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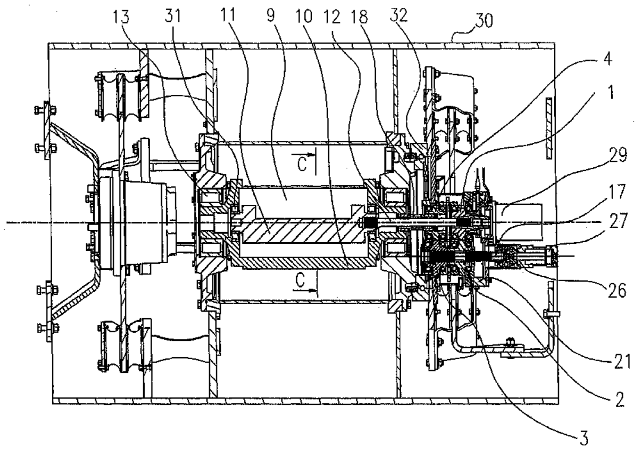

FIG.1

(57) **Abstract**: A vibration system for an earth compacting machine with a vibration roller or for similar machines comprising a first and a second eccentric weights, a first and a second shafts (12,18), which are arranged in the roller axis, where the first eccentric weight (10) is connected via the first shaft (12) substantially directly to the drive (29), whilst the second eccentric weight (11) is connected via the second shaft (18) to the drive (29) indirectly by means of a spiral rod (17) provided with two contra-rotating spiral toothings (15, 16). The first spiral toothing (15) is arranged slidingly in the first sleeve (7) provided with the corresponding inner toothing, which toothing is meshing with the first spiral toothing (15) and the second spiral toothing (16) is arranged displaceably in the second sleeve (8). Provided also with the corresponding internal toothing, where this toothing is meshing with the second spiral toothing (16). One of the sleeves (7, 8) is arranged for its turning by the drive (29), whilst the second of the sleeves (8, 7) is arranged for driving of the second eccentric weight (11). The spiral rod (17) is connected via the bearing (6) to the linear drive (26) for shifting of the spiral rod (17) with regard to both sleeves (7, 8) for changing of positions of both eccentric weights (10,11), and thereby for changing of the vibration amplitude of the roller.

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Vibration system for earth compacting machine and earth compacting machine equipped with such vibration system

Field of the invention

The invention relates to a vibration system for an earth compacting machine with at least one roller with adjustable amplitude of vibrations.

Background of the Invention

Generally, vibration rollers are used for subsoil compacting and are used e.g. for compacting of the freshly laid asphalt, soil, and other compactable materials. The vibration rollers are a design of the compacting mechanisms using at least one subsoil compacting rotary roller for the subsoil compacting by traversing on it. In this case the force acting on the contact surface of the roller with the subsoil is very important for a high-quality compacting. Exactly to increase the compacting efficiency the vibration rollers are equipped with a vibration mechanism acting on the rotary roller. The vibration mechanisms comprise external and internal, eccentrically arranged weights arranged on a rotary shaft, which shaft is placed within the rotary roller, whereby roller vibrations are produced.

The vast majority of the vibration rollers for the subsoil compacting uses a constantly set amplitude of vibrations. However, considering that the vast majority of the compacting machines comprises two vibration rollers arranged one after the other, the necessity appeared to set the amplitudes of vibrations of the front and the rear rollers differently in such machines. The documents CS AO184081 and CS 244465 disclosed a solution, which allows to set the amplitude of vibrations continuously. However, none of the solutions is used at present because they were very complex and expensive to produce. Development of solutions allowing to change the amplitude continued in the direction of the two-amplitude designs, which designs were substantially cheaper. Therefore, the so designed compacting machines allow selecting of the vibration amplitude from two values – a small one and a big one. The basic disadvantage of the two-amplitude vibrator is that it is necessary to switch off the vibrations at first, before switching from the big amplitude to the small one, because in this design a switch-over of a two-amplitude vibrator requires to change the rotation direction of the vibrator. This means to switch off one of the vibrations, and to switch on the other one.

In the operation of the two-amplitude vibrator, a substantial drawback is the fact that if the vibrating runner jumps off for a longer time than for one period of the vibrator, a situation comes about when the machine starts to shake significantly, and this including the working place of the operator. Subsequently, the operator has to switch off the vibrating, then switch to the lower amplitude, and not to return to the higher amplitude any more.

According to one known solution, it is possible to adjust the vibrations of the respective roller invariably according to the requirement on the vibration amplitude size of the relevant roller.

Such adjustments are to be carried out at standstill, and it is a relatively hard work task. Therefore, such adjustment is carried out only intermittently. According to the known solution, adjustment of the amplitude is carried out by means of a spiral rod with one spiral, which represents by its movement mutual position of the two imbalances (eccentric) in two fixed adjustable positions. However, the arrangement with fixed amplitude in no case provides the possibility to set any different amplitude of the vibrations according to the momentary need.

At present, only a small part of the vibration rollers uses the continuously adjustable amplitude. An example of a machine allowing continuous adjustment of the amplitude of vibrations of each roller independently, and thereby to react on the momentary situation is disclosed for example in the document EP0034914, the applicant of which is the Hyster Company. This patent describes a vibration mechanism formed by the first weight, eccentrically placed within the compacting roller, and a second eccentric weight, arranged as rotary within the first weight. Further, the vibration mechanism comprises the first shaft, which is connected to the first weight for its turning, and a second shaft, placed coaxially with the first shaft being in contact with it, formed by a helix and the corresponding cuts between the first shaft and the second weight. The position of the second weight to the first one, and thereby also the amplitude formed by rotation of both eccentric weights, is changed by the relative bend of the shafts to each other because of the turning of one shaft . Patent US

6,769,838, the applicant of which is Caterpillar Inc., is also based on similar principle. This document discloses a vibration mechanism formed both by the inner eccentric weight arranged within the roller and the external eccentric weight, arranged coaxially rotationally around the inner one. The first, i.e. the inner weight, is connected to the first shaft, and the second, i.e. the external weight is connected to the second hollow shaft, arranged coaxially around the first one. Both shafts are connected with a gearbox with planet pinions. By means of two planet gears, of which one has rotary adjustable ring gear, the gearbox then allows continual adjustment of the amplitude of vibrations of the given roller. Then, the patent describes mainly the possibility of mutual setting of vibrations of the front and the rear rollers. However, this solution brings about disadvantages, such as relatively high number of parts including eleven toothed wheels with straight gearing and one toothed rack, what causes high weight as a consequence. This is a substantial disadvantage especially in small machines. Another substantial disadvantage is higher noise level caused by the high number of straight-toothed gearwheel pairs.

The patent EP 1460178, the applicant of which is Metso Dynapac AB, is also based on the principle of two coaxial shafts. However, this solution is different in that according to this patent both shafts are arranged in the compacting roller axis. Two sets of weights, whereby their mutual position is changed, are arranged within the shaft. It the weights are opposite to each other, their effects are neutralized, if they are in view of the axis direction place done behind the other, their effects on the amplitude of vibrations are maximal. However, this solution also brings about some disadvantages, such as the impossibility to use this solution for the divided runner, and also it is not possible to use it for the heavy earth compacting machines, especially with weight above 15 tonnes, where it is necessary to use four bearings for bearing of the vibrator, what this solution does not allow. From this follows the limited possibility of its utilization.

