

PATENT SPECIFICATION

(11)

1 570 750

1 570 750

- (21) Application No. 46249/77 (22) Filed 7 Nov. 1977 (19)
(31) Convention Application No. 51/135399 (32) Filed 12 Nov. 1976
(33) Japan (JP)
(44) Complete Specification Published 9 Jul. 1980
(51) INT. CL.³ B66B 9/12
(52) Index at Acceptance
B8A LU R15 W7



(54) PASSENGER CONVEYOR BALUSTRADE

(71) We, HITACHI, LTD., a Corporation organised under the laws of Japan, of 5-1, 1-chome, Marunouchi, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to a balustrade for use with passenger conveyors such as escalators and electrically operated passageways and, more particularly, to a balustrade which is formed of stainless steel sheets.

Passenger conveyors have become widely known as fixtures which are indispensable to a building as a means for conveying persons from one point to another within the building. In recent years, a variety of demands have been put forward for industrial designs of balustrades. As is well known, the balustrade constitutes a major part of a designed body in a passenger conveyor, and it is generally recognized by the parties concerned that whether the balustrade has an attractive industrial design or not is a major selling point in respect of making a discrimination among room designs.

As described in U.S. Patents Nos. 3,321,059 and 3,353,650, the balustrade includes stationary members except for an endless series of steps adapted to convey passengers thereon, and moving parts such as handrails. As described above, each balustrade includes, as main components thereof, a main deck member upon which handrail is mounted, a lower deck member and a glass panel, all of which constitute an object of industrial design. It is conventional to form the main and lower deck members by extruded material of aluminium alloy, of which surfaces have been subjected to alumite treatment.

Aluminium alloy material has been widely used for the main and lower deck members of a balustrade since it is advantageous in its formability into substantially complex shapes. However, the use of this material has a disadvantage in that the manufacturing cost thereof continues to be increased due to high electric power consumption and the raw material therefor tends to be reduced. However, what is more significant than the high manufacturing cost is the fact that aluminium alloy material is relatively soft (as compared to such metallic materials as steel) so as to be readily marred. This presents a serious problem in which the respective members of balustrade present scratches and impressions on the inner sides thereof facing the steps after the members have been contacted by a large number of passengers during several years of operation. Thus such passenger conveyors present an unsightly appearance. Particularly in the case of passenger conveyors installed in underground markets, corrosion of the material of the balustrades caused by underground water adds to deterioration of the industrial design of the balustrades.

Therefore, stainless steel sheets have begun to be used in place of aluminium alloy material, which sheets are superior to the latter in price stabilization, hardness and anticorrosive resistance. However, the use of stainless steel for balustrades raises the technical problem of the material being deformed when worked to bend the same. Since this problem has not been solved satisfactorily, the practice of using a stainless steel sheet has not yet become popular.

It is an object of the present invention to provide a balustrade for passenger conveyors which is highly productive and obviates the aforementioned problem of deformation upon bending.

50

55

60

65

70

75

80

85

90

According to the present invention there is provided a balustrade for use with passenger conveyors, comprising a first deck member provided with a guide for guiding a handrail which is adapted to be moved in synchronism with an endless series of steps, and a second deck member formed of sheet material connected to the first deck member, the second deck member having a U-shaped cross-sectional configuration opening in a direction opposite the first deck member each of said first and second deck members being bent to assume an arcuate shape at the landings, and further comprising inwardly bent deformation prevention strips provided on the second deck member adjacent the opening at the arcuate-shaped section of the second deck member for preventing deformation of the second deck member in an area of the arcuate-shaped sections.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which,

Figure 1 is a side elevational view of a portion of a passenger conveyor adjacent an upper landing;

Figure 2 is a sectional view taken along the line II-II in Figure 1, showing a prior balustrade having deck members made of aluminium alloy material;

Figure 3 is a sectional view similar to Figure 2 but showing a prior balustrade having deck members made of stainless steel;

Figure 4 to Figure 7 are views showing a deck member of stainless steel being subject to bending,

Figure 4 showing the member being subjected to tensile forces, Figure 5 showing the manner in which various forces act on the member, and Figures 6 and 7 showing the manner in which the member is deformed;

Figure 8 is a sectional view similar to Figure 2, but showing a balustrade having deck members made of stainless steel according to one embodiment of the invention;

Figure 9 is a detailed view showing the essential part of the balustrade shown in Figure 8; and

Figure 10 is an exploded, detailed view similar to Figure 9 but showing the essential part of another embodiment of the invention.

