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(54) **Room-less lifting equipment for persons and goods**

(57) The room-less lifting equipment is characterized in that:

- the car hoisting machine and the relevant supporting fixed frame are entirely allocated inside the top of the hoistway,
- the car hoisting machine consists of a brushless D.C. motor with permanent magnets, fed by a low voltage, driving an epicyclical gear system,
- the hauling ropes are toothed belts,
- the traction pulleys are toothed pulleys.

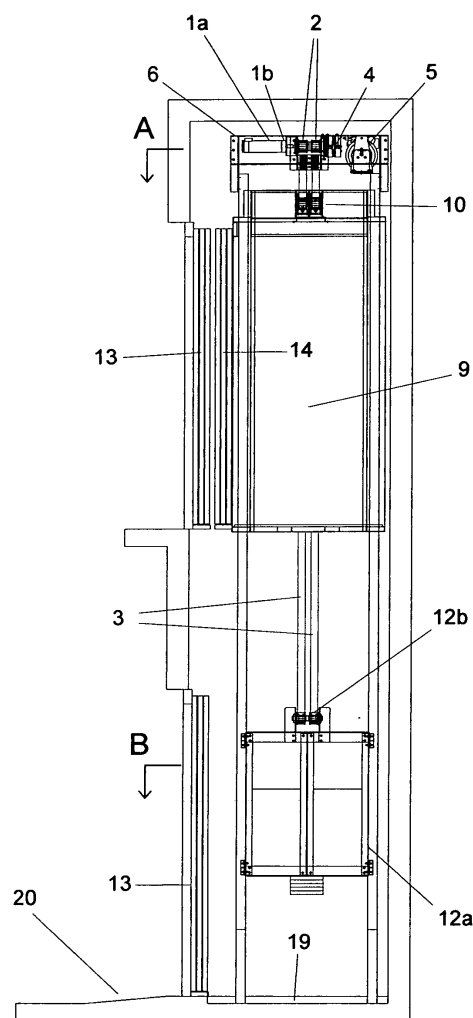


Fig. 1b

Description

THE TECHNICAL FIELD

[0001] The present invention relates to a room-less equipment for persons and goods particularly suitable for limited pay-load, speed and car travel.

BACKGROUND

[0002] Nowadays, for a maximum of 1000 kg of pay-load, 0,5 m/s of linear speed, and 12 m of car travel, industry offers lifts where the movement of the car is obtained through a hydraulic ram driven by a pump unit, or by hauling ropes driven by a electric gear.

[0003] All the above cases present shortcomings such as a relatively high energy consumption due to the fact that the load is not partially balanced by a counter-weight, when the motion is obtained by using a hydraulic system, or a lack of safety when a driving a.c. geared motor, currently used for the electric lifts with lifting ropes, is used due to the fact that this technology doesn't allow any automatic rescue operation in case of a power failure, in a economically convenient way.

[0004] Moreover the hydraulic lifts needs an additional space where to locate the pump unit and, as far as the electric lift with lifting ropes is concerning, the geared motor with the traction pulley which has got to have a diameter of 40 times that of the traction ropes, by all the existing codes, requires a considerable reservation of space inside or outside the lift well; last but not least the a.c. geared motor cannot operate in the case of a power failure and, hence, doesn't allow any automatic rescue operation if passengers are trapped in the car because of that.

[0005] In other words, the above technologies, available today from the industry, are energy and space wasting and also with some safety limitation, like the electric traction lift.

OBJECTS

[0006] The present invention has been developed with the aim of overcoming the above drawbacks of the prior art. In particular the general purpose of present invention is to realize a machine room-less lifting equipment having the following improved characteristics:

- considerable economy of energy consumption;
- considerable economy of space occupied by the equipment;
- possibility to supply the equipment either by a single phase power supply or a dc voltage feeder.

SUMMARY OF THE INVENTION

[0007] The room-less lifting equipment for persons and goods, according to the invention, comprises:

- a hoistway,
- a load car,
- a car hoisting machine,
- a counterweight,
- hauling cables supporting both the car and the counterweight,
- traction pulleys driving the hauling cables,
- guide tracks guiding the movement of the car-rack frame and counterweight, located near a same wall of the hoistway,
- a fixed frame supporting the hoisting machine and the traction pulley, positioned upon said guide tracks and discharging the overall load force on the same guide tracks, and is characterized in that:
- the car hoisting machine and said fixed frame are entirely allocated inside the top of the hoistway,
- the car hoisting machine consists of a brushless D.C. motor with permanent magnets, fed by a low voltage, driving an epicyclical gear system,
- the hauling cables are toothed belts,
- the traction pulleys are toothed pulleys.

DRAWINGS

[0008] Preferred embodiments of present invention are described in the following with the aid of the annexed drawings, which show:

Fig.1a: vertical cross section front view of a hoistway with a relevant room-less lifting equipment according to the invention;

Fig.1b: vertical cross section side view of the hoistway of Fig.1a;

Fig.2a: horizontal cross section view of the above equipment and hoistway, according to the section A-A of figs. 1a, 1b;

Fig.2b: horizontal cross section view of the above equipment and hoistway, according to the section B-B of figs. 1a, 1b;

Fig.3a: schematic enlarged view of the belts of fig. 1a making more clear their arrangement;

Fig.3b: a variant of the arrangement of the belts of fig. 1a;

Fig.4: schematic view of a preferred embodiment of the above belts;

Fig.5: perspective enlarged view displaying the upper and lower parts of the lifting equipment of figs. 1a-1b in more details;

Figs.6a, 6b, 6c: side view of the fastening device 11 of Fig.5, in different positions;

Fig.7: belt guard bar installed over the traction pulleys.

