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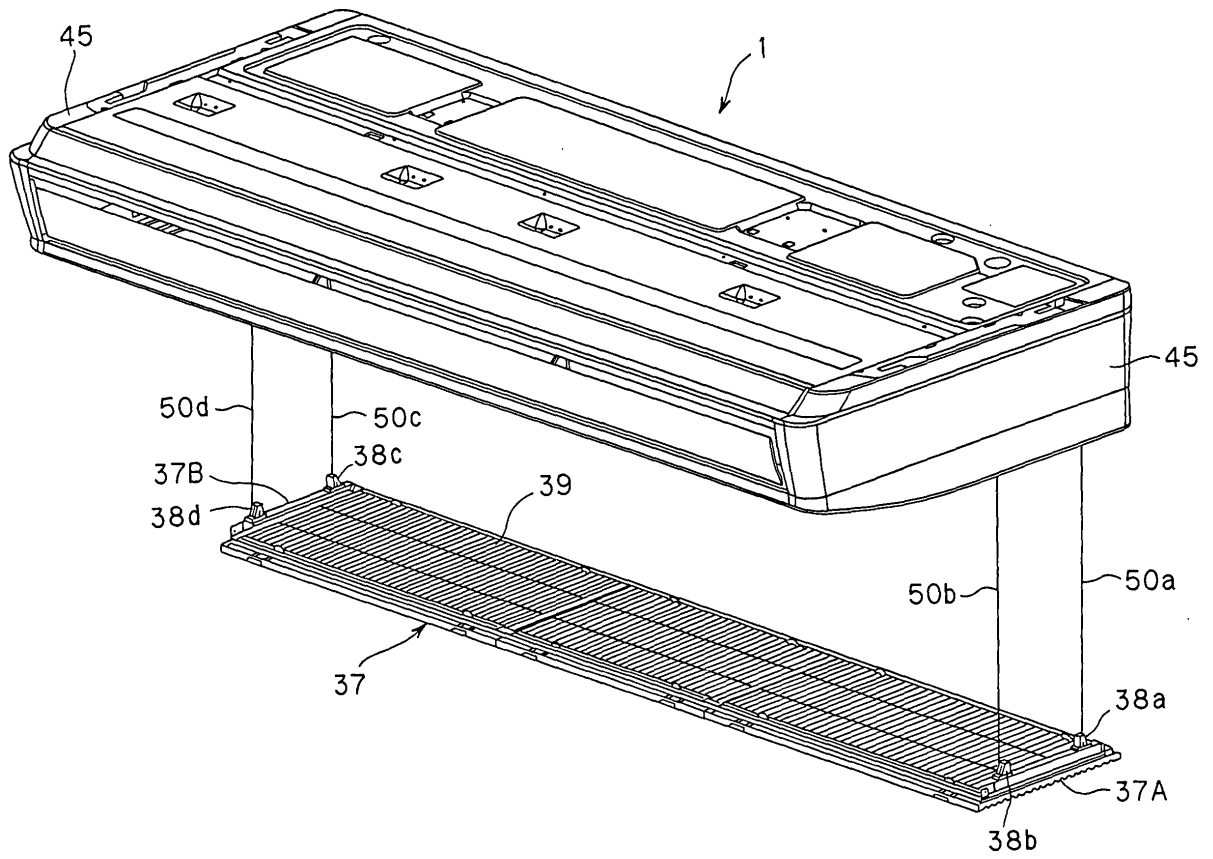
(54) **AIR CONDITIONER, AND CONTROL METHOD AND CONTROL PROGRAM FOR AIR CONDITIONER**

(57) There is provided an air conditioner in which filter cleaning can be more simply and safely performed.

The air conditioner is equipped with a suction grille 37 at the bottom surface thereof, the suction grille 37 having an air cleaning filter mounted thereon, and first and second units as elevating means that supports the suction grille by suspending cords 50a to 50d and upwardly and downwardly moves the suction grille 37 by playing out or rewinding the suspending cords 50a to 50d. In the operation of accommodating the suction grille, when during the period from the time when any one end of the suction grille 37 in the width direction abuts against the main body 1a of the air conditioner till a predetermined time elapses, the other end of the suction grille 37 does not abut against the main body 1a, the suspending cords 50a to 50d are played out to downwardly move the one end abutting against the main body 1a of the air conditioner by only a predetermined distance. A filter chamber having a high-performance filter is provided between the main body of the air conditioner and the suction grille, and the first and second units as the elevating means for elevating the suction grille are disposed inside of the side covers provided to both the sides of the main body of the air conditioner, and the suction grille are supported through the suspending cords by the elevating means.

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FIG. 4



Description**Technical Field**

5 **[0001]** The present invention relates to an air conditioner equipped to a ceiling or the like of an indoor space, a control method for the air conditioner and a control program.

Background Art

10 **[0002]** There has been known a ceiling-suspended type air conditioner which is set up while suspended from the ceiling of a room by using suspending bolts (for example, patent document 1). In this type of ceiling-suspended air conditioner, a suction grille is provided to the bottom surface of the main body of the air conditioner (the surface confronting the floor surface of the building), and a filter is provided to the suction grille. The filter provided to the suction grille is periodically detached by hands of a worker or the like and cleaned, whereby the performance of the air conditioner can be sufficiently exercised. Furthermore, there is a case where this type of air conditioner is provided with a filter chamber in which a high-performance filter (for example, long-life filter) other than the filter provided to the suction grille is accommodated (for example, patent document 2).

Patent Document 1: JP-A-9-275251

Patent Document 2: JP-A-11-101497

Disclosure of the Invention

20 **[0003]** However, in order to clean the filter, a worker or the like must carry out a work of detaching the filter disposed in the suction grille from the main body of the air conditioner in the neighborhood of the ceiling on a case-by-case basis. Therefore, not only it is very cumbersome, but also it is not favorable from the viewpoint of safety because the worker or the like must carry out the work while staying on a table to carry out the work. Furthermore, likewise, with respect to even an air conditioner having a filter chamber as described above, not only it is very cumbersome to carry out the work of detaching the filter in the neighborhood of the ceiling on a case-by-case basis, but also it is not favorable from the viewpoint of safety because the worker or the like must carry out the work while staying on a table.

30 **[0004]** The present invention has been implemented in view of the foregoing situation, and has an object to provide an air conditioner that can perform filter cleaning more simply and safely, a method of controlling the air conditioner and a control program.

Means of solving the Problem

35 **[0005]** In order to attain the above object, an air conditioner having an accommodation portion for accommodating a suction grille in which an air cleaning filter is mounted, comprises elevating means for supporting the suction grille with suspending cords and upwardly or downwardly moving the suction grille together with the filter by playing out or rewinding the suspending cords; and control means for controlling the elevating means to play out the suspending cords if one end of the suction grille in a width direction of the suction grille does not abut against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion during an operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, whereby the other end abutting against the accommodating portion is downwardly moved by only a predetermined distance, and then rewinding the suspending cords to move the overall suction grille upwardly.

40 **[0006]** Furthermore, according to the present invention, if one end of the suction grille in a width direction of the suction grille abuts against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion during the operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, the control means controls the elevating means to play out the suspending cords to thereby downwardly move the overall suction grille by only a predetermined distance and then rewind the suspending cords again to thereby upwardly move the overall suction grille by only a predetermined distance.

45 Furthermore, according to the present invention, the control means repeats at n times ($n \geq 2$) an downward/upward moving operation of making the elevating means to play out the suspending cords to thereby move the overall suction grille downwardly by only a predetermined distance and then making the elevating means to rewind the suspending cords again to thereby move the overall suction grille upwardly by only a predetermined distance.

50 **[0007]** Furthermore, according to the present invention, the elevating means is provided to each of both the sides in the width direction of the main body of the air conditioner.

[0008] Furthermore, according to the present invention, the air conditioner is a ceiling-suspended type air conditioner

that is set up while being suspended from the ceiling of a room.

[0009] According to the present invention, in the air conditioner, a filter chamber having a high-performance filter is provided between the main body of the air conditioner and the suction grille, elevating means for upwardly and downwardly moving the suction grille is disposed inside of side covers provided to both the sides of the main body of the air conditioner, and the elevating means supports the suction grille with suspending cords.

[0010] Furthermore, according to the present invention, the filter chamber is provided with a gap through which the suspending cords are passed.

[0011] Still furthermore, according to the present invention, the elevating means is secured and fixed to a place to be covered by each side cover.

[0012] Still furthermore, according to the present invention, the elevating means is secured and fixed to the side cover.

[0013] Still furthermore, according to the present invention, the filter chamber has a four-way frame disposed at a suction port of the main body of the air conditioner, and a filter frame for disposing the high-performance filter, and a gap through which the suspending cords are passed is provided between the four-way frame and the filter frame.

[0014] Still furthermore, according to the present invention, the suction grille has a suspending cord joint portion that is projected to the main body side of the air conditioner and to which the suspending cords are connected, and the filter chamber is provided with a gap through which the suspending cord joint portion is passed.

[0015] According to the present invention, a method of controlling an air conditioner having an accommodation portion for accommodating a suction grille in which an air cleaning filter is mounted, and elevating means for supporting the suction grille with suspending cords and upwardly or downwardly moving the suction grille together with the filter by playing out or rewinding the suspending cords, characterized in that the elevating means is made to play out the suspending cords if one end of the suction grille in a width direction of the suction grille does not abut against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion during an operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, whereby the other end abutting against the accommodating portion is downwardly moved by only a predetermined distance, and then the suspending cords are rewound to move the overall suction grille upwardly.

[0016] Still furthermore, according to the present invention, a control program for controlling an air conditioner having an accommodation portion for accommodating a suction grille in which an air cleaning filter is mounted, and elevating means for supporting the suction grille with suspending cords and upwardly or downwardly moving the suction grille together with the filter by playing out or rewinding the suspending cords, characterized in that the air conditioner is made to function as means of making the elevating means play out the suspending cords if one end of the suction grille in a width direction of the suction grille does not abut against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion during an operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, whereby the other end abutting against the accommodating portion is downwardly moved by only a predetermined distance, and then to rewind the suspending cords to move the overall suction grille upwardly.

[0017] According to the present invention, when the suction grille is upwardly moved to be accommodated in the accommodating portion, if any one end in the width direction of the suction grille does not abut against the accommodating portion until the predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion, the elevating means is made to play out the suspending cords to downwardly move the other end of the suction grille abutting against the accommodating portion by only the predetermined distance, and then the suspending cords are rewound to upwardly move the overall suction grille, whereby the worker or the like can be clean the filter of the air conditioner more simply and safely.

[0018] Furthermore, according to the present invention, the filter chamber having the high-performance filter is provided between the main body of the air conditioner and the suction grille, the elevating means for upwardly and downwardly moving the suction grille is disposed inside of the side covers provided to both the sides of the main body of the air conditioner, and the elevating means supports the suction grille through the suspending cords, whereby the suction grille can be upwardly and downwardly moved even when the filter chamber is provided.

Best Modes for Carrying out the Invention

[0019] Embodiments according to the present invention will be described hereunder with reference to the drawings.
<First Embodiment>

Fig. 1 is a perspective view showing the outlook construction of a ceiling-suspended type air conditioner as an example of an air conditioner according to this embodiment. Fig. 2 is a cross-sectional view showing the internal construction of the main body 1a of the air conditioner, and Fig. 3 is a plan view showing the internal construction of the main body 1a of the air conditioner.

[0020] In the ceiling-suspended type air conditioner 1, side covers 45 are disposed at both the sides of the main body 1a of the air conditioner as shown in Fig. 1, and a bottom panel 14 and a suction grille 37 are disposed at the lower

portion (bottom portion) of the main body 1a of the air conditioner. The bottom portion of the main body 1a of the air conditioner is constructed as an accommodating portion for the suction grille 37. Furthermore, the main body 1a of the air conditioner is provided with a reception unit (not shown) for receiving an instruction signal from a remote controller (no shown) for controlling the main body 1a of the air conditioner.

