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(54) **Oscillatory actuator for concrete pumps, with hydraulically driven rack and pinion unit**

(57) Oscillatory actuator for pumps for concrete or other dense or incoherent liquid products, having a pinion or ring gear unit (11) which is connected to the end of the gooseneck pipe (CC) which is to be made to rotate alternately in both directions, and which interacts with a rack (10) driven hydraulically by the alternating sliding of its end pistons (110, 110') in sealed chambers formed in a box-like body (1) which contains the rack and pinion unit, **characterized in that** the end pistons of the rack, with their piston rings and lateral gaskets (9, 9'), slide in wear liners (5, 5') mounted in a sealed way with corresponding gaskets (4, 4') in robust tubes (2, 2') which are fixed, with their sealing means (3, 3'), in axially aligned seats (201, 201') of said box-like body, together with the caps (7, 7') which interact in a sealed way with said liners and which have holes (12, 12') for connection to the pipes of the hydraulic drive circuit, these pipes having alternating delivery and discharge functions.

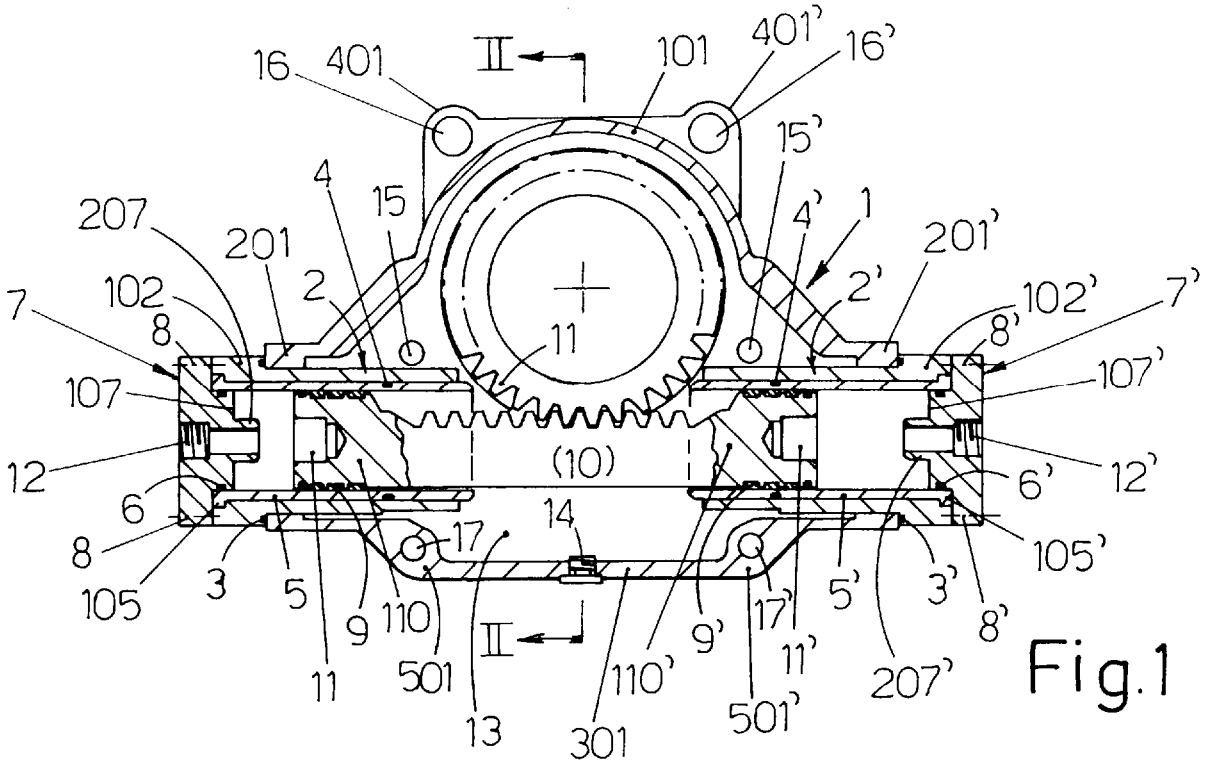

Fig.1

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Description

[0001] The invention relates to apparatus for pumping concrete, mortar or other liquid products, which may be dense or incoherent, over a distance, the apparatus comprising a hopper into which the concrete for pumping is placed, the hopper containing in its lower part a gooseneck pipe, one end of which is connected to the concrete removal pipe and made to rotate in an alternating way by an external oscillatory actuator, while the other end oscillates in a pendulum-like way and alternately contacts two apertures to which corresponding reciprocating single-acting pump units, driven by corresponding hydraulic actuators, are permanently connected. When one pump unit is in the phase in which it draws concrete from said hopper, with which it communicates directly, the other pump unit is in the phase in which the concrete drawn in previously is discharged through said gooseneck pipe which is in contact with it.

[0002] There are known actuators, of the type described in Italian patent 223 832 in the name of the present applicant, for oscillating said gooseneck pipes. An actuator of this type comprises a rack which is driven at its ends by hydraulic cylinder and piston units and which engages with a ring gear fixed on one of the two ends of the oscillation shaft of said gooseneck pipe. When the ring gear is fixed in axial alignment with the end of the gooseneck pipe which is supported rotatably by said loading hopper and from which the pumped concrete emerges, the gear is housed in an oil bath in a box-like body in which are formed the opposing chambers in which the end pistons of the rack slide in a sealed way, with attached hydraulic dampers for limiting the stroke. The projection of these chambers is limited, and the box-like body which contains them is provided with external cooling fins at the positions of the chambers.

[0003] In these oscillatory actuators, which have the major advantage of operating safety because all the moving parts, namely the hydraulic cylinders, the rack and the pinion, are housed in the oil bath chamber, problems have been encountered due to the production costs, premature wear and deficient hydraulic sealing, and the invention is intended to overcome these by means of the solution, described in Claim 1 and the subsequent claims, which will now be illustrated in one of its preferred embodiments, with reference to the figures on the single attached sheet of drawing, of which

