

US 20190308812A1

(19) **United States**(12) **Patent Application Publication**  
**LINDBLOM**(10) **Pub. No.: US 2019/0308812 A1**(43) **Pub. Date: Oct. 10, 2019**(54) **A MULTI-STOREY GOODS STORAGE  
ARRANGEMENT, A METHOD OF  
OPERATING SUCH AN ARRANGMENT AND  
A PICKER TRANSFER CART FOR  
OPERATION THEREIN**(52) **U.S. Cl.**  
CPC ..... **B65G 1/1375** (2013.01); **B65G 1/0492**  
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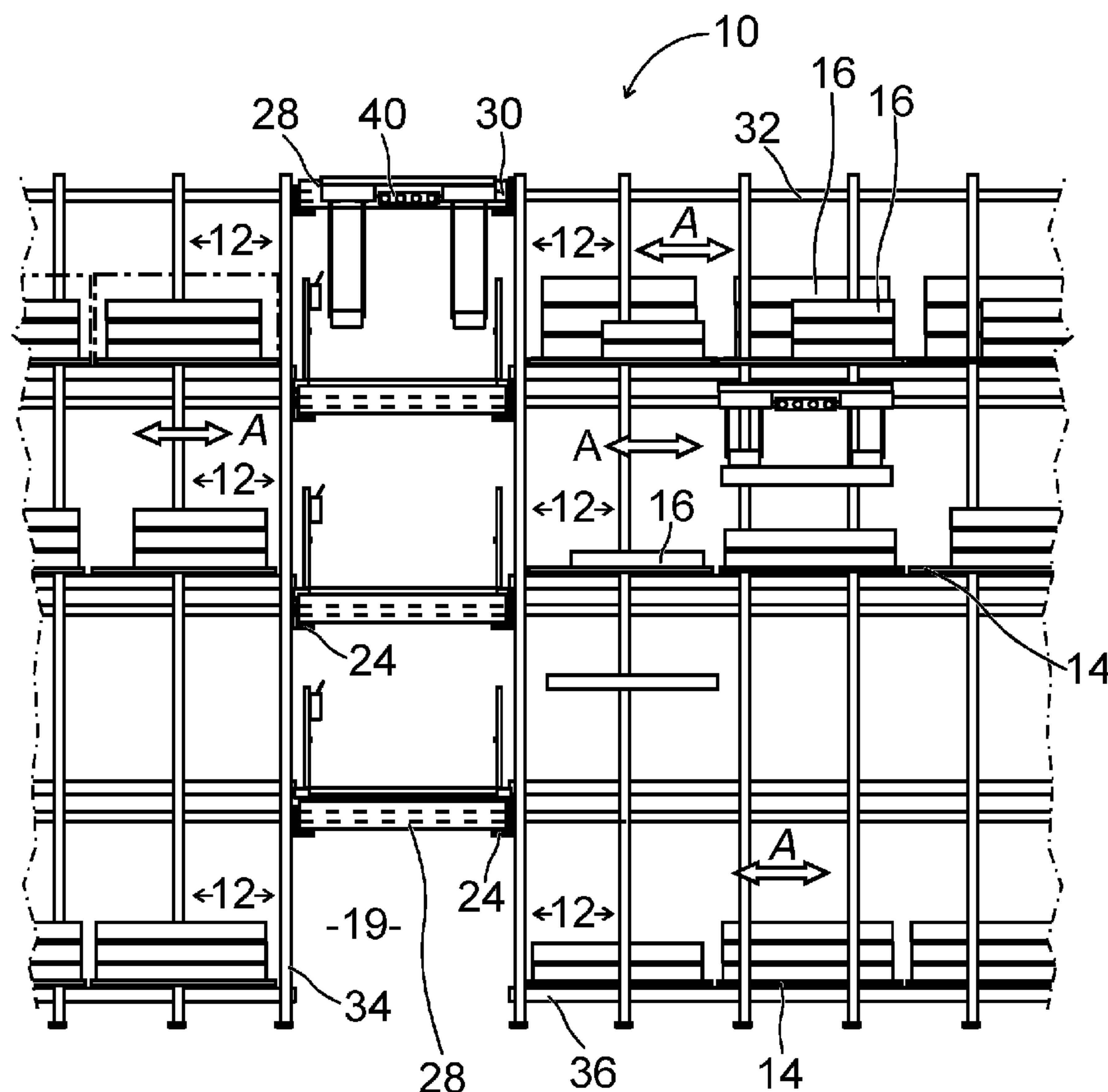
(2) Date: **Apr. 9, 2019**(30) **Foreign Application Priority Data**

Oct. 14, 2016 (SE) ..... 1651350-9

**Publication Classification**(51) **Int. Cl.**  
**B65G 1/137** (2006.01)  
**B65G 1/04** (2006.01)(57) **ABSTRACT**

A picker transfer cart (28) arranged to move along picking aisles (19) in a multi-storey goods storage arrangement (10) comprising a plurality of levels of storage lines (12) arranged in parallel, each storage line (12) supporting a plurality of baseboards (14) with packages (16),

transport aisles (18) extending in parallel between opposing ends of sets said storage lines (12). Each picker transfer cart (28) supports at least one picker cart (40) suspended from a top rail arrangement (30), and said picker cart (40) comprises lifting means (46) to lift a package (16) stored in said storage lines (12) and to transport lifted package to a picking aisle (19) after returning said picker cart (40) to said picker transfer cart (28). Said lifting means (46) comprises two lifting yokes (48) suspended from said picker cart (40), each of said lifting yokes (48) comprising a suction device (60) having a surface to be firmly engaged to a package (16).



