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(54) METHOD AND APPARATUS FOR GENERATING DRINKING WATER BY CONDENSING AIR HUMIDITY

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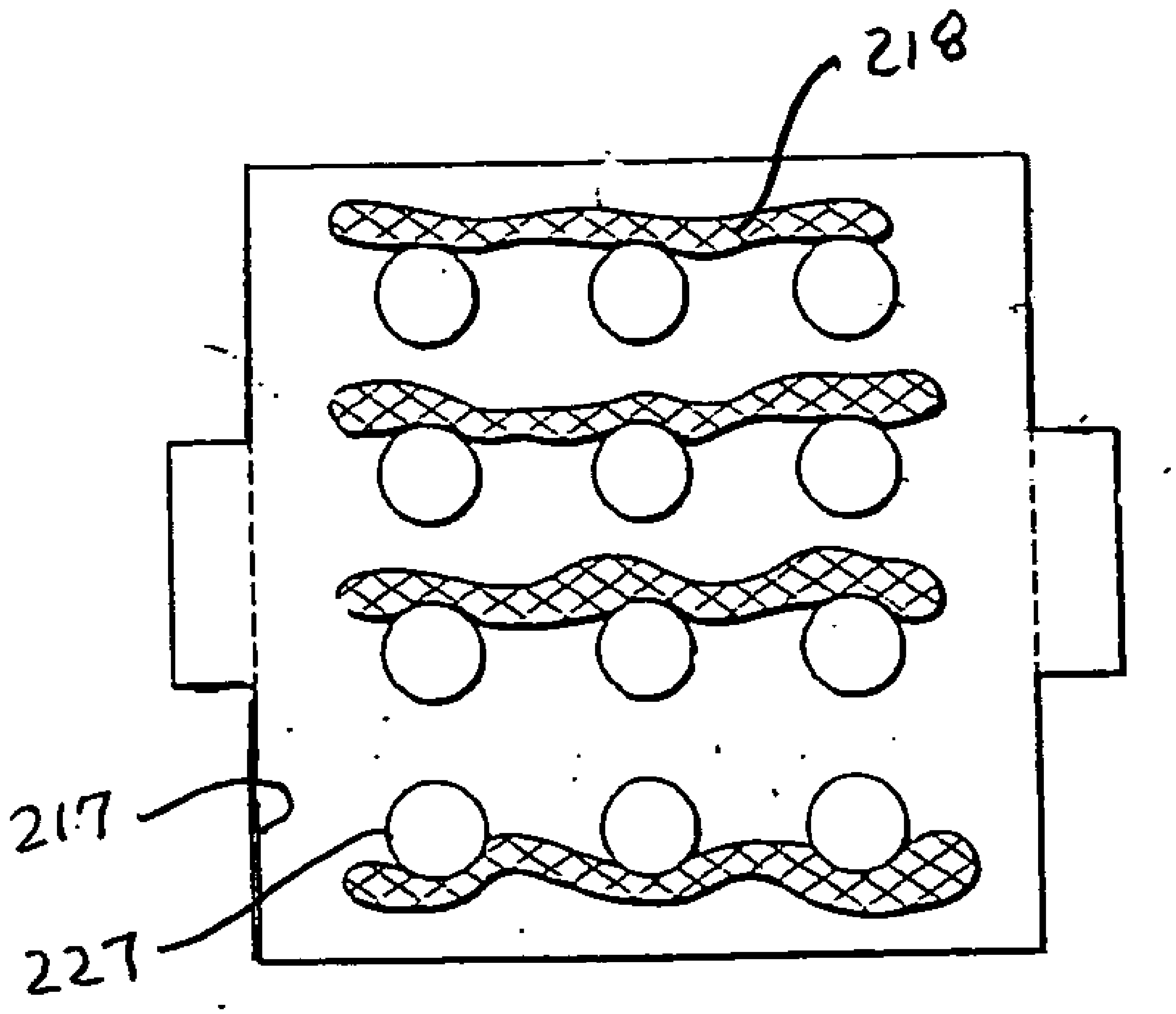
(57) ABSTRACT

A system and method are shown which utilize a hybrid mechanical and evaporative air conditioning system to produce potable drinking while cooling an enclosure. The system operates on direct current, making it suitable for use in areas effected by natural disaster, power outage, or simply rural locations without access to electricity. The conditioning system includes both evaporative air conditioning and mechanical air conditioning functioning components to produce a water discharge. The system is operated to cool an enclosure. A portion of the water discharge is then drawn off and purified for use as drinking water.



