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ROTOR PUMP SEAL

Filed April 1, 1963

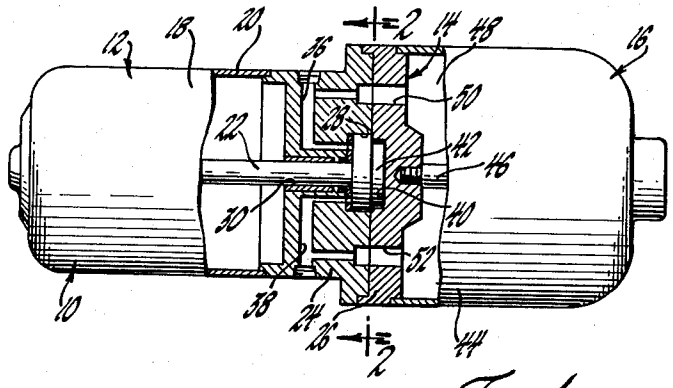


Fig. 1

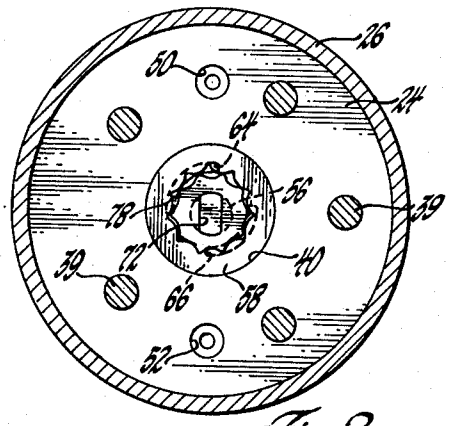


Fig. 2

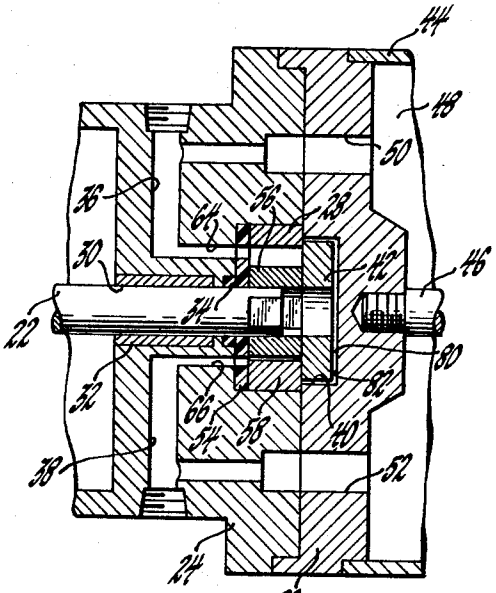


Fig. 3

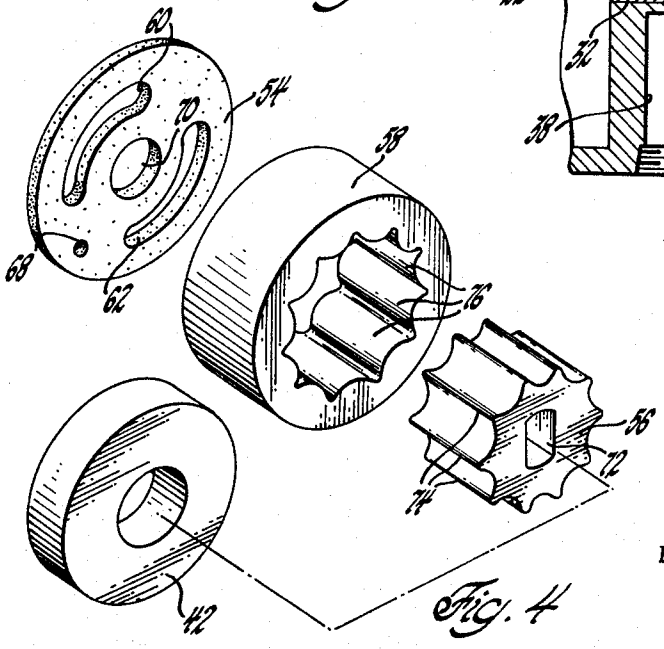


Fig. 4

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ROTOR PUMP SEAL

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This invention relates to fluid transfer pumps in general and more particularly to rotary pumps and the fluid sealing problems thereof.

