(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 263 558 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87201880.9**

(51) Int. Cl.4: **F04B 49/10**

(22) Date of filing: **01.10.87**

(30) Priority: **09.10.86 IT 2195186**

(43) Date of publication of application:
13.04.88 Bulletin 88/15

(84) Designated Contracting States:
AT BE CH DE ES FR GB IT LI NL

(71) Applicant: **RIVA CALZONI S.p.A.**
Via Emilia Ponente 72
I-40133 Bologna(IT)

(72) Inventor: **De Vietro, Ivano**
Via Jussi 43
S. Lazzaro Di Savena Bologna(IT)

(74) Representative: **Raimondi, Alfredo, Dott. Ing. Prof. et al**
Studio Tecnico Consulenza Brevetti Piazzale Cadorna 15
I-20123 Milano(IT)

(54) Hydraulic piston motor having means for measuring the speed of rotation.

(57) The hydraulic piston motor comprising means for measuring the speed of rotation according to the invention comprises a rotating hydraulic distributor adapted to supply hydraulic pressure fluid in cycles to the pistons driving the motor, and having a revolving internal member rotating integrally with the drive shaft and comprising ducts for distributing hydraulic fluid, a sensor being present in a fixed position on the hydraulic distributor and facing the revolving member, the outer surface of which is formed with discontinuities detectable by the sensor which, corresponding to the periodic detection of the aforementioned discontinuties during the rotation of the revolving member, generates a signal at a frequency proportional to the speed of rotation of the member, means being present for protecting the sensors from the pressure of the hydraulic fluid in the fixed outer casing of the distributor.

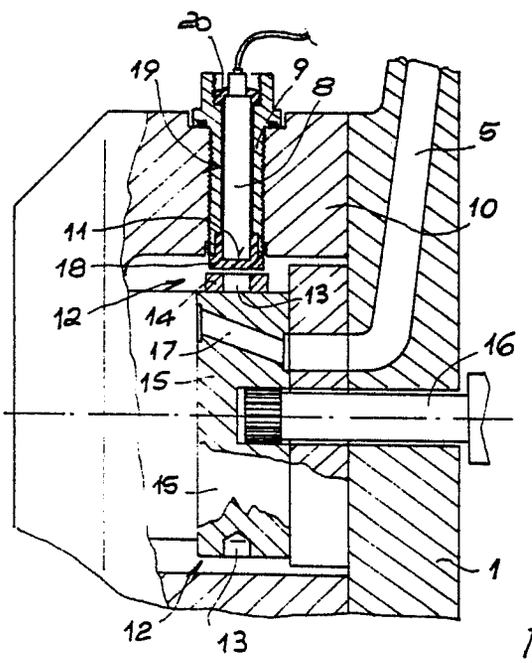

Fig. 2

EP 0 263 558 A2

Hydraulic piston motor having means for measuring the speed of rotation

The invention relates to a hydraulic piston motor having means for measuring the speed of rotation.

It is necessary to know the speed of rotation of radial or axial piston hydraulic motors, in order to know the actual operating conditions when required, or to make various adjustments with regard to the characteristics of devices actuated by the motor.

The speed can be directly recorded at the motor by conventional means by attaching a tachometric device to a secondary shaft mechanically connected to the motor shaft, but these embodiments require hydraulic seals and bearings for the secondary shaft, so the the structure becomes complicated and there are problems regarding the sealing-tightness and wear of the rotating parts. These applications also substantially increase the axial dimension of the motor and also greatly increase the costs. There is therefore a need for a motor in which the speed of rotation can be detected by a device which does not add to the dimensions of the motor structure and also operates without mechanical contact with the rotating parts of the motor, thus eliminating the problems regarding sealing-tightness and wear.

To this end, the invention provides a hydraulic piston motor which has means for measuring the speed of rotation and comprises a rotating hydraulic distributor adapted to supply hydraulic pressure fluid in cycles to the pistons driving the motor, and having a revolving internal member rotating integrally with the drive shaft and comprising ducts for distributing hydraulic fluid, a sensor being present in a fixed position on the hydraulic distributor and facing the revolving member, the outer surface of which is formed with discontinuities detectable by the sensor which, corresponding to the periodic detection of the aforementioned discontinuties during the rotation of the revolving member, generates a signal at a frequency proportional to the speed of rotation of the member, means being present for protecting the sensors from the pressure of the hydraulic fluid in the fixed outer casing of the distributor.

