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(54) Title: RAIL GRINDING MACHINE

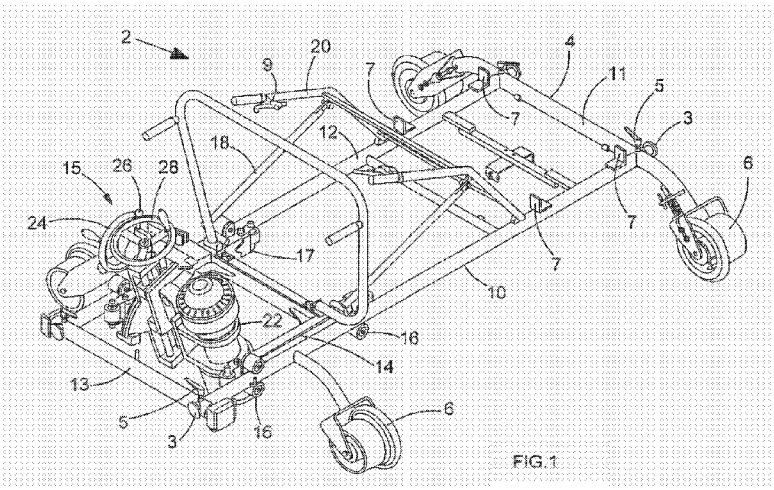


FIG.1

(57) Abstract: A rail grinding machine (2) having a trolley including a frame (4) and wheels (6) for running on a railway track, a rail grinder (15) and a battery (38) for providing electrical power to the rail grinder. The machine is easy to use in tunnels due to its portability and lack of emissions.

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# Rail Grinding Machine

The invention relates to a rail grinding machine, in particular a rail grinding machine that can be used easily in tunnels.

Railway tracks are constructed with a specific profile that can enable smooth-running of trains. Typically, rails have a slightly curved upper surface and vertical sides. Rail grinding is performed to re-shape rails that have become worn in use, or to re-shape rails after welding. Wear can occur simply due to the weight of trains, sometimes causing a lip to form on one side of rails. Additionally, wear can occur at junctions, increasing the risk of derailment. For this reason reduced speed limits are sometimes provided through junctions or regions with suspected wear. Active rail grinding programs can mitigate some of the adverse effects of wear.

Rail grinding machines are produced to facilitate the grinding and re-shaping of rails. Typically these machines include a trolley which can roll along a track. A grinder is mounted on the trolley for providing a specific grinding operation. One type machine includes a grinder with a “lipping” grind head, having a generally horizontal axis of rotation for grinding the sides of the rail. Another type of machine includes a grinder with a “profiling” grind head, having a generally vertical axis of rotation for grinding the tops of the rails. An adjustment mechanism can be provided in these machines for adjusting the position of the grind head and its angle relative to the rail.

Typically an operator selects the appropriate machine for lipping or profiling the rail. The position of the relevant grinder can be adjusted in order to adjust the shape of the rail, and the trolley can be rolled back and forth along the track. Multiple adjustments in the position of the grinder may be required to achieve the desired profile. Rail grinding is a manual task, and a certain amount of skill and training is required on the part of the operator in order to operate rail grinding machines effectively and to achieve the desired rail profile.

A diesel or petrol engine is usually provided on the trolley for providing power to the grinder and driving the grind head. These engines are effective in outdoor environments, but can be disadvantageous in tunnels because of the difficulty in

ventilating toxic emissions and the hazards involved in re-fuelling. These factors can limit the length of time that a machine can be used by a single operator in a tunnel. The noise produced by these engines can also be a problem in some environments. A fixed drive mechanism is generally required between the engine and the grinder. Thus, rail grinding machines are typically bulky and heavy (usually more than 150kg). These machines present logistical and safety challenges for use in an underground train network, where they may need to be carried into position down stairs and escalators and through a labyrinth of passages.

Some rail grinding machines are provided with an electrical power source. These machines can be lighter, but mains electricity may lack the power required for effective grinding.

An object of the present invention is to provide a rail grinding machine that resolves some of these problems. Another object of the invention is to provide a rail grinding machine that can be more easily transported into an underground rail network.

According to an aspect of the invention there is provided a rail grinding machine comprising: a trolley including a frame and wheels for running on a railway track; a grinder mounted on the frame for grinding the railway track; and a battery mounted on the frame for providing electrical power to the grinder.

In this way the machine can be used safely in a tunnel without producing any toxic fumes. The battery operated grinder can also be operated quietly, enabling use of the machine while minimising disturbance especially in densely populated areas adjacent to a railway. The on-track time can also be reduced because there is no need to limit machine time in order to avoid toxic emissions.

Preferably the battery is removably mounted on the frame or demountable from the frame. Thus, the battery and the trolley can be transported separately into a tunnel environment. This can improve safety during transportation into an underground rail network along an intricate path which may include stairs, escalators and tight corners.

Preferably the grinder is removably mounted on the frame or demountable from the frame. A rail grinder may weigh around 30kg so this modular construction can allow the grinder to be carried separately into the rail network.

The frame may include an adaptor or support structure that can support either a grinder with a profiling grind head or a grinder with a lipping grind head. A profiling grind head is arranged to rotate about a generally vertical axis, and is for grinding the top of the railway tracks. A lipping grind head is attached to rotate about a generally horizontal axis and is for grinding the sides of the railway tracks. Preferably both of these grinders can be powered electrically by the battery. Thus, a single rail grinding machine can advantageously perform two grinding functions.

Preferably the frame includes a tiltable or adjustable pitch adaptor that can support the grinder. In this way an operator has ability to vary the angle of the grind head relative to the rail. This can allow an operator to re-shape the rail as required.

The tiltable adaptor is preferably provided on a translatable carriage that can adjust the position of the grinder in a direction that is substantially perpendicular to the railway track. In this way an operator can adjust both the position and orientation of the grinder relative to a rail. The operator can also adjust the position of the grinder longitudinally along the rail by rolling the trolley on its wheels.

