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(54) **FLUID-COLUMN HYDRAULIC MOTOR WITH IMPROVED MEANS FOR RETAINING THE
PROPULSION MEMBERS AGAINST ASSOCIATED SLIDING SURFACES**

FLUID-SÄULEN-HYDRAULIKMOTOR MIT VERBESSERTEN MITTELN ZUM HALTEN DES
ANTRIEBS GEGEN ZUGEHÖRIGE GLEITFLÄCHEN

MOTEUR À COLONNE DE FLUIDE HYDRAULIQUE DOTÉ DE MOYENS AMÉLIORÉS
PERMETTANT DE RETENIR LES ÉLÉMENTS DE PROPULSION CONTRE DES SURFACES DE
GLISSEMENT ASSOCIÉES

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(56) References cited:
**EP-A2- 0 851 119 DE-A1- 3 726 957
US-A- 3 040 716 US-A- 3 577 830
US-A- 3 945 766 US-A- 4 144 799
US-A- 4 310 290 US-A- 4 683 806**

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Description

[0001] The present invention relates to a fluid-column hydraulic motor provided with improved means for sealingly retaining the propulsion members against associated sliding surfaces.

[0002] It is known in the technical sector relating to the construction of motors with propulsion members moved by means of a fluid supply and therefore referred to as being of the fluid column type that there exists the possibility of realizing said propulsion members with a cylinder and a piston which are telescopically coupled together so as to be displaced relative to each other, being extended or shortened upon rotation of an eccentric cam associated with the drive shaft, thus transmitting a thrust to the said shaft by means of the fluid supplied/discharged inside them.

[0003] Said propulsion members may be arranged radially, axially or inclined.

[0004] For the purposes of the present patent below hydraulic motors will also be understood as referring to the said fluid column motors.

[0005] It is also known that, in the case of hydraulic motors with radial propulsion members, one of the problems of the latter consists in the need to keep the end edge of the cylinder and the piston sealingly in contact against respectively the said eccentric cam and a reaction element formed by a cover fixed to the casing of the motor, so as not to cause seepage of fluid during the relative stroke of piston and cylinder.

[0006] In greater detail and with regard to retention of the element - normally the internal piston - which must remain in contact with a spherical surface of the motor cover, the prior art envisages complicated constraining means formed with a large number of parts which require separate machining, preassembly for installation and complicated operations carried out by skilled personnel for final assembly of the motor.

[0007] An example of this prior art is for example described and illustrated in EP 0,851,119.

[0008] DE 37 26 957 A1 describes a motor according to the preamble of Claim 1.

[0009] A further example of a motor according to the prior art is illustrated in US 4,683,806 A.

[0010] The technical problem which is posed therefore is that of providing a fluid-column hydraulic motor, in particular, but not necessarily of the radial type, which has simplified means for retaining the external cylinder of the propulsion members against respective surfaces with which they must make contact in a sealingly stable manner.

[0011] In connection with this problem it is also required that such a hydraulic motor should have small dimensions, be able to be produced and assembled in an easy and low-cost manner and be able to be installed at any user site, including those not specialized for this purpose, thus also allowing simplified ordinary maintenance operations to be performed.

[0012] These results are obtained according to the present invention by a fluid-column hydraulic motor according to the characteristic features of Claim 1.

[0013] Further details may be obtained from the following description of a non-limiting example of embodiment of the subject of the present invention, provided with reference to the accompanying drawings, in which:

Figure 1: shows a schematic partially cross-sectioned view of a detail of a radial-motor propulsion member according to the prior art;

Figure 2: shows a schematic partially cross-sectioned perspective view of a radial motor according to the present invention; and

Figure 3: shows an enlarged partially cross-sectioned view of a detail of the motor propulsion member according to Fig. 2.

[0014] As shown and assuming solely for the sake of convenience of the description and without a limiting meaning a longitudinal direction X-X corresponding to the axis of the drive shaft 2 and transverse/radial direction Y-Y corresponding to the axis of the propulsion member 10, the hydraulic motor in the version with radial propulsion members according to the prior art comprises a casing 1 having, housed inside it, the shaft 2 mounted on bearings and provided with the eccentric cam 3 against which the propulsion members 10 act radially.

