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### (54) **Assembly of a mechanical or hydraulic drive and a piston pump**

Zusammenbau eines mechanischen oder hydraulischen Antriebs mit einer Kolbenpumpe

Assemblage d'un entraînement mécanique ou hydrostatique pour une pompe à piston

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## Description

**[0001]** The invention relates to a ram pump assembly and to a mounting plate assembly for use with a ram pump.

**[0002]** Ram pumps are reciprocating piston pumps which are often used for pumping fluids such as water or sewage. The ram pump comprises a pump piston arranged for reciprocating movement in a pump body and the pump piston is driven up and down by a drive piston which is, in turn, driven by a hydraulic drive mounted above or adjacent the pump. The hydraulic drive may be mounted on two pillars or tie bars attached to the pump body and the drive piston is attached to the pump piston by means of a rigid block to hold the drive piston and the pump piston stationary relative to one another. Alternatively, the drive may be provided by a motor and crank drive mounted at the side of the pump body with the crank drive arm connected to the pump piston.

**[0003]** GB 677,136 and GB 2,159, 888A disclose a pumping apparatus in which a ram type piston is mounted on a crosshead which slides on two parallel vertical guide bars or pillars. The piston is linked directly to the piston rod of a double acting hydraulic ram mounted on the guide bars.

**[0004]** GB 2,107,798 discloses a pumping apparatus for pumping liquids such as slurries comprising a pumping cylinder/piston driven by the piston/cylinder of an operating device, the supply of fluid under pressure being controlled by valve mechanism.

**[0005]** The use of ram pumps with two pillars or tie bars has been known for many years. The arrangement is a simple and effective means of mounting a hydraulic drive and drive piston for a ram pump. However, these pumps have problems with lack of stability of the mounting plate on the two pillars and with rocking and flexing of the pillars during use. Due to the effects of back pressure caused by the ram displacement piston, the wear factors increase with time. Thus, as the ram displacement piston is lifted up and down, it also rocks the piston from side to side, causing uneven wear of the ram displacement piston and thus shortening the life of the ram displacement piston seals.

**[0006]** The twisting and yawing forces to which the ram pump and drive assembly is subjected can cause the life of the pump, in particular the seals, to be shortened.

**[0007]** It is an object of the invention to provide an improved ram pump assembly that has longer pump life and improved seal life over existing arrangements.

**[0008]** It is a further object of the invention to provide a mounting plate assembly that is suitable for mounting a hydraulic drive or crank drive to a ram pump whilst reducing the twisting and yawing forces to which the ram pump piston is subjected.

**[0009]** The invention provides a ram pump assembly in accordance with claim 1 and a mounting plate assembly in accordance with claim 11 of the appended claims.

**[0010]** Preferably the mounting plate assembly comprises four pillars. Preferably the four pillars are arranged to form the four corners of a square.

prises four pillars. Preferably the four pillars are arranged to form the four corners of a square.

**[0011]** Advantageously the drive means may comprise a hydraulic piston. In this arrangement, the hole in the mounting plate is advantageously round and is sized to provide an easy fit for the flange of the hydraulic piston to pass through.

**[0012]** Alternatively, the drive means may comprise a crank drive. In this arrangement, the hole in the mounting plate is advantageously square to allow reciprocating movement of the drive shaft arm of the crank drive.

**[0013]** Preferably the drive shaft arm is attached to the upper surface of the crosshead by means of bolts or screws. If the drive shaft arm comprises a piston, it is preferably attached by a rigid connection to the crosshead.

**[0014]** Alternatively, if the drive shaft arm comprises a crank drive shaft arm, it is preferably attached by a suitable connection allowing relative rotational movement of the drive shaft arm with respect to the connection.

**[0015]** Advantageously, the crosshead comprises at least two arms with slidable attachment means at the ends that are slidably mounted on corresponding pillars. Advantageously the attachment means comprise sleeves that fit over the pillars so that the crosshead can slide up and down but is held rigidly so that it cannot move sideways with respect to the pump body. The crosshead may have more than two arms and attachment means, of fewer than or of a corresponding number to the number of pillars.

**[0016]** Advantageously, where the mounting plate assembly comprises four pillars, the crosshead has two arms with slidable attachment means at the ends that are slidably mounted on pillars at opposed corners of the mounting plate. Preferably the four pillars are arranged at the four corners of a square and the crosshead slides up and down on two opposing pillars which thus form the longest point of the square.