- Fig. 1 shows the improved actuator in question, in front elevation and in a sectional view through a theoretical vertical plane which contains the axis of the end pistons of the rack;
- Fig. 2 shows other details of the actuator in a view taken through the section line II-II of Figure 1.

[0004] As the drawings reveal, the actuator comprises a box-like body 1 formed from a single piece made by casting a suitable metal alloy in a mould with a core box, or by any other suitable method. When seen from the front as in Figure 1, the body 1 takes the form of an octagon elongated on the horizontal plane, with a curved and upwardly convex upper side 101 and with symmetrical horizontal parallelepipedal extensions 201, 201' at the opposite ends. These end extensions are machined internally and on their outer faces, and into these extensions there are inserted identical robust steel tubes 2, 2', which are axially aligned with each other, which are provided with external flanges 102, 102' having polygonal faces, for example square faces, and through holes in their corner areas, and which interact in a sealed way with the faces of said extensions 201, 201' by means of gaskets 3, 3'. Wear liners 5, 5' are inserted with a lateral seal by means of gaskets 4, 4' into the tubes 2, 2' with a high degree of precision, each liner being provided on its outer end with a small outer collar 105, 105' which is housed in a corresponding recess of the flange 102, 102', the cylindrical projection 107, 107' of a cap 7, 7' being inserted into each liner in a sealed way by means of the gaskets 6, 6', each cap also having a square base and being provided in its corner areas with through holes of stepped section to allow the passage of the shanks of screws which are indicated schematically by 8, 8' and to contain the heads of these screws, which fix the parts 2, 7 and 2', 7' to the extensions 201, 201' of the body 1 with the interposition of the corresponding wear liners 5, 5'. The end pistons 110, 110' of the rack 10 slide with a lateral seal, provided by means of the gaskets 9, 9', in these liners, the rack having an exposed portion, between the guide parts 2, 5 and 2', 5', which interacts with a ring gear 11 which is described more fully below. On the inner faces of the caps 7, 7' there are provided cylindrical shanks 207, 207' which are made in one piece with the caps and which, as the rack 10 reaches the alternating ends of its stroke, enter, with a precise clearance, corresponding axial recesses 11, 11' of the pistons 110, 110', to provide suitable damping of the end of the stroke of the rack, in a way which is known in the art. The shanks 207, 207' are axially hollow and have threaded holes 12, 12' opening on the caps 7, 7', to which it is possible to connect the pipes of the hydraulic circuit for driving the actuator, these pipes having alternating delivery and discharge functions, to provide the desired reciprocating motion of the rack 10. As the drawings reveal, the body 1 has, below the rack and the guide parts for the corresponding pistons, a wide bowl-shaped chamber 13, which can contain a large quantity of oil and whose base wall 301 is suitably distant from said rack, in such a way that any impurities due to the wear of the parts are collected on this base wall in a position remote from the moving parts, with the consequent advantages. The wall 301 is provided with a hole with a sealing plug 14, which can be removed in order to discharge all the oil contained in the body 1, together with the impurities, for the periodic replacement of the internal lubricating oil of the actuator, the level of the oil being subsequently restored through feed, overflow and/or inspection holes 15, 15' provided

