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(54) MACHINE FOR INSPECTION AND MAINTENANCE OF TRAINS AND TRAMS

(57) A machine (1) for inspection and maintenance of trains and trams, comprising a first load-bearing structure (2a) formed by at least one elevated guiding element (3a) and by at least one supporting post (7a) associated with the elevated guiding element (3a) by means of a first slider coupling (8a); the elevated guiding element (3a) can be installed in a room designed to accommodate a train or tram (4) to be inspected and/or to be maintained at a raised height with respect to the floor (5) so as to have an orientation that is substantially parallel to the longitudinal extension of the tracks (6) that are present in the room and on which the train or tram (4) is to be placed and the first slider coupling has the degree of translational freedom that lies on a directrix that is oriented substantially parallel to the tracks (6).

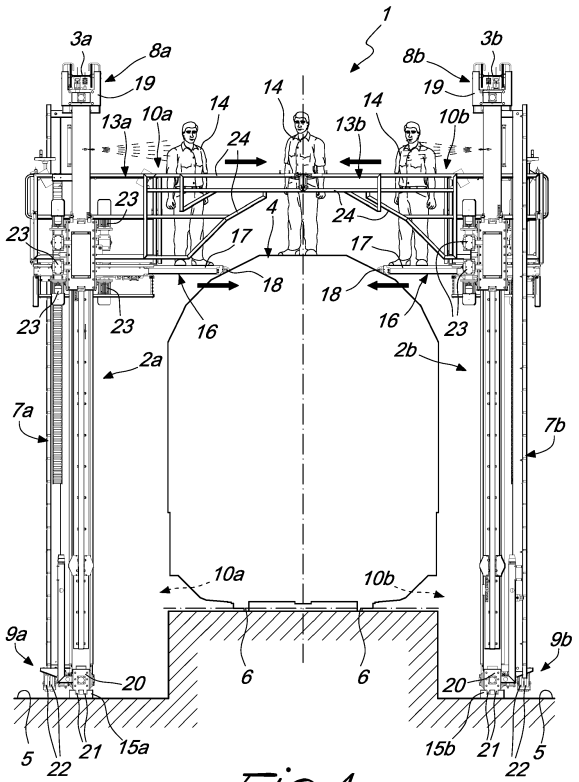


Fig. 4

EP 3 816 097 A1

Description

[0001] The present invention relates to a machine for inspection and maintenance of trains and trams.

[0002] In the train and term sector it is customary to subject trains and trams to continuous and frequent inspection and maintenance operations.

[0003] The parts of the train or tram that require the most attention in order to be able to operate with the highest ergonomics of safety are the roof, known as "imperial" in the jargon, and the sides.

[0004] Platform machines have therefore been developed which are adapted to allow the reaching of these train parts and, generally speaking, can be divided between fixed platforms and movable platforms.

[0005] The former are characterized substantially by a load-bearing structure which forms a walking surface at a fixed height which extends laterally to the tracks designed to accommodate a train or tram for a length that is comparable with that of said train or tram.

[0006] In order to ensure the safety level necessary to protect the operators, these fixed platforms can be provided with walking surfaces that can be extended in the direction of the train or tram, so as to reduce or eliminate the void between the coach, the platform and all the devices required for operator safety.

[0007] These fixed platforms of the known type, which due to their shape have a high stability of the access surface, are not free from drawbacks, which include the fact that since they have a fixed height they do not allow to determine the ideal conditions for access to all types of trains or trams.

[0008] In other words, they are too high for some, too low for others, and at the right height only for a few.

[0009] Furthermore, another drawback of these fixed platforms resides in that, since they have a non-removable or movable structure, they constitute very often a hindrance and limitations of movement within the room in which the structure is installed.

[0010] The latter instead consist of a pantograph structure that is mounted on a truck so as to allow height adjustments of the access surface.

[0011] In this case also, in order to ensure the safety level necessary to protect the operators, these movable platforms can be provided with walking surfaces that can be extended in the direction of the train or tram so as to reduce or eliminate the void between the coach, the platform and all the devices required for operator safety.

[0012] However, these movable platforms of the known type are not free from drawbacks, which include the fact that they are substantially unstable structures, i.e., subject to oscillations, and have in any case significant space occupations, such as to hinder access to the regions proximate to the footing of the platform.

[0013] The aim of the present invention is to provide a machine for inspection and maintenance of trains and trams that is such as to obviate the drawbacks and overcome the limitations of the background art.

[0014] Within this aim, an object of the present invention is to provide a machine that allows to reach any part of the train or tram, maintaining space occupations that are small or in any case such as to not be a hindrance for access to the regions proximate to the footing of the machine.

[0015] Another object of the present invention is to provide a machine that ensures the highest levels of reliability and safety, being at the same time simple to provide and quick to install.

[0016] This aim, as well as these and other objects which will become better apparent hereinafter, are achieved by a machine for inspection and maintenance of trains and trams, characterized in that it comprises a first load-bearing structure formed by at least one elevated guiding element, which can be installed in a room designed to accommodate a train or tram to be inspected and/or to be maintained at a raised height with respect to the floor of said room so as to have an orientation that is substantially parallel to the longitudinal extension of the tracks that are present in said room and on which said train or tram is to be placed, and by at least one supporting post associated with said at least one elevated guiding element by means of a first slider coupling, the degree of translational freedom of which lies on a directrix that is oriented substantially parallel to said tracks; said at least one supporting post being configured so as to rest on said floor by means of a second slider coupling (the degree of translational freedom of which is oriented substantially parallel to the degree of translational freedom of said first slider coupling; a first platform being further comprised which is slidingly associated with said at least one supporting post along an elevation direction that is substantially normal to said floor; said first platform being provided with first lifting and lowering and locking means for its arrangement and retention at a preset height along said at least one supporting post and with first perimetric delimitation means which are configured so as to define a safety enclosure in which at least one operator can perform the planned inspection and/or maintenance operations.

