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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Electrically-driven fuel feed pump.**

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Description

This invention relates to a fuel feed pump of the type comprising an electric motor, a pumping unit driven by this latter, and a casing for supporting said motor and unit.

In pumps of this type, the pumping unit comprises substantially a housing in which an impeller is rotatably mounted for rotation by a shaft driven by the pump electric motor. This impeller can be of any structure, and can be for example of centrifugal type (ie provided with blades disposed on its most outer peripheral part) or of the roller type (ie provided with a plurality of rollers housed in suitable cavities provided in the most outer peripheral part of the impeller).

In certain pumps of this type, the pumping unit is in the form of an actual unit separated from the other parts of the pump, in order to be able to test this unit separately from the complete pump and to be able if necessary to store it during the various pump production stages. In such a case, this pumping unit is rather complicated because the impeller has to be supported in its housing by suitable pins or by a shaft, and means have to be provided for mechanically connecting the shaft driven by the electric motor to the pump impeller, these normally consisting of couplings, insertion joints or entrainment members of various types.

Consequently, pumps of the described type in which the pumping unit can be constructed separately from the other parts of the pump are constructionally rather complicated because of the large number of component parts, and they require supplementary members for mechanically connecting the pumping unit to the electric motor.

Moreover, these pumps are usually arranged such that the fluid takes a precisely defined path between the low-pressure zone from which it is withdrawn and the high-pressure zone into which it is delivered, and they thus allow only one method of operation. This fluid path can for example be of the type in which the fluid flow traverses that compartment in the pump casing which also houses the electric motor, and thus the fluid inlet is provided in one end of this casing, discharge taking place at the opposite end (pumps in which the electric motor is wetted by the fluid); alternatively, the flow of the fluid pumped by the pump is kept completely separated from the zone in which the electric motor operates (pumps with dry motors).

A pump of this second type is described in the US—A—4496297. The pumping unit of this pump comprises a plate and a cover defining a cavity in which is rotatable an impeller driven by a shaft.

The pumping unit of this patent is fixed to a casing of an alternating current generator which is, in its turn, driven by the motor of the vehicle; therefore this pump is directed to pump water in the cooling system of a vehicle and the problem of wetting the electric motor does not exist in it.

Finally, in pumps of the indicated type, it is difficult to gain access to the pump impeller from the outside, and thus impeller setting or repair operations cannot be carried out.

The overall object of the present invention is to provide an electrically-driven fuel feed pump of the initially stated type by which the described drawbacks are obviated.

It is therefore a first object of the present invention to provide a pump comprising a constructionally very simple pumping unit which can be produced or tested separately from the other parts of the pump and can be mounted on this latter rapidly and simply.

A further object of the invention is to provide a pump of the stated type which allows at least two different methods of operation, one with the fluid flow traversing the inner casing compartment and thus actually wetting the electric motor, and the other with the flow completely external to the pump to thus provide dry operation.

A further object of the invention is to provide a pump in which the impeller of the pumping unit is easily and immediately accessible from the outside of the pump.

These objects are attained according to the invention by a fuel feed pump comprising an electric motor, a pumping unit driven by said electric motor, and a casing for supporting said motor and said unit, said pumping unit comprising a housing in which an impeller is rotatable for rotation by a shaft driven by said electric motor, characterised in that said pumping unit comprises:

a spacer ring (8) interposed between said first and second circular plate;

a set of screws (9) fixing together said plates and said spacer ring;

an impeller (5) housed in said cavity and provided with a cylindrical bore (15) engaging, under rotation, with said sleeve;

said shaft being provided with insertion-joint means (19) arranged to make said shaft torsionally rigid with said impeller;

two axial ports (31, 33) being provided in said first and second plates in order to create a flow of fuel coming from outside, crossing said cavity (10) and said compartment (32) of the casing and coming out at the end of the casing opposite to said one end or, alternatively, two axial ports (34, 35) being provided in said second plate one of which (34) is arranged to enable the fuel to be fed into said cavity (10) and the other of which (35) is arranged to enable the fuel to be discharged from said cavity.

