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(54) **GEAR PUMP**

(57) A gear pump comprising a housing (1) with a spur-toothed drive gear (4) and a spur-toothed idle gear (5) that are mounted rotatably around two parallel rotation axes within the housing (1) with bushings (8), a connecting flange (2) that is arranged on a first lateral side of the housing (1) in the direction of the axes, a cover (3) that is arranged on a second lateral side of the housing (1),

opposite the connecting flange (2), a drive shaft (7) being rotatably mounted in the connecting flange (2) by at least one bearing (80) and being sealed against the connecting flange (2) by at least one shaft seal (9), wherein the drive shaft (7) being operatively connected to the drive gear (4) by a coupling piece (6), wherein the drive gear (4) and the idler gear (5) are identical.

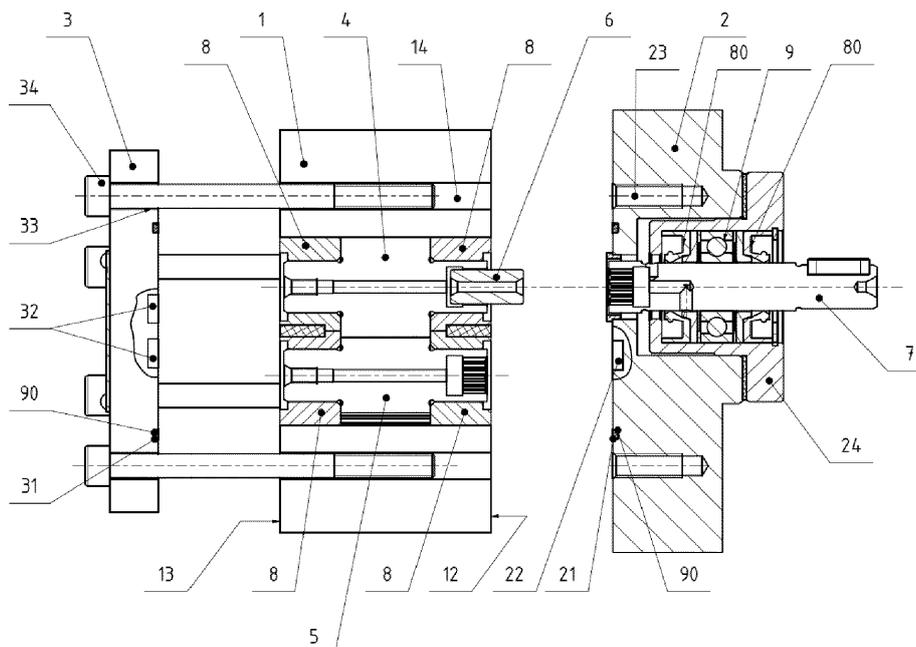


Fig. 3

Description

TECHNICAL FIELD OF THE INVENTION

5 **[0001]** The current invention relates to gear pumps, in particular to spur-toothed external gear pumps that are easy to maintain and easy to clean after a pumping process.

DESCRIPTION OF THE RELATED ART

10 **[0002]** Known embodiments of such gear pumps have a pump housing, in which a drive gear and an idler gear are rotatably mounted. The housing is laterally closed off on one side with a flange and on the opposite side thereof is closed off with a cover. The flange comprising a drive shaft and a coupling piece, by means of which the drive shaft is operatively connected to the drive gear. For example, such a gear pump is disclosed in CN 105298834. Such a known gear pump has the disadvantage of comprising a rather high number of spare parts resulting in high maintenance costs.

SUMMARY OF THE INVENTION

[0003] In the present invention, a problem to be solved is the provision of a gear pump that is easy to maintain.

20 **[0004]** This problem is solved by a gear pump with the features of claim 1. Further embodiments of the gear pump are defined by the features of further claims.

[0005] A gear pump according to the present invention comprises a housing with a spur-toothed drive gear and a spur-toothed idle gear that are mounted rotatably around two parallel rotation axes within the housing with bushings. A connecting flange is arranged on a first lateral side of the housing, in the direction of the axes. A cover is arranged on a second lateral side of the housing, opposite the connecting flange. A drive shaft is rotatably mounted in the connecting flange by at least one bearing and is sealed against the connecting flange by at least one shaft seal, wherein the drive shaft is operatively connected to the drive gear by a coupling piece. The drive gear and the idle gear are identical.

