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(54) A machine for pile-driving, a method for transport and erection of a machine for pile-driving, and a method for establishment of a foundation.

(57) A machine for pile-driving comprises a driving chassis (3) with wheels (5,6) for moving on railway or road, and an upper part (4) pivotally mounted about a vertical swivel axis (13) on the driving chassis. A mast (15) with slide guide (17) for a hammer 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 by a telescopically extensible and contractible boom having a base part (28) being connected to the upper part of the machine by means of a hinge with a hinge axis (44) perpendicularly to the swivel axis of the upper part, and a telescopically extensible part (29) connected to the base part, said mast being mounted to said part (29) by a hinge having its axis (49) substantially parallel to the hinge axis of the base part. It is hereby achieved that the mast may be erected while the vehicle is standing on a track above which an electric overhead traction wire is mounted.

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.

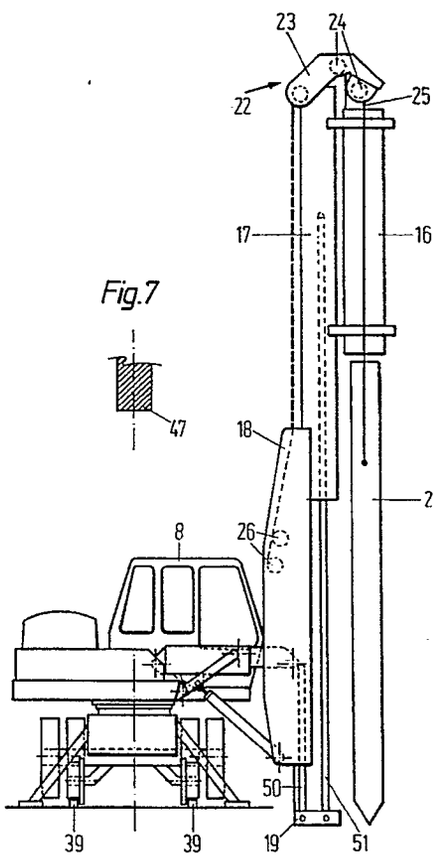

Fig.7

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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 a foundation.

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 an 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 cart 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.

For erection of the mast a considerable headroom above the machine is, of course, required, and in practice, erection will be impossible if there are overhead wires extending above the site. 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 in proportion to 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 incapable of performing an occasionally useful adjustment movement which may be performed by certain other pile-driving machines, i.e. forcing a pile 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 pile-driving machine for transport on railway is hereby achieved, which machine can operate from a position standing on the track and which in simple manner can be installed in working position and dismantled for transport. A pile-driving machine of a particularly good flexibility is achieved, as the height of erection of the mast may be adjusted by tilting the boom about the axis in the upper part of the machine, and the mast in the working position may be displaced in direction towards or away from the swivel axis by extension of the boom. The swivel mechanism of the machine may also be utilized for operation at right angles to the track or within an interval of oblique directions within the restrictions of space determined by the driving chassis. The mast may operate in vertical positions or may be placed in inclined position by tilting about the axis of the outer end of the boom, if desired. The machine is therefore suitable for placing foundations also on sloping locations, for example where the railway extends over an embankment or at low-level lines. If necessary, a foundation may also during driving be forced towards or away from the swivel axis by utilizing the telescope mechanism of the boom. Dismantling of the mast requires very little space, and, in particular, restricted height above the track, as the boom need to be only slightly raised to release the mast foot from the ground. The mast is tilted about the hinge at the end of the boom and so far back as the upper part of the machine allows, whereafter mast and boom together can be tilted about the machine hinge until the mast lies in the substantially horizontal transport position. Furthermore, the double hinges and the possibility of extending the boom facilitate adjustment of the transport position of the mast to place the centre of gravity as favourably as possible.

A very important advantage according to the invention is achieved in that it is made possible to erect and dismantle a mast of a considerable length from a railway vehicle standing on a track with an overhead electric traction wire.

According to an advantageous embodiment of the invention the boom is in its transport position contracted and sloping upwards from the supporting pivot in the upper part of the vehicle. It is hereby achieved that the mast top immediately at the beginning of the erection operation is moved towards the swivel axis so that the mast can be tilted upwardly into an inclined attitude, utilizing the maximum available space above the track, the mast extending in the longitudinal direction of the track and without any danger of collision between the mast top and the vehicle chassis. Provided that the mast is of a suitable short length, it can thereafter be swivelled from the longitudinal direction into a direction transversely to the rails in such a manner that the mast top during swivelling does not intersect the structural gauge section for traffic hauled on the track.

According to advantageous embodiments, power-driven and controlled means are provided for erection and dismantling of the mast, and according to a particular embodiment the hoisting gear comprises a winch mounted on the mast. It is hereby made possible to erect and dismantle the mast automatically from a control panel.

According to an advantageous embodiment, the means for tilting the mast about the hinge at the end of the guide boom comprises a linear actuator acting on the mast at a point which in the vertical working position of the mast lies below the tilting point of the mast. Such anchoring of the mast is very efficient in cases where it is necessary, during ramming, to adjust the position of the foundation by transverse forcing. Only the lowermost part of the mast must be designed to support the relatively heavy bending loads which may occur during this operation, while the uppermost part of the mast may be designed relatively weak, as it is only required to support the hoisting forces acting substantially in its longitudinal direction.

According to advantageous embodiments of the invention the mast is divided into a plurality of mutually sliding parts, and the hoisting means may comprise a pivotable mast top with wire roller. It is hereby made possible to arrange a relatively long effective mast within the narrow space being available, if erection of the mast is required under the above-mentioned confined conditions.