Said housing is fixed to one end of the casing in such a manner as to close the compartment defined inside this latter, and said annular support element comprises a sleeve which is forced into an axial bore of the housing, and of which the outer surface constitutes said cylindrical support surface. The insertion-joint means conveniently comprise a series of axial grooves provided in an axial bore through the impeller, and a series of axial projections formed on the end of the shaft and arranged to engage with said grooves.

The present invention will be more apparent from the detailed description thereof given hereinafter by way of example with reference to the accompanying drawings, in which:

Figure 1 is an axial section through part of the pump according to the present invention, to illustrate the structure of the pumping unit with which the pump is provided;

Figure 2 is a section analogous to that of the preceding figure, in which a second embodiment of the pumping unit is shown;

Figure 3 is a section analogous to that of the preceding figures, and showing the pumping unit of Figure 2 in which some modifications have been introduced.

The fuel feed pump according to the invention comprises substantially an electric motor, not shown in the figures for simplicity, for driving a shaft 1 and disposed in a casing 2 of any shape, for example cylindrical, and a pumping unit 3 to be driven by the shaft 1.

The shaft 1 can be supported in the casing in any convenient manner and comprise bearings of any type.

The pumping unit 3 comprises a housing 4 in which there is rotatable an impeller 5 which can be of any shape and comprise for example a plurality of blades disposed on the peripherally most outer part (centrifugal impeller) or a plurality of radial cavities in which rollers are housed (roller impeller).

Conveniently, said housing comprises substantially a pair of flat plates 6 and 7 between which a spacer ring 8 is disposed. These parts, which are fixed together for example by screws 9, define substantially a cylindrical cavity 10 housing the impeller 5.

According to the invention, the pumping unit comprises an annular support element 13 rigid with the housing 4 and provided with at least one cylindrical support surface 14 arranged to engage a corresponding cylindrical surface 15 of the impeller in order to support the rotating impeller in the housing. Conveniently, the support element 13 consists of a sleeve, the outer cylindrical surface of which is forced into the cylindrical surface 16 of an axial bore provided in the plate 6, as can be clearly seen in Figure 1. Conveniently, that cylindrical surface 15 of the impeller 5 which engages under rotation with the surface 14 of said sleeve is obtained by means of a cylindrical cavity formed in the hub part of the impeller.

According to the invention, the impeller 5 and the end 17 of the shaft 1 are provided with insertion-joint means able to make the shaft torsionally rigid with the impeller. These means comprise substantially a series of axial cavities 18 formed in a bore of the impeller 5, and a series of corresponding axial projections 19 provided on the end 17 of the shaft 1 and arranged to engage with the preceding. Conveniently, as can be seen in Figure 1, on the end 17 of the shaft 1 there is provided a conical seat 20 arranged to house a ball 21, which is interposed between said seat and a substantially flat surface 22 provided in a cavity of the plate 7. This ball is therefore able to act as a thrust bearing for the shaft 1, in order to support the axial loads transmitted to it which tend to displace the shaft towards the right in the figure.

Conveniently, the plate is provided with a sleeve 23 projecting axially towards the pump electric motor, and inside which a bearing 24 can be housed to support the end 17 of the shaft 1.

This bearing, which can be of any suitable type, is inserted into the same cylindrical surface 16 into which the support element 13 is forced.

The pumping unit 3 is connected to the pump casing 2 by fixing the plate 6 to one end of the casing in any suitable manner.

This fixing can be carried out for example in the manner shown in Figure 1, by providing a shoulder 25 on the casing against which the plate 6 is rested, and then turning-over on to it the end edge 26 of the casing. Conveniently, a seal ring 27 is disposed between the plate and casing.