25 **[0006]** With such a design, the gear pump can be taken apart individually, upon requirement, i.e. the seals can be replaced without removing the gears, or the gears can be replaced without removing the seals. Additionally, fewer spare parts are needed as the drive gear and the idle gear are interchangeable.

30 **[0007]** In a further embodiment of the present invention, each gear comprises a first bearing pin arranged on a first lateral side of the gear and a second bearing pin arranged on a second lateral side of the gear, opposite to the first lateral side. The axis of rotation of the bearing pins are congruent and the length and the diameter of the bearing pins are identical.

35 **[0008]** In further embodiments of the present invention, the first bearing pin comprises an internal driving profile. Alternatively, the first bearing pin and the second bearing pin comprise an internal driving profile. However, it is also possible to provide an external driving profile at the first and/or second bearing pin.

[0009] In still further embodiments of the present invention, the driving profile is part of a form-fit shaft-hub connection with a shaft selected from the group comprising polygon shaft, toothed shaft, splined shaft and cycloidal shaft. However, any regular or irregular profile can be used that can act as a driving profile.

40 **[0010]** In still further embodiments of the present invention, a lubrication channel extends along the axis of rotation through each gear, from the first bearing pin to the second bearing pin, i.e. through the entire length of each gear.

[0011] In further embodiments of the present invention, the drive shaft extends along a longitudinal axis from a first end to a second end. The second end of the drive shaft comprises a driving profile.

45 **[0012]** In further embodiments of the present invention, the driving profile of the drive shaft is identical to the driving profile of the gears, i.e. they all are either internal driving profiles or external profiles with identical cross-sections.

[0013] In still further embodiments of the present invention, a lubrication channel extends along the longitudinal axis of the drive shaft, at least in the region of the second end. The lubrication channel has a lateral opening spaced apart from the second end of the drive shaft.

50 **[0014]** In still further embodiments of the present invention, the first end of the drive shaft comprises a connecting profile for the connection to a drive element. The connecting profile acting as a driving profile is part of a form-fit shaft-hub connection with a shaft selected from the group comprising polygon shaft, toothed shaft, splined shaft and cycloidal shaft. However, any regular or irregular profile can be used that can act as a driving profile.

55 **[0015]** In further embodiments of the present invention, the coupling piece extends along a longitudinal axis and comprises a driving profile over its entire length that is complementary to the driving profile of the gears or the driving profile of the drive shaft, respectively. Thus, if the driving profile of the gears or the drive shaft is an internal profile, the driving profile of the coupling piece is an external profile and vice versa. Therefore, if the drive gear comprises an internal drive profile and the drive shaft comprises an external drive, the coupling piece comprises an external driving profile on its one side and an internal driving profile on its other side.

[0016] In further embodiments of the present invention, a lubrication channel extends along the longitudinal axis over the entire length of the coupling piece.

[0017] In further embodiments of the present invention, a first sealing surface of the housing faces a sealing surface of the connecting flange, and a second sealing surface of the housing faces a sealing surface of the cover. The end faces of the first bearing pin of the drive gear and of the idle gear and the outside end faces of the corresponding bushes are flush with the first sealing surface. The end faces of the second bearing pin of the drive gear and of the idle gear and the outside end faces of the corresponding bushes are flush with the second sealing surface.

[0018] In further embodiments of the present invention, the sealing surface of the connecting flange comprises a sealing groove surrounding the corresponding bushes and comprises a first sealing ring. The sealing surface of the cover comprises a sealing groove surrounding the corresponding bushes and comprises a second sealing ring.

[0019] In further embodiments of the present invention, the connecting flange comprises a seal cover that is removable from a side opposite the housing. The at least one bearing, the at least one shaft seal and the drive shaft are securely arranged in a recess in the seal cover. This design allows for the exchange of the shaft seal of the drive shaft without the need to disassemble the gear pump otherwise.

[0020] In further embodiments of the present invention, the sealing surface of the connecting flange comprises a lubrication groove for connecting the lubrication channel of the idle gear with a lubrication port adjacent to the drive shaft and the sealing surface of the cover comprises a lubrication groove for connecting the lubrication channel of the drive gear with the lubrication channel of the idle gear. Thus, the lubrication groove of the connecting flange extends from a region comprising the projection of the lubrication channel of the idle gear in the direction of the axis of rotation and the lubrication groove of the cover extends from a region comprising the projection of the lubrication channel of the drive gear in the direction of the axis of rotation to a region comprising the projection of the lubrication channel of the idle gear in the direction of the axis of rotation.

