



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.04.2013 Bulletin 2013/17

(51) Int Cl.:
E04H 6/22 (2006.01)

(21) Application number: **12189115.4**

(22) Date of filing: **18.10.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(30) Priority: **20.10.2011 IT PN20110070**

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(54) **Drive units for movable platforms for automated parking systems**

(57) Drive units for movable platforms for supporting and transporting motor-vehicles for automated parking systems having one or more overlapped floors, adapted to actuate and to transport said movable platforms toward and from parking positions selected in advance. There are provided two drive units (10) identical to each other, adapted to displace the movable platforms (11), one in

the longitudinal direction and the other one in the transversal direction of each parking floor, each one of which comprises a lifting and sliding unit (14) constituted by a rotating roller (19) and a bellows element (16), and an actuating unit (15) constituted by a gearmotor (36) and movement transmission members (33, 34, 35) for the lifting and sliding unit (14).

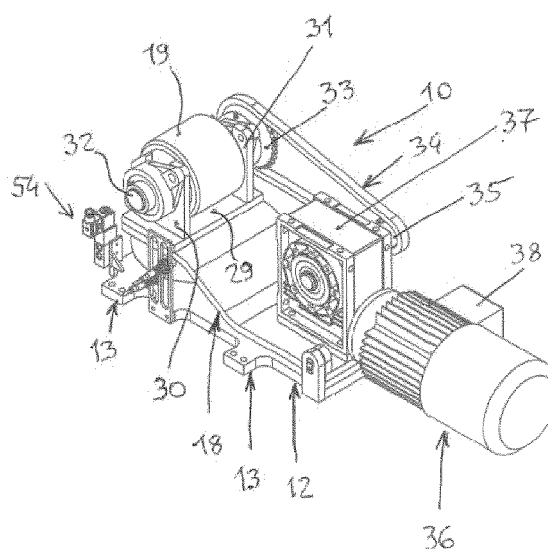


FIG. 3

Description

[0001] The invention relates to control devices for a movable platform for supporting and transporting motor-vehicles for automated parking systems with one or more overlapped floors, adapted to actuate and transport such movable platforms toward and from parking positions selected in advance.

[0002] Known in the art are automated parking systems having one or several overlapped floors, which are adapted to park the motor-vehicles in urban areas even on limited parking surfaces, and therefore with a smaller number of available parking places or - anyway - with a considerable increase in the surface-to-parking bays ratio, and with a compact structure that makes them suitable for installation in building sites of rather limited spaciousness. In particular, the one of the automated parking systems comprises a modular construction structure that is suitable for installation, in the case of several overlapped parking floors, either under the ground level or in positions raising above the ground, which structure is made with the characteristics already described in the patent application for invention n. PN2009A000030, filed on the 27.4.2009 in the name of Dr. Luigi Filippo von Mehlem.

[0003] In the parking system referred to, the motor-vehicles are arranged on to movable supporting and transporting platforms, provided with wheels slidable on guide rails, which are secured on to each floor of the parking system and are oriented in the longitudinal and the transversal direction, and the movable platforms may be displaced on to the different parking floors in the same direction along the relative sliding rails, by means of suitable actuators of hydraulic, oil-dynamic, pneumatic etc.. types, which are installed in the same parking floors and driven by powered means controlled by electronic control systems according to pre-established control programs.

[0004] In order to allow for the displacement of the platforms from the one to the other one of the longitudinal and transversal orientation directions of the guide rails, the parking system referred to is provided, for each parking place and in correspondence of the four crossing points of the rails, with rotation means shaped like a movable disc with a central cross, which is driven by suitable powered means and which rotation means are housed into a cavity below the parking floor.

[0005] On the contrary, in order to allow for the platforms to slide, the disc or contact roller can be displaced in the alternate vertical direction by the relative gearmotor, from a lowered position thereof in which the disc doesn't contact the platform, to a raised position thereof in which the disc comes into contact with the platform and raises it, and subsequently such disc is rotated in the orthogonal direction, together with the platform, so as to position the same platform in a direction orthogonal with respect to that in which it was situated, afterward such disc is lowered together with the platform, so that this latter arranges itself aligned with the orthogonal rails

and may displace itself along these rails. In another known solution, the displacement of the movable platforms along the guide rails with longitudinal and transversal orientation directions, is effected by providing the platforms with wheels swinging in two directions orthogonal to each other, at least one of which or all the wheels are driven in rotation by at least a motor fixed in the same movable platforms.

[0006] In this way, when the movable platforms are displaced along the guide rails with a determinate orientation, in order to displace such platforms along the rails with the other orientation direction, in correspondence of the crossing points of the rails the wheels are rotated by the motor from the one to the other one orientation position thereof, so as to slide the wheels in the crossing points with the other orientation direction thereof, thereby allowing the displacement of the movable platforms along the rails with such orientation direction. However, the so realized parking systems, still operating in a satisfactory and reliable manner, involve the presence of a great number of movable parts, of mechanical components and of electro-mechanical and electronic components, for performing and checking the required operations both for determining the displacement of the platforms in the different parking floors and in the elevator provided into such parking systems, and for determining the rotation of the same platforms from the one to the other one of the longitudinal and transversal orientation positions of the guide rails, which in the first case require the raising and the lowering of the same platforms, and in the second case require the presence of swinging wheels which can be driven in rotation by at least a motor, and in both known systems it is required the presence of mechanical components having considerable powers and energetic consumptions, which are complicated and burdensome and require periodical checking and maintenances for being maintained perfectly efficient.

[0007] The object of the present invention is to eliminate the above drawbacks and limits of the automated parking systems of this kind, by employing control devices for a movable platform for supporting and transporting motor-vehicles, which are made in a simplified manner, which is different than the mechanisms utilized in the above mentioned parking systems, and such as control the displacement of the movable platform on to the guide rails of each parking floor, and of the elevator, with a smaller number of mechanical, electric and electronic component parts which are utilized with respect to the preceding platforms, and in addition these control devices are adapted to displace in a simple and quick manner such movable platform into different orientation directions, without the need to raise and to lower as previously the same platforms, or to provide for swinging wheels as described above. These control devices for a movable platform for supporting and transporting motor-vehicles are made with the substantially described constructive characteristics, with particular reference to the attached claims of the present patent.

[0008] The invention will be better understood from the following description, given by way of not-limitative example only and with reference to the accompanying drawings, wherein :

- Fig. 1 shows a front view of the one of the control devices according to the invention ;
- Fig. 2 shows a plan view of the control device of the Fig. 1 ;
- Fig. 3 shows a perspective side view of the control device of Fig. 1 ;
- Fig. 4, 5 and 6 show a respective front view, a side view and a plan view of the platform, which is driven and displaced by the control devices of Figs. 1-3 ;
- Fig. 7 shows an enlarged view of a portion of the platform of Figs. 4-6, with one of the feet mounted in the lower part of the same platform, and provided for sliding along the guide rails of the different parking floors, and of the elevator ;
- Fig. 8 shows a perspective and enlarged front view of the sliding foot of Fig. 7, which is laid on to a guide rail in correspondence of the crossing point of two rails orthogonal to each other ;
- Fig. 9 shows a perspective view from below of the sliding foot of the Fig. 8, which is raised with respect to the guide rails ;
- Fig. 10 shows a perspective front view of a set of guide rails of the present movable platform, oriented into two directions orthogonal to each other and applied in the parking places, with two control devices of the platform associated with the same rails ;
- Fig. 11 shows a perspective and enlarged front view of some guide rails orthogonal to each other, and of the relative crossing points of the same rails.

[0009] Schematically illustrated in the Figures listed above are two control devices 10 identical to each other, for a movable platform 11 for supporting and transporting motor-vehicles in automated parking systems having one or more overlapped floors, which are adapted to drive and to transport the different movable platforms, with or without motor-vehicles, along guide rails with orientation directions which are different and orthogonal to each other, toward and from parking positions selected in advance in these parking systems.

[0010] Automated parking systems of this kind are known and substantially made with the constructive characteristics described in the above patent application, to which therefore reference is made for better understanding the same characteristics.

[0011] In the present parking system too, like the parking system known in the art, in each parking floor and in each elevator provided for displacing the movable platforms, with or without motor-vehicles arranged on to the same, from a parking floor to another one, there are installed guide rails which are oriented in the longitudinal and the transversal directions, so as to allow for the alternate sliding of the movable platforms along the relative

guide rails, and in this case each movable platform and the guide rails are shaped in a manner different with respect to the preceding one, as it will be described. Turning now to the Figs. 1-3, the one of the two control devices 10 according to the invention is described, which is made and mounted as it will be described into each parking floor of the automated parking system. This control device 10 is substantially constituted by a flat and metallic base plate 12 with enlarged shape, provided on its longitudinal sides with perforated side projections 13, for inserting corresponding bolts or the like (not indicated) into corresponding holes (also not indicated) provided on the floor of each parking floor and the elevator floor (not indicated), and for screwing the same bolts into such holes so as to secure firmly each plate 12 in the established position.

