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(54) Title: A pipe alignment system

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A pipe alignment system

Field of the invention

This invention relates to a pipe alignment system, and in particular an alignment system that facilitates the quick and accurate alignment of sections of pipe and/or other cylindrical fittings for tacking prior to welding.

Background of the invention

At present, the mechanical construction of pipe or similar cylindrical assemblies, for example as used in above ground gas stations, water/fuel pumping stations, steam and water supplies for electrical power stations, etc. primarily involve the following key stages:

1. Preparation of isometric drawings.
2. Cutting of specific pipe lengths.
3. Welding preparation of cut pipe (spools).
4. Fitting and tacking prior to welding.
5. Welding of spools to fittings and valves or the like.
6. Final assembly.
7. Pressure Testing of the System.

Of the above the most costly and labour intensive stages are stages four and five. However in recent years there have been technological advances in welding which are continually making it more cost and labour effective.

It is therefore an object of the present invention to advance the fitting and tacking operations in order to considerably reduce cost and time by providing a pipe alignment system which is capable of quickly and easily aligning and engaging the end faces of two sections of pipe to be joined, and which can be operated by a single user.

Summary of the invention

According to the present invention there is provided a pipe alignment system comprising a base; a support mounted on the base; and a tool holder carried by the support; wherein the support is operable to bias the tool holder in a substantially horizontal direction.

Preferably, the pipe alignment system comprises a biasing element operable to bias the tool holder in a substantially horizontal direction.

Preferably, the biasing element is disposed between the base and the support and arranged to effect the substantially linear displacement of the support relative to the base.

Preferably, the biasing element comprises at least one bearing disposed between the base and the support.

Preferably, the bearing is arranged to allow the support to be linearly displaced relative to the base under the influence of gravity.

Preferably, the pipe alignment system is adapted to enable the support to be immobilised relative to base.

Preferably, the support defines a guideway, the alignment system further comprising a carriage arranged for linear displacement along the guideway, the tool holder extending from the carriage such as to permit height adjustment of the tool holder.

Preferably, the pipe alignment system comprises drive means for displacing the carriage along the track.

Preferably, the base comprises a pair of legs.

Preferably, the base comprises three wheels, one fixed wheel mounted about a free end of each leg, and a steerable wheel positioned to define a triangular wheel array.

Preferably, the tool holder is pivotable about a first pivot axis.

Preferably, the tool holder is pivotable about a second pivot axis oriented substantially orthogonally to the first pivot axis.

Preferably, the pipe alignment system comprises a handle to facilitate manual displacement of the system.

Preferably, the pipe alignment system comprises a brake in order to facilitate immobilisation of the base.

Preferably, the pipe alignment system comprises a tool mounted to the tool holder and adapted to hold a section of pipe.

Preferably, the tool comprises a three point contact system.

Preferably, the location of at least one of the contact points is adjustable.

Preferably, the tool comprises one or more seats on which a section of pipe may be supported, and a template defining an array of sites at which one of the seats may be secured.

Preferably, the array of sites define a plurality of sets of sites which position the seats at fixed spacing and/or orientation relative to one another in order to accommodate pipe sections of standard dimension and/or configuration.

Brief description of the drawings

Embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 illustrates a perspective view of a pipe alignment system according to a first embodiment of the present invention;

Figure 2 illustrates a plan view of the pipe alignment system shown in Figure 1;

Figure 3 illustrates a front elevation of the pipe alignment system shown in Figure 1;

Figure 4 illustrates a side elevation of the pipe alignment system shown in Figure 1;

Figure 5 illustrates a rear elevation of the pipe alignment system shown in Figure 1;

Figure 6 illustrates a plan view from beneath of the pipe alignment system shown in Figure 1;

Figure 7 illustrates a perspective view of a pipe alignment system according to a second embodiment of the present invention;

Figure 8 illustrates a plan view of the pipe alignment system shown in Figure 7;

Figure 9 illustrates a front elevation of the pipe alignment system shown in Figure 7;

Figure 10 illustrates a side elevation of the pipe alignment system shown in Figure 7;

Figure 11 illustrates a rear elevation of the pipe alignment system shown in Figure 7;

Figure 12 illustrates an enlarged view of a portion of a carriage tool holder forming part of the alignment system shown in Figure 7; and

Figure 13 illustrates a perspective view of a tool forming part of the alignment system of the present invention.

Detailed description of the drawings

Referring now to Figures 1 to 6 of the accompanying drawings there is illustrated a first embodiment of a pipe alignment system, generally indicated as 10, which is designed to reduce the time taken, and increase the accuracy of, the assembly of two pipe sections (not shown) and/or fittings to one another, for example fitting a radius or elbowed pipe section (not shown) to a straight length of pipe or spool (not shown).

The apparatus 10 allows two such pipe sections to be aligned, both axially and angularly with significant speed and accuracy. The sections of pipe can then be tacked together while being held in position relative to one another by the alignment system 10, for ease of welding once removed, thus allowing the final pipe assembly to be fully welded while reducing distortion and increasing accuracy of the fit between sections.

The alignment system 10 comprises a base 12 which is intended, in use, to be free standing on the floor of a workshop or the like, a support 14 mounted above and to the base 12 and carrying a tool holder 16 via a guide way 18 and carriage 20 displaceable therealong, the tool holder 16 being mounted to the carriage 20. The tool holder 16 is arranged, as will be described in detail hereinafter, to hold a tool 56 which is adapted to grip a work piece, for example in the form of a section of pipe or a fitting or connection to another section of pipe (not shown). The tool 56 allows the gripped section of pipe to be brought into register with a corresponding section of pipe to be joined together, and to be substantially horizontally biased against that section of pipe in order to permit the two sections to be tacked together before being released from the tool holder 16, following which the sections may

be fully seam or otherwise welded. The tool 56 is interchangeable with alternative tools (not shown) which may have different configurations and/or modes of operation, in order to facilitate the retention of various work pieces by the alignment system 10.

The base 12 in the embodiment illustrated comprises a pair of splayed and substantially horizontally disposed legs 22, which in the embodiment illustrated are formed from box section steel/aluminium or the like, a fixed or non-steerable wheel 24 being secured at the outer free end of each of the legs 22. A third steerable wheel 26 is mounted adjacent the inner free ends of the legs 22 and at the free end of a vertical column 28 having a handle 30 at an upper free end thereof in order to allow the wheel 26 to be steered by rotating the column 28, in similar fashion to a conventional hand truck or the like. It will of course be appreciated from the following description of the configuration and operation of the alignment system 10 that the base 12 may be of any other suitable configuration, preferably being mobile while carrying a work piece in order to allow the work piece to be manoeuvred into an initial position before being accurately aligned with a corresponding pipe section to which it is to be joined, as hereinafter described.

The support 14 is mounted above the base 12, via a biasing element in the form of a bearing defined by a pair of substantially parallel guideways 32 which facilitate, as described in detail hereinafter, substantially horizontal linear movement of the support 14 and thus tool holder 16 relative to the base 12. It will however be appreciated from the following description that the guideways 32 could be replaced with an alternative biasing element, for example a mechanical, pneumatic or hydraulic spring (not shown) or the like and which is arranged between the base 12 and the support 14 in such a way as to be operable to displace the support 14 relative to the base 12 in a substantially horizontal direction.

Each of the guideways 32 comprises a lower section 34 secured to the base 12 by suitable means and a corresponding upper portion 36 mounted to the lower end of the support 14. Captured between the lower portion 34 and upper portion 36 are roller bearings (not shown) which enable the upper portion 36 to undergo linear displacement relative to the lower portion 34, without allowing the lower and upper portions 34, 36 to become separated from one another. The guideways 32 are oriented such that the plane of linear motion of the upper portion 36 relative to the lower portion 34 is very slightly off horizontal, for example between 0-30°, more preferably between 0-10°, and most preferably between 2-3° from horizontal, sloping downwardly towards the pair of fixed wheels 24. In this way, the dead load of the track 18, carriage 20, tool holder 16 and section of pipe (not shown) held by the tool 56, will result in the gradual linear displacement of the upper portion 36 of each of the guideways 32 towards the fixed wheels 24, which will thus advance the clamped section of pipe in a substantially horizontal direction, for the reasons set out hereinafter. It will therefore be appreciated that the bearing formed by the pair of guideways 32 could be of any other suitable form which facilitates this substantially horizontal displacement, whilst also being capable of withstanding the significant loading that will be experience during use when a section of steel pipe or the like is being held in the tool holder 56.

