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(54) Method for installing a foundation for a traffic course as well as device

(57) The invention is concerned with a method for installing a foundation for a traffic course, wherein a ribbon shaped pattern of mutually spaced foundation piles is made by pressing piles into the soil until a desired penetration depth is met, wherein the pitch of the piles in said pile pattern is preferably relatively small.

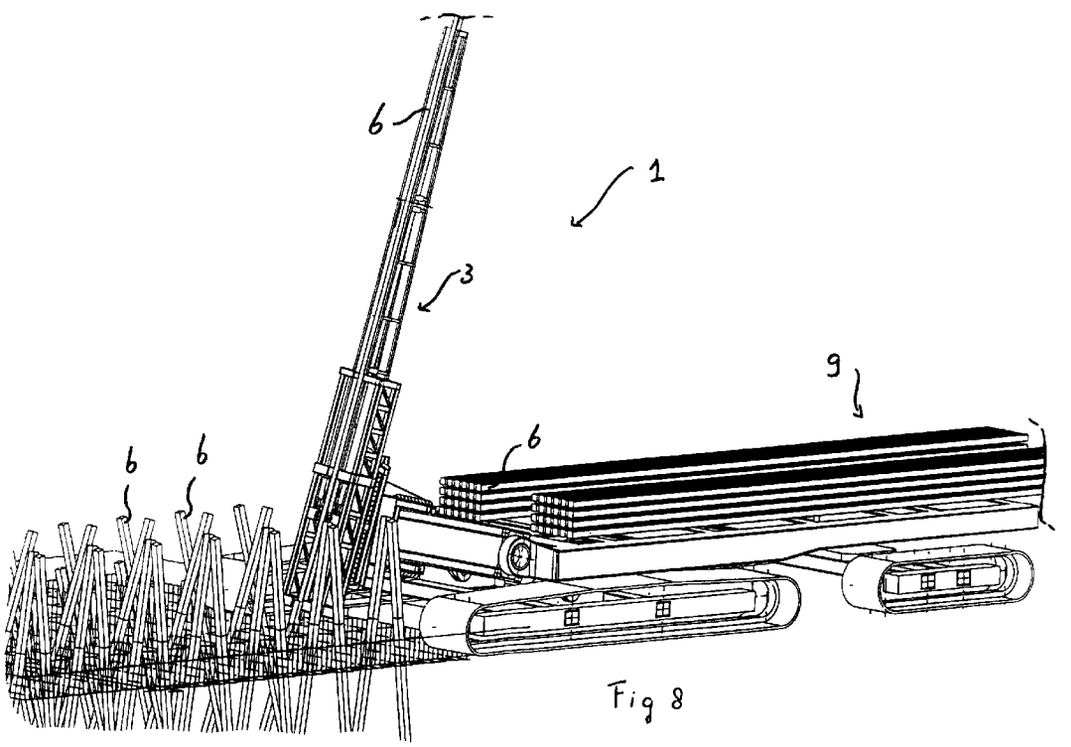

Fig 8

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Description

[0001] It is known, to support a traffic course like a road, lane, landing strip or rail way on a concrete slab or reinforced soil mattress supported by ram piles rammed into a sub layer with bearing capacity.

[0002] A foundation technique is known for light buildings, like factory halls, hangars, and small houses, based on the principle that concrete piles in sections of about 3 meters are pressed into the ground with a hydraulic penetration device, wherein one locates a next section on top of the preceding section, already partly penetrating the ground, and presses it into the ground, until a sub layer with bearing capacity is met. The part of the last section projecting above the ground is removed at the desired height. In here, "traffic course" particularly means a course at least substantially following the shape of the surface of the earth, i.e. at least substantially horizontal or completely or partially inclined at angles typical for known traffic roads.

[0003] In one aspect, the invention proposes to support a traffic course on piles that are pressed into the ground until a desired penetration depth is met, whereafter at the top side of those piles a plate like body supported by those piles, like a concrete slab or an reinforced soil mattress, is provided, which plate like body is adapted to support the traffic course. A reinforced soil mattress is a combination of geotextile and granular material, e.g. sand and/or stones. The plate like body can also be any other supporting body extending striplike at least substantially parallel to the traffic course, like a sand bed or a geotextile with a sand bed on it. A possible over length of the pile, penetrating to the desired depth, can be removed. The traffic course is e.g. some meters or some tens of meters wide and some hundred meters or some kilometers long or longer.

[0004] In one aspect the object of the invention is restriction of the required work space, e.g. by eliminating the requirement for a neighbouring work road or by restricting the work height such that it is e.g. possible as well to work under a flyover. In one aspect the object of the invention is to be able to offer the possibility, to work on a surface layer with little bearing capacity without taking special bearing capacity increasing measurements like the use of ride plates. In one aspect the object of the invention is a foundation for a traffic course that can bear one or more, preferably all of the following forces; weight of the traffic course; thermal elongation of e.g. rails or road surface anchored to the foundation; brake forces, derailment forces, centripetal forces, weight from the traffic units, like automobiles, trains, airplanes, etc., moving on the road surface. In one aspect the object of the invention is installing a traffic course more environmental friendly. In one aspect the object of the invention is quick installation. In one aspect the object of the invention is making an at least substantially settlement free foundation. In one aspect the object of the invention is an implement to position the pile, particularly at least substantially all piles of the foundation, shore, preferably in two mutually perpendicular directions, e.g. to take up dynamic forces acting on the traffic course in its longitudinal and/or horizontal cross direction. Preferably, the shore orientation per axis measures between about 10° and about 30°, more preferably about 20° with respect to the vertical. The piles of two at least substantially parallel pile arrays are preferably oppositely shore positioned at at least one axis. The shore position is preferably measured by automatic measuring means. The shore position is measured preferably independent from the attitude of the insertion member. The shore position is preferably measured with the aid of the gravity field. The insertion device is preferably provided with an automatic shore position measuring device, e.g. one or more inclinometers, with which e.g. the orientation can be measured of the insertion member engaging the pile and inserting it into the ground. In one aspect the object of the invention is a pile foundation with a relatively closely spaced pile pattern with relatively small pitch (e.g. at least about 800 mm. in the lengthwise direction of the traffic course) and relatively leight loaded piles.

[0005] The piles are preferably at least substantially prismatic, except for possible local thickening at one or both their longitudinal ends to provide e.g. supporting feet. The piles are prefabricated, and preferably of concrete with suitable reinforcement, such as a central, pre stressed iron rod, and can be of intergral length or can be of length parts mutually connected end to end. With a view to the working speed, the single part pile is preferred. If the pile is assembled from prefabricated length parts, a next length part is preferably located upon a preceding length part, already partly pressed into the ground, and pressed into the ground, until the desired penetration depth is reached. The length parts are preferably suitably mutually connected, such that after assembly the assembly behalves like a single piece pile. A suitable bush is e.g. used for the connection, in which the facing longitudinal ends of two succeeding length parts are pushed with press fitting into each other. The length parts can have each dimension, however a length ranging between about 4 and about 8 meter is prefered at this moment. The desired depth of penetration can be the arrival at a load bearing sub layer, but also the arrival at a sufficient bearing capacity or penetration force. On top of each pile a head is preferably placed with a diameter that is substantially bigger than that of the pile, such that the bearing surface is increased, particularly for a reinforced soil mattress. The pile, or the upper pile part, can possibly be integrated with such a head as well. Although the pile can be inserted in an at least partly pre-drilled hole in the ground, it is prefered from the viewpoint of working speed, that the pile is pressed in virgin ground until the end depth. According to the invention a pattern of piles pressed into the ground is made, extending in the longi-

tudinal direction of the course, wherein the pattern is preferably obtained from mutually spaced, substantially parallel pile arrays extending in the longitudinal direction of the course. In view of the installation the pile arrays are preferably aligned in the direction at least substantially perpendicular to the longitudinal direction of the course, although e.g. an arbitrary or regular staggered or offset pattern can be advantageous to e.g. obtain an e.g. minimum pile density at a predetermined bearing capacity per unit surface of the course.

