

April 23, 1942.

J. KANUCH ET AL

2,281,157

OIL PUMP SEAL ASSEMBLY

Filed Oct. 23, 1940

Fig. 1

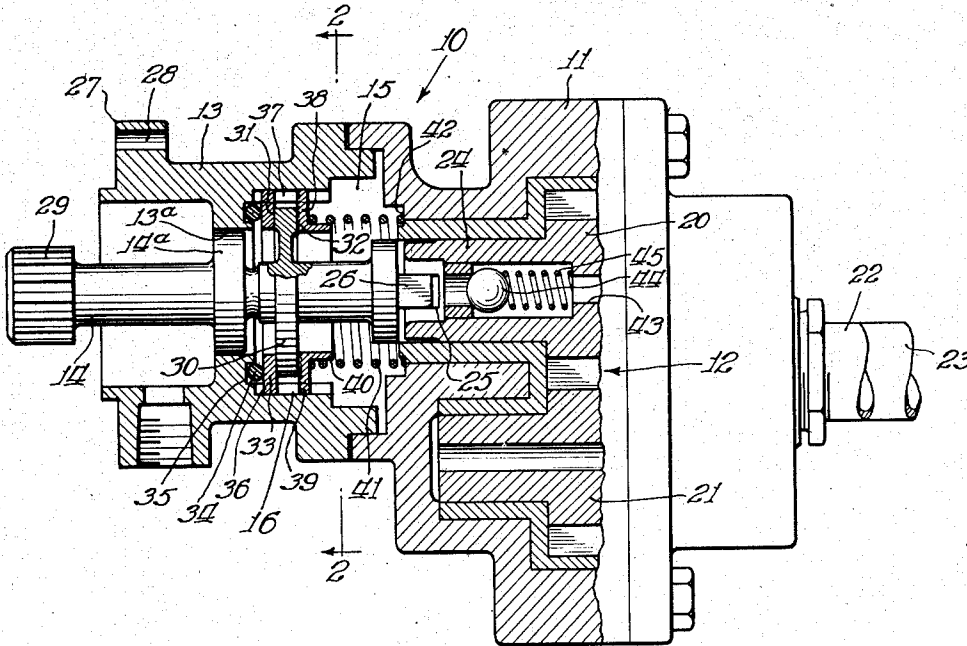


Fig. 2

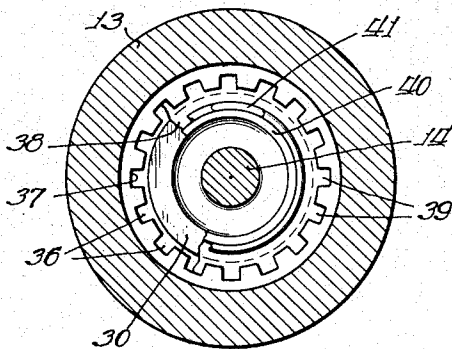
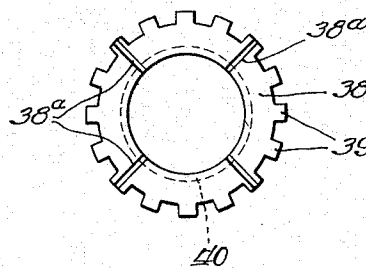


Fig. 3



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UNITED STATES PATENT OFFICE

2,281,157

OIL PUMP SEAL ASSEMBLY

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Application October 23, 1940, Serial No. 362,461

4 Claims. (Cl. 286—7)

This invention relates to pumps and particularly to an improved seal assembly between the pump draft shaft and housing.

It is an object to provide an improved arrangement of elements cooperating with the radial flange of a pump drive shaft for effecting a seal therebetween to prevent the inadvertent leakage thereby of the fluid being pumped. A more specific object is to provide a sealing arrangement of the present type wherein the usual end thrust imposed on the pumping element by the spring positioned between the drive shaft and the pumping element is eliminated, thus reducing the end wear on the pumping element. A further specific object is the provision of resilient means for urging the sealing elements into engagement, which arrangement eliminates the normal tendency to cause cocking of the drive shaft. Still another specific object is the provision of an improved arrangement of the above type including seal and bearing elements engaging a radially extending flange on both faces thereof and wherein the resilient means is maintained stationary thus improving, among other things, the alignment and effectiveness of the sealing assembly. It is also a specific object to provide an improved assembly of the above type wherein the fluid pressure within the pump housing acts against the sealing means to increase the effectiveness thereof.