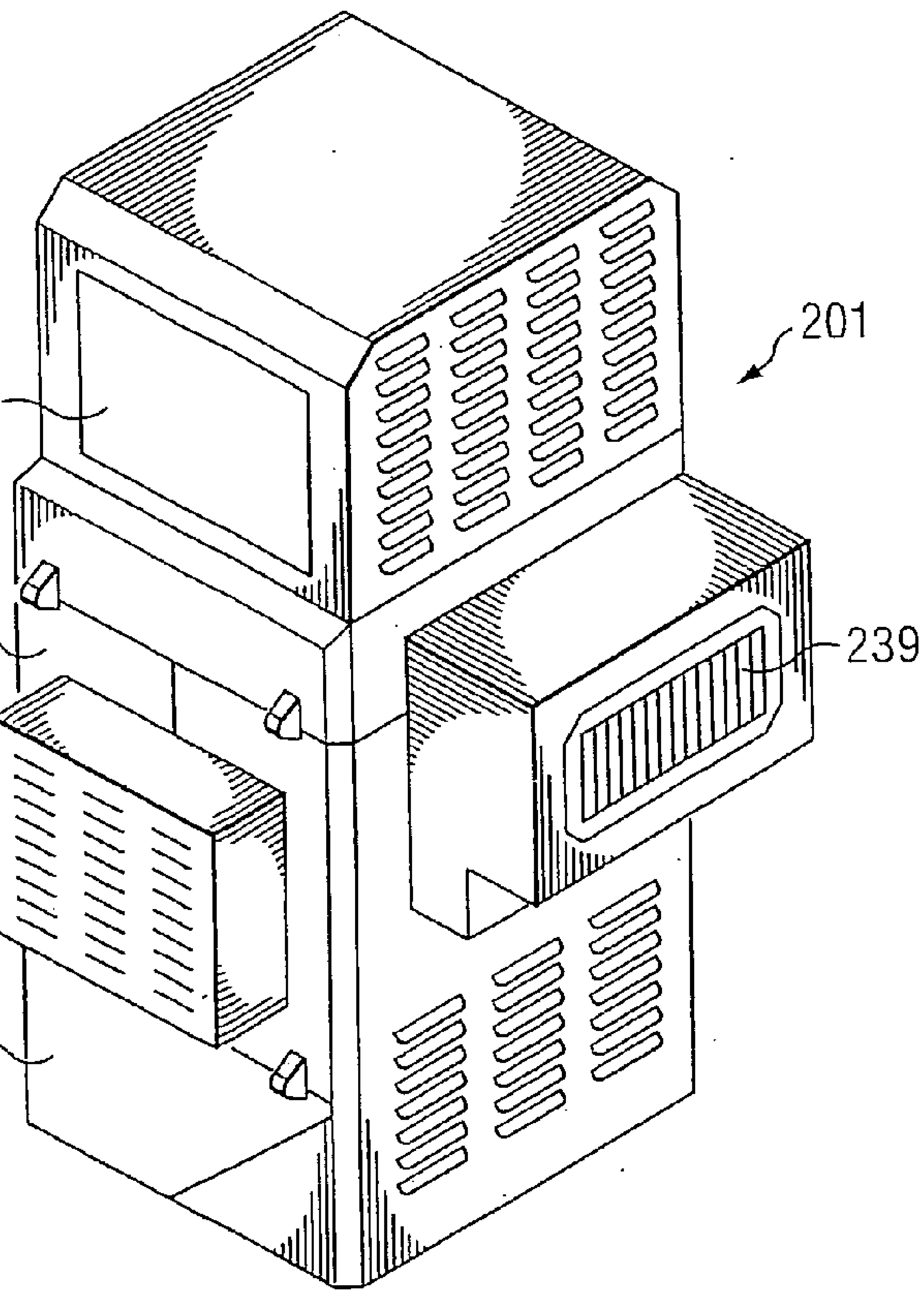


FIG. 1

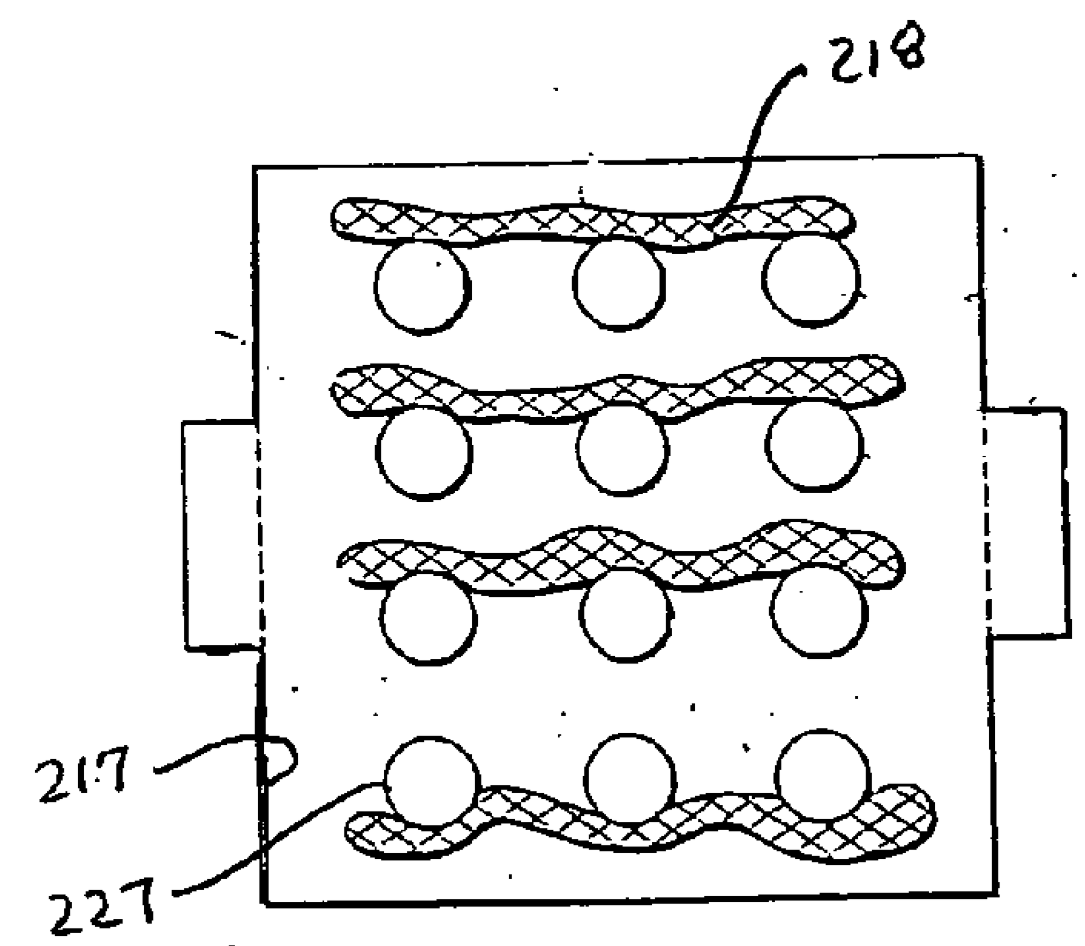


FIG. 2

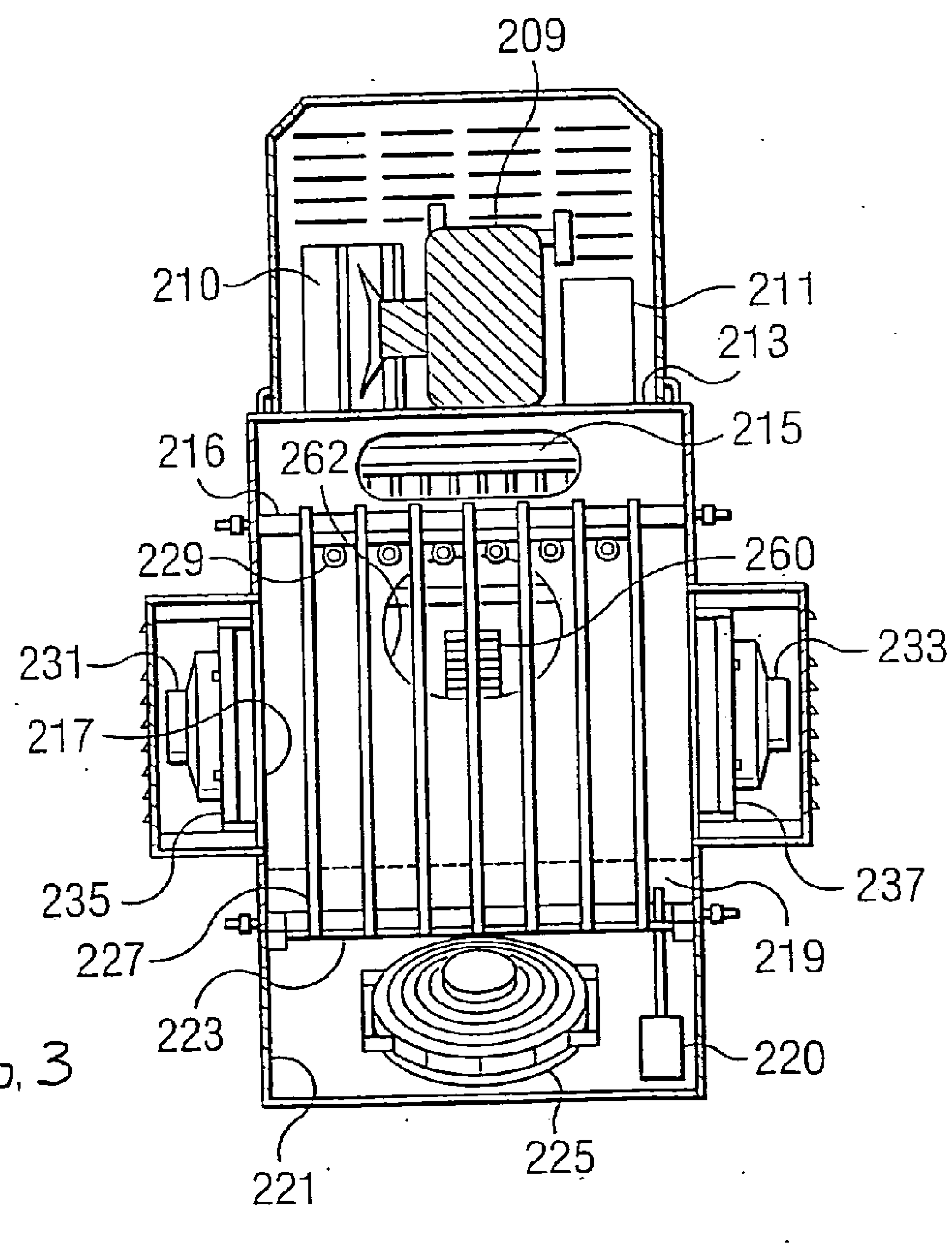


FIG. 3

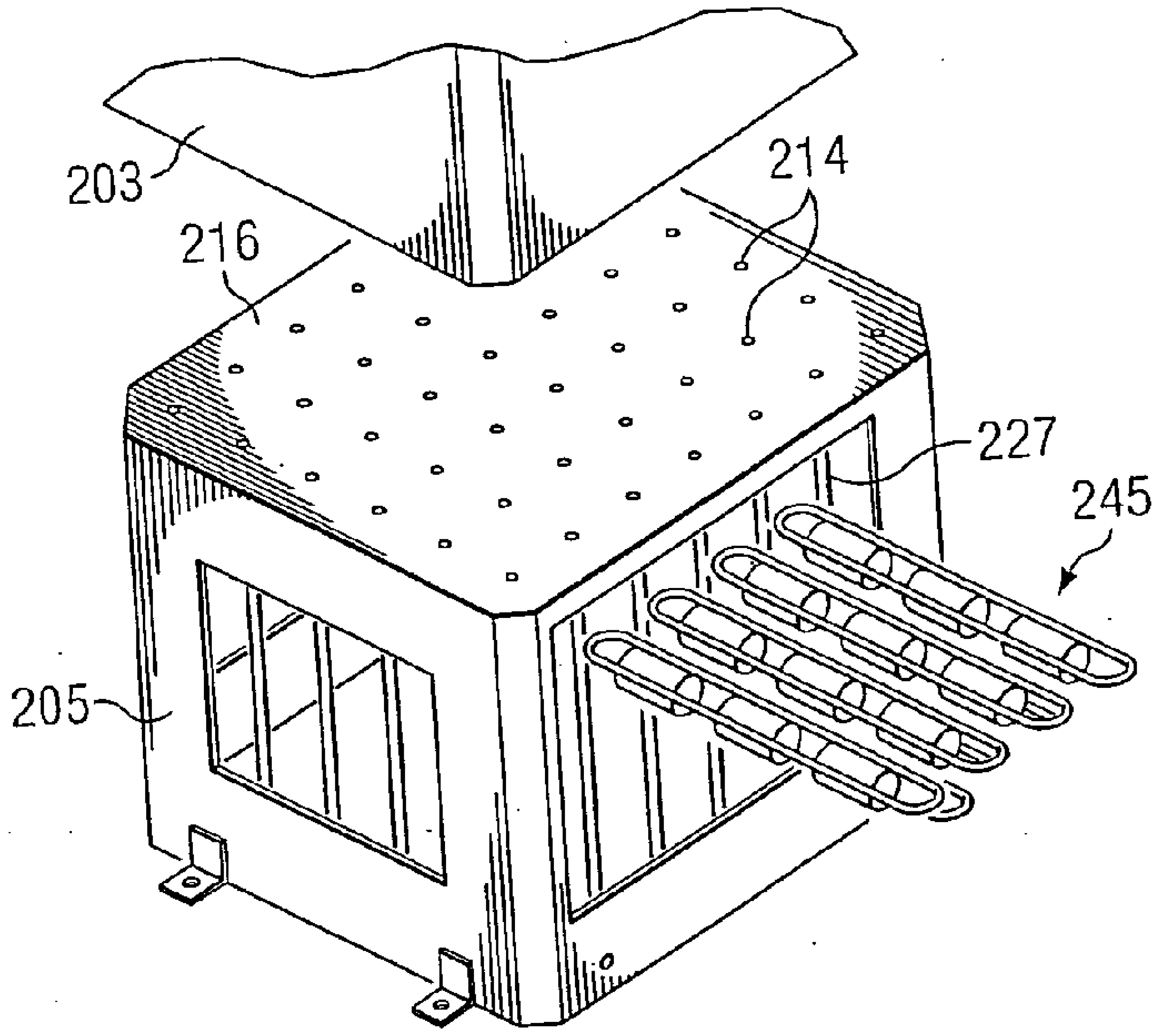

203
214
216
227
245
205

FIG.4

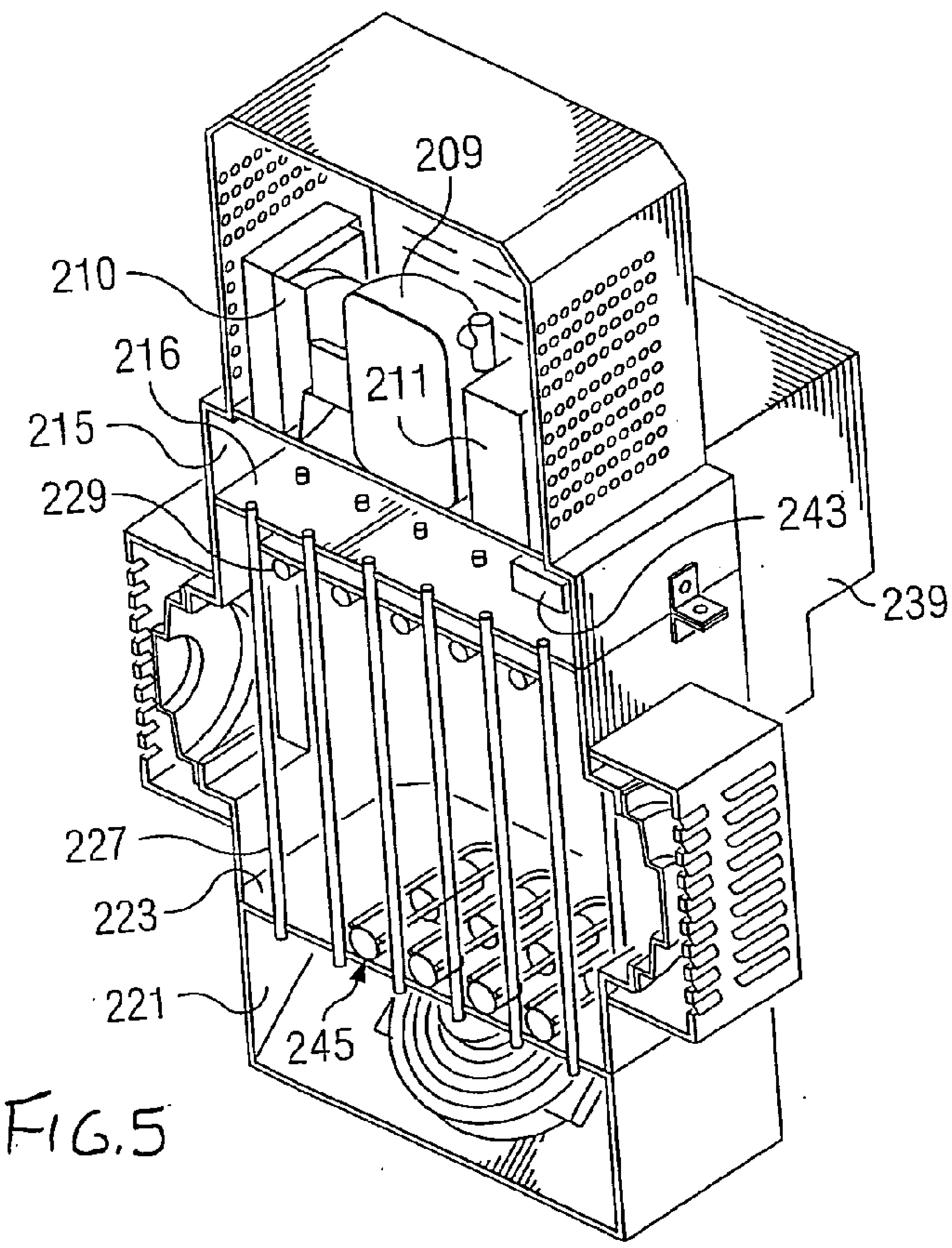

209
210
216
211
215
229
243
239
227
223
221
245

FIG.5

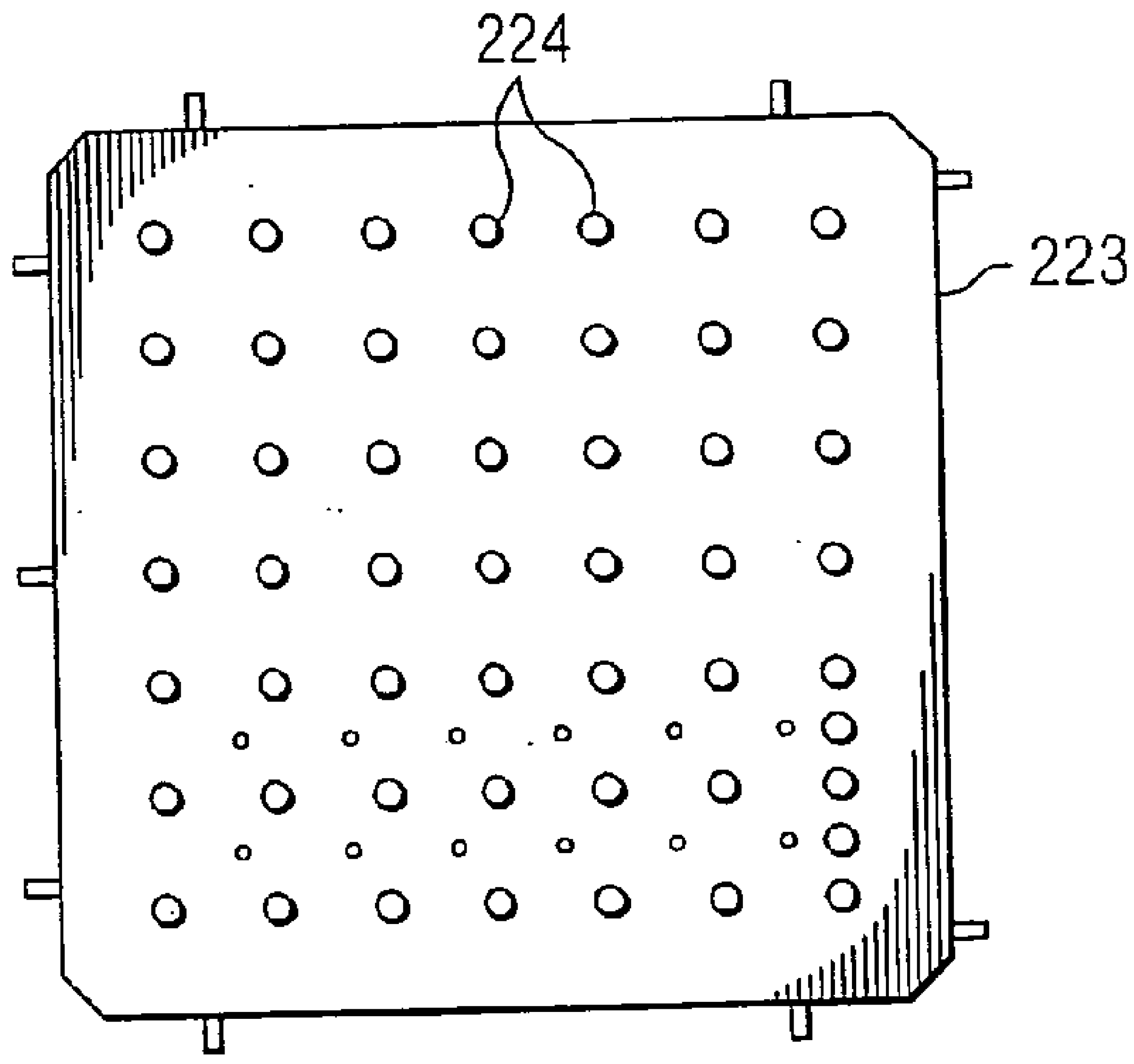


FIG. 6

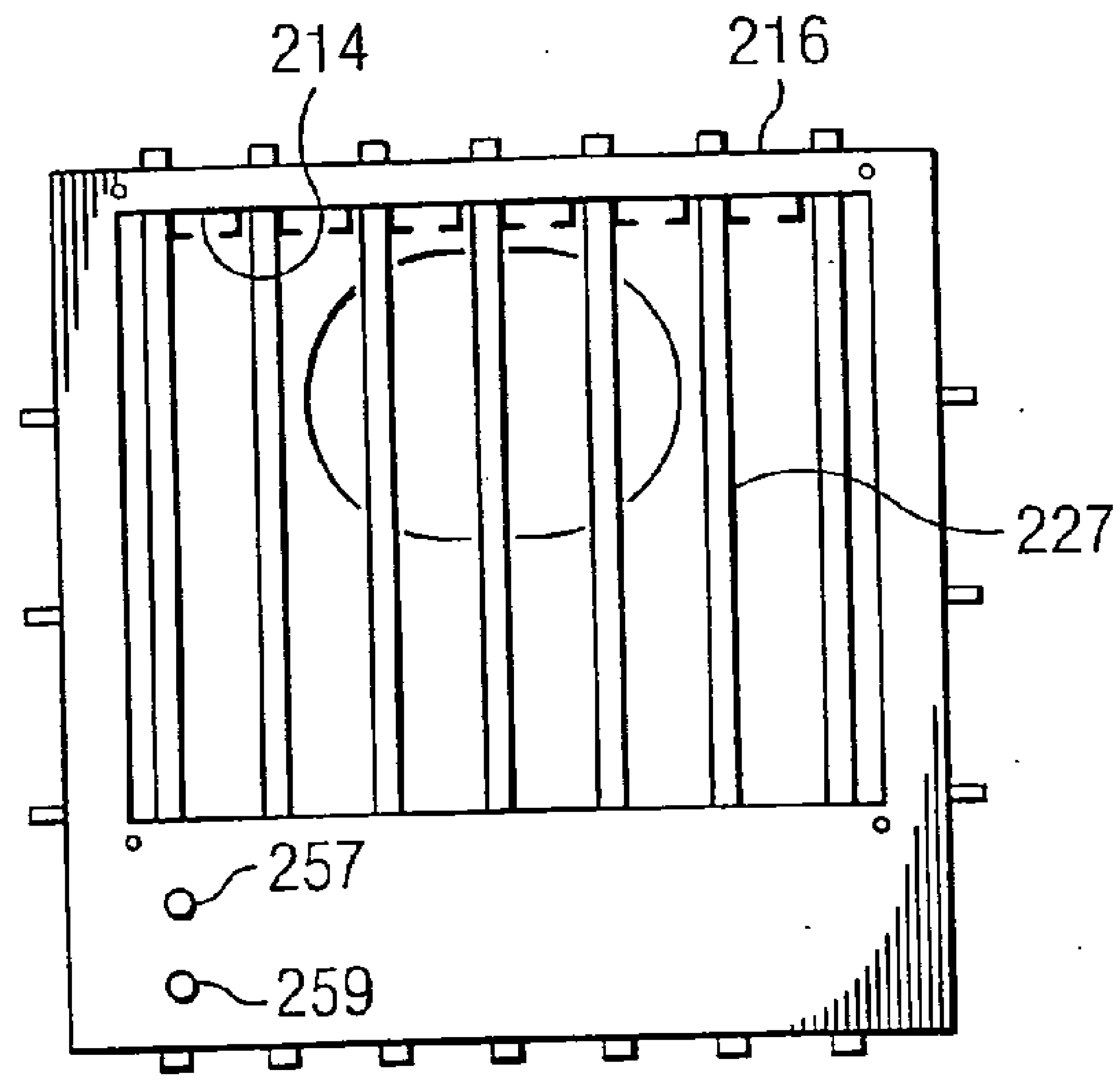


FIG. 7

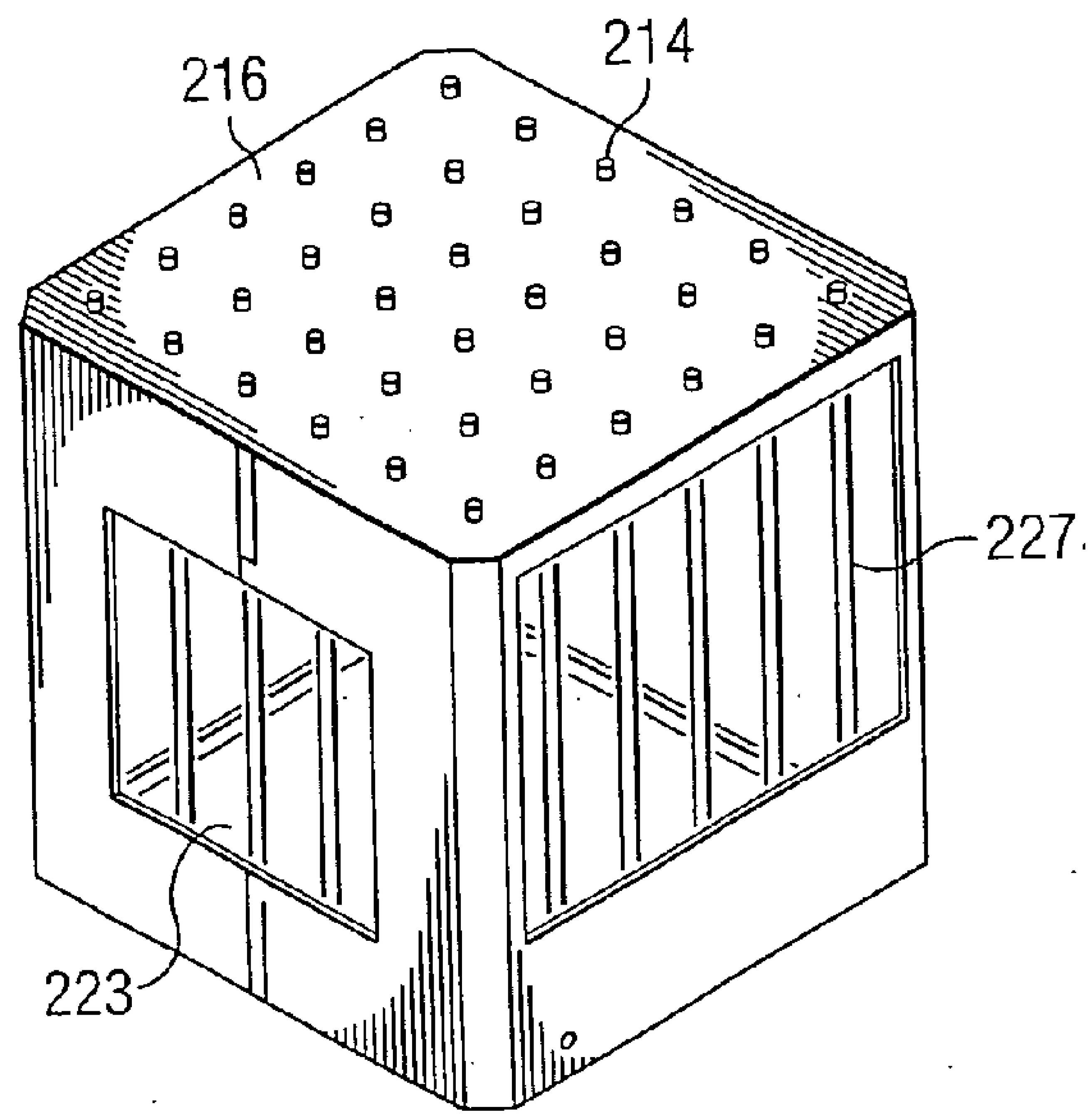


FIG. 8

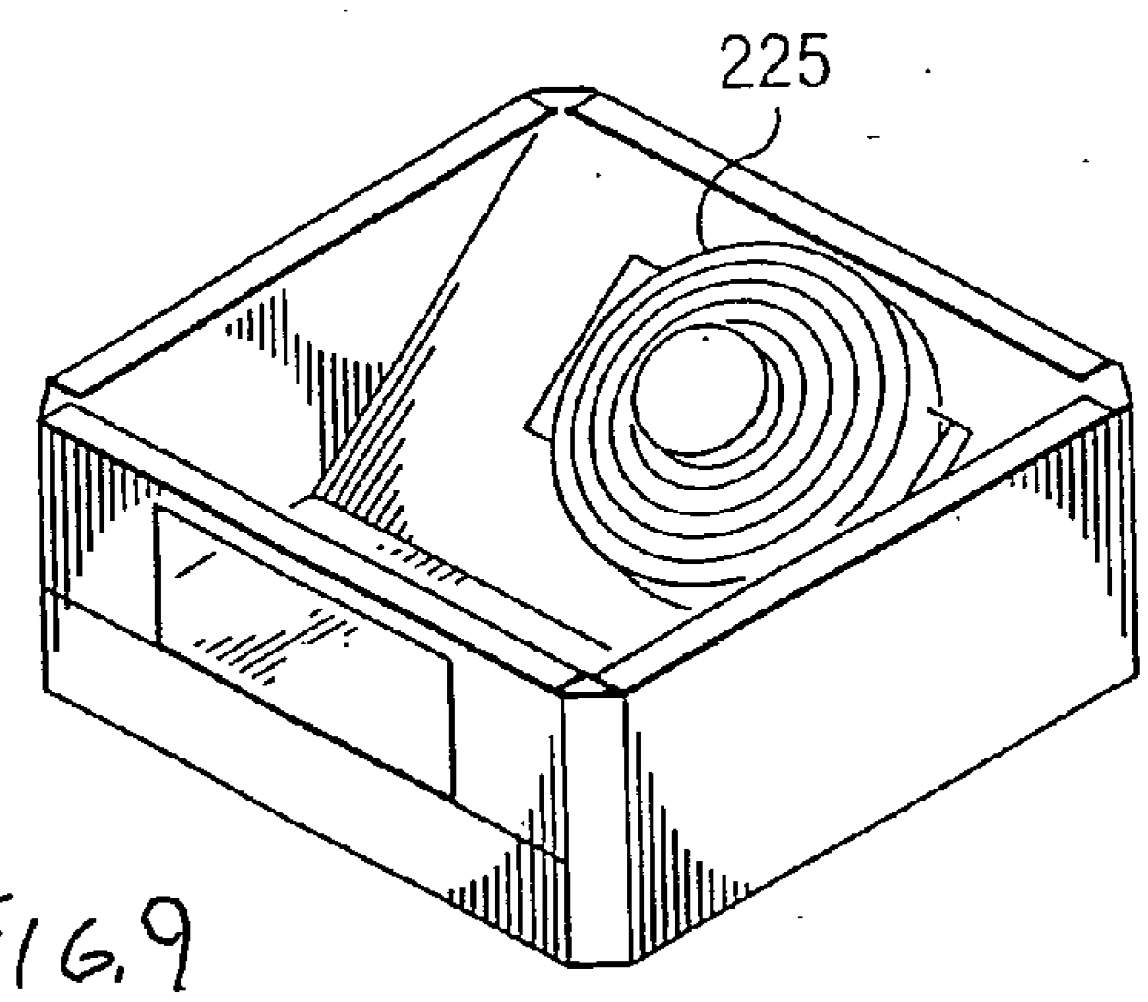


FIG. 9

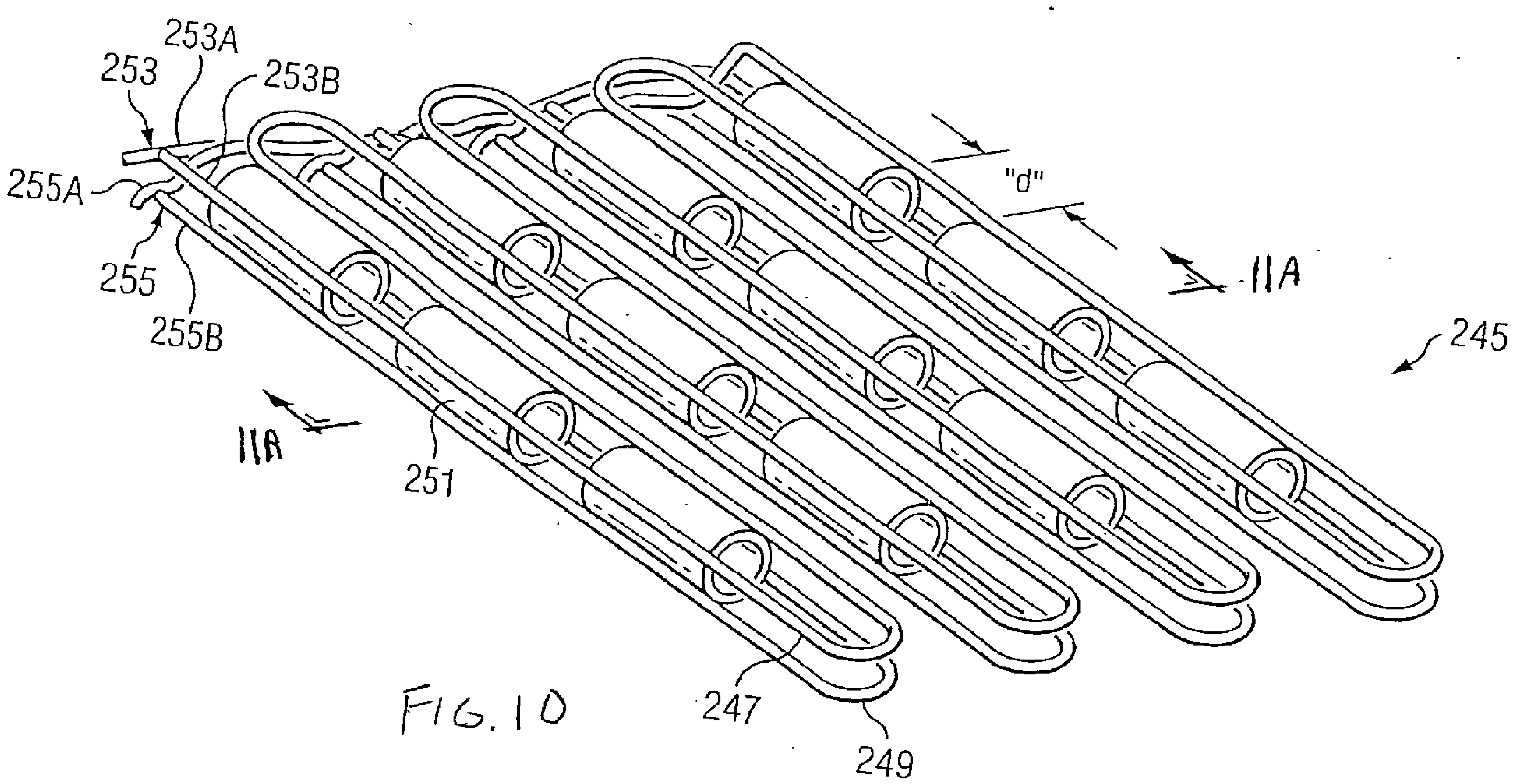


FIG. 10

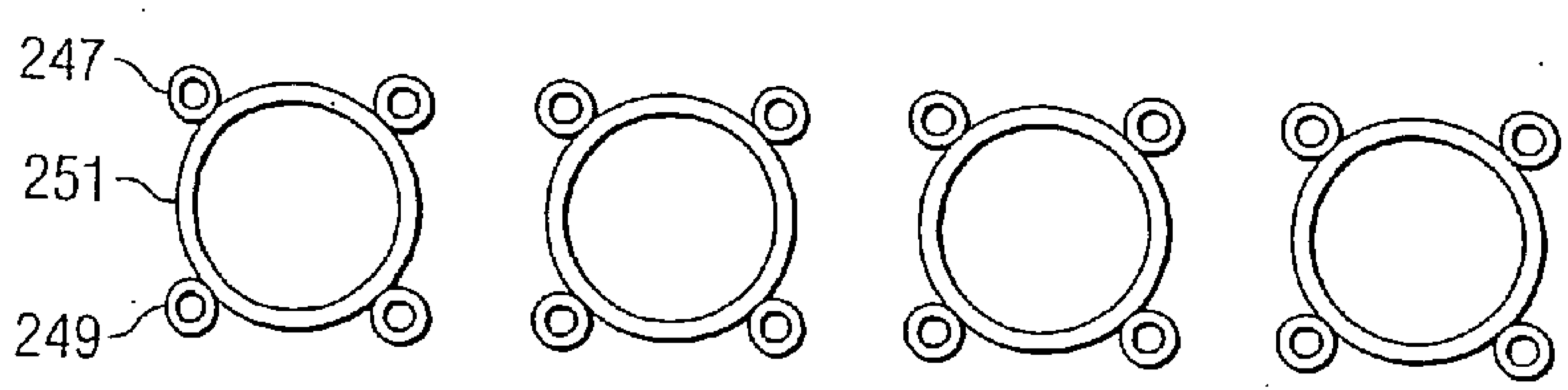


FIG. 11

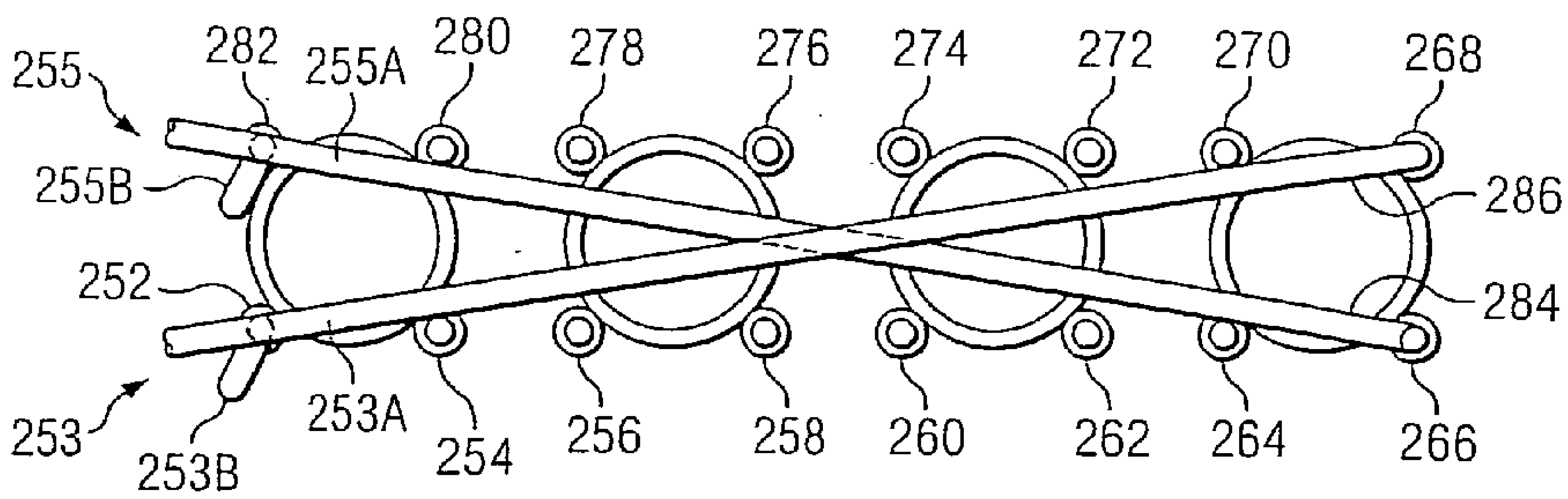


FIG. 12

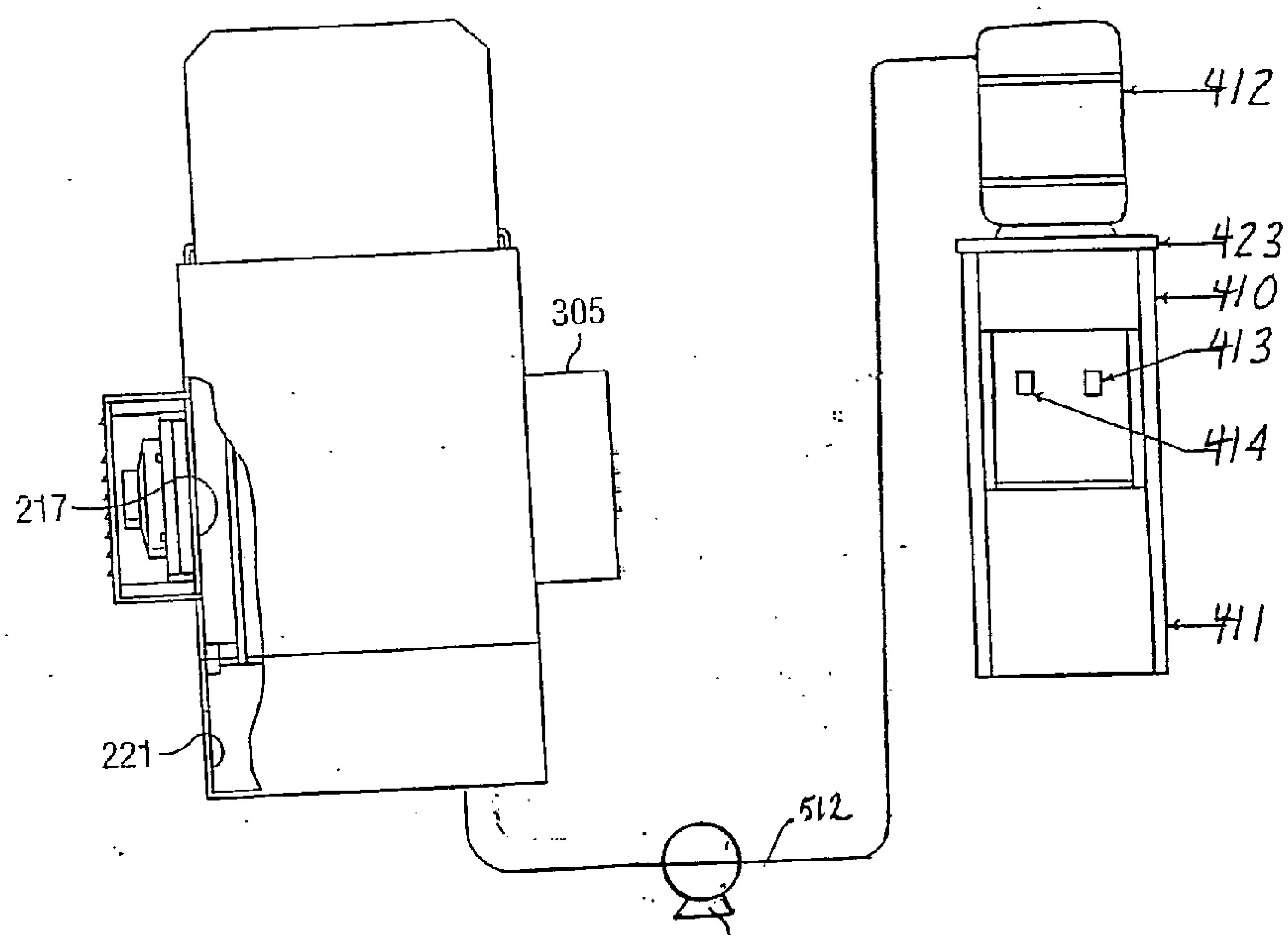


FIG. 13

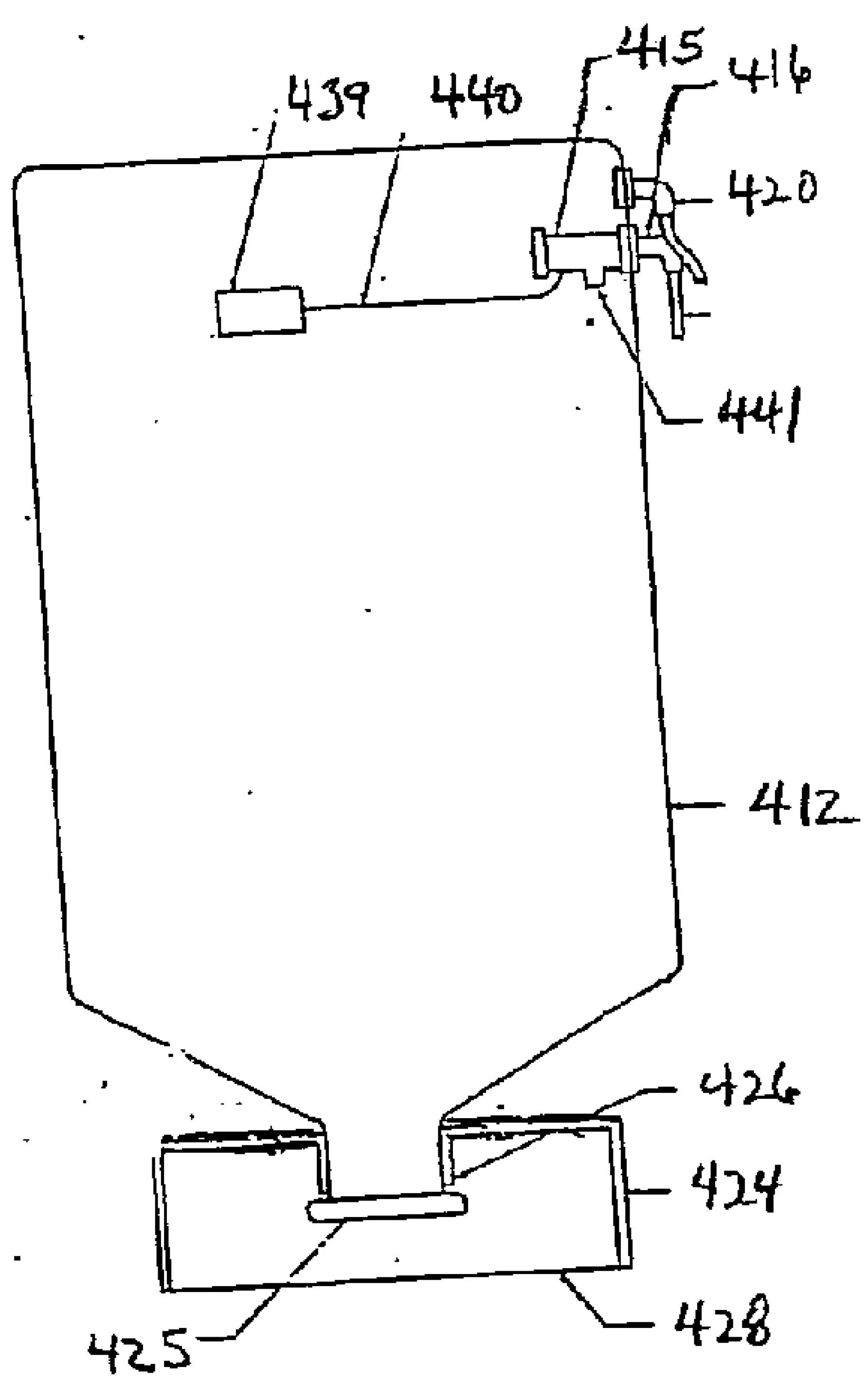


FIG. 14

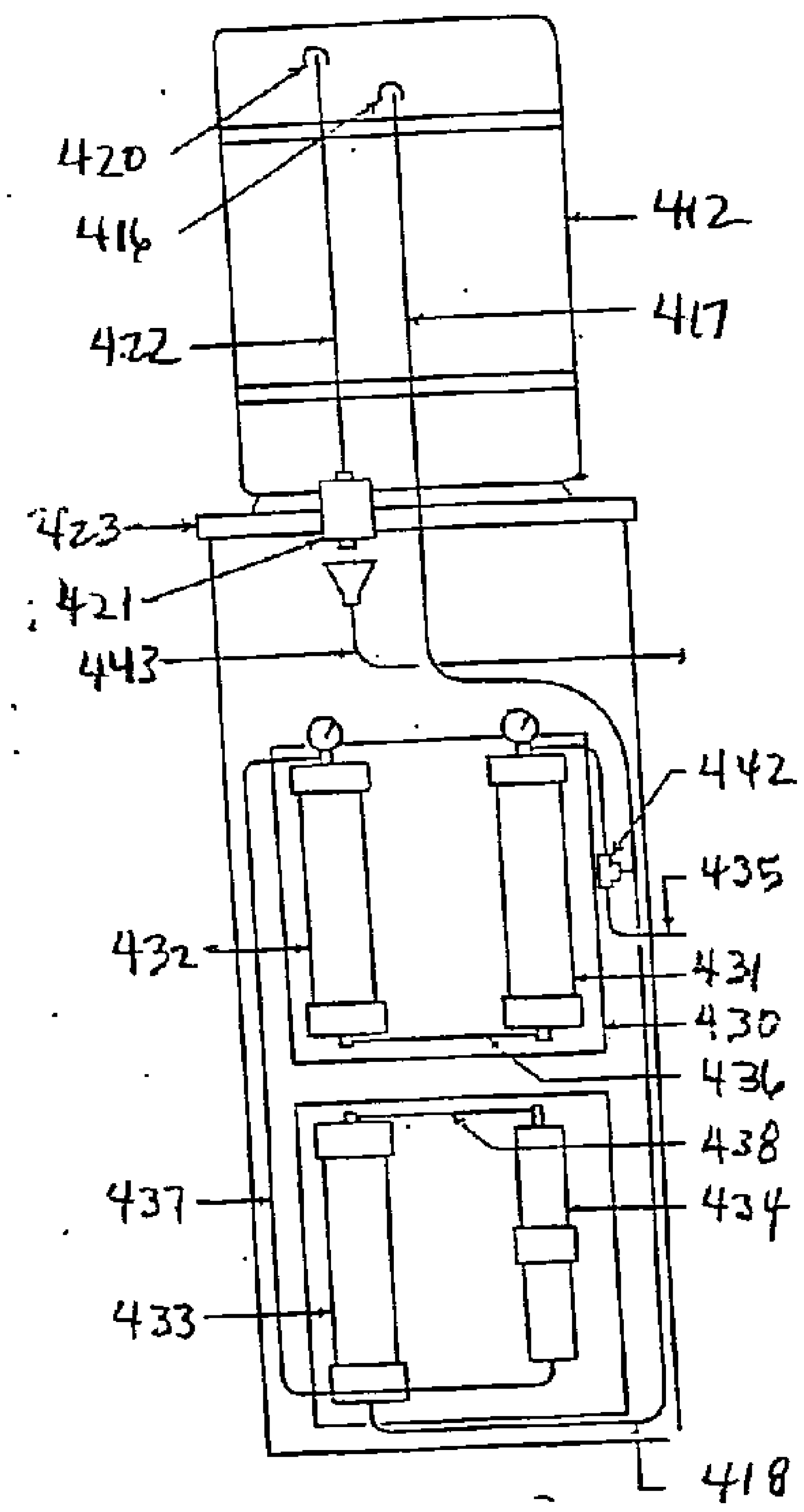


FIG. 15

METHOD AND APPARATUS FOR GENERATING DRINKING WATER BY CONDENSING AIR HUMIDITY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation-in-part of my earlier filed application Ser. No. 10/963,188, filed Oct. 12, 2004, entitled "Cooling Assembly", presently pending.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates in general to low powered air conditioning systems, and in particular, to a low power air conditioning system capable of running on direct current which is also capable of generating potable drinking water from humidity in the air. The system can be used in such irregularly powered locations as those that are affected by natural disaster or power blackouts and, in addition to cooling, produce potable drinking water.

[0004] 2. Description of the Prior Art

[0005] Heat in tropical and semi-tropical regions is usually accompanied by extremes of high humidity, especially at low altitude where the geographic features include bayous, marshlands, swamps, shallow lakes, heavy vegetations, and forests. This is also true in the case of tropical islands, such as the islands of the Caribbean Sea; arid land and deserts which are adjacent oceans shorelines or seashores; such as the regions East of the red Sea and West of the Gulf on the Arabian Peninsula. Generally, natural freshwater resources are scarce or limited in very hot and humid arid areas by or near shorelines due to low precipitation and rainfall and high salinity of underground water. There are also portions of the United States which have sufficient humidity to make the removal of drinking water from the atmosphere a feasible quest.

[0006] Shortage in supply of potable water and freshwater is increasing at a vast rate as deserts expand and overtake fertile land and as many of the existing water resources are being depleted. Global weather patterns in recent years have, in some cases, resulted in a drop in the rate of rainfall in many populated areas. In addition, large cities are expanding at a fast pace, swallowing neighboring villages and small towns, leading to drastic change in the lifestyle of inhabitants. The shift from rural to urban lifestyle has, in many cases, forced people to live in crowded housing and congested apartments with no or little opportunities to fresh air, thus suffering from stuffiness, heat and humidity, and being more exposed to an increasing shortage of freshwater supply.

