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(54) **Titre : AGITATEUR POUR MELANGER DES FLUIDES**
(54) **Title: AGITATOR FOR MIXING FLUIDS**

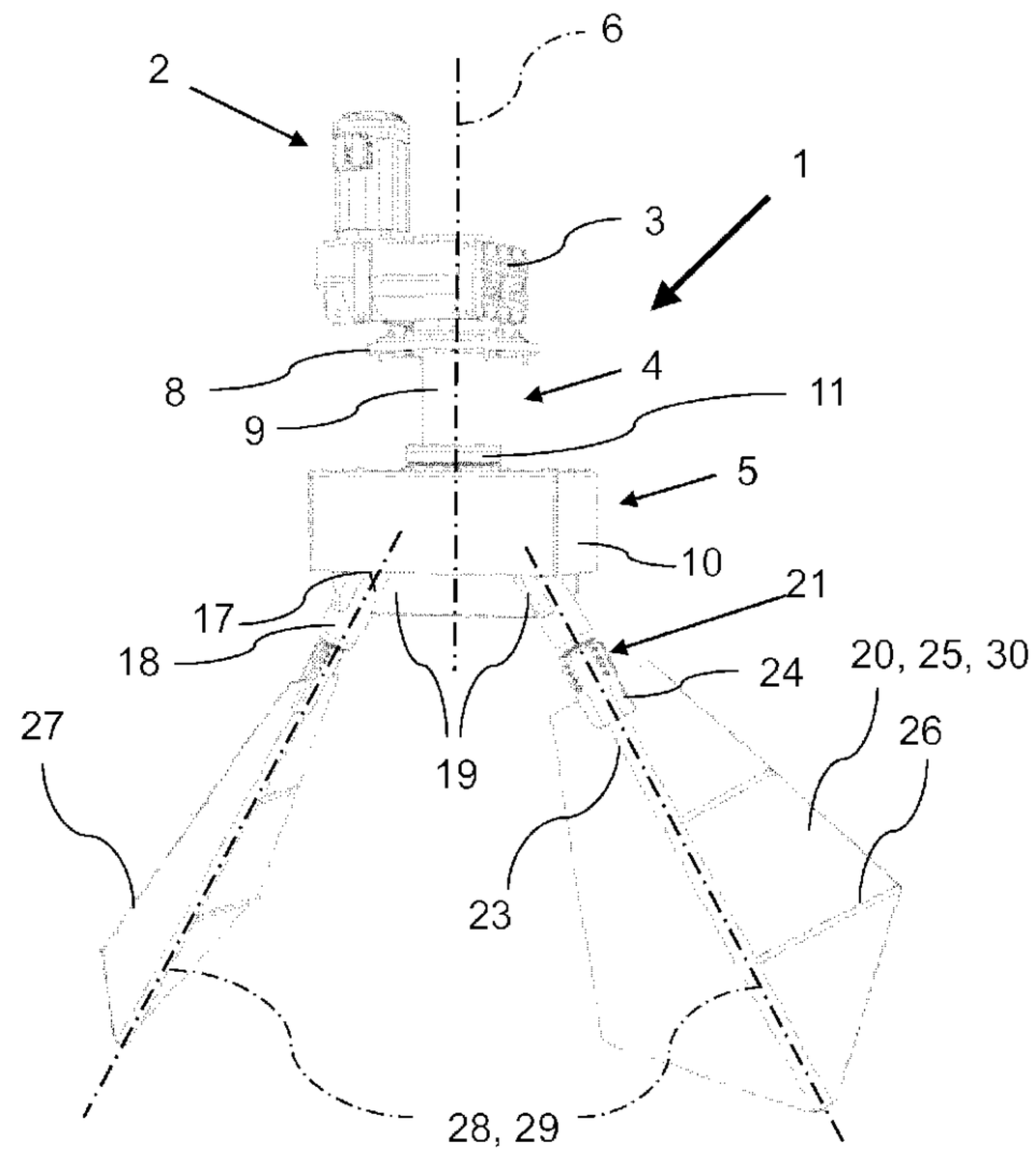

Fig. 1

(57) **Abrégé/Abstract:**
The invention relates to an agitator for mixing fluids having different viscosities, wherein the agitator (1) is a bionic agitator, comprising a main shaft (4) with a rotational axis (6) and with paddles (20) which are connected to the main shaft (4), wherein the

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(57) **Abrégé(suite)/Abstract(continued):**
paddles (20) each comprise a paddle shaft (15) with a paddle shaft axis (28), and wherein the paddle shaft axes (28) comprise a first angle (a) to the rotational axis (6), which angle has a value between 20° and 40°, and wherein the paddles (20) with the paddle surfaces (30) are arranged in a second angle (β) of 90° to each other, and wherein the paddles (20), during operation of the agitator (1), exhibit a first rotation around the main shaft (4) and a second rotation around the respective paddle axes (28). According to the invention, in relation to the rotational axis (6), a radial first distance of the paddle shaft axes (28) to a bottom end (21) of the paddle shafts (15), which paddle end is formed facing away from the main shaft (4), is greater than a second distance of the paddle shaft axes (28) to an upper end of the paddle shafts (15) formed facing the main shaft (4), in relation to the rotational axis (6).

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Abstract

Agitator for Mixing Fluids

The invention relates to an agitator for mixing of fluids with different viscosities, wherein the agitator (1) is a bionic agitator with a main shaft (4) with an axis of rotation (6) and paddles (20) which are connected with the main shaft (4), wherein the paddles (20) each comprise one paddle shaft (15) with one paddle shaft axis (28), and wherein the paddle shaft axes (28) exhibit a first angle (α) relative to the axis of rotation (6) ranging between 20 ° and 40 °, and wherein the paddles (20) with their paddle surfaces (30) are arranged at a second angle (β) of 90 ° relative to one another, and wherein the paddles (20) with the agitator (1) operating perform a first rotation about the main shaft (4) and a second rotation about the respective paddle shaft axis (28).

According to the invention, a radial first distance of the paddle shaft axes (28) relative to the axis of rotation (6) at a lower end (21) of the paddle shafts (15), which is formed facing away from the main shaft (4), is larger than a radial second distance of the paddle shaft axes (28) relative to the axis of rotation (6) at an upper end of the paddle shafts (15), which is formed facing the main shaft (4).

