



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
18.12.2002 Bulletin 2002/51

(51) Int Cl.7: **B66B 7/00, B66B 11/04**

(21) Application number: **01900729.3**

(86) International application number:
PCT/JP01/00157

(22) Date of filing: **12.01.2001**

(87) International publication number:
WO 02/055424 (18.07.2002 Gazette 2002/29)

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

(72) Inventor: **MIZUNO, Satiomi,**
c/o Mitsubishi Electric
Chiyoda-ku, Tokyo 100-0004 (JP)

(71) Applicant: **mitsubishi denki kabushiki**
KAISHA
Chiyoda-ku Tokyo 100-8310 (JP)

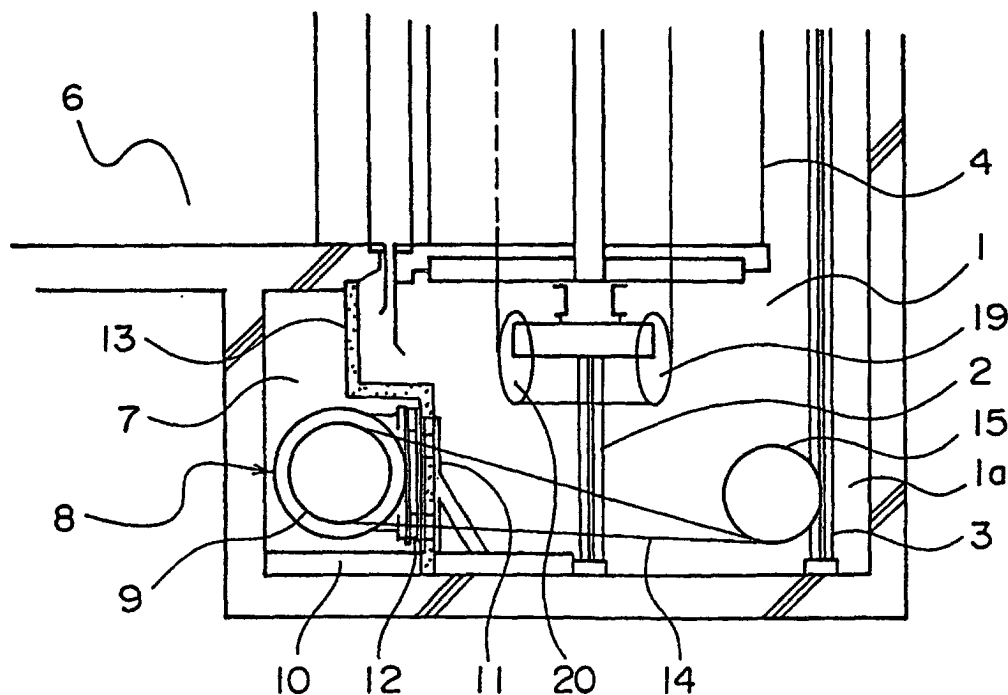
(74) Representative: **HOFFMANN - EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **ELEVATOR DEVICE**

(57) An elevator apparatus includes a hoistway having a pit at the bottom. A car is raised and lowered in the hoistway by a driving machine through a main rope. Un-

der the floor of the landing of the lowermost floor, there is provided an installation space adjacent to the pit. The driving machine is arranged in the installation space.

FIG. 2



Description

TECHNICAL FIELD

[0001] This invention relates to a so-called machine-room-less type elevator apparatus in which no dedicated machine room for installing the driving machine and control panel is provided in the upper portion of the hoistway.

BACKGROUND ART

[0002] In a conventional machine-room-less type elevator apparatus, in which no machine room is provided in the upper portion of the hoistway, a driving machine for raising and lowering the car is arranged in a pit at the bottom of the hoistway. When a driving machine is arranged in the pit, the pit must be made deeper in order to prevent interference between the car and the driving machine, resulting in higher building costs.

[0003] It might be possible to arrange the driving machine in the upper portion or the intermediate portion of the hoistway. However, that would make it necessary to secure sufficient space for arranging the driving machine in the hoistway. Further, maintenance would involve operations at high places and can be very troublesome.

DISCLOSURE OF THE INVENTION

[0004] This invention has been made with a view toward solving the above problems. It is accordingly an object of this invention to provide an elevator apparatus in which interference between car and driving machine can be prevented, and in which maintenance can be conducted with ease.

[0005] To this end, according to one aspect of the present invention, there is provided an elevator apparatus comprising: a hoistway having a pit at the bottom; a car that ascends and descends in the hoistway; a main rope for suspending the car in the hoistway; and a driving machine for raising and lowering through the main rope, wherein an installation space adjacent to the pit is provided under the floor of a landing of a lowermost floor, the driving machine being arranged in the installation space.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1 is a plan view of an elevator apparatus according to Embodiment 1 of this invention;
Fig. 2 is a side view of the pit periphery of the elevator apparatus of Fig. 1;
Fig. 3 is a side view of the pit periphery of an elevator apparatus according to Embodiment 2 of this invention;

Fig. 4 is a side view showing a state in which the driving machine of Fig. 3 has been moved to the pit side;

Fig. 5 is a plan view of an elevator apparatus according to Embodiment 3 of this invention;

Fig. 6 is a side view of the pit periphery of the elevator apparatus of Fig. 5;

Fig. 7 is a plan view of an elevator apparatus according to Embodiment 4 of this invention;

Fig. 8 is a side view of the pit periphery of the elevator apparatus of Fig. 7;

Fig. 9 is a plan view of an elevator apparatus according to Embodiment 5 of this invention;

Fig. 10 is a side view of the pit periphery of the elevator apparatus of Fig. 9;

Fig. 11 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 6 of this invention;

Fig. 12 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 7 of this invention;

Fig. 13 is a side view showing a state in which the driving machine of Fig. 12 has been moved to a position on the floor of a landing;

Fig. 14 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 8 of this invention;

Fig. 15 is a side view showing a state in which the driving machine of Fig. 14 has been moved to a position on the floor of a landing;

Fig. 16 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 9 of this invention;

Fig. 17 is a side view showing a state in which the driving machine of Fig. 16 has been moved to a position on the floor of a landing;

Fig. 18 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 10 of this invention;

Fig. 19 is a side view showing a state in which the driving machine of Fig. 18 has been moved to a position on the floor of a landing;

Fig. 20 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 11 of this invention; and

Fig. 21 is a side view showing a state in which the driving machine of Fig. 20 has been moved to a position on the floor of a landing.

50 BEST MODE FOR CARRYING OUT THE INVENTION

[0007] Preferred embodiments of this invention will now be described with reference to the drawings.

55 Embodiment 1

[0008] Fig. 1 is a plan view of an elevator apparatus according to Embodiment 1 of this invention, and Fig. 2

is a side view of the pit periphery of the elevator apparatus of Fig. 1.

[0009] In the drawings, a pair of car guide rails 2 and a pair of counterweight guide rails 3 are provided in a hoistway 1. A car 4 is guided by the car guide rails 2 and is raised and lowered in the hoistway 1. A counterweight 5 is guided by the counterweight guide rails 3 and is raised and lowered in the hoistway 1.

[0010] A pit 1a is provided at the bottom of the hoistway 1. Under the floor of a landing 6 of the lowermost floor (including the portion below the landing threshold), there is provided an installation space 7 adjacent to the pit 1a. The installation space 7 accommodates a driving machine (hoisting machine) 8 for causing the car 4 and the counterweight 5 to ascend and descend. The driving machine 8 has a driving sheave 9.

[0011] The driving machine 8 is supported by a support base 10 through the intermediation of a machine base 11. A plurality of rubber vibration isolators 12 are provided between the driving machine 8 and the machine base 11. Between the installation space 7 and the pit 1a, there is arranged a detachable partition 13 serving as both a soundproof wall and a fireproof wall.

[0012] The car 4 and the counterweight 5 are suspended in the hoistway 1 by a main rope 14 wound around the driving sheave 9, and are raised and lowered by the driving machine 8 through the main rope 14. In the pit 1a, there are arranged a car-side deflector wheel 15 and a counterweight-side deflector wheel 16. In the upper portion of the interior of the hoistway 1, there are arranged a car-side return wheel 17 and a counterweight-side return wheel 18. Under the car 4, there are provided a pair of car suspending wheels 19 and 20. Above the counterweight 5, there is provided a counterweight suspending wheel 21.

[0013] A first end portion and a second end portion of the main rope 14 are respectively connected to a rope locking portion (not shown) in the upper portion of the interior of the hoistway 1. Starting from the first end portion, the main rope 14 is sequentially wound around the car suspending wheels 20 and 19, the car-side return wheel 17, the car-side deflector wheel 15, the driving sheave 9, the counterweight-side deflector wheel 16, the counterweight-side return wheel 18, and the counterweight suspending wheel 21, and ends at the second end portion.

[0014] In this elevator apparatus, the installation space 7 is provided under the floor of the landing 6 of the lowermost floor, and the driving machine is accommodated in this installation space 7, with the result that it is possible to prevent interference between the car 4 and the driving machine 8 without making the pit 1a deeper, thereby achieving a reduction in building cost. Further, since the underfloor portion of the landing 6 is generally not utilized in many cases, it is relatively free from restrictions and can be effectively utilized as the installation space 7.

[0015] Further, compared to cases where the driving

machine 8 is arranged at a high position, maintenance on the driving machine 8 can be performed more easily.

[0016] Furthermore, as the partition 13 serving as a fireproof wall is provided between the installation space 7 and the pit 1a, even if a fire were to be caused in the driving machine 8, intrusion of flames into the hoistway 1 can be prevented. Further, since the partition 13 also serves as a soundproof wall, the noise of the driving machine 8 is prevented from being transmitted to the interior of the car 4 through the hoistway 1.

