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(54) **TRANSMISSION APPARATUS IN HOMOGENISER OR HIGH PRESSURE PISTON PUMP**

ÜBERTRAGUNGSVORRICHTUNG IN HOMOGENISATOR ODER
HOCHDRUCKKOLBENVORRICHTUNG

APPAREIL DE TRANSMISSION DANS UNE POMPE À PISTON HAUTE PRESSION OU UN
HOMOGÉNÉISATEUR

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EP 2 082 134 B1

Description

TECHNICAL FIELD AND BACKGROUND ART.

[0001] The present invention relates to a transmission apparatus, in a homogeniser or high pressure piston pump, said apparatus comprising: a fixed body housing a rotating crankshaft, a motor able to actuate the crankshaft, a reducer interconnected between said shaft and said transmission means. Documents US-A-223/131, US-A-2419775 US-A-1385141 and GB-A 547455 disclose such transmission apparatus.

[0002] The present invention further relates to a technical solution for the assembly of a transmission apparatus, for a homogeniser or high pressure piston pump.

[0003] Within the field of the treatment of high pressure fluids (indicatively, from 150 to 1,500 bar), in particular with regard to applications involving emulsion micronisation, stabilisation of spills and also the controlled cellular rupture / break-up of a fluid, apparatuses known as homogenisers are frequently used. Such apparatuses generally comprise a piston pump part, used to achieve the reciprocating motion of the pumping pistons, synchronous and mutually offset by an angle $360^\circ/n$ where n is the number of the pistons. In particular, the Italian patent application PR99A000045 discloses a homogeniser comprising an adjustable valve (called homogenising valve), which accomplishes the forced passage of the fluid to be treated from a high pressure area to a low pressure area, and a transmission apparatus, in turn comprising a high pressure piston pump, an electric motor which drives the pump and a reducer connected between the motor and the pump. Said reducer is necessary to reduce the rotation rate of the motor (generally about 1500 ÷ 1800 revolutions per minute) to a speed that is useful for the operation of the pump (about 150 ÷ 180 revolutions per minute). Typically, the reducer is of the type with parallel axes and it achieves a reduction ratio of about 1:5, whilst a further reduction of said rotation rate (about 1:2) is achieved by the means for transmitting motion from the motor to the reducer, generally comprising a system of multiple belts with pulleys. The pump is provided with a crankshaft, mounted on a fixed pump body, that through a classic piston rod / crank / cross head mechanism allows the reciprocating motion of the n pumping pistons that move and compress the fluid within the process part of the machine.

[0004] In known solutions, the connection between the reducer, the pump and the motor takes place according to a fastening / assembly technique called "pendulum-like". Said technique provides for keying the reducer (in particular, the slow shaft of the reducer) directly on a projection of the crankshaft of the pump and connecting, by means of a belt and pulley system, the fast shaft of the reducer to the motor. In this way, the reducer is movable relative to the pump body, because it can rotate around the axis defined by the crankshaft. This possibility of rotating the reducer around the crankshaft is exploited

when assembling the transmission apparatus, to apply the necessary tension to the belt system in order to transit the driving torque from the motor to the crankshaft. In known solutions, the distance between the motor and pump body is fixed, therefore a rotation of the reducer around its own slow shaft (connected to the crankshaft) entails a change in the distance between the fast shaft of the same reducer and the motor, starting from the assumption that the reducer is of the kind with non coaxial shafts. The pendulum-like mounting of the reducer also provides for the presence of a reaction arm, which fastens the reducer to a fixed frame, exerting thereon a traction force in a direction that is parallel and is opposite in direction relative to the tension of the belt, to counter-balance it. The pendulum-like mounting of the reducer is convenient during the assembly stage, because the belt is tensioned acting on the reaction arm, whose length can be varied. However, said known technical solution entails some disadvantages, because it introduces unwanted stresses and oscillations in the transmission apparatus. In the first place, it should be noted that the weight of the reducer, mounted in overhang on the end of the shaft, is fully borne by the crankshaft and by its bearings; therefore, the weight of the reducer generates a flexing moment on the crankshaft.

[0005] Moreover, the fact that the tension force of the belts and the reaction discharged by the reaction arm and their components act on two different, albeit parallel, planes, produces on the body of the reducer a torque characterised by an arm equal to the distance between the two parallel planes of action of the forces (in turn identified by the axis of the tension of the belts and by the axis of the reaction arm, respectively), which generates an additional flexing moment discharged on the crankshaft.