[0006] The insertion takes place preferably at least substantially shockless, wherein use is preferably made of hydraulic actuated insertion equipment. However, it is expected that during the initial phase of the insertion, the insertion operation can take place shockwise, if the pile point moves through soil with irregular bearing capacity, e.g. peat ground alternated with thin layers of sand. However, it is appreciated that the pile point moves as regular as possible through soil with more bearing capacity, such as can be obtained with e.g. a pressing head actuated by a hydraulic cylinder with a stroke of e.g. one meter. The pressing can be at least substantially completely vibration free, however pressing can be understood as vibration ramming here as well. Importantly, the pile is preferably controlled inserted into the soil. This part of the invention does not cover ramming or hitting a pile into the soil, wherein with large shocks, e.g. generated by a free falling heavy body the pile is forced into the soil. This part of the invention also does not cover the so called screw pile injection method or a similar principle wherein a pile is formed in situ by applying fluid concrete and reinforcement in a hole made in the ground. The invention does cover the use of a pile with either intergrated supporting foot, or in situ grouted supporting foot by e.g. pulling up the pile, already installed into the soil, over a limited height of e.g. one meter, while a suitable fluid, curing substance, like a mixture of portland cement and grout, is meanwhile injected from the pile point. The biggest advantage is obtained, if the pile pattern to be installed is as regular as possible. This is e.g. the case if at least substantially all piles have at least about the same pitch.

[0007] The pile can also be of e.g. wood or steel or any other material with bearing capacity. The pile can have any suitable section, such as round, rectangular, square, or plate like, as long as it is slender enough and has a sufficient large buckling length for its function.

[0008] The pressing of the piles can be done by a self propelled, wheeled device that is provided with tracks or different, and that has sufficient weight to give counter pressure to the required press force, and that has an actuating means, e.g. a hydraulic penetrator that actuates the press head. By providing it with an automatic location determination mechanism, each pile can be pressed independently. By way of alternative it is possible as well, to provide the device with an e.g. mechanical sensor means, e.g. provided with a gripping head, engaging one or more piles inserted earlier, to determine the location of the next pile. It is also feasible, e.g. with a penetration device of lower weight, to get at least some of the pressing force to be generated from piles already installed because the device is holding them. Alternatively it is even feasible, that the device "walks" on the installed piles and holds itself to them and gets at least substantially all pressing force from those piles. In that case the design of the device can be very light, and it can be provided with moveable grippers, engaging the pile heads of installed piles to forwardly move the device a small distance each time (e.g. shifting). The device can have a press head moveable in side-way direction with respect to the device, with a stroke of e.g. at least 1 meter, preferably at least about 1.5 meter, to sequentially instal two piles next to each other before the device is moved in lengthwise direction of the traffic course for installing the next pile in the lengthwise direction of the traffic course. Said stroke can also be larger, preferably at least about 3 meters, to e.g. successively install three piles next to each other. The device can also be provided with several press heads to install several piles next to each other simultaneously or shortly after each other while the device is at least substantially stationary. The device can further be provided with a storage for temporary storing of a limited number of piles (e.g. a plurality of e.g. twentyfive or fifty pieces) or pile sections, and/or a storage for coupling parts for mutual connection of pile sections, and/or a motorized actuated jib to bring a pile or pile section into location in de penetration means.

[0009] One could argue, that the foundation according to the invention is obvious in view of the known road foundations and the known foundation technique for light weight buildings based on pile penetration with hydraulically pressed piles assembled from pile sections. However it is known that the penetration pile is developed as an alternative to the relatively expensive screw pile injection method for the building of public utilities in residential area's were ramming is prohibited. Both the screw pile injection method and the known penetration pile are methods requiring craftsmanship. In view of that object and that nature of the known penetration pile the person skilled in the art will not immediately realise, that the present invention can be financial competitive with typical ram techniques to make a regular pile pattern, extending like a ribbon, in an industrial fashion.

[0010] Apart from that, compared to traditional ramming the invention offers a substantial sound reduction. The reliability of the foundation is also better, e.g. because a higher % of the foundation piles provides for the required bearing capacity, e.g. because at least substantially all foundation piles get the prescribed proof load.

[0011] Hereafter, non-limiting illustrative embodiments are described of a device for carrying out the method, referring to the enclosed drawing, showing in:

Figure 1 a side view of the device;
Figure 2 a front view of the device;
Figure 3 a top view of the device;
Figure 4 a view according to figure 2, with the device in another position;
Figure 5 a front view of a detail of the device of figure 1;
Figure 6 a side view of the detail of figure 5;
Figure 7a-c a top, sectional and side view, respectively, of a detail from the view of figure 5;
Figure 8 a perspective view of another embodiment of the device; and
Figure 9a-c a top, front and side view, respectively, of the device of figure 8.

[0012] The device 1 according to the invention shown in figure 1 has a self propelling wheeled carriage 2 with tracks, a hydraulic implement for actuating two pile guides or king posts 3, an extendable lift arm 4, rotatable and pivotable in several positions, and a working platform 5. By way of alternative the device 1 can have one king post 3 or more than two king posts 3. The typical moving direction of the device 1 between sequentially installing sets of foundation piles 6 is according to arrow A. The device is direction controllable in a manner that is typical for riding on tracks. Each king post 3 is pivotable between an upright position (shown in full lines) and a lying position (shown in dashed lines) by means of preferably motorized, such as hydraulic, actuated pivoting means. In the lying position a foundation pile 6 can be located in the king post 3 by the lift arm 4. The king posts 3 are preferably independent pivotable. As shown in phantom for the king post 3 to the right-hand side of the drawing of figure 2, each king post can be moved sideways with respect to the carriage 2, by moving means, preferably of the motorized, preferably hydraulic, type. The carriage 2 can tilt sideways with respect to the working platform 5 by tilting means, preferably of the motorized, e.g. hydraulic, actuated type, as shown particularly in figure 4. Each king post 3 can furthermore be moved forward with respect to the carriage 2 by moving means, such as a hydraulic ram and a guiding device, such as a slide, e.g. over a distance of 30 cm., to disengage the king post from the pile 6 installed at the desired depth by retracting the king post therefrom.

[0013] Each king post 3 kan be shortened to be able to act at small working height, e.g. under a fly over. Then multiple part piles or shorter single part piles are installed. Each king post 3 can be tilted with respect to two axis to position a pile shore in two directions. To determine the shore position of the pile, each king post 3 is provided with one or more inclinometers.

