Feb. 14, 1967 NOBUO MORITA 3,303,793

ROTARY GEAR PUMP

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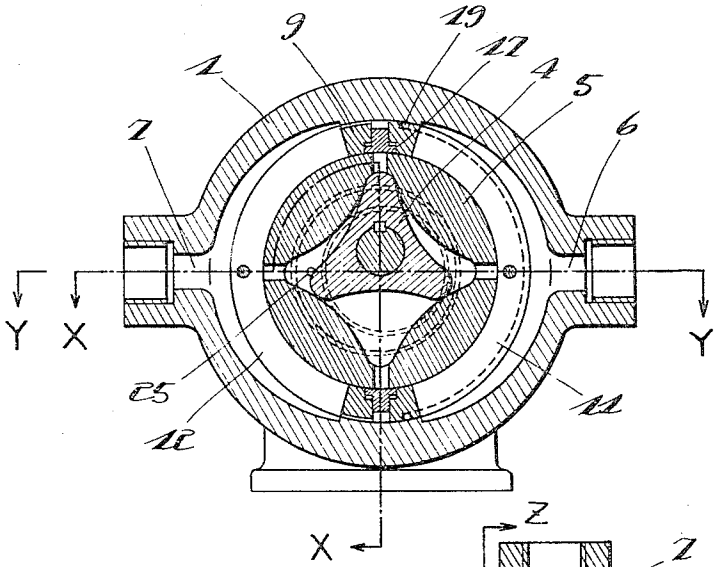


Fig. 1

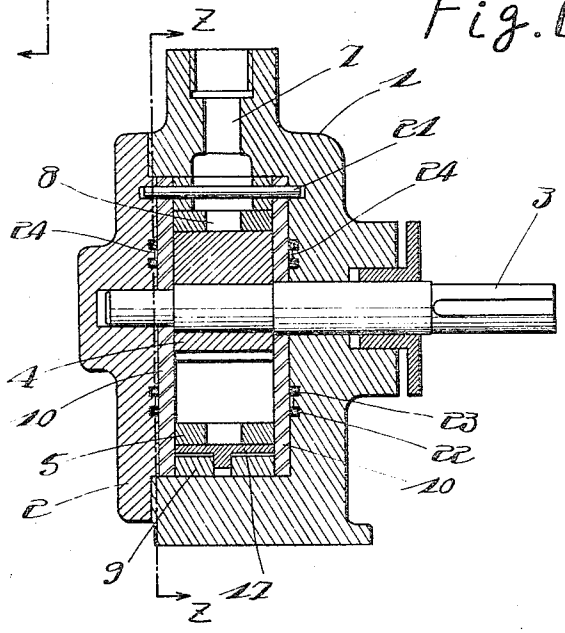
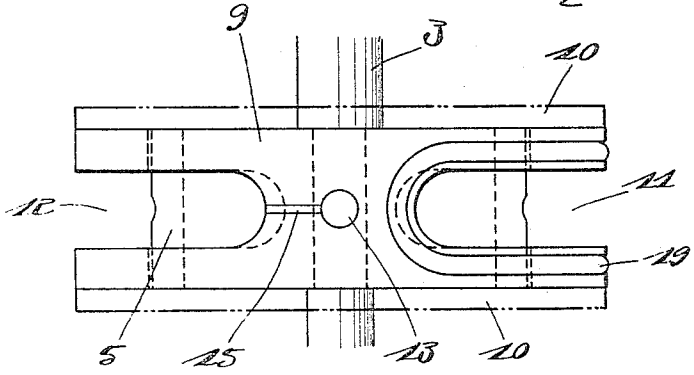


