

A PEOPLE MOVER APPARATUS

The present invention relates to a people mover apparatus, such as an escalator and a moving sidewalk, and particularly to the improvement of a people mover system with a power converting unit.

Nowadays, there is known, for example, by the laid-open Japanese Patent Application JP-A-62-269882 (1987), a people mover apparatus of the type that an induction motor for driving the apparatus is selectively fed by a power converting unit and the moving speed of the apparatus is adjusted in accordance with the necessity. However, the aforesaid prior art never gives any consideration to the constructional arrangement of various kinds of component devices of a driving and controlling system for a people mover apparatus, such as a driving motor, a power converting unit, a control device therefor and so on.

A people mover apparatus of this type has additional component devices, such as a power converting unit and devices related thereto, which a people mover apparatus

of the conventional type never had. Without any special consideration of the constructional arrangement of component devices, therefore, the people mover apparatus becomes large in size as a whole, compared with a
5 conventional people mover apparatus. This causes the problem in the installation of people mover apparatus in a building.

Further, a people mover apparatus of this type has more component devices, which generate heat, noise and/or
10 vibration giving the undesirable influence to other component devices and the environment, compared with a conventional people mover apparatus. If all of the component devices are accommodated in a single machine room, like a conventional people mover apparatus, sources
15 of heat, noise and vibration are concentrated, whereby other kinds of problems, such as the undesirable temperature rise, serious noise or vibration caused by a resonance phenomenon and the like, will be seriously caused.

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An object of the present invention is to provide a people mover apparatus with a power converting unit, which
25 is easy to be installed in a building without causing any other problems.

Most generally, a feature of the present invention is in that component devices included in a driving mechanism of a people mover apparatus are categorized into at least two groups and component devices of different groups are arranged in different locations of the people mover apparatus, which are remote from each other. Those locations are located remotely from each other in the direction of the length of the people mover apparatus.

With the constructional arrangement of component devices as mentioned above, it becomes unnecessary to provide the large size of a machine room for accommodating the component devices, which has conventionally been provided on either end of a people mover apparatus. Instead, plural separate machine rooms of the smaller size are provided, most preferably on both ends of a people mover apparatus and, further, on an appropriate location of a middle portion of the people mover apparatus, if necessary. With this, the categorized component devices are accommodated in the respective machine rooms, whereby a people mover apparatus never causes the increase in size as a whole and, hence, can be easily installed in a building.

The component devices can be categorized from the point of view of a predetermined factor influencing the environment. By way of example, the component devices can be categorized in consideration of heat generated by the respective component devices in such a manner that

heat generating devices are made to belong to a group and heat sensitive devices to another group. The component devices of the respective groups are accommodated in different machine rooms. With this, the temperature rise within a machine room for accommodating the heat sensitive devices, such as electronic equipment, for example, can be suppressed below an allowable temperature of the equipment.

Further, if the component devices are categorized in consideration of noise or vibration created by the respective devices, the noise or vibration locally created can be prevented from becoming seriously large.

In the accompanying drawings:-

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Fig. 1 shows an example of a driving and controlling system for an escalator with a power converting unit;

Fig. 2 schematically shows a partially sectioned view of an escalator as an example of a people mover apparatus according to an embodiment of the present invention;

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Figs. 3a and 3b schematically show sectional views of two example of a balustrade of the escalator, which is sectioned alone a chain line II - II in Fig. 2;

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Fig. 4 shows an example of a part of an upper machine room of the escalator of Fig. 2;

Fig. 5 shows an example of a part of a lower machine room of the escalator of Fig. 2; and

Fig. 6 schematically shows the construction of another type of an escalator, to which the present invention can be applied.

In the following, the description will be made of embodiments of the present invention, in which the invention is applied to an escalator, with reference to the accompanying drawings.

Referring at first to Fig. 1, the description will be given to the overall component arrangement of a driving and controlling system of an escalator of the type that a driving motor can be selectively fed directly by a three phase ac power source or through a power converting unit, in order to make it clear what component devices are included in the driving and controlling system for the escalator of this type. Since, however, the present invention does not have any particular close relationship to the component arrangement of this system itself, the following explanation will be made briefly.

