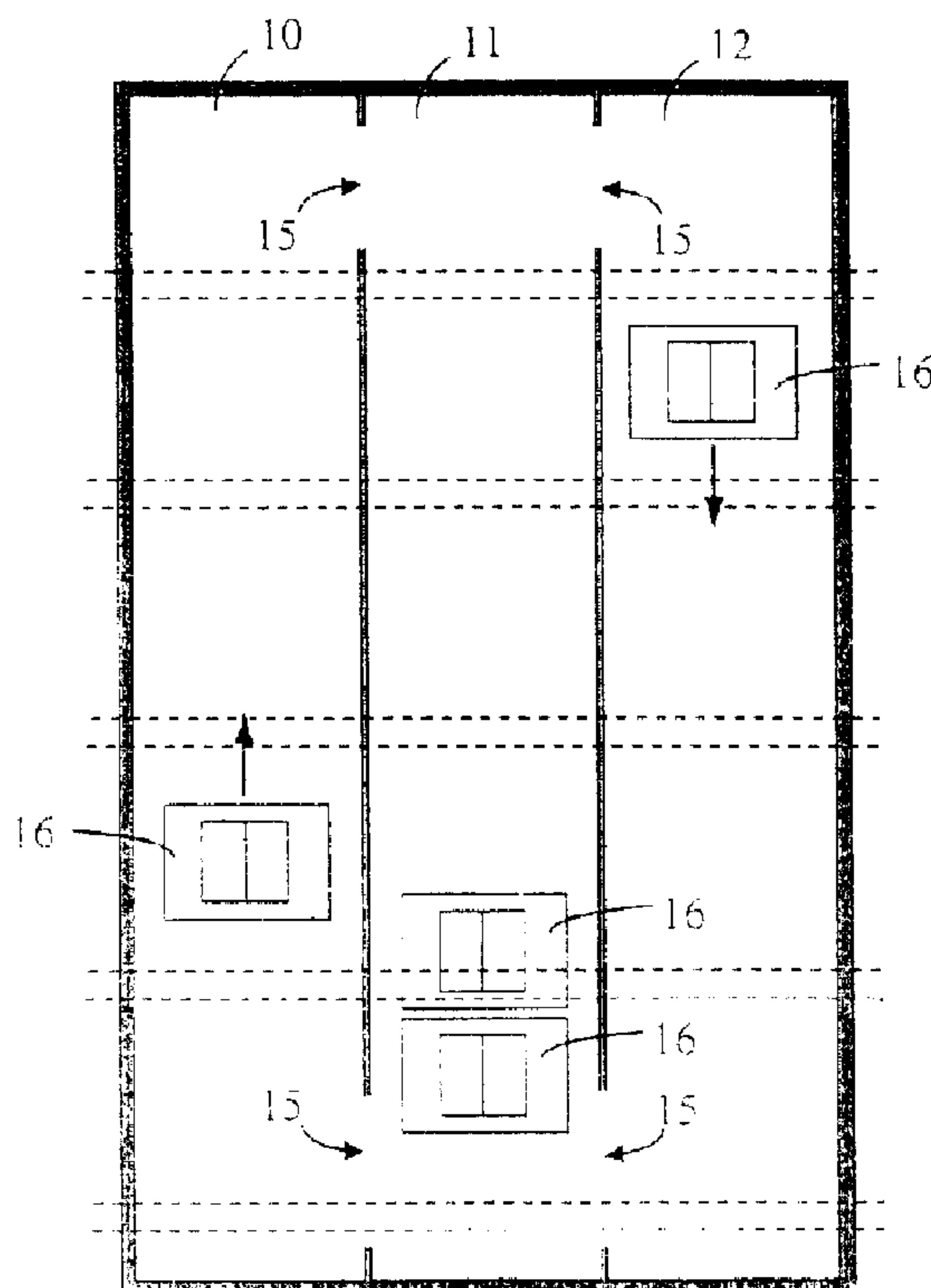




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CONTIGUS
 (54) Title: ELEVATOR INSTALLATION WITH SEVERAL SELF-PROPELLED CARS AND AT LEAST THREE ELEVATOR
HOISTWAYS SITUATED ADJACENTLY



(57) Abrégé/Abstract:

Elevator with one or several elevator cars (16), which move in a first vertical elevator hoistway (10) and in a second vertical elevator hoistway (12), these elevator hoistways (10, 12) having access openings (14). Arranged between the two elevator hoistways (10, 12) is a vertical parking hoistway (11) which has crossing-points (15) which allow transfer of the elevator cars (16) between two adjacent hoistways (10, 11, 12). The elevator has a control system (40) and driving means which enable it to move empty elevator cars (16) through the crossing-points (15), and in case of need to make the empty elevator cars (16) ready in the first elevator hoistway (10) and in the second elevator hoistway (12).

Abstract

Elevator with one or several elevator cars (16), which move in a first vertical elevator hoistway (10) and in a second vertical elevator hoistway (12), these elevator hoistways (10, 12) having access openings (14). Arranged between the two elevator hoistways (10, 12) is a vertical parking hoistway (11) which has crossing-points (15) which allow transfer of the elevator cars (16) between two adjacent hoistways (10, 11, 12). The elevator has a control system (40) and driving means which enable it to move empty elevator cars (16) through the crossing-points (15), and in case of need to make the empty elevator cars (16) ready in the first elevator hoistway (10) and in the second elevator hoistway (12).

(Fig. 2)

Elevator installation with several self-propelled cars and at least three elevator hoistways situated adjacently

The invention relates to an elevator with several self-propelled cars and at least three adjacently situated vertical elevator hoistways, and to a method of operating such an elevator.

It provides several approaches to arranging the elevator hoistways of an elevator installation. Several examples are shown in a diagrammatic plan view in Figures 1A - 1D.

In Figure 1A, two vertical elevator hoistways 1 and 2 are shown, which are situated adjacently. In each of the two hoistways 1 and 2, at least one elevator car 3 moves up and down. Each hoistway 1, 2 has a hoistway door 4.

In Figure 1B a further arrangement is illustrated, which shows two vertical elevator hoistways 5 and 6, which are situated adjacently. Along the depth of the hoistway, each of the elevator hoistways 5 and 6 has two sections of hoistway situated one behind the other. An elevator car 3, which moves in the front section of one of the hoistways 5, 6 (as shown in the left hoistway 5), serves the hoistway doors 4. An elevator car 3, which moves in the back section of one of the hoistways 5, 6 (as shown in the right hoistway 6), does not afford access to any of the hoistway doors 4. There can be several elevator cars 3 in circulation.

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The Japanese patent application with publication number JP 6080324 shows an arrangement with two adjacently situated hoistways, similar to that shown in Figure 1B. Different than in Figure 1B, along the depth of the hoistway, each of

the elevator hoistways has three sections of hoistway situated one behind the other. Only the front section of the hoistway has access to the hoistway doors, in a manner similar to Figure 1B. An extension of the concept according to Figure 1B is to be seen in the Japanese patent application with publication number JP 6080352. Along the depth of the hoistway, the arrangement according to JP 6080352 has several hoistway sections and horizontal or sloping crossing-points. There are hoistway doors both in the front hoistway wall (as in Figure 1B) and in the back hoistway wall. The elevator cars must therefore have access openings on two opposite sides.

A further arrangement is shown in Figure 1C. This arrangement has one vertical elevator hoistway 7. Left and right in this elevator hoistway 7, elevator cars 3 can be moved up and down. In the central hoistway section 9, there are no hoistway doors 4. There are two different approaches to transportation which can be realized in such a hoistway 7. Either the central hoistway section 9 is used only for transferring the elevator cars 3 from left to right, or vice versa, or the central section 9 is used for vertical transportation and/or for parking the elevator cars 3.

In US patent specification 3,658,155 an arrangement is described which is comparable with the variant in Figure 1C. According to this US patent specification, the central section between the left hoistway section and the right hoistway section is used for temporarily parking the elevator cars. The elevator cars move along a central transportation arrangement. An elevator car can be disengaged and parked in the central section.

The Japanese patent application with publication number JP 09077418 shows an arrangement with three adjacently

situated hoistway sections, similar to that shown in Figure 1C. The left section of the hoistway is used for upward trips, and the right section of the hoistway is used for downward trips, The central section of the hoistway is used for fast downward trips, but has no hoistway doors for boarding or exiting. Behind the three adjacently situated sections of hoistway, in both the headroom and the pit, there is a connecting hoistway for the purpose of transferring the cars between the three vertical sections of hoistway. In the right and left sections of hoistway, the elevator cars are moved together as a group in a vertical direction. In the central section of hoistway, an autonomous vertical movement is possible.

The Japanese patent application with publication number JP 2000185885 shows an arrangement with four adjacently situated sections of hoistway, similar to that shown in Figure 1C. A significant difference is to be seen in that the sections of hoistway are arranged separately, and only connected by sloping crossing-points.

A variant of the arrangement shown in Figure 1C is outlined in Figure 1D. The hoistway 7 has three complete sections of hoistway which are situated adjacently. Not only the left and the right sections of hoistway have hoistway doors 4, but the central section of hoistway also has hoistway doors 8.

With regard to the drive of the elevator cars 3, there are two different basic approaches. Either the elevator cars 3 are conveyed together at least in the vertical direction, or the cars can be moved individually. The latter approach results in additional flexibility.

