(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 757 758 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
28.10.1998 Bulletin 1998/44

(21) Application number: **95916853.5**

(22) Date of filing: **28.04.1995**

(51) Int Cl.[6]: **F04C 11/00**, F04C 2/16

(86) International application number:
PCT/NL95/00157

(87) International publication number:
WO 95/30090 (09.11.1995 Gazette 1995/48)

(54) **AN INSTALLATION AND A METHOD FOR PUMPING UP FLUID FROM THE EARTH'S CRUST**

VERFAHREN UND VORRICHTUNG ZUR FÖRDERUNG VON FLUIDEN AUS ÖLBOHRLÖCHERN

INSTALLATION ET PROCEDE D'EXTRACTION PAR POMPAGE D'UN LIQUIDE A PARTIR DE LA CROUTE TERRESTRE

(84) Designated Contracting States:
DE FR IT SE

(30) Priority: **29.04.1994 NL 9400708**

(43) Date of publication of application:
12.02.1997 Bulletin 1997/07

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EP 0 757 758 B1

Description

Liquids from the earth's crust such as petroleum are usually pumped up either with a suction pump (for instance a so-called nodding donkey) or with a pump lowered into a drilled hole and having a screw-like member. Such a pump for this purpose usually comprises a screw member (rotor) of metal which is rotatably drivable relative to a statically arranged member (stator) of rubber or plastic-like material.

In particular oil fields a viscous petroleum type which may also be hot, for instance in the order of 150-300°C, can cause a high degree of wear, particularly of the rubber or plastic-like stator. Since such a lowered pumping means can be situated at considerable depth, for example up to 1000-2000 m into the earth's crust, maintenance of such pumps is laborious, time-consuming and therefore costly due to standstill losses in petroleum production.

Known from the European patent application EP-A-0168366 is an apparatus for pumping up oil wherein both the pump and the drive means are immersed in the oil or other liquids. When in this known apparatus maintenance of the drive means has to be carried out, the whole apparatus must be raised from the bore hole to above the ground surface, which is time-consuming and whereby oil extraction must be interrupted. This apparatus further makes use of balancing collars, whereby the bearing construction will be subject to wear due to sand or dirt occurring in the liquid, while this bearing construction is also complicated and play can easily occur therein.

Also known from the European patent application EP-A-0280294 is a device, with which the earth's crust can be inspected for test purposes. Contrary to the above mentioned pumps, the pump contained in the device is located at the earth's surface. However in this application use is made of a worm pump instead of a screw pump that usually is employed for pumping up (large amounts of) oil. The device according to this application is therefore not suitable for pumping up oil or other liquids from the earth's crust.

Further known from the German Offenlegungsschrift DE-A-3718863 is a screw pump for use in an automobile which, if only because of the dimensions, is not suitable for pumping up oil or other liquids from the earth's crust.

The present invention provides an installation for pumping up liquids from the earth's surface, comprising:

- a screw pump lowered into the earth which is provided with a first screw member and a counter-screw member, the liquid being transported or pumped up upwardly between helical grooves and helical ridges there between, characterized by
- drive means arranged on or close to the surface and spaced from the screw pump, and for driving the screw member which in turn drives the counter-screw member;
- mechanical transmission means for mechanically transmitting the driving force produced by the drive means, which mechanical transmission means extend from the drive means on or close to the earth's surface to the lowered screw pump; and
- one or more axial and or radial ceramic slide bearings for bearing mounting of the first screw member and/or the counter-screw member which are both lowered to a level substantially below the earth's surface.

Because the drive means are disposed close to the earth's surface and the driving movement is transmitted to the lowered screw pump via transmission means, maintenance of the drive means can be performed easily and large standstill losses can be avoided.

The screw member and/or the counter-screw member are preferably provided with slide bearings, wherein lubrication can take place by the liquid for pumping up. This also prevents the screw member and/or the counter-screw member from lying against the housing of the pump, so that wear is limited to a minimum. It is anticipated that the lifespan of a screw pump according to the present invention will amount to a minimum of 10,000 hours before maintenance thereon has to be carried out.