(Fig. 1)

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Agitator for Mixing Fluids

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

Agitators for agitating or mixing, respectively, fluids are known. For agitating or mixing, respectively, the fluid propellers or modifications of a propeller, respectively, are employed, which are referred to as agitator. Propellers or the modifications respectively, thereof are to be understood as devices which consist of two or more blades or paddles, respectively, which are equally spaced about a shaft. The propeller mixes fluids, while the blades or paddles, respectively, rotate about the shaft.

Agitators with propellers are utilised for mixing various fluids. For example, patent specification CH 690836 A5 discloses an agitator for agitating a dough, wherein additional elements are attached to the blades or paddles, respectively, in order to influence the generated flow behaviour.

Utility model AT 007987 U1 shows an agitator for biomass, sewage sludge or the like, whose propeller axis or whose drive shaft, respectively, assumes various angles relative to the horizontal in order to achieve a better spatial mixing of the fluid.

A movable propeller of an agitator, which may be moved in the longitudinal direction along its drive axis, may be taken from utility model DE 20 2008 015 990 U1. A propeller whose axis may be inclined is disclosed in patent specification DE 197 56 485 C2.

An agitator is known from the unexamined patent application DE 10 2010 002 461 A1, which is enclosed by a shroud with several openings, so that the fluid is sucked or pressed, respectively, through the channel, whereby a movement is generated.

Beside the employment of various configurations of the propeller, there are other forms which have been used to mix fluids, as may be taken form 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.

It is the object of the present invention to provide an agitator for improved mixing of the fluids.

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According to the invention, this object is solved by an agitator for mixing fluids with the features of Claim 1. Advantageous embodiments with suitable and non-trivial developments of the invention are indicated in the respective sub-claims.

The inventive agitator for mixing fluids with different viscosities, wherein the agitator is a bionic agitator, comprises a main shaft and paddles. The paddles are connected with 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 axis of rotation, which ranges between 20 ° and 40 °. The paddles are arranged with their paddle surfaces at a second angle of 90 ° relative to one another. With the agitator operating, the paddles perform 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 axis of rotation at a lower end of the paddle shafts, which is formed facing away from the main shaft, is larger than a radial second distance of the paddle shaft axes relative to the axis of rotation at an upper end of the paddle shafts, which is formed facing the main shaft. The advantage is an oblique position of the paddles in an area of the paddles, which faces away from the main shaft to the outside so that an improved fluid flow may be achieved.

From the state of the art an oblique position of the paddles in the area of the paddles facing away from the main shaft towards the inside, i. e. a position of the paddles towards the axis of rotation is known. With the same shape of the paddles, the inventive position of the paddles results in a considerably larger circumferential radius because of the outwardly directed paddles, whereby an enlarged flow radius may be achieved as well, which ultimately leads to an improved flow of the fluid and thus to improved mixing of the fluid.

In an embodiment, the first rotation may be transferred to the paddles via a non-rotating connection between the main shaft and the paddles, and the second rotation may be transferred to the paddles via a friction drive, wherein the friction drive is arranged between the main shaft and the paddles.

Preferably, the non-rotating connection is formed by means of second guide tubes rotatably receiving the paddle shafts, which tubes are non-rotatably connected with the main shaft.

For making the non-rotatable connection, it is particularly preferred to accommodate the second guide tubes non-rotatably at a housing which is non-rotatably connected with the main shaft. This provides the possibility to fix the guide tubes at the housing.

In a further embodiment of the inventive agitator, the friction drive comprises gears. By means of the gears, preferably great forces may be transferred.

Preferably, the gears are formed as bevel gears so that an oblique position of the paddle shaft axis relative to the axis of rotation may be achieved in a simple manner.

In a further embodiment, the friction drive is accommodated in a transmission gear housing so that any entering of the fluid is prevented and may be completely excluded by means of seals at the transmission gear housing.

The paddle shafts preferably comprise stabilising tubes with support plates, wherein the stabilising tubes are provided with notches for additional feather keys of the paddle shafts. This allows a rapid and precision-fit assembly and the paddles cannot be displaced from their specified angles or their specified positions, respectively, during operation. This fastening may also be accomplished by locks, bolts and other mechanical screw connections.

In a further embodiment of the inventive agitator, the paddle shafts comprise feather keys at one end facing away from the paddle for the connection to the stabilising tubes, with supports of the paddles being provided. This ensures that the stabilising tubes of the paddles may be rapidly assembled and that upon movement of the paddles the connections between den paddle shafts and the stabilising tubes of the paddles do not slip. Alternatively, all possible locks, bolts and other mechanical screw connections may also be used.

In a further embodiment of the inventive agitator, the paddle shafts are rotatably accommodated in second guide tubes, wherein they are connected via reinforcing means with a transmission gear housing of a smaller gear ratio, and wherein they are supported in multiple bearings and sealed against the transmission gear housing. This is advantageous in that by means of the second guide tubes an improved stability and a smooth agitating behaviour is achieved and simultaneously the fluid is prevented from penetrating into the lower transmission gear housing.

Further advantages, features and details of the invention result from the following description of the preferred exemplary embodiments and the drawing. The features and feature combinations mentioned above in the description as well as the features and feature combinations mentioned in the following description of the figures and/or shown only in the figures are not only applicable in the respective indicated combination, but also in other combinations or alone, without exceeding the scope of the invention. Similar or

functionally identical elements are assigned identical reference numerals. For the sake of clarity, the elements might not be provided with their reference numerals in all figures, without, however losing their assignment. In the drawing:

Fig. 1 is a perspective view of an inventive agitator with a drive,

Fig. 2 is a section through a lower transmission gear of the agitator according to Fig. 1,

Fig. 3 is a perspective view of the lower transmission gear according to Fig. 2,

Fig. 4 is a perspective view of the paddle of the agitator according to Fig. 1,

Fig. 5 is a partial section of the lower transmission gear with paddle, and

Fig. 6 is a top view of the lower transmission gear with paddle.

An inventive agitator 1 for mixing fluids, in particular a bionic agitator, is configured according to Fig. 1. The agitator 1 comprises a drive 2 which may set it in motion. The drive 2 may be designed electrically, pneumatically or hydraulically. In the illustrated exemplary embodiment the drive 2 is designed as an electric motor.

Alternatively, water or a vapour, gasoline or another type of combustion engine may be employed. The drive 2 of the bionic agitator 1 is determined by the viscosity and the quantity of the fluid to be moved or to be mixed, respectively, as well as by the objective.