Preferably the angle of the tiltable adaptor can be adjusted over at least 90°. In this way, an angular overlap may be provided between a profiling grind head and a lipping grind head. This may be advantageous to ensure that all positions on the sides and upper surface of the rail can be reached by a grinder. In a preferred embodiment the angle of the tiltable adaptor may be adjustable over around 120°.

The frame may include handles which can be extended to assist carrying. There may be four handles, positioned so that the weight of the machine can be distributed evenly. Each handle may be arranged telescopically with respect to the remainder of the frame. The handles may be retracted once the machine has been laid on the track so that they do not interfere with operation of the machine in a tunnel environment.

According to another aspect of the invention there is provided a method of assembling a rail grinding machine, comprising the steps of: mounting a trolley, including a frame and wheels, on a railway track; mounting a grinder on the frame; mounting a battery on the frame; and electrically connecting the battery and the grinder.

In this way each component can be transported separately into a tunnel. The weight of the individual components is preferably such that they can be carried without any significant safety risks.

The grinder may have a lipping grind head for grinding the side of a rail, and the method may comprise removing the grinder and replacing it with a second grinder having a profiling grind head for grinding the upper surface of the rail. Alternatively, the grinder may have a profiling grind head, and the method may comprise replacing the grinder with another grinder having a lipping grind head.

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

Figure 1 is a perspective view of a rail grinding machine for use in an embodiment of the present invention;

Figure 2 is a top view of the rail grinding machine shown in Figure 1;

Figure 3 is a side view of the rail grinding machine shown in Figure 1;

Figure 4 is an end view of the rail grinding machine shown in Figure 1;

Figure 5 is a detailed perspective view of a rail grinding machine without any grinder installed;

Figure 6 is a detailed perspective view of a rail grinding machine with a profiling grinding head in an embodiment of the present invention;

Figure 7 is a detailed perspective view of a rail grinding machine with a lipping grinding head in an embodiment of the present invention; and

Figure 8 is a perspective view of a rail grinding machine in an embodiment of the present invention.

Referring to Figures 1-4, a rail grinding machine 2 is provided, having a frame 4 and insulated wheels 6. The wheels 6 are arranged to run along rails 8 of a railway track. A grinder 22 having a DC motor is mounted on the frame 4. The grinding machine 2 can be used in a number of configurations to remove rail defects such a field-side lipping, gauge side lipping, corrugation removal, rail head profiling and head defects.

The frame 4 includes two cross-beams 10, 12 and two end beams 11, 13. One end beam 11 is provided directly between two wheels 6 so that it overlays a rail 8. The other end beam 13 is provided to one side of the wheels 6 so that it is provided on the outside of the rail 8. This can allow space inside the end beam 13 for grinding equipment 15 to operate on the rail 8. The grinding equipment 15 is carried on a carriage 14 that can be translated on rollers 16 along the cross-beams 10, 12. A lever 20 is connected to the carriage 14 using a linkage 18. The lever 20 can be raised or lowered in order to adjust the position of the carriage 14 on the cross-beams 10, 12. A locking mechanism 17 is provided for locking the carriage 14 in position.

The lever 20 includes dead-man's brake levers 9 for locking the wheels 6. In order to move the trolley 2 on the rails 8 the brake lever 9 must be depressed so that the wheels 6 can rotate freely.

Retractable sleeve handles 3 are provided in each corner of the frame 4. The handles 3 can be released by loosening retaining clamps 5 and withdrawing handles 3 that are telescoped within the cross-beams 10, 12. The retaining clamps 5 can then be tightened to secure the handles 3 in their extended position so that the machine 2 can be lifted. Once the machine 2 is in position on the rails 8 the handles 3 can be retracted to avoid interfering with grinding operations. The frame 4 has a

length (along the track) of around 1.9m, a width of around 1.3m and a height of around 0.7m, which means it can be an unwieldy piece of apparatus for transporting into an underground rail network. Once the battery 38 (as shown in Figure 8) and the grinder 22 have been disconnected the frame 4 is light enough to be transported safely by four operators.

The cross-beams 10, 12 include L-shaped guide members 7 at the end of the frame 4 that is close to the end beam 11 (i.e. at the end of the frame that is opposite to the grinding equipment 15). These guide members 7 are used to support a battery 38 which is mounted on the frame 4 (as shown in Figure 8). The battery 38 is arranged for electrical connection to the grinder 22. In embodiments of the invention the battery 38 may be lead-acid or lithium polymer. The battery is arranged to supply 48 volts DC, with a maximum discharge current of 100A (providing a maximum power of 5kW).

The carriage 14 supports a removable grinder 22 together with a mechanism for controlling the position and orientation of the grinder head 23. In the embodiment shown in Figures 1-4 the grinder 22 includes a profiling grind head 23, which is arranged to rotate in a generally vertical axis for grinding the upper surface of the rail 8. A slewing head hand wheel 24 is provided for adjusting the tilt of the grinder 22 relative to the rail 8. In order to operate the hand wheel 24 a lock 26 is manually released. The rotation of the wheel 24 drives a rack and pinion mechanism so that the grinder 22 can be rotated into the desired orientation. The lock 26 can then be applied to hold the grinder 22 in place during grinding. The lock 26 can allow 2° increments between tilt angles. The slewing head hand wheel 24 allows a tilting range of 120° (i.e. ±60° from vertical). This range of tilting can allow an angular overlap where grinding is possible by both the lipping grind head 36 and the profiling grind head 34.

A head feed hand wheel 28 is provided for adjusting the vertical position of the grinder 22 relative to the rail 8. To raise the grinder 22 the wheel 28 is rotated clockwise, and to lower the grinder 22 the wheel 28 is rotated anti-clockwise. The grinder 22 is raised and lowered along its tilted direction, as controlled by the slewing head hand wheel 24.