[0015] Each propulsion member 10 is contained inside the casing 1 closed by respective covers 4 which are fastened to the casing by respective fixing means which are preferably inserted in the radial direction.

[0016] Said propulsion members 10 are in turn formed by a cylinder 11, one of the two radial end edges of which bears against the outer surface 3a of the said eccentric cam 3, and by a piston 12 telescopically slidable in a radial direction inside the cylinder 11 and having one of its two radial end edges in bearing contact against a respective sliding surface 4b of the cover 4.

[0017] In order to allow the to-and-fro movement while maintaining sealed bearing contact of the piston 12 during the extension/shortening due to rotation of the eccentric cam 3, the sliding surface 4b of the cover 4 has a convex spherical shape and correspondingly the contact surface 12b of the piston 12 is shaped as a corresponding concave spherical surface.

[0018] According to the prior art (Figs. 1 and 2) said retaining means have substantially three elements both in the contact zone between the cylinder 11 and the eccentric cam 3 and in the contact zone between the piston 12 and the cover 4.

[0019] In the contact zone between each cylinder 11 and the eccentric cam 3 said locking elements consist of: a respective shoe 13 provided with a coaxial hole 13a having a diameter slightly greater than the external diameter of the cylinder 11 so as to allow the passage thereof.

[0020] Said shoe 13 also has at least one pair of op-

posite and parallel edges having a substantially L-shaped cross-section and extending in the manner of a cylindrical profile coaxial with the axis of the eccentric cam 3. The short arm 13d of each L has an upper surface 13f designed to form an engaging element for a single ring 15 having its centre on an axis parallel to that of the drive shaft 2 and passing through the centre of the spherical cam and arranged around each edge 13c of all the shoes 13 for retaining each cylinder 11. In this way the opposite rings 15 radially retain all the shoes 13 which, in turn, keep the associated cylinder 11 in bearing contact against the eccentric cam 3 during rotation thereof. In order to keep the shoe 13 and the base 11a of the cylinder 11 in contact with each other, the same have, arranged between them, a resilient element, in the example a wave spring 16, which is designed to impart a radial force for ensuring relative contact between the sliding surfaces which is constant and independent of the working phases of the propulsion member.

[0021] In the zone of contact between the piston 12 and the cover 4 the retaining elements are in turn formed by a ring 17 which has its centre on the radial/transverse axis Y-Y and is constrained to the cover 4 of the motor and which has a concave spherical surface 17a which is concentric with the concave spherical surface 12b and is designed to push against a corresponding convex spherical surface 18a of shoe 18 in turn acting in the radial direction on an annular edge 12a of the piston 12.

[0022] In this case also a wave spring 16 is arranged between shoe 18 and annular edge 12a so as to ensure constant contact between the sliding surfaces during the various working phases of the propulsion member 10.

[0023] As shown in Fig. 3, in the motor according to the present invention the end 12a of the piston 12 making contact with the sliding surface 4b of the cover 4 is in contact with an internal spring 13 arranged between piston 12 and cylinder 11 and able to exert the dual thrusting action between cylinder and eccentric cam and between piston and crown of the cover.

[0024] The same end 12 also has a radially inner surface 12d opposite to the surface 12b making contact with the sliding surface on the cover 4, which inner surface 12d has a convex spherical shape parallel to that of the sliding surface 4b of the cover 4. Correspondingly the casing 1 of the motor has an annular projection 1a axially directed towards the inside of the motor and provided with a concave, spherical shaped, upper surface 1d parallel to the said convex, radially inner, spherical surface 12d of the end of the piston 12.

[0025] When the cover 4 is closed onto the casing 1 using conventional screw means 41, the spring 13 pushes the top end 12a of the piston 12 against the cover 4, bringing the respective surfaces 12b and 4b into contact with each other, while keeping at the same time the radially inner surface 12d spaced from the corresponding surface 1d of the projection 1a, thus determining the triple effect of: a stable sealed contact of the piston of the propulsion member against the corresponding sliding sur-

face of the cover, a free floating movement of the cylinder inside the motor casing, and also mechanical retention of the piston which, in the event of malfunction, is prevented, by the projection 1a, from coming out of its correct working position, thus avoiding possible serious damage to the motor which would otherwise occur if the piston were left free to come of its position.

