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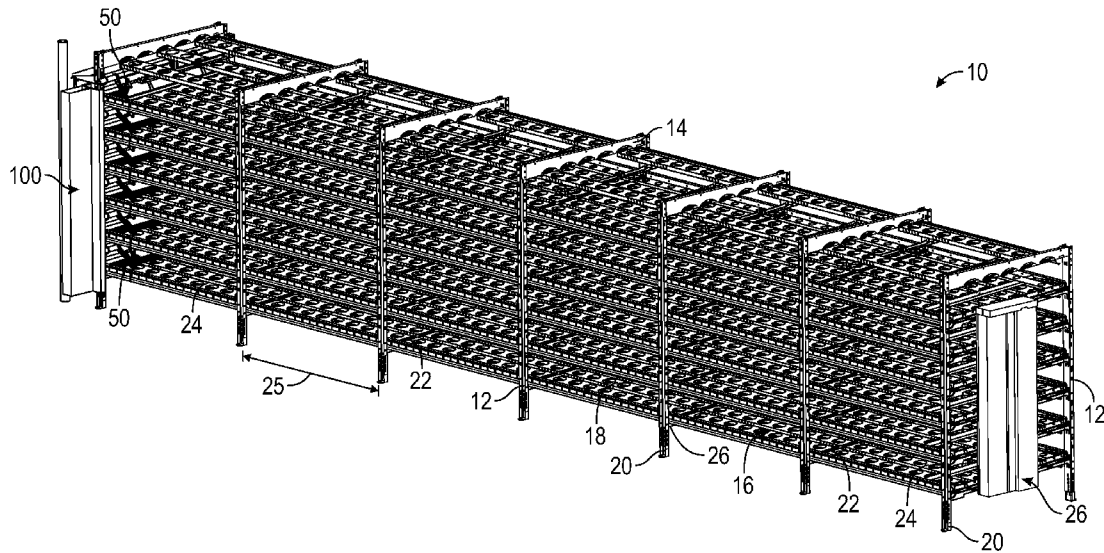


FIG. 1

(57) Abstract: A controller for a hydroponic growing apparatus, system, and method is provided. The controller includes a programmable logic controller housed within a control housing and a graphical user interface operable by the programmable logic controller and disposed on the control housing. A home screen has one or more status indicators for each seed bed on the plurality of levels. A seeding screen has one or more seeding controls for actuating a seeder for depositing seed on each seed bed on the plurality of levels. A harvesting screen has one or more harvesting controls for autonomously controlling seed growth harvesting from each seed bed on the plurality of levels.



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TITLE: CONTROLLER FOR A HYDROPONIC GROWER**PRIORITY STATEMENT**

This application claims priority to U.S. Provisional Patent Application No. 5 62/807,633, filed on February 19, 2019, titled CONTROLLER FOR A HYDROPONIC GROWER all of which is hereby incorporated by reference in its entirety.

BACKGROUND**I. Field of the Disclosure**

10 The present disclosure relates to a controller for a hydroponic grower. More specifically, but not exclusively, the present disclosure relates to a controller for a hydroponic growing apparatus, system, and method.

II. Description of the Art

15 Hydroponic seed growing is of increasing interest for many reasons. The increasing cost for raising seed have become, in some instances, cost prohibitive. Alternative measures for raising seed are quickly becoming of paramount concern. Scarcity of the inputs and costs of those and other inputs for growing seed also contribute to the increase in interest in hydroponically growing seed. Other concerns include labor costs, availability of laborers, consistency of grown product, shrinking availability of and increases in cost of farmland, 20 reduction to carbon footprint, availability of food in highly populated areas, and public interest in whole-sourced foods. Still, existing hydroponic systems do not solve the present concerns and the need for a cost-effective solution for growing seed hydroponically.

SUMMARY OF THE DISCLOSURE

25 Therefore, it is an object, feature, or advantage of the present disclosure to provide a controller for a hydroponic growing apparatus, system, and method that addresses the deficiencies in existing hydroponic and non-hydroponic processes for growing seed.

Often, hydroponic control systems are developed and sold without the volume of seed production and return on investment being an integral factor. In other words, existing 30 control systems are not easily tailorable to fit the size of a herd.

Therefore, another object, feature, or advantage of the present disclosure is to provide a controller for a hydroponic growing apparatus, system, and method that is completely

tailorable to fit the specific volume of seed production desired and meets the return on investment criteria considered when weighing other hydroponic and non-hydroponic seed growing options.

A significant factor in growing seed are the cost of the inputs. Water availability and cost is of increasing significance. Water and/or liquid conservation for both hydroponic and non-hydroponic seed growth is of paramount concern. Other inputs of significant, and certainly relevant consideration include the cost of seed and preservation of seed in the process of hydroponically growing seed. Still other inputs or concerns include the operational footprint or floor space needed, the electricity required, and the ability to tailor the input and output according to need and the costs, abundance/non-abundance of the relevant inputs into the process for controlling growing seed hydroponically at comparatively low operating costs providing healthy seed growth or live green feed 365 days of the year.

Therefore, another object, feature, or advantage of the present disclosure is to provide a controller for a hydroponic growing apparatus, system, and method that maximizes the return on investment for the inputs needed for controlling hydroponically growing seed by providing a control solution that addresses each concern and other factors or concerns relevant to the process of growing seed hydroponically.

A still further object, feature, or advantage of the present disclosure is to provide a controller for a hydroponic growing apparatus, system, and method designed as modulated systems for meeting the variation in the needs of hydroponic seed growers while providing cost effective solutions for controlling pre and post-handling seed, growing seed and managing other inputs used in the process.

Yet another object, feature, or advantage of the present disclosure is to provide a controller for a hydroponic grower for small seeds or grains such as barley and wheat that can be harvested autonomously or nearly autonomously in 3-7 days, or shorter or longer depending on the type of seed or grain being sprouted or use of the finished product.

Still another object, feature, or advantage of the present disclosure is to provide a fully automated controller that with the push of a harvest button the system harvests, cleans, seeds, and re-grows seed again.

One or more of these and/or other objects, features or advantages of the present disclosure will become apparent from the specification and claims that follow.

SUMMARY OF THE DISCLOSURE

The present disclosure provides a controller for a hydroponic grower. The controller for a hydroponic grower is a controller for a seed growing system, apparatus,
5 and method.

The controller for a hydroponic system can be a controller for a seed growing system that includes, for example, a control system for a hydroponic seed grower having a plurality of levels each with a seed bed for hydroponically growing seed. The controller includes a programmable logic controller housed within a control housing and a graphical user interface
10 operable by the programmable logic controller and disposed on the control housing. A home screen is displayed by the graphical user interface and includes one or more status indicators for each seed bed on the plurality of levels. A seeding screen is accessible from the home screen and displayed by the graphical user interface. The seeding screen has one or more seeding controls for actuating a seeder for depositing seed on each seed bed on the plurality
15 of levels. A harvesting screen is also accessible from the home screen and displayed by the graphical user interface. The harvesting screen has one or more harvesting controls for controlling seed growth harvesting from each seed bed on the plurality of levels.

The controller for a hydroponic system can be a controller for a seed growing apparatus that includes, for example, a controller for a hydroponic seed grower having a
20 plurality of levels each with a seed bed for hydroponically growing seed. The controller includes a housing configured for operable attachment to the hydroponic seed grower and a display carried by the housing. The display has a graphical user interface for controlling the hydroponic seed grower. At least one programmable logic controller is housed within the housing for controlling the display, the graphical user interface and the hydroponic seed
25 grower. A main menu is displayed by the graphical user interface. At least one status indicator regarding seed growth from each seed bed on the plurality of levels is displayed by the graphical user interface. At least one or more seed harvesting controls is displayed by the graphical user interface for controlling seed growth harvesting from each seed bed on the plurality of levels.

The controller for a hydroponic system can be a method for controlling
30 hydroponically growing seed, such as for example, a method for controlling hydroponically growing a variety of seed. The method can include controlling a hydroponic seed grower

having a plurality of levels each with a seed bed for hydroponically growing seed. The method includes providing a control housing configured for operable attachment to the hydroponic seed grower. A graphical user interface with a display is carried by the control housing. Operator input is received at the graphical user interface for controlling seed growth on and harvesting from each seed bed on the plurality of levels of the hydroponic seed grower. The hydroponic seed grower is controlled with at least one programmable logic controller housed within the control housing for processing operator input and outputting one or more control signals to one or more actuators of the hydroponic seed grower.

10

BRIEF DESCRIPTION OF THE DRAWINGS

Illustrated aspects of the present disclosure are described in detail below with reference to the attached drawing figures, which are incorporated by reference herein, and where:

15 Fig. 1 is a side perspective view of a hydroponic grower and controller for a hydroponic grower in accordance with an illustrative aspect of the disclosure;

Fig. 2 is an opposite side perspective view of the hydroponic grower;

Fig. 3 is an end view of the hydroponic grower;

Fig. 4 is an opposite end view of the hydroponic grower;

20 Fig. 5 is a top perspective view of the seed belt in an unloaded position in accordance with an illustrative aspect of the disclosure;

Fig. 6 is a top perspective view of the seed belt in an offloaded position in accordance with an illustrative aspect of the disclosure;

25 Fig. 7 is a perspective view of a seed belt return system of the hydroponic grower in accordance with an illustrative aspect of the disclosure;

Fig. 8 is a top view of the seed belt return system;

Fig. 9 is an end view of the seed belt return system;

Fig. 10 is a perspective view of a seed belt drive system of the hydroponic grower in accordance with an illustrative aspect of the disclosure;

30 Fig. 11 is a perspective view of the seed belt drive system illustrating a single seed belt drive mechanism with an engaged clutch;

Fig. 12 is another perspective view of the seed belt drive system illustrating the single seed belt drive mechanism with a disengaged clutch;

Fig. 13 is a top view of a cutter of the hydroponic grower in accordance with an illustrative aspect of the disclosure;

5 Fig. 14 is a bottom view of the cutter;

Fig. 15 is a perspective view of a seed dispenser system of the hydroponic grower in accordance with an illustrative aspect of the disclosure;

Fig. 16 is a perspective view of the seed dispenser system illustrating a single seed dispenser mechanism thereof;

10 Fig. 17 is a perspective view of the seed dispenser system illustrating a single seed mechanism and seed staging column thereof;

Fig. 18 is a perspective view of a seed cleaner of the hydroponic grower in accordance with an illustrative aspect of the disclosure;

15 Figs. 19 is a side perspective view of a portion of the hydroponic grower illustrating a lighting system thereof;

Fig. 20 is a side perspective view of a portion of the hydroponic grower illustrating an irrigation system thereof;

Fig. 21 is a side perspective view of a portion of the hydroponic grower illustrating another irrigation system thereof;

20 Fig. 22 is an end perspective view of a portion of the hydroponic grower further illustrating the irrigation system shown in Fig. 21;

Fig. 23 is a side perspective view of a portion of the hydroponic grower illustrating another irrigation system thereof;

25 Fig. 24 is a schematic illustration of liquid applications, handling, collection and recycling for the hydroponic grower in accordance with an illustrative aspect of the disclosure;

Fig. 25 is a schematic illustration of a controller, drive mechanisms and power applications system for the hydroponic grower in accordance with an illustrative aspect of the disclosure;

30 Fig. 26 is a schematic illustration of seed and grown plant handling and growth systems for the hydroponic grower in accordance with an illustrative aspect of the disclosure;

Fig. 27 is a pictorial representation of a home screen in accordance with an illustrative aspect of the disclosure;

Fig. 28 is a pictorial representation of a harvesting operation screen in accordance with an illustrative aspect of the disclosure;

5 Fig. 29 is a pictorial representation of an irrigation screen in accordance with an illustrative aspect of the disclosure;

Fig. 30 is a pictorial representation of an irrigation schedule screen in accordance with an illustrative aspect of the disclosure;

10 Fig. 31 is a pictorial representation of an all level screen in accordance with an illustrative aspect of the disclosure;

Fig. 32 is a pictorial representation of a level 1 screen in accordance with an illustrative aspect of the disclosure

Fig. 33 is a pictorial representation of an input value window in accordance with an illustrative aspect of the disclosure;

15 Fig. 34 is a pictorial representation of an advanced irrigation schedule window in accordance with an illustrative aspect of the disclosure;

Fig. 35 is a pictorial representation of a general settings screen in accordance with an illustrative aspect of the disclosure;

20 Fig. 36 is a pictorial representation of a duty cycle settings screen in accordance with an illustrative aspect of the disclosure;

Fig. 37 is a pictorial representation of an advanced settings screen in accordance with an illustrative aspect of the disclosure;

Fig. 38 is a pictorial representation of an input password window in accordance with an illustrative aspect of the disclosure;

25 Fig. 39 is a pictorial representation of a maintenance mode screen in accordance with an illustrative aspect of the disclosure;

Fig. 40 is a pictorial representation of a toggle switch screen in accordance with an illustrative aspect of the disclosure;

30 Fig. 41 is a pictorial representation of a level 1 screen in accordance with an illustrative aspect of the disclosure; and

Fig. 42 is a pictorial representation of a controller hardware in accordance with an illustrative aspect of the disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

The present disclosure, for example, provides a hydroponic growing apparatus, system, and method. In general, a hydroponic growing apparatus, system, and method can be operated, configured and scaled according to need and/or change in need, according to the type and/or cost of the inputs and/or change in the type and/or cost of the inputs, according to the available footprint and/or change in the available footprint for housing a hydroponic grower, according to the size and/or changes in size of a herd, according to the number of available laborers and/or change in number of available laborers, according to the climate and/or change in the climate, according to the grower's allocatable resources and/or change in the grower's allocatable resources. What follows are exemplary aspects and descriptions for one or more of a hydroponic growing apparatus, system, and method of the present disclosure.

15 *I. Hydroponic Grower*

Figures 1-42 illustrate a hydroponic grower 10 and a controller 140 for the hydroponic grower 10 in accordance with an illustrative aspect. The grower 10 shown in the various views includes a plurality of vertical members 12 and a plurality of horizontal members 14 removably interconnected to form an upstanding seed growing table 16 with one or more seed beds 18. Each vertical member 12 can be configured to terminate at the bottom in an adjustable height foot 20. Controller 140 can be operably attached to vertical member 12. Each foot 20 can be adjusted to change the relative vertical position or height of one vertical member 12 relative to another vertical number 12 of the seed growing table 16. The horizontal member 14 can be configured to include one or more lateral members 22 removably interconnected with one or more longitudinal members 24. Controller 140 can be operably attached to horizontal member 14. A pair of vertical members 12 are separated laterally by a lateral member 22 thereby defining the width or depth of the seed growing table 16. In at least one aspect of the grower 10, the lateral member 22 can be configured so that the width/depth of the seed growing table 16 can range from two feet up to eight feet, and wider for specific applications. In one aspect, the growing table 16 is six feet wide. Other configurations of the grower 10 contemplate widths/depths in excess of 6-8 feet, based, for example, on the desired seed output and footprint for a structure housing the

grower 10. In the case where narrower widths/depths are needed, the lateral member 22 can be configured so that the width/depth of the seed growing table 16 is less than six feet, and even less than two feet for specific applications. Members 12, 14, 22 and 24, including other members forming grower 10 can be comprised of stainless steel, mild steel (powder coated), mild steel (galvanized), galvanized steel, galvanized steel and like metal/metal-alloy compositions, but are not limited to those expressly provided herein. Members of grower 10 can comprise a baked-on powder coat paint, liquid-coated painting, hot galvanized finish and/or stainless-steel finish. All contemplated parts can be laser cut to exact CAD drawing specifications, bent to appropriate shape, and in the case of the mild steel, for example, can be either powder coated or galvanized, or painted. Thus, grower 10 is low maintenance and capable of long-term use within a variety of environments, including corrosive ones. Also, and ideally, each lateral member 22 is removably interconnected to vertical members 12 by connector 26, such as a tongue and groove connection, to allow for quick assembly, disassembly, and reassembly of the grower 10. Although a tongue and groove connection is specified, the present disclosure contemplates other connectors, fittings, and attachment means for interconnecting components, subcomponents and assemblies of the present disclosure. For example, a slot and/or bolt configuration can be used to removably secure components of grower 10 together. Horizontal members 14 can include lateral members 22 and longitudinal members 24. As set forth herein, lateral members 22 are also described as transverse members. Longitudinal members 24 are removably interconnected with lateral members 22 by one or more connectors 26. Ideally, lateral members 22 are removably interconnected to longitudinal members 24 by a tongue and groove connection to allow for quick assembly, disassembly, and reassembly of the grower 10. Although a tongue and groove connection 26 is specified, the present disclosure contemplates other connectors, fittings, and securement means for interconnecting components, subcomponents and assemblies of the present disclosure. Longitudinal members 24 are spaced, generally equally, laterally across the depth/width of the seed growing table 16. In accordance with at least one aspect, longitudinal members 24 are spaced up to six inches apart or less to best carry the weight of each seed bed 18. Other spacing distances for longitudinal members 24 are contemplated. For example, longitudinal members 24 can be spaced closer together such as three inches apart or farther apart such as eight inches apart or greater. The spacing of longitudinal members 24 provides a subfloor for supporting seed bed 18.

The length of vertical member 12 generally determines the height of the seed growing table 16. By adjusting the height of vertical member 12 can adjust a height of seed growing table 16. The height of the seed growing table 16 can be configured, for example, according to the desired seed output and available footprint of the structure for housing the grower 10.

5 The seed growing table 16, constructed vertically, can be configured with one or more seed beds 18. In at least one configuration, seed growing table 16 can be configured with 1-6 seed beds 18. In another configuration, seed growing table 16 can be configured with 1-7 seed beds 18. In another configuration, seed growing table 16 can be configured with more than 6 seed beds 18. The number of seed beds 18 can be increased or decreased according

10 to need and available footprint of the structure for housing the grower 10. In some instances, seed growing table 16 can be configured with more than seven, more than eight, or even more than nine seed beds 18, or even more than twelve seed beds 18. Seed can be grown hydroponically to full growth in roughly 5-7 days depending upon elevation, added nutrients, irrigation, lighting, etc. The number of seed beds 18 can be configured based on the time

15 seed needs to grow a plant to maturity. For example, a grower 10 can be configured with 6 seed beds 18 if seed growth occurs over a 6-day period, so that grown plants can be harvested from one seed bed 18 for each day of 6-day feeding cycle. Grower 10 can be configured with 7 seed beds 18 for a 7-day feeding cycle, by harvesting one bed 18 each day. If more mature plants are needed, an operator can increase the growing time of each bed 18. For example,

20 a 6-day growing period for each seed bed 18 produces grown plants suitable for feeding all types of midsize to large animals, such as cows, horses, large swine, sheep, goat, etc. Similarly, a 3-day growing period for each seed bed 18 produces grown plants suitable for feeding small to midsize animals, such as poultry and swine. The spacing between seed beds 18 can also determine the number of seed beds 18 of seed growing table 16, in the case where

25 vertical space is limited. For example, increasing the spacing between seed beds 18 can decrease the number of seed beds 18 of seed growing table 16, when vertical spacing is limited. Alternatively, decreasing the spacing between seed beds 18 can increase the number of seed beds 18 of seed growing table 16, when vertical spacing is limited.

The length of seed growing table 16 is determined generally by the length of

30 horizontal member 14. A pair of vertical members 12 our removably interconnected by one or more horizontal members 14 to form a span of seed growing table 16. Like planks, horizontal members 14 are configured generally to form a subfloor for seed bed 18. The

length of seed bed 18 is determined generally by the length of horizontal members 14. In at least one configuration, horizontal members 14 are eight feet in length. The growing table 16 can be configured from one or more 8-foot sections 25. The sections 25 can vary in length from eight or more feet in length or eight or less feet in length. In one aspect, each section is eight feet in length. For example, the growing table 16 can be configured from one 8-foot section, two 8-foot sections, three 8-foot sections, four 8-foot sections, five 8-foot sections, six 8-foot sections, or more. This means, seed grow table 16 can be configured to have an 8-foot, 16-foot, 24-foot, 32-foot, 40-foot, 48-foot, or more overall length. Other lengths, of course, are contemplated according to the desired grown plant output and available footprint of the structure housing grower 10.

The dimensions of seed growing table 16 are configurable according to need, desired grown plant output, available footprint of the structure housing grower 10, etc. Each of the components of seed growing table 16 are configured so that the seed growing table 16 can be modulated and thereby provide a scalable grower 10. For example, length of seed bed 18 can be configurable according to need, desired grown plant output, available footprint of the structure housing grower 10, etc. In at least one configuration, length of each section 25 of the seed bed 18 can be scalable in length from 8-foot to 16-foot, 16-foot to 24-foot, 24-foot to 32-foot, 32-foot to 40-foot, 40-foot to 48-foot, and so forth, by increasing the number of 8-foot sections 25. Alternatively, length of seed bed 18 can be configurable according to need, desired grown plant output, available footprint of the structure housing grower 10, by altering length of seed bed 18 which can be scalable in length from 48-foot to 40-foot, 40-foot to 32-foot, 32-foot to 24-foot, 24-foot to 16-foot, 16-foot to 8-foot, and so forth, by decreasing the number of 8-foot sections 25. Although dimensions are provided here, the present disclosure contemplates other increments in scalability of grower 10. The type of connectors 26 allow quick assembly, disassembly, and reassembly of grower 10. Moreover, connectors 26 and the overall design of grower 10 allow quick expansion or reduction of the size/scale of grower 10 to fit need, desired grown plant output, available footprint of the structure housing grower 10, and other consideration criteria set forth herein. By way of example, grower 10 can be configured as an 8-foot seed growing table 16 and because the design is highly scalable can be quickly converted into a larger seed growing table 16, such as a sixteen, twenty-four, thirty-two, forty-eight foot, or larger seed growing table 16. Similarly, a larger seed growing table 16 can be quickly reconfigured as a smaller seed

growing table 16 to accommodate the decrease in need, desired seed growth output, or change in available footprint of the structure housing grower 10 or change in other consideration criteria set forth herein. When assembled, a need can arise to change or level seed growing table 16. Feet 20 are adjustable to adjust the level of each seed growing table
5 16.

II. Seed Bed, Seed Belt & Drive Mechanism

Each seed bed 18 includes a seed belt 28, such as a seed film, operably supported by seed growing table 16. Seed belt 28 can be configured according to the width/depth of seed
10 growing table 16. By way of example, the width/depth of seed belt 28 can be altered according to changes in the width/depth of seed growing table 16. The seed belt 28, such as a seed film, can be configured of vinyl, polycarbonate, rubber, nitrile rubber, polyvinyl chloride, or other like materials. The seed belt 28 material can be a film material constructed of a polycarbonate or polypropylene material, such as the material used for a poultry manure
15 belt. The seed belt 28 material can be hydrophobic, semi-hydrophobic or permeable to liquid. In at least one aspect, a hydrophobic material they be employed to keep liquid atop the seed belt 28. In another aspect, a permeable or semi-permeable material can be employed to allow liquid to pass through the seed belt 28. Advantages and disadvantages of both are discussed herein. In one aspect, seed belt 28 is discontinuous and has separate or separated
20 terminal ends 32A and 32B. The seed belt 28 has a length of at least the length of the seed bed 18 and generally a width of the seed bed 18 and is configured to provide a seed bed for carrying seed. The seed belt 28 is configured to move across the seed bed 18. Seed belt 28 rests upon and slides on top of horizontal members 14. One or more skids or skid plates (not shown) may be disposed between seed belt 28 and horizontal members 14 to allow seed belt
25 28 to slide atop horizontal members 14 without binding up or getting stuck. Additionally, one or more lubricants can be applied to horizontal members 14 before installation of seed belt 28 or when seed belt 28 is wound upon roller 30.

To provide movement of the seed belt 28, terminal end 32A of seed belt 28 is operably attached to a roller 30. The roller 30 is configured at the end of the seed bed 18
30 across the width between a pair of vertical members 12. The seed belt 28 is wound onto roller 30 during movement of the seed belt 28 in a first direction. Terminal end 32B of the seed belt 28 is configured with a linkage 34. The linkage 34 is preferably secured across the

width of terminal end 32B of the seed belt. The seed belt 28 is unwound off roller 30 by drawing terminal end 32B of seed belt 28 in a second direction opposite the first direction. In this manner, terminal end 32B moves across the length of seed bed 18 in first and second opposite directions for purposes discussed herein. Although the present disclosure contemplates a seed belt 28 configured as a noncontinuous belt with separate distinct (e.g., terminal) ends, in at least aspect of the disclosure seed belt 28 can be configured as a discontinuous belt with terminal ends 32A and 32B separated from each other and interconnected by linkage 34. Linkage 34 can be a cable, wire, rope, bracket or other like linkage member. One or more linkages 34 can be interconnected between terminal ends 32 of seed belt 28. Together, seed belt 28 and linkage(s) 34 can comprise a continuous belt. Thus, seed belt 28 includes a mat portion 36 and a linkage portion 34. Seed belt 28 is supported by seed bed 18. The mat portion 36 of seed belt 28 and one or more linkages 34 can be operably supported by seed bed 18. Mat portion 36 of seed belt 28 is wound upon roller. In one aspect, roller 30 can be configured as a belt roller. In one aspect, roller 30 is adjustable in position along the end of the seed bed 18 to provide better tracking of the belt 28 when winding upon and unwinding from roller 30. Although the disclosure describes a belt roller, other roller types configured to support rotation, alignment and tracking of seed belt 28 when moving are contemplated. Terminal end 32B of seed belt 28 can be configured with a push bar 35 operably attached to move with terminal end 32B when seed belt is wound upon roller 30. Push bar 35 is disposed across the width of the seed belt 28 and assists in supporting movement of seed growth toward roller 30 and stabilizing terminal end 32B of seed belt 28 during movement in the first and second direction.

Rotation of the roller 30 and movement of the seed belt in the first direction can be achieved using a drive mechanism 37A operably connected or configured to rotate the roller 30. Movement of both linkage 34 and push bar 35 attached to terminal end 32B of seed belt 28 along with terminal end 32B of seed belt 28 in the second direction can be achieved using a drive mechanism 37B operably connected or configured to rotate a reel 31. A cable 33 of belt return 26 is wound on reel 31 for moving the seed belt 28 in the second direction. Cable 33 is operably attached to linkage 34 and reel 31 for moving seed belt 28 in the second direction under operation of drive mechanism 37B. The drive mechanisms 37A and 37B can be a motor, powered electrically, pneumatically, hydraulically, or even manually. In one aspect, the drive mechanism 37A and 37B is an electrical motor powered by an electrical

source remote from or associated with the seed growing table 16. The electrical motor can be a high torque motor, such as an intermittent duty 12 VDC, 10+ amp motor. For example, drive mechanism 37A can be electrically connected to an independent power source and a 16V motor used instead of a 12V motor for moving the heavier load on the seed belt 28 during harvesting. The electrical motor can be controlled by controller 140. A clutch 29A can be configured between the drive mechanism 37A and roller 30 for managing torque at roller 30. A clutch 29B can also be configured between drive mechanism 37B and reel 31 for managing torque at reel 31. Clutches 29A and 29B can be powered electrically, pneumatically, hydraulically, or even manually. In one aspect, clutches 29A and 29B are pneumatically driven by pneumatic sources 74A and 74B for engaging and disengaging opposing clutch plates 27A and 27AA as well as clutch plates 27B and 27BB. The clutch plates of each clutch can have planar, undulated or cogged surface profiles. Power for operating the drive mechanism 37A, drive mechanism 37B and clutches 29A and 29B (e.g., pneumatic sources 74A and 74B) can be from any number of power sources. For example, seed growing table 16 can be operably configured with a power source that is an alternating current (AC) current source or a direct current (DC) source, such as an electrochemical source or power storage device 138. Other power sources are contemplated, including but not limited to, solar power, grid power, self-generated power or manual operation. In one aspect, alternating current is converted to direct current power using a power converter 136. Direct power from power converter 136 is used to power the grower and the electrical systems operating the grower. Using direct power to run grower 10 has several benefits that include, for example, minimizing/eliminating the chance for fatal electrical shock to an operator or maintenance personal. Additionally, one or more electrochemical cells or power storage devices 138, such as batteries, can be charged with alternating current power and discharged to provide power to grower 10 during a power outage. In one aspect, grower 10 can operate for 12 to 16 hours, or more without power or during a power outage.

