United States Patent

[11] 3,614,276

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[21] Appl. No. **3,136**
[22] Filed **Jan. 15, 1970**
[45] Patented **Oct. 19, 1971**
[73] Assignee **Industrial Electronic Hardware Corp.**
New York, N.Y.
[32] Priority **Jan. 17, 1969**
[33] **Germany**
[31] **P 19 02 187.5**

[54] **ROTARY VANE PUMP**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **418/238,** 418/266
[51] **Int. Cl.** **F01c 1/00**
[50] **Field of Search** 418/122, 123, 266, 267, 238

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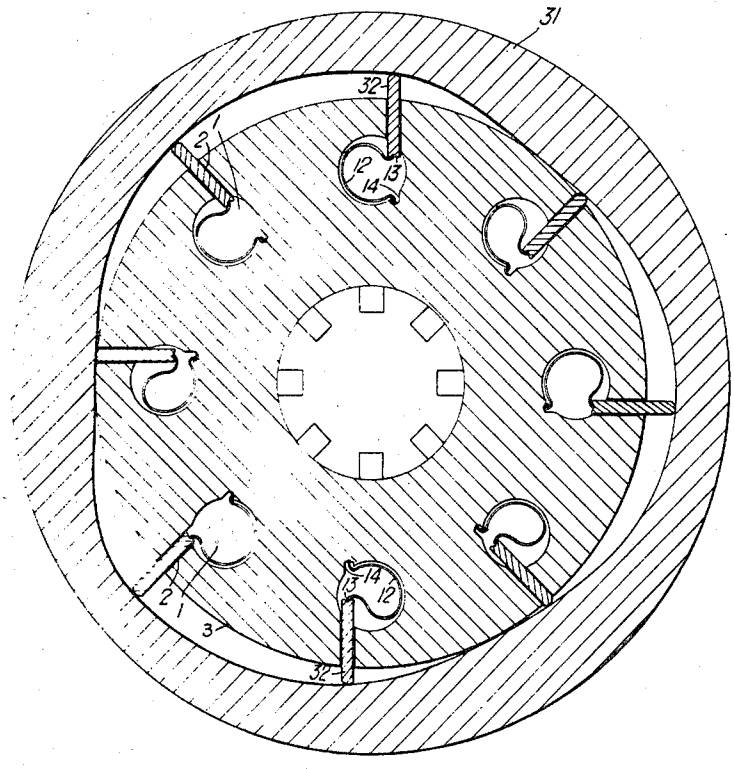
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Primary Examiner—Carlton R. Croyle
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ABSTRACT: A rotary sliding vane machine in which the vane springs are positioned in chambers under the vane guide slots which are eccentrically arranged with respect to the guide slots. The springs may be either curved strip springs or cylindrical helical springs.

