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Becker et al.

[11] **3,876,347**

[45] **Apr. 8, 1975**

[54] **GEAR PUMP OR MOTOR WITH UNITARY FLEXIBLE END SEAL PLATE**

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[73] Assignee: **Sperry Rand Corporation,** Troy, Mich.

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[52] **U.S. Cl.** **418/133**
[51] **Int. Cl.**..... **F01c 19/08;** F03c 3/00; F04c 15/00
[58] **Field of Search** 418/131–133

[56] **References Cited**

UNITED STATES PATENTS

2,702,509	2/1955	Garnier	418/133
3,213,799	10/1965	Trick	418/132
3,213,800	10/1965	McAlvay et al.	418/132
3,270,680	9/1966	Rich	418/132
3,376,824	4/1968	Turolla	418/132

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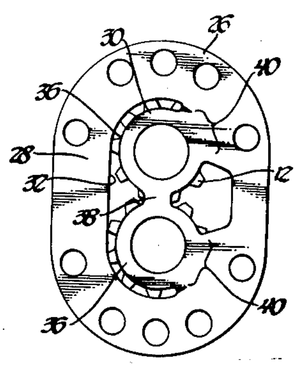
[57] **ABSTRACT**

A gear pump has a seal for the end faces of the gears formed of a flexible plate clamped between body parts at its periphery. The inner part of the plate is physically separated from the periphery by a through-slot along the pressure arc of the gears and by an opening along the intake arc; being joined to the periphery only along a short arc of less than 90° adjacent the intake arc by a cantilever beam portion of the plate. This allows freedom for the sealing portion to maintain flatter contact with the gear end faces, particularly at the arc of tooth intermesh.

