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(54) Rotational die-casting apparatus with mold

Rotations-Kokillengussvorrichtung mit Form

Appareil de coulée rotative à moule permanent et moule

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(56) References cited:
EP-A1- 1 155 763 DE-A1- 2 447 837

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Description

[0001] The present invention relates to a gravity die-casting apparatus with mold.

[0002] Currently, one of the processes most widely used for the manufacture of metal castings is the so-called oscillating mold casting process.

[0003] Such process is performed by an apparatus that comprises a shell forming machine that has a device for opening/closing two mold parts and allows the oscillation, during casting, by gravity, of the shell about one or more horizontal axes.

[0004] Mold oscillation is performed in order to ensure optimum quality of the casting.

[0005] In particular, oscillating the mold avoids the formation of turbulence that might cause the embedding of air bubbles in the molten mass.

[0006] The casting of the molten mass within the mold can be performed manually by an operator who pours a certain quantity of molten mass into a feeder opening, defined by the mold, or by a robot.

[0007] In any case, the entry of the molten mass into the mold at the feeder opening must occur with a certain orientation.

[0008] Since the placement of the feeder robots is often determined by the overall layout of the apparatus, it is often necessary, when the mold is associated with the shell forming machine, to study its orientation as a function of the position of the feeder robot, acting on the mold movement means.

[0009] In some cases this entails long times for the setup of the system.

[0010] DE 24 47 837 A1 discloses a moulding machine having two mould-halves mounted on guides so the mould can be opened and closed, Each set of guides is located in housings which pivot on two horizontal axes at 90 degrees to each other, and the guide-housings are fixed on a traverse which can be rotated 30-60 degrees on a horizontal axis, the traverse also moving up and down on a column which houses the machine. Each mould-half can be swung 90 degrees from the horizontal casting position to a vertical immersion position (for cooling) and then back again.

[0011] EP 1 155 763 A1 discloses a device for rotational casting with a casting mould mounted on a base plate and having a gate which is directed pointing away from the upper side of the base plate. The base plate is mounted in bearing means so as to be rotatable through at least 180° about a horizontal axis. A casting container is provided with an opening that can be orientated opposite to the upper side of the base plate. Motion means for the casting container being provided with which the latter may be docked with its opening in a sealing manner onto the downward facing gate of the casting mould and in a rotated position, may be removed from the upward facing gate of the casting mould. Motion means are also provided with which the casting container with the casting mould may be rotated together through at least 180°

about a horizontal rotary axis.

[0012] The aim of the present invention is to provide an apparatus that can eliminate the drawbacks noted above.

[0013] Within this aim, an object of the present invention is to provide an apparatus that is extremely flexible in its use.

[0014] This aim, as well as these and other objects that will become better apparent hereinafter, are achieved by an apparatus according to the provisions of claim 1.

[0015] Further characteristics and advantages of the invention will become better apparent from the description of some preferred but not exclusive embodiments of an apparatus according to the present invention, illustrated by way of nonlimiting example in the accompanying drawings, wherein:

Figure 1 is a perspective view of an apparatus according to the invention with the shelf on a horizontal plane;

Figure 2 is again a perspective view of an apparatus with the shelf on a vertical plane;

Figure 3 is a top view of the apparatus;

Figure 4 is a front view of the apparatus;

Figure 5 is a side elevation view of the apparatus;

Figure 6 is a perspective view of a constructive variation of the apparatus;

Figure 7 is a side elevation view of the variation of the apparatus shown in Figure 6;

Figures 8 to 10 are perspective views of the various steps of use of the apparatus shown in Figures 6 and 7.

[0016] In the examples of embodiment that follow, individual characteristics, given in relation to specific examples, may actually be interchanged with other different characteristics that exist in other examples of embodiment.

[0017] With reference to the figures, the present invention relates to an apparatus, generally designated by the reference numeral 1, for gravity die-casting in a mold.

[0018] The apparatus 1 comprises a shell forming machine 3, which comprises a footing 4 with which at least one mold 2 is to be associated.

[0019] The apparatus 1 further comprises means for feeding the molten mass at a casting intake region 2a of the mold 2.

[0020] The mold 2 has at least one mold portion 12a, 12b,... that can move on a working surface.

[0021] The mold 2 can move with respect to the footing 4 about at least one substantially horizontal oscillation axis 100.

[0022] In particular, the mold 2 can move on command with respect to the footing 4 about the oscillation axis 100 during the operations for casting the molten mass into the mold 2.

[0023] According to a first aspect of the present invention, the mold 2 can rotate about the oscillation axis 100

through an angular stroke at least equal to 180°.

[0024] Advantageously, the mold 2 can rotate about the oscillation axis 100 through an angular stroke at least equal to 270°.

[0025] With reference to the embodiment shown in Figures 6 to 10, the mold 2 can rotate about the oscillation axis 100 through 360° in both directions of rotation.

[0026] Preferably, the means for feeding the molten mass at a casting intake region 2a of the mold 2 are adapted to allow such feeding when the casting intake region 2a is at least partially directed downwardly.

[0027] According to a further aspect of the present invention, the mold 2 can rotate about a rotation axis 101 that is substantially perpendicular to the working surface.

[0028] Advantageously, the rotation axis 101 is substantially perpendicular to the intake region 2a.

[0029] According to a preferred embodiment, the footing 4 supports a shelf-like body 6 for supporting the mold 2.

[0030] With reference to this embodiment, the shelf-like body 6 is supported by the footing 4 so that it can rotate about the oscillation axis 100.

[0031] Conveniently, the mold 2 is supported by the shelf-like body 6 so that it can rotate about the rotation axis 101.

[0032] Advantageously, the shelf-like body 6 can be moved on command with respect to said footing 4 along a movement direction 104 that is substantially parallel to the rotation axis 101.

[0033] Substantially in a manner similar to known solutions, the apparatus 1 comprises mold closing and locking means 20, which are adapted to move respective portions 12b, 12c, ... of the mold 2 along respective opening/closing directions 102, 103 that lie on the working surface.

[0034] The oscillation of the mold 2 about the oscillation axis 100 can be obtained by way of first motor means intended to move a center bearing body 4a that is supported rotatably by the footing 4 and, in turn, supports the shelf-like body 6.

[0035] The rotation of the mold 2 about the rotation axis 101 can instead be actuated by second motor means, supported advantageously by the shelf-like body 6, the output shaft of which is connected to a pinion that engages a gear 6a that is integral with the resting surface of the mold 2.

[0036] With reference to Figures 6 to 10, the means for feeding the molten mass at the casting intake region 2a of the mold 2 comprise at least one hand ladle 30, into which the molten mass is to be poured and means for transferring the molten mass from the hand ladle 30 toward the intake region 2a.

[0037] Preferably, the means for transferring the molten mass from the hand ladle 30 toward the intake region 2a act when the intake region 2a is directed downwardly.

[0038] The molten mass is fed to the hand ladle 30 with the free rim 30a of the hand ladle 30 directed upwardly.

[0039] The hand ladle 30 is adapted to pass on com-

mand between a feeding condition, in which it is spaced from the intake region 2a, and a condition for coupling to the intake region 2a, in which its free rim 30a is hermetically adjacent to the peripheral rim of the intake region 2a.

[0040] The transfer of the molten mass from the hand ladle 30 to the mold 2 is performed by rotating the mold 2 and the hand ladle 30 about the oscillation axis 100.