Rotary pumps require that the parts thereof be machined to much closer tolerances than other type pumps. This applies to the fluid pumping faces of the pump parts but equally as well to the end-to-end dimensions of rotor parts and bores to preclude fluid volume and pressure losses either between or around the fluid transfer parts.

Providing an edequate fluid seal between relatively rotatably parts is always a problem but it is particularly difficult where several relatively rotatable parts are involved and small size pump parts are desirable.

A Gerotor type pump such as is used in a pump, motor and fluid reservoir assembly to supply hydraulic fluid to power cylinders of a convertible folding top mechanism provides a good example for explaining the scope of the problem mentioned and the solution to such problems offered by this invention.

In a Gerotor type pump there are cooperative and relatively rotatable internal and external rotor parts which are received within a rotor chamber or bore in a housing part. The rotor chamber or bore is closed at one end by a cover, or a housing part which serves such purpose, and the internal rotor is driven by a shaft extended through the other end of the housing and engaged therewith. The internal rotor drives the external rotor and both rotate relatively and with respect to the end walls of the rotor chamber.

In this type pump the inlet and outlet ports are formed through one of the rotor chamber end walls and are provided in open communication between the relatively rotatably rotor parts and on diametrically opposite sides thereof. Accordingly, any undue clearance between the ends of the rotor parts and the wall closing the rotor chamber provides a direct passageway between the fluid inlet and outlet ports.

A pump having a one-inch rotor will require tolerances as close as .0005 in the depth of the rotor chamber bore and .0003 thickness for the rotor parts. This usually means problems in matching rotor parts to each other as well as to particular housing bores, if losses are to be minimized, and requires further expense in this regard.

Just as close tolerances must be maintained to prevent fluid volume and pressure losses across the pump, it is also obvious that reasonable clearance or other means must be provided to enable free movement of the rotor parts without binding, scoring pressures or the like which might later cause pump failures or inefficiencies.

In the past efforts have been made to provide either a fluid pressure seal or a spring loaded seal between the rotor and cover members in this type of pump. However, neither have proven acceptable and the close tolerance requirements have prevailed.

Fluid pressure seals normally include a small disc received between the cover and rotor parts with means for applying the pump pressure between the disc and the cover to seat the seal on the rotor parts. The sealing pressure must be light to avoid any interference with the rotor drive and it must be effected before fluid passage occurs under the seal. Otherwise the seal is either seated against the cover or balanced up off the rotor parts and is ineffective.

Spring loaded seals on the other hand present numerous problems in small pump assemblies. They normally include a disc and a small spring or a spring washer which makes assembly extremely difficult. The spring or spring washer is received between the rotor chamber cover and the sealing disc. The spring pressure must be light to prevent binding and there is invariably a wear problem sooner or later.

It is an object of this invention to provide a fluid pressure seal for rotary pumps and others which is simple in construction, easily provided in a pump assembly, essentially wear resistant, frees tolerances, and is highly effective in use.

It is an object of this invention to provide a self-retaining and positionable seal having magnetic properties and responsive to proper seating fluid pressures.

The fluid seal of this invention includes a sealing ring or disc having magnetic characteristics for attraction and seating against the rotor members in a pump housing bore. It is disposed to receive pump fluid thereover, between itself and a closing cover member, to supplement the force of magnetic attraction and to keep the seal seated and prevent fluid passage between inlet and outlet parts. The flux attachment between the magnetic disc and rotor parts provides no hindrance to relative movement between the rotor parts and the resultant efficiency of the fluid pumps is immeasurably improved.

