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(54) **Method and apparatus for embedding a slab in a substrate containing a type of sand**

Verfahren und Vorrichtung zum Einbetten von Platten in einem eine Art von Sand enthaltendes Substrat

Procédé et dispositif pour encastrier des dalles dans un substrat contenant un type de sable

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Description

[0001] The invention relates to a method for at least partly embedding a slab comprising a top side and a bottom side in a substrate containing a type of sand, with the method at least comprising: placing the bottom side of the slab against the substrate.

[0002] The invention further relates to an apparatus for at least partly embedding a slab comprising a top side and a bottom side in a substrate.

[0003] In this context, a slab is understood to mean a slab which is, for instance, manufactured from a type of stone and/or concrete. The term slab also includes steel or plastic slabs. Such slabs are used in civil engineering and other construction activities. Such a slab can have a weight of some hundreds to some thousands of kilograms. The dimensions can differ from slab to slab.

[0004] Such a method is known per se and is often used in the preparation of a ground on or over which, for instance, a traffic route is constructed. After placing the bottom side of the slab against the substrate, in the known method, for instance a truck, in some cases a train, or another vehicle generating vibration when moving, is driven over or along the slab. The vibrations supplied to the slab when such a vehicle is being moved over or along the slab result in a compaction of the sand present between the slabs and/or under the slab near the longitudinal edges of the slab. To compensate for the compaction of this sand, sand needs to be regularly supplied to a substrate located near a longitudinal edge or circumferential edge of the slab. After each vibration treatment given to the slab by means of one of the above vehicles, it is assessed whether the compaction of the sand under the slab has been effected to a desired extent. This may, for instance, be done by determining whether sand should be supplied to the substrate located near the longitudinal edge of the slab to compensate for the compaction of the sand present under the slab. If, after a vibration treatment, compared to a previous vibration treatment, there is no change in the substrate located near the longitudinal edge of the slab, it is assumed that the sand present near the longitudinal edges of the slab will hardly or not compact any further. If this is the case, no sand needs to be added to the substrate located near the longitudinal edge of the slab. The slab is then embedded to the desired extent.

[0005] The drawback of a known method is that the time taken up by this method depends on the frequency at which one of the above-mentioned vibration-generating vehicles moves over or along the slab. It is possible that a train or a truck needs to be moved over or along the slab as many as five to ten times before the desired extent of embedding of the slab can be achieved. After each passing of one of the above-mentioned vehicles, it needs to be examined whether sand needs to be added to compensate for the compaction of the sand under the slab. This requires manpower and time. In other words, the known method is a time-consuming and expensive

method.

[0006] The invention contemplates meeting the above-mentioned problem.

[0007] The object of the invention is achieved by a method according to the invention which is characterized in that the method further comprises transmitting vibrations to the slab by means of a vibrator which is substantially fixated with respect to the slab.

[0008] By means of a method according to the invention, it is possible to embed the slab in the substrate to the desired extent within a short space of time. The vibrations are simply transmitted from the vibrator substantially fixed with respect to the slab, to the slab. Prior to the transmission of the vibrations or during the transmission of the vibrations to the slab, the sand can be supplied to the substrate located near the longitudinal edge of the slab. When the desired extent of embedding has been achieved, that is, when it is observed that a further compaction of the sand under the slab will hardly take place anymore, it can be decided to stop the transmission of vibrations to the slab. It has been found that the time between turning on the vibrator for transmitting vibrations to the slab and turning off the vibrator can be limited to a much shorter space of time than the space of time that is needed for embedding the slab by means of the known method. For instance, it has been found that, by a method according to the invention, a slab weighing 800 to 2000 kg can be embedded to the desired extent in a substrate containing a type of sand within a space of time of tens of seconds or less. By means of the known method, the time needed for embedding corresponds to the time needed for a vibration-generating vehicle to be able to pass over or along the slab many times. Usually, this involves much more time than tens of seconds. In addition, it is possible for one person, near the slab to which vibrations are transmitted, to observe directly during the transmission of the vibrations whether more sand needs to be supplied to the substrate located near the longitudinal edge or circumferential edge of the slab and/or whether the desired extent of embedding has been achieved. In addition, the method according to the invention offers the advantage that the embedding of the slab can be scheduled, since it only depends on the availability of the vibrator substantially fixated with respect to the slab. In the known method, the embedding depends on the availability of the vibration-generating vehicles for transmitting vibrations to the slab when these vehicles are moving over or along the slab. In other words, the method according to the invention is faster and less expensive.

[0009] DE 10105587 discloses a method for embedding paving stones. Said method comprises placing a vibrating body on a top side of the paving stones and, while providing a limitation to sideways movement of the vibrating body, glidingly moving said vibrating body over the top of the paving stones.

[0010] DE3324441 discloses a movable apparatus for transporting concrete parts, provided with at least one

suction cup for lifting said concrete parts.

[0011] In particular, in a method according to the invention, the vibrations from each vibrator are transmitted to a suction cup applied against the top side of the slab. This offers the advantage that, by means of the suction cup, the bottom side of the slab can be placed against the substrate before the vibrations are transmitted to the suction cup. In that case, the slab does not need to be provided with means, such as for instance a crane hook, which facilitate the placing of the slab. Also, applying and removing the suction cup are simple operations. The at least one vibrator does not need to be separately provided against the slab after the slab has been placed.

[0012] Preferably, the method further comprises maintaining a vacuum in a room bounded by the slab and the suction cup. This makes it possible to move a very heavy slab. It is also possible to transmit vibrations to this very heavy slab via the suction cup. This is because, due to the vacuum created in the room, the slab and the suction cup will be sucked against each other such that, during the method, the slab and the suction cup can be considered a rigid whole. The vibrations transmitted from each vibrator to the suction cup will hardly be damped by the suction cup.

[0013] In particular, the suction cup may be provided with a substantially rigid plate-shaped frame having a first side and a second side located substantially opposite the first side, the first side being provided with the at least one vibrator and the second being provided with recesses for forming the room. Such a rigid slab is eminently suitable for transmitting vibrations to the slab. In particular, the at least one vibrator has been provided against the first side of the frame, so that the vibrations from each vibrator are directly transmitted to the frame.

[0014] Further, in particular, the method also comprises preventing air from leaking into the room by means of a band provided on a circumferential edge of the second side of the frame, which band is substantially manufactured from a compressible material. This has the advantage that the method can be carried out using a relatively small vacuum pump.

