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(54) HYDRAULIC MOTOR WITH INTEGRATED SERIES/PARALLEL SPOOL

HYDRAULIKMOTOR MIT INTEGRIERTER SERIEN-/PARALLELSPULE

MOTEUR HYDRAULIQUE À BOBINE INTÉGRÉE EN SÉRIE/PARALLÈLE

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(73) Proprietor: **Robert Bosch GmbH
70442 Stuttgart (DE)**

(72) Inventors:
• **O Hara, Frank**
Auchtermuchty, Fife KY14 7ER (GB)
• **Edward, Iain**
North Queensferry, Fife KY11 1EDC (GB)
• **Hare, David**
Kirkliston, Fife EH29 9GH (GB)

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EP-A1- 2 918 831 GB-A- 1 399 596
GB-A- 2 278 890

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Description

[0001] The invention concerns a hydraulic motor according to the preamble of claim 1 and a hydraulic drive system which makes use of the inventive hydraulic motor.

[0002] EP 2 841 763 B1 shows a radial piston motor with a casing and a separate distributor.

[0003] EP 3 524 859 A1 shows a closed hydraulic circuit with two hydraulic motors and a pump. The motors are connected in series or in parallel depending on the switching position of a valve.

[0004] EP 2 918 831 A1 shows a radial piston motor with an integrated spool. The spool is configured to switch the motor between a large and a small cylinder configuration, which differ in the connections between multiple chambers of the distributor and the three working ports. This results in a hydraulic function which is not analogous to EP 3 524 859 A1.

[0005] GB 2 278 890 A shows radial piston motor with a capacity selector device having two spools. The motor has only two working ports.

[0006] GB 1 399 596 A shows a further radial piston motor having a distributor with multiple chambers.

[0007] An advantage of the invention is that the basic principle according to EP 3 524 859 A1 can be integrated in existing vehicles wherein only one or two motors have to be exchanged by the inventive motor. The inventive motor has nearly the same size as a conventional hydraulic motor. The number of working ports, which have to be connected to high pressures and high flow, is minimal. A large diameter spool can be used so that the flow resistance induced by the series/parallel switching is minimal.

[0008] According to claim 1 it is proposed that the casing has a third working port, wherein there is a second and a fourth chamber which are delimited by the casing and the distributor respectively, wherein the second chamber is permanently connected to the second working port, wherein the fourth chamber is permanently connected to the third working port, wherein there is a movable spool located inside the casing, which has a first and a second position, wherein in the first position there is a connection from the third chamber to the second chamber via the spool, wherein in the second position there is a connection from the third chamber to the fourth chamber via the spool and a connection from the first chamber to the second chamber via the spool. The casing and the distributor are preferably separate parts, wherein a circumferential surface of the distributor contacts the casing. It is possible to make the casing and the distributor as one unitary part.

[0009] Further improvements of the invention are indicated in the dependent claims.

[0010] It is preferred that the first, the second, the third and the fourth chamber are shaped as a circular ring with respect to the axis respectively and are located at a circumferential surface of the distributor. The circumferential surface is preferably rotational symmetric with respect

to the axis. This is basically a proven design for the separation of the distributor and the casing. The connections of the first to fourth chambers according to the invention are especially adapted for the use of this proven design.

[0011] It is preferred that a spring urges the spool into the first or into the second position, wherein a pressure at a control port urges the spool into the other position, namely the second or the first position. Preferably the spring urges the spool into the first position, such that the serial connection of the first and the second motor is the default configuration. The first position is active most of the time during the operation of a vehicle.

[0012] According to the invention the casing has a drain channel which connects the spool to an interior of the casing. The interior of the casing is preferably connected to a tank. With this configuration any leakage from the spool is discharged in a controlled manner such that no unintentional pressure increase takes place.

[0013] It is preferred that in the first position of the spool a connection between the third and the fourth chamber is blocked and a connection between the first and the second chamber is blocked. With this configuration an unintentional parallel connection of the first and the second motor is avoided in the first position.

[0014] It is preferred that in the second position of the spool a connection between the third and the second chamber is blocked. With this configuration an unintentional series connection of the first and the second motor is avoided in the second position.

[0015] An inventive hydraulic drive system has at least one first and at least one second motor and a pump, wherein the at least one first motor is configured according to the invention, wherein the at least one second motor has a first and a second port respectively, wherein the pump has a first and a second port respectively, wherein the first port of the pump is permanently connected to the third working port of the at least one first motor and to the second port of the at least one second motor in parallel, wherein the second port of the pump is permanently connected to the first working port of the at least one first motor in parallel, wherein each second working port of a first motor is permanently connected to an associated first port of a second motor. Preferably there are two first motors and two second motors. Preferably the number of the first and the second motors is the same. Preferably the hydraulic drive system is part of a vehicle, wherein the at least one first motor and the at least one second motor drives an associated wheel.

