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Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
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(54) Title: STRADDLE CARRIER

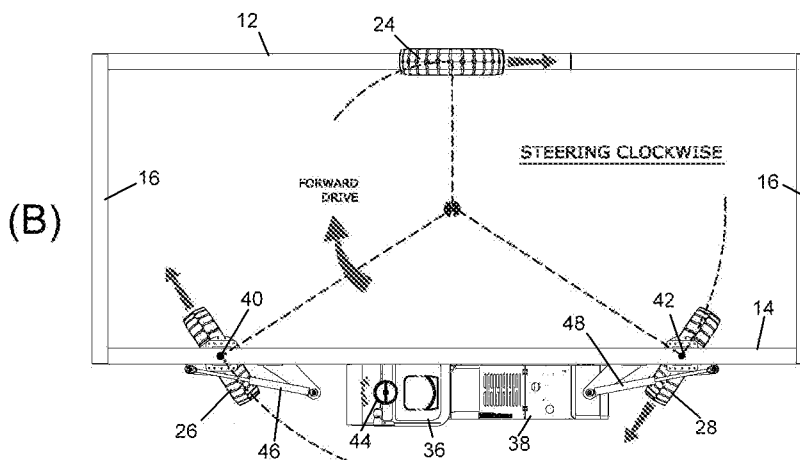


FIG. 2

(57) Abstract: A straddle carrier comprises a frame (10) having opposite substantially parallel sides (12, 14) and which is configured for straddling a container to be lifted and transported between said opposite sides. The carrier has three ground wheels (24, 26) and (28) to enable the frame to be positioned over the container. The ground wheels comprise a first ground wheel (24) disposed at least approximately centrally on one side (12) of the frame, and second and third ground wheels (26, 28) disposed at opposite ends of the other side (14) of the frame. The second and third wheels (26, 28) are steerable by rotation about respective substantially vertical axes (40, 42).



STRADDLE CARRIER

Technical Field

This invention relates to straddle carriers.

5

Background Art

A straddle carrier is a vehicle for use in e.g. port terminals and intermodal yards used for stacking and moving intermodal containers. Straddle carriers pick up and carry
10 containers while straddling their load and, depending upon capacity, they have the ability to stack containers up to four high. They are capable of relatively low speeds (typically up to 30 km/h) with a laden container, and are generally not road-going.

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Conventionally, straddle carriers are equipped with four ground wheels. When the carrier is not used on a level surface, a suspension system is required to ensure the four wheels stay in contact with the ground at all times.

20 However, due to cost, the majority of straddle carriers have no suspension system. Without a suspension system a wheel may lose contact with the ground, therefore losing traction and braking and reducing stability.

25 Disclosure of the Invention

According to the present invention there is provided a straddle carrier comprising a frame having opposite substantially parallel sides and which is configured for straddling a container to be lifted and transported between
30 said opposite sides, a plurality of ground wheels to enable

the frame to be positioned over the container, and means for lifting the container within the frame, wherein the ground wheels comprise a first ground wheel disposed at least approximately centrally on one side of the frame, and second
5 and third ground wheels disposed at or adjacent opposite ends of the other side of the frame, the second and third wheels being steerable by rotation about respective substantially vertical axes.

- 10 In a preferred embodiment the first wheel is non-steerable with its rotational axis extending across the width of the frame.

Preferably the second and third wheels are synchronized for
15 steering by substantially equiangular amounts in opposite directions of rotation about their vertical axes.

Brief Description of the Drawings

An embodiment of the invention will now be described, by way
20 of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a straddle carrier according to the embodiment of the invention.

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Figs. 2(A) to (C) are schematic top views of the carrier of Figure 1 showing steering in various directions.

Figures 3(A) and (B) are side views showing the carrier
30 lifting loads of different lengths.

Figure 4 is a schematic end view of the carrier of Figure 1.