[0014] Each king post 3 contains press means comprising two hydraulic rams 7 engaging a press slide 8 provided with clamping means to engage the foundation pile 6 by clamping. In the drawing the ram slide 8 is shown half way its working stroke from above to below. In its uppermost position the ram slide clamps the foundation pile 6 and takes said foundation pile 6 with him on its way down. At the end of its stroke the ram slide 8 releases the foundation pile 6 and goes back upward, to clamp the foundation pile 6 again and press it over a stroke length. This operation is repeated until the required penetration depth for the foundation pile 6 is reached. The device 1 is adapted to press two foundation piles 6 simultaneously. To keep the weight of the device 1 as low as possible, it is prefered not to press both foundation piles 6 simultaneously over the last part of their penetration movement. Since the device 1 must generate with its own weight the reaction force for the total required press force for pressing the foundation piles. Both foundation piles 6 are e.g. pressed to a press force of 30 tons, while the weight of the device is just enough to allow generation of the required, and moreover maximum allowable, press force of 30 tons in a safe and reliable way. Then according to the invention e.g. a, preferably automatic, control means is provided that allows simultaneous pressing of foundation piles as long as the maximum allowable press force is not exeeded. During the first phase of pressing, when the foundation piles move through soil with low bearing capacity, such as peat soil, simultaneous pressing takes place. When the maximum allowable penetration force is exceeded or to be exceeded, e.g. because the pile points meet better bearing soil, less and less foundation piles will be inserted. In this example, finally all foundation piles are pressed to the test load of 30 tons one by one. In this way an optimum can be attained between a low weight for the device 1 (thus efficient manoeuvrable and without special implements adapted to move across relatively weak soil) and insertion of as many foundation piles 6 with one device 1 as possible per unit of time. Irrespective whether one, two or more piles are inserted simultaneously, it is preferred that there is preferably an automatic control system, monitoring the requirement that each pile experiences the set maximum penetration force, wherein e.g. an operator is informed of said event. Each preferably electronically operating control system comprises for its automatic operation the relevant sensing, evaluate and actuating means to carry out the instructions derived from the evaluation of the sensed data, as well as e.g. a data processing device like a microprocessor with which the said means are connected in a data transferring sense while there can be memory and/or data input and/or data output means for data transmission with an operator.

[0015] In a sense not further illustrated, the device 1 is furthermore provided with automatic position determination means for the position where the foundation pile must be pressed into the soil. On the one hand said means can be adapted to recognise the position of marking spots at the location where the foundation piles must be pressed into the soil. Said marking spots are e.g. so called pickets, on forehand partly hammered in the ground at the relevant location. To recognise the

location of such markings, suitable sensors can be used. Such sensors e.g. react to interception of a bundle of energy, such as a light beam by said mark. Said light beam, e.g. a laser beam, e.g. extends between two parts of the device 1 With this, e.g. a one dimensional automatic positioning system can be made, wherein e.g. merely the forward displacement of the king post to the set location is carried out automatically, and the shore setting and the transverse displacement of the king post is manually controlled. An alternative one dimensional automatic positioning system applies e.g. measuring the distance covered by the device 1, e.g. with a tachometer at one of the tracks. For a two dimensional automatic positioning system one can e.g. select a laser- or ultrasound scanning system, with a transmitter and a receiver. The signal from the transmitter is reflected by the marking and received by the receiver. By measuring the time laps between transmission and receival, and possibly the angle of transmission or receival, the two dimensional position of the mark can be located. In that case it is preferred, that the transmission signal is a relatively tiny bundle in the measuring dimensions, which makes a "scanning" movement. An alternative two dimensional automatic positioning system is e.g. based on the GPS system known as such. With that, the location can be directly determined, i.e. without using a mark placed on forehand.

[0016] Preferably both the horizontal and vertical alignment are measured with the automatic positioning system. The horizontal alignment is preferably determined with dGPS. The vertical alignment is preferably determined with a level meter, such as a laser level meter.

[0017] The automatic pile positioning system described above is preferably part of an automatic control system wherein the desired pile position is fed in and the current pile position is measured and compared with the desired pile position while based on said evaluation the current pile position is changed to decrease the difference between the current pile position and the desired pile position, e.g. by transverse displacement of the king post or by changing its tilting position or by displacement of the complete device. Preferably said movement takes place fully automatic with the aid of signals initiated on the basis of the result of said evaluation. Alternatively in view of safety, the rough positioning of the pile in the desired position, for which e.g. the complete device 1 must be displaced, takes place at least partly manually. Then the fine positioning takes place fully automatic, wherein in view of e.g. safety e.g. the control is such that during fine positioning the control system is not able to displace the complete device 1. The automatic control is preferably fully electronically carried out, for which reason the automatic control system preferably exclusively comprises electric or electronic parts. The automatic control system preferably has an evaluation device such as a microprocessor, that mutually compares the current and desired values and on the basis of the outcome gives a signal to carry out a movement by the device 1. Alternatively a signal is merely given to carry out a movement by the device 1 if a predetermined threshold comparison value is exceeded, which threshold comparison value is e.g. determined by the allowable tolerances for the desired position. To make it possible that the control can be fully automatic, it is preferred that the control system is associated by signal transmission means with the relevant actuating means of the device 1, e.g. the pivoting, displacing and tilting means to let the king post move in the desired way. The evaluation means can be e.g. part of a central dataprocessing unit (e.g. a so called CPU). The automatic control system preferably has a preferably electronic memory device for storing therein at least one desired pile position. The data of the memory device can be fed into the evaluation device, for which a suitable preferably electical connection can be made between those two devices by means of signal transmission means. Also, it is preferably possible to transfer signals from the evaluation device to the memory device for e.g. storage. The pile positioning system is preferably connected to the evaluation device by signal transmission means. There can also be data input means, like a key board or a modem, to feed the control system with external data, such as with respect to the desired pile position, for which said data input means are preferably connected to the central data processing unit via signal transmission means, e.g. a connection cable. There can also be data output means, like a monitor or a printer to show data, e.g. about the current pile position, to the operator, for which said data output means are preferably connected to the central data processing unit via signal transmission means, e.g. a connection cable. The control system is preferably connected to a suitable energy source, e.g. an electrical power source. The automatic shore position measuring means can also be connected to the evaluation device of the control system in a data transferring sense. In stead of determining the position of the pile by direct pile measuring, it is feasible to meaure a reference point, e.g. at the device 1, from which the pile position can be calculated. Hence it is possible to bring the current pile position in conformity with the desired pile position without requiring human interference, by which the speed, safety, reliability and quality of the work is substantially improved. Due to the lack of important vibrations with a pile pressing device compared to a hammer type pile driver or vibrator type pile driver, particularly the former can be equiped with the automatic control device since it can have vulnerable parts.

[0018] This automatic control system of the pile positioning system can also be used in other types of devices to bring a pile body into the ground, such as a hammer type pile driver, vibrator type pile driver or screw pile injection device.

[0019] It is appreciated that the device 1 can have one or more implements such as a store for a number of

foundation piles 6. The parts of the device 1 of figure 1-7 similar to those of the device 1 of figure 8 and 9 are referenced by similar reference numbers. With the device 1 of figure 8 and 9 there is now room for two pile storages 9 between which the single king post can be pivoted. Apart from all, it is feasible to locate the pile storage on a seperate wheeled carriage, which rides with the device 1, e.g. continuously keeping a short distance therewith.

[0020] By choosing for pressing in of the foundation piles, it was surprisingly found out that it is possible to insert two or more foundation piles simultaneously.

