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(54) **Sliding door assembly provided with a linear motor**

(57) A sliding door assembly comprises a door leaf (24) provided with an upper horizontal edge and a lower horizontal edge; an upper guide rail assembly (20, 42) for guiding the upper edge of the door leaf (24) in translation parallel to a horizontal sliding direction (100) relative to the upper guide rail assembly (20, 42) between a first end position and a second end position; and one or more rows (28, 30) of first magnetic field generating elements fixed to the door leaf (24), each of the rows (28, 30) extending horizontally. The one or more rows (28, 30) of first magnetic field generating elements are each located at an intermediate position below the upper horizontal edge and upper guide rail (20, 42) and above a lower horizontal edge of the door leaf. One or more stators (38, 40) each associated with one of the rows (28, 30) of first magnetic field generating elements overlap with one end of the rows (28, 30) of first magnetic field generating elements in the first position. Each stator comprises an second magnetic field generating element located at an air gap distance of the associated one of the rows (28, 30) of first magnetic field generating elements for generating an induced electromagnetic force in the sliding direction (100) on the associated one of the rows (28, 30) of first magnetic field generating elements, the one or more stators (38, 40) being stationary with respect to the upper guide rail assembly (20, 42).

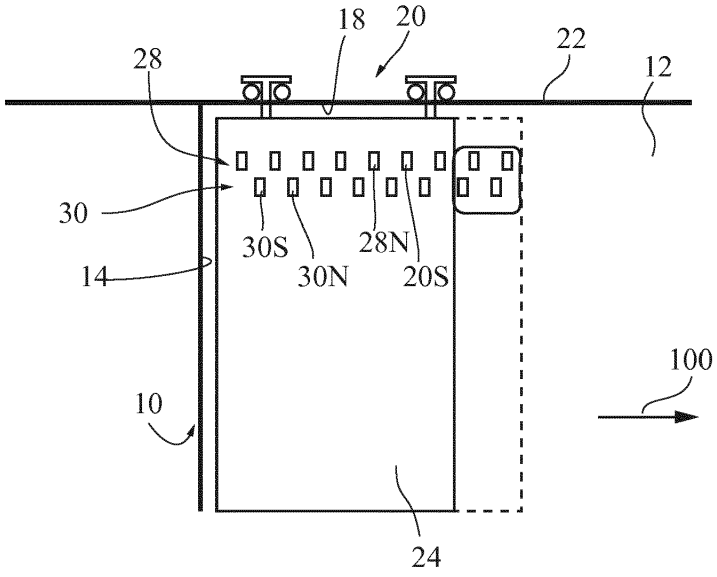

Fig.1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to a sliding door assembly, in particular but not exclusively for a public transportation vehicle such as a railway vehicle.

BACKGROUND ART

[0002] Interior sliding door and exterior door assemblies for railway vehicles are usually provided with electro-pneumatic or electromechanical driving means, which require a substantial amount of space directly above the door leaf at the level of the transom and upper guide rail of the door.

[0003] It has been suggested in EP 1 681 426 to operate a sliding door by means of a linear motor. The stator, which essentially consists of a row of interconnected electrical coils, is disposed above a sliding door leaf in a specific space provided in a longitudinal cavity of a fixed guide and support rail. The door leaf is provided with one or more carriages with rollers that roll on corresponding rectilinear raceways of the guide and support rail. At least one of the carriages is provided with a row of permanent magnets that faces the row of electrical coils with a reduced air gap. While this arrangement offers an alternative to the more conventional electro-pneumatic or electromechanical driving means, it does not substantially reduce the space necessary for accommodating the driving means in the region of the transom of the door opening. Moreover, access to the electromagnetic circuit for maintenance purposes is particularly difficult.

[0004] There is therefore a need for an alternative driving means that does not necessitate space in the region of the transom of the door and is easier to access.

SUMMARY OF THE INVENTION

[0005] According to one aspect of the invention, there is provided a sliding door assembly comprising:

- a door leaf provided with an upper horizontal edge and a lower horizontal edge;
- an upper guide rail assembly for guiding the upper edge of the door leaf in translation parallel to a horizontal sliding direction relative to the upper guide rail assembly between a first end position and a second end position;
- one or more rows of first magnetic field generating elements fixed to the door leaf, each of the rows extending horizontally and being located at an intermediate position below the upper horizontal edge and upper guide rail and above a lower horizontal edge of the door leaf each row consisting of adjacent poles of alternate polarities;
- one or more stators each associated with one of the rows of first magnetic field generating elements and each comprising an second magnetic field generating element located at an air gap distance of the associated one of the rows of first magnetic field generating elements for generating an induced electromagnetic force in the sliding direction on the associated one of the rows of first magnetic field generating elements, wherein the one or more stators are stationary with respect to the upper guide rail assembly and overlap with one end of the rows of first magnetic field generating elements in the first position.

[0006] Thanks to the location of the row or rows of first magnetic field generating elements, the structure of the upper guide rail assembly can be simplified and made more compact such that more room is available above the door leaf.

[0007] As will be readily understood, the stators are located at the same height as the associated rows of first magnetic field generating elements, such that they do not necessitate additional space at the level of the upper guide rail assembly. Access to the stators is particularly easy for maintenance purposes. The overall concept is particularly reliable since the upper rail assembly is independent and separated from the driving means.

[0008] Preferably, the one or more stators face and overlap an end of the rows of first magnetic field generating elements close to a first vertical edge of the door leaf, so as to generate an electromagnetic force in the first position. During the subsequent motion towards the second position, the rows of first magnetic field generating elements progressively move past the associated stators such that when the door reaches the second position, a stators face and overlap a second end of the rows of first magnetic field generating elements, close to a second vertical edge of the door leaf.

[0009] According to a preferred embodiment, the sliding door assembly further comprises a lower guide rail assembly for guiding the lower edge of the door leaf. The one or more rows of first magnetic field generating elements are preferably each located above the lower guide rail assembly, such that the lower guide rail assembly can be kept simple and compact.

[0010] The door leaf is preferably at least partially, and preferably fully supported on rollers rolling on one or more raceways of the lower guide rail assembly.

[0011] According to a preferred embodiment, the upper guide rail assembly may consist, as is well known in the art, of a rail provided with one or more raceway on which rollers attached to the door leaf can roll. In particular, the door leaf can be at least partially, and preferably fully suspended from one or more carriages rolling on one or more raceways of the upper guide rail assembly.

