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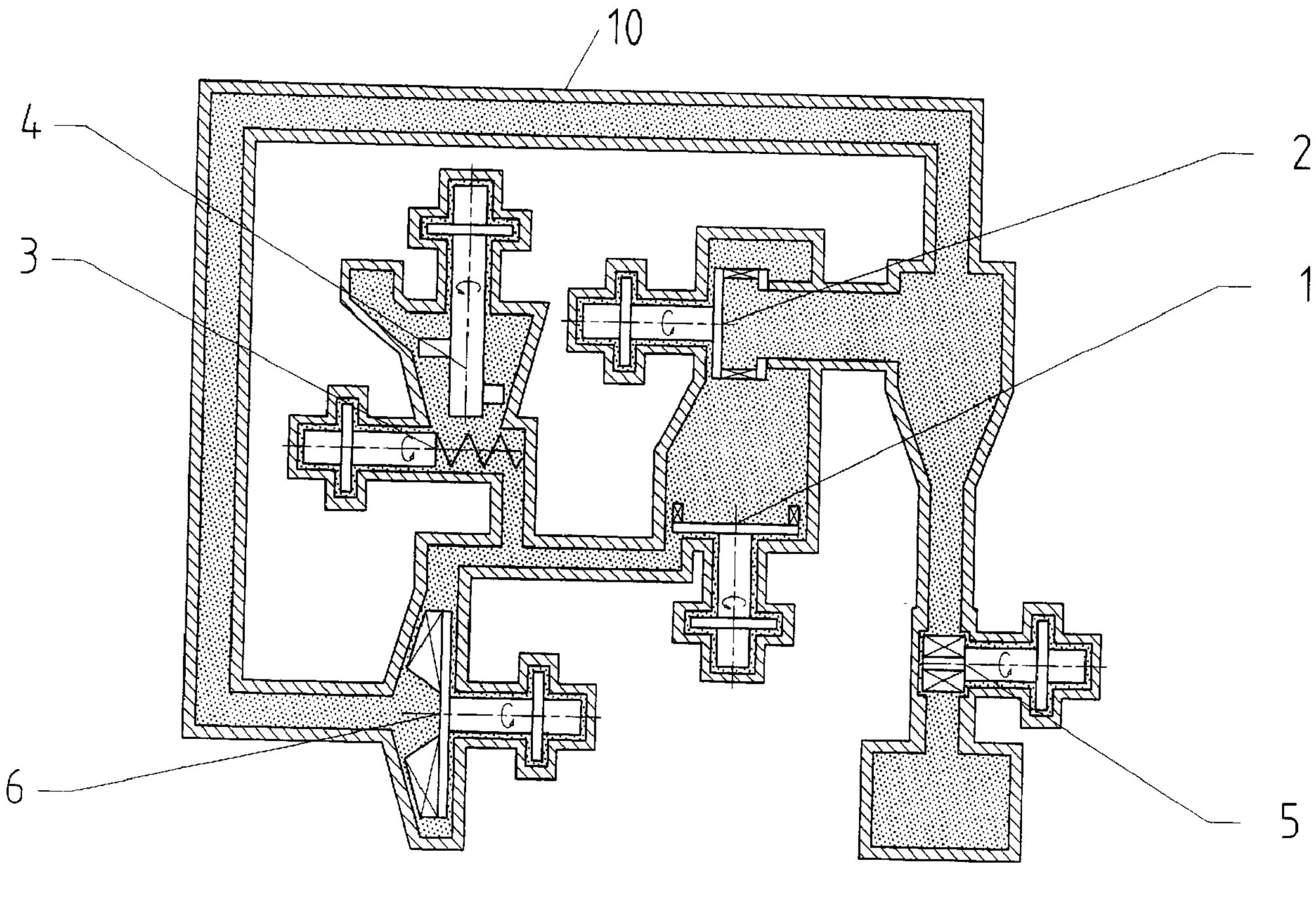
(54) Titre : CONCEPT DE SYSTEME POUR BROYEURS ET CLASSIFICATEURS AVEC DISPOSITIFS D'ENTRAINEMENT PAR BROCHE SUR PALIER MAGNETIQUE

(54) Title: SYSTEM CONCEPT FOR MILLS AND CLASSIFIERS WITH MAGNETIC BEARING SPINDLE DRIVES



(57) Abrégé/Abstract:
The invention concerns a system concept for process-technological machines such as mills and classifiers in enclosed design with no rotary unions between the ambient air and the inside of the system. This system concept is particularly suitable for CIP and SIP mode, glove-box operation and combinations thereof. Over and above this, the invention concerns an encapsulation of mills and

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(57) Abrégé(suite)/Abstract(continued):
classifiers with magnetic bearing spindle drive in order to seal the components of the magnetic bearing spindle drive located below the encapsulation against the working zone of the shaft in the magnetic bearing spindle housing. The magnetic bearing spindle drive is designed such that the magnetic bearing spindle shaft can be pulled out to facilitate simpler and easier component exchange as well as thorough cleaning.

Abstract

The invention concerns a system concept for process-technological machines such as mills and classifiers in enclosed design with no rotary unions between the ambient air and the inside of the system. This system concept is particularly suitable for CIP and SIP mode, glove-box operation and combinations thereof. Over and above this, the invention concerns an encapsulation of mills and classifiers with magnetic bearing spindle drive in order to seal the components of the magnetic bearing spindle drive located below the encapsulation against the working zone of the shaft in the magnetic bearing spindle housing. The magnetic bearing spindle drive is designed such that the magnetic bearing spindle shaft can be pulled out to facilitate simpler and easier component exchange as well as thorough cleaning.