A disadvantage of some of the known hoistway arrangements is that when the elevator cars cross over from one travel path to another, or when they change over from one elevator hoistway to the other elevator hoistway, the elevator cars containing passengers undergo lateral acceleration. Such lateral acceleration is unpleasant for the passengers being transported. Such changeovers are also associated with strong vibrations, which can be experienced as disturbing. These factors can cause passengers to feel insecure, especially since the passenger is in an enclosed car and has no visual contact or reference to the outside.

On the other hand, other arrangements require a relatively large amount of space, without significantly increasing the transportation capacity, or else the constructional outlay is large. Some of the known arrangements require stopping places and/or hoistway doors on several side walls of a hoistway. From the constructional standpoint, this is costly. Furthermore, on changing direction, or when changing cars, passengers must under certain circumstances walk around a hoistway to board another elevator car.

Given the known arrangements, it is an objective of the present invention to provide an elevator system and a corresponding method which reduce the disadvantages of the state of the art, or avoid them completely.

A particular objective is to provide an elevator system and a corresponding method by means of which the passengers being transported are not subjected to any influences which are experienced as disturbing.

The objectives are fulfilled by the characteristics of the present invention.

In one aspect, the present invention provides a method of operating an elevator installation with three adjacently situated vertical elevator hoistways having a centrally situated hoistway and two outwardly situated elevator hoistways and several individually driven elevator cars, the two outwardly situated elevator hoistways having access openings which lie in one plane, and the centrally situated elevator hoistway having crossing-points which allow movement of the elevator cars between two adjacently arranged elevator hoistways, the method comprising the following steps: a) ready one of the elevator cars in a first of the two outwardly situated elevator hoistways, if a call command for an upward trip arrives, b) ready one of the elevator cars in the second of the two outwardly situated elevator hoistways if a call for a downward trip arrives, c) execute a transfer of an empty elevator car from one of the two outwardly situated elevator hoistways to the centrally situated elevator hoistway to park the empty elevator car in the centrally situated elevator hoistway, d) depending on requirements, ready in the centrally situated elevator hoistway in waiting positions in the vicinity of the crossing-points empty elevator cars so said empty elevator cars can be rapidly readied in case of an ordering call.

In a further aspect of the present invention, each of the elevator cars has an autonomous car-mounted drive which enables the elevator cars to move independently in a vertical direction in the vertical elevator hoistways, whereby the method comprised the following steps: - command the drive to cause an upward trip or a downward trip of an elevator car, depending on the ordering call.

In yet a further aspect of the present invention, each of the elevator cars has one of:- a further drive to move the elevator cars independently in a horizontal direction between two adjacently situated elevator hoistways, and the drive being

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so designed as to move the elevator cars independently in a horizontal direction between two adjacently situated elevator hoistways.

In yet a further aspect of the present invention, the drive is a linear drive, and the following step is executed before moving an elevator car: - swivel the linear drive of the elevator car.

In yet a further aspect of the present invention, one of the following additional steps is executed: - refer to a stored requirements profile, to enable empty elevator cars to be readied depending on requirements.

In still yet a further aspect of the present invention, before execution of a transfer, the following additional steps are executed: - halt the elevator car at the height of a passage, - check whether the respective elevator car is empty.

In still yet a further aspect of the present invention, before executing a transfer, the following additional steps are executed: - create a contact between engaging elements on the elevator car and horizontal guiding elements which are present in the vicinity of a passage in the elevator hoistway, - tilt the elevator car to disengage pairs of rollers of the elevator car from guide rails fastened to the hoistway.

In still yet a further aspect of the present invention, each of the elevator cars has a control unit which can be connected via a communication connection to a control system of the elevator installation, the method comprising the following further steps: - receipt by the control system

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of an ordering call, - selection of a readied elevator car, - transmission of control information from the control system via the communication connection to the control unit of the readied elevator car, - via the control unit, command the car-mounted drive of the readied elevator car to move the elevator car to the access opening of the story from which, or for which, the ordering call has arrived.

In yet still a further aspect of the present invention, the control system executes software-controlled steps to control and ready the elevator cars depending on traffic.

In a second aspect, the present invention provides an elevator installation with - several individually driven elevator cars, - a first vertical elevator hoistway which has access openings, a second vertical elevator hoistway, which has access openings, - a vertical parking hoistway which is situated between the first vertical elevator hoistway and the second vertical elevator hoistway and which has crossing-points which allow movement of the elevator cars between two adjacently situated elevator hoistways, - a control system and driving means, the first elevator hoistway and the second elevator hoistway being arranged in such manner that the access openings lie in one plane, and empty elevator cars being movable by means of the control system and the driving means through the crossing-points, and empty elevator cars being readable in case of need in the first elevator hoistway and in the second elevator hoistway.

In a further aspect of the present invention, each of the elevator cars has an autonomous car-mounted drive which enables the elevator cars to move independently in a vertical direction in the vertical elevator hoistways and in the

parking hoistway.

In yet a further aspect of the present invention, - the autonomous car-mounted drive is a linear drive, - each of the elevator cars either has a further drive to move the elevator cars independently in a horizontal direction between two adjacently situated elevator hoistways, or - the linear drive is so designed as to be able to move the elevator cars independently in a horizontal direction between two adjacently situated elevator hoistways.

In still yet a further aspect of the present invention, the elevator installation includes means of swiveling the linear drive.

In still yet a further aspect of the present invention, each of the elevator cars has means of creating a contact between engaging elements on the elevator car and horizontal guiding elements, the horizontal guiding elements being located in the vicinity of a passage in the elevator hoistway.

In still yet a further aspect of the present invention, each of the elevator cars has means of tilting the elevator car for the purpose of disengaging pairs of rollers of the elevator car from guide rails fastened to the hoistway.

In still yet a further aspect of the present invention, one of the vertical elevator hoistways is designed as a long-trip hoistway.

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Following below, the invention is described in detail by reference to exemplary embodiments and drawings. The drawings show:

- Figs 1A - 1D diagrammatic plan views of various known elevator systems;
- Fig. 2 a diagrammatic front view of a first elevator system according to the invention;
- Fig. 3 a diagrammatic cross-sectional view of the first elevator system according to the invention;
- Fig. 4 a diagrammatic side view of a section of the first elevator system according to the invention;
- Fig. 5 a diagrammatic cross-sectional view of a further elevator system according to the invention;
- Fig. 6A - 6B a diagrammatic side view of a section of a further elevator system according to the invention;
- Fig. 7 a diagrammatic cross-sectional view of a further elevator system according to the invention.

A first embodiment of the invention is described by reference to Figures 2 and 3. An elevator installation is shown which has three adjacently situated vertical elevator hoistways 10, 11, and 12. A total of five stories 13.1 - 13.5 are served. Within the elevator hoistways 10, 11, and 12, there are several individually driven elevator cars 16 (see Figure 3). The two outwardly situated elevator hoistways 10 and 12 have access openings 14, which all lie in one plane defined by the plane of the drawing. The access openings 14 are usually provided with hoistway doors. The centrally situated elevator hoistway 11 serves as a vertical parking hoistway and has crossing-points 15 (e.g. in the form of passages) which allow movement of the elevator cars 16 between two adjacently situated elevator hoistways. An elevator car 16 can, for example, be moved through a passage 15 from the elevator hoistway 10 or from the elevator hoistway 12 into the parking hoistway 11. The elevator cars 16 can also be moved from the parking hoistway 11 into one of the two outward elevator hoistways 10 or 12.

According to the invention, elevator cars 16 are first readied in a first of the two outwardly situated elevator hoistways (for example, in the elevator hoistway 10), if a call command for an upward trip arrives at the elevator control. If a call command for a downward trip arrives, one of the elevator cars 16 in the second of the two outwardly situated elevator hoistways (for example, in the elevator hoistway 12) can be readied. The installation is so designed that a crossover of an empty elevator car 16 from one of the two outwardly situated elevator hoistways 10, 12 into the centrally situated parking hoistway 11 only takes place if the elevator car 16 is empty. Empty elevator cars 16 are parked in the parking hoistway 11. The elevator control is preferably so designed that readying of empty

elevator cars 16 takes place depending on requirements. For this purpose, empty elevator cars 16 are parked in waiting positions in the parking hoistway 11 in the vicinity of the crossing-points 15, to allow rapid readying in case of a
5 call command.

For the elevator installation a rectangular plan was selected, since this arrangement of the three elevator hoistways 10, 11, 12 ensures a good transportation
10 performance with acceptable space utilization.

According to another embodiment, each of the elevator cars 16 has an autonomous car-mounted linear drive 21, 22 which enables the elevator cars 16 to move independently in a
15 vertical direction in the vertical elevator hoistways 10, 11, 12. Such a system is illustrated in Figure 4, which shows a section through the elevator hoistway 10. Arranged on the rear wall 20 of the hoistway is a non-electrified driving component 23 (e.g. the secondary component of a
20 linear-motor drive) along which the linear drive 21, 22 moves. The linear drive 21, 22 has a control which enables it so to control the linear drive 21, 22 that the latter causes an upward trip or a downward trip of the elevator car 16 in the respective elevator hoistway. Control of the
25 linear drive 21, 22 takes place by reference to a call command which can be initiated, for example, by pressing a call button.

In a further embodiment, an elevator car 16 has an
30 additional drive for the purpose of moving the elevator car 16 independently in a horizontal direction from one elevator hoistway 10 or 12 into the parking hoistway 11, or out of the parking hoistway 11.