When the seed belt 28 is moved in the first direction, the clutch 29A operably attached between roller 30 and drive mechanism 37A is engaged (i.e., clutch plates 27A and 27AA are clamped together, see Fig. 11), the clutch 29B operably attached between drive mechanism 37B and reel 31 is disengaged (i.e., clutch plates 27B and 27BB are unclamped from each other, see Fig. 8), the seed belt 28 is wound on roller 30 by actuation of drive mechanism 37A, and cable 33 of connector 26 is unwound from reel 31. Conversely, when

the seed belt 28 is moved in the second direction, the clutch 29A operably attached between roller 30 and drive mechanism 37A is disengaged (i.e., clutch plates 27A and 27AA are unclamped from each other, see Fig. 12), the clutch 29B operably attached between drive mechanism 37B and reel 31 is engaged (i.e., clutch plates 27B and 27BB are clamped together, see Fig. 9), seed belt 28 is unwound from roller 30, and cable 33 of connector 26 is wound on reel 31 by actuation of drive mechanism 37B. Seed belt 28 moves between offloading and onloading positions and continuous positions therebetween by operating drive mechanisms 37A or 37B. The seed belt 28 is in an “onloaded position” when the seed belt 28 is atop the seed bed 18 and terminal end 32B is proximate reel 31 (see, for example, Fig. 5). Conversely, seed belt 28 is in an “offloaded position” when terminal end 32B is proximate roller 30 and seed belt 28 is wound on roller 30 (see, for example, Fig. 6). One or more limit switches can be disposed proximate opposite ends of the seed bed 18. The limit switches can be operably mounted to monitor movement of the seed belt 28. Limit switches can be tripped by one or more switch members 45 operably attached to linkage 34 or push bar 35 on terminal end 32B of seed belt 28. In one aspect, the limit switches can monitor the location of terminal end 32B relative to roller 30 and reel 31. For example, drive mechanism 37A can be turned off and/or clutch 29A disengaged to stop movement of seed belt 28 when terminal end 32B is proximate roller 30. Conversely, drive mechanism 37B of belt return 26 can be turned off and/or clutch 29B disengaged to stop movement of seed belt 28 when the terminal end 32B is proximate reel 31. Before moving seed belt 28, controller 140 can activate drive mechanism 37A and/or drive mechanism 37B to remove tension off of seed belt 28 to allow clutch 29A and/or clutch 29B to engage or disengage with respective drive mechanism 37A or 37B. Each clutch 29A and 29B can include one or more sensors to verify clutch position to prevent drive mechanism 37A from moving seed bed 28 before disengaging clutch 29B from drive mechanism 37B or to prevent drive mechanism 37B from moving seed bed 28 before disengaging clutch 29A from drive mechanism 37A. The process of monitoring and controlling movement of seed belt 28, monitoring and controlling drive mechanisms 37A-B, monitoring and controlling clutches 29A-B can be automated by controller 140, graphical user interface, and/or remote control.

30

III. Liquids Application for Seed

Each seed bed 18 includes a liquid applicator 38A, 38B and 38C operably configured atop each seed bed 18 for irrigating seed disposed atop each seed belt 28. Liquid applicator 38A is configured adjacent at least one longitudinal edge of seed belt 28. Liquid applicator 38A can also be operably configured adjacent at least one lateral edge of seed belt 28.

5 Preferably, liquid applicator 38A is configured adjacent a longitudinal edge of seed belt 28 to thereby provide drip-flood irrigation to seed belt 28 and seed disposed atop seed belt 28. Liquid applicator 38A includes a liquid guide 39 and liquid distributor 40A with a liquid egress 42 having a generally undulated profile, such as a sawtooth or wavy profile generally providing peak (higher elevated) and valley (lower elevated) portions. Liquid applicator

10 38A can include a liquid line 41A configured to carry liquid from a liquid source 43, such as a liquid collector 46 or plumbed liquid source 43. Liquid exits liquid line 41A through one or more openings and is captured upon exiting liquid line 41A by liquid guide 39 and liquid distributor 40A. The one or more openings in liquid line 41A can be configured as liquid drippers, intermittently dripping a known or quantifiable amount of liquid over a set

15 timeframe into liquid guide 39. The one or more openings be configured intermittently along a length of liquid line 41A or dispersed in groupings along a length of liquid line 41A. The one or more openings in liquid line 41A can be operably configured to equally distribute the water down the seed bed 18 and slowly drip liquid onto each seed bed 18. It is important to keep seed saturated during early stages of hydroponic growth. Drip irrigating the seed belt

20 for providing a layer of water 47 for saturating seed is achieved by operating liquid applicator 38A. Liquid applicator 38A can be operated manually or automatically using one or more controllers operated by controller 140. The process of irrigating seed with liquid applicator 38A by controlling the on and off position of one or more liquid valves can be automated by controller 140, graphical user interface, and/or remote control.

25 Drip or flood irrigation can provide liquid to seed on seed bed 18 in a controlled, even distributive flow. Liquid distributor 40A can be configured with a liquid guide 39 (e.g., a hood portion) adapted to collect liquid as it exits liquid line 41A. Collected liquid is evenly distributed by liquid distributor 40A and exits liquid distributor 40A onto seed belt 28 via liquid egress 42. According to at least one aspect, liquid egresses onto seed belt 28 through

30 valley (lower elevated) portions of liquid egress 42. In this manner, egressing liquid is evenly distributed across seed belt 28. A liquid applicator 38A is generally configured to irrigate seed belt 28 from a longitudinal edge of seed belt 28. Liquid applicator 38A can be

operably configured along a longitudinal edge of seed belt 28 at an elevation generally above the elevation of the seed belt 28. In one aspect, liquid distributor 40A can be operably configured to extend inward from the longitudinal edge of seed belt 28 to thereby position liquid egress 42 a further distance away from the longitudinal edge of seed belt 28 in a direction toward the center of seed belt 28. In another aspect, liquid distributor 40A can be configured having a downward profile to encourage movement of liquid toward liquid egress 42. According to at least one design, liquid egressing from liquid distributor 40A travels atop seed belt 28 beneath and/or between a seed mass atop seed belt 28. Other configurations of liquid applicator 38 are also contemplated herein. For example, in one design, liquid enters liquid applicator 38 through a liquid line 41A and exits liquid line 41A through a plurality of openings. Liquid from liquid line 41A coalesces into a small reservoir creating a balanced distribution of liquid across a length of liquid distributor 40A. When this small reservoir becomes full the liquid runs over and out of liquid egress 42, such as between the teeth of liquid egress 42. In this manner, liquid is equally distributed down an entire length of each seed bed 18 of the seed growing table 16. From liquid egress 42, liquid drips onto a seed belt 28 of each seed bed 18 where it runs under a bulk of seed on the seed belt 28 to hydrate the seed. The root system of seed on seed belt 28, along with a wicking effect, moves the liquid up through the seed to water all the seeds and/or plants.

Liquid applicator 38B is disposed atop each seed bed 18. Liquid applicator 38B includes a plurality of liquid distributors 40B operably configured in a liquid line 41B operably plumbed to a liquid source 43. Liquid distributor 40B can be spray heads, such as single or dual-band spray heads/tips, for spray irrigating seed disposed atop each seed belt 28. In one aspect, a plurality of liquid lines 41B are disposed in a spaced arrangement atop each seed bed 18. Each liquid line 41B traverses the length of the seed bed 18 and is plumbed into connection with liquid source 43. Other liquid lines 41B can be configured to traverse the width of seed bed 18. Liquid is discharged from each liquid distributor 40B for spray irrigating seed atop each seed belt 28. In another aspect, each liquid line 41B is oscillated back and forth over a 10°, 15°, 20°, 25°, 30°, 35°, 40°, 45°, or greater radius of travel for covering the entire surface area of the seed atop each seed belt 28. In the case where dual angle spray heads are used for liquid distributor 40B, the oscillation travel of each liquid line 41B can be reduced thereby reducing friction, wear and tear on liquid applicator 38B. A drive mechanism 37C can be operably connected to each liquid line 41A for oscillating or

rotating each line through a radius of travel. Liquid applicator 38B can be operated manually or automatically using one or more controllers operated by controller 140. The process of irrigating seed belt 28 using liquid applicator 38B can be automated by controller 140, graphical user interface, and/or remote control.

5 Liquid applicator 38C is disposed atop each seed bed 18. Liquid applicator 38C includes a plurality of liquid distributors 40C operably configured in a liquid line 41C operably plumbed to a liquid source 43. Liquid distributor 40C can be spray heads, such as single or dual angle heads, for spray irrigating seed disposed atop each seed belt 28. In one aspect, liquid line 41C is disposed atop and generally traverses the width of each seed bed
10 18 proximate roller 30 and seed dispenser 52. Each liquid line 41C is plumbed into connection with liquid source 43. Liquid is discharged from each liquid distributor 40C for spray irrigating seed immediately upon discharge from seed dispenser 52 onto each seed belt 28. Liquid line 41C can mounted stationary to the underside of each seed bed 28. Alternatively, liquid line 41C can be oscillated back and forth over a 10°, 15°, 20°, 25°, 30°,
15 35°, 40°, 45°, or greater radius of travel, like liquid line 41B, for covering a greater surface area of the seed discharged from seed dispenser 52 atop each seed belt 28. In the case where dual-band spray heads/tips are used for liquid distributor 40C, the oscillation travel of each liquid line 41C can be reduced thereby reducing friction, wear and tear on liquid applicator 38C. A drive mechanism akin to drive mechanism 37C for actuating liquid applicator 38B
20 can be used for actuating liquid applicator 38C, in the case where oscillation is desired. Liquid applicator 38C can be operated manually or automatically using one or more controllers operated by controller 140. The process of irrigating seed belt 28 using liquid applicator 38C can be automated by controller 140, graphical user interface, and/or remote control.

25 Liquid applicator 38D is disposed adjacent roller 30 and includes one or more liquid distributors 40D for directing liquid at the seed belt 28 as it is wound and unwound from roller 30. Liquid applicator 38D is configured to clean seed belt 28 of debris, contaminants, mold, fungi, bacteria, and other foreign/unwanted materials before winding on roller 30. Liquid applicator 38D is also configured to clean seed belt 28 of debris, contaminants, mold,
30 fungi, bacteria, and other foreign/unwanted materials while unwinding seed belt 28 off roller 30. Liquid distributor 40D can be spray heads, such as single or dual angle heads, for spraying roller 30. Liquid line 41D is plumbed into connection with liquid source 43. In

one aspect, liquid provided to liquid applicator 38D can include one or more additives or disinfectants, such as chlorine or hydrogen peroxide, to kill bacteria, fungi, or mold on seed belt 28. In one aspect, hydrogen peroxide is used as a disinfectant to kill mold spores, fungi or bacteria while preventing good bacteria present on the seed belt 28 from being destroyed during the disinfection process. Liquid applicator 38D can also be used to irrigate seed with a disinfectant as seed is released onto seed belt 28 from seed dispenser 52. A disinfectant can be used to disinfect seed on the seed belt 28. A time delay operable by controller 140 can be used to allow disinfectant to remain on seed for a desired time before applying irrigating with fresh water. Liquid applicator 38D can be operated manually or automatically using one or more controllers operated by controller 140. The process of cleaning, descaling and disinfecting seed belt 28 using liquid applicator 38D can be automated by controller 140, graphical user interface, and/or remote control.

Duration and timing of liquid application using liquid applicators 38A-D can be automated by controller 140, graphical user interface, and/or remote control. Liquid applicator 38A can be operated immediately after seeding of seed bed 28 to saturate seed with liquid. Seed in early, mid and late stages of growth can be irrigated using liquid applicator 38A. Liquid applicator 38B can also be operated immediately after seeding of seed bed 28 to saturate seed with liquid. Seed in early, mid and late stages of growth can also be irrigated using liquid applicator 38B. Liquid applicators 38A-D can be operated simultaneously, intermittently, alternately, and independent of each other. During early stages of seed growth, both liquid applicators 38A-B are operated to best saturate seed to promote sprouting. During later stages of growth, liquid applicator 38A can be used to irrigate more than liquid applicator 38B. Alternatively, liquid applicator 38B can be used to irrigate more than liquid applicator 38A, depending upon saturation level of seed growth. Liquid applicator 38C can be operated during seeding of seed bed 28 and movement of seed bed 28 in the second direction to spray seed dispensed atop seed bed 18 to saturate seed with liquid. In one aspect, liquid provided to liquid applicator 38C can include one or more additives or disinfectants, such as chlorine or hydrogen peroxide, to kill bacteria, fungi, or mold in seed. In one aspect, hydrogen peroxide is used as a disinfectant to kill mold spores, fungi or bacteria while preventing good bacteria present in the seed from being destroyed during the disinfection process. Liquid provided to liquid applicators 38A-D could include additives, such as disinfectants and/or nutrients. Nutrients, such as commonly known plant

nutrients, can be added to liquid dispensed from liquid applicators 38A-D to promote growth of healthy plants and/or increase the presence of desired nutrients in harvested seed. Liquid applicators 38C-D can be used also to sanitize seed belt 28 before and/or after winding on or unwinding from roller 30.

5 Liquid distributors 38A-D and their various components, along with other components of grower 10, can be sanitized by including one or more disinfectants in liquid used by each liquid distributor 38A-D. For example, liquid guide 39, liquid lines 41A-D, liquid egress 42, drain trough 44, liquid collector 46, seed belt 28, liquid distributors 40A-C, and other components of the grower 10 can be sanitized by including one or more
10 disinfectants in liquid used by grower 10. In another aspect, liquid applicators 38A-D can be used to clean and sanitize seed belt 28 before, between, or after seeding and harvesting. A separate liquid distributor or manifold can be configured to disinfect or sanitize any components of grower 10 that carry liquid for irrigation and cutting or receive irrigation or cutting runoff from the one or more seed beds 18 and cutter 100.

15

IV. Illumination

Each seed bed 18 includes one or more lighting elements 48 housing lights 49 for illuminating seed atop seed belt 28 to facilitate hydroponic growth of seed or a seed mass atop seed belt 28. Lighting elements 48 are operably positioned directly/indirectly above
20 each seed bed 18. Lighting elements 48 can be turned off and on for each level using controller 140. Lighting elements 48 can be powered by an electrochemical source or power storage device 138, electrical outlet, and/or solar power. In one aspect, lighting elements 48 are powered with direct current power. Contemplated lighting elements 48 include, for example, halide, sodium, fluorescent, and LED strips/panels/ropes, but are not limited to
25 those expressly provided herein. One or more reflectors (not shown) can be employed to redirect light from a remote source not disposed above each seed bed 18. Lighting elements 48 can be operably controlled by controller 140, a timer, user interface or remotely. Operation of lighting elements 48 can be triggered by one or more operations of grower 10. For example, operation of a seed belt 28 can trigger operation of lighting elements 48. The
30 process of lighting a seed bed 18 can be automated by controller 140, graphical user interface, and/or remote control. In one aspect, lighting elements 48 are low heat emission,

full ultraviolet (UV) spectrum, light emitting diodes that are cycled off and on with controller 140, preferably on 18 hours and off 6 hours in a 24-hour period.

V. Seeding

5 The figures provide pictorial representations of a seeder 50 in accordance with an illustrative aspect. Seeder 50 includes a seed dispenser 52 having an intake 54 configured for connection to seed source 66, such as a seed hopper, and a discharge 56 for dispensing seed onto seed belt 28. Seed dispenser 52 can be configured to extend across the width of seed bed 18 and disposed atop each seed bed 18 proximate one end of each seed bed 18
10 adjacent roller 30 or adjacent reel 31. In one aspect, seed dispenser 52 is disposed on each seed bed 18 proximate roller 30 to dispense seed onto seed belt 28 when seed belt 28 is unwound from roller 30 and terminal end 32B is drawn toward reel 31. An auger 58, such as a flex auger, is disposed within intake 54 and driven by a drive mechanism 37D for metering seed from seed source 66 out metering apertures 55 and discharge 56. Each seed
15 dispenser 52 is rotatably attached atop seed bed 18 and rotated by a drive mechanism 37E between a first position wherein the discharge 56 is disposed closely adjacent seed belt 28 and the seed dispenser 52 is oriented closer to vertical and a second position wherein discharge 56 is positioned above the seed belt 28 and oriented closer to a horizontal position. Seed dispenser 52 can include one or more veins, ridges, channels, ducts, or elements 61
20 spaced between auger 58 and discharge 56 for guiding or directing seed from the auger 58 to discharge 56 in a desired pattern or direction for further controlling seed metered onto the seed belt 28. A support plate 60 can be operably attached at discharge 56 of each seed dispenser 52 to support and properly space discharge 56 of seed dispenser 56 on and relative to seed belt 28 while seed is dispensed onto moving seed belt 28. A seed rake 62 can also
25 be operably attached at discharge 56 of each seed dispenser 52 to evenly rake seed across the width of seed belt 28 while seed is dispensed onto moving seed belt 28. Seed rake 62 separates seed into furrows to enhance watering. The drive mechanisms 37D and 37E can be a motor, powered electrically, pneumatically, hydraulically, or even manually. In one aspect, drive mechanism 37D and 37E are driven pneumatically with compressed air from a
30 pneumatic source 74. In the case of drive mechanism 37E, a pneumatic cylinder can be operably attached to seed bed 18 and seed dispenser 52 for rotating discharge 56 between the first and second positions. The pneumatic drive mechanism can be disposed in the

middle of the width of each seed bed 18 to best support the weight and movement of seed dispenser 52. Drive mechanism 37E can be operated with compressed air from pneumatic source 74. The process of metering seed with auger 58 by controlling drive mechanism 37D and rotating seed dispenser 52 by controlling drive mechanism 37E can be automated by
5 controller 140, graphical user interface, and/or remote control. Additionally, one or more sensors 69 can be configured within seed dispenser 52 to monitor level of seed within seed dispenser 52. For example, when seed level within seed dispenser 52 drops below a certain level and is detected by a sensor, movement of seed belt 28 can be stopped to wait for seed dispenser 52 to fill back up with seed to insure level distribution of seed across the entire
10 width of seed belt 28 during seeding. The sensor 69 can be a pressure, light, sound, or other type of sensor suitable for detecting the presence of seed. The sensor 69 can be a switch, such as a pressure switch, light switch, sound switch, or other type of switch suitable for detecting the presence of seed. Seed filling up the seed dispenser between the intake 54 and discharge 56 can trip sensor 69 to indicate that the seed dispenser is full thereby turning off
15 auger 58 under operable control of controller 140. Sensors can be operated in combination with one or more timers to reduce the number of sensors, relays, wiring, connectors and other hardware. Operation of drive mechanism 37D can be controlled with feedback from one or more sensors 69 within seed dispenser. For example, when the level of seed within seed dispenser drops below a certain level, drive mechanism 37D can be actuated to move
20 seed into seed dispenser 52 to fill seed dispenser 52 with seed, while the seed belt 28 is moving or stopped.

Seeder 50 also includes a seed conveyor 64 for conveying seed from seed source 66 to intake 54 of each seed dispenser 52. Seed conveyor 64 can include one or more sections of conduit operably attached between seed source 66 and seed dispenser 52. Seed source 66
25 can be a seed hopper having a top end through which seed is introduced into seed hopper. Contemplated seed includes, for example, wheat, barley, alfalfa, clover, oats, sorghum, greens, peas, sunflower, buckwheat, millet, hemp, microgreens, short vegetables, and rye, but are not limited to those expressly provided herein. Seed can include a mixture of seed
30 to create a seed blend with desired nutrients and digestive parameters. For example, a seed blend may be used, such as barley and peas, to increase the nutrient content (e.g., omega content) in the grown plant. The grown plant can be used for feed, plant oils, food preservatives and additives, medical uses, nutritional supplements, protein production,

cosmetics, and other uses. The one or more sections of conduit of seed conveyor 64 can include augers 68, such as a by rotating a flighted or spiral auger in place, for moving seed through seed conveyor 64 conduit. In another aspect, seed is moved through seed conveyor 64 using intermittently spaced, singulated flighting or gaskets 70 fixed to a draw cable 72
5 that is pulled through the conduit of seed conveyor 64 by a drive mechanism 37F. Seed can also be metered through seed conveyor 64 using compressed air from pneumatic source 74. The drive mechanisms 37F can be a motor, powered electrically, pneumatically, hydraulically, or even manually. The process of conveying seed with augers 68 or gaskets 70 by controlling drive mechanism 37F can be automated by controller 140, graphical user
10 interface, and/or remote control.

Seeder 50 can include a seed cleaner 76 operably disposed within seed conveyor 64. Often raw or bulk seed contains debris and other contaminants. Seed cleaner 76 removes debris and contaminants from seed before conveying seed to seed dispenser 52. Seed cleaner 76 includes a separator housing 78 having a seed inlet 80, seed discharge 82, and disposed
15 between seed inlet 80 and seed discharge 82 are one or more augers 84 disposed vertically within conduit 86 having a diameter of the flighting 88. Flighting 88 is preferably non-continuous thereby leaving gaps between intermittently spaced sections of flighting for seed, debris and contaminants to freefall from one level of flighting onto the next level of flighting. A vacuum line 90 is operably connected at or near seed inlet 80 and connected at an opposing
20 end to a vacuum source 92. Seed is introduced through seed conveyor 64 into seed cleaner 76 through seed inlet 80 and descends flighting 88 and freefalls between gaps in flighting 88 on each auger 84. Debris and contaminants are sucked into vacuum line 90 and the seed descends through seed discharge free of the debris and contaminants that are suctioned off into a refuse container 94. Suctioned off debris can be discharged onto conveyor belts 124,
25 126 and discharged with cut grown plant parts. The debris, often in the form of chaff from the seed, is generally ruffage based and can be fed to the animals. The falling seed has a greater mass than the debris and contaminants keeping the seed from being suctioned off by the vacuum line. A valve 98, manually or controller 140 controlled, on vacuum line 90 can be opened to decrease or closed to increase suction in the separator housing 78. Cleaned
30 seed exits seed discharge 82 and is mechanically conveyed through seed conveyor 64 to a staging column 96 operably connected in communication with each seed dispenser 52. Seed is drawn into each seed dispenser 52 from staging column 96 as seed is dispensed onto each

seed belt 28. Staging column 96 continues to fill with seed from seed conveyor 64 during seed dispensing. In some instances, seed includes larger debris that cannot be suctioned off without suctioning off seed too. A screen (not shown) can be operably disposed at the exit of seed discharge 82 to screen off larger debris that is not suctioned off while passing through seed cleaner 76. One or more UV lighting elements can be operably configured to irradiate seed within seed cleaner 76 with UV light to kill bacteria on seed. The process of cleaning seed with seed cleaner 76 by controlling the open and closed position of valve 98, irradiating seed with UV light, and the general operation of seed cleaner 76, can be automated by controller 140, graphical user interface, and/or remote control.

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VI. Cutting

The figures provide pictorial representations of a cutter 100 in accordance with an illustrative aspect. Each seed bed 18 includes a cutter 100. Cutter 100 includes an offloading plate 102 operably attached to grower 10 adjacent roller 30 and extending across the width of seed bed 18 for harvesting grown plants that consists of sprouted seed, root mass, stem portion, and leaves. For purposes of the present disclosure, when referring to sprouted seed, root mass, stem portion, and leaves, the term “grown plants” is used. It is the grown plants that is harvested from grower 10. Returning to offloading plate 102, the plate is configured to include opposing outer edges 103A-B spaced between an inlet side 104 and discharge side 106. Discharge plate has generally the same width as seed belt 128. Inlet side 104 faces seed belt 28 and is disposed immediately adjacent roller 30 to receive offloaded grown plants. Discharge side 106 faces outward, extending away from roller 30 for offloading cut grown plants. At least one high pressure liquid nozzle 108 is operably attached to a top side of offloading plate 102 and disposed generally in the middle across the width and between inlet side 104 and discharge side 106. Liquid nozzle 108 is oriented to direct a high-pressure stream of liquid directly upward. One or more ports 107 extend through offloading plate 102 across the width and between discharge side 106 and liquid nozzle 108. In one aspect port 107 is configured as a narrow channel, just wide enough for a stream of liquid to pass through, that extends generally across the width of offloading plate 102 and is disposed between nozzle 108 and discharge side 106. On the underside of offloading plate 102 are at least two high pressure liquid nozzles 110 operably mounted to a carriage 112 operably attached to the underside of offloading plate 102. In one aspect, carriage 112 is operably

attached to one or more guide shafts 113, using for example, one or more slide bearings. Liquid nozzles 110 are oriented to direct a high-pressure stream of liquid directly upward through port 107 in offloading plate 102. A drive mechanism 37G is operably attached to carriage 112 to actuate carriage 112 between first and second positions. Drive mechanism 37G can be a high torque electrical motor that operates on AC or DC current, or a pneumatic/hydraulic motor or cylinder. In one aspect, the electrical motor can be an intermittent duty 12 VDC, 10+ amp motor. Movement of carriage 112 between first and second positions moves a first one of liquid nozzles 110 generally across half of port 107 and a second one of liquid nozzles 110 generally across the other half of port 107. Alternatively, a single liquid nozzle or multiple liquid nozzles can be mounted to carriage 112 for cutting across the width of offloaded grown plants. The drive mechanism 37G can be a motor, powered electrically, pneumatically, hydraulically, or even manually. In one aspect, drive mechanism 37G is driven electrically with direct current power from a power source, such as a battery or AC-to-DC power converter 136 plugged into a utility service line. One or more switches or sensors (not shown) can be operably configured to control drive mechanism 37G to control movement of carriage 112 in a first and second opposite direction between first and second positions. In one aspect, carriage 112 moves across the width and on the underside of offloading plate 102. In the first position of carriage 112, a first one of liquid nozzles 110 is located nearly adjacent outer edge 103A and the second one of liquid nozzles 112 is located generally at the middle of offloading plate 102. In the second position of carriage 112, a first one of liquid nozzles 110 is located generally at the middle of offloading plate 102 and the second one of liquid nozzles 110 is located nearly adjacent outer edge 103B. During operation, liquid nozzles 110 reciprocate back and forth between first and second positions of the carriage by actuation of drive mechanism 37G. The process of actuating drive mechanism 37G for moving carriage 112 between first and second positions can be automated by controller 140, graphical user interface, and/or remote control. In this manner and in operation, liquid nozzle 108 cuts through offloaded grown plants in a first direction and liquid nozzles 110 cut through offloaded grown plants in a second direction opposite the first direction of liquid nozzle 108.

