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(54) APPARATUS FOR SOIL COMPACTION, ESPECIALLY HAND-OPERATED, COMPRISING AN ELECTRIC DRIVE, AND A METHOD FOR OPERATING SUCH AN APPARATUS

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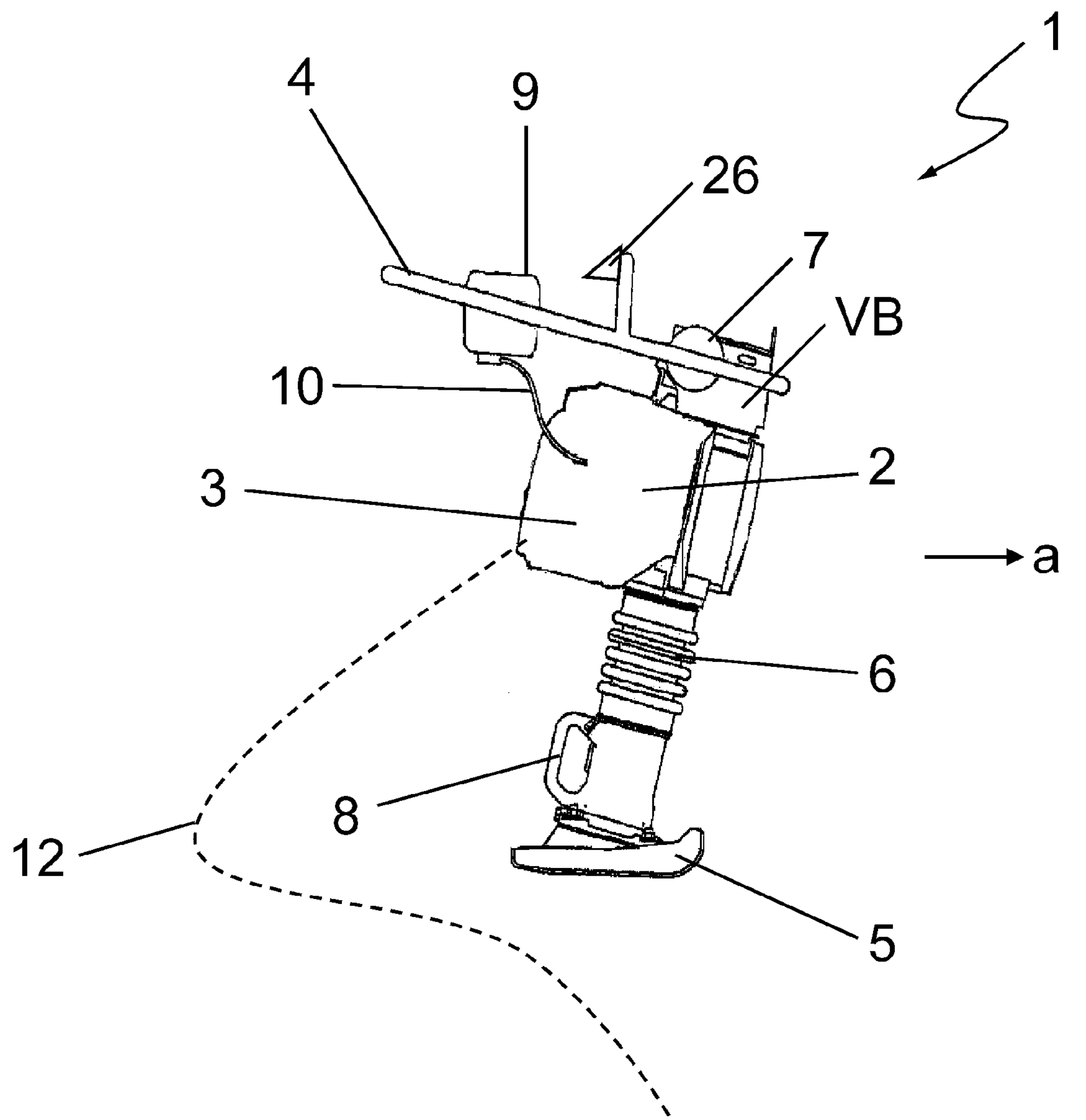
(57) ABSTRACT

The invention relates to an apparatus for soil compaction, especially a vibration tamper and a vibrating plate, comprising a compaction device which is driven via an electric motor, a rechargeable storage unit for electrical power, and an especially vibration-damped guide device. The invention further relates to an apparatus and a method for compaction control, especially for electromotively driven compaction apparatuses.