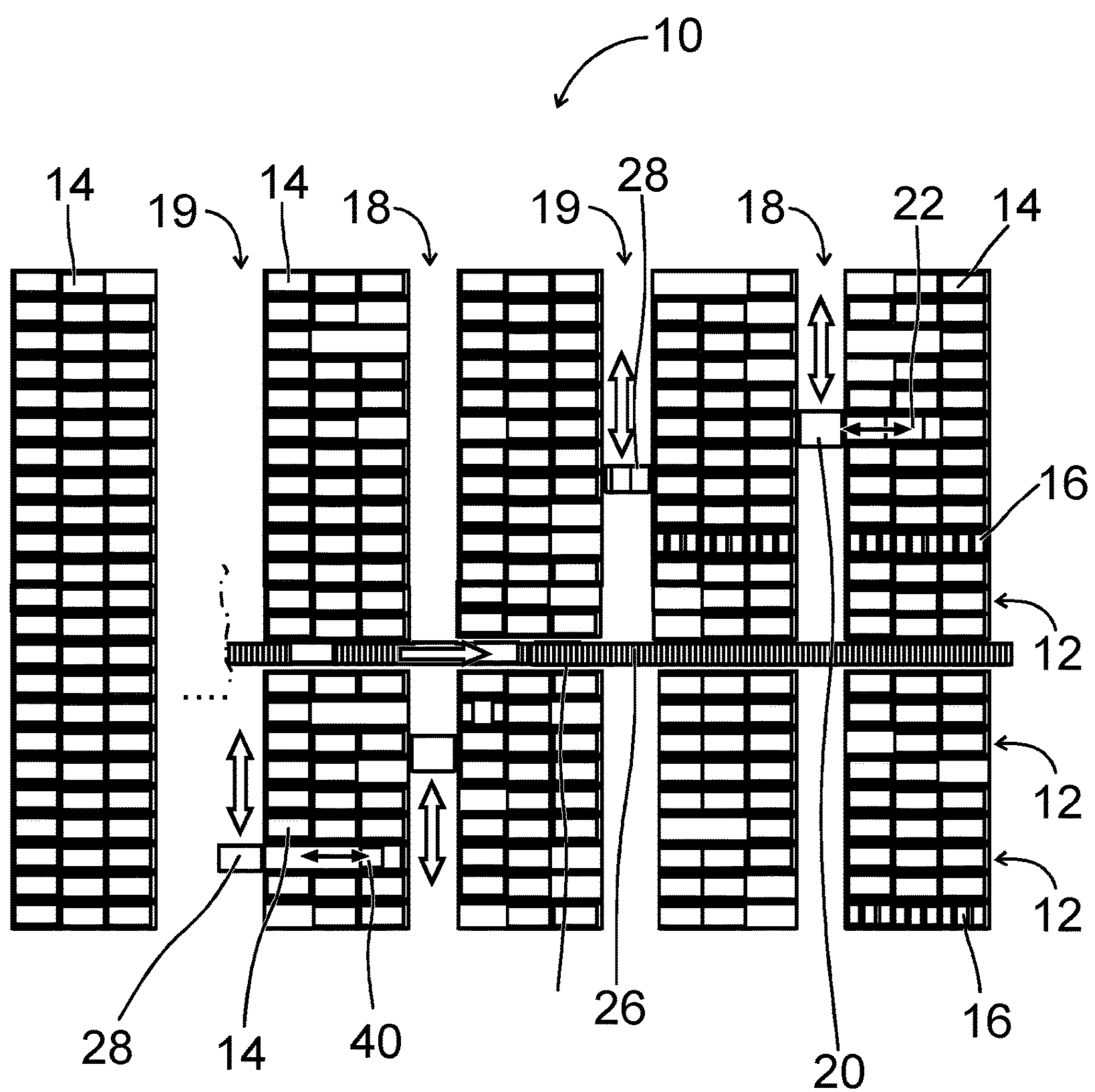


Fig. 1

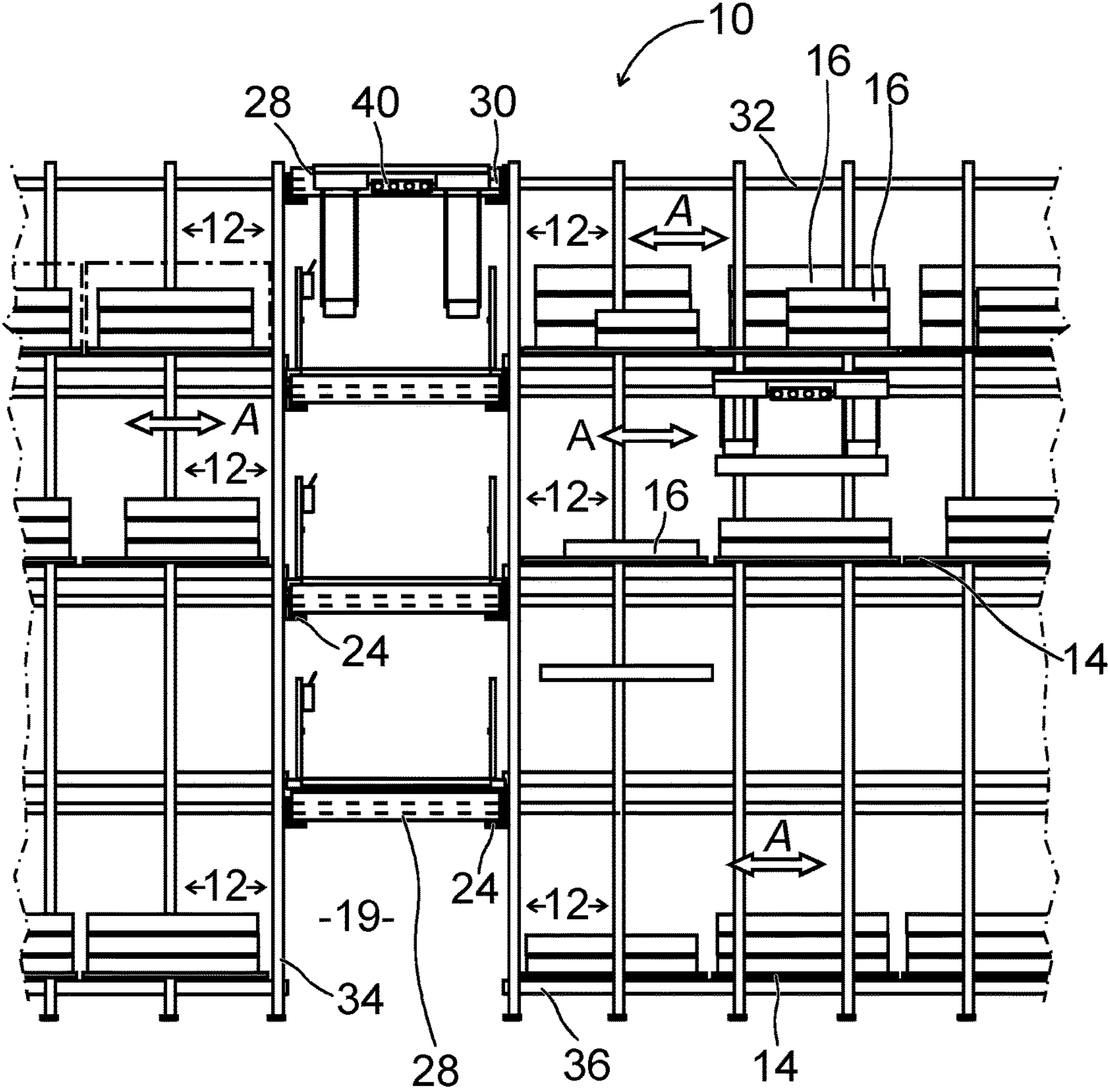
