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(54) **INTERNAL GEAR PUMP**

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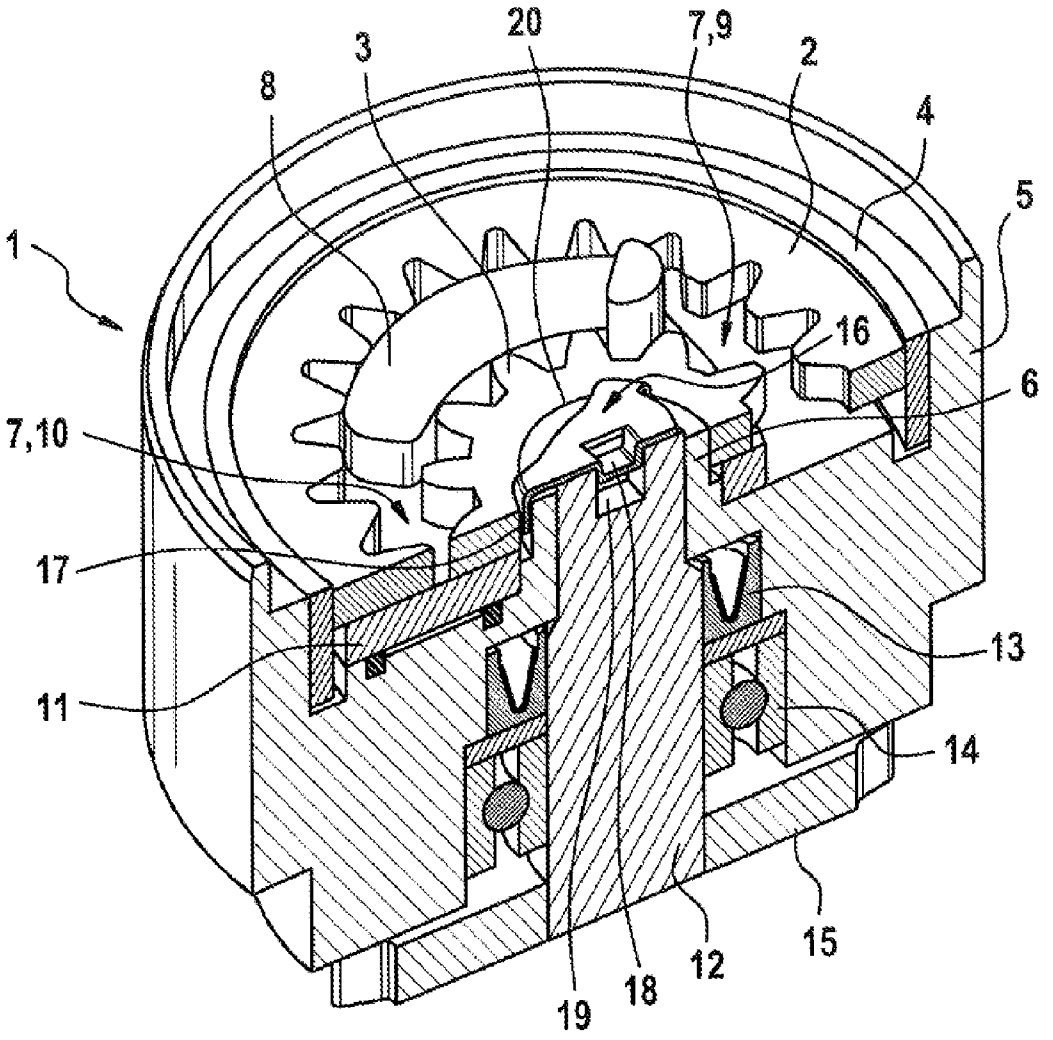
(57) **ABSTRACT**

An internal gear pump for a hydraulic vehicle brake system includes a bearing formed for a pump shaft in a tubular form. The bearing is integrally formed with a housing of the internal gear pump. The bearing is configured to mount a pinion of the internal gear pump rotatably on the bearing. The internal gear pump also includes a catch configured to connect the pinion to the pump shaft for conjoint rotation.



