

March 18, 1969

C. M. SMITH ET AL
HYDROPONICS APPARATUS

3,432,965

Filed July 5, 1966

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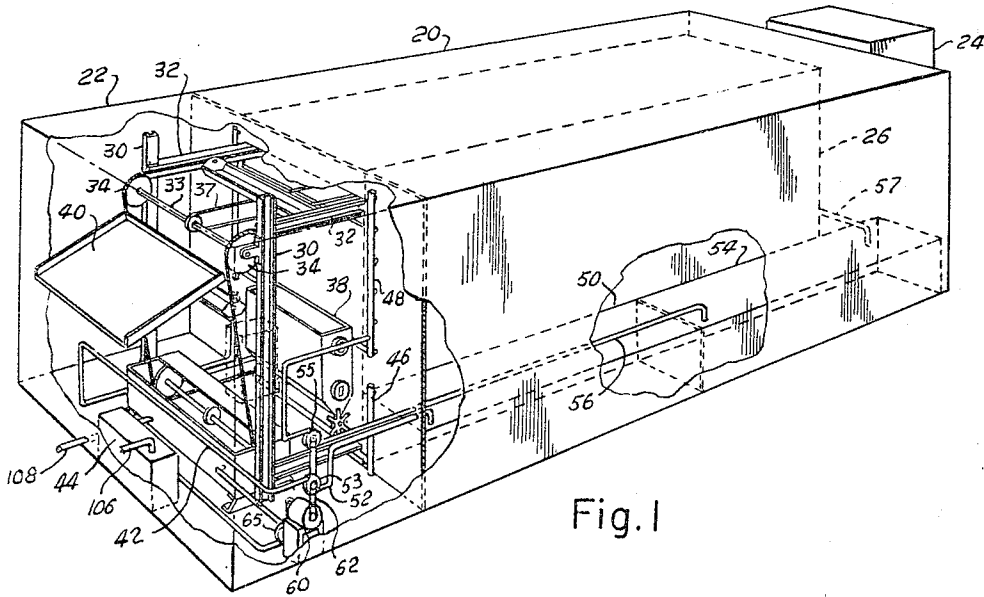
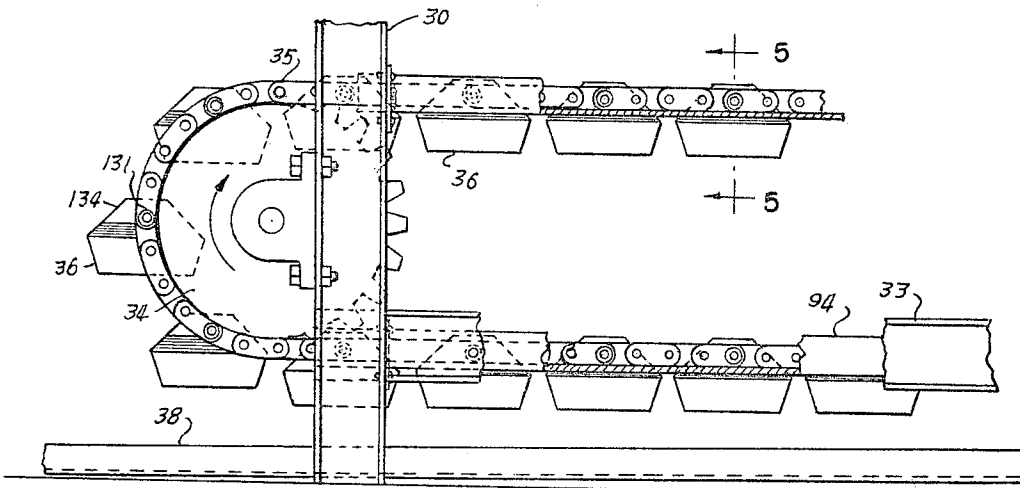


Fig. 1



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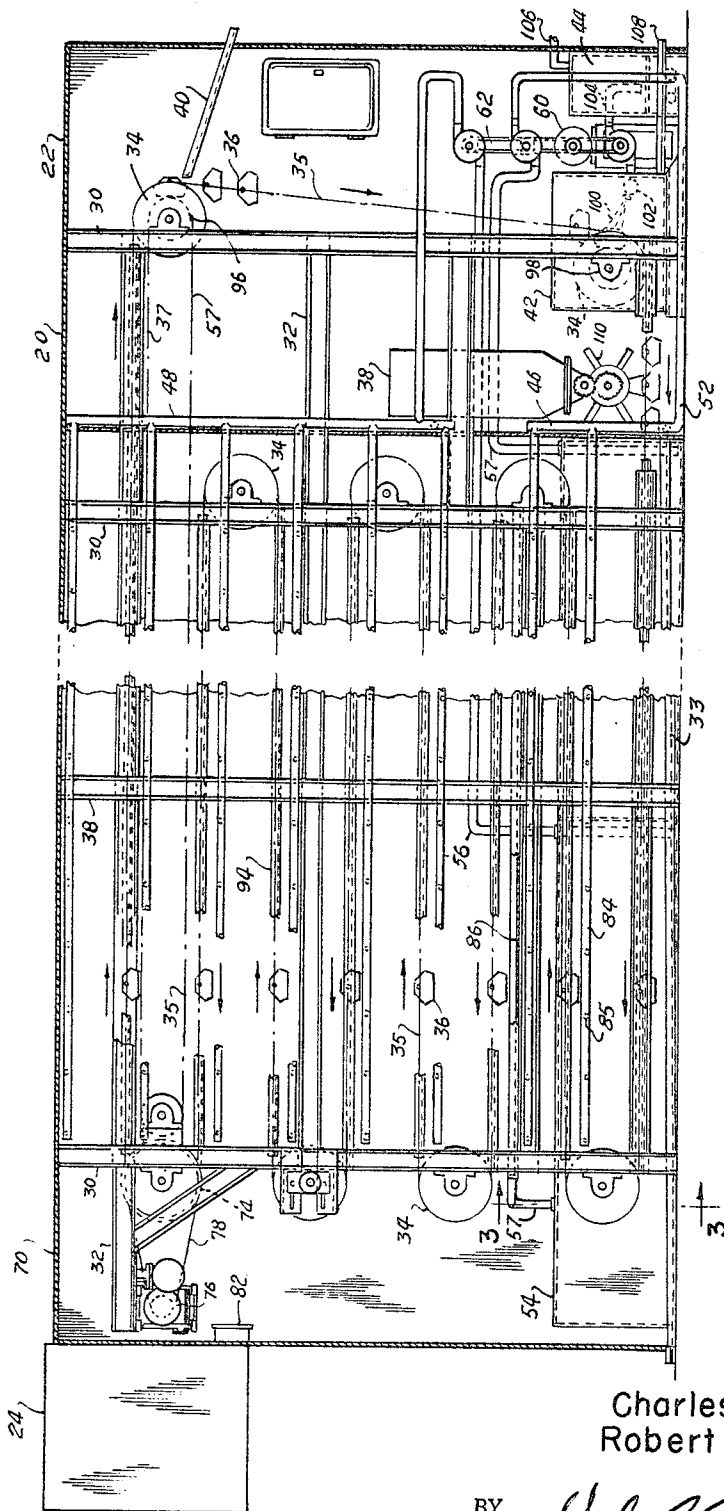


