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(54) IMPROVED SPINDLE FOR ROTATING HEADS FOR CALIBRATION OR SMOOTHING OF ARTIFICIAL OR NATURAL PLANAR MATERIALS

(57) A spindle for rotating heads for calibrating or dressing artificial or natural planar materials comprises: a sleeve (10) within which a body (5) of the spindle is slidable in turn provided with a spindle shaft (6) at the lower end (3) of which a rotating head (2) with abrasive tools (9) is applied; at least two pneumatic cylinders (11) for positioning the spindle (1), i.e., the head connected thereto, on a supporting structure (13); fixing the sleeve to the structure (13) of a machine on which the spindle is mounted by means of an adjustment flange (12) with spherical surface (20); at least two electric rotation drive motors (24) of the spindle and a transmission from said motors to the spindle shaft (6); said electric motors being coupled in rotation to the spindle shaft each with a belt transmission (21); between said sleeve and said spindle shaft (6) a sliding body which supports the spindle shaft (1) in rotation and is pushed in a raised or lowered position on the planar surface (30) in operation with said pneumatic cylinders (11); furthermore, it has the pneumatic cylinders connected outside the sleeve (10) and, with a stem (14) at the lower sheet (15) of a transmission box (16) on whose upper sheet (17) a front flanged support (25) is fixed for each electric motor (24); the transmission box (16) comprises outer closing walls positioned between the two lower (15) and upper sheets (17); a central cover (42) for closing, stiffening and accessing the internal compartment with the central groove wheel (22), for belt transmissions, connected and rotating with the spindle shaft (6).

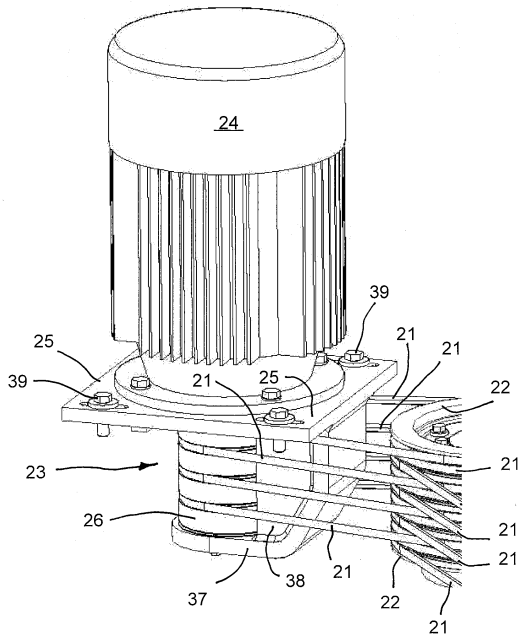

Fig. 10

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Description

Field of application

[0001] The invention relates to: an improved spindle for rotating heads for calibrating or dressing artificial or natural planar materials, such as concrete tiles, concrete blocks, ceramic tiles, natural stone sheets, processed with rotating abrasive heads, i.e., a spindle placed in rotation on the surface being processed to communicate the rotation to said heads with normal rotation axis at the planar surface to be processed, made particularly advantageous in the realization due to the high powers applied to communicate to the abrasive head mounted and rotating thereon. That is, it is advantageous in both construction and operation to perform delicate material thickness calibration operations, dressing the planar surface itself which require a high power installed on each head to realize the envisaged processing methods.

Background Art

[0002] The state of the art comprises support and motorization spindles of rotating abrasive heads, built both for a simple planar disc conformation with abrasive elements distributed on the active surface thereof conveniently spaced apart from each other, and with calibration heads in which abrasive tools oscillating or rotating against the planar surface being processed are present. In fact, these types of spindles, although known for years in the state of the art, generally have a single electric motor of adequate power to put and keep in rotation the rotating abrasive head mounted thereon.

[0003] Thus it is known, for rotating disc abrasive heads on planar cementitious surfaces such as concrete tiles and concrete blocks, that the processing occurs with the use of heads as described in the previous EP 1849557 A2 in which, to cover the high surfaces being processed, a rotating head is described on the axis thereof and with several counter-rotating abrasive discs operating simultaneously on the planar surface. This document seeks the most even distribution of the cutting front of the individual abrasive sectors assembled. Nothing is mentioned in terms of the generation of the spindle rotation. In fact, in the field of cement surface processing, it is undisputed to use a single motor with power suited to that which is required by the mounted abrasive head.

[0004] Moreover, in the state of the art for the processing of natural or artificial planar surfaces which are very hard such as slabs, strips or tiles in granite, hard stones, marble or porcelain stoneware tiles, it is known to use rotating heads mounted on spindles which use a rotational motion transmission obtained with two electric motors and which transmit the motion to the same rotating spindle carrying the single abrasive and rotating head.

[0005] In fact, EP 1536916 B1 describes a rotating spindle with internal hydraulic lifting and lowering control and with a geared transmission which allows the generation of rotation to be balanced, avoiding the lateral mounting of a single motor to the spindle itself, replacing the former with the assembly of two simultaneously rotating motors.

[0006] Furthermore, an improvement of the previous spindle is known from WO 2015/124990 A1 in which the geared transmission is replaced with a belt transmission so as to make both the realization and use more efficient and economical; in fact, with the belt transmission described the necessary balancing of the head and the consequent processing precision, which is typical of the very hard materials for which the aforementioned spindle was built, is maintained.

[0007] From the above, the technical problem of realizing a concentration of power to be transmitted to the rotating abrasive head remains unresolved, as used in the calibration and dressing processing of flat cement surfaces, given the high power required, the simple increase in the power of the electric motors applied to a spindle with double motor and balanced transmission for the rotation thereof is not suitable.

[0008] Moreover, the constitution of such a spindle with belt transmission cannot be directly transposed in the creation of a head with a high concentration of power, since it is necessary to include high-power electric motors which, when mounted on a column support, are of considerable mass so as to make the belt transmission less agile, rigid in assembly and adjustment if made as in the aforementioned previous document. In fact, the column mounting supports on which the individual electric motors are fixed in the prior art document are fixed and adjusted on a support plate which is removably connected to the body of the spindle, for interventions in adjusting the ratio of the belt transmission which can be modified if necessary by the user.

[0009] It has been found that in the construction of rotating abrasive heads for cementitious materials, therefore with a high concentration of transmitted power, the modification of the transmission ratio is not necessary; instead, it is necessary to considerably increase the power of the motors and maintain the necessary rigidity of the motor coupling plate to the spindle structure.

[0010] Such a state of the art is subject to considerable improvements with regard to the possibility of overcoming the drawbacks described above and the limitations of the prior art.

