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## (54) A machine for pile-driving, a method for transport and erection of a machine for piledriving, and a method for establishement of foundations beside rails.

(57) A machine for pile-driving comprises a driving chassis with wheels (5,6) for moving on railway or road, and an upper part (4) pivotally mounted about a swivel axis on the driving chassis. A mast (215) with slide guide for a ram mechanism (16) is connected to the upper part. The mast may be erected to substantially vertical position for the purpose of pile-driving and may be lowered into substantially horizontal position for the purpose of transport.

According to the invention the mast is connected to the upper part of the machine by a telescopically extensible and contractible boom having a base part (228) being connected to the upper part of the machine by means of a hinge with axis at right angles to the swivel axis of the upper part, and a telescopically extensible part (229) connected to the base part, said part (229) being connected to the mast by a slide guide so that it is movable along the longitudinal axis of the mast retaining the angle between the axis of the mast and the extension axis of the boom. A very simple erection and dismantling of the mast is hereby achieved as well as the possibility of swivelling said mast through 180° when the machine is standing on one half of a double track, without the mast thereby getting in the way of traffic on the neighbour track.

The invention also relates to a method for transport and erection of such a machine and a method for placing of foundations next to a railway track.

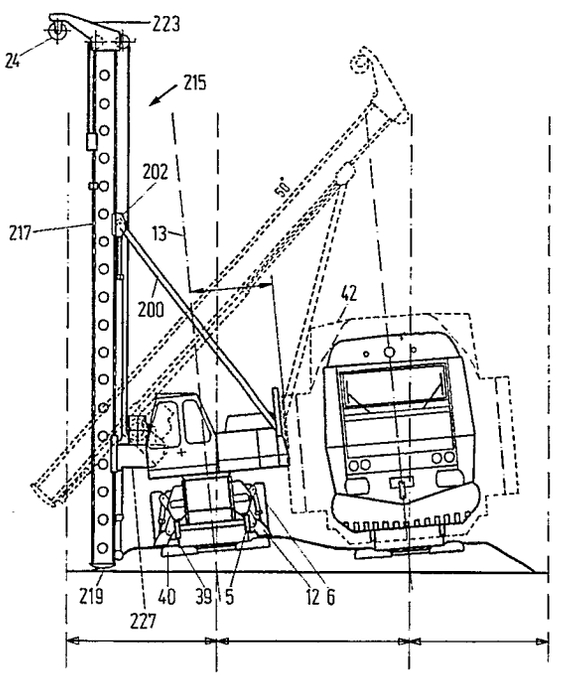


Fig.3

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# A machine for pile-driving, a method for transport and erection of a machine for pile-driving, and a method for establishment of foundations beside rails.

The present invention relates to a machine for pile-driving. The machine is transported on railway and is able to drive piles from a position on the rails. The invention furthermore relates to a method for transport and erection of such a machine and to a method for establishment of a foundation next to a track.

A large number of foundations is used along railway tracks for various equipment to be installed next to the track. For purposes such as signal masts, masts for various electric wires, and masts for carrying the overhead traction wire above electrified tracks, foundations of a substantial size are required due to the strict requirements for stability of the masts. For example, foundations of a size up to 1.5 tons and a length of up to 5.5 meters are used for masts for overhead traction wires. The establishment of such foundations represents a major task, not only by new installations, but also in connection with renewal of existing installations, such as replacement of damaged foundations or replacement of existing foundations by more stable types of foundations, etc. Often the foundations are to be established on locations where the ground is sloping either upwards or downwards in relation to the rails, and where there is very limited space. Moreover, the work is impeded by the requirement for maintaining the railway traffic with the lowest possible delays, and by safety measures to be taken for the workers. Methods developed for mechanized establishment of foundations at other locations can very often not be used along railways due to the very narrow space and difficulty of access and, therefore, traditional methods requiring a large amount of manual work are used. Such methods often involve pouring of the foundations on site which is a very time-consuming process requiring a considerable amount of manpower and many different kinds of equipment on location, and if weather conditions are not optimal, it can be very difficult to perform this work with a satisfactory result.

For other purposes it is known to pre-fabricate concrete piles which are subsequently transported to the location where they are to be driven into the ground. It is thereby possible to produce concrete piles of good quality in economical and controlled manner and indoors, so that a very rational production is achieved. Driving of the piles on location can to a large extent be mechanized and may be performed relatively quickly by using specially developed piling rigs. Such piling rigs normally comprise a vehicle with power supply and a driver's cab to which a mast with leader is connected, i.e. the slide guide for the hammer also called the pile hammer. The mast is provided with a hoisting arrangement for the hammer assembly and for hoisting the pile. The mast must be of a considerable length as there must be space for the entire length of the pile above ground, for the hammer assembly above the pile, which hammer assembly in itself may have a height of f. ex. 2 meters, and for the hoisting arrangement. Piles having a length of abt. 6 meters therefore require a mast of a length of about 10 meters, and it is obvious that transport and erection of such a mast can be a very difficult job. In practice, the mast must be transported lying in horizontal position and erected on location into practically vertical position, which often requires a good deal of assembling work.

A pile-driving rig is known, which in its swayable upper part has a horizontally projecting, telescopically extensible boom, called the guide boom, to which the mast is hinged about a horizontal axis in such a manner that it can be swung about the hinge between its horizontal transport position and its vertical working position, said mast being supported by two stays holding the mast in the area near the middle and which is anchored at the upper rear portion of the swayable upper part of the vehicle. Manual operation is still required for erecting and dismantling the mast, as the hoisting gears for the hammer and the pile are mounted on the rig in such a manner that the wires extending from the rig to the mast top must be manually fixed and loosened, respectively, during these operations. The mast is erected by means of hydraulic actuators, and the hammer assembly itself is driven hydraulically, hydraulic power being transmitted through hoses from the rig to the mast and onward to the hammer assembly.