The support 14 mounted above the guideways 32 essentially functions as a bracket for securing the substantially vertical track 18 to the base 12. In the embodiment illustrated the track 18 is a hollow section of tubing having a linear slot 38 formed along one side, the carriage 20 being mounted substantially internally of the track 18 for linear displacement therein, and projecting partially through the slot 38. Secured to the outwardly projecting portion of the carriage 18 is the tool holder 16, and in particular a support bracket 40 forming part of the tool holder 16. The support bracket 40 is pivotally mounted to the carriage 20 about a first substantially horizontal pivot axis 42, the angular position of the support bracket 40 being adjustable by means of a first actuator 44 which may take any suitable form.

The tool holder 16 further comprises an arm 46 which is pivotally mounted to the support bracket 40 about a second substantially horizontal pivot axis 48 which is preferably substantially orthogonal to the first pivot axis 42. The angular position of the arm 46 relative to the support 40 may be adjusted by means of a second actuator 50 in the form of a pair of manually operable threaded bars 52 each of which bears against a corresponding shoulder 54 formed on the arm 46. By retracting one of the bars 52 while advancing the other the angular orientation of the arm 46 about the second pivot axis 48 may be adjusted.

The tool 56 of the embodiment illustrated defines three contact points and comprises an upright 58, a U shaped channel 60 extending horizontally from a lower portion of the upright 58, first and second passive contact elements 62, 64 secured transversely across the channel 58, and a third active contact element in the form of a gripping member 66 which is adjustably mounted to the upright 58 above the channel 60. In the embodiment illustrated the gripping member 66 is in the form of an adjustable nut which may be tightened against a section of pipe located between the three contact elements 62, 64, 66 in order to secure that section of pipe within the tool 56 and projecting outwardly away from the tool 56, above and between the pair of legs 22 of the base 12.

The orientation and attitude of a section pipe held within the tool 56 may then be adjusted as necessary in order to exactly align said section of pipe with another section of pipe (not shown) in order to allow the two sections to be tack welded to one another whilst being substantially horizontally biased into face to face engagement such as to ensure good contact between the opposed engaging faces of the two sections of pipe.

Turning to the operation of the alignment system 10, the horizontal position of each of the contact elements 62, 64, in addition to the vertical position of the gripping member 66, are adjusted in order to comfortably accommodate a section of pipe therein. The section of pipe, once located within the tool 56, is then secured by tightening the gripping members 62 against the section of pipe, which will then act to clamp that section of pipe between the three contact points.

The vertical position of the section of pipe may then be adjusted by raising or lowering the carriage 28 within the track 18, thereby raising or lowering the tool holder 16 and section of pipe retained within the tool 56. In the embodiment illustrated the system 10 comprises a manually operable winch 68 mounted at the upper end of the track 18 and operable to raise or lower the carriage 20. It will of course be appreciated that any other manual, electric, hydraulic or alternative means of displacing the carriage 20 may be provided.

Once the height of the pipe section has been matched to that of the section of pipe to be joined, the axial orientation of the pipe section may then be adjusted through displacement of the support 40 about the first pivot axis 42. Similarly the angular attitude of the pipe section may be adjusted through displacement of the arm 46 about the second pivot axis 48. These orientational adjustments would generally be carried out with the pipe section positioned in close proximity to the other pipe section, in order to allow accurate alignment therewith. The steerable wheel 26 and handle 30 allow the system 10 to be manoeuvred into an initial position at which these adjustments may be performed. Once all of the adjustments are completed a brake (not shown) may be applied one or more of the wheels 24, 26, while a brake (not shown) locking the guideways 32 may be released. This action frees the lower and upper sections 34, 36 of the two guideways 32 for displacement relative to one another which will allow the support 14, carrying the track 18 and tool holder 16, to undergo linear movement in a substantially horizontal direction, and towards the fixed section of pipe. This displacement will automatically occur due to the slightly off horizontal orientation of the guideways 32.

The sections of pipe retained in the tool 56 will thus engage and be biased into contact with the other section of pipe to be joined, and the two will be held in this position without requiring any operator input. Any final adjustments to orientation may then be made before the two sections of pipe are tack welded to one another. At this point the gripping member 66 may be loosened in order to release the section of pipe from the tool 56 and the alignment system 10 may then be disengaged and manoeuvred out of the way in order to allow the two sections of pipe to be fully welded.

Turning now to Figures 7 to 11 there is illustrated a second embodiment of a pipe alignment system, generally indicated as 110, which is again designed to reduce the time taken, and increase the accuracy of, the assembly of two pipe sections or the like. In this second embodiment like components have been accorded like reference numerals and unless otherwise stated perform a like function.

The alignment system 110 comprises a base 112 which may again be of any suitable configuration which enables the alignment system 110 to be manoeuvred, for example about the floor of a workshop or the like. The base 112 bears a support 114 thereon which is arranged to carry and allow multiple orientational adjustments of a tool holder 116. The tool holder 116 is mounted on a guideway 118 via a carriage 120 displaceable along the guideway 118, which together form part of the support 114. In the embodiment illustrated, the guideway 118 is in the form of a hollow tube, for

example formed from steel of the like, the carriage 120 being secured about an exterior surface of the guideway 118 and displaceable vertically therealong by means of a manually operable winch 168, although any other means of displacement may be employed. The carriage 120 comprises a pair of profiled rollers 121 between which the tubular guideway 118 is captured. The rollers 121 are arranged one to the front and one to the rear of the guideway 118 while being vertically offset relative to one another.

It will of course be understood that any other suitable arrangement may be employed in order to secure the carriage 120 to the guideway 118 while allowing linear displacement of the carriage 120 along the guideway 118. Figure 12 illustrates a cutaway view of the tool holder 116 and carriage 120, in which the outer walls of the carriage 120 are omitted in order to clearly show the arrangement of the rollers121 and the configuration of the tool holder 116 as hereinafter described.

The base 112 again comprises a pair of splayed and substantially horizontally disposed legs 122 located at the free end of each of which is a fixed wheel 124. The base 112 further comprises a steerable wheel 126 mounted at the lower end of a column 128 having a handle 130 at the upper end thereof which permits the alignment system 110 to be steered as hereinbefore described with reference to the first embodiment. Again any other functional alternative configuration for the base 112 may be employed which embodies the requisite manoeuvrability and support.

The support 114 is mounted, and displaceable relative to, the base 112 by means of a biasing element in the form of a bearing defined by a pair of parallel guideways 132, each comprising a lower portion 134 fixed to the base 112 and an upper portion 136 provided about an underside of the support 114. The upper potion 136 is linearly displaceable relative to the lower portion 134 by any suitable means, for example a linear array of roller bearings or the like. The guideways 32 are oriented such that the plane of linear motion of the upper portion 136 relative to the lower portion 134 is marginally off horizontal, for example approximately 0-30°, more preferably between 0-10°, and most preferably between 2-3° from horizontal, sloping downwardly with respect to a direction from the steerable wheel 126 to the fixed wheels 124. In this way a load born by the tool holder 116 will effect a gradual linear displacement of the support 114 relative to the base 112, which can effectively be considered a horizontal displacement or biasing, in order to achieve the above-mentioned biasing of a workpiece held by the alignment system 110 against a second workpiece to which the first workpiece is to be joined.

It will be appreciated that the guideways 132 could be replaced with an alternative biasing element, for example a mechanical, pneumatic or hydraulic spring (not shown) or the like and which is arranged between the base 12 and the support 14 in such a way as to be operable to displace the support 14 relative to the base 12 in a substantially horizontal direction.

The tool holder 116 comprises a support bracket 140 (visible in Figure 12) which is captured between the walls (omitted in Figure 12 for clarity) of the carriage 120, at a position in front of the

guideway 118, the support bracket 140 being pivotally mounted about a first pivot axis 142. During operation the first pivot axis is disposed in a substantially horizontal orientation. The support bracket 140 can thus be pivoted about the first pivot axis 142 by means of a first actuator 144 which projects through an arm 146 of the tool holder 116. This adjustment can be used to bring the face of a pipe section held in the tool holder 116 into a vertical or other orientation, generally referred to as "plumping" the face of the pipe section.

The arm 146 of the tool holder 116 is pivotally mounted to the support bracket 140 about a second pivot axis 148 which is preferably substantially orthogonal to the first pivot axis 42, and in use is disposed in a substantially horizontal orientation. The angular position of the arm 146 relative to the support bracket 140 may be adjusted by means of a second actuator 150 in the form of a pair of manually operable threaded bars 152 each of which bears against a corresponding shoulder 154 formed on an upper portion of the arm 146. By retracting one of the bars 152 while advancing the other the angular orientation of the arm 146 about the second pivot axis 148 may be adjusted.

