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(54) **Hydraulic machine, in particular hydraulic pressure exchanger**

Hydraulikmaschine, insbesondere Hydraulikdruckaustauscher

Machine hydraulique, en particulier échangeur de pression hydraulique

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(56) References cited:
EP-A1- 1 508 361
WO-A1-00/71852
DE-A1- 3 614 257
DE-A1-102010 026 645

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Description

[0001] The invention relates to a pressure exchanger comprising a drum rotatable about a rotational axis, a motor connection for driving said drum, a first front plate arrangement at a first front face of said drum, a second front plate arrangement at a second face of said drum, said drum comprising a plurality of cylinders, said first front plate arrangement comprising a first front plate and a pressure shoe, said first front plate comprising at least a port.

[0002] Such a hydraulic machine in the form of a hydraulic pressure exchanger is known from EP 1 508 361 A1. A pressure exchanger of this kind can be used for example in a reverse osmosis system in which the liquid is pumped through a membrane under a rather high pressure. The liquid not passing the membrane is supplied to the high pressure supply port of the pressure exchanger. This high pressure is transferred to a fluid being supplied to the second front face of the drum. A piston in each cylinder is used to affect the pressure transfer. When a cylinder is in fluid connection with the high pressure supply port high pressure fluid enters this cylinder and shifts the piston to the other side, thereby transferring the high pressure to the liquid on the other side. The drum rotates. After a predeterment rotational angle this cylinder comes in contact to a low pressure supply port in which fresh liquid under a lower pressure fills the cylinder shifting the piston back again.

[0003] The path between the high pressure supply port (and all other ports as well) and the cylinder must be as tight as possible to avoid leakage. In the known case each cylinder is provided with a bushing at each end. This bushing is pressed axially outwardly to contact the pressure shoe with a force being high enough to establish the necessary tightness. This force is also used to press the pressure shoe at each front face axially outwardly so that the pressure shoes rests against the front plates at each front face of said drum.

[0004] The object underlying the invention is to have a simple construction of a hydraulic machine.

[0005] This object is solved by a hydraulic machine as mentioned above in that said pressure shoe is movable relative to the drum in a direction of said rotational axis and comprises at least a high pressure channel connected to said port and an outer pressure area loaded by a pressure in said port in a direction towards said drum, said outer pressure area being larger than an inner pressure area on a side of said pressure shoe facing said drum, whereby the force on the pressure shoe acting in a direction towards the drum is larger than the force acting in the opposite direction so that the pressure shoe is firmly pressed against the drum.

[0006] The term "drum" is used for the purpose of explanation only. It is not necessary that the "drum" is cylindrical body. The term "drum" just means a carrier of the cylinders mentioned above which is rotatable about the rotational axis. Furthermore, the cylinders can have a cross section which may be circular or may have any other form. Furthermore, the cylinders may be straight or curved in longitudinal direction. The pressure shoe is pressed against the front face of the drum by means of the pressure at the high pressure supply port. A pressure shoe is necessary only on one side. The other side of the drum rests against the second front plate arrangement. In this way equal pressures on both front faces of the drum can be realised.

[0007] This leads automatically to an equilibrium of forces over the drum (independent of pressure).

[0008] Preferably said pressure shoe is held unrotatable. In this way the first front face of the drum rests against the pressure shoe and friction is generated between this front face and the pressure shoe only. This reduces wear. Since the pressure shoe is not rotating, the number of bushings needed is dramatically reduced. Only one bushing is necessary for the high pressure port connecting said first front plate and said pressure shoe. A second bushing may be necessary between the first front plate and the pressure shoe in a region of another port. The pressure shoe can be moved in the direction of the rotational axis only, wherein such movement is very small.

[0009] Preferably said outer pressure area is arranged within said channel. No other areas are necessary. The liquid entering the channel acts automatically on the outer pressure area.

[0010] Preferably said channel comprises a section area decreasing in a direction towards said drum. The decreasing section area automatically provides the outer pressure area on which the pressure acts at the high pressure supply port.

[0011] In a preferred embodiment said high pressure channel comprises a circle-shaped inlet on a side facing said first front plate and a kidney-shaped outlet on a side facing said drum. The circle-shaped inlet comprises an area which is larger than the kidney-shaped outlet. The difference between the area of the circle-shaped inlet and the kidney-shaped outlet is the area on which the pressure at the high pressure supply port acts in a direction towards the drum.

