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(54) **VIBRATOR BEAM, VIBRATOR FRAME AND METHOD FOR COMPACTING CONCRETE**

(57) The invention relates to a vibrator beam (10) comprising at least two vertical tubes (11, 12) and, therebetween, a support structure (13) comprised of at least one horizontal upper support tube (14) and at least one horizontal lower support tube (15) arranged between the vertical tubes (11, 12) of the vibrator beam, and a plurality of vibrators in the direction of the support structure, and lift means (16) for moving the vibrator beam (10). The invention further relates to a vibrator frame and a method for compacting concrete.

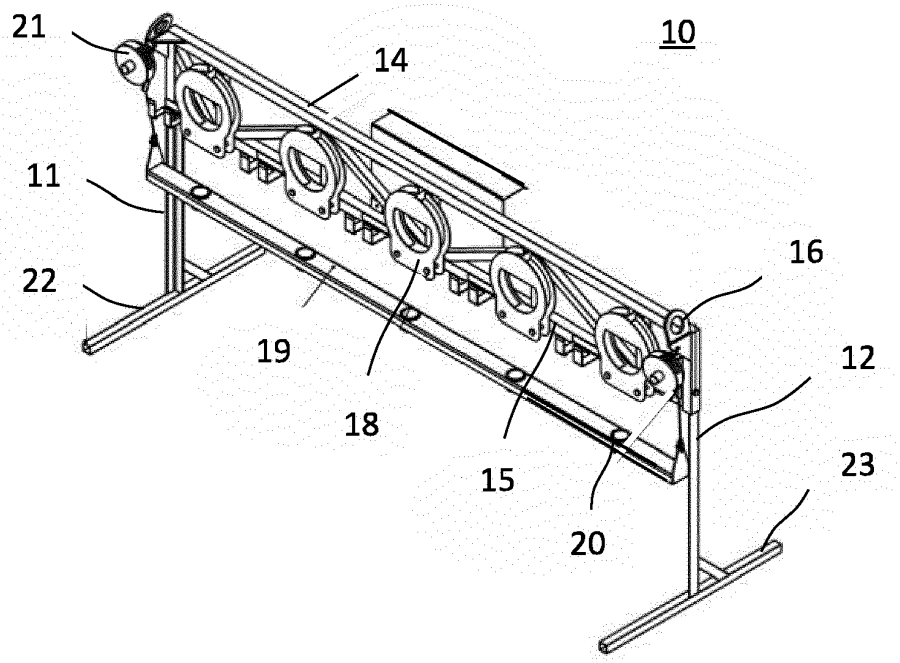

Figure 1

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Description

Field of technology

[0001] The object of the invention is a vibrator beam and a vibrator frame used for compacting concrete. Another object of the invention is a method for compacting concrete.

Background of the invention

[0002] Concrete mass cast at the concreting step is typically cast at the worksite into a form by pouring it straight downward and typically compacted with a rod vibrator. The purpose of compacting the concrete is to fill the form in its entirety, surround the steel parts, make the aggregate granules move closer together and remove extra air from the concrete. Uncompacted concrete cast in a form may contain up to 20 percent entrapped air. Compaction thus significantly improves the strength of concrete by removing excessive air from the concrete.

[0003] During compaction, a rod vibrator is allowed to sink by gravity vertically through the entire cast layer, and in multi-layer casts, to a depth of between 10 and 15 cm up to the previously cast layer. The rod is carefully lifted so that the cavity left behind is allowed to close up. The vibrating time may be determined based on when the surface of the concrete around the rod evens out and air bubbles no longer rise to the surface of the concrete. The vibrating time may be, for example, between 10 and 30 seconds. Vibrating is performed across the entire concreted area at insertion intervals of approximately 0.5 meters. When the cast concrete mass is reinforced with steel, vibration of the reinforcement must be avoided. As positioning of the reinforcement must remain in accordance with the plan in order to ensure the functionality of the structure, walking on the reinforcement must also be avoided.