[0007] Historically, power outages can have devastating effects on residential populations such as apartment dwellings that require electricity to power, among other things, air conditioning units that primarily run on AC. Blackouts are especially dangerous in high temperature environments where extended exposure to the heat for long periods of time may result in adverse health conditions. Children and elderly are especially vulnerable to extreme heat conditions, wherein heat related sickness such as heat strokes can cause serious health detriment or even death. Therefore a problem exists with current air conditioning technology, which is primarily based on powering units by AC, as users of these units are susceptible to power outages. There are numerous reasons for power failures, such as defects in a power station, damage to a power line or other part of the distribution system, a short circuit, or the overloading of electricity mains. Overloading of electricity mains is common during the hottest months of the year in highly populated areas, largely due to the fact that there is such a large demand for power in order to run the enormous amount of air conditioning units located in the region.

[0008] In addition to the problem of power outages and the need to supply air conditioning in hot environments, the problem of supplying drinking water often goes hand in hand, particularly in the area of natural disaster. In the event of serious natural disasters, access to freshwater needed for drinking purposes can be limited or even completely eliminated for long periods of time. This can have a devastating effect on residential communities located within the region of the disaster, whereby purifying and providing potable water may pose serious health threats. In some cases, disaster relief agencies aid residents by distributing bottled water to disaster areas. However, this activity is not always efficient in getting the drinking water to those who need it the most. In addition, this process is not energy efficient due to transport and labor needed to execute properly.

[0009] Water condensation from humid hot air takes place as part of any air conditioning or air drying cycle. Usually the condensate from such devices drips out and is customarily disposed of as useless wastewater. It would be preferable to be able to reclaim such condensate for use as drinking water, or for other household purposes. Some technologies exist for this or similar purposes. For example, air-drying equipment is presently used in such applications as for dehumidify air in basements. Dehumidifiers are also used in cold regions as well as hot humid regions in spaces used for storage of clothes