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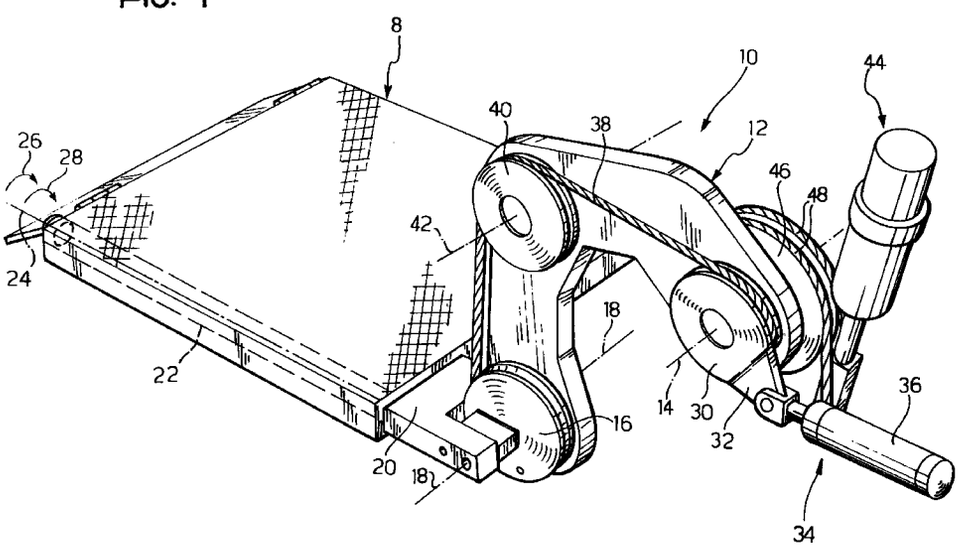
## (54) A lifting device which can be fitted in railway and tramway vehicles, particularly for enabling disabled people to board and alight

(57) The device comprises an arm (12) which is pivotable relative to the vehicle about a first axis (14) and carries a platform (8) in a manner such that it can pivot about a second axis (18). An actuator (44) imparts to the arm (12) an angular movement which brings the platform (8) from a lowered position to a raised position. Transmission means (30, 38, 16) enable the platform (8) to remain constantly parallel to its starting position during the pivoting movement of the arm (12).

FIG. 1

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## Description

The present invention relates to a lifting device which can be fitted in railway and tramway vehicles, particularly for enabling disabled people to board and alight.

A lifting device with a vertical guide upright along which a horizontal platform is movable vertically between a lowered position substantially level with the railway platform or pavement and a raised position substantially level with a floor of the vehicle has already been proposed.

The fitting of a lifting device in existing railway or tramway vehicles involves a series of problems connected with the need to retract the lifting device fully into the vehicle and with the problem of permitting access to the vehicle in conventional manner, without using the lift.

In most cases, the fitting of a lifting device of known type in a vehicle which has not been specially designed to house the lifting device involves the need to carry out substantial modifications of the access opening of the vehicle.

The object of the present invention is to provide a simple and compact lifting device which does not require appreciable modification of the access opening of the vehicle.

According to the present invention, this object is achieved by a lifting device having the characteristics which form the subject of the claims.

Further characteristics and advantages of the present invention will become clear in the course of the detailed description which follows, given purely by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a schematic, perspective view of a lifting device according to the invention,

Figures 2-5 are schematic side views showing the operation of the device according to the invention, and

Figure 6 is a diagram showing the kinematic principle upon which the device according to the invention is based.

With reference initially to Figure 3, a railway vehicle, schematically indicated 1, is beside a railway platform 2. The vehicle 1 has a floor 4 which is above the platform 2 by a distance H.

With reference now to Figure 1, a lifting device according to the invention, generally indicated 6, comprises a platform 8 and an operating device 10 which can move the platform 8 parallel to its starting position between a lowered position substantially level with the railway platform 2 and a raised position substantially level with the floor 4.

The operating device 10 comprises a structure 12 which, in the embodiment shown in the drawings, takes the form of a right-angled arm. A first end of the arm 12 is articulated to the body of the vehicle 1 about a horizontal axis 14 and its second end carries a pulley 16 which can rotate freely relative to the arm 12 about a second axis 18 parallel to the first axis 14.