Fig. 2

Fig. 3



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Fig. 4

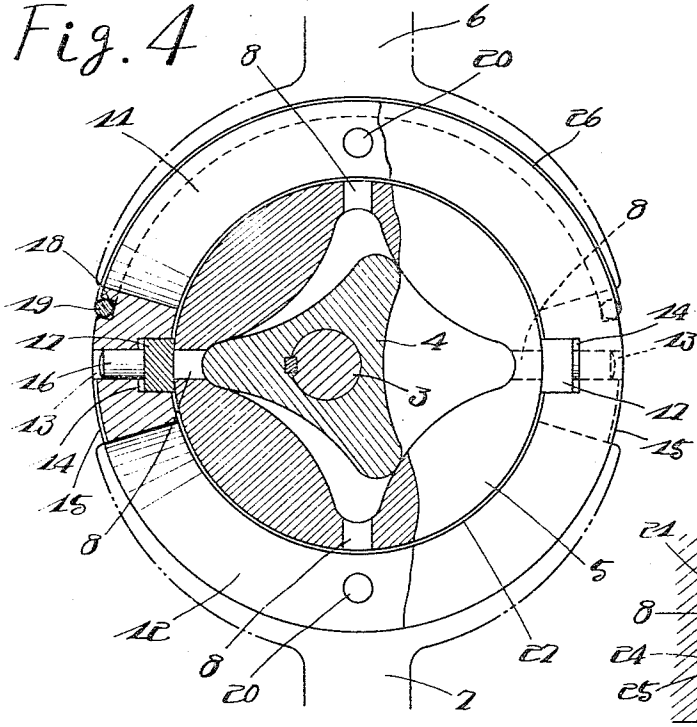


Fig. 5

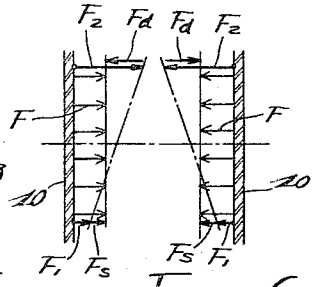


Fig. 6

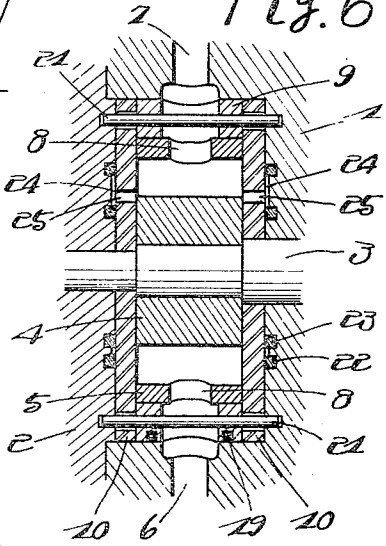
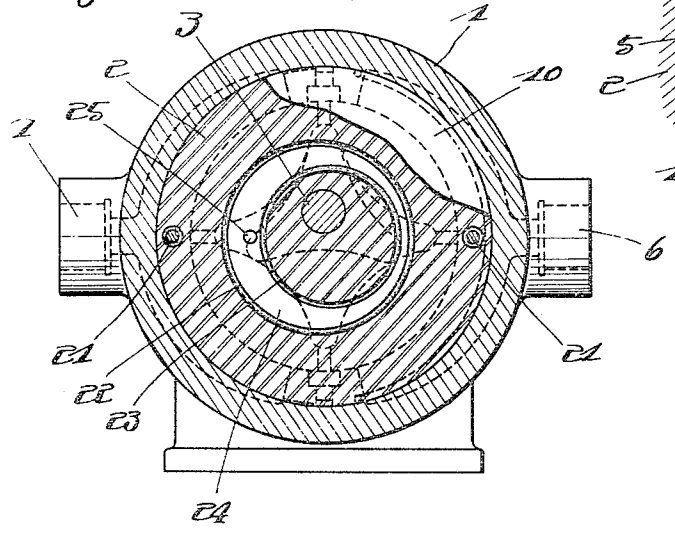


Fig. 7



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Fig. 8

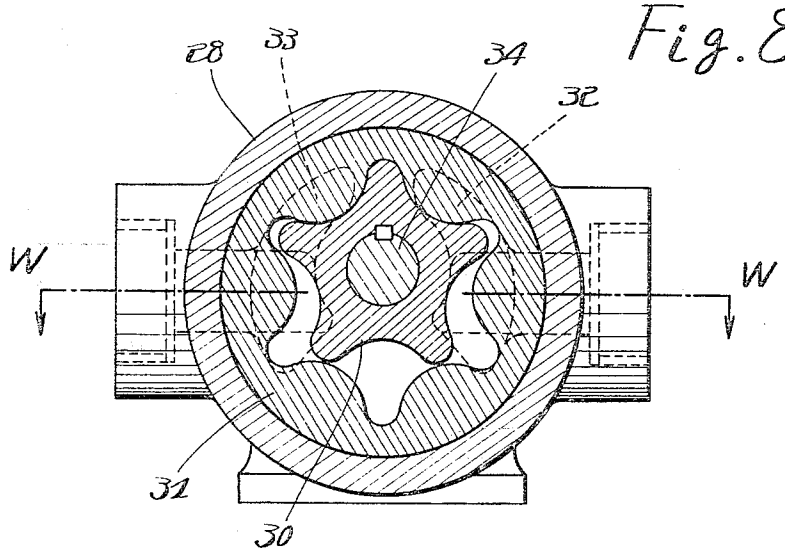
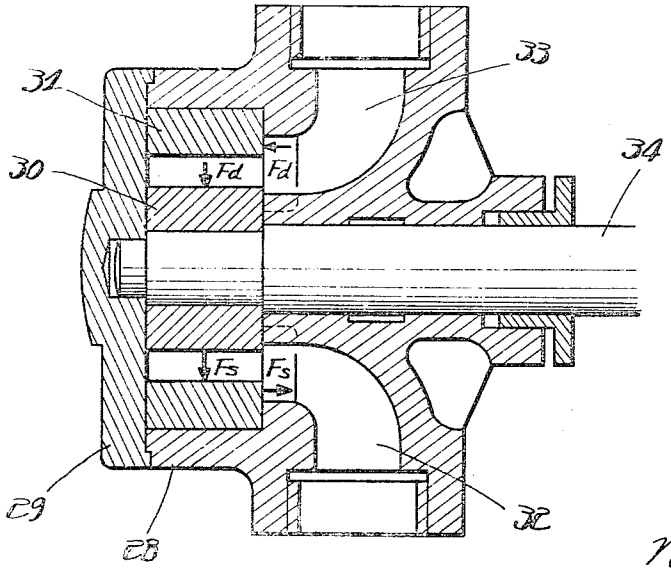


