A pallet sensor assembly for a passenger conveyer includes a proximity sensor and a limit switch. The proximity sensor detects the presence of the pallets and the limit switch monitors the wear of the pallet assembly. Neither sensor is in direct contact with the pallets during normal operation of the passenger conveyer. Both sensors are mounted and positioned on a single frame that is then mounted onto the pallet assembly. The pallet sensor assembly is positioned such that the passenger conveyer may be stopped prior to exposure of the opening caused by the missing pallet or exposure of the worn pallet to the passengers.
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Description
Pallet Sensor Assembly

Technical Field
The present invention relates to passenger conveyors, and more particularly to pallet sensing assemblies for such passenger conveyors.

Background of the Invention
Passenger conveyors, such as escalators and moving walks, are an efficient method to transport people over a relatively short distance from one point to another. The effectiveness of the passenger conveyors depends in part upon the reliability of the operating mechanism.

A typical moving walk includes a pallet assembly having a plurality of sequentially connected pallets and a pallet chain on each side. The pallet assembly travels through a path forming a continuous loop. Under normal operating conditions some wear will occur in the mechanical linkages between adjacent pallets and links of the pallet chains. This wear may lead to misalignments in the pallet assembly that could result in damage to the pallets or pallet chains as they are driven along the path.

Devices have been developed to monitor the wear of the pallet assembly and to ensure that no pallets are missing. A common device is a spring loaded arm having a roller disposed on one end. The roller is in rolling contact with the pallets traveling through the path. In the event that a pallet is missing, the spring loaded arm will pivot and trigger a switch to stop the passenger conveyor. To monitor wear of the pallet assembly, the device is typically located below the return path of the pallet assembly. Any undue wear will cause the pallet assembly to sag under the force of gravity. If the sagging of the pallet assembly exceeds a predetermined amount, the arm of the device is forced to pivot against
the spring force and trigger a second switch that stops the passenger conveyor. In this way the passenger conveyor is protected against the harms of wear and missing pallets.

Although the devices are useful, a drawback to them is that the devices themselves wear during operation of the passenger conveyor. Wear of the device may lead to the device responding unnecessarily and stopping the operation of the passenger conveyor. These unnecessary stoppages reduce the efficiency of the passenger conveyor. To avoid unnecessary stoppages of the passenger conveyor, the devices must be checked frequently and re-calibrated. This need for service adds to the cost of operation of the passenger conveyor.

The above art notwithstanding, scientists and engineers under the direction of Applicant’s Assignee are working to develop reliable and cost efficient methods to detect the presence and wear of the pallet assembly in passenger conveyors.

Disclosure of the Invention

According to the present invention, a pallet sensing assembly senses both the presence of pallets in the passenger conveyor and wear of the pallet assembly without contact between the sensor assembly and the pallet assembly under normal operating conditions.

The advantage that results from the elimination of contact between the sensing assembly and the pallet assembly is that the sensing assembly does not wear and does not require recalibration during use.

According to a particular embodiment of the present invention, the pallet sensing assembly includes a proximity sensor and a limit switch mounted on a frame. The proximity sensor detects the presence of each of the pallets in the pallet assembly. The limit switch is proximate to the path of the pallet assembly and is actuated if wear of the pallet assembly exceeds a predetermined threshold.
The advantage of this particular embodiment is that both sensors produce reliable signals without any wearing contact during normal operation of the passenger conveyor. In addition, installation of the sensor assembly is simplified as a result of mounting both sensors on the same frame. This configuration permits the pair of sensors to be precisely located, relative to the frame, before installation onto the passenger conveyor. The frame may then be properly positioned in a single step during the installation of the passenger conveyor.

According further, the proximity sensor and limit switch are electrically connected in a parallel manner such that if either the proximity sensor responds to a missing pallet or the limit switch is actuated, the passenger conveyor is shut off. Electrically connecting the proximity sensor and the limit switch in this manner enhances the safety of the passenger conveyor.

The foregoing and other objects, features and advantages of the present invention become more apparent in light of the following detailed description of the exemplary embodiments thereof, as illustrated in the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a side view of a passenger conveyor.

Fig. 2 is a side view of a pallet sensing assembly, partially cut-away to show the location of a proximity sensor and a limit switch.

Fig. 3 is an end view of the pallet sensing assembly taken along line 3-3 of Fig. 2.

Fig. 4 is an end view of the pallet sensing assembly taken along line 4-4 of Fig. 2.
Best Mode for Carrying Out the Invention

Fig. 1 illustrates a moving walk 12 that includes a truss 14, a pallet assembly 16 having a pallet chain 18 and a plurality of sequentially connected pallets 22 that form a continuous loop, a portion of which is exposed to provide a passenger conveying surface 24, a main drive 26 for the pallets 22, and a pair of balustrades 28 extending up both sides of the pallets 22. Each of the balustrades 28 includes a handrail 32 over the outer edge of the balustrade 28. A handrail drive 34 for moving the pair of handrails 32 is disposed in the truss 14.

The main drive 26 includes a machine 36 for providing motive force, a main drive shaft 38 driven by the machine 36, and a pair of drive sprockets 42 disposed on the ends of the main drive shaft 38. Each of the sprockets 42 is engaged with the pallet chain 18. Rotating of the main drive shaft 38 and sprockets 42 results in motion of the pallet assembly 16 through its path of travel.

Referring to Fig. 2, the pallet chain 18 includes a plurality of rollers 44 that are interconnected to form the pallet chain 18. The rollers 44 ride in a track 46 disposed in the truss 14 and that defines the path of travel of the pallet chain 18 and thereby the pallets 22.

