Dec. 17, 1957 E. KORKOWSKI ET AL 2,816,511

HIGH PRESSURE GEAR PUMP

Filed Nov. 25, 1952

FIG. 1

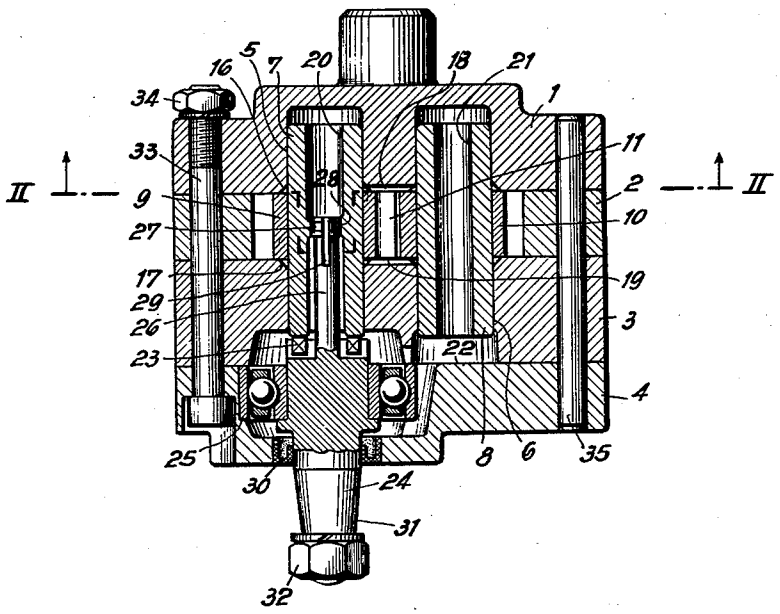
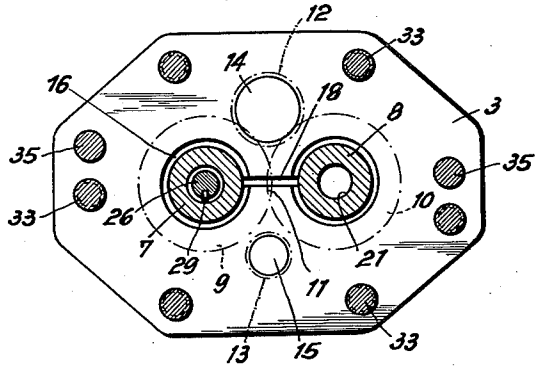


FIG. 2



INVENTORS

Eberhard Korkowski

Gustav Schmidt

by Stevens, Davis, Miller & Mosher

their attorneys

United States Patent Office

2,816,511

Patented Dec. 17, 1957

2,816,511

HIGH PRESSURE GEAR PUMP

Eberhard Korkowski, Stuttgart-Feuerbach, and Gustav Schmidt, Stuttgart-Vaihingen, Germany, assignors to Robert Bosch G. m. b. H., Stuttgart, Germany

Application November 25, 1952, Serial No. 322,398

Claims priority, application Germany December 7, 1951

2 Claims. (Cl. 103—126)

This invention concerns a high pressure gear pump having gear wheels which are self-adjusting in the pump casing or housing through an axial clearance space on both sides of the wheels and through the aid of pressure cushions produced by the medium being pumped. These pressure cushions dispose themselves in the clearance space between the side faces of the gear wheels and the adjacent faces of the pump casing and function to maintain the gear wheels in a central position between the casing faces, even in the case where the gear wheels have a relatively large axial displacement. The reason for this is that with the axial displacement of a gear wheel towards a side of the casing, the pressure of the medium being pumped rises greatly in the decreasing axial clearance space at this side of the casing and forces the gear wheel back again to the central position.

In a known type of gear pump this adjustment is obtained by extracting the pressure medium from the outlet side of the pump and feeding it to the side faces of the gear wheels. The effectiveness of this arrangement thus depends on the delivery pressure of the pump; in addition, the hydraulic efficiency of the pump is impaired due to the loss of pressure medium which, in turn, depends on the delivery pressure and on the extent of the axial and radial play or clearance.

These disadvantages are avoided according to this invention by the fact that the medium which is subjected to high pressure in the spaces between the teeth of the gear wheels during the meshing of the teeth, is utilized for producing the pressure cushions at the sides of the gear wheels. The so-called high pressure medium, e. g. liquid is created forcibly during operation of the pump and its pressure and quantity are not dependent upon the delivery pressure. Hitherto, it had to be diverted or discharged without being of any specific use. The high pressure of same and pulsating action promotes the automatic adjustment of the gear wheels.