System Concept for Mills and Classifiers with Magnetic Bearing Spindle Drives

Description

The invention concerns a system concept for process-technological machines in enclosed design with no rotary unions between the ambient air and the inside of the system. Machines which are correspondingly encapsulated – especially mills and classifiers with magnetic bearing spindle drives – are used hereby. The magnetic bearing spindle drive is designed such that the magnetic bearing spindle shaft can be removed without having to dismantle the magnetic bearing spindle housing, thus facilitating simpler and easier component exchange as well as thorough cleaning.

State of the Art

EP 1 300 195 A1 describes a powder processing system which is operated inside a glove box. The working zones and the rotating components of the machine are located inside the glove box whereas the machine bearings and drives are located on the outside. The machine shafts extend from outside the glove box via rotary unions into the working zone of the machines where they accommodate the respective rotating components. To prevent material ingress from the working zone into the bearings or the ambient air or vice versa, the shafts are sealed by means of two rinsing gaps, whereby one separates the working zone from the intermediate zone, and the other separates the intermediate zone from the outside.

Machines with magnetic bearings or magnetic bearing spindle drive are known. A refiner with a corresponding drive is described in WO 99/19070 A1. The refiner features a rotor consisting of a shaft with refiner elements plus complementary stator elements, which together with the rotating elements form a gap in which a slurry is treated. The shaft of the rotor is supported in magnetic bearings which simultaneously define the axial and radial position of the shaft. The shaft has a disc-shaped extension designed to support and position the shaft in axial direction. Axial magnetic bearings are located upstream and downstream of this extension. Besides shaft positioning in axial direction, an adjustment of the grinding gap is also facilitated.

Objective of Invention

The objective of the invention is to create a concept for a system comprising process-technological machines such as mill or classifiers which meets all the requirements for operation in a clean room, a glove box, in SIP or CIP mode and combinations thereof in that it has no rotary unions between the product zone and the ambient air. A further objective of the invention is to design a process-technological machine with magnetic bearing spindle drive where the penetration of contaminants into the working zone as well as leakage of the product out of the working zone is prevented. This task is solved by a system concept with the characteristics described in Claim 1.

Description of the Invention

High demands are made of systems that are operated in the pharmaceutical industry. Product contamination from the outside and by system components must be minimised or prevented. Over and above this, users and system operators must be protected from contact with the highly active substances being processed in the best possible way. Residue-free cleaning of the system must be possible, and the system – especially the machines – must be suitable for SIP and CIP mode.

With the invention-design system, this is achieved in that a drive concept is chosen that requires no rotary unions leading to the outside of the system. Such a system consists of process-technological machines with different functions such as mills or classifiers. As a rule, the encapsulation that seals the system to the outside comprises machine housing, housing to accommodate the rotating components, equipment with no rotating parts, bins, ductings and connecting elements with static seals. The system is thus sealed not only against the ambient air, but also against the components such as bearings and drive. Material and product are supplied to and removed from the system by means of transfer ports.

In the case of the invention-design device and in contrast to the known machines, the inside wall of the magnetic bearing spindle housing is lined and the magnetic bearing spindle shaft is encapsulated, which serves to seal the components of the magnetic bearing spindle drive located below the lining or encapsulation against the working zone of the shaft in the magnetic bearing spindle housing. In the pharmaceutical industry, pharma-compatible polymers or stainless steel are the materials of choice

for this purpose. The lining of the magnetic bearing spindle housing comprises a gap element which seals the bearing and motor components off against the working zone of the shaft. The components on the other side of the shaft are sealed off against the working zone by means of encapsulation. The gap element thus also seals the product-contact zone against the ambient air. The invention-design device thus features no rotary union between the outside of the machine and the product-contact zone through which, for example, product could leak out of the mill. In another variant, the gap area is separated from the working zone of the mill by means of gap rinsing. This has the task of preventing product from penetrating into the gap area.

The invention-design process-technological machines such as mills or classifiers are characterised in that the product-contact areas with the rotating component such as classifying wheel or grinding disc are accessible once the machine housing is opened. The magnetic bearing spindle shaft and the rotating component form a unified whole. The magnetic bearing is in tapered design, whereby the widest diameter is on the side of the rotating component. The radial bearing and the motor are arranged concentrically in relation to the shaft in the housing. All components and counterparts are annular in design. The counterparts of the bearing and motor on the magnetic bearing spindle shaft are located in the effective magnetic range of the motor and bearings. This design makes it possible to pull the magnetic bearing spindle shaft out of the bearing housing together with the rotating component. The shaft and rotating component can now be cleaned outside the machine. The product-contact areas of the working zone can also be cleaned thoroughly without the rotating component getting in the way and without product remaining between the rotating component and the wall of the working zone. The entire rotor comprising shaft and rotating component can be exchanged as one unit, thus minimising maintenance time.

Other specific features and advantages of the invention can be found in the following description of a preferred design example using the figures as a basis. They show:

Figure 1 Schematic representation of a grinding-classifying system

Figure 2 Detail from Fig. 1

Figure 3 Detail from Fig. 1 with rinsing lines for CIP and SIP mode

Figure 4 Encapsulation of a pin mill with magnetic bearing spindle drive in longitudinal section

Figure 5 A pin mill with magnetic bearing spindle drive in longitudinal section

Figure 6 Top view of the mill in Fig. 5

Design example

Figure 1 shows a schematic of a typical grinding-classifying system comprising mill (24), dynamic classifier (2), mixer (4), rotary valve (5), fan (6), feed metering screw (3) with a feed bin sealed to the outside and a sealed end-product bin for batch processing. The system components are encapsulated to seal them off to the outside. The system can, for example, be installed in a glove box that is not shown here.