The drive 2 is coupled with a transmission gear 3 which in turn drives a main shaft 4 of the agitator 1, which is connected with a lower transmission gear 5 of the agitator 1, see in particular Fig. 2. The used gear ratio is dependent on the respective fluid and the objective. Depending on the requirement, the gear ratio covers a range from low to high speeds. The gear ratio is also adapted to the respective drive 2 in order to achieve an energy efficient and gentle mixing of the respective fluid.

The main shaft 4 is supported in several bearings. These multiple supports enable a relatively frictionless rotation about the axis of rotation 6. In addition, the multiple supports provide for an improved weight distribution to the individual bearings because the main shaft 4 carries the entire weight of the agitator 1.

An exact fit of the connection of the transmission gear 3 to the main shaft 4 is made my means of a feather key 7.

For the assembly of the bionic agitator 1, an assembly plate 8 is provided. The assembly plate 8 may be connected with the device which is provided for assembly and which may consist of wood, concrete, stone, plastic or metal by means of highly efficient screws, seals and bearings.

In this exemplary embodiment, the assembly plate 8 is for example arranged on a lid (not shown in detail) of a closed space (not shown in detail) in which the fluid to be agitated is located. Firstly, this connection of the bionic agitator 1 with the lid achieves stability of the bionic agitator 1 and, secondly, it prevents the fluid from escaping or that undesired fluid may penetrate into the space where the fluid is agitated, respectively. Depending on the condition of the lid and the fluid, different seals and different fastening means are employed. This construction enables a rapid replacement of the respective components and a fast (re)start of the bionic agitator 1 after construction, maintenance or repair.

The assembly plate 8 is firmly connected with a guide tube 9 wherein 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 may also assume other shapes than a tube and the material may again vary. That which only matters is that it is sufficiently leakproof so that the fluid cannot enter the interior.

The lower end of the guide tube 9 which is positioned facing the lower transmission gear 5 is coupled via a connection 11 with the lower transmission gear 5 which is rotatable. In this case, too, the connection has to be sufficiently leakproof so that no fluid reaches the interior, and the lower transmission gear housing 10 has to be rotatable. These two requirements are met by different seals and supports.

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

Bevel gears 14 are arranged in the transmission gear housing 10, which define an end of paddle shafts 15 facing the drive 2. As can be seen in Fig. 2, one paddle shaft 15 each comprises one bevel gear 14. The bevel gears 14 are in operative connection, as can be seen in particular in Fig. 2, via a drive gear 16 which is non-rotatably connected with the main

shaft 4. Thereby, a friction drive is formed.

The bevel gears 14 are driven by the cone-shaped drive gear 16 of the main shaft 4. Because of the connection, i. e. the non-rotating connection of the bevel gears 14 with the respectively associated paddle shaft 15, the paddle shafts 15 are set in rotation.

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

It is important that the transmission gear housing 10 is sufficiently sealed so that no fluid enters the interior and that the generated fluid flow is not affected by the size and shape of the transmission gear housing 10.

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

The second guide tubes 18 are attached at the transmission gear housing 10 by reinforcing means 19 which are formed at the bottom side 17. These reinforcing means 19 provide for a higher stability and a smooth and uniform movement of the paddles 20 mounted on the paddle shafts 15. As can be seen in particular in Fig. 1, one paddle shaft 15 each comprises one paddle 20.

The paddle shafts 15 are accommodated in their respectively assigned second guide tubes 18 and supported in multiple bearings. At the same time, they are also sealed by multiple seals so that no fluid can enter the interior of the transmission gear housing 10. In this context it should be noted that the mentioned seals may be formed as suitable rubber or metal seals. Here, in particular the fluid to be mixed is to be taken into consideration and if the fluid exhibits a corrosive and/or corroding property against the material of the used seals exists.

At a lower end 21 of the paddle shafts 15 facing away from the main shaft 4 or from the transmission gear housing 10, respectively, additional feather keys 22 for the connection to stabilising tubes 23 and mountings in the form of support plates 24 of the paddles 20 are provided. The additional feather keys 22 ensure that the stabilising tubes 23 of the paddles 20 may be rapidly assembled and that the connection between the paddle shaft 15 and the respective stabilising tube 23 is not displaced or loosened, respectively, by the movement of the paddles 20.

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

The stabilising tubes 23 with the support plates 24 which are provided with notches (not shown in detail) for the additional feather keys 22 are attached to the paddle shafts 15. This fastening may also be accomplished by locks, bolts and other mechanical screw connections.

The stabilising tubes 23 of the paddles 20 serve as mountings for the paddles 20, they increase the stability of the respective paddle 20 and also prevent twisting 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 relative position and relatively to the main shaft 4, so that a loss of position is prevented and angles or angular positions, respectively, as will be explained below, are maintained.

The paddles 20 are provided with metal brackets 26 for reinforcement and flow improvement of the paddles 20. Moreover, the paddle edges 27 of the paddles 20 folded, in order to further improve the flow behaviour of the paddles 20.

The shape, in other words the outer contours, and the size of the paddles 20 are determined by the fluid as well as the amount of fluid to be agitated. The following shapes for the paddles 20 are used: round, oval, triangular, trapezodial, diamond-shaped, rhombic, parallelogram-shaped, square, rectangular, quadrangular and natural shapes from fauna and nature. The paddle 20 may also be bent or deformed if this helps to improve the stability of the paddles 20 and/or has a positive influence on the flow behaviour of the fluid. As shown in Figures 1, 2, 4 and 6, the paddle 20 is designed plane or plate-shaped, respectively.

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 ° relative to the main shaft 4 in order to generate an ideal flow behaviour of the fluid.

The paddles 20 are to be mounted at the paddle shafts 15 in such a manner that the paddle surfaces 30 are positioned at a second angle β of 90 ° to one another, as can be seen in particular in Fig. 6, in order to generate an ideal flow behaviour of the fluid. For a better understanding, a first sectional plane E1 of the one paddle surface 30 and a second

sectional plane E2 of the other paddle surface 30 are drawn in. This shows that the paddle surfaces 30 are arranged at the second angle β of 90 ° to one another.

Due to the rotations of the paddles 20, i. e. by a first rotation of the paddles 20 about the axis of rotation 6 and by a second rotation of the respective paddles 20 about their associate paddle shaft axis 28, the fluid is pushed ahead of the paddles 20 or displaced, respectively. The thereby generated movement is responsible for a 360 ° shift of the fluid, which again leads to an intimate mixing of the constituents of the fluid and a maximum homogeneity of the fluid.