[0026] In addition, the correspondence between the spherical contact surfaces favours sliding of the piston on the projection without any jamming and/or damage.

[0027] The sealed contact of the cylinder against the eccentric cam may be obtained in accordance with the prior art.

[0028] It is therefore clear how the motor according to the invention results in a significant reduction in the parts required for its operation and also a substantial simplification of the machining operations which must be carried out on the single parts and the assembly operations; the formation of the convex and concave spherical surfaces on the respective covers and projections of the casing, piston and cover may in fact be easily realized during production of the two components and does not require additional machining and/or handling during assembly of the motor.

[0029] Taking into account that a hydraulic motor on average has a ring of five propulsion members, but also in some cases two rings of five propulsion members in pairs, it has been estimated that, owing to the particular constructional design of the retaining element as one piece and the corresponding particular form of the motor casing with an annular contact projection, a reduction of between 20% and 35% in the time required for preparation of the motor may be achieved.

[0030] Although described in connection with an embodiment of the radial type it is understood that the solution according to the present invention may also be applied to motors of the axial type and/or with inclined propulsion members.

[0031] The scope of the present invention also includes the equivalent configuration of the propulsion member inverted with an inner cylinder and outer piston.

[0032] Although described in connection with a number of embodiments and a number of preferred examples of embodiment of the invention, it is understood that the scope of protection of the present patent is determined solely by the claims below.

Claims

1. Fluid-column hydraulic motor comprising a casing (1), a drive shaft (2) provided with an eccentric cam (3), a plurality of propulsion members (10) acting on said eccentric cam and each comprising a cylinder (11) and a piston (12) which are coaxial with each other and telescopically movable relative to each other so as to be extended or shortened, said propulsion members (10) being contained in respective

seats of the casing (1) closed by a cover (4), the fluid-column hydraulic motor further comprising means for sealingly retaining the ends of the cylinders (11) against the eccentric cam (3) and the ends of the pistons (12) against respective sliding-contact surfaces (4b) of the cover (4), wherein the surface (4b) of the cover (4) making sliding contact with the piston (12) has a convex spherical shape, the means for retaining the free end (12a) of the piston (12) against this sliding-contact surface (4b) have a radially outer surface (12b) in contact with the sliding-contact surface (4b) of the cover (4) which is shaped in the form of a concave spherical surface (12b) parallel to the convex spherical surface of the sliding-contact surface (4b) of the cover (4) and a radially inner surface (12d) opposite to the radially outer surface (12b), which inner surface (12d) has a convex spherical shape parallel to that of the sliding-contact surface (4b) of the cover (4) and

characterized in that the casing (1) of the motor has an annular projection (1a) axially directed towards the inside of the motor and provided with a concave, spherical shaped, upper surface (1d) parallel to the said convex, radially inner, spherical surface (12d) of the corresponding end of the piston (12), and **in that** during working conditions a gap is maintained between the said convex, radially inner, spherical surface (12d) of the corresponding end of the piston (12) and the parallel, concave, spherical shaped, upper surface (1a) of the projection (1a).

2. Fluid-column hydraulic motor according to Claim 1, **characterized in that** the end (12a) of the piston (12) making contact with the sliding surface (4b) of the cover (4) is in contact with an internal spring (13) arranged between piston (12) and cylinder (11) and able to exert the dual thrusting action between cylinder and eccentric cam and between piston and crown of the cover.
3. Fluid-column hydraulic motor according to any one of the preceding claims, **characterized in that** it is of the type with radial propulsion members.
4. Fluid-column hydraulic motor according to Claim 1 or 2, **characterized in that** it is of the type with axial propulsion members.
5. Fluid-column hydraulic motor according to Claim 1 or 2, **characterized in that** it is of the type with inclined propulsion members.