Figure 5 is a detailed perspective view of the mechanism for controlling the position and orientation of a grinder 22, but without any grinder installed. A grinder support structure 30 having a pair of spaced pins 32 is provided on a threaded bar 33 so that rotation of the head feed hand wheel 28 can raise or lower the structure 30. The spaced pins 32 are arranged to fit in corresponding holes on a grinder 22. In this way it is straightforward to replace one grinder 22 with another. Specifically, a grinder with a profiling grind head can be easily replaced with a grinder having a lipping grind head.

Figure 6 is a perspective view of a rail grinding machine with a profiling grind head 34 installed. The profiling grind head 34 is arranged to rotate about the same axis as the head feed hand wheel 28 for re-shaping the top surface of the rail 8. An operator can adjust the tilt angle of the grinder 22 using the slewing head hand wheel 24 in order to achieve the desired shape.

Figure 7 is a perspective view of a rail grinding machine with a lipping grind head 36 installed. The lipping grind head 36 is arranged to rotate about a generally horizontal axis, perpendicular to the axis of rotation of the head feed hand wheel 28. In this way the lipping grind head 36 can be used to re-shape the side of the rail 8.

Figure 8 is a perspective view of a rail grinding machine 2 with a battery 38 located between the guides 7 on the cross-beams 10, 12.

An operator can easily replace the profiling grind head 34 with a lipping grind head 36 and *vice-versa*. Thus, the rail grinding machine can be used to perform two distinct grinding tasks. The grinders can also be removed so that they can be carried into position in an underground rail network separately from other machine components. This can allow for faster operations and can reduce the number of men required to carry out the work.

In its fully assembled state with a battery 38 and a grinder 22, the rail grinding machine 2 can weigh around 200kg. It would be dangerous to attempt to transport such a heavy device through a labyrinth of passages and stairs in an underground

rail network. Thus, the rail grinding machine 2 is designed to be modular so that certain components can be transported separately. In particular, the frame 4, battery 38 and grinder 22 can be easily separated from one another.

One design of the frame 4 has a weight of around 78kg. Thus, the frame 4 can be safely carried into position by four operators, each holding one of the handles 3. One design of the battery 38 has a weight of around 108kg. This battery 38 can be transported safely into position by four operators. One design of grinder 22 with a lipping grind head has a weight of around 30kg. Another design of grinder 22 with a profiling grind head has a weight of around 28kg. These grinders 22 can be transported safely by one or two operators, depending on ability.

Once all of the separate components have been transported into a tunnel the machine 2 can be assembled. The frame 4 is laid to rest on the rails 8. The relevant grinder 22 is selected and is mounted on the pins 32 of the grinder support structure 30. The battery 38 is then mounted between the guides 7 on the cross-beams 10, 12, and is electrically connected to the grinder 22. The position of the grinder 22 is then adjusted using the head feed hand wheel 28 and the slewing head hand wheel 24. The operator can then use the machine 2 to grind the rail 8, making several adjustments in the position of the grinder 2 until the rail has the desired profile.

**Claims**

1. A rail grinding machine comprising:
a trolley including a frame and wheels for running on a railway track;
a grinder mounted on the frame for grinding the railway track; and
a battery mounted on the frame for providing electrical power to the grinder.

2. The rail grinding machine of claim 1 wherein the battery is removably mounted on the frame.

3. The rail grinding machine of claim 1 or claim 2 wherein the grinder is removably mounted on the frame.

4. The rail grinding machine of any of the preceding claims wherein the frame includes an adaptor that can support both a grinder with a profiling grind head and a grinder with a lipping grind head.

5. The rail grinding machine of any of the preceding claims wherein the frame includes a tiltable adaptor that can support the grinder.

6. The rail grinding machine of claim 5 wherein the tiltable adaptor is provided on a translatable carriage that can adjust the position of the grinder in a direction that is substantially perpendicular to the railway track.

7. The rail grinding machine of claim 5 or claim 6 wherein the angle of the tiltable adaptor can be adjusted over at least 90°.

8. The rail grinding machine of any of the preceding claims wherein the frame includes extendable handles which can be extended to assist carrying.

9. A method of assembling a rail grinding machine, comprising the steps of:
mounting a trolley, including a frame and wheels, on a railway track;
mounting a grinder on the frame;
mounting a battery on the frame; and

electrically connecting the battery and the grinder.

10. The method of claim 9 wherein the grinder has a lipping grind head for grinding the side of a rail, and wherein the method comprises removing the grinder and replacing it with a second grinder having a profiling grind head for grinding the upper surface of the rail.