According to advantageous embodiments of the invention, the control means controlling the movements of the upper part of the machine and the mast, are provided with blocking means so that the mast can only swivel to one side of the track, and possibly only in a predetermined oblique position of the mast. The machine can hereby operate on one side of a double track, placing foundations along the outside of the track and with sufficient safety of operation to permit simultaneous traffic on the neighbour track. The blocking means is, of course, arranged in such a manner that it can optionally be switched to one side or the other under observance of appropriate precautionary measures.

According to the invention a method for transport and erection of a pile-driving machine is provided, as stated in Claim 13. A very uncomplicated and flexible erection of the mast is hereby achieved, as described above. Dismantling of the mast is, of course, carried out in the reverse sequence of operation.

According to advantageous embodiments of this method, the mast is provided with a plurality of mutually sliding parts, whereby it is achieved that the mast has a greater effective length of operation, simultaneously being relatively compact for dismantling and transport.

According to the invention a method is provided for installing foundations along a track as stated in Claim 16. A fast prefabrication of foundations under controlled conditions, f. ex. in a factory, is hereby made possible, whereafter the foundations can be installed on location with a minimum of inconveniences for the railway traffic. Furthermore, the installation can be carried out with very limited use of manpower.

According to the invention a method as stated in Claim 19 is provided, where the distance of a foundation from a track is adjusted during ramming. It is hereby achieved that, if desired, the position of a foundation may readily and effectively be adjusted in relation to the track, whereby a very accurate position of the foundations is achieved.

The invention is described in more detail in the following, with reference to embodiments shown in the drawings, wherein

Fig. 1 shows a pile-driving machine according to the invention, shown from the side, as transported on a railway track,

Fig. 2 shows a step of the erection of the machine according to the invention, where the upper part of the machine has just been swivelled transversely over the track,

Fig. 3 shows a step of the erection of the machine according to the invention, where the mast has been raised so far upwardly that the guide boom is in substantially horizontal position,

Fig. 4 shows a step of the erection of the machine according to the invention, where the guide boom is in substantially horizontal position and is expanded into its full length,

Fig. 5 shows a step during erection of the

machine according to the invention, where the mast has been swung sidewardly to a position outside the overhead traction wire above the track and telescopically extended slightly upwards,

Fig. 6 shows a step of the erection, where the mast is in vertical position and the mast top is tilted upwards,

Fig. 7 shows the machine in the position of operation, ready for driving a pile,

Fig. 8 shows a plane view of the guide boom seen from below, with a section through the slide guide,

Fig. 9 shows a cross section of the guide boom along the line 9-9 of Fig. 8,

Fig. 10 shows a vertical, longitudinal section through the guide boom, and

Fig. 11 shows a plane view of the machine standing in operating position on a track.

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 an 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 controllable 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 is seen at the top, with the hammer assembly or hammer carriage 16 being transported in substantially horizontal position. The mast 15 comprises a slide guide or leader 17 for the hammer assembly, the leader being displaceable in relation to the part of the mast called the slide guide 18. The mast foot 19 is shown to the right in the figure and may likewise be extended in relation to the slide guide 18. The mast top 23 is shown to the left.

Mast and hammer assembly are supported by the guide boom 27 which comprises a base part 28 pivotally mounted about a horizontal axis through the hinge eyes 44, and a telescopically extensible part 29 connected to the slide guide 18 at the pivot point 37. The base part of the guide boom can be tilted up and down in relation to the top part of the machine by means of the lifting actuators 36. The mast is tiltable in relation to the guide boom about the hinge point 37 guided by an actuator 46 and in a manner to be described in more detail below. When the mast is in the folded position as shown, the whole equipment lies within the normal clearance profile for vehicles moving on rails.

The machine can in this way be driven on the rails to the working location where it is stopped, the feet 12 are placed on the sleepers or on the ground to provide a stable support for the machine. Thereafter the actuator 36 is slightly contracted, whereby the guide boom and mast in a fixed mutual angular relation are tilted about the hinge eye 44 into a position being defined by the clearance of the driving chassis and which may be defined by the maximum height available above the track.

In an inclined position, for example raised 15° over horizontal plane, the machine is thereafter swivelled into the position shown in Fig. 2. Fig. 2 illustrates the same components as Fig. 1 as well as the side limit 42 for the free gauge section for equipment moving on the track and a profile 47 indicating the area within which an overhead wire for electric traction would be placed. It appears clearly from Fig. 2 that already a limited inclination of the mast brings the mast top closer towards the swivel axis 13 which gives a better possibility of swivelling the machine in this position, without bringing the mast top into interference with the neighbour track or to collide with other fixed objects which may be situated along the track.

When the upper part 4 of the machine is positioned in direction transversely to the track, the driving chassis does no longer block the tilting of the lowermost end of the mast, and the mast may then be tilted further from the position shown in

Fig. 2, still with the mast and guide boom in the same mutual angular relation about the eye 44, into the position shown in Fig. 3. When the upper part of the machine is in the position shown in Fig. 2, the leader 17 may be extended telescopically along the slide guide 18 and slightly downwards for decreasing the requirement of free height above the machine during the upward tilting. In the position shown in Fig. 3 the guide boom 27 is substantially horizontal, and the mast top is so close to the overhead wire gauge section 47 that the mast cannot be tilted further upwards. At the same time, the mast foot 19 has been swung down to a position slightly above the level of the top of the rails. It is important that the machine can operate, also if the ground lies in this level, and the equipment is therefore designed so that the mast may be swung upwardly without the mast foot thereby moving below the level of the upper edges of the rails.