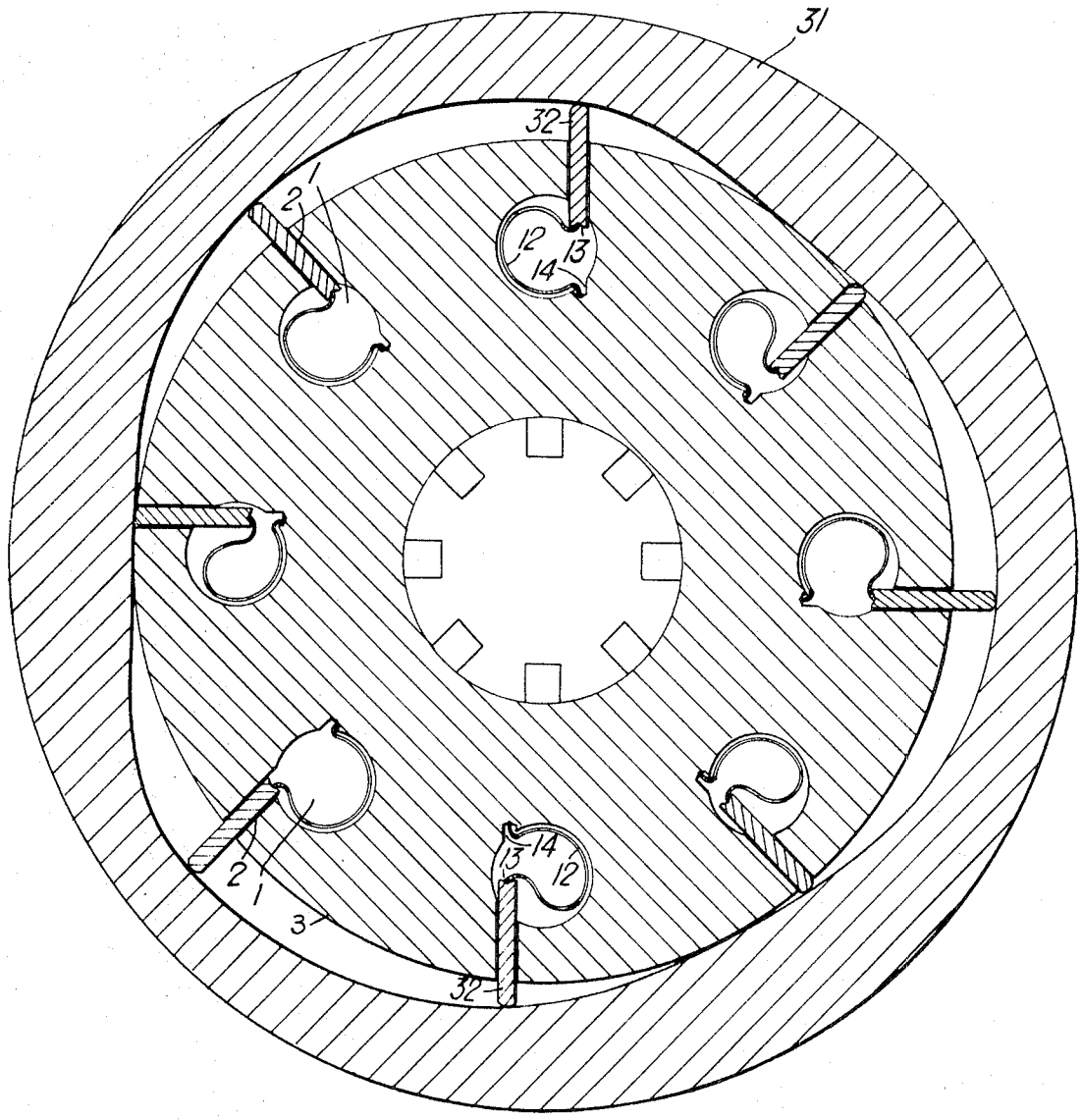


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SHEET 1 OF 2

Fig. 1.



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Fig. 2.

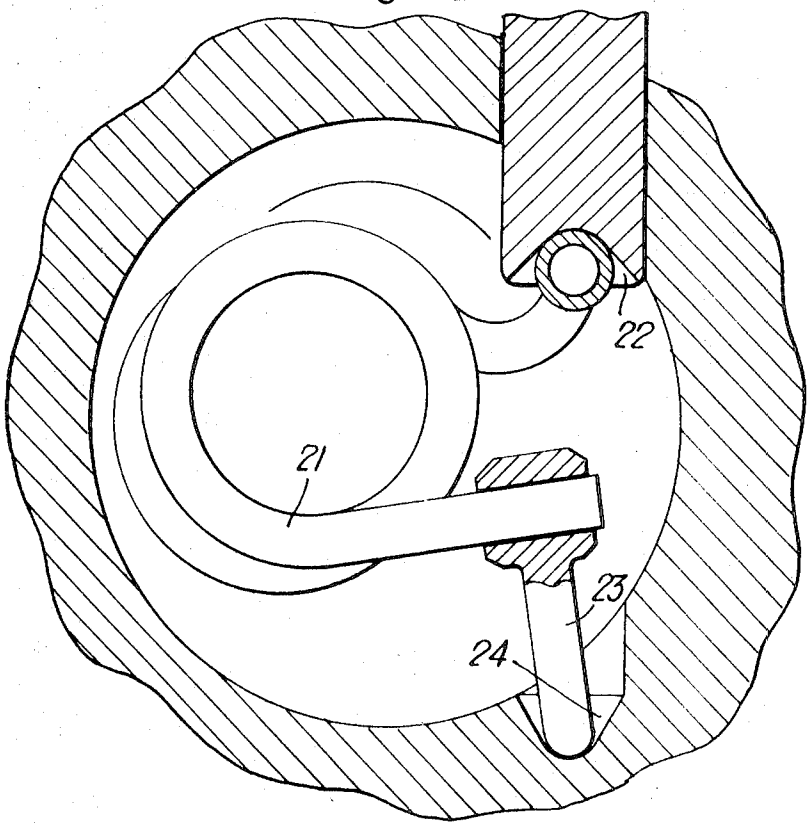
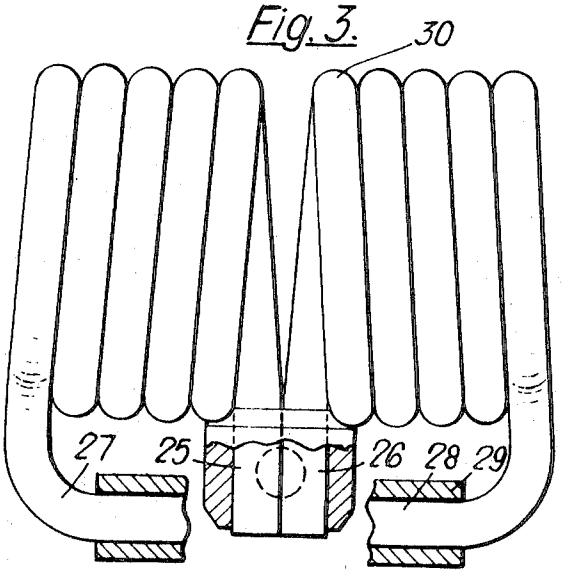


