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(54) Forklift with reach mechanism.

(57) Forklift (1) comprising a frame (2), which supports a mast (4), a load bearer (5) with load gripping means such as forks (6) and drive means (7) gripping onto the load bearer (5) for moving the load bearer (5) up and downward along the mast (4), wherein the load bearer (5) comprises a reach mechanism construction (8) having a auxiliary mast (23) movably guided along the mast (4), a reach mechanism mast (22) supporting the load gripping means (6) and two pairs of mechanism levers, which each comprise two mechanism levers (9, 10) which are connected with their bottom end in a fixed point of rotation (11, 12) to respectively the auxiliary mast (23) or the reach mechanism mast (22) and with their top end (13, 14) to the other mast in a point of rotation slidable therealong, and which are connected to each other in a pivoting point (16) lying between the ends. The pivoting point (16) of each pair of mechanism levers (9, 10) is provided out of the centre between the points of rotation at the ends and that the constituent parts of the auxiliary mast (23), the reach mechanism mast (22) and the mechanism levers (9, 10) are positioned mutually adjacent in the direction transversely of the reach direction, such that in the retracted position the axes of the points of rotation of each pair of mechanism levers (9, 10) lie moved vertically in relation to each other and the parts of the auxiliary mast (23), the reach mechanism mast (22) and the mechanism levers (9, 10) fall substantially inside the main mast (4).

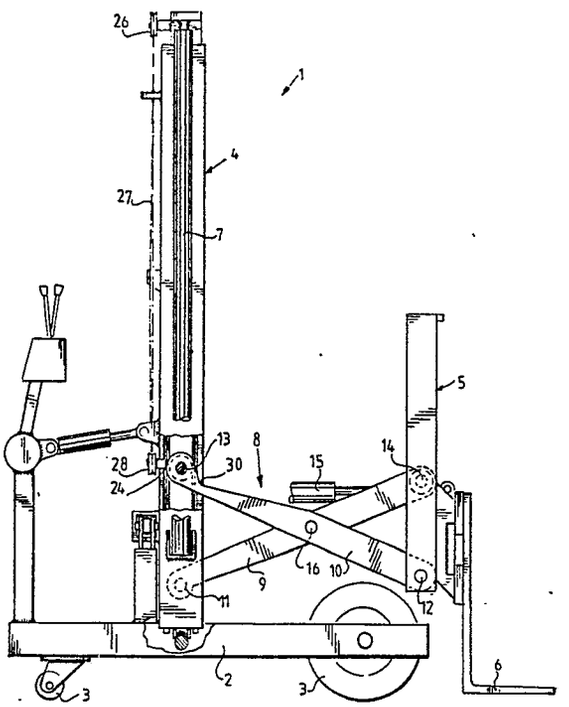

FIG. 1

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FORKLIFT WITH REACH MECHANISM

The invention relates to a forklift comprising a frame, which supports a mast, a load bearer with load gripping means such as forks and drive means gripping onto the load bearer for moving the load bearer up and downward along the mast, wherein the load bearer comprises a reach mechanism construction with an auxiliary mast movably guided along the mast, a reach mechanism mast supporting the load gripping means and two pairs of mechanism levers, which each comprise two mechanism levers which are connected with their bottom end in a fixed point of rotation to respectively the auxiliary mast or the reach mechanism mast and with their top end to the other mast in a point of rotation slidable therealong, and which are connected to each other at a pivoting point lying between the ends.

Such a forklift is per se known. The reach mechanism construction serves to be able to pick up or set down a load at a distance from the forklift, for instance when the truck cannot come close enough because of obstacles on the ground, or when work is being carried out with a rack in which pallets are disposed in two rows behind each other.

A drawback of the known reach mechanism construction is that the carrying capacity of a forklift provided with such a construction is strictly limited. In the extended position of the reach mechanism construction the load gripping means are situated at a distance from the main mast, which corresponds with the design reach distance plus the distance which the load gripping means already have in relation to the main mast in the retracted position of the reach mechanism construction, as a result of the space taken up thereby.

