(19) DANMARK

(10) DK/EP 3065852 T3

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: *B 01 F 7/30 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2018-08-06**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2018-05-02**

(86) Europæisk ansøgning nr.: **14793142.2**

(86) Europæisk indleveringsdag: **2014-11-04**

(87) Den europæiske ansøgnings publiceringsdag: **2016-09-14**

(86) International ansøgning nr.: **EP2014073689**

(87) Internationalt publikationsnr.: **WO2015067599**

(30) Prioritet: **2013-11-08 DE 102013018725**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **AGITATOR TIL BLANDING AF FLUIDER**

(56) Fremdragne publikationer:
WO-A1-02/30552
DE-C- 154 115
US-A- 3 126 196
US-A- 4 697 929

Description

The invention relates to an agitator for mixing fluids with different viscosities according to the preamble of Claim 1.

Agitators for stirring or mixing fluids are known. For stirring or mixing fluids propellers or variations of a propeller are used, which are referred to as agitators. Propellers or the variations are understood to mean a device, which comprises two or several blades or vanes arranged at equal intervals about a shaft. The propeller mixes the fluids, by the blades or vanes rotating about the shaft.

Agitators with propellers are used for mixing different fluids. Thus, from the patent document CH 690836 A5 an agitator emerges for stirring dough, the attachment of further elements to the vanes or blades, in order to influence the flow behaviour generated.

An agitator for biomass, sewage sludge or the like can be learned from utility model AT 007987 U1, the propeller axis of which or drive shaft of which is inclined towards the horizontal at different angles, in order to achieve a better spatial mixing of the fluid.

A displaceable propeller of an agitator, which is longitudinally displaceable along its drive axis, can be learned from the utility model DE 20 2008 015 990 U1. A propeller, which can be inclined with its drive axis, is disclosed in patent document DE 197 56 485 C2.

From the unexamined patent application DE 10 2010 002 461 A1 an agitator is known, which is enclosed by a casing having a plurality of openings, so that the fluid is drawn or pressed through the channel and a movement is thereby generated.

Besides the use of different forms of the propeller, there are still other shapes, which were used, in order to mix fluids, such as can be learned from DE 91 02 832 U1, DE 20 2011 052 408 U1, DE 20 2011 107 055 U1, DE 6 910 714 T2 or DE 88 11 813 U1.

In addition, an agitator for mixing fluids with different viscosities emerges from DE 154 115 C. The agitator has a main shaft with a rotational axis and paddles, which are connected to the main shaft. The paddles each have a paddle shaft with a paddle shaft axis, wherein said paddles are arranged at an angle relative to the rotational axis with a value between 20° and 40°. A radial distance of the paddle shafts relative to the main shaft at a lower end of the paddle shafts, which is formed facing away from the

main shaft, is greater than a radial distance of the paddle shafts relative to the main shaft at an upper end of the paddle shafts, which is formed facing the main shaft. The paddles, that is, the paddle surfaces of the paddles are aligned to one another in a plane.

The problem addressed by the present invention is to provide an agitator which brings about an improved mixing of the fluids.

The problem is solved according to the present invention by an agitator for mixing fluids having the features of Claim 1. Advantageous embodiments with suitable and non-trivial further developments of the invention are indicated in the respective dependent claims.

The agitator according to the present invention for mixing fluids with different viscosities, wherein the agitator is a bionic agitator, comprises a main shaft with a rotational axis and paddles. The paddles are connected to the main shaft, wherein the paddles each have a paddle shaft with a paddle shaft axis. The paddle shaft axes have a first angle relative to the rotational axis, which has a value between 20° and 40°. The paddles are arranged with their paddle surfaces at a second angle of 90° relative to one another. During operation of the agitator the paddles have a first rotation about the main shaft and a second rotation about the respective paddle shaft axis. A radial first distance of the paddle shaft axes relative to the rotational axis at a lower end of the paddle shafts, which is formed facing away from the main shaft, is greater than a radial second distance of the paddle shaft axes relative to the rotational axis at an upper end of the paddle shafts, which is formed facing the main shaft. The advantage is an inclined position of the paddle outwards in an area of the paddle, which is formed facing away from the main shaft, so that an improved flow can be achieved in the fluid.

An inclined position of the paddle inwards in the area of the paddle, which is formed facing away from the main shaft, therefore, a position of the paddle, which is formed facing the rotational axis, is known from the prior art. With the same form of the paddles the position of the paddles according to the present invention leads to a substantially larger circumferential radius due to the paddles being directed outwards, whereby a likewise enlarged flow radius can be achieved, which finally leads to an improved flow of the fluid and thus to an improved mixing of the fluid.

