United States Patent

Niemiec et al.

[15] **3,645,654**

[45] **Feb. 29, 1972**

[54] POWER TRANSMISSION

[72] Inventors: **Albin J. Niemiec**, Sterling Heights; **Raymond B. Pettibone**, Troy, both of Mich.

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

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[21] Appl. No.: **33,754**

[52] **U.S. Cl.** **418/133**, 418/70

[51] **Int. Cl.** **F01c 19/08**, F01c 19/10

[58] **Field of Search** 418/133, 132, 131, 70

[56] **References Cited**

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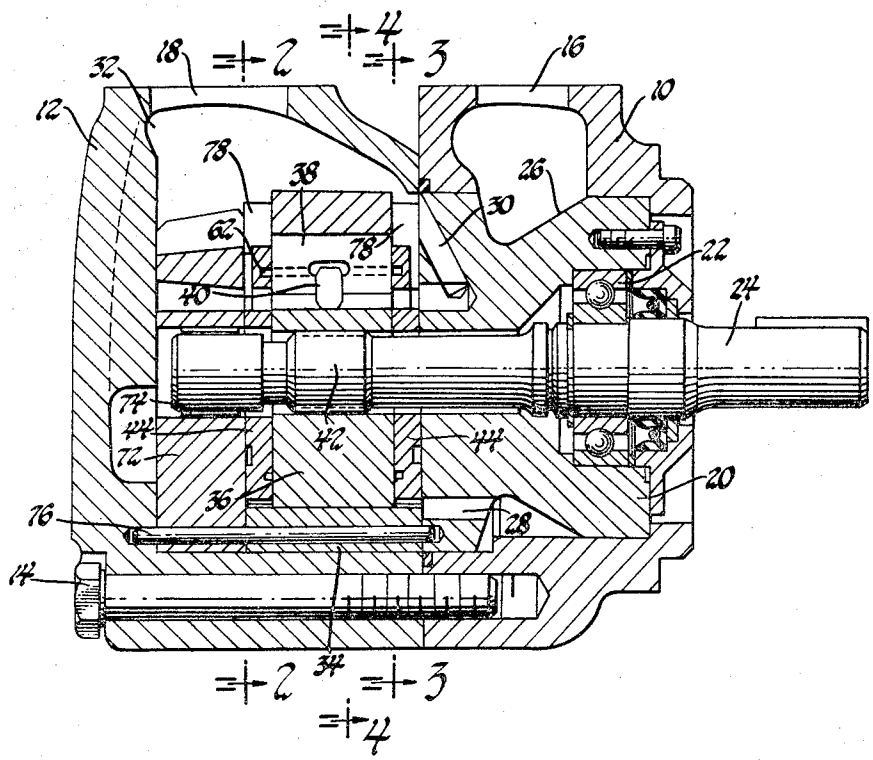
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Primary Examiner—Carlton R. Croyle
Assistant Examiner—Richard E. Gluck
Attorney—Van Meter and George

[57] **ABSTRACT**

A hydraulic pump or motor unit of the rotary sliding vane type has a casing which supports a shaft and a replaceable cartridge. The cartridge has a wide cam ring and narrower vanes supported in a narrower rotor. Pressure-loaded cheek plates are contoured to fit within the cam ring and have sealed pockets on their outer face in which fluid pressure is applied to clamp the cheek plates against the rotor and vanes.