With this movement of the fluid, turbulences are reduced as far as possible and shear forces are avoided. This ensures a considerably better mixing of the fluid. At the same time, the movement of the paddles 20 and the movement generated in the fluid have the consequence that far less energy is required for keeping the fluid in motion than with conventional agitators. Another advantage of this kind of agitating is that any solid substances in the fluid do not wrap around the paddles 20 or connections, i. e. the paddle shafts 15, the support plates 24 and the stabilising tubes 23.

Figures 3 and 5 are intended for better clarity.

The agitator 1 is manufactured and offered in a wide variety of sizes and configurations for the most diverse applications, wherein fluids are circulated or mixed, respectively. These may cover, for example, applications in agriculture (such as biogas plants with and without gas hoods, manure tanks, milk cooling etc.), in the industry (such as emulsion tanks, agitating techniques in laboratories etc.), in the food industry (such as soft drink and fruit juice producers, dairies, breweries etc.), in municipalities and communities (sewage treatment plants, drinking water treatment, stagnant bodies of water etc.) and many more.

The bionic agitator may be made from any wood, plastic, carbon, metal-type and from other existing materials. The connections, in particular the paddle shafts 15, the support plates 24 and the stabilising tubes 23 which connect the components of the bionic agitator are always dependent on type and condition of the material from which the agitator is built. Accordingly, the connections may be screw connections, bonded connections, plug connections or riveted connections.

The inventive bionic agitator 1 relates to agitating in various fields of application, such as e. g. agitating in biogas plants with and without gas hoods, agitating of manure in agricultural businesses, agitating in sewage treatment and wastewater systems of municipalities, communities and cities, agitating in water treatment plants, agitating in

laboratories, agitating in the food industry, agitating in the metal industry, agitating in the chemical industry, circulating of air in residential buildings and residential complexes, circulating of air in air-conditioned and heated rooms, circulating of air in garden centres, circulating of air in commercial and industrial areas, to any orientation of the agitator in horizontal and vertical position, to any type of installation, to any embodiment of the agitator with respect to size and used materials, to any described agitator, the kind of the used drive, the gear ratios, the seals and the connections of which differs from the described, but which otherwise has the same objective as the described bionic agitator 1.

Claims

1. An agitor for mixing fluids with different viscosities, wherein the agitator (1) is a bionic agitor with a main shaft (4) with an axis of rotation (6) and paddles (20) which are connected with the main shaft (4), wherein the paddles (20) each comprise one paddle shaft (15) with one paddle shaft axis (28), and wherein the paddle shaft axes (28) exhibit a first angle (α) relative to the axis of rotation (6) ranging between 20 ° and 40 °, and wherein the paddles (20) with their paddle surfaces (30) are arranged at a second angle (β) of 90 ° relative to one another, and wherein the paddles (20) with the agitator (1) operating perform a first rotation about the main shaft (4) and a second rotation about the respective paddle shaft axis (28),
characterised in that
a radial first distance of the paddle shaft axes (28) relative to the axis of rotation (6) at a lower end (21) of the paddle shafts (15), which is formed facing away from the main shaft (4), is larger than a radial second distance of the paddle shaft axes (28) relative to the axis of rotation (6) at an upper end of the paddle shafts (15), which is formed facing the main shaft (4).

2. The agitator according to Claim 1,
characterised in that
the first rotation may be transferred to the paddles (20) by a non-rotatable connection (10, 18) between the main shaft (4) and the paddles (20), and the second rotation may be transferred to the paddles (20) by a friction drive (14, 16), wherein the friction drive (14, 16) is formed between the main shaft (4) and the paddles (20).

3. The agitator according to Claim 2,
characterised in that
the non-rotatable connection (10, 18) is formed by means of second guide tubes (18) rotatably receiving the paddle shafts (15), which are non-rotatably connected with the main shaft (4).

4. The agitator according to Claim 3,
characterised in that
for forming the non-rotatable connection (10, 18), the second guide tubes (18) are non-rotatably accommodated at a housing (10) which is non-rotatably connected

with the main shaft (4).

5. The agitator according to one of Claims 2 to 4,
characterised in that
the friction drive (14, 16) comprises gears (14, 16).

6. The agitator according to Claim 5,
characterised in that
the gears (14, 16) are bevel gears.

7. The agitator according to one of Claims 2 to 6,
characterised in that
the friction drive (14, 16) is accommodated in a transmission gear housing (10).

8. The agitator according to one of the previous claims,
characterised in that
the paddle shafts (15) comprise stabilising tubes (23) with mountings (24), and wherein the stabilising tubes (23) are provided with notches for additional feather keys (22) of the paddle shafts (15).

9. The agitator according to one of the previous claims,
characterised in that
the paddle shafts (15) comprise feather keys an end facing away from the paddle (20) for the connection to stabilising tubes (23), and wherein mountings (24) of the paddles are provided.

10. The agitator according to one of the previous claims,
characterised in that
the paddle shafts (15) are rotatably accommodated in second guide tubes (18), wherein they are connected with a transmission gear housing (10) of a lower transmission gear (5) via reinforcing means (19), and wherein they are supported in multiple bearings and sealed by several seals against the transmission gear housing (10).