[0021] As shown in Fig. 2, the main body 1a of the air conditioner is mounted/fixed on the lower surface of an indoor ceiling plate 5 while suspended by suspending bolts suspended from the ceiling. A heat exchanger 15 and an air blower 13 are disposed in this order from the front surface provided with an air blow-out port 41 in the main body 1a of the air conditioner, and further various kinds of equipment such as an electronic equipment box 11, a refrigerant pipe 29, etc. are accommodated with little gap.

[0022] As shown in Fig. 3, the air blower 13 comprises four air blower units 21 to 24, and they are fixed/disposed on a rotational shaft 27 driven by one motor 25. The heat exchanger 15 is designed as a fin tube type heat exchanger as shown in Fig. 2, and disposed obliquely in the main body 1a of the air conditioner. A refrigerant pipe 29 is connected to the heat exchanger 15, and the refrigerant pipe 29 is led to the outside of the main body 1a of the air conditioner and connected to a compressor, a pressure-reducing device, an outdoor heat exchanger, etc. of an outdoor unit (not shown).

[0023] A drain pan 31 formed of foamed polystyrene is disposed at the lower side of the heat exchanger 15 as shown in Fig. 2, and a metal plate type panel 33 is disposed at the lower surface of the drain pan 31. A drain pump unit 35 is connected through a flexible tube 32 to a drain pool 31a of the drain pan 31 as shown in Fig. 3, and a drain pump mounted in the drain pump unit 35 sucks drain collected in the drain pool 31a and discharges the drain to the outside of the main body 1a of the air conditioner.

[0024] The suction grille 37 of resin is disposed at the lower side of the air blower 13 as shown in Fig. 13, and an air cleaning filter 39 is secured to the suction grille 37. When the air blower 13 is driven, indoor air is sucked into the main body 1a of the air conditioner through the suction grille 37 and the filter 39. This air is heat-exchanged by the heat exchanger 15, and then blown out through the blow-out port 41 into the room. A partition plate 43 is a partition plate that transversely partitions the center portion of the main body 1a of the air conditioner, and the air blower 13 is disposed in a chamber partitioned by the partition plate 43.

[0025] In this embodiment, as shown in Fig. 4, plural suspending cord joint portions 38a to 38d projecting upwardly are provided to the suction grille 37 as shown in Fig. 4, and the suction grille 37 is supported by the main body 1a of the air conditioner through plural suspending cords 50a to 50d connected to the suspending cord joint portions 38a to 38d. The suspending cords 50a to 50d are played out or rewound to upwardly or downwardly move the suction grille in a predetermined range, whereby the filter 39 mounted on the suction grille 37 can be detached while the suction grille 37 is located at a lower position.

In the foregoing description, when it is not necessarily required to discriminate the suspending cords 50a to 50d from one another and also discriminate the suspending cord joint portions 38a to 38d from one another, they are represented as "suspending cord 50" and "suspending cord joint portion 38".

[0026] As shown Fig. 3, the elevating mechanism for playing out or rewinding the four suspending cords 50a to 50d is accommodated in each of two units 60, that is, first and second units 60a and 60b secured to both the ends of the main body 1a of the air conditioner. Each of the first unit 60a and the second unit 60b is secured to the side surface of the main body 1a of the air conditioner as shown in Fig. 5, and then held and fixed by a holder 62. The first unit 60a is fixedly secured to the right end face of the main body 1a of the air conditioner, and the two suspending cords 50a and 50b for supporting one side 37A of the suction grille 37 (see Fig. 4) are connected to the first unit 60a. The second unit 60b is secured and fixed to the left end surface of the main body 1a of the air conditioner and the remaining two suspending cords 50c and 50d for supporting the other side 37B (see Fig. 4) of the suction grille 37 are connected to the second unit 60b.

[0027] Fig. 6 is a schematic diagram showing the construction of the first unit 60a. As shown in Fig. 6, the first unit 60a is equipped with two bobbins around which one suspending cord 50 is wound, and a driving motor 71 that is provided every bobbin 70 and rotates the bobbin 70. The driving motor 71 drives the bobbin 70 through a gear train (not shown), whereby the two suspending cords 50 can be played out or rewound. The first unit 60a is provided with a control circuit (for example, MPU) 72 for controlling the rotation of the driving motor 71, and a control program for controlling the operation is stored in the control circuit 72. Each bobbin 70 is provided with a rotation detector 75 such as a rotary encoder or the like for detecting the rotation amount of the bobbin 70, and the rotation amount of the bobbin 70 is output to the control circuit 72.

[0028] Furthermore, plural signal lines 73 are drawn out from the control circuit 72, and connected to a unit side connector 74 formed at the outside of the housing surface of the first unit 60a. The unit side connector 74 is formed within a surface of the housing of the first unit 60a, the surface facing the side surface of the main body 1a of the air conditioner when the first unit 60 is secured to the main body 1a of the air conditioner. The unit side connector 74 is fitted to a main body side connector (not shown) provided to the side surface of the main body 1a of the air conditioner, whereby the first unit 60a and the main body 1a of the air conditioner are connected to each other so that the signal communication can be performed therebetween. That is, the first unit 60a is secured to the main body 1a of the air conditioner, whereby a control circuit (not shown) at the main body 1a side of the air conditioner and the control circuit

72 at the first unit 60a side can communicate with each other. The construction of the second unit 60b is the same as the first unit 60a and thus the description thereof is omitted.

[0029] When the worker upwardly or downwardly move the suction grille 37 (filter 39), the worker first gives an elevating instruction of the suction grille 37 to the main body 1a of the air conditioner by a remote controller or the like by using a remote controller or the like. When the control circuit of the main body 1 of the air conditioner receives this instruction, the control circuit transmits the instruction to the control circuit 72 of each of the first unit 60a and the second unit 60b. The control circuit 72 receiving this instruction rotates (forwardly or reversely rotating) the driving motor 71, whereby the four suspending cords 50a to 50d are played out or rewound to upwardly or downwardly move the suction grille 37.

[0030] When the suction grille 37 is downwardly moved, the control circuits 72 of the first unit 60a and the second unit 60b are controls the play-out amount of the suspending cords 50 on the basis of the detection signal from the rotation detector 75 so that the suction grille 37 stops at a working position. Here, the working position corresponds to a position at which the worker can easily detach the filter 39 mounted on the suction grille 37 and also a height of about 1m from the floor surface, for example. In this embodiment, the distance from the bottom of the main body 1a of the air conditioner (that is, the fixing position of the suction grille 37) to the working position is set in the control circuit 72 in advance, and the control circuit 72 rotates the bobbins 70 so that the suspending cords 50 are played out by the distance concerned.

[0031] On the other hand, when the suction grille 37 is upwardly moved, the control circuit 72 controls the driving motors 71 on the basis of the detection signals from the rotation detectors 75 so that the suspending cords 50 are rewound by the amount corresponding to the play-out amount of the suspending cords 50 when the suction grille 37 is downwardly moved, whereby the suction grille 37 can be accommodated in the bottom surface of the main body 1a of the air conditioner.

[0032] There is a case where the suction grille 37 is downwardly moved while being tilted in the lateral width direction (the lateral width direction of the mainbody 1a of the air conditioner) or there is a case where both the sides 37A, 37B of the suction grille 37 are not aligned with each other in height in the horizontal direction (the horizontal direction to the ceiling surface) when the suction grille 37 is upwardly moved and accommodated because the play-out amounts or rewinding amounts of the suspending cords 50 by the two driving motors 71 are different from each other. Furthermore, there may be a case where when the suction grille 37 is upwardly or downwardly moved, the suction grille 37 is swung due to vibration of the suction grille 37 or the like, and thus the suction grille 37 is not fitted to the bottom surface of the main body 1a of the air conditioner while the bottom surface is fully closed by the suction grille 37 and thus some corner or the like of the suction grille 37 gets stuck on the bottom panel 14 of the main body 1a of the air conditioner. Particularly, this phenomenon is more remarkable as the lateral width of the suction grille 37 is longer (that is, the aspect ratio of the suction grille 37 is larger).

[0033] Therefore, according to this embodiment, in the operation of accommodating the suction grille 37, if even when a fixed time elapses from the time when any one of both the sides 37A and 37B of the suction grille 37 abuts against the bottom surface of the main body 1a of the air conditioner, the other side of the suction grille does not abut against the bottom surface of the main body 1a of the air conditioner, the tilt in the horizontal direction of the suction grille is judged as being large and thus the operation of correcting this tilt is carried out.

[0034] Furthermore, according to this embodiment, in the above operation, a downward/upward moving control operation of temporarily moving the suction grille 37 downwardly after the suction grille 37 reaches the bottom surface of the main body 1a of the air conditioner and then upwardly moving the suction grille again so that the suction grille 37 reaches the main body 1a of the air conditioner is repeated, whereby the swing motion of the suction grille 37 can be suppressed, and the suction grille 37 can be surely accommodated in the main body 1a of the air conditioner while the main body 1a of the air conditioner is fully closed by the suction grille 37.

[0035] The operation when the suction grille 37 is accommodated will be described with reference to the flowchart of Fig. 7. Fig. 7 is a flowchart showing the procedure of the operation executed by the control circuit 72 when the suction grille 37 is accommodated.

[0036] As shown in Fig. 7, in a case where one side of both the sides 37A and 37B of the suction grille abuts against the bottom surface of the main body 1a of the air conditioner or the like when the control circuit 72 drives each of the two driving motor 71 to rewind the suspending cords 50, so that some driving motor 71 is locked and lock current caused by the lock concerned is detected (step S1), the control circuit 72 starts a timer (not shown) installed therein to start counting, and judges whether lock current at the other driving motor 71 which is caused by the abutting of the other side of the suction grille 37 against the bottom surface of the main body 1a of the air conditioner is detected during a preset count time C_t (step S2).

[0037] The count time is set in accordance with the permissible degree of the tilt in the lateral width direction of the suction grille 37. Describing in detail, when the lateral width of the suction grille 37 is represented by W and the tile angle in the lateral direction is represented by θ as shown in Fig. 8, the displacement amount L in the height direction between both the sides 37A and 37B of the suction grille 37 is approximately equal to θXW . Furthermore, when the rewinding amount of the suspending cord 50 per unit time of the driving motor 71 is represented by S , the time T required for rewind the suspending cord by the displacement amount L is approximately equal to L/S .

That is, the permitted tilt angle of the suction grille 37, that is, the count time $Ct = Lt/S$ when the displacement amount is represented by Lt is set as a time to be counted in the control circuit 72.

[0038] In the judgment of the step S2, if no lock current is detected at the other driving motor 71 and the abutting of the other side of the suction grille 37 is not detected (step S2: NO), the control circuit 72 stops each of the two driving motor 71 (step S3), and then drives only the driving motor 71 corresponding to the abutting side of the suction grille to play out the corresponding suspending cord 50, whereby the abutting side of the suction grille is downwardly moved by only a predetermined distance M (step S4). Thereafter, the processing procedure is returned to step S1.

[0039] Through the above operation, as shown in Fig. 9, the displacement amount L' in the height direction between both the sides 37A and 37B is reduced to $L' = |L-M|$ ($|x|$ represents the absolute value of a value x). By repeating the operations of these steps S1 to S4, the displacement amount L' is reduced to the permissible displacement amount Lt and the tilt in the lateral width direction of the suction grille 37 can be reduced to be as less as possible.

[0040] When the displacement amount L in the height direction between both the sides 37A and 37B is reduced to the permissible displacement amount Lt or less as described above, the judgment result of the step S2 becomes YES, and the control circuit 72 shifts the processing procedure to step S5 to carry out the operation of surely accommodating the suction grille 37 under the fully-closed state.