According to the invention the first rotation may be transferred to the paddles via a non-rotatable connection between the main shaft and the paddles, and the second rotation may be transferred to the paddles via a friction drive provided between the main shaft and the paddles.

The non-rotatable connection is formed by means of second guide tubes rotatably accommodating the paddle shafts, which are non-rotatably connected to the main shaft.

In order to form the non-rotatable connection the second guide tubes are accommodated non-rotatably at a housing, which is connected non-rotatably to the main shaft. Thus, the possibility exists of fixing the guide tubes to the housing.

In a further embodiment of the agitator according to the present invention the friction drive has gearwheels. Large forces can preferably be transferred by means of the gearwheels.

Preferably, the gearwheels are designed in the form of bevel gears, so that an inclined position of the paddle shaft axis relative to the rotational axis can be easily achieved.

According to the invention the friction gear is accommodated in a transmission gear housing, whereby a penetration of the fluid can be prevented and can be completely prevented by means of seals on the transmission gear housing.

Preferably, the paddle shafts have stabilising tubes, which have mounts, and wherein the stabilising tubes are provided with notches for additional feather keys of the paddle shafts. Thus, a rapid and exactly-fitting mounting is possible and the paddles do not get out of the provided angles or out of their provided positions during the operation. This mounting can also be carried out by fasteners, bolts and other types of mechanical screw connections.

In a further embodiment of the agitator according to the present invention the paddle shafts at an end facing away from the paddle have feather keys for connecting to stabilising tubes, wherein mountings of the paddles are provided. It is thereby ensured that the stabilising tubes of the paddles can be rapidly mounted and when the paddles move the connection between the paddle shafts and the stabilising tubes of the paddles does not shift. Alternatively, however, all possible fasteners, bolts and mechanical screw connect ions can be used.

In a further embodiment of the agitator according to the present invention the paddle shafts are accommodated rotatably in second guide tubes, wherein they are connected to a transmission gear housing of a lower transmission gear via reinforcing means, and wherein they are supported by multiple means and sealed by multiple means against the transmission gear housing. The advantage is that by means of the second guide tubes an improved stability and a quiet stirring behaviour is provided and at

the same time the penetration of the fluid into the interior of the lower transmission gear housing is prevented.

Further advantages, features and details of the invention result from the following description of preferred embodiments as well as by means of the drawing.

For the sake of clarity it is possible, that the elements are not provided in all figures with their reference signs, without, however, losing their assignment.

Fig. 1 shows an agitator according to the present invention with a drive in a perspective depiction.
Fig. 2 shows a lower transmission gear of the agitator according to Fig. 1 in a section,
Fig. 3 shows the lower transmission gear according to Fig. 2 in a perspective view,
Fig. 4 shows paddles of the agitator according to Fig. 1 in a perspective view,
Fig. 5 shows the lower transmission gear with paddles in a partial section, and
Fig. 6 shows the lower transmission gear with paddles in a top view.

An agitator 1 according to the present invention for mixing fluids, in particular, a bionic agitator is constructed according to Fig. 1. The agitator 1 has a drive 2, by which it can be set into motion. The drive 2 can be designed electrically, pneumatically or hydraulically. In the depicted embodiment the drive 2 is designed in the form of an electric motor.

Alternatively, water or a steam, gasoline or other type of internal combustion engine can also be used. The drive 2 of the bionic agitator 1 depends on the viscosity and the quantity of the fluid, which must be moved or mixed as well as on the objective.

The drive 2 is coupled with a transmission 3, which in turn drives a main shaft 4 of the agitator 1, which is connected to a lower transmission gear 5 of the agitator 1, see in particular Fig. 2. A transmission ratio used depends on the respective fluid and the objective. Depending on the requirement the transmission ratio is used with slow to rapid running properties. The transmission ratio is also matched with the drive 2 used in each case, in order to achieve an energy-efficient and gentle mixing of the respective fluid.

The main shaft 4 is supported by multiple means. This multiple support permits a relatively frictionless rotation about its rotational axis 6. In addition, since the main shaft 4 supports the entire weight of the agitator 1, said multiple support serves to provide an improved weight distribution on the individual bearing.

An exact fit of the connection of the gear 3 to the main shaft 4 is carried out by means of a feather key 7.

In order to mount the bionic agitator 1 a mounting plate 8 is provided. The mounting plate 8 can be connected by means of high-efficiency screws, seals and bearings to the device, which is provided for the mounting and which can consist of wood, concrete, stone, plastic or metal.