Preferably the sensor is an inductive proximity sensor rigidly connected to the fixed external casing of the distributor and facing the revolving member and adapted to generate a signal each time its front faces the discontinuities on the outer surface of the revolving distributor member.

More particularly, in a preferred embodiment, the sensitive sensor element is slidingly inserted into an orifice in a sheath of non-magnetic material connected to the distributor casing, the front part of the sheath having a cap of pressure-resistant material abutting the front end of the sensitive element which is held in position by a resilient means pressed against its rear end and connected to the sheath, in which the resilient means allows the sensitive element to slide under limited force inside the sheath in response to deformation in the cap in contact therewith, as a result of the pressure of the hydraulic fluid in the distributor.

Advantageously, the sheath cap is made of reinforced plastics, and the resilient means is a sealing layer of elastomeric material such as silicone resin or the like, so as to provide a resiliently yielding connection of simple structure and limited cost. In an optional alternative, the resilient means is a helical or cup spring or similar resilient element, one end of which abuts the sensor whereas the other end is connected to the sheath.

The discontinuities on the outer surface of the revolving member can comprise a ferromagnetic ring formed with a number of orifices having radial axes, or with equidistant recesses or raised portions on its side surface, the ring being disposed outside the revolving member and integral therewith, or alternatively the discontinuities can comprise a number of orifices having radial axes or equidistant recesses or raised portions formed directly on the surface of the revolving member.

In one of the previously-described embodiments, the number of discontinuities detectable by the sensor is such that on the circumference along which the discontinuities are disposed on the outer surface of the revolving member, the combined length of the solid portions is equal to the length of the empty portions and the discontinuity is made as small as compatible with the sensitivity of the sensor.

Other details will be clear from the following description with reference to the accompanying drawings in which:

Fig. 1 is a diagram of a hydraulic motor equipped with the device according to the invention;

Fig. 2 is a larger-scale view in section of the sensing means in the device, and

Fig. 3 is a diagram of the signal at the output of the sensing means.

A radial piston-type hydraulic motor substantially comprises a frame 1 in which a camshaft 2 is rotatably mounted, a number of radial cylinder-piston drive means, called radial pistons for short, being disposed around the shaft and acting on the

eccentric portion 4 thereof and being successively supplied with oil under pressure via respective supply ducts 5 and a distributor 6, thus exerting thrusts on the cam and driving shaft 2 in rotation.

A device 7 for recording the speed of rotation of the motor is attached to distributor 6, as shown in detail in Fig. 2. The device comprises an inductive proximity sensor 8 inserted into a non-magnetic metal sheath 9 secured, e.g. by screwing as shown, to the fixed external casing 10 of the distributor.

The sensitive end 11 of sensor 8 radially faces an element 12 formed with a number of orifices or notches 13 at its periphery. Element 12 can be a ring 14 secured to the exterior of a rotating member 15 of the distributor which is coupled for rotation to shaft 2 via a spindle 16 and comprises oil supply ducts 17. Alternatively element 12 can be the member 15, which can be directly formed with apertures or notches 13 on its outer cylindrical surface.

The sensor 8 could be damaged or its life could be reduced by stresses from the hydraulic pressure fluid inside member 15. The sensitive end of sensor 8 is protected from these stresses by a cap 18 of non-magnetic material, advantageously made of reinforced plastics, which withstands the pressure of the hydraulic fluid without transmitting stresses to the sensor.

Sensor 8 is slid into an orifice 19 in sheath 9. The rear end of the sensor is axially secured in the sheath by a seal 20 of elastomeric material, e.g. silicone rubber.

Consequently, deformations to cap 18 caused by pressure and transmitted to the sensor 8, which is in contact with the cap so as to reduce the distance between the end of the sensor and element 12 to a minimum, do not result in stresses on the sensor itself, since seal 20 forms a connection which can resiliently yield. The seal behaves like a spring but is simpler and cheaper to assemble. Alternatively or where advantageous, the seal 20 can be replaced by a helical or cup metal spring or similar resilient means, one end of which bears against the sensor whereas the other end bears against a suitable raised portion of sheath 9.

The sensor outputs a signal whose frequency varies with the speed of rotation and can therefore be sent to a display or monitoring unit depending on the use made of the motor. The accuracy of the measurement depends on the number of orifices or notches 13 on member 15, and consequently the number of apertures or notches should be made as large as is compatible with the dimensional requirements of the component.