As shown in Figure 1, the passenger conveyor comprises balustrades each including stationary members except for an endless series of steps 1 adapted to convey passengers thereon, and a handrail 2 disposed above the steps. The stationary members comprise mainly a main deck member 3 for supporting the handrail 2, a

lower deck member 4 and a balustrade glass panel 5, all of which are objects of industrial design. A material for balustrades is, first of all, required to have a good bending workability since the contour of a balustrade consists of a concave or U-shaped curve, T-shaped terminal curve and unique, streamlined arc.

Referring now to Figure 2, the prior main deck member 3 made of aluminium alloy has a glass panel 5 fitted thereto at the lower portion thereof and has a guide 2a secured thereto at the upper end portion thereof by means of bolts 6, which guide guides the handrail 2. The configuration in section of the main deck member 3 is conventionally determined such that portions of the main deck member 3 are thickened at areas where wrinkles tend to be produced (as at 3a in Figure 2), are thinned at areas where wrinkles are hard to be produced (as at 3c in Figure 2), and are in the form of decorative line 3b. In the prior art, attempts have been made to meet the requirements of compensating for the lack of workability of the material and increasing the attractiveness of the decorative design as aforementioned.

In Figure 3, there is shown a main deck member formed of stainless steel which has come to attract attention in recent years. A thin sheet of 1 to 3 millimeter in thickness t is subject to bending by means of a press brake to provide a main deck member having a desired cross-sectional shape. Therefore, it is conventional neither to provide any variation in thickness of the material nor to provide a decorative line. As it is, the main deck member 3 is produced by separately forming a first U-shaped deck portion or member 7a and a second U-shaped deck portion or member 7b, and then secure them together by means of bolts 8 when assembled.

Although the deck portions or members 7a and 7b lack variety in industrial design (such as the use of a decorative line) and it is troublesome to join the two deck portions or members 7a, 7b together by means of bolts, there has been an increasing demand for deck members made of stainless steel because they are resistant to scratches, are highly durable, and present deep gloss thereon which is favored by many people.

The manner in which a balustrade deck member made of stainless steel is subjected to bending will now be described by referring to the deck member 7a by way of illustration.

As shown in Figures 4 to 7, opposite end portions a and b are subject to tension in the directions of arrows A and B with the deck member 7a faced inwardly, so

that an outer peripheral surface g_1 may have radius of curvature R_1 and an inner peripheral surface g_2 may have radius of curvature R_2 . In this case, reaction forces against the tensile forces in the directions of arrows A and B are distributed over substantially all the area of the inner peripheral portion as designated by an arrow C, and the outer peripheral surface g_1 is elongated as indicated by the arrows D. As a result, the portion of the deck member 7a disposed inwardly of a neutral axis L, as shown in Figure 6, begins to contract as indicated by the arrows F (Figure 5). Such phenomenon is physically natural, but causes disadvantages as presently to be described when this type of thin stainless steel sheet is bent.

More specifically, the aforementioned contaction indicated by the arrows F manifests itself as large wrinkles on the inner peripheral surfaces g_2 , as shown in Figure 7. Therefore, the flange portions of the deck member 7a extending over a width of W are displaced laterally a distance S_1 (Figure 6). It will be appreciated that much work is required to correct the deformation of the deck member 7a into a regular shape. The wrinkles S are, of course, greatly related to the position of the neutral axis L from the viewpoint of strength of materials, and can not be avoided due to the shape of the deck member 7a, as shown in Figure 6, in which the neutral axis L is spaced a short distance n from the outer peripheral surface g_1 and a radius of curvature R_3 at the neutral axis L is close to radius of curvature R_1 ($>R_3 = R_2$) of the outer peripheral surface g_1 . Therefore, it will be apparent that in order to eliminate wrinkles S or displacement S_1 , the neutral axis L should be positioned near the inner peripheral surface g_2 where wrinkles tend to occur.