in the body 1 at a level above the tubes 2, 2'.

[0005] In order to fix the actuator described herein to the wall P of the hopper T, in which said gooseneck pipe CC is located (Fig. 2), the box-like body 1 is provided externally, in its upper part, with two symmetrical lateral appendages 401, 401' with holes 16, 16' for the passage of corresponding fixing screws, while in its lower part the body 1 has inner parts 501, 501' of increased thickness in which through holes 17, 17' are formed, these holes also being adapted for the passage of fixing screws. The outer front surface of the body 1 is provided with suitable heat exchange fins 18, as shown in part in Figure 2, to improve the dissipation of the heat produced by the reciprocating movement of the rack and by its interaction with the ring gear 11.

[0006] As shown in Figure 2, the box-like body 1 is provided on opposite faces with apertures 601, 601' which are machined on their inner diameters in such a way that they are aligned axially with each other and which contain low friction rings 19, 19' which are in close contact with them, the rings being made, for example, from suitable plastic material or appropriate sintered material and being capable of supporting rotatably the end portions of a steel sleeve 111, which carries the ring gear 11 which is made in one piece with it or is fitted on it, and whose ends project from the body 1 in the form of a rear portion 211, having an outer gasket 20 for connection to the tubing for removing the pumped concrete, and a front portion 311 1 which can be fixed, with the interposition of a sealing gasket 22, to a sleeve 21 whose other end is adapted to be fixed and connected in a sealed way by means of a gasket 23 to the end of the gooseneck pipe CC which is to be made to oscillate by the actuator in question within the hopper T, as stated in the introduction to this description. The aforesaid support rings 19, 19' are provided, on their inner surfaces in contact with the sleeve 111, with lubrication grooves which allow a sufficient degree of outward permeation of some of the lubricating oil which is contained in the body 1, for which reason suitable means are provided outside the apertures 601, 601' of the body 1 to prevent leaks of said lubricating oil. For this reason, the rear aperture 601 is provided with a projecting collar 701 which forms an inner annular chamber 24 in which is inserted an internal gasket of metal and rubber which comprises a metal ring 25 for contacting the ring 19 and a part 125 made from elastomeric material, with a C-shaped profile and an internal spring, which interacts with the outer lateral surface of the portion 211 of the aperture 111 to form a lateral seal. An annular cap 27 is then mounted on said collar 701 in a sealed way by means of the gasket 26, this cap interacting in a sealed way with the portion 211 of the aperture 111 by means of a gasket 126 on its inner diameter, and being provided externally with a pair of diametrically opposite lugs 127 which can be fixed with screws 28 to corresponding outer thickened areas 801 of the body 1.

[0007] On the other face, it can be seen that the front aperture 601' is machined on its outer diameter in such a way that it has a collar 901 which is mounted, with a sealing gasket 29, in a hole 30 formed in the rear plate P of the hopper T, and which terminates in said hopper with a portion 130 of smaller diameter, to retain in said hole 30 a composite metal and rubber gasket, with an outer ring 31 made from metal and with an inner annular insert 131 made from a suitable elastomeric material, with interacts in a sealed way with the outer lateral surface of the sleeves 111 and 21. The metal ring 31 is provided with a plurality of radial holes 32 which communicate with both inner and outer annular manifolds, indicated by 132, the outer of which communicates with a pipe 33 formed in the plate P and leading to a connector 34 which is connected to a source of pressurized air (not shown) to pressurize the rubber part 131 of the gasket in a centripetal way, in order to maintain the best possible contact of the gasket with the sleeves 111, 21, and in order to prevent the ingress of liquid and dirt into the box-like body 1 if this gasket becomes worn. A flowmeter or any suitable means or sensor for indicating an anomalous flow of air towards the sealing gasket 31, 131 can be connected to the connector 34, to provide a warning when this gasket needs to be replaced.

