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(54) **Lift truck for handling slabs of material.**

(57) The invention is a self-propelled lift truck (1) for handling slabs of material (33) packaged in a containing structure (34) that comprises a frame (35) arranged on the perimeter of the slabs (33) and provided at the ends with projecting elements (36, 37), comprising a bearing structure (2) provided with wheels and power means for travelling. The lift truck (1) comprises a telescopic arm

(3) having one end connected to the bearing structure (2) through first articulation means (5) and the opposite end provided with means (9) for gripping the projecting elements (36, 37), connected to the telescopic arm (3) through second articulation means (8).

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Description

[0001] The invention concerns a self-propelled lift truck for handling slabs of material, particularly suitable for the horizontal loading and unloading of containers.

[0002] It is known that for transporting slabs of material, particularly glass slabs, these are packaged in suitable containing structures, called "cases", suitable for transport in containers.

[0003] These cases, generally made of wood, comprise a frame arranged around the perimeter of the slabs, which protects them against breakage during handling and transportation.

[0004] The crosswise dimensions of a case depend on the size of the slabs contained therein, while its thickness depends on their number, which in turn depends on the capacity limit of the case, usually in the order of 2000 kg.

[0005] In practice, the thickness of a case is considerably inferior to its crosswise dimensions and therefore it is handled by gripping it from above to prevent it from overturning.

[0006] The cases, therefore, are provided with projecting elements arranged on the frame, so that they can be gripped by the machines used for handling the material.

[0007] According to the known technique, there are substantially two types of container for transporting cases, with upper or lateral loading door, so that the loading/unloading of the material is carried out vertically or horizontally, respectively.

[0008] The containers of the first type, that is, those loaded from above, pose the drawback that they involve higher transport costs, because they must be positioned on top of the load due to the fact that they cannot be stacked.

[0009] In the containers with horizontal loading, the cases are introduced longitudinally, arranging them side by side and locking them with suitable fastening means that at the destination are removed to allow the cases to be unloaded from the container and stored in the warehouse.

[0010] During the loading, unloading, transporting operations, from and into the warehouse, the cases must be secured to the handling means to prevent them from accidentally falling down which, beside damaging the material, can cause injuries to the operators, above all when the transported material is fragile, like for example glass.

[0011] According to the known art, the cases are transported from the warehouse to the parking area in proximity of the container or vice versa using self-propelled lift trucks.

[0012] These lift trucks, which in some versions can transport even more than one case at a time, are equipped with gripping means manoeuvred by the operator, which engage with the underside of the above mentioned elements projecting from the frame and comprise devices suited to secure the case.

[0013] Said gripping means can be adjusted through

actuators, in such a way as to adapt them to the dimensions and number of the cases to be handled.

[0014] The lift trucks described above pose the drawback that they cannot load and unload the cases into/from the container, since they handle the cases frontally while the above mentioned operations required longitudinal handling of the same.

[0015] Therefore, the cases are deposited by these lift trucks on special stands, from which they are successively loaded in the container through a suitable lifting structure.

[0016] Said structure is U shaped, with two arms arranged horizontally on top of each other.

[0017] The upper arm is coupled to a bridge crane, thus allowing the structure to be moved, while the lower arm is provided with means for gripping the case that are similar to those present on the lift trucks described above.

[0018] The lifting structure is designed so that the lower arm can get into the container together with the case, while the upper arm, coupled to the bridge crane, remains outside the container itself.

[0019] The cases are unloaded from the container by repeating the operations described above in the reverse order.

[0020] A first drawback posed by this loading and unloading system lies in the complexity of the operations, which is due to the need to provide for intermediate deposit of the cases and to use two different means of transport.

[0021] A further drawback lies in that the lifting structure, being simply coupled with the bridge crane, requires the presence of two or more persons inside the container to receive the case, keep it properly aligned and manoeuvre the gripping means.

[0022] Due to the considerable weight of the cases, this involves risk for the operators, especially in the case of fragile materials like for example glass, since these produce dangerous splinters in case of breakage.

[0023] Economic equipment for the rapid handling of cases is also known, comprising a rigid arm provided with means for gripping the case to be fixed to the uprights of the lift truck, which allow the case to be held and transported directly inside the container.

[0024] For economic reasons, the gripping means of these pieces of equipment are adjusted manually and pose drawbacks analogous to those observed in the system described above.

[0025] A further drawback lies in that, due to the fixed arm, the case manoeuvring range is limited, which makes the loading operation unsafe and the unloading operation practically impossible, the latter requiring a much greater manoeuvring precision than that offered by this type of equipment.

[0026] A further drawback of this system is represented by the fact that, to ensure quicker loading operations, it does not comprise means for securing the case, which therefore can accidentally slip and fall down during handling.

[0027] The present invention aims to overcome all the mentioned drawbacks mentioned above, occurring in the known systems for handling slabs of material.

[0028] In particular, it is a first object of the invention to construct a lift truck that ensures a wide range of movement of the case, so that it can be transported in and out of the warehouse and can be loaded in and unloaded from the container with no need for intermediate deposit.

[0029] Furthermore, it is one object of the lift truck of the invention to allow all the operations described above to be carried out in total safety.

[0030] The objects described above have been achieved through the construction of a lift truck according to the contents of the main claim, to which the reader should refer for the sake of brevity.

[0031] Other details of the lift truck that is the subject of the invention are described in the dependent claims.

[0032] According to the preferred embodiment of the invention described herein, the lift truck comprises a self-propelled bearing structure equipped with wheels and suitable power means.

[0033] The lift truck also comprises a telescopic arm, one end of which is connected to the bearing structure through first articulation means, while the opposite end is provided with means for gripping the projecting elements of the frame for coupling with and handling of the structure containing the material.