and household furniture that can be affected by humidity and subsequent mold buildup. Air-drying equipment is also used in drying of manufacturing environment wherein wet raw material and stock material saturated with moisture for ease of production; such as the case in paper and wood fabrication. Often relatively dry air is required for maintenance of the quality of some products that may be affected by increase in humidity over a set level even for a short period.

[0010] The quantity of wastewater produced by dehumidifiers depends on the humidity of the ambient air and could reach large quantities in regions of extremely high humidity and high temperature wherein water is usually scarce. In case of traditional air conditioning equipment used for air-cooling and ventilation, the amount of water condensate depends on the capacity of equipment, the temperature setting inside and the temperature and relative humidity outside the building and accordingly the rate of condensation changes with the daily and seasonal variation of the local weather.

[0011] The use of such air conditioning or dehumidification product as potable water offers a number of potential advantages. Perhaps one of the greatest is the fact that the effort to condense air humidity to obtain a specific quantity of water is much less than the effort to be expended in obtaining the same quantity of freshwater by desalination of seawater or underground brackish water. Water quality in areas for which freshwater can be transported from natural or man-made resources is often lower than the standards for drinking water quality due to exposure to contamination during handling, transport and storage in water tanks on top of buildings, thus forcing the residents to use bottled water. The transportation of loads of freshwater is costly and exposes the water to contamination en route and during handling and storage. Also, reliance on bottled water is expensive for the average consumer.

[0012] Prior art encompasses inventions that utilize chemical adsorbents to dry atmospheric air or moisture-laden gases. The moisture from these type units is extracted as water for use whether as drinking water or fresh water after appropriate treatment. The adsorbent is regenerated and recycled for reuse. The use of adsorbents may be necessary in cases wherein insignificant amount of moisture is present in the atmosphere, but in the case of hot and humid environments the use of chemicals seems to be a nuisance and would require additional steps for extraction of water and regeneration of the chemicals. It would therefore be preferable to provide a system which does not require the use of adsorbents, desiccants and hygroscopic materials.

[0013] Heat pipes are also used in some applications to cool a condensing surface to dew point to precipitate the water vapor from the atmosphere and thereby control the indoor environment. However, the present invention is not based on this type of technology and does not contemplate the use of heat pipes to achieve its objectives.

