Jan. 26, 1971 B. GAERTNER 3,558,247

METHOD AND DEVICE FOR ADJUSTING THE LATERAL CLEARANCE IN A ROTARY DISPLACEMENT PUMP

Filed Nov. 22, 1968 2 Sheets-Sheet 1

FIG. 1

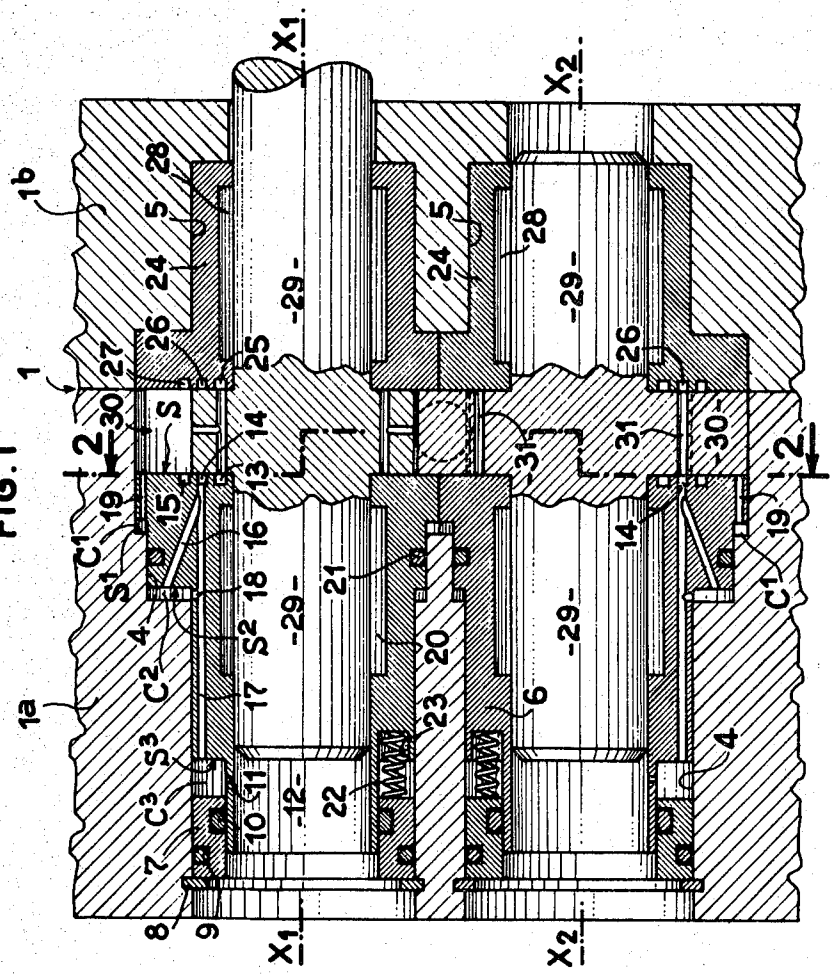
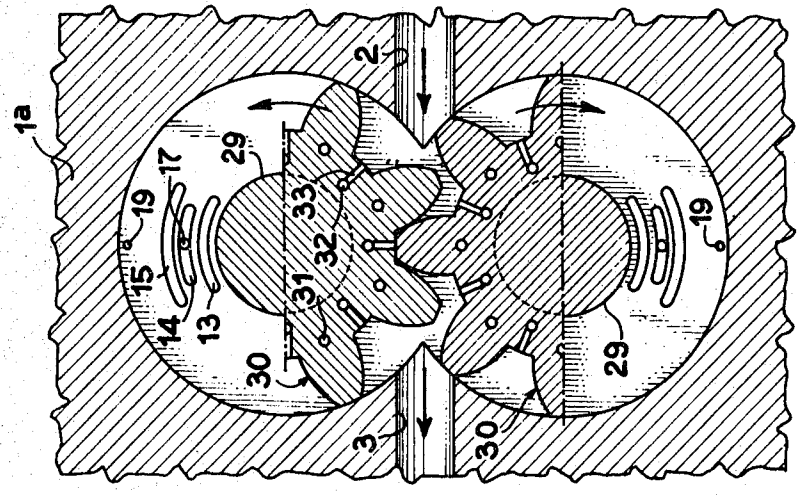
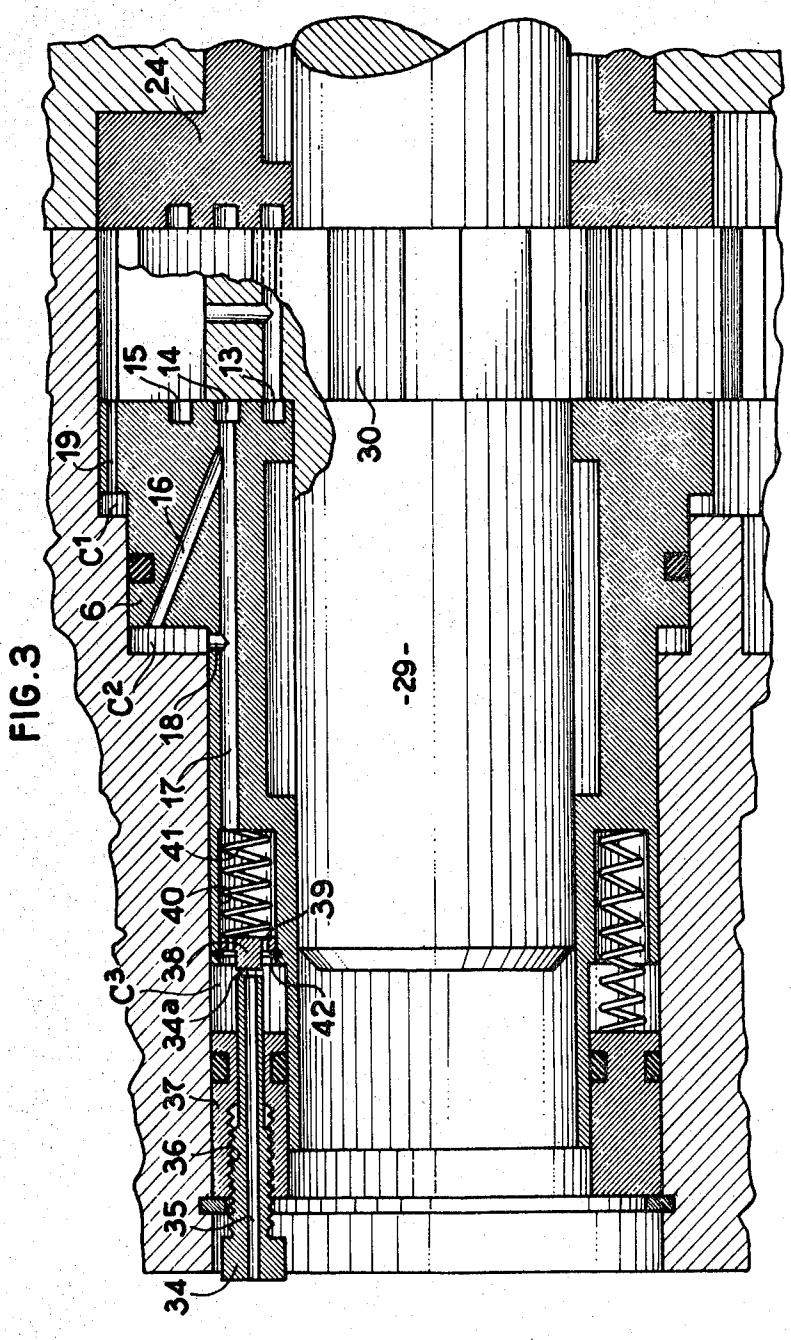


