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TEMPORARY PANEL RAILS

Abstract

A system is disclosed. The system includes a panel comprising a printed circuit board (PCB) and a first panel side comprising a first interlock length configured to interlock with a first rail element. The first interlock length includes a projection that interlocks within a corresponding recess of the first rail element, wherein the first interlock length is configured to interlock with the first rail element and be removed from the first rail element without damaging the PCB or the projection. The system may further include the first rail element.

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Background/Summary

BACKGROUND

[0001] Printed circuit boards (PCBs) are often produced on large scales (e.g., greater than 100,000 units). Large-scale production of PCBs often requires manufacturing techniques that make use of increased speed and/or automation. PCB panelization is a manufacturing technique in which PCBs are manufactured on a large scale as connected PCBs as a single array (e.g., one panel per PCB), which makes it easier for the PCBs to move through an assembly line. After production, the individual PCBs are depanelized and removed from the array for packaging for installation or further modification.

[0002] Panelization requires that excess PCB base material in the form of rails be included on one or more sides of each panel (e.g., of what would be the finished product). The rail enables the PCB to be integrated into the assembly machinery during production and may also protect overhanging or peripheral PCB componentry during the assembly process. However, the rail also increases the overall cost of PCB production as the rail material is discarded after depanelization, which can cost a manufacturer up to 10%-30% of the cost of the PCB. Therefore, there is a need for a system and method to reduce the waste of discarded PCB base material.

SUMMARY

[0003] In some aspects, the techniques described herein relate to a system including: a panel including: a printed circuit board (PCB); and a first panel side including a first interlock length configured to interlock with a first rail element including: a projection that interlocks within a corresponding recess of the first rail element, wherein the first interlock length is configured to interlock with the first rail element and be removed from the first rail element without damaging the PCB or the projection

[0004] In some aspects, the techniques described herein relate to a system, further including a second panel side opposite to the first panel side, the second panel side including a second interlock length configured to interlock with a second rail element, wherein the first rail element and the second rail element are parallel.

[0005] In some aspects, the techniques described herein relate to a system, wherein the projection includes a tab.

[0006] In some aspects, the techniques described herein relate to a system, wherein the first rail element is formed from non-PCB material.

[0007] In some aspects, the techniques described herein relate to a system, wherein the first rail element is configured to engage a conveyor belt.

[0008] In some aspects, the techniques described herein relate to a system, wherein the first interlock length can be pressed into the first rail element.

[0009] In some aspects, the techniques described herein relate to a system, wherein the first rail element further includes a lip disposed the below the corresponding recess that limits a depth of interlock between the first interlock length and the first rail element, forming a componentry space between the panel and a rail assembly floor.

[0010] In some aspects, the techniques described herein relate to a system, wherein the first rail element and the second rail element are joined, forming a cradle that contains the panel.

[0011] In some aspects, the techniques described herein relate to a system including: a first rail element configured to secure to a panel including at least one printed circuit board (PCB), the first rail element including: a recess that interlocks a corresponding projection of a first interlock length of a first panel side of at least one PCB, wherein the first interlock length is configured to interlock with the first rail element and be removed from the first rail element without damaging the PCB or the corresponding projection.

[0012] In some aspects, the techniques described herein relate to a system including a second rail element configured to interlock with a second interlock length of a second panel side of the panel, wherein the second rail element is parallel to the first rail element.

