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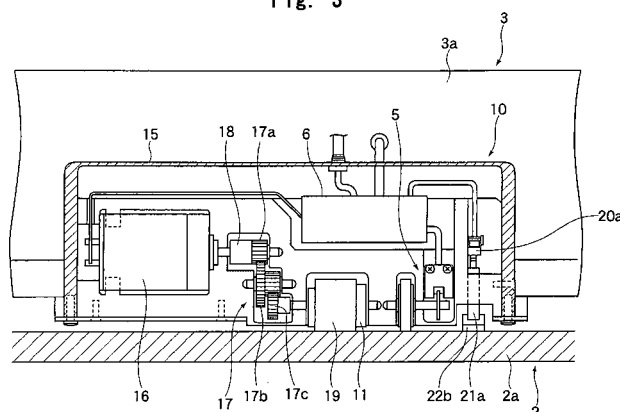
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(54) **MOVABLE BODY DRIVE UNIT AND AUTOMATIC DRAWER DEVICE USING THE SAME**

(57) Provided is an automatic drawer device in which advancement/retreating of a drawer (3) is immediately stopped when the drawer (3) comes into contact with an obstacle to thereby prevent damage of the obstacle and the drawer (3) itself and secure a sufficient level of safety for the user and the like. The automatic drawer device includes a fixed frame body (2); the drawer (3) capable of freely advancing and retreating with respect to the fixed frame body (2); and a movable body drive unit (10) causing the drawer (3) to advance and retreat with respect to

the fixed frame body (2). The movable body drive unit (10) is equipped with: a conveyance roller (11) for causing the drawer (3) to move; a drive means (16) for rotating the conveyance roller (11); a control means (6) for generating a drive signal for the drive means (16); and obstruction detection means (5, 6) which makes a judgement as to whether there is any obstruction to the advancement/retreating of the drawer (3), and which, upon determining there is an obstruction, gives the control means (6) a command to stop the drive means (16).

Fig. 3



Description

TECHNICAL FIELD

[0001] The present invention relates to a movable body drive unit provided between a pair of members making relative reciprocating movement in a predetermined direction such as sliding doors of fittings and drawers of an article of furniture and adapted to cause those members to advance and retreat relative to each other, and an automatic drawer device using the same.

BACKGROUND OF THE INVENTION

[0002] There has conventionally been proposed a device which opens and closes a movable member such as a drawer of an article of furniture or of a built-in kitchen (JP 2003-189955 A, JP 2003-334120 A, etc.). More specifically, a movable member such as a drawer is arranged so as to be freely retractable with respect to a fixed frame body such as an article of furniture, and the movable member is equipped with a rack extending in the direction in which the rack advances and retreats. On the other hand, a gear that is in mesh with the rack is provided on the fixed frame body, and through rotation of the gear upon switch operation by a user, the drawer is caused to advance or retreat according to the rotating direction of the gear. In order that the user can operate the switch unintentionally as if the user opens or closes the drawer by hand, a grip of the drawer grasped by the user is equipped with a measuring device for detecting a direction and a magnitude of a force applied thereto. Further, the gear is rotated upon an output signal from the measuring device, making it possible to automatically open and close the drawer.

Patent Document 1: JP 2003-189955 A

Patent Document 2: JP 2003-334120 A

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0003] However, if, in a case in which there exists an obstacle in an advancing/retreating route of the drawer, the user does not notice it and performs switch operation, the drawer, which advances or retreats irrespective of the presence of the obstacle, will collide with the obstacle, and there is a fear of the obstacle being damaged by being pushed down or the like. Further, there is a danger of the user or some other person having his finger inadvertently caught between the fixed frame body and the drawer, which means consideration for safety is rather insufficient.

MEANS FOR SOLVING THE PROBLEMS

[0004] The present invention has been made in view of the above problems. It is an object of the present in-

vention to provide a movable body drive unit for causing a movable member such as a drawer to advance and retreat along a predetermined advancing/retreating route, in which, even in a case where there exists an obstacle in the advancing/retreating route of the movable member, the movable member is caused to immediately stop its advancing/retreating movement upon collision with the obstacle to thereby prevent damage of the obstacle and the movable member itself and secure a sufficient level of safety for the user and the like.

[0005] Another object of the present invention is to provide an automatic drawer device for opening and closing a drawer by using the movable body drive unit, in which when the drawer comes into contact with an obstacle, the advancement/retreating of the drawer is immediately stopped to thereby prevent damage of the obstacle and the drawer itself and secure a sufficient level of safety for the user and the like.

[0006] That is, the present invention relates to a movable body drive unit mounted to a second member supported so as to be capable of making relative reciprocating movement relative to a first member and adapted to cause the second member to advance and retreat relative to the first member. Here, the movable body drive unit causes the second member to advance and retreat relative to the first member, so it is possible for the first member to be on a fixed side, with the movable body drive unit advancing and retreating together with the second member, or for the second member to be on the fixed side, with the movable body drive unit causing solely the first member to advance and retreat with respect to the second member.

[0007] Further, the movable body drive unit includes: a conveyance roller held in press contact with a traveling surface provided on the first member; a drive means for rotating the conveyance roller in a normal direction or a reverse direction; a user input means for giving the drive means a command to cause the second member to advance or retreat; a control means for generating a drive signal for the drive means in response to an input signal of the user input means; and an obstruction detection means which makes a judgment as to whether there has been generated any obstruction to relative advancement/retreating of the first member and the second member, and which, upon determining there is an obstruction, gives the control means a command to stop the drive means.

[0008] For example, in the case in which the first member is on the fixed side and in which the second member advances and retreats with respect to the first member together with the movable body drive unit, when there is an obstacle in a route for the second member, and advancement of the second member is thereby hindered, the obstruction detection means detects it. When it is determined that there is an obstruction, a command is given to the control means to stop the drive means. As a result, the drive means is stopped irrespective of the input signal of the user input means, and the rotation of

the conveyance roller stops, thus stopping the movement of the second member with respect to the first member. As a result, it is possible to prevent damage of those members due to contact of the second member with the obstacle. Further, in the case in which the first member is a fixed frame body of an article of furniture or the like and in which the second member is a drawer retractable to the fixed frame body, if a finger is inadvertently caught between the drawer and the fixed frame body, this does not lead to serious injury since the drawer stops immediately.

[0009] Here, it is only necessary for the obstruction detection means to be capable of judging whether there has been generated an obstruction to relative advancing and retreating of the first member and the second member. For example, in a case in which there is provided a speed detection means for detecting an advancing/retreating speed of the second member with respect to the first member, when it is judged from an output signal of the speed detection means that the advancing/retreating speed of the second member has been markedly reduced, it is determined that there is an obstruction. In this case, it is possible for the speed detection means to be, for example, a rotary encoder rotating according to the advancing/retreating amount of the second member or a linear encoder for reading a magnetic scale attached to the first member as the second member moves. It is possible to ascertain the advancing/retreating speed of the second member from an output signal from such an encoder. When the drive means is an electric motor, another example of the obstruction detection means may be one which detects generation of an obstruction from fluctuations in the value of an electric current flowing through the motor. Further, as a still another example of the obstruction detection means, it is possible to provide pressure sensors on the front and rear sides in the advancing/retreating direction of the second member in order to directly detect contact with an obstacle, judging the presence/absence of an obstacle from a change in an output signal from the pressure sensors.

