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(54) **Vertically movable floor apparatus for swimming pool and the like**

(57) A vertically movable floor apparatus for swimming pool and the like in which the movable floor is readily set to a required height level and provided with a stably supporting device for preventing shaking of the movable floor. The apparatus comprises a movable floor having means for giving it buoyancy under water by sealing air therein, a lifting device for vertically moving

the movable floor, stably supporting device for supporting the movable floor in a required height level. The lifting device has a chain to which suitable tension is given by a tension wheel. The stably supporting device includes a locking device provided for the movable floor and a state detection device for detecting which of a lock state and an unlock state of the locking device.

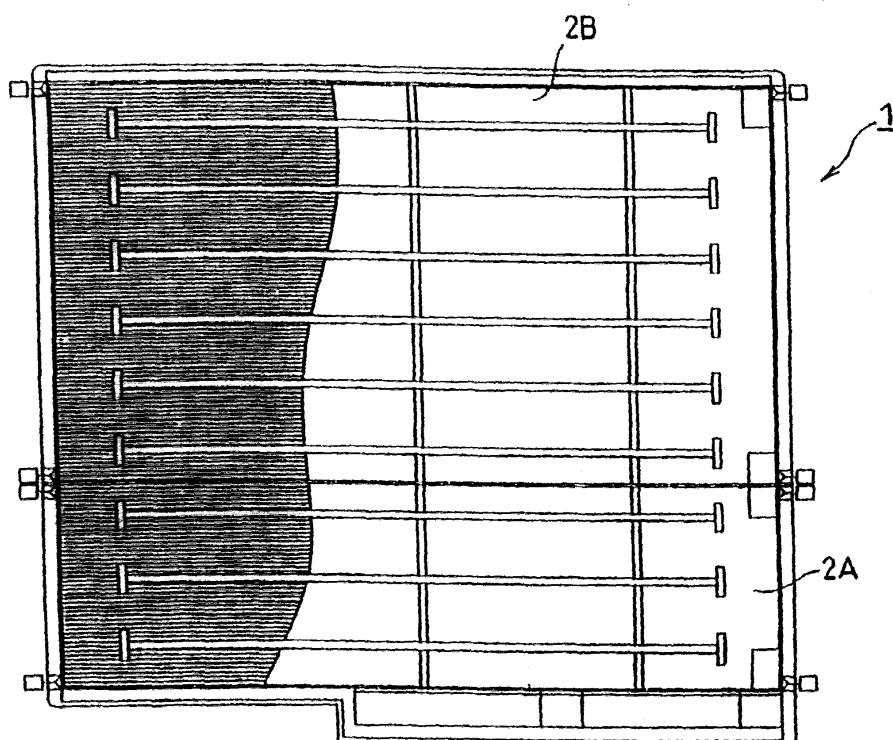


Fig. 1

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a vertically movable floor apparatus of swimming pool and the like in which the movable floor can be certainly and safely set to a required vertical position.

[0002] In recent years, health care consciousness raises and swimming becomes popular among persons from children to old men as one of the most suited sports for health care and facilities such as swimming clubs have gradually developed.

[0003] In general, swimming pools in the facilities are formed in depth convenient for adults. In case a pool is used for children or juniors, it is required to adjust the depth of the pool to make the pool shallower. There are proposed various apparatuses capable of adjusting the depth of the pool to an optional level.

[0004] For example, in one conventional method, many plates having legs are arranged on the fixed floor of the pool to be able to remove them when the adults use the pool. In another conventional method, a vertical movable bottom floor of a pool is moved by means of a mechanism such as bellows, pantographs, cylinders or so.

[0005] However, in the former, it is very troublesome to carry the plates in the pool and remove them from the pool. In the latter, when such a mechanism is provided for a pool, it is required to destroy and construct the pool with high construction expenses and there is a problem that the pool cannot be utilized under construction.

[0006] Further, in the above conventional vertical movable floor device for pool and the like, even if the movable floor is set to a required height, the movable floor slightly shakes up and down or horizontally by waves, actions of swimmers and others to give swimmers a feeling of uneasiness and to lack safety.

SUMMARY OF THE INVENTION

[0007] In the light of the state of the art described above, it is an object of the present invention to provide a vertically movable floor for swimming pool and the like capable of easily and rapidly setting the movable floor for pool and the like to a required depth position, providing the pool with such a vertical movable floor without destroying the fixed floor of the pool in a very short construction period with a low cost, setting the movable floor to a required height level, locking the movable floor to satisfactorily prevent unstable movements thereof, and offering superior safety.

[0008] In order to achieve the above object, a vertically movable floor for swimming pool and the like according to the present invention comprises a vertically movable floor apparatus capable of moving in up and down direction and in which air is hermetically sealed so that buoyant force of the movable floor becomes sub-

stantially zero in the water, a lifting device for moving the movable floor up and down, and a stably supporting device for keeping the movable floor a required height position. The lifting device includes chains disposed on at least side portions of the movable floor opposite each other, groups of wheels on which the chains are wound, respectively, and a motor for driving at least one wheel of the groups of wheels. The chains wound on the groups of wheels are given suitable tension by a tension wheel of the group of wheels. The stably supporting device includes a locking device disposed on the movable floor, a state detecting device for detecting whether the locking device is in lock state or in unlock state, and a device for preventing the movable floor from horizontally moving during operation for moving the movable floor up and down.

[0009] In the present invention, the vertically movable floor may be divided into a plurality of vertically movable floor members capable of independently moving up and down, respectively, or the movable floor may be formed to occupy a part of opening area in the pool. The movable floor may be provided with a device for locking a wheelchair.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a plane view showing an embodiment of the vertically movable floor apparatus for swimming pool and the like relating to the present invention with removing a part of upper portion of the apparatus.

[0011] Fig. 2 is a side view for explaining the movable floor apparatus.

[0012] Fig. 3 is a front view for explaining the movable floor apparatus.

[0013] Fig. 4 is a plain view of one of movable floor members constituting the movable floor.

[0014] Fig. 5A is a perspective view of an important part of a floor member.

[0015] Fig. 5B is a plane view showing an example for connecting the movable floor members.

[0016] Fig. 6 is an plane view showing a mechanical structure of the lifting device for the movable floor apparatus.

[0017] Fig. 7 is a diagram for explaining a tension application mechanism for the lifting device.

[0018] Fig. 8 is a side view showing a mechanical structure of the lifting device.

[0019] Fig. 9 is a partial diagram of the movable floor explaining a state in which a roller for preventing the shaking of the movable floor is fitted

[0020] Fig. 10 is a plane view showing a state of the roller fitted to the movable floor.

[0021] Fig. 11 is a side view of a device for locking the movable floor apparatus.

[0022] Fig. 12 is a front view of the movable floor locking device.

[0023] Fig. 13 is a block diagram showing a state detection device in the movable floor apparatus being set

to a locking state.

[0024] Fig. 14 is a block diagram showing the state detection device being set to unlocking state.

[0025] Fig. 15 is a half sectional view showing a structure of an electromagnetic valve of the state detection device.

[0026] Fig. 16 is a side view of the electromagnetic valve.

[0027] Fig. 17 is a diagram of the state detection device for explaining states of a second electromagnetic valve with omitting a part thereof when switching it in a locking state or an unlocking state.

[0028] Fig. 18 is a plane view showing a stabilizer for preventing the shaking of the movable floor.

[0029] Fig. 19 is a side view showing the stabilizer.

[0030] Fig. 20 is a plane view showing arrangement state of a device for preventing the movable floor members from overlapping.

[0031] Fig. 21 is a sectional view showing an operational example of the overlap prevention device.

[0032] Fig. 22 is a sectional view showing another operational example of the overlap prevention device.

[0033] Fig. 23 is an explanation diagram showing an important portion of the overlap prevention device with enlarging it.

[0034] Fig. 24 is an explanation diagram showing a movable floor providing with a handrail.

[0035] Fig. 25 is an enlarged explanation view showing the handrail provided for the movable floor.

DETAILED EXPLANATION OF EMBODIMENTS

[0036] The present invention is explained in detail with reference to embodiments of the present invention as illustrated in the accompanying drawings.

[0037] In an embodiment of the vertically movable floor apparatus for swimming pool relating to the present invention, as shown in Figs. 1-4, there are comprised a vertically movable floors 2A and 2B which are capable of vertically moving to opening portion of the pool 1 and in which air is hermetically sealed so that the buoyant force thereof is substantially zero under water, lifting devices 10 for independently moving up and down each of the movable floors 2A and 2B, and a stably supporting device 20 for supporting the movable floors 2A and 2B to keep it in a required height.

[0038] The movable floor comprises floor members 3 including a number of rectangular pipes made from aluminum, stainless or plastics, and support frames 4 formed in a rectangular shape fixedly for support floor members 3 (refer to Fig. 5A).

[0039] Many floor members are arranged in mutually parallel. For example, in a swimming pool having width of 5 meters and length of 15 meters, many floor members 3 are assembled in a rectangular form to suit the movable floor to a size of the pool by steadily fixing the floor members on the support frames 4 by means of bolts and nuts or the like.

[0040] Air is enclosed in the rectangular pipes constituting the individual floor member 3 and both the ends of the respective rectangular pipes are hermetically sealed by plugs like rubber caps. Such structure gives the movable floors 2A and 2B buoyant force to reduce weight thereof under water. Especially, it is possible to suitably adjust the weight of the movable floors 2A and 2B under water, if some of rectangular pipes are sealed by the plugs and the remaining rectangular pipes are in taking off the plugs. In that case, the weight of the movable floors 2A and 2B under water is substantially zero, if a balance is taken between the weight and the buoyancy of the movable floor, as a result, it is possible to minimize a driving power for vertically moving the movable floors 2A and 2B under water. In addition, it is possible to adjust the buoyancy of the movable floors 2A and 2B by removably fixing a suitable number of floats not shown in the drawings on the under surface of the movable floors.

[0041] A kind of floor member 3 is manufactured in the manner of pultrusion to be longitudinal members made of rigid vinyl chloride resin. Minute roughness is formed on whole surface of the floor member 3 made by the pultrusion. The minute roughness produces friction to prevent a person from slipping on the floor members. Accordingly, it is not required to stick a special member on the floor members for preventing slip or to add a special material in the floor member material, as a result, the floor member can be produced with low cost.

[0042] The longitudinal floor member has three spaces 3C, 3D and 3E compartmentalized by partitions 3A and 3B as shown in Fig. 5A. The bottom of the center space 3D has a slot for inserting a fixing member such as the bolt and nut.

[0043] Plugs 3H can be removably capped at both ends of the spaces 3C and 3E to seal air in the spaces 3A and 3C.

[0044] On the other hand, referring to Fig. 5B, the support frame 4 comprises a plurality of connection members 6 for connecting a plurality of floor members 3 arranged in mutually adjacent. The floor members are made from an inherent light material such as aluminum material, plastics material, or stainless material or a material made in light weight. The floor members 3 made from such a material are connected with one another by the conventional connection members 6 to form the movable floor in a required area.

[0045] The movable floors 2A and 2B formed in the manner as mentioned above may be formed in the same area as that of an opening portion of the pool 1, or only one of the movable floors 2A and 2B may be constructed.

[0046] The movable floors 2A and 2B are vertically moved by respective lifting devices 10 in independent from each other. The lifting devices 10 are disposed in recesses 2a formed at facing portions on facing side-walls of the pool and at portions on the pool sidewall

corresponding to both end portions of longitudinal sides of the movable floors 2A and 2B (refer to Fig. 1). Referring to Figs. 6-8, the respective lifting device 10 includes a plurality of guide boxes 11 for guiding the movable floors to be vertically moved, a group of pulleys P installed in each of the guide boxes, an electric motor M provided in the pool side 1c as a driving source, a non-step transmission 13 which does not need any speed change gears, operating as a reduction gear box which is driven by the electric motor M, and a cable 14 such as chain, rope, wire or the like which is laid or wound on the pulleys and a part of the cable is fixed to an arm extended from an end portion of each one of the movable floors 2A and 2B.

[0047] The group of pulleys P include upper and lower pulleys 15 and 16, a driving pulley 17, a guide pulley 18 and a tension pulley 19 for adding a suitable tension to the cable 14.

[0048] In Fig. 7, the tension pulley 19 is disposed between the driving pulley 17 and the upper pulley 15, but a position to dispose the tension pulley 19 is not limited to the above position and the tension pulley may be disposed at an optional position capable of adding a suitable tension thereto. Further, the tension may be applied to the cable, for example, by adjusting a position of the tension pulley 19 to move before and behind it by means of a screw, a piston, a cylinder mechanism or the like, or by utilizing the tension of a spring.

[0049] The electric motor M is rotated in one or another direction to rotate the driving pulley 17 at a suitable reduction speed via the non-step transmission 13 to drive the cable 14 in one or another direction, as a result, the movable floor 2A or 2B is vertically moved along the guide boxes 11 to change or adjust the depth of the pool. When the movable floor 2A or 2B reaches to an upper or lower limit position, a switch (not shown) set to one of the limit positions is operated to automatically stop the electric motor M.

[0050] As mentioned before, when the number of the floor members 3 in which the air is filled is adjusted in a suitable number so that the weight of the movable floors 2A and 2B under water is equal to the buoyancy thereof, the movable floors can be smoothly moved under a small driving force and the torque of the electric motor M can be minimized and therefore it is possible to use an electric motor having small size to be economical.

[0051] In the movable floors 2A and 2B assembled in the above structure relating to the present invention, the movable floors further comprise the required number of rollers R against the walls of the pool at some portions on the circumference of the movable floors 2A and 2B to prevent shaking, as shown in Figs. 9 and 10, and the stably supporting device, in order to effectively suppress the shaking occurring by up and down movement when the movable floor is vertically moved or is used.

[0052] In an embodiment shown in Fig. 3, the stably supporting device includes a pair of movable floor locking devices (sizerse) 21 disposed at an interval of a re-

quired distance on a larger one 2B of the movable floors, and a pair of stabilizers for preventing shaking disposed at an interval of a required distance on a smaller movable floor 2A. The locking device 21 is provided with a lock cylinder 31 (refer to Fig. 12) whose a state of lock or unlock is detected by a state detection device 30 (refer to Figs. 13 and 14). The larger movable floor 2B is prevented from shaking by engagement of a chrysanthemum-shaped metal fixture 24 (refer to Figs. 11 and 12). The smaller movable floor 2A does not need strong engagement such as chrysanthemum-shaped metal fixture 24 of the locking device 21 and is satisfactorily supported by the stabilizers 60 for preventing the shaking without an engagement mechanism (refer to Figs. 18 and 19). If the movable floor locking device 21 and the shaking suppression stabilizer 60 have satisfactory strength, they may be disposed on movable floors exchanged from each other, respectively, or they may be disposed on both the movable floors.

[0053] The locking device 21 has a first arm 22 fixed to the bottom floor 8 and a second arm 23 fixed to a lower portion of the movable floor 2B as shown in Figs. 11 and 12. An upper end of the first arm 22 is rotatably connected with a lower end of the second arm 23 through the chrysanthemum-shaped metal fixture 24 as shown in Fig. 11.

[0054] In case the chrysanthemum-shaped metal fixture 24 is engaged, the first and second arms 22 and 23 are kept in an engaged state to lock the movable floor 2B in a required height.

[0055] On the other hand, in case the chrysanthemum-shaped metal fixture 24 is disengaged, the first and second arms 22 and 23 can be freely rotated about an axis of the chrysanthemum-shaped metal fixture 24 so that the movable floor 2B can be freely moved in up and down direction (this state is called an unlock state).