These and other objects and advantages to be gained in practice of this invention will be better understood and appreciated upon a reading of the following specification in regard to a preferred embodiment of the invention and having reference to the accompanying drawings wherein:

FIGURE 1 is a side view of a pump, motor and reservoir assembly having parts broken away and shown in cross-section to better show an embodiment of this invention used therein.

FIGURE 2 is an enlarged cross-sectional view of the pump portion of the assembly shown by FIGURE 1 as seen in the plane of line 2—2 thereon.

FIGURE 3 is an enlarged, fragmentary, and cross-sectional view of the pump portion of the assembly shown by FIGURE 1, with the details of the fluid pressure sealing means of this invention shown more clearly.

FIGURE 4 is an exploded view of certain pump parts and the fluid seal of this invention as taken from FIGURE 3.

FIGURE 1 shows an assembly **10** including a motor housing **12**, pump **14** and reservoir member **16**.

The motor housing **12** includes a housing shell **18** which is crimped or otherwise engaged as at **20** to the pump **14**. A reversible electric motor (not shown) is provided in the housing shell **18** and has the shaft **22** thereof extended into the pump **14** for driving engagement with the operable parts thereof.

The pump **14** includes a pump housing and cover parts **24** and **26** respectively.

Referring to FIGURE 3, the pump housing **24** has a cylindrical bore **28** provided in an end face thereof and receptive of the operable parts of the pump later described. A passage **30** is provided through the other end of the housing, from the bore **28**, for the drive shaft **22** and a suitable journal bearing **32** and fluid seal **34** are provided therein. In addition, interchangeable inlet and outlet passages **36** and **38** are provided through the housing and in communication with the bore **28**.

The cover part **26** of pump **14** is secured to the end of the housing part **24** by threaded bolt fasteners **39**. It includes a recess **40** formed in the face thereof abutting the housing part and in concentric alignment with the bore **28** which, as previously mentioned, is receptive of

the operative parts of the pump. The recess 40 is itself receptive of an annular disc 42 of magnetic material.

The reservoir member 16 includes a housing or shell 44 which is secured to the cover part 26 of the pump 14 by a tie bolt 46. A fluid reservoir chamber space 48 is provided within the housing or shell 44 and suitable reservoir passages 50 and 52 are formed through the cover and housing parts 24 and 26 of the pump 14 for communication with the inlet and outlet passages 36 and 38 of the pump.

The motor, pump and reservoir assembly unit 10 is of the type used to supply hydraulic fluid to one or more hydraulic cylinders such as may be used to operate a folding convertible top for automotive vehicles. Accordingly, a reversible motor is used to operate the pump for supplying fluid from one or the other of the inlet and outlet passages 36 and 38 through the pump and to the other thereof.

Although not specifically shown, it will also be appreciated that the reservoir passages 50 and 52 include check valve means to assure communication only between the inlet side of the pump and the reservoir chamber in the course of the fluid flow transfer. Such check valve means have not been specifically shown or described since they do not pertain to the present invitation other than as makes the overall fluid transfer system more efficient.

Referring now to FIGURES 2–4:

Within the pump bore 28 is provided a wear place 54 and concentrically disposed internal and external rotor parts 56 and 58.

The wear plate 54 is of plastic or like non-magnetic and wear resistant material. It is provided in the bottom of the rotor bore 28 and is formed to include crescent shaped inlet and outlet pasages 60 and 62 disposed on diametrically opposite sides thereof. Similarly formed and disposed inlet and outlet ports 64 and 66 are provided through the pump housing part 24 and extend from the rotor chamber bore 28 to the inlet and outlet passages 36 and 38 to provide means of fluid flow communication therebetween. The wear plate 54 includes a positioning detent 68 which serves to locate it within the rotor chamber bore with its inlet and outlet passages alinged with the fluid flow inlet and outlet ports.

