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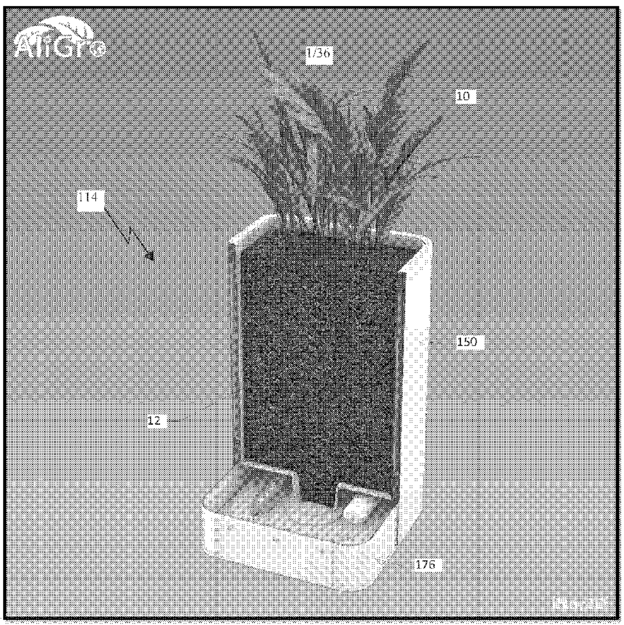

FIGURE 1

(57) Abstract: A controlled environment agricultural system having a self-regulating grow module 114 that automatically waters the plant without over-watering or under-watering. The system may further comprise a self-regulating lift mechanism 102 with an optic sensor 200, the lift mechanism 102 capable of raising, lowering, and rotating each grow module 114 independently of any other grow module, to monitor and provide individual attention to individual plants within a crop in order to maximize growth and plant yield.

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AUTOMATED PLANT GROWING SYSTEM

TECHNICAL FIELD

[0001] This invention relates to a controlled environment agricultural system that implements a self-regulating system to maintain optimum conditions to individual plants within a crop in order to maximize plant growth and yield.

BACKGROUND

[0002] The goal of any controlled environment agriculture facility or grow room is to produce a consistent crop in both quality and quantity day-after-day, regardless of season, at an affordable cost. The key factor in achieving this goal is the plant's distance and orientation to the light. No other influence has a greater effect on a plant's ability to produce phenomenal yields than how that plant is positioned under the light source.

[0003] It is a common occurrence to see lighting apparatuses mounted on the ceiling and grow modules located on the floor. This substantial distance between plant and light source has devastating consequences on the crop owner/investor's pocketbook in a number of ways that will become evident as described below.

[0004] Aside from light, proper watering is another critical factor affecting a plant's ability to flourish. Most people simply hand water their plants or use timers. Hand watering is time consuming and can lead to over-watering or under-watering. Timers can have the same effect. Since the weather is constantly changing watering a plant for the same period of time every day does not necessarily provide the right amount of water each day. Some may simply over-water their plants to make sure it is not under-watered. Over-watering involves drainage holes to allow excess water to flow out. This, however, is a waste of water.

[0005] To never over water, never under water, and never hand water one's plants is a fantasy come true for a majority of gardeners or growers, and surely is Mother Nature's wet dream. Consistently providing the exact amount of water required by a plant to thrive is a challenge even for those with the greenest of thumbs. Temperature, humidity, root zone conditions, plant size and species, as well as dozens of other factors play a part in determining how much water a plant needs to flourish on any given day. Missing the mark can mean irreversible damage to the plant, possibly leading to death, or it can hinder a crops ability to generate optimal yields. And missing the mark always means wasting precious water, which is unfavorable to the plant, to the planet, and to the grower/investor's pocketbook.

[0006] Over watering, under watering and irregularly watering harms the plant and wastes water in a world where water is a rapidly disappearing element. Over watering is a waste for obvious reasons: unneeded water runs off, is evaporated, and/or causes the plant to expend energy driving excess water away to prevent drowning. Under watering is a waste because the plant is using the scarce amount of water provided to recover from or adapt to less-than-ideal water conditions. Irregularly watering causes the plant to be constantly in a defensive position – fighting to stay alive – instead of being on the offense generating phenomenal yields. In the water starved world in which we all live, every single ounce of water needs to be used to efficiently grow a plant's bounty.

[0007] The daily task of watering one's plants is tedious and is often ignored. Work, children, vacation, illness, lack of free time and laziness are only a few on a laundry list of reasons why plants do not get watered consistently. And to compound the problem of not watering on a regular schedule, novice growers mistakenly believe that over watering the plant today will make up for days missed or for days anticipated to be away. Grave consequences are a sure outcome of this aquatic blunder.

[0008] Highly effective water conservation products and efforts are of immediate urgency the globe over. The present invention plays a critical role in such an effort by minimizing a plant's dependence on humans in the watering process - whether in a gardener's backyard or a grower's commercial operation. Removing human participation means removing shameful water waste.

[0009] For the reasons stated above and others not noted, there is a need for a plant growth module/planter that ensures the grower never over waters, never under waters, and never hand waters their plants...EVER.

[0010] Therefore, there is a need for a system that can maintain the proper distance of a plant from its light source to maximize the growing potential of the plant, while providing a watering system that is automated so as not to over-water, under-water, or manually water any plant.

SUMMARY

[0011] The present invention is directed to a plant growing system that creates the most optimal conditions for plant growth. The term plant includes trees, flowers, vines, and any other organism under the kingdom Plantae. In the preferred embodiment, the system comprises a grow module that automatically waters the plant without over-watering, under-watering, or manually watering the plant. The grow module can be configured with sensors to optimize other conditions for optimal plant growth.

[0012] The grow module can be used in conjunction with a lift system that places the plant at an ideal location from a light source. The lift system utilizes a rotating lift mechanism and a controller with an optic sensor. The system is designed and engineered to provide individual attention to each individual plant within a crop. Although plants are often times clones, without equal attention given to each plant there will be considerable differences in size and yield. In cases when the crop/investment has medicinal properties, there can be potency inconsistencies as well. The system virtually alleviates these variances by either focusing grow room variable solutions to individual plant sites or by controlling, monitoring, and/or avoiding grow room variables at each individual plant site.

[0013] The system of the present application sets out to provide fortunate owners—who often times have no prior growing experience, have been misled, or use outdated techniques—a sense of comfort knowing their investment (crop) is in safe hands with the most advanced combination of grow techniques and grow technologies in a single automated unit. Furthermore, the owners will experience relief knowing that their wallet and conscience are not being maliciously attacked by an inefficient piece of equipment that wastes energy (which has both financial and environmental consequence) and that they can rely on a product of consistent quality and quantity with minimal effort.

[0014] The need for such advanced automated systems is vast with a broad spectrum of target users. Customers will range from the general garden enthusiast, organic foods consumer, and herbal medicine grower to plant physiology researchers, biotechnology and pharmacology industries, fertilizer developers as well as Controlled Environment Agriculture facilities (CEA), schools and universities. Customers will also include remote (and often times offshore) oil and diamond exploration companies, hotel and restaurant chains located afar that wish to include fresh/organic menu options year round from exotic venues; world hunger, global medical service providers, and international charities heading abroad where food supply is sparse or unpalatable. Finally, military and government efforts that may require food supply without a compromise in security (e.g. covert observation and intelligence gathering mission within hostile territory where entry to the said location could jeopardize valued personnel).

[0015] The system has very significant water/nutrient delivery advancements that makes it unlike any other product. All of the other multi-plant grow systems on the market have a community pool of water from which all plants must share. They are made up of a single water source and/or a single reservoir that a combination of water and nutrients are drawn and then introduced to the crop's roots, including systems that utilize recirculation technologies. This means that every plant within that crop must be of the same species (or favor the same nutrient solution) and must be in the same lifecycle stage – all must be in the vegetative stage or all must be in the flowering stage – because the nutrient needs are different during each stage of life.

[0016] The present system provides each plant site/grow module with its own source of water and nutrient solution. No two plants need to share the same source of food and drink. Additionally, no two plants need to be grown via the same technique; meaning one plant may be grown by traditional soil means while another may be simultaneously grown by a newer "progressive gardening" technique such as hydroponics or aeroponics. This is significant because this allows individualized attention to an individual plant's needs using whichever grow medium (soil, water, or air) is required by application or preferred by the grower. Thus, allowing for important research to take place, allowing crops of various strains and maturity to accompany one another, etc. Equally important, it prevents the spread of root borne diseases and other water/nutrient problems that may regrettably occur. In regards to water/nutrient supply, by design, the system is an "insurance policy" that guarantees the entire investment is not lost in one sad swoop of aquatic misfortune.

[0017] The system utilizes a revolutionary planter design that is relished with relevant features and capabilities not found in prior art. In the preferred embodiment, the planters/grow modules come in a plurality of configurations – soil and soil-less – that share the same outer housing yet each configuration has its own unique inner components.

[0018] The planter/grow module is divided into two key areas: 1) Root Zone and 2) Reservoir Area. The Root Zone of the planter is the location in which the plant's roots are grown. The Reservoir Area of the planter is the location where the water/nutrient supply is delivered to and stored for use.

[0019] Roots tell us a lot about the plant's health, and ultimately, how well our crop and/or yields may be. For this reason, the present invention may have "root windows." These root windows allow the grower to examine the Root Zone with ease and are of particular importance in the Aeroponic/Hydroponic Hybrid Planter embodiment where roots are suspended in air.

[0020] A built-in collapsible trellis feature, such as a tomato cage, provides plant support on-call. When growing tall plants that require support such as tomatoes, peppers, or some varieties of herbs, simply extend the tomato cage. If growing lettuce, carrots, or flowers, collapse the tomato cage into the planter.

[0021] To help minimize evaporation, weed growth, and pest infestation grow medium covers may be included. This simple yet effective feature conserves water and minimizes the need for pesticides and weed preventers.

[0022] Easily accessing to the Reservoir Area of the planter without having to remove the plant is not only convenient, it is important. Plants experience "stress", which could very well lead to death, when being removed from their planters or the ground. Being able to access the system components for repair or replacement, cleaning the Reservoir Area, manually testing water/nutrient levels, etc. and not having to uproot the plant is a lifesaver.

[0023] As stated above, human participation in the watering process is devastating to plant life, to water conservation efforts, and to wallets. The present invention not only eliminates the need to water one's plants – it perfectly waters plants unfailingly with zero water waste. To achieve this amazing claim, the system utilizes three key components: 1) fluid fill level control device (aka "float valve"), 2) wicking instrument (aka "wicking basket"), and 3) aerator.

[0024] A water/nutrient solution supply line comes in communication with the fluid fill level control device, which in turn keeps the reservoir filled to a desirable level. Thus, the planter is always supplied with an ideal amount of water/nutrients without hand watering. A wicking instrument then facilitates capillary action, allowing the plant to draw water from the reservoir or to drive access water to the reservoir, therefore, never over watering or under watering. (Note: Excess water, for example, could be introduced to the Root Zone of the planter on rainy days.)

[0025] It is critical to understand that air equals yield. The more air we can introduce to the Root Zone, the greater the harvest. Increasing Root Zone oxygenation is paramount to increasing crop yields, and therefore, an aerator is an important feature of the present invention. The air stone serves a dual purpose. For one it aerates the water in the Reservoir Area, preventing the negative consequences of stagnant, nutrient-rich water (a breeding ground for bacteria and such.) Secondly, oxygen-rich water is drawn to the roots by the plant, providing the yield maximizing conditions/environment only afforded by an oxygenated Root Zone.

[0026] The system further optimizes growing conditions by providing a divider that separates the root zone from the reservoir area. The divider may have hundreds of tiny drain/aeration holes rather than by having fewer large holes. Roots that reach into the

Reservoir Area and/or soak in the water/nutrient solution are prone to root rot and other root-related ailments. Having a greater number of little holes helps prevent roots from accessing the Reservoir Area from the Root Zone and allows for good air flow to the Root Zone from the Reservoir Area.

[0027] In some embodiments, the present invention of the present application utilizes highly advanced planters/grow modules equipped with both aeroponic and hydroponic functionality in a single unit – an aeroponic primary operating system and a hydroponic failsafe backup system. It is to be understood, however, that the same or equivalent functions may be accomplished by different embodiments that are also intended to be encompassed within the spirit and scope of the invention. For example, a planter/grow module may be constructed that has only aeroponic capabilities or only hydroponic capabilities.

[0028] In relation to aeroponics, prior art falls into one of two groups of systems. The first group consists of aeroponic systems designed for multiple plants within a single housing. The second group consists of systems advertised as "aeroponic;" which in actuality provide hydroponic nutrient delivery. Neither group provides individualized attention to individual plants within a multi-plant system nor do they provide the depth of system control required to maximize crop yields while using the absolute least amount of water.

[0029] Realizing yields beyond the capability of any other technique or technology requires many precise components working seamlessly together to manage every variable of the Root Zone. Water/nutrient atomization, temperature and humidity levels, oxygenation versus dosing ratios, air introduction and circulation practices, and more contributes to the success of each plant.

[0030] Atomization occurs when the relative velocity between air and water is high enough to rip the water apart and into small particles – or droplets. In general, the higher this relative velocity the smaller the average droplet size will be. Unlike prior art, the present invention uses a centrifugal atomizer. Centrifugal atomization uses centrifugal force to accelerate the water/nutrient solution to a speed high enough for atomization. The system simply requires water/nutrient solution to come in communication with the center portion of the spinning disk for operation. It does not rely on high pressures or flow rates (as does prior art) and droplet size can be easily controlled by increasing or decreasing the speed at which the disk is spinning (studies by NASA and other reputable institutions have determined that different droplet size is favored during different stages of a plant's lifecycle.)

[0031] A primary system failure detection instrument (e.g. a water sensing circuit) will monitor the primary system, and in the event of failure, will activate the backup system. The backup system (e.g. a drip system) ensures nutrients reach the Root Zone during primary system downtime, as there is no soil acting as a nutrient reserve for the plant to tap.

[0032] Temperature monitoring is performed by having thermistors in various locations in the Root Zone. By having sensors in various locations, an average can be calculated and the temperature of the Root Zone can be accurately monitored and controlled.

[0033] Humidity monitoring is of high importance as it gives a quick look at the status of the root system – low humidity can alert the user that the roots may be drying out. Changes in relative humidity can be monitored, for example, by a capacitive type hygrometer.

[0034] To accomplish air flow to the Root Zone, a function that helps control temperature and contributes to oxygenation, a fan is incorporated in the design. As stated before, air equals yield, so oxygenation in the Root Zone is a key factor to producing elevated yields.

BRIEF DESCRIPTION OF DRAWINGS

[0035] Figure 1 shows an embodiment of the grow module in use with portions removed to see the inside.

[0036] Figure 2 shows a perspective view of an embodiment of the grow module.

[0037] Figure 3 shows the embodiment in Figure 2 with the door and part of the lid removed.

[0038] Figure 4 shows a perspective view of the bottom thereof.

[0039] Figure 5 is a cross-sectional elevation view thereof.

[0040] Figure 6 shows a perspective of the grow module with the trellis in the expanded configuration.

[0041] Figure 7 shows a close-up perspective view of an embodiment of the reservoir pan.

[0042] Figure 8 shows a side view of an embodiment of a float valve.

[0043] Figure 9 shows a cross-section view thereof.

[0044] Figure 10 shows a perspective view of another embodiment of the grow module.

[0045] Figure 11 shows a perspective view of the watering system of the grow module shown in Figure 10 with the housing and reservoir pan removed.

[0046] Figure 12 shows an exploded view of the watering system of the embodiment in Figure 10.

[0047] Figure 13 shows an exploded view of an embodiment of the atomizer system.

[0048] Figure 14 shows the following views of an embodiment of the atomizer: a bottom view (upper-left), a perspective view (upper-right), a top view (lower-left), and a side, cross-section view (lower-right) taken through line K-K shown in the top view.

[0049] Figure 15 shows another cross-sectional side view, taken through line K-K shown in Figure 14, showing the flow of air and water.

[0050] Figure 16 shows the following views of an embodiment of the flow generator: a top view (upper-left), a perspective view (upper-right), a cross-sectional side view (lower-left) taken through line C-C shown in the top view, and a side view (lower-right).

[0051] Figure 17A shows the following views of an embodiment of the diffuser: a top view (upper-left), a perspective view (upper-right), a side view (lower-left), and a close up view (lower-right) of the portion marked A in the side view.

[0052] Figure 17B shows the following views of another embodiment of the diffuser: a side view (upper figure) and a close up (lower figure) of the portion marked as A in the side view.

[0053] Figure 18 shows the following views of an embodiment of the motor mount: a top view (upper-left), a perspective view (upper-right), a cross-sectional side view (lower-left) taken along line A-A shown in the top view.

[0054] Figure 19 shows the following views of an embodiment of the atomizer housing: a top view (upper-left), a perspective view (upper-right), a cross-sectional side view (lower-left) taken along line A-A shown in the top view.

[0055] Figure 20 shows the following views of an embodiment of the fan duct: a top view (upper-left), a perspective view (upper-right), a back view (lower-left), and a front view (lower-right).

[0056] Figure 21 shows the following views of an embodiment of the sprinkler: a top view (left), a cross-sectional side view (right) taken along line A-A shown in the top view, and a perspective view (upper-right).

[0057] Figure 22A shows a top view of a grow module kit assembled.

[0058] Figure 22B shows a top view of a grow module kit with the divider removed to show the contents below the divider.

[0059] Figure 22C shows a side view of the grow module kit showing the measuring device used in creating the inlet.

[0060] Figure 22D shows a top view of the float valve installed on a circular planter.

[0061] Figure 22E shows the same top view with a wedge washer installed with the float valve.

[0062] Figure 22F shows a top view of the float valve with the wedge washer. The insets show a front view (left) and a side view (right) of an embodiment of the wedge washer.

[0063] Figure 23 shows a perspective view of an embodiment of the lift system.

[0064] Figure 24 shows close-up view of a base portion of the lift system thereof.

[0065] Figure 25 shows a close-up side view of the base portion thereof.

[0066] Figure 26 shows an exploded view of an embodiment of the lift plate.

[0067] Figure 27 shows a close-up side view of the lifting mechanism.

[0068] Figure 28 shows a bottom view of the lifting mechanism.

[0069] Figure 29 shows a side view of an embodiment of the lift system in use (right side) as compared to typical grow rooms (left side).

[0070] Figure 30 shows an embodiment of the controller.

DETAILED DESCRIPTION OF THE INVENTION

[0071] The detailed description set forth below in connection with the appended drawings is intended as a description of presently-preferred embodiments of the invention and is not intended to represent the only forms in which the present invention may be constructed or utilized. The description sets forth the functions and the sequence of steps for constructing and operating the invention in connection with the illustrated embodiments. It is to be understood, however, that the same or equivalent functions and sequences may be accomplished by different embodiments that are also intended to be encompassed within the spirit and scope of the invention.

[0072] The automated plant growing system of the present invention comprises a grow module **114** configured so as to practically eliminate over-watering, under-watering, and manual-watering of plants for optimal plant growth and minimized waste. In conjunction with a unique lift system **102**, the plants not only get the proper water and nutrients, but also the optimal exposure to light.

[0073] The system will serve many markets, and therefore, can be purchased in various configurations. In one embodiment, the system will be sold to individual consumers, primarily with the intent of personal use as an appliance-sized unit with an appliance-looking (i.e. stainless steel, slate, etc.) or cabinet-looking (i.e. mahogany, oak, etc.) appearance. In another embodiment, the system will be sold to commercial and/or large scale growers with intent to mass produce. For example, in one embodiment, the system may be contained in an 8ft x 40ft sized unit, referred to as a grow room. These units may be repurposed shipping containers that can be easily transported to global locations without any additional permits (i.e. wide load, excess weight, etc.). Each commercial grow room unit may have a plurality of plant growing systems. For example, some units may contain approximately 8-24 systems of the present invention.

[0074] Grow room components must work harmoniously together to provide and maintain conditions that promote accelerated plant growth. Dramatic fluctuations will slow or stop this enhanced growth process. Reversing the damage caused by the fluctuations is time-consuming and, therefore, costly. Controlling and monitoring grow room variables is paramount. These variables include, but are not limited to, the following: light intensity, "hot spots," day/night times, carbon dioxide enrichment, air temperature, air circulation, humidity, water temperature, water aeration, water/nutrient delivery and re-circulation, nutrient levels, and grow calendars/plant lifecycles. The system is the principal solution to addressing these variables.

[0075] Monitoring grow room conditions, making the necessary adjustments, evenly distributing the results and then communicating these facts to the grower/investor is important. The investor does virtually nothing but watch via his smart phone, tablet, or computer.

[0076] Grow Module

[0077] The grow module **114** has very significant plumbing advancements that make it unlike any other product. All of the other multi-plant grow systems on the market have a community pool of water from which all plants must share. They are made up of a single water source and/or a single reservoir that a combination of water and nutrients are drawn and then introduced to the crop, including systems that utilize recirculation technologies. This means that every plant within that crop must be of the same species (or favor the same nutrient solution) and must be in the same lifecycle stage—all must be in the vegetative stage or all must be in the flowering stage—because the nutrient needs are different during each stage of life.

[0078] The present system provides each plant site/grow module its own source of water and nutrient solution. No two plants need to share the same source of food and drink. This is significant because this allows individual attention to an individual plant's needs and desires; thus, allowing for important research to take place, allowing crops of various strands and age to accompany one another, etc. Equally important, it prevents the spread of root borne diseases and other water/nutrient problems that may regrettably occur. In regards to water/nutrient supply, by design, the system is an "insurance policy" that guarantees the entire investment is not lost in one sad swoop of aquatic misfortune.

[0079] The grow module **114** is used to house an individual plant **10** in soil or potting mix **12**, as shown in Figure 1. With reference to Figures 2-5, in the preferred embodiment, the grow module **114** comprises a housing **150** and a reservoir pan **176**. The housing **150** comprises a sidewall **154** defining a main cavity **151**. The main cavity **151** may be divided into a root zone **170** and a reservoir area **172** below the root zone **170**, as shown in Figure 5. Depending on the shape of the grow module **114**, the sidewall **154** may be comprised of multiple walls (e.g. front, back, and sides) attached together, or a single wall having multiple side portions (e.g front, back, and sides), or a single wall with no particular orientation (e.g. cylindrical). Therefore, reference to a sidewall is not intended to limit the sidewall to a specific number. Therefore, the housing **150** may take on any shape, including, by way of example only, a cylinder, a triangle, a rectangle, and the like, as long as the plant is provided the ability to grow upwards as needed and its leaves have sufficient access to light.

[0080] At least a portion of the sidewall **154** may be a dual panel sidewall comprising an inner wall **155** and an outer wall **157** surrounding the inner wall **155**, in which case the inner wall **155** defines the main cavity **151,** as shown in Figure 5. In some embodiments, at least a portion of the dual panel sidewall may have a transparent portion **156** so that the interior of the housing **150** can be seen. In other words, the housing **150** may have a window to see inside the housing **150**. In some embodiments, only the inner wall **155** may have the transparent portion **156**.

[0081] On the outer wall **157**, adjacent to the transparent portion **156** of the inner wall **155** may be a door **158**. This allows the user to open the door **158** of the outer wall **157** to expose the transparent portion **156** of the inner wall **155** in order to see inside the housing **150**. In other embodiments, the grow module **114** may utilize an opaque housing **150** with a viewing window **156** in order to monitor plant roots and growth.

[0082] In some embodiments, the grow module **114** may further comprise a lid **162** to cover the main cavity **151**, as shown in Figures 2 and 3. In the preferred embodiment, the lid **162** is a segmented lid **162** having a first lid piece **162a** and a second lid piece **162b** that fit together to form the fully assembled lid **162**. The lid **162** may be segmented into even more pieces if preferred. The first lid piece **162a** defines a slot **164** into which the second lid piece **162** can be inserted to fully assemble the segmented lid **162**. When fully assembled, the segmented lid **162** defines a grow hole **166**. By making the lid **162** in multiple pieces, the lid **162** can be placed on the housing **150** without disrupting the plant **10** that has already been planted in the grow module **114**. Thus, the first lid piece **162a** can be placed or slid onto the housing **150** with the plant **10** being inserted into the slot **164**. The second lid piece **162b** may be attachable to the first lid piece **162a** using tongue and groove type attachment, or any other attachment to allow the second lid piece **162b** to mate with the first lid piece **162a**. The second lid piece **162b** can then be slid or placed into the slot **164** towards the plant. The second lid piece **162b** stops short of fully closing the slot **164** to define the grow hole **166**. The grow hole **166** then allows the plant to continue growing out of the housing **150**.

[0083] The segmented lid **162** can be made up of a plurality of slidable and removable pieces. With multiple sliding and removable lid pieces, the grow hole **166** can be made larger, smaller, different shapes, and put into different positions. For example, although shown centrally located, the grow hole **166** can be position offset from the center, if necessary. This reduces the need for the user to place the plant exactly in the center of housing **150**.

[0084] In some embodiments, the grow module **114** may also comprise a trellis **161**, as shown in Figure 6. The trellis can be attached to the housing **150**. Preferably, the trellis **161** has a telescoping action so that it can be expanded to various heights. Preferably, the trellis **161** is housed in between the inner wall **155** and the outer wall **157** of the dual panel sidewall. Thus, in the collapsed configuration, the trellis **161** is hidden within the walls **155**, **157** of the housing **150**. When expanded, the trellis **161** extends above the lid **162**. This allows plants with vines to grow up along the trellis **161**. The trellis **161** can also be used as a protective barrier for plants in general. So, even for plants that may not need the trellis **161** for vines, the trellis **161** can still be expanded to protect the plants. This may be useful, for example, during transportation of the grow module **114** to different locations when a plant has already been planted. By way of example only, the telescoping trellis can be made by concentrically arranging substantially similar trellis pieces **161**, **161a**, **161b** like a telescope.

[0085] In some embodiments, the grow module **114** may comprise a chute **159**. The chute **159** can be created through the lid **162**, the sidewall **154**, or through the reservoir pan **176**. The chute **159** allows nutrients to be deposited into the grow module **114** from the outside. In the preferred embodiment, the chute **159** is formed in the sidewall **154**.

The sidewall **154** may comprise an opening to receive the chute **159**. The chute **159** may be a door, a drawer, a channel, or some other passageway that leads from the outside of the grow module **114** to the inside of the grow module **114**, and in particular, to the reservoir area **172**. The user can open the chute **159**, deposit the nutrient, and close the chute **159**. The nutrient then falls into the reservoir area **172**. In some embodiments, this may be automated by attaching a delivery device, such as tubing, to the chute **159**. The delivery device may be attached to a nutrient reservoir and controlled by a controller **201** to release a certain amount and/or certain type of nutrient according to established instructions or protocol.