The platform 8 is connected to the pulley 16 so as to be fixed rigidly thereto for movements about the axis 18. This connection is effected by means of a plate 20 fixed to the pulley 16 and carrying a shaft 22 on which the platform 8 is articulated about an axis 24. The plate 20 has one or more abutments (not visible in the drawings) which prevent the platform 8 from pivoting under the effect of its own weight in the sense indicated by the arrow 26 in Figure 1. The platform 8 is free, however, to pivot about the axis 24 in the opposite sense, indicated by the arrow 28 in Figure 1.

On the first end of the arm 12 there is a pulley 30 which is rotatable about the axis 14 independently of the arm 12. A radial flange 32 is fixed to the pulley 30 and the end of a fluid actuator 34 is articulated thereto, the body 36 of the actuator being articulated to a support (not shown) which is fixed relative to the vehicle 1. A first end of a flexible and inextensible transmission element 38, constituted, for example, by a metal cable or a chain, is anchored on the pulley 30. The second end of the flexible element 38 is anchored on the pulley 16. The ends of the flexible element 38 are wound partially onto the pulleys 16 and 30 and a central portion of the flexible element 38 cooperates with a transmission pulley 40 rotatable on the arm 12 about an axis 42.

A pressurized-fluid actuator, indicated 44, is intended to pivot the arm 12 about the axis 14. The arm 12 and the actuator 44 are connected by means of a wheel 46 which is fixed rigidly to the arm 12 and on which a cable or chain 48, connected to the end of the rod of the actuator 44, is anchored.

The operating device 10 described above has the characteristic that it enables the platform 8 to move between the lowered position and the raised position in a direction such that it is constantly parallel to its starting position and this is achieved solely by means of the pivoting of the arm 12 about the axis 14. This is possible since the device described reproduces the kinematic behaviour of an articulated quadrilateral.

In fact, with reference to Figure 6, from a kinematic point of view, the arm 12 and its pulleys 16 and 30 and the flexible transmission member 38 are equivalent to an articulated quadrilateral 50 having a horizontal side 52 which is fixed relative to the vehicle, a side 54 which is fixed to the platform 8, and two further sides 56 and 58 which interconnect the corresponding ends of the sides 52, 54. In the diagram of Figure 6, the side 58 of the articulated quadrilateral 50 would correspond to a line joining the pivot axes 14, 18 of the operating device 10.

The diagram of Figure 6 enables it to be understood immediately that pivoting of the side 58 between a lowered position and a raised position corresponds to a vertical movement of the platform 8 and, during this movement, the platform 8 is kept constantly parallel to its starting position.

More generally, the concept upon which the present invention is based consists of the provision of transmission means which can impart to the platform 8 an angular movement relative to the arm 12 about the axis 18 the movement being equal in extent but in the opposite sense to the angular movement of the arm 12 relative to the axis 14.

This concept will become clearer with reference to Figure 6 and by observing that, initially, the side 58 is inclined at an angle $\alpha$ to a vertical axis, in the condition in which the platform 8 is level with the railway platform. The angle between the platform 8 and the side 58 is $90°+\alpha$. Starting from this condition, the side 58 is made to perform an angular movement of amplitude $\alpha 1$ about the axis 14 until the platform 8 is brought level with the floor of the vehicle. In this condition, the side 58 is inclined at an angle of $\alpha+\alpha 1$ to the vertical reference axis whilst the platform 8 is inclined at an angle of $90°+\alpha+\alpha l$ to the side 58. This demonstrates that, during the movement of the side 58, the platform 8 performs an angular movement relative to the arm of equal extent but in the opposite sense to the angular movement of the arm relative to the vehicle.

The sequence of operation of the embodiment of the device shorn in Figure 1 will now be described with reference to Figures 2-5.

In the operative position of Figure 2, the actuator 34 connected to the pulley 30 is in the rest position and the flange 32 fixed to the pulley 30 cooperates with a stop 60 carried by a support which is fixed to the vehicle and can prevent the pulley 30 from rotating in the sense indicated by the arrow 62 in Figure 2. The platform 8 is substantially level with the railway platform 2 and can receive a wheelchair 64.