Alternatively, the linear drive 21, 22 which is present and used to move the elevator cars 16 vertically can be swiveled in such manner that this linear drive 21, 22 can also be used to cause the horizontal movement between adjacent elevator hoistways. This swiveling preferably takes place together with a swiveling of a section of the non-electrified drive component 23, since swiveling of the linear drive 21, 22 alone would necessitate detachment of the linear drive 21, 22 from the non-electrified drive component 23. Such detachment is laborious, because between the linear drive 21, 22 and the non-electrified drive component 23 enormous adhesive forces prevail.

According to a further embodiment of the invention, the elevator system has a control system 40, as shown diagrammatically in Figure 5. The control system 40 is so designed that use is made of a so-called requirements profile to enable empty elevator cars 36.1 - 36.3 to be readied according to needs. Such a requirements profile can have a fixed specification, or it can adapt itself dynamically. The requirements profile is preferably stored in a memory 38. Specially suitable is a requirements profile in which certain basic requirement patterns are specified, but which automatically develop further through daily observation of the elevator operation.

This is explained by a simple example. In the case of an elevator system in an office building, when work starts there are many upward trips to the various offices. According to the invention, the requirements profile is so designed that several empty elevator cars 36.1 - 36.3 are parked in the lower sector of the parking hoistway 31, so that sufficient empty elevator cars 36.1 - 36.3 stand ready for the forthcoming upward trips. In the evenings, or when work ends, several empty elevator cars 36.1 - 36.3 are

required in the upper and middle sectors of the hoistway, since many passengers leave their offices and travel in the direction of the ground floor 13.2 or parking basement 13.1. An automatically adapting control system 40 can, for example, take into account that there may be differences in passenger behavior between summer and winter. It is also conceivable that during absences for vacations the requirements profile adapts itself by recording how many upward trips are requested in the morning, and then in the evening of the same day, possibly readying fewer elevator cars 36.1 - 36.3 than usual.

The elevator system according to the embodiment shown in Figure 5 has three adjacently situated elevator hoistways 30, 31, 32, of which the central hoistway serves as a vertical parking hoistway 31. In the example shown, in the vicinity of the bottom story 13.1 (parking basement), in the vicinity of the story 13.3, and on the top story 13.5 there are passages 35, which allow transfer of the elevator cars 36.1 - 36.3 between two adjacently situated elevator hoistways 30, 31, 32. In the example shown, the control system 40 comprises a memory 38 which, for example, readies requirements profiles. On each of the stories 13.1 - 13.5 there is a panel 41.1 - 41.5 by means of which, in case of need, one of the elevator cars 36.1 - 36.3 can be called. In the embodiment shown, the panels 41.1 - 41.5 are connected via a communication connection 37 to the control system 40. Each of the elevator cars 36.1 - 36.3 has a control unit 39, which can be connected via communication connections 42.1 - 42.3 to the central control system 40 of the elevator installation. The components 37, 38, 39, 40, 41.1 - 41.5, 42.1 - 42.3, and 43 collectively are designated as the elevator control. In Figure 5, the communication connections 37 and 42.1 - 42.3 are shown only diagrammatically. The communication connections 37 and 42.1

- 42.3 are usually bus connections or parallel wired connections.

Following initiation of a call command by, for example,
5 actuation of the "up" button on the panel 41.1, this call
command is transmitted via the communication connections 37
to the control system 40. The control system 40 selects an
elevator car 36.3 which is close to the story 41.1 and
empty. Via the communication connection 42.3, the control
10 system 40 commands the control unit 39 of the elevator car
36.3. This can take place, for example, by the control
system 40 passing to the control unit 39 of the elevator
car 36.3 a requirements profile, which is then
automatically executed by the control unit 39. In this
15 case, the control unit 39 must be of an intelligent form to
be capable of independently executing a requirements
profile. In another embodiment, the control units 39 are
subordinated to the control system 40, and therefore need
not be designed so elaborately.

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The control unit 39 activates and controls the autonomous
linear drive of the elevator car 36.3 in such manner that
the latter moves from the parking hoistway 31, in which
according to Fig. 5 it is present, through the passage 35
25 into the left elevator hoistway 30 which is reserved for
upward trips. The elevator car 36.3 then halts
independently at story 41.1, from which the call command
was issued, where it opens the car doors (if present) and
hoistway doors. After the passenger has boarded the
30 elevator car 36.3 and pressed a story button on the car
panel 43 in the car, the doors close and the elevator car
36.3 is set in motion. At the desired destination story,
the elevator car 36.3 halts, to allow the passenger to
exit. The elevator car 36.3 then moves through the nearest
35 passage 35 back into the parking hoistway 31, if the

control system 40 has transmitted to the control unit 39 of the elevator car 36.3 a corresponding requirements profile. Otherwise, the elevator car 36.3 can, for example, remain in the elevator hoistway 30 until a new requirements
5 profile is passed to the control unit 39 by the control system 40.

It is self-evident that there are various variants of the elevator control which can be realized in such an elevator
10 system. It is preferable for the control system 40 to retain a certain authority over the control units 39 of the elevator cars 36.1 - 36.3. This is advantageous for the following reasons:

- avoidance of collisions of the elevator cars 36.1 -
15 36.3;
- readying of the elevator cars 36.1 - 36.3 in the elevator hoistways 30, 32 according to requirements;
- readying of the elevator cars 36.1 - 36.3 in the
20 parking hoistway 31 according to requirements;
- reversal of direction in the elevator hoistways 30, 31, 32;
- special traffic for maintenance, or in case of other faults, etc.

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According to a further embodiment of the invention, the elevator system is so designed that before execution of a transfer of an elevator car from one of the hoistways into another hoistway, the respective elevator car is checked
30 for emptiness. For this purpose, sensors can be fitted in or on the elevator car. Only then does the elevator stop at the height of a passage, and only then is the change of hoistway initiated and executed.

A further embodiment according to the invention is shown in a side view in Figures 6A and 6B. Supported by the elevator car 56 on a lower suspension 59 is a lower pair of rollers 57 (of which pair of rollers 57, only one wheel is visible in the figure). Diagonally opposite on an upper edge of the elevator car 56, a further pair of rollers 58 is supported (of which pair of rollers 58, only one wheel is visible in the figure). These pairs of rollers 57, 58 guide the elevator car 56 along the guide rails 53 and 55. For this purpose, the pairs of rollers 57, 58 may possibly be provided with flanges so that guidance in the direction of movement is assured. It is preferable for the car-mounted drive (not shown in Figures 6A, 6B) to be arranged on the outside back wall 66 of the elevator car 56. This eccentric arrangement of the drive on the back of the car 66 gives rise to a torque (as shown in Figure 6A by the arrow 67), so that for positioning of the elevator car 56 only the two pairs of rollers 57, 58 are needed. This torque acts clockwise, and is of such magnitude in every travel situation that the rollers of the roller pairs 57, 58 are under pressure. The torque results from the force of the car-mounted drive and the force of gravity.

When executing a crossover of the elevator car 56 from one elevator hoistway 50 into an adjacent hoistway, the following steps are executed once the elevator car 56 is empty and has been halted at a prescribed position in the elevator hoistway 50. This situation is shown in Figure 6A. So as to be able to move the elevator car 56 into the adjacent hoistway, the elevator car 56 is brought into contact with horizontal guiding elements 62, 64. For this purpose, engaging elements 63, 65 are provided on the elevator car 56. The horizontal guiding elements 62, 64 are located in the vicinity of a passage. The engaging element 63 in Figure 6A is pushed out beyond the lower edge of the

car and the elevator car 56 slightly lowered, so that the latter supports itself on the guiding element 62 by means of the engaging element 63.

5 The supporting force, and the weight of the elevator car 56, result in a torque which tilts the elevator car 56 counterclockwise about a pivot point situated at the elements 62, 63 (as indicated in Figure 6B by the arrow 68) until it rests with its engaging element 65 against the
10 guiding element 64. As a result of this tilting motion, the guiding rollers 57, 58 become disengaged from (out of contact with) the guide rails, and the elevator car 56 can be moved horizontally.

15 This tilting movement is preferably initiated by cessation of the torque (arrow 67) which originates from the drive. If the drive is switched off, this torque ceases, and the elevator car 56 tilts counterclockwise under its own weight as shown in Figure 6B. The tilting motion can, however,
20 also be produced or assisted by mechanical or electro-mechanical means.

Return of the elevator car 56 to the vertical after a horizontal movement can be achieved by generating an upward
25 force in the car-mounted drive.

By the slight tilting of the elevator car 56, the rollers of the lower pair of rollers 57 are moved to the right away from the guide rail 53. At the same time, the upper pair of
30 rollers 58 moves to the left away from the guide rail 55. In other words, tilting causes both pairs of rollers 57, 58 of the elevator car 56 to be disengaged from the guide rails 53, 55 fastened to the hoistway. While tilting, the engaging element 63 makes contact with a horizontal guiding
35 element 62 in the form of a long angle iron. In the

specific example, the engaging element 63 rests on a horizontal leg of the guiding element 62. The engaging element 65 which is fastened diagonally opposite makes contact with the guiding element 64 through being pressed
5 against this element 64.

When tilting has finished, the pairs of rollers 57, 58 no longer have a guiding function. The elevator car 56 can now be moved along the guiding elements 62, 64 perpendicular to
10 the longitudinal direction of the elevator hoistway 50 (i.e. into the plane of the drawing, or out of this plane).

