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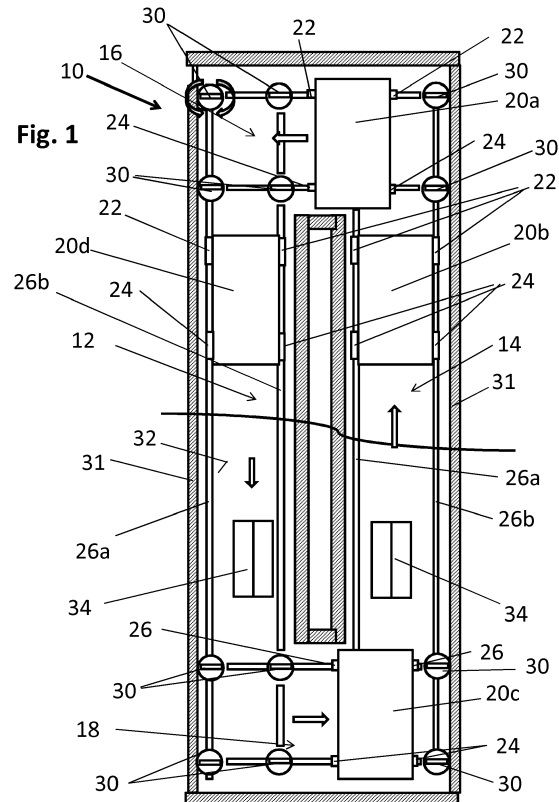
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(54) **PASSENGER CONVEYOR**

(57) The invention relates to a passenger conveyor (10) comprising at least one linear electric motor formed by linear stator rails (26a,b, 28a,b) with stator poles (52; 74, 78) being located in a fixed correlation to an environment, and at least one mover (22, 24) co-acting and moving along the stator rails (26a,b, 28a,b). The stator rails comprise at least a first stator rail (28a,b) extending in a first movement path in a first direction of the passenger conveyor (10) and at least a second stator rail (28a,b) extending in a second movement path in a second direction of the passenger conveyor (10). The first direction and the second direction are different directions, selected from the group of horizontal, inclined and vertical directions, characterized that at least one physical property of the first stator rail (26a,b) differs from that of the second stator rail (28a,b).



Description

[0001] The present invention relates to a passenger conveyor comprising at least one linear electric motor formed by at least one particularly linear stator rail with stator poles being located in a fixed correlation to an environment, and at least one mover co-acting and moving along the stator rail, the stator rails comprising at least a first stator rail extending in a first movement path in a first direction of the passenger conveyor and at least a second stator rail extending in a second movement path in a second direction of the passenger conveyor.

[0002] Such a passenger conveyor can for example be an elevator having at least one, particularly several, elevator cars, whereby each elevator car is suspended and driven by at least one, particularly at least two of the above mentioned linear electric motors, whereby at least one mover, particularly at least two movers are connected to the at least one elevator car and co-acting on the stator rail. The linear stator rails of an elevator comprise at least one vertical linear stator rail extending in a vertical movement path of the elevator car and at least one horizontal linear stator rail extending in a horizontal movement path of the elevator car. This type of elevators having a linear electric motor is particularly configured for high-rise elevators where on one hand the weight of the elevator ropes becomes too large and on the other hand the presence of only one elevator car in an extremely long shaft of several hundred meters would reduce the economic use of this elevator shaft which of course uses valuable building room in the skyscraper. In these solutions, usually rotatable rail parts are located between the vertical and horizontal stator rails and the elevator car has preferably a mover which is pivoted at the elevator car so that it can be rotated along with the rotatable stator rail part between a vertical and a horizontal position. Via such a simple mechanism, the elevator car is able to change between the vertical and horizontal movement parts.

[0003] Such a passenger conveyor of the abovementioned type can also be an escalator or moving sidewalk or ramp, where the mover(s) carry pallets of an endless conveyor structure. Independent of the type of passenger conveyor, the common feature thereof are stator rails which extend horizontally as also extend in a direction which deviates from the horizontal plane, i.e. are inclined or vertical. As the movers of the linear motors carry the gravitational force acting on the mover, e.g. an elevator car or an escalator pallet plus load, the impact of this weight or gravitational force is different depending on the orientation of the corresponding stator rail. In a horizontal stator rail this force acts normal to the stator rail, in a vertical rail it acts parallel thereto and in an inclined stator rail the force impact can be divided in a force vector parallel to the stator rail and a force vector normal to the stator rail. The value of these vectors depend on the angle between the horizontal and inclined stator rail.

[0004] It is object of the invention to improve the econ-

omy of such kind of passenger conveyor. This object is solved with a passenger conveyor according to claim 1. Preferred embodiments of the invention are subject-matter of the dependent claims.

[0005] According to the invention, at least one physical property of the horizontal stator rail differs from that of the vertical stator rail. The invention thus considers the fact that in the horizontal stator rail the weight of carried by the mover, e.g. an elevator car or a loaded escalator pallet acts in a normal direction of the stator rail and in the vertical stator rail, the force acting on a mover extends parallel to the stator rail. In the inclined stator rail the force acting on a mover acts in parallel and normal direction according to the inclination angle. According to the invention at least one of the physical properties of the horizontal and inclined or vertical stator rails are made differently so as to consider this fact. The physical properties of the horizontal stator rail are thus chosen in a way that aside of the propulsion force to move the mover horizontally a resulting upwards directed force is generated in the horizontal linear motor between the horizontal stator rail and the mover which supports the car or pallet according to the expected gravitational force acting in normal direction. On the other side the vertical stator rails are optimized to only provide upwards directed propulsion force. Nearly no normal force is acting on the mover in the area of this vertical stator rail. Consequently, much lower propulsion force is required for the horizontal movement path than for the vertical movement path.

[0006] There are different options to provide additional normal supporting power in the horizontal stator rails and to provide additional propulsion power in the vertical rails as it is described in more detail hereinafter. Accordingly, in the horizontal stator rail, a geometrical structure may be used which differs from that of the vertical stator rail. Thus, in the vertical stator rail, the stator teeth or stator poles could be inclined a little bit downwards to their free ends which better meets the requirements to pull the elevator car always in the upwards direction (large propulsion force). On the other hand, in the horizontal stator rails, the stator teeth could be straight, extending in the direction of normal of stator beam. This way larger normal force (attraction force between stator and mover) may be achieved than for the vertical stator rail portion. In particular, the stator teeth facing downwards could preferably have a larger width and/or length than the stator teeth extending upwards. Via this measure, the attraction between the mover and the downwards extending stator teeth is larger so that the suspension function of motor in the area of the horizontal stator rail is essentially increased with respect to normal stator rails where all stator teeth are formed identically, e.g. in the vertical stator rails. Of course, instead of the geometry also the material of the downwards extending stator teeth or poles may vary from that/those of the upwards extending stator poles in that the downwards extending teeth are made of a more ferromagnetic material or of stronger permanent magnets than the upwards extending stator teeth or poles.