[0012] In one particular embodiment, the door leaf is completely supported on the lower guide rail assembly and the upper guide rail assembly provides only lateral guidance. Still in another embodiment, the door leaf is

completely suspended from the upper guide rail assembly with a lower guide rail assembly providing lateral guidance only or without lower guide rail assembly.

[0013] The distance between the upper guide rail assembly or lower guide rail assembly and the row or rows of first magnetic field generating elements has to be adapted to take into account rolling friction between the door leaf and the lower and/or upper guide rail assembly. In the case of a fully supported door leaf, for instance, at least one of the one or more rows of permanent magnets is preferably located closer to the lower guide rail assembly than to the upper guide rail assembly, e.g. at a distance of ca. 10 to 30cm above the lower guide rail assembly of the door leaf, while an optional other row of permanent magnets can be located at a greater distance from the lower guide rail assembly, e.g. between the first row of permanent magnets and mid-height of the door leaf. Conversely, in the case of a fully suspended door leaf, at least one of the one or more rows of permanent magnets is preferably located closer to the upper guide rail assembly than to the lower guide rail assembly, e.g. at a distance of ca. 10 to 30cm below the upper guide rail assembly, while an optional other row of permanent magnets can be located at a greater distance from the upper guide rail assembly, e.g. between the first row of permanent magnets and mid-height of the door leaf. If for any reason the rows of permanent magnets are not ideally placed with respect to the guide rail assembly, a compensation can be provided with two rows of permanent magnets located at different heights, if the stators associated with the two rows are controlled such as to induce both a resulting electromagnetic force in the sliding direction and a torque to balance the moment of the mechanical resistance of the guide rail assemblies.

[0014] According to one embodiment, the one or more rows of first magnetic field generating elements include at least two rows of first magnetic field generating elements and each of the two rows of first magnetic field generating elements consists of adjacent poles of alternate polarities, distributed such that when the stator associated with one of the two rows faces one of the poles, the stator associated with the other of the two rows faces a space between two adjacent poles.

[0015] According to one embodiment, the first magnetic field generating elements of each row consist of individual permanent magnets and the one or more second magnetic field generating elements include one or more electric windings.

[0016] Preferably, the electric windings of the first and/or second magnetic field generating elements are energised only when needed, i.e. only to generate the electromagnetic forces to open and close the door leaf. Hence, when the door is stationary, no substantial electromagnetic field is generated, which reduces electromagnetic interferences with the environment.

[0017] According to one embodiment, the upper guide rail assembly is fixed relative to a wall including a doorway closed by the door leaf. In this case, the door leaf moves in translation only. The first position is the closed position and the second position is the open position. This embodiment is particularly suitable for an interior door or compartment door in a railway vehicle.

[0018] According to another embodiment particularly suitable for a side door of a railway vehicle, the door leaf assembly further comprises a linkage for guiding the upper guide rail with respect to a doorway in a wall between a closed position and a semi-open position. The doorway is closed by the door leaf when the upper guide rail is in the closed position and the door leaf is in the first position. The doorway is fully open when the upper guide rail assembly has moved to the semi-open position and the door leaf has moved to the second position. As stated before, the stator or stators are preferably fixed relative to the upper guide rail means. Advantageously, the linkage allows a pivoting movement of the guide rail assembly about a vertical pivot axis. The vertical pivot axis is preferably fixed relative to the doorway. The door leaf assembly is provided with a lower guide rail means, and one or more coordination bars may extend between the upper and lower guide rail assemblies.

[0019] An independent driving means may be provided to move the upper guide rail assembly between the closed and semi-open position. Alternatively or additionally, the linkage may further comprise a coordination linkage for coordinating a translation motion of the door leaf with respect to the upper guide rail assembly and a motion of the upper guide rail with respect to the doorway.

[0020] According to another aspect of the invention, there is provided a railway vehicle including a sliding door assembly as defined above.

[0021] According to one embodiment, the door leaf includes a transparent panel, at least one of the one or more rows of first magnetic field generating elements being located on the transparent panel substantially at eye-height or elbow-height to form a visible marking on the transparent panel. More specifically, the row may be located at a height between 1500 mm and 2000 mm, preferably between 1500 mm and 1800 mm. As an option, a second row may be located at a height between 850 mm and 1000 mm. Each row has preferably a height of at least 100 mm.

[0022] The row of first magnetic field generating elements can be provided as a magnetic sheet applied on the surface of the transparent panel. It can also be integrated into the transparent panel.

[0023] To provide an even more contrasted marking of the door, at least one of the one or more rows of first magnetic field generating elements may be coloured with at least two contrasting colours, and/or with specific patterns.

[0024] Various embodiments of the invention can be combined at will.

[0025] According to another aspect of the invention, there is provided a public transportation vehicle, in particular a railway vehicle provided with a sliding door assembly as described above, in particular as interior par-

tition door at the end of a saloon or voyager compartment.

DESCRIPTION OF THE FIGURES

[0026] Other advantages and features of the invention will become more clearly apparent from the following description of specific embodiments of the invention given as non-restrictive example only and represented in the accompanying drawings, in which:

- Fig. 1 illustrates a sliding door assembly according to one embodiment of the invention, in a closed position;
- Fig.2 illustrates the sliding door assembly of Fig. 1, in an open position;
- Fig.3 illustrates a horizontal section of the sliding door assembly of Fig.1, through plane III-III of Fig.4;
- Fig.4 illustrates a vertical section of the sliding door assembly of Fig.1 through the plane IV-IV of Fig. 3;
- Fig.5 illustrate a sliding door assembly according to another embodiment of the invention;
- Fig.6 illustrates the sliding door assembly of Fig. 5 in a closed position;
- Fig.7 illustrates the sliding door assembly of Fig. 5 in an open position;
- Fig.8 illustrates a section through a lower guide rail assembly of the sliding door assembly of Fig. 5;
- Fig. 9 illustrates a section through an upper guide rail assembly of the sliding door assembly of Fig. 5;
- Fig. 10 illustrates a coordination linkage of a variant of the embodiment of Fig. 5;
- Fig.11A to E illustrates various other embodiments of the invention.
- Fig. 12 illustrates a horizontal section of a sliding door assembly according to another embodiment of the invention;
- Fig. 13 illustrates a horizontal section of a sliding door assembly according to another embodiment of the invention.

