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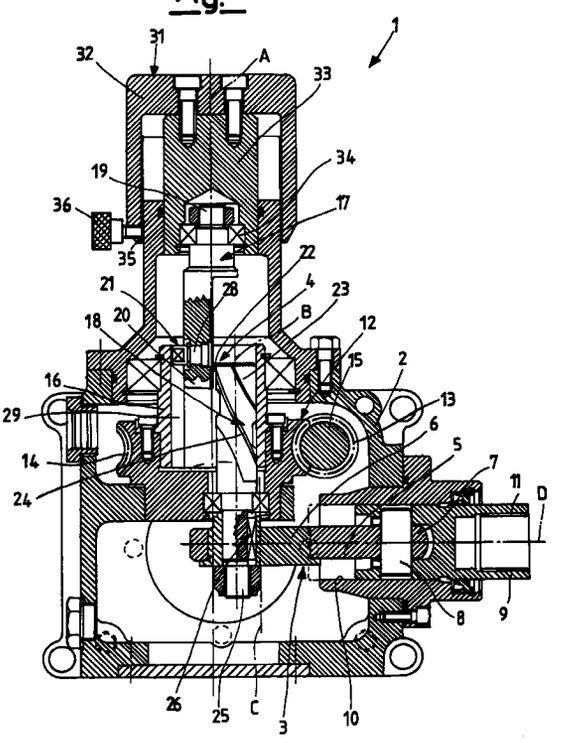
(54) Output regulator applicable to metering pumps

(57) The purpose is to produce a simple, reliable and economical output regulator (1), comprising a sprocket (14) keyed to a hollow shaft (16) rotating with respect to a main axis (A) parallel to the axis of rotation (C) of a crank (6). The inside of the hollow shaft (16) on opposite sides of the main axis (A) holds a sliding shaft (17) and a contoured shaft (18). The contoured shaft (18) has its own axis (B) parallel to the main axis (A). The sliding shaft (17) has a first extremity (19) coaxial with the main axis (A) and a second extremity (20) provided with a first (21) and a second (22) coupling which engage it while allowing it to slide parallel to the main axis (A), both on said hollow shaft (16) and on said contoured shaft (18). The contoured shaft (18) has a first section (23) provided with a helical projection (24) which is part of the second coupling (22) and a second section (25) keyed to the crank button (6) of the first kinematic mechanism (3).

Fig.1



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Description

[0001] This invention refers to an output regulator applicable to metering pumps.

[0002] The known output regulators comprise a mechanical body interposed between the motor of the pump and the pump itself. A first and a second kinematic mechanism is essentially fitted inside said body. The first kinematic mechanism is of a connecting rod and crank type and suitable for converting the rotary motion of the motor into a rectilinear alternating motion with a pre-established stroke, depending on the output of the pump.

[0003] The second kinematic mechanism has a structure suitable for selecting the stroke of said rectilinear alternating motion depending on the desired output.

[0004] Such regulators operate in a satisfactory and expected manner, but are often composed of a number of parts that should be reduced for reasons of economy, reliability and space savings. However, it is necessary to achieve the object stated above while also observing the current API 675 standards which codify the metering pump characteristics on an international scale, including the flow regulators associated with said pumps. These standards prescribe tight tolerances as regards the possibility of applying a linear variation of output and the possibility of achieving a given output. As an indicative detail, the allowable tolerance on output linearity is ± 3% of the nominal value, while that on output precision is ± 1%.

[0005] The purpose of this invention is to provide a solution for the mentioned problem. This means producing an output regulator applicable to alternating pumps capable of providing the best compromise between the virtues of economy, reliability and space saving as well as a capability of operating in observance of the mentioned tolerances.

[0006] These purposes are achieved by an output regulator according to claim 1, here being referred to for brevity.

[0007] The connecting rod provided at the end of the grooved shaft allows to define the diameter of the crank only as a function of the actual load, without for example having to take into account any other regulating organs. This circumstance allows to minimize the space required for a full rotation of the connecting rod. The body housing this kinematic mechanism is consequently less bulky than that of equivalent regulators having the same potential; in other words, it offers a greater capability and reliability than that offered by known regulator types.

[0008] The change of output is obtained by a helical device which guarantees precision and linear action.