[0015] The method may also comprise determining a depth over which the slab is embedded in the substrate. The determination may take place visually on the basis of a marking provided on a longitudinal edge of the slab. However, it is also possible for the determination to take place by means of an assembly comprising first means having a fixed position with respect to the slab and second means having a fixed position with respect to the substrate, the assembly being designed to stop the transmission of vibrations the slab when the first and second means have reached a predetermined height relative to each other.

[0016] The invention and further embodiments thereof are further elucidated with reference to a drawing, in which:

Fig. 1 shows a slab and an apparatus according to

the invention for carrying out a method according to the invention;

Fig. 2 shows a top plan view of the slab and an apparatus according to the invention;

5 Fig. 3 diagrammatically shows a cross section along the line I-I of the slab and apparatus according to the invention shown in Fig 2; and

10 Fig. 4 diagrammatically shows, in cross section, two slabs which are each embedded in a substrate by an apparatus according to the invention using a method according to the invention.

[0017] In the description of the drawing, same parts have same reference numerals or reference symbols.

15 **[0018]** Fig. 1 shows, in perspective, an apparatus 1 for at least partly embedding, in a substrate 2, a slab 3 manufactured from, for instance, a type of stone and/or concrete, which slab comprises a top side 4 and a bottom side 5. The apparatus 1 is provided with at least one suction cup 6 which, in use, is fixatable against the top side 4 of the slab 3. In addition, the suction cup 6 is provided with a vibrator 7 substantially fixated with respect to the suction cup 6 for, in use, transmitting vibrations to the slab 3 via the suction cup 6. In the embodiment shown, the suction cup 6 is provided with two vibrators 7. The suction cup 6 is provided with means 8 for connecting a vacuum pump (not shown) by means of which, in use, a vacuum can be maintained in a room 9 bounded by the slab and suction cup 6 (see Fig. 3 and Fig. 4). In the example shown, the suction cup 6 is provided with a substantially rigid plate-shaped frame 10 having a first side 11 and a second side 12 located substantially opposite the first side. The first side 11 is provided with two vibrators 7 and the second side is provided with recesses 13 for forming the room 9 (see Fig. 3 and Fig. 4). In the embodiment shown, the frame 10 comprises a frame plate 14 which is provided with plates 15 on the second side 12 of the suction cup 6 for, in use, maintaining a distance between the frame plate 14 and the slab 3 manufactured from a type of stone and/or concrete when the suction cup 6 has been applied against the slab 3. As is shown in Figs. 3 and 4, this results in the room 9 bounded by the slab and the suction cup when the suction cup has been applied against the slab 3. It could also be said that the recesses 13 on the second side 12 of the plate-shaped frame 10 are located between the plates 15 provided against the frame plate 14. The frame plate 14 comprises openings 30. The frame 10 designed as a suction cup is provided with an air discharge connection extending from positions in the recesses 13, through the frame, to the means 8 for connecting a vacuum pump. In the embodiment shown, the means 8 are designed as outlets to which vacuum lines 16 can be connected. The vacuum lines 16 form an air discharge connection between the outlets and the vacuum pump not shown. As said, the outlets further have an air discharge connection through the plate-shaped frame 10 to the recesses 13, that is, in use, the rooms 9. In the example shown, the frame plate

14 is provided with perforations for obtaining the openings 30.

[0019] Apparatus 1 is further provided with a band 17 provided along a circumferential edge 21 of the second side 12 of the frame 10 (see Fig. 3 and Fig. 4). The band 17 is closed upon itself and substantially manufactured from a compressible material for, in use, preventing air from leaking into the room. The compressible material preferably substantially contains rubber. Preferably, the band 17 is provided with a side 18 substantially facing the slab, which side comprises pores. Thus, the band can be manufactured from a rubber comprising pores. Further, the band 17 closed upon itself may be provided with an inside 19 and an outside 20 which each comprise a skin which substantially seals the pores (not shown). In the exemplary embodiment shown, the frame comprises a U-section 22 extending along the circumferential edge 21 of the frame 10, in which U-section the band 17 is included. Preferably, the band 17 is provided with a band side 18 facing the slab 3 in which recesses (not shown) have been provided. These recesses allow the compressible band to deform easily and to remain connected to the surface of the slab 3 when that surface has been provided with relief.

[0020] As said before, in the example shown, the apparatus 1 is provided with two vibrators 7 substantially fixated with respect to the suction cup 6 for, in use, transmitting vibrations to the slab 3. In the exemplary embodiment shown, the vibrators have been provided against the first side 11 of the frame 10. Preferably, the vibrators 7 are electric vibrators. However, it is also possible to use pneumatic or hydraulic vibrators.

[0021] In the exemplary embodiment shown, each vibrator is provided with an eccentric (not shown) which rotates in use for the purpose of generating the vibrations. Preferably, the eccentrics are arranged such that, in use, they each rotate in a substantially vertically located plane. It is still more preferred that, in use, the eccentrics rotate in the same plane. As shown in Fig. 2 by the arrows E, looking at the top side 4 of the slab 3, the eccentrics preferably rotate towards each other. The fluid connection already discussed can also be described as an air discharge connection between the second side 12 of the plate-shaped frame 10 and the means 8 for connecting the vacuum pump. Preferably, in the air discharge connection already discussed, means are included for weakening an airflow. These means can comprise the frame plate 14 when this plate 14 is, for instance, provided with perforations. Preferably, the means for weakening an airflow comprise a buffer room 23. In the exemplary embodiment shown, the buffer room 23 is at least partly designed as a hollow beam. Preferably, at least a part of this hollow beam extends parallel to the slab 3 in a longitudinal direction. In this manner, it is achieved that the hollow beam also has a strengthening function for the plate-shaped frame. This promotes the rigidity of the plate-shaped frame. Preferably, the hollow beams 23 are connected to one another by means of a fluid connection.

Thus, in use, the air to be discharged from the rooms 9 can end up in the hollow beams 23 via the perforations in the frame plate 14 and then be exhausted therefrom via the outlets 8 connected to the hollow beams 23 by and in the direction of the vacuum pump (not shown).

[0022] In the exemplary embodiment shown of the apparatus according to the invention, also, the suction cup is provided with hoisting means 24 for placing the suction cup 6. Hoisting means may be designed such that the suction cup 6 with the slab 3 fixedly sucked against it in use can also be moved.

[0023] The apparatus according to the invention is by no means limited to the embodiment shown hereinabove. For instance, the apparatus may also be provided with an assembly comprising first means which, in use, have a fixed position with respect to the suction cup 6 and second means which are designed such that, in use, these second means assume a fixed position with respect to the substrate 2. This assembly may be designed to stop the transmission of vibrations to the suction cup 6 when the first and second means have reached a predetermined height relative to each other. Such an assembly may, for instance, comprise a feeler and a contact point. It is also possible for the assembly to comprise a laser and a laser light detector.