In this embodiment the mounting plate 8 is attached, for example, to a lid not depicted in more detail of a closed space not depicted in more detail, in which the fluid to be stirred is located. Through this connection of the bionic agitator 1 to the lid first a stability of the bionic agitator 1 is achieved and second it is prevented that the fluid can exit or undesired fluid can enter into the space, in which the fluid is stirred. Depending on the nature of the lid and the fluid different seals and different mounting devices are used. This construction permits a rapid replacement of the respective components and permits a rapid entry into service of the bionic agitator 1 in the assembly, the maintenance or after a repair.

The mounting plate 8 is fixedly connected to a guide tube 9, in the interior of which the main shaft 4 extends to the lower transmission gear 5, which is accommodated in a lower transmission gear housing 10. The guide tube 9 can also take other forms than a tube and the material can here too vary again. It is only important that it is so tight that the fluid does not pass into the interior.

At the lower end of the guide tube 9, which is positioned facing the lower transmission gear 5, said guide tube is coupled with a connection 11 to the lower transmission gear 5, which is rotatable. Here again it is the case that the connection must be so tight, that no fluid passes into the interior and that the lower transmission gear housing 10 is rotatable. Both requirements are achieved by different seals and bearings.

In the transmission gear housing 10 the end 12 of the main shaft 4 formed facing away from the drive 2 is located, which main shaft is connected to the transmission gear housing 10 via a supported mounting 13. Through the rotation of the main shaft 4 the transmission gear housing 10 is also set into rotation, so that the entire lower part of the bionic agitator 1 rotates about the rotational axis 6 of the main shaft 4. In other words, this means that the main shaft 4 is connected non-rotatably to the transmission gear housing 10.

Bevel gears 14 are accommodated in the transmission gear housing 10, which bevel gears mark an end of the paddle shafts 15, which is formed facing the drive 2. As can be learned from Fig. 2, each paddle shaft 15 has a bevel gear 14. The bevel gears 14, as can be seen in particular in Fig. 2, are in operative connection with one another via a drive gearwheel 16, which is connected non-rotatably to the main shaft 4. Thus, a friction drive is formed.

The bevel gears 14 are driven by the cone-shaped drive gearwheel 16 of the main shaft 4. Based on the connection, that is, non-rotatable connection of the bevel gears 14 to the paddle shaft 15 associated in each case with them, the paddle shafts 15 are set into rotation.

The drive of the paddle shafts 15 formed by the bevel gears 14 and the drive gearwheel 16 in the transmission gear housing 10 can also be produced by means of a toothed belt drive, rotary joint drive, belt drive, chain drive, magnets and others.

It is important that the transmission gear housing 10 is sealed to the extent that no fluid passes into the interior and the flow generated in the fluid is not affected by the size and form of the transmission gear housing 10.

At a lower side 17 of the transmission gear housing 10, which is formed facing away from the drive 2, second guide tubes 18 of the paddle shafts 15 are formed, wherein each second guide tube 18 at least partially comprises a paddle shaft 15.

By means of reinforcing means 19, which are formed at the lower side 17, the second guide tubes 18 are mounted on the transmission gear housing 10. Said reinforcing means 19 provide for a greater stability and a quiet and uniform movement of the paddle 20 mounted on the paddle shafts 15. As can be learned in particular from Fig. 1, each paddle shaft 15 has a paddle 20.

The paddle shafts 15 are accommodated in the second guide tubes 18 associated in each case with them and are supported by multiple means. At the same time, they are sealed by multiple means, so that no fluid can penetrate into the interior of the transmission gear housing 10. At this point it should be mentioned that the cited seals can be designed in the form of suitable rubber seals or metal seals. In this connection, in particular the fluid to be mixed must be taken into account, and it must be observed to what extent there is a corrosive and/or eroding tendency of the fluid relative to the material of the seals used.

At a lower end 21 of the paddle shafts 15, which is formed facing away from the transmission gear housing 10 or from the main shaft 4, said paddle shafts are provided with further feather keys 22 for the connection to stabilising tube 23 and mountings in the form of mounting plates 24 of the paddles 20. The further feather keys 22 ensure that the stabilising tubes 23 of the paddles 20 can be mounted rapidly and when the paddles 20 move the connection between the paddle shaft 15 and the respective stabilising tube 23 does not shift or is not detached.

As can be learned in particular from Fig. 2, a radial first distance of the paddle shaft axes 28 relative to the rotational axis 6 is greater at the lower end 21 than a second distance of the paddle shaft axes 28 relative to the rotational axis 6 at an upper end of the paddle shafts 15 formed facing the main shaft 4, in particular at the bevel gears 14.

The stabilising tubes 23 are mounted on the paddle shafts 15 with mounts 24, which are provided with notches not depicted in more detail for the further feather keys 22. This mounting can also be carried out by fasteners, bolts and other types of mechanical screw connections.