[0014] Other applications in the prior art have relied upon heat convection in large structures in extraction of freshwater from the atmosphere and cooling or dehumidification of local open space. However, these type systems also do not relate to the present invention since they are generally not capable of performing economically within compact structures.

[0015] Domestic central air conditioning units used to cool homes or any other buildings operate in combination with air directing units that produce a quantity of waste condensate. However, to the best of Applicant's knowledge, none of the prior art-references disclose modifications of those units that enhance cooling while increasing of freshwater output of the units by condensation of outdoor atmospheric humidity. Rather, the condensate and drainage that come from such units has generally been limited to watering of flower beds, lawns and similar limited applications.

[0016] In view of the foregoing, a need exists in residential areas, particularly in humid regions, for a means for supplying a freshwater potable water supply as well as for means to cool and dry indoor atmospheres to levels which are promote a healthy and relatively comfortable existence in the dwellings of people with limited resources.

[0017] A need also exists for such a means which is preferably operable on direct current, so that the system can be powered by solar panels or batteries in areas where no electrical grid is present, or in the case of emergency conditions.

SUMMARY OF THE INVENTION

[0018] The present invention seeks to provide an alternative evaporative air conditioning unit that is capable of producing potable drinking while cooling an enclosure. The system is able to effectively function on direct current, making it ideal for use in areas effected by natural disaster, power outage, or simply rural locations without access to electricity.

[0019] In the method and system of the invention, an air conditioning system is provided that includes both evaporative air conditioning and mechanical air conditioning functioning components and which produces a water discharge, the mechanical air conditioning component of the system being operable entirely off direct current supplied from a direct current energy source. The air conditioning unit is operated to cool an enclosure. A portion of the water discharge is drawn off and purified before being discharged as potable drinking water.

