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(54) **CLEANING SYSTEM FOR AN EXTERNAL SURFACE OF A BUILDING**

REINIGUNGSSYSTEM FÜR EINE AUSSENFLÄCHE EINES GEBÄUDES

SYSTÈME DE NETTOYAGE D'UNE SURFACE EXTÉRIEURE D'UN BÂTIMENT

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## Description

### Technical field

[0001] The present disclosure relates to a cleaning system for an external surface of a building. In particular, the present disclosure relates to a cleaning system for cleaning external surfaces of windows of a building.

### Background art

[0002] Many buildings, and in particular high-rise buildings, have fixed glazing which prevents access to the external surface of the building from the inside.

[0003] Conventionally, the external surface of buildings with fixed glazing is cleaned by hand from the outside by specialised personnel who is lifted on platforms or through harnesses.

[0004] There have been attempts at developing unmanned machines capable of cleaning the windows or walls of buildings, however these devices have experienced only limited commercial acceptance. Generally, these devices include a tank containing cleaning fluid, nozzles for spraying the cleaning fluid on the building and rubs or wipes for rubbing it.

[0005] Prior art document US4797969 shows a cleaning apparatus according to the preamble of independent claim 1, which is positionable by an operator above a vertical row of windows and then is remotely operated to clean the exterior building surface as the apparatus descends between a pair of vertical mullions. At the end of the vertical descent, the cleaning apparatus is hauled to the roof, repositioned in the next successive pair of mullions and the cycle is recommenced.

[0006] Prior art document and US4025984 shows a similar type cleaning device adapted to ascend and descend between pairs of vertical mullions of the building, wherein the used cleaning fluids are recovered and recirculated.

### Summary of the invention

[0007] The Applicant has observed that the above briefly disclosed types of cleaning apparatus can be limited by the need of carrying enough cleaning fluid to complete a full vertical run especially in the case of high buildings.

[0008] Indeed, the Applicant has observed that high buildings may require providing the cleaning apparatus with heavy and bulky tanks to store an adequate amount of cleaning fluid so as to ensure sufficient clean fluid or recycled fluid to satisfactory clean a whole vertical row of windows.

[0009] The Applicant has further observed that difficulties can occur in transferring the cleaning apparatus from a pair of vertical mullions to the next one after the completion of each cycle, especially in case of heavy and bulky tanks.

[0010] In view of the foregoing drawbacks of the prior art cleaning apparatus, as well as other disadvantages not specifically mentioned above, it should be apparent that there exists a need in the art for cleaning system for an external surface of a building which is not affected by the height of the building.

[0011] The present disclosure thus relates to a cleaning system for an external surface according to claim 1.

[0012] The present disclosure relates to a cleaning system for an external surface of a building, comprising:

- a plurality of horizontal tracks configured to be attached to an external surface of a building so as to extend in a substantially horizontal direction and to be vertically spaced from one another;
- a cleaning module movable along each horizontal track of the plurality of horizontal tracks, the cleaning module comprising: at least one delivery nozzle configured to deliver cleaning fluid on the external surface of the building, and a cleaning fluid tank fluidly coupled with the at least one delivery nozzle for supplying the at least one delivery nozzle with cleaning fluid;

the cleaning system further comprising:

- a vertical track configured to be attached to the external surface of the building so as to extend in a substantially vertical direction;
- a displacement module fluidly coupled with a source of cleaning fluid;

wherein in a first operative condition of the cleaning system the cleaning module is movable along a first horizontal track of the plurality of horizontal tracks and the displacement module is engaged with the vertical track; and

wherein in a second operative condition of the cleaning system the cleaning module is engaged with the displacement module and disengaged from the first horizontal track, the source of cleaning fluid is fluidly coupled with the cleaning fluid tank for filling the cleaning fluid tank with cleaning fluid, the displacement module is engaged with the vertical track and movable along the vertical track for displacing the cleaning module toward a second horizontal track of said plurality of horizontal tracks.

[0013] Throughout this disclosure, the expressions referring to a horizontal direction such as "horizontal" and "horizontally" are to be understood as referring to a direction parallel to the floors of the building.

[0014] Throughout this disclosure, the expressions referring to a vertical direction, such as "vertical" and "vertically" are to be understood as referring to a direction perpendicular to the floors of the building.

[0015] Throughout this disclosure, the expressions referring to an "oblique direction" are to be understood as

referring to a direction having an angle greater than 0° and lower than 90° with respect to the horizontal direction.

**[0016]** Throughout this disclosure, the expression "used cleaning fluid" is used to indicate cleaning fluid already dispensed from the cleaning module onto the building surface.

**[0017]** The present disclosure can be implemented according to one or more of the following embodiments, optionally combined together.

**[0018]** In some embodiments, the size of the cleaning fluid tank is determined in order to guarantee that the cleaning module may complete a run along an horizontal track while the delivery nozzles delivers cleaning fluid to the external surface.

**[0019]** In some embodiments, the displacement module comprises a displacement track.

**[0020]** In some embodiments, in the second operative condition the cleaning module engages the displacement track.

**[0021]** In some embodiments, when the cleaning module is engaged with the displacement track, the cleaning module is disengaged from the horizontal track.

**[0022]** In some embodiments, the cleaning module comprises engagement portions, each engagement portion being configured to engage a horizontal track of the plurality of horizontal tracks for holding the cleaning module to the horizontal track.

**[0023]** In some embodiments, each engagement portion is configured to engage the displacement track for holding the cleaning module to the displacement track.

**[0024]** In some embodiments, each engagement portion of the cleaning module is configured to disengage a horizontal track of the plurality of horizontal tracks and to engage the displacement track of the displacement module.

**[0025]** In some embodiments, each horizontal track of the plurality of horizontal tracks extends from a respective first end to a respective second end.

**[0026]** In some embodiments, the displacement track extends from a respective first end to a respective second end.

**[0027]** In some embodiments, the second end of the displacement track is positionable contiguous with the first end of the first horizontal track.

**[0028]** In some embodiments, the second end of the displacement track is positionable contiguous with the first end of the second horizontal track.

**[0029]** In some embodiments, the second end of the displacement track is positionable contiguous with the first end of the any of the horizontal tracks.

**[0030]** In some embodiments, the displacement track is movable with the displacement module along the vertical track.

**[0031]** In some embodiments, the second end of the displacement track is configured to be selectively and horizontally aligned to any horizontal track of said plurality of horizontal track.

**[0032]** In some embodiments, the cleaning module engages the displacement track from a horizontal track by moving along the horizontal track towards the first end of the horizontal track and by overstepping the first end of the horizontal track.

**[0033]** In some embodiments, in the second operative condition the cleaning module is contained within the horizontal and vertical extents of the displacement module.

**[0034]** In some embodiments, the displacement module comprises a displacement frame provided with an internal housing for the cleaning module and an access opening for accessing the internal housing.

**[0035]** In some embodiments, in the second operative condition the cleaning module is housed in said internal housing.

**[0036]** In some embodiments, the displacement track extends within the internal housing.

**[0037]** In some embodiments, the displacement track is contained within the internal housing.

**[0038]** In some embodiments, the cleaning module further comprises a first cleaning fluid connector fluidly coupled with the cleaning fluid tank.

**[0039]** In some embodiments, the displacement module further comprises a second cleaning fluid connector fluidly coupled with the source of cleaning fluid.

**[0040]** In some embodiments, the first cleaning fluid connector is configured to fluidly connect to the second cleaning fluid connector when the cleaning module engages the displacement module.

**[0041]** In some embodiments, the first cleaning fluid connector is configured to engage the second cleaning fluid connector when the cleaning module engages the displacement module.

**[0042]** In some embodiments, in the first operative condition the first cleaning fluid connector is disengaged from the second cleaning fluid connector.

**[0043]** In some embodiments, in the second operative condition the first cleaning fluid connector is fluidly connected to the second cleaning fluid connector.

**[0044]** In some embodiments, the cleaning module further comprises at least one suction head configured to draw used cleaning fluid from the external surface of the building.

**[0045]** In some embodiments, the cleaning module further comprises a waste fluid tank fluidly coupled with the at least one suction head for receiving used cleaning fluid from the at least one suction head.

**[0046]** In some embodiments, the displacement module is fluidly coupled with a disposer of used cleaning fluid.

**[0047]** In some embodiments, in the second operative condition the disposer of used cleaning fluid is fluidly coupled with the waste fluid tank for receiving used cleaning fluid from the waste fluid tank.

**[0048]** In some embodiments, the cleaning module further comprises a first waste fluid connector fluidly coupled with the waste fluid tank.

**[0049]** In some embodiments, the displacement module further comprises a second waste fluid connector fluidly coupled with the disposer of used cleaning fluid.

**[0050]** In some embodiments, the first waste fluid connector is configured to engage the second waste fluid connector and to fluidly connect to the second waste fluid connector when the cleaning module engages the displacement module.

**[0051]** In some embodiments, in the first operative condition the first waste fluid connector is disengaged from the second waste fluid connector.

**[0052]** In some embodiments, in the second operative condition the first waste fluid connector is fluidly connected to the second waste fluid connector.

**[0053]** In some embodiments, a purifier is provided, wherein the purifier is fluidly coupled with the disposer of used cleaning fluid for receiving used cleaning fluid from the disposer of used cleaning fluid.

**[0054]** In some embodiments, the purifier is configured to purify used cleaning fluid.

**[0055]** In some embodiments, the purifier is fluidly connected with the source of cleaning fluid for delivering the purified cleaning fluid to the source of cleaning fluid.

**[0056]** In some embodiments, the at least one suction head comprises a wiper having a wiper surface configured to gather used cleaning fluid on the external surface of the building.

**[0057]** In some embodiments, the wiper is provided with a plurality of suction openings fluidly coupled with a vacuum pump for sucking the gathered used cleaning fluid.

**[0058]** In some embodiments, the wiper extends in an oblique direction with respect to the horizontal direction and the vertical direction.

**[0059]** In some embodiments, the cleaning module comprises a mop horizontally interposed between the at least one delivery nozzle and the at least one suction head.

**[0060]** In some embodiments, the mop is cylindrical.

**[0061]** In some embodiments, the mop is rotatable about a mop axis, preferably vertical.

**[0062]** In some embodiments, the mop vertically extends substantially through the full vertical extension of the cleaning module.

**[0063]** In some embodiments, the displacement module comprises a power supply.

**[0064]** In some embodiments, an extendable power cable extends from the power supply to the cleaning module for powering the cleaning module.

**[0065]** In some embodiments, the extendable power cable is coupled to a winch installed on the displacement module.

**[0066]** In some embodiments, each horizontal track of the plurality of horizontal tracks comprises a first cavity.

**[0067]** In some embodiments, in the first operative condition a length of the extendable power cable extending between the displacement module and the cleaning module is housed in the first cavity of the first horizontal

track.

**[0068]** In some embodiments, the displacement module comprises a recovery winch.

**[0069]** In some embodiments, an extendable recovery cable extends from the recovery winch to the cleaning module.

**[0070]** In some embodiments, the recovery winch is configured for displacing the cleaning module along the respective horizontal track of the plurality of horizontal tracks towards the displacement module.

**[0071]** In some embodiments, each horizontal track of the plurality of horizontal tracks comprises a second cavity.

**[0072]** In some embodiments, in the first operative condition a length of the extendable recovery cable extending between the displacement module and the cleaning module is housed in the second cavity of the first horizontal track.

**[0073]** In some embodiments, in the first operative condition at least one from the first cavity and the second cavity of the first horizontal track at least partially houses at least one engagement portion of said engagement portions of the cleaning module.

**[0074]** In some embodiments, in the first operative condition the first cavity of the first horizontal track at least partially houses at least one engagement portion of said engagement portions of the cleaning module.

**[0075]** In some embodiments, in the first operative condition the first cavity of the first horizontal track at least partially houses two engagement portions of said engagement portions of the cleaning module.

**[0076]** In some embodiments, in the first operative condition the second cavity of the first horizontal track at least partially houses at least one engagement portion of said engagement portions of the cleaning module.

**[0077]** In some embodiments, in the first operative condition the second cavity of the first horizontal track at least partially houses two engagement portions of said engagement portions of the cleaning module.

**[0078]** In some embodiments, the engagement portions housed into the first cavity of the first horizontal track are distinct from the engagement portions housed into the second cavity of the first horizontal track.

**[0079]** In some embodiments, each horizontal track of the plurality of horizontal tracks has at least one horizontal opening for accessing a respective cavity and at least one deformable seal for closing the at least one horizontal opening.

**[0080]** In some embodiments, each engagement portion of the cleaning module has an idler wheel rotatable about a first axis of rotation and a driving wheel rotatable about a second axis of rotation perpendicular to the first axis of rotation.

**[0081]** In some embodiments, in the first operative condition each idler wheel engages the first horizontal track for slidingly supporting the cleaning module and each driving wheel engages the first horizontal track for providing a traction to the cleaning module in the hor-

izontal direction.

**[0082]** In some embodiments, in the first operative condition the idler wheel is inserted in the respective cavity of the first horizontal track and the driving wheel engages an exposed surface of the first horizontal track facing outside the respective cavity.

**[0083]** In some embodiments, the driving wheel is coupled with a pusher and the idler wheel is coupled with a roller facing the driving wheel and having a third axis of rotation parallel to the second axis of rotation of the driving wheel.

**[0084]** In some embodiments, in the first operative condition the pusher presses the driving wheel against the first horizontal track and the roller opposes the driving wheel.

**[0085]** In some embodiments, in the first operative condition each roller is located inside a respective cavity of the first horizontal track.

**[0086]** In some embodiments, the cleaning module comprises main frame supporting the engagement portions.

**[0087]** In some embodiments, the cleaning module comprises an adjustable frame.

**[0088]** In some embodiments, the adjustable frame is movable with respect to the main frame in a direction orthogonal to a vertical direction and to a horizontal direction.

**[0089]** In some embodiments, at least one delivery nozzle is mounted on the adjustable frame.

**[0090]** In some embodiments, the vertical track comprises a plurality of anchoring portions vertically spaced from one another.

**[0091]** In some embodiments, the cleaning system comprises a jacking apparatus mounted on the displacement module.

**[0092]** In some embodiments, the jacking apparatus comprises a plurality of gripping portions configured to reversibly engage respective anchoring portions.

**[0093]** In some embodiments, the jacking apparatus comprises a primary actuator assembly configured to move the gripping portions towards and away from the displacement module.

**[0094]** In some embodiments, in the second operative condition the jacking apparatus displaces the displacement module and the cleaning module along the vertical track and in the first operative condition the jacking apparatus holds the displacement module on the vertical track.

**[0095]** In some embodiments, the actuator assembly comprises a plurality of actuator arms.

**[0096]** In some embodiments, each actuator arm comprise: a first end connected to the displacement module, a second end connected to a respective anchoring portion of the plurality of anchoring portions, and a linear actuator configured to modify the distance between the first end and the second end of the respective actuator arm.

**[0097]** In some embodiments, each anchoring portion is shaped as a protrusion and each gripping portion has a

concave profile substantially counter-shaped to said protrusion.

**[0098]** In some embodiments, the jacking apparatus comprises a secondary actuator assembly configured to rotate each gripping portion from a first position in which the gripping portion can be hooked on a respective anchoring portion to a second position in which the gripping portion disengages the anchoring portion.

**[0099]** In some embodiments, a main winch configured to be attached to the building is provided, the main winch having a main winch cable connected to the displacement module.

**[0100]** In some embodiments, in the second operative condition the main winch displaces the displacement module and the cleaning module along the vertical track and in the first operative condition the main winch holds the displacement module on the vertical track.

**[0101]** In some embodiments, a counterweight is provided connected to the main winch cable.

**[0102]** In some embodiments, the vertical track comprises a cavity configured to house the counterweight.

**[0103]** In some embodiments, the displacement module comprises a display.

**[0104]** In some embodiments, the display is configured for displaying advertising messages or images or a combination thereof.

**[0105]** In some embodiments, the display is a LED display.

**[0106]** In some embodiments, the display is a LCD display.

#### Brief description of the drawings

**[0107]** The features and advantages of the present disclosure will be made apparent by the following detailed description of some exemplary embodiments thereof, provided merely by way of non-limiting examples, description that will be conducted by making reference to the attached drawings, wherein:

- figure 1 shows a side view of a cleaning system for an external surface of a building according to the present disclosure;
- figure 2 shows a vertical cross-section view of a particular of the cleaning system of figure 1;
- figure 3 shows a detail of the vertical cross-section view of figure 2;
- figure 4 shows a perspective view of components of the cleaning system of figure 1;
- figure 5 shows a different view of the components of figure 4;
- figure 6 shows a vertical cross-section view of a detail of the cleaning system of figure 1;

- figure 7 shows a perspective view of a detail of the components of figure 4;
- figure 8 shows a schematic view of the components of figure 4;
- figure 9 shows a perspective view of a detail of the components of figure 4;
- figure 10 shows a horizontal cross-section view of a particular of the cleaning system of figure 1;
- figure 11 shows a perspective view of components of the cleaning system of figure 1;
- figure 12 shows a horizontal cross-section view of a particular of the cleaning system of figure 1;
- figure 13 shows a detail of the horizontal cross-section view of figure 12;
- figure 14 shows a vertical cross-section view of the components of figure 11;
- figure 15 shows a detail of the vertical cross-section view of figure 14;
- figure 16 shows a schematic view of the cleaning system of claim 1;
- figure 17 shows a side view of a particular of a cleaning system for an external surface of a building in a different embodiment according to the present disclosure;
- figure 18 shows a perspective view of a particular of the cleaning system of figure 17;
- figure 19 shows a side view of a detail of the cleaning system of figure 17;
- figure 20 shows a perspective view of a detail of the cleaning system of figure 17;
- figure 21 shows a schematic view of the cleaning system of figure 1 in a first operative condition;
- figure 22 shows a schematic view of the cleaning system of figure 1 in a second operative condition;
- figure 23 shows a schematic view of the cleaning system of figure 1 in a third operative condition.