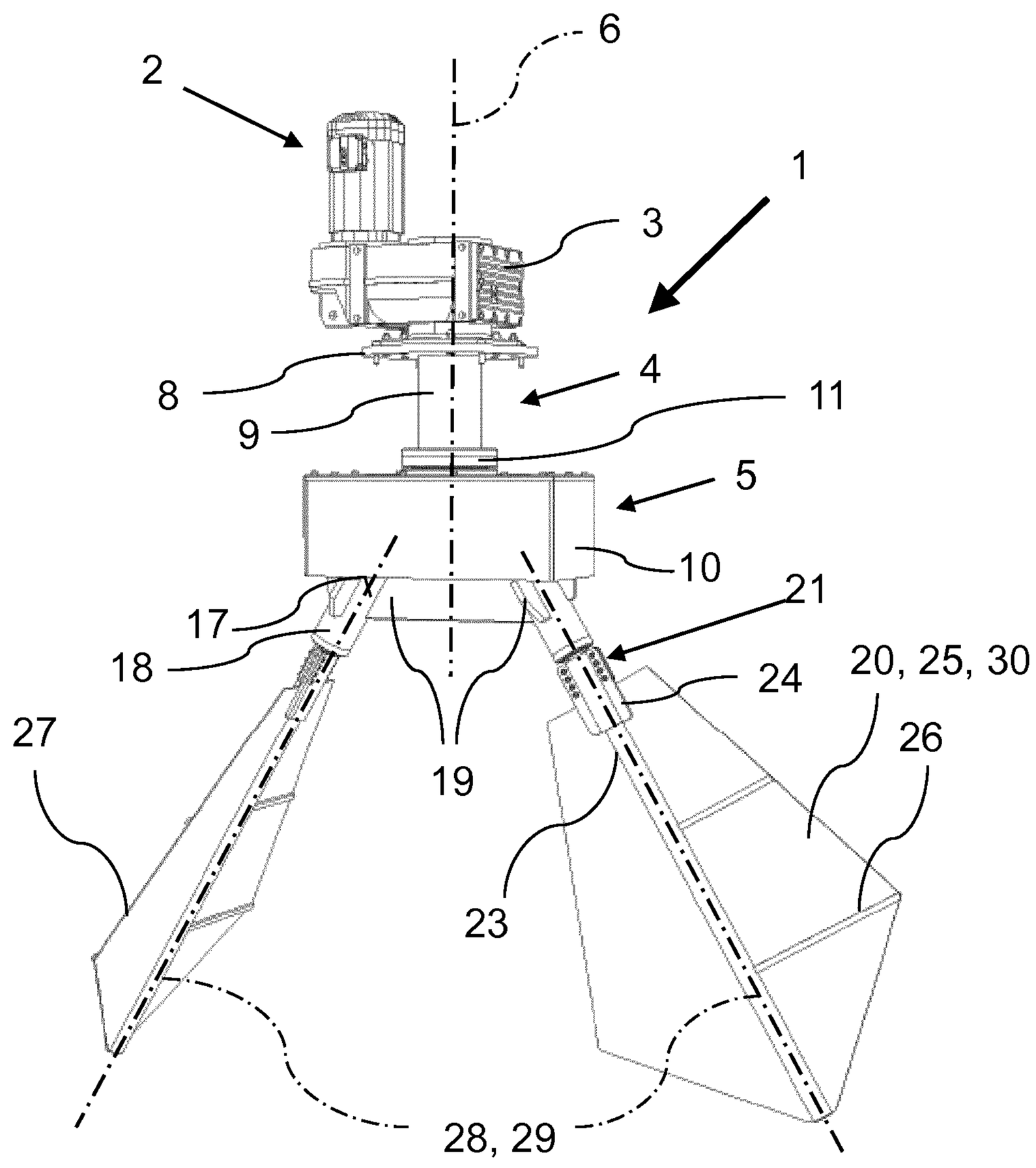

Fig. 1

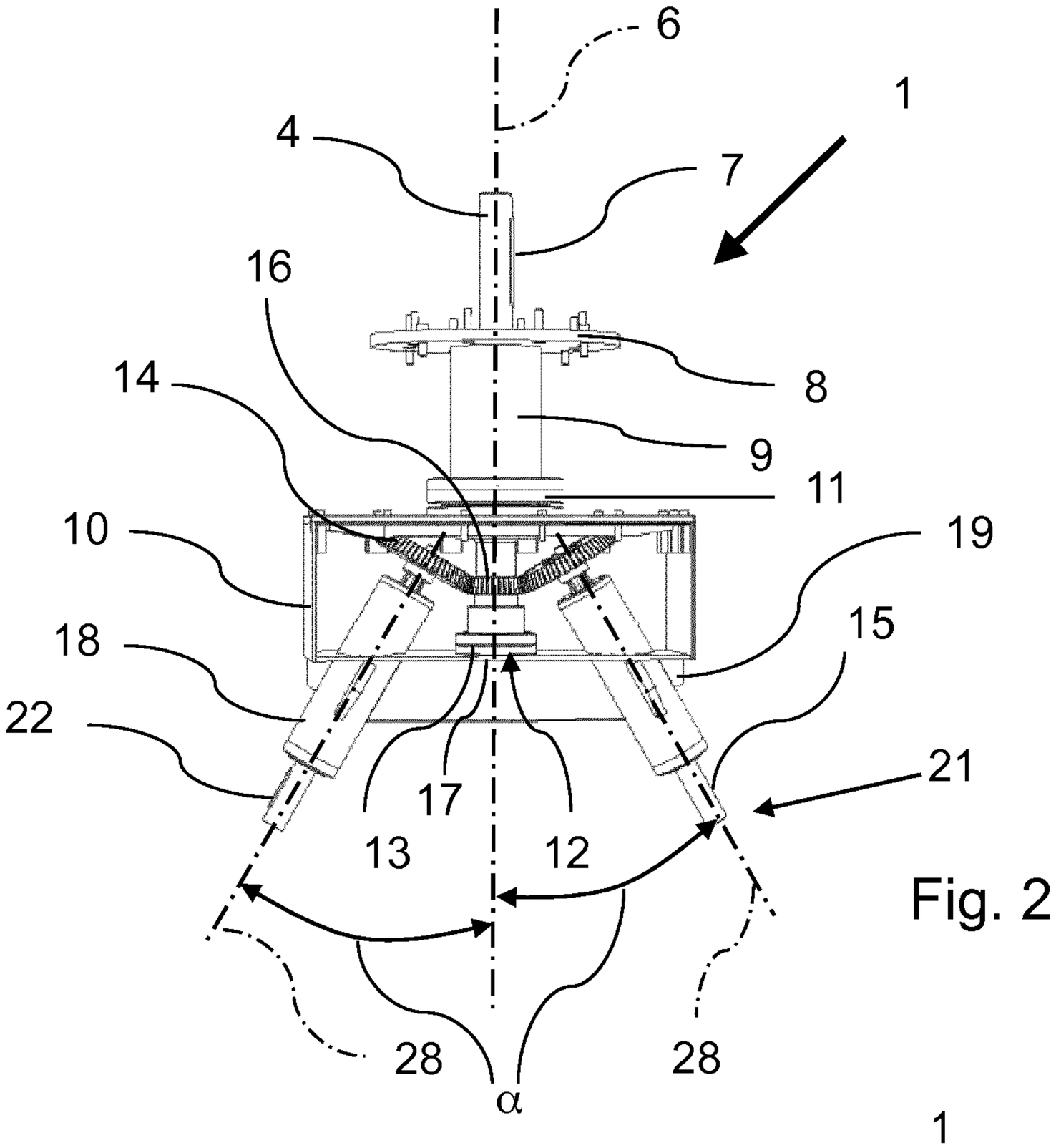
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Fig. 2

