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(54) INDUSTRIAL DOOR

INDUSTRIETOR

PORTE INDUSTRIELLE

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Description

[0001] The present invention relates to industrial doors comprising a movable sheet between an extended closed position and a compacted open position of the industrial door.

[0002] Usually, the sheet is compacted by lifting it upwards.

[0003] In a known embodiment to which the present invention refers, in order to provide the necessary resistance to wind force, the fabric is rigidly supported by transverse bars, for example, metal tubes. The ends of these bars are supported on guide carriages that slide vertically along lateral guide uprights. For moving the sheet, the door is provided with a motor that controls in rotation a horizontal shaft extending over the sheet from one side of the door to the other. To this shaft are fixed, so as to be wound or unwound depending on the direction of rotation of the motor, a plurality of horizontally equidistant belts supporting the lower stiffening bar.

[0004] For compacting the sheet, the belts are wound around the horizontal shaft. While lifting the lower bar, the respective guide carriages are supported against the carriages above, pulling all or part of the guide carriages upwards until the desired sheet height with respect to the ground is reached.

[0005] When the door has a particularly large width, for example over 5 meters, the bars are not rigid enough and at least the lower bar must be replaced by a beam or a reticular structure.

[0006] Furthermore, large-size doors require that the motor apparatus, the belt winding shaft, and the shaft end support bearings are also appropriately sized.

[0007] GB 2 306 995 A discloses a tensioned movable door, supported and guided at its edges by wheeled trolleys. In case of a flexible door, the door can be stiffened by rods. US 6 035 918 A discloses a fast-opening and fast-closing goods-handling door including a foldable or rollable flexible curtain, the edges of which are guided in respective slideways. EP 1 692 365 B1 discloses a screening device with a movable screen and guiding means for the movement of the mobile screen.

[0008] The presence of the horizontal shaft which extends from one side of the door to the other to support the lifting belts significantly affects the bulk in height of the door and limits the space available above it.

[0009] It is also evident that, especially when it has large dimensions, the industrial door described above requires the use of particularly bulky and heavy components. This entails a whole set of disadvantages or drawbacks in the stages of procurement, storage and transport of such components, installing the door and maintenance.

[0010] The object of the present invention is to propose an industrial door able to at least partially overcome the aforementioned disadvantages.

[0011] In particular, an object of the invention is to propose an industrial door having reduced bulk in height.

[0012] Another object of the invention is to propose an industrial door that does not require the use of a heavy and bulky handling apparatus even when the door's width is increased.

[0013] Said objects are achieved with an industrial door according to claim 1. The dependent claims describe preferred or advantageous embodiments of the invention.

[0014] The features and advantages of the industrial door according to the invention will, however, become evident from the description hereinafter of their preferred embodiments, provided by way of indicative and nonlimiting examples, with reference to the accompanying figures, wherein:

- figure 1 is a front view of an industrial door according to the invention in a first embodiment and with the sheet fully lowered;
- figure 1a is a view similar to the preceding one but with the sheet partially raised;
- figure 2 is a plan view of the door of figure 1;
- figure 3 is a side view of the sheet of the industrial door;
- figure 4 is a top plan view of a towing carriage;
- figure 4a is a sectional view of an embodiment of a magnetic pulling device for the towing carriage;
- figures 5 and 6 are perspective and side views of the towing carriage, respectively;
- figure 7 is a perspective view of a towed carriage;
- figure 8 is a diagram of the pneumatic control circuit of the pulling devices of the structure in the previous figures;
- figure 9 is a front view of an industrial door according to the invention, in one variant of embodiment;
- figure 10 is a top plan view of a towing carriage;
- figure 11 is a sectional view of an example of embodiment of a magnetic pulling device for the towing carriage;
- figure 12 is a perspective view of the towing carriage;
- figure 13 is a perspective view of a towed carriage;
- figure 14 is a front view of an industrial door according to the invention, in a further variant of embodiment; and
- figure 15 is a top plan view of a towing carriage for the door in figure 7.

[0015] In the following description, elements common to the various embodiments of the invention are indicated with the same reference numbers.

[0016] In said drawings, at 1; 100; 1000 is indicated collectively an industrial door according to the present invention.

[0017] The door 1 closes an opening 2, generally rectangular in shape, delimited by two side walls 3 and an upper horizontal wall 4.

[0018] The door 1 comprises a sheet 10 and a structure 5; 105; 1005 for supporting and moving the sheet 10.

[0019] Such structure 5; 105; 1005 is of a type suitable

for progressively compacting the sheet 10 by raising its lower edge so as to increase progressively the distance of the sheet from the ground to the door's maximum opening position wherein the sheet is completely shirred beneath the upper horizontal wall 4 of the opening 2.

[0020] The sheet 10 is furthermore stiffened, i.e. placed in tension, by a plurality of horizontal tensioning elements 12 which extend substantially from one side of the sheet 10 to the other. These tensioning elements 12 are positioned in respective horizontal pockets 13 formed at regular intervals along the entire height of the sheet 10.

[0021] The tensioning elements 12 are freely housed in the horizontal pockets 13, i.e. they are operatively disconnected from the sheet 10, so as to have greater freedom to deform under the action of a transverse load to the sheet, as will be described hereinafter.

[0022] It should be noted, in fact, that the primary function of the tensioning elements 12 is not to reinforce the sheet in the coupling zones in the carriages, but, as will be explained in the description hereinafter, to perform a pre-tensioning of the sheet and a transfer of the transverse load from the sheet to the carriages.

[0023] The structure for supporting and moving 5; 105; 1005 comprises two vertical support uprights 20, each adapted to be attached to a respective side wall 3, or to a special support extending from such wall.

[0024] The structure for supporting and moving 5; 105; 1005 further comprises a towing carriage 14; 114; 1014 sliding along each vertical support upright 20 and a plurality of towed carriages 15; 115; 1015 sliding along each vertical support upright 20.

[0025] The towed carriages 15; 115; 1015 are superposed on each other vertically along each upright 20.

[0026] The lower towed carriage 15; 115; 1015 is engageable by the towing carriage 14; 114; 1014 during the towing carriage's ascent phase along the respective vertical support upright 20 (Figure 1a).

[0027] Each towing carriage 14; 114; 1014 and each towed carriage 15; 115; 1015 are provided with sheet connection means 16; 116 suitable for connecting to one respective end of a horizontal sheet tensioning element 12.

[0028] In accordance with one aspect of the invention, each sheet tensioning element 12 is made up of a tie-rod. "Tie-rod" means, as a mechanical definition, an element which works in traction and which, on the other hand, does not pose compression resistance and poses hardly any torsion resistance.

[0029] In one embodiment, each tie-rod 12 at rest, i.e. not subject to the force of the wind, is subjected to the load required to give the sheet the desired geometry in the presence of wind. In this regard, it should be noted that, preferably, the tie-rods do not yield axially as they are not elastic.

[0030] In other words, in the absence of wind, the sheet 10 lies in a plane perpendicular to the floor with the tie-rods 12 lying in their seats formed, for example, in the pockets 13, and forming a curve facing downward; in the presence of wind, the curves drawn by the tie-rods rotate in a plane parallel to the floor, giving the sheet the form of a sail (figure 2).

[0031] The tie-rods 12, at rest, are thus subjected to a suitable pre-tensioning, sized according to the displacement that one desires to give to the sheet in the presence of wind.

[0032] Such pre-tensioning of the tie-rods 12 is however chosen in such a way that, in the absence of wind or with very low wind, the traction force exerted on the carriages does not generate particularly significant frictions from sliding along the respective uprights.

[0033] For example, the pre-tensioning of the tie-rods 12 is the minimum necessary to ensure, in the absence of wind, that the friction between the carriages and the uprights is sufficient to cause the carriages to roll along their respective uprights.

[0034] Therefore, the length of the tie-rods is greater than the distance between the connecting points of the ends of the tie-rods on the relative carriages so that, in the absence of wind, the load exerted on the carriages is almost null and is given by the minimum pre-tensioning of the tie-rods; in the presence of a load exerted by the wind on the surface of the sheet, however, the tie rods stretch to the extent permitted by their length and transfer the load of the wind to the respective carriages.

[0035] It should be noted that, as mentioned above, the tie-rods are not elastic, or in any case they have a negligible elastic modulus. Therefore, in the presence of wind load on the sheet, the tie-rods stretch to the extent permitted exclusively or almost exclusively by their greater length relative to the distance between the carriages and not by their elastic deformation, other than to a negligible extent.

[0036] The substantial absence of elasticity of the tie-rods prevents the sheet, in the presence of wind, from being excessively deformed radially or "bulging" excessively, causing an obstacle to persons or things close to the industrial door.

[0037] The tie-rods' substantial absence of elasticity involves transferring to the carriages all of the load exerted by the wind on the sheet. However, it has been experienced that when the carriages are stationary, this load transfer is not a problem, also due to the way the carriages are coupled to their respective uprights, which will be described hereinafter. When the carriages are in the lifting stage of the sheet, the surface of the sheet subjected to the action of the wind is progressively reduced, thus limiting the load to be transferred to the carriages.

[0038] For example, the length of the tie-rods is about 5-10% greater than the distance between the connecting points to the respective carriages. In this way, good compromises are obtained between a small difference in length, which gives the tie-rods the pre-tensioning required to ensure a correct rolling of the carriages along their respective uprights and contains the transverse bulk of the sheet in the presence of wind, and an increased

difference in length, which instead allows, due to a wide curvature of the tie-rods in the presence of a transverse load, for the axial load acting on the carriages to be reduced.

[0039] In a preferred embodiment, the ends of each tie-rod 12 are connected to respective towing or towed carriages by means of ring connection elements 17.

[0040] Furthermore, in one embodiment, the sheet connection means 16; 116 are adjustable in length when setting up the industrial door, for example, by a threaded connection between their two axial portions, so as to adjust the total length of the tie-rods.

[0041] It should be noted, however, that once the length of the tie-rods is set, this length is not modifiable by the action of the wind or by other loads acting on the sheet so as to maintain constant the pre-tensioning selected during the step of setting up the door.

[0042] For example, the tie-rods are made with an element selected from: rope, strap, steel strap or synthetic fiber cable, e.g. Dyneema®.

[0043] In accordance with one embodiment illustrated in figures 1-8, each lateral support upright 20 comprises a tubular guide element 21 extending substantially for the entire height of the industrial door 1.

[0044] A towing carriage 14 is mounted slidably along each tubular guide element 21.

[0045] A plurality of towed carriages 15 are also slidably mounted along each tubular guide element 21.

[0046] The towed carriages 15 are superposed on each other vertically along each tubular guide element 21. The lower towed carriage 15 is engageable by the towing carriage 14 during the towing carriage's 14 ascent phase along the respective tubular guide element 21.

[0047] Each towing carriage 14 comprises a carriage pulling device 22 operable to translate vertically along the respective tubular guide element 21. Such a carriage pulling device 22 is suitable to pull the towing carriage 14 at least in the direction from the bottom to the top along the tubular guide element 21.

[0048] Each carriage pulling device 22 comprises a pulling element 23 operable to translate axially within the respective tubular guide element 21, and an outer slide 24 operatively connected to the pulling element 23 so as to slide along the tubular guide element 21 following the translation of the pulling element 23.