**[0017]** Advantageously, where the mounting plate assembly comprises three pillars, the crosshead is slidably mounted on the three pillars. The crosshead may have three arms with slidable attachment means at the ends that are slidably mounted on the three pillars or, alternatively, it may comprise a plate with three holes corresponding to the positions of the three pillars to enable the crosshead to move up and down the pillars.

**[0018]** Preferably the ram pump piston is attached to the lower surface of the crosshead by bolts or screws.

**[0019]** Preferably the mounting plate comprises a heavily constructed casting or fabrication to support the drive means such as a hydraulic unit or motor and gearbox arrangement.

**[0020]** Preferably the height of the pillars is selected to provide an optimum gap for the height of the hydraulic piston or crank. Advantageously the pillar height can be adjusted or the pillars can be changed to provide different heights to enable the optimum stroke length of the pump piston to be achieved for various discharge flow rates.

**[0021]** Preferably the pillars are made of high tensile steel. Advantageously the pillars are attached to the ram pump body and the mounting plate by removable fasteners.

**[0022]** The invention further provides a mounting plate assembly for a ram pump in accordance with claim 11 of the appended claims.

**[0023]** Preferably the mounting plate assembly comprises four pillars. Preferably the four pillars are arranged to form the four corners of a square.

**[0024]** The invention will now be described, by way of example only, by reference to the accompanying drawings, of which:

Figure 1 shows a side view of one embodiment of a ram pump assembly according to the invention;

Figure 2 shows an isometric view of a mounting plate forming part of the ram pump assembly shown in Figure 1; and

Figure 3 shows an isometric view of a second embodiment of a ram pump assembly according to the invention.

**[0025]** As shown in Figure 1, a ram pump assembly 1 according to the invention comprises a ram pump 2, having a pump body 3 and a pump piston 4, and a mounting plate assembly 5.

**[0026]** Referring also to Figure 2, the mounting plate assembly 5 comprises four high tensile steel pillars 6a, 6b, 6c, 6d attached at their bases 7a, 7b, 7c, 7d to the pump body 3 by fasteners such as screws (not shown) such that the pillars 6a, 6b, 6c, 6d form the four corners of a square. A mounting plate 8 is attached by fasteners (not shown) through holes 9a, 9b, 9c, 9d to the tops 10a, 10b, 10c, 10d of the pillars 6a, 6b, 6c, 6d.

**[0027]** The mounting plate 8 has a hole 11 through the centre. Mounted on plate 8 is a hydraulic motor 12 having a drive arm, or hydraulic piston, 13 which extends down through the hole 11.

**[0028]** The drive arm 13 is attached to link means 14 on the upper surface of a crosshead 15. The crosshead 15 has two extending arms 16, 17, each having a sleeve 18, 19 at the end that is slidably fitted on opposing pillars 6a, 6d.

**[0029]** The pump piston 4 is fastened to the lower surface of a flange 20 on the crosshead 15.

**[0030]** In use, the hydraulic motor 12 moves the drive arm 13 up and down through the hole 11. This moves the crosshead 15, with the pump piston 4 attached, up and down, thus transferring energy from the hydraulic motor 12 to the ram pump 2. The pillars 6a, 6b, 6c, 6d hold the mounting plate assembly 5 rigidly and with maximum stability with respect to the pump 2. The height of the pillars 6a, 6b, 6c, 6d is selected to provide a sufficient gap for the stroke of the pump piston 4 to provide a desired flow rate.

**[0031]** The arrangement of the invention has the particular advantage that the crosshead 15 is lifted up and

down smoothly and does not jerk as will often happen with the prior art two pillared arrangements. Thus the displacement piston 4 is also lifted up and down more consistently square with the pump body 3.

**[0032]** Figure 3 shows an alternative embodiment of the invention. Features corresponding to those shown in Figures 1 and 2 have corresponding reference numerals. In this embodiment, the drive means comprises a motor (not shown) driving a crank shaft 30 which in turn causes a drive shaft arm 31 to be reciprocated up and down through a hole 32 in the mounting plate 8. The hole 32 is square to allow for the side to side movement of the drive shaft arm 31. Pump piston 4 is not shown in this figure, for clarity.

**[0033]** The arrangement of the mounting plate enables energy to be transferred from the drive means via a piston or shaft through the crosshead to the ram pump piston. The three or more pillars hold the mounting plate rigidly and prevent yawing and twisting of the drive means with respect to the ram pump. This extends the life of the seals and other pump elements.

