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Niemiec et al.

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[54] VANE PUMP WITH FLUID-BIASED END WALLS

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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, 132, 133, 418/135

[56] **References Cited**

UNITED STATES PATENTS

2,544,987	3/1951	Gardiner et al.	418/133
2,924,182	2/1960	Blasutta et al.	418/133
3,193,190	7/1965	Lindberg	418/131
3,194,168	7/1965	Rosaen	418/132
3,204,565	9/1965	Kirkpatrick	418/133
3,303,793	2/1967	Morita	418/132
3,479,962	11/1969	Pettibone	418/133
3,549,288	12/1970	Nichols et al.	418/133

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Assistant Examiner—John J. Vrablik
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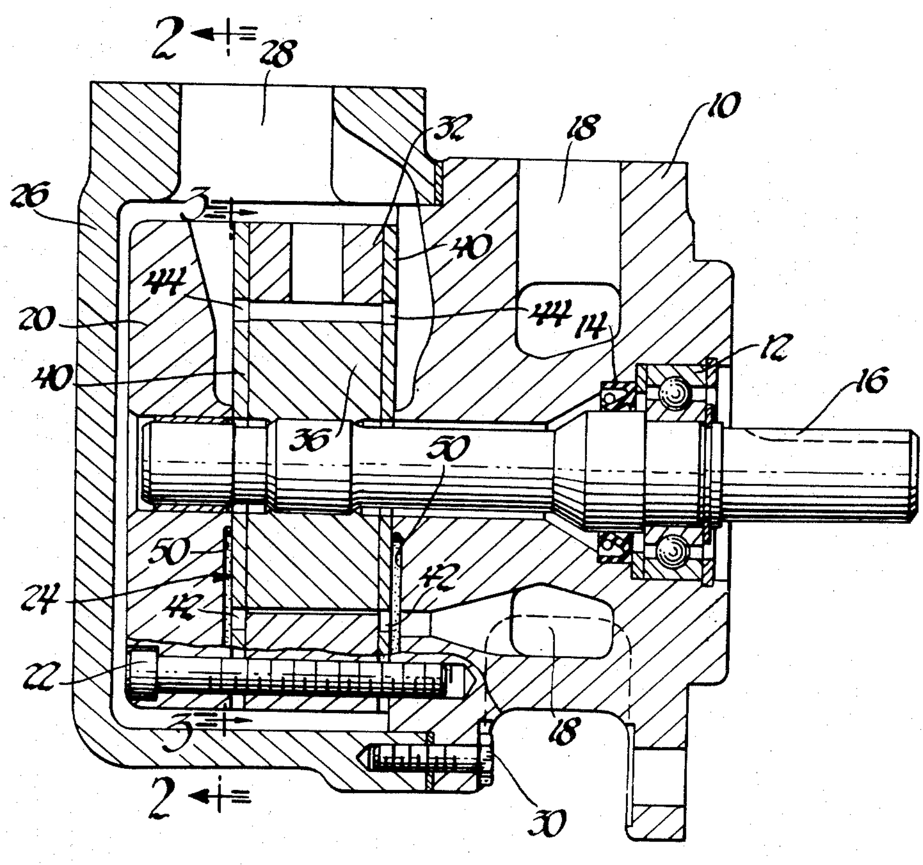
[57] **ABSTRACT**

A balanced vane pump has a body supporting the drive-shaft and clamping together the pumping cartridge. The cartridge includes an ovoid cam ring and a slotted rotor carrying radially slidable vanes. Flexible cheek plates are clamped against the cam ring and pressed toward the rotor and vanes by outlet pressure applied over limited areas defined by pressure pockets surrounding the outlet ports in the cheek plates.