[0049] The outer slide 24 is configured to support a portion of the towing carriage 14 at least in the ascent phase.

[0050] In a preferred embodiment, the pulling element 23 and the respective outer slide 24 are connected to each other by magnetic coupling.

[0051] In one embodiment, each tubular guide element 21 has a substantially circular cross-section. The pulling element 23 has a substantially cylindrical shape and the outer slide 24 has a substantially annular shape, coaxial with the pulling element 23.

[0052] In one embodiment, the pulling element 23 comprises one or more magnetic elements that generate a magnetic field that closes on one or more magnetic or ferromagnetic elements of the outer slide 24.

[0053] Examples for making a magnetic pulling device are described in WO2014115096A2.

[0054] In one embodiment, the pulling element 23 comprises at least one central magnetic element 231 and two end polar expansions 232. The central magnetic element 231 has substantially a radial magnetization, i.e. it has a first polarity on at least one of its outer annular portions. The end polar expansions 232 have a second polarity, opposite the first, at least on one of their outer annular portions.

[0055] In other words, the pulling element 23 is, relative to the longitudinal axis, a tripolar unit of the South-North-South or North-South-North type.

[0056] In one embodiment, the outer slide 24 comprises at least one outer magnetic unit 241 of a substantially annular shape coaxial to the pulling element 23. This external magnetic unit 241 comprises an annular magnetic element 242 and a cylindrical polar expansion 243. The annular magnetic element 242 surrounds the central magnetic element 231; the cylindrical pole expansion 243 surrounds the annular magnetic element 242 and ends with end flanges 244 surrounding the end polar expansions 232. The annular magnetic element 242 is radially magnetized and has the second polarity on an inner annular portion thereof. The end flanges 244 have the first polarity at least on an annular portion thereof facing towards the end polar expansions 232.

[0057] In one embodiment, the annular magnetic element 242 has an axial extension substantially equal to that of the central magnetic element 231 and is radially magnetized so as to generate, between said central magnetic element 231 and the annular magnetic element 242, a magnetic field with mainly radial lines of force which tend to radially attract the two elements.

[0058] Due to the cylindrical configuration and the magnetization of the pulling element 23 and the outer slide 24, and due to the circular cross-section of the tubular guide element 21, the internal pulling element 23 is practically "suspended", that is, in equilibrium with the forces inside the tubular guide element 21. In this way, the contact and rubbing friction of the two magnetic units with the tubular guide element 21 is minimal, resulting in advantages with regard to pulling efficiency.

[0059] In one embodiment, in order to improve the sliding of the pulling element 23 and the outer slide 24 on the respective surfaces of the tubular guide element 21, the contact surfaces of the pulling element 23 and the slide 24 with the tubular guide element 21 are covered with respective sliding rings with a low friction coefficient.

[0060] In one embodiment, each tubular guide element 21 and the respective pulling element 23 form a piston-cylinder assembly that may be fluidically connected to a control circuit.

[0061] Thus, the pulling element 23 forms a rodless piston suitable to translate inside the tubular guide element 21 under the action of a control fluid, such as com-

pressed air.

[0062] In one embodiment, the pulling element 23 divides the chamber delimited by the tubular guide element 21 into an ascent chamber portion 21' and into a descent chamber portion 21".

[0063] Therefore, in one embodiment, the control circuit comprises a compressed air generator 25 and an operable solenoid valve 26 so as to send pressurized air at least into the ascent chamber portion 21' which, when pressurized, pushes the pulling element 23 upwards, and discharges the other descent chamber portion 21".

[0064] In one embodiment, the solenoid valve 26 is operable to send pressurized air also in the descent chamber portion 21" to control the descending movement of the pulling element 23.

[0065] In one embodiment, the control circuit further comprises, along the tubes connecting the solenoid valve 26 to the tubular guide element 21, flow regulators 27 suitable to permit an adjustment of the ascending and descending speeds of the pulling element 23, and hence of the towing carriage 14.

[0066] In a preferred embodiment, each towing carriage 14 comprises at least one substantially annular upper portion 28 defining a lower support surface for the outer slide 24 during the ascent phase.

[0067] In one embodiment, each towing carriage 14 further comprises a substantially annular lower portion 29 integral with the upper portion 28 and defining an upper surface for supporting the outer slide 24 in the descent phase. The outer slide 24 is positioned between the lower 29 and upper 28 portions of the towing carriage 14.

[0068] In one embodiment, the upper 28 and lower 29 portions of the towing carriage 14 are connected to each other by a connecting plate 30 to which the sheet connection means 16 are attached.

[0069] Therefore, the carriage pulling device 22 is not subject to any traction force and is free to perform only the pulling function of the respective carriage 14. In particular, the pulling devices 22 are not subjected to frictional forces resulting from the traction load of the sheet.

[0070] In one embodiment, the towed carriages 15 are identical to each other and consist of a simple annular element, for example, with dimensions like the upper 28 and lower 29 portions of the pulling carriage 14.

[0071] In one embodiment, a longitudinal stiffening fin 31 extends from the side wall of each tubular guide element 21, suitable to anchor to the respective side wall 3, which laterally delimits the opening of the industrial door.

[0072] In this case, the towed carriages 15 and the part of the towing carriages 14 sliding on the outer surface of the tubular guide elements 21 have a "C" shape.

[0073] With reference to figures 9 to 15, variants of embodiment of the industrial door will now be described, collectively indicated at 100; 1000, which differ from the industrial door 1 described previously due to a different construction of the sheet's moving and supporting structure 105; 1005. These embodiments of the structure for moving and supporting the sheet are particularly suitable for very wide doors where the simple tubular guide element of the carriages may not be sufficient to support the load of the sheet, for example in the case of strong wind.

[0074] Each vertical support upright 20 has an "H"-shaped cross-section, i.e. formed by a first wall 202 facing the sheet 10 and oriented perpendicularly to the plane whereon the sheet 10 lies when it is fully extended, by a second wall 204 perpendicular to the first and extending from the median line of the first wall 202, and by a third wall 206 parallel to the first and suitable to anchor the upright to the side wall 3.

[0075] A towing carriage 114 is slidably mounted on each upright 20.

[0076] Moreover, on each upright 20 are slidably mounted towed carriages 115. The towed carriages 115 are superposed on each other vertically along each upright 20. The towing carriage 114 is positioned below the lower towed carriage 115.

[0077] The lower towed carriage 115 is engageable by the towing carriage 114 during the ascent phase of the towing carriage 114 along the respective vertical support upright 20.

[0078] In one embodiment, the towed carriages 115 are identical to each other.

[0079] Each towing carriage 114 and each towed carriage 115 are provided with sheet connection means 116 suitable for connecting to one end of a respective tie-rod 12.

[0080] Each towing carriage 114 and each towed carriage 115 is further provided with upright coupling means 134 suitable to transfer the traction load exerted on the carriage by the respective tie-rod 12 onto the respective vertical support upright 20.

[0081] The moving and supporting structure 105; 1005 further comprises, for each line of carriages 114, 115 of an upright 20, a carriage pulling device 110 operable to translate vertically.

[0082] Each pulling device 110 is suitable to pull the towing carriage 114 at least in the downward-facing direction along the vertical support upright 20.

[0083] Each pulling device 110 is positionable between the respective vertical support upright 20 and the sheet connection means 116.

[0084] The entire load exerted on the structure 105; 1005 by the sheet 10 through the tie-rods 12 is absorbed by the towing carriages 114 and the towed carriages 115 and transferred from the carriages to the uprights 20 through the upright coupling means 134.

[0085] The carriage pulling devices 110, on the other hand, are not subject to any traction force and are free to perform only the carriage lifting function. In particular, the pulling devices 110 are not subjected to frictional forces deriving from the traction load of the sheet.

[0086] Returning now to the vertical support uprights 20, the first vertical wall 202 defines, from the part facing the side wall 3, a carriage support surface 202' orthogonal to the direction of the traction force exerted by the tie-rod

12.

[0087] In one embodiment, the upright coupling means 134 comprise at least one coupling wheel 342 disposed so as to roll along the carriage support surface 202'.

[0088] Preferably, each carriage 114, 115 is provided with at least one pair of coupling wheels 342, coaxial and parallel to each other. For example, the two wheels 342 of the pair of wheels are separated from the second vertical wall 204 of the upright 20.

[0089] In one embodiment, the towing carriage 114 is provided with two pairs of coupling wheels 342, vertically superposed on each other, so as to increase the load distribution from the carriage 114 to the upright 20.

[0090] In one embodiment, each towing carriage 114 and each towed carriage 115 are also provided with at least one pair of anti-rotation members 136 arranged to skim without contact the opposite sides of the second vertical wall 204 of the upright 20.

[0091] These anti-rotation members 136 are therefore not active during the normal sliding of the carriages, as there is play between them and the second vertical wall 204. However, in the case of a strong transverse load on the sheet, for example due to strong gusts of wind, the anti-rotation members 136 limit the rotation of the carriages around the vertical sliding axis, thus containing the sliding frictions along the upright 20.

[0092] In one embodiment, the anti-rotation members comprise a pair of opposing wheels 362 parallel to the second vertical wall 204.

[0093] In one embodiment, each towing carriage 114 and each towed carriage 115 comprises a pair of parallel side plates 138. These plates 138 are parallel to the second vertical wall 204 of the upright 20.

[0094] In one embodiment, the first vertical wall 202 of the upright 20 and at least one part of the second vertical wall 204 are interposed between the two plates 138.

[0095] The two side plates 138 are integral with each other, for example by means of a junction element 140.

[0096] In one embodiment, the junction element 140 connects the end portions of the plates 138 which extend towards the sheet 10 beyond the first vertical wall 202.

[0097] For example, the junction element 140 is in the form of a pin, which, in addition to performing the function of connecting the plates 138, constitutes an element of the sheet connection means 116.

[0098] In one embodiment, the side plates 138 have, at least superiorly, respective bent upper portions 382 facing each other so as to form a horizontal support surface for the carriage above.

[0099] Also, in an embodiment further described hereinafter, the bent portions 382 of the plates 138 of the towing carriage 114 form an abutment element by which the pulling device 110 pulls the towing carriage 114 at least from the bottom upwards.

[0100] In one embodiment, the plates 138 of the towing carriage also have similar bent lower portions 384, whereby the pulling device pulls the towing carriage also downwards.

[0101] In one embodiment, the bent portions 382, 384 have a gap 382' which accommodates a respective edge of the first vertical wall 202 of the upright 20. Such geometric coupling between the bent portions and the first vertical wall permits the tilting of the carriages to be limited with respect to a horizontal axis orthogonal to the side plates 138.

[0102] In an embodiment illustrated in figures 9-13, each carriage pulling device 110 comprises a tubular element 102 extending substantially for the entire height of the industrial door. This tubular element 102 is suitable to be installed alongside a respective vertical support upright 20.

[0103] For example, the tubular element 102 is supported by the first vertical wall 202 of the respective vertical upright 20, for example by means of two end collars 104 bracketed to the first vertical wall.

[0104] The tubular element 102 defines an inner chamber 106. The inner chamber 106 preferably extends substantially for the entire length of the tubular element 102.

[0105] A towing element 108 is housed in the inner chamber 106. The towing element 108 is operable to translate axially within the inner chamber 106.