[0021] In further embodiments of the present invention, the gear pump comprises a lubrication channel insert that extends along a longitudinal axis and comprising a driving profile over its entire length that is complementary to the driving profile of the idle gear and a lubrication channel that extends along the longitudinal axis over the entire length of the lubrication insert. The length of the lubrication channel insert is identical to the length of a recess in the idle gear comprising the driving profile and an adjoining undercut for the driving profile. If the lubrication channel insert is introduced in said recess, the lubrication channel of the lubrication channel insert connects the lubrication channel of the idle gear to the lubrication groove of the connecting flange.

[0022] In further embodiments of the present invention, the housing is clamped between the connecting flange and the cover by means of clamping elements.

[0023] The features of the above-mentioned embodiments of the gear pump can be used in any combination, unless they contradict each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Embodiments of the present invention are described in more detail in the following with reference to the drawings. These are for illustrative purposes only and are not to be construed as limiting. It shows:

Fig. 1 a perspective exploded view of a gear pump according to the present invention;

Fig. 2 an alternative view of the exploded view according to Fig. 1;

Fig. 3 a sectional view of the gear pump according to Fig. 1;

Fig. 4 a partial sectional view of a gear according to the present invention;

Fig. 5 a sectional view of a coupling piece according to the present invention; and

Fig. 6 a partial sectional view of a drive shaft according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Fig. 1 shows a perspective exploded view of a gear pump according to the present invention and Fig. 2 shows an alternative view of the exploded view of Fig. 1.

[0026] The gear pump comprises a housing 1 with a spur-toothed drive gear 4 and a spur-toothed idle gear 5 that are mounted rotatably around two parallel rotation axes within the housing 1 comprising bushings 8. A connecting flange 2 is arranged on a first lateral side of the housing 1 in the direction of the axes. A cover 3 is arranged on a second lateral

side of the housing 1, opposite the connecting flange 2. A drive shaft 7 is rotatably mounted in the connecting flange 2. The housing 1 comprises a pressure port 10 and a suction port 11. The housing 1 further comprises a first sealing surface 12 facing the connecting flange 2 and a second sealing surface 13 facing the cover 3. Through holes 14 extend from the first sealing surface 12 to the second sealing surface 13. The connecting flange 2 comprises a sealing surface 20 facing the housing 1. The sealing surface 20 comprises a lubrication groove 22 extending from a region of the rotation axis of the idle gear 5 to a location adjacent to the drive shaft 7. The connecting flange 2 further comprises thread holes 23 that are distributed around the periphery of the sealing surface 20. The connecting flange 2 further comprises a seal cover 24 that is removable from a side opposite the housing 1 and that is secured to the housing by means of screws. The drive shaft 7 is rotatably arranged in the seal cover 24. The cover 3 comprises a sealing surface 30 facing the housing 1. The sealing surface 20 of the connecting flange 2 comprises a lubrication groove 22 extending from a region of the rotation axis of the drive gear 4 to a region of the rotation axis of the idle gear 5. The cover 3 further comprises through holes 33 distributed around the periphery of the sealing surface 30 and extending from the sealing surface 30 through the entire thickness of the cover 3. In the assembled state, screws 34 extend through the through holes 33 of the cover 3 and the through holes 14 of the housing 1 and are screwed-in in the thread holes 23 of the connecting flange 2. Thus, the housing 1 is clamped between the connecting flange 2 and the cover 3 by said screws 34. The sealing surface 20 of the connecting flange 2 comprises a closed sealing groove 21 that surrounds the corresponding region of the end faces of the bushings 8 and a corresponding lubrication groove 22 in the sealing surface 20 of the connecting flange 2. A first sealing ring 90 is arranged in said sealing groove 21 of the connecting flange 2. The sealing surface 30 of the cover 3 comprises a closed sealing groove 31 that surrounds the corresponding region of the end faces of the bushings 8 and the corresponding lubrication groove 32 in the sealing surface 30 of the cover 3. A second sealing ring 91 is arranged in said sealing groove 32.