[0056] The engagement and the disengagement of the chrysanthemum-shaped metal fixture 24 is controlled by moving before and behind a piston P constituting a lock cylinder 31 in the state detection device 30 (refer to Figs. 13 and 14), as described hereinafter.

[0057] Referring to Figs. 13 and 14, the state detection device 30 includes the lock cylinder 31, a first and a second reducing valves 32 and 33, a first and a second electromagnetic valves 34 and 35, a first, a second and a third conduits 36, 37 and 38 communicating the above members 31-35 with one another, and pressure sensors 39 and 40.

[0058] The lock cylinder 31 is a fluid pressure cylinder including a cylinder 41 in which a first and a second connection holes 42 and 43 are formed. The first connection hole 42 is formed at a position on a side nearer to an end of the cylinder 41 than a position of the piston P in the lock state. The second connection hole 43 is formed at a position on a side nearer to another end of the cylinder 41 than a position of the piston P in the unlock state. The cylinder 41 further includes a third hole 44 formed at a position on the another end of the cylinder

41, matching with the position of the second hole 43. The first conduit 36 is connected at one end thereof to an air tank 45 which is a fluid storage unit (refer to Fig. 17) and at another end thereof to the first connection hole 42. The second conduit 37 is connected at one end thereof to the first electromagnetic valve 34 which is a first change valve and at another end thereof to the second connection hole 43. The conduit 38 is connected at one end thereof to the air tank 45 and at another end thereof to the third connection hole 44.

[0059] The first electromagnetic valve 34 is positioned on a part of the first conduit 36. There are provided the second reducing valve 33, a one-directional valve 57, the second electromagnetic valve 35 which is a second change valve, and a first pressure sensor 39 for detecting a first set pressure and a second pressure sensor 40 for detecting a second set pressure lower than the first set pressure between the second electromagnetic valve 35 and the third connection hole 44, on the third conduit 38 in order from upstream to downstream.

[0060] The first electromagnetic valve 34 can be changed over between a state in which the first conduit 36 is communicated to the atmosphere and in which the second conduit 37 is connected to the air tank 45 and another state in which the first conduit 36 is connected to the air tank 45 and in which the second conduit 37 is communicated to the atmosphere. The second electromagnetic valve 35 can be changed over between a state in which the third conduit 38 is communicated to the atmosphere and another state in which the third conduit 38 is connected to the air tank 45.

[0061] The first and second electromagnetic valves 34 and 35 are a conventional one as shown in Figs. 15 and 16. The electromagnetic valve shown in Figs. 15 and 16 has a first and a second connection holes 48 and 49 on both ends in longitudinal direction (in horizontal direction on Fig. 15) of a cylinder portion 47 having a bottom in which a hollow portion 46 is formed. The electromagnetic valve further has a third connection hole 51 on a side opposite the connection holes 48 and 49. A piston 52 can close one of the first and second connection holes 48 and 49. The piston 52 is connected to a rod 53 which is moved before and behind by a solenoid (not shown). Fig. 15 shows a state in which the second connection hole 49 is closed. Accordingly, the first connection hole 48 is communicated with the third connection hole 51 through the hollow portion 46. When the rod 53 is moved in left direction from the state shown in Fig. 15, the first connection hole 48 is closed and the second connection hole 49 is communicated with the third connection hole 51 through the hollow portion 46.

[0062] In the present embodiment, the pressure of a compressed air from the air tank 45 is set to 6.5 Kg/cm^2 . The first reducing valve 32 is set to pressure of 5 Kg/cm^2 and the second reducing valve 33 is set to pressure of 2 Kg/cm^2 . The first pressure sensor 39 detects a first predetermined set pressure (for example, 3 Kg/cm^2). On the other hand, the second pressure sensor 40 de-

fects a second predetermined set pressure (for example, 2 Kg/cm^2) lower than the first predetermined set pressure. The pressure sensor 39 or 40 operates to turn on a light-emitting element (not shown) such as LED when the pressure sensor 39 or 40 detects a pressure value more than the set pressure (3 Kg/cm^2 or 2 Kg/cm^2). Numeral references 55a, 55b and 55c in Figs. 13 and 14 denote opening and closing valves which are usually opened, but they are closed during maintenance work.

[0063] The state detection device 30 in the locking device 21 of the movable floor relating to the present embodiment is assembled as mentioned above. Accordingly, it can be recognized by the light-emitting elements in the manner described hereinafter which state the lock cylinder 31 in the state detection device 30 of the movable floor 2B is in. States to be recognized are a lock state that the locking device 21 is locked, an unlock state that the locking device 21 is unlocked and a fault state that the lock cylinder itself is in fault.

[0064] Next, the operation for detecting the above respective states is explained. Fig. 13 shows a state of the piston P of the lock cylinder 31 in the lock state of the locking device 21. In the case, the first electromagnetic valve 34 is changed over in the state that the first conduit 36 is communicated to the atmosphere and the second conduit 37 is connected to the air tank 45. And the second electromagnetic valve 35 is changed over in the state that the third conduit 38 is connected to the air tank 45. Therefore, the compressed air from the air tank 45 is introduced into the cylinder 41 through the second conduit 37 and then the piston P is moved to draw in the rod 56 connected to the piston P and the locking device 21 is in the lock state. The air forced out from the cylinder 41 by the movement of the piston P sends out into the atmosphere through the first connection hole 42 and the first conduit 36.

[0065] The cylinder 41 is communicated to the second reducing valve 33 through the connection hole 44 and the third conduit 38, but the compressed air of pressure higher than the pressure by the second reducing valve 33 is introduced into the cylinder 41 through the second conduit 37 from the first reducing valve 32. As a result, the pressure in the third conduit 38 becomes higher than the first and second set pressure of the first and second pressure sensors 39 and 40 to turn on both the light-emitting elements corresponding to the first and second pressure sensors 39 and 40.

[0066] As mentioned above, since the light-emitting elements indicate the first detection state that the first and second pressure sensors 39 and 40 detect a pressure value higher than both the first and second set pressures, an operator can recognize that the lock cylinder 31 brings the locking device 21 in the lock state. Further, at least the light-emitting elements of the first and second pressure sensors 39 and 40 are disposed at a place the operator can readily enter and at which the operator can readily observe them.

[0067] Fig. 14 shows a state that the locking device 21 was shifted from the lock state to the unlock state. In the case, the first electromagnetic valve 34 is changed over in a state that the first conduit 36 is connected to the air tank 45 and the second conduit 37 is communicated into the atmosphere. And the second electromagnetic valve 35 is changed over in a state that the third conduit 38 is connected to the air tank 45. Thereby, the compressed air from the air tank 45 is introduced into the cylinder 41 through the first conduit 36 to move the piston P from the position indicated by a broken line to the position indicated by a solid line, as a result, the rod 56 connected to the piston P is pushed out from the cylinder 41 in the left direction to bring the locking device 21 in the unlock state. When the piston P is moved to a left end in the cylinder 41, the air in the cylinder 41 is sent to the atmosphere through the connection hole 43 and the second conduit 37 with the movement of the piston.

[0068] When the piston P reached to the left end in the cylinder 41, the piston P closes the third connection hole 44 and the pressure in the third conduit 38 is under pressure controlled or reduced by the second reducing valve 33. As a result, there is indicated a second state that an light-emitting element corresponding to the first pressure sensor 39 is not turned on and a light-emitting element corresponding to the second pressure sensor 40 is turned on.

[0069] Thus, the first pressure sensor 39 does not detect that the pressure in the conduit 38 exceeds the set pressure (3 Kg/cm²), while the second pressure sensor 40 detects that the pressure in the conduit 38 exceeds the set pressure (2 Kg/cm²). In such a manner, an operator is apprised of the second detection state to recognize that the lock cylinder 31 brings the locking device 21 to the unlock state.

[0070] Next, when the locking device 21 is changed from the lock state to the unlock state, if the lock cylinder 31 is in fault state, explanation is made hereinafter as to how to detect such a fault state.

[0071] In the case, at the beginning, the lock cylinder 31 is in the state as shown in Fig. 13. First of all, the second electromagnetic valve 35 is changed over in the state that the third conduit 38 is communicated to the atmosphere, as shown in Fig. 17 to turn off the light-emitting elements corresponding to the first and second pressure sensors 39 and 40.

[0072] Thereafter, the second electromagnetic valve 35 is changed over in the manner that the third conduit 38 is connected to the air tank 45. On this occasion, the electromagnetic valve 34 is changed over in the manner that the first conduit 36 is connected to the air tank 45 and the second conduit 37 is communicated to the atmosphere.

[0073] When the lock cylinder 31 is in the normal state, as mentioned above, the light for the first pressure sensor 39 is turned off, while the light for the second pressure sensor 40 is turned on. That is to say, in case

the lock cylinder 31 is operated in normal, the pressure sensors 39 and 40 are turned off once and then only the pressure sensor 40 is turned on.

[0074] However, if the lock cylinder 31 is in a fault state, since the piston P does not move to the left end of the cylinder 41, the third conduit 38 is communicated to the atmosphere through the third connection hole 44, the second connection hole 43 and the second conduit 37. As a result, both the lights for pressure sensors 39 and 40 remain being turned off. Accordingly, the operator can be apprised of a fault of the lock cylinder 31 by recognizing that the light-emitting elements continue a turning off state thereof, after once the light-emitting elements are turned off. In this occasion, the operator inspects and repairs the lock cylinder 31.

[0075] The state detection device 30 relating to the present embodiment is assembled and operated as mentioned above. Therefore, although the device 30 has a simple structure, the device 30 can surely detect that the lock cylinder 31 is in one of the three states, that is, the first state in which the locking device is locked, the second state in which the locking device is unlocked and the third state in which the lock cylinder 31 itself is out of order. Accordingly, the maintenance working for the vertically movable floor type pool can surely be achieved. Further, various members such as the first and second electromagnetic valves 34 and 35 and others can use conventional ones.

[0076] In the above explanation of the present embodiment, a fault detection of the lock cylinder is explained as to only when the locking device is changed over from the lock state to the unlock state. The present embodiment executes the fault detection of the lock cylinder 31 only when the locking device is changed over from the lock state to the unlock state for a following reason. In case the locking device is changed into unlock state in order to move up or down the movable floor 2B, if the lock cylinder 31 is out of order, there is the possibility of suffering a great deal of damage to the movable floor system. On the other hand, when the locking device 21 is changed over from the unlock state to the lock state, even if the lock cylinder is out of order, the movable floor system suffers lightly from damage.

[0077] Further, the fault detection for the lock cylinder 31 may be executed not only when the locking device 21 is changed over from the lock state to the unlock state but also when the locking device 21 is changed over from the unlock state to the lock state.

[0078] In order to execute such fault detections, additional constituent elements are needed. That is to say, in Fig. 17, the lock cylinder 31 has a fourth connection hole 58 at a position matching with the first connection hole 42. There is provided a fourth conduit 59 connected at one end portion thereof to the air tank and at another end portion thereof to the fourth connection hole 58.

[0079] On the fourth conduit 59, there are provided a reducing valve and a one-directional valve in the same manner as the third conduit 38, a third electromagnetic

valve like the second electromagnetic valve 35, and a third and a fourth pressure sensors like the first and second pressure sensors 39 and 40. In other words, a conduit 59 like the conduit 38 including the members 33, 57, 35, 39 and 40 in order shown is connected to the fourth connection hole 58. A set pressure of the reducing valve, a third set pressure of the third pressure sensor and a fourth set pressure of the fourth pressure sensor are equal to that of the second reducing valve 33, the first set pressure of the first pressure sensor 39 and the second set pressure of the second pressure sensor 40, respectively. Further, the third electromagnetic valve can be changed over between a state that the fourth conduit 59 is communicated to the atmosphere and a state that the fourth conduit 51 is connected to the air tank 45.

[0080] When the locking device is changed over from the unlock state to the lock state, if both the third and fourth pressure sensors indicates a fourth detection state in which the pressure sensors do not detect a pressure value larger than the respective set pressures together, it is judged that the lock cylinder 31 is in fault state.

[0081] According to the above structure, the state detection device can achieve not only detection of the lock state of the locking device 21, detection of the unlock state of the lock cylinder 21 and detection of a fault state of the lock cylinder 31 in time when the locking device 21 is changed over from the lock state to the unlock state, but also detection of a fault state of the lock cylinder 31 when the locking device 21 is changed over from unlock state to the lock state.

[0082] In the beginning, the lock cylinder 31 is in the state (unlock state) as shown in Fig. 14. Thereafter, the third electromagnetic valve is changed over to a state that the fourth conduit 59 is communicated to the atmosphere to turn off lights corresponding to the third and fourth pressure sensors.

[0083] Next, the third electromagnetic valve is changed over to connect the fourth conduit 59 to the air tank 45. In the case, the first electromagnetic valve 34 is set to a state that the first conduit 36 is communicated to the atmosphere and the second conduit 37 is connected to the air tank 45, as shown in Fig. 13. When the lock cylinder 31 is operated in normal, as mentioned above, the compressed air is introduced into the cylinder 41 through the conduit 37 to move the piston P so that the rod 56 connected to the piston P is drawn in the cylinder 41. Air forced out from the cylinder 41 by the movement of the piston P sends out to the atmosphere through the first connection hole 42 and the first conduit 36.

[0084] On the other hand, since air of reduced pressure (for example, 2Kg/cm²) from the third reducing valve is introduced into the conduit 59, the conduit 59 fills with air reduced by the reducing valve after the piston finishes the movement to the end portion in the cylinder. Accordingly, once the light-emitting elements cor-

responding to the third and fourth pressure sensors are turned off, and then only a light-emitting element for the fourth pressure sensor is turned on. That is, in case the operation is in normal, the lights for both the pressure sensors are turned off and then only the light for the fourth pressure sensor is turned on.

[0085] However, if the lock cylinder 31 is out of order, the first conduit 36 communicated to the atmosphere is connected to the fourth conduit 59 through the first connection hole 42 and the second connection hole 58 to turn on the lights for the third and fourth pressure sensors and thereafter such turning off state is continued. Accordingly, the operator is apprised that both the light-emitting elements continue to be in turning off and the operator can recognize that the lock cylinder 31 is out of order. In the occasion, the operator inspects and repairs the lock cylinder 31.

[0086] Further, description is not made in the drawings, but a display unit is provided as a device for indicating signals or results detected by the pressure sensors 39 and 40 (including the third and fourth pressure sensors, when they are used in an embodiment). In the case, for example, the detected signals are inputted to a controller (CPU) to indicate on the display unit one of the first detection state of the lock state, the second detection state of the unlock state and the third detection state of the fault state (including the fourth detection state of the fault state, when the fourth conduit is provided). In the above structure, the operator can further readily and surely recognize detection states to be obviously apprised of the lock, unlock and fault states as clear information, as a result, the utility is improved. The lock cylinder 31 may use a conventional cylinder such as an oil pressure cylinder as a fluid pressure cylinder.

[0087] Referring to Figs. 18 and 19, the shaking prevention stabilizer 60 includes a first arm 62 installed on the bottom floor 8 and a second arm 61 installed on the movable floor 2A. An end portion (an upper end portion in Fig. 18) of the first arm 62 is rotatably connected with an end portion (an lower end portion in Fig. 18) of the second arm 61 by means of a shaft 63.

[0088] The first and second arms 62 and 61 are assembled by wide channel members as shown in Fig. 18 to surely prevent the movable floor 2A from shaking. A combination of the first and second arms is bended and stretched in accordance with vertical movement of the movable floor 2A.

