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(54) DEVICE FOR TRANSPORTING LOADS

(71) We, EISENWERK WESERHÜTTE AKTIENGESELLSCHAFT, of 18, Mindener Strasse, 497 Bad Oeynhausen, Germany, a joint stock company organised under the laws of the Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a mobile device for transporting heavy loads.

A device already known comprises three walking feet; at each walking foot, there are two mutually inclined moving or driving legs fastened to a base plate resting on the ground. These fastenings are mounted on a common support by means of universal joints. For such a unit, however, it is difficult from a constructional point of view to realise two joints of the ball-and-socket type with a common centre.

A further device already known comprises at least three walking feet, each walking foot having three stays acting in different directions, namely a substantially vertical lift stay with two substantially horizontal moving and driving stays articulated to the lift stay by means of two ball-and-socket joints. Since, however, these two ball-and-socket joints cannot be arranged exactly at the central axis of the lift stay, but only at its circumference at a certain distance from the central axis, i.e. in front of the lift stay, the moving or driving stays, when subjected to pressure, produce a failure at the ball-and-socket joints or a distortion of the lift stay, which would have to be prevented or compensated by means of additional guide members or stays.

Other devices already known comprise substantially horizontal moving stays subjected to exclusively tensile loads; in these, the moving stays are grouped in pairs, each stay of a pair counteracting the other and acting on a base plate. In such a case, only

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one moving stay at any time—according to the direction of force—is used to absorb the force in the form of a tensile load. Such a construction is, however, relatively expensive because of the need to double the number of required horizontal moving stays.

According to the present invention, there is provided a mobile device for transporting heavy loads, the device comprising a load support frame and carrying means to carry the frame, the carrying means comprising at least one base plate movable relatively to the frame, lifting stays of variable length connecting the or each base plate with the frame, and further stays each associated with a respective one of at least some of the lifting stays, at least one of the further stays being provided with means to vary the length thereof in either sense, each further stay being connected at one end to the frame at a position lower than the connection of the associated lifting stay to the frame for pivotal motion relative thereto in any direction and connected at the other end to a location on the carrying means for pivotal motion relative to the associated base plate in any direction, the location being spaced from the connection between the associated lifting stay and base plate.

In one construction the location is on the longitudinal axis of the associated lifting stay, while in another construction the location is on the associated base plate.

The device may comprise a stabilising stay connected between the frame and the or one base plate to limit the range of directions in which the device is mobile. At least one of the further stays may be of invariable length and may be mounted at each of its ends for pivotal movement in a single plane only.

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

Fig. 1 is a perspective view of one em-

bodiment of device including three separate base plates;

Fig. 2 is a perspective view of a second embodiment including a common base plate;

5 Fig. 3 is a plan view of the embodiment shown in Fig. 2;

Fig. 4 is a perspective view of a third embodiment including a common base plate and comprising various, separately attached
10 lifting stays and further stays;

Fig. 5 is a plan view of the embodiment shown in Fig. 4;

Fig. 6 is a plan view of a fourth embodiment comprising more than three lifting
15 stays and further stays attached to a common base plate; and

Fig. 7 shows a fifth embodiment having a stabilising stay.

Referring now to the various Figs. of the drawings there are shown lifting stays 1, 2, 3 (Figs. 1 to 7) and 9 (Figs. 6 and 7), each connected by a universal joint at one of its ends to a load support frame 7 and at the opposite end either to the separate base
25 plates 8 (Fig. 1) or to a common base plate 8 (Figs. 2 to 7), respectively. Further stays, which act so as to cause motion in a horizontal direction are shown by reference numerals 4, 5 and 6 (Figs. 1 to 6) and 5 and 6 (Fig. 7). Additionally in Fig. 6, reference
30 numeral 10 indicates another further stay. Each of the further stays is connected at one of its ends to the frame 7 and at the opposite end either to lifting stays 1, 2 and 3 in line with their axes, or to the base plates, respectively. In Fig. 7 a stabilising stay is shown by reference numeral 11, and is of
35 invariable length.

The lifting stays and further stays are
40 variable in length, hydraulically or pneumatically operable cylinders and pistons being suitable devices to form each stay so that its length is variable. Furthermore, the lifting stays, the further stays and the or each base
45 plate together constitute a carrying means for carrying the load support frame.

With such an arrangement three degrees of freedom are possible between the stays and the frame, pivotal motion being possible in any direction to achieve these degrees
50 of freedom. Thus the piston rod of each lifting stay can rotate about the axis of the stay relatively to the cylinder which forms the remainder of the stay, and similarly the
55 piston rod of each further stay can rotate about the axis of the stay relatively to the cylinder forming the remainder of the stay, and a simple pivotal joint forms a convenient device for pivotally mounting a further stay
60 onto the associated lifting stay in the embodiments of Figs. 1 to 3. Thus as shown on the left in Fig. 1, for example, the further stay 4 is pivotally mounted by means of its cylinder portion onto the cylinder portion of
65 the associated lifting stay 1, a bifurcate end

portion being provided on the cylinder portion of the stay 4 and embracing between its bifurcations the cylinder of the stay 1. Pivot pins are provided to mount the bifurcations about the cylinder of the stay 1. The combination of such a pivotal joint, making
70 possible pivoting of the further stay relatively to the associated lifting stay in such a way as to maintain the axes of the two stays in the same plane, with the other degrees of
75 freedom available, has the full universal mobility which would be possessed by a ball-and-socket joint, the latter also being usable as an alternative to the pivotal joint described. Any undesired failure due to buckling
80 of a linkage or distortion of the lifting cylinder of a lifting stay when compressively loaded does not occur, the above described bifurcations acting as a guiding bearing for the cylinder of the lifting stay.