[0004] The vibrating time is dependent on numerous factors such as the rod vibrator, properties of the concrete, density of the reinforcement and the form structure. The vibrating interval applied also has a significant effect on the vibrating time. The vibrating time is often a compromise. Too short a vibrating time leaves entrapped air in the concrete and thus weakens its strength properties. On the other hand, too long a vibrating time may cause the concrete to separate. In practice, the correct vibrating time has to be estimated by visual observation. Because of the vibrating, compacting concrete may be very arduous and require a large amount of manpower for carrying out the compacting within the planned time frame at the worksite.

[0005] One disadvantage related to use is the vibration generated by known vibrating devices, such as rod vibrator, conveyed through the surfaces of the vibrating device onto the operator while using the vibrating devices. Due to the vibration, it is typical that operators take breaks during the compaction so as to minimize the adverse health effects brought on by the use of the vibrating devices on the operators using the vibrating devices. Breaks lengthen the working time required for compacting. If an operator uses the vibrating device for, e.g., 10 minutes and takes a 10-minute break, the break has then doubled the time required for compacting the concrete.

Summary of the invention

[0006] The aim of the present invention is to solve the above-mentioned problems and to provide a new and innovative solution for compacting concrete.

[0007] These goals are achieved with the invention presented in the accompanying independent claims. Other preferred embodiments of the invention are presented in the dependent claims.

[0008] The invention is based on a beam structure enabling the simultaneous use of multiple vibrators in concreting when compacting concrete mass. The invention helps reduce the time required for compacting concrete and reduce the adverse health effects caused to the operators by the vibration of the vibrators.

Brief description of the drawings

[0009] Next, the invention is described in more detail with reference to the accompanying drawings, in which:

Figure 1 shows a perspective view of a vibrator beam according to an embodiment of the invention equipped with support legs,

Figure 2 shows a view of the embodiment presented in figure 1 as viewed from the side,

Figure 3 shows a view of the embodiment presented in figure 1 as viewed from the end,

Figure 4 shows a perspective picture of a vibrator frame according to an embodiment of the invention.

Detailed description of the invention

[0010] The following describes embodiments of the invention implemented in such a way that they may be used as attachable accessories used with working machinery, such as cranes, particularly in connection with the use of lift booms.

[0011] Figures 1 to 3 show a vibrator beam 10 according to an embodiment of the invention used for compacting concrete, which vibrator beam 10 may be used when casting a wall, for example. The vibrator beam 10 comprises two vertical tubes 11, 12 spaced at a distance from one another, and, therebetween, a support structure 13 comprised of at least one horizontal upper support tube 14 and, spaced at a distance therefrom, at least one horizontal lower support tube 15, wherein the upper support

tubes 14 and lower support tubes 15 are perpendicular to the vertical tubes 11, 12. The vibrator beam 10 shown in figures 1 to 3 further comprises parallel support tubes 17 extending in two different directions between the upper support tube 14 and the lower support tube 15, strengthening the support structure and forming a zigzag pattern between the upper support tube 14 and the lower support tube 15. The support structure 13 is arranged on the level of the top ends of the vertical tubes 11, 12. The support structure 13 may be fixed to the vertical tubes by welding, for example. In figures 1 to 3, the vibrator beam 10 has further been mounted on detachable support legs 22, 23, in order to keep the vibrator beam 10 in a desired position, for example during storage, when the support beam is not in use.

[0012] The vibrator beam 10 is further equipped with lift means 16 which are, for example, steel plates. The steel plates 16 are located at the top ends of the vertical tubes 11, 12. The steel plates 16 are bent toward the center of the vibrator beam 10 and fixed to vertical tubes 11, 12 by welding, for example. The steel plates 16 have central openings for e.g., lift hooks, a wire or a lift sling, by means of which the vibrator beam 10 may be lifted and moved during use, for example with the help of a lift boom.

[0013] In the embodiment presented in figures 1 to 3, the vibrator beam 10 is further fitted with five vibrator mounting plates 18 arranged in the direction of the support structure 13 between the upper support tube 14 and the lower support tube 15. The mounting plates are used to mount the vibrators to the vibrator beam. Mounting the vibrators to the vibrator beam without mounting plates may also be possible. The mounting plates 18 are arranged on one side of the vibrator beam 10. In this example, the distance between the centers of the mounting plates 18 is approximately 600 mm. However, the distance between the mounting plates may vary according to the needs of use, for example between 300 and 700 mm or more. The distance may be affected by, for example, the number of vibrators used in the vibrator beam 10, the vibrator model used and the dimensions thereof.