[0010] On the other hand, when the obstruction detection means judges an obstacle to be present and gives the control means a command to stop the drive means, if the first member or the second member stops in a state in which it abuts against the obstacle, the operation of removing the obstacle is rather hard to perform. In particular, in a case in which a finger is caught between the fixed frame body being the first member and the drawer being the second member, when the movement of the drawer is stopped with the finger caught, this state will be allowed to continue, resulting in an unexpected injury. Thus, to facilitate the operation of removing the obstacle, when the obstruction detection means judges the obstacle to be present and the drive means stops, it is desirable to separate the first member or the second member immediately from the obstacle after the stopping. However, taking the trouble to perform control to reverse the conveyance roller in order to separate the first member or

the second member from the obstacle will result in a rather complicated construction of the control portion generating the drive signal of the drive means.

[0011] Thus, from this point of view, it is desirable to provide an absorption/repulsion means which absorbs at least a part of torque transmitted from the drive means to the conveyance roller from the point in time when the first member or the second member abuts against the obstacle and is locked in its movement until the point in time when the drive means is stopped, and which, as the drive means stops, separates the first member or the second member from the obstacle by using a reaction force of the absorbed torque. It is possible to realize the absorption/repulsion means, for example, by covering the surface of the conveyance roller with a soft and elastic layer or by providing an elastic joint in the power transmission route from the drive means to the conveyance roller. Due to the provision of such an absorption/repulsion means, when the drive means is stopped by a command from the obstruction detection means after the first member or the second member abuts against an obstacle to be locked in its motion, the torque absorbed by the absorption/repulsion means is released as a reaction force, so the first member or the second member that has abutted against the obstacle slightly retreats so as to be separated from the obstacle. As a result, it is possible to cancel the state in which the first member or the second member abuts against the obstacle without having to perform any special control on the drive means, so in a case in which, for example, a finger is caught, the finger can be released immediately.

[0012] Further, in the case in which the first member or the second member is thus caused to retreat from the obstacle by the reaction force generated by the absorption/repulsion means, it is desirable to provide an electromagnetic clutch in the transmission route for the rotational power from the drive means to the conveyance roller, the control means separating the conveyance roller from the drive means upon the stopping of the drive means. In this construction, it is possible to mitigate the drag load with respect to the reverse rotation of the conveyance roller, making it possible to smoothly effect retraction of the first member or the second member from the obstacle by the absorption/repulsion means.

[0013] In addition, when the electromagnetic clutch cuts off the connection between the conveyance roller and the drive means while the drive means is at rest, the user can move the first member relative to the second member through manual operation without having to use the movable body drive unit of the present invention, thereby helping to achieve an improvement in terms of convenience.

[0014] By using the movable body drive unit of the present invention constructed as described above, it is possible to easily form an automatic drawer device that can open and close various drawers of built-in kitchens, articles of furniture, or the like through switch operation. Further, in such an automatic drawer device, when there

exists an obstacle hindering the drawer opening/closing operation, the opening/closing operation is automatically stopped, making it possible to prevent damage of the obstacle or the drawer itself and to avoid trouble such as catching of the user's finger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a plan view of an example of an automatic drawer device equipped with a movable body drive unit according to the present invention.

Fig. 2 is a side sectional view of the automatic drawer device shown in Fig. 1.

Fig. 3 is a detailed sectional view of the movable body drive unit.

Fig. 4 is a schematic diagram showing a construction of a position switch mounted to the movable body drive unit.

Fig. 5 is an enlarged sectional view of an example of a speed detection means mounted to the movable body drive unit.

Fig. 6 is a sectional view of a rotary encoder of the speed detection means shown in Fig. 5.

Fig. 7 is a block diagram showing a control system of the movable body drive unit.

Fig. 8 is a flowchart showing drawer stop control procedures.

Fig. 9 is a block diagram showing another example of the control system of the movable body drive unit.

DESCRIPTION OF SYMBOLS

[0016] 1 ... automatic drawer device, 2 ... fixed frame body, 3 ... drawer, 5 ... speed detection means, 11 ... conveyance roller, 14 ... switch panel, 16 ... electric motor, 17 ... gear row, 18 ... electromagnetic clutch, 19 ... soft and elastic layer, 51 ... rotary encoder

BEST MODE FOR CARRYING OUT THE INVENTION

[0017] In the following, a movable body drive unit according to the present invention and an automatic drawer device using the same will be described in detail with reference to the accompanying drawings.

[0018] Figs. 1 and 2 are a plan view and a side sectional view, respectively, of an automatic drawer device 1 equipped with a movable body drive unit according to the present invention. The automatic drawer device 1 includes a fixed frame body 2 formed in a box shape, a drawer 3 drawn into and out of the fixed frame body 2 in the horizontal direction as seen in the drawing, and a movable body drive unit 10 for causing the drawer 3 to advance and retreat with respect to the fixed frame body 2, the movable body drive unit 10 causing the drawer 3 to advance and retreat through switch operation.

[0019] The drawer 3 is supported by the fixed frame

body 2 through the intermediation of a pair of slide devices 4a, 4b. The slide devices 4a, 4b, for example, have outer rails fixed to the fixed frame body 2, inner rails fixed to the drawer 3, and a large number of balls rolling between those rails while bearing load, making it possible to cause the drawer 3 to freely advance and retreat with respect to the fixed frame body 2 with a very small force. Regarding the slide devices 4a, 4b, it is possible to select and use a well-known slide device construction as appropriate.

[0020] On the other hand, the movable body drive unit 10 has a conveyance roller 11 fixed to a back plate 3a of the drawer 3 and traveling on a bottom plate 2a of the fixed frame body 2. By rotating the conveyance roller 11, the movable body drive unit 10 runs of its own accord on the bottom plate 2a of the fixed frame body 2 together with the drawer 3. In order to prevent slippage of the conveyance roller 11 with respect to the bottom plate 2a of the fixed frame body 2, a roughened skidproof sheet 12 is attached to the traveling region of the bottom plate 2a for the conveyance roller 11.

[0021] Further, a power cord 13 extends from a back plate 2b of the fixed frame body 2 to the movable body drive unit 10, making it possible to supply electricity to the movable body drive unit 10. As the power cord 13, a curled cord is used, which expands and contracts as the drawer 3 is opened and closed. Further, on a front plate 3b of the drawer 3, there is provided a switch panel 14 as the user input means; by operating the switch panel 14, an operational command is given to the movable body drive unit 10. The switch panel 14 may be one equipped with pushbutton switches respectively corresponding to the operations of opening, closing and stopping the drawer 3, or one which allows operational input according to the number of times by which a pushbutton switch is depressed. Further, it is not necessary for the switch panel 14 to be mounted to the front plate 3b of the drawer 3; according to the arrangement of the drawer 3 to be operated, it may be provided on the fixed frame body 2 side instead on the drawer 3 (movable body) side. Further, the switch panel 14 may be formed as a foot switch allowing operation with tiptoes. In the case of a foot switch, it is possible for the user to open the drawer 3 even when the user is holding with both hands the article to be accommodated in the drawer 3, which leads to superiority in convenience.

[0022] Fig. 3 is a front sectional view of an example of the movable body drive unit 10. The unit 10 is equipped with a casing 15 fixed to the back plate 3a of the drawer 3, the conveyance roller 11 supported so as to be rotatable with respect to the casing 15, an electric motor 16 fixed to the casing 15 and serving as a drive means, a gear row 17 including a plurality of gears 17a, 17b, 17c and adapted to transmit the rotational output of the electric motor 16 to the conveyance roller 11, and an electromagnetic clutch 18 provided between the electric motor 16 and the gear row 17. By energizing the electromagnetic clutch 18, the electric motor 16 and the gear

row 17 are connected, making it possible to transmit the torque of the electric motor 16 to the conveyance roller 11. As the electric motor 16, a DC motor is used; by changing the direction in which voltage is applied to the electric motor 16, the rotating direction of the electric motor 16 is reversed, making it possible to switch the rotating direction of the conveyance roller 11.