**[0034]** The arrangement prevents bending or twisting of the construction whilst it is in operation, which can be caused by the forces created by the drive means when the pump is in operation. Keeping these forces in check, as is achieved by the invention, increases the overall lifetime of the ram pump, in particular it increases the life of the pump seals.

## Claims

### 1. A ram pump assembly (1) comprising:

a ram pump (2) comprising a pump body (3) and pump piston means (4);  
drive means (12) having a drive shaft arm (13, 31); and  
a mounting plate assembly (5),

**characterised in that** the mounting plate assembly (5) comprises:

at least three pillars (6) attached at one end to the pump body (3);  
a mounting plate (8) attached to the other end of each of the pillars (6) and comprising a hole (11) therethrough; and  
a crosshead (15) slidably mounted on at least two of the pillars (6), and wherein the drive means (12) is mounted on the mounting plate (8) with the drive shaft arm (13, 31) extending through the hole (11) in the mounting plate (8), the drive shaft arm (13, 31) being attached to one surface of the crosshead (15) and the pump piston means (4) being attached to the opposed surface of the crosshead (15).

2. A ram pump assembly (1) according to claim 1 **characterised in that** the mounting plate assembly (5) comprises four pillars (6).
3. A ram pump assembly (1) according to any one of the preceding claims **characterised in that** the drive means (12) comprises a hydraulic piston (13).
4. A ram pump assembly (1) according to claim 3 **characterised in that** the hole (11) in the mounting plate (8) is round and is sized to provide an easy fit for a flange of the hydraulic piston (13) to pass through.
5. A ram pump assembly (1) according to claim 1 or claim 2 **characterised in that** the drive means (12) comprises a crank drive (30).
6. A ram pump assembly (1) according to claim 5 **characterised in that** the hole (11) in the mounting plate (8) is square to allow reciprocating movement of the drive shaft arm (31) of the crank drive (30).
7. A ram pump assembly (1) according to any one of the preceding claims **characterised in that** the crosshead (15) comprises at least two arms (16,17) with slidable attachment means (18,19) at the ends that are slidably mounted on corresponding pillars (6).
8. A ram pump assembly (1) according to claim 7 **characterised in that** the attachment means comprise sleeves (18,19) that fit over the pillars (6) so that the crosshead (15) can slide up and down but is held rigidly so that it cannot move sideways with respect to the pump body (3).
9. A ram pump assembly (1) according to any one of the preceding claims **characterised in that** the height of the pillars (6) is selected to provide an optimum gap for the height of the drive shaft arm (13,31).
10. A ram pump assembly (1) according to claim 9 **characterised in that** the pillar height can be adjusted or the pillars (6) can be changed to provide different heights to enable the optimum stroke length to be achieved for various discharge flow rates.
11. A mounting plate assembly (5) for use with a ram pump according to claim 1 comprising:
  - at least three pillars (6) adapted to be attached at one end to the pump body (3);
  - a mounting plate (8) attached to the other end of each of the pillars (6) and comprising a hole (11) therethrough; and
  - a crosshead (15) slidably mounted on at least two of the pillars (6).

12. A mounting plate assembly (5) according to claim 11 **characterised in that** the mounting plate assembly (5) comprises four pillars (6).
13. A mounting plate assembly (5) according to claim 11 or claim 12 **characterised in that** the crosshead (15) comprises at least two arms (16,17) with slidable attachment means (18,19) at the ends that are slidably mounted on corresponding pillars (6).
14. A mounting plate assembly (5) according to claim 13 **characterised in that** the attachment means comprise sleeves (18,19) that fit over the pillars (6) so that the crosshead (15) can slide up and down but is held rigidly.

## Revendications

1. Un ensemble de pompe à piston (1), comprenant :
  - une pompe à piston (2), comprenant un corps de pompe (3) et des moyens formant piston de pompe (4) ;
  - des moyens d'entraînement (12) ayant un bras d'arbre entraînement (13, 31) ; et
  - un ensemble de plaque de montage (5),

**caractérisé en ce que** l'ensemble de plaque de montage (5) comprend :

- au moins trois piliers (6), attachés à une extrémité au corps de pompe (3) ;
- une plaque de montage (8), attachée à l'autre extrémité de chacun des piliers (6) et comprenant à travers elle un trou (11) ; et
- une crosse de piston (15), montée à coulissement sur au moins deux des piliers (6) ;

et dans lequel les moyens d'entraînement (12) sont montés sur la plaque de montage (8), le bras d'arbre entraînement (13, 31) s'étendant à travers le trou (11) ménagé dans la plaque de montage (8), le bras d'arbre entraînement (13, 31) étant fixé à une surface de la crosse de piston (15) et les moyens formant piston de pompage (4) étant attachés à la surface opposée de la crosse de piston (15).