Fig. 2

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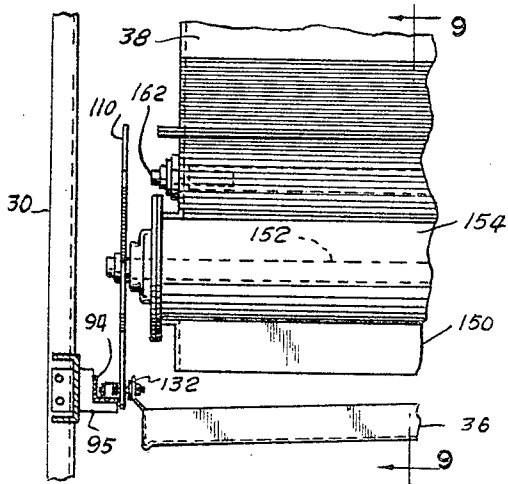


Fig. 8

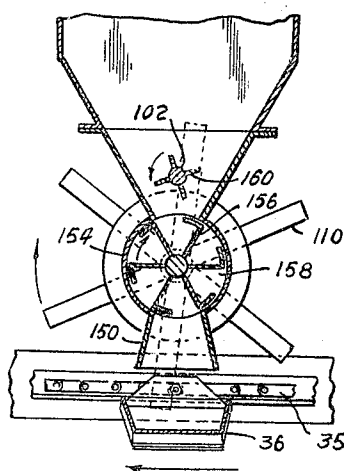


Fig. 9

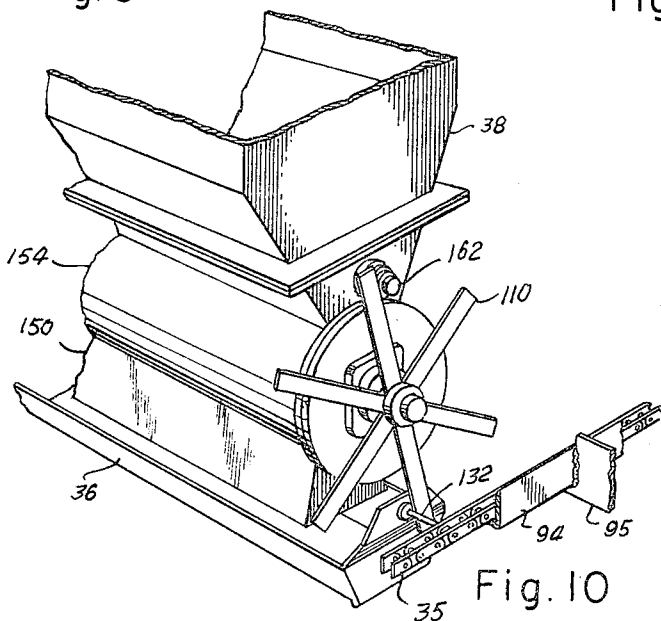


Fig. 10

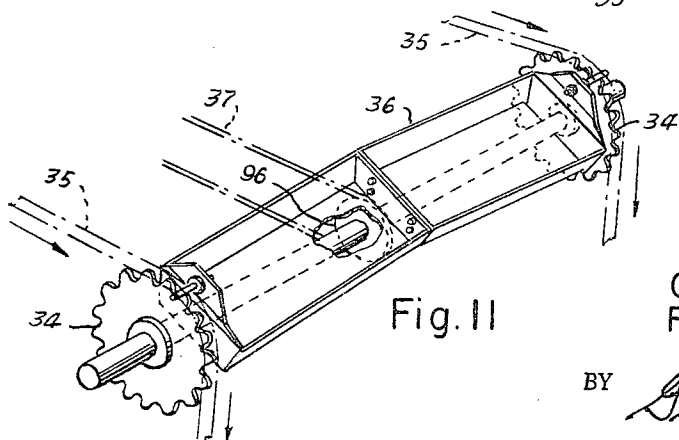


Fig. 11

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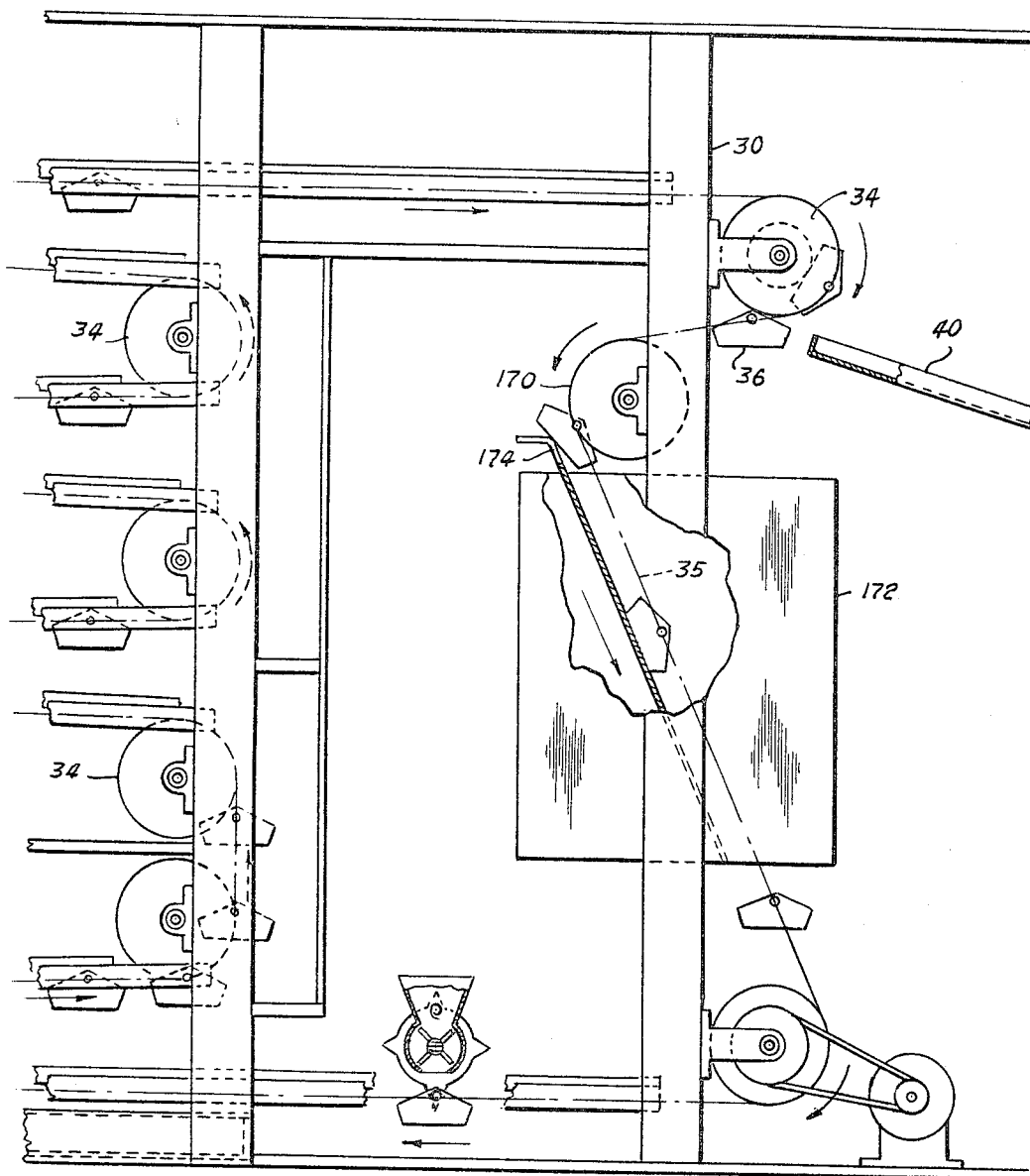


Fig. 12

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3,432,965

HYDROPONICS APPARATUS

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17 Claims

ABSTRACT OF THE DISCLOSURE

There is disclosed hydroponic apparatus for automatic germination of seed, growth of produce therefrom and harvesting of the produce in which there is provided a frame and conveyor means which comprise a pair of substantially parallel and spaced apart members supported within the frame along a tortuous path for movement therethrough. The tortuous path includes a plurality of spaced apart, substantially horizontally disposed sections arranged in a vertical array. Containers are rotatably connected to the flexible members whereby the containers will remain in an upright position when carried by the flexible members along the tortuous path. There is also provided feeder means for introducing seed into each container as it enters the vertical array, and cleaning means positioned between the harvesting means and the seed dispensing means for cleaning and sterilizing each container by directing hot water or steam onto the container as the container is transported from the harvesting means to the seed dispensing means.

The science of hydroponics is very old, although very little, if anything has been done in the way of realizing any substantial quantity of production of plant material or produce by means of this science. Most of the work in the hydroponics science has been performed manually insofar as the handling of the seed from the time it has germinated to the time that growth of the plant material has been attained. The cost of labor involved in hydroponically growing produce has severely limited its commercial acceptance, although substantial interest has been accorded hydroponics for many years.

A primary advantage of hydroponics is that soil is not required within which the plants or produce are grown. It is therefore at least theoretically possible to eliminate vast areas of ground and soil within which plants are normally grown, and to allow the seed and plant material to be compacted in practically any desired configuration so long as sufficient water is provided for the plants to grow. By decreasing the time required for plant material to grow, the science of hydroponics can be quite useful in the mass production of food for both animals and humans.