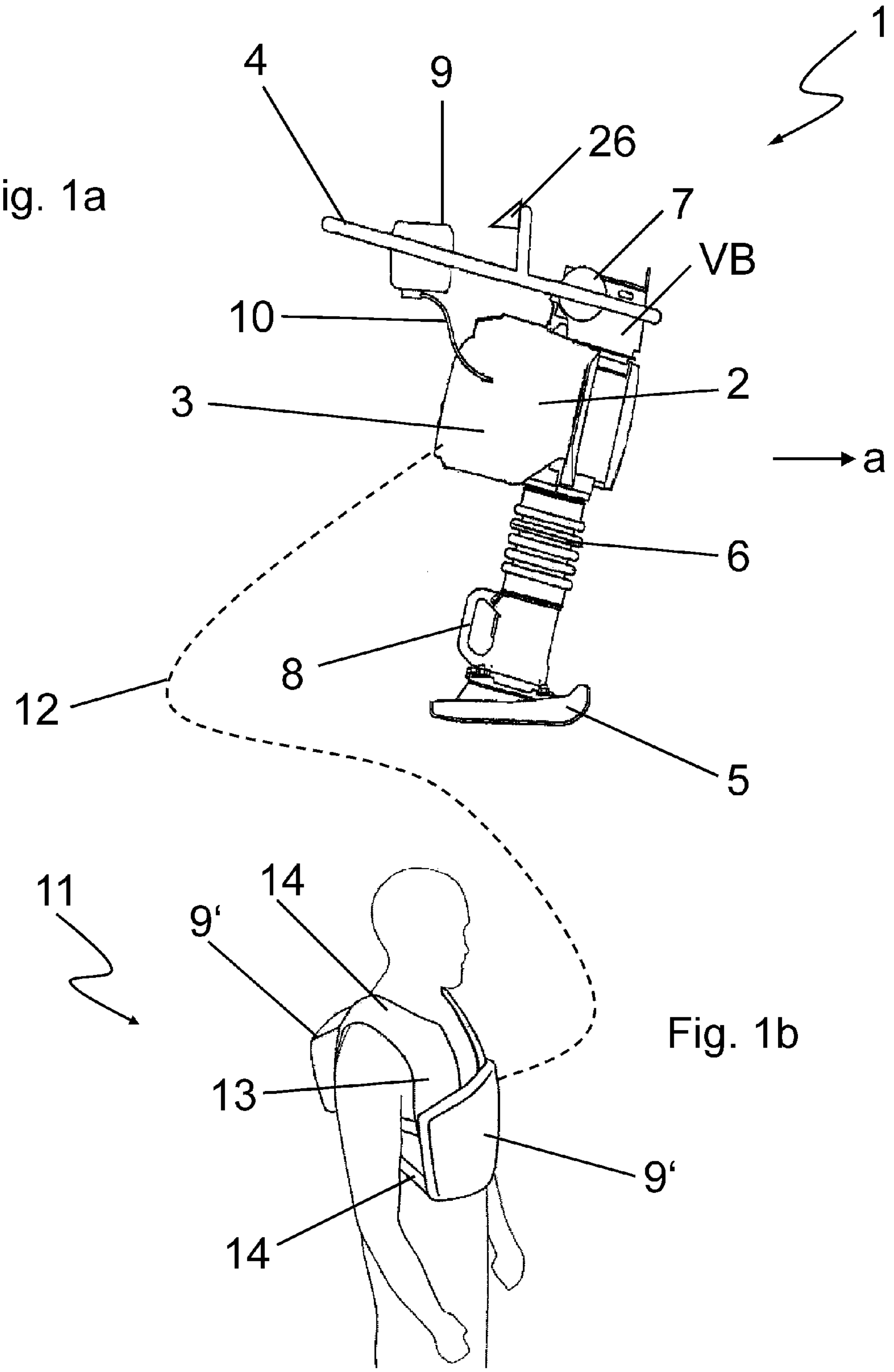
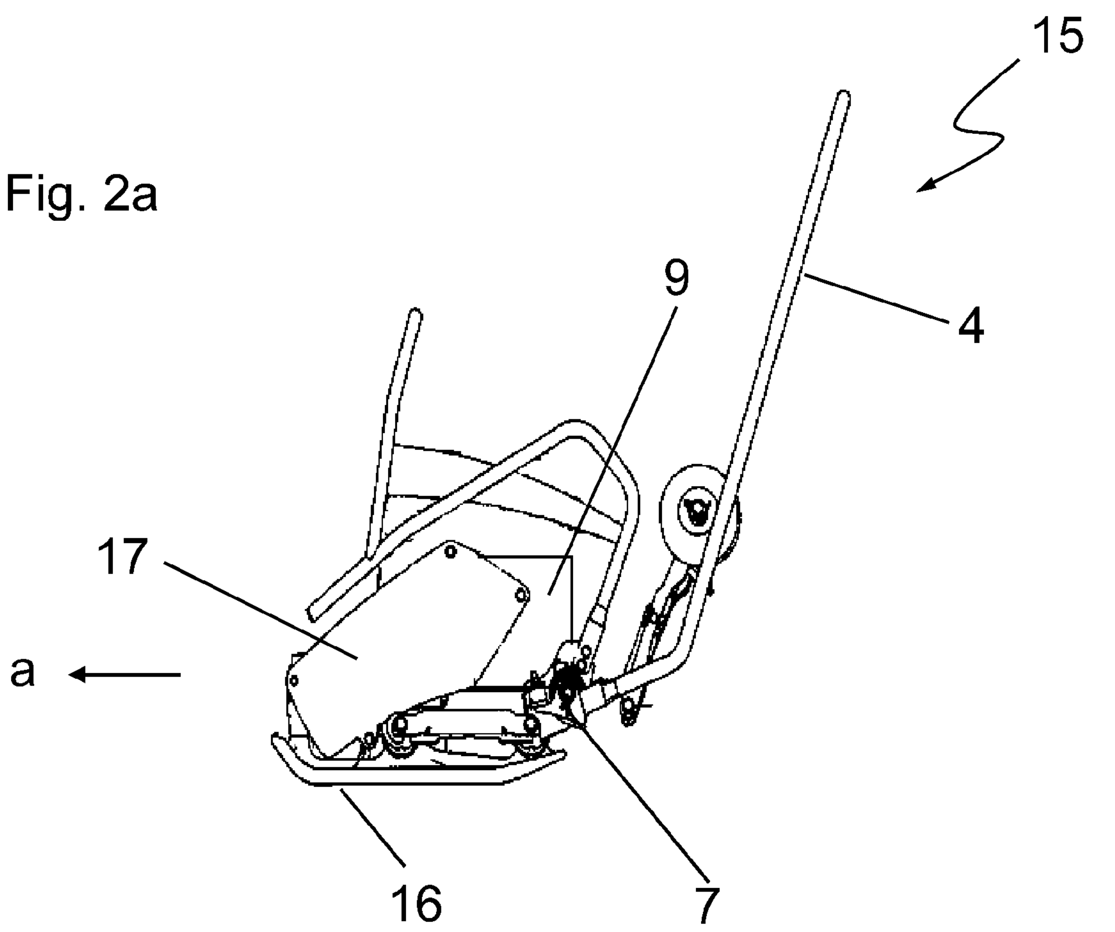