[0016] It goes without saying that the features mentioned above and those which are still to be explained below can be used not only in the particular combination indicated but also in other combinations or in independent form without departing from the scope of the present invention.

[0017] The invention is explained in more detail below with reference to the accompanying drawings. It shows:

Fig. 1 a longitudinal section of the inventive hydraulic

motor;

Fig. 2 a perspective view of the distributor; and

Fig. 3 a hydraulic circuit diagram of the inventive hydraulic drive system.

[0018] Fig. 1 shows a longitudinal section of the inventive hydraulic motor 40, which is configured as a radial piston motor. It is possible to use the invention with an axial piston motor or other types of hydraulic motors, which have multiple moveable pistons 71.

[0019] The hydraulic motor 40 has a casing 50 and a separate distributor 60, wherein they may be configured as one part. Inside the casing 50 there is a rotor 70 which is rotatable about an axis 45 with respect to the casing 50. The rotor 70 has a plurality of movable pistons 71. With the radial piston motor at hand these pistons 71 are moveable radially with respect to the axis 45. Each piston 71 may have a rotatable roller 72, which abuts against a cam ring (not shown). The cam ring has two or more lobes, which urge the piston inward or outward, while the rotor 70 rotates. With an axial piston motor a swash plate may be used to move the pistons.

[0020] The distributor 60 has an end face 63, which is perpendicular to the axis 45 and a circumferential surface 64, which is preferably rotational symmetric with respect to the axis 45. The casing 50 is adapted to the distributor 60 in a fluid tight manner. Especially the first, the second, the third and the fourth chamber 41; 42; 43; 44 are sealed to each other with a corresponding sealing ring 90. Each chamber 41; 42; 43; 44 is ring shaped with respect to the axis 45, wherein the circumferential surface 64 cuts each chamber 41; 42; 43; 44 in two halves. The sequence of the first to fourth chamber 41 - 44 along the axis 45 may be selected as desired. With the selection according to Fig. 1, i.e. in numerical order, the spool 80 has a simple configuration and the hydraulic motor 40 is very compact. At the end face 63 there are a plurality of first and plurality of second 61; 62 openings, which are described in further detail with reference to Fig. 3 below.

[0021] The casing 50 has a first, a second and a third working port 51; 52; 53. The first working port 51 is permanently connected to the first chamber 41 within the casing 50. The first chamber 41 is permanently connected to all first openings 61 in parallel within the distributor 60. The second working port 52 is permanently connected to the second chamber 42 within the casing 50. The third chamber 43 is permanently connected to all second openings 62 in parallel within the distributor 60. The fourth chamber 44 is permanently connected to the third working port 53 within the casing 50.

[0022] Inside the casing 50 there is a moveable spool 80, wherein the direction of movement is preferably parallel to the axis 45. In Fig. 1 the spool 80 is shown in its second position, which is present when there is a pressure at the control port 54. When there is no or a very low pressure at the control port 54 the spool is urged 80

into the first position by the spring 81. In the second position shown in Fig. 1 the spool 80 provides a first fluid connection from the first chamber 41 to the second chamber 42 and a second fluid connection from the third chamber 43 to the fourth chamber 44. There are no further fluid connections between the first to fourth chamber 41; 44 in the second position of the spool 80.

[0023] In the first position of the spool 80 there is a fluid connection from the second to the third chamber 42; 43. There are no further fluid connections between the first to fourth chamber 41; 44 in the first position of the spool 80.

[0024] A leakage flow at the spool 80 near the control port 54 is directed into the interior of the casing 50 via a drain channel 55. The interior of the casing 50 is the cavity surrounded by the casing 50 wherein this cavity is preferably connected to the tank such that there is a low pressure inside the interior of the casing 50. The rotor 70 is located in the interior of the casing 50. All leakage flow from the rotor 70 is gathered in the interior of the casing 50 too.

[0025] Fig. 2 shows a perspective view of the distributor 60. The first and the second openings 61; 62 are preferably circular shaped respectively. They are distributed uniformly around the axis (no. 45 in Fig. 1) at a constant distance to the axis. Adjacent to the openings 61; 62 the end face 63 is flat and perpendicular to the axis. This area is a sealing surface which abuts against the rotor (no. 70 in Fig. 1). Away from the sealing surface the end face 63 is set back, so that there is a defined area of sealing contact.