The telescopic guide boom is hereafter extended so that the extensible part 29 is brought into its outermost position, as shown in Fig. 4. It is hereby observed that the actuator 46 tilting the mast in relation to the guide boom in a manner to be explained later with reference to Figs. 8, 9, and 10, is acting between the mast and an attachment point in the extensible part 29 of the guide boom that an extension of the guide boom causes a strictly parallel extension of the mast.

From the position shown in Fig. 4 the mast can be tilted about the hinge point 37, the equipment being so adapted that there is still some space left before the mast foot hits the ground. As mentioned, the leader 17 and the mast foot 19 are so arranged that they are extensible in longitudinal direction with respect to the slide guide 18, and it is consequently possible, when the mast is tilted in a certain angular position, to extend the leader 17, the mast foot 19, and the mast top 23 upwardly as soon as the mast top is clear of the overhead wire gauge section 47, as seen in Fig. 5. This extension may be performed gradually, simultaneously with the tilting so that no point of the mast will ever get below the level of the upper edges of the rails.

Finally, the mast will reach substantially vertical position as shown in Fig. 6, where it is also shown how the mast top 23 by means of an actuator, not shown, can be swung upwardly.

The operating position is shown in Fig. 7, and it appears herefrom how the mast foot 19 has been extended downwardly, preferably until it has reached a position standing on the ground, while the leader 17 has been extended upwardly into its highest position and the hammer assembly or ram 16 likewise have been hoisted straight up into their highest position. It appears from Fig. 7 how an actuator 50 is arranged between the slide guide 18 and the mast foot 19, whereby the mast foot may be raised and lowered. It can furthermore be seen how the leader 17 is supported by an actuator 51 attached to the mast foot 19.

A wire is fastened to a pile 2 which in advance has been laid on location so that it can be hoisted into position just below the hammer assembly 16 and be brought into position ready to be driven. Hoisting of the hammer assembly and pile is effected by means of wires 25 guided over wire rollers 24 at the tiltable mast top 23. The hoisting gear comprises two winches 26 arranged in the slide guide 18. The hammer assembly is driven by hydraulic means, hydraulic power being conveyed from the machine engine 7 through hydraulic hoses, not shown in detail. As the pile is being driven, the hammer assembly 16 follows the pile downwards. As can be understood from Fig. 7, the leader 17 is of limited length, and the necessary operational length is achieved thereby that the leader 17 can be extended downwardly in the slide guide 18 straight down to the mast foot 19, as shown in Fig. 2, whereby the hammer assembly 16 can be guided and can operate at a level lying below the top of the rails.

The hoisting gear has sufficient strength to pull up a pile which might have been placed in a wrong position. If it appears that a pile, after ramming has been initiated, has not been placed in a correct distance from the track, it will be possible, even while the pile is being driven, to force it in direction towards the track or away therefrom by means of the machine. The telescopic extension mechanism of the guide boom is used herefor, being dimensioned of sufficient strength for this purpose. The pile 2 may be fastened to the mast foot 19 by means of chains or the like, or an intermediate plate, such as a wooden plate, may be laid between the pile and the mast foot.

Although not shown in detail, il will be apparent from Fig. 7 how the mast, also by means of the actuator 46, may be tilted about the hinge point 37 towards the median plane of the rails or in direction away therefrom in case it is desired to drive piles in oblique directions. Inclinations in a plane parallel to the median plane of the rails can be effected by utilizing the possibility of adjusting the positions of the feet 12 of the machine, it being possible to raise and lower said feet so as to tilt the entire machine and thereby also the mast.

As the guide boom is a very essential component according to the invention, its construction will now be described in more detail with reference to Figs. 8, 9, and 10. As apparent from these Figures, the base part of the guide boom comprises a box-formed beam, and the extensible part 29 of the guide boom likewise a box-formed beam, but of a dimension so that the extensible part may move

within the base part 28. As shown in Fig. 9 the two parts are provided with corresponding slide bars 31, to secure a well-controlled guidance of the two parts. The extension of the parts of the guide boom may be performed by an actuator 30 mounted within the boom and acting between the bearing points 32. The base part of the guide boom is at one end (left side of Fig. 10) provided with eyes 33, by means of which the base part is fastened to the hinge eyes 44 of the machine by means of an appropriate pivot pin 10. The extensible part 29 of the guide boom is provided with eyes at 37 for hinged connection to hinge eyes 49 in the slide guide 18 by means of a suitable pivot pin 10 as shown in Fig. 8. For fastening of the tilting actuator 46 of the slide guide, a projection or lug 38 with an attachment eye is provided at the lower end of the extensible part 29 of the guide boom. The base part 28 of the guide boom is on the underside provided with an opening 35, through which the projection 38 extends. It is hereby secured that the parts of the guide boom can be designed with suitable overlapping to secure a good stability and, at the same time, the boom may be sufficiently contracted. As previously mentioned, the base part 28 of the guide boom may be tilted in upward and downward direction in relation to the machine about the eyes 44 by means of the previously mentioned lifting actuators 36 being linked to a pivot pin 10 through the lowermost hinge eyes 45 of the machine. The lifting actuators 36 are connected to the base part 28 of the guide boom by means of pivot pins 34, a lifting actuator 36 being placed on each side of the base part 28 of the guide boom. Finally, Fig. 8 shows how the slide guide is arranged around the end of the guide boom and is provided with slide claws 21 by means of which the slide guide grips around slide bars 20 mounted on the leader 17. On the opposite side, the leader 17 is provided with further slide bars 20 for guiding the hammer assembly 16, gripping with suitable slide claws 21.