[0027] Corresponding reference numerals refer to the same or corresponding parts in each of the figures.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0028] Referring to Figs. **1** to **4,** a doorway **10** in a partition wall **12** of a railway vehicle, e.g. a saloon or compartment doorway, has two vertical sides **14, 16** and a transom **18.** The transom **18** is equipped with a fixed guiding rail assembly **20** fitted with raceways **22,** which define a linear path. A door leaf **24** is suspended from two carriages **26,** provided with rollers **27** which roll on the raceways **22** of the guiding rail assembly **20** in a known manner, such that the door leaf **24** can slide between a closed position illustrated in Fig. **1** and an open position illustrated in Fig. **2,** parallel to the linear path of the raceway **22** and to a sliding direction **100.**

[0029] The door leaf **24** is provided with two rows **28, 30** of first magnetic field generating elements, which are illustrated as permanent magnets but can also be electric windings. Each row consists of individual alternate north and south poles **28N, 28S, 30N, 30S,** which may be realised with individual magnets or with a continuous band of rigid or flexible material filled or otherwise charged with magnetic, preferably ferromagnetic, particles oriented such as to provide a succession of sections of alternate magnetisation directions. In the example, individual U-shaped permanent magnets **28M, 30M** are embedded in the door leaf **24** with their ends **28N, 28S, 30N, 30S** flush with the door leaf surface **32.** Each row **28, 30** forms a so-called "unrolled rotor" of a multipolar linear synchronous motor.

[0030] One side **16** of the doorway **10** is provided with a slot **34** for accommodating the door leaf **24** in the open position. At the height of each of the two rows **28, 30** of permanent magnets, the slot is provided with two stators **38, 40,** each of which includes a number of windings **38W, 40W** and an armature **38A, 40A.** Each stator **38,** resp. **40** is associated to one of the two rows **28,** resp. **30** and its windings **38W, 40W,** which constitute second magnetic field generating elements, face the associated row **28** resp. **30** at an air gap distance D.

[0031] Each pole **30S, 30N** of the second row **30** of permanent magnets is located vertically between two adjacent poles **28S, 28N** of the first row **28** of permanent magnets. The windings **40W** of the second stator **40** are vertically aligned with the windings **38W** of the first stator **38.** Hence, when one of the windings **38W** of the first stator **38** faces one of the poles **28S, 28N** of the first row **28,** the aligned winding **40W** of the second stator **40** is located between two poles **30S, 30N** of the second row **30.**

[0032] The windings of the two stators are energised in quadrature, i.e. with a phase difference of 90° ($\pi/2$ radians). Depending on which of the stators leads in phase, the door leaf will move in one direction or the other.

[0033] The embodiment of Figs. **5** to **9** differs from the embodiment of Figs. **1** to **4** in that the guide rail assembly **20** is movable with respect to the wall and doorway. As will be explained below, this different structure of the

guide rail assembly **20** involves a different positioning of the stators **38, 40** and rows of permanent magnetic poles **28, 30.**

[0034] More specifically, a doorway **10** in an external side wall **12** of a railway vehicle, has two vertical sides **14, 16** and a transom **18.** The doorway **10** is equipped with an articulated guide rail assembly **20,** which includes an upper guide rail **42** and a lower guide rail **44.** The upper guide rail **20U** is connected to the transom of the doorway via an upper axial pivot connection **46.** Similarly, the lower guide rail **44** has one end connected to a doorsill **19** of the doorway **10** via a lower axial pivot connection **48.** The lower and upper pivot connections **46, 48** define a common vertical pivot axis **50.** A coordination linkage **52** between the upper and lower guide rails includes a vertical shaft **54** provided with an upper bell crank **56** linked to the upper guide rail **42** via a connecting rod **58,** and with a lower bell crank **60** linked to the lower guide rail **44** by means of a lower connecting rod **62.** At least one of the lower and upper bell cranks **56, 60,** in this case the lower bell crank **60,** is driven by an actuator **64,** which can be an electromechanical actuator or a pneumatic cylinder. The vertical shaft **54** rotates about a vertical axis **66** fixed relative to the wall. A vertical flat support bar **68** is attached to the upper and lower guide rails **42, 44** and supports the stators **38, 40** of a linear drive assembly, such that the stators are fixed relative to the upper and lower rails **42, 44.** As illustrated in Fig. **8,** the door leaf **24** is supported on a pair of lower carriages **70** provided with rollers **72,** which roll on a horizontal rolling track **74** of the lower guide rail **44.** The upper edge of the door leaf **24,** illustrated in Fig. **9,** is provided with rollers **76,** which roll on vertical tracks **78, 80** of the upper guide rail to provide lateral guidance. The door leaf **24** is provided with two rows of permanent magnets **28, 30** at an air gap distance of the stators **38, 40.** As illustrated, the rows **28, 30** of permanent magnets and the stators **38, 40** are located at intermediate position between the upper and lower rails **42, 44,** closer to the lower rail **44.**

[0035] The assembly operates as follows. In the closed position in Fig. **6,** the guide rails **42, 44** are in the plane of the doorway **10** closed by the door leaf **24,** which is in a first position with respect to the guide rails. The upper and lower guide rails **42, 44** can be locked to the transom and doorsill and/or to the sides of the doorway by positive locking means (not shown). The door leaf **24** is preferably also directly secured to the wall by positive locking means.

[0036] In order to open the door, the locking means are unlocked and the actuator drives the shaft in the clockwise direction in Fig. **7,** so that the upper and lower guide rails **42, 44** rotate about the vertical pivot axis **50** together with the door leaf **24** and the stators **38, 40** to reach a semi open position in which the door leaf **24** has not yet moved relative to the upper and lower rails and **42, 44** is still in the first position. Once this motion has been completed, the stators **38, 40** are powered and move the door leaf **24** towards a second, open position.