Fig. 3.



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ROTARY VANE PUMP

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to rotary sliding vane pumps and particularly to pumps of this type having springs for pressing the vanes outward against the cam wall.

Description of Art

In order to eliminate elastic deformations of the rotor segments or guide of the segments under the influence of the hydraulic force exerted on the vanes of a rotary sliding vane pump, the trend is to design the vanes and the guide slots in the rotor as thin as possible to increase the strength of the segments. However, this increases the difficulty in designing springs for pressing the vanes against the cam plate curve and the use of coil springs acting against the bottom of the vanes is not practical with the thinner vanes.

To meet these requirements, a known vane-type machine has vanes which are pressed against the cam plate by means of a bracketlike fastening spring arranged on the side of the rotor. The ends of the bracket spring are propped against two vanes located at an angle of 90° to each other and the loop in the center of the spring is wound around a bolt fixed in the rotor. The pump is designed so that when the vane at one end of the spring is being pushed into its slot by the cam surface the vane at the other end of the spring is sliding outward in its slot. Thus the bracket spring acts like a two-armed lever which is resilient to compensate for the tolerance.

A disadvantage of this arrangement is that the spring is arranged on the side of the rotor and the rotor can be pressed against the sidewalls only in a narrow area in the peripheral region of the rotor thereby causing a sealing problem. Further, the guide slots of the vanes communicate with one another through the cavity between the rotor and the sidewall so that they can only be pressurized jointly. But in the pressure-controlled vane-type machines which are common today it is necessary to vary the pressure continuously in the individual vane slots. A vane-type machine of the kind in which a controlled pressure acting against the bottom of the vane stem assists the spring in pressing the vane against the cam plate could not be obtained with the above-mentioned construction.

A further disadvantage of this bracket spring arrangement is that an even number of vanes must be provided at suitable angular spacing between vanes. Also, the vanes may have a tendency to tilt in their guide slots.

In pumps having vanes thick enough to have holes in the bottoms of the vanes for retaining coil springs, the thickness of the vanes reduces the strength of the rotor segments between the vanes. The thick vanes also have a large absorption and displacement volume causing considerable quantities of pressure medium to flow through the control of the holes in the vane stem, thus unfavorably influencing the pressure ratio between the working chamber and the space under the vane stem and necessitating a stiffer spring.

Moreover, in order to assure easy sliding in the vane slot, a certain limiting value of the ratio of vane thickness to guiding length must not be exceeded.

The copending application entitled "Rotary Vane Pump" by Fritz Ostwald, filed Jan. 15, 1970, Ser. No. 033,135 having the same assignee as the present application discloses one improved rotary vane machine in which the vanes are positioned in the working chamber and engage recesses in the sides of the vane springs to press the vanes outward against the cam surface.

SUMMARY OF THE INVENTION

An object of this invention is to provide an improved rotary vane machine having thin spring-loaded vanes and vane slots which may be separately pressurized.

The present invention achieves this object by providing a chamber under the vane stem arranged eccentrically with respect to the guide slot and a spring in the curved spring in the chamber having one end retained by a groove in the bottom of the vane stem and the other end retained by a recess in the rotor under the stem.