[0017] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of a machine for inspection and maintenance of trains and trams, according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic lateral elevation view of a machine according to the present invention;

Figure 2 is a schematic front elevation view of the machine shown in Figure 1 during the positioning operations;

Figure 3 is a schematic top plan view of the machine shown in Figure 2;

Figure 4 is a schematic front elevation view of the machine shown in the preceding figures during the

inspection and/or maintenance operations;

Figure 5 is an enlarged-scale view of the machine shown in Figure 4;

Figure 6 is a schematic top plan view of the machine shown in Figure 4;

Figure 7 is a schematic perspective view of the platform of the machine shown in the preceding figures.

[0018] With reference to the figures, the machine for inspection and maintenance of trains and trams, generally designated by the reference numeral 1, comprises a first load-bearing structure 2a which is formed by at least one elevated guiding element 3a, which can be installed in a room designed to accommodate a train or tram 4 to be inspected and/or to be maintained at an elevated height with respect to the floor 5, so as to have an orientation that is substantially parallel to the longitudinal extension of the tracks 6 on which the train or tram 4 is to be placed, and by at least one supporting post 7a which is associated with the elevated guiding element 3a by means of a first slider coupling the degree of translational freedom of which lies on a directrix that is oriented substantially parallel to the tracks 6.

[0019] The supporting post 7a is configured so that it rests on the floor 5 by means of a second slider coupling 9a and 9b, the degree of translational freedom of which is oriented substantially parallel to the degree of translational freedom of the first slider coupling 8a.

[0020] Furthermore, a first platform 10a is comprised which is slidingly associated with the supporting post 7a along an elevation direction 11 that is substantially normal to the floor 5.

[0021] In greater detail, the first platform 10a is provided with first lifting and lowering and locking means 12a for its positioning and retention at a preset height along the supporting post 7a and with first perimetric delimitation means 13a configured so as to form a safety enclosure within which at least one operator 14 can perform the planned inspection and/or maintenance operations.

[0022] Advantageously, the first load-bearing structure 2a comprises at least one ground guiding element 15a which can be installed on the floor 5 in a manner that is parallel and lateral to the tracks 6, so that the supporting post 7a is associated slidingly with said ground guiding element 15a to provide the second slider coupling 9a.

[0023] In the proposed embodiment, the first load-bearing structure 2a comprises at least two supporting posts 7a which are associated with the elevated guiding element 3a, respectively, by means of two first slider couplings 8a and with the ground guiding element 15a, respectively, by means of two second slider couplings 9a.

[0024] Conveniently, the first platform 10a is associated slidingly with both of the supporting posts 7a so as to form a substantially H-shaped structure in which the first platform 10a is arranged transversely between the two supporting posts 7a.

[0025] In the proposed embodiment, there is a second platform 10b associated with a second load-bearing structure 2b which is substantially mirror-symmetrical to the first load-bearing structure 2a with respect to the tracks 6.

[0026] In other words, what has been described so far for the first load-bearing structure 2a occurs in a similar manner in the second load-bearing structure 2b and its components occur identically to those listed for the first load-bearing structure 2a, maintaining the same reference numerals modified for the index from "a" to "b".

[0027] The second platform 10b is therefore arranged opposite the first platform 10a and is provided with second lifting and lowering and locking means 12b and with second perimetric delimitation means 13b, respectively, which are similar to the first lifting and lowering and locking means 12a and to the first perimetric delimitation means 13a.

[0028] Conveniently, at least one or both of the platforms 10a and 10b are provided with a movable walkway 16 which can be extended in the direction of the train or tram 4 so that it is possible to form a walking surface that is continuous with the train or tram 4 and free from tripping points for the operator 14.

[0029] More specifically, each movable walkway 16 comprises a walkable deck 17 which can be moved, by virtue of movement means with manual or motorized actuation, toward and away from the train or tram 4 between a retracted position, in which the walkable deck 17 is arranged below the working balcony of the respective platform 10a or 10b, and an extracted position, in which the walkable deck 17 is extended in the direction of and in contact with the outline of the train or tram 4.

[0030] Conveniently, each walkable deck 17 is provided with a rubber-lined profile 18 which is formed at the edge that is designed to make contact with the outline of the train or tram 4.

[0031] As regards the elevated guiding elements 3a and 3b, each one of them comprises an overhead track which can be associated with at least one from the walls and the ceiling of the room in which the machine 1 is installed, and each first slider coupling 8a and 8b is provided by a first wheelbox 19 provided with first wheels in engagement with the overhead track.

[0032] Conveniently, the first wheels form a sliding interlocking with the overhead track so as to hang from it.

[0033] As regards instead the ground guiding elements 15a and 15b, each one of them comprises a ground track which can be recessed in the floor 5 and each second slider coupling 9a or 9b is constituted by a second wheelbox 20 provided with second wheels 21 of the motorized type in engagement with the ground track and by third wheels 22 of the rubber-lined type and configured to remain selectively suspended or resting on the floor 5 in a manner that is adjacent to the second wheels 21.

[0034] As regards the lifting and lowering and locking means 12a and 12b, they comprise, for each platform 10a and 10b, two racks which are associated with the respective supporting posts 7a or 7b and four pinions associated in pairs with said two racks.

[0035] The pinions are then provided with respective gearmotors 23 which are mutually independent and controlled by electronic control and management means so as to ensure the horizontal arrangement of the platforms 10a and 10b.

[0036] With particular reference to Figure 7, the perimetric delimitation means 13a and 13b comprise extractable handrails 24 and gates 25 which can move toward and away from each other between a maneuvering position, in which the extractable handrails 24 and the gates 25 of each platform 10a and 10b delimit laterally the platforms 10a and 10b independently and separately from each other, so as to form for each one of them a closed enclosure within which the operator 14 can be contained safely during the operations for the movement of the platforms 10a and 10b, and an active position, in which the extractable handrails 24 and the gates 25 of each platform 10a and 10b are extracted and open so as to connect to each other the platforms 10a and 10b and so as to form a single enclosure which delimits laterally a work area of the operator 14 formed at the working balconies of the platforms 10a and 10b, at the walkable decks 17 of the extractable walkways 16 and by the outline of the train or tram 4.

[0037] To complete the machine 1, there are fall prevention devices for the operator 14 and sensor and position means associated with the platforms 10a and 10b, with the perimetric delimitation means 13a and 13b, and with the electronic control and management means for the mutual alignment of the platforms 10a and 10b and for the selective and/or sequential opening of the perimetric delimitation means 13a and 13b, so as to define in each condition of use a closed enclosure around the operator 14.