PREFERRED EMBODIMENTS

[0009] In the figs. 1a, 1b, 2a, 2b, 3a, the marked parts have the following meaning:

1a: a brushless D.C. motor with permanent magnets, fed by a low voltage,
 1b: an epicyclical gear system driven by motor 1a,
 2: two toothed traction pulleys,
 3: two toothed hauling belts,
 4: a double action disc brake (as usually used in traction lifts);
 5: a speed governor (as usually used in traction lifts);
 6: a fixed frame supporting the hoisting machine and the traction pulleys, positioned upon said guide tracks and discharging the overall load force on the same guide tracks,
 9: a load car (cabin),
 12a: a counterweight,
 7a, 7b: guide tracks guiding the movement of the car-rack frame, located near a wall of the hoistway,
 8a, 8b: guide tracks guiding the movement of the counterweight, located near the same wall of the hoistway,
 10: diverting toothed pulleys supporting the load car;
 12b: diverting toothed pulleys supporting the counterweight,
 13: external doors of the equipment,
 14: door of the load car,
 16: fixed plate to which the ends of the toothed belts are attached,
 17: upper console-wise beam holding the metal frame of the load car and incorporating the driving pulleys 10.

[0010] It should be clear that according to the belt arrangement pointed out in Fig.3a a clockwise rotation of pulley 2 causes the descent of the load car, while a counterclockwise rotation causes its ascent.

[0011] A room-less lifting equipment according to the invention, as above described, with:

- the car hoisting machine and relevant fixed frame entirely allocated inside the top of the hoistway,
- the car hoisting machine consisting of a brushless D.C. motor with permanent magnets, fed by a low voltage, with a speed control incorporated, driving an epicyclical gear system,
- toothed hauling belts and traction pulley, entails the following advantages:
- it does not require a separate room for the hoisting machine,
- lifting the pay-load by means of hauling toothed belts, in a counter-weighted arrangement, driven through a toothed traction pulleys, allows the use of traction and diverting pulleys having a primitive diameter from 80 mm to 100 mm, so making extremely compact the space reservation for the traction machinery, inside the hoistway; moreover, being the traction pulleys and the transmission belts toothed, any slip between the traction pulleys and the transmission belts is made impossible and the movement syn-

chronisation of the two traction belts is assured;

- employing an epicyclical gear system, driven from a brushless D.C. motor with permanent magnets, fed by a low voltage, consents an absorption of power which represents one fourth of the power which is so far absorbed by a equivalent hydraulic and two third of that absorbed by a electric traction lift, and allows the load car motion by either an a.c. single phase power supply and/or a rechargeable battery, in case of a power failure, which is a by-product of this low voltage driving technology and which represents a new state-of-art, compared with the other existing similar products.

[0012] As can be desumed by figs. 1a, 1b, and 3a the cabin and its frame form a compact structure having as upper side a console-wise beam 17, which holds the total load.

[0013] This compact structure consents to minimize both its weight and the depth of the pit (indicated with 19 in Fig. 1b), so allowing the access to the car from the lower floor through a ramp (indicated with 20 in Fig.1b) not higher e.g. than 50 mm from the basement floor, being 50 mm the depth of the pit.

[0014] In particular the self-supporting, cantilever type, chassis consists of a bolted metal frame where the upper console-wise beam holds the loading platform through four uprights which represent the four corners of the car-cage. The upper beam incorporates the idle pulleys on which the total load is hauled by the traction belts. The two uprights in correspondence of the car guide rails are fitted with shoes which guide the car along the hoistway on the relevant guide rails.

[0015] Fig.4 shows a preferred embodiment of the two hauling belts 3.

[0016] According to this preferred embodiment any belt comprises a polyurethane covering embedding a number of metal wires 23 positioned parallel to the sides of the belt and connected in serial at the two ends of the belt.

[0017] As far as the traction force is concerned, the number of metal wires and their diameter are calculated in accordance with the indication of EN81-1, which represents the European code for the lifts.

[0018] With the purpose of matching the most rigorous principle of safety, the integrity of the metal wires, embodied into the toothed belt, is permanently monitored by a detecting circuit.

[0019] In fact the two terminals of the metal wires series are serially connected to a voltage feeder 24 and to a detector circuit 25. If the wire chain becomes interrupted by a broken wire, the detector emits alarm signals and switches off the traction motor.

[0020] Fig.5 is a perspective enlarged view displaying the upper and lower parts of the lifting equipment of figs. 1a-1b in more details. In this figure 15 represents a tensioner, a device which is normally associated to a speed governor (see speed governor 5), while 11 (even isolately

represented in Fig.5a for a better comprehension) represents a fastening device 11 which ensures the anchoring of the diverting pulleys 10 to the upper beam 17 of the load car.

[0021] According to a preferred embodiment of the fastening device 11, every diverting pulleys 10 is supported by a rocker bearing 18 which can pivot on a shaft 21, fixed to the upper beam 17. A spring device prevents an excessive pivoting of the rocker bearing caused by value variations of the load, as long as the value of the load supported by the pulley remains in a regular range. As soon as a slack of the belt or a over-load occurs the rocker bearing pivots in clockwise or counterwise direction activating one of two different switches, which immediately prevents the gear motor from moving.

