(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 September 2008 (25.09.2008)

PCT

(10) International Publication Number
WO 2008/115964 A2

(51) International Patent Classification:
F24J 2/08 (2006.01) *F24J 2/00* (2006.01)

(21) International Application Number: PCT/US2008/057448

(22) International Filing Date: 19 March 2008 (19.03.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/725,366 19 March 2007 (19.03.2007) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:
US 11/725,366 (CON)
Filed on 19 March 2007 (19.03.2007)

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US (patent), UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: SOLAR POWER PLANT

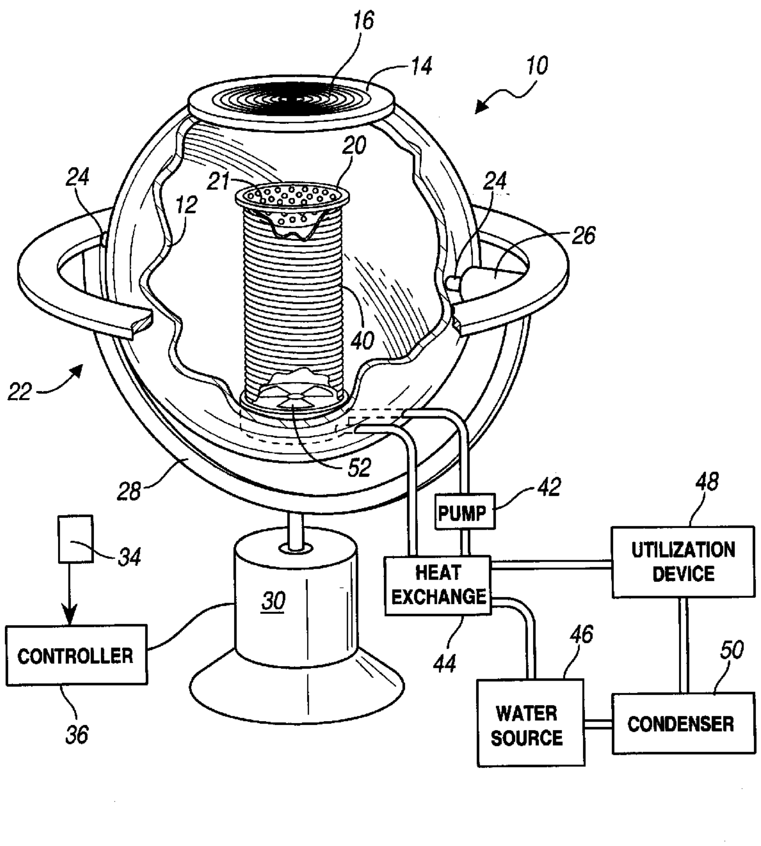

FIG. 1

(57) Abstract: A collector for solar energy is provided in one embodiment having a parabolic dish reflector for reflecting solar energy. An absorber is provided at a focal location of the reflector. A pump circulates fluid through the absorber to a heat exchanger for transferring thermal energy from the fluid in the absorber to a utilization device. Another embodiment provides a container mounted to the reflector about the absorber, with a fan for forcing fluid within the container. Another embodiment includes a fluid in the container in contact with tubing that absorbs the solar energy. Yet another embodiment provides a heat sink on the tubing.

WO 2008/115964 A2

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *without international search report and to be republished upon receipt of that report*

SOLAR POWER PLANT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Application Serial No. 11/725,366, filed March 19, 2007, which claims the benefit of U.S. Provisional Application Serial No. 60/783,956, filed March 20, 2006, which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

Embodiments of the invention relate to an apparatus for capturing solar energy and using that energy for various power purposes such as boiling water, building heating, desalinization and the like.

BACKGROUND

A variety of solar energy collectors have been proposed, particularly for use in areas in the middle latitudes which have a high percentage of sunlight. The energy produced may be used to desalinate water, produce thermal power for cooking or industrial operations, and a wide variety of similar uses. These devices all differ in their efficiency and in their cost and complexity. Embodiments of the present invention are accordingly directed toward a unit which is relatively simple in construction so as to be low in cost and reliable in operation and which converts a high percentage of the incident solar energy into useful thermal energy.