[0089] In case the shaking prevention stabilizer 60 is installed on the smaller movable floor 2A so that the width direction of the arms crosses 62 and 61 at a right angle to the longitudinal direction of the movable floor 2A, shaking in a direction crossing at a right angle to the longitudinal direction of the movable floor 2A can be surely prevented. Therefore, when walking and others for exercise or rehabilitation under water are taken in condition immersing part of body under the chest or the waist under water, such exercises can be stably done.

[0090] In an embodiment of the present invention,

overlap prevention wall plates 70 and 71 are provided on opposite edge portions of the movable floors 2A and 2B as shown in Figs. 20-23.

[0091] The overlap prevention wall plate 71 is supported on the opposite edge of the movable floor 2B to be capable of sliding in up and down direction. The overlap prevention wall plate 70 is fixedly supported on the opposite edge of the movable floor 2A. The slidable prevention wall plate 71 is slidably engaged with engaging member 72 of the other prevention wall plate 70.

[0092] When the movable floors 2A and 2B are moved to the most lower position, the overlap prevention wall plates 70 and 71 are positioned in condition overlapping and facing each other so that a gap does not occur between the movable floors 2A and 2B, as shown in Fig. 21.

[0093] On the other hand, for example, when one of the movable floors 2a and 2B is lifted to a position higher than the other movable floor as shown in Fig. 22, the prevention wall plates 70 and 71 are provided for the movable floors 2A and 2B are relatively moved along the slidable mechanism 72 to shut a gap between the opposite edges of the movable floors by means of the overlap prevention wall plates. Accordingly, the overlap prevention wall plates surely prevents an accident that any children dive under the movable floor 2A or 2B by accident and a safe movable floors can be provided.

[0094] Further, the overlap prevention wall plates 70 and 71 are not limited to plate members and may be made of metal mesh and such like having stiff and light property.

[0095] Furthermore, in other embodiment of the present invention, a handrail 75 is removably provided on said opposite edge portion of the movable floor 2A or 2B as shown in Figs. 24 and 25.

[0096] In case the handrail 75 is provided, when height levels of the movable floors 2A and 2B are different from each other, any persons can visually recognize the presence of difference in level between the movable floors to improve the safety.

[0097] In the movable floor system providing the stably supporting device including all of the handrail 75, the shaking prevention rollers R, the locking devices 21 for the movable floors, the state detection device 30 and the shaking prevention devices 60, since the movable floor system can effectively prevent various shakings occurring when the pool is used by a lot of people exercising and doing rehabilitation under water, the movable floor system can shapely improve utility and safety.

[0098] In the above embodiments of the present invention, the explanation is made as to the case applying to the vertically movable floor apparatus for swimming pool, but the present invention is not applied to only such a swimming pool. For example, the present invention can be applied to an apparatus for vertically moving a floor in a bath with which an old people's home is provided. Such an movable floor bath apparatus for old people's home can use as a rehabilitation facility for

people having functional disease such as cerebral apoplexy or the like.

[0099] In the movable floor apparatus for swimming pool or the like relating to the present invention, as mentioned above, the movable floor is readily carried and assembled and then set to a required height level. The apparatus does not need a special design for fitting to individual pool or the like and not need a troublesome construction for reforming a bottom floor in a pool. Accordingly, there is not inconvenience as the pool cannot be used for reason of construction in a long term and the movable floor apparatus can be easily installed in a short period to reduce cost for installing it.

[0100] Further, in the present invention, the movable floor is very easily set to a required height level and it is not required that the movable floor is fixed by a working person diving under the movable floor. Moreover, it is possible to provide the movable floor with a shaking prevention roller, a locking device for the movable floor, a state detection device for lock cylinder or a shaking prevention device, or a stably supporting device combining all or some of them. Accordingly, people like swimmers can enjoy swimming and do rehabilitation and others.

Claims

1. A vertically movable floor apparatus for swimming pool and the like comprising:

a movable floor for vertically moving along a sidewall of a pool or the like, said movable floor having means for sealing air giving said movable floor buoyancy so that the weight thereof is substantially zero under water;

a lifting device for vertically moving the movable floor along the sidewall, and

a stably supporting device for keeping said movable floor a required height:

said lifting device including a cable connected to at least edge portion of said movable floor, a group of wheels engaging with said cable, and a driving motor for driving a driving wheel of said group of wheels, wherein said cable is given suitable tension by a tension wheel of said group of wheels; and

said stably supporting device including a locking device installed on said movable floor, a state detection device for detecting which of a lock state and an unlock state said locking device is in, and a device for preventing shaking occurring in accordance with movement of said movable floor.

2. A vertically movable floor apparatus for swimming pool and the like according to Claim 1, wherein said movable floor is divided into a plurality of movable floors which are capable of vertically moving in independent from each other. 5
3. A vertically movable floor apparatus for swimming pool and the like according to Claim 1, wherein said movable floor is provided to occupy a part of opening portion of the pool or the like. 10
4. A vertically movable floor apparatus for swimming pool and the like according to Claim 1, wherein said movable floor includes means for locking a wheelchair. 15
5. A vertically movable floor apparatus for swimming pool and the like according to Claim 1, wherein said movable floor is formed by arranging a lot of floor members. 20
6. A vertically movable floor apparatus for swimming pool and the like according to Claim 5, wherein at least a part of said floor members is made of rigid vinyl chloride resin made by pultrusion. 25
7. A vertically movable floor apparatus for swimming pool and the like according to Claim 6, wherein said floor members are in a longitudinal shape. 30
8. A vertically movable floor apparatus for swimming pool and the like according to Claim 7, wherein at least one of said floor members is a hollow pipe which air is sealed. 35
9. A vertically movable floor apparatus for swimming pool and the like according to Claim 8, wherein said hollow pipe is removably sealed by plugs at ends thereof. 40
10. A vertically movable door apparatus for swimming pool and the like according to Claim 7, wherein each of said longitudinal floor members in which three spaces are formed by dividing by partitions and wherein a center space of said three spaces has a slot for fitting a fixed member therein. 45