Two or more screw pumps are preferably lowered into the earth in series. If in this preferred embodiment both screw pumps are designed to produce a pumping pressure of 30 bar, in total 60 bar, it may occur that due to small differences in dimensioning of each of the screw pumps one of the two screw pumps produces in the first instance a pressure greater than 30 bar. After a time the pressure build-up by this first screw pump will decrease slightly due to a certain degree of wear, wherein this decrease is however compensated by the second screw pump, so that the total required 60 bar is maintained.

The present invention further provides a method for pumping liquids from the earth's crust, wherein one or more screw pumps, each comprising a screw member and a counter-screw member, is lowered into a hole drilled in the earth's surface, wherein the first screw member is driven close to or above the earth's surface and the counter-screw member is driven by the screw member and wherein the liquid is pumped up between the screw member and the second screw member.

Further advantages, features and details of the present invention will become apparent in the light of the following description with reference to the annexed drawings, in which:

fig. 1 shows a sectional view under the earth's surface of a first preferred embodiment of an installation according to the present invention for performing the method according to the present invention;
fig. 2 shows a side view along line II-II of the installation of fig. 1;
fig. 3 is a sectional view above the lower screw

pump of a second preferred embodiment of the installation according to the present invention;
fig. 4 shows a view in cross section of detail IV of fig. 1;
fig. 5 shows a view in cross section of detail V of fig. 1; and
fig. 6 is a view along line VI-VI in fig. 5.

A first preferred embodiment of an installation 1 according to the present invention (fig. 1, 2, 5 and 6) contains drive means 8 disposed on the ground S and provided with a connecting flange 2 for connection to a drain pipe 3 for the pumped-up oil. Driven by drive means 8 is a tube, rod or shaft 4 which transmits the drive power to a depth of for instance 1000 or 2000 metres in the ground to an assembly of two screw pumps 5 and 6. Each of the screw pumps, for instance screw pump 6, comprises a driven screw member 7 and a counter-screw member 9 which is driven by the associated screw member. Screw member 7 and counter-screw member 9 are mutually adapted such that the liquid is transported between the helical grooves and helical ridges, while the counter-screw member follows precisely the movement of the screw member.

The screw member and the counter-screw member are preferably manufactured from hardened stainless steel which can withstand temperatures of 300°C and is little subject to wear. It can further be seen, particularly in fig. 1, 2 and 6, that the drive rod 4 and the screw pumps 5 and 6 can be received in a closed housing which has for instance a largest diameter d of about 15 cm so that the installation can be applied in a bore hole with such a dimension which may or may not be provided with a cemented casing.

At a length in the order of magnitude of 1 metre a pressure of about 30-40 Bar can be produced by the above described screw pump shown in the figures, so that the petroleum can be pumped from a considerable depth, for instance 1000-3000 metres. When a number of screw pumps are placed in series in the manner shown it is possible to work at still greater depth.

The screw members and counter-screw members are preferably provided in each case with axial and radial bearing elements 30, 31, respectively 32, 33, 34 and 35 (fig. 5) of ceramic material which are lubricated by the petroleum for pumping up.

Fig. 3 shows a second preferred embodiment of an installation for performing the method according to the present invention, wherein a first pump 10 is lowered to great depth while a second screw pump 11 is situated close to the surface at ground level S. If maintenance has to be carried out on this second screw pump 11 the drive rod 4' does not have to be withdrawn completely from the bore hole.

The rights applied for are not limited by the above described preferred embodiments, but are defined in the first instance by the following claims. It is recommended that two or more screw pumps are lowered along the bore hole in interspaced manner, wherein the upper screw pump is situated at a minimum of for instance 300 metres below ground level and no pressures higher than 30 bar will occur in the installation.