[0013] In some aspects, the techniques described herein relate to a system, wherein the first rail element is configured to engage to a conveyor belt.
[0014] In some aspects, the techniques described herein relate to a system, further including the panel.
[0015] In some aspects, the techniques described herein relate to a system, wherein the first rail element is formed from non-PCB material.
[0016] In some aspects, the techniques described herein relate to a system, wherein the recess includes a socket.
[0017] In some aspects, the techniques described herein relate to a system, wherein a panel including: a printed circuit board (PCB); and a first panel side including a first interlock length configured to interlock with a first rail element including: a recess that interlocks within a corresponding projection of the first rail element, wherein the first interlock length is configured to interlock with the first rail element and be removed from the first rail element without damaging the PCB or the projection
[0018] In some aspects, the techniques described herein relate to a system, wherein the system further includes the first rail element.
[0019] This Summary is provided solely as an introduction to subject matter that is fully described in the Detailed Description and Drawings. The Summary should not be considered to describe essential features nor be used to determine the scope of the Claims. Moreover, it is to be understood that both the foregoing Summary and the following Detailed Description are example and explanatory only and are not necessarily restrictive of the subject matter claimed.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0020] The detailed description is described with reference to the accompanying figures. The use of the same reference numbers in different instances in the description and the figures may indicate similar or identical items. Various embodiments or examples (“examples”) of the present disclosure are disclosed in the following detailed description and the accompanying drawings. The drawings are not necessarily to scale. In general, operations of disclosed processes may be performed in an arbitrary order, unless otherwise provided in the claims. In the drawings:
[0021] FIG. **1** illustrates a pan view of a traditional panel for PCB manufacturing, in accordance with one or more embodiments of the disclosure.
[0022] FIG. **2**A illustrates a perspective view of a PCB conveyor, in accordance with one or more embodiments of the disclosure.
[0023] FIG. **2**B illustrates a perspective view of a traditional panel placed upon the conveyor belts of a PCB conveyor, in accordance with one or more embodiments of the disclosure.
[0024] FIG. **3**A illustrates a pan view of a panel for PCB manufacturing with a first interlock length containing a series of projections, in accordance with one or more embodiments of the disclosure.
[0025] FIG. **3**B illustrates a pan view of a panel for PCB manufacturing with a first interlock length containing a series of projections, and a first rail element containing a series of recesses that interlock with the series of projections, in accordance with one or more embodiments of the disclosure.
[0026] FIG. **3**C illustrates a pan view of a panel for PCB manufacturing with a first interlock length containing a series of projections interlocked with a series of recesses of a first rail element, in accordance with one or more embodiments of the disclosure.
[0027] FIG. **4**A illustrates a pan view of a panel for PCB manufacturing with a first interlock length containing a series of projections interlocked with a series of recesses of a first rail element, and a second interlock length containing a series of projections interlocked with a series of recesses of a

second rail element, in accordance with one or more embodiments of the disclosure.
[0028] FIG. **4**B illustrates a perspective view of a panel for PCB manufacturing placed upon the conveyor belts of a PCB conveyor, the panel having a first interlock length containing a series of projections interlocked with a series of recesses of a first rail element, and a second interlock length containing a series of projections interlocked with a series of recesses of a second rail element, in accordance with one or more embodiments of the disclosure.
[0029] FIG. **5** illustrates the interlocking between a projection **324** and a recess **328**, in accordance with one or more embodiments of the disclosure, in accordance with one or more embodiments of the disclosure.
[0030] FIG. **6** illustrates a method a method for securing a panel, in accordance with one or more embodiments of the disclosure.
[0031] FIG. **7**A illustrates a side view of a panel for PCB manufacturing with a first interlock length that is interlocked with a first rail element and a second rail element, in accordance with one or more embodiments of the disclosure.
[0032] FIG. **7**B illustrates a side view of a panel for PCB manufacturing with a first interlock length that is interlocked with a first rail element and a second rail element, with the first rail element and the second rail element forming a cradle, in accordance with one or more embodiments of the disclosure.
[0033] FIG. **8** illustrates a pan view of a panel for PCB manufacturing, the panel having a first interlock length containing a series of recesses that are to interlock with a respective series of projections of a first rail element, in accordance with one or more embodiments of the disclosure
[0034] FIG. **9** disclosure illustrates a pan view of a panel for PCB manufacturing, the panel interlocking with a first rail element via a set of recesses and projections, with the interlocking forming gaps between the panel and the first rail element, in accordance with one or more embodiments of the disclosure.
[0035] FIG. **10** discloses a pan view of a panel for PCB manufacturing with a first interlock length containing a wavy line that interlocks with a respective first rail element, in accordance with one or more embodiments of the disclosure.
[0036] FIG. **11** discloses a pan view of a panel for PCB manufacturing with a first interlock length containing a relatively straight line that interlocks with a respective first element, in accordance with one or more embodiments of the disclosure.