4 Claims, 5 Drawing Figures



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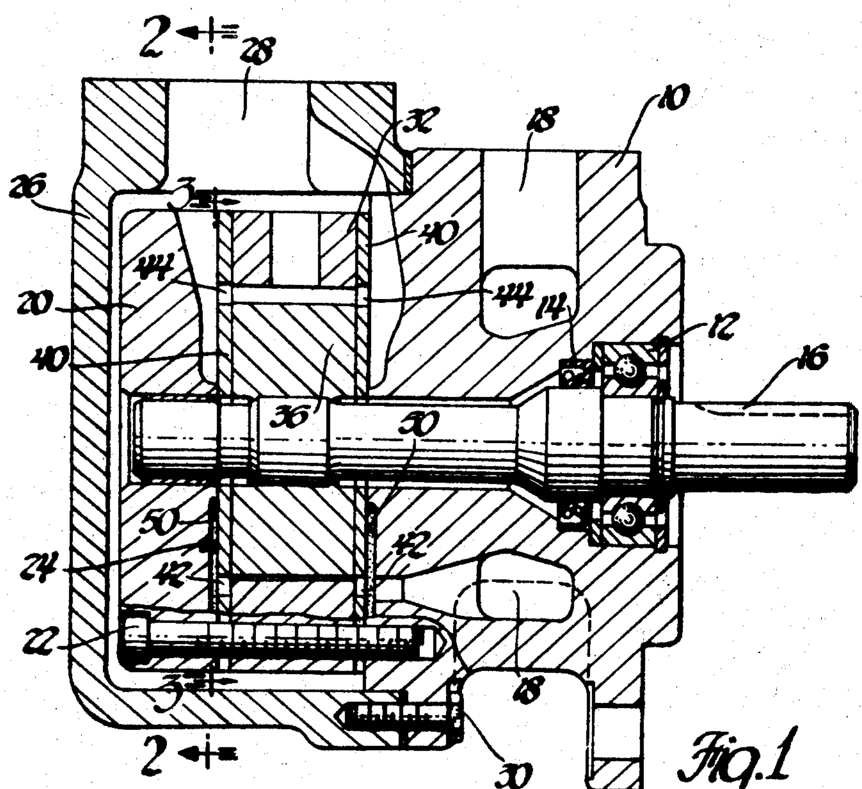