In use a tool, for example the tool 56 described and shown with respect to the first embodiment is mounted to in the tool holder 116, normally but not exclusively via the arm 146, and is operable as hereinbefore described to retain a section of pipe therein. The tool may however be of any suitable design which is adapted to grip and retain a workpiece therein to be welded or otherwise joined to a corresponding workpiece. For example referring to Figure 13 there is illustrated an exemplary embodiment of a tool 256 comprising a pair of parallel plates 258 spaced from one another, each plate 258 incorporating a corresponding array of apertures 260 therein which define a template for receiving one or more stands 262 therein, at predefined locations in order to accommodate pipe sections of varying shape and/or size.

Each stand comprises a cylindrical stem 264 dimensioned for a sliding fit within a pair of the apertures 260 such as to be retained in place therein. Extending from an upper end of the stem 264 is a V shaped saddle 266 on which can be placed and retained a pipe section (not shown). By locating two of the stands at spaced locations about the tool 256, as defined by the apertures, a section of pipe can be supported between the two saddles 266. Suitable restraints such as chains 268 straps or chains may be provided to be secured around the pipe section to hold the pipe section securely in place. The tool 256 further comprises a pillar 270 extending from an underside of the lower plate 258 and dimensioned to be received in the end of the arm 146 of the tool holder 116. The entire tool 256 can then be pivoted on the pillar 268 in order to allow the pipe section held in the tool 256 to be rotated into a desired orientation for alignment with a component to which the pipe section is to be joined.

The array of apertures 260 in the plates 258 allow a pair of the stands 262 to be placed in a large number of relative positions in order to accommodate pipe sections of different size. In addition the height that the stand 262 projects from the upper plate 258 is preferably adjustable, such that one

stand 262 may be positioned at a different height to the second stand in order to receive a tapered or reducing section of pipe or the like.

The various orientational adjustments which can be made by the tool holder 16; 116 enable the orientation of a workpiece to be quickly, easily, safely and precisely adjusted in order to establish optimum alignment with another component to which the workpiece is to be joined while also accommodating a large range of dimensions for the various components/fittings to be joined. The ability of the alignment system 10; 110 to bias a workpiece against another component also simplifies the operation of joining the two parts, such that a single operator can perform the task effectively unaided.

Claims

1. A pipe alignment system comprising a base; a support mounted on the base; and a tool holder carried by the support; wherein the support is operable to bias the tool holder in a substantially horizontal direction.

2. A pipe alignment system according to claim 1 comprising a biasing element disposed between the base and the support and arranged to effect the substantially linear displacement of the support relative to the base.

3. A pipe alignment system according to claim 2 in which the biasing element comprises at least one bearing disposed between the base and the support, and arranged to allow the support to be linearly displaced relative to the base under the influence of gravity.

4. A pipe alignment system according to any preceding claim in which the support defines a guideway, the alignment system further comprising a carriage arranged for linear displacement along the guideway, the tool holder extending from the carriage such as to permit height adjustment of the tool holder.

5. A pipe alignment system according to any preceding claim in which the tool holder is pivotable about a first pivot axis and about a second pivot axis oriented substantially orthogonally to the first pivot axis.

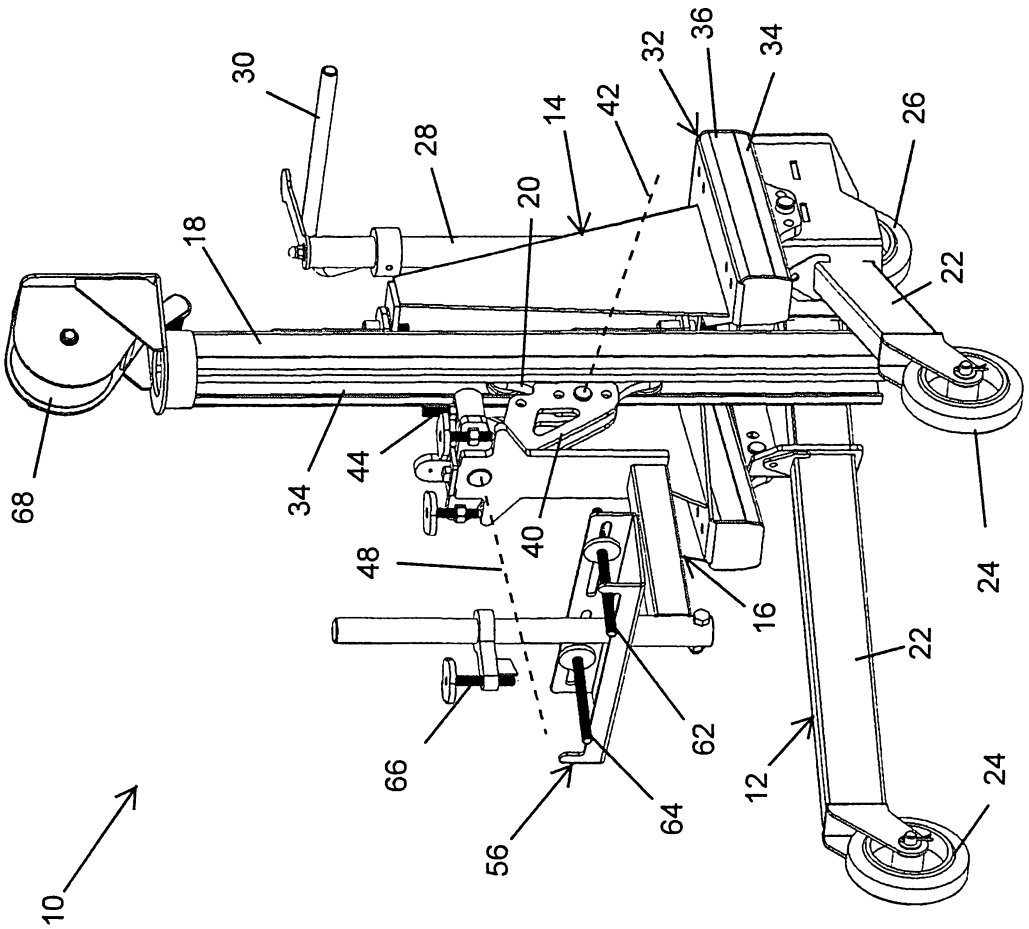
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Fig. 1