Fig. 1a

Fig. 1b

Fig. 2a



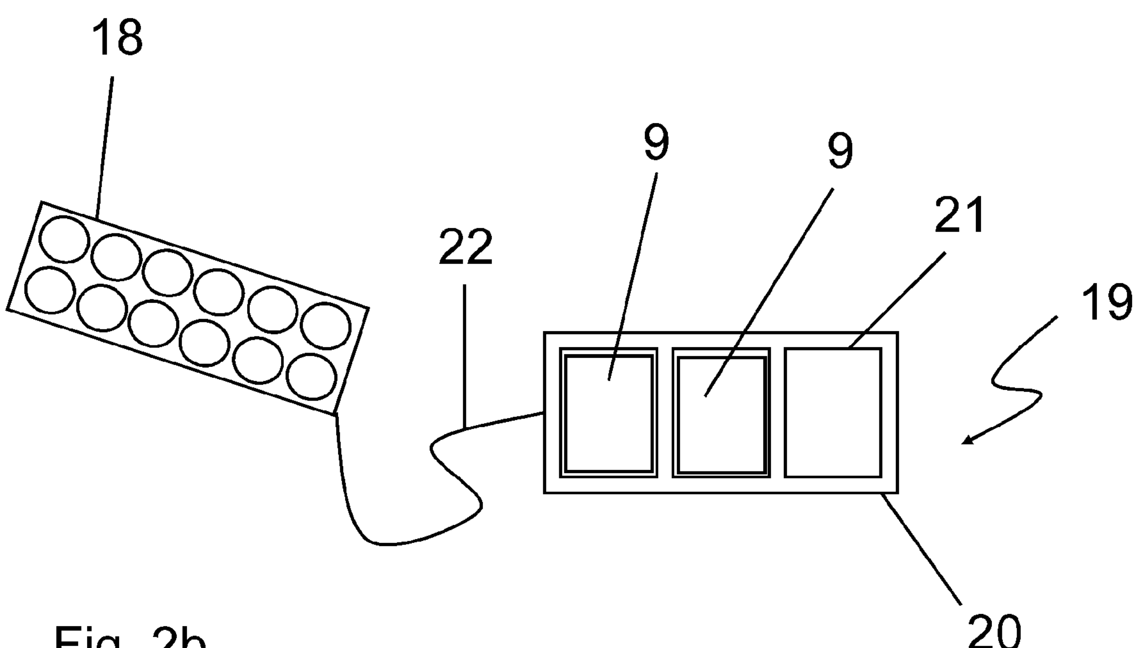


Fig. 2b

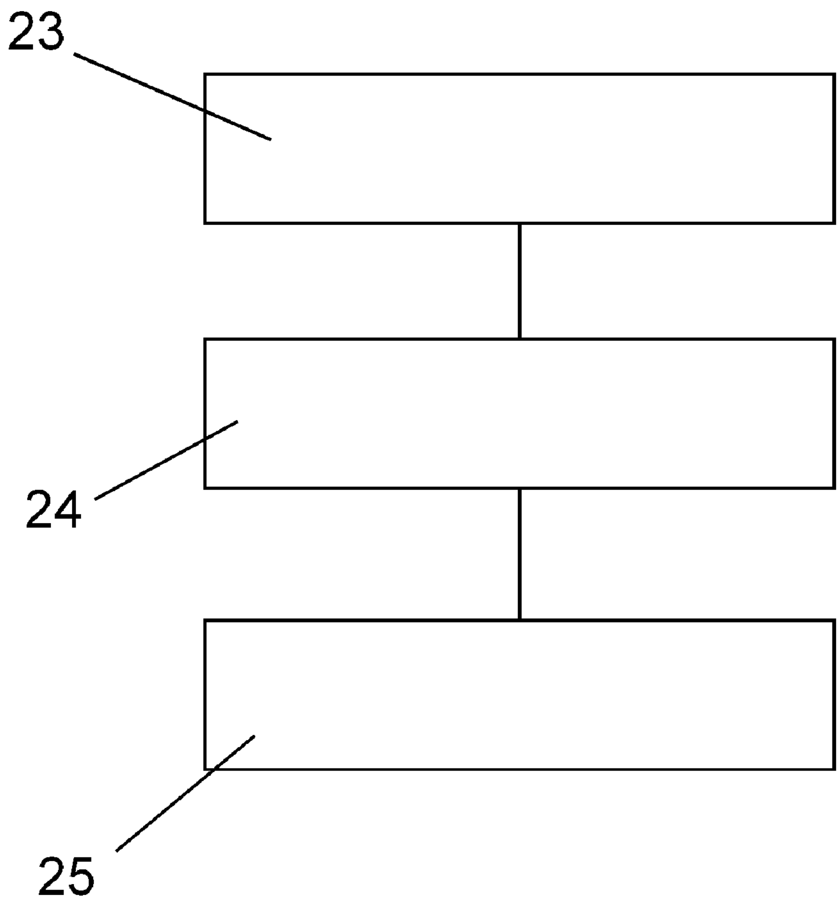


Fig. 3

Fig. 4a

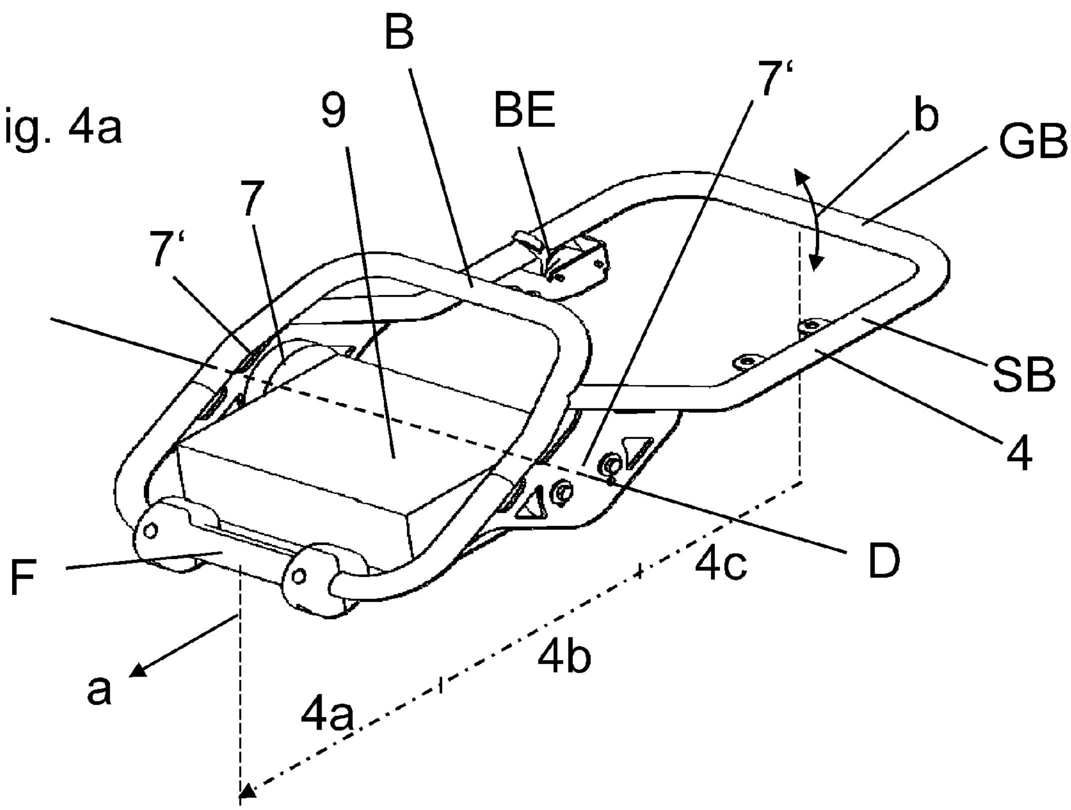
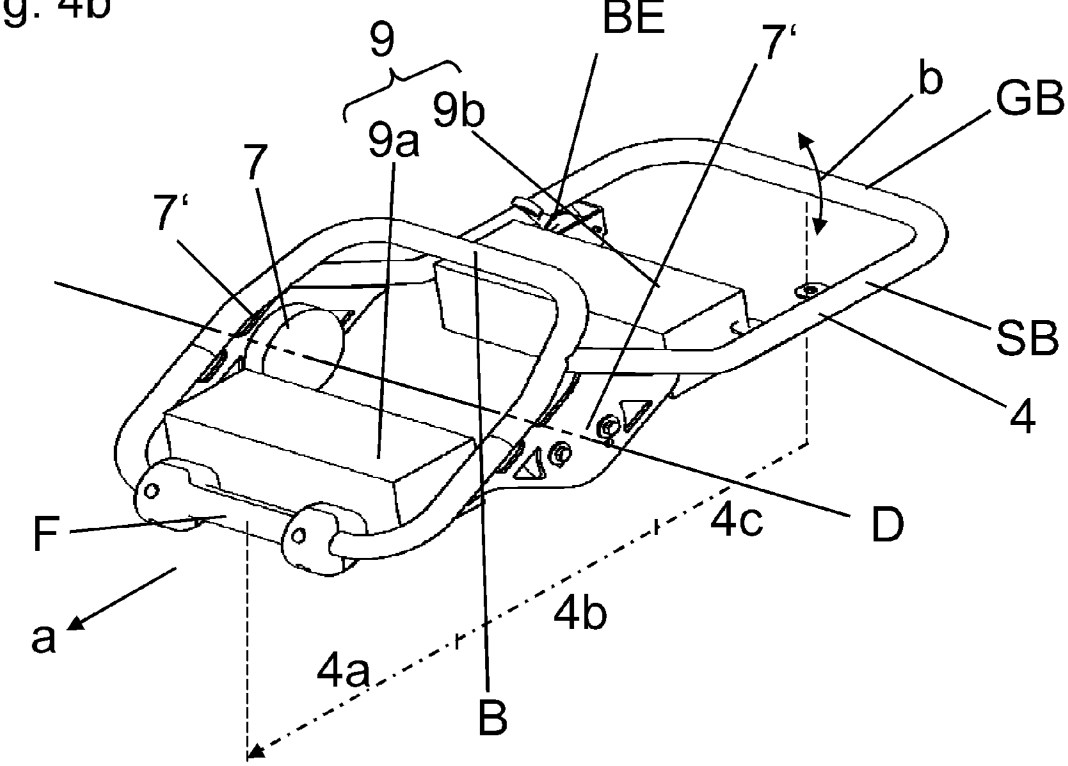


