United States Patent

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[54] WALKING MECHANISM FOR MOVING HEAVY LOADS

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Sept. 27, 1968 Germany ..... G 67 51 750
Sept. 27, 1968 Germany ..... G 67 51 752

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[58] Field of Search ..... 180/8 R, 8 D

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[57] ABSTRACT

This invention relates to a walking mechanism for moving heavy loads comprising variable length lifting legs and variable-length moving legs articulated to at least one baseplate, each of the moving legs being connected, by means including universally movable articulation means, at one end to a load and at the opposite end to one of the lifting legs at the axis of the latter.

5 Claims, 7 Drawing Figures

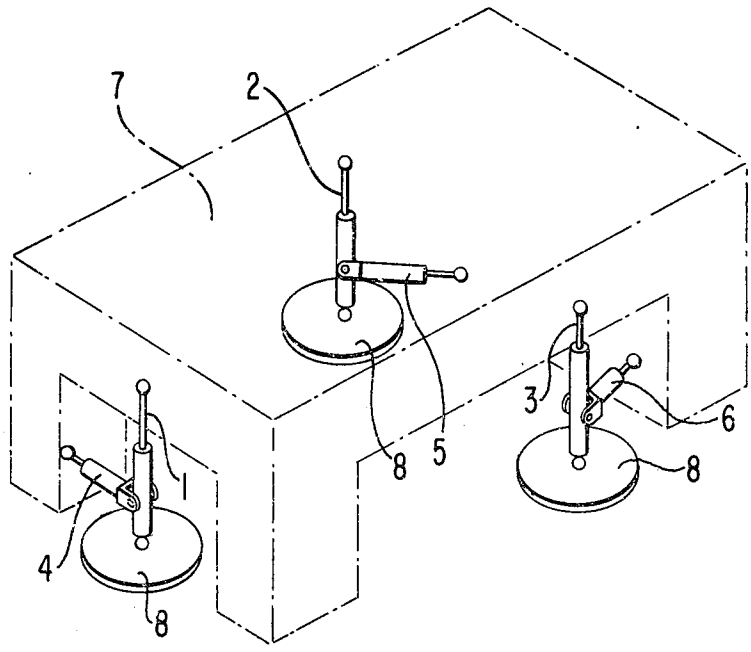

FIG. 1

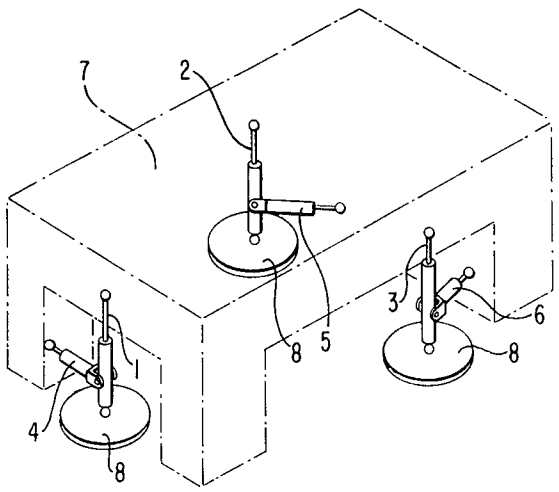

FIG. 2

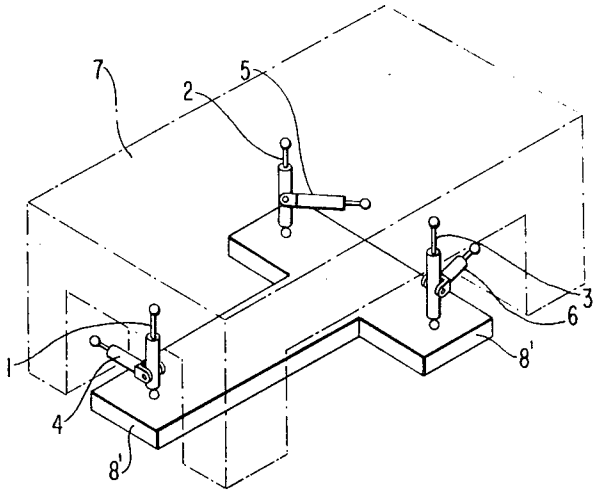

FIG. 3

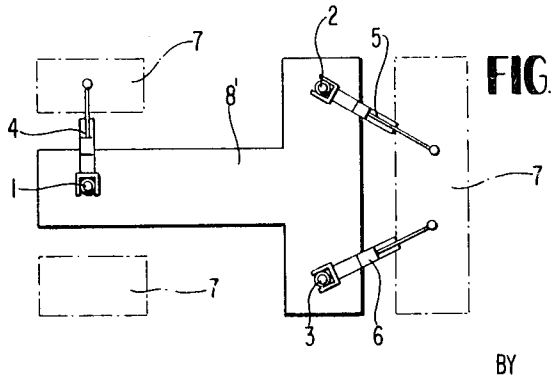

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FIG. 4

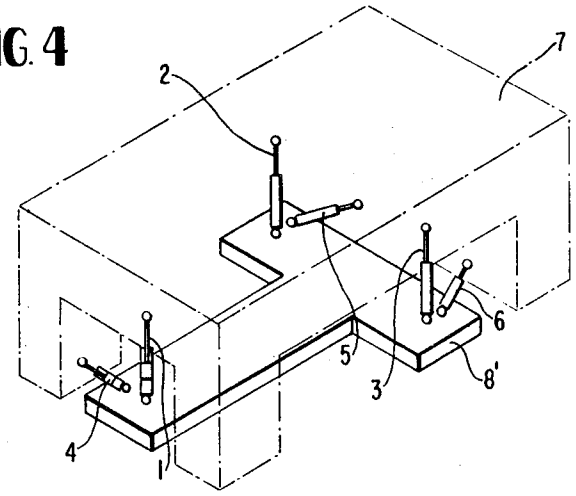


FIG. 5

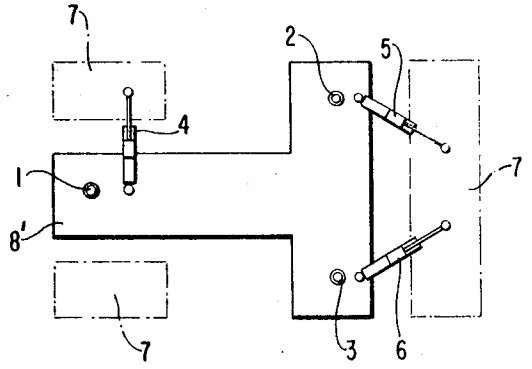


FIG. 6

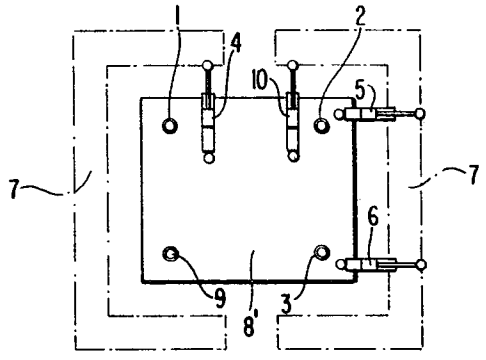
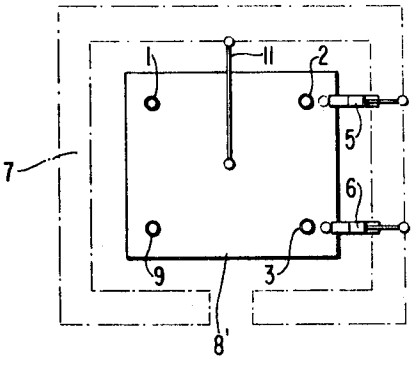


FIG. 7



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WALKING MECHANISM FOR MOVING HEAVY LOADS

The present invention relates to a walking mechanism for moving heavy loads. By using the means according to the present invention, the hitherto known walking mechanisms are improved or simplified in design.

A unit already known is a walking mechanism including three walking feet where, at each walking foot, there are two moving or driving legs inclined to each other and connected to a baseplate lying on the ground. Such connection is made at a common base or supporting point, by means of universally movable articulations or joints. For such a unit, however, it is difficult, from a constructional point of view, to design two joints of the ball-and-socket type to have a common center.