#### Detailed description

**[0108]** The subject-matter of the present disclosure relates to a cleaning system for an external surface of a building, illustrated in the attached figures and hereon

referred to as "cleaning system 1".

**[0109]** The cleaning system 1 comprises a plurality of horizontal tracks 10 to be mounted on the external surface S of a building B.

5 **[0110]** In the illustrated embodiment of figure 1, the external surface S is planar and each horizontal track 10 is rectilinear. Alternatively, the horizontal tracks 10 may have any shape suitable for following the profile of the external surface S. Each horizontal track 10 is intended to  
10 be attached to the external surface S and to extend horizontally between a first end 11 and a second end 12.

**[0111]** Each horizontal track 10 comprises a plurality of guides 15. In the preferred embodiment, each horizontal track 10 comprises two guides 15, namely a lower guide  
15 13 and an upper guide 14, illustrated in cross-section in figure 2 and in detail in figure 3. The guides 15 are mounted on the external surface S one above the other at a predetermined distance and parallel to each other.

**[0112]** Each guide 15 comprises an elongated beam extending horizontally from a first end 11 to a second end 12. Each guide 15 is preferably mounted at a floor F of the building B.  
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**[0113]** In the illustrated embodiment, the upper guide 14 of a first horizontal track 10 and the lower guide 13 of a second horizontal track 10 located immediately above the first horizontal track are made as a single piece, namely they are integral with each other.  
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**[0114]** Each horizontal track 10 comprises a first cavity 16 extending horizontally from the first end 11 to the second end 12. The first cavity 16 is located in the upper guide 14. The horizontal track 10 has a first horizontal opening 17 for accessing the first cavity 16. The first horizontal opening 17 faces downwards. The horizontal track 10 has at least one deformable seal 18 for sealing the first horizontal opening 17, for example an elastomeric membrane. The at least one deformable seal 18 is configured for preventing water, dust and external objects from entering the first cavity 16. In the illustrated embodiment, each horizontal track 10 has two deformable seals 18 located at opposite sides of the first horizontal opening 17 for sealing it.  
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**[0115]** Each horizontal track 10 comprises a second cavity 19 extending horizontally from the first end 11 to the second end 12. The second cavity 19 is located in the lower guide 13. The horizontal track 10 has a second horizontal opening 20 for accessing the second cavity 19. The second horizontal opening 20 faces upwards. The horizontal track 10 has at least one deformable seal 21 for sealing the second horizontal opening 20, for example an elastomeric membrane. The at least one deformable seal 21 is configured for preventing water, dust and external objects from entering the second cavity 19. In the illustrated embodiment, each horizontal track 10 has two deformable seals 21 located at opposite sides of the second horizontal opening 20 for sealing it.  
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**[0116]** The cleaning system 1 further comprises a cleaning module 30, shown in perspective view in figure 4.

**[0117]** The cleaning module 30 can be selectively coupled to each horizontal tracks 10 for horizontally moving along the latter.

**[0118]** Figure 5 shows the cleaning module 30 from behind. That is to say, figure 5 shows a view of the cleaning module 30 from the external surface S towards the outside of the building B.

**[0119]** The cleaning module 30 comprise a main frame 30a, preferably a rigid frame.

**[0120]** The cleaning module 30 further comprises a plurality of engagement portions 31, shown in figure 6, configured to support the cleaning module 30 to a respective horizontal track 10. The engagement portions 31 are connected to the main frame 30a. The engagement portions 31 are configured to engage the horizontal tracks 10 so as to keep the main frame 30a at a pre-determined distance from the external surface S.

**[0121]** Each engagement portion 31 is configured to support the cleaning module 30 to a respective horizontal track 10. The cleaning module 30 comprises lower engagement portions 32 configured to engage the lower guide 13 of the respective horizontal track 10. The cleaning module 30 comprises upper engagement portions 33 configured to engage the upper guide 14 of the respective horizontal track 10. In the illustrated embodiment, the cleaning module 30 comprises two lower engagement portions 32 and two upper engagement portions 33.

**[0122]** The upper engagement portions 33 are partially inserted in the first cavity 16 through the first horizontal opening 17. Deformation of the deformable seal 18 allows the upper engagement portions 33 to move along the upper guide 14 in the first cavity 16 while maintaining the first cavity 16 sealed around the upper engagement portions 33.

**[0123]** The lower engagement portions 32 are partially inserted in the second cavity 19 through the second horizontal opening 20. Deformation of the deformable seal 21 allows the lower engagement portions 32 to move along the upper guide 14 in the second cavity 19 while maintaining the second cavity 19 sealed around the lower engagement portions 32.

**[0124]** Each engagement portion 31 comprises an idler wheel 34 which is configured to engage a respective horizontal track 10 for slidingly support the cleaning module 30 to the horizontal track 10. The idler wheels 34 allow the cleaning module 30 to translate horizontally along the respective horizontal track 10.

**[0125]** Each idler wheel 34 has a first axis of rotation R1. When the engagement portions 31 engage a horizontal track 10 the first axis of rotation R1 is oriented horizontally, orthogonal to the external surface S.

**[0126]** When the engagement portions 31 engage a horizontal track 10, the idler wheels 34 of the lower engagement portions 32 are housed in the second cavity 19. Analogously the idler wheels 34 of the upper engagement portions 33 are housed in the first cavity 16.

**[0127]** The engagement portions 31 also comprise brackets 34a for connecting the idler wheel 34 to the

main frame 30a. The bracket 34a of the lower engagement portions 32 is partially inserted in the second cavity 19 and extends through the second horizontal opening 20. The bracket 34a of the upper engagement portions 33 is partially inserted in the first cavity 16 and extends through the first horizontal opening 17.

**[0128]** At least one of the engagement portions 31 comprises a driving wheel 35 which is configured to engage a respective horizontal track 10 for providing traction to the cleaning module 30 in order to drive it along the horizontal track 10. The driving wheel 35 is driven by an electric actuator 35a. The driving wheel 35 is configured to engage an exposed surface 22 of the horizontal track 10 which faces outside of the first cavity 16 and the second cavity 19. The driving wheel 35 has a second axis of rotation R2. The second axis of the rotation R2 is orthogonal to the first axis of rotation R1. When the engagement portions 31 engage a horizontal track 10, the second axis of the rotation R2 is oriented vertically. Preferably, at least one lower engagement portion 32 and at least one upper engagement portion 33 comprise a driving wheel 35.

**[0129]** Each engagement portion 31 comprising a driving wheel 35 further comprises a pusher 36 connected to the driving wheel 35. The pusher 36 is configured to press the driving wheel 35 against the exposed surface 22 of the horizontal track 10 in order to provide sufficient friction between the driving wheel 35 and the exposed surface 22 for the driving wheel 35 to generate enough traction and drive the cleaning module 30 along the horizontal track 10.

**[0130]** Each engagement portion 31 further comprises a roller 37 coupled to the idler wheel 34. In the illustrated embodiment, the roller 37 is located within an outer circumference of the idler wheel 34. The roller 37 is configured to abut against an inner surface 23 of the horizontal track 10 opposite to the exposed surface 22, in order to resist the force exerted by the pusher 36. An inner surface 23 is defined within the first cavity 16 and the second cavity 19. When the engagement portions 31 engage a horizontal track 10, the rollers 37 of the upper engagement portions 33 are located within the first cavity 16 and the rollers 37 of the lower engagement portions 32 are located within the second cavity 19. The roller 37 keeps the idler wheel 34 correctly engaged with the respective horizontal track 10, contacting it with its outer circumference only. Each roller 37 has a third axis of rotation R3 parallel to the second axis of rotation R2.

**[0131]** The cleaning module 30 further comprises an adjustable frame 39 slidingly connected to the main frame 30a. When the engagement portions 31 engage a horizontal track 10, the adjustable frame 39 is movable with respect to the main frame 30a towards and away from the external surface S so as to adjust the distance between the adjustable frame 39 and the external surface S. The adjustable frame 39 is movable with respect to the main frame 30a along a direction orthogonal to the external surface S.

**[0132]** The adjustable frame 39 is preferably contained within the main frame 30a at least in the horizontal and vertical directions. The adjustable frame 39 may protrude from main frame 30a towards the external surface S.

**[0133]** As illustrated in figure 8, in order to allow movement between the adjustable frame 39 and the main frame 30a, one or more axial guides 40 are connected to one of the adjustable frame 39 and the main frame 30a and one or more sliders 41 engaged on the axial guides 40 are connected to the other of the adjustable frame 39 and the main frame 30a. With reference to the first operative conditions, the axial guides are oriented in a direction orthogonal to the external surface S.

**[0134]** An electric actuator 41a drives the movement of the adjustable frame 39 with respect to the main frame 30a.

**[0135]** The cleaning module 30 comprises at least one delivery nozzle 42 configured to deliver cleaning fluid on the external surface S while the cleaning module 30 moves along any one of the horizontal tracks 10. In the illustrated embodiment, the cleaning module 30 comprises a plurality of delivery nozzles 42. The delivery nozzles 42 are vertically spaced from one another. The delivery nozzles 42 are supported by the adjustable frame 39, so as to adjust their distance from the external surface S. The orientation of the delivery nozzles 42 may be adjustable so as to adjust the direction of the delivery of cleaning fluid.

**[0136]** The cleaning module 30 further comprises a cleaning fluid tank 43 configured for containing cleaning fluid, such as water or other liquids suitable for cleaning an external surface of a building. The cleaning fluid tank 43 comprises a plurality of baffles 44 oriented obliquely with respect to the horizontal and vertical directions for reducing movement in the cleaning fluid within the cleaning fluid tank 43. The cleaning fluid tank 43 is mounted on the main frame 30a.

**[0137]** The cleaning fluid tank 43 is fluidly coupled to the delivery nozzles 42 for supplying cleaning fluid to the delivery nozzles 42. A pump 44a is provided for pressurising the cleaning fluid between the cleaning fluid tank 43 and the delivery nozzles 42. A heater (not shown) may be provided for heating the cleaning fluid between the cleaning fluid tank 43 and the delivery nozzles 42 in order to increase the cleaning power of the cleaning fluid.

**[0138]** The cleaning module 30 further comprises a mop 45 for mopping the external surface S. The mop 45 is mounted on the adjustable frame 39 so as to adjust its distance from the external surface S. The mop 45 is arranged next to the delivery nozzles 42, horizontally spaced from the delivery nozzles 42, in order to operate on the cleaning fluid delivered on the external surface S by the delivery nozzles 42 during the horizontal movement of the cleaning module 30.

**[0139]** The mop 45 is preferably cylindrical and rotatable about a mop axis M. The mop axis M is preferably oriented vertically. The mop 45 preferably extends along substantially the whole vertical extension of the cleaning

module 30.

**[0140]** The cleaning module 30 comprises at least one suction head 46, shown in detail in figure 7. The suction head 46 is configured to suck used cleaning fluid from the external surface S while the cleaning module 30 moves along any one of the horizontal tracks 10. In the illustrated embodiment, the cleaning module 30 comprises a plurality of suction heads 46. The suction heads 46 are vertically spaced from one another. The suction heads 46 are arranged next to the mop 45 so that the mop 45 is positioned horizontally between the delivery nozzles 42 and the suction heads 46. In this way, the suction heads 46 can suck the cleaning fluid that has been delivered on the external surface S by the delivery nozzles 42 and has been used by the mop 45 to mop the external surface S. The suction heads 46 are mount on the adjustable frame 39, so as to adjust their distance from the external surface S.

**[0141]** Each suction head 46 comprises a wiper 47 configured to wipe the external surface S while the cleaning module 30 moves along one of the horizontal tracks 10. The wiper 47 is elongated in an oblique direction with respect to the horizontal direction and to the vertical direction. The oblique direction of the wiper 47 allows to meet substantially perpendicularly the cleaning fluid traveling downwards on the external surface S due to gravity.

**[0142]** The wiper 47 has a wiper surface 47a configured to contact the external surface S in order to gather used cleaning fluid while wiping the external surface S. The wiper 47 comprises a plurality of suction openings 48 provided on the wiper surface 47a. The suction head 46 is configured to suck the used cleaning fluid gathered by the wiper surface 47a through the suction openings 48. Preferably, the suction heads 46 are configured to suck substantially all the cleaning fluid delivered by the delivery nozzles 42 on the external surface S.

**[0143]** The cleaning module 30 further comprises a waste fluid tank 49 configured for containing used cleaning fluid recovered from the external surface S. The waste fluid tank 49 comprises a plurality of baffles 50 oriented obliquely with respect to the horizontal and vertical directions for reducing movement in the used cleaning fluid within the waste fluid tank 49. The waste fluid tank 49 is mounted on the main frame 30a.

**[0144]** The waste fluid tank 49 is fluidly coupled to the suction heads 46 for receiving cleaning fluid from the suction heads 46. A vacuum pump 51 is provided for sucking the used cleaning fluid through the suction heads 46 and sending it to the waste fluid tank 49. The vacuum pump 51 also separates the used cleaning fluid from the air sucked by the suction heads 46 together with the used cleaning fluid.

**[0145]** The cleaning module 30 further comprises a first cleaning fluid connector 52, shown in detail figure 9, provided on a lateral side of the cleaning module 30. The first cleaning fluid connector 52 can be accessed horizontally from a side of the cleaning module 30. The

first cleaning fluid connector 52 is fluidly coupled with the cleaning fluid tank 43 and is configured for filling the cleaning fluid tank 43 with cleaning fluid.

**[0146]** The cleaning module 30 further comprises a first waste fluid connector 53, analogous to the first cleaning fluid connector 52 shown figure 9. The first waste fluid connector 53 is provided on a lateral side of the cleaning module 30. The first waste fluid connector 53 is located below the first cleaning fluid connector 52. The first waste fluid connector 53 can be accessed horizontally from a side of the cleaning module 30. The first waste fluid connector 53 is fluidly coupled with the waste fluid tank 49 and is configured for emptying the waste fluid tank 49 of used cleaning fluid.

**[0147]** The cleaning module 30 further comprises a power connector 54 for supplying power to the electrical utilities of the cleaning module 30, for example its pumps, actuators and the rotatable mop 45. The power connector 54 is configured to be inserted in the first cavity 16 through the first horizontal opening 17 in order to connect to a power cable 95 housed in the first cavity 16.

**[0148]** The cleaning system 1 comprises a vertical track 60, shown in cross-section in figure 10, to be mounted on the external surface S of the building B. The vertical track 60 is configured to be mounted at a recess R of the external surface S so as to extend vertically within the recess R. The recess R is preferably located at an end of the external surface S, next to an edge of the building B.

**[0149]** The vertical track 60 is configured to extend vertically substantially along the whole vertical extension of the external surface S.

**[0150]** Preferably, the vertical track 60 is located directly next to the first ends 11 of the horizontal tracks 10.

**[0151]** The vertical track 60 comprises two main vertical guides 61. Each main vertical guide 61 comprises a vertical groove 62. The two main vertical guides 61 are configured to be mounted in the recess R so as to extend vertically and to face each other from opposite sides of the recess R.

**[0152]** The vertical track 60 comprises a main wall 63 for closing the recess R, forming a main cavity 64. The vertical track 60 further comprises two secondary walls 65 for forming two respective secondary cavities 66 within the recess, such as each main vertical guide 61 is located in a respective secondary cavity 66.

**[0153]** Two vertical openings 67 are provided in the main wall 63. The vertical openings 67 extend vertically along the vertical track 60, at opposite sides of the main wall 63. Each vertical opening 67 allows access to a respective one of the secondary cavities 66 from outside the recess R. At least one deformable seal 68 is arranged at each vertical opening 67 for sealing the respective secondary cavity 66. Preferably two deformable seals 68 are located at each vertical opening 67 on opposite sides of the latter for sealing it.

**[0154]** The vertical track 60 further comprises two additional vertical guides 69 configured to be mounted

within the main cavity 64 so as to extend vertically parallel to the main vertical guides 61. The additional vertical guides 69 are configured to be mounted between the main vertical guides 61 and a back wall B1 of the recess R.

**[0155]** The cleaning system 1 further comprises a displacement module 80, shown in perspective view in figure 11.

**[0156]** The displacement module 80 is vertically movable along to vertical track 60.

**[0157]** The displacement module 80 comprises a displacement frame 81, preferably a rigid frame. The displacement module 80 has at least a guiding portion 82 configured to slidably engage the vertical track 60 for guiding the displacement module 80 along the vertical track 60.

**[0158]** In the illustrated embodiment, the displacement module 80 comprises two guiding portions 82, each configured to engage a respective main vertical guide 61, as shown in cross-section in figure 12 and in detailed cross-section in figure 13.

**[0159]** Each guiding portion 82 is partially inserted in a respective secondary cavity 66 through a vertical opening 67. Deformation of the deformable seals 68 allows the guiding portions 82 to move along the vertical track 60 while maintaining the secondary cavities 66 sealed around the guiding portions 82.