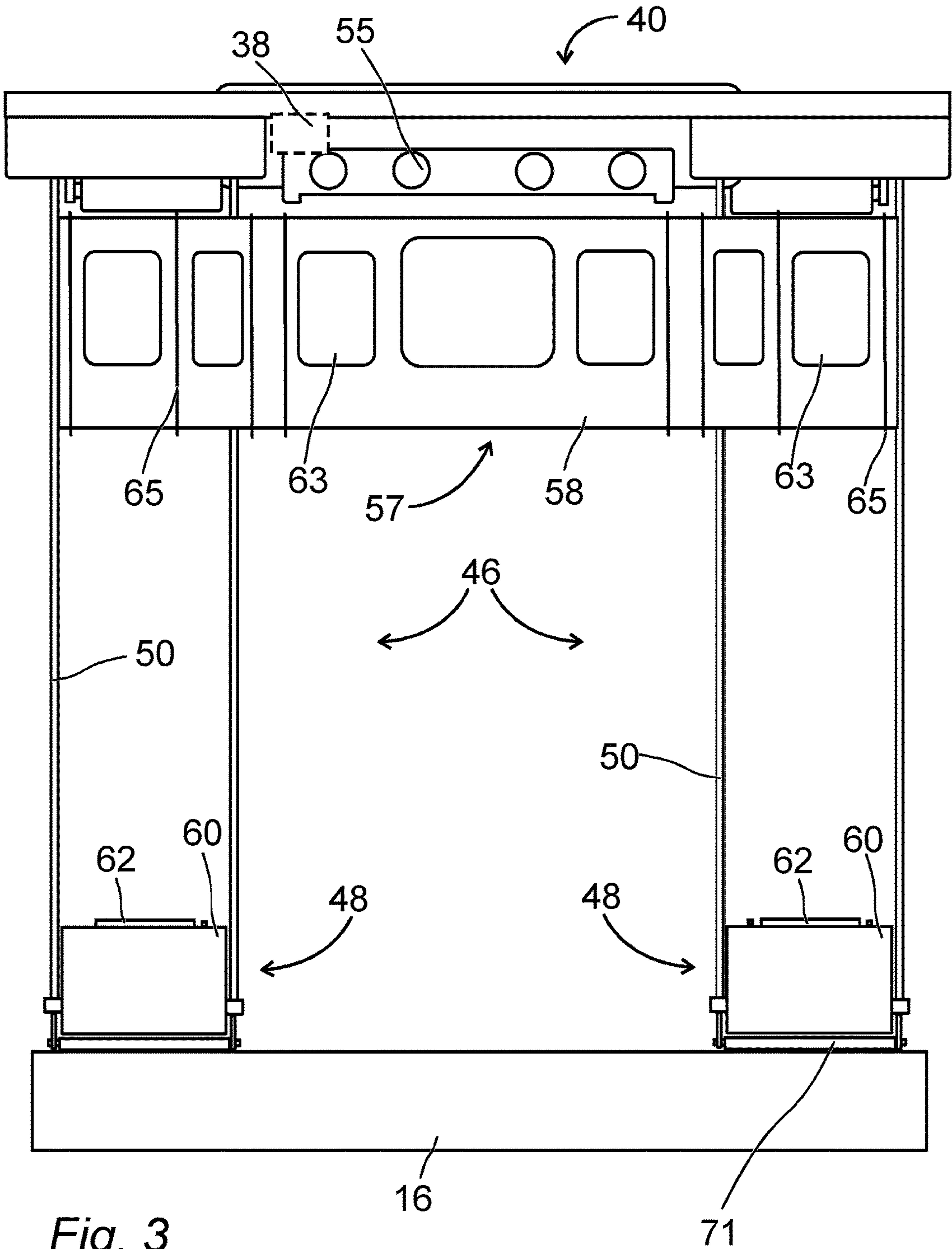
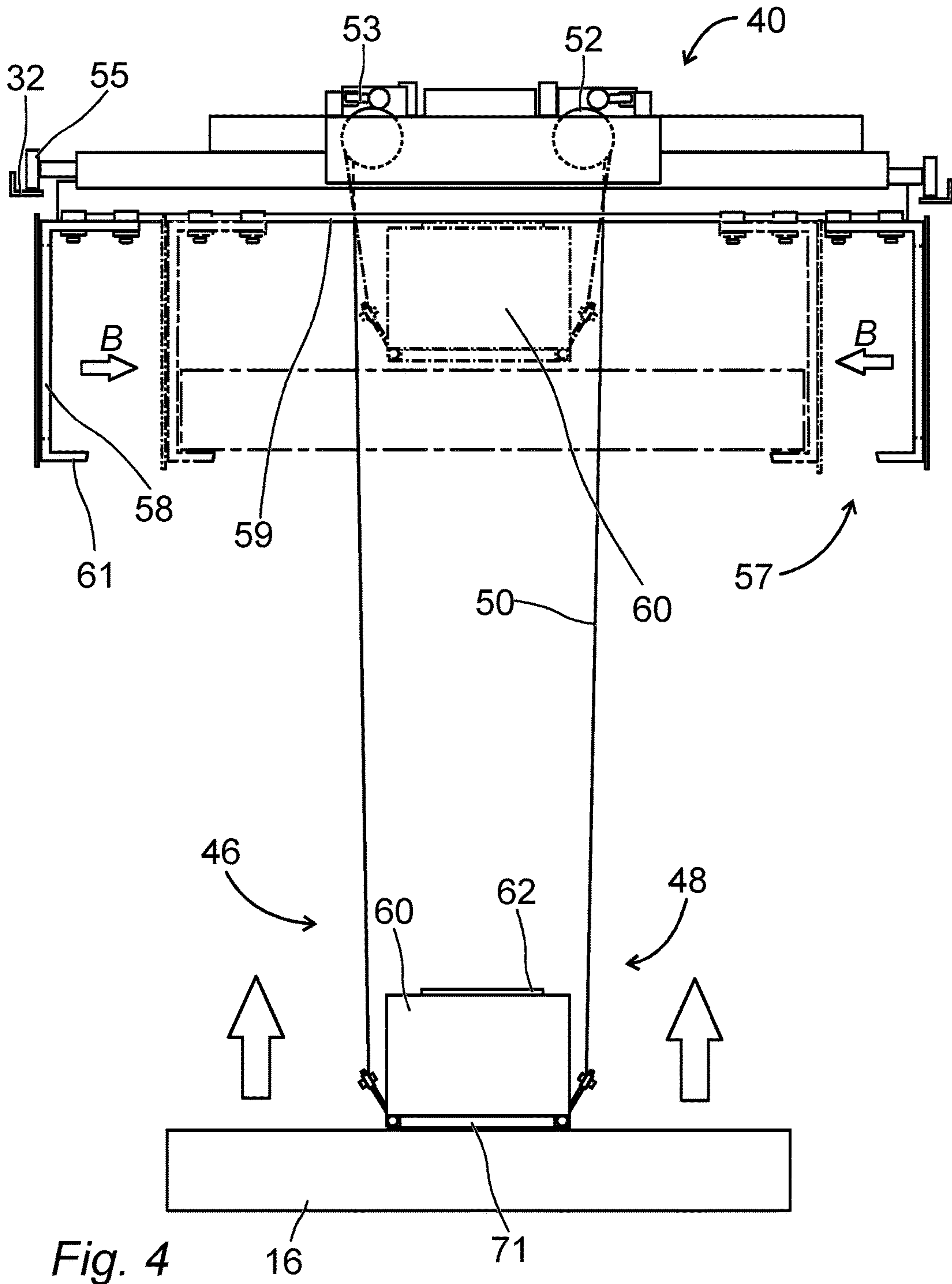
