[007] According to a further embodiment, the present invention provides a material handling system that includes a storage and retrieval system for transferring items to a plurality of transfer locations and a separate input/output system for transferring items to and from the transfer locations. Optionally, the storage and retrieval system includes a plurality of storage locations for storing items. The storage and retrieval system may also include a plurality of independently operable displaceable storage and retrieval vehicles operable to retrieve items from the storage locations and convey the items to one or more of the transfer locations. Optionally, the input/output system includes a plurality of picking vehicles for transporting items. The input/output system may also include a picking track for guiding the picking vehicles. Optionally, the track comprises a loop. There may also be an input/output station along the track where an item can be removed from one of the delivery vehicles. Additionally, the picking vehicles may optionally circulate around the loop between the input/output station and the one or more transfer locations. Additionally, optionally the picking vehicles may be configured differently than the optional displaceable storage and retrieval vehicles. The system may control operation of the picking vehicles so that the vehicles are driven along the picking track adjacent one of transfer locations to transfer items between the picking vehicle and the transfer location.

[007a] According to a first aspect, the present invention provides a material handling system, comprising: a storage and retrieval system, comprising: a plurality of storage locations for storing items; a displaceable storage and retrieval device movable horizontally between the plurality of storage locations and operable to retrieve items from the storage locations and move the items to one or more transfer locations; a picking system operable to transport items to and from the one or more transfer locations, wherein the picking system comprises: a plurality of vertically and horizontally displaceable picking

vehicles for transporting items; a picking track for guiding the picking vehicles, wherein the track comprises a vertical loop; an input/output station along the track configured so that an item can be removed from one of the delivery vehicles; wherein the picking track is configured so that the picking vehicles are operable to circulate vertically and horizontally around the vertical loop between the input/output station and one or more of the transfer locations; wherein each vehicle comprises a drive system for driving the vehicle around the picking track and a motor for driving the drive system; wherein the picking system is configured to control operation of the picking vehicles so that the vehicles are driven along the track to an area adjacent one of transfer locations to transfer items between the picking vehicle and the storage and retrieval system at the transfer location; and wherein the picking system is configured to control operation of the picking vehicles so that the picking vehicles are driven from one of the transfer locations to the input/output station to allow removal of items from the picking vehicle.

[007b] According to a second aspect, the present invention provides a material handling system, comprising: a storage and retrieval system, comprising: a plurality of storage locations for storing items; a plurality of independently operable vertically and horizontally displaceable storage and retrieval vehicles operable to retrieve items from the storage locations and convey the items to one or more transfer locations, wherein the storage and retrieval vehicles are displaceable between the plurality of storage locations; an input/output system operable to transfer items to and from the one or more transfer locations, wherein the input/output system comprises: a plurality of picking vehicles for transporting items; a picking track for guiding the picking vehicles, wherein the track comprises a vertical loop; an input/output station along the track configured to facilitate removal of an item from one of the delivery vehicles; wherein the picking vehicles circulate vertically and horizontally around the vertical

loop between the input/output station and the one or more transfer locations; wherein the picking vehicles are configured differently than the displaceable storage and retrieval vehicles.

Brief Description of the Drawings

[008] The foregoing summary and the following detailed description of the preferred embodiments of the present invention will be best understood when read in conjunction with the appended drawings, in which:

[009] Figure 1 is a perspective view of a storing and retrieving apparatus

CLAIMS

1. A material handling system, comprising:
a storage and retrieval system, comprising:
a plurality of storage locations for storing items;
a displaceable storage and retrieval device movable horizontally between the plurality of storage locations and operable to retrieve items from the storage locations and move the items to one or more transfer locations;
a picking system operable to transport items to and from the one or more transfer locations, wherein the picking system comprises:
a plurality of vertically and horizontally displaceable picking vehicles for transporting items;
a picking track for guiding the picking vehicles, wherein the track comprises a vertical loop;
an input/output station along the track configured so that an item can be removed from one of the delivery vehicles;
wherein the picking track is configured so that the picking vehicles are operable to circulate vertically and horizontally around the vertical loop between the input/output station and one or more of the transfer locations;
wherein each vehicle comprises a drive system for driving the vehicle around the picking track and a motor for driving the drive system;
wherein the picking system is configured to control operation of the picking vehicles so that the vehicles are driven along the track to an area adjacent one of transfer locations to transfer items between the picking vehicle and the storage and retrieval system at the transfer location; and
wherein the picking system is configured to control operation of the picking vehicles so that the picking vehicles are driven from one of the transfer locations to the input/output station to allow removal of items from the picking vehicle.

