

July 27, 1943.

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Re. 22,353

SHAFT SEAL

Original Filed Oct. 18, 1941

Fig. 1

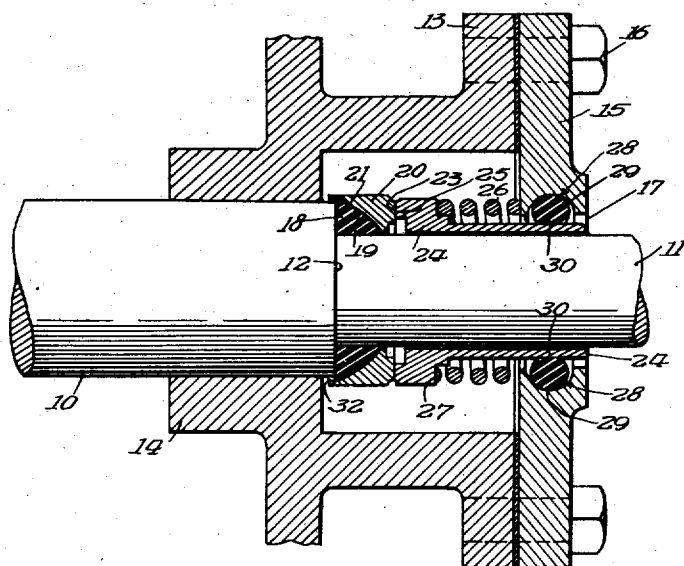
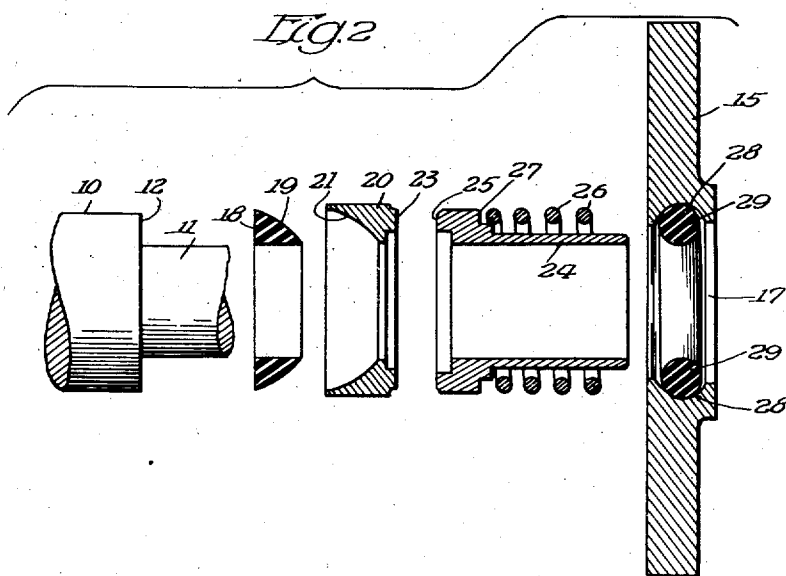


Fig. 2



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UNITED STATES PATENT OFFICE

22,353

SHAFT SEAL

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Original No. 2,299,395, dated October 20, 1942, Serial No. 415,592, filed October 18, 1941. Application for reissue October 20, 1942, Serial No. 462,721

14 Claims. (Cl. 286—7)

This invention relates to seals for shafts, particularly adapted, though not necessarily limited in its use, for sealing compressor shafts which project through a wall of the compressor casing, to prevent escape or leakage of oil and gas.

Heretofore, with seals of this character, there has been provided a bellows constructed of metal, which encompasses the shaft, and this bellows has running engagement with a metal element at both ends. The bellows, being connected at one end to the shaft, will expand and contract not only under torsional stresses, but also by reason of any longitudinal movement of the shaft. Such expansion and contraction of the bellows is detrimental to a sealing organization, as the continuous flexing causes the material to crystallize and break.

It is one of the objects of the present invention to overcome these difficulties and objections, and to provide an improved shaft seal of this character, in which the bellows is dispensed with, and, at the same time, to provide an improved structure whereby an effective and efficient seal will be provided, and there will be provided sealing elements at one end of the sleeve, which latter encompasses the shaft, and a seal at the other end of the sleeve which will permit the sleeve not only to rotate with respect to the casing wall, but will also permit it to move longitudinally with respect to and through the casing wall, at the same time maintaining a perfect seal.