**[0160]** Each guiding portion 82 comprises a guiding wheel 83 which is configured to engage a respective main vertical guide 61 for slidably engage the displacement module 80 to the vertical track 60. The guiding wheels 83 allow the displacement module 80 to translate vertically along the vertical track 60. In another embodiment the guiding wheels 83 may be substituted by slides, protrusions or any other body suitable for engaging the vertical track 60 for guiding the displacement module 80 vertically.

**[0161]** Each guiding portion 82 also comprises a bracket 84 for connecting the guiding wheel 83 to the displacement frame 81. Each bracket 84 is partially inserted in a secondary cavity 66 and extends through the respective vertical opening 67.

**[0162]** The displacement module 80 is configured to engage the cleaning module 30 and to vertically displace the cleaning module 30 along the vertical track 60.

**[0163]** The displacement module 80 comprises a displacement track 85, shown in cross-section in figure 14. The displacement track 85 extends horizontally from a first end 86 to a second end 87. Through vertical movement of the displacement module 80 along the vertical track 60 it is possible to align the displacement track 85 with any of the horizontal tracks 10, so that the second end 87 of the displacement track 85 is located at first end 11 of the aligned horizontal track 10, contiguous to the latter.

**[0164]** The displacement track 85 comprises a lower displacement guide 88 and an upper displacement guide 89, illustrated in cross-section in figure 14 and in detail in

figure 15. The lower displacement guide 88 and the upper displacement guide 89 are mounted on the displacement frame 81 at a vertical distance from each other equal to the distance from the lower guide 13 and the upper guide 14 of the horizontal tracks 10. The lower displacement guide 88 and the upper displacement guide 89 can be aligned with the lower guide 13 and the upper guide 14 respectively of any of the horizontal tracks 10.

**[0165]** The engagement portions 31 of the cleaning module 30 can engage the displacement module 80 by engaging the displacement track 85 and sliding over the displacement track 85. The cleaning module 30 can therefore be supported by the displacement track 85 and is movable along the displacement track 85.

**[0166]** The displacement frame 81 of the displacement module 80 is hollow and comprises an internal housing 90 in which the cleaning module 30 can be housed when the cleaning module 30 is engaged with the displacement module 80. The displacement frame 81 has an access opening 91 through which the cleaning module 30 can access the internal housing 90.

**[0167]** The displacement track 85 extends inside the internal housing 90. The cleaning module 30 can be supported by the displacement track 85 inside the internal housing 90. The displacement track 85 may extend to or through the access opening 91. The cleaning module 30 can move over the displacement track 85 through the access opening 91 to access the internal housing 90.

**[0168]** The displacement module 80 further comprises a second cleaning fluid connector 92. The second cleaning fluid connector 92 is fluidly coupled to a source of cleaning fluid 100, which will be described more in detail below. The second cleaning fluid connector 92 is located in the internal housing 90.

**[0169]** The second cleaning fluid connector 92 is configured to fluidly connect automatically to the first cleaning fluid connector 52 when the cleaning module 30 engages the displacement module 80. When the second cleaning fluid connector 92 is fluidly connected to the first cleaning fluid connector 52, the cleaning fluid tank 43 of the cleaning module 30 is fluidly coupled with the source of cleaning fluid 100 and can be filled with cleaning fluid by the source of cleaning fluid 100.

**[0170]** The displacement module 80 further comprises a second waste fluid connector 93. The second waste fluid connector 93 is fluidly coupled to a disposer of used cleaning fluid 101, which will be described more in detail below. The second waste fluid connector 93 is located in the internal housing 90.

**[0171]** The second waste fluid connector 93 is configured to fluidly connect automatically to the first waste fluid connector 53 when the cleaning module 30 engages the displacement module 80. When the second waste fluid connector 93 is fluidly connected with the first waste fluid connector 53, the waste fluid tank 49 of the cleaning module 30 is fluidly coupled with the disposer of used cleaning fluid 101 and can be emptied into the disposer of used cleaning fluid 101.

**[0172]** The source of cleaning fluid 100 may be a reservoir of cleaning fluid. The source of cleaning fluid 100 may for example be located on the roof of the building B, as shown in figure 16. The source of cleaning fluid 100 may be fluidly connected to the second cleaning fluid connector 92 through a flexible hose 100a. The flexible hose 100a may be housed in the main cavity 64 of the vertical track 60. Suitable pumps may be provided for pumping cleaning fluid from the source of cleaning fluid 100 towards the second cleaning fluid connector 92.

**[0173]** The disposer of used cleaning fluid 101 may be a reservoir of used cleaning fluid. The disposer of used cleaning fluid 101 may for example be located on the roof of the building B, as shown in figure 16. The disposer of used cleaning fluid 101 may be fluidly connected to the second waste fluid connector 93 through a flexible hose 101a. The flexible hose 101a may be housed in the main cavity 64 of the vertical track 60. Suitable pumps may be provided for pumping used cleaning fluid from the second waste fluid connector 93 towards the disposer of used cleaning fluid 101.

**[0174]** The cleaning system 1 may further comprise a purifier 102, for example a water purifier, configured to recycle the cleaning fluid. The purifier 102 is fluidly coupled with the disposer of used cleaning fluid 101 for receiving used cleaning fluid to purify and fluidly coupled with the source of cleaning fluid 100 for delivering the purified cleaning fluid to the latter. In the example of figure 16 the purifier 102 is located on the roof of the building B.

**[0175]** In other embodiments according to the subject-matter described herein, the source of cleaning fluid 100, the disposer of used cleaning fluid 101 and the purifier 102 may be located in any suitable position in or next to the building B.

**[0176]** The displacement module 80 further comprises a power supply 94. The power supply 94 may for example be an alternator which can receive an alternated current from a power source 103 and converted it to a direct current. The alternated current can be for example at 120 V and 60 Hz or any other standard grid alternated current. The direct current can be for example 24 V or any other suitable direct current.

**[0177]** A power cable 95 connects the power supply 94 to the cleaning module 30 to supply electricity to all of its electric utilities. The power cable 95 electrically connects to the power connector 54 of the cleaning module 30. The displacement module 80 comprises a power cable winch 96 for winding the power cable 95 in order to allow its extension and retraction while the cleaning module 30 is moving over a horizontal track 10. The portion of the power cable 95 between the cleaning module 30 and the displacement module 80 is preferably housed in the first cavity 16 for protection.

**[0178]** The power source 103 may be located on the roof of the building B, as shown in figure 16, and be connected to the displacement module 80 through a flexible power cable 99. The flexible power cable 99 may be housed in the main cavity 64 of the vertical track

60. Alternatively, the power source 103 may be located in any suitable position in or next to the building B.

**[0179]** The displacement module 80 further comprises a recovery winch 97 for pulling the cleaning module 30 towards the displacement module 80. The recovery winch 97 is preferably powered by the power supply 94. The recovery winch 97 may be activated for example if the cleaning module 30 gets stuck or the drivers for driving the cleaning module 30 along the horizontal tracks 10 malfunction. The recovery winch 97 acts on a recovery cable 98 which extends from the recovery winch 97 to the cleaning module 30. The recovery cable 98 is left unwinding from the recovery winch 97 as the cleaning module 30 moves further from the displacement module 80 along one of the horizontal tracks 10. Analogously, the recovery cable 98 is wound on the recovery winch 97 as the cleaning module 30 moves closer to the displacement module 80 along one of the horizontal tracks 10.

**[0180]** The displacement module 80 further comprises a display 105 located at a visible surface of the displacement module 80, opposite to the vertical track 60, so that it can be seen from outside the building B by looking towards the external surface S. The display 105 may be a LED display. Alternatively, the display 105 may be an LCD display. The display 105 may be used for displaying information such as advertising messages or images or a combination thereof. The display 105 may also be used for displaying data concerning the operation of the cleaning system 1.

**[0181]** In a first embodiment of the cleaning system 1, illustrated in figure 1, the displacement module 80 is driven along the vertical track 60 by a main winch 110. The main winch 110 drives the displacement module 80 through a main winch cable (not shown) extending from the main winch 110 to the displacement module 80. The main winch 110 is configured to vertically displace upwardly and downwardly the displacement module 80 and the cleaning module 30 engaged with the displacement module 80. A counterweight (not shown) is positioned within the recess R and connected to the main winch 110 in order to at least partially counterbalance the weight of the displacement module 80 and the cleaning module 30, in an elevator-like configuration. The counterweight may be guided by the vertical track 60 and in particular by the auxiliary vertical guides 69 described above. The counterweight is housed in the main cavity 64 of the vertical track 60.

**[0182]** In a second embodiment of the cleaning module 1, illustrated in figures from 17 to 20, a main winch 110 is not provided. Furthermore, the vertical track 60 may not be provided with the main wall 63 described above.

**[0183]** In the second embodiment, the vertical track 60 further comprises a plurality of anchoring portions 70 vertically spaced from one another. Each anchoring portion 70 is shaped as a protrusion. The vertical track 60 comprises two columns of anchoring portions 70 vertically spaced from one another.

**[0184]** The two columns of anchoring portions 70 are configured to be mounted in the recess R so as to face each other from opposite sides of the recess R. The respective protrusions of the two columns of anchoring portions 70 project towards each other.

**[0185]** Each column of anchoring portions 70 is supported by a vertical frame 71 which can be attached to a wall of the recess R. The anchoring portions 70 are configured to be positioned in the recess R between the main vertical guides 61 and the back wall B1 of the recess R.

**[0186]** In the second embodiment, the displacement module 80 is driven along the vertical track 60 by a jacking apparatus 120 mounted on the displacement module 80.

**[0187]** The jacking apparatus 120 comprises a primary actuator assembly 121. The primary actuator assembly 121 comprises a plurality of actuator arms 122. The plurality of actuator arms 122 comprise lower actuator arms 122a, extending from the displacement module 80 downwards, and upper actuator arms 122b, extending from the displacement module 80 upwards. In particular, there are two lower actuator arms 122a and two upper actuator arms 122b.

**[0188]** Each actuator arm 122 extends from a first end 123 to a second end 124. The first end 123 is connected to the displacement module 80, for example to a guiding portion 82 to the displacement module 80. Each actuator arm 122 has a linear actuator 125 configured to modify the distance between the first end 123 and the second end 124, by modifying the length of the actuator arm 122 itself.

**[0189]** The jacking apparatus 120 further comprises a plurality of gripping portions 126. Each gripping portion 126 is located at the second end 124 of a respective actuator arm 122. The primary actuator assembly 121 moves the gripping portions 126 towards and away from the displacement module 80.

**[0190]** Each gripping portion 126 is configured to hook a respective anchoring portions 70. Each gripping portion 126 has a concave profile substantially counter shaped to the protrusion shape of the respective anchoring portions 70, in order to engage it.

**[0191]** Each gripping portion 126 is rotatable about a gripping axis of rotation G, shown in figure 19. The gripping axis of rotation G is operatively orthogonal to the external surface S. Each gripping portion 126 between a first position and a second position. In the first position, shown in figures 19 and 20, the gripping portion 126 is configured to engage a respective anchoring portions 70. The plurality of gripping portions 126 in the first position are configured to hold the displacement module 80, and the cleaning module 30 engaged with the displacement module 80, to the anchoring portions 70.

**[0192]** In the second position, not illustrated in the attached figure, the gripping portion 126 is rotated with respect to the first position, for example by 90°, in order to disengage from the anchoring portions 70.

**[0193]** A lower linking arm 128 extends between the

lower actuator arms 122a, linking the lower actuator arms 122a to each other. The lower linking arm 128 is hinged at its ends to the second ends 124 of the lower actuator arms 122a.

**[0194]** An upper linking arm 129 extends between the upper actuator arms 122b, linking the upper actuator arms 122b to each other. The upper linking arm 129 is hinged at its ends to the second ends 124 of the upper actuator arms 122b.

**[0195]** The jacking apparatus 120 further comprise a secondary actuator assembly 127 configured to rotate the gripping portions 126 from the first position to the second position.

**[0196]** The secondary actuator assembly 127 comprises electric actuators 130 mounted on the lower linking arm 128 and on the upper linking arm 129 and connected to the gripping portions 126 for rotating the gripping portions 126 from the first position to the second position.

**[0197]** When the gripping portions 126 are in the first position, the displacement module 80 may be moved upwardly along the vertical track 60 by extending the length of the lower actuator arms 122a and shortening the length of the upper actuator arms 122b. Analogously, the displacement module 80 may be moved downwardly along the vertical track 60 by extending the length of the lower actuator arms 122a and shortening the length of the upper actuator arms 122b.

**[0198]** In the second position, a gripping portion 126 may be moved from an anchoring portion 70 to another anchoring portion 70 by modifying the length of the respective actuator arm 122. For example, during upward motion of the displacement module, after extending the lower actuator arms 122a and shortening the upper actuator arms 122b, the gripping portions 126 of the upper actuator arms 122b may be moved to the second position, the upper actuator arms 122b may be extended until their gripping portions 126 reaches the next anchoring portions 70, and their gripping portions 126 may be moved to the first position in order to engage the new anchoring portions 70. Subsequently, the gripping portions 126 of the lower actuator arms 122a may be moved to the second position, the lower actuator arms 122a may be shortened until their gripping portions 126 reaches the next anchoring portions 70, and their gripping portions 126 may be moved to the first position in order to engage the new anchoring portions 70.

**[0199]** In this way, the displacement module 80, and the cleaning module 30 attached to the displacement module 80 can be moved upwards and downwards along the vertical track 60 by the "slog-like" motion of the jacking apparatus 120.

**[0200]** Figure 21 shows a first operative condition of the cleaning system 1, in which the cleaning module 30 engages a first horizontal track 24 of the plurality of horizontal tracks 10 and is disengaged from the displacement module 80.

**[0201]** In the first operative condition, the displacement module 80 is kept stationary on the vertical track 60 at the

height of the first horizontal track 24. The cleaning module 30 moves on the first horizontal track 24, away from the displacement module 80 or towards displacement module 80. The power cable 95 extends in the first cavity 16 for powering the cleaning module 30. The power cable winch 96 winds or unwinds the power cable 95 for following the motion of the cleaning module 30 respectively towards or away from the displacement module 80. The recovery cable 98 extends in the second cavity 19. The recovery winch 97 winds or unwinds the recovery cable 98 for following the motion of the cleaning module 30 respectively towards or away from the displacement module 80. The first cleaning fluid connector 52 is disengaged and fluidly decoupled from the second cleaning fluid connector 92. The first waste fluid connector 53 is disengaged and fluidly decoupled from the second waste fluid connector 93.

**[0202]** In the first operative condition, the delivery nozzles 42 may be activated for receiving cleaning fluid from the cleaning fluid tank 43 and delivering it towards the external surface S. The rub 45 may be activated for rubbing the external surface S. The suction heads 46 may be activated for sucking used cleaning fluid from the external surface S and deliver it the waste fluid tank 49. The adjustable frame 39 may be positioned for keeping the rub 45 and the suction heads 46 in contact with the external surface S.

**[0203]** Figure 22 shows a second operative condition of the cleaning system 1, in which the cleaning module 30 is engaged the displacement module 80 and is disengaged from the horizontal tracks 10.

**[0204]** In the second operative condition, the cleaning module 30 is engaged with the displacement track 85. The cleaning module 30 is housed in the internal housing 90. The cleaning module 30 does not project from the displacement module 80 in a direction parallel to the external surface S. The displacement module 80 may move along the vertical track 60 away from the first horizontal track 24 and towards a second horizontal track 26 for transferring the cleaning module 30 from the first horizontal track 24 to the second horizontal track 26.

**[0205]** In the second operative condition, the first cleaning fluid connector 52 is engaged and fluidly coupled with the second cleaning fluid connector 92. The cleaning fluid tank 43 may receive cleaning fluid from the source of cleaning fluid 100 through the first cleaning fluid connector 52 and the second cleaning fluid connector 92. The first waste fluid connector 53 is engaged and fluidly coupled from the second waste fluid connector 93. The waste fluid tank 49 may send used cleaning fluid to the disposer of used cleaning fluid 101 through the first waste fluid connector 53 and the second waste fluid connector 93.

**[0206]** Fig. 23 shows a third operative condition in which the cleaning system 1 is transitioning from the first operative condition to the second operative condition. In the third operative condition, the displacement track 85 is aligned with the first horizontal track 24, the second end

87 of the displacement track 85 being positioned contiguous with the first end 11 of the first horizontal track 24. The cleaning module 30 is moving towards the displacement module 80, transitioning from being engaged with the first horizontal track 24 to the being engaged with the displacement track 85 and entering the internal housing 90 through the access opening 91. The adjustable frame 39 may be moved away from the external surface S in order to separate the rub 45 and the suction heads 46 from the external surface S.

**[0207]** At the end of the transition, the first cleaning fluid connector 52 automatically engages and fluidly couples with the second cleaning fluid connector 92. Also, the first waste fluid connector 53 automatically engages and fluidly couples with the second waste fluid connector 93.