[0020] The mechanical air conditioning component of the system includes a compressor for pumping a compressible refrigerant in a closed loop while the evaporative air conditioning component of the system includes a vortex cooling chamber. The preferred evaporative air conditioning component of the system includes a liquid sump and wherein a liquid conduit is run from the liquid sump to a water cooler. A motive means, such as a positive displacement pump is connected to the liquid conduit, wherein the pump propels the liquid from the liquid sump to the water cooler. At least one filter element is located in series with the liquid conduit, whereby the filter unit purifies the liquid before reaching the water cooler. Preferably, the water in the water cooler is maintained at a desired level, and wherein the level of water in the water cooler is automatically adjusted by means of a float and an associated valve between the pump and the water cooler.

[0021] In one version, the air conditioning system of the present invention is comprised of a shell and tube heat exchanger wherein ambient air is forced through both sides and discharged approximately together into the interior of the structure that is to be cooled. The shell side of the heat exchanger is preferably wet with a shower or weep of liquid such as water, and the air flow is turbulent through the shell side. The stream of flowing air is directed from the shell side to an outlet. The air flowing through the tube side is cooled by contact with the walls of the tubes, and is discharged to an outlet. For convenience, the air streams from the two sides can be combined into one combined stream before being discharged into the interior of the structure, or they may be is charged separately into the structure.

[0022] In a particularly preferred embodiment, the air conditioning system of the present invention comprises a direct/indirect evaporative cooler with refrigerated chilled sump water. The cooler is preferably designed as a stacked arrangement. A refrigeration compressor and storage batteries occupy a top section of the design and rest on a top shelf. The top shelf forms the top wall of an exhaust air plenum. A forced-air evaporative cooling chamber, located below the exhaust air plenum, occupies the middle section of the design. A cold water sump and an intake air plenum occupy the bottom floor of the cooling chamber. The bottom floor of the cooling chamber also comprises the top wall of an intake plenum which houses an intake fan. The intake fan draws air upwardly through a plurality of riser tubes which connect the intake plenum with the exhaust plenum and which pass through the cooling chamber.

[0023] Water in the cold water sump is refrigerated by the refrigeration compressor located in the top section of the design. Cold water from the cold water sump is introduced into the evaporative cooling chamber through a distribution header. The cold water saturates an evaporative media which surrounds or otherwise contacts the riser tubes in the cooling chamber. Air is introduced into the cooling chamber by means of oppositely arranged fans mounted on sidewalls of the cooling chamber which create a turbulent air flow in the cooling chamber and which enhance the evaporative cooling process. Cooled air from the cooling chamber can be discharged through a suitable duct to the interior of the structure to be cooled.