[0041] Specifically, the tilt in the lateral width direction of the suction grille 37 is corrected through the operation of the above steps S1 to S4, however, the suction grille 37 is not necessarily accommodated in the bottom surface of the main body 1a of the air conditioner under the fully-closed state, and thus it may be kept stuck on the bottom panel 14. Therefore, in order to accommodate the suction grille 37 under the fully-closed state, the control circuit 72 rotates the driving motor 71 to temporarily move the overall suction grille 37 downwardly by only a first predetermined distance (for example, 1 meter) (step S5), and then upwardly move the suction grille 37 again until the suction grille 37 abuts against the bottom surface of the main body 1a of the air conditioner, that is, by only the first predetermined distance by which the suction grille 37 was moved downwardly in step S5 (step S6), whereby the suction grille 37 abuts against the bottom surface of the main body 1a of the air conditioner.

[0042] The suction grille 37 is temporarily downwardly moved by the operation of the steps S5 and S6, so that the attitude of the suction grille 37 is corrected. Thereafter, the suction grille 37 is upwardly moved again, so that the suction grille 37 is accommodated under the fully-closed state. However, when the correction of the attitude is not sufficient, the suction grille 37 may get stuck on the bottom surface. Therefore, in order to enhance the certainty, the control circuit 72 downwardly moves the suction grille 37 again by a second predetermined distance (step S7), and then upwardly moves the suction grille 37 again by only the second predetermined distance (step S8) so that the suction grille 37 abuts against the bottom surface. At this time, the swinging motion of the suction grille 37 when the suction grille 37 is upwardly moved is suppressed by the above-described contact between the suction grille 37 and the main body 1a of the air conditioner (the contact in step S6). In addition, the downward distance (second predetermined distance) when the suction grille 37 is downwardly moved again is made smaller than the first predetermined distance, whereby the swing motion of the suction grille 37 occurs hardly. Therefore, the suction grille 37 abuts against the bottom surface of the main body 1a of the air conditioner while the swing motion thereof is sufficiently suppressed, and the suction grille 37 can be accommodated under the substantially certainly fully closed state.

[0043] In order to accommodate the suction grille 37 in the fully-closed state, the repetitive frequency of downward/upward movement of the suction grille 37 is not limited to once, and by increasing the repetitive frequency (for example, twice or the like), the suction grille 37 can be more surely accommodated in the bottom surface of the main body 1a of the air conditioner under the fully-closed state.

[0044] As described above, according to this embodiment, since the suction grille 37 is upwardly and downwardly movable, the worker can downwardly move the suction grille 37 to the working position to detach the filter 39 therefrom. Therefore, it is unnecessary to carry out the work of detaching the filter 39 while staying in the neighborhood of the ceiling surface at which the main body 1a of the air conditioner is set up, and thus the worker can carry out the work simply and safely.

[0045] Furthermore, according to this embodiment, the first and second units 60a and 60b for upwardly and downwardly moving the suction grille 37 are not mounted in the main body 1a of the air conditioner (that is, accommodated in the casing 12A), but provided to the outside of the side surface of the main body 1a of the air conditioner, and furthermore the communication with the main body 1a of the air conditioner can be performed by the unit side connector 74, so that the first and second units 60a and 60b can be easily detached and attached when the maintenance is carried out on these units or the like.

[0046] Still furthermore, according to this embodiment, in the operation of accommodating the suction grille 37, the upwardly/downwardly moving operation of temporarily moving the suction grille 37 downwardly after the suction grille 37 reaches the bottom surface of the main body 1a of the air conditioner, and then upwardly moving the suction grille 37 again until the suction grille 37 reaches the main body 1a of the air conditioner is repeated at plural times. Therefore, the swing motion of the suction grille 37 can be suppressed, and the suction grille 37 can be surely accommodated while the suction grille 37 is accommodated in the main body 1a of the air conditioner under the fully-closed state.

[0047] According to this embodiment, in the operation of accommodating the suction grille 37, when a fixed time has elapsed from the time when any one of both the sides 37A and 37B of the suction grille 37 abuts against the bottom surface of the main body 1a of the air conditioner, but the other side has not yet abutted against the bottom surface of the main body 1a of the air conditioner, only the side which has abutted against the bottom surface is temporarily moved downwardly, and then the overall suction grille 37 (both the sides 37A and 37B) are upwardly moved again. This operation is repeated, so that's the tilt of the suction grille 37 in the lateral direction when the suction grille 37 is accommodated can be corrected.

<Second Embodiment>

[0048] In this embodiment, a filter chamber 90 is mounted on the suction port of the main body 1a of the air conditioner as shown in Figs. 10 and 11. In each figure, the same parts as the first embodiment are represented by the same reference numerals, and the detailed description thereof is omitted.

[0049] This filter chamber 90 is used when a high-performance filter is added. For example, a filter which is exchanged in a relatively short cycle is disposed on the suction grille 37, and a filter (long life filter) 100 which is exchanged in a relatively long cycle is disposed on the filter chamber 90. Not only a disposable filter, but also an optically recyclable deodorant filter, a normal-temperature recyclable deodorant filter or the like is used as the filter 100.

[0050] In this embodiment, the suction grille 37 is mounted on the lower surface of the filter chamber 90, and the suction grille 37 is suspended so as to be freely upwardly and downwardly movable through the suspending cords as shown in Figs. 12 to 14.

That is, the suction grille 37 is provided with plural suspending cord joint portions 38a to 38d projecting upwardly as shown in Fig. 12, and the suction grille 37 is supported by the lower surface of the filter chamber 90 through the plural (four) suspending cords 50a to 50d joined to the suspending cord joint portions 38a to 38d. The suspending cords 50a to 50d are played out or rewound, whereby the suction grille 37 is upwardly and downwardly movable in a predetermined range, and the filter 39 mounted on the suction grille 37 is detachable while the suction grille 37 is downwardly moved to a lower position.

[0051] An elevating mechanism of playing out or rewinding the four suspending cords 50a to 50d (Fig. 14) is accommodated in each of two units 60 fixed to both the ends of the main body 1a of the air conditioner, that is, the first and second units 60a and 60b as shown in Fig. 12. Each of the first unit 60a and the second unit 60b is secured to the side surface of the main body 1a of the air conditioner, and then held and fixed by a holder 62. The first unit 60a is fixedly secured to the right end face of the main body 1a of the air conditioner and the two suspending cords 50a and 50b for supporting one side 37A (see Fig. 14) of the suction grille 37 are joined to the first unit 60a. The second unit 60b is fixedly secured to the left end face of the main body 1a of the air conditioner, and the two suspending cords 50c and 50d for supporting the other side 37 (see Fig. 14) of the suction grille 37 are joined to the second unit 60b.

[0052] As shown in Fig. 12, the filter chamber 90 comprises a four-way frame 91 formed of a metal plate which can be mounted on the suction port of the main body 1a of the air conditioner, and a filter frame 92 in which a filter 100 is disposed.

As shown in Fig. 13, the four-way frame 91 comprises frame members 91a and 91b each of which is disposed in the longitudinal direction and formed of a metal plate having a substantially U-shaped section, and frame members 91c and 91d each of which is disposed in the short-side direction and formed of a metal plate having a substantially U-shaped section. A partition member 93 having a substantially rectangular section is provided at the substantially center of the four-way frame 91 so as to extend along the short-side direction. In general, the filter chamber comprises the four-way frame comprising the frame member of the metal plate having the substantially U-shaped section. Therefore, in a broad air conditioner like a ceiling-suspended type air conditioner, the frame member in the longitudinal direction (width direction) is insufficient in strength and thus easily sags. However, according to this embodiment, since the partition member 93 is provided, the strength is enhanced, and thus there can be avoided such a disadvantage that the filter chamber 90 is deformed when the air conditioner is transported or the like.

[0053] The filter frame 92 comprises an outer filter frame 92a and an inner filter frame 92b as shown in Figs. 15 and 16. These frames are disposed at both the right and left ends of the four-way frame 91, and they are disposed as pairs along the short-side direction of the four-way frame 91. In this air conditioner, two kinds of filters 100 which are different in size can be selectively mounted. Under the state of Fig. 16, a smaller filter 100 is mounted between the pair of the inner filter frames 92b. When a larger filter 100 is mounted, the inner filter frames 92b joined to the outer filter frames 92a through screws 92c are detached, and the larger filter 100 is mounted between the pair of outer filter frames 92a.

[0054] In this embodiment, as shown in Fig. 16, the suspending cords 50 for suspending the suction grille 37 are passed through the gap S between the four-way frame 91 and the outer filter frame 92a. This gap S is formed so as to have such a size that not only the suspending cords 50, but also the suspending cord joint portions 38 to which at least the suspending cords 50 are hooked pass through the gap S, and the first unit 60a (or the second unit 60b) is disposed just above the suspending cord joint portion 38.

As described above, the gap S for passing therethrough the plural suspending cords 50 for suspending the suction grille 37 is provided between the four-way frame 91 and the outer filter frame 92a. Therefore, even when the filter chamber 90 is mounted at the suction port of the main body 1a of the air conditioner, the filter chamber 90 does not interfere with the suspending cords 50 and the suspending cord joint portions 38, whereby the suction grille 37 can be upwardly and downwardly moved. Accordingly, according to the above-described construction, even when the filter chamber 90 is mounted (second embodiment) or the filter chamber 90 is not mounted (first embodiment), the suction grille 37 can be upwardly and downwardly moved by using the elevating mechanism having the same structure.

[0055] Furthermore, as shown in Fig. 16, the inside dimension L1 of the four-way frame 91 of the filter chamber 90 is set to be substantially equal to the inside dimension L2 of the main body 1a of the air conditioner. Accordingly, even when the filter chamber 90 is mounted (second embodiment) or the filter chamber 90 is not mounted (first embodiment), the suction grille 37 having the same structure can be used. In Fig. 16, when the suction grille 37 is upwardly moved, the upper surface of the peripheral edge portion of the suction grille 37 abuts against the four-way frame 91, and thus the suction grille 37 can be positioned in a horizontal position in close contact with the filter chamber 90.

[0056] Here, by detecting stop of the rotation of the bobbins 70, the first and second units 60a and 60b detect that the suction grille 37 reaches the accommodation position of the suction grille 37. Accordingly, even when the filter chamber 90 is mounted (second embodiment) or the filter chamber 90 is not mounted (first embodiment), only the rewinding amount of the suspending cords 50 is varied when the suction grille 37 is accommodated. Under the control of the elevating mechanism of the second embodiment, the suction grille 37 can be substantially surely stopped at the abutting position against the filter chamber 90.

[0057] According to this embodiment, even when the filter chamber 90 is mounted, the suction grille 37 can be upwardly and downwardly moved, and thus the worker can detach the filter 39 while downwardly moving the suction grille 37 to the working position.

Accordingly, it is unnecessary to carry out the work of detaching the filter 39 in the neighborhood of the ceiling surface on which the main body 1a of the air conditioner is set up.

[0058] The above-described embodiment is merely an embodiment of the present invention, and any modification may be made without departing from the subject matter of the present invention. For example, in the above-described embodiment, each of the first unit 60a and the second unit 60b serving as the elevating mechanism is fixed to the outside of each side surface of the main body 1a of the air conditioner (see Fig. 5 or Fig. 12), and covered by the side cover 45. However, the present invention is not limited to this embodiment, and each of the first unit 60a and the second unit 60b may be disposed inside the side cover 45 as shown in Fig. 17.

In this construction, the signal lines 73 drawn out from the control circuit 72 (see Fig. 6) of the first unit 60a (second unit 60b) are drawn out to the outside of the housing of the unit as shown in Fig. 17, the unit side connector 74 provided to the tips of the signal lines 73 is connected to the side surface of the main body 1a of the air conditioner, whereby the first unit 60a and the second unit 60b are connected to the main body 1a of the air conditioner so that communications can be performed therebetween.