Patentansprüche

1. Fluid-Säulen-Hydraulikmotor umfassend ein Gehäuse (1), eine mit einem Exzenternocken (3) versehene Antriebswelle (2), eine Vielzahl von Antrieb-

selementen (10), welche auf den Exzenternocken einwirken und jeweils einen Zylinder (11) und einen Kolben (12) umfassen, die koaxial zueinander und teleskopartig relativ zueinander beweglich sind, um so verlängert oder verkürzt werden zu können, wobei die Antriebselemente (10) in entsprechenden Sitzen des Gehäuses (1) enthalten und durch eine Abdeckung (4) verschlossen sind, wobei der Fluid-Säulen-Hydraulikmotor ferner Mittel zum abdichtenden Fixieren der Enden der Zylinder (11) gegen den Exzenternocken (3) und der Enden der Kolben (12) gegen die jeweiligen Gleitkontaktflächen (4b) der Abdeckung (4) umfasst, wobei die Oberfläche (4b) der Abdeckung (4), welche einen gleitenden Kontakt mit dem Kolben (12) herstellt, eine konvexe, sphärische Form aufweist, wobei die Mittel zum Fixieren des freien Endes (12a) des Kolbens (12) gegen die Gleitkontaktfläche (4b) eine radiale Außenfläche (12b) in Kontakt mit der Gleitkontaktfläche (4b) der Abdeckung (4) aufweisen, welche in der Form einer konkaven, sphärischen Oberfläche (12b) parallel zu der konvexen, sphärischen Oberfläche der Gleitkontaktfläche (4b) der Abdeckung (4) ausgeformt ist und die Mittel eine radiale Innenfläche (12d) gegenüber der radialen Außenfläche (12b) aufweisen, wobei die Innenfläche (12d) eine konvexe, sphärische Form parallel zu der der Gleitkontaktfläche (4b) der Abdeckung (4) hat und

dadurch gekennzeichnet, dass das Gehäuse (1) des Motors einen ringförmigen Vorsprung (1a) aufweist, welcher axial zum Inneren des Motors gerichtet ist und mit einer konkaven, sphärisch geformten, oberen Oberfläche (1d), parallel zu der konvexen, radialen und sphärischen Innenfläche (12d) des entsprechenden Endes des Kolbens (12), versehen ist, und dass unter Betriebsbedingungen ein Abstand zwischen der konvexen, radialen und sphärischen Innenfläche (12d) des entsprechenden Endes des Kolbens (12) und der parallelen, konkaven, sphärisch geformten, oberen Oberfläche (1d) des Vorsprungs (1a) aufrecht erhalten wird.

2. Fluid-Säulen-Hydraulikmotor gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das Ende (12a) des Kolbens (12), welches Kontakt mit der Gleitfläche (4b) der Abdeckung (4) herstellt, in Kontakt mit einer inneren Feder (13) steht, die zwischen Kolben (12) und Zylinder (11) angeordnet und der Lage ist, die Doppelschubwirkung zwischen Zylinder und Exzenternocken und zwischen Kolben und Krone der Abdeckung auszuüben.
3. Fluid-Säulen-Hydraulikmotor gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** dieser vom Typ mit radialen Antriebselementen ist.
4. Fluid-Säulen-Hydraulikmotor gemäß Anspruch 1

oder 2, **dadurch gekennzeichnet, dass** dieser vom Typ mit axialen Antriebselementen ist.

5. Fluid-Säulen-Hydraulikmotor gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** dieser vom Typ mit geneigten Antriebselementen ist.