[0023] The reason for thus providing the electromagnetic clutch 18 in the power transmission route from the electric motor 16 to the conveyance roller 11 is to lighten the operational feel when the user opens/closes the drawer 3 through manual operation without using the movable body drive unit 10. If the electromagnetic clutch 18 is not provided and the electric motor 16 and the conveyance roller 17 are directly connected through the gear row 17, opening/closing the drawer 3 manually without energizing the electric motor 16 would cause the conveyance roller 11 to rotate the electric motor 16, thereby making the operational feel in opening/closing the drawer 3 rather heavy.

[0024] A soft and elastic layer 19 formed of urethane rubber or the like is provided on the surface of the conveyance roller 11. When the conveyance roller 11 is pressed against the bottom plate 2a of the fixed frame body 2, the soft and elastic layer 19 is slightly crushed, thereby preventing slippage between the conveyance roller 11 and the bottom plate 2a. While in Fig. 3 the rotation of the conveyance roller 11 is directly supported by the casing 15, it is also possible to provide a saddle plate supported by the casing 15 through the intermediation of a spring, supporting the conveyance roller 11 by this saddle plate. That is, with the construction using the saddle plate, even when the conveyance roller 11 is tilted with respect to the bottom plate 2a of the fixed frame body 2, it is possible to reliably bring the conveyance roller 11 into contact with the bottom plate 2a through expansion and contraction of the spring, making it possible to more reliably prevent slippage between the conveyance roller 11 and the bottom plate 2a.

[0025] Further, the movable body drive unit 10 has, on the front and rear sides in the moving direction of the drawer, a pair of position switches 20a, 20b for detecting the end positions in the advancement and retreating of the drawer 3, that is, the state in which the drawer 3 has been completely accommodated in the fixed frame body 2 and the state in which it has been completely drawn out of the fixed frame body 2. Fig. 4 shows those position switches in detail. Movable blocks 21a, 21b are respectively provided on the front surfaces of actuators of the position switches 20a, 20b, and the movable blocks 21a, 21b are retained so as to be vertically movable with respect to the casing 15. On the other hand, switch dogs 22a, 22b are fixed to the bottom plate 2a of the fixed frame body 2 in correspondence with both ends of the advancing/retreating stroke of the drawer 3. When the drawer 3 is completely closed, the movable block 21a runs onto the switch dog 22a, and when the drawer 3 is completely opened, the movable block 21b runs onto the

switch dog 22b. With this construction, when the drawer 3 is drawn out of the fixed frame body 2 and attains the opening terminal position, the movable block 21b is pushed up, and the actuator of the position switch 20b is depressed, whereby the output signal of the position switch 20b undergoes a change. Further, also when the drawer 3 is accommodated in the fixed frame body 2 and attains the completely closed state, the movable block 21a is pushed up, and the actuator of the position switch 20a is depressed, whereby the output signal of the position switch 20a undergoes a change. That is, when the drawer 3 attains one of the two ends of the advancing/retreating stroke, the output signal of the position switch 20a or 20b undergoes a change, and it is possible to judge which of the terminal positions the drawer 3 has reached.

[0026] Further, the movable body drive unit 10 is provided with a speed detection means 5 for detecting the moving speed of the drawer 3. As shown in Fig. 5, the speed detection means 5 includes a detection roller 50 rotatably supported by the casing 15, and a rotary encoder 51 adapted to output a signal corresponding to the rotating speed of the detection roller 50. Further, the rotary encoder 51 includes a transmission type photo sensor 52 in which a light emitting element and a light receiving element are opposed to each other across a detection space 52a, and a disc dog 53 inserted into the detection space 52 and intercepting the optical path between the light emitting element and the light receiving element, with the disc dog 53 being fixed to a rotation shaft 50a of the detection roller 50. As shown in Fig. 6, the disc dog 53 has a large number of slits 53a arranged radially at equal intervals; each time one of the slits 53a passes the detection space 52a of the photo sensor 52, an optical path is formed between the light emitting element and the light receiving element, and the output signal of the photo sensor 52 undergoes a change. Thus, when the drawer 3 is caused to advance or retreat with respect to the fixed frame body 2, the detection roller 50 runs on the bottom plate 2a of the fixed frame body 2, and the output signal of the photo sensor 52 is turned on/off at a speed corresponding to the rotating speed of the detection roller 50.

[0027] In the speed detection means 5, it is not necessary to provide the detection roller 50; from the viewpoint of detecting the advancing/retreating speed of the drawer 3 with respect to the fixed frame body 2, it is also possible to fix the disc dog 53 directly to the rotation shaft of the conveyance roller 11. It should be noted, however, that rotational torque for causing the drawer 3 to advance and retreat is input to the conveyance roller 11 from the electric motor 16, and that there is a risk of the conveyance roller 11 undergoing slippage with respect to the bottom plate 2a of the fixed frame body 2. Thus, from the viewpoint of more correctly grasping the moving speed of the drawer 3, it is desirable to provide the detection roller 50 separately from the conveyance roller 11 as described above, fixing the disc dog 53 to the detection

roller 50. Further, in order to prevent slippage of the detection roller 50 with respect to the bottom plate 2a, it is desirable to cover the surface of the detection roller 50 with a material of high friction coefficient such as rubber. Further, while in the movable body drive unit 10 of Fig. 3 the rotary encoder 51 is used as the speed detection means 5, it is possible to obtain a similar output signal by using a linear encoder. In this case, a linear scale having physical marks arranged at equal intervals is attached to the bottom plate 2a of the fixed frame body 2, and the marks of the linear scale is read by a reading head fixed to the casing 15 as the drawer 3 moves.

[0028] Fig. 7 is a block diagram showing a control system of the movable body drive unit 10. In the drawing, a control portion 6 is equipped with an LSI serving as a microcomputer; it controls the rotation of the electric motor 16 and controls the operation of the electromagnetic clutch 18 in response the output signals from the switch panel 14, the position switches 20a, 20b, and the rotary encoder 51. The control portion 6 is supplied with power from a power source 7 through the power cord 13.

[0029] When the opening or closing of the drawer 3 is input from the switch panel 14, the control portion 6 applies a voltage according to the direction of the input to the electric motor 16 to rotate the electric motor 16, and applies a voltage also to the electromagnetic clutch 18 to connect the electric motor 16 and the gear row 17. As a result, the conveyance roller 11 of the movable body drive unit 10 rotates, and the drawer 3 moves with respect to the fixed frame body 2. When the stopping of the drawer 3 is input from the switch panel 14, the control portion 6 stops the application of voltage to the electric motor 16, and then also stops the application of voltage to the electromagnetic clutch 18 to separate the electric motor 16 and the gear row 17 from each other. As a result, the conveyance roller 11 stops its rotation, and the advancement/retreating of the drawer with respect to the fixed frame body 2 is stopped, making it possible from this onward to cause the drawer 3 to advance and retreat through manual operation. By checking the input signals of the pair of position switches 20a, 20b, the control portion 6 can ascertain whether the drawer 3 is in the open state or the closed state. Therefore, if, for example, a opening command is input from the switch panel 14 although the drawer is in the open state, no voltage is applied to the electric motor 16 and the electromagnetic clutch 18, and they are kept at rest. This also applies to the case in which a closing command is input from the switch panel 14 although the drawer is in the closed state.