Reference is now being made to Fig. 11 showing a plane view of the machine in the operative position. This Figure also clearly shows the rails 39 and the sleepers 40; it furthermore shows the position of the rubber wheels 6 and the rail wheels 5 and illustrates how the feet or supporting legs 12 are positioned so as to only just rest on the outermost ends of the sleepers. The position of the double swivel eyes 44 and the double supporting eyes 45 on the machine, as well as the two lifting actuators 36 on both sides of the guide boom 27, are shown. As indicated by dotted lines 43 the machine can swivel a considerable angle to both sides, and this possibility in combination with the extensibility of the guide boom 27 means that the machine can cover the entire working area designated 48. According to a suitable embodiment of the invention, the position of the pile may be varied from approx. 3.0 meters to approx. 3.5 meters from the swivel axis 13, and the angle of operation of the machine can be extended to 50° on each side of the line perpendicularly to the middle line 41 of the rails.

In a preferred embodiment of the invention all manoeuvering functions, including transport, 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 transferring and controlling the manoeuvering power, such as by means of mechanical connection, compressed air or electricity, and the invention comprises all such variants.

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 into substantially vertical operational position for the purpose of pile-driving, and to lowering into substantially horizontal transportation 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 said upper part by means of a telescopically extensible and contractible boom having a base part linked to the upper part by a hinge with a hinge axis perpendicular to said swivel axis, and a telescopically extensible part connected with said base part, said mast being linked to said extensible part by means of a hinge whose axis is substantially parallel to said hinge axis of the base part.

2. An apparatus according to Claim 1, CHARACTERIZED in that the boom when in the transportation position is contracted and directed from the support hinge on the upper part of the apparatus inclined upwardly and outwardly from the swivel axis to the anchor hinge on the mast.

3. An apparatus according to Claim 1 or 2, CHARACTERIZED in that power-driven and controllable means are provided for tilting the mast in relation to the extensible part of the boom.

4. An apparatus according to Claim 3, CHARACTERIZED in that the means for tilting the mast comprise a linear actuator acting on the mast at a point which in the operational position of the mast is located below the hinge connecting the extensible boom part with the mast.

5. An apparatus according to any of the Claims 1-4, CHARACTERIZED in that the mast is divided into at least two mutually longitudinally displacable parts, one of said parts being linked to the boom and the other one carrying the slide guide for the ram mechanism.

6. An apparatus according to Claim 5, CHARACTERIZED in that the mast is divided into at least three parts, of which the first part is linked to the boom, the second part carries the slide guide for the hammer carriage and is slideably supported by the first part, and the third part is provided with a foot for support on the ground and is longitudinally extensible in relation to the first and the second parts.

7. A method for relocation and erection of a pile-driving apparatus, whereby a mast carrying a slide guide for a hammer carriage is relocated while in substantially horizontal position on a railway carriage within the conventional structural gauge allowed 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 swivelled about a vertical, first axis between the rails, in that the mast is tilted about a horizontal, second axis into an oblique attitude, in that the mast is displaced in a direction transversely to the rails and substantially horizontally, and in that the mast is tilted about a third axis substantially parallel to the second axis, but located at a distance therefrom and into a substantially vertical position.

8. A method according to Claim 7, CHARACTERIZED in that the slide guide, after erection of the mast, is displaced upwardly together with a part of the mast in relation to a supporting part of the mast, before pile-driving is commenced.

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 is erected by the method according to Claims 6 or 7, 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.

Fig. 2

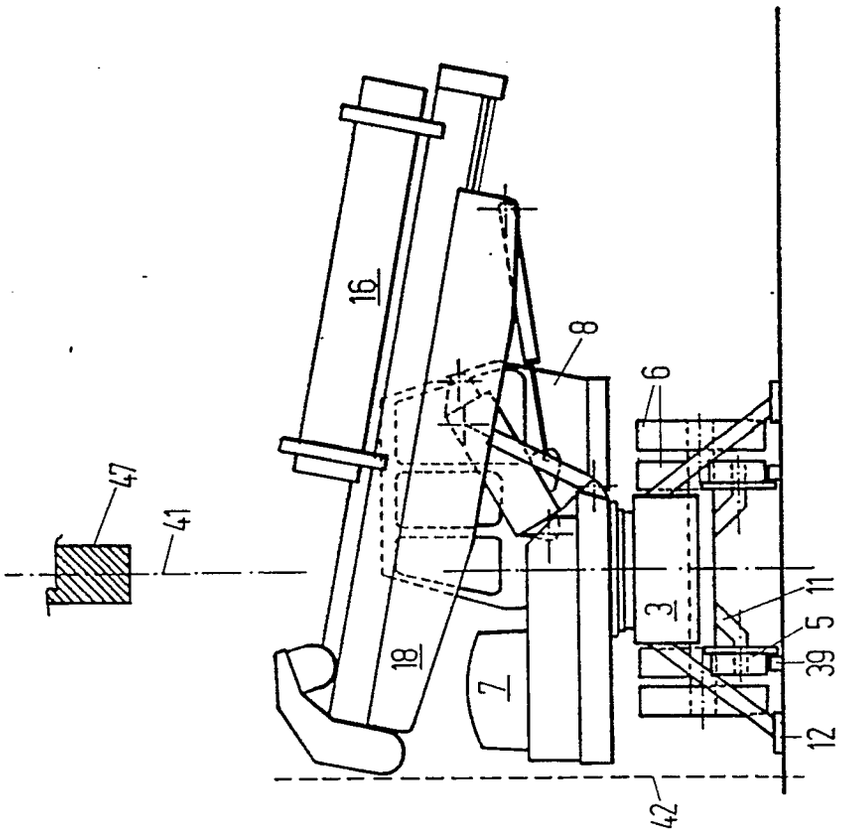
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Fig. 1