[0086] As shown in Figure 5, in some embodiments, the grow module **114** may comprise a divider **168** separating the main cavity of the housing into the root zone **170** and the reservoir area **172**. In the preferred embodiment, the divider **168** may comprise a wicking basket **175**, a plurality of small holes **174**, and a main opening **177** leading into the wicking basket **175**. The divider **168** is a flat piece of rigid material that is strong enough to hold the soil **12** that will fill the root zone **170**. The plurality of small holes **174** are small enough so that the soil does not continuously fall through and fill the reservoir area **172**. In addition, the small holes **174** prevent the roots of the plant from entering the reservoir area **172**. The divider **168** has a top surface and a bottom surface. The wicking basket **175** extends below the bottom surface; and therefore, into the reservoir area **172**. The wicking basket **175** comprises a plurality of openings **173** allowing the reservoir area **172** and the root zone **170** to maintain fluid communications. The wicking basket **175** can be filled with dirt and/or soil. Like the small holes **174**, the plurality of openings **173** in the wicking basket **175** are small enough to prevent the soil or dirt from continuously escaping into the reservoir area **172**.

[0087] The grow module **114** further comprises a reservoir pan **176** that occupies the reservoir area **172** and removably attaches to the sidewall **154** of the housing **150**. The reservoir pan **176** houses the watering system, such as a float valve **184** to control the flow of water, and an aerator **186** that oxygenates the water. As shown in Figure 7, the reservoir pan **176** comprises a bottom plate **178** and a raised wall **180** connected to or formed with the bottom plate **178**. Like the sidewall **154** of the housing **150**, the raised wall of the **180** of the reservoir pan **176** can be made of multiple walls attached together or a single wall formed accordingly. The raised wall **180** may comprise an inlet **182** through which water is introduced. Preferably, the reservoir pan **176** comprises a plurality of inlets **182**. Having a plurality of inlets allows the user to pick and choose which inlet to use, allows for interconnectivity with other grow modules, and the option of introducing various substances through the different inlets. Unused inlets can be sealed with a plug **230**.

[0088] In some embodiments, a float valve **184** may be attached to the reservoir pan **176** at any of the inlets **182** to control a flow of the water into the reservoir pan **176**. The float valve **184** controls the flow of the water based on the water level. Therefore, the inlet **182** is positioned along the raised wall **180** and/or sidewall **150** such that when the water level reaches a certain predetermined height, the float valve **184** shuts off the water flow coming through the inlet **182**. This prevents the water level from exceeding a certain level. In the preferred embodiment, the inlet **182** and the float valve **184** are configured so that the water level does not rise above the divider **168**. This way, the water level stays inside the reservoir area **172**. However, since the wicking basket **175** is in the reservoir area **172**, the water is able to reach the plants **10** by capillary action.

[0089] With reference to Figures 8 and 9, the float valve **184** is uniquely designed to fit quickly and easily into the inlet **182**. In the preferred embodiment, the float valve **184**

comprises a float **193**, a valve arm **194** attached to the float **193**, and a valve housing **195** attached to the valve arm **194** and insertable into an inlet **182**. The float **193** can be any type of buoyant device that floats on water. The valve arm **194** has a first end **196** that can be attached to the float **193**, and a second end **197** that is attached to the valve housing **195** at a hinge **198**. This attachment allows the valve arm **194** to pivot about the hinge **198** as the float **193** is moved up and down. The second end **197** of the valve arm **194** also comprises a plug **199**. The valve housing **195** comprises an inlet end **214** and an outlet end **216** in fluid communication through a channel **218**. The outlet end **216** has a small hole **220** that can be completely covered by the plug **199**. The inlet end **214** has a hole **222** into which tubing can be inserted to provide a water source.

[0090] In the preferred embodiment, the inlet end **214** further comprises a tube lock **224**. The tube lock **224** is configured to quickly and easily lock tubing inside the channel **218** to provide a source of water through the float valve **184**. For example, the channel **218** may have a gradual taper towards the inlet end **216**. The tube lock **224** may also be similarly tapered so as to have a slight frustoconical shape with the narrower end external to the channel **218** and the wider end inside the channel **218**. A spring may also be placed inside the channel **218** abutting against the wider end of the tube lock **224**. This creates a biasing force against the tube lock **224**, pushing the tube lock **224** out of the channel **218**. However, due to the dimensions of the tube lock **224**, it cannot be forced out of the channel **218** though the inlet end **214**. The tube lock **224** may further comprise longitudinal slits intermittently and preferably evenly spaced around the tube lock **224**. This allows the tube lock **224** to expand and contract. The tube lock **224** and the channel **218** are precisely dimensioned so that when the narrow end of the tube lock **218** is pushed towards the channel **218** the wider end is allowed to expand. When the tube lock **224** is released, the spring forces the tube lock **224** out of the channel **218**, and due to the tapering, causes the wider end to shrink. In use, the user can push the tube lock **224** deeper into the channel **218** to expand the tube lock **224**, then insert a piece of tubing into the tube lock **224**. When the user releases the tube lock **224**, the spring forces the tube lock **224** away from the valve housing **195** and the wider end of the tube lock **224** shrinks in size. This causes the tube lock **224** to clamp down on the tubing and lock the tubing in place.

[0091] In the preferred embodiment, the channel **218** is exteriorly threaded **226**. Thus the channel **218** can be inserted through the inlet **182** with the float **193** on the inside of the reservoir pan **176**. The inlet end **214** of the valve housing **195** will project out of the reservoir pan **176**. A nut **277** can be used to screw onto the channel **218**. A washer **228** may be used on one or both sides the inlet valve **182** to assure a water tight seal.

[0092] In some embodiments, an aerator **186** may be placed in the reservoir pan **176** to aerate the water. For example, an airstone may be used. An air pump **192** can supply air to the aerator **186**.

[0093] In some embodiments, the reservoir pan **176** may comprise an auxiliary wall **188** spaced apart from but connected to the raised wall **180**. The auxiliary wall **188** and the raised wall **180** defining a gap **190** therebetween. This gap **190** can be used to house electricals, power packs, pumps **192** and the like. Due to the wall configuration; however, these auxiliary equipment can be hidden from view.

[0094] Since the grow module **114** is an artificially created environment, soil is technically not necessary. Aside from providing certain nutrients, soil provides a stable foundation from which the plant can grow. However, if the nutrients are provided from a different source and the plant is supported by an artificial structure, the soil is not required. Without the soil, the user can actually see the roots of the plant. Based on the visual characteristics of the roots, the user is able to determine the condition or health of the plant. Therefore, in some embodiments, an alternate watering system may be provided that allows the plants to receive water and nutrients without the use of soil.

[0095] With reference to Figures 10-21, in a soil-less system, the grow module **114** can utilize the housing **150** and reservoir pan **176**, and optionally, lid **162** and trellis **161**, as described above. The soil-less system, however, utilizes a different watering system. Rather than relying on a body of water that can be taken up by capillary action through the soil/dirt, the soil-less system utilizes and an atomizer system **234**, a sprinkler **232**, or both. In the preferred embodiment, the atomizer system **234** is used as the primary source of water and nutrients and the sprinkler **232** functions as a backup should the atomizer system **234** malfunction.

[0096] In the preferred embodiment, fluid is introduced through a tube inserted through the inlet **182** of the reservoir pan **176** to fill the reservoir pan **176** with fluid. The atomizer system **234** comprises an atomizer **236**, a flow generator **238**, and a motor **240**. The motor **240** drivers the atomizer **236**, which receives fluid from the flow generator **238**, such as an Archimedes' screw, an impeller, a pump, and the like. An example of an Archimedes' screw is shown in Figure 16.

[0097] The atomizer **236** breaks the fluid into tiny droplets to form a mist. In the preferred embodiment, a centrifugal atomizer is used, as shown in Figure 14. The centrifugal atomizer comprises a feed tube **242** attached to a disk **244**. The feed tube **242** has one or more channels **246**, and preferably a plurality of channels arranged off center from the longitudinal axis **L** of the feed tube **242**. As shown in Figure 15, fluid flows into the feed tube **242** while the disk **244** and feed tube **242** are rotated at a high rate of speed. This causes radial forces to be applied to the fluid in the feed tube **242**. As the fluid exits the feed tube **242**, the fluid disperses and is projected radially outwardly as a mist.

[0098] In some embodiments, under the disk **244** may be a plurality of blades **248** that rotate with the disk **244**. The rotating blades **248** function like a fan thereby creating airflow. Preferably, the air is drawn up from the bottom of the disk **244** then pushed upwardly and radially outwardly to carry the mist outwardly and upwardly towards the root zone, as shown in Figure 15.

[0099] In some embodiments, a diffuser screen **250** may be positioned around the disk **244** so that the fluid passes through the diffuser screen **250** to further increase dispersion of the fluid mist. As shown in Figures 17A and 17B, the diffuser screen **250** may be ring-like structure with a plurality of small or thin openings **252**. In the preferred embodiment, the openings may be approximately 0.70 mm wide. Each opening may be approximately 0.40 mm apart from each other.

[00100] The motor **240** may sit on top of a motor mount **254** (Figure 18) and housed in a motor housing **256** for safety and protection. An atomizer housing **258**, as shown in Figure 19, may hold the atomizer system **234**. The atomizer housing **258** may have a central hole **259** through which the feed tube **242** of the atomizer **236** can be inserted. In some embodiments, a cooling fan **260** may be provided to blow on the motor **240** to control the temperature of the motor **240** and prevent overheating and/or blow the mist around the root zone **170**. A fan duct **262**, as shown in Figure 20 may be provided to direct the airflow directly on to the motor **240** and/or throughout the root zone **170**. An electronics bay **264** may be provided to provide the electrical wiring to the various components. The electronics bay **264** may also comprise a controller **201** to control the various components.

[00101] In some embodiments, a sprinkler **232** is also provided. A pump **233** may be attached to the sprinkler to provide a source of water and nutrients. The sprinkler **232** is positioned in the root zone **170**. The sprinkler **232** can be used in lieu of the atomizer **236**, with the atomizer **236**, or as a back-up for the atomizer **236**. For example, if the atomizer **236** malfunctions, the controller **201** may switch the water source to the sprinkler **232**. In some embodiments, this is a temporary back-up until the atomizer **236** is fixed.

[00102] As shown in Figure 21, the sprinkler **232** is a tube-like structure comprising an inlet **266**, and a plurality of outlets **268**. In the preferred embodiment, the sprinkler is a ring-like structure with the inlet **266** positioned on the outside of the ring and the outlets **268** positioned on the inside of the ring. Therefore, the sprinkler is configured to spray radially inwardly. With the plant positioned on the inside of the ring, the sprinkler **232** is in the perfect position for evenly spraying water and nutrients to the plant's roots. A water pump **233**, such as a submersible water pump, may be used to drive water through a tube connected to the inlet **266** of the sprinkler **232**.

[00103] Additional features that can be used with the grow module **114** include heating coils **270** to control the temperature of the environment or the fluids, and various types of sensors to assure that the optimal environment is provided for the plants. For example, the grow module **114** may include a water sensor **272** to detect the water level, a temperature sensor **274**, such as a thermometer, thermistor, etc., and a moisture sensor **276**, such as a hygrometer, to detect the humidity level. Thus, the precise atmospheric condition inside the grow module (for any embodiment described herein), can be precisely controlled, just like the atmospheric environment of a grow room. This may be done by a single controller **201**.

[00104] In some embodiments, the grow modules **114** may utilize netted pots connected to, or hung within, the grow module **114** in the root zone **170** to securely hold plant seeds such that when the seeds sprout their roots spread through and outward from the netted pot and throughout the root zone, and soil, if any. In some embodiments, the netted pots may be placed in lids that are placed on top of the housing **150**. Lids may be configured to allow the roots to grow into the housing **150**. Each netted pot **160** may be of any size and shape. Multiple netted pots **160** may be connected to or hung within each grow module **114** in order to accommodate any number of plants or flowers in any arrangement or spacing configuration.

[00105] In some embodiments, a grow module kit may be provided for users to create their own makeshift grow module. As shown in Figures 22A-C, the grow room kit comprises a divider **168**, a plurality of supports **502**, a float valve **184**, tubing **504**, and an aerator **186**. The divider **168** can be the same as described above. In some embodiment, the wicking basket **175** may be integrally formed with the bottom surface of the divider **168** or it may be attachable to the bottom surface of the divider **168**. In some instances, depending on the size of the planter, having the wicking basket **175** in a central location may not be feasible. Therefore, allowing the wicking basket **175** to be attachable improves the versatility of the divider by allowing it to fit in a variety of planters. Once the wicking basket's position is established, a hole **177** can be cut through the divider **168** above the wicking basket **175** to allow the soil and/or dirt to be placed in wicking basket **175**.

[00106] In embodiments in which the wicking basket **175** is integrally formed with the bottom surface of the divider **168**, the divider **168** can be cut in various ways so as to place the wicking basket **175** in the proper location.

[00107] In some embodiments, a measuring device **506** may be provided to help determine the proper level for creating the inlet **182**. The measuring device **506** may come with a pre-cut hole **508**. To use the kit, the user can get any planter **510**. The measuring device **506** is placed on the ground against the planter where the inlet is to be created. The user need only trace the pre-cut hole **508** against the planter to create a mark where the inlet **182** will be created. The measuring device may be already dimensioned to place the inlet at the proper level. The supports **502** are also dimensioned properly so as to elevate the divider **168** at the proper height relative to the inlet. The divider may have to be trimmed to fit inside the pot **510**. The inlet can be created with any appropriate tool. Once the inlet is created, the float valve can be installed by inserting the channel through the inlet from the inside so that the float remains inside the pot. The valve housing can be secured using a nut. The supports **502** can be placed along the periphery of the pot. The aerator can be placed anywhere. A second hole may be created for the connections for the aerator. The divider is then placed on top of the supports **502**. The tube **504** can be inserted into the valve housing. The other end of the tube can be connected to a water source.

[00108] In some embodiments, the grow module **114** may be cylindrical in shape or a user may want to apply the kit to a cylindrical planter. In such situations, the float valve may not necessarily provide a water tight seal at the inlet **182** as shown in Figure 22D. In such a situation, a wedge washer **290** may be used as shown in Figure 22E. As shown in Figure 22F, the wedge washer is a partially-cylindrical shaped washer. Essentially, the washer is a cylinder having a transverse hole **292** through the cylinder, then cut along a longitudinal plane so as to create a flat face **294** on one side and a curved face **296** on the opposite side. As shown in Figure 22F, the channel **218** of the valve housing **195** is inserted through the transverse hole **292** with the flat face **294** abutting against the valve housing **195**. The channel **218** can then be inserted through the inlet **182** from the inside to the outside. This causes the curved face **296** to abut against the curved wall of the cylindrical pot thereby creating a water tight seal. As such, the wedge washer 290 may be made from rubber, silicone, plastic, and the like.

[00109] Rotatable Lift System

[00110] In some embodiments, the grow module **114** may be used in conjunction with a rotatable lift system **102** upon which the grow module **114** can be mounted so that the plant can be positioned at an optimum distance from a light source **300**. With the use of a sensor **200** operatively connected to the rotatable lift system **102**, the rotatable lift system **102** rotates the grow modules **114** in a planetary path about a main axis **A** defined by the lift system **102**. Simultaneously, the rotatable lift system **102** is capable of raising and lowering, via lift arms **110**, each grow module **114** independently of any other grow module **114**. In addition, each grow module **114** is capable of being rotated about its own axis. The rotatable lift housing **102** may be placed inside of a grow room configured to monitor and maintain the most optimal growing conditions for plants.

[00111] Figure 29 shows a comparison of current plant growing systems (left side) and an embodiment of the present invention (right side). The same three plants of various sizes are depicted on both sides. Plant A is the tallest (1 foot away from the light source **300**), Plant B is the shortest (2 feet away from the light source **300**), and Plant C is of intermediate height (1.67 feet away from the light source **300**) compared to Plant A and Plant B. The left side depicts the plants in a typical scenario—level plane without a lift mechanism. The right side depicts the same plants atop of the lift system **102**.

[00112] The shortcomings of the prior art is evident—the plants are not receiving the same amount of illumination from the light source. The Inverse Square Law of Lighting demonstrates the critical need for a lifting apparatus for controlled environment horticulture. The formula is: illumination of an object (I) equals the inverse of the square of the distance (D) of an object from the light source ($I = 1/D^2$).

[00113] Assume ideal illumination onto a plant when it is one foot away from the light source. At two feet, the illumination is one-fourth the ideal value. At three feet, the illumination is one-ninth the ideal value. With each foot of distance, the illumination decreases exponentially.

[00114] Applying this formula to the example in Figure 29, we see Plant B (two feet from the light source) is receiving only one-fourth of the light intensity as Plant A (one foot from the light source). Secondly, Plant B suffers from the shadowing caused by Plants A and C, so it has two distinct hindrances that hamper its ability to grow. Plant C is also suffering from a tremendous loss of light intensity as well because it too is not at the ideal one foot mark away from the light source. As the three plants continue through their lifecycles, Plant B and Plant C's respective distances from the light source will unfortunately grow further and further because of the light intensity being received by Plant A will facilitate growth that outpaces that of Plant B and C. The positive impact of Plant A receiving optimal light intensity is enormous. But at the same time, the consequence of not having each plant receive that same benefit is costly—the other plants under that light source will suffer from receiving fractional quantities of light and the effects of shadowing (which means plants receiving even less light.) Plant A's success becomes Plant B's and C's enemy. Plant A will produce generous yields, while Plants B and C lag utterly behind. A mere few inches translate to a lot of light loss, which translates to a lot of yield loss, which translates to a lot of cash loss. Note that simply lowering the lighting apparatus is not a solution because one can only lower the light to the height of the tallest plant.

[00115] The individual lifting capability of the lift system **102**, as depicted on the right side in Figure 29, solves this problem by affording all the plants within a crop, Plant A's fortune. This eliminates the loss of intensity and shadowing. The lift system **102** ensures each and every plant receives equal light intensity and even light exposure regardless of the size of plant or its position under the light source, and therefore, increasing crop yields exponentially at a savings to the crop owner. Having a whole crop of champions, not just one featured star followed by a set of mediocre performers, is every grower's dream. Growers/investors who value a high volume of high quality product on a highly consistent basis will respect and appreciate the lift system **102**.

[00116] A "rotating turntable" or "plant mover" helps resolve the issue of "hot spots" and shadows, which are created by the light source, its reflective hood, grow room lighting configuration and/or by other considerations. By rotating the plants, a turntable ensures that plants share equal time in such hot spots, which is necessary, but, it does absolutely nothing about the intensity of light afforded to each individual plant. By lifting the plants to absorb the maximum energy allowance of the light source—or to the highest point tolerable by a specific plant/flower—while rotating them and then maintaining that distance, a grower achieves prime reward from the energy for which he/she is paying. When evaluating yields and monetary returns pertaining to investments/crops of pharmaceutical utility, the advantages of the system creates a remarkable return on investment that is unparalleled or unachievable by other techniques or technologies.

[00117] An optic sensor **200** working in cooperation with the lift device can be used to raise a plant to an ideal height in relation to the light source **300** and maintain that plant-to-light distance by gradually lowering the lift plate as the plant grows. This prevents the laborious task of continuously needing to raise/lower one's plants to receive the full benefit of the energy being provided by the light source.

[00118] As shown in Figure 23, in the preferred embodiment, the lift system **102** comprises a tower **105** defining a main axis **A**, the tower **105** connected to a base **103** to allow the tower **105** to rotate about its main axis **A**, using a system of gears.

[00119] In the preferred embodiment, the tower **105** is perpendicular to the ground when properly mounted on its base **103**. The tower **105** comprises a top **104**, a bottom **106** opposite the top **104**, and at least one sidewall **107a-d** therebetween connecting the top **104** to the bottom **106.** The main axis **A** is perpendicular to and passes through the top and bottom **104** and **106**, preferably at their respective centers.

[00120] The bottom **106** is attached to the base **103** in a rotatable manner, for example, by being rotatably mounted on a post **113** on the base **103**. Thus, the bottom **106** of the tower **105** may function as a turntable or a lazy susan, which is rotatably coupled to the base **103**. The tower **105** may be a polyhedron of any shape, including, by way of example only, a cylinder, a triangle, a rectangle, a hexagon, an octagon, and the like.

[00121] In other embodiments, only the sidewalls of the lift housing **102** may be rotatable about the main axis **A**. Other embodiments may also utilize a roller system, in which high friction rollers, or wheels, may be used to rotate the bottom **106** about the main axis **A** from below and/or along the side of the bottom **106**. Rollers may also be positioned adjacent to the periphery of the bottom **106** to provide additional support.

[00122] Each sidewall **107a-d** may be lined with a track **130a-d**. Each track **130a-d** may have a lift device **132a-d** that rides vertically up and down along the track **130a-d**. Each track **130a-d** can line substantially the full length of the sidewall **107a-d**. The tracks **130a-d** may be any type of linear rail or toothed track that utilizes gears, spiral screws, lead screws, pulleys, hydraulic lifts, and the like to move the lift device 132a-d, such as a truck or carrier, in a vertical direction upon rotation of lift gears **404a-d**.

[00123] Attached to the tower **105** is a plurality of support assemblies that hold the grow modules **114** as the grow modules **114** are lifted and rotated about. In the preferred embodiment, each support assembly is essentially identical, comprising lift arms **110a-d**,

lift plates **112a-d**, and plate gears **408a-d**; therefore, only one will be described, but the description applies to all of the support assemblies.

[00124] With reference to Figure 26, the support assembly comprises a lift arm **110a** attached to one sidewall **107a**, the lift arm **110a** configured to move in a vertical manner independently of another lift arm along its respective sidewall. The lift arm **110a** is used to support a lift plate **112a**. In the preferred embodiment, the lift arm **110a** is a ring-like structure attached to a mounting bracket **117a**. The mounting bracket **117a** is configured to attach to the lift device **132a**. Thus, as the lift device **132a** moves up and down along its track **132a**, the lift arm **110a** moves with it. The shorter a plant is, the closer the plant will need to be to the light source **300**. As each plant grows within its respective grow module **114** it will be lowered from the light source **300** via the lift arm **110a** to maintain the optimal distance from the light source **300**. Furthermore, the lift arm **110** may assist with directing, routing, and concealing electrical wiring and tubing for water, nutrients, air supply, and run-off. Therefore, in some embodiments, the lift arm **110a** may comprise wire management members **115**. The wire management member **115** may be a series of loops, hooks, clips, and the like to manage any wires, tubing, cords, and the like that may be utilized by the grow module **114** so as to minimize tangling and kinks.

[00125] Mounted on the lift arm **110a** is a lift plate **112a**. The lift plate **112a**, which hold the grow modules **114**, may be raised and lowered toward and away from a light source **300** while the lift plates **112** maintain a parallel relation to the ground. In addition, the lift plates **112a-d** revolve around the tower **105**, while at the same time rotating about their own axes **B1-B4**.

[00126] In the preferred embodiment, the lift plate **112a** is a disk-like plate having a top surface **140** and a bottom surface **142**. The top surface **140** may comprise a recess similar in shape to the grow module **114** so that the grow module **114** can be seated securely in the lift plate without sliding off during the revolution, rotation, or vertical movement actions. The dimension of the bottom surface **142** is slightly smaller than the dimension of the top surface thereby creating a lip **144** on the bottom side. The bottom surface is also dimensioned to be substantially similar to the inner side of the lift arm **110a** so as to fit inside the lift arm **110a**. The lip **144** then abuts against the top side of the lift arm **110a** with the bottom surface residing within the ring of the lift arm **110a** to allow the lift plate **112a** to rest on top of the lift arm **110a**. An opening **146** may be created through the top and bottom surfaces **140**, **142** to allow any wire, tubing, or cords to pass through from the bottom surface **142** to the top surface **140** to connect with a grow module **114** sitting atop of the lift plate **112a**.

[00127] A plate gear **408a** is operatively connected to the lift plate **112a** preferably at its center. The plate gear **408a** comprises gear teeth **145** attached to a spindle **147**. The spindle is attached to the bottom surface **142** of the lift plate **112a** such that rotation of the gear teeth **145** causes rotation of the spindle **147**, which causes rotation of the lift plate **112a**. In some embodiments, to facilitate the rotation of the lift plate **112a-d**, a low friction interface **148** may be positioned in between the lift plate **112a-d** and the lift arm **110a**. In the preferred embodiment, the low friction interface **148** is in the form of a Teflon ring having dimensions substantially similar to that of the lift arm **110a-d**.

[00128] In some embodiments, along the spindle **147** may be a protrusion **149** that can function as a stop. In some embodiments, a guard **116a** may be inserted in between the lift plate **112a** and the protrusion **149**, such that the guard is mounted on the protrusion **149** beneath the lift plate **112a** with a gap therebetween. As the lift plates 112 revolve about the tower and rotate about their own axes in a clockwise and counterclockwise manner, the tubes and wires entering into the grow modules may get tangled. The guard 116a reduces the possibility of tangling and getting caught in the gears.

[00129] In some embodiments, the lift arm **110** may fit into and be attached to the lift housing **102** via an opening on the sidewall **107** of the lift housing **102** that may extend the vertical length of the lift housing **102**. In some embodiments, the lift arm **110** may be attached to the sidewall **107**.

[00130] The lift arm **110** may be of many different forms. In some embodiments, the lift arm **110** may be elevated on a track **130** inside the side wall opening **109** or on the sidewall **107**, and rigidly connected to the lift plate **112** such that the lift arm **110** and lift plate **112** are in a parallel relation to each other, as well as to the ground, in order to keep the lift plate **112** level. The lift arm **110**, in other embodiments, may also be elevated via a pulley, spiral, or hydraulic lifting system, or the like, located inside the sidewall opening or on the sidewall **107** of the lift housing **102**. Other embodiments of the lift arm **110** may include an articulating lift arm **110** located within the sidewall opening **109** or on the sidewall **107** of the lift housing **102** where a first joint exists between a first end of the lift arm **110** and the lift plate **112** and a second joint exists between a second end of the lift arm **110** and the lift housing **102** so that the lift plate **112** does not have to follow the rigid movements of the lift arm **110**. The joints in this embodiment are utilized to control the movement of the lift plate **112** by ensuring the lift plate **112** maintains a flat and level surface so the grow module **114** it supports is not disturbed. This embodiment may be used with or without a track, pulley, spiral, or hydraulic lift system, or the like.