The invention has for its object to provide a forklift of the sort described in the preamble wherein the carrying capacity, taking into account the design reach distance, is as great as possible.

In a forklift according to the invention this is achieved because the pivoting point of each pair of mechanism levers is provided out of the centre between the points of rotation at the ends and that the constituent parts of the auxiliary mast, the reach mechanism mast and the mechanism levers are positioned mutually adjacent in the direction transversely of the reach direction, such that in the retracted position the axes of the points of rotation of each pair of mechanism levers lie vertically moved in relation to each other and the parts of the auxiliary mast, the reach mechanism and the mechanism levers fall substantially inside the main mast. The constituent parts of the reach mechanism construction, in the retracted position thereof, hereby lie at least virtually inside the main mast. The load gripping means are therefore situated at practically the same distance from the main mast as in a similar forklift without reach mechanism construction. In the extended position of the reach mechanism construction the load gripping means are thus not situated further from the main mast than the design reach distance.

An additional advantage of the forklift according to the invention is that in the retracted position of the reach mechanism construction a load on the load bearer is situated as closely as possible to the main mast, so that driving the forklift according to the invention with a load involves no greater danger of tipping over than is the case with a similar forklift without reach mechanism construction.

A further important advantage of the invention is that the reach mechanism construction in the retracted position thereof does not increase the total length of the forklift. This is particularly important for transportable forklifts, which are carried behind a truck. In accordance with traffic regulations such a transportable forklift qualifies as a load protruding behind the truck. Stringent limitations are applied to the distance over which a load may protrude.

With the invention it is now possible to provide a transportable forklift provided with a reach mechanism construction, the length whereof remains limited such that it can comply with these requirements.

An additional favourable development of the invention is achieved when at least some of the corresponding ends of the pairs of mechanism levers are also connected to each other for torsional stiffness by a connecting shaft. Because according to the invention the axes of the points of rotation of each pair of mechanism levers in the retracted position lie vertically moved in relation to each other, the connecting shafts also come to lie underneath each other in vertical direction. In this way it is thus possible to obtain a favourable torsion stiff construction.

A further improvement of the torsional stiffness is obtained when according to the invention the pivoting points of the pairs of mechanism levers are mutually connected for torsional stiffness by a connecting shaft.

A favourable embodiment of the forklift according to the invention is characterized in claim 4.

Further advantages and features of the forklift according to the invention are elucidated in the following description of an embodiment thereof, with reference to the annexed figures.

Fig. 1 shows a schematic side view of a

forklift according to the invention, with extended reach mechanism construction.

Fig. 2 shows a partially broken away perspective view of a portion of the forklift from fig. 1.

Fig. 3 shows a front view according to arrow III in fig. 2.

Fig. 4 shows a vertical section along line IV-IV in fig. 3.

The forklift 1 shown in the figures comprises a frame 2 which can drive over a ground surface by means of wheels 3 connected thereto. As shown the forklift 1 is of the transportable type, wherein the front wheels 3 normally lie at a distance in front of the mast construction 4, so that the centre of gravity of a transported load lies within the support surface defined by the wheels. No counter weight is hereby necessary and the forklift can therefore take a light form.

Mounted on the mast construction 4 is a load bearer 5 which is provided with load gripping means such as forks 6. Drive means, here in the form of piston cylinder devices 7, grip onto the load bearer to move the load bearer 5 up and downward along the mast 4.

The load bearer 5 comprises a reach mechanism construction here generally designated by 8, which makes it possible to displace the lifting forks 6 between a retracted position, wherein the lifting forks are situated close to the mast 4, and an extended position, as shown in fig. 1. The reach mechanism construction 8 is operated using a piston cylinder device 15.

In the forklift 1 the lifting forks 6 can be moved to a position in front of the front wheels 3, by extending the reach mechanism construction 8. When unloading a truck the lifting forks 6 can thus be inserted into a pallet on the carrying floor of the truck and this pallet can be picked up, even when the wheels 3 cannot travel beneath the truck because for instance a wheel of the truck is situated at that location.