An induction motor 22 is coupled to ac power source, R,S,T of the three phases through power converting unit 25 surrounded by a dotted chain line. As is well known, the unit 25 comprises converter 26, capacitor 26' and

inverter 27, and if necessary, resistor 28 is further added across the dc side of the inverter 27. The converter 26 is coupled to the ac power source R,S,T by line L₂ through contacts 10V, and the inverter 27 is coupled to the converter 26 on its dc side and to the induction motor 22 on its ac side by line L, through contacts 10VX.

The power converting unit 25 further includes power converting unit controller 29, which will be referred to more in detail later. The contacts 10V and 10VX are contacts which are closed under the control of operation controller 30 as explained later, only when the motor 22 is to be fed by the power converting unit 25.

Further, as understood from the existence of capacitor 26' on the dc side of the converter 26, the power converting unit 25 shown is of the so called voltage source type. However, it should be noted that the present invention can also be realized by the use of the so called current source type power converting unit.

The resistor 28 consumes electric power regenerated by the motor 22 during the downward movement using the power converting unit 25, as heat. Therefore, the resistor 28 must be provided with a cooling fan (not shown). If the regenerated electric power is not consumed as heat, but returned to the ac power source R,S,T, the resistor 28 can be omitted. Further, the converter 26 and the inverter 27 generate some heat and are usually

accommodated in a single container box. Therefore, they are also necessary to be cooled by a fan (not shown) provided in the box.

5 The ac power source R,S,T is also coupled to the
motor 22 through electromagnetic contactor 33, which has
two sets 101, 102 of three phase contacts. Either one of
the two sets of the contactor 33 is closed, when the motor
22 is to be fed directly by the ac power source R,S,T.
When the contacts 101 are closed, the motor 22 rotates in
10 the rotational direction for the upward movement of the
escalator, and when the contacts 102 are closed, the motor
rotates in the rotational direction for the downward
movement thereof.

15 Further, the ac power source R,S,T supplies the
electric power to operation controller 30 through
transformer 31. The controller 30, which includes a
microcomputer, receives various instructions given by
switches 32 as well as speed and load signals from
detectors 35, 36 as described later, and executes the
20 predetermined processing operation to produce signals to
the power converting unit controller 29 and signals for
selectively closing the contacts 101 or 102 or the
contacts 10V, 10VX.

25 The ac power source R,S,T is also coupled to
rectifier 34', the output of which excites electromagnetic
brake 34 through contacts 101a, 102a or 10Va and 10VXa.
The electromagnetic brake, 34 are coupled to the axle of

the motor 22 and gives the braking force to the motor 22, when it is deenergized. The contacts 10Va, 10VXa, 101a and 102a, which are of the normally open type, are auxiliary contacts of the corresponding contacts 10V, 10VX, 101 and 102.

Further, rotary encoder 35 is coupled to the axle of the motor 22 to detect the rotating speed thereof. An output signal of the rotary encoder 35 is given to the operation controller 30. If necessary, load detector 36 will be further provided. The detector 36 detects the current of the motor 22 and gives its output to the operation controller 30 as a load signal. With these signals, the fine control of the escalator operation can be realized and the abnormal operation of the escalator can be detected.

In the arrangement mentioned above, it is at first determined, by the user's or caretaker's manipulation of one of the switches 32, whether the motor 22 is to be fed by the power converting unit 25 or directly by the power source R,S,T. In the case where the power converting unit 25 is used, the operating speed of an escalator is also instructed by manipulating another of the switches 32.

If it is instructed that the power converting unit 25 is used to feed the motor 22, the operation controller 30 produces a signal for closing the contacts 10V and 10VX. If, otherwise, it is instructed that the motor 22

is to be fed directly by the power source R,S,T, the operation controller 30 produces a signal for closing either the contacts 101 or the contacts 102 in accordance with an instructed moving direction of the escalator.

5 When the operation controller 30 produces the aforesaid signal and accordingly either the contacts 101 or the contacts 102, or the contacts 10V and 10VX are closed, the corresponding auxiliary contacts 101a, 102a, or 10Va and 10VXa are closed simultaneously, whereby the
10 electromagnetic brake 34 is excited to release the braking force and the motor 22 starts rotating at an instructed speed.

 By way of example, the component devices as mentioned above will be categorized as follows, in consideration of
15 heat generated by respective component devices. The motor 22, the converter 26, the inverter 27, the resistor 28, the transformer 31 and the electromagnetic brake 34 are categorized into the heat generating device, and on the other hand, the operation controller 30 which includes
20 the microcomputer belongs to the heat sensitive device. From the point of view of noise or oscillation, a driving mechanism including the motor 22 and various moving parts will categorized into the noise or oscillation generating device.

