

Nov. 10, 1931

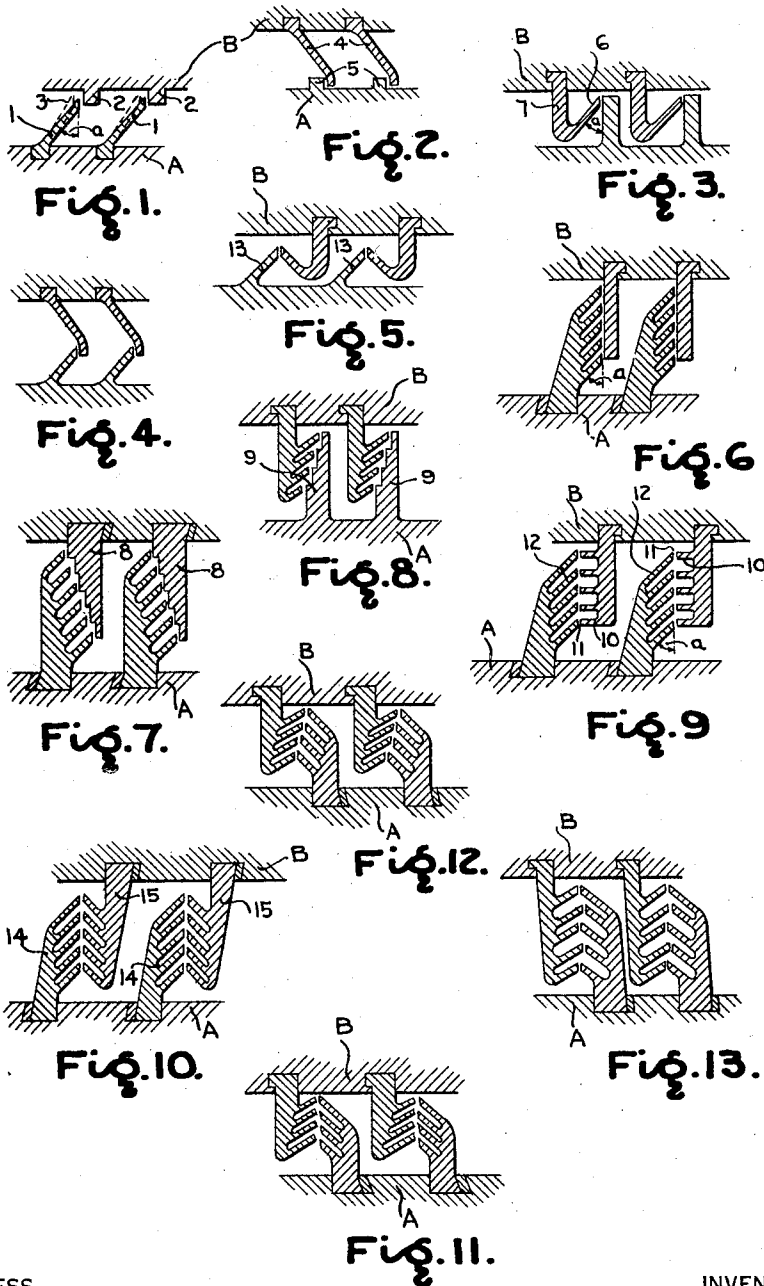
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1,831,224

LABYRINTH PACKING

Filed Oct. 26, 1928

2 Sheets-Sheet 1



WITNESS

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2 Sheets-Sheet 2

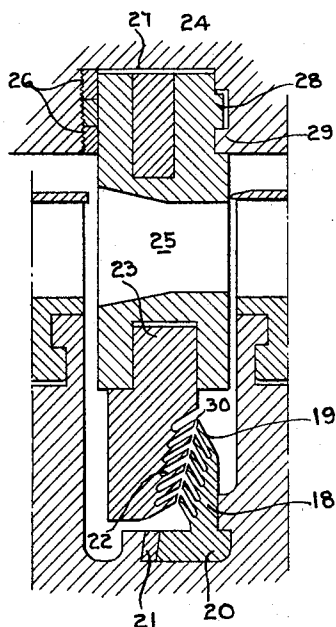


Fig. 18.