The stabilising tubes 23 of the paddles 20 serve as mounts of the paddles 20; they provide an additional stability to the respective paddle 20 and also prevent a rotation of paddle outer surfaces 25 of the paddles 20. In other words, this means that the stabilising tubes 23 stabilise the paddles 20 in their position relative to one another and relative to the main shaft 4, so that a depositioning is prevented and angles or angular positions, as elucidated below, are maintained.

The paddles 20 are provided with metal angle 26 for the reinforcement and flow improvement of the paddles 20. Also, paddle edges 27 of the paddles 20 are turned over, in order to also improve the flow behaviour of the paddles 20.

The form, in other words outer contours, and size of the paddles 20 depend on the fluid as well as the quantity of the fluid, which must be circulated. The following forms are used for the paddles 20: round, oval, triangle, trapezoid, diamond, rhombus, parallelogram, square, rectangle, quadrilateral and natural forms from the animal kingdom and nature. At the same time, the paddle 20 can be bent or deformed, if this serves the stability of the paddles 20 and/or positively influences the flow behaviour of the fluid. The paddle 20, as depicted in Figs. 1, 2, 4 and 6, is designed to be flat or plate-shaped.

The paddle shafts 15 with their shaft axes 28 and in an axial extension the paddles 20 with their coaxial paddle axes 29 are positioned at a first angle α of 20° to 40° to the main shaft 4, so that an ideal flow behaviour of the fluid is generated.

The paddles 20 must be attached to the paddle shafts 15 such that the paddle surfaces 30 are at a second angle β of 90° relative to one another, as can be learned in particular from Fig. 6, so that an ideal flow behaviour of the fluid is generated. To facilitate a better understanding, a first section plane E1 of the one paddle surface 30 and a second section plane E2 of the other paddle surface 30 are delineated. From this it follows that the paddle surfaces 30 are arranged relative to one another at the second angle β with a value of 90°.

By the rotations of the paddles 20, which means by a first rotation of the paddles 20 about the rotational axis 6 and by a second rotation of the respective paddles 20 about the paddle shaft axis 28 associated with them, the fluid is pushed ahead or displaced by the paddles 20. The thus generated movement ensures that the fluid is shifted by 360°, which in turn has the result that the components of the fluid are completely mixed and the fluid thus becomes maximally homogenous.

During this movement of the fluid turbulences are reduced as much as possible and shearing forces are prevented. Thus, a substantially better mixing of the fluid is realised. At the same time, the movement of the paddles 20 and the movement generated in the fluid have the result that substantially less energy must be expended, in order to keep the fluid moving, than is the case in conventional agitators. A further advantage of this type of stirring consists in that solids possibly contained in the fluid do not wrap around the paddles 20 or connections, that is, the paddle shafts 15, the mounts 24 and the stabilising tubes 23.

Figs. 3 and 5 serve to provide improved clarity.

The agitator 1 is produced and offered in a wide variety of sizes and designs for a wide variety of applications, in which fluids are circulated or mixed. For example, these can be applications in agriculture (such as biogas plants with and without gas hoods, slurry box, milk cooling, etc.), industry (such as emulsion tank, agitator technology in laboratories, etc.), food industry (such as soft drink- and fruit juice producers, dairies, breweries, etc.), in municipalities and communities (treatment plants, drinking water treatment, standing bodies of water, etc.) and much more.

The bionic agitator can be produced from any type of wood, plastic, carbon, metal and from other existing materials. The connections, in particular the paddle shafts 15, the mounts 24 and the stabilising

tubes 23, which connect the components of the bionic agitator, are always dependent on the type and nature of the material, from which the agitator is built. Accordingly, the connections can be screwed, adhesively attached, inserted or riveted.

The bionic agitator 1 according to the present invention relates to the stirring in different areas, such as, for example, the stirring in biogas plants with and without gas hoods, the stirring of slurry stores in agricultural operations, the stirring in purification- and sewage plants in communities, municipalities and cities, the stirring in water treatment plans, the stirring in laboratories, the stirring in the food industry, the stirring in the metal industry, the stirring in the chemical industry, the circulation of air in homes and residential buildings, the circulation of air in air-conditioned and heated rooms, the circulation of air in nurseries, the circulation of air in commercial and industrial facilities, to any orientation of the agitator in the horizontal as well as vertical position, to any type of mounting, to any design of the agitator in respect to size and the material used, to any agitator described, that deviates in the type of drive, transmission ratios, the seals and the connections from that described, but otherwise has the same objective as the bionic agitator 1 described.