2. Un ensemble de pompe à piston (1) selon la revendication 1, **caractérisé en ce que** l'ensemble de plaque de montage (5) comprend quatre piliers (6).
3. Un ensemble de pompe à piston (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les moyens d'entraînement (12) comprennent un piston hydraulique (13).
4. Un ensemble de pompe à piston (1) selon la reven-

dication 3, **caractérisé en ce que** le trou (11) ménagé dans la plaque de montage (8) est rond et est dimensionné pour fournir un ajustement aisé, pour qu'une bride du piston hydraulique (13) passe à travers lui.

5. Un ensemble de pompe à piston (1) selon la revendication 1 ou la revendication 2, **caractérisé en ce que** les moyens d'entraînement (12) comprennent un entraînement à manivelle (30). 10
6. Un ensemble de pompe à piston (1) selon la revendication 5, **caractérisé en ce que** le trou (11) ménagé dans la plaque de montage (8) est carré afin de permettre un déplacement alternatif du bras d'arbre d'entraînement (31) de l'entraînement par manivelle (30). 15
7. Un ensemble de pompe à piston (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la crosse de piston (15) comprend au moins deux bras (16, 17) ayant des moyens de fixation (18, 19) coulissant aux extrémités, qui sont montées à coulissement sur des piliers (6) correspondants. 20
8. Un ensemble de pompe à piston (1) selon la revendication 7, **caractérisé en ce que** les moyens d'attachement comprennent des douilles (18, 19) qui s'ajustent sur les piliers (6), de manière que la crosse de piston (15) puisse coulisser en levée et en descente mais soit maintenue rigidement, de manière à ne pas pouvoir se déplacer latéralement par rapport au corps de pompe (3). 30
9. Un ensemble de pompe à piston (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la hauteur des piliers (6) est sélectionnée pour fournir un intervalle optimal concernant la hauteur du bras d'arbre entraînement (13, 31). 40
10. Un ensemble de pompe à piston (1) selon la revendication 9, **caractérisé en ce que** la hauteur de pilier peut être ajustée ou bien les piliers (6) peuvent être modifiés, pour fournir différentes hauteurs afin de permettre à la longueur de course optimale d'être atteinte pour différents débits de refoulement. 45
11. Un ensemble de plaque de montage (5) pour utilisation avec une pompe à piston selon la revendication 1, comprenant : 50
  - au moins trois piliers (6) adaptés pour être attachés à une extrémité au corps de pompe (3) ;
  - une plaque de montage (8), attachée à l'autre extrémité de chacun des piliers (6) et comprenant à travers elle un trou (11) ; et
  - une crosse de piston (15) montée à coulisse-

ment sur au moins deux des piliers (6).

12. Un ensemble de plaque de montage (5) selon la revendication 1, **caractérisé en ce que** l'ensemble de plaque de montage (6) comprend quatre piliers (6). 5
13. Un ensemble de plaque de montage (5) selon la revendication 11 ou la revendication 12, **caractérisé en ce que** la crosse de piston (15) comprend au moins deux bras (16, 17) ayant des moyens d'attachement (18, 19) coulissant aux extrémités, montés à coulissement sur des piliers (6) correspondants. 10
14. Un ensemble de plaque de montage (5) selon la revendication 13, **caractérisé en ce que** les moyens d'attachement comprennent des douilles (18, 19) qui ajustent sur les piliers (6), de manière que la crosse de piston (15) puisse coulisser en levée et en descente, mais soit maintenue rigidement. 15

#### Patentansprüche

1. Kolbenpumpen-Baueinheit (1), die folgendes umfasst: 25

- eine Kolbenpumpe (2) mit einem Pumpenkörper (3) und Pumpenkolben-Einrichtungen (4),
- Antriebseinrichtungen (12), die einen Antriebswellenarm (13, 31) umfassen, und
- eine Montageplatten-Baueinheit (5),