SUMMARY

One embodiment discloses a generally parabolic dish reflector for reflecting the solar energy. An absorber is supported in the container at a focal location of the reflector for absorbing the solar energy. A pump circulates fluid through the absorber. A heat exchanger transfers thermal energy from the fluid in the absorber to a utilization device.

Another embodiment discloses a collector for solar energy with a partially closed hollow partially spherical container having a window for permitting solar energy to enter the container. The container has a reflective inner surface for retaining solar energy within the container. Central tubing is supported in the container. A pump circulates fluid through the tubing. A heat exchanger transfers thermal energy from the fluid in the tubing to a utilization device. A fan is oriented within the container for forcing fluid within the container about the tubing for even distribution of the collected solar energy.

Another embodiment discloses a collector for solar energy with a partially closed hollow partially spherical container having a window for permitting solar energy to enter the container. The container has a reflective inner surface for retaining solar energy within the container. Central tubing is supported in the container. A pump circulates fluid through the tubing. A heat exchanger transfers thermal energy from the fluid in the tubing to a utilization device. A fluid is contained within the container in contact with the tubing.

Yet another embodiment discloses a collector for solar energy with a partially closed hollow partially spherical container having a window for permitting solar energy to enter the container. The container has a reflective inner surface for retaining solar energy within the container. Central tubing is supported in the container. A pump circulates fluid through the tubing. A heat sink is mounted upon the tubing for receiving the focused solar energy and for conducting the solar energy to the tubing. A heat exchanger transfers thermal energy from the fluid in the tubing to a utilization device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective drawings, partially broken away, of a first embodiment according to the present invention employing a collector coil in the form of a cylindrical helix;

FIGURE 2 is a perspective view, partially broken away, of a second embodiment according to the present invention employing a spherically wound collector coil;

FIGURE 3 is a partial section view of a container of another embodiment in accordance with the present invention;

FIGURE 4 is a section view of another embodiment of a heat sink in accordance with the present invention;

FIGURE 5 is a schematic illustration of a torque converter for another embodiment in accordance with the present invention;

FIGURE 6 is a fragmentary perspective view of a collector according to another embodiment of the invention;

FIGURE 7 is a fragmentary perspective view of an absorber of the collector of Figure 6;

FIGURE 8 is a schematic elevation view of the collector of Figure 6;

FIGURE 9 is an enlarged schematic elevation view of the absorber of Figure 7;

FIGURE 10 is a schematic elevation view of a collector according to another embodiment of the invention;

FIGURE 11 is a perspective view of the collector of Figure 10;

FIGURE 12 is another perspective view of the collector of Figure 10;

FIGURE 13 is an enlarged perspective view of an absorber of the collector of Figure 10;

FIGURE 14 is an enlarged perspective view of an adjustment mechanism for the collector of Figure 10; and

FIGURE 15 is another perspective view of the collector of Figure 10 illustrated in another orientation.

DETAILED DESCRIPTION OF EMBODIMENTS

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The Figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for the claims and/or as a representative basis for teaching one skilled in the art to variously employ the present invention.

The solar collector of an embodiment of the present invention is constructed about a rigid container, generally indicated at 10 in Figure 1. The container 10 is shown as being a sphere in the depicted embodiment, but other shapes are useful in connection with the present invention such as rectangular, oval, etc. The wall 12 of the container 10 is rigid and may include multiple layers with insulating material including a vacuum layer, to retain the heat produced by solar energy within the container 10.

The container 10 is fully enclosed with the exception of a transparent window 14. The window 14 may be of a varying dimension, but in the case of the spherical enclosure 10 occupies a minor fraction of the surface of the container, such as ten to twenty percent. According to another embodiment, the window 14 occupies the entire upper hemisphere of the container 10 for permitting light to enter the container 10. A lens 16 is embedded in the window 14. In the embodiment of Figure 1 the lens 16 is illustrated as a Fresnel lens, but a conventional lens could also be employed. The lens may occupy the entire window or only allow light to pass through the remainder to the interior of the container 10 through the entire window area including the lens. The lens 16 focuses sunlight on the surface of a conical heat sink 20 supported in the center of the container 10. In another embodiment, the lens 16 is a bifocal lens for providing an intense beam of light into the window 14, while permitting other visual light to enter the window 14. The heat sink 20 has an array of ventilation holes 21 for permitting air within the container 10 to pass therethrough thereby providing even distribution of heat within the container 10.