Patentkrav

1. Agitator til blanding af fluider med forskellige viskositeter, hvor agitatoren (1) er en bionisk agitator, omfattende en hovedaksel (4) med en rotationsakse (6) og padler (20), som er forbundet til hovedakslen (4), hvor padlerne (20) hver omfatter en paddelaksel (15) med en paddelakselakse (28), og hvor paddelakselaksen (28) strækker sig ved en første vinkel (α) i forhold til rotationsaksen (6) i et område på mellem 20° og 40°,
og hvor padlerne (20), under drift af agitatoren (1), udfører en første rotation omkring hovedakslen (4) og en anden rotation omkring den respektive paddelaksel akse (28), hvor en radial første afstand af paddelakselakserne (28) i forhold til rotationsaksen (6) ved en nedre ende (21) af paddelakslerne (15), hvilken ende er dannet vendende væk fra hovedakslen (4), er større end en radial anden afstand af paddelakselakserne (28) i forhold til rotationsaksen (6) ved en øvre ende af paddelakslerne (15), som er dannet vendende mod hovedakslen (4), og hvor den første rotation kan overføres til padlerne (20) via en drejefast forbindelse (10, 18) mellem hovedakslen (4) og padlerne (20), og den anden rotation kan overføres til padlerne (20) via et kardandrev (14, 16) tilvejebragt mellem hovedakslen (4) og padlerne (20), og hvor den drejefaste forbindelse (10, 18) er dannet ved hjælp af anden føringsrør (18) drejbart akkommoderende paddelakslerne (15) og forbundet drejfast til hovedakslen (4), **kendetegnet ved, at** padlerne (20) er anbragt med deres paddelflader (30) ved en anden vinkel (β) på 90° i forhold til hinanden, hvor for at danne den drejefaste forbindelse (10, 18) de anden føringsrør (18) er akkommoderet drejfast ved et transmissionsgearhus (10), hvilket er forbundet drejfast til hovedakslen (4), hvor kardandrevet (14, 16) er akkommoderet i transmissionsgearhuset (10).

2. Agitator ifølge krav 1, **kendetegnet ved, at** kardandrevet (14, 16) omfatter tandhjul (14, 16).

3. Agitator ifølge krav 2, **kendetegnet ved, at** tandhjulene (14, 16) er koniske tandhjul.

4. Agitator ifølge et af de foregående krav, **kendetegnet ved, at** paddelakslerne (15) har stabiliseringsrør (23) omfattende beslag (24), og hvor stabiliseringsrørene (23) er tilvejebragt med riller til yderligere fer (Passfedern) (22) af paddelakslerne (15).

5. Agitator ifølge et af de foregående krav, **kendetegnet ved, at** paddelakslerne (15) ved en ende, som vender væk fra padlen (20), omfatter fertil at forbinde til stabiliseringsrør (23), og hvor beslag (24) af padlerne er tilvejebragt.

6. Agitator ifølge et af de foregående krav, **kendetegnet ved, at** paddelakslerne (15) er akkommoderet drejbart i anden føringsrør (18), hvor de er forbundet til et transmissionsgearhus (10) af et nedre transmissionsgear (5) via forstærkninger (19), og hvor de er støttet på flere måder og tætnet på flere måder mod transmissionsgearhuset (10).