[0009] The invention is illustrated for merely exemplary but non-limiting purposes in the figures given in the enclosed drawings.

Figure 1 is a sectional view of the output regulator along the line I-I of Figure 2.

Figure 2 is a sectional view of the output regulator along the line II-II of Figure 1.

Figure 3 is a sectional view of a pair of output regulators kinematically connected to each other.

Figure 4 is an exploded prospective view of two components of the regulator.

Figures 5-7 offer a simplified view of the change in the regulator main axes at the changing of the required output.

[0010] With reference to the mentioned figures, the output regulator according to this invention, generically indicated by the numeral 1, is of a type applicable to metering pumps. It basically comprises a body 2 housing a first kinematic mechanism 3 and a second one 4. The body 2 can mechanically be interposed between the pump motor (not shown) and the pump itself (not shown).

[0011] The first kinematic mechanism 3 is of a type suitable for converting the motor rotary motion to a rectilinear alternating motion supplied to the pump depending on the desired output. It basically comprises a connecting rod 5 and a crank 6. The foot of the connecting rod 7 is connected by a pin 8 to a guide shoe 9 sliding in a guide 10 fitted to the body 2 of the regulator 1 along the axis D of the same connecting rod 5. The guide shoe 9 carries means 11 to provide a kinematic connection with the pump.

[0012] To permit the elimination of possible wear, the guide 10 fitted to the body 2 of the regulator 1 can be separated from the same. The body 1 is sealed in order to contain the lubricating oil of the kinematic mechanisms. In order to reduce space and cost, the connection between the connecting rod 5 and the crank 6 is left without a bearing.

[0013] The second kinematic mechanism 4 is suitable for selecting the stroke length of the foot 7 of the connecting rod 5, which moves with an alternating linear motion along the axis D. The desired output depends on the length of this motion.

[0014] The second kinematic mechanism 4 comprises a gear 12 to transmit the power from the motor to the output regulator 1. The gear 12 consists of a worm screw 13 and a sprocket 14. The worm screw 13 is keyed to a shaft 15 passing through both said worm screw 13 and the body 2 of the regulator 1. The extremities of said shaft 15 can be connected to a motor (not shown) or to an identical shaft 15 together with the body 2 of the regulator 1, so as to form a set of regulators 1 (see Figure 3, which exemplifies the case of two regulators), capable of regulating several pumps arranged in parallel and driven by a single motor. The sprocket 14 of said gear 12 is keyed to a hollow shaft 16 rotating with respect to a main axis A parallel to the rotary axis C of the crank 6 of the first kinematic mechanism 3. The inside of said hollow shaft on opposite sections of said main axis A holds a sliding shaft 17 and a contoured

shaft 18. The axis B of the contoured shaft 18 is parallel to the main axis A, which is perpendicular to the axis D of the connecting rod 5. The sliding shaft 17 has a first extremity 19 coaxial with the main axis A, and a second extremity 20 fitted with a first coupling 21 and a second coupling 22 that engage it while allowing it to slide parallel to the main axis A with respect to both said hollow shaft 16 and said contoured shaft 18. The contoured shaft 18 has a first section 23 that carries a helical projection 24 constituting the male portion of said second coupling 22. The second section 25 of the contoured shaft 18 is connected to the button of the crank 6 of the first kinematic mechanism 3 by a third coupling 26. In order to allow a reciprocal sliding parallel to the main axis A, the second coupling 22 is formed by a cavity 27, as shown in Figure 4 (or female portion of the second coupling 22) provided on the sliding shaft 17, which is complementary to the helical projection 24 (or male portion of the second coupling 22) fitted on the contoured shaft 18. In the preferred embodiment visible in Figure 4, the cavity 27 provided on the sliding shaft 17 and the helical projection 24 fitted on the contoured shaft 18 have a triangular cross section.