[00131] In the preferred embodiment the rotation of the lift housing **102** may be automated with the use of a gear system operatively connected to a controller 201, to cause the tower **105** to rotate about its main axis **A** in either a clockwise or counterclockwise direction. The gear system may be located directly on or below the bottom surface **106** of the tower **105**.

[00132] With reference to Figures 23-28, in the preferred embodiment, the gear system comprises three motorized gears **402**, **406**, **410**, a central gear **108** that causes the lift plates **112a-d** to revolve around the tower **105**, a plurality of lift gears **404a-d** to cause the lift plates **112a-d** to move vertically up and down, and the plurality of plate gears **408a-d** discussed above.

[00133] The central gear **108** is operatively connected to the bottom **106** of the tower **105**, wherein rotation of the central gear **108** causes rotation of the tower **105** about the main axis A. For protection, the central gear **108** may be housed in a covering **210**. A first motorized gear **402** is operatively connected to the central gear **108**, the operation of which causes the central gear **108** to rotate. The first motorized gear **402** may be fixed to the base **103**. Rotation of the central gear **108** causes its associated post **113** to rotate. The post **113** is connected to the tower **105** thereby causing the tower **105** to rotate.

[00134] A plurality of lift gears **404a-d** are attached to the bottom **106** of the tower **105**. One lift gear **404a-d** is operatively connected to one lift arm **110a-d** via its respective lift device **132a-d**, such that rotation of the lift gears **404a-d** causes vertical movement of the respective lift device **132a-d**, and therefore, the lift arms **110a-d**. A second motorized gear **406** is operatively connectable to each lift gear **404a-d**, such that when one of the lift gears **404a-d** is operatively connected to the second motorized gear **406**, operation of the second motorized gear **406** causes the operatively connected lift gear **404a-d** to rotate.

[00135] In the preferred embodiment, the second motorized gear **406** is fixed on the base **103**. Since the lift gears **404a-d** are connected to the bottom **106** of the tower **105**, the lift gears **404a-d** rotate with the tower **105**. Rotation of the tower, then causes different lift gears **404a-d** to engage with the second motorized gear **406**. Thus, each lift gear **404a-d** can be rotated by the second motorized gear **406** in turn. At the area where the second motorized gear **406** connects with one of the lift gears **404a-d**, the cover **210** may be faceted **214** to allow the second motorized gear **406** to be as close to the cover **210** as possible. This improves the economy of space. In some embodiments, each lift gear **404a-d** could have its own motorized gear **406** so that each lift arm **110a-d** can move simultaneously with the others if necessary. However, as plants grow slowly, this is not necessary.

[00136] A plurality of plate gears **408a-d** may be attached to the bottom of the lift plates **112a-d**, one plate gear operatively connected to one lift plate, wherein rotation of one plate gear causes rotation of the respective lift plate. A third motorized gear **410** is operatively connectable to each plate gear **408a-d**, such that when one of the plate gears **408d** is operatively connected to the third motorized gear **410**, operation of the third motorized gear **410** causes the operatively connected plate gear **408b** to rotate, which causes the lift plate **112b** to rotate.

[00137] The base **103** may comprise a wire management device **280** to manage the various wires, tubing, cords, and the like. The base may also comprise the controller **282** that controls the various features of the present invention.

[00138] At least one grow module **114** is situated on top of a lift plate **112**. Each lift plate **112** is subsequently attached to the lift housing **102** via a lift arm **110**. In some embodiments, within the lift housing **102** a separate motor or hydraulic pump is housed capable of raising and lowering each grow module **114** independently via the lift arm **110** and lift plate **112** combination. Each lift arm **110** may be guided along a flexible toothed track **130** so that the lift plate **112** may be raised and lowered in a smooth fashion in order not to disturb the grow module **114** it is supporting.

[00139] In some embodiments, the lift arm **110** and lift plate **112** may further serve as a means for routing power, water, air supplies, nutrients, and run-off between the lift housing **102** and the independent grow modules **114**. A hollow tunnel through the interior of the lift arm **110** and lift plate **112** may be able to enclose and route electricity via a power supply from the lift housing **102** to each grow module **114** so that each grow module **114** may be independently operated. The lift arm **110** and lift plate **112** may also be capable of enclosing and routing multiple independent hoses via a second hollow tunnel so that water, air supplies, nutrients, and run-off may be pumped between the lift system **102** and the grow modules **114** from various reservoirs.

[00140] In some embodiments, the lift system **102** may also comprise a plurality of controllers and/or monitors to automatically optimize the conditions for plant growth in each grow module **114**. A lift and rotation controller may be used for controlling an individual plate's movements, a flow meter for ensuring consistent water and nutrient supply, a pH tester and monitor, a nutrient dosing controller for automated feeding, a digital grow calendar display, a water temperature gauge for monitoring and regulating water temperature, air distribution vents for controlling air intake and outtake, carbon dioxide distribution vents for controlling carbon dioxide levels, a reservoir water level monitor for maintaining consistent reservoir levels, a fill/drain controller, and/or a leaf sensor to monitor a specific plant to determine whether it is receiving adequate or too much water and other nutrients. Each of these sensors and controllers can feedback to the system to make the necessary adjustments. In some embodiments, the sensors may feed into a single controller.

[00141] As shown in Figure 30, a sensor **200** may be mounted upon or integrated with a controller **201** placed at the optimal distance below the light source **300** and operatively connected to the lift housing **102** and each lift arm **110**, and may be capable of determining when the lift plate **112** has reached the appropriate height to optimize the distance between the plant and the light source so as to maximize the plant or flower's growth potential.

[00142] For example, as shown in Figure 29, the sensor **200** may output a beam **204** that is transmitted to a receiver **206**. The lift housing **102** rotates the grow modules **114** such that each plant passes directly under the sensor beam **204**. The lift housing **102** and lift arms **110** continue to raise each lift plate **112** and grow module **114** until the plant it supports crosses and interrupts the beam **204** by blocking the beam **204** from getting to the receiver **206** from the sensor **200**. Once the beam **204** has been blocked by a particular plant, a signal is sent to the controller 201 of the lift housing **102**, and that plant's lift arm **110** will stop lifting and subsequently begin to descend until the beam **204** is able to be detected by the receiver **206**. Once the receiver **206** detects the beam **204** again the particular lift arm **110** holding the plant that originally interrupted the beam **204** will stop lowering and remain in that position until its plant breaks the beam **204** between the sensor **200** and the receiver **206** again, in which case the lift arm **110** will repeat this process.

[00143] In another embodiment, in order to allow for plant growth, a recalibration may take place periodically, (e.g. once every 12 hours). During the recalibration each lift arm **110** and lift plate **112** is lowered to the lowest possible setting and then re-raised up until the plant or flower interrupts the sensor beam **204** from being received by the receiver **206** again. Upon interruption of the sensor beam **204** the lift arm **110** and lift plate **112** move down slightly until the beam **204** reaches the receiver **206** again and are held at that location until the next calibration. Each lift housing's sensor **200** may be programed to recalibrate at a different time depending on what type of plant, flower, or crop is being grown.

[00144] By way of example only, the sensor **200** may be an optic or touch sensor and may relay an infrared, a photoelectric or a laser beam to a receiver **206**.

[00145] As shown in Figure 30, the plant growing system further comprises a controller **201** to control the activity required to maintain optimum growth of the plant. The lift system **102**, grow module **114**, and grow room may have separate controllers, or they may all be integrated into a single controller. If separate controllers, each controller should be capable of communicating with each other. Continuously monitoring grow room conditions and making necessary adjustments in real time is absolutely essential to maintaining an accelerated growing environment. The system's controller may 1) maintain plants at the ideal plant-to-light distance, 2) continuously measure grow room variables, 3) report the data to the grower, 4) allow changes remotely, 5) record every action taken by the grower, and 6) store and process the grow room data and grower actions for automated uploading at a later date and/or between systems to recreate the growth cycle minute-by-minute, action-for-action.

[00146] By way of example only, the controller **201** may include, but is not limited to, a recording system, a digital camera **203** (with time lapse photography feature) for monitoring, relaying, and communicating a live digital image or feed for viewing and/or security; a thermostat for measuring, relaying, and controlling air temperature; a hygrometer for measuring, relaying, and controlling relative humidity; a carbon dioxide sensor for regulating and relaying carbon dioxide levels; a light timer for lighting control thus allowing the grower to pre-program light times; an optic sensor for maintaining ideal plant-to-light distances; a lumen sensor for measuring, relaying, and controlling light source discharge; and a communication module for controlling and providing power and data signals between each unit on the controller **201** and the grow module **114** and/or the lift system **102**, as well as sending information to users, investors, and the like. Other embodiments of the controller **201** may include a synchronization controller for "daisy chaining" units together in order to maintain similar conditions between various units. The detection, control, and optimization of the parameters discussed above can occur within the grow modules **114** and/or in the grow room in general. Thus, the grow room may have the various sensors so that the controller can control the humidity, temperature, carbon dioxide levels, etc. of the room itself. Thus, the controller **201** can monitor and control the micro-environment of the grow module as well as the macro-environment of the grow room in which the grow modules reside.

[00147] The controller **201** allows the user to monitor and record data for the different variables associated with the growing of the plants, such as watering information, temperature information, revolution information, rotation information, lighting information, lift information, nutrient information, and the like. By monitoring and recording all variables, the user is able to correlate which conditions produced the best results. The user can also input data for each plant into the controller. By identifying the plant with the best result, the user can determine the best conditions. These conditions can be stored as a file that can be read and run as a program by the controller for the next similar plant. Having the controller run a program that created conditions that produced great results in one plant should produce similar results in a similar plant. Therefore, the next time a user plants the same type of plant for which he obtain great growing results, he can simply upload the same program to get the same results.

[00148] An application, or "app," may be created for portable or mobile devices such as, by way of example only, a laptop computer, tablet, or cell phone that allows a user to monitor, receive, and control all aspects and features of the controlled environment agricultural system of the present invention while away from the physical unit. The application may send line feeds, or pictures of these plants and their environment. In some embodiments, a website may be established for the user to log-in and monitor his plants. Tools on the app will allow the user to move the camera or view from multiple cameras simultaneously or one-by-one. Additional tools allow the user to change or modify any of the features described above. A GPS unit may also be placed on the system to track its location.

[00149] Multiple controlled environment agricultural systems, as substantively described herein, may housed in a common grow room. Collectively housing multiple controlled environment agricultural systems in one room allows for common monitoring systems to be used including, by way of example only, a single thermostat, a single hygrometer, a single carbon dioxide sensor, a single communication module, and the like. A solar panel may be installed on the grow rooms so as to power the system using solar power.

[00150] The components of the grow module **114** and the lift system **102** can be made from metal, plastic, wood, glass, rubber, and the like.

[00151] The foregoing description of the preferred embodiment of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention not be limited by this detailed description, but by the claims and the equivalents to the claims appended hereto.

INDUSTRIAL APPLICABILITY

[00152] This invention may be industrially applied to the development, manufacture, and use of a plant growing system that automatically waters the plants without over-watering or under-watering using a unique grow module. A lift mechanism can also be used to maximize lighting efficiency.

CLAIMS

What is claimed is:

1. A plant growing system, comprising:

   a. a rotatable lift housing, the rotatable lift housing comprising:

      i. a base,

      ii. a tower operatively connected to the base, the tower comprising a top surface, a bottom surface opposite the top surface, and a plurality of sidewalls therebetween connecting the top surface to the bottom surface, the tower defining a main axis perpendicular to and passing through the top and bottom surfaces, the bottom surface attached to the base in a rotatable manner,

      iii. a plurality of lift arms, one lift arm attached to one sidewall, each lift arm configured to move in a vertical manner independently of another lift arm along its respective sidewall,

      iv. a plurality of lift plates, each lift plate defining a central axis parallel to the main axis, one lift plate attached to one lift arm, wherein the lift plates revolve about the tower in a planetary path, each lift plate configured to rotate about their respective central axis,

      v. a central gear operatively connected to the bottom surface of the tower, wherein rotation of the central gear causes rotation of the tower about the main axis,

      vi. a first motorized gear operatively connected to the central gear, operation of which causes the central gear to rotate,

vii. a plurality of lift gears, one lift gear operatively connected to one lift arm, wherein rotation of the lift gears cause vertical movement of the respective lift arms,

viii. a second motorized gear operatively connectable to each lift gear, wherein when one of the lift gears is operatively connected to the second motorized gear, operation of the second motorized gear causes the operatively connected lift gear to rotate,

ix. a plurality of plate gears, one plate gear operatively connected to one lift plate, wherein rotation of one plate gear causes rotation of the respective lift plate,

x. a third motorized gear operatively connectable to each plate gear, wherein when one of the plate gears is operatively connected to the third motorized gear, operation of the third motorized gear causes the operatively connected plate gear to rotate;

b. a plurality of grow modules positionable on top of the lift plate, wherein each grow module comprises a housing, the housing comprising:

i. a sidewall, wherein at least a portion of the sidewall is a dual panel sidewall comprising an inner wall and an outer wall surrounding the inner wall, the inner wall defining a main cavity, wherein at least a portion of the dual panel sidewall is transparent,

ii. a chute formed in the sidewall for depositing nutrients into the housing from outside of the housing,

iii. a segmented lid, comprising a first lid piece and a second lid piece, wherein the first lid piece defines a slot into which the second lid piece is inserted to fully assemble the segmented lid, wherein the fully assembled segmented lid defines a grow hole;

iv. a telescoping trellis housed in between the inner wall and the outer wall of the dual panel sidewall, and extendable above the segmented lid,

v. a divider separating the main cavity of the housing into a root zone and a reservoir area, the divider comprising a wicking basket, a plurality of small holes, a main opening leading into the wicking basket,

vi. a reservoir pan occupying the reservoir area and removably attached to the sidewall, the reservoir pan comprising a bottom plate and a raised wall connected to the bottom plate, the raised wall comprising an inlet through which water is introduced,

vii. a float valve attached to the reservoir pan through the inlet to control a flow of the water into the reservoir pan, wherein control of the flow of the water is dependent on a water level,

viii. an aerator positioned in the reservoir pan,

ix. an auxiliary wall spaced apart from but connected to the raised wall defining a gap therebetween,

x. an air pump housed within the gap between the raised wall and the auxiliary wall, the air pump operatively connected to the aerator;

c. a sensor mounted upon a controller placed at an optimal distance below the light source and operatively connected to the lift housing, capable of determining when the lift plate has reached the appropriate height to optimize a distance between a plant and a light source so as to maximize the plant's growth potential; and

d. a controller operatively connected to the sensor, the first motorized gear, the second motorized gear, and the third motorized gear, wherein the controller operates the first motorized gear, the second motorized gear, and the third motorized gear based on a set of instructions.

2. A plant growing system, comprising a grow module, wherein the grow module comprises:

a. a housing having a sidewall defining a main cavity, wherein the main cavity has a root zone and a reservoir area;

b. a segmented lid, comprising a first lid piece and a second lid piece, wherein the first lid piece defines a slot into which the second lid piece is inserted to fully assemble the segmented lid, wherein the fully assembled segmented lid defines a grow hole;

c. a trellis attachable to the sidewall, the trellis extending above the segmented lid when attached to the sidewall; and

d. a reservoir pan occupying the reservoir area and removably attached to the sidewall, the reservoir pan comprising a bottom plate, a raised wall connected to the bottom plate, and an inlet.

3. The plant growing system of claim 2, wherein at least a portion of the sidewall is a dual panel sidewall comprising an inner wall and an outer wall surrounding the inner wall, and wherein the trellis is telescopic having a collapsed configuration and an extended configuration, wherein in the collapsed configuration the trellis is hidden in between the inner wall and the outer wall.

4. The plant growing system of claim 2, further comprising a float valve attached to the reservoir pan through the inlet to control a flow of the water into the reservoir pan, wherein control of the flow of the water is dependent on a water level.

5. The plant growing system of claim 4, wherein the float valve comprises:

a. a float;

b. a valve arm attached to the float;

c. a valve housing attached to the valve arm and configured to fit through the inlet, wherein the valve arm is attached to the valve housing at a hinge, wherein the valve housing comprises a tube lock for locking a piece of tubing inside the valve housing.

6. The plant growing system of claim 2, wherein at least a portion of the sidewall is transparent.

7. The plant growing system of claim 2, further comprising a chute formed in the sidewall for depositing nutrients into the housing from outside of the housing.

8. The plant growing system of claim 2, further comprising a divider that separates the main cavity of the housing into the root zone and the reservoir area, the divider comprising a wicking basket, a plurality of small holes, a main opening leading into the wicking basket.

9. The plant growing system of claim 2, further comprising:

a. an auxiliary wall spaced apart from but connected to the raised wall defining a gap therebetween;

b. an aerator positioned in the reservoir pan; and

c. an air pump housed within the gap between the raised wall and the auxiliary wall, the air pump operatively connected to the aerator.

10. The plant growing system of claim 2, further comprising a sprinkler housed in the root zone.

11. The plant growing system of claim 2, further comprising an atomizer system housed in the reservoir area.

12. The plant growing system of claim 11, wherein the atomizer system comprises:

a. an atomizer to atomize water into a mist;

b. a flow generator to provide water to the atomizer; and

c. a motor to rotate the atomizer to atomize the water.

13. The plant growing system of claim 12, wherein the atomizer comprises

a. a disk that is rotatable when driven by the motor; and

b. a plurality of blades adjacent to the disk and is rotatable with the disk to create airflow.

14. The plant growing system of claim 13, further comprising a diffuser screen positioned around the disk so that the water passes through the diffuser screen.

15. The plant growing system of claim 2, further comprising a plurality of sensors to provide an optimal environment for the plant.

16. The plant growing system of claim 15, further comprising:

a. a water sensor to detect a water level;

b. a temperature sensor to measure a temperature; and

c. a moisture sensor to detect a humidity level.

17. The plant growing system of claim 11, further comprising a netted pot connected to the grow module and hung within the root zone to securely hold a plant seed such that when the seed sprouts roots, the roots spread through and outward from the netted pot and throughout the root zone.

18. The plant growing system of claim 2, further comprising a lift system comprising:

a. a tower; and

b. a plurality of lift plates operatively connected to the tower to revolve around the tower, wherein the plurality of lift plates automatically lift a plurality of grow modules to a respective predetermined optimum distance from a light source, independently of each other.

19. The plant growing system of claim 18, wherein the plurality of lift plates automatically maintain a plurality of grow modules at the predetermined optimum distance, independent from each other.

20. The plant growing system of claim 18, wherein the lift plates automatically rotate the plurality of grow modules independent of each other.

21. The plant growing system of claim 18, further comprising a recording system for monitoring and recording activity of the lift system and the grow modules to correlate growing conditions with growth of a plant.

22. The plant growing system of claim 2, further comprising at least one controller to monitor and adjust the lift system and the grow module to maintain optimum conditions.

23. A plant grow module kit, comprising:

a. a divider to separate a pot into a root zone and a reservoir area;

b. a plurality of supports to elevate the divider for the reservoir area;

c. a measuring device to determine a location for creating an inlet on the pot, wherein the measuring device comprises a pre-cut hole for demarcating the inlet location on the pot, the measuring device and the plurality of supports dimensioned to position the inlet below the divider;

d. a float valve insertable into the inlet;

e. an aerator positionable under the divider; and

f. tubing attachable to the float valve and a water source to provide a flow of water to the float valve.

24. The kit of claim 23, wherein the float valve comprises a tube lock to quickly and easily lock the tubing into the float valve.