As is shown in more detail in fig. 2 the reach mechanism construction 8 comprises an auxiliary mast 23 guided movably along the main mast 4, a reach mechanism mast 22 supporting the load gripping means 6 and two pairs of mechanism levers, each comprising two mechanism levers 9, 10. The mechanism levers 9 are connected with their bottom ends to the auxiliary mast 23 in a fixed point of rotation 11, while the mechanism levers 10 are connected with their bottom ends to the reach mechanism mast 22 in a fixed point of rotation 12.

As can be seen from the figures the main mast 4, the auxiliary mast 23 and the reach mechanism mast 22 are each assembled from two pillars placed at a mutual distance.

The top ends of the levers 9 and 10 are connected respectively to the reach mechanism mast 22 and the auxiliary mast 23 by means of a point of rotation slidable along the relevant mast.

The main mast 4 comprises an outer mast 25 connected to the frame and an inner mast 24 slidable therein. The auxiliary mast 23 is again mounted slidably in the inner mast 24 by means of rollers 31, 32. The piston cylinder devices 7 are connected with a bottom end to the outer mast 25 and with their top end to a beam connecting the inner masts 24. On either side at the top and bottom the inner mast 24 supports the respective pulleys 26 and 28. A cable 27 is tensioned around each pair of associated pulleys 26 and 28. The outer portion of the cable 27 is fixedly connected in each case to the outer mast 25, close to the top end thereof. The inner portion of the cable 27 is connected in each case to the auxiliary mast 23, close to the top end thereof.

As a result of extending the piston cylinders 7 the inner mast 24 is thus moved upward in relation to the outer mast 25. Simultaneously however the auxiliary mast 23 is moved upward at double the speed. The vertical displacement of the auxiliary mast 23 and thus of the load bearer 5 connected thereto therefore amounts to twice the stroke of the piston cylinders 7.

As is shown the top ends of the pairs of mechanism levers 9 and 10 are in each case connected to each other in torsion stiff manner by the respective connecting shafts 19 and 18. The ends of these shafts carry rollers slidable in the respective reach mechanism mast 22 and auxiliary mast 23. The bottom ends of the mechanism levers 9 are likewise connected to each other in torsion stiff manner by means of a connecting shaft 18. The ends of this connecting shaft are mounted rotatably in the auxiliary mast 23 and in the line thereof rollers 31 are arranged, by means of which the auxiliary mast 23 can be moved in the inner mast 24. Arranged at the top end of the auxiliary mast 23 are corresponding rollers 32. The mechanism levers 9 and 10 are rotatably connected to each other in a pivoting point 16. The levers 9 are mutually connected in the pivoting point 16 in torsion stiff manner by the connecting shaft 20, while the levers 10 are rotatably mounted on the extension of this shaft 20.

As can be seen most clearly in fig. 1 the pivoting point 16 of each mechanism lever 9, 10 is provided out of the centre between the points of rotation at the ends. In particular, the distance between the point of rotation 12 and the pivoting point 16 is smaller than the distance between the point of rotation 13 and the pivoting point 16 of the lever 10. In similar manner the distance between the point of rotation 14 and the pivoting point 16 is smaller than the distance between the point of rotation 11 and the pivoting point 16 of the levers

9. In the embodiment shown the stated distances of the respective levers 9 and 10 are in each case equal on the same side of the pivoting point 16. For good operation, that is, a guiding such that the reach mechanism mast 22 remains in each case parallel to the auxiliary mast 23, it is sufficient that only the ratio of these distances is equal in each lever.