Embodiment 2

[0017] Fig. 3 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 2 of this invention. In the drawing, the driving machine 8 is supported by a machine base 22. The machine base 22 is supported by a support base 23 and is capable of sliding reciprocatingly between the installation space 7 and the pit 1a. Between the support base 23 and the machine base 22, there is provided a screw shaft 24, which is threadedly engaged with a screw shaft support member 25 secured to the support base 23. Otherwise, the construction of this embodiment is the same as that of Embodiment 1.

[0018] As shown in Fig. 4, in this elevator apparatus, a handle 26 is connected to the end portion of the screw shaft 24; by rotating the screw shaft 24, the machine base 22 can be moved to the pit 1a together with the driving machine 8. Thus, at the time of maintenance, the driving machine 8 is moved to the pit 1a which is larger than the installation space 7, whereby it is possible to achieve an improvement in maintenance operability.

Embodiment 3

[0019] Fig. 5 is a plan view of an elevator apparatus according to Embodiment 3 of this invention, and Fig. 6 is a side view showing the pit periphery of the elevator apparatus of Fig. 5. In the drawings, there are provided in the floor 6 of the lowermost floor an inspection hole 27 communicating with an installation space 32 and a cover 28 for opening and closing the inspection hole 27. Further, there is fastened to the wall surface of the installation space 32 a ladder 29 used when getting in and out the installation space 32.

[0020] In Embodiment 3, a long and narrow driving machine 30 is used. The driving machine 30 is arranged vertically so that the rotation shaft of its driving sheave 31 extends in the vertical direction. The installation space 32 is large enough to perform maintenance on the driving machine 30. A control panel 33 is arranged in the operation space 32. Otherwise, the construction of this embodiment is the same as that of Embodiment 1.

[0021] In this elevator apparatus, when performing maintenance operations on the driving machine 30, the operator opens the cover 28, and enters the installation space 32 by using the ladder 29. If the car 4 has stopped

as a result of failure, it is sometimes difficult to inspect the driving machine 30 from the pit 1a depending upon the position where the car 4 has stopped. On the other hand, in Embodiment 3, the operator can enter the installation space 32 from the landing 6 safely and easily to perform inspection on the driving machine 30 independently of the position of the car 4.

[0022] Further, in a state in which the operator can enter the pit 1a, the partition 13 is removed from the pit 1a side, whereby it is also possible to inspect the driving machine 30 from the pit 1a side.

Embodiment 4

[0023] Fig. 7 is a plan view of an elevator apparatus according to Embodiment 4 of this invention, and Fig. 8 is a side view showing the pit periphery of the elevator apparatus of Fig. 7. In this example, the long and narrow type driving machine 30 is arranged horizontally so that the rotation shaft of its driving sheave 31 extends in the horizontal direction. Otherwise, the construction of this embodiment is the same as that of Embodiment 3.

[0024] In this elevator apparatus also, the operator can enter the installation space 32 safely and easily from the landing 6 to inspect the driving machine 30. Further, by removing the partition 13 from the pit 1a side, it is also possible to inspect the driving machine 30 from the pit 1a side.

Embodiment 5

[0025] Fig. 9 is a plan view of an elevator apparatus according to Embodiment 5 of this invention, and Fig. 10 is a side view showing the pit periphery of the elevator apparatus of Fig. 10. In this example, a narrow type driving machine 34 is arranged horizontally so that the rotation shaft of its driving sheave 35 may extend in the horizontal direction. By using the narrow type driving machine 34, the installation space 32 can be made smaller. Otherwise, the construction of this embodiment is the same as that of Embodiment 3.

[0026] In this elevator apparatus also, the operator can enter the installation space 32 safely and easily from the landing 6 to inspect the driving machine 34. Further, by removing the partition 13 from the pit 1a side, it is also possible to inspect the driving machine 34 from the pit 1a side.

Embodiment 6

[0027] While in Embodiment 5 the driving machine 34 is arranged horizontally, it is also possible, as shown in Fig. 11, to arrange the driving machine 34 vertically so that the rotation shaft of the driving sheave 35 may extend in the vertical direction.

Embodiment 7

[0028] Fig. 12 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 7 of this invention. In the drawing, the control panel 33 is mounted on the driving machine 30. The top side of the installation space 32 is opened by removing two covers 28a and 28b. The driving machine 30 and the control panel 33 are supported by the machine base 11 through the intermediation of a moving base 36 capable of moving vertically relative to the machine base 11, a swinging base 37 swingable around a shaft 38 relative to the moving base 36, and a plurality of rubber vibration isolators 12.

[0029] Between the moving base 36 and the swinging base 37, there is provided a swinging screw rod 39 for swinging the swinging base 37. The base portion of the swinging screw rod 39 is connected to the moving base 36 through the intermediation of a rotating nut 40, and its intermediate portion is threadedly engaged with the swinging base 37. Between the installation space 32 and the pit 1a, there is arranged a guide pipe 41 for preventing interference of the main rope 14 with apparatus, structures, etc. when the driving machine 30 is displaced.

[0030] A screw rod 42 for vertically moving the moving base 36 is connected to the moving base 36 at the time of maintenance. A handle 43 for rotating the screw rod 42 is connected to the upper end portion of the screw rod 42. The screw rod 42 is supported by a screw reception base 44. The screw reception base 44 is secured in position in the vicinity of the landing threshold by a mounting bolt 45 at the time of maintenance.

[0031] In this elevator apparatus, the covers 28a and 28b are removed at the time of maintenance, and the screw reception base 44 is fixed to the landing 6, the screw rod 42 being connected to the moving base 36. Thereafter, the screw rod 42 is rotated by the handle 43, and the moving base 36 is raised to a position on the floor of the landing 6 together with the driving machine 30 and the control panel 33.

[0032] Next, a handle 43 is connected to the forward end portion of the swinging screw rod 39, and the swinging screw rod 39 is rotated, whereby, as shown in Fig. 13, the swinging base 37 is swung, and the driving machine 30 and the control panel 33 are tilted.

[0033] Since the load of the car 4 and the counterweight 5 is applied to the driving machine 30 through the main rope 14, a great force is applied to the handle 43. Thus, the driving machine 30 may be raised after separately supporting the car 4 and the counterweight 5.

[0034] In this way, the driving machine 30 can be moved to a position on the floor of the landing 6 at the time of maintenance, with the result that the operator can perform maintenance operations at the landing 6 without entering the installation space 32, whereby an improvement can be achieved in terms of operational efficiency. Further, when there is a fear of flooding due

to heavy rains or the like, the operation of the elevator is stopped, and the driving machine 30 and the control panel 33 are raised beforehand, whereby it is possible to prevent the driving machine 30 and the control panel 33 from being flooded in water.

Embodiment 8

[0035] Fig. 14 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 8 of this invention, and Fig. 15 is a side view showing a state in which the driving machine of Fig. 14 has been moved to a position on the floor of the landing. In the drawings, the driving machine 30 is supported by the machine base 11 through the intermediation of slide guides 47 and 48. A screw rod 49 is provided between the machine base 11 and the slide guide 48.

[0036] As shown in Fig. 15, by connecting a handle 50 to the screw rod 49 and rotating the screw rod 49, the driving machine 30 and the control panel 33 are moved from the installation space 32 onto the floor of the landing 6. At this time, the slide guide 48 is caused to slide so as to be extended obliquely upwards.

[0037] In this construction also, the driving machine 30 can be moved onto the floor of the landing 6 at the time of maintenance, with the result that maintenance operation can be conducted at the landing 6, thereby achieving an improvement in operational efficiency. Further, it is possible to prevent the driving machine 30 and the control panel 33 from being flooded in water.

Embodiment 9

[0038] Fig. 16 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 9 of this invention, and Fig. 17 is a side view showing a state in which the driving machine of Fig. 16 has been moved onto the floor of the landing. In the drawings, the driving machine 30 is mounted on a rotating base 52 rotatable around a shaft 51. Between the machine base 11 and the rotating base 52, there is provided a hydraulic cylinder 53 serving as an raising device for rotating the rotating base 52.

[0039] A hydraulic motor pump 55 is connected to the hydraulic cylinder 53 through a hose 54. A speaker 56 serving as an alarm means is provided at the landing 6. In the pit 1a, there is provided a flood sensor 57 for detecting accumulation of water.

[0040] Next, the operation of this embodiment will be described. When a maintenance switch (not shown) is operated at the time of maintenance, the rotating base 52 is rotated by the hydraulic cylinder 53, and, as shown in Fig. 17, the driving machine 30 and the control panel 33 are moved onto the floor of the landing 6. Thus, it is possible to conduct the maintenance operation at the landing 6, thereby achieving an improvement in operational efficiency.

[0041] When water accumulates in the pit 1a as a re-

sult of a heavy rain or the like, and a detection signal is output from the flood sensor 57, the passengers in the car 4 and on each floor are informed of the start of emergency operations. The car 4 is then moved to a predetermined floor, where the passengers in the car 4 are let off at the landing.

[0042] Thereafter, a warning to the effect that the driving machine 30 is going to be raised is given from the speaker 56 to the passengers on the landing 6 of the lowermost floor. The rotating base 52 is then rotated by the hydraulic cylinder 53, and the driving machine 30 and the control panel 33 are moved onto the floor of the landing 6. Thus, the driving machine 30 and the control panel 33 are automatically prevented from being flooded in water.

