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(71) Applicant: **Visam S.r.l.**
41100 Modena (IT)

(72) Inventors:
- **Scarabelli, Roberto c/o Visam S.r.l.**
41100 Modena (IT)
- **Panciroli, Luca c/o Visam S.r.l.**
41100 Modena (IT)
- **Serri, Giuseppe c/o Visam S.r.l.**
41100 Modena (IT)

(74) Representative: **Corradini, Corrado et al**
Ing. C. Corradini & C. S.R.L.
Via Dante Alighieri 4
42100 Reggio Emilia (IT)

(54) Improved vibrator

(57) Vibrator comprising an outer carcass (2) intended to be fixed to a structure to be excited, which contains at least two rotary shafts (9), parallel and opposite, each of which is rotatably associated with two distinct supports (7, 8) fixedly connected to the carcass (2), and has two lateral portions (91, 92) projecting from them, on which a first and a second unbalancing mass (13b) are respectively fitted; and a transmission system (11, 12), suitable for transmitting the motion between said rotary shafts (9), so that they are suitable for rotating at the same speed, synchronous with each other and in a desired mutual phase. Said Vibrator comprises at least one drive motor (10) rigidly associated with the carcass (2), which is suitable for making one of said rotary shafts (9) rotate, coupling with an end thereof. Moreover, each rotary shaft (9) is provided with at least a third unbalancing mass (13a), which is fitted onto the central portion (90) between said supports (7, 8), through means (130, 131, 133) that allow its angular position on the shaft (9) itself to be adjusted.

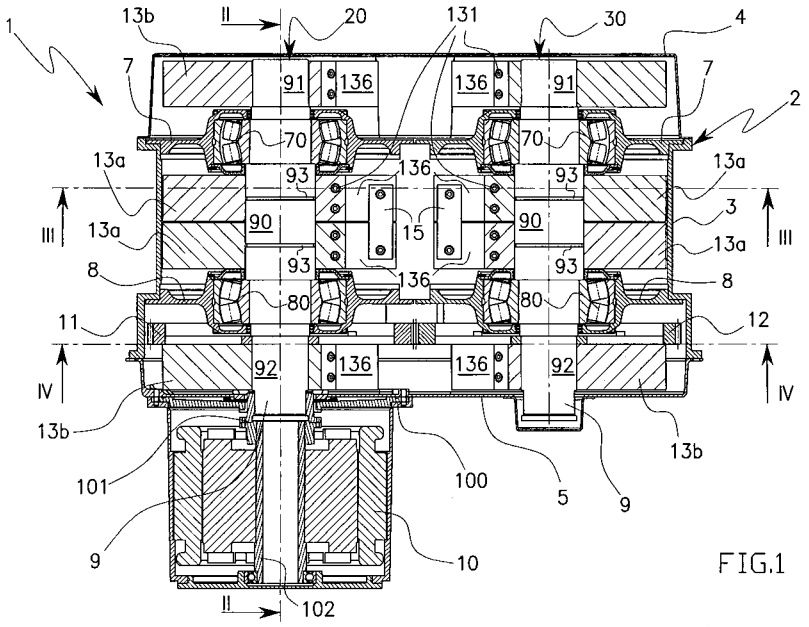

FIG.1

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Description

[0001] The present invention concerns, in a totally general sense, vibrators, i.e. devices suitable for generating mechanical vibrations, typically of adjustable size and frequency, in an oscillating system to which they are rigidly fixed.

[0002] Generally, vibrators are used in the field of industrial automation and specifically, although not exclusively, they are suitable for being installed on automatic machines like, for example, vibrating conveyors, screening machines, compacters and feeders.

[0003] Known vibrators are substantially divided into two types: rotary vibrators (also known as electric vibrators), suitable for creating a rotational centrifugal force that makes the connected structure move on an elliptical trajectory; and unidirectional vibrators (also known as mechanical vibrators) lacking its own motorisation, suitable for creating an excitation force directed along a single direction, in an alternating manner and sinusoidal over time.

[0004] In particular, the present invention concerns a mechanical vibrator equipped with its own motorisation.

[0005] As known, a mechanical vibrator generally comprises a carcass intended to be fixed to the structure to be excited, which contains two rotary shafts, parallel and counter-rotating, each of which is rotatably associated with two distinct supports, so as to have a central portion between said supports, and two lateral portions that project from them.

[0006] On the lateral portions of each rotary shaft two unbalancing masses are fitted, which are identical and aligned with each other, suitable for generating a rotational centrifugal force; whereas a pair of gears is fitted onto the central portion of each of the rotary shaft respectively, so that they are made to rotate in opposite ways, at the same speed and in perfect synchrony.

[0007] In this way, during the operation of the vibrator, the rotary shafts generate two equal and counter-rotating centrifugal forces, the components of which in the plane of the rotation axes cancel each other out, whereas the perpendicular components add together, giving rise to a unidirectional alternating excitation force.

[0008] Said excitation force is transmitted to the connected structure through the carcass of the vibrator.

[0009] In particular, in order to advantageously orientate the unidirectional excitation force with respect to said connected structure, for example with respect to the translation plane of the feeders, known mechanical vibrators must be installed through bulky rigid frames that allow them to be physically inclined by a predetermined angle.

[0010] Usually, a vibrator of this type is associated with an independent drive motor that needs a suitable transmission, and it is suitable for making a first of the aforementioned rotary shafts rotate; the second being moved by the first, by means of the gearing formed from said gears.

[0011] Generally, to modify the frequency of the vibration transmitted from the vibrator to the structure, the speed of rotation of the rotary shafts is varied; whereas to modify the size of such vibration, the intensity of the centrifugal forces generated is varied.

[0012] In particular, so as to make this adjustment possible, each unbalancing mass of the vibrator consists of an eccentric body, which is provided with a plurality of spaces, suitable for removably housing the ballast masses; said ballast masses being able to be added or removed according to needs.

[0013] A first drawback of known mechanical vibrators is the fact that such adjustment is a long and laborious operation, since it normally requires the dismounting of the transmission and of the relative protective casings, and the manual dismounting/mounting of the ballast masses; moreover, it does not allow the size of the vibration produced to be varied continuously, but rather it only allows a small variation, actually limiting the adjustability of the mechanical vibrator.

[0014] A further drawback is the fact that the unbalancing masses, being arranged just at the ends of the rotary shafts, subject the latter to a high bending load. So as not to bend excessively under the action of said load, the shafts must therefore have a sufficiently large cross section, but this involves a dual problem: firstly, it requires that the vibrator be provided with large bearings (larger than those needed to withstand the loads) the cost of which is very high; and secondly, with the same drive motor, it delays or limits the reaching of the maximum rotation speed and, therefore, has a less versatile use.