Claims

1. An installation (1) for pumping up liquid from the earth's crust, comprising:
   - a screw pump (5, 6) lowered into the earth which is provided with a first screw member (7) and a counter-screw member (9), the liquid being transported or pumped up upwardly between helical grooves and helical ridges there between, characterized by
   - drive means (8) arranged on or close to the surface and spaced from the screw pump, and for driving the screw member (7) which in turn drives the counter-screw member (9);
   - mechanical transmission means (4) for mechanically transmitting the driving force produced by the drive means (8), which mechanical transmission means extend from the drive means (8) on or close to the earth's surface to the lowered screw pump (5, 6); and
   - one or more axial and or radial ceramic slide bearings (30 -35) for bearing mounting of the first screw member and/or the counter-screw member which are both lowered to a level substantially below the earth's surface.

2. An installation (1) according to claim 1, characterized in that the transmission means comprise one or more shafts (4).

3. An installation (1) according to claim 1 or 2, characterized in that the first screw member (7) and/or the counter screw member (9) are manufactured from heat resistant and hard material.

4. An installation (1) according to claim 3, characterized in that the material is hardened stainless steel.

5. An installation according to claim 1, 2 or 3, characterized in that two or more screw pumps are placed in series under the earth's surface.

6. A method for pumping liquid from the earth's crust wherein one or more screw pumps (5, 6), each comprising a screw member (7) and a counter screw member (9), is lowered into a hole drilled in the earth's surface, wherein the first screw member (7) is driven close to or above the earth's surface, and the counter screw member (9) is driven by the screw member (7), wherein the liquid is pumped up between the screw member (7) and the counter screw

member (9) and wherein bearings for the screw member and the counter screw member (9) are lubricated by the pumped liquid.

Patentansprüche

1. Eine Vorrichtung (1) zum Heraufpumpen von Flüssigkeit aus der Erdkruste, die aufweist:

   - eine Schraubenpumpe (5, 6), die in die Erde abgesenkt ist und mit einem ersten Schraubenelement (7) und einem Gegenschraubenelement (9) versehen ist, wobei die Flüssigkeit zwischen deren Schraubennuten und Schraubenrücken nach oben transportiert oder heraufgepumpt wird, gekennzeichnet durch

   - Antriebsmittel (8), die auf oder nahe der Oberfläche und von der Schraubenpumpe beabstandet, angeordnet sind und das Schraubenelement (7) antreiben, das wiederum das Gegenschraubenelement (9) antreibt;

   - mechanische Übertragungsmittel (4) zum mechanischen Übertragen der durch die Antriebsmittel (8) erzeugten Antriebskraft, wobei sich die mechanischen Übertragungsmittel von dem Antriebsmittel (8) auf oder nahe der Erdoberfläche zu der abgesenkten Schraubenpumpe (5, 6) erstrecken und

   - ein oder mehrere axiale und/oder radiale, keramische Gleitlager (30, 35) zur gelagerten Montage des ersten Schraubenelementes und/oder des Gegenschraubenelementes, die beide auf ein Niveau im wesentlichen unterhalb der Erdoberfläche abgesenkt sind.

2. Vorrichtung (1) nach Anspruch 1, dadurch gekennzeichnet, daß die Übertragungsmittel einen oder mehrere Schäfte (4) aufweisen.

3. Vorrichtung (1) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das erste Schraubenelement (7) und/oder das Gegenschraubenelement (9) aus hitzebeständigem oder hartem Material hergestellt sind.

4. Vorrichtung (1) nach Anspruch 3, dadurch gekennzeichnet, daß das Material gehärteter, rostfreier Stahl ist.

5. Vorrichtung nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß zwei oder mehrere Schraubenpumpen in Reihe unter der Erdoberfläche angeordnet sind.

6. Verfahren zum Pumpen von Flüssigkeit aus der Erdkruste, wobei eine oder mehrere Schraubenpumpen (5, 6), von denen jede ein Schraubenelement (7) und ein Gegenschraubenelement (9) aufweist, in ein in die Erdoberfläche gebohrtes Loch abgesenkt ist/sind, wobei das erste Schraubenelement (7) nahe oder oberhalb der Erdoberfläche angetrieben wird und das Gegenschraubenelement (9) durch das Schraubenelement (7) angetrieben wird, wobei Flüssigkeit zwischen dem Schraubenelement (7) und dem Gegenschraubenelement (9) heraufgepumpt wird und wobei Lager für das Schraubenelement und das Gegenschraubenelement (9) durch die gepumpte Flüssigkeit geschmiert werden.