[0021] Thus in one aspect the object of the invention is a pressing device with at least one king post that is pivotable between an at least substantial lying position and an at least substantial upright position, for which there are motorized pivoting means. Furthermore, in one aspect the object of the invention is the simultaneous pressing of two or more pile bodies next to each other, preferably wherein the number of pile bodies simultaneously pressed decreases when the target depth or bearing capacity for at least one of said pile bodies during said pressing is neared. Also, in one aspect the object of the invention is a driving device, e.g. hammer type pile driver or vibrator type pile driver, with sensing means to determine the position of a pile body to be rammed. The foundation piles are preferably of the type that can be pressed with a maximum between 50 and 100 tons, and have therefore a cross section of preferably between 100*100 and 300*300 mm, more preferably about 140*140 mm. Because of the relatively low press force required, one can do with a relatively light weight pressing device requiring no special measurements to ride across weak soil. The foundation piles are preferably intergal, preferably with a view to inclined positioning in the ground (rakers), that have to take up transverse forces from e.g. braking or derailment of or riding in curves by vehicles, possibly resulting in a tension load on the piles, such that the foundation pile can bear tension forces. For most applications, the foundation piles will have a relatively large length of preferably more than seven meters, more preferably about ten meters or more, e.g. 15 meters. Shorter lengths, e.g. about 5 meters, are feasible as well.

[0022] The foundation piles are preferably supplied in a joke, rack or store, such that they can be transported without harm, but also to locate them in the ramming device, wherein they are e.g. tilted and positioned, such that the number of manipulations with the pile is reduced. This joke, rack or store can replace the above mentioned king post completely or partly. This joke, rack or store is e.g. in a lying position located in the ramming device and e.g. coupled to motorized erection means at said device, to erect said joke, rack or store to bring the piles in the upright position. Preferably there are at least two foundation piles located in a rack, more preferably e.g. five or ten piles, wherein the rack is preferably in the manner of a cartridge located in the ramming device such that those foundation piles are successively e.g. engaged with the insertion equipment and thus are inserted or rammed in the soil one by one next to each other until the cartridge is empty, whereafter it is replaced by a next, full cartridge. The cartridge is therefore e.g. by motorized actuating means shifted in the ramming device by one position each time to register a next pile with the ramming equipment. The cartridge protects the piles from overloading and offers the possibility to substantially increase the speed of pile processing, e.g. because for each rack the manipulations for locating in the ramming device have to be made once. The piles are preferably releasably clamped in the rack. One or more filled racks can be supplied with a truck, such that the racks can be filled at the factory. Thus, the invention offers the opportunity, to install piles in the soil in an industrial manner.

[0023] Above all, it is appreciated that the principle of at least two piles in a store, joke or rack as indicated above, can also be applied to ramming foundation piles in the ground by a hammer type pile driver or a vibrator type pile driver, and this field of application is also covered by the invention.

[0024] Thus, in one aspect the object of the invention is ramming, such as pressing, hammering or vibrating pile bodies into the ground with a motorised implement, wherein at least one pile body is contained in a cartridge and this cartridge is located in the implement and is freed from said pile by said implement, wherein of a cartridge with at least two pile bodies said pile bodies are preferably successively rammed in the ground for which the cartridge is displaced with respect to said implement preferably over at least substantially the pitch of those pile bodies in the cartridge.

[0025] According to another aspect of the invention it is suggested to install a road or railway in the following manner: Prefabricated bridging elements, e.g. concrete slabs, are located on top of the pressed pile bodies, such that a temporary road surface is made across which building traffic can ride, e.g. for supplying of next prefabricated bridging elements and later on one finishes the connection between the pile bodies and the bridging elements to get the finished structure, whereafter e.g. the rails are installed. Alternatively, prior to start the use as a building road, the reinforcement of the pile body and bridging element are mutually connected in a load carrying manner, e.g. by welding. As a temporary road surface for building traffic it is e.g. not necessary to take account of catastrophes, such as derailment of a train or massive bracking of cars at e.g. the beginning of a traffic congestion, such that as a building road there are less requirements for the stability of the foundation. Then it is e.g. sufficient if the prefabricated bridinging elements have suitable recesses at their lower side for receiving the pile heads. As a temporary road surface an e.g. frictional engagement between pile bodies and bridging elements can then be sufficient. The bridging

elements are finally connected mutually and with the pile bodies later on, e.g. by suitable grouting. For a suitable bond between the bridging elements it is prefered to give them a matching shape, e.g. one or more projections and corresponding recesses. Said matching shape gives already extra cohesion with use as a temporary road surface. For the final finishing for use as a rail way it is further preferred to apply a girder element extending all the way alongside the rail way and connected to the bridging elements. Said continuous girder element makes preferably a upright wall along said bridging elements. If the bridging element is a concrete slab, it is prefered to make it at least substantially rectangular and support it on at least four pile elements, one at each corner. First, e.g. a temporary rail can be applied, that is replaced by the final rail later on. This offers in particular logistic advantages when two train tracks are installed next to each other.

[0026] When installing two train tracks next to each other, the pile foundation is preferably installed in one pass by ramming piles across the full width of both tracks with preferably one ramming device, simultaneously installing e.g. four pile arrays; one below each rail beam. Then the bridging elements are located on top of the possibly initially machined pile heads, preferably in two spaced strips; one strip for each rail track. One builds preferably a temporary rail on the one strip, preferably wherein the foundation for the pile bodies and bridging elements is not fully complete yet, such that one can quickly start therefrom with finishing of the other strip into final rail. Then the temporary rail is changed into final rail.

[0027] Also alternatives that become clear after reading the above belong to the invention. In stead of a track one can use e.g. a wheel or a stepping strut. The pressing can e.g. be done with a press member with a stroke that is at least substantially the same as the length of the pile to be pressed, such that the pile is pressed to the final depth in one stroke while it is possible to press such that the pile is continuously moving. In stead of a reciprocating press member one could also apply a rotating press member, such as one or more driven rolls e.g. engaging the pile to one side such that they move the pile forward while rolling and maintaining their location at the king post. The press member can also make an orbiting movement, such as a driven endless belt engaging the side of the pile with its active part and taking the pile with him moving it in forward direction. With the endless belt, the contact surface with the pile is increased which is favourable for the force transmission. for a proper force transmission between pile and press member it is prefered to tightly press the press member against the pile and/or to support the pile at the opposite side, preferably such that the pile experiences as little friction as possible from said support that is interfering its movement in the lengthwise direction. Said support e.g. comprises one or more rolls or the active part of an endless belt. The invention also covers an embodiment derived by combination of a feature of an embodiment described above or shown in a figure of the drawing with one or more features of another embodiment as described above or shown in the drawing.

Claims

1. Method for installing a foundation for a traffic course, wherein a ribbon shaped pattern of mutually spaced foundation piles is made by pressing piles into the soil until a desired penetration depth is met, wherein the pitch of the piles in said pile pattern is preferably relatively small.

2. Method according to cliam 1, wherein the piles are sequentially pressed by a pressing device, as viewed in the lengthwise direction of said traffic course.

3. Method according to claim 1 or 2, wherein said piles are pressed in such a position that the foundation can bear horizontal loads from the unit or units moving across said traffic course, such as by braking or following a curve in the course.

4. Method according to claim 1, 2 or 3, wherein at least substantially each pile is pressed into the soil to the same, predetermined press force.