25. The kit of claim 23, further comprising a wedge washer.

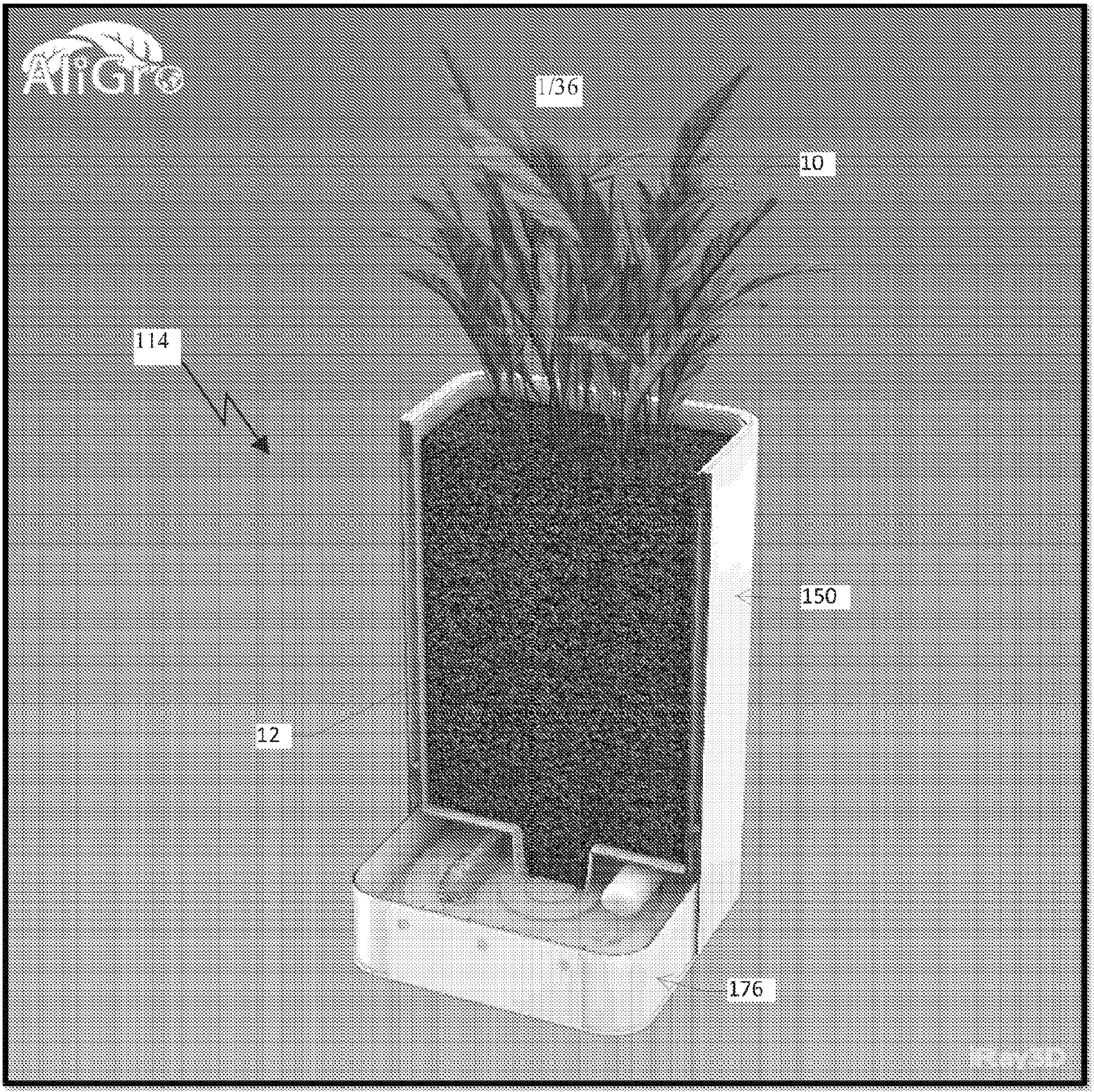


FIGURE 1

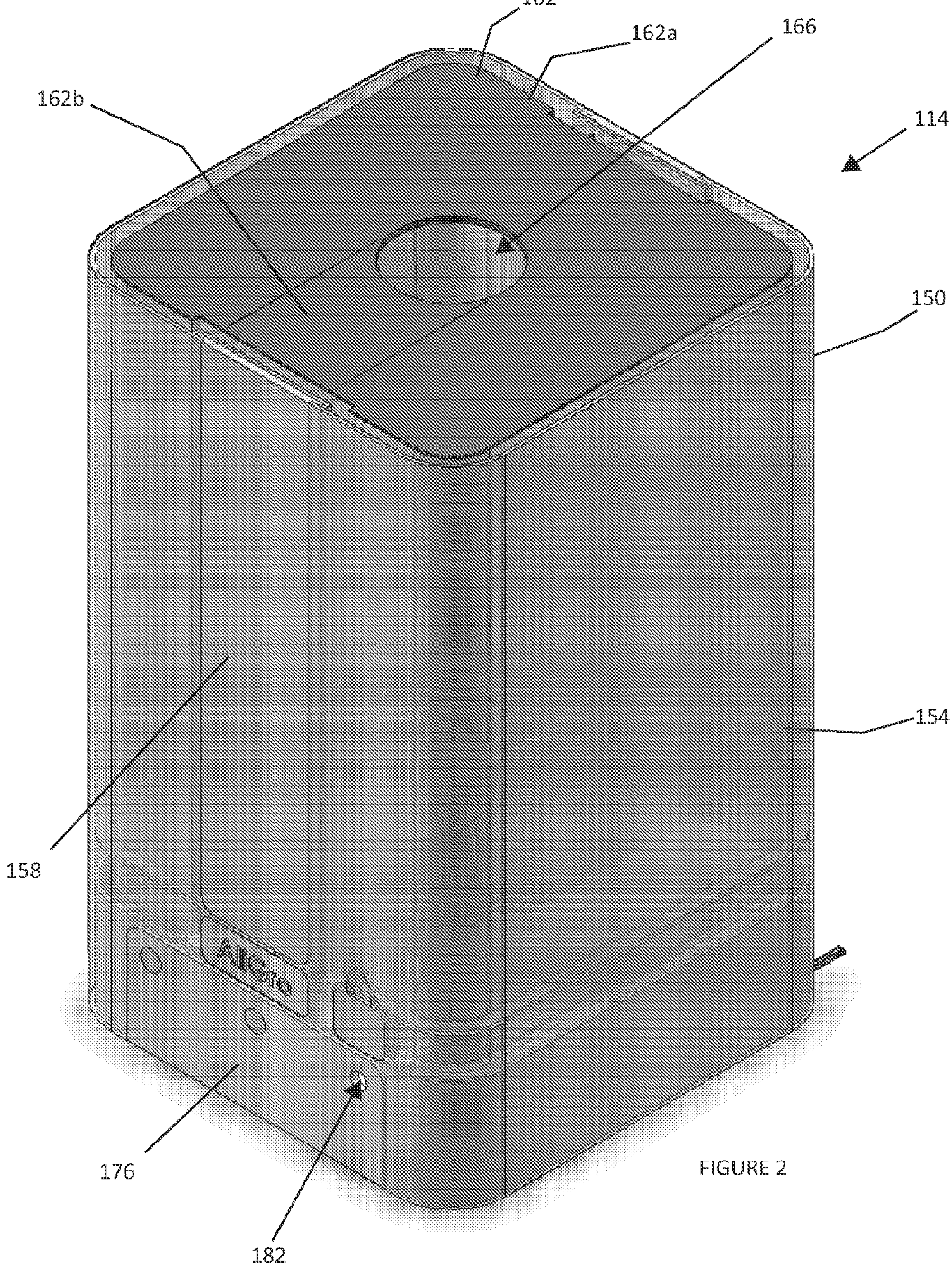


FIGURE 2

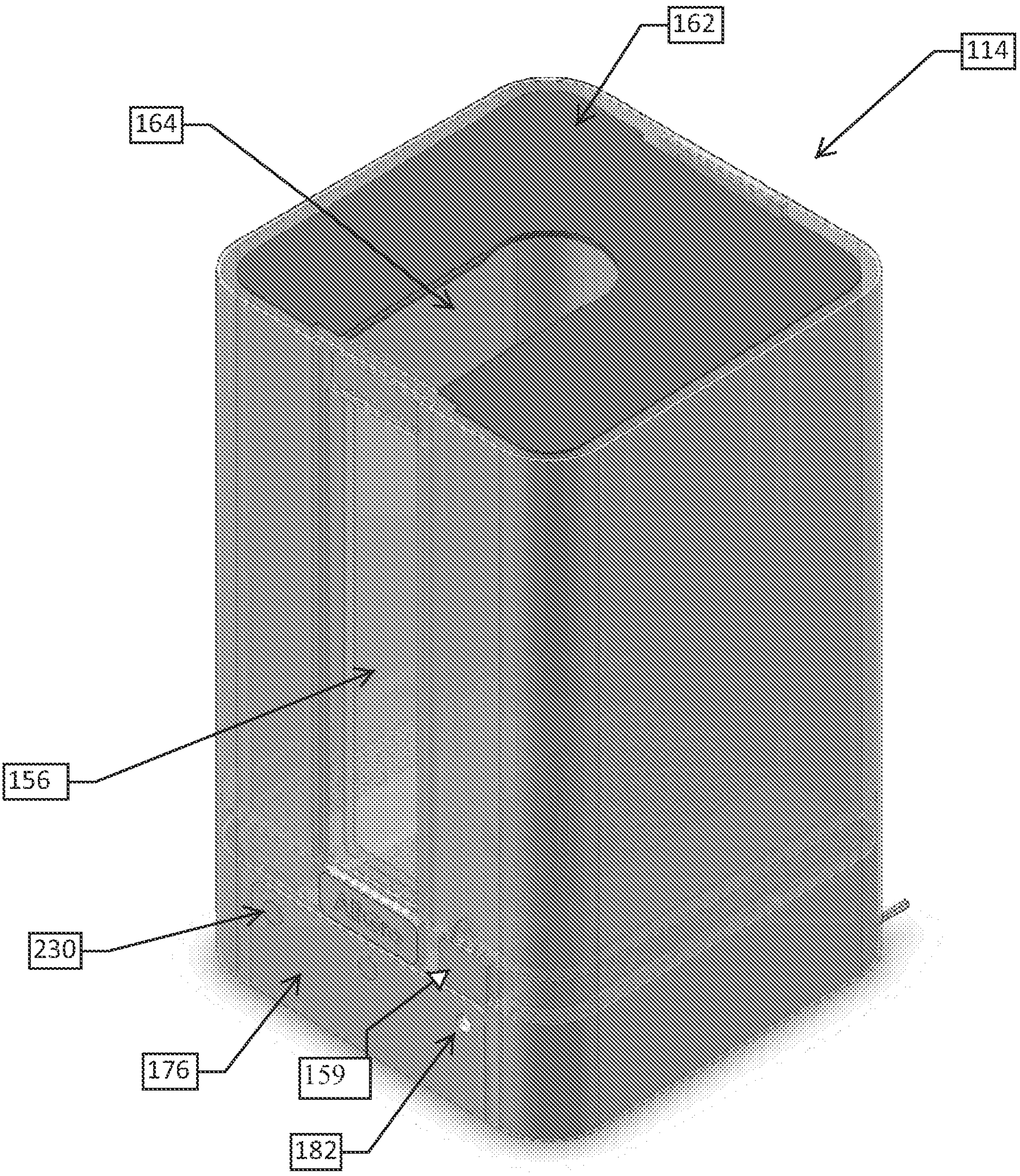


FIGURE 3

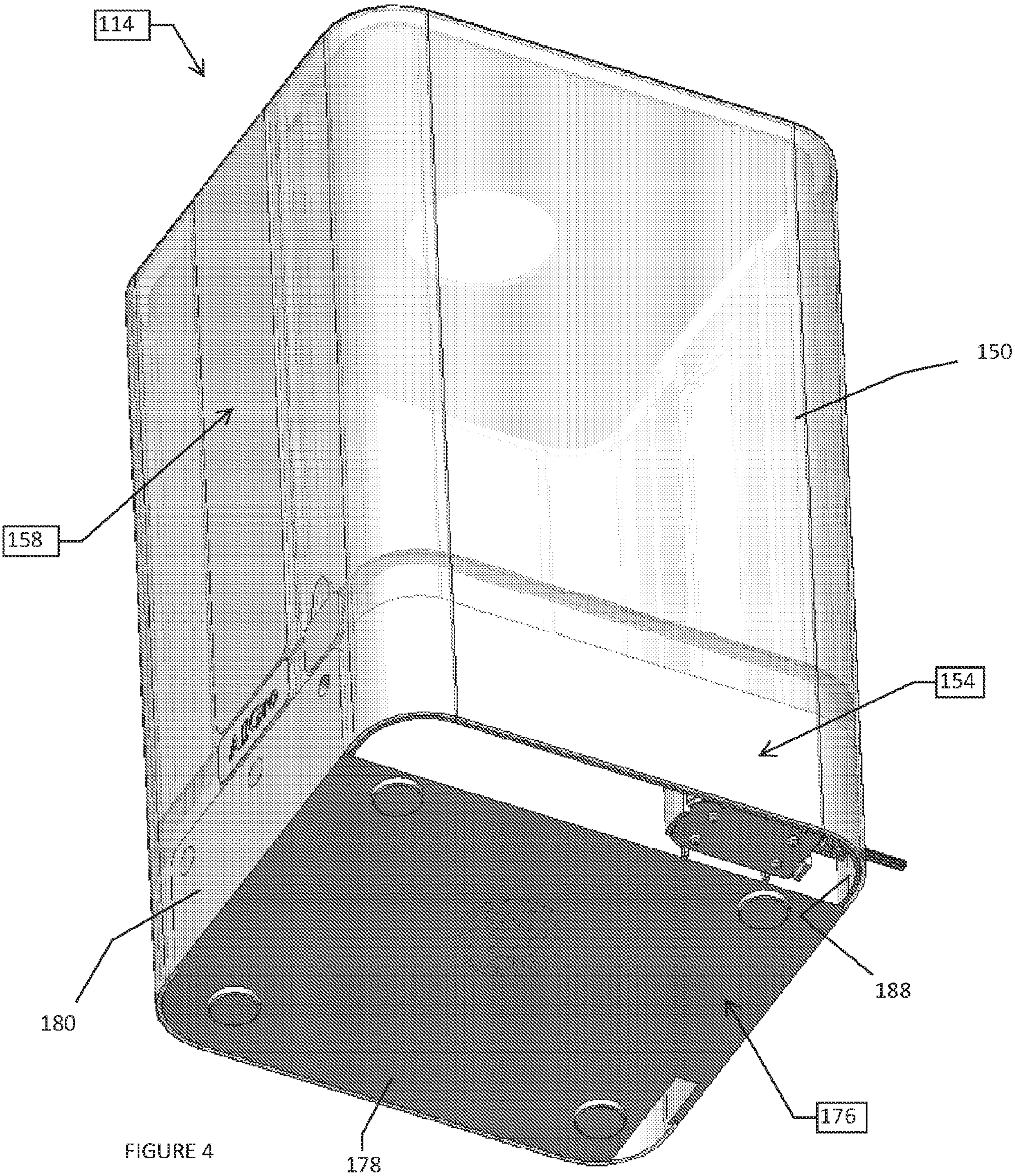
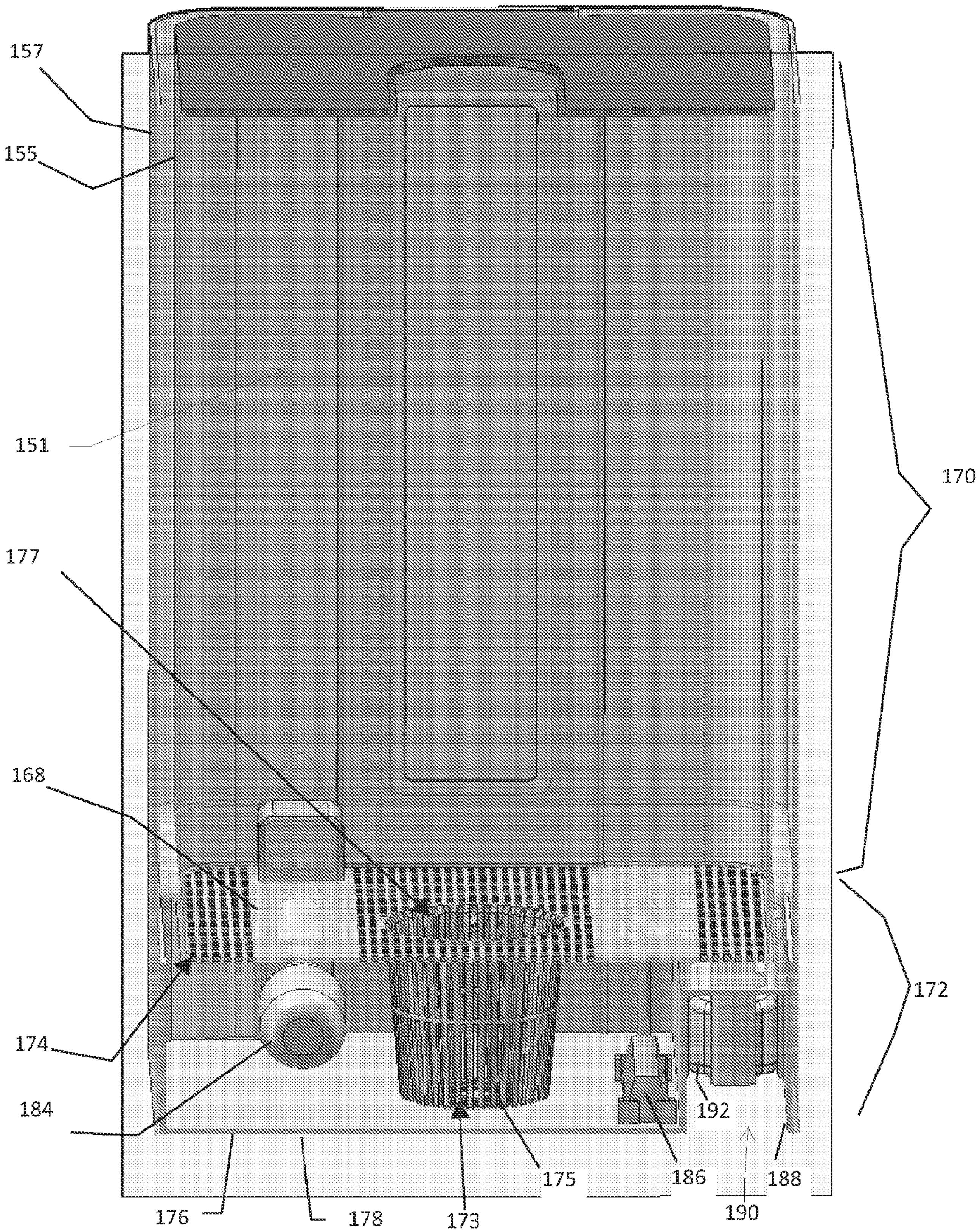


FIGURE 4

FIGURE 5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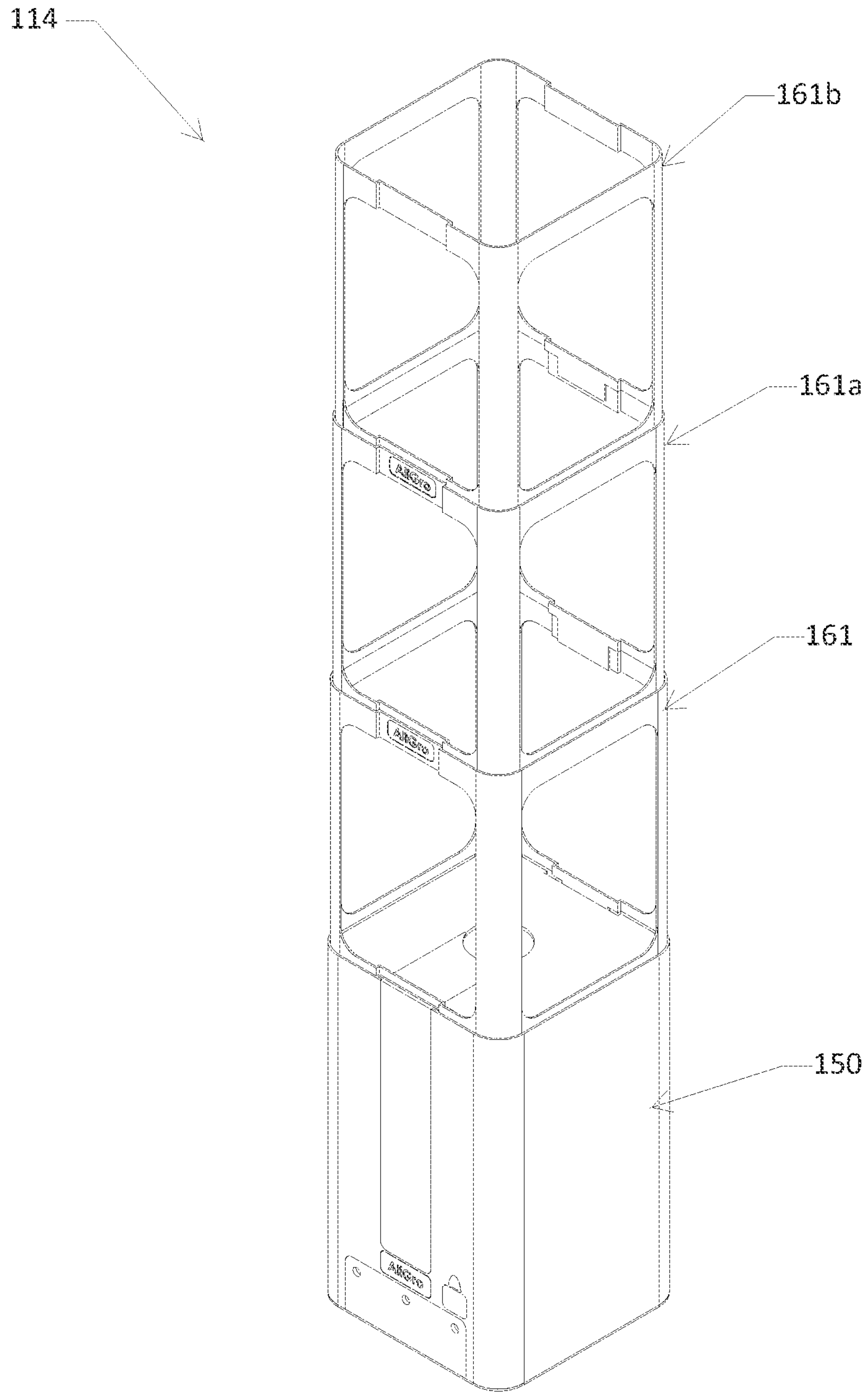