Fig. 4b



APPARATUS FOR SOIL COMPACTION, ESPECIALLY HAND-OPERATED, COMPRISING AN ELECTRIC DRIVE, AND A METHOD FOR OPERATING SUCH AN APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119 of German Patent Application No. DE 10 2011 105 899.4, filed Jun. 28, 2011, the disclosure of which is hereby incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention generally relates to the field of electrically driven machines for soil compaction, especially hand-operated machines. The present invention is especially suitable for use in vibration tampers and vibrating plates.

BACKGROUND OF THE INVENTION

[0003] Machines for soil compaction are known, for example, from DE 201 05 768 U1, owned by the common assignee, which is hereby incorporated herein by reference. Relevant elements of a generic vibration tamper are an upper structure with a drive element and a bottom structure with a tamping base plate. The upper structure and the bottom structure together form a compaction unit. The drive element is connected with the tamping base by way of a connecting rod for example, which converts a rotational movement of the drive element into a linear movement or tamping movement. Vibration tampers are usually associated with the so-called hand-operated "walk behind" machines. For this purpose, the vibration tamper comprises a guide device which is mounted on the upper structure via elastic damping elements, especially a guide bar. In operation, a user can manually guide the vibration tamper via the guide bar over the surface to be compacted.

[0004] A further widely distributed group of hand-operated machines for soil compaction are further the so-called vibrating plates. Such a vibrating plate is disclosed, for example, in DE 10 2008 033 525 A1 and DE 10 2008 045 557 A1, both owned by the common assignee, which are hereby incorporated herein by reference as well. The core elements of a machine for soil compaction arranged as a vibrating plate are a base plate, an exciter unit arranged on the base plate which makes the base plate vibrate in operation, and a guide bar (at least in hand-operated vibrating plates) which is arranged on the vibration plate in a frequently vibration-insulated manner especially in relation to the exciter unit. The base plate and the exciter unit together form the compaction unit. Both machines for soil compaction have in common that there is a plate-shaped compaction device, a drive unit and, in the case of hand-operated machines, a vibration-insulated guide device, with the latter being mounted in a vibration-insulated manner in relation to the respective compaction unit, for example via a frame element of the compaction unit.

[0005] The drive device comprises in most cases an internal combustion engine which provides the required mechanical energy for operating the respective machine for soil compaction by combustion of fuel. The usually numerous machines that are present on the construction site generally lead to a considerable burden for the persons working on the construction site by exhaust fumes. Possibilities to reduce this burden caused by the exhaust fumes lie among other things in the integration of systems for exhaust gas treatment such as filters and/or catalysts in the exhaust gas system of the internal combustion engine. Machines with an electric motor are alternatively also known. For instance, the common assignee already offers a vibration plate with an electric motor under the name BP 10/36-2E, with the connection to the electric power grid occurring via a suitable cable connection that needs to be carried along. However, carrying along a connecting cable is often perceived as obstructive because the working area is limited for example by the length of the connecting cable.

[0006] Irrespective of this, it is frequently desirable for the user when using machines for soil compaction to be provided with information on the degree of compaction in order to achieve sufficient and constant compaction. In this regard, the common assignee already offers a system for compaction control for reversible vibration plates under the brand ECONOMIZER, with conclusions being drawn on the degree of compaction on the basis of the measurement of the rebound. This system has proven its worth, but requires the continuous measurement of the rebound, for which purpose a separate sensor system is required.

SUMMARY OF THE INVENTION

[0007] Based on the aforementioned prior art, it is the object of the present invention to provide possibilities to improve the utilization of electric motors as a drive device for apparatuses for soil compaction and to ensure an optimized compaction process in an ideally simultaneous fashion.

[0008] The present invention relates to several aspects which subsequently will be described separately.

[0009] A first relevant aspect of the present invention relates to an apparatus, especially one that is hand-guided, for soil compaction (which will also be referred to below as a compaction apparatus), comprising a compaction device driven via an electric motor, a rechargeable storage unit for electrical power (also referred to below as storage element) and a guide device, especially one that is vibration dampened. The compaction device generally is the component via which the compaction force is introduced into the ground to be compacted. Accordingly, in the case of a vibration tamper, the compaction device is the tamper foot, and in the case of a vibrating plate it is the base plate. The apparatus for soil compaction comprises a rechargeable storage unit, via which the electric motor draws the electrical power required for operation. Specifically, the storage element concerns a rechargeable battery. The relevant feature of the rechargeable battery is that it can store and supply electrical power on the one hand, and can be recharged with electrical power on the other hand.