Encapsulated magnetic bearing spindle drives are used to drive the units. The drives have no rotary unions for individual machine elements such as shafts. This makes it possible to do without expensive bearing rinsing systems between the drives located outside the clean room and the machine components inside to prevent the exchange of product and/or contaminants between the ambient air and the product zone.

Figure 2 shows a detail of the system shown in Figure 1. A magnetic bearing spindle drive supplies the energy necessary to stabilise the bearings (8) and rotate (9) the components (7) of the process-technological machines, which as a result of the common encapsulation (10) sealed to the outside and the gap (11), is routed to the energy-absorbing parts (12) of the components. The common encapsulation (10) sealed to the outside generally consists of the machine housing (13), which forms the product-contact working zone (14), the housing (15) to accommodate the rotating components which together with the energy-absorbing part of the component delimits the gap area (16), units with no rotating parts, bins, connecting ductings (17) and connecting elements with static seals (18). For continuous operation, product and working media can be supplied to and removed from the system via transfer ports.

The detail of the system from Figure 1 shown in Figure 3 represents the system in a design suitable for CIP and SIP mode. Ductings (21) for the supply of cleaning and sterilisation agents (20) are fitted at the highest point of the housing, whereas the drainage ductings (22) are fitted at the lowest point of the unit. In SIP and CIP mode,

the rinsing lines (23) can be integrated into the cleaning, sterilisation and drying process. A state of suspension or slow rotation of the components (7) assists the process.

Figure 4 shows a pin mill equipped with a magnetic bearing spindle drive. The mill consists of a mill housing (24) with intake (25) and product discharge (26) that accommodates the static pin disc (27). The dynamic pin disc (28) is accommodated by the magnetic bearing spindle shaft (29). The mill housing (24) and magnetic bearing spindle drive are connected with each other to swivel by means of a connecting element.

The magnetic bearing spindle drive comprises the magnetic bearing spindle housing (30) with intermediate ring (31), which accommodates the motor (32), radial bearing with position measuring system A (33), radial bearing with position measuring system B (34), axial bearing A (35) with axial position measuring system (36) as well as a magnetic bearing spindle shaft (29). The counterparts of the motor (37), bearings (38, 39, 40) and position measuring systems (41) are located on the magnetic bearing spindle shaft (29). The shaft (29) accommodates the rotating component, in this case the dynamic pin disc (28). The magnetic bearing spindle shaft (29) is located in the magnetic bearing spindle housing (30) at the centre of the above-described components. The counterparts (38, 37, 39) of the motor and bearings on the magnetic bearing spindle shaft (29) are located in the effective magnetic range of the motor (32), radial bearings (33, 34) and axial bearings (35, 42).
Together with the outside contour of the magnetic bearing spindle shaft (29), the inside contour of the magnetic bearing spindle housing (30) forms the gap area (42), i.e. the working zone of the shaft. The shaft rotates within the magnetic bearing spindle housing without physical contact and is wear-free in operation.

A gap element (43) is fitted in the magnetic bearing spindle housing (30). The preferred design of the gap element (43) is in the form of a container with collar made of a pharma-qualified polymer. It seals the motor (32) and bearings (33, 34, 34, 42) and the position measuring system (36) located in the magnetic bearing spindle housing (30) against the working zone (42) of the magnetic bearing spindle shaft

(29). A variant of the gap element (43) has a connection (44) at the bottom through which cleaning and/or rinsing media can be supplied and drained off.

The tubular encapsulation (45) of the magnetic bearing spindle shaft (29) which is designed to taper in a staged or conical manner is press-fitted to enclose the spacer rings (46) and the counterparts (38, 37, 39), and has a permanent connection with the edge of the shaft shoulder and the end cap (35). The encapsulation (45) is preferably made of stainless steel.

An intermediate ring (31) with rinsing medium feed point (48) is linked to the magnetic bearing spindle housing (30) by means of connecting elements (49) and fixes the axial and radial position of the gap element (43). The fixing point of the gap element (43) is in the form of an enlargement (50) which acts as a seal and as a reinforcement. The other enlargement (51) also acts as a reinforcement. Rinsing air can be routed into the axial gap (52, 53) via the rinsing medium feed point (48); this prevents the ingress of product from the product-contact zone (54) into the working zone of the magnetic bearing spindle shaft and vice versa.

The counterring (55) in relation to the collar (50) of the gap element (43) is centred in the mill housing (24) and together with the rinsing gap (53), acts as a seal against the product-contact zone (54) of the mill.
The gap element (43) exhibits elevations (56 and 57) in radial direction. The magnetic bearing spindle shaft (29) rests on these elevations when the magnetic bearing spindle drive is inactive. The elevations (56, 58, 57, 59) are dimensioned such that in the event of damage, their effective surfaces serve as contact points, i.e. they constitute emergency bearing surfaces.

Figure 5 shows a pin mill as an example for a process-technological machine which is equipped with a magnetic bearing spindle drive. The mill comprises a mill housing (24) with product intake (25) and product discharge (26). The mill housing (24) accommodates the static pin disc (27), which interacts with the dynamic pin disc (28) on the magnetic bearing spindle shaft (29).

The magnetic bearing spindle drive consists of a magnetic bearing spindle housing (30) and a magnetic bearing spindle shaft (29). The magnetic bearing spindle shaft (29) is centred in the magnetic bearing spindle housing (30). The magnetic bearing spindle shaft (29) accommodates the dynamic pin disc (28) which is centred at one end. The shaft (29) is designed to taper in stages, this makes it possible to pull the shaft out of the magnetic bearing spindle housing (30) without having to dismantle the magnetic bearing spindle housing (30) or remove the rotating component (28) from the shaft (29).