Starting from this configuration, the actuator 44 is operated so as to bring about a pivoting of the arm 12 in the sense 66. The pivoting movement of the arm 12 ends when the actuator 44 reaches the end of its travel and, in this situation, the platform 8 is level with the floor 4 (Figure 3).

In order to retract the lifting device into the vehicle, starting from the configuration of Figure 3, the arm 12 is kept in the raised position and the actuator 34 is operated, rotating the pulley 30 in the sense 68. The flexible element 38 is tensioned and brings about rotation of the pulley 16 and pivoting of the platform 8 fixed thereto, retracting the platform 8 into the vehicle (see Figure 4). Upon completion of the lifting, the platform 8 extends parallel to the access opening of the vehicle and obstructs the way through the access opening. To place the device in the rest condition, it suffices to rotate the platform 8 through 90° about the axis 24 as indicated by the arrow 70 in Figure 4 so as to orient the platform 8 perpendicular to the access opening of the vehicle.

The device according to the invention also enables the platform 8 to be oriented in a chute configuration, as indicated in Figure 5, to allow disabled people to be evacuated from the vehicle 1 in the event of an emergency. Starting from the rest configuration of Figure 4, this can be achieved simply by pivoting the platform 8 so that it is parallel to the loading opening and then allowing the pulley 30 to rotate freely. The platform 8 is brought to the inclined position of Figure 5 under the effect of its own weight. The pulley 30 can be released in various ways and one of these consists of the removal of the stop 60 and the de-activation of the actuator 34. The pulley 30 is thus no longer restrained in any way and is free to rotate under the effect of the weight of the platform 8.

## Claims

1. A lifting device which can be fitted in railway or tramway vehicles, particularly for enabling disabled people to board and alight, comprising:

   - a platform (8) which is movable parallel to its starting position between a lowered position substantially level with a railway platform or pavement (2) and a raised position substantially level with a floor (4) of the vehicle (1), and
   - an operating device (10) for moving the platform (8) from the lowered position to the raised position and vice versa,

   characterized in that the operating device (10) comprises:

   - a structure (12) mounted for pivoting relative to the vehicle (1) about a first axis (14) and carrying the platform (8) in a manner such that it can pivot about a second axis (18),
   - drive means (44) for imparting to the structure (12) an angular movement about the first axis (14), and
   - transmission means (16, 30, 38) for imparting to the platform (8) an angular movement relative to the structure (12) about the second axis (18) the movement being of an extent substantially equal to the extent of the angular movement of the structure (12) relative to the first axis (14) but in the opposite sense to the sense in which the structure (12) pivots about the first axis (14).

2. A device according to Claim 1, characterized in that the transmission means (16, 30, 38) bring about the kinematic behaviour of an articulated quadrilateral mechanism (50) with one side (52) fixed rigidly to the vehicle and one side (54) fixed rigidly to the platform (8) for movements about the second axis (18).

3. A device according to Claim 1 or Claim 2, characterized in that the transmission means comprise a first pulley (30) which is rotatable relative to the structure (12) about the first axis (14), a second pulley (16) which is rotatable relative to the structure (12) about the second axis (18) and is fixed rigidly to the platform (8) for movements about its pivot axis (18), and a flexible and substantially inextensible transmission element (38) with ends anchored and wound at least partially on the first and second pulleys (30, 16).

4. A device according to Claim 3, characterized in that the aforesaid structure comprises a right-angled arm (12) carrying the first and second pulleys (30, 16) at its ends and also carrying a transmission pulley (40) cooperating with the flexible transmission element (38).

5. A device according to Claim 4, characterized in that the right-angled arm (12) is connected to a fluid actuator (44) for pivoting the arm (12) about the first axis (14) between two positions corresponding to the lowered position of the platform and the raised position of the platform, respectively.

6. A device according to Claim 5, characterized in that it comprises a second fluid actuator (34) which is connected to the first pulley (30) and, by means of the flexible transmission element (38), can bring about an angular movement of the platform (8) between a substantially horizontal, operative position and a substantially vertical, inoperative position.