[0026] The total number of all openings 61; 62 equals the number of pistons in the rotor. In any rotational position of the rotor each opening 61; 62 is essentially connected with a single piston. The first and the second openings 61; 62 are arranged alternately around the axis. While the rotor rotates every piston is alternately connected to the first or the third chamber 41; 43. The second and the fourth chamber 42; 44 have no direct connection to the pistons within the distributor 60.

[0027] Fig. 3 shows a hydraulic circuit diagram of the inventive hydraulic drive system 10. The hydraulic drive system 10 may be part of a vehicle, wherein the corresponding wheels 91 are driven by the first and second motors 11; 20.

[0028] In the hydraulic drive system 10 at hand there are two first motors 11 which are configured according to the invention, wherein there are two second motors 20 which are configured in a conventional way. The second motors 20 have a first and a second port 21; 22 respectively.

[0029] There is a pump 30 with a first and a second port 31; 32. The pump 30 is preferably driven by a diesel engine, so that the direction of rotation is fixed. The pump 30 has a displacement volume, which is continuously adjustable such that the direction of flow through the pump can be reversed by adjusting the displacement volume. The pump 30 may be an axial piston pump in swash plate

design. Preferably there is an auxiliary pump 13 which is driven by the shaft of the (main) pump 30. The auxiliary pump 13 may be a gear pump.

[0030] The first port 31 of the pump 30 is permanently connected to the second ports 22 of the two second motors 20 and the third working ports 53 of the two first motors 11 in parallel. The second port 32 of the pump 30 is permanently connected to the first working port 51 of the two first motors 11 in parallel. Each first motor 11 has an associated second motor 20, wherein the second working port 52 of the first motor 11 is permanently connected to the first port 21 of the associated second motor 20.

[0031] The connections described above result in a closed hydraulic circuit. When a spool 80 of the a first motors 11 is in the first position 82 the corresponding first motor 11 and the associated second motor 20 are in a series connection. When the spool 80 is in the second position 83 the corresponding first motor 11 and the associated second motor 20 are in a parallel connection.

[0032] The flushing valve 92 is connected to the first and the second port 31; 32 of the pump 30 to direct a defined flow of hydraulic fluid to the tank 12. The auxiliary pump 13 may be connected (not shown) to the first and the second port 31; 32 of the pump 30 to replace this hydraulic fluid flow. With such a conventional configuration overheating of the hydraulic fluid in the closed hydraulic circuit is prevented.

[0033] The control valve 14 is an electrically adjustable pressure reducing valve. Its output is connected the control ports 54 of the two first motors 11 in parallel. Its two inputs are connected to the auxiliary pump 13 and the tank 12. With this configuration the pressure at the control ports 54 can be adjusted by an electrical signal. This is the preferred type of operation, wherein other ways of adjusting the pressure at the control port 54 are also possible, e.g. a manual adjustment.

[0034] All tank symbols 12 in Fig. 3 refer to the same tank.

Reference Numerals

[0035]

10	hydraulic drive system
11	first motor
12	tank
13	auxiliary pump
14	control valve
20	second motor
21	first port of the second motor
22	second port of the second motor
30	pump
31	first port of the pump
32	second port of the pump

40	hydraulic motor
41	first chamber
42	second chamber
43	third chamber
5	44 fourth chamber
45	axis
50	casing
51	first working port
10	52 second working port
53	third working port
54	control port
55	drain channel
60	distributor
15	61 first opening
62	second opening
63	end face
64	circumferential surface
20	70 rotor
71	piston
72	roller
80	spool
25	81 spring
82	first position
83	second position
90	sealing ring
30	91 wheel
92	flushing valve

Claims

- 35 1. Hydraulic motor (40) with a casing (50) which has a first (51) and a second (52) working port, wherein there is a rotor (70) inside the casing (50) which is rotatable with about an axis (45) with respect to the casing (50), wherein the rotor (70) has a plurality of movable pistons (71), wherein there is a distributor (60) located fixed inside the casing (50) which has an end face (63), wherein the rotor (70) abuts against the end face (63), wherein there is a first (41) and a third chamber (43) which are delimited by the distributor (60) and the casing respectively (50), wherein the first chamber (41) is permanently connected to a plurality of first openings (61) in the end face (63), wherein the third chamber (43) is permanently connected to a plurality of second openings (62) in the end face (63), wherein the first chamber (41) is permanently connected to the first working port (51),
- 40
- 45
- 50
- 55
- wherein the casing has a third working port (53), wherein there is a second (42) and a fourth (44) chamber which are delimited by the casing (50) and the distributor (60) respectively, wherein the second chamber (42) is permanently connected