[0037] In order to close the door, the operations are reversed, with the stators **38, 40** being first powered to drive the door leaf **24** back to the first position, after which the door leaf **24** and drive rails **42, 44** are moved back to the closed position with the actuator **64.**

[0038] According to a variant illustrated in Fig. **10,** the upper and lower bell cranks **56, 60** can be replaced with two separate levers **70,** each of which is articulated at one end with a connecting rod **72** pivotally connected to the corresponding upper or lower rail **42, 44,** the other end of each of the two levers **70** being provided with a roller **74** which directly cooperates with the door leaf **24** and is received in a cavity **76** of the door leaf **24** in the first position. This arrangement renders the actuator and vertical shaft unnecessary. To move the door from the closed to the open position, the stators **38, 40** of the linear drive are powered to move the door leaf **24** towards the right in Fig. **10.** In the very first centimetres of the sliding motion of the door leaf **24,** the rollers **74** are pushed out of engagement with the cavities **76** provided in the door leaf and start to roll on the face **78** of the door leaf **24.** Simultaneously, the levers **70** rotate about their common rotation axis **80** and push the connecting rods **72** and the upper and lower guide rails **42, 44,** which rotate about the fixed pivot axis **50.** In order to close the door, the operation is simply reversed. A spring **82** or another type of return means, e.g. an electromagnetic return means can be added to bias the rails towards the closed position.

[0039] According to another variant, the sliding door assembly can be provided with two symmetrical door leafs **24,** each provided with its own linear drive.

[0040] According to a variant of the first embodiment, particularly suitable for an interior partition door of a passenger railway vehicle, the door leaf includes a transparent panel, e.g. a glass panel, and the two rows of permanent magnets are located at different heights in or on this glass panel, so as to be plainly visible. More specifically, one row of permanent magnets is located on the transparent panel substantially between eye-height and elbow-height, e.g. at a height between 1500 mm and 2000 mm, preferably between 1500 mm and 1800 mm. As an option, the second row may be located at a height between 850 mm and 1000 mm. Each row has preferably a height of at least 100 mm. The rows of permanent magnets **28, 30** can be painted in different colours, as illustrated in Figs. **11A** to **11E.**

[0041] More generally, it may prove advantageous in all embodiment to have one row **28** of permanent magnets located in the upper half of the door leaf **24** and the other row **30** located in the lower half, or at least to have the two rows **28, 30** spaced apart from one another by a distance of more than **1/10** of the door leaf height. It becomes possible to control the two stators **38, 40** such as to balance the effects of resulting magnetic forces on the upper and/or lower guide rails.

[0042] In all embodiments, the permanent magnets **28M, 30M** of the two rows **28, 30** can be replaced with electric windings to form the first magnetic field generat-

ing elements. In such a case, the windings **38W, 40W** that constitute the second magnetic field generating elements of the two stators **38, 40** can be replaced with permanent magnets. In the variant of Fig. **12,** the door leaf is equipped with one or several rows **28** of windings **28W,** which face a stator **38,** which includes two permanent magnets **38M** providing two pairs of alternate poles **38N,** 38S. In the variant of Fig. **13,** both the first magnetic field generating elements fixed relative to the door leaf and second magnetic field generating elements fixed relative to the upper guide rail assembly consist of windings.

[0043] In all embodiments, the windings **28W, 38W, 40W** are preferably energised only when needed, i.e. to generate the electromagnetic forces to open or close the door leaf.

Claims

1. A sliding door assembly comprising:

- a door leaf (24) provided with an upper horizontal edge and a lower horizontal edge;
- an upper guide rail assembly (20, 42) for guiding the upper edge of the door leaf (24) in translation parallel to a horizontal sliding direction (100) relative to the upper guide rail assembly (20, 42) between a first end position and a second end position;
- one or more rows (28, 30) of first magnetic field generating elements fixed to the door leaf (24) , each of the rows (28, 30) extending horizontally;
- one or more stators (38, 40) each associated with one of the rows (28, 30) of first magnetic field generating elements and each comprising one or more second magnetic field generating elements located at an air gap distance of the associated one of the rows (28, 30) of first magnetic field generating elements for generating an induced electromagnetic force in the sliding direction (100) on the associated one of the rows (28, 30) of first magnetic field generating elements, the one or more stators (38, 40) being stationary with respect to the upper guide rail assembly (20, 42);

characterised in that the one or more rows (28, 30) of first magnetic field generating elements are each located at an intermediate position below the upper horizontal edge and upper guide rail (20, 42) and above a lower horizontal edge of the door leaf and **in that** the one or more stators (38, 40) overlap with one end of the rows (28, 30) of first magnetic field generating elements in the first position.

2. The sliding door assembly of claim 1, **characterised in that** it further comprises a lower guide rail assembly (44) for guiding the lower edge of the door leaf and **in that** the one or more rows (28, 30) of first magnetic field generating elements are each located above the lower guide rail assembly (44).

3. The sliding door assembly of claim 2, **characterised in that** at least one of the one or more rows (28, 40) of permanent magnet is located closer to the lower guide rail assembly (44) than to the upper guide rail assembly (42).

4. The sliding door assembly of any one of the preceding claims, **characterised in that** at least one of the one or more rows (28, 30) of permanent magnet is located closer to the upper guide rail assembly (20) than to the lower edge of the door leaf.

5. The sliding door assembly of any one of the preceding claims, **characterised in that** the door leaf (24) includes a transparent panel, at least one of the one or more rows (28, 30) of first magnetic field generating elements being located on the transparent panel substantially at eye-height or elbow-height.

6. The sliding door assembly of any one of the preceding claims, wherein at least one of the one or more rows of first magnetic field generating elements includes first magnetic field generating elements coloured with at least two contrasting colours.

7. The sliding door assembly of any one of the preceding claims, **characterised in that** the one or more rows (28, 30) of first magnetic field generating elements include at least two rows (28, 30) of first magnetic field generating elements and each of the two rows of first magnetic field generating elements consists of adjacent poles (28N, 28S, 30N, 30S) of alternate polarities, distributed such that when the stator (38, 40) associated with one of the two rows (28, 30) faces one of the poles (28N, 28S, 30N, 30S), the stator (38, 40) associated with the other of the two rows (28, 30) faces a space between two adjacent poles (28N, 28S, 30N, 30S).

8. The sliding door assembly of any one of the preceding claims, **characterised in that** the first magnetic field generating elements of each row consist of individual permanent magnets or magnetised portions of a continuous magnetic sheet and the one or more second magnetic field generating elements include one or more electric windings.