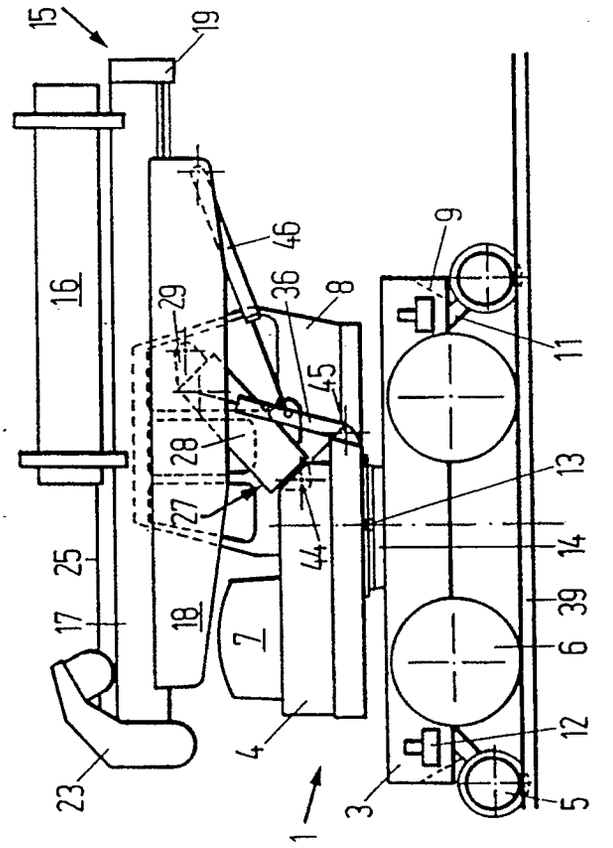
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Fig.4

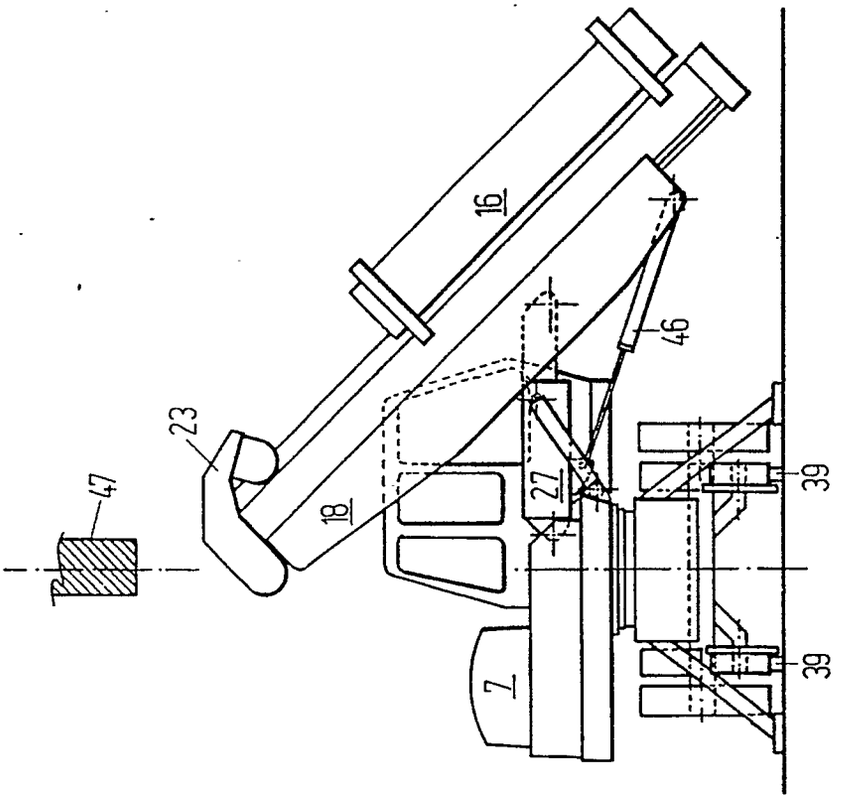
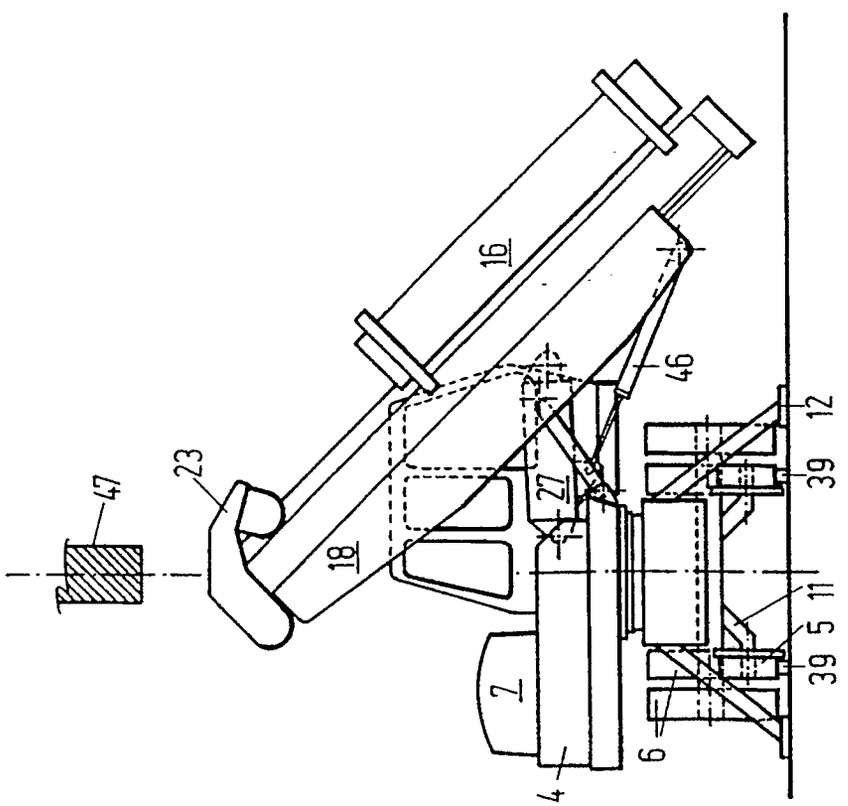