As will subsequently be described, the container 10 is supported in a manner which allows the window 14 to be oriented to track the motion of the sun so that sunlight collected by the windows and lens 16 is directed to the interior of the container 10. According to another embodiment of the invention, a plurality of containers 10 are arranged in a grid for maximizing the collection of solar energy over a given surface area of land. Example of a grid type arrangement is disclosed in Mori U.S. Patent No. 4,565,185 issued January 21, 1986, which is incorporated in its entirety by reference herein.

The interior wall of the container is reflective. In the embodiment of Figure 1, a single reflective coating or a tessellated structure (Figure 2) could be applied to the interior. The reflective coating could be vacuum formed on the interior or the interior surface could be polished to produce the necessary reflection. The mirrored interior acts to reflect the light focused by the lens 16 through the volume of the container 10 and also acts to insulate the volume in the same manner as a reflective coating on the interior of a thermos bottle. The wall of the structure 12 could include a vacuum layer in a thermos bottle to improve its thermal retention.

In order to track the sun, the container 10 is supported on a gimbaled structure, generally indicated at 22. The container 10 is supported for rotation about the gimbal on an axis 24-24. A servo motor 26 rotates the container 10 about this axis to control the inclination of the sphere and accordingly inclination of the window 14 and the lens 16. The servo motor 26 and the axis 24-24 are supported on a gimbaled structure 28 which is in turn rotated by a servo motor 30. By control of the inclination of the container l0 through the servo motor 26 and rotation of the container 10 through rotation of the servo motor 30, the inclination and attitude of the window 14 may be controlled. A solar sensor 34 drives a microprocessor-based controller 36 to control the rotation of the motors 26 and 30 and thereby control the container 10 to track the sun. Thus, the gimbal is a turntable with two pivot points; one for rotation and the other for azimuth, which is orientation relative to the sun.

The thermal energy collected by the lens 16 and window 14 and reflected by the mirrored structure 20 is directed at the heat sink 20 which is in conductive contact with a central coil 40 arranged as a cylindrical helix. A pump 42, exterior of the container 10, pumps water, liquid metal, or other heat exchange fluid such as refrigerant through the coil 40 where it picks up heat and passes it to a heat exchanger 44. Water from the source 46 receives heat from the operating fluid and the heat exchanger 44 and provides it to a utilization device 48 which could be a steam engine, heating plant for a structure, or the like. A condenser 50 receives the output steam from the utilization device 48 and returns the condensed water to the source 46. A fan 52 circulates air within the container 10 through the hollow interior of the coil 40 and back downwardly, over the interior wall of the container 10 for even distribution or convection of the heat within the container 10.

An alternative embodiment of the invention, illustrated in Figure 2, differs essentially from the embodiment of Figure 1 in three aspects. First, instead of a single Fresnel lens disposed in the window 14, a plurality of lens, which may include a central Fresnel lens 50 and an array of conventional lenses 52, is supported in the window. Secondly, instead of the coil 40 being in the form of a cylindrical helix, it is wound as a spherical structure 54 which provides a more symmetrical arrangement and a more even distribution of the heat accumulated within the container 10. Finally, the interior wall 70 of the sphere 10 is covered with tessellated mirrors.

The thermal collector of an embodiment of the present invention is therefore simple in construction and in operation. It may be adjusted in size to provide a variety of capacities and its form may be engineered depending upon the geographical area in which it is employed.

Referring now to Figure 3, the wall 12 of the container 10 is illustrated for another embodiment container 10. The wall 12 has multiple layers 72, 74, 76 with reflective inner surfaces. The multiple layers 72, 74, 76 of the wall 12 permit radiant heat and light to enter the window 14 of the wall 12 and for retaining the light and radiant heat once it enters the window 14. The reflective inner surfaces of the multiple layers 72, 74, 76 retain any light and radiant heat that may reflect off each layer 72, 74, 76. Additionally, each of the layers 72, 74, 76 may be configured to accept certain wavelengths of the light and radiant heat such that each layer 72, 74, 76 directs a prescribed wavelength range of light and reflects a prescribed wavelength range of light. Although three layers 72, 74, 76 are illustrated, the invention contemplates any number of layers in the wall 12. Additionally, a vacuum layer 78 may be provided between consecutive wall layers, such as layers 72, 74 to further insulate the wall 12 and prevent heat from escaping the container wall 12.