[0030] On the other hand, the control portion 6 counts the number of output signals from the rotary encoder 51 per unit time; when the count value becomes not more than a predetermined value, the application of voltage to the electric motor 16 and the electromagnetic clutch 18 is stopped regardless of the input from the switch panel 14. The rotary encoder 51 outputs pulse signals at a speed corresponding to the moving speed of the drawer 3, so if the number of output signals from the rotary en-

coder 51 per unit time has become not more than a predetermined value, it means that the moving speed of the drawer 3 has been reduced to an extreme degree, and trouble is to be expected, such as locking of the drawer 3 by an obstacle. Thus, in this case, the application of voltage to the electric motor 16 and the electromagnetic clutch 18 is immediately stopped, and the rotation of the conveyance roller 11 is stopped. That is, in the movable body drive unit 10, the obstruction detection means, which is a constituent feature of the present invention, is formed by the speed detection means 5 and the control portion 6.

[0031] Fig. 8 is a flowchart illustrating the control procedures related to the stopping of the conveyance roller 11; while the control portion 6 is applying voltage to the electric motor 16, those procedures are always executed irrespective of the moving direction of the drawer 3. When the application of voltage to the electric motor 16 is started, the input signal of the rotary encoder 51 is first checked, thereby checking whether or not the moving speed of the drawer 3 has been reduced to a level not higher than a predetermined speed (ST1). This predetermined speed is set relatively low with leeway with respect to the moving speed of the drawer 3 generated through rotation of the conveyance roller 11. The judgment as to whether the moving speed has been reduced to a level not higher than the predetermined speed is made by counting the number of output signals of the rotary encoder 51 per unit time as described above and by checking whether the count number has become smaller than a predetermined value or not.

[0032] When it is determined from the checking result in ST1 that the moving speed of the drawer 3 is not higher than the predetermined speed, it is to be expected that the drawer has come into contact with an obstacle. Therefore, the application of voltage to the electric motor 16 is immediately stopped, and then the application of voltage to the electromagnetic clutch is stopped (ST3). This causes the drawer 3 to stop.

[0033] On the other hand, when it is determined that the moving speed of the drawer 3 has not been reduced to a level lower than the predetermined speed, it is checked whether the output signal of the position switch 20a, 20b has been turned on or not (ST2). Here, when the output signal of the position switch has been turned on, it is to be assumed that the drawer 3 has moved to the terminal end of the open position or the closed position. Accordingly, in this case also, the application of voltage to the electric motor 16 is immediately stopped, and then the application of voltage to the electromagnetic clutch 18 is stopped (ST3). Further, upon stopping of the drawer 3, the control procedures are completed.

[0034] As described with reference to the flowchart of Fig. 8, when the application of voltage to the electric motor 16 is stopped upon abutting of the drawer 3 against an obstacle, the conveyance roller 11 stops its rotation, so the drawer 3 naturally stops with respect to the fixed frame body. However, in the case in which the movable

body drive unit 10 shown in Fig. 3 is used, when the application of voltage to the electric motor 16 and to the electromagnetic clutch 18 is stopped, with the movement of the drawer 3 being locked by an obstacle, the drawer 3 moves slightly in a direction reverse to the direction in which it has thus far moved, and is automatically separated from the obstacle. This is due to the fact that the surface of the conveyance roller 11 is covered with the soft and elastic layer 19 and that a part of the torque transmitted from the electric motor 16 to the conveyance roller 11 is accumulated as strain from the moment when the movement of the drawer 3 is locked by the obstacle until the moment when the electric motor 16 stops. When the application of voltage to the electric motor 16 and the electromagnetic clutch 18 is stopped, the conveyance roller 11 becomes capable of freely rotating. Therefore, the strain accumulated in the soft and elastic layer 19 is released as a reaction force, and a slight rotational force in a direction reverse to that in which it has thus far rotated is applied to the conveyance roller 11. As a result, the drawer 3 is automatically retracted away from the obstacle.

[0035] Thus, in the movable body drive unit 10, when the movement of the drawer 3 is forcibly locked by an obstacle, and the driving of the electric motor 16 is stopped upon detection of this locking, the drawer 3 is automatically separated from the obstacle with which it has been in contact. Thus, it is possible to instantaneously cancel the state in which the drawer 3 is in contact with the obstacle, and there is no need for the user him/herself to manually retract the drawer 3 to remove the obstacle, thus achieving an improvement in terms of operability. Further, even when the user inadvertently gets his finger caught between the fixed frame body 2 and the drawer 3, the drawer 3 automatically retreats immediately after the stopping of the electric motor 16, so it is possible to instantaneously cancel the state in which the finger is caught, thus making it possible to prevent an accidental injury.

[0036] That is, in the movable body drive unit 10 shown in Fig. 3, the soft and elastic layer 19 covering the surface of the conveyance roller 11 constitutes the absorption/repulsion means of the present invention. In this case, the retracting amount of the drawer 3 depends upon the amount of strain generated in the soft and elastic layer 19. For example, when the thickness of the soft and elastic layer 19 is increased, the amount of strain generated by the soft and elastic layer 19 is so much the larger, so the retracting amount of the drawer 3 when the strain is released is increased. Further, this absorption/repulsion means is not always restricted to the soft and elastic layer 19 covering the conveyance roller 11. For example, it is also possible to provide an elastic joint between the gear 17c and the conveyance roller 11, absorbing a part of the torque of the electric motor 16 through elastic deformation of the elastic joint when the drawer is locked by an obstacle.

[0037] While in the example described above a speed

detection means such as the rotary encoder 51 is used to detect the state in which the movement of the drawer 3 is locked by an obstacle against which it abuts, it is also possible, for example, to ascertain the presence/absence of an obstacle from fluctuations in the value of electric current flowing during the driving of the electric motor 16. Fig. 9 is a block diagram showing a control system used in this case. An ampere meter 8 is provided between the control portion 6 and the electric motor 16, and the output signal of the ampere meter 8 is compared with a predetermined value at the control portion 6. When the drawer abuts an obstacle, the torque of the electric motor increases, and the value of electric current flowing through the electric motor increase in accordance therewith. As a result, when the output signal of the ampere member 8 becomes larger than a predetermined value, the control portion 6 decides that the drawer 3 has abutted an obstacle, and stops the application of voltage to the electric motor 16 and the electromagnetic clutch 18. With this construction also, it is possible to detect whether the drawer has abutted an obstacle or not.

[0038] While in the above description the movable body drive unit of the present invention is applied to an automatic drawer, the movable body drive unit is also applicable to various other conveying devices; by being fixed to the object to be conveyed, it allows the object to attain linear self-propelling motion. Thus, it is only by way of example that the movable body drive unit has been described as applied to an automatic drawer device.