[0015] Finally, a third substantial drawback is the fact that the drive motor, since it is generally installed on an independent structure, must be coupled with the mechanical vibrator through an elastic transmission that is not damaged when subjected to the vibration produced by the vibrator; such a transmission being generally expensive, difficult to maintain, and above all bulky.

[0016] The purpose of the present invention is to provide a vibrator that is able to overcome the aforementioned drawbacks of the prior art, in the context of a simple, rational and cost-effective constructive solution.

[0017] Another purpose of the invention is to make a compact vibrator that has low bulk and is easy to maintain.

[0018] Such purposes are accomplished thanks to the characterising elements indicated in the main claim.

[0019] In a general sense, this vibrator is of the type indicated in the preamble, i.e. it comprises an outer carcass intended to be fixed to a structure to be excited, which contains:

- at least two rotary shafts, parallel and opposite, each of which is rotatably associated with two distinct supports fixedly connected to the carcass, so as to have two lateral portions projecting from them, on which a first and a second unbalancing mass are respec-

tively fitted; and

a transmission system suitable for transmitting the motion between said rotary shafts, so that they are suitable for rotating at the same speed, synchronous with each other and in the desired mutual phase.

[0020] In accordance with the invention, the vibrator comprises at least one drive motor rigidly associated with the carcass, which is suitable for making one of said rotary shafts rotate, coupling with an end thereof; moreover, each rotary shaft is provided with at least a third unbalancing mass, which is fitted onto the central portion between said supports, through means that allow its angular position on the shaft itself to be adjusted.

[0021] Furthermore, according to the finding, the transmission system that transmits the motion between the shafts is arranged outside of the supports of the shafts, so as to be easily accessible for the reasons that shall be seen hereafter.

[0022] Thanks to this solution, irrespective of the size of the drive motor, the vibrator can be very compact and, consequently, have low bulk; moreover, since said motor is fixedly connected to the carcass, there is no longer any need for expensive and complicated elastic transmissions to kinematically couple it with the rotary shaft.

[0023] Moreover, the invention advantageously allows the intensity of the vibration produced by the vibrator to be continuously modified, by simply varying, for each rotary shaft, the angular position of the unbalancing mass fitted onto the central portion, with respect to those fitted onto the lateral portions, which remain fixed. In particular, such an intensity is at its maximum when all of the unbalancing masses of each shaft are aligned with each other, and at its minimum when the third mass is dephased by 180° with respect to the others.

[0024] Furthermore, thanks to the third unbalancing mass fitted onto the central portion of the rotary shafts, they are biased more uniformly and, therefore, they can have a small cross section, which allows the use of smaller and less expensive bearings.

[0025] According to a preferred embodiment of the invention, the transmission system between the rotary shafts is placed so that the masses of the shafts are in a mirroring position, and so that the shafts themselves are made to rotate at the same speed and in opposite ways.

[0026] In this way, the vibrator advantageously generates a unidirectional excitation force perpendicular to the plane of the rotation axes of the rotary shafts.

[0027] Alternatively, according to a different embodiment of the invention, said transmission system can be placed so that the masses of the rotary shafts are in non-symmetrical position.

[0028] In this way, it is possible to advantageously set the direction of the excitation force transmitted from the vibrator to the connected structure, without needing to use bulky frameworks suitable for physically inclining the vibrator itself.

[0029] Lastly, according to a third embodiment, the transmission system can be placed so that the shafts rotate in complementary ways, so that the vibrator generates a rotational vibration of double the intensity of a usual rotational vibrator, whilst still retaining a low bulk.

[0030] According to the invention, the transmission system that connects the two rotary shafts, comprises at least one pair of gears that are fitted, each on a respective rotary shaft, outside of the supports. In this way, such gears are accessible from the outside, and can be kinematically coupled with a manual actuation system that, as shall become clear hereafter, allows the angular position of both of the unbalancing masses that are fitted onto the central portions of the rotary shafts to be simply and quickly adjusted.

[0031] According to a preferred embodiment of the invention, two distinct unbalancing masses are mounted on the central portion of each rotary shaft, said masses being preferably aligned and connected to each other, so as to be able to be rotated as a unit on the corresponding rotary shaft.

[0032] In this way, the vibrator comprises in total eight unbalancing masses, which can all be constructively the same as one another, advantageously reducing the production costs, and allowing complete adjustment of the vibrator itself.

[0033] Thanks to this solution, indeed, the unbalancing masses placed in the central portion of each rotary shaft are always suitable for generating a centrifugal force of intensity equal to the sum of the centrifugal forces generated by the unbalancing masses placed on the lateral portions; therefore, the overall force generated by each rotary shaft can vary between a maximum value, when the unbalancing masses are all aligned, to a zero value, when the central ones are staggered by 180° with respect to the lateral ones.

[0034] Lastly, an alternative embodiment of the invention foresees that the vibrator can comprise three distinct rotary shafts, connected together through a suitable transmission and each equipped with respective unbalancing masses.

[0035] Thanks to this solution, the excitation force generated by the vibrator shall be the resultant of a variable unidirectional force that is sinusoidal over time and of a rotational force; therefore, such a force shall be suitable for generating a vibration on an elliptical trajectory in the connected structure.

[0036] Further advantageous characteristics of the invention shall become clearer from reading the following description, provided purely as a non-limiting example, with the help of the figures displayed in the attached tables of drawings, in which:

- figure 1 is a view from above in longitudinal section of a vibrator in accordance with the invention;
- figure 2 is the section along the line II-II indicated in figure 1;
- figure 3 is the section along the line III-III indicated

in figure 1;

- figure 4 is the section along the line IV-IV indicated in figure 1;
- figure 5 is a detail of the section along the line V-V indicated in figure 4;
- figure 6 is figure 1 in which the vibrator is shown not sectioned;
- figure 7 shows two vibrators 1 in accordance with the invention, coupled together.

[0037] From the aforementioned figures and in particular from figure 1, it is possible to see a vibrator 1 comprising a carcass 2 formed from a hollow central body 3, which is closed at the ends, respectively, by a top cover 4 and by a bottom cover 5, and is provided with a base 6 suitable for being rigidly fixed to a structure to be excited (see fig.2).

[0038] Inside the carcass 2 a first rotary group 20 and a second rotary group 30 are contained, which are totally identical and are mounted so as to perfectly mirror one another (see also figs. 3 and 4).

[0039] In detail, each rotary group 20 and 30 comprises a shaft 9 that is rotatably supported, with the interposition of two rolling bearings 70 and 80, by a pair of supports, 7 and 8, firmly fixed to the hollow central body 3, inside the volume of the carcass 2.