[0022] Figs.6a, 6b, 6c show side views of fastening device 11 displaying the position of the rocker bearing 18 in case of normal load (Fig.6a), or in case of belt slack (Fig.6b), or in case of overload (Fig.6c).

[0023] Another preferred embodiment is represented in Fig.7. This figure shows a bar 22 installed over the traction pulleys near the hauling belts. This bar represents a safety provision foreseen in order to prevent possible slippings of the belts out of the pulleys due to possible shocks whatsoever caused during the car motion.

[0024] The above preferred embodiments of the present invention have been given by way of non-limiting example, many obvious variants being possible.

[0025] A variant could concern the number of the hauling belts which could be more than two.

[0026] Another variant could e.g. concern the arrangement of the belts which instead the one of Fig.3a could be the one of Fig.3b, i.e. without the diverting pulleys 10 and 12b, being the ends of the belts directly attached to the load car and to the counterweight (this means, for a same speed and a same load of the car, a sliding speed of the belts which is an half the one of Fig.3a and a load of the belts which is twice).

Claims

1. Room-less lifting equipment for persons and goods comprising:

- a hoistway,
- a load car (9),
- a car hoisting machine (1a,1b),
- a counterweight (12a),
- hauling cables (3) supporting both the car and the counterweight,
- traction pulleys (2) driving the hauling cables,
- guide tracks (7a,7b,8a,8b) guiding the movement of the car-rack frame and counterweight, located near a same wall of the hoistway,
- a fixed frame (6) supporting the hoisting machine and the traction pulley, positioned upon said guide tracks and discharging the overall

load force on the same guide tracks,

characterized in that:

- the car hoisting machine and said fixed frame are entirely allocated inside the top of the hoistway,
 - the car hoisting machine consists of a brush-less D.C. motor (1a) with permanent magnets, fed by a low voltage, driving an epicyclical gear system (1b),
 - the hauling cables are toothed belts (3),
 - the traction pulleys are toothed pulleys (2).
2. Room-less lifting equipment as set forth in previous claim 1 **characterized in that** the cabin and the frame of the load car form a compact structure having as upper side a console-wise beam (17), which holds the total load of the car.
3. Room-less lifting equipment as set forth in previous claim 1 **characterized in that** any toothed belt comprises a polyurethane covering embedding a series of metal wires (21) positioned parallel to the sides of the belt and connected in serial at the two ends of the belt, and **characterized by** the fact that the integrity of the metal wires is permanently monitored by a detecting circuit, being the two terminals of the metal wires series serially connected to a voltage feeder (24) and to a detector circuit (25), which emits alarm signals and switches off the traction motor when the wire chain becomes interrupted by a broken wire.
4. Room-less lifting equipment as set forth in previous claim 2 **characterized in that:**
- the load of the car is supported by first diverting pulleys (10) anchored to the upper beam (17) while the load of the counterweight is supported by second diverting pulleys (12b);
 - every one of the first diverting pulleys (10) is supported by a rocker bearing (18) which can pivot on a shaft (19) fixed to the upper beam (17);
 - a spring device prevents an excessive pivoting of the rocker bearing caused by value variations of the load, as long as the value of the load supported by the pulley remains in a regular range, and on the contrary, as soon as a slack of the belt or a over-load occurs, it allows the rocker bearing to pivot in clockwise or counterwise direction for activating one of two different switches, which prevents the gear motor from moving.
5. Room-less lifting equipment as set forth in previous claim 1 **characterized in that** a bar (20) is installed over the traction pulleys (2) near the hauling belts (3) in order to prevent possible slippings of the belts

on the traction pulleys due to possible shocks whatsoever caused during the car motion.

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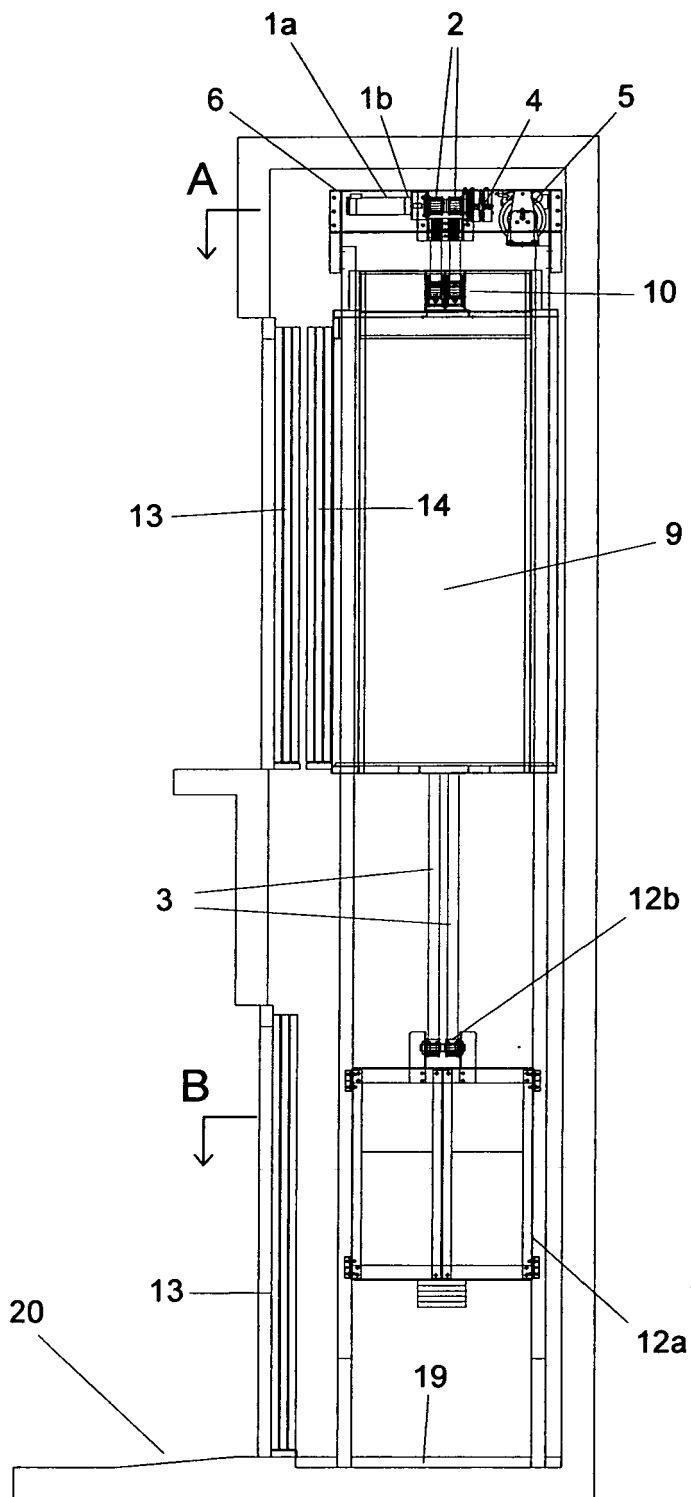


