May 30, 1950 T. H. HOLMES 2,509,973

SEAL FOR FLUID PUMPS

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FIG. 1

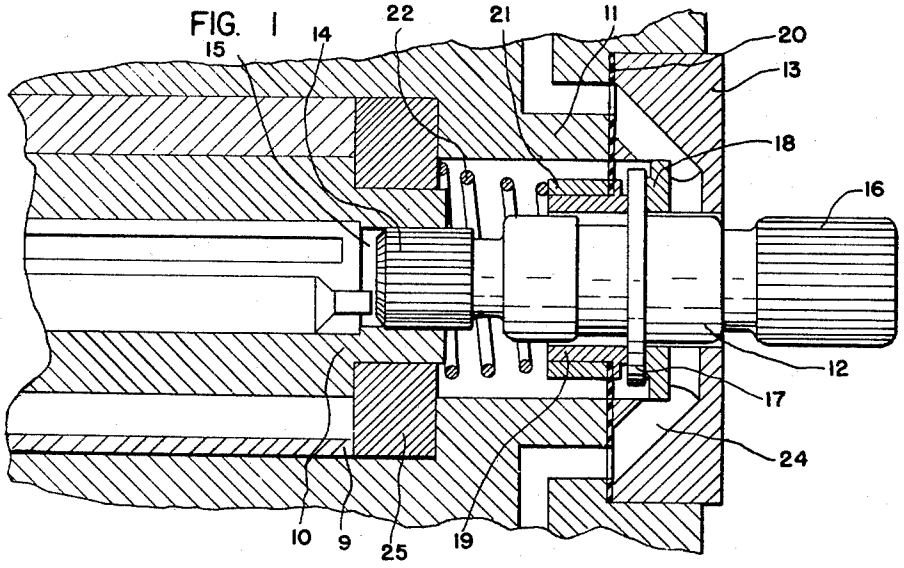
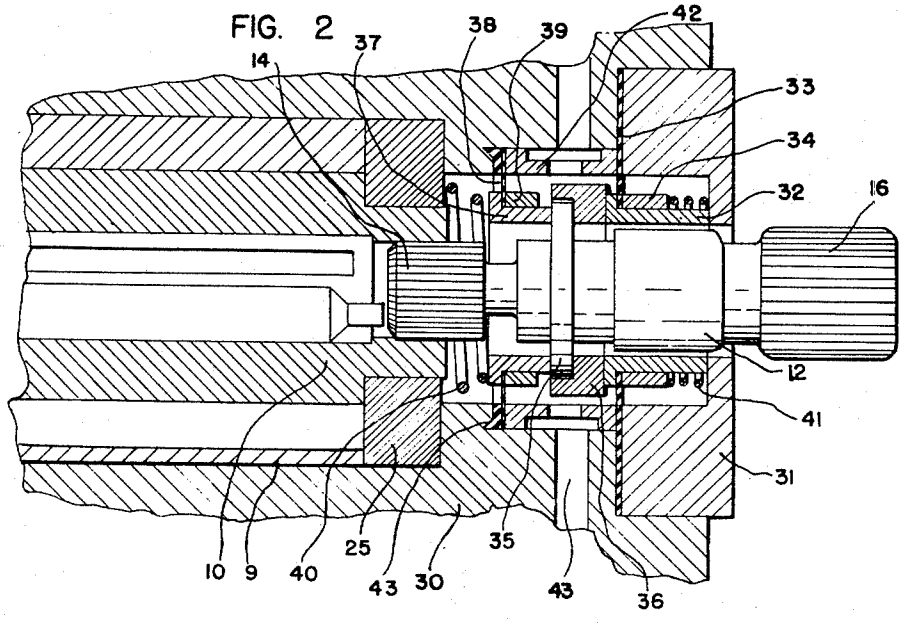


FIG. 2



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SEAL FOR FLUID PUMPS

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3 Claims. (Cl. 286—11)

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This invention relates to fluid pumps and more particularly to fluid pumps of the rotating and radially movable vane type.