Revendications

1. Moteur hydraulique à colonne de fluide comprenant un carter (1), un arbre d'entraînement (2) pourvu d'une came excentrique (3), une pluralité d'éléments de propulsion (10) agissant sur ladite came excentrique et comprenant chacun un cylindre (11) et un piston (12) qui sont coaxiaux, mobiles de manière télescopique l'un par rapport à l'autre de façon à être déployés ou rétractés, lesdits éléments de propulsion (10) étant contenus dans des logements respectifs du carter (1) fermés par un couvercle (4), le moteur hydraulique à colonne de fluide comprenant en outre des moyens de maintien de manière étanche des extrémités des cylindres (11) contre la came excentrique (3) et des extrémités des pistons (12) contre des surfaces de contact glissant respectives (4b) du couvercle (4), dans lequel la surface (4b) du couvercle (4) établissant un contact glissant avec le piston (12) a une forme sphérique convexe, les moyens de maintien de l'extrémité libre (12a) du piston (12) contre ladite surface de contact glissant (4b) comportent une surface radialement extérieure (12b) en contact avec la surface de contact glissant (4b) du couvercle (4) qui est conçue avec la forme d'une surface sphérique concave (12b) parallèle à la surface sphérique convexe de la surface de contact glissant (4b) du couvercle (4) et une surface radialement intérieure (12d) opposée à la surface radialement extérieure (12b), laquelle surface intérieure (12d) a une forme sphérique convexe parallèle à celle de la surface de contact glissant (4b) du couvercle (4), et **caractérisé en ce que** le carter (1) du moteur comporte une saillie annulaire (1a) orientée axialement vers l'intérieur du moteur et pourvue d'une surface supérieure, concave, de forme sphérique (1d) parallèle à ladite surface sphérique, convexe, radialement intérieure (12d) de l'extrémité correspondante du piston (12), et **en ce que**, dans des conditions de travail, un espace est maintenu entre ladite surface sphérique, convexe, radialement intérieure (12d) de l'extrémité correspondante du piston (12) et la surface supérieure, parallèle, convexe, de forme sphérique (1a) de la saillie (1a).
2. Moteur hydraulique à colonne de fluide selon la revendication 1, **caractérisé en ce que** l'extrémité (12a) du piston (12) établissant un contact avec la surface de glissement (4b) du couvercle (4) est en contact avec un ressort interne (13) disposé entre

un piston (12) et un cylindre (11) et pouvant exercer la double action de poussée entre un cylindre et la came excentrique et entre un piston et une couronne du couvercle.

3. Moteur hydraulique à colonne de fluide selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'il** est du type à éléments de propulsion radiaux.
4. Moteur hydraulique à colonne de fluide selon la revendication 1 ou 2, **caractérisé en ce qu'il** est du type à éléments de propulsion axiaux
5. Moteur hydraulique à colonne de fluide selon la revendication 1 ou 2, **caractérisé en ce qu'il** est du type à éléments de propulsion inclinés.