Detailed Description of Preferred Embodiments

- 5 Referring to the drawings, the straddle carrier comprises a steel frame 10 which, in end view, Figure 4, is generally in the form of an inverted "U". The frame 10 has opposite substantially parallel sides 12, 14 joined at the top by cross members 16, an open base 18 and opposite open ends 20.
- 10 This structure forms a kind of tunnel which allows the frame to straddle a container 22 to be lifted and transported. In Figure 1 (dashed lines) and in Figure 4 the container 22 is shown on the ground, while in Figure 1 (solid lines) and in Figure 3 the container 22 is shown lifted within the frame.
- 15 The frame 10 is mounted on three ground-wheels 24, 26 and 28 to allow the frame to be driven over the container 22 while the latter is resting on the ground, as shown in Figure 4. The construction and operation of the wheels 24-28 will be described in more detail below.
- 20 The container 22 is attached to the frame by four flexible steel members 30, e.g. chains or cables. In use, one end of each member 30 is attached to a respective bottom corner of the container 22 and the member 30 passes over a respective
- 25 pulley 32 at the top of the frame 10 where its other end is attached to one end of a respective hydraulic cylinder 34. By retracting the cylinders 34 the container 22 can be lifted off the ground for transport, Figures 1 and 3, and by extending the cylinders the container can be lowered to the

ground once again, Figures 1 and 4 (the members 30 are not shown in Figure 4).

Since the flexible members 30 can be swung over an angle shown in dashed lines in Figure 3(A), they can be connected to different lengths of container 22, as shown in Figures 3(A) and 3(b), so that the carrier is capable of lifting and transporting loads of different lengths. The straddle carrier is also capable of lifting the container on and off haulage vehicles, or stacking them two or more high provided the internal clearance height of the frame 10 is sufficient to raise the container to the required height. For transportation, the container 22 can be lifted right to the top of the frame 10 where it is held tight against the underside of the cross members 16. This secures and stabilises the container.

The straddle carrier is operated by an operator seated in a cabin 36 mounted on the outside of the frame 10, between the wheels 26, 28. Behind the cabin 36 is a hydraulic power unit 38 which, under operator control, supplies hydraulic power to the cylinders 34 via a hydraulic circuit, not shown. The operator in the cabin 36 is able to raise and lower the container 22 by contracting and extending the cylinders 34 in known manner. The container 22 can be lifted high enough for the operator to have good visibility underneath it - see Figure 3.

The straddle carrier's ground wheels comprise a single wheel 24 which is disposed below the side 12 at least approximately

centrally between the opposite open ends 20 of the frame 10,
and two wheels 26, 28 which are disposed below the side 14
respectively at or adjacent the opposite open ends of the
frame. The three wheels lie approximately on an equilateral
5 triangle whose apex is at the wheel 24 and whose base extends
between the wheels 26 and 28. The wheel 24 is fixed, i.e. it
is non-steerable, its rotational axis X (Figure 3) extending
across the width of the frame perpendicular to the sides 12,
14. However, each of the wheels 26, 28 is steerable by
10 rotation about respective substantially vertical axes 40 and
42.

The steering of the wheels 26, 28 is synchronized such that
under the control of an operator's steering wheel 44 in the
15 cabin 36 the wheels 26, 28 rotate about their vertical axes
40, 42 by substantially equiangular amounts in mutually
opposite directions of rotation. The rotation of the
steerable wheels 26, 28 about their vertical axes is effected
by hydraulic cylinders 46, 48 which are connected to the
20 hydraulic power unit 38 and controlled by the steering wheel
44. The direction and amount by which the steering wheel 44
is turned determines the direction in which the wheels 26, 28
are rotated about their vertical axes, and through what
angle.

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In addition to the hydraulic circuits necessary to operate
the lifting cylinders 34 and steering cylinders 46 and 48,
the carrier also includes a hydraulic circuit connected to
one or more hydraulic drive motors associated respectively
30 with one or more of the wheels 24-28 to allow the carrier to

be driven over the ground under operator control. The hydraulic motor(s) and drive circuitry is not shown, but the manner of its implementation will be readily known to the skilled man.