[0012] Preferably a sleeve is inserted in said high pressure channel in said pressure shoe and in said port in said first front plate. This sleeve makes a fluid tight path between the first front plate and the pressure shoe. When a circle-shaped inlet is used it is rather simple to use a cylindrical sleeve.

[0013] In a preferred embodiment said sleeve is fixed in said pressure shoe and movable and sealed in said first front plate. The movement is restricted to the axial direction and allows to establish sufficient pressure contact between the pressure shoe and the front face of the drum.

[0014] Preferably said first front plate comprises two ports the centres of which are arranged on a first straight line and said second front plate arrangement comprises a second front plate with two ports the centres of which

are arranged on a second straight line, said first straight line and said second straight line being angularly offset to each other. In this way it is possible to have connecting lines on one side extending in a first direction and connection lines at the other side extending in a second direction which is angularly offset to the first direction. This gives a greater freedom in the arrangement of connecting lines.

[0015] Preferably one of said front plates comprises a connecting geometry having at least a first mounting surface in which one of the ports is arranged, said first mounting surface being arranged under a predetermined angle relative to the rotational axis of said drum, said angle being in the range of 10° to 80°, in particular in the range of 30° to 60°, and preferably in the range of 40° of 50°. When the mounting surface is arranged under an angle relative to the rotational axis and relative to a plane which is perpendicular to the rotational axis there is a larger area available for connecting a line to the mounting surface.

[0016] In a preferred embodiment said pressure shoe rests against said drum in a contact area, two different materials contacting each other in said contact area, one material being steel and the other material being a plastic material sliding with slow friction on steel, in particular a high-resistant thermoplastic plastic material on the basis of polyaryl etherketones, particularly polyetheretherketones (PEEK), polyamides, polyacetals, polyarylethers, polyethylene terephthalates, polyphenylene sulfides, polysulphones, polyether sulphones, polyether imides, polyamide imides, polyacrylates, phenol resins, like novolacquer resins or the like, preferably provided with a filling of glass, graphite, polytetraflourethylene or carbon, the fillings being particularly useful as fibres. In this case, the hydraulic machine and advantages be used as a water hydraulic device.

[0017] A preferred example of the invention will now be described in more detail with reference to the drawing, wherein

Fig. 1 is a schematic longitudinal section of a hydraulic machine,

Fig. 2 is an enlarged detail II of Fig. 1,

Fig. 3 is a perspective view of the hydraulic machine,

Fig. 4 is a view of a pressure shoe seen from the inside,

Fig. 5 is a section V-V according to Fig. 6,

Fig. 6 is a view of a pressure shoe seen from the outside and

Fig. 7 is a perspective view of the pressure shoe.

[0018] Fig. 1 shows a hydraulic machine 1 in form of a hydraulic pressure exchanger in a schematically longitudinal section. However, hydraulic machine can also be, for example, a pump, a motor, an energy converter, an amplifier etc.

[0019] The hydraulic machine 1 comprises a drum 2 rotatable about an axis 3. The term "drum" is used to facilitate the explanation. It is not necessary that this drum 2 is of cylindrical form. The main purpose of the drum 2 is to form a basis for cylinders 4. The cylinders 4 can be considered as channels. It is not necessary that they are of circular cross section.

[0020] A first front plate arrangement 5 is arranged at a first front face of the drum 2. A second front plate arrangement 6 is arranged at a second front face of the drum 2 which is opposite of the first front face of the drum 2. The first front plate arrangement 5 comprises a first front plate 7 and a pressure shoe 8. Further more, sealing means 9 are provided at the first front plate arrangement 5.

[0021] The first front plate 7 comprises a first port 10 and a second port 11. The first port 10 may be a high pressure supply port and the second port 11 may be a low pressure return port. However, other pressures and other flow directions may be possible.

[0022] The first front plate 7 is connected to a housing 12. The housing 12 is connected to a second front plate 13 which is arranged on the opposite side of the housing 12 relative to the first front plate 7. The second front plate 13 is part of the second front plate arrangement 6.

[0023] Means for rotatably supporting and driving the drum 2 are not shown in order to keep the illustration simple. However, the drum 2 can be rotatable supported within the housing 12. A driving shaft can be passed through the second front plate 13 and be connected to a motor (not shown).