[0027] Fig. 3 shows a sectional view of the gear pump of Fig. 1. The section being in a plane defined by the axis of rotation of the gears 4 and 5 and the drive shaft 7. Both, the drive gear 4 and the idle gear 5, are rotatably arranged with bushings 8 within a recess in the housing 1. The bushings 8 are arranged on both sides of each gear 4 and 5, respectively. The recess extends along the axis of rotation of the gears 4 and 5 through the entire housing 1 from the first sealing surface 12 to the second sealing surface 13. This design allows the introduction or the removal of the gears 4 and 5 and the bushings 8 from either side of the recess. There are bearing pins on both sides of the gears 4 and 5 which rest within the corresponding bushings 8. The end faces of the bearing pins and the outside end faces of the corresponding bushes 8 are flush with the first sealing surface 12, and the end faces of the bearing pins and the outside end faces of the corresponding bushes 8 are flush with the second sealing surface 13. A coupling piece 6 is partially introduced in a complementary recess in the drive gear 4. The rest of the coupling piece 6 extends over the first sealing surface 12 and into a complementary recess in the drive shaft 7. The drive shaft 7 is rotatably mounted in the seal cover 24 of the connecting flange 2 with two bearings 80. The drive shaft 7 is sealed against the seal cover 24 with one shaft seal 9. The drive shaft 7, the bearings 80 and the shaft seal 9 are secured in a recess in the seal cover 24 by means of a retaining element, i.e. a retaining ring. The seal cover 24 has a cylindrical husk body that is introduced into a corresponding recess of the flange body of the connecting flange 2. The seal cover 24 comprises a brim that extends laterally over the diameter of the husk body. Through holes are evenly distributed around the circumference of the brim. The seal cover 24 is fixed to the flange body by means of screws (see Fig. 1).

[0028] Fig. 4 shows a partial sectional view of a gear according to the present invention, i.e. the drive gear 4 or the idle gear 5. The gear 4 comprises a gearing 40 located in its middle and extending in the direction of the axis of rotation A. On one side of the gearing 40, a first bearing pin 41 extends along the axis of rotation A having an outside diameter that is smaller than the outside diameter of the gearing 40 and having a length that is shorter than the width of the gearing 40. A second bearing pin 42 is arranged on the opposite side of the gearing 40, having an outside diameter and a length that are identical to the ones of the first bearing pin. A recess is provided centrally in the first bearing pin 41 extending from the end face. The recess comprising a toothing 43 complementary to the one of the coupling piece 6 and an undercut adjoining the toothing 43. A lubrication channel 44 extends along the axis of rotation A from the undercut towards the end face of the second bearing pin 42.

[0029] Fig. 5 shows a sectional view of a coupling piece 6 according to the present invention. The coupling piece 6 has a cylindrical body that extends along a longitudinal axis L that comprises an external toothing 60 along its entire length that is complementary to the one of the drive gear 4 and the drive shaft 7. A lubrication channel 61 extends along the longitudinal axis L over the entire length of the coupling piece 6.

[0030] Fig. 6 shows a partial sectional view of a drive shaft 7 according to the present invention. The drive shaft 7 has a cylindrical body 70 that extends along a longitudinal axis L from a first end 71 to an opposite second end 72. The first end 71 having an outside diameter that is smaller than the one of an adjoining middle section, and the outside diameter of the middle section is smaller than the one of the adjoining second end 71. The outside diameter of the second end 71 is identical to the outside diameter of the bearing pins 41, 42 of the drive gear 4. A recess is provided centrally in the second end 72 extending from the end face towards the middle section. The recess comprising a gearing 73 complementary to the one of the coupling piece 6 and an undercut adjoining the gearing 73. A lubrication channel 74 extends

along the longitudinal axis L from the undercut into the middle section. From there, the lubrication channel 74 extends essentially perpendicular to the longitudinal axis L towards a lateral opening 740. The diameter of the lubrication channel 74 of the drive shaft 7 is identical to the one of the coupling piece 6 and the gears 4, 5. A connecting groove 75 in the form of a keyseat is provided at the first end 71.