[0038] The machine 1 described so far can be used for various interventions, including:

visiting the upper parts of trains or trams 4 with limited descents onto the imperial by the operators;
interventions that provide for a longer stay on the imperial for a replacement of faulty elements, using for example a crane with a sliding arm;
interventions on the sides for operations for the maintenance of the body, of the windows and of the doors of the train or tram.

[0039] In the first two cases, the operator is positioned longitudinally with respect to the train or tram 4 at the height of the coach on which he is to intervene, by adjusting the height of the platforms 10a and 10b to the desired working height on the basis of the type of train or tram 4.

[0040] This operation can be set directly from the platform 10a or 10b by means of a dedicated user interface.

[0041] Once the height detected by an adapted sensor has been reached, lifting stops and enables the opening of the sliding gate 25 - on the side of the train or tram 4 -, which allows to exit from the balcony of the platform 10a or 10b and to access the imperial of the train or tram 4.

[0042] However, before opening the gate 25, the operator 14 extends the movable walkway 16 of both platforms 10a and 10b until it makes contact with the contour of the train or tram 4 by means of a manually actuated handle and extends at the same time also the extractable handrails 24 of both platforms 10a and 10b until they make mutual contact.

[0043] At this point the operator 14 can optionally engage the fall prevention devices and freely access the imperial of the train or tram 4.

[0044] In the third case, instead, the operator can be positioned, depending on the requirements of the work to be performed, at any height between the low position and the high position that is set.

[0045] However, in this case he will not be able to open the sliding gate but he will be able to act from the balcony.

[0046] In practice it has been found that the machine according to the invention meets the technical problem described above, allowing to reach all the external parts of a train or tram in a manner that is simple and quick and in full safety.

[0047] The machine for inspection and maintenance of trains and trams thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0048] All the details may furthermore be replaced with other technically equivalent elements.

[0049] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to the requirements and the state of the art.

[0050] The disclosures in Italian Patent Application No. 102019000019924 from which this application claims priority are incorporated herein by reference.

[0051] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A machine (1) for inspection and maintenance of trains and trams, **characterized in that** it comprises a first load-bearing structure (2a) formed by at least one elevated guiding element (3a), which can be installed in a room designed to accommodate a train or tram (4) to be inspected and/or to be maintained at a raised height with respect to the floor (5) of said room so as to have an orientation that is substantially parallel to the longitudinal extension of the tracks (6) that are present in said room and on which said train or tram (4) is to be placed, and by at least one supporting post (7a) associated with said at least one elevated guiding element (3a) by means of a first

slider coupling (8a), the degree of translational freedom of which lies on a directrix that is oriented substantially parallel to said tracks (6); said at least one supporting post (7a) being configured so as to rest on said floor (5) by means of a second slider coupling (9a) the degree of translational freedom of which is oriented substantially parallel to the degree of translational freedom of said first slider coupling (8a); a first platform (10a) being further comprised which is slidingly associated with said at least one supporting post (7a) along an elevation direction (11) that is substantially normal to said floor (5); said first platform (10a) being provided with first lifting and lowering and locking means (12a,12b) for its arrangement and retention at a preset height along said at least one supporting post (7a) and with first perimetric delimitation means (13a) which are configured so as to define a safety enclosure in which at least one operator (14) can perform the planned inspection and/or maintenance operations.

2. The machine (1), according to claim 1, **characterized in that** said first load-bearing structure (2a) comprises at least one ground guiding element (15a) which can be installed on said floor (5) in a manner that is parallel and lateral to said tracks (6); said at least one supporting post (7a) being associated slidingly with said at least one ground guiding element (15a) to provide said second slider coupling (9a).

3. The machine (1), according to claim 1 or 2, **characterized in that** said first load-bearing structure (2a) comprises at least two of said supporting posts (7a) which are associated with said at least one elevated guiding element (3a), respectively, by means of two of said first slider couplings (8a); said first platform (10a) being associated slidingly with both of said at least two supporting posts (7a) in such a manner as to form a substantially H-shaped structure with said first platform (10a) arranged transversely between said at least two supporting posts (7a).

4. The machine (1), according to claim 3, **characterized in that** said at least two supporting posts (7a) are associated with said at least one ground guiding element (15a), respectively, by means of two of said second slider couplings (9a).

5. The machine (1), according to one or more of the preceding claims, **characterized in that** it comprises a second platform (10b) which is associated with a second load-bearing structure (2b) which is substantially mirror-symmetrical to said first load-bearing structure (2a) with respect to said tracks (6); said second platform (10b) being arranged opposite said first platform (10a) and being provided with second lifting and lowering and locking means (12b) and with second perimetric delimitation means (13b), which are respectively analogous to said first lifting and lowering and locking means (12a) and to said first perimetric delimitation means (13a).

6. The machine (1), according to one or more of the preceding claims, **characterized in that** at least one of said first platform (10a) and said second platform (10b) is provided with a movable walkway (16) which can be extended in the direction of said train or tram (4) so as to be able to form a continuous walking surface with said train or tram (4), free from tripping points for said at least one operator (14).

7. The machine (1), according to claim 6, **characterized in that** said movable walkway (16) comprises a walkable deck (17) which can move toward and away from said train or tram (4) between a retracted position, in which said walkable deck (17) is arranged below the working balcony of the respective one of said first and second platforms (10a, 10b), and an extracted position, in which said walkable deck (17) is extended in the direction of and in contact with the outline of said train or tram (4).

8. The machine (1), according to claim 7, **characterized in that** said walkable deck (17) is provided with a rubber-lined profile (18) which is formed at the edge designed to make contact with the outline of said train or tram (4).

9. The machine (1), according to one or more of the preceding claims, **characterized in that** each one of said elevated guiding elements (3a, 3b) comprises an overhead track which can be associated with at least one between the walls and the ceiling of said room and **in that** each one of said first slider couplings (8a, 8b) is provided by a first wheelbox (19) which is provided with first wheels which engage said overhead track; said first wheels forming a sliding interlocking with said overhead track so as to hang from said overhead track.