It is the broad object of this invention to provide a method and an apparatus that employs the science of hydroponics to produce plant material in a substantial mass quantity over a relatively short interval of time. Moreover, it is an object to provide such an apparatus that is substantially compact within which the plant material is produced. Further, it is an object to provide such an apparatus that is automatic, thus substantially eliminating any manpower required to operate same.

The hydroponics method and apparatus of the invention provides the functions of germination of seed, promoting the growth of the seed into plant material or pro-

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duce and harvesting of the produce once it is grown. The apparatus generally comprises container means within which the seed is contained and within which the plant material is grown therefrom, a seed dispensing means for dispensing seed into the container means just prior to the germination and growth cycle, harvesting means for effecting the removal of the plant material from the container means once it is grown, and conveyor means for transporting the container means through the germination and growth cycle from the seed dispensing means to the harvesting means, and back to the seed dispensing means, all over a time cycle sufficient to permit the growth of the plant material. In one embodiment of the invention, the apparatus includes an enclosure within which the containers are transported from the seed dispensing means to the harvesting means during the germination and growth of the seeds and plant material. Temperature regulating means is provided for controlling the temperature within the enclosure to promote the most effective growth of the material, and means are provided for applying liquids to the seed and plant growth within the enclosure. In still a further embodiment, cleaning means is provided between the harvesting means and the seed dispensing means along which the container means are transported, so that the container means are cleaned after the produce is harvested therefrom, but before the seed is introduced into the container means.

In yet a further embodiment of the invention, the conveyor means comprises a pair of substantially parallel and spaced apart flexible members which are supported within a framework along a tortuous path for movement therethrough. Container means, in the form of a plurality of individual containers, are supported in upright, horizontal positions between the pair of flexible members and are conveyed along the tortuous path with the flexible members. Preferably, the tortuous path includes a plurality of substantially horizontal and spaced apart sections for each of the flexible members in which the horizontal sections are disposed in a vertical array. This vertical array portion of the apparatus is surrounded by an enclosure and constitutes the germination and growth zones of the apparatus. Suitable means are provided for moving the flexible members throughout the tortuous path in a continuous movement so that the containers are conveyed through the vertical array, past the harvesting means, the cleaning means and the seed dispensing means, and back into the vertical array. The tortuous path of the conveyor means permits the reduction in size of the over-all hydroponics apparatus to a compact unit. Further, it facilitates the application of liquids to the seed and growth material within the enclosure and the accurate control of temperature therewithin. In yet another embodiment, means are provided for draining excess liquids from the container means so as to eliminate molding of the seed and plant material.

Many objects, features and advantages of the invention will become readily apparent from the following detailed description thereof when taken in conjunction with the appended claims and the attached drawing, wherein like reference numerals refer to like parts throughout the several figures, and in which:

FIGURE 1 is a partly cut away, perspective view of the automatic hydroponics apparatus of the invention;

FIGURE 2 is a side elevational view, in section, of the apparatus shown in FIGURE 1;

FIGURE 3 is an end view, in section, of the apparatus taken through section lines 3—3 of FIGURE 2;

FIGURE 4 is a fragmentary, side elevational view of the conveyor means for conveying container means containing seed and plant material grown therefrom through the apparatus;

FIGURE 5 is a fragmentary, end view, in section, of the conveyor means taken through section line 5—5 of FIGURE 4 illustrating one means for attaching the container means to the conveyor means;

FIGURE 6 is a fragmentary, perspective view, partly in section, of the container means and conveyor means shown in FIGURE 5;

FIGURE 7 is a fragmentary, end view, in section, illustrating another means for attaching the container means to the conveyor means;

FIGURE 8 is a fragmentary, end elevational view of an automatic seed dispensing unit for dispensing seed into the container means;

FIGURE 9 is a fragmentary, side elevational view, partly in section, of the seed dispensing unit and container means shown in FIGURE 8, taken through section lines 9—9 of FIGURE 8;

FIGURE 10 is a fragmentary, perspective view of the seed dispensing unit shown in FIGURE 8;

FIGURE 11 is a perspective view of a seed and plant material carrying tray as it engages means for inverting the tray to discharge the plant material grown therein; and

FIGURE 12 is a fragmentary, side elevational view of another embodiment of a tray cleaning unit.

The automatic hydroponics apparatus of the invention is shown in the partly cut-away, perspective view of FIGURE 1, wherein the apparatus includes a housing or enclosure 20 within which there is contained seed germination and growth zones of the apparatus. Attached to the front of housing 20 is another housing or enclosure 22 (or an extension of housing 20), within which there is enclosed an automatic seed dispensing unit for dispensing seed into seed carrying trays, the latter of which enter the front of the apparatus at the bottom thereof and are conveyed through the apparatus. The trays emerge from the top of the apparatus in the front thereof and are emptied and cleaned by automatic means also enclosed within housing 22. An air conditioning and heating unit 24 is attached to the rear of housing 22 for controlling the temperature within the germination and growth zones of the apparatus. The germination and growth zones of the apparatus are contained within a framework 26, shown in phantom, which will be described in detail below. However, the framework generally comprises a plurality of vertical structural members 30, and a plurality of longitudinal structural members 32 secured thereto forming two parallel sides of the rectangular framework 20. Lateral structural members, not shown, are also provided for securing the two sides of the framework together.