3 Claims, 5 Drawing Figures



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SHEET 1 OF 2

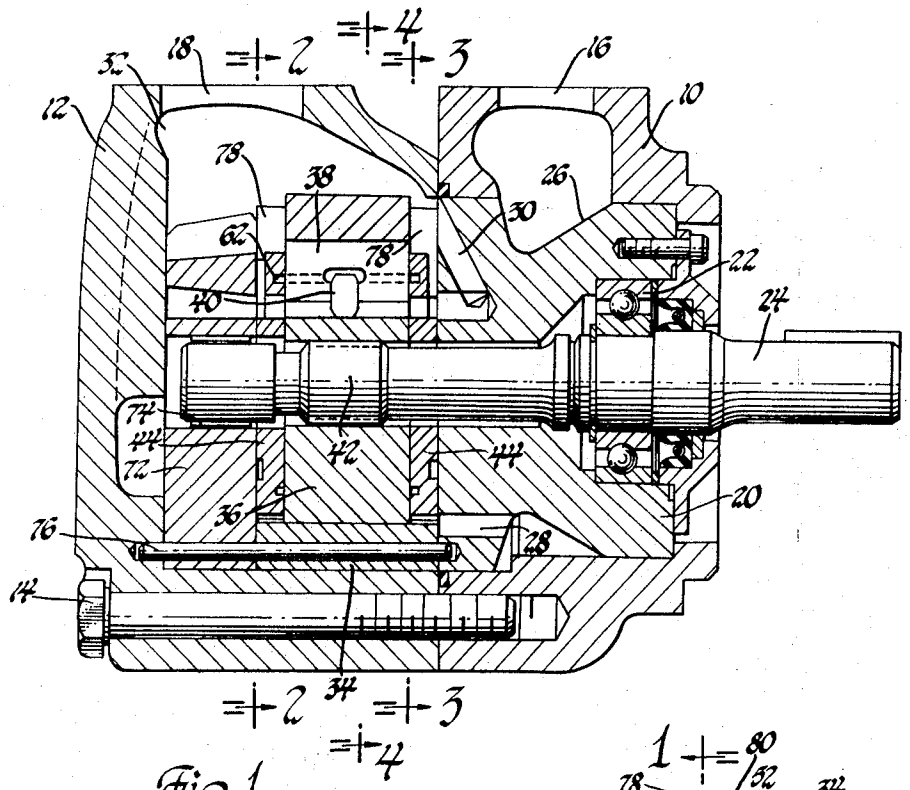


Fig. 1

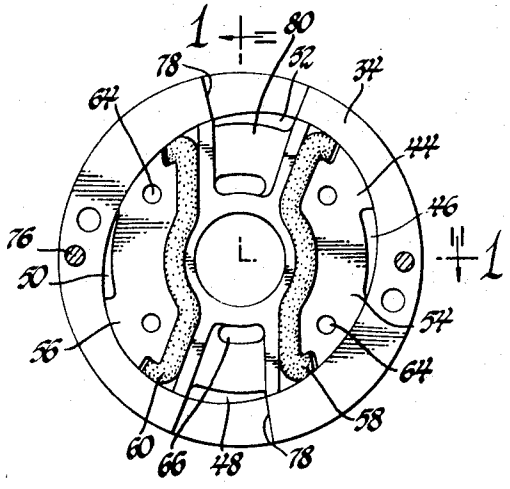


Fig. 2

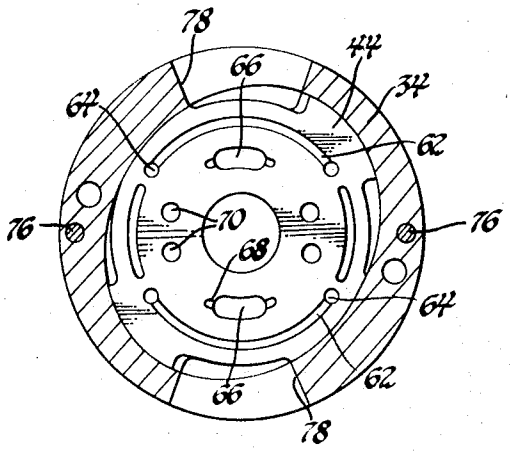


Fig. 3

INVENTORS
Albin J. Niemiec &
BY Raymond B. Pettibone
ATTORNEYS

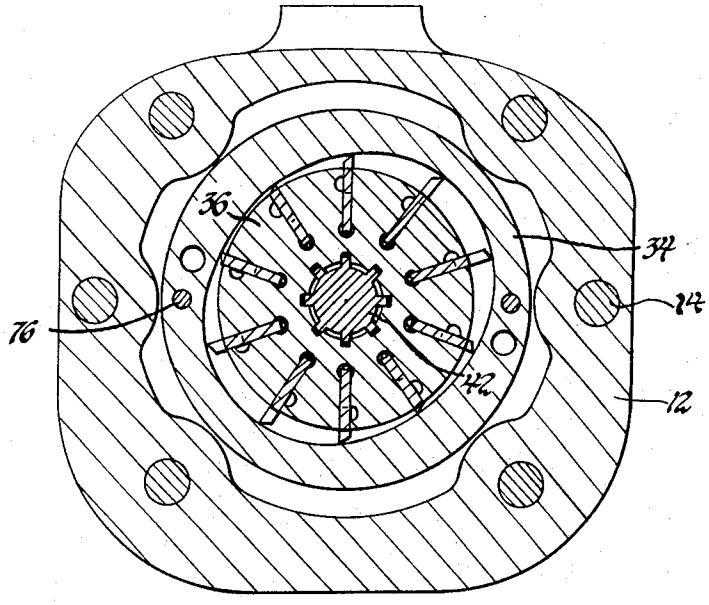


Fig. 4

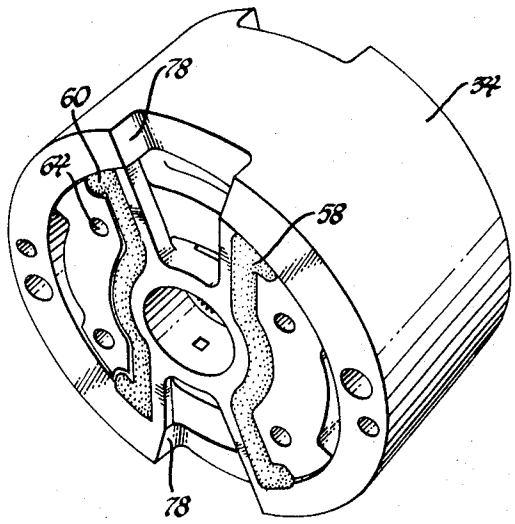


Fig. 5

INVENTORS
Albin J. Niemiec &
BY Raymond B. Pettibone
ATTORNEYS

POWER TRANSMISSION

In the construction of rotary sliding vane pumps for high pressure hydraulic service, problems arise in controlling the side clearance between rotor and stator so that minimal leakage as well as adequate lubrication are maintained and high efficiency is thus achieved. The problem is further complicated in the design of a series of units in a range of pumping capacities with a maximum of common parts. One approach to this problem is illustrated in Pettibone U.S. Pat. No. 3,451,346 which utilizes a pressure loaded cheek plate which is subject to a slight bending under high pressure forces and tends to close the gap between the rotor and vanes on the one hand and the cheek plate on the other. A series of units of this type requires only a change from one cam ring to another to change the volumetric displacement of the unit, all other parts remaining the same. However, the bendable cheek plate is only partially effective in controlling the rotor-stator gap in response to pressure since its periphery rests firmly upon the end face of the cam ring and cannot move to close the gap at the periphery of the rotor assembly.

It is an object of the present invention to provide an improved hydraulic pump or motor unit of the rotary sliding vane type in which a more effective pressure loaded cheek plate may be utilized and at the same time a wide range of pumping capacities may be incorporated in a single basic design requiring only a few alternately substitutable parts.