Referring to FIGURE 2, it will be noted that the drive shaft 22 is received eccentrically within the rotor bore 28 and similarly through a shaft passage 70 in the wear plate. The end of the drive shaft 22 is in turn formed for driving engagement with the internal rotor member 56 within a D-drive slot 72 provided therein.

The internal or inner disposed rotor member 56 is formed to include teeth 74 formed for driving engagement with the outer disposed or external rotor part 58. The outer rotor part 58 is, in turn, formed to include lobes 76 between which the inner rotor teeth 74 are engaged and over which the teeth pass in the transfer of fluid in the manner commonly known with such cooperative rotor parts. For purposes of discussion the expanded and contracted fluid pockets formed between the rotor parts in the course of their relative rotation will henceforth be referred to as the pump chamber space and is identified in the drawings by the numeral 78.

The magnetic discs 42 which is disposed within the cover recess 40 is annular in shape and with an exteral rotor member which is one inch in diameter and it is about one-eighth inch in thickness. The disc is disposed to overlap both of the rotor parts and to close the ends of the chamber spaces provided therebetween. It is of less thickness than the cover recess 40 and a clearance space 80 is accordingly present between the disc and the end wall 82 of the cover recess.

The housing part 24 and cover part 26 are of a non-magnetic material, as a zinc or aluminum die casting, while the rotor parts 56 and 58 are themselves magnetically responsive.

The disc 42 is accordingly magnetically attracted and normally retained to the rotor parts by magnetic flux lines passing therebetween.

In the operation of the disclosed motor, pump and reservoir assembly 10 the magnetic disc 42 provides a fluid seal in the manner hereinafter described:

When the drive motor is started, the drive shaft 22 turns the internal rotor member 56 in one direction or the other and it in turn drives the external rotor 58 and the transfer of fluid across the pump commences.

Fluid flow is induced through one of the inlet and outlet passages 36 and 38 to the appropriate supply port 64 or 66. The reservoir check valve system (not shown) opens the appropriate reservoir passage 50 or 52 and closes the other thereof. Fluid flow is accordingly obtained through the inlet port to the rotor bore 28 and within the appropriate pump chamber spaces between the rotor members 56 and 58 in the course of their rotation.

The initial build-up of fluid pressure within the inlet fluid passage will also cause fluid to bleed and pass under the rotor part 56, about the end of the drive shaft 22, through the D-drive slot 72 in the rotor part 56 centrally through the annular magnetic disc 42 and to the clearance space 80 on the back side thereof and between the magnetic disc and the end wall 82 of the disc receptive recess 40 provided in the pump cover part 26.

The magnetic attraction of the annular disc 42 to the rotor parts assures an initial closure engagement over the chamber space between the rotor parts and also assures having the clearance space 80 over the disc.

The permissive bleeding or flow of fluid through the disc 42 to the clearance space 80 is provided to assure proper seating thereof, to supplement the force of magnetic attraction holding the annular disc in sealing relation over the rotor parts, and also to provide a light pressure seal to safeguard against fluid pressure within the pump chamber spaces having an initial build-up sufficient to lift the magnetic disc from its magnetically attracted engagement with the rotor parts and permit a by-passing fluid flow across the ends of the rotor parts which is the very thing to be avoided. The fluid pressure within the clearance space 80 is sufficient to counteract the fluid pressure within the pump chamber spaces 78 and to assure magnetic attraction of the disc 42 to the rotor parts precluding this cross flow. Furthermore, once this pressure build-up is obtained within the clearance space 80 the magnetic disc 42 itself, by the pressure applied on the opposite face of the internal rotor member 56 precludes any significant fluid flow to the clearance space or otherwise under the rotor parts and between the pump chamber spaces.

Neither the magnetic flux connection of the magnetic disc 42 to the rotor parts, nor the fluid pressure assuring such connection, interferes with the relative movement between the rotor parts. The flux lines of attraction are readily sheared and re-established at points of relative contact between the magnetic disc and the respective rotor parts.