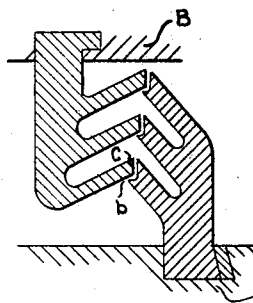


Fig. 14.

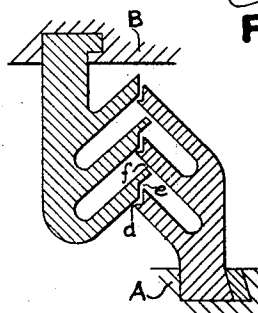


Fig. 15.

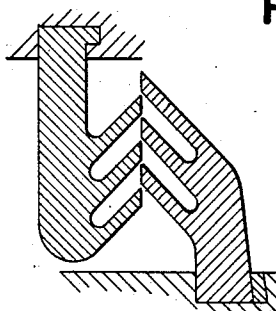


Fig. 16.

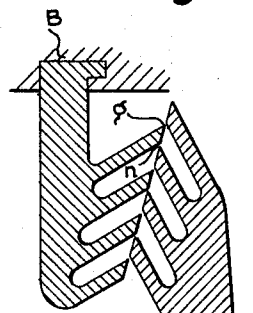


Fig. 17.

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LABYRINTH PACKING

Application filed October 26, 1928, Serial No. 315,302, and in Great Britain November 7, 1927.

The invention relates to labyrinth packing for use between relatively rotatable machine members as for instance between a turbine shaft and the part of the turbine casing through which it passes.

The object of the invention is to provide improved forms of such packing in which the contiguous packing members are shaped and arranged so that they tend to separate automatically if rubbing contact occurs therebetween.

Labyrinth packings usually comprise a number of annular strips so arranged as to provide a devious path for the steam or other fluid which tends to pass from the high pressure to the low pressure side of the packing and for the purpose of considering the construction and arrangement of the packing strips it is convenient to refer to the cross-sectional form which they present on a plane containing the axis of rotation. The strips considered in this manner are more or less of cantilever form, one end being free, and the other end, conveniently termed the "root", being secured directly or indirectly to the appurtenant relatively rotating member. It is in this sense that the term "end" is hereinafter employed or the cross-section considered where stated.

The labyrinth packing concerned in this invention comprises an annular strip secured at one end to one of the relatively rotatable members and so arranged relatively to another annular strip secured at one end to the other relatively rotatable member, that a constricted passage is formed therebetween. Such packing has already been described in the specification of Letters Patent No. 1,708,044, April 9, 1929. According to the present invention however, at least one of the annular strips is conically formed and provides in combination with a radial or conical surface on the other strip an axial clearance constriction, the construction and arrangement of these parts being such that upon the occurrence of rubbing contact between the strips at the constriction, said conical strip, by its expansion due to increased temperature at the region of contact, tends to increase the axial width of the constriction by combined

axial and radial movement away from the co-acting surface of the co-adjacent strip. With this form of packing, moreover, the width of the constrictions or clearances between coacting strips may be adjusted by relative axial displacement of the strips.

A plurality of strips on one of the relatively rotatable members may coact with one strip carried by the other relatively rotatable member, which latter strip may be of stepped formation to obtain more effective throttling, or the strips on the respective members may coact in pairs wherein either or both strips may be of conical form.

The invention also provides labyrinth packing comprising one or more pairs of co-acting annular strips whereof one strip is secured at one end to one of the relatively rotatable members and the other strip to the other relatively rotatable member, the strips being shaped and arranged to form one or more axial clearance constricted passages therebetween such that upon the occurrence of rubbing contact between the strips, both of the strips, by expansion due to increased temperature at the places of contact, tend to move apart so as to increase the axial width of such constricted passages. Furthermore, in any of the constructions one strip may be shaped and arranged so as to form a plurality of constrictions together with one or more coacting strips. In cases where the packing comprises a set of strips adapted to coact with one or a plurality of other strips, the constricted passages therebetween are not necessarily in line, but may be staggered or otherwise displaced so that, while the general direction of the steam or other fluid through the several passages is more or less radial, it is also necessary for said fluid to flow in a devious path.

It is evident that the invention may be carried out in a variety of forms, all of which, however, employ conical strips which are preferably inclined at an angle from 30° to 60° to the axis of rotation, while the angle made by each of said strips on the inside with respect to the coacting surface provided by an adjacent strip is less than 90°, and is preferably also from 30° to 60°.