[0024] The method of the apparatus according to the invention will become clear from the following description of the method according to the invention.

[0025] The method for at least partly embedding a slab comprising a top side and a bottom side in a substrate containing a type of sand comprises at least placing the bottom side of the slab against the substrate and transmitting vibrations to the slab by means of a vibrator substantially fixated with respect to the slab. Preferably, this method is carried out using the apparatus 1. In this case, the suction cup 6 is placed against the top side of the slab 3 such that a room 9 is formed. The means 8 for connecting a vacuum pump will be connected to a vacuum pump. By means of the vacuum pump, air is exhausted from the room 9. This causes the top side 4 of the slab 3 and the suction cup to be sucked against each other. It could also be said that, in use, the atmospheric pressure, which is higher than the pressure of the vacuum in room 9, presses the slab and the suction cup against each other. It is then possible to place the bottom side 5 of the slab 3 against the substrate 2 by means of the hoisting means 24. Then, by means of the at least one vibrator 7 fixated with respect to the slab 3, vibrations can be transmitted to the slab 3. The vibrations from each vibrator are transmitted to the suction cup 6 applied against the top side 4 of the slab 3. The vacuum pump maintains a vacuum in the room 9 bounded by the slab 3 and the suction cup 6. Because the slab and the suction cup are tightly pressed against each other and because the suction cup has a rigid design, in use, the vibrations transmitted from the vibrators to the suction cup are passed on to the slab. In more detail, the suction cup 6 is provided with a rigid plate-shaped frame 10 having a

first side 11 and a second side 12 located substantially opposite the first side 11. The first side 11 is provided with the at least one vibrator 7 and the second side 12 is provided with recesses 13 for forming a room 9. The prevention of air leaking into the room 9 takes place by means of a band 17 provided on or along a circumferential edge 21 of the second side 12 of the frame 10, which band is manufactured substantially from a compressible material. In this method, further, a band is used as described in the description of the apparatus 1. Preferably, the vibrators 7 are provided against the first side 11 of the frame so that the vibrations can be transmitted directly from each vibrator 7 to the suction cup 6. Each vibrator 7 is preferably provided with an eccentric (not shown) which rotates for the purpose of generating the vibrations. Preferably, the eccentrics each rotate in a substantially vertical plane. A proper embedding of the slab and/or compaction of the sand present under the slab 3 takes place when the eccentrics rotate in the same plane. The direction of rotation of the vibrators 7 provided against the first side 11 of the frame 10 is preferably such that, looking at the top side of the slab 3, the eccentrics rotate towards each other.

[0026] The method may further comprise: determining a depth over which the slab is embedded in the substrate. This determination may take place visually on the basis of markings provided on a longitudinal edge of the slab 3. However, it is also possible for the determination to take place by means of an assembly comprising first means having a fixed position with respect to the slab and second means having a fixed position with respect to the substrate. The assembly has been designed to stop the transmission of vibrations to the slab when the first and second means have reached a predetermined height relative to each other. Examples of such an assembly have been discussed in the description of the apparatus 1. In many cases, the bottom side 5 of the slab will be smaller than the top side 4. In other words, the slab will be provided with a sloping longitudinal edge. Before or during embedding, sand is provided against or near the longitudinal edge of the slab. Preferably, the provision of sand takes place only once. Two slabs can be embedded such that the top sides form virtually one continuous surface. Preferably, the sand is provided a single time on or in a joint present between the slabs. Providing the sand may be done near the arrow Z shown in Fig. 4.

[0027] The invention is not limited to the method shown. It is, for instance, possible for the vibrators to be provided at some distance from the first side 11 of the frame instead of directly against the first side 11 of the frame. It is then, of course, required that such a medium is present between each vibrator 7 and the first side of the frame 10 that vibration generated by each vibrator 7 can be transmitted to the frame 10 designed as a suction cup and the slab 3. The vibrations may be generated by means of electrically driven eccentrics, pneumatically driven eccentrics or hydraulically driven eccentrics, by

rotation of the eccentrics. It is also conceivable that vibrations are generated without using eccentrics. It will be clear that, after embedding the slab 3 to a sufficient extent, the suction cup 6 is removed from the slab 3 by letting airflow into the room 9. The suction cup may then be removed from the slab 3 without the slab 3 changing position. The method can largely be carried out automatically. In particular, the removal of the suction cup 6 from the slab 3 can take place without manual operations by a worker stationed near the slab 3. Operating the vacuum, hoisting the suction cup, and operating the vibrators will have to be done by a worker. However, these operations can be carried out remotely from the slab. This promotes safety. It is also possible that adding sand to the substrate near a longitudinal edge of the slab 3 is carried out automatically. The method may also provide such a step. Optionally, the apparatus may be designed such that sand can be added to the substrate located near the longitudinal edge of the slab prior to or during vibration. The supply of sand can stop automatically when it has been determined that the slab has been embedded to a sufficient extent.

[0028] Such variants are each understood to be within the scope of the invention, which is determined by the terms of the claims.

Claims

1. A method for at least partly embedding a slab (3) comprising a top side (4) and a bottom side (5) in a substrate (2) containing a type of sand, wherein the method at least comprises:
 - placing the bottom side (5) of the slab (3) against the substrate (2), **characterized in that** the method further comprises:
 - transmitting vibrations to the slab (3) by means of at least one vibrator (7) substantially fixated with respect to the slab (3).
2. A method according to claim 1, **characterized in that** the vibrations from each vibrator (7) are transmitted to a suction cup (6) applied against the top side (4) of the slab (3).
3. A method according to claim 2, **characterized in that** the method comprises:
 - maintaining a vacuum in a room (9) bounded by the slab (3) and the suction cup (6).
4. A method according to claim 3, **characterized in that** the suction cup (6) is provided with a rigid substantially plate-shaped frame (10) having a first side (11) and a second side (12) located substantially opposite the first side (11), wherein the first side (11) is provided with the at least one vibrator (7) and the

second side (12) is provided with recesses (13) for forming the room (9).

5. A method according to claim 4, **characterized in that** the method comprises:

- preventing air from leaking into the room (9) by means of a band (17) provided on a circumferential edge (21) of the second side of the frame (10), which band (17) is manufactured substantially from a compressible material.

6. A method according to claim 5, **characterized in that** the compressible material comprises substantially rubber.

7. A method according to claim 6, **characterized in that** the band (17) is provided with a side (18) substantially facing the slab (3), which side comprises pores.

8. A method according to claim 5, 6, or 7, **characterized in that** the band (17) is manufactured from a rubber comprising pores.

