



(11) **EP 2 035 708 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:  
**04.05.2011 Bulletin 2011/18**

(21) Application number: **07764954.9**

(22) Date of filing: **29.06.2007**

(51) Int Cl.:  
**F04C 2/107<sup>(2006.01)</sup>**

(86) International application number:  
**PCT/EP2007/005787**

(87) International publication number:  
**WO 2008/000505 (03.01.2008 Gazette 2008/01)**

(54) **MOINEAU PUMP**

MOINEAUPUMPE

POMPE MOINEAU

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR**

(30) Priority: **30.06.2006 DK 200600885**

(43) Date of publication of application:  
**18.03.2009 Bulletin 2009/12**

(73) Proprietor: **Grundfos Management A/S**  
**8850 Bjerringbro (DK)**

(72) Inventors:  
• **GRØNBORG BRUN, Esben**  
**DK-9000 Ålborg (DK)**

- **GRANN, Helge**  
**DK-8850 Bjerringbro (DK)**
- **ANDERSEN, Eigil, Dalgaard**  
**DK-8859 Bjerringbro (DK)**

(74) Representative: **Vollmann, Heiko**  
**Vollmann & Hemmer**  
**Patentanwälte**  
**Wallstrasse 33a**  
**23560 Lübeck (DE)**

(56) References cited:  
**GB-A- 1 583 582 US-B1- 6 361 292**  
**US-E- R E21 374**

**EP 2 035 708 B1**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

## Description

**[0001]** The invention relates to a Moineau pump, i.e. a progressing cavity pump.

**[0002]** Such Moineau or progressive cavity pumps are for example known from US 1,892,217. These pumps consist of a ring shaped outer element and an inner element arranged in the cavity of the ring shaped outer element. Both the inside of the cavity and the outside of the inner element have a helical shape. The inner element is rotating inside the outer element on an eccentric path. Further, the helical structure of the outer element has one more thread than the helical structure of the inner element.

**[0003]** US R E21,374 discloses a progressive cavity pump with an inner element and an outer element, wherein both, the inner and the outer element are rotatable about a longitudinal axis. Further, these two longitudinal axes are inclined to one another.

**[0004]** A problem of such Moineau pumps is the complex motion of the rotor inside the stator. Further, it is difficult to keep the pump cavity between stator and rotor pressure tight at high pressures without increasing the friction and wear of the elements because of occurring friction.

**[0005]** In view of this it is an object of the invention to provide an improved Moineau pump allowing a less complex motion of inner and outer element with reduced wear of the elements.

**[0006]** This object is solved by a Moineau pump having the features defined in claim 1. Preferred embodiments are defined in the subclaims, the following description and enclosed drawings.

**[0007]** The Moineau pump according to the invention comprises an outer helical pumping element and an inner helical pumping element which is arranged inside the outer pumping element. According to this design the outer element is ring shaped with a cavity inside. In this cavity the inner element is arranged. The surface of the cavity of the outer element has a helical shape and the outside of the inner element also has a helical shape. Between the outer surface of the inner element and the inner surface of the outer element the pump chamber or cavity is formed by this helical shape of these two opposing surfaces.

**[0008]** Further, according to the invention the inside of the outer element and the inner element are of conical shape. This means the inner element has an increasing diameter from one end to the opposite other end in the longitudinal direction. The cavity of the outer element has a corresponding shape with an increasing diameter of the cavity from one end to opposite other end in longitudinal direction. According to the invention both the inner and the outer element are rotatable. Both elements are arranged in a manner that they may rotate about their longitudinal axes. The longitudinal axis of the inner element forms a first rotation axis about which the inner element is rotatable. The longitudinal axis of the outer el-

ement forms a second rotation axis about which the outer element is rotatable. Both rotation axes, i.e. the first and the second rotation axes are not parallel to one another, but inclined to each other. This means both axes intersect in one intersection point. The inner and outer element are driven in a way that only one of these elements is directly driven by an external driving means. The other element is driven indirectly by the other element connected to the external driving means. This means according to the invention either the inner element is driven by the outer element or the outer element is driven by the inner element.

**[0009]** This design allows a simplified motion of both elements, i.e. the inner element and the outer element. Both rotation axes are fixed axes. It is not required to arrange a flexible joint or cardan joint in the driving shaft for driving the rotor as necessary with conventional Moineau pumps because of the eccentric motion between inner and outer element. Since according to the invention both elements are rotating both elements fulfil a relative eccentric motion to each other but each element can rotate about a fixed rotation axis which must not move itself.

**[0010]** Because of the inclined rotation axes which results in a linear increasing eccentricity from one end to the other end of the pump a constant flow of the pump can be achieved.