### Claims

1. Cleaning system (1) for an external surface of a building, comprising:

- a cleaning module (30) comprising: at least one delivery nozzle (42) configured to deliver cleaning fluid on an external surface (S) of a building (B), and a cleaning fluid tank (43) fluidly coupled with the at least one delivery nozzle (42) for supplying the at least one delivery nozzle (42) with cleaning fluid;
- a vertical track (60) configured to be attached to the external surface (S) of the building (B) so as to extend in a substantially vertical direction;

**characterized in that** the cleaning system further comprises:

- a plurality of horizontal tracks (10) configured to be attached to the external surface (S) of the building (B) so as to extend in a substantially horizontal direction and to be vertically spaced from one another, the cleaning module (30) being movable along each horizontal track (10) of said plurality of horizontal tracks (10);
  - a displacement module (80) fluidly coupled with a source of cleaning fluid (100);
- wherein in a first operative condition of the cleaning system (1), the cleaning module (30) is movable along a first horizontal track (10, 24) of the plurality of horizontal tracks (10) and the displacement module (80) is engaged with the vertical track (60); and
- wherein in a second operative condition of the cleaning system (1) the cleaning module (30) is engaged with the displacement module (80) and disengaged from the first horizontal track (10, 24), the source of cleaning fluid (100) is fluidly coupled with the cleaning fluid tank (43) for filling the cleaning fluid tank (43) with cleaning fluid,

the displacement module (80) is engaged with the vertical track (60) and movable along the vertical track (60) for displacing the cleaning module (30) toward a second horizontal track (10, 26) of said plurality of horizontal tracks (10).

2. Cleaning system (1) according to claim 1,

wherein the displacement module (80) comprises a displacement track (85); and wherein in the second operative condition the cleaning module (30) engages the displacement track (85).

3. Cleaning system (1) according to claim 2,

wherein each horizontal track (10) of the plurality of horizontal tracks (10) extends from a respective first end (11) to a respective second end (12); wherein the displacement track (85) extends from a respective first end (86) to a respective second end (87); and wherein the second end (87) of the displacement track (85) is positionable contiguous with the first end (86) of the first horizontal track (10, 24) and the second end (87) of the displacement track (85) is positionable contiguous with the first end (11) of the second horizontal track (10, 26).

4. Cleaning system (1) according to any of the previous claims, wherein in the second operative condition, the cleaning module (30) is contained within the horizontal and vertical extents of the displacement module (80).

5. Cleaning system (1) according to claim 3 or claim 4, when dependent on claim 2, wherein the displacement module (80) has a displacement frame (81) provided with an internal housing (90) for the cleaning module (30) and an access opening (91) for accessing the internal housing (90),

wherein in the second operative condition the cleaning module (30) is housed in said internal housing (90), and wherein the displacement track (85) extends within the internal housing (90).

6. Cleaning system (1) according to any previous claim,

wherein the cleaning module (30) further comprises a first cleaning fluid connector (52) fluidly coupled with the cleaning fluid tank (43) and the displacement module (80) further comprises a second cleaning fluid connector (92) fluidly coupled with the source of cleaning fluid (100), wherein the first cleaning fluid connector (52) is

configured to engage the second cleaning fluid connector (92) and to fluidly connect to the second cleaning fluid connector (92) when the cleaning module (30) engages the displacement module (80), and

wherein in the first operative condition the first cleaning fluid connector (52) is disengaged from the second cleaning fluid connector (92) and in the second operative condition the first cleaning fluid connector (52) is fluidly connected to the second cleaning fluid connector (92).

**7.** Cleaning system (1) according to any of the previous claims

wherein the cleaning module (30) further comprises: at least one suction head (46) configured to draw used cleaning fluid from the external surface (S) of the building (B), and a waste fluid tank (49) fluidly coupled with the at least one suction head (46) for receiving used cleaning fluid from the at least one suction head (46); wherein the displacement module (80) is fluidly coupled with a disposer of used cleaning fluid (101); and

wherein in the second operative condition the disposer of used cleaning fluid (101) is fluidly coupled with the waste fluid tank (49) for receiving used cleaning fluid from the waste fluid tank (49).

**8.** Cleaning system (1) according to claim 7,

wherein the cleaning module (30) further comprises a first waste fluid connector (53) fluidly coupled with the waste fluid tank (49) and the displacement module (80) further comprises a second waste fluid connector (93) fluidly coupled with the disposer of used cleaning fluid (101),

wherein the first waste fluid connector (53) is configured to engage the second waste fluid connector (93) and to fluidly connect to the second waste fluid connector (93) when the cleaning module (30) engages the displacement module (80), and

wherein in the first operative condition the first waste fluid connector (53) is disengaged from the second waste fluid connector (93) and in the second operative condition the first waste fluid connector (53) is fluidly coupled to the second waste fluid connector (93).

**9.** Cleaning system (1) according to any of the claims from 6 to 8, wherein the at least one suction head (46) comprises a wiper (47) having a wiper surface (47a) configured to gather used cleaning fluid on the external surface (S) of the building (B), the wiper (47)

being provided with a plurality of suction openings (48) fluidly coupled with a vacuum pump (51) for sucking the gathered used cleaning fluid.

**10.** Cleaning system (1) according to any of the previous claims, wherein the displacement module (80) comprises a power supply (94), an extendable power cable (95) extending from the power supply (94) to the cleaning module (30) for powering the cleaning module (30), wherein each horizontal track (10) of the plurality of horizontal tracks (10) comprises a first cavity (16), and wherein in the first operative condition a length of the extendable power cable (95) extending between the displacement module (80) and the cleaning module (30) is housed in the first cavity (16) of the first horizontal track (10, 24).

**11.** Cleaning system (1) according to any of the previous claims, wherein the displacement module (80) comprises a recovery winch (97), an extendable recovery cable (98) extending from the recovery winch (97) to the cleaning module (30), the recovery winch (97) being configured for displacing the cleaning module (30) along the respective horizontal track (10) of the plurality of horizontal tracks (10) towards the displacement module (80), wherein each horizontal track (10) comprises a second cavity (19), and wherein in the first operative condition a length of the extendable recovery cable (98) extending between the displacement module (80) and the cleaning module (30) is housed in the second cavity (19) of the first horizontal track (10, 24).

**12.** Cleaning system (1) according to any of claims 1 to 10, wherein the cleaning module (30) comprises a plurality of engagement portions (31), wherein each horizontal track (10) of the plurality of horizontal tracks (10) comprises a first cavity (16) and a second cavity (19) and wherein in the first operative condition at least one from the first cavity (16) and the second cavity (19) at least partially houses one engagement portion (31) of said plurality of engagement portions (31).

**13.** Cleaning system (1) according to claim 12, wherein the cleaning module (30) comprises a main frame (30a) supporting said engagement portions (31) and an adjustable frame (39) on which the at least one delivery nozzle (42) is mounted, the adjustable frame (39) being movable with respect to the main frame (30a) in a direction orthogonal to a vertical direction and to an horizontal direction.

**14.** Cleaning system (1) according to any of the previous claims, wherein the vertical track (60) comprises a plurality of anchoring portions (70) vertically spaced from one another, wherein the cleaning system (1) comprises a jacking apparatus (120) mounted on the

displacement module (80), the jacking apparatus (120) comprising a plurality of gripping portions (126) configured to reversibly engage respective anchoring portions (70) and a primary actuator assembly (121) configured to move the gripping portions (126) towards and away from the displacement module (80), and wherein in the second operative condition the jacking apparatus (120) displaces the displacement module (80) and the cleaning module (30) along the vertical track (60) and in the first operative condition the jacking apparatus (120) holds the displacement module (80) on the vertical track (60).

15. Cleaning system (1) according to any of the previous claims from 1 to 13, comprising a main winch (110) configured to be attached to the building (B), the main winch (110) having a main winch cable connected to the displacement module (80), wherein in the second operative condition the main winch (110) displaces the displacement module (80) and the cleaning module (30) along the vertical track (60) and in the first operative condition the main winch (110) holds the displacement module (80) on the vertical track (60).

#### Patentansprüche

1. Reinigungssystem (1) für eine Außenfläche eines Gebäudes, umfassend:

- ein Reinigungsmodul (30), umfassend: mindestens eine Abgabedüse (42), die so konfiguriert ist, dass sie Reinigungsflüssigkeit auf eine Außenfläche (S) eines Gebäudes (B) abgibt, und einen Reinigungsflüssigkeitstank (43), der mit der mindestens einen Abgabedüse (42) strömungstechnisch gekoppelt ist, um die mindestens eine Abgabedüse (42) mit Reinigungsflüssigkeit zu versorgen;
- eine vertikale Schiene (60), die so konfiguriert ist, dass sie an der Außenfläche (S) des Gebäudes (B) so angebracht werden kann, dass sie sich in einer im Wesentlichen vertikalen Richtung erstreckt;

**dadurch gekennzeichnet, dass** das Reinigungssystem ferner Folgendes umfasst:

- eine Vielzahl von horizontalen Schienen (10), die so konfiguriert sind, dass sie an der Außenfläche (S) des Gebäudes (B) so angebracht werden können, dass sie sich in einer im Wesentlichen horizontalen Richtung erstrecken und vertikal voneinander beabstandet sind, wobei das Reinigungsmodul (30) entlang jeder horizontalen Schiene (10) der Vielzahl von ho-

izontalen Schienen (10) bewegbar ist;  
- ein Verschiebemodul (80), das mit einer Reinigungsflüssigkeitsquelle (100) strömungstechnisch gekoppelt ist;

wobei in einem ersten Betriebszustand des Reinigungssystems (1) das Reinigungsmodul (30) entlang einer ersten horizontalen Schiene (10, 24) der Vielzahl von horizontalen Schienen (10) bewegbar ist und das Verschiebemodul (80) mit der vertikalen Schiene (60) in Eingriff steht; und wobei in einem zweiten Betriebszustand des Reinigungssystems (1) das Reinigungsmodul (30) mit dem Verschiebemodul (80) in Eingriff steht und von der ersten horizontalen Schiene (10, 24) außer Eingriff steht, die Reinigungsflüssigkeitsquelle (100) mit dem Reinigungsflüssigkeitstank (43) strömungstechnisch gekoppelt ist, um den Reinigungsflüssigkeitstank (43) mit Reinigungsflüssigkeit zu füllen, das Verschiebemodul (80) mit der vertikalen Schiene (60) in Eingriff steht und entlang der vertikalen Schiene (60) bewegbar ist, um das Reinigungsmodul (30) in Richtung einer zweiten horizontalen Schiene (10, 26) der Vielzahl von horizontalen Schienen (10) zu verschieben.

2. Reinigungssystem (1) nach Anspruch 1,

wobei das Verschiebemodul (80) eine Verschiebeschiene (85) umfasst; und wobei im zweiten Betriebszustand das Reinigungsmodul (30) mit der Verschiebeschiene (85) in Eingriff steht.

3. Reinigungssystem (1) nach Anspruch 2,

wobei sich jede horizontale Schiene (10) der Vielzahl von horizontalen Schienen (10) von einem jeweiligen ersten Ende (11) zu einem jeweiligen zweiten Ende (12) erstreckt; wobei sich die Verschiebeschiene (85) von einem jeweiligen ersten Ende (86) zu einem jeweiligen zweiten Ende (87) erstreckt; und wobei das zweite Ende (87) der Verschiebeschiene (85) an das erste Ende (86) der ersten horizontalen Schiene (10, 24) angrenzend positionierbar ist und das zweite Ende (87) der Verschiebeschiene (85) an das erste Ende (11) der zweiten horizontalen Schiene (10, 26) angrenzend positionierbar ist.

4. Reinigungssystem (1) nach einem der vorstehenden Ansprüche, wobei im zweiten Betriebszustand das Reinigungsmodul (30) sich innerhalb der horizontalen und vertikalen Ausdehnung des Verschiebomoduls (80) befindet.

5. Reinigungssystem (1) nach Anspruch 3 oder An-

spruch 4, wenn abhängig von Anspruch 2, wobei das Verschiebemodul (80) einen Verschieberahmen (81) aufweist, der mit einem Innengehäuse (90) für das Reinigungsmodul (30) und einer Zugriffsöffnung (91) für den Zugriff in das Innengehäuse (90) versehen ist,

wobei im zweiten Betriebszustand das Reinigungsmodul (30) in dem Innengehäuse (90) untergebracht ist, und  
wobei sich die Verschiebeschiene (85) innerhalb des Innengehäuses (90) erstreckt.

**6.** Reinigungssystem (1) nach einem der vorstehenden Ansprüche,

wobei das Reinigungsmodul (30) ferner einen ersten Reinigungsflüssigkeitsanschluss (52) umfasst, der mit dem Reinigungsflüssigkeitstank (43) strömungstechnisch gekoppelt ist, und das Verschiebemodul (80) ferner einen zweiten Reinigungsflüssigkeitsanschluss (92) umfasst, der mit der Reinigungsflüssigkeitsquelle (100) strömungstechnisch gekoppelt ist, wobei der erste Reinigungsflüssigkeitanschluss (52) so konfiguriert ist, dass er mit dem zweiten Reinigungsflüssigkeitanschluss (92) in Eingriff steht und sich strömungstechnisch mit dem zweiten Reinigungsflüssigkeitanschluss (92) verbindet, wenn das Reinigungsmodul (30) mit dem Verschiebemodul (80) in Eingriff steht, und

wobei in dem ersten Betriebszustand der erste Reinigungsflüssigkeitanschluss (52) von dem zweiten Reinigungsflüssigkeitanschluss (92) außer Eingriff steht und in dem zweiten Betriebszustand der erste Reinigungsflüssigkeitanschluss (52) mit dem zweiten Reinigungsflüssigkeitanschluss (92) strömungstechnisch verbunden ist.

**7.** Reinigungssystem (1) nach einem der vorstehenden Ansprüche,

wobei das Reinigungsmodul (30) ferner Folgendes umfasst: mindestens einen Saugkopf (46), der so konfiguriert ist, dass er verbrauchte Reinigungsflüssigkeit von der Außenfläche (S) des Gebäudes (B) ansaugt, und einen Abfallflüssigkeitstank (49), der mit dem mindestens einen Saugkopf (46) strömungstechnisch gekoppelt ist, um verbrauchte Reinigungsflüssigkeit von dem mindestens einen Saugkopf (46) aufzunehmen;

wobei das Verschiebemodul (80) mit einem Entsorger für verbrauchte Reinigungsflüssigkeit (101) strömungstechnisch gekoppelt ist; und wobei im zweiten Betriebszustand der Entsor-

ger für verbrauchte Reinigungsflüssigkeit (101) mit dem Abfallflüssigkeitstank (49) strömungstechnisch gekoppelt ist, um verbrauchte Reinigungsflüssigkeit aus dem Abfallflüssigkeitstank (49) aufzunehmen.

**8.** Reinigungssystem (1) nach Anspruch 7,

wobei das Reinigungsmodul (30) ferner einen ersten Abfallflüssigkeitsanschluss (53) umfasst, der mit dem Abfallflüssigkeitstank (49) strömungstechnisch gekoppelt ist, und das Verschiebemodul (80) ferner einen zweiten Abfallflüssigkeitsanschluss (93) umfasst, der mit dem Entsorger für verbrauchte Reinigungsflüssigkeit (101) strömungstechnisch gekoppelt ist, wobei der erste Abfallflüssigkeitsanschluss (53) so konfiguriert ist, dass er mit dem zweiten Abfallflüssigkeitsanschluss (93) in Eingriff steht und sich strömungstechnisch mit dem zweiten Abfallflüssigkeitsanschluss (93) verbindet, wenn das Reinigungsmodul (30) mit dem Verschiebemodul (80) in Eingriff kommt, und wobei im ersten Betriebszustand der erste Abfallflüssigkeitsanschluss (53) vom zweiten Abfallflüssigkeitsanschluss (93) außer Eingriff steht und im zweiten Betriebszustand der erste Abfallflüssigkeitsanschluss (53) mit dem zweiten Abfallflüssigkeitsanschluss (93) strömungstechnisch gekoppelt ist.

**9.** Reinigungssystem (1) nach einem der Ansprüche 6 bis 8, wobei der mindestens eine Saugkopf (46) einen Wischer (47) mit einer Wischfläche (47a) umfasst, die so konfiguriert ist, dass sie verbrauchte Reinigungsflüssigkeit auf der Außenfläche (S) des Gebäudes (B) aufnimmt, wobei der Wischer (47) mit einer Vielzahl von Saugöffnungen (48) versehen ist, die mit einer Vakuumpumpe (51) zum Ansaugen der aufgenommenen verbrauchten Reinigungsflüssigkeit strömungstechnisch gekoppelt sind.

**10.** Reinigungssystem (1) nach einem der vorstehenden Ansprüche, wobei das Verschiebemodul (80) eine Stromversorgung (94) und ein verlängerbares Stromkabel (95) umfasst, das sich von der Stromversorgung (94) zum Reinigungsmodul (30) erstreckt, um das Reinigungsmodul (30) mit Strom zu versorgen, wobei jede horizontale Schiene (10) der Vielzahl von horizontalen Schienen (10) einen ersten Hohlraum (16) umfasst, und wobei im ersten Betriebszustand eine Länge des verlängerbaren Stromkabels (95), das sich zwischen dem Verschiebemodul (80) und dem Reinigungsmodul (30) erstreckt, in dem ersten Hohlraum (16) der ersten horizontalen Schiene (10, 24) untergebracht ist.