[0012] A lifting and sliding unit 14 is mounted on and secured adequately to the front part of the base plate 12, while a driving unit 15 for such unit 14 is mounted on and secured adequately to the back part of the base plate 12, and both these units are provided with the component parts which will be described and are foreseen for supporting the movable platform 11 and for lifting and lowering as well as for displacing it along the guide rails, from the starting position of the parking floor in which the motor-vehicle is introduced in the parking system and is loaded on to the movable platform, to the selected parking position in which the platform is displaced automatically and stopped and left at this point for the duration of the selected stop time and, when the stop time is terminated, for bringing back automatically the platform together with the motor-vehicle with reverse movements to the starting position, so as to unload the motor-vehicle from the movable platform 11 and to give back it to the relative owner. The lifting and sliding unit 14 is substantially constituted by a bellows element 16, arranged on and fixed to a flat support plate 17 secured to the upper surface of the base plate 12, by a movable support plate 18 situated above and into contact with respect to the bellows element 16 and shaped and constrained as it will be described, and by a rotating supporting and transporting roller 19 overlying the movable plate 18 and secured to and supported by the same as it will be described. In particular, the bellows element 16 is made of a metallic or elastomeric material or other suitable resistant and elastically expandable material, and is internally hollow and shaped preferably with a flattened oval shape, and its peculiar characteristic consists in that to be able to expand and to shrink itself in the vertical direction, in a manner to change its height within determinate limits, so as to be able to lift or to lower the overlying rotating roller 19 for the function which will be described. To this purpose, the bellows element 16 is communicating with its inner chamber, through at least a valve member 20 for regulating the gas flow and a conduit (not indicated), with a gas compressor (not indicated too), of which the valve member 20 is housed into and supported by a vertical plate 21, secured laterally the base plate 12 and provided

with two lengthened and vertical through slots 22 and 23, in the first of which 22 the valve member 20 is housed, in such a way as to be able to slide vertically along such slot for the same extent in which the bellows element 16 is let to expand or to shrink, and this vertical movement of the bellows element 16 is determined by admitting the gas in a different extent into the inner chamber thereof. For this aim, the valve member 20 is of per se known type and is connected to a pneumatic circuit of the parking system, into which also the gas compressor is connected, and the valve member 20 and the gas compressor are controlled by an electronic control system, arranged with a pre-established software, of the parking system, and in this way these two component parts are controlled by the electronic control system based on the selected operative cycle for displacing the platform in the parking system. In particular, when the valve member 20 is displaced in the closed position thereof, and the gas compressor is off, the gas isn't admitted into the bellows element 16, so that such bellows element arranges itself on its shrunk rest position, in which the rotating roller 19 is lowered.

[0013] On the contrary, when the valve member 20 is displaced in the opened position thereof, and the gas compressor is on, such compressor pumps compressed gas into the inner chamber of the bellows element 16, which therefore expands itself and increases its height and therefore lifts the rotating roller 19. Such displacement in height of the rotating roller 19 may be regulated at will within the established limit, by changing the quantity of compressed gas admitted into the inner chamber of the bellows element 16, and by closing the valve member 20 when the bellows element 16 has been displaced in the required lifted position thereof, as well as by stopping the gas compressor. Conversely, the bellows element 16 may be brought back again into its shrunk position with a reverse operation with respect to the preceding one, namely by stopping the operation of the gas compressor and by opening the valve member 20, under the condition in which the weight of the overlying rotating roller 19 compresses downward the same bellows element, and brings it back to its fully lowered position. In turn, the flat support plate 18 is folded into two positions, in a way to define a first flat portion 24, a second portion inclined upward 25 and a third flat portion 26, which are joined to each other, of which the free end portion of the first flat portion 24 is articulated in two vertical hinges 27, secured to the two sides of the base plate 12, in a manner that such first flat portion 24 is slightly raised and moved away parallel with respect to the upper surface of the base plate 12 and may rotate about the relative hinges 27, thereby displacing itself with a limited vertical lifting and lowering movement. The third flat portion 26 is raised with respect to the first flat portion 24 and its lower surface is fixed to the upper surface of the bellows element 16, through an intermediate flat plate 28. The flat base 29 of the rotating roller 19 is supported by and secured to the upper surface of the third flat portion 26, and two vertical

walls 30 and 31 are secured to this flat base, which walls are parallel and spaced away from each other in the transversal direction of the same base, and the stud 32 of the rotating roller 19 is supported and pivoted between such walls.

[0014] In this way, the lifting or lowering movement of the bellows element 16, which is produced as described above, determines a consequent lifting or lowering of the flat support plate 18, articulated in the hinges 27, and a consequent lifting or lowering of the rotating roller 19 too, which is supported as described by the not hinged end portion of the same flat support plate.

[0015] The rotation actuation of the rotating roller is produced by a movement transmission mechanism, which in the example is constituted by a gear 33 fixed to the projected end portion of the stud 32, which is opposite to that in which the valve member 20 is positioned, and by a toothed chain 34 meshing at its one end portion with such gear 33 and meshing at its other end portion with a driving gear 35, receiving the actuation rotating movement by the driving unit 15 which will be described hereinafter. Obviously, the movement transmission mechanism may be made also with components different than those described by way of example, thus without departing from the protection sphere of the present invention. The driving unit 15 of the rotating roller 19 is substantially constituted by a gearmotor 36 having lengthened shape, which is supported by and secured laterally to a box-like container 37, fixed at its lower part on to the upper surface of the base plate 12, in the length direction of the same plate, and including the movement transmission members of traditional type, meshing with the relative mechanical transmission members of the gearmotor 36, and secured to and supporting the driving gear 35, so as to actuate in rotation the rotating roller 19, and in turn the gearmotor 36 is provided with its electric and electronic control and regulating circuits (not indicated), which are enclosed into a box 38 fixed to the gearmotor 36, and which are supplied and controlled by the control circuit of the parking system, and provided for determining the rotation of the roller 19 and the expansion or the shrinkage of the bellows element 16, and therefore the lifting or lowering of the same roller, based on the respectively selected operative cycles.

[0016] The so realized control device 10 is mounted, together with another control device 10 identical to it, in the central position of each parking position of the parking system, and is able to provide for the displacement of each movable platform 11, with or without a motor-vehicle arranged on to the same platform, by arranging the platform in correspondence of the rotating roller 19 in a manner that the lower surface of the platform arranges itself above and into contact with the same roller, under the condition in which the rotation of the roller in either one rotation direction determines the correspondent frictional entrainment and the displacement in the same direction of the platform along the relative guide rails of the parking floor.

[0017] The Figs. 4-9 show now the constructive structure of each movable platform 11 of the present invention, while the Fig. 10 shows the different guide rails oriented in the longitudinal and the transversal directions of the one of the parking positions of the present parking system, and two control devices 10 mounted in the central position of each parking position, and foreseen for determining the displacement of the relative movable platforms 11 in the alternate directions along the guide rails from one to another one of the parking positions, with the platform oriented in a determinate (longitudinal or transversal) direction, and with the platform oriented in the other direction, which is orthogonal to the preceding one. Finally, the Fig. 11 show two cross points of the guide rails, which are realized in the intersection position of each longitudinal guide rail with each transversal guide rail. Turning now to the Figs. 4-6 in which the present movable platform 11 is shown, and to the Figs. 7-9 in which a component part of the same platform is shown, it is noted that this movable platform 11 is constituted substantially by metallic flat supporting plate 39 having a rectangular shape or another suitable shape, which is dimensioned with a limited thickness and such length and width that to be able to support any kind of motor-vehicle on to its upper flat surface. Moreover, such movable platform 11 is shaped for being able to be displaced in any one of the longitudinal or the transversal directions of each parking floor and of the floor of any possible elevator, in the case in which the parking systems having several floors are provided.

[0018] To this purpose, the platform 11 is provided in its lower part with a set of supporting and sliding feet, in the example constituted by four metallic feet 40 secured along the two longitudinal sides 41 and 42 of the same platform and shaped as it will be described, so as to be able to slide along all the guide rails of the different parking floors, and the platform 11 is also able to be displaced into different parking positions, in the same orientation direction, and to be oriented from the one to the other one of the longitudinal and the transversal directions, by displacing the same by means of the rotating rollers 19 of the two control devices 10, which displacement is effected as it will be described subsequently, in a manner to be able to be displaced into the desired positions during the steps of arrangement of each motor-vehicle in the respectively selected parking place, and the steps of drawing this motor-vehicle from such parking place.

