

STEPS FOR A PASSENGER CONVEYOR

This invention relates to steps of a passenger conveyor such as moving stairway, moving passengerway etc.

Passenger conveyors have become indispensable to living in urban communities as an installation adding to the comfort of the citizens by facilitating their movements. Functioning as escalators, passenger conveyors are now built not only inside buildings, such as department stores, but also in subway stations and elevated railroad stations as a link for means of public transportation. Since subway stations and elevated railroad stations are usually located in densely populated areas, the passenger conveyors built in these areas are forced to operate under conditions which are heavier than those under which the counterparts in department stores have hitherto been operated.

For example, passenger conveyors have hitherto been built mostly in department stores and large office buildings. The conditions under which passenger conveyors are built and operated therein are somewhat distinct from the conditions under which they are built and operated as facilities in stations. One problem which is raised with regard to passenger conveyors in

1 subway stations involves corrosion of conveyor components
due to exposure to underground water. Another problem
is how to increase surface hardness of the conveyor
components to avoid damage thereto which might be caused
5 by frequent contact with passengers. Increased populari-
zation achieved in recent years has made it necessary to
increase durability of passenger conveyors and there is
a demand for such passenger conveyors in the market.

A passenger conveyor of the prior art comprises
10 movable parts and stationary parts. The movable parts
include a plurality of treads or steps linked in an
endless belt, a pair of handrails disposed on both sides
of the steps and movable in synchronism therewith, etc.,
and the stationary parts include a pair of balustrade
15 sections disposed on both sides of the steps and support-
ing handrails, outer decks, inner decks, panels, etc.
All the component parts, both movable and stationary,
are supported by a strongly built support structure.

The steps which are important for transporting
20 passengers are each composed of a tread on which a
passenger stands, a riser connected to the trailing edge
of the cleat for closing the gap, and a frame supporting
the tread and riser. Each step has a pair of rollers
connected to either end and rotated to move the step
25 forwardly.

The tread cleat of each step of the prior art
has hitherto been made of an aluminum alloy by using
extrusion techniques, and a problem has hitherto been

1 raised with regard to its durability and susceptibility
to surface damage as subsequently to be described in
detail.

A proposal has recently been made by us to
5 make step tread of stainless steel. Such steps are
faced with the following problem. Each step made of
stainless steel includes a cleat formed by shaping thin
stainless steel sheet (or steel sheet) of 1-3 mm thick
into a corrugated form, and attaching a reinforcing member
10 to the undersurface of the cleat tread. As subsequently
to be described, when provision is made for rolling
surfaces of guide rollers restricting the sideways
movement of the step by increasing the thickness of the
reinforcing member, the thickness of the reinforcing
15 member would inevitably become substantially equal to
the thickness of the guide rollers. This would
considerably increase the weight of the reinforcing
member, and the increased weight of the step would not
only form an obstacle to increased transportation
20 efficiency but also cause an increase in energy consump-
tion, thereby running counter to the policy of energy
conservation.

Therefore, there is a need to provide
25 steps of a passenger conveyor which enable guidance
of the guide rollers to be effected without increasing
the thickness of the reinforcing member for each cleat.

According to one aspect of the present invention there is a step for a passenger conveyor comprising a steel tread cleat constituting a surface layer and shaped by bending steel sheet into a corrugated shape with a plurality of elevated portions and a
5 plurality of depressed portions arranged alternately and each having a top and a bottom respectively, a reinforcing member connected to the undersurface of the cleat, a plurality of guide members each attached to one of opposite sides of the step, each side guide member being separate from said reinforcing member and having a width greater
10 than the thickness of guide rollers arranged to restrict sideways movement of the step and a length substantially equal to the length of the step as measured from back to front.

According to another aspect of the present invention there is provided a passenger conveyor including a plurality of steps each
15 step comprising a steel tread cleat constituting a surface layer and shaped by bending steel sheet into a corrugated shape with a plurality of elevated portions and a plurality of depressed portions arranged alternately and each having a top and a bottom respectively a reinforcing member connected to the undersurface of the cleat, a plurality
20 of guide members each attached to one of opposite sides of the step, each said guide member being separate from said reinforcing member and having a width greater than the thickness of guide rollers arranged to restrict sideways movement of the step and a length substantially equal to the length of the step as measured from front to back.