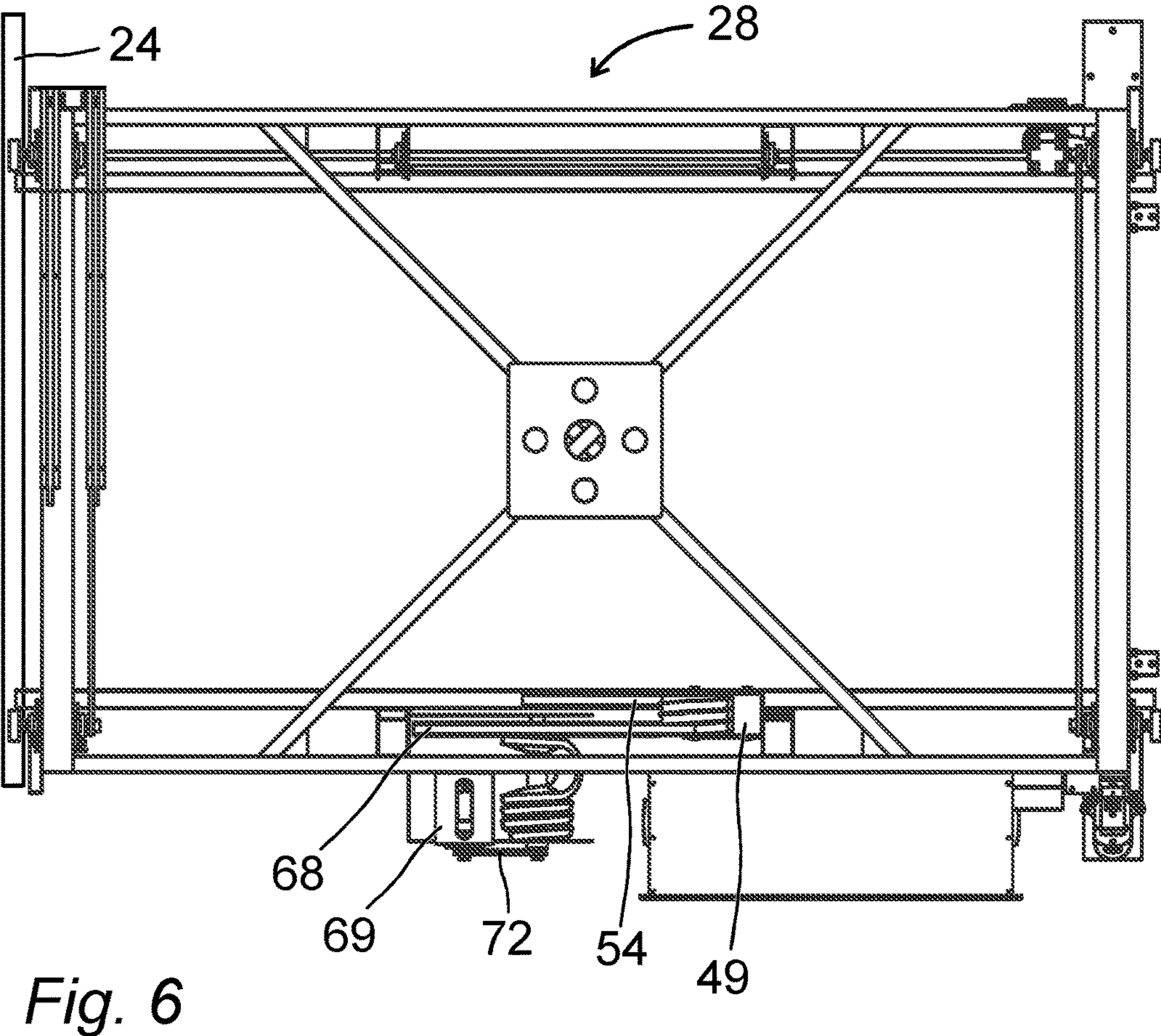
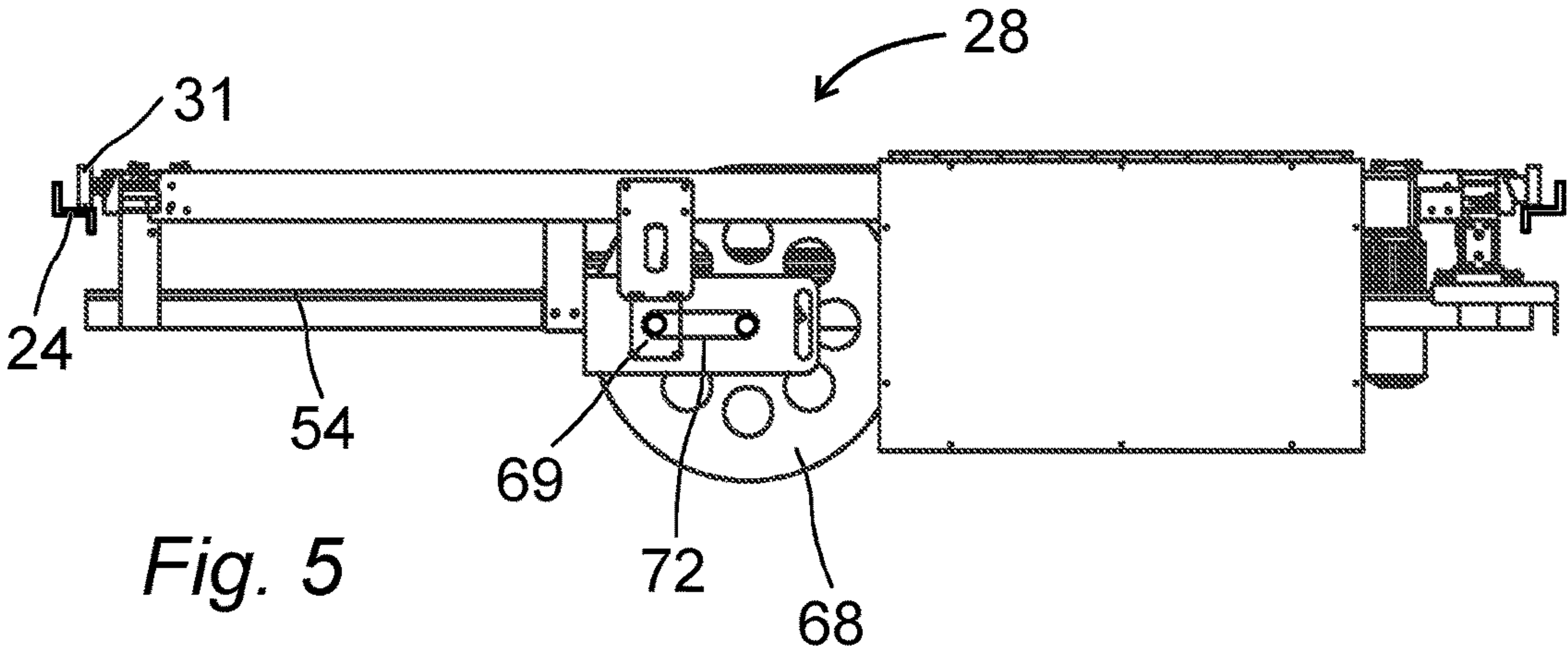