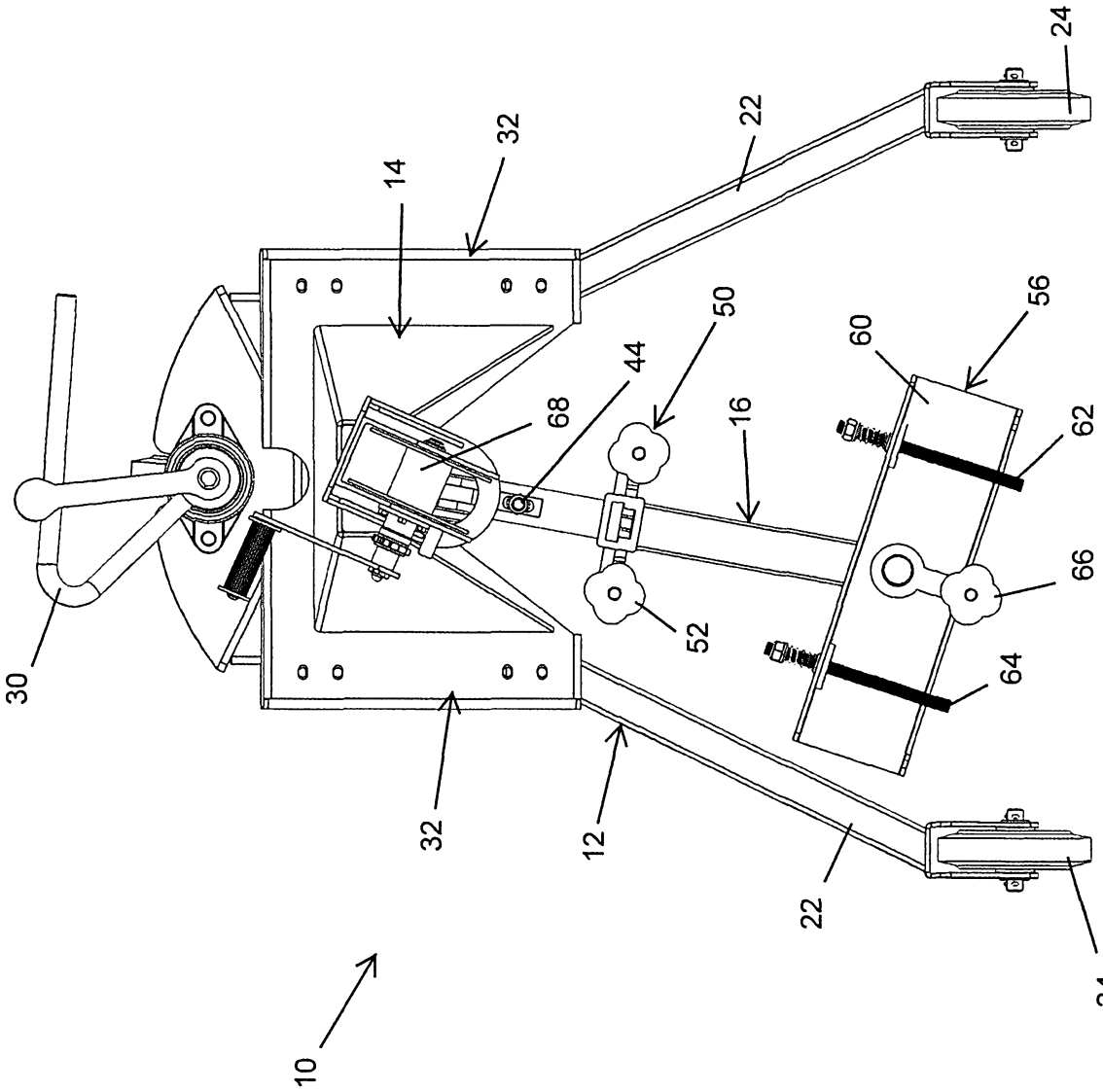

Fig. 2

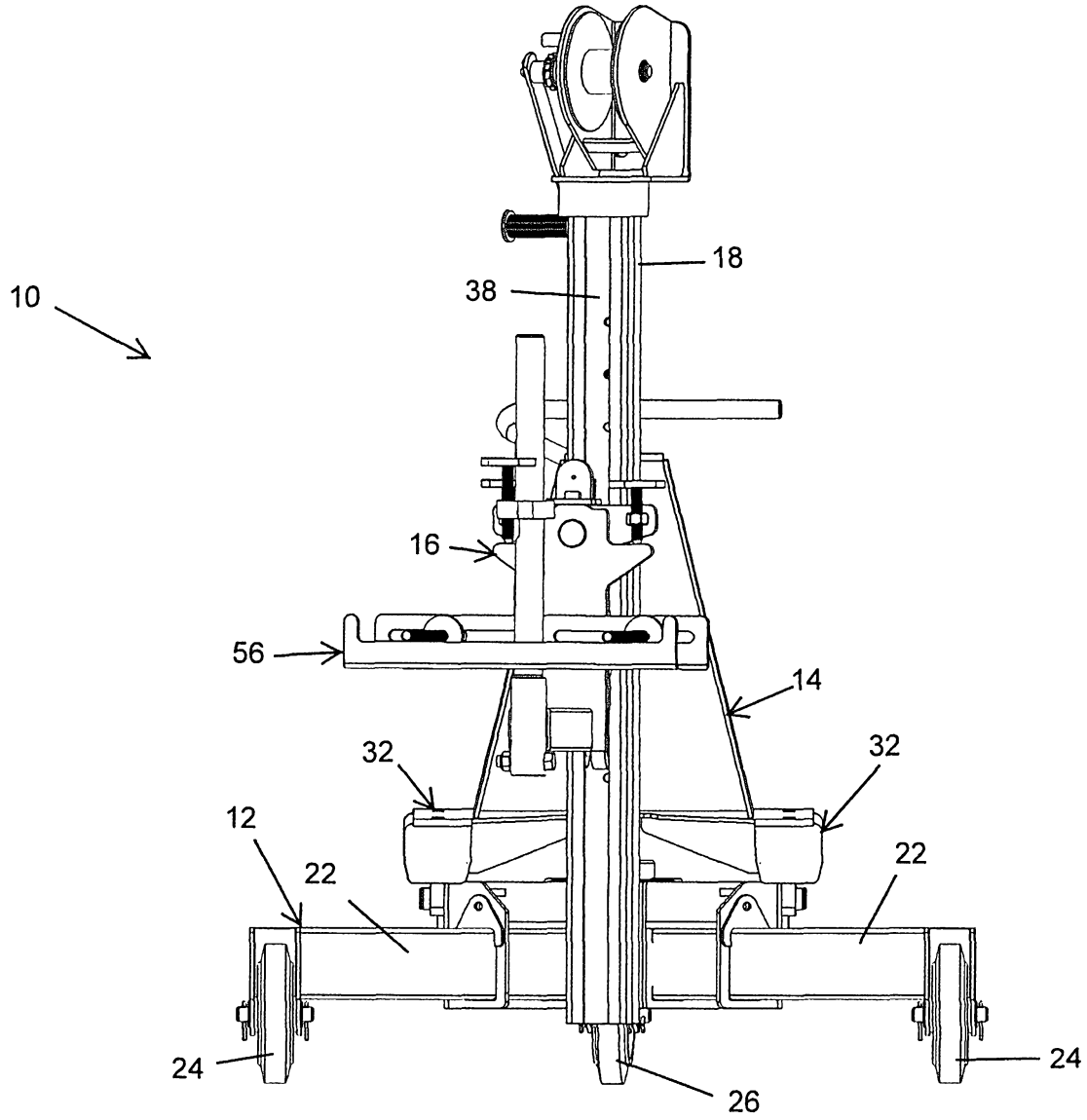

Fig. 3

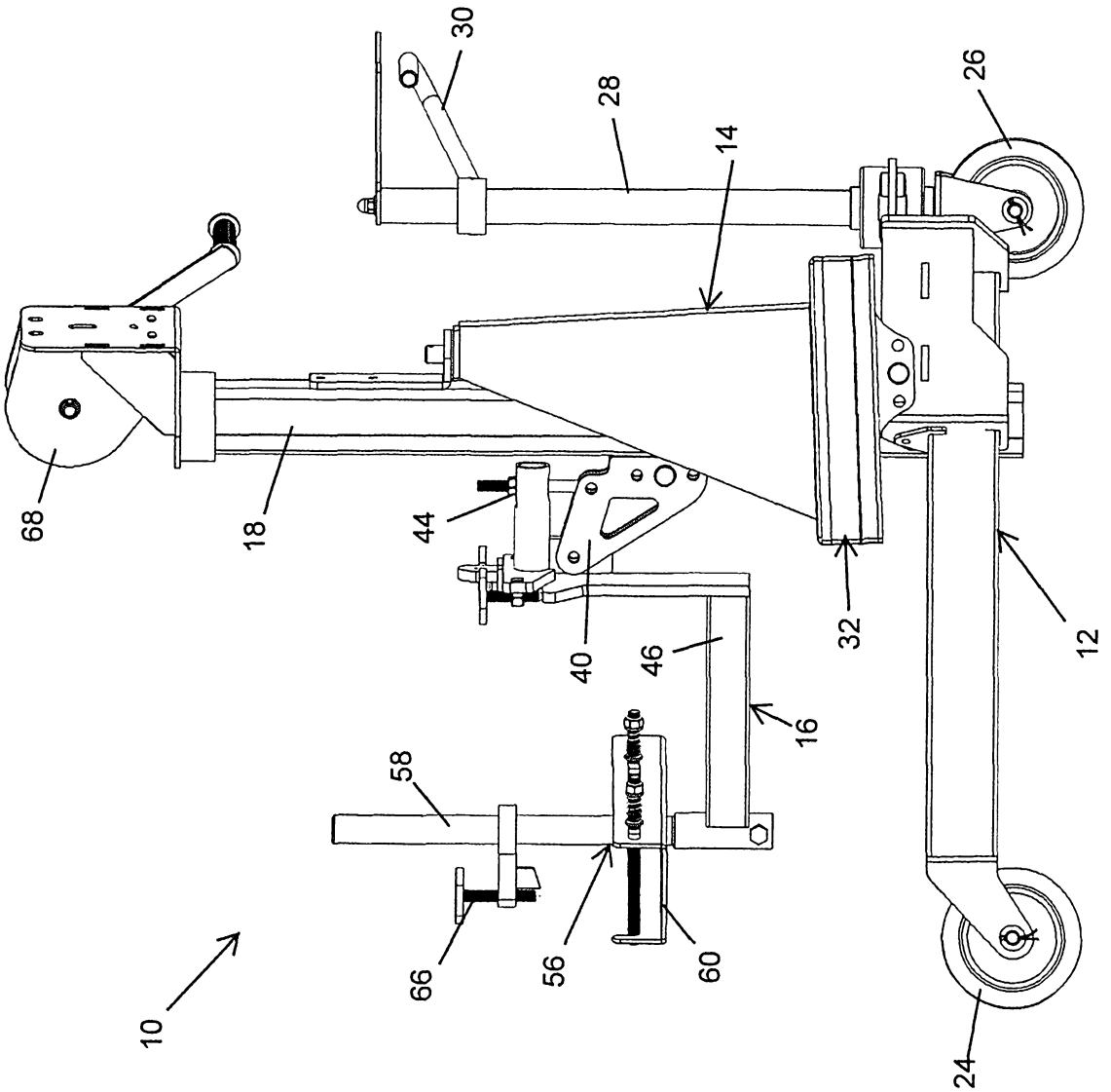

Fig. 4

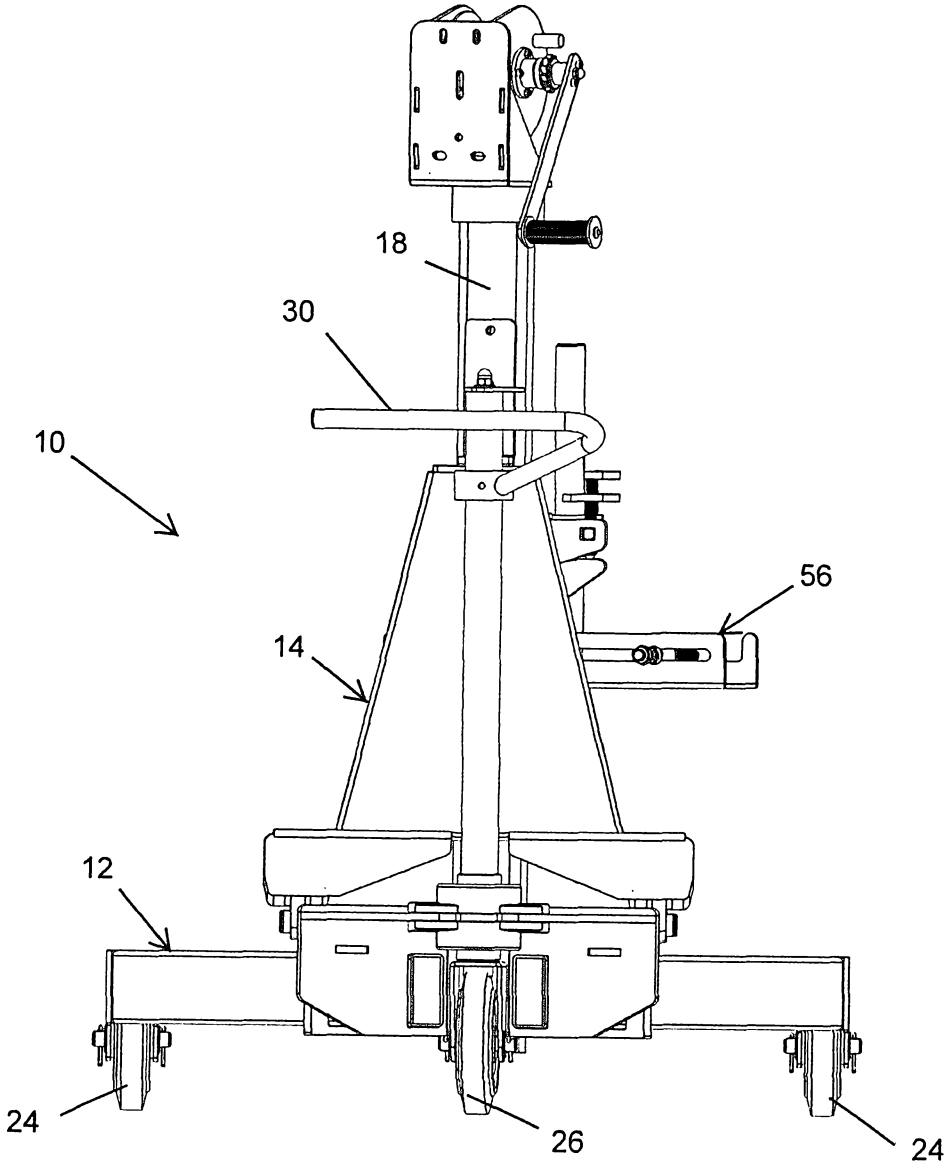