[0019] As particularly visible from the Figs. 7-9, each supporting and sliding foot 40 of the movable platform 11 is formed by a metallic vertical structural piece 43 having squared shape and limited height, delimiting an inner cavity 44 and adapted to be fixed removably by means of bolts or the like (not indicated) to the lower surface of the movable platform 11, and is also formed by a metallic vertical insert 45 acting as a sliding element on to the guide rails, which insert is inserted from below through the inner cavity 44 of the structural piece 43 and fixed and kept into position by means of proper metallic

supports 46 secured into the same inner cavity.

[0020] To this aim, the metallic insert 45 is shaped with a restricted upper shank 48, which is secured to the metallic supports 46, and is extended at its lower part with an enlarged part 49, passing and fixed through the correspondent lower opening 50 of the structural piece 43, and such enlarged part terminates with a shaped end portion 51 made of antifriction material, having dimensions slightly smaller than the width of the guide rails 52, in a way that such shaped end portion 51 may be laid on to and slide in the alternate direction along the relative guide rail, thereby acting as a sliding block. In the described example, the shaped end portion 51 has a semi-spherical shape, however it may have also different shapes, so as to be able to slide along all the guide rails, namely the rails oriented in the longitudinal direction and the rails oriented in the transversal direction of the relative parking place, and may slide without difficulty even through all the crossing points between the longitudinal rails and the transversal rails. Of course, such shaped end portion may be also coupled to and/or replaced by suitable rotating spheres (not indicated), adequately fixed in the shaped end portion 51 of the insert 45, so as to allow for always the sliding on to the different guide rails 52.

[0021] In the lower part of each so realized foot 40 a squared plate 53 is bolted or secured with other suitable means, which plate is dimensioned for adapting itself to slide on to the guide rails 52 and the different cross points 54 between the longitudinal guide rails and the transversal guide rails. Such squared plate 53 is made with dimensions which are slightly smaller than those of the structural piece 43, and is shaped with projections 55 identical and having the same size, made integral on the angles of the same plate, in positions corresponding to those of the zones of the rails and the cross points on to which the feet 40 slide. Besides, these projections 55 are perforated for inserting the bolts 56 securing the plate below the structural piece 43 and delimit among them a central through opening 57, communicating with the shaped end portion 51 of the insert 45 included in the foot, which in turn terminates in a position re-entering with respect to the lower edge of the projections 55. Thanks to this configuration of the squared plate 53, therefore, it may adapt itself to slide along all the rails, longitudinal and transversal ones, and along all the cross points between the same rails, which are shaped as it will be described later on.

[0022] The Fig. 10 shows now some longitudinal and transversal guide rails 52 which have been installed in a parking floor of the parking system according to the invention, as well as the two control devices 10 mounted in the central parking positions in which the relative movable platforms 11, with or without motor-vehicles supported thereon, are displaced.

[0023] From such Figure, it is noted that the two control devices 10 are installed into positions which are approached and have orientations orthogonal to each other,

namely that while a device 10 is installed with its rotating roller 19 oriented in the longitudinal direction of the guide rails 52, the other device 10 is installed with its rotating roller 19 oriented in the transversal direction of the guide rails. Such so oriented devices are fixed at the level of the floor with their base plates 12, in a manner that the device 10 with the rotating roller 19 oriented in the transversal direction be positioned in the central zone of the relative parking position of the platform 11, while the device 10 with the rotating roller 19 oriented in the longitudinal direction of this parking position be positioned near the one of the two transversal guide rails 52.

[0024] This arrangement of the two control devices 10 is identical for all the parking positions adjacent to that indicated, and the devices with the longitudinal or the transversal orientations of the rotating rollers 19 of each parking position are spaced away from the devices with the same orientation of the adjacent parking positions of such a distance as to allow for each movable platform 11 to be displaced from the one to the other one parking position, in both the longitudinal and the transversal direction, by keeping the platform 11 always supported by at least two devices 10 and by preventing any possible falling and stopping thereof.

[0025] Now, let's imagine that in the parking position of the Fig. 10 a movable platform is arranged, with or without a motor-vehicle supported thereon, and that such platform should be displaced in the longitudinal direction. Under this condition, the platform is supported by the longitudinal rails 52 and is laid with its lower surface on to both the movable rollers 19, oriented orthogonally to each other. The displacement is started by inflating the bellows element 16 of the movable roller 19 oriented in the longitudinal direction, of such an extent as to obtain a slight lifting of the movable plate 18 and the movable roller 19, in a manner that the movable platform comes into contact with such movable roller only, and is slightly lifted from the other movable roller 19, which isn't actuated in rotation. Then, during this operation there are lifted also both the valve member 20 of the bellows element 16, which is sliding in the relative vertical slot 22, and the supply conduit of the compressed gas supplied to the bellows element 16, while the lifting of the movable plate 18 is guided by a projected stud 58 fixed laterally the same plate and slidable vertically in the correspondent through slot 23. Thereafter, the rotating roller 19 into contact with the movable platform 11 is actuated in rotation, in the established advancement direction, with consequent displacement in the same direction of the movable platform, the sliding blocks 51 of which and the projections 55 of the squared plates 53 slide along the relative longitudinal guide rails 52 and the advancement of the platform continues until it has been completely displaced in the adjacent parking position and arranges itself over the relative rotating roller 19 oriented in the longitudinal direction, which is displaced in the lowered rest position. Under this condition, as soon as the platform 11 has lost the contact with the previous rotating roller 19,

the rotation of this latter is stopped and therefore the advancement of the platform is terminated, which platform is slightly lowered and therefore comes into contact with this new movable roller 19.

5 **[0026]** The same sequence of the just described operative steps occurs for both the displacement of the movable platform in the same longitudinal direction, into different parking positions, and in the transversal direction too, from a parking position to the adjacent one, and from here into further parking positions, in this case by activating only the movable rollers 19 oriented in the transversal direction of the control devices 10 installed in these parking positions.

10 **[0027]** All the control devices 10 are also provided with suitable electric, electronic etc.. sensors 59 of per se known type, connected in the control circuit of the parking system and acting on to the different components of the same units, in order to detect the presence or the absence of the movable platforms 11 in the relative parking positions and therefore to control the just described operative sequences. Thanks to the presence of the control devices 10 in all the parking positions, it is therefore possible to displace automatically the movable platforms with or without motor-vehicles along all the guide rails, both the longitudinal and the transversal ones, toward and from all the parking positions selected in advance, by a series of advancement movements determined by the rotating rollers 19. Reference is still made to the Fig. 10 and the Fig. 11 too, in which there are now described the structural configurations of the guide rails 52 and the crossing points 54, so as to allow for the different feet 40 of the movable platforms 11 to slide.

25 **[0028]** In these Figures, there appear visible three guide rails 52 with longitudinal extension, which are arranged spaced away and parallel to each other, and a guide rail 52 with transversal extension, and some cross points 54 between such longitudinal and transversal extended guide rails.

30 **[0029]** A rectangular rectilinear piece 60 is applied along each rail 52 for the entire length of the same rail, which piece is inserted through a correspondent groove (not shown) of each rail, in a manner to be slightly raised with respect to the wings 61 and 62 of the rail, so as to permit the shaped end portion 51 of each foot 40 of the movable platform 11 to be laid on and to slide on to its upper surface, and the end portions of each rail are connected with a relative cross point 54, which is fixed on the floor of the relative parking floor, and each one of which is made with a flat plate shaped with a pair of short rectilinear sides 63 and 64, which are parallel and spaced away from each other, and oriented in the transversal direction of the rails, and with another pair of short sides 65 and 66 parallel and spaced away from each other of the same distance of the preceding sides, however oriented in the longitudinal direction of the rails, so that such sides are forming a square 67 having the same dimension of the squared plate 53 of each foot 40, having the same height of the wings 61 and 62 of each rail, and being

provided for permitting said squared plate to be laid on and to slide along both the longitudinal and the transversal sides of the same square.

[0030] Moreover, such sides of the square 67 delimit among them a squared central hole 68, in which an insert 69 slightly smaller and having the same shape of the hole 68, and the same height of the rectangular piece 60, is introduced and secured therein.