**dadurch gekennzeichnet, dass** die Montageplatten-Baueinheit (5) folgendes umfasst:

- wenigstens drei Säulen (6), die an einem Ende am Pumpenkörper (3) befestigt sind,
- eine Montageplatte (8), die an dem anderen Ende einer jeden der Säulen (6) befestigt ist und ein durch sie hindurchgehendes Loch (11) aufweist, und
- einen Gleitkopf (15), der in verschieblicher Weise an wenigstens zwei der Säulen (6) montiert ist, wobei die Antriebseinrichtungen (12) an der Montageplatte (8) montiert sind, wobei sich der Antriebswellen-Arm (13, 31) durch das Loch (11) in der Montageplatte (8) erstreckt, und wobei der Antriebswellen-Arm (13, 31) an der einen Oberfläche des Gleitkopfes (15) und die Pumpenkolben-Einrichtungen (4) an der gegenüberliegenden Oberfläche des Gleitkopfes (15) montiert sind.

2. Kolbenpumpen-Baueinheit (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Montageplatten-Baueinheit (5) vier Säulen (6) umfasst.
3. Kolbenpumpen-Baueinheit (1) nach einem der vor-

hergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Antriebseinrichtungen (12) einen Hydraulikkolben (13) umfassen.

4. Kolbenpumpen-Baueinheit (1) nach Anspruch 3, **dadurch gekennzeichnet, dass** das Loch (11) in der Montageplatte (8) rund und so bemessen ist, dass es eine Gleitpassung für einen Flansch des durch es hindurch verlaufenden Hydraulikkolbens (13) liefert. 5
5. Kolbenpumpen-Baueinheit (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Antriebseinrichtungen (12) einen Kurbelantrieb (30) umfassen. 10
6. Kolbenpumpen-Baueinheit (1) nach Anspruch 5, **dadurch gekennzeichnet, dass** das Loch (11) in der Montageplatte (8) rechteckig ist, um eine Hin- und Herbewegung des Antriebswellenarms (31) des Kurbelantriebs (30) zu ermöglichen. 15
7. Kolbenpumpen-Baueinheit (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Gleitkopf (15) wenigstens zwei Arme (16, 17) mit Gleitbefestigungseinrichtungen (18, 19) an den Enden umfasst, die in gleitender Weise an entsprechenden Säulen (6) montiert sind. 20
8. Kolbenpumpen-Baueinheit (1) nach Anspruch 7, **dadurch gekennzeichnet, dass** die Befestigungseinrichtungen Hülsen (18, 19) umfassen, die über die Säulen (6) passen, so dass der Gleitkopf (15) auf und abgleiten kann, aber starr so gehalten wird, dass er sich bezüglich des Pumpenkörpers (3) nicht seitlich bewegen kann. 25
9. Kolbenpumpen-Baueinheit (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Höhe der Säulen (6) so gewählt ist, dass ein optimaler Zwischenraum für die Höhe des Antriebswellenarms (13, 31) geschaffen wird. 30
10. Kolbenpumpen-Baueinheit (1) nach Anspruch 9, **dadurch gekennzeichnet, dass** die Säulenhöhe eingestellt werden kann oder dass die Säulen (6) ausgetauscht werden können, um unterschiedliche Höhen zu ergeben, um zu ermöglichen, dass eine optimale Hublänge für verschiedene Abgabe-Strömungsraten erzielt werden kann. 35
11. Montageplatten-Baueinheit (5) zur Verwendung mit einer Kolbenpumpe nach Anspruch 1, die die folgenden Bestandteile umfasst: 40
  - wenigstens drei Säulen (6), die an einem Ende am Pumpenkörper (3) befestigt werden können,
  - eine Montageplatte (8), die am anderen Ende

einer jeden der Säulen (6) befestigt ist und ein durch sie hindurchgehendes Loch (11) aufweist, und

- einen Gleitkopf (15), der in verschieblicher Weise an wenigstens zwei der Säulen (6) montiert ist.