Fig. 1b

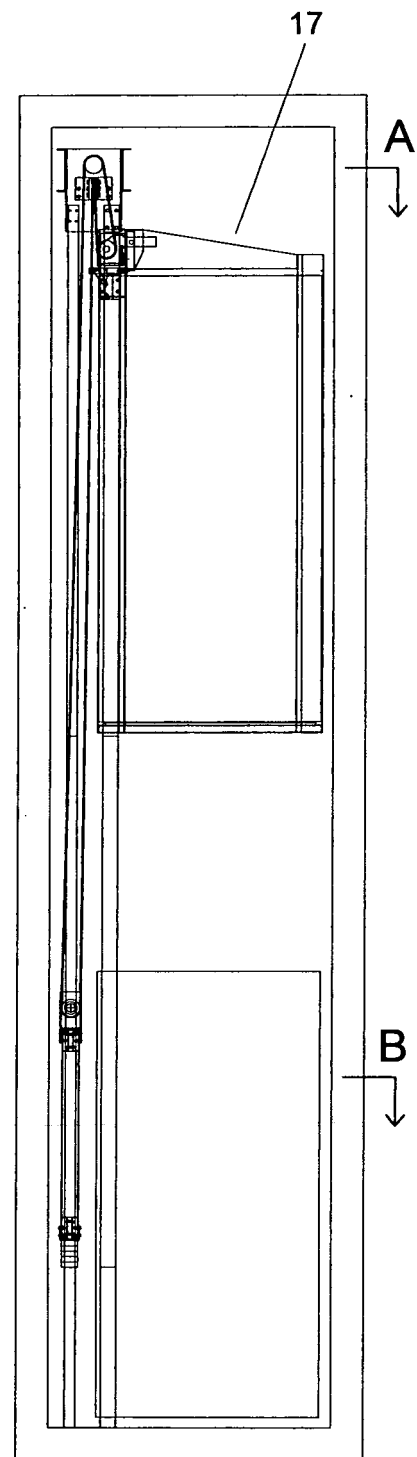


Fig. 1a

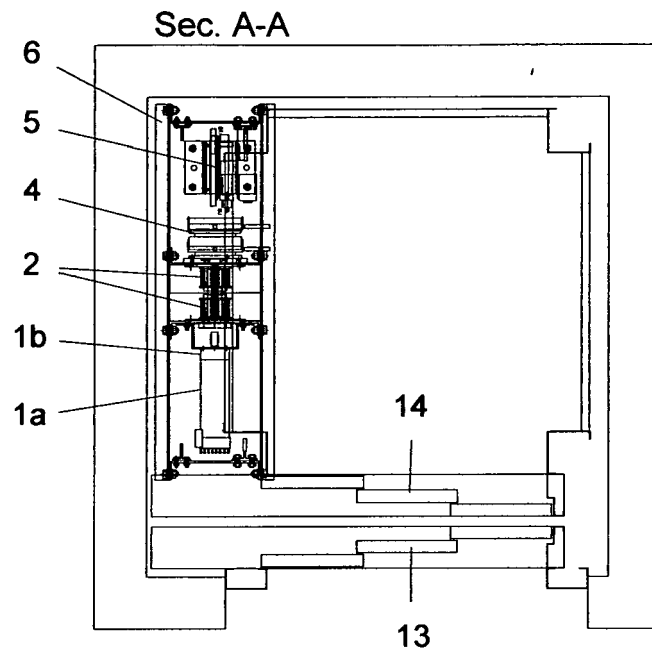