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Referring to Figure 2, when driving forward straight ahead, Figure 2(A), all three wheels are aligned parallel to the sides 12, 14. When driving forward and the operator turns the steering wheel 44 clockwise, the straddle carrier steers clockwise, Figure 2(B), the wheels 26, 28 turning in mutually opposite directions by equal angles. When driving forward and the operator turns the steering wheel 44 anti-clockwise, the straddle carrier steers anti-clockwise, Figure 2(C) the wheels 26, 28 again turning in mutually opposite directions by equal angles (although in this case the direction of rotation of each wheel is opposite that for clockwise steering). At the extreme limits of steering, which are the wheel positions shown in Figures 2(B) and 2(C), the carrier can turn within its own circle.

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In a modification of the above embodiment one or more of the wheels 24, 26 and 28 may comprises one of a pair of wheels disposed coaxially side-by-side, the pair of wheels being driven and/or steered as a single unit.

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In another modification the operator's cabin could be removed and the straddle carrier controlled remotely.

Although in the foregoing embodiment the ground wheels are driven by hydraulic motors (not shown) and steered by

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hydraulic cylinders 46 and 48, and the flexible steel lifting members 30 are operated by hydraulic cylinders 34, all powered from the hydraulic power unit 38, any or all of these mechanisms could alternatively be operated by electric motors
5 powered by heavy duty rechargeable batteries in the unit 38.

The three main advantages of the three-wheel straddle carrier described above are:

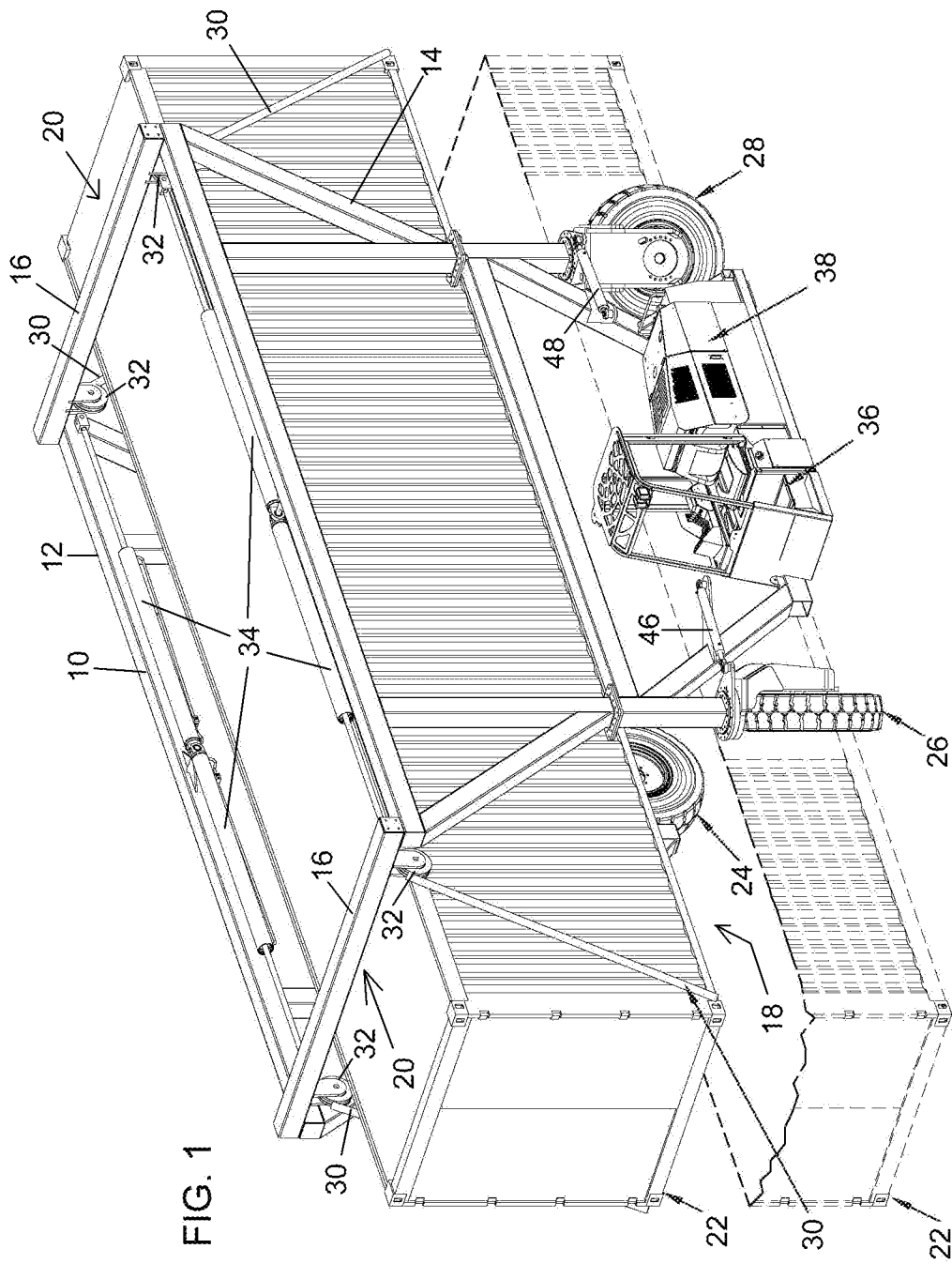
- 10 1. No suspension system is required. All three wheels will remain in contact with the ground irrespective of the terrain.
2. Traction and braking are maintained. All three wheels
15 will remain in contact with the ground irrespective of the terrain, therefore none of the wheels will lose traction or braking.
3. The carrier is more maneuverable. The straddle and its
20 load can turn within its own circle.