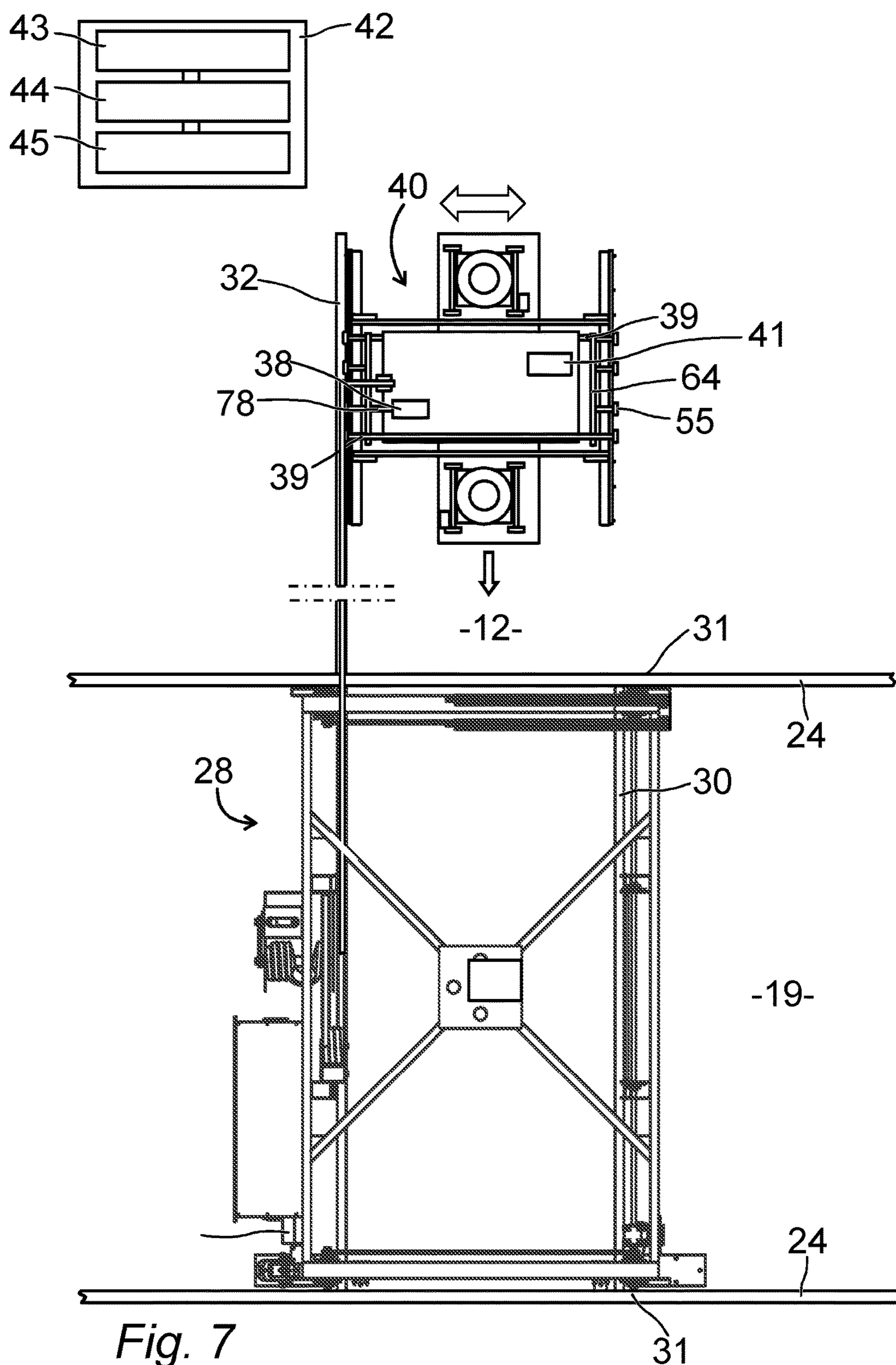
Fig. 2



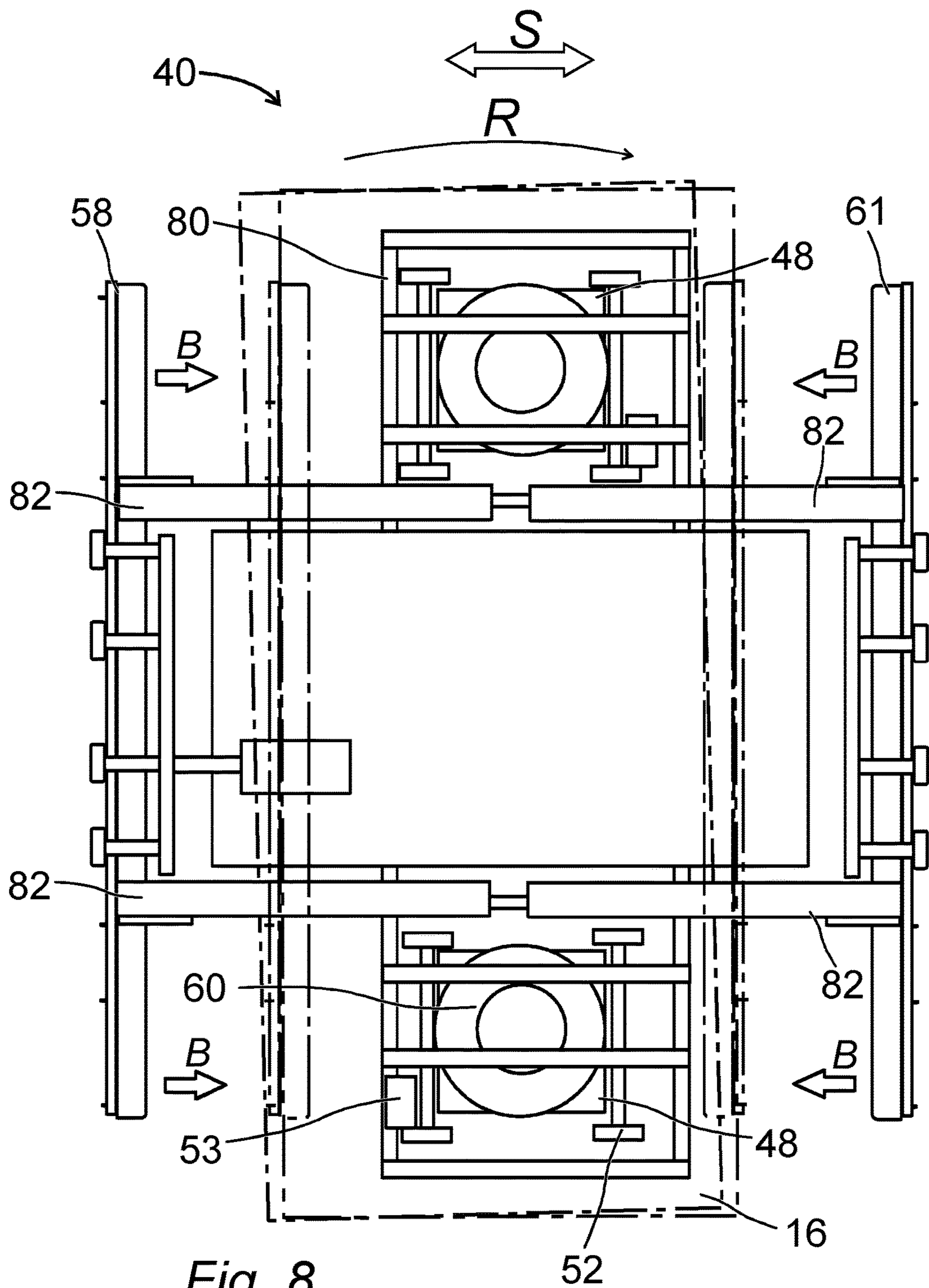














**A MULTI-STOREY GOODS STORAGE  
ARRANGEMENT, A METHOD OF  
OPERATING SUCH AN ARRANGMENT AND  
A PICKER TRANSFER CART FOR  
OPERATION THEREIN**

TECHNICAL FIELD

**[0001]** A multi-storey goods storage arrangement comprising a plurality of levels of storage lines arranged in parallel, each storage line supporting a plurality of baseboards with packages, and transport aisles extending in parallel between opposing ends of sets of said storage lines, wherein at least one baseboard transfer cart is operable along each transport aisle and a plurality of picker carts are arranged for picking packages in said storage lines and for delivering packages on conveyors.

PRIOR ART

**[0002]** Multi-storey goods storage arrangements or pallet racks are used in a wide area of applications, such as conventional warehouses, storages and stores. Goods, such as packages or cases, are normally arranged on pallets that are transported in the multi-storey goods storage arrangement by different kinds of carts, carriages, shuttles and conveyors. In automated multi-storey goods storage arrangements, the carriages, shuttles and conveyors are controlled by computer systems and pick up, transport, store and deliver goods without human influence.

**[0003]** In some multi-storey goods storage arrangements manual picking from pallets on a picking line is used to combine different objects from different pallets into mixed pallets for delivery or packaging.

SUMMARY OF THE INVENTION

**[0004]** It would be desirable to improve the process in prior art multi-storey goods storage arrangements when separate items or parcels are picked from storage lines. The multi-storey goods storage arrangement comprises a plurality of levels of storage lines arranged in parallel and transport aisles or lines extending between opposing ends of said storage lines. At least one picking aisle extends in parallel between opposing ends of sets of said storage lines and in parallel with said transport aisles.

**[0005]** At least one picker transfer cart is operating along each picking aisle at each level and each picker transfer cart supports a picker cart. The picker carts are suspended from the picker transfer carts and are operable from the picker transfer carts into the storage lines. The picker carts are provided with means for picking up goods stored on pallets or baseboards. After returning to the picker transfer cart and positioning the picker transfer cart above a conveyor the goods is lowered and placed on the conveyor.

**[0006]** The means for picking up goods comprises lifting means and a hoist. In various embodiments the means for picking up goods comprises a lifting yoke with a suction device. The picker cart comprises a locking device. The locking device will ensure that goods will remain in position on the picker cart, should the suction device be faulty.

**[0007]** In various embodiments the picker carts suspend from a top rail arrangement on said picker transfer cart and are moveable out from said picker transfer cart into a suspension rail arrangement in said storage lines.

**[0008]** In various embodiments said picker carts are provided with a cable winder. The cable of the cable winder is electrically connected to a power outlet on said picker transfer cart for providing electric power to the lifting yoke and to said locking device. Also compressed air and control signals are transferred through the cable or cables. The length of the cable extends the length of a storage line and also the distance from a top level of the multi-storey goods storage arrangement the level where the conveyor is arranged. As a result, the lifting yoke is provided with electric power and control signals during operation.

BRIEF DESCRIPTION OF THE DRAWINGS