Also this supports the suspension function in normal direction of the horizontal stator rails in connection with the movers of the elevator car. In this connection it has to be emphasized that the active sides of the mover facing the teeth or poles of the stator rails are identical in each direction, horizontal, inclined or vertical, as one and the same mover has to be able to co-act with stator rails extending in all directions. Thus, the changes between the vertical and horizontal movement paths are only realized by differences in the stator rail of the linear motors.

[0007] The stator rail comprises poles which are normally teeth but which could also embodied as permanent magnets or corresponding magnetic or electro-magnetic devices. Usually the stator rail consists of a ferromagnetic material as iron. But they may also consist of or comprise permanent magnetic materials as e.g. Halbach devices.

[0008] In a preferred embodiment of the invention, the horizontal stator rail comprises upper gaps between upper stator poles and lower gaps between lower stator poles whereby the width ratio between the upper stator poles and the upper gaps is lower than the width ratio between the lower poles and the lower gaps of the horizontal stator rail. Via this feature, the attraction between the downwards extending part of the stator rail and the mover is higher than between the upwards extending part of the stator rail and the mover which leads to a better suspension function for the weight of the car including its load acting on the mover.

[0009] It has turned out that a width ratio between the upper stator poles and upper gaps between 0.2 and 0.6, particularly between 0.3 and 0.5 is preferable, while the width ratio between the lower stator poles and the lower gaps is preferably between 0.7 and 1.5, particularly between 0.8 and 1.2. These ratios allow a good compensation of the gravitational force of the car+load/pallet+load acting in normal direction on the mover co-acting with the horizontal stator rail.

[0010] In a preferred embodiment of the invention, in the vertical cross-section of the surface between the upper stator poles forming the upper gaps of the horizontal stator rail is smooth, i.e. differentiable. This leads to a reduction of harmonics and thus to a better efficiency of the motor.

[0011] In a preferred embodiment of the invention, the width of the upper stator poles is between 5 and 10 mm, particularly between 6 and 9 mm, while the width of the lower stator poles is between 10 and 15 mm, particularly between 11 and 13 mm. These dimensions have revealed to best meet the suspension difference for compensating gravitational forces acting in normal direction on the mover, e.g. an elevator car plus its load or a loaded pallet or conveyor part of an escalator/moving ramp.

[0012] In a preferred embodiment of the invention, the horizontal stator rail is formed of a separate upper stator rail part comprising the upper stator poles, particularly stator teeth, and a separate lower stator rail part comprising the lower stator poles, particularly stator teeth, which upper and lower stator rail parts are connected to

each other. With this measure it is possible to use a different materials, e.g. different ferromagnetic material for the upper and stator poles so that the attraction between the lower stator poles and the mover can be made higher than the attraction between the upper stator poles and the mover so as to compensate for the car load. The use of a two-part stator rail enables or facilitates the manufacturing of the upper and lower teeth from different materials.

[0013] Preferably, at least the top portion of the stator poles of the vertical stator rail facing the mover is inclined with respect to the normal of the vertical stator rail while the stator poles of the horizontal stator rail are extending normally to the length of the horizontal stator rail. This different geometry of the poles of the vertical and horizontal stator rail considers the fact that any gravitational force acts parallel to the vertical stator rail. Thus, the inclined top end of the stator poles can be made as to support the propulsion force in upwards direction better than normally extending stator poles extending in normal direction. Preferably, the stator poles are inclined downwards as to better support the carload. In contrast thereto, the horizontal stator rail bears the carload in a normal direction so that preferably the stator poles are extending normally in the horizontal stator rails.

[0014] In an embodiment of the invention, the stator poles are permanent magnets, such as Halbach arrays, and the geometrical structure and/or material of the permanent magnets of the horizontal stator rails differs from that of the permanent magnets of the vertical stator rail. Accordingly, the permanent magnet poles of the vertical and horizontal stator rails can be individually designed to cope with the different force direction of the gravitational force acting on the mover which is in the vertical stator rails parallel to the rail whereas it is in the horizontal stator rails normal to the stator rail. Accordingly, in the horizontal stator rail, the downwards extending poles can be made of a permanent magnet material with a higher permeability than the upwards extending poles of the horizontal stator rail. On the other hand, all the poles of the different sites of the vertical stator rails are preferably made identical, which is more easy and cheaper to realize.

[0015] Preferably, the width and/or length of the poles of the horizontal stator rail is/are smaller than that of the vertical stator rail as to provide a better pulling force of the horizontal stator rail on the mover in upwards direction whereas the poles on the different sites of the vertical stator rail is preferably made identical as the gravitational force is pulling in downwards direction, i.e. parallel to the vertical stator rail.

[0016] In a further preferred embodiment, the material of the permanent magnets of the horizontal stator rail has a lower remanence than the material of the permanent magnets of the vertical stator rail. As the vertical stator rails have to provide a high propulsion force in upwards direction, this is not the case for the horizontal stator rails which mainly have to bear the gravitational force of an

elevator car or escalator pallet acting on the mover in normal direction. Thus, for the permanent magnets of the horizontal stator rails a more economic and cheaper material can be used than for the vertical stator rails, which leads generally to a more economic construction of the inventive passenger conveyor. In some embodiments, additional guide shoes or guide rollers of the elevator car are introduced to suspend the elevator car against the gravitational force.

[0017] In one embodiment the passenger conveyor is an elevator comprising at least one elevator car running in at least one, particularly several elevator shaft(s). In the elevator the elevator car is suspended and driven by the at least one linear electric motor whereby the at least one mover is connected to the at least one elevator car. The linear stator rails comprise at least one vertical stator rail extending in a vertical movement path of the elevator car and at least one horizontal stator rail extending in a horizontal movement path of the elevator car.