25 By the way, a single machine room may be able to accommodate all of the component devices as mentioned above, if its capacity is made large. As described above,

some of the component devices as mentioned above and fans for cooling them generate heat, oscillation and/or noise. If all of the component devices are accommodated in such a single machine room, sources of generating heat, oscillation and/or noise are concentrated.

As a result, there is a danger, for example, that the temperature within a machine room rises to exceed the allowable temperature, e.g., 50°C, of the microcomputer of the operation controller 30. Further, it is easily presumed that the concentration of the source of noise and vibration will cause many other problems.

Then, according to an embodiment of the present invention, all of the component devices as mentioned above are arranged in the people mover apparatus in such a manner as described hereinbelow, with reference to Figs. 2 to 5.

As shown in Fig. 2 and Fig. 3a, an escalator has escalator frame 1 installed between upper floor FU and lower one FL. On an upper chord of the frame 1, plural posts 2 for supporting a balustrade are provided at predetermined intervals in the direction of the length of the frame 1.

On the top of the plural posts 2, there is attached handrail frame 3 which extends in the direction of the length of the frame 1, and endless handrail 4 moves on the handrail frame 3, while guided thereby. The handrail 4, although not shown, returns under the posts 2.

There is provided, inside the escalator with respect to the posts 2, interior panel 5, the upper end of which is fixed to the handrail frame 3 and the lower end thereof to the neighbor of the lower ends of the posts 2.

5 Interior ledge 6 is attached to the lower portion of the interior panel 5. Further, outside the escalator with respect to the posts 2, there is provided exterior panel 7, the upper end of which is fixed to the handrail frame 3 and the lower end thereof extends over the lower ends
10 of the posts 2 so as to cover the frame 1.

The interior and exterior panels 5, 7 are made of opaque material, such as an opaque acrylic resin plate, a stainless steel plate, a lithic plate or a wooden plate.

Inside the lower portion of the balustrade as
15 constructed above, there are movably provided plural treadboards 8 linked in the endless form and attached to a step chain (not shown for simplicity of the drawing). Further, skirt guard 9 is positioned between the treadboards 8 and the interior ledge 6.

20 The balustrade as shown in Fig. 3a and mentioned above is opaque, but there is also a people mover apparatus having a transparent balustrade. Fig. 3b shows a sectional view of a typical example of such a balustrade. Identical reference numerals to those in the
25 previous figures indicate identical parts.

In this type of the balustrade, there is provided reinforced glass panel 37, the bottom end of which is

supported by an appropriate fixture (not shown) provided on the upper chord of the frame 1, and to the top end of which there is attached the handrail frame 3. The balustrade of this type is further divided into two types, one of which is not provided with the supporting posts 2. In this case, the handrail frame 3 is supported directly by the glass panel 37. The other type of the balustrade has the posts 2 for supporting the handrail frame 3 in the same manner as shown in Fig. 3a.

10 Inside the lower portion of the glass panel 37, there are provided the interior ledge 6 and the skirt guard 9 attached thereto. Outside the lower portion of the glass panel 37, there are provided deck board 38 and panel 39 as an exterior covering.

15 Returning again to Fig. 2, the frame 1 can be considered as being formed by horizontal upper portion 10A, inclined middle portion 10B and horizontal lower portion 10C. In the upper and lower horizontal portions 10A and 10C, there are formed upper and lower machine rooms 14 and 15, respectively, which are further divided by partition plates 16, 17 into two rooms, i.e., inner machine rooms 14A, 15A and outer machine rooms 14B, 15B.

20 The machine rooms 14A, 14B, 15A and 15B are covered by floor plates 11A, 11B, 12A and 12B, respectively, which are provided detachably from the frame 1 and function as a lid for the respective machine rooms. When the component devices accommodated therein are maintained or

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repaired, the floor plates 14A, 14B, 15A and 15B can be opened or removed. On the sides of the upper and lower floor plates 11A and 12A, which face the treadboards 8, combplate members 13A, 13B and fixed to the frame 1 with
5 a small air gap against the treadboards 8.