The company Atlas-Weyhausen in Delmenhorst, West-Germany, produces a machine suitable for driving on road as well as railway and which can carry, and operate with a pile driving mechanism. This vehicle comprises an undercarriage with rubber wheels for driving on road and with uncoupled rail rollers which can be raised and lowered hydraulically to enable the vehicle to raise on these wheels for transport on railway. The vehicle may be adjusted for combined support on both road and rail wheels, in such a manner that the rail wheels keep the vehicle on the track, while the contact of the road wheels against the rails enables the vehicle to transmit and utilize the normal power of propulsion of the road wheels. If the vehicle has to leave the track, this can be done by drawing the rail wheels upwards away from the rails, whereafter

the vehicle can drive on the rubber wheels alone. The upper part of the vehicle wherein the motor and the driver's cab are arranged, is mounted on the driving chassis so that it can swivel about a vertical axis called the swivel axis lying in the longitudinal middle plane of the driving chassis.

The machine can be mounted with leader and hammer carriage or hammer assembly for pile-driving, the mast with the leader being carried by a guide boom being pivotable about a horizontal axis of the upper part of the machine, and where the leader is pivotable in relation to the guide boom about an axis parallel to the first axis. For transport the leader is tilted backwards over the machine, and the guide boom is directed forward in practically horizontal position, but sloping slightly upwards. The mast can be erected by hydraulic actuators and raised and lowered to a limited degree by swinging the guide boom, but there is no true possibility of adjusting the distance between the leader in the working position and the swivel axis. The hoisting gears for hammer and pile are mounted on the upper part of the machine and it is, therefore, necessary to manually arrest and free the wires for erection and dismantling, respectively, of the mast. To permit transport and erection without unacceptably displacing the centre of gravity, the guide boom must in the chosen geometry of assembly be rather long, and the machine can, therefore, only with difficulty operate with the guide boom in horizontal position, as the centre of gravity will thereby be placed too far out from the area of support of the machine, even if supporting legs are used. If the machine is in operation standing on the rails at a location with parallelly extending double tracks at usual spacing, it will not be possible to erect the mast without blocking the neighbour track, because the mast cannot be raised while the upper part of the machine is placed in direction longitudinally to the track, as the bottom part of the machine will then be in the way of the end of the mast swinging downwardly. It will, therefore, be necessary first to swivel the upper part of the machine transversely to the track. As double tracks may be laid with a distance between their centre lines of down to 4.5 meters, a mast being approx. 10 m long will have to overhang the neighbour track before it can be tilted upwardly. Although the machine itself can leave the track, this will in practice only be possible if the ground is plane and very firm which often is not the case where it is desired to drive piles.

The special geometry makes the machine uncapable of performing an occasionally useful adjusting movement which may be performed by certain other pile-driving machines, i.e. forcing a pile slightly sidewards during driving, so as to adjust its position in case it should initially have been slightly displaced in relation to the desired position. This function must be considered necessary for driving piles into an uneven base, and where accuracy is required. This known machine is therefore not considered to be practically applicable for driving piles from a position standing on the track.

It should be remembered that there are particularly strict requirements for a rapid operation of a machine for driving piles from a position standing on a track, including erection and dismantling of a mast, because the railway traffic must necessarily be suspended as long as the machine is in operation.

According to the invention a machine as described in Claim 1 attached hereto is provided.

A machine is hereby achieved which even in an embodiment with a relatively long mast may be transported with the hammer mechanism in position within the structural gauge section for railway vehicles, and the machine is, therefore, very suitable for driving on railway tracks. Furthermore, a very simple erection and dismantling of the mast for pile-driving is achieved, and an appropriate possibility of adjustment of the mast is achieved so that pile foundations may be driven down at different distances from the track.

According to a suitable embodiment, the winches for hoisting of a pile and a ramming mechanism are mounted on the part of the boom being connected to the mast. Erection and dismantling of the mast is hereby facilitated, as it will not be necessary to take special measures for arresting or freeing the hoisting wires for erection and dismantling operations, as by the prior art machines. It is furthermore achieved that the mast may be displaced sidewardly during a working operation without this having any influence on the hoisting gears.

According to suitable embodiments, power-driven actuators are provided for all operations for erection and dismantling of the mast. It is hereby achieved that erection and dismantling of the mast may be carried out fully automatically from a control panel in a very rapid and safe manner. This is a very important advantage as there will often only be very short periods of time available where there is no traffic on the track.

According to advantageous embodiments of the invention, the control means for the erection and dismantling operations are provided with blocking means so that the mast must be raised into a certain angular position before the upper part of the machine may swivel and so that it can only swivel to one side of the track. The oblique angle is so adjusted that the mast top is raised to a position where it will not be in the way of traffic on the other half of a double track, irrespective of swivelling of

the upper part of the machine. By such blocking means a safety of the control of operations is achieved to an extent that the machine may operate on one half of a double track for establishment of foundations on the outer side of the double track while at the same time traffic is allowed on the neighbour track. This counts for all working operations of the pile-driving machine, i.e. ramming, transport, erection and dismantling. The blocking means is, of course, so adapted that it can optionally be switched to one side or the other, under observance of appropriate precautionary measures.

According to a suitable embodiment of the invention the two parts of the boom are so arranged that they may mutually turn about an axis being parallel to the direction of extension. It is hereby achieved that the mast may be inclined sidewardly so that foundations may be placed in directions diverging from vertical within a plane parallel to the rails. The mast is supported by the stays, and said stays are suitably so arranged that they are extendable in longitudinal direction and individually controllable, hereby enabling adjustment of the angle of the mast.

According to a further suitable embodiment of the invention, a support is provided for supporting the mast in the transport position on the upper part of the machine, said support being so adapted that it can swing the mast upwardly from horizontal into oblique position. From this oblique position, the mast can be raised further upwards by means of an actuator acting on the stay slide in direction towards the boom. With the chosen geometry, this actuator itself may hardly be able to raise the mast from the horizontal position where the angle between actuator and stay is very acute so that the system will almost be at a dead angle, and it will therefore be expedient to arrange the support so that it can lift the mast during this part of the movement.

According to the invention a method for transport and erection of a machine for pile-driving is achieved as stated in Claim 11. Advantages are hereby achieved in accordance with the above statements.

According to the invention a method as stated in Claim 12 is provided for establishing a foundation next to a track. It is hereby achieved that such foundations may be established very rapidly and without requiring much labour on location.