[0059] In the above-described embodiment, on the basis of the detection signal of the rotation detector 75 (see Fig. 6), the suction grille 37 detects that the suction filter 37 abuts against the main body 1a of the air conditioner or the filter chamber 90, however, the present invention is not limited to this embodiment. A proper number of switches for detecting the abutting of the suction grille 37 may be provided at the place where the suction grille 37 is accommodated in the main body 1a of the air conditioner or the filter chamber 90. Alternatively, the driving current of the driving motor 71 may be detected to detect the transient current caused by the stop of the rotation of the bobbin 70.

Furthermore, in the above-described embodiment, the suction grille 37 is suspended by the four suspending cords 50a to 50d. However, the number of suspending cords may be set to any number.

[0060] In the above-described embodiments, the present invention is applied to the ceiling-suspended type air conditioner. However, the present invention may be broadly applied to air conditioners such as an in-ceiling mount type air conditioner, etc.

Brief Description of the Drawings

[0061]

[Fig. 1] is a perspective view showing the outlook construction of a ceiling-suspended type air conditioner according to an embodiment of the present invention.

[Fig. 2] is a cross-sectional view showing the construction of an air conditioner.

[Fig. 3] is a top view showing the inner construction of the main body of the air conditioner.

[Fig. 4] is a diagram showing the upward and downward movement of a suction grille.

[Fig. 5] is a diagram showing a unit in which an elevating mechanism is accommodated.

[Fig. 6] is a diagram showing the functional construction of the unit.

[Fig. 7] is a flowchart showing the flow of the operation of the main body of the air conditioner when the suction grille is accommodated.

[Fig. 8] is a diagram showing the operation of correcting tilt in a lateral width direction when the suction grille is accommodated.

[Fig. 9] is a diagram showing the operation of correcting the tilt in the lateral width direction when the suction grille is accommodated.

[Fig. 10] is a perspective view showing the outlook construction of the ceiling-suspended type air conditioner when a filter chamber is mounted.

[Fig. 11] is a cross-sectional view showing the ceiling-suspended type air conditioner when a filter chamber is mounted.

[Fig. 12] is a perspective view showing the filter chamber of the ceiling-suspended type air conditioner together with the peripheral construction thereof.

[Fig. 13] is a perspective view showing the filter chamber of the ceiling-suspended type air conditioner together with the peripheral construction thereof.

[Fig. 14] is a perspective view showing the filter chamber of the ceiling-suspended type air conditioner together with the peripheral construction thereof.

[Fig. 15] is a perspective view showing the elevating mechanism for the suction grille.

[Fig. 16] is a cross-sectional view showing the elevating mechanism for the suction grille.

[Fig. 17] is a diagram showing a unit according to a modification of the present invention.

Description of Reference Numerals

[0062]

1	ceiling-suspended type air conditioner
1a	main body of air conditioner
11	electric equipment box
13	air blower
14	bottom panel
15	heat exchanger
31	drain pan
37	suction grille
38, 38a to 38d	suspending cord joint portion
39, 100	filter
45	side cover
50, 50a to 50d	suspending cord
60a	first unit
60b	second unit
70	bobbin
72	control circuit
74	unit side connector
75	rotation detector
90	filter chamber
91	four-way frame
91a to 91d	frame member
92	filter frame

Claims

1. An air conditioner having an accommodation portion for accommodating a suction grille in which an air cleaning filter is mounted, comprising:

elevating means for supporting the suction grille with suspending cords and upwardly or downwardly moving the suction grille together with the filter by playing out or rewinding the suspending cords; and
control means for controlling the elevating means to play out the suspending cords if one end of the suction grille in a width direction of the suction grille does not abut against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating

portion during an operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, whereby the other end abutting against the accommodating portion is downwardly moved by only a predetermined distance, and then rewinding the suspending cords to move the overall suction grille upwardly.

2. The air conditioner according to 1, wherein if one end of the suction grille in a width direction of the suction grille abuts against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion in the operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, the control means controls the elevating means to play out the suspending cords to thereby downwardly move the overall suction grille by only a predetermined distance and then rewind the suspending cords again to thereby upwardly move the overall suction grille by only a predetermined distance.
3. The air conditioner according to claim 2, wherein the control means repeats at n times ($n \geq 2$) an downward/upward moving operation of making the elevating means to play out the suspending cords to thereby move the overall suction grille downwardly by only a predetermined distance and then making the elevating means to rewind the suspending cords again to thereby move the overall suction grille upwardly by only a predetermined distance.
4. The air conditioner according to claim 1, wherein the elevating means is provided to each of both the sides in the width direction of the main body of the air conditioner.
5. The air conditioner according to claim 1, wherein the air conditioner is a ceiling-suspended type air conditioner that is set up while being suspended from the ceiling of a room.
6. An air conditioner comprising:
 - a filter chamber that has a high-performance filter and is provided between the main body of the air conditioner and a suction grille;
 - elevating means that upwardly and downwardly moves the suction grille and is disposed inside of side covers provided to both the sides of the main body of the air conditioner, wherein the elevating means supports the suction grille with suspending cords.
7. The air conditioner according to claim 6, the filter chamber is provided with a gap through which the suspending cords are passed.
8. The air conditioner according to claim 6, wherein the elevating means is secured and fixed to a place to be covered by each side cover.
9. The air conditioner according to claim 6, wherein the elevating means is secured and fixed to the side cover.
10. The air conditioner according to claim 7, wherein the filter chamber has a four-way frame disposed at a suction port of the main body of the air conditioner, and a filter frame for disposing the high-performance filter, and a gap through which the suspending cords are passed is provided between the four-way frame and the filter frame.
11. The air conditioner according to claim 8, wherein the suction grille has a suspending cord joint portion that is projected to the main body side of the air conditioner and to which the suspending cords are connected, and the filter chamber is provided with a gap through which the suspending cord joint portion is passed.
12. A method of controlling an air conditioner having an accommodation portion for accommodating a suction grille in which an air cleaning filter is mounted, and elevating means for supporting the suction grille with suspending cords and upwardly or downwardly moving the suction grille together with the filter by playing out or rewinding the suspending cords, **characterized in that** the elevating means is made to play out the suspending cords if one end of the suction grille in a width direction of the suction grille does not abut against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion during an operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, whereby the other end abutting against the accommodating portion is downwardly moved by only a predetermined distance, and then the suspending cords are rewound to move the overall suction grille upwardly.

13. A control program for controlling an air conditioner having an accommodation portion for accommodating a suction grille in which an air cleaning filter is mounted, and elevating means for supporting the suction grille with suspending cords and upwardly or downwardly moving the suction grille together with the filter by playing out or rewinding the suspending cords, **characterized in that** the air conditioner is made to function as means of making the elevating means play out the suspending cords if one end of the suction grille in a width direction of the suction grille does not abut against the accommodating portion until a predetermined time elapses from the time when the other end of the suction grille abuts against the accommodating portion during an operating of upwardly moving the suction grille to accommodate the suction grille in the accommodating portion, whereby the other end abutting against the accommodating portion is downwardly moved by only a predetermined distance, and then to rewind the suspending cords to move the overall suction grille upwardly.