[0024] Air is also being drawn into the intake plenum by the intake fan, which air flow is forced upwardly through the riser tubes in the cooling chamber. The riser tubes pass through the cold water sump and also contact the evaporative media in the cooling chamber, whereby the outside of the tubes are cooled. The air within the tubes is cooled by conduction through the tubes. This relatively drier air can be directed through a suitable duct to the interior of the structure to be cooled and can be combined with the more moist, cooled air from the cooling chamber, if desired.

[0025] In this version of the invention, air is being cooled using two simultaneous processes. Air is cooled by direct contact with water in the evaporative cooling chamber, raising the absolute humidity of the air cooled in this manner. Additional air is also being cooled by conductive heat transfer within the riser tubes. If desired, the two air flows can be combined into a discharge duct so that the discharged air consists of a mixture of relatively humid air from the evaporative process and air with near ambient humidity. The cold water sump at the bottom of the cooling chamber serves as a cooling mass, as well as a water storage sump. The water in the sump is refrigerated to near freezing by means of a low temperature compressor similar to that used on an ice machine. The compressor can be AC or DC operated, but is preferably DC operated. The electric fans used in the intake plenum and on the cooling chamber are preferably DC fans which can be driven by solar cells or storage batteries.

[0026] The present invention therefore has as a primary aim to provide purified, potable drinking water while operating as an air conditioning unit. The excess discharge water that is generated during the air conditioning process is filtered and can be channeled through a fluid conduit directly into a water cooler, if desired. In one version of the device, the air conditioning system of the invention has been used to produce up to about a gallon and a half of purified, potable drinking water every day in addition to providing indoor cooling for an inhabited structure. The system requires low power input to operate, and is capable of functioning on direct current, allowing the system to be ideal for locations experiencing irregular power distribution or blackouts. The direct current power source may be a battery, or in the preferred embodiment of the present invention, a solar panel which may be used to charge a storage battery.

[0027] Additional objects, features and advantages will be apparent in the written description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] FIG. **1** is a perspective view of one embodiment of the device of the invention which features combined direct/indirect evaporative cooling with refrigerated chilled sump water.

[0029] FIG. **2** is a partially schematic view of the cooling chamber of the device of FIG. **1** showing the evaporative cooling pads hanging therein.

[0030] FIG. **3** is a perspective view of the device of FIG. **1** with the rear wall removed for ease of illustration of the internal components of the device.

[0031] FIG. **4** is an isolated view of the cooling chamber and refrigeration manifold used in the device of FIGS. **2** and **3**.

[0032] FIG. **5** is a perspective view of the device of FIG. **1** with the rear wall removed for ease of illustration.

[0033] FIG. **6** is a view of the top wall of the cooling chamber which also serves as a tube sheet for the riser tubes.

[0034] FIG. **7** is a side view of the cooling chamber showing the location of the water distribution array.

[0035] FIG. **8** is an isolated view of the cooling chamber of the device of FIG. **1**

[0036] FIG. **9** is an isolated view of the air intake plenum and air intake fan.

[0037] FIG. **10** is an isolated view of the refrigeration manifold used in the cold water sump of the device of FIG. **1**.

[0038] FIG. **11** is a cross sectional view taken along lines **11**A-**11**A in FIG. **10**.

[0039] FIG. **12** is an end view of the manifold of FIG. **10** showing the cross-over piping arrangement used to produce the interlayered flow pattern.

[0040] FIG. **13** is a simplified schematic view of the air conditioning system of the invention being used to provide potable water to a self-filling water cooler.

[0041] FIG. **14** is an isolated view of the water cooler bottle which receives water from the air conditioning system of the invention.

[0042] FIG. **15** is a side view of the water cooler of FIG. **14**, showing the filter units located on the back side thereof.

DETAILED DESCRIPTION OF THE INVENTION

[0043] Referring now to FIGS. **1-16**, there is shown an air conditioning system of the invention which can be adapted for use in high temperature, low humidity environments, but which is preferably used in a higher humidity environment, including tropical or semi-tropical environments.

[0044] With reference to FIG. **1**, there is shown an air conditioner **201** which is a combined direct/indirect evaporative cooler with refrigerated chilled sump water. The variable humidity device **201** shown in FIG. **1** is preferably designed as a stacked arrangement having a top section **203**, a middle section **205** and a bottom section **207**. A refrigeration compressor **209**, an associated condenser unit **210**, and a storage battery **211** (FIG. **3**) occupy the top section **203** of the design and rest on a top shelf **213**. The top shelf **213** forms the top wall of an exhaust air plenum **215** having an opposing wall **216**. A forced-air evaporative cooling chamber (**217** in FIG. **3**) is located below the exhaust air plenum and occupies the middle section of the design. The cooling chamber comprises a shell plenum for the air conditioner and comprises about 65% of the total height of the unit in the particular embodiment illustrated in the drawings. A cold water sump **219** (indicated by dotted lines in FIG. **3**) is located in the bottom of the cooling chamber. The bottom floor **223** of the cooling chamber **217** also comprises the top wall of an intake plenum **221** housing an intake fan **225**. The intake fan **225** draws air upwardly through a plurality of riser tubes **227** which connect the intake plenum **221** with the exhaust plenum **215** and which pass through the cooling chamber **217**.

[**0045**] As shown in FIG. **5**, the bottom floor **223** of the cooling chamber has a plurality of openings **224** (detail shown in FIG. **6**) which form a lower tube sheet for the riser tubes **227**. Similarly, the opposing wall **216** has aligned openings (**214** in FIG. **4**) which form an upper tube sheet. In the embodiment of the invention illustrated in FIGS. **1-9**, there are approximately 49 copper tubes of approximate ¼-⅜ inch diameter arranged vertically within the cooling chamber **217** between the tube sheets. The sizing and arrangement of the tube bundle creates a back pressure effect during operation which acts as a self-regulating thermostat.

[**0046**] The operation of the variable humidity embodiment of the invention will now be briefly described. Cold water from the cold water sump **219** (FIG. **3**) is introduced into the evaporative cooling chamber through a distribution header **229**. The distribution header in FIG. **3** is a series of PVC pipes which have downwardly directed perforations. The cold water which is sprayed downwardly from the distribution header saturates an evaporative media which surrounds or otherwise contacts the riser tubes **227** in the cooling chamber **217**. The evaporative media is illustrated by the downwardly hanging pads **218** in FIG. **2**. The evaporative media is removed for ease of illustration in FIGS. **3** and **5** but can comprise any of the media materials known in the relevant arts, e.g., tubular foam blankets or loose reticulated foam sheets. Preferably, the evaporative media is supplied as generally rectangular pads which are suspended from a rack (see FIG. **2**) on the roof of the cooing chamber so that the pads are spaced between and separate the various vertical riser tubes **227**.

[**0047**] Air is introduced into the cooling chamber by means of oppositely arranged fans **231**, **233** (FIG. **3**). The fans **231**, **233** are mounted on louvers (**235**, **237** in FIG. **3**) which can be manually adjusted to direct incoming and exhaust air from the cooling chamber **217** in a circular, vortex type flow path which creates a turbulent air flow in the cooling chamber **217** and which enhances the evaporative cooling process. The vortex effect created by the side louvers **235**, **237** causes air moving through the cooling chamber **217** to have an increased residence time within the cooling chamber. This increases the cooling effect and also prevents water droplets from being blown directly out of the shell plenum. Cooled air from the cooling chamber can be discharged through a suitable grate (such as grate **239** in FIG. **5**) to the interior of the structure to be cooled or can be routed through suitable ducts to the desired regions of the interior of the structure being cooled.

[**0048**] Air is also being drawn into the intake plenum **221** by the intake fan **225**, which air flow is forced upwardly through the riser tubes **227** located in the cooling chamber. The riser tubes pass though the cold water sump and also contact the evaporative media in the cooling chamber, so that the outside of the tubes are cooled. The air within the tubes **227** is cooled by conduction through the tubes. This relatively drier air can be directed through a suitable duct to the interior of the structure to be cooled and can be combined with the cooled air from the cooling chamber, if desired.

[**0049**] In this embodiment of the invention, air is being cooled using two simultaneous processes. Air is cooled by direct contact with water in the evaporative cooling chamber **217**, raising the absolute humidity of the air cooled in this manner. Additional air is also being cooled by conductive heat transfer within the riser tubes **227**. The absolute humidity of this additional air is either unchanged or only slightly changed, or decreases slightly, due to condensation on the inside of the riser tubes. If desired, the two air flows can be combined into a single discharge duct as described with respect to the first embodiment of the invention, so that the discharged air consists of a mixture of relatively humid air from the evaporative process and air with near ambient humidity.

[**0050**] The cold water sump (illustrated generally at **219** in FIG. **3**) at the bottom of the cooling chamber serves as a cooling mass, as well as a sump. The water in the sump is refrigerated to near freezing by means of a commercially available, low temperature compressor similar to that used on an ice machine and which can be AC or DC operated, but is preferably operable on 12 Volt DC power. In the embodiment of the invention illustrated in FIG. **5**, the compressor **209** is battery operated. However, an associated inverter **243** (in FIG. **5**), which in this case is located within the exhaust plenum area **215** allows the unit to be operated off AC current to, for example, charge the batteries, during non-peak hours of operation. Locating the inverter within the chilled exhaust plenum compartment prolongs its life since the operating temperature is reduced. The electric fans used in the intake plenum and on the cooling chamber are also preferably 12 Volt DC fans which can be driven by solar cells or storage batteries.

[**0051**] FIGS. **10-13** illustrate another feature of the system in which a particularly preferred refrigeration manifold **245** (FIG. **10**) is cooled by the compressor **209** and associated condenser **210** using traditional mechanical refrigeration techniques. While a number of different traditional manifold or coil arrangements could be utilized with the compressor **209** to cool the water in the sump **219**, the preferred manifold **245** is especially efficient for the intended application. As best seen in the isolated view of FIG. **10**, the manifold **245** is a "double shock" manifold having a front layer **247** and a rear layer **249**. The front and rear layers or coils are spaced apart by means of a plurality of cylindrical spacers **251**. The cylindrical spacers **251** are less wide than the total width of the manifold, leaving a distance "d" between adjacent spacers. The cylindrical spacers are also hollow and open at both ends, allowing water in the sump **219** to flow around and through the spacers. As shown in FIG. **10**, the manifold **245** is arranged in a generally horizontal plane when in place in the sump region of the cooling chamber.

[**0052**] Refrigerant is supplied to and returned from the manifold layers by a pair of "splits", shown generally at **253** and **255** in FIG. **12**. As shown in FIG. **12**, the top layer of coils is made up of loops **252**, **254**, **256**, **258**, **260**, **262**, **264**, and **266**. (The loops are shown as broken-away halves for ease of illustration.) The rear layer of coils is made up of loops **268**, **270**, **272**, **274**, **276**, **278**, **280** and **282**. The loop halves **252-266** form a continuous coil on the front of the manifold. The loop halves **268-282** similarly from a continuous loop on the rear of the manifold. The points at which the front and rear loops exit or terminate (generally **266**, **268** in FIG. **12**) are connected by cross-over pipes **284**, **286**. The cross-over pipes **284**, **286** intersect the first loop halves (**252**, **282**, in FIG. **12**) to form the "splits **253**, **255**. The cross-over piping arrangement and the splits **253** and **255** result in a type of "interlayered flow" through the manifold. For example, refrigerant passing through the split **253** flows through branch **253**B (FIG. **12**) to the front layer **247** and through branch **253**A to the rear layer **249**. Refrigerant returning from the front and rear layers **247**, **249** meets at the split **255**. The double shock manifold with its split flow operation nearly doubles the cooling capacity of the compressor **209**.