Other and more specific objects, advantages and uses of our invention will become apparent from the reading of the following specification taken in connection with the accompanying drawing forming a part thereof and wherein:

Fig. 1 is a broken-away axial cross-section of a pump embodying the present invention;

Fig. 2 is a transverse section taken substantially on the line 2—2 of Fig. 1 with certain of the pumping structure broken away; and

Fig. 3 is a view showing the innermost one of the bearing washer elements and bringing out to advantage one arrangement of grooves thereon for effecting lubrication.

Referring now in greater detail to the figures of the drawing, we have indicated generally at 10 one form of pump assembly incorporating a preferred embodiment of our invention. This pump assembly includes essentially a main pump housing 11 containing pumping mechanism indicated generally at 12, and adaptor or drive shaft housing 13 containing a pump drive shaft 14.

Defined between adjacent portions of the adaptor housing 13 and pump housing 11 is a seal chamber 15 surrounding the inner portion of

shaft 14, this chamber containing a special arrangement of seal structure 16 for preventing the fluid being pumped from leaking thereby and discharging from the adaptor housing along the outer end portion of shaft 14. It is to this novel seal construction in combination that our invention is particularly directed.

The particular pumping mechanism shown for purposes of illustration and indicated generally at 12, comprises a pair of intermeshing gears 20 and 21 which function to receive liquid from inlet opening 22 and discharge the same from outlet opening 23 in a well-known manner. Gear 20 is formed with an extension 24 provided on the forward portion thereof with a transverse slot 25 for cooperation with a complementarily formed tongue 26 on the end of shaft 14, thus defining a flexible joint connection providing for a positive drive between shaft 14 and gear 20, while at the same time providing for a limited amount of axial misalignment. The present construction of pump has been found to be particularly adaptable for use on aircraft in which installations the pump is mounted on the aircraft engine to be driven therefrom. Adaptor housing 13 is fastened to the aircraft motor housing by means of flange 27, this flange being perforated as indicated at 28 for the reception of suitable fastening bolts. Shaft 14 is formed on the exterior end thereof with a gear 29 adapted to mesh with a driving gear of the aircraft motor.

In the general relationship above outlined, it has been found that peculiar and difficult seal problems are presented. Due to the fact that shaft 14 must be in effect a floating shaft, this problem is made additionally difficult. It will be noted that shaft 14 has provisions for a limited amount of axial reciprocation as well as provision for a limited amount of axial misalignment with gear 20. In other words, the axis of shaft 14 is allowed a limited amount of play to take care of the irregularities that are usually present. This variation in the axis of shaft 14 is indicated in an exaggerated manner by dotted lines x' while the normal axis of shaft 14 is indicated by dotted line x , which is the fixed axis of rotation of gear 20. It will be observed that in practice this variation is so very small as not to be particularly discernible, nevertheless it is a real factor in the operation of this type of pump.

The seal construction indicated generally at 16 has been devised with special reference to the problem of providing an effective seal for floating shaft 14. This shaft is formed intermediate

the ends thereof with a radially outwardly extending flange 30, this flange being defined in part by axially and oppositely facing bearing surfaces 31 and 32. Cooperating with bearing surface 31 is a washer-like bearing ring 33 effective to prevent the flow of liquid therebetween. On the opposite side of washer-like bearing ring 33 the same engages a compressible ring-like member 34 carried in an annular groove 35 formed in the adjacent portion of adaptor housing 13. This ring likewise functions to prevent the flow of liquid between it and the structure engaged thereby. Compressible ring 34 may be made of any one of the commercially available materials such for example as "duprene." For preventing the rotation of thrust ring 33 the same is formed at the periphery thereof with radially extending teeth 36 cooperating with complementarily formed axially extending splines 37 on the inner periphery of the adaptor housing 13 within seal chamber 15. The fit between the teeth 36 and splines 37 is sufficiently close so that the leakage thereby is not appreciable, however such leakage as does occur is of no significance in view of the sealing relation between the "neoprene" ring 34, thrust washer-like member 33 and bearing surface 31.