- to the second working port (52), wherein the fourth chamber (44) is permanently connected to the third working port (53), wherein there is a movable spool (80) located inside the casing (50), which has a first and a second position (82; 83),
 wherein in the first position (82) there is a connection from the third chamber (43) to the second chamber (42) via the spool (80),
characterized in that the second position (83) there is a connection from the third chamber (43) to the fourth chamber (44) via the spool (80) and a connection from the first chamber (41) to the second chamber (42) via the spool (80), wherein the casing (50) has a drain channel (55) which connects the spool (80) to an interior of the casing (50).
2. Hydraulic motor according to claim 1, wherein the first, the second, the third and the fourth chamber (41; 42; 43; 44) are shaped as a circular ring with respect to the axis respectively and are located at a circumferential surface (64) of the distributor (60).
 3. Hydraulic motor according to any of the preceding claims, wherein a spring (81) urges the spool (80) into the first or into the second position (82; 83), wherein a pressure at a control port (54) urges the spool (80) into the other position, namely the second or the first position (83; 82).
 4. Hydraulic motor according to any of the preceding claims, wherein in the first position (82) of the spool (80) a connection between the third and the forth chamber (43; 44) is blocked and a connection between the first and the second chamber (41; 42) is blocked.
 5. Hydraulic motor according to any of the preceding claims, wherein in the second position (83) of the spool (80) a connection between the third and the second chamber (43; 42) is blocked.
 6. Hydraulic drive system (10) with at least one first (11) and at least one second motor (20) and a pump (30), wherein the at least one first motor (11) is configured according to any of the claims 1 to 5
- respectively, wherein the at least one second motor (20) has a first (21) and a second (22) port respectively, wherein the pump (30) has a first (31) and a second port (32) respectively, wherein the first port (31) of the pump (30) is permanently connected to the third working port (53) of the at least one first motor (11) and to

the second port (22) of the at least one second motor (20) in parallel,
 wherein the second port (32) of the pump (30) is permanently connected to the first working port (51) of the at least one first motor (11) in parallel,
 wherein each second working port (52) of a first motor (11) is permanently connected to an associated first port (21) of a second motor (20).

Patentansprüche

1. Hydraulikmotor (40) mit einem Gehäuse (50), das einen ersten (51) und einen zweiten (52) Arbeitsanschluss aufweist, wobei sich ein Rotor (70) in dem Gehäuse (50) befindet, der um eine Achse (45) in Bezug auf das Gehäuse (50) drehbar ist, wobei der Rotor (70) eine Mehrzahl von beweglichen Kolben (71) aufweist, wobei ein Verteiler (60) fest in dem Gehäuse (50) angeordnet ist, der eine Endfläche (63) aufweist, wobei der Rotor (70) an der Endfläche (63) anliegt, wobei eine erste (41) und eine dritte Kammer (43) vorhanden sind, die durch den Verteiler (60) bzw. das Gehäuse (50) begrenzt sind, wobei die erste Kammer (41) dauerhaft mit einer Mehrzahl von ersten Öffnungen (61) in der Endfläche (63) verbunden ist, wobei die dritte Kammer (43) dauerhaft mit einer Mehrzahl von zweiten Öffnungen (62) in der Endfläche (63) verbunden ist, wobei die erste Kammer (41) dauerhaft mit dem ersten Arbeitsanschluss (51) verbunden ist,

wobei das Gehäuse einen dritten Arbeitsanschluss (53) aufweist, wobei eine zweite (42) und eine vierte (44) Kammer vorhanden sind, die durch das Gehäuse (50) bzw. den Verteiler (60) begrenzt sind, wobei die zweite Kammer (42) dauerhaft mit dem zweiten Arbeitsanschluss (52) verbunden ist, wobei die vierte Kammer (44) dauerhaft mit dem dritten Arbeitsanschluss (53) verbunden ist, wobei ein beweglicher Schieber (80) in dem Gehäuse (50) angeordnet ist, der eine erste und eine zweite Position (82; 83) aufweist,
 wobei in der ersten Position (82) eine Verbindung von der dritten Kammer (43) zu der zweiten Kammer (42) über den Schieber (80) vorhanden ist,

dadurch gekennzeichnet, dass in der zweiten Position (83) eine Verbindung von der dritten Kammer (43) zu der vierten Kammer (44) über den Schieber (80) und eine Verbindung von der ersten Kammer (41) zu der zweiten Kammer (42) über den Schieber (80) vorhanden ist, wobei das Gehäuse (50) einen Ablaufkanal (55) aufweist, der den Schieber (80) mit einem Inneren des Gehäuses (50) verbindet.