FIGURE 6

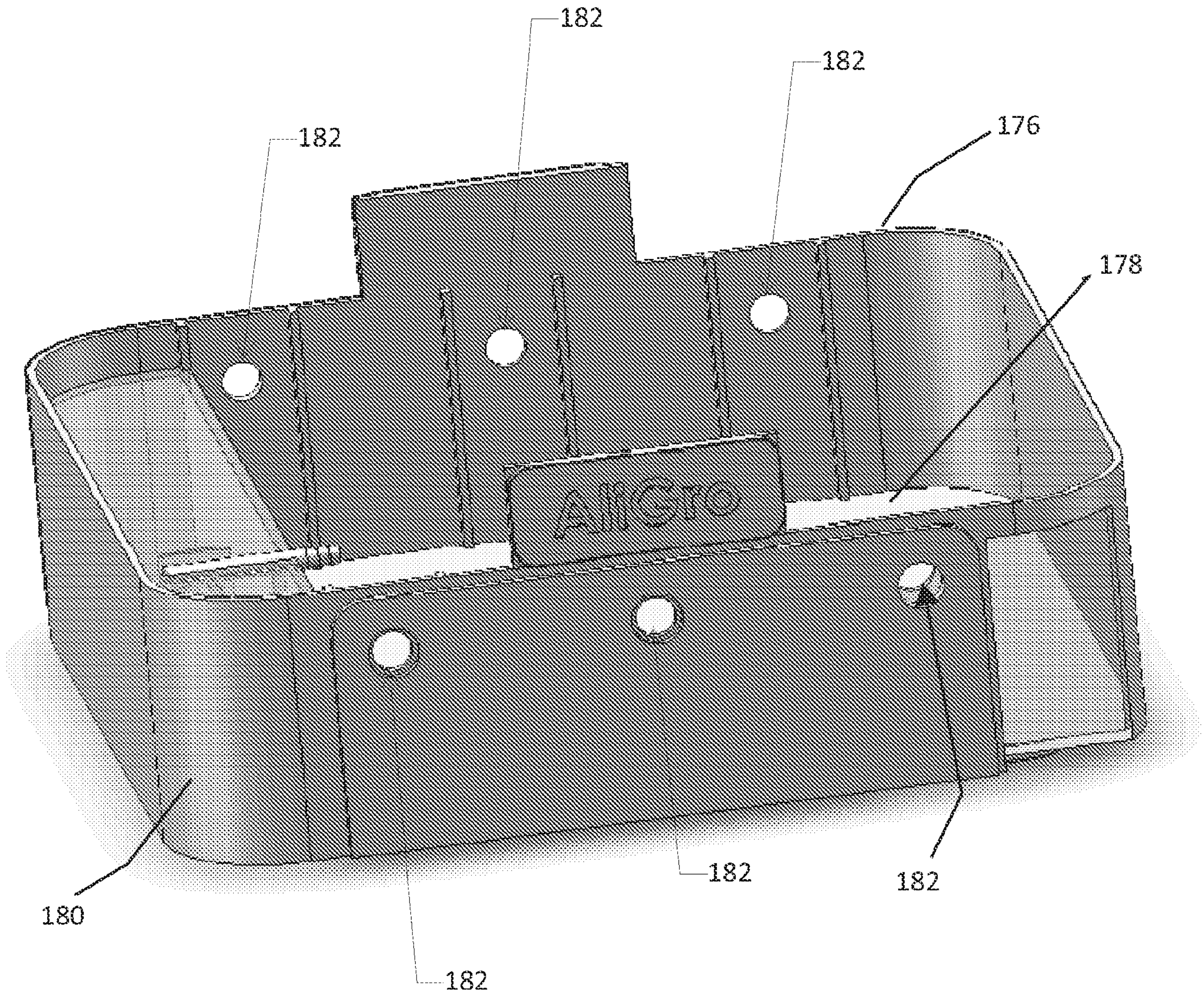


FIGURE 7

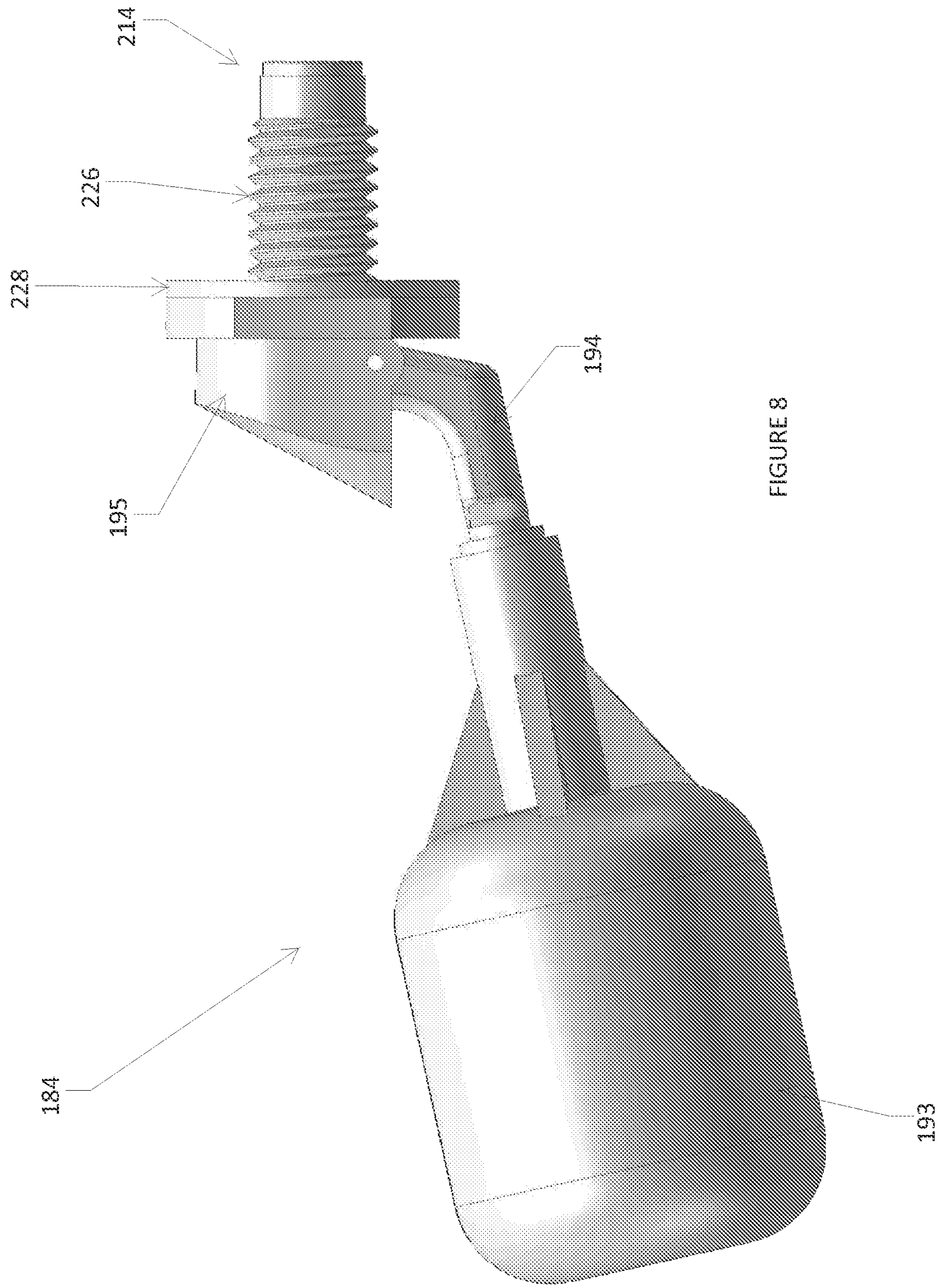


FIGURE 8

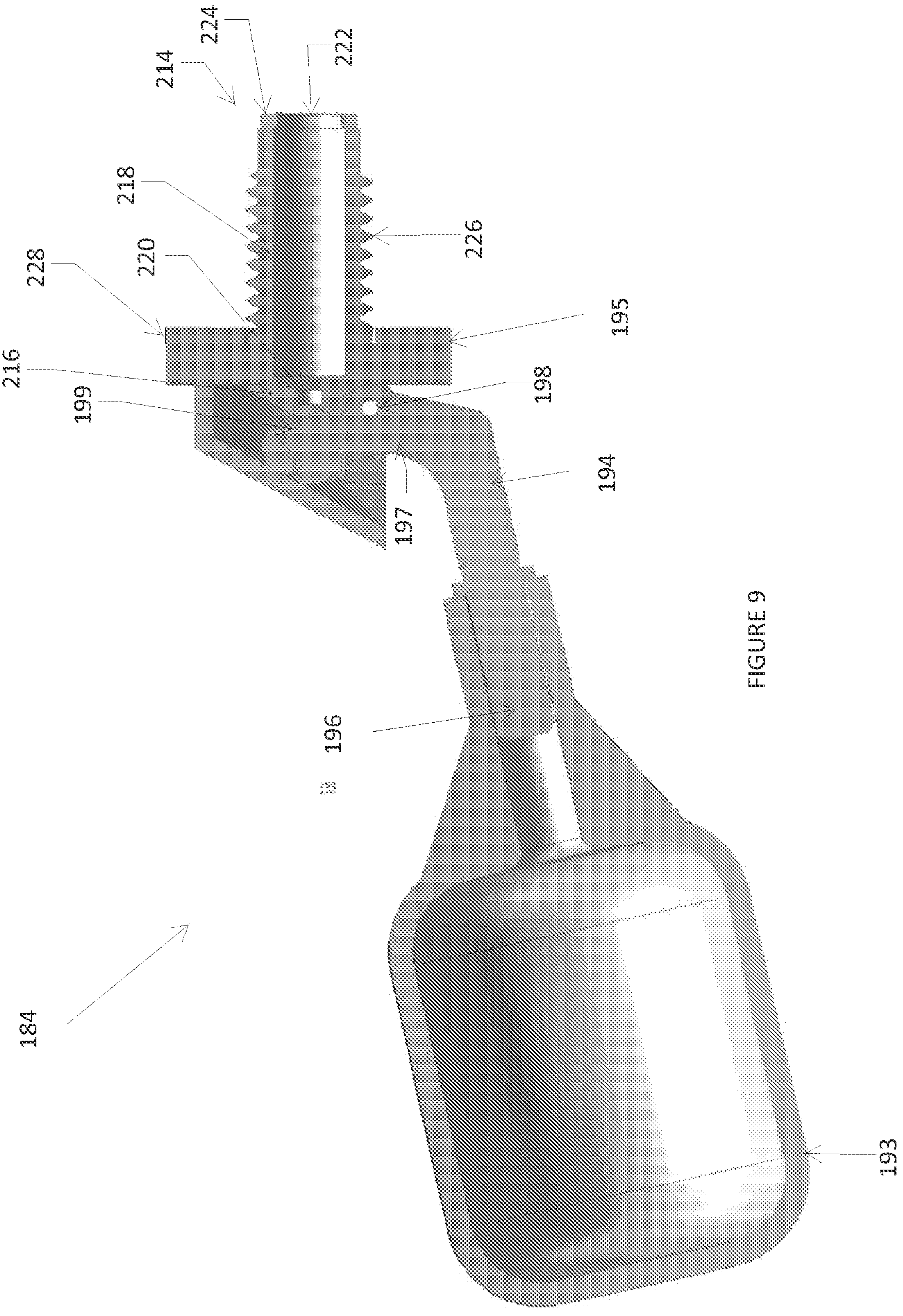


FIGURE 9

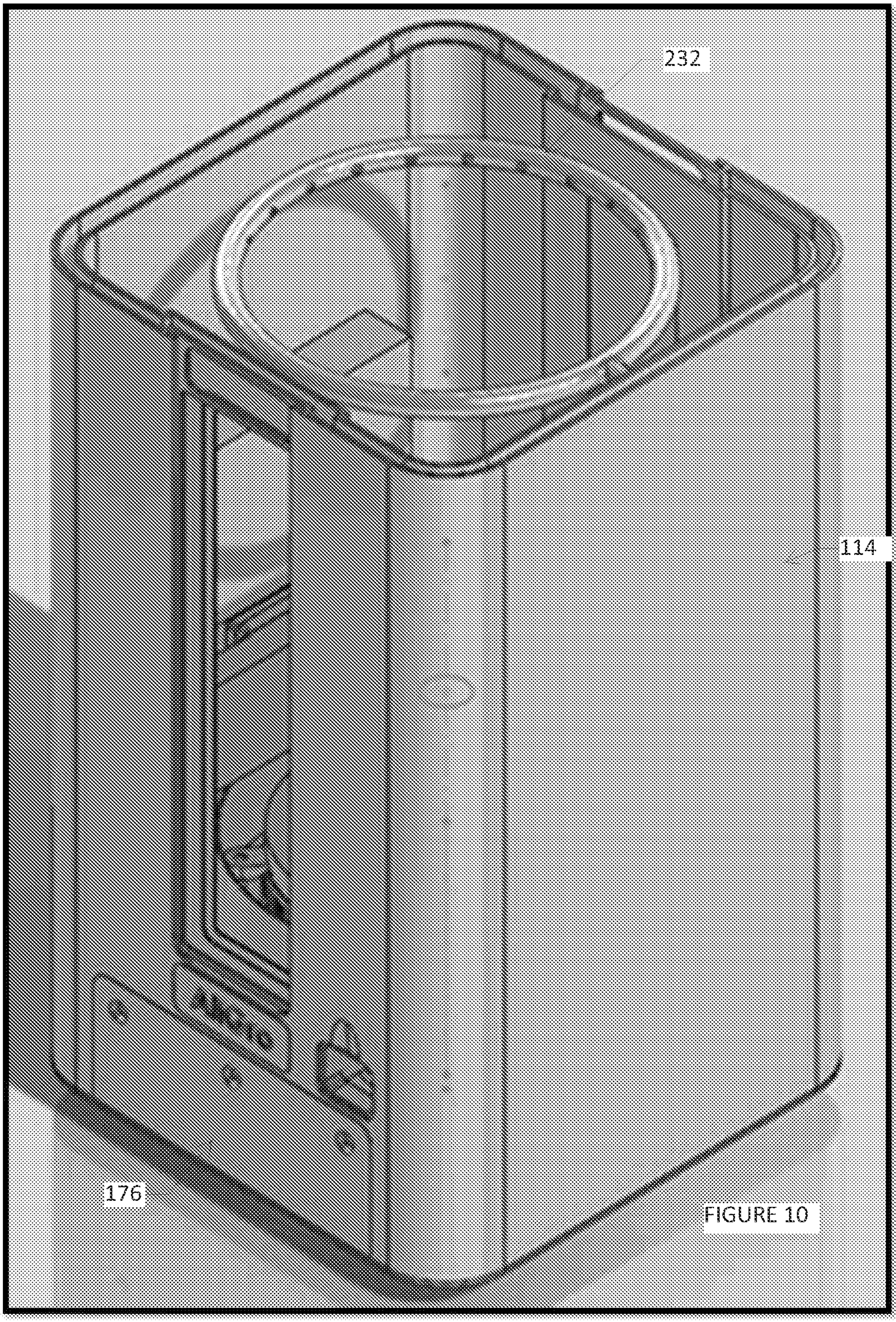
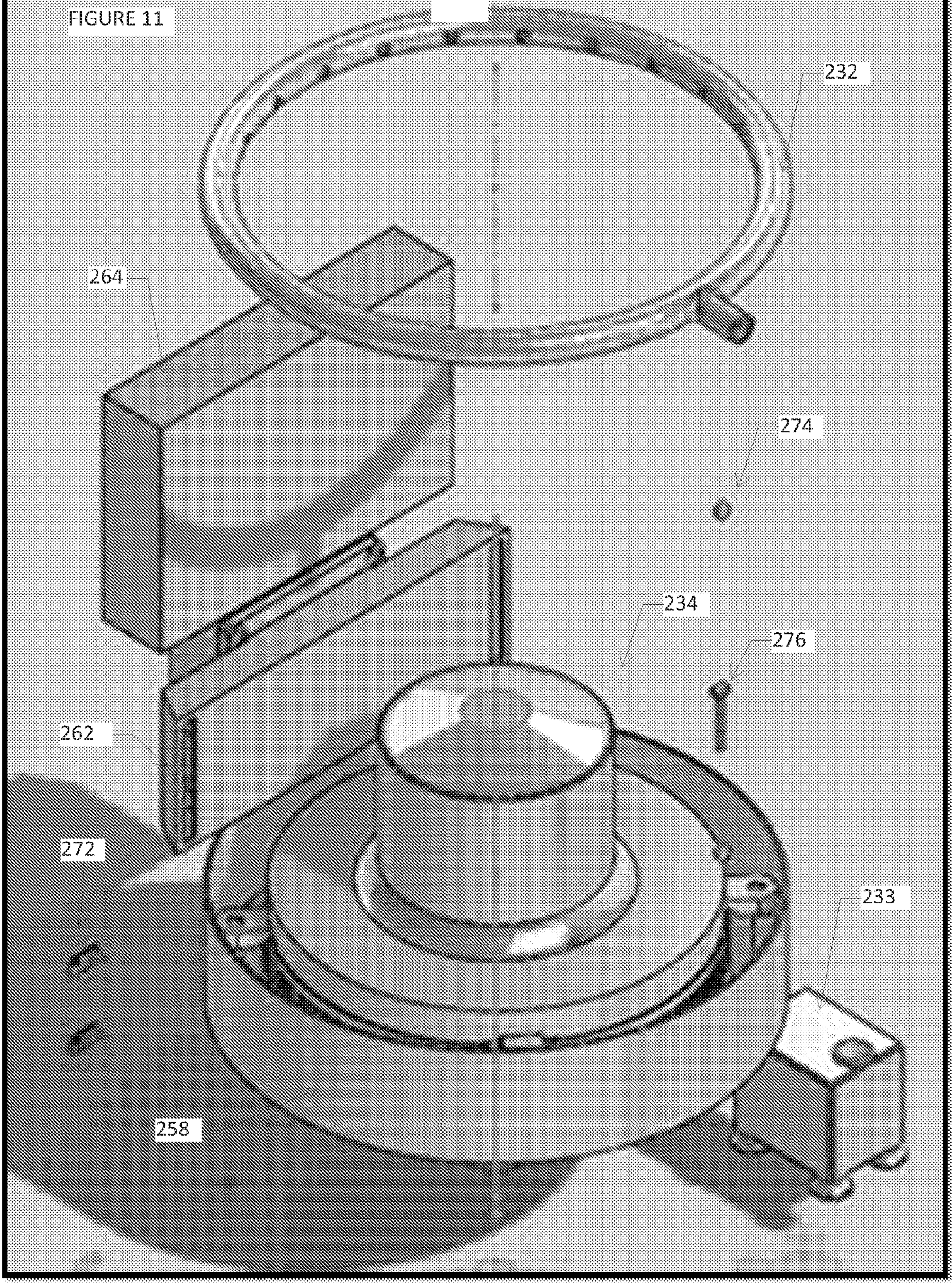
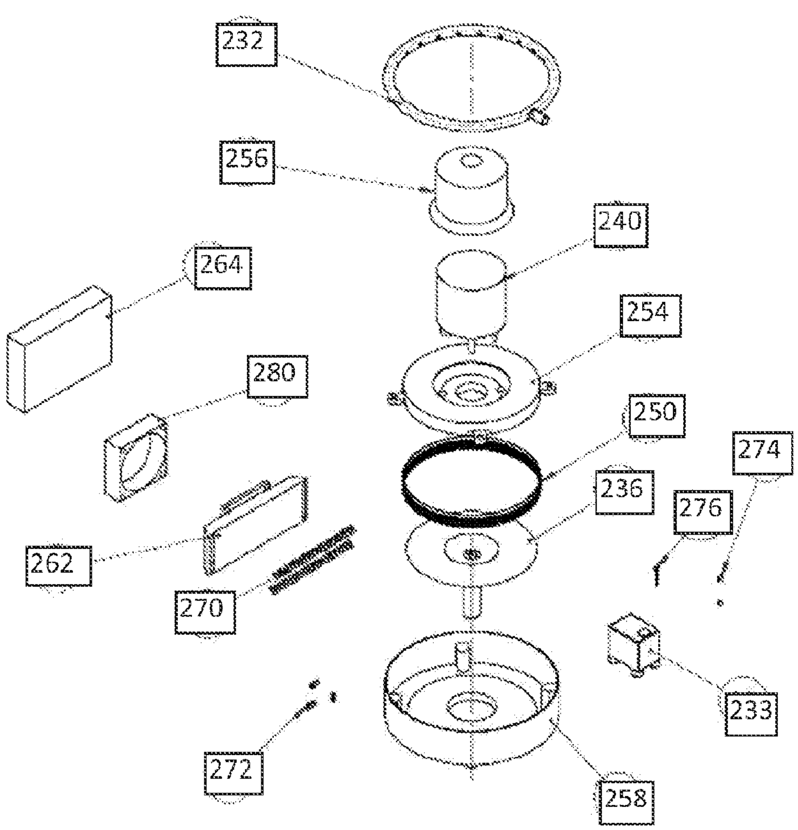
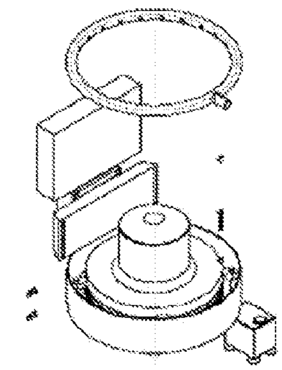


FIGURE 10

FIGURE 11







ITEM NO.	PART NUMBER	QTY.
1	DIFFUSER SCREEN	1
2	MOTOR	1
3	ARCHIMIDES PUMP	1
4	ATOMIZER	1
5	SYSTEM HOUSING	1
6	MOTOR HOUSING	1
7	MOTOR MOUNT	1
8	COOLING FAN	1
9	FAN DUCT	1
10	HYDRO SPRINKLER	1
11	SUBMERSIBLE PUMP	1
12	ELECTRONICS BAY HOUSING	1
13	HEATING COIL	2
14	WATER SENSOR	3
15	THERMISTER	2
16	HYGROMETER	1

FIGURE 12

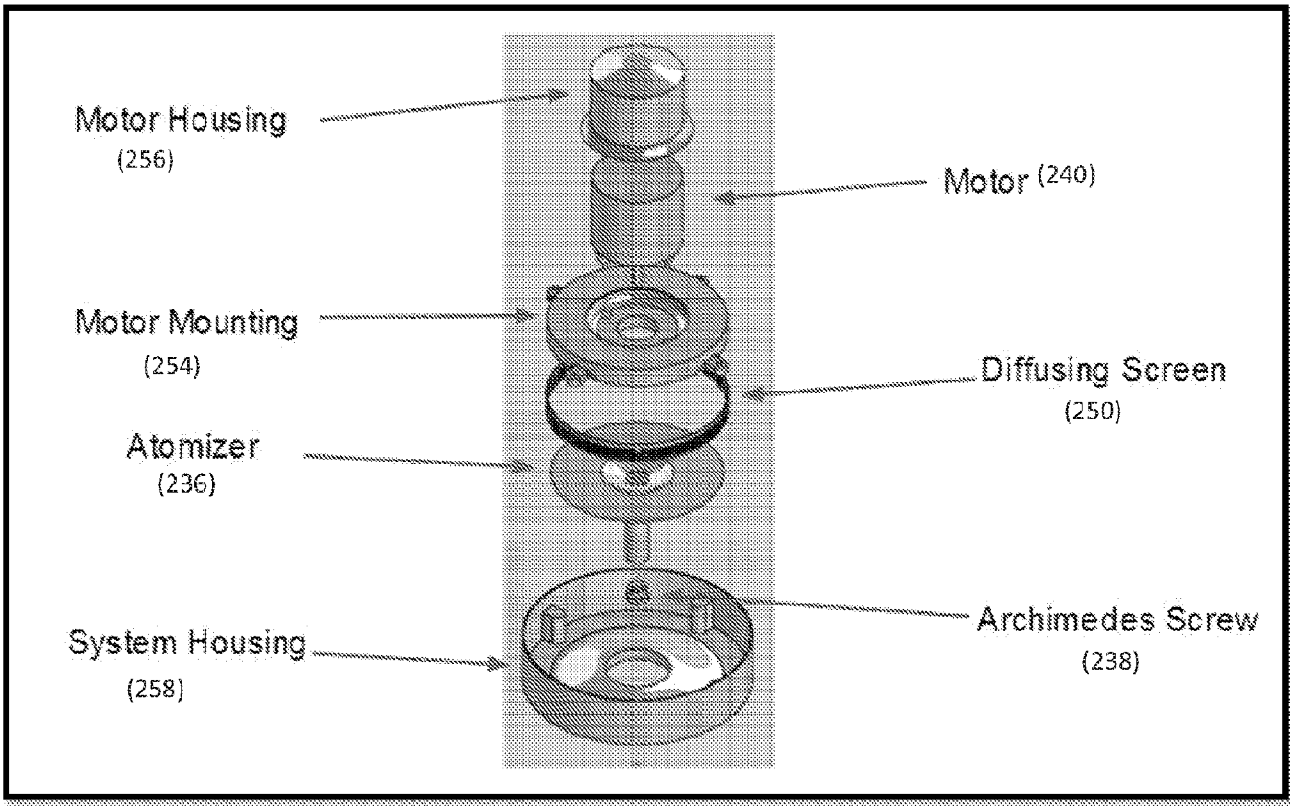
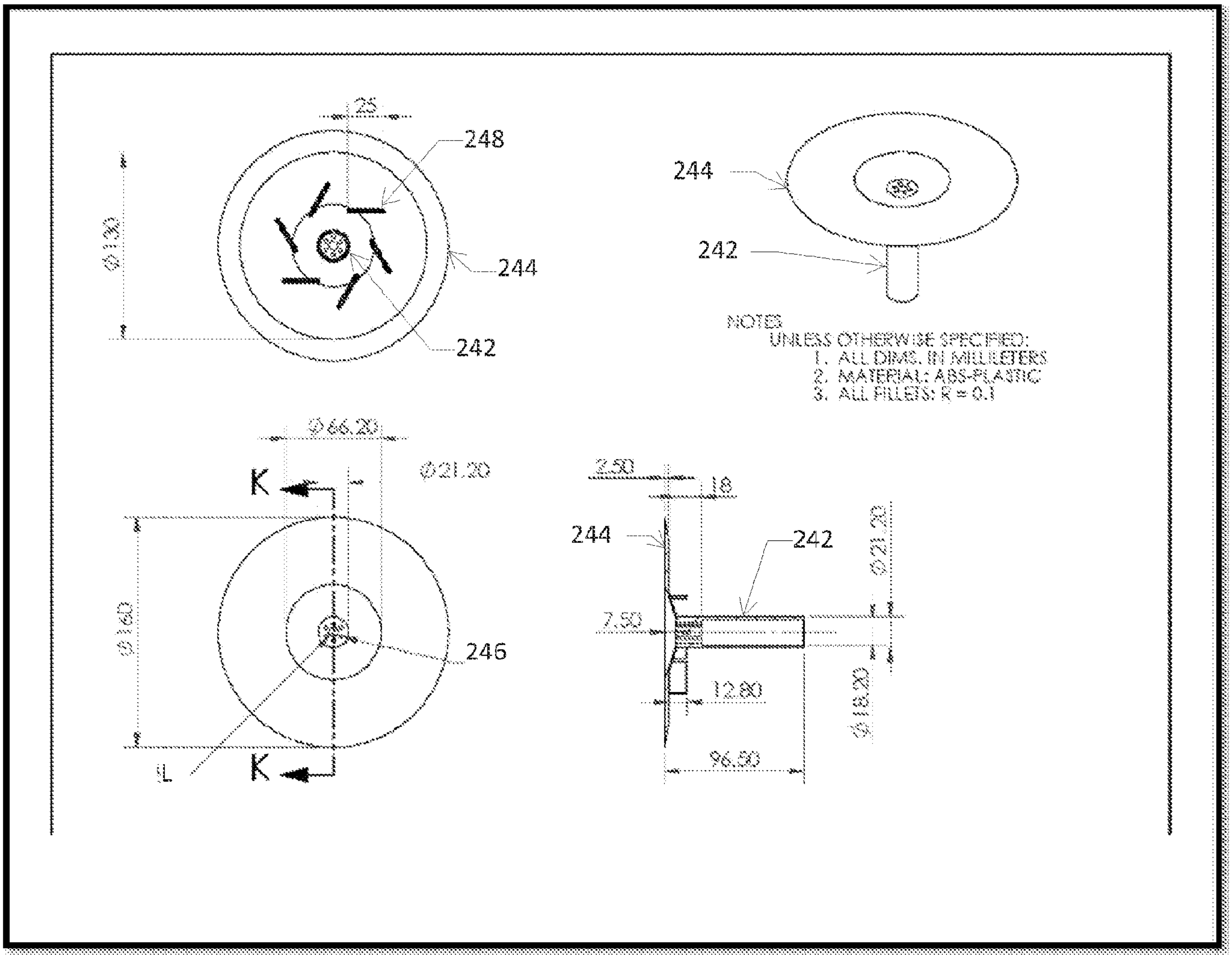

Motor Housing
(256)
Motor (240)
Motor Mounting
(254)
Diffusing Screen
(250)
Atomizer
(236)
System Housing
(258)
Archimedes Screw
(238)

FIGURE 13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NOTES
UNLESS OTHERWISE SPECIFIED:
1. ALL DIMS. IN MILLILETERS
2. MATERIAL: ABS-PLASTIC
3. ALL FILLETS: R = 0.1
Ø66.20
Ø21.20
K
Ø160
246
K
2.50
18
244
242
Ø21.20
7.50
12.80
Ø18.20
96.50

FIGURE 14

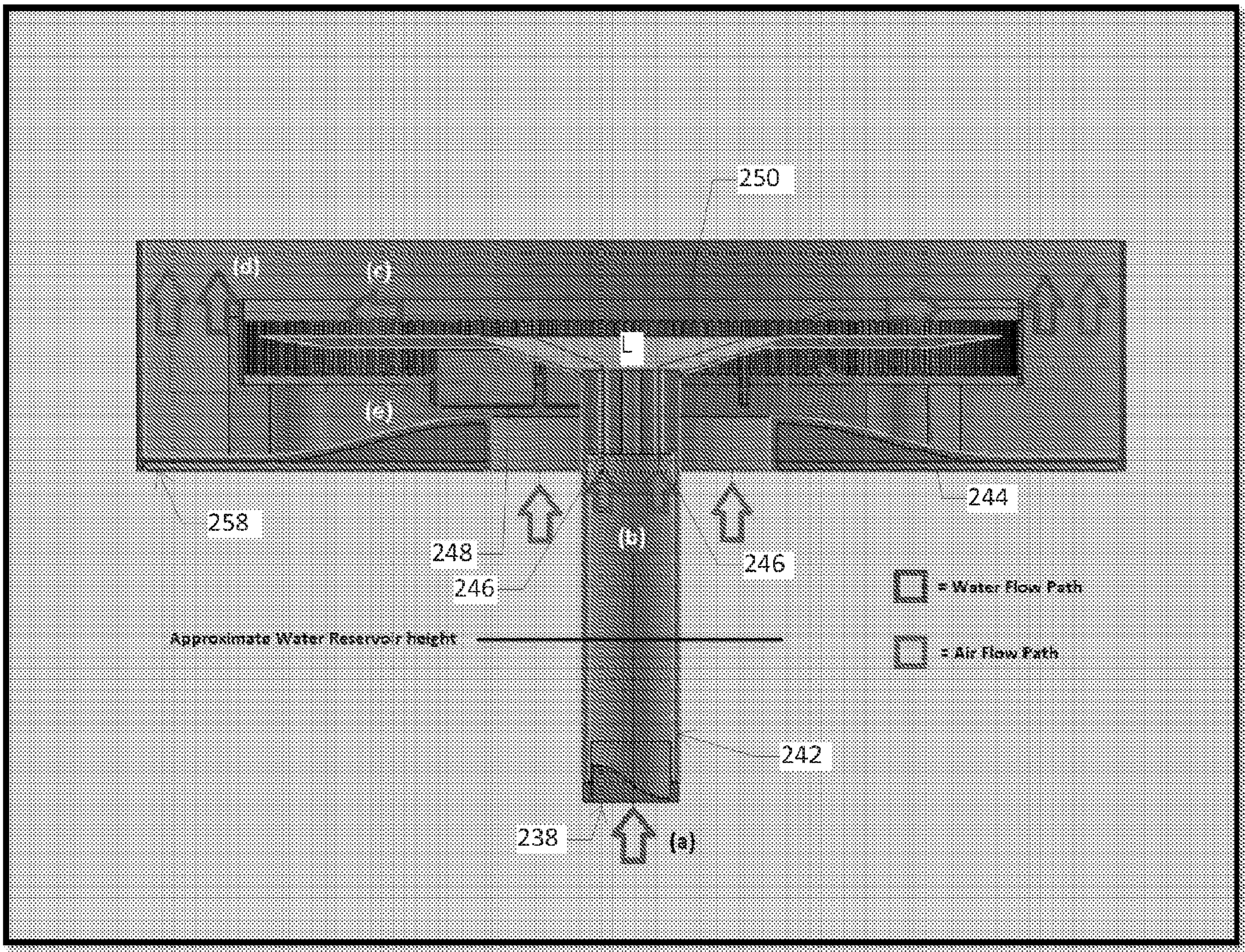

250
(d)
(c)
L
(e)
258
244
248
(b)
246
246
= Water Flow Path
Approximate Water Reservoir height
= Air Flow Path
242
238
(a)

FIGURE 15

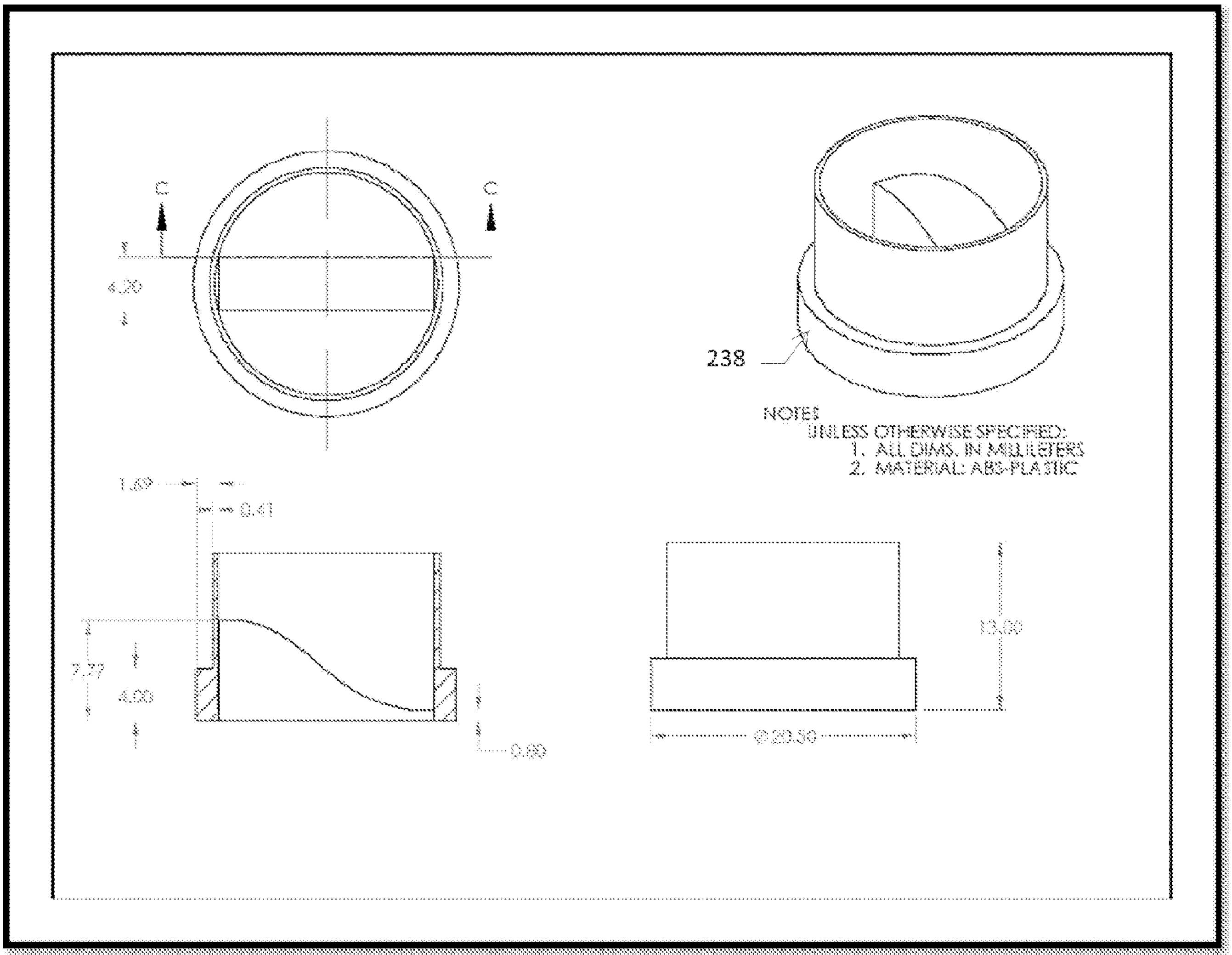

C
C
4.20
238
NOTES
UNLESS OTHERWISE SPECIFIED:
1. ALL DIMS. IN MILLILETERS
2. MATERIAL: ABS-PLASTIC
1.69
0.41
7.27
4.00
0.80
13.00
Ø 23.50