In the following, the invention will be further explained with reference to embodiments shown in the drawings, in which

Fig. 1 shows the machine on the track, seen from the side, with mast and upper part in the transport position,

Fig. 2 shows the machine on the track, seen from the side, during a step of the erection of the mast in a position abt. 50° above horizontal plane,

Fig. 3 is a view at right angles to the track, showing the machine in the last step of the erection of the mast and in operational position,

Fig. 4 is a plane view of the machine in operational position,

Fig. 5 is a sectional view of the machine seen in longitudinal direction of the track and in the operational position, in a larger scale than Fig. 3, and

Fig. 6 is a sectional view of the machine, seen from the side of the track, and in the operational position.

It is remarked that the figures are not drawn to scale and that they only show fundamental details being essential for explaining the invention. In all figures, the same or corresponding parts are denoted by like reference numerals.

Reference first being made to Fig. 1, a pile-driving machine or vehicle is shown, generally referred to by reference numeral 1, said machine comprising a driving chassis or carriage 3 and a machine top section 4. The driving chassis 3 is provided with rubber wheels 6 which by means of control and driving means, not shown in detail, enable the machine to drive on a ordinary road. The driving chassis 3 is, furthermore, at the ends provided with uncoupled track rollers or rail wheels 5 mounted on swing arms 11 so that they may be raised and lowered in relation to the driving chassis by means of guidable actuators 9. For road transport the rail wheels 5 are in raised position (not shown), whereafter the machine is carried by the rubber wheels 6. In the other direction the rail wheels 5 can be lowered so far downwardly that the rubber wheels are disengaged from the track, whereafter the machine 1 can be hauled. In the position shown in Fig. 6 the rail wheels are adjusted so that the weight of the machine is supported by both the rail wheels 5 and the rubber wheels 6. The machine is hereby guided by the rails, i.e. it is moved as a railway vehicle, while the contact of the rubber wheels against the rails provides sufficient friction to enable the machine to utilize the normal propelling machinery of the rubber wheels, and the machine is thus self-propelling.

The driving engine 7 and the driver's cab 8 are provided in the upper part 4 of the machine, and upper eyes 44 and lower eyes 45 are provided, with horizontal, parallel axes, for carrying working equipment. The engine is provided with a hydraulic system, not shown in detail, so that it may provide hydraulic power for various manoeuvering and working functions. The upper part 4 of the machine is mounted on the driving chassis 3 in such a manner that the upper part can turn or swivel about a vertical axis 13 by means of a power-driven

swivel gear 14. The machine is provided with supporting legs or feet 12 which are in raised position during transport and which can be lowered to provide a stable support for the machine during the working operations. The mast 215 is seen at the top, with the hammer assembly or hammer carriage 16 being transported in substantially horizontal position. The mast 215 comprises a slide guide or leader 217 for the hammer assembly. The mast top 223 with wire rollers 24 are seen to the left in Fig. 1. The mast and the hammer mechanism are supported by the guide boom 227 which comprises a base part 228 pivoting about a horizontal axle 233 being stationary in relation to the upper part of the machine 4, and a telescopically extensible part 229 connected to the leader 217 by means of slide guides which together form the boom slide 203. The mast is thus extensible in its longitudinal direction in relation to the extensible part 229 of the guide boom, but is not tiltable in relation thereto. With the mast in folded position, as shown in Fig. 1, the whole equipment lies within the normal structural gauge section for vehicles moving on rails. In this way the machine may, with raised supporting legs, be driven along the rails to the working site, where it is stopped and the feet 12 are placed on the sleepers or on the ground to give the machine a stable support. This is the situation shown in Fig. 1.

By means of lifting mechanisms to be explained in more detail later herein, the mast is thereafter raised from the horizontal position into the oblique position shown in dashed lines in Fig. 2, and which may be f. ex. 50° above horizontal plane. As can be seen from Fig. 2, the mast cannot be tilted much further before the driving chassis of the machine gets in the way of the lowermost end of the mast. The upper part of the machine with mast is thereafter swivelled away from the direction longitudinally to the track into direction transversely to the track, i.e. into the position shown in dashed lines in Fig. 3. The mast can thereafter be raised right up into vertical position and its elevation may thereafter be be slightly adjusted in up- or downward direction so as to adjust the installation to the configuration of the ground.

Fig. 3 shows the machine standing on one part of a double track, and a train is sketched in driving on the neighbour track. The figure shows a situation where the rails are sloping slightly from the horizontal plane, such as the rails may be laid in curves to compensate for centrifugal forces during driving of the train. It can be seen from the figure that even in this case where the top of the train on the neighbour track is inclined very closely towards the piling machine, the latter will still clear the structural gauge section of the neighbour track, i.e. the section to be kept clear for traffic on the neighbour track. The machine may here swivel through 180° between the two positions longitudinally to the track without getting in the way of the passing train. By comparison with Fig. 2, it will be obvious that this will only be possible after the mast has been raised into the position shown in dashed lines, or higher. It will also be understood that the placement of the tilting point of the mast at a distance below the mast, at the beginning of its swinging movement will cause the mast top and the stays to move relatively quickly forward, so that in the transverse position it can go clear of the neighbour track without having to be raised so much upwards as would be necessary if it had to swing about a point closer to the mast.

Reference is now being made to Fig. 5 which in larger scale illustrates parts of the machine being essential for the invention, the uppermost part of the mast not being shown here. The machine is seen in the operational position with a pile 2 carried by wires holding a lifting rod going through an eye 254 in the pile. In relation to the ramming mechanism the pile is guided by a ram head 110. It can be seen how the mast 215 is supported by stays 200 being anchored at the back of the upper part of the machine at anchoring points 201, said stays at the opposite ends being pivotally anchored to the stay slide 202. As appears from Figs. 4 and 6, two stays are mounted in a triangular arrangement to give the mast a stable support. The stay slide 202 is provided with slide claws 221 gripping around slide bars 220 on the leader 217 (see Fig. 4). The mast can thus be displaced freely in its longitudinal direction in relation to the stay slide 202.