11. An apparatus substantially as herein described with reference to and/or as illustrated in the accompanying drawings.

12. A method substantially as herein described with reference to the accompanying drawings.

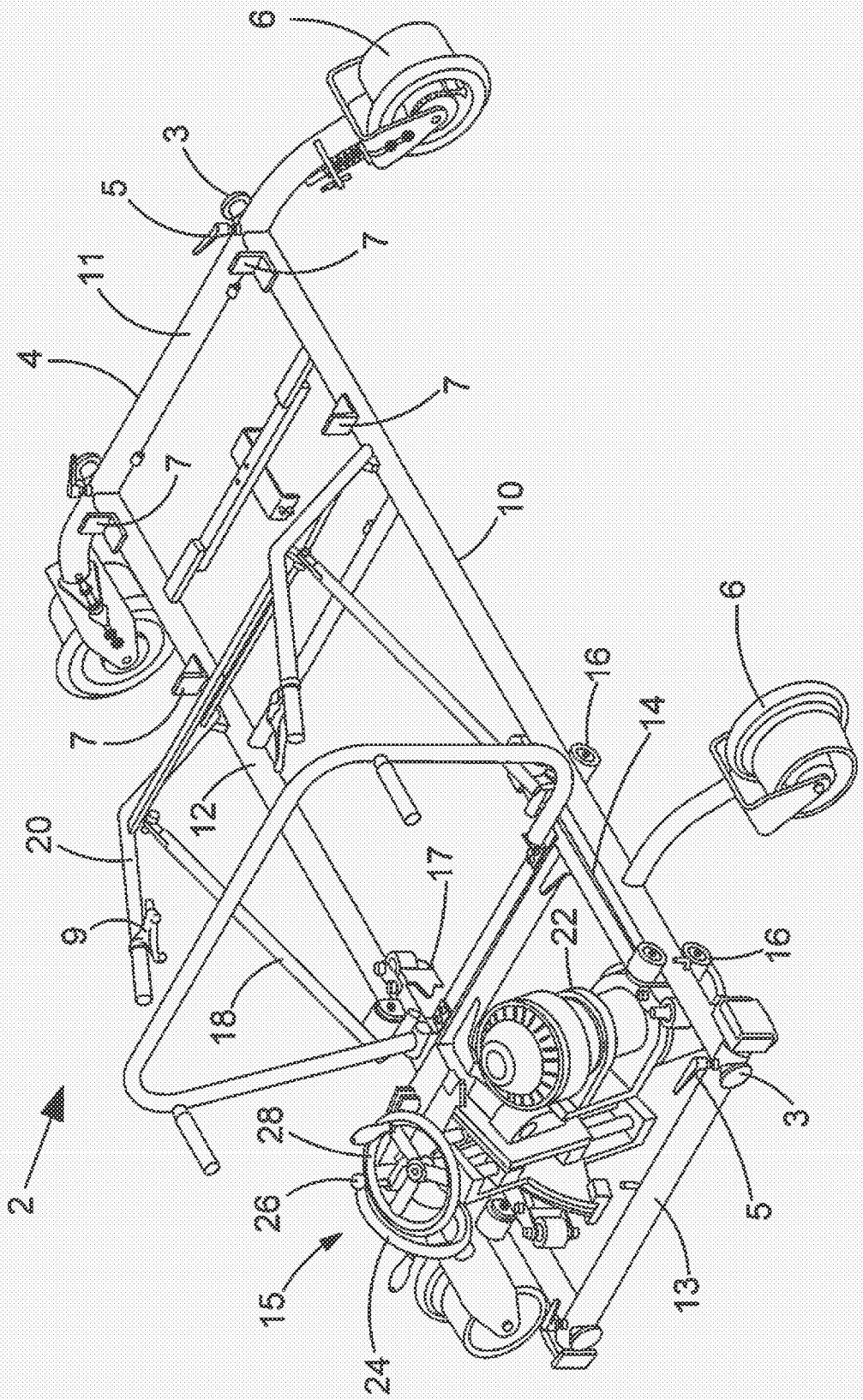