[0010] According to one aspect of the present invention, the storage element is not arranged directly on the electric motor or a component carrying the electric motor, but in a purposeful manner on the guide device. The guide device generally designates the part by which the user guides the compaction apparatus in operation manually over the ground area to be compacted, with the user, relative to the forward direction, usually walking behind the machine. The guide device thus normally extends from the rear section of the machine. The arrangement of the storage element on the guide bar in accordance with one aspect of the present invention is advantageous in several respects. The guide device is usually decoupled from vibrations or damped in relation to the remaining part of the machine for soil compaction such as the machine frame. For this purpose, suitable damping elements such as rubber bearings and the like are arranged between the guide device and the part of the machine carrying the guide device, especially the compaction unit. Said carrying part can especially be a frame element, especially of a connection bracket connecting the drive unit with the tamping device. The storage element can have a comparatively high weight in order to be able to store a sufficient quantity of electrical power. The weight of the storage element is preferably in the range of 3 to 10 kg, especially 8 kg. By arranging the storage element on the guide device, a vibration-decoupled mounting of the storage element is simultaneously achieved. This is advantageous for example in that wearout, especially in the region of electric contacts, can be reduced. On the other hand, the storage element increases the mass of the guide device and therefore its inertia of masses, so that in total especially advantageous damping results are obtained. This special embodiment is further characterized in that the mass distribution remains constant in contrast to the known common arrangements with internal combustion engines and fuel tank because the weight of the storage element does not change with decreasing or increasing charging state.

[0011] Principally, the storage element can be arranged on already known prior art guide devices for machines for soil compaction, especially vibration dampers and vibrating plates. It has been found, however, that the use of a guide device arranged as a guide bar is especially advantageous. A guide bar is essentially characterized by two supporting tubes which are connected with one another via at least one connecting element such as a connecting bar. The supporting tubes are arranged on the frame or a comparable, ideally supporting, element of the machine via ideally vibration-damped bearings such as rubber bearings for example. The connecting bar is gripped by the user and used for guiding the machine. The two supporting tubes therefore extend at a distance from one another, frequently in a mirror-symmetrical and/or parallel fashion. The storage unit is now preferably arranged between these two supporting tubes of the guide bar. This offers the advantage that two mutually opposite bearing points are obtained by the two supporting tubes. Moreover, the machine can thereby still be maintained in a comparatively compact way, because the storage unit will not protrude from the sides of the machine in this arrangement.

[0012] Ideally, the guide device is mounted on the compaction unit of the apparatus for soil compaction, especially a frame of the compaction unit, via at least two bearings, with the storage element being arranged as near as possible, for example adjacent, to the at least two bearings. Further, the at least two bearings preferably form a part of the vibration damping of the guide bar in relation to the compaction unit of the apparatus for soil compaction. As near as possible in this regard is to be understood with respect to the spatial arrangement, especially in a horizontal plane. The at least two bearings are frequently arranged opposite to each other on a virtual swivelling axis of the guide device relative to the remaining part of the apparatus for soil compaction. Especially relative to the forward direction, the storage element is arranged adjacent, especially as near as possible, to said swivelling axis. An arrangement of the storage element on the swivelling axis is also possible and comprised by the present invention.

[0013] In vertical direction, the storage element is preferably mounted above the compaction unit. This especially concerns an apparatus for soil compaction arranged as vibration tamper.

[0014] The arrangement of the storage element in the front third of the guide device, especially the guide bar, has proven especially suitable. With respect to the extension of the guide device in longitudinal direction, especially in the horizontal plane, the guide device can be separated into several sections. In most cases, the guide device extends longitudinally, relative to a horizontal plane, in the working or forward direction of the apparatus for soil compaction. A handle area via which the operator can guide and walk behind the apparatus for soil compaction during operation is arranged in the rear third. The front third of the guide device, whose lateral parts frequently overlaps with the section in which the guide device is mounted to the apparatus for soil compaction, is especially suitable for arrangement of the storage element, since such an arrangement provides for comparatively weak vibration for example during operation.

[0015] To obtain optimal damping results, the storage element is preferably arranged in a section of the guide device which, relative to the working direction of the apparatus for soil compaction, is opposite to the handle area of the guide device, which arrangement helps minimize the transfer of vibrations to the handle area. Arrangement opposite to the handle bar in this respect means relative to the forward direction of the apparatus for soil compaction, i.e., the direction into which, for example, a vibration tamper proceeds during operation.

[0016] Good damping results are especially obtained if the overall balance point of the guide device is arranged with the storage element in the front third relative to the working direction, especially in front of a swivelling area of the guide device. The term overall balance point thus designates the balance point of the unit comprising the guide device, especially the guide bar, and the storage element.

[0017] A separation of the storage element into several storage element components is also possible and provides certain advantages. Accordingly, the storage element comprises at least two storage element components which are arranged separately and, especially relative to the working direction of the apparatus for soil compaction, respectively in front of and behind a swivelling or mounting area of the guide device. This, for example, allows for a variable size of the storage element depending on the number of components. Further, by an appropriate arrangement of the at least two storage element components, an especially advantageous distribution of the mass of the storage element can be obtained on the guide device, and, for example, allow for a shift of the total balancing point of the unit comprising the storage element and the guide device as described above.

[0018] It is known that storage capacity of the storage element for electrical power is limited. A fixed installation of the storage in the machine, which is obviously principally possible, results in the disadvantage that the machine cannot be operated during the charging period. This problem is solved by integrating an exchange receiver for the storage element which is arranged for the rapid installation and deinstallation of the storage unit in the guide device. An exchange receiver is therefore a device which allows the rapid exchange for example of a discharged storage element by a charged storage element. The machine can therefore rapidly be put back into operation again. At the same time, the empty storage element can be recharged, so that virtually interruption-free operation of the machine is possible.

[0019] The exchange receiver can also be varied in many ways. In a very simple embodiment, the exchange receiver is a holding device into which the storage element will be introduced and thereafter connected to respective contacts. Preferably, the exchange receiver and the respective storage elements are arranged in the manner with respect to one another that a quick-acting closure is provided, which in addition to the holding function in order to keep the storage element in a defined position within the exchange receiver simultaneously fulfils a contact function by which a current-conducting connection between the storage element and the electrical system of the machine will be achieved. For this purpose, suitable latching and/or locking devices are frequently provided. The quick-acting closure is ideally arranged in the manner that merely a pressing actuation of a suitable release means is required for releasing and/or locking the storage element in the exchange receiver. In a further preferred embodiment, the exchange receiver further comprises an ideally closable housing the interior of which is designed to accommodate the storage element. As a result, the storage element and the respective contacts can be shielded towards the outside and soiling in this region will be avoided.