9. A method according to claim 8, **characterized in that** the band (17) closed upon itself is provided with an inside (19) and an outside (20) which each comprise a skin which substantially seals the pores.

10. A method according to any one of claims 5-9, **characterized in that** the band is provided with a band side (18) facing the slab (3), in which recesses have been provided.

11. A method according to any one of the preceding claims, **characterized in that** the method comprises:

- transmitting vibrations to the slab (3) by means of two vibrators (7) substantially fixated with respect to the slab (3).

12. A method according to any one of the preceding claims, **characterized in that** each vibrator (7) is provided with an eccentric which rotates for the purpose of generating the vibrations.

13. A method according to claims 11 and 12, **characterized in that** the eccentrics each rotate in a substantially vertically located plane.

14. A method according to claim 13, **characterized in that** the eccentrics rotate in the same plane.

15. A method according to the invention to claim 12, 13 or 14, **characterized in that**, looking at the top side (4) of the slab (3), the eccentrics rotate towards each

other.

16. A method according to any one of the preceding claims, **characterized in that** the method further comprises: determining a depth over which the slab (3) is embedded in the substrate (2).

17. A method according to claim 16, **characterized in that** the determination takes place visually on the basis of markings provided on a longitudinal edge of the slab.

18. A method according to claim 16 or 17, **characterized in that** the determination takes place by means of an assembly comprising first means having a fixed position with respect to the slab (3) and second means having a fixed position with respect to the substrate (2), wherein the assembly is designed to stop the transmission of vibrations to the slab (3) when the first and second means have reached a predetermined height relative to each other.

19. A method according to claim 18, **characterized in that** the assembly comprises a feeler and a contact point.

20. A method according to claim 18 or 19, **characterized in that** the assembly comprises a laser and a laser light detector.

21. A method according to any one of the preceding claims insofar as dependent on claims 2 and 3, **characterized in that** placing the bottom side (5) of the slab (3) against the substrate (2) takes place by means of hoisting (24) and placing the suction cup (6).

22. A method according to any one of the preceding claims, **characterized in that** the bottom side (5) of the slab is smaller than the top side (4).

23. A method according to claim 22, **characterized in that** sand is provided against or near the longitudinal edge of the slab (3).

24. A method according to any one of the preceding claims, **characterized in that** the method comprises: embedding two slabs (3) such that the top sides (4) virtually form a continuous surface.

25. A method according to claim 24, **characterized in that** sand is provided a single time on or in a joint present between the slabs (3).

26. An apparatus for at least partly embedding a slab (3) according to the method of any one of claims 1 to 25, the slab comprising a top side (4) and a bottom side (5) in a substrate (2) containing a type of sand,

the apparatus comprising at least one vibrator (7) for, in use, transmitting vibrations to the slab (3), **characterized in that** the apparatus is provided with at least one suction cup which is, in use, fixatable against the top side (4) of the slab (3) and the at least one vibrator (7) is substantially fixated with respect to the suction cup (6) for, in use, transmitting the vibrations to the slab (3) via the suction cup (6).

27. An apparatus according to claim 26, **characterized in that** the suction cup (6) is provided with means (8) for connecting a vacuum pump by means of which, in use, a vacuum can be maintained in a room (9) bounded by the slab (3) and the suction cup (6).

28. An apparatus according to claims 26 and 27, **characterized in that** the suction cup (6) is provided with a rigid plate-shaped frame (10) having a first side (11) and a second side (12) located substantially opposite the first side (11), wherein the first side (11) is provided with the at least one vibrator (7) and the second side (12) is provided with recesses for forming the room (9).

29. An apparatus according to any one of claims 26-28, **characterized in that** the apparatus is provided with a band (17) provided along a circumferential edge (21) of the second side (12) of the frame (10), which band (17) is closed upon itself and is manufactured substantially from a compressible material for preventing air from leaking into the room (9).

30. An apparatus according to claim 29, **characterized in that** the compressible material comprises substantially rubber.

31. An apparatus according to claim 29 or 30, **characterized in that** the band (17) is provided with a side (18) substantially facing the slab (3), which side comprises pores.

32. An apparatus according to claim 29, 30 or 31, **characterized in that** the band (17) is manufactured from a rubber comprising pores.

33. An apparatus according to any one of claims 29-32, **characterized in that** the band (17) closed upon itself is provided with an inside and an outside which each comprise a skin which substantially seals the pores.

Patentansprüche

1. Verfahren zum mindestens teilweise Einbetten einer Platte (3), umfassend eine obere Seite (4) und eine untere Seite (5), in ein eine Art von Sand aufweisendes Substrat (2), wobei das Verfahren mindestens

umfasst:

- Platzieren der unteren Seite (5) der Platte (3) gegen das Substrat (2), **dadurch gekennzeichnet, dass** das Verfahren aufweist:

- Übertragen von Vibrationen auf die Platte (3) mit Hilfe wenigstens eines Vibrators (7), welcher bezüglich der Platte (3) im Wesentlichen fixiert ist.

2. Verfahren gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Vibrationen jedes Vibrators (7) zu einem Saugnapf (6) übertragen werden, welcher gegen die obere Seite (4) der Platte (3) aufgebracht ist.

3. Verfahren gemäß Anspruch 2, **dadurch gekennzeichnet, dass** das Verfahren aufweist:

- Aufrechterhalten eines Vakuums in einem bezüglich der Platte (3) und des Saugnapfes (6) begrenzten Raum (9).

4. Verfahren gemäß Anspruch 3, **dadurch gekennzeichnet, dass** der Saugnapf (6) mit einem steifen, im Wesentlichen plattenförmigen Rahmen (10) ausgestattet ist, der eine erste Seite (11) und eine zweite Seite (12) aufweist, die im Wesentlichen gegenüber der ersten Seite (11) liegt, wobei die erste Seite (11) mit dem mindestens einen Vibrator (7) ausgestattet ist und die zweite Seite (12) mit Aussparungen (13) zur Ausbildung des Raumes (9) ausgestattet ist.

5. Verfahren gemäß Anspruch 4, **dadurch gekennzeichnet, dass** das Verfahren aufweist:

- Verhindern, dass Luft in den Raum (9) austritt mit Hilfe eines Bandes (17), das auf der Umfangskante (21) der zweiten Seite des Rahmens (10) vorgesehen und im Wesentlichen aus einem zusammendrückbaren Material hergestellt ist.

6. Verfahren gemäß Anspruch 5, **dadurch gekennzeichnet, dass** das zusammendrückbare Material im Wesentlichen Gummi aufweist.