9. The sliding door assembly of any one of claims 1 to 7, **characterised in that** the first magnetic field generating elements of each row include an electric winding, the sliding door assembly further comprising a control circuit for powering the electric winding to generate the induced electromagnetic force in the sliding direction.

10. The sliding door assembly of claim 9, **characterised in that** the one or more second magnetic field generating elements include one or more permanent magnets.

11. The sliding door assembly of any one of the preceding claims, **characterised in that** it further comprises a linkage for guiding the upper guide rail (20, 42) with respect to a doorway (10) in a wall (12).

12. The sliding door assembly of claim 11, **characterised in that** the linkage allows a pivoting movement of the guide rail assembly about a vertical pivot axis (50), preferably a vertical pivot axis that is fixed relative to the doorway (10).

13. The sliding door assembly of any one of claims 11 to 12, **characterised in that** the linkage further comprises a coordination linkage for coordinating a translation motion of the door leaf with respect to the upper guide rail assembly and a motion of the upper guide rail with respect to the doorway.

14. A railway vehicle provided with the sliding door assembly of any one of the preceding claims.

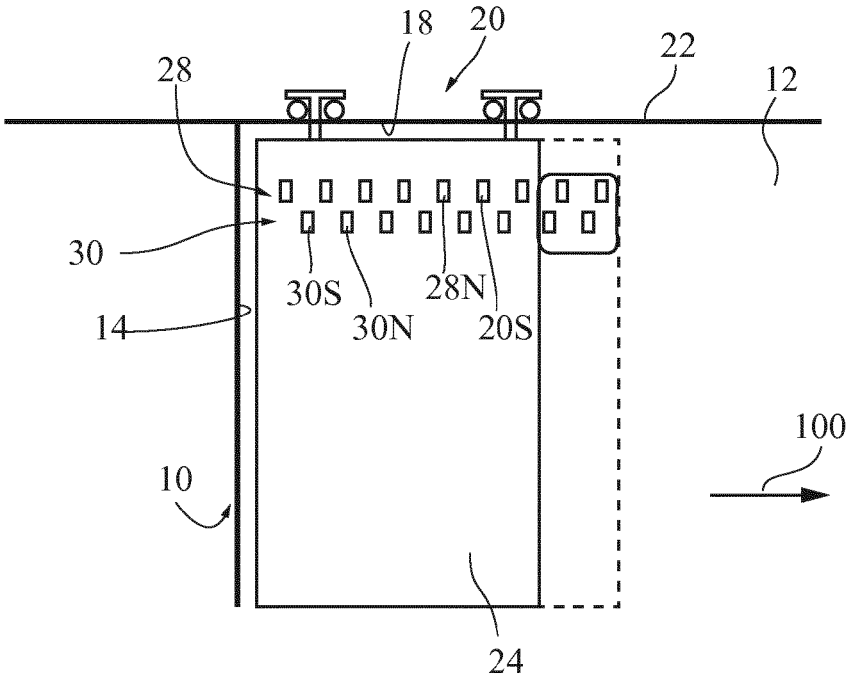


Fig.1

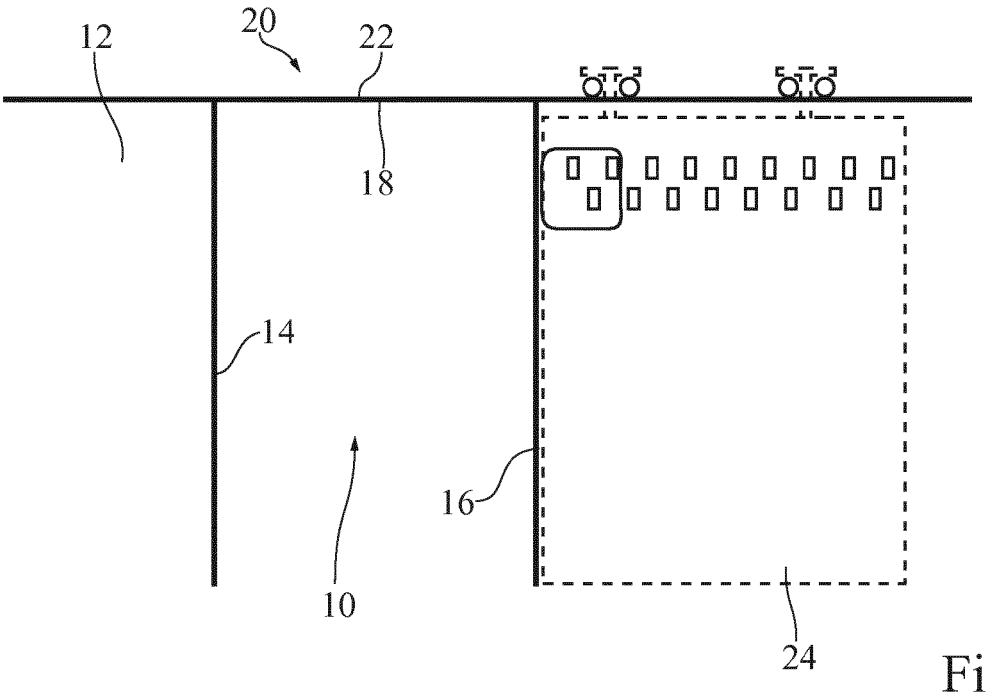
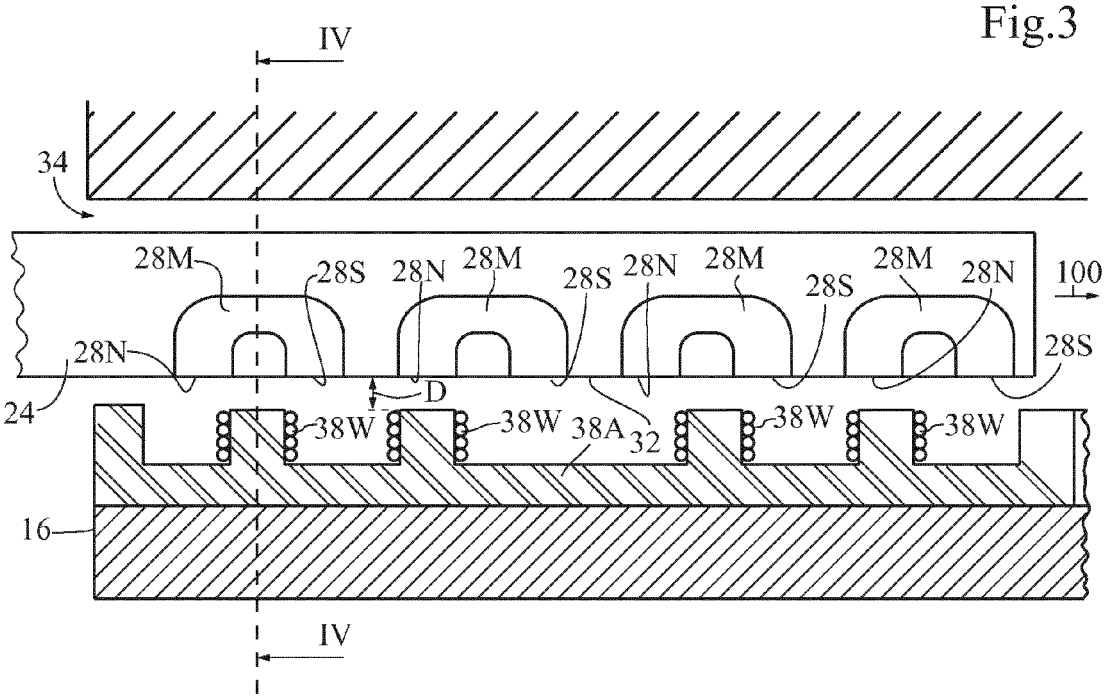