[0031] Finally, the end portions of the sides of each pair of transversal sides 63 and 64 and longitudinal sides 65 and 66 are slightly extended beyond the square 67, so as to form a seat 70 into which the end portion of the relative rectangular piece 60 is inserted, which piece is applied on to its own rail. In the example of the Fig. 11, it is noted that there are provided only three extended end portions of sides of the square 67, and not four portions, in that in this case the cross point serves to join only two rectangular pieces 60 of two transversal rail portions, and a longitudinal rail portion.

[0032] Thanks to the so realized configuration of the different cross points 54, each foot 40 of the movable platform 11 may slide along both the guide rails and the cross points, and in particular the sliding on to the rails occurs thanks to the fact that the shaped end portion 51 of the foot is laid on and into sliding contact with each rectangular piece 60 of the rails, while the sliding on to the cross points occurs thanks to the fact that the projections 55 of the squared plate 53 of the foot are laid on and slide along either the transversal sides 63 and 64 or the longitudinal sides 65 and 66 of the square 67 of each cross point 54. In this way, for changing the sliding direction of the movable platform 11, it is sufficient to position the feet 40 thereof in correspondence of the cross points 54 and to push the platform in the desired direction by actuating either one of the rotating rollers 19 of the control devices according to the invention, which consequently displace the same platform along the guide rails oriented in the selected advancement direction.

[0033] In order to allow for these changes of sliding direction, the parking system is provided with suitable sensors (not shown) detecting when the feet 40 of the platform 11 are positioned in correspondence of the cross points, and signalling this position to the control system of the parking system, which thereby provides to control in rotation the desired movable rollers of each parking position. Therefore, each parking system provided with these control devices and the movable platforms provided with these feet, and not more with sliding wheels as previously, allows for obtaining plants which are considerably simplified in their mechanical, electro-mechanical, electric and electronic parts, with consequent lesser quantities of required harnesses and conduits, and simplified control software, and lesser needs and costs for maintaining and managing the systems referred to. Furthermore, in the case in which the two control devices 10 of each parking position be built in into the floor, into proper containers built in into the same floor, it is possible at one hand to reduce of various centimetres (up to about

18/20 cm.) the difference in height among the different horizontal floors and the loading floors of the parking systems, which with the current systems is greater (about 38/40 cm.), so as to achieve a large number of intermediate floors and therefore a greater height of the motor-vehicles to be parked, and at the other hand to realize a greater number of floors and therefore of parking places with the same height of the buildings in which they are installed.

Claims

1. Control devices for movable platform for supporting and transporting motor-vehicles for automated parking systems with one or more overlapped floors, adapted to actuate and to transport such movable platforms with the relative motor-vehicles toward and from parking positions selected in advance, in two sliding directions orthogonal to each other, wherein each parking system can be installed on urban towns and buildable surfaces having different shapes and limited widths, or anyway requiring a considerable increasing of the ratio surface/places of motor-vehicles, and comprising one or more parking floors overlapped to each other and, in the case of more floors overlapped to each other, also vertically displacing elevator means actuated by per se known means and displaceable through the different parking floors for transporting said movable platforms with or without motor-vehicles from the one to the other one of the different parking floors, and wherein each parking floor and the floor of said elevator are provided with guide rails oriented into directions orthogonal to each other, said control devices being **characterized by** two devices (10) identical to each other, adapted to displace said movable platforms (11) the one in the longitudinal direction and the other one in the transversal direction, each one of said devices being constituted by at least a first lifting and sliding unit (14) and by a second actuating unit (15) for said first unit (14), which are associated to each other and mounted in the parking position of each parking floor and the floor of said elevator, in a position below that in which said movable platform (11) is parked, by sliding on to said guide rails (52), said first unit (14) being adapted to be actuated by said second unit (15) from a lowered rest position to a slightly lifted operating position, and vice versa, and being adapted, in its lifted position, to displace said movable platform (11) in either one direction along the direction in which it is oriented, toward an adjacent parking position, and from this one toward further parking positions, and being adapted to stop the advancement of said movable platform (11) when it has been moved in the respectively adjacent parking position, by returning then back in the lowered position, said first unit (14) of a control device (10) being mounted

in each parking position together with at least a further lifting and sliding unit (14) of the other control device (10), actuated by a relative further second actuating unit (15), and adapted to be actuated by said further second unit (15) from a lowered rest position to a lifted operating position, and vice versa, and being adapted, in its lifted position, to displace said movable platform (11) in either one direction along a direction in which its is oriented, which is orthogonal to the preceding direction, toward an adjacent parking position, and from this toward further parking positions, and being adapted to stop the advancement of said movable platform (11) when it has been moved in the respectively adjacent parking position, by returning then back in the lowered position.

2. Control devices for movable platform according to claim 1, **characterized in that** each lifting and sliding unit (14) is substantially constituted by a bellows element (16), arranged on and secured to a flat support plate (17) fixed to the upper surface of the base plate (12), by a movable support plate (18) situated above and into contact with respect to the bellows element (16), and by a supporting and transporting rotating roller (19) arranged over the movable plate (18), said bellows element (16) being made of a metallic or elastomeric material or other suitable resistant and elastically expandable material, which is internally hollow and shaped preferably with an oval flattened form, adapted to expand and to shrink itself in the vertical direction, in a manner to change its height within determinate limits, in order to be able to lift or to lower the overlying rotating roller (19), said bellows element (16) being communicating with its inner chamber, through at least a valve member (20) for regulating the gas flow and a conduit, with at least a gas compressor, of which the valve member (20) is housed into and supported by a vertical plate (21), secured laterally to the base plate (12) and provided with two lengthened and vertical through slots (22, 23), in the first of which (22) the valve member (20) is housed, in a manner to be able to slide vertically along such slot for the same extent in which the bellows element (16) is let to expand or to shrink, and this vertical movement of the bellows element (16) is determined by admitting in a different extent the gas into the inner chamber thereof, and **characterized in that** when the valve member (20) is displaced into the closed position, and the gas compressor is turned off, the gas isn't introduced into the bellows element (16), so that such bellows element arranges itself into its shrunk rest position, in which the rotating roller (19) is lowered, while when the valve member (20) is displaced into the opened position, and the gas compressor is turned on, such compressor pumps compressed gas into the inner chamber of the bellows element (16), which therefore expands itself, thereby increasing its height and lifting the ro-

tating roller (19), wherein such height displacement of the rotating roller (19) may be adjusted at will within the established limit, by varying the amount of compressed gas introduced into the inner chamber of the bellows element (16), and by closing the valve member (20) when the bellows element (16) has been displaced in the requested lifted position, as well as by stopping the gas compressor, and **characterized in that** the bellows element (16) may be returned back again into its shrunk position with an operation reverse to the preceding one, namely by stopping the operation of the gas compressor and by opening the valve member (20), under the condition in which the weight of the overlying rotating roller (19) compresses downward the same bellows element, and returns it back into its fully lowered rest position.

3. Control devices for movable platform according to claim 2, **characterized in that** the flat support plate (18) is folded into two positions, in a manner to define a first flat portion (24), a second portion (25) inclined upward and a third flat portion (26), joined to each other, of which the free end portion of the first flat portion (24) is articulated into two vertical hinges (27), fixed to the two sides of the base plate (12), in a way that such first flat portion (24) is slightly raised and displaced parallel with respect to the upper surface of the base plate (12) and may rotate about the relative hinges (27), so as to displace itself with a limited vertical lifting and lowering movement, said third flat portion (26) being lifted with respect to the first flat portion (24) and its lower surface being secured to the upper surface of the bellows element (16), through an intermediate flat plate (28); and that on to the upper surface of the third flat portion (26) the flat base (29) of the rotating roller (19) is supported and secured, and on to this flat base there are fixed two vertical walls (30, 31) parallel to and spaced away from each other in the transversal direction of the same base, through which the stud (32) of the rotating roller (19) is supported and pivoted, and under this condition the lifting or lowering movement of the bellows element (16) causes a consequent lifting or lowering of the flat support plate (18), articulated in the hinges (27), and a consequent lifting or lowering of the rotating roller (19) too.
4. Control devices for movable platform according to claim 3, **characterized in that** said rotating roller (19) is driven in rotation by a movement transmission mechanism, which in the example is constituted by a gear (33) fixed to the projected end portion of the stud (32), which is opposite to that in which the valve member (20) is positioned, and by a toothed chain (34) meshing at its one end portion with such gear (33) and meshing at its other end portion with a driving gear (35), receiving the rotating driving move-

ment from said actuating unit (15).