[0034] Said gripping means are connected to the telescopic arm via second articulation means.

[0035] To advantage, the wide range of movement of the case ensured by the lift truck of the invention allows all the operations to be carried out by a single operator that manoeuvres the truck.

[0036] Still to advantage, thanks to the precision of movement ensured by the truck of the invention the presence of operators inside the container during the loading and unloading operations is not necessary any more, which reduces the risks compared to the known handling systems.

[0037] The above-mentioned aims and advantages, and others that will be described below, are highlighted in greater detail in the description that follows, which is provided herein as an example without limitation, with reference to the attached drawings, wherein:

- Figure 1 shows an axonometric view of the lift truck that is the subject of the invention;
- Figure 2 is an axonometric view of a detail of the lift truck shown in Figure 1;
- Figure 3 shows an axonometric view of a section plane of the detail of the lift truck shown in Figure 1;
- Figure 4 shows a longitudinal section of the detail of Figure 3;
- Figure 5 shows the detail of Figure 4, sectioned crosswise along plane II-II;
- Figure 6 shows an axonometric view of the lift truck of Figure 1 while it is gripping a case;
- Figure 7 shows an axonometric view of the lift truck

of Figure 1 with a case attached to it.

[0038] The lift truck that is the subject of the invention is shown in Figure 1, where it is indicated as a whole by **1**.

[0039] It can be observed that it comprises a bearing structure **2** provided with wheels, set moving by power means not represented herein, which in the preferred embodiment comprise an electric motor, but which may be any power means commonly used in the known art.

[0040] The lift truck **1** also comprises a telescopic arm **3** provided with actuator means **4** for its extension.

[0041] In the preferred embodiment of the invention, the telescopic arm **3** consists of two telescopic sections arranged one inside the other, but it is clear that other embodiments may comprise more than two sections.

[0042] The telescopic arm **3** is connected at one end to the bearing structure **2** through first articulation means **5**, comprising a pin **6** that defines a horizontal axis and actuator means **5a** for rotating the telescopic arm **3** around said pin **6**. The above mentioned pin **6** and actuator means **5a** are supported by a revolving turret **7** provided with driving means for rotation around a pin defining a vertical axis, said means being not represented herein.

[0043] At the opposite end of the telescopic arm **3** there are means **9** for gripping the containing structure **34**, connected to the telescopic arm **3** through second articulation means **8**.

[0044] As shown in greater detail in Figure 2, said gripping means **9** comprise a beam **10** that defines a longitudinal axis **X** and is provided at each end with a projecting shelf **11**, **12** at the side of the beam **10** itself.

[0045] The projecting shelves **11**, **12** allow the containing structure **34** to be gripped, since they match with the underside of the undercut surfaces defined on each projecting element **36**, **37** of the same and ensuring attachment and handling of the same.

[0046] The second articulation means **8** comprise a joint **16** provided with a first pin **17** defining a horizontal axis, attached to the telescopic arm **3**.

[0047] The first pin **17** supports a second pin **18** defining an axis at right angles to that of the first pin **17** to which the beam **10** is hinged at right angles to its longitudinal axis **X**.

[0048] The lift truck **1** also comprises actuator means **19** for rotating the joint **16** around the first pin **17** and driving means **20** for rotating the beam **10** around the second pin **18**.

[0049] In the preferred embodiment of the invention, the above mentioned actuator means **5a** for rotating the telescopic arm **3** are operatively connected to the actuator means **19** of the joint **16** that cooperate with the actuator means **5a** to keep said beam **10** in horizontal position.

[0050] To advantage, this makes it possible to constantly keep the containing structure **34** in the position that is most favourable to its handling.

[0051] It is clear, however, that according to construction variants of the invention the beam **10** may be slightly

inclined with respect to the horizontal, in order to adapt to a possible inclination of the container.

[0052] As regards the driving means **20** for the rotation of the beam **10** around the second pin **18**, in the preferred embodiment of the invention they comprise a motor **21**, fixed to the joint **16**, and a pinion **22** connected to the shaft of the motor **21**, meshing with a gear **23** fixed to the beam **10**.

[0053] It is evident, however, that in construction variants of the invention the driving means **20** may be different from those just described, provided that they are suited to set the beam **10** rotating around the second pin **18**.

[0054] It is clear that, with the characteristics described above, the containing structure **34** attached to the gripping means **9** can be pushed inside the container with the telescopic arm **3**, while the first articulation means **5** and the second articulation means **8** ensure that the holding means **9** have a wide range of movement, necessary for the various operations.

[0055] Therefore, the lift truck **1** achieves the object to permit both the handling of the containing structure **34** and the execution of the loading and loading operations.

[0056] The projecting shelves **11**, **12** and the relevant kinematic motions are illustrated in detail in Figure 3.

[0057] In these figures it can be observed that each shelf **11**, **12** is a substantially prismatic body **13**, **14** defining a longitudinal axis **Y1**, **Y2** arranged substantially at right angles to the longitudinal axis **X** of the beam **10**.

[0058] There are powered guide means **15** for moving the projecting shelves **11**, **12** along a direction parallel to the longitudinal axis **X** of the beam **10**.

[0059] Said powered guide means **15** comprise one pair of sliding elements **24** respectively arranged on each end of the beam **10** and associated with actuator means **25** to control their sliding movement.

[0060] In the preferred embodiment of the invention and as can be observed in particular in Figure 4, which shows a longitudinal section of the beam **10**, the sliding elements **24** are telescopically coupled with the beam **10**.

[0061] It is evident, however, that in different embodiments the beam **10** and the sliding elements **24** may be coupled in a manner different from that described above, for example through linear guides or other known techniques.

