United States Patent [19]

Gelin

[11] **3,912,421**

[45] **Oct. 14, 1975**

[54] **RADIAL PISTON MACHINE**

[75] Inventor: **Robert Gelin,** Blaustein, Germany

[73] Assignee: **G. L. Rexroth GmbH,** Lohr (Main), Germany

[22] Filed: **June 18, 1974**

[21] Appl. No.: **480,503**

[30] **Foreign Application Priority Data**

June 29, 1973 Germany 2333103

[52] **U.S. Cl.** **417/273;** 417/464; 417/570

[51] **Int. Cl.²** **F04B 1/04;** F04B 19/02

[58] **Field of Search** 417/273, 319, 570, 464

[56] **References Cited**

UNITED STATES PATENTS

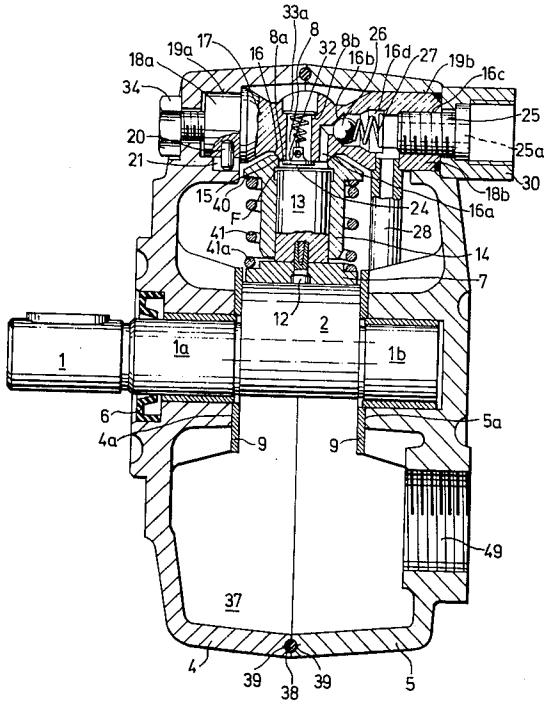
1,990,703	2/1935	Liddle	92/119
2,642,748	6/1953	Widmer	417/465
3,227,094	1/1966	Cailloux	417/464
3,527,547	9/1970	Dieter et al.	417/570

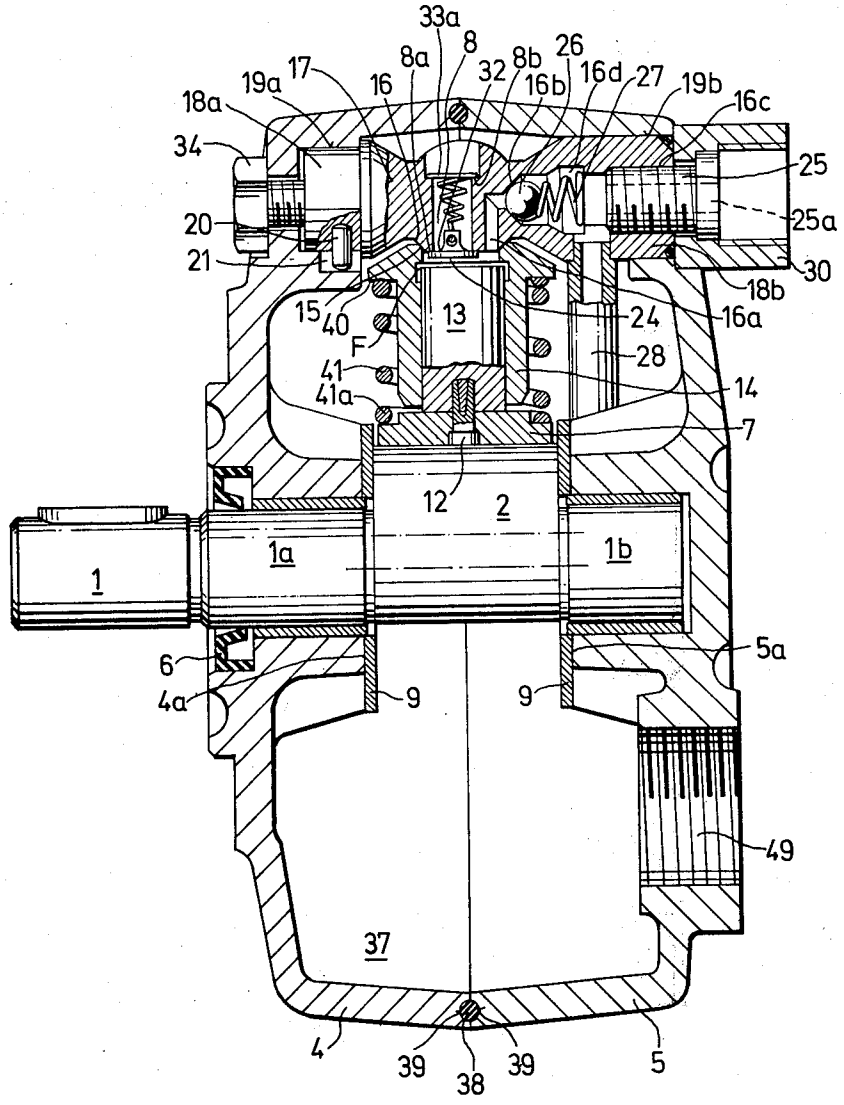
Primary Examiner—William L. Freeh
Assistant Examiner—G. P. LaPointe
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A plurality of radially oriented pistons are each surrounded by a cylinder sleeve so as to be free to slide within the same. Each of the cylinder sleeves has a radially outer end which engages and surrounds a portion of a part-spherical surface of a stationary member. Inlet and outlet valves are provided in the stationary member on the respective portions of the part-spherical surface which are surrounded by the radially outer ends of the cylinder sleeves.