Fig.3



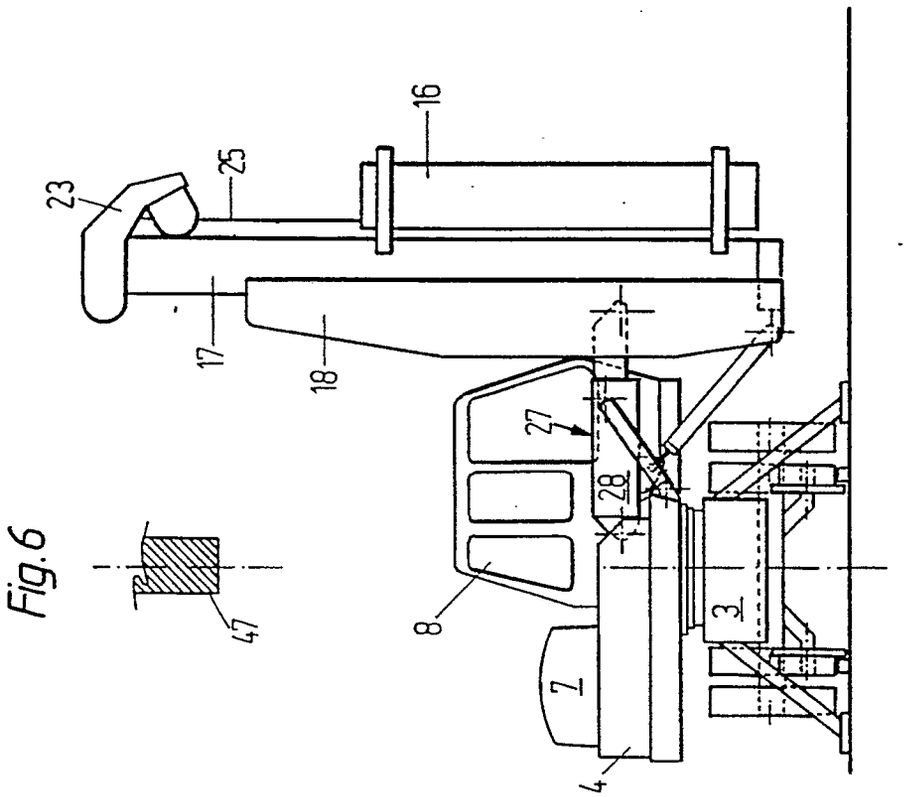

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Fig.6