The opposite thrust bearing surface 32 on flange 30 is engaged by a second washer-like bearing ring 38 similar to member 33 in being provided with teeth 39 for cooperation with spline 37 but differing therefrom in being provided with an axially extending flange portion 40. A coil compression spring 41 has one end portion thereof embracingly received about flange 40 in engagement with the body portion of bearing ring 38 while the other end thereof is received in an annular channel 42 formed in main housing 11.

It is important to note that spring 41 exerts pressure between the housing 11 and the bearing washer-like member 38 at a position considerably removed from the normal axis X of shaft 14 and gear 20 as differentiated from the previously followed practice of interposing a spring corresponding to spring 41 between gear 20 and shaft 14. This has the important effect of removing undesirable end thrust pressure from gear 20 as well as the further desirable result of eliminating the tendency to cause cocking of shaft 14, which tendency is present where the spring is located closely adjacent to the axis X.

Referring to Figure 3, it will be seen that bearing ring 38 is formed with radially extending grooves 38a in the face thereof for the purpose of effecting the proper lubrication. Four of these lubricating grooves 38a are shown. However, any other desired number may be employed. We have found that where four of these grooves are employed satisfactory results are obtained by making these grooves $\frac{3}{8}$ " wide x $\frac{1}{64}$ " deep. While we disclose bearing ring 38 formed about the entire periphery thereof with teeth for cooperation with complementarily formed splines on the interior of the housing, since this arrangement gives excellent results, it is to be understood that we contemplate as coming within the broad scope of our invention any smaller number of teeth that will give satisfactory results in a particular installation.

In addition to the above, shaft 14 is provided with an enlarged bearing flange 14a cooperating with bearing 13a formed in adaptor housing 13, the fit between bearing flange 14a and bearing 13a not being a sealed fit but permitting the

above described limited movement of the axis of shaft 14.

Gear 20 is formed with an axial passage there-through indicated generally at 43, the flow through this passage from sealed chamber 15 being limited by ball valve 44 held in engagement with its seat by means of spring 45. Ball valve 44 is thus effective to limit the maximum pressure that may be built up in seal chamber 15. Passage 43 within gear 20 is arranged in communication with the pump inlet in a well-known manner not shown in detail.

It will thus be seen that we have provided a sealing arrangement for a floating shaft which is both responsive to a predetermined fluid pressure and to spring means for assuring the effectiveness thereof. We have further provided an arrangement of seal means which permits a limited amount of shifting of the axis of shaft 14 without destroying the effectiveness of the seal which arrangement includes moving the position of application of spring 41 sufficiently away from the normal axis of the shaft to prevent the spring from causing further cocking when the axis of the shaft 14 is moved out of line with the axis gear 20.

While we have illustrated our invention in connection with a gear type pump, it will be understood that the same is equally applicable to other pump assemblies wherein the present problem exists. More specifically, our invention is applicable in all situations similar to that here disclosed wherein a floating shaft is employed having one portion thereof subject to fluid pressure and requiring the other portion thereof to be sealed from said first portion while at the same time permitting of a limited amount of axial displacement of the normal axis of the shaft.

While we have disclosed our invention in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration and not by way of limitation and that the following claims are to be construed as broadly as the prior art will permit.

We claim:

1. In a sealing arrangement between the drive shaft and housing of a pump assembly including a shaft extending into said housing and being formed at the outer end thereof for cooperation with a source of driving power and formed at the inner end thereof with a tongue-like connecting element adapted for cooperation with a complementarily formed extension on a pump gear for driving the same, a radially outwardly extending axial thrust receiving flange formed intermediate the ends of said shaft, said flange being defined in part by a pair of oppositely facing axial thrust receiving surfaces, a circular opening formed in said housing through which said shaft extends, said opening being smaller in diameter than said flange but providing for slight axial adjustment between said housing and said shaft, said flange being disposed within said housing and adjacent said opening, a resilient seal ring in engagement with the inside of said housing about said opening, a generally flat metal bearing washer-like member in engagement on one side with said resilient seal ring and on the other side thereof with the adjacent thrust surface of said flange, a second metal bearing washer-like member in engagement with the opposite thrust surface of said flange, a coil compression spring having a diameter not substantially less than that of said flange received about said shaft with one end portion thereof in engagement with

said second bearing washer-like member for urging the same into engagement with said second thrust surface, the other end portion of said coil spring being in engagement with said housing at a point removed axially inwardly of said housing from said flange, at least one axially extending spline on said housing, complementary recesses in the periphery of said washer-like members for preventing the same from turning when said flange thrust surfaces are turned relative thereto by the rotation of said shaft;