In one aspect, liquid nozzle 108 cuts longitudinally along the midpoint of offloaded grown plants and liquid nozzles 110 cut transversely across the width of offloaded grown plants. In this manner, offloaded grown plants are cut into portions smaller than the mass of

grown plants on seed belt 28. The length of each cut piece of grown plants can be controlled by increasing or decreasing the speed of seed belt 28 or increasing or decreasing the reciprocating speed of carriage 112. To increase the size of cut pieces of grown plants the speed of seed belt 28 or carriage 112 can be reduced. Alternatively, to decrease the size of cut pieces of grown plants the speed of seed belt 28 or carriage 112 can be increased. The process of controlling drive mechanism 37A and 37G for controlling speed of seed belt 28 and carriage 112 can be automated by controller 140, graphical user interface, and/or remote control.

As discussed herein, carriage 112 with liquid nozzles 110 is operably secured to the underside of offloading plate 102 and shielded from being impacted from below by liquid from liquid nozzle 108 and liquid nozzles 110 using a cover plate 114. The distance 115 between offloading plate 102 and cover plate 114 can range from 5 to 8.5 inches, 4 to 7.5 inches, 6 to 9.5 inches. In one aspect, the distance 115 between plates 102 and 114 is at least 8.5 inches to allow taller grown plants to pass between plates 102 and 114 for cutting.

A pump 116, such as a high-pressure pump, receiving liquid from liquid source 43, can be operably plumbed, using for example flexible, high-pressure hose, into liquid communication with liquid nozzle 110 and liquid nozzles 112. Pump 116 can operate between 2000-2,500 psi in at least one mode. In another mode, pump can operate at pressures lower than 2000 psi or higher than 2,500 psi. In one aspect, pump 116 is configured to operate liquid nozzles at 2,200 psi with a liquid flowrate of 4 gal/min. One or more valves 118, such as high-pressure valves, can be plumbed into fluid communication between liquid nozzle 108 and liquid nozzles 110. Valves 118 can be controlled manually or electronically by controller 140, graphical user interface, and/or remote control.

VII. Liquid Application, Handling, Collection and Recycling

The figures provide a pictorial representation of liquid handling, collection and recycling for grower 10. A liquid source 43 is needed to supply liquid to grower 10. One or more pumps are plumbed into liquid communication with liquid source 43. In one aspect, high-pressure pump 116 is plumbed into liquid communication with liquid source 43. Liquid nozzle 108 and liquid nozzles 110 are plumbed into liquid communication with pump 116. One or more flexible, high-pressure hoses can be operably configured between pump 116 and liquid nozzle 108 and liquid nozzles 110. Pump 116 can operate between 2000-3,000

psi in at least one mode. In another mode, pump can operate at pressures lower than 2000 psi or higher than 3,000 psi. In one aspect, pump 116 is configured to operate liquid nozzles 108, 110 at 2,200 psi with a liquid flowrate of 4 gal/min. In another aspect, pump 116 is configured to operate liquid nozzles 108, 110 at 2,500 psi with a liquid flowrats of 4-6
5 gal/min.

One or more valves 118 can be operably plumbed into liquid communication between pump 116 and liquid nozzle 108 and liquid nozzles 110 to control flow of liquid to each nozzle on each seed bed 18. One or more drain troughs can be operably configured at each cutter 100 to collect liquid. Collected liquid can pass through one or more drainage
10 lines operably connected between drain troughs and a sewer drain or liquid collector 46.

Pump 120 can also be plumbed into liquid communication with liquid source 43. liquid applicator 38A, liquid applicator 38B, liquid applicator 38C, and liquid applicator 38D can each be plumbed into liquid communication with pump 120 directly or via a liquid distribution manifold 132. One or more liquid conduits can be operably configured between
15 pump 120 and liquid applicator 38A, liquid applicator 38B, liquid applicator 38C, and liquid applicator 38D to control flow of liquid to each liquid applicator on each seed bed 18. One or more additive or disinfectant sources 134 can be operably plumbed into liquid communication with one or more or all liquid conduits disposed between pump 120 and liquid applicator 38A, liquid applicator 38B, liquid applicator 38C, and liquid applicator
20 38D. In one aspect, a disinfectant or additive source 134 operably plumbed into liquid communication with liquid conduit attached to liquid applicator 38C can be configured to hold one or more disinfectants, such as chlorine or hydrogen peroxide, for dispensing liquid disinfectant through liquid applicator 38C. A drain trough 44 is operably configured at each seed bed 18 to collect liquid from liquid applicator 38A, liquid applicator 38B, liquid
25 applicator 38C, and liquid applicator 38D. Collected liquid can pass through one or drain lines operably connected between drain trough 44 and a sewer drain or liquid collector 46. For example, as liquid flows across each seed belt 28 of each seed bed 18, which can be tilted towards drain trough 44, any plant that needs liquid will utilize it. Any unused liquid can continue across seed belt 28 and drain into drain trough 44. Once in the drain trough 44
30 liquid passes in plumbed connection into a liquid collector 46 or sewer drain, depending upon how the system is plumbed, based on the discretion of the owner/operator. According to one design, drain trough 44 can be operably attached to vertical members 12 of grower 10

and the orientation of drain trough 44 relative to level can be configured to control the flow of liquid in drain trough 44 to an outlet or drain. Liquid applicator 38B, liquid applicator 38C, liquid applicator 38D, and liquid applicator 38E can be collected and recycled using the same system used for collecting and recycling liquid from liquid applicator 38A. A
5 liquid applicator 38E can be plumbed into liquid line 41D to dispense liquid from a liquid distributor 40E for spraying liquid into drain trough 44 thereby cleaning drain trough 44. A disinfectant can be included in the liquid dispensed from liquid applicator 38E for disinfecting drain trough 44.

A liquid collector 46 can be operably plumbed into connection with drain trough 44
10 or other drainage lines of grower 10 for collecting and recycling or discarding runoff liquid. Liquid collector 46 can be configured with an open top to receive descending liquid from above disposed seed beds 18. A liquid collector 46 can be operably plumbed to receive pump pressure from pump 120 to recycle liquid collected from liquid applicator 38A, liquid applicator 38B, liquid applicator 38C, liquid applicator 38D, liquid applicator 38E, and
15 cutter 100. Additives can be combined with liquid in the liquid collector 46 and recycled to liquid applicator 38A, liquid applicator 38B, liquid and applicator 38C for irrigating seed with liquid having desired additives. Liquid collector 46 can be configured as a settling tank where sentiment and other particulate matter separates from liquid before being recycled back to liquid applicator 38A, liquid applicator 38B, liquid and applicator 38C. Liquid
20 collector 46 can be configured alone as a multi-gallon tank, such as a 50-gal, 75-gal, 100-gal or larger capacity tank together with a small settling tank. Liquid collected in liquid collector 46 can be retained and recycled over a 24-hour period, 48-hour period, 72-hour period and so forth before being dumped or discarded into a drain. Liquid collector 46 can be configured with a fitting with a screen material over it (e.g., plastic screen) to catch debris
25 and seed, such as, to prevent them from entering into the plumbed drain system of seed growing table 16. Additives can be introduced directly or indirectly into liquid applicator 38A, liquid applicator 38B, liquid applicator 38C, liquid applicator 38D, and liquid applicator 38E. Contemplated additives include, for example, additives added into a tank to promote plant growth, increase vitamins and minerals in liquid feed form and/or increase
30 seed growth nutritional value, but are not limited to those expressly provided herein. One or more disinfectants, such as chlorine or hydrogen peroxide, can be introduced into liquid applicator liquid applicator 38A, liquid applicator 38B, and liquid applicator 38C. Seed-

sprouting and growth nutrients can also be introduced into liquid applicator 38A, liquid applicator 38B, liquid applicator 38C, and liquid applicator 38D to support healthy, development and growth of seed into grown plants. The process of handling, collecting and recycling liquid can be automated by controller 140, graphical user interface, and/or remote control.

VIII. Handling of Cut Grown Plants

Cut grown plants drop under gravity from each seed bed 18 onto a conveyor belt 124 feeding into another conveyor belt 126 that, in one aspect, offloads into a vertical mixer, frontend loader, cart or other container for transporting cut grown plants. Conveyor belts 124, 126 can be actuated with drive mechanism 37H. The drive mechanism 37G can be a motor, powered electrically, pneumatically, hydraulically, or even manually. The process of conveying cut grown plants with conveyor belt 124, 126 by controlling drive mechanism 37G can be automated by controller 140, graphical user interface, and/or remote control. In the case where conveying cut pieces of grown plants upward to a higher elevation is desired, conveyor belt 126 can be configured with upstanding ridges for keeping cut pieces of grown plants stationary on conveyor belt 126 while ascending. The shape of conveyor belt 126 can be altered to further grip and keep cut pieces of grown plants stationary while conveyor belt 126 ascends. For example, the ridges can be notched so that conveyor belt 126 can be conformed from a flat shape into a U-shape to cup or surround cut pieces of grown plants to keep stationary plant pieces from falling down the belt when ascending, such as, up steep inclines. In the case where multiple growers are configured side-by-side, cut grown plants drop from each grower 10 onto conveyor belt 124 feeding into conveyor belt 126.

IX. Power Sources

A power source 128, such as a 110V or 220V service from an electrical utility, can be used to power grower 10. Power source 128 can be from renewable power sources, such as hydropower, biomass wood, biomass waste, biomass biofuels, wind, geothermal, and/or solar. Power source 128 can a direct current or alternating current source. In one aspect, grower 10 includes an AC/DC power converter 136 for powering one or more drive mechanisms 37A-H with direct current. According to at least one configuration, each of the one or more drive mechanisms 37A-H can receive direct current from an independent power

converter 136 for driving one or more DC motors. Increasing amperage to each motor, as needed, can increase the drive torque of each motor. Controlling operation of each motor and amperage to each motor can be automated by controller 140, graphical user interface, and/or remote control. Using a direct current power source reduces, and can eliminate, shock or electrocution that could result in harm or even death to an operator or owner of grower 10. Power source 128 can be one or more electrochemical cells or power storage device 138. Electrochemical cells or power storage devices 138 can be charged by power from an electrical utility or a renewable power source. In the case of a power outage, grower 10 can be operated using power from one or more electrochemical cells, power storage devices 138 and/or a renewable power source. Power source 128 can be configured to power a pneumatic or hydraulic source of energy. In one aspect, power source 128 operates pneumatic source 74, such as an air compressor, for powering one or more drive mechanisms 37A-H pneumatically. In another aspect, power source 128 operates a hydraulic source 130, such as a hydraulic pump, for powering one or more drive mechanisms 37A-H hydraulically. Drive mechanisms 37A-H can also be operated manually in the case of power or mechanism failure. In one aspect, one or more drive mechanisms 37A-H can be powered with alternating current from power source 128. A power source 128, of the type described, can be operably connected to actuate clutches 29A-B, lighting elements 48, vacuum source 92, pump 116, and pump 120. Switches, relays, voltage-amperage regulator(s) and other electrical components, including but not limited to, drive mechanisms 37A-H, clutches 29A-B, lighting elements 48, vacuum source 92, pump 116, hydraulic source 130, pneumatic source 74, and pump 120 of grower 10 can be automated by controller 140, graphical user interface, and/or remote control.

25 X. Controller

Controller 140 is configured to operate hydroponic grower 10. Figures 27-42 provide illustrations. Controller 140 can include a display configured to display a home screen 142. The home screen includes an emergency stop 154 that can be a mechanical and/or electrical control button. Harvest 144, pause 146 and cancel 148 icons control operations of the hydroponic grower 10. Setup for the controller is accessed with a system setup 150 icon. The water schedule for grower 10 can accessed using a view water schedule 152 icon. Each seed bed 18 is indicated by a level, for example levels 156-166. Harvest icons 168-178 are

provided for performing a harvesting function of the hydroponic grower 10 for each level 156-166. Operational indicators such as Planted data 180-190 displays the elapsed time since each of the levels 156-166 was planted or seeded by operation of seeder 50. Status indicators 192-202 provide the operating status of each level 156-166. Current operation
5 indicator 204 shows the operations taking place on an active level 156-166, such as “Harvesting Level 6.” A maintenance system of the hydroponic grower 10 can be accessed through the maintenance icon 206. In at least one mode of operation of controller 140, selecting the harvest 144 icon activates a harvesting operation of the oldest level 156-166, which for purposes of illustration, is Level 6 166, as shown by harvesting operation window
10 208. Selecting one of the harvest icons 168-178 associated with each level 156-166 starts the harvesting operation of the selected level regardless of the elapsed time since planted. Pause 146 and Cancel 148 icons can be selected during a harvesting operation selected using Harvest 144 icon. Similar Pause 178 and Start 172 icons can be selected during a harvesting operation performed on a specific level. The emergency stop 154 can be selected at any time
15 to immediately terminate any operation of the hydroponic grower 10. Upon selecting the Harvest 144 icon controller 140 activates a harvesting operation, which includes operating the seed belt 28 from the onloaded to offloaded position to move the grown plants through cutter 100 for cutting into selectable sized cuttings that are collected by conveyor belts 124-126. Upon completion of the harvesting operation, seeder 50 is operated to perform a seeding
20 operation while belt return 26 moves the seed belt 28 back to the onloaded position. An irrigation operation is activated during and/or after seeding by controlling liquid applicators 38A-D. Controller 140 activates operations automatically upon selecting the harvesting operation for a level 156-166. Harvesting operations can also be manually selected by an operator.

25 During irrigation, as shown by irrigation window 210 and current operation indicator 204, Temperature and Humidity 212-222 indicators provide information retrieved from one or more sensors on each level 156-166 about the growing environment.

To access and control irrigation schedule window 224 of controller 140, the View Water Schedule 152 icon can be selected from the home screen 142. Each level 156-166 is
30 shown with the irrigation Start Time 230, Last Watered 232 status and the irrigation system used, such as by Spray using liquid applicator 38B or Drip using liquid applicator 38A. Next Water 234 indicators show the date and time for the next watering and the irrigation system

to be used. The irrigation type, Drip and/or Spray 236-246 can be selected and updated with Update 248-258 icons for each level 156-166. The irrigation schedule window 224 also includes Schedule Setup 228, Master 226, Level 1, Level 2, Level 3, Level 4, Level 5, and Level 6 icons for accessing dedicated irrigation screens for each level 156-166, a Master 226
5 schedule screen for controlling global irrigation properties and the Schedule Setup 228 screen as shown by the irrigation schedule window 224. Back 260 icon can be used to access home screen 142.

By selecting Master 226 icon on Scheduled Setup screen 228, an operator can access an All Level screen 262 for controlling the global irrigation properties of the hydroponic
10 grower 10. Changes to the properties on the All Level screen 262 will change all levels 156-166. Irrigation schedule is broken up by Quarter 270 of days, or six hour increments. During each Quarter 270 options are provided for changing the increment of time 280-286 for S-On 272 (i.e. sprays on), S-Off 274 (i.e. sprays off), D-On 276 (i.e. drips on), and D_Off 278 (i.e. drips off). For example, Water Minutes Day 1 / Qtr 2 (i.e. the second six hours of
15 Day 1) the sprays are on for 90 (1.5x 60 seconds) seconds and off for 600 seconds (10.0 x 60 seconds), while the drips are on for 120 seconds (2.0 x 60 seconds) and off for 900 seconds (15.0 x 60) for All Level 264 (i.e. levels 156-166). Irrigation beyond Day 6 (i.e. Water Minutes Days > 6) is scheduled to cycle sprays on for 30 seconds (0.5 x 60 seconds) and off for 2400 seconds (40.0 x 60 seconds) and cycle drips on for 120 seconds (2.0 x 60
20 seconds) and off for 3600 seconds (60.0 x 60 seconds). Irrigation settings can be reset to default settings using the Reset 266 icon and new settings can be applied by using Apply 268 icon. Navigation back to the prior screen can be performed by selecting Back 260 icon. Irrigation controls can be configured for operating liquid applicators 38A-38D. The same irrigation controls are available for Levels 156-166 for specifying separate irrigation
25 parameters for one or more Levels 156-166 outside the Master 226 irrigation settings. For example, by selecting Level 1 156 icon an operator can access Level 1 screen 288 for specifying irrigation parameters for Level 1 156. To change an increment of time 280-286 for any Quarter 270 the operator selects it whereby an Input value screen 290 with a Value 292 field appears for entering the new increment of time 280-286. Both the All Level screen 262 and Level 1 screen 288 have an Advanced 280 icon. An Advanced Irrigation Schedule screen 294 is accessible using Advanced 280 icon. Advanced Irrigation Schedule screen 294 provides increments of time 280-286 for S-On 272 (i.e. sprays on), S-Off 274 (i.e. sprays
30

off), D-On 276 (i.e. drips on), and D_Off 278 (i.e. drips off), which allow an operator to control the Description 270 for the first six hours of watering starting from the time of seeding. The first six hours is the most crucial in watering, so the controller 140 includes an Advanced 280 that allows the increments of time 280-286 to be changed down to every-hour
5 increments by entering a new value and selecting Update 296 icon or Cancel 148 icon for leaving Advanced Irrigation Schedule screen 294.

From home screen 142 an operator can select System Setup 150 icon for accessing a General Settings screen 298 of controller 140. The General Settings screen 298 includes fields for Current Date & Time 306, Lights on Time 308, and Lights off Time 310. Icons
10 on the General Settings screen 298 include a General 300, Duty Cycle 302, Advanced 304, 120 VAC Bypass 312, Back 260, and Apply 268 icons. Illumination of lighting elements 48 can be controlled by specifying the Lights on Time 308 and Lights off Time 310. For example, seed can be illuminated with lighting elements 48 for 16-18 hours and off for 8-6 hours. Current Date & Time 306 can be updated manually in one aspect and updated
15 automatically in another aspect, for example, by Wi-Fi when the controller 140 automatically connects to Wi-Fi and the Wi-Fi router pings back with the Current Date & Time 306. Hydroponic grower 10 can operate using AC or DC power by toggling 120VAC Bypass 312 "On/Off". If Current Date & Time 306, Lights on Time 308 or Lights off Time 310 is changed the new settings can be saved by selecting Apply 268 icon or left the same
20 by selecting Back 260 icon.

A Duty Cycle 302 icon is provided on the General Settings screen 298 to access a Duty Cycle Settings screen 314 to change the duty cycle for one or more of the drive mechanisms 37A-H. The Duty Cycle Settings screen 314 includes a General 300, Duty
25 Cycle 302, Advanced 304, Back 260, and Apply 268 icons. Duty cycle settings for H-Motor 318 (i.e. drive mechanism 37A) and S-Motor 320 (i.e. drive mechanism 37B) during harvesting and H-Motor 322 (i.e. drive mechanism 37A) and S-Motor 324 (i.e. drive mechanism 37B) during seeding are controllable on the Duty Cycle Settings screen 314 by increments of Starting Time 316. In at least one aspect, motor duty cycles are controlled as the seed belt 28 rolls up on roller 30 it increases in diameter. The bigger the diameter, the
30 faster the seed belt 28 moves. To keep a consistent speed, phasing of H-Motor 318 is performed, which causes the motor to cut out intermittently and phasing to maintain the same speed.

An Advanced 304 icon is provided on the Duty Cycle Settings screen 314 for accessing an Advanced Settings screen 326 that includes General 300, Duty Cycle 302, Advanced 304, Back 260, and Apply 268 icons. Inputs for Harvest Return 328, Seeding Return 330, Gutter Spray Duration 332, Gutter Spray Frequency 334, and Enable Disinfectant 336 are also provided on the Advanced Settings screen 326. The amount of movement, for example, in seconds, of seed belt past a belt sensor can be specified by entering a value into Harvest Return 328. During harvesting grown plant is moved through cutter 100 by moving seed belt 28 from the unloaded position to the offloaded position. To make sure all grown plant matter passes through cutter 100, drive mechanism 37A continues to operate and move seed belt for the specified time in the Harvest Return 328 field. Since belt movement sensors are about 6-8 inches away from cutter 100, the seed belt needs to continue to travel after the sensor(s) are tripped for all grown plant material to pass through cutter 100. Thus, as shown, Harvest Return 328 is set for 18 seconds, which means drive mechanism 37A will continue to run 18 seconds after the seed belt sensor(s) proximate cutter 100 are tripped. Seeding return indicates the time drive mechanism 37B will operate before seeding of the seed belt 28 begins, thereby moving seed belt from the offloaded position back toward the onloaded position, before seed dispenser is rotated from a generally horizontal position to a generally vertical position with its discharge 56 rotated in close or touching proximity to seed belt 28. A Gutter Spray Frequency 334 field can be adjusted to a desired frequency for applying liquids to drain trough 44. For example, spray can be cycled for one minute every 60 minutes, such as, during Growing 204. A disinfectant can be added to the spray by toggling Enable Disinfectant button to "On" from "Off."

From home screen 142 the maintenance 206 icon can be selected for accessing Maintenance Mode screen 342 through an Input Password screen 338. Maintenance Mode screen 342 includes Level 1-6 icons 156-166, Back 260 icon, Reboot 346 icon, and Maintenance Mode indicator 204. From Maintenance Mode screen 342 operation of relays and sensors of the hydroponic grower 10 can be monitored and changed. For example, tripped and untripped sensors of the hydroponic grower 10 can be monitored from screen 342. Each level 156-166 includes sensor trip indicators for Seeder Full 354, Seeder Low 356, Tray Home 358, Tray Full Harvest 360, and Seeder Stop 362. "On/Off" toggle buttons are provided for Lights 348, Main Sprayer 352 (i.e. pump 116), Half Switch 354, Gutter Disinfectant 356, and Disinfectant Boom 350. A toggle screen 400 appears when toggling

“On/Off” toggle buttons. For example, toggling Main Sprayer 352 “On/Off” brings up toggle window 400, asking operator to confirm whether to power Main Sprayer 352 on. A Half Switch 354 is also provided for larger systems, three sections or more, or greater than three sections, in order to compensate for different water pressures at different install
5 locations, controller 140 only will spray the front half and the back half of hydroponic grower
10 independently. Using Half Switch 354 the controller 140 can irrigate a six-section table, by operating the front three sections spray then the back three sections spray. The Lights 348 toggle is programmed to allow an operator to turn lighting elements 48 on and off. The Main Sprayer 352 toggle is programed to allow an operator to turn pump 120 for cutter 100
10 on and off.

From Maintenance Mode screen 342 an operator can access a Level 1 screen 364 for managing maintenance parameters specifically for Level 1 156. Levels 2-6 158-166 can also be accessed from Maintenance Mode screen 342. Dedicated level 156-166 maintenance screens, such as Level 1 screen 364, include a relay/sensor status for Seeder Full 354, Seeder
15 Low 356, Tray Home 358, Full Harvest 360, and Seeder Stop 362 operations of the hydroponic grower 10. Toggles are provided for turning Main Harvest 368 motor (i.e. drive mechanism 37A), Main Seeder 372 (i.e. drive mechanism 37B) motor or both on for the selected level. Direction of travel for each motor 368, 372 can be controlled using “On/Off” toggle buttons associated with Tray Harvest Motor 380 and Tray Seeding Motor 382. For
20 example, if Main Harvest 368 motor (i.e. drive mechanism 37A) is selected and Tray Harvest Motor 380 is toggled on this causes Main Harvest 368 motor to rotate roller 30 thereby moving seed belt 28 from the onloaded position toward the offloaded position. Similarly, if Main Harvest 368 motor (i.e. drive mechanism 37A) is selected and Tray Seeding Motor 382 is toggled on this causes Main Harvest 368 motor to rotate roller 30 to thereby move
25 seed belt 28 from the offloaded position toward the onloaded position. Additionally, if Main Seeder 372 motor (i.e. drive mechanism 37B) is selected and Tray Harvest Motor 380 is toggled on this causes Main Seeder 372 motor to rotate reel 31 thereby moving seed belt 28 from the onloaded position toward the offloaded position. Similarly, if Main Seeder 372 motor (i.e. drive mechanism 37B) is selected and Tray Seeding Motor 382 is toggled on this
30 causes Main Seeder 372 motor to rotate reel 31 to thereby move seed belt 28 from the offloaded position toward the onloaded position. A Fill Seeder 384 toggle is provided for turning auger 58 “On/Off” for filling seed dispenser 52 with seed from staging column 96.

A Cleaning Nozzles 386 toggle is provided for turning liquid applicator 38D “On/Off” for cleaning the seed belt 28. A Cutting Nozzles 388 toggle is provided for turning liquid nozzles 108, 110 “On/Off.” A Cutting Nozzles Motor 390 toggle is provided for turning drive mechanism 37G for operating carriage 112 back and forth. A Spray Nozzles 392 toggle is provided for turning liquid applicator 38B “On/Off” and simultaneously activating drive mechanism 37C for articulating liquid distributors 40B back and forth for irrigating seed on seed belt 28. A Dripper Nozzles 394 toggle is provided for turning liquid applicator 38A “On/Off” for drip irrigating seed on seed belt 28. A Seeder Up 396 toggle is provided for activating drive mechanism 37D for rotating seed dispenser 52 up thereby positioning seed dispenser in a generally horizontal position (i.e., generally parallel) relative to seed belt 28. Similarly, a Seeder Down 398 toggle is provided for activating drive mechanism 37D for rotating seed dispenser 52 down thereby positioning seed dispenser in a generally vertical position (i.e., generally perpendicular) relative to seed belt 28 with discharge 56 is close proximity to or touching seed belt 28. A Planted date 366 field is provided for an operator to specify the planting date and update the Planted date 366 field by selecting Update 296 icon. Changing the plant date allows an operator to change the water schedule or delay the water schedule which date the controller 140 uses to control irrigation schedules.

Control system 400 includes a controller 140 for operating hydroponic grower 10. The control system 400 can include one or more analog 416 and digital 404 inputs. In one aspect, one or more sensors 422, such as sensor 69 or other grower sensors, are connected to controller 140. The control system 400 can include one or more analog 414 and digital 412 outputs. In one aspect, one or more actuators 402, such as drive mechanism 37A-H, pneumatic source 74A, vacuum source 92, pump 116, hydraulic source 130, etc., are connected to controller 140. Power supply 418 is connected to power source 128 for powering control system 400.

The present disclosure is not to be limited to the particular aspects described herein. In particular, the present disclosure contemplates numerous variations in the type of ways in which aspects of the disclosure can be applied to a hydroponic growing apparatus, system, and/or method that addresses the deficiencies in existing hydroponic and non-hydroponic processes for growing seed. The foregoing description has been presented for purposes of illustration and description. It is not intended to be an exhaustive list or limit any of the disclosure to the precise forms disclosed. It is contemplated that other alternatives or

exemplary aspects are considered included in the disclosure. The description is merely examples of aspects, processes or methods of the disclosure. It is understood that any other modifications, substitutions, and/or additions can be made, which are within the intended spirit and scope of the disclosure. For the foregoing, it can be seen that the disclosure
5 accomplishes at least all of the intended objectives.

The previous detailed description is of a small number of aspects for implementing the disclosure and is not intended to be limiting in scope. The following claims set forth a number of the aspects of the disclosure disclosed with greater particularity.