[0020] It is important for smooth operation of the apparatus for soil compaction that the contacting between the line contacts on the storage element and the respective line contacts on the apparatus is ensured during operation. This may be problematic especially in vibration dampers and vibrating plates in that these machines are especially subject to strong vibrations during operation. It is therefore advantageous to arrange the contact points for current conduction between the storage element and the apparatus in the manner that the occurring shearing forces in this region are as low as possible in order to achieve the lowest possible wearout especially at these points during operation.

[0021] A further aspect of the present invention also relates to an apparatus for soil compaction, especially according to the aforementioned, with a compacting device driven by way of an electric motor, especially a vibration tamper or a vibration plate. Other than in the preceding embodiments, the storage element is not mounted directly on the construction machine but is, especially as a supplement to a storage element mounted on the guide device, carried separately. The operator is especially suitable who obviously will be in the direct vicinity of the machine during its operation. The storage element is connected for this purpose via a cable with the power network of the machine.

[0022] The housing of the storage element in a carrying means with at least one carrying belt, such as a rucksack, has proven to be especially practical. For better weight distribution, the storage element can preferably comprise several individual elements which are carried by the operator on the front and on the back.

[0023] It is understood that the two aforementioned aspects of "storage element held on the apparatus" and "storage element carried independently from the apparatus" can also be combined with one another. In this case, a storage element is arranged on the construction machine, e.g., the vibration tamper or the vibrating plate, and the operator additionally carries a further storage element which is connected to the construction machine via a cable connection. It is especially advantageous for this embodiment when a control device is provided which coordinates the operation of electric motor with energy from the two storage elements.

[0024] The storage elements for electric power obviously only have a limited capacity. A charging indicator is therefore preferably arranged on the apparatus for soil compaction, especially in accordance with the aforementioned, which informs the operator about the current charging state. For this purpose, the charging indicator can be positioned for example on the guide bar or in the direct vicinity so that the operator can conveniently monitor the charging state, especially in operation.

[0025] Especially in spatially limited conditions, it is especially advantageous if it is not necessary to carry along a cable leading to a central power supply. There are also situations, however, in which an especially long operating interval is desired, for example in the compaction of comparatively large areas. In order to optimize the apparatus for soil compaction similarly for both applications, a separate connection to a power cable can be provided, via which the power supply of the electric motor of the apparatus can occur alternatively to the storage element. The user can then choose individually between power supply via the mobile storage element or via a cable connection to the power grid. In addition, a control unit can be provided which automatically recognizes the connection to the power grid and ensures that in this case preferably the power supply occurs via the power cable in order to relieve the storage element. Alternatively, it is also possible to provide a manually actuated device such as a switch, via the position of which the access to the power supply via the cable or via the storage element is controlled. Preferably, it is further possible in this embodiment that the storage element can be recharged via the simultaneously connected cable.

[0026] The operation of further consumers of electrical power is substantially facilitated by carrying along a storage element, either directly on the compaction machine or by the user with cable connection to the compaction apparatus. This can relate to illumination means such as searchlights, a handle heating etc.

[0027] A further aspect of the present invention relates to an apparatus for soil compaction with a compaction device, a drive (with the drive comprising an electric motor) and a cable connection which is arranged for connecting a cable connected with a power source. The power source can be a storage element, especially a rechargeable battery carried along by the operator, or a cable connection to a power grid. The escape of the machine in operation should be prevented to the highest possible extent for safety reasons especially in the case of hand-guided machines, especially vibration tampers and vibrating plates, and the operation should be interrupted in vibration tampers when it falls over. The present invention contemplates, especially as a supplement to the aforementioned embodiments, a cable connection for this purpose which is arranged in the manner that upon exceeding a fixed tensile load of the cable it will detach automatically from the cable. Especially in the case that the operator of, for example, a vibrating plate or a vibration tamper carries along the storage element which is connected via a cable connection with the respective machine, this embodiment ensures that the operator will always be close to the machine, ideally at the level of the respective guide device. If the user moves away from the machine exceeding a previously determined maximum distance, the connecting cable will be tensioned and loaded with tensile forces. In the present case, the cable connection is now arranged in the manner that it will release in this case and the cable connection will thereby be interrupted. As a result, the electric motor of the vibration tamper or the vibrating plate is disconnected from the power source and comes to a standstill. In applications in which the operator does not carry along any storage element and the cable is instead connected to the power grid of the construction site, a slinging apparatus can be provided on the operator into which the cable is tightly slung. It is ensured in this manner that only a specific cable length is available between the operator and the compaction device, and a tensile loading of the cable will occur when the vibration tamper falls over for example. For example, a suitable plug-in connection for connecting a cable end into a respective receiver can specifically be provided for this purpose, with the receiver being arranged in the manner that the plug-in connection will be released upon exceeding a defined tensile load on the cable.

[0028] A further aspect of the present invention relates to the operating convenience of an apparatus for soil compaction, especially according to the aforementioned embodiments, and more especially a hand-guided vibration tamper or a hand-guided vibrating plate, comprising an electromotive drive and a compaction device. Compaction work principally places increased demands on the operator in that a certain minimum compaction in the compaction process needs to be achieved on the one hand and overcompaction or an excessively long processing interval is to be avoided on the other hand. The present invention proposes in this connection a device for compaction control which comprises means for determining the operating performance of the electric motor and which uses the values thus determined for determining the compaction of the ground. The compaction device in accordance with the present invention is outstandingly suitable for vibration tampers and vibrating plates with electromotive drive. This aspect of the present invention is based on the finding that the compacting performance provided by the apparatus for soil compaction to the ground is a measure for the stiffness of the ground. If the ground has a high level of stiffness, a low amount of compaction energy will be introduced into the ground and vice versa. With rising compaction, the power of the electric motor will decrease, so that a determination of the compaction is indirectly possible via a determination of the current power, especially the electric power, of the electric motor. The apparatus for soil compaction ideally comprises a control unit for this purpose which directly converts the determined power values into respective compaction values and displays such information to the user, for example by way of a suitable display device. It is ensured in this manner that the desired degree of compaction will be achieved and the compaction work will not be extended beyond the desired measure. It is understood that this system for compaction control comprises respective measuring devices at suitable positions, via which the data required for determining the current power can be obtained. For the purpose of determining the electric power, these can be devices for example via which the voltage and the amperage can be detected.