FIG. 2



Jan. 26, 1971 B. GAERTNER 3,558,247
METHOD AND DEVICE FOR ADJUSTING THE LATERAL CLEARANCE IN A ROTARY DISPLACEMENT PUMP
Filed Nov. 22, 1968 2 Sheets-Sheet 2

FIG.3



United States Patent Office 3,558,247
Patented Jan. 26, 1971

3,558,247

METHOD AND DEVICE FOR ADJUSTING THE LATERAL CLEARANCE IN A ROTARY DISPLACEMENT PUMP

Berthold Gaertner, Rueil-Malmaison, France, assignor to Bronzavia, Courbevoie, France, a French body corporate

Filed Nov. 22, 1968, Ser. No. 778,114
Claims priority, application France, Nov. 28, 1967, 129,912
Int. Cl. F01c *1/08, 19/08*
U.S. Cl. 418—131 16 Claims

ABSTRACT OF THE DISCLOSURE

Rotary displacement pump having at least one rotary element. Two side-wall members are disposed in the pump housing on each side of the rotary element. At least one of the side-wall members is axially movable relative to the housing and to the rotary element. One face of the movable side-wall member is subjected on at least a part of its face, to a pressure in the neighbourhood of the delivery pressure of the pump and means apply on at least a part of the other face of the movable side-wall member a regulated back-pressure whose magnitude determines the magnitude of the lateral clearance between the rotary element and the side-wall members.

The present invention relates to rotary displacement pumps and concerns in particular the adjustment of the lateral clearance of the rotating parts of such pumps.

It is important in rotary displacement pumps to reduce the clearances, and in particular the lateral clearance, to a minimum so as to eliminate leakages and in this way improve the characteristics of the pump.

The invention provides a method for regulating the lateral clearance in a displacement pump comprising a housing in which a rotary element is mounted to rotate about an axis, wherein said rotary element is mounted between two side-wall members disposed in said housing, at least one of said side-wall members being axially movable relative to said housing and to said rotating element, there being established on at least a part of the face of said movable side-wall member facing said rotary element a pressure in the neighborhood of the delivery pressure of the pump and on at least a part of the opposite face of said movable side-wall member a back-pressure whose magnitude determines the magnitude of the lateral clearance between the rotary element and said side-wall members.

By means of this method it is possible to reduce, in a rotary displacement pump, the lateral clearance between the or each rotary element and the respective side-wall members of the housing, to a roughly constant minimum value.

The invention also provides a rotary displacement pump having a housing in which at least one rotary element is rotatably mounted, said pump comprising two side-wall members disposed in said housing and between which said rotary element is mounted, at least one of said side-wall members being axially movable relative to said housing and relative to said rotary element, the face of the movable side-wall member being subjected on at least a part of its area to a pressure in the neighborhood of the delivery pressure of the pump, means being provided for applying on at least a part of the other face of said movable side-wall member a regulated back-pressure whose magnitude determines the value of the lateral clearance between said rotary element and said side-wall members.

The invention can be employed in particular in a gear displacement pump in which the rotary elements are interengaged gear pinions.

Further features and advantages of the invention will be apparent from the ensuing description with reference to the accompanying drawings.

In the drawings:

FIG. 1 is a partial longitudinal sectional view, with parts cut away, of a gear pump comprising a device according to the invention regulating the lateral clearance;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1, and

FIG. 3 is a partial longitudinal sectional view, on an enlarged scale, of a modification of the invention.

A rotary displacement pump according to the invention will first be described with reference to FIGS. 1 and 2, this pump being a gear pump.

Such a pump comprises a housing **1** in two parts **1***a*, **1***b* interconnected by any suitable means (not shown). The part **1***a* of said housing is provided with pipes **2**, **3**, nameiy the inlet and outlet pipes and two identical stepped bores **4** having axes X_1—X_1 and X_2—X_2. The part **1***b* ly the inlet and outlet pipes and two identical stepped bores **5** having the same axes X_1—X_1, X_2—X_2 as the bores **4**.

Slidably mounted in the bores **4** are two identical side-wall members **6** only one of which will be described in detail. This side-wall is slidable in the bore **4** and partly in a ring **7** having an S-shaped section locked in position by a ring **8** and provided with sealing elements **9**, **10**.

The side-wall member **6** is stepped and defines with the bore **4** and the ring **7** annular chambers C1, C2, C3. The lateral annular faces of the side-wall members **6** which partially define the chambers C1, C2, C3, will be respectively designated by the reference characters S1, S2, S3. The chamber C3 communicates, by way of a small-diameter nozzle **11** constituting a jet, with the inner chamber or cavity **12** of the side-wall member **6** connected to the inlet of the pump.