[0018] Preferably, in the above elevator a rotatable stator rail part is located between the vertical stator rail and the horizontal stator rail. The rotatable stator rail part is rotatable between a vertical and horizontal orientation as to allow the elevator car to transfer from a vertical movement path to a horizontal movement path of the elevator and vice versa. Preferably, in this connection, also the mover is pivoted rotatably at the elevator car, i.e. at an outer wall or support structure thereof. Thus, the mover is rotatable together with the rotatable stator rail part between a vertical and horizontal orientation. In this case, only one pivot drive may only be used for the mover to rotate the rotatable stator rail part by the interaction between mover and stator rail part or the stator rail part is connected with a rotating drive as to rotate the mover by the interaction between mover and rotatable stator rail part. Of course, the rotatable stator part and the mover are rotatable together around a common rotation axis. This reduces the number of necessary drives for rotating the rotatable stator rail part and mover between the vertical and horizontal orientation of the corresponding movement trajectory of the elevator car.

[0019] Alternatively or additionally a separate brake device may be provided to keep the car standstill during change of moving direction.

[0020] It is obvious for the skilled person that the above-mentioned embodiments may be combined with each other. It is to be considered that the configuration of the mover is the same for both horizontal and inclined and vertical movement paths. Therefore, obviously, the tooth pitch between the vertical and inclined and horizontal stator rail is the same. For considering the different influence of gravity, - i.e. the carload ore escalator pallet - on the mover/stator rail configuration in the vertical, inclined and horizontal parts the geometry and/or material of the corresponding stator rail may be varied to consider the different effect and orientation of gravity on these differently extending stator rail parts.

[0021] Following terms are used as a synonym: stator

pole - stator tooth - tooth; normal - perpendicular - 90 degrees;

The invention is now described in greater detail in connection with the enclosed drawings. In these show:

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Fig. 1 a side view of an elevator with two elevator shafts having vertical and horizontal stator rails acting together with movers pivoted at several elevator cars moving in those shafts,

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Fig. 2 a horizontal cross-section in the corner area between the elevator shaft and the elevator car showing a rotatable stator rail part co-acting with a rotatably pivoted mover of the elevator car,

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Fig. 3 a vertical stator rail co-acting with a mover of the elevator car,

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Fig. 4 a vertical schematic drawing indicating a linear FSPM mover co-acting with a stator rail having downwards inclined stator teeth,

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Fig. 5 an enlarged vertical side view of a vertical stator rail comprising curved and downwards extending stator teeth, and

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Fig. 6 a horizontal stator rail with a different geometry of upper and lower stator teeth working together with an FSPM mover.

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[0022] Fig. 1 shows an elevator 10 as an example of a passenger conveyor, having two vertical elevator shafts 12, 14 are at least at their upper and lower ends connected by horizontal shaft parts 16, 18 in which elevator cars 20a-20d are movable via linear motors. The linear motors are formed by upper movers 22 and lower movers 24 which are rotatably mounted, i.e. pivoted to the back side of the elevator cars, co-acting together with vertical stator rails 26a,b, horizontal stator rails 28a,b and with rotatable stator rails parts 30 which are rotatably mounted to a common back wall 32 of the vertical and horizontal shafts 12, 14, 16, 18. The vertical elevator shafts 12, 14 are usually located between shaft walls 31 of a building.

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[0023] Via this arrangement of vertical stator rails 26a,b and horizontal stator rails 28a,b and the rotatable stator rail parts 30 located in between them, the elevator cars 20a-20d are able to move via their movers 22, 24 in the two elevator shafts 12, 14 and two horizontal elevator shaft parts 16, 18 in a trajectory path as indicated by the arrows. The advantage of such a solution is that no counterweights and no hoisting ropes are necessary which makes this basic concept very useful for high buildings as skyscrapers wherein the vertical length of the elevator shaft is more or less unlimited. A height limiting factor for conventional traction sheave elevators was the weight of the elevator ropes, which sum up in high shafts to a weight of tons. This restriction is not present in this

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linear motor based elevator concept.

[0024] With the reference number 34, landing doors are indicated which are preferably located in the common sidewall facing the viewer, i.e. opposite to the common back wall 32 where the stator rails 26a,b, 28a,b are mounted. But of course the landing doors could also be on the same back wall 32 or where the stator rails are mounted.

[0025] Fig. 2 shows the co-action of the rotatable stator parts 30 and the movers 22, 24 which are via a pivoted joint 36 rotatably mounted to a wall, particularly back wall or support structure 38 of the elevator car 20. The rotatable stator part 30 and the mover 22,24 are rotatable around a common rotation axis r. The rotatable rail part 30 comprises a rail section 40 which abuts in the vertical direction (as indicated) with the vertical stator rails 26a, 26b. The stator sections 40 are mounted to a rotating disc 42, which is optional, and a bearing 44 to the back wall 32 of the elevator shaft whereby preferably either the rotating disk 42 or the mover 22, 24 is driven with a rotation drive around the common rotation axis r. Thus, the whole arrangement of rotatable stator part and mover can be rotated with only one rotating drive. During the rotation, the linear motor is switched off so that the mover 22, 24 and the stator section 40 are via the magnetic force between the stator section and the mover 22, 24 fixedly attached to each other which keeps the car from moving during change of trajectory path. Accordingly, a brake for keeping the mover 22, 24 and the stator section 40 of the rotatable stator part 30 together is not necessary. Alternatively, an additional separate brake device may be introduced to keep the car standstill. This may be necessary in alternative embodiments where the magnetic force would not otherwise be adequate, for example, in embodiments wherein the stator poles are implemented with magnets, such as Halbach arrays, and the rotor coils of the mover are air core coils, i.e. the rotor is implemented without ferromagnetic core. After the whole arrangement has turned into the horizontal direction, the stator section 40 is now in line with the horizontal stator rails 28a, 28b and the mover 22, 24 can again be energized as to convey the elevator car 20a-d along the horizontal elevator shaft parts 16, 18.

[0026] Fig. 3 shows a horizontal cross-section of the vertical stator rail 26a,b and the mover 22, 24. Accordingly, the vertical stator rail 26a,b comprises a stator beam 46 with square cross section having on its sides four stator faces 50 comprising stator teeth 52. The mover 22, 24 comprises active parts 54 located in a C-shaped mover housing 56 surrounding the stator beam 46, which active parts 54 face the corresponding stator faces 50 of the stator beam 46 as to generate an upwards directed propulsion force which is able to drive the elevator car 20a-d against the gravity force in upwards and downwards direction. The mover housing 56 together with the active mover parts 54 form the movers 22, 24 of the linear motors of the elevator. The mover housing 56 is via the pivot joint 36 mounted to a support structure 38 of the

car 20. The stator beam 46 is supported with mountings 58 to the back wall 32 of the elevator shaft 12, 14, 16, 18. The physical properties of the four different stator phases 50 of the vertical stator rail 26a,b and the physical properties of the corresponding active mover parts 54 of the mover 24, 25 are identical.