LIST OF REFERENCE SIGNS

[0031]

5				
10			40	gearing
	1	housing	41	first bearing pin
	10	pressure port	42	second bearing pin
	11	suction port	43	gearing
15	12	first sealing surface	44	lubrication channel
	13	second sealing surface	5	idle gear
	14	through hole	6	coupling piece
	2	connecting flange	60	gearing
20	20	sealing surface of the connecting flange 2	61	lubrication channel
	21	sealing groove of the connecting flange 2	7	drive shaft
	22	lubrication groove of the connecting flange 2	70	body
			71	first end
			72	second end
25	23	thread hole	73	gearing
	24	seal cover	74	lubrication channel
	3	cover	740	lateral lubrication opening
30	30	sealing surface of the cover 3	75	connecting groove
	31	sealing groove of the cover 3	8	bushing
	32	lubrication groove of the cover 3	80	bearing
	33	through hole	9	shaft seal
35	34	screw	90	first sealing ring
	4	drive gear	91	second sealing ring
			A	axis of rotation
			L	longitudinal axis

Claims

1. A gear pump comprising a housing (1) with a spur-toothed drive gear (4) and a spur-toothed idle gear (5) that are mounted rotatably around two parallel rotation axes within the housing (1) comprising bushings (8), a connecting flange (2) that is arranged on a first lateral side of the housing (1) in the direction of the axes, a cover (3) that is arranged on a second lateral side of the housing (1) opposite the connecting flange (2), a drive shaft (7) being rotatably mounted in the connecting flange (2) by at least one bearing (80) and being sealed against the connecting flange (2) by at least one shaft seal (9), wherein the drive shaft (7) being operatively connected to the drive gear (4) by a coupling piece (6), **characterized in that** the drive gear (4) and the idle gear (5) are identical.
2. The gear pump according to claim 1, wherein each gear (4; 5) comprising a first bearing pin (41) arranged on a first lateral side of the gear (4; 5) and a second bearing pin (42) arranged on a second lateral side of the gear (4; 5), opposite to the first lateral side, wherein the axis of rotation (A) of the bearing pins (41; 42) are congruent and the length and the diameter of the bearing pins (41; 42) are identical.
3. The gear pump according to claim 2, wherein the first bearing pin (41) comprising an internal driving profile (43) or wherein the first bearing pin (41) and the second bearing pin (42) comprising an internal driving profile (43) .