The signal is of the kind shown in Fig. 3 and comprises a succession of peaks corresponding to the successive occasions when the front of the sensor faces the solid parts and the spaces resulting from the orifices or notches 13 in the revolving member.

Although the invention has been described in detail with reference to a radial piston-type motor, it can also be applied to different kinds of hydraulic motors, e.g. axial piston motors or the like.

Many variants can be introduced without thereby departing from the scope of the invention in its general features.

Claims

1. A hydraulic piston motor having a device for measuring the speed of rotation, characterised in that it comprises a rotating hydraulic distributor adapted to supply hydraulic pressure fluid in cycles to the pistons driving the motor, and having a revolving internal member rotating integrally with the drive shaft and comprising ducts for distributing hydraulic fluid, a sensor being present in a fixed position on the hydraulic distributor and facing the revolving member, the outer surface of which is formed with discontinuities detectable by the sensor which, corresponding to the periodic detection of the aforementioned discontinuties during the rotation of the revolving member, generates a signal at a frequency proportional to the speed of rotation of the member, means being present for protecting the sensors from the pressure of the hydraulic fluid in the fixed outer casing of the distributor.

2. A hydraulic piston motor having means for measuring the speed of rotation according to claim 1, characterised in that the sensor is an inductive or capacitive or magnetic proximity sensor rigidly connected to the fixed external casing of the distributor and facing the revolving member and adapted to generate a signal each time its front faces the discontinuities on the outer surface of the revolving distributor member.

3. A hydraulic piston motor having means for measuring the speed of rotation acording to claim 2, characterised in that the sensitive sensor element is slidingly inserted into an orifice in a sheath of non-magnetic material connected to the distributor casing, the front part of the sheath having a cap of pressure-resistant material abutting the front end of the sensitive element which is held in position by a resilient means pressed against its rear end and connected to the sheath, in which the resilient means allows the sensitive element to slide under limited force inside the sheath in response to de-

formation in the cap in contact therewith, as a result of the pressure of the hydraulic fluid in the distributor.

4. A motor according to claim 3, characterised in that the sheath cap is made of reinforced plastics.

5. A motor according to claim 3, characterised in that the resilient means is a sealing layer of elastomeric material such as silicone resin or the like.

6. A hydraulic motor according to claim 3, characterised in that the resilient means is a helical or cup spring or similar resilient element, one end of which abuts the sensor whereas the other end is connected to the sheath.

7. A motor according to claims 1 and 2, characterised in that the discontinuities on the outer surface of the revolving member comprise a ring formed with a number of equidistant orifices having radial axes and on the side surface of the ring and disposed outside the revolving member and integral therewith.

8. A motor according to claims 1 and 2, characterised in that the discontinuities on the outer surface of the revolving member comprise a number of equidistant orifices having radial axes and formed directly on the surface of the revolving member.

9. A motor according to claims 1 and 2, characterised in that the discontinuities on the outer surface of the revolving member comprise a ring formed with a number of equidistant recesses or raised portions on its side surface and disposed outside the revolving member and integral therewith.

10. A motor according to claims 1 and 2, characterised in that the discontinuities on the outer surface of the revolving member comprise a number of equidistant recesses or raised portions formed directly on the side surface of the revolving member.

11. A motor according to any of claims 7, 8, 9 or 10, characterised in that the number of discontinuities is such that, on the circumference along which the discontinuities are disposed on the outer surface of the revolving member, the combined length of the solid portions is equal to the length of the empty portions and the discontinuity is made as small as compatible with the sensitivity of the sensor.