[0041] For this reason, means are provided for coupling rotationally the hand ladle 30 to the mold 2 at least during the step for transfer of the molten mass from the hand ladle 30 to the mold 2.

[0042] The hand ladle 30 is supported by an elongated element 31, which in turn is supported by the center bearing body 4a.

[0043] Conveniently, the elongated element 31 can rotate on command with respect to the center bearing body 4a about a first axis 106 that lies on a plane that is tangent to the oscillation axis 100.

[0044] The elongated element 31 furthermore can rotate with respect to the center bearing body 4a about a pivoting axis that is diametrical to the oscillation axis 100.

[0045] The hand ladle 30 can rotate about a positioning axis 105 that is arranged substantially at right angles to the first axis 106 and/or to the oscillation axis 100.

[0046] The positioning axis 105 is extended conveniently substantially parallel to the movement direction 104.

[0047] The rotation of the hand ladle 30 about the positioning axis 105 allows to place the hand ladle 30 outside the footprint, allowing the assembly and disassembly of the mold 2 and the corresponding maintenance operations.

[0048] The movement of the hand ladle 30 about the first axis 106 instead allows to perform operations of a different type on the hand ladle 30.

[0049] Conveniently, the hand ladle 30 furthermore can move longitudinally parallel to the positioning axis 105 in order to allow its approach and spacing with respect to the mold 2.

[0050] Use of an apparatus according to the invention is evident from what has been described above.

[0051] In particular, thanks to the possibility to rotate the mold 2 and the corresponding intake region 2a about the rotation axis 101 it is possible to orient very rapidly and effectively the mold 2 in order to make the molten mass casting operations efficient.

[0052] During casting, the mold 2 is therefore oscillated about the oscillation axis 100.

[0053] All the characteristics of the invention indicated above as advantageous, convenient and the like may also be omitted or be replaced with equivalents.

[0054] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0055] In practice it has been found that the invention has achieved the intended aim and objects in all of the embodiments.

[0056] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements.

[0057] All the details may further be replaced with other technically equivalent elements.

[0058] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A gravity die-casting apparatus (1) with a mold (2) comprising a shell forming machine (3) comprising a footing (4) with which at least one mold (2) is to be associated and means for feeding the molten mass at a casting intake region (2a) of said mold (2), said mold (2) having at least one mold portion (12a, 12b,...) that can move on a working surface, said mold (2) being movable with respect to said footing (4) about at least one substantially horizontal oscillation axis (100), said mold (2) can rotate being rotatable about said oscillation axis (100) through an angular stroke of at least 180°, said footing (4) supporting a shelf-like body (6) for supporting said mold (2), said shelf-like body (6) being supported by said footing (4) so that it can rotate about said oscillation axis (100), the oscillation of said mold (2) about the oscillation axis (100) being obtained by way of first motor means adapted to move a center bearing body (4a) that is supported rotatably by said footing (4) and, in turn, supporting said shelf-like body (6), said means for feeding the molten mass at said intake region (2a) comprising at least one hand ladle (30) into which the molten mass is to be poured and means for transferring the molten mass from said hand ladle (30) toward said intake region (2a), said hand ladle (30) being supported by an elongated element (31) which in turn is supported by the center bearing body (4a), said elongated element (31) being rotatable on command with respect to the center bearing body (4a) about a first axis (106) that lies on a plane that is tangent to the oscillation axis (100), and said hand ladle (30) being rotatable about a positioning axis (105) that is arranged substantially at right angles to the first axis (106) and/or to the oscillation axis (100).
2. The gravity die-casting apps (1) according to claim 1, **characterized in that** said mold (2) can rotate about said oscillation axis (100) through an angular stroke of at least 270°.
3. The gravity die-casting apparatus (1) according to one or more of the preceding claims, **characterized in that** said mold (2) can rotate about said oscillation axis (100) through 360° in both directions of rotation.
4. The gravity die-casting apparatus (1) according to one or more of the preceding claims, **characterized in that** said means for feeding the molten mass at said intake region (2a) are adapted to allow said feeding when said intake region (2a) is at least partially directed downwardly.
5. The gravity die-casting apparatus (1) according to one or more of the preceding claims, **characterized in that** said mold (2) can rotate about a rotation axis (101) that is substantially perpendicular to said working surface.
6. The apparatus (1) according to claim 5, **characterized in that** said rotation axis is substantially perpendicular to said intake region (2a).
7. The apparatus (1) according to one or more of the preceding claims 5 and 6, **characterized in that** said mold (2) is supported by said shelf-like body (6) so that it can rotate about said rotation axis (101).
8. The apparatus (1) according to one or more of the preceding claims 5-7, **characterized in that** it comprises means for moving said shelf-like body (6) with respect to said footing (4) along a movement direction (104) that is substantially parallel to said rotation axis (101).
9. The apparatus (1) according to one or more of the preceding claims, **characterized in that** it comprises mold closing and locking means (20) adapted to move respective portions (12b, 12c,...) of said mold (2) along respective opening/closing directions (102, 103) that lie on said working surface.
10. The apparatus (1) according to one or more of the preceding claims, **characterized in that** said means for transferring the molten mass from said hand ladle (30) toward said intake region (2a) act when said intake region (2a) is directed downwardly.
11. The apparatus (1) according to one or more of the preceding claims, **characterized in that** said hand ladle (30) is adapted to pass on command between a feeding condition, in which it is spaced from said intake region (2a), and a condition for coupling to said intake region (2a), in which its free surface (30a) is hermetically adjacent to the peripheral rim of said intake region (2a).
12. The apparatus (1) according to one or more of the preceding claims, **characterized in that** the transfer

of the molten mass from said hand ladle (30) to said mold (2) is performed by means of the rotation of said mold (2) and of said hand ladle (30) about said oscillation axis (100).

