in the controlled environment. The reciprocating cam mechanism can be arranged to increase the spacing of the grow towers as they are conveyed through the controlled environment to index the crops growing on the towers. The present disclosure also describes an irrigation system that provides aqueous nutrient solution to the vertical grow towers.

**[0010a]** According to an aspect of the present invention, there is provided a crop production system for controlled environment agriculture, comprising: one or more grow lines, each of the one or more grow lines comprising a grow conveyance mechanism; and a plurality of grow towers, each of the plurality of grow towers vertically attached to, and moveable along, a respective one of the one or more grow lines; wherein each of the one or more of the conveyance mechanisms comprises: a common beam disposed in a track, the track extending in a direction parallel to the grow line; an actuator attached to the common beam, wherein the actuator is operative to move the common beam along the track in a forward stroke and a back stroke; and a plurality of cams pivotally attached at select positions along the common beam, wherein each cam is mounted to limit rotation of the cam during the forward stroke causing the cam to engage and push a first tower forward in a first direction during the forward stroke and to allow the cam to slide over a second tower during the back stroke; wherein the select positions of the plurality of cams are each configured such that in a forward stroke a respective cam engages a first grow tower during the forward stroke and ratchets over a second grow tower adjacent to the first tower during the back stroke.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0011]** Figure 1 is a functional block diagram illustrating an example controlled environment agriculture system.

**[0012]** Figure 2 is a perspective view of an example controlled environment agriculture system.

**[0013]** Figures 3 A and 3B are perspective views of an example grow tower.

**[0014]** Figure 4A is a top view of an example grow tower; Figure 4B is a perspective, top view of an example grow tower; Figure 4C is an elevation view of a section of an example grow tower; and Figure 4D is a sectional, elevation view of a portion of an example grow tower.

**[0015]** Figure 5A is a perspective view of a portion of an example grow line.

**[0016]** Figure 5B is a perspective view of an example tower hook.

**[0017]** Figure 6 is an exploded, perspective view of a portion of an example grow line and reciprocating cam mechanism.

**[0018]** Figure 7A is a sequence diagram illustrating operation of an example reciprocating cam mechanism.

**[0019]** Figure 7B illustrates an alternative cam channel including an expansion joint.

**[0020]** Figure 8 is a profile view of an example grow line and irrigation supply line.

**[0021]** Figure 9 is a side view of an example tower hook and integrated funnel structure.

**[0022]** Figure 10 is a profile view of an example grow line.

CLAIMS

What is claimed is:

1. A crop production system for controlled environment agriculture, comprising:

one or more grow lines, each of the one or more grow lines comprising a grow conveyance mechanism; and

a plurality of grow towers, each of the plurality of grow towers vertically attached to, and moveable along, a respective one of the one or more grow lines;

wherein each of the one or more of the conveyance mechanisms comprises:

a common beam disposed in a track, the track extending in a direction parallel to the grow line;

an actuator attached to the common beam, wherein the actuator is operative to move the common beam along the track in a forward stroke and a back stroke; and

a plurality of cams pivotally attached at select positions along the common beam, wherein each cam is mounted to limit rotation of the cam during the forward stroke causing the cam to engage and push a first tower forward in a first direction during the forward stroke and to allow the cam to slide over a second tower during the back stroke;

wherein the select positions of the plurality of cams are each configured such that in a forward stroke a respective cam engages a first grow tower during the forward stroke and ratchets over a second grow tower adjacent to the first tower during the back stroke.

2. The crop production system of claim 1 wherein the spacing of the select positions increases in the first direction such that spacing of the grow towers increases as such grow towers are pushed along the one or more grow lines with successive cycles of the actuator.

3. The crop production system of claim 1 wherein the common beam has a u-shaped profile having first and second walls extending from a base, and wherein the plurality of cams are each mounted at the select positions along the first and second walls.

4. The crop production system of claim 1 wherein each of the plurality of grow towers comprises a hook attached to the top of the grow tower, wherein the hook is configured to engage the grow line.

5. The crop production system of claim 4 wherein each of the one or more grow lines includes a groove region to which the hook of a grow tower slidably attaches.

6. The crop production system of claim 1 wherein each of the plurality of grow towers comprises a first plurality of plug containers arranged along a first face of the grow tower.

7. The crop production system of claim 6 wherein each of the plurality of grow towers comprises a second plurality of plug containers arranged along a second face of the grow tower, wherein the second face is opposite to the first face.

8. The crop production system of claim 1 further comprising an onloading mechanism comprising a powered and free conveyer and one or more carriages; wherein the one or more carriages are configured to releasably engage grow towers; and wherein the powered and free conveyer is configured to insert a grow towers on a selected grow line of the one or more grow lines.

9. The crop production system of claim 2 wherein the common beam comprises a first beam section, a second beam section, and an expansion joint attached to opposing ends of the first and second beam sections, wherein the expansion joint is movable from a collapsed position to an open position and configured such that, during the forward stroke, the expansion joint moves from the collapsed position to the open position thereby causing the first beam section to move forward while the second beam section remains stationary until the expansion joint is in the open position and, during the back stroke, the expansion joint moves from the open position to the collapsed position.