[0106] An outer slide 112 is operatively connected to the towing element 108. The outer slide 112 is suitable to slide along the tubular element 102 following the translation of the towing element 108.

[0107] The outer slide 112 is configured to support the towing carriage 114 at least in the ascent phase.

[0108] In one embodiment, the outer slide 112 has an upper end portion with a transverse footprint such as to abut against the upper bent portions 382 of the parallel side plates 138 of the towing carriage 114.

[0109] In one embodiment, the outer slide 112 also has a lower end portion with a transverse footprint so as to abut against the lower bent portions 384 of the parallel side plates 138 of the towing carriage 114.

[0110] In other words, in a preferred embodiment, the outer slide 110 is confined between bent portions 382, 384 of the towing carriage 114. Consequently, the translation of the slide 112 results in a corresponding translation of the towing carriage 114.

[0111] In one embodiment, the inner chamber 106 forms the chamber of a cylinder fluidically connectable to a control circuit, for example a pneumatic circuit operating with compressed air.

[0112] The towing element 108 is in the form of a rodless piston which may translate into the inner chamber 106 under the action of a control fluid, such as compressed air.

[0113] Therefore, in one embodiment, the pneumatic circuit described above may be used as the control circuit, with reference to figure 8.

[0114] Moreover, in one embodiment, the towing element 108 and the outer slide 112 are formed in such a way as to form a reciprocal magnetic coupling circuit, in accordance with the foregoing with reference to the embodiment of figures 1-8, and in particular of figure 4a.

[0115] In one variant of embodiment illustrated in figures 14 and 15, each pulling device 1110 comprises a pulling member 1502 integral to the towing carriage 114.

[0116] The towing member 1502 is fixed to a wire or a cable 1504. The wire or cable 1504 is connected to a winch 1506 suitable to be positioned above the industrial door 1000 for winding/unwinding the wire or cable 1504.

[0117] For example, the towing member comprises a cross member welded to the two side plates 138 of the towing carriage 114. In this case, the bent upper portions 382 of the two plates serve to form an abutment plane for the above towing carriage 115.

[0118] The winch 1506 is operable in rotation by a motor apparatus 1508.

[0119] In one embodiment, each winch 1506 has its own motor apparatus 1508. In this way, the two pulling devices, although synchronized, may be moved independently of each other.

[0120] The tie-rod tensioning elements 12, in fact, allow the pulling devices to translate in height even in a non-perfectly synchronized manner.

[0121] The pulling devices described above permit the tie-rods 12 to be moved, acting only on the ends of the tie-rods 12, without needing to employ intermediate lifting belts supported by a horizontal shaft extending above the door along its whole width.

[0122] In one embodiment, the structure for supporting and moving according to the invention further comprises a sheet-supporting horizontal cross member 300 suitable to be fixed to the wall 4, which upwardly limits the opening of the industrial door and is configured to be fixed to an upper edge of the sheet of the industrial door.

[0123] However, this horizontal cross-section has an impact on the dimensions of the lower door relative to the horizontal winding shaft of the sheet's lifting belts and the related control and support devices.

[0124] An industrial door utilizing the structure for supporting and moving the sheet described above has many advantages.

[0125] The horizontal shaft for winding/unwinding the sheet's lifting belts, the related motor, the support bearings of the shaft end and the lifting belts are eliminated, resulting in advantages with regard to bulk, production costs, storage, transportation, installation and maintenance.

[0126] Tie-rod tensioning elements are much lighter, economical and much less bulky to store and transport.

[0127] For lifting the sheet, less powerful motors may be used than those that have been used up to now.

[0128] The structure, particularly in the case of pneumatic pulling devices, is very clean and light, while being robust enough to withstand the loads to which the sheet is subjected.

[0129] In some embodiments, each vertical support upright forms a first vertical wall defining an orthogonal carriage support surface relative to the direction of the traction force exerted by the horizontal sheet tensioning elements, and each towed carriage and each towing carriage further comprises upright coupling means suitable to transfer onto said first vertical wall the traction load exerted on the carriage by the respective horizontal tensioning element.

[0130] More specifically, the upright coupling means comprise at least one wheel arranged so as to roll along said carriage support surface.

[0131] In one embodiment, each vertical support upright forms a second vertical wall perpendicular to the first vertical wall, and each towing carriage and each towed carriage is provided with at least one pair of anti-rotation members arranged so as to skim over the sides opposite said second vertical wall without contact.

[0132] For example, each towing carriage and each towed carriage comprise a pair of parallel lateral plates the ends of which, directed toward the sheet, are connected by a plate joining element, the sheet connecting means including said plate junction element.

[0133] More in detail, the side plates have, at least superiorly, respective bent portions facing each other so as to form a horizontal support surface for the carriage above, the outer slide being adapted to abut against said bent portions.

[0134] In one embodiment, each towing carriage is actuated by a respective carriage pulling device comprising a pulling member integral with the towing carriage, a cable to which said pulling member is fixed, a winch for winding/unwinding said cable, and a motor control apparatus for rotating the winch.

Claims

1. Industrial door, comprising a sheet (10), a plurality of horizontal, sheet tensioning elements (12) distributed over the surface of the sheet, and a structure for supporting and moving the sheet (5; 105; 1005), said structure comprising:

- two vertical support uprights (20), each suitable to be attached to a wall (3) which defines the opening meant to be closed by the industrial door;
- a towing carriage (14; 114) sliding along each vertical support upright (20);
- a plurality of towed carriages (15;115) sliding along each vertical support upright, said towed carriages (15;115) superposing each other vertically along each upright (20), the lowermost towed carriage (15;115) being engageable by the towing carriage (14;114) during the ascent phase of the towing carriage (14;114) along the respective vertical support upright (20),
each towing carriage (14;114) and each towed carriage (15;115) being equipped with sheet connection means (16; 116) suitable to connect to a respective end of a respective horizontal sheet tensioning element (12),

characterized in that
the sheet tensioning elements (12) are freely housed in respective horizontal pockets (13) formed at regular
intervals along the entire height of the sheet (10), wherein each sheet tensioning element (12) is formed by a tie-rod (12),
wherein the length of the tie-rods (12) is greater than the distance between the connecting points of the ends of the tie-rods (12) on the relative carriages (14;114; 15; 115), and
wherein the tie-rods (12) have a negligible elastic modulus.

2. Industrial door according to claim 1, wherein each tie-rod (12), when connected to the respective carriages, undergoes a pre-tensioning chosen so that in the absence of a force exerted by the wind on the sheet, the sheet lies on a plane perpendicular to the floor and so that, in the presence of a wind force on the sheet, the tie-rod forms a curve parallel to the floor, giving the sheet the shape of a sail.

3. Industrial door according to any of the preceding claims, wherein each pocket (13) is made in or attached to the sheet.

4. Industrial door according to any of the preceding claims, wherein the ends of each tie-rod are connected to the respective towing or towed carriages by means of ring-shaped connection elements (17).

5. Industrial door according to any of the preceding claims, wherein the tie-rods are made with an element chosen from among: rope, belt, steel stranded wire, synthetic fiber cable.

6. Industrial door according to any of the preceding claims, wherein each vertical support upright (20) is formed by or is connected to a tubular guide element (21; 102), wherein each towing carriage (14; 114) comprises a carriage pulling device (22; 110) operable to move vertically along the respective tubular guide element (21; 102) and suitable to pull the towing carriage (14; 114) at least in the upward direction along the vertical support upright (20), and wherein each carriage towing device comprises a pulling element (23; 108) operable to move axially inside the respective tubular guide element (21; 102), and an outer slide (24; 112) operatively connected to said pulling element so as to slide along the tubular guide element following the movement of the pulling element, said outer slide being configured to abut against the towing carriage at least in the ascent phase.

7. Industrial door according to the preceding claim, wherein the pulling element (23; 108) and the respective outer slide (24; 112) are connected to each other via a magnetic coupling.

8. Industrial door according to the preceding claim, wherein each tubular guide element (21; 102) has a substantially circular cross-section, the pulling element (23; 108) has a cylindrical shape and the outer slide (24; 112) has a substantially annular shape, coaxial to the pulling element.

9. Industrial door according to claim 7 or 8, wherein the pulling element (23; 108) comprises one or more magnetic elements, and wherein the outer slide (24; 112) comprises one or more magnetic or ferromagnetic elements.

10. Industrial door according to any of the claims 6-9, wherein each tubular guide element (21; 102) and the respective pulling element (23; 108) form a piston-cylinder assembly, fluidically connectable to a control circuit, the pulling element (23; 108) forming a rodless piston suitable to move inside the tubular guide element under the action of a control fluid.

11. Industrial door according to any of the claims 6-10, wherein each towing carriage (14) comprises at least one substantially annular upper portion (28) defining a lower support surface for the outer slide (24) during the ascent phase.

12. Industrial door according to the preceding claim, wherein each towing carriage also comprises a substantially annular lower portion (29) integral with the upper portion and defining an upper support surface for the outer slide during the descent phase, the outer slide being positioned between said upper and lower portions of the towing carriage.

13. Industrial door according to the preceding claim, wherein the upper and lower portions of the towing carriage are connected by a connection plate (30) to which the sheet connection means (16) are attached.

14. Industrial door according to any of the claims 6-13, wherein, on the side wall of each tubular guide element, a longitudinal stiffening fin (31) extends, suitable for anchoring to the respective side wall laterally defining the opening of the industrial door.

Patentansprüche

1. Industrietor, umfassend eine Platte (10), eine Vielzahl von horizontalen Plattenspannelementen (12), die über die Oberfläche der Platte verteilt sind, und eine Struktur zum Tragen und Bewegen der Platte (5; 105; 1005), wobei die Struktur Folgendes um-

fasst:

- zwei vertikale Stützpfeiler (20), die jeweils dafür geeignet sind, an einer Wand (3) befestigt zu werden, die die Öffnung definiert, die durch das Industrietor geschlossen werden soll;
- einen Zugschlitten (14; 114), der an jedem vertikalen Stützpfeiler (20) entlanggleitet;
- eine Vielzahl von gezogenen Schlitten (15; 115), die an jedem vertikalen Stützpfeiler entlanggleiten, wobei sich die gezogenen Schlitten (15; 115) entlang jedes Pfeilers (20) einander vertikal überlagern, wobei der unterste gezogene Schlitten (15; 115) während der Aufstiegsphase des Zugschlittens (14; 114) entlang des jeweiligen vertikalen Stützpfeilers (20) von dem Zugschlitten (14; 114) in Eingriff genommen werden kann,

wobei jeder Zugschlitten (14; 114) und jeder gezogene Schlitten (15; 115) mit Plattenverbindungsmitteln (16; 116) ausgestattet ist, die dafür geeignet sind, mit einem jeweiligen Ende eines jeweiligen horizontalen Plattenspannelements (12) verbunden zu werden,

dadurch gekennzeichnet, dass

die Plattenspannelemente (12) in jeweiligen horizontalen Taschen (13) frei untergebracht sind, die in gleichmäßigen Abständen entlang der gesamten Höhe der Platte (10) ausgebildet sind,

wobei jedes Plattenspannelement (12) durch eine Zugstange (12) gebildet wird, wobei die Länge der Zugstangen (12) größer als der Abstand zwischen den Verbindungspunkten der Enden der Zugstangen (12) an den entsprechenden Schlitten (14; 114; 15; 115) ist, und

wobei die Zugstangen (12) einen vernachlässigbaren Elastizitätsmodul aufweisen.