[0014] There may be various different vibrator models, vibrators and vibrator rods, thus the shape of the mounting plate 18 may vary according to the model used. In the example described above, e.g., five Wacker Neuson Iren model vibrators may be used in the vibrator beam 10. The vibrator mounting plates are in this case comprised of two opposing steel plates of the same shape with a thickness of approximately 3 mm, for example. The mounting plate 18 has a central circular opening, the outer diameter of the mounting plate being approximately 320 mm and its inner diameter approximately 110 mm. The vibrators are mounted to the mounting plates 18 in the vibrator beam by means of suitable fixing means, such as screws, nuts and/or bolts. When using vibrator beams larger than the above-described vibrator beam 10, the number of vibrators may be increased. There may be, for example, between 1 and 18 vibrators in the vibrator beam.

[0015] The vibrator beam further comprises a guide 19 formed by an elongated bar, for example a steel bar, with several openings 20 spaced at a distance from one another in the longitudinal direction of the guide 19. The guide 19 preferably lies under the vibrators mounted to the vibrator beam 10 such that the vibrator rods (not shown in the figures) of the vibrators (not shown in the figures) go through the openings 20 in the guide 19. The openings 20 are dimensioned such that they are larger than the diameter of the end of the vibrator rod, whereby the vibrator rod is able to go through the opening 20 and the guide 19 may thereby be moved in the longitudinal direction of the vibrator rod, essentially upward and downward in the vertical direction.

[0016] The vibrator beam 10 is further equipped with control means 21, the control mechanisms of which are arranged at the top edges of the vibrator beam 10 close to the lift means 16. The control means enable adjusting the distance of the guide 19 in relation to the vibrator beam 10. The vibrator beam preferably comprises a control means 21 at each end of the vibrator beam. When installing the control means 21, a first end thereof may be attached e.g., to a mounting flange in the vibrator beam 10 and a second end thereof is attached to the end of the guide 19, which may comprise a similar mounting flange as the vibrator beam. The control mechanism may be used manually from outside the vibrator beam. When the guide is adjusted to a desired distance from the vibrator beam, the guide may be further moved manually in the vertical and/or horizontal direction during use of the vibrator beam in order to guide the vibrator rods to a desired location for applying the vibrator rods. The control means 21 may be e.g., a wire, a wire spool, a chain or a chain block.

[0017] The vibrator beam 10 further comprises a switchboard 28 to which the vibrators in the vibrator beam 10 can be coupled and with which switchboard the vibrators can be switched on and off simultaneously during use of the vibrator beam 10.

[0018] The above-described vibrator beams 10 may be manufactured as welded structures of varying sizes utilizing e.g., a steel tube with a size of 40x40x2 mm (width x height x wall thickness) and/or a steel tube with a size of 50x50x2 mm in the manufacture. The support legs may be manufactured, for example, from an L-shaped steel bar. The steel flanges 16 may be manufactured, for example, from a 12 mm thick plate, with a size of 120 x 200 mm, for example.

[0019] Figure 4 shows a perspective view of a vibrator frame according to an embodiment of the invention. The vibrator frame 30 shown in figure 4 may be used when concreting vaults and foundations, for example. The vibrator frame 30 comprises two vibrator beams 10 as described hereinbefore positioned opposite each other such that the mounting plates 18 of the vibrator beams face each other in pairs. Between the vibrator beams 10, there is a support structure 24 comprised of at least two

horizontal upper support tubes 25 and at least two horizontal lower support tubes 26. There may be more support tubes 25, 26, if the aim is to build larger vibrator frames, for example. The upper support tubes 25 and lower support tubes 26 are arranged between the vibrator beams 10 of the vibrator frame such that the vibrator beams 10 and the tubes 25, 26 confine a rectangular base 27 opening upward. The base 27 may be covered by e.g., a plywood, plastic, rubber or metal sheet or grid. In this example, the length of the vibrator frame 30 is approximately 2250 mm and the width of the ends is approximately 855 mm. The height of the sides and the ends is approximately 1045 mm.