As a result of the location of the pivoting point 16 out of the centre between the respective points of rotation of each lever it is achieved in favourable manner that in the retracted position of the mechanism construction the points of rotation lie vertically above each other. This is clearly apparent from fig. 4. The connecting shaft 18 lies in the retracted position above the connecting shaft 19 while the connecting shaft 17 lies beneath the points of rotation 12. Because in addition, as shown in fig. 3, the mechanism levers 9 lie inside the mechanism levers 10 it is possible to fold in the mechanism levers almost entirely. As is shown in the figures the levers 10 are provided close to the connecting shaft 18 with a notch 30, in which, in the retracted position, the connecting shaft 19 can be arranged.

In addition the respective pillars of the reach mechanism mast 22 are disposed at a distance such that in the folded in state the outer mechanism levers 10 again fall inside them. The pillars of the auxiliary mast 23 are again placed at a distance such that the pillars of the reach mechanism mast 20 again fall between them. The whole reach mechanism construction therefore falls in the retracted position at least virtually within the space defined by the outer mast 25 of the main mast 4.

As is further shown in the figures the mast construction according to the invention can be used in combination with a so-called "side shift". As shown schematically this comprises a transverse guide bar 36 arranged in the frame and on which the mast construction rests using wheels 33. These wheels 33 are mounted in a beam fixedly connected to the outer mast 25. This construction is per se known and will not be further described in detail.

Although the invention is described with reference to an application thereof in a so-called transportable forklift, where this has particular advantages as earlier described, the invention is also applicable with equal advantage to other forklifts. In the retracted transporting state a load can be carried in each case closely against the mast, so that a stable positioning of the forklift is achieved. As a result of the very torsion stiff embodiment of the mechanism construction according to the further development of the invention, this is in practice easy and safe to use.

Claims

1. Forklift comprising a frame, which supports a mast, a load bearer with load gripping means such as forks and drive means gripping onto the load bearer for moving the load bearer up and downward along the mast, wherein the load bearer comprises a reach mechanism construction having a auxiliary mast movably guided along the mast, a reach mechanism mast supporting the load gripping means and two pairs of mechanism levers, which each comprise two mechanism levers which are connected with their bottom end in a fixed point of rotation to respectively the auxiliary mast or the reach mechanism mast and with their top end to the other mast in a point of rotation slidable therealong, and which are connected to each other in a pivoting point lying between the ends, **characterized in that** the pivoting point of each pair of mechanism levers is provided out of the centre between the points of rotation at the ends and that the constituent parts of the auxiliary mast, the reach mechanism mast and the mechanism levers are positioned mutually adjacent in the direction transversely of the reach direction, such that in the retracted position the axes of the points of rotation of each pair of mechanism levers lie moved vertically in relation to each other and the parts of the auxiliary mast, the reach mechanism and the mechanism levers fall substantially inside the main mast.

2. Forklift as claimed in claim 1, **characterized in that** at least some of the corresponding ends of the pairs of mechanism levers are in each case mutually connected in torsion stiff manner by a connecting shaft.

3. Forklift as claimed in claim 1 or 2, **characterized in that** the pivoting points of the pairs of mechanism levers are mutually connected in torsion stiff manner by a connecting shaft.

4 Forklift as claimed in any of the foregoing claims, **characterized in that** the main mast, the auxiliary mast and the reach mechanism mast each comprise two pillars placed at a mutual distance, whereby the mechanism levers fall inside the reach mechanism mast, the reach mechanism mast falls inside the auxiliary mast and the auxiliary mast falls inside the main mast.

5. Forklift as claimed in any of the foregoing claims, **characterized in that** the forklift is a transportable forklift to be carried along behind a truck.