What is claimed is:

1. A control system for a hydroponic seed grower having a plurality of levels each with a seed bed for hydroponically growing seed, the control system comprising:
a programmable logic controller housed within a control housing;
5 a graphical user interface operable by the programmable logic controller and disposed on the control housing;
a home screen displayed by the graphical user interface, the home screen having one or more status indicators for each seed bed on the plurality of levels;
a seeding screen accessible from the home screen and displayed by the graphical user
10 interface, the seeding screen having one or more seeding controls for actuating a seeder for depositing seed on each seed bed on the plurality of levels;
a harvesting screen accessible from the home screen and displayed by the graphical user interface, the harvesting screen having one or more harvesting controls for
controlling seed growth harvesting from each seed bed on the plurality of levels.
15
2. The control system of claim 1, further comprising:
an irrigation screen accessible from the home screen and displayed by the graphical user
interface, the watering screen having one or more irrigation controls for controlling
irrigation of each seed bed on the plurality of levels.
20
3. The control system of claim 1, further comprising:
a maintenance screen accessible from the home screen and displayed by the graphical user
interface, the maintenance screen having one or more seed grower controls for each
seed bed on the plurality of levels.
25
4. The control system of claim 1, further comprising:
a cutting screen accessible from the home screen and displayed by the graphical user
interface, the cutting screen having one or more cutter controls for controlling
cutting of seed growth offloaded from each seed bed on the plurality of levels.
30
5. The control system of claim 1, further comprising:

- a duty cycle screen accessible from the home screen and displayed by the graphical user interface, the duty cycle screen having one or more motor controls for each seed bed on the plurality of levels.
- 5 6. The control system of claim 5 wherein, the one or more motor controls comprise at least one seeder motor and at least one harvesting motor and a duty cycle parameter for each.
7. The control system of claim 2 wherein, the one or more irrigation controls comprise
10 at least one drip irrigation selection, at least one spray irrigation selection, and at least one irrigation cycling time parameter.
8. The control system of claim 4 wherein, the one or more cutter controls comprise at least one cutter motor, at least one fluid nozzle, and at least one cutter cycling parameter
15 for cutting offloaded seed growth.
9. A controller for a hydroponic seed grower having a plurality of levels each with a seed bed for hydroponically growing seed, the controller comprising:
a housing configured for operable attachment to the hydroponic seed grower;
20 a display carried by the housing, the display having a graphical user interface for controlling the hydroponic seed grower;
at least one programmable logic controller housed within the housing for controlling the display, the graphical user interface and the hydroponic seed grower;
a main menu displayed by the graphical user interface, at least one status indicator
25 regarding seed growth from each seed bed on the plurality of levels displayed by the graphical user interface, and at least one or more seed harvesting controls displayed by the graphical user interface for controlling seed growth harvesting from each seed bed on the plurality of levels.
- 30 10. The controller of claim 9, further comprising:

- a seeding screen accessible from the main menu and displayed by the graphical user interface, the seeding screen having one or more seeding controls for actuating a seeder for depositing seed on each seed bed on the plurality of levels.
- 5 11. The controller of claim 9, further comprising:
a harvesting screen accessible from the main menu and displayed by the graphical user interface, the harvesting screen having the one or more seed harvesting controls for controlling seed growth harvesting from each seed bed on the plurality of levels;
- 10 12. The controller of claim 9, further comprising:
an irrigation screen accessible from the main menu and displayed by the graphical user interface, the watering screen having one or more irrigation controls for controlling irrigation of each seed bed on the plurality of levels.
- 15 13. The controller of claim 9, further comprising:
a maintenance screen accessible from the main menu and displayed by the graphical user interface, the maintenance screen having one or more seed grower controls for each seed bed on the plurality of levels.
- 20 14. The controller of claim 9, further comprising:
a cutting screen accessible from the main menu and displayed by the graphical user interface, the cutting screen having one or more cutter controls for controlling cutting of seed growth offloaded from each seed bed on the plurality of levels
- 25 15. The controller of claim 9, further comprising:
a duty cycle screen accessible from the main menu and displayed by the graphical user interface, the duty cycle screen having one or more motor controls for each seed bed on the plurality of levels.
- 30 16. A method for controlling a hydroponic seed grower having a plurality of levels each with a seed bed for hydroponically growing seed, the method comprising:

- providing a control housing configured for operable attachment to the hydroponic seed grower;
- presenting a graphical user interface with a display carried by the control housing;
- receiving operator input at the graphical user interface for controlling seed growth on and
5 harvesting from each seed bed on the plurality of levels of the hydroponic seed grower;
- controlling the hydroponic seed grower with at least one programmable logic controller housed within the control housing for processing operator input and outputting one or more control signals to one or more actuators of the hydroponic seed grower.
10
17. The method for controlling a hydroponic seed grower 16, further comprising:
seeding each seed bed on the plurality of levels with one or more seeding controls displayed by the graphical user interface.
- 15 18. The method for controlling a hydroponic seed grower 16, further comprising:
harvesting seed growth from each seed bed on the plurality of levels with one or more harvesting controls displayed by the graphical user interface.
19. The method for controlling a hydroponic seed grower 16, further comprising:
20 cutting offloaded seed growth from each seed bed on the plurality of levels with one or more cutter controls displayed by the graphical user interface.
20. The method for controlling a hydroponic seed grower 16, further comprising:
irrigating seed on each seed bed on the plurality of levels with one or more irrigation
25 controls displayed by the graphical user interface.

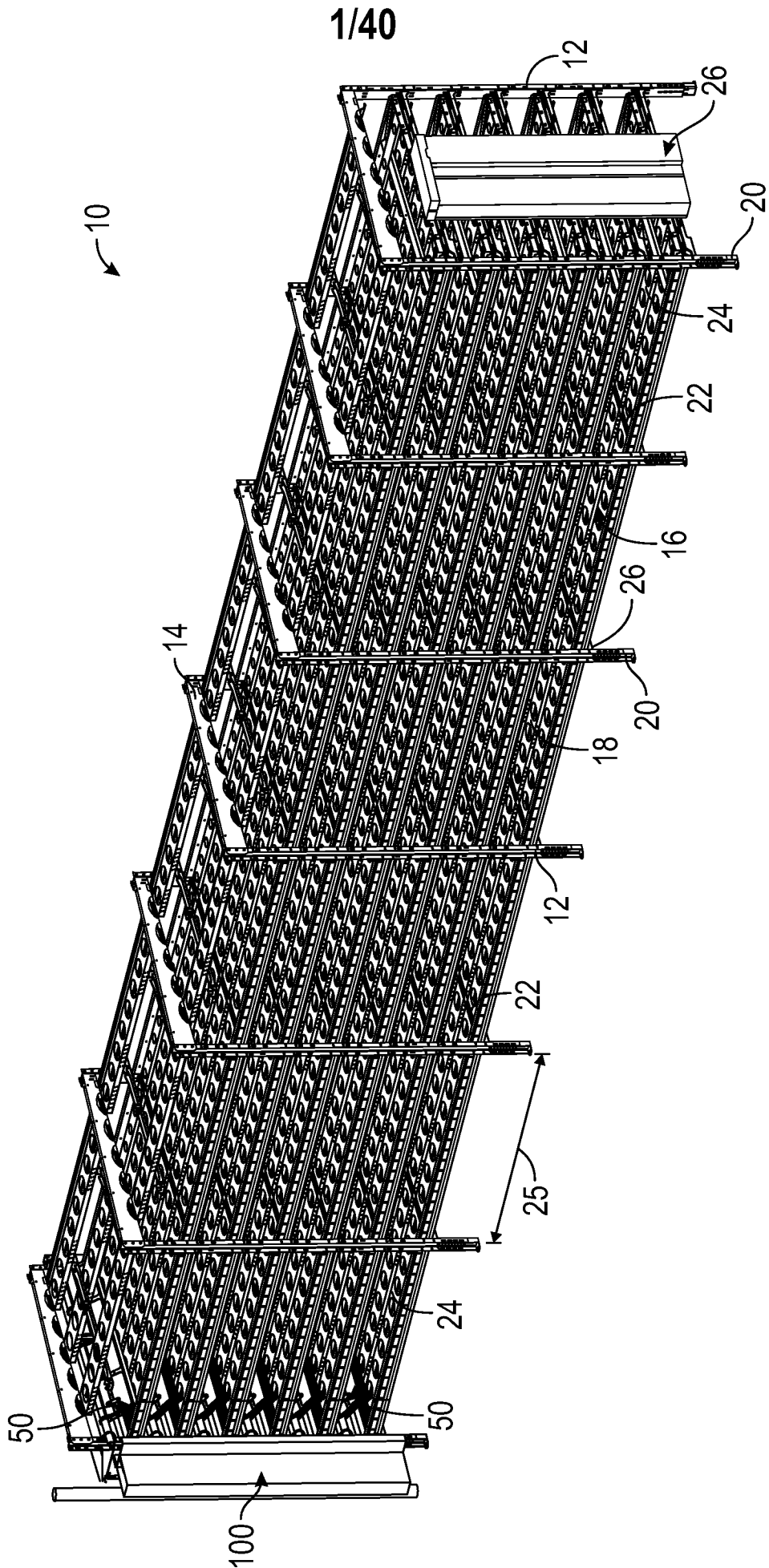


FIG. 1

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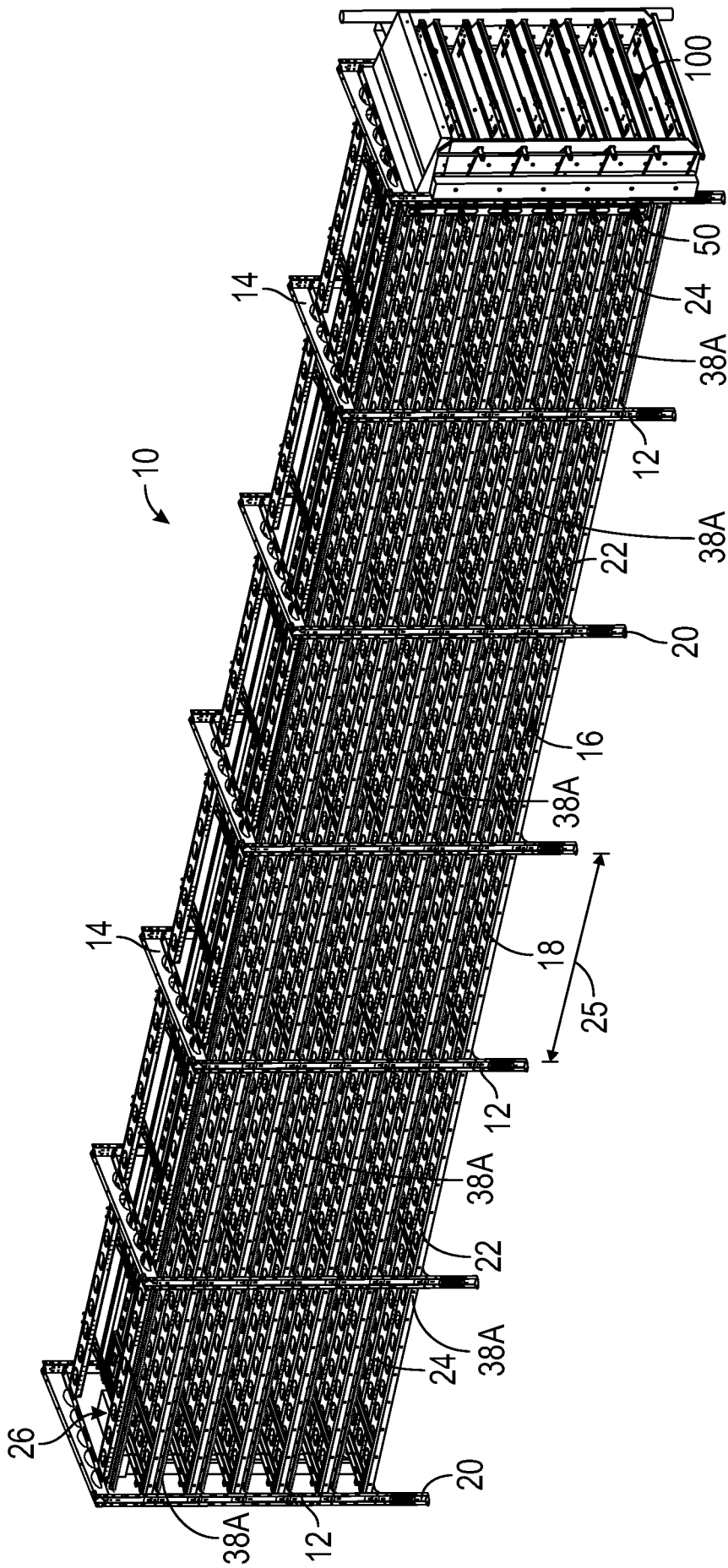


FIG. 2

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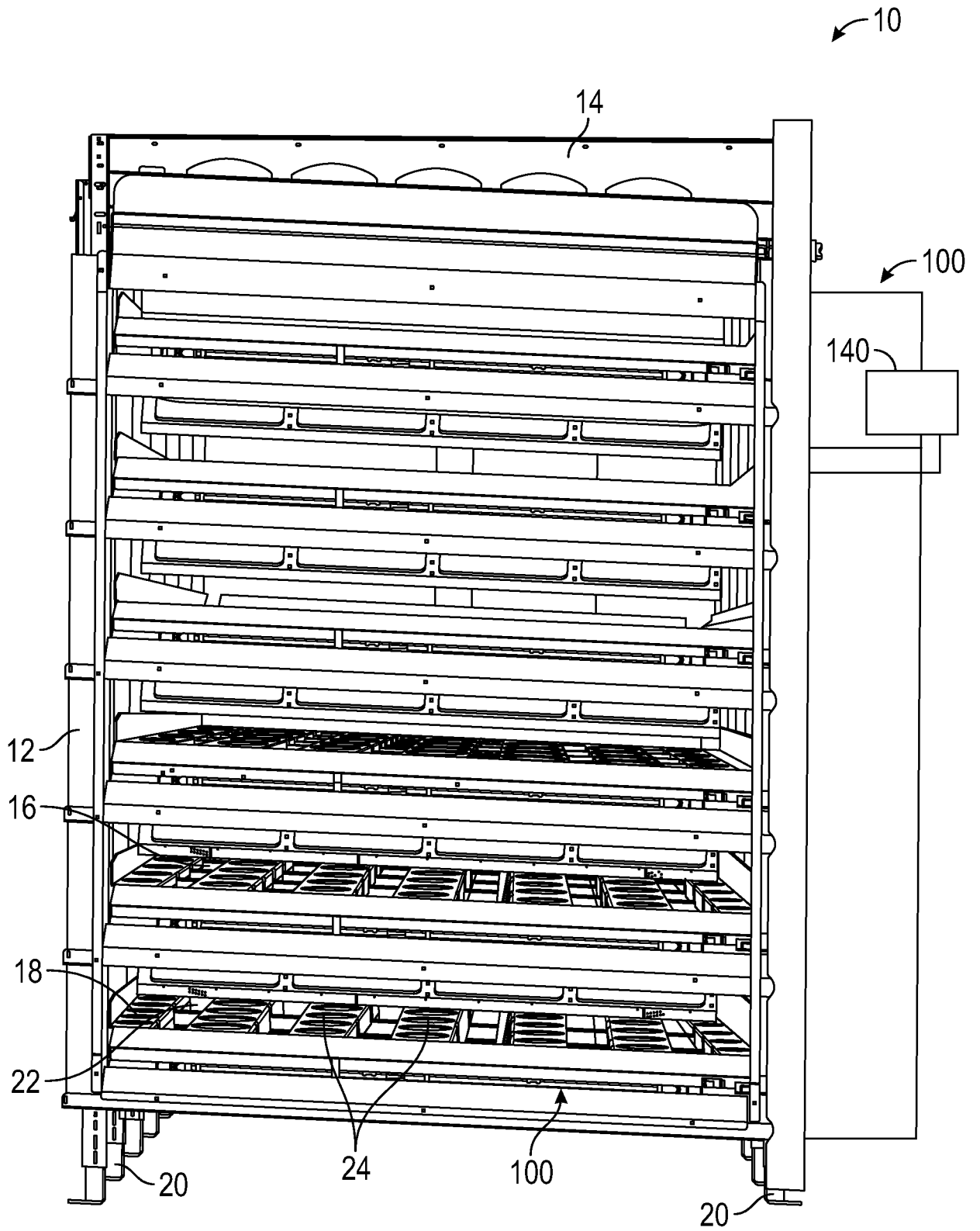


FIG. 3

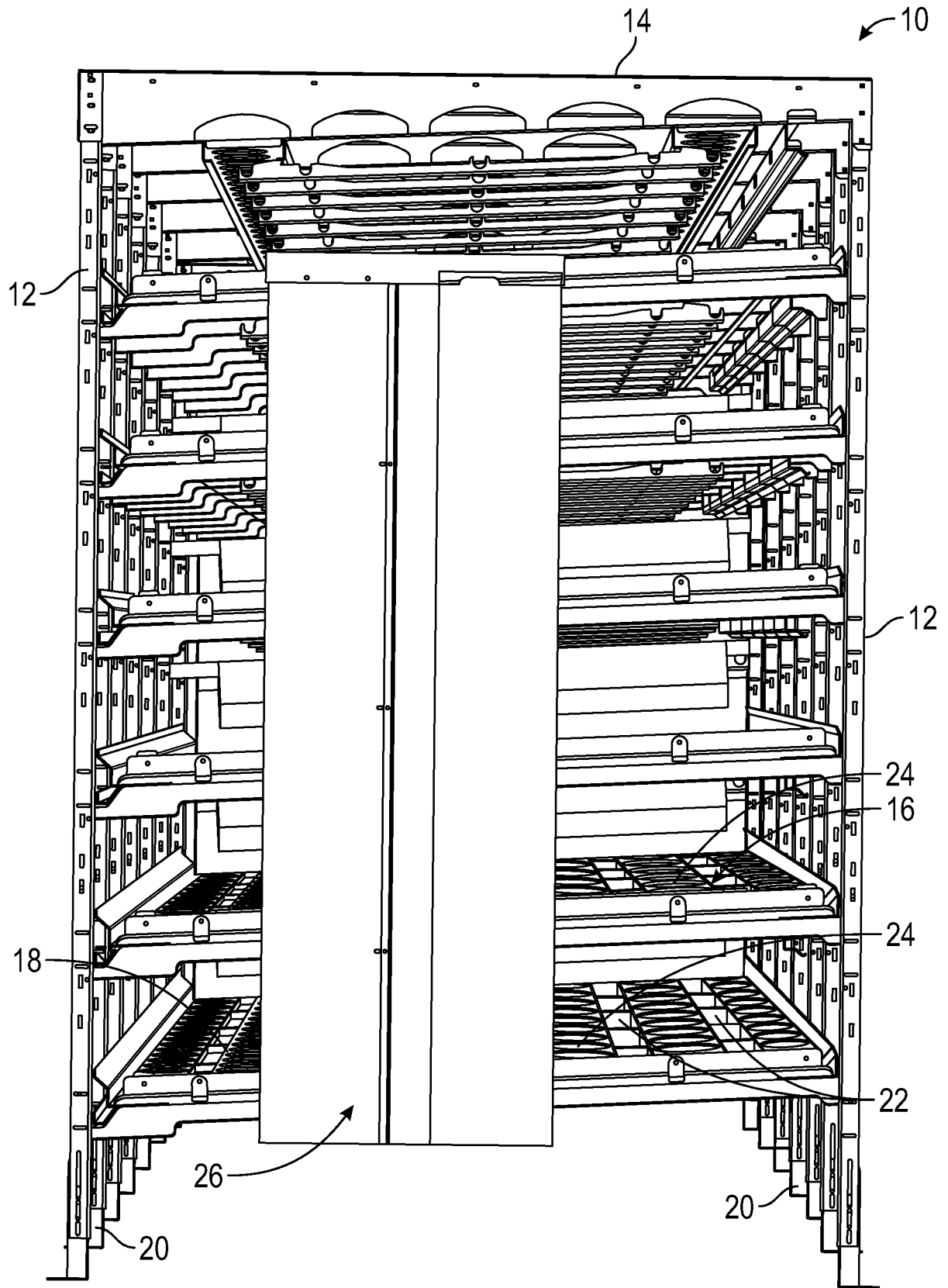


FIG. 4

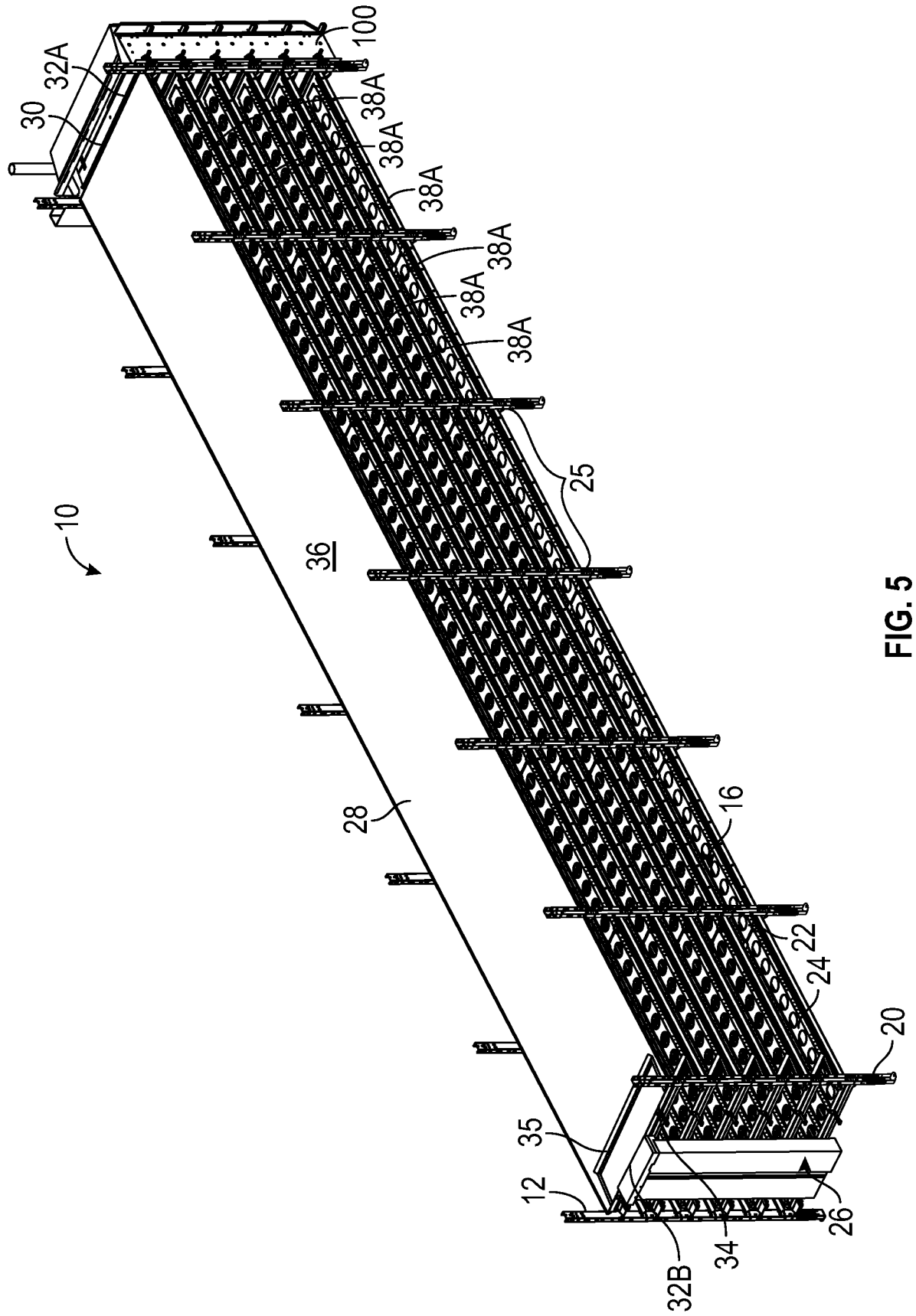


FIG. 5

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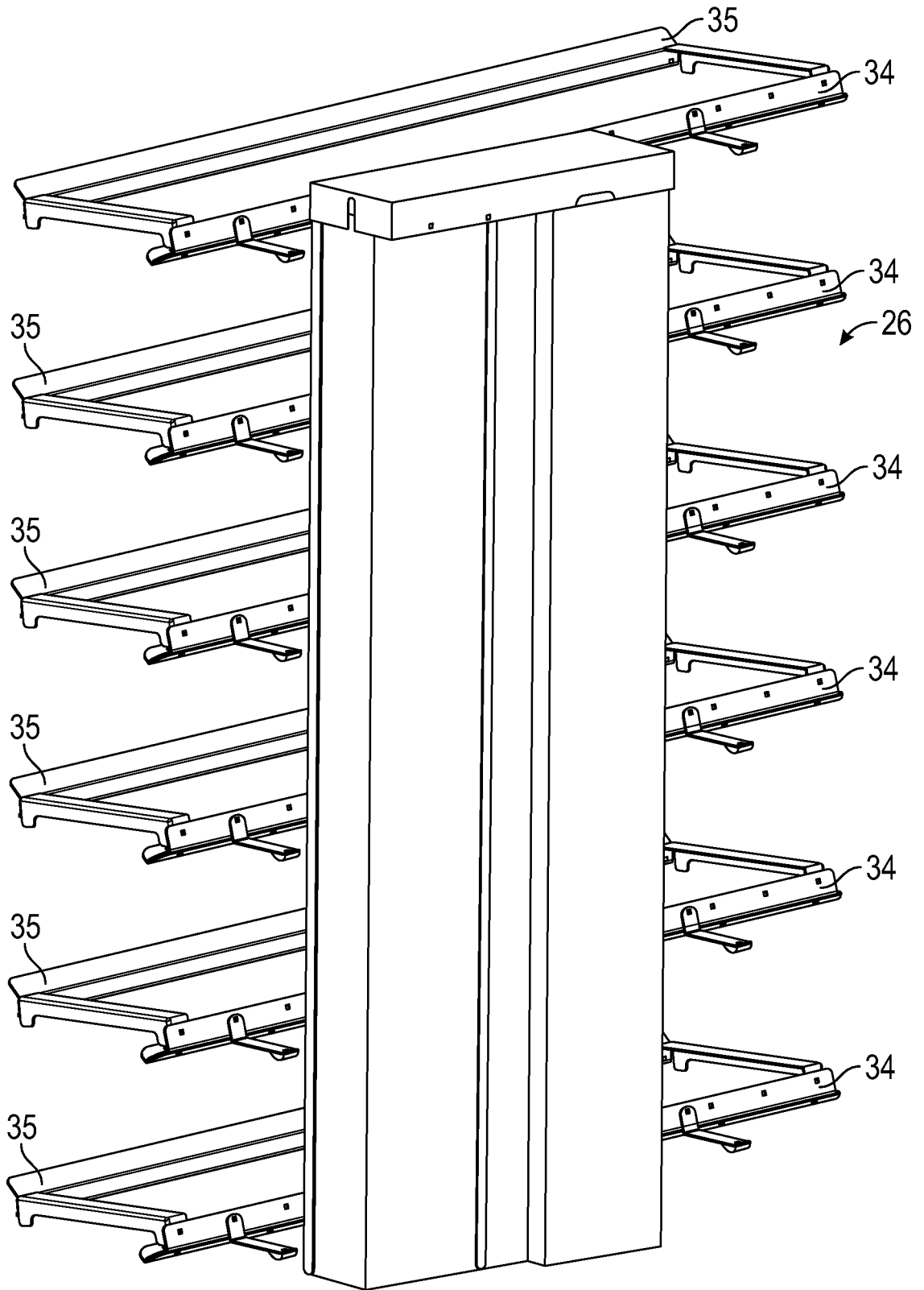