The common disadvantage of all described solutions with continually adjustable amplitude of vibrations is that they are complex and exhibit high production costs, and last but not least they also incline to breakdowns.

The above-mentioned disadvantages are removed or at least substantially limited by a solution according to the present invention.

Summary of the invention:

The present invention provides a vibration system with the possibility of the continuous adjustment of the amplitude of vibrations from the minimal to the maximal required value entirely linearly by means of a spiral rod provided with two spirals in opposite directions. Thereby, the uplift of the spiral rod is shortened to one half. According to one aspect of the present invention the spiral rod is placed in the gearbox with four gear toothed wheels arranged off the vibrator axis. The continual adjustment of the mutual positions of the two eccentric weights, i.e. eccentric with regard to the roller axis, is controlled by a hydraulic circle comprising a pump, a proportional distributor with a distributor PID controller and a linear hydraulic motor. The proportional distributor receives the required signal from a hand-held actuator or automatically from the controlling unit.

An advantage of the solution according to this invention is a low requirement on a construction space. Another advantage is that the vibration amplitude can be varied very quickly in relation to the current conditions. According to this invention a change in vibrations can be carried out either manually or automatically. An advantage of the earth compacting machine provided by a vibration system with continually variable amplitude according to this invention is exactly the possibility to equip the machine with a controlling unit, a part of which is, according to this advantageous embodiment, also a compaction meter. The controlling unit, which is for example a computer, a processor, etc., connected to a compaction meter, can optimize the size of the vibrations of the roller/rollers, or other characteristics eventually.

An advantage of the vibration system according to the present invention is that considering the fact that the earth compacting machine equipped with such vibration system does not have to alter the rotation direction of the eccentric weights causing the roller vibrations, so as it is in the case of the two-amplitude machines. The machine operates the whole time below the limit when uncontrollable vibrations start to emerge. Because of this, the machine is more efficient and compacts the whole area in higher quality, as well as it is much more convenient for operation. In case of using this solution in the two-runner machine each runner can operate independently, according to the current conditions under the runner.

An advantage of this solution is the broad scope of settings of characteristics, the possibility of their optimization by means of a control unit. By this a higher machine performance and compacting of higher quality are obtained, i.e. a higher quality of the work done in comparison to the two-amplitude solution.

The advantages of the present solution in comparison to the known solutions of the continually variable amplitude of vibrations are as follows:

1) A lower number of parts is used: only 4 gearwheels with oblique toothing, a spiral rod with two toothings and 2 spiral hubs, or even only a spiral rod with two toothings and 2 spiral hubs;

2) Low weight, especially in case of the second embodiment with only a spiral rod and spiral hubs.

3) Low noise level. The oblique toothing exhibits significantly lower noise than the straight one especially at high number of rotations per minute. The solution using the spiral rod and two spiral hubs is noiseless absolutely because the spiral rod only glides in the spiral hubs.

4) Possibility to be used for the divided and undivided runners.

According another aspect of the present invention an earth compacting machine equipped with a vibration system with an adjustment and/or control unit for controlling of vibrations is presented.

Brief Description of the Drawings

The invention will be more readily understood from the attached drawings.

Fig. 1 shows in cross-section made vertically in the axis plane a view of an embodiment of a vibration system with an undivided roller, e.g. for an earth compacting machine.
Fig. 2 shows a complete side view of a roller of a vibration system by the vibration device of Fig. 1.
Fig. 3 shows a detail of a gearbox in a cut-out of the view of the roller in Fig. 1 in a cross-section made in the plane marked as A-A in the Fig. 2.
Fig.4 shows the same detail of the cut-out of the view on the roller in Fig. 1, so as in Fig. 2, but in cross-section made in the plane marked as B-B in Fig. 2.
Fig. 5 shows the second embodiment of the roller with divided runner, comprising the vibration device according to the present invention.
Fig. 6 shows enlarged detail of the gearbox, designated as Area A in Fig. 5.
Fig. 7 shows a view of the embodiment shown in Fig. 1 in cross-section C-C and shows the angle α of the shift of both weights.

Examples of embodiments of the present invention:

There is a number of possible embodiments of the vibration system according to the present invention. The substance of the invention will be explained on two examples of its embodiment, where the first example describes an embodiment of the roller with the undivided runner as presented in Fig. 1 to 4.

In this example of embodiment the roller, which can be called also the vibration roller, comprises an undivided runner 30 having in its axes placed a vibration mechanism 9, a gearbox 21 and a motor 29. The motor 29 is firmly attached to the gearbox 21, which gearbox 21 is rotationally connected with the runner 30 of the roller via a bearing 32. The vibration mechanism 9 is rotationally positioned in the runner 30, and is formed by the first eccentric weight 10 and the second eccentric weight 11, which weights are arranged rotationally within the roller, and they are angularly shiftable, whereby they allow to vary the size of the vibration roller. In the example of embodiment shown in Fig. 1, the second eccentric weight 11 is arranged as internal and is rotationally supported on bearings 13 in the roller axis, and it is substantially directly connected by a shaft 12 to the motor 29 for its direct rotation by this motor. The first eccentric weight 10 is arranged rotationally supported on bearings 31 outside the second eccentric weight 11 and is connected to the motor 29 via a spiral rod 17 and the relevant transmissions, via which the driving force of the motor 29 is transmitted on this weight, i.e. the second eccentric weight 11 is driven by the driving motor 29 indirectly.

The gearbox 21 comprises two pairs of gearwheels, the first pair of gearwheels 1, 2 and the second pair of gearwheels 3, 4. The toothed sleeves 7 and 8 with internal spiral toothings are firmly placed in the toothed wheels 2 and 3. The spiral rod 17, which will be described in more detail later, is slidingly arranged in the sleeves 7 and 8 with spiral toothing. The toothed spiral rod 17 is adapted to transfer torque moment from the sleeve 7 to the sleeve 8 and is axially shiftable to them. The spiral rod 17 is connected to the linear hydraulic motor 26 via a thrust bearing 6. The motor 29, which is preferably a rotational hydraulic motor, is placed on the gearbox 21 and is connected via a shaft 12 with the other eccentric weight 11 to drive it. In this example of embodiment the motor 29 is also connected with the gearwheel 1 via a conical toothed clutch 5, which gearwheel 1 meshes with the gearwheel 2, in which gearwheel 2 the sleeve 7 with spiral toothing is firmly placed. The spiral toothing of the sleeve 8, which sleeve 8 is firmly placed in the gearwheel 3, is provided with a spiral toothing of the opposite direction than what is that of the spiral toothing of the sleeve 7. The spiral rod 17 is provided both with the first spiral toothing 15 and the second spiral toothing 16. Both spiral toothings 15 and 16 exhibit mutually opposite direction of the spirals. According to the example of the embodiment, the first spiral toothing 15 is right-handed and the other spiral toothing 16 is left-handed. Both spiral toothings are formed together with the corresponding toothings in sleeves 7 and 8 slidingly to allow mutual swivelling of both sleeves 7 a 8 to each other during shifting of the spiral rod sleeves 7 and 8.