Fig. 2a

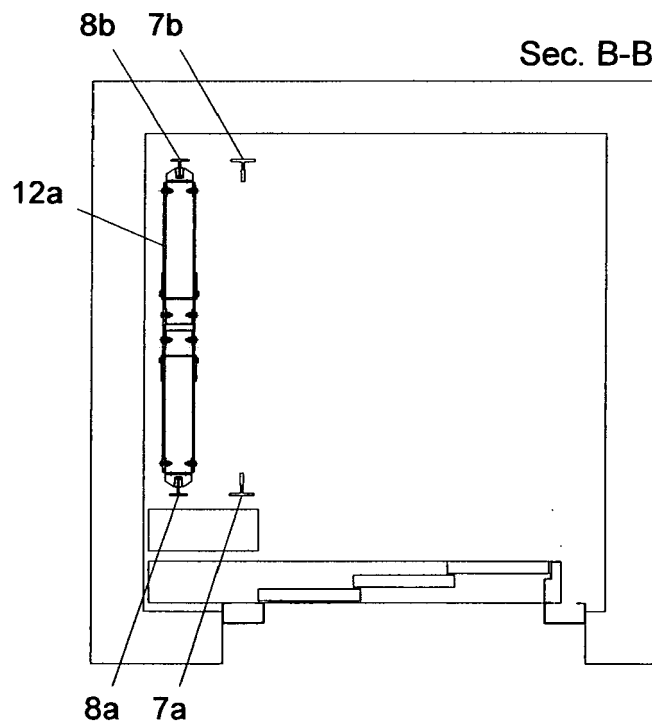
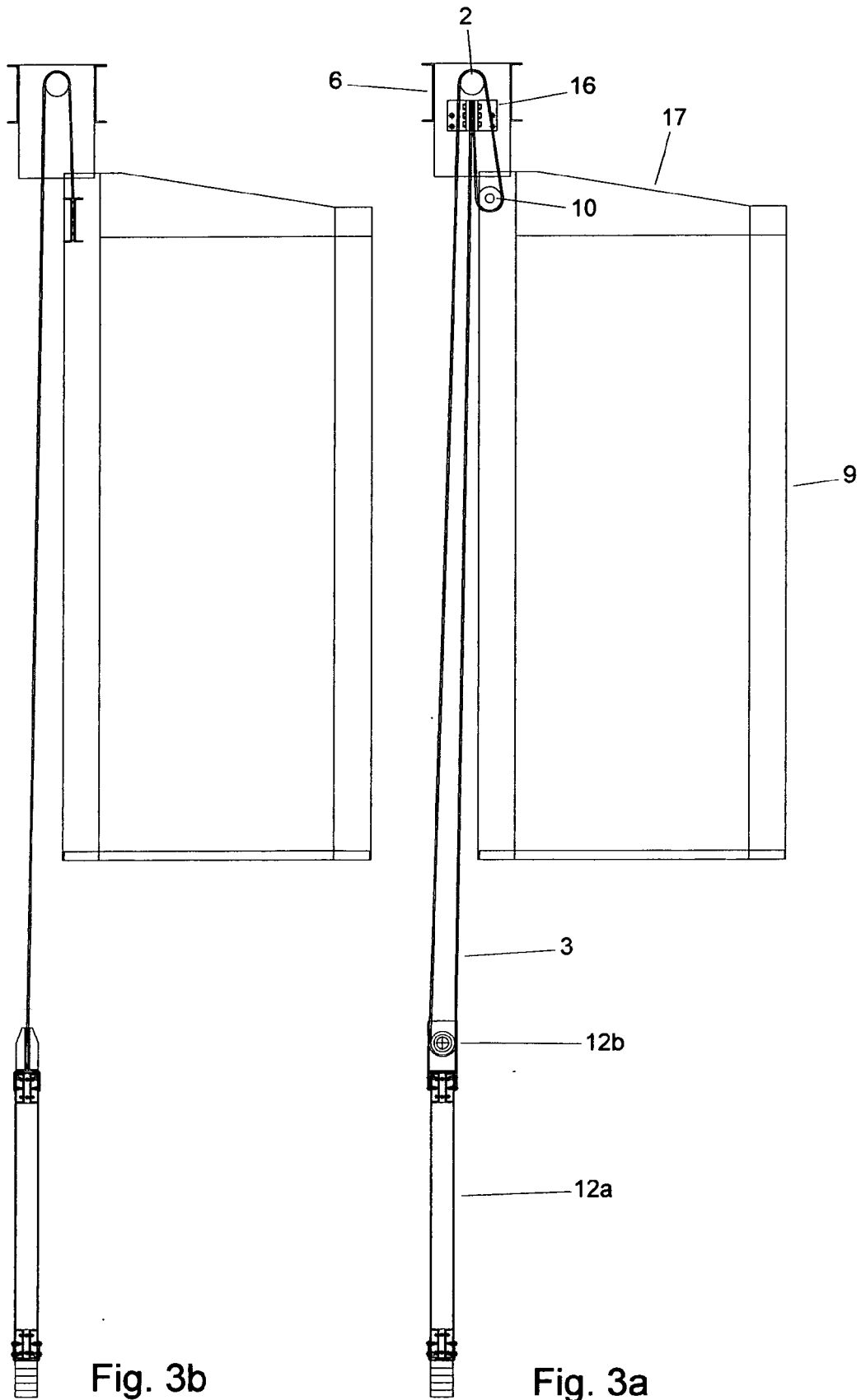