7. A device according to any one of the preceding claims, characterized in that the first pulley (30) is rotatable both relative to the arm (12) and relative to the vehicle (1), and in that the first pulley (30) is associated with a releasable stop (60) which prevents the first pulley (30) from rotating relative to the vehicle during the movement of the platform (8) between the raised and lowered positions and vice versa, the stop being releasable to allow the platform (8) to be brought, under the effect of its own weight, to an inclined position for emergency evacuation.

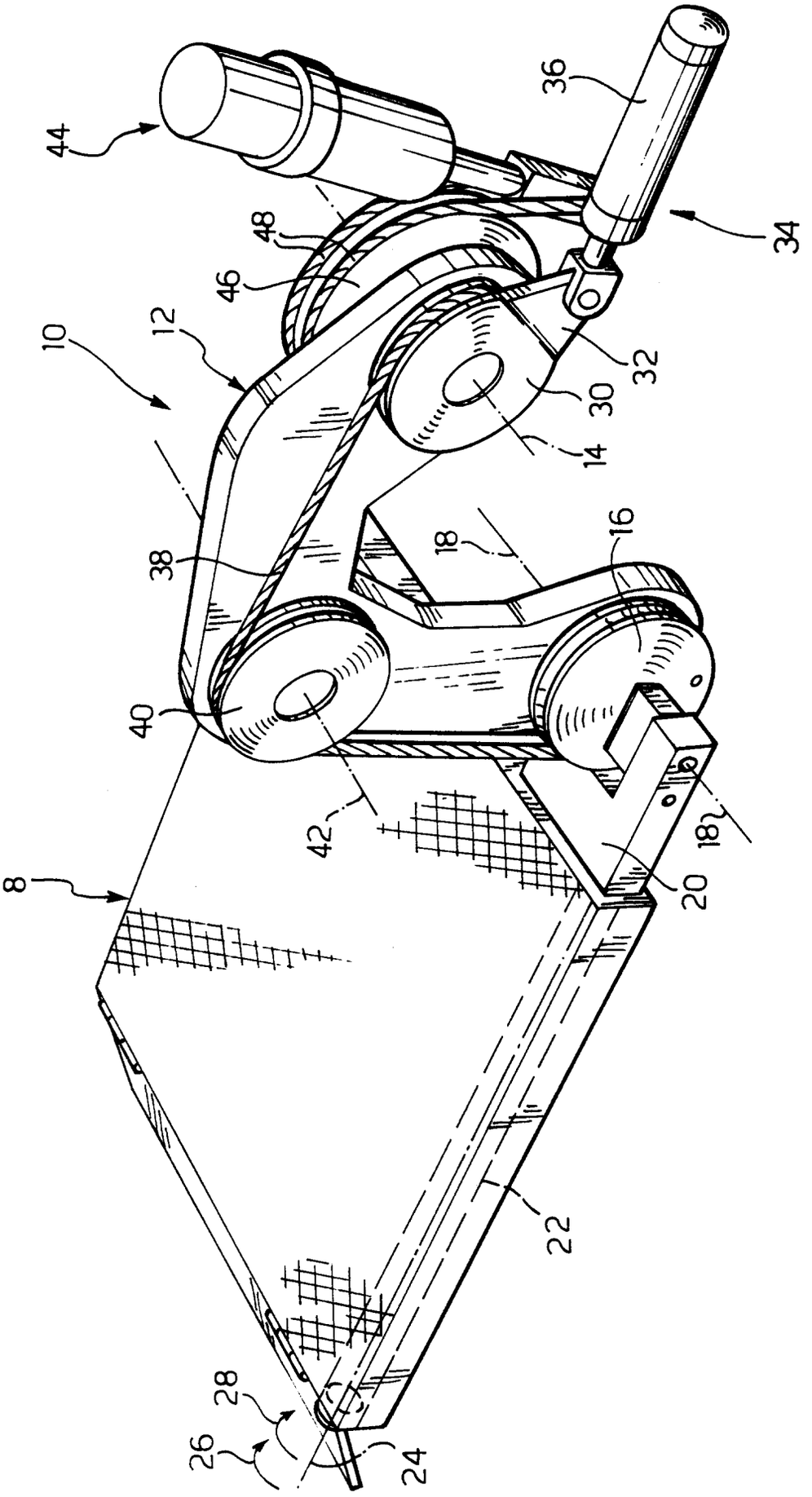
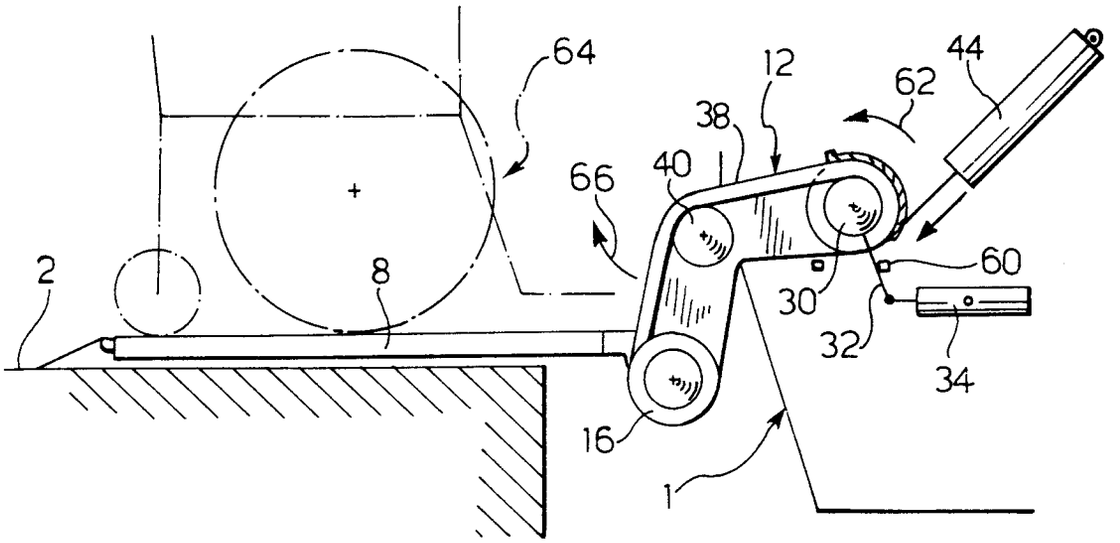