5. Control devices for movable platform according to claim 4, **characterized in that** the actuating unit (15) of the rotating roller (19) is substantially constituted by a gearmotor (36) having lengthened form, which is supported by and secured laterally to a box-like container (37), fixed at its lower part to the upper surface of the base plate (12), in the length direction of the same plate, and including the movement transmission members of traditional type, meshing with the relative mechanic transmission members of the gearmotor (36), and fixed to and supporting the driving gear (35), so as to drive in rotation the rotating roller (19), and in turn the gearmotor (36) is provided with its electric and electronic control and regulating circuits, which are enclosed into a box (38) fixed into the gearmotor (36), which are supplied and controlled by the parking system control circuit, and provided for determining the rotation of the roller (19) and the expansion or the shrinkage of the bellows element (16), and therefore the lifting or lowering of the same roller, based on the respectively selected operative cycles.
6. Control devices for movable platform according to claim 5, **characterized in that** said movable platform (11) is constituted substantially by a metallic support flat plate (39) having rectangular form or other suitable form, dimensioned with limited thickness and such length and width as to support on to its flat upper surface any kind of motor-vehicle, and is provided at its lower side with a set of supporting and sliding feet, in the example constituted by four metallic feet (40) fixed along the two longitudinal sides (41, 42) of the same platform, adapted to slide along the guide rails of the different parking floors and of said elevator.
7. Control devices for movable platform according to claim 6, **characterized in that** each supporting and sliding foot (40) of the movable platform (11) is formed by a metallic vertical structural piece (43) having squared form and limited height, delimiting an inner cavity (44) and adapted to be fixed removably by means of bolts or the like to the lower surface of the movable platform (11), and is also formed by a metallic vertical insert (45) acting as sliding element on to the guide rails, which insert is inserted from below through the inner cavity (44) of the structural piece (43) and fixed and kept into position by appropriate metallic supports (46) fixed into the same inner cavity, said metallic insert (45) being shaped with a restricted upper shank (48) which is fixed to the metallic supports (46), and extends at its lower part with an enlarged part (49), passing and fixed through the corresponding lower opening (50) of the structural piece (43), and such enlarged part

terminates with a shaped end portion (51) made of antifriction material, having dimensions slightly smaller than the width of the guide rails (52), in a way that such shaped end portion (51) may be laid on to and slide in the alternate direction along the relative guide rail, thereby acting as sliding block, said shaped end portion (51) having preferably a semi-spherical shape, and being able to be also coupled to and/or replaced by suitable rotating spheres, adequately secured to the shaped end portion (51) of the insert (45), thereby permitting always a sliding on to the different guide rails (52).

8. Control devices according to claim 7, **characterized in that** in the lower part of each foot (40) it is bolted or fixed with other suitable means a squared plate (53), dimensioned for being slidably adapted on to the guide rails (52) and the different cross points (54) between the longitudinal guide rails and the transversal guide rails, said squared plate (53) being made with dimensions slightly smaller than those of the structural piece (43), and being shaped with some projections (55) identical and having the same size, provided integrally on the angles of the same plate, in positions corresponding to those of the zones of the rails and the cross points on to which the feet (40) are sliding, said projections (55) being bored for inserting therein the bolts (56) for fixing the plate below the structural piece (43) and delimiting among them a central through opening (57), communicating with the shaped end portion (51) of the insert (45) included into the foot, which in turn terminates in a recessed position with respect to the lower edge of the projections (55), under the condition in which said squared plate (53) may adapt itself slidably along all the rails, longitudinal and transversal ones, and along all the cross points (54) between the same rails.
9. Control devices according to claim 8, **characterized in that** the displacement of said movable platform (11) begins by inflating the bellows element (16) of the movable roller (19) oriented in a determinate direction, of such an extent as to achieve a slight lifting of the movable plate (18) and the movable roller (19), in a manner that the movable platform (11) comes into contact with such movable roller (19) only and is slightly lifted by the other movable roller (19), which isn't driven into rotation, under the condition in which it is also lifted the valve member (20) of the bellows element (16), which is slidable into the relative vertical slot (22) and the compressed gas conduit supplying the gas to the bellows element (16), while the lifting of the movable plate (18) is guided by a projected stud (58) secured laterally to the same plate and slidable vertically into the corresponding through slot (23), and **characterized in that** afterwards the rotating roller (19) into contact with the movable plat-

form (11) is driven in rotation, in the established advancement direction, with consequent displacement in the same direction of the movable platform, the sliding blocks (51) of which and the projections (55) of the squared plates (53) are sliding along the relative guide rails (52), and the advancement of the platform continues until it has been fully displaced in the adjacent parking position and arranges itself above the relative rotating roller (19) oriented in the same direction, which is displaced in the lowered rest position, and under this condition, as soon as the platform (11) has lost the contact with the preceding rotating roller (19), the rotation of this latter is stopped and therefore the platform advancement terminates, which platform lowers itself slightly and thus arranges itself into contact with this new movable roller (19), and **characterized in that** the displacement of the movable platform (11) in the direction orthogonal to the previous one, and from here toward further parking positions, is effected by activating only the movable rollers (19) which are oriented in the orthogonal direction, with the same operative sequences.

10. Control devices according to claim 9, **characterized in that** all the control devices (10) are also provided with suitable electric, electronic etc.. sensors (59) of per se known type, connected in the parking system control circuit and acting on to the different components of the same units, for detecting the presence or the absence of the movable platforms (11) in the relative parking positions and thereby controlling the displacement operative sequences of the movable platform (11).

11. Control devices according to the preceding claims, **characterized in that** along each guide rail (52) it is applied a rectangular rectilinear piece (60) for the entire length of the same rail, which piece is inserted through a corresponding groove of each rail, in a way to be slightly lifted with respect to the wings (61, 62) of the rail, for permitting the shaped end portion (51) of each foot (40) of the movable platform (11) to be laid and to slide on its upper surface, and the end portions of each rail are joined with a relative cross point (54), fixed to the floor of the relative parking floor, each one of which is realized with a flat plate, shaped with a pair of short rectilinear sides (63, 64) which are parallel to and spaced away from each other, and oriented in a determinate direction of the rails, and with another pair of short sides (65, 66) which are parallel to and spaced away from each other of the same distance of the preceding sides, however oriented in the other direction of the rails, such sides forming a square (67) having the same dimension of the squared plate (53) of each foot (40), and the same height of the wings (61, 62) of each rail, and provided for allowing said squared plate to

be laid on and to slide along the longitudinal sides and the transversal sides of the same square, the sides of said square (67) delimiting a squared central hole (68) among them, in which an insert (69) is inserted and fixed, which is slightly smaller than and has the same shape of the hole (68), and the same height of the rectangular piece (60), and the end portions of the sides of each pair of sides having a determinate orientation (63, 64) and the other orientation (65, 66) thereof being slightly extended beyond the square (67), thereby forming a seat (70) into which the end portion of the relative rectangular piece (60) is inserted, which is applied on to its own rail, under the condition in which each foot (40) of the movable platform (11) may slide along the guide rails and through the cross points, and in particular the sliding on to the rails occurs thanks to the fact that the shaped end portion (51) of the foot is laid on and is into slidable contact on to each rectangular piece (60) of the rails, while the sliding on to the cross points occurs thanks to the projections (55) of the squared plate (53) of the foot which are laid on and slide along either the sides with a determinate orientation (63, 64) or the sides with the other orientation (65, 66) of the square (67) of each cross point (54).

12. Control devices according to claim 1, **characterized in that** for permitting these changes of the sliding direction of said movable platform (11), the parking system is provided with suitable sensors which detect when the feet (40) of the same platform are positioned in correspondence of the cross points, and signal this position to the control system of the parking system, which therefore provides to operate into rotation the desired movable rollers (19) of each parking position.

13. Control devices according to claim 12, **characterized in that** in the case in which the two control devices (10) of each parking position are built in into the floor, into proper containers built in into the same floor, it is possible at one hand to reduce of several cm. (up to about 18/20 cm.) the difference in height between the different horizontal floors and the loading planes of the parking systems, which with the current systems is higher (about 38/40 cm.), for obtaining a larger numbers of intermediate floors and therefore a greater height of the motor-vehicles to be parked, and at the other hand to provide a greater number of floors and therefore of parking places with the same height of the buildings into which they are installed.