FIG. 1

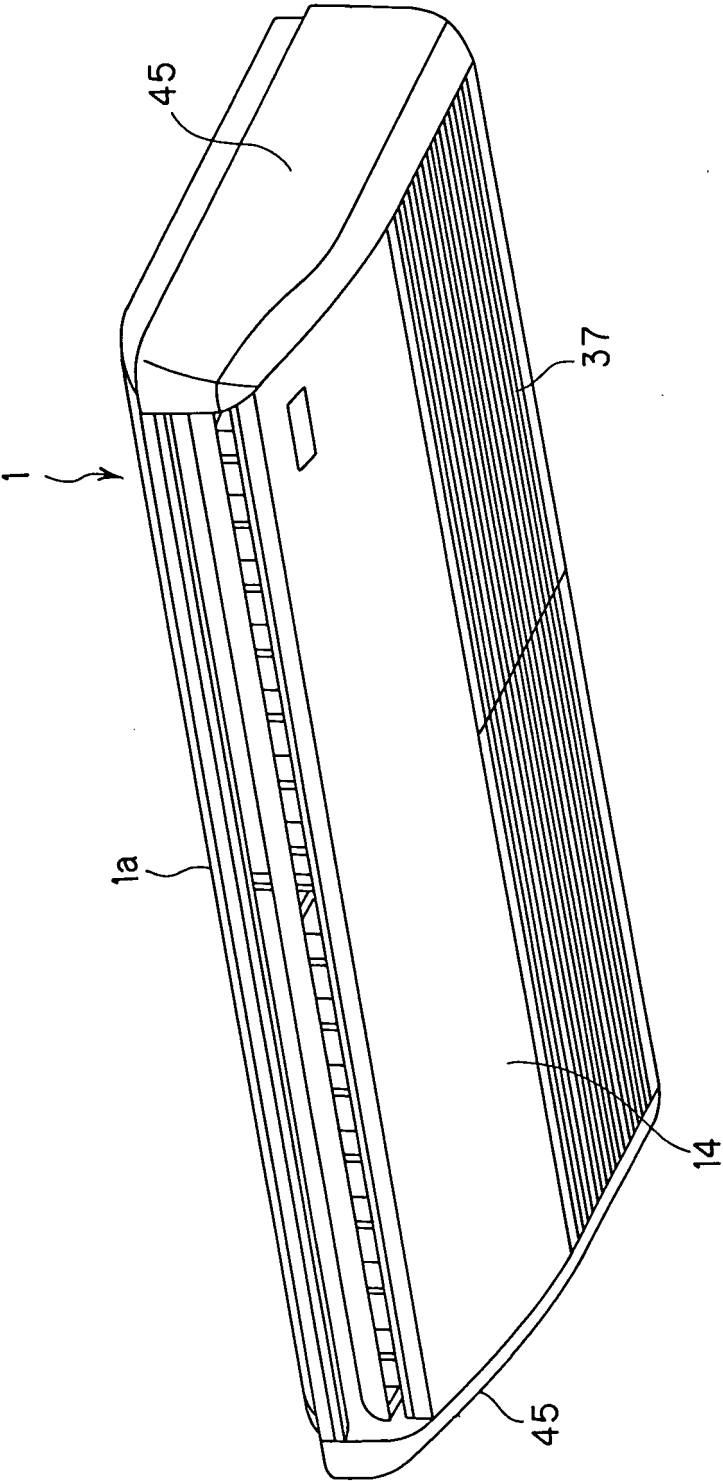


FIG. 2

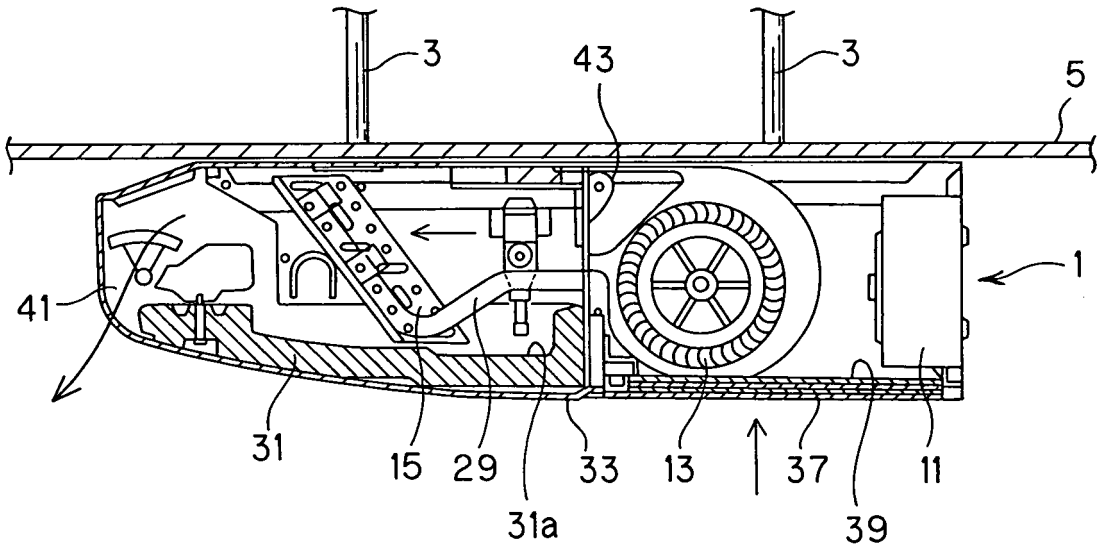


FIG. 3

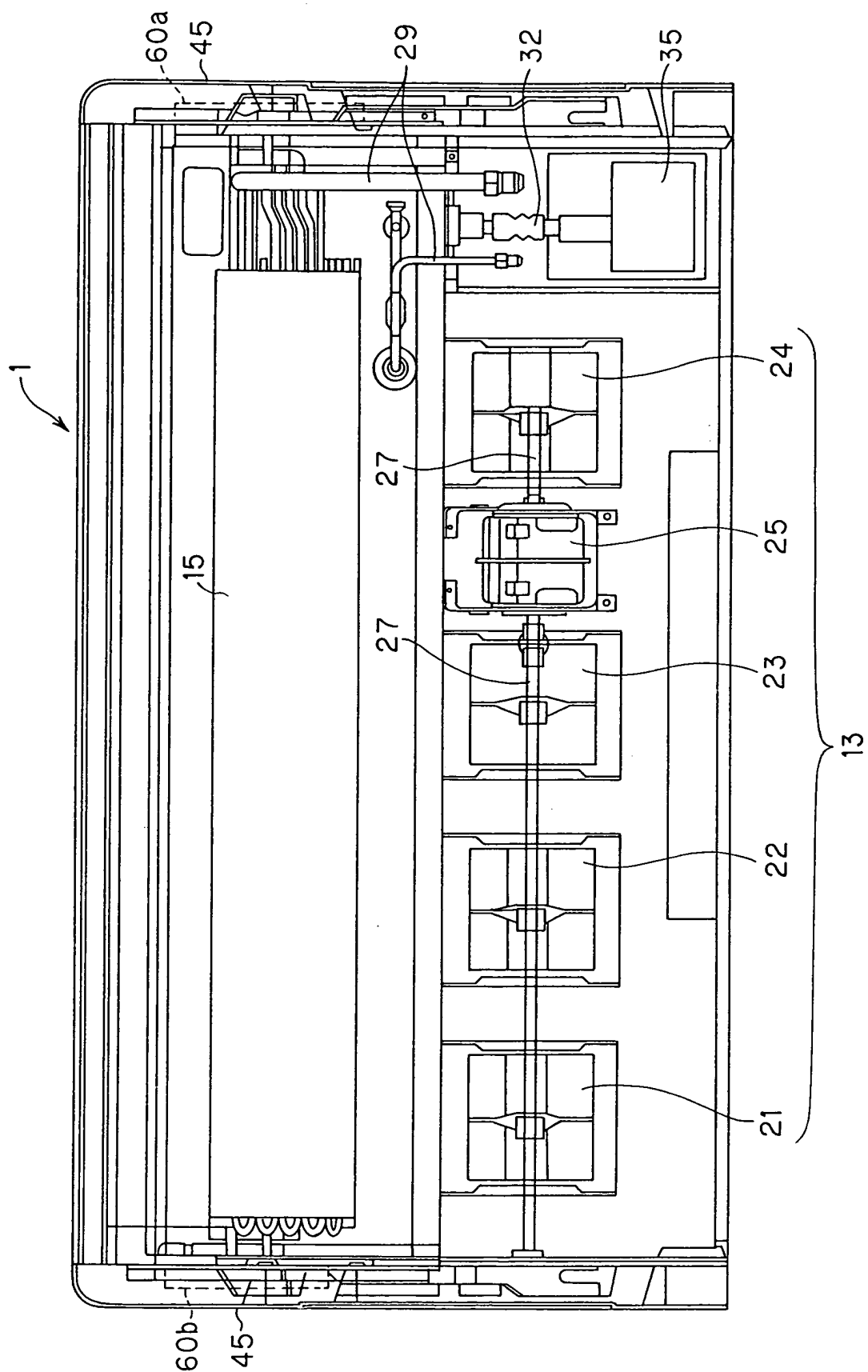


FIG. 4

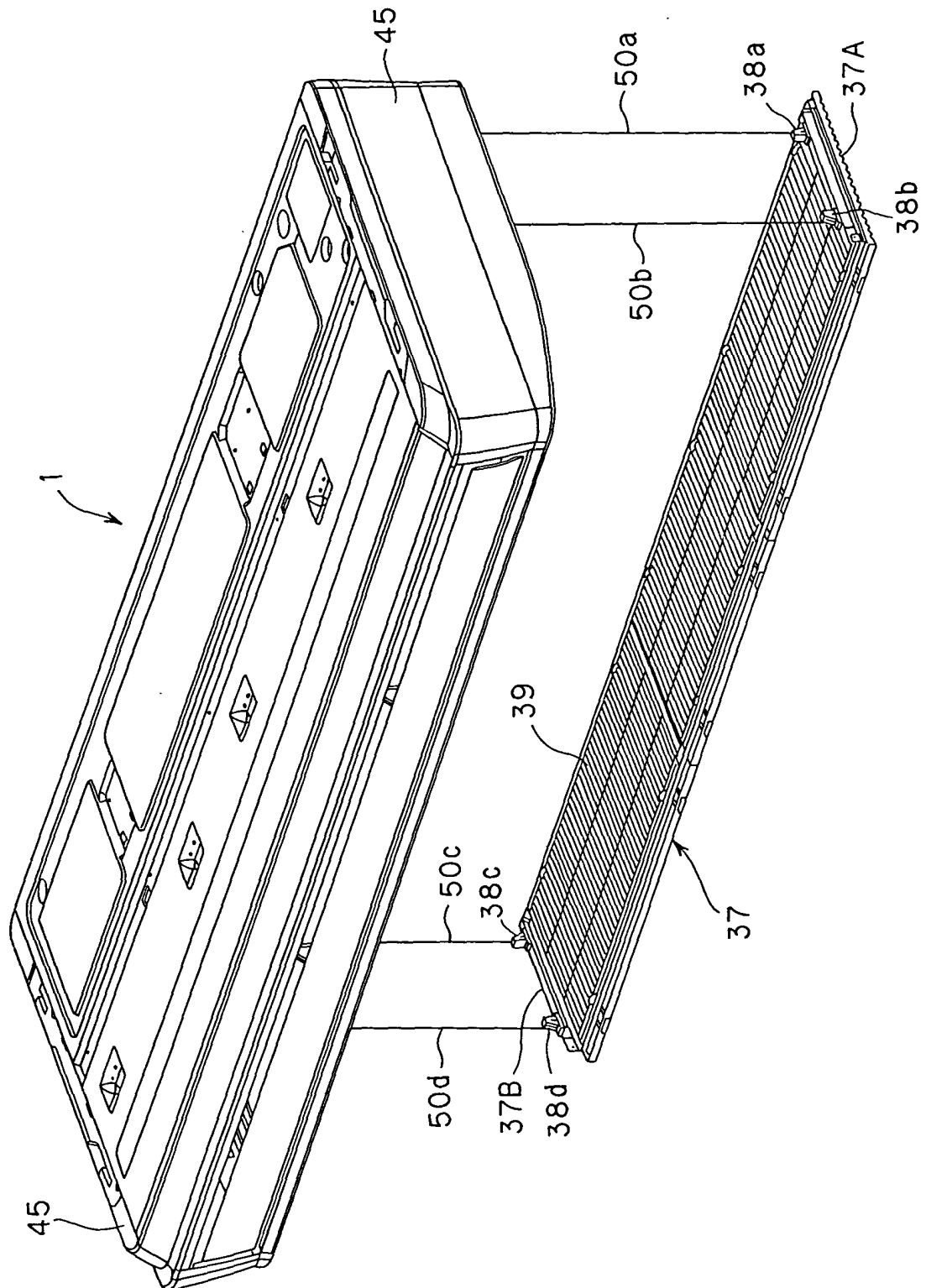


FIG. 5

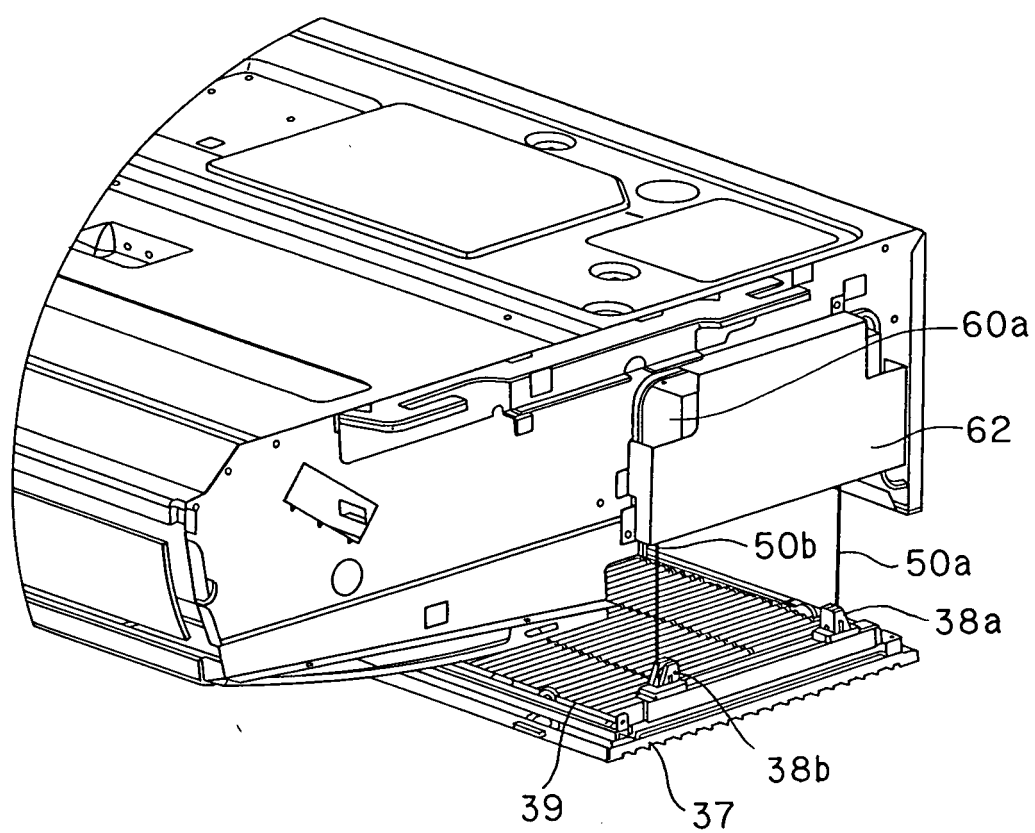


FIG. 6

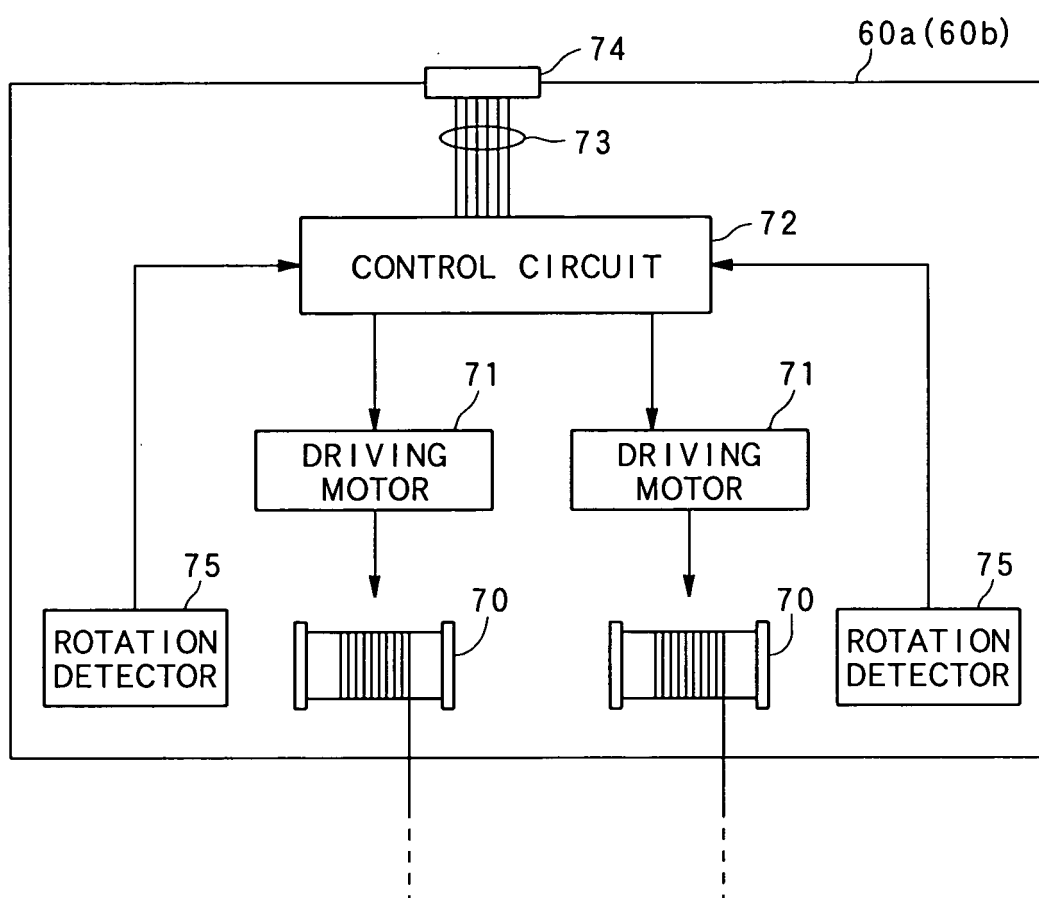


FIG. 7

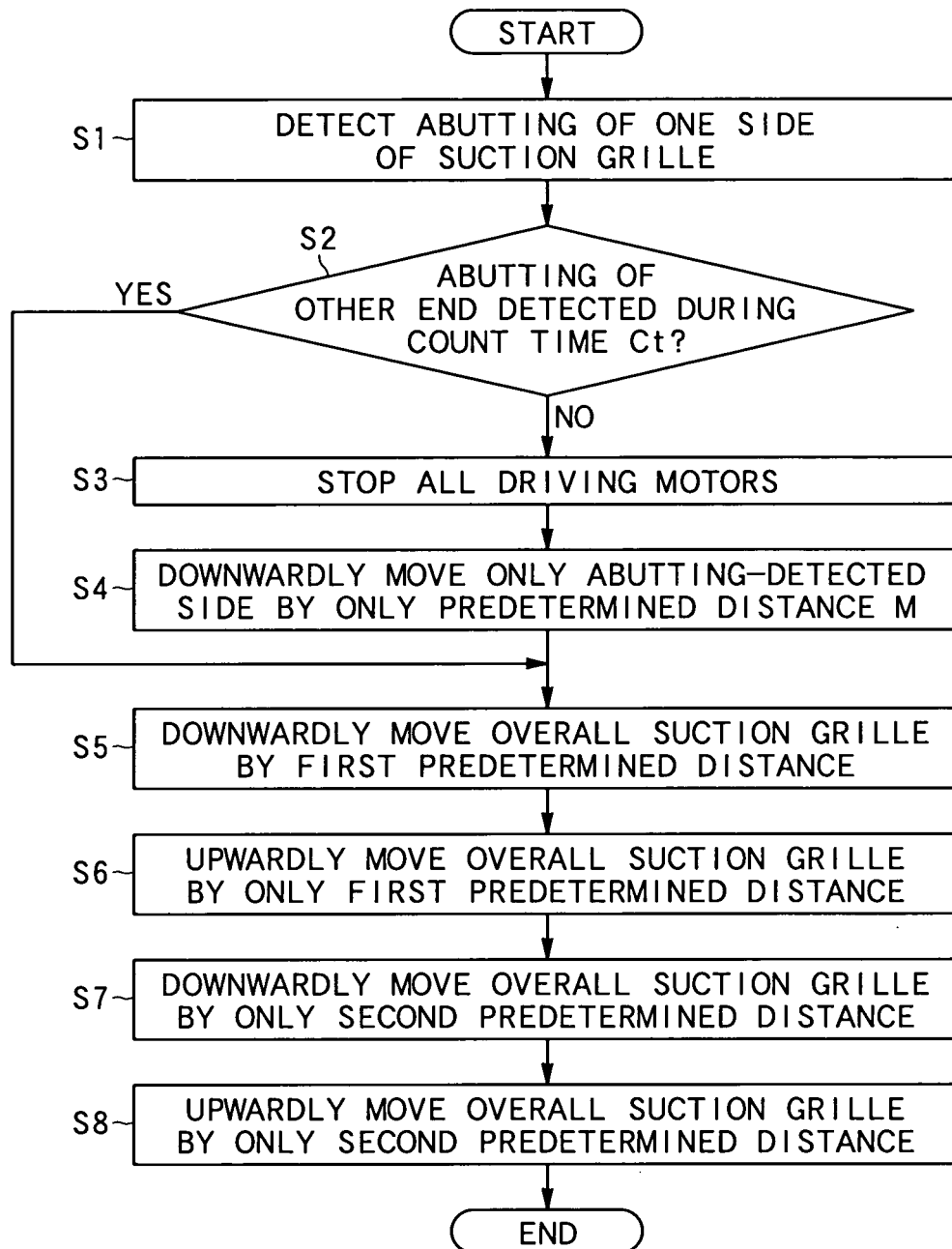


FIG. 8

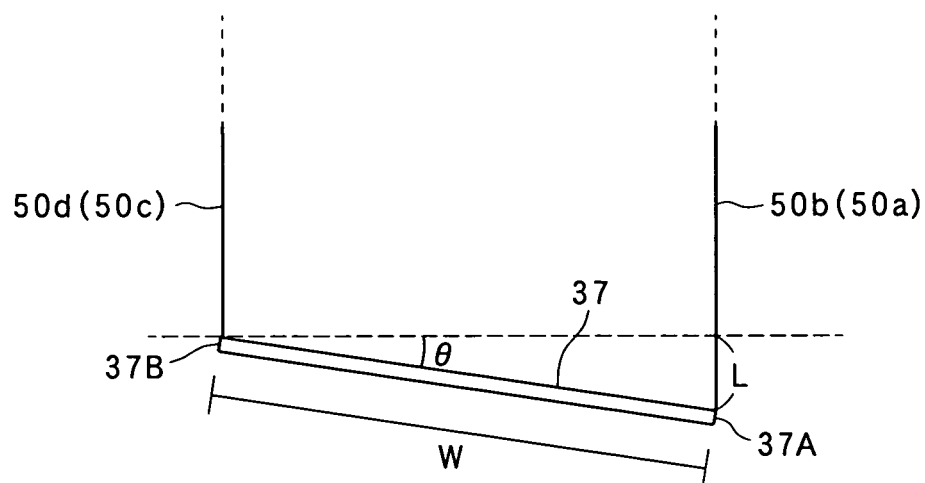


FIG. 9