[0011] From the above derives the need to solve the technical problem of finding an arrangement of the parts of the spindle, for rotating heads for calibrating or dressing artificial or natural planar materials, which allows to realize a transmission of the rotating motion from the electric motors in a simple and economical manner, but at the same time to realize a spindle which has a rigid constitution and also one which is functional to the economics of realization and maintenance.

[0012] Furthermore, as a corollary to said technical problem, the new spindle must be able to easily adjust the transmission and, at the same time, facilitate the con-

trol and maintenance thereof.

[0013] However, these achievements must be obtained at low costs even if they require a much higher power installation than the spindles described in the prior art.

Summary of the Invention

[0014] This technical problem is solved, according to the present invention, by an improved spindle for rotating heads for calibrating or dressing artificial or natural planar materials, comprising: a sleeve within which a spindle body is slidable, in turn provided with a spindle shaft at the lower end of which a rotating head with abrasive tools is applied; at least two pneumatic cylinders for positioning the spindle, i.e., the head connected thereto, on a supporting structure; fixing the sleeve to the structure of a machine on which the spindle is mounted by means of a surface adjustment flange with spherical surface; at least two electric rotation drive motors of the spindle and a transmission from said motors to the spindle shaft; said electric motors coupled in rotation to the spindle shaft each with a belt transmission; between said sleeve and said spindle shaft there is a sliding body which rotatably supports the spindle shaft and is pushed in a raised or lowered position on the planar surface being processed with the actuation of said pneumatic cylinders; characterized in that, which has the pneumatic cylinders connected to the outside of the sleeve and, with a stem at the lower sheet of a transmission box on the upper sheet of which a front flanged support is fixed for each electric motor; the transmission box comprises outer closing walls positioned between the two lower and upper sheets; a central cover for closing, stiffening and accessing the internal compartment with the central groove wheel, for the belt transmissions, connected and rotating with the spindle shaft.

[0015] Furthermore, in a further embodiment: each front flanged support is provided with a lower support shelf rotating the lower end of a pulley keyed to the shaft of the electric motor; said lower shelf is housed within openings made in the lower sheet of the transmission box.

[0016] Still further, in a further advantageous embodiment: three electric motors are provided, the transmission box shaped with three tips, and three pneumatic cylinders connected to said sleeve and with the stem connected to said lower sheet of the transmission box.

[0017] Furthermore, in an improved constructive form: the central groove wheel is connected and rotated with the spindle shaft by means of a hub fixed to the sliding body and provided with a rotation bearing seat to support the central groove wheel.

[0018] Still further, in a further embodiment: between the sleeve and the sliding body within the sleeve there is at least one axial slot within which at least one adjustable feather is inserted to define the extreme sliding positions of the sliding body within the sleeve.

[0019] Finally, in an embodiment: at the lower end of the spindle there is a lower containment chamber of a telescopic extension of the sleeve in order to protect the sliding body in the lowering stroke of the improved spindle towards the planar surface being processed.

[0020] The features and advantages of the present invention, in the realization of an improved spindle for rotating heads for calibrating or dressing artificial or natural planar materials, are given by way of non-limiting example, with reference to the six attached drawings.

Brief description of the drawings

[0021]

Figure 1 is a schematic side view of the spindle provided with a rotating disc abrasive head for cementitious materials; the belt transmission box is shown partially open to show the transmission;

Figure 2 is a limited perspective schematic view, realized with the section on a vertical plane II-II of Figure 1 of the transmission box only, containing the rotation axes of the spindle and one of the three electric motors; the spindle shaft is not depicted as instead the hub of the sliding body with the seat of the rotating support bearing of the shaft;

Figure 3 is a schematic side view of the spindle, free of electric motors, and the box with the closed belt transmission, depicted in the lowered position of the rotating head with abrasive disc;

Figure 4 is a schematic section in plan IV-IV of Figure 3 where the position of the spindle axis of the central groove wheel and drive pulleys for each electric motor is visible;

Figure 5 is a schematic side view of the spindle of Figure 1 rotated here at a right angle thereto and lacking the abrasive disc protective cap;

Figure 6 is a schematic plan view of the spindle, the transmission box and the electric motors mounted thereon;

Figure 7 is a schematic section view of the spindle and transmission VII-VII of Figure 6, with the abrasive disc rotating head lowered on the surface being processed;

Figure 8 is a schematic section view of the spindle and transmission VIII-VIII of Figure 6;

Figure 9 is a schematic enlarged and limited section view of the spindle and the belt transmission, of line VII-VII of Figure 6, with the rotating abrasive disc head raised from the surface being processed;

Figure 10 is a schematic perspective view of a front flanged support of the drive pulley and of mounting and fixing an electric motor on the belt transmission box with which the spindle is provided.

Detailed description of a preferred embodiment

[0022] In the Figures, an improved spindle 1 carries

the rotating head 2 at the lower end 3 thereof; it is protected by a circular cap 4 connected to a sliding body 5 in axis with the improved spindle 1; inside the sliding body is housed and rotating a spindle shaft 6 which has an end flange 7 on which an abrasive disc 8 is fixed and rotated therewith provided with abrasive sectors 9, usual for cementitious materials, to form the active part of the head. The body 5 of the spindle is slidable within a sleeve 10 following the operation of pneumatic cylinders 11 connected to said sleeve and to an adjustment flange 12 on the structure 13 of the machine on which the improved spindle is mounted. The end 14 of the stem of each piston 11 is connected with a lower sheet 15 of a transmission box 16 of the rotational motion to the spindle shaft 6; the transmission box in turn connected to said sliding body 5 of the improved spindle 1; said transmission box is completed by an upper sheet 17 which creates a boxed structure with the lower sheet and the outer closing walls 18. The upper end 19 of the sleeve 10 is connected with said adjustment flange 12 in turn supported, adjusted and fixed by an annular spherical surface 20 for adjusting the improved spindle 1 and, consequently, the rotating head 2 with respect to the structure 13 of the machine.

[0023] The transmission box 16 encloses the underlying transmission belts 21 between a central groove wheel 22 and single pulleys 23 on each electric motor 24 which transmits the rotational motion with the belts 21; the central groove wheel 22 is connected to the spindle shaft 6 and is rotatably supported, by the pulling of the belts, by a hub M, integral with said sliding body 5, and provided with a seat S for a rolling bearing visible in Figures 2 and 9. Each electric motor 24 is connected with the transmission box 16 by a front flanged support 25, which allows the electric motor to be rigidly fixed to the boxed structure of the transmission box. This front flanged support also creates the support of the opposite end 26 of the pulley 23 keyed on the drive shaft 27 of each electric motor 24 so as to distance, interspersing them, the individual belts 21 which simultaneously lie on the central groove wheel 22 and, divided and equally spaced, respecting the position thereof on the groove wheel, on the pulley 23, as clearly visible in Figures 2, 9 and 10.