Fig. 5

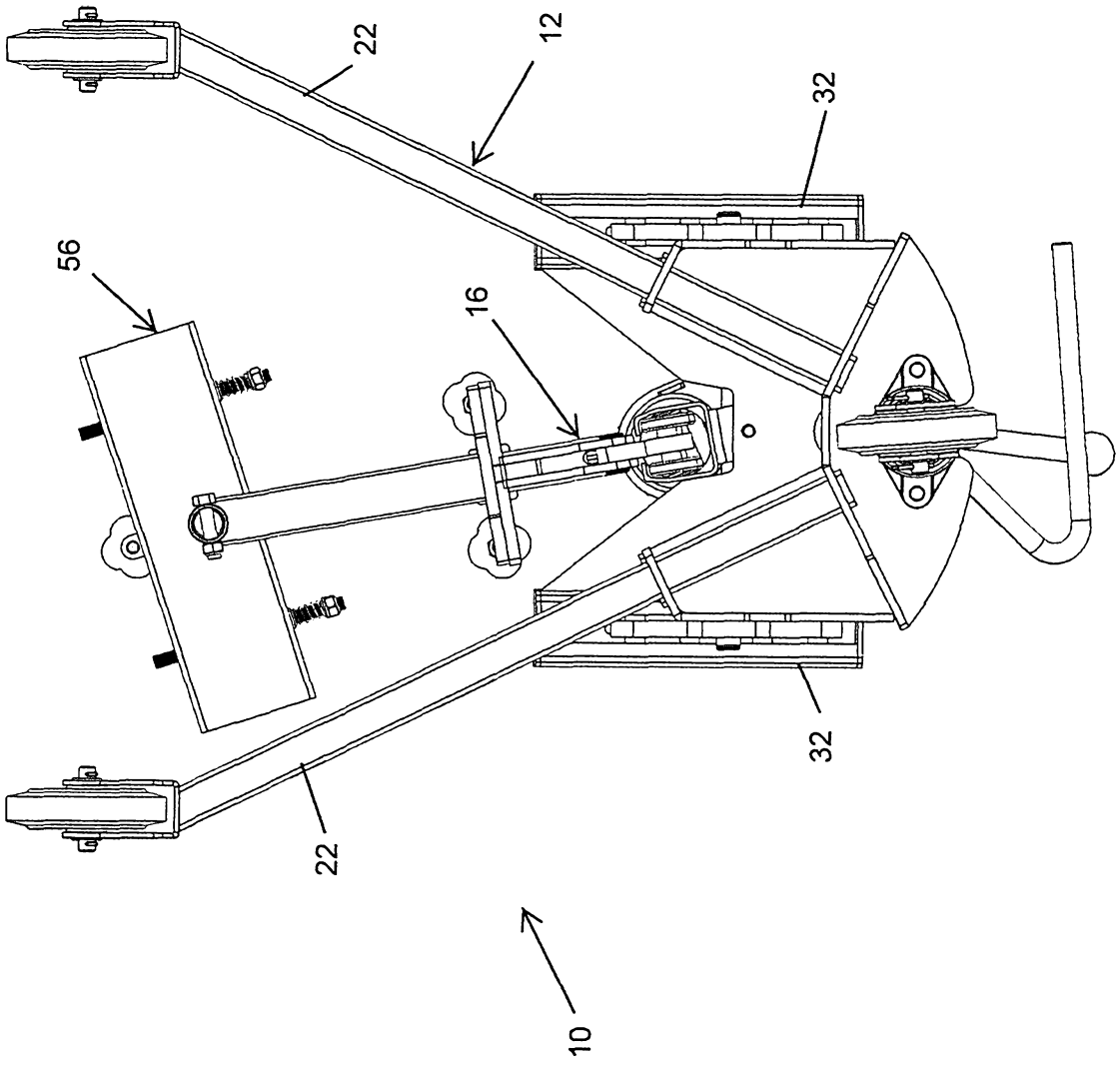

Fig. 6

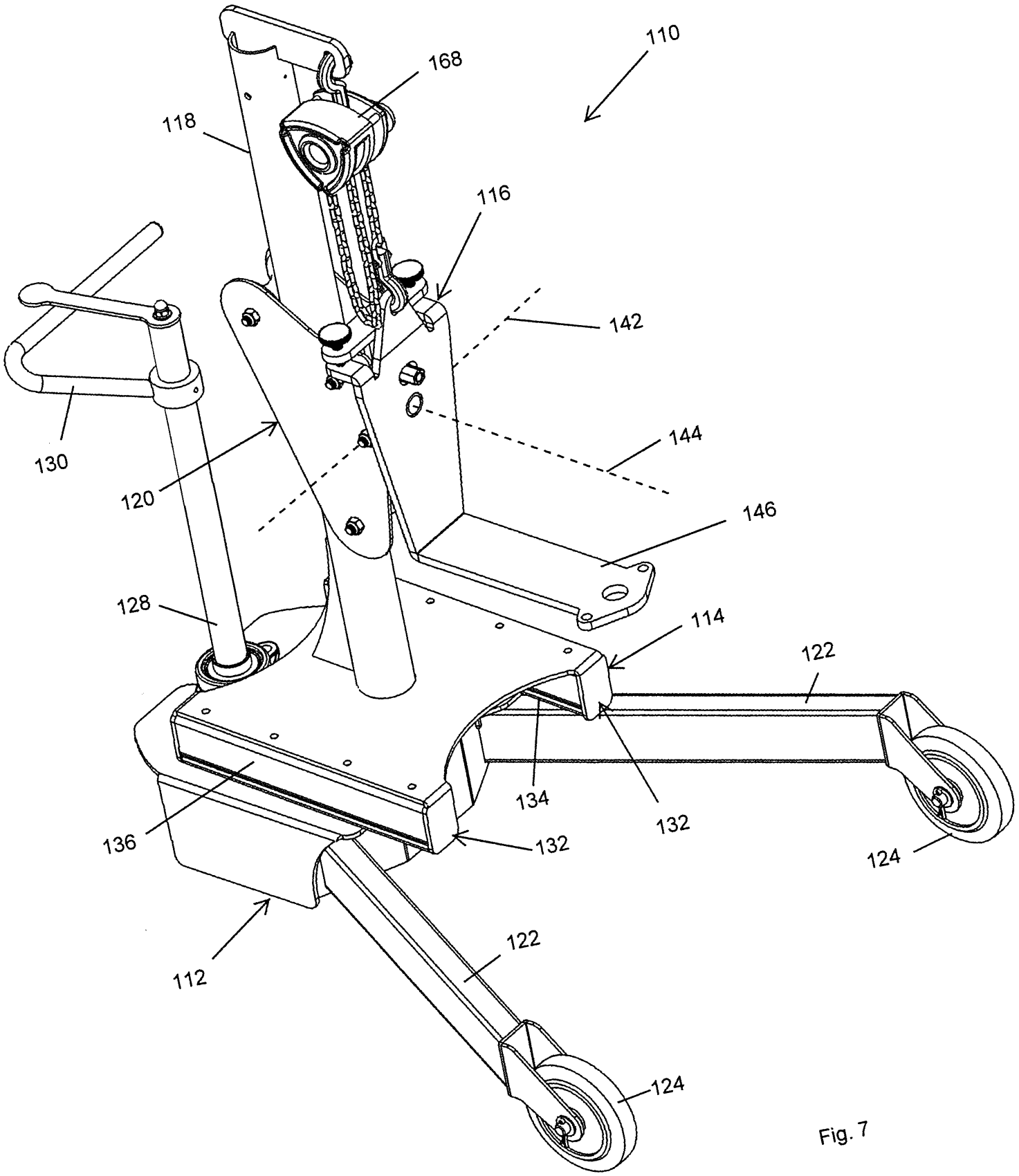
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Fig. 7