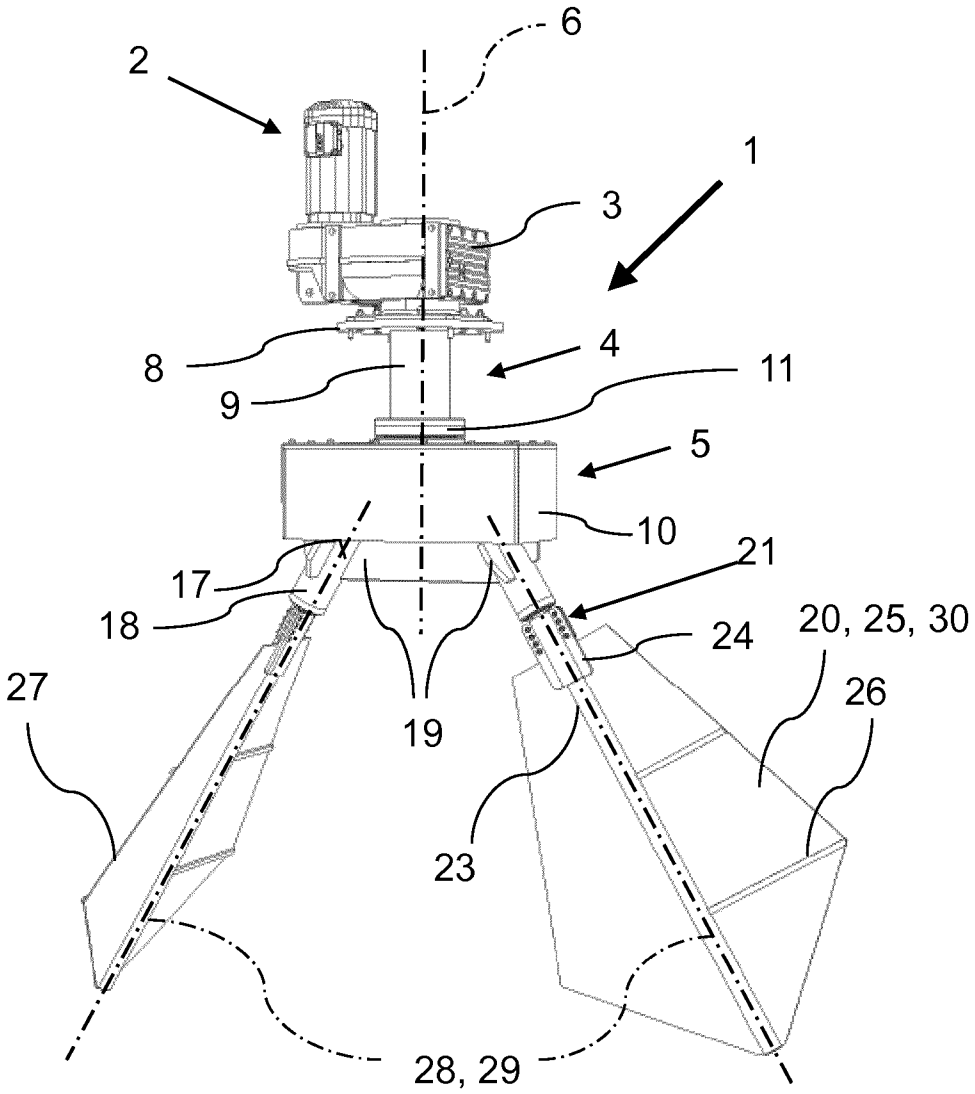

Fig. 1

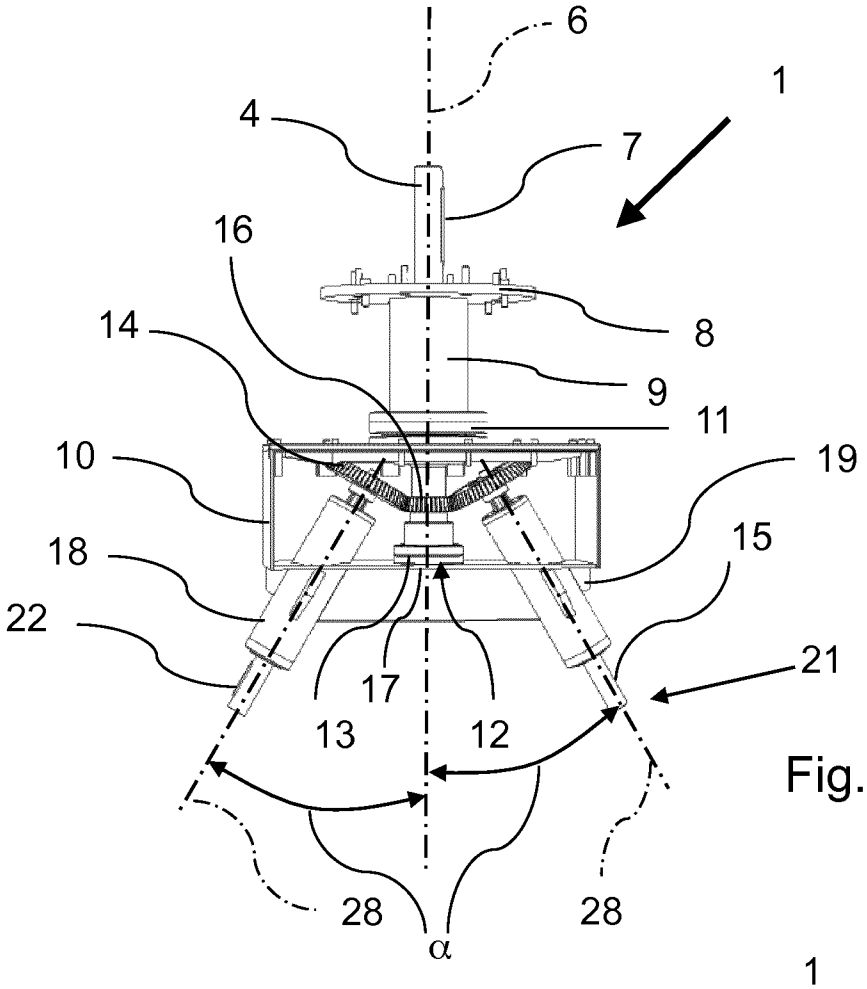
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Fig. 2