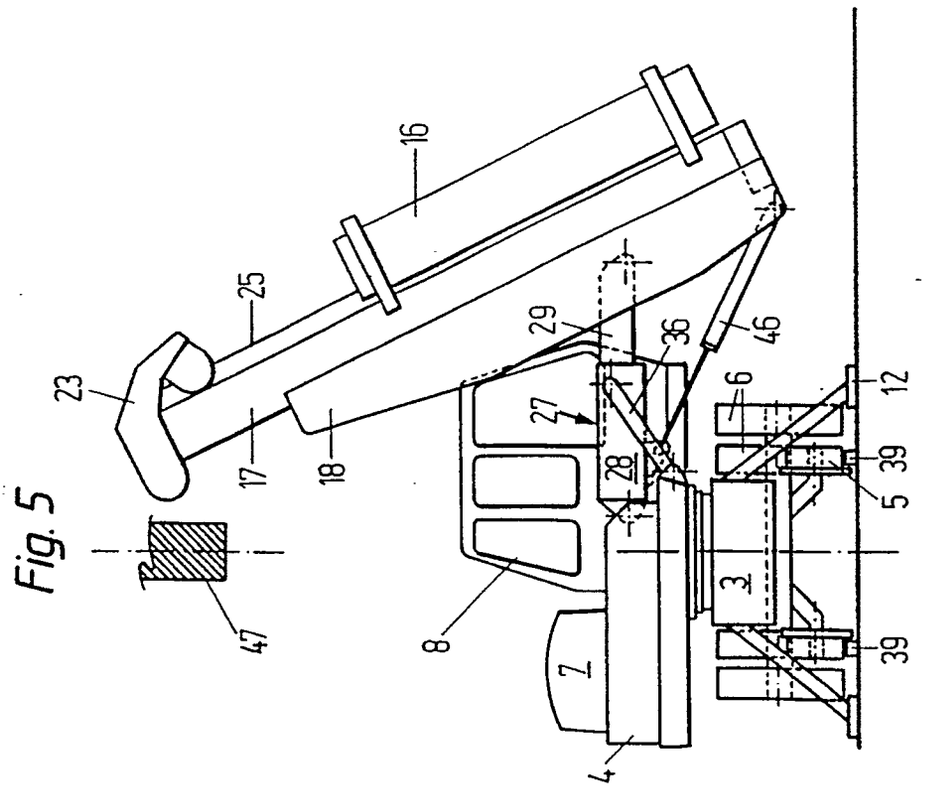
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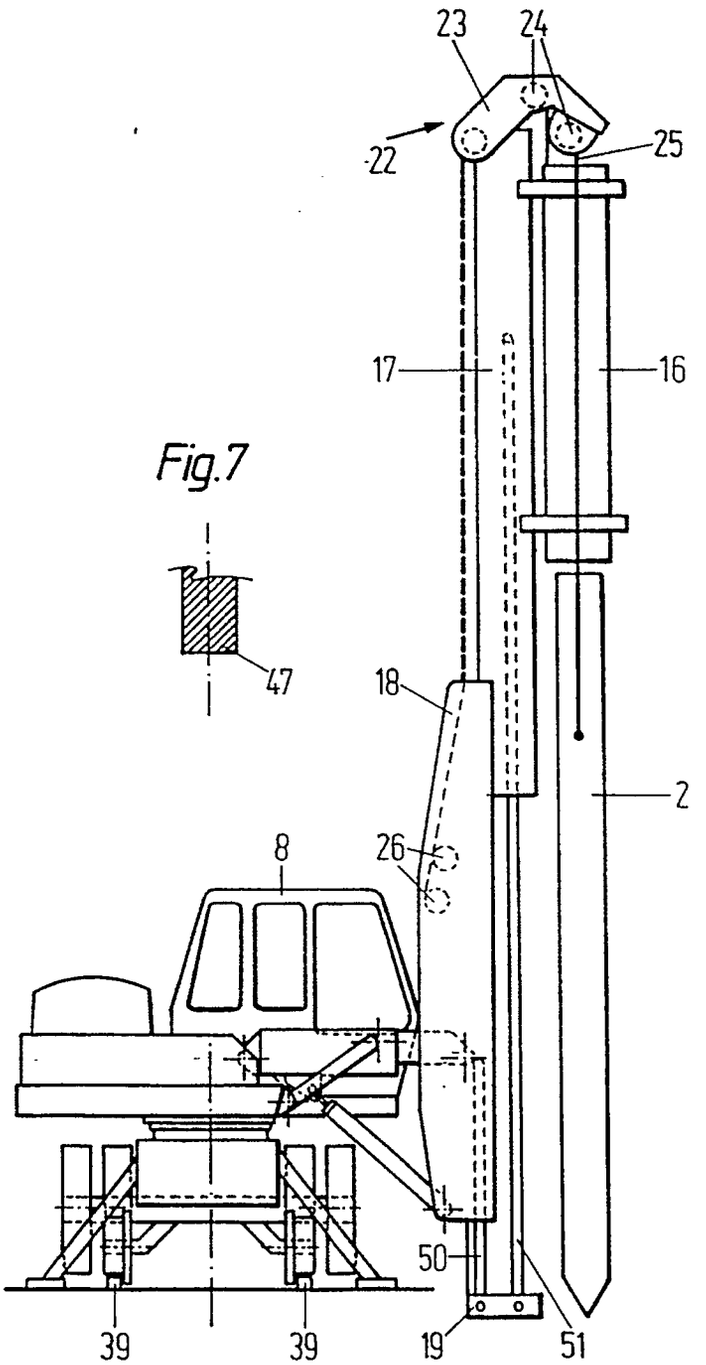
Fig.5