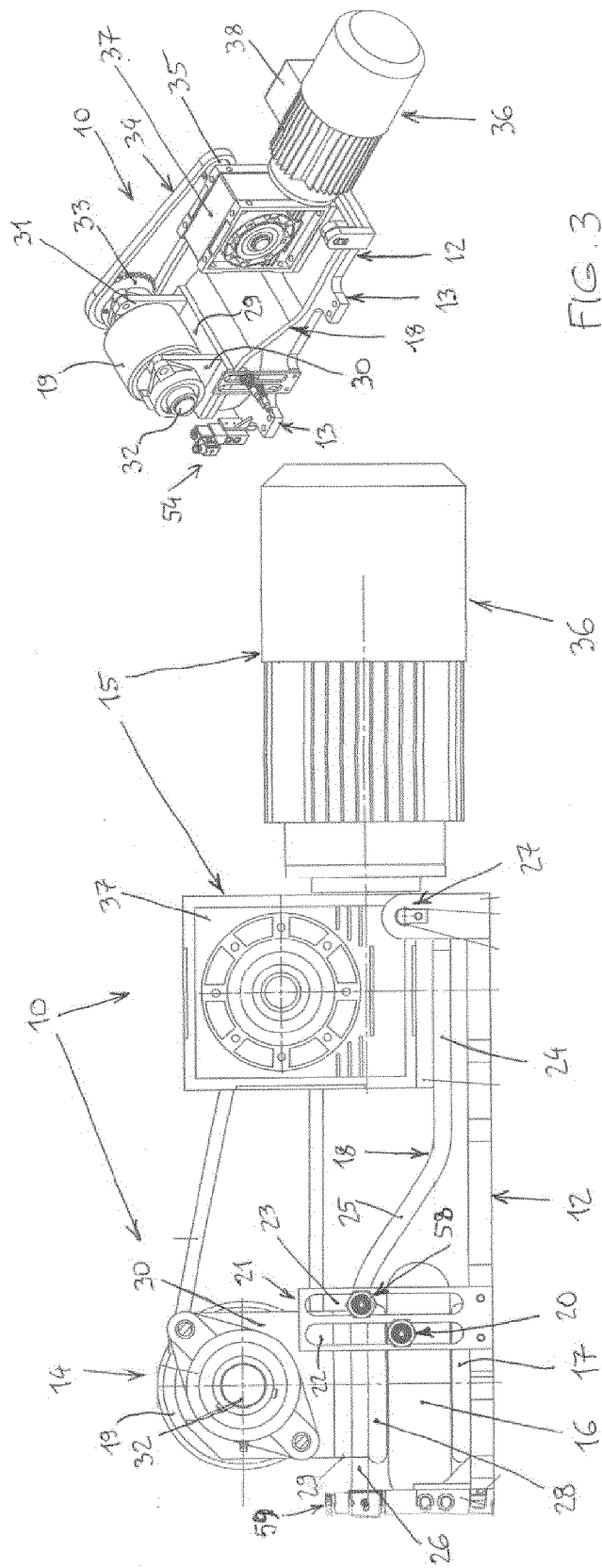
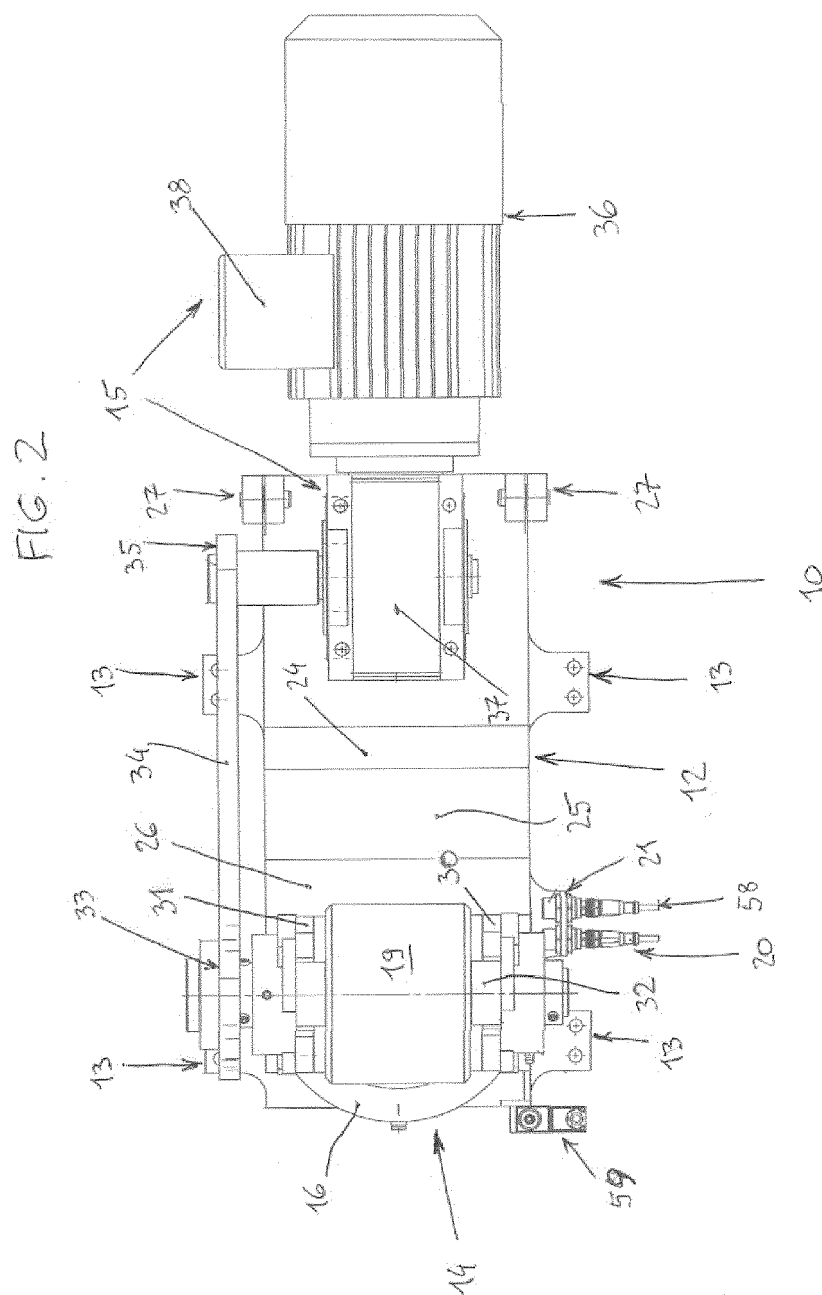
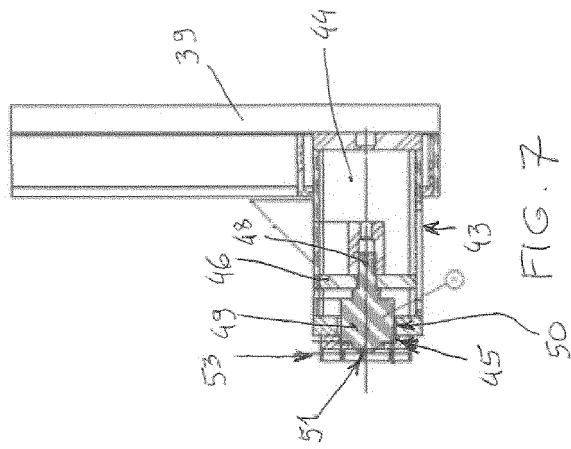