**[0009]** In order that the manner in which the above recited and other advantages and objects of the invention are obtained will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings.

**[0010]** Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

**[0011]** FIG. 1 is a schematic partial top view of one level of a first embodiment of a multi-storey goods storage arrangement in accordance with the invention,

**[0012]** FIG. 2 is a schematic side view of an embodiment of a picking aisle in a four-level multi-storey goods storage arrangement in accordance with the invention,

**[0013]** FIG. 3 is a schematic side view of an embodiment of a picker cart in accordance with the invention with lowered lifting means supporting a package,

**[0014]** FIG. 4 is a schematic front view of the picker cart shown in FIG. 3,

**[0015]** FIG. 5 is a schematic side view of a picker transfer cart,

**[0016]** FIG. 6 is a schematic top view of the picker transfer cart shown in FIG. 5,

**[0017]** FIG. 7 is a schematic top view of a picker cart in a position in a storage line and picker transfer cart in a position in a picking aisle, and

**[0018]** FIG. 8 is a more detailed top view of one embodiment of a picker cart in accordance with the invention,

DETAILED DESCRIPTION

**[0019]** In the embodiment shown in FIG. 1 and FIG. 2 a multi-storey goods storage arrangement or pallet racking 10 comprises a plurality of levels of storage lines 12 in which pallets 14 with packages 16 are stored. The storage lines 12 extend in two opposite directions from transport lines 18 extending between opposite ends of said storage lines 12, said transport lines 18 also having a plurality of levels. Baseboard transfer carts 20 supporting a shuttle 22 operate in said transport lines 18 in a direction perpendicular to the storage lines 12. The shuttle 22 is supported in a conventional way on a rail system in a lower section of the baseboard transfer cart 20. A corresponding rail system extends along said storage lines 12 to allow said shuttle 22 to transport pallets 14 to and from selected positions along said storage lines 12.



[0020] The rail system in said storage lines also supports baseboards or pallets **14** on which packages **16** are stored. Normally each baseboard **14** in one storage line **12** supports one type of articles or packages. Packages are received to and delivered from the multi-storey goods storage arrangement through different means.

[0021] Each shuttle **22** is arranged to move away from the transfer cart **20** into said storage lines **12** carrying packages **16** on baseboards **14**. The baseboards **14** can be transported along a storage line **12** to be placed at a selected position in the storage line **12**. The baseboards **14** also can be picked up at a selected position by the shuttle **22** and transported to the transfer cart **20** which then will transport the picked-up pallet along the transport line to a selected new storage line.