Referring now to Figure 4, another heat sink 20 is illustrated depicting another embodiment. The heat sink 20 includes a series of heat sink layers 80, 82, 84, which may be stacked in axial alignment as depicted in Figure 4. The additional heat sink layers 82, 84 collect light and radiant heat that passes through the first heat sink 80. For example, if light and radiant heat pass through the apertures 21 in the first heat sink 80, then the subsequent heat sink layers 82, 84 collect the light and radiant heat to ensure that all focused solar energy is collected by the heat sink 20. In another embodiment, the first heat sink layer 80 is configured to absorb heat from a predefined wavelength range. The first heat sink layer 80 may be partially transparent such that other wavelength ranges of light pass on to the subsequent heat sink layers 82, 84. Heat sink layers 80, 82, 84 of varying transparency may be stacked to incrementally absorb all of the focused light directed to the heat sink 20. Additionally, each heat sink layer 80, 82, 84 may have an undercoating to reflect solar energy to subsequent layers.

Various collectors for solar energy are disclosed, which may be utilized for various solar energy applications as discussed above. In one embodiment, the solar energy may be utilized for driving various utilization devices 48, such as a turbine. Conventional turbines experience difficulties in processing wet steam and therefore a large fraction of the steam may be released thereby reducing the efficiency of the turbine. One such difficulty associated with wet steam is the mass of the wet steam. Referring now to Figure 5, a utilization device 48, such as a torque converter 86 is illustrated in accordance with the present invention. The torque converter 86 has a rotor 88 that is driven about a shaft 90. Condensed steam or wet steam is conveyed axially through the rotor 88 and exits about a radial array of generally tangential outlet nozzles 92. The wet steam exits the outlet nozzles 92 as illustrated by the arrows in Figure 5. The rotor 88 may be hollow or may include a series of channels for directing pressurized fluid from the nozzles 92. The fluid under pressure cannot expand until it discharges. Therefore, the fluid may be hydronic or vapor. The outlet nozzles 92 are oriented generally tangentially for driving the rotor 88 about the shaft 90 in a clockwise direction as illustrated by the arcuate arrow. As the rotor 88 drives shaft 90, the torque converter 86 drives a generator for generating electrical energy. Alternatively, the rotor 88 may be utilized for providing any rotary output.

For maximizing output from the torque converter 86, the torque converter 86 may be oriented with an axis of rotation in the horizontal direction. The torque converter 86 in another embodiment includes a multiple arrays of nozzles 92 stacked axially for collectively driving the shaft 90.

In one embodiment, the torque converter 86 includes a drum 94 for enclosing the torque converter 86 and collecting the steam within the torque converter 86. The drum 94 may be stationery and may be provided with a radial array of stator blades 96 for providing a reaction force to the outlet steam for maximizing the efficiency of the rotor 88. The stator blades 96 may be formed from a simplified process, such as stock materials that are cold formed to provide low cost blades that may be interchanged as they experience fatigue and wear. Thus, many of the costs of conventional torque converter blades may be avoided by utilization of simplified stator blades 96. The drum 94 may extend axially with multiple arrays of stator blades 96 stacked axially in alignment with the axial arrays of nozzles 92.

According to another embodiment of the invention, the torque converter includes a rotary drum 94 that may also be connected to an output shaft for counter-rotation relative to the rotor 88. The shaft of the drum 94 may also drive a generator for optimizing the output of electricity generated from the rotation of the rotor 88 and drum 94 of the torque converter 86. Accordingly, the torque converter 86 may include a perforated shield 98 for collecting condensed steam that travels down and empties in a chase. Further, an outer housing 100 is provided of any suitable diameter for retaining the components of the torque converter 86.