FIG. 1

FIG. 2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1

FIG. 3

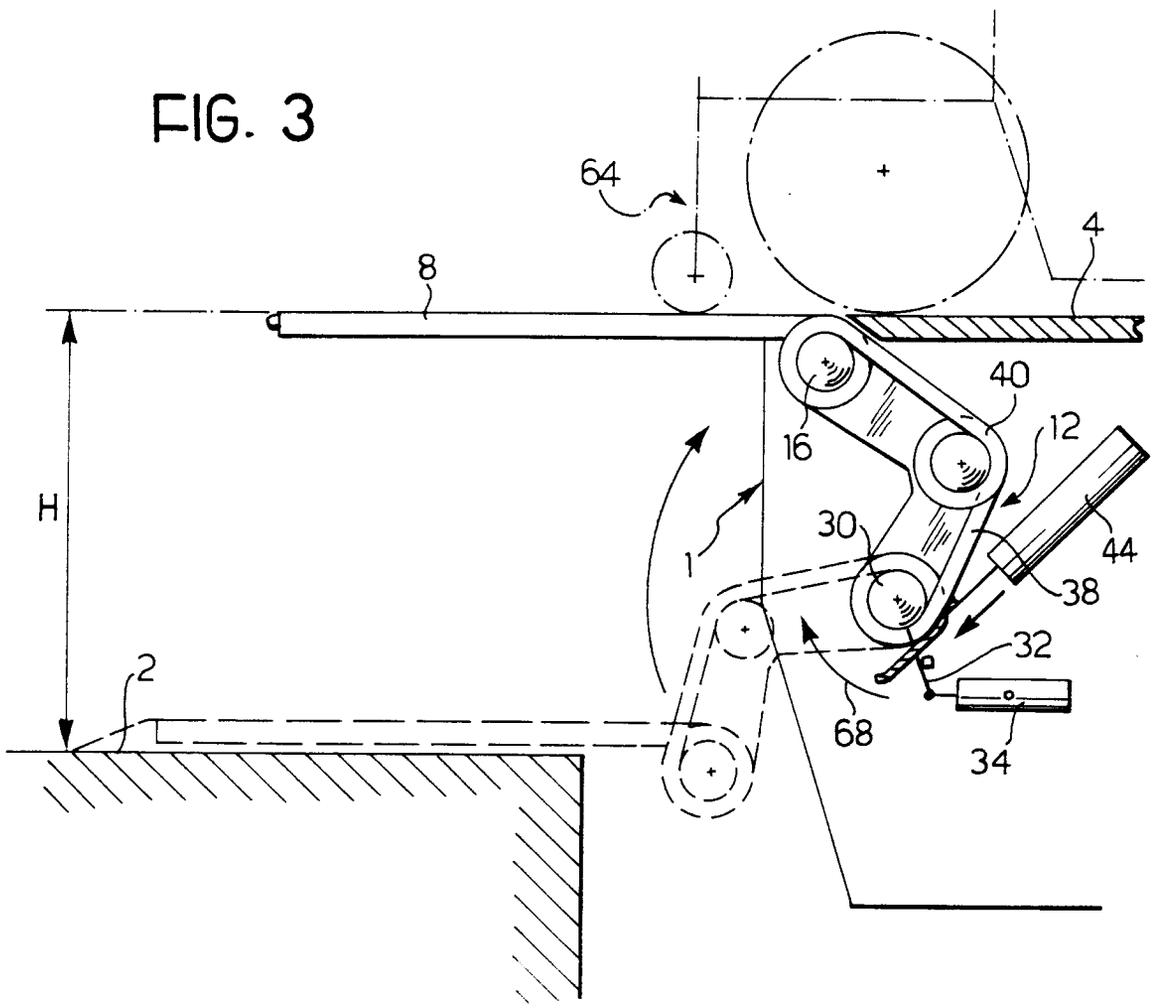
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FIG. 4