2. Industrietor nach Anspruch 1, wobei jede Zugstange (12), wenn sie mit den jeweiligen Schlitten verbunden ist, einer Vorspannung ausgesetzt ist, die so ausgewählt ist, dass die Platte, bei Fehlen einer Kraft, die durch den Wind auf die Platte ausgeübt wird, auf einer Ebene senkrecht zum Boden liegt, und so, dass die Zugstange, bei Vorhandensein einer Windkraft an der Platte, eine Krümmung parallel zum Boden bildet, die der Platte die Form eines Segels verleiht.

3. Industrietor nach einem beliebigen der vorhergehenden Ansprüche, wobei jede Tasche (13) in der Platte hergestellt oder daran befestigt ist.

4. Industrietor nach einem beliebigen der vorhergehenden Ansprüche, wobei die Enden jeder Zugstange mittels ringförmiger Verbindungselemente (17) mit den jeweiligen Zug- oder gezogenen Schlitten verbunden sind.

5. Industrietor nach einem beliebigen der vorhergehenden Ansprüche, wobei die Zugstangen aus einem Element hergestellt sind, das ausgewählt ist aus: Seil, Band, Stahllitzendraht, Kunstfaserkabel.

6. Industrietor nach einem beliebigen der vorhergehenden Ansprüche, wobei jeder vertikale Stützpfeiler (20) von einem rohrförmigen Führungselement (21; 102) gebildet wird oder damit verbunden ist, wobei jeder Zugschlitten (14; 114) eine Schlittenziehvorrichtung (22; 110) umfasst, die betriebsfähig ist, sich vertikal entlang des jeweiligen rohrförmigen Führungselements (21; 102) zu bewegen, und die dafür geeignet ist, den Zugschlitten (14; 114) zumindest in der Aufwärtsrichtung entlang des vertikalen Stützpfeilers (20) zu ziehen, und wobei jede Schlittenzugvorrichtung ein Zugelement (23; 108), das betriebsfähig ist, sich im Inneren des jeweiligen rohrförmigen Führungselements (21; 102) axial zu bewegen, und einen äußeren Schieber (24; 112), der mit dem Zugelement betriebsfähig verbunden ist, um sich, der Bewegung des Zugelements folgend, entlang des rohrförmigen Führungselements zu schieben, umfasst, wobei der äußere Schieber so ausgestaltet ist, dass er zumindest in der Aufstiegsphase an dem Zugschlitten anliegt.

7. Industrietor nach dem vorhergehenden Anspruch, wobei das Zugelement (23; 108) und der jeweilige äußere Schieber (24; 112) über eine Magnetkopplung miteinander verbunden sind.

8. Industrietor nach dem vorhergehenden Anspruch, wobei jedes rohrförmige Führungselement (21; 102) einen im Wesentlichen kreisförmigen Querschnitt aufweist, das Zugelement (23; 108) eine zylindrische Form aufweist und der äußere Schieber (24; 112) eine im Wesentlichen ringförmige Form, koaxial zu dem Zugelement, aufweist.

9. Industrietor nach Anspruch 7 oder 8, wobei das Zugelement (23; 108) ein oder mehrere magnetische Elemente umfasst, und wobei der äußere Schieber (24; 112) ein oder mehrere magnetische oder ferromagnetische Elemente umfasst.

10. Industrietor nach einem beliebigen der Ansprüche 6-9, wobei jedes rohrförmige Führungselement (21; 102) und das jeweilige Zugelement (23; 108) eine Kolben-Zylinder-Anordnung bilden, die fluidisch mit einem Steuer- bzw. Regelkreis verbindbar ist, wobei das Zugelement (23; 108) einen stangenlosen Kolben bildet, der dafür geeignet ist, sich unter der Wirkung eines Steuer- bzw. Regelfluids im Inneren des rohrförmigen Führungselements zu bewegen.

11. Industrietor nach einem beliebigen der Ansprüche 6-10, wobei jeder Zugschlitten (14) mindestens ei-

nen im Wesentlichen ringförmigen oberen Abschnitt (28) umfasst, der eine untere Stützfläche für den äußeren Schieber (24) während der Aufstiegsphase definiert.

12. Industrietor nach dem vorhergehenden Anspruch, wobei jeder Zugschlitten außerdem einen im Wesentlichen ringförmigen unteren Abschnitt (29) umfasst, der einstückig mit dem oberen Abschnitt ausgeführt ist und eine obere Stützfläche für den äußeren Schieber während der Absenkphase definiert, wobei der äußere Schieber zwischen dem oberen und dem unteren Abschnitt des Zugschlittens positioniert ist.

13. Industrietor nach dem vorhergehenden Anspruch, wobei der obere und der untere Abschnitt des Zugschlittens mittels einer Verbindungsplatte (30) verbunden sind, an der die Plattenverbindungsmittel (16) befestigt sind.

14. Industrietor nach einem beliebigen der Ansprüche 6-13, wobei sich an der Seitenwand jedes rohrförmigen Führungselements eine längliche Versteifungsrippe (31) erstreckt, die zur Verankerung an der jeweiligen Seitenwand geeignet ist, die die Öffnung des Industrietors seitlich definiert.

Revendications

1. Porte industrielle comprenant une feuille (10), une pluralité d'éléments de tension de feuille horizontaux (12) répartis sur la surface de la feuille, et une structure permettant de supporter et de déplacer la feuille (5 ; 105 ; 1005), ladite structure comprenant :

- deux montants de support verticaux (20), chacun étant adapté à être fixé à une paroi (3) qui définit l'ouverture destinée à être fermée par la porte industrielle ;
- un chariot de remorquage (14 ; 114) coulissant le long de chaque montant de support vertical (20) ;
- une pluralité de chariots remorqués (15 ; 115) coulissant le long de chaque montant de support vertical, lesdits chariots remorqués (15 ; 115) étant superposés les uns sur les autres verticalement le long de chaque montant (20), le chariot remorqué le plus inférieur (15 ; 115) pouvant être mis en prise par le chariot de remorquage (14 ; 114) pendant la phase d'ascension du chariot de remorquage (14 ; 114) le long de chaque montant de support vertical respectif (20),
chaque chariot de remorquage (14; 114) et chaque chariot remorqué (15 ; 115) étant équipés de moyens de raccordement de feuille (16 ; 116) adaptés à se raccorder à une extrémité respective d'un élément de tension de feuille horizontal respectif (12), **caractérisée en ce que**
les éléments de tension de feuille (12) sont librement reçus dans des poches horizontales respectives (13) formées au niveau d'intervalles réguliers le long de toute la hauteur de la feuille (10),
dans laquelle chaque élément de tension de feuille (12) est formé par une tige de liaison (12),
dans laquelle la longueur des tiges de liaison (12) est supérieure à la distance entre les points de raccordement des extrémités des tiges de liaison (12) sur les chariots relatifs (14 ; 114 ; 15 ; 115), et
dans laquelle les tiges de liaison (12) présentent un module d'élasticité négligeable.

2. Porte industrielle selon la revendication 1, dans laquelle chaque tige de liaison (12), lorsqu'elle est raccordée aux chariots respectifs, subit une pré-tension choisie de façon telle qu'en l'absence d'une force exercée par le vent sur la feuille, la feuille repose sur un plan perpendiculaire au sol et de façon telle que, en présence d'une force de vent sur la feuille, la tige de liaison forme une courbe parallèle au sol, donnant à la feuille la forme d'une voile.

3. Porte industrielle selon l'une quelconque des revendications précédentes, dans laquelle chaque poche (13) est réalisée dans ou fixée à la feuille.

4. Porte industrielle selon l'une quelconque des revendications précédentes, dans laquelle les extrémités de chaque tige de liaison sont raccordées aux chariots de remorquage ou remorqués respectifs au moyen d'éléments de raccordement annulaires (17).

5. Porte industrielle selon l'une quelconque des revendications précédentes, dans laquelle les tiges de liaison sont dotées d'un élément choisi parmi : une corde, une courroie, un fil d'acier toronné, un câble de fibres synthétiques.

6. Porte industrielle selon l'une quelconque des revendications précédentes, dans laquelle chaque montant de support vertical (20) est formé par ou est raccordé à un élément de guidage tubulaire (21 ; 102), dans laquelle chaque chariot de remorquage (14; 114) comprend un dispositif de traction de chariot (22 ; 110) pouvant se déplacer verticalement le long de l'élément de guidage tubulaire respectif (21 ; 102) et conçu pour tirer le chariot de remorquage (14 ; 114) au moins dans la direction vers le haut le long du montant de support vertical (20), et dans laquelle chaque dispositif de remorquage de chariot comprend un élément de traction (23 ; 108) pouvant se déplacer axialement à l'intérieur de l'élément de guidage tubulaire respectif (21 ; 102), et une coulisse

externe (24 ; 112) fonctionnellement raccordée audit élément de traction de manière à coulisser le long de l'élément de guidage tubulaire suivant le mouvement de l'élément de traction, ladite coulisse externe étant configurée pour venir buter contre le chariot de remorquage au moins dans la phase d'ascension.

7. Porte industrielle selon la revendication précédente, dans laquelle l'élément de traction (23 ; 108) et la coulisse externe respective (24 ; 112) sont raccordés l'un à l'autre via un accouplement magnétique.

8. Porte industrielle selon la revendication précédente, dans laquelle chaque élément de guidage tubulaire (21 ; 102) présente une section transversale sensiblement circulaire, l'élément de traction (23 ; 108) présente une forme cylindrique et la coulisse externe (24 ; 112) présente une forme sensiblement annulaire, coaxiale à l'élément de traction.

9. Porte industrielle selon la revendication 7 ou 8, dans laquelle l'élément de traction (23 ; 108) comprend un ou plusieurs éléments magnétiques, et dans laquelle la coulisse externe (24 ; 112) comprend un ou plusieurs éléments magnétiques ou ferromagnétiques.

10. Porte industrielle selon l'une quelconque des revendications 6 à 9, dans laquelle chaque élément de guidage tubulaire (21 ; 102) et l'élément de traction respectif (23 ; 108) forment un ensemble piston/cylindre, pouvant être fluidiquement raccordé à un circuit de commande, l'élément de traction (23 ; 108) formant un piston sans tige adapté pour se déplacer à l'intérieur de l'élément de guidage tubulaire sous l'action d'un fluide de commande.

11. Porte industrielle selon l'une quelconque des revendications 6-10, dans laquelle chaque chariot de remorquage (14) comprend au moins une partie supérieure sensiblement annulaire (28) définissant une surface de support inférieure pour la coulisse externe (24) pendant la phase d'ascension.

12. Porte industrielle selon la revendication précédente, dans laquelle chaque chariot de remorquage comprend également une partie inférieure sensiblement annulaire (29) d'un seul tenant avec la partie supérieure et définissant une surface de support supérieure pour la coulisse externe pendant la phase de descente, la coulisse externe étant positionnée entre lesdites parties supérieure et inférieure du chariot de remorquage.