The relative movement between the disc and rotor parts is minimal since it is only such as exists between the rotor parts themselves. That is, the magnetic disc 42 will rotate with one of the rotor parts and will move relative to the other thereof only in the same respect as the rotor parts more relative to each other.

No wear will be experienced as regards the magnetic disc 42 and the end wall 82 of the cover recess 40 since the two are not in engagement and a fluid film is provided therebetween.

With the magnetic seal of this invention, supplemented by the pressure seal in the manner disclosed, fluid flow through the pump 14 is through one of inlet and outlet passages 36 and 38, to the pump chamber spaces between the rotor members 56 and 58 and through the other of the inlet and outlet passages without significant fluid

volume or pressure loss therebetween as experienced with conventional Gerotor pumps.

Without further discussion it should be obvious that some variations, modifications, alternate arrangements in structure and the like are conceivable and within the scope of this invention.

Although a preferred embodiment and arrangement of structure has been specifically shown and described in detail, it will be appreciated that this has been done to illustrate the scope of the present invention and without intent to unnecessarily limit the invention thereto in any regard. Accordingly, such improvements, modifications and alterations as come to mind and are within the spirit of this invention and are not specifically excluded by the language of the hereinafter appended claims are to be considered as inclusive thereunder.

We claim:

1. In a rotor gear pump including a fluid receptive chamber and having a pair of relatively rotatable gear-toothed fluid pumping rotor members provided in concentric and eccentric relation therein, with fluid transfer spaces provided therebetween in the course of their rotation and open on one axial side of said chamber,

the method of sealing said pump against fluid flow between said transfer spaces, comprising;

providing means in magnetically retained obstructing relation across the open ends of said transfer spaces.

2. The method of sealing a rotor gear pump of claim 1, and including;

magnetically attracting said means to at least one of said rotors for rotation therewith and from engagement with the end wall of said chamber.

3. The sealing method for rotor gear pumps of claim 2, including;

biasing said magnetically attracted means for engagement with said rotors just prior to and in the course of fluid transfer through said pump.

4. In a rotor gear pump including a fluid receptive chamber and having a pair of relatively rotatable gear-toothed fluid pumping rotor members provided in concentric and eccentric relation therein, with fluid transfer spaces provided therebetween in the course of their rotation and open on one axial side of said chamber,

sealing means, comprising;

an axially moveable disc provided on the side of said chamber on which said fluid transfer spaces are open,

and means magnetically attracting said disc to said rotors for rotation therewith and the closing of the spaces formed therebetween.

5. In the rotor gear pump of claim 4,

said disc being magnetic for attraction to said rotors and said chamber having a non-magnetic end wall on the opposite side of said disc from said rotors.

6. In a rotor gear pump including a fluid receptive chamber and having a pair of relatively rotatable gear-toothed fluild pumping rotor members provided in concentric and eccentric relation therein, with fluid transfer spaces provided therebetween in the course of their rotation and open on one axial side of said chamber,

sealing means, comprising;

an axially magnetic disc of a thickness receptive between the ends of said rotors and the end wall of said chamber next thereof for magnetically retained engagement with the former closing said fluid transfer spaces and spaced disposition apart from said chamber end wall.

7. In a rotor gear pump including a fluid receptive chamber and having a pair of relatively rotatable gear-toothed fluid pumping rotor members provided in concentric and eccentric relation therein, with fluid transfer spaces provided therebetween in the course of their rotation and open on one axial side of said chamber,

means for preventing the flow of fluid between said transfer spaces and across the ends of said rotors, comprising;

a chamber closing cover having a chamber joining clearance space provided therein,

an axially moveable disc provided in said clearance space,

said disc being magnetic and said chamber closing cover being non-magnetic.

and said rotor members being of a material attractive of said disc in overlapping end engagement therewith and therebetween for closing said transfer spaces.

8. In the rotor gear pump of claim 7;

fluid passage means provided through said disc to the back side thereof for fluid pressure supplementation of the attractive force holding said disc in engagement with said rotor parts.

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