In the upper and lower inner machine rooms 14A and 15A, driving sprocket 18 and driven sprocket 19 are rotatably supported, respectively, and an endless step chain (not shown) is provided between the two sprockets
10 18, 19. The plural treadboards 8 are attached to the endless step chain. An axle of the driving sprocket 18 is provided with another sprocket S, which is driven, through driving chain 20, by driving device 21, which is, as described below, provided in the outer upper machine
15 room 14B. Although not shown for simplicity of the drawing, the handrail 4 is also driven by a sprocket rotating synchronously with the sprocket 18.

The driving device 21 is provided in the outer upper machine room 14B, a partial view of which is shown in
20 Fig. 4. As shown in the figure, the driving device 21 comprises the three phase induction motor 22 and reduction gear 23, an input axle of which is coupled to the motor 22 and an output axle thereof to sprocket 24 for driving the driving chain 20. The outer upper machine room 14B
25 also accommodates the operation controller 30. It is to be noted here that an amount of heat generated by the motor 22 is usually smaller than that generated by the converter 26, the inverter 27, the resistor 28 and so on.

In the outer lower machine room 15B, as shown in Fig. 5, there are provided a box accommodating both the converter 26 and the inverter 27, a box including the resistor 28 and a box for the power converting unit controller 29. Namely, devices, which have the comparatively large heat generation, are accommodated in the outer lower machine room 15B. Since the machine room 15B is remote from the machine room 14B and there are the partition plates 16, 17 therebetween, the heat generated by the devices of the machine room 15B is scarcely transmitted to the machine room 14B, so that the microcomputer of the operation controller 30, which is accommodated in the machine room 14A, never receives any bad influence from the heat generated by those devices.

Further, in the case, as shown in Fig. 3a, where an inner space is formed within the balustrade, some of the component devices can be accommodated in that space. In Fig. 3a, there is shown the example that the transformer 31 or the power converting unit 25 is supported by the post 2 within the inner space of the balustrade. Since the interior plate 5 can be removed by detaching the lower ledge 6, as shown by broken arrow lines and dotted chain lines, the transformer 31 can easily be maintained or repaired. Also in the case of the transparent balustrade as shown in Fig. 3b, some of the component devices can be accommodated in an appropriate space within the frame 1 under the balustrade and supported by beam 1V of the frame 1.

Similarly, a location, in which some of the component devices are accommodated, can be formed even in the middle portion of the escalator in the direction of the length thereof.

5 Further, in the embodiment mentioned above, the motor 22 is arranged in the upper outer machine room 14B and the power converting unit 25 in the lower outer machine room 15B. Therefore, the motor 22 and the power
10 converting unit 25 must be electrically coupled by the long power line L_1 . The current flowing through the line L_1 includes various kinds of harmful harmonic components caused by the control of the inverter 27. Preferably, therefore, a shield cable is to be used for the power
15 line L_1 , whereby the bad influence on electronic equipment closely existing can be prevented.

The inventors measured the level of noise of an escalator, in which component devices are arranged in a manner as described above. The locations of measurement are points of 1 meter high over the upper floor plate 11
20 and the lower floor plate 12. The result of the measurement is as follows.

Table 1

Measurement location	Level of noise
Upper floor plate	63 dB
Lower floor plate	61 dB

There levels are almost the same as or somewhat lower than the level of noise in the conventional escalator. Further, when it is considered that the measurement took place in the inventors' factory for an escalator before the completion and therefore the escalator was not yet provided with the partition plates 16, 17 and the exterior plate 39, it is expected that the level of noise will be able to be further lowered in a completed escalator.

Also, the temperature rise within the upper machine room 14 and the lower machine room 15 was measured. The result thereof is as follows.

Table 2

Location of measurement	Temperature rise
Upper machine room	18 °C
Lower machine room	26 °C

The temperature rise 18°C of the upper machine room 14 does not give any bad influence on the microcomputer of the operation controller 30, which is accommodated in the upper machine room 14.

In the foregoing, the present invention is applied to an escalator. It is of course that the present invention can be applied to a so called moving sidewalk, in which treadboards linked in the endless form moves on the same level. Further, in the above embodiment, the driving device 21, including the motor 22, the reduction

gear 23 and so on, has been arranged in one end of the frame, i.e., the upper machine room 14. However, the present invention is also applied to an escalator or a moving sidewalk, in which a driving device is provided in the middle portion of a frame, as shown in Fig. 6.