[0062] The mobility of the projecting shelves **11**, **12**, obtained through the sliding elements **24** and the corresponding actuator means **25**, makes it possible to remotely control the mutual approach and separation of the projecting shelves **11**, **12**, respectively to grip and release the containing structure **34**.

[0063] To advantage, this makes the presence of one or more operators inside the container for manoeuvring the gripping means **9** no more necessary and consequently operations become safer.

[0064] In the preferred embodiment of the invention, the actuator means **25** of the sliding elements **24** are operatively connected to one another to carry out mutu-

ally opposing movements of the sliding elements **24** themselves.

[0065] Furthermore, the actuator means **25** are connected to suitable valves known in the sector and not represented herein, which make it possible to limit the clamping pressure of the sliding elements **24** around the containing structure **34**, so that they stop once they have come into contact with the latter. In this way it is possible to avoid damaging the containing structure **34** during the gripping stage and also to prevent it from being dangerously dragged by the sliding element **24** that is the first to come into contact with it.

[0066] The above advantageously makes it possible to simplify the operations for gripping and releasing the containing structure **34**, in particular when visibility is scarce, like for example when the containing structure **34** is inside the container.

[0067] It is clear that in construction variants of the invention the sliding elements **24** may also move in the same direction.

[0068] Each projecting shelf **11**, **12** is provided at least at one end with a projecting body **13a**, **14a** parallel to the longitudinal axis of the beam **10** and directed towards the centre of said beam **10**.

[0069] While the case is being gripped, said projecting bodies **13a**, **14a** are arranged on the opposite side of the containing structure **34** with respect to the beam **10**, thus stopping the side movements of the containing structure **34** to prevent it from accidentally slipping and falling down.

[0070] This, together with the other characteristics described above, achieves the object to construct a lift truck **1** that allows the operations to be carried out in total safety.

[0071] As regards the sliding element **24**, it has a recess **26** that slidably houses the projecting shelf **11**, **12**, thus permitting its movement along a direction parallel to the longitudinal axis **Y1**, **Y2** of the projecting shelf **11**, **12** itself.

[0072] As can be seen in particular in Figure 5, this movement is carried out through a rack **27**, present on each projecting shelf **11**, **12** and developed along the longitudinal axis **Y1**, **Y2** of the same, which meshes with a gear wheel **28** coupled with driving means **29** that set it rotating.

[0073] The driving means **29** comprise a motor **30** provided with an intermediate shaft **31** that, in the preferred embodiment, is a telescopic shaft with grooved profile having one end operatively connected to the motor **30** through transmission means **30a** and the opposite end coupled with the gear wheel **28**. The movement of the projecting shelf **11**, **12** described above advantageously makes it possible to vary the degree of projection of the shelf **11**, **12** to adapt it to the thickness of the containing structure **34**, in such a way as to avoid the oscillation of the latter and minimize the space occupied by the shelves **11**, **12** in the operating area.

[0074] The gear wheels **28** are pulled by the sliding

elements **24** during the movement of the latter, in such a way as to be always engaged with the racks **27** of the projecting shelves **11, 12**.

[0075] Therefore, the above mentioned telescopic shafts allow the rotary motion to be transmitted to the gear wheels **28** independently of the position of the latter along the beam **10**.

[0076] Furthermore, in the preferred embodiment of the invention, the transmission shafts **31** of the gear wheels **28** are operatively connected to one another, so that the gear wheels **28** all rotate to the same degree and the shelves **11, 12** all project to the same extent.

[0077] It is clear that, in different embodiments not represented herein, the movement of the projecting shelves **11, 12** in the direction of their longitudinal axis **Y1, Y2** can be achieved using any means different from those described herein, like for example linear actuators.

[0078] As to the actuator means **4, 5a, 19, 25** and the motors **21, 30** of the lift truck **1** of the invention, in the preferred embodiment they are respectively hydraulic jacks and motors using preferably but not necessarily oil, or pneumatic jacks and motors.

[0079] The lift truck **1** also comprises a driving cab **32** provided with control means that an operator can manoeuvre to control the power means, the actuator means **4, 5a, 19, 25** and the driving means **20, 29** of the lift truck **1**.

[0080] Advantageously, this allows all the handling, loading and unloading operations to be carried out by a single operator.

[0081] First of all the operator adjusts the projecting means **11, 12** according to the thickness of the containing structure **34** to be gripped.

[0082] Successively, as shown in Figure 6, the operator manoeuvres the lift truck **1** to approach the containing structure **34**, after which he/she operates the telescopic arm **3**, the first articulation means **5** and the second articulation means **8** to position the beam **10** at the side of the containing structure **34**, in such a way as to arrange the projecting shelves **11, 12** just below the projecting elements **36, 37** of the containing structure **34**.

[0083] After clamping the two projecting shelves **11, 12** around the sides of the containing structure **34**, the latter is lifted by operating the telescopic arm **3** and the first articulation means **5** to which it is connected, as shown in Figure 7, and thus can be handled by exploiting the mobility of the lift truck **1** and its kinematic motions described above.

[0084] The release of the containing structure **34** takes place in an analogous manner, carrying out the steps described above in the reverse order.

[0085] For the reasons explained above, it is clear that the invention achieves all the set objects.

[0086] In the construction stage, further changes or construction variants of the lift truck of the invention - that are not described and represented in the drawings - may be carried out.

[0087] Said changes or construction variants must all

be considered protected by the present patent, provided that they fall within the scope of the claims expressed below.