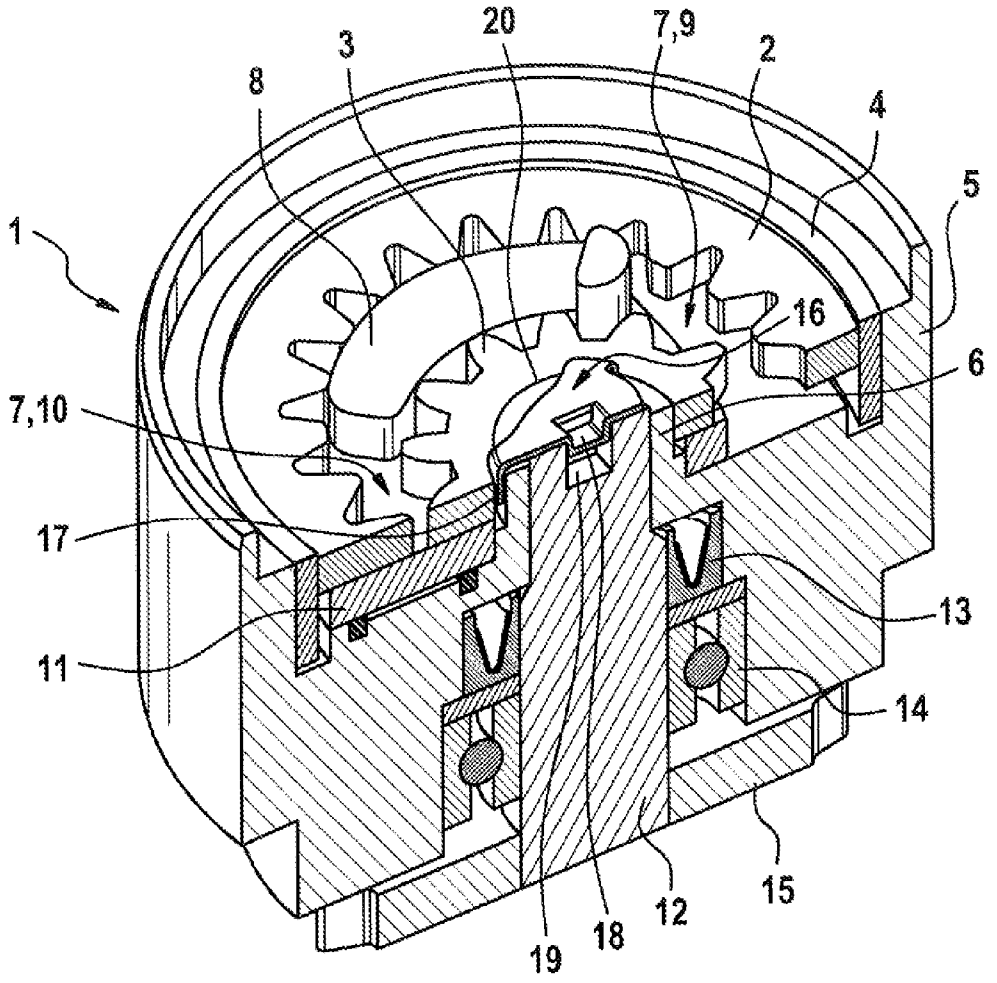


FIG. 1

INTERNAL GEAR PUMP

[0001] This application claims priority under 35 U.S.C. §119 to patent application number DE 10 2013 204 071.7, filed on Mar. 11, 2013 in Germany, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] The description relates to an internal gear pump for a hydraulic vehicle brake system having the features described below. Internal gear pumps of this kind are used instead of conventionally used piston pumps in slip-controlled and/or power-operated vehicle brake systems and are often referred to, though not necessarily correctly, as return pumps.