Claims

1. A movable body drive unit (10), which is mounted to a second member (3) supported so as to be capable of freely reciprocating relative to a first member (2), and which causes the second member (3) to advance and retreat relative to the first member (2), comprising:

a conveyance roller (11) held in press contact with a traveling surface provided on the first member (2);

a drive means (16, 17) for rotating the conveyance roller (11) in a normal direction or a reverse direction;

a user input means (14) for giving the drive means (16, 17) a command to cause the second member (3) to advance or retreat;

a control means (6) for generating a drive signal for the drive means (16, 17) in response to an input signal of the user input means (14); and an obstruction detection means (5, 6) which makes a judgment as to whether there has been generated any obstruction to relative advancement/retreating of the first member (2) and the second member (3), and which, upon determining there is an obstruction, gives the control

- means (6) a command to stop the drive means (16, 17) upon determining there is an obstruction.
2. A movable body drive unit according to Claim 1, wherein the obstruction detection means (5, 6) has a speed detection means (5) for detecting an advancing/retreating speed of the second member (3), and judges whether there is any obstruction to advancement/retreating of the second member (3) from an output signal of the speed detection means (5).
 3. A movable body drive unit according to Claim 2, wherein the speed detection means (5) comprises a rotary encoder (51) adapted to rotate according to an advancing/treating amount of the second member (3).
 4. A movable body drive unit according to Claim 1, wherein the obstruction detection means (6) has an ampere meter for measuring an electric current value of the drive means (16), and judges whether there is any obstruction to advancement/retreating of the second member (3) from a measurement value of the ampere meter.
 5. A movable body drive unit according to Claim 1, further comprising an absorption/repulsion means (19) which absorbs at least a part of torque transmitted from the drive means (16, 17) to the conveyance roller (11) from the moment when an obstruction to the relative advancement/retreating of the first member (2) and the second member (3) is generated until the moment when the drive means (16, 17) stops, and which, as the drive means (16, 17) stops, separates the first member (2) or the second member (3) from an obstacle by using a reaction force of the torque absorbed.
 6. A movable body drive unit according to Claim 5, wherein the absorption/repulsion means (19) comprises a soft and elastic layer covering a surface of the conveyance roller (11).
 7. A movable body drive unit according to Claim 5, wherein the drive means is composed of a motor (16) and a gear row (17) transmitting rotational power from the motor (16) to the conveyance roller (11), and wherein the control means (6) cuts off electricity supply to the motor (16) when the drive means is to be stopped.
 8. A movable body drive unit according to Claim 7, wherein the gear row (17) includes an electromagnetic clutch (18), and wherein the electromagnetic clutch (18) cuts off power transmission through the gear row (17) when the drive means is to be stopped.
 9. A movable body drive unit according to Claim 7, wherein at both ends of an advancing/retreating stroke of the second member (3) with respect to the first member (2), there are provided position switches (20a, 20b) for detecting reaching of the second member (3), and wherein the control means (6) cuts off electricity supply to the motor (16) in response an output signal of each of the position switches (20a, 20b).
 10. An automatic drawer device, comprising:
 - a fixed frame body (2);
 - a drawer (3) capable of freely advancing and retreating with respect to the fixed frame body (2); and
 - a movable body drive unit (10) fixed to one of the fixed frame body (2) and the drawer (3) and causing the drawer (3) to advance and retreat with respect to the fixed frame body (2),
 wherein the movable body drive unit (10) is equipped with:
 - a conveyance roller (11) causing the drawer (3) to move;
 - a drive means (16, 17) rotating the conveyance roller (11) in a normal direction or a reverse direction;
 - a user input means (14) for giving the drive means (16, 17) a command to cause the drawer (3) to advance or retreat;
 - a control means (6) for generating a drive signal for the drive means (16, 17) in response to an input signal of the user input means (14); and
 - an obstruction detection means (5, 6) which makes a judgment as to whether there is any obstruction to advancement/retreating of the drawer (3), and which, upon determining there is an obstruction, gives the control means (6) a command to stop the drive means (16, 17).
 11. An automatic drawer device according to Claim 10, wherein the obstruction detection means (5, 6) has a speed detection means (5) for detecting an advancing/retreating speed of the drawer (3), and judges whether there is any obstruction to advancement/retreating of the drawer (3) from an output signal of the speed detection means (5).
 12. An automatic drawer device according to Claim 10, wherein the speed detection means (5) comprises a rotary encoder (51) adapted to rotate according to an advancing/treating amount of drawer (3).
 13. An automatic drawer device according to Claim 10,

wherein the obstruction detection means (5, 6) has an ampere meter for measuring an electric current value of the drive means (16), and judges whether there is any obstruction to advancement/retreating of the drawer (3) from a measurement value of the ampere meter. 5

14. An automatic drawer device according to Claim 10, further comprising an absorption/repulsion means (19) which absorbs at least a part of torque transmitted from the drive means (16) to the conveyance roller (11) from the moment when an obstruction to advancement/retreating of the drawer (3) is generated until the moment when the drive means (16) stops, and which, as the drive means (16) stops, separates the drawer (3) from an obstacle by using a reaction force of the torque absorbed. 10 15
15. An automatic drawer device according to Claim 14, wherein the absorption/repulsion means (19) comprises a soft and elastic layer covering a surface of the conveyance roller (11). 20
16. An automatic drawer device according to Claim 14, wherein the drive means is composed of a motor (16) and a gear row (17) transmitting rotational power from the motor (16) to the conveyance roller (11), and wherein the control means (6) cuts off electricity supply to the motor (16) when the drive means is to be stopped. 25 30
17. An automatic drawer device according to Claim 16, wherein the gear row (17) includes an electromagnetic clutch (18), and wherein the electromagnetic clutch (18) cuts off power transmission through the gear row (17) when the drive means (16) is to be stopped. 35
18. An automatic drawer device according to Claim 16, wherein at both ends of an advancing/retreating stroke of the drawer (3), there are provided position switches (20a, 20b) for detecting reaching of the drawer (3), and wherein the control means (6) cuts off electricity supply to the motor (16) in response to an output signal of each of the position switches (20a, 20b). 40 45
19. An automatic drawer device according to Claim 10, wherein the user input means (14) comprises a foot switch provided on a front surface of the drawer in correspondence with feet of a user. 50