7. Verfahren gemäß Anspruch 6, **dadurch gekennzeichnet, dass** das Band (17) mit einer Poren aufweisenden Seite (18) im Wesentlichen der Platte (3) zugewandt vorgesehen ist.

8. Verfahren gemäß Anspruch 5, 6 oder 7, **dadurch gekennzeichnet, dass** das Band (17) aus einem Poren aufweisenden Gummi gefertigt ist.

9. Verfahren gemäß Anspruch 8, **dadurch gekennzeichnet, dass** das auf sich selbst geschlossene

- Band (17) mit einem Inneren (19) und einem Äußeren (20) ausgestattet ist, die beide eine die Poren im Wesentlichen verschließende Haut aufweisen.
10. Verfahren gemäß einem der Ansprüche 5-9, **dadurch gekennzeichnet, dass** das Band mit einer Bandseite (18) der Platte (3) zugewandt vorgesehen ist, in welcher Aussparungen vorgesehen sind.
11. Verfahren gemäß einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** das Verfahren aufweist:
- Übertragen von Vibrationen zu der Platte (3) mit Hilfe von zwei Vibratoren (7), welche bezüglich der Platte (3) im Wesentlichen fixiert sind.
12. Verfahren gemäß einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** jeder Vibrator (7) mit einem Exzenter ausgestattet ist, welcher zum Zwecke der Erzeugung von Vibrationen rotiert.
13. Verfahren gemäß Anspruch 11 und 12, **dadurch gekennzeichnet, dass** die Exzenter jeweils in einer im Wesentlichen vertikal gelegenen Ebene rotieren.
14. Verfahren gemäß Anspruch 13, **dadurch gekennzeichnet, dass** die Exzenter in der gleichen Ebene rotieren.
15. Verfahren gemäß der Erfindung von Anspruch 12, 13 oder 14, **dadurch gekennzeichnet, dass**, bei Betrachtung der oberen Seite (4) der Platte (3) die Exzenter gegeneinander rotieren.
16. Verfahren gemäß einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** das Verfahren weiter aufweist: Bestimmung einer Tiefe über welche die Platte (3) in dem Substrat (2) eingebettet ist.
17. Verfahren gemäß Anspruch 16, **dadurch gekennzeichnet, dass** die Bestimmung visuell auf Basis von Markierungen durchgeführt wird, welche auf der Längskante der Platte angeordnet sind.
18. Verfahren gemäß Anspruch 16 oder 17, **dadurch gekennzeichnet, dass** die Bestimmung mit Hilfe einer Baugruppe durchgeführt wird, welche erste Mittel mit einer festen Position bezüglich der Platte (3) und zweite Mittel mit einer festen Position bezüglich des Substrats (2) aufweist, wobei die Baugruppe entworfen ist, um die Übertragung von Vibrationen zu der Platte (3) zu unterbrechen, wenn die ersten und zweiten Mittel eine vorbestimmte Höhe relativ zueinander erreicht haben.
19. Verfahren gemäß Anspruch 18, **dadurch gekennzeichnet, dass** die Baugruppe einen Taster und einen Kontaktpunkt aufweist.
20. Verfahren gemäß Anspruch 18 oder 19, **dadurch gekennzeichnet, dass** die Baugruppe einen Laser und einen Laserlichtdetektor aufweist.
21. Verfahren gemäß einem der vorangegangenen Ansprüche, sofern abhängig von Anspruch 2 und 3, **dadurch gekennzeichnet, dass** das Platzieren der unteren Seite (5) der Platte (3) gegen das Substrat (2) durch Heben (24) und Platzieren des Saugnapfs (6) stattfindet.
22. Verfahren gemäß einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** die untere Seite (5) der Platte kleiner als die obere Seite (4) ist.
23. Verfahren gemäß Anspruch 22, **dadurch gekennzeichnet, dass** Sand gegen oder nahe der Längskante der Platte (3) bereitgestellt ist.
24. Verfahren gemäß einem der vorausgegangenen Ansprüche, **dadurch gekennzeichnet, dass** das Verfahren aufweist: Einbetten zweier Platten (3) so, dass die oberen Seiten (4) praktisch eine kontinuierliche Oberfläche bilden.
25. Verfahren gemäß Anspruch 24, **dadurch gekennzeichnet, dass** Sand ein einziges Mal auf oder in einer zwischen den Platten (3) auftretenden Fuge bereitgestellt wird.
26. Gerät zum mindestens teilweisen Einbetten einer Platte (3) gemäß dem Verfahren gemäß einem der Ansprüche 1-25, wobei die Platte eine obere Seite (4) und eine untere Seite (5) in einem Substrat (2) aufweist, welches eine Art von Sand enthält, das Gerät mindestens einen Vibrator (7) aufweist um im Betrieb Vibrationen zur Platte (3), **dadurch gekennzeichnet, dass** das Gerät mit mindestens einem Saugnapf ausgestattet ist, welcher im Betrieb gegen die obere Seite (4) der Platte (3) fixierbar ist und dass der mindestens eine Vibrator (7) bezüglich eines Saugnapfs (6) im Wesentlichen fixiert ist, um im Betrieb die Vibrationen zu der Platte (3) über den Saugnapf (6) zu übertragen.
27. Gerät gemäß Anspruch 26, **dadurch gekennzeichnet, dass** der Saugnapf (6) mit Mitteln (8) zum Verbinden einer Vakuumpumpe ausgestattet ist, mit Hilfe derer im Betrieb ein Vakuum in einem Raum (9) aufrechterhalten wird, der durch die Platte (3) und den Saugnapf (6) begrenzt ist.
28. Gerät gemäß Anspruch 26 und 27, **dadurch ge-**

kennzeichnet, dass der Saugnapf (6) mit einem festen plattenförmigen Rahmen (10) ausgestattet ist, welcher eine erste Seite (11) und eine zweite Seite (12) aufweist, die im Wesentlichen gegenüber der ersten Seite liegt (11), wobei die erste Seite (11) mit dem mindestens einen Vibrator (7) ausgestattet ist und die zweite Seite (12) mit Aussparungen zur Ausbildung eines Raumes (9) ausgestattet ist.