According to this example, the sleeve 8 is provided with a left-hand spiral toothing inside, with which toothing it meshes the left-handed second spiral toothing 16 of the spiral rod 17, whilst the right-handed first spiral toothing 15 of the spiral rode 17 meshes with the right-handed spiral toothing of the sleeve 7. By axial shifting of the spiral rod 17 mutual swivelling of the sleeve 7 to the sleeve 8 takes place, and thereby also of the gearwheel 2 to the gearwheel 3. The gearwheel 3 meshes with the gearwheel 4, which gearwheel 4 is firmly connected with the first eccentric weight 10 by a hollow shaft 18. Shifting of the spiral rod 17 is provided by a linear hydraulic motor 26 connected with the spiral rod 17 with the help of a thrust bearing 6. According to a preferable embodiment, the piston 27 of the linear hydraulic motor 26 is secured against swivelling by an axially arranged sliding rod 34. The sliding rod 34 prevents swivelling of the piston 27, and in case of the identical axial shift of the piston 27 and the sliding rod 34 the thrust bearing 6 allows rotation of the spiral rod 17.

By axial shift of the spiral rod 17 the first eccentric weight 10 is continuously swivelled against the second eccentric weight 11 by the required angle α. Therefore, it is obvious that the axial position of the spiral rod 17 in a given moment determines the vibration size, of the vibration caused by the adjusted mutual positions of both eccentric weights 10, 11. Considering this arrangement, it is readily possible to know the vibration size for any position of the spiral rod 17. Therefore, it is easy to adjust the required size of the vibrations by setting of the respective position of the first eccentric weight 10 with relation to the other eccentric weight 11. According the example of the embodiment shown in Fig. 3 it is possible to set this position by the actuator 24 manually, or eventually by the controlling unit 19 automatically. The information from the actuator 24 or the controlling unit 19 enters the evaluating controller device 23, where the size of vibrations, given by the actual position of the first eccentric weight 10 with regard to the second eccentric weight 11, is evaluated. In accordance with the presented solution, this position is found easily by means of a linear sensor 28, which sensor 28 is adopted for sensing the actual position of the spiral rod 17. The evaluating controller device 23 calculates the required size of vibrations and adjusts the proportional distributor 22 controlling the oil quantity delivered into the linear hydraulic motor 26 for adjusting the shift of the spiral rod 17 to the required position. The oil who has passed the distributor 22 and the hydraulic hoses 25 into the linear hydraulic motor 26 moves its piston 27 into the required position, which was determined by the actuator 24, or the control unit. The control unit 19 controlling the size of vibrations can be connected e.g. to the sensors monitoring the material compaction, the sensors for monitoring of the machine vibrations, etc.

Controlling of vibrations by means of the control unit is sufficiently known from the state of the art, and will not be discussed any more in detail here. Important is only the fact that the vibration system according to the invention is particularly advantageous for using the possibility of automatic adjusting of the size of vibrations in relation to the measured characteristics. Types of the measured characteristics and the method of their measuring are not subject of this application. Substantial is that thanks to the linear change in adjustments of both eccentric weights, which change is not dependent on wear or on other operational causes, in the subject of the invention it is possible to obtain entirely reliable information on actual adjustment and on the necessary change, which was determined by the control unit on the basis of the measured characteristics or for example by the operator on the basis of his feelings and/or according to the current need. Before the first use or after the total repair it is necessary to set the basic angle α, between the first eccentric weight and the second one and this angle will be saved in the control unit as the basic reference value. This setting will be carried out by releasing the conical coupling 5, which will be released with regard to the position of the_gearwheel 1. After releasing, the first eccentric weight 10 can be swivelled independently of the second eccentric weight 11, and it is possible to modify the setting of the basic angle α, which setting is set after assembly or the mentioned repair with the help of a tool provided with a scale. Advantageously, the basic angle α is set to 32°, whereupon the conical coupling 5 is tightened. Advantageously, the releasing and tightening are carried out by means of screws, which are not shown in the figures, as they are not important for the substance of the invention and such connecting can be designed by any average designer. The unwanted independent movement between the internal and the external eccenters are prevented by tightening of the conical coupling 5 and the mutual positions becomes controllable only by means of shift of the spiral rod 17, and this only within the defined scope of angles given by the kinematics. The degree of freedom from the motor 29 remains unaltered.

According to the invention, the spiral rod 17 has two purposes. On the one hand it transfers rotational movement from the motor to the second eccentric weight for formation of vibrations during movement of the roller, and on the other hand it allows movement of the first eccentric weight with regard to the other one for continuous setting of the vibration amplitude. Here, it is important to realize that for the substance of the invention it is not important, whether the internal or the external weight is connected to the motor. This fact has not any substantial importance for the substance of the invention. Also, it is not important, whether the first or the second spiral toothing is right-handed, or left-handed. Important is only that always one hast to be left-handed and the other one right-handed. Of course that design of the subsequent transmissions has to be adapted to it. However, this can be carried out by any average designer, and therefore, it is not subject of the invention.

Important is that thanks to the direct axial transmission of the axial movement of the linear spiral rod 17 for adjustment of position of the first eccentric weight 10 with regard to the second eccentric weight 11, in the vibration system according to the invention it is possible to know the actual mutual position of both weights 10 and 11 reliably, and thereby also the size of the resultant centrifugal force of both weights, which force causes the size (amplitude) of the roller vibrations. An advantage of this solution is that after the above-mentioned first adjustment of the position and calibrating of the sensor it is not necessary any more to carry out any further calibration unless the position of the spiral rod to the sensor changes, and unless the mutual position of both weights would correspondingly change, what can happen e.g. during a repair. So it is possible to modify the size of vibrations continuously, for example according the compacted surface, or according to other requirements. Thanks to the present invention, a modification to the amplitude of vibrations of the roller is carried out rapidly, and so it can prevent damage of the compacted surface, if e.g. the size of vibrations would reach unacceptable values.

The permitted size of vibrations can be determined both empirically, e.g. according to the surface type and mutual position of both weights, and by measuring, when the roller is provided by a sensor of real vibrations. Moreover, in machines with two vibration rollers arranged in tandem, it is possible to modify vibrations of both rollers to each other , to prevent addition of both vibrations.

The other example of an embodiment of the vibration system according to the present invention is the vibration roller with divided runner. Fig. 5 and Fig. 6 show vibration device according to the present invention for the divided runner, which allows different rotational speed for the left and the right halves of the roller, what is suitable e.g. for rolling of the asphalt surface in curves etc. Design of a roller with a runner divided into two halves is commonly known. Therefore, it will not be discussed here as such any further. In this design the vibrations are adjusted together of both the left and the right half of the runner, because difference in their speeds has not any influence on the size of vibrations. In this vibration equipment the two hydraulic motors for driving both halves of the runner are arranged at the sides of the roller body. The vibration device is arranged in one of the halves and it is similar to that in Fig. 1, whereby it is common for both halves of the runner.