Another unit already known is a walking mechanism comprising at least three walking feet where each walking foot has three legs acting in various directions. More specifically, there is a substantially vertical lifting leg with two substantially horizontal moving and driving legs articulated to the lifting leg by means of two ball-and-socket joints. Due to the fact, however, that these two ball-and-socket joints cannot be positioned exactly at the central axis of the lifting leg but only at the outer periphery thereof at a certain distance from the central axis, i.e., in front of the above-mentioned lifting leg, the moving or driving legs, when exposed to pressure, produce a failure at the ball-and-socket joints or a torsion of the lifting leg which must be prevented or compensated by means of additional guide members.

Other walking units already known comprise substantially horizontal moving legs exclusively subjected to tensile load by providing—grouped in pairs—two moving legs each counteracting to each other and acting on a baseplate. In such a case, one moving leg only—according to the direction of force—is used to absorb the force in the form of a tensile load. Such a design, however, is relatively expensive because of the necessity to double the number of required horizontal moving legs.

The walking mechanism of the present invention eliminates the disadvantages of the known designs and comprises one or several baseplates, lifting legs variable in length and usable for compressive and tensile loads articulated to the aforementioned baseplate or plates, moving or driving legs variable in length and also usable for compressive and tensile loads, the moving legs each being articulated at one end to the load and at the opposite end, distanced from the baseplate or plates, to the axis of the lifting legs, which articulation is made by means of universally movable joints.

Hydraulic cylinders are suitable means to make the legs variable in length.

In such an arrangement, the three possible rotary motions, e.g., between the piston rod and the lifting cylinder, the piston rod and the moving cylinder, as well as a moving cylinder fork and corresponding lifting cylinder swing bolt, make possible the three degrees of freedom or the universal mobility of a ball, respectively. An undesirable failure due to buckling in the joint articulation, or a torsion of the lifting cylinder when under compressive load by the moving cylinder, respectively, cannot occur since the lifting cylinder is guided by the moving cylinder fork.