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Fig. 1

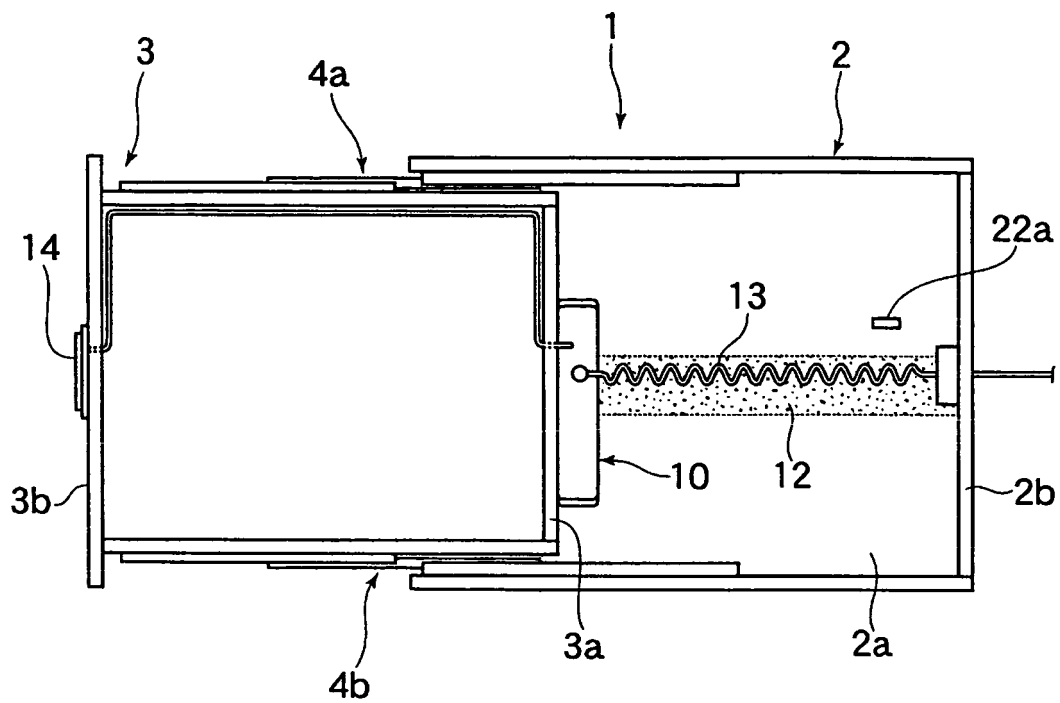


Fig. 2

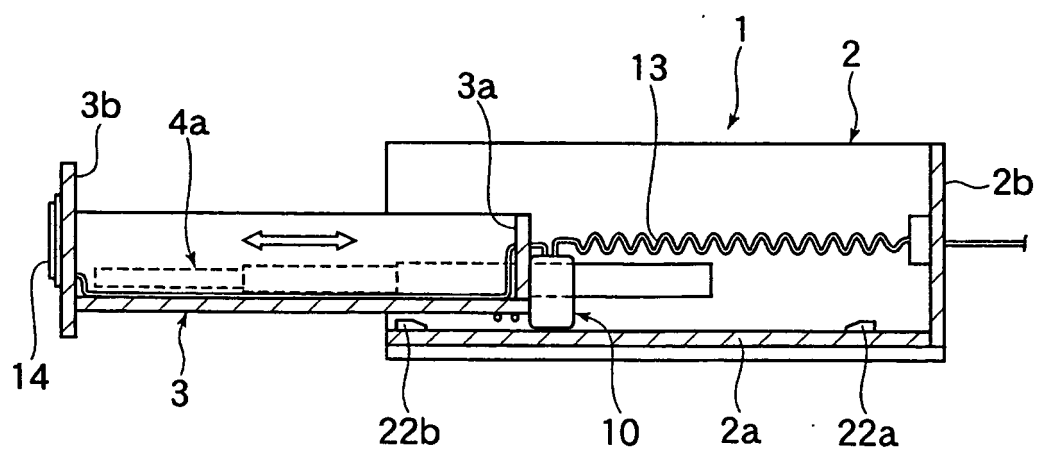


Fig. 3

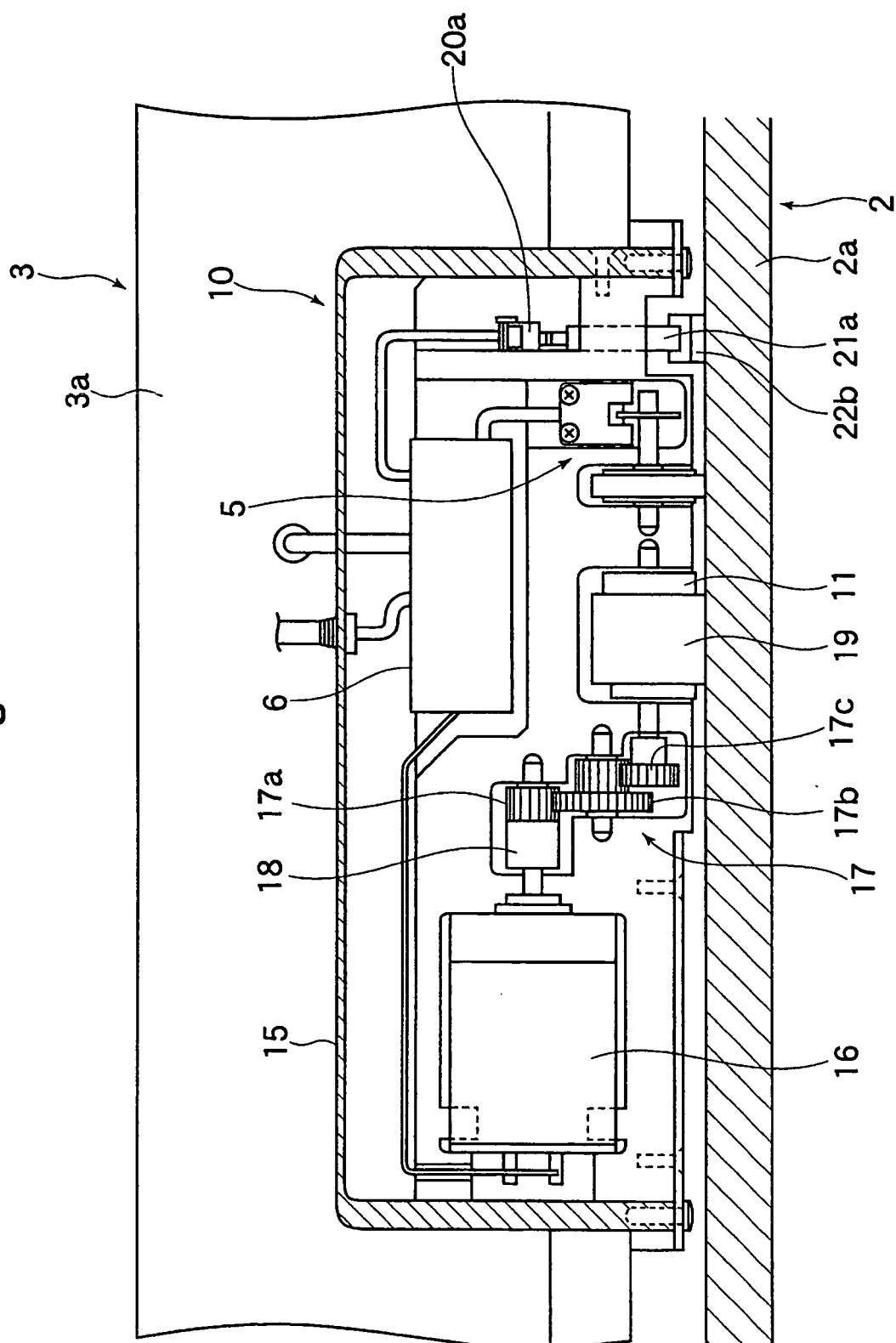


Fig. 4

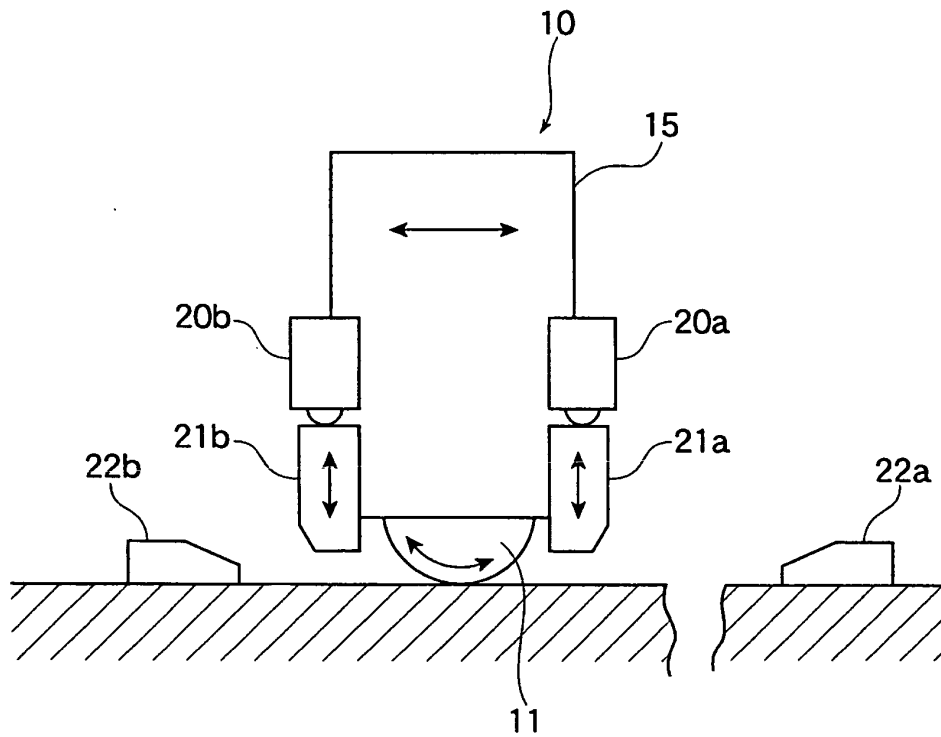


Fig. 5

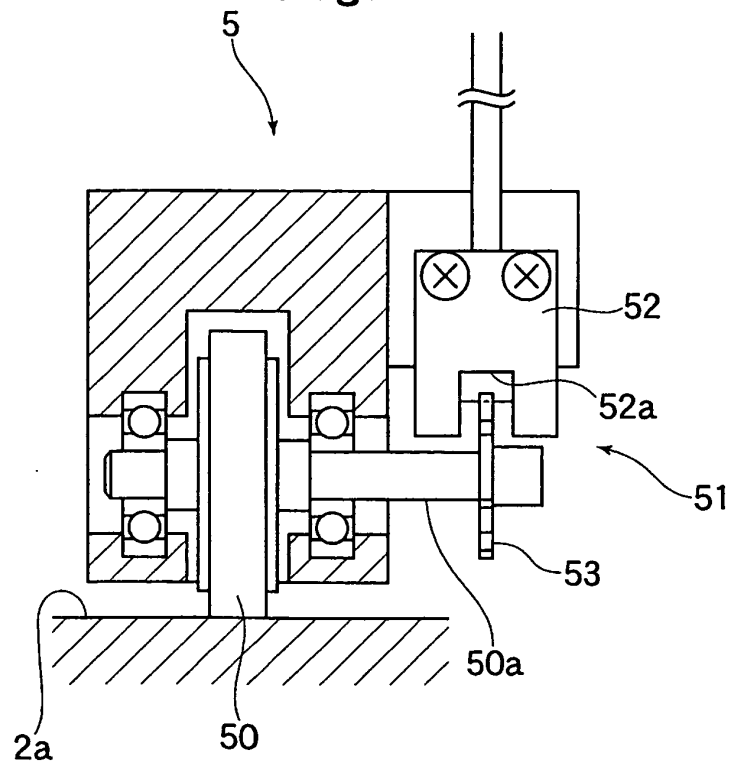


Fig. 6

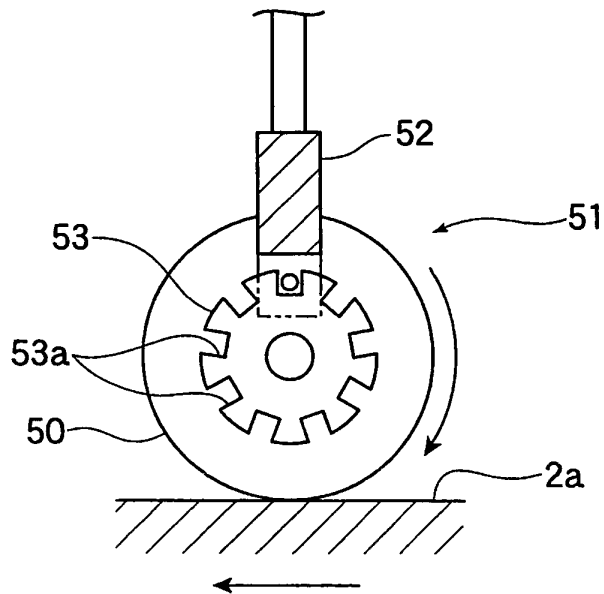


Fig. 7

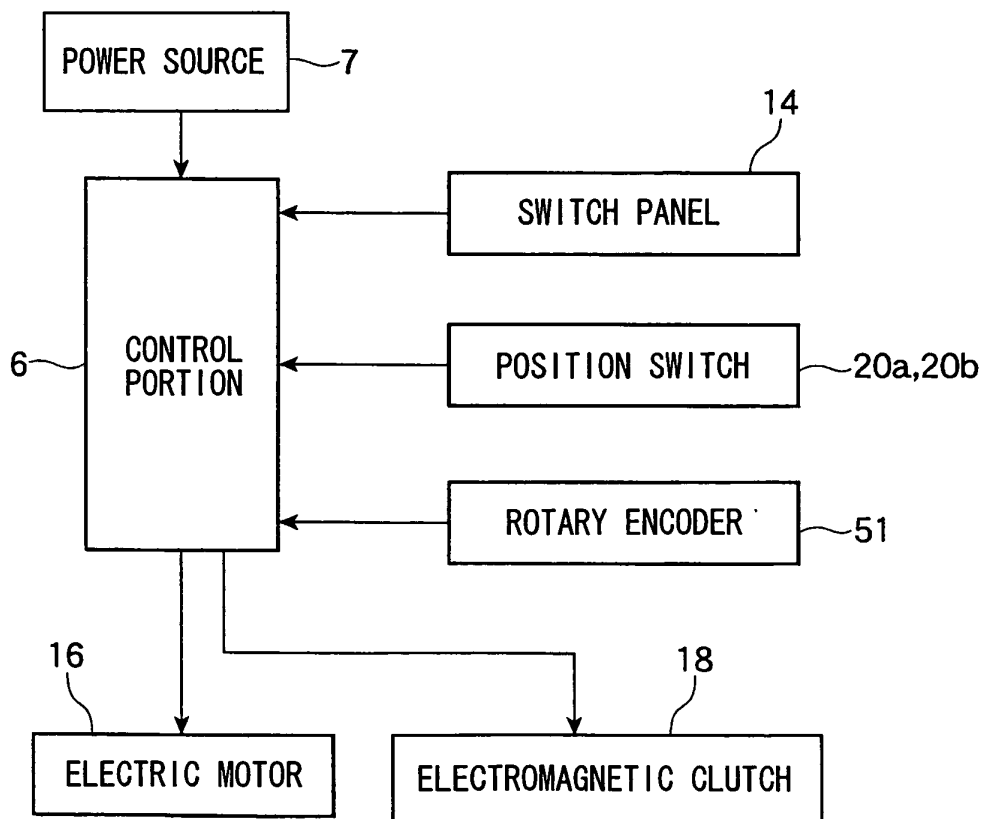


Fig. 8

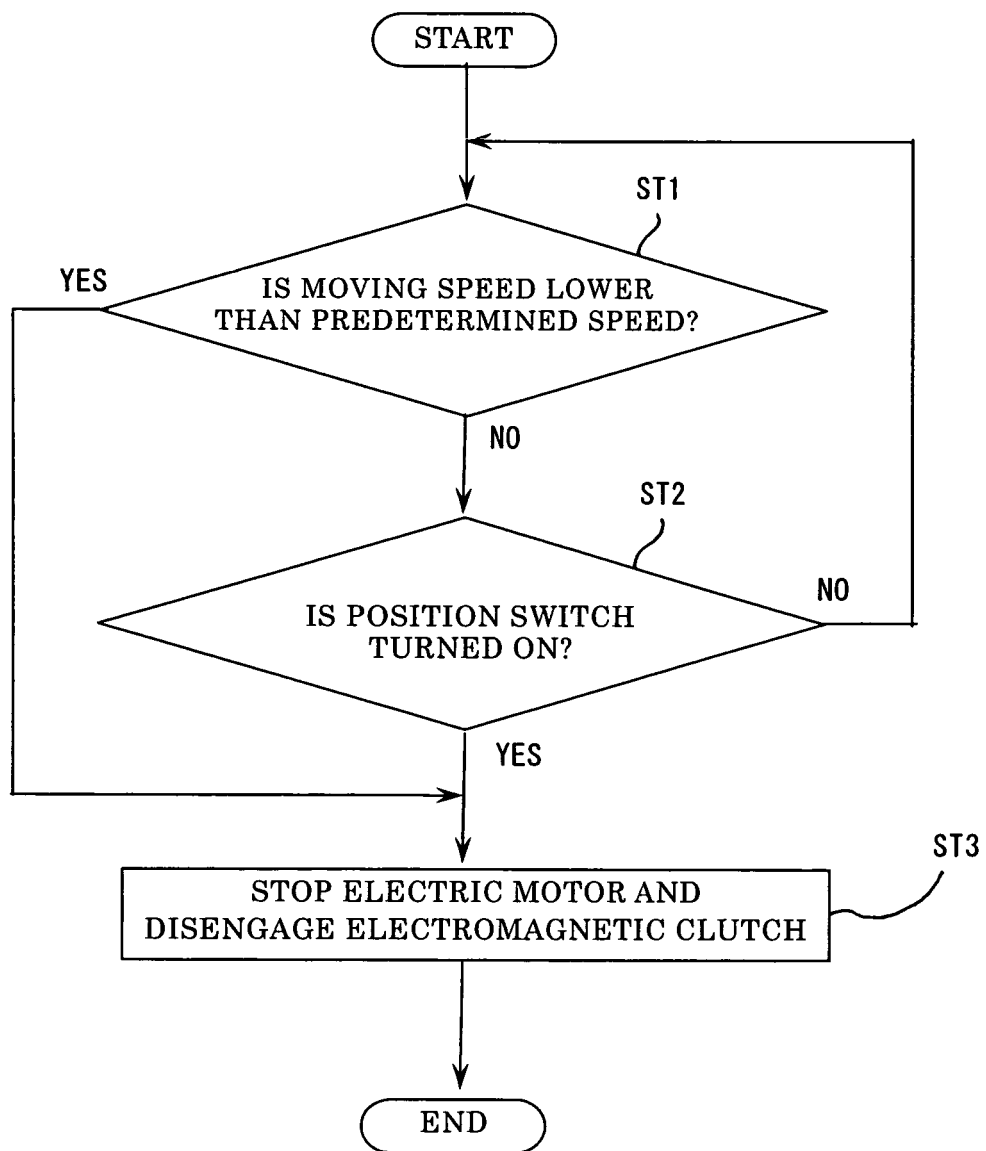
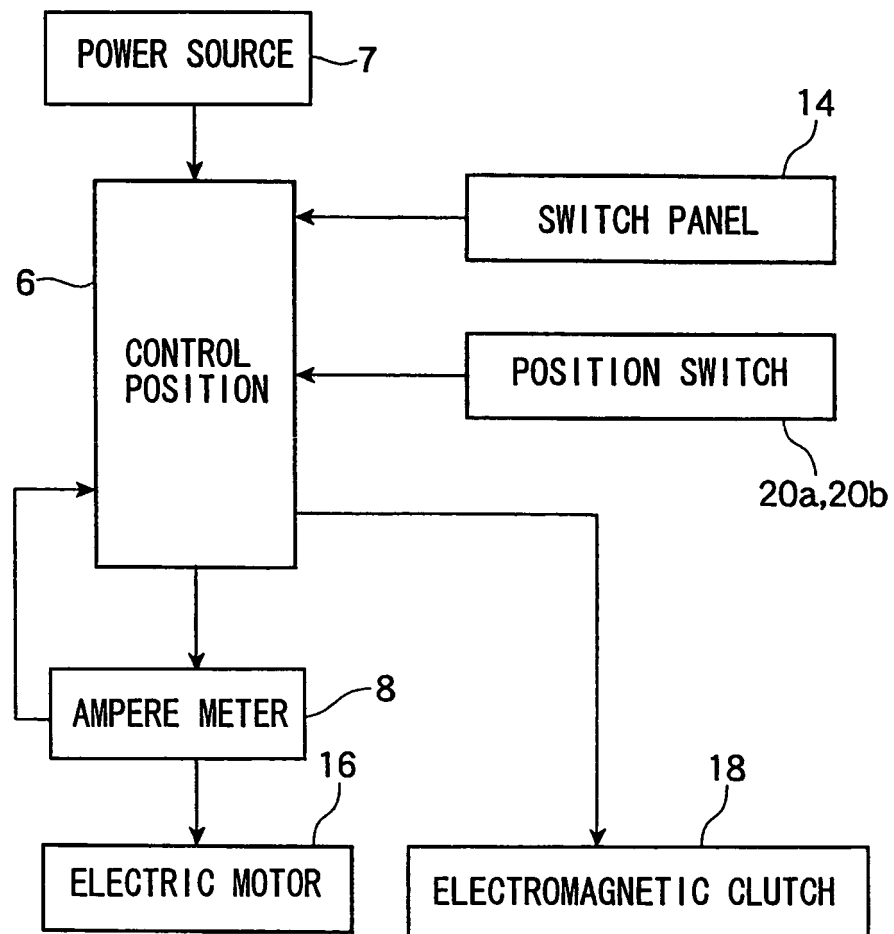


Fig. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/304347

A. CLASSIFICATION OF SUBJECT MATTER A47B88/00 (2006.01) , E05F15/14 (2006.01)		
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) A47B88/00 (2006.01) , E05F15/14 (2006.01)		
Documentation 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 1996-2006 Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006		
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.