2. Hydraulikmotor nach Anspruch 1,
wobei die erste, die zweite, die dritte und die vierte
Kammer (41; 42; 43; 44) jeweils als ein kreisförmiger
Ring in Bezug auf die Achse geformt sind und an
einer Umfangsfläche (64) des Verteilers (60) ange-
ordnet sind. 5
3. Hydraulikmotor nach einem der vorhergehenden
Ansprüche,
wobei eine Feder (81) den Schieber (80) in die erste
oder in die zweite Position (82; 83) drückt, wobei ein
Druck an einem Steueranschluss (54) den Schieber
(80) in die andere Position, und zwar die zweite oder
die erste Position (83; 82), drückt. 10
4. Hydraulikmotor nach einem der vorhergehenden
Ansprüche,
wobei in der ersten Position (82) des Schiebers (80)
eine Verbindung zwischen der dritten und der vierten
Kammer (43; 44) gesperrt ist und eine Verbindung
zwischen der ersten und der zweiten Kammer (41;
42) gesperrt ist. 15 20
5. Hydraulikmotor nach einem der vorhergehenden
Ansprüche,
wobei in der zweiten Position (83) des Schiebers (80)
eine Verbindung zwischen der dritten und der zwei-
ten Kammer (43; 42) gesperrt ist. 25
6. Hydraulikantriebssystem (10) mit mindestens einem
ersten (11) und mindestens einem zweiten Motor
(20) und einer Pumpe (30), wobei der mindestens
eine erste Motor (11) jeweils nach einem der Ansprü-
che 1 bis 5 ausgelegt ist, wobei der mindestens eine
zweite Motor (20) einen ersten (21) bzw. einen zwei-
ten (22) Anschluss aufweist, wobei die Pumpe (30)
einen ersten (31) bzw. einen zweiten Anschluss (32)
aufweist, 30 35
- wobei der erste Anschluss (31) der Pumpe (30)
dauerhaft mit dem dritten Arbeitsanschluss (53)
des mindestens einen ersten Motors (11) und
mit dem zweiten Anschluss (22) des mindestens
einen zweiten Motors (20) parallel verbunden
ist, 40 45
- wobei der zweite Anschluss (32) der Pumpe (30)
dauerhaft mit dem ersten Arbeitsanschluss (51)
des mindestens einen ersten Motors (11) paral-
lel verbunden ist,
- wobei jeder zweite Arbeitsanschluss (52) eines
ersten Motors (11) dauerhaft mit einem zugehö-
rigen ersten Anschluss (21) eines zweiten Mo-
tors (20) verbunden ist. 50

Revendications

1. Moteur hydraulique (40) avec un carter (50) qui com-

porte un premier (51) et un deuxième (52) orifice de travail, un rotor (70) étant situé à l'intérieur du carter (50), celui-ci étant rotatif autour d'un axe (45) par rapport au carter (50), le rotor (70) comportant une pluralité de pistons mobiles (71), un distributeur (60) étant disposé fixement à l'intérieur du carter (50), celui-ci comportant une face d'extrémité (63), le rotor (70) étant accolé à la face d'extrémité (63), des première (41) et troisième (43) chambres étant respectivement délimitées par le distributeur (60) et le carter (50), la première chambre (41) étant raccordée de façon permanente à une pluralité de premières ouvertures (61) dans la face d'extrémité (63), la troisième chambre (43) étant raccordée de façon permanente à une pluralité de secondes ouvertures (62) dans la face d'extrémité (63), la première chambre (41) étant raccordée de façon permanente au premier orifice de travail (51),

le carter comportant un troisième orifice de travail (53), des deuxième (42) et quatrième (44) chambres étant respectivement délimitées par le carter (50) et le distributeur (60), la deuxième chambre (42) étant raccordée de façon permanente au deuxième orifice de travail (52), la quatrième chambre (44) étant raccordée de façon permanente au troisième orifice de travail (53), un tiroir mobile (80) étant disposé à l'intérieur du carter (50), celui-ci ayant des première et seconde positions (82 ; 83), la troisième chambre (43) étant raccordée à la deuxième chambre (42) par le biais du tiroir (80) dans la première position (82),

caractérisé en ce que, dans la seconde position (83), la troisième chambre (43) est raccordée à la quatrième chambre (44) par le biais du tiroir (80) et la première chambre (41) est raccordée à la deuxième chambre (42) par le biais du tiroir (80), le carter (50) comportant un canal d'évacuation (55) qui raccorde le tiroir (80) à un intérieur du carter (50).