[0024] The pressure shoe 8 is supported unrotatably in the housing 12 so that it remains stationary in rotating direction relative to the first front plate 7. A bushing or sleeve 14 is inserted into an inlet 15 (Fig. 2) of the pressure shoe 8. This inlet 15 has the form of a circle, so that the sleeve 14 can be made as a hollow cylinder. The sleeve 14 is inserted as well in the first port 10. Here, the sealing means 19 are used to form a fluid tight connection between the first port 10 and the inlet 15 of the pressure shoe 8.

[0025] As can been seen in Fig. 4 the pressure shoe 8 shows at the side opposite to the inlet 15 an outlet 16 having the form of a kidney. The side of the pressure shoe 8 in which the kidney-shaped outlet 16 is arranged faces the drum 2. The kidney-shaped outlet 16 is arranged on the same radius as the cylinders 4. Therefore, the openings of the cylinders 4 come in overlapping relation with the kidney-shaped outlet 16 during a rotation of the drum. As can be seen in Fig. 4-6, the pressure shoe 8 comprises a high pressure channel 17 between the first port 10 and the drum 2.

[0026] A pressure area 18, which is termed "outer pressure area", is arranged in this channel 17. The outer pres-

sure area is larger than an inner pressure area 19 on a side of said pressure shoe 8 facing said drum 2.

[0027] Due to this construction the force on the pressure shoe 8 acting in a direction towards the drum 2 is larger than the force acting in the opposite direction so that the pressure shoe 8 is firmly pressed against the drum 2. The effect is that a pressure tight connection is formed between the high pressure channel 17 and the cylinders 4 overlapping the kidney-shaped outlet 16. The force acting in direction towards the drum 2 is a product of the pressure in the first port 10 and the outer pressure area 18. The force acting in the opposite direction is the product of the same pressure and the slightly smaller inner pressure area 19.

[0028] Due to this construction only one pressure shoe on the first front face of the drum 2 is necessary. The force pressing the pressure shoe 8 against the drum 2 also presses the drum 2 against the second front plate 13 so that a liquid tight seal is formed between the drum 2 and the second front plate 13 as well.

[0029] In this way an equilibrium of forces is formed over the drum 2 (independent of pressure). By adjusting the sizes of the outer pressure area 18 and the inner pressure area 19 the forces acting between the pressure shoe 8 and the drum 2 or the drum 2 and the second front plate 13 can be adjusted very accurately.

[0030] Due to the sleeve 14, the pressure shoe 8 can be moved in axial direction, i.e. parallel to the axis 3. Such a movement is necessary only to press the pressure shoe 8 against the drum 2. Therefore, such a movement can be kept very small.

[0031] As can been seen in Fig. 3, the first front plate 7 comprises two ports (only the second port 11 is visible). These ports are arranged on a first straight line.

[0032] The second front plate 13 comprises two ports as well, i.e. a first port 20 and a second port (not visible). The last two ports are arranged on a straight line as well. As can be seen in Fig. 3, these two straight lines are angularly offset to each other. In the embodiment shown in Fig. 3, the first straight line is arranged vertically and the second straight line is arranged on the angle of 45° relative to the vertical direction.

[0033] As can be seen in Figs. 1 and 3, the first front plate 7 comprises a connecting geometry having at least a mounting surface 21, 22. The mounting surfaces 21, 22 are arranged under a predetermined angle relative to the rotational axis 3 of the drum 2. In the present case, this angle is approximately 45°. However, it can be in the range of 10° to 80°, and particular in the range of 30° to 60°and preferably in the range of 40° to 50°.

[0034] When the hydraulic machine 1 is used as a water hydraulic machine, the pressure shoe 8 and the drum 2 rest against each other in a contact area. In this contact area at least the surfaces of the drum 2 and the pressure shoe 8, respectively, have different materials, one material is steel and the other material is a plastic material, said plastic material having a low friction coefficient on steel. This plastic material is in particular a high-resistant thermoplastic plastic material on the basis of polyaryl etherketones, particularly polyetheretherketones (PEEK), polyamides, polyacetals, polyarylethers, polyethylene terephthalates, polyphenylene sulfides, polysulphones, polyether sulphones, polyether imides, polyamide imides, polyacrylates, phenol resins, like novolacquer resins or the like, preferably provided with a filling of glass, graphite, polytetraflourethylene or carbon, the fillings being particularly useful as fibres. Such a combination of materials guarantee a long lifetime duration even in the case water is used as hydraulic fluid instead of an lubricating oil.