The embodiment shown in Figures 6A and 6B offers various advantages. A car-mounted drive usually presents the
15 problem that the driving force acts outside the center of gravity of the car. This can cause the elevator car to tilt, thereby resulting in jerky movements during travel. The embodiment proposed here transforms this disadvantage into an advantage by the torque from the drive being used
20 during travel to press the pairs of rollers 57, 58 against the guide rails 53, 55. As soon as the guiding forces are no longer needed, these forces can be removed by the drive being switched off. This allows slight disengagement of the
pairs of rollers 57, 58 from the guide rails 53, 55.

25 Because of the type of guidance selected, vertical travel is very comfortable despite the excentric drive. According to the invention, guidance of the elevator car 56, and crossover from hoistway to hoistway, use relatively few moving parts. The solution is therefore robust and
30 inexpensive.

Movement of the elevator car 56 along the guiding elements 62, 64 can be effected by the elevator car 56 itself, with the movement being provided by a drive of the car, or the

movement can be effected by motive means which are located in the elevator hoistway in the vicinity of the passage.

In a further embodiment, contact between elements on the elevator car and guiding elements in the elevator hoistway can be effected by mechanical or electro-mechanical means. In this case, no tilting motion of the elevator car need be executed, since both disengagement of the pairs of rollers from the guide rails, and the creation of contact, can be effected by the mechanical or electro-mechanical means.

A further embodiment is characterized in that before the car drive is switched off, a slide or similar means (e.g. the engaging element 63) on the elevator car 56 can be extended to make contact with an opposite means (e.g. the guiding element 62) in the hoistway. This means can be implemented in such manner as to prevent sinking of the elevator car 56, and/or to serve as the pivot point for execution of the tilting motion.

In a further embodiment, which is represented diagrammatically in Figure 7, there are at least four elevator hoistways 70 - 72 and 77, of which at least one elevator hoistway 77 is reserved for long trips. Preferably, there is one elevator hoistway for long trips in upward direction (e.g. the elevator hoistway 77) and one elevator hoistway for long trips in downward direction. These elevator hoistways (e.g. the elevator hoistway 77) can serve as an overtaking route. Delays on long trips can thereby be largely avoided.

The number of crossing-points 74 to the long-trip hoistways 77 can be less than the number of crossing-points 75 between the elevator hoistways 70, 72 and the parking hoistway 71, since in these long-trip hoistways 77, as the

name already implies, preferably only long trips are made. Changing from an elevator hoistway 77 for long trips, into another elevator hoistway 72, only takes place after a long trip is completed, for example at the top story 73.10 or at the bottom story 73.1. An advantage of the arrangement with long-trip hoistways is that time-consuming long trips are not delayed by elevator cars 76.2 waiting on the first story 73.1. Short trips are preferably made in the two elevator hoistways 70 and 72, between which the vertical parking hoistway 71 is situated. With this arrangement, the elevator cars 76.1 and 76.3 can cross over into the parking hoistway 71 as soon as a trip is completed.

In the example shown, two elevator cars 76.1 are traveling upward in elevator hoistway 70, and two elevator cars 76.3 are traveling downward in elevator hoistway 72. There are six elevator cars 76.2 in the parking hoistway 71. One elevator car 76.4 is moving upward at high speed on a long trip in elevator hoistway 77.

Instead of an autonomous car-mounted linear drive, the elevator cars can be provided with a friction-wheel drive, gearwheel drive, rack drive, or similar.

The arrangement according to the invention is particularly advantageous because it depends on a combination of two important parameters. The parameters particularly support each other in the claimed arrangement. Firstly, the vertical parking hoistway affords the advantage that elevator cars which are not in use can be withdrawn from traffic in the hoistway. The vertical embodiment and arrangement of the parking area as a central hoistway requires little space. Further, the crossing-points between the elevator hoistways and the parking hoistway can be arranged so that each story can be traveled to within a

specified time. Moreover, the elevator cars can be distributed and readied away from the passenger traffic.

The vertical parking hoistway affords the advantage that
5 additional elevator cars can be stored in the elevator system and called into use when required. Also, according to the invention, one-way operation can be continued indefinitely, since elevator cars can be repeatedly made ready from the parking hoistway. Empty elevator cars
10 preferably remain in the vertical elevator hoistways for only as long as absolutely necessary.

The arrangement according to the invention affords a high degree of comfort for the passengers, since vibrations are
15 avoided, and passengers are not subjected to lateral acceleration.

According to the invention, all hoistway doors are arranged in one vertical plane. By this means, travel of the
20 elevator cars in direction normal to said plane is avoided. Lateral acceleration of loaded elevator cars is also avoided by the elevator cars only executing changes of hoistway in the empty (unloaded) state.

25 According to the invention, the direction of travel can be defined for each hoistway. Preferably, one of the hoistways is used exclusively for upward trips, and another hoistway for downward trips.

30 According to the invention, an arrangement and a method are provided which allow good transportation performance with reasonable constructional outlay. The invention affords great flexibility since, in case of need, empty elevator cars can be made ready at several different places.

The greater the number of crossing-points provided between adjacent elevator hoistways, the more flexibly the traffic concept of the elevator installation can be designed.

According to the invention, one of the elevator hoistways
5 (preferably the central hoistway) serves as a lay-by and parking hoistway. This elevator hoistway need not have any access openings.

Use of a parking hoistway has the advantage that at any
10 time, only the number of elevator cars required at that time need be kept in circulation. This has, for example, an influence on the overall energy balance of an elevator installation. Furthermore, wear is reduced through the elevator cars not being in continuous use.

15

There are advantages of the invention in that the cross-section of the elevator hoistway is substantially reduced relative to that of a conventional hoistway arrangement for the same traffic capacity. Waiting times in front of the
20 elevator hoistways, and time spent in the elevator cars, are made shorter by the invention. Building construction costs can be reduced by comparison to traditional approaches.

Patent Claims

1. Method of operating an elevator installation with three adjacently situated vertical elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77) having a centrally situated hoistway and two outwardly situated elevator hoistways and several individually driven elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4), the two outwardly situated elevator hoistways (10, 12) having access openings (14) which lie in one plane, and the centrally situated elevator hoistway (11; 31; 71) having crossing-points (15; 35; 74, 75) which allow movement of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) between two adjacently arranged elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77),
the method comprising the following steps:
 - a) ready one of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) in a first of the two outwardly situated elevator hoistways (10; 30; 70), if a call command for an upward trip arrives,
 - b) ready one of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) in the second of the two outwardly situated elevator hoistways (12; 32; 72) if a call for a downward trip arrives,
 - c) execute a transfer of an empty elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) from one of the two outwardly situated elevator hoistways (10, 12; 30, 32; 70, 72) to the centrally situated elevator hoistway (11; 31; 71) to park the empty elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) in the centrally situated elevator hoistway (11; 31; 71),
 - d) depending on requirements, ready in the centrally situated elevator hoistway (11; 31; 71) in waiting

positions in the vicinity of the crossing-points (15; 35; 74, 75) empty elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) so said empty elevator cars can be rapidly readied in case of an ordering call.

2. Method according to Claim 1, each of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) having an autonomous car-mounted drive (21, 22) which enables the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) to move independently in a vertical direction in the vertical elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77), the method comprising the following steps:
 - command the drive (21, 22) to cause an upward trip or a downward trip of an elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4), depending on the ordering call.
3. Method according to Claim 1 or 2,
 - each of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) having one of:
 - a further drive to move the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) independently in a horizontal direction between two adjacently situated elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77), and
 - the drive (21, 22) being so designed as to move the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) independently in a horizontal direction between two adjacently situated elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77).
4. Method according to Claim 1, 2, or 3, the drive being a linear drive, and the following step being executed before moving an elevator car (16; 36.1 - 36.3; 56;

76.1 - 76.4) :

- swivel the linear drive (21, 22) of the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4).

5. Method according to any one of Claims 1 to 4, characterized in that one of the following additional steps is executed:
 - refer to a stored requirements profile, to enable empty elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) to be readied depending on requirements.
6. Method according to any one of Claims 1 to 5, characterized in that before execution of a transfer, the following additional steps are executed:
 - halt the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) at the height of a passage (15; 35; 74, 75),
 - check whether the respective elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) is empty.
7. Method according to any one of claims 1, 2, or 3, characterized in that before executing a transfer, the following additional steps are executed:
 - create a contact between engaging elements (63, 65) on the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) and horizontal guiding elements (62, 64) which are present in the vicinity of a passage (15; 35; 74; 75) in the elevator hoistway,
 - tilt the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) to disengage pairs of rollers (57, 58) of the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) from guide rails (53, 55) fastened to the hoistway.