2. Moteur hydraulique selon la revendication 1, dans lequel les première, deuxième, troisième et quatrième chambres (41 ; 42 ; 43 ; 44) sont réalisées respectivement sous la forme d'un anneau circulaire par rapport à l'axe et sont placées au niveau d'une surface circonférentielle (64) du distributeur (60). 45
3. Moteur hydraulique selon l'une quelconque des revendications précédentes, dans lequel un ressort (81) sollicite le tiroir (80) vers la première ou la seconde position (82 ; 83), une pression au niveau d'un orifice de commande (54) sollicitant le tiroir (80) vers l'autre position, à savoir la seconde ou la première position (83 ; 82). 50 55

4. Moteur hydraulique selon l'une quelconque des re-

vendications précédentes,
 dans lequel, dans la première position (82) du tiroir
 (80), un raccordement entre les troisième et quatrième
 chambres (43 ; 44) est obturé et un raccorde- 5
 ment entre les première et deuxième chambres (41 ;
 42) est obturé.

5. Moteur hydraulique selon l'une quelconque des re-
 vendications précédentes,
 dans lequel, dans la seconde position (83) du tiroir 10
 (80), un raccordement entre les troisième et deuxième
 chambres (43 ; 42) est obturé.

6. Système d'entraînement hydraulique (10) compor- 15
 tant au moins un premier (11) et au moins un second
 (20) moteur et une pompe (30),

dans lequel l'au moins un premier moteur (11)
 est conçu, respectivement, selon l'une quelcon- 20
 que des revendications 1 à 5,
 dans lequel l'au moins un second moteur (20)
 comporte respectivement des premier (21) et
 second (22) orifices,
 dans lequel la pompe (30) comporte respective- 25
 ment des premier (31) et second (32) orifices,
 dans lequel le premier orifice (31) de la pompe
 (30) est raccordé de façon permanente au troi-
 sième orifice de travail (53) de l'au moins un
 premier moteur (11) et au second orifice (22) de 30
 l'au moins un second moteur (20) en parallèle,
 dans lequel le second orifice (32) de la pompe
 (30) est raccordé de façon permanente au pre-
 mier orifice de travail (51) de l'au moins un pre-
 mier moteur (11) en parallèle,
 dans lequel chaque deuxième orifice de travail 35
 (52) d'un premier moteur (11) est raccordé de
 façon permanente à un premier orifice (21) as-
 socié d'un second moteur (20) .