[0015] The first coupling 21 comprises a key 28 on the sliding shaft 17 and a groove 29 on the hollow shaft 16. The first extremity 19 of the sliding shaft 17 is connected, with the possibility of rotating around its axis B, to a regulating hand-wheel 31, which comprises a first outer section 32 screwable into the body 2 of the regulator 1 and a second inner section 33 slidable inside the body 2 of the regulator 1. This inner section 33 is connected to the first extremity 19 (fitted with a bearing 34), as seen in Figure 1, of said sliding shaft 17, which is therefore telescopically arranged with respect to the body 2 . For the same reason and in the same manner, the hand-wheel 31 slides with respect to the body 2, so that its lower rim 35 can be taken as an indicator of the selected output. In order to prevent undesirable output changes during the operation of the regulator, the regulating hand-wheel 31 can be locked in a pre-established position by a stop 36, preferably formed by a screw.

[0016] During operation the power flows from the regulator through the shaft 15, which transmits it to the sprocket 14 that passes it on to the hollow shaft 16. The hollow shaft 16 rotates around the main axis A and by its first coupling 21 induces the sliding shaft 17 to rotate around itself with respect to the axis A. By using the second coupling 22, the sliding shaft 17 impresses a rotary motion on itself with respect to the axis B, and a revolution around the main axis A of the contoured shaft 18. By using a third coupling 26 the contoured shaft 18 induces a rotation around the axis C of the crank 6, which moves the connecting rod 5 and alternatively the shoe 9 connected to an alternative pump. The stroke of the shoe 9 is always equal to the distance between the main axis A and the rotary axis of the crank C with respect to the axis D of the connecting rod 5. In other words, the stroke is always equal to the distance existing between the projection of the axis A on the axis D and the projection of the axis C on the same axis D.

[0017] Figure 5 is a simplified view of the position of the axes A-D when the regulator is set to the maximum stroke or output. This distance may be varied by acting on the hand-wheel 31, which can only rotate. The rotation of the hand-wheel 31 provokes the rectilinear sliding along the main axis A of the sliding shaft 17, which engages the helical projection 24 of the contoured shaft 18 by the cavity 2, inducing the rotation of said contoured shaft around its axis B and consequently changing the position of the axis C with respect to the axis D and therefore its stroke. This change can be appreciated by comparing Figure 5 with Figure 6. A further rotation of the hand-wheel can cause the projection of the axis C on the axis D and the projection of the axis A on the axis D to coincide (Figure 7). In this condition the stroke and therefore the output equal zero, even if the device is in operation. As can be seen, the change of the stroke from zero to the maximum value can be achieved continuously and without any jumps in output, which may preclude certain values. The operation of the device for any given output is smooth and free of any jumping or knocking action.

Claims

1. An output regulator (1) applicable to metering pumps, comprising a body (2) mechanically interposable between the pump motor and the pump itself and housing a first (3) and a second (4) kinematic mechanism in which:

   - said first kinematic mechanism (3) is of a connecting rod and crank type, suitable for converting the motor rotary motion into a rectilinear alternating motion with a stroke pre-established by the output delivered by the pump;
   - said second kinematic mechanism (4) is suitable for selecting the stroke of said rectilinear alternating motion depending on the desired output,

   characterized in that said second kinematic mechanism (4) comprises a gear (12) for transmitting the motor power to the output regulator 1, in which a sprocket (14) of said gear (12) is keyed to a hollow shaft (16) rotating with respect to a main axis (A) parallel to the rotary axis (C) of the crank (6) of the first kinematic mechanism (3), where said hollow shaft (16) opposite said main axis (A) holds a sliding shaft (17) and a contoured shaft (18) in which the contoured shaft (18) has its axis (B) parallel to the main axis (A) and in which said sliding shaft (17) has a first extremity (19) coaxial with the main axis (A) and a second extremity (20) fitted with a first (21) and a second (22) coupling which engage it while allowing it to slide parallel to the main axis (A)

with respect to both said hollow shaft (16) and said contoured shaft (18), in which said contoured shaft (18) has a first section (23) provided with a helical projection (24) which constitutes the male part of said second coupling (22) and a second section (25) keyed to the crank button (6) of the first kinematic mechanism (3).

2. An output regulator according to claim 1, characterized in that that the second coupling (22) is formed by a cavity (27) (female part of the coupling) provided on the sliding shaft (17), and that said cavity (27) is complementary to the helical projection (24) (male part of the coupling) provided on the contoured shaft (18).

3. An output regulator according to claim 2, characterized in that the cavity (27) provided on the sliding shaft (17) and the helical projection (24) provided on the contoured shaft (18) have a triangular cross-section.