Figure 6 shows a top view of the mill. The magnetic bearing spindle housing (30) and the mill housing (24) are connected to each other by means of an external shaft (60). Once the locking mechanism (not shown here) is opened, the mill housing (24) can be hinged off to the side, thus permitting access to the shaft (29) with the rotating component (28). The tapered magnetic bearing spindle shaft (29) can now be removed from the magnetic bearing spindle housing together with the rotating component (28). The mill housing (24) can be cleaned easily and thoroughly. The rotating component (28) can be removed from the shaft (29) and cleaned or exchanged. The shaft (29) and rotating component (28) can also be manufactured in one piece.

The invention is not restricted to the design shown in the drawings and described in detail in the preceding text.

CLAIMS:

1. A system comprising:

at least one mill or classifier with a rotating component in a working zone, with a bearing unit and drive as well as a common encapsulation shell that seals off all system components to the outside, wherein the shell encapsulating all system components has no rotary unions, and the rotating component is supported and driven by a magnetic bearing spindle drive, said magnetic bearing spindle drive comprising a magnetic bearing spindle housing and a magnetic bearing spindle shaft.

2. The system in accordance with claim 1, wherein the system is equipped with connections for rinsing, cleaning or sterilizing media.

3. The system in accordance with claim 1 or 2, wherein the magnetic bearing spindle drive of the mill or classifier, comprising a magnetic bearing spindle housing and a magnetic bearing spindle shaft, is equipped with a gap element that hermetically seals the magnetic bearing spindle housing against the working zone of the magnetic bearing spindle shaft, and the gap element further comprises an encapsulating shell that hermetically seals the magnetic bearing spindle shaft against the working zone of the magnetic bearing spindle shaft.

4. The system in accordance with any one of claims 1 to 3, wherein the gap element that seals the magnetic bearing spindle housing is designed as a container with a collar.

5. The system in accordance with any one of claims 1 to 4, wherein the gap element exhibits elevations which are designed as emergency bearing surfaces.

6. The system in accordance with any one of claims 1 to 5, wherein a counterring exhibits elevations which are designed as emergency bearing surfaces.

7. The system in accordance with any one of claims 1 to 6, wherein the gap element is equipped with a central connection for the supply and discharge of a rinsing, cleaning or sterilizing agent.

8. The system in accordance with any one of claims 1 to 7, wherein once a locking mechanism has been released, the machine housing of the mill or classifier can be hinged back against the magnetic bearing spindle housing and the rotating component with magnetic bearing spindle shaft can be pulled out of the magnetic bearing spindle housing without having to dismantle the magnetic bearing spindle housing or remove the rotating component from the shaft.

9. The system in accordance with any one of claims 1 to 8, wherein the working zone of the magnetic bearing spindle shaft is separated from the working zone in which the rotating component is located by means of a rinsing agent.