2. The material handling system of claim 1 wherein the displaceable storage and retrieval device is configured differently than the picking vehicles.

3. The material handling system of claim 1 or 2 wherein the displaceable storage and retrieval device comprises a plurality of storage and retrieval vehicles, wherein the storage and retrieval vehicles are of a first type and the picking vehicles are of a second type that is different than the first type.

4. The material handling system of claim 1 wherein the displaceable storage and retrieval device comprises a plurality of storage and retrieval vehicles and the storage and retrieval system comprises a storage and retrieval track that guides

the storage and retrieval vehicles and wherein the storage and retrieval track is separate from the picking track.

5. The system of claim 4 wherein the storage and retrieval track terminates separate from the picking track to prevent storage and retrieval vehicles from entering the picking track.

6. The system of claim 4 comprising a stop that impedes displacement of the storage and retrieval vehicles onto the picking track.

7. The system of claim 6 wherein the stop comprises a wall of the picking track.

8. The system of any of claims 1-7 wherein the storage and retrieval system is configured to impede displacement of the displaceable storage and retrieval device into the picking track.

9. The system of any of claims 1-7 wherein each picking vehicle comprises a substantially horizontal support for supporting items in a generally horizontal orientation.

10. The system of any of claims 1-7 comprising a transfer mechanism for transferring items from the storage and retrieval devices to the transfer locations.

11. The system of claim 10 wherein the transfer mechanism is mounted on one of the picking vehicles.

12. The system of any of claims 1-7 wherein each transfer location comprises two sections, a first section configured to receive items from the displaceable storage and retrieval device and a second section configured to receive items from the picking vehicles.

13. The system of claim 12 wherein each transfer location comprises a conveyor for conveying items between the first section and the second section.

14. The system of any of claims 1-7 wherein the storage and retrieval system is configured so that the displaceable storage and retrieval device is operable to transfer items directly onto one of the picking vehicles.

15. A material handling system, comprising:

a storage and retrieval system, comprising:
a plurality of storage locations for storing items;
a plurality of independently operable vertically and horizontally displaceable storage and retrieval vehicles operable to retrieve items from the storage locations and convey the items to one or more transfer locations, wherein the storage and retrieval vehicles are displaceable between the plurality of storage locations;
an input/output system operable to transfer items to and from the one or more transfer locations, wherein the input/output system comprises:
a plurality of picking vehicles for transporting items;
a picking track for guiding the picking vehicles, wherein the track comprises a vertical loop;
an input/output station along the track configured to facilitate removal of an item from one of the delivery vehicles;
wherein the picking vehicles circulate vertically and horizontally around the vertical loop between the input/output station and the one or more transfer locations;
wherein the picking vehicles are configured differently than the displaceable storage and retrieval vehicles.

16. The material handling system of claim 15 wherein the storage and retrieval system comprises a storage and retrieval track that guides the storage and retrieval vehicles and wherein the storage and retrieval track is separate from the picking track.

17. The system of claim 16 wherein the storage and retrieval track terminates separate from the picking track to prevent storage and retrieval vehicles from entering the picking track.

18. The system of claim 16 comprising a stop that impedes displacement of the storage and retrieval vehicles onto the picking track.

19. The system of claim 18 wherein the stop comprises a wall of the picking track.

20. The system of claim 15 wherein the storage and retrieval system is configured to impede displacement of the storage and retrieval vehicles into the picking track.

21. The system of any of claims 15-20 wherein each picking vehicle comprises a substantially horizontal support for supporting items in a generally horizontal orientation.

22. The system of any of claims 15-20 comprising a transfer mechanism for transferring items from one of the storage and retrieval vehicles to the transfer locations.