**11.** Reinigungssystem (1) nach einem der vorstehenden

Ansprüche, wobei das Verschiebemodul (80) eine Rückholwinde (97) umfasst, wobei sich ein verlängerbares Rückholseil (98) von der Rückholwinde (97) zu dem Reinigungsmodul (30) erstreckt, wobei die Rückholwinde (97) so konfiguriert ist, dass sie das Reinigungsmodul (30) entlang der jeweiligen horizontalen Schiene (10) der Vielzahl von horizontalen Schienen (10) zu dem Verschiebemodul (80) hin verschiebt, wobei jede horizontale Schiene (10) einen zweiten Hohlraum (19) umfasst, und wobei im ersten Betriebszustand eine Länge des verlängerbaren Rückholseils (98), das sich zwischen dem Verschiebemodul (80) und dem Reinigungsmodul (30) erstreckt, in dem zweiten Hohlraum (19) der ersten horizontalen Schiene (10, 24) untergebracht ist.

12. Reinigungssystem (1) nach einem der Ansprüche 1 bis 10, wobei das Reinigungsmodul (30) eine Vielzahl von Eingriffsabschnitten (31) umfasst, wobei jede horizontale Schiene (10) der Vielzahl von horizontalen Schienen (10) einen ersten Hohlraum (16) und einen zweiten Hohlraum (19) umfasst und wobei im ersten Betriebszustand mindestens einer von dem ersten Hohlraum (16) und dem zweiten Hohlraum (19) mindestens teilweise einen Eingriffsabschnitt (31) der Vielzahl von Eingriffsabschnitten (31) aufnimmt.

13. Reinigungssystem (1) nach Anspruch 12, wobei das Reinigungsmodul (30) einen Hauptrahmen (30a), der die Eingriffsabschnitte (31) trägt, und einen verstellbaren Rahmen (39) umfasst, an dem die mindestens eine Abgabedüse (42) angebracht ist, wobei der verstellbare Rahmen (39) in Bezug auf den Hauptrahmen (30a) in einer Richtung orthogonal zu einer vertikalen Richtung und zu einer horizontalen Richtung bewegbar ist.

14. Reinigungssystem (1) nach einem der vorstehenden Ansprüche, wobei die vertikale Schiene (60) eine Vielzahl von Verankerungsabschnitten (70) umfasst, die vertikal voneinander beabstandet sind, wobei das Reinigungssystem (1) eine Hebevorrichtung (120) umfasst, die an dem Verschiebemodul (80) angebracht ist, wobei die Hebevorrichtung (120) eine Vielzahl von Greifabschnitten (126) umfasst, die so konfiguriert sind, dass sie reversibel entsprechende Verankerungsabschnitte (70) in Eingriff nehmen, und eine primäre Betätigungsanordnung (121), die so konfiguriert ist, dass sie die Greifabschnitte (126) zu dem Verschiebemodul (80) hin und von diesem weg bewegt, und wobei im zweiten Betriebszustand die Hebevorrichtung (120) das Verschiebemodul (80) und das Reinigungsmodul (30) entlang der vertikalen Schiene (60) verschiebt und im ersten Betriebszustand die Hebevorrichtung (120) das Verschiebemodul (80) auf der vertikalen

Schiene (60) hält.

15. Reinigungssystem (1) nach einem der vorstehenden Ansprüche 1 bis 13, umfassend eine Hauptwinde (110), die zur Befestigung am Gebäude (B) konfiguriert ist, wobei die Hauptwinde (110) ein Hauptwindenseil aufweist, das mit dem Verschiebemodul (80) verbunden ist, wobei die Hauptwinde (110) im zweiten Betriebszustand das Verschiebemodul (80) und das Reinigungsmodul (30) entlang der vertikalen Schiene (60) verschiebt und im ersten Betriebszustand die Hauptwinde (110) das Verschiebemodul (80) auf der vertikalen Schiene (60) hält.

## Revendications

1. Système de nettoyage (1) d'une surface extérieure d'un bâtiment, comprenant :

- un module de nettoyage (30) comprenant : au moins une buse de distribution (42) configurée pour distribuer un liquide de nettoyage sur une surface extérieure (S) d'un bâtiment (B), et un réservoir (43) de liquide de nettoyage couplé de manière fluïdique à l'au moins une buse de distribution (42) pour alimenter l'au moins une buse de distribution (42) en liquide de nettoyage ;

- un rail vertical (60) configuré pour être fixé à la surface extérieure (S) du bâtiment (B) de manière à s'étendre dans une direction sensiblement verticale ;

**caractérisé en ce que** le système de nettoyage comprend en outre :

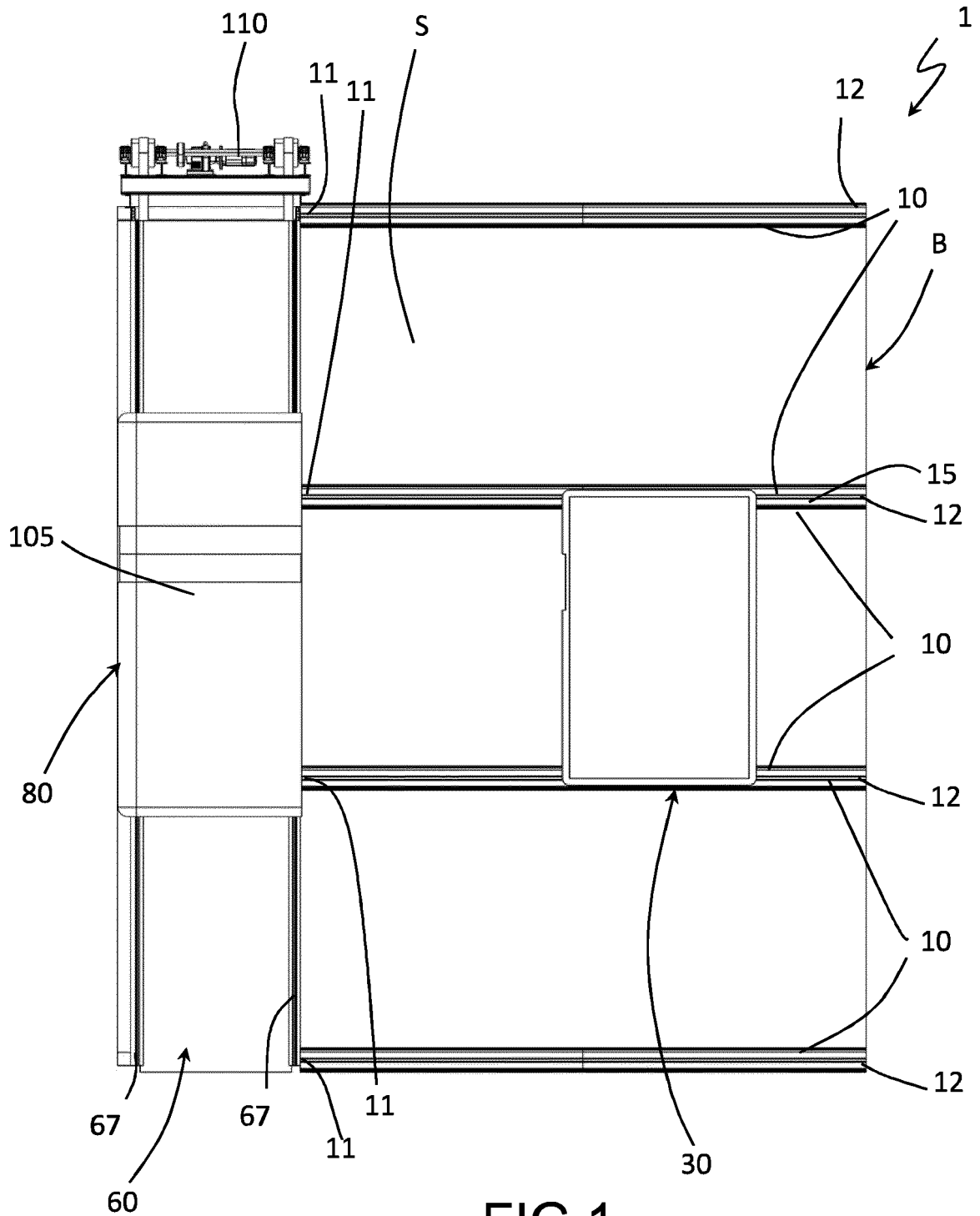
- une pluralité de rails horizontaux (10) configurés pour être fixés à la surface extérieure (S) du bâtiment (B) de manière à s'étendre dans une direction sensiblement horizontale et à être espacés verticalement les uns des autres, le module de nettoyage (30) étant mobile le long de chaque rail horizontal (10) de ladite pluralité de rails horizontaux (10) ;

- un module de déplacement (80) couplé de manière fluïdique à une source de liquide de nettoyage (100) ;

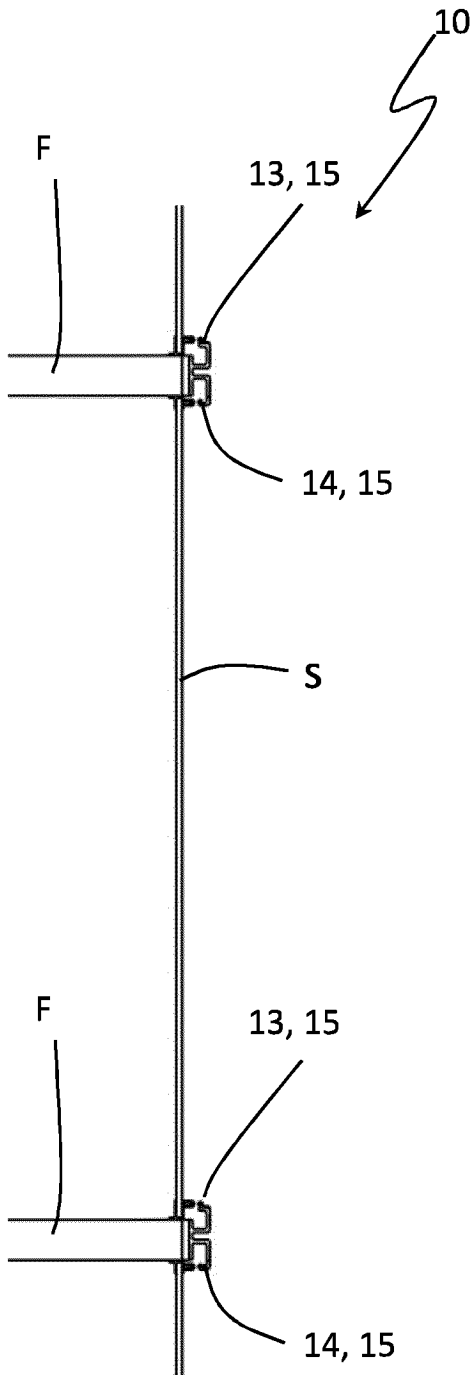
où, dans une première condition de fonctionnement du système de nettoyage (1), le module de nettoyage (30) est mobile le long d'un premier rail horizontal (10, 24) de la pluralité de rails horizontaux (10) et le module de déplacement (80) est mis en prise avec le rail vertical (60) ; et où, dans une seconde condition de fonctionnement du système de nettoyage (1), le module de nettoyage (30) est mis en prise avec le module de déplacement (80) et est désengagé du pre-

- mier rail horizontal (10, 24), la source de liquide de nettoyage (100) est couplée de manière fluïdique au réservoir (43) de liquide de nettoyage pour remplir le réservoir (43) de liquide de nettoyage avec du liquide de nettoyage, le module de déplacement (80) est mis en prise avec le rail vertical (60) et est mobile le long du rail vertical (60) pour déplacer le module de nettoyage (30) vers un second rail horizontal (10, 26) de ladite pluralité de rails horizontaux (10).
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2. Système de nettoyage (1) selon la revendication 1,
- le module de déplacement (80) comprenant un rail de déplacement (85) ; et
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- où, dans la seconde condition de fonctionnement, le module de nettoyage (30) se met en prise avec le rail de déplacement (85).
3. Système de nettoyage (1) selon la revendication 2,
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- chaque rail horizontal (10) de la pluralité de rails horizontaux (10) s'étendant d'une première extrémité (11) respective à une seconde extrémité (12) respective ;
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- le rail de déplacement (85) s'étendant d'une première extrémité (86) respective à une seconde extrémité (87) respective ; et
- la seconde extrémité (87) du rail de déplacement (85) peut être positionnée de façon contigüe à la première extrémité (86) du premier rail horizontal (10, 24) et la seconde extrémité (87) du rail de déplacement (85) peut être positionnée de façon contigüe à la première extrémité (11) du second rail horizontal (10, 26).
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4. Système de nettoyage (1) selon l'une quelconque des revendications précédentes, où, dans la seconde condition de fonctionnement, le module de nettoyage (30) est contenu dans les extensions horizontale et verticale du module de déplacement (80).
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5. Système de nettoyage (1) selon la revendication 3 ou la revendication 4, lorsqu'elle dépend de la revendication 2, le module de déplacement (80) comportant un cadre de déplacement (81) pourvu d'un logement interne (90) pour le module de nettoyage (30) et d'une ouverture d'accès (91) pour accéder au logement interne (90),
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- où, dans la seconde condition de fonctionnement, le module de nettoyage (30) est logé dans ledit boîtier interne (90), et
- la rail de déplacement (85) s'étendant à l'intérieur du logement interne (90).
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6. Système de nettoyage (1) selon l'une quelconque
- des revendications précédentes,
- le module de nettoyage (30) comprenant en outre un premier connecteur (52) de liquide de nettoyage couplé de manière fluïdique au réservoir (43) de liquide de nettoyage et le module de déplacement (80) comprenant en outre un second connecteur (92) de liquide de nettoyage couplé de manière fluïdique à la source de liquide de nettoyage (100),
- le premier connecteur (52) de liquide de nettoyage étant configuré pour se mettre en prise avec le second connecteur (92) de liquide de nettoyage et pour se mettre en communication fluïdique avec le second connecteur (92) de liquide de nettoyage lorsque le module de nettoyage (30) se met en prise avec le module de déplacement (80), et
- où, dans la première condition de fonctionnement, le premier connecteur (52) de liquide de nettoyage est désengagé du second connecteur (92) de liquide de nettoyage et, dans la seconde condition de fonctionnement, le premier connecteur (52) de liquide de nettoyage est en communication fluïdique avec le second connecteur (92) de liquide de nettoyage.
7. Système de nettoyage (1) selon l'une quelconque des revendications précédentes,
- le module de nettoyage (30) comprenant en outre : au moins une tête d'aspiration (46) configurée pour aspirer le liquide de nettoyage usagé de la surface extérieure (S) du bâtiment (B), et un réservoir (49) de fluïde résiduaire couplé de manière fluïdique à l'au moins une tête d'aspiration (46) pour recevoir le liquide de nettoyage usagé de l'au moins une tête d'aspiration (46) ; le module de déplacement (80) étant couplé de manière fluïdique à un éliminateur de liquide de nettoyage usagé (101) ; et
- où, dans la seconde condition de fonctionnement, l'éliminateur de liquide de nettoyage usagé (101) est couplé de manière fluïdique au réservoir (49) de fluïde résiduaire pour recevoir le liquide de nettoyage usagé du réservoir (49) de fluïde résiduaire.
8. Système de nettoyage (1) selon la revendication 7,
- le module de nettoyage (30) comprenant en outre un premier connecteur (53) de fluïde résiduaire couplé de manière fluïdique au réservoir (49) de fluïde résiduaire et le module de déplacement (80) comprenant en outre un second connecteur (93) de fluïde résiduaire couplé de manière fluïdique à l'éliminateur de liquide de nettoyage usagé (101),