10. The machine (1), according to one or more of the preceding claims, **characterized in that** each one of said ground guiding elements (15a, 15b) comprises a ground track which can be recessed in said floor (5) and **in that** each one of said second slider couplings (9a, 9b) is provided by a second wheelbox (20) which is provided with second wheels (21) which engage said ground track and third wheels (22) configured to remain selectively suspended or resting on said floor (5) adjacent to said second wheels (21).

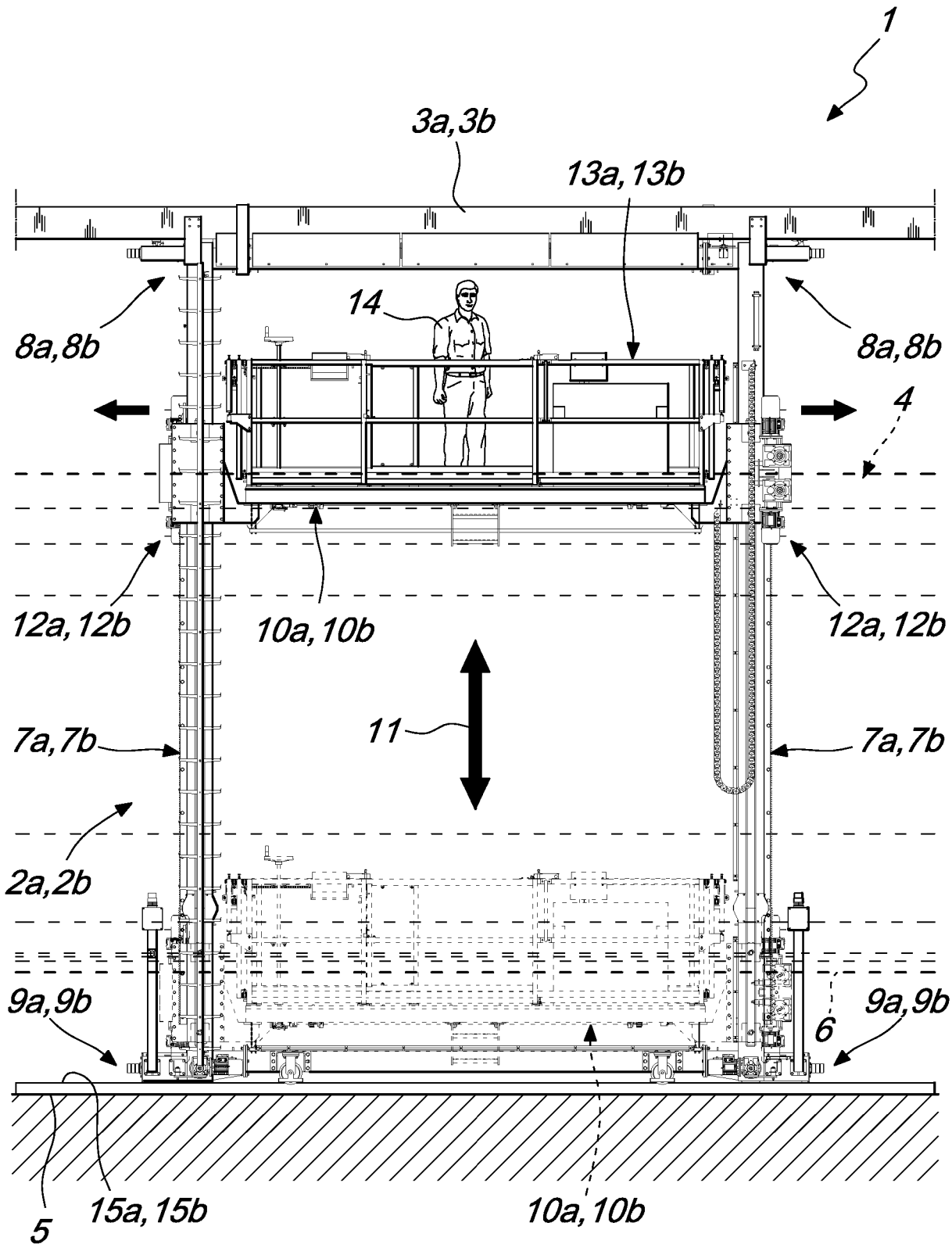
11. The machine (1), according to claim 10, **characterized in that** said second wheels (21) are of the motorized type and **in that** said third wheels (23) are of the rubber-lined type.

12. The machine (1) according to one or more of the preceding claims, **characterized in that** said first and second lifting and lowering and locking means (12a, 12b) comprise, for each one of said first and second platforms (10a, 10b), two racks which are associated with the respective said supporting posts (7a, 7b) and four pinions which are associated in pairs with said two racks; said pinions being provided with respective gearmotors (23) which are mutually independent and controlled by electronic control and management means so as to ensure the horizontal arrangement of said first and second platforms (10a, 10b).

13. The machine (1), according to one or more of the preceding claims, **characterized in that** said first and second perimetric delimitation means (13a, 13b) comprise extractable handrails (24) and gates (25) which can move toward and away from each other between a maneuvering position, in which said extractable handrails (24) and said gates (25) of each one of said first and second platforms (10a, 10b) laterally delimit said first and second platforms (10a, 10b) in a mutually independent and separate manner, so as to define, for each one of said first and second platforms (10a, 10b), a closed enclosure within which said at least one operator (14) can be contained safely during the operations for moving said first and second platforms (10a, 10b), and a working position, in which said extractable handrails (24) and said gates (25) of each one of said first and second platforms (10a, 10b) are extracted and open so as to mutually connect said first and second platforms (10a, 10b) and so as to form a single enclosure which delimits laterally a work area of said at least one operator (14) which is defined at the working balconies of said first and second platforms (10a, 10b), at said walkable decks (17) of said extractable walkways (16) and by the outline of said train or tram (4).

14. The machine (1), according to one or more of the preceding claims, **characterized in that** it comprises sensor and position means associated with said first and second platforms (10a, 10b), with said first and second perimetric delimitation means (13a, 13b), and with said electronic control and management means for the mutual alignment of said first and second platforms (10a, 10b) and for the selective and/or sequential opening of said first and second perimetric delimitation means (13a, 13b) in such a manner as to define, in any condition of use, a closed enclosure around said at least one operator (14).