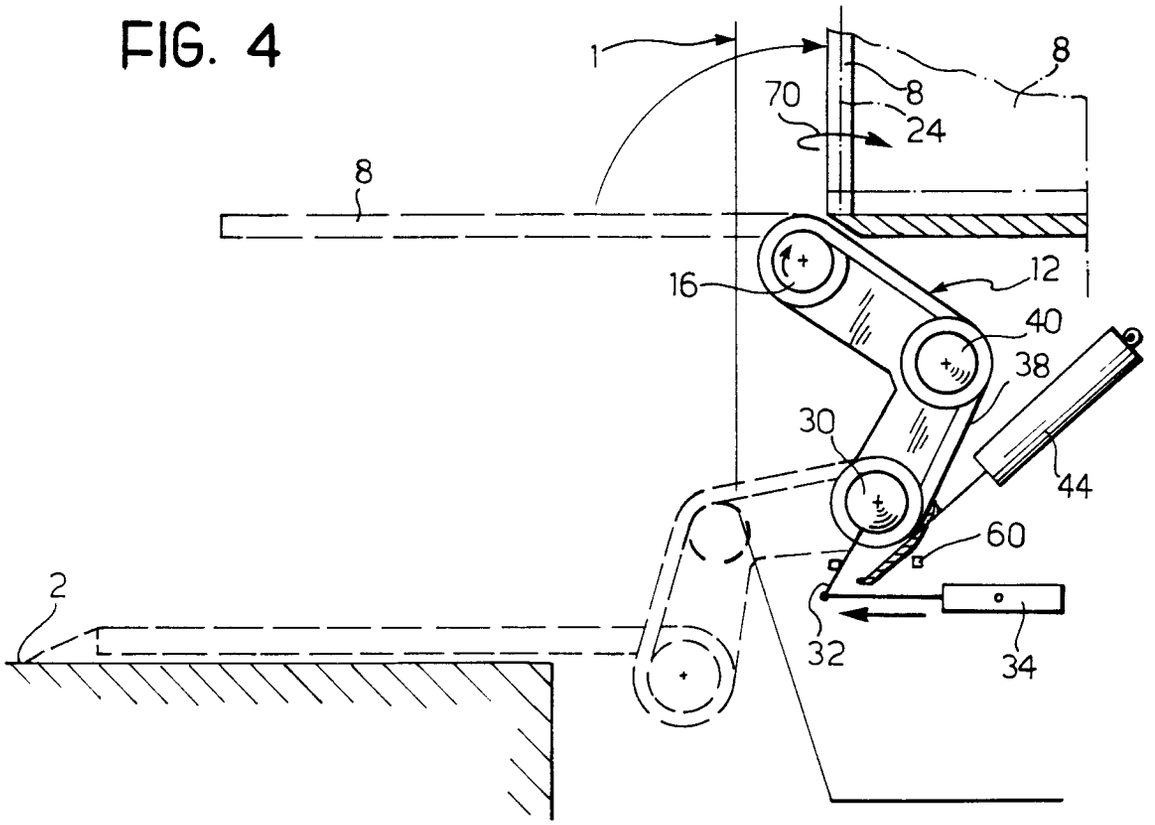
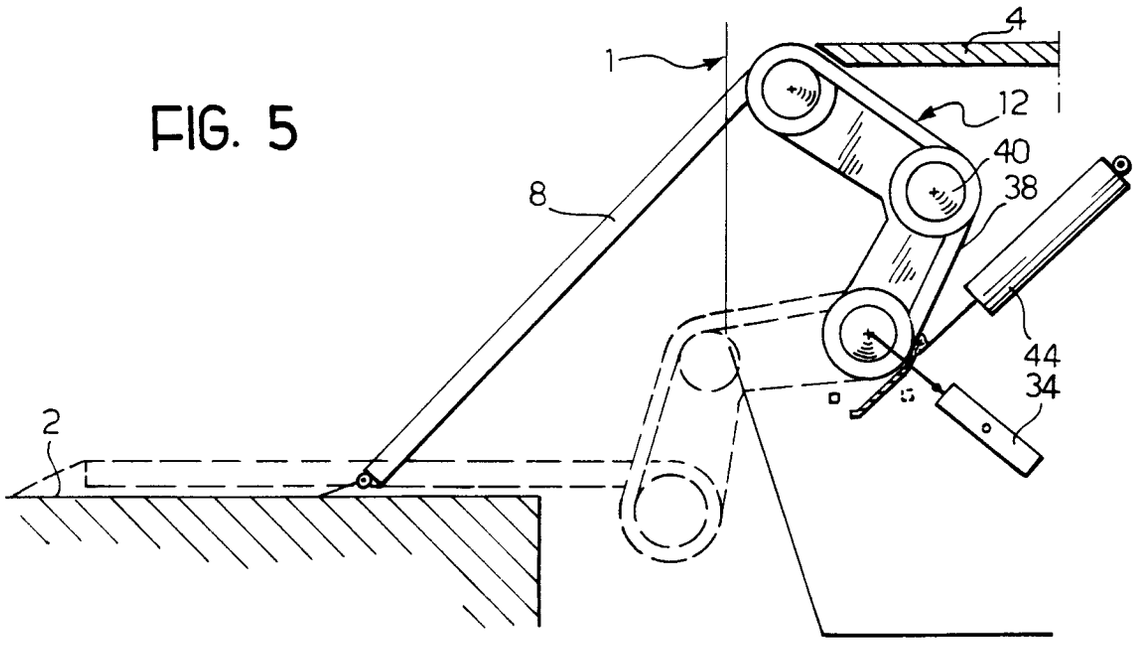