Claims

1. A pressure exchanger (1) comprising a drum (2) rotatable around a rotational axis (3), a motor connection for driving said drum (2), a first front plate arrangement (5) at a first front face of said drum (2), a second front plate arrangement (6) at a second front face of said drum (2), said drum (2) comprising a plurality of cylinders (4), said first front plate arrangement (5) comprising a first front plate (7) and a pressure shoe (8), said first front plate (7) comprising at least a port (10), **characterized in that** said pressure shoe (8) is movable relative to the drum (2) in a direction of said rotational axis (3) and comprises at least a high pressure channel (17) connected to said port (10) and an outer pressure area (18) loaded by a pressure in said port (10) in a direction towards said drum (2), said outer pressure area (18) being larger than an inner pressure area (19) on a side of said pressure shoe (8) facing said drum (2), whereby the force on the pressure shoe (8) acting in a direction towards the drum (2) is larger than the force acting in the opposite direction so that the pressure shoe (8) is firmly pressed against the drum (2).

2. The pressure exchanger according to claim 1, **characterized in that** said pressure shoe (8) is held unrotatable.

3. The pressure exchanger according to claim 1 or 2, **characterized in that** said outer pressure area (18) is arranged within said channel (17).

4. The pressure exchanger according to claim 3, **characterized in that** said channel (17) comprises a section area decreasing in a direction towards said drum (2).

5. The pressure exchanger according to claim 4, **characterized in that** said high pressure channel (17) comprises a circle-shaped inlet (15) on a side facing said first front plate (7) and a kidney-shaped outlet (16) on a side facing said drum (2).

6. The pressure exchanger according to any of claims 1 to 5, **characterized in that** a sleeve (14) is inserted in said high pressure channel (17) in said pressure shoe (8) and in said high pressure supply port (10) in said first front plate (7).

7. The pressure exchanger according to claim 6, **characterized in that** said sleeve (14) is fixed in said pressure shoe (8) and movable and sealed in said first front plate (7).

8. The pressure exchanger according to any of claims 1 to 7, **characterized in that** said first front plate (7) comprises two ports (10, 11) the centers of which are arranged on a first straight line and said second front plate arrangement (6) comprises a second front plate with two ports (20) the centers of which are arranged on a second straight line, said first straight line and said second straight line being angularly offset to each other.

9. The pressure exchanger according to claim 8, **characterized in that** at least one of said front plates (7, 13) comprises a connecting geometry having at least a first mounting surface (21, 22) in which one of the ports (10, 11) is arranged, said first mounting surface (21, 22) being arranged under a predetermined angle relative to the rotational axis (3) of said drum (2), said angle being in the range of 10° to 80°, in particular in the range of 30° to 60° and preferably in the range of 40° to 50°.

10. The pressure exchanger according to any of claims 1 to 9, **characterized in that** said pressure shoe (8) rests against said drum (2) in a contact area, two different materials contacting each other in said contact area, one material being steel and the other material being a plastic material sliding with slow friction on steel, in particular a high-resistant thermoplastic plastic material on the basis of polyaryl etherketones, particularly polyetheretherketones (PEEK), polyamides, polyacetals, polyarylethers, polyethylene terephthalates, polyphenylene sulfides, polysulphones, polyether sulphones, polyether imides, polyamide imides, polyacrylates, phenol resins, like novolacquer resins or the like, preferably provided with a filling of glass, graphite, polytetraflourethylene or carbon, the fillings being particularly useful as fibres.