[0003] Internal gear pumps are known. They have an annulus and a pinion, which is arranged eccentrically in the annulus and meshes over a segment of the circumference with the annulus. The annuluses are internally toothed gear wheels, the pinions are externally toothed gearwheels, and the annulus and the pinion can also be regarded as gearwheels of the internal gear pumps. The terms "pinion" and "annulus" are used to distinguish between them. Opposite the segment of the circumference over which the gearwheels mesh there is a crescent-shaped free space between the annulus and the pinion, which is here referred to as a pump space. Arranged in the pump space is a dividing element, on the outside and inside of which tooth tips of the two gearwheels rest and which divides the pump space into a suction space and a pressure space. Owing to its typical shape, the dividing element is often also referred to as a crescent or a crescent element. Another name for the dividing element is "filler piece". When driven in rotation, the gearwheels pump fluid from the suction space into the pressure space. The prior art also includes internal gear pumps without a dividing element, and these can be referred to as gear ring pumps for the sake of distinguishing them.

[0004] German Offenlegungsschrift DE 43 22 239 A1 discloses an internal gear pump, the pinion of which is arranged rigidly on a pump shaft, which is provided for the purpose of driving the pinion in rotation and, via the pinion, the annulus that meshes with the pinion. On both sides of the pinion, the pump shaft is rotatably mounted in sliding bearings, which are press-fitted into a pump housing.

SUMMARY

[0005] The internal gear pump according to the disclosure, having the features described below, has an annulus, a pinion meshing with the annulus, and a pump shaft for driving the pinion and the annulus in rotation. According to the disclosure, a bearing is arranged within the pinion to provide rotatable mounting of the pump shaft, i.e. the bearing is situated in one plane with the pinion and not to the side of the pinion, for instance. However, the bearing can be longer in the axial direction than the width of the pinion and can project from the pinion on one or both sides. For example, the bearing passes through a central hole in the pinion, in particular the pinion is mounted rotatably in the bearing and/or the pump shaft is mounted rotatably on the bearing, which is embodied as a bearing bush, for example. Arranging the bearing within the pinion shortens an overall length of the internal gear pump. A further advantage is radial support for the pinion by the bearing in the plane of the pinion in which an inward-directed force acts on the pinion during the operation of the internal gear pump, said force being exerted on the pinion by fluid from the outside, which is pumped by the internal gear pump and is under pressure in the pressure space between the pinion and the annulus. The radial force acting on the pinion is supported without a moment about an axis transverse to the pump shaft by the bearing arranged within the pinion. This has the additional advantage that the pump shaft is not subjected to bending stress by the radial force acting on the pinion, and this improves pump running and reduces bearing wear. Because the pump shaft is not subjected to bending stress, there is no angular and radial misalignment of a driving wheel, generally a gearwheel, which is fitted for conjoint rotation on the pump shaft to drive the pump shaft in rotation. This improves truth of running of the internal gear pump and reduces wear, friction and noise generation at the driving wheel. Overall, the disclosure improves accuracy of position and truth of running of the pump shaft. The disclosure allows larger production tolerances.

[0006] The description below relates to advantageous embodiments and developments of the disclosure.

[0007] At least one embodiment of the disclosure includes a bearing which is integral with a housing of the internal gear pump, thereby eliminating a separate bearing and the assembly thereof.

[0008] At least one embodiment of the disclosure relates to a catch, which connects the pinion to the pump shaft for conjoint rotation. This embodiment allows rotatable mounting of the pinion on the outside of the bearing and of the pump shaft in the bearing. The catch can be arranged laterally on the pinion and adjacent to the bearing. The pump shaft can pass through the catch or the catch can be arranged on one end of the pump shaft.

[0009] For the formation of the bearing integrally with the housing of the internal gear pump, the disclosure provides a housing made of cast iron, e.g. gray cast iron. This material is good for primary forming and machining and is a good bearing material. It can be provided with permanent lubrication in the region of the bearing.

[0010] At least one embodiment of the disclosure provides for the pinion not to be arranged directly on the pump shaft but, as already described, for the pinion to be on the outside of the bearing and the pump shaft in the bearing, for example, the bearing thus being situated between the pinion and the pump shaft.