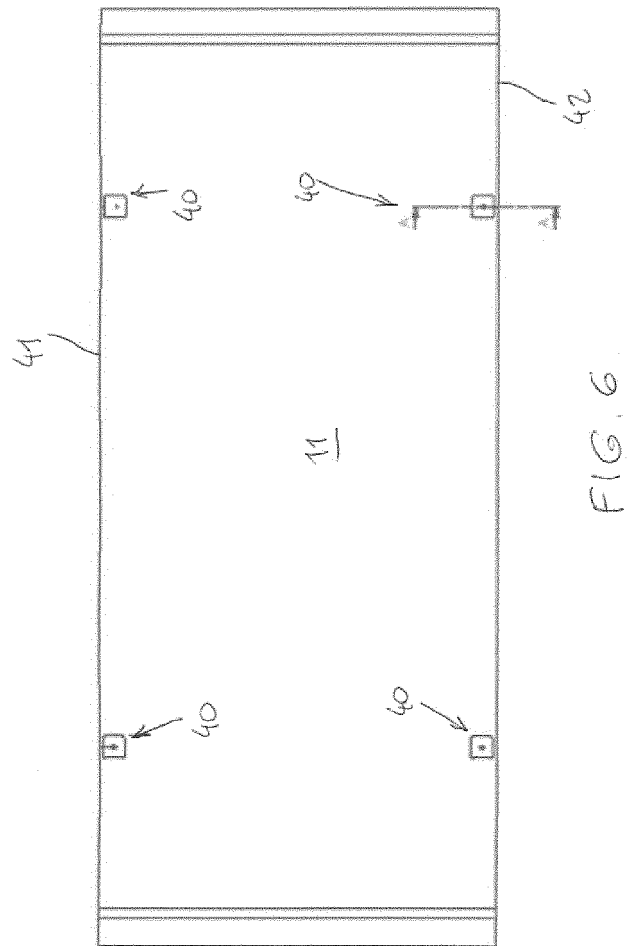
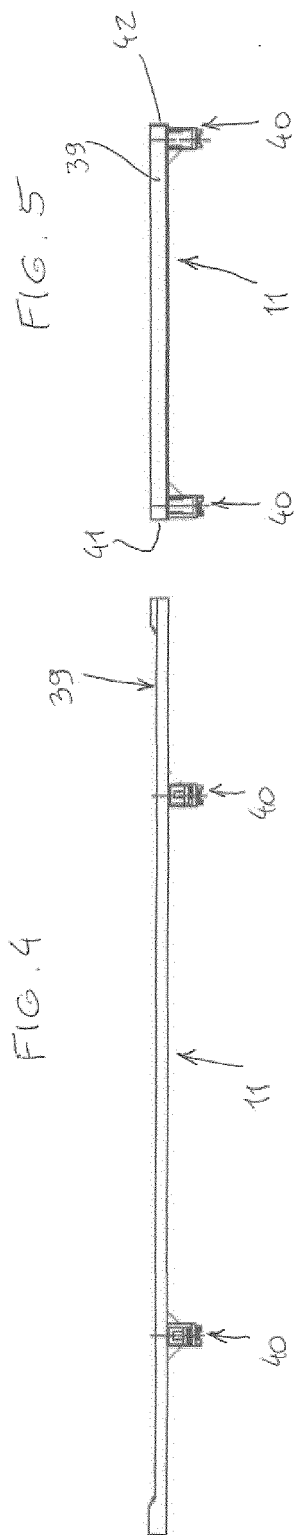
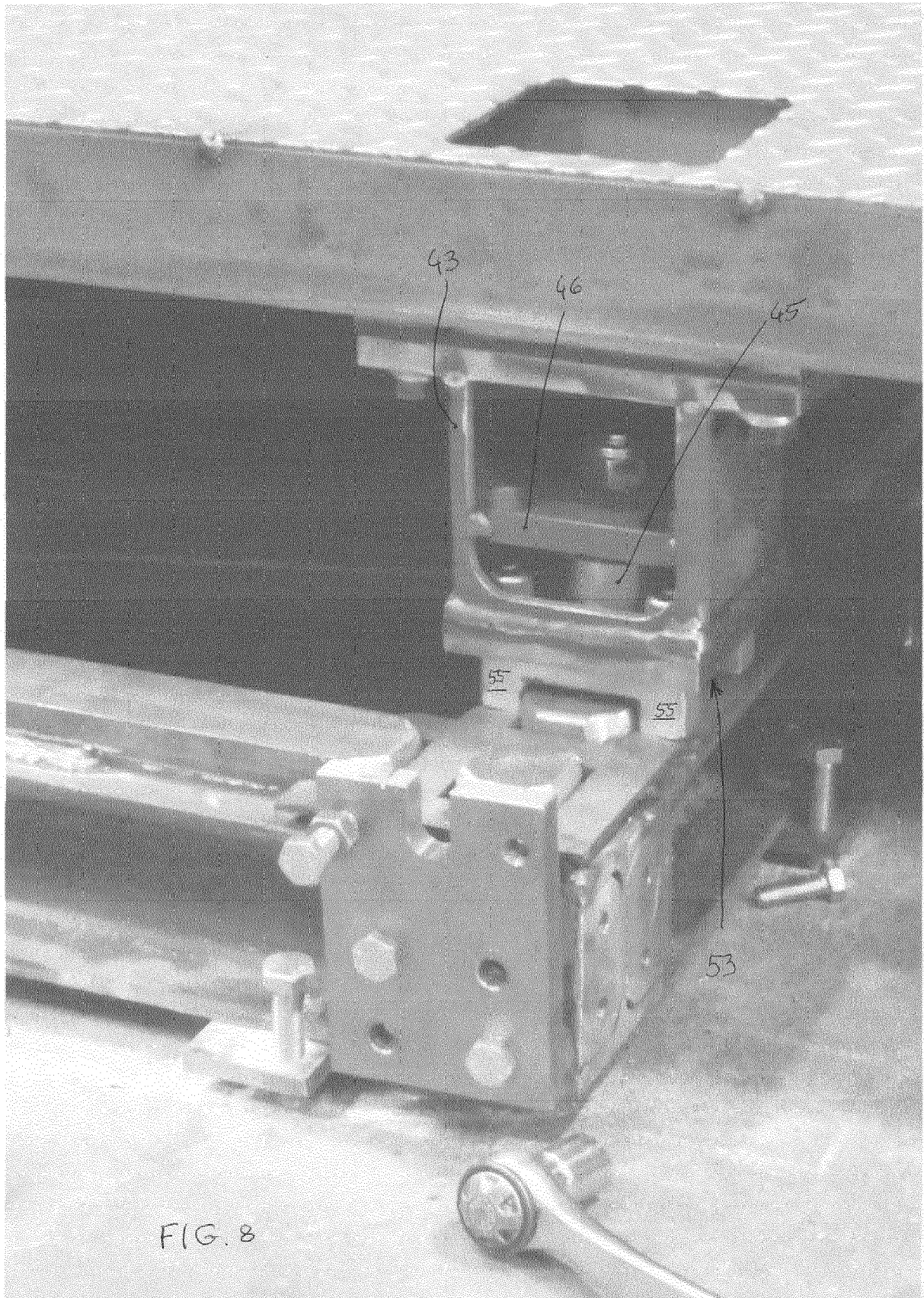