[0088] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

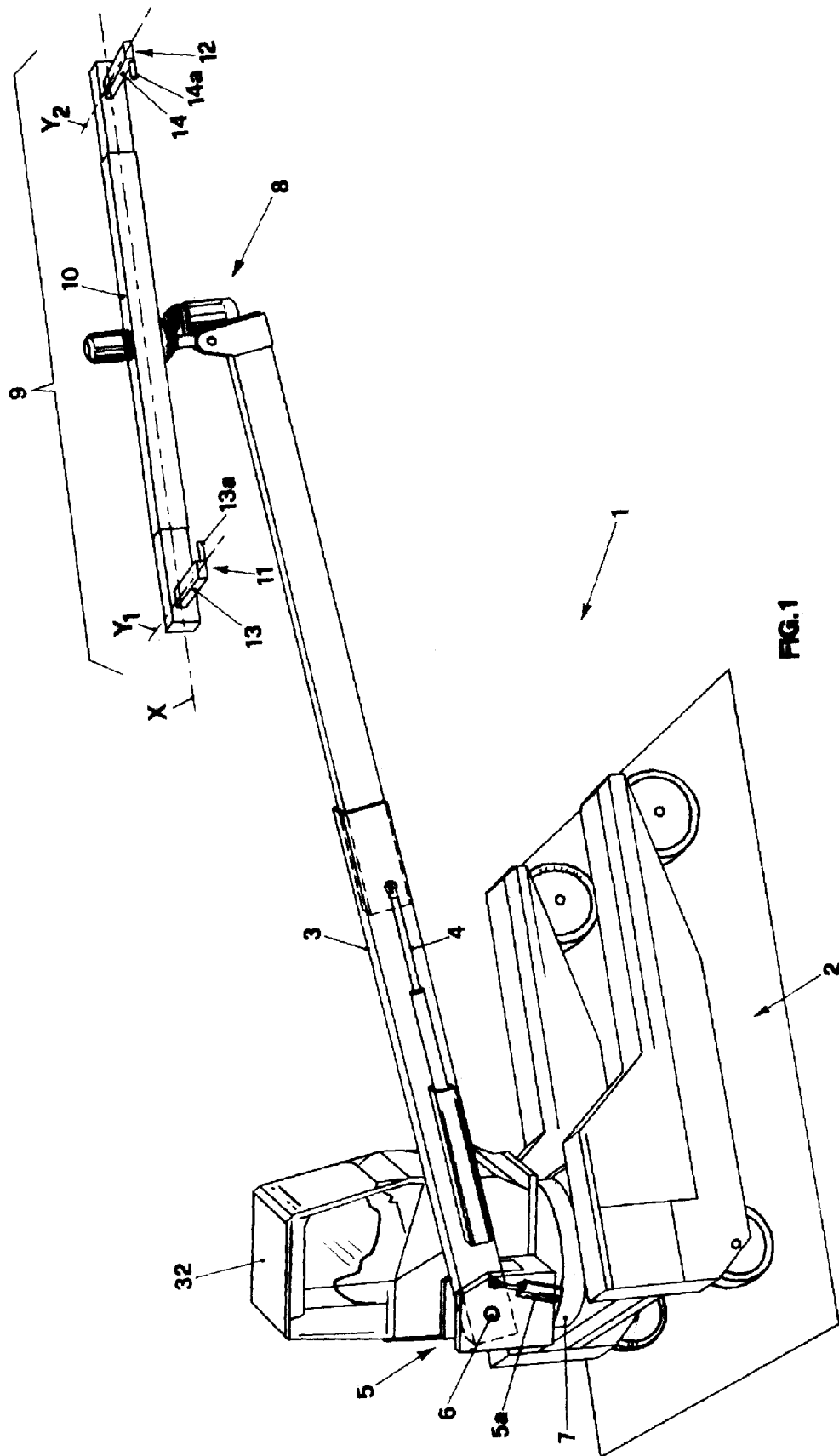
1. Self-propelled lift truck (1) for handling slabs (33) packaged in a containing structure (34) that comprises a frame (35) arranged on the perimeter of said slabs (33) and provided at its ends with projecting elements (36, 37), comprising a bearing structure (2) provided with wheels and power means for travelling, **characterized in that** it comprises a telescopic arm (3) having one end connected to said bearing structure (2) through first articulation means (5) and the opposite end provided with gripping means (9) of said projecting elements (36, 37), connected to said telescopic arm (3) through second articulation means (8).
2. Lift truck (1) according to claim 1, **characterized in that** said telescopic arm (3) comprises at least two telescopic sections arranged one inside the other and actuator means (4) for the extension.
3. Lift truck (1) according to claim 1, **characterized in that** said first articulation means (5) comprise actuator means (5a) for rotating said telescopic arm (3) around a pin (6) defining a horizontal axis, supported by a revolving turret (7) provided with driving means for rotation around a pin defining a vertical axis.
4. Lift truck (1) according to claim 1, **characterized in that** said gripping means (9) comprise a beam (10) defining a longitudinal axis (X) and provided, at each end, with a projecting shelf (11, 12) for coupling with a corresponding undercut surface defined by each one of said projecting elements (36, 37) of said containing structure (34).
5. Lift truck (1) according to claim 4, **characterized in that** said projecting shelf (11, 12) is a substantially prismatic body (13, 14) defining a longitudinal axis (Y1, Y2) substantially perpendicular to said longitudinal axis (X) of said beam (10) and provided, at least at one end, with a projecting body (13a, 14a) parallel to said longitudinal axis (X) of said beam (10) and directed towards the centre of said beam (10).
6. Lift truck (1) according to claim 4, **characterized in**