Revendications

1. Installation (1) destinée à pomper un liquide provenant de la croûte terrestre, comprenant:

   - une pompe à vis (5,6) descendue dans la terre, laquelle est munie d'un premier élément (7) formant vis et d'un élément (9) formant contre-vis, le liquide étant transporté ou pompé vers le haut entre des rainures et des arêtes hélicoïdales passant entre les rainures, caractérisée par:
   - des moyens d'entraînement (8) placés sur ou près de la surface et distants de la pompe à vis, et destinés à entraîner l'élément (7) formant vis, lequel à son tour entraîne l'élément (9) formant contre-vis;
   - des moyens de transmission mécanique (4) destinés à transmettre mécaniquement la force d'entraînement produite par les moyens d'entraînement (8), lesquels moyens de transmission mécanique s'étendent depuis les moyens d'entraînement (8) placés sur ou près de la surface de la terre jusqu'à la pompe à vis (5,6) descendue; et
   - un ou plusieurs paliers (30 à 35) en céramique à glissement de sens axial et/ou radial, pour monter à l'aide de paliers le premier élément formant vis et/ou l'élément formant contre-vis qui sont tous deux descendus à un niveau sensiblement en-dessous de la surface de la terre.

2. Installation (1) selon la revendication 1, caractérisée en ce que les moyens de transmission comprennent un ou plusieurs arbres (4).

3. Installation (1) selon la revendication 1 ou 2, caractérisée en ce que le premier élément (7) formant vis et/ou l'élément (9) formant contre-vis sont fabriqués dans un matériau dur et résistant.

4. Installation (1) selon la revendication 3, caractérisée en ce que ledit matériau est un acier inoxydable trempé.

5. Installation selon la revendication 1, 2 ou 3, caractérisée en ce que deux ou plusieurs pompes à vis sont placées en série sous la surface de la terre.

6. Procédé pour pomper un liquide à partir de la croûte terrestre, dans lequel une ou plusieurs pompes à vis (5,6), chacune comprenant un élément (7) formant vis et un élément (9) formant contre-vis, est (sont) descendue(s) dans un trou foré dans la surface la terre, le premier élément (7) formant vis étant entraîné près ou au-dessus de la surface de la terre, et l'élément (9) formant contre-vis étant entraîné par l'élément (7) formant vis, le liquide étant pompé entre l'élément (7) formant vis et l'élément (9) formant contre-vis, et des paliers pour l'élément formant vis et l'élément (9) formant contre-vis étant lubrifiés par le liquide pompé.