Fig.1

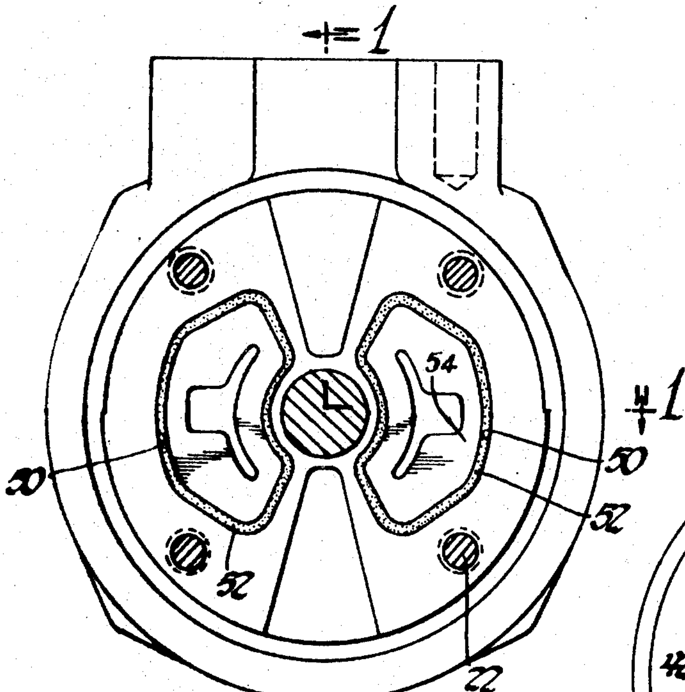

Fig.2

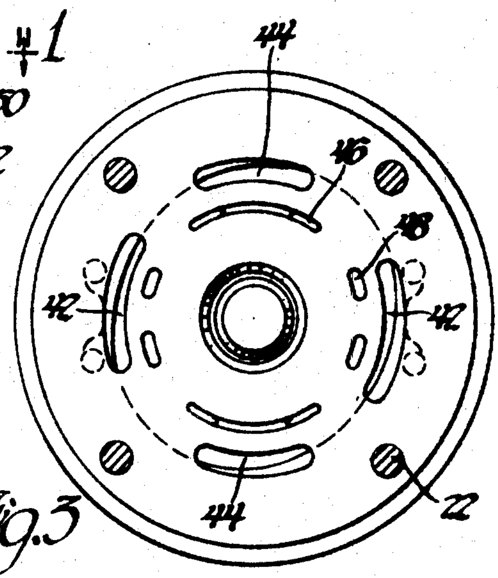

Fig.3

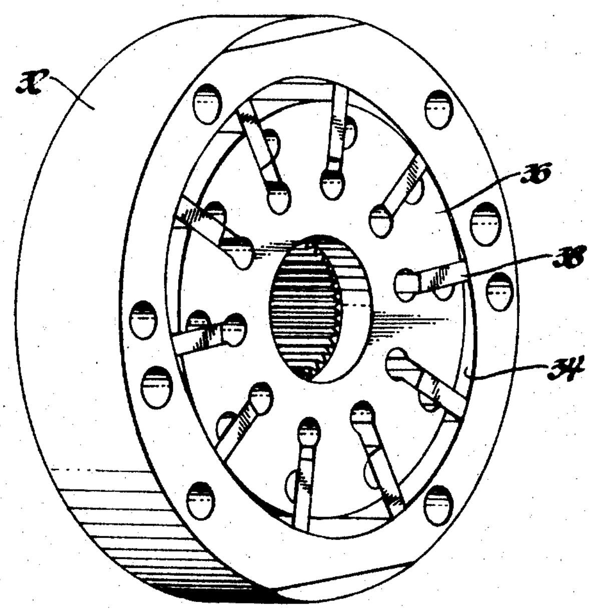

Fig.4

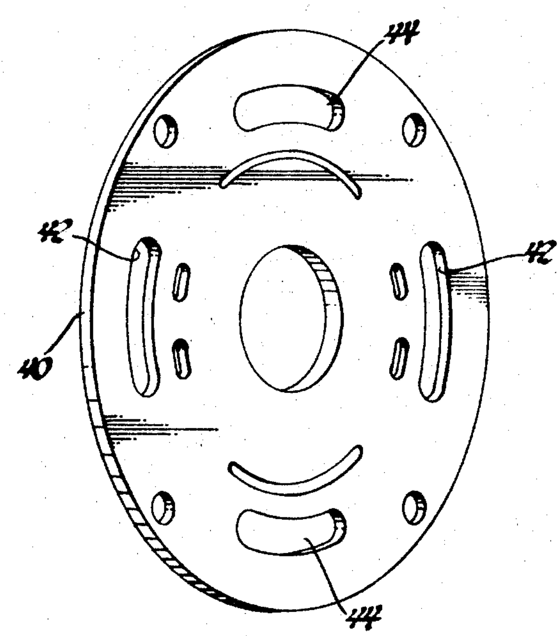

Fig.5

VANE PUMP WITH FLUID-BIASED END WALLS

In rotary sliding vane pumps, an obstacle to the achievement simultaneously of both high volumetric efficiency and high mechanical efficiency has been the difficulty of maintaining the proper clearances between the rotary and the stationary parts at the end faces of the rotor and vanes. Some pump designs endeavor to maintain this clearance fixed, but the need to allow for distortion of the parts under pressure and at elevated temperatures requires a clearance so large that volumetric efficiencies are poor. Smaller clearances will reduce mechanical efficiency through excessive friction. On the other hand, attempts to automatically control this clearance in accordance with the outlet pressure have had only limited success through the use of movable cheek plates. One type uses cheek plates which slide within the cam ring and introduce new leakage paths at their peripheries, e.g. Beust U.S. Pat. No. 2,044,873. Another approach utilizes a cheek plate resting against the cam ring and exposed to outlet pressure over its full area, causing it to deflect closer to the rotor as the outlet pressure increases, e.g. Gardiner U.S. Pat. No. 2,544,988. This approach exposes large areas to the distorting effects of outlet pressure and requires a very heavy body if these distortions are to be held within feasible limits.

The present invention aims to provide a vane pump in which the clearances at the faces of the rotor may be adjusted automatically in accordance with changes in outlet pressure and which permits the use of a smaller and lighter pump body than has heretofore been possible.

The invention consists in a balanced vane pump comprising a first body portion forming a base, a driveshaft journalled in the base, a pumping cartridge supported by the base, a second body portion forming a head clamping the cartridge to the base, a third body portion comprising a cup-like cover secured to the base and enclosing the cartridge and the head, means forming an inlet passage in the cover, means forming an outlet passage in the base, the cartridge comprising a cam ring having an ovoid interior cavity, a rotor driven by the shaft and carrying radially slidable vanes, the rotor and vanes being slightly shorter axially than the cam ring, flexible cheek plates clamped at their peripheries against the sides of the cam ring and providing diametrically opposite arcuate inlet ports and diametrically opposite arcuate outlet ports, means at the interfaces of the cheek plates with the base and the head forming two pairs of pressure pockets surrounding the outlet ports, and elastomeric seals surrounding the pressure pockets.

IN THE DRAWINGS

FIG. 1 is a cross section taken on line 1—1 of FIG. 2 of a vane pump incorporating a preferred form of the present invention.