Further, this side-wall member **6** comprises on its outer face S opposed to the faces S1, S2, S3 grooves **13**, **14**, **15** of partly annular shape which are seen best in FIG. 2. The groove **14** is connected by way of passages **16**, **17** to the chambers C2, C3 respectively, the passage **17** communicating moreover with the chamber C2 by way of a passage **18**.

The chamber C1 communicates with the outer face S of the side-wall member **4** by way of a passage **19**.

Note moreover that the side-wall member **6** carries a bearing **20** and a sealing element **21** and that it is subject to the action of compression springs **22** which bear on one hand against the ring **7** and on the other hand against the bottom of cavities **23** in the face S3. The purpose of this spring will be explained in the course of the description of the operation of the device.

Disposed in the stepped bores **5** are identical fixed side-wall members **24** which comprise on their outer face grooves **25**, **26**, **27** which are identical to the grooves **14**, **15**, **16** and are located opposite the latter. These side-wall members **24** also carry bearings **28**.

Journalled in the aligned bearings **19**, **28** is a shaft **29** integral with a gear pinion **30** disposed between the two sidewall members **6** and **24**. In a conventional manner, the pump comprises an interengaged pair of such gear pinions. According to the invention, each gear pinion **30** comprises two series of longitudinal passages **31** and **32**. The passages **31** open onto the lateral faces of the pinion teeth in front of the grooves **14** and **26** of the corresponding side-wall members. The passages **32** open onto the lateral faces of the gear pinion in front of the grooves **13** and **25** and are put into communication, by way of

radial passages **33**, with the roots of the teeth and consequently with the chambers defined by the gear pinions and the housing. The grooves **15**, **27** have such length that they are always in communication with at least one gap between two successive teeth.

Likewise, the grooves **14**, **26** are always in communication with a passage **31** and the grooves **13**, **25** with a passage **32**.

As a result of this arrangement, an equal pressure in the neighbourhood of the delivery pressure is created in this zone on each side of the gear pinion **28**, despite the very small clearance between these gear pinions and the side-wall members.

The device according to the invention operates in the following manner.

When starting up, the springs **22** which have a force just sufficient to overcome friction, apply the side-wall members **6** against the gear pinions **30** so as to preclude excessive leakages.

In normal operation, it can be assumed that ¾ of the area S of the side-wall member **6** facing the gear pinion is subjected to a pressure in the neighbourhood of the delivery pressure P_R, the remaining quarter being subjected to a pressure near the inlet pressure P_a.

Owing to the passage **19**, there prevails in the chamber C1 a pressure also in the neighbourhood of the delivery pressure P_R. As to the pressure set up in the chambers C2 and C3, it depends on the diameter of the nozzle **11** which performs the function of a jet for the fluid contained in the chamber C3. This pressure constitutes a regulated back-pressure of mean value P_c which is less than the delivery pressure P_R. The axial position of the side-wall member **6** is determined by the equilibrium between the pressure forces

$$P_R \cdot \frac{3}{4} S + P_a \cdot \frac{1}{4} S$$

which are exerted on one face in one direction and the pressure forces $P_R S_1 + P_c(S_2+S_3)$ exerted on the other faces and in the opposite direction. A regulated back-pressure P_c therefore corresponds to a value of the lateral clearance between the gear pinion and the side-wall members **6** and **24** and this back-pressure is mainly determined by the dimension of the nozzle **11**.

However, this back-pressure could be disturbed by variations in the local pressure in the immediate vicinity of the groove **14**.

Now, the arrangement of the grooves **13** and **15** on each side of this groove **14** enables maintaining in the vicinity of the latter a pressure of constant magnitude equal to the delivery pressure.

Further, owing to the arrangement of the identical grooves on the two opposite side-wall members and the various passages provided in the gear pinion, it is of no importance, for the value of the regulated pressure, that the same clearance be established on either side of the gear pinion or distributed between these two sides.