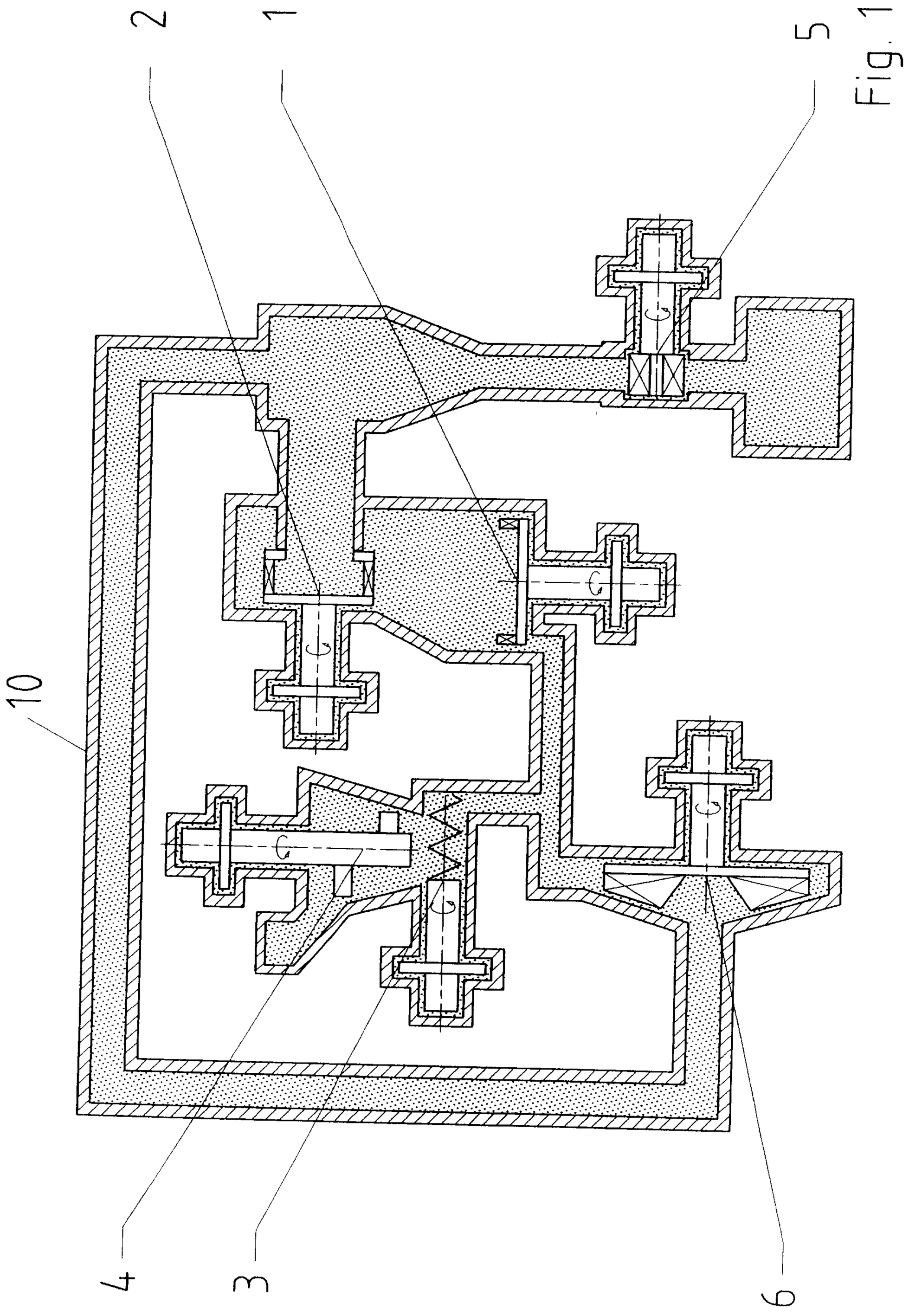

Fig. 1

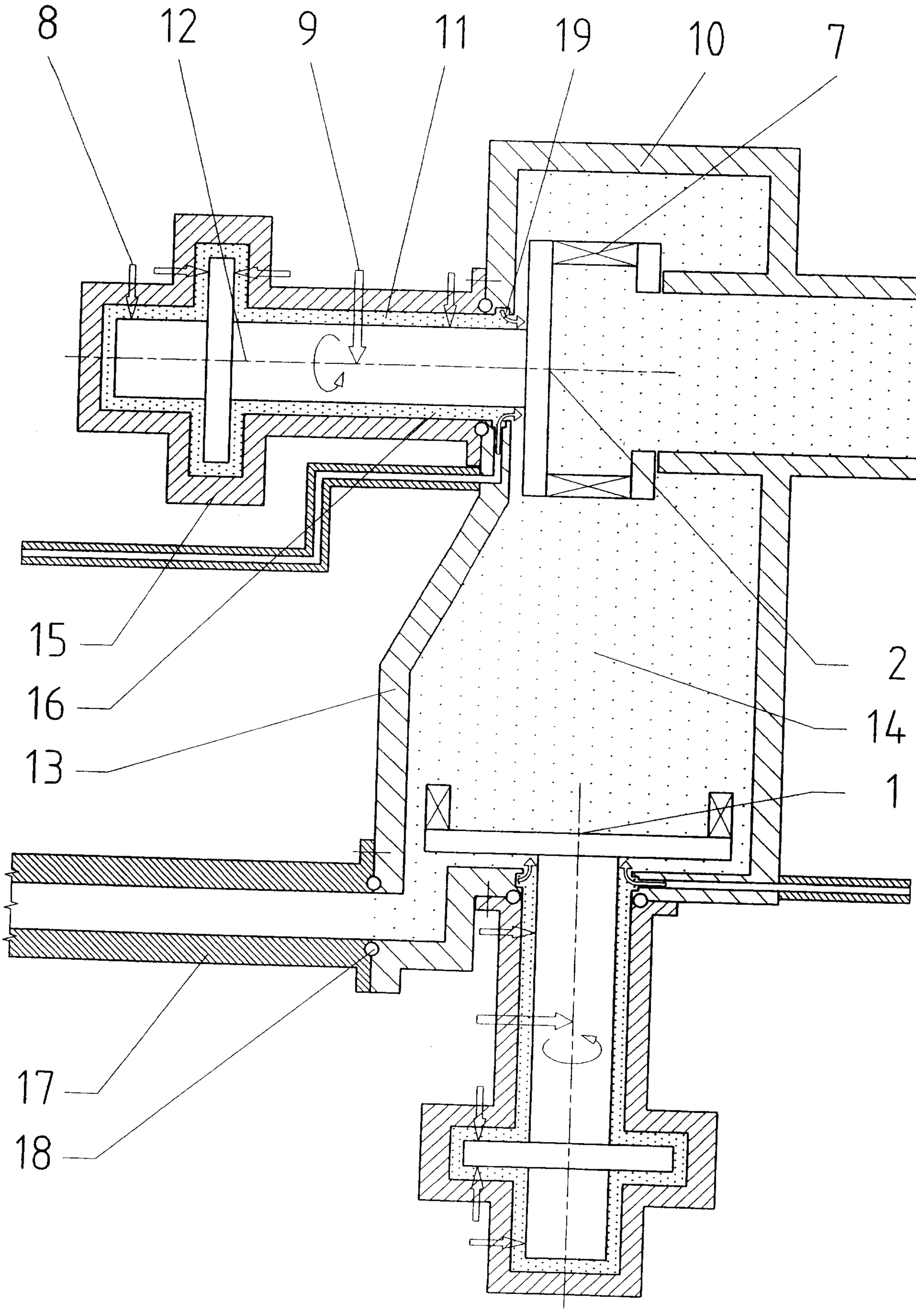

Fig. 2

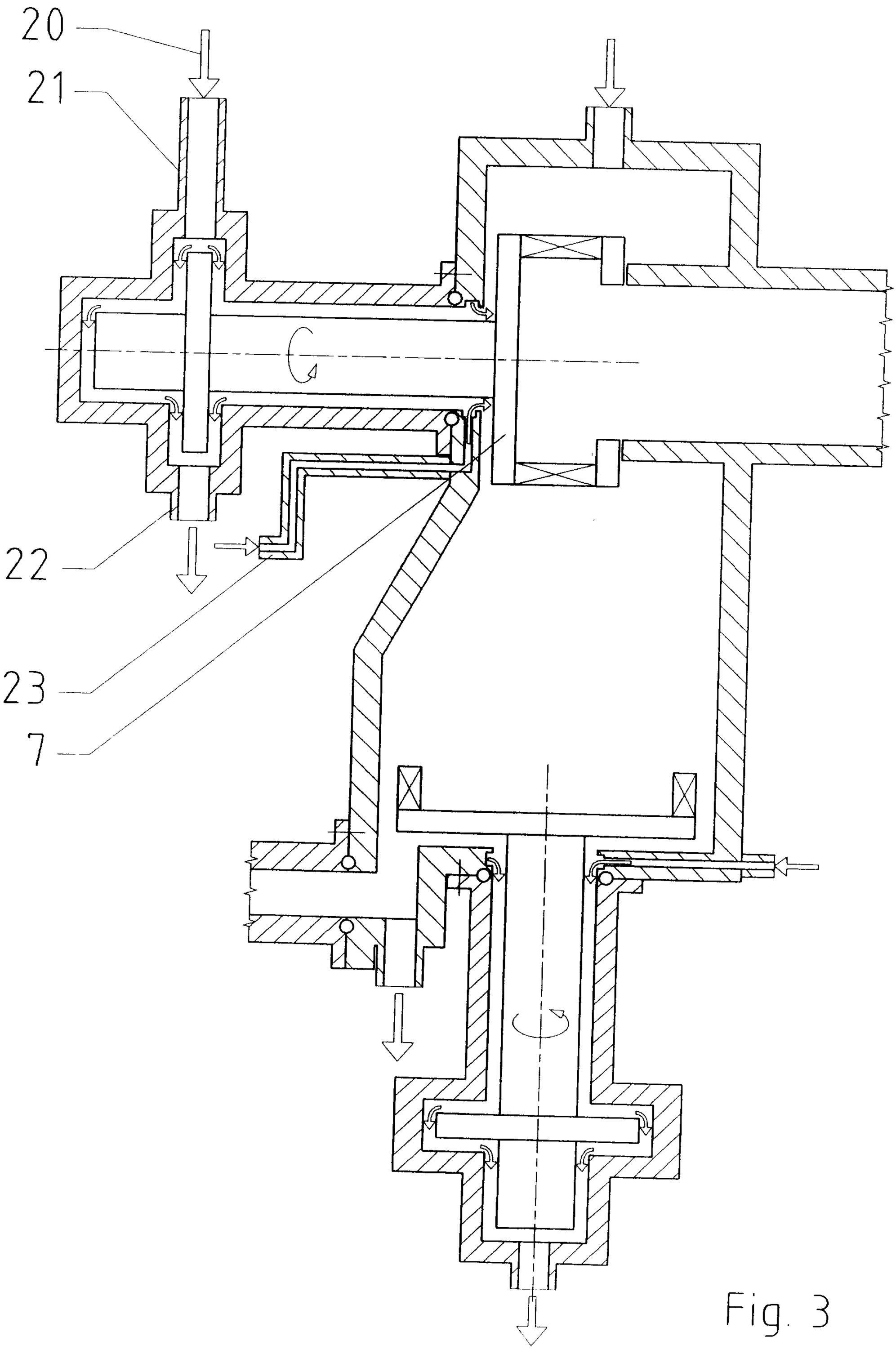