DETAILED DESCRIPTION

[0037] Before explaining one or more embodiments of the disclosure in detail, it is to be understood that the embodiments are not limited in their application to the details of construction and the arrangement of the components or steps or methodologies set forth in the following description or illustrated in the drawings. In the following detailed description of embodiments, numerous specific details may be set forth in order to provide a more thorough understanding of the disclosure. However, it will be apparent to one of ordinary skill in the art having the benefit of the instant disclosure that the embodiments disclosed herein may be practiced without some of these specific details. In other instances, well-known features may not be described in detail to avoid unnecessarily complicating the instant disclosure.
[0038] As used herein a letter following a reference numeral is intended to reference an embodiment of the feature or element that may be similar, but not necessarily identical, to a previously described element or feature bearing the same reference numeral (e.g., **1**, **1***a*, **1***b*). Such shorthand notations are used for purposes of convenience only and should not be construed to limit the disclosure in any way unless expressly stated to the contrary.
[0039] Further, unless expressly stated to the contrary, “or” refers to an inclusive or and not to an exclusive or. For example, a condition A or B is satisfied by anyone of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

[0040] In addition, use of “a” or “an” may be employed to describe elements and components of embodiments disclosed herein. This is done merely for convenience and “a” and “an” are intended to include “one” or “at least one,” and the singular also includes the plural unless it is obvious that it is meant otherwise.

[0041] Finally, as used herein any reference to “one embodiment” or “some embodiments” means that a particular element, feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment disclosed herein. The appearances of the phrase “in some embodiments” in various places in the specification are not necessarily all referring to the same embodiment, and embodiments may include one or more of the features expressly described or inherently present herein, or any combination of sub-combination of two or more such features, along with any other features which may not necessarily be expressly described or inherently present in the instant disclosure.

[0042] Broadly embodiments of the concepts disclosed herein are directed to a system and method, which may include a panel used in the assembly or printed circuit boards (PCBs) and a rail element. The panel has at least one side containing an interlock length that is configured to interlock with the rail element as the panel is placed in, or transported through, a PCB conveyor or other PCB device used in PCB manufacturing. The interlock between the interlock length and the rail element comprises projections and corresponding recesses that allow the panel to be pressed into the rail element. The interlock system reduces the amount of PCB material needed for a rail, as the rail element does not include PCB material. The system may include the panel and/or the rail element.

[0043] A traditional panel **100** is shown in FIG. **1**. The traditional panel **100** includes a traditional rail **104** configured to be placed upon a conveyor belt or guide during the assembly and manufacture of the PCB. The traditional rail **104** is made of PCB material, such as FR4, and does not include any electronic componentry. The traditional panel **100** further includes a PCB area **108** that can be mounted with electronic components, such as a PCB **112**. The traditional rail **104***a-b* may be coupled to the PCB area or PCB **112** via tab sets **114***a-b* or via scored/drilled areas that need to be broken (e.g., snapped) to release the PCBs **112** from the traditional panel **104***a-b*.

[0044] A PCB conveyor **200** is shown in FIG. **2**A. The PCB conveyor **200** includes conveyor walls **204***a-b* that guide the traditional panel **100** along the PCB conveyor **200**. The PCB conveyor **200** further includes conveyor belts **208***a-b* or guides that the traditional rail **104** of the traditional panel lays upon, or otherwise engages with, during the PCB assembly process, as shown in FIG. **2**B. The traditional panel **100** may include a traditional rail **104** on two sides of the panel (e.g., corresponding to the sides touching the conveyor belts **208***a-b*, or on all four sides of the panel.

[0045] Referring now to FIGS. **3** to **8**, embodiments of a system **300** according to the concepts disclosed are depicted. The system **300** may be implemented in any electronic or PCB manufacturing scheme, such as an automated PCB assembly system that includes a PCB conveyor **200**. In embodiments, the system **300** includes a panel **302** made of a PCB substrate, as shown in FIG. **3**A. The PCB substrate may include any type of PCB substrate material including, but not limited to, flame retardant material (e.g., FR1 to FR 6), composite epoxy material (e.g., CEM**1** to CEM **5**), and glass epoxy laminate (e.g., G**10** and G**11**). For example, the PCB substrate material may include flame retardant four (FR4) material. The PCB material may be formed in any shape including, but not limited to, a rectangle). The panel **302** includes a PCB area **308** for the placement, design, and or assembly of one or more PCBs **312***a-d*. The panel **302** may include one PCB **112** (e.g., a one-up array) or 2, 3, 4, 5, 6, 7, 8, 9, or 10 or more PCBs **112**.