Two triangular, vertical base plates 252 are mounted on the upper part of the machine (see Figs. 4 and 5) said plates being fixed to the hinge eyes 44 and 45. At the axle 233 a pivot pin 10 is mounted through the triangular base plates 252, said pin forming a support for the base part 228 of the guide boom which is freely tiltable about the pin. The extensible part 229 of the guide boom can be moved telescopically within the base part by means of a built-in actuator 230 shown in dashed lines in Fig. 5. The extensible part 229 of the guide boom is firmly connected to slide guides, together forming the boom slide 203 holding the mast so that it may slide freely up and down in relation to the extensible part 229 of the guide boom. The slide guides of the boom slide are mounted at a mutual distance and are of a sturdy construction so that the angle of the guide boom in relation to the mast, here approx. 90°, is accurately retained, even under considerable stress.

For controlling and manoeuvering the longitudinal displacement of the mast a mast foot actuator 251 is mounted between the extensible part 229 of the guide boom and the mast foot 219. A socalled

stay slide actuator 250 is mounted between the extensible part 229 of the guide boom and the stay slide 202. It will be appreciated from Fig. 5 and Figs. 2 and 3, that the stay slide actuator 250 may be used for inclining the mast, as an extension of the actuator in relation to the position shown in Fig. 5 - provided that the stays are of constant length - will tilt the mast backwards, i.e. towards horizontal position.

When the mast approaches its horizontal position (see Fig. 2), the angle between the stay slide actuator 250 and the stays 200 will become very acute, so that both the stay slide actuator and the stays 200 will be subjected to a considerable stress if they are the only supports for the upper part of the mast. According to an advantageous embodiment of the invention a support 257 is therefore provided for supporting the upper part of the mast in the transport position, and being so adapted that it can raise the mast slightly, f. ex. 10°, from horizontal position by means of built-in actuators, whereafter the stay slide actuator 250 alone can control the further upward tilting motion.

Fig. 5 furthermore shows two winches 26 with wires 25 used for hoisting, partly of the ram mechanism 16, partly the pile 2. By arranging these winches on the extensible part of the guide boom, erection and dismantling of the mast is very much facilitated, as these operations may then be carried out without the necessity of manual arresting or freeing the hoisting wires. It is furthermore achieved that the up- and downward movement or changes of the angular position of the mast will be of no importance for the wire tightening, so that the winches may just be in a fixed position during such movements.

Although the machine in Fig. 5 is shown with the mast in vertical position or perpendicular to the plane of the rail surfaces, it will be obvious that also other positions may be achieved by displacement of the stay slide actuator 250, and the machine may thus operate with the mast tilted as much as 10° outwardly from or 45° inwardly over the upper part of the machine. Height adjustment of the mast is readily carried out by the mast foot actuator 251, so that the placing may be adapted to the sloping of the ground and other conditions.

According to an advantageous embodiment, the stays are so arranged that their displacement can be individually controlled, so that they may be used for tilting the mast within a plane parallel to the track over a range of attitudes inclining f. ex. up to 3° from vertical to either side. To make this possible, the guide between the two parts of the guide boom is of cylindrical configuration, so that the extensible part 229 is pivotal about the longitudinal axis in relation to the base part 228.

Fig. 6 further shows the arrangement of the lifting rod 255 in the pile, said lifting rod being held by wires from a lifting yoke 256. This arrangement allows space for the ram mechanism (not shown in Fig. 6) so that it may be hoisted up or down in relation to the pile.

According to an advantageous embodiment of the invention a particular slide 253 is provided, being movable in relation to the leader and having guide rollers 24 for the wires. This slide is held by a part of the stay slide actuator 250 so that it is kept in a fixed distance from the extensible part of the guide boom. A suitable guidance of the wires is hereby achieved being independent of inclinations of the mast, and, in particular, a firm securing of the wires during dismantling of the mast.

The machine can operate at right angles to the track, but may also be swivelled into various inclined positions within an angular space of abt. 45° to each side, as shown in Fig. 4 in dashed lines 43.

In a preferred embodiment of the invention all manoeuvering functions, including the propelling engine, winches and all actuators are driven hydraulically by power being transmitted through suitable tubes and hose connections from the engine 7 of the machine and controlled from a manoeuvering panel (not shown) in the driver's cab. It is obvious that there are numerous other ways of transmitting and controlling the manoeuvering powers, such as by means of mechanical connection, compressed air or electricity, and the invention comprises all such variants.

For establishing a foundation, the machine is erected into the position shown in Figs. 3-6, and a wire is fastened to a pile 2 which in advance has been placed on location so that the pile may be hoisted into position below the ram 16 and driven into the ground.

If the pile during driving is slightly displaced in relation to the desired position, it will be possible to adjust it by pulling or pushing in direction transversely to the track during the subsequent driving. For this purpose the pile may optionally be fastened to the mast foot by means of chains, or an intermediate plate, such as a wooden plate, may be placed between pile and mast foot, whereafter the telescopic extension mechanism of the guide boom is utilized for exerting a lateral force on the pile during the subsequent driving.

## Claims

1. A pile-driving apparatus comprising a driving carriage for driving on railway, an upper part pivotally mounted about a vertical axis, denominated the swivel axis, so that it may swivel relative to the driving carriage and having power-driven swivel means, to which upper part a mast is connected,

said mast being provided with a slide guide for a ram mechanism, means for hoisting said ram mechanism, and means for hoisting a pile, said mast being adapted to erection to a substantially vertical, operational position for the purpose of pile-driving, in which position it is supported by stays being linked to a slide which is supported displacably in longitudinal direction on the mast, and said mast being adapted to lowering into substantially horizontal position for the purpose of relocating said apparatus, said apparatus comprising a power supply for powering said ram mechanism, said hoisting means and said swivel means, CHARACTERIZED in that said mast is connected to the upper part by means of a telescopically extensible and contractible boom having a base part linked to said upper part by a hinge with a hinge axis perpendicular to the swivel axis, and a telescopically extensible part connected to the base part, said telescopically extensible part being connected to the mast by being connected to a slide fixture being displacable along the longitudinal axis of the mast, while maintained at a fixed, predetermined angle between the axis of the mast and the extension axis of the boom.

2. An apparatus according to Claim 1, CHARACTERIZED in that the slide fixture is adapted to maintain the extension axis of the boom substantially at right angles to the axis of said slide guide for the ram mechanism.