29. Gerät gemäß einem der Ansprüche 26-28, **dadurch gekennzeichnet, dass** das Gerät mit einem Band (17) ausgestattet ist, das entlang der Umfangskante (21) der zweiten Seite (12) des Rahmens (10) vorgesehen ist, um sich selbst geschlossen ist und im Wesentlichen aus einem zusammendrückbaren Material gefertigt ist, um Austreten der Luft in den Raum (9) zu verhindern.
30. Gerät gemäß Anspruch 29, **dadurch gekennzeichnet, dass** das zusammendrückbare Material im Wesentlichen Gummi aufweist.
31. Gerät gemäß Anspruch 29 oder 30, **dadurch gekennzeichnet, dass** das Band (17) mit einer Poren aufweisenden Seite (18) im Wesentlichen der Platte (3) zugewandt vorgesehen ist.
32. Gerät gemäß Anspruch 29, 30 oder 31, **dadurch gekennzeichnet, dass** das Band (17) aus einem Poren aufweisenden Gummi gefertigt ist.
33. Gerät gemäß einem der Ansprüche 29-32, **dadurch gekennzeichnet, dass** das auf sich selbst geschlossene Band (17) mit einem Inneren und einem Äußeren ausgestattet ist, die beide eine die Poren im Wesentlichen verschließende Haut aufweisen.

Revendications

1. Procédé pour encastrier au moins partiellement une dalle (3) comprenant un côté supérieur (4) et un côté inférieur (5) dans un substrat (2) contenant un type de sable, dans lequel le procédé comprend au moins les étapes consistant à :
 - placer le côté inférieur (5) de la dalle (3) contre le substrat (2), **caractérisé en ce que** le procédé comprend :
 - transmettre des vibrations à la dalle (3) au moyen d'au moins un vibreur (7) sensiblement fixé par rapport à la dalle (3).
2. Procédé selon la revendication 1, **caractérisé en ce que** les vibrations provenant de chaque vibreur (7) sont transmises à une coupe d'aspiration (6) appliquée contre le côté supérieur (4) de la dalle (3).
3. Procédé selon la revendication 2, **caractérisé en ce que** le procédé comprend l'étape consistant à :
 - maintenir un vide dans une chambre (9) délimitée par la dalle (3) et la coupe d'aspiration (6).
4. Procédé selon la revendication 3, **caractérisé en ce que** la coupe d'aspiration (6) est pourvue d'un cadre rigide sensiblement en forme de plaque (10) ayant un premier côté (11) et un second côté (12) situé sensiblement à l'opposé du premier côté (11), dans lequel le premier côté (11) est pourvu du au moins un vibreur (7) et le second côté (12) est pourvu d'évidements (13) pour former la chambre (9).
5. Procédé selon la revendication 4, **caractérisé en ce que** le procédé comprend l'étape consistant à :
 - empêcher l'air de fuir dans la chambre (9) au moyen d'une bande (17) disposée sur un bord circconférentiel (21) du second côté du cadre (10), laquelle bande (17) est fabriquée essentiellement à partir d'un matériau compressible.
6. Procédé selon la revendication 5, **caractérisé en ce que** le matériau compressible comprend essentiellement du caoutchouc.
7. Procédé selon la revendication 6, **caractérisé en ce que** la bande (17) est pourvue d'un côté (18) sensiblement en regard de la dalle (3), lequel côté comprend des pores.
8. Procédé selon la revendication 5, 6 ou 7, **caractérisé en ce que** la bande (17) est fabriquée à partir d'un caoutchouc comprenant des pores.
9. Procédé selon la revendication 8, **caractérisé en ce que** la bande (17) fermée sur elle-même est pourvue d'un intérieur (19) et d'un extérieur (20) qui comprennent chacun une peau qui obture sensiblement les pores.
10. Procédé selon l'une quelconque des revendications 5 à 9, **caractérisé en ce que** la bande est pourvue d'un côté de bande (18) en regard de la dalle (3), dans lequel des évidements ont été disposés.
11. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le procédé comprend l'étape consistant à :
 - transmettre des vibrations à la dalle (3) au moyen de deux vibrateurs (7) sensiblement fixes par rapport à la dalle (3).
12. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** chaque vibra-

- teur (7) est pourvu d'un excentrique qui tourne dans le but de générer les vibrations.
13. Procédé selon les revendications 11 et 12, **caractérisé en ce que** les excentriques tournent chacun dans un plan situé de manière sensiblement verticale. 5
14. Procédé selon la revendication 13, **caractérisé en ce que** les excentriques tournent dans le même plan. 10
15. Procédé selon la revendication 12, 13 ou 14, **caractérisé en ce que**, en regardant le côté supérieur (4) de la dalle (3), les excentriques tournent les uns vers les autres. 15
16. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le procédé comprend en outre l'étape consistant à : déterminer une profondeur sur laquelle la dalle (3) est encastrée dans le substrat (2). 20
17. Procédé selon la revendication 16, **caractérisé en ce que** la détermination a lieu visuellement sur la base de marques disposées sur un bord longitudinal de la dalle. 25
18. Procédé selon la revendication 16 ou 17, **caractérisé en ce que** la détermination a lieu au moyen d'un assemblage comprenant un premier moyen ayant une position fixe par rapport à la dalle (3) et un second moyen ayant une position fixe par rapport au substrat (2), dans lequel l'assemblage est conçu pour arrêter la transmission de vibrations à la dalle (3) lorsque les premier et second moyens ont atteint une hauteur prédéterminée l'un par rapport à l'autre. 30
19. Procédé selon la revendication 18, **caractérisé en ce que** l'assemblage comprend un palpeur et un point de contact. 40
20. Procédé selon la revendication 18 ou 19, **caractérisé en ce que** l'assemblage comprend un laser et un détecteur de lumière laser. 45
21. Procédé selon l'une quelconque des revendications précédentes, tant qu'elles dépendent de la revendication 2 et 3, **caractérisé en ce que** le placement du côté inférieur (5) de la dalle (3) contre le substrat (2) a lieu au moyen d'un hissage (24) et d'un placement de la coupe d'aspiration (6). 50
22. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le côté inférieur (5) de la dalle est plus petit que le côté supérieur (4). 55
23. Procédé selon la revendication 22, **caractérisé en ce que** du sable est disposé contre ou près du bord longitudinal de la dalle (3).
24. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le procédé comprend l'étape consistant à : encastrer deux dalles (3) de telle sorte que les côtés supérieurs (4) forment virtuellement une surface continue.
25. Procédé selon la revendication 24, **caractérisé en ce que** du sable est fourni en une seule fois sur ou dans un joint présent entre les dalles (3).
26. Appareil pour encastrer au moins partiellement une dalle (3) selon le procédé selon l'une quelconque des revendications 1 à 25, la dalle comprenant un côté supérieur (4) et un côté inférieur (5) dans un substrat (2) contenant un type de sable, l'appareil comprenant au moins un vibreur (7) pour transmettre, en utilisation, des vibrations à la dalle (3), **caractérisé en ce que** l'appareil est pourvu d'au moins une coupe d'aspiration qui, en utilisation, peut être fixée contre le côté supérieur (4) de la dalle (3) et le au moins un vibreur (7) est sensiblement fixe par rapport à une coupe d'aspiration (6) pour transmettre, en utilisation, les vibrations à la dalle (3) par l'intermédiaire de la coupe d'aspiration (6).
27. Appareil selon la revendication 26, **caractérisé en ce que** la coupe d'aspiration (6) est pourvue d'un moyen (8) pour raccorder une pompe à vide au moyen de laquelle, en utilisation, un vide peut être maintenu dans une chambre (9) délimitée par la dalle (3) et la coupe d'aspiration (6).
28. Appareil selon les revendications 26 et 27, **caractérisé en ce que** la coupe d'aspiration (6) est pourvue d'un cadre en forme de plaque rigide (10) ayant un premier côté (11) et un second côté (12) situé sensiblement à l'opposé du premier côté (11), dans lequel le premier côté (11) est pourvu d'au moins un vibreur (7) et le second côté (12) est pourvu d'évidements pour former la chambre (9).
29. Appareil selon l'une quelconque des revendications 26 à 28, **caractérisé en ce que** l'appareil est pourvu d'une bande (17) disposée le long d'un bord circonferentiel (21) du second côté (12) du cadre (10), laquelle bande (17) est fermée sur elle-même et est fabriquée sensiblement à partir d'un matériau compressible pour empêcher l'air de fuir dans la chambre (9).
30. Appareil selon la revendication 29, **caractérisé en ce que** le matériau compressible comprend essentiellement du caoutchouc.
31. Appareil selon la revendication 29 ou 30, **caractérisé en ce que** la bande (17) est pourvue d'un côté