[0029] The present invention also lies in a method for compaction control for an apparatus for soil compaction, especially an apparatus according to one of the preceding embodiments and, more especially, a vibration tamper and a vibrating plate, comprising the steps of a) determining the power of an electric motor and b) deriving the degree of compaction from the power of the electric motor. The method can further comprise the visual display of the degree of compaction in further preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The present invention will be described below in closer detail by reference to the preferred embodiments shown schematically in the drawings. The same components are provided with the same reference numerals, wherein the drawings show schematically:

[0031] FIG. **1***a* shows a side view of a vibration tamper;

[0032] FIG. **1***b* shows an operator with a multi-cell rechargeable battery;

[0033] FIG. **2***a* shows a side view of a vibrating plate;

[0034] FIG. **2***b* shows a charging system for a rechargeable battery;

[0035] FIG. **3** shows a flow chart for the method for compaction control;

[0036] FIG. **4***a* shows an angled perspective view on a guide bar of a vibration tamper with a storage unit; and

[0037] FIG. **4***b* shows an angled perspective view of a guide bar of a vibration tamper with a storage unit comprising multiple components.

DETAILED DESCRIPTION

[0038] FIG. **1***a* shows a vibration tamper **1**, comprising an upper structure **2** with an electric motor **3** and a guide device arranged as a guide bar **4** and a tamper foot **5** with a transport handle **8** connected via a bellows **6** with the upper structure **2**. A load transmission apparatus, such as a connecting rod, is arranged within the bellows **6**, which connecting rod converts the rotational drive force of the electric motor **3** into a linear movement and transmits the same onto the tamper foot **5**. In operation, the tamper foot **5** approximately tamps in the vertical direction, e.g., with a frequency of approximately 10 Hz. The guidance of the vibration tamper **1** occurs manually via the guide bar **4** which is mounted on the upper structure **2** via elastic damping bearings **7**. Except for the guide device, all components of the vibration tamper **1** together form the compaction unit.

[0039] A storage element **9** in form of a rechargeable battery is provided for supplying the electric motor **3** with electrical energy, which storage element is connected with the electric motor **3** via a cable connection **10**. The storage element **9** is arranged between two lateral tubes of the generally circumferential guide bar **4** and is therefore also mounted in a vibration-damped manner on the upper structure **2**.

[0040] A further storage element **9'** for the power supply of the electric motor **3** with electrical energy can be used according to FIG. **1***b* as an alternative or supplement to the power supply via the storage element **9**. The storage element **9'** differs from the storage element **9** in that it is not mounted directly on the machine (vibration tamper **1** in FIG. **1***a*), but is carried along in operation separate from the vibration tamper **1** (in the present case by an operator **11**) and is connected for this purpose via a cable connection **12** (shown with the dashed lines between the FIGS. **1***a* and **1***b*) to the electric motor **3** (or its supply network). For this purpose, a rucksack-like carrying apparatus **14** with shoulder straps **14** is provided which is worn by the operator **11** during operation. The carrying apparatus **13** comprises a breast pocket and a back pocket in which one respective storage element **9'** is introduced. The two storage elements **9'** are interconnected via cable connections integrated in the carrying apparatus **13**, so that only one cable connection to the electric motor **2** is required for the connection of the two storage elements **9'**. Furthermore, operation is also possible with only one storage element **9'** and/or without the storage element **9** which is directly arranged on the vibration tamper **1**. Both storage elements **9'** are arranged for this purpose to be removable from the carrying apparatus **13**.

[0041] Further, in practice the cable connection **12** as shown in FIGS. **1***a* and **1***b* is dimensioned such that the operator **11** needs to be positioned in the direct vicinity in the rear region of the guide bar **4** (to the left in FIG. **1***a*) for the connection to the vibration tamper **1**, since otherwise the cable connection **12** will be too short. The cable connection **12** further has a connection to the electric motor **3** which is not shown in closer detail and which is arranged in the manner that it will detach even under slight tensile loading. If the vibration tamper **1** for example tilts forwardly in operation (to the right in FIG. **1***a*), the cable connection **12** will be detached from the vibration tamper **1** and the power supply to the storage elements **9'** in the carrying apparatus **13** will be interrupted automatically.

[0042] The vibration tamper **1** further comprises a display unit **26** which supplies the operator **11** in the present embodiment with information on the charging state of the storage element **9** and also with information on the degree of compaction. For the latter function, a control unit which is not designated in closer detail is integrated in the vibration tamper **1** which continuously monitors the performance of the electric motor **3** in operation and determines the degree of compaction and the development of the compaction of the ground from the obtained performance data.

[0043] An alternative embodiment of the present invention is shown in FIG. **2***a* and relates to a vibrating plate **15**. The vibrating plate **15** comprises a base plate **16** on which an electromotively driven exciter unit **17** is arranged (reference numeral **17** comprises in FIGS. **2***a* both the exciter unit and the electric motor) which makes the base plate **16** vibrate in operation, especially at least in part in the vertical direction. Furthermore, a guide bar **4** is provided which is mounted on the vibrating plate **15** in a vibration-damped manner via the damping bearings **7** on the vibrating plate **15**.

[0044] The storage element **9** is arranged on the vibrating plate **15** for supplying the electric motor **17** with electrical power. The storage element **9** can alternatively be mounted on the guide bar **4**, deviating from the embodiment in FIG. **2***a*. In the present embodiment, it is arranged however on a frame which is not designated in closer detail and which is mounted in a vibration-insulated way in relation to the base plate **16**. The storage element **9** is arranged as an exchangeable rechargeable battery and can be removed from the vibrating plate **15** by releasing a locking means not designated in closer detail.

[0045] In order to allow the storage element **9** to be charged as independently as possible from the grid, a charging station **19** is provided in accordance with FIG. **2***b*, which comprises a housing **20** in addition to a solar panel **18** which is connected via a cable **22**. Several receiving chambers **21** are provided in the housing **20** which are respectively arranged for accommodating a storage element **9** for charging with electrical power. The charging station **19** can optionally also be directly connected to the grid. The charging station **19** can further also be arranged independently as a mobile unit or be integrated in a transport vehicle for example.

[0046] FIG. **3** finally illustrates a method for compaction control, which has already been mentioned above in connection with the vibration tamper **1**. The steps as mentioned in FIG. **3** are essentially carried out by the control unit. The principal concept of the compaction control as provided in FIG. **3** is based on the finding that the compaction power introduced into the ground will change with increasing compaction, and, in particular, will decrease with increasing stiffness of the ground. The present method for compaction control makes use of this behavioral pattern especially in connection with electromotively driven compaction apparatuses, especially vibration tampers or vibrating plates with electric motor. In a first step **23**, the power, especially the electrical power, of the electric motor of the compaction apparatus will be determined. The determined measured values will be processed subsequently (**24**) by the control unit, with the control unit determining the current degree of compaction. The determined degree of compaction can subsequently be displayed in a further step **25** (e.g., in the display **26**). This can occur in form of numbers for example, but preferably by way of illustration for example in form of a traffic light, which upon reaching the desired compaction degree switches over to green, or the like.