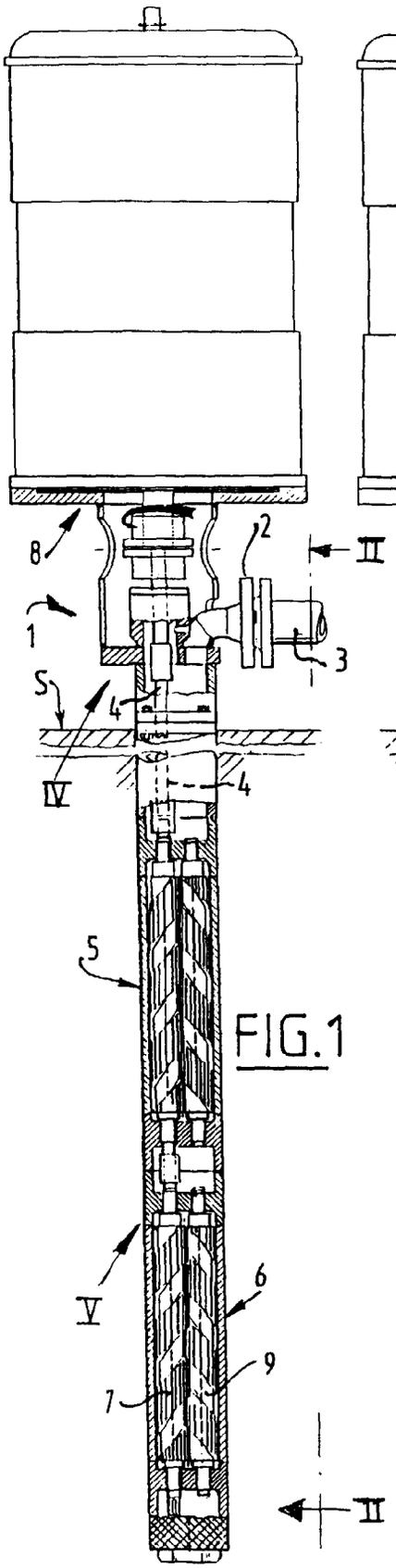


FIG.1

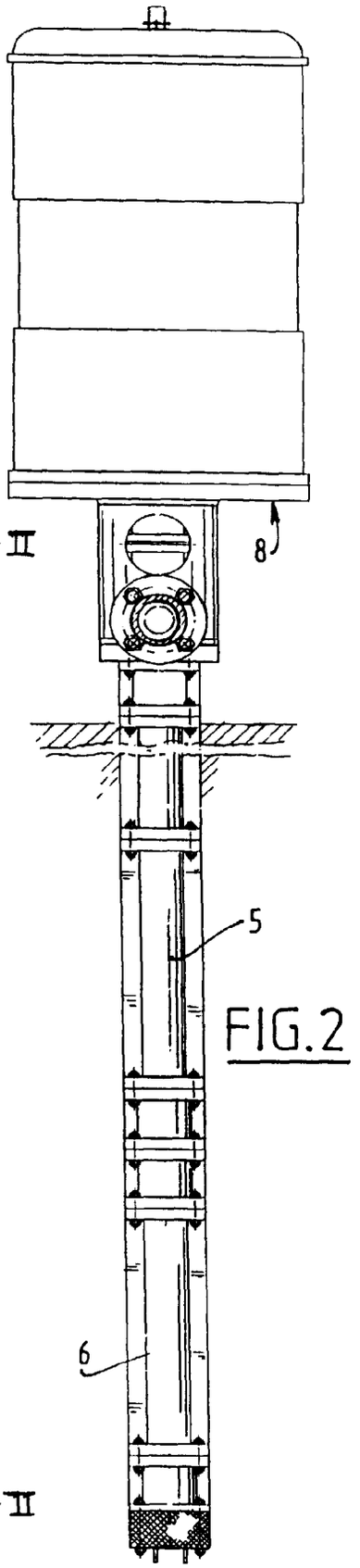