[0046] In embodiments, the panel **302** includes a first interlock length **316** on a first panel side **320**. The first interlock length **316** may include one or more projections **324***a-h* that protrude from the PCB area **108** or one or more PCBs **112** and are positioned in a space typically taken by the traditional rail **104**. The one or more projections **324***a-h* are configured to interlock with a first rail element **332** that lies upon or otherwise engages with, the conveyor belts **208***a-b* or guides, as

shown in FIG. **3**B. The one or more projections **324***a-h* are configured to interlock (via an interlocking action **336** with one or more recesses **328***a-h* of the first rail element **332**, resulting in a plurality of interlocks **340***a-f* as shown in FIG. **3**C. The first interlock length **316** may include any number of projections **324** per panel **302** including, but not limited to, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, or 50 or more projections **324** per panel. The first rail element **332** may include any number of recesses including, but not limited to, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, or 50 or more recesses per first rail element **332**. The first interlock length **116** may include one or more recesses **328**, and first rail element **332** may include one or more projections **324**. The plurality of interlocks **340***a-f* may be equally or unequally distributed along the first side, for example, the plurality of interlocks **340***a-f* may be concentrated near the corners of the panel **302**. As noted above, the interlocks may include projections **324** on the first rail element **332** and recesses **328** on the first interlock length. One or more of the plurality of interlocks **340** may be formed via one or more projections on the first rail element **332** interlocking with a respective recess on the panel **302**, as shown in FIG. **8** and as described herein.

[0047] In embodiments, the panel **302** may include a second interlock length **404** on a second panel side **408** (e.g., the side opposite the first panel side **320**) as shown in FIG. **4**A. The second interlock length **404** may include one or more projections **324** similar to the first interlock length **316** configured to interlock with recesses on a second rail element **412**, resulting in a plurality of interlocks **340***i-p* (e.g., the first rail element **332** and the second rail element **412** being parallel). The panel **302** with the first interlock length **316**, the first rail element **332**, the second interlock length **404**, and the second rail element **412** laid upon conveyor belts **208***a-b* are shown in FIG. **4**B. For conveyor systems that require a physical connection, such as a connection directly to a conveyor belt or chain, the first rail element **332** and the second rail element **412** may include a coupler that engages with the conveyor belt or chain.

[0048] A close-up view of an interlock **304** between a projection **324** and a recess **328** are shown in FIG. **5**. The projection **324** may include a tab **504** (e.g., a knob, bump, or key). The projection **324** may also include a stem **508**. The recess **328** may include a socket **512** (e.g., a pocket or slot) and a gap **516**. The projection **324** and the recess **328** are intended to interlock and interlocking action **336** similar to the interlocking of two pieces of a puzzle. For example, the interlocking action **336** may include manually snapping the projection **324** into the recess **328**. The interlocking action **336** may also be made automatically by an alignment and interlocking machine. The interlocking action (e.g., interlocking and removing the interlock **340** can be repeated many times without breaking or snapping the panel (e.g., such as to release the PCBs **112**) or otherwise damaging the panel **100**, the PCBs **112**, or the projections **324**.

[0049] The tab **504** and stem **508** and the corresponding socket **512** and gap **516** may be of any size or shape. For example, the tab **504** may have a general shape of an oval, as shown in FIG. **5**. Other shapes of the tab **504** may include, but not be limited to, a circle, triangle, rectangle, star, mushroom, dovetail, or other polygon. The shape of the tab **504** may also include a custom atypical shape, such as a shape that resembles a logo of a PCB manufacturer.

[0050] FIG. **6** illustrates a method **600** for securing the panel **302** containing at least one printed circuit boards (PCB) **112** onto a first rail element **332**. The method may be performed within any PCB assembly or PCB rework system. In a first step **610**, the method **600** includes aligning at least two projections **324** of the first interlock length **316** of the first panel side **320** of the panel **302** with corresponding recesses **328** located on the first rail element **332**. The aligning step **610** may be performed visually and manually by an operator or automatically by a machine.