Fig. 2b



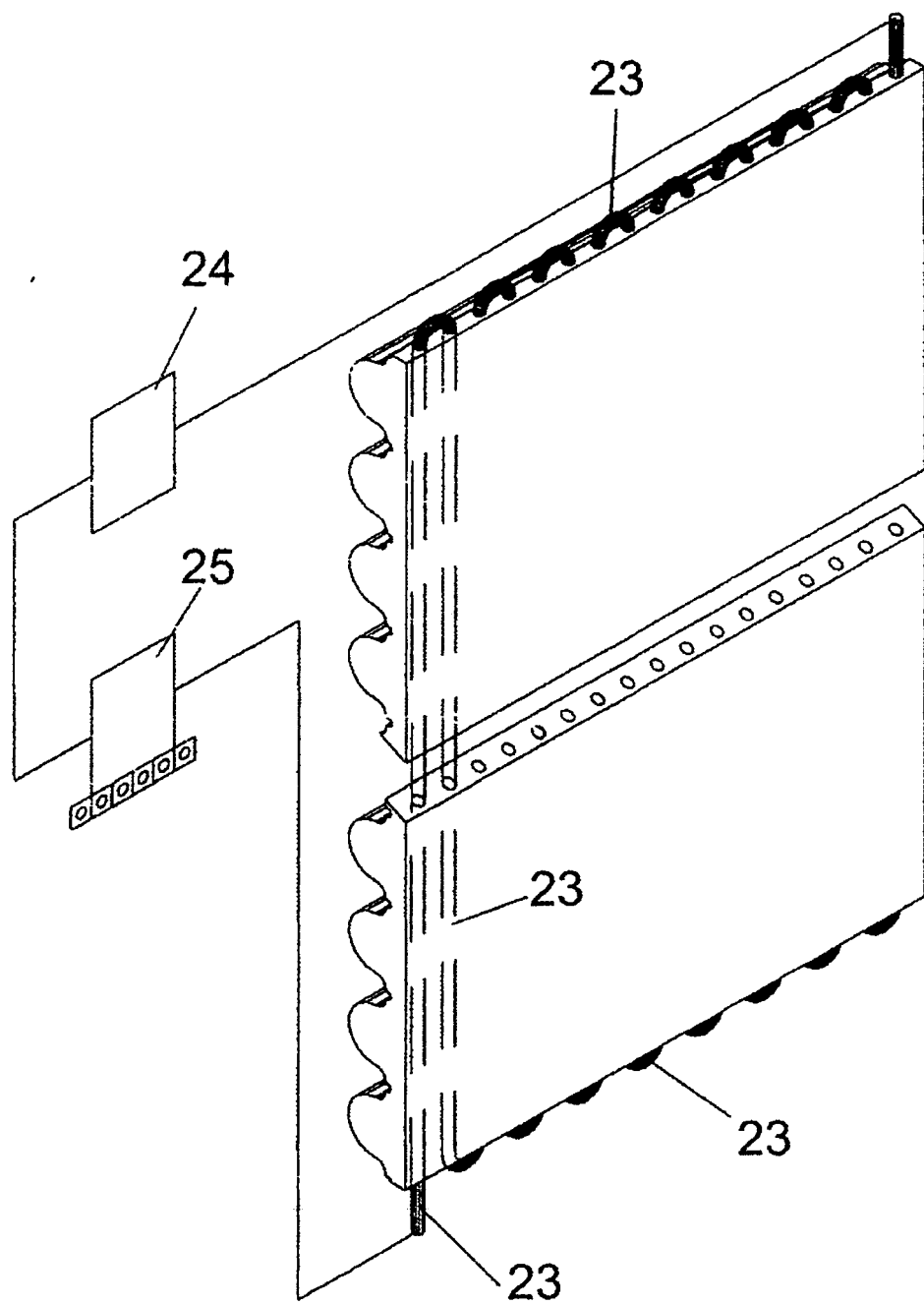
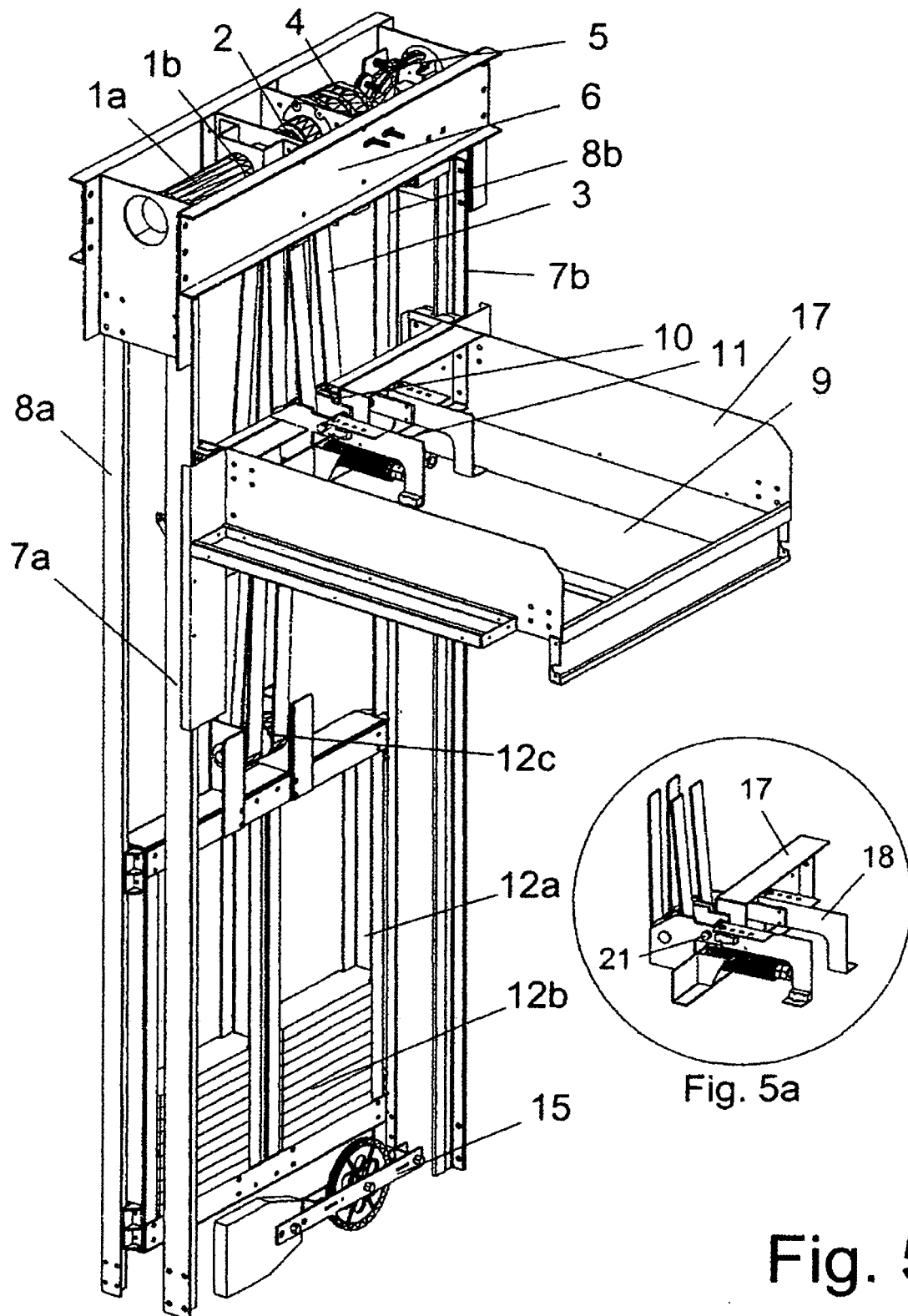