Embodiment 10

[0043] Fig. 18 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 10 of this invention, and Fig. 19 is a side view showing a state in which the driving machine of Fig. 18 has been moved onto the floor of the landing. In the drawings, the driving machine 8 is mounted on a rotating base 62 rotatable around a shaft 61 by the hydraulic cylinder 53. The rotating base 62 is provided with a guide pipe 63 for preventing the main rope 14 from interfering with apparatus, structures, etc. Otherwise, the construction of this embodiment is the same as that of Embodiment 9.

[0044] In this construction also, the maintenance operation can be conducted at the landing 6, thereby achieving an improvement in terms of operational efficiency. Further, the driving machine 30 and the control panel 33 can be automatically prevented from being flooded in water.

Embodiment 11

[0045] Fig. 20 is a side view showing the pit periphery of an elevator apparatus according to Embodiment 11 of this embodiment, and Fig. 21 is a side view showing a state in which the driving machine of Fig. 20 has been moved onto the floor of the landing. In the drawings, the driving machine 8 is supported by the machine base 11 through the intermediation of slide guides 47 and 48. Mounted on the slide guide 48 is a motor 65 serving as an raising device for causing the slide guides 47 and 48 to slide by rotating a screw rod (not shown) through a speed reduction gear 64.

[0046] In this construction also, the maintenance operation can be conducted at the landing 6, thereby achieving an improvement in terms of operational efficiency. Further, the driving machine 30 and the control panel 33 can be automatically prevented from being flooded in water.

Claims

1. An elevator apparatus comprising: a hoistway having a pit at the bottom; a car that ascends and descends in the hoistway; a main rope for suspending the car in the hoistway; and a driving machine for raising and lowering through the main rope, 5
 wherein an installation space adjacent to the pit is provided under the floor of a landing of a lowermost floor, the driving machine being arranged in the installation space. 10
2. The elevator apparatus according to claim 1, wherein the driving machine can reciprocate between the installation space and the pit. 15
3. The elevator apparatus according to claim 1, wherein the floor of the landing is provided with an inspection hole communicating with the installation space and a cover for opening and closing the inspection hole. 20
4. The elevator apparatus according to claim 1, wherein a detachable soundproof wall is provided between the installation space and the pit. 25
5. The elevator apparatus according to claim 1, wherein a detachable fireproof wall is provided between the installation space and the pit. 30
6. The elevator apparatus according to claim 1, wherein the driving machine can reciprocate between the installation space and a position on the floor of the landing. 35
7. The elevator apparatus according to claim 6, wherein a control panel can reciprocate together with the driving machine. 40
8. The elevator apparatus according to claim 1, wherein the pit is provided with a flood sensor for detecting accumulation of water in the pit, and wherein the installation space is provided with an raising device for allowing the driving machine to be raised when accumulation of water is detected by the flood sensor. 45
9. The elevator apparatus according to claim 8, wherein when accumulation of water is detected by the flood sensor, the driving machine is raised onto the floor of the landing, and wherein the landing is provided with an alarm means giving a warning to passengers to the effect that the driving machine is to be raised. 50
 55