[0040] In particular, the shaft 9 has a central portion 90 between the supports 7 and 8, and two lateral portions 91 and 92 - a first portion 91 projecting from the support 7, and a second portion 92 projecting from the support 8.

[0041] As can be seen in figures 1 and 2, the shaft 9 of each rotary group, 20 and 30, is fitted with four unbalancing masses, two of which, both indicated with 13a, are positioned in the central portion 90, whereas the remaining two, both indicated with 13b, are respectively positioned at the lateral portions 91 and 92.

[0042] In particular, said unbalancing masses 13a and 13b are all substantially identical to each other and, as can be seen in figure 3, each of them consists of a shaped plate, which is fitted onto the shaft 9, so that its barycentre does not lie on the rotation axis.

[0043] In detail, said shaped plate is a half-disc coaxial with the shaft 9, which is equipped with a hub 130 that, acting as a clamp, is suitable for being slotted onto the rotary shaft 9, and for being tightened on it thanks to a pair of clamping screws 131 (see fig. 1).

[0044] It should be observed that the unbalancing masses 13a and 13b differ from each other just in the size of the hub 130, since said hub 130 must respectively couple with the central portion 90 and lateral portions 91, 92 of the shaft 9, which have a cross section of different diameter.

[0045] The unbalancing masses 13b of each rotary group, 20 and 30, are positioned on the corresponding rotary shaft 9 so as to be perfectly interfacing with one another and, as shown in figure 2, their angular position is ensured by a threaded worm screw 132, which screws into a hole of the hub 130 and engages in a corresponding hole of the rotary shaft 9 itself.

[0046] The unbalancing masses 13a also perfectly interface with one another, but are not bound in a fixed angular position with respect to the corresponding rotary shaft 9, but rather can be rotated as a unit, so as to be able to vary their angular position with respect to the unbalancing masses 13b of the same shaft; said rotation being guided by two threaded worm screws 133 that, screwed into corresponding holes of the hubs 130, each engage in a respective circumferential throat 93 of the shaft 9.

[0047] In particular, as shown in figure 2, the unbalancing masses 13a of each rotary group, 20 and 30, are made fixedly connected together through an elastic peg 134, which is inserted inside two longitudinal holes 135, facing one another, which are respectively formed in the two half-discs that constitute the unbalancing masses 13a themselves.

[0048] As illustrated in figures 1 and 4, the two rotary groups, 20 and 30, perfectly mirror one another and are kinematically coupled through a transmission system that allows a single electric motor 10, to simultaneously actuate both groups.

[0049] In particular, as illustrated in figures 1, 2 and 5, said motor 10 is fixed outside of the bottom cover 5 he carcass 2, and is kinematically coupled with the shaft 9 of the rotary group 20, the lateral portion 92 of which is provided with an end tang suitable for coupling, by means of a joint 101, with the rotor 102 of the electric motor 10 itself.

[0050] Alternatively, for reasons of bulk, the vibrator 1 can be provided with two distinct drive motors 10, of half the power and therefore of reduced bulk, which are electrically coupled with each other and are each connected to a respective rotary shaft 9.

[0051] As illustrated in figure 2, the transmission system comprises two opposite gear wheels 11 and 12, which are respectively fitted onto the lateral portions 92 of the two shafts 9, between the support 8 and the half-disc 13b.

[0052] Such gear wheels 11 and 12 are suitable for meshing together and have the same diameter (see fig. 4), so that the shafts 9 of the two rotary groups 20 and 30 are made to rotate in opposite ways, at the same speed and in perfect synchrony with each other.

[0053] In the case in which it is desired for the vibrator 1 to generate a rotational vibration, an intermediate gear must be introduced into the transmission that makes the shafts 9 rotate in the same way.

[0054] As shown in figures 4 and 5, the vibrator 1 also comprises a manual actuation system, which allows the two gear wheels 11 and 12 to be rotated manually when the electric motor 10 is not operating.

[0055] Said manual actuation system comprises a pinion 14 that meshes with just the gear wheel 12 (see fig. 4), which is fitted on a pin 16 rotatably mounted between the support 8 and the bottom cover 5 (see fig.5).

[0056] Said pin 16 projects outside of the bottom cover

5 with a hexagonal-shaped portion for coupling with a normal manoeuvring key, and it is rotatably associated with it with the interposition of an anti-reversal bearing 17, which allows the pin 16 itself to rotate in just one way.

[0057] Moreover, said pin 16 also projects from the support 8, with which it is coupled through a sliding bush 18, and is provided with a spring 19 that, arranged between the pinion 14 and the bearing 17, pushes the pinion into engagement with the gear wheel 12.

[0058] In order to disengage the pinion 14, before actuating the vibrator 1, it is sufficient to manually push the bush 18, so that the pin slides in contrast with the spring 19, until it locks in a position in which the pinion 14 is not in contact with the wheel 12.

[0059] During the operation of the vibrator 1, the motor 10 makes the shafts 9 rotate, so that each rotary group, 20 and 30, generates overall a centrifugal force equal to the resultant of the centrifugal forces, in phase with each other, produced by the unbalancing masses 13b, and of the centrifugal forces, also in phase with each other, produced by the unbalancing masses 13a.

[0060] In particular, since said masses 13b and 13a are all the same, the centrifugal forces produced by them have the same intensity; therefore, the intensity of the resultant centrifugal force produced by each rotary group, 20 and 30, can be varied between a maximum value, when the respective masses 13a and 13b perfectly interface, to zero value, when the masses 13a are staggered by 180° with respect to the masses 13b.

[0061] The overall centrifugal forces generated by the two rotary groups, 20 and 30, add together vectorily and, since they are the same in module but counter-rotating, their components in the plane of the rotation axes of the shafts 9 cancel each other out, whereas the perpendicular components add together, creating a unidirectional resultant force that is variable in a sinusoidal manner over time, suitable for exciting the vibration in the connected structure.

[0062] The frequency of the vibration transmitted from the vibrator 1 to the structure can be modified by acting upon the motor 10 to vary the rotation speed of the shafts 9, whereas the size of such a vibration can be modified by adjusting the angular position of the masses 13a of both of the rotary groups, 20 and 30, with respect to the corresponding masse 13b.

[0063] This adjustment, however, must be carried out taking great care that the unbalancing masses 13a of the two rotary groups, 20 and 30, always mirror each other.

[0064] Therefore, to make this adjustment quicker and easier, the invention foresees that the vibrator 1 be made respecting some special provisions.

[0065] A first provision concerns the embodiment of the unbalancing masses 13a, which are provided, as can be seen in figure 3, with a flat abutment surface 136 that lies in a radial plane of the corresponding shaft 9.

[0066] A second provision, on the other hand, concerns the use of two abutment plates 15, each of which is fixed onto the flat surfaces 136 of the unbalancing masses 13a of a respective rotary shaft 9.