[0027] Preferably, in this arrangement, the stator teeth 52 are inclined downwards by an angle α as it is shown in Fig. 4. The tooth pitch is d in case of all stator faces 50. Between the stator teeth 52 of the stator face 50, gaps 53 are provided which are also identical on all four stator faces 50 of the vertical stator rail 26a,b. The active mover part 54 form together with the stator rails 26, 28 an FSPM motor. The active mover parts 54 each comprise successive packages with two mover irons 60, 62 between which one thin permanent magnet 64 is located. This arrangement of mover irons 60, 62 and permanent magnet 64 is followed by two windings 66, 68 which are controlled as to produce a magnetic field in opposite direction. This package comprising the succession 60, 62, 64, 68 of mover irons, permanent magnets and windings is successively repeated along to the length of the mover 22, 24. By this way, a very effective linear motor is formed which allows a good control of the car movement. Via the downwards inclination of the stator teeth 52 by the angle α , the pulling effect of the linear motor in upwards direction is increased so that this vertical stator rail is particularly adapted to compensate the gravitational force of the elevator car in downwards direction.

[0028] Fig. 5 shows a second embodiment of a stator rail wherein the stator face 50b comprises stator teeth 52b which are directed downwards by an angle α but additionally to Fig. 4 the centre line of the teeth 52 is curved. Also this stator rail leads to an increased pulling force of the linear motor in upwards direction thus being able to compensate for the force impact on the mover caused by the gravitational force of the elevator car and its load.

[0029] Fig. 6 shows in a vertical cross-section the two active mover parts 54 of a mover 22, 24 facing a horizontal stator rail 28a,b which consists of a separate upper stator rail part 70 and lower stator part 72 which are connected to each other, e.g. by welding or gluing or via bolts or similar connection methods. The upper stator part 70 comprises upper stator teeth 74 extending upwards which are separated by upper gaps 76 located between the upper stator teeth 74. The surface of the upper gaps 76 between the upper stator teeth 74 is smooth, i.e. differentiable as to reduce the harmonics during operation of the linear motor. The lower stator rail part 72 comprises lower stator teeth 78 extending downwards which are separated by lower air gaps 80. The pitch d of the upper stator teeth 74 is of course the same as the pitch of the lower stator teeth 78 and the same pitch as that of the vertical stator rails 26a,b. All stator teeth 74, 78 of the horizontal stator rail 28a,b extend normal to the stator rail 28a,b. Anyway, the lower stator teeth 78 have a larger width w1 than the upper stator teeth 74 which have a

smaller width w2. Also the ratio between the tooth width and gap width is for the upper stator rail part 70 smaller than for the lower stator rail part 72. Thus, by this difference of the geometrical configuration of the upper and lower stator rail parts 70, 72 the attraction between the mover 22, 24 and the lower stator rail part 72 is essentially larger than the attraction between the upper active mover parts 54 and the upper stator rail part 70, thus compensating for the gravitational force of the loaded car acting on the mover 22, 24. Thus, the invention provides individualized vertical and horizontal stator rails 26a,b, 28a,b which consider the fact that the gravitational force acting on the car 20 and its load is acting parallel to the vertical stator rails while it is acting normally to the horizontal stator rails.

[0030] In an embodiment, the first stator rail extends in an inclined direction in an inclined movement path and the second stator rail extends in a vertical direction in a vertical movement path. In this case, stator teeth of the first, inclined stator rail may be designed to deal with the normal force component caused by gravity. For example, free ends of the stator teeth of the first stator rail may be less downwards-inclined than free ends of the stator teeth of the second stator rail (i.e. stator teeth of the first stator rail may be more straight than stator teeth of the second stator rail).

[0031] The invention is not limited to the disclosed embodiments but variations of the invention may be possible within the scope of the appended patent claims.

List of reference numbers:

[0032]

10 elevator - passenger conveyor
 12 first (vertical) elevator shaft
 14 second (vertical) elevator shaft
 16 upper horizontal shaft part
 18 lower horizontal shaft part
 20 elevator car
 22 upper car movers
 24 lower car movers
 26a,b vertical stator rails
 28a,b horizontal stator rails
 30 rotatable stator rail parts between the horizontal and vertical stator rails
 31 elevator shaft walls
 32 common back wall of all elevator shafts carrying the stator rails
 34 landing doors
 36 pivoted joint between the car and the mover
 38 (back) wall or support structure of the elevator car for mounting the pivoted joint
 40 stator section fixed to rotating disc of rotatable stator rail part
 42 rotating disc
 44 bearing for the rotating disc on the back wall of the elevator shaft

46 stator beam with square horizontal cross section having on its four side faces a stator face each
 48 mountings for the stator beam to the back wall of the elevator shaft
 50 stator face with stator poles/teeth
 54 active mover parts of the mover facing the stator faces of the stator beam
 56 mover housing carrying the active mover parts surrounding the stator beam
 10 60 first mover iron of a package of the mover
 62 second mover iron of a package of the mover
 64 permanent magnet between the mover iron
 66 first winding of a package of the mover
 15 68 second winding of a package of the mover
 70 upper stator rail part
 72 lower stator rail part
 74 upper stator teeth
 76 upper gaps
 20 78 lower stator teeth
 80 lower gaps
 r common rotation axis of rotatable stator part and mover
 d pitch of the stator teeth
 25 α angle of downwards inclination of the teeth of the vertical stator rails vs the horizontal plane
 w1 width of the lower teeth of the horizontal stator rail
 w2 width of the upper teeth of the horizontal stator rail
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Claims

35 1. Passenger conveyor (10) comprising at least one linear electric motor formed by linear stator rails (26a,b, 28a,b) with stator poles (52; 74, 78) being located in a fixed correlation to an environment, and at least one mover (22, 24) co-acting and moving along the stator rails (26a,b, 28a,b), the stator rails comprising at least a first stator rail (28a,b) extending in a first movement path in a first direction of the passenger conveyor (10) and at least a second stator rail (28a,b) extending in a second movement path in a second direction of the passenger conveyor (10), wherein the first direction and the second direction are different directions, selected from the group of horizontal, inclined and vertical direction, characterized that at least one physical property of the first stator rail (26a,b) differs from that of the second stator rail (28a,b).
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 55 2. Passenger conveyor (10) according to claim 1, **characterized in that** the first direction is the horizontal direction and the second direction is the vertical direction or inclined direction; and **in that** the first movement path is a horizontal movement path and the second movement path is

a vertical or an inclined movement path;

and **in that** the first stator rail is a horizontal stator rail and the second stator rail is a vertical or an inclined stator rail.