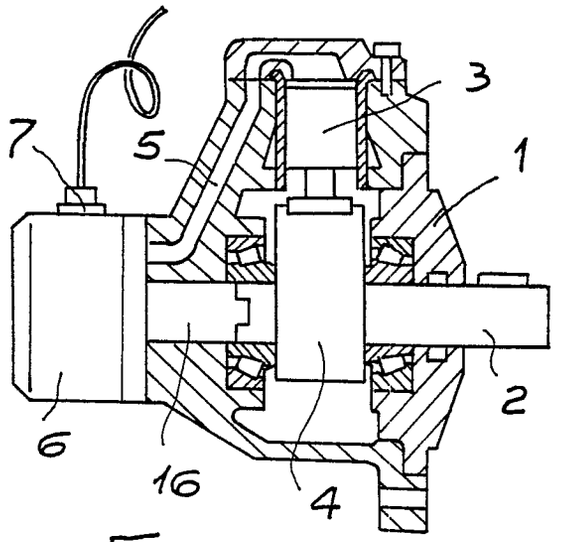

Fig. 1

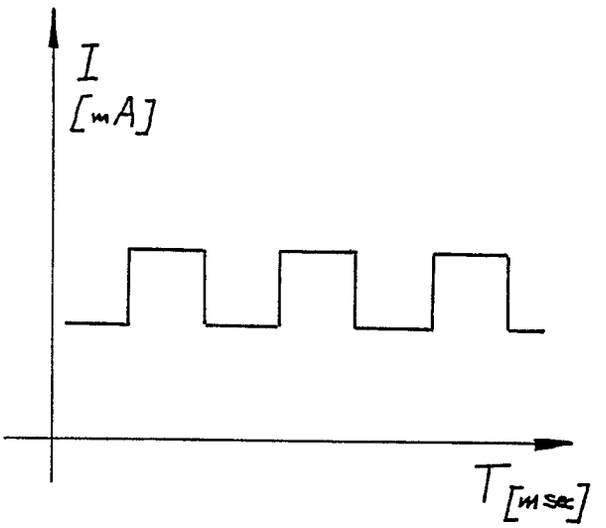

Fig. 3

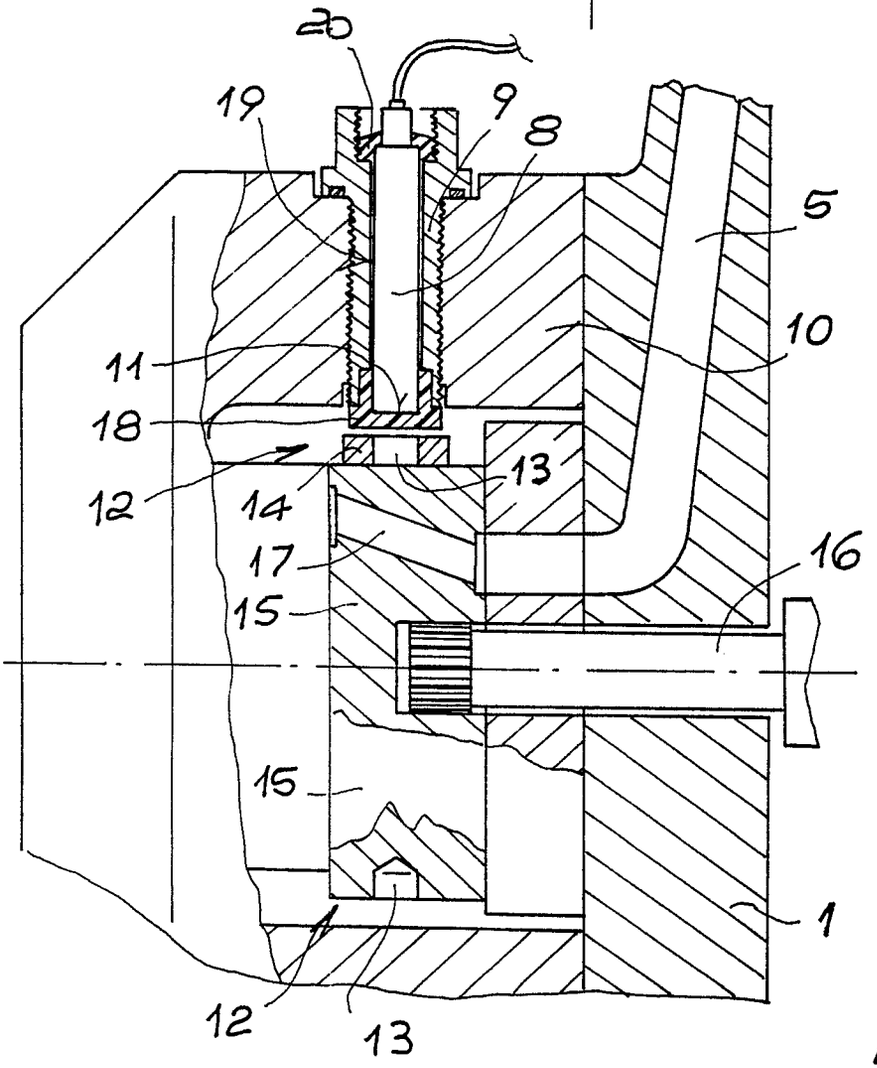

Fig. 2