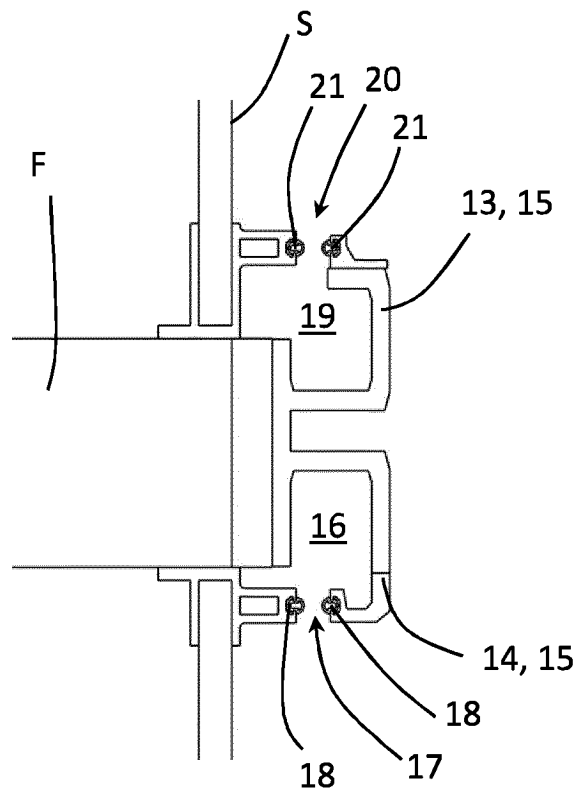
- le premier connecteur (53) de fluide résiduaire étant configuré pour se mettre en prise avec le second connecteur (93) de fluide résiduaire et pour être en communication fluïdique avec le second connecteur (93) de fluide résiduaire lorsque le module de nettoyage (30) se met en prise avec le module de déplacement (80), et où, dans la première condition de fonctionnement, le premier connecteur (53) de fluide résiduaire est désengagé du second connecteur (93) de fluide résiduaire et, dans la seconde condition de fonctionnement, le premier connecteur (53) de fluide résiduaire est couplé de manière fluïdique au second connecteur (93) de fluide résiduaire.
9. Système de nettoyage (1) selon l'une quelconque des revendications 6 à 8, l'au moins une tête d'aspiration (46) comprenant un racleur (47) ayant une surface de raclage (47a) configurée pour recueillir le liquide de nettoyage usagé sur la surface extérieure (S) du bâtiment (B), le racleur (47) étant pourvu d'une pluralité d'ouvertures d'aspiration (48) couplées de manière fluïdique à une pompe à vide (51) pour aspirer le liquide de nettoyage usagé recueilli.
10. Système de nettoyage (1) selon l'une quelconque des revendications précédentes, le module de déplacement (80) comprenant une alimentation électrique (94), un câble d'alimentation extensible (95) s'étendant de l'alimentation électrique (94) au module de nettoyage (30) pour alimenter le module de nettoyage (30), chaque rail horizontal (10) de la pluralité de rails horizontaux (10) comprenant une première cavité (16), et où, dans la première condition de fonctionnement, une longueur du câble d'alimentation extensible (95) s'étendant entre le module de déplacement (80) et le module de nettoyage (30) est logée dans la première cavité (16) du premier rail horizontal (10, 24).
11. Système de nettoyage (1) selon l'une quelconque des revendications précédentes, le module de déplacement (80) comprenant un treuil de récupération (97), un câble de récupération extensible (98) s'étendant du treuil de récupération (97) au module de nettoyage (30), le treuil de récupération (97) étant configuré pour déplacer le module de nettoyage (30) le long du rail horizontal (10) respectif de la pluralité de rails horizontaux (10) vers le module de déplacement (80), chaque rail horizontal (10) comprenant une seconde cavité (19), et où, dans la première condition de fonctionnement, une longueur du câble de récupération extensible (98) s'étendant entre le module de déplacement (80) et le module de nettoyage (30) est logée dans la seconde cavité (19) du premier rail horizontal (10, 24).
12. Système de nettoyage (1) selon l'une quelconque des revendications 1 à 10, le module de nettoyage (30) comprenant une pluralité de parties d'engagement (31), chaque rail horizontal (10) de la pluralité de rails horizontaux (10) comprenant une première cavité (16) et une seconde cavité (19) et où, dans la première condition de fonctionnement, au moins une parmi la première cavité (16) et la deuxième cavité (19) loge au moins partiellement une partie d'engagement (31) de ladite pluralité de parties d'engagement (31).
13. Système de nettoyage (1) selon la revendication 12, le module de nettoyage (30) comprenant un cadre principal (30a) supportant lesdites parties d'engagement (31) et un cadre réglable (39) sur lequel est montée l'au moins une buse de distribution (42), le cadre réglable (39) étant mobile par rapport au cadre principal (30a) dans une direction orthogonale à une direction verticale et à une direction horizontale.
14. Système de nettoyage (1) selon l'une quelconque des revendications précédentes, le rail vertical (60) comprenant une pluralité de parties d'ancrage (70) verticalement espacées les unes des autres, le système de nettoyage (1) comprenant un appareil de levage (120) monté sur le module de déplacement (80), l'appareil de levage (120) comprenant une pluralité de parties de préhension (126) configurées pour se mettre en prise, de manière réversible, avec les parties d'ancrage (70) respectives et un ensemble d'actionneur primaire (121) configuré pour déplacer les parties de préhension (126) vers le module de déplacement (80) et à distance de ce dernier, et où, dans la seconde condition de fonctionnement, l'appareil de levage (120) déplace le module de déplacement (80) et le module de nettoyage (30) le long du rail vertical (60) et, dans la première condition de fonctionnement, l'appareil de levage (120) maintient le module de déplacement (80) sur le rail vertical (60).
15. Système de nettoyage (1) selon l'une quelconque des revendications précédentes de 1 à 13, comprenant un treuil principal (110) configuré pour être fixé au bâtiment (B), le treuil principal (110) comportant un câble de treuil principal relié au module de déplacement (80), où, dans la seconde condition de fonctionnement, le treuil principal (110) déplace le module de déplacement (80) et le module de nettoyage (30) le long du rail vertical (60) et, dans la première condition de fonctionnement, le treuil principal (110) maintient le module de déplacement (80) sur le rail vertical (60).



**FIG 1**



**FIG 2**



**FIG 3**

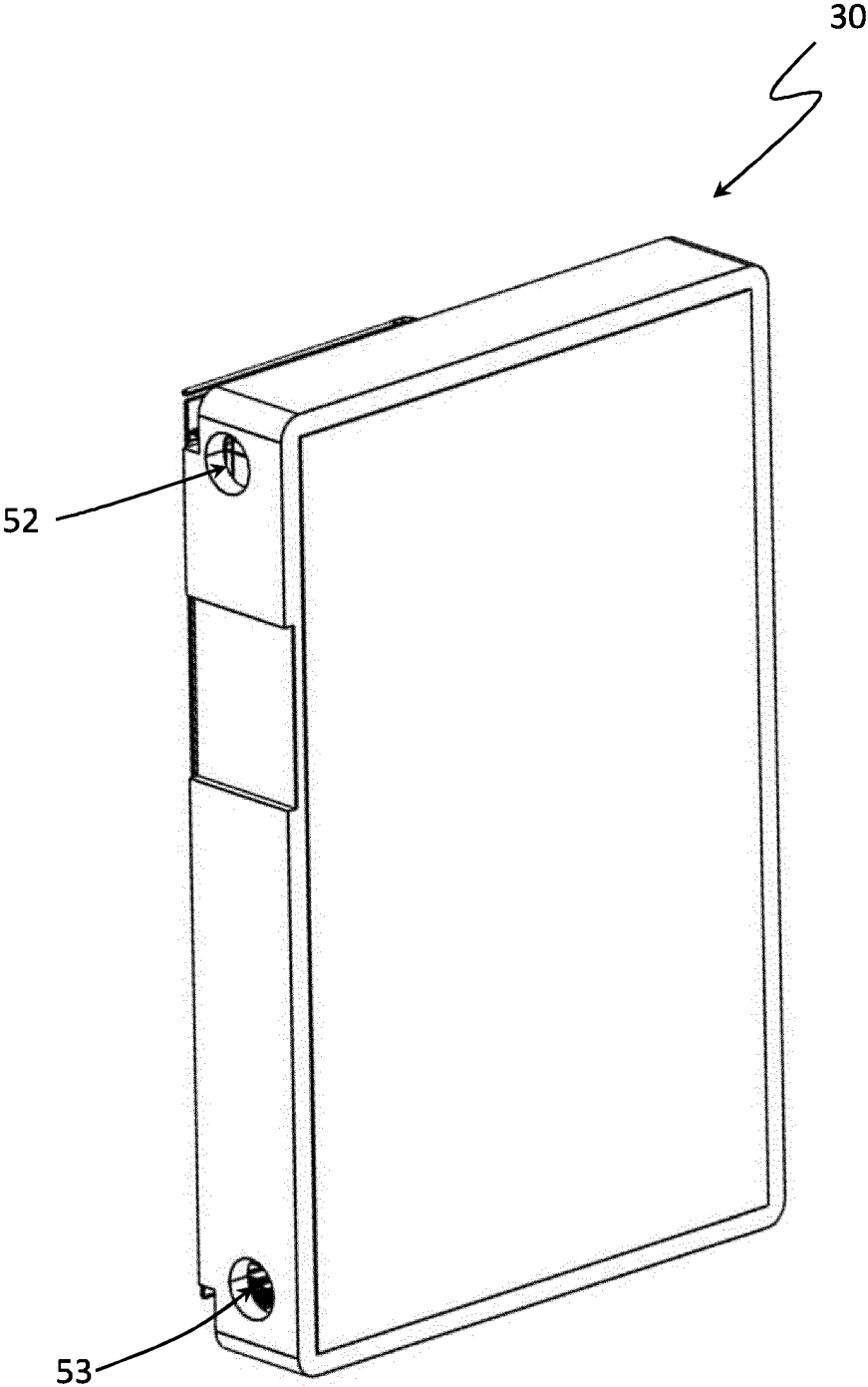
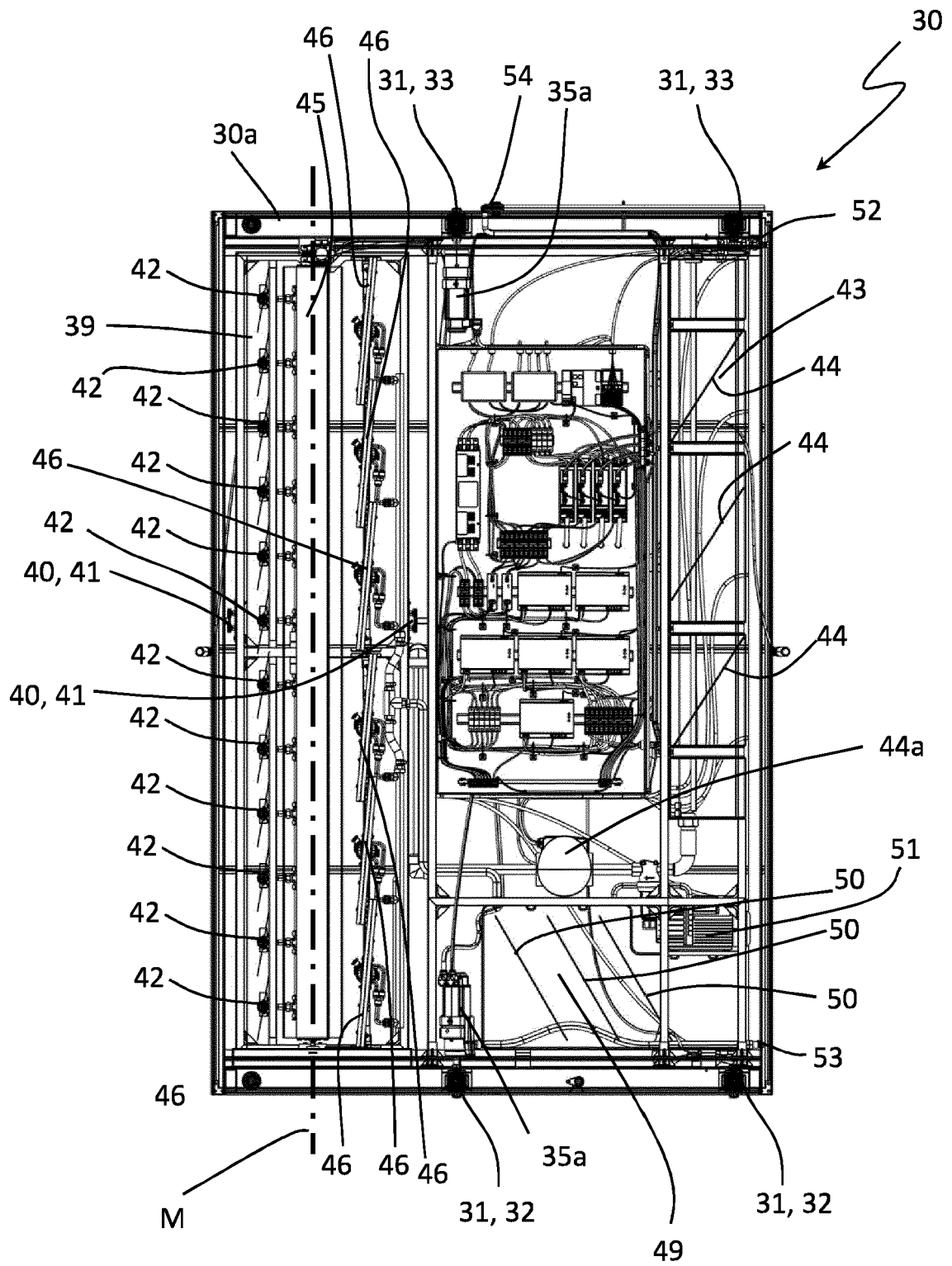
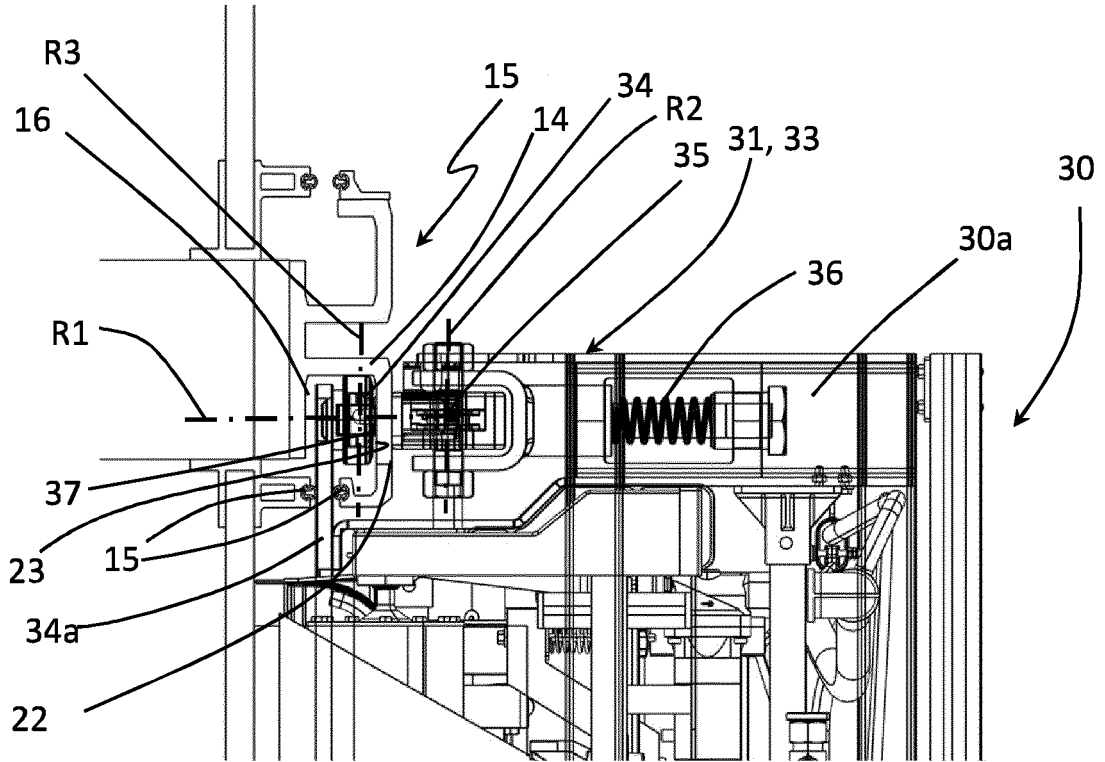