FIG.2

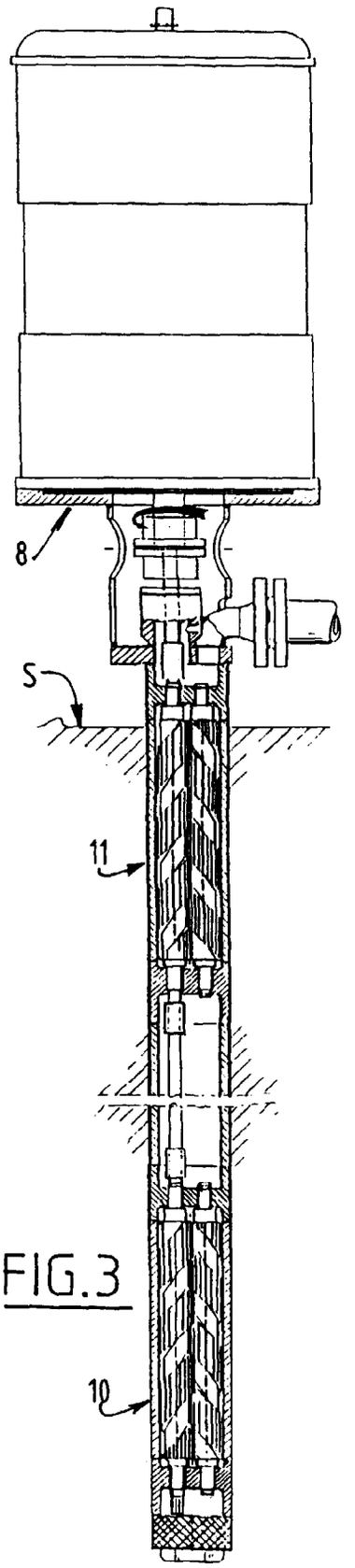


FIG.3

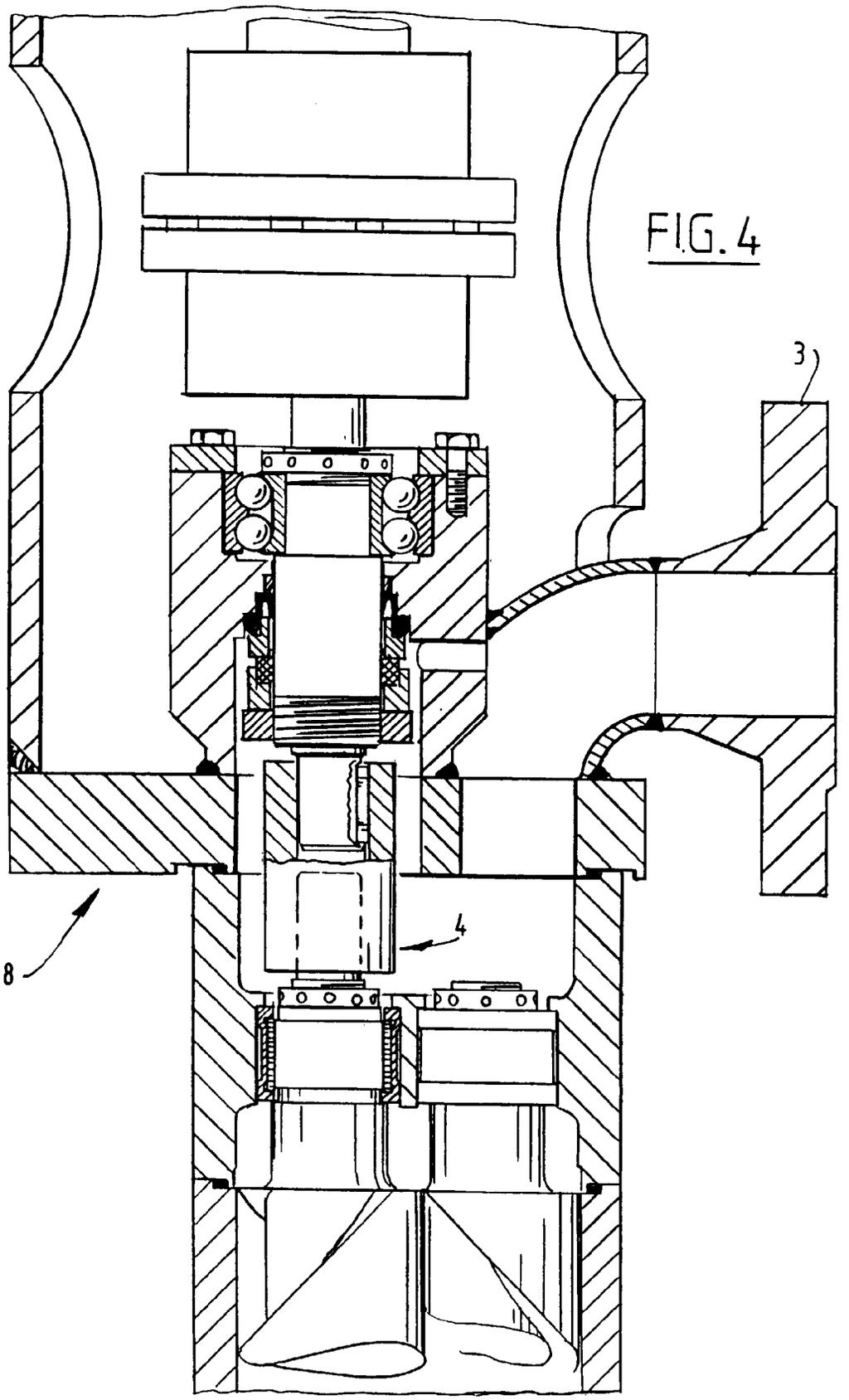