FIG. 7

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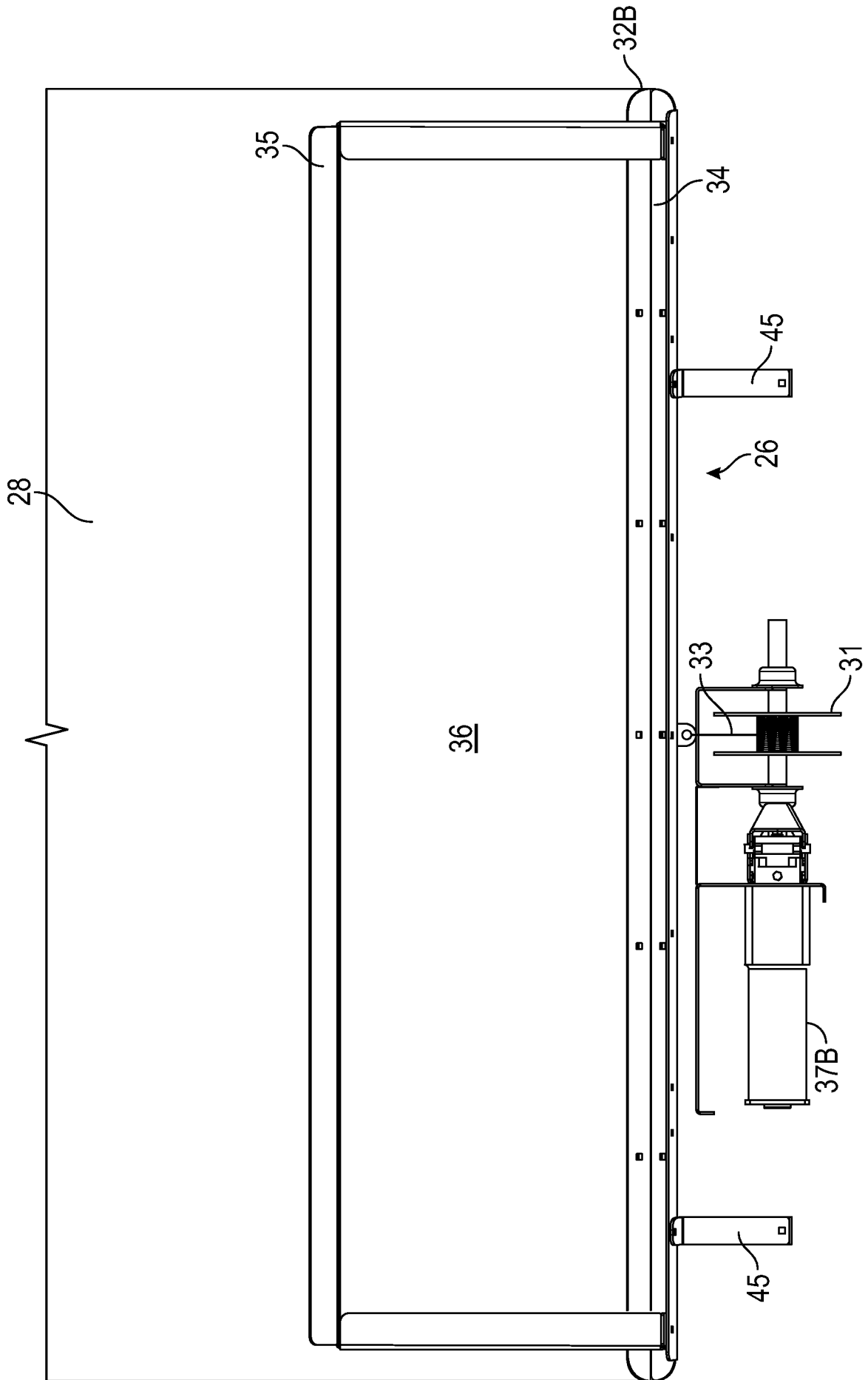


FIG. 8

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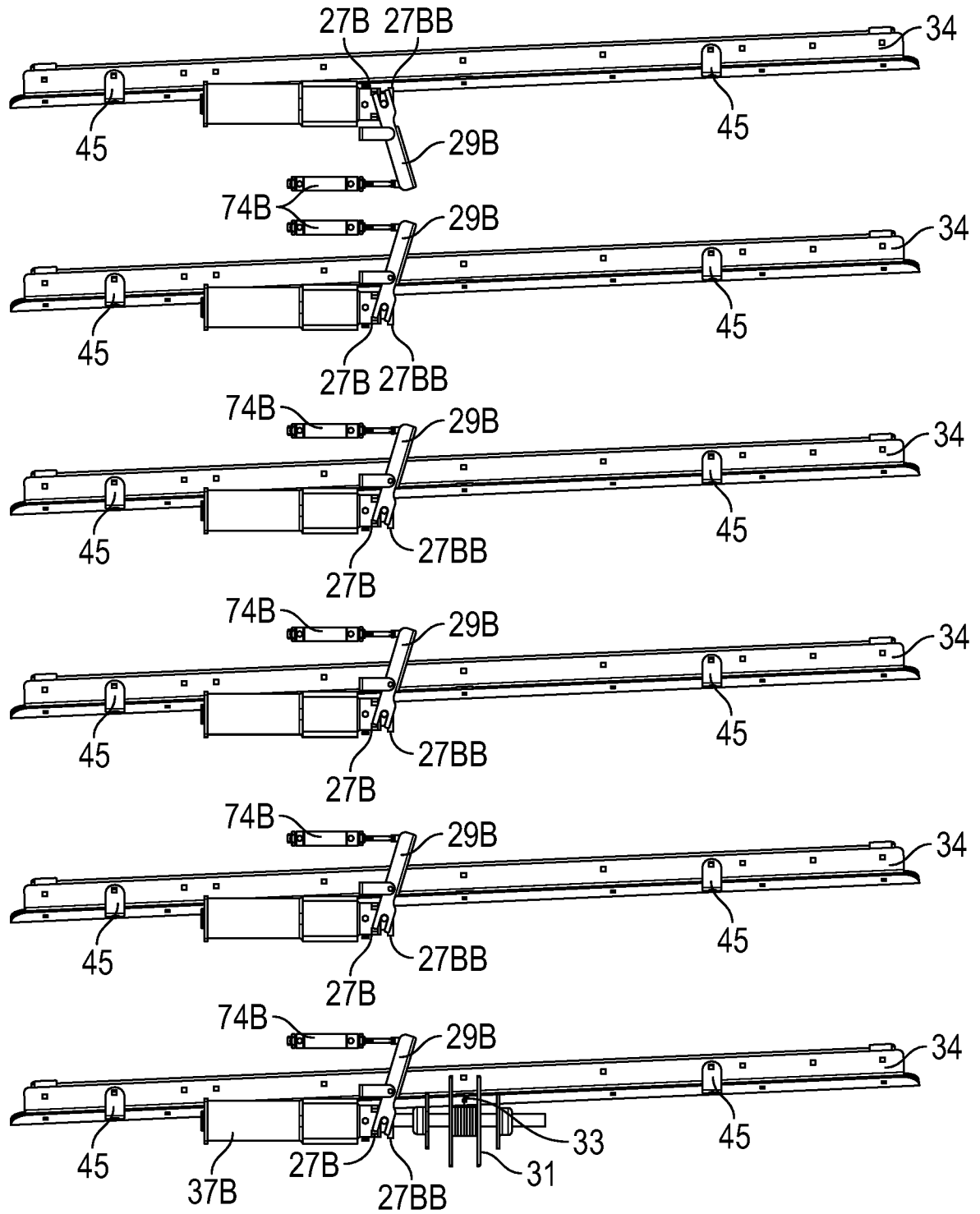


FIG. 9

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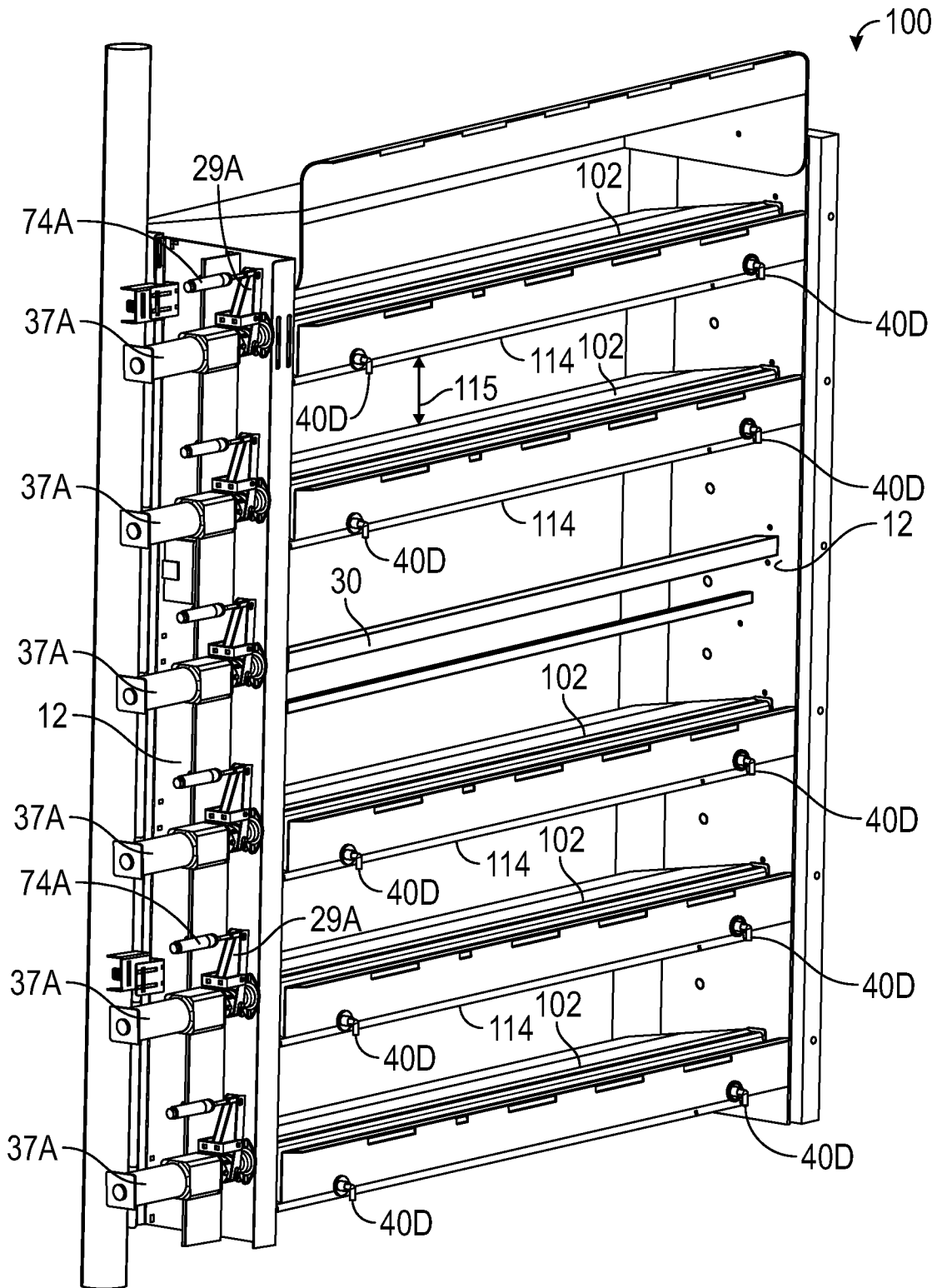


FIG. 10

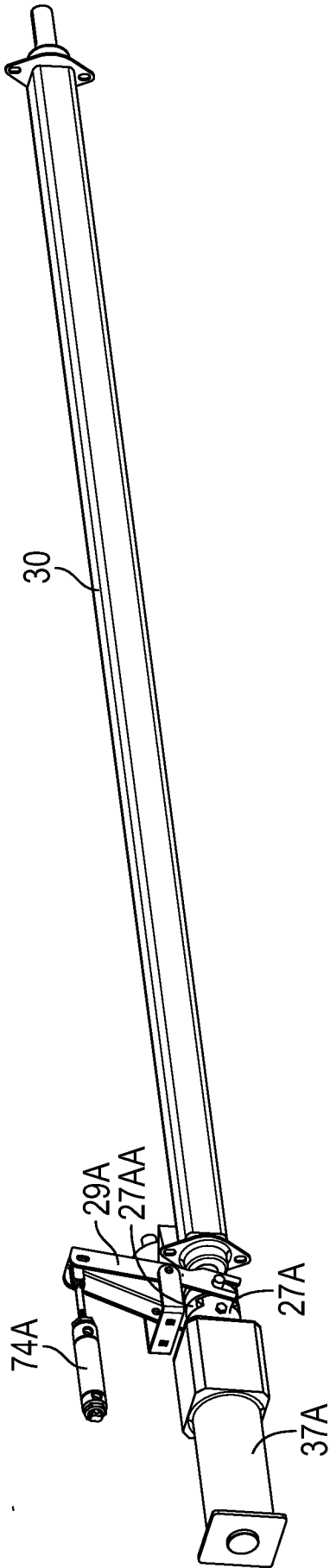


FIG. 11

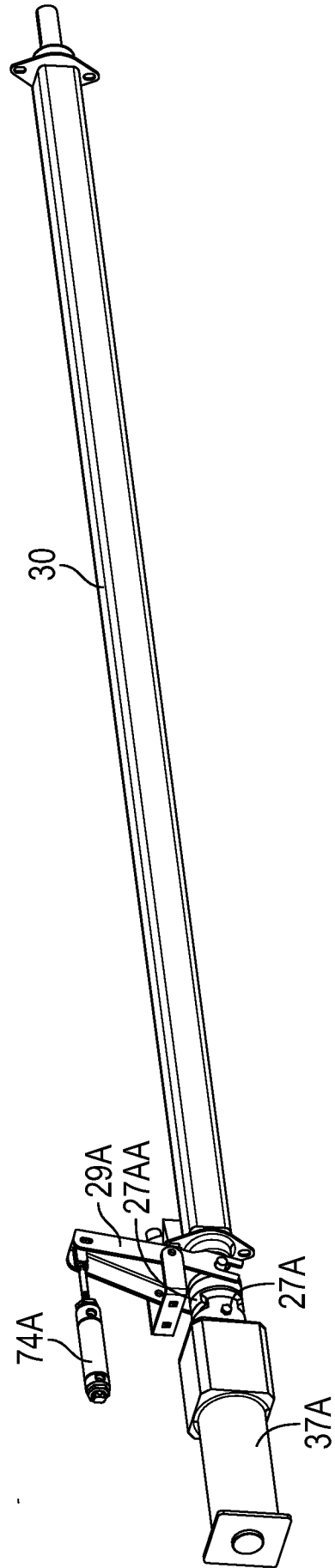


FIG. 12

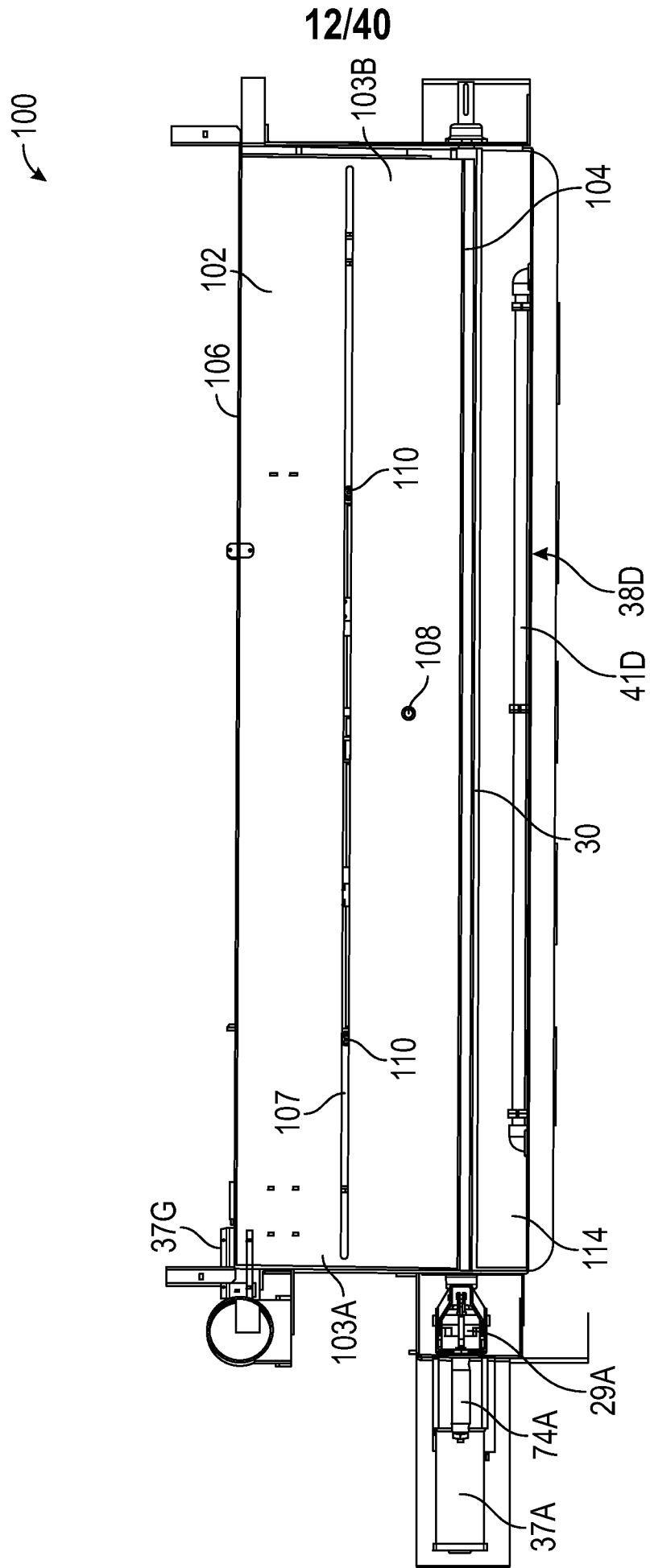


FIG. 13

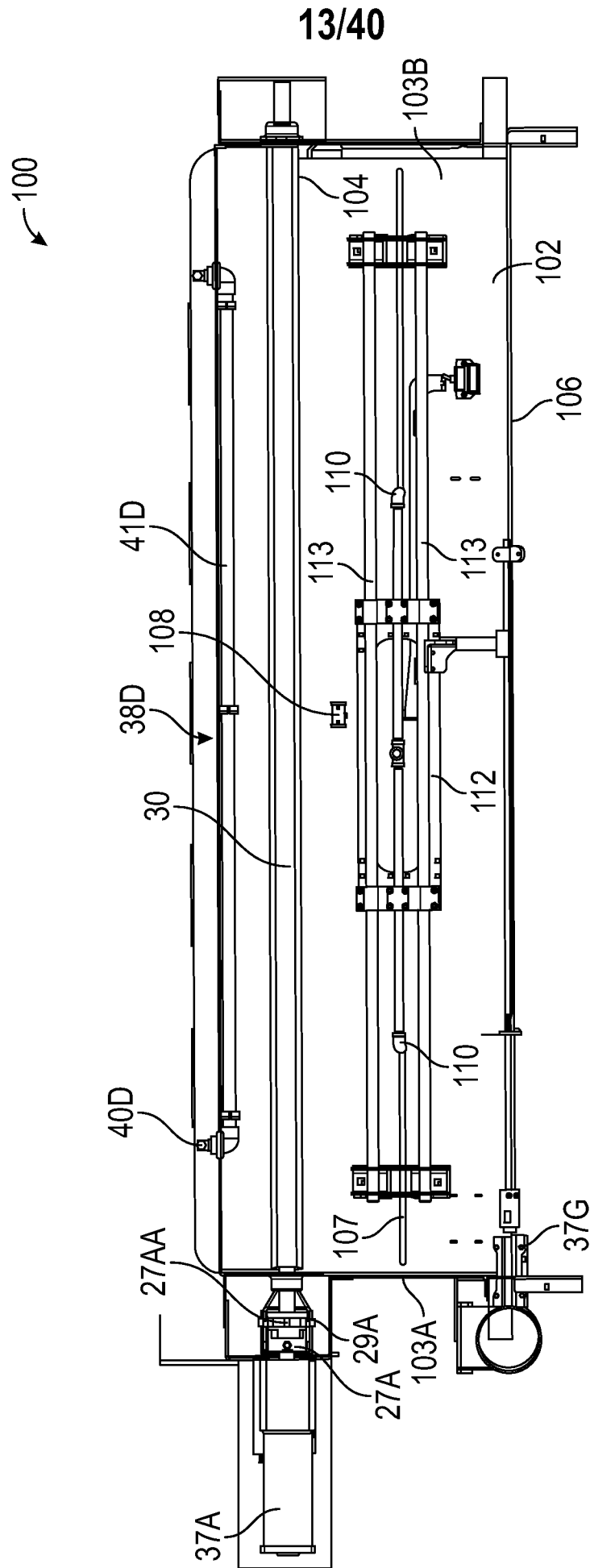


FIG. 14

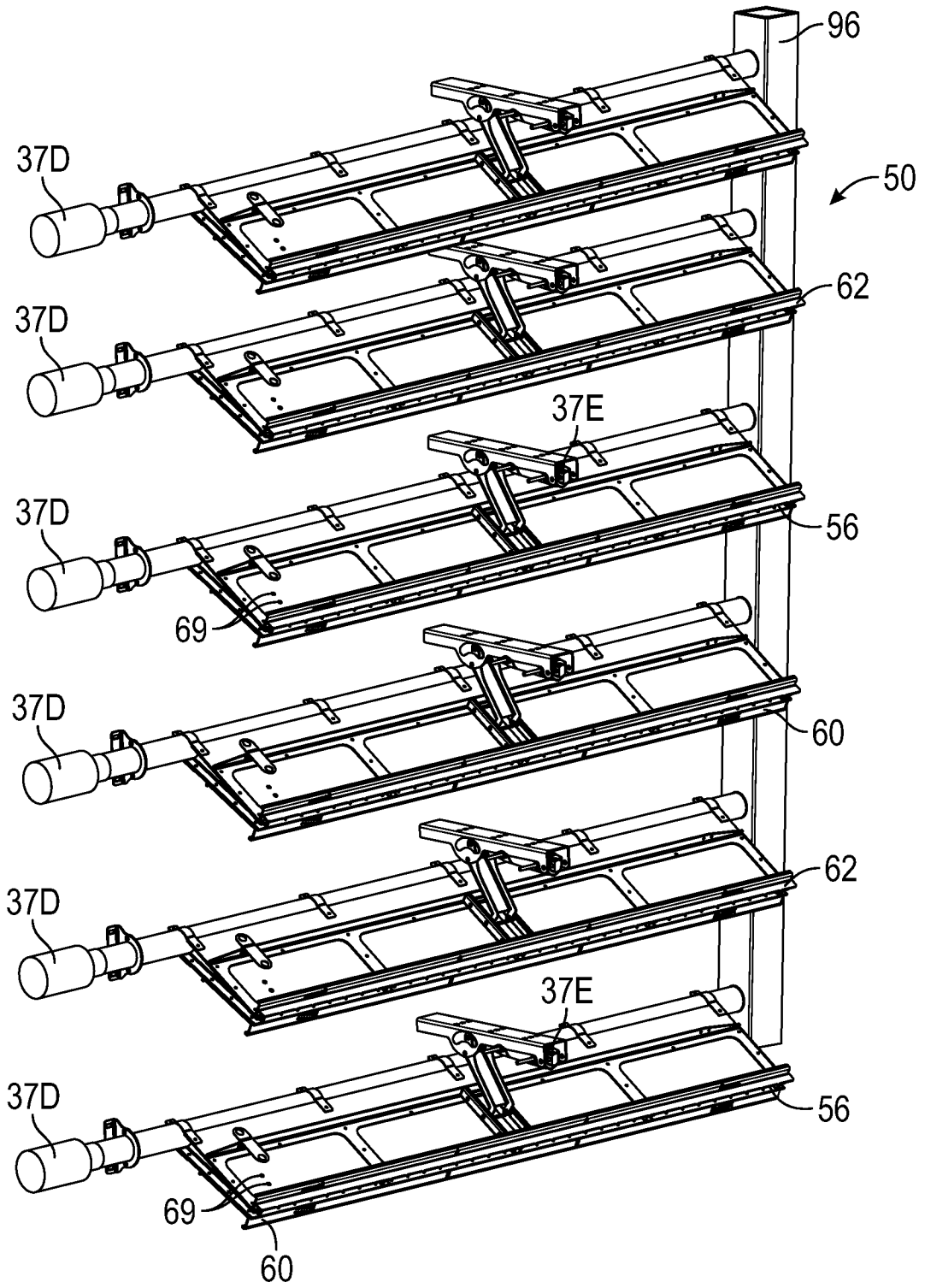


FIG. 15

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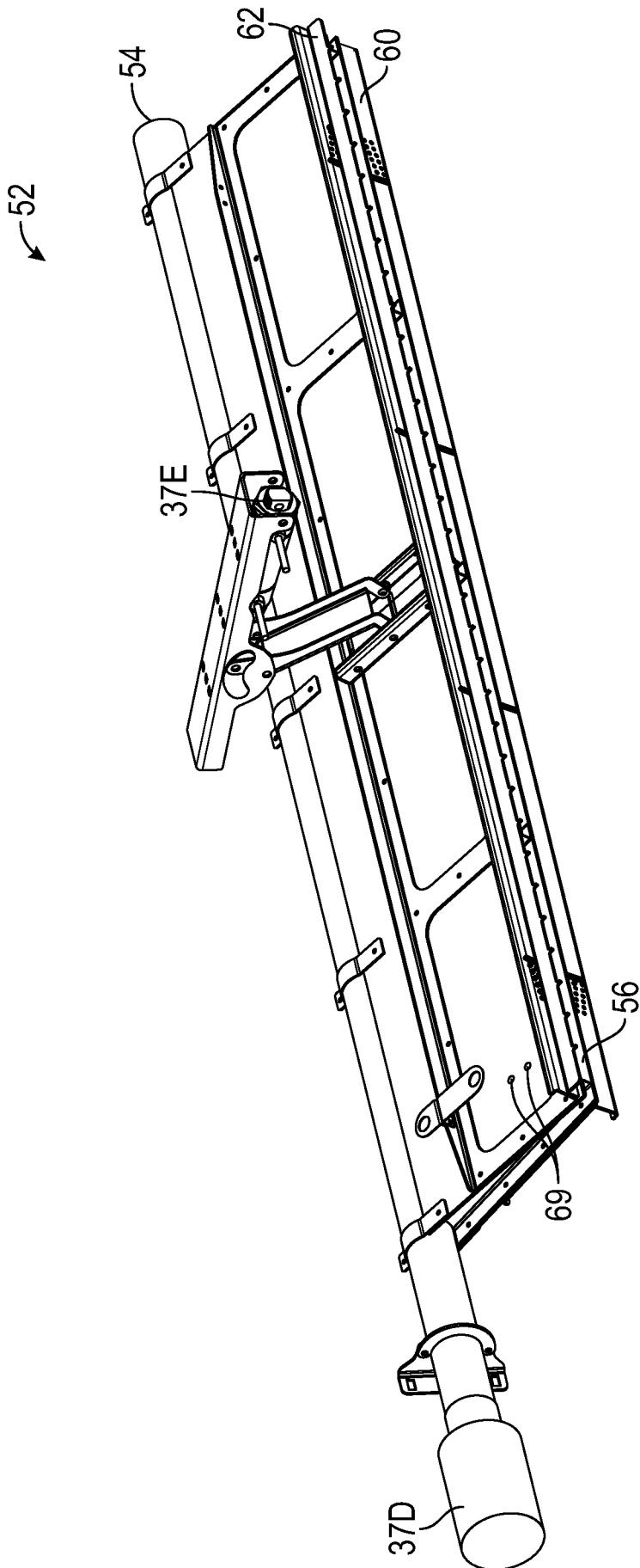