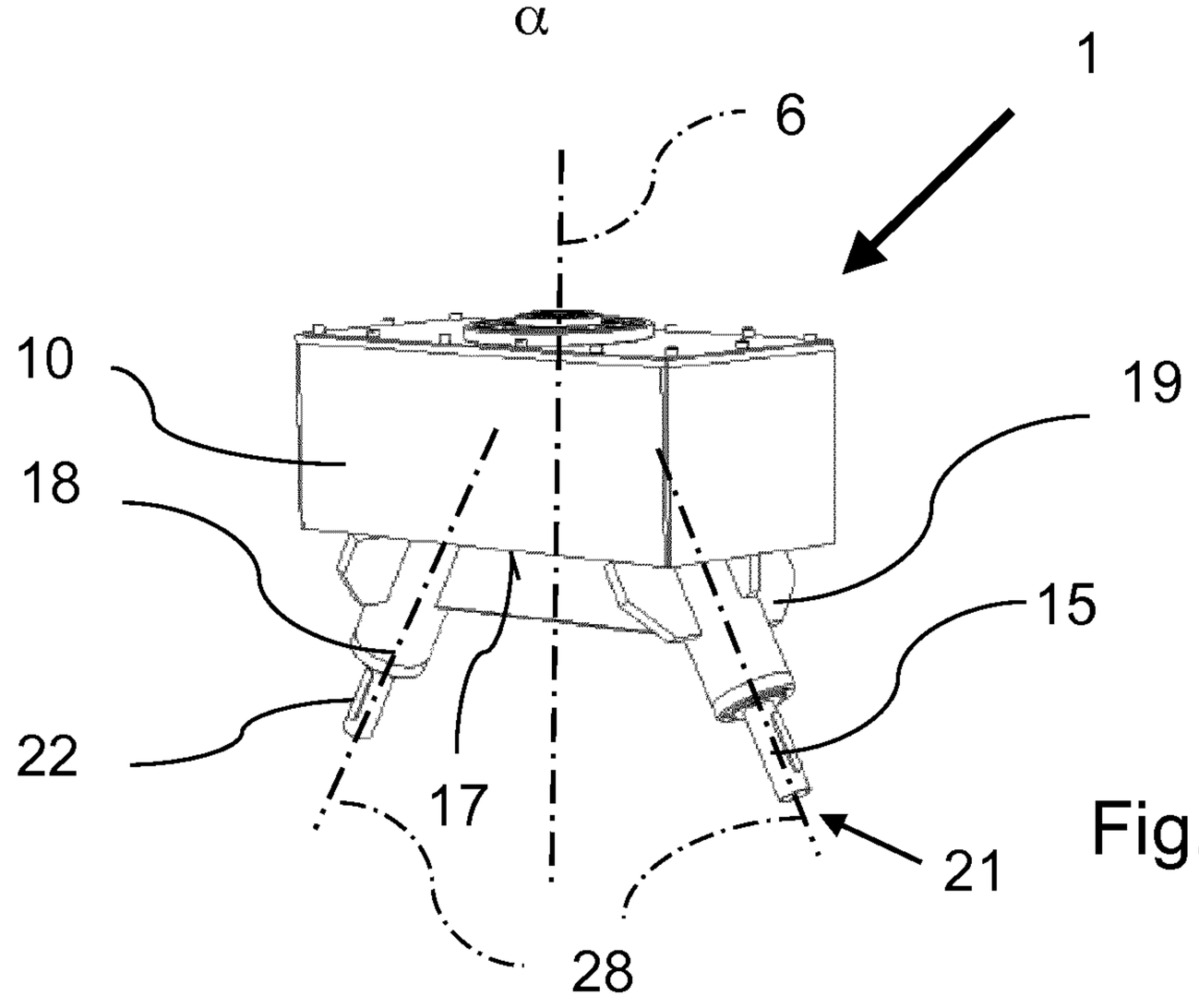
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Fig. 3