FIG. 1

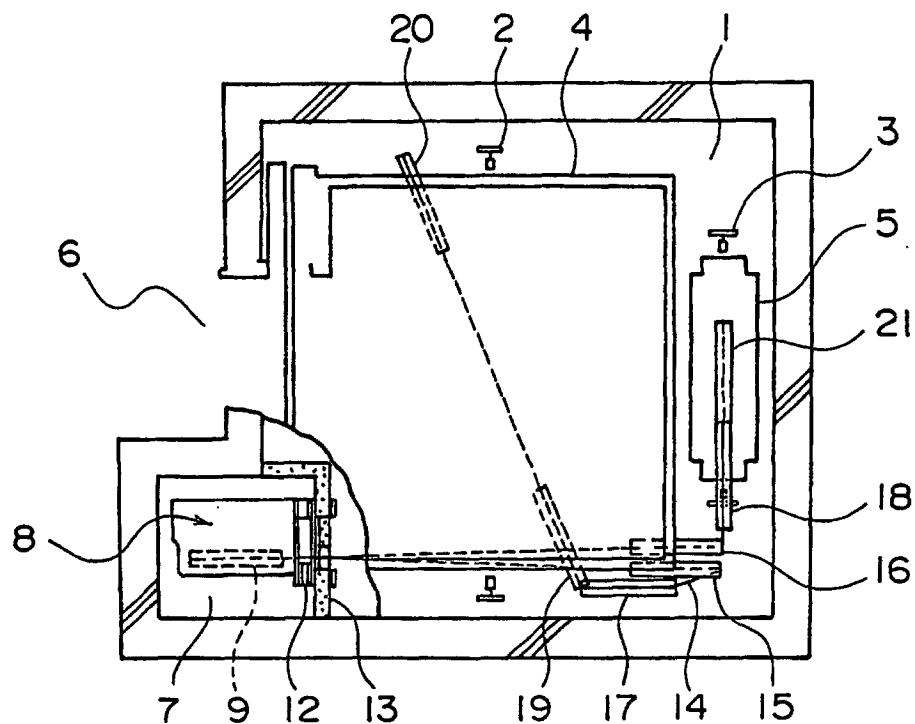


FIG. 2

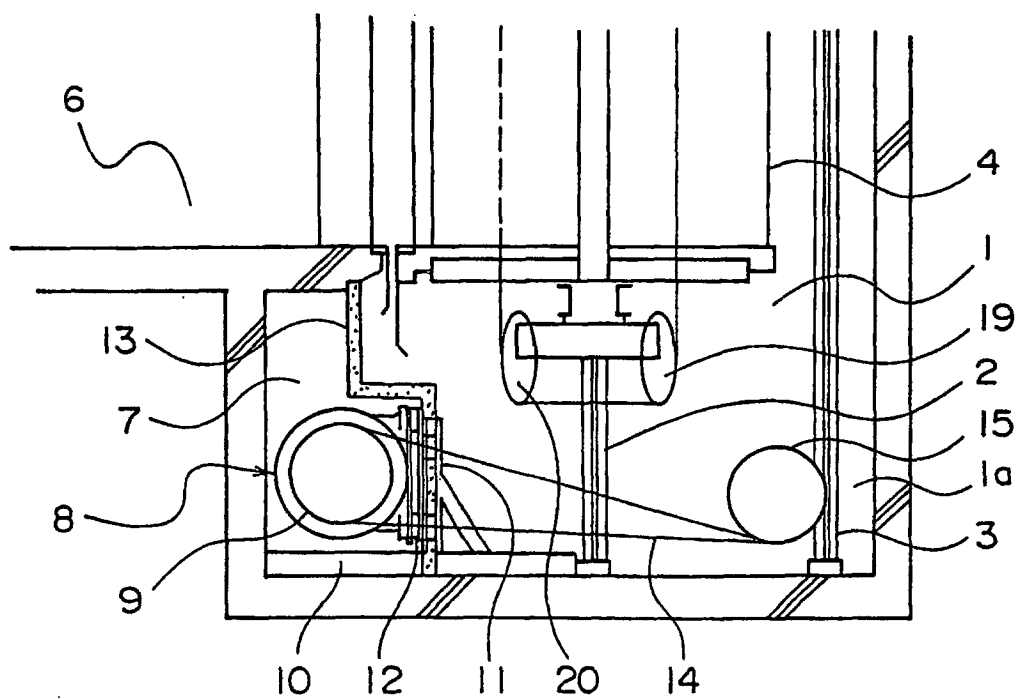


FIG. 3

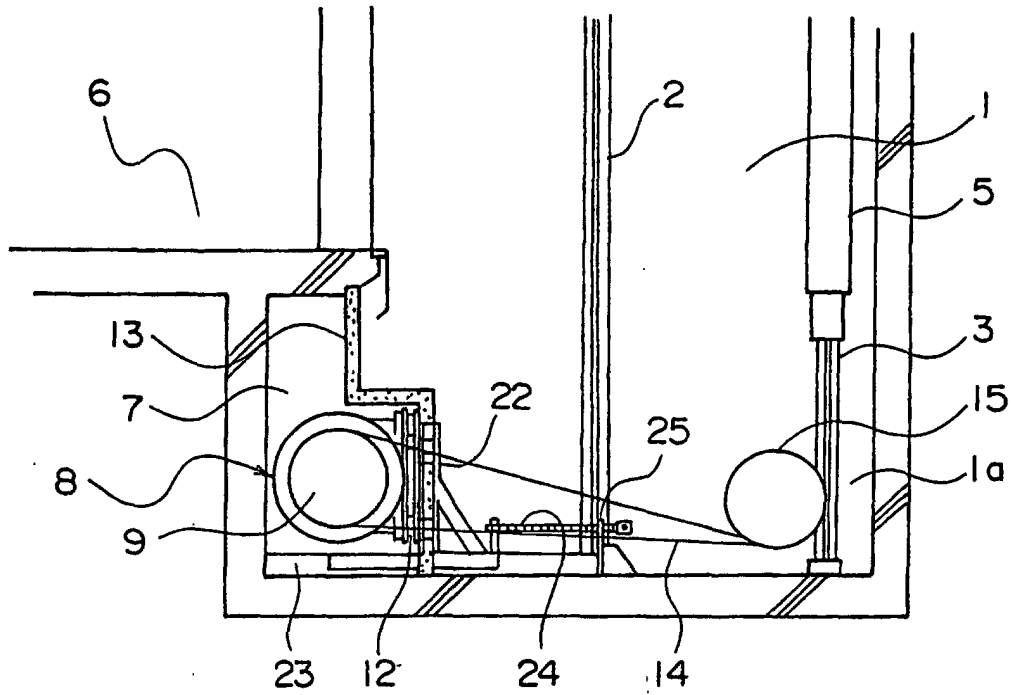


FIG. 4

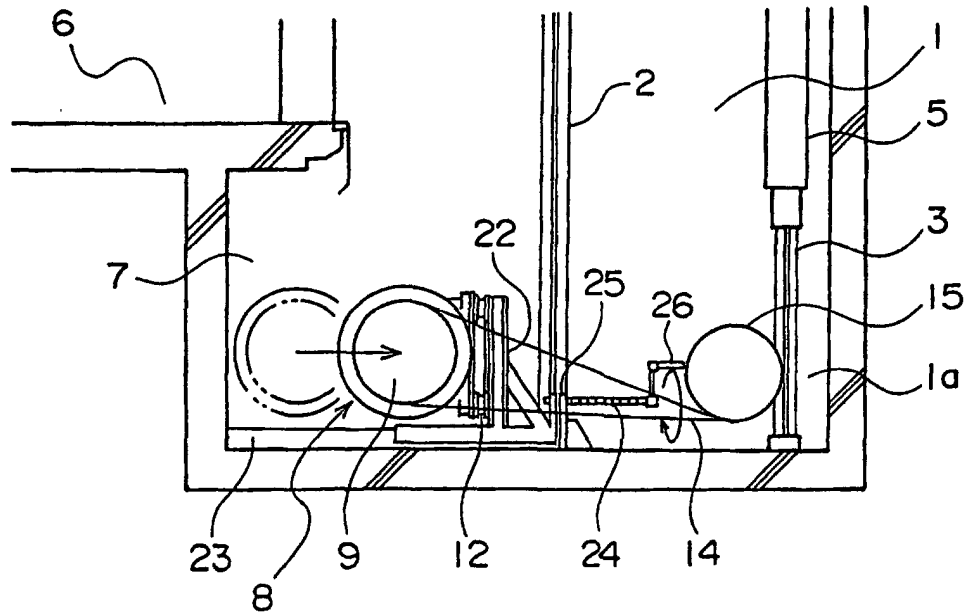


FIG. 5

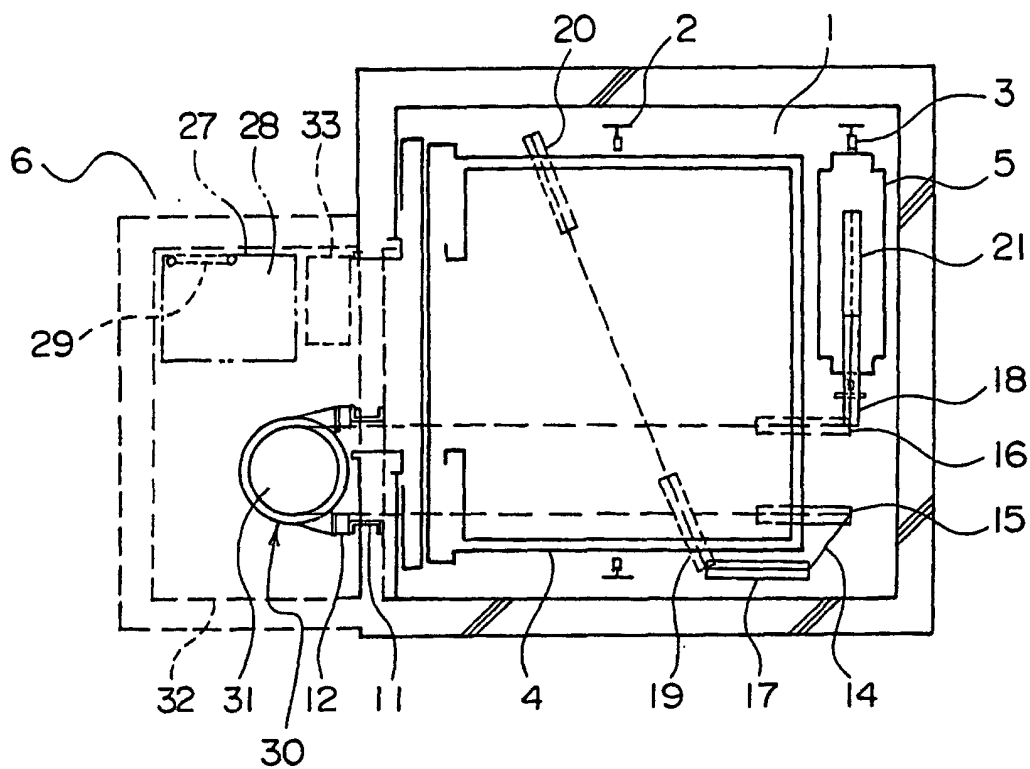


FIG. 6

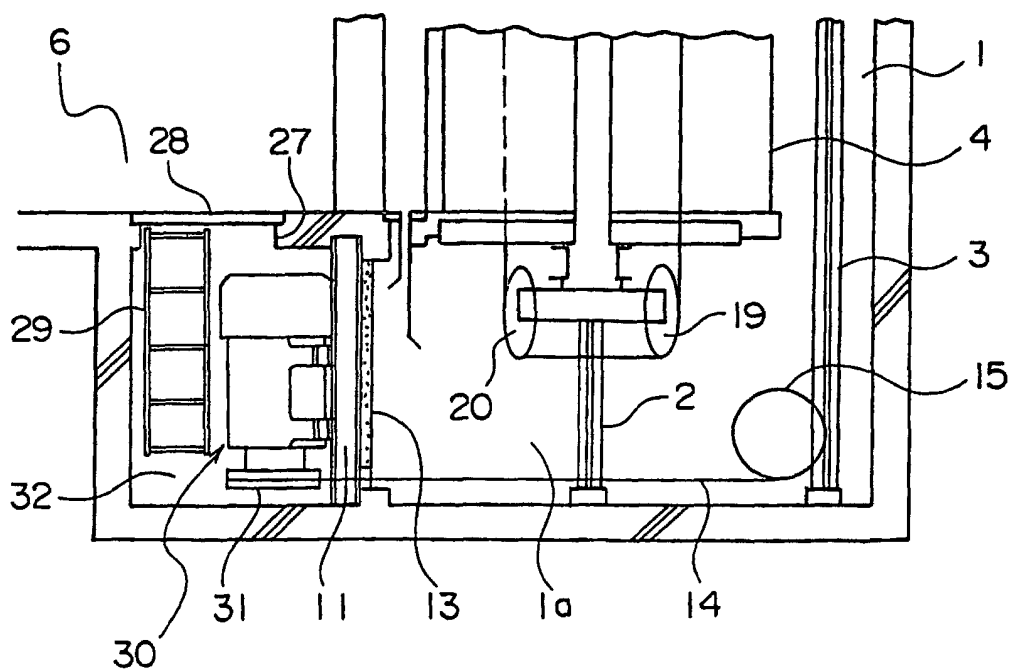


FIG. 7

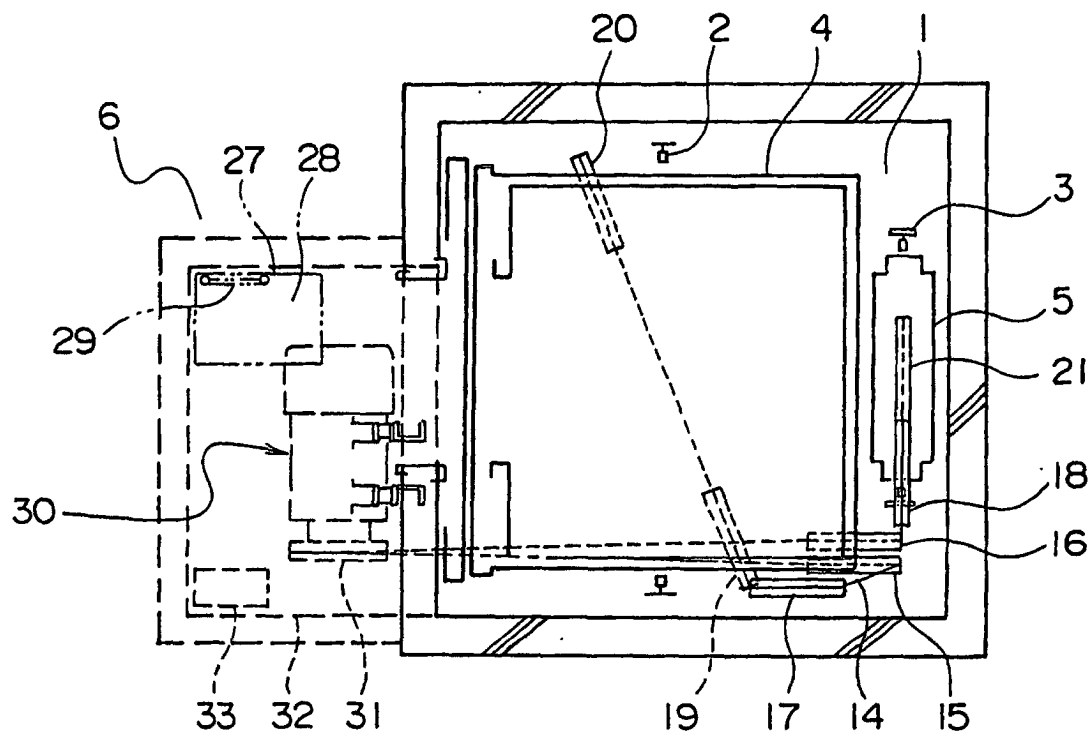


FIG. 8

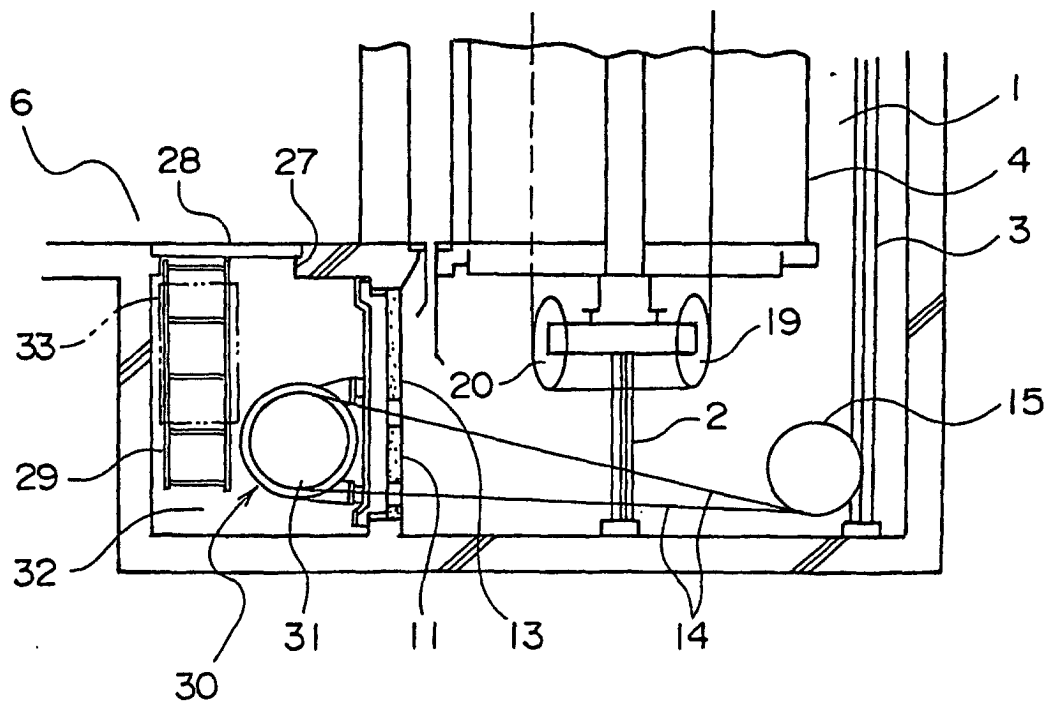


FIG. 9

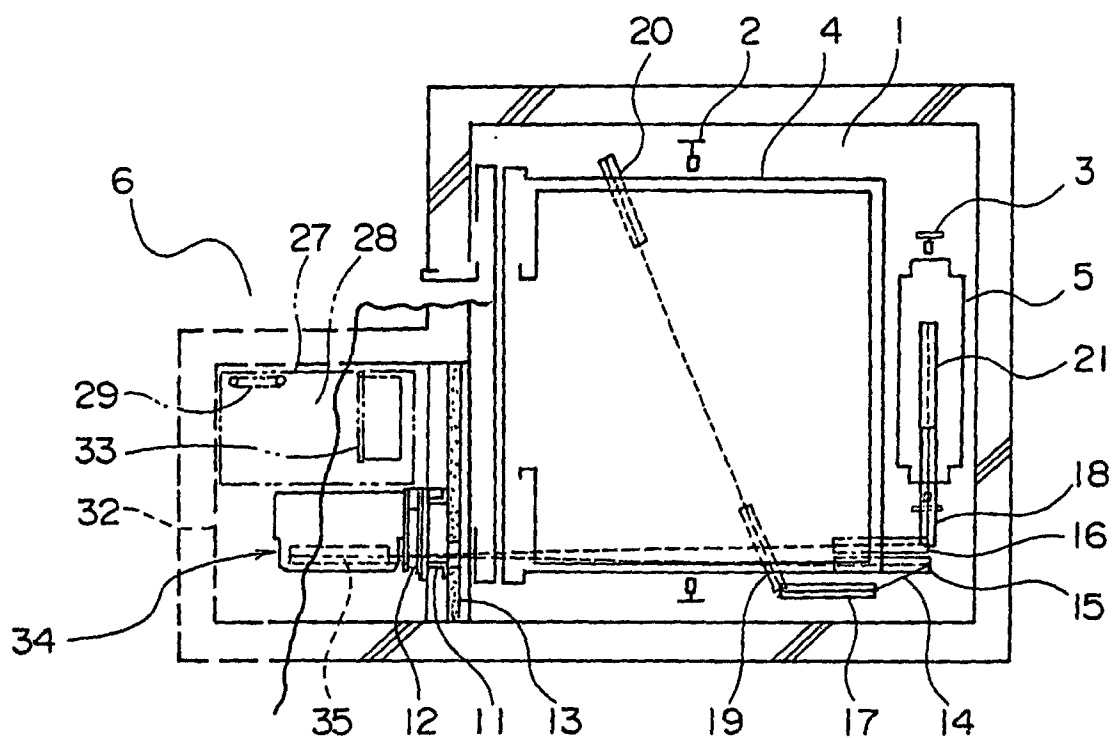


FIG. 10

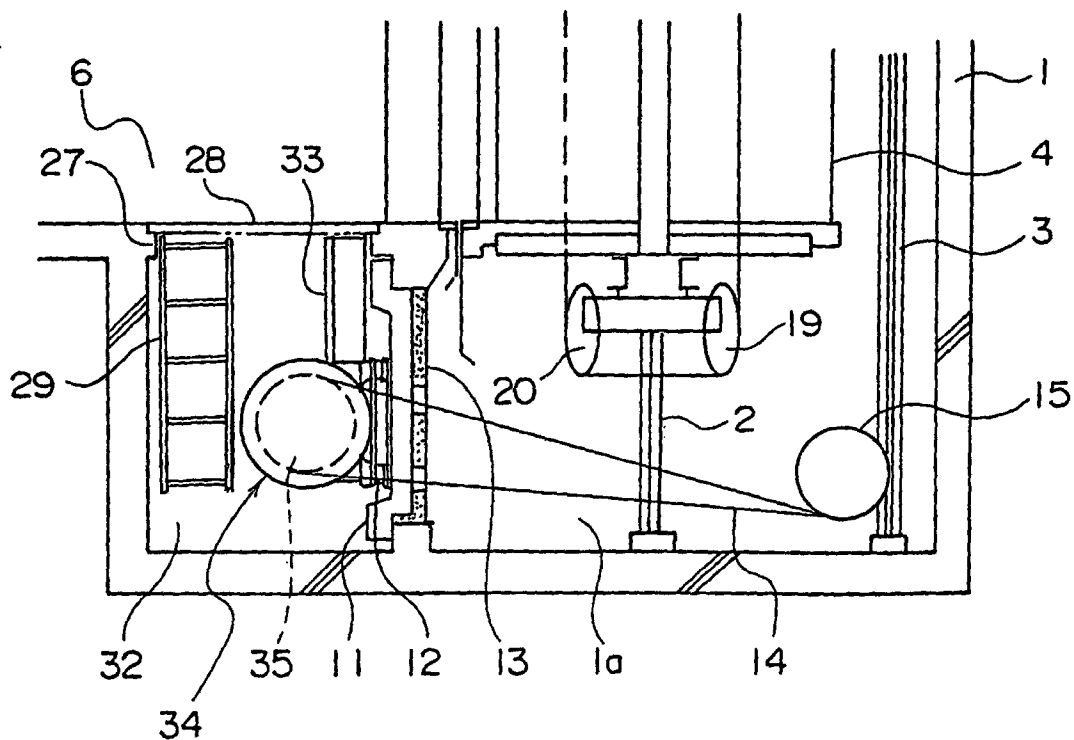


FIG. 11

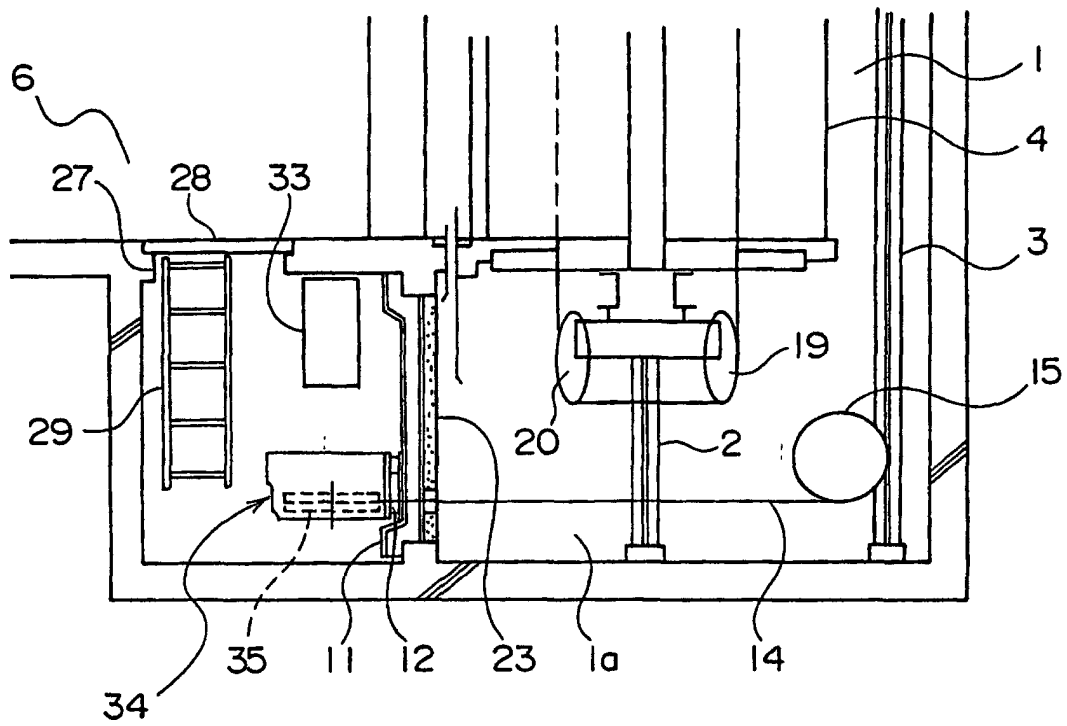