As an alternative measure for preventing wrinkles S from being produced, that portion of the deck member 7a which may produce wrinkles can be thickened so as to absorb wrinkles therein, as shown in Figure 2. However, such measure cannot go well in cases where stainless steel sheets of a uniform thickness are subject to bending to form deck members 7a. Thus, there has been a significant problem how to prevent wrinkles in balustrades made of stainless steel.

Figures 8 and 9 show one embodiment of the invention. In the drawings, a hand-rail (not shown) and a balustrade glass panel 5 are similar in construction to those of the prior balustrade. According to the embodiment, a deck member 9a is substantially U-shaped in cross section and includes deformation prevention plates 10,

each of which extends a distance M_1 inwardly along an inner peripheral surface g_3 (corresponding to g_2 of the prior deck member). The deformation prevention plates 10 are formed upon bending in a press brake when a stainless steel sheet is formed into a substantially U-shaped body. The distance over which each deformation prevention plate 10 extends along the surface g_3 is 1.5 or more, preferably 2 to 4 times the thickness t of the sheet. The deformation prevention plates 10 increase the flexural rigidity of the inner peripheral surface g_3 (as seen from Figure 9, the cross-sectional area of the inner peripheral surface portion g_3 is greater than that of the inner peripheral surface portion g_2 in Figure 6), and the neutral axis + is displaced substantially toward the inner peripheral surface g_1 where N is larger than b that is ($N > n$), and the radius of curvature is R_4 at the position of the neutral axis ℓ . ($R_1 - R_4 = N$). It will be apparent that wrinkles are difficult to produce. In addition, the inner peripheral surface g_3 increases flexural rigidity and is therefore effective in eliminating wrinkles.

From the foregoing description, it will be appreciated that the present invention provides deck members which facilitate bending work and facilitate production thereof. Moreover, the invention is advantageous in that problems associated with scratches and corrosion can be solved so as to render a passenger conveyor durable.

It is to be understood that the invention is not limited to the specific shape of the deformation preventing plate of the deck member shown and described hereinabove. For example, the plate may assume the shape as at 11 in Figure 10, in which the plate is turned down to be brought into contact with the flange portion of the deck member 9a. The invention essentially resides in the provision of a deck member which is U-shaped in section and is provided at the inner peripheral surface thereof with deformation prevention plates. The shape and the width of the deformation prevention plate may be selected as desired. The deformation prevention plate can be applied to the deck member as illustrated, but also to all the members adapted to be subject to bending work. The material used for forming the deck members of the balustrade is not limited to stainless steel sheets, but may be common steel sheets.

WHAT WE CLAIM IS:-

1. A balustrade for use with passenger conveyors, comprising a first deck member provided with a guide for guiding a hand-rail which is adapted to be moved in synchronism with an endless series of steps, and a second deck member formed of

70

75

80

85

90

95

100

105

110

115

120

125

130



that an outer peripheral surface g_1 may have radius of curvature R_1 and an inner peripheral surface g_2 may have radius of curvature R_2 . In this case, reaction forces against the tensile forces in the directions of arrows A and B are distributed over substantially all the area of the inner peripheral portion as designated by an arrow C, and the outer peripheral surface g_1 is elongated as indicated by the arrows D. As a result, the portion of the deck member 7a disposed inwardly of a neutral axis L, as shown in Figure 6, begins to contract as indicated by the arrows F (Figure 5). Such phenomenon is physically natural, but causes disadvantages as presently to be described when this type of thin stainless steel sheet is bent.

More specifically, the aforementioned contaction indicated by the arrows F manifests itself as large wrinkles on the inner peripheral surfaces g_2 , as shown in Figure 7. Therefore, the flange portions of the deck member 7a extending over a width of W are displaced laterally a distance S_1 (Figure 6). It will be appreciated that much work is required to correct the deformation of the deck member 7a into a regular shape. The wrinkles S are, of course, greatly related to the position of the neutral axis L from the viewpoint of strength of materials, and can not be avoided due to the shape of the deck member 7a, as shown in Figure 6, in which the neutral axis L is spaced a short distance n from the outer peripheral surface g_1 and a radius of curvature R_3 at the neutral axis L is close to radius of curvature R_1 ($> R_3 = R_2$) of the outer peripheral surface g_1 . Therefore, it will be apparent that in order to eliminate wrinkles S or displacement S_1 , the neutral axis L should be positioned near the inner peripheral surface g_2 where wrinkles tend to occur.