As shown in the figure, endless step chain 41 provided between two driven sprockets 19A and 19B is driven by the driving sprocket 18 arranged in the middle portion of the frame 1. The driving sprocket 18 is driven by the driving device 21 comprising the motor 22 and the reduction gear 23, which is also provided in the middle portion of the frame 1. Other main component devices, such as the power converting unit 25 and the operation controller 30, can be arranged in the lower machine room 15 and the upper machine room 14, similarly to the previous embodiment.



CLAIMS

1. A people mover apparatus, comprising:
a plurality of treadboards, coupled with each other
5 in the endless form, for conveying people thereon; and
driving means for driving said treadboards, which
has a driving mechanism, including an electric motor, for
transmitting a driving force from the motor to said
treadboards and a power converting unit for supplying
10 electric power to the motor,
c h a r a c t e r i z e d in that
component devices included in said driving means are
categorized into at least two groups from the point of
view of a predetermined factor influencing environment,
15 and
ones of said component devices, which belong to
different groups, are arranged in different parts within
said apparatus, respectively, which are located remotely
from each other in the direction of the length of said
20 apparatus.

2. A people mover apparatus as set forth in claim
1, wherein said apparatus includes a frame which is
provided to link different places and movably supports
25 said treadboards, in which component devices of a certain
group are arranged in a part of the frame and the
remaining component devices in another part which is



remote from the part in the direction of the length of the frame.

3. A people mover apparatus as set forth in claim
5 2, wherein said component devices included in said driving means are categorized on the basis of heat generated by the respective devices.

4. A people mover apparatus as set forth in claim
10 2, wherein said component devices included in said driving means are categorized on the basis of noise generated by the respective devices.

5. A people mover apparatus as set forth in claim
15 2, wherein said component devices included in said driving means are categorized on the basis of mechanical vibration created by the respective devices.

6. A people mover apparatus as set forth in claim
20 2, wherein the driving mechanism is arranged in one end of the frame and the power converting unit in the other end of the frame.

7. A people mover apparatus as set forth in claim
25 6, wherein the motor in the driving mechanism and the power converting unit are connected by a shield power line.



8. A people mover apparatus as set forth in claim 7, wherein the shield power line is provided along the frame.

5 9. A people mover apparatus as set forth in claim 2, wherein the frame is divided into three sections composed of both end sections and a middle section therebetween, in which the driving mechanism and the power converting unit are arranged in different ones of the
10 three sections, respectively.

 10. A people mover apparatus as set forth in claim 9, wherein the frame is provided with machine rooms in both of the end sections thereof, in which the driving
15 mechanism is installed in one of the machine rooms and the power converting unit in the other machine room.

 11. A people mover apparatus as set forth in claim 10, wherein at least one of the machine rooms is provided
20 with a partition which divides the one machine room into a part open to the middle section of the frame and a closed part spatially separated from the open part, in which component devices to be installed in the machine rooms are arranged in the closed part of the respective
25 machine rooms.



12. A people mover apparatus as set forth in claim 2, wherein said apparatus is provided with a balustrade, which has a handrail moving synchronously with said treadboards and inner and outer panels which are provided between the handrail and said frame and movably support the handrail, in which the power converting unit is arranged in a space formed between the inner and outer panels.

10 13. A people mover apparatus as set forth in claim 10, wherein said apparatus is further provided with an operation control device for controlling at least the moving speed of said treadboards, in which the operation control device is accommodated in a machine room which
15 accommodates only such component devices as generate a small amount of heat to keep the temperature of the machine room under the allowable temperature of the operation control device.

20 14. A people mover apparatus as set forth in claim 10, wherein said apparatus is further provided with an operation control device for controlling at least the moving speed of said treadboards, in which the driving mechanism and the operation control device are installed
25 in one of the machine rooms and the power converting unit in the other machine room.



15. A people mover apparatus as set forth in claim 14, wherein the motor and the power converting unit are connected by a shield power line provided along the frame.

5 16. A people mover apparatus as set forth in claim 10, wherein the driving mechanism is installed in the middle section of the frame and the power converting unit in one of the end sections thereof.

10 17. A people mover apparatus substantially as described herein with reference to any ^{of} Figures 2 to 5 or Figure 6 of the accompanying drawings.