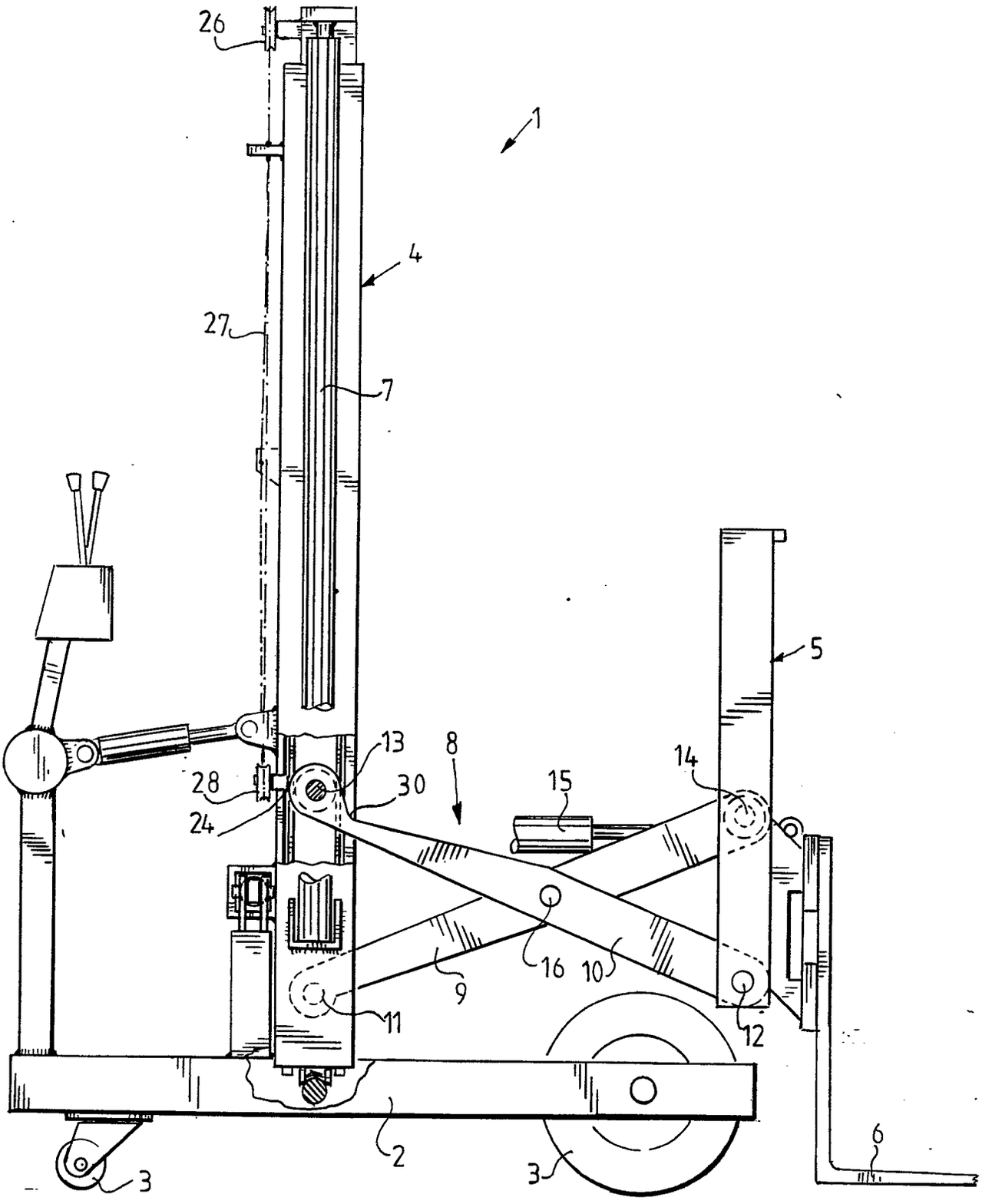

FIG. 1

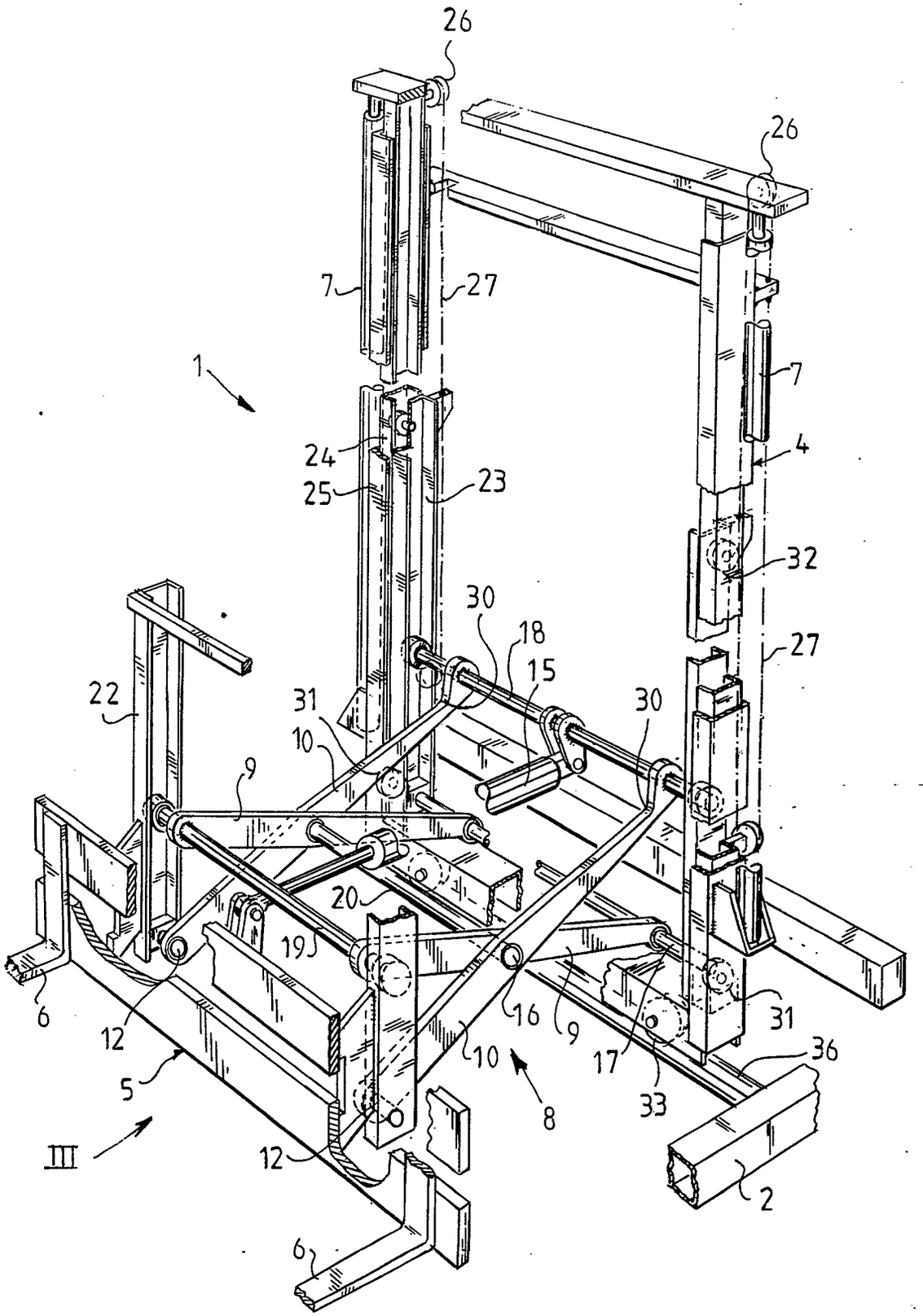
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FIG. 2