Fig. 9



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3,303,793

ROTARY GEAR PUMP

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Claims priority, application Japan, Aug. 17, 1965, 40/50,248
1 Claim. (Cl. 103—126)

The present invention relates to a rotary gear pump of the kind that a pair of rotors arranged in an inscribed relation are kept oil-tight with a pair of discs in the both sides and with a pair of blocks in the circumference by the application of its own delivery pressure, in order to protect the sliding members from uneven wearing and check the reverse flow of liquid from delivery to suction side so as to improve the volume efficiency of pump in high pressure delivery.

It is of known practice in rotary gear pumps for feeding pressure oil to hydraulic system that manufacturing tolerances and gear profiles are taken as major factors to minimize the wearing loss and pocketing phenomenon so as to improve the volume efficiency of pump. Rotary gear pumps of known practice are however impossible to maintain sufficiently high volume efficiency over a long period in high pressure delivery where the clearances around the rotors are an important factor to determine the volume efficiency of pump.

In a conventional type of rotary gear pump as shown in FIGS. 8 and 9, sectioned vertically in the former and taken on the W—W line in the latter, an outer rotor **31** and an inner rotor **30** inscribed in it are rotating in a slidingly engaged relation with each other in a casing **28** and cover **29** with a suction port **32** and a delivery port **33** opening at either side of rotors **30** and **31**. In such a mechanism of rotary gear pump, both the rotors **30** and **31** are given positive reactions F*d* due to delivery pressure and negative reactions F*s* due to suction pressure in quite an unbalanced manner not only to wear sliding members of pump unevenly but also to place excessive bending stress on the shaft **34**. The uneven wear of sliding members will naturally enlarge the circumferential clearances of rotors so as to increase the reverse flow of liquid from delivery to suction side and therefore to decrease the volume efficiency of pump. The excessive bending stress on shaft will naturally lower the mechanical efficiency of pump.

The above-described disadvantages of conventional rotary gear pumps are overcome by the present invention, which will be more apparent from the following description of a preferred form of embodiment shown by way of example in the accompanying FIGS. 1 to 7.

FIG. 1 is a vertical section of a rotary gear pump in accordance with the invention.

FIG. 2 is a horizontal section taken on the line X—X in FIG. 1.

FIG. 3 is an enlarged plan view showing the rotors and port ring of gear pump in FIG. 1.

FIG. 4 is a vertical section of FIG. 3.

FIG. 5 illustrates a balance of reactions acting on the discs shown in FIG. 2.

FIG. 6 is the cross-sectional detail along Y—Y line of FIG. 1.

FIG. 7 is a vertical section taken on the line Z—Z in FIG. 2.