[0008] Clearly, the actuator described herein is highly reliable, is easy to construct and to maintain by both routine and extraordinary procedures, and has a long service life, in part due to the fact that the actuator can be completely restored and returned to its best operating condition by periodically changing the wear liners 5, 5' and the piston rings and sealing gaskets 9, 9' of the pistons 110, 110' of the rack, and by periodically changing the phase of the ring gear 11 with respect to the rack 10.

Claims

1. Oscillatory actuator for pumps for concrete or other dense or incoherent liquid products, having a pinion or ring gear unit (11) which is connected to the end of the gooseneck pipe (CC) which is to be made to rotate alternately in both directions, and which interacts with a rack (10) driven hydraulically by the alternating sliding of its end pistons (110, 110') in sealed chambers formed in a box-like body (1) which contains the rack and pinion unit, **characterized in that** the end pistons of the rack, with their piston rings and lateral gaskets (9, 9'), slide in wear liners (5, 5') mounted in a sealed way with corresponding gaskets (4, 4') in robust tubes (2, 2') which are fixed, with their sealing means (3, 3'), in axially aligned seats (201, 201') of said box-like body, together with the caps (7, 7') which interact in a sealed way with said liners and which have holes (12, 12') for connection to the pipes of the hydraulic drive circuit, these pipes having alternating delivery and discharge functions.

2. Actuator according to Claim 1), in which said box-

like body (1) is made in a single piece by casting a suitable metal alloy in a mould with a core box or by an equivalent method, in such a way that, viewed from the front, said box-like body has, for example, the shape of an octagon elongated on the horizontal plane, with a curved and outwardly convex top side (101), to form a housing capable of containing the toothed ring (11), this body having symmetrical horizontal parallelepipedal extensions (201, 201') at the opposite ends, in which are formed the seats for housing said tubes (2, 2') with the inner liners (5, 5') and with said closing caps (7, 7'), this box-like body (1) being made to have, under the rack and the parts for guiding the corresponding pistons, a wide chamber or bowl (13) which can contain a large quantity of oil which reaches the level of feed and inspection holes (15, 15') provided in the body (1) at a level above that of said tubes (2, 2'), the base wall (301) of said bowl having a discharge plug (14) and being suitably distant from said rack.

3. Actuator according to the preceding claims, **characterized in that**, for the purpose of fixing for use, said box-like body (1) has two external lateral symmetrical appendages (401, 401') in its upper part with holes (16, 16') for the passage of corresponding fixing screws, while in its lower part the body (1) has parts of increased thickness (501, 501') in which are formed through holes (17, 17') which can also be used for the passage of fixing screws.