FIGURE 16

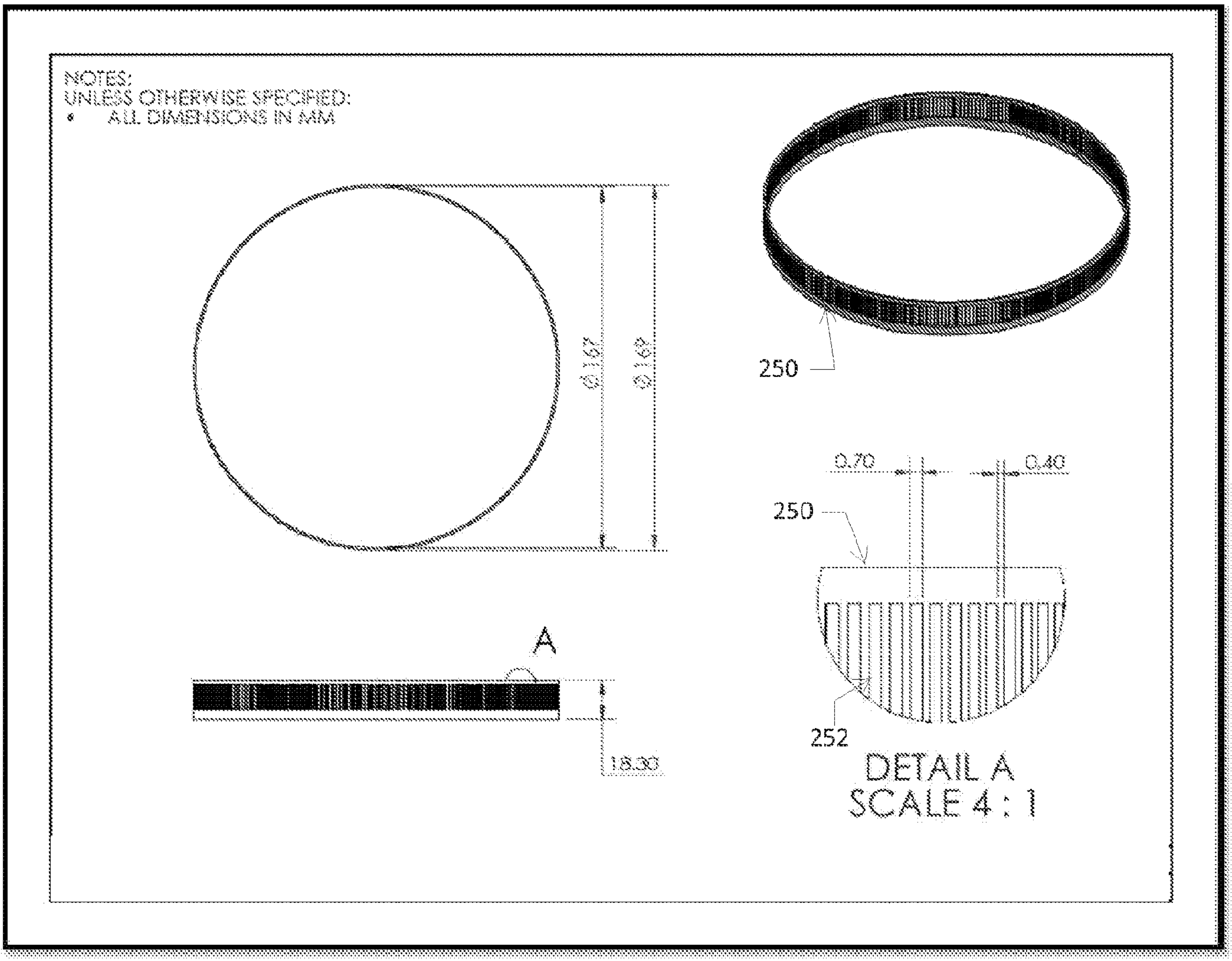

NOTES:
UNLESS OTHERWISE SPECIFIED:
• ALL DIMENSIONS IN MM
Ø167
Ø169
250
0.70
0.40
250
A
18.30
252
DETAIL A
SCALE 4 : 1

FIGURE 17A

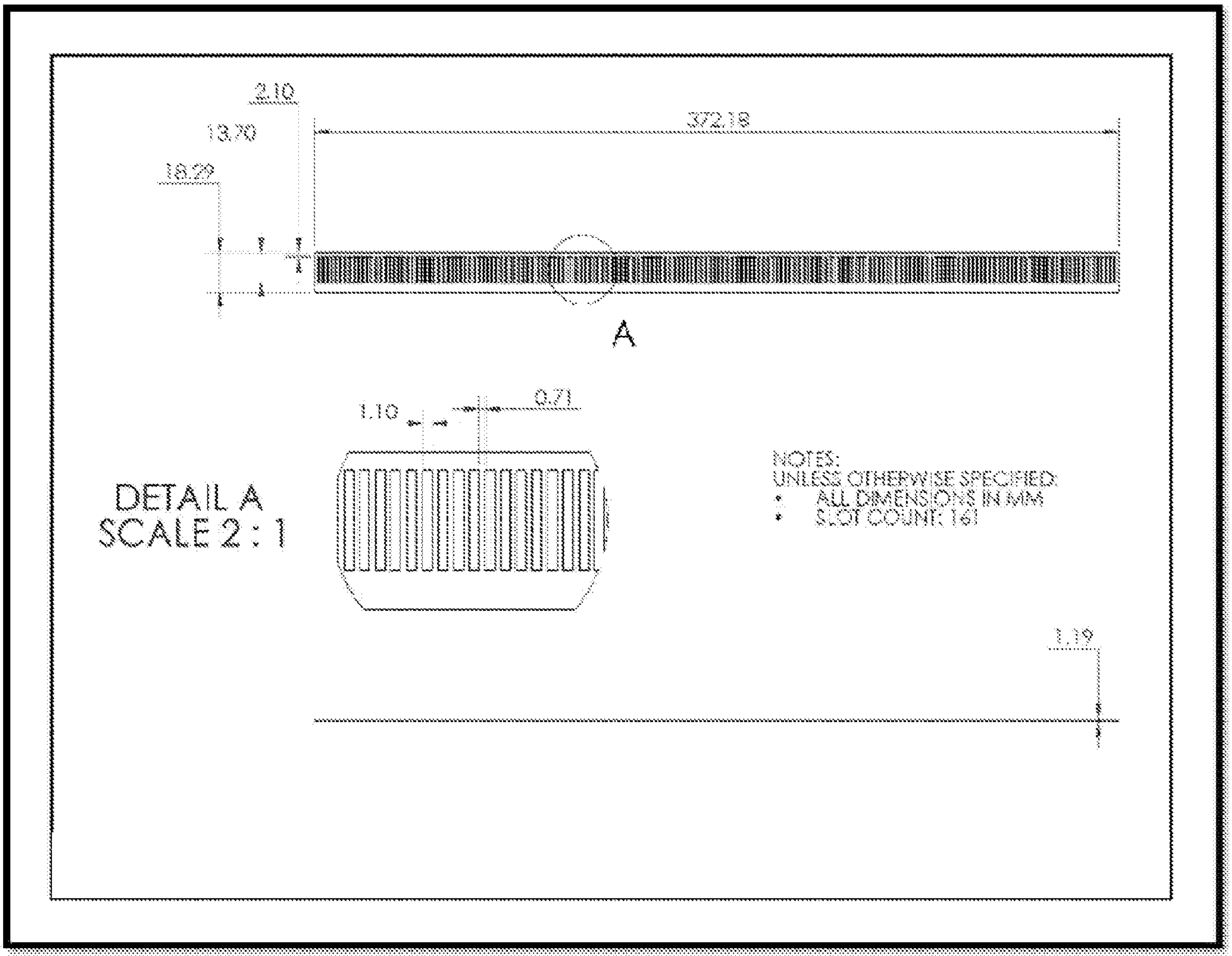
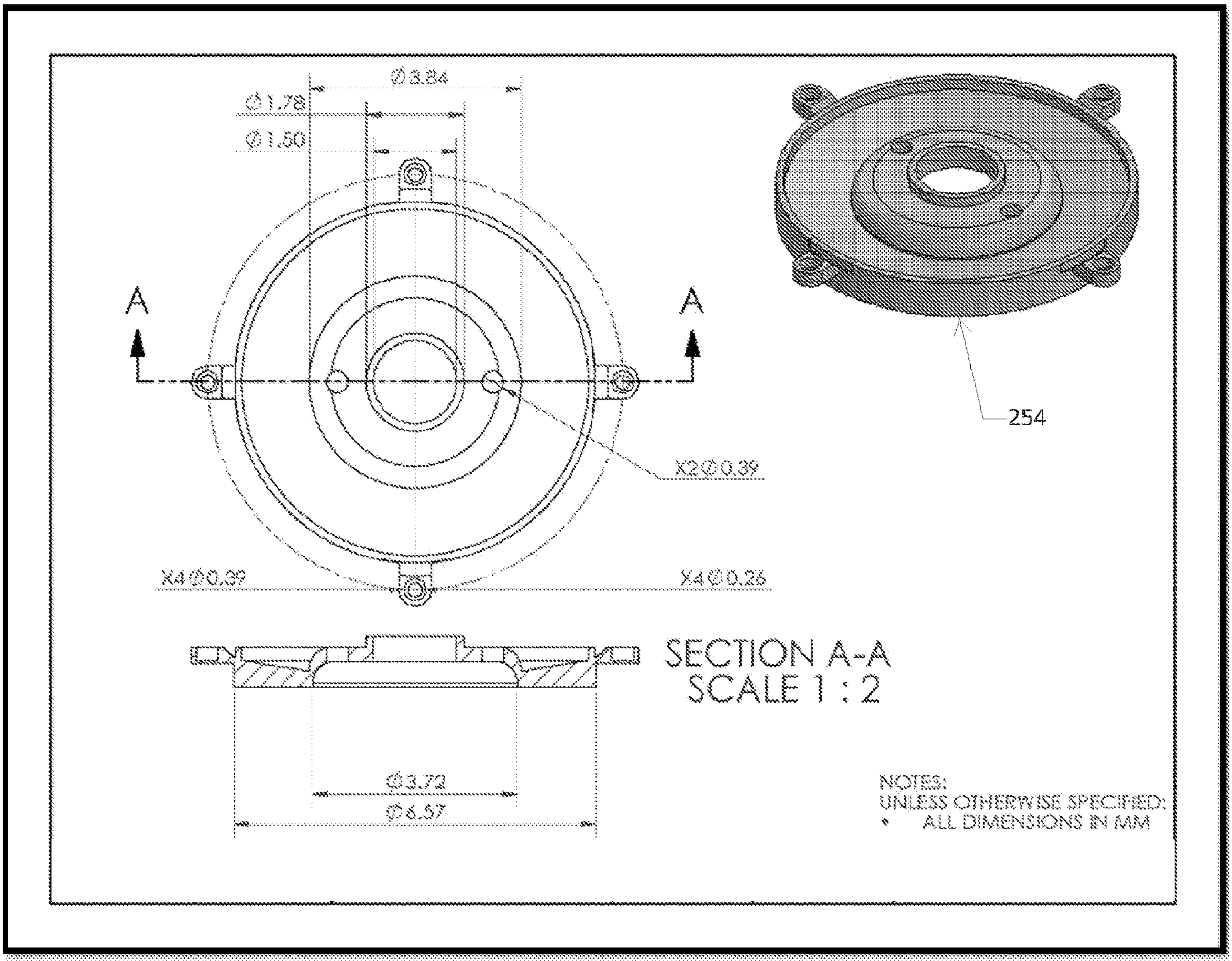
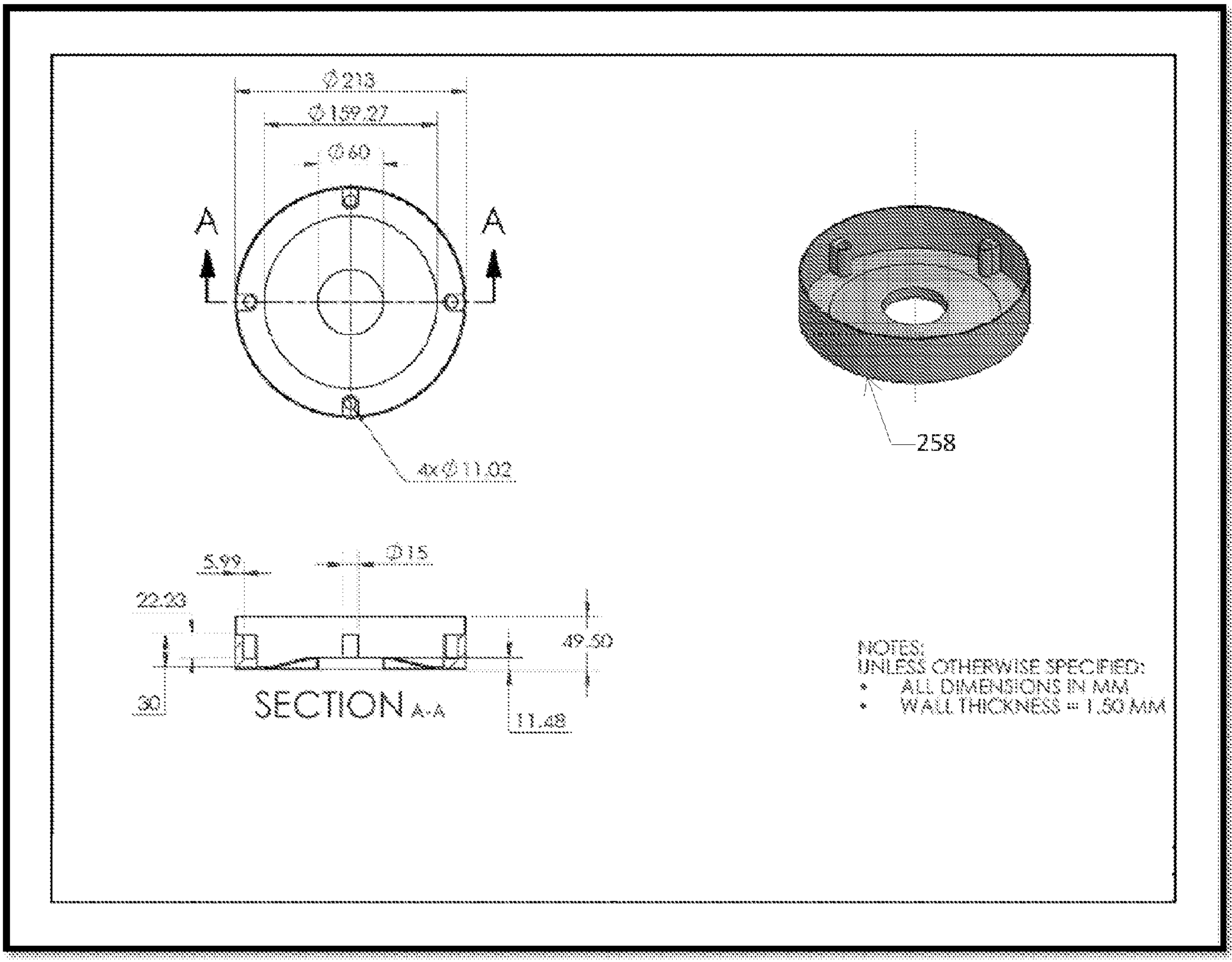

2.10
13.70
18.29
372.18
A
1.10
0.71
DETAIL A
SCALE 2 : 1
NOTES:
UNLESS OTHERWISE SPECIFIED:
• ALL DIMENSIONS IN MM
• SLOT COUNT: 161
1.19

FIGURE 17B



Ø3.84
Ø1.78
Ø1.50
A
A
X2 Ø0.39
X4 Ø0.39
X4 Ø0.26
254
SECTION A-A
SCALE 1 : 2
Ø3.72
Ø6.57
NOTES:
UNLESS OTHERWISE SPECIFIED:
* ALL DIMENSIONS IN MM

FIGURE 18



∅218
∅159.27
∅60
A
A
4x∅11.02
258
5.99
∅15
22.23
1
49.50
30
SECTION A-A
11.48
NOTES:
UNLESS OTHERWISE SPECIFIED:
• ALL DIMENSIONS IN MM
• WALL THICKNESS = 1.50 MM

FIGURE 19

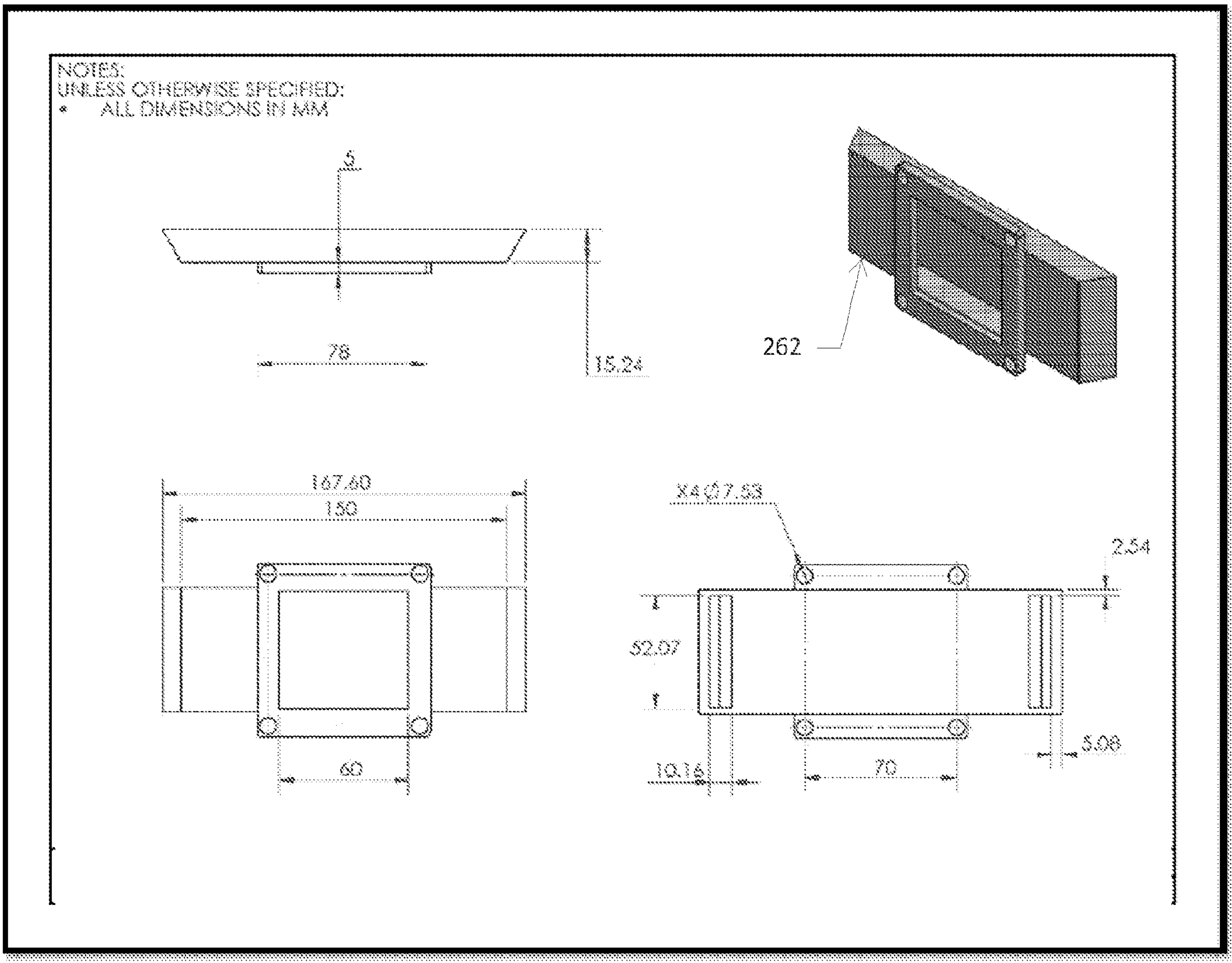

NOTES:
UNLESS OTHERWISE SPECIFIED:
* ALL DIMENSIONS IN MM
5
78
15.24
262
167.60
150
60
X4 ∅7.53
2.54
52.07
10.16
70
5.08

FIGURE 20

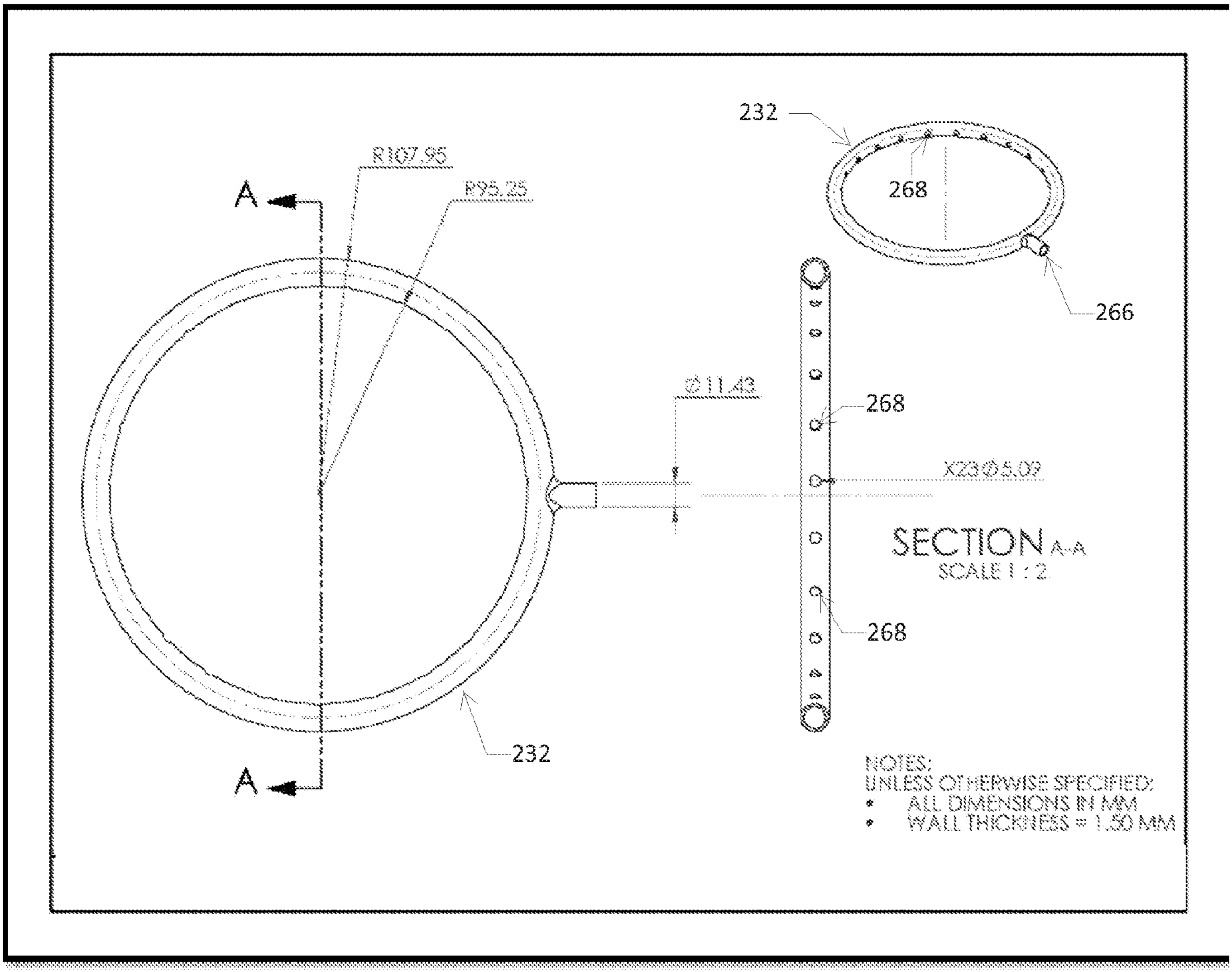

232
R107.95
R95.25
A
268
266
Ø11.43
268
X23 Ø5.09
SECTION A-A
SCALE 1 : 2
268
232
A
NOTES:
UNLESS OTHERWISE SPECIFIED:
• ALL DIMENSIONS IN MM
• WALL THICKNESS = 1.50 MM