A further construction providing for elimination of the disadvantages inherent to the known walking mechanisms is a walking unit comprising lifting legs variable in length and articulated to one or several baseplates, moving or driving legs variable in length and usable for compressive and tensile loads, the moving legs being articulated at one end to the load and at the opposite end, distanced from the articulations of the lifting legs and separated from the same, at any desired point on the baseplate or plates, using universally movable joints. In this way, lifting legs and lifting leg articulations are simplified.

The number of lifting and moving legs usable for compressive as well as tensile loads may be selected as required. For reasons of statics, preference is given to three lifting legs and three moving legs.

Where definite directions of movement of the walking mechanism are not required, one or several driving legs can be employed without adjustment in length, but may be designed as stabilizing legs articulated at both ends or may be replaced by stabilizing bearings of other types.

The accompanying drawings show some preferred embodiments of the invention. In these schematic illustrations:

FIG. 1 is a perspective view of a walking mechanism having three separate baseplates,

FIG. 2 is a perspective view showing a walking mechanism having a common baseplate,

FIG. 3 is a plan view of FIG. 2,

FIG. 4 is a top plan view showing a walking mechanism having a common baseplate and comprising, separately connected to the same, the various lifting and moving legs,

FIG. 5 is a plan view of FIG. 4,

FIG. 6 is a top plan view showing a unit comprising more than three lifting and moving legs connected to a common baseplate, and

FIG. 7 is a top plan view showing the mounting of a stabilizing bearing.

Referring to the drawings, the lifting legs **1**, **2**, **3**, and **9** are articulated, in a universally movable manner, at one end to a load **7** and at the opposite end to the separate baseplate **8**, or to the common baseplate **8'**, respectively. The moving legs **4**, **5**, **6**, and **10** are articulated at one end to the load **7** and at the opposite end to the lifting legs **1**, **2**, **3** at their respective axes, or to the baseplates, respectively. A stabilizing bearing is designated **11**.

When the walking mechanism is in operation, the program sequence is as follows:

1. The horizontal stride cylinders, i.e., **4**, **5**, and **6** in FIG. 2, for example, pull the raised baseplate **8'** forward;
2. The vertical lifting cylinders, i.e., **1**, **2**, and **3** of FIG. 2, for example, lift the mechanism;
3. The horizontal stride cylinders push the elevated mechanism one stride in the desired direction, and
4. The vertical lifting cylinders lower the mechanism onto the ground once again and raise the baseplate **8'**, etc.

The approximately vertical lifting cylinders therefore bring about the raising and lowering of the load and the raising and lowering of the baseplates and/or baseplate. The approximately horizontal stride cylinders bring about the horizontal movements of the load while it is in the raised position and the horizontal movements of the raised baseplates and/or raised baseplate.

In the arrangements according to the FIGS. **1**, **2**, **3**, **4**, and **5**, three lifting cylinders and three stride cylinders each are provided for. The raised load is therefore supported sixfold, for example. In this case, in other words, the load in the raised position is definitely positioned statically, i.e., statically definitely supported. For this reason, each lifting cylinder and each stride cylinder may be individually or separately varied in the length thereof independently of the other lifting cylinders and/or stride cylinders. By appropriately varying the length of either one or several cylinders, any desired movement can be obtained.

If more than three lifting cylinders or three stride cylinders are present, for example four, at least two cylinders must in each case be varied in the length thereof. Here again, any desired movement can be achieved. The same is true when even more cylinders are present.

Since all of the cylinders are secured at the ends thereof by means of spatially movable joints, the load can be moved in any direction. This means that the movement can take place either in the direction of an axis of the load, or at a right angle with respect thereto, or it can be effected obliquely in any desired angle with respect to an axis. The load further may be rotated clockwise or counterclockwise while standing in place. Finally, it is even possible to cause the movement to be effected in any desired direction together with a simultaneous rotation.

For example, it is provided for that the movement of a load be caused and effected along its axis, or at a right angle thereto, or at an angle of 45° each in both directions and/or toward both sides, so that eight striding possibilities result. Hence, the load can be moved toward any point. Since the load also can be rotated, it equally can be brought into any position.

It will be obvious to those skilled in the art that many modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. A walking mechanism for moving heavy loads comprising variable-length lifting legs and variable-length moving lets articulated to at least one baseplate, each of the moving legs being connected, by means including universally movable articulation means, at one end to a load and at the opposite end to one of the lifting legs at the axis of the latter, and stabilizing leg means connected between said load and said baseplate.

2. A walking mechanism according to claim 1 in which the connections between the moving legs and the lifting legs are at a distance from the baseplate.

3. A walking mechanism according to claim 1 including a plurality of baseplates.

4. A walking mechanism according to claim 1 in which each of the moving legs is connected, by means including universally movable articulation means, at one end to a load and at the opposite end to the baseplate.

5. A walking mechanism according to claim 1 in which at least one of the moving legs is also a stabilizing leg articulated at both ends.

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