Patentansprüche

1. Druckaustauscher (1), umfassend eine Trommel (2), die um eine Drehachse (3) drehbar ist, eine Motorverbindung zum Antreiben der Trommel (2), eine erste vordere Plattenanordnung (5) an einer ersten vorderen Fläche der Trommel (2), eine zweite vordere Plattenanordnung (6) an einer zweiten vorderen Fläche der Trommel (2), wobei die Trommel (2) mehrere Zylinder (4) umfasst, wobei die erste vordere Plattenanordnung (5) eine erste vordere Platte (7) und einen Druckschuh (8) umfasst, wobei die vordere Platte (7) mindestens eine Anschlussöffnung (10) umfasst, **dadurch gekennzeichnet, dass** der Druckschuh (8) in Bezug auf die Trommel (2) in einer Richtung der Drehachse (3) beweglich ist und mindestens einen Hochdruckkanal (17) umfasst, der mit der Anschlussöffnung (10) und einem äußeren Druckbereich (18), der durch einen Druck in der Anschlussöffnung (10) in einer Richtung zur Trommel (2) hin geladen wird, verbunden ist, wobei der Druckbereich (18) größer als ein innerer Druckbereich (19) auf einer Seite des Druckschuhs (8) ist, der zur Trommel (2) weist, wodurch die Kraft auf den Druckschuh (8), die in einer Richtung zur Trommel (2) hin wirkt, größer ist als die Kraft, die in Gegenrichtung wirkt, sodass der Druckschuh (8) fest gegen die Trommel (2) gedrückt wird.

2. Druckaustauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** der Druckschuh (8) nicht drehbar gehalten wird.

3. Druckaustauscher nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der äußere Druckbereich (18) innerhalb des Kanals (17) angeordnet ist.

4. Druckaustauscher nach Anspruch 3, **dadurch gekennzeichnet, dass** der Kanal (17) einen Schnittbereich umfasst, der in einer Richtung zur Trommel (2) hin abnimmt.

5. Druckaustauscher nach Anspruch 4, **dadurch gekennzeichnet, dass** der Hochdruckkanal (17) einen kreisförmigen Einlass (15) auf einer Seite umfasst, die zur ersten vorderen Platte (7) weist, und einen nierenförmigen Auslass (16) auf einer Seite, die zur Trommel (2) weist.

6. Druckaustauscher nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** eine Hülse (14) in den hohen Druckkanal (17) in den Druckschuh (8) und in die Hochdruck-Versorgungsanschlussöffnung (10) in der ersten vorderen Platte (7) eingeführt wird.

7. Druckaustauscher nach Anspruch 6, **dadurch gekennzeichnet, dass** die Hülse (14) in dem Druckschuh (8) befestigt ist und in der ersten vorderen Platte (7) beweglich und abgedichtet ist.

8. Druckaustauscher nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** die erste vordere Platte (7) zwei Anschlussöffnungen (10, 11) aufweist, deren Mitten auf einer ersten geraden Linie

angeordnet sind, wobei die zweite vordere Plattenanordnung (6) eine zweite vordere Platte mit zwei Anschlussöffnungen (20) umfasst, deren Mitten auf einer zweiten geraden Linie angeordnet sind, wobei die erste gerade Linie und die zweite gerade Linie in einem Winkel voneinander versetzt sind.

9. Druckaustauscher nach Anspruch 8, **dadurch gekennzeichnet, dass** mindestens eine der vorderen Platten (7, 13) eine Verbindungsgeometrie umfasst, die mindestens eine erste Montagefläche (21, 22) aufweist, in der eine der Anschlussöffnungen (10, 11) angeordnet ist, wobei die erste Montagefläche (21, 22) in einem vorbestimmten Winkel in Bezug auf die Drehachse (3) der Trommel (2) angeordnet ist, wobei der Winkel in dem Bereich von 10° bis 80° liegt, insbesondere im Bereich von 30° bis 60° und bevorzugt im Bereich von 40° bis 50°.

10. Druckaustauscher nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** der Druckschuh (8) an der Trommel (2) in einem Kontaktbereich anliegt, wobei zwei unterschiedliche Materialien in dem Kontaktbereich miteinander in Kontakt treten, wobei ein Material Stahl und das andere Material ein Kunststoffmaterial ist, das mit geringer Reibung auf Stahl gleitet, insbesondere ein hochbeständiges thermoplastisches Kunststoffmaterial auf Basis von Polyaryletherketonen, insbesondere Polyetheretherketonen (PEEK), Polyamiden, Polyacetalen, Polyarylether, Polyethylenterephthalaten, Polyphenylensulfiden, Polysulfonen, Polyethersulfonen, Polyetherimiden, Polyamidimiden, Polyacrylaten, Phenolharzen, wie Novolackharzen oder dergleichen, die vorzugsweise mit einer Füllung aus Glas, Graphit, Polytetraflourethylen oder Kohlenstoff bereitgestellt sind, wobei die Füllungen insbesondere als Fasern nützlich sind.