[0022] The multi-storey goods storage arrangement basically is a pallet racking with a plurality of uprights **34** and horizontal load beams **36**. The load beams **36** can be designed as or include said rail system for supporting the shuttle **22**. Conventional diagonal braces and horizontal braces can also be used.

[0023] The shuttle **22** moves from the transfer cart **20** into the storage lines **12** and back carrying pallets or baseboards **14** with or without packages **16**. The shuttle **22** is provided with support means that can be raised in position under a baseboard **14** and kept in a raised position during transport in the storage line **12**. When packages have reached an intended position in the storage line or elsewhere the support means is lowered and the packages will rest on rails or load beams **36** or on the baseboard transfer cart **20**.

[0024] The multi-storey goods storage arrangement shown in FIG. 1 and FIG. 2 comprises also picking aisles **19** in which picker transfer carts **28** operate. The picking aisles **19** extend parallel to the transport aisles **18** and are normally arranged between transport aisles **18** forming an arrangement with alternating transport aisles **18** and picking aisles **19**. Picker transfer carts **28** operate back and forth in each picking aisle **19** running on rails **24**. Each picker transfer cart **28** supports a picker cart **40** suspended from a top rail arrangement **30** and movable into and out of a suspension rail arrangement **32** in the storage lines **12** as indicated by arrow A.

[0025] In each transport aisle **18** at least one baseboard transfer cart **20** operates to transport baseboards **14** with packages using shuttles **22** to selected positions in the storage lines **12**. In each picking aisle **19** at least one picker transfer cart **28** is arranged to pick up packages **16** in the storage lines **12** using a picker cart **40**. The shuttles **22** and the picker carts **40** have an operation distance corresponding the length of a storage line **12** between a transport aisle **18** and a picking aisle **19**. All baseboards **14** and packages **16**, respectively, in each storage line thus can be reached and positioned correctly.

[0026] In various embodiments, such as those shown in FIG. 3 and FIG. 4, the picker cart **40** comprises lifting means **46** for lifting top packages disposed on pallets in the storage lines **12**. The lifting means **46** is designed in dependence on the type of goods, packages or boxes that are stored in the storage lines **12**. In the embodiment shown in FIG. 3 and FIG. 4 the lifting means **46** comprises two lifting yokes **48** suspended in hoisting belts **50**.

[0027] The picker cart **40** supports the lifting means **46** comprising the lifting yoke **48** suspended in hoisting belts **50**. The hoisting belts **50** are suspended from hoisting

wheels **52** driven by a motor and gearbox **53**. The lifting yoke **48** comprises a fan such as a suction device **60** driven by a suction motor **62**.

[0028] The picker cart **40** is driven by an electric motor **38**, c.f. FIG. 7 and FIG. 8. The electric motor **38** and other electric equipment of the picker cart **40** can be provided with electric power from a power outlet **49**, c.f. FIG. 6, on the picker transfer cart **28** through a control cable **54**. The picker transfer cart **28** is powered through a conductor rail (not shown) in the rails **24**.

[0029] In various embodiments the power used by the electric motor **38** and other electric equipment of the picker cart **40** is reduced and a mobile power supply comprising super capacitors or similar charge storing devices replaces the power outlet and control cable **54**. In such embodiments the charge storing devices are charged when the picker cart **40** has returned to the picker transfer cart **28**.

[0030] The suction device **60** and particularly the suction plate **71** are designed and arranged in dependency of the shape and weight of packages **16**. Normally, one type of packages is arranged together in one or a plurality of storage lines **12**. As a result, a picker cart **40** supporting a suitable suction device **60** and suction plate **71** is associated to and operates in these storage lines **12**.

[0031] The picker cart **40** is provided with a locking device **57** arranged to hold a package **16** during movements of the picker cart **40**. The locking device **57** is activated when a package **16** has been lifted by one or two lifting yokes **48** to a position close to a bottom side of picker cart **40**. In the embodiment shown in FIG. 3 and FIG. 4 the locking device **57** comprises two rectangular plates **58** arranged on sliding members **59**, c.f. FIG. 8. The plates **58** are arranged to be moved towards each other in the direction of arrow B from a starting position as shown in FIG. 4 to a closer position where a package **16** is firmly held between the plates **58**. A support section **61** extends perpendicularly along a lower side edge of each plate **58**. When the plates **58** have been moved to the closer position as shown with dash and dot lines in FIG. 4 a package **16** will be supported by the support sections **61** and the suction device **60** is deactivated.

[0032] It is desirable to reduce the weight of picker cart **40**. The plates **58** are formed with a plurality of recesses **63** substantially reducing the weight of the plates **58**. A plurality of reinforcing ribs **65** extending vertically along side edges of plates **58**. The longer sides of the plates **58** extend in the same direction as the direction of movement of the picker cart **40**. As shown in FIG. 3, the reinforcing ribs **65** have a vertical extension over the length of the shorter sides of the plates **58**. The number and positions of reinforcing ribs **65** and recesses **63** are determined by the size and weight of the packages **16**. The orientation and direction of movement of the plates **58** also will facilitate a correction of a possible obliquity of the package in the storage line.

[0033] Each suction device **60** is supported by four hoisting belts **50**, each hoisting belt being attached to different corners of the suction device and being wound up on a separate hoisting wheel **52**. As shown in FIG. 4 the hoisting belts do not extend in parallel but are closer to each other where attached to the suction device than where they are wound up on hoisting wheels **52**. As a result, swinging movements during lifting and lowering of a package are restricted.

[0034] In the embodiment of a rectangular picker transfer cart **28** shown in FIG. 5 and FIG. 6 one cart wheel **31** is



arranged in each corner. The cart wheels run on rails **24** extending along a picking aisle **19**. Electrical power, compressed air and control signals are provided from the picker transfer cart **28** to the picker cart **40** through the control cable **54**. The control cable **54** is wound up on a cable winder **68** which is driven by a cable motor **69** through a chain **72**. The length of the control cable **54** corresponds to or extends the length of a storage line, so as to allow full operation of the picker cart **40** along the full length of a storage line. The control cable **54** is formed as a chain and may comprise pipes, fibres and different types of electrical cables. The cable motor **69** has a defined moment to ensure that the control cable **54** is properly stretched and that the picker cart **40** does not spin. The cable motor **69** is provided with a pulse transducer which is used to determine the movement and position of the picker cart **40**.

[0035] The picker cart **40** shown in FIG. 7 has moved into an end position in a storage line **12** suspended from said top rail arrangement **30** in picker transfer cart **28** and from said suspension rail arrangement **32** in said storage line **12**, rail only shown on one side in FIG. 7. The picker cart **40** runs on a plurality of support wheels **55**. The picker transfer cart **28** runs in a similar way on cart wheels **31** supported on said rails **24**. An electric motor **38** drives the wheels **55** through drive shafts **39**. The electric motor **38** includes a gearbox. A chain drive (not shown) or similar drive means can be arranged between shafts **39** and between wheels **55**.