The invention consists in a hydraulic pump or motor unit of the rotary sliding vane type having first and second housing members secured together to provide a cartridge receiving cavity; means in the first member journaling a drive shaft which extends into the cavity; passages formed in each member to provide high and low pressure terminal connections; and a replaceable cartridge assembly mounted in the cavity. The cartridge may comprise a slotted rotor axially slidable in keyed relation to the shaft, vanes slidable in the slots in the rotor and an ovoid cam ring of greater axial width than the rotor and vanes together with one or more cheek plates of complementary ovoid form positioned within the cam ring adjacent the rotor and vanes, the cheek plate being provided with clamping pressure pockets of predetermined configuration on their outer faces and in communication with the high pressure passage.

IN THE DRAWINGS

FIG. 1 is a longitudinal cross section taken on a dihedral plane such as indicated at 1—1 in FIG. 2 of a pump or motor unit incorporating a preferred form of the present invention.

FIG. 2 is a fragmentary section taken on line 2—2 of FIG. 1.

FIG. 3 is a fragmentary section taken on line 3—3 of FIG. 1.

FIG. 4 is a sectional view taken on line 4—4 of FIG. 1.

FIG. 5 is a perspective view of the cartridge.

The unit comprises a main body consisting of two sections 10 and 12 secured together by bolts 14. The first section 10 has a high pressure passage 16 and section 12 has a low pressure passage 18. A block 20 pressed into section 10 carries a bearing and seal assembly 22 in which the main shaft 24 is journaled. The block 20 is provided with a groove 26 communicating with a pair of arcuate high pressure ports, one of which is shown at 28. The block 20 also has on its end a pair of low pressure passageways, one of which is indicated at 30, and which are open to the left-hand end of the block 20. The housing section 12 provides a cavity 32 for the reception of a fluid displacement cartridge assembly. This consists essentially of a cam ring 34, a slotted rotor 36, a series of sliding vanes 38 and preferably a series of differential pressurizing vanes 40. The rotor and vanes are narrower than the cam ring 34, the rotor being slidable onto the shaft 24 at the spline section 42.