Fig.2

Fig.3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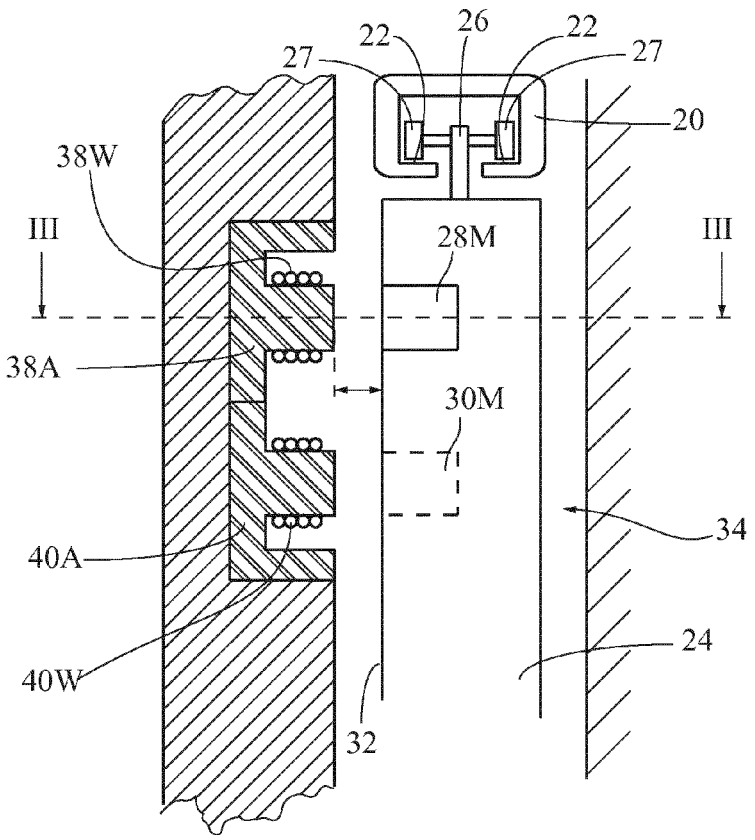
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Fig.4