A further object is to provide in a seal of this character, improved means at both ends of the sleeve to permit of sufficient flexibility to provide for adjustment of the shaft when normally out of line, the sleeve being free from rigid anchorage at both ends thereof.

A further object is to provide in a sealing organization of this character, improved sealing means at one end of the sleeve which will permit of rotation with respect to the casing wall, and longitudinal movement therethrough, in association with a resilient sealing element, the sealing action of which latter is increased under the action of the longitudinal movement of the sleeve.

To the attainment of these ends and the accomplishment of other new and useful objects as will appear, the invention consists in the features of novelty in substantially the construction, combination and arrangement of the several parts hereinafter more fully described and claimed, and shown in the accompanying drawing illustrating this invention, in which:

Figure 1 is a view, partly in elevation and

partly in vertical section, of a structure embodying this invention.

Figure 2 is an exploded view of the parts of the sealing organization.

Referring more particularly to the drawing, the numeral 10 designates a portion of a driven shaft which is to be sealed, and this shaft is provided with a reduced portion 11, to form a shoulder 12.

The numeral 13 designates, generally, a portion of a compressor housing having a bearing 14 connected thereto, in which the shaft 10 rotates.

A front plate 15 is secured to the housing wall 13, preferably by means of screws or bolts 16, and this plate is provided with an opening 17 therethrough, through which the reduced portion 11 of the shaft 10 passes. This opening 17 is of a diameter considerably greater than the external diameter of the portion 11 of the shaft.

Encompassing the portion 11 of the shaft and abutting the shoulder 12, is a resilient sealing element 18, the outer surface 19 of which is convex.

A bearing element 20 encompasses the portion 11 of the shaft and is provided with a concave recessed face 21, to receive the convex face 19 of the element 18. A portion of the bearing element 20 preferably extends over the shoulder 12, as at 32, so as to prevent a portion of the element 18 from being forced between the extremity of the element 20 and the shoulder 12, in the event of excessive compression of the element 18.

The bearing element 20 has an outer flat bearing surface 23. A non-rotatable sleeve 24 encompasses the portion 11, and is provided with a bearing surface 25 which contacts the surface 23 of the element 20, and a spring 26 encompassing the sleeve rests against a shoulder 27 thereon at one end, while the other end of the spring 26 preferably contacts the inner surface of the plate 15, and tends normally to maintain the bearing faces 23 and 25 in contact, as well as the surfaces 19 and 21 of the elements 18 and 20.

With this construction, the sleeve 24 will have a running contact against the bearing element 20; the bearing element 20, in turn, having contact with the resilient element 18, will permit of a rocking movement of the shaft 10—11 while maintaining an effective seal.

Within the wall of the opening 17 in the plate 15, and encompassing the opening and disposed within the planes of the inner and outer faces of the plate 15, is an open recess or groove 28.

The sleeve 24 projects into the opening 17 and is of a length to normally project beyond the recess or groove 28 in the plate 15. Within the

recess 28 and encompassing the sleeve 24 is disposed a resilient packing element 29, the body of which is preferably of a circular cross-sectional configuration, and the element is annular in configuration, and through which element 29 the sleeve passes. The internal diameter of the annular element 29 is less than the external diameter of the portion of the sleeve 24 that passes therethrough, so that the body of the element 29 will be distorted or flattened, as at 30, to form a tight seal and, at the same time, permit the sleeve to slide therethrough.

The groove or channel 28 is of a semi-circular configuration in cross-section, and the length of the opening is only slightly greater than the cross-sectional diameter of the body of the element 29, so that when the sleeve 24 is moved with respect to the casing wall of the plate 15 to be projected through the opening 17, the sleeve will not only slide through the element 29, but the element 29 will be given a rolling movement. By reason of the configuration of the groove or channel 28, the instant that the element 29 is given such a rolling movement, it will be further compressed and the sealing qualities thereof will be immediately increased.

With this construction, it will be manifest that the sealing organization is free from rigid anchorage at both ends. By reason of the frictional engagement of the bearing element 20 with the resilient element 18, the element 20 will be caused to rotate with the shaft, and, at the same time, it will be adapted for relative rotary movement with respect to the shaft, thereby overcoming excessive torsional stresses.