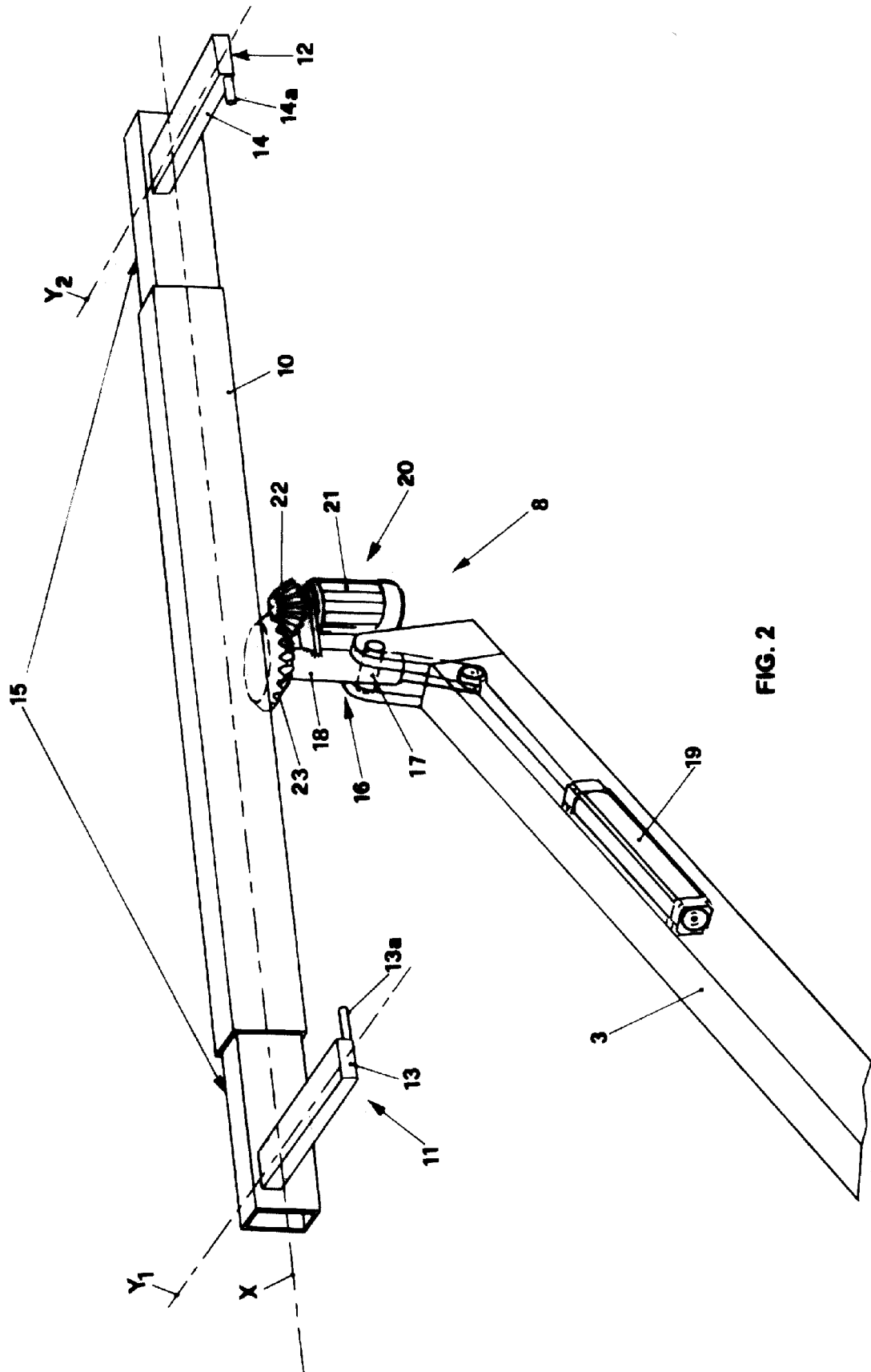
that it comprises powered guide means (15) for moving each one of said projecting shelves (11, 12) along a direction parallel to said longitudinal axis (X) of said beam (10).