[0020] It is obvious to a person skilled in the art that the invention is not limited to the presently described solutions but that the inventive idea may be applied in numerous ways within the scope defined by the claims.

Claims

1. A vibrator beam (10), comprising

- at least two vertical tubes (11, 12) and, therebetween, a support structure (13) comprised of at least one horizontal upper support tube (14) and at least one horizontal lower support tube (15) arranged between the vertical tubes (11, 12) of the vibrator beam,
- a plurality of vibrators, comprising vibrator rods, in the direction of the support structure (13), and
- lift means (16) for moving the vibrator beam (10),

characterized in that the vibrator beam (10) further comprises a guide (19) formed by an elongated bar below said vibrators, which guide is movable in the vertical and horizontal directions during use of the vibrator beam (10), and which guide (10) comprises control means (21) for adjusting the distance between the guide (19) and the support structure (13) and a plurality of openings (20) in the longitudinal direction of the guide (19), which openings are dimensioned to be larger than the diameter of the vibrator rods such that when adjusting the distance between the guide (19) and the support structure (13), the vibrator rods go through the openings in the guide (19) and the guide (19) is movable in opposite directions in relation to the vibrator rods, both upward and downward.

2. The vibrator beam (10) according to claim 1, **characterized in that** the control means (21) comprise a wire, a wire spool, a chain or a chain block.

3. The vibrator beam (10) according to claim 1, **characterized in that** the upper support tube (14) and the lower support tube (15) are fixed to the vertical tubes (11, 12) by welding.

4. The vibrator beam (10) according to claim 1, **characterized in that** parallel support tubes (17) extending in one direction or in two directions are provided between the upper support tube (14) and the lower support tube (15).

5. The vibrator beam (10) according to claim 1, **characterized in that** the vibrator beam (10) comprises a plurality of vibrator mounting plates (18) in the direction of the support structure (10) on the same side of the vibrator beam (10).

6. The vibrator beam (10) according to claim 1, **characterized in that** the vibrator beam (10) is equipped with a switchboard (28) for controlling the operation of the vibrators.

7. The vibrator beam (10) according to claim 1, **characterized in that** the vibrator beam (10) is equipped with detachable support legs (22, 23).

8. A vibrator frame (30), **characterized in that** the vibrator frame (30) comprises at least two vertical vibrator beams (10) according to any of the preceding claims 1 to 7, and, therebetween, a support structure (24) comprised of at least two horizontal upper support tubes (25) and at least two horizontal lower support tubes (26) arranged between the vibrator beams (10) of the vibrator frame such that the vibrator beams (10) and the horizontal tubes (25, 26) confine a rectangular base (27) opening upward.

9. The vibrator frame (30) according to claim 8, **characterized in that** the base (27) of the vibrator frame (30) is covered with a plywood, metal, rubber or plastic sheet or grid.

10. A method for compacting concrete, **characterized in that** the method comprises the steps of

- moving the vibrator beam (10) according to any of the preceding claims 1 to 7 or the vibrator frame (30) according to any of the preceding claims 8 to 9 by means of a lift boom;
- adjusting the guide (19) to a distance from the vibrator beam (10), and
- moving the guide (19) in order to guide the vibrator rods.