[0067] During the normal operation of the vibrator 1, said abutment plates are suitable for connecting together the masses 13a of each rotary shaft 9 making them firmly connected together; whereas during adjustment, such plates 15 are rotated relative to the respective unbalancing masses 13a, so as to occupy the space between the rotary shafts 9, providing an abutment for the surfaces 136 of the masses 13a of both shafts 9.

[0068] Thanks to the aforementioned provisions, the angular position of the unbalancing masses 13a with respect to the corresponding unbalancing masses 13b can be varied simultaneously for each rotary group, 20 and 30, following the simple process described hereafter, with a single operation, and with the guarantee that the masses 13a of one group always mirror those of the other.

[0069] First of all, through the manual actuation system (rotating the pin 16 with a manoeuvring key) the shafts 9 are made to rotate until the radial surfaces 136 of the unbalancing masses 13a are substantially parallel.

[0070] Then both of the abutment plates 15 of the two rotary groups 20 and 30 are rotated (as shown with a broken line in figure 3), and the unbalancing masses 13a fitted on both of the shafts 9 are fixed together, through said abutment elements 15.

[0071] In this way, the masses 13a of the two rotary groups, 20 and 30, are bound in perfectly mirroring position; indeed, their rotation is prevented, in one way, by the abutment 15 and, in the other way, by the anti-reversal bearing 17 of the manual actuation system.

[0072] At this point, the clamping screws 131 of all of the unbalancing masses 13a of the first 20 and second 30 rotary group are loosened, and the shafts 9 are made to rotate again through the manual actuation system (in the way allowed by the anti-reversal bearing 17), so that they rotate simultaneously inside the hubs 130 of the respective masses 13a, until the desired angular position between them and the unbalancing masses 13b that rotate as a unit with the shafts is obtained.

[0073] Finally, the clamping screws 131 are tightened again and the abutment plate 15 is repositioned in the initial position.

[0074] It should be emphasised that, in accordance with the invention, said adjustment can be carried out without dismounting the motor 10 and the covers 4 and 5 of the vibrator 1; indeed, as illustrated in figures 3 and 6, the hollow central body 3 is provided with a top opening that, normally closed by a removable panel 31, makes the flat surfaces 136 of the unbalancing masses 13a of both of the rotary groups 20 and 30 accessible.

[0075] In particular, as can be seen in figures 3 and 4, the outer carcass 2 of the vibrator 1 has a perfectly symmetrical configuration with respect to the plane that contains the rotation axes of the rotary shafts 9 and, therefore, the hollow central body 3 is also provided with a bottom opening, equal and opposite to the aforementioned top opening.

[0076] As illustrated, said bottom opening is closed by

the base 6, which is dismountably fixed to the hollow body 3.

[0077] In accordance with the invention, the base 6 and the removable panel 31 are interchangeable, i.e. the first can be arranged to close the top opening, and the second to close the bottom opening, so that the vibrator 1 can be connected to the structure to be excited even in inverted position.

[0078] In particular, as illustrated in figure 7, this characteristic is particularly advantageous when, for power requirements, it is necessary to connect two distinct vibrators 1 to the structure to be excited.

[0079] In order to ensure their perfect synchrony, said vibrators 1 are coupled together through a rigid joint 40, which is suitable for connecting together the rotary shafts 9 that are not coupled with the respective drive motor 10.

[0080] In this case, as shown in figure 7, by mounting a first vibrator 1 in the usual position and a second vibrator 1 in inverted position, they are arranged symmetrically to each other, the connection joint 40 occupies substantially just the bulk of the drive motors 10 and, therefore, the group is overall very compact.

[0081] Finally, it should also be emphasised that although the motor 10 is an electric motor, the invention foresees that it can be replaced with a different type of motor, without needing to modify the structure of the vibrator 1.

[0082] Such a motor 10, indeed, is connected to the bottom cover 5 of the carcass 2 through a flange 100, which can advantageously be installed on any type of motor, for example hydraulic, according to the particular applications for which the vibrator 1 is intended (see figs. 1, 2 and 6).

[0083] Of course, numerous modifications or improvements can be made to the vibrator 1 as described, dictated by contingent or specific requirements, without for this reason departing from the scope of the invention as claimed below.

Claims

1. Vibrator comprising an outer carcass (2) intended to be fixed to a structure to be excited, which contains at least two rotary shafts (9), parallel and opposite, each of which is rotatably associated with two distinct supports (7, 8) fixedly connected to the carcass (2), and has two lateral portions (91, 92) projecting from them, on which a first and a second unbalancing mass (13b) are respectively fitted, **characterised in that**
   it comprises at least one drive motor (10) rigidly associated with the carcass (2), which is suitable for making one of said rotary shafts (9) rotate, coupling with an end thereof, and **in that** each rotary shaft (9) is provided with at least a third unbalancing mass (13a), which is fitted onto the central portion (90) between said supports (7, 8), through means (130, 131, 133) that allow its angular position on the shaft (9) itself to be adjusted; a transmission system (11, 12) being foreseen, suitable for transmitting the motion between said rotary shafts (9), so that they are suitable for rotating at the same speed, synchronous with each other and in a desired mutual phase.

2. Vibrator according to claim 1, **characterised in that** the transmission system comprises at least one pair of gears (11, 12) that are fitted, each on a respective rotary shaft (9), outside of said supports (7, 8), which ensure the rotation of the shafts (9) in opposite ways.

3. Vibrator according to claim 2, **characterised in that** the transmission system comprises an intermediate gear suitable for making the rotary shafts (9) rotate in the same way.

4. Vibrator according to claim 2, **characterised in that** it comprises a manual actuation system (14, 15, 16) of the rotary shafts (9).

5. Vibrator according to claim 4, **characterised in that** the manual actuation system comprises a pinion (14) suitable for stably meshing with one of the gears (11, 12) that transmit the motion between the rotary shafts (9), which is fitted onto a pin (16) that, rotatably associated with the carcass (2), projects outside of it.

6. Vibrator according to claim 5, **characterised in that** the pin (16) is associated with the carcass (2) with the interposition of at least one anti-reversal bearing (17).

7. Vibrator according to claim 1, **characterised in that** two distinct unbalancing masses (13a) are mounted on the central portion (90) of each rotary shaft (9).

8. Vibrator according to claim 7, **characterised in that** said unbalancing masses (13a) are made to be fixedly connected together through connection means (134, 135, 15).

9. Vibrator according to claim 7, **characterised in that** all of the unbalancing masses (13a, 13b) fitted on the rotary shafts (9) are the same as each other.