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Fig. 1

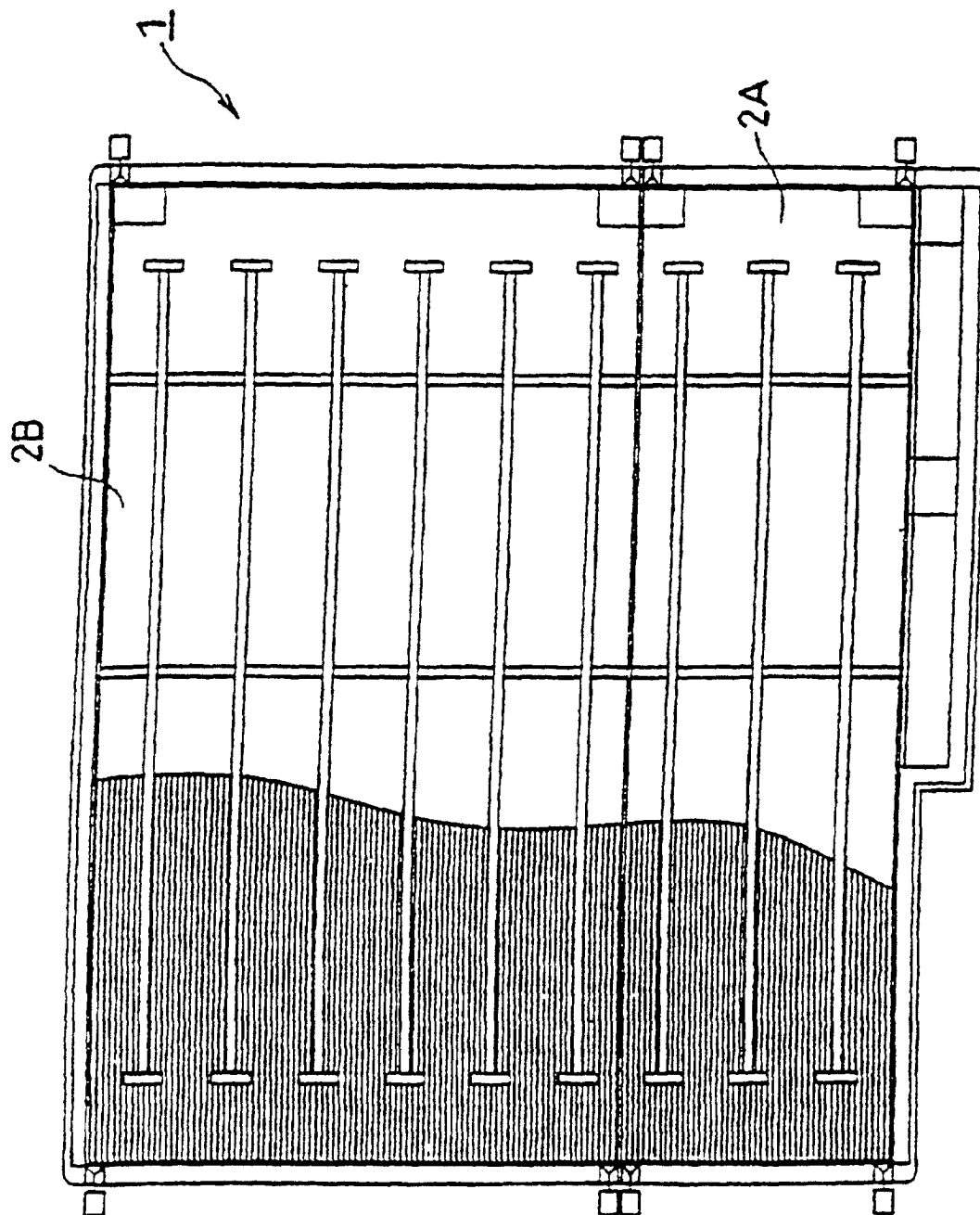


Fig. 2

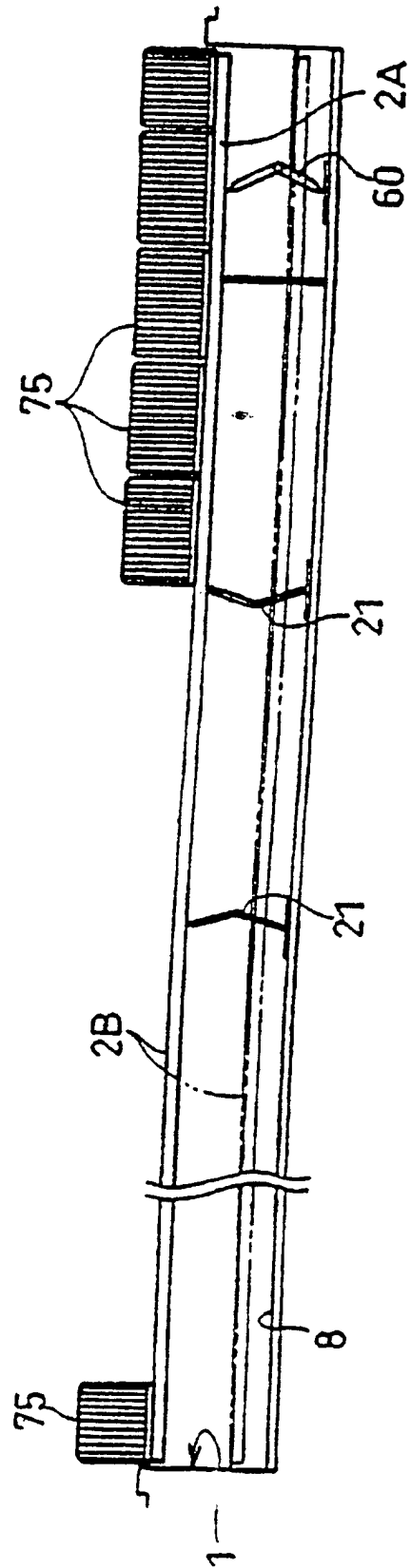


Fig. 3

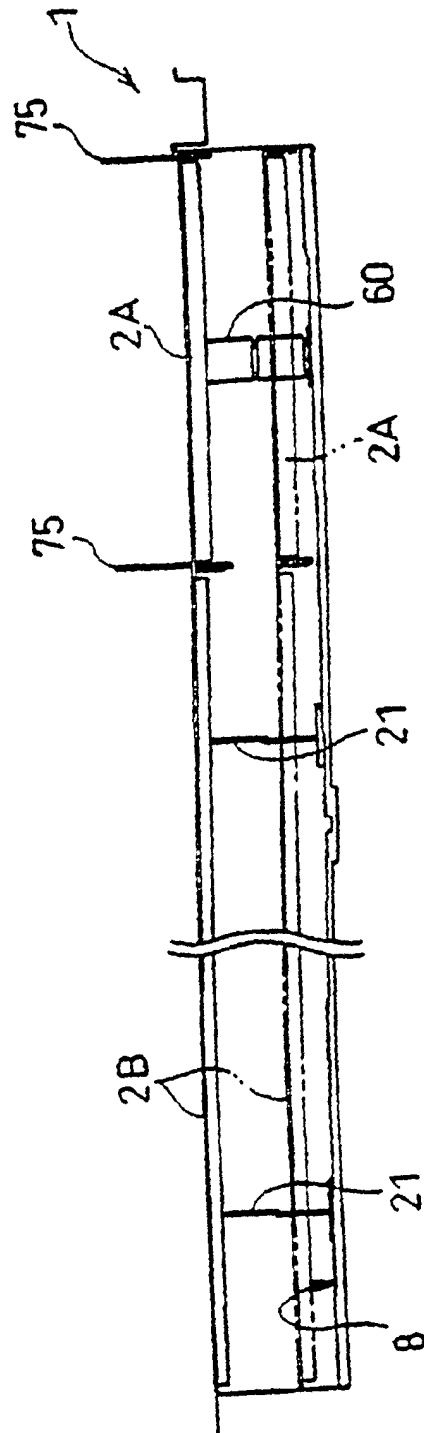


Fig. 4

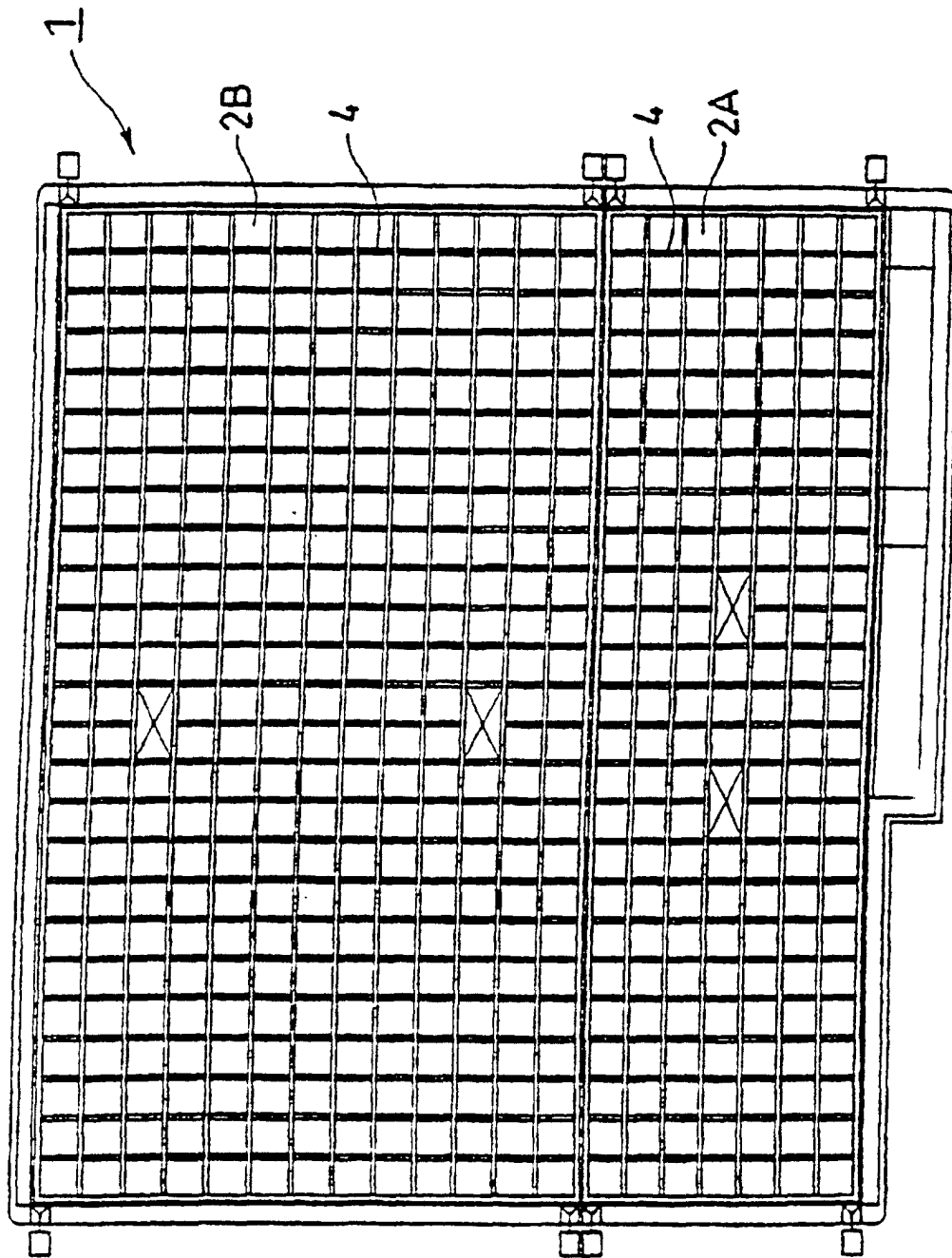