The sleeve 24 will be resiliently held against rotation by means of the sealing element 29, and as the bearing element 20 rotates, its face 21 will have running contact with the face 25 of the sleeve 24.

The spring 26 operates, at all times, to hold the end of the sleeve 24 in contact with the bearing element 20. Under excessive rotative stresses, the sleeve 24 is adapted to rotate within the element 29, and in the event that there is any longitudinal movement of the shaft 10 and 11, for any reason, the spring 26 will yield and the sleeve 24 will slide freely through the packing element 29 and the opening 17 in the plate 15. At the same time, a perfect seal will be maintained between the sealing element 29 and the sleeve 24 and the wall of the opening 17 in the plate 15.

The opening 17 is of sufficient diameter to permit of a rocking movement of the shaft 11, whereby the shaft may be adjusted when it is out of alinement, and the convex and concave bearing surfaces 19 and 21 between the elements 18 and 20 will permit of such rocking movement. The sealing element 29 forms a resilient support for the sleeve and maintains the sleeve out of contact with the wall of the opening, adapting the sleeve for a substantially universal movement.

While the preferred form of the invention has been herein shown and described, it is to be understood that various changes may be made in the details of construction and in the combination and arrangement of the several parts, within the scope of the claims, without departing from the spirit of this invention.

What is claimed as new is:

1. In combination with a sealing organization, a casing embodying a chamber and a wall forming a closure for the chamber, the faces of said wall being substantially parallel throughout substantially their areas, there being an opening in said wall in alinement with said chamber, a shaft

passing through said opening and of a diameter considerably less than the diameter of said opening, a non-rotatable sleeve of substantial length encompassing the shaft, one end of the sleeve extending into and adapted to pass through said opening, there being an annular recess in the wall of said opening, disposed entirely within the confines of the said faces of said wall, a resilient element seated in said recess and itself being disposed and maintained, at all times, within the planes of the faces of said wall, and outside of said chamber, said resilient element being compressed and also maintained under pressure solely by and between the bottom of said recess and said sleeve, a resilient sealing element spaced from the wall of the casing and abutting a shoulder on said shaft, a bearing element abutting the last said resilient element, and with which bearing element one end of the sleeve has running engagement, and resilient means interposed between said wall and a shoulder on said sleeve for maintaining the said end of the sleeve in contact with said bearing element.

2. In combination with a sealing organization, a casing having an opening in its wall, a shaft passing through said opening and of a diameter considerably less than the diameter of said opening, a non-rotatable sleeve of substantial length encompassing the said shaft, one end of the sleeve extending into and adapted to pass through said opening, a resilient sealing annular member positioned between said sleeve and the wall of said opening, and disposed within the planes of the faces of said wall, said element being seated in a recess in said opening in the wall and compressed between the bottom of said recess and said sleeve, a resilient sealing element spaced from the wall of the casing and abutting a shoulder on said shaft, a bearing element abutting the last said resilient element, and with which bearing element one end of the sleeve has running engagement, and resilient means for maintaining the said end of the sleeve in contact with said bearing element, the abutting faces of said bearing element and the second recited sealing element being provided one with a convex surface and the other with a concave surface to receive the convex surface, to provide a rocking movement one with respect to the other.

3. In combination with a sealing organization, a casing having an opening in its wall, a shaft passing through said opening and of a diameter considerably less than the diameter of said opening, a non-rotatable sleeve of substantial length encompassing the said shaft, one end of the sleeve extending into and adapted to pass through said opening, a resilient sealing annular member, the body of which is normally substantially round in cross-section, and being positioned between said sleeve and the wall of said opening, and disposed within the planes of the faces of said wall, said element being seated in a recess in said opening in the wall and compressed between the bottom of said recess and said sleeve, a resilient sealing element spaced from the wall of the casing and abutting a shoulder on said shaft, a bearing element abutting the last said resilient element, and with which bearing element one end of the sleeve has running engagement, and resilient means for maintaining the said end of the sleeve in contact with said bearing element, the said recess in the wall of said opening being arc-shaped, the maximum chord of the said arc being slightly greater than the diameter of the body of said annular sealing member and operating

to cause the latter to be further compressed as it is moved axially in the recess by the sleeve moving longitudinally through said opening.