10. Vibrator according to claim 1, **characterised in that** it comprises at least one abutment element (15) mobile between a position in which it allows the free rotation of the third unbalancing masses (13a) of each rotary shaft (9), and a position in which it prevents said rotation, binding the third unbalancing mass (13a) of a rotary shaft (9) in a position mirroring the third unbalancing mass (13a) of the other rotary shaft (9).

11. Vibrator according to claim 1, **characterised in that**

each unbalancing mass (13a, 13b) comprises a shaped plate suitable for being fitted onto the corresponding rotary shaft (9), so that its barycentre does not lie on the rotation axis of the rotary shaft (9) itself.

12. Vibrator according to claim 10, **characterised in that** said shaped plate is provided with a hub (130) shaped like a clamp, which is intended to be slotted onto the corresponding rotary shaft (9), and to be locked onto it through at least one clamping screw (131).

13. Vibrator according to claim 9, **characterised in that** the abutment element is a plate (15) that can be positioned in the space between the two rotary shafts (9), at the central portions (90) thereof.

14. Vibrator according to claim 1, **characterised in that** the carcass (2) comprises at least one opening that, normally closed by a removable panel (31), makes the third unbalancing masses (13a) of both of the rotary shafts (9) accessible, so as to allow them to be adjusted.

15. Vibrator according to claim 1, **characterised in that** a dismountable base (6) suitable for connecting the vibrator (1) to the structure to be excited is fixed to the carcass (2); said base (6) being able to be fixed to the carcass (2) on opposite sides with respect to the plane of the rotary shafts (9), so as to be able to connect the vibrator (1) to the structure to be excited even in inverted position.

16. Vibrator according to claim 15, **characterised in that** the carcass (2) has a symmetrical configuration with respect to the plane of the rotary shafts (9), and is provided with two opposite openings with respect to said plane of the shafts (9), which make the third unbalancing masses (13a) of both of the rotary shafts (9) accessible, of which a first opening is closed by a removable panel (31) and a second opening is closed by the dismountable base (6); said panel (31) and base (6) being mutually interchangeable.

17. Vibrator according to claim 1, **characterised in that** the drive motor (10) is dismountably fixed to the carcass.

18. Vibrator according to claim 1, **characterised in that** the drive motor (10) is an electric motor.

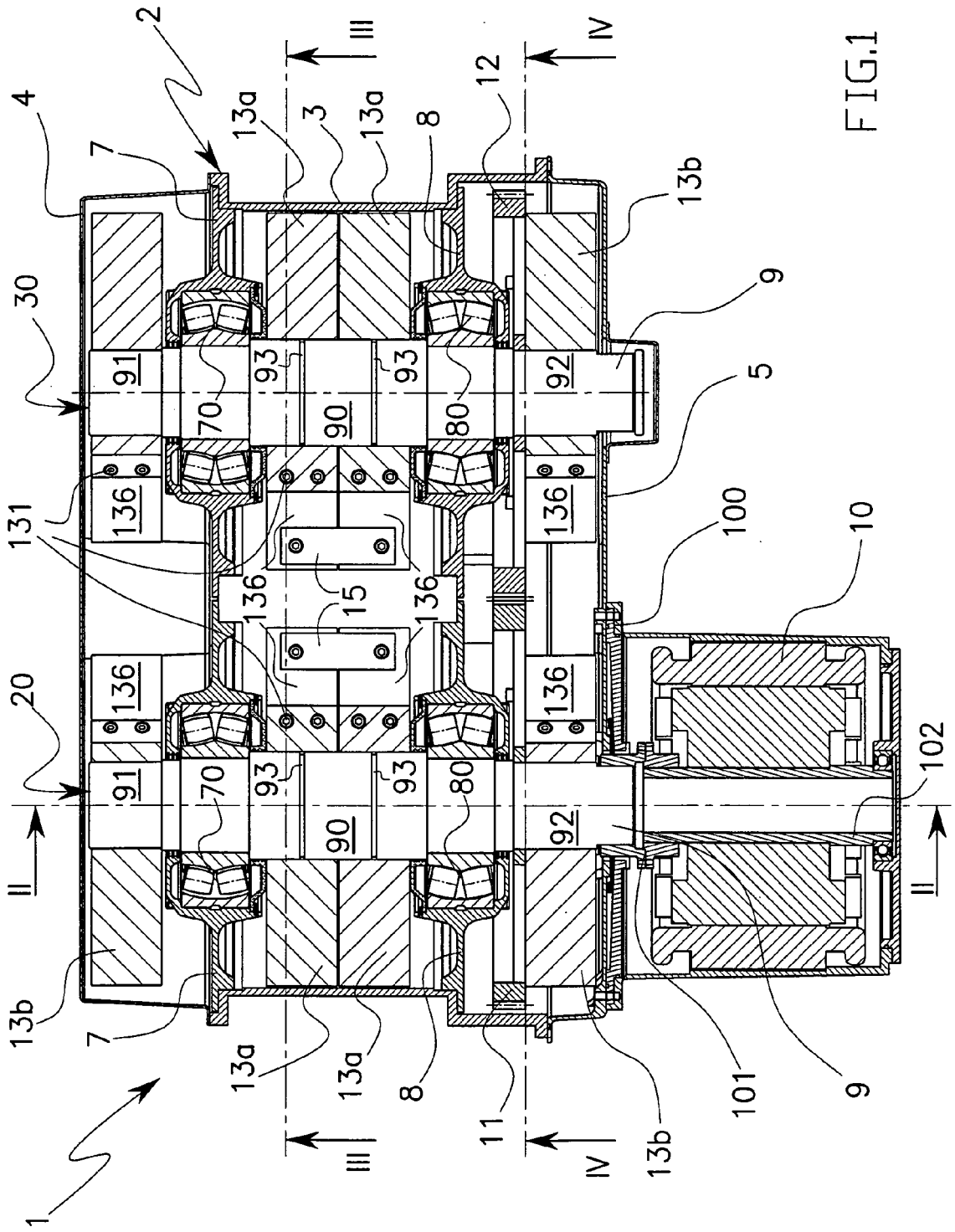
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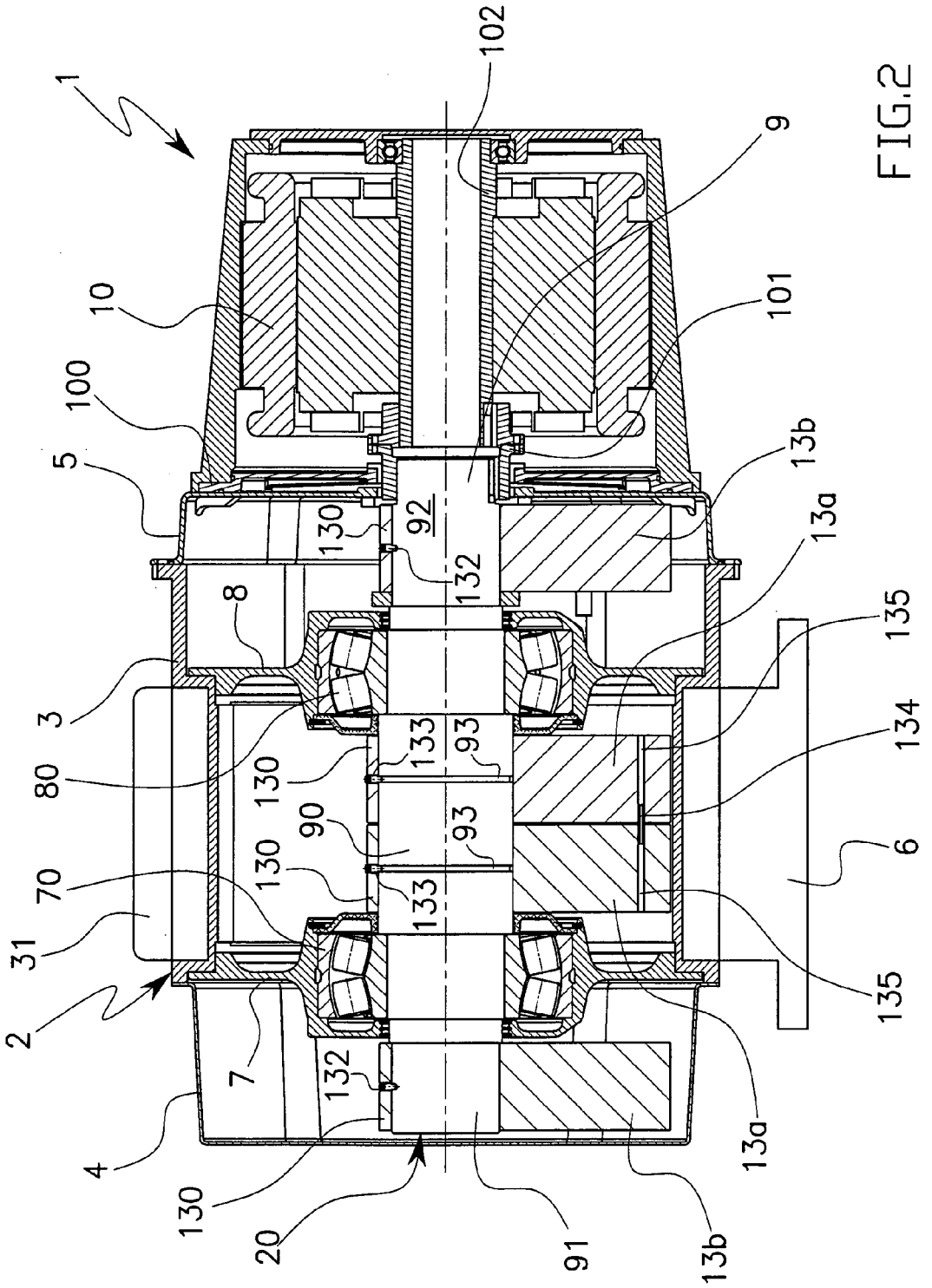
FIG.1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20
91
13b
13a