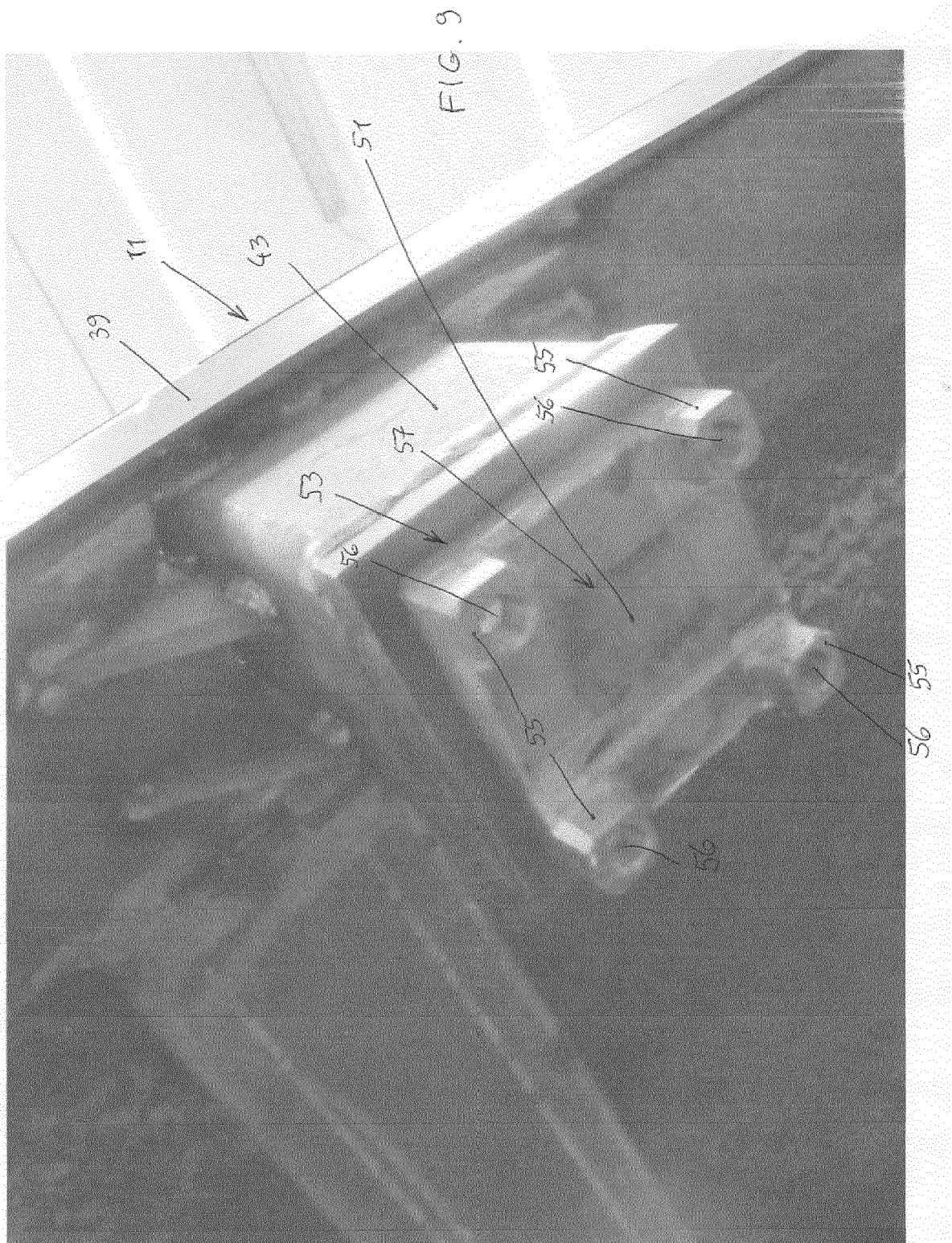
FIG. 1

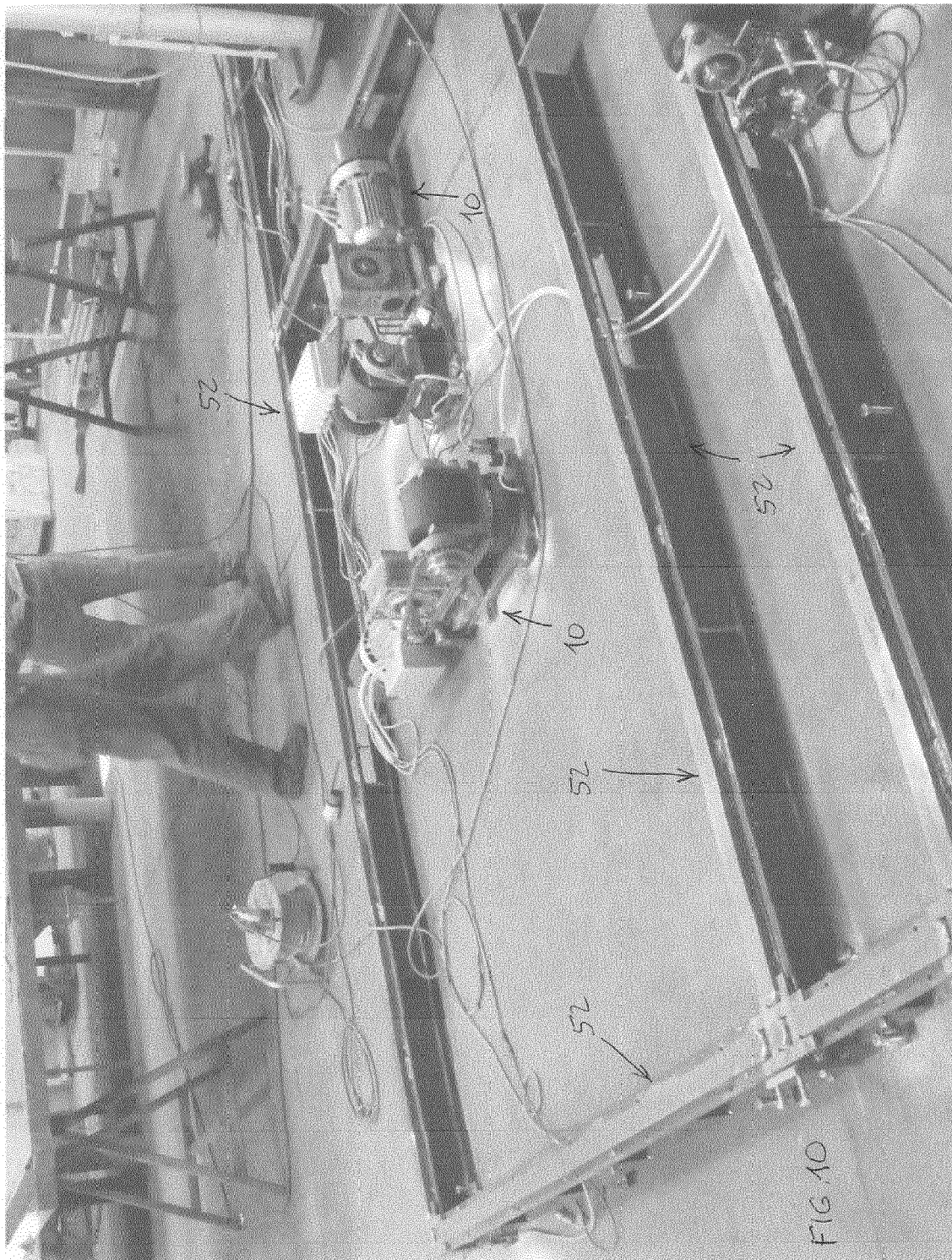
FIG. 3











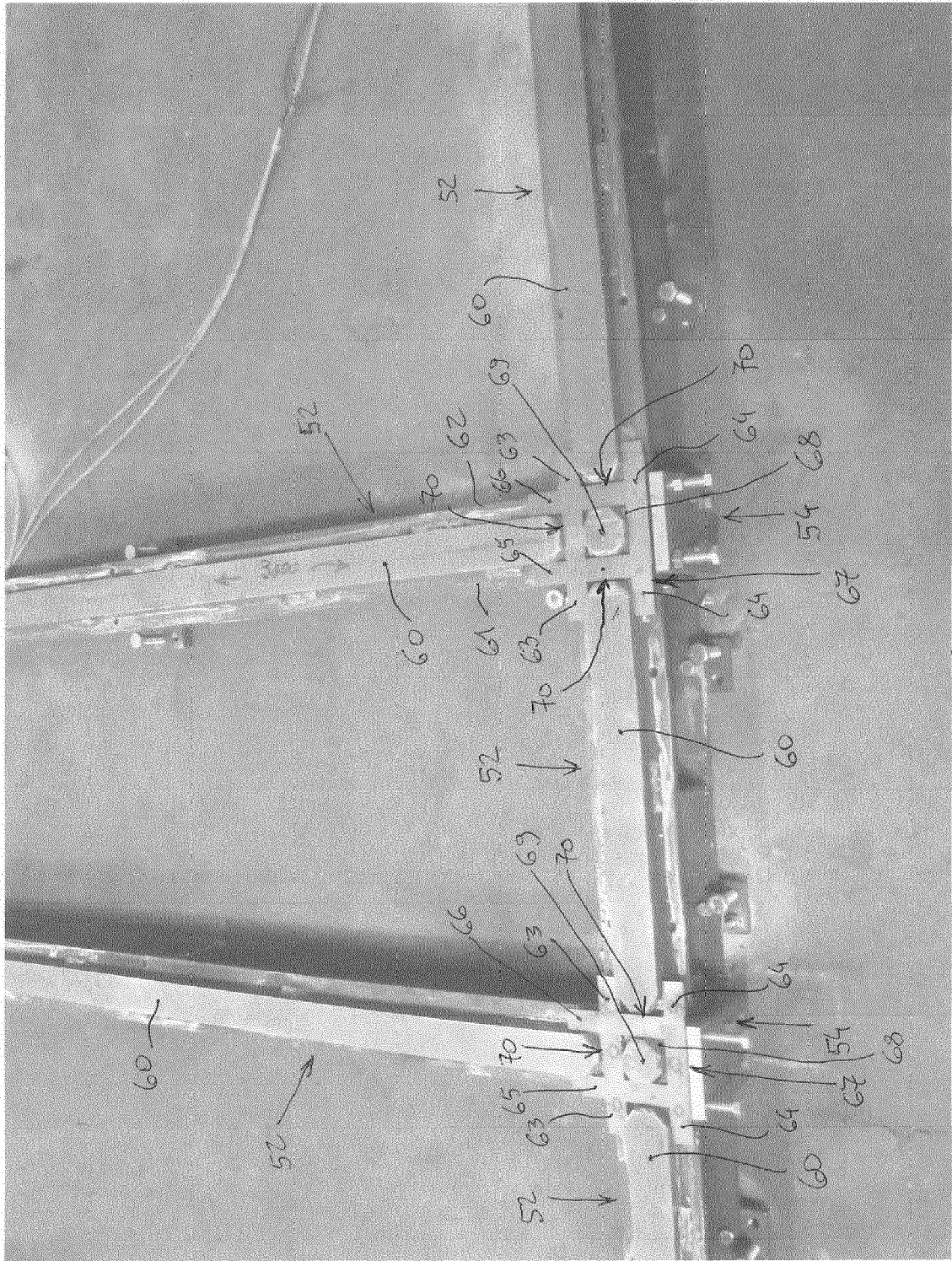


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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