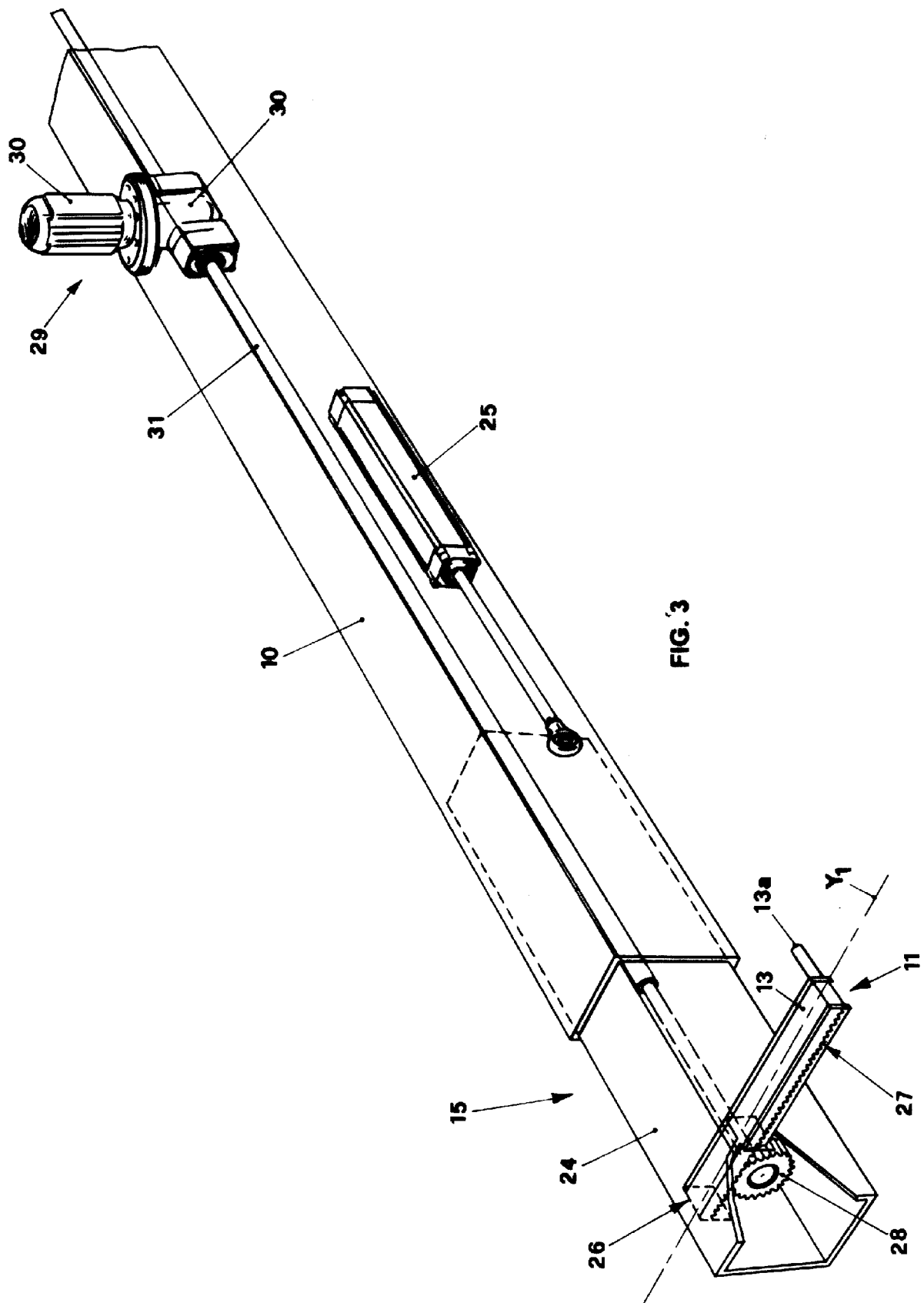
7. Lift truck (1) according to claim 4), **characterized in that** said second articulation means (8) comprise a joint (16) provided with a first pin (17) coupled with said telescopic arm (3), which supports a second pin (18) coupled with said beam (10) at an intermediate point according to a direction orthogonal to said longitudinal axis (X) of said beam (10), said first pin (17) and said second pin (18) defining axes that are perpendicular to each other.
8. Lift truck (1) according to claim 7), **characterized in that** said first pin (17) defines a horizontal axis.
9. Lift truck (1) according to claim 7), **characterized in that** it comprises actuator means (19) for rotating said joint (16) around said first pin (17) and driving means (20) for rotating said beam (10) around said second pin (18).
10. Lift truck (1) according to claim 3) and 9), **characterized in that** said actuator means (5a) for rotating said telescopic arm (3) and said actuator means (19) of said joint (16) are operatively connected and co-operating to maintain said beam (10) in horizontal position.
11. Lift truck (1) according to claim 6), **characterized in that** said powered guide means (15) comprise an element (24) that slides along a direction parallel to said longitudinal axis (X) of said beam (10), arranged at each end of said beam (10) and associated with actuator means (25) for the movement.
12. Lift truck (1) according to claim 11), **characterized in that** said actuator means (25) for moving said sliding elements (24) are operatively connected to carry out mutually opposing movements of said sliding elements (24).
13. Lift truck (1) according to claim 11), **characterized in that** said sliding element (24) is provided with a recess (26) which slidably houses said projecting shelf (11, 12) along a direction parallel to said longitudinal axis (Y1, Y2) of said projecting shelf (11, 12).
14. Lift truck (1) according to claim 13), **characterized in that** said projecting shelf (11, 12) is provided with a rack (27) that develops along the direction of said longitudinal axis (Y1, Y2) of said projecting shelf (11, 12), meshing with a gear wheel (28) rotatably coupled with driving means (29).
15. Lift truck (1) according to claim 14), **characterized**