[0047] FIGS. **4***a* and **4***b* are angled perspective views of a guide bar **4** for a vibration tamper as shown for example in FIG. **1** with the vibration tamper **1**. According to FIG. **4***a*, the guide bar **4** comprises a front section F, two following lateral sections SB extending opposite to the working (forward) direction, and a rear handle section. Further, a bar B is arranged, relative to the working direction a, between the front section F and the handle section G. With respect to its general appearance, the guide bar **4** is arranged as an essentially horizontal rectangle. Below the bar area B a bearing area **7'** is arranged on each side of the guide bar **4**, which constitutes the component of the rubber bearing which is fixed to the bar, and which, via a suitable damping element such as, for example, a rubber bump, is connected with the compaction unit, for example with the connection bracket VB as shown in FIG. **1***a*, which connects the guide bar with the remaining part of the vibration tamper or compaction device. The vibration-insulated mounting thus obtained allows for swivelling the guide bar **4** in a limited range (arrow b in FIG. **4***a*) around a swivelling axis or a rotating axis D extending vertically in the horizontal plane relative to the compaction device. The swivelling axis extends through the rubber bearings **7** and the bearing areas **7'**, which are respectively connected with the damping element via two screw joints not designated in closer detail. The damping elements are respectively connected with the connection bracket VB as shown in FIG. **1***a* via two further screw joints not designated in closer detail in FIGS. **4***a* and **4***b*.

[0048] Essentially, the guide bar **4** comprises three sections **4***a*, **4***b* and **4***c*, relative to the working direction. The front third **4***a* constitutes the front section F, the middle third **4***b* the bar section B and the rear third **4***c* the handle section GB. The handle section GB is the section used by the operator to guide the machine during operation. Accordingly, the operator will normally walk behind the guide section of the vibration tamper during operation. Further, for example a control element BE is arranged in the handle section. The storage element **9** is mounted on the guide bar **4** between the lateral supporting tubes SB extending in working direction on both sides of the guide bar **4**, with the storage element being arranged essentially in the front third **4***a*. In this manner it is possible to position the balance point of the unit comprising the guide bar **4** and the storage element **9** particularly close to the swivelling axis D, and optimal damping results can be obtained during operation. In this manner, the storage element **9** is not only used for storing electric energy but its mass is also used for obtaining optimal damping results by appropriate arrangement on the guide bar **4**. In this respect, it is generally advantageous to arrange the storage element **9** as closely as possible to, or, as shown in FIG. **4***a*, even overlapping with, the swivelling axis D.

[0049] Finally, FIG. **4***b* shows an alternative embodiment to FIG. **4***a*, with the following merely discussing the essential differences. The essential feature of the embodiment according to FIG. **4***b* is the splitting of the storage element **9** into two storage element components **9***a* and **9***b*, which together constitute the storage element storing the electric energy. In detail, the storage element components **9***a* and **9***b* are arranged in a manner that the storage element component **9***a*, relative to the working direction a, is arranged in front of the swivelling axis D, while the storage element component **9***b*, relative to the working direction, is arranged behind the swivelling axis D, which further optimizes the obtained damping results. Both storage element components **9***a* and **9***b* are arranged as exchange elements and can be exchanged in a time-efficient manner through a rapid exchange system not designated in closer detail.

[0050] While the present invention has been illustrated by description of various embodiments and while those embodiments have been described in considerable detail, it is not the intention of Applicants to restrict or in any way limit the scope of the appended claims to such details. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of Applicants' invention.

What is claimed is:

1. An apparatus for soil compaction, comprising:

a compaction device driven via an electric motor,

a rechargeable storage unit for electrical power, and

a vibration-damped guide device, wherein the storage unit is mounted on the guide device.

2. An apparatus for soil compaction according to claim **1**, wherein the guide device is a guide bar, and that the storage unit is arranged between two support tubes of the guide bar.

3. An apparatus for soil compaction according to claim **1**, wherein the guide device is mounted on a compaction unit of the apparatus for soil compaction via at least two bearings, and that the storage unit is arranged adjacent to the at least two bearings.

4. An apparatus for soil compaction according to claim **1**, wherein the storage unit is, in vertical direction, arranged above the compaction unit.

5. An apparatus for soil compaction according to claim **1**, wherein the storage unit is arranged in a front third of the guide device.

6. An apparatus for soil compaction according to claim **1**, wherein the storage unit is arranged in a section of the guide device which is located opposite to a handle section of the guide device.

7. An apparatus for soil compaction according to claim **1**, wherein an overall balance point of the guide device with the storage unit, relative to a work direction, is arranged in a front third of the guide device.

8. An apparatus for soil compaction according to claim **1**, wherein the storage unit comprises at least two storage element components which are arranged separately, relative to the work direction, in front of and behind a swivelling section of the guide device.

9. An apparatus for soil compaction according to claim **1**, wherein an exchange receiver is provided for the rapid installation and deinstallation of the storage unit on the guide device.

10. An apparatus for soil compaction with a compaction device according to claim **1**, that can be driven via an electric motor, wherein a rechargeable storage unit for electrical power which is connected with the electric motor via a cable is provided for the supply of the electric motor with electrical power, which rechargeable storage unit is carried along in operation independently of the apparatus by an operator.

11. An apparatus for soil compaction according to claim **10**, wherein the storage unit is arranged for transport by an operator and comprises carrying means having one or several shoulder straps.

12. An apparatus for soil compaction according to claim **1**, wherein a device for an additional connection of the storage unit to a power cable is provided.

13. An apparatus for soil compaction with a compaction device, a drive comprising an electric motor, and a cable connection which is arranged for connection with a cable connected with a power source, wherein the cable connection is arranged in a manner that it will automatically detach from the cable after the cable exceeds a fixed tensile load.

14. An apparatus for soil compaction with a drive comprising an electric motor and a compaction device, wherein a device for compaction control is provided which comprises means for determining operating power values of the electric motor and which uses the determined values for determining the compaction of the ground.

15. An apparatus for soil compaction according to claim **14**, wherein a display device is provided, which informs an operator about a current degree of compaction.

16. A method for compaction control for an apparatus for soil compaction according to claim **1**, comprising the following steps:

determining the performance of an electric motor, and

deriving the degree of compaction from the performance of the electric motor.

17. An apparatus for soil compaction according to claim **3**, wherein the guide device is mounted on a frame of the compaction unit.

18. An apparatus for soil compaction according to claim **7**, wherein the overall balancing point of the guide device with the storage unit is arranged in front of a swiveling section of the guide device.

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