FIG. 16

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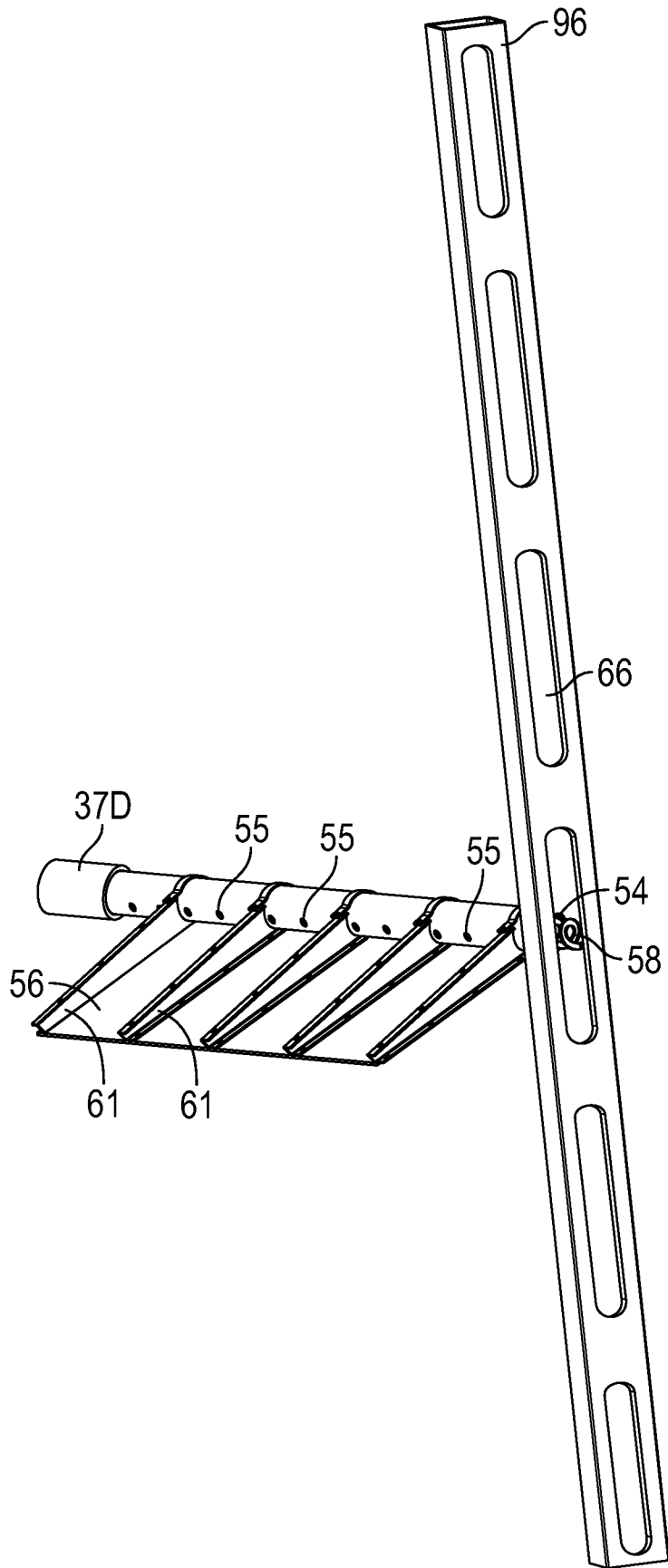


FIG. 17

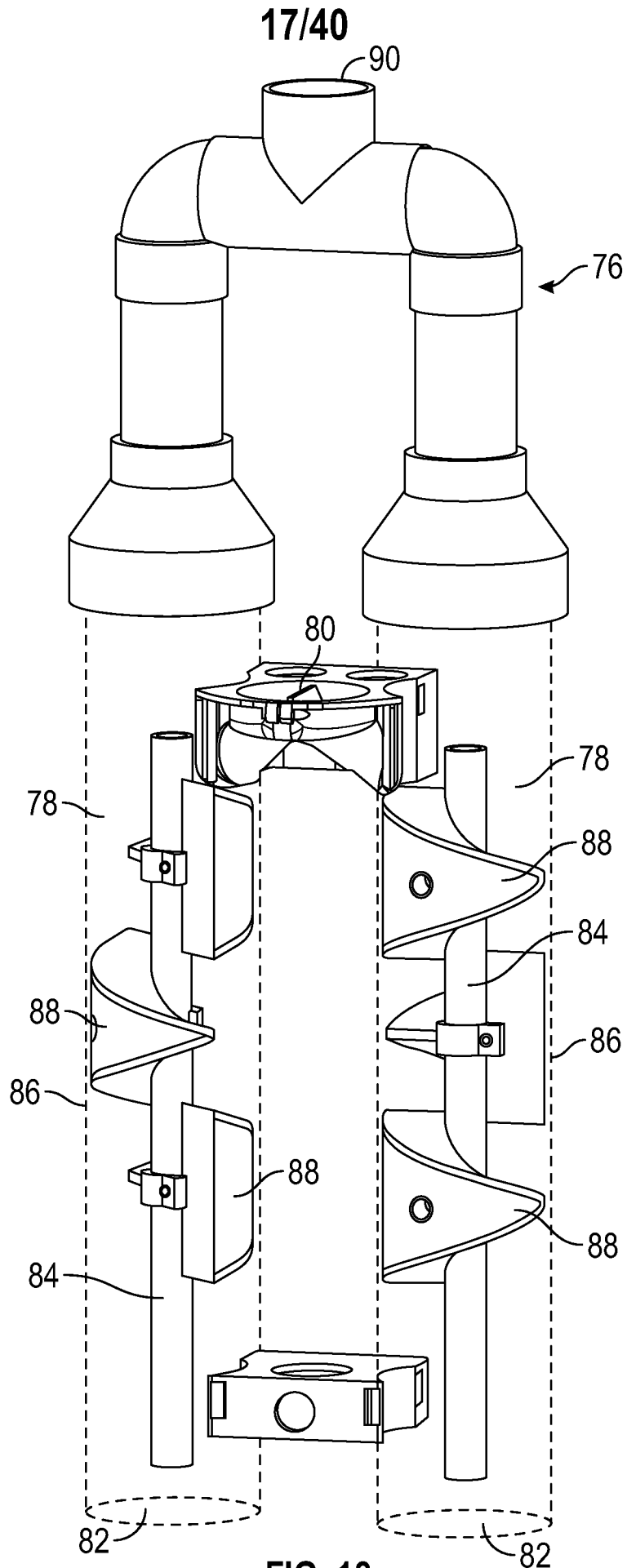


FIG. 18

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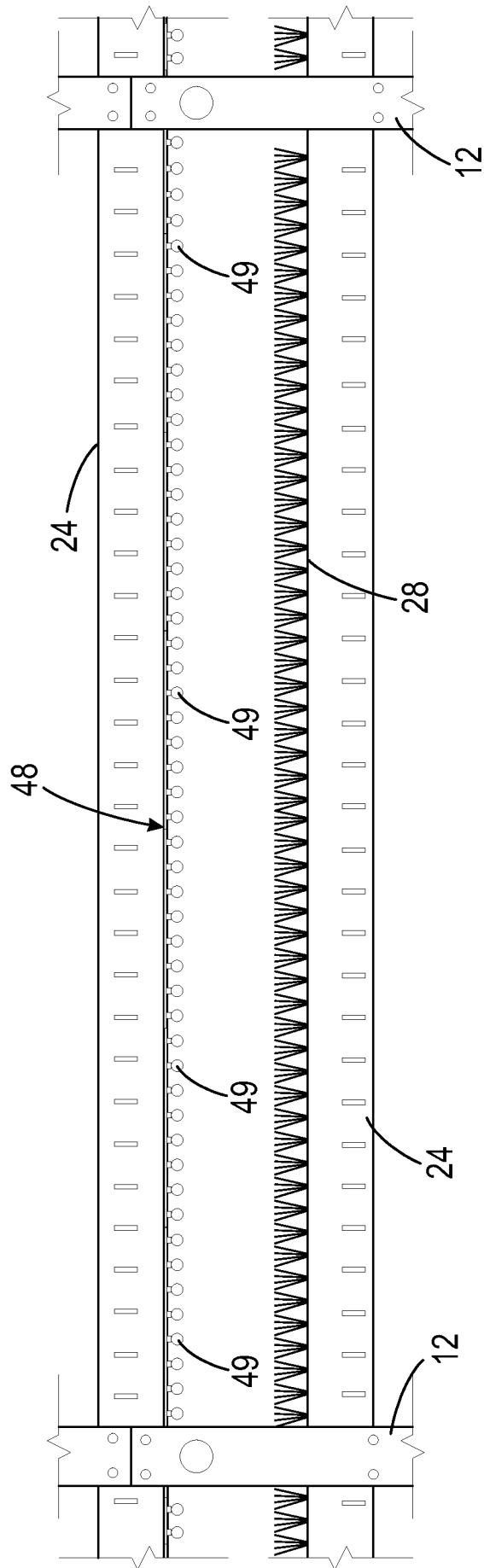


FIG. 19

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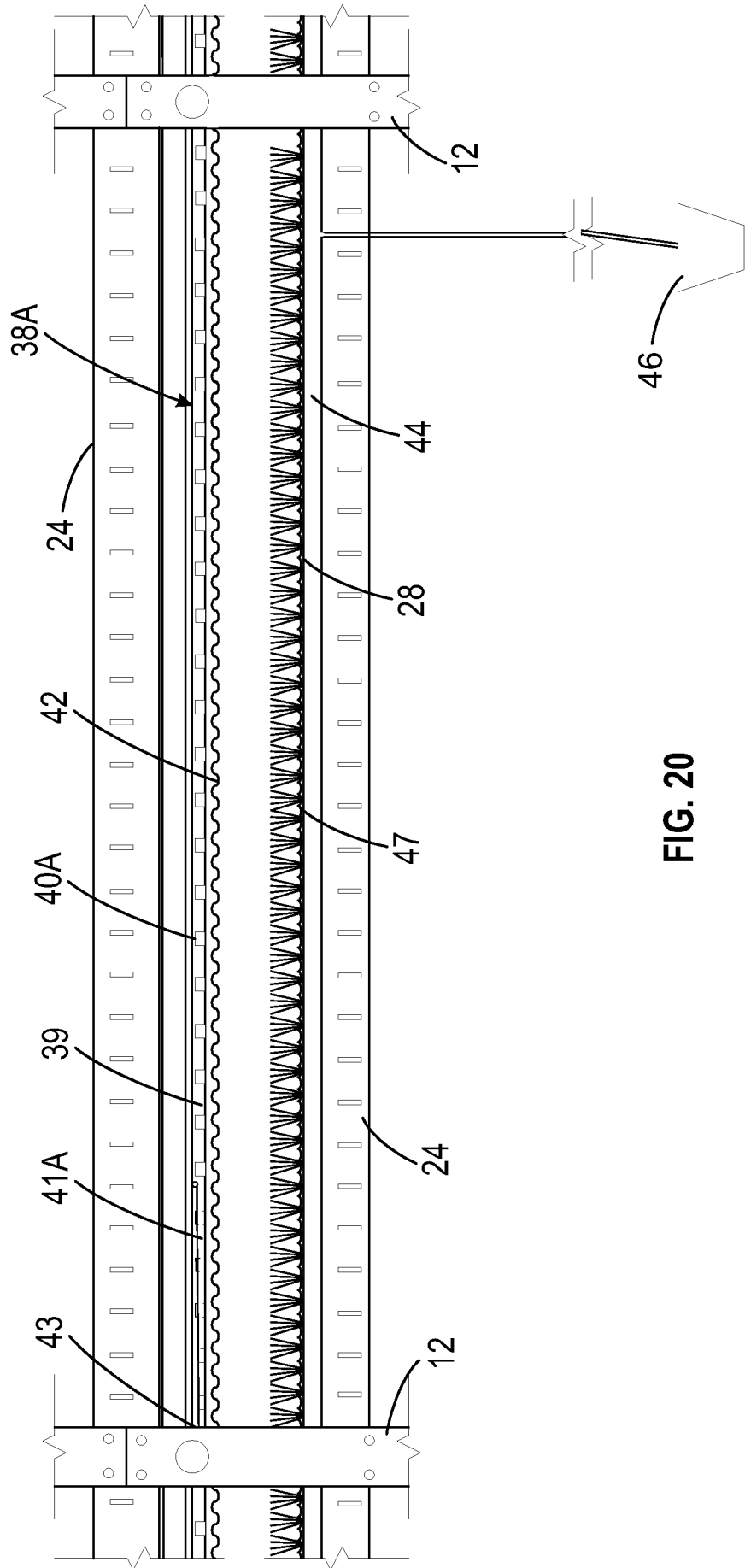


FIG. 20

20/40

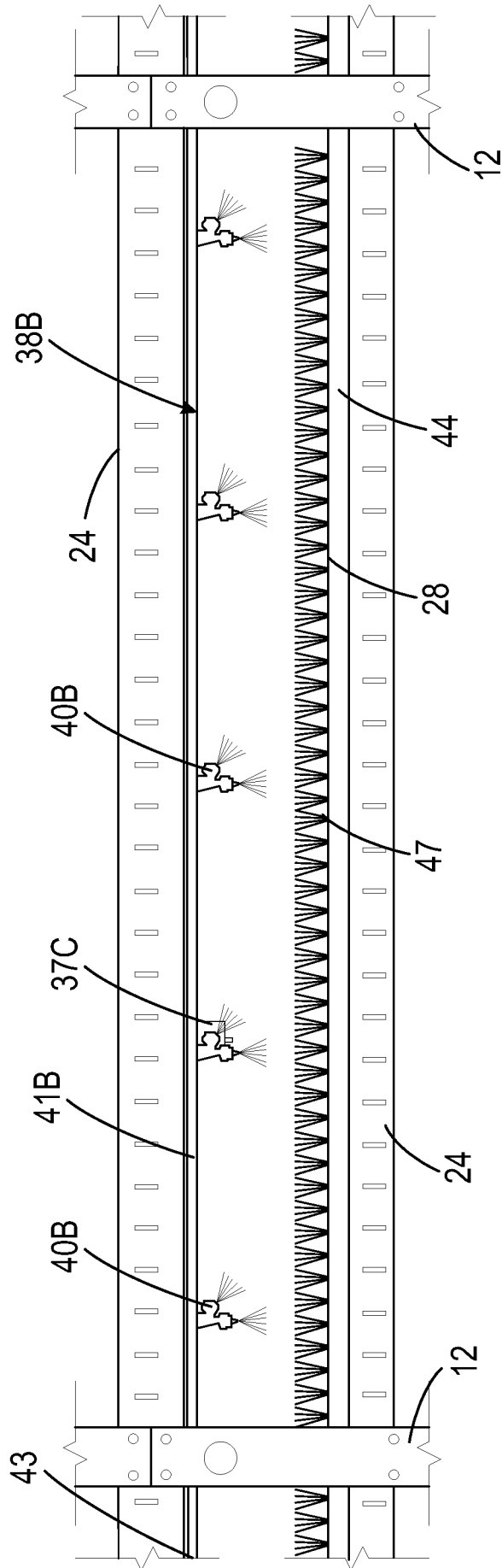


FIG. 21

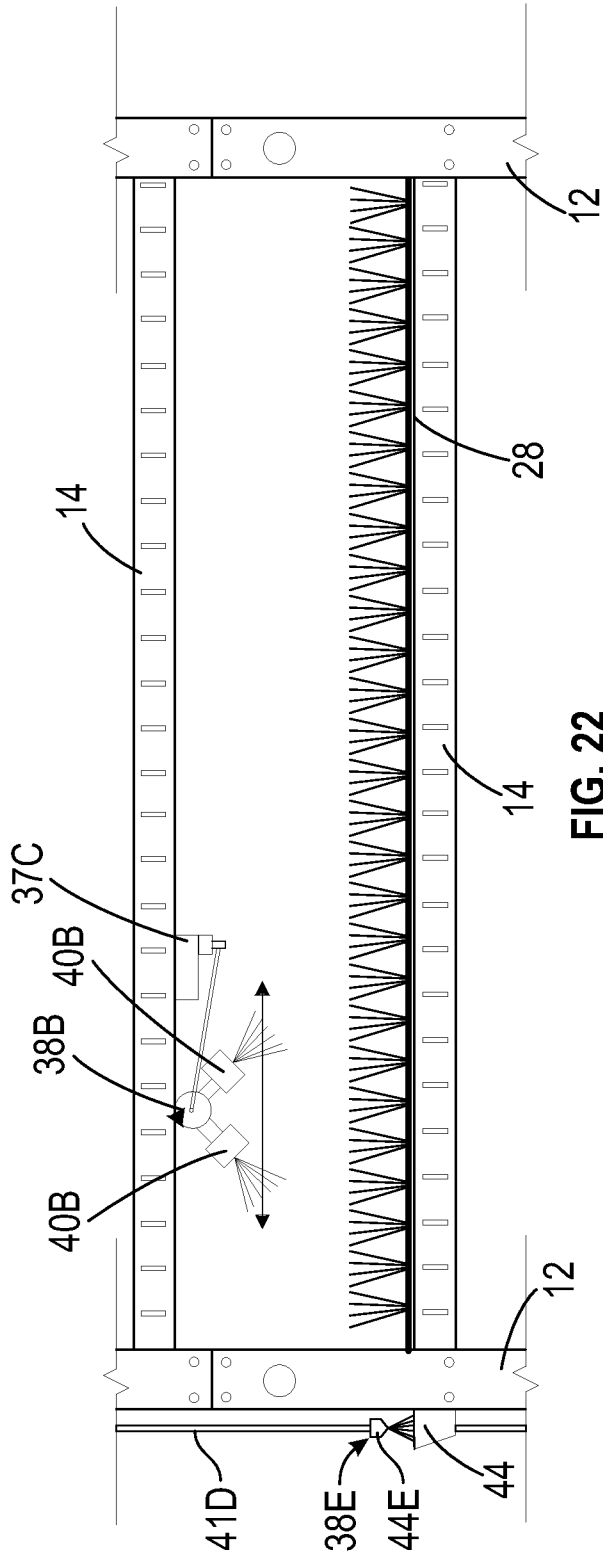


FIG. 22

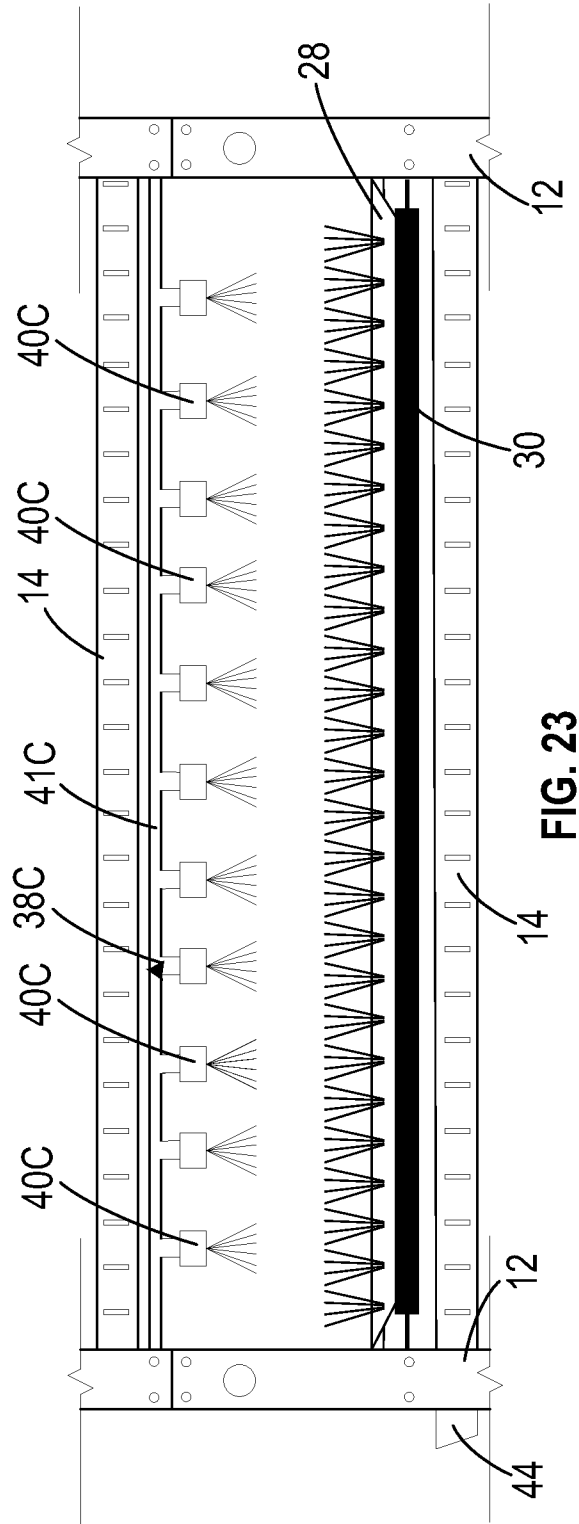


FIG. 23

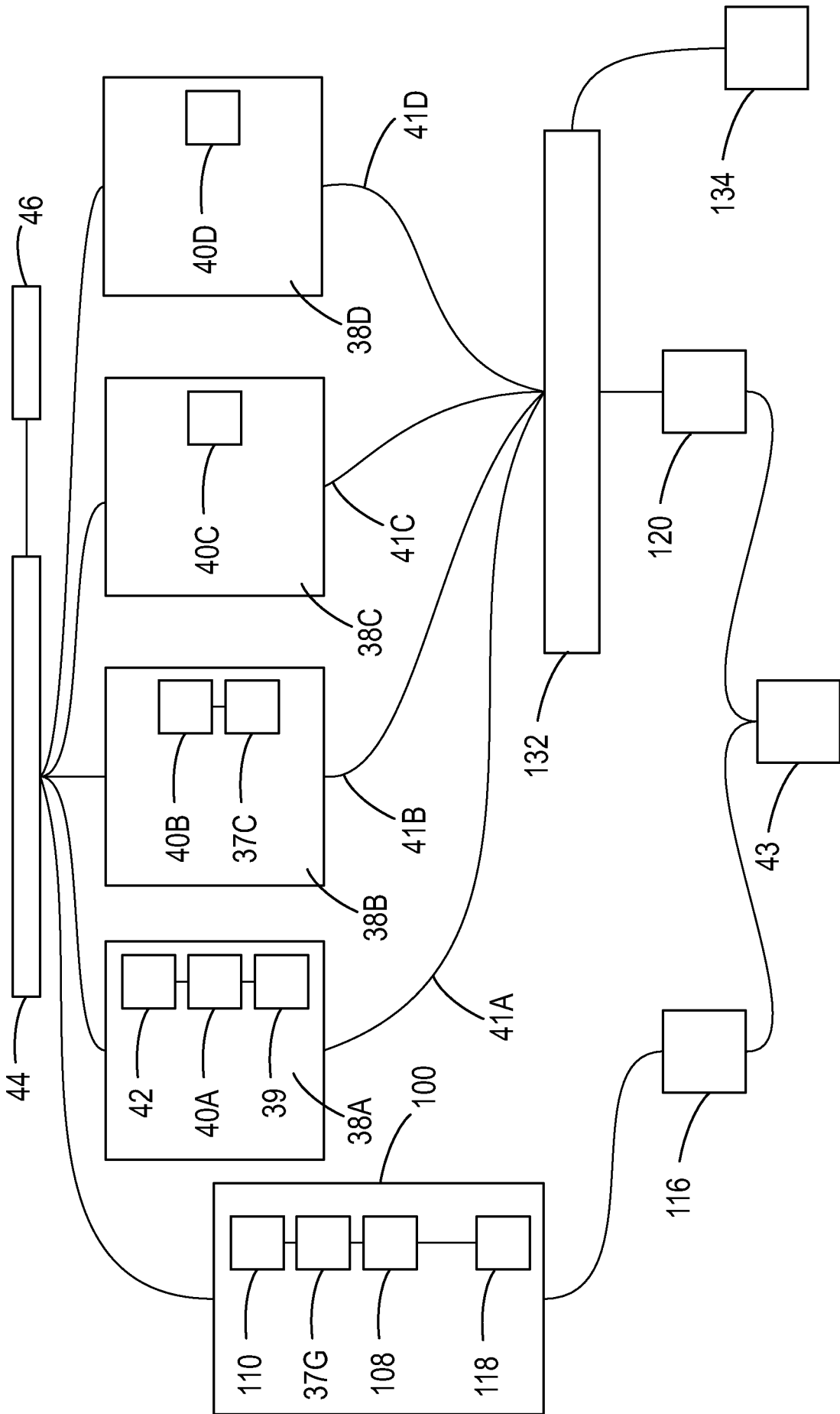


FIG. 24

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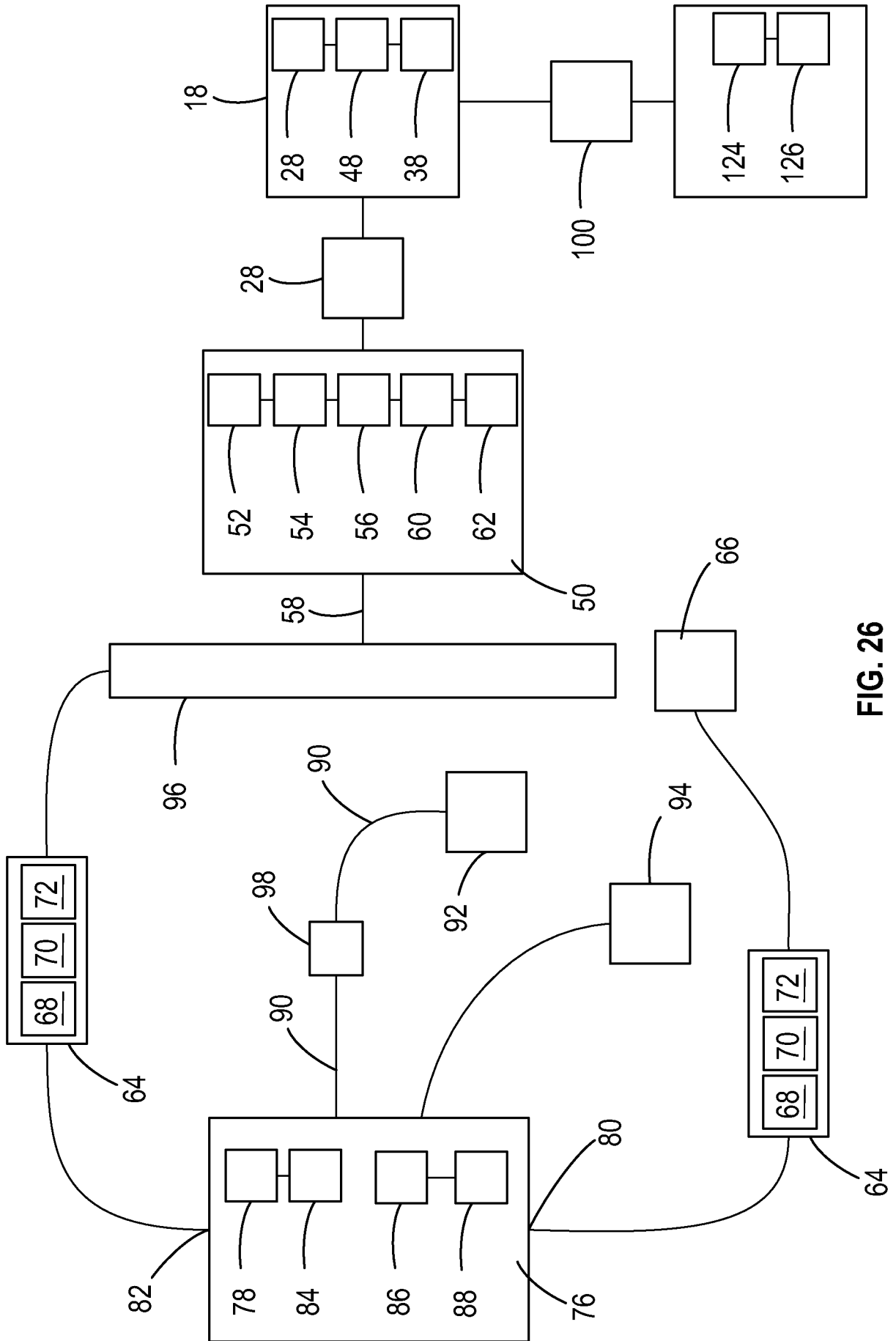