13. Porte industrielle selon la revendication précédente, dans laquelle les parties supérieure et inférieure du chariot de remorquage sont raccordées par une plaque de raccordement (30) à laquelle le moyen de raccordement de feuille (16) est fixé.

14. Porte industrielle selon l'une quelconque des revendications 6-13, dans laquelle sur la paroi latérale de chaque élément de guidage tubulaire s'étend une ailette de renforcement longitudinale (31) appropriée pour s'ancrer à la paroi latérale respective définissant latéralement l'ouverture de la porte industrielle.

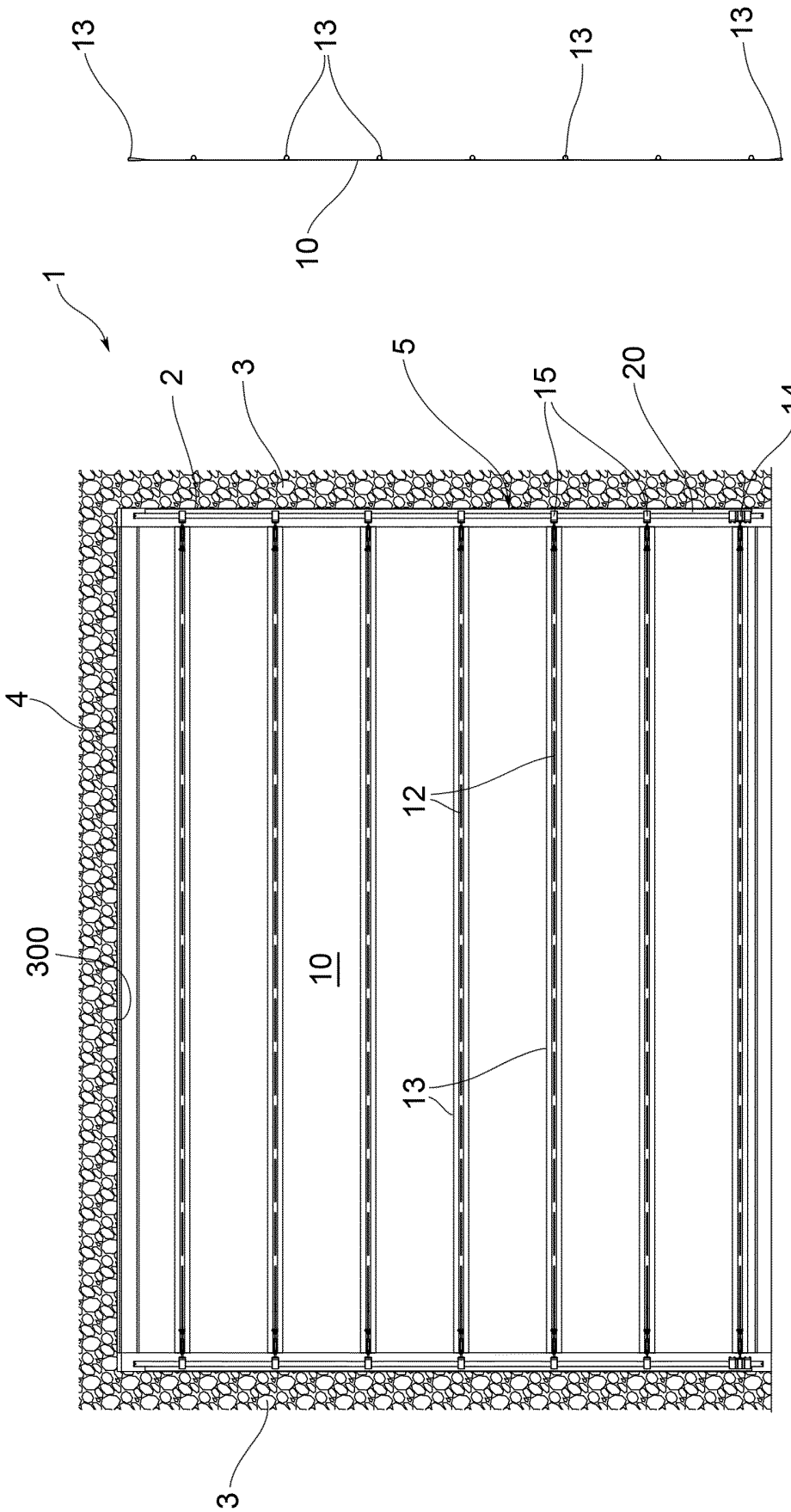


FIG.1

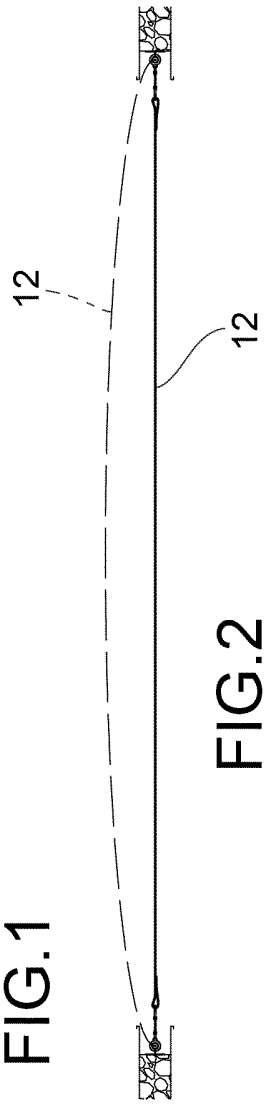


FIG.2

FIG.3

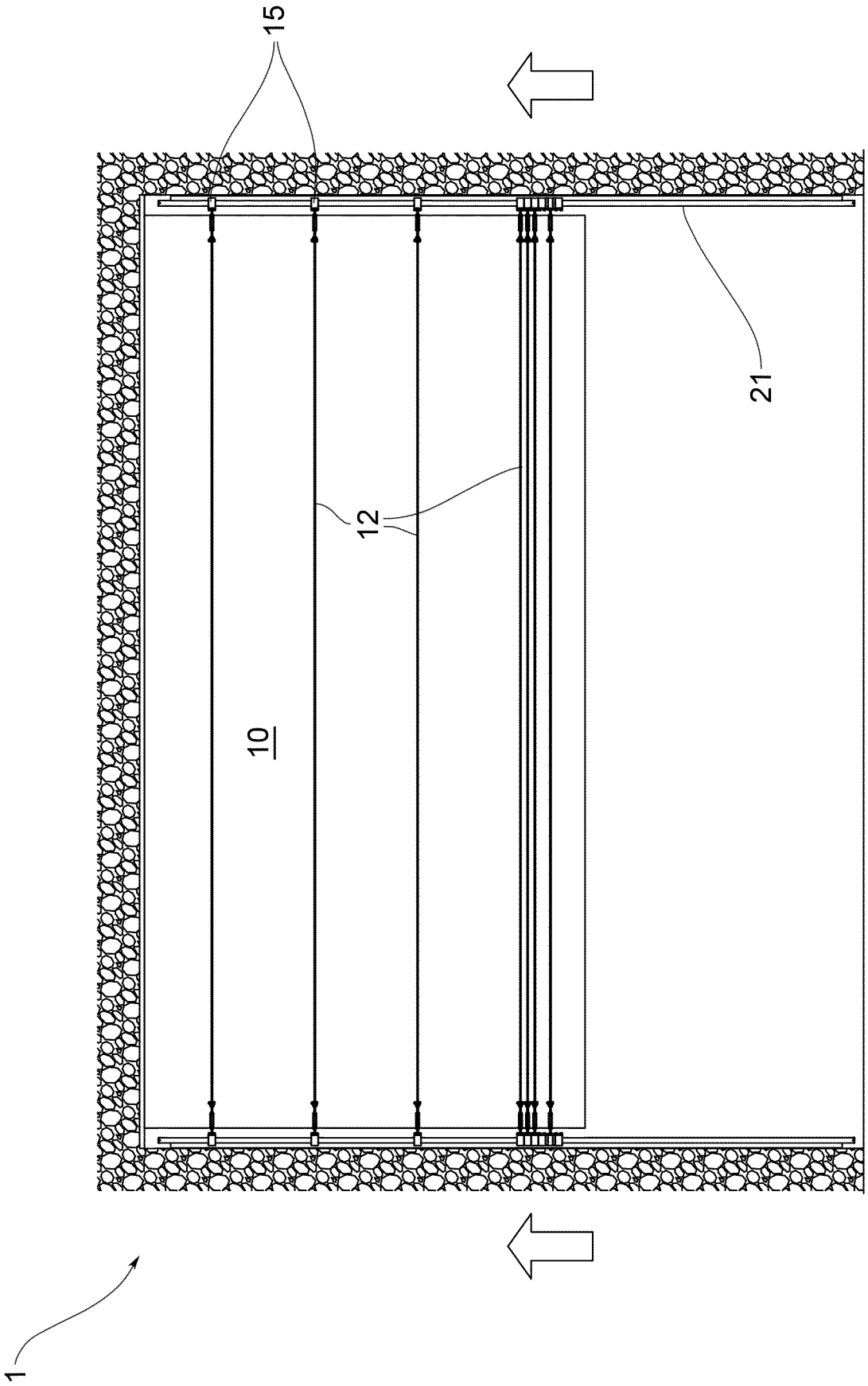


FIG.1a

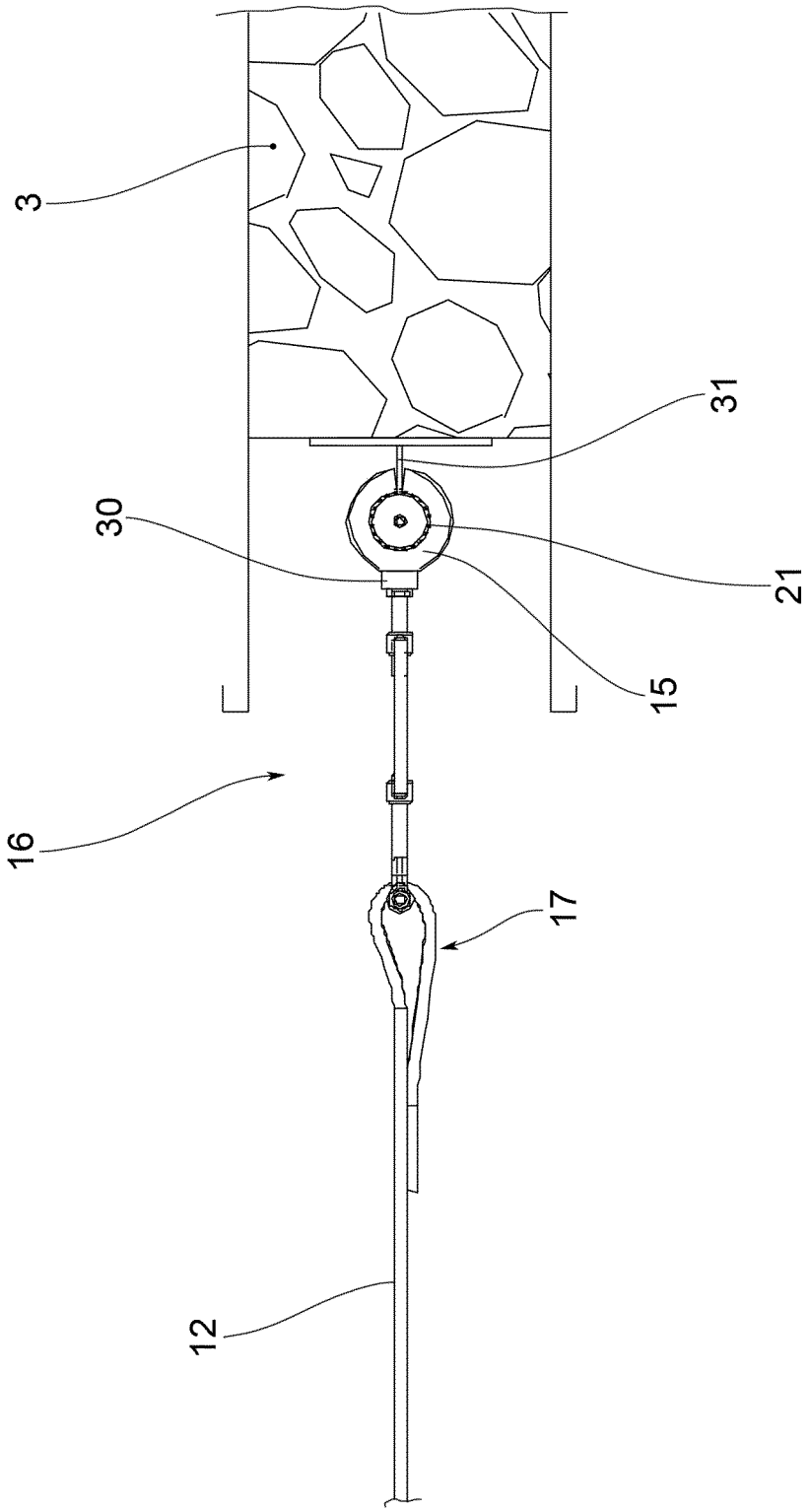


FIG.4

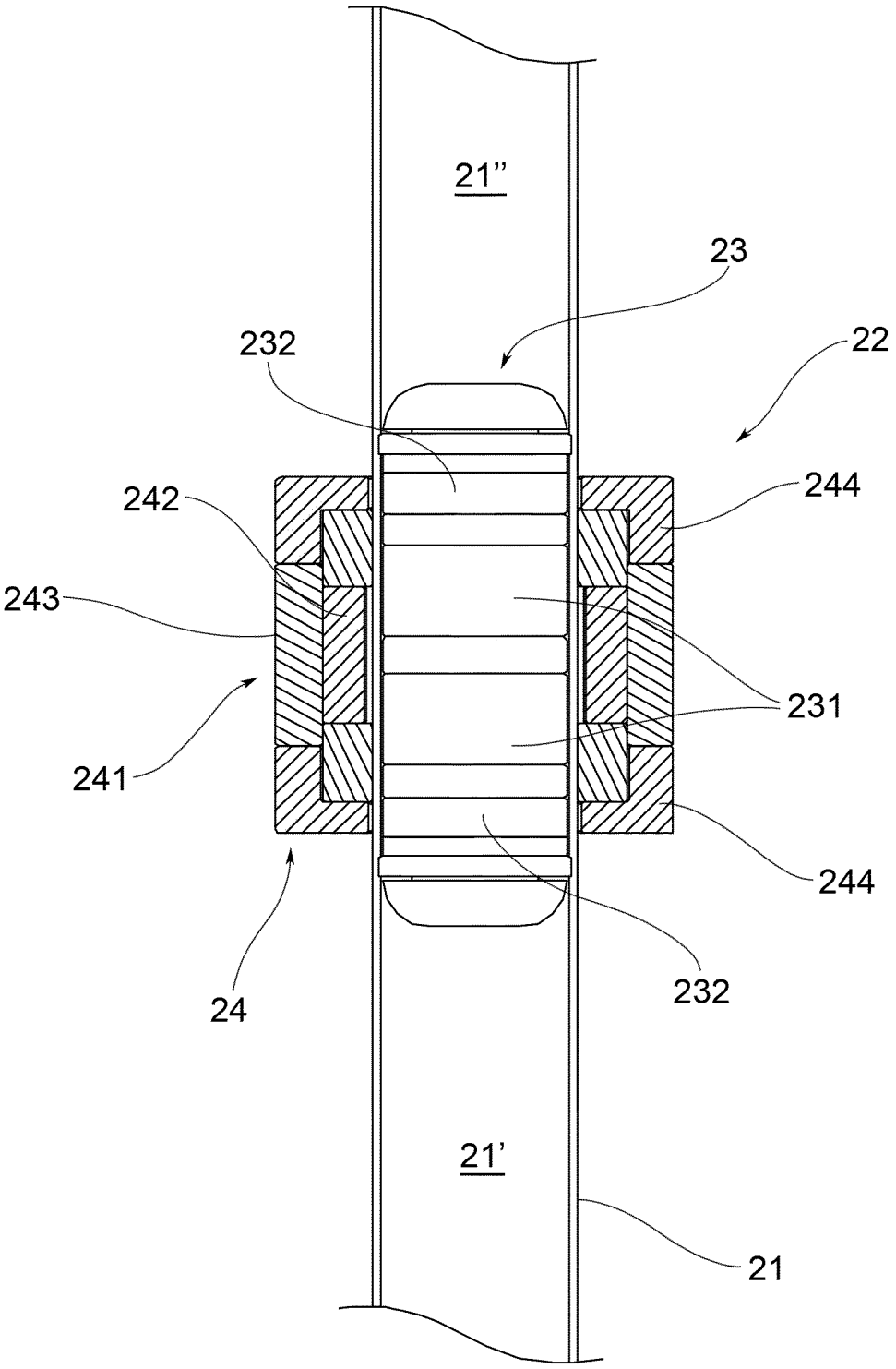


FIG.4a