4. An output regulator according to claim 1, characterized in that the gear (12) for transmitting the motor power comprises a sprocket (14) and a worm screw (13) coupled on a through-shaft (15) with respect to both said worm screw (13) and body (2) of the regulator, and that the extremities of said shaft (15) can be engaged to a motor or an identical shaft (15) together with the body (2) of the regulator (1) so as to form a set of regulators (1) suitable for regulating several pumps arranged in parallel and driven by a single motor.

5. An output regulator according to claim 1, characterized in that the first coupling (21) comprises a coupling (28) on the sliding shaft (17) and a groove (29) on the hollow shaft (16).

6. An output regulator according to claim 1, characterized in that the first extremity 19 of the sliding shaft (17) is connected, while freely rotating around its axis (A) to a regulating hand-wheel (31) which comprises a first outer section (32) screwable into the body (2) of the regulator (1), and that a second inner section (33) is sliding in the body (2) of the regulator (1) on said inner section (33), while the first extremity (19) of said telescopic sliding shaft (17) is engaged.

7. An output regulator according to claim 6, characterized in that the regulating hand-wheel (31) can be locked in a pre-established position.

8. An output regulator according to claim 7, characterized in that the regulating hand-wheel (31) can be locked in a pre-established position by set-screws.

9. An output regulator according to claim 6, characterized in that the lower rim (35) of the hand-wheel (31) can be taken as an indicator of the selected output.

10. An output regulator according to claim 1, characterized in that the foot (7) of the connecting rod (5) is connected by a pin (8) to a shoe-shaped element (9) sliding on a guide (10) provided on the body (2) of the regulator (1), said shoe-shaped element (9) being provided with means for a kinematic connection (11) to a pump.

11. An output regulator according to claim 9, characterized in that the guide (10) provided on the body (2) of the regulator (1) can be separated from the same.

12. An output regulator according to claim 1, characterized in that the body (2) is sealed so as to contain the lubricating oil of the kinematic mechanisms and that the connection between the connecting rod and crank is not equipped with a bearing.

Fig.1

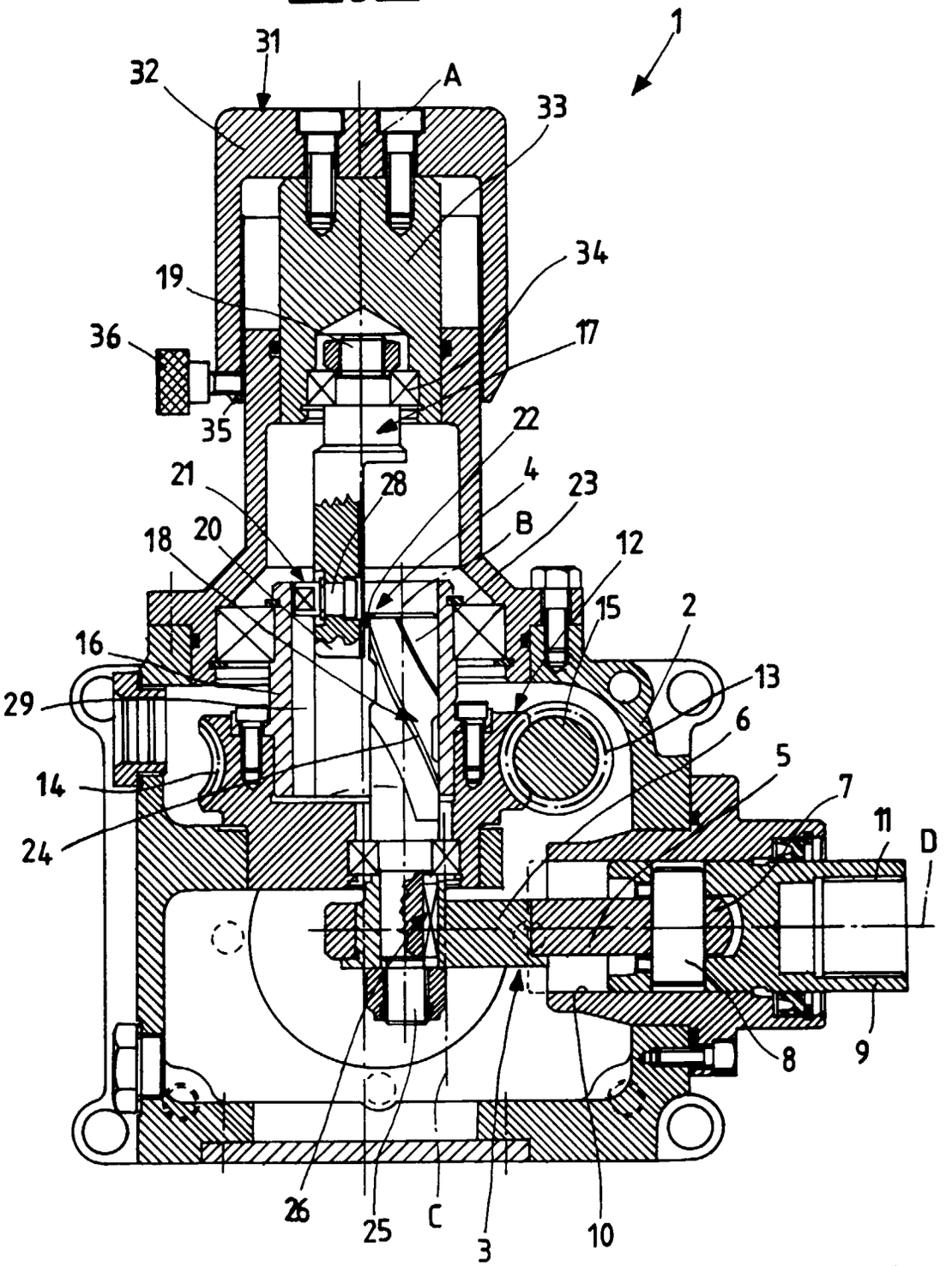
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Fig.2