Patentansprüche

1. Eine Dauerformgussvorrichtung (1) mit einer Form (2), die eine Schalenformmaschine (3) umfasst, einen Sockel (4) umfassend, mit dem mindestens eine Form (2) verbunden werden soll, und Mittel zum Zuführen der Schmelze an einem Eingussbereich (2a) der Form (2), wobei die Form (2) mindestens einen Formabschnitt (12a, 12b,...) hat, der sich auf einer Arbeitsfläche bewegen kann, wobei die Form (2) im Verhältnis zu dem Sockel (4) um mindestens eine im Wesentlichen horizontale Schwenkachse (100) beweglich ist, wobei die Form (2) sich drehen kann, somit um die Schwenkachse (100) um einen Stellwinkel von mindestens 180° drehbar ist, wobei der Sockel (4) einen regalartigen Körper (6) zum Tragen der Form (2) trägt, wobei der regalartige Körper (6) von dem Sockel (4) so getragen wird, dass er sich um die Schwenkachse (100) drehen kann, wobei die Oszillation der Form (2) um die Schwenkachse (100) mit Hilfe erster Motormittel erzielt wird, die ausgebildet sind, um einen zentralen Lagerkörper (4a) zu bewegen, der drehbar von dem Sockel (4) getragen wird und wiederum den regalartigen Körper (6) trägt, wobei die Mittel zum Zuführen der Schmelze an dem Eingussbereich (2a) mindestens eine Gießkelle (30) umfassen, in die die Schmelze gegossen werden soll, und Mittel, um die Schmelze von der Gießkelle (30) an den Eingussbereich (2a) zu übertragen, wobei die Gießkelle (30) von einem länglichen Element (31) getragen wird, das wiederum vom zentralen Lagerkörper (4a) getragen wird, wobei das längliche Element (31) auf Befehl im Verhältnis zum zentralen Lagerkörper (4a) um eine erste Achse (106) drehbar ist, die auf einer Ebene liegt, welche tangential zur Schwenkachse (100) ist, und die Gießkelle (30) um eine Positionierachse (105) drehbar ist, die im Wesentlichen in rechten Winkeln zur ersten Achse (106) und/oder zur Schwenkachse (100) angeordnet ist.
2. Die Dauerformgussvorrichtung (1) gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Form (2) sich um die Schwenkachse (100) um einen Stellwinkel von mindestens 270° drehen kann.
3. Die Dauerformgussvorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Form (2) sich in beide Drehrichtungen um 360° um die Schwenkachse (100) drehen kann.
4. Die Dauerformgussvorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Mittel zum Zuführen der Schmelze an dem Eingussbereich (2a) ausgebildet sind, um das Zuführen zu ermöglichen, wenn der Eingussbereich (2a) zumindest teilweise abwärts gerichtet ist.
5. Die Dauerformgussvorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Form (2) sich um eine Drehachse (101) drehen kann, die im Wesentlichen senkrecht zu der Arbeitsfläche ist.
6. Die Vorrichtung (1) gemäß Anspruch 5, **dadurch gekennzeichnet, dass** die Drehachse im Wesentlichen senkrecht zu dem Eingussbereich (2a) ist.
7. Die Vorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche 5 und 6, **dadurch gekennzeichnet, dass** die Form (2) so von dem regalartigen Körper (6) getragen ist, dass sie sich um die Drehachse (101) drehen kann.
8. Die Vorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche 5-7, **dadurch gekennzeichnet, dass** sie Mittel zum Bewegen des regalartigen Körpers (6) im Verhältnis zu dem Sockel (4) entlang einer Bewegungsrichtung (104) umfasst, die im Wesentlichen parallel zu der Drehachse (101) ist.
9. Die Vorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** sie Formschieß- und -verriegelungsmittel (20) umfasst, ausgebildet, um entsprechende Abschnitte (12b, 12c,...) der Form (2) entlang entsprechenden Öffnungs-/Schließrichtungen (102, 103) zu bewegen, die auf der Arbeitsfläche liegen.
10. Die Vorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Mittel zum Überführen der Schmelze von der Gießkelle (30) zu dem Eingussbereich (2a) arbeiten, wenn der Eingussbereich (2a) nach unten gerichtet ist.
11. Die Vorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Gießkelle (30) ausgebildet ist, um sich auf Befehl zwischen einem Zuführzustand, in dem sie von dem Eingussbereich (2a) beabstandet ist, und einem Zustand zur Kopplung mit dem Eingussbereich (2a) zu bewegen, in dem ihre freie Oberfläche (30a) hermetisch mit dem Umfangsrand des Eingussbereichs (2a) abschließt.
12. Die Vorrichtung (1) gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet,**

dass die Überführung der Schmelze von der Gießkelle (30) zu der Form (2) durch die Drehung der Form (2) und der Gießkelle (30) um die Schwenkachse (100) bewerkstelligt wird.

Revendications

1. Appareil de moulage en coquille par gravité (1) comportant un moule (2) comprenant une machine de formation de coque (3) comprenant un pied (4) auquel doit être associé au moins un moule (2) et un moyen pour introduire la masse fondue dans une région d'entrée de moulage (2a) dudit moule (2), ledit moule (2) ayant au moins une partie de moule (12a, 12b) qui peut se déplacer sur une surface de travail, ledit moule (2) étant mobile par rapport audit pied (4) autour d'au moins un axe d'oscillation substantiellement horizontal (100), ledit moule (2) peut tourner en étant rotatif autour dudit axe d'oscillation (100) sur une course angulaire d'au moins 180°, ledit pied (4) supportant un corps en forme de console (6) pour supporter ledit moule (2), ledit corps en forme de console (6) étant supporté par ledit pied (4) de telle manière qu'il peut tourner autour dudit axe d'oscillation (100), l'oscillation dudit moule (2) autour de l'axe d'oscillation (100) étant obtenue à l'aide d'un premier moyen formant moteur adapté pour déplacer un corps d'appui central (4a) qui est supporté à rotation par ledit pied (4) et qui supporte à son tour ledit corps en forme de console (6), ledit moyen pour introduire la masse fondue dans ladite région d'entrée (2a) comprenant au moins une poche à main (30) dans laquelle doit être versée la masse fondue et un moyen pour transférer la masse fondue de ladite poche à main (30) vers ladite région d'entrée (2a), ladite poche à main (30) étant supportée par un élément allongé (31) qui est lui-même supporté par le corps d'appui central (4a), ledit élément allongé (31) pouvant tourner sur commande par rapport au corps d'appui central (4a) autour d'un premier axe (106) qui se trouve sur un plan qui est tangent à l'axe d'oscillation (100), et ladite poche à main (30) étant rotative autour d'un axe de positionnement (105) qui est disposé substantiellement à angle droit par rapport au premier axe (106) et/ou à l'axe d'oscillation (100).
2. Appareil de moulage en coquille par gravité (1) selon la revendication 1, **caractérisé en ce que** ledit moule (2) peut tourner autour dudit axe d'oscillation (100) sur une course angulaire d'au moins 270°.
3. Appareil de moulage en coquille par gravité (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit moule (2) peut tourner

autour dudit axe d'oscillation (100) sur 360° dans les deux directions de rotation.

4. Appareil de moulage en coquille par gravité (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit moyen pour introduire la masse fondue dans ladite région d'entrée (2a) est adapté pour permettre ladite introduction quand ladite région d'entrée (2a) est au moins partiellement dirigée vers le bas.
5. Appareil de moulage en coquille par gravité (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit moule (2) peut tourner autour d'un axe de rotation (101) qui est substantiellement perpendiculaire à ladite surface de travail.
6. Appareil (1) selon la revendication 5, **caractérisé en ce que** ledit axe de rotation est substantiellement perpendiculaire à ladite région d'entrée (2a).
7. Appareil (1) selon l'une ou plusieurs des précédentes revendications 5 et 6, **caractérisé en ce que** ledit moule (2) est supporté par ledit corps en forme de console (6) de telle manière qu'il peut tourner autour dudit axe de rotation (101).
8. Appareil (1) selon l'une ou plusieurs des précédentes revendications 5 à 7, **caractérisé en ce qu'il** comprend un moyen pour déplacer ledit corps en forme de console (6) par rapport audit pied (4) le long d'une direction de déplacement (104) qui est substantiellement parallèle audit axe de rotation (101).
9. Appareil (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce qu'il** comprend un moyen de fermeture et de verrouillage de moule (20) adapté pour déplacer des parties respectives (12b, 12c, ...) dudit moule (2) le long de directions d'ouverture/fermeture respectives (102, 103) qui se trouvent sur ladite surface de travail.
10. Appareil (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit moyen pour transférer la masse fondue de ladite poche à main (30) vers ladite région d'entrée (2a) agit quand ladite région d'entrée (2a) est orientée vers le bas.
11. Appareil (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ladite poche à main (30) est adaptée pour passer sur commande entre un état d'introduction, dans lequel elle est espacée de ladite région d'entrée (2a), et un état qui lui permet de s'accoupler à ladite région d'entrée (2a), dans lequel sa surface libre (30a) est hermétiquement adjacente au rebord périphérique de ladite

région d'entrée (2a).