[0006] Said forces entail an oscillatory motion of the reducer both relative to a plane that is orthogonal to the axis of the crankshaft, and relative to a reference plane that is perpendicular to the crankshaft, resulting in a complex oscillatory motion; moreover, said flexing moments combine with the twisting moment due to point load stresses generated by the individual pumping pistons during the compression phase, in relation to the rotation of the crankshaft, thus subjecting it to undesired stresses. Therefore, prior art technical solutions globally entail possible limitations with regard to the reliability of the transmission system.

DISCLOSURE OF INVENTION.

[0007] An object of the present invention is to eliminate the aforesaid drawbacks and to make available a transmission apparatus, in a homogeniser or high pressure piston pump, that is particularly rugged and reliable, within a particularly simple and economical solutions, even in situations of unforeseeable overload of the machine due to incorrect conditions of use thereof.

[0008] Said objects are fully achieved by the apparatus

of the present invention, which is characterised by the content of the claims set out below and in particular in that it comprises means for rigidly hastening the reducer to said fixed body.

[0009] An additional object of the present invention is to make available a method for assembling a transmission apparatus, in a homogeniser with high pressure piston pump, which assures ruggedness and reliability for the apparatus itself.

[0010] Said object is fully achieved by the method of the present invention, which is characterised by the content of the claims set out below and in particular in that it comprises the following steps:

- fastening a reducer, keyed on the crankshaft, rigidly to said fixed body, in order to inhibit all oscillations of the reducer relative to the crankshaft;
- connecting the reducer to a motor by means of a system of transmission belts and associated pulleys;
- tensioning the transmission belts by translating the motor, said motor being movable relative to said fixed body;
- locking the motor relative to the fixed body, once tensioning is complete.

BRIEF DESCRIPTION OF DRAWINGS.

[0011] This and other characteristics shall become more readily apparent from the following description of a preferred embodiment, illustrated surely by way of non limiting example in the accompanying drawing tables, in which:

- Figure 1 shows a perspective view of a transmission apparatus according to the present invention;
- Figure 2 shows the apparatus of Figure 1, according to a different perspective;
- Figure 3 shows a perspective view of an apparatus of Figure 1, open and in partial transparence;
- Figure 4 shows a view from a different perspective from Figure 3 of an apparatus of Figure 1, open and in partial transparence;
- Figure 5 shows a section view of the apparatus of Figure 1.

BEST MODE FOR CARRYING OUT THE INVENTION.

[0012] With reference to Figures 1 and 2 and 1, the number 1 designates a transmission apparatus in a homogeniser, the number 2 designates a fixed frame supporting the transmission apparatus 1. Within said transmission apparatus 1, the reference number 3 designates an electric motor, connected to a reducer 4 by means of a system of parallel belts 5 and pulleys 6. In turn, said reducer 4 is connected to a fixed body 7. The motor 3 is originally movable relative to the frame 2, because it bears on slides 8, along which it can translate. The position of the motor 3 relative to the frame 2 is adjusted

and fattened by actuating means, constituting, in the illustrated embodiment, by a tie rod 9.

[0013] Figures 3 and 4 show the connection between the fixed body 7 and the reducer 4, the latter being shown in see-through view. The fixed body 7, integral with the frame 2, houses a crankshaft 10, of a known kind, rotating within said fixed body 7. The crankshaft 10 has an overhang portion relative to the fixed body 7. On said portion of the crankshaft 10, is keyed the reducer 4; therefore, the crankshaft 10 defines the slow shaft of the reducer which, in the illustrated embodiment, is of the type with parallel axes. The reference 11 designates a fast shaft of the reducer 4, which is set in rotation by the motor 3. The reducer 4 is originally made integral with the fixed body 7 by fastening means. Said fastening means preferably comprise a flange 12, connected to the reducer 4 by means of a plurality of screws 13a and to the fixed body 7 by means of an additional plurality of screws 13b. Therefore, the flexing moment associate to the weight of the reducer 4 and every other flexing moment associated to the tension of the belt 6 originally unloads on the fixed body 7 through the flange 12, relieving the crankshaft 10 from dangerous stresses, in particular the flexing moment generated by the torque identified by belt tension, reaction and related arm. The flange 12 constitutes a rigid connection between the reducer 4 and the fixed body 7, able to inhibit the oscillations of the reducer, thanks to the presence of a plurality of screws, which work in shear mode, positioned in such a way as to surround the shaft 10, preferably, but not exclusively, distributed uniformly.