Fig. 5 shows a vibration roller comprising a vibration mechanism with circular vibration according to the present invention, which mechanism is provided with a divided runner 30. In the axis of the vibration roller a hydraulic motor 29, a vibration mechanism 9 and a linear hydraulic motor 27 are arranged. The vibration mechanism 9 is rotationally supported on bearings 13 within the runner 30. The vibration mechanism 9 comprises especially a first eccentric weight 10, in which weight 10 the first sleeve 7 is firmly places with the respective internal sliding spiral toothing , and the second eccentric weight 11, in which the sleeve 8 with the respective internal sliding spiral toothings firmly supported. The spiral toothing of the second sleeve 8 has opposite direction of the spiral than what is that of the spiral toothing of the first sleeve 7. The spiral rod 17 is appropriately provided with spiral toothings of both directions of rotation for cooperation with the respective spiral toothings of sleeves 7 and 8. The second eccentric weight 11 is slidingly supported in bearings 31 with regard to the first eccentric weight 10.

In this embodiment the basic adjustment of the angle α is carried out, because of the absence of the conical coupling, which is not present here mainly because of space reasons, so that the first spiral toothing 15 and the second spiral toothing 16 are provided with different numbers of teeth, what allows to set up the position in steps given by the difference in the number of teeth in the first and the second spiral toothing. If both toothings have the same number of teeth, it is not possible to use the shift properly, as then the adjustment is given only by the angle corresponding to the difference of one tooth, what causes unacceptable roughness in the adjusting. However, in the embodiment with different number of teeth it is possible to use the resulting number of combinations, which number is given by a multiple of the number of teeth of the first and the second spiral toothings. According to an especially advantageous embodiment a combination of 16 and 17 teeth is used, a consequence of which there are 272 possible positions within 360°. Therefore, if the first spiral gearing 15 with sixteen teeth is offset to the adjacent grooves of the sleeve 7 by one tooth, the spiral rod turns by 22.4°, but if the second spiral gearing 16 with seventeen teeth is also offset into the adjacent groves in its sleeve toothing 8, i.e. by one tooth, in the opposite direction, the spiral rod 17 turns back only by 21.1°. The resulting turning of the spiral rod 17 is so only 1.3°, what allows the required accuracy in the adjustment.

During the operation, the vibration amplitude is changed continuously by changing the turning of the first eccentric weight 10 against the second eccentric weight 11, what is carried out by axial shifting of the spiral rod 17, provided in this embodiment by the first spiral toothing 15, in this embodiment left-handed, and by the other spiral toothing 16, in this embodiment right-handed. According to the shown embodiment, the right-handed second spiral toothing 16 of the spiral rod 17 meshes with the right-handed spiral in the sleeve 8. The left-handed first spiral toothing 15 of the spiral rod 17 meshes with the left-handed spiral of the sleeve 7.

By shifting of the spiral rod 17 in the axial direction the first eccentric weight10 is swivelled against the second eccentric weight 11 by the required angle over the spiral 15 meshing with the sleeve 7, which is firmly connected with the first eccentric weight 10, and over the spiral 16 meshing with the sleeve 8, which is firmly connected with the second eccentric weight 11.

It is obvious that by simple modifications of both the first described example and the second described example (i.e. both of the embodiment with the divided runner and of the embodiment with undivided runner) it is possible to carry out further possible embodiments of the vibration system within using the substance of the invention. So it is possible for example to connect the second eccentric weight directly on the drive, whilst the first eccentric weight is connected over the spiral rod 17 and further simple modifications, which however do not influence the substance of the invention, e.g. swapping of the directions of the spiral toothings 15 and 16. Therefore, it is important to understand the given examples really as the possible variants only and not as anyhow limiting with regard to the scope of protection. The protection is specified only by the scope of the claims, and it is necessary to understand that the term the first eccentric weight can comprise both the external and the internal eccentric weight and in the same way under the meaning of the term „second eccentric weight“ it is to understand that it is in reality the complementary eccentric weight to the first one, it is that if the first eccentric weight is the external one, the second is the internal one, and vice versa and that, therefore, it is not possible to limit the terms the first and the second eccentric weight exactly to the arrangement according to the figures, but that the reference numbers indicating these terms are only illustrative and serve for better understanding of the substance of the invention.

Both examples of the invention according to Figures 1 and 5 preferably have the same method of control.

The required position of the first eccentric weight 10 with regard to the second eccentric weight 11 is adjusted by the actuator 24, or automatically by the controlling unit 19. Information from the actuator 24 or from the control unit 19 enter the controller 23, where they are compared with the information on real position of the first eccentric weight 10 with regard to the second eccentric weight 11, determined by the sensor 28. The controller 23 evaluates the actual state and adjusts the distributor 22 in the desired position. The oil flowing through the proportional distributor 22 and hydraulic hoses 25 moves the piston 27 of the linear hydraulic motor 26 into the required position determined by the actuator 24, or automatically by the controlling unit 19.

Industrial use

The invention can be used especially in the earth compacting machines for compacting of the subsoil, for example of the asphalt macadam, with at least one roller equipped with a vibration system for intensifying of the compacting. It is especially preferable also for the machines with two rollers equipped with vibration system.

CLAIMS

1. A vibration system for an earth compacting machine with a vibration roller or for similar machines comprising
a first and a second weights, arranged within the vibration roller for causing of vibrations of this roller during its rotation,
a first and a second shafts connected appropriately to the first and the second weights for their turning,
a drive arranged for driving of the first and the second shafts for their turning,
wherein the second shaft is arranged for changing the position of the second weight with regard to the first one to change the amplitude of vibrations of the roller,
characterized in that
the first and the second weights are arranged eccentrically to the cylinder axis as the first eccentric weight (10) and the second eccentric weight (11),
the first and the second shafts (12,18) are arranged in the roller axis and
the first eccentric weight (10) is connected via the first shaft (12) substantially directly to the drive (29) for its turning with this drive (29),
whilst the second eccentric weight (11) is connected via the second shaft (18) to the drive (29) indirectly by means of a spiral rod (17) provided with two contra-rotating spiral toothings (15, 16),
where the first spiral toothing (15) is arranged displaceably in the first sleeve (7) provided with the corresponding inner toothing, which toothing is meshing with the first spiral toothing (15),
whilst the second spiral toothing (16) is arranged displaceably in the second sleeve (8) provided also with the corresponding internal toothing, where this toothing is meshing with the second spiral toothing (16),
whilst one of the sleeves (7, 8) is arranged for its turning by the drive (29),
whilst the second of the sleeves (8, 7) is arranged for driving of the second eccentric weight (11)
and that the spiral rod (17) is connected via the bearing (6) to the linear drive (26) for shifting of the spiral rod (17) with regard to both sleeves (7,8),

whilst the arrangement of the contra-rotating spiral toothings (15, 16) and of the with them meshing sleeves (7,8) is adapted for changing of the position of the second weight (11) with regard to the first weight (10) in shifting of the spiral rod (17) by the linear drive (26).