Primarily, the invention relates to an improved form of seal for a pump of the above type particularly adapted for supplying liquid fuel to an aircraft engine.

An object of importance of the invention is to provide an improved seal for the fluid being pumped at the driving end of the pump casing that will maintain a perfect seal when the driving shaft is subjected to an end thrust as well as when the driving shaft is slightly out of alignment with its driving member.

A feature of importance of the invention is that a flange is provided on an intermediate portion of the driving shaft resiliently forced into contact with a member supported against rotation within the casing.

Other objects and advantages will be apparent from the specification and claims and from the drawings which illustrate what is now considered to be a preferred embodiment of the invention.

In the drawing annexed hereto and forming a part of this specification:

Figure 1 is a fragmentary longitudinal sectional view thru the driving end of a rotary pump provided with the present invention; and

Figure 2 is a similar view showing another form of the invention, in which a double seal is provided.

In its preferred forms the invention may include the following principal parts: First, a casing having a rotating pump impeller therein provided with radially movable blades or vanes; second, a driving shaft for said impeller splined thereto at one end; third, a flange outstanding from an intermediate portion of said shaft; fourth, a flexibly supported sealing ring secured nonrotatably within the casing and engaging one face of said flange; and fifth, resilient means holding the ring in sealing contact with the adjacent face of said flange.

Referring more in detail to the figures of the drawing and first to the form of the invention shown in Figure 1, it will be seen that a single seal is provided therein at all times and an effective double seal at other times.

The pump is of the rotary sliding vane type, and includes a rotor 10 supported by bearings, one of which is shown at 25. The rotor 10 turns in a liner 9 having a central axial opening eccentric with respect to the axis of rotor 9.

At one end of the pump rotor 10 is a driving shaft 12 extending thru seal plate 13 which is

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suitably secured to the pump casing 11. Splines 14 at the inner end of the shaft 12 engage corresponding splines 15 within the pump rotor 10. At the outer or free end of the driving shaft 12 are splines 16 by means of which the shaft 12 may be rotated by any driving means connected thereto.

At an intermediate portion of the driving shaft 12 is an integral flange 17, one face of which bears against a wearing ring of bronze or carbon 18 pressed in a suitable recess in the seal plate 13. This member 18 forms a fixed abutment against which the flange 17 normally engages. Bearing against the opposite face of the flange 17 is a flexibly supported ring 19. As shown, this ring 19 is centrally attached to a diaphragm 20 of flexible material by means of a small sleeve 21 pressed over the ring 19 and holding the diaphragm 20 against a shoulder formed on the ring 19. At its outer periphery the diaphragm 20 is held between surfaces of the casing 11 and seal plate 13 so that the ring 19 may move axially a limited distance within the casing but is nonrotatably supported therein. Disposed between the end face of the bearing 25 and the flexibly supported ring 19 is a helical spring 22 normally forcing the ring 19 into contact with the flange 17 on the driving shaft 12 and forcing the shaft 12, as shown in Figure 1, to the right. By means of spring 22 the flange 17 will be maintained in sealing contact with the bearing ring 18 housed within a recessed portion of the sealing plate 13.

Within the sealing plate 13 are one or more drain conduits 24 for the removal of any fluid that might escape between the flange 17 and rings 18 and 19.

The drain conduits 24 communicate with the recess in which the wearing ring 18 is seated at a point on the inside of that ring. The drain passages 24 also communicate with the space surrounding the shaft 12 just outside of the wearing ring 18.