With this constructional arrangement, the pumping unit 3 completely seals one end of the pump casing, and all its parts, with the exception of the plate 6, are external to the casing and completely accessible.

Axial ports, 30 and 31 respectively, are conveniently provided in the plates 7 and 6 to allow the fuel to be fed into the cavity 10 of the pumping unit 3 and to be delivered under pressure from said cavity into the compartment 32 provided in the pump casing 2. This constructional arrangement therefore provides a method of pump operation in which the fluid flow traverses the compartment 32 housing the motor, to wet the motor and leave from the other end of the pump. Conveniently, a further series of axial ports 33 provided in the plates 6 and 7 and in the spacer ring 8 enables the fuel to pass between the compartment 32 and the outside of the pump, along this path there being provided a pressure relief valve.

The pumping unit of the embodiment shown in Figure 2 differs from the preceding only in the structure of the plate 7. This latter comprises at least two ports 34 and 35 arranged respectively to feed fuel into the cavity 10 and to deliver it under pressure from said cavity to the user item. Conveniently, a further bore 36 connects together the two preceding ports, and along it there is disposed a pressure relief valve 37. In this embodiment, ports are not provided in the plate 6, and thus the compartment 32 in the casing 2 housing the electric motor is completely separated from the fuel flow.

In the embodiment shown in Figure 3, which constitutes a modification of that of Figure 2, inside the support element 13 there is provided a substantially cylindrical cavity 38 housing seal rings 39 arranged to form a hydraulic seal against the cylindrical surface of the end 17 of the shaft 1. Said rings can conveniently be of rubber, and be provided with radial lips which slide along said surface. These can be mounted in any convenient manner, for example against a shoulder of the support element 13, by using a spacer 40 and a stop ring 41.

Conveniently, in the support element 13 there is provided a radial bore 42 in communication with grooves 43 of the plate 6, in order to form a channel between the cavity lying between the seal rings 39 and the pump cavity 10. In this manner, any fuel which seeps beyond the first seal ring can be conveyed into the pump suction zone by the suction action exerted by it. This constructional arrangement enables the pressure by which the seal rings 39 are forced against the end 17 of the shaft to be reduced, thus reducing mechanical wear losses.

The construction and use of the described pump can be as follows. The pumping unit of any of the illustrated embodiments can be constructed separately from the other parts of the pump. For this purpose, it is necessary only to firstly mount the support element 13 in the bore 16 of the plate 6, then engage the impeller 5 with this support element, and finally fix the spacer ring 8 and the other plate 7 on the plate 6 by means of the screws 9, to form the housing for the unit. It is apparent that in the pumping unit obtained in this manner the impeller 5 is supported correctly in the housing and perfectly coaxial to it. Under these conditions, the pumping unit can be tested by using suitable drive means, for example a shaft on the end of which axial projections are provided of the same type as those provided on the end 17 of the shaft 1, and able to engage the axial cavities 18 of the impeller 5.

The pumping unit thus prepared can be stored for use when the pump is to be completely assembled. For this latter, it is necessary only to mount the bearing 24 on the plate 6 of said unit, and fix the plate to the casing 2 in the manner shown in the figures. The end 17 of the shaft 1 is then inserted into the bearing and support element 13 until the axial projections 19 engage the corresponding axial cavities 18 of the impeller. This operation thus results simultaneously in the electric motor becoming mechanically connected to the impeller 5, one end of the shaft 1 becoming supported by the bearing 24, and one end of the pump casing 2 becoming sealed.

Using the described assembly method, any one of the pumping units of the embodiments of the illustrated figures can be constructed, to thus obtain a fuel flow which either completely traverses the pump or is entirely external to the compartment 32 housing the electric motor.

If a pump arranged for operation by one of the two operating methods is to be converted into the other, it is necessary only to replace the plate 7 by separating this from the other parts by unscrewing the screws 9. This replacement operation is extremely rapid and simple, because of the complete accessibility of the parts on which work has to be done.