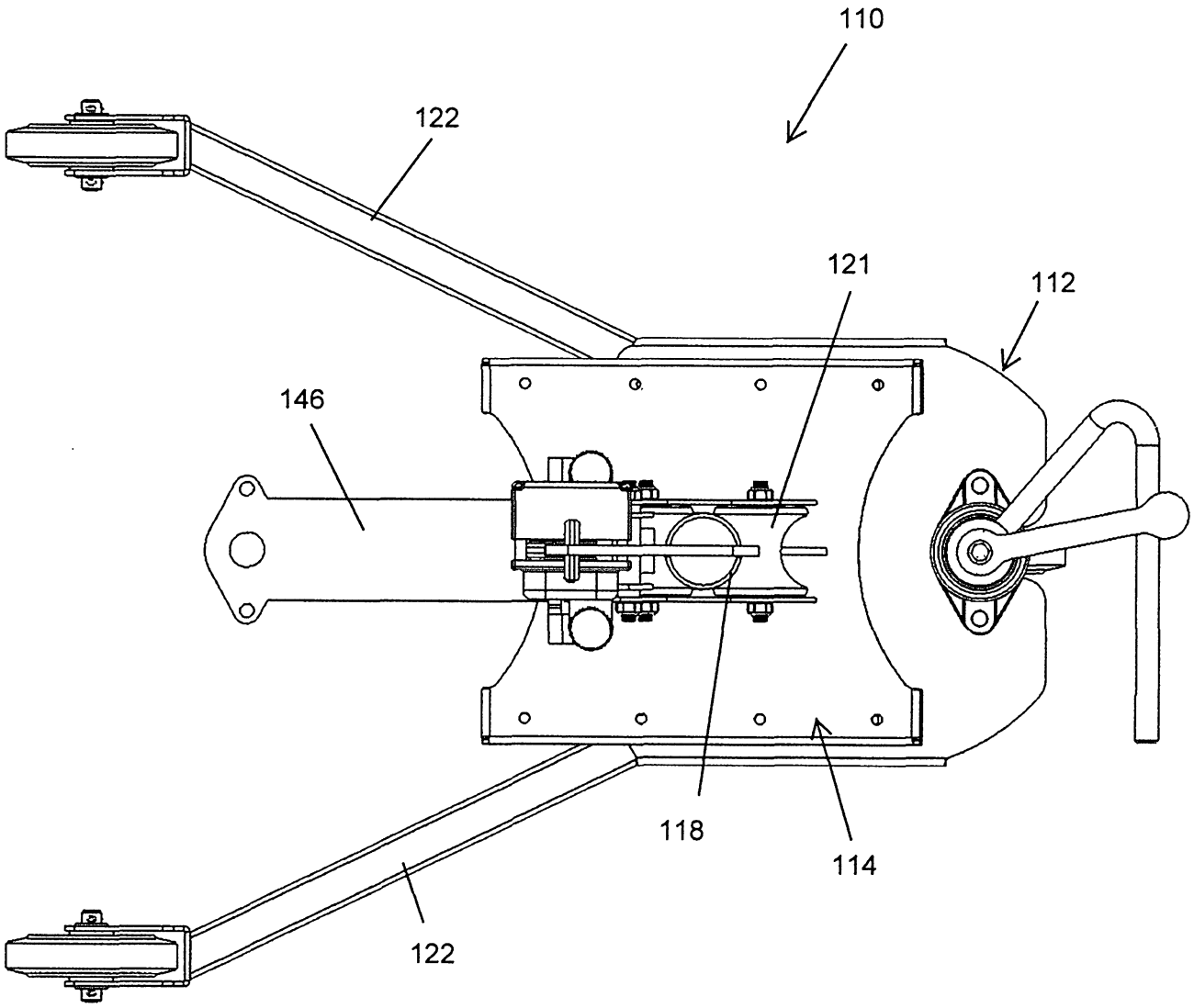


Fig. 8

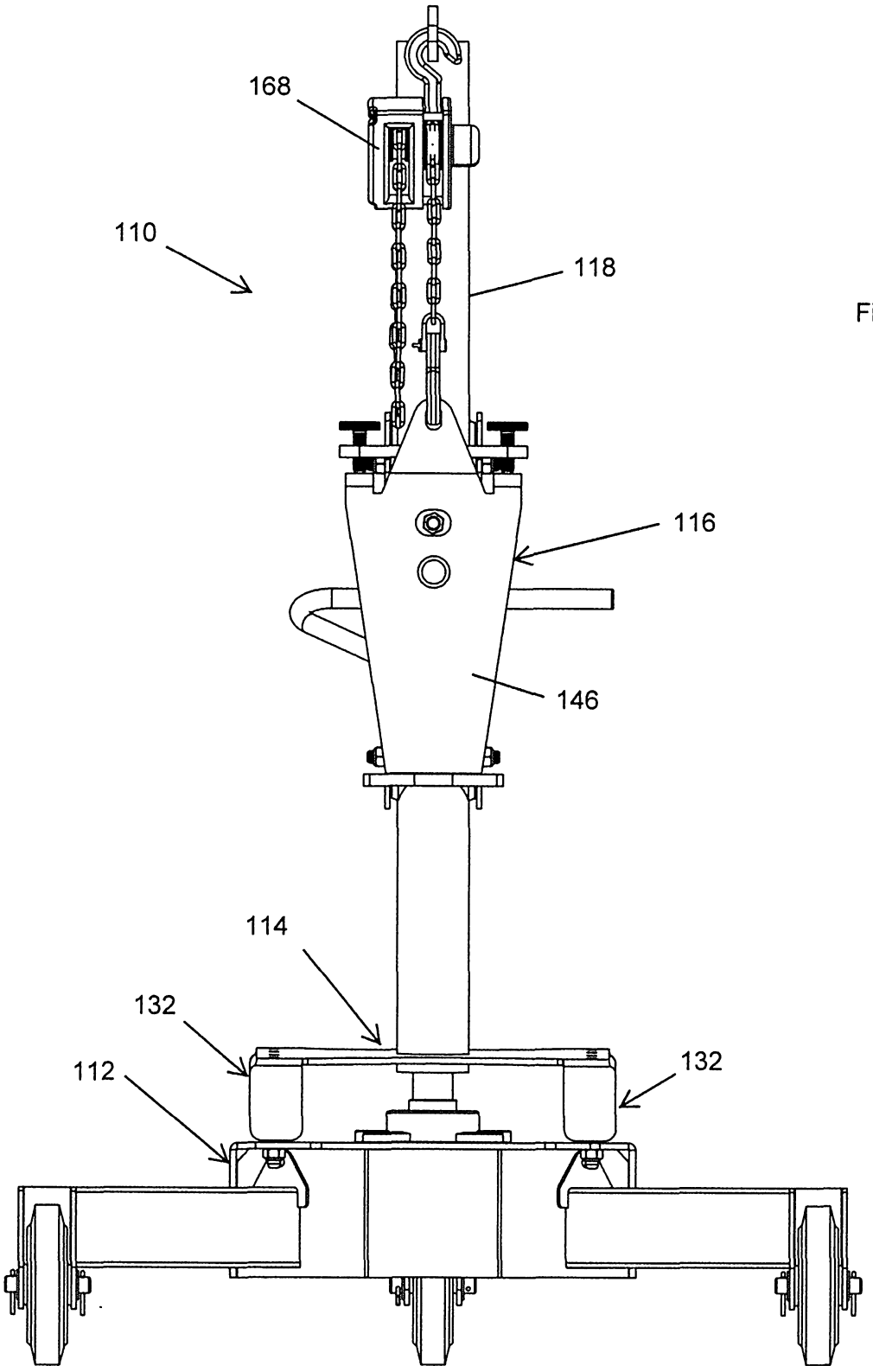