A pallet sensing assembly 48 is mounted on the track 46 in a position proximate to the exit point of the pallets 22 into the exposed portion of the path. As is conventional, a combplate 52 defines this exit point (see Fig. 1). The pallet sensing assembly 48 defines means to ensure that no pallets 22 in the pallet assembly 16 are missing prior to reaching the combplate 52 and also means to monitor the wear of the pallet assembly 16. The position of the pallet sensing assembly 48 relative to the combplate 52 is selected to be at a distance at least as great as the braking distance of the pallet assembly 16 once the passenger conveyor 12 has been stopped.
As shown in Figs. 2-4, the pallet sensing assembly includes an inductive proximity sensor 54 and a limit switch 56 mounted on a frame 58. The frame 58 is positioned on the track 46 such that the sensors 54, 56 are underneath the pallet assembly 16 path.

The inductive proximity sensor 54 is oriented to detect the presence of a metallic article within the sensor's field of response, in this case, immediately above the sensor 54. In this instance, the metallic article under normal operating conditions is the plurality of pallets 22 moving through the path. If a pallet 22 is missing, the open space will trigger the inductive proximity sensor 54 to respond and stop the passenger conveyor before the open space passes the combplate 52.

The limit switch 56 is shown in Fig. 4 and includes a mechanical plunger 62 that is spaced a predetermined distance d from the pallet assembly 16 as it travels through the path. The predetermined space d is selected to provide a threshold based upon the acceptable amount of wear of the pallet assembly 16. Use of the pallet assembly 16 will result in wear that causes the pallet assembly 16 to begin to sag under the force of its weight as it travels through the return portion of the path. If this wear exceeds the threshold amount, one of the pallets 22 will contact the plunger 62 and actuate the limit switch 58. Once the limit switch 58 responds, the passenger conveyor 12 is triggered to stop before that specific pallet 12 passes the combplate 54. In the alternative, the limit switch may be used to provide only a warning that unusual wear has occurred and to instigate maintenance of the pallet assembly. In this embodiment, the passenger conveyor may be permitted to continue to operate after actuation of the limit switch.

During normal operation of the passenger conveyor 12, there is no contact between the pallet sensing assembly 48 and the pallets 22. This feature avoids any wear due to contact and eliminates the need to recalibrate the pallet sensing assembly to accommodate the wear. Mounting the two sensors 54, 56
on the same frame 58 permits the sensors 54,56 to be properly positioned and
aligned before installation onto the passenger conveyor 12. The person
installing the pallet sensing assembly 48 only has to position the frame 58
relative to the track 46 to ensure proper installation.

The two sensors 54,56 are electrically connected in parallel to ensure
that if either of the sensors 54,56 responds, the passenger conveyor will be
triggered to stop. In this way, if either a pallet 22 is sensed as missing or the
pallet assembly is sensed as exceeding the predetermined amount of wear, the
passenger conveyor 12 will respond appropriately and prevent that missing or
worn pallet from passing the combplate 52.

Although the invention has been shown and described with respect to
exemplary embodiments thereof, it should be understood by those skilled in the
art that various changes, omissions, and additions may be made thereto, without
departing from the spirit and scope of the invention.
Claims

What is claimed is:

1. A pallet sensor assembly for a passenger conveyor, the conveyor including a plurality of sequentially connected pallets traveling about a continuous path, the pallet sensor assembly including:
   a frame disposed adjacent to the path of the plurality of pallets;
   a proximity sensor mounted on the frame proximate to and spaced from the path of the pallets, the proximity sensor responding to the absence of one of the plurality of pallets; and
   a limit switch mounted on the frame and having a contact surface spaced a predetermined distance away from the path of the pallets under normal operating conditions, the limit switch responding to divergence of one of the plurality of pallets from the path a distance greater than the predetermined distance.

2. The pallet sensor assembly according to Claim 1, wherein the proximity sensor and the limit switch are electrically connected in a parallel manner such that activation of either the proximity sensor or the limit switch causes the passenger conveyor to stop.

3. The pallet sensor assembly according to Claim 1, wherein the proximity sensor is an inductive sensor that responds to the presence of metallic articles within the sensor’s field of response.
4. A passenger conveyor including a plurality of sequentially connected pallets traveling about a continuous path, means to drive the plurality of pallets through the path, and a pallet sensor assembly, the pallet sensor assembly including:
   a frame disposed adjacent to the path of the plurality of pallets;
   a proximity sensor mounted on the frame proximate to and spaced from the path of the pallets, the proximity sensor responding to the absence of one of the plurality of pallets; and
   a limit switch mounted on the frame and having a contact surface spaced a predetermined distance away from the path of the pallets under normal operating conditions, the limit switch responding to divergence of one of the plurality of pallets from the path a distance greater than the predetermined distance.

5. The passenger conveyor according to Claim 4, wherein the proximity sensor and the limit switch are electrically connected in a parallel manner such that activation of either the proximity sensor or the limit switch causes the driving means to stop.

6. The passenger conveyor according to Claim 4, wherein the proximity sensor is an inductive sensor that responds to the presence of metallic articles within the sensor’s field of response.
7. The passenger conveyor according to Claim 4, wherein the path of the pallets includes a combplate defining the point along the path at which the pallets are exposed to the passengers, wherein the passenger conveyor has a braking distance defined as the distance along the path a pallet will travel after power to drive the passenger conveyor has stopped, and wherein the pallet sensor assembly is located at a position along the path that is separated from the combplate a distance greater than or equal to the braking distance.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

| IPC 6 | B66B29/00 |

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)

| IPC 6 | B66B |

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>Y</td>
<td>EP, A, 0 599 452 (OTIS ELEVATOR CO) 1 June 1994 see column 2, line 43 - column 3, line 8 see figure 1</td>
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**Date of the actual completion of the international search**

27 June 1996

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