(18) sensiblement en regard de la dalle (3), lequel côté comprend des pores.

32. Appareil selon la revendication 29, 30 ou 31, **caractérisé en ce que** la bande (17) est fabriquée à partir d'un caoutchouc comprenant des pores. 5
33. Appareil selon l'une quelconque des revendications 29 à 32, **caractérisé en ce que** la bande (17) fermée sur elle-même est pourvue d'un intérieur et d'un extérieur qui comprennent chacun une peau qui obture sensiblement les pores. 10

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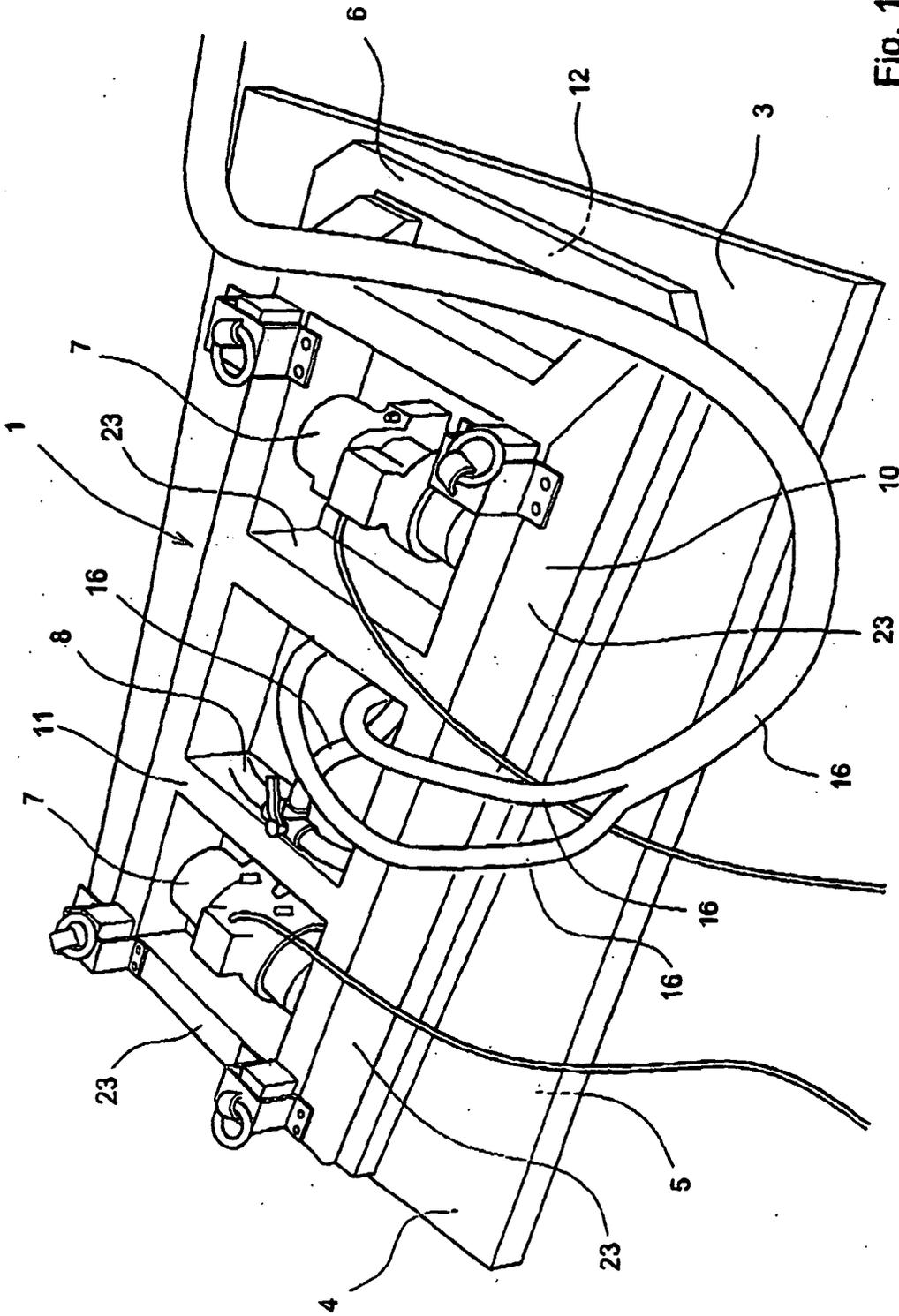