FIG. 26

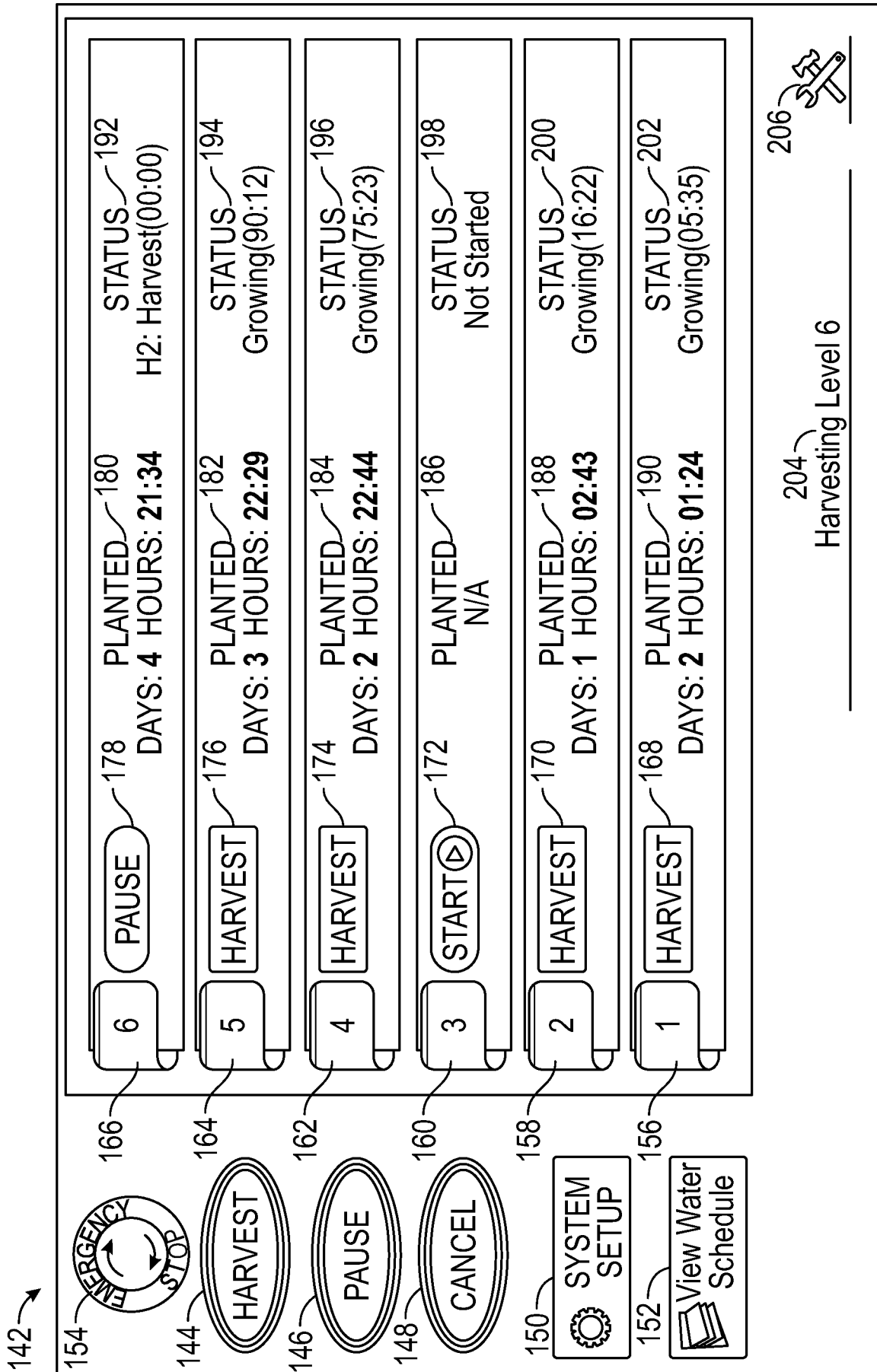


FIG. 27

208

Temp Humidity		STATUS	
HIGH	77.9	58.4	
LOW	32.0	0.0	
AVG	69.1	46.5	

Temp Humidity		STATUS	
	1.89	Growing	(53:58)
		Growing	(00:08)
		Growing	(56:12)
		Growing	(47:12)
		Drip	(04:19)

Would you like to have rest last?
The oldest: level 6

Yes No

Watering Level 1...

FIG. 28

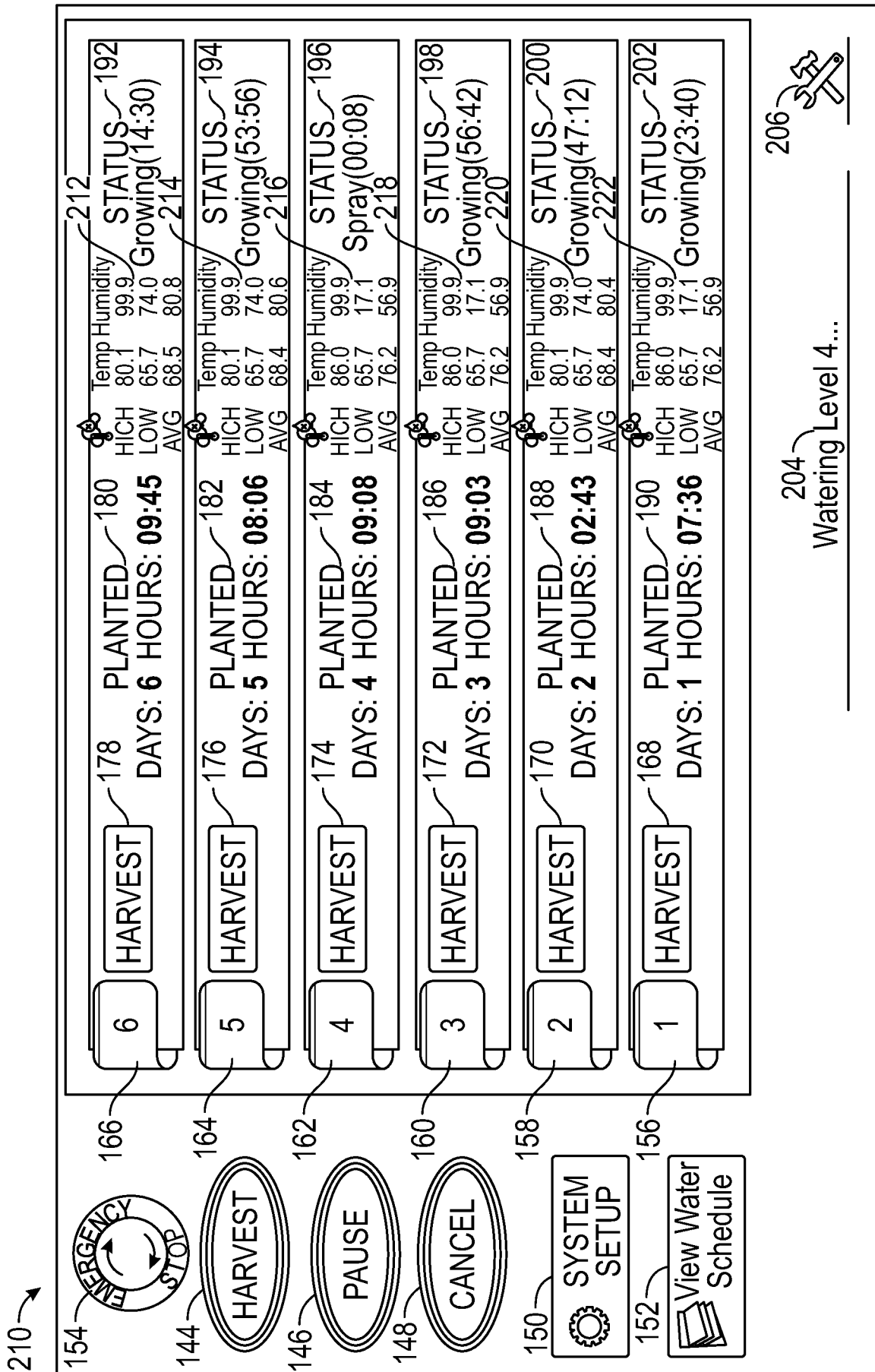


FIG. 29

224 ↙

Schedule Setup

MASTER

LEVEL 1

LEVEL 2

LEVEL 3

LEVEL 4

LEVEL 5

LEVEL 6

228 226 156 158 160 162 164 166

230 232 234

	Start Time	Last Watered	Next Water	
LEVEL 6	04/30/2017 10:00:00	05/05/2017 13:20:00	05/05/2017 14:40:00	<input type="checkbox"/> Drip <input checked="" type="checkbox"/> Spray UPDATE
LEVEL 5	05/01/2017 10:00:00	05/05/2017 13:30:17	05/05/2017 14:06:32	<input checked="" type="checkbox"/> Drip <input type="checkbox"/> Spray UPDATE
LEVEL 4	05/02/2017 10:00:00	05/05/2017 13:40:31	05/05/2017 14:06:31	<input checked="" type="checkbox"/> Drip <input type="checkbox"/> Spray UPDATE
LEVEL 3	05/03/2017 10:00:00	05/05/2017 13:00:43	05/05/2017 15:00:43	<input checked="" type="checkbox"/> Drip <input checked="" type="checkbox"/> Spray UPDATE
LEVEL 2	05/04/2017 10:00:00	05/05/2017 13:00:57	05/05/2017 15:00:57	<input type="checkbox"/> Drip <input checked="" type="checkbox"/> Spray UPDATE
LEVEL 1	05/05/2017 10:00:00	05/05/2017 13:58:11	05/05/2017 14:06:26	<input type="checkbox"/> Drip <input checked="" type="checkbox"/> Spray UPDATE

236 238 240 242 244 246

248 250 252 254 256 258

260 204

Watering Level 1
BACK

FIG. 30

262

228 Schedule Setup		226 MASTER		258 LEVEL 1		260 LEVEL 2		262 LEVEL 3		264 LEVEL 4		266 LEVEL 5		268 LEVEL 6							
270 Quarter		272 S_ON		274 S_OFF		276 D_ON		278 D_OFF		280 S_ON		282 S_OFF		284 D_ON		286 D_OFF					
Water Minutes Day 1 / Qtr 1		1.5		10.0		2.0		15.0		Water Minutes Day 4 / Qtr 1		1.0		20.0		60.0					
Water Minutes Day 1 / Qtr 2		1.5		10.0		1.0		15.0		Water Minutes Day 4 / Qtr 2		1.0		30.0		60.0					
Water Minutes Day 1 / Qtr 3		1.0		15.0		1.0		60.0		Water Minutes Day 4 / Qtr 3		1.0		30.0		60.0					
Water Minutes Day 1 / Qtr 4		0.5		60.0		0.0		60.0		Water Minutes Day 5 / Qtr 1		1.0		30.0		60.0					
Water Minutes Day 2 / Qtr 1		0.3		160.0		0.0		60.0		Water Minutes Day 5 / Qtr 2		1.0		40.0		60.0					
Water Minutes Day 2 / Qtr 2		0.3		140.0		0.0		60.0		Water Minutes Day 5 / Qtr 3		1.0		40.0		60.0					
Water Minutes Day 2 / Qtr 3		0.5		120.0		0.0		60.0		Water Minutes Day 5 / Qtr 4		1.0		40.0		60.0					
Water Minutes Day 2 / Qtr 4		0.5		60.0		1.0		60.0		Water Minutes Day 6 / Qtr 1		1.0		40.0		60.0					
Water Minutes Day 3 / Qtr 1		0.5		60.0		1.5		60.0		Water Minutes Day 6 / Qtr 2		1.0		40.0		60.0					
Water Minutes Day 3 / Qtr 2		0.5		60.0		2.0		60.0		Water Minutes Day 6 / Qtr 3		0.5		40.0		60.0					
Water Minutes Day 3 / Qtr 3		0.5		60.0		2.0		60.0		Water Minutes Day 6 / Qtr 4		0.5		40.0		60.0					
Water Minutes Day 3 / Qtr 4		0.5		60.0		2.0		60.0		Water Minutes Days > 6		0.5		40.0		60.0					
260		280		282		284		286		266		268		280		282		284		286	
BACK		RESET		APPLY		Watering Level 1 ...															

FIG. 31

288

228 Schedule Setup		226 MASTER		256 LEVEL 1		258 LEVEL 2		260 LEVEL 3		262 LEVEL 4		264 LEVEL 5		266 LEVEL 6	
270 Quarter	272 S_ON	274 S_OFF	276 D_ON	278 D_OFF	270 Quarter	272 S_ON	274 S_OFF	276 D_ON	278 D_OFF	270 Quarter	272 S_ON	274 S_OFF	276 D_ON	278 D_OFF	
Water Minutes Day 1 / Qtr 1	1.5	10.0	2.0	15.0	Water Minutes Day 4 / Qtr 1	1.0	20.0	2.0	60.0	Water Minutes Day 4 / Qtr 1	1.0	20.0	2.0	60.0	
Water Minutes Day 1 / Qtr 2	1.5	10.0	1.0	15.0	Water Minutes Day 4 / Qtr 2	1.0	30.0	2.0	60.0	Water Minutes Day 4 / Qtr 2	1.0	30.0	2.0	60.0	
Water Minutes Day 1 / Qtr 3	1.0	15.0	1.0	60.0	Water Minutes Day 4 / Qtr 3	1.0	30.0	2.0	60.0	Water Minutes Day 4 / Qtr 3	1.0	30.0	2.0	60.0	
Water Minutes Day 1 / Qtr 4	0.5	60.0	0.0	60.0	Water Minutes Day 5 / Qtr 1	1.0	30.0	0.0	60.0	Water Minutes Day 5 / Qtr 1	1.0	30.0	2.0	60.0	
Water Minutes Day 2 / Qtr 1	0.3	160.0	0.0	60.0	Water Minutes Day 5 / Qtr 2	1.0	40.0	2.0	60.0	Water Minutes Day 5 / Qtr 2	1.0	40.0	2.0	60.0	
Water Minutes Day 2 / Qtr 2	0.3	140.0	0.0	60.0	Water Minutes Day 5 / Qtr 3	1.0	40.0	2.0	60.0	Water Minutes Day 5 / Qtr 3	1.0	40.0	2.0	60.0	
Water Minutes Day 2 / Qtr 3	0.5	120.0	0.0	60.0	Water Minutes Day 5 / Qtr 4	1.0	40.0	0.0	60.0	Water Minutes Day 5 / Qtr 4	1.0	40.0	0.0	60.0	
Water Minutes Day 2 / Qtr 4	0.5	60.0	1.0	60.0	Water Minutes Day 6 / Qtr 1	1.0	40.0	2.0	60.0	Water Minutes Day 6 / Qtr 1	1.0	40.0	2.0	60.0	
Water Minutes Day 3 / Qtr 1	0.5	60.0	1.5	60.0	Water Minutes Day 6 / Qtr 2	1.0	40.0	2.0	60.0	Water Minutes Day 6 / Qtr 2	1.0	40.0	2.0	60.0	
Water Minutes Day 3 / Qtr 2	0.5	60.0	2.0	60.0	Water Minutes Day 6 / Qtr 3	0.5	40.0	2.0	60.0	Water Minutes Day 6 / Qtr 3	0.5	40.0	2.0	60.0	
Water Minutes Day 3 / Qtr 3	0.5	60.0	2.0	60.0	Water Minutes Day 6 / Qtr 4	0.5	40.0	2.0	60.0	Water Minutes Day 6 / Qtr 4	0.5	40.0	2.0	60.0	
Water Minutes Day 3 / Qtr 4	0.5	60.0	2.0	60.0	Water Minutes Days > 6	0.5	40.0	2.0	60.0	Water Minutes Days > 6	0.5	40.0	2.0	60.0	

260 BACK
266 RESET
268 APPLY

280 Watering Level 1 ...

282 284 286

FIG. 32

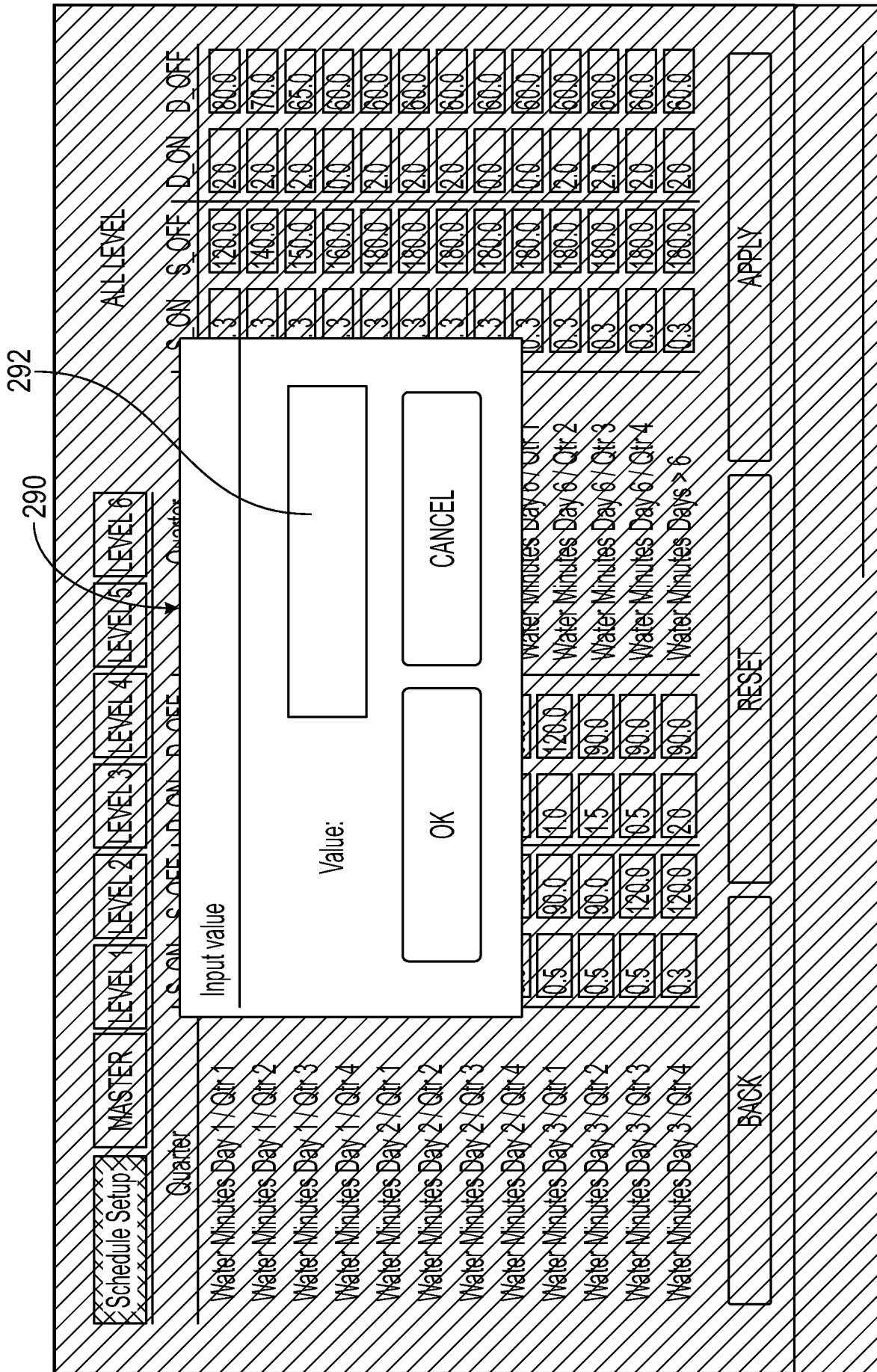


FIG. 33

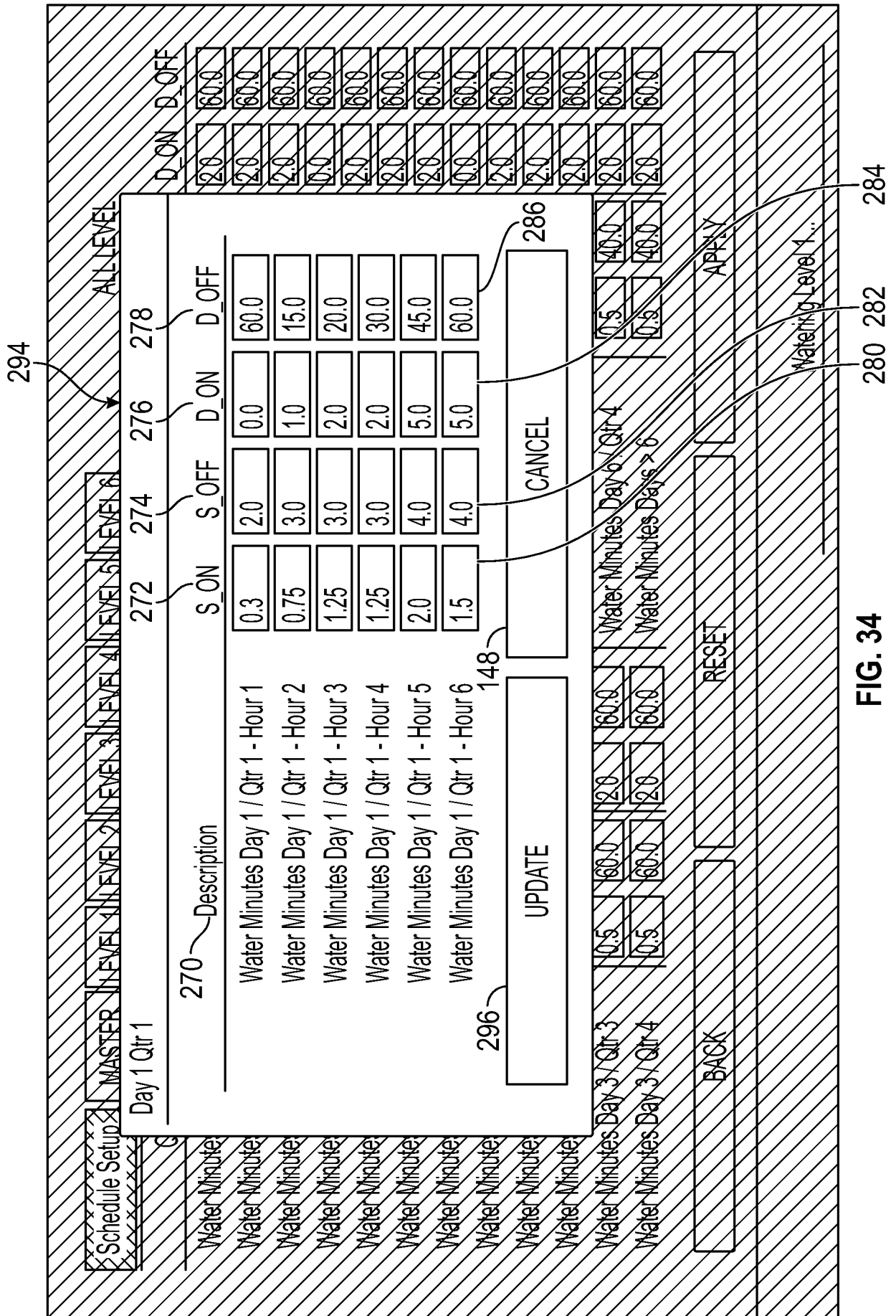


FIG. 34

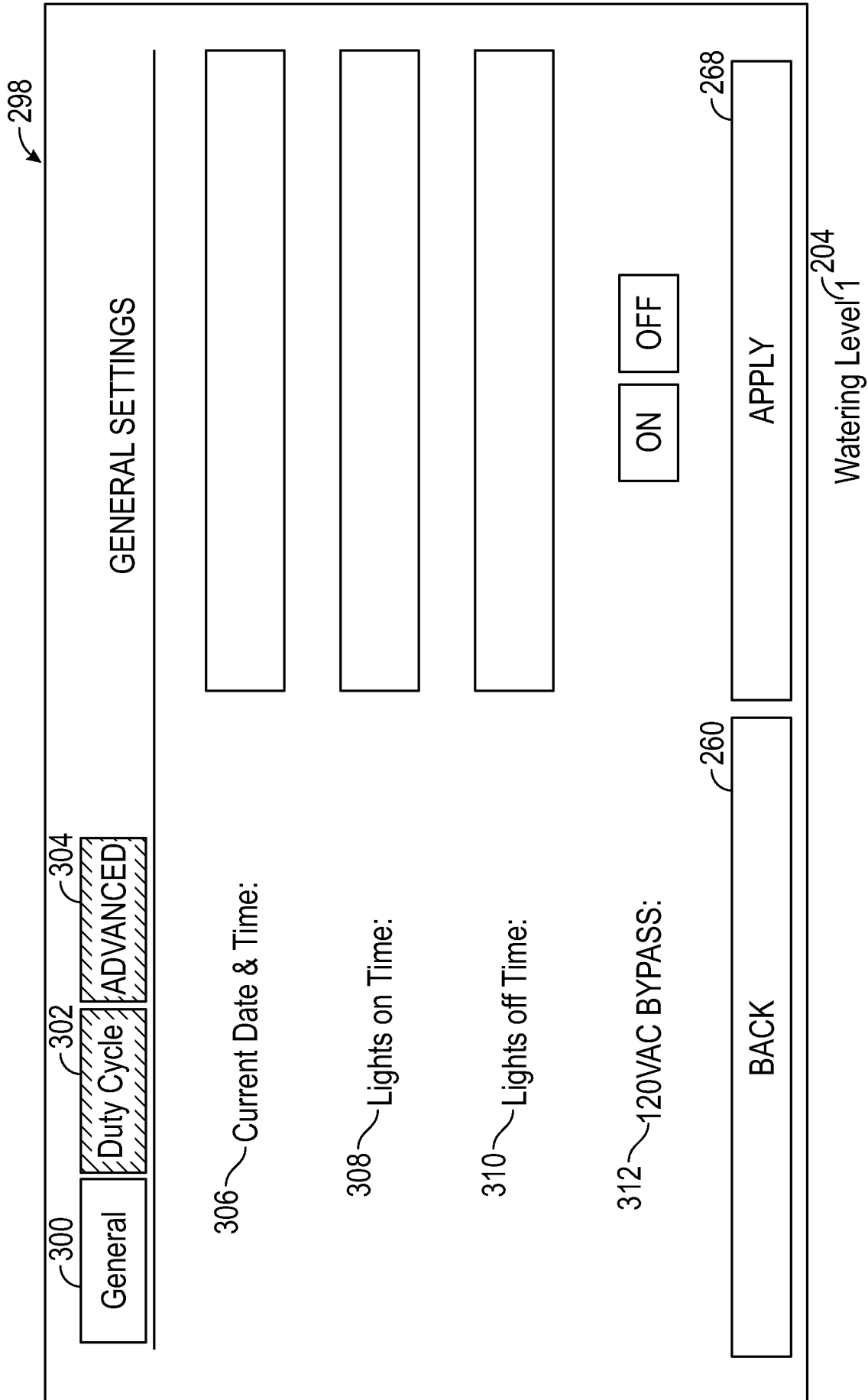


FIG. 35

314

General

Duty Cycle

ADVANCED

300

302

304

DUTY CYCLE SETTINGS

Starting Time	H-Motor	S-Motor	H-Motor	S-Motor
00:00	100 %	10 %	30 %	100 %
00:09	20 %	20 %	30 %	100 %
00:20	80 %	30 %	30 %	100 %
02:00	80 %	20 %	35 %	100 %
02:40	80 %	20 %	35 %	100 %
03:20	80 %	20 %	40 %	100 %
04:00	80 %	20 %	40 %	100 %
04:40	80 %	20 %	45 %	100 %
05:20	65 %	22 %	45 %	100 %
06:00	65 %	24 %	50 %	100 %
06:40	80 %	30 %	55 %	100 %
07:20	65 %	31 %	60 %	100 %
08:00	40 %	30 %	65 %	100 %
08:40	30 %	10 %	60 %	100 %

BACK

APPLY

316

318

320

322

324

260

268

H A R V E S T

S E E D

204

Watering Level 1...