8. Method according to any one of claims 2 to 7, characterized in that each of the elevator cars (16; 36.1 - 36.3; 76.1 - 76.4) has a control unit (39) which can be connected via a communication connection (42.1 - 42.3) to a control system (40) of the elevator installation, the method comprising the following further steps:
- receipt by the control system (40) of an ordering call,
 - selection of a readied elevator car (16; 36.1 - 36.3; 76.1 - 76.4),
 - transmission of control information from the control system (40) via the communication connection (42.1 - 42.3) to the control unit (39) of the readied elevator car (16; 36.1 - 36.3; 76.1 - 76.4),
 - via the control unit (39), command the car-mounted drive (21, 22) of the readied elevator car (16; 36.1 - 36.3; 76.1 - 76.4) to move the elevator car (16; 36.1 - 36.3; 76.1 - 76.4) to the access opening (14) of the story (13.1 - 13.5; 73.1 - 73.10) from which, or for which, the ordering call has arrived.
9. Method according to Claim 8, characterized in that the control system (40) executes software-controlled steps to control and ready the elevator cars (16; 36.1 - 36.3; 76.1 - 76.4) depending on traffic.
10. Elevator installation with
- several individually driven elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4),
 - a first vertical elevator hoistway (10; 30; 70) which

- has access openings,
a second vertical elevator hoistway (12; 32; 72),
which has access openings (14),
- a vertical parking hoistway (11; 31; 71) which is situated between the first vertical elevator hoistway (10; 30; 70) and the second vertical elevator hoistway (12; 32; 72) and which has crossing-points (15; 35; 74, 75) which allow movement of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) between two adjacently situated elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77),
 - a control system (39, 40) and driving means (21, 22), the first elevator hoistway (10; 30; 70) and the second elevator hoistway (12; 32; 72) being arranged in such manner that the access openings (14) lie in one plane, and
empty elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) being movable by means of the control system (39, 40) and the driving means (21, 22) through the crossing-points (15; 35; 74, 75), and empty elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) being readable in case of need in the first elevator hoistway (10; 30; 70) and in the second elevator hoistway (12; 32; 72).
11. Elevator installation according to Claim 10, characterized in that
each of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) has an autonomous car-mounted drive (21, 22) which enables the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) to move independently in a vertical direction in the vertical elevator hoistways (10, 12; 30, 32; 70, 72, 77) and in the parking hoistway (11; 31; 71).

12. Elevator installation according to Claim 11, characterized in that
- the autonomous car-mounted drive is a linear drive (21, 22),
 - each of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) either has a further drive to move the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) independently in a horizontal direction between two adjacently situated elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77), or
 - the linear drive (21, 22) is so designed as to be able to move the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) independently in a horizontal direction between two adjacently situated elevator hoistways (10, 11, 12; 30, 31, 32; 70, 71, 72, 77).
13. Elevator installation according to Claim 12, characterized in that the elevator installation includes means of swiveling the linear drive (21, 22).
14. Elevator installation according to any one of Claims 10 to 13, characterized in that each of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) has means of creating a contact between engaging elements (63, 65) on the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) and horizontal guiding elements (62, 64), the horizontal guiding elements (62, 64) being located in the vicinity of a passage (15; 35; 74, 75) in the elevator hoistway (10, 11, 12; 30, 31, 32; 70, 71, 72, 77).

15. Elevator installation according to any one of Claims 10 to 13, characterized in that each of the elevator cars (16; 36.1 - 36.3; 56; 76.1 - 76.4) has means of tilting the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) for the purpose of disengaging pairs of rollers (57, 58) of the elevator car (16; 36.1 - 36.3; 56; 76.1 - 76.4) from guide rails (53, 55) fastened to the hoistway.

16. Elevator installation according to any one of Claims 10 to 15, characterized in that one of the vertical elevator hoistways is designed as a long-trip hoistway.