A plurality of idler sprockets 34 are rotatably mounted on each of the two sides of the framework, and a pair of parallel flexible members 35, such as endless roller chains, are carried by the plurality of sprockets throughout the apparatus. A plurality of seed and plant growth carrying trays 36 are carried by and between the pair of chains through the apparatus, wherein the plurality of trays are spaced apart along the lengths of the chains. Corresponding sprockets 34 are mounted opposite each other on the two sides of the framework and are rigidly attached to shafts 33, so that as one sprocket is caused to rotate, the corresponding sprocket on the other side of the framework rotates accordingly. A pulley or roller 96 is secured to shaft 33 midway between the corresponding uppermost sprockets disposed within housing 22 where the seed carrying trays emerge from the apparatus after the plant material has been grown. A belt 37 is carried between pulley 96 on one end and another pulley, or pulleys, within the apparatus (not shown) at the other end. The purpose of belt 37 is to

maintain the trays in a horizontal position in the top of the growth zone of the apparatus, and the dual purpose of pulley 96 is to carry belt 37 and to invert the trays as they emerge from the apparatus to dispense the plant material into a dispensing tray 40, all as will be described more in detail.

Located generally in the bottom of housing 22 and adjacent the intake to enclosure 20 is an automatic seed dispensing unit 38 that dispenses seed into the trays as the trays pass beneath the seed dispensing unit and actuates same. Prior to the trays passing beneath the seed dispensing unit, they are cleaned as they pass through a cleaning unit 42 located in front of housing 22. The trays can be cleaned by steam or scalding water, and in the apparatus shown in FIGURE 1, a heated water supply 44 is provided within housing 22 for supplying heated water to the cleaning unit 42.

The apparatus includes both a seed germination zone and a growth zone, the germination zone being located in the bottom of the framework 26 within housing 20, and the growth zone being located directly above the germination zone. Moisture and nutrients are applied to the seed in the germination zone while the proper temperature is controlled within this zone by heating and cooling unit 24. Moreover, it is necessary to provide the seed and plant material with moisture in the growth zone, all as the term hydroponics implies. Accordingly, a pipe or conduit 46 is provided for supplying water and nutrients to a plurality of spraying units (not shown) within the germination zone of the apparatus. Another pipe or conduit 48 is provided for supplying water to a plurality of spray units (not shown) within the growth zone of the apparatus. Actually, there are two of each of the conduits 46 and 48 provided on the two sides of the apparatus, respectively. The conduit 46 is supplied from a tank 50 containing water and nutrients, wherein the liquid is supplied to conduit 46 through conduit 52 leading from this tank. Similarly, conduit 48 is supplied from a tank 54 containing water through another conduit 56. As will be described below, the liquid withdrawn from tank 50 and sprayed into the germination zone of the apparatus is not reused. The water from the tank 54 that is sprayed into the growth zone can be reused, and accordingly is returned to the tank 54 through a conduit 57 after draining from the growth zone.

A suitable motor 60, electric or otherwise, is provided within housing 22 and drives pumps 53 and 55 connected in conduits 52 and 54, respectively, by means of pulley belt 62. Moreover, the motor drives a pump 65 connected within a conduit 64 for pumping the heated water from tank 44 to the cleaning unit 42.

A more detailed description of the germination and growth zones of the apparatus and the over-all operation thereof will now be given in conjunction with the side elevational view, in section, of FIGURE 2, wherein this description will generally conform to the chronological sequence of the plant growth from the start to finish. In addition, reference will be had to the fragmentary, end view, in section, of FIGURE 3, taken through section lines 3—3 of FIGURE 2.

Trays 36, which extend laterally the width between the framework and which are supported and conveyed through the apparatus by the chains 35, enter the framework 26 within housing 20 at the bottom front thereof as denoted by the arrow. This view shows a plurality of vertically spaced apart sprockets 34 rotatably mounted on a vertical member 30 at the rear of the framework, and another plurality of vertically spaced apart sprockets 34 rotatably mounted on another vertical framework 30 at the front of the framework. Additional sprockets, as already noted, are supported within the front housing 22. An endless roller chain 35 passes about and engages each sprocket within the framework in a tortuous path between front and rear sprockets to form a plurality of substantially horizontal sections of the chain that are

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spaced apart in a vertical array. The endless chain also passes about the sprockets located within the front housing 22 so that the trays carried thereby can be processed in and out of the framework. One of the sprockets 74 disposed at the rear of the framework is driven through a belt or chain 78 by means of a suitable motor 76 through a speed reducer 77. Sprocket 74 is driven at the desired speed and causes the chain to be driven through the apparatus on all of the sprockets.

An outlet 82, communicating with a blower within the heating and air conditioning unit 24, is directed into the framework to control the temperature therewithin.

The trays 36 enter the front of the framework at the bottom thereof into what is referred to as the germination zone. FIGURE 3 shows an end view, in section, of the germination zone, which zone is separated from the growth zone disposed directly thereabove by a baffle 86 that extends substantially the length and width of the framework. Spray pipes 84 having a plurality of nozzles 85 spaced along the length thereof are provided along the sides of the germination zone and communicate with conduit 46, the latter of which supplies the spray pipes from tank 50. The trays are pivotally supported on the chains from the two ends thereof in much the same way as a carriage is supported on a ferris wheel. As the trays are conveyed throughout the length of the germination zone and pass over the first set of pulleys at the rear of the framework, the trays remain in an upright position as a result of the pivotal connections and the center of gravity. The trays are then conveyed the length of the germination zone in an opposite direction to pass over another set of sprockets disposed at the front of the framework, and so forth for as many passes through the germination zone as may be required. During the passage through the germination zone, water and nutrients are applied to the seed in the trays through sprays from nozzles 85.