**[0011]** Further, the fixed rotation axes allow a better fitting of inner and outer element which results in reduced friction and wear.

**[0012]** Preferable at least a part of said inner element and/or said outer element are made from at least one rigid material. The rigid or hard material for one of the inner and outer element, preferable for both inner and outer element has the advantage of reduced wear and allows a more precise fitting of both elements. Further, an enhanced reliability and durability can be achieved. In particular the simplified motion between inner and outer element allows the use of such rigid materials for the surfaces of inner and outer element coming into contact with each other. Because of the better fitting a pressure tight contact between inner and outer element can be achieved without the use of elastic materials. It is possible to make the entire inner element and/or the entire outer element from a rigid material. Further, it is also possible to make only parts of these elements from a rigid material, in particular to apply a coating from the rigid material onto the surfaces of the inner element and/or outer element which are in contact with one another. Further, it is possible to make the inner and/or outer element at least partly from one rigid material. Alternatively, several rigid materials can be used for example as composite material. Further, it is possible to make different parts of the element from different materials to exactly adapt these parts to the requirements in particular in view of friction and wear.

**[0013]** In particular it is preferred to make the inner element and/or said outer element from a ceramic ma-

terial. Ceramic material is very hard and has a minimum wear resulting in a high durability of the pumping elements, i.e. the inner and the outer element.

**[0014]** Further, it is preferred that either said inner or said outer element is driven by a driving means, preferably a motor. Such motor may be an electric motor, in particular an AC, DC or PM electric motor. Further, also a hydraulic motor, combustion engine or similar motor may be used to drive the pump according to the invention.

**[0015]** Concerning the use of the motor is preferred that the rotation axis of said motor extends in the same fixed direction as the rotation axis of the element which is directly driven by said motor. This means the rotation axis of the motor is either coupled with the rotation axis of the inner element or the rotation axis of the outer element, depending whether the inner or the outer element is driven by the motor. The element which is not directly driven by the motor is driven by the other element which is coupled to the motor. This means either the inner element is directly driven by the motor and the outer element is driven by the inner element or the outer element is driven directly by the motor and the inner element is driven by the outer element. In both cases the inner element fulfils a rolling movement on the inside of the outer element, the arrangement according to which the rotation axis of the motor extend in the same direction as the rotation axis of the driven element has the advantage that no gears and in particular no flexible joint as for example a cardan is required between the motor axis and the axis of the driven element.

**[0016]** Further, it is preferred that said outer element has one more tooth than said inner element. This means that the helical structure on the inside of the cavity of the outer element has one more tooth or thread than the helical structure on the outside of the inner element.

**[0017]** Said inner element or said outer element is arranged so that said inner element or said outer element is movable in axial direction. This allows the design in which due to a compensation of the axial forces there is no need for axial bearings of the freely movably element, i.e. the element driven by the other element. In case that the inner element is driven by the outer element, preferably the inner element is movable in axial direction. On the other side when the outer element is driven by the inner element, preferably the outer element is movable in axial direction so that no axial bearing is required for this element.

**[0018]** The compensation of the forces is achieved if the inner and the outer element have a conical shape and there is provided a surface on the axially movable element on which the pressure produced by the pump is acting to press said inner element and said outer element together. The surface which is loaded with the pressure produced by the pump is arranged so that an axial force is generated. Preferably the surface is a surface extending normal to the axial direction, preferably an end face of the element. This axial force presses inner and outer element together and acts against the forces generated

by the pressure inside the pump cavity between inner and outer element. This pressure in the pump cavity results in an axial force pushing apart the inner and outer element. This is compensated by the pressure acting on the surface of the axially movable element. This design has the further advantage that the contact pressure between inner and outer element is reduced when the pump is not working. By this wear and tolerances can be reduced. Further, the starting torque of the pump is reduced, since there can be a small clearance between said inner element and said outer element when the pump pressure or pump head, respectively, is zero. With increasing pump pressure the pressure acting on the surface of the axially movable element increases and the force acting on this element and pressing inner and outer element together also increases.

**[0019]** With the increasing compression of inner and outer element with increasing pump pressure it is possible to reduce the friction loss in the pump, since with low pressure the friction between inner and outer element is reduced because of the reduced compression force at low pump pressures.

**[0020]** In case that the surface on which the pump pressure acts to apply an axial force on the movable element is one end face of the element the axial force produced by the pump pressure can be regulated or defined by choosing the size of this surface or area. The area upon which the pump pressure is exerted can be defined by the diameter of the radial bearing. Therefore, the optimal surface area can be achieved by choosing an appropriate diameter of the radial bearing.