The above and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Figs. 1 to 17 are sectional views, taken on a plane containing the axis of rotation, of various constructions of packing according to the invention; and

Fig. 18 is a similar sectional view, showing an application of the invention to turbine diaphragm packing.

Referring to the drawings more in detail, I show, in each of Figs. 1 to 17, an inner relatively rotatable member A, and an outer member B, as an example of relatively rotatable members to which my invention may be applied.

In the single form shown in Fig. 1, the conical strips 1, secured at one end to one of the relatively rotatable members, namely A, terminate at their free ends adjacent the sides of annular buttress-like projections 2, thereby forming substantially radial constricted passages 3 or axial clearances between the adjacent surfaces of the strips 1 and the projections 2. If rubbing contact should occur between these adjacent surfaces, the conical strips 1 will be immediately heated at their free ends and will tend to expand circumferentially, thereby moving in a direction partly radial and partly axial away from the projections 2, as indicated (somewhat exaggerated) by dotted lines in Fig. 1. The axial clearances between the coating members 1, 2 of the packing are thus automatically adjusted in use so as to reduce to a minimum wear and friction losses due to rubbing contact.

Fig. 2 shows a construction similar to Fig. 1 in that it employs conical strips coating with the sides of annular buttress-like projections, but in this case the conical strips A are secured to the outer member B and pass over the buttresses 5 and coat with the sides of the latter remote from the roots of the respective conical strips.

Alternatively, as shown in Fig. 3, the conical strips 6 carried by the member B may be provided with annular root portions 7 extending inwardly, the conical portions of the strips extending outwardly from the inner ends of said root portions. This latter construction may be developed by the provision of a plurality of conical strips integral with the common root portion, as shown for example, in Fig. 8, while Figs. 6 and 7 show similar developments applied to the form of construction indicated in Fig. 1. The buttress members 8, 9 shown in Figs. 7 and 8, respectively, are stepped so that the constricted passages formed between the coating packing members are relatively staggered, thereby permitting more effective throttling to be obtained.

Fig. 9 shows a further modified construc-

tion wherein a buttress member such as shown in Fig. 6, is provided with laterally extending strips 10, the extremities of which form substantially radial constricted passages 11 in conjunction with the ends of the conical strips 12 carried by the member A. This construction possesses the advantage over those in which a plain buttress member is employed, in that upon the occurrence of rubbing contact at the constricted passages 11 there will be no tendency for the outer member to bulge or warp laterally as may possibly occur with solid buttress members of the type shown in Fig. 6.

It will be observed that in the cases above described, except in Fig. 2, the angle which a conical strip makes on the inside with respect to the coating surface of the adjacent strip, together with which it forms a restricted passage, namely, the angle α (Figs. 1, 6 and 9), is acute. It will also be noted that the conical strips are inclined at an angle from 30° to 60° to the axis of rotation.

Further examples of packing provided in accordance with the invention and comprising pairs of coating conical strips are shown in Figs. 4 and 5 and 10-17. With these constructions the arrangements are such that upon the occurrence of rubbing contact between a pair of strips, each contacting strip tends to move away from the coating surface of the opposed strip so as to tend to increase the axial width of the constricted passage therebetween. Figs. 4 and 5 show this feature of the invention applied to the forms of packing shown in Figs. 2 and 3 the angular buttress members of the latter figures being replaced by conical strips 13, similar to those shown in Fig. 1.

Fig. 10 shows a simple construction in which each packing member 14, 15 comprises a plurality of conical strips, the ends of which coat to form a series of radial constricted passages or axial clearances. In Fig. 11 a somewhat similar construction is shown, the constricted passages being, however, formed between conical end surfaces of the strips, whereby a devious path is presented for the passage of fluid between the packing members. Devious paths are also afforded by the constructions shown in Figs. 12 and 13 wherein the constricted passages formed between consecutive pairs of strips are relatively staggered.

Figs. 14-17 show by way of example, and to a somewhat enlarged scale, constructions wherein one strip is shaped and arranged to form a plurality of constrictions in conjunction with one or more coating strips. In Fig. 14 constrictions are formed at b and c while in Fig. 15 constrictions d , e and f are provided and in each case a devious path through the series of passages is afforded.