3. Passenger conveyor (10) according to claim 2, **characterized in that** the geometrical structure of the horizontal stator rail (28a,b) differs from that of the inclined or vertical stator rail (26a,b).
4. Passenger conveyor (10) according to claim 1, 2 or 3, **characterized in that** the poles (52; 74, 78) are stator teeth, and width and/or geometry of the stator teeth of the horizontal stator rail (28a,b) differs from that/those of the inclined or vertical stator rail (26a,b).
5. Passenger conveyor (10) according to claim 4, **characterized in that** the distance between the stator teeth and/or the width of the gaps between the stator teeth of the horizontal stator rail (28a,b) differs from that/those of the inclined or vertical stator rail (26a,b).
6. Passenger conveyor (10) according to one of the claims 4 or 5, wherein the horizontal linear stator rail (28a,b) comprises upper stator teeth (74) extending upwards from the stator rail (28a,b) and lower stator teeth (78) extending downwards from the stator rail (28a,b), **characterized in that** the width and / or length of the upper stator teeth (74) of the horizontal stator rail (28a,b) is lower than the width and / or length of the lower stator teeth (78) of the horizontal stator rail (28a,b), while the stator teeth (52) of the inclined or vertical stator rail (26a,b) are similar on all side faces (50) of the inclined or vertical stator rail (26a,b).
7. Passenger conveyor (10) according to claim 6, wherein the horizontal stator rail (26a,b, 28a,b) comprises upper gaps (76) between the upper stator teeth (74) and lower gaps (80) between the lower stator teeth (78), **characterized in that** the width ratio between the upper stator teeth (74) and the upper gaps (76) of the horizontal stator rail (28a,b) is lower than the width ratio between the lower teeth (78) and the lower gaps (80) of the horizontal stator rail (28a,b).
8. Passenger conveyor (10) according to claim 7, wherein the width ratio between upper stator teeth (74) and upper gaps (76) is between 0,2 and 0,6, preferably between 0,3 and 0,5, while the width ratio between the lower stator teeth (78) and the lower gaps (80) is between 0,7 and 1,5, preferably between 0,8 and 1,2.
9. Passenger conveyor (10) according to one of claims 6 to 8, wherein the width (w2) of the upper stator teeth (74) is between 5 and 10 mm, particularly be-

tween 6 and 9 mm, while the width (w1) of the lower stator teeth (78) is between 10 and 15 mm, particularly between 11 and 13 mm.

10. Passenger conveyor (10) according to one of claims 6 to 9, wherein the horizontal stator rail (28a,b) is formed of a separate upper stator rail part (70) comprising the upper stator teeth (74) and a separate lower stator rail part (72) comprising the lower stator teeth (78), which upper and lower stator rail parts (70, 72) are connected to each other.
11. Passenger conveyor (10) according to one of the preceding claims, **characterized in that** the difference between the at least one physical property between the horizontal stator rail (28a,b) and the inclined stator rail depends on the angle between the horizontal and the inclined stator rail.
12. Passenger conveyor (10) according to claim 1, wherein the poles are permanent magnets, such as Halbach arrays, and wherein the geometrical structure and/or material of the permanent magnets of the horizontal stator rail (28a,b) differs from that/those of the inclined or vertical stator rail (26a,b).
13. Passenger conveyor (10) according to claim 12, wherein the width and/or length of the poles (74, 78) of the horizontal stator rail (28a,b) is/are smaller than that of the inclined or vertical stator rail (28a,b).
14. Passenger conveyor (10) according to claim 12 or 13 wherein the material of the permanent magnets of the horizontal stator rail (28a,b) has a lower remanence than the material of the permanent magnets of the inclined or vertical stator rail (26a,b).
15. Passenger conveyor (10) according to one of the preceding claims, which passenger conveyor (10) is an elevator comprising at least one elevator car (20a-d) running in at least one elevator shaft (12, 14, 16, 18) and in which elevator the elevator car (20a-d) is suspended and driven by the at least one linear electric motor whereby the at least one mover (22, 24) is connected to the at least one elevator car (20a-d), the stator rails (26a,b, 28a,b) comprise at least one vertical stator rail (26a,b) extending in a vertical movement path (12, 14) of the elevator car (20a-d) and at least one horizontal stator rail (28a,b) extending in a horizontal movement path (16, 18) of the elevator car (20a-d).
16. Elevator according to claim 15, **characterized in that** at least the top portion (92) of the stator teeth (52) of the vertical stator rail (26a,b) facing the mover (24, 26) is inclined (a) with respect to the normal of the vertical stator rail (26a,b, 28a,b) while the stator teeth (74, 78) of the horizontal stator rail (28a,b) are

extending normally to the length of the horizontal stator rail (28a,b).

17. Elevator according to one of claim 16, wherein the free ends of the stator teeth (52a,b) of the vertical stator rail (26a,b) are extending downwards. 5
18. Elevator according to one of claims 15 to 17, wherein between the vertical stator rail (26a,b) and the horizontal stator rail (28a,b) a rotatable stator rail part (30) is located which is rotatable between a vertical and horizontal orientation. 10
19. Elevator according to claim 18, wherein the mover (22, 24) is pivoted (36) at the elevator car (20a-d) and is rotatable together with the rotatable stator rail part (30) between a vertical and a horizontal orientation. 15