As an alternative measure for preventing wrinkles S from being produced, that portion of the deck member 7a which may produce wrinkles can be thickened so as to absorb wrinkles therein, as shown in Figure 2. However, such measure cannot go well in cases where stainless steel sheets of a uniform thickness are subject to bending to form deck members 7a. Thus, there has been a significant problem how to prevent wrinkles in balustrades made of stainless steel.

Figures 8 and 9 show one embodiment of the invention. In the drawings, a hand-rail (not shown) and a balustrade glass panel 5 are similar in construction to those of the prior balustrade. According to the embodiment, a deck member 9a is substantially U-shaped in cross section and includes deformation prevention plates 10,

each of which extends a distance M_1 inwardly along an inner peripheral surface g_3 (corresponding to g_2 of the prior deck member). The deformation prevention plates 10 are formed upon bending in a press brake when a stainless steel sheet is formed into a substantially U-shaped body. The distance over which each deformation prevention plate 10 extends along the surface g_3 is 1.5 or more, preferably 2 to 4 times the thickness t of the sheet. The deformation prevention plates 10 increase the flexural rigidity of the inner peripheral surface g_3 (as seen from Figure 9, the cross-sectional area of the inner peripheral surface portion g_3 is greater than that of the inner peripheral surface portion g_2 in Figure 6), and the neutral axis + is displaced substantially toward the inner peripheral surface g_1 where N is larger than b that is ($N > n$), and the radius of curvature is R_4 at the position of the neutral axis ℓ . ($R_1 - R_4 = N$). It will be apparent that wrinkles are difficult to produce. In addition, the inner peripheral surface g_3 increases flexural rigidity and is therefore effective in eliminating wrinkles.

From the foregoing description, it will be appreciated that the present invention provides deck members which facilitate bending work and facilitate production thereof. Moreover, the invention is advantageous in that problems associated with scratches and corrosion can be solved so as to render a passenger conveyor durable.

It is to be understood that the invention is not limited to the specific shape of the deformation preventing plate of the deck member shown and described hereinabove. For example, the plate may assume the shape as at 11 in Figure 10, in which the plate is turned down to be brought into contact with the flange portion of the deck member 9a. The invention essentially resides in the provision of a deck member which is U-shaped in section and is provided at the inner peripheral surface thereof with deformation prevention plates. The shape and the width of the deformation prevention plate may be selected as desired. The deformation prevention plate can be applied to the deck member as illustrated, but also to all the members adapted to be subject to bending work. The material used for forming the deck members of the balustrade is not limited to stainless steel sheets, but may be common steel sheets.

WHAT WE CLAIM IS:-

1. A balustrade for use with passenger conveyors, comprising a first deck member provided with a guide for guiding a hand-rail which is adapted to be moved in synchronism with an endless series of steps, and a second deck member formed of

10

(11)

4

1,570,750

4

5 sheet material connected to the first deck member, the second deck member having a U-shaped cross-sectional configuration opening in a direction opposite the first deck member, each of said first and second deck members being bent to assume an arcuate shape at the landings, and further comprising inwardly bent deformation prevention strips provided on the second deck member adjacent the opening at the arcuate-shaped section of the second deck member for preventing deformation of the second deck member in an area of the arcuate-shaped sections.

10 2. A balustrade as claimed in Claim 1, wherein each said deformation prevention strip is formed so as to project from the second deck member for a distance which is in excess of 1.5 times the thickness of the sheet material of the second deck member.

15 3. A balustrade as claimed in Claim 1, wherein said first and second deck members are formed of stainless steel material.

20 4. A balustrade as claimed in Claim 1, 2 or 3, wherein the inwardly bent deformation prevention strips are formed by inwardly bent opposite end portions of the opening of the second deck member.

25 5. A balustrade substantially as hereinbefore described with reference to, and as illustrated in, Figures 8 to 10 of the accompanying drawings.

30
35 LANGNER PARRY
Chartered Patent Agents,
High Holborn House,
52-54, High Holborn,
London WC1V 6RR
Agents for the Applicants

Printed for Her Majesty's Stationery Office,
by Croydon Printing Company Limited, Croydon, Surrey, 1980.
Published by The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.



* C L M S *