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

FIG. 3 is a view taken on line 3—3 of FIG. 1.

FIG. 4 is a perspective view of a pumping cartridge forming part of FIG. 1 with the cheek plates removed.

FIG. 5 is a perspective view of a cheek plate incorporated in the pumping cartridge.

The body of the pump illustrated in FIGS. 1 and 2 includes a main or base section 10 in which is incorporated a bearing 12 and seal 14 for the support of a rotary driveshaft 16. The base portion 10 incorporates a pump outlet passage 18. A second body part 20 comprises a head which is secured to the base 10 by screws 22 and clamps together a pumping cartridge 24. Surrounding the head 20 and cartridge 24 is a third body portion 26 which is of cup-like configuration and has an inlet passage 28. Bolts 30 secure the cover 26 to the base 10.

The pumping cartridge 24 includes a cam ring 32, FIG. 4, having an ovoid cavity 34 and a slotted rotor 36 slidably splined to the driveshaft 16, and carrying radially slidable vanes 38. The axial dimensions of the rotor and vanes are somewhat smaller than the axial width of the cam ring 32 by an amount which is somewhat larger than the minimum allowable clearance at full rated pressure. The pumping cartridge also includes a pair of cheek plates 40 which are preferably formed of a bimetallic sheet material, such as steel and bronze, with the steel forming a resilient flexible support for the bronze bearing material adjacent to the rotor and vanes. The cheek plates may be formed inexpensively by a punching operation which, besides the usual bolt holes and shaft hole, forms a pair of diametrically opposite outlet ports 42 which register with two branches of the outlet passage 18 in the base 10. Also punched out of the plate 40 are a pair of diametrically opposite inlet ports 44 which open to the inlet passage 28. Other passages, such as 46 and 48, may be punched out to provide communication between the bottom of the vane slots in the rotor and the appropriate inlet and outlet passages.

The clamping faces of the base 10 and of the head 20 are each provided with a diametrically opposite pair of pressure pockets 50, FIG. 2, which surround the outlet ports 42 and extend arcuately approximately twice the length of the ports 42. Each pressure pocket has an irregularly curved outline within which an elastomeric seal 52 is located around the periphery. This is preferably a simple O-ring distorted by means of a filler plate 54 (not shown in FIG. 1) which holds the O-ring into contact with the periphery of the pressure pocket 50.

In operation, fluid entering the inlet 28 is handled by the pumping cartridge 24 in the well known manner and delivered to the outlet passage 18. The clearance between the cheek plates 40 and the rotor and vanes is automatically adjusted by outlet pressure applied in the pockets 50 to the outer faces of the cheek plates 40 over a limited area surrounding each outlet port 42. The modulus of the backing material of the cheek plates and their thickness is so chosen that at maximum rated pressure, the deflection of the cheek plates inwardly closes up the clearance at the face of the rotor to a value commensurate with the film strength of the oil, the cheek plates bending as cantilevers in the arcs between the inlet and outlet ports. In this way, leakage along the end faces of the rotor and vanes may be closely controlled to maintain both high volumetric and high mechanical efficiency.

We claim:

1. A balanced vane pump comprising a first body portion forming a base, a driveshaft journalled in the base, a pumping cartridge supported by the base, a second body portion forming a head clamping the cartridge to the base, a third body portion comprising a cup-like cover secured to the base and enclosing the cartridge and the head, means forming an inlet passage in the cover, means forming an outlet passage in the

base, the cartridge comprising a cam ring having an ovoid interior cavity, a rotor driven by the shaft and carrying radially slidable vanes, the rotor and vanes being slightly shorter axially than the cam ring, flexible cheek plates clamped at their peripheries against the sides of the cam ring and providing diametrically opposite arcuate inlet ports and diametrically opposite arcuate outlet ports, means at the interfaces of the cheek plates with the base and the head forming two pairs of pressure pockets surrounding the outlet ports, and elastomeric seals surrounding the pressure pockets.

2. A pump as defined in claim 1 wherein the pressure pockets extend circumferentially along arcs substantially twice the arcuate length of the outlet ports.

3. A pump as defined in claim 1 wherein the cheek plates are of laminar material including a layer of bearing material supported on a resilient backing material.

4. A pump as defined in claim 1 wherein the pockets comprise recesses of uniform depth and having irregularly curved outlines, the elastomeric seals comprising normally circular O-rings and filler pieces conforming to the outlines of the recesses and holding the O-ring against the peripheries of the pockets.

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