X Y A	JP 9-221958 A (Tachikawa Corp.) , 26 August, 1997 (26.08.97) , Full text; all drawings	1 2-4 5-9
Y	JP 2002-168044 A (Nissan Shatai Co., Ltd.) 11 June, 2002 (11.06.02) , Par. Nos. [0003], [0004]	2, 3, 11, 12
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 46960/1983 (Laid-open No. 152085/1984) (Fuso Denki Kogyo Kabushiki Kaisha) , 12 October, 1984 (12.10.84) , Page 9, line 1 to page 10, line 4; Fig. 7	4, 13
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 31 May, 2006 (31.05.06)		Date of mailing of the international search report 06 June, 2006 (06.06.06)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/304347

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y A	JP 6-267168 A (Fujitsu Ten Ltd.), 22 September, 1994 (22.09.94), Par. Nos. [0025] to [0032]; Fig. 5	10-13, 19 14-18
Y A	JP 3001747 U (Kohori Sekkei Kabushiki Kaisha), 06 September, 1994 (06.09.94), Full text; all drawings	19 10-18
Y	JP 10-304944 A (Peka-Metall AG.), 17 November, 1998 (17.11.98), Full text; all drawings	19
Y	JP 2004-248848 A (Matsushita Electric Works, Ltd.), 09 September, 2004 (09.12.04), Full text; all drawings	19
P,A	JP 2005-237766 A (Shinano Kenshi Co., Ltd.), 08 September, 2005 (08.09.05), Full text; all drawings	1-19
P,A	JP 2005-213929 A (THK Kabushiki Kaisha), 11 August, 2005 (11.08.05), Full text; all drawings	1-19
P,A	JP 2005-211443 A (THK Kabushiki Kaisha), 11 August, 2005 (11.08.05), Full text; all drawings	1-19
A	JP 2004-24873 A (Julius Blum GmbH.), 29 January, 2004 (29.01.04), Full text; all drawings	1-19
A	JP 2003-189955 A (Julius Blum GmbH.), 08 July, 2003 (08.07.03), Full text; all drawings	1-19
A	JP 2003-334120 A (Julius Blum GmbH.), 25 November, 2003 (25.11.03), Full text; all drawings	1-19

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- JP 2003189955 A [0002] [0002]
- JP 2003334120 A [0002] [0002]