[0014] Note also that the flange 12 for fastening the reducer 4 to the fixed body 7 must be constructed in such a way as to assure the coupling with the body 7 itself both on a surface of the fixed body 7 perpendicular to the crankshaft 10, both on a cylindrical surface coaxial with the crankshaft 10, identified on the fixed body 7, thereby achieving a cylindrical coupling between reducer and body. In this way, an optimal distribution is obtained of the stresses between the reducer 4 and the fixed body 7, which are thus rigidly bound. However, in different embodiments, the reducer 4 can be connected to surfaces of the pump body 11 that are not orthogonal to the crankshaft 10, or even to other surfaces, provided that it is rigidly fastened relative to the pump body 11 or to the frame 2, with no chance of being subjected to oscillations or vibrations.

[0015] It should also be observed that, when assembling the transmission apparatus 1, the tensioning of the parallel belt system 5, is originally accomplished by moving the motor 3; in particular the motor 3 is translated along the slides 8, away from the reducer 4, which is fixed.

[0016] The present invention also makes available a method for assembling a transmission apparatus 1, comprising a pump 7 provided with a crankshaft 10 that rotates inside a fixed body 7. Said method comprises the following steps:

- fastening a reducer, keyed on the crankshaft 10, rig-

- idly to said fixed body, in order to inhibit all oscillations of the reducer relative to the crankshaft 10;
- connecting the reducer 4 to a motor 3 by means of a system of transmission belts 5 and associated pulleys;
- tensioning the transmission belt 5 by translating the motor 3, said motor being movable relative to said fixed body 7;
- locking the motor 3 relative to the fixed body 7, once tensioning is complete.

[0017] Said method originally enables to assemble the transmission Apparatus, tensioning the transmission belts 5, without moving the reducer, which always remains rigidly fastened to the fixed body 7, i.e. integral with the frame 2. In this way, one also has the advantage of being able to use a reducer in which the slow shaft and the fast shaft are coaxial, limiting the overall bulk of the machine. Therefore, the described method assures a greater ruggedness and reliability of the transmission apparatus, because the stresses generated by the belt tensioning load are not discharged on the crankshaft 10 but on the fixed body 7, on the flange 12 and on the body of the reducer 4, by means of appropriate connecting members.

Claims

1. Transmission apparatus (1), in homogeniser or high pressure piston pump, said apparatus comprising:

- a fixed body (7) housing a rotating crankshaft (10)
- a motor (3) able to actuate the crankshaft (10);
- a reducer (4) interconnected between said shaft (10) and transmission means (5, 6);

characterised in that it comprises means for rigidly fixing the reducer (4) to said fixed body (7), said means comprising a flange (12) constituting a rigid connection between the reducer (4) and the fixed body (7) and achieving a cylindrical coupling between the reducer and the body (7), coaxial with the crankshaft (10)

2. Apparatus as claimed in claim 1, **characterised in that** said means for fastening the reducer (4) are applied to at least one surface of said pump body (7) that is orthogonal to the axis of said shaft (10).

3. Apparatus as claimed in any of the previous claims, wherein said transmission means comprise a system of belts (5) and related pulleys (6) for the transmission of motion from the motor (3) to the input shaft (11) of the reducer (4).

4. Apparatus as claimed in claim 3, **characterised in**

that it comprises means for moving the motor (3) relative to the fixed body (7), to tension said system of belts (5).

5. Apparatus as claimed in claim 4, wherein said means for moving the motor comprise at least one slide (8) where to is fastened the motor (3) and at least one actuating means (9), operatively active on the motor in a direction away from / towards the reducer (4).

6. Apparatus as claimed in any of the previous claims, wherein said means for fastening the reducer (4) to the pump body comprise a flange (12), means for connecting said flange to the reducer (4) and means for connecting the flange (12) to the fixed body (7).

7. Apparatus as claimed in claim 6, wherein said means for connecting the flange (12) to the reducer comprise a plurality of screws (13a).

8. Apparatus as claimed in claim 6 or 7, wherein said means for connecting the flange (12) to the fixed body (7) comprise a plurality of screws (13b).

9. Apparatus as claimed in claim 6, wherein the flange (12) is provided with a planar coupling surface that is orthogonal to the axis of symmetry of the flange and coincides with that of the crankshaft (10).

10. Apparatus as claimed in claim 6, wherein the flange (12) is provided with a cylindrical coupling surface that is coaxial with the corresponding cylindrical surface of the fixed body (7), said surfaces being in turn coaxial with the axis of the crankshaft (10).

11. Method for assembling a transmission apparatus, in homogeniser or high pressure piston pump, said apparatus comprising a fixed body (7) housing a rotating crankshaft (10), **characterised in that** it comprises the following steps:

- fastening a reducer (4), keyed on the crankshaft (10), rigidly to said fixed body (7), in order to inhibit all oscillations of the reducer (4) relative to the crankshaft (10);
- connecting the reducer (4) to a motor (3) by means of a system of transmission belts (5) and associated pulleys (6);
- tensioning the transmission belts (5) by translating the motor (3), said motor being movable relative to said fixed body (7);
- locking the motor relative to the fixed body, once tensioning is complete,

said step of fastening the reducer (4) keyed on the crankshaft (10) to the fixed body (7) comprises a step of fastening a flange (12) to the fixed body (7) and a step of fastening the reducer (4) to the flange, said

flange achieving a substantially cylindrical coupling.