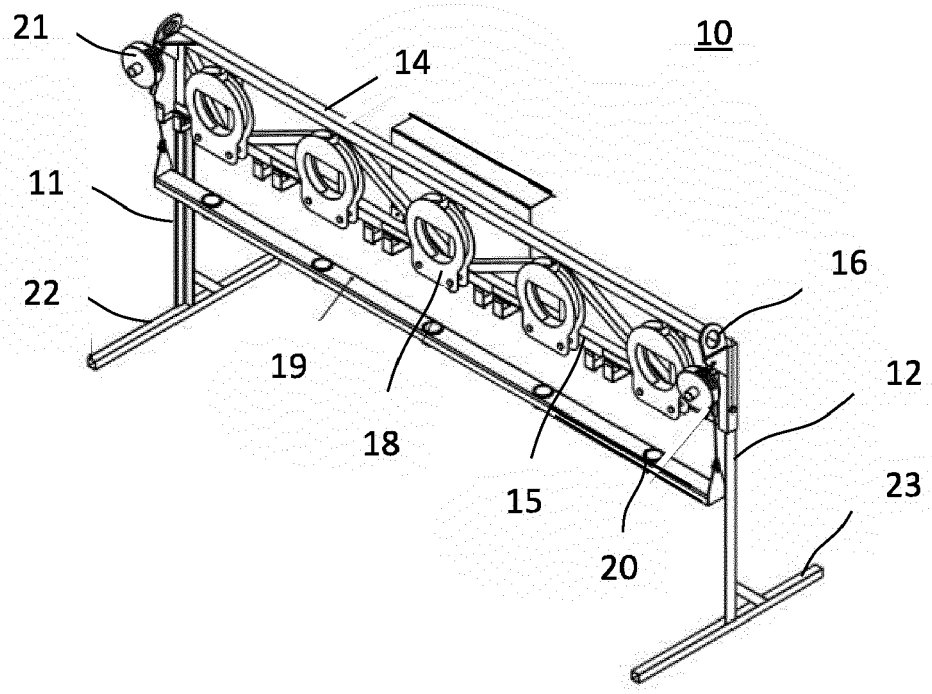

Figure 1

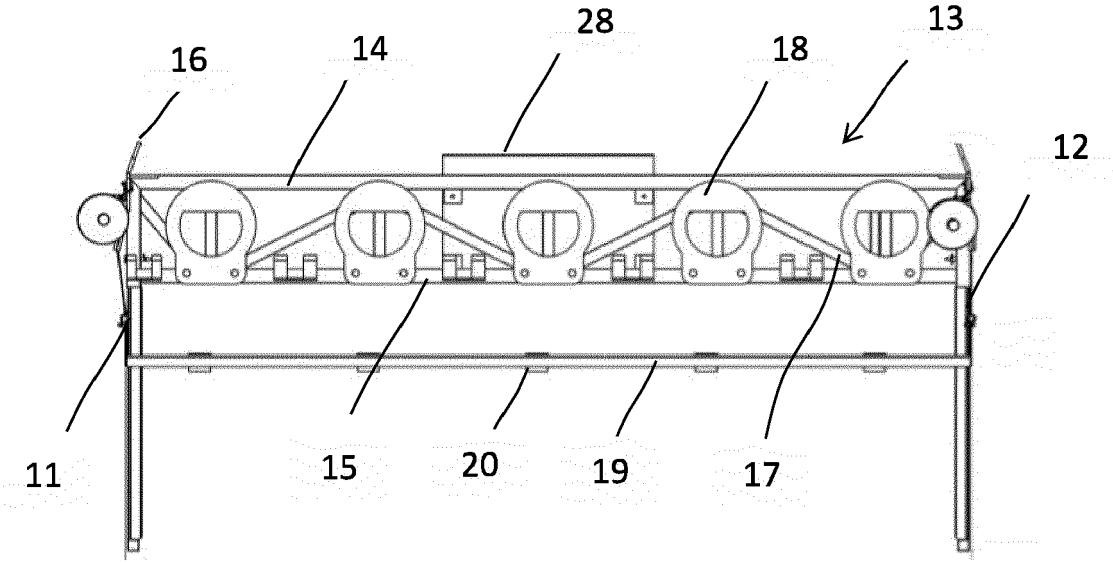

Figure 2

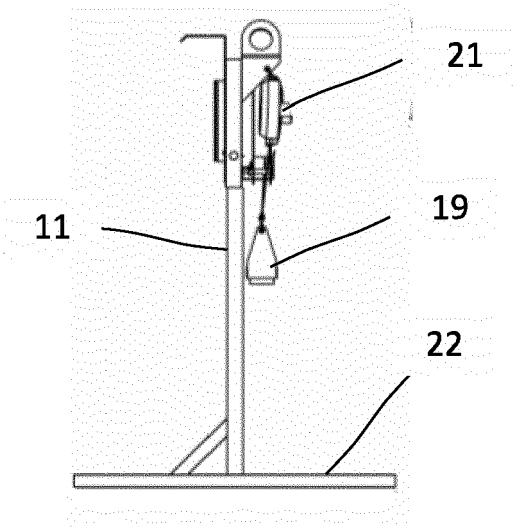

Figure 3

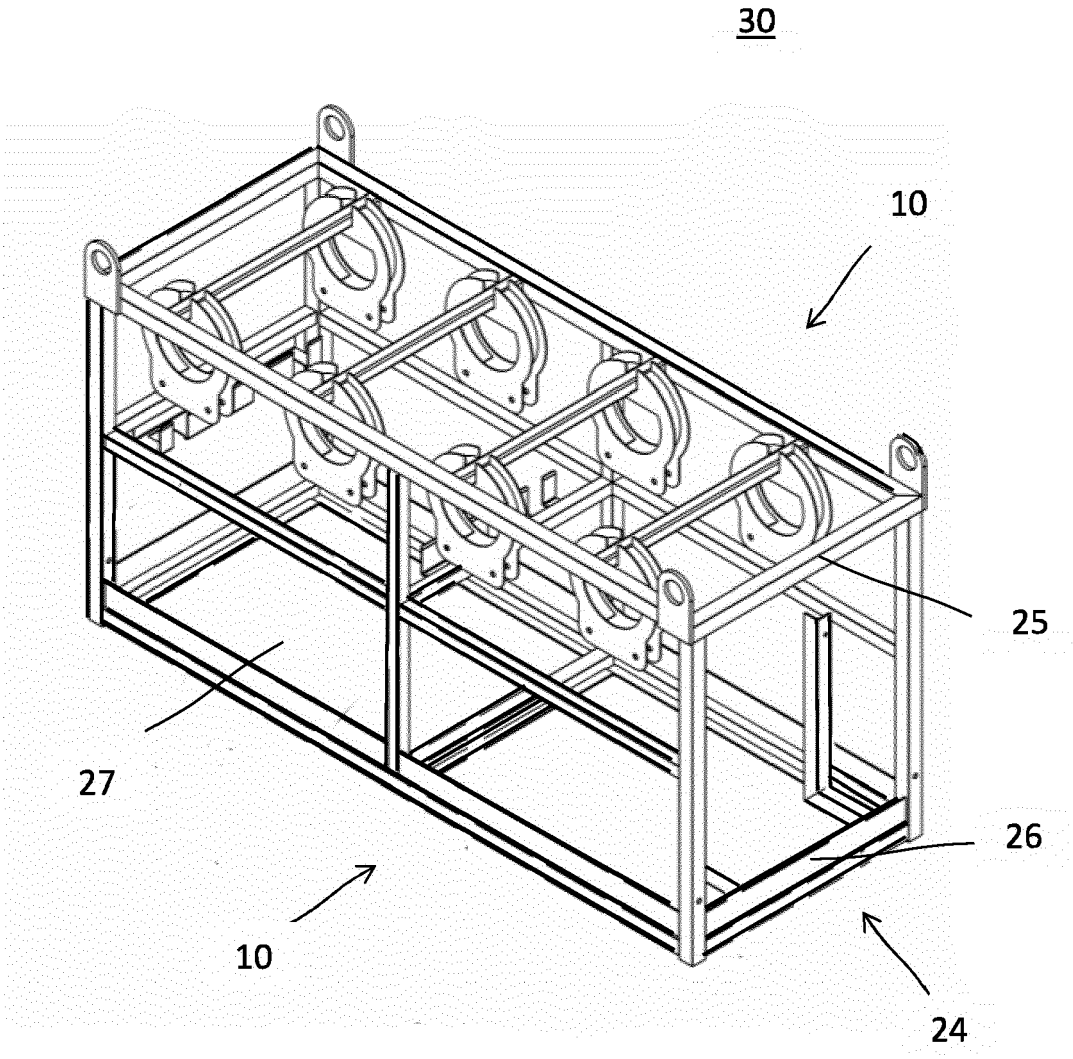

Figure 4

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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 2947

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 October 2021	Baumgärtel, Tim

CATEGORY OF CITED DOCUMENTS

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