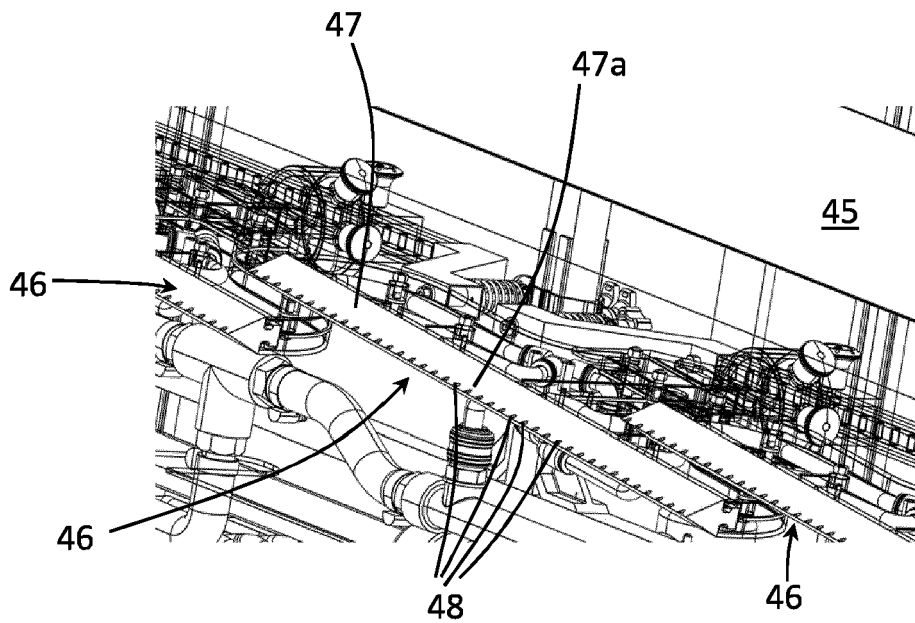
FIG 4



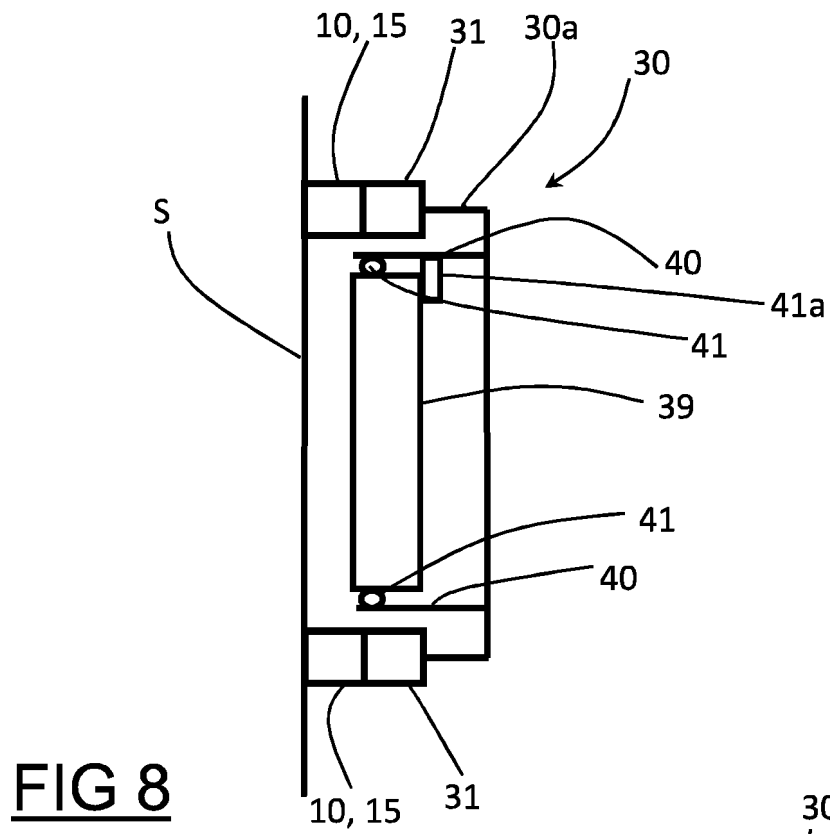
**FIG 5**



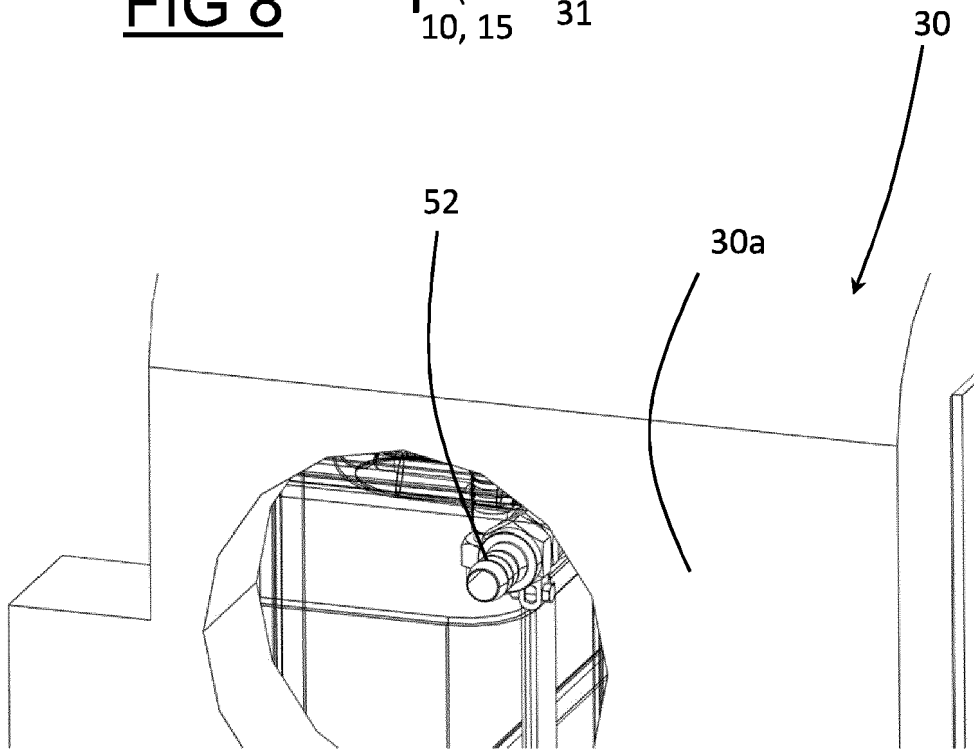
**FIG 6**



**FIG 7**



**FIG 8**



**FIG 9**



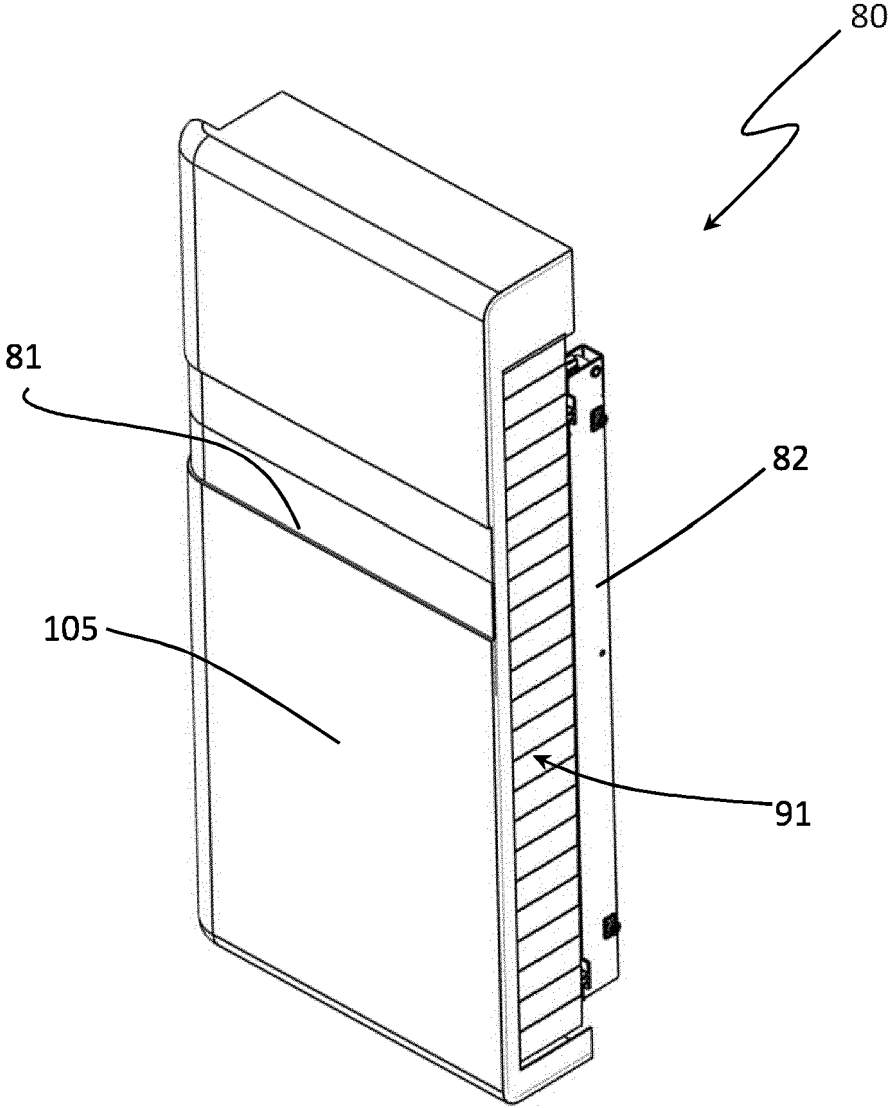
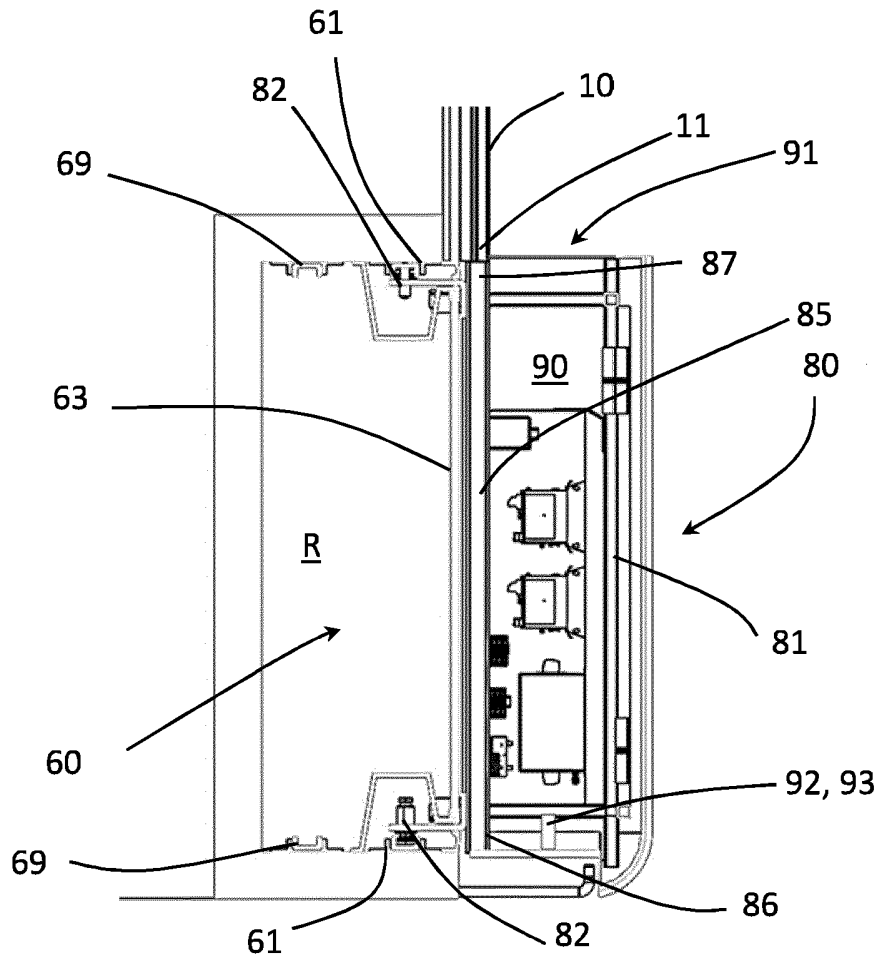
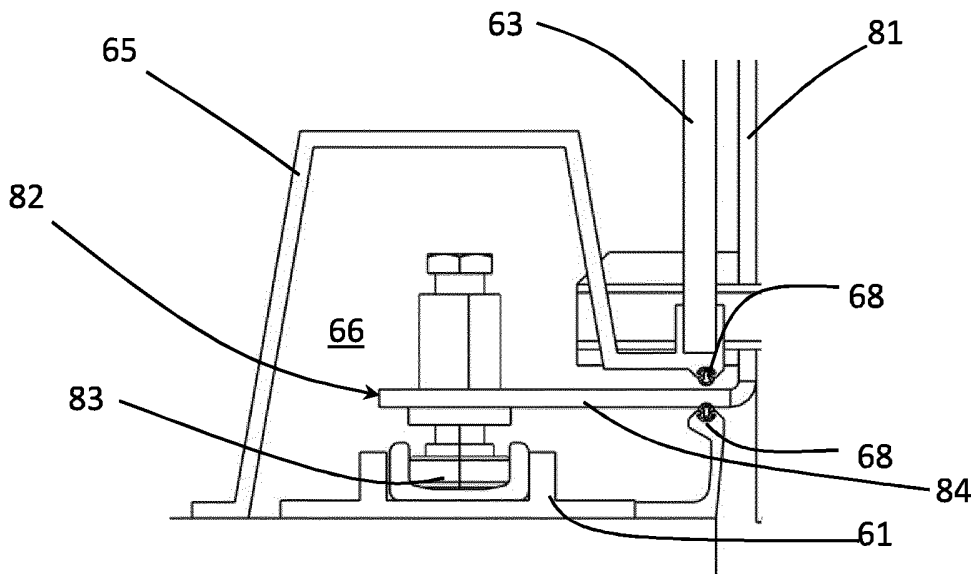