FIGURE 21

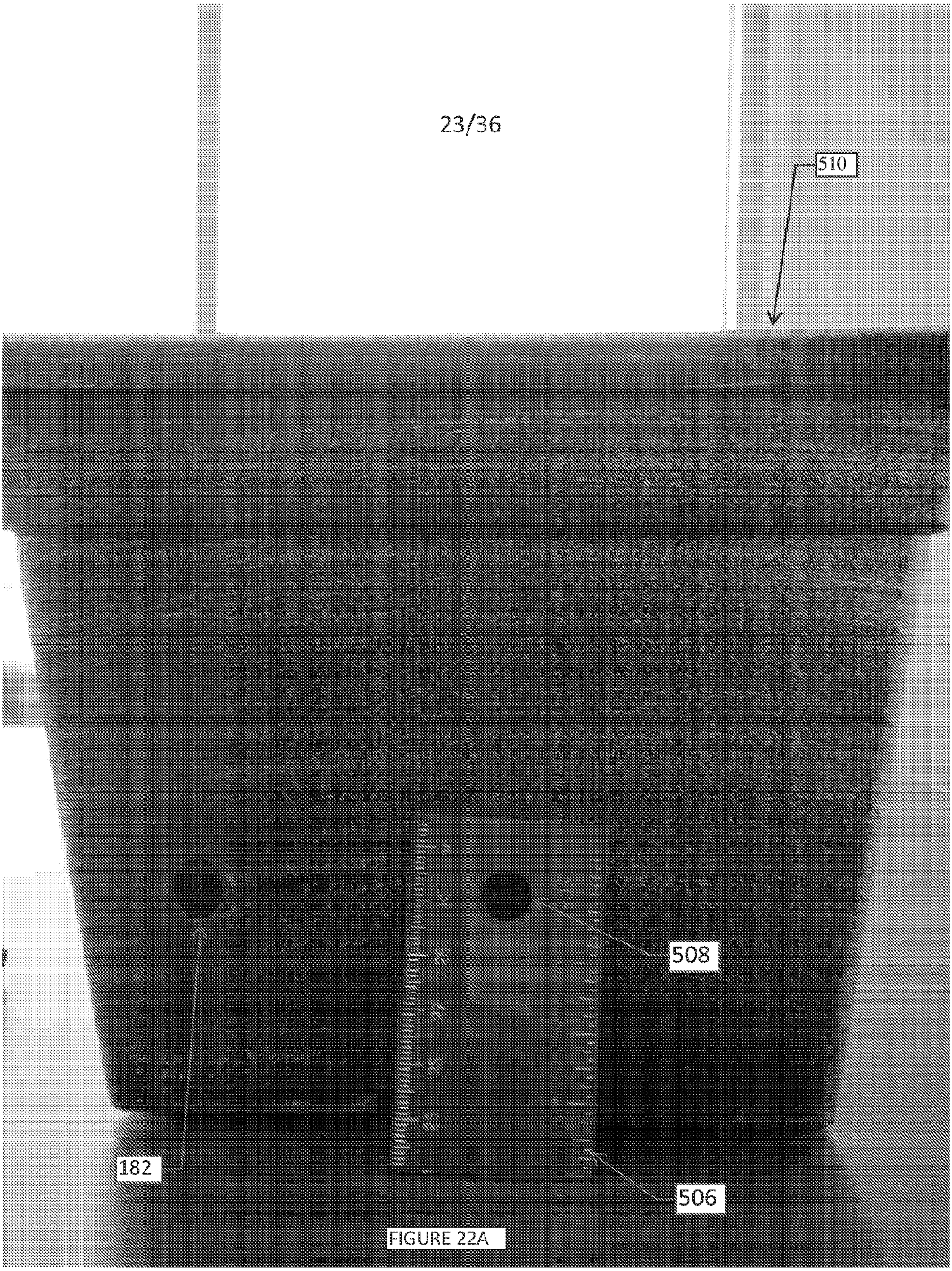


FIGURE 22A

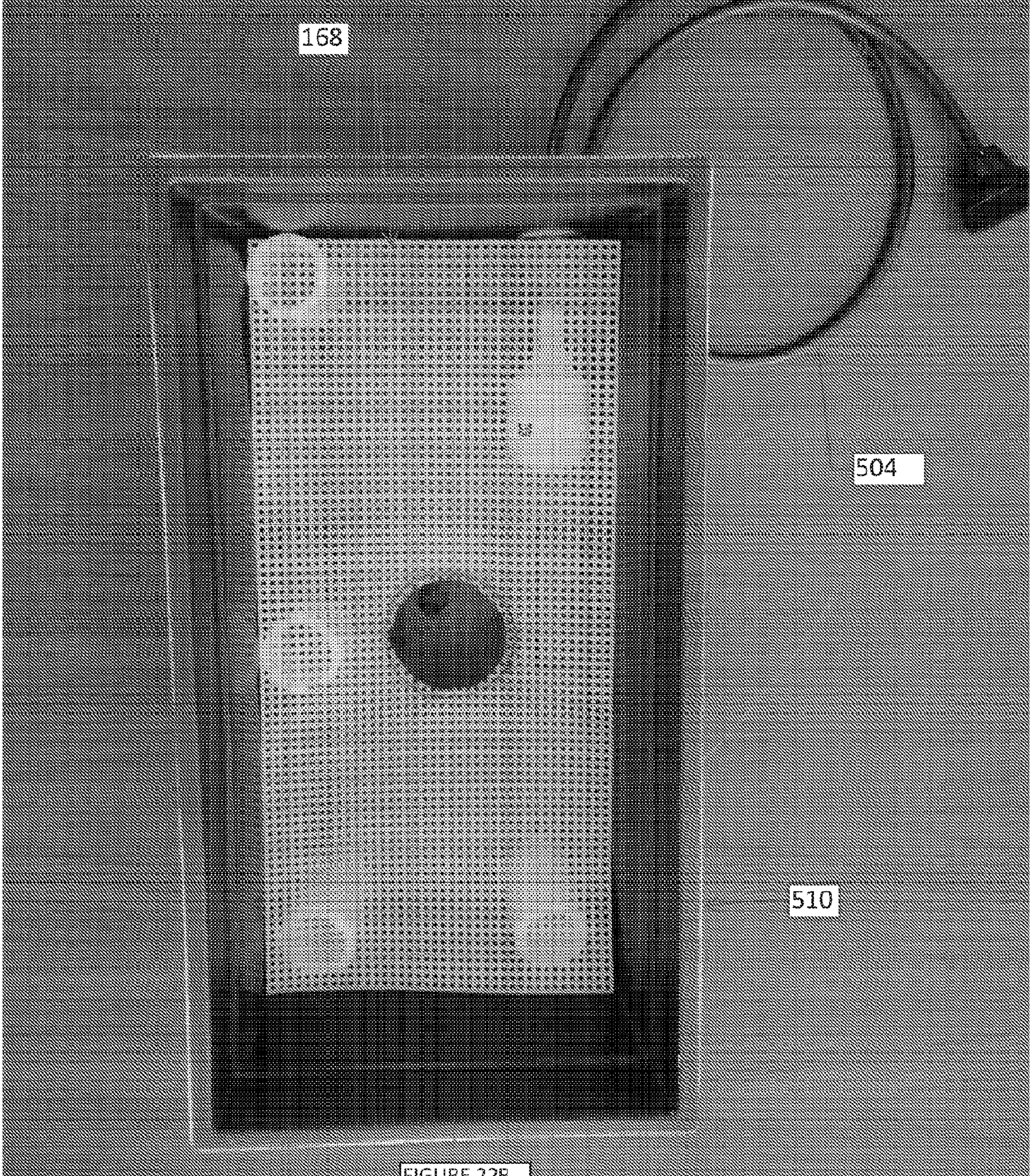


FIGURE 22B

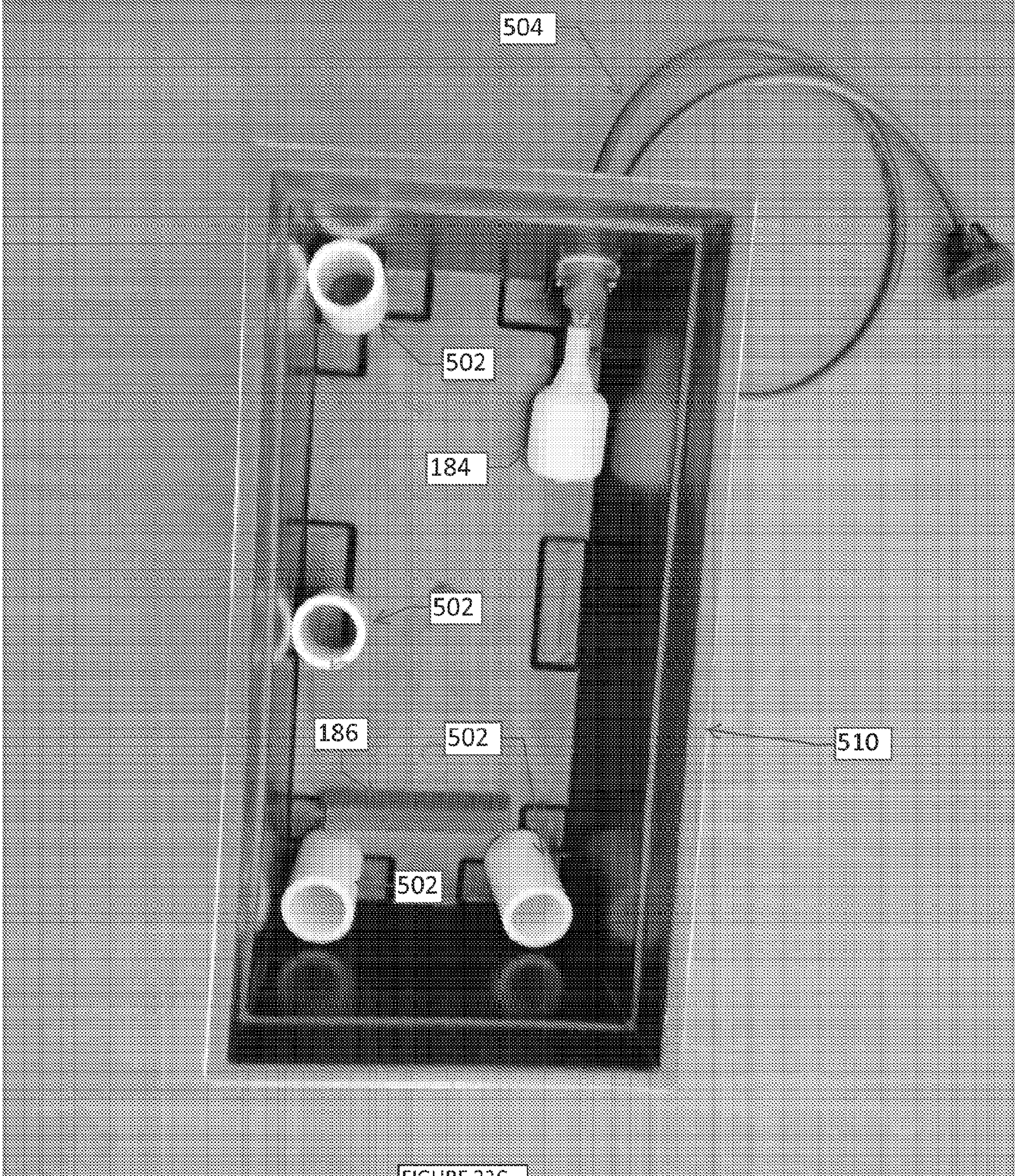


FIGURE 22C

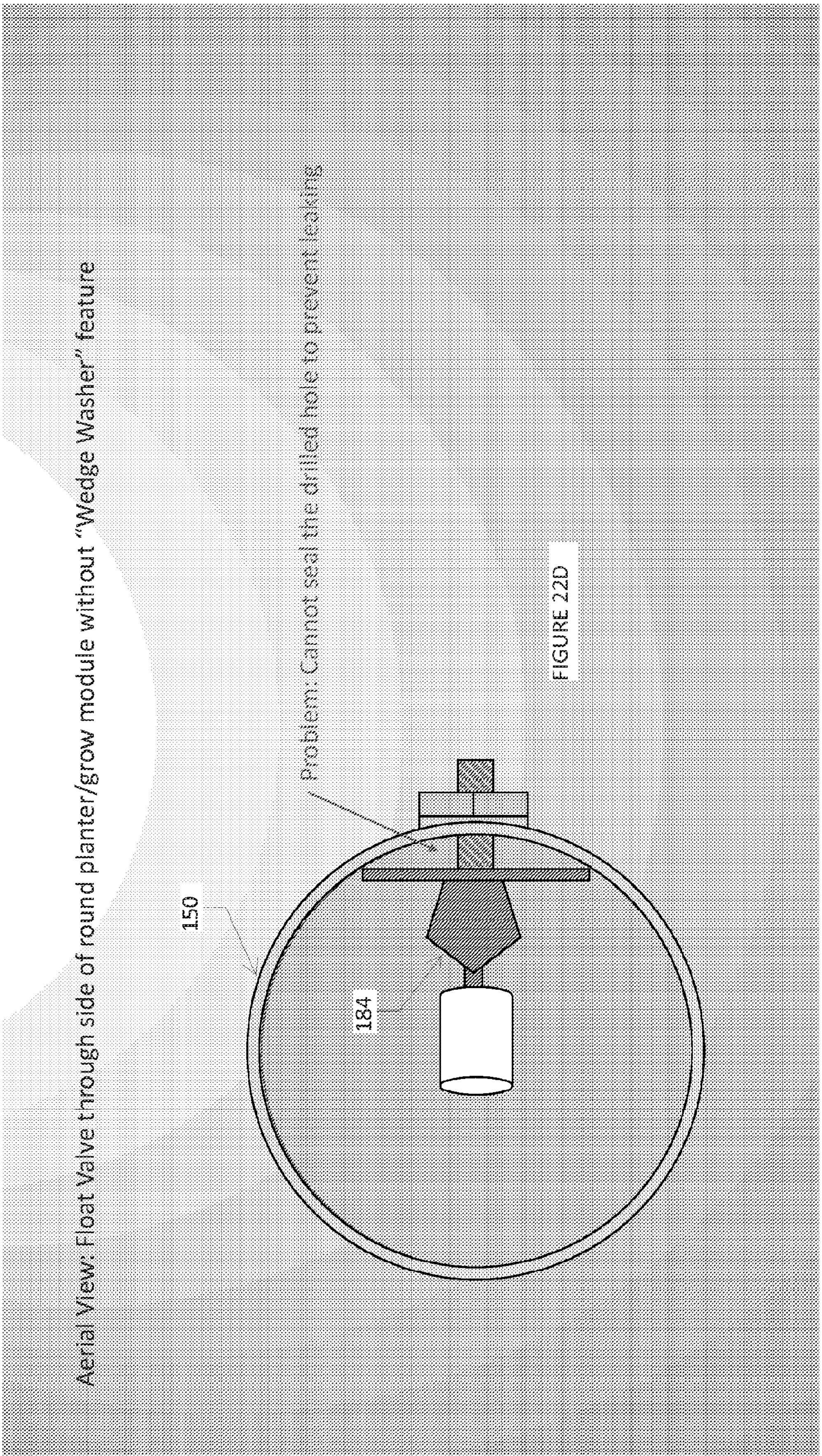

Aerial View: Float Valve through side of round planter/grow module without "Wedge Washer" feature
Problem: Cannot seal the drilled hole to prevent leaking
150
184

FIGURE 22D

Aerial View: Float Valve through side of round planter/grow module with "Wedge Washer" feature

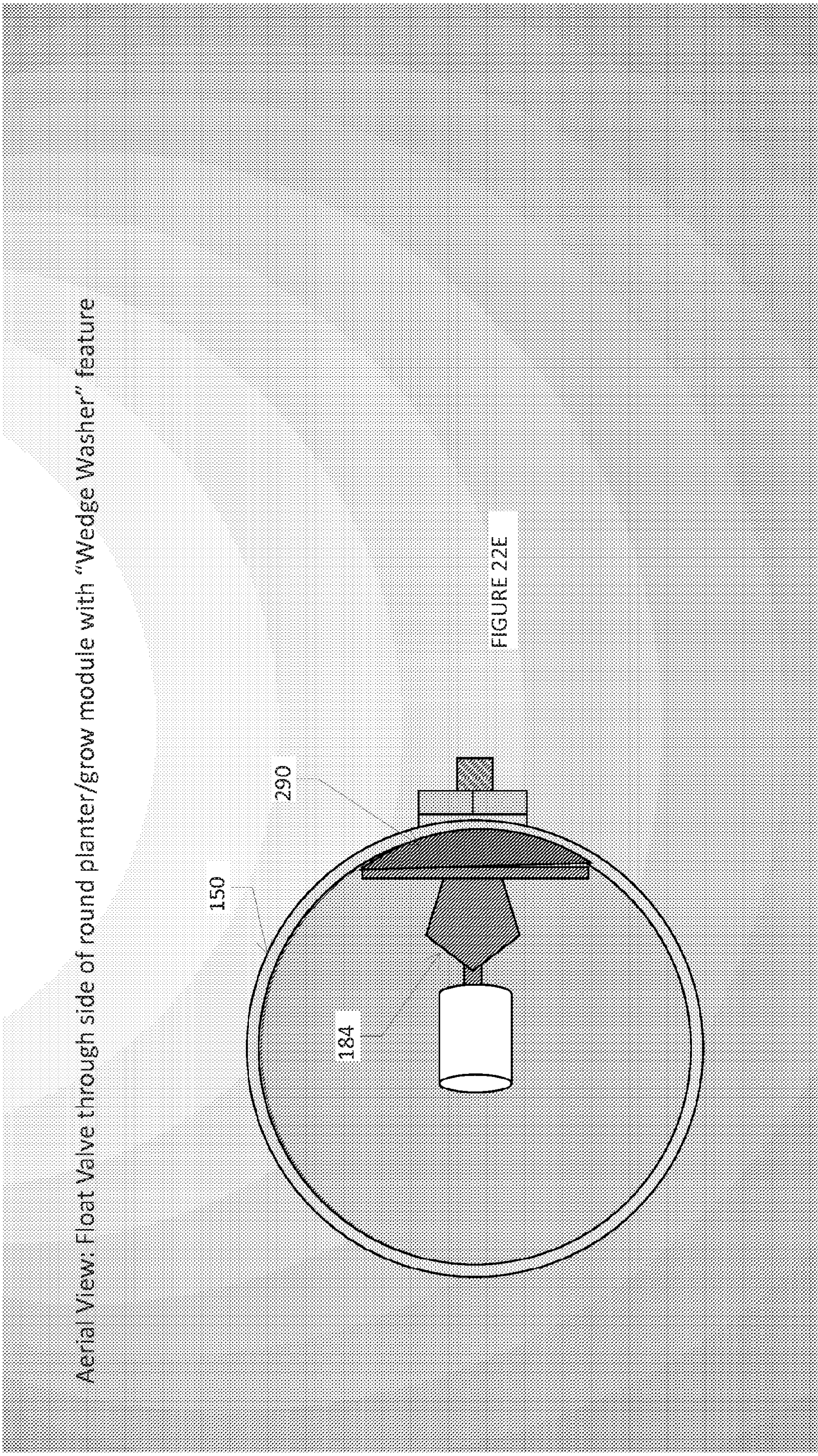
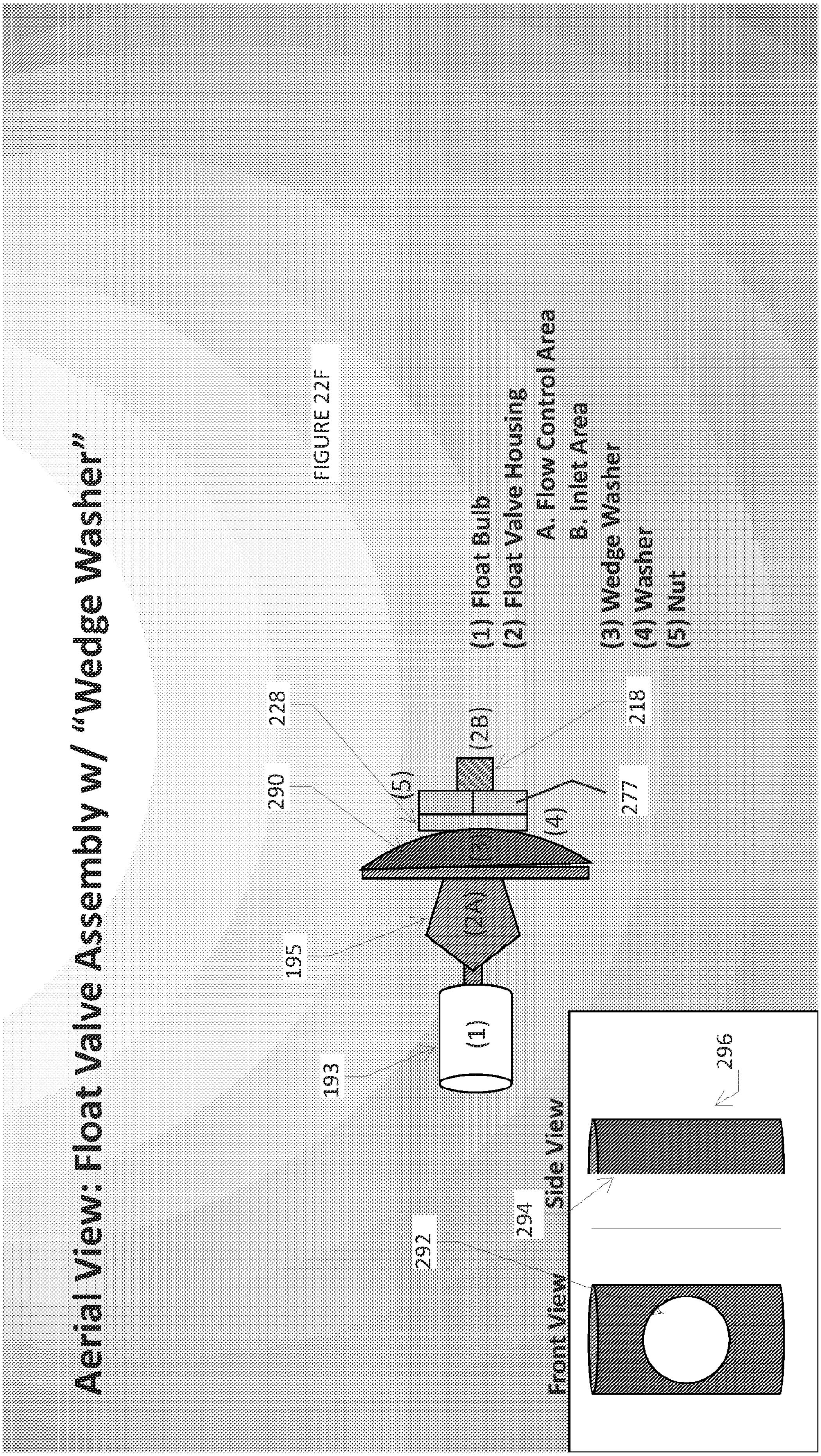


FIGURE 22E


Aerial View: Float Valve Assembly w/ "Wedge Washer"
FIGURE 22F
(1) Float Bulb
(2) Float Valve Housing
A. Flow Control Area
B. Inlet Area
(3) Wedge Washer
(4) Washer
(5) Nut
228
290
195
193
218
277
(1)
(2A)
(2B)
(3)
(4)
(5)
Front View
Side View
292
294
296

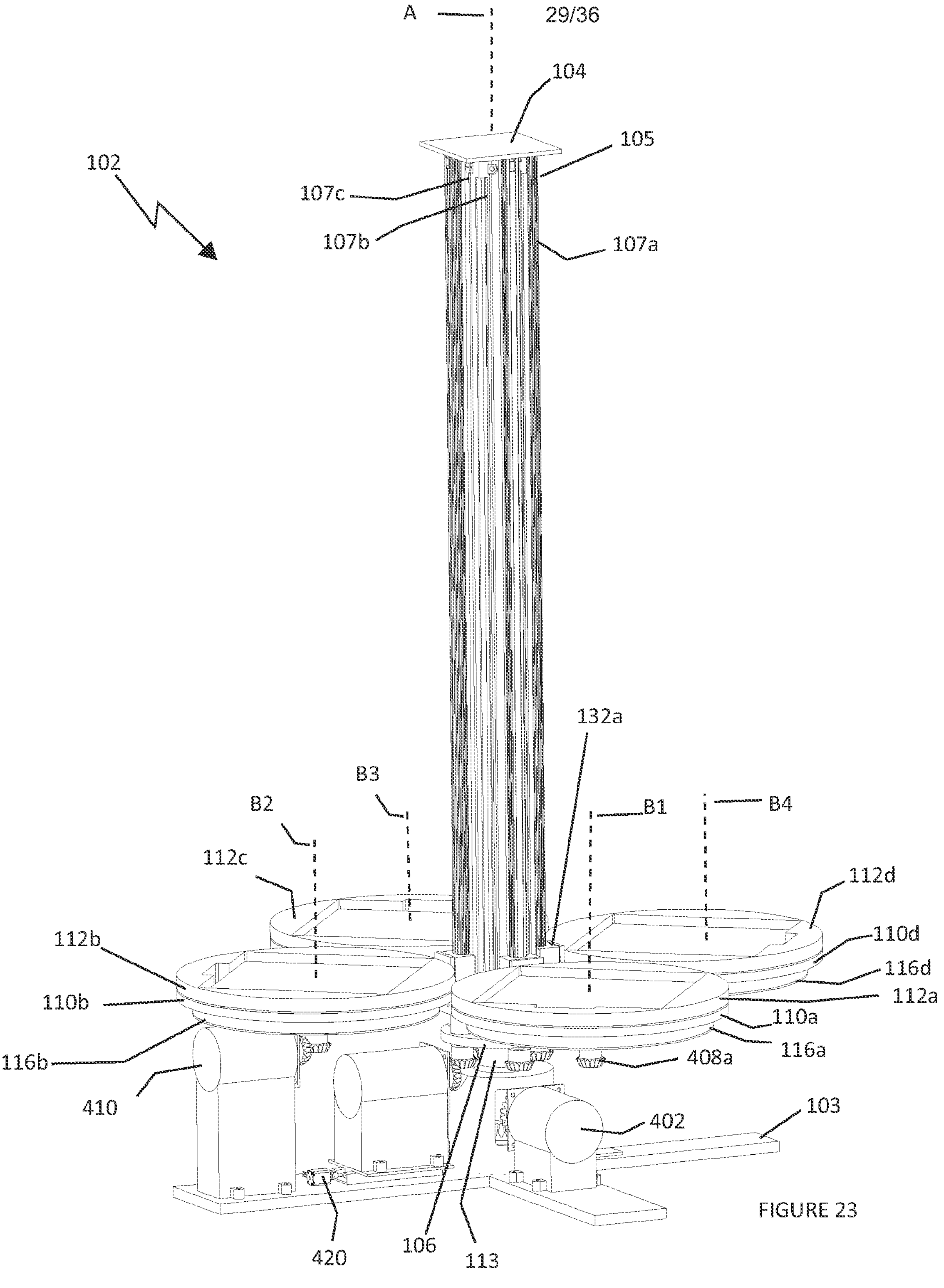

A
104
105
102
107c
107b
107a
132a
B3
B2
B1
B4
112c
112d
112b
110d
116d
110b
112a
110a
116a
116b
408a
410
402
103
420
106
113