FIG.1

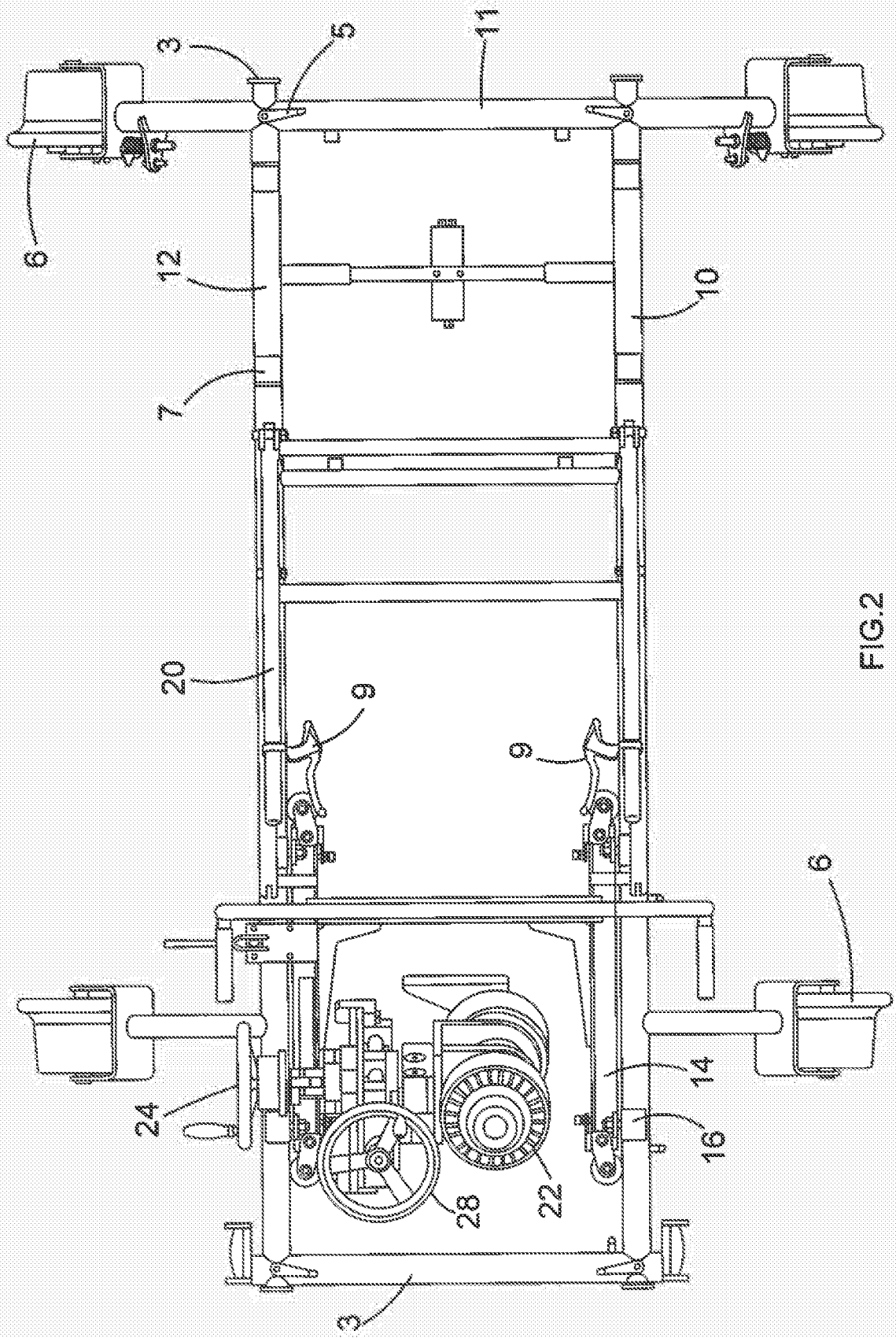


FIG.2

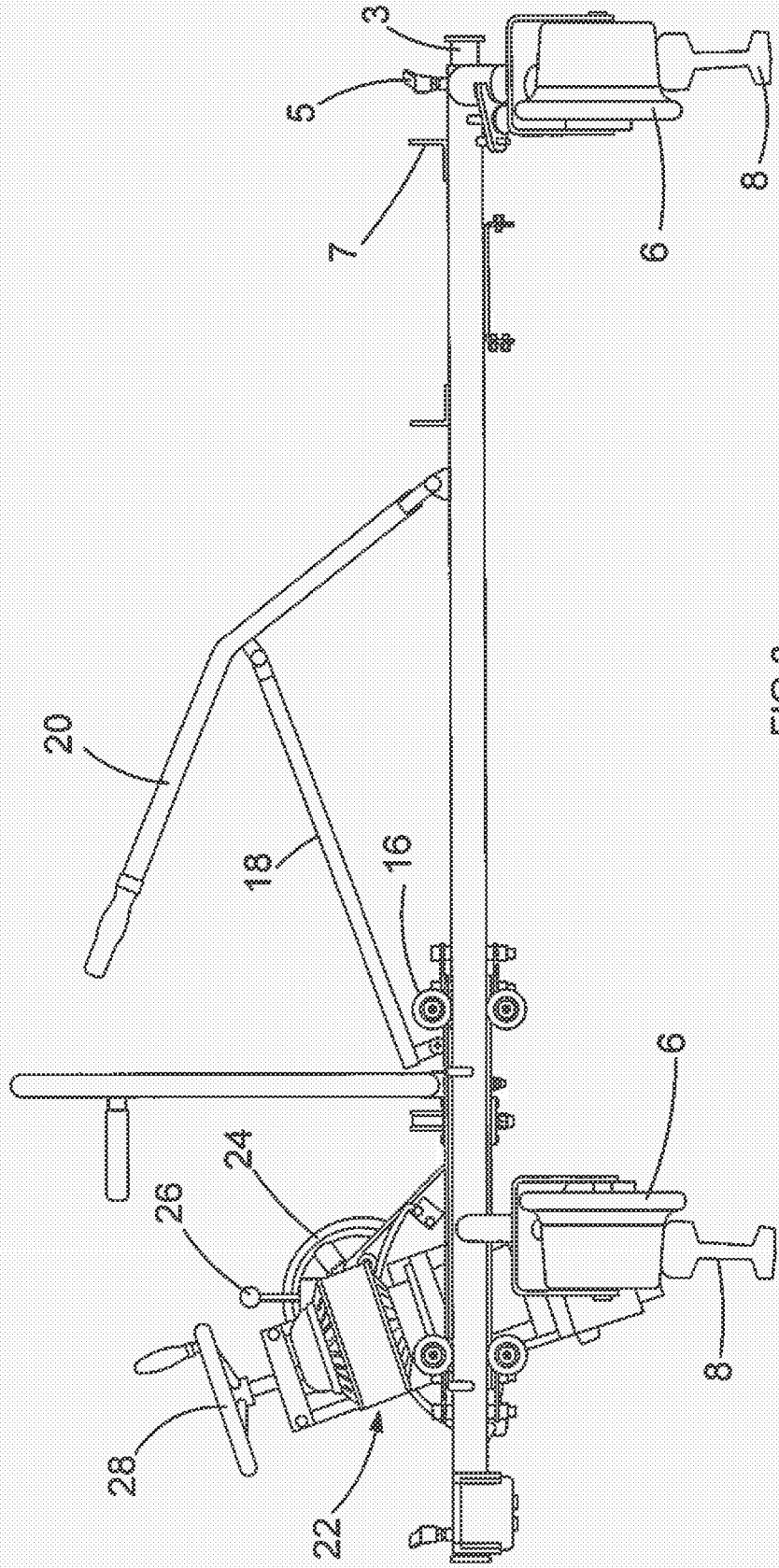


FIG.3

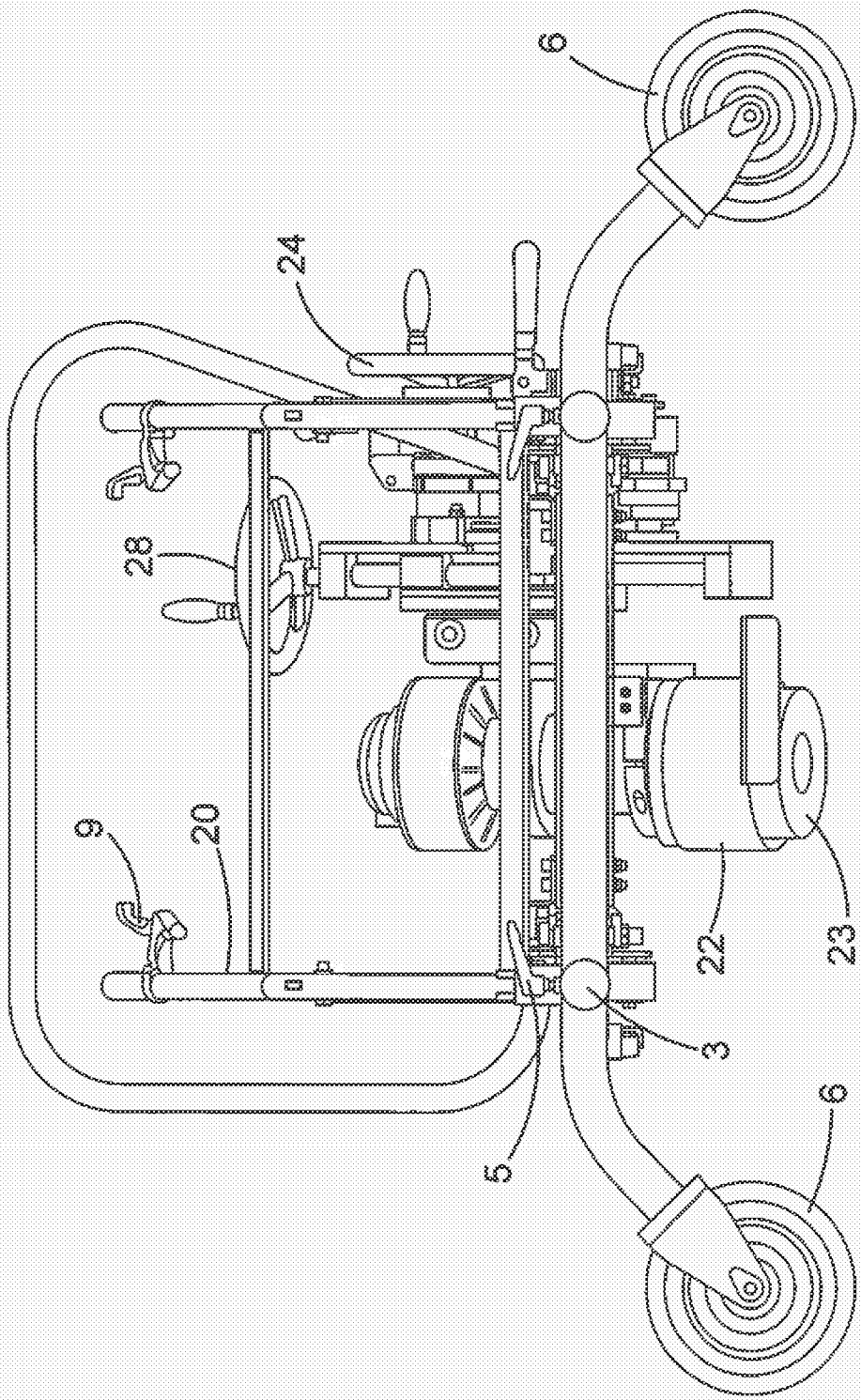


FIG.4

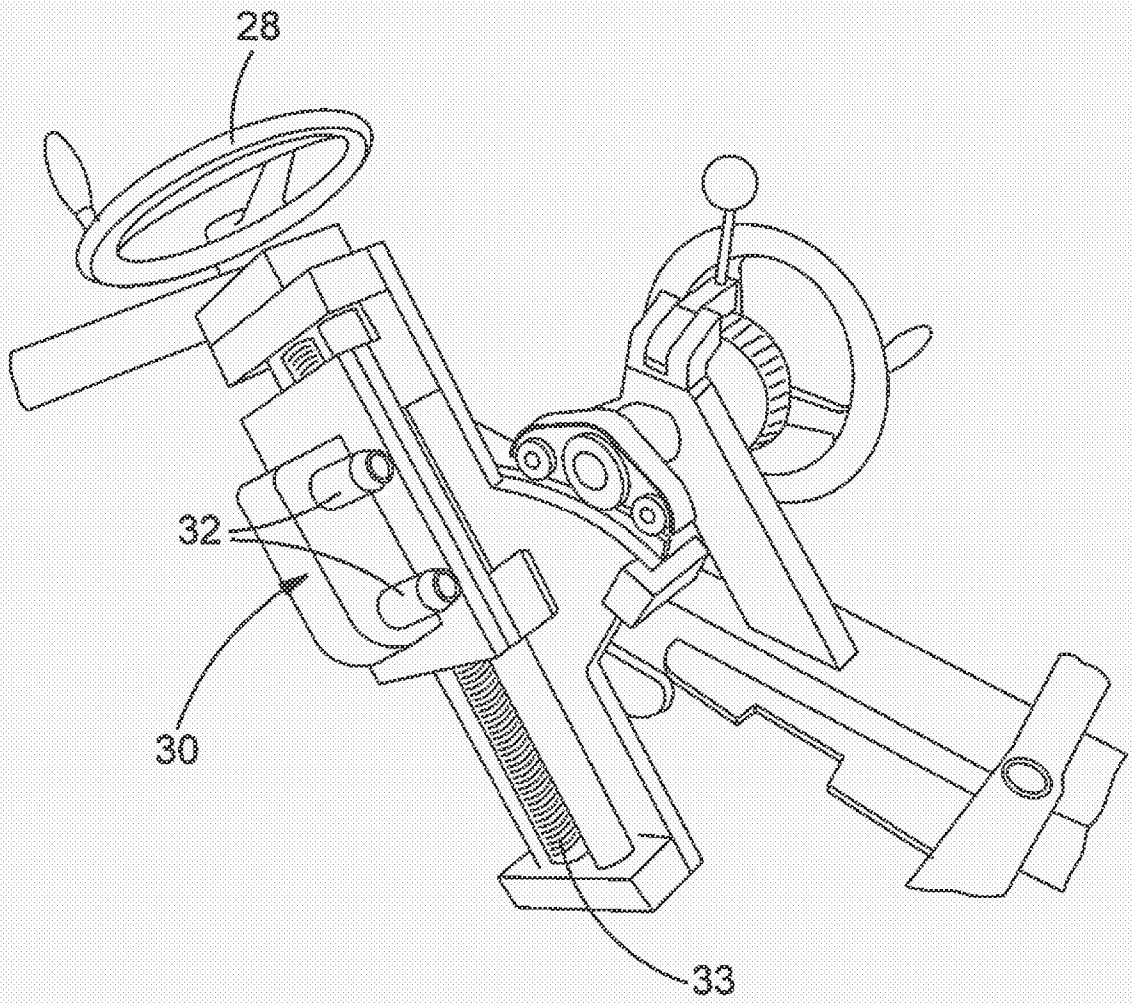


FIG.5