The invention is further described with reference to the accompanying drawings which illustrate one embodiment of the invention by way of example only and in which:

Fig. 1 is a section through the gear pump, and

Fig. 2 is a section taken on the line II—II of Fig. 1.

The casing of the gear pump consists of an upper part 1, a central or intermediate part 2, a lower part 3 and an end plate 4. In the upper and lower casing parts there are formed bearing bores 5 and 6 in which respective shafts 7 and 8 are slidably mounted with slight radial clearance. Shrunk on to these shafts are gear wheels 9 and 10 which fit into corresponding chamber recesses formed in the central casing part 2. This casing part 2 is provided on either side of the point 11, i. e. the region in which the gear wheels are in mesh with one another, with further recesses 12 and 13 (shown in chain dotted lines in Fig. 2). The recess 12 is larger than the recess 13 and communicates with a bore 14 formed in the upper casing part 1, which bore 14 is in communication with the suction pipe line of the pump. The

smaller recess 13 in the central casing part 2 communicates through a bore 15, also formed in the upper casing part, with the pressure pipe or delivery line of the pump.

The central casing part 2 is slightly thicker than the gear wheels 9 and 10 so that when the gear wheels are assembled in the casing they are capable of limited axial play or movement for example, 0.04 mm. The bearing bores 5 and 6 in the upper and lower casing parts are bevelled at their ends which face the gear wheels so as to provide annular grooves 16 and 17. The annular grooves 16 in the upper casing part 1 are interconnected by a groove 18 formed in this face of casing part 1, whilst the annular grooves 17 in the lower casing part 3 are interconnected by a groove 19 formed in this face of the lower casing part. The grooves 18 and 19 extend across the meshing point 11 of the gear wheels.

The shafts 7 and 8 are provided with longitudinal bores 20 and 21, respectively, which communicate with a common hollow space or chamber 22 in the lower casing part 3. This space or chamber communicates with the suction side of the pump by means of a passage which is not shown. The shaft 7 carries claws or dogs 23 on its driving end for engagement with corresponding claws or dogs on a stub shaft 24. This stub shaft is mounted in the end plate 4 by means of a ball bearing 25 and has an extension 26 situated in the longitudinal bore 20 of the shaft 7. Extension 26 has an enlarged end portion 27 which constitutes a bearing and which slides on a collar 28 formed in the interior of bore 20. This sliding bearing is situated in the central plane of the gear wheel 9. In the end portion 27 of the extension 26 there is provided a longitudinal groove 29.

The stub shaft 24 extends through an opening in the end plate 4 and this opening is closed by means of a sealing ring 30. The outer end of the stub shaft is provided with a conical part 31 and a securing nut 32 for mounting a driving wheel.

The various casing parts are held together by means of bolts 33, nuts 34, and positioning pins 35.

Only the torque force of the drive acts on the gear wheel 9. The transmission of axial forces to gear wheel 9 is prevented by the longitudinally displaceable connection of the shaft 7 with the stub shaft 24, whilst tilting moments are also prevented by mounting the shaft 7 in the long arcuately fitting bores 5 and 6 and by the central position of the collar 28 of shaft extension 26.

When the pump is connected to a system of pipes, which, for example, contain oil, and driven, the pump draws oil through the bore 14, feeds it from the recess 12, with the aid of the spaces between the teeth of the gear wheels, to the recess 13 and discharges it through the bore 15. Oil is also present between the tooth spaces in the vicinity of the point 11 where the gear wheels are in mesh with one another; the oil is partly enclosed in the tooth spaces and is thus subjected to a relatively high pressure. This high pressure oil escapes on both sides of the gear wheels through the grooves 18 and 19 into the annular grooves 16 and 17. As the clearance spaces between the shafts 7 and 8 and the bores 5 and 6 are small, only a relatively small quantity of the high pressure oil can leak or escape therethrough. This leaking or escaping oil lubricates the sliding bearing surfaces, flows directly through the clearance spaces to chamber 22 or through the bore 20, the groove 29 and the bore 21 into the space or chamber 22, lubricates the ball bearing 25 and returns to the suction side of the pump through the connecting passage which is not shown.