It is also apparent that on separating the plate 7 from the other parts of the housing 4, access is gained to the impeller 5 to enable checking or maintenance operations to be carried out on it.

It is apparent that modifications can be made to the various parts of the described pump in terms both of their shape and arrangement, but without leaving the scope of the inventive idea. In particular, the support element 13 provided with a cylindrical support surface 14 for the impeller 5 can be formed in a different manner. This surface could for example be provided directly on an annular projection projecting axially from the circular plate 6, or by providing a support element 13 which is of a shape different from that illustrated and is connected to the plate by a different method, Instead of being connected to the plate 6, this support element could be connected to the plate 7 by obvious structural modifications.

Furthermore, the insertion-joint means for torsionally connecting the end of the shaft 1 to the impeller 5 could be of a type different from those shown, and instead of comprising axial projections and cavities could comprise entrainment members of a different type, for example frontal teeth.

Claims

1. A fuel feed pump comprising an electric motor driving a shaft (1), a tubular casing (2) for supporting said motor and said shaft, a first circular plate (6) fixed to one end of said casing in such a manner to close said tubular casing and to define inside it a compartment (32), said first plate being provided with an axial bore (16) completely crossing the plate and with an external flat surface;

a sleeve (13) forced into said axial bore and protruding from said external surface;

a second circular plate (7) fixed to said first circular plate and defining with it a cylindrical cavity (10);

characterized in that it comprises:

a spacer ring (8) interposed between said first and second circular plate;

a set of screws (9) fixing together said plates and said spacer ring;

an impeller (5) housed in said cavity and provided with a cylindrical bore (15) engaging, under rotation, with said sleeve;

said shaft being provided with insertion-joint means (19) arranged to make said shaft torsionally rigid with said impeller;

two axial ports (31, 33) being provided in said first and second plates in order to create a flow of fuel coming from outside, crossing said cavity (10) and said compartment (32) of the casing and coming out at the end of the casing opposite to said one end or, alternatively, two axial ports (34, 35) being provided in said second plate one of which (34) is arranged to enable the fuel to be fed into said cavity (10) and the other of which (35) is arranged to enable the fuel to be discharged from said cavity.

2. A pump as claimed in claim 1 characterized in that said two axial ports (34, 35) are connected together by a third port (36) along which a pressure relief valve (37) is disposed.

3. A pump as claimed in claims 1 or 2 charac-

terized in that said insertion-joint means (19) comprise a series of axial grooves provided in an axial bore (18) of said impeller, and a series of axial projections formed on said shaft end and arranged to engage with said grooves.

4. A pump as claimed in one of the preceding claims characterized in that a conical seat (20) is provided on said shaft end, between said conical seat and a surface (22) of said second circular plate there being disposed a ball (21) arranged to support the axial loads acting on said shaft.

5. A pump as claimed in one of the preceding claims characterized in that a cavity (38) is provided inside said sleeve to house seal rings (39) arranged to form a hydraulic seal against the surface of said shaft end.

6. A pump as claimed in claim 5, characterized in that zone of said cylindrical cavity lying between said seal rings (39) is in communication with said cavity (10).

Patentansprüche

1. Kraftstoffpumpe mit einem elektrischen Motor, der eine Welle (1) antreibt, einem rohrförmigen Gehäuse (2) zum Halten des Motors und der Welle, einer ersten kreisförmigen Platte (6), die an einem Ende des Gehäuses so befestigt ist, daß sie das rohrförmige Gehäuse verschließt und in dessen Innerem ein Abteil (32) bestimmt, wobei die erste Platte mit einer axialen Bohrung (16) versehen ist, die die Platte vollständig durchquert, sowie mit einer flachen Außenfläche,

mit einer Muffe (13), die in die axiale Bohrung gedrückt ist und aus der Außenfläche hervorragt,