12. Montageplatten-Baueinheit (5) nach Anspruch 11, **dadurch gekennzeichnet, dass** die Montageplatten-Baueinheit (5) vier Säulen (6) umfasst. 45
13. Montageplatten-Baueinheit (5) nach Anspruch 11 oder 12, **dadurch gekennzeichnet, dass** der Gleitkopf (15) wenigstens zwei Arme (16, 17) mit Gleitbefestigungseinrichtungen (18, 19) an den Enden umfasst, die in verschieblicher Weise an entsprechenden Säulen (6) montiert sind. 50
14. Montageplatten-Baueinheit (5) nach Anspruch 13, **dadurch gekennzeichnet, dass** die Befestigungseinrichtungen Hülsen (18, 19) umfassen, die so über die Säulen (6) passen, dass der Gleitkopf (15) auf und abgleiten kann, aber festgehalten wird. 55

Fig. 1

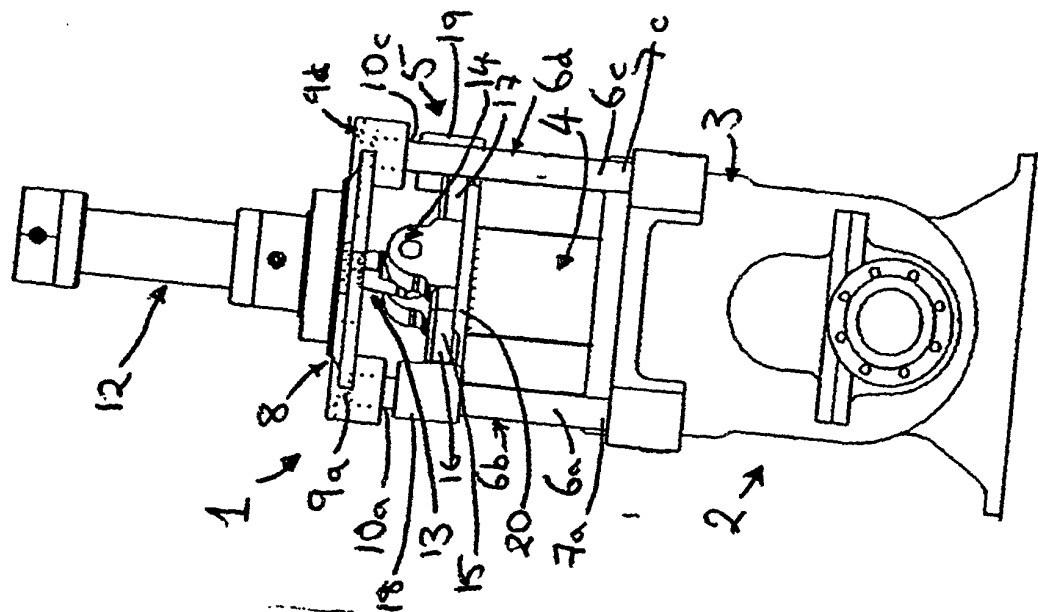


Fig. 2.

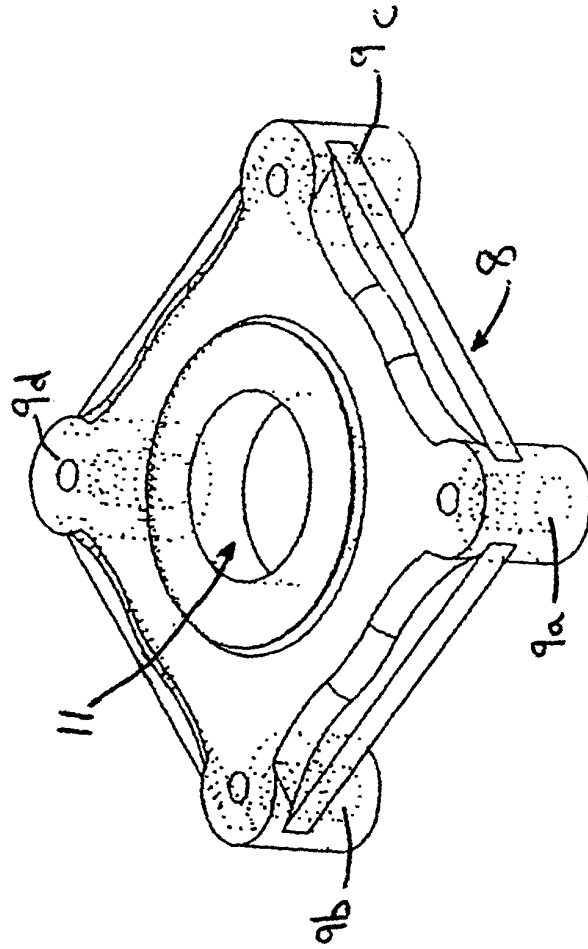


Fig. 3