Fig. 9

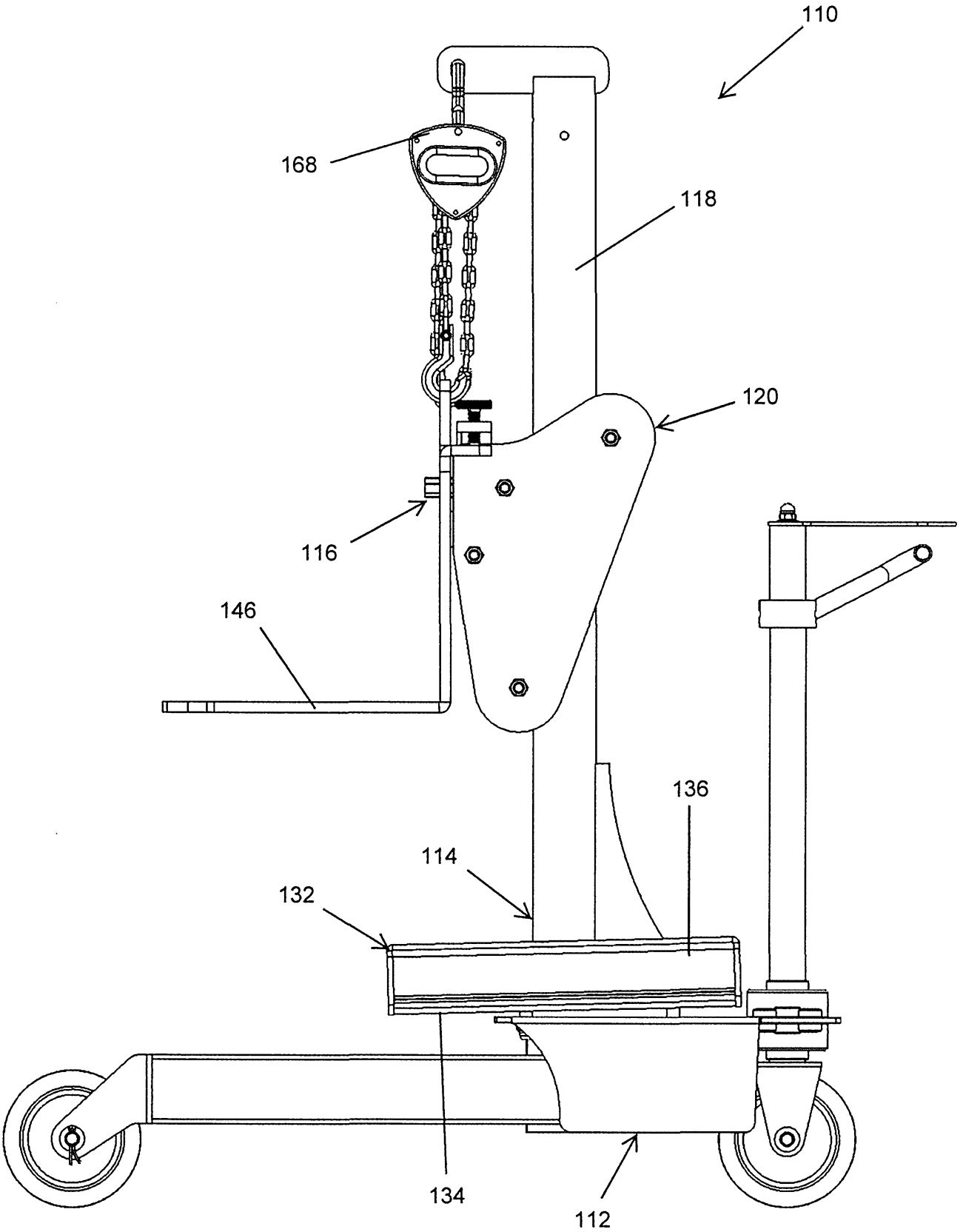
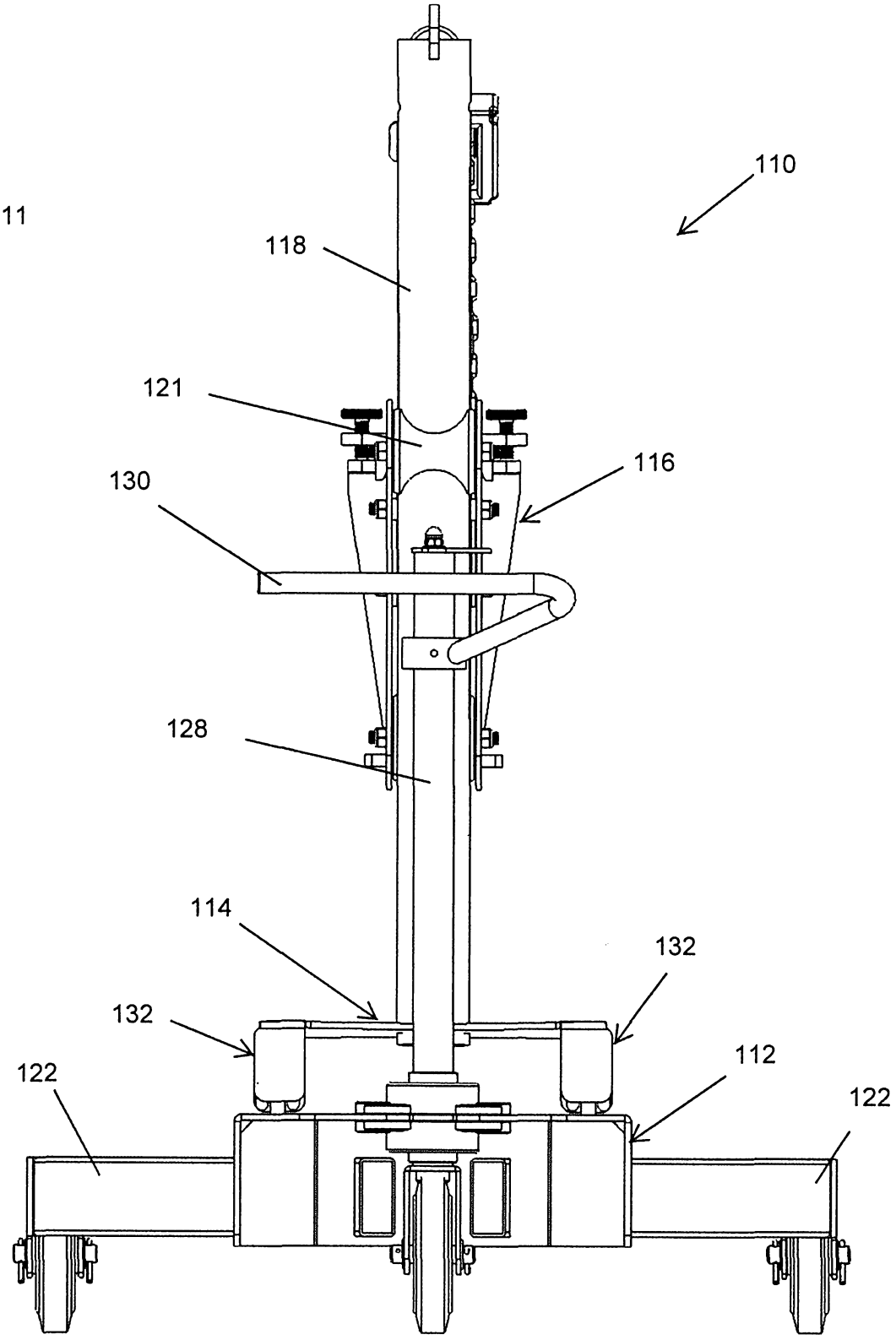