mit einer zweiten kreisförmigen Platte (7), die an der ersten Platte befestigt ist und mit ihr eine zylindrische Höhlung (10) bestimmt, dadurch gekennzeichnet, daß sie

einen Abstandsring (8) aufweist, der zwischen die erste und die zweite kreisförmige Platte eingesetzt ist,

einen Schraubensatz (9), der die Platten und den Abstandsring zusammenhält,

ein Laufrad (5), das in der Höhlung untergebracht ist und mit einer zylindrischen Bohrung (15) versehen ist, die bei Drehung mit der Muffe in Eingriff steht,

wobei die Welle mit Einsatz-Verbindungsmitteln (19) versehen ist, die so angeordnet sind, daß die Welle mit dem Laufrad torsionssteif verbunden ist, sowie

zwei axiale Öffnungen (31, 33), die in der ersten und zweiten Platte vorgesehen sind, um einen Kraftstoffluß zu schaffen, der von außen kommt, die Höhlung (10) und das Abteil (32) des Gehäuses kreuzt und der an dem Ende des Gehäuses herauskommt, das gegenüber dem einen Ende liegt, oder, als Alternative, zwei axiale Öffnungen (34, 35), die in der zweiten Platte angeordnet sind, von denen eine (34) so angeordnet ist, daß sie die Kraftstoffzufuhr in die Höhlung (10) ermöglicht, und von denen die andere (35) so angeordnet ist, daß sie die Kraftstoffabgabe aus der Höhlung ermöglicht.

2. Pumpe nach Anspruch 1, dadurch gekennzeichnet, daß die axialen Öffnungen (34, 35) durch eine dritte Öffnung (36) miteinander verbunden sind, entlang welcher ein Überdruckventil (37) angeordnet ist.

3. Pumpe nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Einsatz-Verbindungsmittel (19) eine Reihe von axialen Nuten aufweisen, die in der axialen Bohrung (18) des Laufrades vorgesehen sind, und eine Reihe von axialen Vorsprüngen, die auf dem Wellenende ausgebildet und so angeordnet sind, daß sie mit den Nuten in Eingriff stehen.

4. Pumpe nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß ein kegelförmiger Sitz (20) an dem Wellenende vorgesehen ist, wobei zwischen dem kegelförmigen Sitz und einer Fläche (22) der zweiten kreisförmigen Platte eine Kugel (21) angeordnet ist, um die axialen Belastungen aufzufangen, die auf die Welle wirken.

5. Pumpe nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß eine Höhlung (38) innerhalb der Muffe vorgesehen ist, um Dichtungsringe (39) unterzubringen, die so angeordnet sind, daß sie eine hydraulische Dichtung gegen die Fläche des Wellenendes bilden.

6. Pumpe nach Anspruch 5, dadurch gekennzeichnet, daß ein Bereich der zylindrischen Höhlung, der zwischen den Dichtungsringen (39) liegt, in Verbindung mit der Höhlung (10) steht.

Revendications

1. Pompe d'alimentation en carburant comprenant un moteur électrique entraînant un arbre (1), un carter tubulaire (2) pour supporter ledit moteur et ledit arbre, une première plaque circulaire (6) fixée à une première extrémité du dit carter de manière à obturer ledit carter tubulaire et à délimiter à l'intérieur de celui-ci un compartiment (32), ladite première plaque étant munie d'un alésage axial (16) traversant complètement la plaque et d'une surface plate externe; une douille (13) montée à force dans ledit alésage axial et faisant saillie par rapport à ladite surface externe;

une seconde plaque circulaire (7) fixée à ladite première plaque circulaire et délimitant avec celle-ci une cavité cylindrique (10);

caractérisée par le fait qu'elle comprend:

une bague d'écartement (8) interposée entre lesdites première et seconde plaques circulaires;

un jeu de vis (9) fixant ensemble lesdites plaques et ladite bague d'écartement;

une roue (5) logée dans ladite cavité et munie d'un trou cylindrique (15) en contact, pendant la rotation, avec ladite douille;