The pair of cheek plates 44 each have contours of an void form fitting closely within the contour of the cam ring 34. These contours however, are interrupted at four places indicated at 46, 48, 50 and 52 to provide fluid passages for inlet and outlet to and from the displacement spaces defined by the rotor, the vanes and the cam ring. The cutouts 48 and 52 provide low pressure passages and the cutouts 46 and 50 provide high pressure passages. When the unit operates as a pump with clockwise rotor direction in FIG. 2, these passages 48 and 52 become the inlets to the displacement spaces.

Each cheek plate 44 is provided with a pair of clamping pressure pockets 54 and 56 which are exposed to high pressure by reason of their including the cutouts 46 and 50. A pair of compressible sealing members 58 and 60 are located in serpentine grooves which bound the inner edges of the pockets 54 and 56. The configuration of these pockets is such that the clamping pressure is applied to an area approximating the area on the inner face of each cheek plate which is exposed to the high pressure, taking into account the pressure gradients across this area.

As shown in FIG. 3, the inner face of each cheek ovoid 44 carries the grooves 62 and passages 64 for conducting high pressure fluid to the space between the vanes 38 and the differential pressurizing vanes 40. Similarly, passages 66 and grooves 68 connect with a low pressure cavity 32 through the passageways 30 to communicate with the inner ends of the vanes 38. Suitable anticavitation recesses 70 may be provided in the inner faces of the cheek plates.

Between the left end of the cartridge proper and the end wall of the housing member 12, there is provided a spacer plate 72 having a bearing 74 for the left end of the shaft 24. Suitable dowel pins such as 76 maintain the filler plate and the cam ring in circumferential alignment with the plug 20.

In operation of the unit as a pump, for example, low pressure fluid enters through the terminal passageway 18 and is admitted to those of the displacement spaces which are expanding, through the ports 48 and 52 (FIG. 2). To avoid restricting this flow path, the cam ring 34 has radial grooves 78 on its side which make the cam ring 34 narrower at these points as illustrated in the top portion of FIG. 1. Fluid in the displacement spaces which are contracting in size exits through the ports 46 and 50 in the cheek plate 44 which lies next to the block 20, and from thence flows through the passageways 28 and around the groove 26 to the high pressure terminal passage 16. Low pressure communication with the bottom of the vane slots is established through ports 66 which are in communication with the cavity 32 through the passageways 30 and through the slots 80 (FIG. 2). High pressure communication to the differential pressurizing area is established from the clamping pockets 54 and 56 through the holes 64 and grooves 62 (FIG. 3).

The high pressure acting on the portions of the cheek plates 44 which lie within the pockets 54 and 56 urges the cheek plates against the side faces of the rotor 36 and the vanes 38. The area and configuration of these pockets is so designed that a small preponderance of clamping pressure exists to overcome the separating force of the internal pressures exerted within the pump mechanism. The operation of the unit as a motor is similar except the flow of fluid and the direction of rotation are opposite.

The unit thus illustrated and described has, of course, a fixed displacement per revolution; however, units of larger or smaller displacement may be constructed using many of the same parts but substituting a cam ring, a rotor and a set of vanes of different widths and a spacer plate 72 to match. Alternatively, the substitution of a cam ring and matching cheek plates having a different "throw" will also give a different displacement. In this way, the advantage of full floating cheek plates may be achieved while at the same time retaining the economies of a design which permits substitution of a variety of pumping cartridges in the same basic housing and drive assembly.

I claim:

1. A hydraulic pump or motor unit of the rotary sliding vane type comprising first and second housing members secured together to provide a cartridge receiving cavity, means in the first member journaling a drive shaft which extends into the cavity, passages formed in each member to provide high and low pressure terminal connections, a replaceable cartridge as-

sembly mounted in the cavity surrounding the drive shaft and which comprises a slotted rotor axially slidable in keyed relation to the shaft, vanes slidable in the slots in the rotor, an ovoid cam ring of greater axial width than the rotor and vanes and at least one cheek plate of complementary ovoid form positioned within the cam ring adjacent the rotor and vanes and means forming clamping pressure pockets of predetermined configuration on the outer side of the cheek plate and in communication with the high pressure passage, whereby the cheek plate maintains the rotor and vanes under a clamping force to minimize leakage along the side faces of the rotor and vanes.

2. A unit as defined in claim 1 wherein the complementary ovoid periphery of the cheek plate is interrupted at four places to provide passageways for fluid into and out of the spaces between the rotor, the vanes and the cam ring.

3. A unit as defined in claim 1 wherein the cam ring has diametrically opposed sections of reduced width providing passageways for low pressure communication with the spaces between the rotor, the vanes and the cam ring.

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