[0051] In embodiments, the method **600** includes a step **620** of pressing at least two projections **324** into the corresponding recesses **328**. For example, the operator may press the projections **324** into the corresponding recesses **328** manually using fingers or a tool. In another example, the projections **324** may be pressed into the corresponding recesses **328** via a machine. Once interlocked, the projections **324** and the recesses **328** are prevented from being pulled out laterally

due to the constriction of the gap **516** preventing the movement of the interlocked tab **504**. The projections **324** and the recesses **328** may also be prevented from being released from the interlock **340** due to an interference fit (e.g., friction fit). As noted above, the method **600** may include securing the panel **302** via interlocks that include projections **324** on the first rail element **332** and recesses **328** on the first interlock length.

[0052] In embodiments, the method may include a further step of forming the at least two projections **324** and/or forming the two recesses **328** (e.g., before the aligning step **610**). Forming the projections **324** and/or the two recesses may include cutting or excising the projections **324** from PCB material or the material of the first rail element **332**. Methods for cutting or excising the projections **324** and/or recesses **328** include, but are not limited to, cutting via a CNC router and cutting via a laser (e.g., a laser router).

[0053] In embodiments, the first rail element **332** and the second rail element **412** may be created from non-PCB materials. For example, the first rail element **332** and the second rail element **412** may be created from materials including, but not limited to, metal, plastic (e.g., polycarbonate, polypropylene, and polyvinyl), and ceramic materials. These non-PCB materials are often less expensive than PCB materials (e.g., FR4), resulting in cost savings. In some instances, the first rail element **332** and the second rail element **412** are created from PCB materials.

[0054] In embodiments, the first rail element **332** and/or the second rail element **412** includes a lip **704***a-b* disposed below the recesses **328** that limits a depth of interlock between the first interlock length **316** and the second interlock length **404** with the respective first rail element **332** and the second rail element **412**, as shown in FIG. **7**A. The lip **704***a-b* along with the interlocking of the first interlock length **316** and the second interlock length **404** with the respective first rail element **332** and the second rail element **412**, creates a componentry space **708** between the PCB area **108** or PCB **112** and a floor **716** of PCB conveyor **200** that allows clearance for PCB components **720***a-e* (e.g., computer chips, transistors) in the assembly of double-sided PCBs.

[0055] In embodiments, the first rail element **332** and the second rail element **412** are combined (e.g., joined) to form a cradle **724**, as shown in FIG. **7**B. The first rail element **332** and the second rail element **412** may also include the lip **704***a-b* as described above that forms a componentry space **708** between the PCB area **108** or PCB **112** and a cradle floor **728** that provides components for PCB components **720***d-e*.

[0056] In some embodiments, a system **800** includes a panel **802** (e.g. that includes one or more PCBs **112**) and that includes a first interlock length **816** containing one or more recesses **824***a-d* that interlock with one or more projections **328***a-d* of the first rail element **832**. The system **800** may further include a similar interlock system on a second rail element **836**. In some embodiments, the second rail element may include a reversed interlocking system similar to the second rail element **412** shown in FIG. **4**A.

[0057] In some embodiments, a system **900** includes a panel **902** (e.g., that includes one or more PCBs **112**), a first rail element **904** and, optionally, a second rail element **906**. The panel **902** is coupled to the first rail element **904** and/or the second rail element **906** via interlocks **908***a-g*. The interlocks may include: projections upon the panel **902** and recesses on the first rail element **904** and/or the second rail element **906**; recesses upon the panel **902** and projections on the first rail element **904** and/or the second rail element **906**; or a mixture of both such that there are recesses and projections upon the panel **902** that align with recesses and projections on the first rail element **904** and/or the second rail element **906**. The recesses and projections that interact with the panel **902** can be particularly small, as shown in FIG. **9**

[0058] In some embodiments of the system **300**,**800**, **900**, the interlocking between the panel **302**, **806**, **908** and the first rail element **332**, **832**, **904** and the second rail element **412**, **836**, **906** result in the formation of gaps **916***a-b*. The gaps **916***a-b* occupy space that would traditionally require the use of PCB material to fill in, providing a saving on material costs and material waste.