ledit arbre étant muni de moyens d'emboîtement (19) agencés pour rendre ledit arbre rigidement solidaire en torsion de ladite roue;

deux orifices axiaux (31, 33) étant prévus dans lesdites première et seconde plaques, afin de créer un écoulement de carburant venant de l'extérieur, traversant ladite cavité (10) et ledit compartiment (32) du carter et débouchant à

l'extrémité du carter opposée à ladite première extrémité, ou, alternativement, deux orifices axiaux (34, 35) étant prévus dans ladite seconde plaque, un d'eux (34) est agencé pour permettre au carburant d'être amené dans ladite cavité (10) et l'autre (35) est agencée pour permettre au carburant d'être evacuée de ladite cavité.

2. Pompe selon la revendication 1, caractérisée par le fait que lesdits orifices axiaux (34, 35) sont reliés entre eux par un troisième orifice (36) le long duquel est placé un clapet de détente de pression (37).

3. Pompe selon la revendication 1 ou 2, caractérisée par le fait que lesdits moyens d'emboîtement (19) comprennent une série de rainures axiales ménagées dans un trou axial (18) de ladite zone, et une série de saillies axiales formées sur l'extrémité dudit arbre et agencées pour venir en prise avec lesdites rainures.

4. Pompe selon l'une des revendications précédentes, caractérisée par le fait qu'un siège conique (20 est prévu à l'extrémité dudit arbre, une bille (21) étant disposée entre ledit siège conique et une surface (22) de ladite seconde plaque circulaire est agencée pour supporter ledit arbre.

5. Pompe selon l'une des revendications précédentes, caractérisée par le fait qu'une cavité (38) est prévue à l'intérieur de ladite douille pour loger des bagues d'étanchéité (39) agencées pour former un joint hydraulique contre la surface de ladite extrémité d'arbre.

6. Pompe selon la revendication 5, caractérisée par le fait que la zone de ladite cavité cylindrique située entre lesdites bagues d'étanchéité (39) est en communication avec ladite cavité (10).

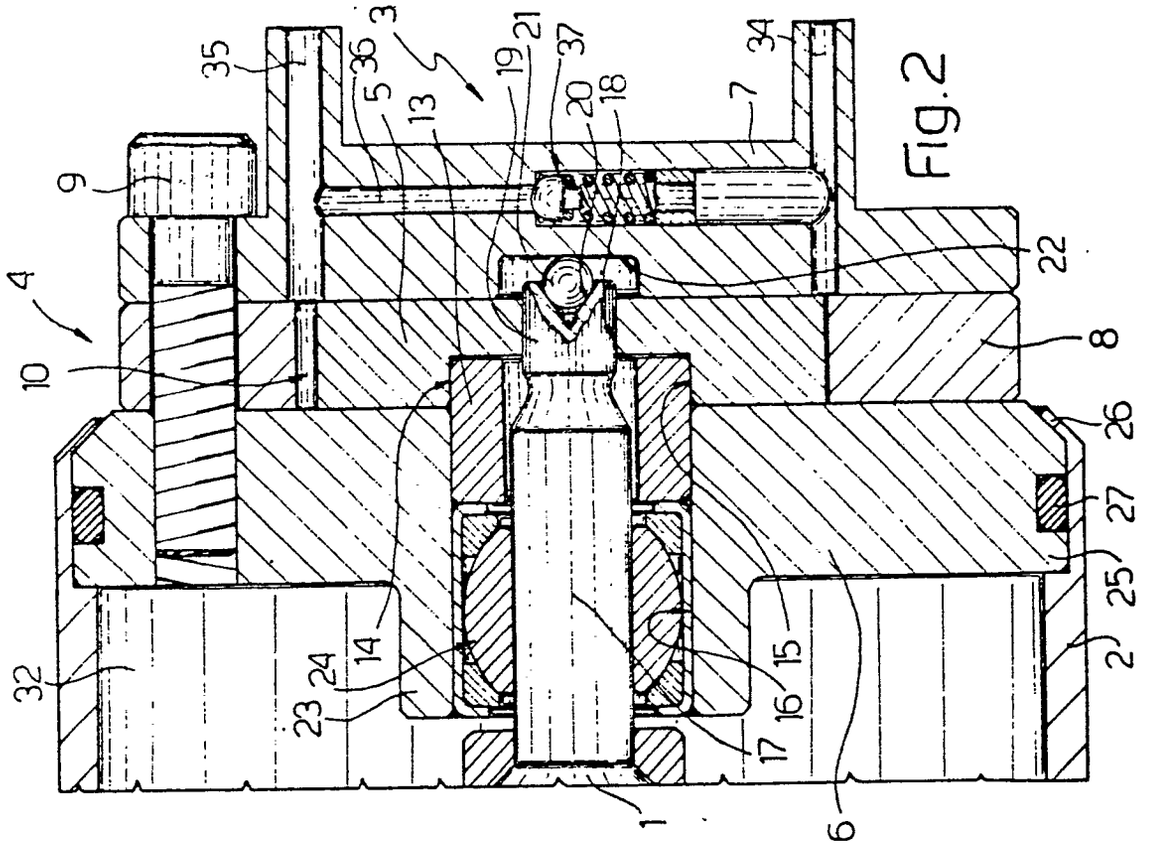
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Fig.2