12. Homogeniser or high pressure piston pump, **characterised in that** it comprises a transmission apparatus (1) of the type claimed in any of the claims 1 through 10.

Patentansprüche

1. Übertragungsvorrichtung (1), in Homogenisator oder Hochdruckkolbenvorrichtung, diese Vorrichtung umfasst:

- einen fixierten Körper (7), der eine drehende gekröpfte Welle (10) aufnimmt
- einen Motor (3), um die gekröpfte Welle (10) anzutreiben;
- ein Untersetzungsgetriebe (4), mit dem die Welle (10) und die Übertragungsmittel (5, 6) verbunden sind;

dadurch gekennzeichnet, dass sie Befestigungsmittel zur festen Befestigung des Untersetzungsgetriebes (4) an den fixierten Körper (7) beinhaltet, diese Befestigungsmittel besitzen einen Flansch (12), der eine steife Verbindung zwischen dem Untersetzungsgetriebe (4) und dem fixierten Körper (7) bildet und eine zylindrische Verbindung zwischen dem Untersetzungsgetriebe und dem Körper (7) erzielt, koaxial mit der gekröpften Welle (10).

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Befestigungsmittel des Untersetzungsgetriebes (4) mindestens an einer Oberfläche des Pumpenkörpers (7), orthogonal zur Achse der Welle (10), angebracht sind.

3. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, wobei die Übertragungsmittel ein Riemensystem (5) und entsprechende Rollen zur Übertragung der Bewegung des Motors (3) auf die Eingangswelle (11) des Untersetzungsgetriebes (4) beinhalten.

4. Vorrichtung nach Anspruch 3, **dadurch gekennzeichnet, dass** sie Mittel zur Bewegung des Motors (3) gegenüber dem fixierten Körper (7) einschließt, um das Riemensystem (5) unter Spannung zu setzen.

5. Vorrichtung nach Anspruch 4, wobei die Mittel zur Bewegung des Motors mindestens einen Schlitten (8), an den der Motor (3) befestigt ist, und mindestens ein Antriebsmittel (9) einschließt, das in einer Richtung des Annäherns zum/Entfernen vom Untersetzungsgetriebe (4) aktiv auf den Motor einwirkt.

6. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, wobei die Mittel zur Befestigung des Untersetzungsgetriebes (4) an den Pumpenkörper einen Flansch (12), Mittel zum Anschließen genannten Flansches an das Untersetzungsgetriebe (4) und Mittel zum Anschließen des Flansches (12) an den fixierten Körper (7) einschließen.

7. Vorrichtung nach Anspruch 6, wobei die Mittel zum Anschließen des Flansches (12) an das Untersetzungsgetriebe eine Vielfalt von Schrauben (13a) umfassen.

8. Vorrichtung nach Anspruch 6 oder 7, wobei die Mittel zum Anschließen des Flansches (12) an den fixierten Körper (7) eine Vielfalt von Schrauben (13b) umfassen.

9. Vorrichtung nach Anspruch 6, bei der der Flansch (12) eine ebene Kupplungsoberfläche orthogonal zur Symmetrieachse des Flansches selbst und übereinstimmend mit derjenigen der gekröpfte Welle (10) besitzt.

10. Vorrichtung nach Anspruch 6, wobei der Flansch (12) eine zylindrische Kupplungsoberfläche, koaxial mit der entsprechenden zylindrischen Oberfläche des fixierten Körpers (7), besitzt, und diese Oberflächen ihrerseits mit der Achse der gekröpften Welle (10) koaxial sind.

11. Vorgang zum Zusammenbau einer Übertragungsvorrichtung, in Homogenisator oder Hochdruckkolbenvorrichtung, diese Vorrichtung besitzt einen fixierten Körper (7), der eine drehende gekröpfte Welle (10) aufnimmt, **dadurch gekennzeichnet, dass** er die folgenden Schritte umfasst:

- Befestigen eines Untersetzungsgetriebes (4), verzahnt an der gekröpften Welle (10), starr an dem fixierten Körper (7), in solcher Weise, dass jede Schwingung des Untersetzungsgetriebes (4) gegenüber der gekröpften Welle (10) unterbunden ist;
- Anschließen des Untersetzungsgetriebes (4) an einen Motor (3) mittels eines Riemensystems zur Übertragung (5) und entsprechende Rollen (6);
- Spannen der Übertragungszemen (5) durch Positionsänderung des Motors (3), da dieser Motor gegenüber dem fixierten Körper (7) beweglich ist;
- Blockieren des Motors gegenüber dem fixierten Körper, wenn der Spannvorgang abgeschlossen ist,

dieser Schritt der Befestigung des an der gekröpften Welle (10) verzahnten Untersetzungsgetriebes (4)

an den fixierten Körper (7) umfasst einen Schritt der Befestigung eines Flansches (12) an den fixierten Körper (7) und einen Schritt der Befestigung des Untersetzungsgetriebes (4) an den Flansch, dieser Flansch bekommt dadurch eine hauptsächlich zylindrische Kupplung.

12. Homogenisator oder Hochdruckkolbenvorrichtung, **dadurch gekennzeichnet, dass** er/sie eine Übertragungsvorrichtung (1) besitzt, deren Typ durch einen der Ansprüche 1 bis 10 beansprucht wird.

Revendications

1. Appareil de transmission (1) dans une pompe à piston haute pression ou un homogénéisateur comportant:

- un corps fixe (7) renfermant un vilebrequin rotatif (10),
- un moteur (3) en mesure d'actionner le vilebrequin (10);
- un réducteur (4) connecté entre ledit vilebrequin (10) et un moyen de transmission (5, 6);

caractérisé en ce qu'il comprend un moyen permettant de fixer de manière rigide le réducteur (4) sur ledit corps fixe (7), ledit moyen comprenant une bride (12) formant un raccord rigide entre le réducteur (4) et le corps fixe (7) et réalisant un accouplement cylindrique entre le réducteur et le corps (7), qui est coaxial au vilebrequin (10).

2. Appareil selon la revendication 1, **caractérisé en ce que** ledit moyen de fixation du réducteur (4) est appliqué au moins à une surface dudit corps (7) de la pompe qui est orthogonal à l'axe dudit vilebrequin (10).

3. Appareil selon l'une quelconque des revendications précédentes, dans lequel ledit moyen de transmission comprend un système de courroies (5) et de poulies (6) correspondantes pour la transmission du mouvement du moteur (3) à l'arbre d'entrée (11) du réducteur (4).

4. Appareil selon la revendication 3, **caractérisé en ce qu'il** comprend un moyen pour faire bouger le moteur (3) par rapport au corps fixe (7) et tendre ledit système de courroies (5).

5. Appareil selon la revendication 4, dans lequel ledit moyen pour faire bouger le moteur comprend au moins un coulisseau (8) sur lequel est fixé le moteur (3) et au moins un moyen d'actionnement (9) qui agit sur le moteur dans une direction d'éloignement/de rapprochement du réducteur (4).

6. Appareil selon l'une quelconque des revendications précédentes, dans lequel ledit moyen de fixation du réducteur (4) au corps de la pompe comprend une bride (12), un moyen de raccordement de ladite bride au réducteur (4) et un moyen de raccordement de la bride (12) au corps fixe (7).

7. Appareil selon la revendication 6, dans lequel ledit moyen de raccordement de la bride (12) au réducteur comprend plusieurs vis (13a).

8. Appareil selon les revendications 6 ou 7, dans lequel ledit moyen de raccordement de la bride (12) au corps fixe (7) comprend plusieurs vis (13b).

9. Appareil selon la revendication 6, dans lequel la bride (12) est équipée d'une surface d'accouplement plate qui est orthogonale à l'axe de symétrie de la bride et coïncide avec celui du vilebrequin (10).

10. Appareil selon la revendication 6, dans lequel la bride (12) est équipée d'une surface d'accouplement cylindrique qui est coaxiale à la surface cylindrique correspondante du corps fixe (7), lesdites surfaces étant à leur tour coaxiales à l'axe du vilebrequin (10).

11. Méthode pour assembler un appareil de transmission dans une pompe à piston haute pression ou un homogénéisateur, ledit appareil comprenant un corps fixe (7) renfermant un vilebrequin rotatif (10), **caractérisée en ce qu'elle** présente les phases suivantes:

- fixation d'un réducteur (4), emboîté sur le vilebrequin (10), de manière rigide audit corps fixe (7) pour empêcher toutes les oscillations du réducteur (4) par rapport au vilebrequin (10);
- raccordement du réducteur (4) à un moteur (3) par un système de courroies de transmission (5) et de poulies correspondantes (6);
- mise sous tension des courroies de transmission (5) par le déplacement du moteur (3), ledit moteur étant mobile par rapport audit corps fixe (7);
- blocage du moteur par rapport au corps fixe dès que la mise sous tension est terminée, ladite phase de fixation du réducteur (4), emboîté sur le vilebrequin (10), au corps fixe (7) comprend une étape pour fixer une bride (12) au corps fixe (7) et une étape pour fixer le réducteur (4) à la bride, ladite bride réalisant un accouplement principalement cylindrique.