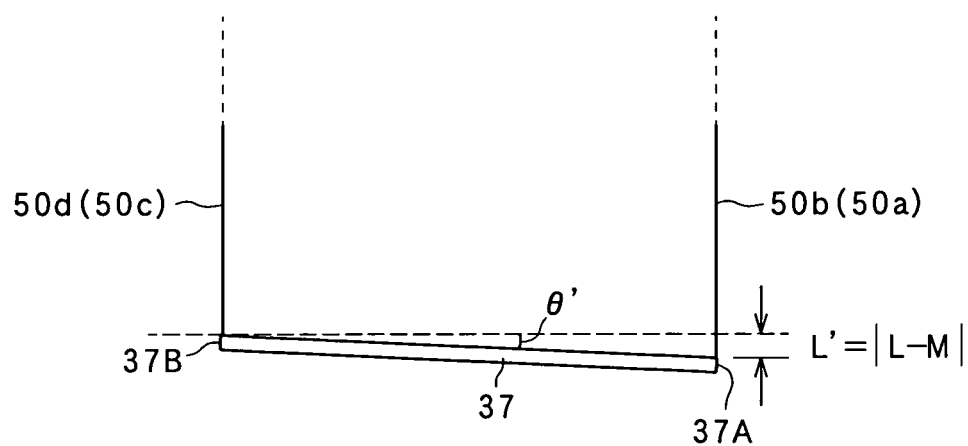


FIG.10

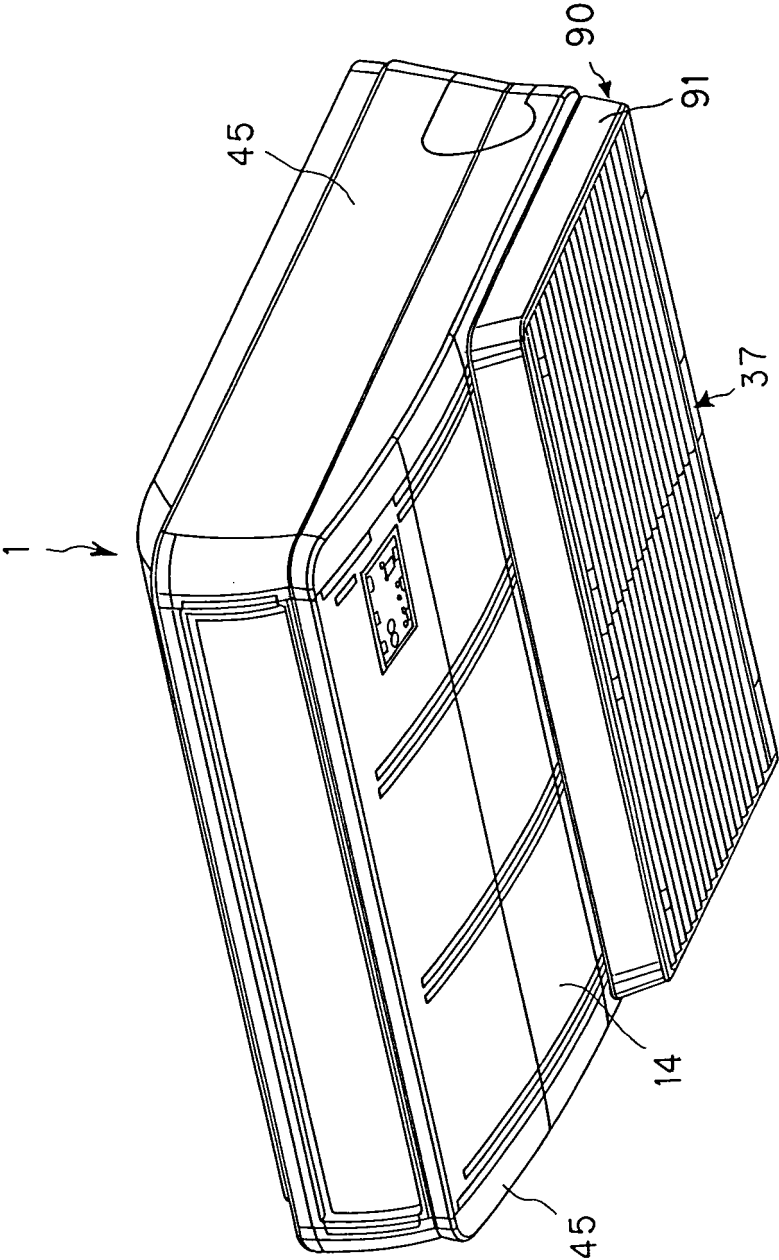


FIG.11

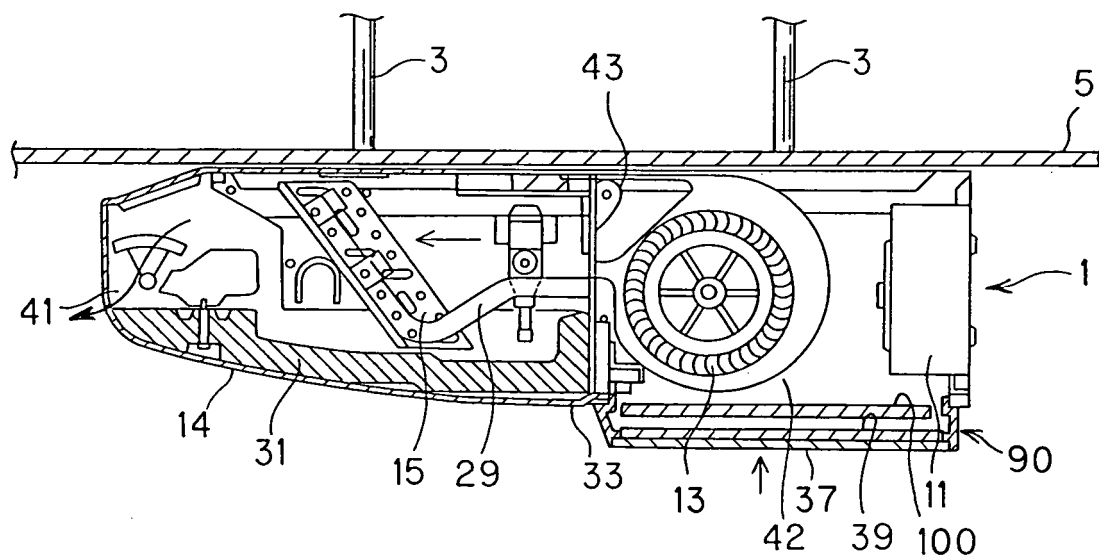


FIG.12

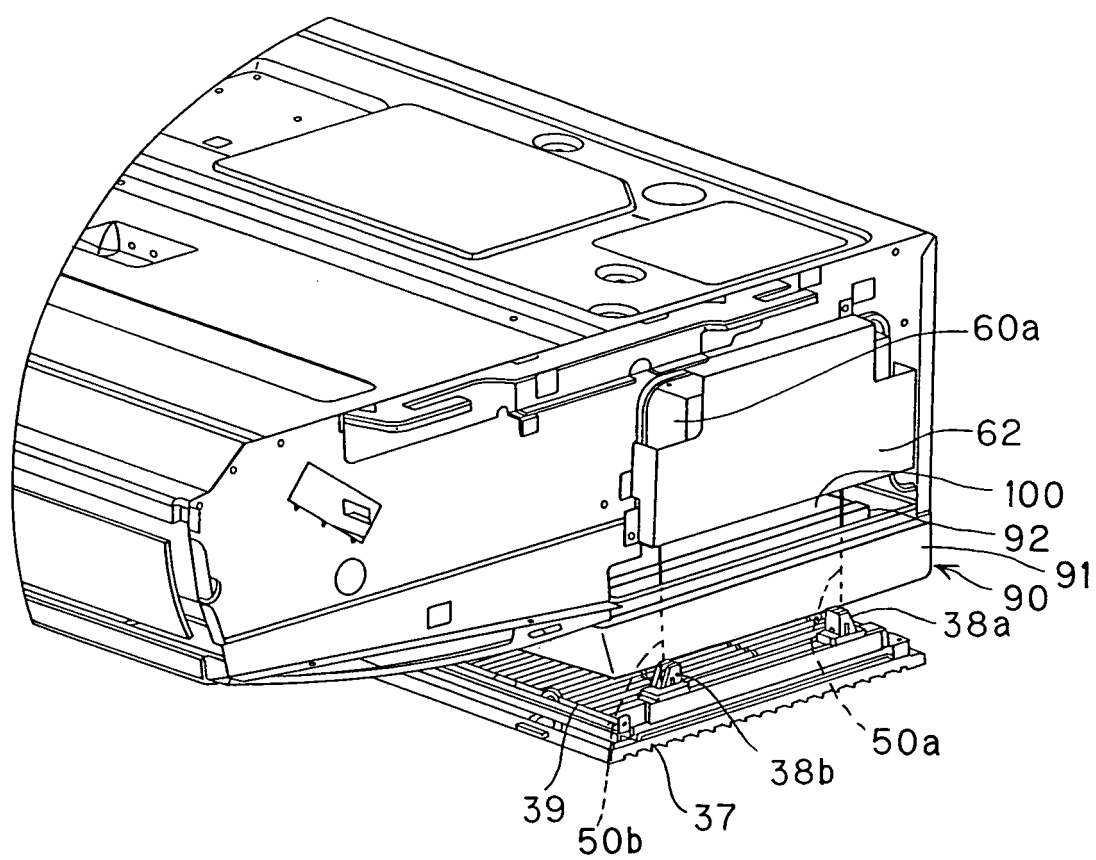


FIG. 13

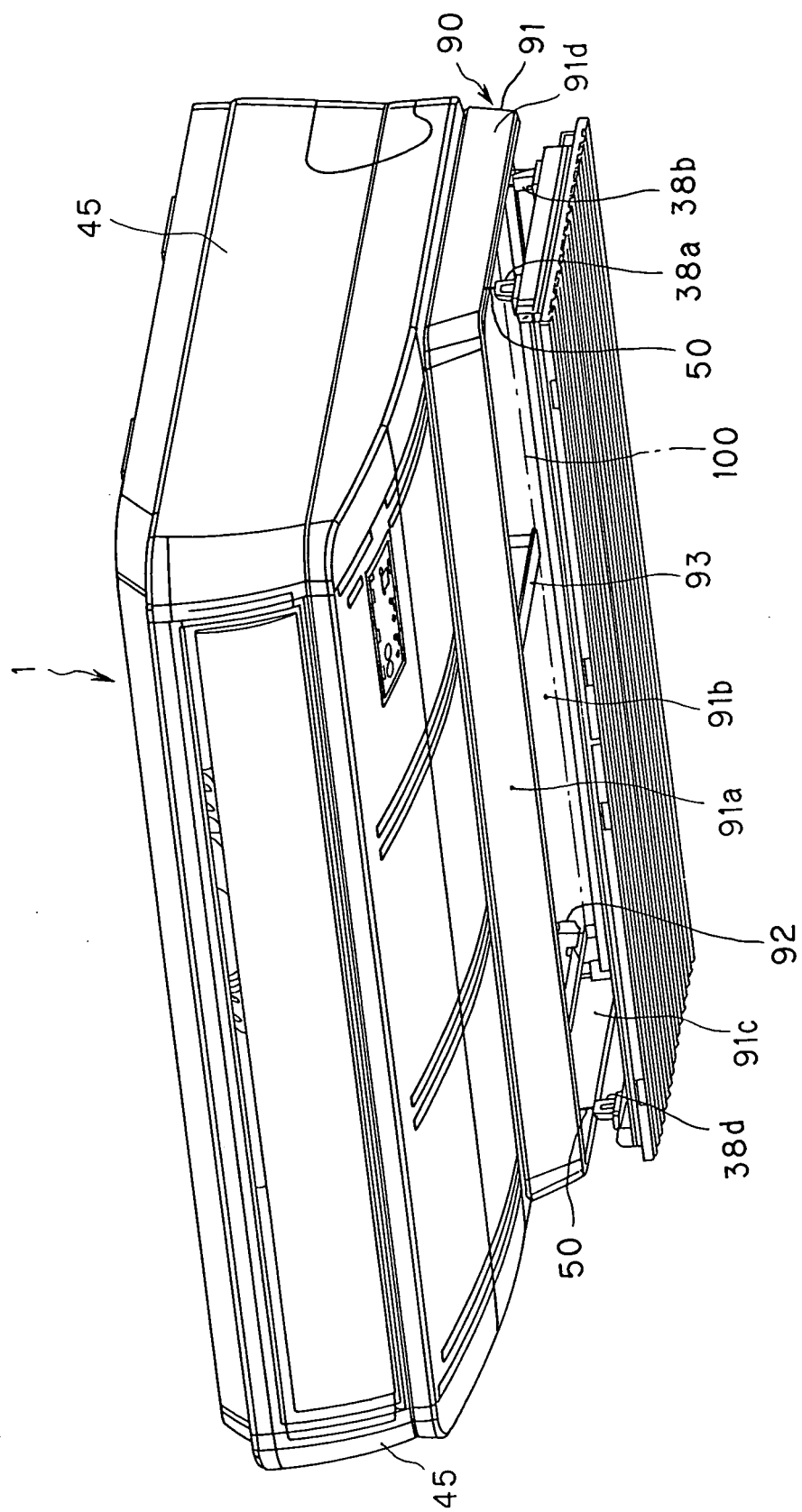


FIG.14

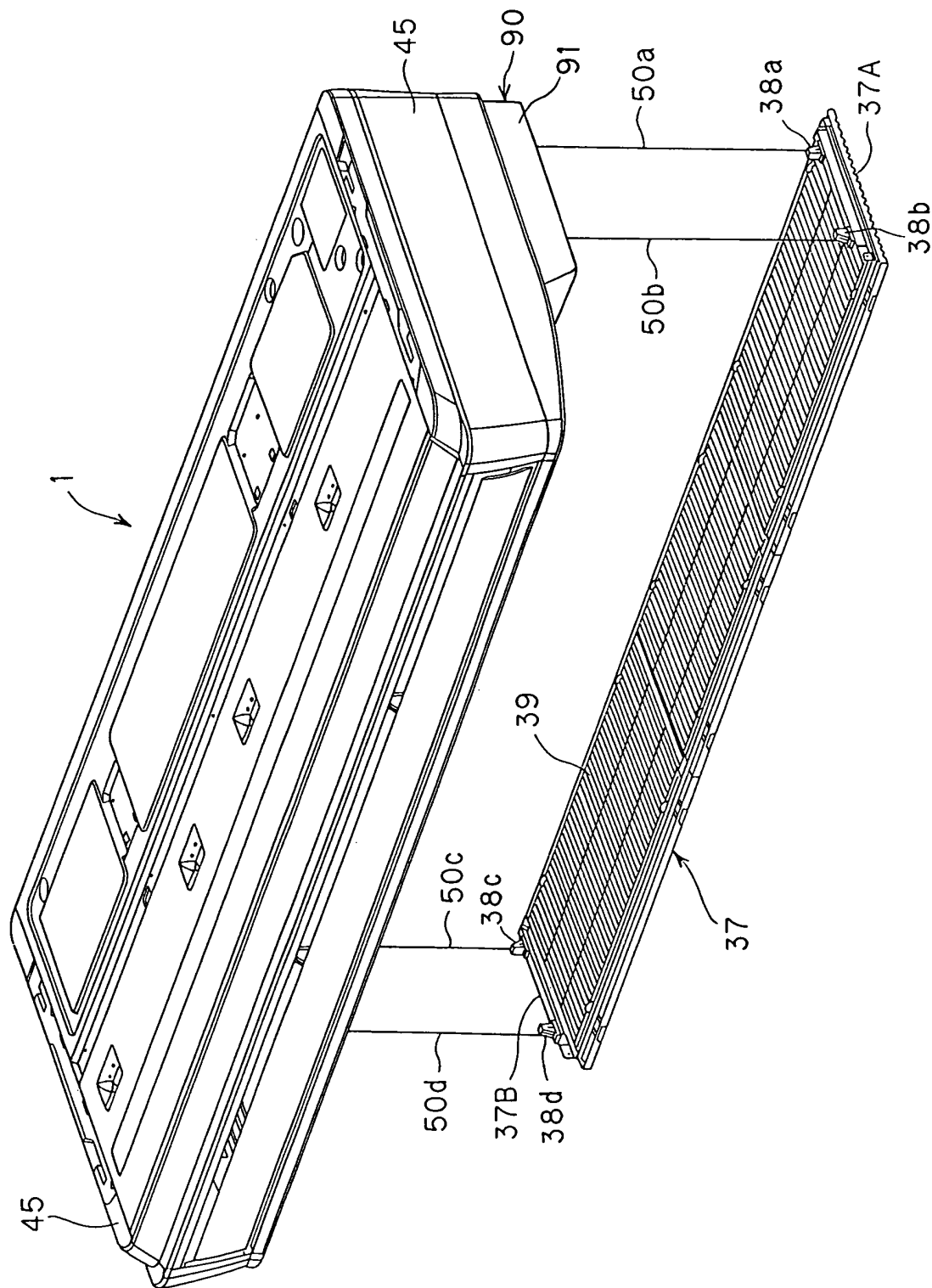


FIG.15

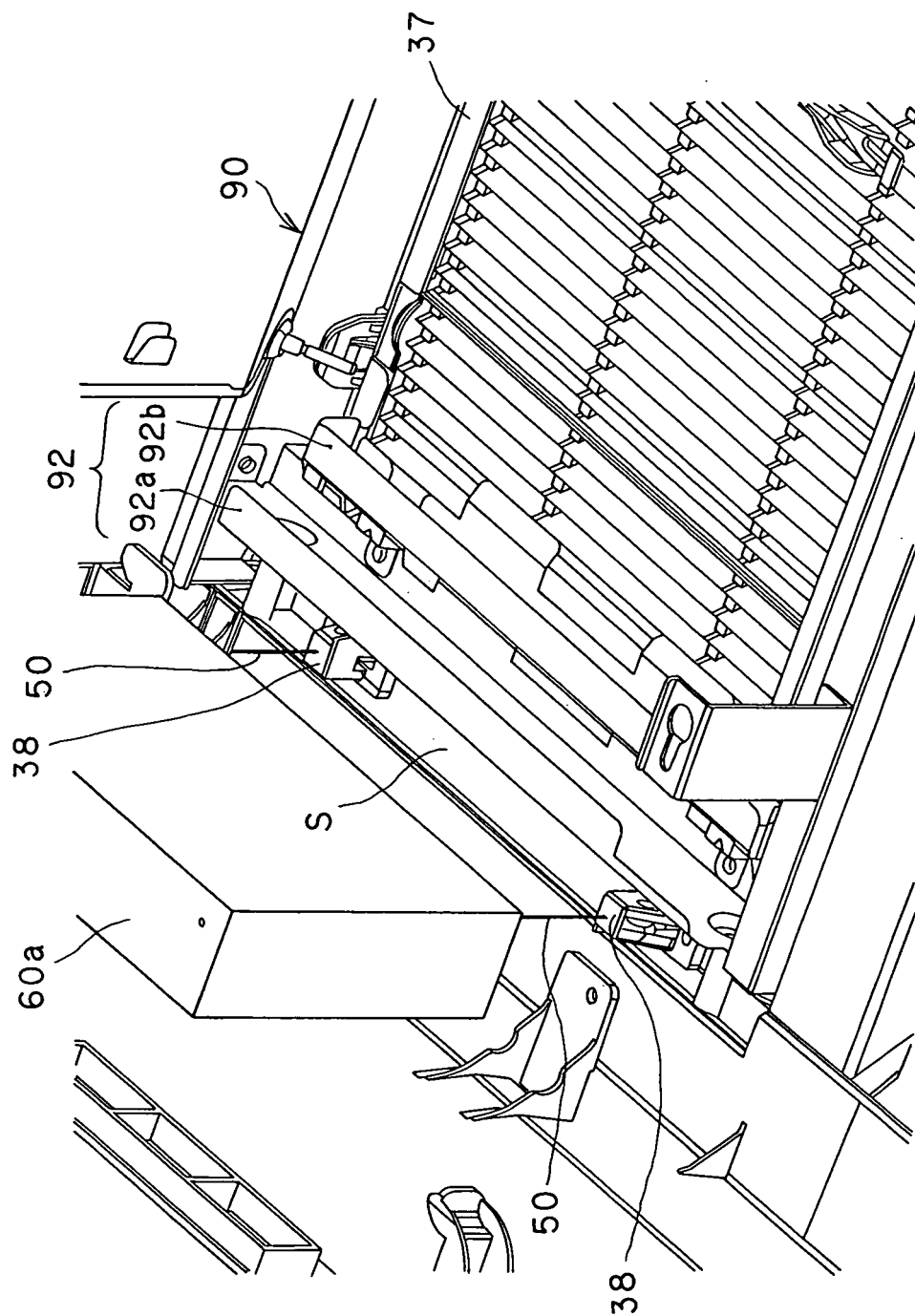


FIG. 16

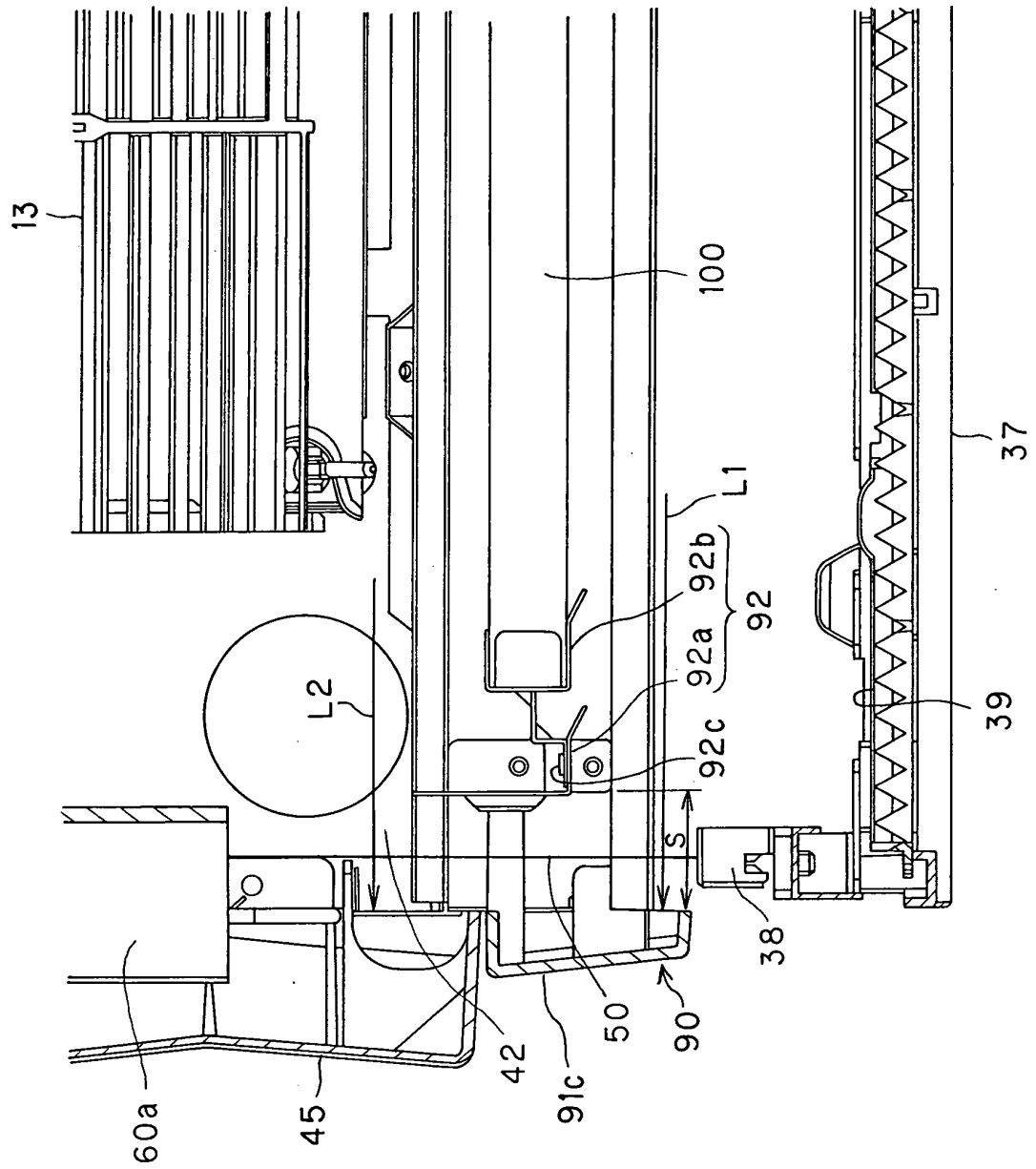
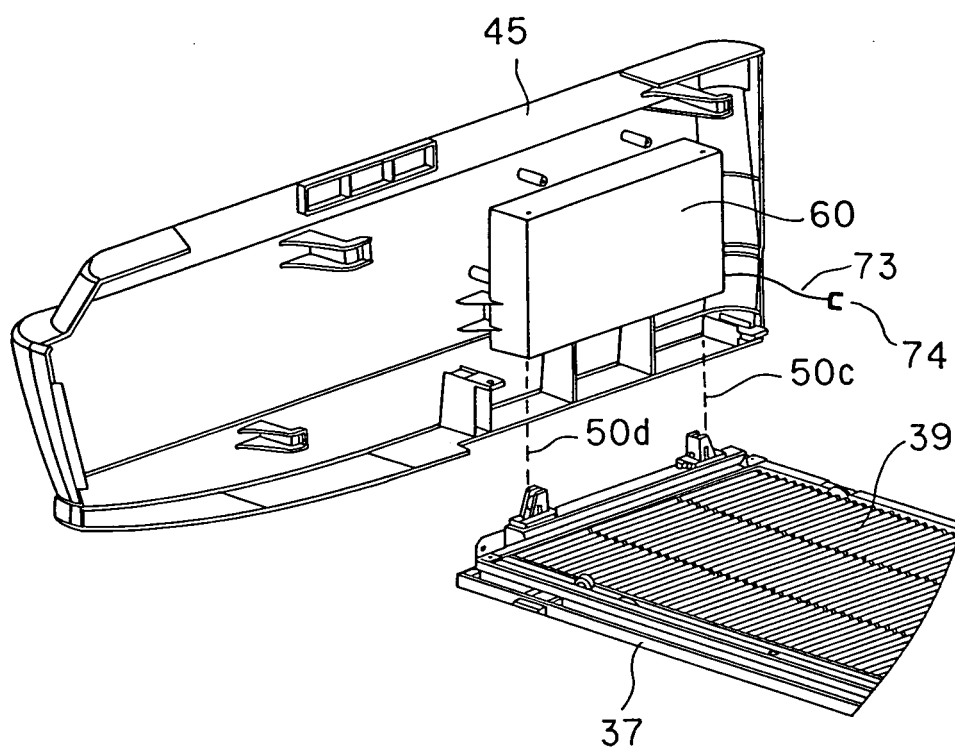


FIG.17



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2004/017385

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl.⁷ F24F1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl.⁷ F24F1/00Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005
Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 10-47750 A (Matsushita Refrigeration Co.), 20 February, 1998 (20.02.98), Full text; all drawings (Family: none)	6-11 1-5, 12, 13
Y	JP 11-101497 A (Sanyo Electric Co., Ltd.), 13 April, 1999 (13.04.99), Full text; all drawings (Family: none)	6-11

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search
19 January, 2005 (19.01.05)Date of mailing of the international search report
01 February, 2005 (01.02.05)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 9275251 A [0002]
- JP 11101497 A [0002]