FIG. 5



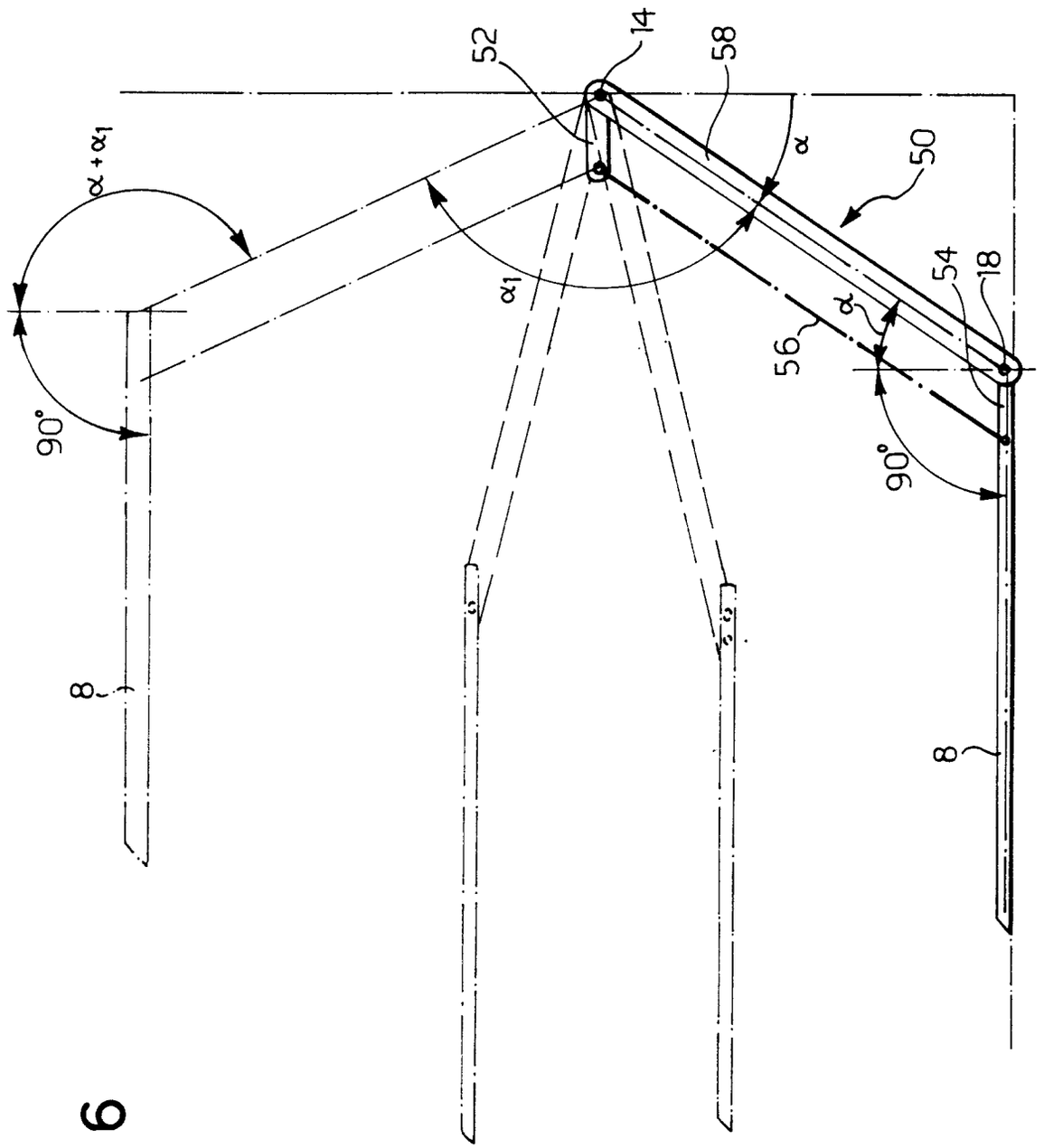



FIG. 6

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# EUROPEAN SEARCH REPORT

Application Number
EP 95 10 2632

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
|---|---|---|---|
| A | EP-A-0 069 611 (MANUTIS SARL) 12 January 1983<br>* page 2, line 13 - page 3, line 35; figures 1-5 *<br>--- | 1 | B61D47/00<br>A61G3/02 |
| A | EP-A-0 318 670 (MAN NUTZFAHRZEUGE GMBH) 7 June 1989<br>* the whole document *<br>----- | 1 | |

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B61D
A61G
B62D
B60P

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 10 October 1995 | Chlosta, P |

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