

Claims

I Claim:

1. ~~An assembly machine comprising:~~
~~— a plurality of track modules, each track module including a section of track, the plurality of track modules connectable to form a continuous circuitous track, the continuous circuitous track configured to receive a dispensing head, the dispensing head configured to rotate about the continuous circuitous track and at least partially assemble an unfinished product;~~
~~— a first feeder module attached to a first length of the continuous circuitous track configured to feed a component to the dispensing head; and~~
~~— a first placement module attached to a second length of the continuous circuitous track configured to receive the unfinished product, wherein the dispensing head is configured to place the component on the unfinished product;~~
~~— wherein the assembly machine is reconfigurable by attaching or removing one or more of the plurality of track modules, the first feeder module and the first placement module.~~
2. ~~The assembly machine of claim 1, wherein the reconfiguration is enabled by attaching or removing the one or more of the plurality of modules of track to accommodate or remove feeder modules or placement modules.~~
3. ~~The assembly machine of claim 1, wherein the reconfiguration is enabled by replacing:~~
~~a second placement module with a second feeder module; or~~
~~the first feeder module with the second placement module,~~
~~without reconfiguring the continuous circuitous track.~~
4. ~~The assembly machine of claim 1, wherein the continuous circuitous track is reconfigurable without machining.~~

5. ~~A method of assembly comprising:~~
~~— providing a continuous circuitous track mounted across a plurality of track modules;~~
~~— receiving, by the continuous circuitous track, a dispensing head;~~
~~— mounting a first feeder module to a first length of the continuous circuitous track;~~
~~— mounting a first placement module to a second length of the continuous circuitous track;~~

- ~~—rotating the dispensing head about the continuous circuitous track;~~
- ~~—at least partially assembling an unfinished product with the dispensing head; and~~
- ~~—reconfiguring the assembly machine by at least one of:

 - ~~attaching one or more of the plurality of track modules, the first feeder module and the first placement module; and~~
 - ~~removing one or more of the plurality of track modules, the first feeder module and the first placement module.~~~~

6. ~~A pick and place head comprising:~~

- ~~—a nozzle configured to pick up a component;~~
- ~~an attachment mechanism for attaching the pick and place head to a continuous circuitous track such that the pick and place head is movable along the continuous circuitous track; and~~
- ~~—a position sensing system for sensing the position of the pick and place head with respect to the continuous circuitous track in two or more dimensions, the position sensing system including a first sensor and a second sensor separately disposed and spaced apart on the pick and place head.~~

7. ~~A method comprising:~~

- ~~—providing a pick and place head that includes:~~
- ~~—

 - ~~a nozzle configured to pick up a component;~~
 - ~~—an attachment mechanism for attaching the pick and place head to a continuous circuitous track such that the pick and place head is movable along the continuous circuitous track; and~~
 - ~~a position sensing system for sensing the position of the pick and place head with respect to the continuous circuitous track in two or more dimensions, the position sensing system including a first sensor and a second sensor separately disposed and spaced apart on the pick and place head;~~~~
- ~~—attaching the pick and place head to a continuous circuitous track such that the pick and place head is movable along the continuous circuitous track;~~
- ~~—sensing, by the pick and place head, the position of the pick and place head with respect to the continuous circuitous track in two or more dimensions;~~
- ~~—picking up, by the pick and place head on the track, a component; and~~
- ~~—placing, by the pick and place head on the track, the component on an electronic assembly.~~

8. ~~An assembly machine comprising:~~

- ~~— a circuitous track;~~
- ~~— a dispensing head configured to at least partially assemble an unfinished product; and~~
- ~~— a permanent magnet linear motor system located within the dispensing head and the track,~~
~~wherein the permanent magnet linear motor system is configured to provide attachment of the~~
~~dispensing head to the circuitous track and configured to provide motion of the dispensing head~~
~~along the circuitous track, wherein the dispensing head is attached to the circuitous track by a~~
~~magnetic attraction between an element of the dispensing head and an element of the circuitous~~
~~track.~~

9. ~~An assembly method comprising:~~

- ~~— providing a dispensing head;~~
- ~~— providing a circuitous track;~~
- ~~— providing a permanent magnet linear motor system located within the dispensing head and~~
~~the track;~~
- ~~— magnetically attaching the dispensing head to the track, wherein the dispensing head is~~
~~attached to the track by a magnetic attraction between an element of the dispensing head and an~~
~~element of the track;~~
- ~~— magnetically moving the dispensing head along the track; and~~
- ~~— at least partially assembling, with the dispensing head, an unfinished product.~~

10. ~~A dispensing head comprising:~~

- ~~— a control system located in the dispensing head;~~
~~an encoder read head located in the dispensing head; and~~
- ~~— a light capture sensor located in the dispensing head configured to detect a light flash of a~~
~~stationary camera when the light flash illuminates a component on the dispensing head or an~~
~~element of the dispensing head;~~
- ~~— wherein the control system is configured to determine a precise encoder position with the~~
~~encoder read head at a moment of the light flash;~~
~~wherein the dispensing head is configured to at least partially assemble an unfinished~~
~~product.~~