2. In a pump housing seal assembly for a floating drive shaft extending therein and adapted for connection to a pumping element for rotating the same, said shaft being formed intermediate its ends and within said housing with a radially extending flange providing a pair of opposed transverse bearing surfaces for receiving axial thrust, and means engaging said surfaces for applying axial pressure to effect a seal preventing the discharge of the fluid being pumped about said shaft, said means comprising a ring of resilient compressible material interposed between the inside of said housing and a first one of said bearing surfaces, a first metal bearing washer-like member interposed between said ring and said first bearing surface, a second metal bearing washer-like member in engagement with the opposed bearing surface of said flange and a coil compression spring surrounding said shaft having one end portion in engagement with said second washer-like member and the other end portion in engagement with said housing at a point removed axially inwardly of said housing with respect to said flange, said arrangement being further characterized by said housing being formed intermediate the ends of said shaft with a pair of adjacently facing annular grooves, said grooves having a diameter not substantially different from the diameter of said flange, one of said grooves receiving said resilient ring in engagement therewith and the other of said grooves receiving the remote end of said coil compression spring, and at least one axially inwardly extending spline formed on said housing, complementary recesses in the periphery of said washer-like members cooperating with said spline for preventing the same from turning when said flange is turned relative thereto by the rotation of said shaft.

3. In a pump housing seal assembly for a floating drive shaft extending into said housing adapted to drive pumping elements therein, said shaft being formed intermediate the ends thereof with a radially extending flange adapted to be located within said housing and providing a pair of opposed axially spaced oppositely facing bearing surfaces and means defining a seal therewith for preventing the fluid being pumped from leaking thereby, said means comprising a ring composed of resilient compressible material interposed between said housing and a first one of said bearing surfaces, a first metal bearing washer-

like member interposed between said resilient ring and said first bearing surface, a second metal bearing washer-like member in engagement with the opposed bearing face of said flange and a coil compression spring surrounding said shaft having one end portion in engagement with said second washer-like member and the other end portion in engagement with said housing at a point removed axially inwardly of said housing and means on said housing cooperating with means on said washers for preventing the latter from rotating when said flange is turned between said washers by the rotation of said shaft, said means on said housing comprising radially inwardly extending splines and said means on said washers comprising peripheral teeth complementary in form to and received between said splines on said housing.

4. In a pump housing seal assembly for a floating drive shaft extending therein and adapted for connection to a pumping element for rotating the same, said shaft being formed intermediate its ends and within said housing with a radially extending flange providing a pair of opposed transverse bearing surfaces for receiving axial thrust, and means engaging said surfaces for applying axial pressure to effect a seal preventing the discharge of the fluid being pumped about said shaft, said means comprising a ring of resilient compressible material interposed between the inside of said housing and a first one of said bearing surfaces, a first metal bearing washer-like member interposed between said ring and said first bearing surface, a second metal bearing washer-like member in engagement with the opposed bearing surface of said flange and a coil compression spring surrounding said shaft having one end portion in engagement with said second washer-like member and the other end portion in engagement with said housing at a point removed axially inwardly of said housing with respect to said flange, said arrangement being further characterized by said housing being formed intermediate the ends of said shaft with a pair of adjacently facing annular grooves, said grooves having a diameter not substantially different from the diameter of said flange, one of said grooves receiving said resilient ring in engagement therewith and the other of said grooves receiving the remote end of said coil compression spring, and means on said housing cooperating with means on said washer-like members for preventing the latter from rotating when said flange is turned between said washer-like members by the rotation of said shaft, said means on said housing comprising a plurality of radially inwardly extending splines, said means on said washers comprising peripheral radially outwardly extending teeth complementary in form to said splines and received therebetween.

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