When the parts are in the positions shown in Figure 1, the liquid inside the pump must, in order to escape from the casing along the shaft 12, pass radially outward between the sealing surfaces of the ring 19 and the flange 17. Any liquid passing between these sealing surfaces enters the small space to the left of wearing ring 18. This fluid tends to collect in the bottom of this space and therefore passes into drain passage 24. Fluid cannot pass from the space at the left of wearing ring 18 back toward the shaft 12 without passing between a second pair of sealing surfaces between the flange 17 and the ring 18,

Although the sealing surfaces between flange 17 and ring 18 do not completely seal the two spaces which they separate, since those spaces are connected thru the drain passages 24, nevertheless these sealing surfaces provide a guide for any fluid leaking past the ring 19, and therefore effectively aid in preventing fluid from leaking to the outside of the pump casing along the shaft 12.

If an inwardly directed end thrust is applied to the splined end 16 of shaft 12, the flange 17 may be separated from the wearing ring 18, but the ring 19 is always maintained in sealing contact with flange 17.

These pumps are commonly used as fuel pumps on aircraft engines, and they are periodically removed from the engines for inspection and repair purposes. The mounting pads for the pumps and the drive shafts for the pumps vary somewhat with different engines, especially if the engines are somewhat worn. Therefore, it is not uncommon to find that the mounting of a given pump on a given engine will produce an end thrust on the pump drive shaft. In the sealing mechanism described, such an end thrust may separate one set of sealing surfaces, but it cannot separate the surfaces of ring 19 and flange 17.

Referring to the form of invention shown in Figure 2 a double seal construction is shown for a pump of the same type as that shown in Figure 1. In this construction the liner 9, pump rotor 10 and driving shaft 12 may be similar to the corresponding parts shown in Figure 1. The housing 30 and seal plate 31 also are generally similar to the housing 11 and seal plate 13 shown in Figure 1. These members 30 and 31, however, are somewhat different in details of construction.

Within the seal plate 31 is a flanged ring 32 loosely surrounding the driving shaft 12 and flexibly supported by means of a diaphragm 33. This ring 32 forms a normally fixed abutment against which the flange 35 engages. The ring 32 is secured to the diaphragm 33 by means of a sleeve 34 tightly fitting the sleeve 32 and holding the diaphragm against the flange on the ring. The outer periphery of the diaphragm 33 is retained between adjacent surfaces of the housing 30 and seal plate 31 so that the ring 32 may move axially to the left as seen in Figure 2 but is nonrotatably supported within the casing.

Between the flanged face of the ring 32 and the flange 35 on the intermediate portion of the driving shaft 12 is disposed a ring or collar 36 preferably of carbon, bronze or other bearing metal forming a bearing and sealing member for the driving shaft 12. To retain this collar 36 in position relative to the shaft 12 a portion may be counterbored so that its outer portion may fit freely over the outer periphery of the flange 35.

Bearing against the opposite or pump side of the flange 35 is a flexibly supported ring 37 secured to a diaphragm 38 in the same manner as ring 32 by means of a small sleeve 39 fitting tightly over the ring 36. The outer periphery of the diaphragm 38 is pressed firmly between a rubber grommet 43 overlying the end wall of a recessed portion of the casing 30 and a sleeve 42 fitting within the recess. The seal plate 31 when secured in position forces the sleeve 42 against the diaphragm 38. Within the casing 30 are drain passages 43 which, as shown, also extend thru the sleeve 42.

Ring 32 bears against the end wall of a counterbored portion of the seal plate 31 and a spring 40 forces ring 37, driving shaft 12, bearing collar 36, and ring 32 toward the right. A light spring 41 bears against ring 34 to force the ring 32 to the left in the event spring 40 fails or the shaft 12 is moved slightly to the left. Normally, however, the spring 40 exerts a stronger force to the right than spring 41 exerts to the left.