11. ~~A method comprising:~~

- ~~— providing a dispensing head;~~
- ~~— providing a control system located in the dispensing head;~~
- ~~— providing an encoder read head located in the dispensing head;~~
- ~~— providing a light capture sensor located in the dispensing head;~~
- ~~— providing a stationary camera;~~
- ~~— flashing a light by the stationary camera at a component on the dispensing head or an element of the dispensing head;~~

~~determining, by the control system and the encoder read head, a precise encoder position at the moment of the flash of light; and~~

~~at least partially assembling, by the dispensing head, an unfinished product.~~

12. ~~An assembly machine comprising:~~

- ~~— a plurality of dispensing heads each including a local control system;~~
- ~~— a continuous circuitous track around which the plurality of dispensing heads are configured to rotate independently from each other, the plurality of dispensing heads each configured to at least partially assemble an unfinished product;~~
- ~~— a control system; and~~

~~a bus communication system configured to provide separate communication between the control system and the local control system of each of the plurality of dispensing heads, wherein each of the plurality of dispensing heads is not connected to the control system with separate wires;~~

~~wherein the plurality of dispensing heads contact the continuous circuitous track and wherein the continuous circuitous track is configured to transmit the separate communications between the bus communication system and the local control system of each of the plurality of dispensing heads through the contact.~~

13. ~~An assembly method comprising:~~

- ~~— providing a continuous circuitous track;~~
- ~~— providing a plurality of dispensing heads each including a local control system, wherein the plurality of dispensing heads contact the continuous circuitous track;~~

~~—providing a control system, wherein the plurality of dispensing heads are not connected to the control system with separate wires;~~

~~—providing a bus communication system;~~

~~—rotating the plurality of dispensing heads about the continuously circuitous track independently from each other;~~

~~—at least partially assembling, with the plurality of dispensing heads, an unfinished product;~~

~~—sending, by the local control system of each of the plurality of dispensing heads, and receiving, by the control system, a first communication through the contact; and~~

~~sending, by the control system, and receiving, by the local control system of each of the plurality of dispensing heads, at least one second communication through the contact.~~

1. An assembly machine comprising:
A circuitous track;
a dispensing head configured to at least partially assemble an unfinished product; and
a permanent magnet linear motor system located within the dispensing head and the track, wherein the permanent magnet linear motor system is configured to provide attachment of the dispensing head to the circuitous track and configured to provide motion of the dispensing head along the circuitous track, wherein the dispensing head is attached to the circuitous track by a magnetic attraction between an element of the dispensing head and an element of the circuitous track.
2. The assembly machine of claim 1, wherein the dispensing head includes a first iron core coil unit of the permanent magnet linear motor system and wherein the track includes a plurality of permanent magnets of the permanent magnet linear motor system.
3. The assembly machine of claim 1, further comprising a plurality of dispensing heads, and wherein the permanent magnet linear motor system is programmable to independently drive the plurality of dispensing heads on the track.

4. The assembly machine of claim 1, wherein at least one of bearings and cam rollers are located between the dispensing head and the track to facilitate movement of the dispensing head with respect to the track.
5. The assembly machine of claim 1, wherein the assembly machine is a pick-and-place machine for assembling printed circuit boards, and wherein the dispensing head is a pick-and-place head and includes a pick-and-place nozzle.
6. The assembly machine of claim 1, wherein the continuous circuitous track includes an air distribution system configured to distribute air to the dispensing head while the dispensing head is moving or stationary.
7. The assembly machine of claim 1, wherein the dispensing head includes a moving permanent magnet and wherein the track includes a plurality of stationary iron core coils.
8. The assembly machine of claim 1, wherein the track is configured to provide power to the dispensing head.
9. An assembly method comprising:
 - providing a dispensing head;
 - providing a circuitous track;
 - providing a permanent magnet linear motor system located within the dispensing head and the track;
 - magnetically attaching the dispensing head to the track, wherein the dispensing head is attached to the track by a magnetic attraction between an element of the dispensing head and an element of the track;
 - magnetically moving the dispensing head along the track; and

at least partially assembling, with the dispensing head, an unfinished product.

10. The assembly method of claim 9, wherein the dispensing head includes a first iron core coil unit of the permanent magnet linear motor system and wherein the track includes a plurality of permanent magnets of the permanent magnet linear motor system.
11. The assembly method of claim 9, further comprising providing a plurality of dispensing heads, and further comprising independently driving the plurality of dispensing heads on the track with the permanent magnet linear motor system.
12. The assembly method of claim 9, further comprising facilitating movement of the dispensing head with respect to the track with at least one of bearings and cam rollers that are located between the dispensing head and the track.
13. The assembly method of claim 9, further comprising providing a pick and place machine for assembling printed circuit boards wherein the dispensing head and circuitous track are components of the pick and place machine, and wherein the dispensing head is a pick and place head and includes a pick and place nozzle.
14. The assembly method of claim 9, further comprising distributing air to the dispensing head through the track while the dispensing head is moving or stationary.
15. The assembly method of claim 9, wherein the dispensing head includes a moving permanent magnet and wherein the track includes a plurality of stationary iron core coils.
16. The assembly method of claim 9, further comprising providing power to the dispensing head through the track.