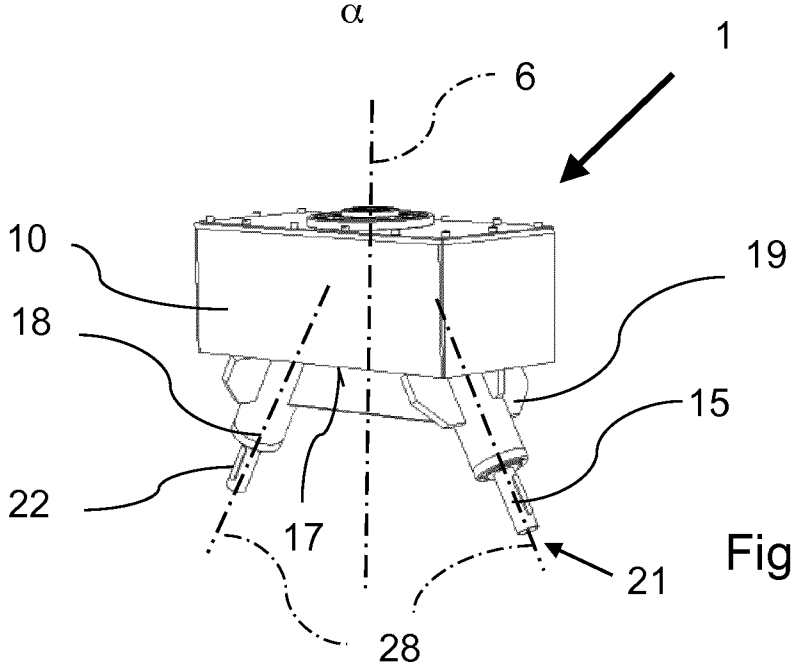
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Fig. 3