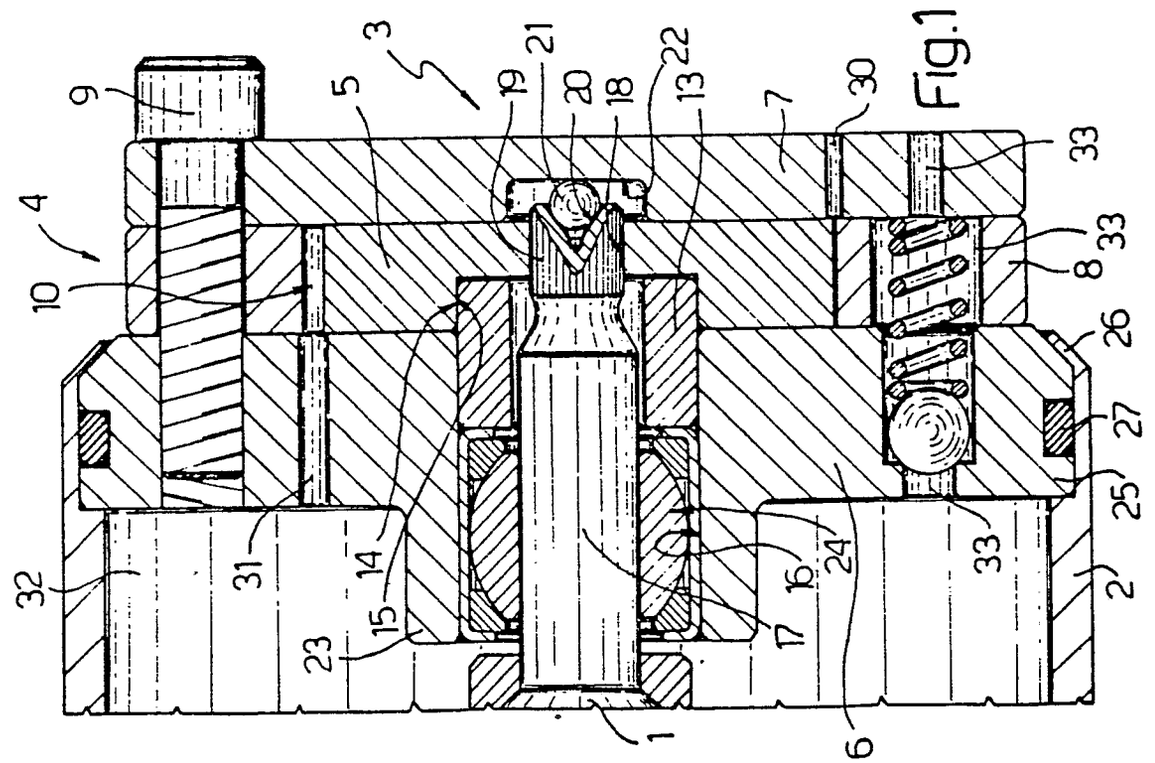
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Fig.1