15. The machine (1), according to one or more of the preceding claims, **characterized in that** it comprises fall prevention devices for said at least one operator (14).


1
3a,3b
13a,13b
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8a,8b
8a,8b
4
12a,12b
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12a,12b
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7a,7b
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Fig. 1

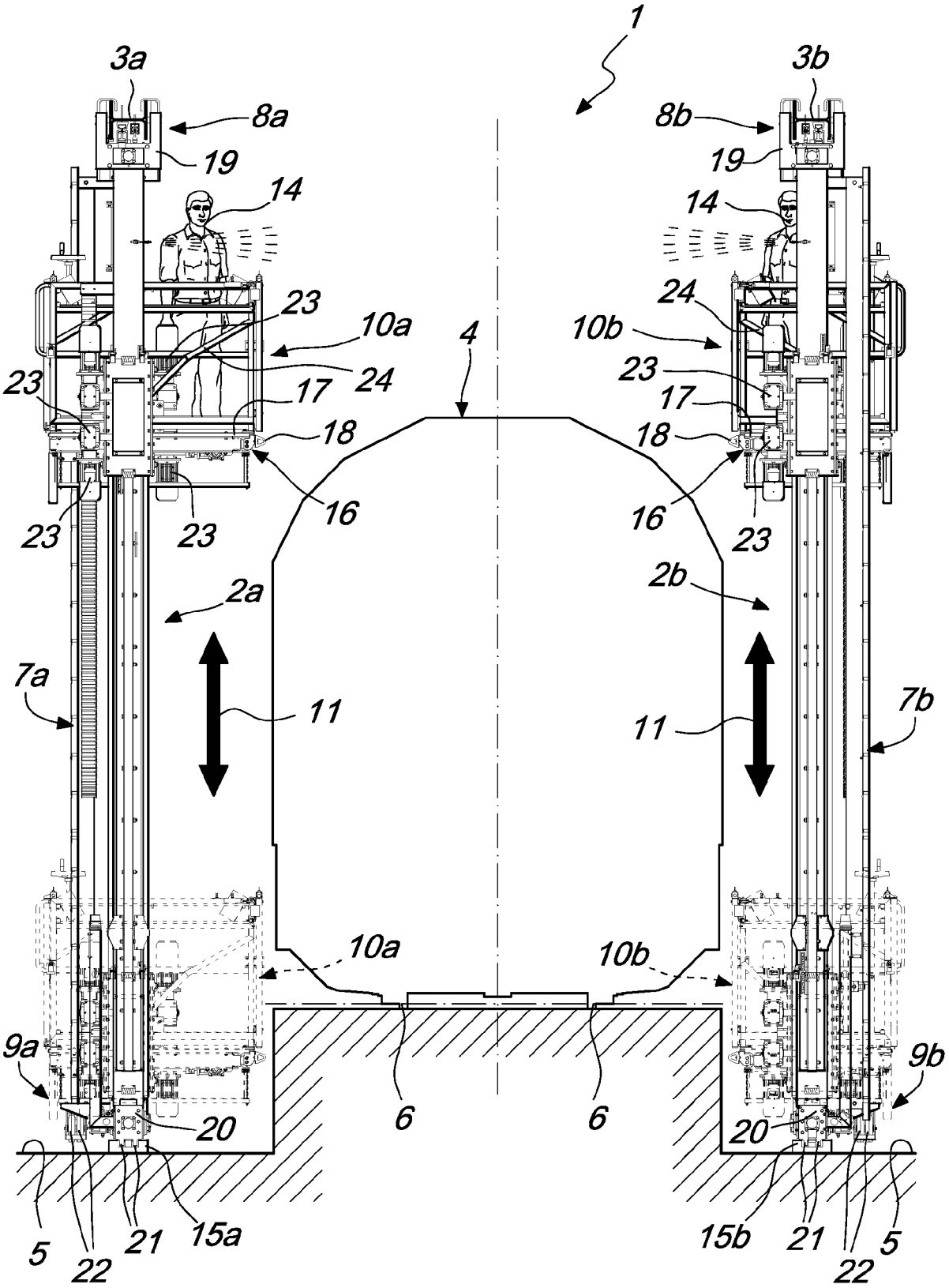
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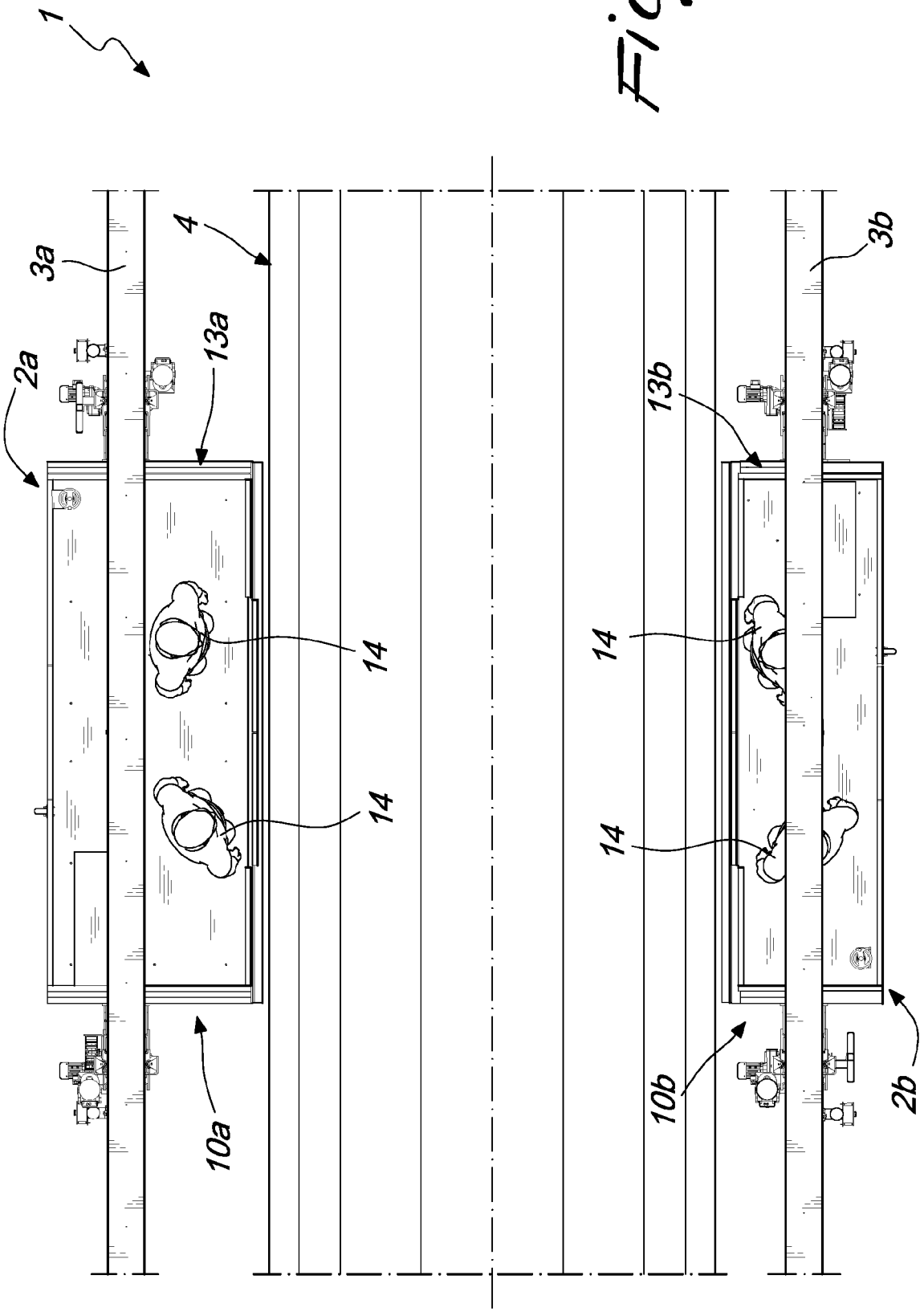
Fig. 2