25 Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a side view of an upper portion of a passenger conveyor;

Fig. 2 is a perspective view of a step of the prior art;

Fig. 3 is a sectional view taken along the line III-III in

5 Fig. 2;

Fig. 4 is a bottom view of the step shown in Fig. 3, as viewed obliquely upwardly from below;

Figs. 5-9 show steps of a stainless steel material in which the invention is to be incorporated, Fig. 5 being a sectional
10 view corresponding to Fig. 3, Fig. 6 being a bottom view corresponding to Fig. 4, Fig. 7 being a perspective view corresponding to Fig. 2, Fig. 8 being a sectional view taken along the line VIII-VIII in Fig. 7 and Fig. 9 being a perspective view, on an enlarged scale, of the essential portions of the step shown Fig. 7;

15 Fig. 10 is a sectional view of a side portion

1 of the tread cleat of the step in which one embodiment
of the invention is incorporated; and

Fig. 11 is a sectional view corresponding to
Fig. 10 showing another embodiment of the invention.

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Referring to Fig. 1, a passenger conveyor
comprises a plurality of steps 1 linked in an endless
belt for supporting passengers thereon, a pair of
handrails 2 located on opposite sides of the steps 1 and
10 moved in synchronism with the steps, a pair of balustrade
sections 3 located on opposite sides of the steps 1 for
supporting the handrails 2 thereon, and panels 4 disposed
on opposite sides of the steps. These parts of the
passenger conveyor, both movable and stationary, are
15 supported by a strongly built main frame 5. The steps
1 which are the main component for conveying passengers
each comprise a tread cleat 1a on which passengers stand,
a riser 1b closing the gap between the steps 1 and a
frame 1c supporting the tread cleat 1a and riser 1b, as
20 shown in Fig. 2. A pair of rollers 1d are connected to
each step 1 at either end thereof for moving same.

The tread cleat 1a has a width W of about 1 m
and extends through the entire length of the passenger
conveyor. The tread cleat 1a which usually has a
25 transverse cross section as shown in Fig. 3 is ridged at
its surface and includes a plurality of elevated portions
each having a top 1e and a plurality of depressed

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1 portions each having a bottom lf. The undersurface of
the tread cleat la has a reinforcing member lg in the
form of a grill attached thereto as shown in Fig. 4.
Recently, in order to draw passengers' attention to
5 possible danger, it has become customary to arrange a
colored portion lh on either side of the tread cleat la
made of resin and colored yellow or other suitable
color.

Each step 1 is ridged on its surface and has
10 a reinforcing member on its underside as aforesaid.
Thus the steps 1 are sufficiently sturdy to enable
passengers to be conveyed without anxiety.

Meanwhile the riser lb has the same width as
the tread cleat la and serves to close the gap between
15 the adjacent steps 1. The riser lb is somewhat curved
so that the vertical movement of the steps 1 and their
movement in an endless belt may not be interfered with.
Usually the riser lb is also ridged at its surface so
that the edge of the tread cleat la may interfit.

20 The tread cleat la and riser lb described
hereinabove have usually been made of an aluminum alloy
by using die casting, and it has been usual practice to
give considerably high precision finishes thereto for
the sake of passengers' safety.

25 Arranged on the path of movement of the steps
1 are guide rollers R which are disposed horizontally
on either side of the steps 1 to ensure the steps mesh with a
comb C at the passenger boarding end of the conveyor as shown in

- 1 Fig. 1. The provision of the guide rollers R avoid
wobbling of the steps 1 in the directions of arrows X
in Fig. 2.

The guide rollers R each have a built-in ball
5 bearing to enable smooth horizontal rotation and their
thickness is about $t_1 = 20-50$ mm. The colored portion
lh of the tread cleat 1a at its side is formed of nylon
or other synthetic resin and is susceptible to wear and
breakage, so that the guide rollers R are prevented
10 from coming into contact with the colored tread cleat
portions lh. Thus the side portions of each tread
cleat 1a have a thickness T ($T > t_1$ or $T \approx t_1$) of 20-50
mm. As a result, the weight of the step 1 is increased,
causing trouble in operation and an increase in operational
15 expenses.

In the steps of the aforesaid construction of
the prior art, there has been a demand for improvements
for increasing the wear resistance of the steps and
making them economically acceptable.

20 Since the passenger conveyors installed in
subway stations are exposed to underground water and
liable to develop corrosion and the passenger conveyors
at the site of building construction are liable to
develop corrosion due to adhesion of concrete, the
25 problem with regard to corrosion caused in passenger
conveyors has been discussed and various proposals have
been made to obviate such problem. However, an aluminum
alloy which is the principal material for forming the

1 steps 1 is considered to be low in resistance to
corrosion, particularly so when it is brought into
contact with concrete (alkaline). It has been recognized
that when concrete adheres to an aluminum alloy it is
5 pitted with ugly dark spots in about 10 days.