[0059] FIG. **10** illustrates a system **1000** where the panel **1002** includes a first panel side **1004**

having a first interlock length **1006** composed of a wavy line with crests **1008** and troughs **1010** (e.g., the trough **1010** may be considered as a recess **328**, and the crest **1008** may be considered as a projection **324**) that interlock with the troughs and crests of the first rail element **1012**. The panel **1002** may further include a second panel side **1014** having a second interlock length **1016** comprising a wavy line that interlocks with a second rail element **1018** in a manner similar to the interlocking of the first interlock length **1006** with the first rail element **1012**.
[0060] FIG. **11** illustrates a system **1100** where the panel **1102** includes a first panel side **1104** having a first interlock length **1106** composed of a relatively straight line that interlocks first rail element **1112** due to friction between the two elements. The panel **1102** may further include a second panel side **1114** having a second interlock length **1116** comprising a relatively straight line that interlocks with a second rail element **1118** in a manner similar to the interlocking of the first interlock length **1106** with the first rail element **1112**.
[0061] It is to be understood that embodiments of the methods disclosed herein may include one or more of the steps described herein. Further, such steps may be carried out in any desired order and two or more of the steps may be carried out simultaneously with one another. Two or more of the steps disclosed herein may be combined in a single step, and in some embodiments, one or more of the steps may be carried out as two or more sub-steps. Further, other steps or sub-steps may be carried in addition to, or as substitutes to one or more of the steps disclosed herein.
[0062] Although inventive concepts have been described with reference to the embodiments illustrated in the attached drawing figures, equivalents may be employed and substitutions made herein without departing from the scope of the claims. Components illustrated and described herein are merely examples of a system/device and components that may be used to implement embodiments of the inventive concepts and may be replaced with other devices and components without departing from the scope of the claims. Furthermore, any dimensions, degrees, and/or numerical ranges provided herein are to be understood as non-limiting examples unless otherwise specified in the claims.

Claims

1. A system comprising: a panel comprising: a printed circuit board (PCB); and a first panel side comprising a first interlock length configured to interlock with a first rail element comprising: a projection that interlocks within a corresponding recess of the first rail element, wherein the first interlock length is configured to interlock with the first rail element and be removed from the first rail element without damaging the PCB or the projection.
2. The system of claim 1, further comprising a second panel side opposite to the first panel side, the second panel side comprising a second interlock length configured to interlock with a second rail element, wherein the first rail element and the second rail element are parallel.
3. The system of claim 1, wherein the projection includes a tab.
4. The system of claim 1, wherein the first rail element is formed from non-PCB material.
5. The system of claim 1, wherein the first rail element is configured to engage a conveyor belt.
6. The system of claim 1, wherein the first interlock length can be pressed into the first rail element.
7. The system of claim 1, wherein the first rail element further comprises a lip disposed the below the corresponding recess that limits a depth of interlock between the first interlock length and the first rail element, forming a componentry space between the panel and a rail assembly floor.
8. The system of claim 2, wherein the first rail element and the second rail element are joined, forming a cradle that contains the panel.
9. A system comprising: a first rail element configured to secure to a panel comprising at least one printed circuit board (PCB), the first rail element comprising: a recess that interlocks a corresponding projection of a first interlock length of a first panel side of at least one PCB, wherein

the first interlock length is configured to interlock with the first rail element and be removed from the first rail element without damaging the PCB or the corresponding projection.

10. The system of claim 9 comprising a second rail element configured to interlock with a second interlock length of a second panel side of the panel, wherein the second rail element is parallel to the first rail element.

11. The system of claim 9, wherein the first rail element is configured to engage to a conveyor belt.

12. The system of claim 9, further comprising the panel.

13. The system of claim 9, wherein the first rail element is formed from non-PCB material.

14. The system of claim 9, wherein the recess includes a socket.

15. A system comprising: a panel comprising: a printed circuit board (PCB); and a first panel side comprising a first interlock length configured to interlock with a first rail element comprising: a recess that interlocks within a corresponding projection of the first rail element, wherein the first interlock length is configured to interlock with the first rail element and be removed from the first rail element without damaging the PCB or the projection.

16. The system of claim 15, further comprising the first rail element.