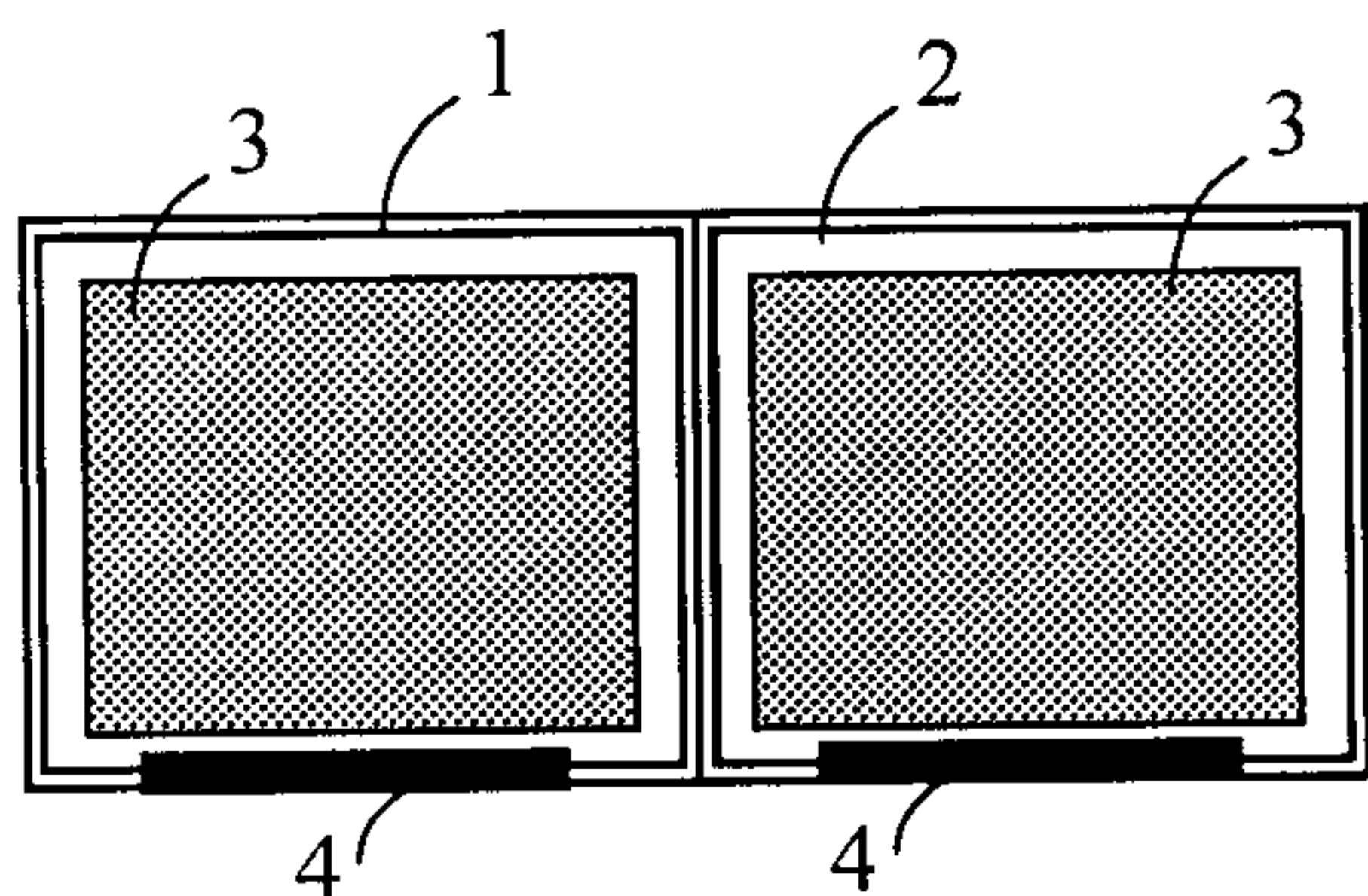


Fig. 1A

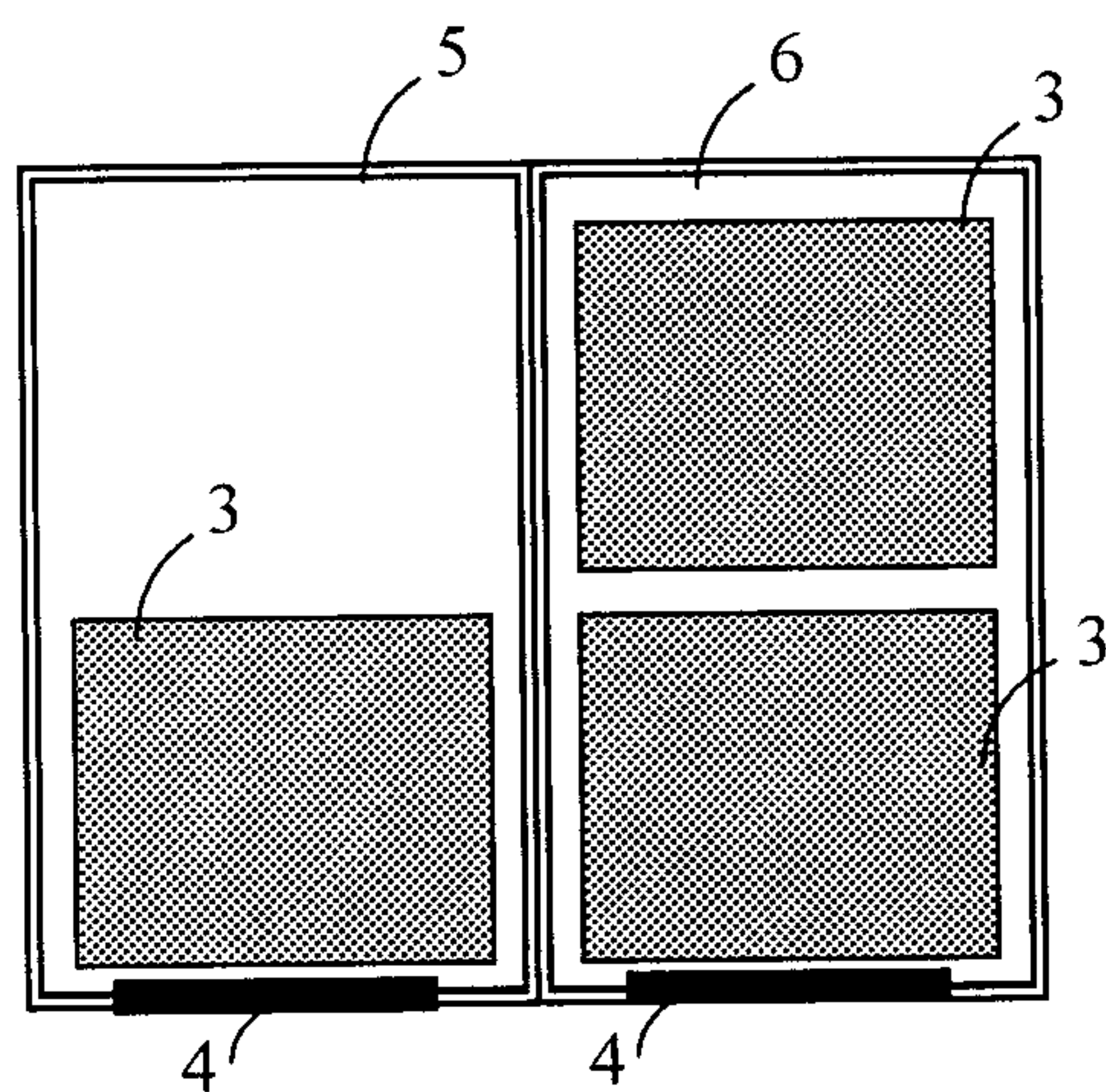


Fig. 1B

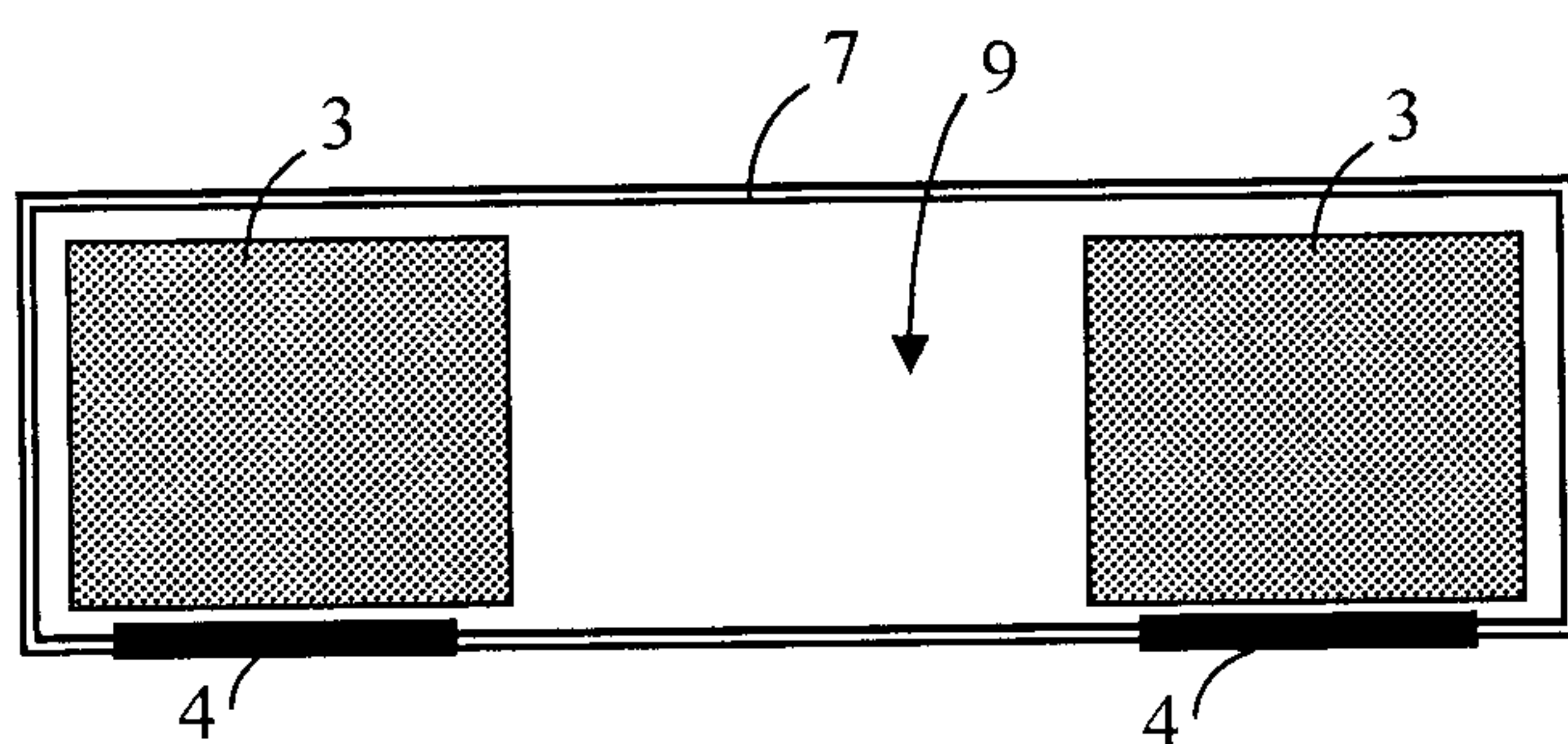


Fig. 1C