Fig. 3

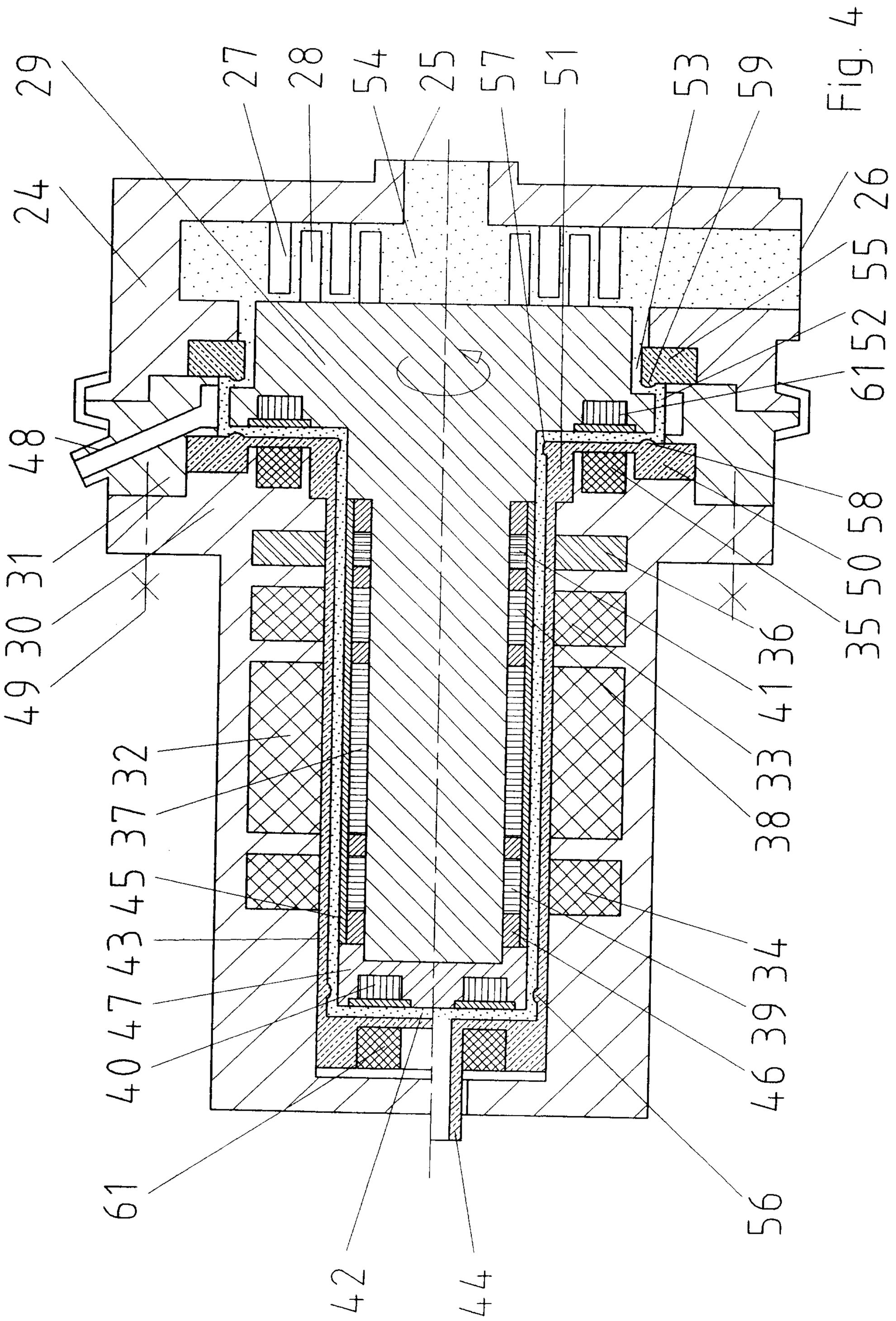
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Fig. 4