[0011] In particular, the internal gear pump according to the disclosure is provided as a hydraulic pump for a hydraulic slip-controlled and/or power-operated vehicle brake system instead of a conventionally used piston pump. In slip-controlled vehicle brake systems, hydraulic pumps are also referred to as return pumps. In this case, a housing of the internal gear pump according to the disclosure is configured for installation, insertion or press-fitting in a receptacle provided for this purpose in a hydraulic block of a slip control system. In this case, the housing of the internal gear pump can also be regarded as a cartridge.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The disclosure is explained in greater detail below by means of an embodiment illustrated in the drawing. The single FIGURE shows an internal gear pump according to the disclosure in a perspective section along the axis.

DETAILED DESCRIPTION

[0013] The internal gear pump **1** according to the disclosure illustrated in the drawing has an internally toothed gearwheel, here referred to as annulus **2**, and an externally toothed gearwheel, here referred to as pinion **3**, which is arranged eccentrically in the annulus **2** in such a way that it meshes with the annulus **2**. The two gearwheels **2**, **3** have parallel axes, have the same width and are arranged in the same plane. The annulus **2** is press-fitted into a bearing ring **4**, which is rotatably mounted in a sliding manner in a housing **5**. The pinion **3** is rotatably mounted in a sliding manner on a bearing **6**, which, in the embodiment of the disclosure illustrated and described, is a hollow cylinder, i.e. is tubular, and can also be regarded as a bearing ring or a bearing bush. The bearing **6** is an integral part of the housing **5** of the internal gear pump **1**. Because of its good machining properties and suitability as a bearing material, the housing **5** and hence also the bearing **6** integral with the housing **5** is composed of gray cast iron and is provided with permanent lubrication on the inside and the outside of the bearing **6**. Gray cast iron for the housing **5** of the internal gear pump **1** according to the disclosure is not essential;

[0014] the housing **5** with the bearing **6** can also be composed of some other metallic or nonmetallic material.

[0015] A segment of the circumference in which the gearwheels **2**, **3** mesh with one another has been cut away in the illustrated section along the axis and is therefore not visible. The figure shows a segment of the circumference of the gearwheels **2**, **3** in which the gearwheels **2**, **3** do not mesh with one another. In this segment of the circumference there is a crescent-shaped gap between the annulus **2** and the pinion **3**, this being referred to here as the pump space **7**. Arranged in the pump space **7** is a dividing element **8**, which divides the pump space **7** into a suction space **9** and a pressure space **10**. The dividing element **8** is crescent-shaped and is therefore also referred to as a crescent or crescent element, another designation for the dividing element **8** being "filler piece". The dividing element **8** is the same width as the gearwheels **2**, **3** and its outside and inside have a convex and concave cylindrical curvature, respectively, such that tooth tips of teeth of the gearwheels **2**, **3** rest on the outside and the inside of the dividing element **8**. When the gearwheels **2**, **3** are driven in rotation, the tooth tips of the teeth of the gearwheels **2**, **3** slide along the outside and the inside of the dividing element **8**, and the gearwheels **2**, **3** pump fluid in the gaps between the teeth in a manner known per se on the outside and inside of the dividing element **8** from the suction space **9** to the pressure space **10**. When the internal gear pump **1** is used as a hydraulic pump of a hydraulic vehicle brake system, the fluid is a liquid, namely brake fluid.

[0016] Axial disks **11** that are fixed against relative rotation and capable of axial movement are arranged on both sides of the gearwheels **2**, **3** and of the dividing element **8**, resting on side faces of the gearwheels **2**, **3** and of the dividing element **8** and covering the pump space **7** laterally, at least in the region of the pressure space **10** and of the dividing element **8**. The upper axial disk is not depicted because it would conceal the gearwheels **2**, **3** and the dividing element **8** of the internal gear pump **1**. Such axial disks **11** are known per se and are also referred to as control disks or pressure plates.