12. Appareil (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** le transfert de la masse fondue de ladite poche à main (30) audit moule (2) est réalisé grâce à la rotation dudit moule (2) et de ladite poche à main (30) autour dudit axe d'oscillation (100).

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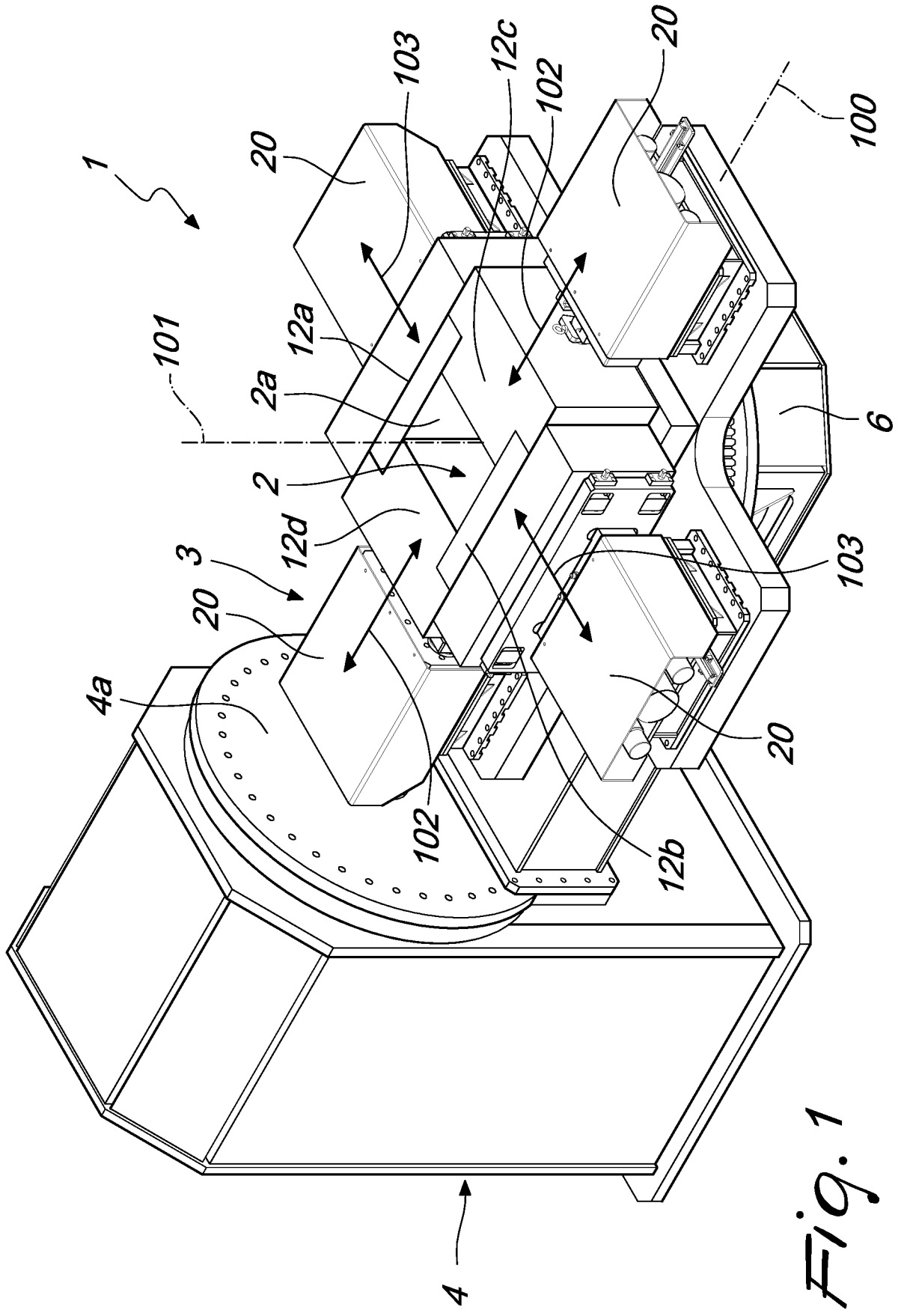