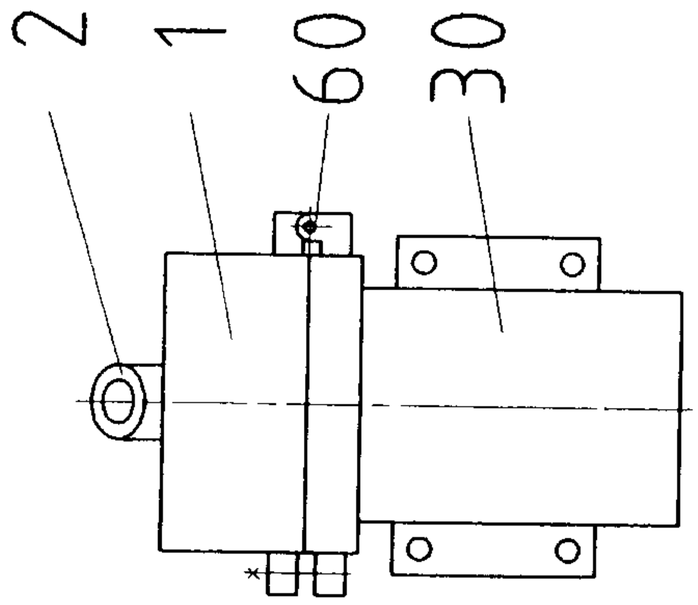
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Fig. 6