5. Method according to any of the preceding claims, wherein bringing at least substantially each pile into its desired position of penetration is carried out by means of automatic poistion determination means, such as GPS or a laser level meter and/or an inclinometer, and wherein preferably said desired penetration position is obtained in a fully automatic manner.

6. Foundation pile installation device such as a pile press device, a hammer type pile driver, a screw pile injection device or a vibration type pile driver, particularly to carry out the method according to any of the preceding claims, in particular with means to take up a pile in its lying position and to bring it in an upright installation position, with said means in particular provided with pressing means, such as of the reciprocating type such as a hydraulic ram or of the rotating or orbiting type, such as one or more drive rolls or belts, that are adapted to become drivingly engaged with the pile.

7. Device according to claim 6, with an implement to transversely displace the press means for pressing the pile in the soil with respect to said device, preferably such that two piles can be pressed in next to each other with a large spacing of more than three times the pile diameter, while the device is stationary.

8. Device according to claim 6 or 7, with means for automatically sensing the press force, that are preferably counnected with an automatic evaluation device to stop the pressing when a predetermined press force is obtained.

9. Device according to any of claims 6-8, with means for automatic sensing the installing position of the pile to be installed, such as the shore position and/or the vertical and/or horizontal alignment, that are preferably coupled with an automatic control system in a data transferring sense to automatically bring the installing position in conformity with a predetermined desired position, e.g. previously fed in the control system.