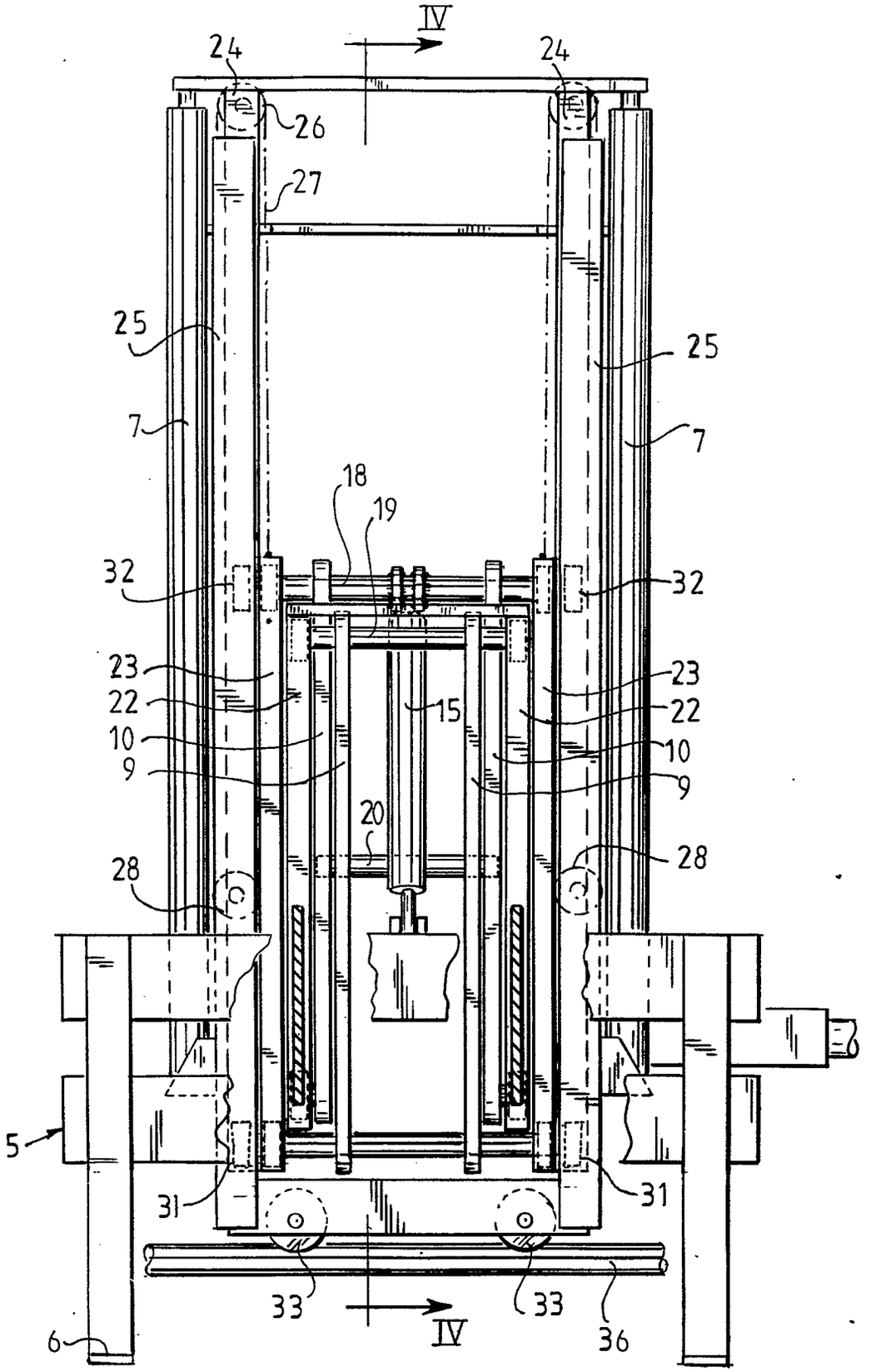
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FIG. 3