**[0021]** The element which is not movable in axial direction is preferably fixed with the motor shaft in axial direction. The element movable in axial direction is preferably fixed in radial bearings in the radial direction.

**[0022]** The material or fluid being pumped by the Moineau pump according to the invention is preferably moved axially basically along a straight line through said pump. This means that the pump cavity between outer and inner element is progressing in axial direction along a straight line when inner and outer element are rotating about their longitudinal axes.

**[0023]** Further, it is preferred that the pump comprises a casing having an inlet and outlet port and said inner element and said outer element are arranged in said casing.

**[0024]** The present invention will become more fully understood from the detailed description given herein below and the accompanying drawings which are given by way example only. In the drawings:

Fig. 1 is a schematic cross section of a Moineau pump according to the invention,

Fig. 2 is a schematic cross section of a Moineau pump according to a second embodiment,

Fig. 3 is a schematic cross section of a Moineau pump

accord- ing to a third embodiment of the inven- tion,

Fig. 4 is a schematic cross section of an arrangement of inner and outer element according to a fourth embodiment of the invention,

Fig. 5 is a schematic cross section of inner and outer element,

Fig. 6 is a cross section of an inner element having one thread,

Fig. 7 is a schematic cross section of an outer element having two threads and

Fig. 8 is a schematic cross section of an outer element having ten teeth or threads.

**[0025]** As shown in the example according to Fig. 1 the Moineau pump comprises an inner element 2 and an outer element 4. Both are of conical shape, i.e. the inner element 2 has a conical outer shape and the cavity of the outer element 4 has a conical inner shape so that the inner element 2 fits into the outer element 4. The outer surface of the inner element 2 and the inner surface of the outer surface 4 have a helical shape with the helical structure of the outer element 4 having one thread more than the helical structure of the inner element 2. Both, inner element 2 and outer element 4 are arranged in a pump housing or casing 6.

**[0026]** The inner element 2 is fixed on a motor shaft (not shown). The motor shaft extends along the longitudinal axis  $X_1$  of the inner element 2. This motor shaft is driving the inner element 2 so that it is rotating about its longitudinal axis  $X_1$  forming a first rotation axis  $X_1$ . The outer element 4 is mounted in radial bearings 8 inside the casing 6. The outer element 4 is freely rotatable about its longitudinal axis  $X_2$  forming a second rotation axis. Further, the outer element 4 is movable in axial direction along the axis  $X_2$  inside the casing 6 and the bearings 8. The radial bearings 8 are fixed in the casing 6.

**[0027]** When the inner element 2 is driven by the motor the inner element 2 rotates so that it fulfils a rolling movement on the inner circumference of the outer element 4 thereby driving the outer element 4 so that it rotates around its longitudinal  $X_2$ . The pump according to Fig. 1 has its pressure side on the side of inner element 2 and outer element 4 having the smaller diameter, the suction side is on the opposite side having the larger diameter. The fluid to be pumped enters the pump housing 6 through inlet 10 and is pumped to outlet 12. Therefore, the pump pressure on the outlet side 12 acts in direction of arrows A parallel to the longitudinal axis  $X_2$  against the outer element 4 so that the outer element 4 is pressed against the outside of the inner element 2. This allows that with increasing pump pressure the pressing force between outer and inner element increases. When the

pump is not working this force can be reduced to zero so that a low starting torque can be achieved.

**[0028]** Since the longitudinal or rotating axes  $X_1$  and  $X_2$  are inclined to one another a linear decreasing eccentricity from the outlet 12 to inlet side 10 is achieved in order to obtain a constant flow of the pump. If said rotation axes would be parallel then the pump will deliver a non constant flow due to the conicity of the inner element 2 and the outer element 4.

**[0029]** A second different embodiment is shown in fig. 2. Also the embodiment according to Fig. 2 has an outer element 4' and an inner element 2' which are arranged and designed as explained above in connection with the first embodiment. The difference between the first and the second embodiment is that according to the second embodiment the outer element 4' is driven by the motor (not shown in fig. 2). The outer element 4' drives the inner element 2'. Therefore, the inner element 2' is mounted for rotation on bearings 14 arranged on a fixed inlet tube 16. The bearings 14 are radial bearings so that the inner element 2' is movable in axial direction parallel to the longitudinal axis of the inlet tube 16. Further, the inner element 2' is rotatable about this longitudinal axis. The outer element 4' rotates about a second longitudinal axis inclined to the longitudinal axis of the inlet tube 16 corresponding to the embodiment of Fig.1. The outer element 4' is connected with the motor shaft and mounted in axial and radial bearings.