Revendications

1. Echangeur de pression (1) comprenant un tambour (2) rotatif autour d'un axe de rotation (3), une connexion de moteur pour entraîner ledit tambour (2), un premier agencement de plaque avant (5) situé à une première face avant dudit tambour (2), un second agencement de plaque avant (6) situé à une seconde face avant dudit tambour (2), ledit tambour (2) comprenant une pluralité de cylindres (4), ledit premier agencement de plaque avant (5) comprenant une première plaque avant (7) et un sabot de pressage (8), ladite première plaque avant (7) comportant au moins un port (10), **caractérisé en ce que** ledit sabot de pressage (8) est mobile par rapport au tambour (2) dans une direction dudit axe de rotation (3) et comprend au moins un canal à haute pression (17) connecté audit port (10) et une région de pression extérieure (18) chargée par une pression dans ledit port (10) dans une direction vers ledit tambour (2), ladite région de pression extérieure (18) étant plus grande qu'une région de pression intérieure (19) sur un côté dudit sabot de pressage (8) qui fait face audit tambour (2), moyennant quoi la force exercée sur le sabot de pressage (8) qui agit dans une direction vers le tambour (2) est plus importante que la force qui agit dans la direction opposée, de telle sorte que le sabot de pressage (8) soit pressé fermement contre le tambour (2).

2. Échangeur de pression selon la revendication 1, **caractérisé en ce que** ledit sabot de pressage (8) est maintenu non-rotatif.

3. Échangeur de pression selon la revendication 1 ou 2, **caractérisé en ce que** ladite région de pression extérieure (18) est agencée à l'intérieur dudit canal (17).

4. Échangeur de pression selon la revendication 3, **caractérisé en ce que** ledit canal (17) comprend une surface de section qui diminue dans une direction vers ledit tambour (2).

5. Échangeur de pression selon la revendication 4, **caractérisé en ce que** ledit canal à haute pression (17) comprend une entrée en forme de cercle (15) sur un côté qui fait face à ladite première plaque avant (7) et une sortie en forme de rein (16) sur un côté qui fait face audit tambour (2).

6. Échangeur de pression selon l'une quelconque des revendications 1 à 5, **caractérisé en ce qu'**un manchon (14) est inséré dans ledit canal à haute pression (17) dans ledit sabot de pressage (8) et dans ledit port d'alimentation de haute pression (10) dans ladite première plaque avant (7).

7. Échangeur de pression selon la revendication 6, **caractérisé en ce que** ledit manchon (14) est fixé dans ledit sabot de pressage (8) et mobile et scellé dans ladite première plaque avant (7).

8. Échangeur de pression selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** ladite première plaque avant (7) comporte deux ports (10, 11) dont les centres sont agencés sur une première ligne droite et ledit second agencement de plaque avant (6) comprend une second plaque avant comportant deux ports (20) dont les centres sont agencés sur une seconde ligne droite, ladite première ligne droite et ladite seconde ligne droite étant décalées de façon angulaire l'une par rapport à l'autre.

9. Échangeur de pression selon la revendication 8, **caractérisé en ce qu'**au moins une desdites plaques

avant (7, 13) comprend une géométrie de connexion qui présente au moins un première surface de montage (21, 22) dans laquelle un des ports (10, 11) est agencé, ladite première surface de montage (21, 22) étant agencée sous un angle prédéterminé angle par rapport à l'axe de rotation (3) dudit tambour (2), ledit angle étant compris dans la gamme de 10° à 80°, en particulier dans la gamme de 30° à 60°, et de préférence dans la gamme de 40° à 50°.