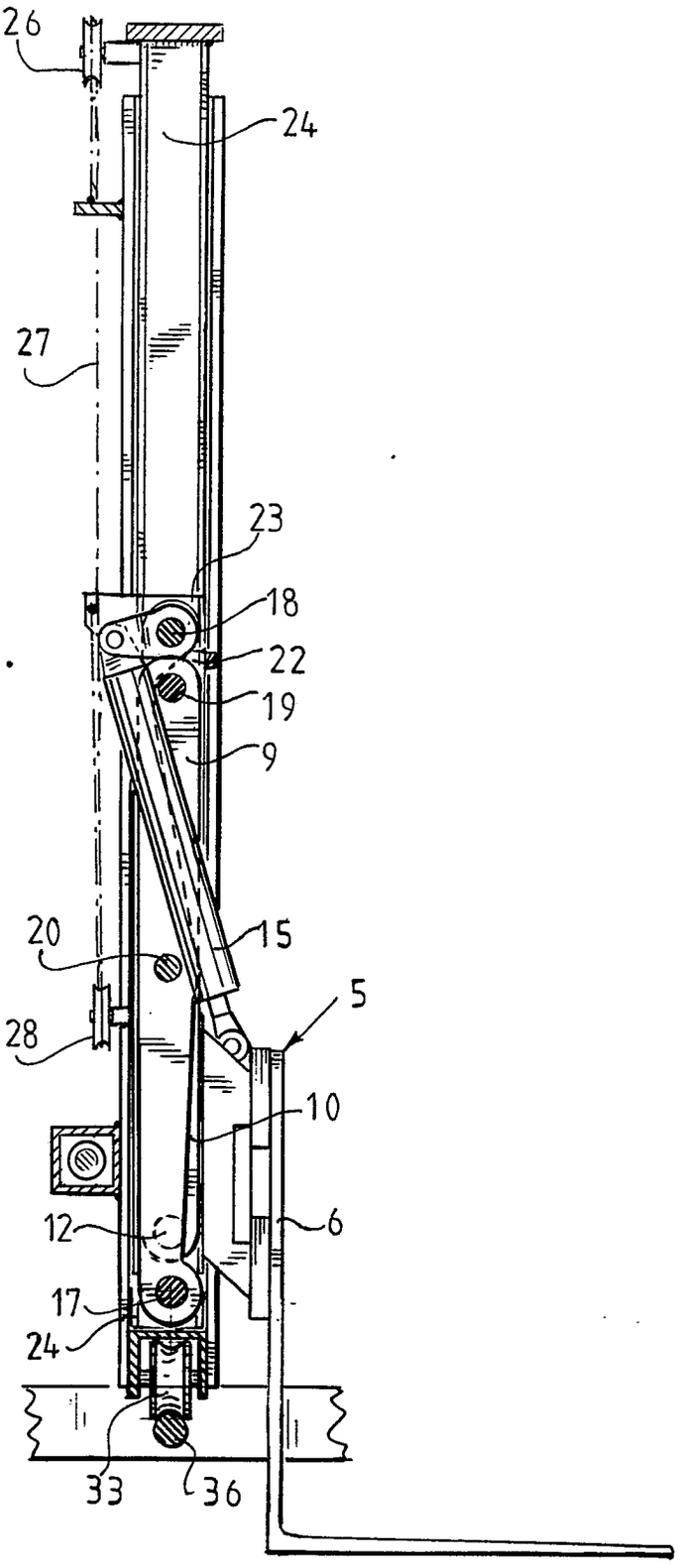

FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 20 2766

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.5)
X	US-A-2 752 058 (C.D. GIBSON) * Column 6, lines 60-75; column 7, lines 1-5; figures 1-4 *	1,2	B 66 F 9/12
Y		3,4	
Y	DE-B-1 134 029 (STEINBOCK) * Whole document *	3	
Y	US-A-3 082 894 (C.D. GIBSON) * Column 1, lines 9-72; column 2, lines 1-5; figures 1-2C *	4	
X	US-A-3 757 977 (BRUDI et al.) * Column 3 , lines 10-46; figures 1,2 *	1,2	
X	FR-A-1 509 609 (BALKANCAR) * Whole document *	1	
A	US-A-3 048 293 (W.W. CUSHMAN)		
A	US-A-3 219 210 (J. LOEF)		TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	GB-A-1 030 788 (A.J. VAN HUET)		B 66 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05-02-1990	VAN DEN BERGHE E.J.J.

CATEGORY OF CITED DOCUMENTS

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