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4. The gear pump according to claim 3, wherein the driving profile (43) is part of a form-fit shaft-hub connection with a shaft selected from the group comprising polygon shaft, toothed shaft, splined shaft and cycloidal shaft.
- 5 5. The gear pump according to one of claims 2 or 4, wherein a lubrication channel (44) extending along the axis of rotation (A) through each gear (4; 5) from the first bearing pin (41) to the second bearing pin (42).
6. The gear pump according to one of the preceding claims, wherein the drive shaft (7) extending along a longitudinal axis (L) from a first end (71) to a second end (72), wherein the second end (72) comprising a driving profile (73) .
- 10 7. The gear pump according to claim 6, wherein the driving profile (73) of the drive shaft (7) is identical to the driving profile (43) of the gears (4; 5).
8. The gear pump according to claim 6 or 7, wherein a lubrication channel (74) extending along the longitudinal axis (L) of the drive shaft (7), at least in the region of the second end (72) and having a lateral lubrication opening (740), spaced apart from the second end (72).
- 15 9. The gear pump according to claim 7 or 8, wherein the first end (71) of the drive shaft (7) comprising a connecting profile (75) for the connection to a drive element.
- 20 10. The gear pump according to one of claims 3 to 9, wherein the coupling piece (6) extending along a longitudinal axis (L) and comprising a driving profile (60) over its entire length that is complementary to the driving profile (43) of the gears (4; 5) or the driving profile (73) of the drive shaft (7), respectively.
- 25 11. The gear pump according to claim 10, wherein a lubrication channel (61) is provided extending along the longitudinal axis (L) over the entire length of the coupling piece (6).
12. The gear pump according to one of the preceding claims, wherein a first sealing surface (12) of the housing (1) facing a sealing surface (20) of the connecting flange (2) and wherein a second sealing surface (13) of the housing (1) facing a sealing surface (30) of the cover (3) and wherein the end faces of the first bearing pins (41) and the outside end faces of the corresponding bushes (8) are flush with the first sealing surface (12) and wherein the end faces of the second bearing pins (42) and the outside end faces of the corresponding bushes (8) are flush with the second sealing surface (13).
- 30 13. The gear pump according to claim 12, wherein the sealing surface (20) of the connecting flange (2) comprising a sealing groove (21) surrounding the corresponding bushes (8) and comprising a first sealing ring (90), and wherein the sealing surface (30) of the cover (3) comprising a sealing groove (31) surrounding the corresponding bushes (8) and comprising a second sealing ring (91).
- 35 14. The gear pump according to one of the preceding claims, wherein the connecting flange (2) comprising a seal cover (24) that is removable from a side opposite the housing (1) and wherein the at least one bearing (80), the at least one shaft seal (9) and the drive shaft (7) are securely arranged in a recess in the seal cover (24).
- 40 15. The gear pump according to one of claims 12 to 14, wherein the sealing surface (20) of the connecting flange (2) comprising a lubrication groove (22) for connecting the lubrication channel of the idle gear (5) with a lubrication port adjacent to the drive shaft (7), and wherein the sealing surface (30) of the cover (3) comprising a lubrication groove (32) for connecting the lubrication channel of the drive gear (4) with the lubrication channel of the idle gear (5).
- 45 16. The gear pump according to one of claims 11 to 15, comprising a lubrication channel insert extending along a longitudinal axis and comprising a driving profile over its entire length that is complementary to the driving profile of the idle gear (5) and comprising a lubrication channel extending along the longitudinal axis over the entire length of the lubrication channel insert and wherein the length of the lubrication channel insert is identical to the length of a recess in the idler gear (5) comprising the driving profile and an adjoining undercut for the driving profile.
- 50 17. The gear pump according to one of the preceding claims, wherein the housing (1) is clamped between the connecting flange (2) and the cover (3) by means of clamping elements (34) .
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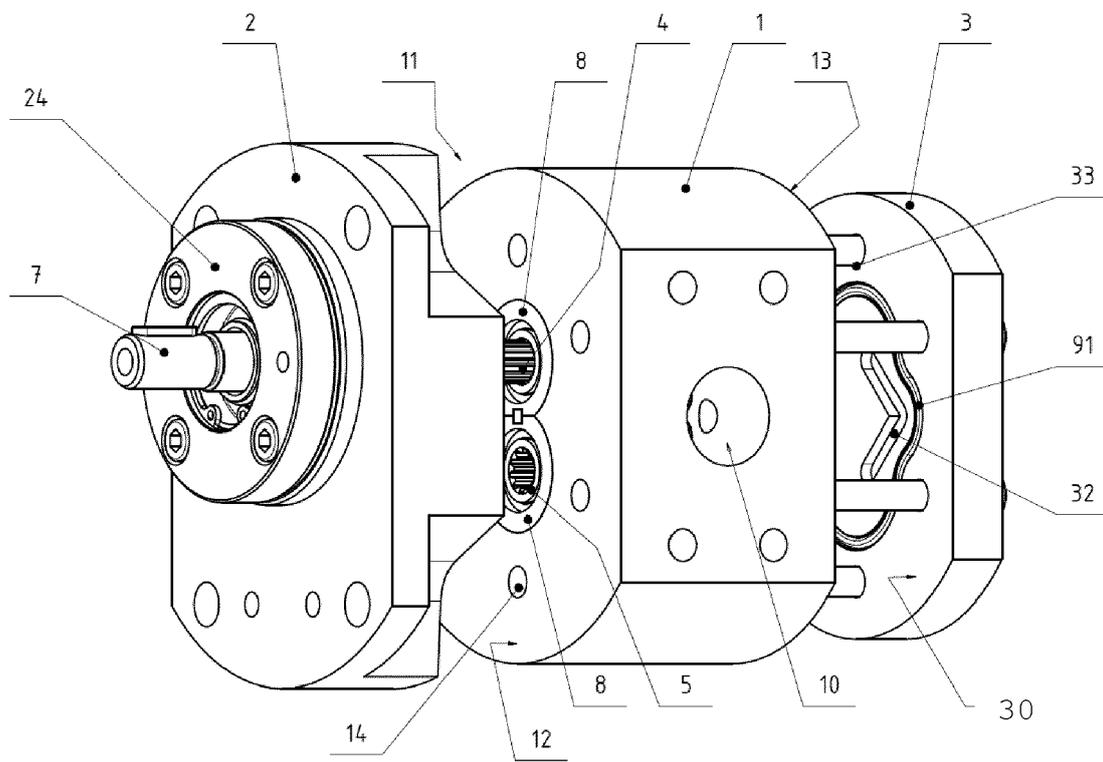