Fig.5

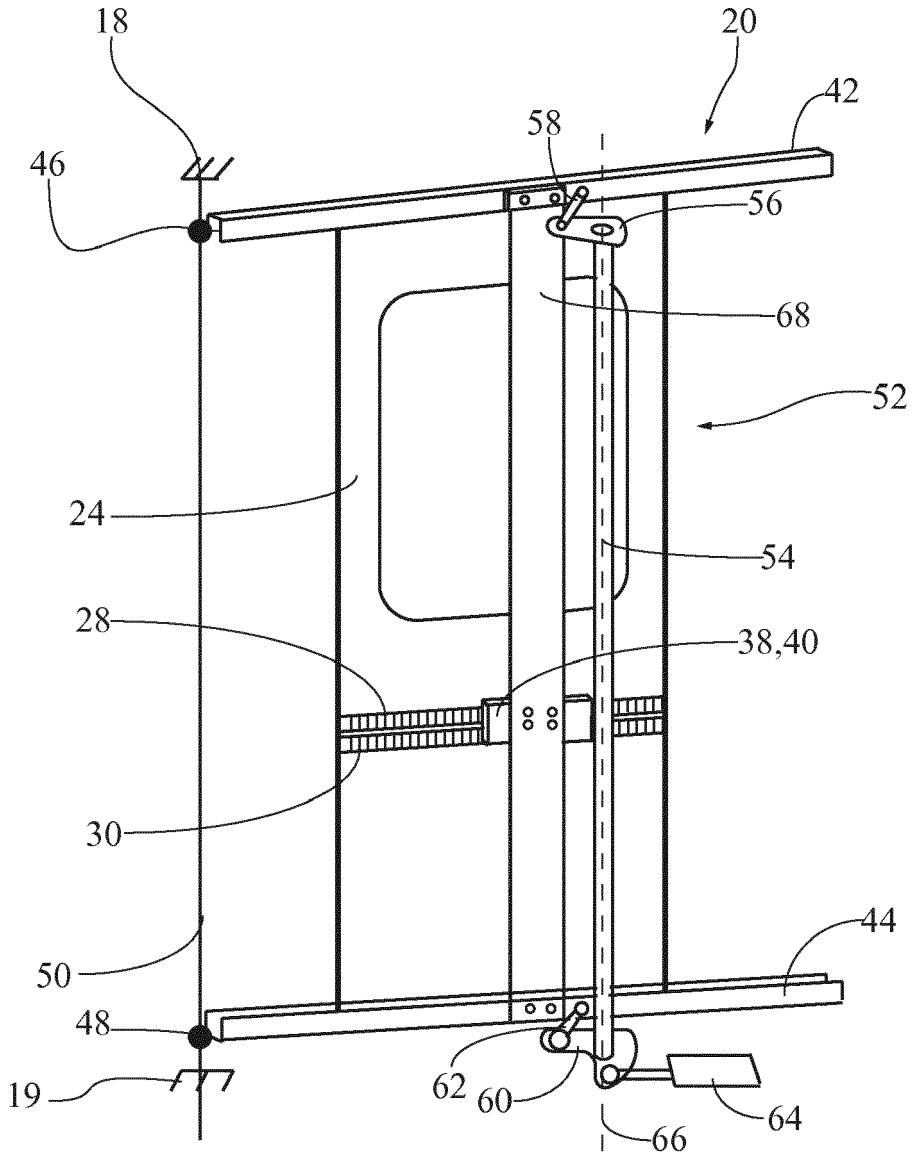


Fig.6

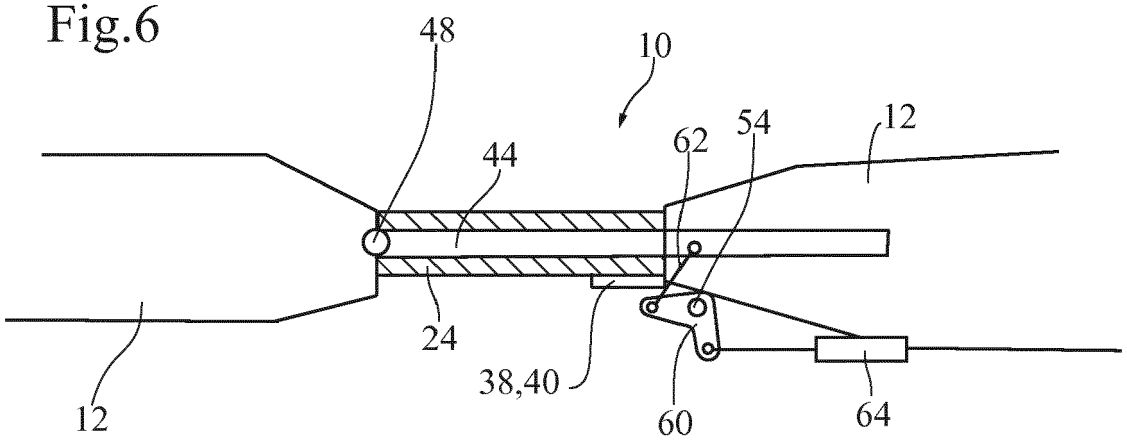


Fig.7

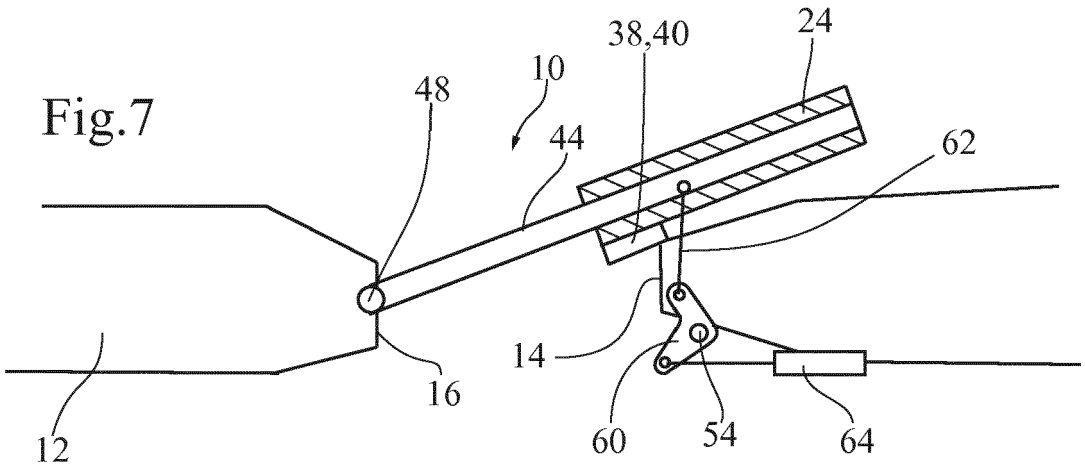
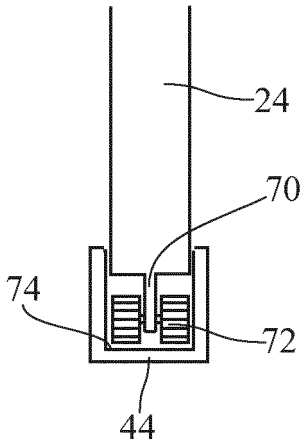