3. An apparatus according to Claim 1 or 2, CHARACTERIZED in that power-driven and controlled means are provided for exerting forces in the longitudinal direction of the mast between the slide of the stays and the slide fixture.

4. An apparatus according to any of the Claims 1-3, CHARACTERIZED in that the hoisting means comprise winches mounted on the extensible part of the boom.

5. An apparatus according to any of the Claims 1-4, CHARACTERIZED in that power-driven and controllable means are provided for exerting forces in longitudinal direction of the mast between the mast and the slide fixture.

6. An apparatus according to any of the Claims 1-5, CHARACTERIZED in that swivelling of the upper part is controlled by control means being provided with switchable blocking means for securing that the upper part can only be swivelled to a preselected side of the track.

7. An apparatus according to Claim 6, CHARACTERIZED in that the control means controlling the swivel movements are provided with blocking means for securing that the upper part can only be swivelled away from the longitudinal direction of the track when the mast has been raised to a predetermined oblique angular position.

8. A method for relocation and erection of a pile-driving apparatus, whereby a mast carrying a slide guide for a ram mechanism is relocated while in substantially horizontal position on a railway carriage within the conventional, structural gauge section for railway vehicles, and whereby said mast is erected to substantially vertical position for the purpose of driving a pile into the ground beside the track, CHARACTERIZED in that the mast is tilted upwards into an inclined attitude, in that the mast is swivelled about a vertical axis between the rails into a direction substantially transversely to the rails and in that the mast is thereafter raised into substantially vertical position.

9. A method for installing a foundation beside a rail track, CHARACTERIZED in that the foundation is prefabricated and transported to the site of installation, in that an apparatus with ram mechanism is erected by the method according to Claim 8, in that the foundation is hoisted into position below the ram mechanism and in that the foundation is rammed down.

10. A method according to Claim 9, CHARACTERIZED in that a lateral force is exerted on the foundation during ramming, by pulling or pushing the mast transversely in its area immediately above the ground towards or away from the track, the foundation if necessary being attached to the lowermost portion of the mast.

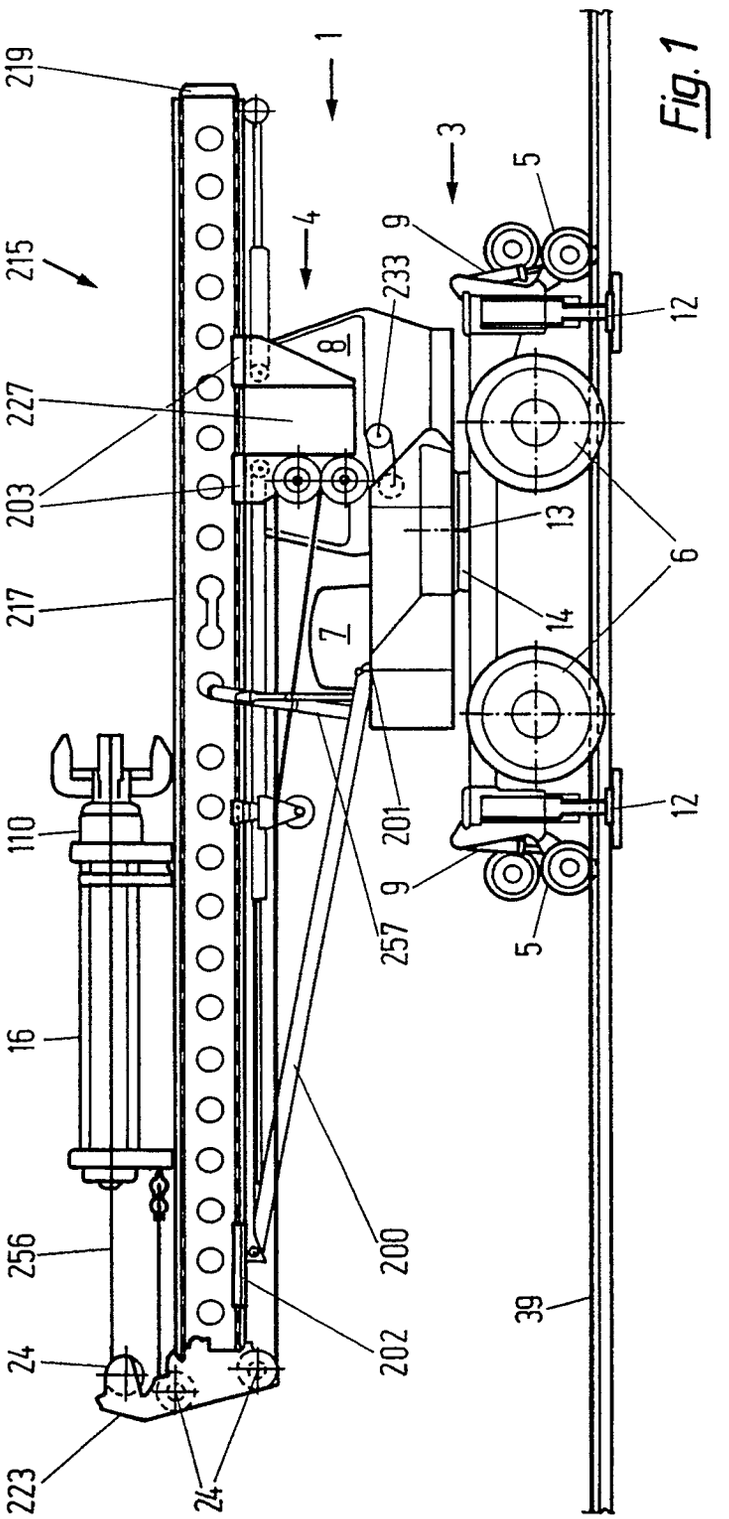
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Fig. 1