[0024] Furthermore, the Figures also show a telescopic extension 28 of the sleeve 10 to protect the lower part of the sliding body 5 which penetrates a lower chamber 29 when the spindle is in the raised position as seen in Figure 9; the planar surface 30 being processed; horizontal adjustment screws 31 of the adjustment flange 12 on the structure of the machine 13; an axial slot 33 on the sliding body 5 in the sliding coupling inside the sleeve 10 within which a feather 34 for guiding the cylindrical coupling between the sliding body 5 and the sleeve 10 is inserted. Figures 7 and 9 show two feathers of which an adjustable feather 35 which also limits the length of the lowering/lifting stroke of the head from the planar surface 30 being processed.

[0025] A usual water supply pipe 36, coaxial to the spindle shaft 6, for supplying the cooling water of the abrasive sectors 9 of the abrasive disc 8 are also visible. The front flanged support 25 of the electric motor 24 has a lower shelf 37, which rotatably supports the opposite end 26 of the pulley 23; the lower shelf has stiffening ribs 38. The front flanged support 25, with the fixing screws 39 loosened, is operated with a tension screw 40 of the belts 21 between the central groove wheel 22 and the pulley 23 mounted on said support.

[0026] The assembly of the improved spindle for rotating heads for calibrating or dressing artificial or natural planar materials, is carried out by laying the adjustment flange 12 on the structure of the machine 13 and tightened by controlling the planarity thereof by tightening the fixing screws 32; the clearance which has the stem of the screws 32 in the seat thereof allows the fine adjustment, sliding on the spherical surface 20, of the correct vertical position of the axis of the improved spindle with respect to the processing surface, where the surfaces 30 which must be processed are laid.

[0027] The transmission has the belts 21 distributed interspersed with each other and simultaneously lie on the central groove wheel 22 and on each of the pulleys 23 on the drive shafts 27 of the electric motors. Since the belts are offset, the distance therebetween, on the pulleys 23, is triple the pitch between the belts on the central groove wheel, so the length of the pulleys 23 is three times the axial distance which would separate the belts adapted to transmit the torque from the shaft 27 of the electric motor 24 A simple assembly of a pulley with four close grooves, since each motor, as shown, requiring four belts for the transmission thereof, does not achieve a balanced transmission; in fact, the belts would lie on contiguous grooves on the central groove wheel 22, instead, an interspersed distribution of the belts 21, as seen in the Figures, allows to transmit the radial stresses on the spindle shaft 6 in a more balanced manner.

[0028] Thus the tensioning of the belts of a pulley 23 with respect to the central groove wheel 22 can occur with the displacement of the flanged support 25 by the action of the tensioning screw 40 of the belts. The tension is also manifested by the length of the pulley 23 with an arm not acceptable by the inner supports of the drive shaft 27 of the electric motor 24. The new construction solution of supporting the opposite end 26 of the pulley allows to avoid bending overloads on the shaft of the electric motor. Moreover, a similar embodiment, i.e., with the spacing of the belts with triple pitch makes the supporting structure with a simple flange of the state of the art unsuitable to withstand the pulling of the belts 21 with the tripled pitch thereof.

[0029] The belt transmission of the improved spindle 1 for rotating heads 2 for calibrating or dressing artificial or natural planar materials solves this technical problem by realizing the transmission box 16 containing the belt transmissions 21 for electric motors 24 mounted on the spindle, as described and depicted above. Advantageously, this box has a three-tips conformation (Figure 4) forming the outer closing walls 18, between the lower

sheets 15 and upper sheets 17, a resistant frame; furthermore, the lower sheet has openings 41 for the passage of the lower shelf 37 of rotating support of each individual pulley 23.

[0030] The assembly of the belts 21 is carried out from above with the transmission box 16 without the central cover 42. It is fixed to the underlying upper sheet 17 of the transmission box with screws 43 which make the upper sheet and the cover integral, closing the transmission structure, i.e., making it boxed and resistant to the tensioning stresses of the belts 21 when properly tensioned. Furthermore, this central cover 42 allows the modification of the transmission ratio by replacing the central groove wheel 22, if necessary, or allows a possible rapid intervention to replace one or more damaged belts.

[0031] The advantages of an improved spindle for rotating heads for calibrating or dressing artificial or natural planar materials described above are summarized in a practical, simple and robust construction which allows the necessary adjustment to be carried out by means of the adjustment flange 12 in the fixing thereof to the structure of the machine 13 with the spherical surface 20 interposed thereon.

[0032] Furthermore, the boxed structure of the transmission box 16 is rigid to support the pulling of the belts 21 and the tensions induced by the transmission of the driving torque between the pulleys 23 and the central groove wheel 22. That is, even if rigid, the transmission box 16 allows both the housing of the front flanged support 25 of the electric motor 24, and the insertion in the correct position of the lower shelf 37 for supporting and sustaining the rotation of the pulley 23 keyed on the shaft of the electric motor 27.

[0033] .Finally, the realization of the transmission box 16 with the outer closing walls 18 to rigidly join the lower sheet 15 and the upper sheet 17, is rigid but also allows maximum accessibility to the transmission with the upper central closure of the cover 42, so as to access the internal compartment where the central groove wheel 22 is located, the upper end of the spindle shaft 6, with the hub of the sliding body M and the relative rotating support bearing of the spindle shaft.

[0034] Obviously, a person skilled in the art, in order to satisfy specific and contingent requirements, may make numerous modifications to an improved spindle for rotating heads for calibrating or smoothing artificial or natural planar materials, as previously described, all nevertheless falling within the scope of protection of the present invention as defined by the following claims. Thus, although less conveniently, even if the description includes the use of three electric motors 24 and consequently three pneumatic cylinders 11, the construction solution of the transmission box 16 with a described boxed shape can also be made with only two electric motors 24 and, consequently, only two pulleys 23, the conformation no longer has three tips, but only two, and the constructive form of the front flanged support 25 and the lower shelf 37 equally allows to achieve the practicality, economy and rigidity described above. In addition, the belt transmission 21, although simplified, has the same practicality as described above by permanently maintaining the presence of the central cover 42 to close the access to the central groove wheel 22. Finally, in the case of a simple pair of electric motors, the front flanged support can lack a lower shelf 37. Finally, a machine for calibrating or dressing artificial or natural planar materials comprises at least one pair of spindles 1 facing the planar surface 30 and aligned in the path of the material.