A report made in the Japan Metal Society
("Corrosion Resting Alloys" published in 1962) shows
that aluminum alloys are 2,000 times higher in
susceptibility to corrosion than stainless steel and
10 iron with respect to alkalinity. The table shown below
contains data supporting this report.

Metal	Degree of Corrosion
Aluminum Alloys	25,000
Stainless steel	1
Iron	1

Unit: $\text{mg/dm}^2/\text{day}$

Remarks: Tests were conducted by immersion in
a 5% caustic soda solution.

15 This report should be given serious consideration in
view of the fact that a passenger conveyor is generally
surrounded by concrete of high alkalinity and the
influences of concrete are not negligible. It would
appear that the incidence of corrosion is considerably

1 high in passenger conveyors now in service.

Meanwhile, in view of the fact that the tread cleat 1a of each step 1 supports passengers thereon at all times and is affected by contact therewith, wear
5 resistance is one of the important factors which should be taken into consideration in selecting the material for the tread cleat 1a. Generally, aluminum alloys are believed to have wear resistance which is about 1/10
10 ordinary skill in the art.

In addition to the aforesaid disadvantages of aluminum alloys, it is impossible to overlook the economic side of the problem concerning aluminum alloys. In recent years cost of aluminum alloys has been increas-
15 ing under circumstances of increased cost of generating electric power because melting of aluminum requires lots of electricity, thereby making aluminum alloys an economically undesirable material.

In light of these circumstances, the use of
20 aluminum alloys for making steps 1 must be reconsidered from the points of view of corrosion resistance, wear resistance and economical feasibility.

A proposal has recently been made by us to form steps of a passenger conveyor of stainless steel.
25 The steps made of stainless steel as proposed are of the constructional form shown in Figs. 5-9.

Reference will be made to a cleat 6a shown in these figures as an example of the constructional form

1 of the cleat made of stainless steel. As shown, the
cleat 6a is made of a stainless steel sheet (or iron
sheet) of 1-3 mm thick which is shaped into a corruga-
tion as shown in Fig. 5. In the example shown, the
5 sheet is worked by means of a press to form alternate
elevated portions and depressed portions each having a
top 6e and a bottom 6f respectively, and has a reinforc-
ing member 7 joined so its undersurface by spot weld-
ing by using an upper electrode Y and a lower electrode
10 Z. Alternatively, the reinforcing member 7 may be
connected to the undersurface of the corrugation as by
screwing or other suitable connecting means, in place
of welding.

The cleat 6a made in this fashion has openings
15 K as shown in Fig. 6. The presence of the openings K

create the danger that a passenger might stick the
tip of an umbrella thereinto or the finger tips of a
passenger might be jammed therein. To eliminate this
danger, it has come to our mind to attach front and rear
20 closing members 8 and 9 to the front and rear ends
respectively as shown in Fig. 7. The rear closing
member 9 is constructed as shown in Figs. 8 and 9.

More specifically, the rear end closing member 9 which
is similar in appearance to the cleat 6a is intimately
25 connected to the cleat 6a at one end Q and has the
riser 6b intimately connected to the other end thereof.
In recent years, a side portion 10 formed of a plastic
material and colored such as yellow has customarily been

- 1 attached to either side of the cleat 6a to draw
passengers' attention to the danger.

However, in the step 1 having the cleat 6a
provided with the front and rear closing members 8 and
5 9 and side portions 10, difficulties are encountered in
attaching the reinforcing member 7 as shown in Fig. 6.
More specifically, as described by referring to Fig. 4,
the rolling surfaces of the guide rollers R must be
provided for by the thickness t_2 of the reinforcing
10 member 7 because of the lack of strength in the side
portions 10 formed of a plastic material. This
inevitably leads to the thickness t_2 of the reinforcing
member 7 becoming substantially equal to the thickness
 t_1 of the guide rollers R.

- 15 Thus, since the guide rollers R have a thick-
ness $t_1 = 20-50$ mm as aforesaid, the reinforcing member
7 will have a thickness $t_2 = 20-50$ mm. This would
considerably increase the weight of the reinforcing
member 7 and raise the problems that operation of the
20 passenger conveyor requires added energy consumption and
maintenance thereof is time consuming because attaching
and detaching of the steps would have to be performed
under difficult conditions.