12. Homogénéisateur ou pompe à piston haute pression, **caractérisé/e en ce qu'il/elle** comprend un appareil de transmission (1) selon l'une quelconque des revendications 1 à 10.

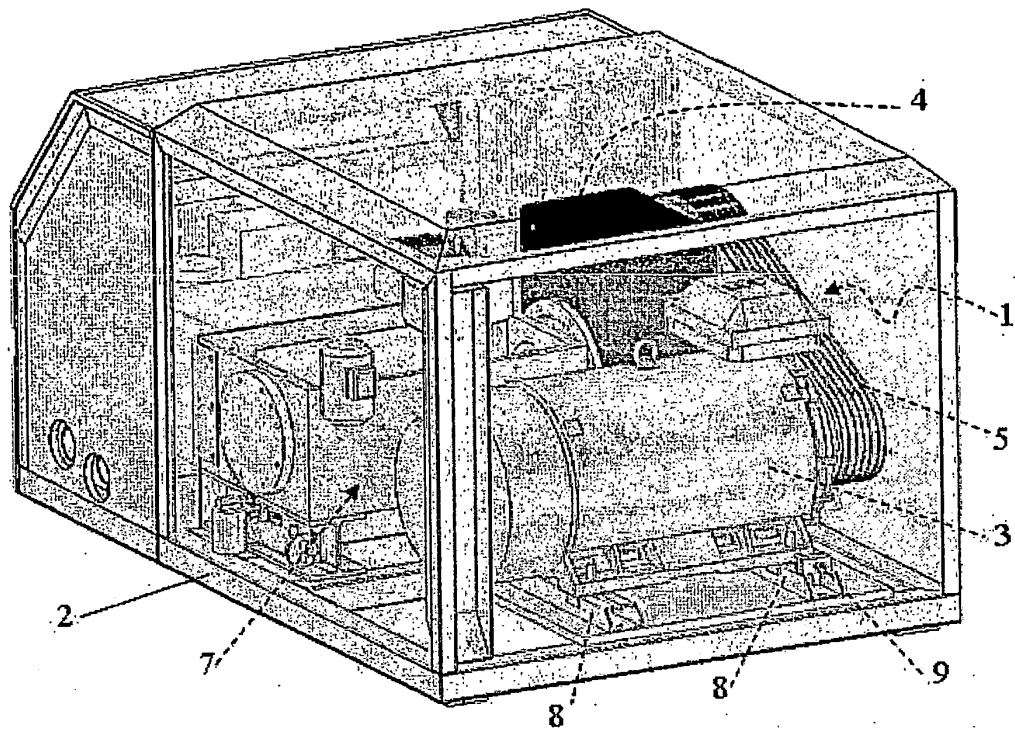


FIG. 1

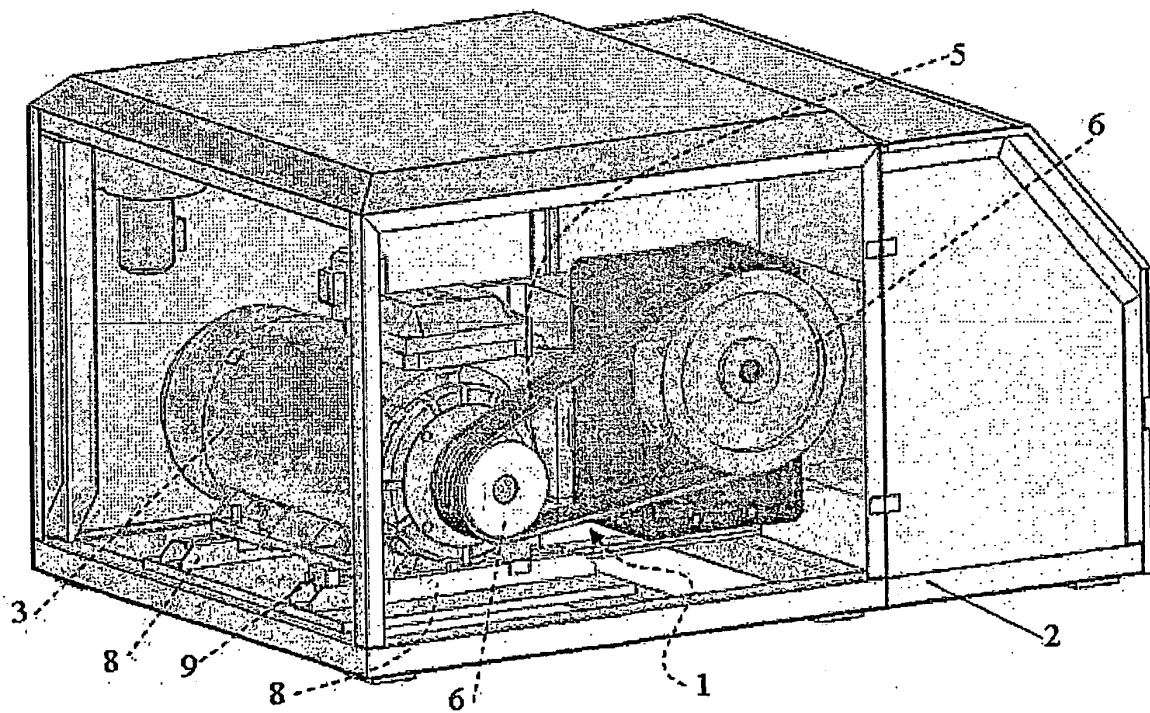


FIG. 2

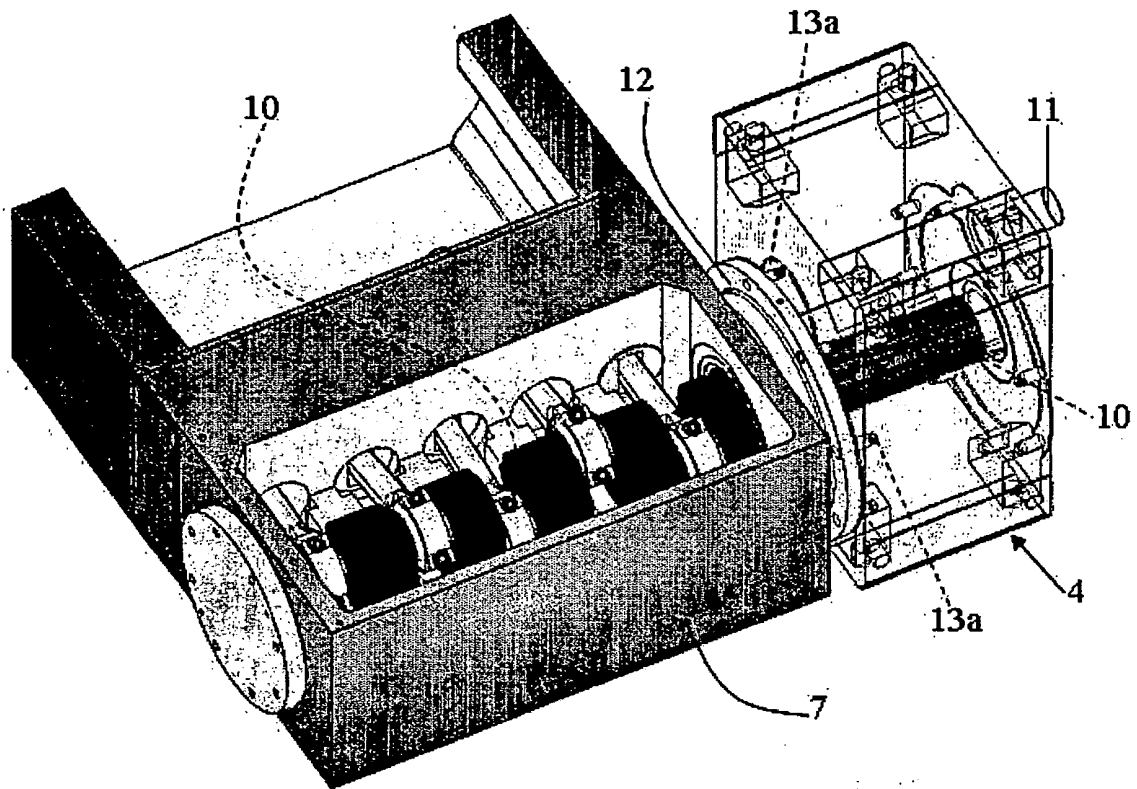


FIG. 3

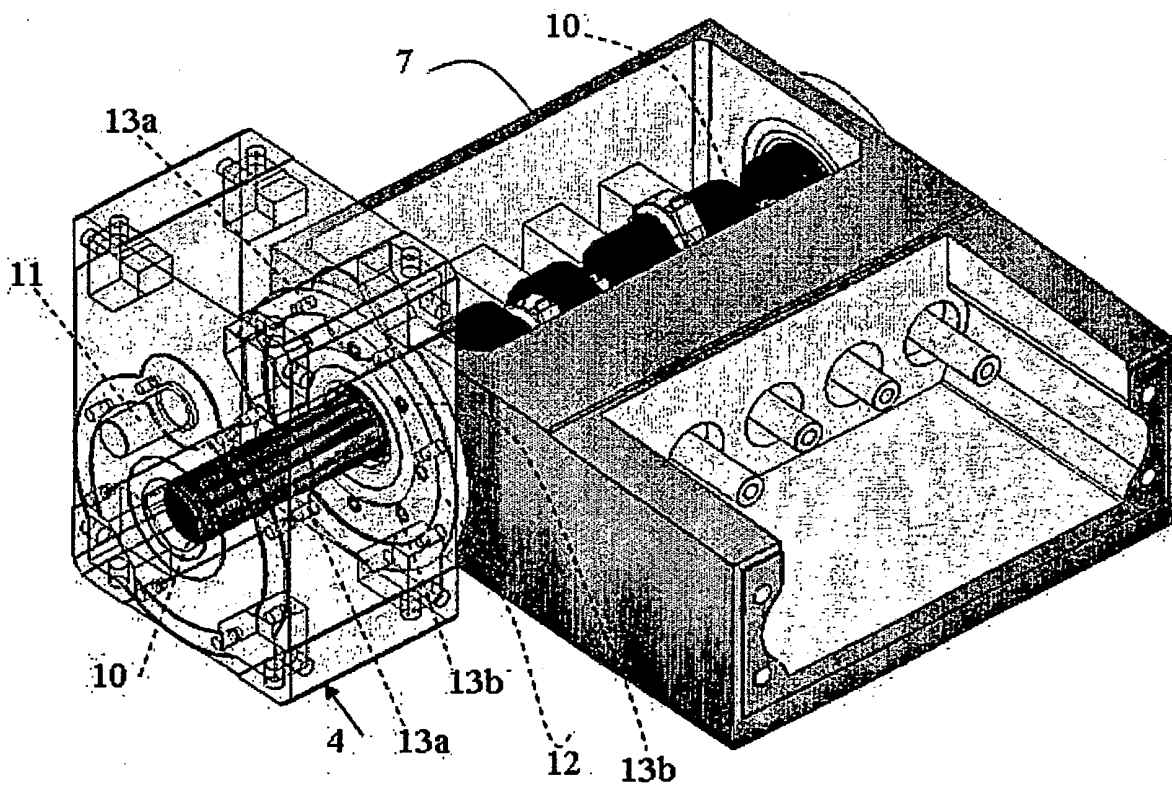