Claims

1. Spindle for rotating heads for calibrating or dressing artificial or natural planar materials, comprising: a sleeve (10) within which a body (5) of the spindle is slidable in turn provided with a spindle shaft (6) at the lower end (3) of which a rotating head (2) with abrasive tools (9) is applied; at least two pneumatic cylinders (11) for positioning the spindle (1), i.e., the head connected thereto, on a supporting structure (13); fixing the sleeve to the structure (13) of a machine on which the spindle is mounted by means of an adjustment flange (12) with spherical surface (20); at least two electric rotation drive motors (24) of the spindle and a transmission from said motors to the spindle shaft (6); said electric motors being coupled in rotation to the spindle shaft each with a belt transmission (21); between said sleeve and said spindle shaft (6) there is a sliding body which supports the spindle shaft (1) in rotation and is pushed in a raised or lowered position on the planar surface (30) in operation with said pneumatic cylinders (11); **characterized in that**, it has the pneumatic cylinders connected outside the sleeve (10) and, with a stem (14) at the lower sheet (15) of a transmission box (16) on whose upper sheet (17) a front flanged support (25) is fixed for each electric motor (24); the transmission box (16) comprises outer closing walls positioned between the two lower (15) and upper sheets (17); a central cover (42) for closing, stiffening and accessing the internal compartment with the central groove wheel (22), for belt transmissions, connected and rotating with the spindle shaft (6).

2. Spindle, according to the preceding claim 1, wherein each front flanged support (25) is provided with a lower shelf (37) for rotating the lower end of a pulley (23) keyed to the shaft (27) of the electric motor (24); said lower shelf is housed in openings (41) made in the lower sheet (15) of the transmission box (16).

3. Spindle, according to claim 2, wherein three electric motors (24) are included, the transmission box (16) shaped with three tips, and three pneumatic cylinders (11) connected to said sleeve (10) and with the stem (14) connected to said lower sheet (15) of the

transmission box (16).

4. Spindle, according to one of the preceding claims 1-3, wherein the central groove wheel (22) is connected and rotatable with the spindle shaft (6) by a hub (M) fixed to the sliding body (5) and provided with a rotation bearing seat (S) to support the central groove wheel.

5. Spindle, according to one of preceding claims 1-4, wherein between the sleeve (10) and the sliding body (5) within the sleeve there is at least one axial slot (33) within which at least one adjustable feather (35) is inserted to define the end sliding positions of the sliding body within the sleeve.

6. Spindle, according to one of the preceding claims, wherein in the lower end of the spindle (3) there is a lower containment chamber (29) of a telescopic extension of the sleeve (28) in order to protect the sliding body (5) in the lowering stroke of the spindle (1) towards the planar surface (30) being processed.

7. Calibration or dressing machine for artificial or natural planar materials, comprising: at least one pair of spindles (1) according to one of the preceding claims 1-6, wherein the spindles face the planar surface (30) and are aligned in the path of the material to be processed.

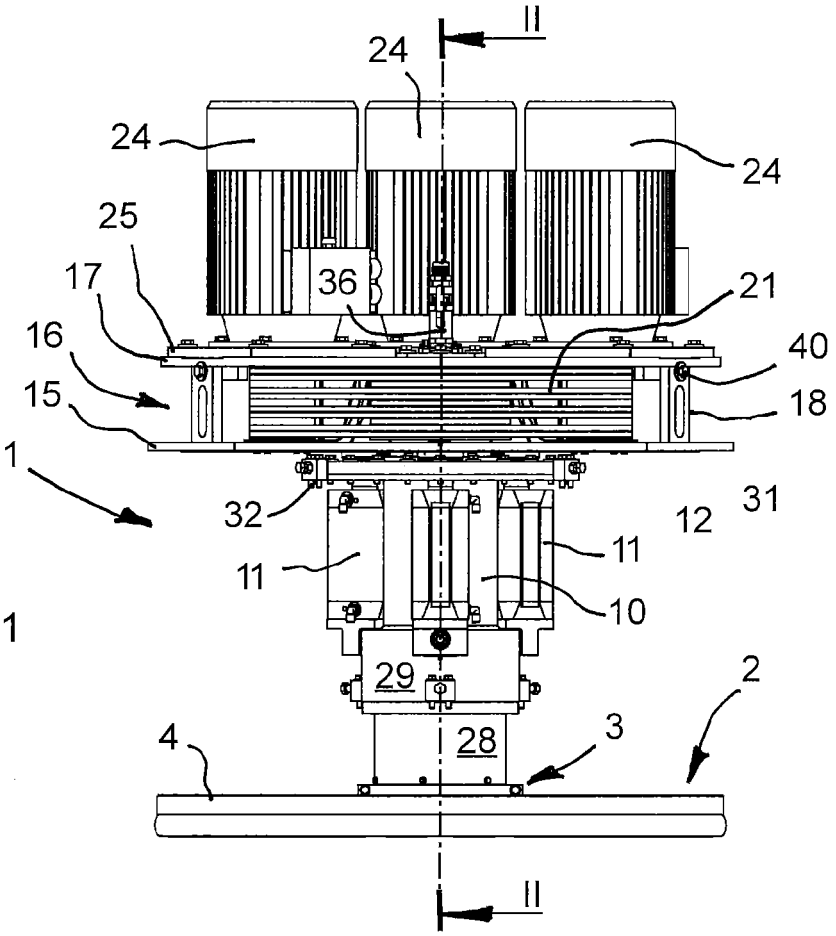
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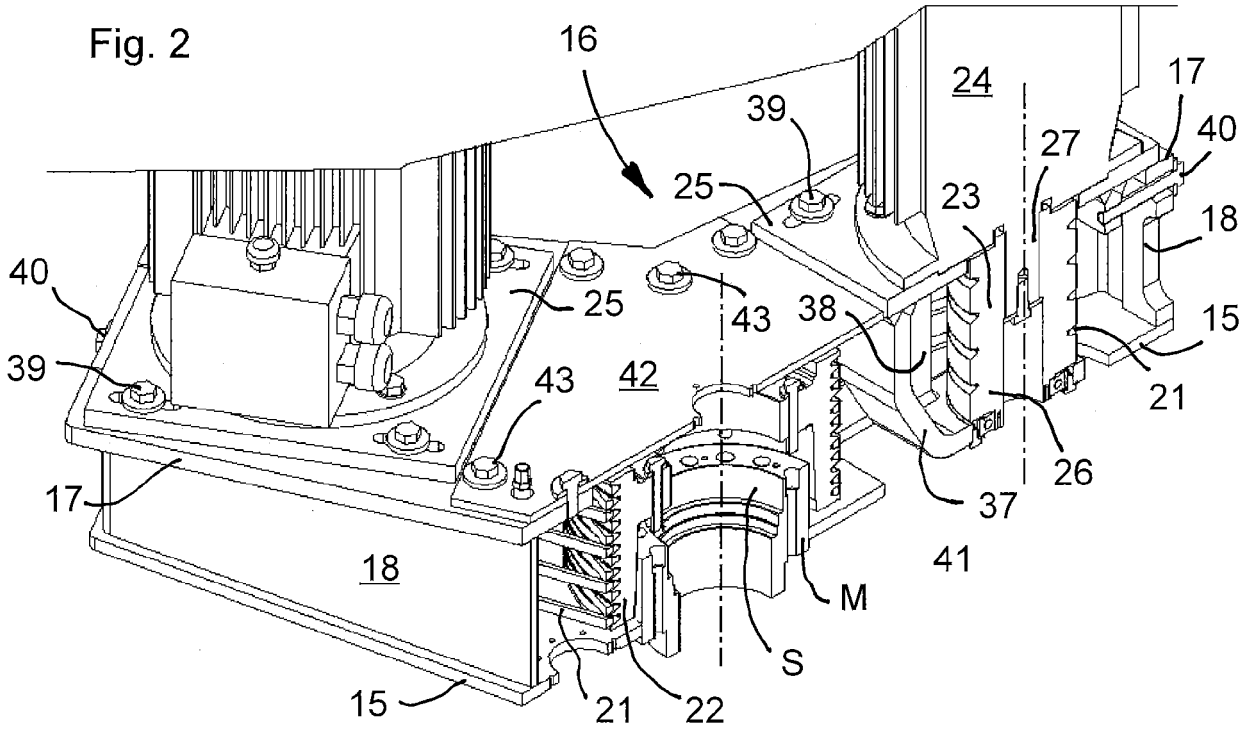
Fig. 1