2 Claims, 5 Drawing Figures



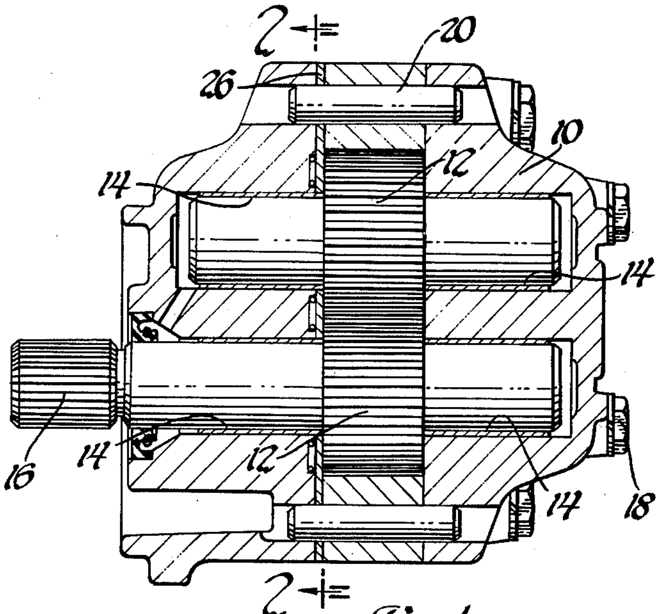


Fig.1

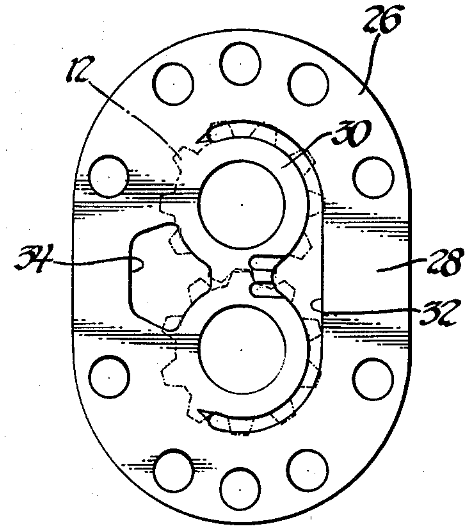


Fig.3

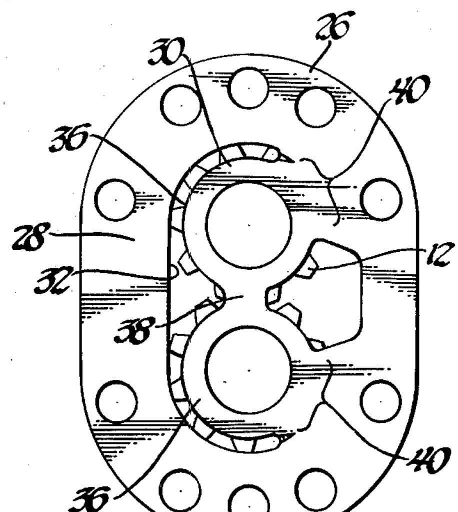


Fig.4

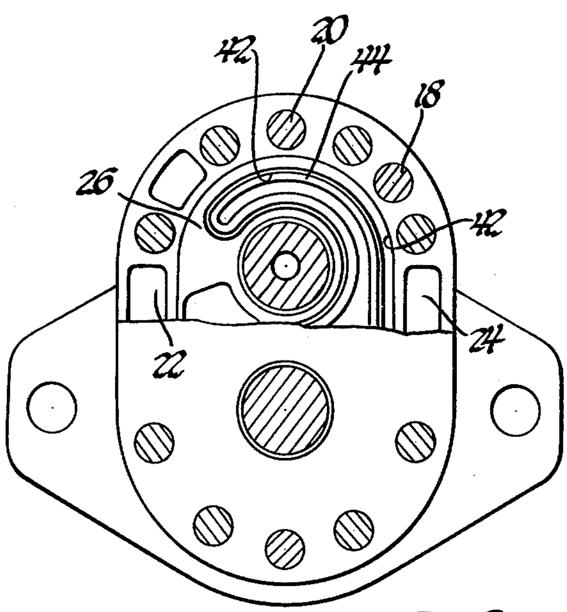


Fig.2

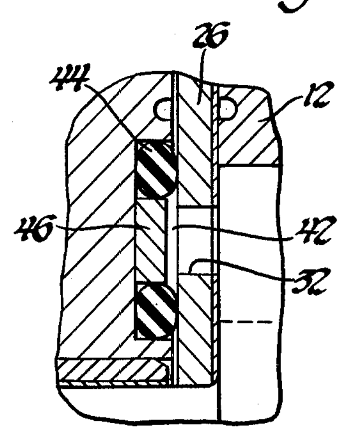


Fig.5

GEAR PUMP OR MOTOR WITH UNITARY FLEXIBLE END SEAL PLATE

Gear pumps, particularly those for high pressure hydraulic service, depend for satisfactory operation upon maintaining low running clearances between the rotary and stationary parts. One of the most troublesome problems lies in sealing the end faces of the gears to the body, both at their toothed portions and at their hub portions. Customarily, some form of pressure loaded sealing member is utilized to contact one end face of the gears and be pressed inwardly by hydraulic pressure. The problem has been dealt with in two principal ways over the years, the first being to provide a rigid sliding cheek plate to which pressure is applied over a limited area to maintain sealing contact with the gear faces. Rigidity is required because the pressure gradient increases from zero to maximum around the arc of each gear as the teeth pass from inlet to outlet. The counterpressure on the back of the cheek plate, however, is a constant value derived from the outlet, and if the cheek plate were flexible, excessive pressures would develop adjacent the inlet. Typical of these approaches are the patents to Beust U.S. Pat. No. 2,044,873 and Hilton U.S. Pat. No. 2,842,066. The other approach has been to utilize a thin flexible cheek plate larger than the gear cavity in the body and bendable into contact with the gear faces by pressure applied over selected areas and derived from several points along the pressure gradient. See, for example, the patent to Miller U.S. Pat. No. 2,809,592.

The disadvantage of the first approach lies in the additional leakage path and the consequent loss of efficiency which is introduced by the need for sliding motion between the cheek plate and the gear cavity at the latter's periphery. The disadvantage of the second approach lies in the need for a large number of separate pressure cavities which are required to be placed along the arc of the pressure gradient if excessive local pressures are not to be experienced along various portions of the flexible sealing plate.

Attempts to avoid both these pitfalls have included such devices as shown in Turolla U.S. Pat. No. 3,376,824 in which a rigid plate is provided with a weakened portion adjacent the gear peripheries to permit flexing toward and away from the gear faces without a sliding seal at that point, and yet which retains the rigidity of a thick plate along the principal sealing areas and thus permits the application of outlet pressure over a unitary area of the back face of the plate. Such a seal plate is, however, difficult and costly to manufacture, involving grooves of graduated depth and does not lend itself to economical production.

All of the foregoing approaches to cheek plate sealing are faced with the problem that the hydraulic pressure on the sealing face of the cheek plate is a variable one, building up along a gradient extending throughout the long arc of tooth travel from the inlet to the outlet, whereas the pressure most conveniently available to apply to the back side of the cheek plate is outlet pressure. The present invention approaches the problem by drastically reducing the arc along which the pressure gradient builds up and thus allowing a major portion of the arc of the gears, including the meshing arc, to be subjected to outlet pressure on both the sealing face and the back face. This permits the use of a thin flexible plate which can be manufactured by economical methods such as die cutting. The seal plate itself, however, effectively avoids excessive contact pressures because full outlet pressure can be applied against both its sealing and its back faces throughout a long arc of the face of each gear and this is an arc which includes the tooth meshing arc and is critical to efficient sealing and operation.

The invention embraces a gear pump or motor comprising a plurality of gears with hub portions and toothed portions having end faces in common planes, a driveshaft for one of the gears, a multi-part body enclosing and providing rotary support for the gears, means forming inlet and outlet connections to points on opposite sides of the gear meshing point, a movable sealing plate at one end face of the gears, means in the body for applying outlet pressure to urge the sealing plate into contact with the gears, the sealing plate having a contour to overlie the toothed portions solely along arcs no larger than 90° adjacent the intake point and along the arc of intermesh and to overlie the hub portions throughout their circumference.