If for some reason the lateral clearance is modified, there results a corresponding variation in pressure in the chambers C2, C3 which tends to return the clearance to its fixed value until the back-pressure has resumed its regulated value. The choice of the respective values of the areas or surfaces S, S1, S2, S3 and of the diameter of the nozzle **11** or, in other words, of the back-pressure P_c, therefore determines the lateral clearance produced between the gear pinion and the adjacent faces of the side-wall members. This clearance, which must remain very small, can thus be maintained at a value of a few microns, for example less than 5 microns. It is difficult to characterize the relation between the lateral clearance and the diameter of the nozzle **11**, it being possible to determine it by trial and error. However, it can be indicated that the diameter of this nozzle must not exceed about 0.3 mm. for the magnitudes of the clearance indicated hereinbefore.

The method and the device according to the invention regulate the value of the lateral clearance of the or each rotary element of a rotary displacement pump to a roughly constant minimum value and this improves and renders more regular the performances of such a pump without necessitating increased precision of the machining of the various parts.

Further, owing to the freedom allowed to side-wall member **6** to move axially to an extreme position determined by the abutment against the shoulder of the stepped bore **14**, damage to the facing faces of the gear pinion and the side-wall members should a foreign body, such as a small cutting or swarf become lodged between said facing faces. In this event, the pump can continue to operate with, however, inferior characteristics but with no danger of seizing or serious damage.

FIG. 3 shows a modification of a pump according to the invention in which the nozzle **11** of fixed diameter is replaced by a device constituting a jet having regulable characteristics.

This device comprises a screw **34** having an axial conduit **35** constituting a jet and screwed in screwthreading **36** formed in a ring **37** whose shape slightly differs from that of the ring **9** of the embodiment shown in FIG. 1. The screw **34** communicates by way of its end **34***a* with the chamber C3 in front of the solid centre part of a washer **38** provided with apertures **39**. This washer is disposed in an aperture **40** in the side-wall member **6** and applied against a stop ring **42** by a spring **41**.

The characteristics of the jet thus constituted are determined by the clearance which exists between the end **34***a* of the screw **24** and the centre part of the washer **38**. Thus, by modifying the position of the screw **34** it is possible to regulate the lateral clearance between the gear pinion and the side-wall members **6** and **24**, this regulation being for example carried out in the course of pump checking or acceptance tests.

This arrangement affords a regulation which is more precise and more flexible than that of the first embodiment described, its operation being however identical.

Further, the presence of the spring **41** allows the side-wall member to move a relatively great distance if a foreign body becomes lodged between the gear pinion and the facing faces of one or the other of the side-wall members.

Indeed, in this case, the washer **38** abuts against the end **34***a* of the regulable jet and compresses the spring **41**.

Although specific embodiments of the invention have been described, many modifications and changes may be made therein without departing from the scope of the invention as defined in the appended claims.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A rotary displacement pump comprising a housing defining a pumping chamber, an inlet and an outlet in said housing, two intermeshing gear pinions rotatably mounted in said housing; two pairs of side-wall members disposed in said housing and between which each of said gear pinions is rotatably mounted, one of said side-wall members of each pair being axially movable relative to said housing and relative to said gear pinion and defining with said housing at least one annular chamber, means for applying on a part of the face of said movable side-wall member facing said gear pinion a first pressure in the neighbourhood of the delivery pressure of the pump, a first arcuate groove defined in said face of each movable side-wall member substantially opposite the meshing area of the gear pinions, a first passage in said movable side-wall member putting on communication said first arcuate groove and said annular chamber, and fluid metering means between said annular chamber and a part of said housing where the pump inlet pressure is prevailing for applying in said annular chamber a regulated back-pressure whose magnitude determines the value of the lateral

clearance between said gear pinion and said side-wall members.

2. A pump as claimed in claim 1, wherein said first arcuate groove is located adjacent and radially inside the root-circle of the adjacent gear pinion.

3. A pump as claimed in claim 1, wherein each gear pinion has a shaft integral therewith and each side-wall member carries a bearing adapted to receive said shaft.

4. A pump as claimed in claim 1, wherein said metering means comprises at least one nozzle constituting a jet.

5. A pump as claimed in claim 4, wherein said jet is a calibrated aperture having a fixed diameter.

6. A pump as claimed in claim 4, wherein said jet is adjustable in size whereby the value of said back-pressure can be adjusted.

7. A pump as claimed in claim 1, comprising between a part of said housing and said movable side-wall member elastically yieldable means which biases said side-wall member against said gear pinion.