Fig. 3



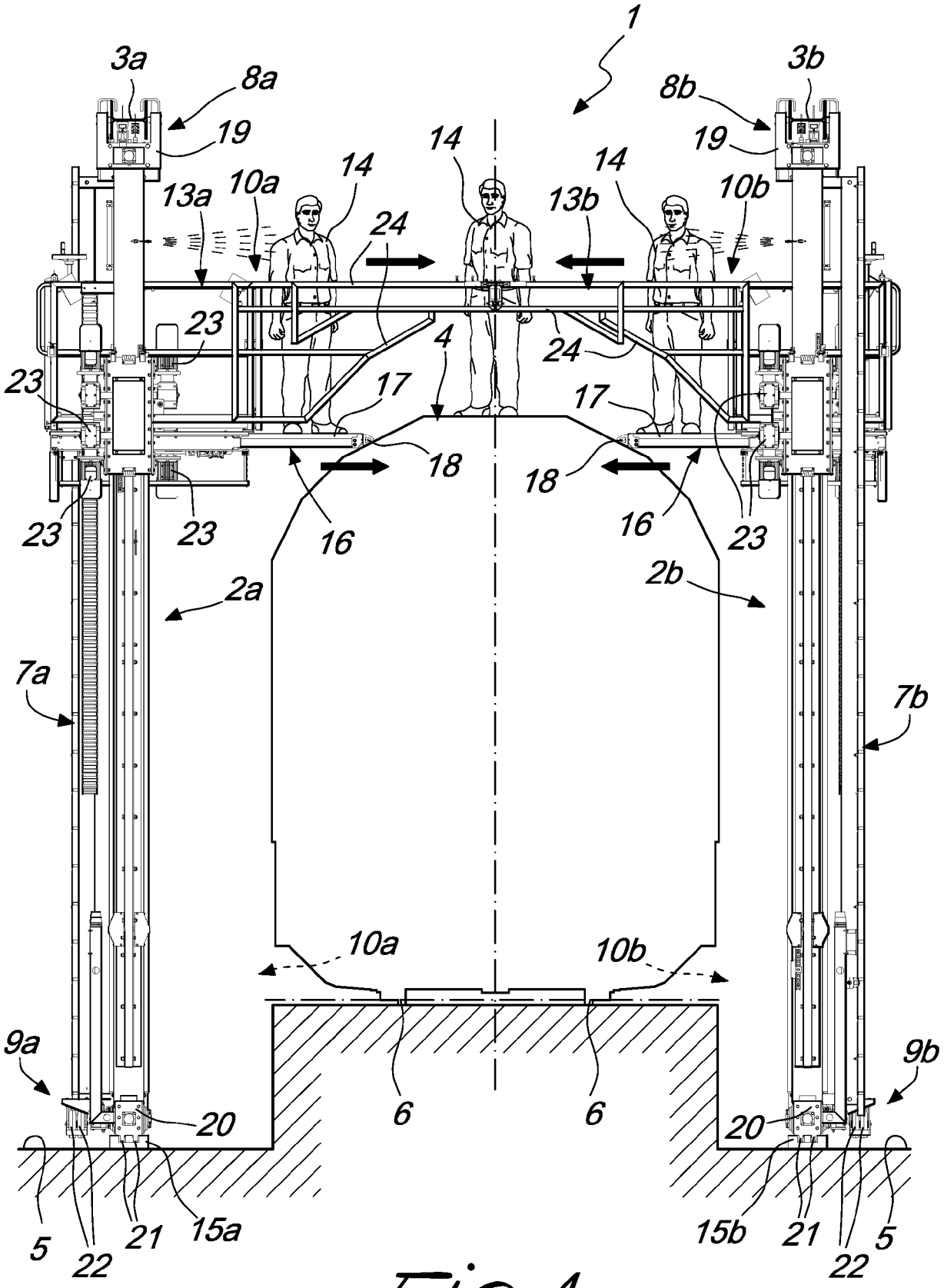

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Fig. 4