2. The vibration system according to Claim 1, **characterized in that** the first and the second weights (10, 11) have approximately the same dimensions and weight.

3. The vibration system according to Claims 1 or 2, **characterized in that** the linear drive (26) is a piston controlled by pressurized liquid.

4. The vibration system according to anyone of the claims 1 to 3, **characterized in that** the connection of the spiral rode (17) to the drive (29) is made by two pairs of contra-rotating with each other meshing transmission gearing, where the first transmission gearing is formed by two contra-rotating toothed wheels (1,2),
whilst the toothed first gearwheel (1) is arranged for its rotation by the drive(29),
whilst the second transmission wheel (2) is adapted on the spiral rod (17) and has the first sleeve (7) arranged in itself, which sleeve (7) is joined with it and which inner toothing is meshing with its first spiral toothing (15) and
the second transmission gearing is also formed by two contra-rotating toothed wheels (3, 4),
where the toothed third gearwheel (3) is internally provided with the sleeve (8), with which sleeve (8) it is connected,
and the toothing sleeve (8) is adapted on the second spiral toothing (16) for turning of the third toothed wheel (3) by the second spiral toothing (16) of the spiral rod (17),
and the toothed fourth gearwheel (4) is adapted on the second shaft (18) for its driving.

5. The vibration system according to anyone of the Claims 1 to 4, **characterized in that** the first spiral toothing (15) and the second spiral toothing (16) have substantially the same pitch and length.

6. The vibration system according to anyone of the claims 1 to 5, **characterized in that** it is provided with a linear sensor of the spiral rod position, which sensor is connected to a device for evaluation of the amplitude size of vibrations.

7. An earth compacting machine for compacting of the subsoil equipped with at least one roller with a s vibration system according to at least one of Claims 1 to 6.

List of reference numbers:

1 The first gearwheel

2 The second gearwheel

3 The third gearwheel

4 The fourth gearwheel

5 Conical coupling

6 Thrust bearing

7 Sleeve with spiral toothing

8 Sleeve with spiral toothing

10 The first eccentric weight

11 The second eccentric weight

12 Shaft

13 Bearing

15 Spiral toothing

16 Spiral toothing

17 Spiral rod

18 Shaft

19 Control unit

21 Gearbox

22 Distributor

23 Controller

24 Actuator

25 Hydraulic hoses

26 Linear hydraulic motor (hydraulic cylinder)

27 Piston

28 Linear sensor

29 Motor

30 Runner

31 Bearing

34 Sliding rod

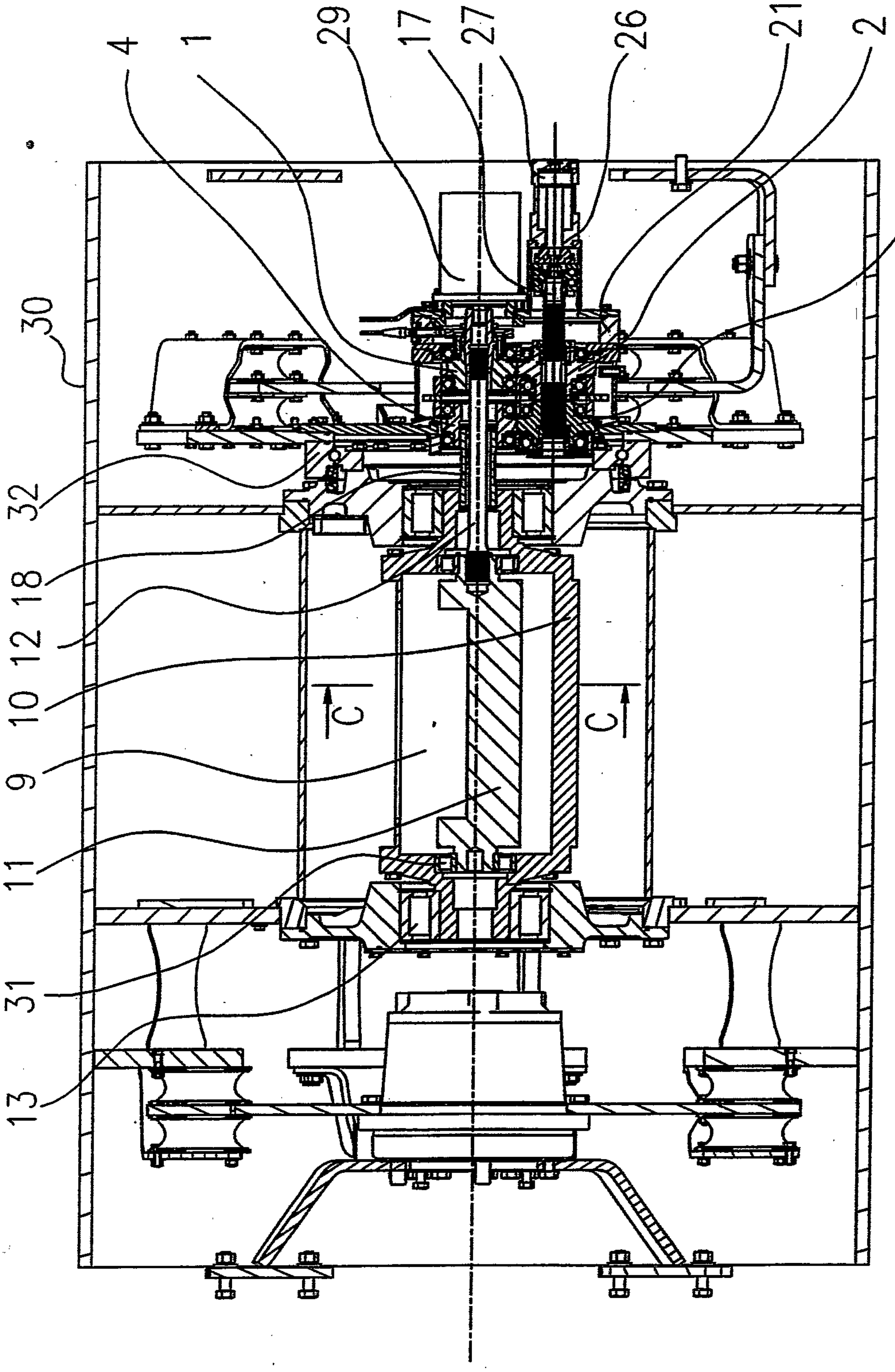