5 Claims, 1 Drawing Figure




33a
8
8a
8b
26
17
19a
16
32
16b
16d
27
19b
16c
18a
34
25
25a
20
21
30
18b
15
40
F
13
24
16a
28
41
41a
14
7
12
2
1
1a
1b
5a
6
4a
9
9
49
37
4
39
38
39
5

RADIAL PISTON MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a piston machine in general, and in particular to a radial piston machine. Still more specifically, the invention relates to a hydraulic radial piston machine.

Radial piston machines are known which are of the type wherein an eccentric shaft turns and engages piston shoes of radially extending pistons, so that as the shaft turns in sliding engagement with the piston shoes, the pistons are reciprocated in radial direction. The pistons are surrounded by cylinder sleeves the radially outer ends of which are supported by a surrounding stationary member.

These prior-art radial piston machines are usually used as low-speed high-torque hydraulic motors, because due to the contact between the eccentric shaft and the piston shoes, the losses due to friction and the wear between the piston shoe and the eccentric must be reduced to a minimum. As a general rule, these radial piston machines are controlled with the aid of a rotary slide valve which governs the fluid flow in them and is coupled with the eccentric shaft. This is acceptable where these machines are used as hydraulic motors, but such control cannot be used if the machine were to be employed as a pump, because a rotary valve control does not permit the machine to have the suction which is required when the machine is to operate as a pump.

While it is desirable to be able to operate this type of rotary piston machine as a pump, no construction has heretofore become known which satisfactorily permits such operation, especially with respect to the control of the fluid flow through the machine.

SUMMARY OF THE INVENTION

It is, therefore, a general object of the invention to overcome this disadvantage of the prior art.

More particularly, it is an object of the invention to provide a radial piston machine of the type outlined above, which can be satisfactorily operated as a pump.

Still more specifically, it is an object of the invention to provide such a radial piston machine which is provided with a control for the fluid flow which makes it possible to operate such a machine satisfactorily as a pump.

An additional object of the invention is to provide such a radial piston machine which is of relatively simple and therefore reliable construction, and which has a maximum possible capability for self-priming suction.

In keeping with these objects and with others which will become apparent hereafter, one feature of the invention resides, in a radial piston machine, in a combination which comprises stationary members having each an inwardly directed part-spherical surface, a plurality of radially oriented pistons, a plurality of cylinder sleeves each surrounding one of the pistons for free relative sliding movement, each of these cylinder sleeves having a radially outer end which engages and surrounds a portion of the respective part-spherical surface, and inlet and outlet valve means in the stationary member and at the respective portions of the part-spherical surface.