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Fig. 1

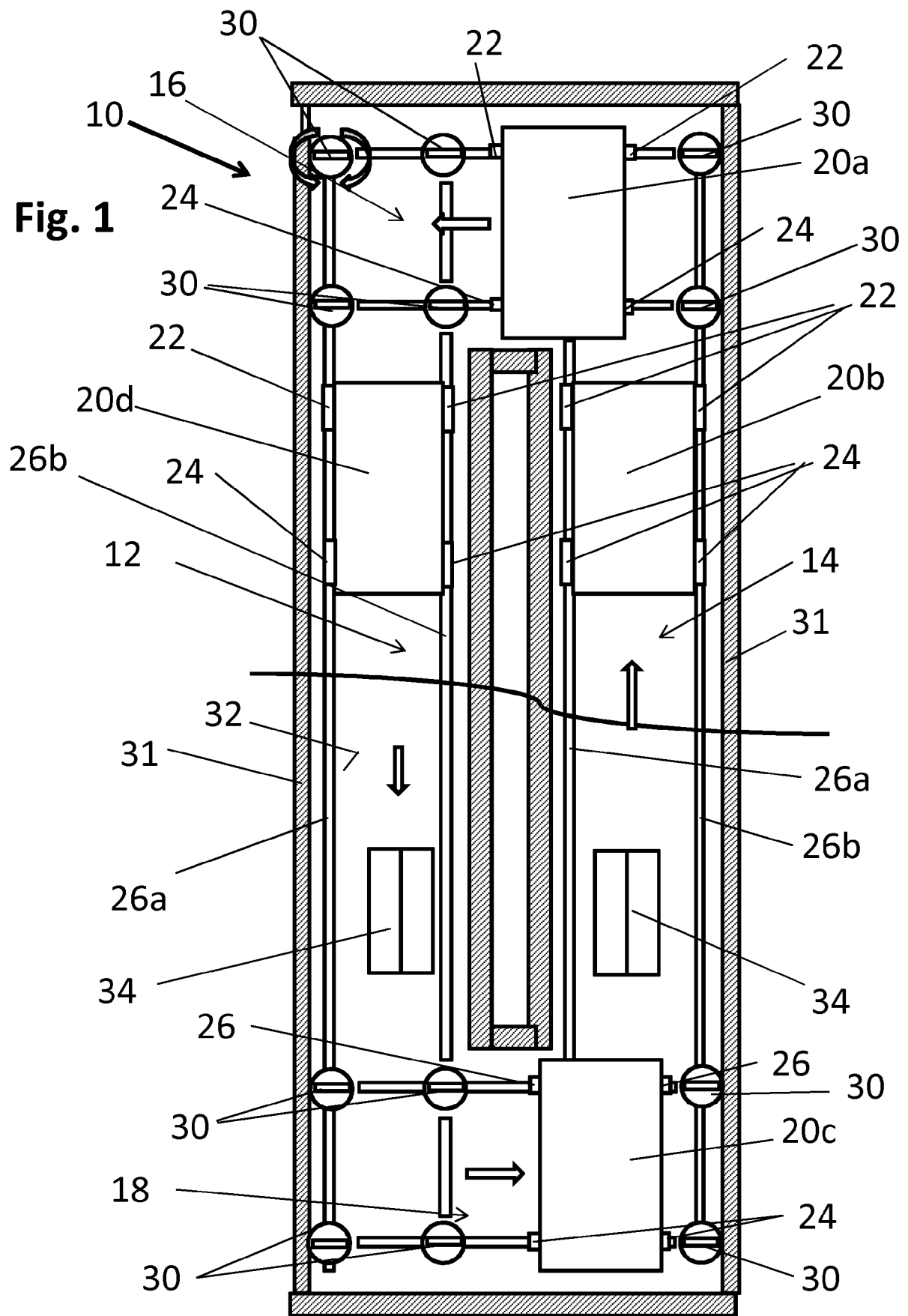


Fig. 2

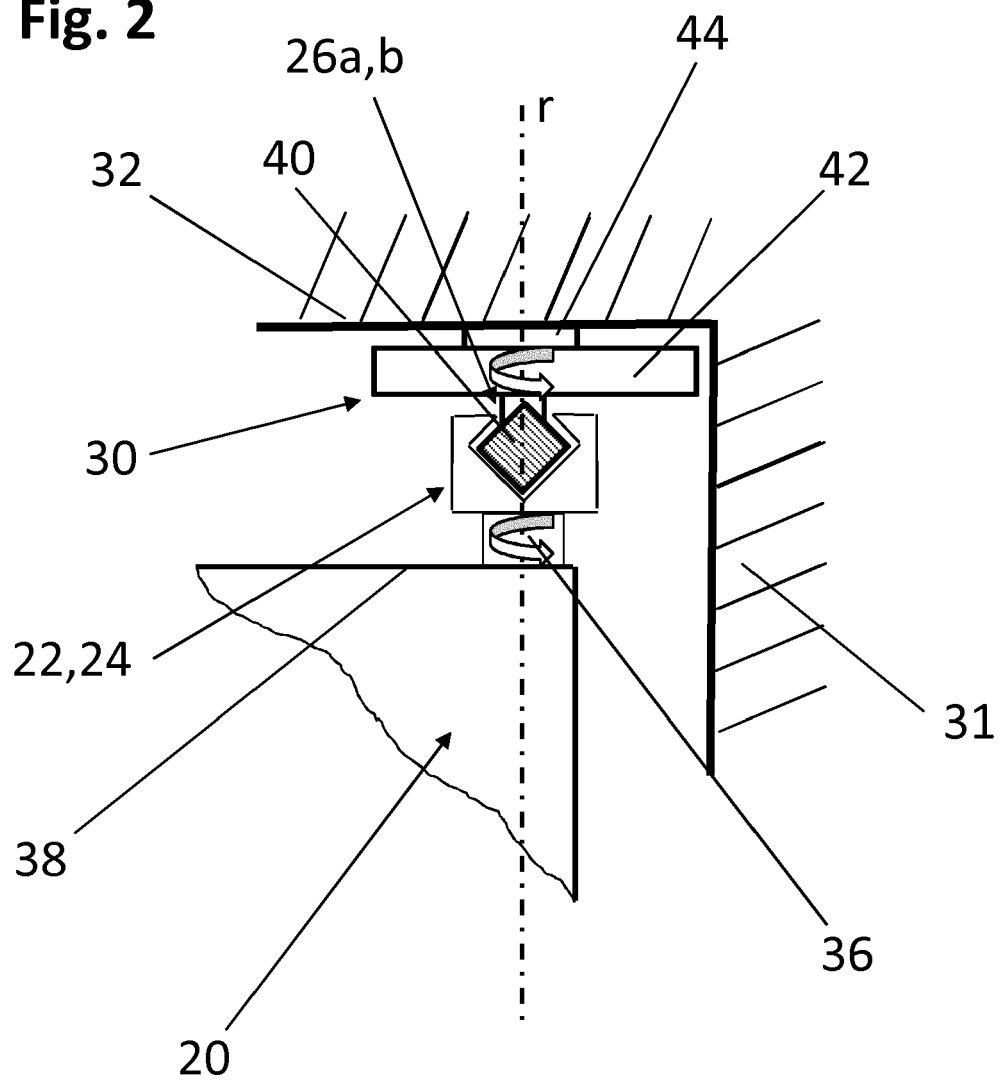


Fig. 3

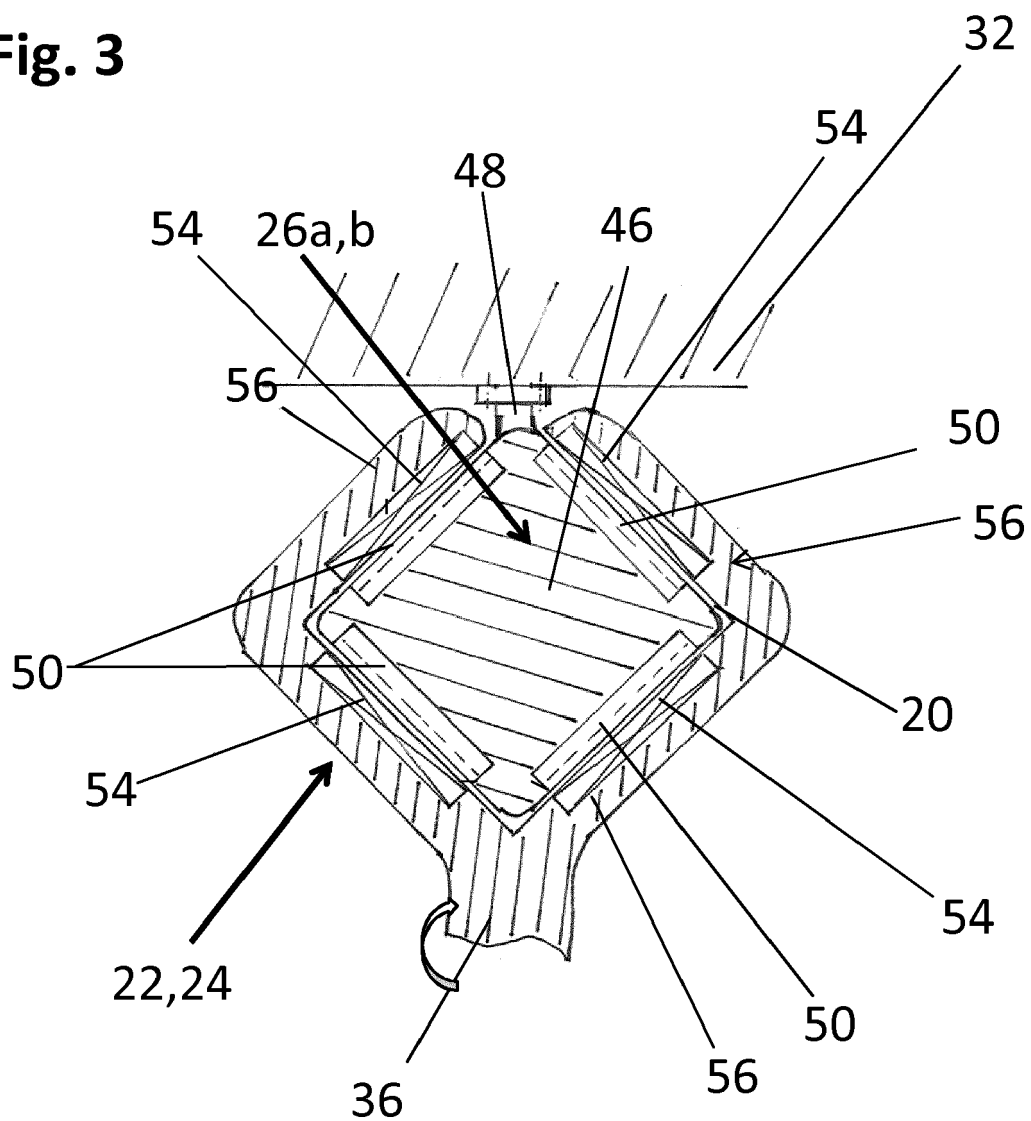