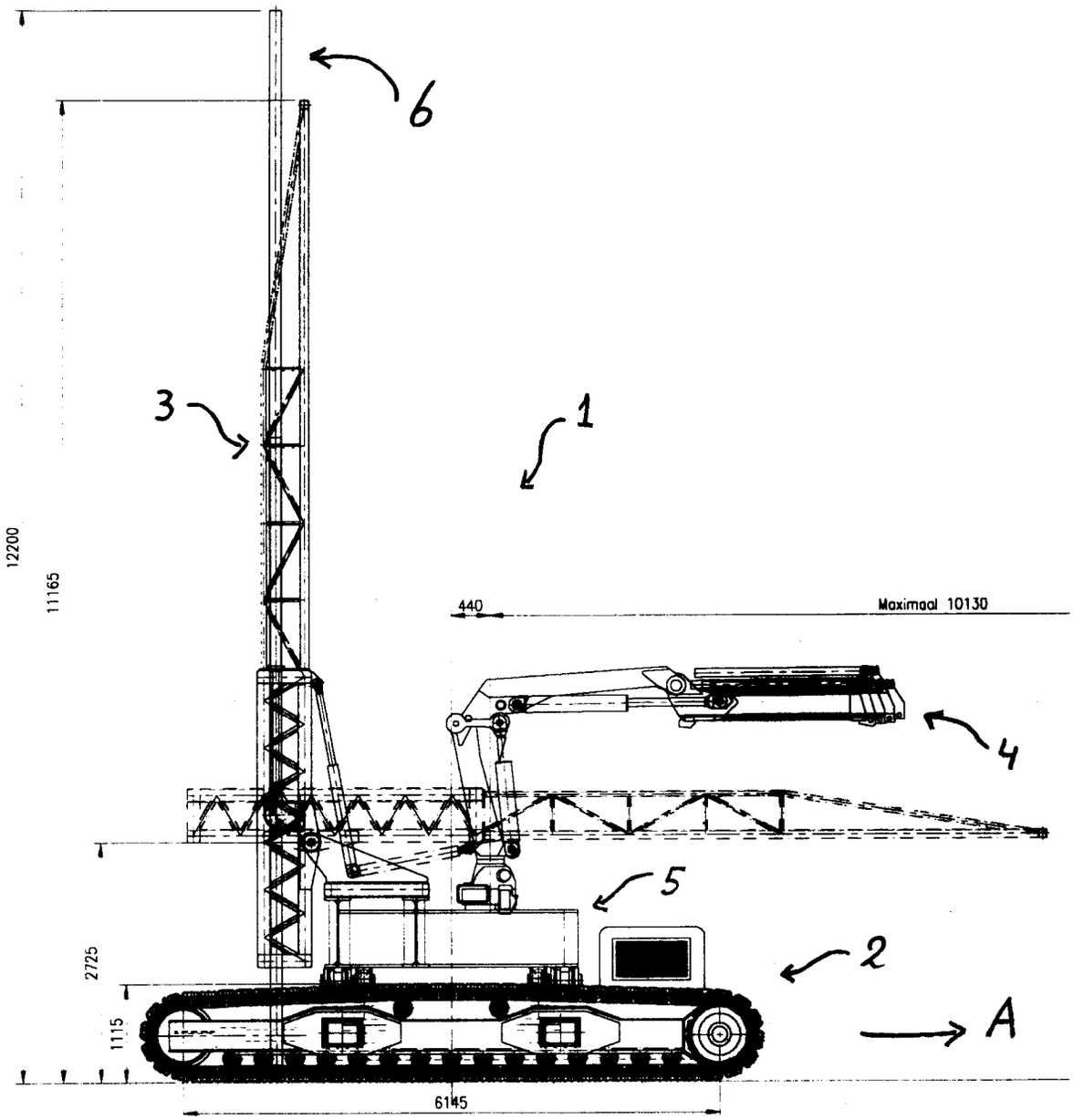


Fig. 1

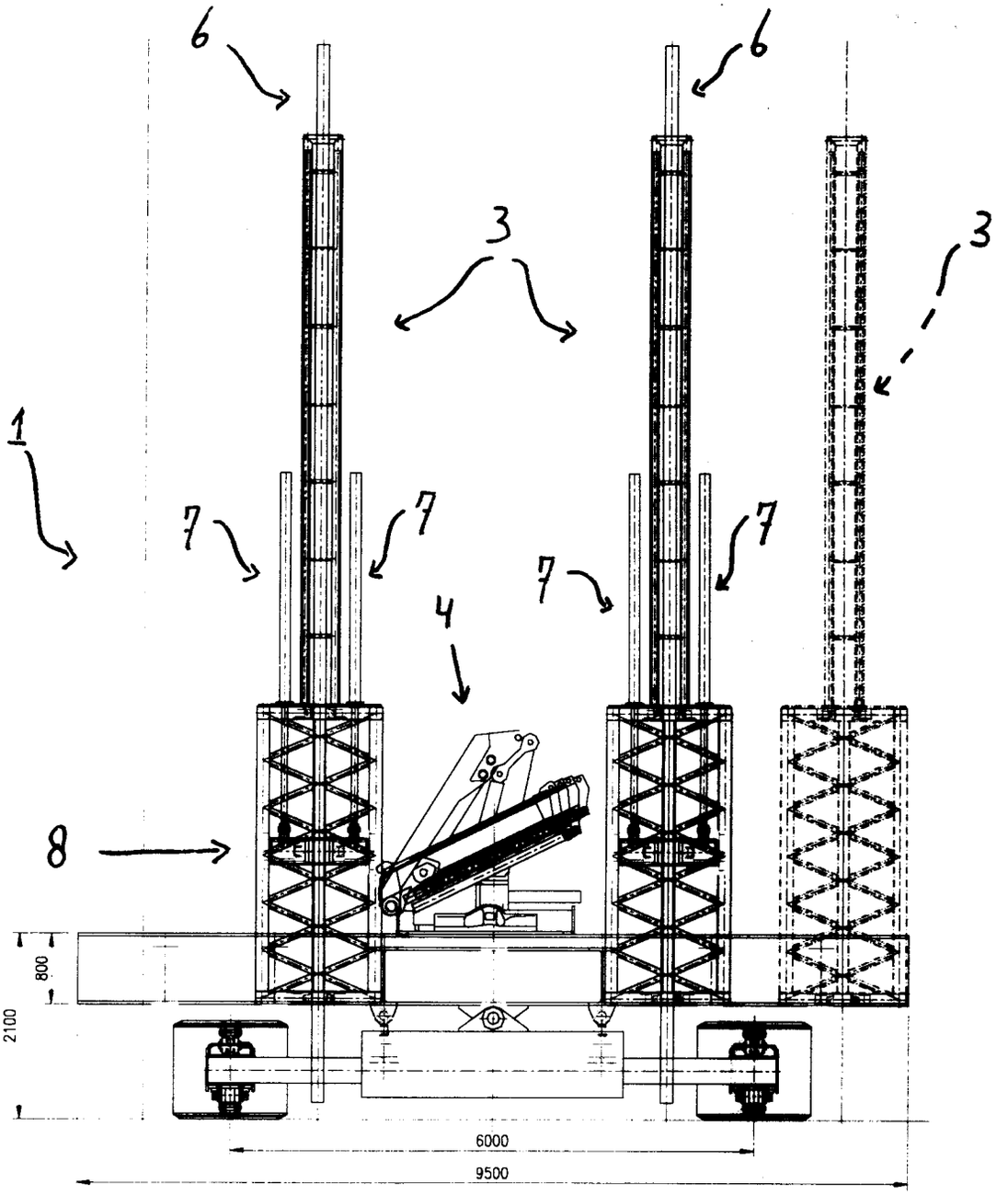


Fig. 2

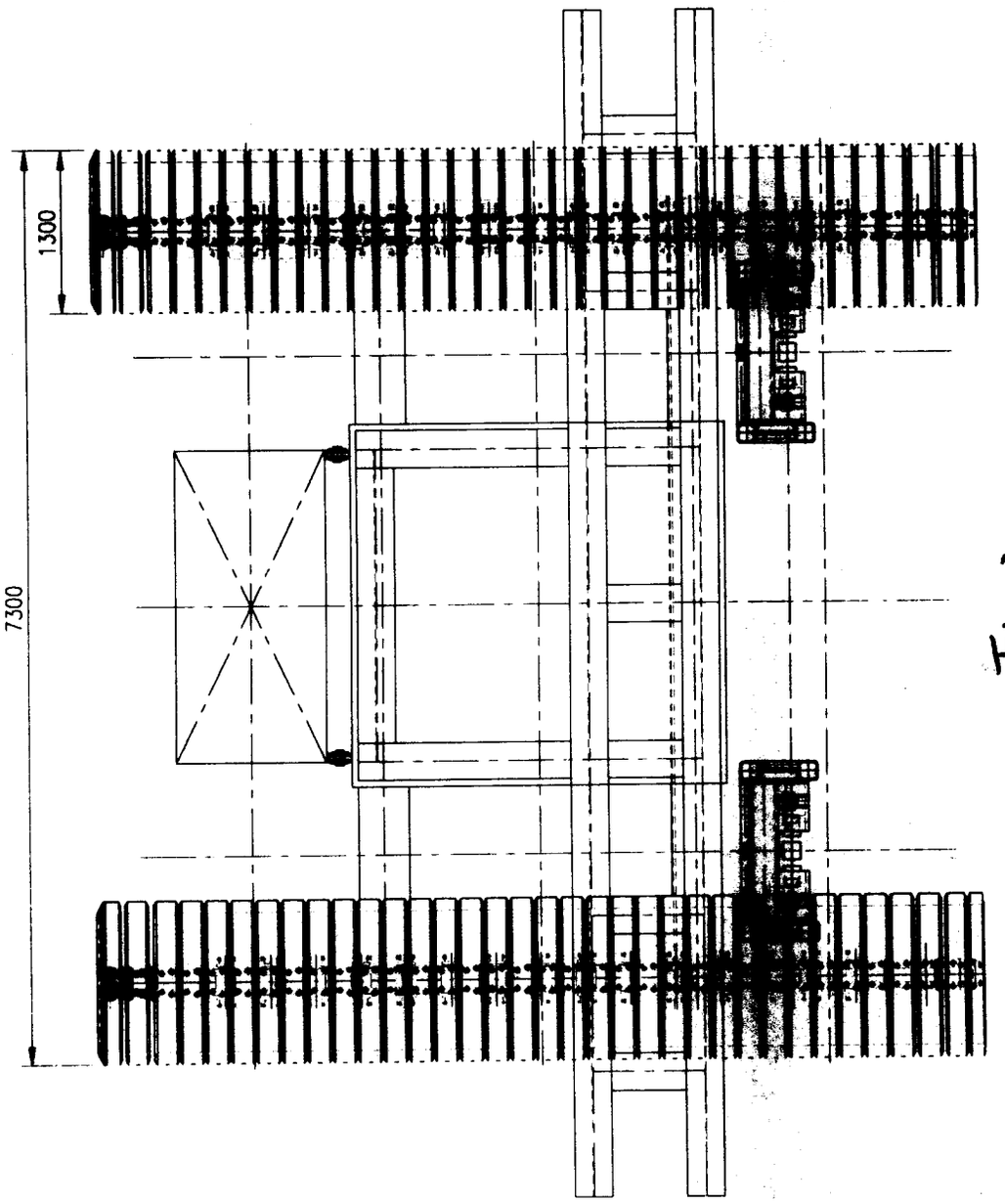