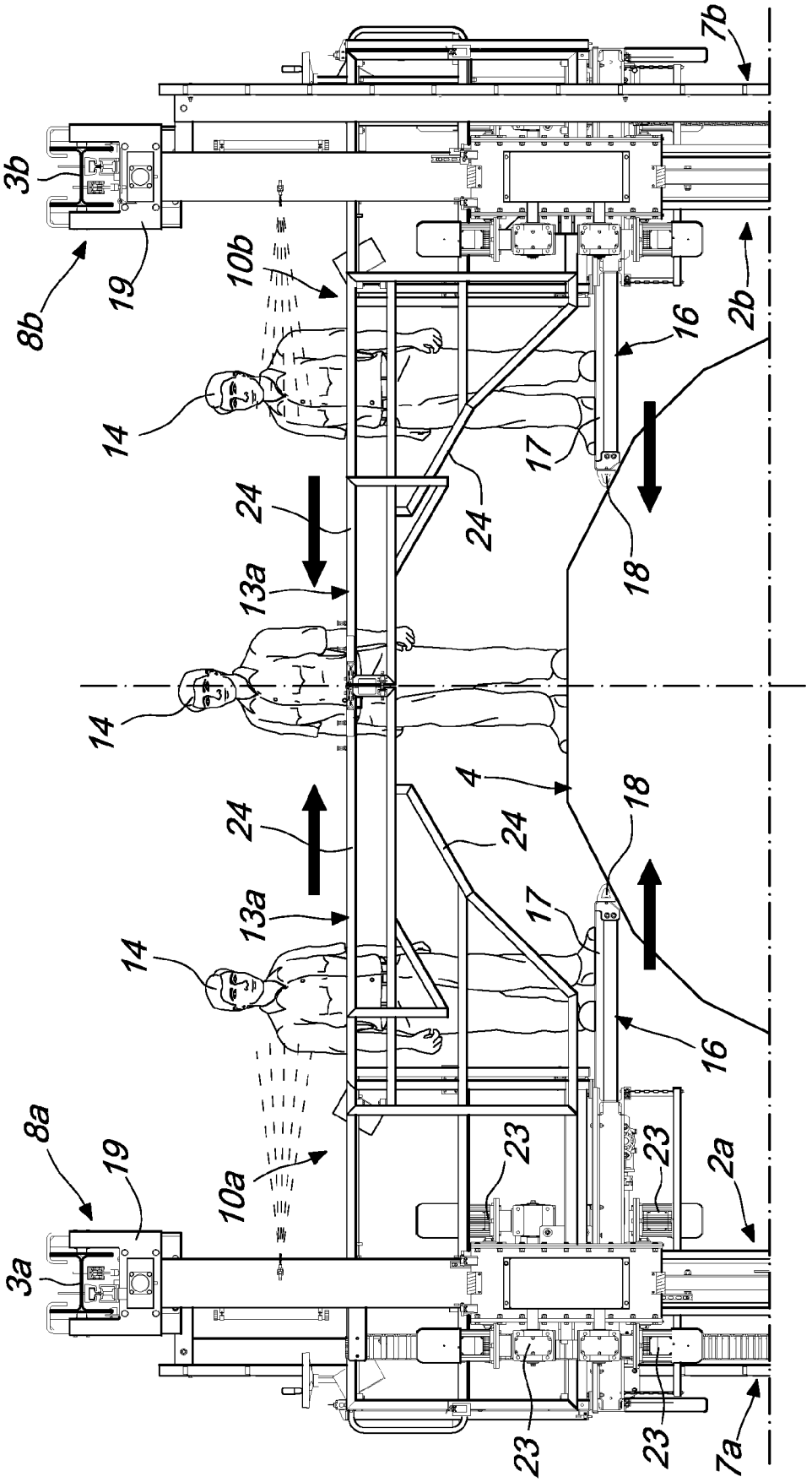
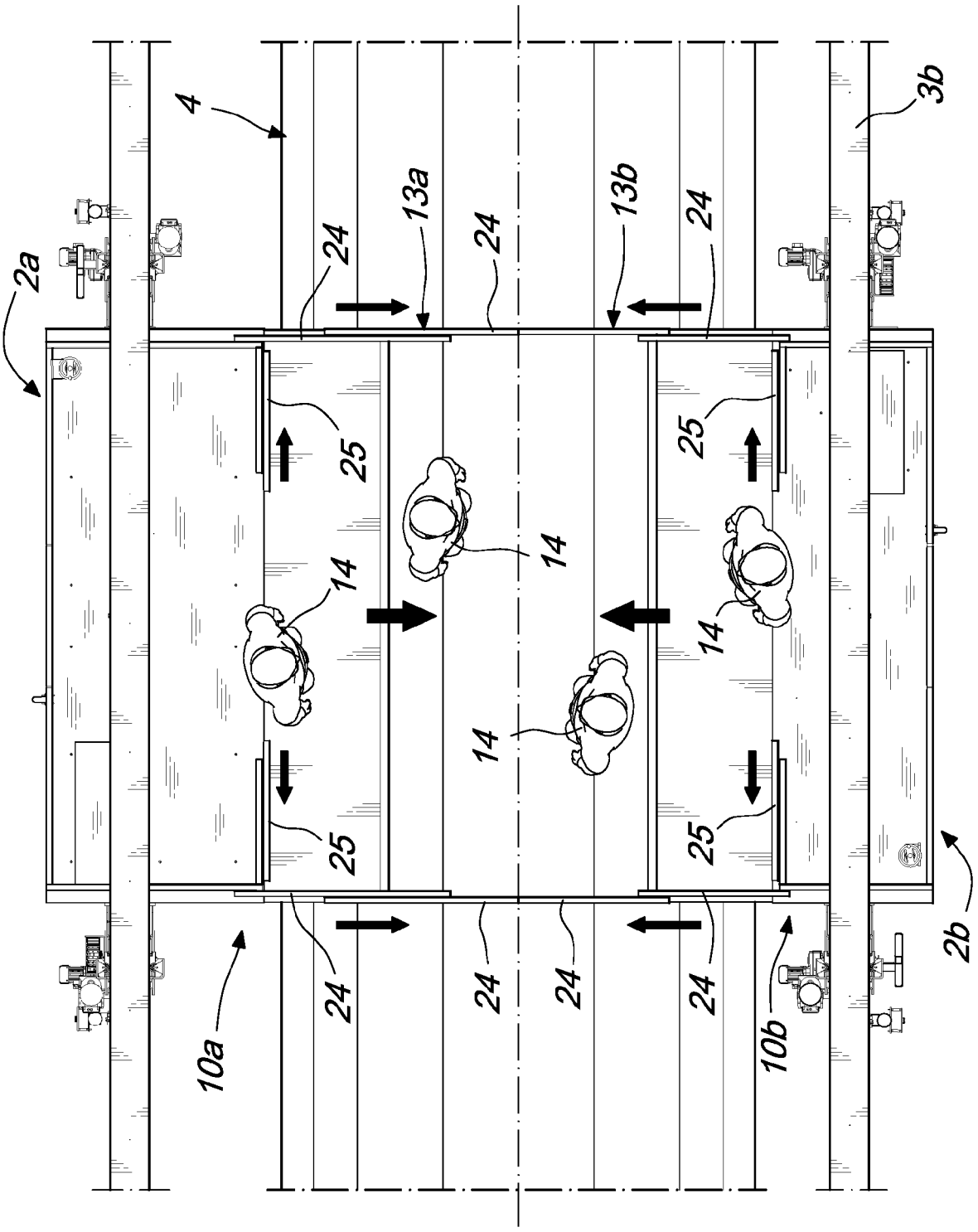