Fig. 1

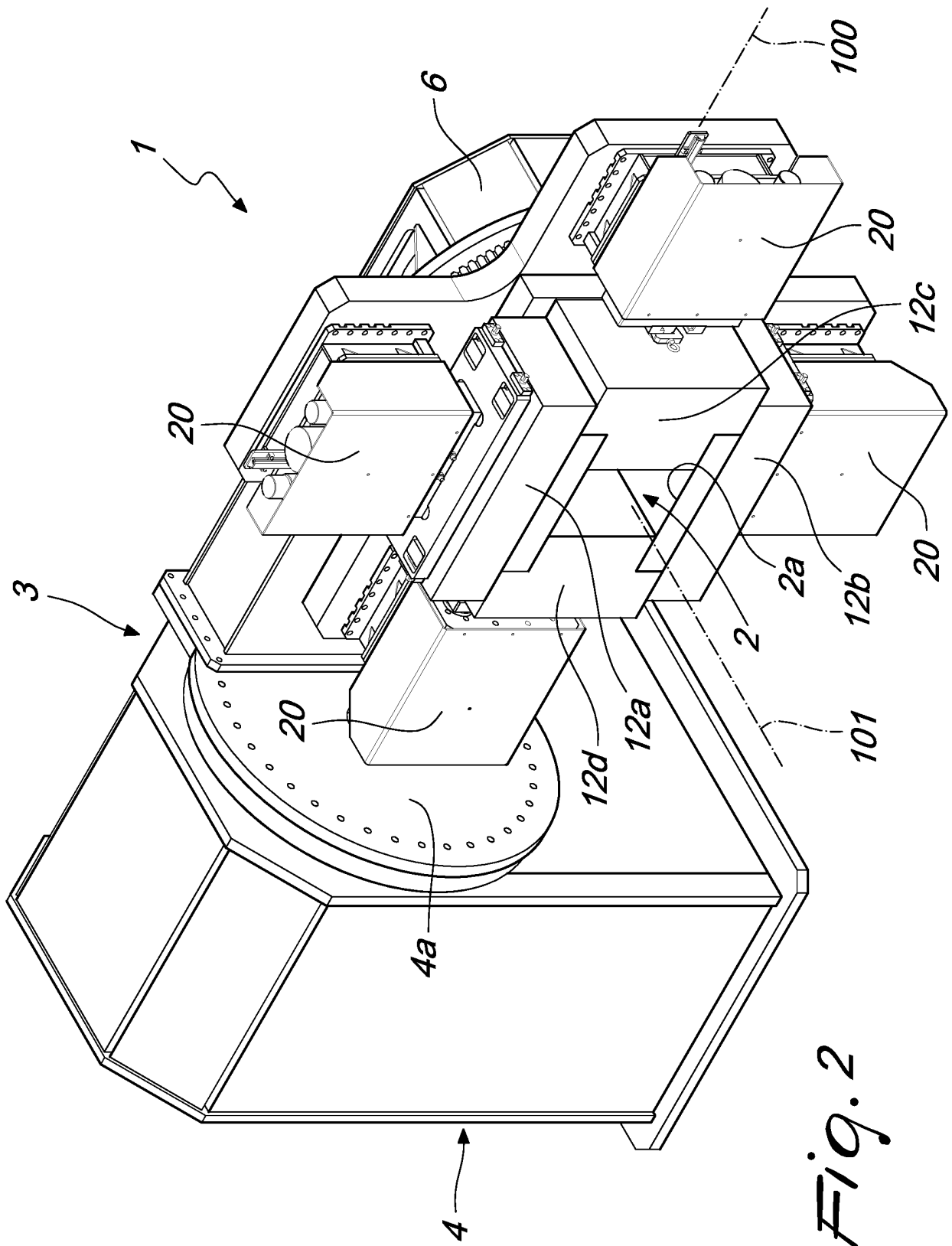


Fig. 2

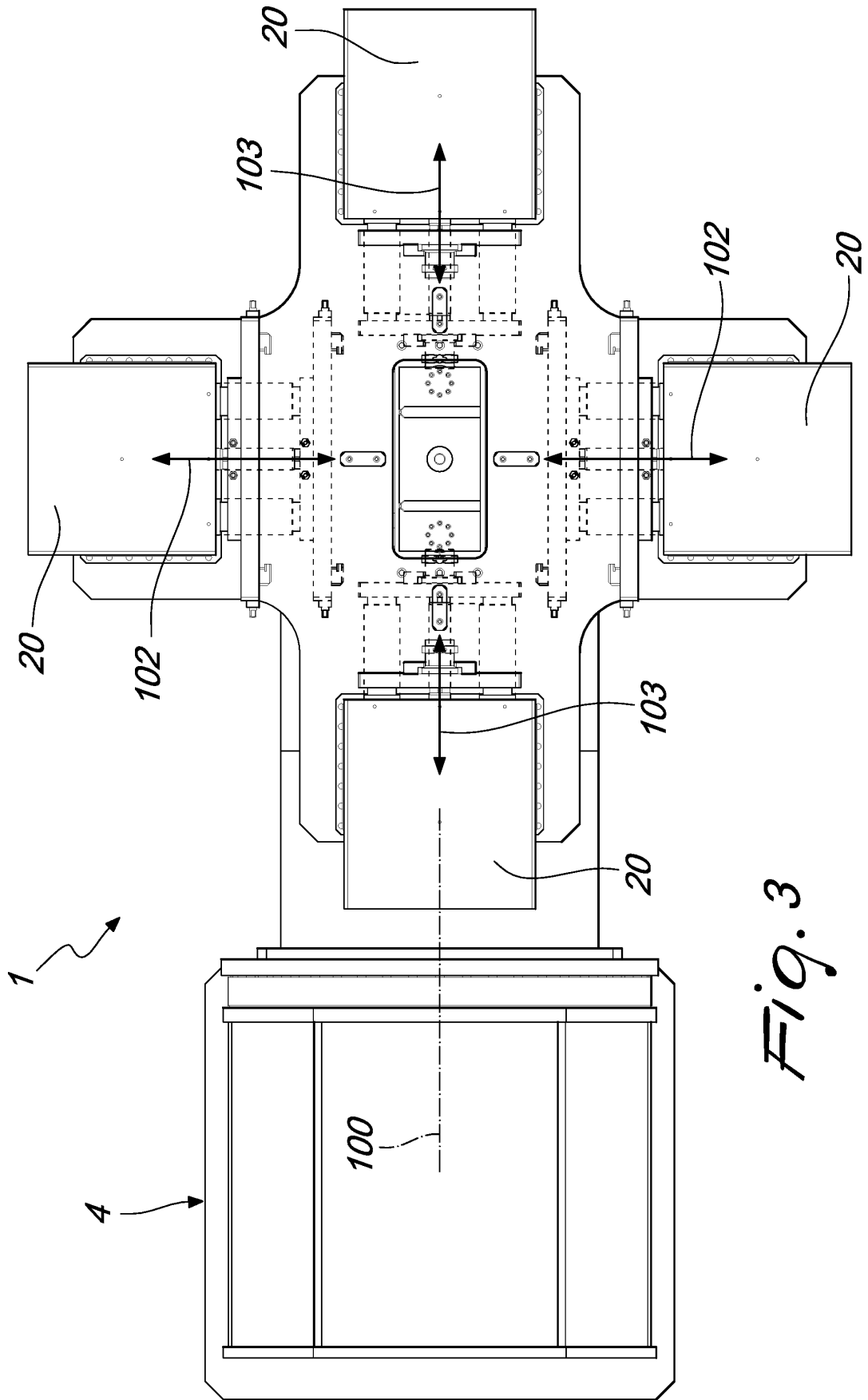


Fig. 3

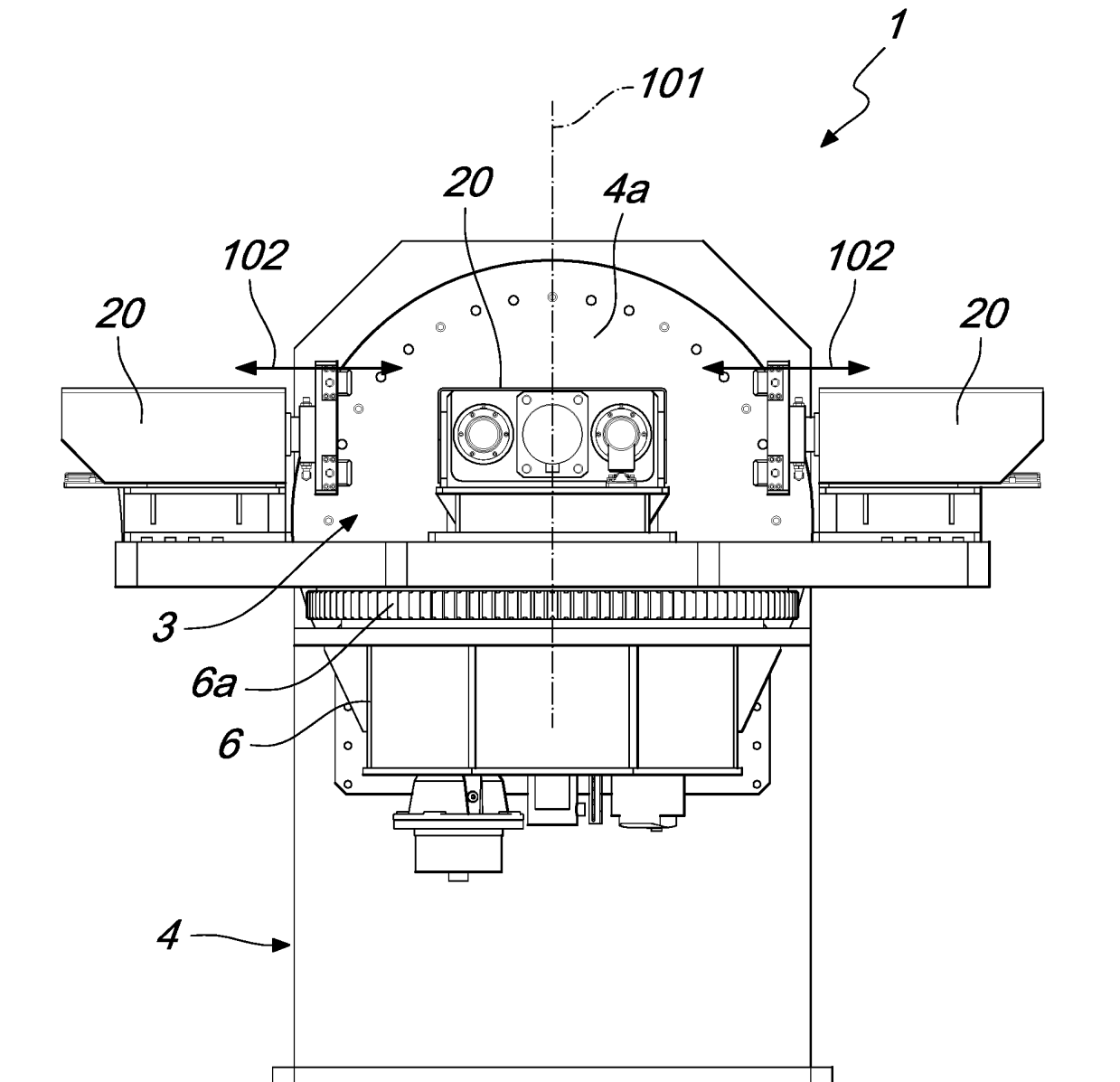