FIG. 36

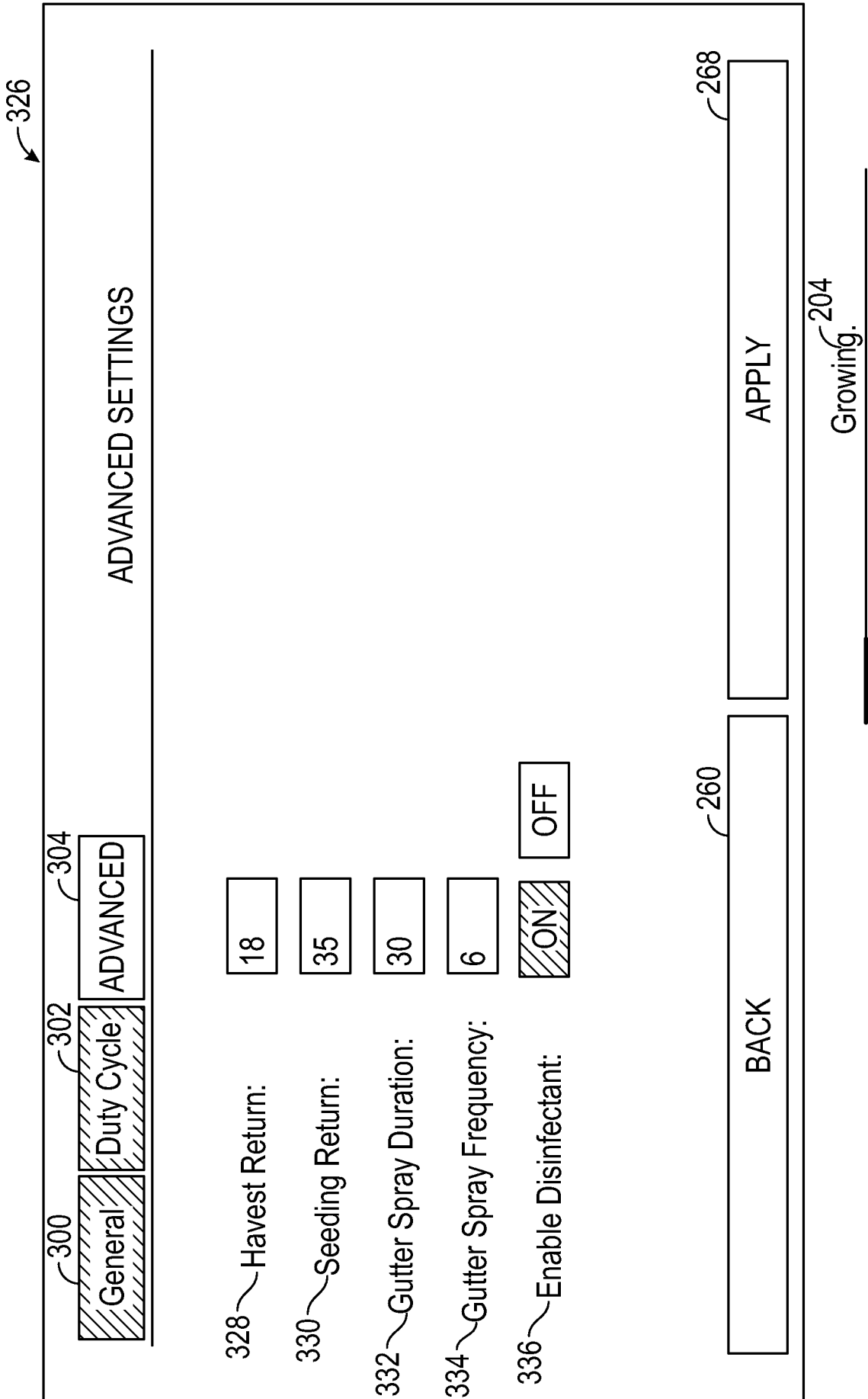


FIG. 37

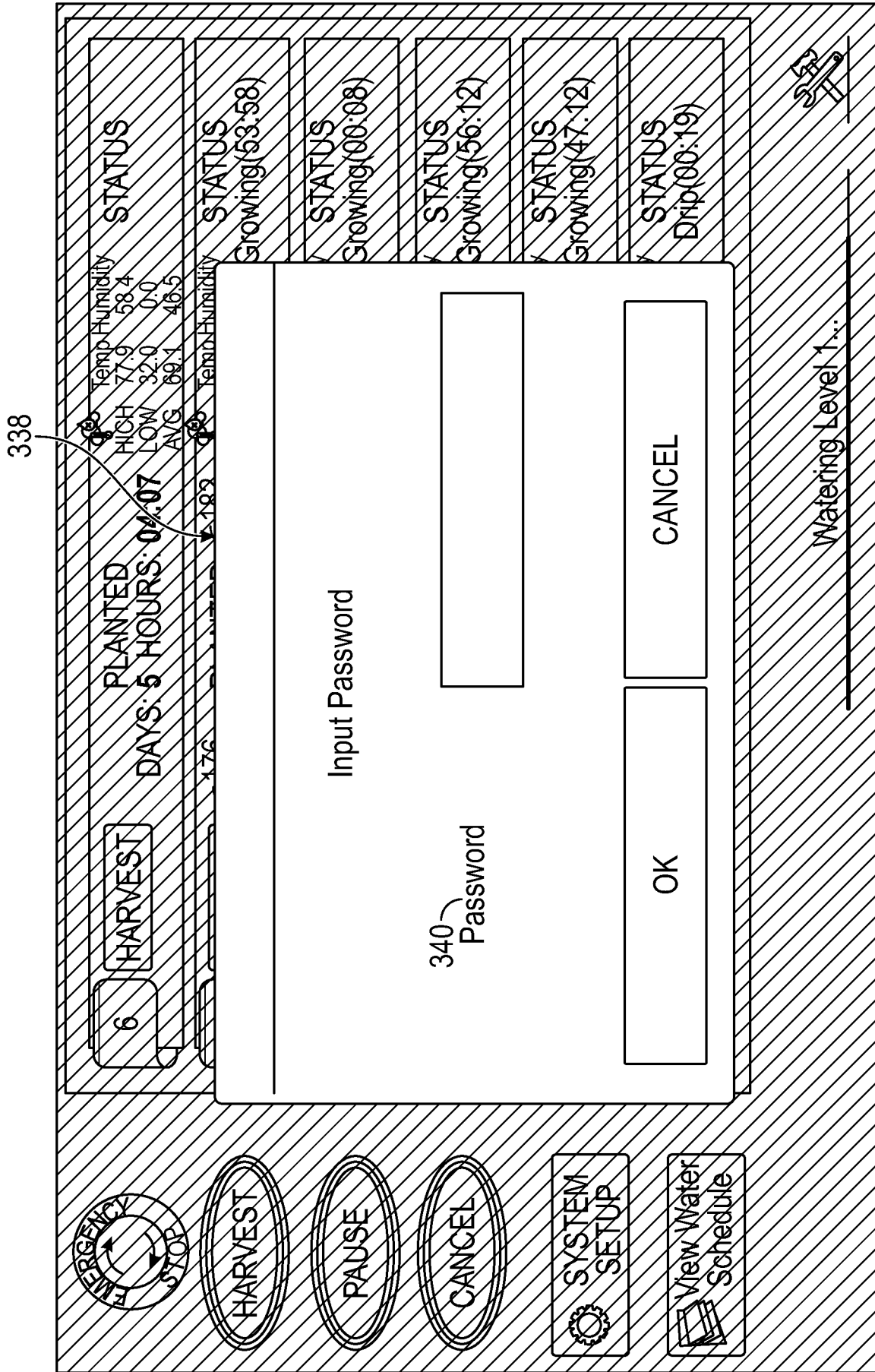


FIG. 38

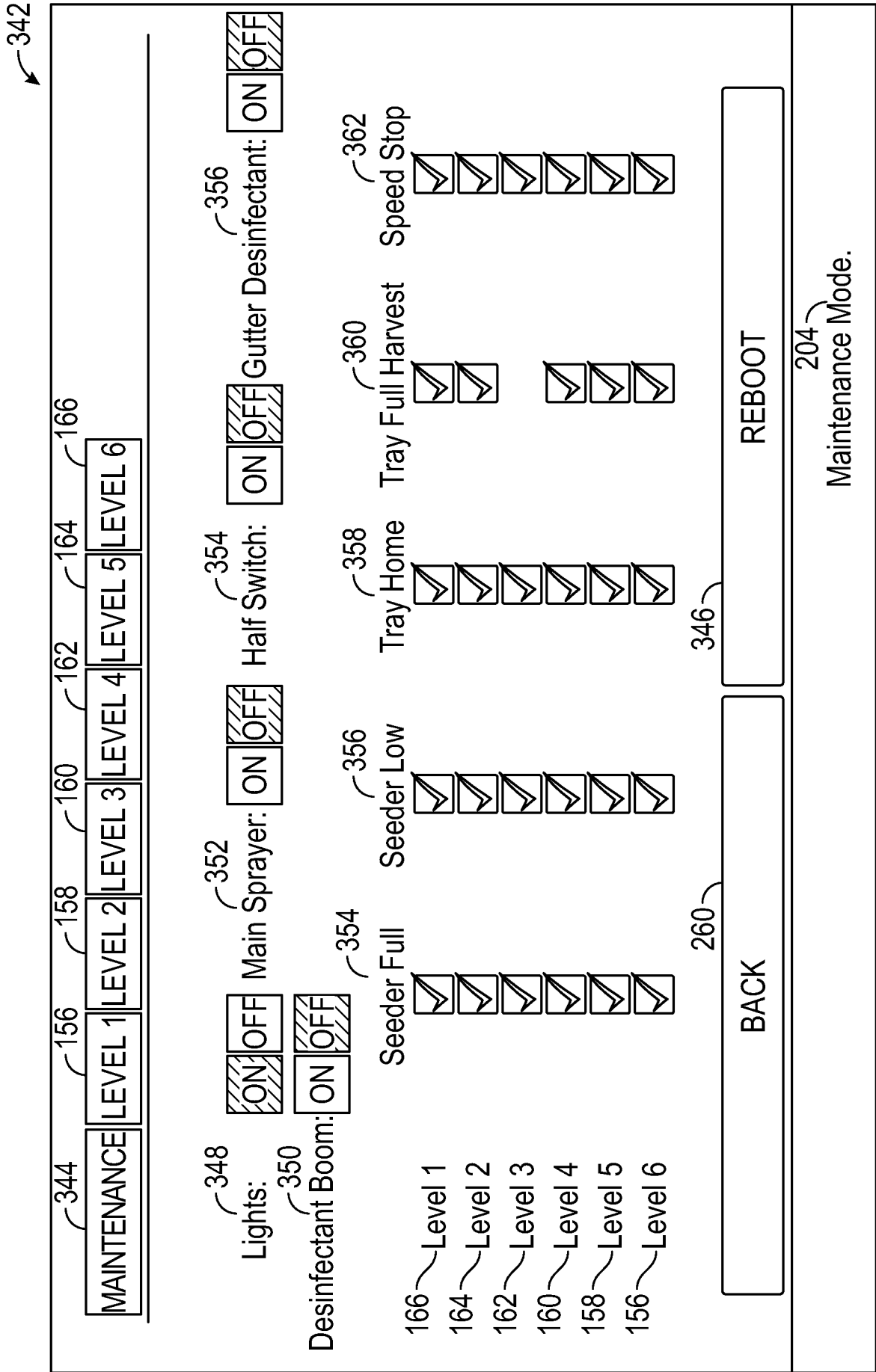


FIG. 39

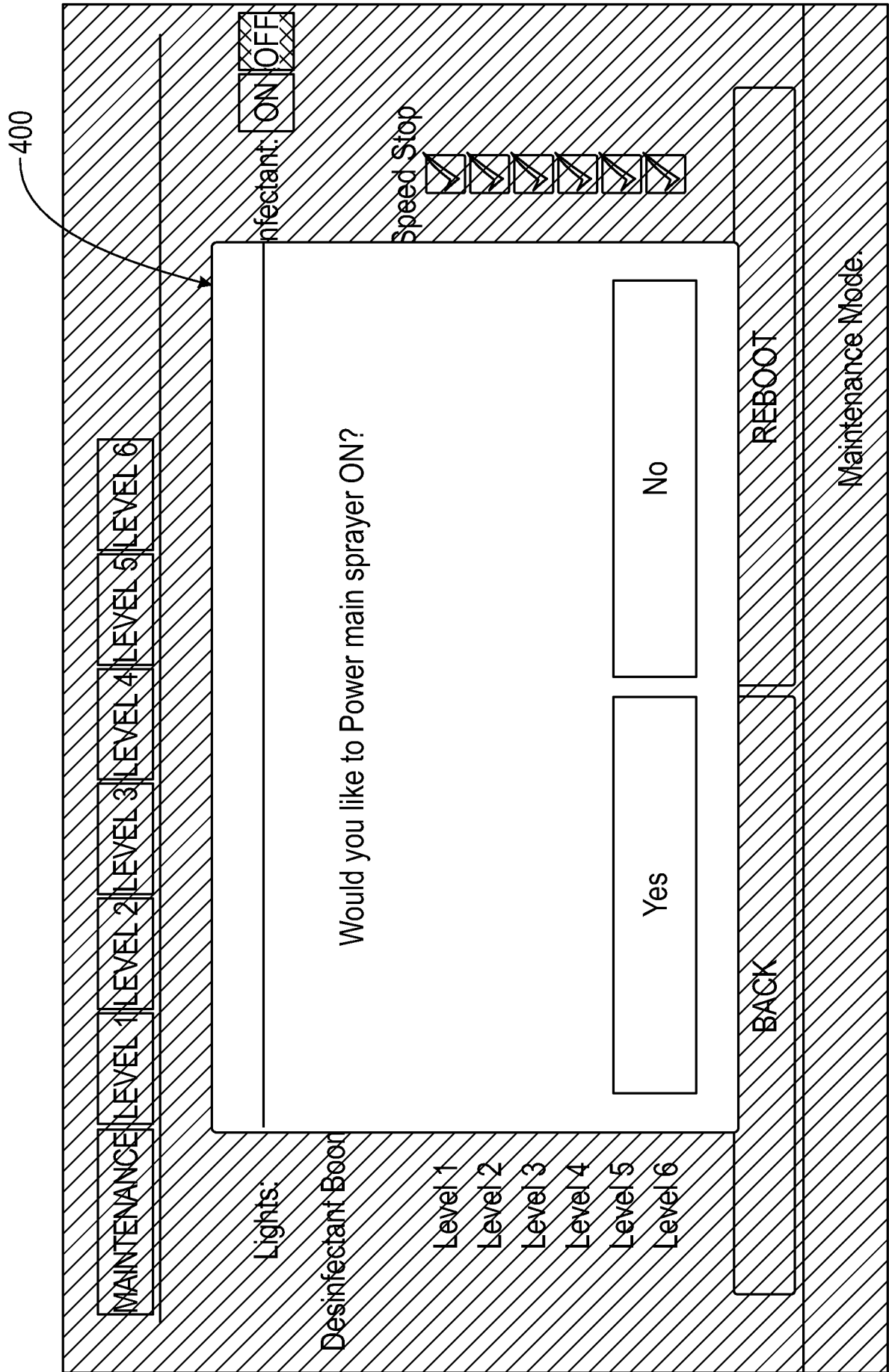


FIG. 40

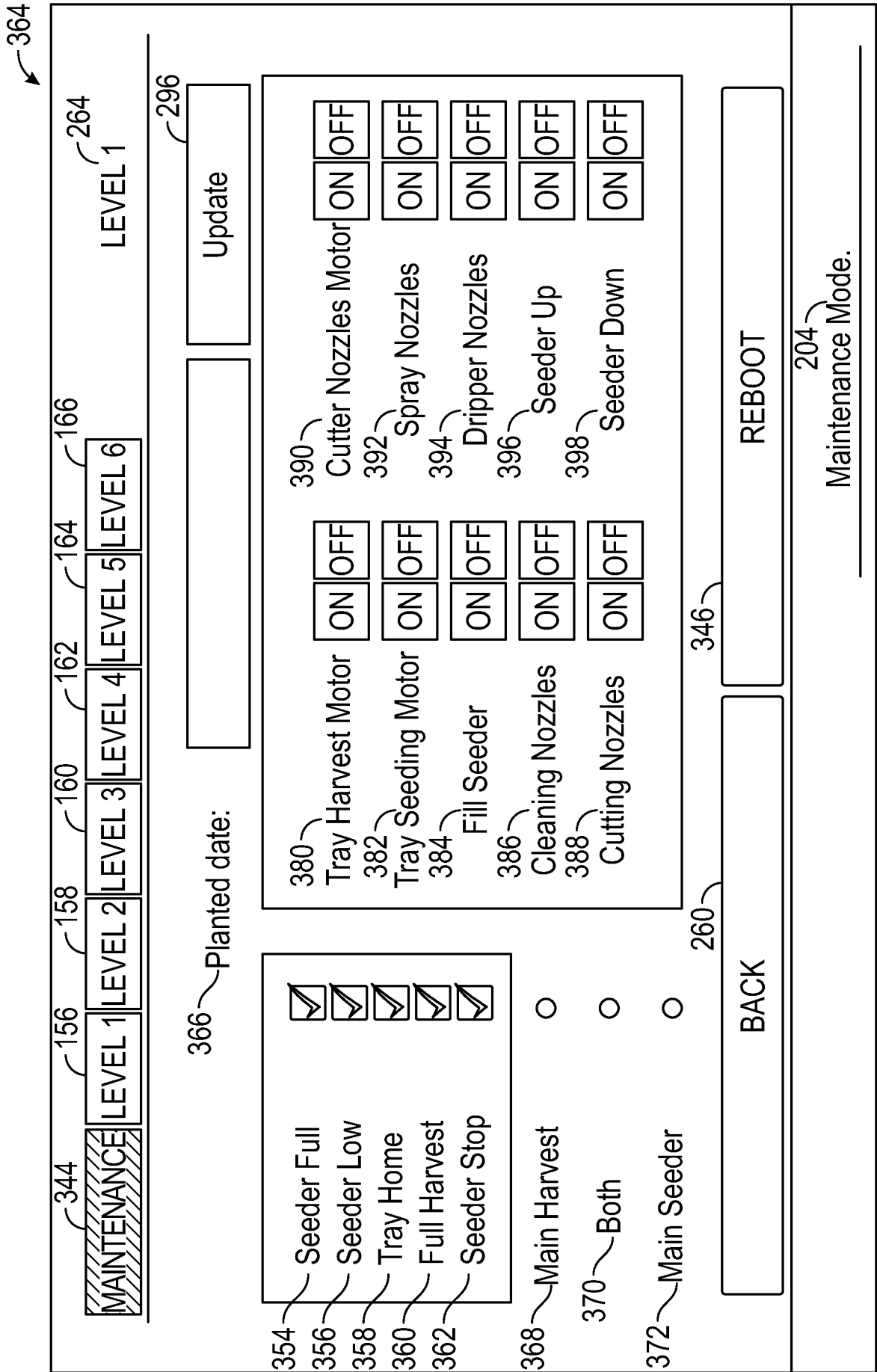


FIG. 41

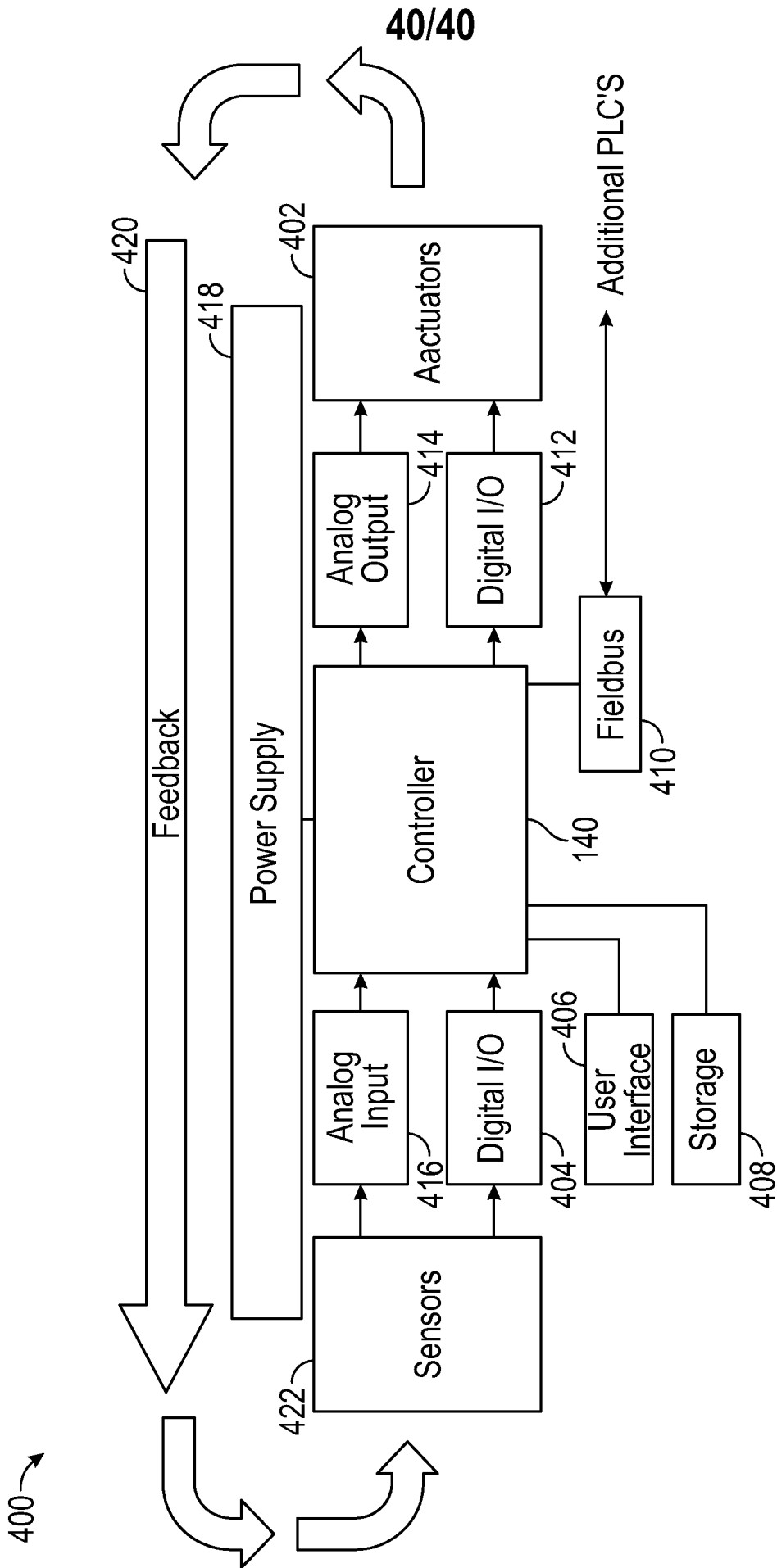


FIG. 42

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2020/018613

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(8) - A01G 31/06; A01G 9/02; A01G 9/24; A01G 31/04 (2020.01)
 CPC - A01G 31/06; A01G 9/24; A01G 31/00 (2020.02)

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)
 See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 USPC - 47/59R; 47/66.6 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 2016/0050862 A1 (GOT PRODUCE? FRANCHISING INC) 25 February 2016 (25.02.2016) entire document	9, 11-16, 18-20 ---
Y		1-8, 10, 17
Y	US 9,661,805 B1 (BALL HORTICULTURAL COMPANY) 30 May 2017 (30.05.2017) entire document	1-8, 10, 17
Y	WO 2017/030524 A1 (PBR LLC) 23 February 2017 (23.02.2017) entire document	6, 8
Y	US 2017/0223904 A1 (FODDER SOLUTIONS HOLDINGS PTY LTD) 10 August 2017 (10.08.2017) entire document	7
A	US 2017/0347547 A1 (NATUFIA LABS OÜ) 07 December 2017 (07.12.2017) entire document	1-20
P, A	US 2019/0075741 A1 (BABYLON MICRO-FARMS INC) 14 March 2019 (14.03.2019) entire document	1-20

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
 16 April 2020

Date of mailing of the international search report
05 MAY 2020

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