Fig. 5

Fig. 6



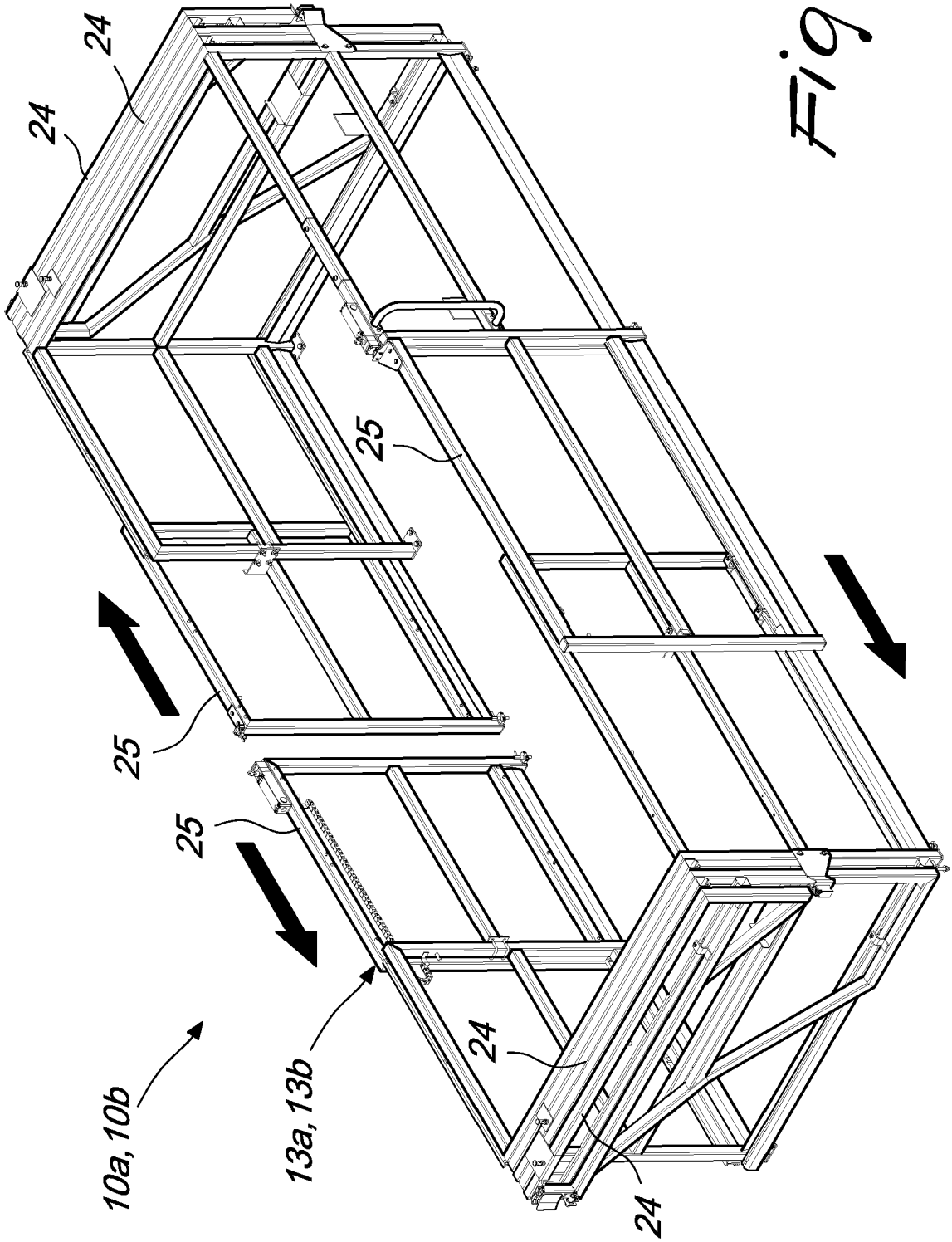


Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 3678

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 Y	CN 208 394 727 U (WAFANGDIAN CITY RAILWAY EQUIPMENT MFG FACTORY) 18 January 2019 (2019-01-18) * the whole document *	1,9,15 2	INV. B66F11/04 B61K11/00
Y A	WO 02/100759 A1 (TGW TRANSPORTGERAETE GMBH [AT]; HANSL RUDOLF [AT] ET AL.) 19 December 2002 (2002-12-19) * page 14; figure 8 *	2 1,10-15	
A	WO 03/048024 A1 (RICCI FRANCESCO [IT]) 12 June 2003 (2003-06-12) * abstract; figures * * page 4, line 6 - page 5, line 21 *	1-15	
A	IT BO20 090 185 A1 (RINIERI ALBERTO COSTRUZIONI M ECCANICHE DI L) 27 September 2010 (2010-09-27) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
B66F B61K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 February 2021	Verheul, Omiros

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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