**[0030]** The pump is arranged in pump housing or casing 6' having the inlet tube 16 and an outlet 18. The driving shaft of the outer element 4 is passed through a shaft seal 20 which prevents leakage in the motor and of the pump.

**[0031]** When the rotation starts the pump pressure produced by the pump or pump head, respectively, will be built up and act on the surface 22, i.e. the axial end face of the inner element 2' on the outlet or pressure side of the pump. Thereby it exerts a force pressing said inner element 2' against said outer element 4' and thereby increasing the contact force or contact pressure between inner element 2' and outer element 4'. Thereby, the internal leakage of the pump is reduced. This design achieves a leakage tight contact between inner element 2' and outer element 4' at high pressure and at the same time reduces the friction at low pressures or when the pump is not working, since then no pressure is acting on surface 22 so that the contact pressure between inner element 2' and outer element 4' is reduced.

**[0032]** Fig. 3 shows an embodiment corresponding to the embodiment according to Fig.1. It can be seen that the rotation axis  $X_1$  of the motor and the inner element 2 is inclined to the longitudinal and rotation  $X_2$  of the outer element 4. The motor 24 is connected to the pump casing 6 and the motor shaft 26 is passed through a seal 28.

**[0033]** In the embodiment according to the Figs. 1 and 3 the inner element 2 drives the outer element 4. The speed of the outer element is determined by the product of the speed of the inner element 2 and the of teeth or threads of said inner element and said outer element.

That means if said inner element has a circular cross section as shown in Fig. 6 (having one tooth or thread) then said outer element has a cross section as elongated circle as shown Fig. 7 (two threads or teeth) and the rotational speed of the outer element 4 will be the half of the rotational speed of the inner element 2. On the other hand if said inner element has nine teeth or threads then said outer element has ten teeth or threads as shown in the cross sectional view of Fig. 8 and the speed of said outer element will be nine tenth of the speed of said inner element.

**[0034]** The motor 24 may be an electro motor AC, DC, PM or hydraulic motor, combustion engine or similar.

**[0035]** Fig. 4 shows a further possibility to arrange the outer element 4" and the inner element 2". According to the embodiment of Fig. 4 the pressure side or outlet 30 of the pump is arranged on the small diameter end of the conical inner element 2" and the conical outer element 4". To achieve the effect that the inner element is pressed against the outer element 4" by the pump pressure on the outlet side 30 the inner element 2" has an internal channel 32 extending along its longitudinal axis from the pressure side 30 to the opposite side. On the opposite side this channel 32 is broadend so that a surface 34 is formed which is directed opposite to the pressure side 30. By this, the outlet pressure produced by the pump acts on the surface 34 and presses the inner element 2" against the outer element 4" with increasing pressure as explained above.

**[0036]** Further, it has to be understood that all aspects discussed in connection with the embodiments according to Figs. 1 to 3 may also be applied to the embodiment according to Fig. 4.

**[0037]** Generally a progressive cavity pump (PCP) or Moineau pump has two parts (inner part 2 and outer part 4) rotating relative to each other and moving in an eccentric track relative to each other. According to the present invention this is achieved by the inclined rotation axes  $X_1$  and  $X_2$  of the inner and outer part.

**[0038]** The shapes in cross section, in particular along its spherical cross section with the intersection point of both rotation axes forming the centre point of this sphere can be made of pieces of hypocycloids connected with epicycloids as shown in Fig. 5. Alternatively it can be occurred with constant distance or offset to hypocycloids. In the axial direction the cross section is rotated around the longitudinal axis so that it forms at least one thread or tooth on the outside of the inner part and at least two threads or teeth on the inside of the outer part 4.

**[0039]** For the n-teeth shape running inside an n+1 teeth shape the number of threads or teeth of the inner part is (n+1)/n times the number of threads or teeth of the outer part. The centre of the inner element 2 is offset relative to the centre of the outer element 4 and moving in a circle with a radius e (eccentricity), In the present case because of the conical shape the eccentricity is increasing from one longitudinal end of the pump to the other longitudinal end.