Fig. 2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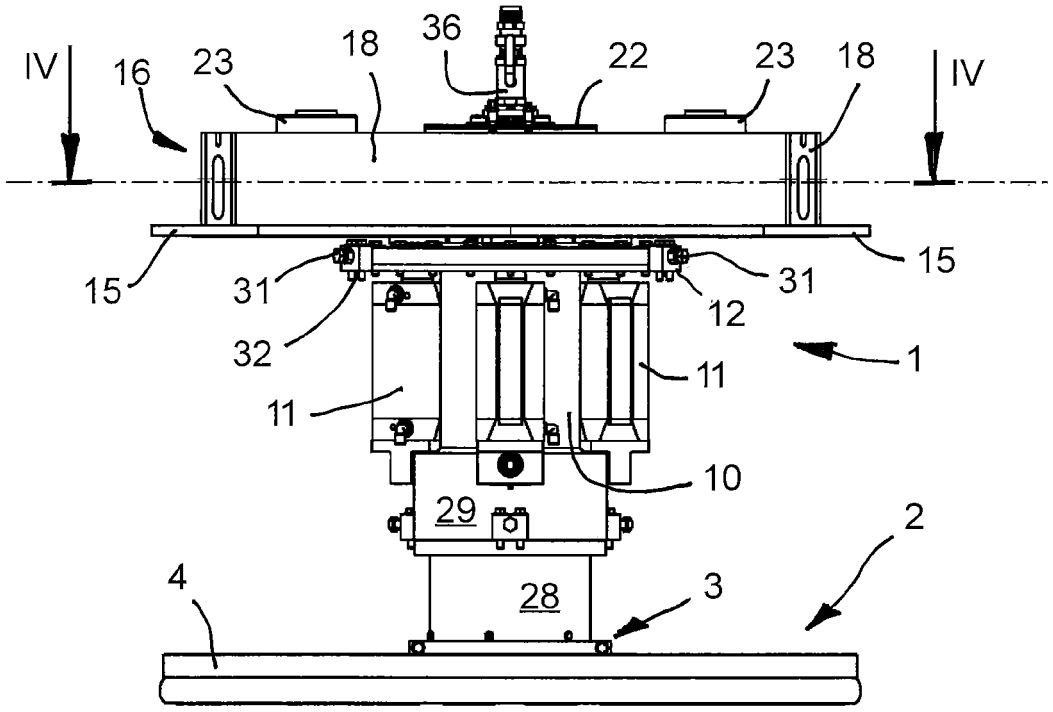
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Fig. 3

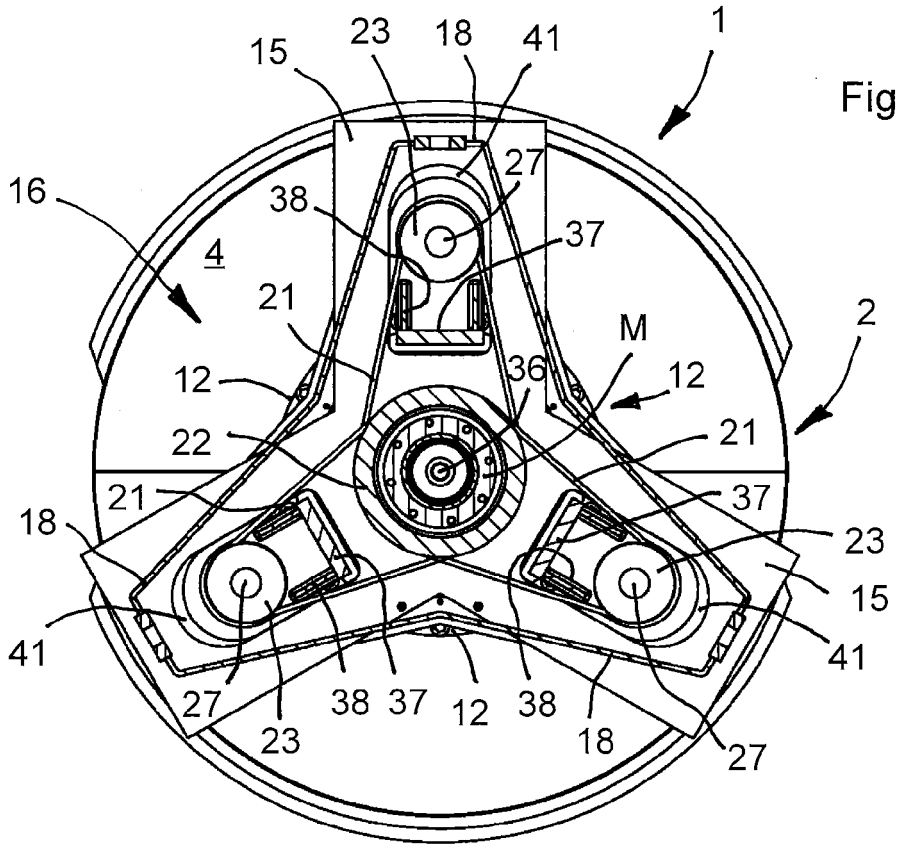
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Fig. 4