Fig. 4

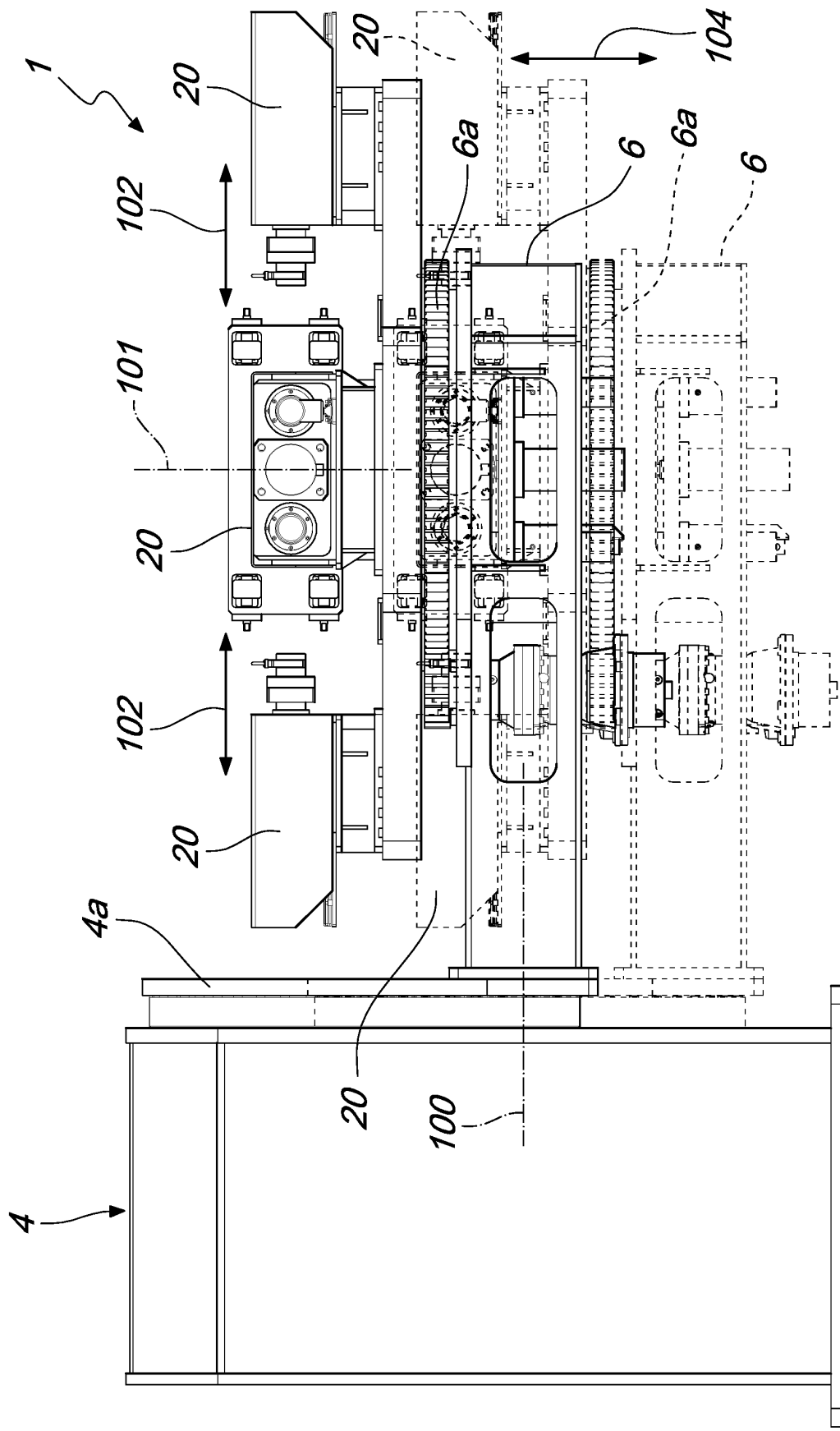


Fig. 5

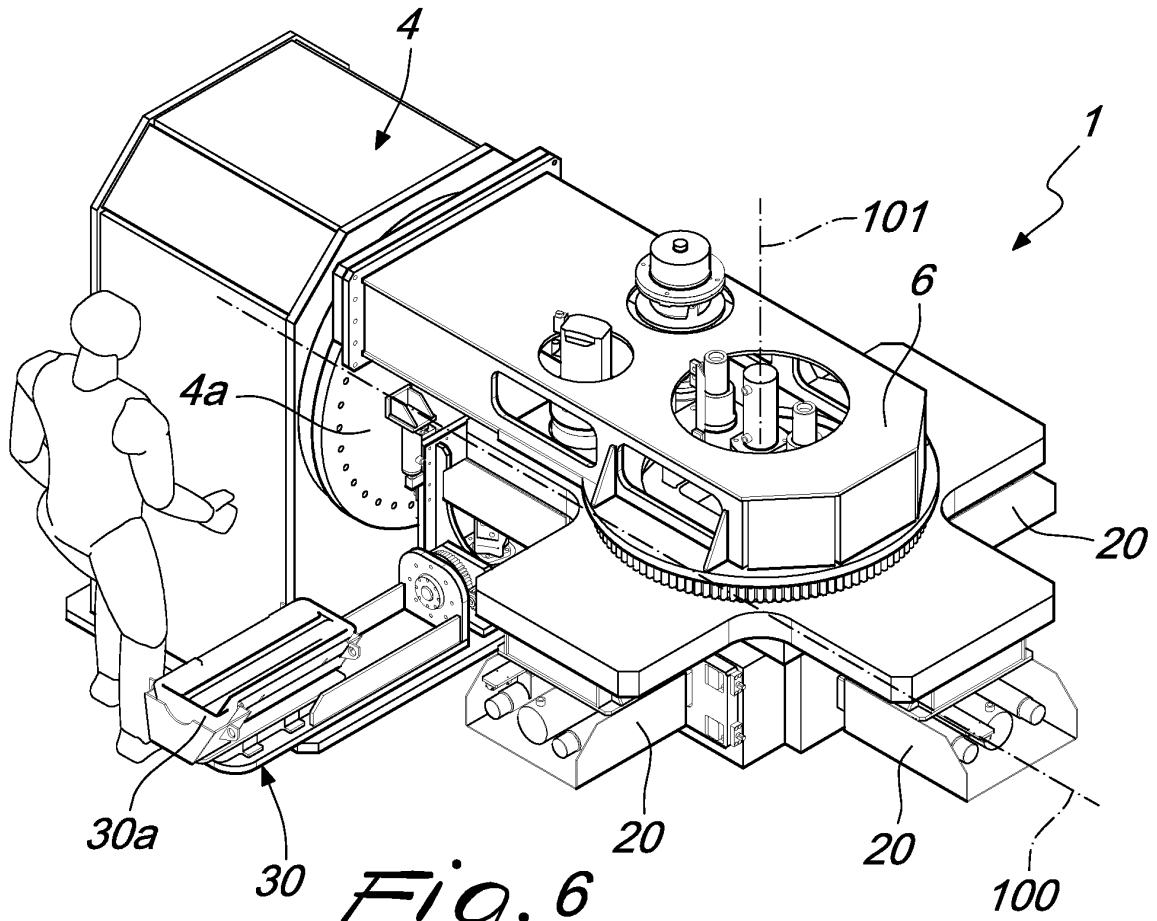


Fig. 6