FIG.1

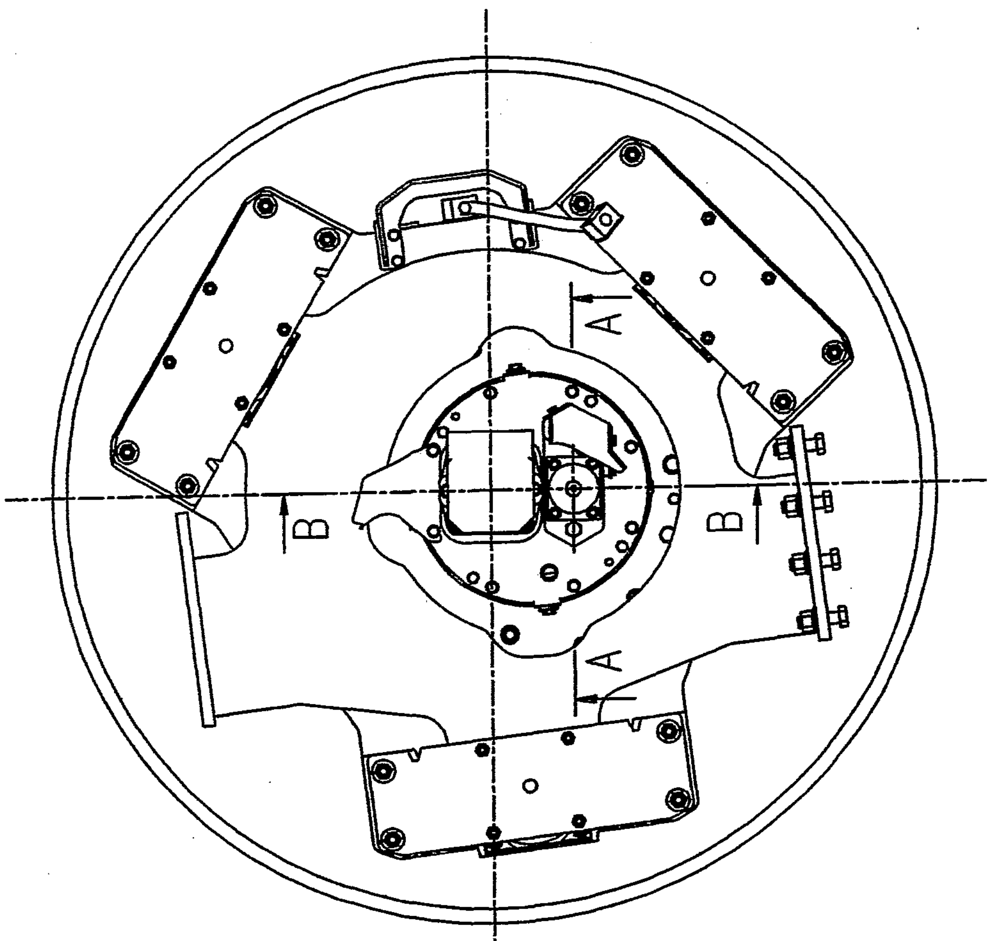

FIG.2

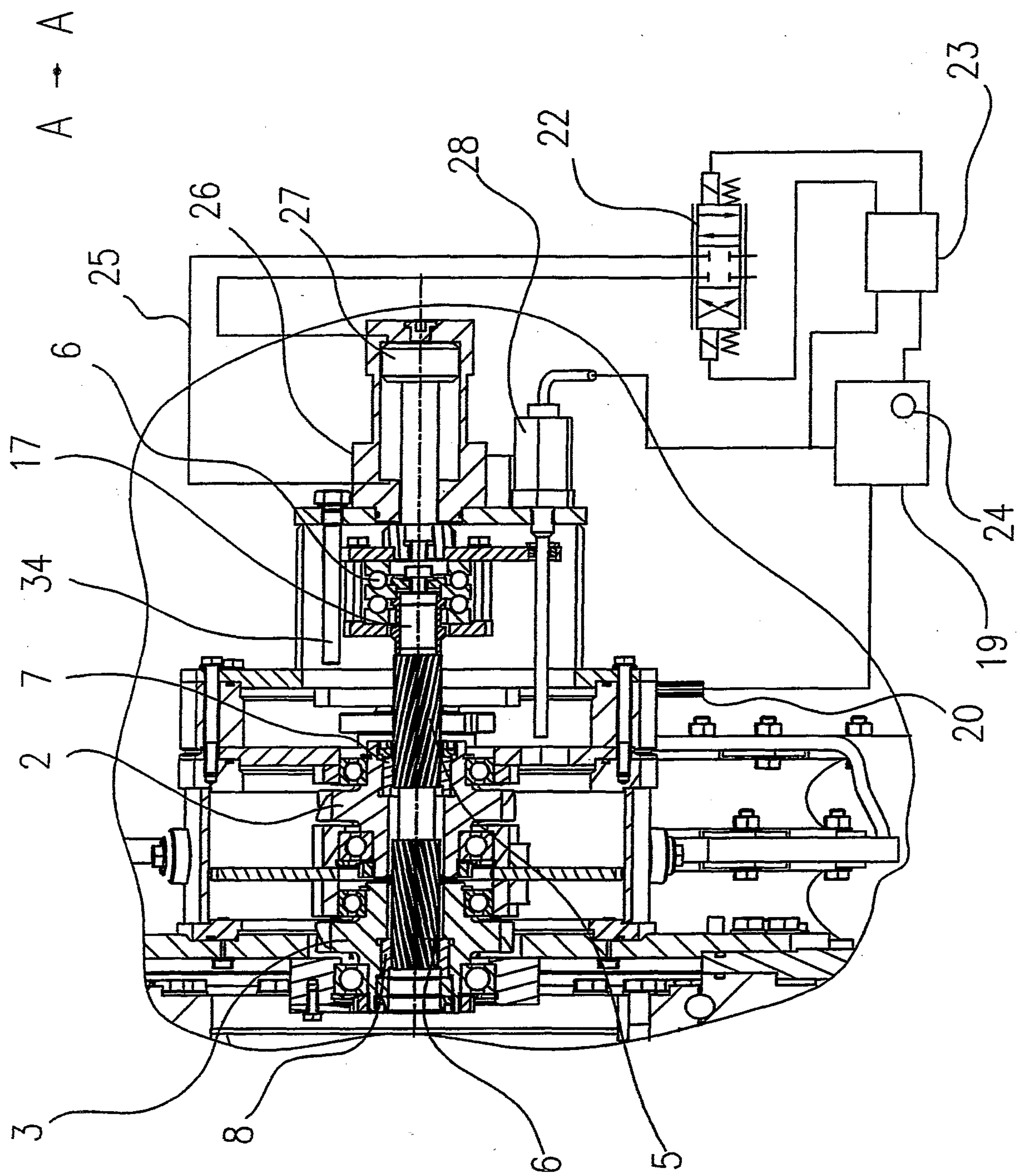

FIG.3

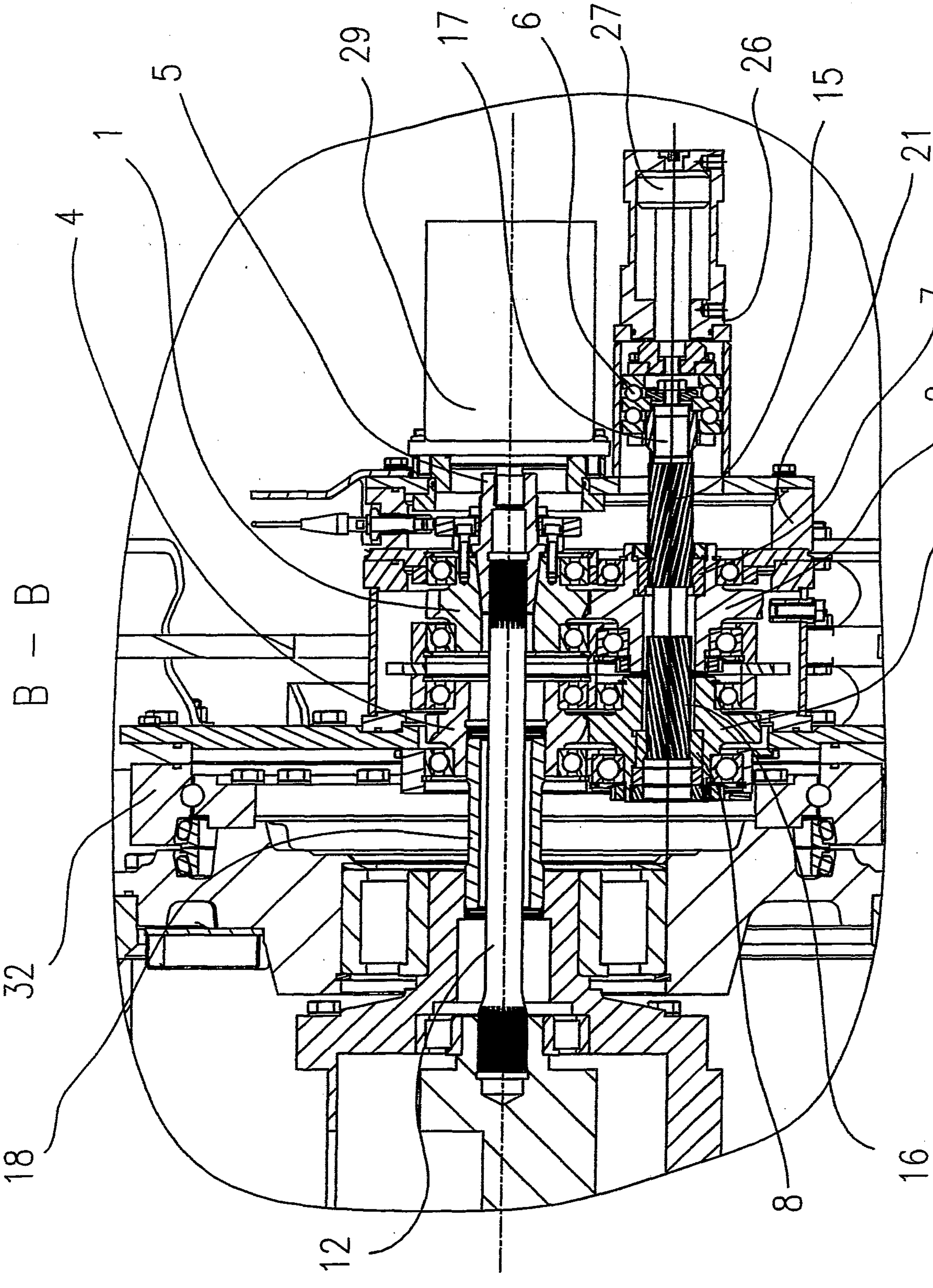

FIG.4

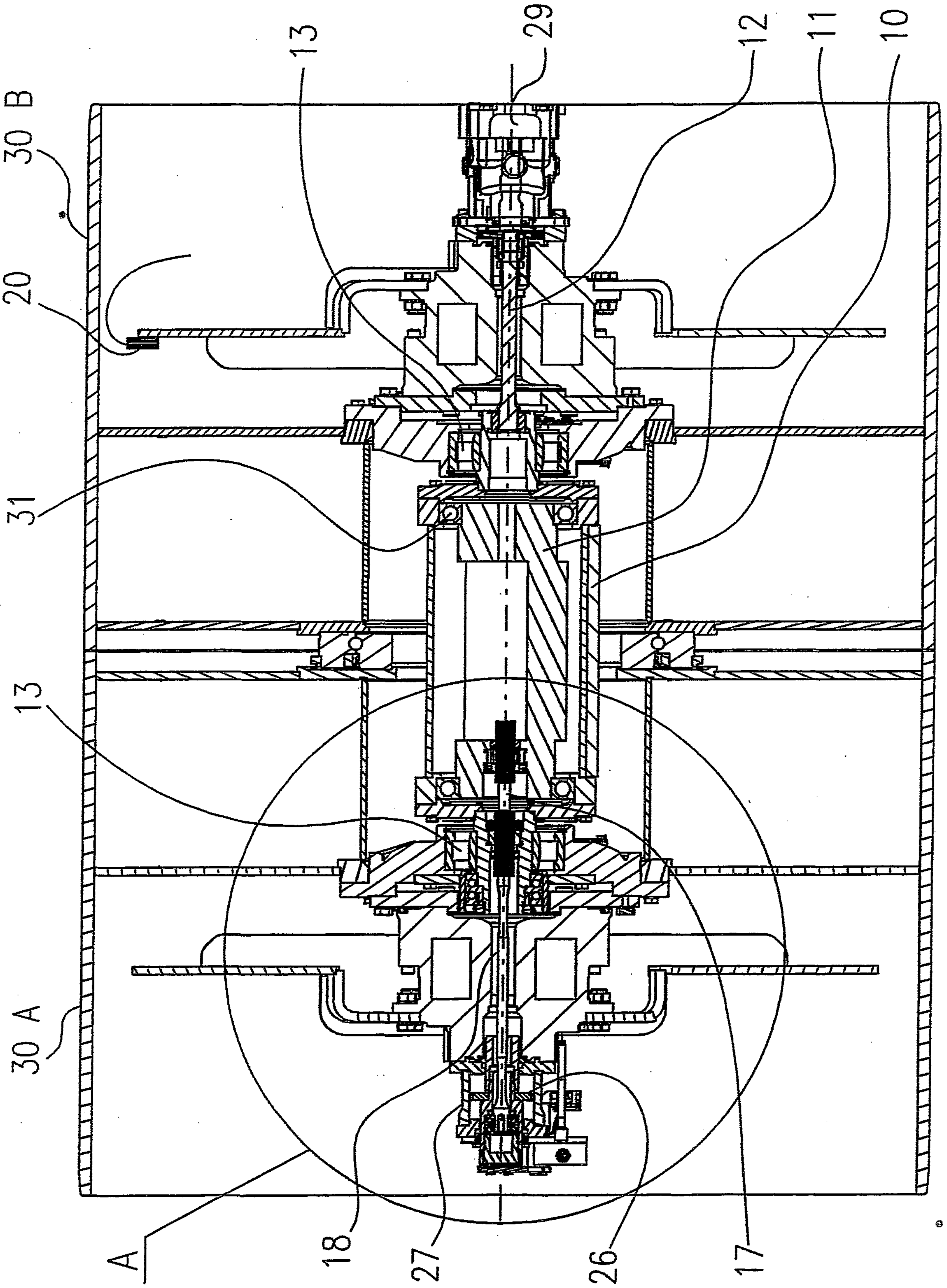

FIG.5

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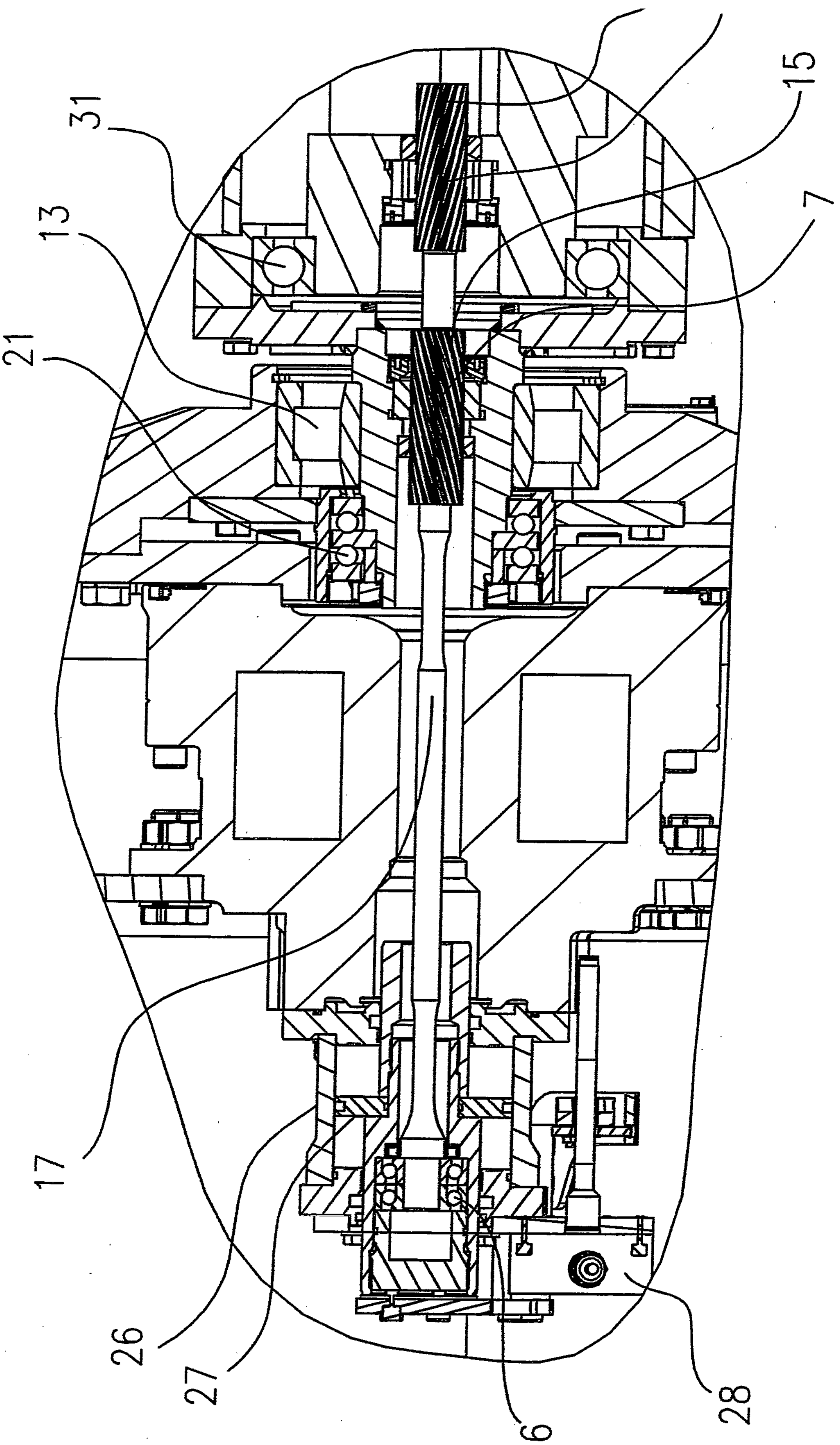

FIG.6

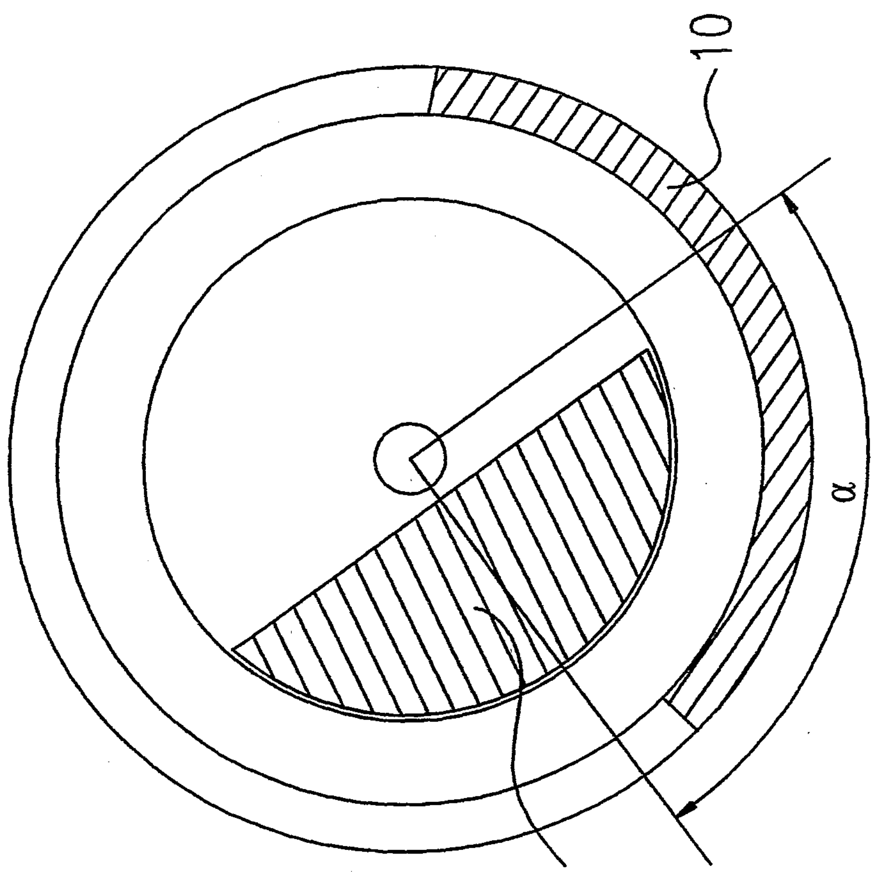

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2013/000034

A. CLASSIFICATION OF SUBJECT MATTER
INV. E01C19/28 B06B1/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E01C B06B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	the whole document	6

X	DE 10 2010 056531 A1 (CATERPILLAR PAVING PROD [US]) 14 July 2011 (2011-07-14)	1
Y	abstract paragraph [0014] - paragraph [0030]; figures 1-4	6

A	DE 35 05 580 A1 (STAVOSTROJ NP [CS]) 29 August 1985 (1985-08-29) the whole document	1-7

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
15 July 2013	25/07/2013
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Beucher, Stefan

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INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2013/000034

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