As an alternative to the arrangement of Figs. 1 to 3, in which the further stays are mounted at one end on the lifting stays, the further stays may be mounted on either the
90 common base plate, or one of a number of base plates, depending upon which arrangement is used, at a location again spaced from any connection between a lifting stay and a or the base plate. In this construction also, similar means are provided for varying the
95 length of the respective stays.

With either construction, the stays may be positively driven to increase or to decrease their length by the piston and cylinder arrangement, and are thus equally operable
100 in compression or tension selectably.

With the second construction, in which each further stay is mounted for universal motion at one end on the load support frame and at the opposite end at a point on a base
105 plate, the manner of construction of the further stays and the connections giving the required degrees of freedom are simplified. The number of further stays in relation to the number of lifting stays may be chosen as desired, as long as the number of further
110 stays does not exceed the number of lifting stays. It is been found that an expedient construction has three lifting stays and three further stays. This situation arises for reasons associated with the statics analysis of the device.

It is possible to construct a device which is not capable of movement in any arbitrary horizontal direction selected within the full
120 range of 360°, but which is capable only of movement in a number of specified directions. In such a construction one or more additional further stays may be provided, these being of fixed length and arranged to
125 act as stabilising stays pivotally connected at both ends. These may, however, be replaced by stabilising devices of other types.

WHAT WE CLAIM IS :—

1. A mobile device for transporting loads, 130

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Fig. 2 is a perspective view of a second embodiment including a common base plate;

5 Fig. 3 is a plan view of the embodiment shown in Fig. 2;

Fig. 4 is a perspective view of a third embodiment including a common base plate and comprising various, separately attached
10 lifting stays and further stays;

Fig. 5 is a plan view of the embodiment shown in Fig. 4;

Fig. 6 is a plan view of a fourth embodiment comprising more than three lifting stays and further stays attached to a common
15 base plate; and

Fig. 7 shows a fifth embodiment having a stabilising stay.

Referring now to the various Figs. of the drawings there are shown lifting stays 1, 2, 3 (Figs. 1 to 7) and 9 (Figs. 6 and 7), each connected by a universal joint at one of its ends to a load support frame 7 and at the opposite end either to the separate base
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With such an arrangement three degrees of freedom are possible between the stays and the frame, pivotal motion being possible in any direction to achieve these degrees
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90 base plates, depending upon which arrangement is used, at a location again spaced from any connection between a lifting stay and a or the base plate. In this construction also, similar means are provided for varying the
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110 desired, as long as the number of further stays does not exceed the number of lifting stays. It is been found that an expedient construction has three lifting stays and three further stays. This situation arises for reasons
115 associated with the statics analysis of the device.

It is possible to construct a device which is not capable of movement in any arbitrary horizontal direction selected within the full
120 range of 360°, but which is capable only of movement in a number of specified directions. In such a construction one or more additional further stays may be provided, these being of fixed length and arranged to
125 act as stabilising stays pivotally connected at both ends. These may, however, be replaced by stabilising devices of other types.

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* C L H S *

- the device comprising a load support frame and carrying means to carry the frame, the carrying means comprising at least one base plate movable relatively to the frame, lifting stays of variable length connecting the or
- 5 each base plate with the frame, and further stays each associated with a respective one of at least some of the lifting stays, at least one of the further stays being provided with
- 10 means to vary the length thereof in either sense, each further stay being connected at one end to the frame at a position lower than the connection of the associated lifting stay to the frame for pivotal motion relative
- 15 thereto in any direction and connected at the other end to a location on the carrying means for pivotal motion relative to the associated base plate in any direction, the location being spaced from the connection
- 20 between the associated lifting stay and base plate.
2. A device as claimed in claim 1, wherein the location is on the longitudinal axis of the associated lifting stay.
- 25 3. A device as claimed in claim 1, wherein the location is on the associated base plate.
4. A device as claimed in any one of the preceding claims, comprising a stabilising
- 30 stay connected between the frame and the or one base plate to limit the range of direc-

tions in which the device is mobile.

5. A device as claimed in any one of claims 1 to 3, wherein at least one of the further stays is of invariable length and is 35 mounted at each of its ends for pivotal movement in a single plane only.

6. A mobile device for transporting heavy loads, substantially as hereinbefore described with reference to Fig. 1 of the 40 accompanying drawings.

7. A mobile device for transporting heavy loads, substantially as hereinbefore described with reference to Figs. 2 and 3 of the accompanying drawings. 45

8. A mobile device for transporting heavy loads, substantially as hereinbefore described with reference to Figs. 4 and 5 of the accompanying drawings.

9. A mobile device for transporting 50 heavy loads, substantially as hereinbefore described with reference to Fig. 6 of the accompanying drawings.

10. A mobile device for transporting heavy loads, substantially as hereinbefore 55 described with reference to Fig. 7 of the accompanying drawings.

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