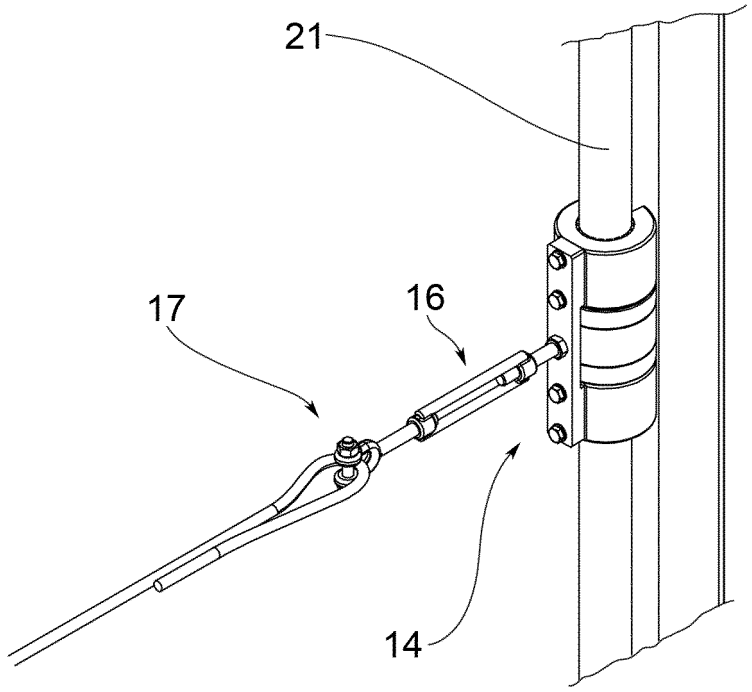


FIG.5

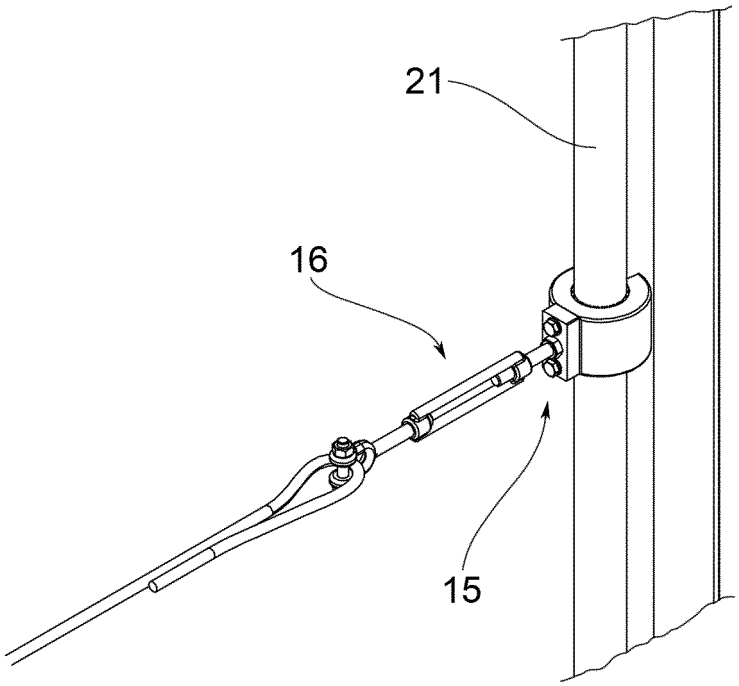


FIG.7

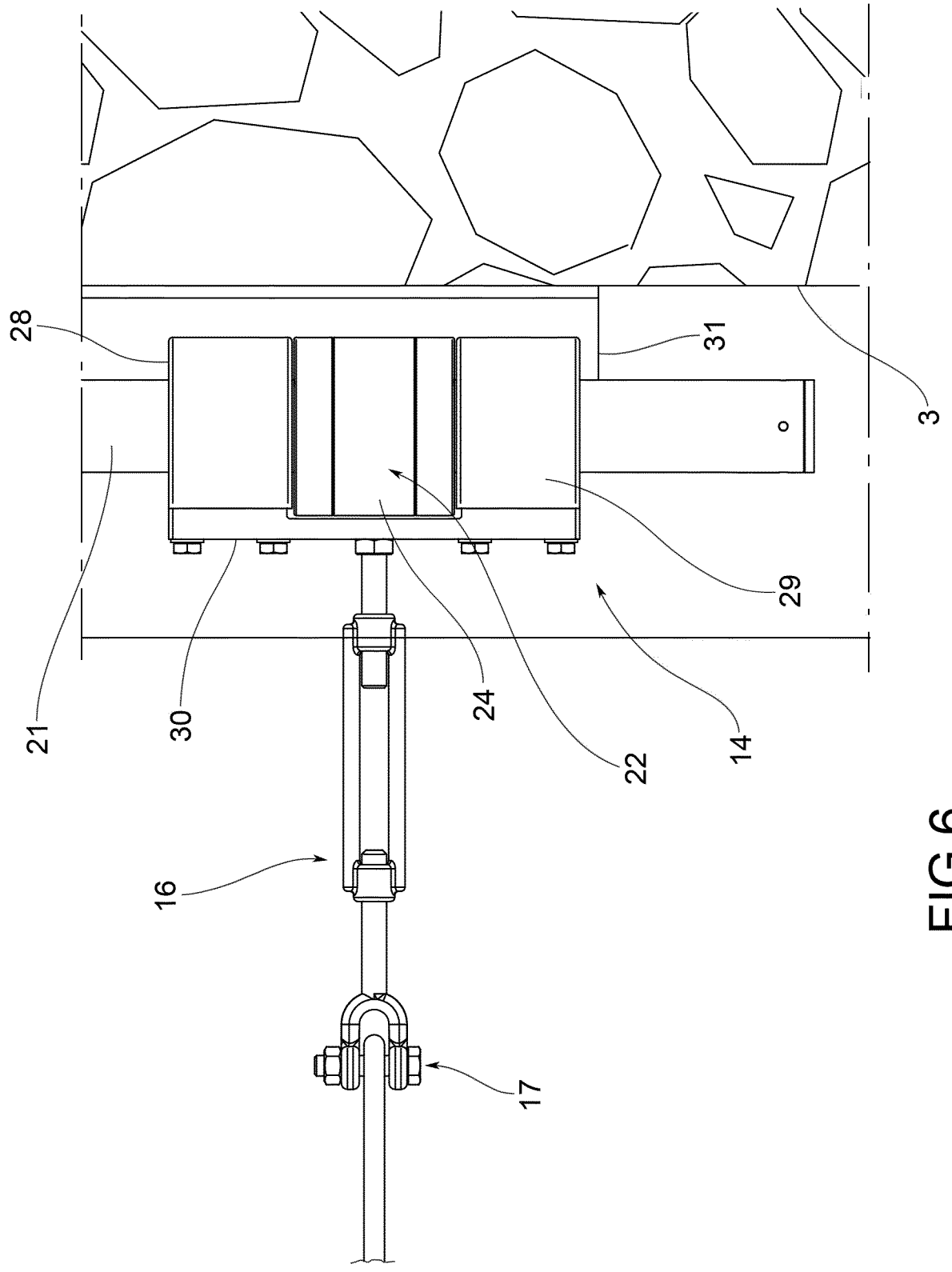


FIG.6

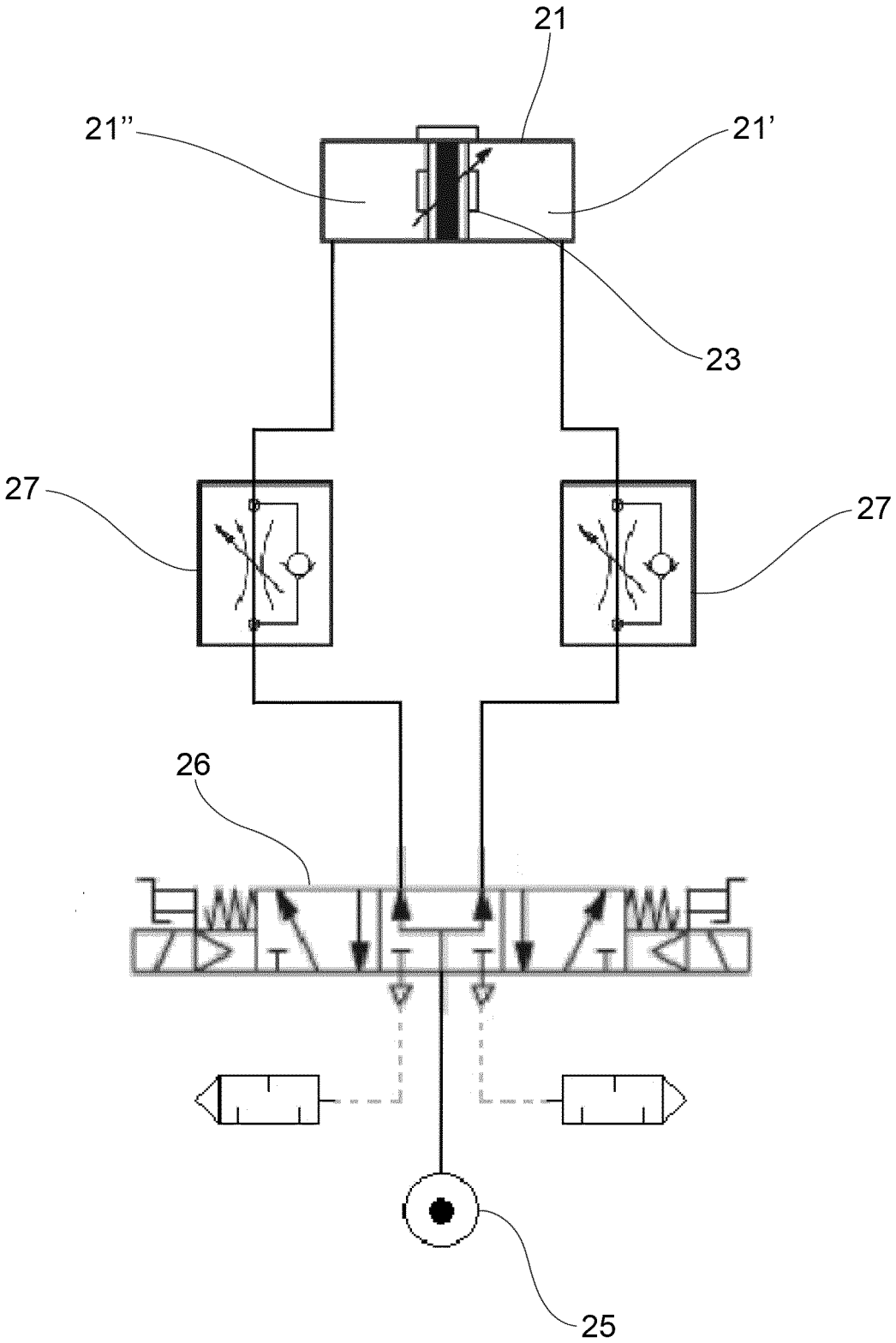


FIG.8

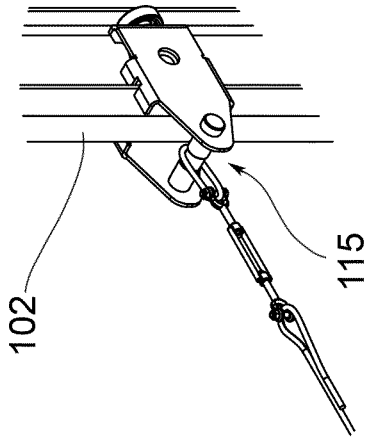


FIG.13

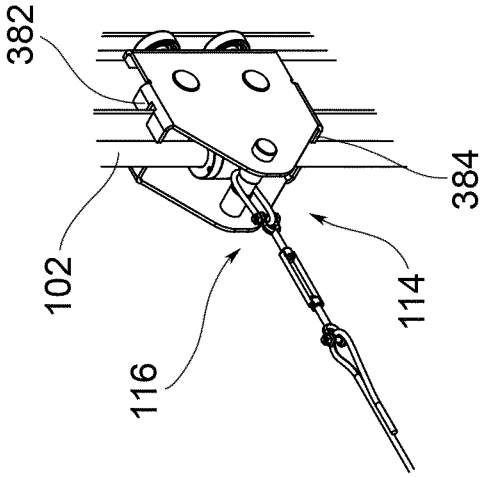


FIG.12

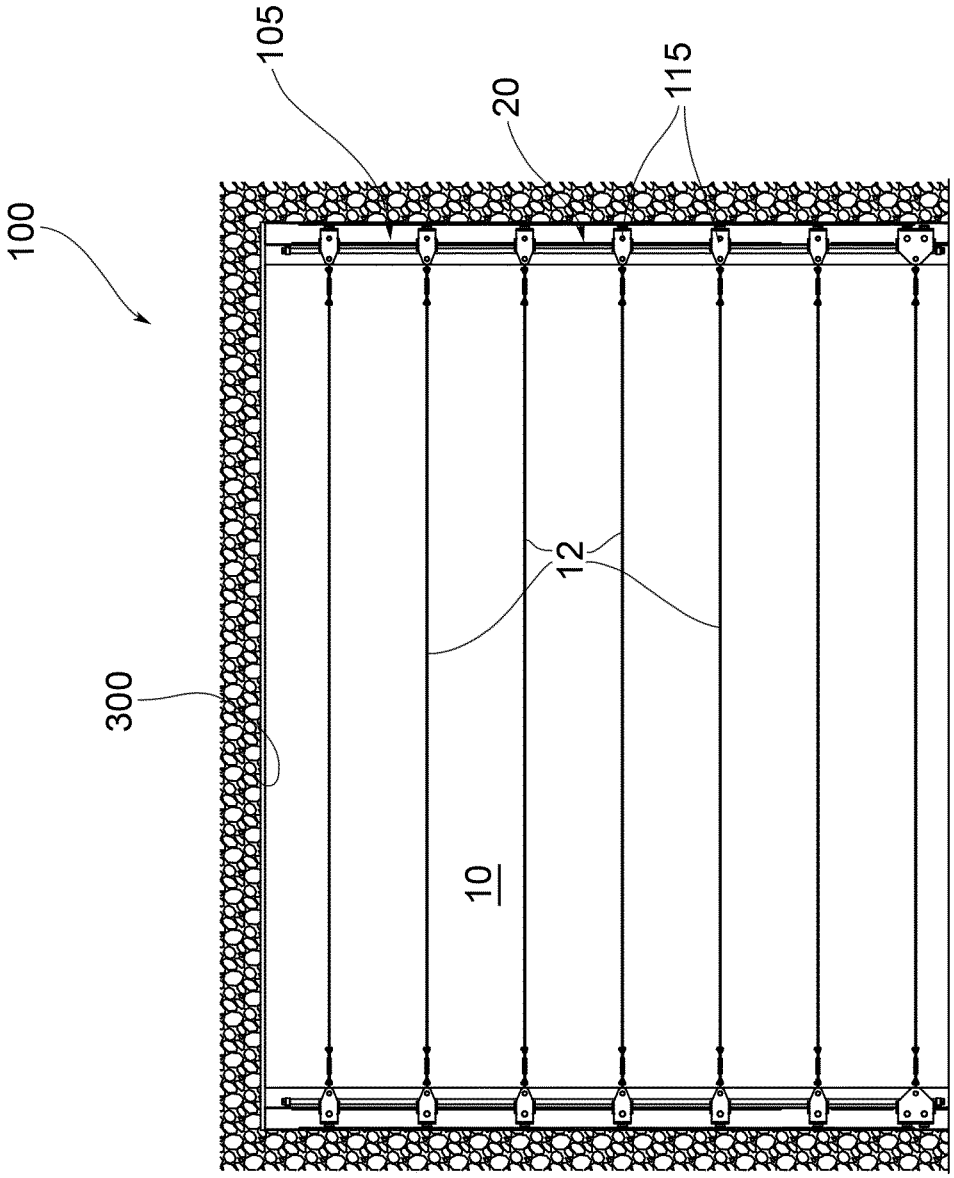


FIG.9

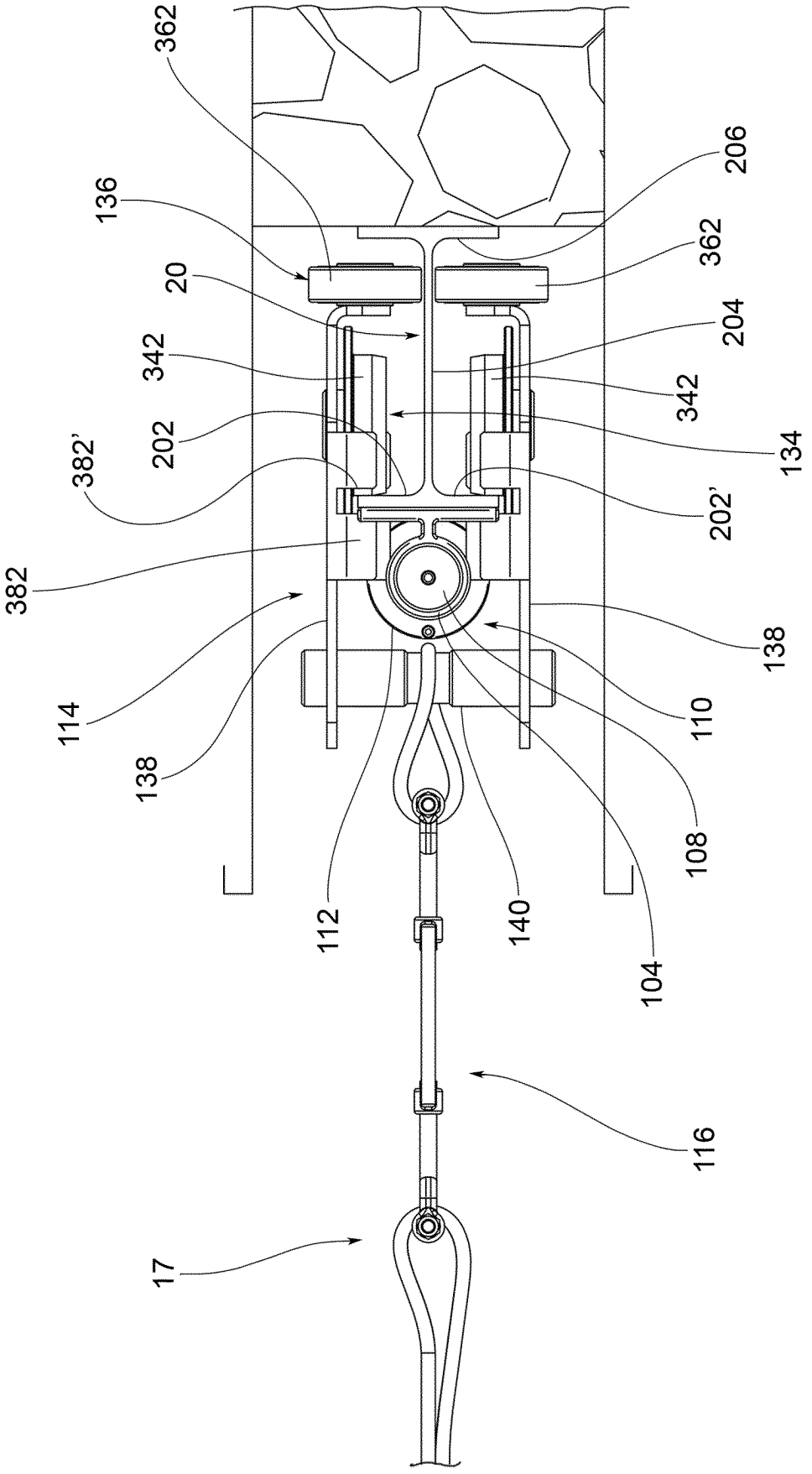

362
136
20
342
382'
202