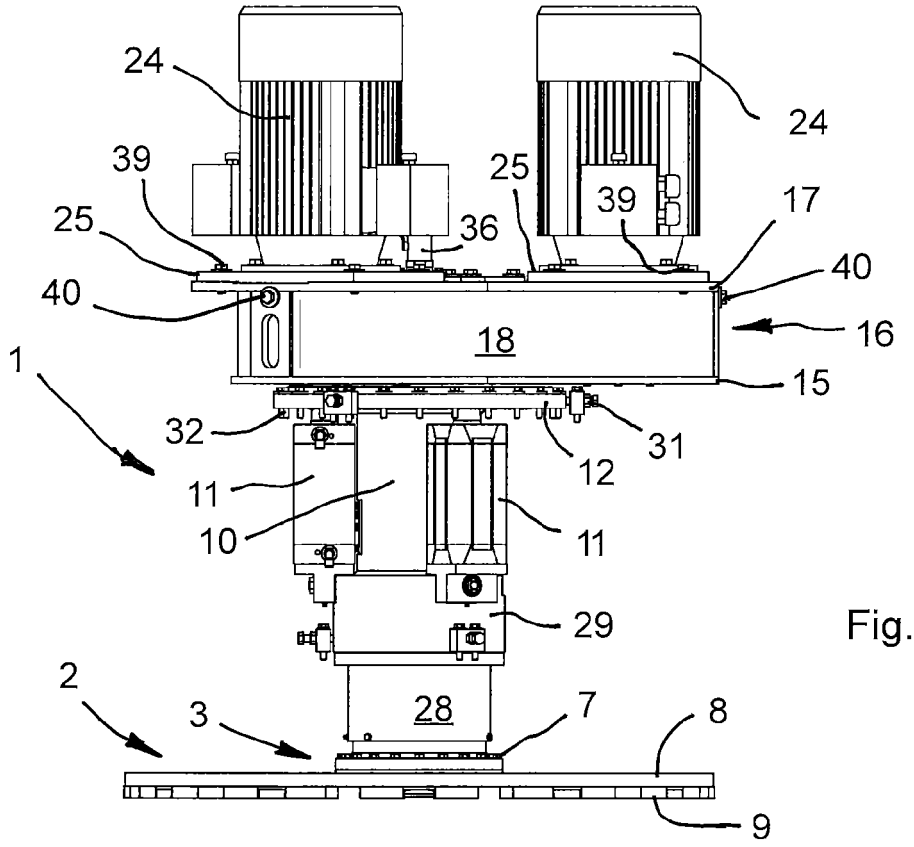
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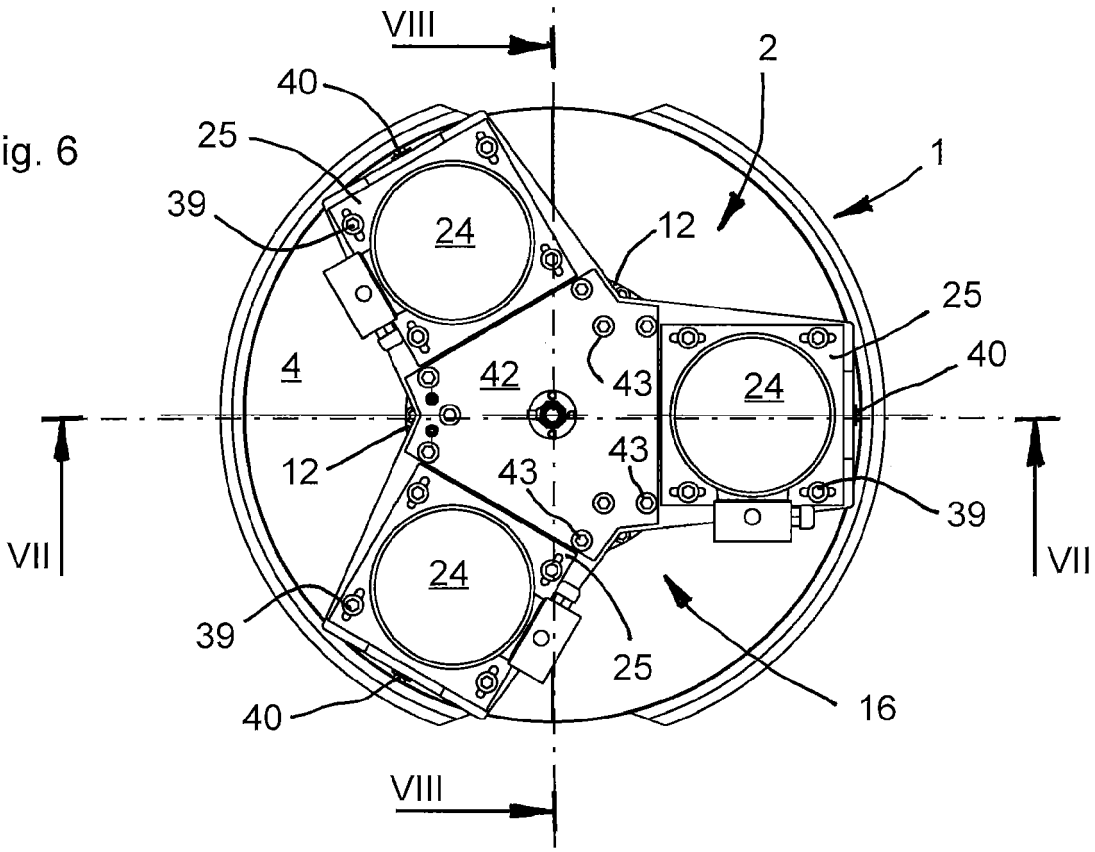
Fig. 5