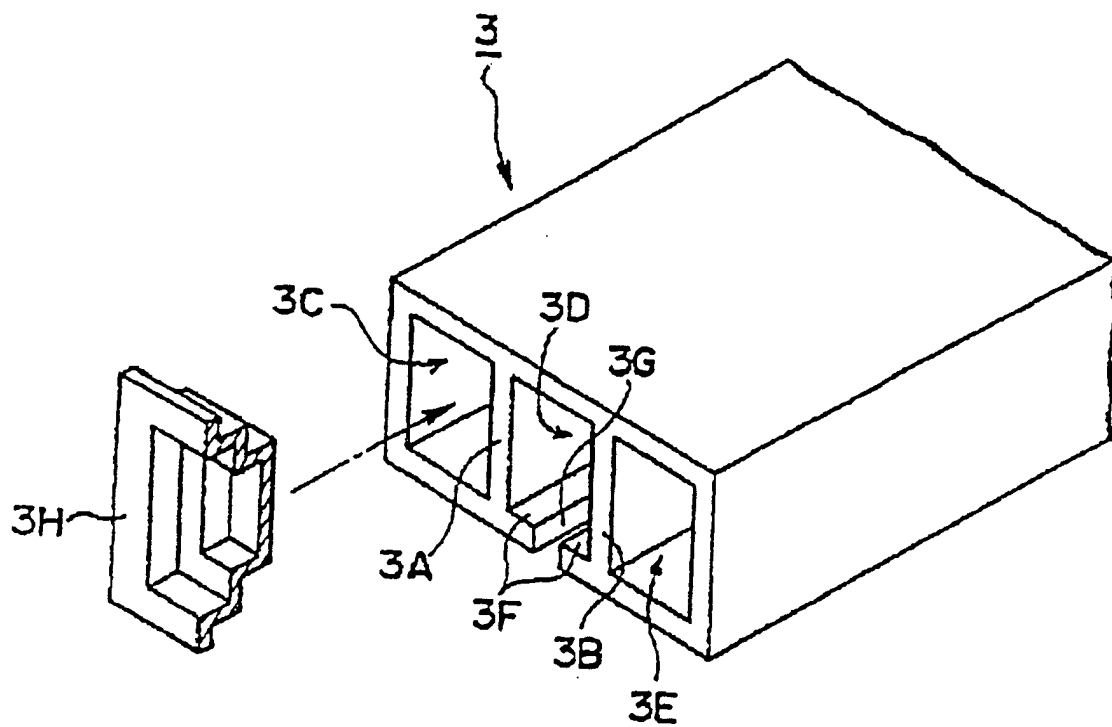


Fig. 5a



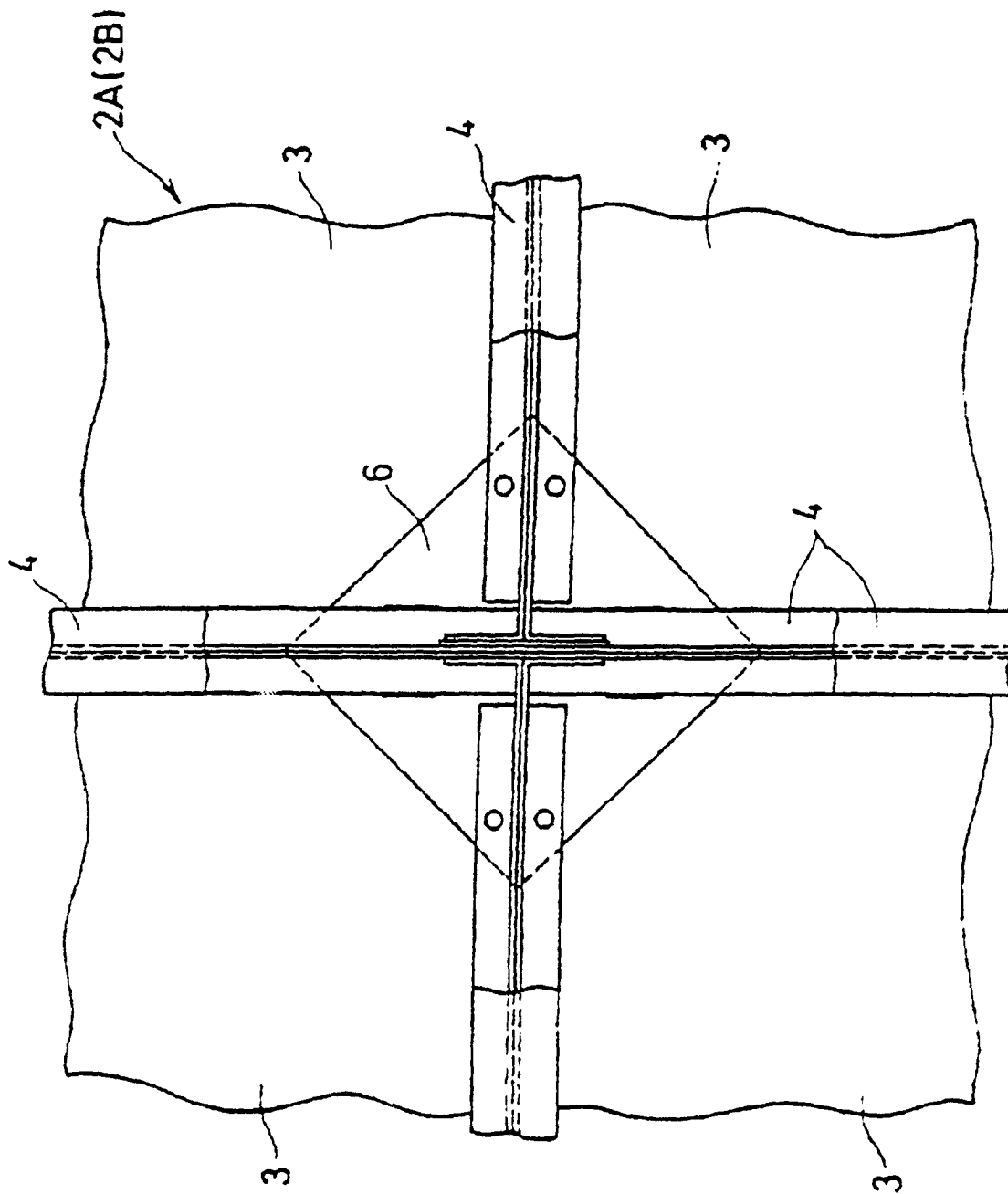


Fig. 5b

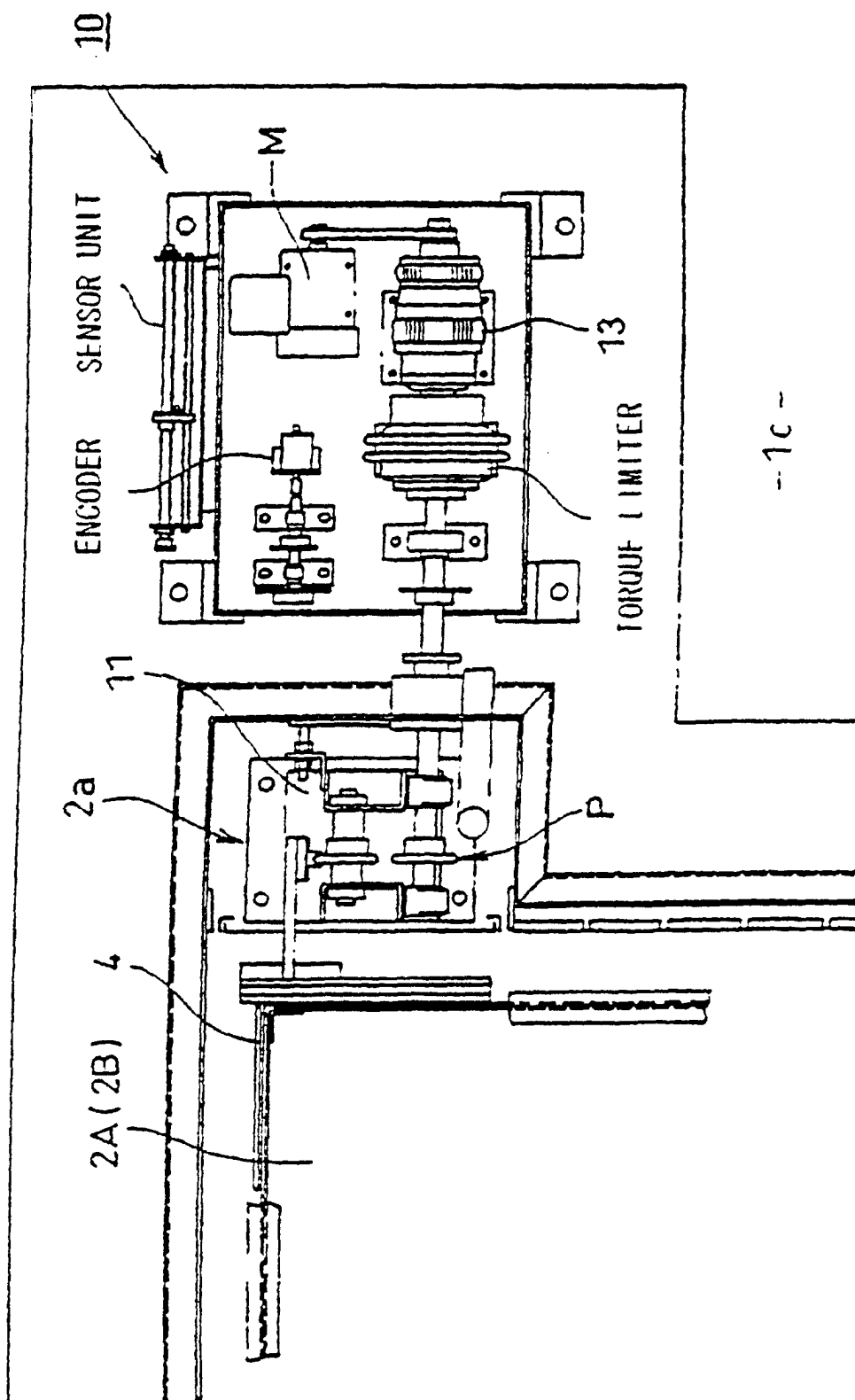


Fig. 6

Fig. 7

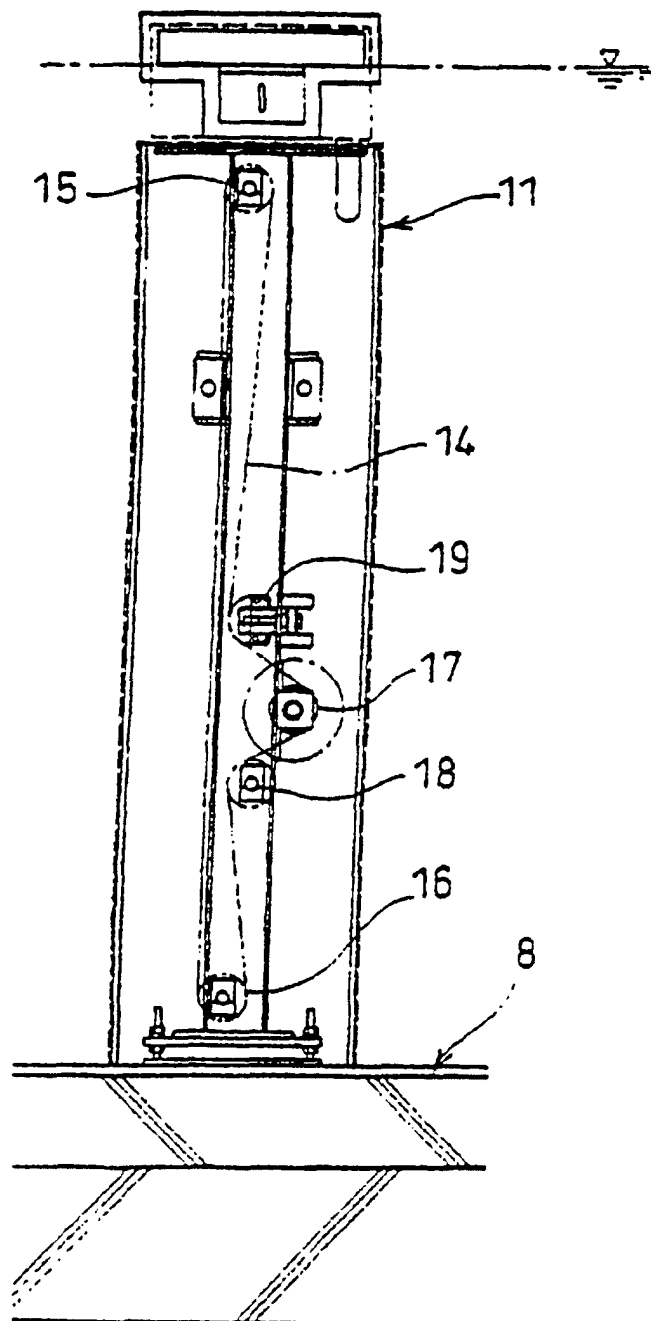
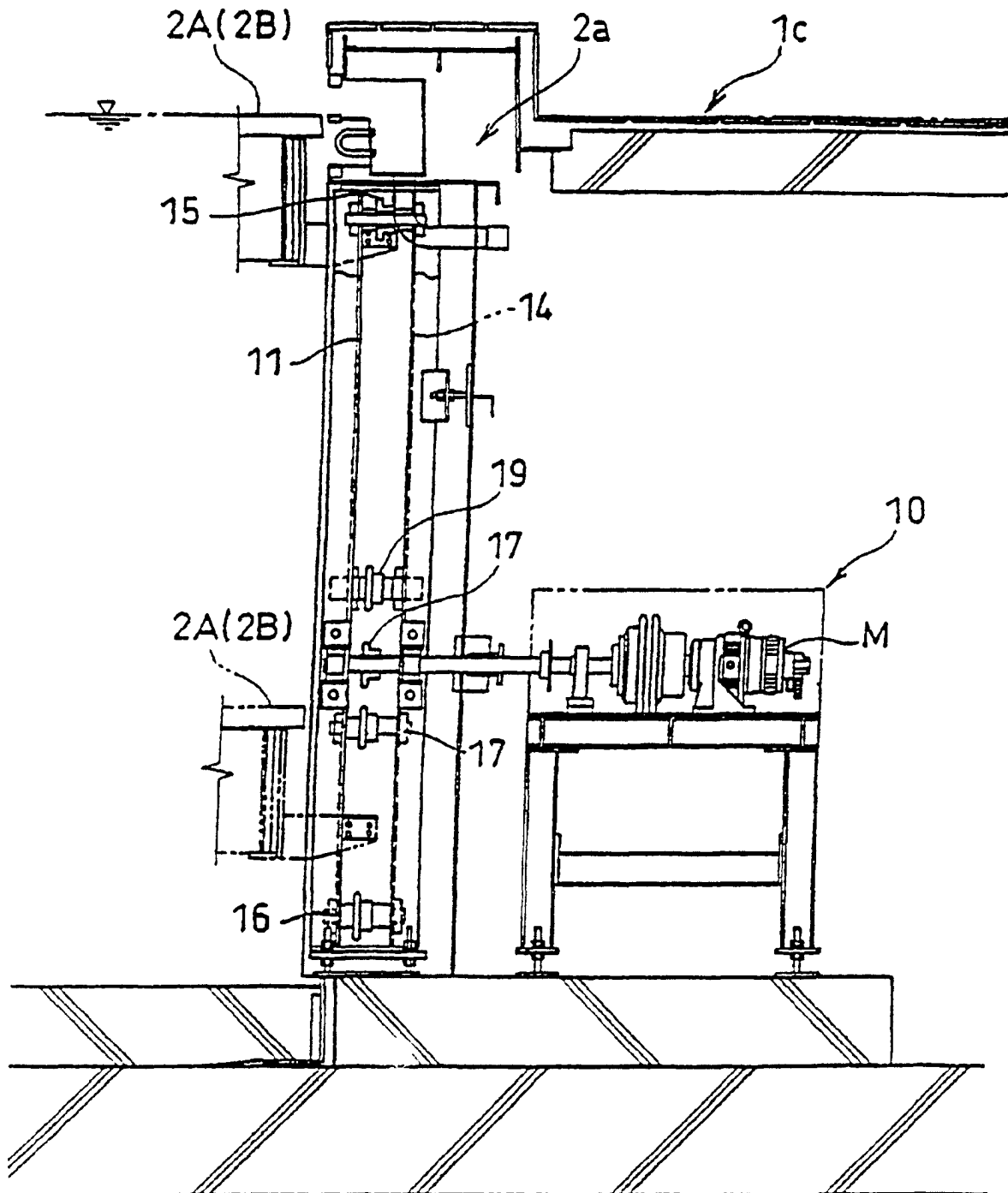