FIG. 4

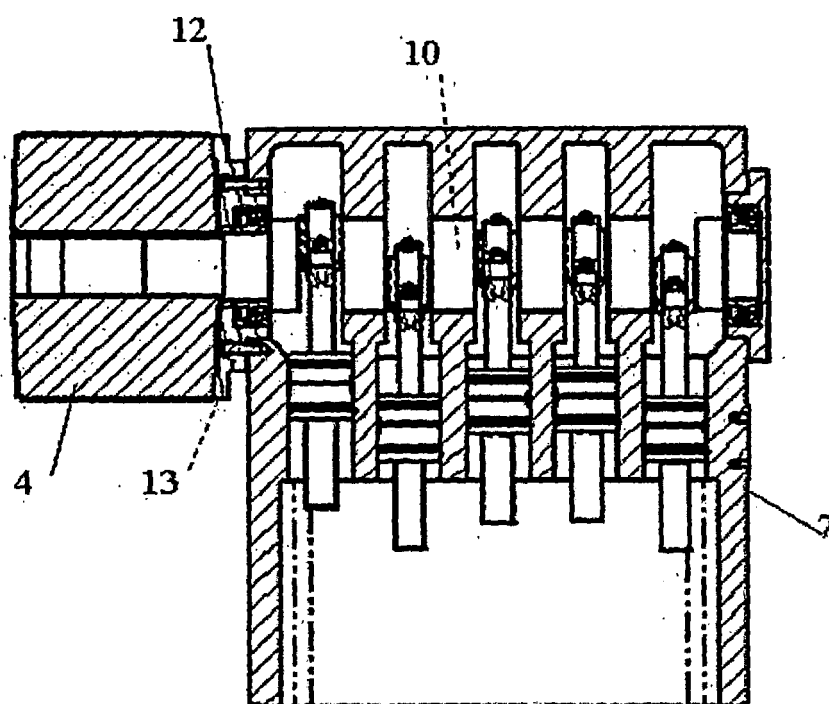


FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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