Fig. 6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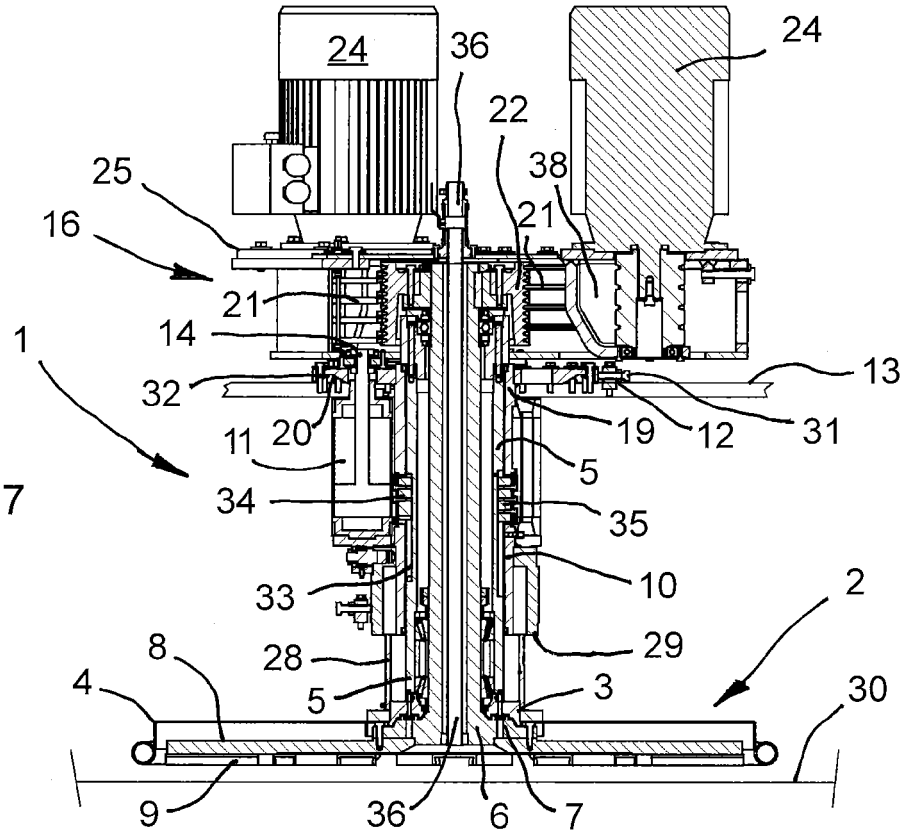
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Fig. 7

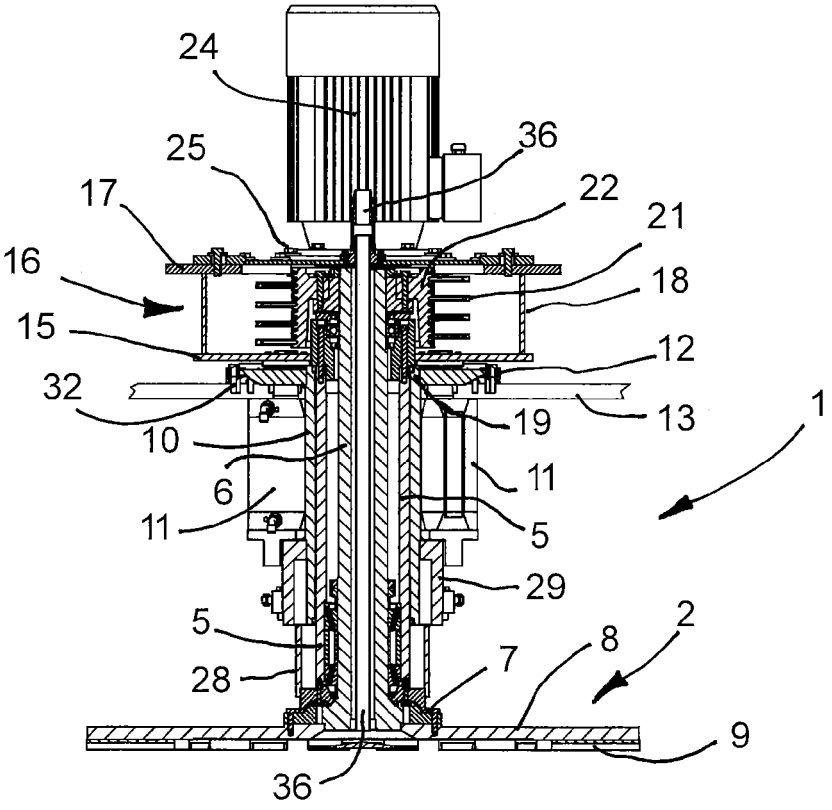
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Fig. 8

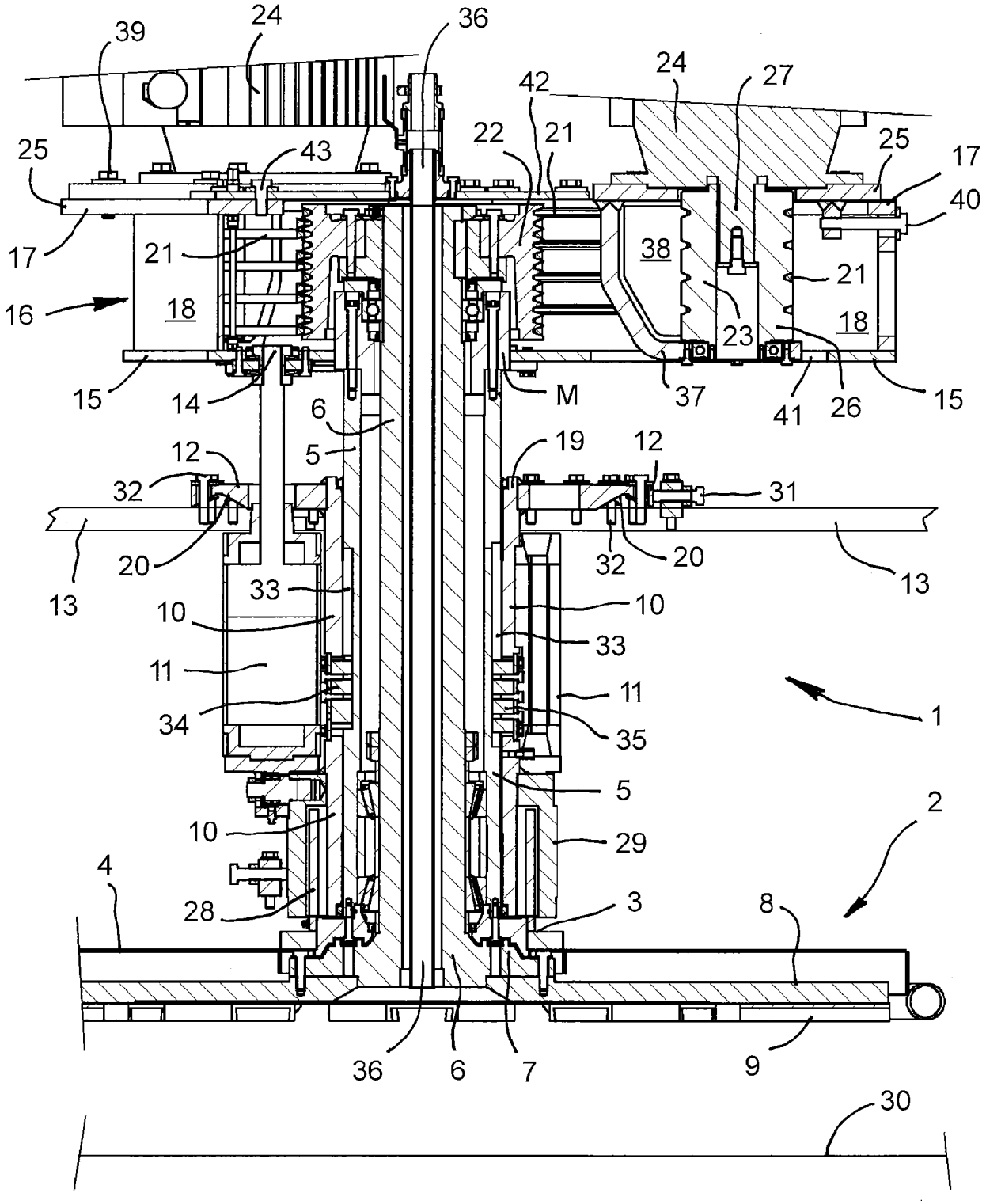
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Fig. 9