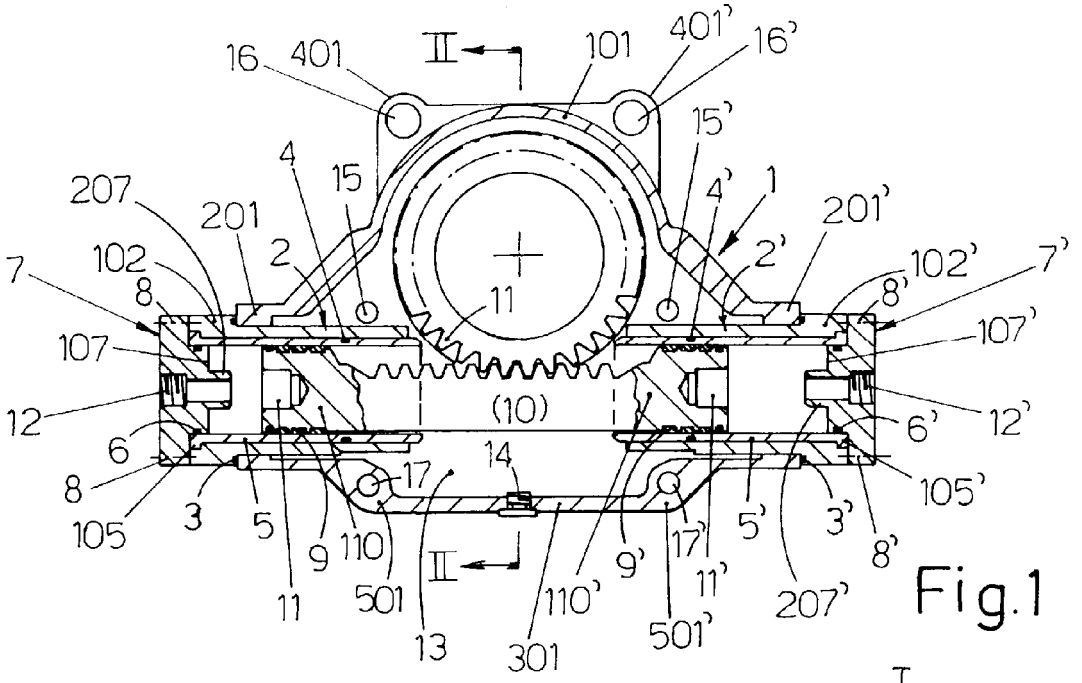
4. Actuator according to the preceding claims, in which said box-like body (1) is provided on its opposite faces with round apertures (601, 601') which are machined in such a way that they are aligned axially with each other and house, with close contact, low friction rings (19, 19') which can rotatably support end portions of a steel sleeve (111) which carries the ring gear (11) which is made in one piece with it or is fitted on it, and whose ends project from said body to the rear, in the form of a portion (211) for connection to the tubing for removing the pumped concrete, and to the front, in the form of a portion (311) which can be fixed, with the interposition of sealing means (22), to a sleeve (21) whose other end is adapted to be fixed in a sealed way to the end of the gooseneck pipe (CC) which is to be made to oscillate by said actuator in question within the hopper (T).

5. Actuator according to Claim 4), in which said support rings (19, 19') are provided, on their inner surfaces which contact the sleeve (111), with lubrication grooves which allow sufficient outward permeation of some of the lubricating oil contained in the box-like body (1), the apertures (601, 601') of this body being provided with sealing means which act on the outer lateral surface of said sleeve (111).

6. Equipment according to Claim 5), in which the rear aperture (601) of the box-like body (1) is provided with a projecting collar (701) which forms an annular chamber (24) housing a sealing means (25, 125) which interacts with the outer lateral surface of the rear portion (211) of said aperture (11), an annular cap (27) being mounted externally in a sealed way on the collar (701), this cap having a seal (126) on its inner diameter which interacts with the rear portion (211) of the sleeve (111) and which is provided externally with means (127) for fixing with screws (28) to corresponding connectors (801) of the box-like body (1).

7. Actuator according to Claim 5), in which the front aperture (601') of the box-like body (1) is also machined on its outer diameter in such a way that it has a collar (901) which is mounted in a sealed way in a hole (30) formed on the rear plate (P) of the hopper (T) and which terminates within the hopper in a portion (130) of smaller diameter, which retains in the hole (30) a composite gasket with an outer metal ring (31) and with an inner annular insert (131) made from a suitable elastomeric material, which interacts in a sealed way with the outer lateral surface of the apertures (111, 21) and which can be connected, through pipes (32, 132) formed in said ring (31) and with others (33, 34) formed in said plate (P), to a source of pressurized air, which pressurizes in a centripetal way the rubber part (131) of said gasket, in order to maintain the best possible contact of the gasket with the inner sleeves, and in order to prevent the ingress of liquid and dirt into the box-like body (1) if this gasket becomes worn.

8. Actuator according to Claim 7), in which a flowmeter or any suitable means or sensor for indicating an anomalous flow of air towards the sealing gasket (31, 131) can be connected to the connector (34) which supplies pressurized air to said gasket, to provide a warning when this gasket needs to be replaced.