Fig 3

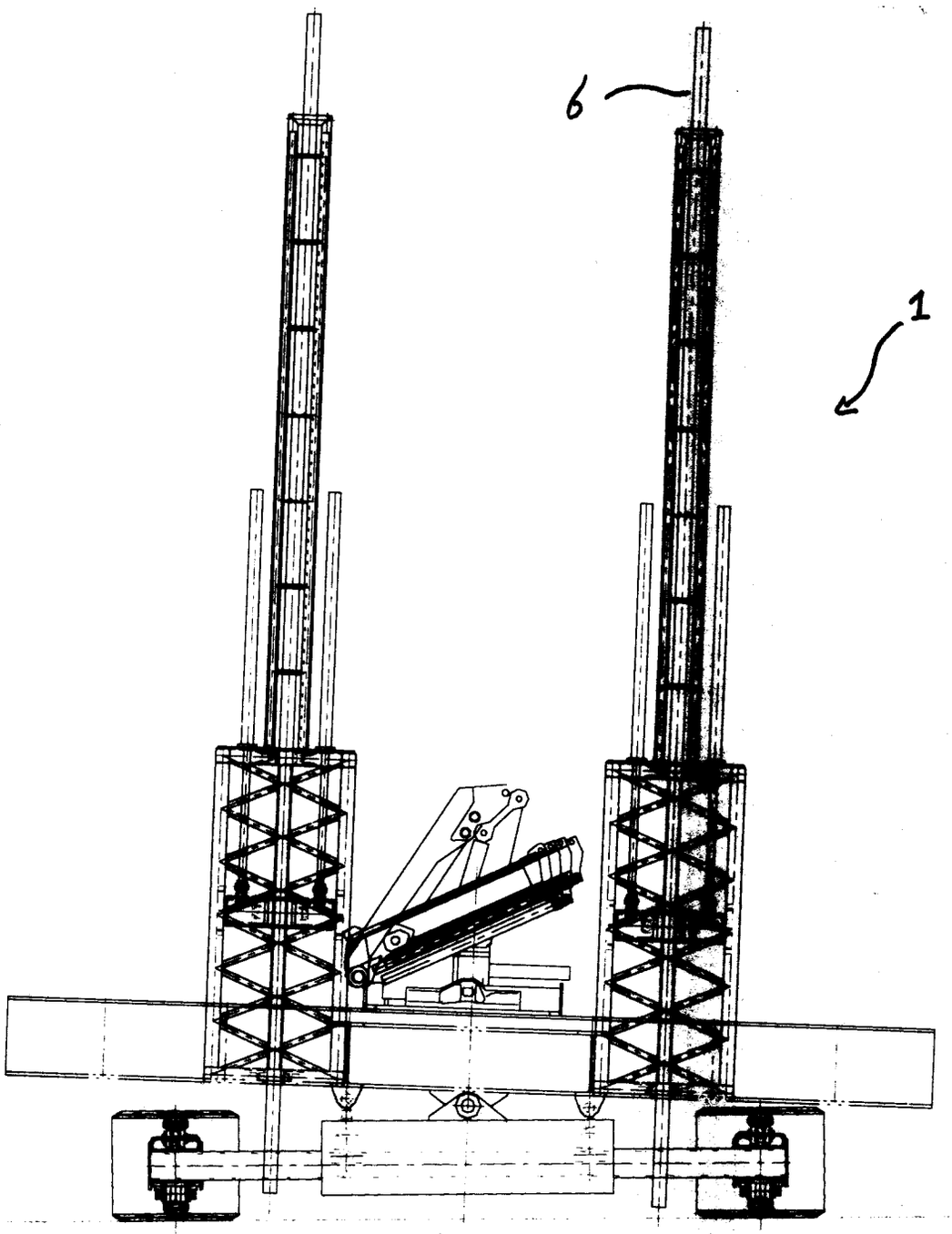
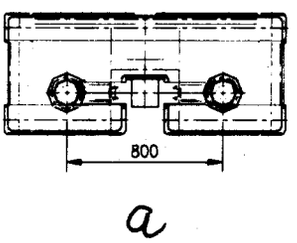
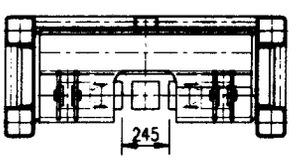