FIGURE 23

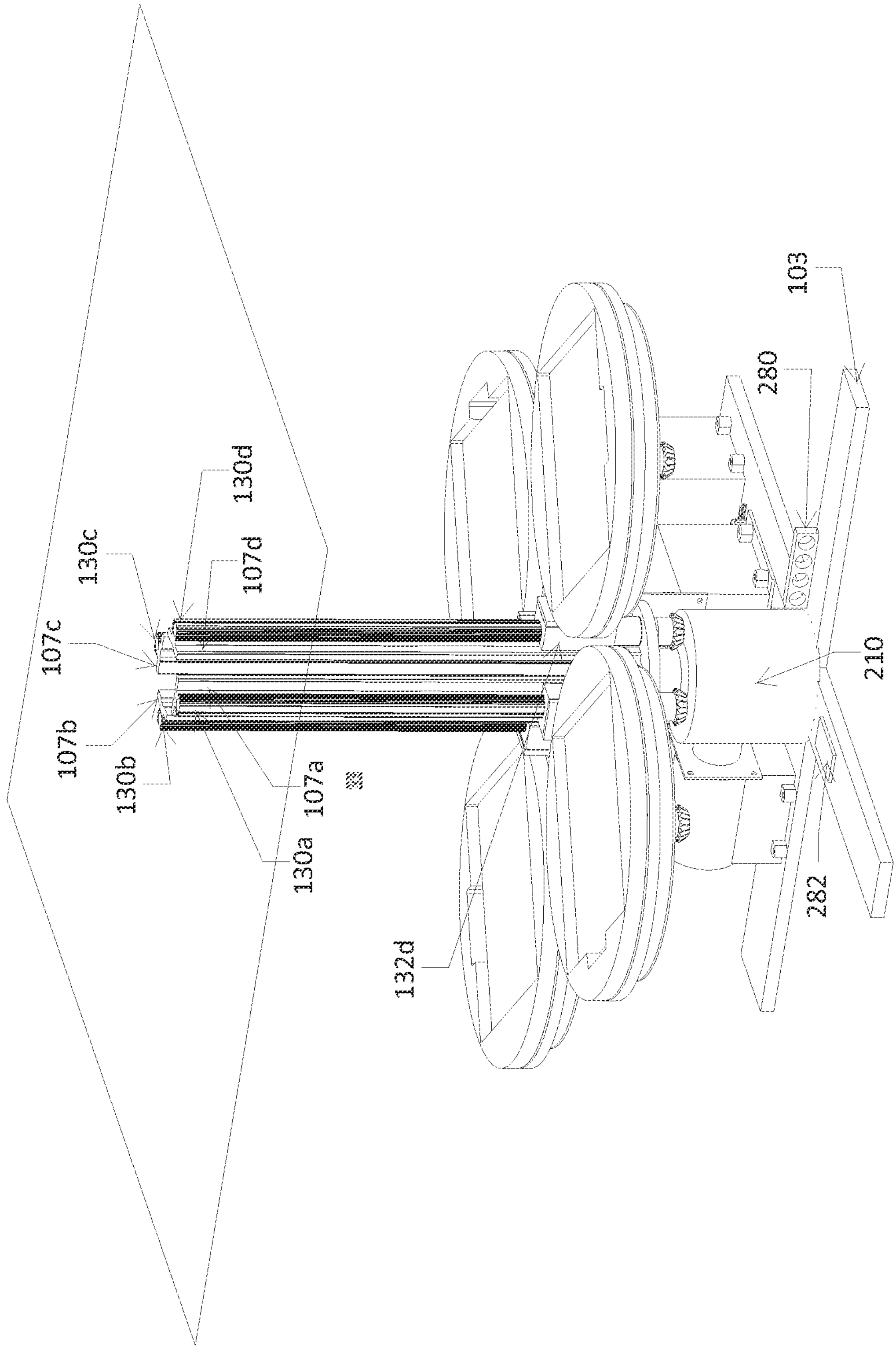


FIGURE 24

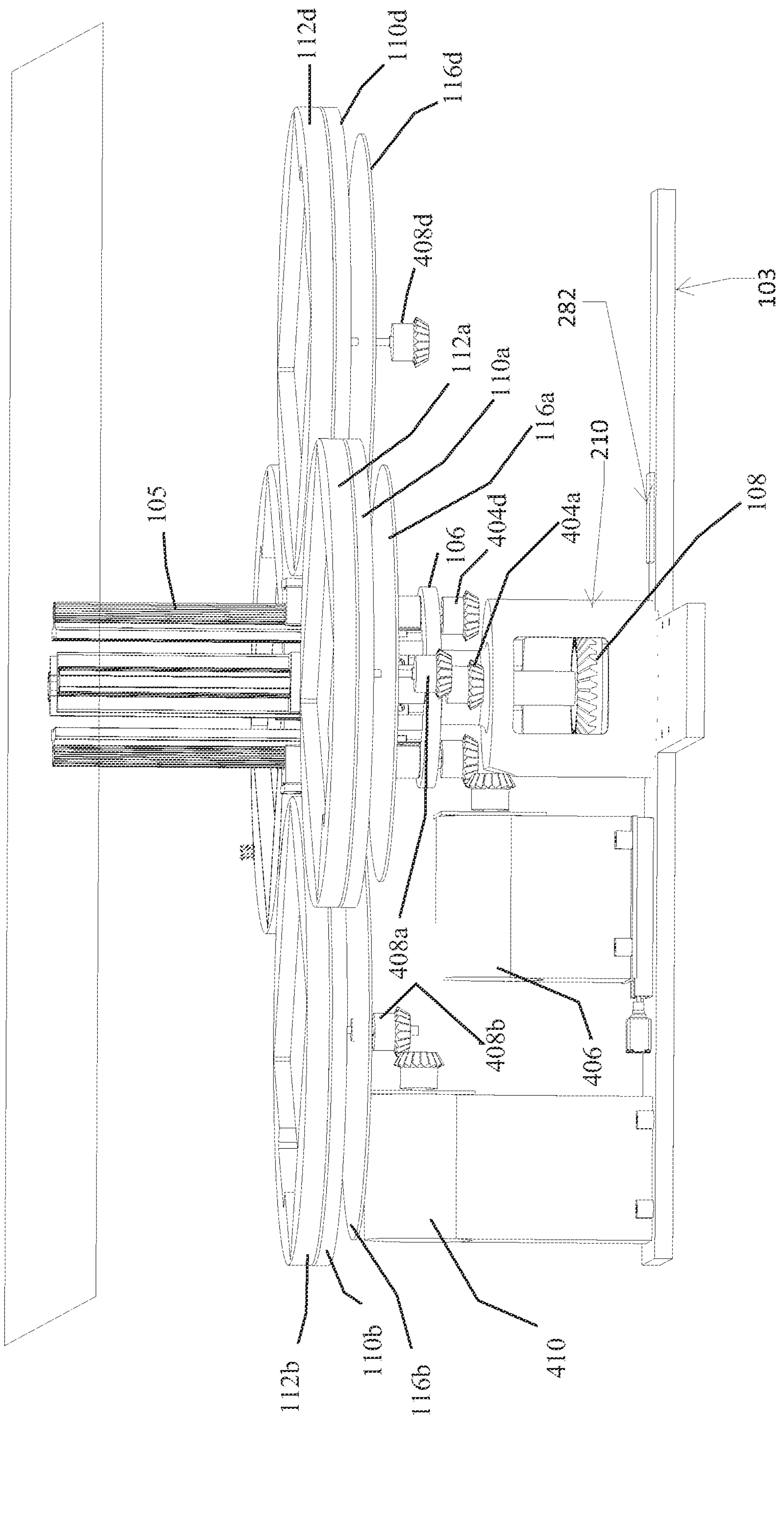

112d
110d
116d
408d
112a
110a
116a
282
103
210
105
106
404d
404a
108
408a
408b
406
410
112b
110b
116b

FIGURE 25

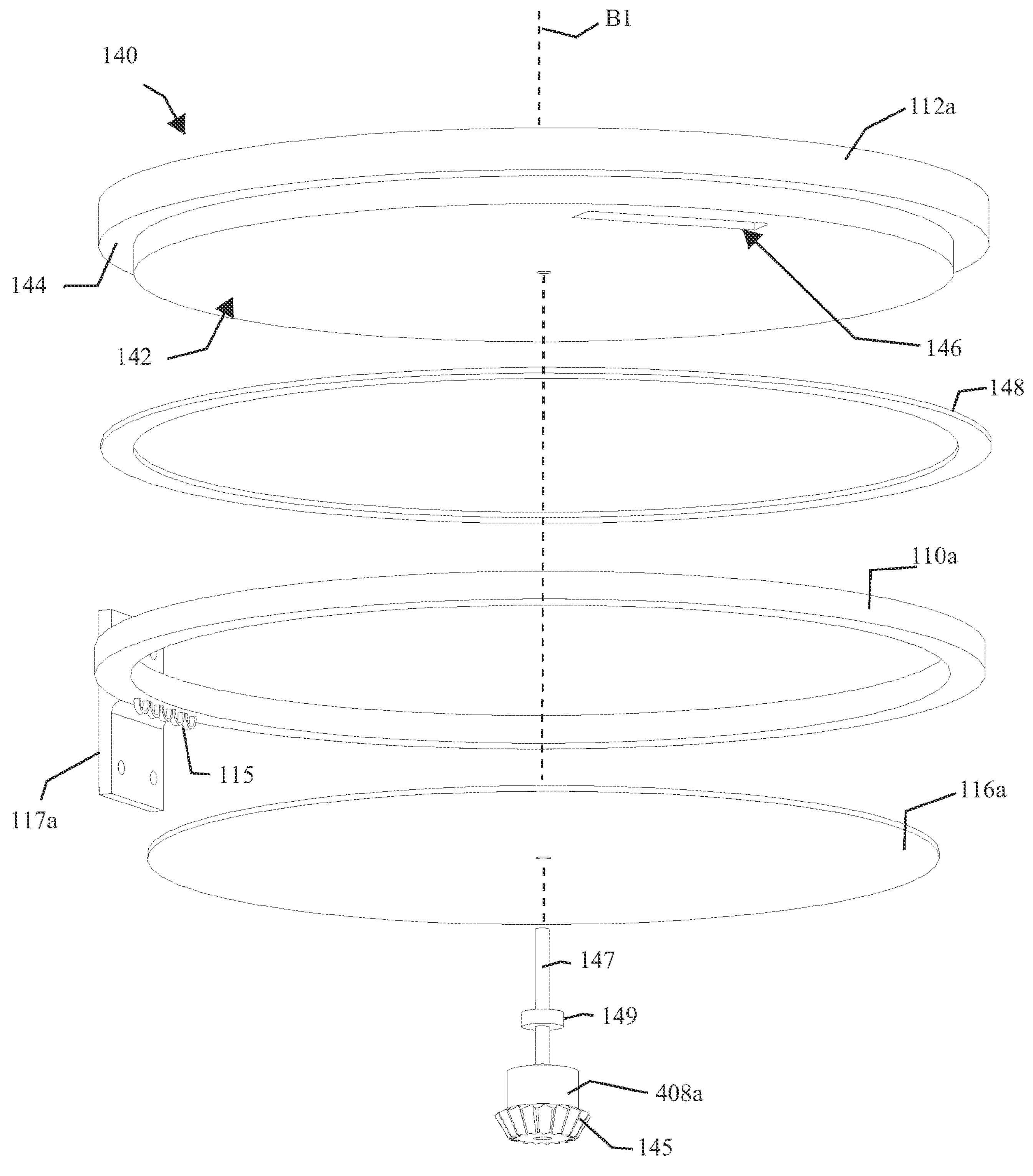


FIGURE 26

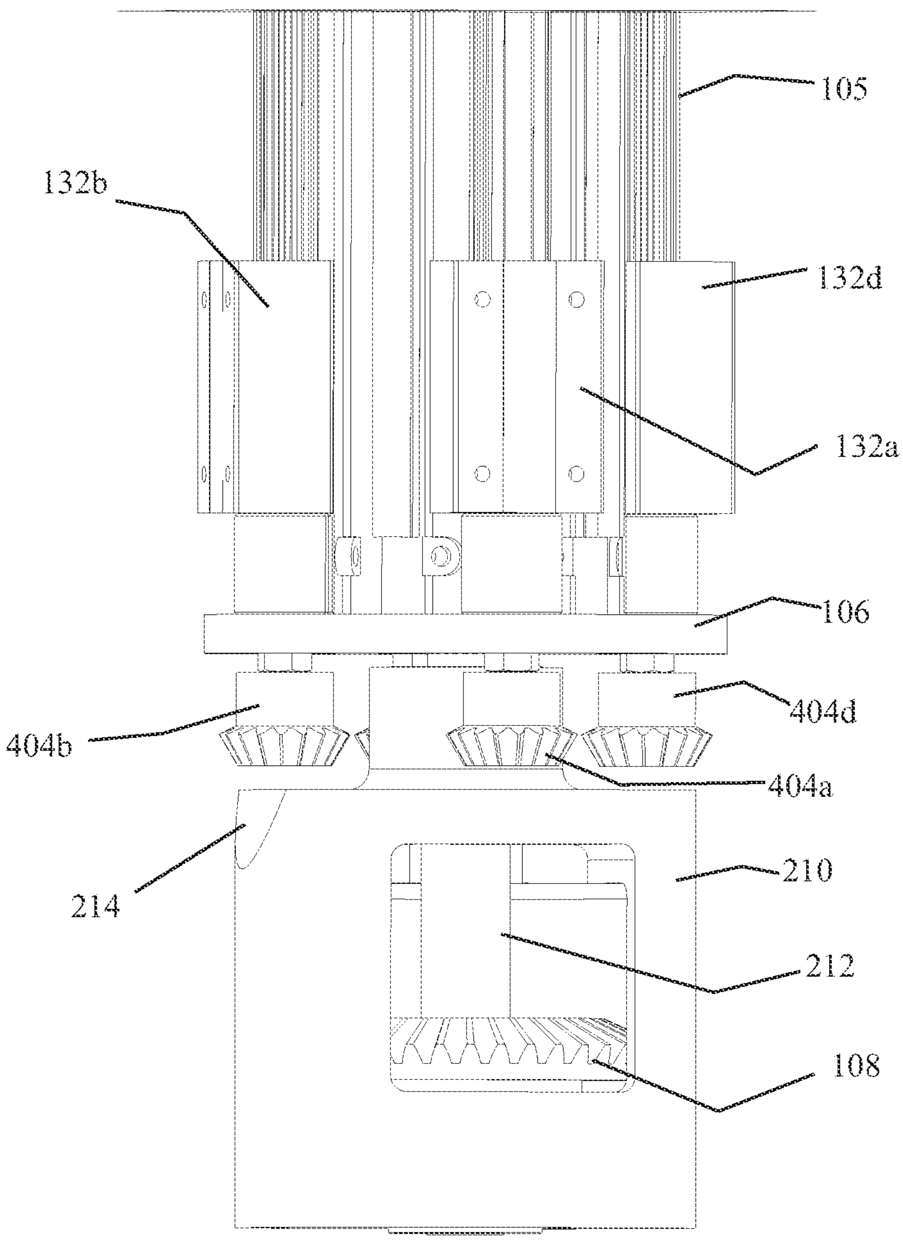


FIGURE 27

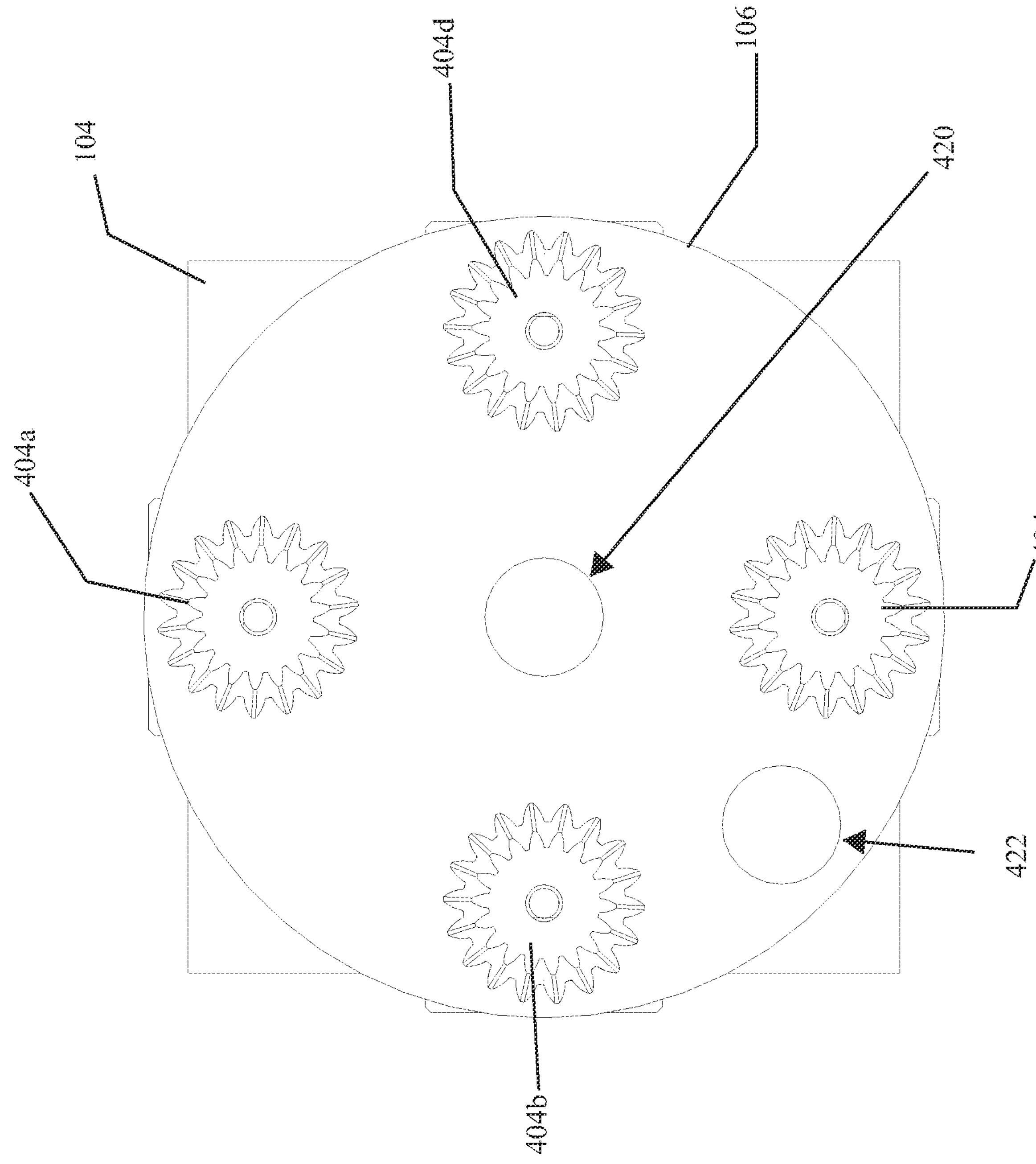


FIGURE 28

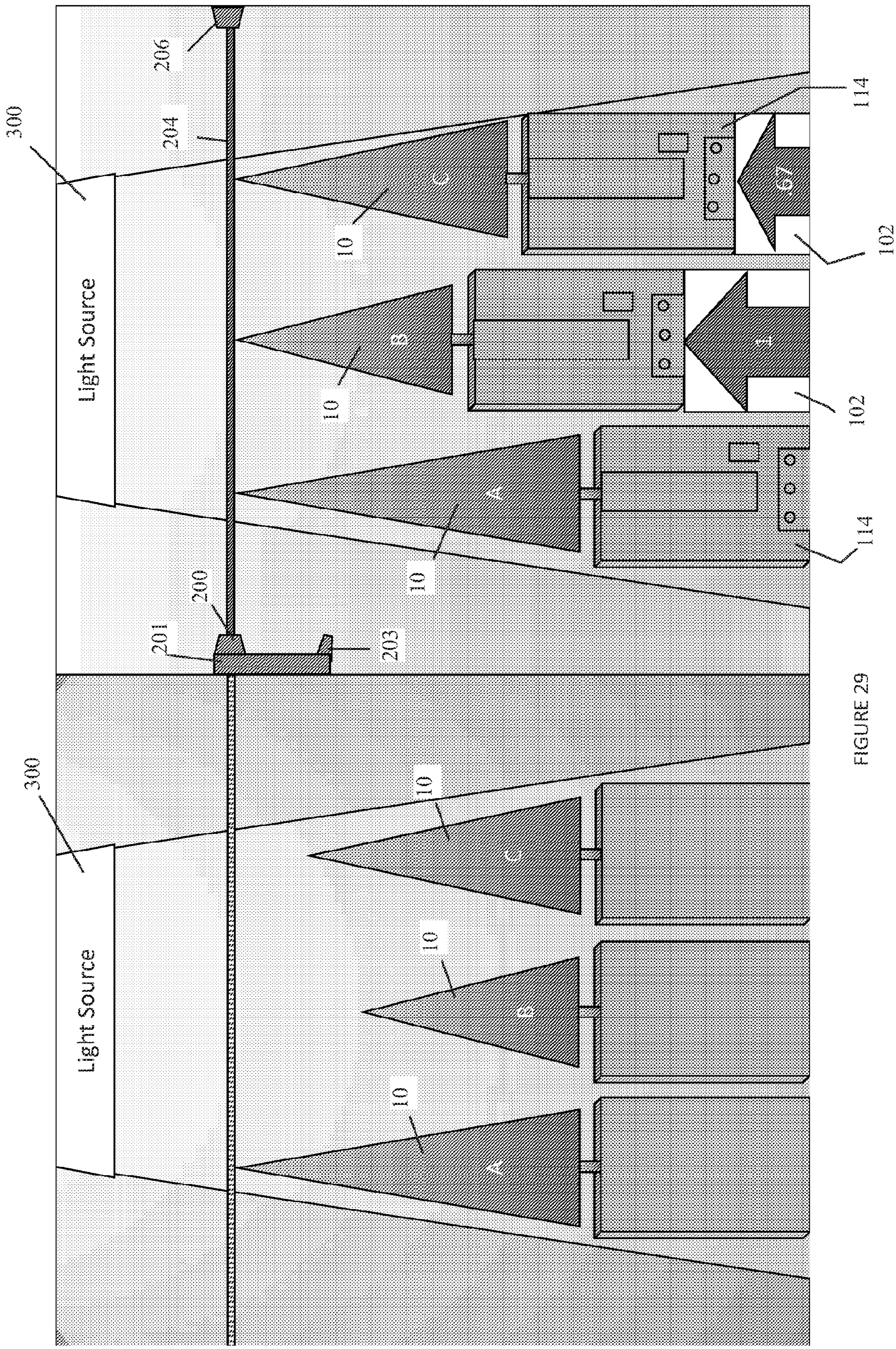

Light Source
300
206
204
200
201
203
10
A
B
C
114
102
1
67
Light Source
300
10
A
B
C

FIGURE 29

Optic Sensor & Monitoring Bar

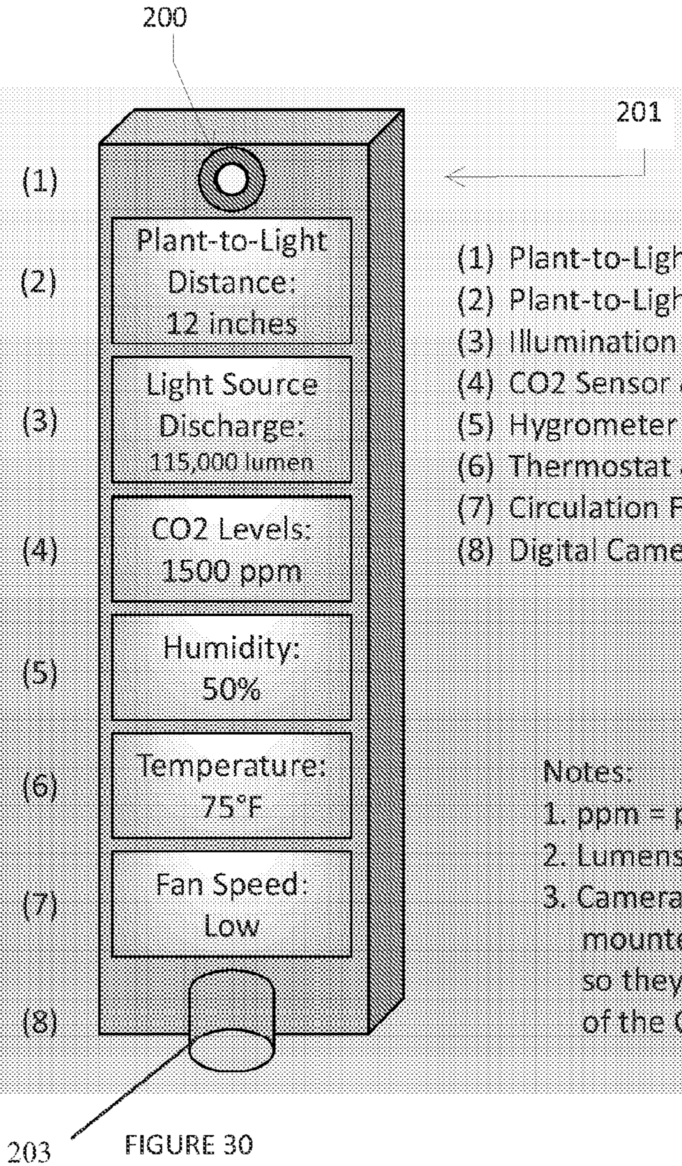


FIGURE 30

(1) Plant-to-Light Proximity Sensor
(2) Plant-to-Light Distance & Rotation Controller
(3) Illumination Sensor & Lighting Schedule Controller
(4) CO_2 Sensor & CO_2 Level Controller
(5) Hygrometer & Humidity Controller
(6) Thermostat & Temperature Controller
(7) Circulation Fan Speed Controller
(8) Digital Camera w/ WiFi and Time-lapse features

Notes:

1. ppm = parts per million
2. Lumens are only one way to measure light.
3. Camera and Optic Sensor will likely be mounted on opposite sides (left and right) so they can travel (and/or swivel) the length of the Optic Sensor & Monitoring Bar.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/048287

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A01G 27/06 (2014.01)
CPC - A01G 27/06 (2014.10)
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)
IPC(8) - A01G 9/02, 9/12, 9/24, 13/02, 13/08, 27/00, 27/04, 27/06, 31/02 (2014.01)
CPC - A01G 9/022, 9/045, 27/001, 27/003, 27/04, 27/06, 31/02 (2014.10)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 47/21.1, 60, 66.1, 79, 81, 82 (keyword delimited)

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

Orbit, Google Patents, Google Scholar
Search terms used: plant, grow, housing, reservoir, trellis,water, lid, float valve, aerator, air, wick, transparent, chute

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013/0014435 A1 (HANSEN et al) 17 January 2013 (17.01.2013) entire document	1-25
A	US 8,443,546 B1 (DARIN) 21 May 2013 (21.05.2013) entire document	1-25
A	US 2011/0154985 A1 (MITTELMARK) 30 June 2011 (30.06.2011) entire document	1-25
A	US 2012/0198767 A1 (HANSEN) 09 August 2012 (09.08.2012) entire document	1-25
A	US 6,986,224 B2 (GELFER) 17 January 2006 (17.01.2006) entire document	1-25
A	US 6,370,819 B1 (REISS et al) 16 April 2002 (16.04.2002) entire document	1-25

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* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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)
"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 October 2014	18 NOV 2014

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774