Fig. 8



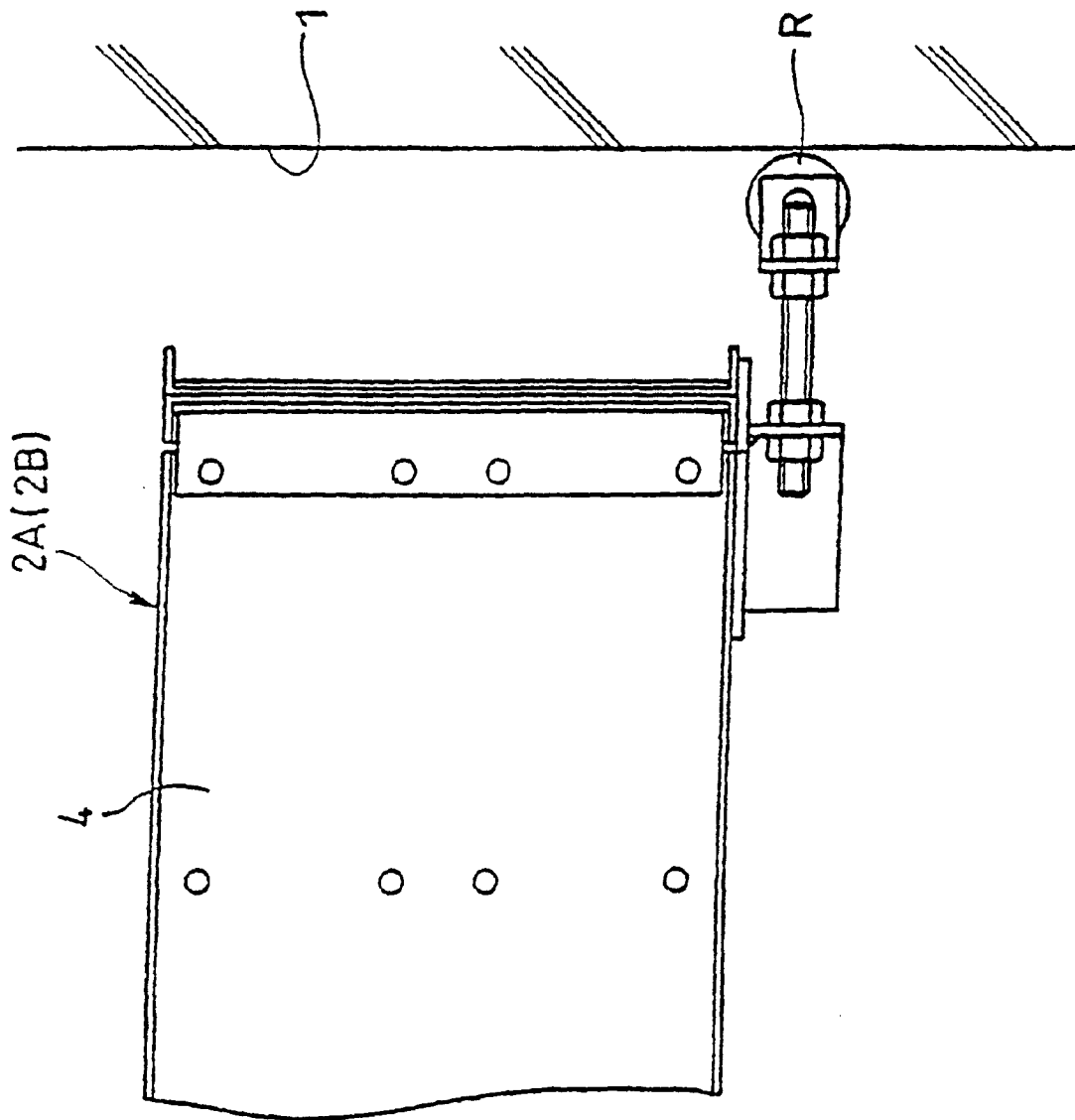


Fig. 9

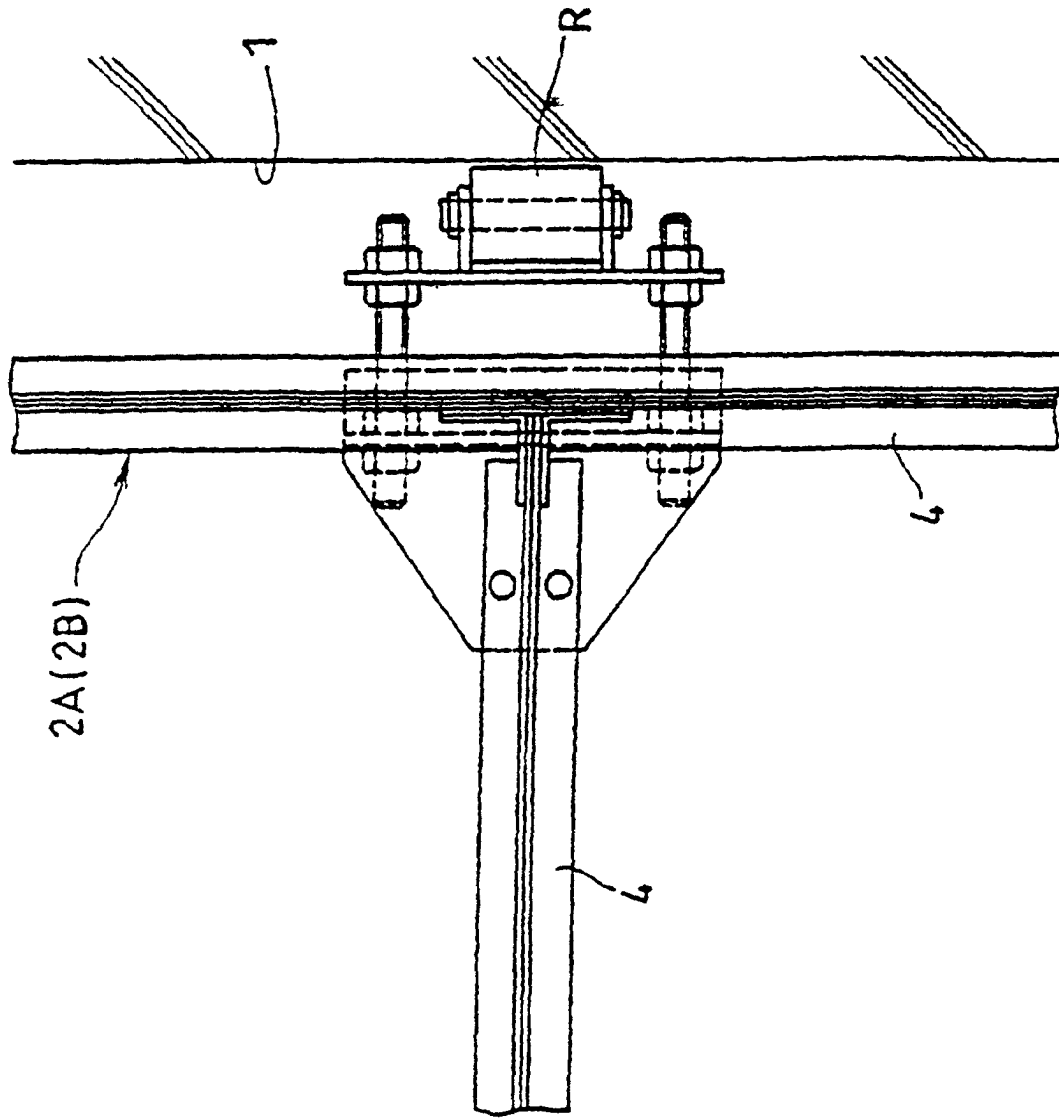


Fig. 10

Fig. 11

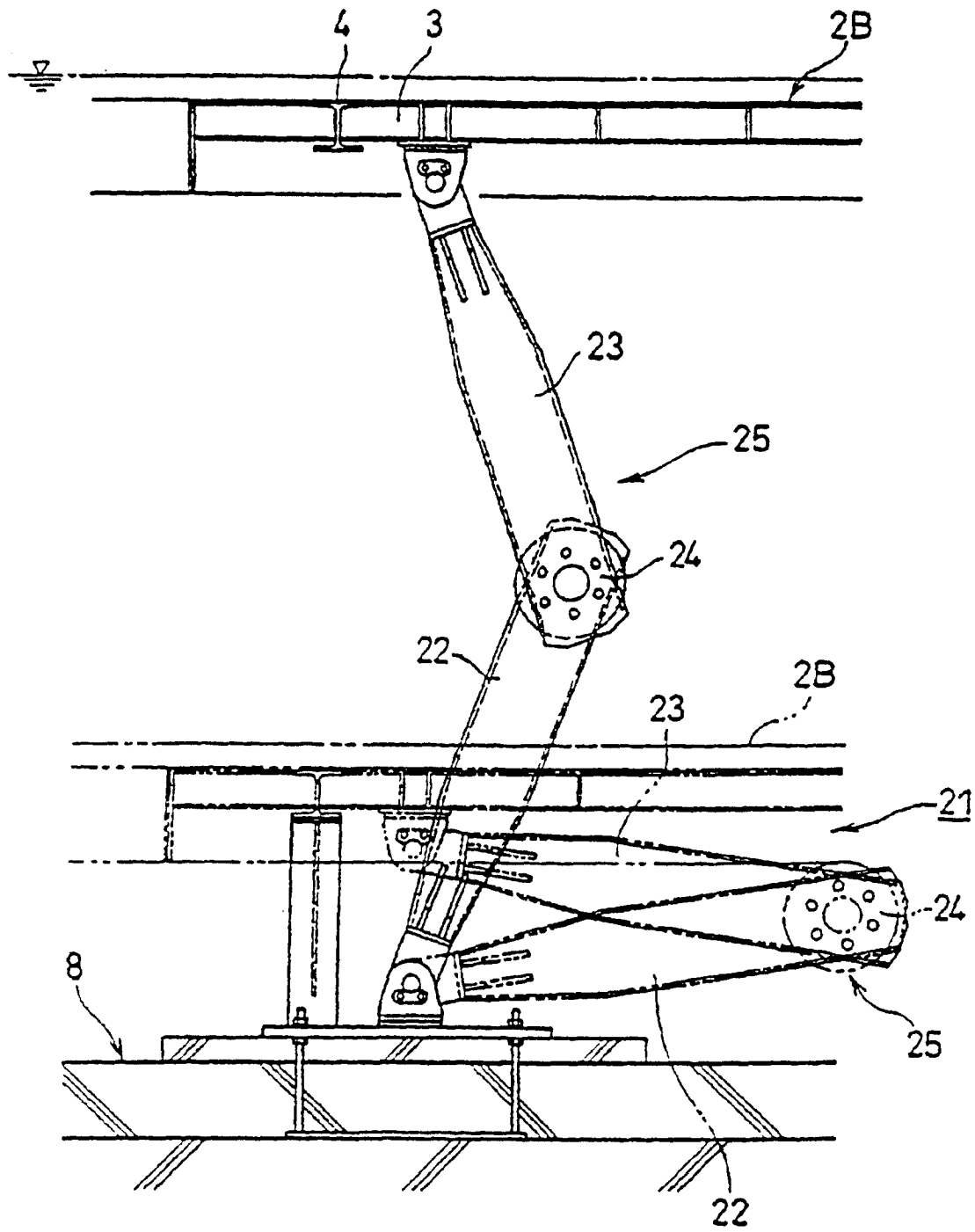


Fig. 12

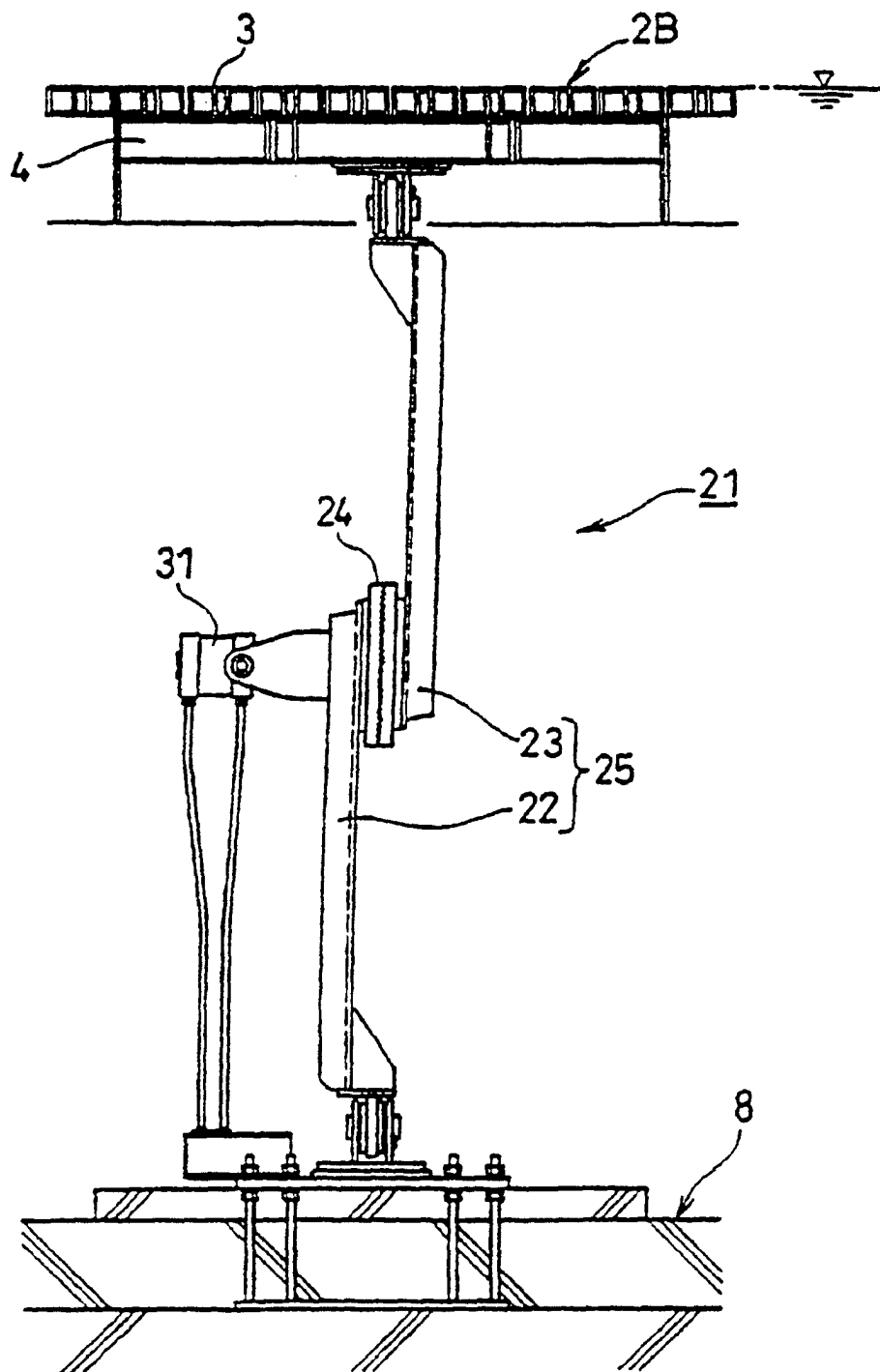


Fig. 13

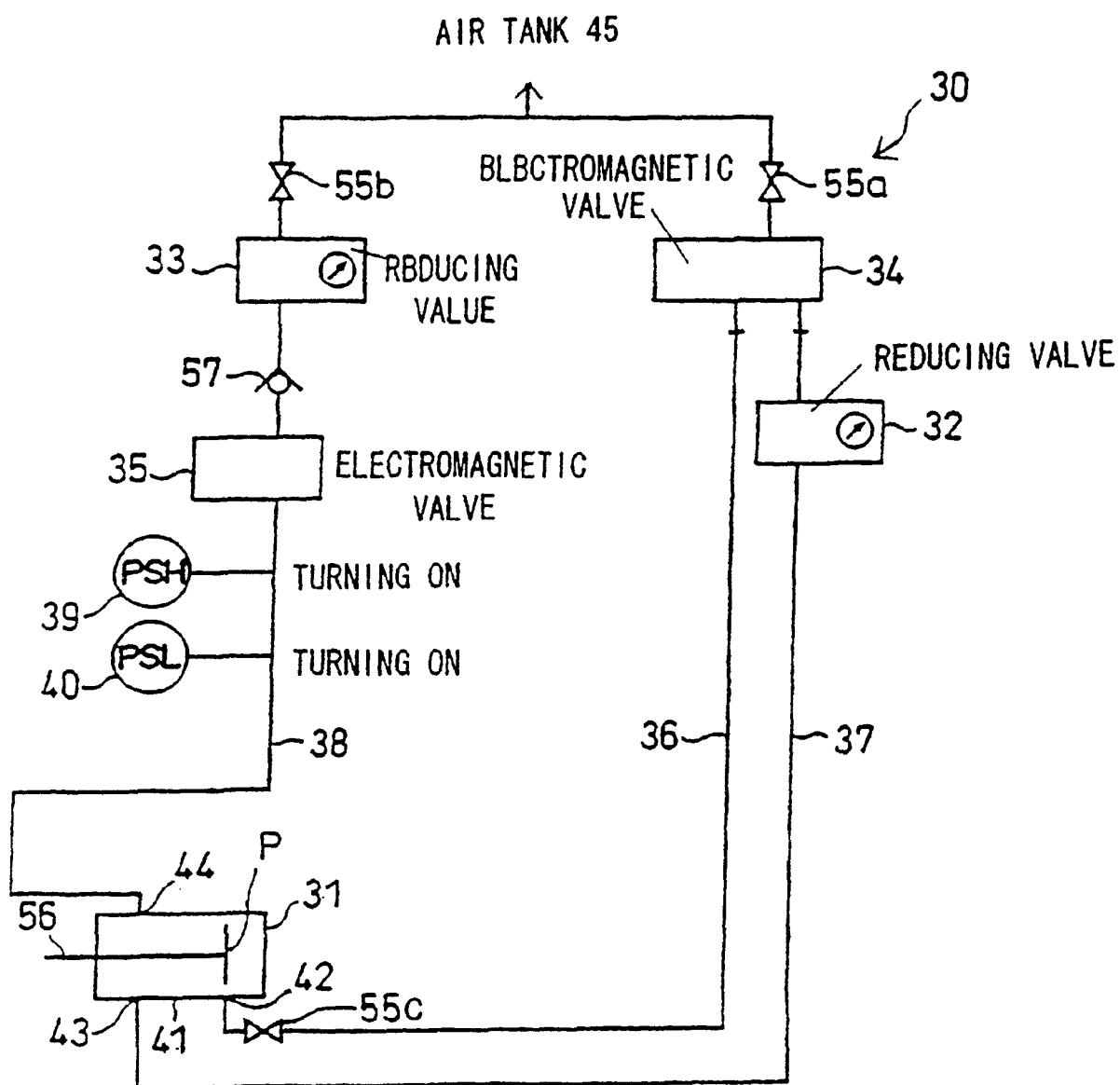


Fig. 14

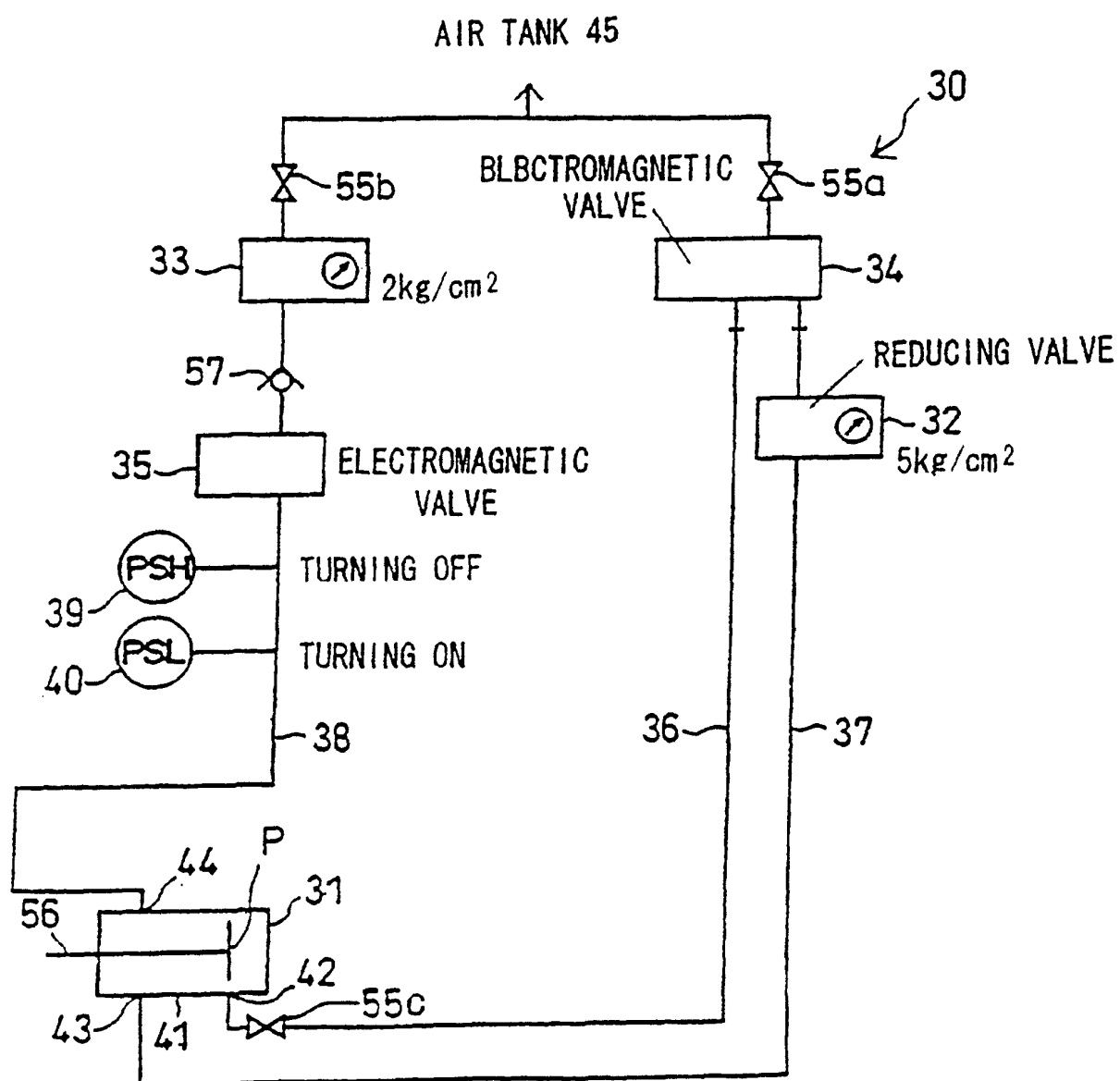


Fig. 15

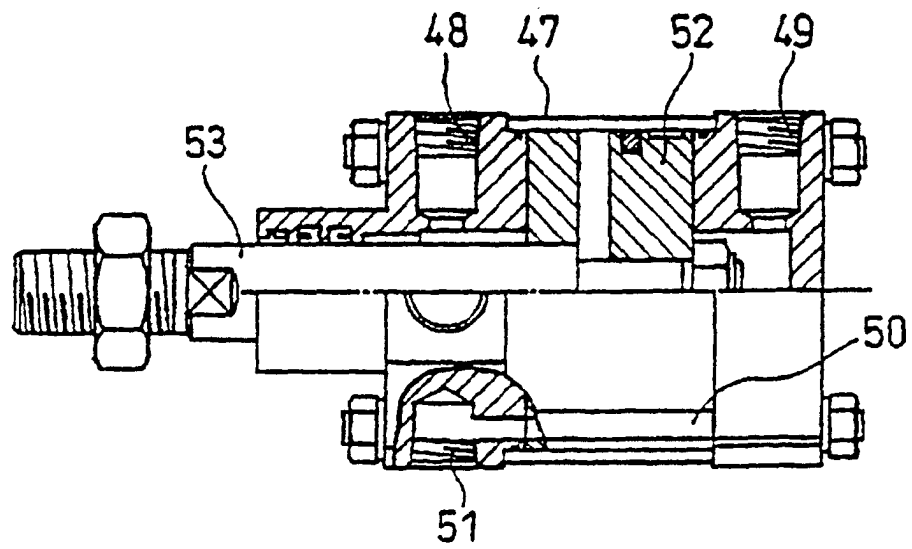