The embodiment of the invention comprises a casing **1** provided radially with a suction port **6** and a delivery port **7**, a cover **2** closing the casing **1** firmly, a shaft **3** supported rotatably in the casing **1** and the cover **2**, an inner rotor **4** fixed on the shaft **3**, an outer rotor **5** engaging with the inner rotor **4** in an inscribingly slidable relation, a pair of discs **10, 10** embracing the outer rotor **4** and inner rotor **5** in a slidable relation at the both sides

of the rotors **4** and **5**, a pair of annular spaces **24, 24** respectively provided on the casing **1** and on the cover **2** in contact with the discs **10, 10**, a port ring **9** embracing the outer rotor **5** at the circumference of rotor **5** with oil wings **11** and **12** respectively extending in the suction and in the delivery side around the rotor **5**, and a pair of blocks **17, 17** with stems **16, 16** being in a slidably contact with the outer rotor **5** respectively at the top and at the bottom of rotor **5**. The outer rotor **5** is provided with a plurality of radial pores **8** each at a corner to connect the inside and the outside of the rotor **5**. Each of the annular spaces **24, 24** is margined by a pair of annular grooves with O-ring packings **22, 23** in them in a manner that one of the annular grooves is inside the other in such an eccentric relation as to have wider space between them in the delivery side of pump than in the suction side of it. The port ring **9** is provided with a pair of narrow apertures **13, 13** respectively at the top and at the bottom of it, each between the oil wings **11** and **12** in a normal direction to them. Each narrow aperture **13** is formed integrally with a wide aperture **14** in the radial direction of rotor **5** so as to guide slidably the block **17** in the wide aperture **14** and the stem **16** in the narrow aperture **13**. The oil wing **12** in the delivery side of pump is connected to the narrow aperture **13, 13** by way of canals **15, 15**. The oil wing **11** in the suction side of pump is provided with an endless groove **18** along the inner edge. The endless groove **18** is provided with a gasket packing **19**. Each of discs **10, 10** is provided with a pore **25** to connect the delivery side of rotors **4, 5** to the annular spaces **24, 24** through it. The port ring **9** is supported by pins **21, 21** received in pin holes **20, 20** provided in the casing **1** and the cover **2**.

In the operation of rotary gear pump in accordance with the invention, positive reactions F*d* due to delivery pressure and negative reactions F*s* due to suction pressure are acted to the inner walls of discs **10, 10**, and, at the same time, reactions F1 and F2 are acted to the outer walls of discs **10, 10** inwardly due to the pressure raised in the annular spaces **24, 24** where system oil is filled from the delivery side of rotors **4, 5** by way of the pores **25, 25**. The discs **10, 10** therefore receive inward even forces F which are resultants of the reactions F*d* partly cancelled by F2 and the reactions F*s* partly added by F1, as illustratively shown in FIG. 5. Thus the rotors **4** and **5** are given a same inward pressure evenly all over the both sides in contact with the discs **10, 10**. Meanwhile, the blocks **17, 17** are put into a sufficiently oil-tight contact with the cricumference of outer rotor **5** by means of the stems **16, 16** which is pressed inwardly by system oil applied to the ends of stems **16, 16** in the narrow apertures **13, 13** from the oil wing **12** in the delivery side of pump by way of canals **15, 15**. Thus the delivery side clearance **27** is definitely closed to the suction side clearance **26** around the circumference of outer rotor **5**.

So far described, the rotary gear pump in accordance with the invention has the clearances closed sufficiently oil-tight with its own delivery pressure by means of the discs **10, 10** and blocks **17, 17** at the both sides and around the circumference of rotors **4, 5**. The oil-tightness of discs **10, 10** and blocks **17, 17** is automatically controlled by the delivery pressure of pump, in other words, always kept at the optimum to the operation. It will thus be seen that the rotary gear pump in accordance with the invention has the sliding members protected sufficiently from uneven wearing and the reverse flow or leakage of liquid checked reliably from delivery to suction side so as to improve both the volume and the mechanical efficiency of pump in response to the pressure working in the delivery side.

What is claimed is:

A rotary gear pump comprising a casing provided radially with a suction port and a delivery port, a cover closing said casing firmly, a shaft supported rotatably in said casing and said cover, an inner rotor fixed on said shaft, and outer rotor engaging with said inner rotor in an inscribingly slidable relation, a pair of discs embracing said outer rotor and said inner rotor in a slidable relation at the both sides of said rotors, a pair of annular spaces respectively provided on said casing and said cover in contact with said discs, a port ring embracing said outer rotor at the circumference of said outer rotor with oil wings respectively extending in the suction and in the delivery side around said outer rotor, and a pair of blocks with stems being in a slidable contact with said outer rotor respectively at the top and at the bottom of said outer rotor, said port ring being provided with a pair of narrow apertures respectively at the top and at the bottom thereof, each positioned between said oil wings in a normal direction to said oil wings and formed integrally with a wide aperture in the radial direction of said outer rotor so as

to guide each of said blocks and stems therein, said annular spaces and said wide apertures being connected to the delivery side of said rotors, whereby said discs and said blocks are put into a contact with said rotors with even tightness in response to the pressure working in said delivery side.

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