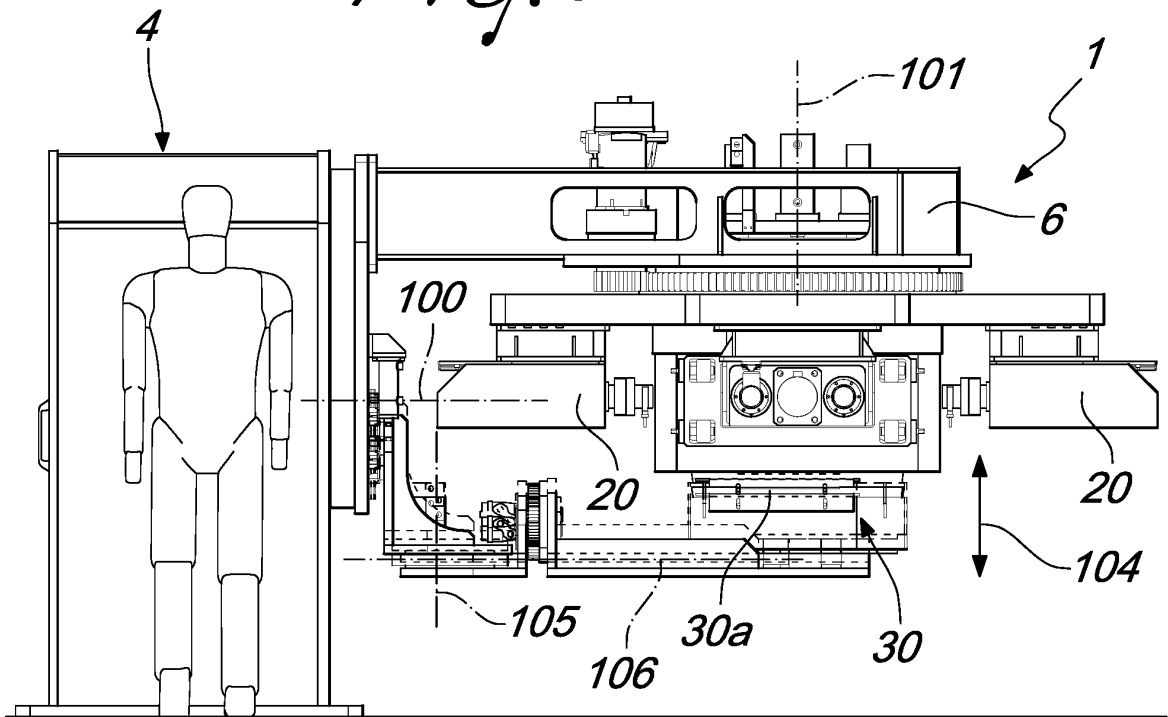


Fig. 7

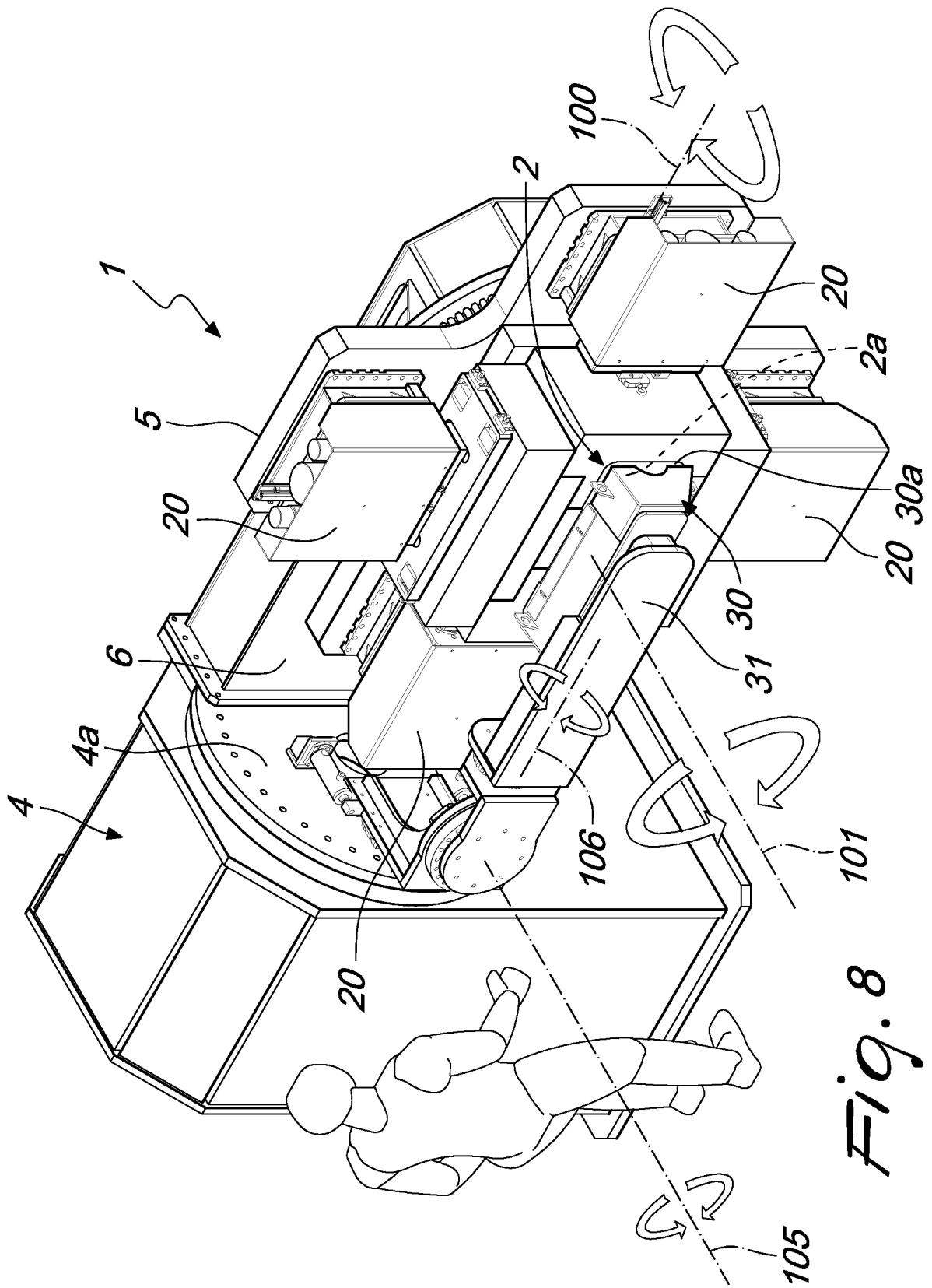


Fig. 8

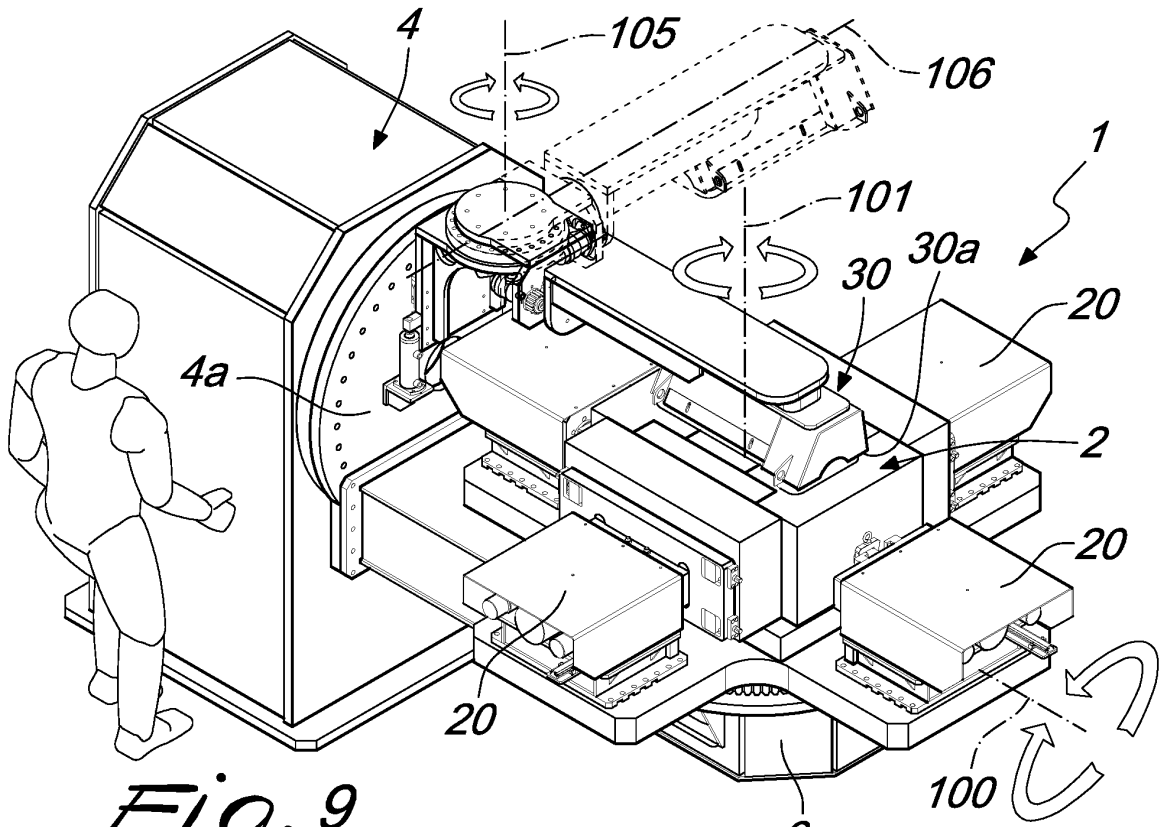


Fig. 9