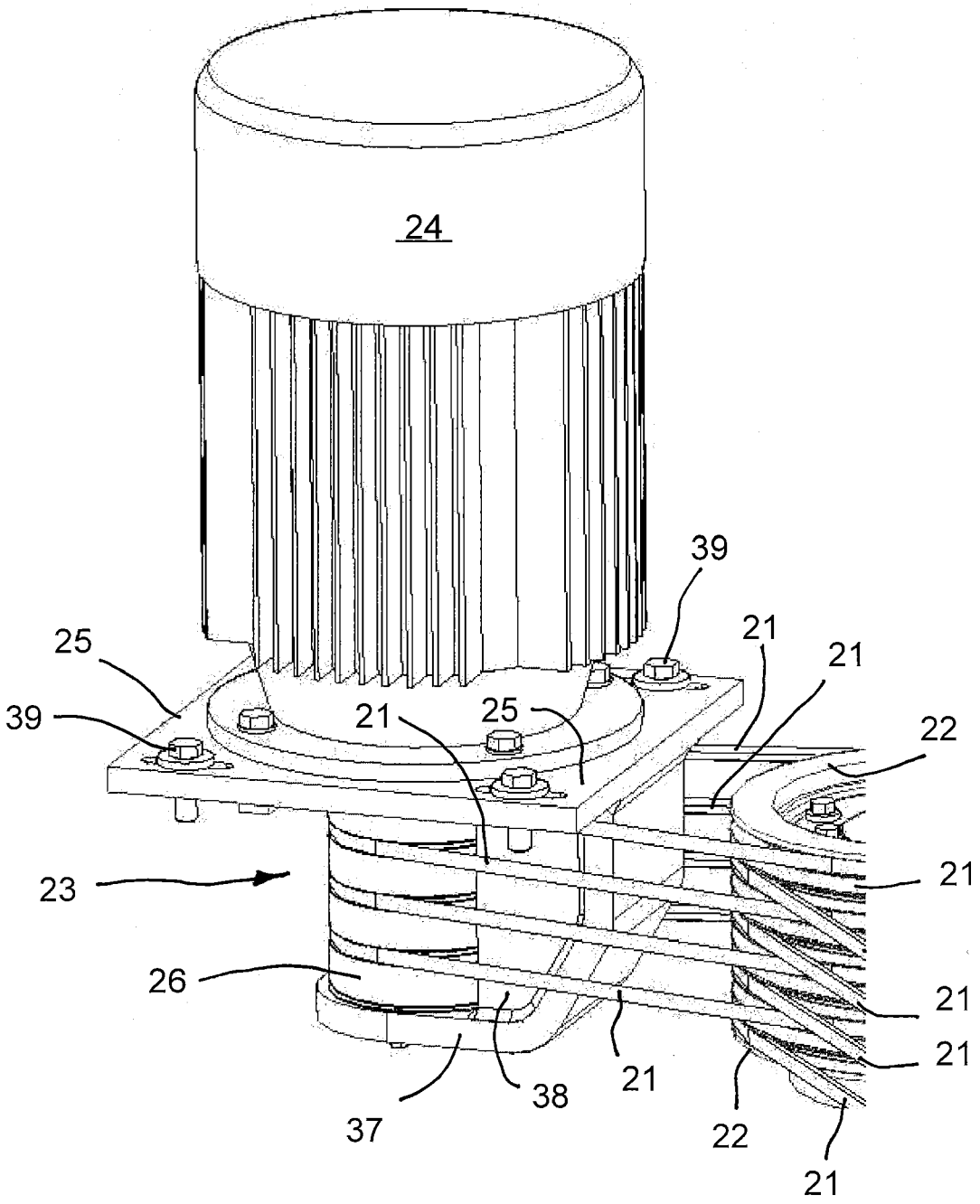

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 21 02 0234

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	WO 2015/124990 A1 (PEDRINI SPA AD UNICO SOCIO [IT]) 27 August 2015 (2015-08-27) * page 6, line 8 - page 10, line 3; figures 1-6 *	1-7	INV. B24B7/22 B24B41/04 B24B47/22
A	CN 106 737 152 A (QUANZHOU ZHIXIN PATENT TECH DEV CO LTD) 31 May 2017 (2017-05-31) * paragraph [0036] - paragraph [0037]; figures 1-10 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B24B
B24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 September 2021	Maier, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 02 0234

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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20-09-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015124990 A1	27-08-2015	BR 112016018894 B1	23-02-2021
		CN 106170369 A	30-11-2016
		EP 3107687 A1	28-12-2016
		ES 2676081 T3	16-07-2018
		WO 2015124990 A1	27-08-2015
CN 106737152 A	31-05-2017	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1849557 A2 **[0003]**
- EP 1536916 B1 **[0005]**
- WO 2015124990 A1 **[0006]**