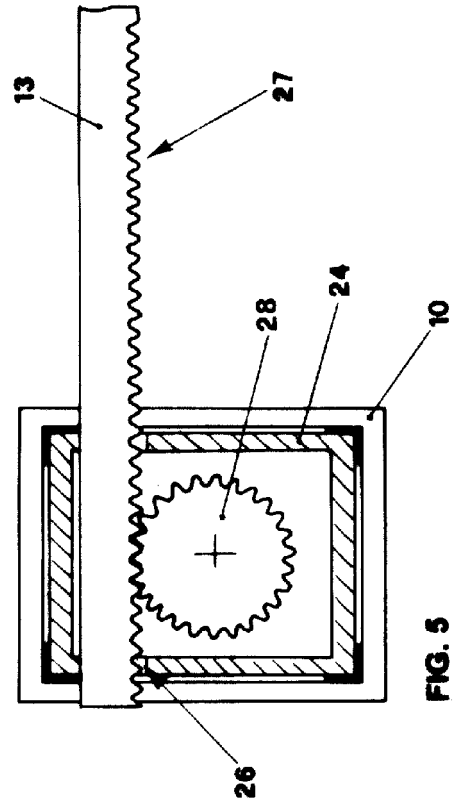
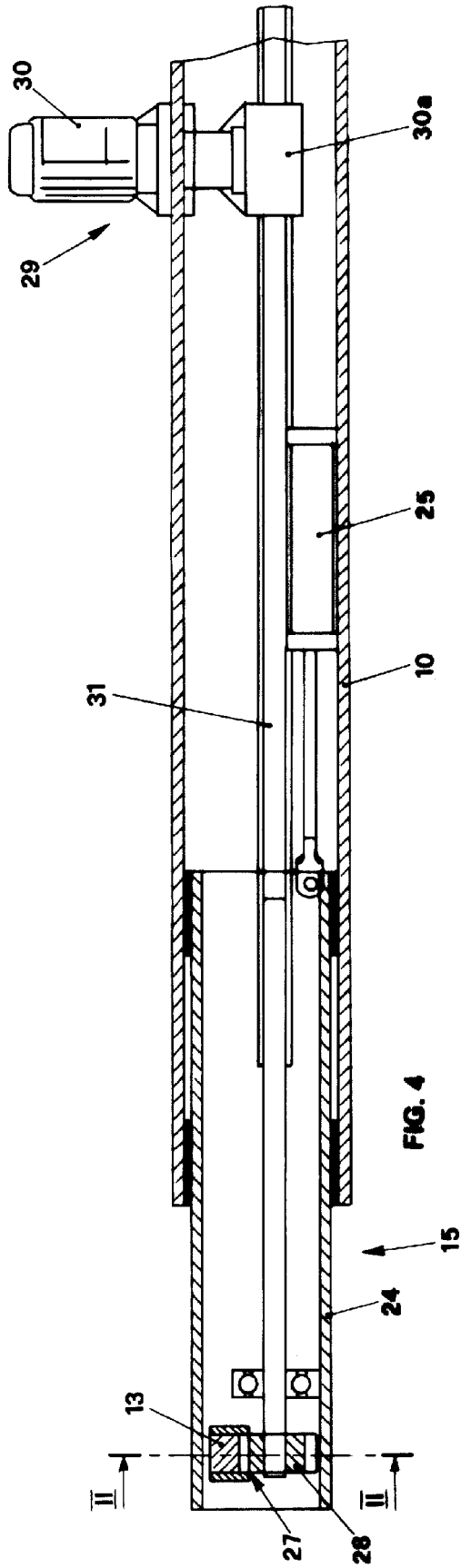
in that said driving means (29) coupled with said gear wheel (28) comprise at least one motor (30) equipped with a transmission shaft (31).

- 5 16. Lift truck (1) according to claim 15), **characterized in that** said transmission shaft (31) is a telescopic shaft with grooved profile, having one end operatively connected with said motor (30) via transmission means (30a) and the opposite end coupled with said gear wheel (28).
- 10 17. Lift truck (1) according to claim 15), **characterized in that** said transmission shafts (31) are operatively connected to each other to carry out equal rotations of all said gear wheels (28).
- 15 18. Lift truck (1) according to claim 9), **characterized in that** said driving means (20) of said joint (16) comprise a motor (21) fixed to said joint (16) and a pinion (22) connected to the shaft of said motor (21), meshing with a gear (23) fixed to said beam (10).
- 20 19. Lift truck (1) according to any of the claims 2) or 3) or 9) or 11), **characterized in that** said actuator means (4, 5a, 19, 25) are hydraulic or pneumatic jacks.
- 25 20. Lift truck (1) according to any of the claims 15) or 18), **characterized in that** said motors (21, 30) are hydraulic or pneumatic motors.
- 30 21. Lift truck (1) according to any of the preceding claims, **characterized in that** it comprises a driving cab (32) provided with means for controlling said power means, said actuator means (4, 5a, 19, 25) and said driving means (20, 29), wherein said control means can be manoeuvred by an operator.
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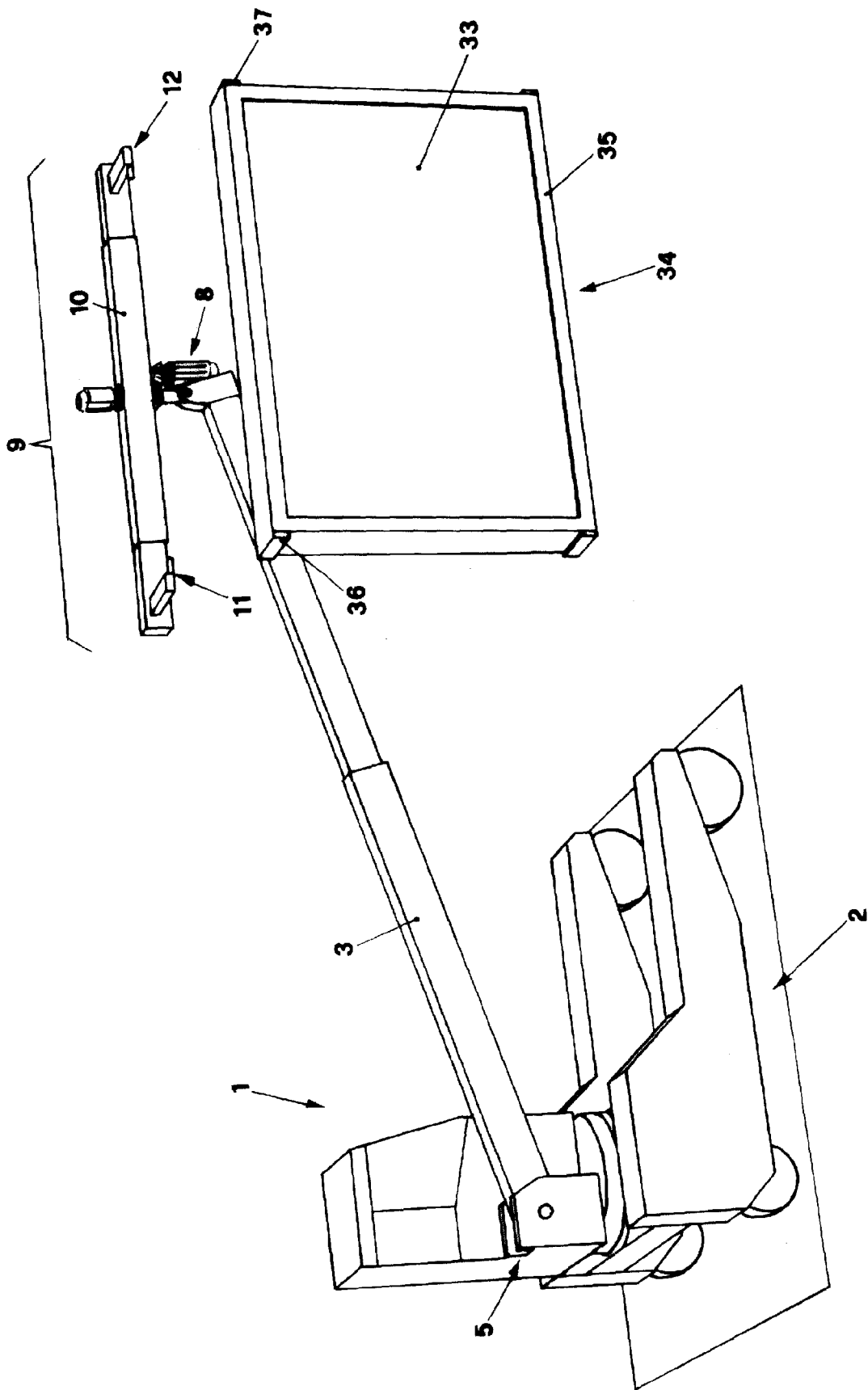