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Fig. 1

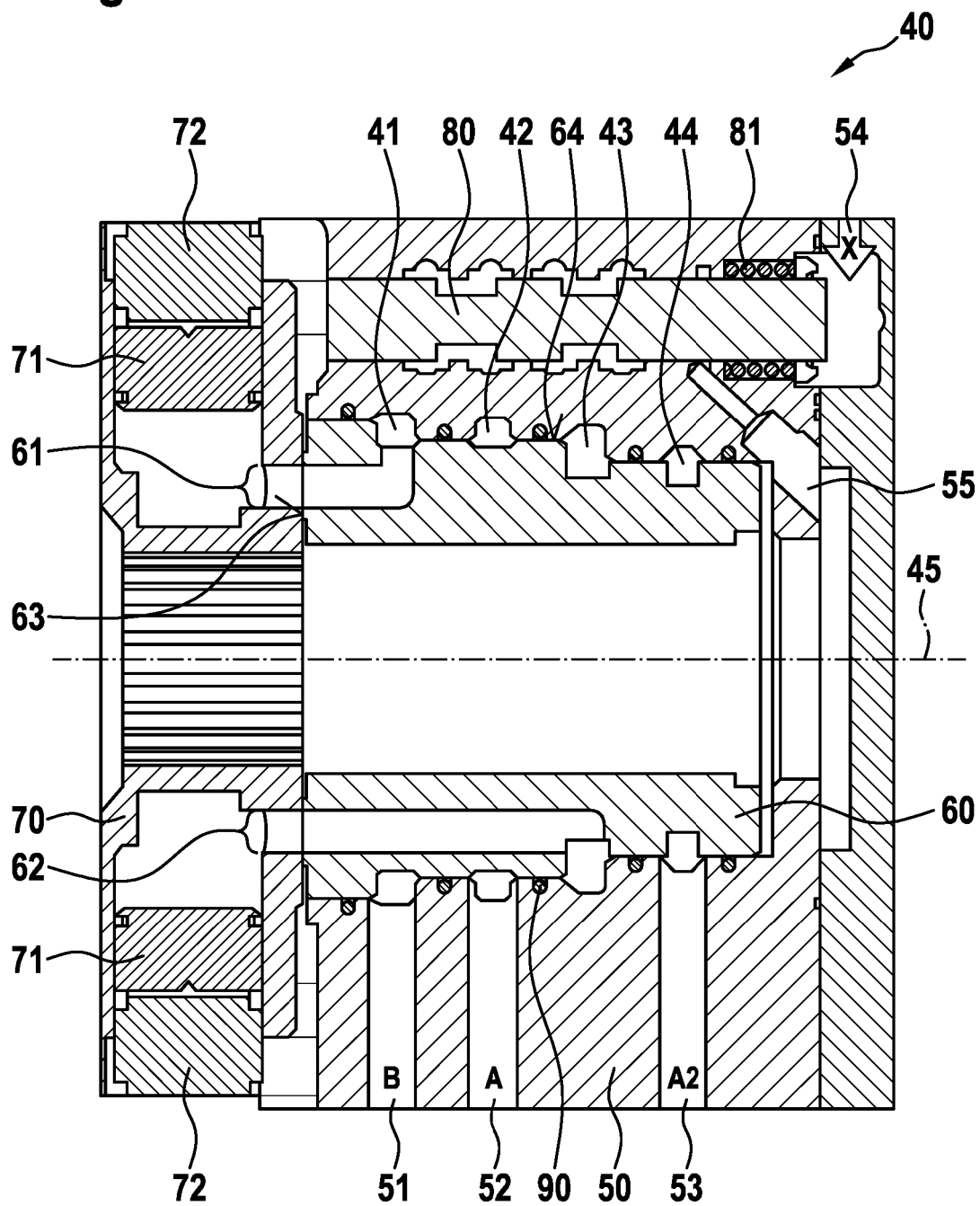


Fig. 2

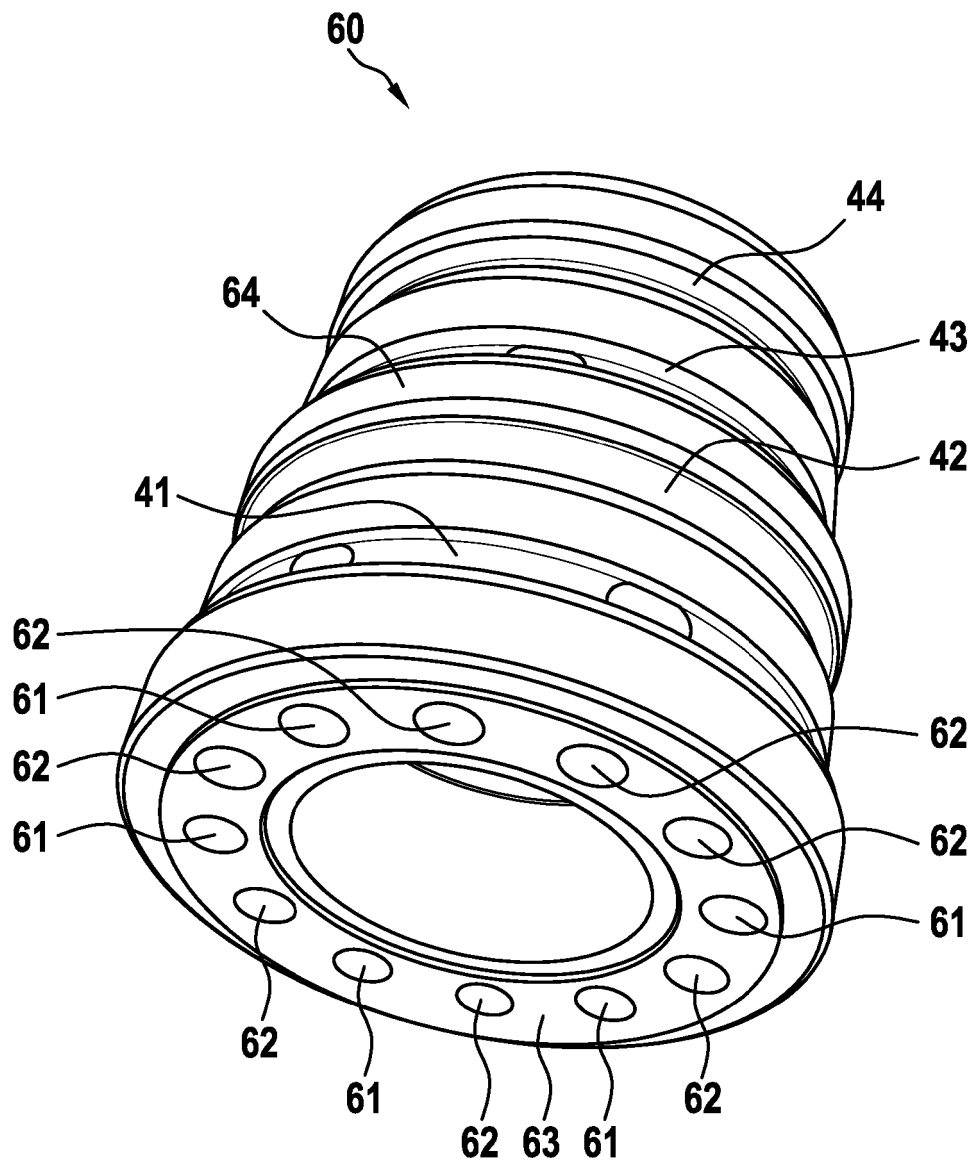