In the sealing arrangement shown in Figure 2, when the parts are in the positions shown in the drawing, both the sealing surfaces of ring 37 and ring 32 are maintained in sealing engagement with flange 12 and ring 36 respectively. If an inwardly directed end thrust is applied to the outer end of the shaft 12, the flange 35 moves inwardly with the shaft, thereby pressing more tightly against the seal ring 37. At the same time, the flange 35 tends to separate from the ring 36, and to permit separation of rings 36 and 32. This tendency is overcome, however, by the spring 41 which forces the rings 32 and 36 to follow the movements of the flange 35. Both sets of sealing surfaces are thereby maintained in engagement at all times, regardless of any end thrust which may be applied to shaft 12.

While I have shown and described certain preferred embodiments of my invention, other modifications thereof will readily occur to those skilled in the art, and I therefore intend my invention to be limited only by the appended claims.

What I claim is:

1. Apparatus for sealing a rotatable and limitedly translatable shaft to a housing thru which it passes, comprising a flange on said shaft, said housing having an opening greater in diameter than said flange to permit insertion of said shaft and flange therethru, a plate for closing said opening, said plate having an aperture smaller than said flange, said flange and plate cooperating to retain said shaft in said housing with said shaft projecting thru said aperture, a first ring of material of a low coefficient of friction between said flange and said plate, drain passages in said plate connecting both sides of said ring, a seal ring located on the opposite side of said flange and having a sealing surface facing said flange, a flexible diaphragm having its edges clamped between said plate and said housing and attached at its center to said seal ring for supporting the same, said diaphragm preventing rotation of said seal but permitting longitudinal movements thereof, and a spring retained between said housing and said ring for maintaining said seal ring in engagement with said flange, said spring also being effective to maintain said flange in engagement with said first ring, thereby forming a running seal to direct any fluid leaking past said seal ring into said drain passages, except when an inwardly directed end thrust is applied to said other end of said shaft, whereupon said spring permits separation of said flange from said first ring while maintaining said seal ring in sealing contact with said flange.

2. Apparatus for sealing a rotatable and limitedly translatable shaft to a housing thru which it passes, comprising a flange on said shaft, said housing having an opening greater in diameter than said flange to permit insertion of said shaft and flange therethru, a plate for closing said opening, said plate having an aperture smaller than said flange, said flange and plate cooperating to retain said shaft in said housing with said shaft projecting thru said aperture, a pair of seal rings located on the opposite sides of said flange and having respective sealing surfaces facing said flange, a pair of flexible diaphragms, each said diaphragm having its edges clamped to said

housing and attached at its center to one of said seal rings for supporting the same, said diaphragms preventing rotation of said seal rings but permitting longitudinal movements thereof, one of said seal rings lying between said flange and said plate, a first spring retained between said housing and the other of said rings for maintaining said other seal ring in engagement with said flange, said flange in sealing engagement with said one ring, and said one ring in engagement with said plate, and a second spring weaker than said first spring retained between said one ring and said plate for maintaining said one ring in sealing engagement with said flange upon inward movement of said shaft and flange due to the application of an inwardly directed end thrust on said other end of said shaft.

3. A fluid sealing apparatus comprising: a casing, a rotatable and limitedly translatable and tiltable shaft housed in said casing without bearing contact therewith, a flange on said shaft, said casing having an opening greater in diameter than said flange for the location of said shaft and flange wholly within said casing, a plate for closing said opening, said plate having an aperture smaller than said flange, said flange and plate cooperating to retain said shaft in said casing with said shaft projecting through said aperture without bearing contact with said plate, a first seal ring of material of a low coefficient of friction between said flange and said plate and forming a running seal with said flange, a second seal ring located on the opposite side of said flange, a flexible diaphragm having its outer edge clamped to said housing and attached near its center to said second seal ring for supporting the same, said diaphragm preventing rotation of said second seal ring but permitting longitudinal movement thereof, a drain passage opening into the space between said first and second seal rings, and a spring retained between said casing and said second seal ring for maintaining said seal ring in engagement with said flange, said spring also being effective to maintain said flange in engagement with said first seal ring, thereby forming a double running seal wherein any fluid leaking past either seal ring drains into said passage.

TRENT H. HOLMES.

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