FIG. 6

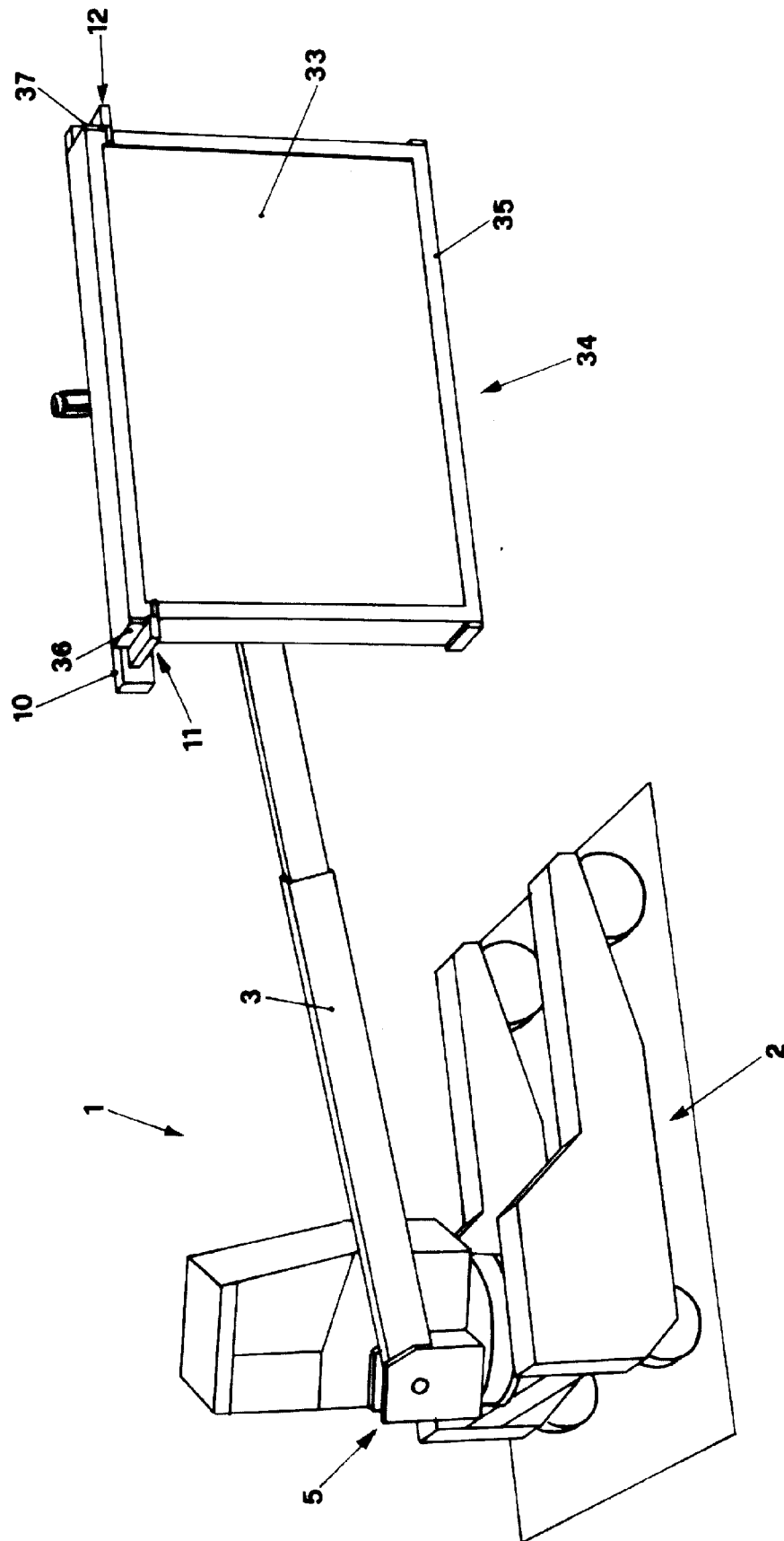


FIG. 7