With the constructions shown in Figs. 16 and 17 constrictions g , h are formed between

the edges of the end portions of the strips and it will be apparent that with these constructions also upon the occurrence of rubbing contact between the strips, both strips will tend to move or deflect so as to lessen the contact pressure or eventually to re-open the passage therebetween.

Fig. 17 also shows a feature which may, if desired be applied to certain of the constructions above described, namely, that the strips of the member 16 are arranged with a greater conical angle than those of the member 17. This affords convenience in manufacture as it enables the width of the grooves between the strips to be made equal on both sets of strips, for example in constructions such as that shown in Fig. 12.

In all the forms of packing according to the invention the axial width of the constrictions may be adjusted, for example, when assembling the packing, by axial movement of the packing members. The packing is particularly suitable for use in high pressure turbines to seal the interior of a turbine cylinder from communication with the external atmosphere or for balance pistons or as diaphragm packing between pressure stages of the turbine or elsewhere as may be desired. The packing members may be formed integrally with the relatively rotatable members by which they are carried, or may be separately formed and secured in position in any convenient manner.

A constructional example showing the application of the packing to a turbine diaphragm is illustrated in Fig. 18. The packing rings are made up of arcuate packing members 18 having a plurality of strips 19, said members 18 being secured in grooves 20 formed in the rotor and held in position by means of caulking strips 21. The strips 22 of the packing carried by the diaphragm 23 are secured to the cylinder 24 through the intermediary of nozzle or blading portions 25 riveted or otherwise secured to the diaphragm 23 and held by caulking members 26 in a slot 27 formed inside the cylinder 24. The portions 25 are spigoted and grooved at 28, 29 to engage corresponding parts of slot 27 thereby preventing any possibility of the diaphragm closing in and altering the position of the nozzle passages or the gland members. The axial width of the constrictions 30 will be adjusted to the desired dimensions when assembling the turbine, and will thereafter be more or less self adjusting in accordance with the principles set forth above.

While I have shown my invention in several forms 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. A labyrinth packing for sealing the space between two relatively rotatable members comprising a plurality of annular conical packing elements disposed in telescopic relation and secured at their inner edges to one of said members, the outer free edges of said elements being disposed in closely-spaced axially-opposed relation to parts of the other member so as to provide axial packing clearances therewith.

2. An axial clearance labyrinth packing for sealing the space between two relatively rotatable members comprising a plurality of annular conical packing strips disposed in telescopic relation and secured at their inner edges to one of said members, a plurality of other conical packing strips disposed in telescopic relation and secured at their inner edges to the other of said members, the free edges of the strips secured to one member opposing the free edges of the strips secured to the other member with axial packing clearances therebetween.

3. A labyrinth packing for sealing the space between two relatively rotatable members comprising a plurality of annular conical packing elements disposed in telescopic relation and secured at their inner edges to one of said members, the outer free edges of said elements being disposed in closely-spaced axially-opposed relation to parts of the other member so as to provide axial packing clearances therewith, said conical packing elements being inclined at an angle from 30° to 60° to the axis of rotation.

4. An axial clearance labyrinth packing for sealing the space between two relatively rotatable members comprising a plurality of annular conical packing strips disposed in telescopic relation and secured at their inner edges to one of said members, a plurality of other conical packing strips disposed in telescopic relation and secured at their inner edges to the other of said members, the free edges of the strips secured to one member opposing the free edges of the strips secured to the other member in end to end relation with axial packing clearances therebetween, said conical packing strips being inclined at an angle from 30° to 60° to the axis of rotation.

5. An axial clearance labyrinth packing for sealing the space between two relatively rotatable members comprising a plurality of annular conical packing strips disposed in telescopic relation and secured at their inner ends to one of said members, a plurality of other conical packing strips also disposed in telescopic relation and secured at their inner ends to the other of said members, the free end surfaces of the strips secured to one member opposing the free end surfaces of the

strips secured to the other member with axial packing clearances therebetween, said end surfaces being disposed out of alignment so that the packing clearances are not in alignment and thereby provide a devious path for the passage of fluid between the packing members.

In testimony whereof, I have hereunto subscribed my name this fifth day of October, 1928.

KARL BAUMANN.

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