Fig.7



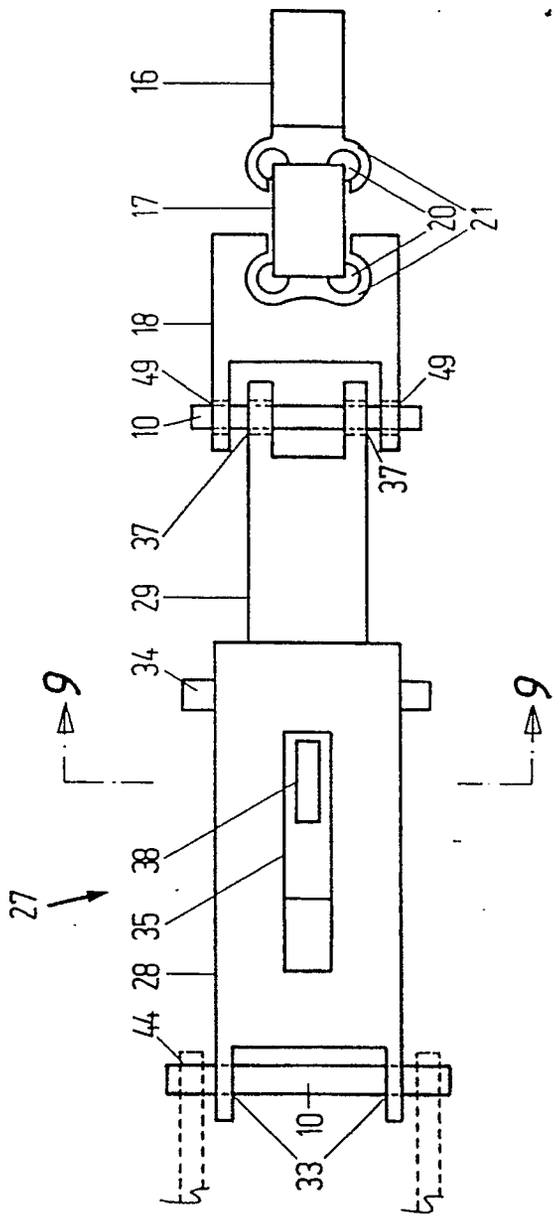


Fig.8

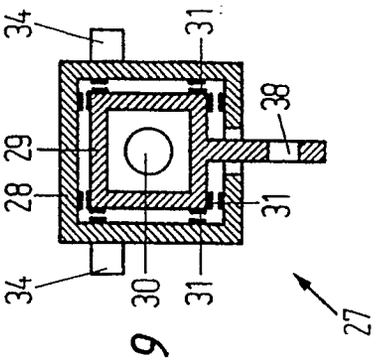


Fig. 9

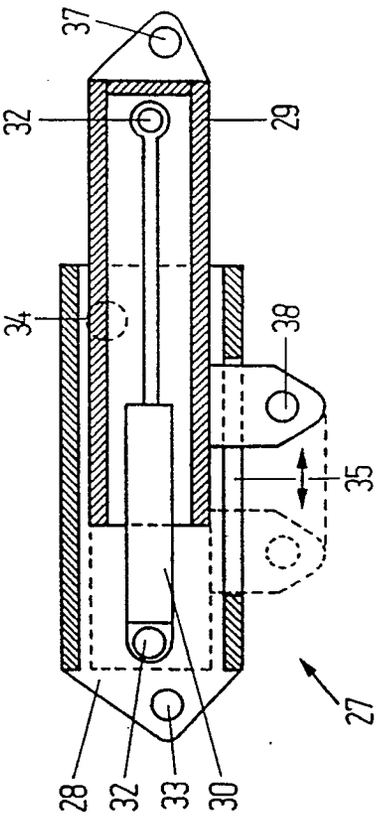
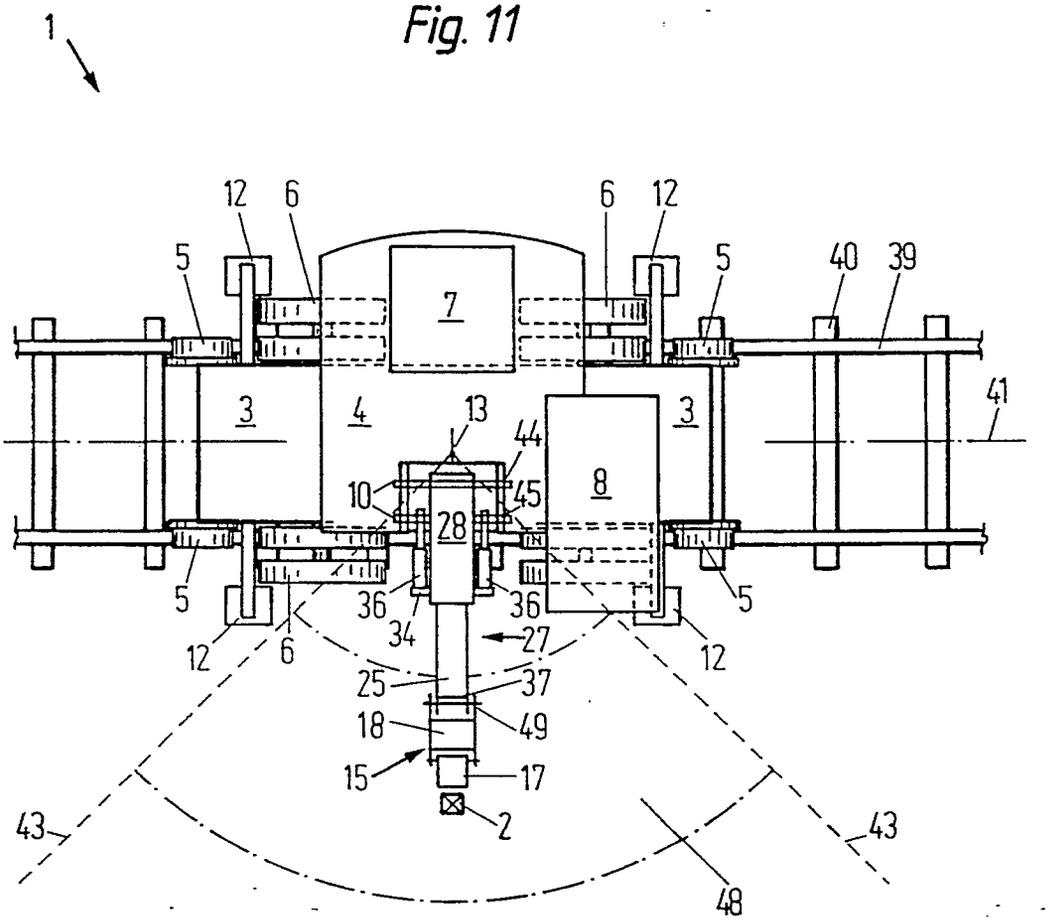


Fig. 10

Fig. 11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