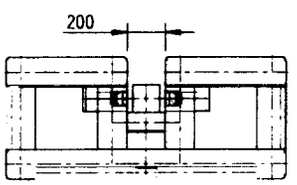
Fig. 4



a



b



c

Fig. 7

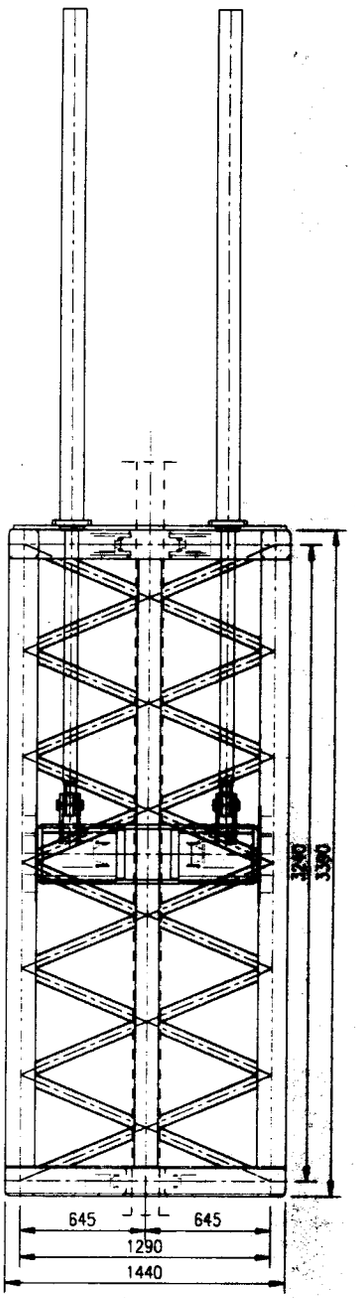


Fig. 5

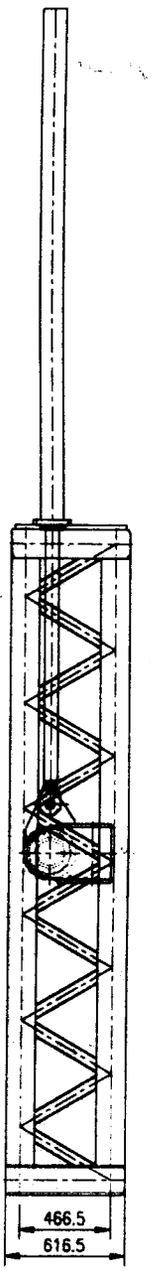


Fig. 6

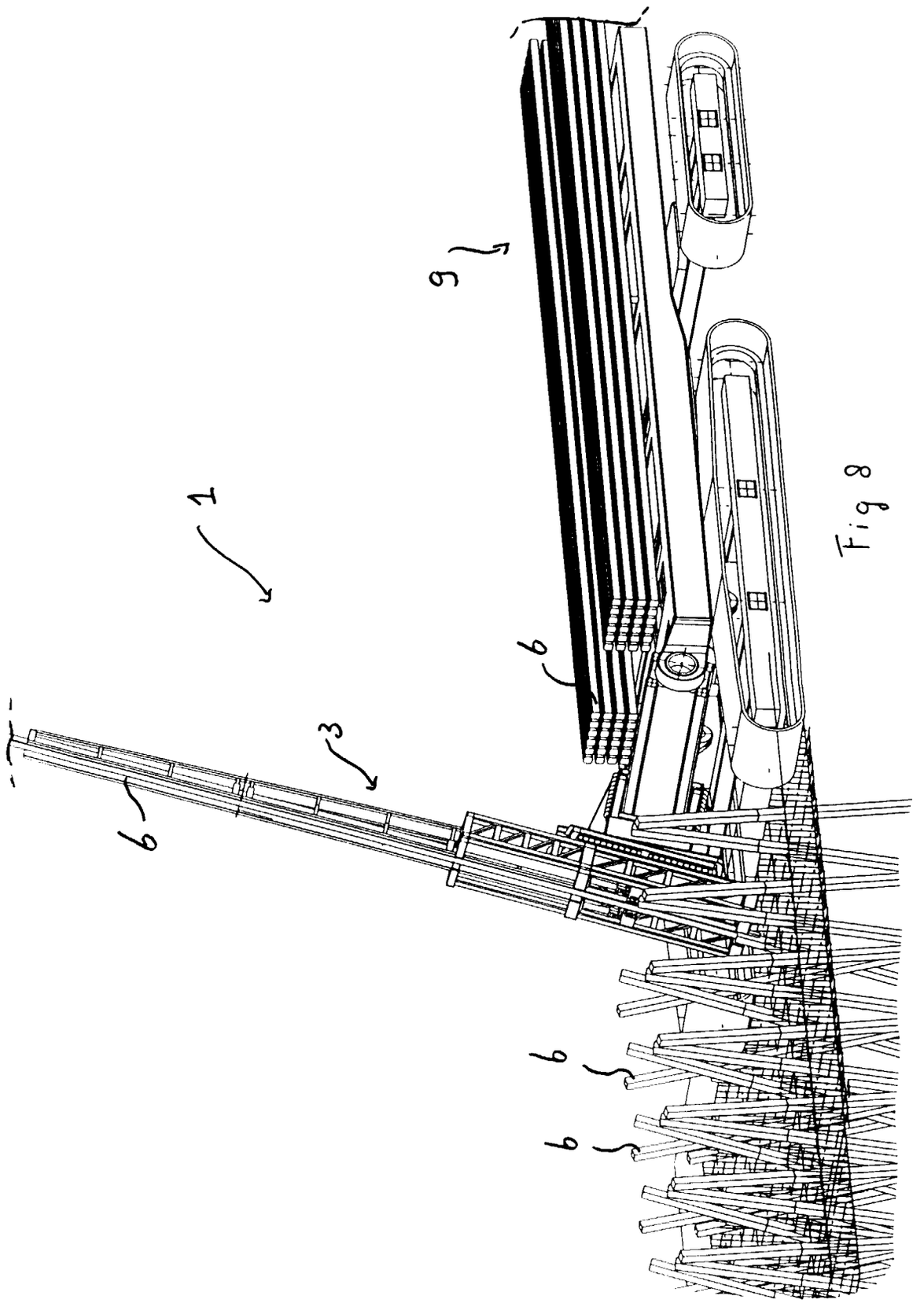


Fig 8

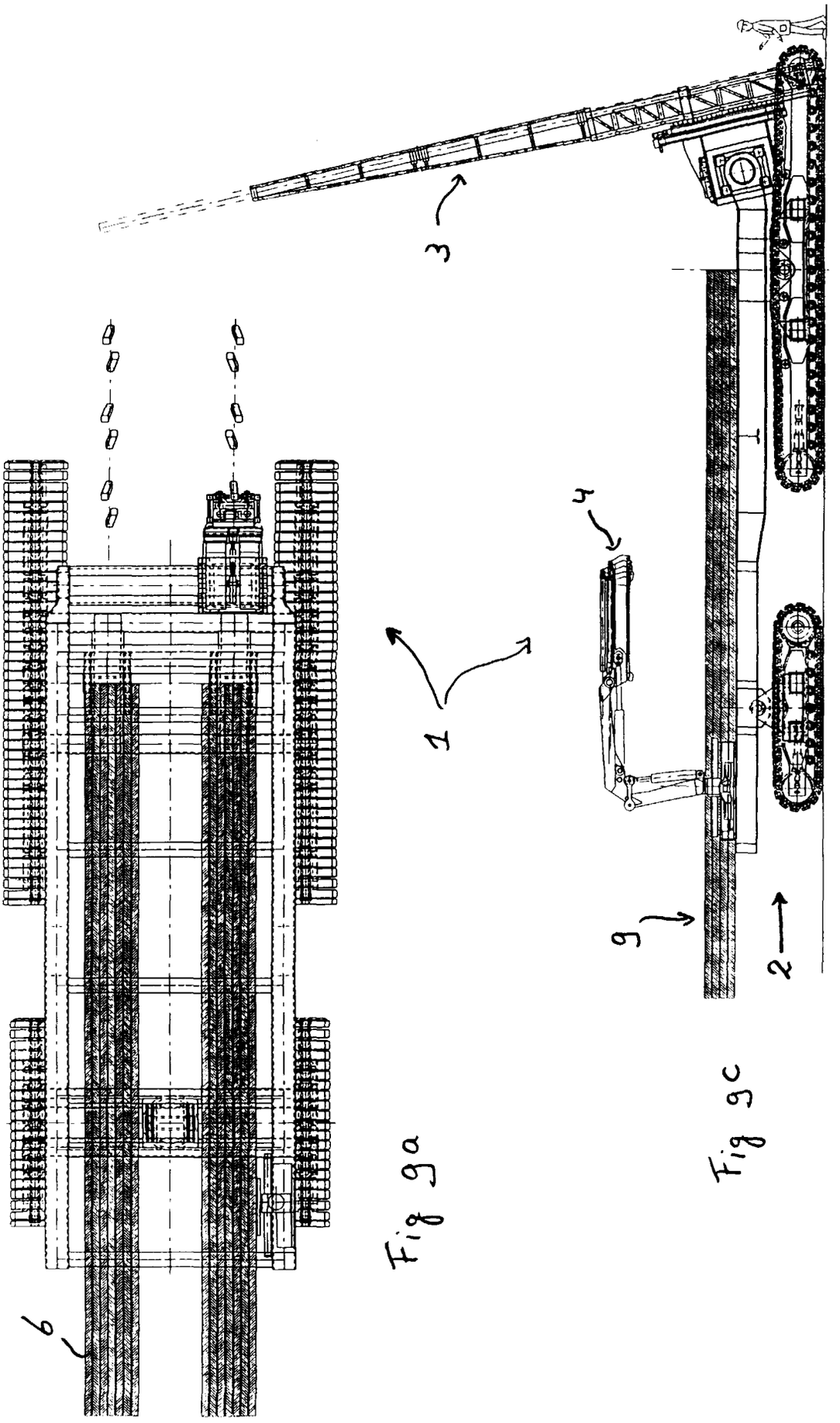


Fig 9a

Fig 9c

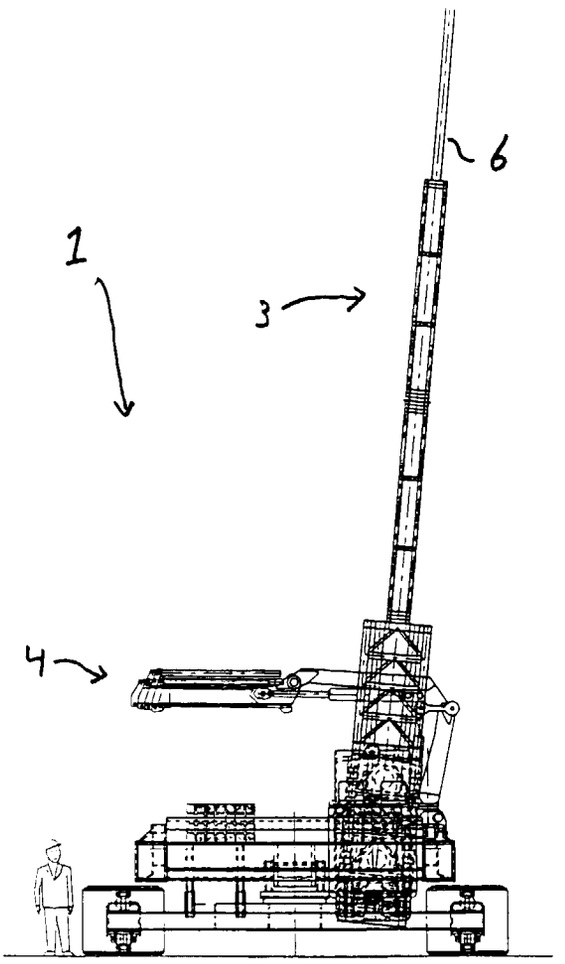


Fig 9b