providing a recess in the filler piece to receive a mould locating spigot the manufacture of the moulded seal is greatly facilitated, making possible the use of a drill rod dowell both to position the filler piece centrally of the mould, and to act as a core for the seal inflation/deflation passage. The cross-sectional form of the filler piece is devoid of sharp external edges to avoid damage of the seal fissure internal surfaces either under the fretting action of working fluid flowing past the seal or due to repeated contact of the fissure walls with the filler piece.

In mounting seals of this type in slots of the turbine housing located in facing relation to coincide with the wicket gate end surfaces when in the closed position damage has previously occurred due to the seal being held up in its housing slot by the presence of working fluid migrating over the seal outer surfaces and entering the slot beneath the seal. As an alternative to attempting the complete sealing-off of the seal within its slot, the present invention overcomes this problem by the provision of slot drain holes connecting the bottom of the seal slot to a low pressure location downstream of the wicket gates. In addition a slot lining is provided, such as wire mesh, to ensure drainage of the slot regardless of the pressurized or unpressurized condition of the seal, so that hydraulic lock-up of the seal, to a

position extending outwardly of its slot when in the uninflated condition, is precluded.

The present invention thus provides an improved seal structure and a method of mounting the seal in a turbine, whereby inadvertent damage to the seal is substantially precluded. It will be apparent to those skilled in the art that opening or closing of the wicket gates in relative shearing movement over the seal when the seal is in an inflated extended position will almost certainly cause damage to the seal.

Certain embodiments of the invention are described, reference being had to the accompanying drawings, wherein:

FIG. 1 is a plan view showing in phantom a pair of adjacent wicket gates incorporating the subject end seal;

FIG. 2 is a section on the line 2—2 of FIG. 1;

FIG. 3 is a cross-section of a mould for the manufacture of the subject seal; and

FIG. 4 shows a section of a second seal embodiment, the seal housing having downstream drainage provision in the seal slot.

Referring to FIG. 1, this shows two adjacent wicket gates in phantom, looking towards the bottom ring 11, in which the gates are journaled in housings 14.

The span between adjacent housings 14 contains a seal housing 15 having a seal 16 located therein. The seal pressurizing connection 17 is illustrated as extending to the downstream edge of the gate housing.

Referring to FIG. 2 the seal housing 21 of generally T-section is provided with a pair of segment strips 23, 25 by means of which the shoulders 26 of seal 16 are secured in the housing 21. A passage 27 receives the seal stem 29, and connects with the pressurizing connection 17. A filler piece 24 consisting of elongated filaments 28 occupies a central fissure extending for substantially the length of the seal, between adjacent housings 14. The fissure ends are sealed in order to retain air admitted through the stem 29 within the fissure, so as to cause the seal to deform along its length as indicated in phantom into sealing contact with the adjacent lower surfaces of the wicket gates to be sealed. The filaments 28 ensure that access to and from the flow passage of stem 29 is always maintained open. In the case of the FIG. 4 embodiment a filler piece 44 having its wall perforated to provide fluid communication with the pressurizing stem 49 at all times. A tapered segment strip 43 secures the oppositely tapered seal 46 in its slot 41, in the FIG. 4 embodiment.

The bottom of slot 41 is provided with a wire mesh liner 42, and a drain passage 48 connecting the slot 41 with the turbine flow path downstream of the gates. The migration of water past the flanks of the seal 46 into the bottom of the slot 41 does not result in entrapment beneath seal 46 of such seepage, as exit of seepage through passage 48 can take place regardless of gate conditions or the activated or de-activated condition of the seal. otherwise liquid entrapped beneath seal 46 can extrude the seal from out of the casing slot 41.

Referring to FIG. 3, this shows a cross-section of a mould 33 having a top half 34 and a bottom half 35 bolted thereto. The filler piece 24 is positioned in the mould 33 by a rod 37 which also forms the moulding core for the seal stem 29.

The mould 33 is completed by filler pieces 36, 38 and the moulding seal 32 secured therebetween, which

serve to secure the rod 37 in relation to the mould halves 34, 35.

On completion of the moulding process it will be seen that the aperture 30 of the filler 24, in which the upper end of the rod 37 is located, provides fluid communication between the surfaces of the filler piece 24, and also communicates with the aperture of stem 29.

The filler piece 24 may be of plastic such as that trademarked Teflon or other suitable material which does not bond with the elastomeric material of the seal 16, thus producing a fissure 28 of smoothly profiled section. The illustrated filler 24 comprises a plurality of wire-like filaments arranged in side by side relation having individual cross-sectional profiles other than rectangular, so as to provide effective drainage interstices between adjacent wires extending for the full length of the seal and ensuring total drainage capability at all times. The over-all sectional profile of the filler 24 is rounded out to the illustrated form by the use of temporary filling material such as Woods metal which may be recovered from the seal when cast, to preserve the necessary drainage profile of the seal recess. The use of an extruded single piece filler of indented or striated section is also contemplated. The filler 24 ensures that the fissure 28 is connected at all times with the filling and exhaust stem 29 to ensure reliable deflation of

the seal on depressurization at the stem 29.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An elongated laterally expansible moulded elastomeric seal for use in expanded sealing relation between a first machine part and a second machine part to be maintained in fluid sealing relation with said first part, said seal having an elongated body, an external shoulder portion thereof for attachment of the seal to a said machine part, an elongated fissure within said seal body extending substantially the full length thereof having a filler piece therein made of material non-adherent to said seal, the filler piece having a cross-section form devoid of external cutting edges and serving to substantially fill the fissure when the seal is in an uninflated condition, the filler piece having an elongated fluid flow path recessed therein to provide a flow passage between opposed faces of the filler piece, the recess being located in aligned flow conducting relation with passage means providing inflation and deflation of the seal, said filler piece precluding blockage of said passage means by an opposing wall portion of the fissure when in a pressurized condition, whereby the seal may be substantially completely deflated.

* * * * *

30

35

40

45

50

55

60

65