It is advantageous if the valve body of the suction or intake valve extends directly into the interior of the respective cylinder sleeve, because this produces particularly good suction conditions. The location of the inlet and outlet valve means in this manner directly at the head or outer end of the respective cylinder sleeves provides favorable conditions for proper operation of the radial piston machine as a pump.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is an axial section through a radial piston machine embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The FIGURE shows an exemplary embodiment of the radial piston machine of the type under discussion, provided with the novel invention. Reference numeral **1** identifies a shaft which turns about its longitudinal axis and is provided with an eccentric **2.** The shaft **1** is journalled at the axially spaced portions **1***a* and **1***b* in slide bearings which are mounted on a housing composed of two housing sections **4, 5.** These housing sections are provided in their contacting edge faces with a pair of circumferentially extending grooves **39** in which a sealing member **38** is located, so as to seal the junction of the housing sections **4** and **5.** A shaft seal **6** seals the point of exit of the shaft **1** from the housing section **4.**

Located within the housing are stationary annular members **17,** and located radially inward of the members **17** is a plurality of radially distributed pistons and cylinder sleeves. Since the invention can be understood from the description of one of the pistons and cylinder sleeves, and since the manner in which the others are arranged radially inwardly of the members **17** is conventional in radial piston machines, only one piston **13** and its associated cylinder sleeve **14** and member **17** have been illustrated. Each piston **13** cooperates with a piston shoe **7** which is in sliding contact with the eccentric **2** and in axial direction of the shaft **1** is supported against displacement by a pair of sliding rings **9** which in turn are supported on the surface portions **4***a* and **5***a* of the housing sections **4** and **5,** respectively. The piston shoe **7** is connected with its associated piston **13** by means of a connection which is here in form of a threaded bolt **12.** The connection between the piston shoe and the piston is therefore rigid. However, the bolt **12** is so dimensioned or else may be appropriately weakened by providing it with grooves or the like, that in the event of, for example, excessively high frictional forces that might develop between eccentric **2** and piston shoe **7,** the piston shoe **7** will be able to separate from its associated piston **13** due to the bolt **12** shearing off, so that further reciprocation of the piston **13** is precluded to prevent the possibility that still more damage might occur.

The piston **13** is surrounded by a cylinder sleeve **14,** the radially outer end of which is formed with an annular conically configurated sealing face which cooperates with the part-spherical inwardly directed surface **16** of the member **17.** The latter is provided at two axi-

ally opposite sides with a pair of oppositely located cylindrical projections **18***a*, 18*b* which are matingly received in corresponding bores **19***a*, 19*b* formed in the housing sections **4** and **5**, respectively. To properly fix the position of the surface **16** with respect to the cylinder sleeves **14**, the member **17** is provided with a pin **20** which is guided in an axially extending slot **21** of the housing section **4**. A bolt or screw **34** is threaded through an opening in the housing section **4** into the projection **18***a* in order to fix the same and thereby the member **17** firmly in the housing.

The wall of the member **17** is formed with an outlet channel **16***a* for the cylinder space **24** which is formed in the cylinder sleeve **14**; the channel **16***a* extends first outwardly and then substantially at a right angle in axial direction of the member **17**, to form an enlarged portion **16***d*, an inclined annular surface **16***b* being provided at the point where the smaller diameter of the channel merges with the larger diameter of the enlarged portion **16***d*. The enlarged portion **16***d* in turn merges with an internally threaded portion **16***c* that extends to the exterior of the machine and into which a nipple **25** having a central bore **25***a* is threaded. A valve member **26**, here in form of a spherical member, is accommodated with some radial play in the enlarged portion **16***b* and is pressed by a relatively weak spring **27** against the surface **16***b* which thus acts as a valve seat. This means that the member **26** together with the surface **16***b* constitutes the pressure valve for the cylinder space **24** through which fluid may be vented from the cylinder space **24**.

A tube **28** is soldered into or otherwise secured to the projection **18***b* and communicates with the enlarged portion **16***d* of the channel **16***a* downstream of the valve member **26**. This tube **28**, together with the others which are not illustrated (it will be appreciated that such a tube is provided for each combination of a piston **13** and associated cylinder sleeve **14**) connects the outlet **30** of the pump with all cylinder and piston combinations, since all of these tubes are in communication with one another and thus with the outlet **30**.

Adjacent the channel **16***a*, the member **17** is formed with a channel **8** which extends to the interior **37** of the housing formed by the sections **4** and **5**. The inner end **8***a* of the channel **8** is closed by a valve member **32** which is located within the actual cylinder space **24** of the cylinder sleeve **14** and which, together with the inner end **8***a* and a relatively weak contraction spring whose outer convolution **33***a* is supported on a shoulder **8***b* formed in the channel **8**, constitutes the suction inlet valve. The spring holds the valve member **32** against the inner end **8***a* but permits it to be moved inwardly of the cylinder space **24** when suction develops in the latter.