FIG.2

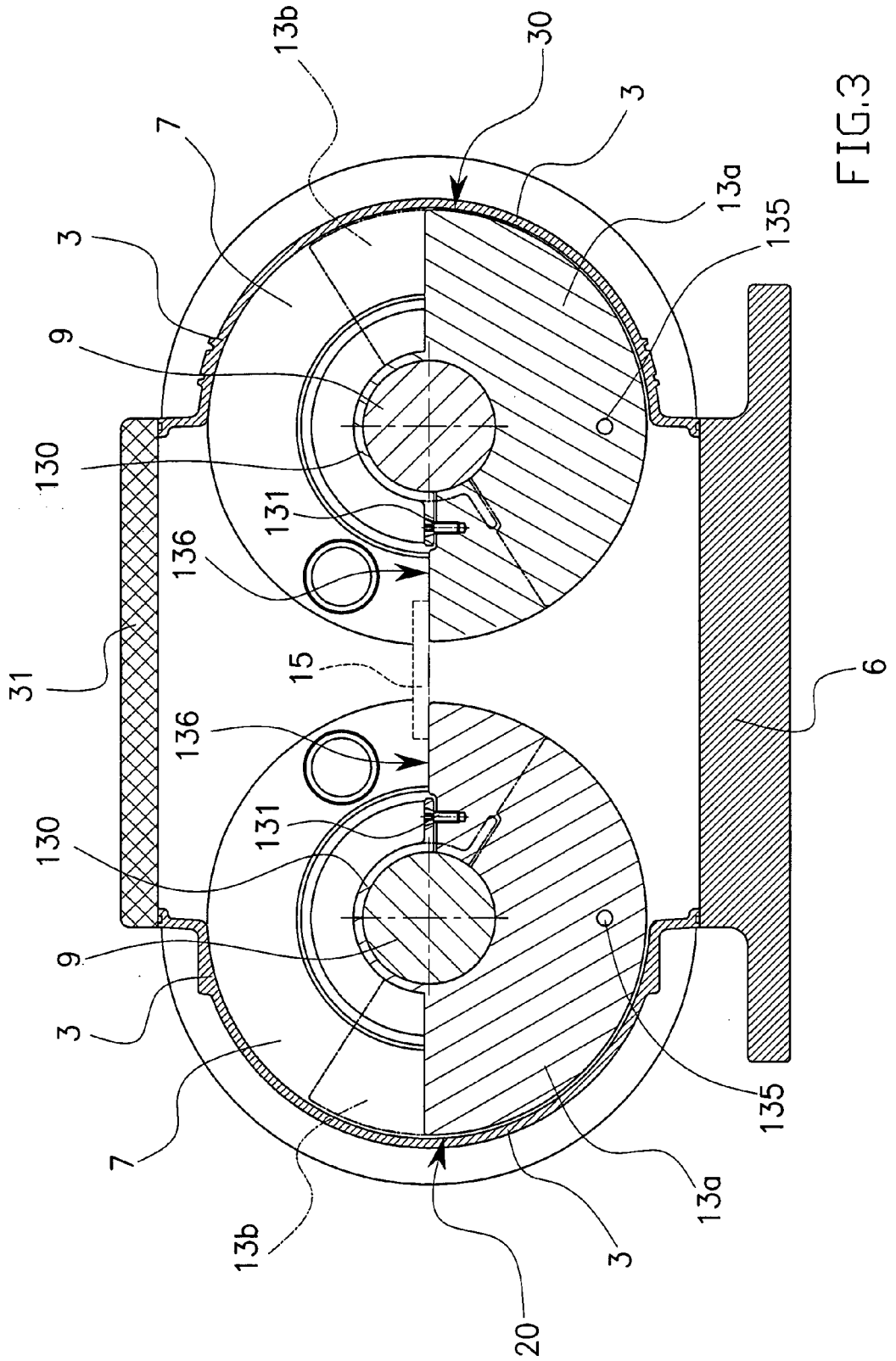
13b
30
3
7
13a
135
3
9
130
131
136
31
15
6
136
131
130
9
3
7
135
13a
13b
3
20