One embodiment of the invention will now be
25 described by referring to Fig. 10. In this embodiment,
the configuration of the cleat 6a and the arrangement
of the reinforcing member 7 as well as the manner in
which the latter is connected to the former are similar

1 to those described by referring to Fig. 5. However, the
embodiment shown in Fig. 10 offers the advantage that
the rolling surfaces of the guide rollers R are provided
without requiring to increase the thickness t_2 of the
5 reinforcing member.

The cleat 6a shown in Fig. 10 has a metallic
guide member 11 disposed below the side portion 10 and
attached to one side of the reinforcing member 7. The
metallic guide member 11 is connected to the reinforcing
10 member 7 by screws 12. The guide member 11 provides a
flat rolling surface for each roller R having a length
substantially equal to the length of the step 1 as
measured in the direction of its movement and a width H
greater than the thickness of the roller R ($H > t_1$ or
15 $H \approx t_1$). It will be apparent that the provision of the
metallic guide members 11 eliminates the need to use
the sides of the reinforcing member as the rolling
surfaces of the guide rollers R. Thus the reinforcing
member 7 has only to perform the functions of supporting
20 the cleat 6a on its surface and the guide members 11 at
the sides. The numeral 14 designates screws connecting
the side portions 10 to the reinforcing member 7.

By this arrangement, it is possible to provide
a suitable rolling surface for each guide roller R with-
25 out increasing the weight of the reinforcing member 7.

Fig. 11 shows another embodiment in which
the side portion 10 is made of metal instead of a
plastic material and formed such that its outer side

1 extends downwardly along the side of the reinforcing member 7 and beyond the underside of the member 7, to provide a rolling surface for the guide roller R. It will be appreciated that this embodiment can achieve the same effects as the embodiment shown in Fig. 10.

The reinforcing member 7 is shown in Figs. 10 and 11 as being in the form of a plate extending along the entire length of each step 1 in the direction of its movement. However, the invention is not limited to this specific form of reinforcing member and the reinforcing member 7 may be composed of a plurality of bars arranged in the direction of movement of each step 1 in spaced apart relation and extending crosswise of the step 1.

15 From the foregoing, it will be appreciated that the invention enables a suitable rolling surface to be provided to each guide roller without increasing the weight of the reinforcing member of the tread cleat. Thus the invention provides steps for a passenger conveyor which are light in weight and conveniently carried at 20 the time maintenance is carried out.



CLAIMS:

1. A step for a passenger conveyor comprising a steel tread cleat constituting a surface layer and shaped by bending steel sheet into a corrugated shape with a plurality of elevated portions and a plurality of depressed portions arranged alternately and each having a top and a bottom respectively, a reinforcing member connected to the undersurface of the cleat, a plurality of guide members each attached to one of opposite sides of the step, each said guide member being separate from said reinforcing member and having a width greater than the thickness of guide rollers arranged to restrict sideways movement of the step and a length substantially equal to the length of the step as measured from back to front.
2. A step as claimed in claim 1, wherein each said guide member is securely connected to one side of said reinforcing member.
3. A step as claimed in claim 1 or 2, including a plurality of side cleat portions each attached to one of opposite sides of each said tread cleat.
4. A step as claimed in claim 3, wherein the side cleat portions are formed of metal and one side of each side cleat portion extends downwardly to constitute one of the guide members.
5. A step as claimed in claim 4, wherein the side cleat portions are made of steel.
6. A passenger conveyor including a plurality of steps each step comprising a steel tread cleat constituting a surface layer and shaped by bending steel sheet into a corrugated shape with a plurality of elevated portions and a plurality of depressed portions arranged alternately and each having a top and a bottom respectively a reinforcing member connected to the undersurface of the cleat, a plurality of guide



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members each attached to one of opposite sides of the step, each said guide member being separate from said reinforcing member and having a width greater than the thickness of guide rollers arranged to restrict sideways movement of the step and a length substantially
5 equal to the length of the step as measured from front to back.

7. A step for a passenger conveyor substantially as hereinbefore described with reference to Figs. 5 to 10, or Figs. 5 to 9 and Fig. 11 of the accompanying drawings.

8. A passenger conveyor substantially as hereinbefore described
10 with reference to Figs. 5 to 10, or Figs. 5 to 9 and Fig. 11 of the accompanying drawings.

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