IN THE DRAWINGS

FIG. 1 is a cross sectional view of a gear pump embodying a preferred form of the present invention.

FIG. 2 is an end view, partially in section along line 2—2 of FIG. 1.

FIG. 3 is a view of the sealing face of the sealing plate.

FIG. 4 is a view of the back face of the sealing plate.

FIG. 5 is a fragmentary sectional view of a portion of FIG. 1.

The gear pump in the embodiment of the invention which is illustrated includes a three-part body **10** which encloses a pair of gears **12**, each of which has shafts journalled in bearings **14**, one of them having a driveshaft **16**. The three parts of the body **10** are secured together by bolts **18** and dowels **20** and have the usual inlet and outlet connections **22** and **24**, all of which are typical of one of the many forms of hydraulic gear pumps.

Clamped between two of the parts of the body **10** is a flexible sealing plate **26**. This plate is preferably made of a bimetallic material such as, for example, a steel backing and a bronze bearing material on the sealing surface.

The configurations of the sealing plate **26** comprises an oval outline and generally consists of two principal portions, the peripheral portion designated **28** and the sealing portion designated **30**. These two portions are separated by a through-slot **32** which is generally in the shape of a FIG. **3** and by a hole or opening **34** opposite the inlet portion of the pump body. These, along with the bolt and dowel holes, are preferably stamped out of a flat blank of material and leave a sealing portion **30** which is generally in the shape of a pair of eyeglass frames. These include something over 270° of annular sealing portion **36** alongside each gear and aligning radially with the face of the hub portion of each. The two annular portions **36** are connected at the tooth intermeshing area by a bridge **38**. Cantilever beam sections **40** connect each of the annular sealing portions **36** with the peripheral portion **28** and act as bendable beams permitting the sealing portions to be pressed against the end faces of the gear hubs while the peripheral portion **28** is rigidly clamped between the body parts.

For the purpose of applying sealing force to the plate **26**, referring to FIGS. **2** and **5**, the adjacent body part at the back of the sealing plate **26** is provided with a symmetrical recess **42** which registers with the groove **32** and extends radially inwardly over the sealing portions **36** to a limited extent. The recess **42** also extends circumferentially around beyond the ends of the slot **32** approximately half way across the bridges **40.** Within this cavity, there is provided a shaped elastomeric seal **44** which may be held in position by a spacer **46.** The cavity **42** is open to outlet pressure through the slot **32.**

In operation with the pump running under pressure, the thin flexible sealing plate **26** has its peripheral portion **28** clamped rigidly between the body parts and its sealing portion **30,** free to move as permitted by the bendable beam portion **40.** Fluid pressure from the outlet passes through the slot **32** to the pressure chamber **42** and exerts full outlet pressure over that portion of the sealing portion **30** which lies within the chamber **42** as well as over the portion of the bridges **40** which also lie within the chamber **42.** The sealing face is exposed to full outlet pressure along the interface with the gear hubs through an arc extending from the tooth intermeshing point circumferentially around to the ends of the slot **32.** This separating force is substantially balanced by the pressure applied within the chamber **42** over the same arc but over a different distance in a radial direction. The bridges **40** are subjected to bending forces by this pressure and yield to the extent of permitting the sealing portion **30** to take up a position in close running contact to the end faces of the gear hubs and to maintain the clearance at an optimum value commensurate with the film strength of the oil at any given set of conditions. In this way, there is no need to utilize comparatively rigid cheek plates or with flexible ones to provide separated areas, each connected to hydraulic pressure at a different level along the arc of gear tooth travel.

We claim:

1. A pump or motor comprising a plurality of intermeshing gears with a driveshaft for one of them, a multi-part body enclosing and providing rotary support for the gears, means forming inlet and outlet connections to points on opposite sides of the meshing point of the gears, an improved end seal for the gears including a unitary flexible plate of uniform thickness having a peripheral portion clamped between body parts in a plane adjacent the gear end faces and having a sealing portion providing connected annular surfaces adapted to be pressed against the gear end faces and which are separated from the peripheral portion throughout more than 270° of arc at each gear by a through-slot surrounding the high pressure arcs of the gears and by an opening adjacent the fluid intake arc of the gears, the plate having short bendable beam portions connecting the peripheral portion and the sealing portion along arcs of the gears between the ends of the slot and the opening, and means forming a pressure chamber in the body adjacent the back face of the plate and shaped to surround the slot and apply outlet pressure to the sealing portion along the meshing point and the high pressure arcs of the gears and to a part of the beam portion.

2. A pump or motor as defined in claim **1** with the sealing portion being shaped in the form of an eyeglass frame and separated from the peripheral portion by a slot in the form of a FIG. **3.**

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