FIG.3

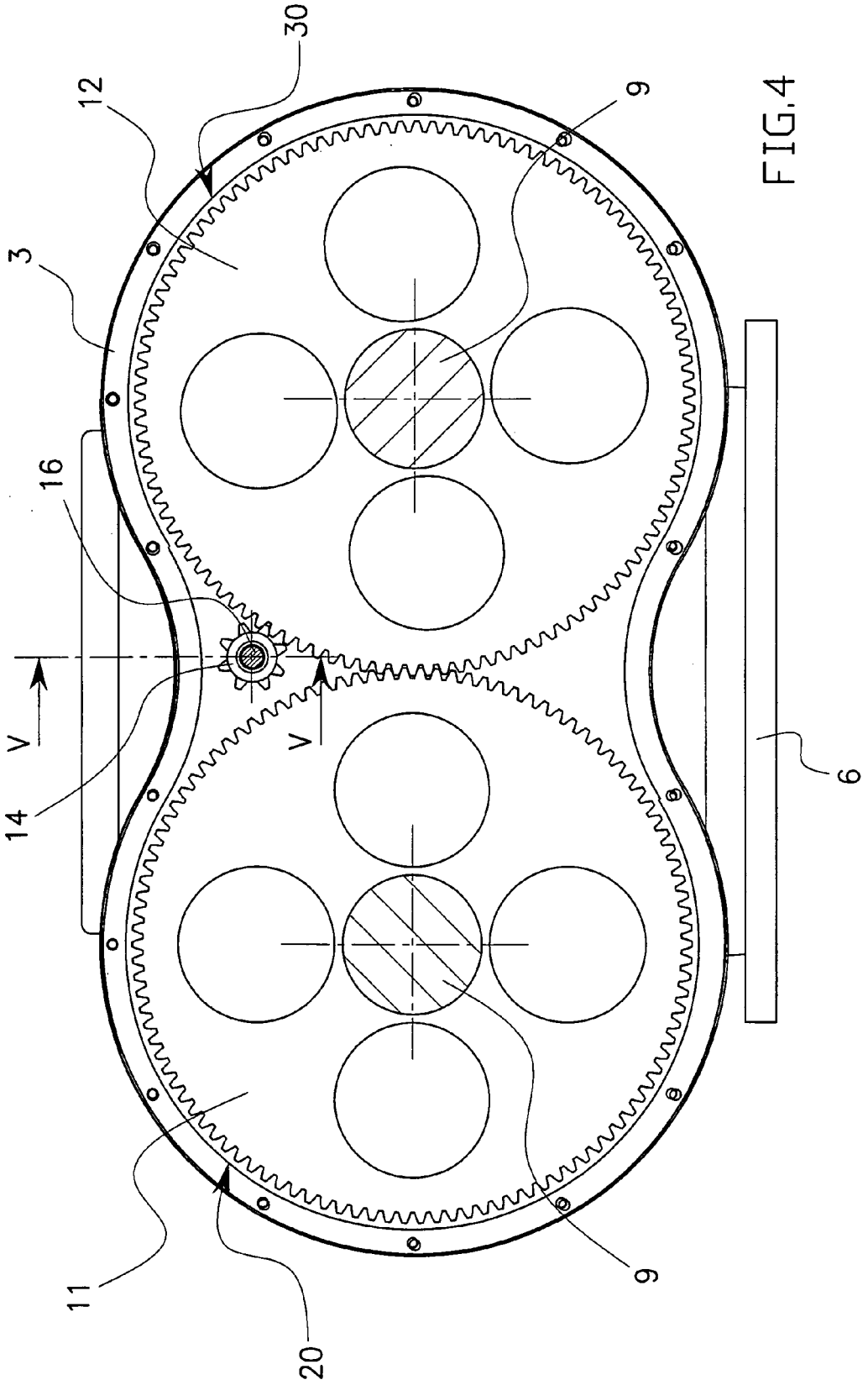

FIG.4

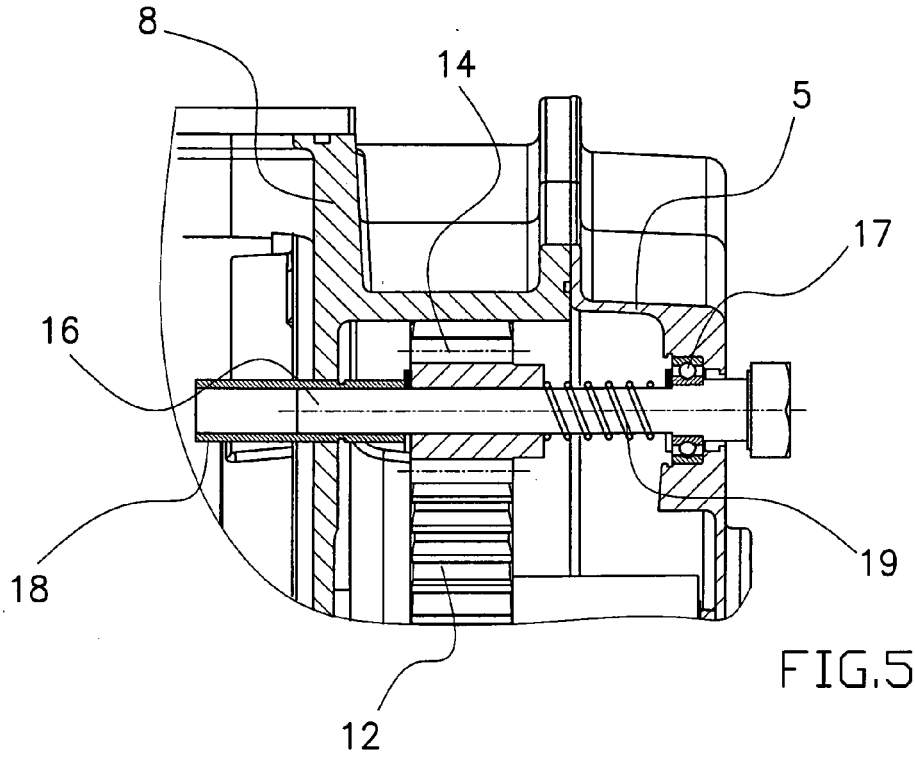

FIG.5

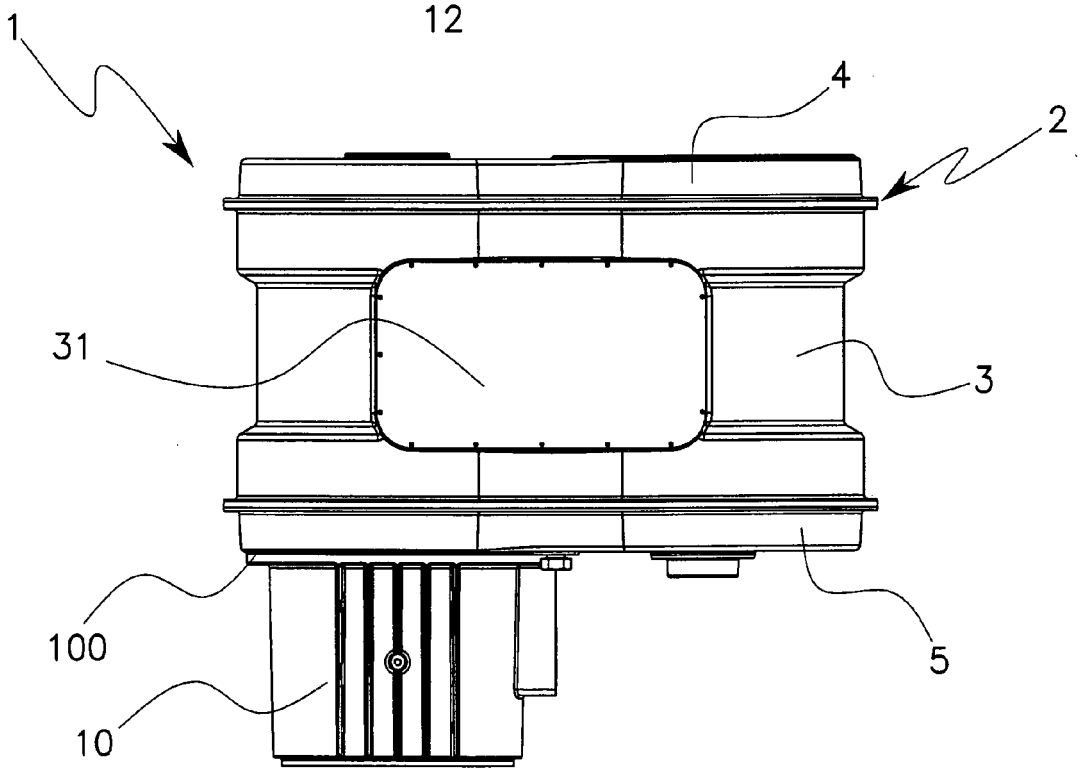

FIG.6

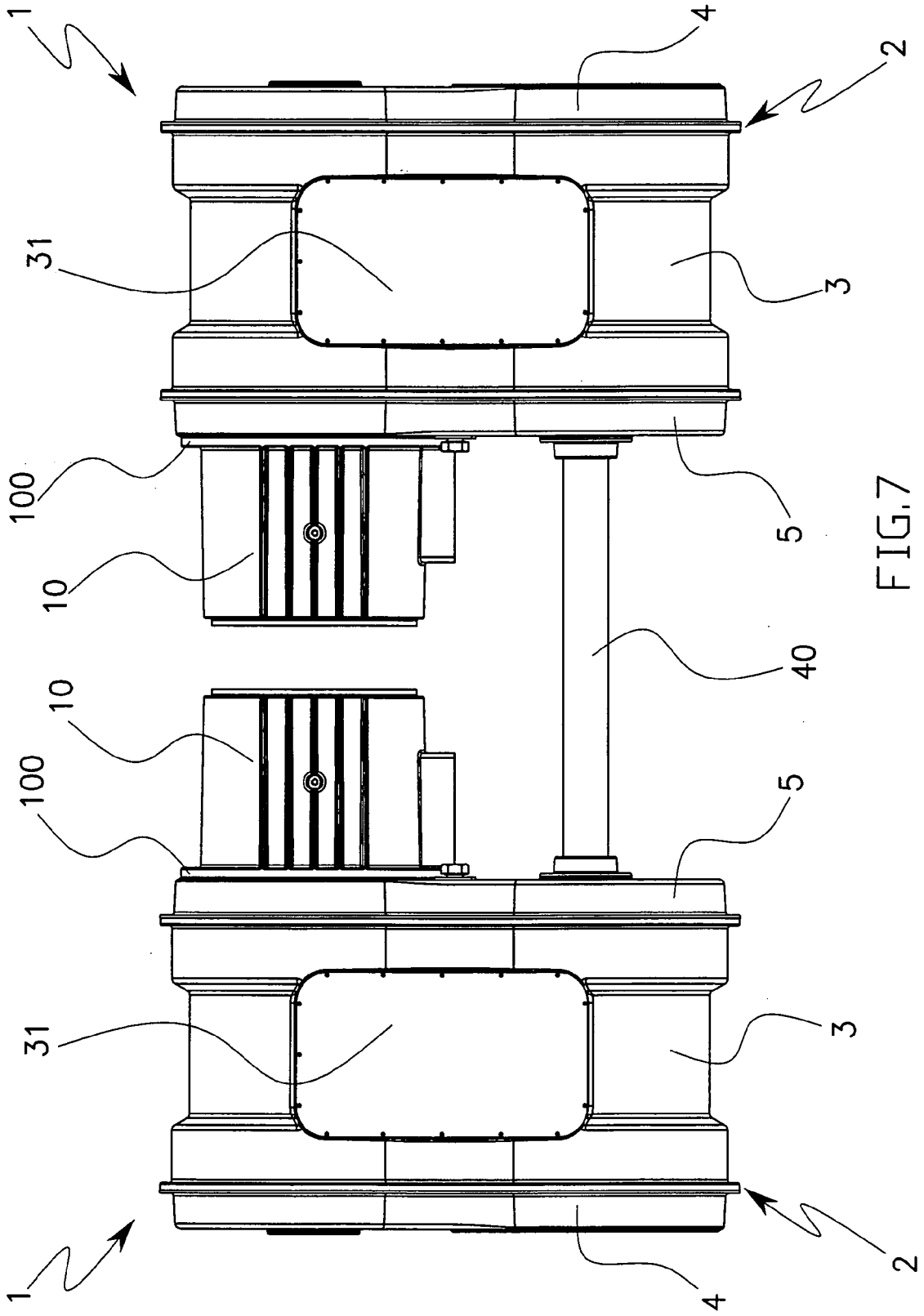

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
EP 06 07 6238

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 February 2007	Modesto, Carlos

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