Reference numeral **49** identifies the inlet opening for the interior **37** of the housing **4**, **5**.

The cylinder sleeve **14** is provided in the region of its radially outer end with an outwardly extending flange **40** which is engages by a helical spring **41** the opposite axial end of which is identified with reference numeral **41***a* and bears upon the piston shoe **7**, thus pressing the sealing face **15** of the cylinder sleeve **14** against the part-spherical surface **16**.

When, due to rotation of the shaft **1**, the eccentric **2** moves from the lower-dead center point to the upper dead-center point (the latter is shown in the drawing), the piston **13** moves from its radially inwardly retracted position to its radially outwardly extended position which is shown in the drawing. During this movement the cylinder sleeve **14** shifts with its sealing edge **15** on the surface **16** counter to the direction of rotation of the shaft **1**. The fluid which is expelled from the cylinder space **24** as a result of the reciprocation of the piston **13** during this movement, is forced into the channel **16***a* displacing the valve member **26** from its valve seat against the force of the spring **27** so that it can escape via the bore **25** into a conduit communicating with the same, for instance a conduit leading to a hydraulic system. The force with which the sealing face **15** of the sleeve **14** during this movement of the piston **13** against the part-spherical surface **16** can be calculated as the product of the area of the annular face F of the sleeve **14** and the pressure which exists in the cylinder space **24**. The size of the annular face F is determined by the diameter difference between the sealing face **15** and the inner diameter of the sleeve **14**.

When subsequently the eccentric **2** moves from the upper dead-center point towards the lower dead-center point, the associated inward retraction of the piston **13** provides suction which lifts the valve member **32** off the inner end **8***a* of the channel **8** against the opposing force of the spring which holds the valve member **32**, and thus permits an inflow of additional fluid from the housing space **37** via the channel **8** whose outer end communicates with the space **37**, so that this fluid can enter into the cylinder space **24**. During this movement the sealing edge **15** of the cylinder sleeve **14** shifts on the part-spherical surface **16** through a small angular distance in the direction of rotation of the shaft **1**. Due to the fact that during the rotation of the eccentric **2** the sealing face **15** of the sleeve **14** performs a pivoting movement on the part-spherical surface **16**, without the sealing face **15** lifting off the surface **16**, a reliable operation of the radial piston machine in a pumping mode is assured. Furthermore, a reliable engagement of the piston shoe **7** with the eccentric is guaranteed in all positions of the eccentric. Assurance against lifting-off of the sealing face **15** of the sleeve **14** from the surface **16** is provided during the pressure of expulsion stroke by the pressing of the sealing face **15** against the surface **16** due to the force acting at the surface F in combination with the force of the spring **41**, and during the suction stroke due to the force of the spring **41** alone.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a radial piston machine, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a radial piston machine, a combination comprising a housing; a shaft having an eccentric portion and

being rotatably mounted in said housing; a plurality of radially oriented pistons mounted within said housing and each having an inner end; a piston shoe connected to the inner end of each piston in sliding engagement with said eccentric portion of said shaft; a plurality of cylinder sleeves, each surrounding one of said pistons for free sliding movement relative thereto, each of said cylinder sleeves having a radially outer end; a stationary member for each of said cylinder sleeves and having an inwardly directed part-spherical surface, a portion of which being engaged and surrounded by the radially outer end of the respective cylinder sleeve; biasing means biasing each of said cylinder sleeves into engagement with said part-spherical surface; inlet and outlet valve means in each member at the respective portion of said part-spherical surface which is surrounded by said outer end of the respective cylinder sleeve, said inlet valve means comprising a valve member located within said cylinder sleeve and spring means connected to said valve member at the side thereof facing away from said cylinder sleeve for biasing the valve member into engagement with said stationary member.

2. A combination as defined in claim **1,** further comprising connecting means connecting each piston shoe with its associated piston and defining between them a weakened zone.

3. A combination as defined in claim **2,** wherein said connecting means comprises a threaded bolt for each piston shoe and associated piston.

4. A combination as defined in claim **1,** wherein said housing has two sections surrounding said member and having a pair of oppositely located recesses; said member having a pair of oppositely located outwardly extending projections each of which is matingly received in one of said recesses.

5. A combination as defined in claim **4,** wherein said member is formed with a fluid channel which communicates with said outer ends of the respective cylinder sleeves; and wherein one of said projections is formed with an outlet which communicates with said channel.

* * * * *