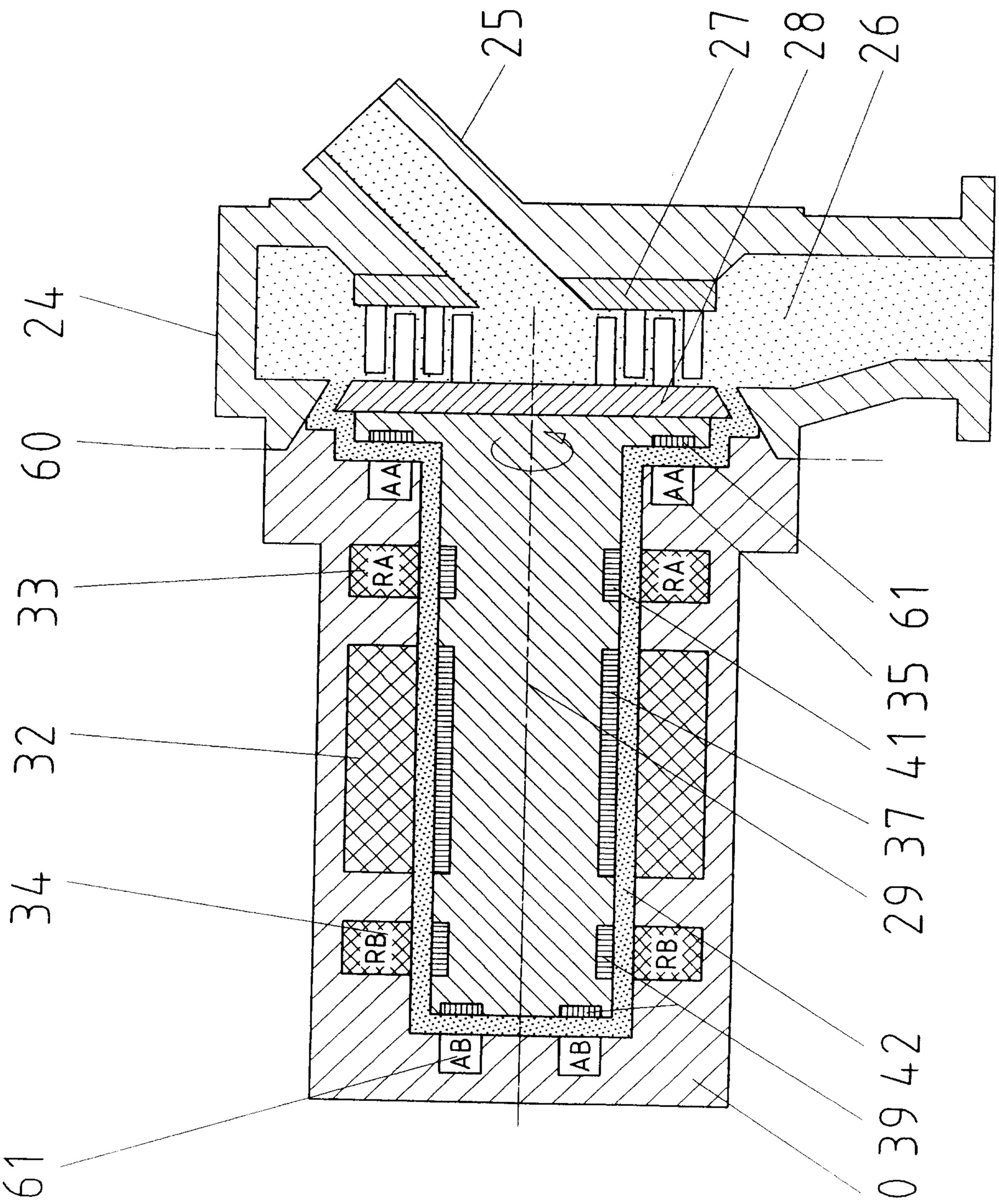
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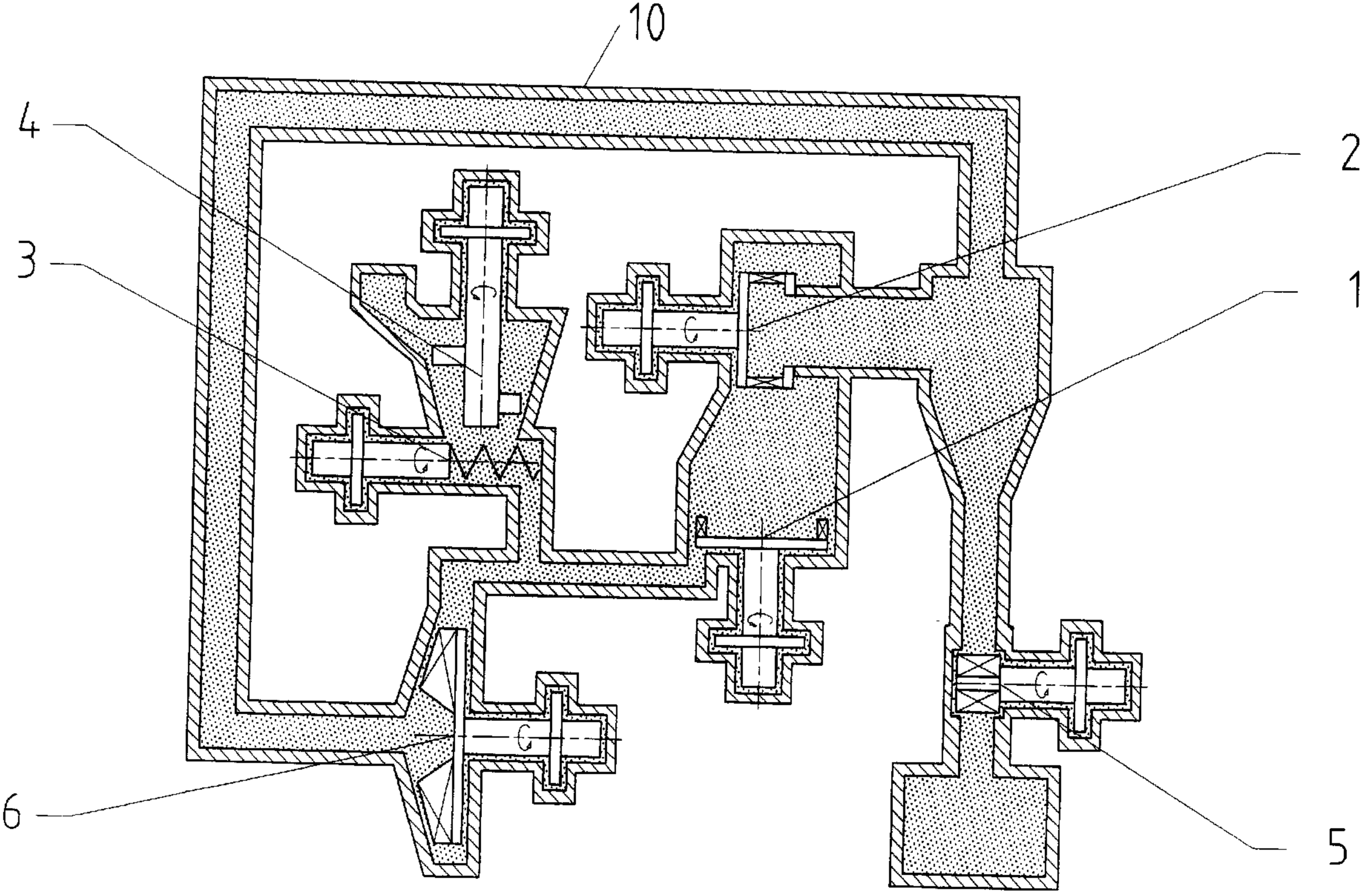
Fig. 5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