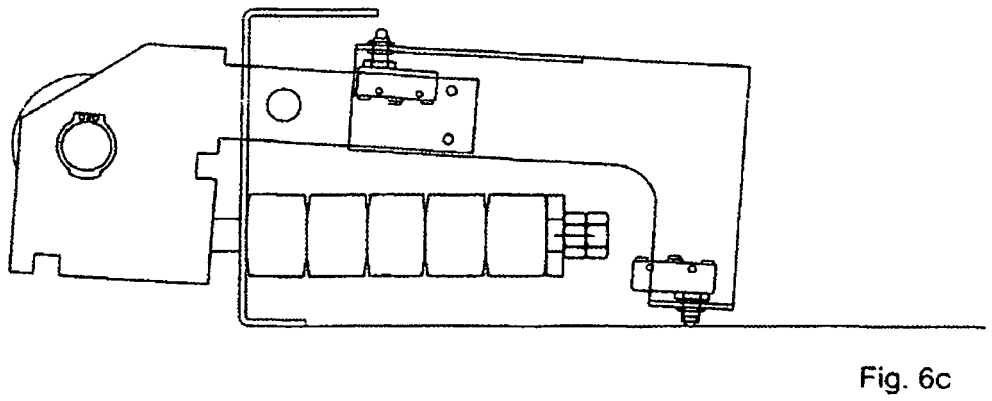
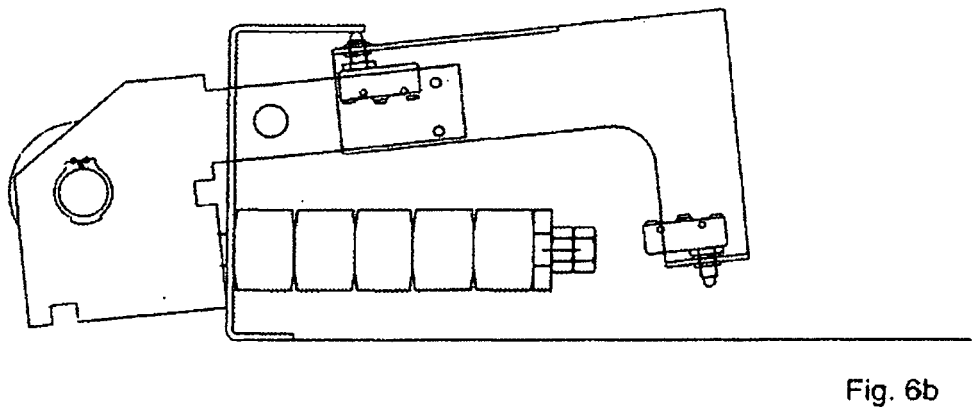
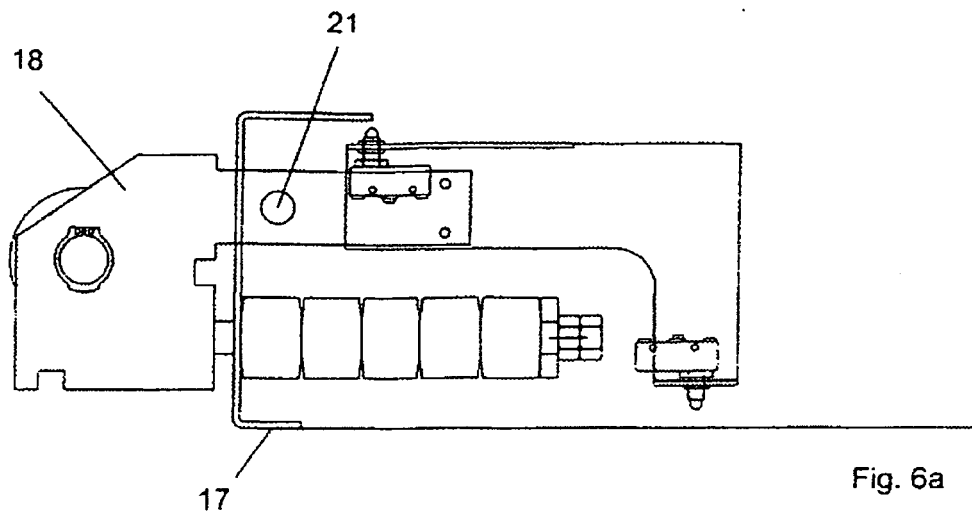