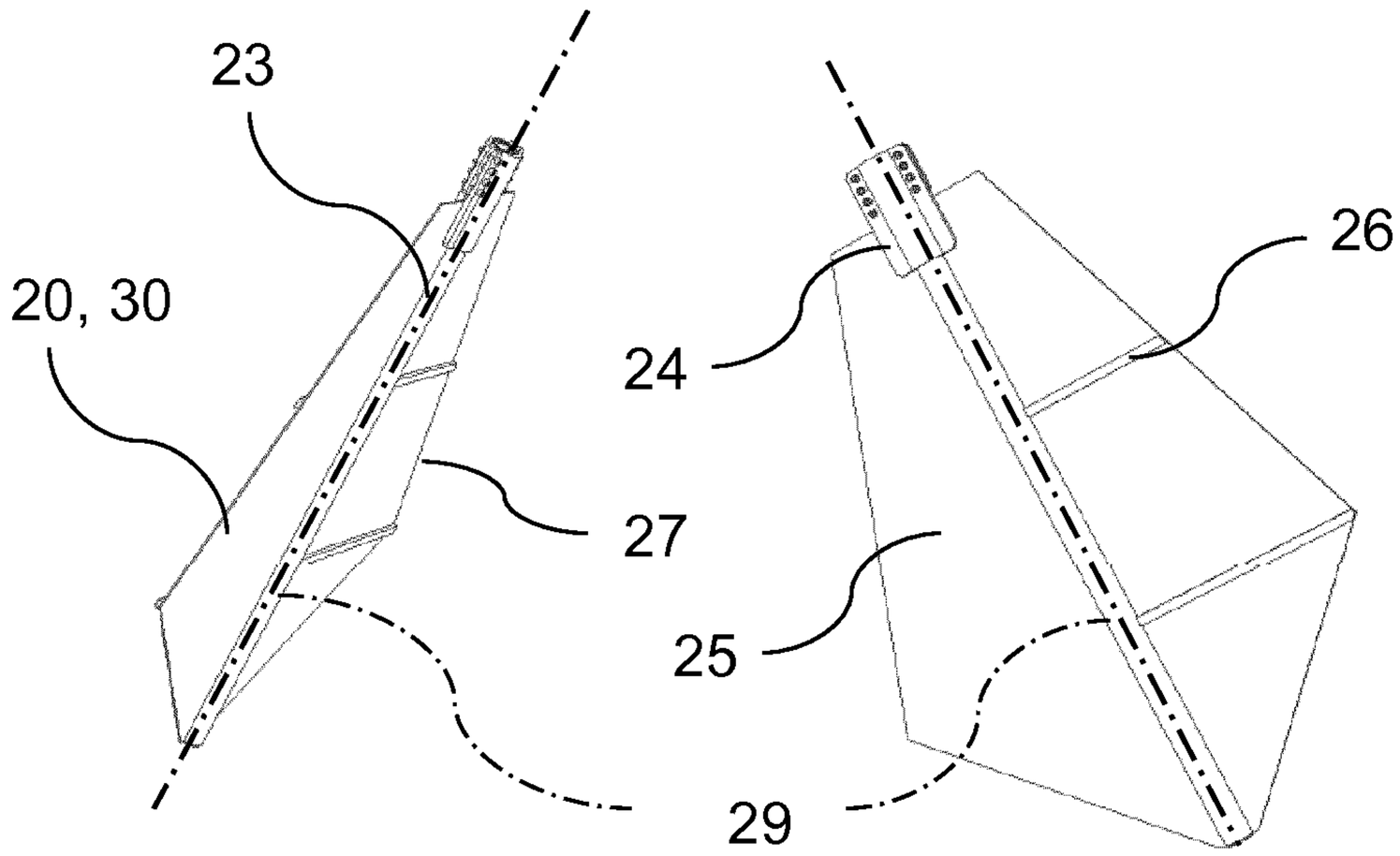

Fig. 4

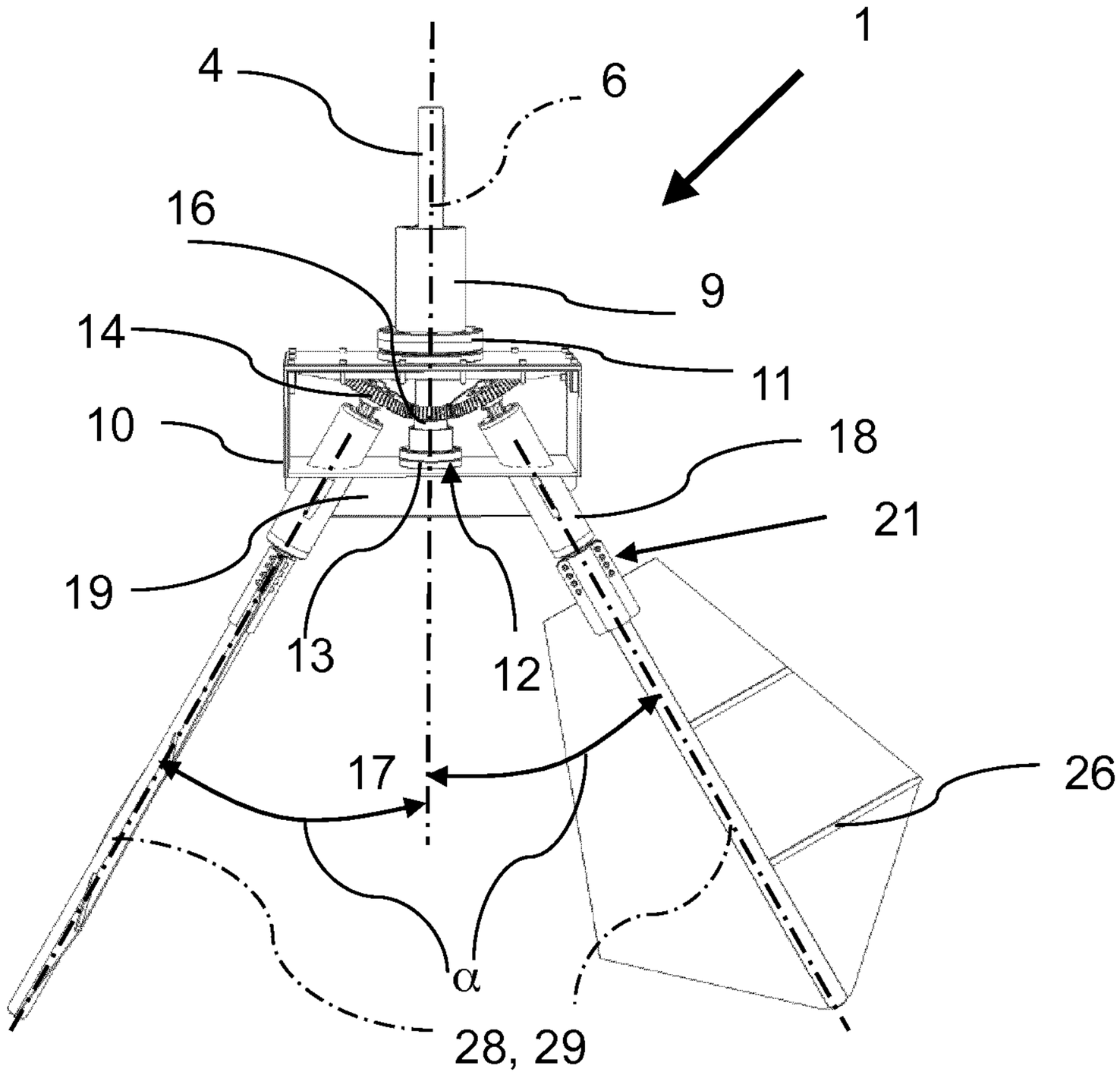

Fig. 5