Fig. 1

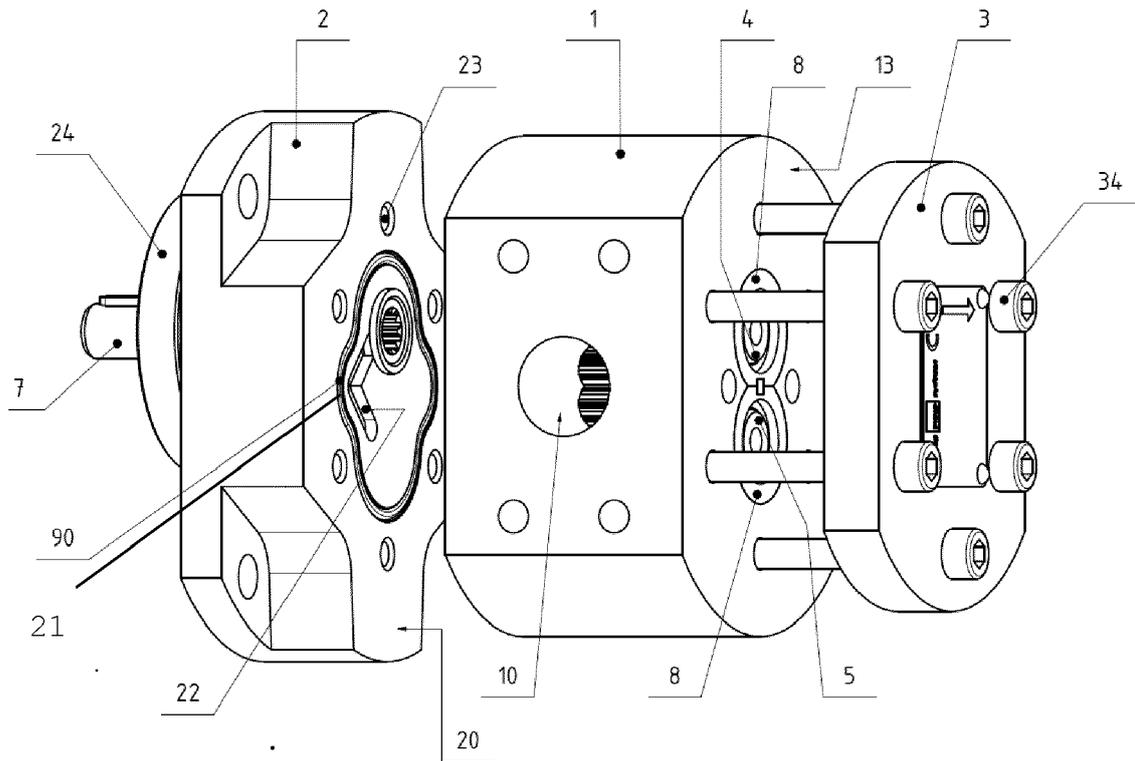


Fig. 2

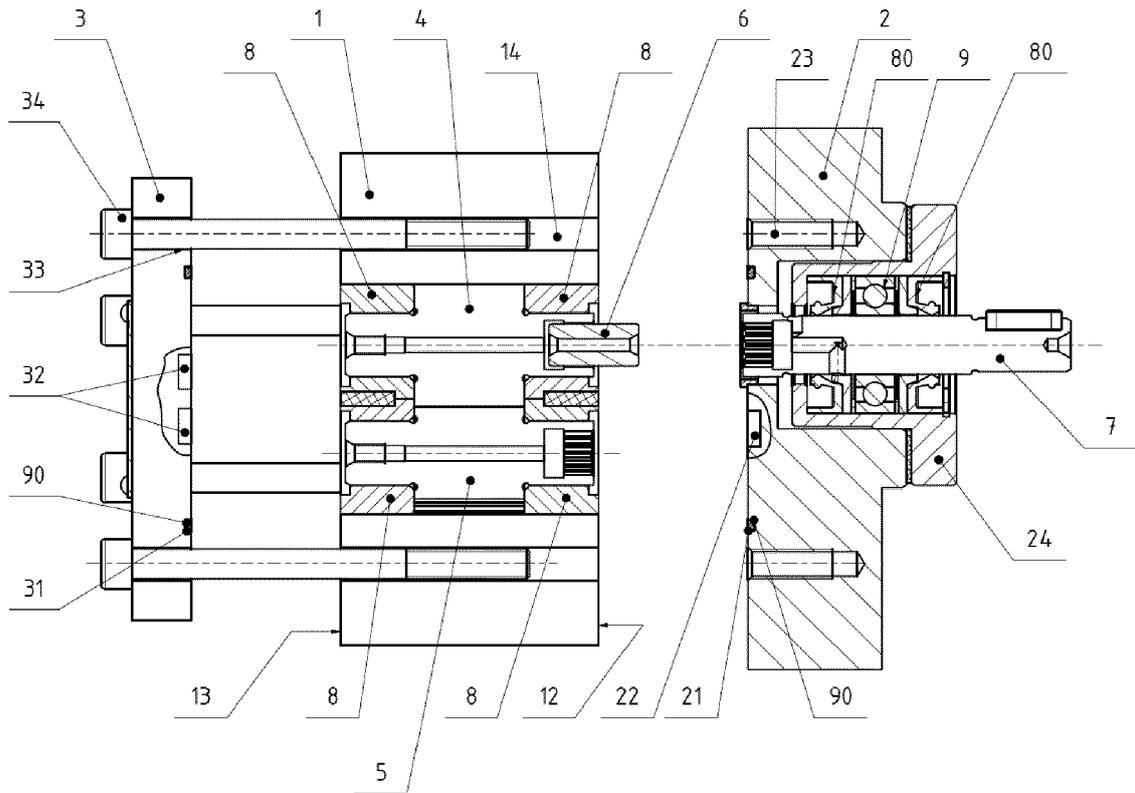


Fig. 3

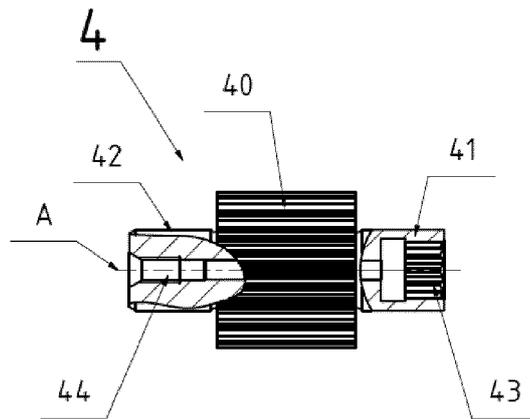


Fig. 4

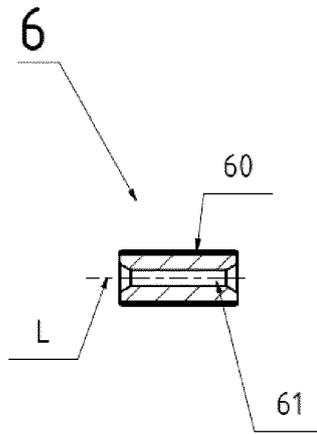