## List of reference numerals

### [0040]

5	2, 2', 2"	inner element
	4, 4', 4"	outer element
	6	casing
	8	radial bearing
	10	inlet
10	12	outlet
	14	bearing
	16	inlet tube
	18	outlet
	20	seal
15	22	surface
	24	motor
	26	motor shaft
	28	seal
	30	outlet
20	32	channel
	34	surface
	$X_1$	first rotation axis
	$X_2$	second rotation axis
	A	direction of axial force
25		

## Claims

1. Moineau pump having an outer helical pumping element (4; 4') and an inner helical pumping element (2; 2') arranged in inside the outer element (4; 4'), wherein  
the inside of the outer element (4; 4') and the inner element (2; 2') are of conical shape,  
the inner element (2; 2') is rotatable about its longitudinal axis ( $X_1$ ) forming a first fixed rotation axis ( $X_1$ ) and the outer element (4; 4') is rotatable about its longitudinal axis ( $X_2$ ) forming a second fixed rotation axis ( $X_2$ ),  
and wherein the first rotation axis ( $X_1$ ) and the second rotation axis ( $X_2$ ) are inclined to one another and the inner element (2; 2') is driven by the outer element (4; 4') or the outer element (4; 4') is driven by the inner element (2; 2'), **characterized in that** said inner element (2; 2') or said outer element (4; 4') is arranged so that  
said inner element (2; 2') or said outer element (4; 4') is movable in axial direction and that there is provided a surface on the axially movable element onto which the pressure produced by the pump is acting such that the action of the pressure results in an axial force pressing inner (2; 2') and outer (4; 4') element together.
2. Moineau pump according to claim 1, **characterized in that** at least a part of said inner element (2; 2') and/or said outer element (4; 4') is made from at least one a rigid material.

3. Moineau pump according to claim 2, **characterized in that** said inner element (2; 2') and/or said outer element (4; 4') are made from a ceramic material.
4. Moineau pump according to one of the preceding claims, **characterized in that** either said inner (2; 2') or said outer element (4; 4') is driven by a driving means, preferably a motor (24).
5. Moineau pump according to claim 4, **characterized in that** either said inner element (2; 2') or said outer element (4; 4') is driven by a motor (24), wherein the rotation axis of said motor extends in the same direction as said rotation axis of said element driven by said motor (24).
6. Moineau pump according to one of the preceding claims, **characterized in that** said outer element (4; 4') has one more tooth than said inner element (2; 2').
7. Moineau pump according to one of the preceding claims, **characterized in that** the material or fluid being pumped is moved axially basically along a straight line through said pump.
8. Moineau pump according to one of the preceding claims, **characterized in that** the pump comprises a casing (6; 6') having inlet (10; 16) and outlet (12; 18) ports and said inner element (2; 2') and said outer element (4; 4') arranged in said casing (6; 6').

#### Patentansprüche

1. Moineau-Pumpe, die ein äußeres spiralförmiges Pumpelement (4; 4') und ein inneres spiralförmiges Pumpelement (2; 2'), das innerhalb des äußeren Elements (4; 4') angeordnet ist, hat, wobei die Innenseite des äußeren Elements (4; 4') und das innere Element (2; 2') eine konische Form haben, das innere Element (2; 2') um eine Längsachse ( $X_1$ ) drehbar ist, die eine erste feststehende Drehachse ( $X_1$ ) bildet, und das äußere Element (4; 4') um eine Längsachse ( $X_2$ ) drehbar ist, die eine zweite feststehende Drehachse ( $X_2$ ) bildet, und wobei die erste Drehachse ( $X_1$ ) und die zweite Drehachse ( $X_2$ ) zueinander geneigt sind und das innere Element (2; 2') durch das äußere Element (4; 4') angetrieben wird oder das äußere Element (4; 4') durch das innere Element (2; 2') angetrieben wird, **dadurch gekennzeichnet, dass** das innere Element (2; 2') oder das äußere Element (4; 4') so angeordnet ist, dass das innere Element (2; 2') oder das äußere Element (4; 4') in Axialrichtung beweglich ist und dass an dem in Axialrichtung beweglichen Element eine Fläche bereitgestellt wird, auf die der durch die Pumpe erzeugte Druck einwirkt derart, dass die Einwirkung

des Drucks zu einer Axialkraft führt, die das innere (2; 2') und das äußere (4; 4') Element zusammendrückt.

2. Moineau-Pumpe nach Anspruch 1, **dadurch gekennzeichnet, dass** wenigstens ein Teil des inneren Elements (2; 2') und/oder des äußeren Elements (4; 4') aus wenigstens einem starren Werkstoff hergestellt ist.
3. Moineau-Pumpe nach Anspruch 2, **dadurch gekennzeichnet, dass** das innere Element (2; 2') und/oder das äußere Element (4; 4') aus einem keramischen Werkstoff hergestellt sind.
4. Moineau-Pumpe nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** entweder das innere (2; 2') oder das äußere (4; 4') Element durch ein Antriebsmittel, vorzugsweise einen Motor (24), angetrieben wird.
5. Moineau-Pumpe nach Anspruch 4, **dadurch gekennzeichnet, dass** entweder das innere (2; 2') oder das äußere (4; 4') Element durch einen Motor (24) angetrieben wird, wobei sich die Drehachse des Motors in der gleichen Richtung erstreckt wie die Drehachse des durch den Motor (24) angetriebenen Elements.
6. Moineau-Pumpe nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das äußere Element (4; 4') einen Zahn mehr hat als das innere Element (2; 2').
7. Moineau-Pumpe nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das gepumpte Material oder Fluid in Axialrichtung im Grunde genommen längs einer geraden Linie durch die Pumpe bewegt wird.
8. Moineau-Pumpe nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Pumpe ein Gehäuse (6; 6') umfasst, das Einlass- (10; 16) und Auslass- (12; 18) Anschlüsse hat und das innere Element (2; 2') und das äußere Element (4; 4') in dem Gehäuse (6; 6') angeordnet sind.