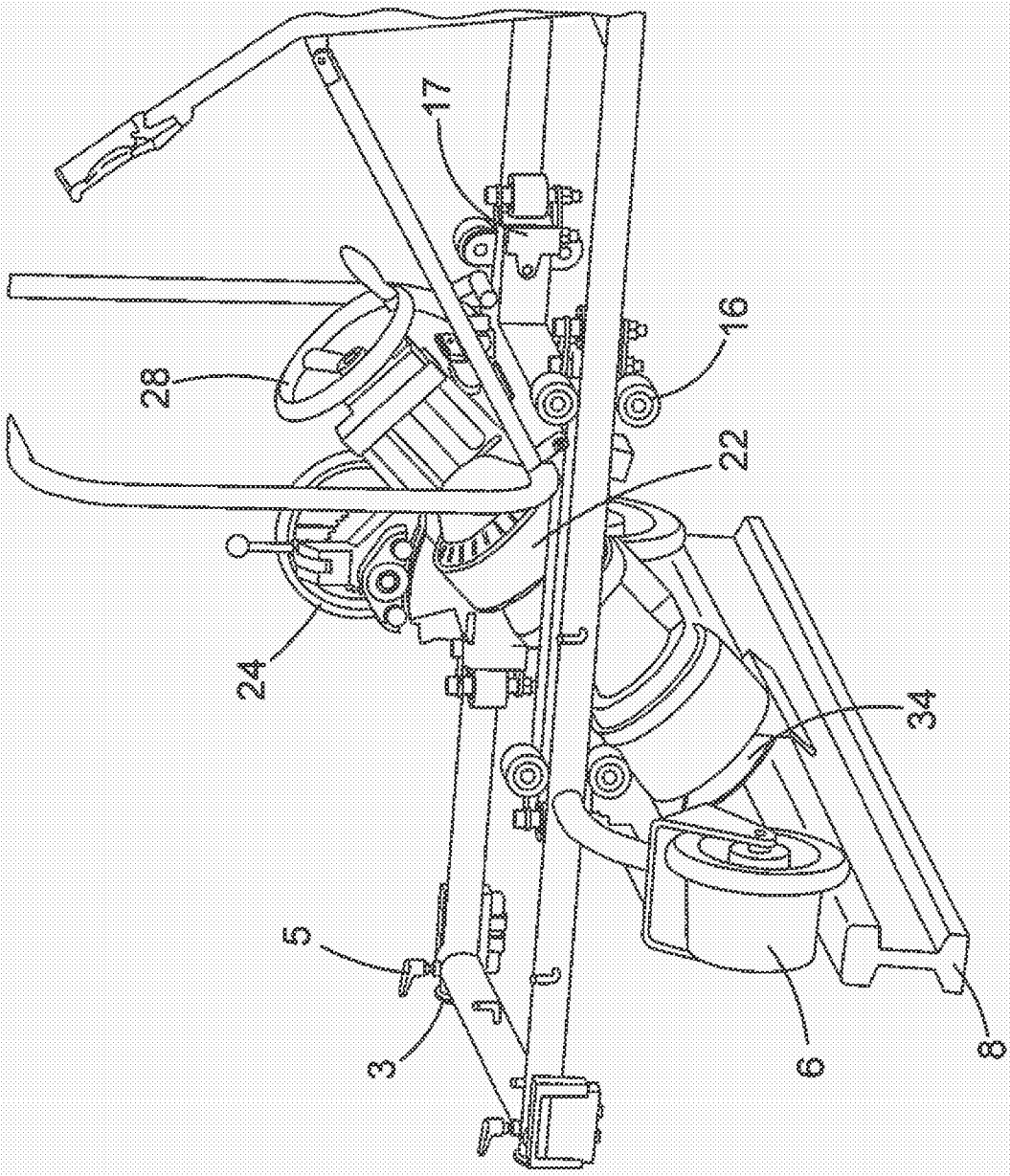


FIG.6

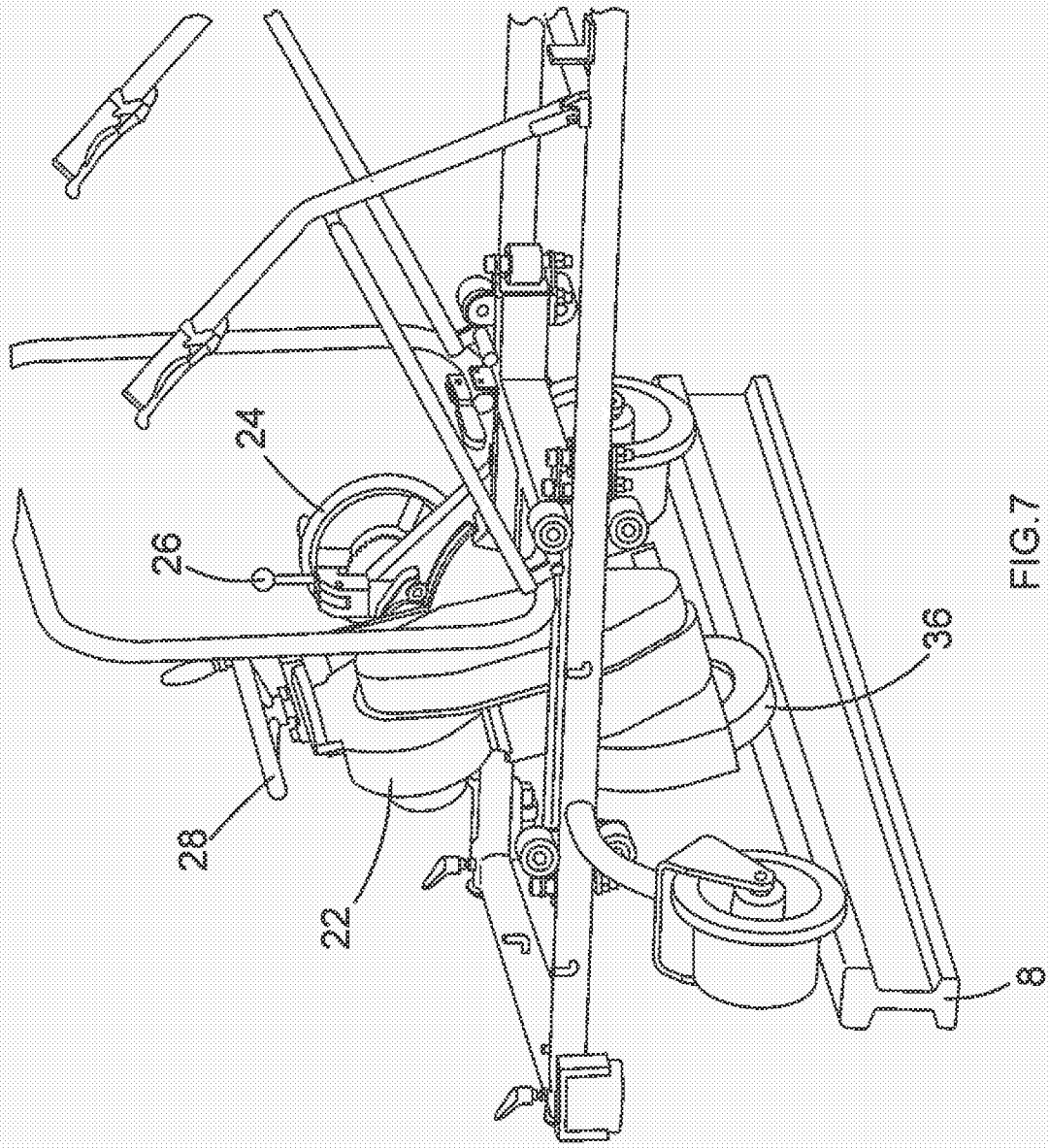


FIG.7

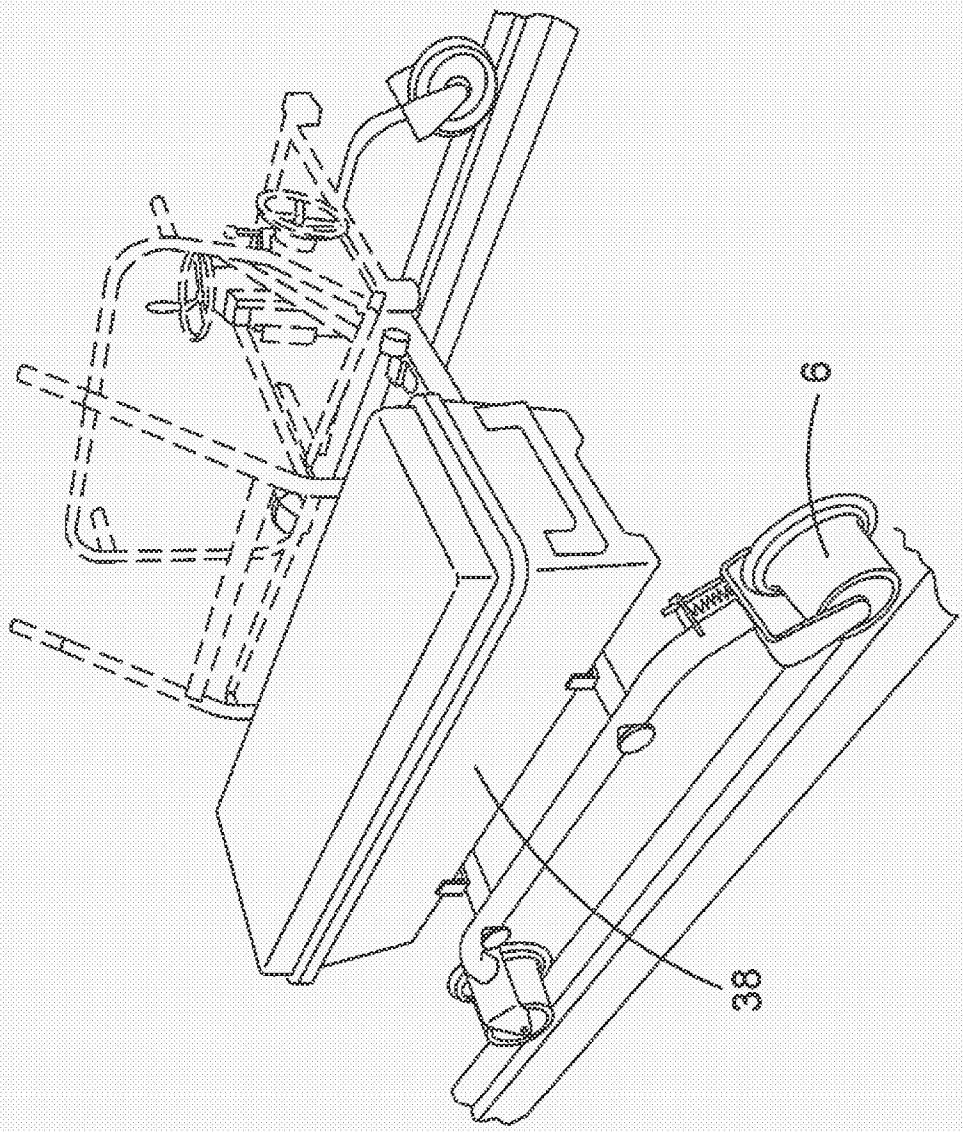


FIG.8

# INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/052278

A. CLASSIFICATION OF SUBJECT MATTER
INV. E01B31/17
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 10 October 2016 | 18/10/2016 |

| Name and mailing address of the ISA/ | Authorized officer |
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| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Herrero Ramos, J |

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Form PCT/ISA/210 (second sheet) (April 2005)

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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