16
401
II
101
401'
16'
15'
4
15
4'
1
207
201
2
2'
201'
102
8
11
102'
7'
7
107
107'
12
(10)
12'
6
6'
8
14
17
105'
105
3
5
9
110
9'
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3'
8'
11
501
13
110'
11'
207'
301
501'

Fig.1

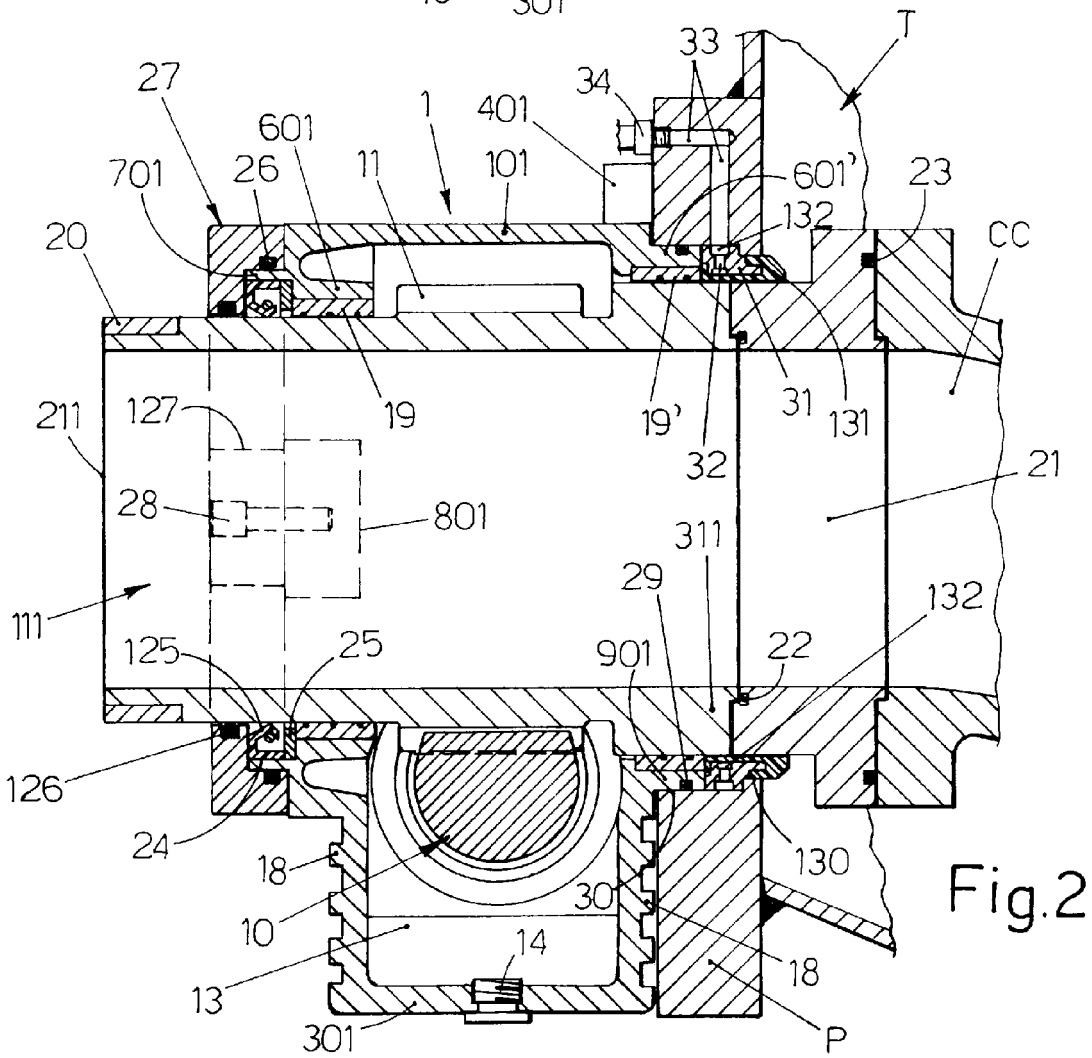
T
33
27
34
1
401
601
701
26
11
101
601'
23
132
20
CC
19
19'
31
131
211
127
32
21
28
801
311
29
132
111
125
25
901
22
126
24
18
130
10
30
14
18
13
301
P

Fig.2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- IT 223832 **[0002]**