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114
138
112
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104
108
110
138
202'
134
342
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362
206
116
17

FIG.10

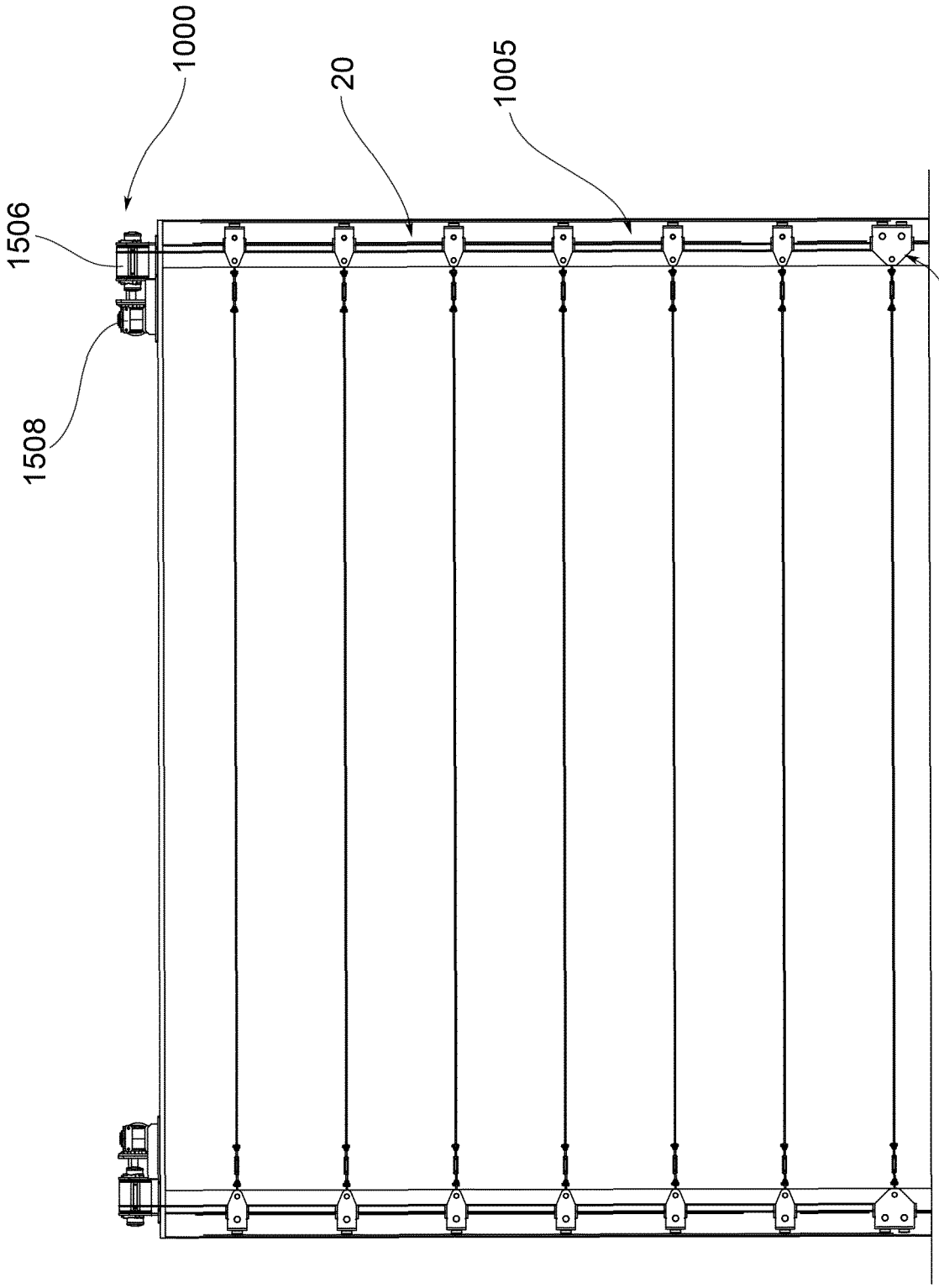


FIG.14

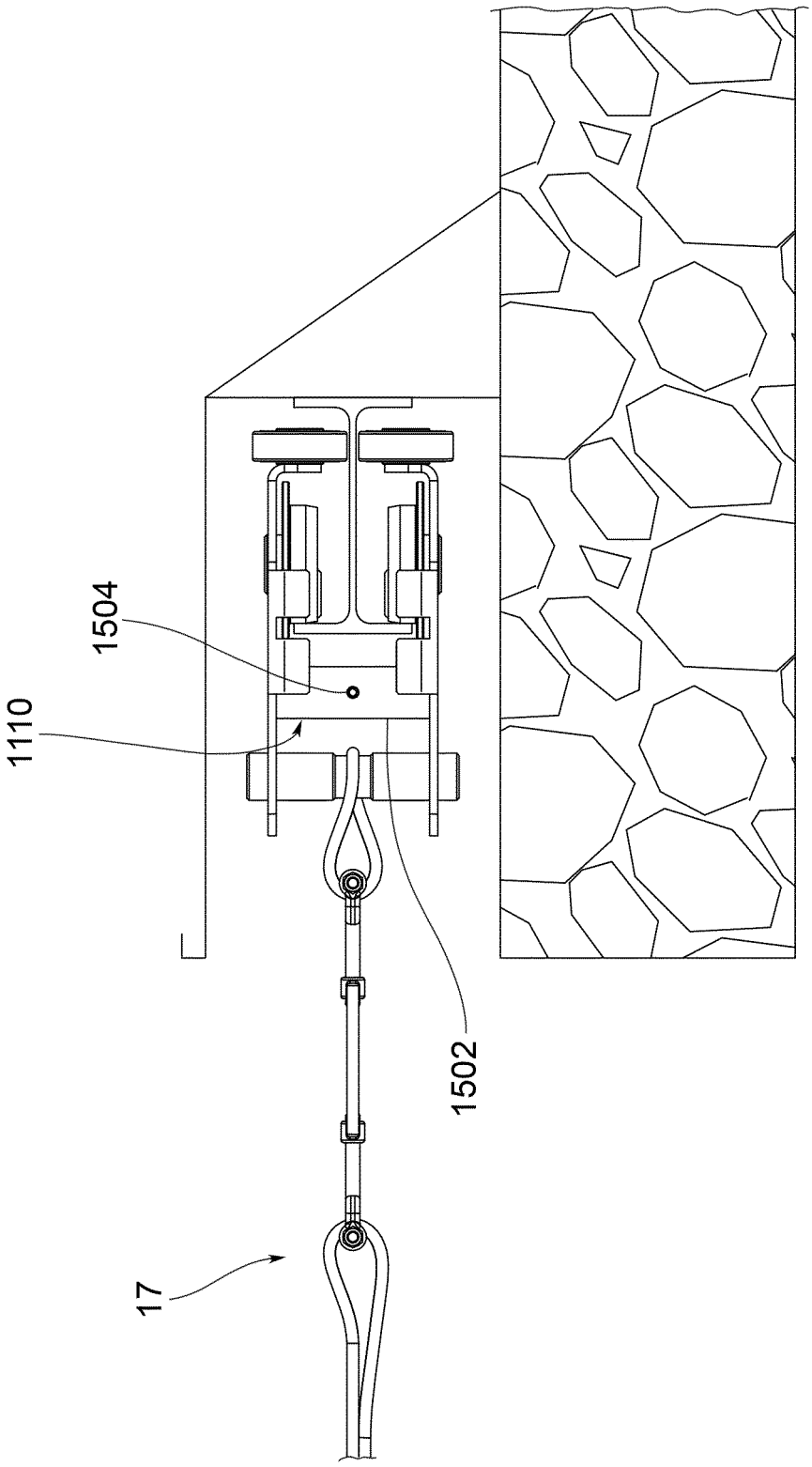


FIG.15

REFERENCES CITED IN THE DESCRIPTION

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- WO 2014115096 A2 **[0053]**