[0017] The internal gear pump **1** has a pump shaft **12**, which is rotatably mounted in a sliding manner in the tubular bearing **6**. To the side of the pinion **3** and the axial disk **11** depicted, the pump shaft **12** is sealed off in the housing **5** by a shaft sealing ring **13** and, on the side of the shaft sealing ring **13** facing away from the pinion **3**, is rotatably mounted in the housing **5** by means of a further bearing **14**. In the illustrated embodiment of the disclosure, the further bearing **14** is a ball bearing, but this is not essential for the disclosure. To drive the internal gear pump **1**, a gearwheel as a driving wheel **15** is press-fitted onto the end of the pump shaft **12** or secured for conjoint rotation in some other way on the pump shaft **12** at one end of the housing **5**.

[0018] The bearing **6** is situated within the pinion **3**, passing through a central hole in the pinion **3**, which is referred to here as bearing hole **20** and by means of which the pinion **3** is rotatably mounted in a sliding manner on the bearing **6**, with sliding bearing being preferred but not essential for the disclosure. By means of the rotary bearing of the pinion **3** with the bearing **6** within the pinion **3**, i.e. in one plane with the pinion **3**, the pinion **3** is supported radially in the plane in which it is situated.

[0019] During the operation of the internal gear pump **1**, there is a pressure in the pressure space **10** which pushes the pinion **3** radially inward. The pinion **3** is supported against the radial pressure by the bearing **6** arranged within the pinion **3**, the support being provided radially in the same plane in which it is subjected to pressure. The radial support for the pinion **3** is thus moment-free and, in particular, there is no tilting moment about an imaginary axis radial with respect to an axis of the pinion **3**. Bending stress on the pump shaft **12** is likewise avoided.

[0020] In order to be able to drive the pinion **3** in rotation by means of the pump shaft **12** to operate the internal gear pump **1**, the internal gear pump **1** has a catch **16**, which connects the pinion **3** for conjoint rotation to the pump shaft **12**. In the embodiment of the disclosure illustrated and described, the catch **16** is arranged on an end of the pump shaft **12** remote from the driving wheel **15**. In the embodiment of the disclosure illustrated and described, the catch **16** is a stamped and bent sheet metal component or a deep drawn component which is triangular or has the shape of a three-pointed star, which has tabs **17** bent at right angles at its corners that engage in pockets in the bearing hole **20** of the pinion **3**, thereby ensuring that the catch **16** is secured to the pinion **3** for conjoint rotation. The pockets are shallow recesses in the bearing hole **16** of the pinion **3**. The catch **16** overlaps an annular end face of the bearing **6** and, in its center, has a shallow hoop **18**, which is approximately square when viewed in the axial direction, is formed by deep drawing and engages in a square countersunk hole **19** in the center of the end of the pump shaft **12**. The hoop **18**, which is integral with the catch **16**, connects the catch **16** to the pump shaft **12** for conjoint rotation by positive engagement in the square countersunk hole **19**.

[0021] For use in a slip control system of a hydraulic vehicle brake system, the internal gear pump **1** is press-fitted by means of its cylindrical housing **5**, which can also be regarded as a cartridge, into a complementary cylindrical receptacle of a hydraulic block (not shown). Such hydraulic blocks are known per se from slip control systems of hydraulic vehicle brake systems. They are typically block-shaped parts made of aluminum having two receptacles for two internal gear pumps **1** and further receptacles for hydraulic components of the slip control system, such as solenoid valves and hydraulic accumulators. The receptacles or the hydraulic components inserted therein are hydraulically interconnected by means of bores in the hydraulic block.

What is claimed is:

1. An internal gear pump, comprising:

an annulus;

a pinion arranged eccentrically in the annulus and configured to mesh with the annulus;

a pump shaft configured to drive the pinion and the annulus in rotation; and

a bearing configured to rotatably mount at least one of the pump shaft and the pinion,

wherein the bearing is arranged within the pinion.

2. The internal gear pump according to claim **1**, wherein the bearing is integral with a housing of the internal gear pump.

3. The internal gear pump according to claim **1**, further comprising a catch configured to connect the pinion and the pump shaft for conjoint rotation.

4. The internal gear pump according to claim **2**, wherein the housing of the internal gear pump is cast iron.

5. The internal gear pump according to claim **1**, wherein the pinion is not arranged directly on the pump shaft.

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