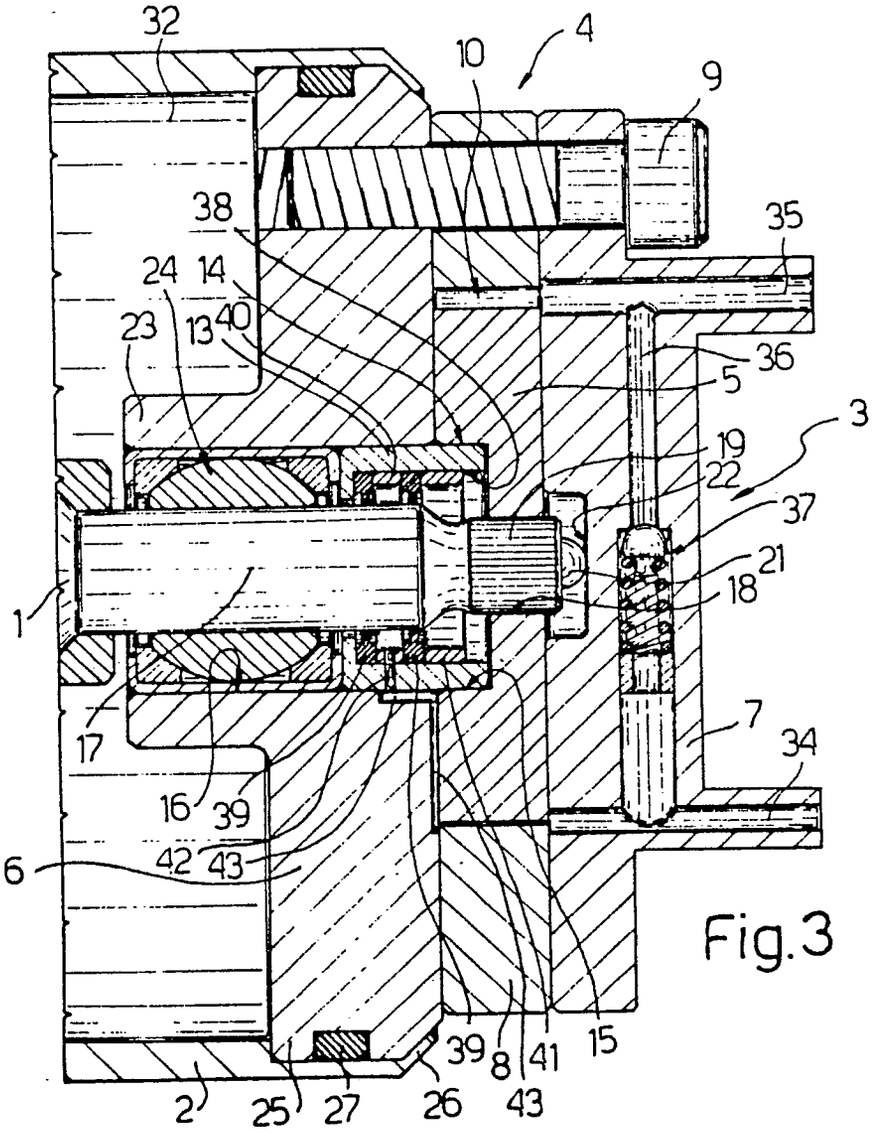
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Fig.3