FIG 11



**FIG 12**



**FIG 13**

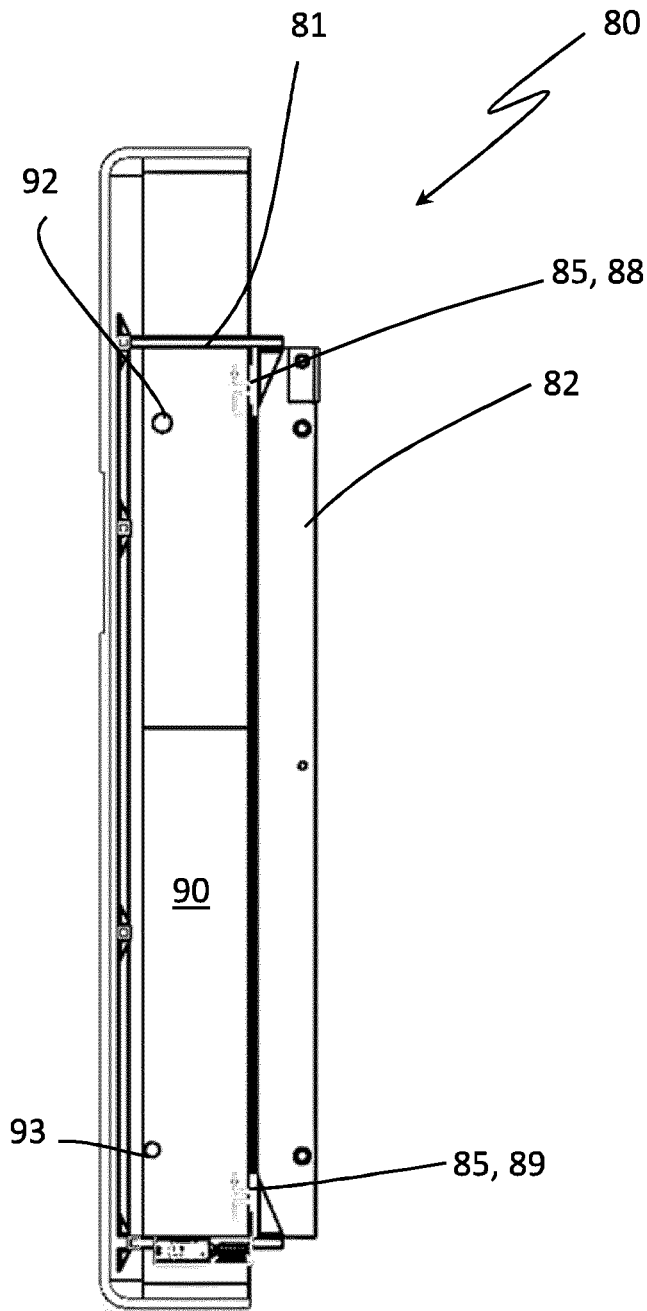


FIG 14

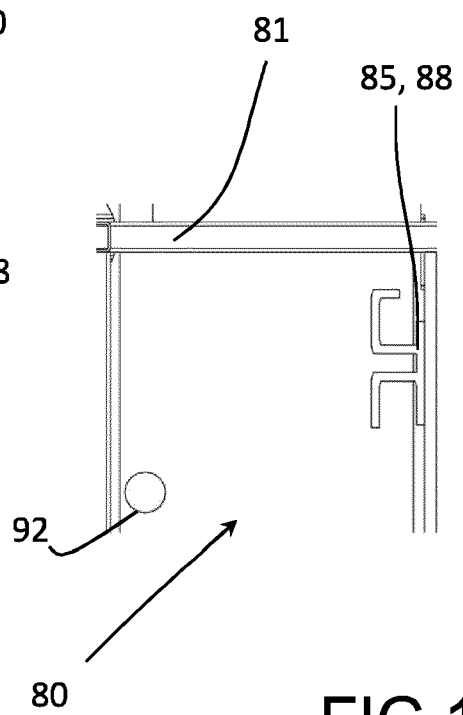


FIG 15

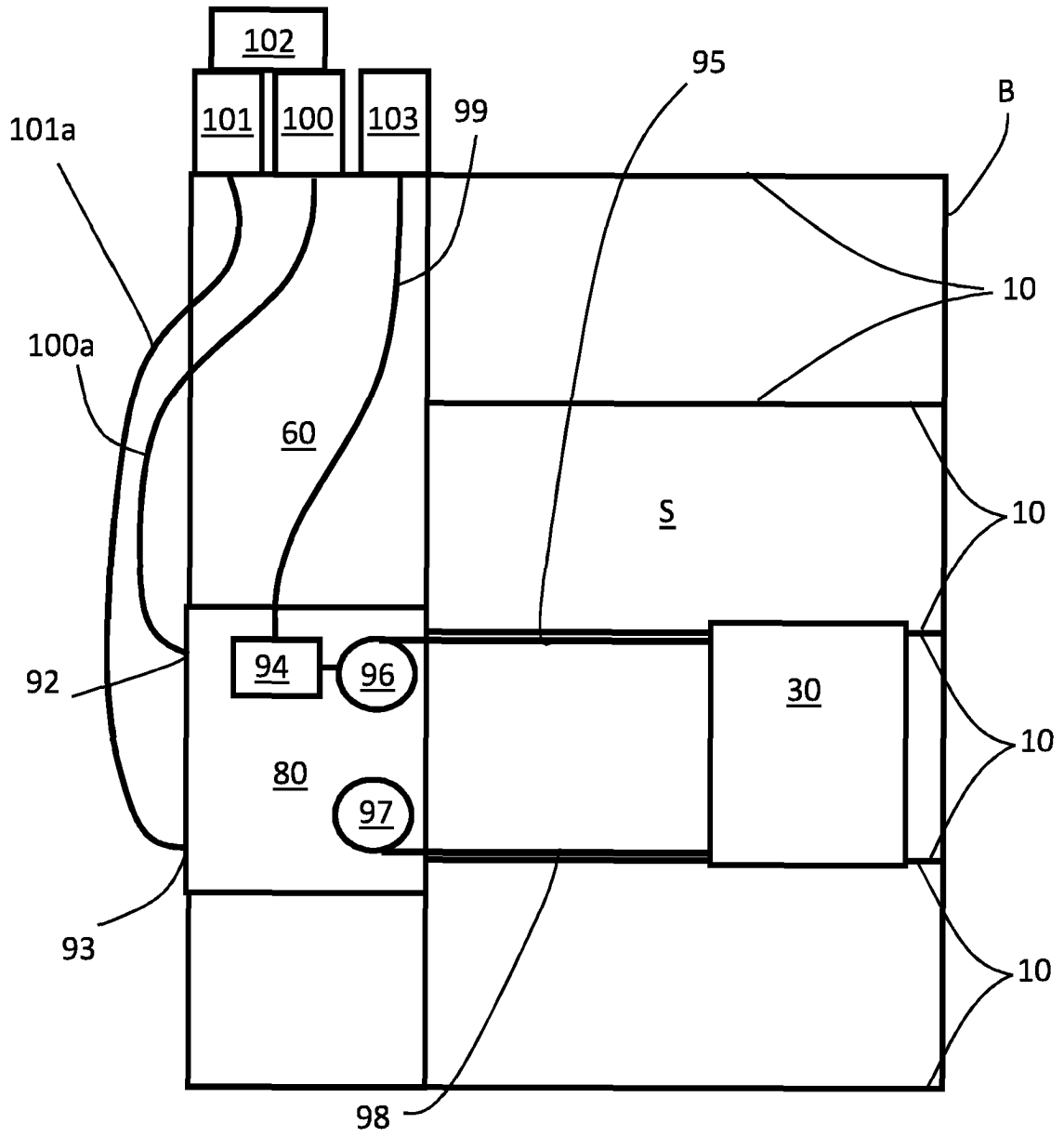
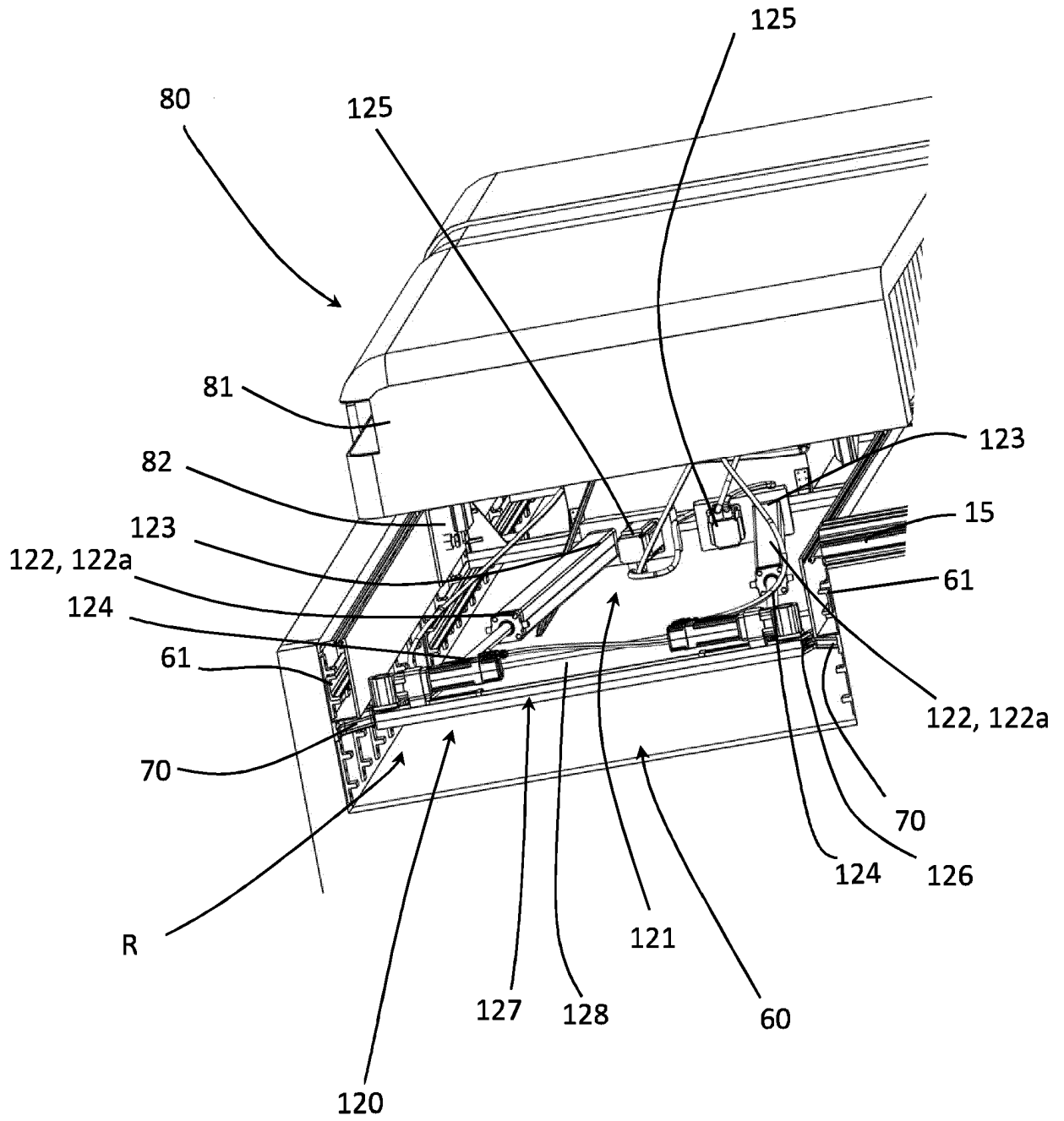
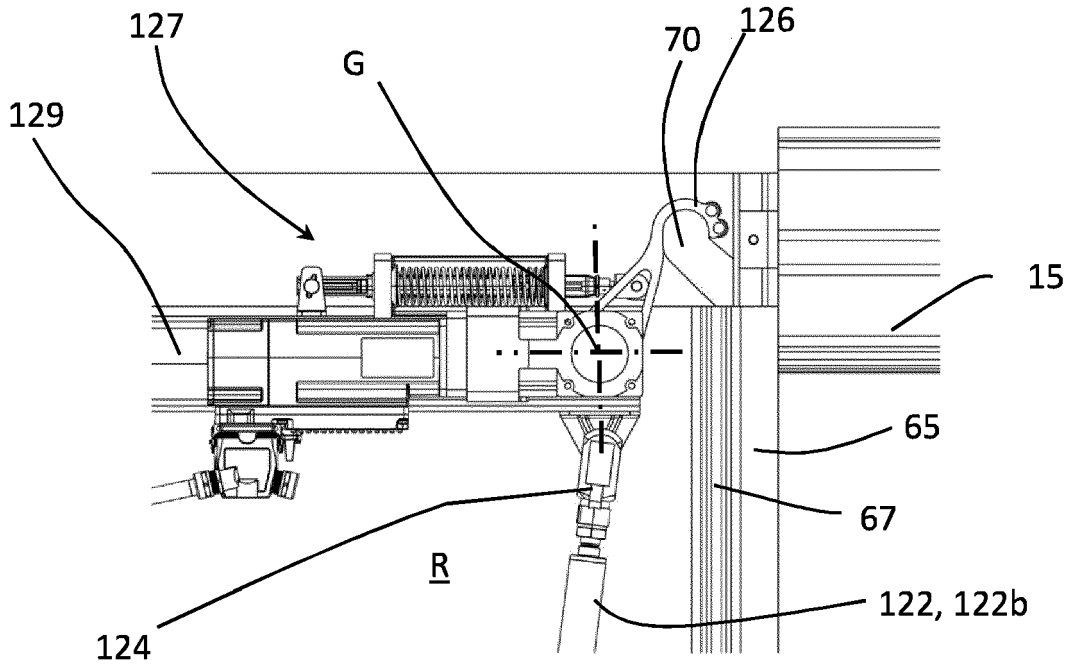


FIG 16

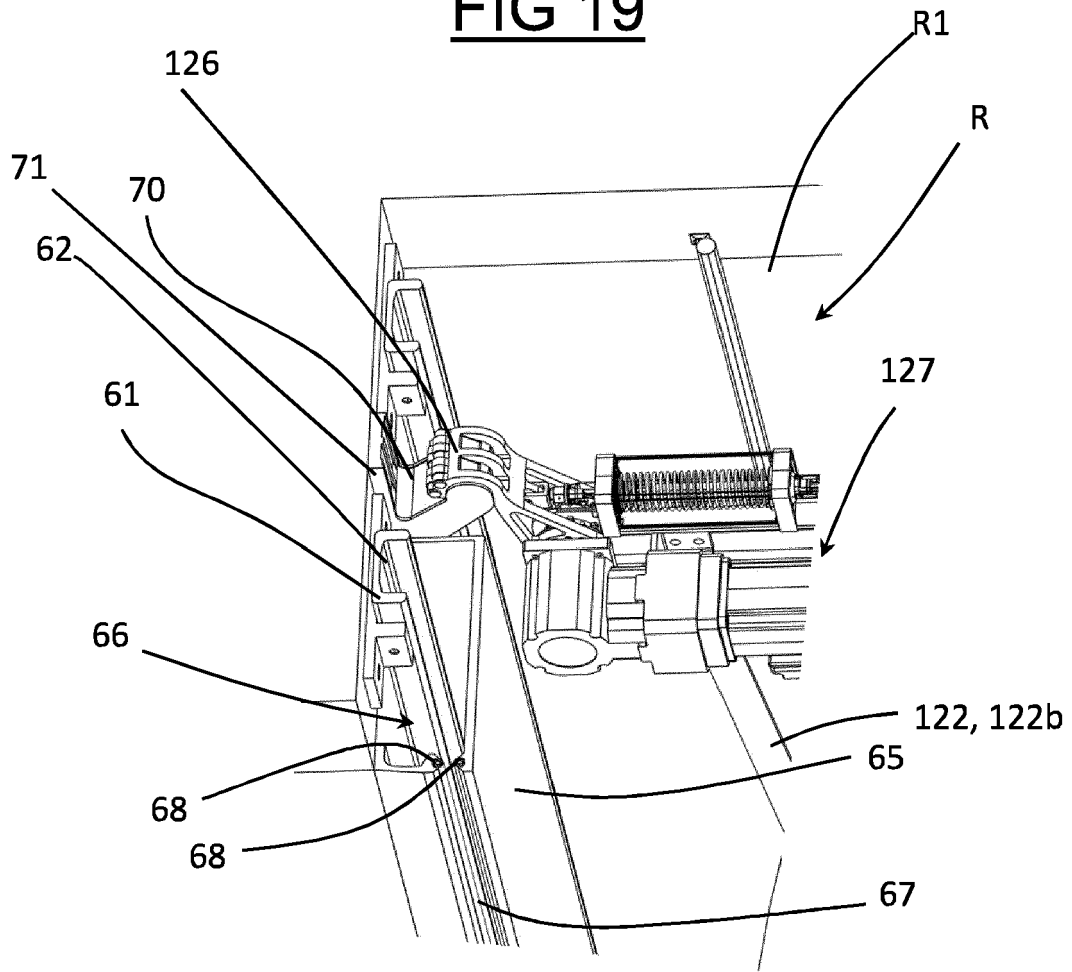




**FIG 18**



**FIG 19**



**FIG 20**

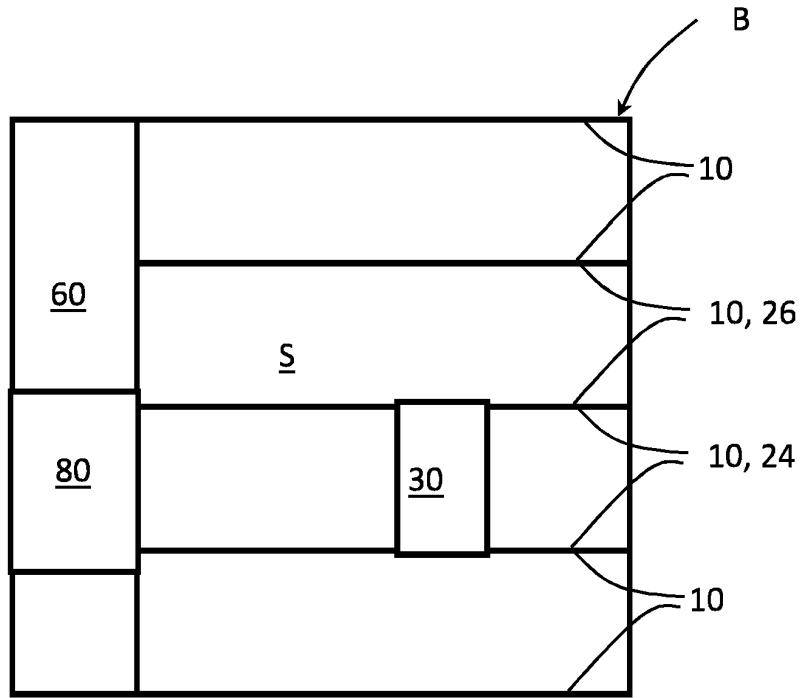


FIG 21

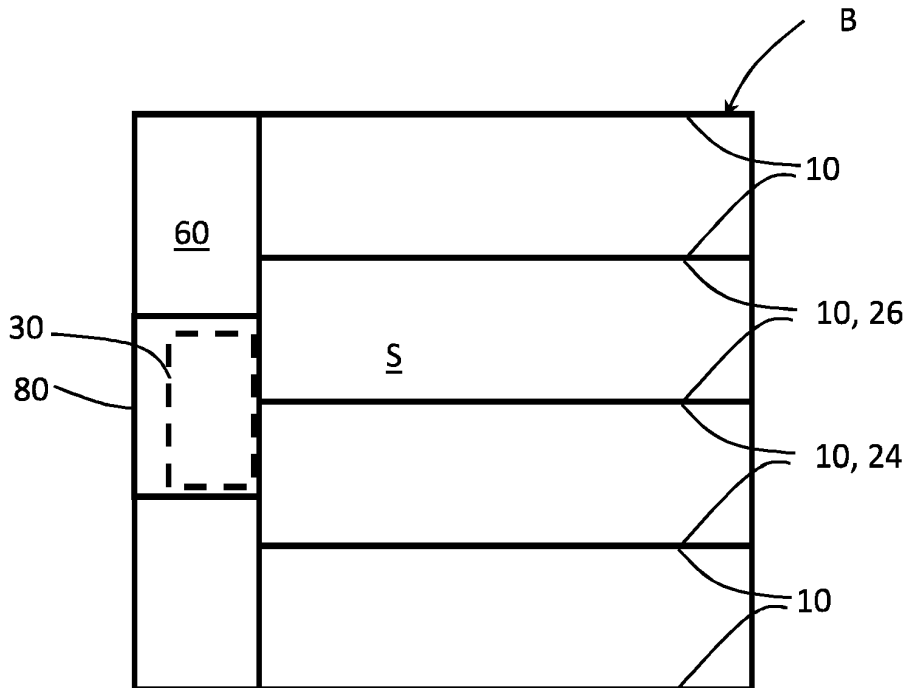


FIG 22

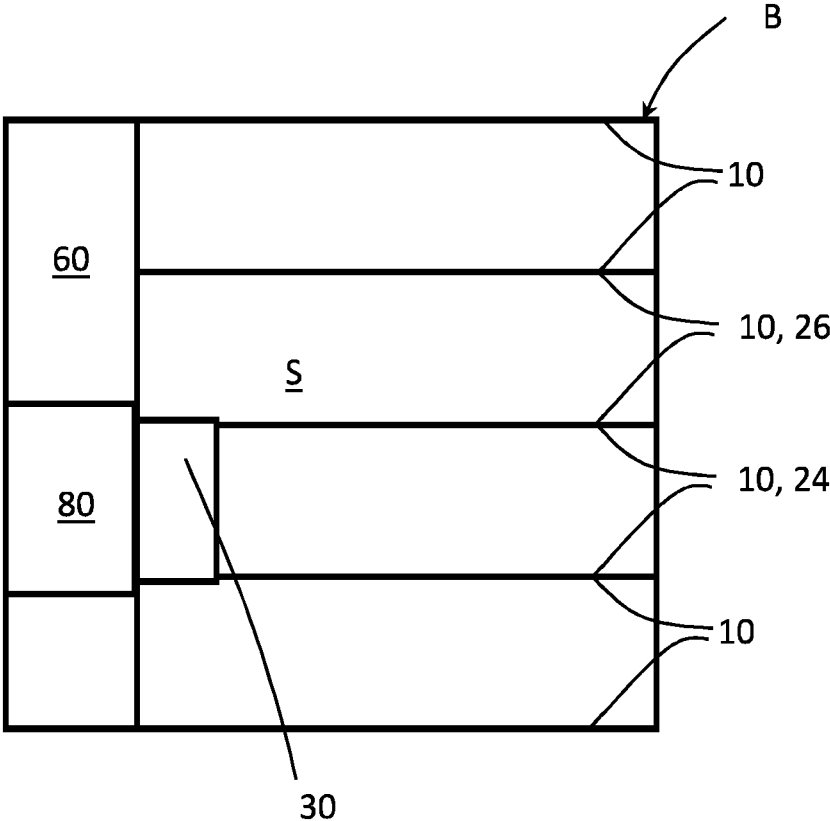


FIG 23

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- US 4797969 A [0005]
- US 4025984 A [0006]