4. In association with a housing member having a shaft extending through an opening in the wall thereof and rotatable with respect to said wall, the combination with a sealing organization embodying a bearing member rotatably mounted with and sealed at one end to the shaft, the seal embodying a resilient sealing element encompassing and frictionally secured to the shaft and disposed against a shoulder on the shaft, one face of the bearing member abutting said element, a non-rotatable sleeve of substantial length encompassing said shaft, the said opening being considerably larger than the external diameter of the adjacent portion of the sleeve, one end of said sleeve having running engagement with said bearing member, the other end of said sleeve passing freely through said opening, there being an open recess in the wall of said opening, a resilient annular sealing element encompassing said sleeve and seated in said recess and disposed within the planes of the faces of said wall, and through which last said sealing element said sleeve is adapted to slide, the depth of said recess being less than the normal cross-sectional diameter of the last said sealing element, whereby the latter will be compressed between the bottom of said recess and said sleeve, the said recess ranging in depth from a medial point towards the ends thereof, to further compress the sealing element as it is moved axially in said recess, and resilient means disposed between a shoulder on said sleeve and a stationary abutment for maintaining one end of said sleeve in running engagement with said bearing member.

5. In a sealing organization, a casing having a chamber and a removable wall forming a closure for the chamber, there being an opening in said wall in alignment with said chamber, a non-rotatable sleeve encompassing a shaft which projects into said opening, said sleeve also projecting into said opening and being of an external diameter considerably less than the diameter of said opening, there being an annular recess in the wall of said opening disposed entirely within the confines of the faces of said wall and opening only into said recess, the size of said recess being unvariable, and an annular resilient element seated in said recess and itself being disposed and maintained, at all times, within the planes of the faces of said wall and constituting, with said closure wall, an assembled unitary structure removable and replaceable as such, said resilient element being compressed and also maintained under pressure solely by and between the bottom of said recess and said sleeve and serving to maintain a tight sealing joint, said element forming a resilient support for the said sleeve and serving to maintain the sleeve out of contact with the wall of said opening, whereby said sleeve is adapted for a substantially universal movement with respect to said closure wall.

6. In a sealing organization, a casing having a chamber and a removable wall forming a closure for the chamber, there being an opening in said wall in alignment with said chamber, a non-rotatable sleeve encompassing a shaft which projects into said opening, said sleeve also projecting into said opening and being of an external diameter considerably less than the diameter of said opening, there being an annular recess in the wall of said opening disposed entirely within the confines of the faces of said wall, and an annular

resilient element seated in said recess and itself being disposed and maintained, at all times, within the planes of the faces of said wall and constituting, with said closure wall, an assembled unitary structure removable and replaceable as such, said resilient element being compressed and also maintained under pressure solely by and between the bottom of said recess and said sleeve and serving to maintain a tight sealing joint, said element forming a resilient support for the said sleeve and serving to maintain the sleeve out of contact with the wall of said opening, whereby said sleeve is adapted for a substantially universal movement with respect to said closure wall, the depth of said recess being less than the normal cross-sectional diameter of the sealing element, the body of said sealing element being substantially round in cross-section, said recess varying in depth from a medial point towards the ends thereof, to further compress the sealing element as it is moved axially in said recess.

7. In combination with a sealing organization, a casing having a chamber, a removable wall for said casing, said wall having an opening therethrough in alignment with the chamber, there being an annular recess in the wall of said opening disposed entirely within the confines of the lateral faces of the wall, said recess opening only into said opening and being unvariable in size, an annular resilient packing element seated in said recess, said packing element being, at all times, maintained in said recess and within the confines of the lateral faces of the wall, the normal exterior diameter of said annular packing element being greater than the diameter of the opening in the lateral faces of the wall, whereby said packing element, when seated in said recess, will be held against displacement through said opening and will, at all times, be maintained within the planes of the faces of the wall, the cross-sectional diameter of the body of said packing element being greater than the depth of said recess, said wall and packing element constituting an assembled unitary structure.