[**0053**] In less arid climates it will generally be possible to extract humidity from the previously described system and use such water as a potable water supply. As briefly mentioned above, the water within sump region **219** of the cooling chamber of the device is typically at least about 10 to 15 degrees Fahrenheit cooler than the surrounding environment. This provides the opportunity to provide some cooling to objects placed in heat exchange relationship with this water. For example, small objects can be cooled without the expenditure of significant additional amounts of energy. Suitable containers can be placed directly in the water on the shell side, or a cabinet accessible from the outside can be built into the shell side, or a stream of water circulated through, for example, cooling coils external to the shell side, or the like.

[**0054**] The chilled water within the sump region **219** also provides the opportunity to provide a source of potable drinking water from the air conditioning system. The hybrid cooler which has been described can be operated in a humid environment to provide fairly large amount of excess water during operation. As illustrated in simplified fashion in FIG. **14**, the excess water generated during the air conditioning process routed by means of a suitable conduit **512** and positive displacement pump **514** to a water cooler **410**. For purposes of the present invention, the water cooler is preferably a "self-filling water cooler" which comes supplied with its own filtration units located on a rear wall thereof. It is important to note that the removal of the excess water will not hinder the operation of the air conditioning unit in any way, as there will remain ample condensation to recirculate back through the system in order to continue the cooling aspect of the air conditioning system.

[**0055**] FIGS. **13-15** illustrate one form of the water generating system of the invention in which a self-filling water cooler **410** is utilized. This type water cooler is known generally in the industry and is described, for example, in issued U.S. Pat. No. 4,881,661, issued Nov. 21, 1989. The following description is intended to be merely explanatory of the general workings of such devices. Referring to FIG. **14**, the bottled water cooler **41.0** comprises a lower frame member **411** which serves as a storage container for various well known appurtenances of a conventional cooler, such as connectors, conduits chilling mechanism (not shown) which are connected in series between the water bottle **412** positioned on top of the stand **411** to the spigot means **413** and **414**. In that particular embodiment, such coolers are provided with two spigots generally to give a source of chilled water and hot water. In the latter instance, a heating apparatus would be included within the stand **411** connected in the conduit of the water bottle **412**. Such bottled water coolers including many variations are old and well known in the art.

[**0056**] Referring now to FIGS. **15** and **16**, the device includes the five gallon plastic bottle **412** which in turn is further defined as comprising the conventionally operated float valve means **415** which is attached inside of the water bottle **412**. The float valve **415** is attached thereto via a bulk head tubing fitting **416** which protrudes through the side wall of the five gallon water bottle **412**. The tubing fitting or adapter **416** provides for connecting the float mechanism to a purified water supply via the conduit means **417**.

[**0057**] The five gallon water bottle **412** also has an additional tubing bulkhead fitting **420** protruding through the rear wall portion of the five gallon bottle **412** to allow connection to the air vent filter means **421**. The latter mechanism allows the displacement of trapped air inside of the bottle **412** as the bottle fills and empties. As the bottle **412** is filled with water, air trapped in the bottle will be discharged through the filter. Conversely, as water is emptied from the bottle, suction produced on the bottle will be alleviated by air passing through the filter member **421** which in turn flows through the conduit member **422** connecting the member **421** to the bulk head fitting **420**. In such manner, air entering the bottle **412** is purified.

[**0058**] The five gallon bottle **412** is sealed to the base **423** of the water cooler **410** by a conventional rubber boot/gasket means **424**. An inner container or sump is positioned immediately below the base **423**. In a conventional bottle water cooler, as water is drawn from either of the spigots **413** or **414**, water exits from the container **412** into the upper tank (not shown) of the cooler; however, the tank does not flow due to the vacuum created within the water bottle **412** even though the tank is opened to the atmosphere. However, in the present system, it is necessary that the water bottle **412** be sealed to the tank. The flexible rubber boot or gasket **424** (FIG. **15**) accomplishes this purpose by sealing the neck **425** of the five gallon water bottle **412** to the upper tank (not shown) of the water cooler **410**. This is accomplished by providing the member **424** with the elongated flexible constricted portion **426** which is adapted to fit over the neck portion **425** of bottle **412**. The bottom portion **428** fits over the top portion of the tank, thus sealing the tank to the container **412**.

[**0059**] FIG. **16** of the drawings illustrates the filter unit of the water cooler which features a small reverse osmosis purification system **430**. The system **430** is further defined as comprising the series of conventional water filtering members **431**, **432**, and **433** which function in combination with the reverse osmosis filter **434**. In such a system, water from, such a conventional tap water source **435** is fed in series through the filter members **431** and **432** via the connecting conduit **436** and **437** to the reverse osmosis unit **434** which in turn is connected via the conduit **438** to the filter member **433** from which a source of high purified water exits and flows through the conduit **417** into the water bottle **412** by virtue of the float means **415**, which operates in a conventional fashion by virtue of the leverage action of the buoyant float member **439** operably connected to the main frame portion of the float member **415** by virtue of the elongated connecting means **440** which is hinged to provide articulate motion relative to the main from body of the float mechanism **415** and is operably connected to a plunger mechanism (not shown) positioned therein which includes a conventional valve stem or piston member that is cause to reciprocate against a seated opening therein so as to seal said opening when the buoyant member **413** is in an upraised position. Conversely, when the member **439** is allowed to deflect downward, water enters the container **412** by virtue of the float valve opening **441**.

[**0060**] When the float valve means **415** is sealed, pressure increases in the conduit **417**, which pressure level is reflected in the flow control member **442** shown in FIG. **16** of the drawings which in turn causes flow from the water source **435** to be interrupted through the first filter member **431**. The over flow line **443** is provided for catching any moisture that may flow through the sub-micron filter member **421**.

[**0061**] While one particular filter system has been illustrated in the drawings, it will be understood that a variety of filter systems could also be utilized with the air conditioning system of the invention in order to supply potable drinking water from the air conditioning condensate.

[**0062**] An invention has been provided with several advantages. The system of the present invention is ideal for use in areas affected by natural disaster, or areas that have limited or no access to purified water. Health risks related to the consumption of unsuitable water is eliminated due to the purification elements involved with the present invention. Furthermore, this method provides an economic and environmentally sound alternative to bottled drinking water. In addition, the present invention requires low power input to operate, and is capable of functioning on direct current, such as battery power, or in the preferred embodiment of the present invention, on solar power. This allows the system to be ideal for locations experiencing irregular power distribution or blackouts. The cooling system of the invention is relatively inexpensive to manufacture. The system achieves as much as a 30 degree or more temperature "split" between incoming and discharged air temperatures. The system can be operated on DC power which can be obtained from solar panels or from wind mills. The inverter lets the unit be plugged into AC power during non-peak times to recharge the DC battery power source. The typical unit can be operated on less than 20 amps of AC power under even peak conditions. The vortex nature of the wet chamber necessarily picks up pollutants in the air such as pollen, dust and the like. The pollutants drop down into the sump area of the device and can be discharged, making the unit act as an air purifier in addition to an air conditioner. The humidity of the system can be adjusted in several different ways, depending upon the intended end application of the unit.

[**0063**] Those skilled in the relevant arts will understand that various changes and modifications may be made in the preferred embodiments of the invention described above. While the present invention has been described with reference to specific embodiments wherein the shell side of a heat exchanger is the wet side and the tube side is the dry side, those skilled in the art will readily appreciate from a consideration of these teachings that other arrangements are possible, including, for example, the use of a wet tube side and a dry shell side, or the like. Also, those skilled in the art will be taught by the teachings herein that other forms of heat exchangers other than shell and tube can be employed, if desired.

[**0064**] What have been described are preferred embodiments in which modifications and changes may be made without departing from the spirit and scope of the accompanying claims. Many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. A method for generating potable drinking water from humidity in the air, comprising the steps of:

providing an air conditioning system that includes both evaporative air conditioning and mechanical air conditioning functioning components and which produces a water discharge, the mechanical air conditioning component of the system being operable entirely off direct current supplied from a direct current energy source;

operating the air conditioning unit to cool an enclosure;

drawing off a portion of the water discharge; and

purifying the portion of water discharge for drinking water.

2. The method of claim 1, wherein the mechanical air conditioning component of the system includes a compressor for pumping a compressible refrigerant in a closed loop and wherein the evaporative air conditioning component of the system includes a vortex cooling chamber.

3. The method of claim 2, wherein:

the evaporative air conditioning component of the system includes a liquid sump and wherein a liquid conduit is run from the liquid sump to a water cooler.

4. The method of claim 3, wherein a positive displacement pump is connected to the liquid conduit, wherein the pump propels the liquid from the liquid sump to the water cooler; and

wherein at least one filter element is located in series with the liquid conduit, whereby the filter unit purifies the liquid before reaching the water cooler.

5. The method of claim 4, wherein the water in the water cooler is maintained at a desired level, and wherein the level of water in the water cooler is automatically adjusted by means of a float and an associated valve between the pump and the water cooler.

6. A system for generating drinking water, the system comprising:

a stacked chamber arrangement having a centrally located, forced-air evaporative cooling chamber which separates an exhaust air plenum located above the cooling chamber from an air intake plenum located below the cooling chamber, the cooling chamber having a top wall and a bottom wall and surrounding sidewalls and a plurality of vertically arranged riser tubes which connect the intake plenum with the exhaust air plenum, the bottom wall creating a cold water sump region;

an intake fan, located within the air intake plenum, for drawing air upwardly through the plurality of vertical riser tubes which connect the intake plenum with the exhaust air plenum to thereby produce a cooled stream of air;

a liquid distributing member located in the cooling chamber adjacent the top wall thereof;

a pump for pumping water from the sump region of the cooling chamber to the liquid distributing member;

a pair of oppositely arranged fans mounted on the cooling chamber sidewalls for moving air through the cooling chamber from different locations to produce a humidified mass of turbulent air within the cooling chamber;

a discharge outlet for discharging air from the cooling chamber;

a mechanical refrigeration unit including a compressor and an associated refrigeration manifold, the refrigeration manifold being located within the sump region of the cooling chamber for refrigerating water contained therein;

a liquid conduit running from the liquid sump to a cooler;

a pump connected to the liquid conduit, wherein the pump propels the liquid from the liquid sump to the water cooler; and

a filter in series with the liquid conduit, wherein the filter purifies the liquid before reaching the water cooler.

7. A method of generating potable drinking water in an area affected by lack of electricity, the steps comprising:

providing an evaporative air conditioning unit that produces a water discharge;

providing a direct current power supply to the air conditioning unit;

operating the air conditioning unit to cool an enclosure;

drawing off a portion of the water discharge; and

purifying the portion of water discharge for drinking water.

8. The method of claim 7, wherein the direct current power supply is a battery.

9. The method of claim 7, wherein the direct current power supply is a solar panel.

10. The method of claim 7, wherein the water discharge from the air conditioning unit is fed to a self-filling water cooler.

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