#### Revendications

1. Pompe Moineau comportant un élément de pompage hélicoïdal extérieur (4; 4'), et un élément de pompage hélicoïdal intérieur (2; 2') agencé à l'intérieur de l'élément extérieur (4; 4'), dans laquelle l'intérieur de l'élément extérieur (4; 4') et de l'élément intérieur (2; 2') sont de forme conique, l'élément intérieur (2; 2') peut tourner autour de son axe longitudinal ( $X_1$ ) qui forme un premier axe de

rotation fixe ( $X_1$ ), et l'élément extérieur (4 ; 4') peut tourner autour de son axe longitudinal ( $X_2$ ) qui forme un second axe de rotation fixe ( $X_2$ ),

et dans laquelle le premier axe de rotation ( $X_1$ ) et le second axe de rotation ( $X_2$ ) sont inclinés l'un par rapport à l'autre, et l'élément intérieur (2 ; 2') est entraîné par l'élément extérieur (4 ; 4') ou l'élément extérieur (4, 4') est entraîné par l'élément intérieur (2 ; 2'),

**caractérisée en ce que** ledit élément intérieur (2 ; 2') ou ledit élément extérieur (4 ; 4') est agencé de telle manière que ledit élément intérieur (2 ; 2') ou ledit élément extérieur (4 ; 4') soit mobile dans la direction axiale et **en ce qu'il** est prévu sur l'élément mobile dans la direction axiale une surface sur laquelle la pression produite par la pompe agit de telle manière que l'action de la pression ait pour résultat une force axiale qui presse l'élément intérieur (2 ; 2') et l'élément extérieur (4 ; 4') l'un contre l'autre.

dans ledit corps (6 ; 6').

- 5
- 10
- 15
- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55
2. Pompe Moineau selon la revendication 1, **caractérisée en ce qu'**au moins une partie dudit élément intérieur (2 ; 2') et/ou dudit élément extérieur (4 ; 4') est faite d'au moins une matière rigide
  3. Pompe Moineau selon la revendication 2, **caractérisée en ce que** ledit élément intérieur (2 ; 2') et/ou ledit élément extérieur (4 ; 4') est ou sont fait(s) d'une matière céramique.
  4. Pompe Moineau selon l'une des revendications précédentes, **caractérisée en ce que**, soit ledit élément intérieur (2 ; 2'), soit ledit élément extérieur (4 ; 4') est entraîné par un moyen d'entraînement, de préférence par un moteur (24).
  5. Pompe Moineau selon la revendication 4, **caractérisée en ce que**, soit ledit élément intérieur (2 ; 2'), soit ledit élément extérieur (4 ; 4') est entraîné par un moteur (24), l'axe de rotation dudit moteur s'étendant dans la même direction que ledit axe de rotation dudit élément entraîné par ledit moteur (24).
  6. Pompe Moineau selon l'une des revendications précédentes, **caractérisée en ce que** ledit élément extérieur (4 ; 4') a une dent de plus que ledit élément intérieur (2 ; 2').
  7. Pompe Moineau selon l'une des revendications précédentes, **caractérisée en ce que** la matière ou le fluide qui est pompé circule axialement à travers ladite pompe, sensiblement selon une ligne droite.
  8. Pompe Moineau selon l'une des revendications précédentes, **caractérisée en ce que** la pompe comprend un corps (6 ; 6') ayant des orifices d'entrée (10; 16) et de sortie (12 ; 18) et ledit élément intérieur (2 ; 2') et ledit élément extérieur (4 ; 4') sont agencés