FIG. 4

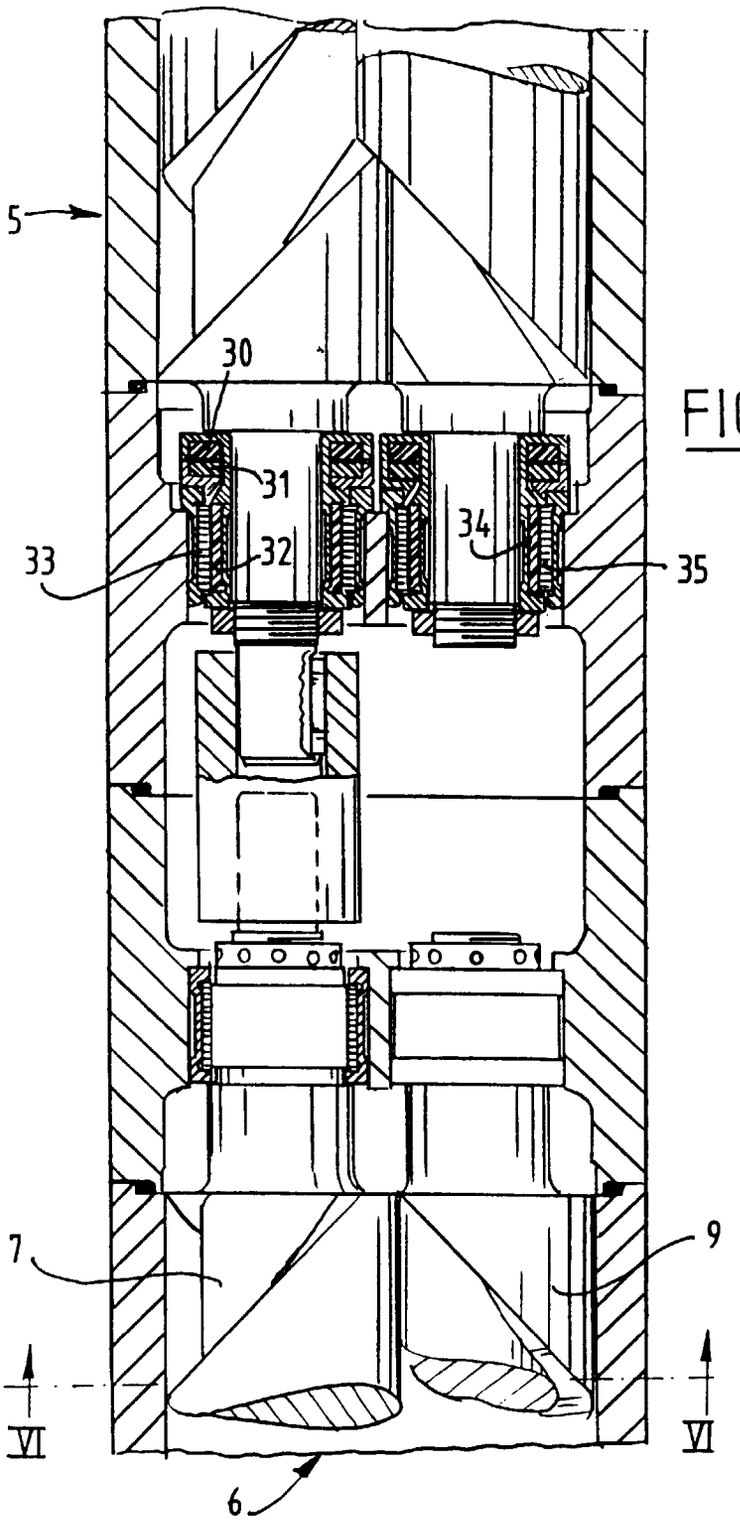


FIG.5

FIG.6