Fig. 16

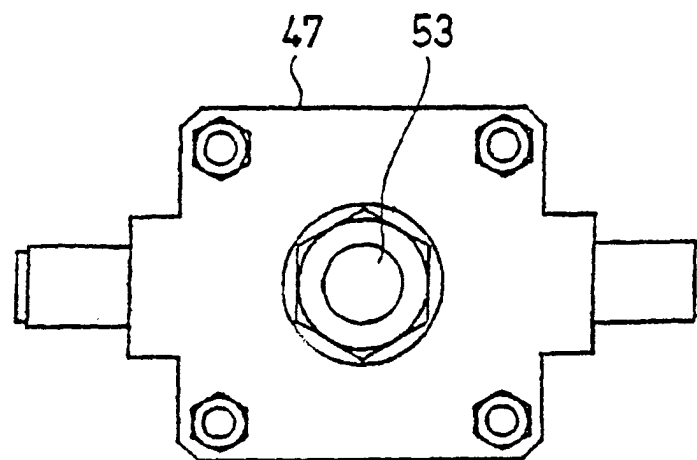


Fig. 17

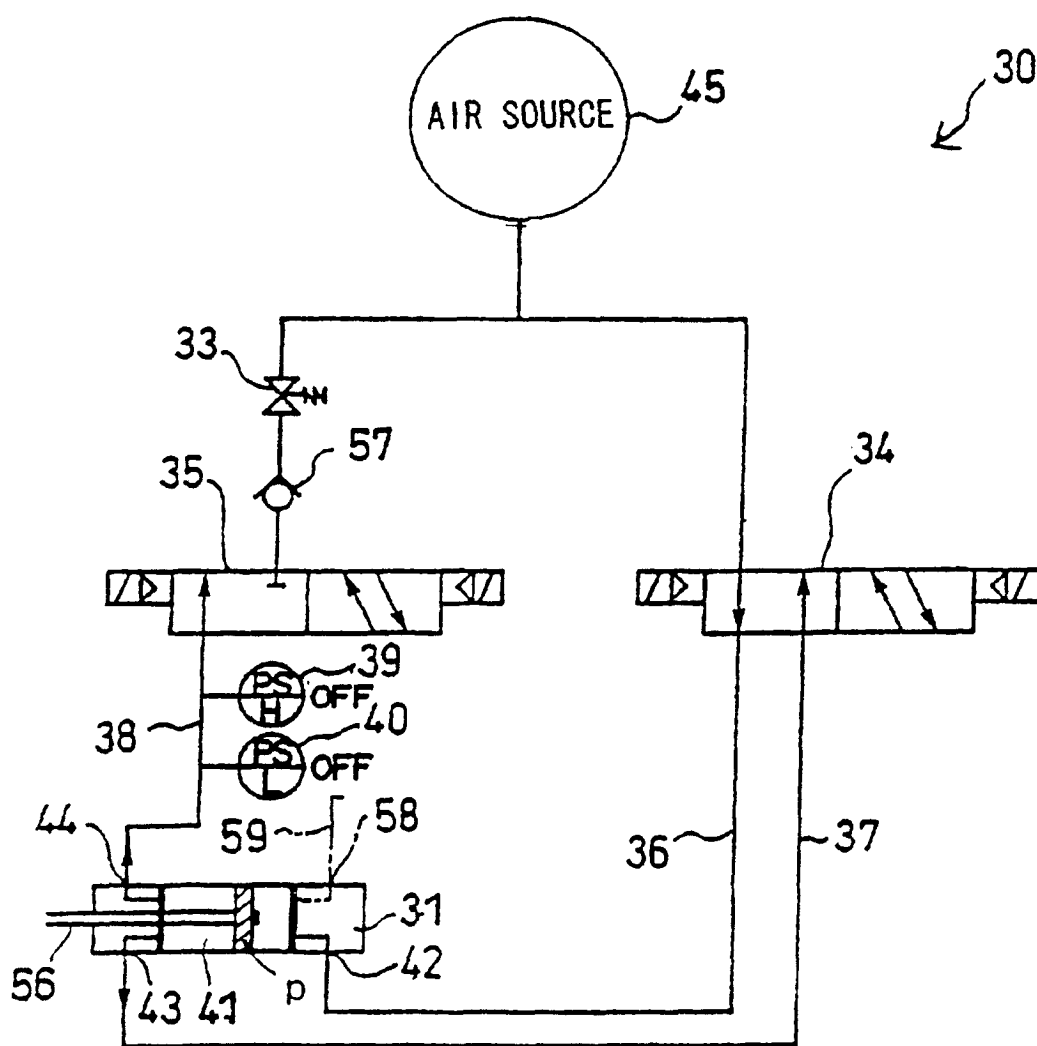


Fig. 18

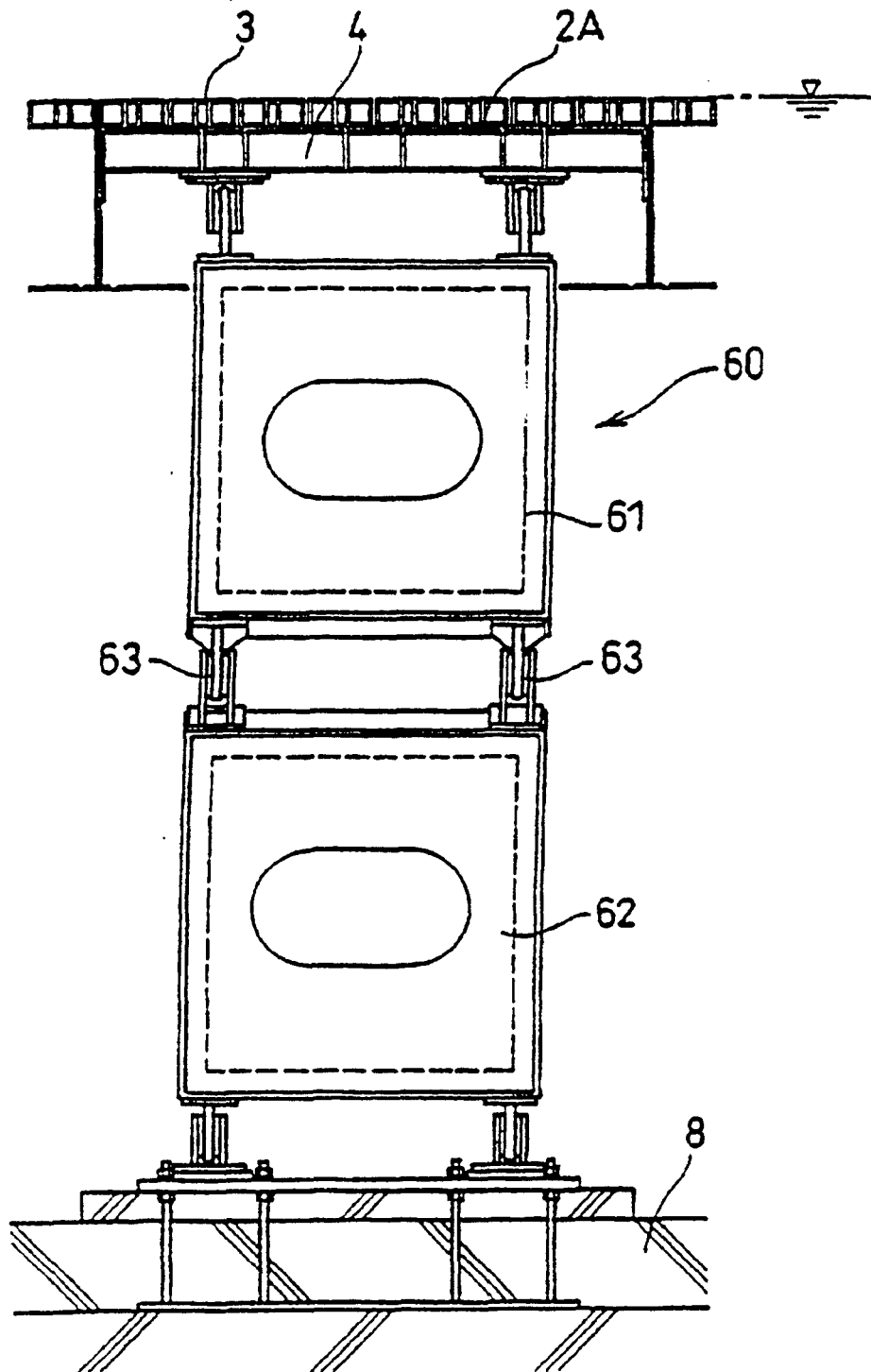


Fig. 19

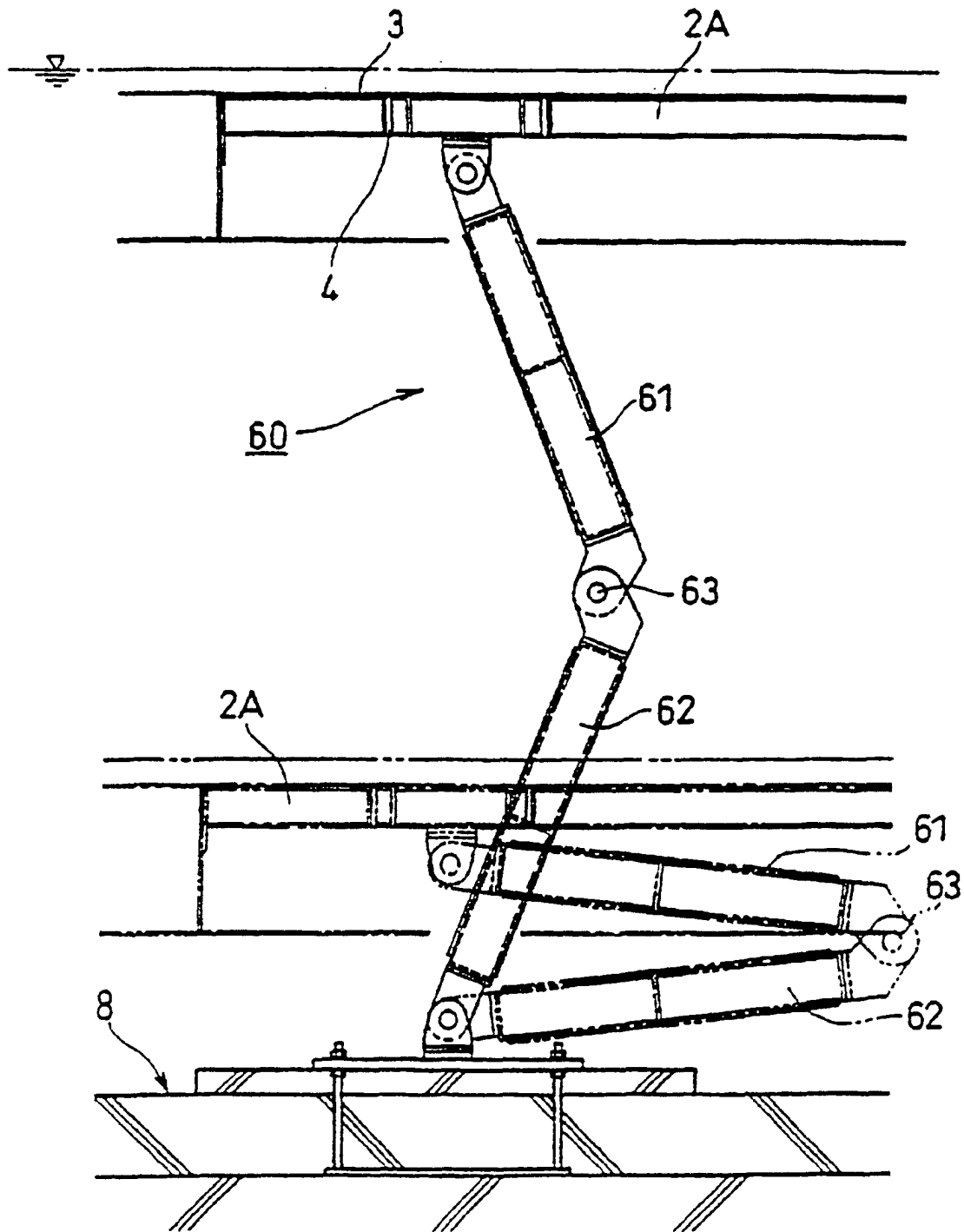


Fig. 20

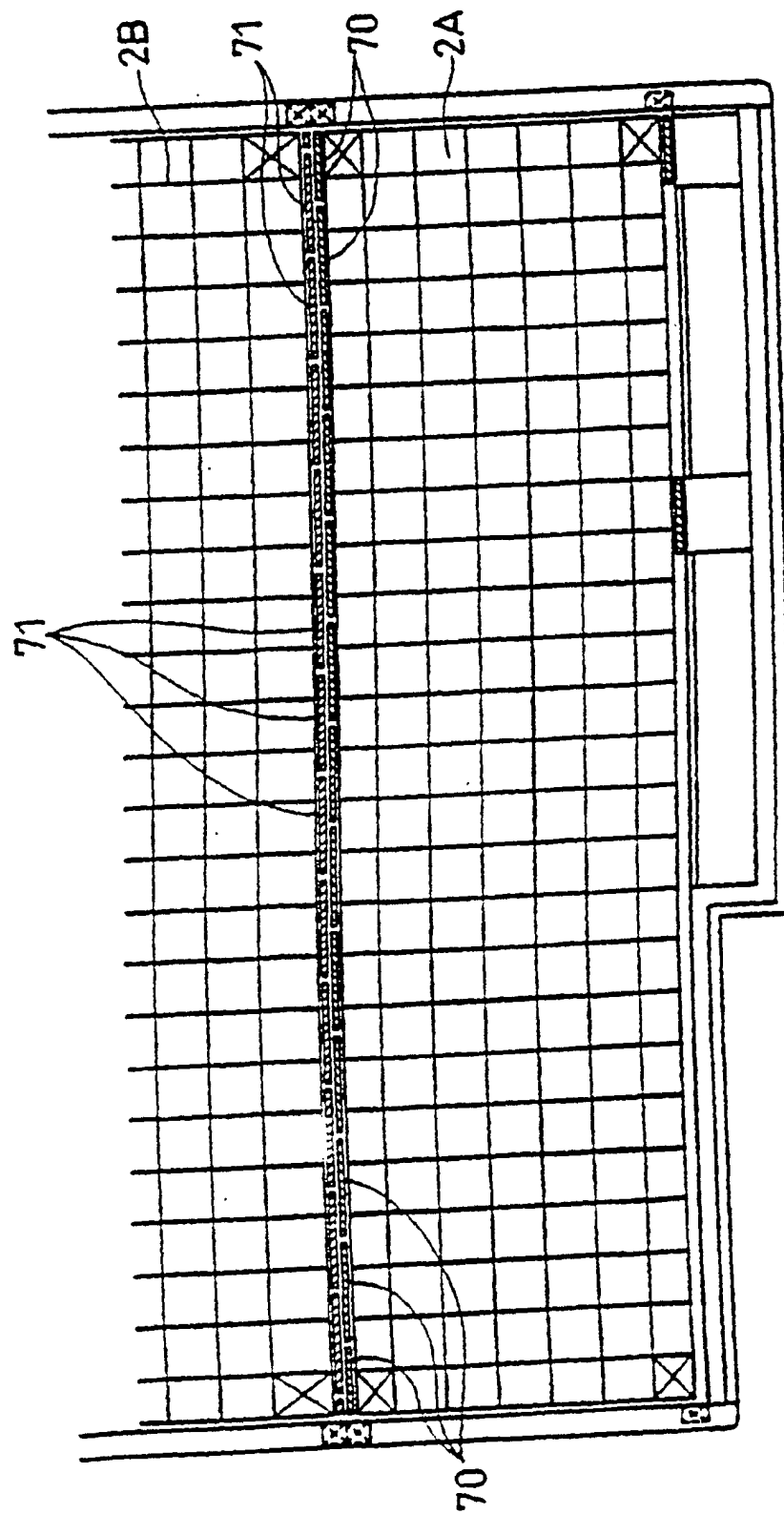


Fig. 21

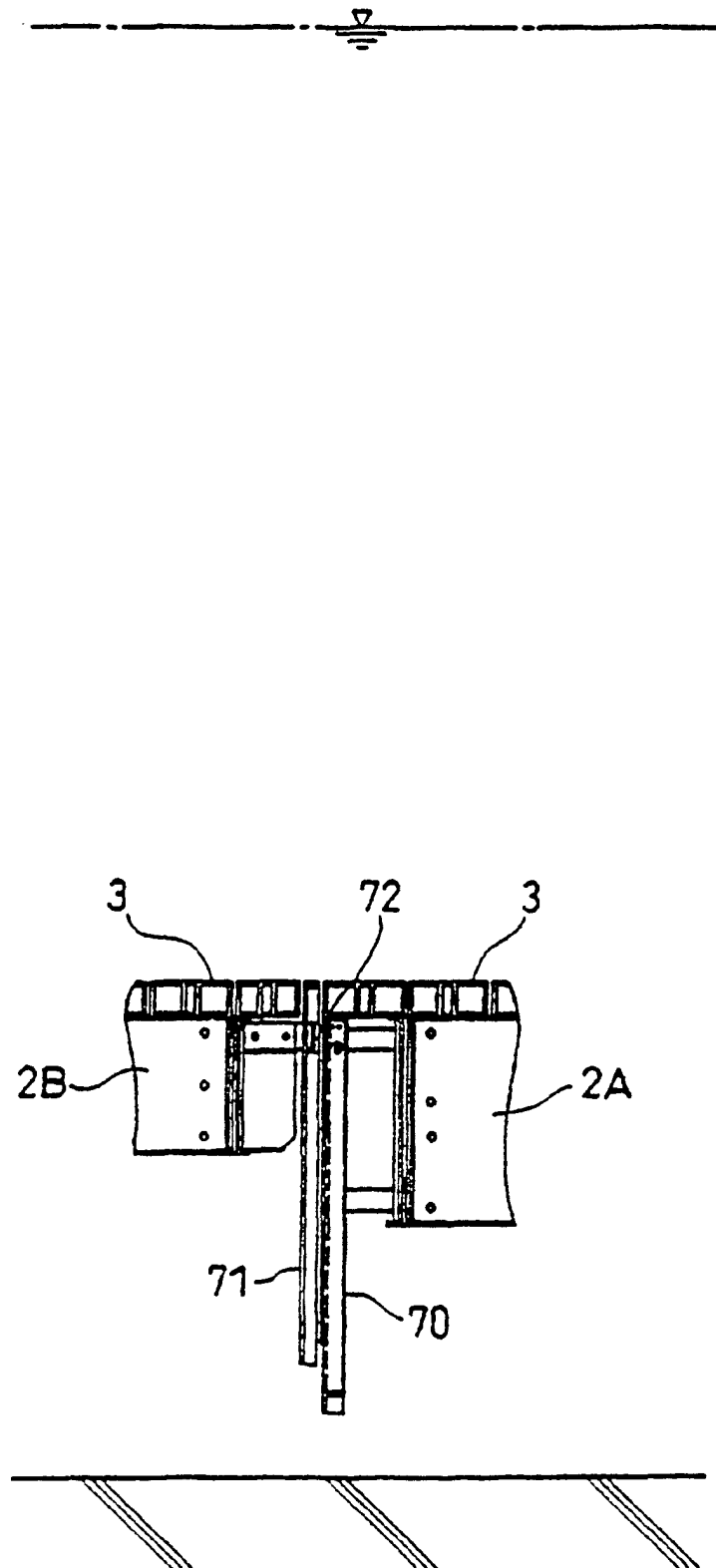


Fig. 22

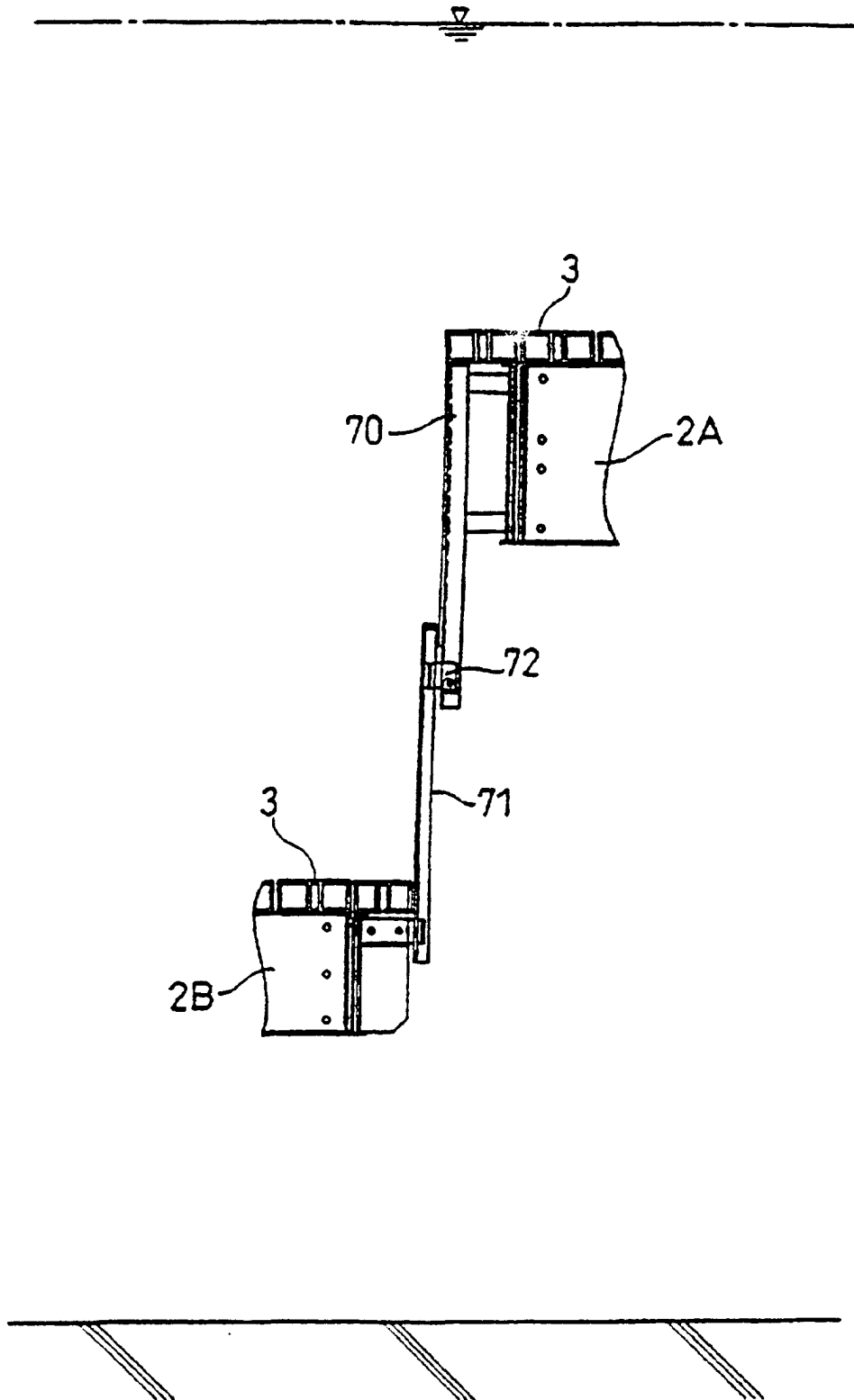