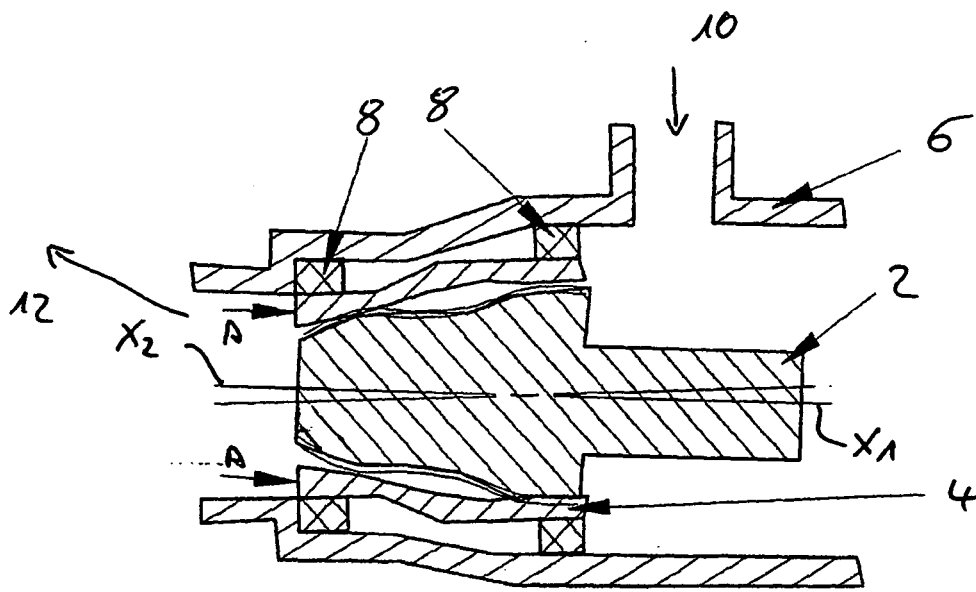


Fig. 1

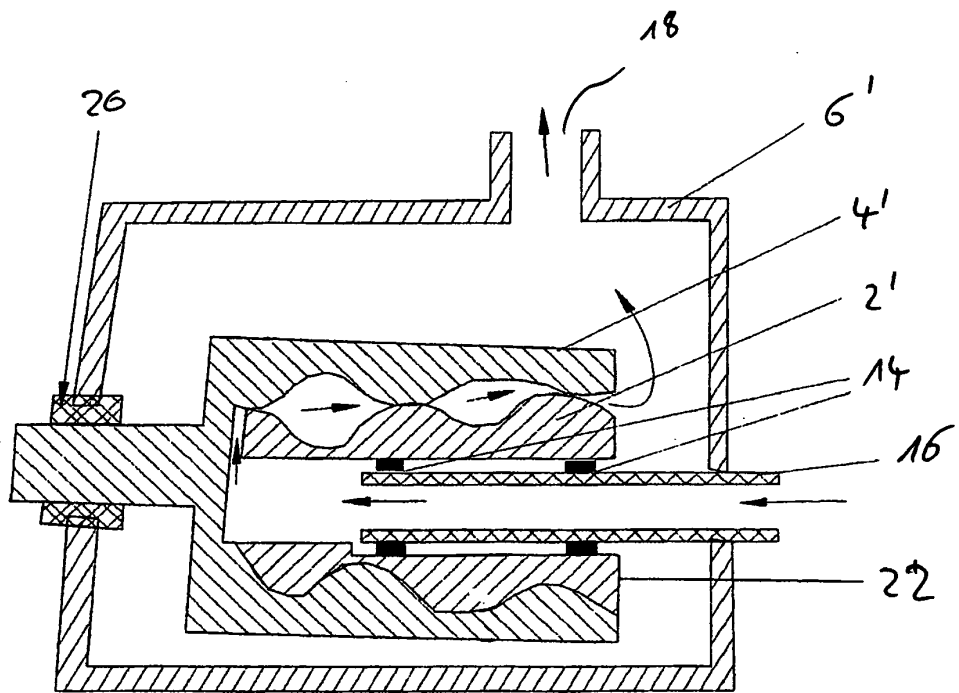


Fig. 2

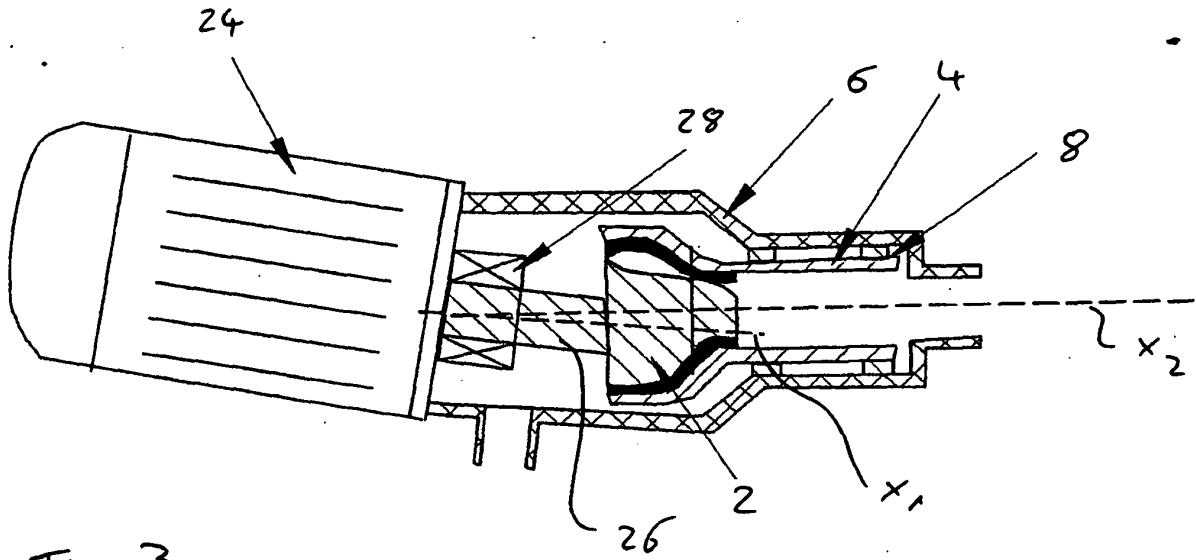


Fig. 3

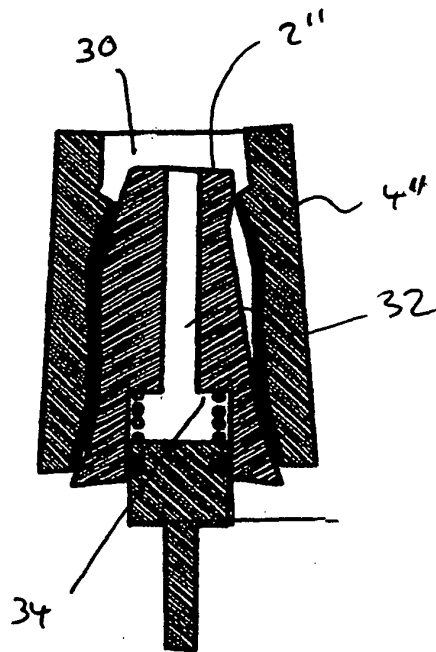


Fig. 4

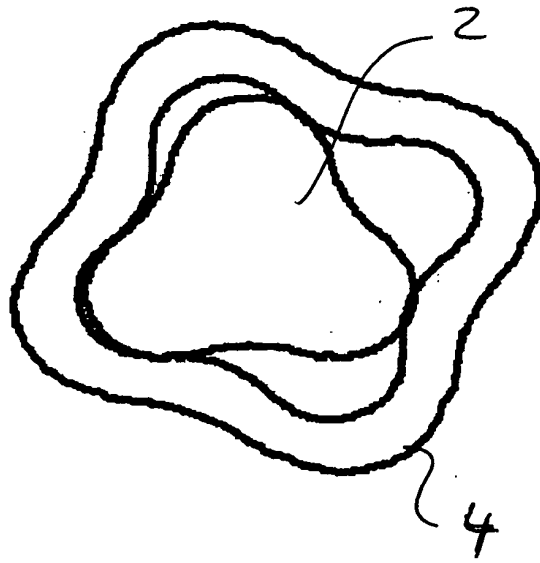


Fig. 5

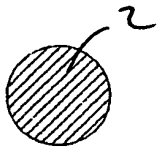


Fig. 6

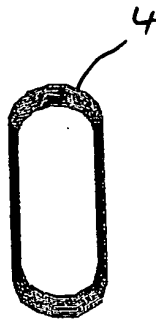


Fig. 7

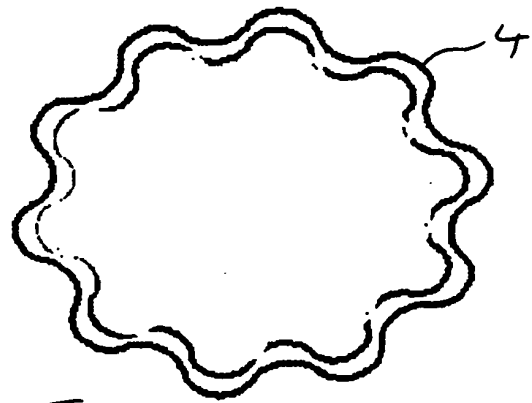


Fig. 8

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- US 1892217 A [0002]
- US RE21374 E [0003]