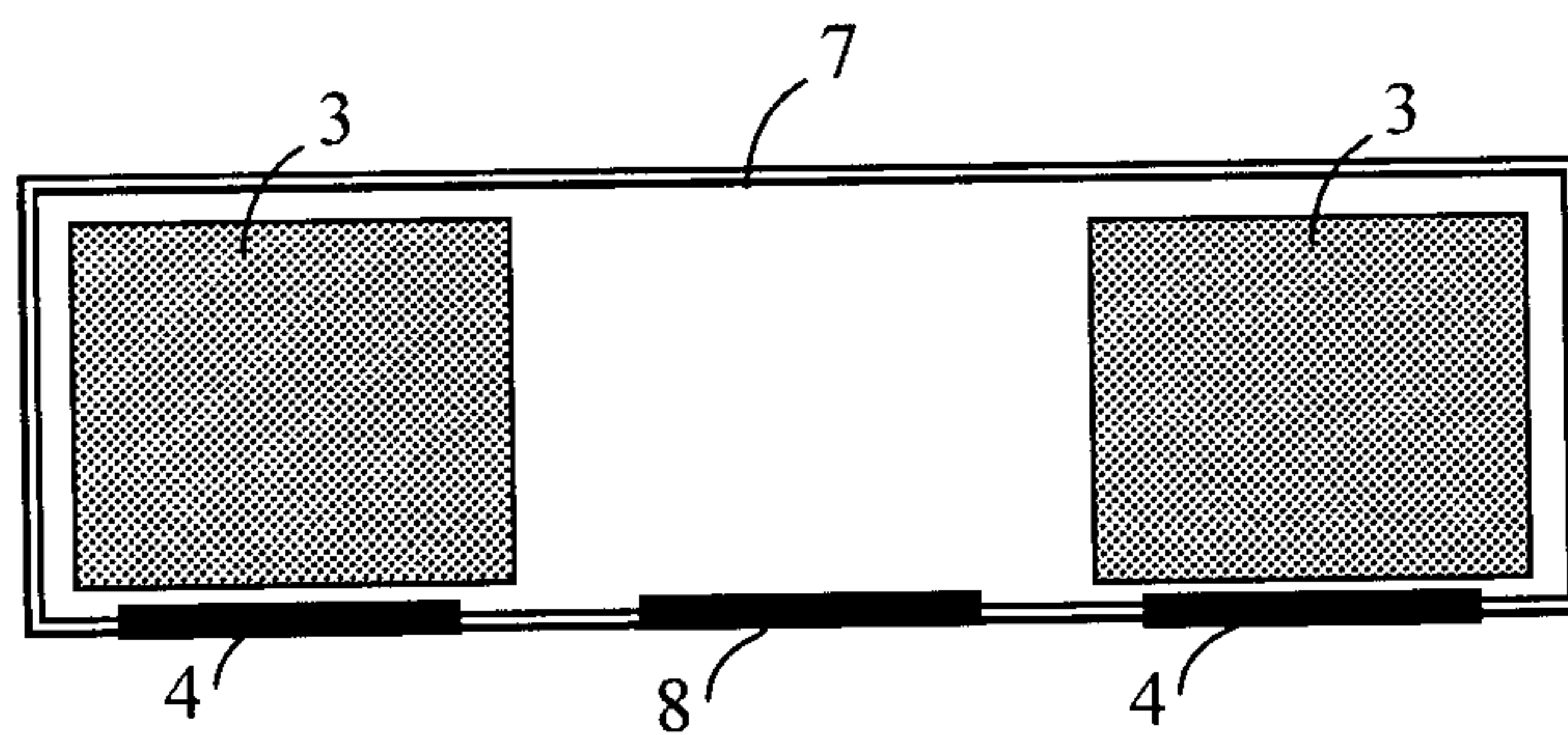


Fig. 1D

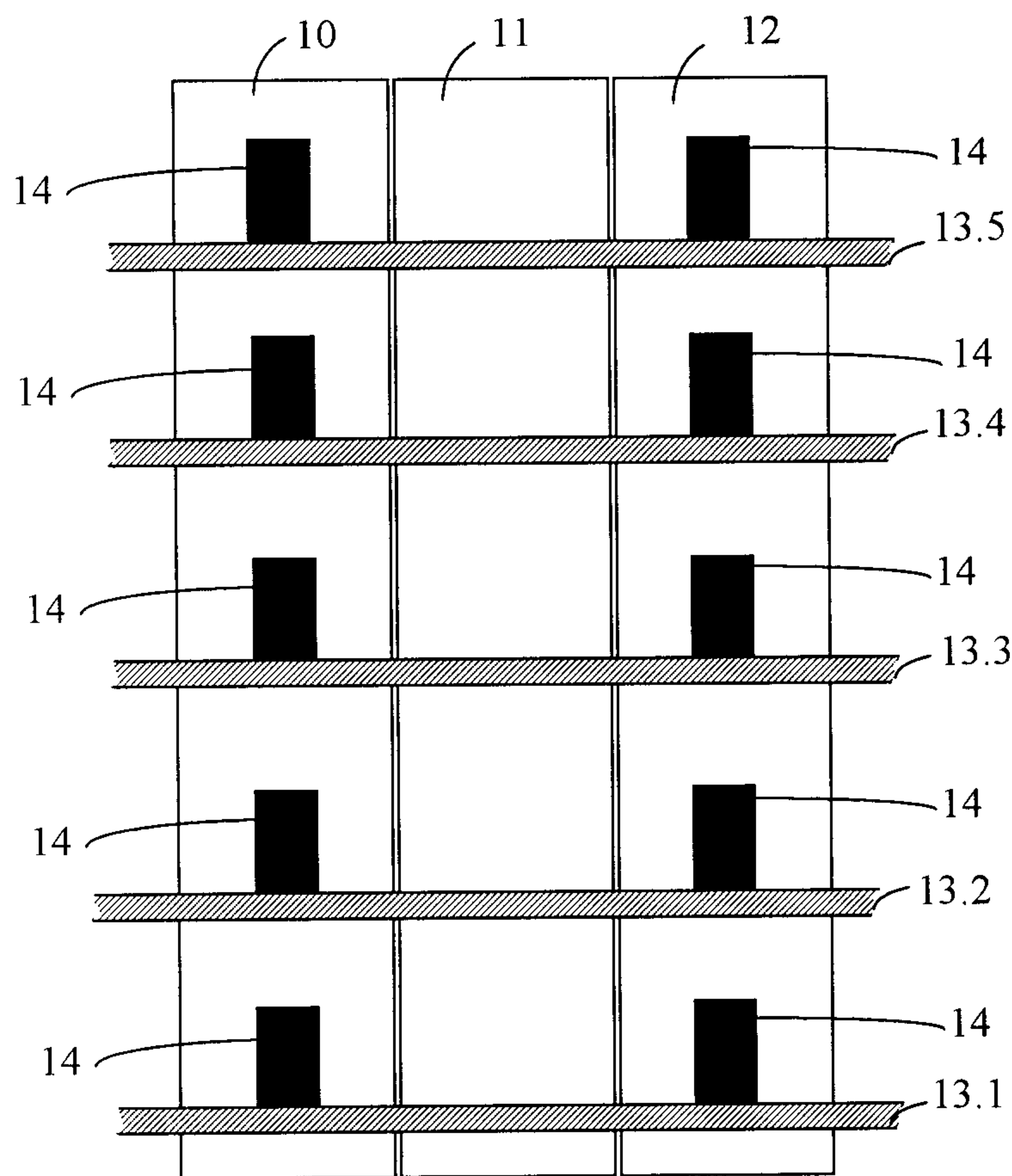


Fig. 2

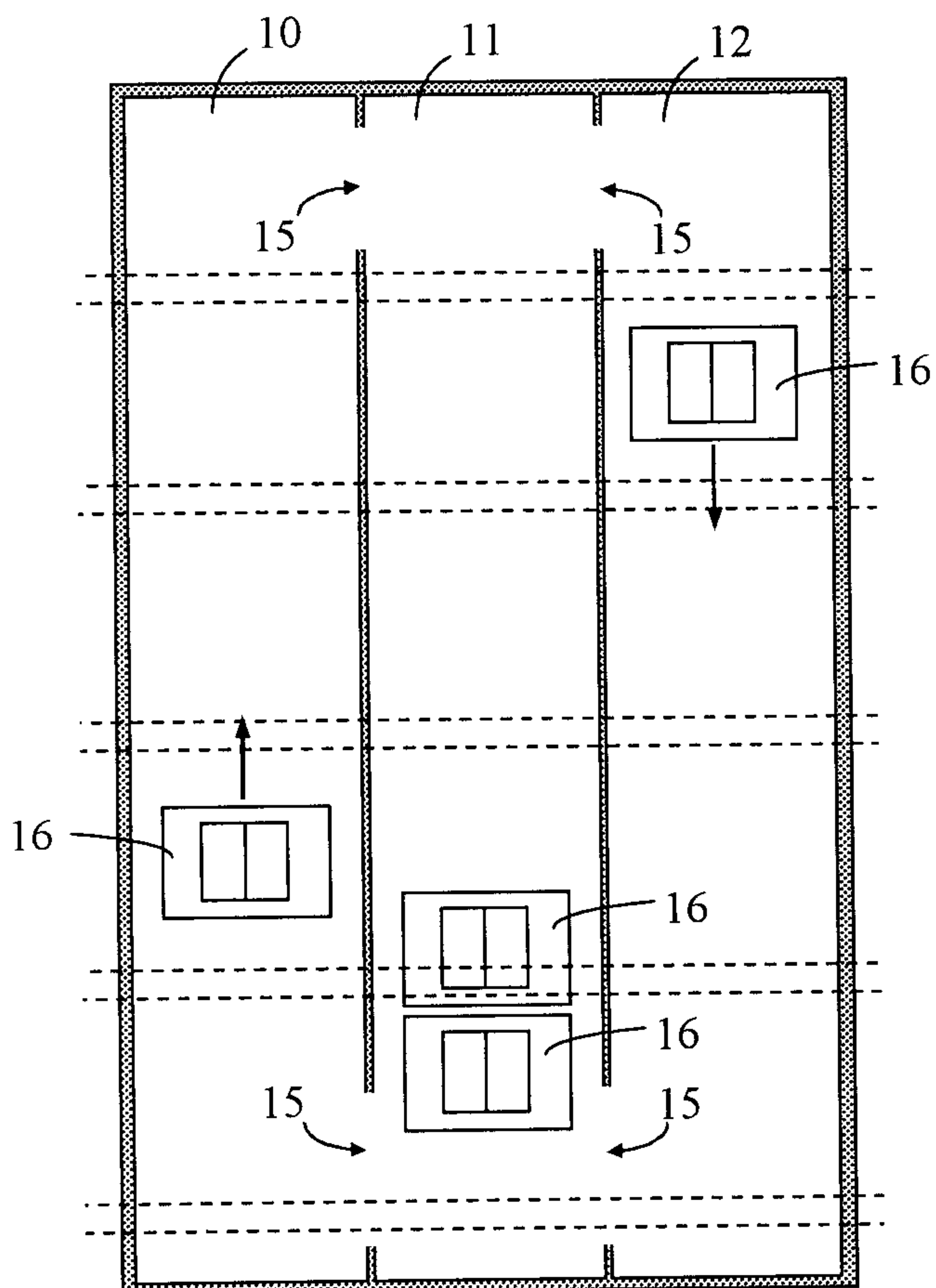


Fig. 3