Fig. 4





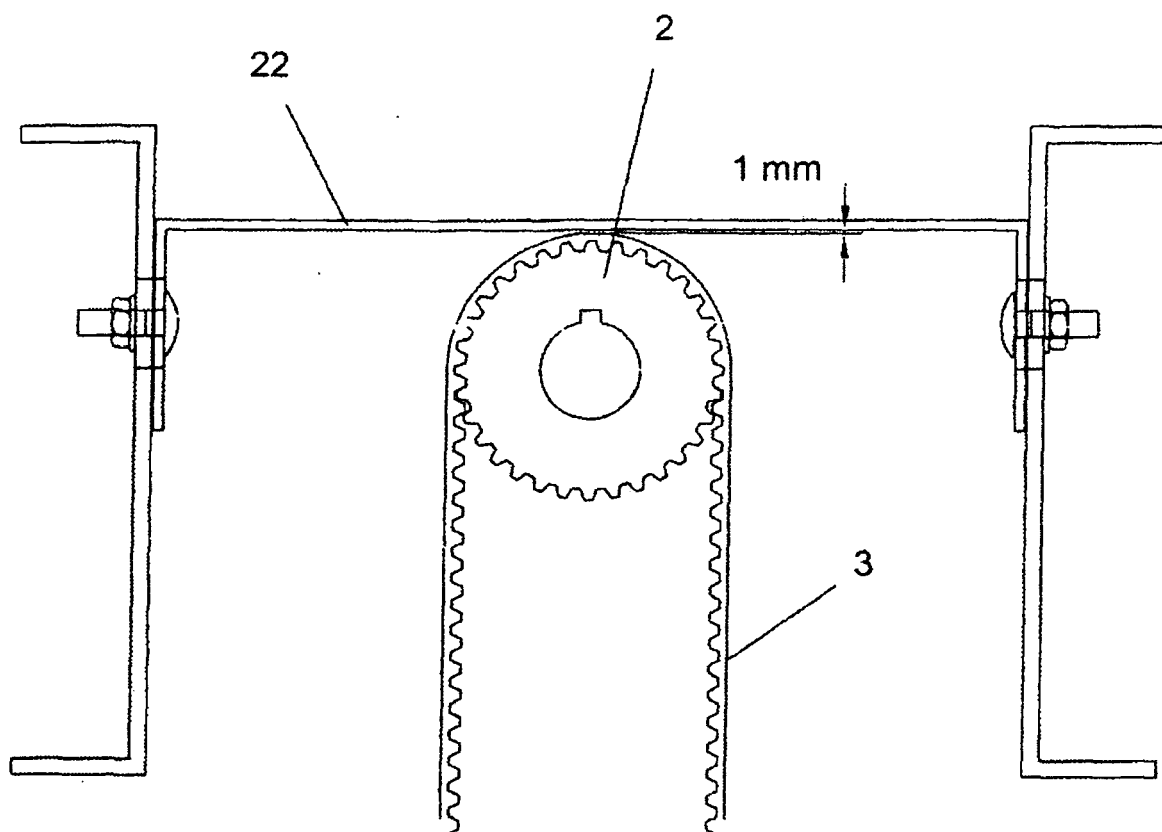


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5623

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 561 720 A (INVENTIO AG) 10 August 2005 (2005-08-10) * abstract * * paragraph [0016] - paragraph [0024] * * paragraph [0026] - paragraph [0029] * * figures 1,13-16 *	1,2	INV. B66B11/00
X	EP 1 428 784 A (BRAVO S.R.L.) 16 June 2004 (2004-06-16) * abstract * * paragraph [0006] - paragraph [0008] * * figure 1 *	1,2	
A	DE 198 29 532 A1 (ZF FRIEDRICHSHAFEN AG) 5 January 2000 (2000-01-05) * abstract * * column 1, line 19 - line 57 * * figure 1 *	1	
A	US 2004/182651 A1 (ISHII TAKASHI ET AL) 23 September 2004 (2004-09-23) * abstract * * paragraph [0085] - paragraph [0102] * * figures 1,2 *	1,2	TECHNICAL FIELDS SEARCHED (IPC) B66B
6 The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 April 2006	Examiner Oosterom, Marcel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)



European Patent
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Application Number
EP 05 42 5623

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1,2



European Patent
Office

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 05 42 5623

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1,2

Compact lay-out for room-less lifting equipment.

2. claim: 3

Integrity monitoring system of the metal wires in the belts of lifting equipment.

3. claim: 5

Belts slipping prevention system for lifting equipment.

4. claim: 4

Slack or over-load prevention system for carrier means of lifting equipment.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 42 5623

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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26-04-2006

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