Fig. 10

Fig. 11



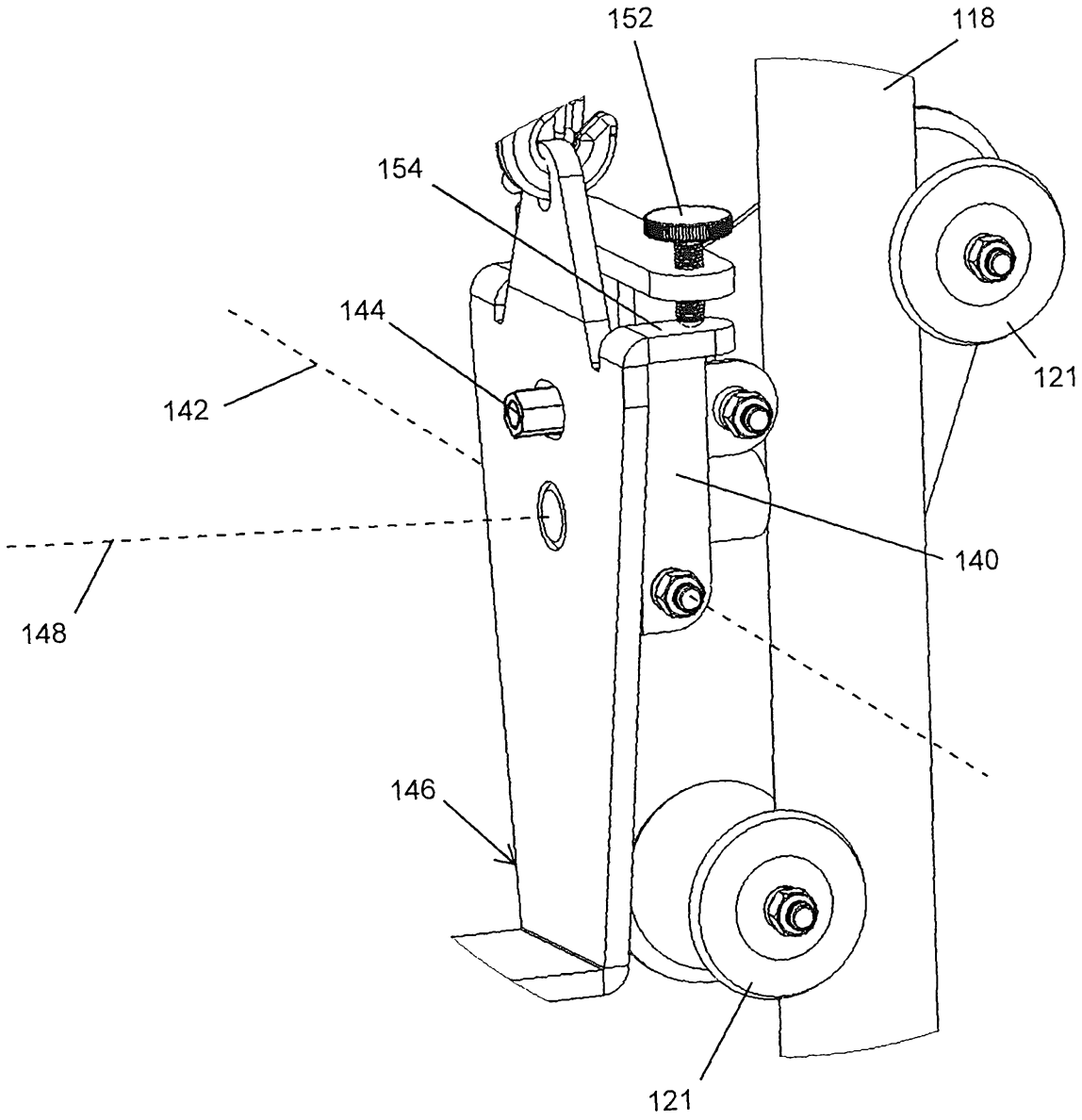


Fig. 12

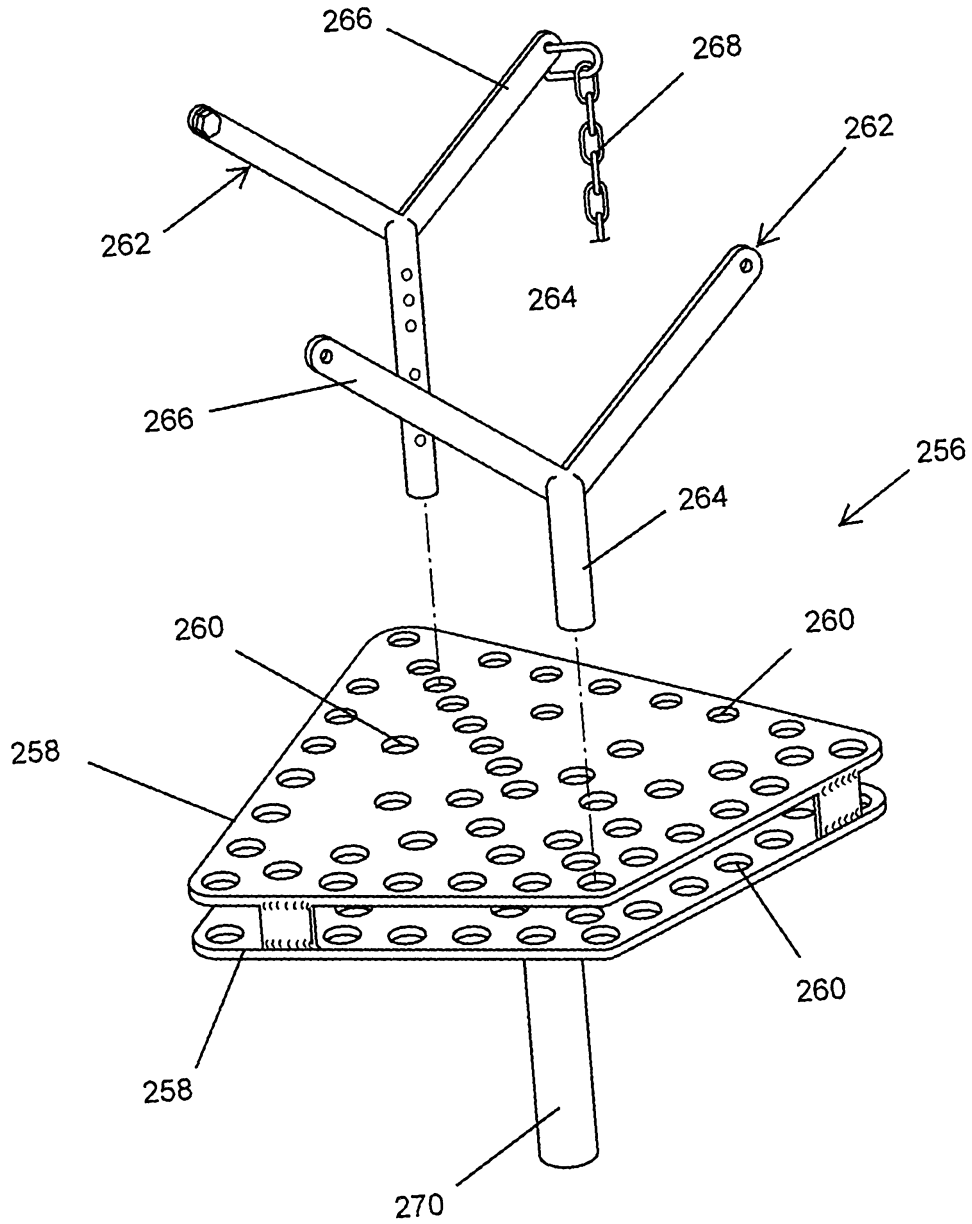


Fig. 13