FIG. 12

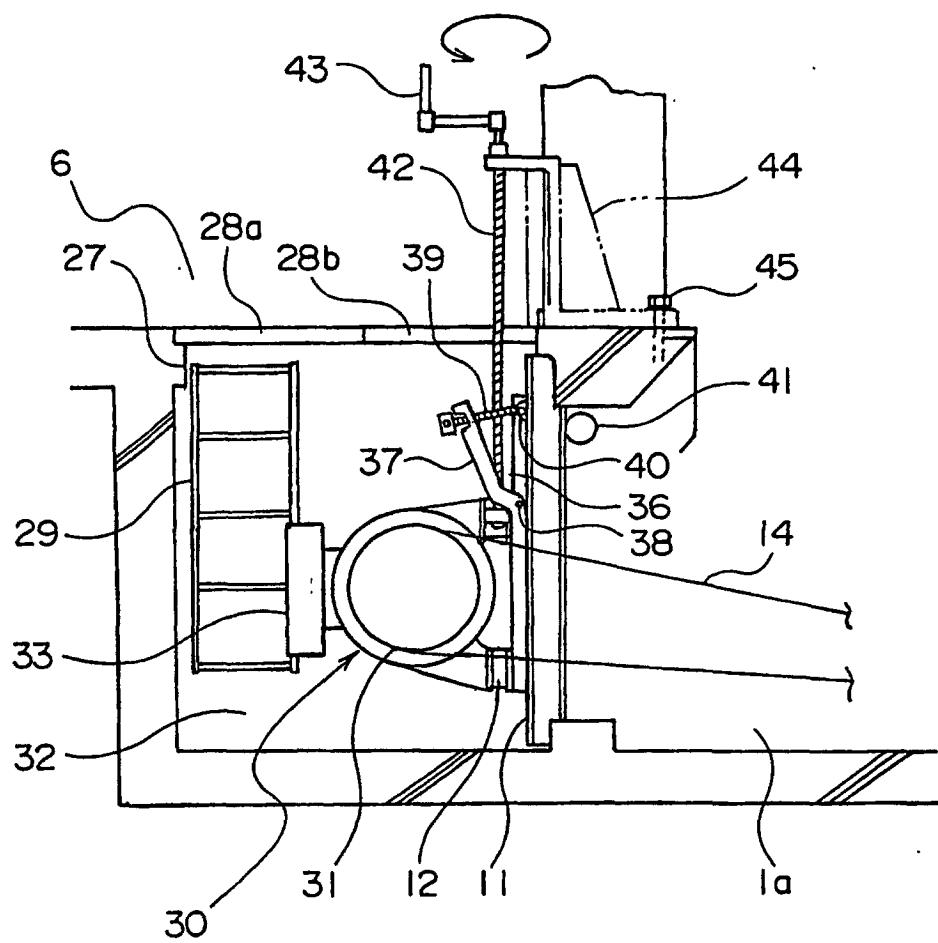


FIG. 13

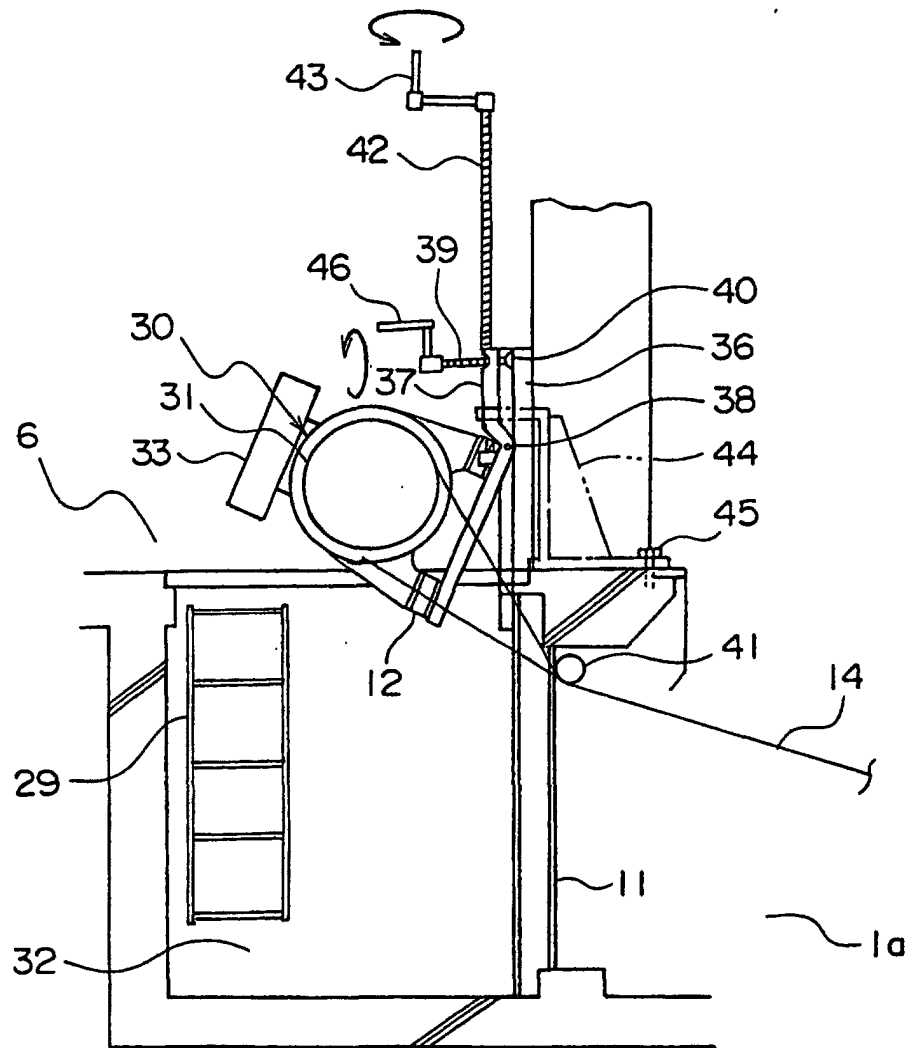


FIG. 14

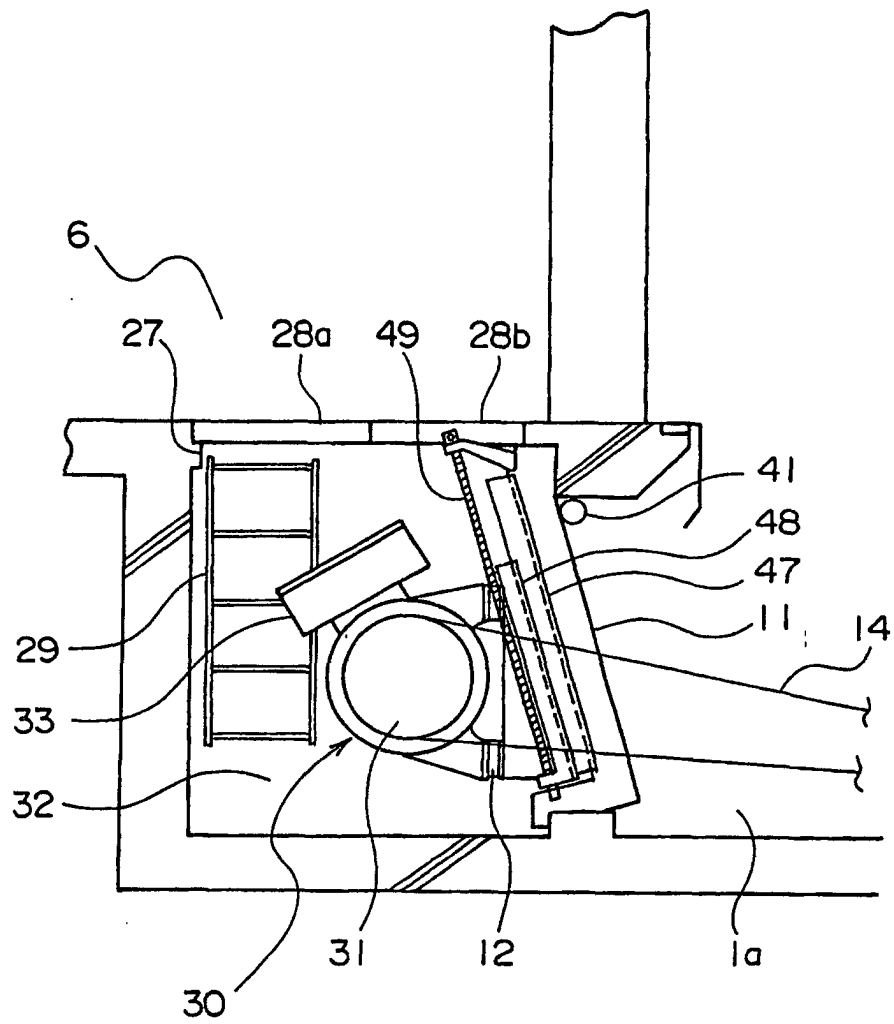


FIG. 15

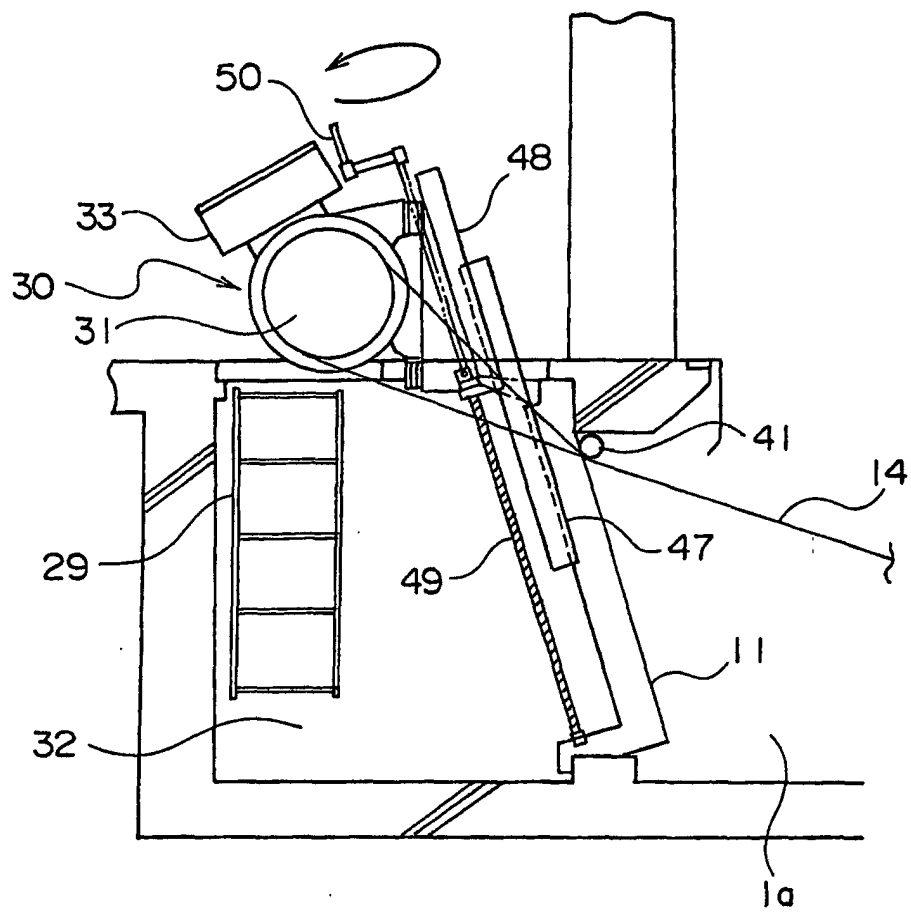


FIG. 16

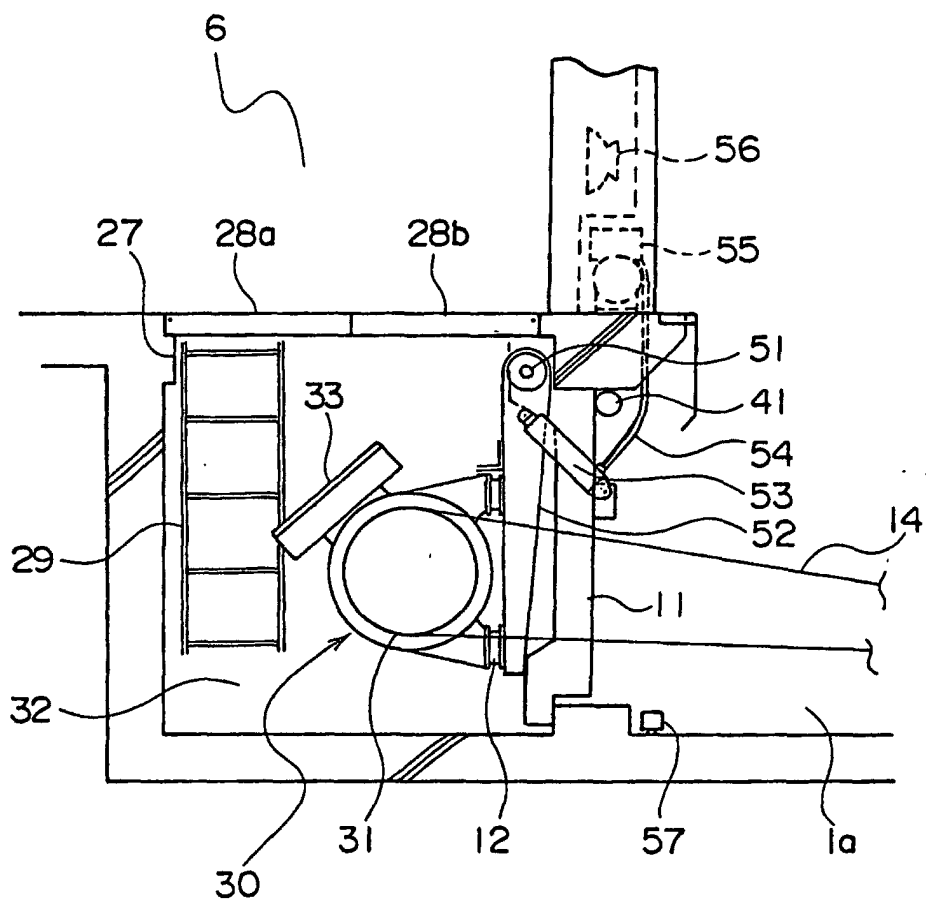


FIG. 17

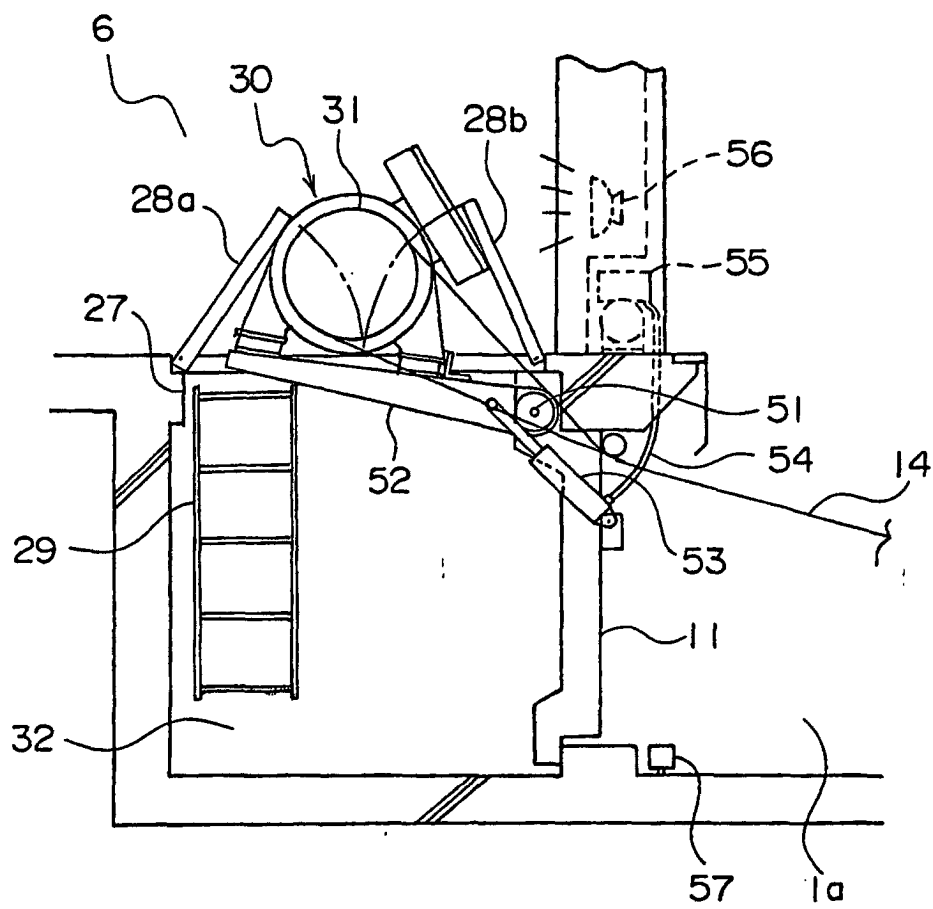


FIG. 18

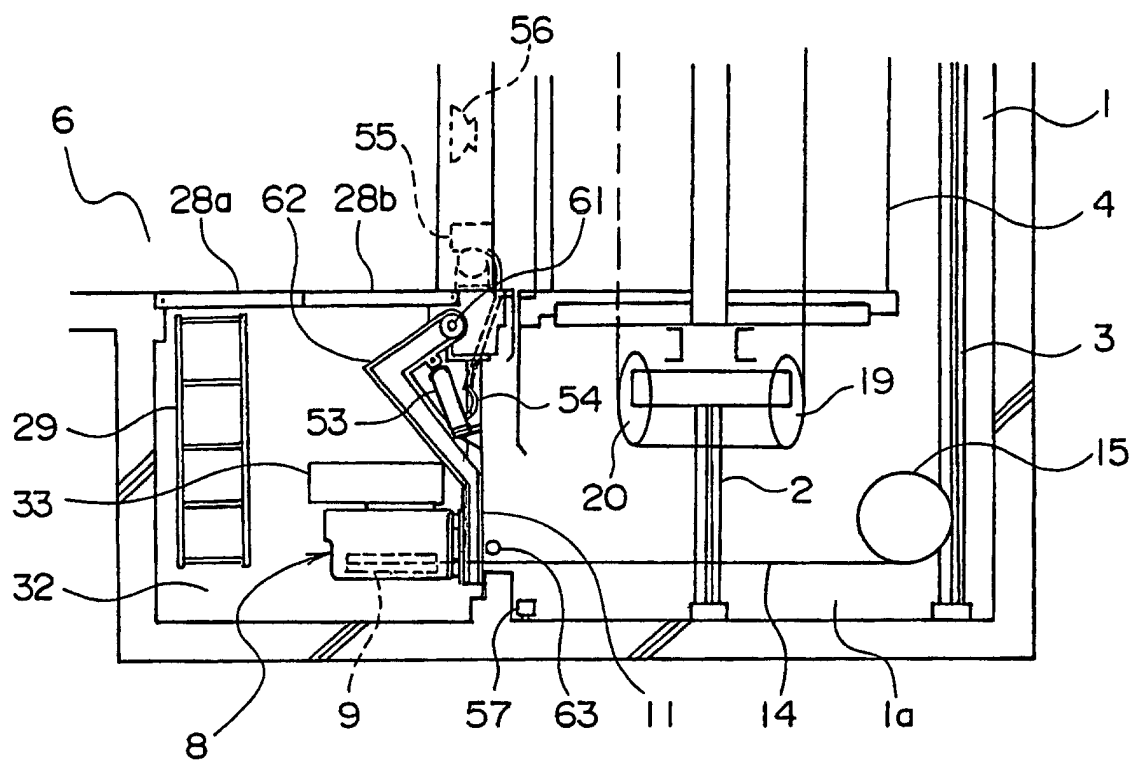


FIG. 19

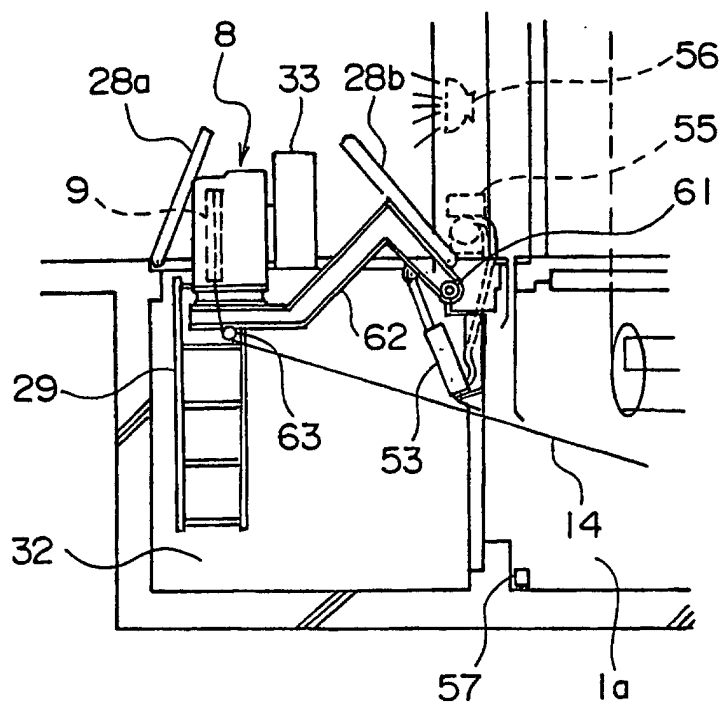


FIG. 20

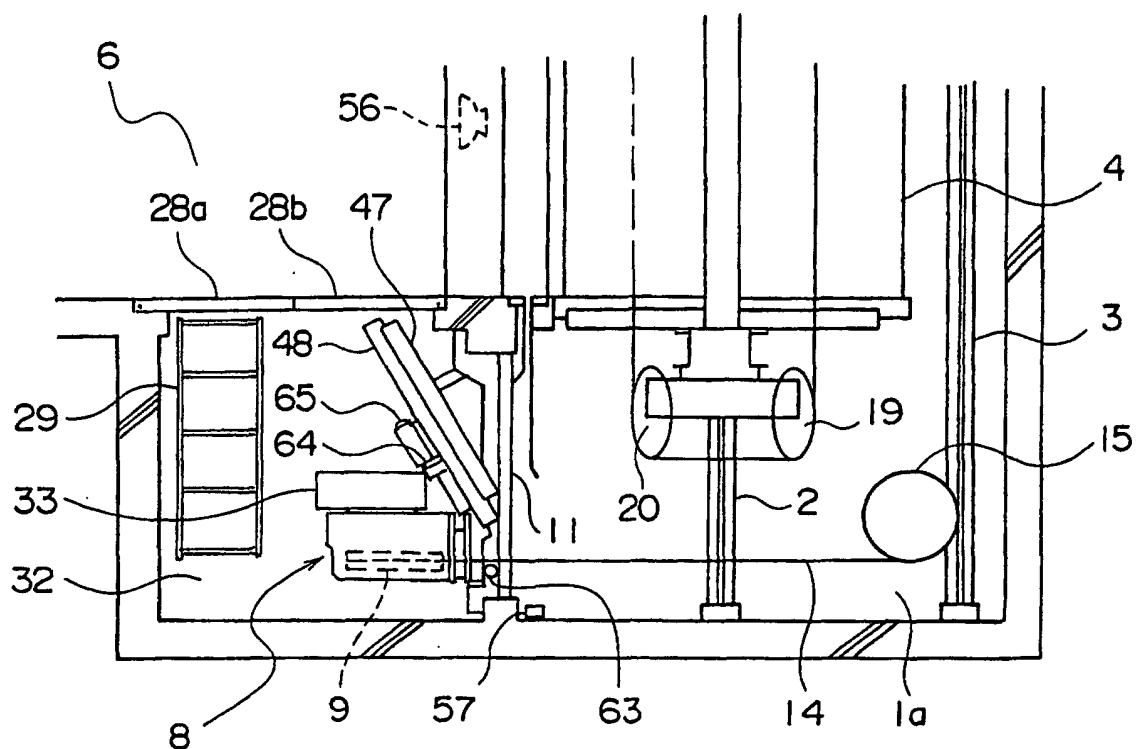
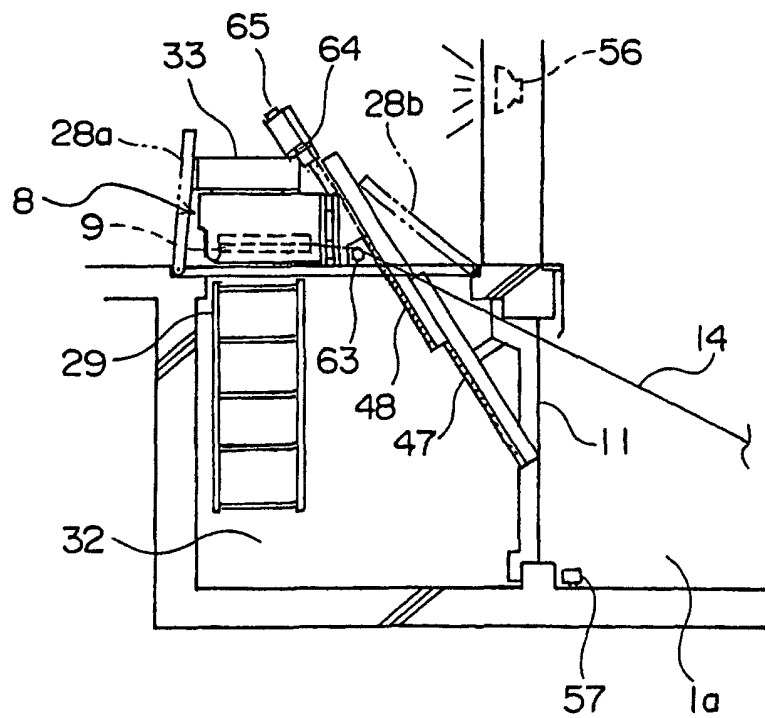


FIG. 21