Referring specifically to FIGURE 3, the trays, which are pivotally attached and supported at their ends between the opposite chains leave a side wall comprised of sections 122 and 124, corresponding bottom sections 126 and 128, respectively, and end walls 134 and 135. It is necessary that the water sprayed onto the seeds be drained therefrom to prevent molding of the seed. Accordingly, drain holes or outlets 129 and 130 are provided in the bottom adjacent the two ends, respectively, of the trays and, in the embodiment shown, the floors 126 and 128 of the trays slope inwardly and upwardly to cause the water to drain. Alternatively, the floors can be made to slope inwardly and downwardly with holes or outlets provided near the center of the tray for drainage.

The seed, in its ungerminated state, has a natural wax coating thereon which is dissolved and washed away by the water sprayed into the trays. This water cannot be re-used because of the wax contained therein. To dispose of the water draining from the trays within the germination zone, a slanted baffle 88 is provided in the bottom of the framework which drains through an outlet 90 at the rear of the apparatus.

Besides the longitudinal structural members 32 forming part of the framework, additional longitudinal structural members 94 are secured to the vertical members 30 along the length of the framework on each side and serve the purpose of providing support surfaces on top of which the chains ride. These particular members will be described in further detail below.

The growth zone of the apparatus extends from just above baffle 86 to the vicinity of the top of the framework, wherein the trays are conveyed by means of the chains and sprockets through another plurality of passes through the framework in a tortuous path as described with reference to the germination zone. Additional spray pipes 92, connected to conduit 48, are disposed up and down the two sides of the framework within the growth zone, and direct a fine spray of water into the air sur-

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rounding the trays from the plurality of nozzles 85. Clean water is sprayed into the growth zone from tank 54 for causing the plant material or produce to continue to grow throughout the growth zone. Simultaneously, the heating unit 24 maintains the proper temperature within the growth zone by means of the heated, or chilled, air blown through the outlet 82 of the heating unit. It is desirable that the humidity of both the germination and growth zones be maintained at the 85%-100% level, which is adequately accomplished by the spraying of water within both zones.

After the trays within which the plant material or produce is grown has completed the path through the growth zone, the trays emerge from the front of the framework into housing 22 at the top thereof. The chains pass over pulleys 34 disposed in the top of housing 22, whereby the trays are engaged along the bottoms thereof by the pulley or roller 96. The belt 37 extending between pulley 96 in the front of the apparatus and pulley 97 in the rear of the apparatus aids in supporting the trays in a level position to prevent the trays from tipping over as a result of the weight of the plant material grown.

As the trays pass over pulley 96, they are at least partially inverted so as to dump or discharge the plant material therefrom onto a dispensing tray or baffle 40. Any suitable container can be disposed beneath tray 40 to receive the plant material. After the trays pass over pulley 96, they return to the upright position and are conveyed by the chains down into the cleaning unit 42.

The cleaning unit also includes a pulley 98 secured to a shaft supported between two opposing sprockets in the same manner as pulley 96. As the trays engage pulley 98, they are again at least partially inverted so that the interiors thereof can be cleaned. The cleaning unit 42 is connected through pump 65 and conduit 104 to a scalding water tank 44, and scalding water is sprayed into the inverted trays through nozzles 102 connected to the pump and conduit. A suitable drain 108 is provided to the cleaning unit to dispose of the used water. The scalding water tank 44 is provided with an intake 106 through which it is supplied with the water.

The cleaning of the trays after passing through the apparatus is necessary to kill all bacteria and other organic substance that would affect the growth of the plant material. Scalding water effectively sterilizes the trays in this respect. Alternatively, steam sprays can be directed onto the trays.

An enlarged view of the trays carried by the chains is shown in FIGURE 4, wherein this view primarily illustrates that the trays remain in an upright position as the chains are carried about the sprockets to change the direction of movement of the chain and trays through the apparatus.

Referring particularly to all of FIGURES 3, 5 and 6, wherein FIGURE 5 is a fragmentary end view, partly in section, of the details of the means for supporting the trays on the chains, and FIGURE 6 is a fragmentary perspective view of same, a bushing or bearing 131 is coupled into one of the chain links through which a pin 132 passes for supporting the tray. Similar bushings or bearings are coupled in the links of the chains in spaced apart relation along the lengths thereof for supporting the other trays. The pin 132 has a shoulder adjacent the inward end thereof to engage the outer surface of an upwardly extending flange 135 of the end wall 134 of the tray. The pin passes through a hole 136 in the flange 135 and is rigidly secured to this flange by any suitable means, such as a nut threaded on the pin. Pin 132 is free to rotate relative to bearing 131, so that as the chain passes over the sprocket, the pin can rotate within the bearing in response to the weight of the tray tending to maintain the tray in an upright position.

Because of the natural tendency of the chains to sag between forward and rearward sprockets, a supporting surface 94 is provided between sprockets along the lengths

of the chains between the front and rear of the framework. In the embodiment shown, the supporting surface 94 comprises a metal angle iron member that is supported from vertical structural members 30 by means of any suitable brackets 95. Thus each chain is provided with a horizontal surface along each path running the length of the framework, whereby the chains ride on the surface and remain in the plane thereof. Because of this surface and the fact that pin 132 is rigidly secured to the tray, the weight of the tray will not cause the chain to become laterally tilted out of the plane of the supporting surface.

Another embodiment of means for supporting the tray from the chain is shown in the fragmentary view, partly in section, of FIGURE 7. All components are the same as previously described with the exception of the tray being provided at the end walls thereof with a cylindrical recess 142 carried on a flange 140 extending above the tray, and an enlarged cylindrical end 144 is provided to pin 132 and is telescopically received within the cylindrical recess 142. The dimensions of the recess portion 142 and enlarged cylindrical end 144 can be such as to provide a tight fit so that the pin 132 is rigidly secured to the tray, or alternatively, the pin can be free to rotate relative to both the tray and bearing 131 coupled in the chain.