10. Échangeur de pression selon l'une quelconque des revendications 1 à 9, **caractérisé en ce que** ledit sabot de pressage (8) repose contre ledit tambour (2) dans une région de contact, deux matériaux différents étant en contact l'un avec l'autre dans ladite région de contact, un premier matériau étant l'acier et l'autre matériau étant un matériau plastique qui glisse avec un lent frottement sur l'acier, en particulier un matériau plastique thermoplastique à haute résistance basé sur des polyaryle éthercétones, en particulier des polyétheréthercétones (PEEK), des polyamides, des polyacétals, des polyaryléthers, des polyéthylène téréphtalates, des sulfures de polyphénylène, des polysulfones, des polyéther sulfones, des polyéther imides, des polyamide imides, des polyacrylates, des résines phénoliques, telles que des résines novolaques ou analogues, de préférence présentant une charge de verre, de graphite, de polytétrafluoroéthylène ou de carbone, les charges étant particulièrement utiles sous la forme de fibres.

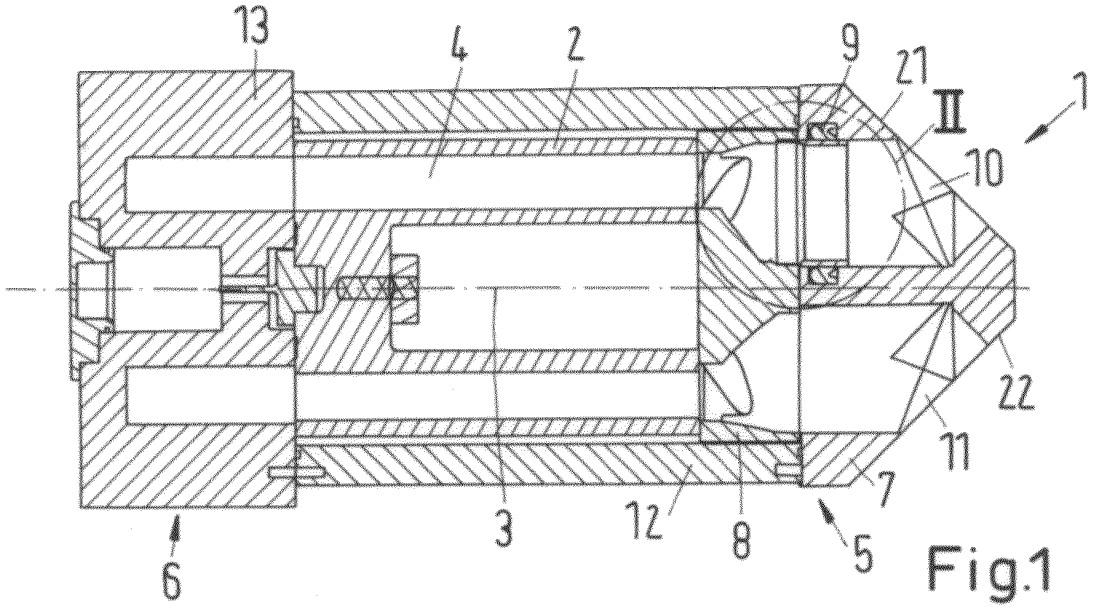

Fig.1

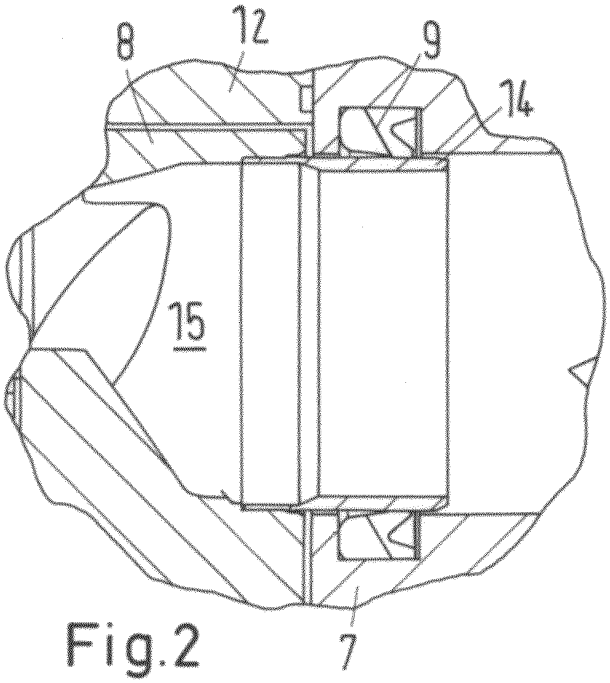

Fig.2

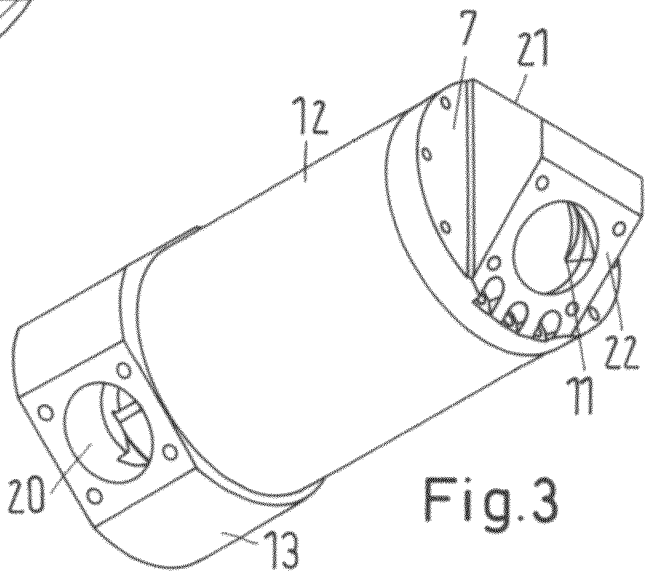

Fig.3

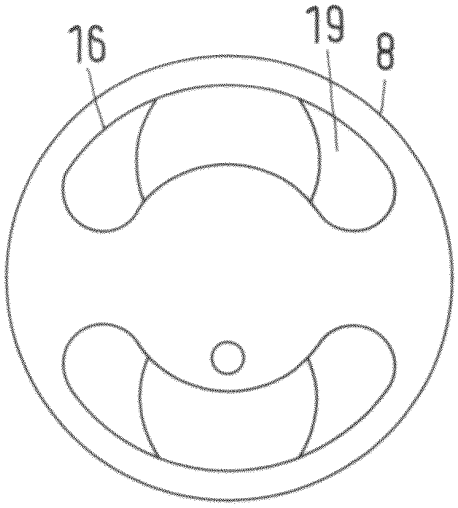

Fig.4

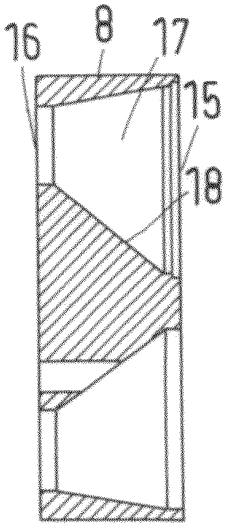

Fig.5

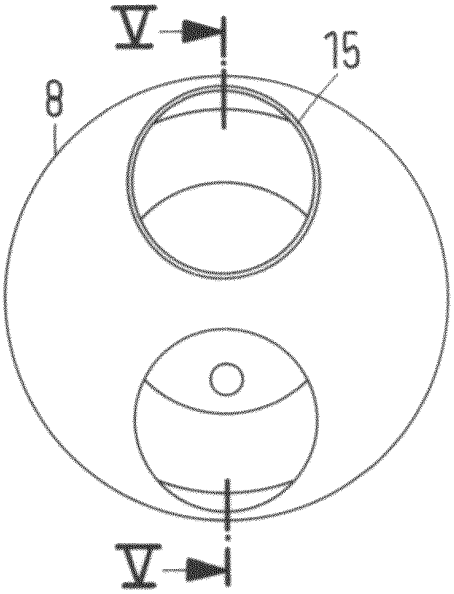

Fig.6

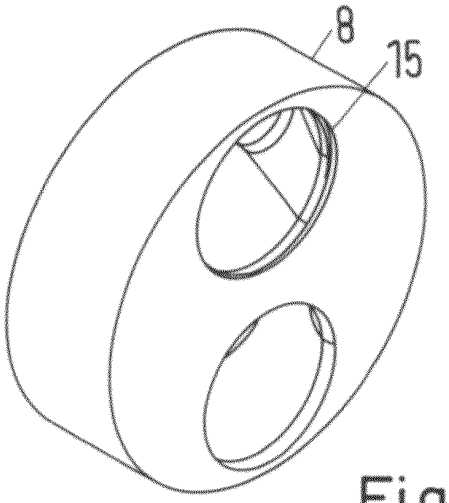

Fig.7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1508361 A1 **[0002]**