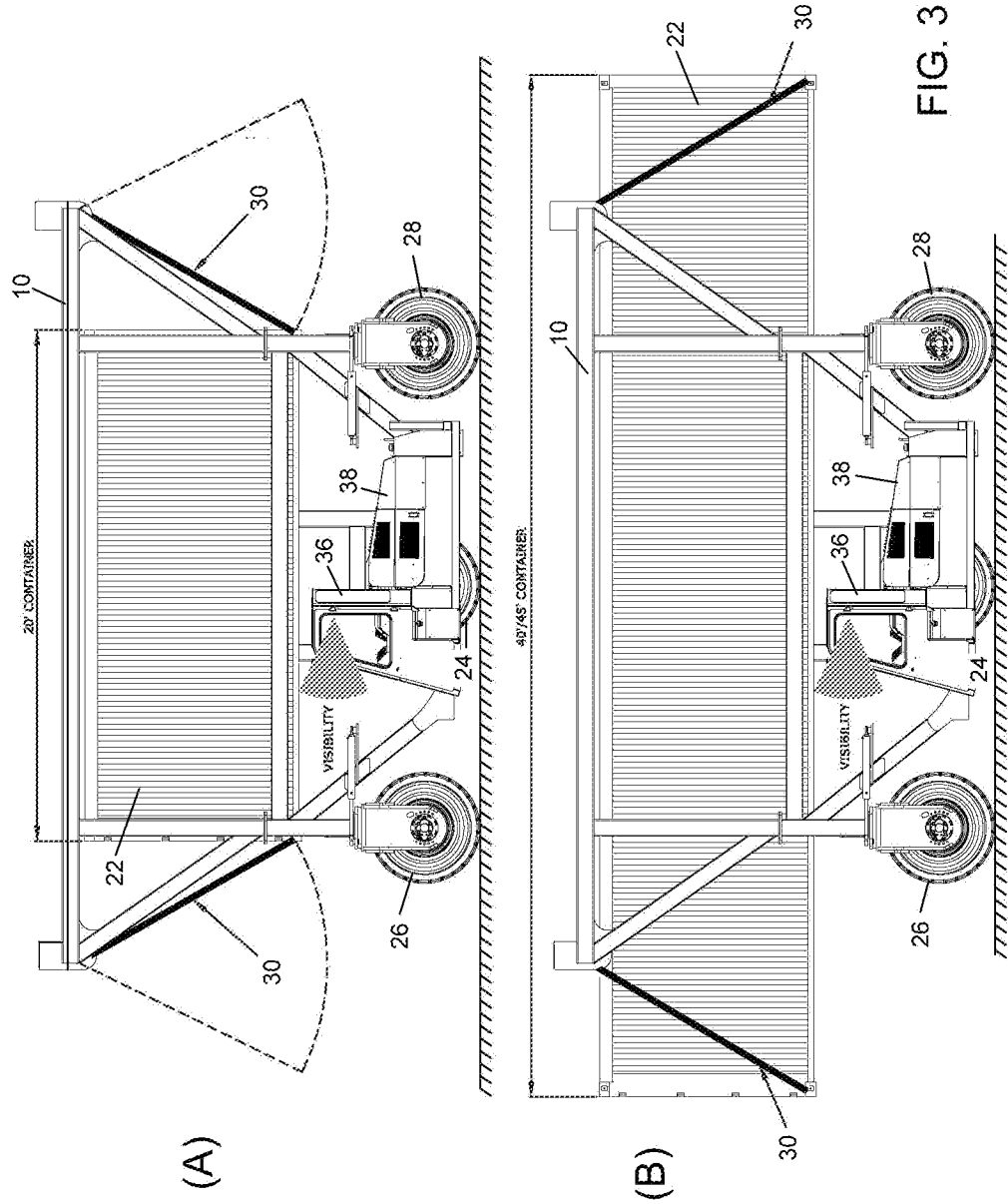
The invention is not limited to the embodiments described herein which may be modified or varied without departing from the scope of the invention.
25