Fig. 23

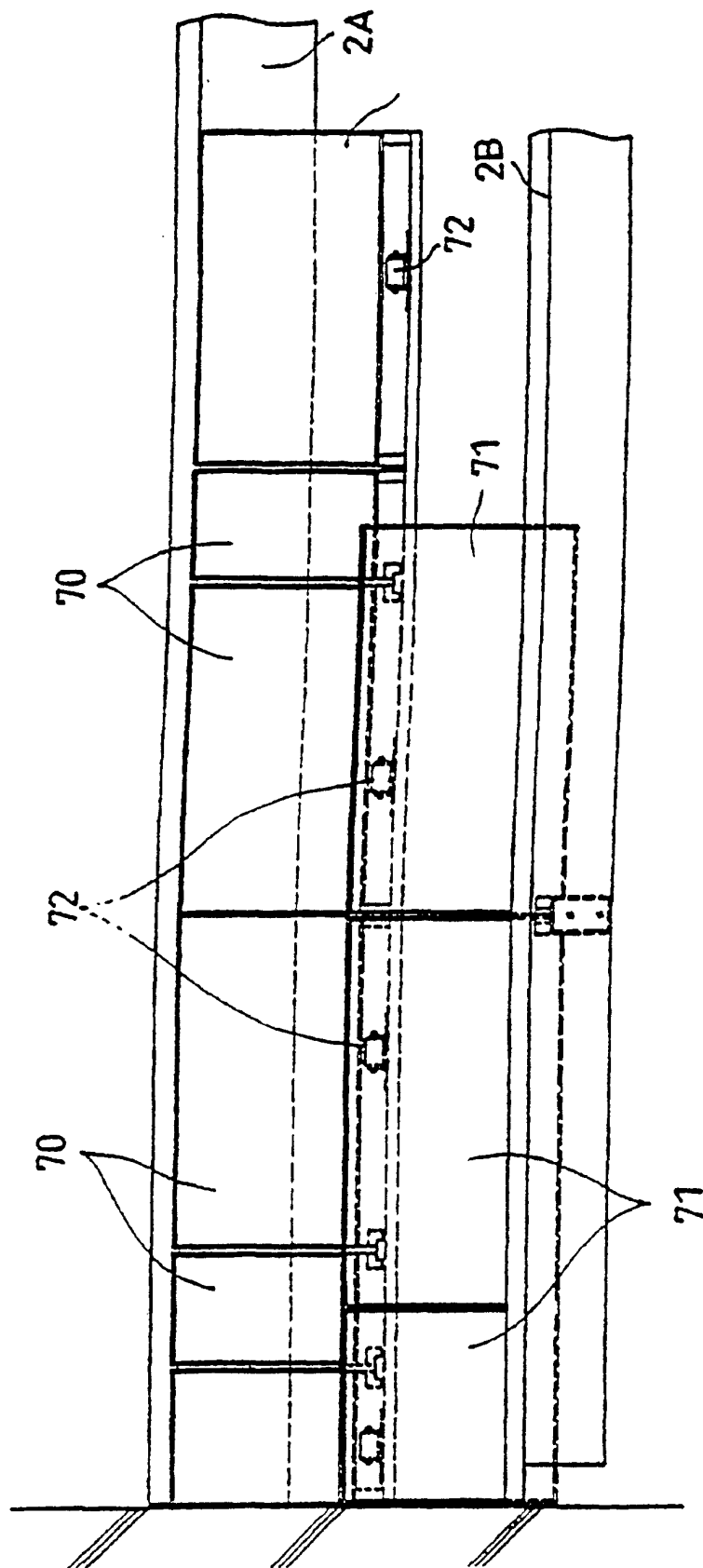


Fig. 24

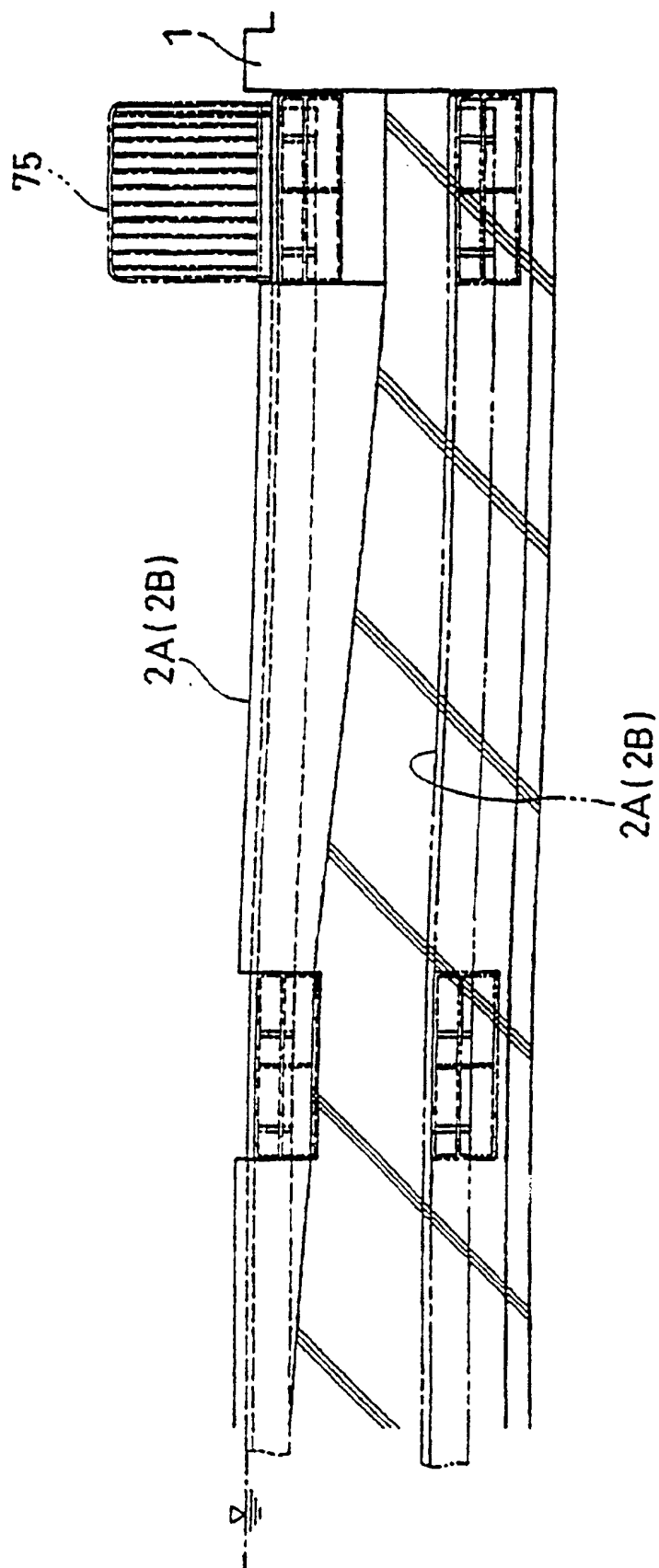
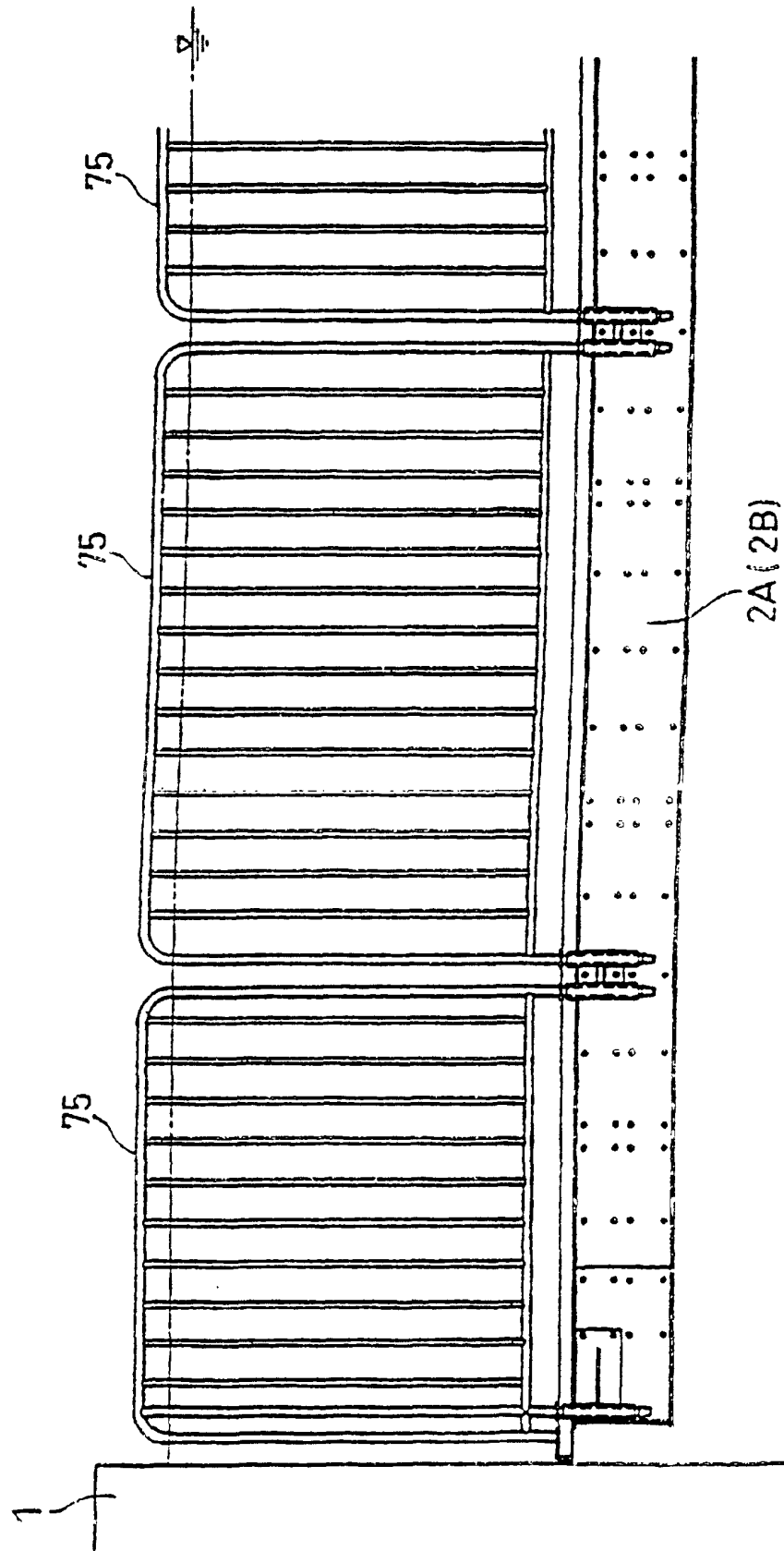


Fig. 25





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 40 2091

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 December 2000	Examiner Kriekoukis, S
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