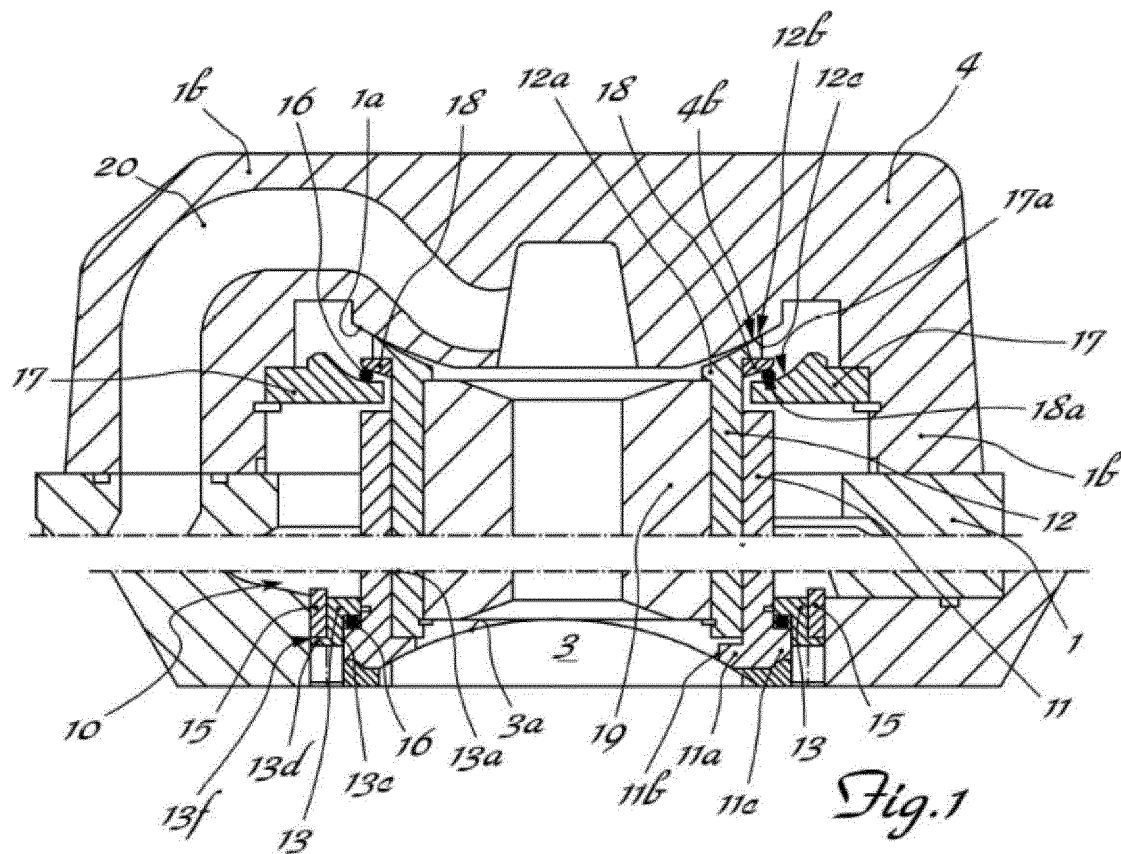


Fig. 1

PRIOR ART

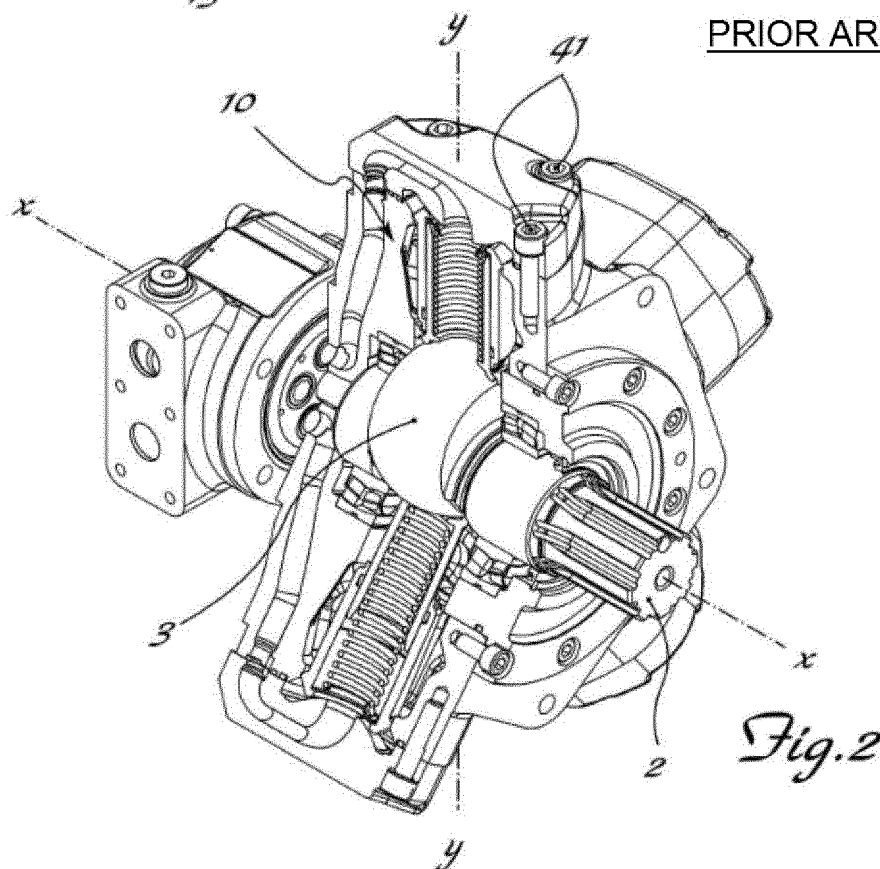
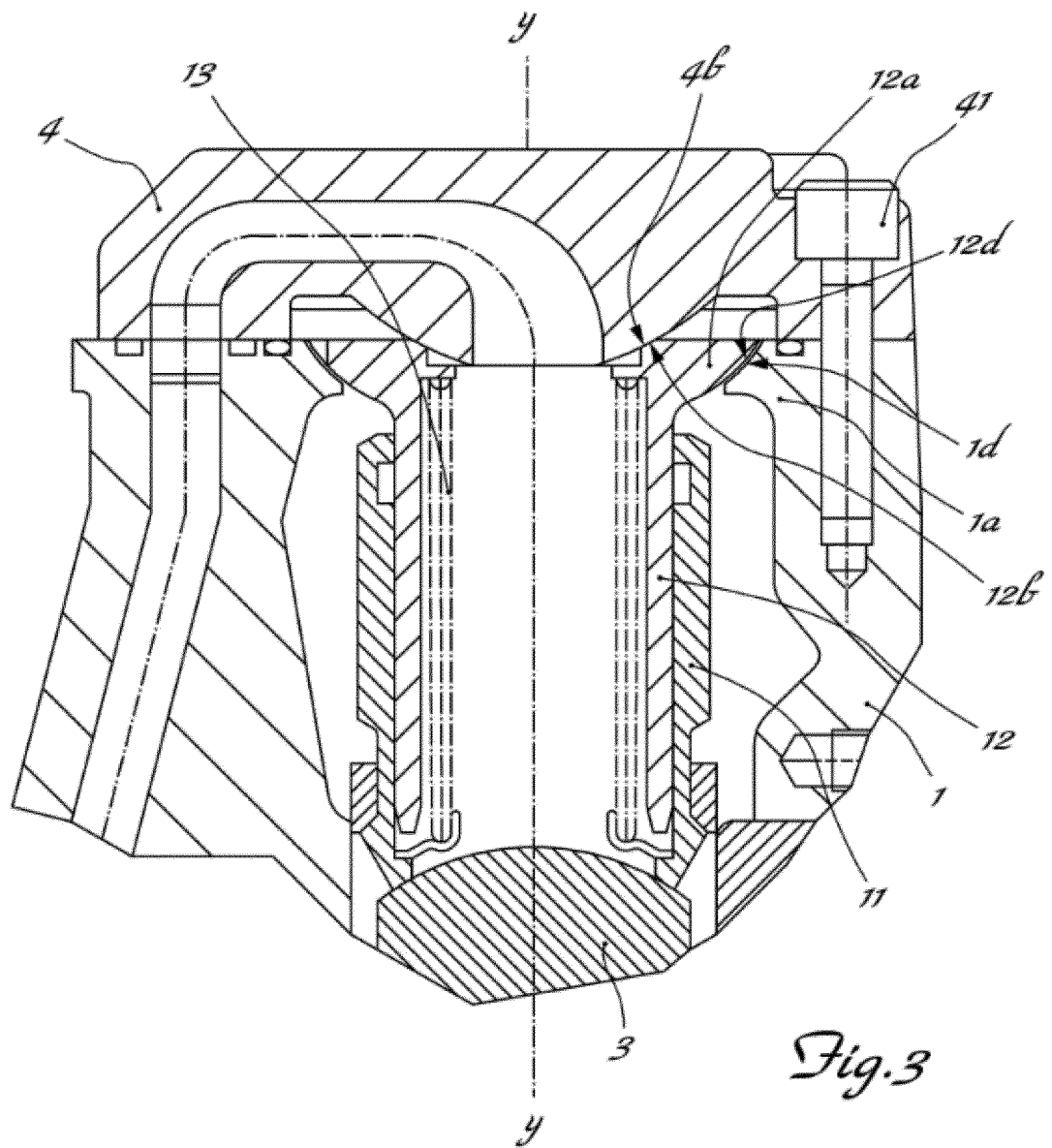


Fig. 2



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0851119 A [0007]
- DE 3726957 A1 [0008]
- US 4683806 A [0009]