[0036] The baseboard transfer cart **20**, picker transfer carts **28** and the picker carts **40** are provided with communication means **41** communicating with a central unit **42**. The central unit **42** comprises a processing unit **43**, a communication device **44** and memory means **45**. The power lines in the rails **24** can be used for communication between the central unit **42** and the baseboard transfer carts **20** and the picker transfer carts **28**, respectively. Stationary data, such as dimensions, distances and performance of the multi-storey goods storage arrangement, carts and other units are stored in the memory means **45**. Dynamic data relating to location and size of specific packages or goods, baseboard, speed of conveyors etc. are continuously received through the communication device **44** from carts and from a plurality of sensors and gauges arranged throughout the multi-storey goods storage arrangement. A control software running in the central unit continuously monitors and controls the function of the multi-storey goods storage arrangement. Information relating to different patterns or sets of packages is also stored and handled with the control software. As a result, any picked package can be positioned and monitored throughout the handling thereof within and out of the multi-storey goods storage arrangement.

[0037] In the embodiment of a picker cart **40** shown in FIG. 8 two lifting yokes **48** are supported on a common carriage **80**. When the picker cart **40** is positioned in a storage line for picking up a package the carriage **80** is centred above a package by sliding the carriage **80** as indicated by arrow S. When the correct position has been reached either one or both of lifting yokes **48** are lowered until the suction plate **71** engages the package **16**. Then the suction devices **60** are activated to be attached to the package **16**. By activating the motor and gearbox **53** the hoisting belts **50** are wound up on the hoisting wheels **52** and the package is lifted.

[0038] When the package has been lifted to a position where a bottom side of the package is above the support

sections **61** of the plates **58** linear motion drives **82** are activated to move the plates **58** in the direction of arrows B. During this movement side edges of the plates **58** will engage side edges of the package **16**. As a result, the package **16** will rotate as indicated by arrow R and be aligned with the plates **58**. This is advantageous because further handling of the package **16** will be facilitated when a correct orientation thereof is ensured.

[0039] In various embodiments the rails supporting the baseboard transfer cart **20** and the picker transfer carts **28** are provided with power lines supplying electrical power to the baseboard transfer cart **20** and the picker carts **40** through sliding contacts (not shown).

[0040] While certain illustrative embodiments of the invention have been described in particularity, it will be understood that various other modifications will be readily apparent to those skilled in the art without departing from the inventive concept. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description set forth herein but rather that the claims be construed as encompassing all equivalents of the present invention which are apparent to those skilled in the art to which the invention pertains.

1. A multi-storey goods storage arrangement comprising a plurality of levels of storage lines arranged in parallel, each storage line supporting a plurality of baseboards with packages, and transport aisles extending in parallel between opposing ends of sets said storage lines, wherein at least one baseboard transfer cart is operable along each transport aisle, wherein

picking aisles extending in parallel between opposing ends of sets said storage lines and in parallel with said transport aisles,

at least one picker transfer cart operating along each picking aisle, each picker transfer cart supporting at least one picker cart, a top rail arrangement on said picker transfer cart from which said picker cart is suspended,

a suspension rail arrangement in said storage lines corresponding to said top rail arrangement to allow said picker cart to move out from said picker transfer cart, into said storage lines while suspended from said suspension rail arrangement, said picker cart comprising lifting means arranged to lift a package stored in said storage lines and to transport lifted package to a picking aisle after returning said picker cart to said picker transfer cart, and

at least one first conveyor extending horizontally at each level and receiving packages from said at least one picking cart while supported on said picker transfer cart, wherein said lifting means comprises two lifting yokes suspended from said picking cart, each of said lifting yokes comprising a suction device having a surface to be firmly engaged to a package.

2. A multi-storey goods storage arrangement as claimed in claim 1, wherein

a locking device is arranged on said picker cart, said locking device extending below a lifted package to lock said package when lifted by said lifting yokes to a position adjacent to a bottom side of said picker cart.

3. A multi-storey goods storage arrangement as claimed in claim 2, wherein

said lifting yokes are connected to hoisting belts arranged on hoisting wheels driven by a motor and gearbox.



4. A multi-storey goods storage arrangement as claimed in claim 2, wherein

said suction device is electrically powered through a control cable connected to a power outlet on said picker transfer cart, and said control cable is formed as a chain.

5. A method of operating a multi-storey goods storage arrangement comprising a plurality of levels of storage lines arranged in parallel, each storage line supporting a plurality of baseboards with packages, and transport aisles extending in parallel between opposing ends of sets said storage lines, wherein at least one baseboard transfer cart is operable along each transport aisle, each baseboard transfer cart supporting at least one self-operated shuttle, wherein storing positions and present content of baseboards in a central unit,

operating a first conveyor at each level of said multi-storey goods storage arrangement,

said central unit directing a picker cart to pick up a package from a baseboard in a storage line and to suspend said package from said picker cart in at least one lifting yoke,

said central unit directing a picker transfer cart supporting said picker cart to a position over said first conveyor, lowering said at least one lifting yoke until said package engages said first conveyor,

releasing said package on said first conveyor, and

storing in said central unit the position where the package is placed on said first conveyor.

6. A picker transfer cart arranged to move along picking aisles in a multi-storey goods storage arrangement comprising a plurality of levels of storage lines arranged in parallel, each storage line supporting a plurality of baseboards with packages, and

transport aisles extending in parallel between opposing ends of sets said storage lines, the picker transfer cart supporting at least one picker cart suspended from a top rail arrangement,

said picker cart comprising lifting means to lift a package stored in said storage lines and to transport

lifted package to a picking aisle after returning said picker cart to said picker transfer cart, wherein said lifting means comprises two lifting yokes suspended from said picking cart, each of said lifting yokes comprising a suction device having a surface to be firmly engaged to a package, and wherein

a locking device is arranged on said picker cart, said locking device extending below a package to lock said package when lifted by said lifting yoke to a position adjacent to a bottom side of said picker cart, and said locking device comprising two vertically standing horizontally moveable rectangular plates arranged opposite each other in parallel at a common vertical level, each plate having a support section extending horizontally towards an opposing plate and supporting together a package.

7. A picker transfer cart as claimed in claim 6, wherein said lifting yoke is connected to hoisting belts arranged on hoisting wheels driven by a motor and gearbox.

8. A picker transfer cart as claimed in claim 6, wherein said suction device is electrically powered through control cable connected to a power outlet on said picker transfer cart, and

said control cable is formed as a chain.

9. A picker transfer cart as claimed in claim 6, wherein said plates are arranged on sliding members mounted at a bottom side of said picker transfer cart.

10. A picker transfer cart as claimed in claim 9, wherein said plates are connected to a linear motion drive arranged to move said plates towards and away from each other.

11. A picker transfer cart as claimed in claim 6, wherein said lifting yokes are suspended in four hoisting belts, each hoisting belt being connected to a corner portion of a suction device and being wound up on four hoisting wheels arranged at an upper portion of the picker cart.

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