The spring may take several forms, such as curved strip spring having holes punched in it to reduce the resistance to movement within the pressure medium, a cylindrical helical spring having one arm acting on the bottom of the vane stem and the other supported in a recess in the rotor under the vane or a double cylindrical helical spring with the two adjacent ends supported in a center hole in the space under the stem by a pin and the outer ends of the spring bent towards each other and connected by a tube resting in a groove in the bottom surface of the vane stem. In axially long rotors it is possible to arrange several similar springs in series in the space under the stem in the guide slot.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional view of a rotary vane machine embodying the present invention.

FIG. 2 is a partial sectional view of another embodiment of the invention.

FIG. 3 is a plane view of a spring similar to the one shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a rotary sliding vane machine having a rotor 3 with vanes 32 slidable within guide slots 2 in the rotor forming working chambers between successive vanes, the end walls not shown, and a cam plate 31. Cylindrical chambers 1 are formed at the bottom of the rotor guide slots and are positioned eccentrically with respect to the guide vanes. The thickness of the vanes is determined by the permissible bending stress, and the diameter of the eccentrically arranged chambers is determined by the size of the guide slots and the necessary strength of the rotor segments. The shape of the chambers under the vane stems meet the design requirement for machines of smaller base circle diameter and with several working cycles per revolution so that there is a smaller angle of rotation per stroke. The space under the stem and the corresponding hole in the control flange should not exceed one third of the angle of rotation per stroke at the curve of the stroke.

Annular strip springs 12 forming an open ring are located in the chambers 1 with one end of the spring 12 supported in a groove 13 in the bottom surface of the vane stem and the other end held in a hole 14 in the rotor directly underneath the vane. The spring has holes punched in its surface to reduce the resistance to displacement during high-speed operation of the machine when the working fluid which may be oil is being displaced by the spring. In addition, to provide passages for the working fluid, these holes tend to spread the bending stress equally over the entire spring surface.

FIG. 2 shows another embodiment of the invention in which the spring 21 is wound in a helical shape with one end of the spring resting in a groove 22 in the bottom of the vane stem and the other being supported by a pin 23 in a countersunk hole 24 under the stem of the vane 32.

The spring 30 shown in FIG. 3 is similar to that used in the embodiment shown in FIG. 2 except that it utilizes a pair of springs having abutting ends 25 and 26 which are jointly supported by a pin under the vanes stem as shown in FIG. 2. The outer ends 27 and 28 are bent toward each other and connected by a tube 29 which lies in the groove in the bottom surface of the vane stem. In this way the spring is secured against displacement and twisting. Joining the springs at both ends insures that the spring does not fall apart if it breaks and this also reduces the pitching moments.

In axially long rotors it is possible to arrange several springs in series under the stem thus increasing operational reliability in case one of the springs breaks. In addition, this tends to prevent tilting of the rotor. Since the springs shown in these examples are restrained only at the ends and have no third point of support, there is a minimal amount of wear.

It will be appreciated that the invention illustrated and described herein may be modified by those skilled in the art without deviating from the spirit and scope of the invention as set forth in the following claims.

I claim as my invention:

1. A sliding vane rotary machine having vanes arranged in guide slots of a rotor and pressed outwardly against a cam plate by springs wherein each of the springs are positioned in a chamber arranged under and eccentrically with respect to the guide slot, one end of each of the springs being retained in a groove in the bottom surface in the vane stem while the other end is supported at a point in the rotor directly in line with the vane stem. in the rotor directly in the vane stem.

2. The sliding vane rotary machine of claim 1 wherein the spring is a strip spring having a C-shape.

3. The sliding vane rotary machine of claim 2 wherein the strip spring has holes in its surface.

4. The sliding vane rotary machine of claim 1 wherein the spring is a cylindrical helical spring having one end supported in a groove in the bottom surface of the vane stem and the other end supported at a point directly under the vane stem.

5. The sliding vane rotary machine of claim 4 wherein the spring is two cylindrical helical springs having abutting ends which are connected and jointly supported by a pin resting in a central hole under the vane stem and the outer ends of the spring are bent toward each other and connected by a tube which rests in the groove in the bottom of the vane stem.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,614,276 Dated October 19, 1971

Inventor(s) Hans Erdmann

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading, after "Assignee", change "Industrial Electronic Hardware Corp." to read --International Telephone and Telegraph Corporation--.

Signed and sealed this 30th day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334