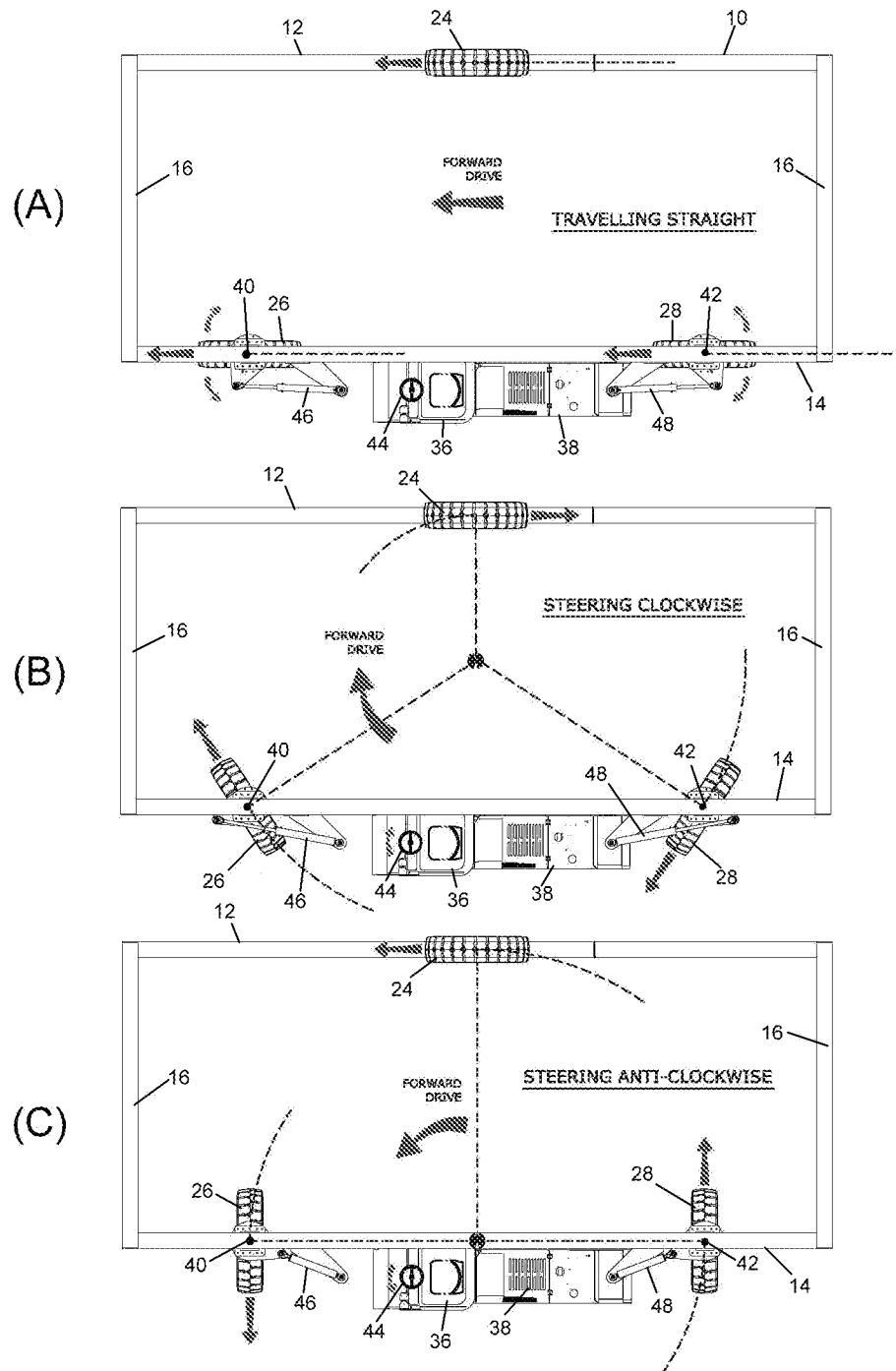
Claims

1. A straddle carrier comprising a frame having opposite substantially parallel sides and which is configured for straddling a container to be lifted and transported between said opposite sides, a plurality of ground wheels to enable the frame to be positioned over the container, and means for lifting the container within the frame, wherein the ground wheels comprise a first ground wheel disposed at least approximately centrally on one side of the frame, and second and third ground wheels disposed at or adjacent opposite ends of the other side of the frame, the second and third wheels being steerable by rotation about respective substantially vertical axes.
2. A straddle carrier as claimed in claim 1, wherein the first wheel is non-steerable with its rotational axis extending across the width of the frame.
3. A straddle carrier as claimed in claim 1 or 2, wherein the second and third wheels are synchronized for steering by substantially equiangular amounts in opposite directions of rotation about their vertical axes.
4. A straddle carrier as claimed in any preceding claim, wherein the internal clearance height of the frame is sufficient to allow stacking of containers at least two high.