Fig. 4

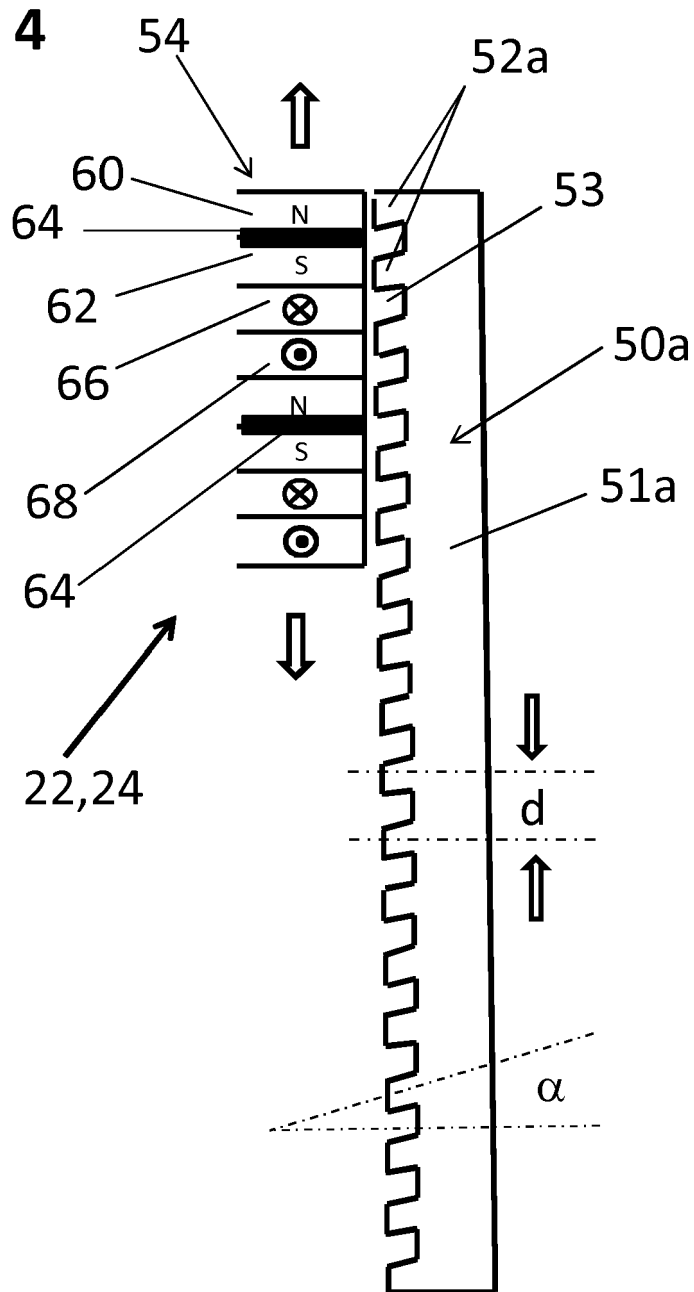
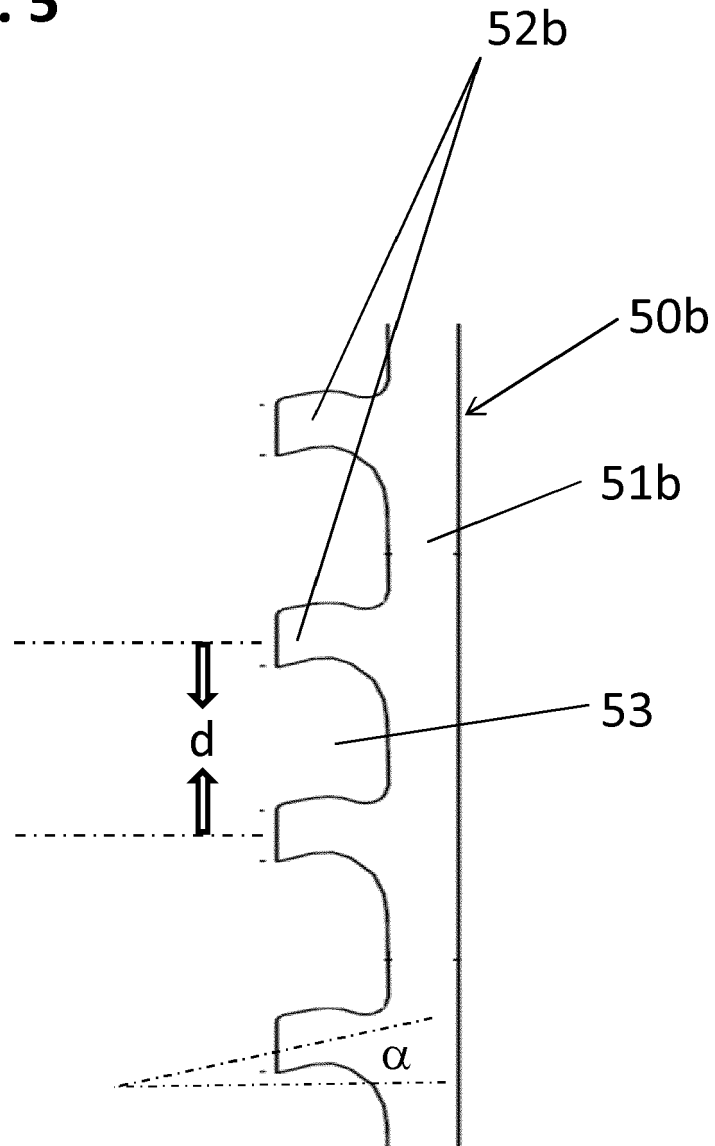
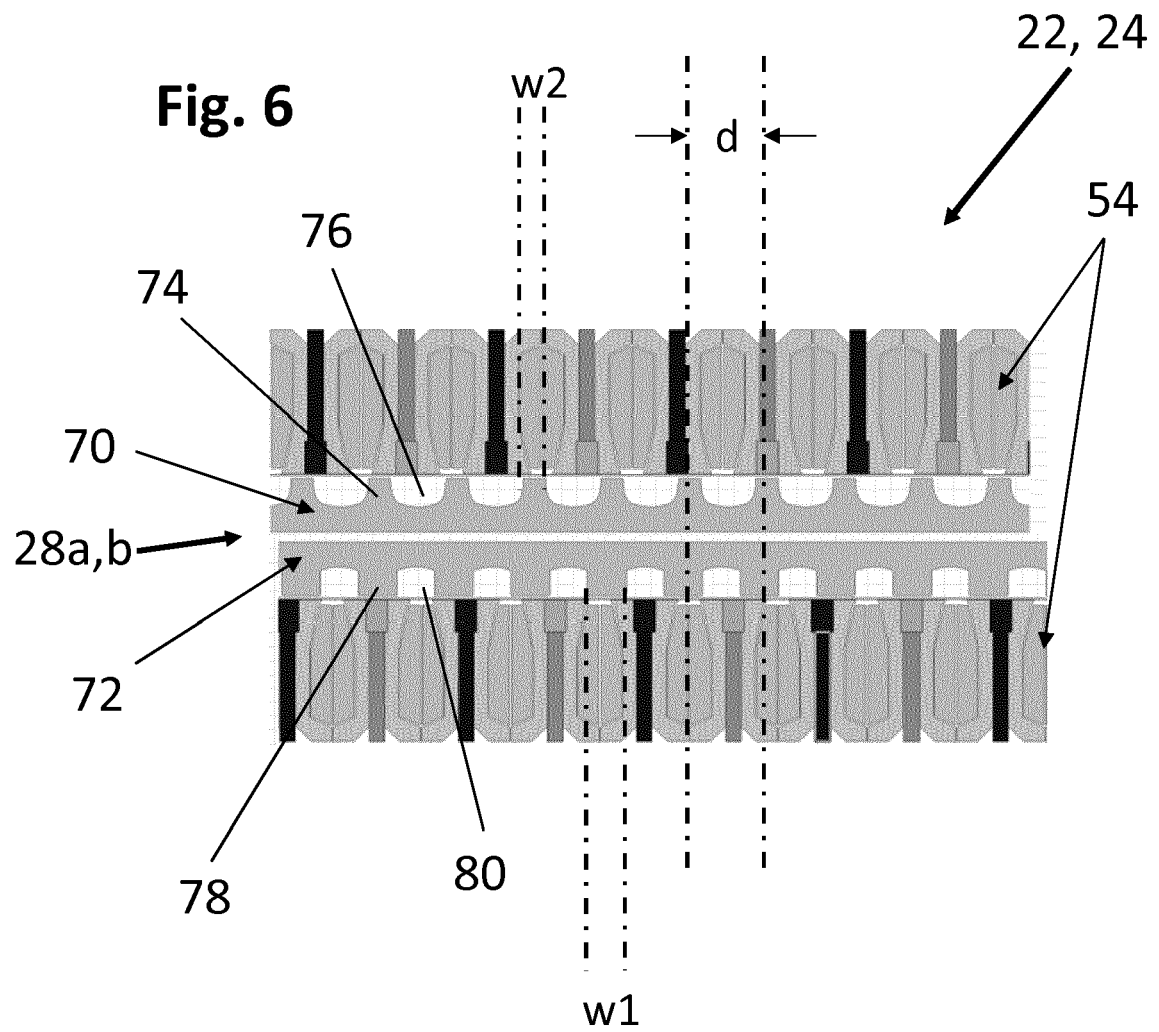


Fig. 5







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Place of search The Hague		Date of completion of the search 16 December 2019	Examiner Janssens, Gerd
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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