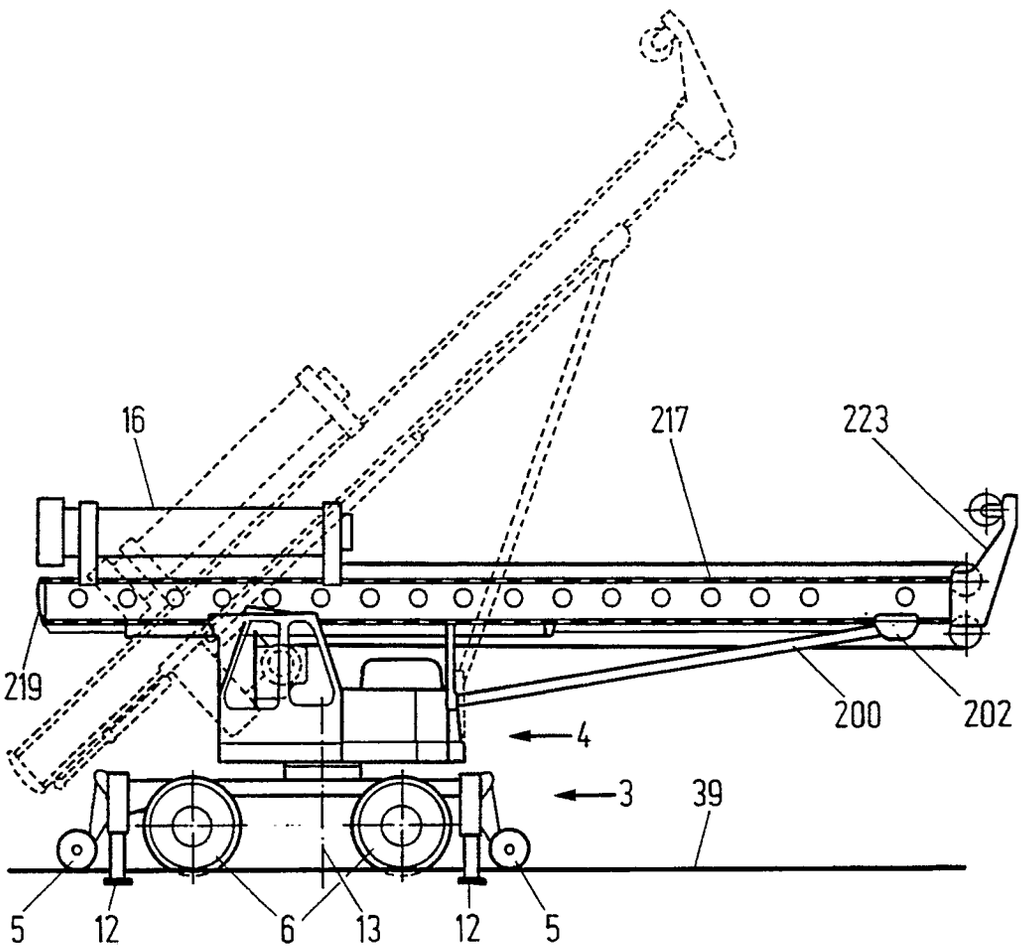


Fig. 2

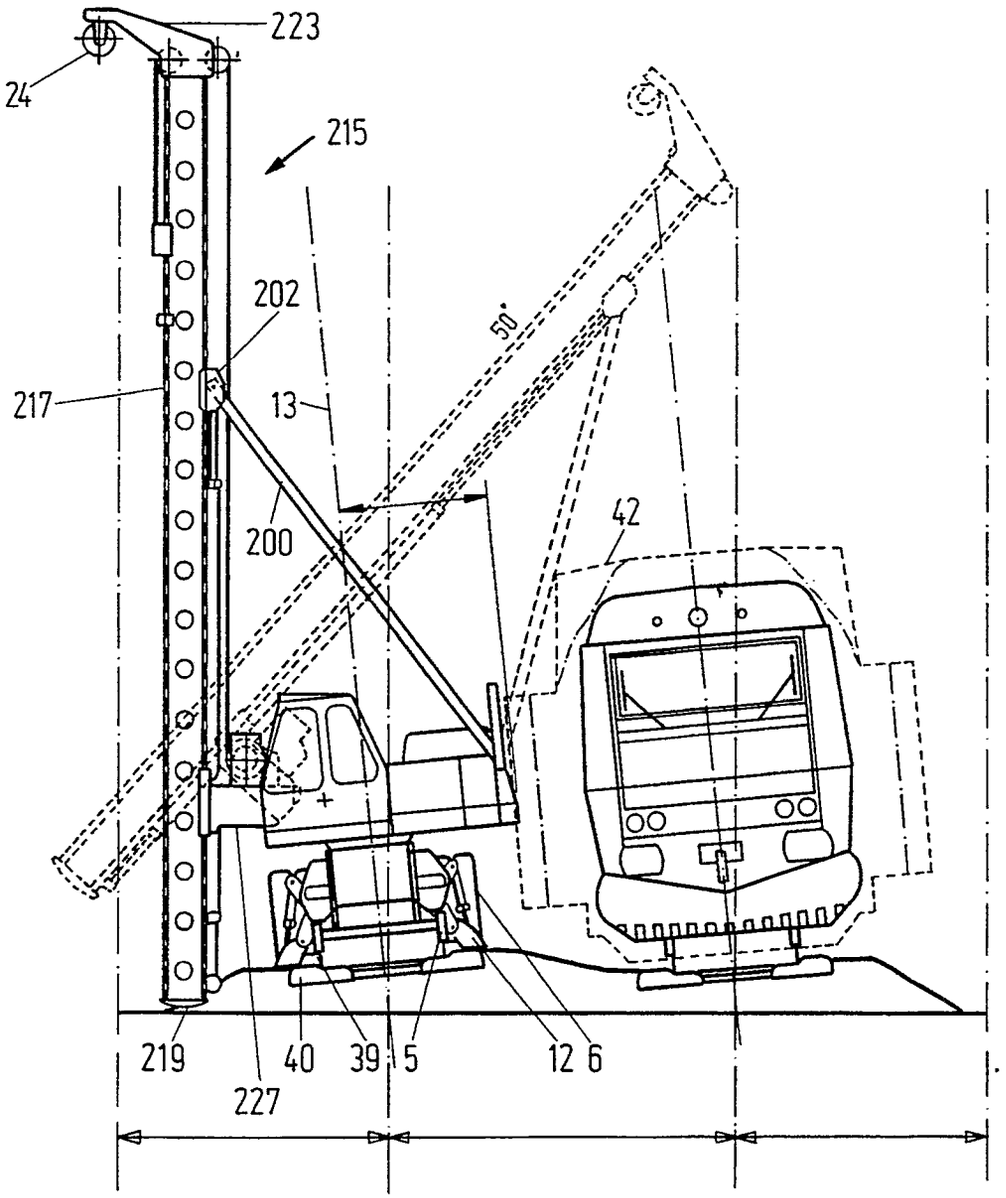


Fig. 3

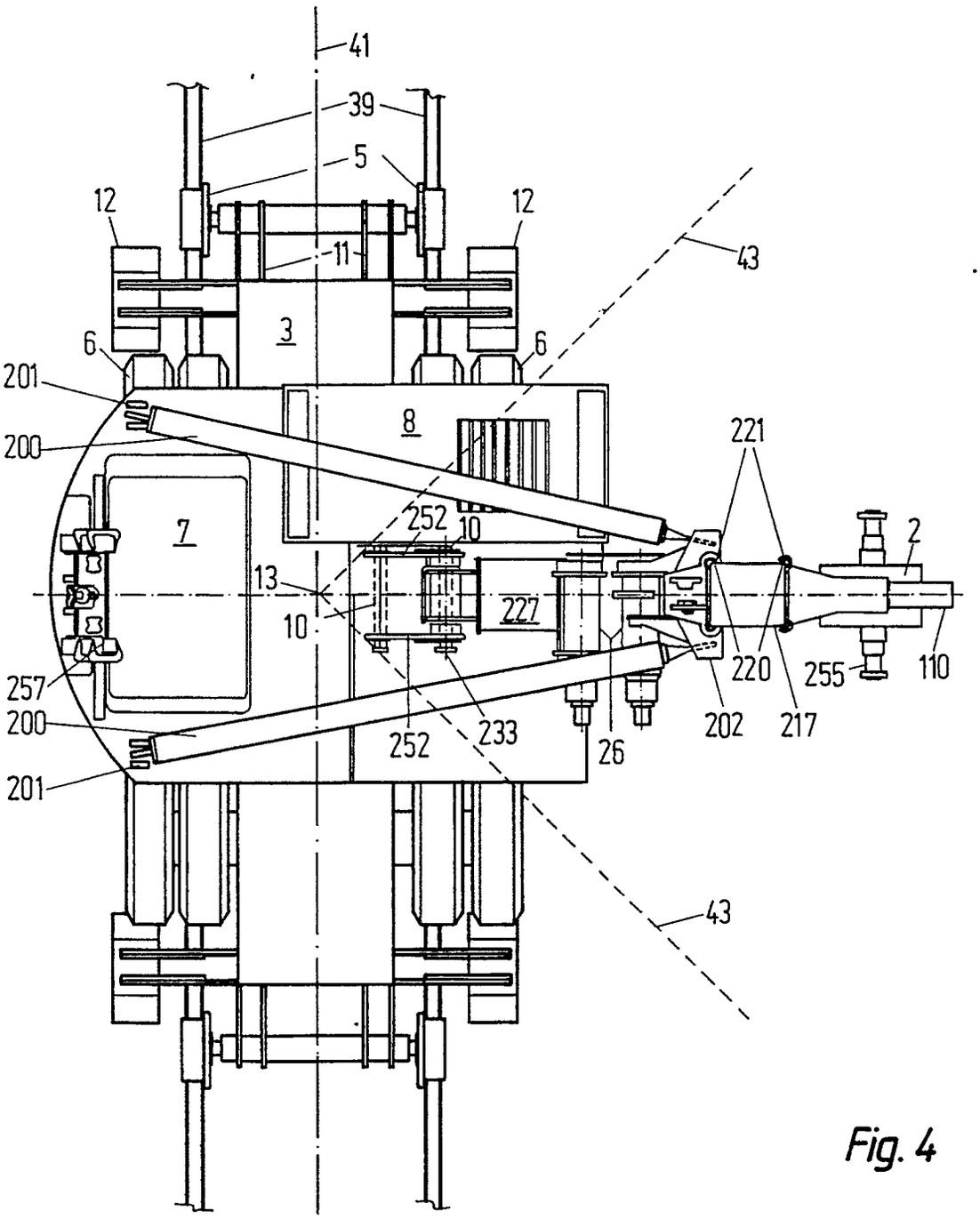
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