Fig.8



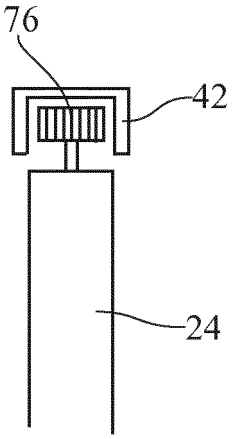


Fig.9

Fig.10

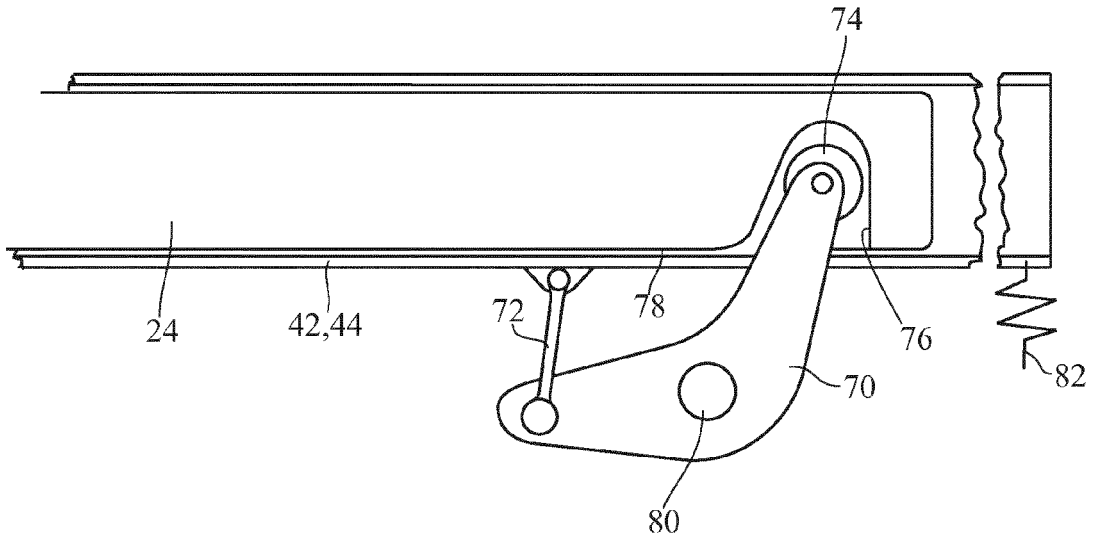


Fig.11

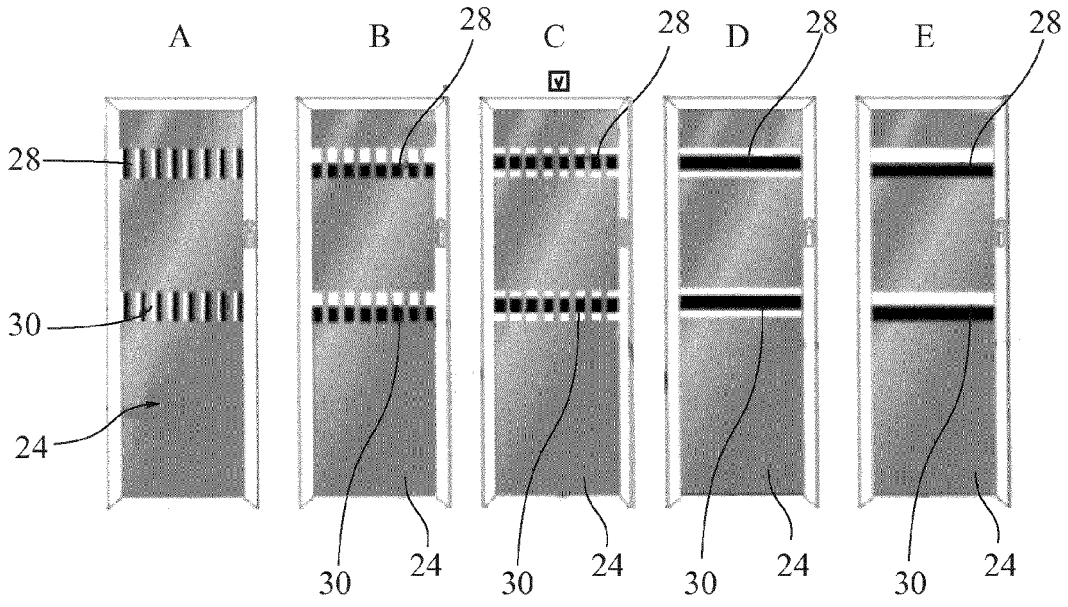


Fig.12

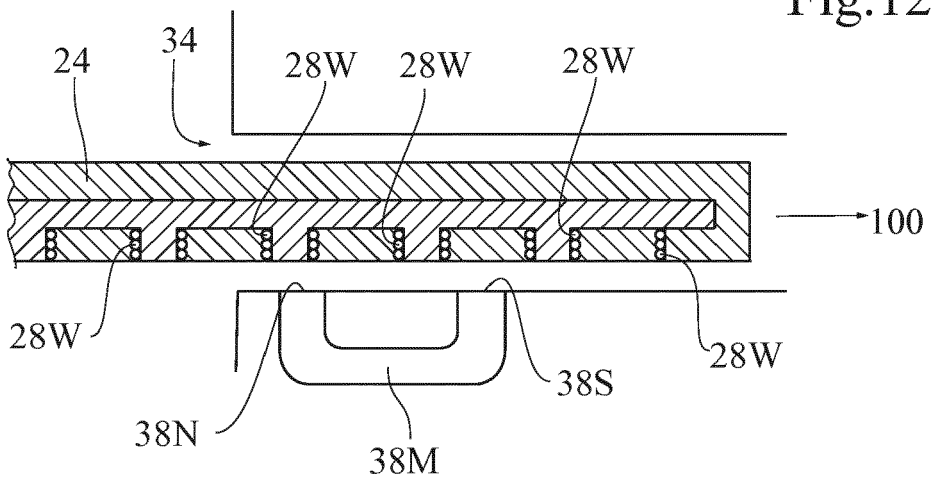

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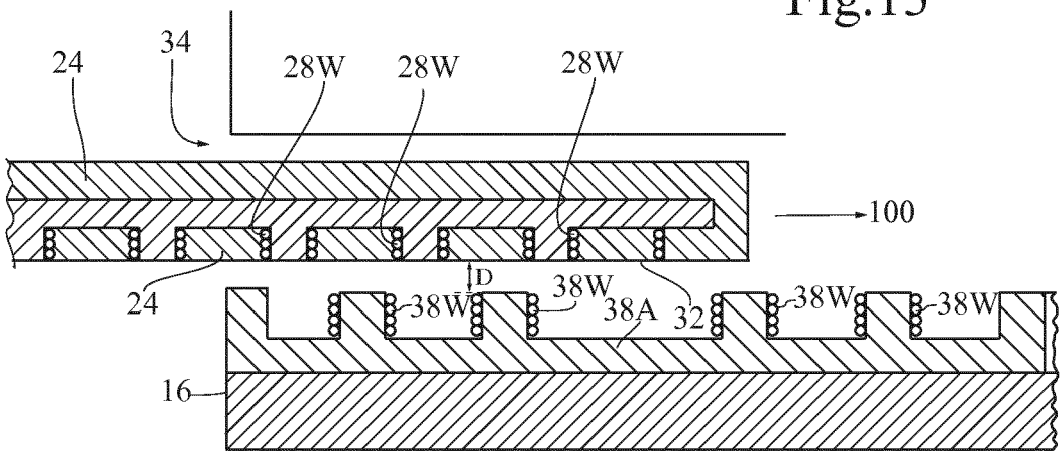
Fig.13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16

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EUROPEAN SEARCH REPORT

Application Number
EP 13 19 3212

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Place of search	Date of completion of the search	Examiner
The Hague	26 March 2014	Wagner, Andrea

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