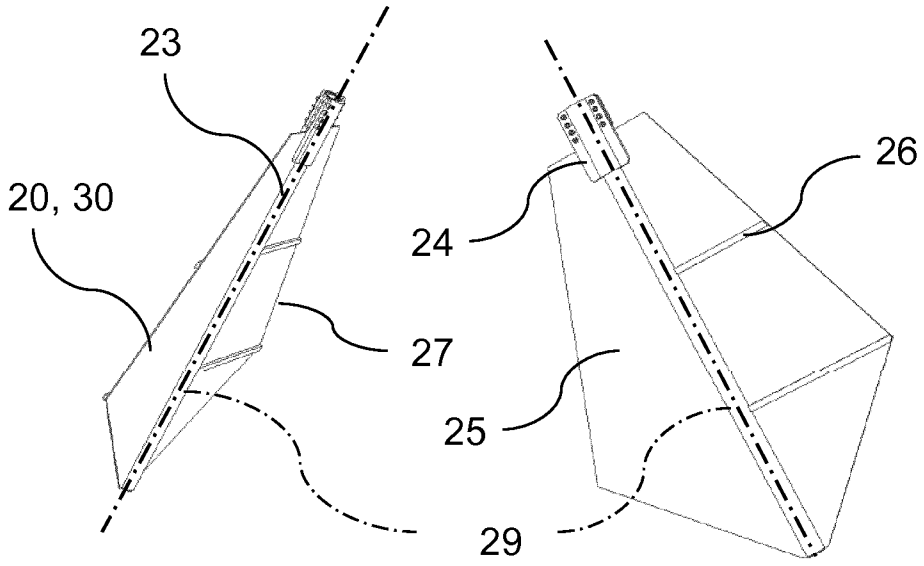

Fig. 4

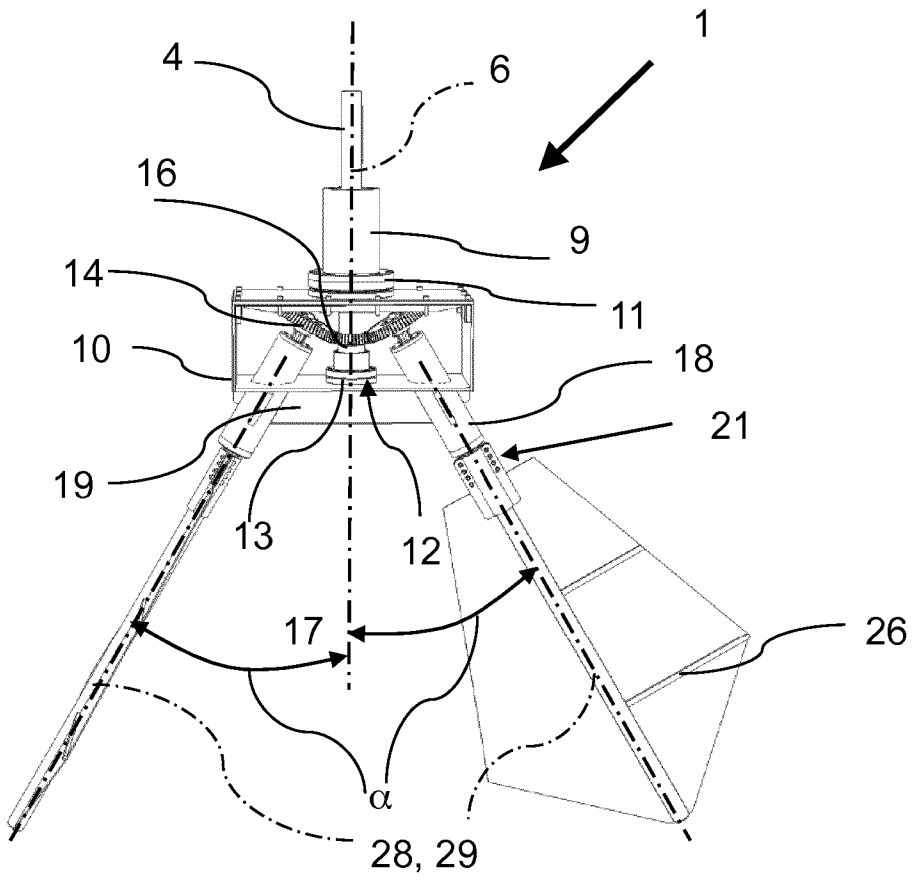

Fig. 5

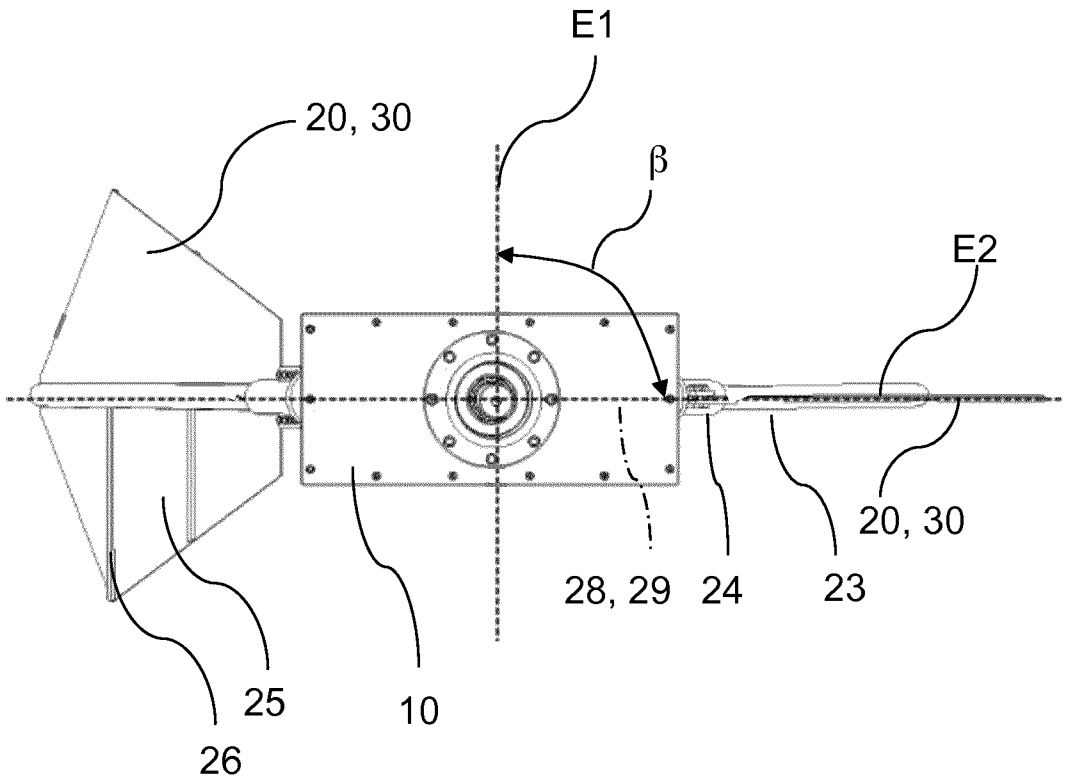

Fig. 6