The main quantity of the pressure oil is forced from the annular grooves 16 and 17 between the side faces of the gear wheels 9 and 10 and the adjacent confronting

faces of the upper and lower casing parts. The pressure oil in the grooves **18** and **19** on both sides of the gear wheels is equal; if the axial clearance space on both sides of the gear wheels is also equal, then the oil flows along both sides of the gear wheels to the peripheries thereof under equal pressure. If a gear wheel is axially displaced, the axial clearance space is correspondingly decreased on one side so that the pressure of the oil rises greatly on this side as the efflux area is constricted. The pressure on the other side of the gear wheel is correspondingly reduced; the gear wheel which is under the influence of this difference in pressure is again displaced to such an extent that the axial clearance space is equal on both of its sides. The gear wheels are thus prevented from coming into contact with the adjacent faces of the upper and lower casing parts with the result that friction losses are avoided. As experience has proved, the pulsating of the pressure oil occurring at regular intervals, has an accelerating influence on this automatic adjustment or self-centering of the gear wheels. The pressure of the oil remains constant and is independent of the supply pressure, thus enabling the gear wheels to adjust themselves accurately under all operational conditions.

The high pressure oil may also be fed first of all from the point **11** through the passages to the bores **5** and **6** or annular grooves therein, so that from these the oil enters the annular grooves **16** and **17** and underneath the side faces of the gear wheels. The clearance space of the shafts **7** and **8** in the bores **5** and **6** must thus be so constricted that sufficient pressure oil flows to the gear wheels.

The purpose of the longitudinal bores **20** and **21** is also to balance or compensate for the differences in pressure on the ends of the shafts **7** and **8**, as such differences would tend to retard the automatic adjustment or self-centering of the gear wheels.

What we claim is:

1. A gear pump comprising a pump housing having a chamber provided with spaced end walls, said end walls having cylindrical bearing bores extending from the chamber, meshing gear wheels positioned in the chamber and being of an axial length slightly less than the axial length of the chamber to provide clearance spaces between the sides of the gear wheels and the end walls of the chamber, cylindrical gear shafts mounted for rotation and axial displacement in the bores and on which the gear wheels are mounted, the chamber being provided on its end walls at both sides of the gear wheels symmetrically with grooves connecting the region in which the gear wheels are in mesh simultaneously with two grooves, each of the latter of which surrounds a bearing bore with its inner edge at least near the bore and its outer edge having a sufficient distance from the grounds of the tooth spaces to provide a sealing rim between the groove and the tooth spaces, the surfaces

of the bores and the shafts being entirely cylindrical and uninterrupted and the clearance between the shafts and the bores being as small as possible so that the fluid medium entrapped at the intermeshing point of the gear wheels disperses constantly and symmetrically into the clearance spaces on both sides of the gear wheels to provide a cushion between the gear wheels and the end walls of the chamber so as to retain the gear wheels in a substantially central axial position in the chamber.

2. A gear pump comprising a pump housing having a chamber provided with spaced end walls, said end walls having cylindrical bearing bores extending from the chamber, meshing gear wheels positioned in the chamber and being of an axial length slightly less than the axial length of the chamber to provide clearance spaces between the sides of the gear wheels and the end walls of the chamber, cylindrical gear shafts mounted for rotation and axial displacement in the bores and on which the gear wheels are mounted, the chamber being provided on its end walls at both sides of the gear wheels symmetrically with straight grooves connecting the region in which the gear wheels are in mesh simultaneously along the shortest distance line with two grooves, each of the latter of which surrounds a bearing bore with its inner edge at least near the bore and its outer edge having a sufficient distance from the grounds of the tooth spaces to provide a sealing rim between the groove and the tooth spaces, the surfaces of the bores and the shafts being entirely cylindrical and uninterrupted and the clearance between the shafts and the bores being as small as possible so that the fluid medium entrapped at the intermeshing point of the gear wheels disperses constantly and symmetrically into the clearance spaces on both sides of the gear wheels to provide a cushion between the gear wheels and the end walls of the chamber so as to retain the gear wheels in a substantially axial position in the chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,271,970	Wood	July 9, 1918
1,372,576	Tullmann	Mar. 22, 1921
1,620,261	Kennedy	Mar. 8, 1927
1,634,023	Davison	June 28, 1927
1,641,486	Heil	Sept. 6, 1927
1,682,842	Hamer	Sept. 4, 1928
1,706,829	Thomson	Mar. 26, 1929
1,972,271	McIntyre	Sept. 4, 1934
2,202,913	Johnson	June 4, 1940
2,316,565	Collier	Apr. 13, 1943
2,391,072	Pugh	Dec. 18, 1945
2,471,149	Girz	May 24, 1949
2,487,732	Schanzlin	Nov. 8, 1949
2,498,911	Chittenden	Feb. 28, 1950
2,626,570	Armington et al.	Jan. 27, 1953