Other suitable arrangements can be provided to pivotally support the trays from the chains. For example, the trays can include pins integral therewith that can be inserted in bearings or bushings coupled in the chain links, so that the tray rotates relative to the bushing when the chain is disposed in other than a horizontal position.

A fragmentary, front elevational view of the seed dispensing means as actuated by the conveyor means and container means is shown in FIGURE 8, and a side elevational view, in section, taken through section lines 9—9 of FIGURE 8 is shown in FIGURE 9. In conjunction therewith, a fragmentary perspective view of the seed dispensing means is shown in FIGURE 10. The seed dispensing means includes a hopper 38 and dispensing chamber 154 disposed beneath the hopper in communication therewith. Disposed below the dispenser is an outlet 150 which communicates with the dispenser and is directed to discharge seed therethrough into the trays when the latter are disposed beneath the dispenser outlet. In the embodiment shown, the hopper is generally rectangular in horizontal cross-section and has slanted sides for the smooth flow of seeds downward. The dispenser is generally cylindrical, and the dispenser outlet is generally flared outward at the lower end and runs the length of the trays. An axle or shaft 152 is supported within the dispenser 154 along the axis thereof running laterally with respect to the framework, and is journaled in the enclosed ends of the dispenser for rotation relative thereto. Generally rectangular vanes 156 are secured to shaft 152 along their lengths parallel with the axis of the dispenser and are rotated therewith with this shaft. The number of vanes 156 is selected in conjunction with the internal radius of the dispenser so as to provide a space 158 of predetermined volume between adjacent vanes. Disposed in the hopper just above the dispenser is another shaft 162 which is also rotatably mounted at its ends through the walls of the hopper. Shaft 162 has a plurality of vanes 160 secured thereto, and the shaft and vanes are rotated responsive to the rotation of shaft 152 and vanes 156 by any suitable mechanical coupling (not shown).

A plurality of radially extending lever arms 110 in the form of an integral unit is secured to axle 152 exterior to the dispenser end, whereby the lever arms are of sufficient length to extend slightly below the chain 35 as the latter passes beneath the dispensing unit. The lever arms extend between the chain and the side wall flange of the tray into the space between the flange of the tray and the chain. As a tray is conveyed beneath the dispensing unit, pin 132 engages one of the lever arms 110 of the dispensing unit and causes shafts 152 and 162 to be rotated

accordingly. As the tray passes by the dispensing unit and urges one of the lever arms 110 along therewith, it brings the next adjacent lever arm down to a position to be engaged by the next succeeding tray.

Rotation of axle 152 also causes rotation of vanes 156 so as to empty seed contained within the space 158 to drop through the dispenser outlet 150. Rotation of vanes 160 on shaft 162 agitates the seed within the hopper to evenly distribute the seed laterally into the space 158 between vanes. The seeds will then be evenly distributed laterally within the trays. Vanes 156 are also provided with flanged ends or shoulders 163 extending part way back to the next adjacent vane. The purpose of this flange is to cause an even distribution of the seed within the tray from one side wall to the other. That is to say, when the vanes are caused to rotate to open one of the spaces 158 in communication with the dispenser outlet 150, the seed cannot drop through the outlet until the flange 163 has cleared the approach side of the opening. Then, some of the seed will be dispensed through the outlet into the tray, but some of the seed will still remain on shoulder 163, the latter of which is substantially in a horizontal position. As the vane continues to pass over the outlet, the remaining seed is continuously dispensed through the outlet as the flange 163 clears the trailing side of the opening. This gives an even distribution of the seed between the side walls of the tray.

A perspective view of a tray is shown in FIGURE 11 as it passes over pulley 96 in the top front part of enclosure 22. As already noted, the tray is at least partially inverted at this point to dispense the produce therefrom. Belt 37 connected between pulleys 96 and 97 aids in supporting the trays along the uppermost path through the framework just before emerging from the growth zone. This is sometimes required because of the weight of the produce in the tray tending to cause the tray to tilt. Other belts can be provided between pulleys at lower levels for the same purpose. As the tray approaches pulley 96, the pulley engages the bottom of the tray so that the tray rolls around the pulley and conforms to the path imposed thereby. This causes the tray to be at least partially inverted so as to dump the contents therefrom onto dispensing tray 40. In fact, with a tray that is substantially filled with grown produce, the tray will completely invert once it is caused to assume a tilted position, resulting from the weight of the material producing a torque on the tray.

Another embodiment of a cleaning unit for the tray is shown in the fragmentary, side elevational view of FIGURE 12. The cleaning unit 172 is supported intermediate the upper position of exit of the trays from the growth zone and the lower entrance position of the trays into the germination zone. The trays are emptied as previously described, and are passed over additional sprockets 170 so as to engage a ramp 174. As the trays are caused to engage the ramp 174 and conform to the path imposed thereby on their downward travel, they are held in a partially inverted position so that the trays can be sprayed and cleansed by any suitable means, such as that previously described with reference to FIGURE 2.

For plants such as grass, rye, barley or oats, for example, it has been found that the temperature within the germination and growth zone should be maintained at about 68° F. to 70° F. Should the temperature substantially exceed 70° F., the plants will usually mold or rot, and should the temperature decrease substantially below 68° F., the growth rate of the plant is appreciably decreased. The relative humidity within both zones should be maintained at about the 85% to the 100% range, which is quite easily and readily effected by the liquid sprayed within the germination and growth zones.