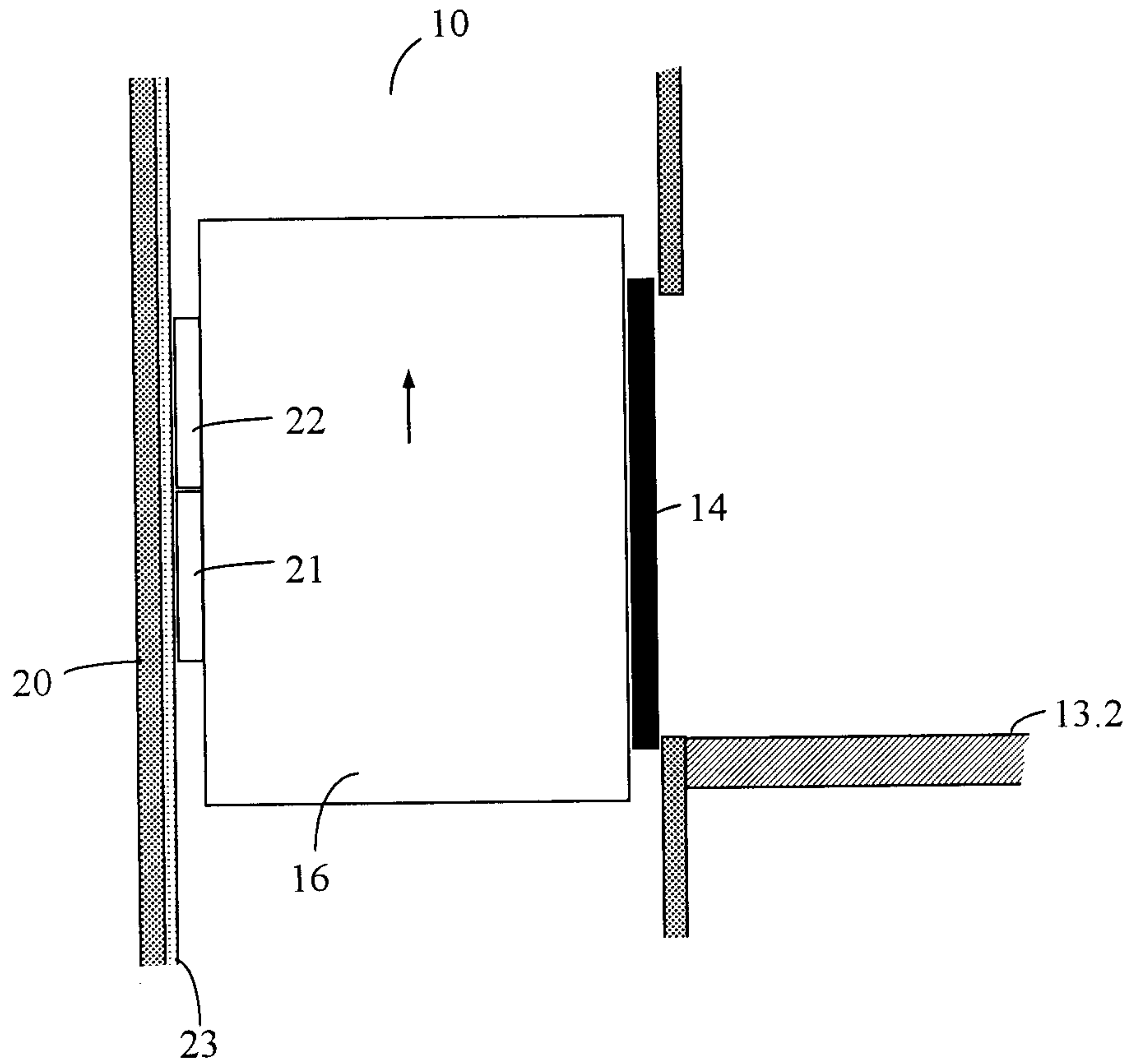


Fig. 4

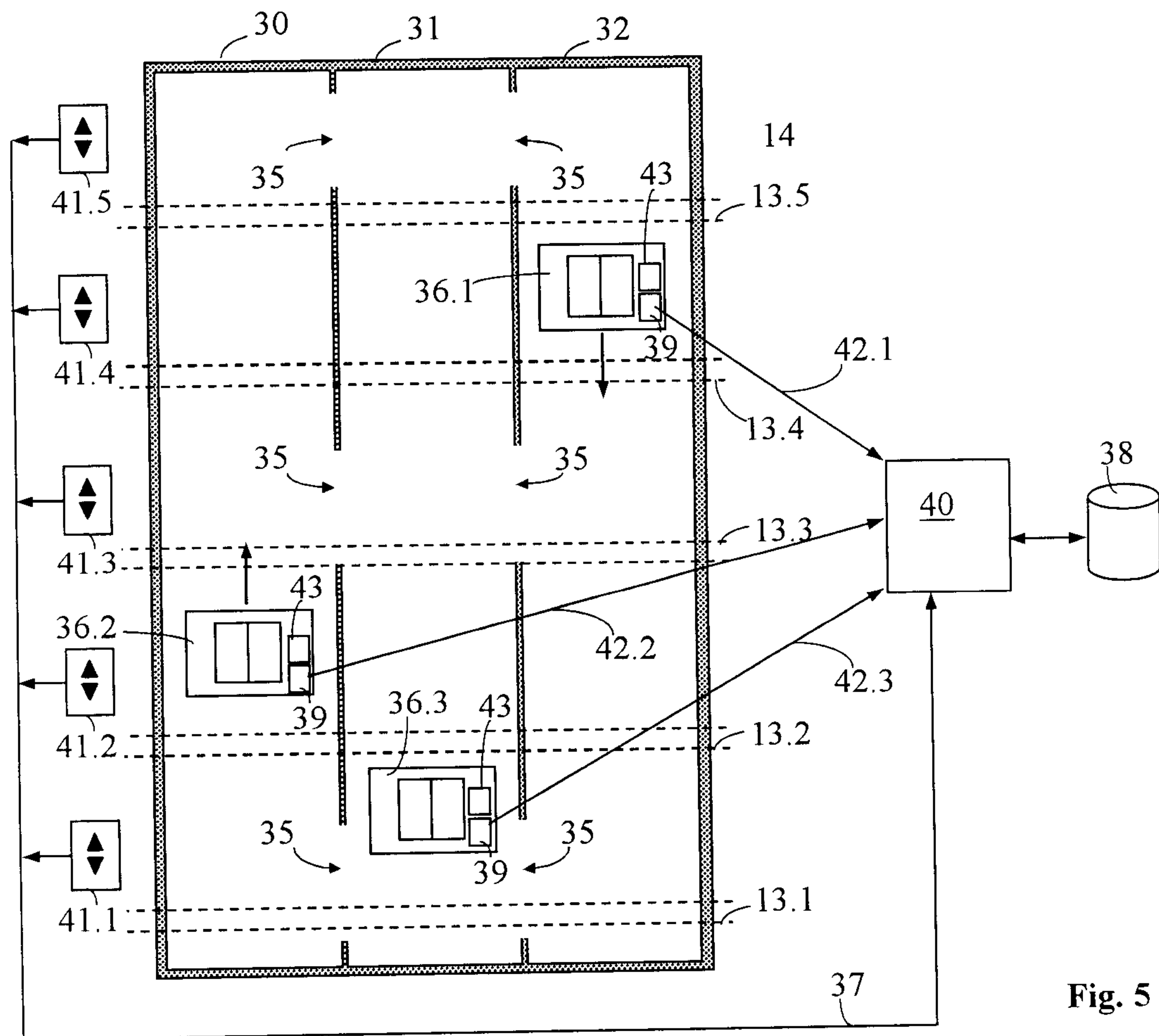


Fig. 5

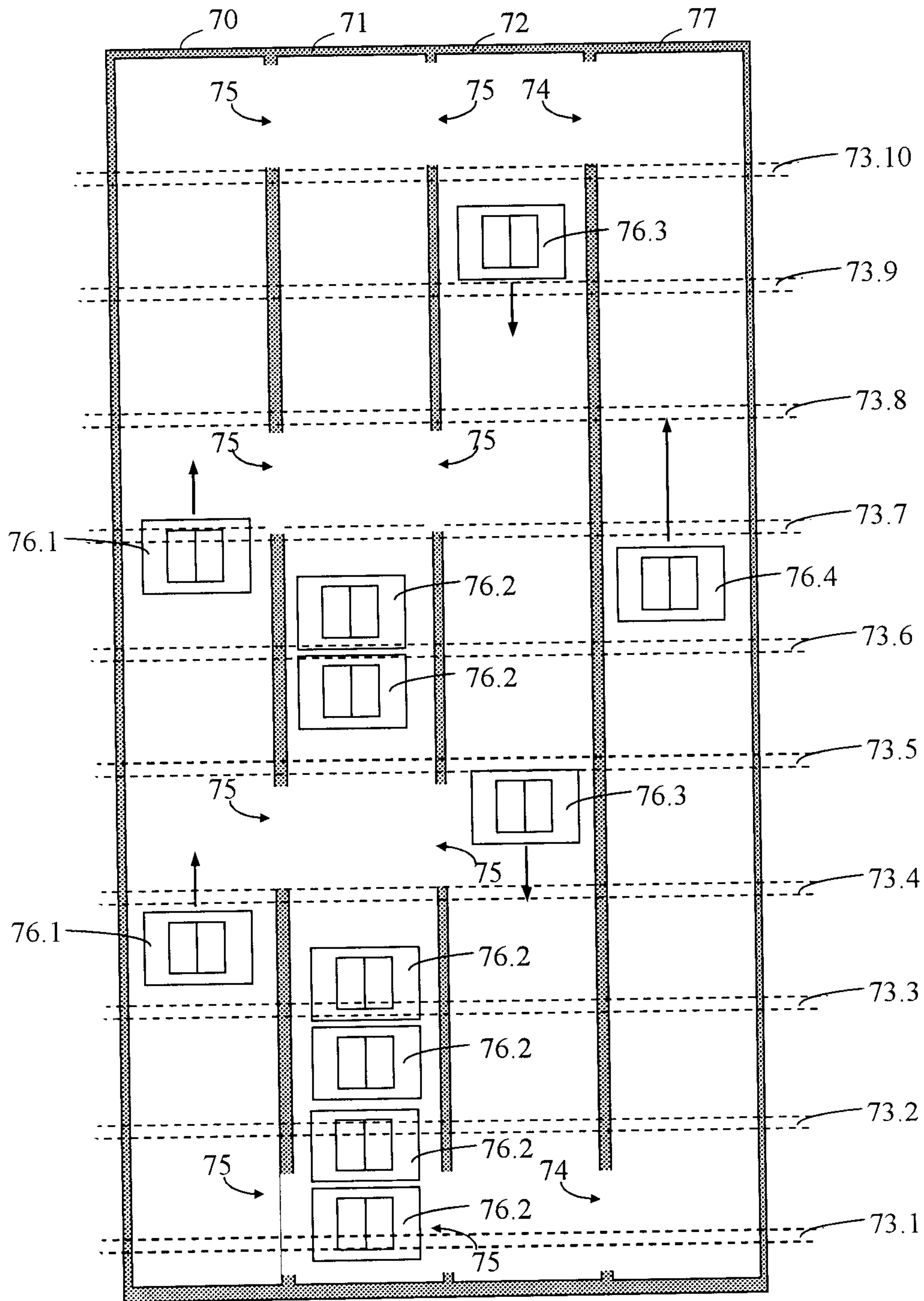


Fig. 7