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/00157

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ B66B 7/00, B66B11/04		
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 B66B 1/00-B66B11/08		
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 1996-2001 Kokai Jitsuyo Shinan Koho 1971-2001 Toroku Jitsuyo Shinan Koho 1994-2001		
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	Microfilm of the specification and drawings annexed to	1, 3
Y	the request of Japanese Utility Model Application	2, 4-5, 8
A	No. 107639/1981 (Laid-open No. 13336/1983), (Mitsubishi Electric Corporation), 27 January, 1983 (27.01.83), (Family: none)	6-7, 9
Y	JP 2000-118922 A (Hitachi Ltd.),	2
A	25 April, 2000 (25.04.00), (Family: none)	6-7
Y	JP 10-139321 A (Inventio AG),	2
A	26 May, 1998 (26.05.98), & CA 2220582 A & EP 0841283 A1 & US 6006865 A	6-7
Y	JP 4-35340 Y2 (Fuji Tec K.K.), 21 August, 1992 (21.08.92), & JP 63-161273 U	4-5
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search 02 October, 2001 (02.10.01)		Date of mailing of the international search report 16 October, 2001 (16.10.01)
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-40665 A (Kone OY), 13 February, 1996 (13.02.96), & FI 942063 A & CA 2148567 A & EP 0680921 A2 & BR 9501919 A & CN 1115300 A & US 5740888 A & AU 1784595 A	5
Y	JP 2000-247557 A (Mitsubishi Electric Building	8
A	Techno-Service Co., Ltd.), 12 September, 2000 (12.09.00), (Family: none)	9
A	JP 8-40675 A (Kone OY), 13 February, 1996 (13.02.96), & FI 942062 A & CA 2148423 A & EP 0680920 A2 & BR 9501920 A & CN 1118763 A & SG 40006 A & US 6148962 A & AU 1784495 A	1

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