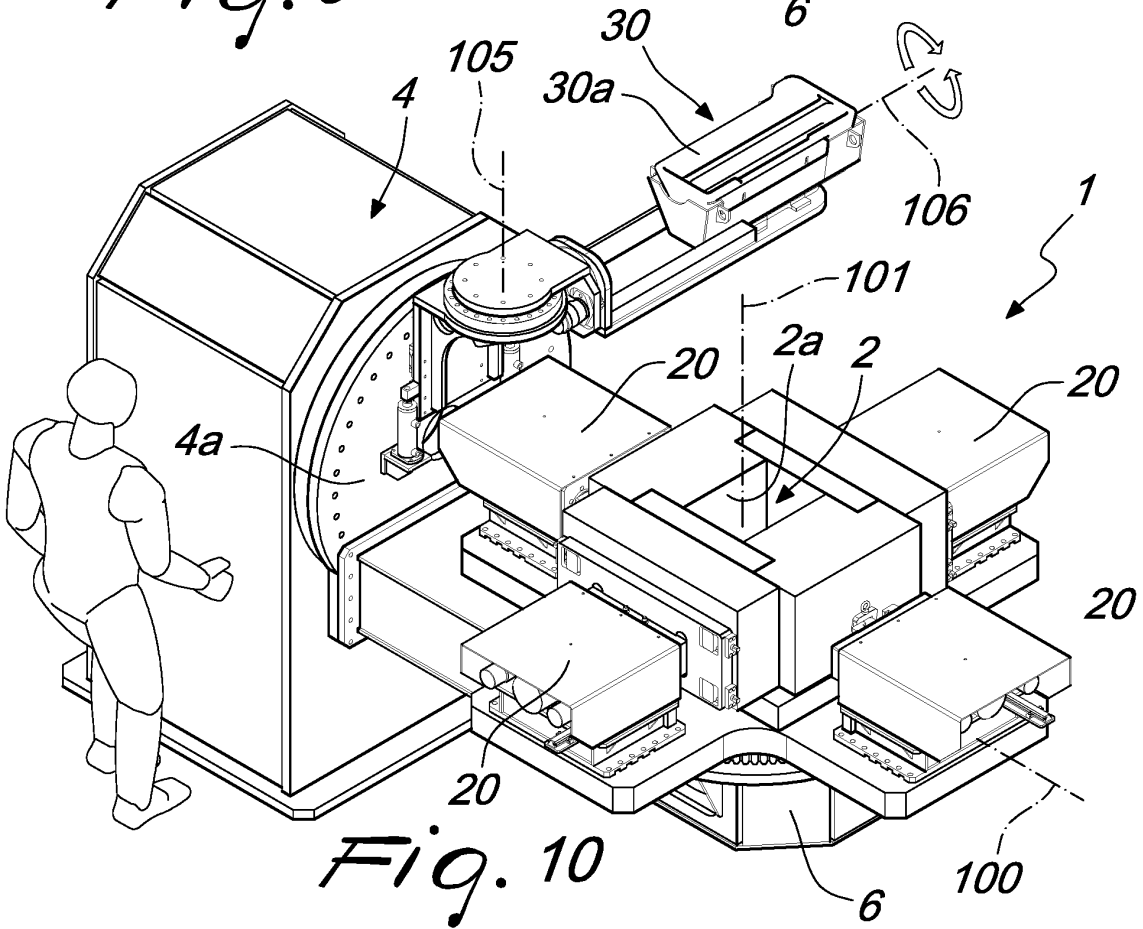


Fig. 10

REFERENCES CITED IN THE DESCRIPTION

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