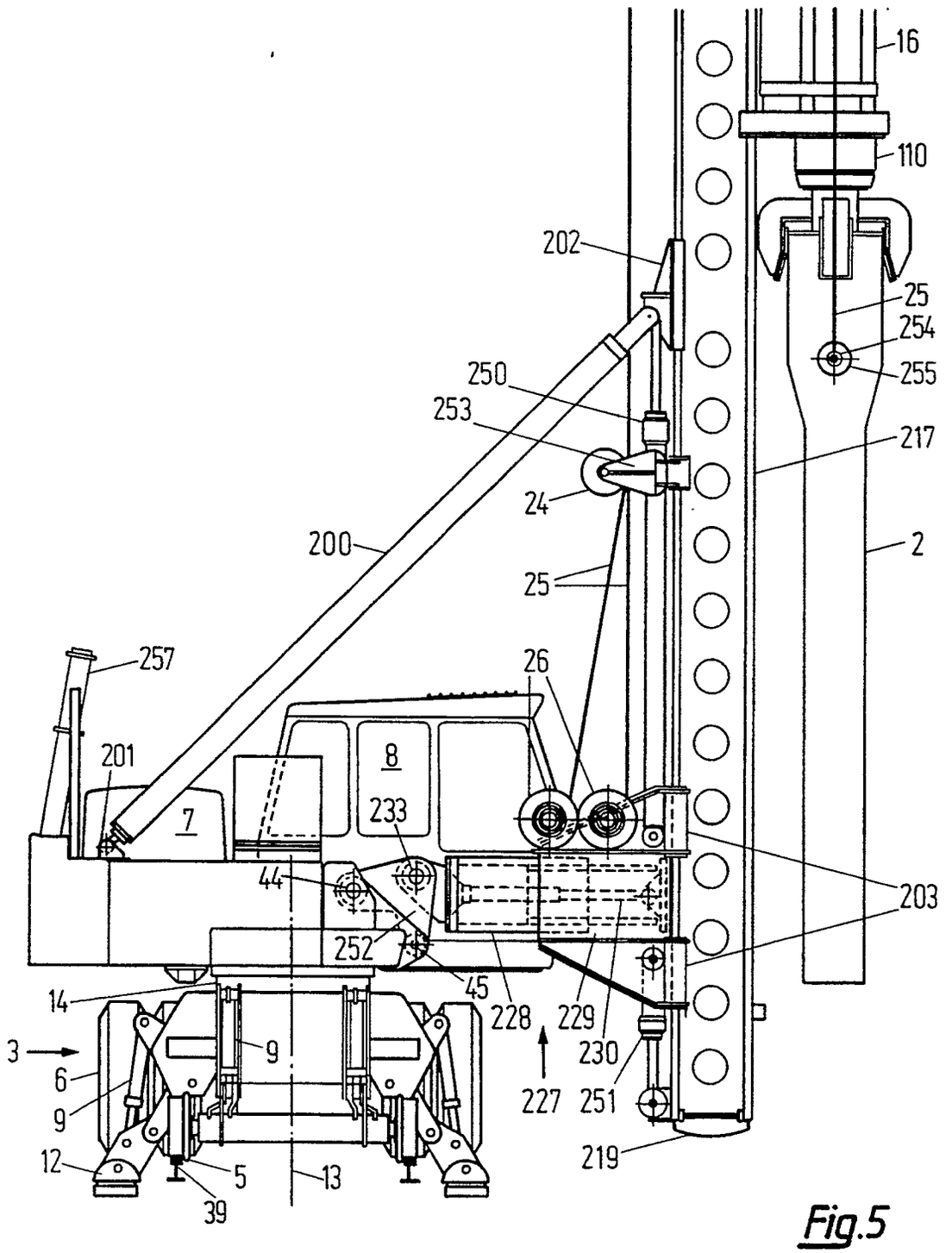
Fig. 4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45
14
228
229
230
3
9
227
251
6
9
219
12
5
13
39