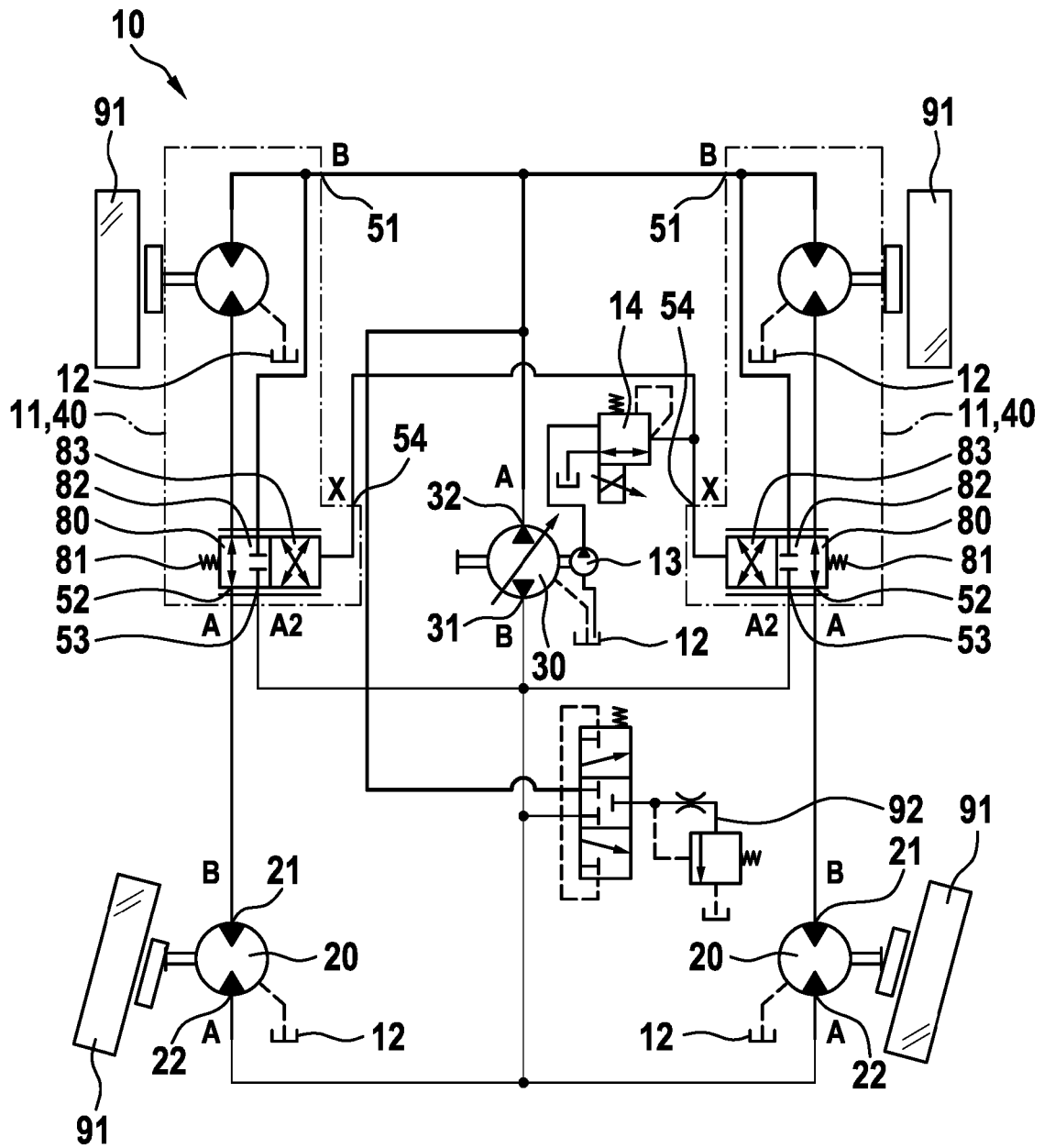


Fig. 3



REFERENCES CITED IN THE DESCRIPTION

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