5. A straddle carrier as claimed in any preceding claim,
wherein at least one of the first, second and third
ground wheels comprises one of a pair of wheels disposed
5 coaxially side-by-side.
6. A straddle carrier as claimed in any preceding claim,
operable by remote control.







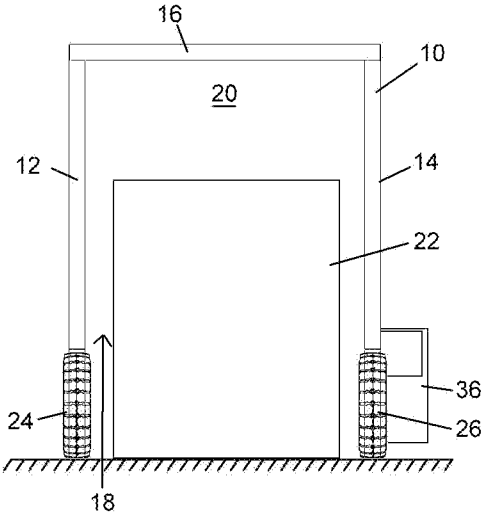


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/051971

A. CLASSIFICATION OF SUBJECT MATTER

INV. B66C19/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B66C B66F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 655 081 A (MONK JOHN THOMAS) 11 April 1972 (1972-04-11) * abstract; figures 1,2,6,11,12 column 5, line 1 - column 6, line 35 -----	1-6
X	US 3 570 695 A (SCHWARTZ WILLIAM H ET AL) 16 March 1971 (1971-03-16) * abstract; figures 1,2 -----	1-6
X	EP 1 752 410 A1 (CONSENS TRANSP SYSTEME GMBH [DE]) 14 February 2007 (2007-02-14) * abstract; figures 1-4 -----	1-6
A	US 4 880 124 A (FEIDER THOMAS [US] ET AL) 14 November 1989 (1989-11-14) the whole document -----	1-6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3655081	A	11-04-1972	NONE	
US 3570695	A	16-03-1971	NONE	
EP 1752410	A1	14-02-2007	NONE	
US 4880124	A	14-11-1989	NONE	