More specifically, the above temperatures and humidity levels apply particularly to the growth of grass or similar plants, wherein it has been found that the complete growth of the grass is effected by maintaining the plants

within the apparatus for approximately three days. The time required to make a complete pass of each tray through the apparatus is controlled by the speed of the conveyor chains and can be regulated accordingly. In the growth of grass, for example, it is sometimes desirable to produce a growth that is green. In this event, light is directed onto the growth by any suitable means, such as by providing a light source within the framework. In other instances, it is not desirable to produce a green coloration of the grass that would naturally occur in sunlight. In this event, no light is provided within the framework or housing 20 so that the color of the grass is substantially a neutral or brown.

As the trays proceed through the framework of the germination and growth zones in an upward direction, the growth becomes taller within each tray. It will be apparent, then, that the distance between each level of trays must be sufficient to allow for the stand of the growth above the trays. In the embodiment shown in FIGURE 2, the distance between each level is constant and sufficient to allow for the growth that occurs. The overall height of the apparatus can be reduced by varying the separation between horizontal sections of the flexible members in accordance with the height of the produce at a particular time in its cycle of growth.

Although the invention has been described with reference to particular embodiments thereof, certain modifications and substitutions that do not depart from the true scope of the invention will undoubtedly occur to those skilled in the art. Accordingly, it is intended that the invention be limited only as defined in the appended claims.

What is claimed is:

1. A hydroponics apparatus for automatic germination of seed, growth of produce therefrom and harvesting of the produce, comprising:

- (a) container means;
- (b) seed dispensing means for introducing seed into said container means at the beginning of a growth cycle;
- (c) harvesting means for removing the produce from the container means at the end of a growth cycle;
- (d) conveyor means connected to said container means for transporting said container means between said seed dispensing means and said harvesting means and back to said seed dispensing means over a predetermined time cycle to permit the growth of produce; and
- (e) cleaning means positioned between said harvesting means and said seed dispensing means for cleaning and sterilizing said container means by directing hot water or steam onto said container means after the produce has been harvested as said container means is transported from said harvesting means to said seed dispensing means.

2. A hydroponics apparatus as set forth in claim 1 wherein said container means comprises a plurality of individual containers.

3. A hydroponics apparatus as set forth in claim 1 including enclosure means, said conveyor means transporting said container means from said seed dispensing means to said harvesting means within said enclosure means during said growth cycle.

4. A hydroponics apparatus as set forth in claim 3 including temperature controlling means for controlling the temperature within said enclosure means.

5. A hydroponics apparatus as set forth in claim 1 including spray means positioned above said conveyor means for applying liquids to said seed to effect the germination thereof and aid in the growth of said seed to produce.

6. A hydroponics apparatus comprising:

- (a) a frame;
- (b) first and second continuous flexible members supported by said frame in parallel relationship;

(c) each of said flexible members being supported by said frame in a tortuous path;

(d) a plurality of containers each supported between said first and second members in a substantially horizontal plane;

(e) each of said containers being rotatably connected to said first and second members whereby said containers remain in an upright position when carried by said first and second continuous flexible members along said tortuous path;

(f) said tortuous path including a plurality of spaced apart, substantially horizontally disposed sections arranged in a vertical array;

(g) seeder means for introducing seed into each container as it enters said vertical array;

(h) harvesting means for displacing each container from the upright horizontal position to dump the contents thereof as each of said containers emerges from said vertical array; and

(i) cleaning means positioned between said harvesting means and said seed dispensing means for cleaning and sterilizing said container means by directing hot water or steam onto said container means after the produce has been harvested as said container means is transported from said harvesting means to said seed dispensing means.

7. A hydroponics apparatus as set forth in claim 6 further including drive means for driving said flexible members at a rate whereby the time required for each container to traverse a path along said vertical array of substantially horizontally disposed sections is sufficient to permit a desired amount of growth of produce.

8. A hydroponics apparatus as set forth in claim 6 further including means contacting said container when supported by at least one of said horizontally disposed sections for maintaining said containers upright.

9. A hydroponics apparatus as defined in claim 6 further including means for spraying liquid into each of said containers as they move along said tortuous path.

10. A hydroponics apparatus as defined in claim 6 further including baffle means dividing said array of horizontally disposed sections into a germination zone and a growth zone.

11. A hydroponics apparatus as defined in claim 10 further including means for spraying a liquid comprising water onto said containers as they move through said germination and growth zones, means for disposing the excess liquid sprayed on said containers and said germination zone and means for recirculating the excess liquid sprayed on said containers in the growth zone.

12. A hydroponics apparatus as defined in claim 10 wherein each of said containers have outlet means for the draining of liquid therefrom, said baffle means being adapted to receive and drain off the liquid drained from said containers within the growth zone of said vertical array and additional means disposed beneath the germination zone of said vertical array for receiving and draining off liquid drained from each container means within the germination zone of the vertical array.

13. A hydroponics apparatus as defined in claim 10 including means for recirculating the liquid drained off by said first mentioned baffle means received from the growth zone.

14. A hydroponics apparatus as defined in claim 6 further including enclosure means substantially enclosing said frame and means for maintaining a substantially constant temperature within said enclosure.

15. A hydroponics apparatus as defined in claim 6 wherein said cleaning means comprises means for displacing said container from the upright position and means for spraying steam or hot water into said container while displaced from the upright position.

16. A hydroponics apparatus as defined in claim 6 wherein said flexible members are roller chains.

17. A hydroponics apparatus as defined in claim 6

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wherein said containers include a base portion shaped to slope toward at least one portion having openings therein through which excess liquids flow.

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