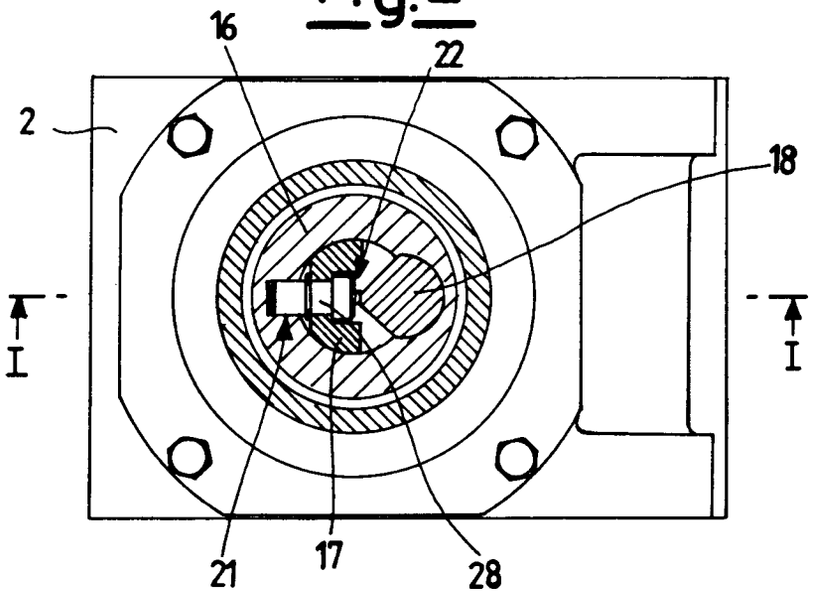


Fig.5

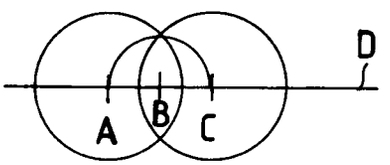


Fig.6

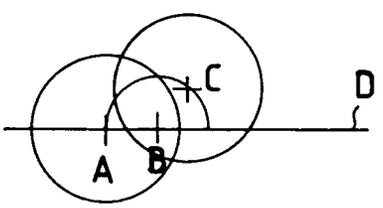


Fig.7

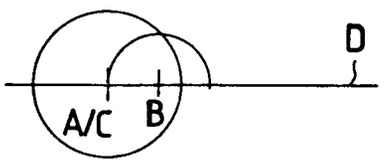


Fig.3

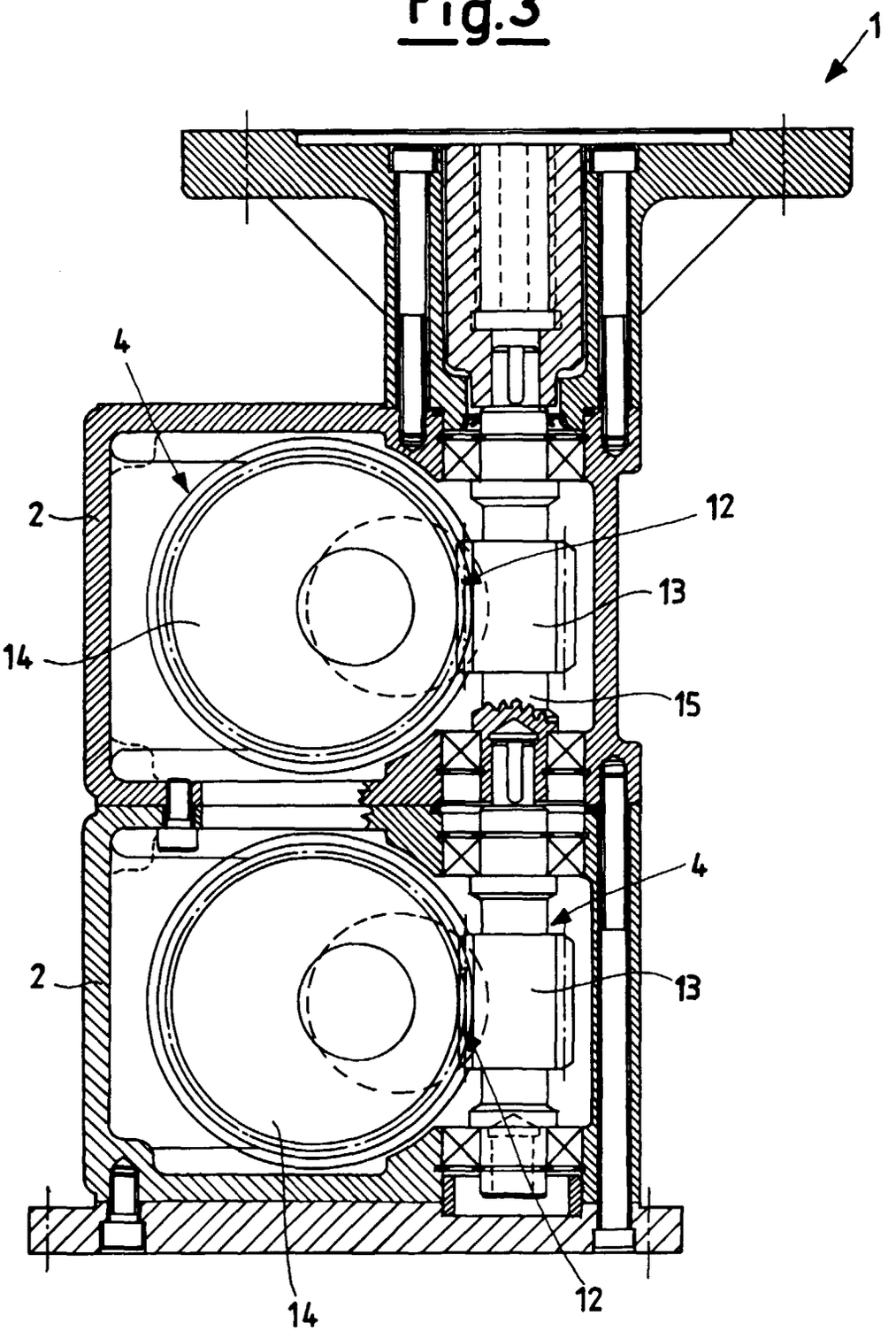
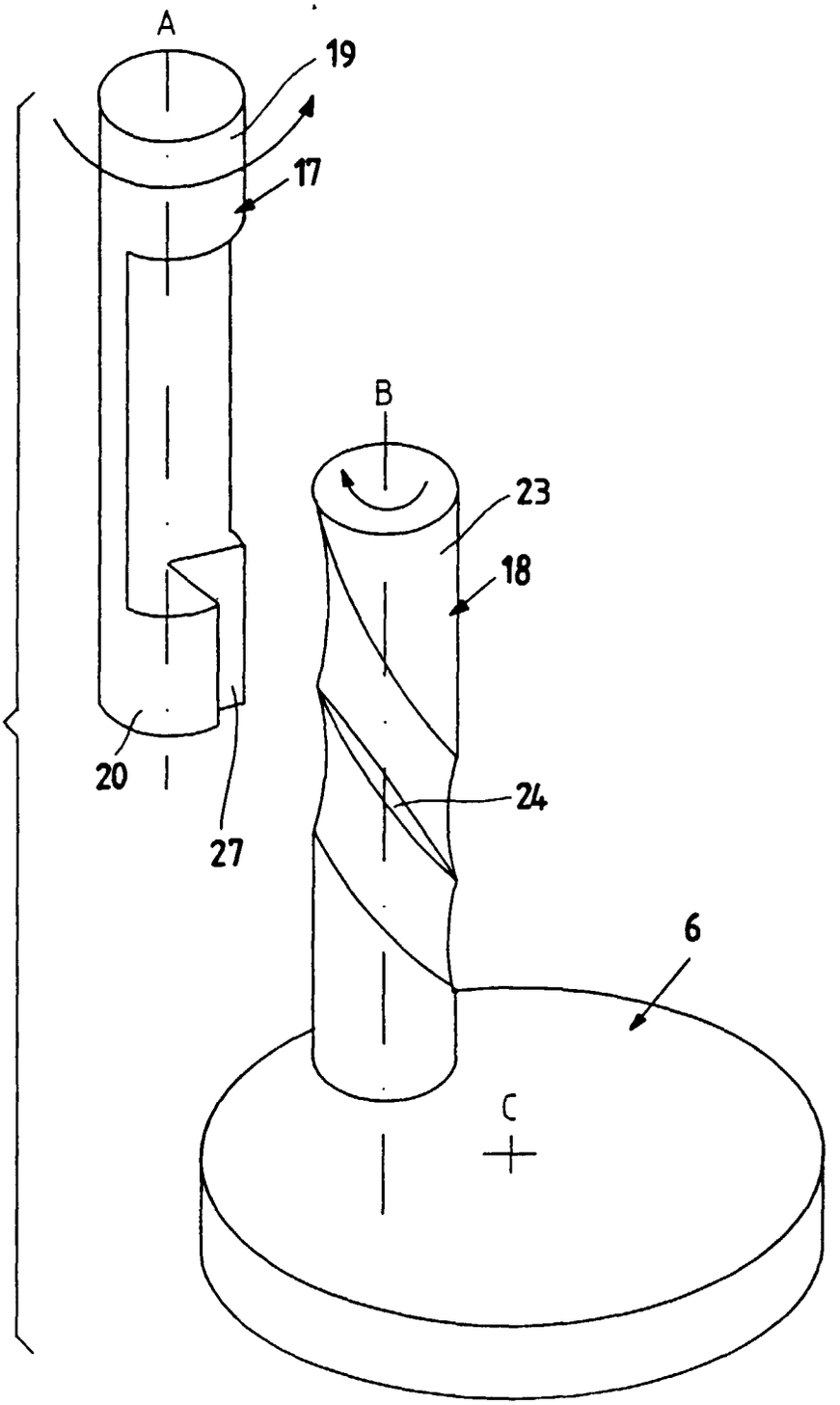


Fig.4



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EUROPEAN SEARCH REPORT

Application Number
EP 98 20 2169

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 2 257 854 A (PETERSON J.A.) 7 October 1941 * page 1, column 2, line 37 - page 3, column 1, line 45; figure 4 *	1	F04B49/12
A	FR 526 897 A (RENAULT L.) 15 October 1921 * page 1, line 21 - page 3, line 2; figures 1,2 *	1	
A	GB 538 320 A (HYLAND C.) 25 June 1941 * the whole document *	1	
A	EP 0 106 808 A (MAURER GUALTIERO) 25 April 1984 * abstract; figure 5 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 September 1998	Ingelbrecht, P

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