Fig.5

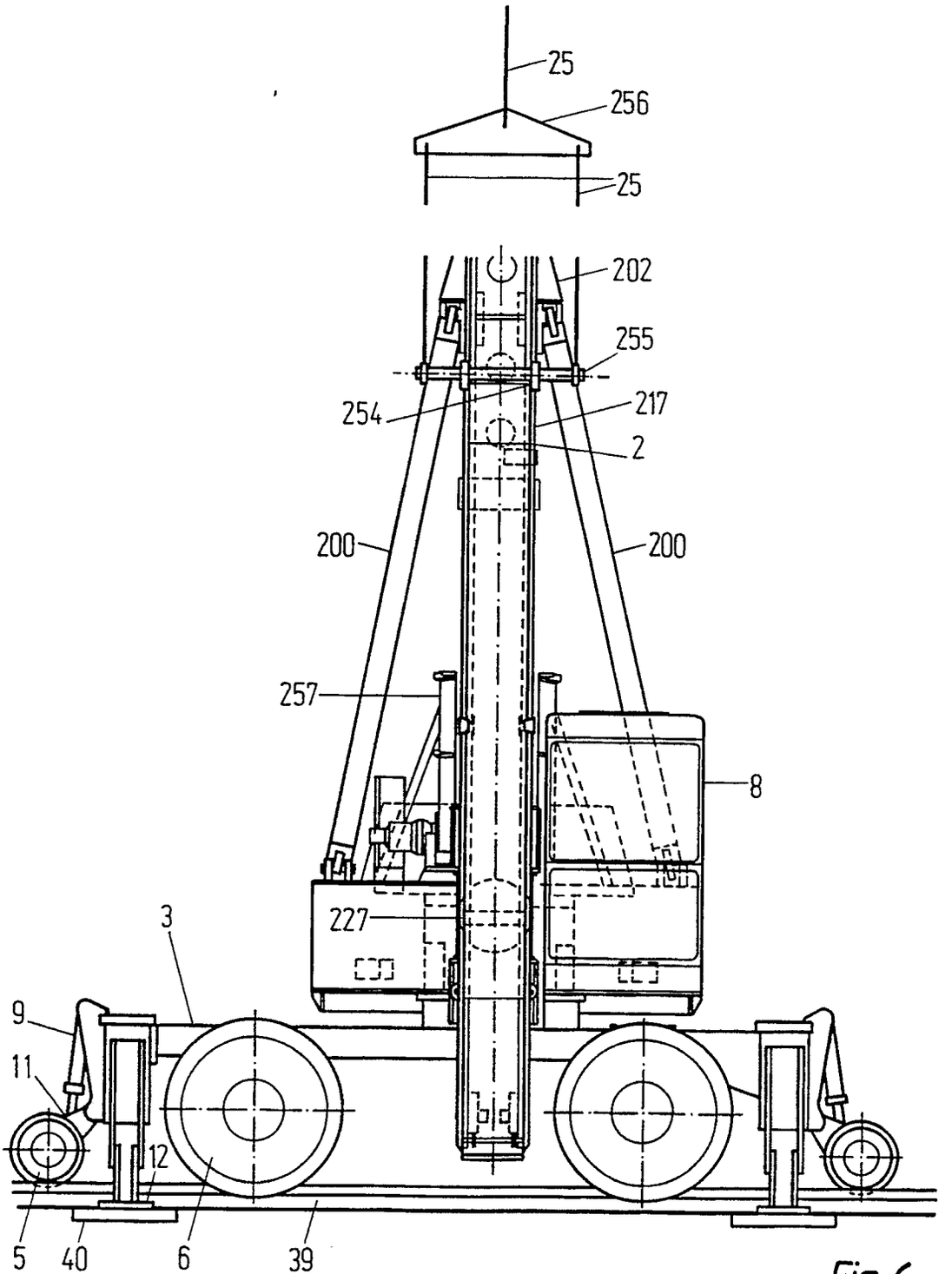


Fig. 6