Fig. 1

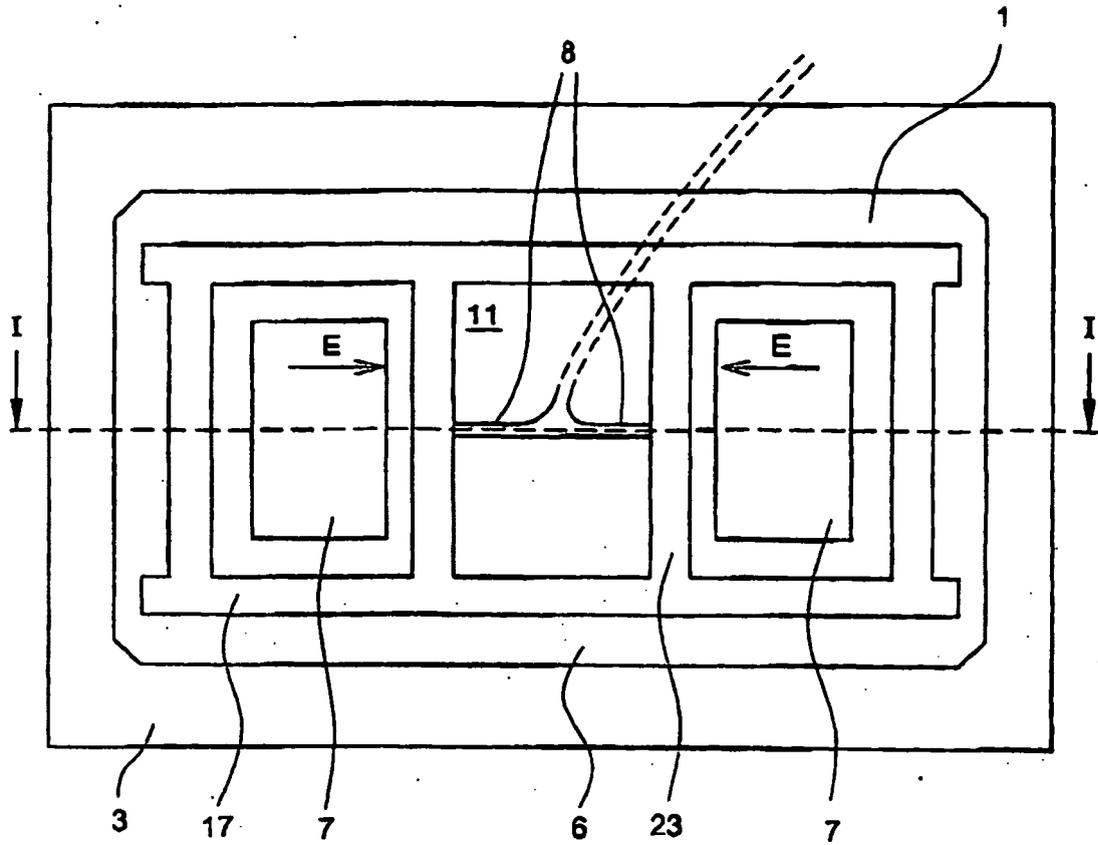


Fig. 2

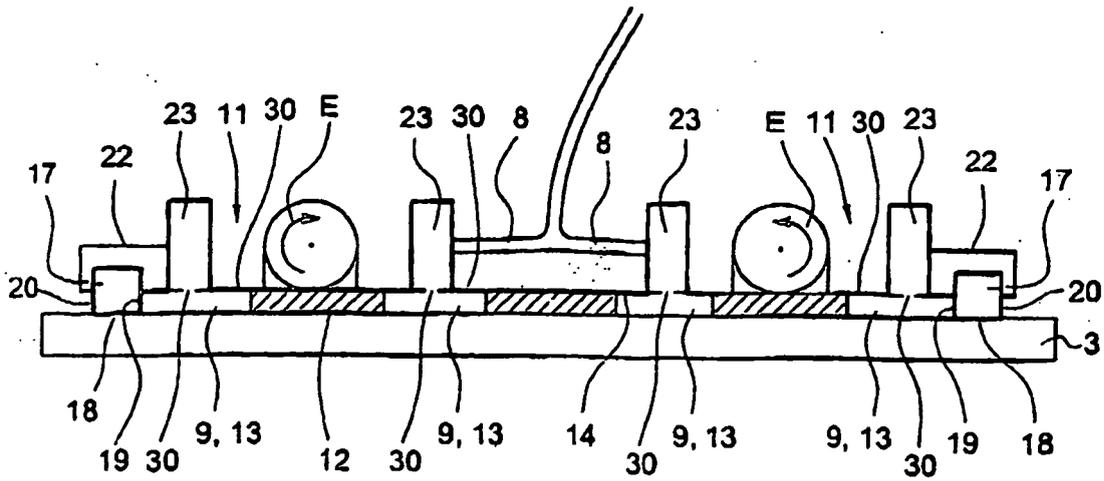


Fig. 3

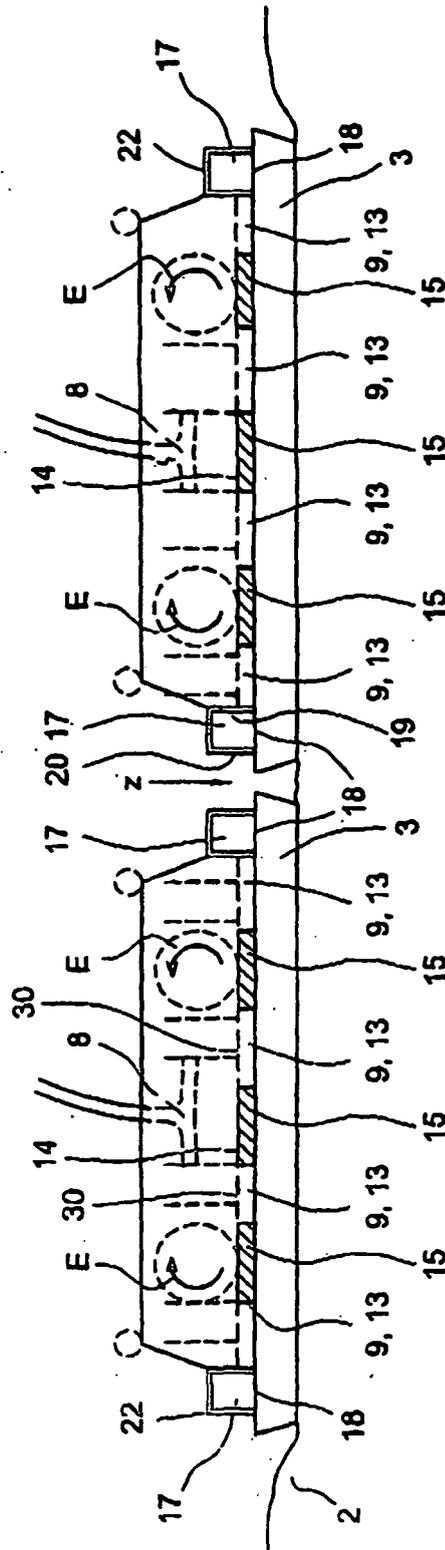


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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