8. A pump as claimed in claim 1, wherein said movable side-wall member is stepped at its outer periphery and comprises three annular shoulders, said housing having a bore stepped in a corresponding manner and defining three annular chambers with said movable side-wall member, a second passage being defined in said movable side-wall member, between the outermost of said annular chamber and said face of the movable side-wall member, further passage means being provided between the two other annular chambers, said fluid metering means being provided between the innermost annular chamber and said part of the housing.

9. A rotary displacement pump comprising a housing, an inlet and an outlet in said housing, two interengaged pump gear pinions, four side-wall members mounted in said housing and cooperative in pairs with each of said gear pinions, each side-wall member including a bearing and each gear pinion being rotatably mounted in said bearings between the corresponding pair of side-wall members, one of said side-wall members of each pair being axially movable relative to said housing and to the corresponding gear pinion and the other of said side-wall members of each pair being fixed with respect to the housing, means for subjecting a part of the face of said movable side-wall member of each pair which faces the adjacent gear pinion to a first pressure in the neighbourhood of the delivery pressure of the pump, first arcuate grooves in said part of said face of each movable side-wall member and in the corresponding part of each fixed side-wall member, said grooves being identical and in facing relationship, each gear pinion comprising a first series of passageways opening onto the lateral faces thereof and in front of said first grooves, each movable side-wall member of each pair of side-wall members defining with said housing at least one annular chamber and comprising a passage putting said chamber in communication with said first groove of said movable side-wall member, fluid metering means being provided between said annular chambear and a part of said housing where the pump inlet pressure is prevailing.

10. A pump as claimed in claim 9, wherein second arcuate grooves are provided in the face of each side-wall member facing said gear pinion, said second arcuate grooves being located adjacent and radially inside said

first arcuate grooves, each pinion comprising a second series of passageways opening onto the lateral faces thereof in front of said second arcuate grooves the circumferential length of which is at least equal to that of the arc between two successive passageways of said second series.

11. A pump as claimed in claim 10, wherein said first grooves are located generally opposite the meshing area of the gear pinions, adjacent and radially inside the root-circle of the adjacent gear pinion, said second arcuate grooves being located adjacent and radially inside said first grooves.

12. A pump as claimed in claim 10, wherein each side-wall member comprises a third arcuate groove located adjacent and radially outside said first arcuate groove, said third arcuate grooves having such a circumferential length that they are always in communication with at least one gap between two successive teeth of the adjacent pinion.

13. A rotary displacement pump as claimed in claim 1, wherein the other side-wall of each pair of side-wall members comprises on its face facing the adjacent pinion a first arcuate groove identical to the first arcuate groove of the movable side-wall member and opposite the latter, each gear pinion comprising a first series of passageways opening onto the lateral faces thereof in front of said first arcuate grooves.

14. A rotary displacement pump as claimed in claim 13, wherein each side-wall member comprises in its face facing the adjacent pinion a second arcuate groove located adjacent and radially inside said first arcuate grooves, each pinion comprising a second series of passageways opening onto the lateral faces thereof in front of said second arcuate grooves the circumferential length of which is at least equal to that of the arc between two successive passageways of said second series.

15. A rotary displacement pump as claimed in claim 14, wherein radial passageways are provided in each pinion, between each passageway of said second series and the root of the space between two adjacent pinion teeth.

16. A rotary displacement pump as claimed in claim 14, wherein each side-wall member comprises a third arcuate groove located adjacent and radially outside said first arcuate groove, said third arcuate grooves having such a circumferential length that they are always in communication with at least one gap between two successive teeth of the adjacent pinion.

References Cited

UNITED STATES PATENTS

2,437,791	3/1948	Roth et al.	103—126L
2,444,165	6/1948	Lauck	103—126L
2,624,287	1/1953	Ilyin	103—126L
2,627,232	2/1953	Lauck	103—126L
2,915,977	12/1959	Campbell	103—126L
3,137,238	6/1964	Gordon	103—126L

CARLTON R. CROYLE, Primary Examiner

W. J. GOODLIN, Assistant Examiner

U.S. Cl. X.R.

418—206