8. In combination with a sealing organization, a casing having a chamber, a removable wall for said casing, said wall having an opening therethrough, in alignment with the chamber, there being an annular recess in the wall of said opening disposed entirely within the confines of the lateral faces of the wall, an annular resilient packing element seated in said recess, said packing element being, at all times, maintained in said recess and within the confines of the lateral faces of the wall, the normal exterior diameter of said annular packing element being greater than the diameter of the opening in the lateral faces of the wall, whereby said packing element, when seated in said recess, will be held against displacement through said opening and will, at all times, be maintained within the planes of the faces of the wall, the cross-sectional diameter of the body of said packing element being greater than the depth of said recess, said wall and packing element constituting an assembled unitary structure, said recess varying in depth from a medial point towards the ends thereof.

9. In a shaft seal of the character described, a wall provided with an opening therethrough and having a recess in the wall of said opening spaced from the lateral faces of the first said wall and communicating with said opening entirely within the confines of the planes of the outer faces of the first said wall, the size of said recess being un-

variable and the depth thereof being greater than the diameter of that portion of the said opening which is adjacent the ends of the recess, a shaft bearing sleeve projecting into said opening and of an external diameter less than the diameter of said opening, and an annular resilient packing member encompassing said sleeve and seated in said recess, the depth of said recess being less than the normal external diameter of the said resilient element, the internal diameter of said resilient element being less than the external diameter of said sleeve.

10. In a shaft seal of the character described, a wall provided with an opening therethrough and having a recess in the wall of said opening spaced from the lateral faces of the first said wall and communicating with said opening entirely within the confines of the planes of the outer faces of the first said wall, the size of said recess being unvariable and the depth thereof being greater than the diameter of that portion of the said opening which is adjacent the ends of the recess, a shaft bearing sleeve projecting into said opening and of an external diameter less than the diameter of said opening, and an annular resilient packing member encompassing said sleeve and seated in said recess, the greatest depth of said recess being less than the normal external diameter of the said resilient element, the internal diameter of said resilient element being less than the external diameter of said sleeve, the said recess ranging in depth from a medial point towards the ends thereof.

11. For use in a shaft sealing organization of the character described, a closure wall of integral structure of substantial thickness and having a shaft receiving opening therethrough, said wall also provided with a recess in the wall of said opening of a depth greater than the diameter of said shaft opening at the ends of the recess, and an annular resilient element seated in said recess and maintained at all times within the confines of the planes of the opposite faces of the wall, the normal external diameter of said annular element being greater than the depth of the said recess, whereby the said element will be maintained seated in said recess and against displacement through the ends of the said wall opening.

12. For use in a shaft sealing organization of the character described, and as an assembled unitary structure insertable into and removable from place as such, a closure wall of integral

structure of substantial thickness and having a shaft receiving opening therethrough, said wall also provided with a recess of unvariable size in the wall of said opening of a depth greater than the diameter of said shaft opening at the ends of the recess, and an annular resilient element seated in said recess and maintained at all times within the confines of the planes of the opposite faces of the wall, the normal external diameter of said annular element being greater than the depth of the said recess, whereby the said element will be maintained seated in said recess and against displacement through the ends of the said wall opening.

13. For use in a shaft sealing organization of the character described, and as an assembled unitary structure insertable into and removable from place as such, a closure wall of integral structure of substantial thickness and having a shaft receiving opening therethrough, said wall also provided with a recess of unvariable size in the wall of said opening of a depth greater than the diameter of said shaft opening at the ends of the recess, and an annular resilient element seated in said recess and maintained at all times within the confines of the planes of the opposite faces of the wall, the normal external diameter of said annular element being greater than the depth of the said recess, whereby the said element will be maintained seated in said recess and against displacement through the ends of the said wall opening, the said recess varying in depth from a medial point towards the ends thereof.

14. For use in a shaft sealing organization of the character described, a closure wall of integral structure of substantial thickness and having a shaft receiving opening therethrough, said wall also provided with a recess in the wall of said opening of a depth greater than the diameter of said shaft opening at the ends of the recess, and an annular resilient element seated in said recess and maintained at all times within the confines of the planes of the opposite faces of the wall, the normal external diameter of said annular element being greater than the depth of the said recess, whereby the said element will be maintained seated in said recess and against displacement through the ends of the said wall opening, the internal diameter of said resilient element being substantially less than the diameter of said opening in the first said wall.

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