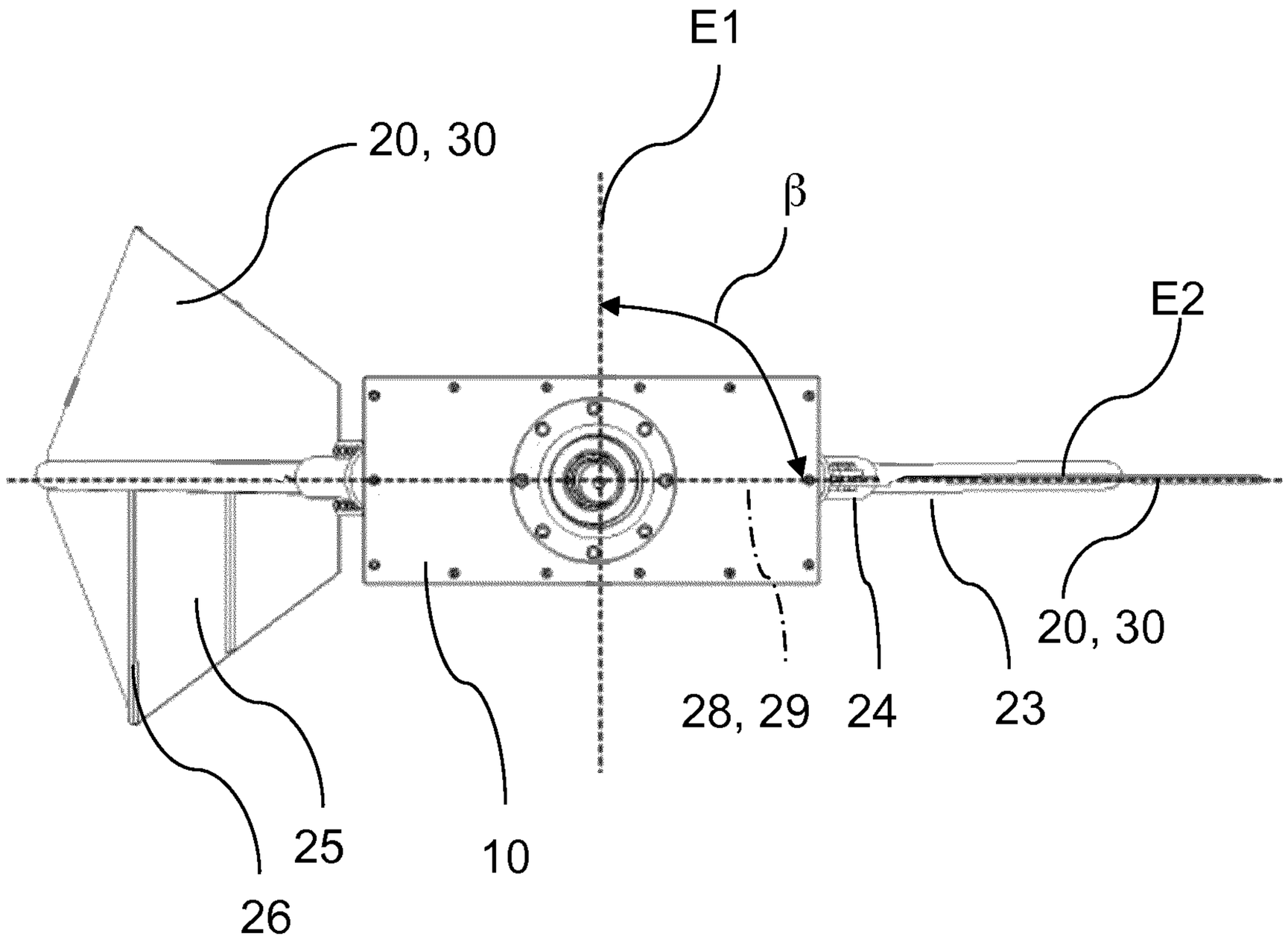

Fig. 6

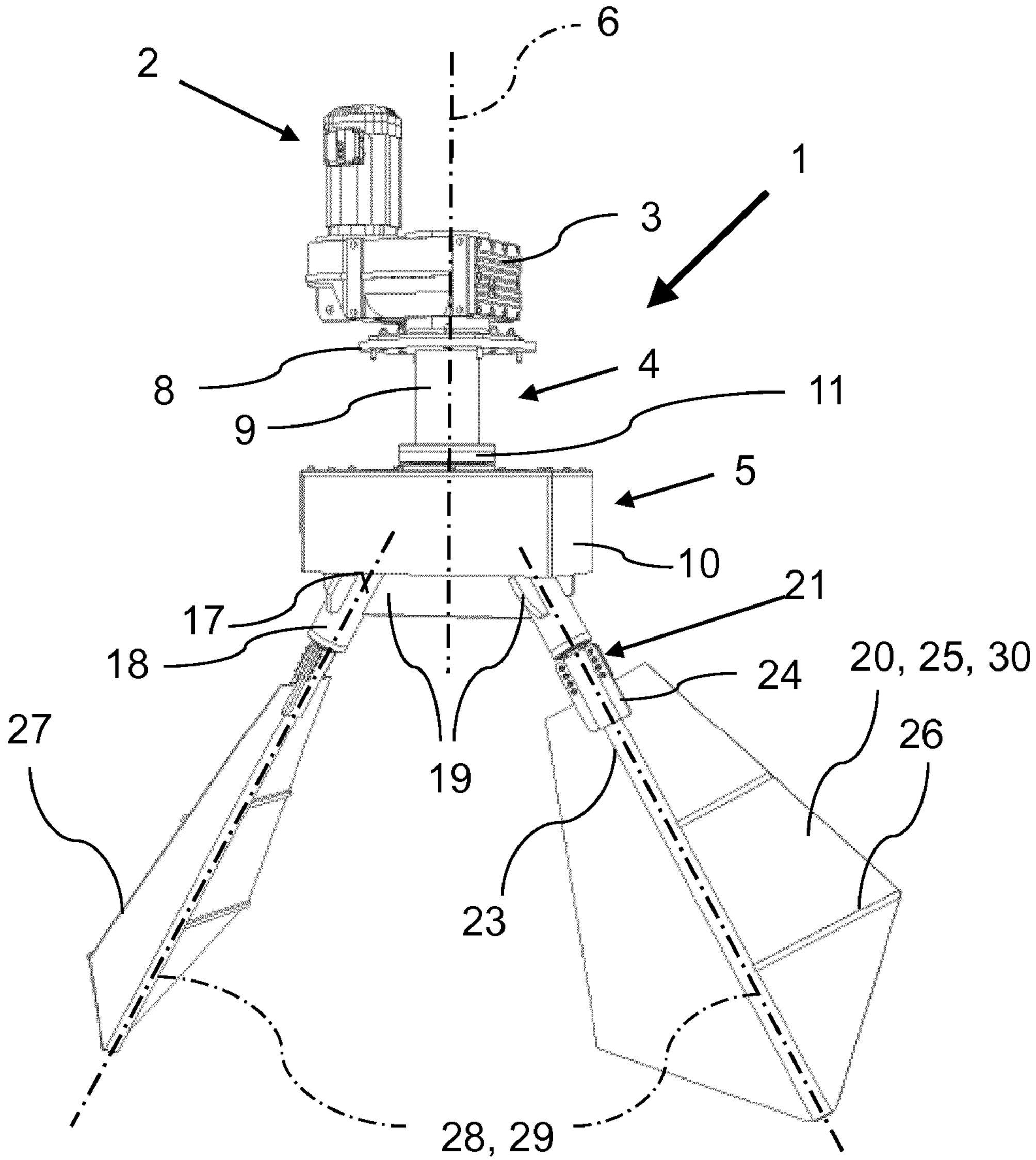

Fig. 1