Fig. 5

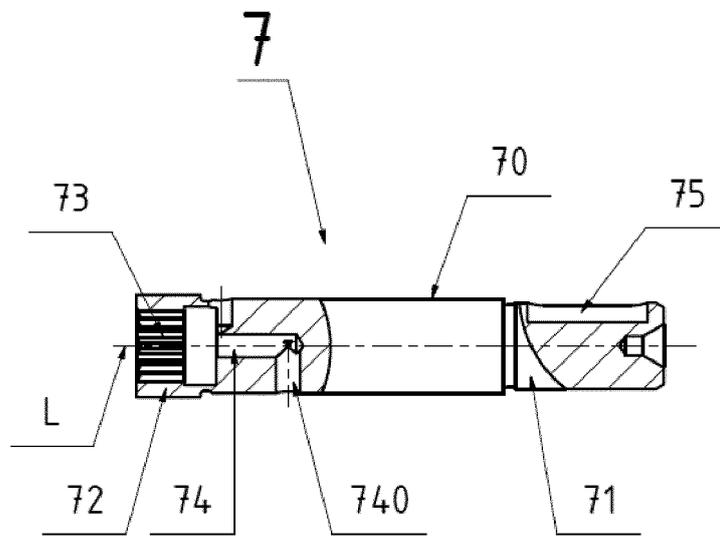


Fig. 6



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Application Number
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