The torque converter 86 may operate at a high torque and low speed for minimizing wear and damage to the torque converter 86 while maximizing output electricity generated by the torque converter 86. Various paths of fluid flow are contemplated within the spirit and scope of the present invention. For example, the fluid may travel in a toroidal path similar to that within a conventional torque converter.

The invention contemplates utilization of the solar power plant and/or the torque converter in various applications. Some applications may include the generation of high temperature water, as well as steam - including low temperature steam. Other applications may include pasteurizing, homogenizing, alcohol distribution, water distribution, curing (such as wood curing), baking, extruding (plastics), metal separation, hydrogen production, paper production, or any suitable application where solar energy is employed or power is generated.

Referring now to Figure 6, another collector 102 is illustrated according to another embodiment of the invention. The collector 102 includes a partially spherical wall 104 that provides a cavity 106. A window 108 is provided with a lens 110. According to one embodiment, the lens 110 is a Fresnel lens. Unlike the prior embodiments, a parabolic dish reflector 112 is mounted to the collector 102 spaced apart from the window 108 so that solar energy that is collected by the collector 102 is reflected off the reflector 112 to its focal point. An absorber 114 is provided at the focal point of the reflector 112 for absorbing the reflected solar energy. The absorber 114 is substantially smaller than prior embodiments for minimizing the surface area to which heat transfer can be lost from the absorber 114 through radiation.

The partially spherical wall 104 and lens 110 help keep the reflector 112 clean. In order to clean the collector, deionized water is sprayed upon the lens 110. If a scratch resistant material is employed for the reflector 112, then the container wall 104 and lens 110 can be removed, resulting in a cost savings by reduction of components. The reflector 112 can be cleaned by sprayed deionized water to avoid scratching the reflective surface.

The reflector 112 can be provided by a fiberglass structure with a reflective polymeric film or an array of glass mirror tiles. Alternatively, the reflector 112 can be provided by a fiberglass structure that is coated with a metallic coating, such as aluminum or silver, for providing the reflective surface. The embodiment contemplates hardening the metallic coating to provide an extremely scratch resistant reflective surface. The hardened metallic coating permits the reflective surface to be cleaned with a brush, thereby increasing performance of the collector 102. The invention contemplates that an automated brush may be mounted beneath the reflector 112 to perform the cleaning operation.

The fiberglass structure of the reflector 112 can be molded. Since the reflector 112 is parabolic, various size reflectors 112 having a common focal point can be molded from a common mold. For example, a ten foot diameter reflector and a twenty foot diameter reflector may be molded from a common mold. The two sized reflectors each have a common focal point. For the ten foot reflector, the reflector may be molded to a twenty foot diameter and subsequently cut down to size. The extra portions may be removed as radial segments; and the radial segments may be removed for multiple diameters. For example, four radial segments may be removed having an outside radius of ten feet and an inside radius of seven and one-half feet. Four more radial segments may be removed having an outside radius of seven and one-half feet and an inside radius of five feet. The center ten foot diameter reflector can be utilized alone, or the eight segments may be reassembled to provide a twenty foot diameter reflector. Disassembly of a twenty foot segment provides compactness for shipping. Alternatively, the eight radial segments may be utilized as replacement parts for repair of other reflectors 112.

Much of the cost of coating processes is attributed to the time associated with the process. The material costs are a lesser factor. Therefore, fabrication of a larger diameter reflector from the mold, and subsequently removing extra radial segments from the reflector after coating, optimizes the results of the coating process, thereby reducing costs associated with replacement parts.

Referring now to Figure 7, the absorber 114 is illustrated enlarged and in greater detail according to one embodiment. For energy production, the absorber 114 may be provided by a photovoltaic cell, or by a concentrated photovoltaic cell. The absorber 114 includes tubing 116 that is coiled into a top coil 118 and a bottom coil 120. Solar energy that is focused from the lens 110 is directed to the top coil 118 for absorption of the solar energy. The coils 118, 120 of the tubing 116 enhance the surface area of the tubing 116 for receiving the focused energy. Additionally the coils 118, 120 are coated with a black absorptive material or coating to act as a heat sink and further enhance efficiency of the absorber 114. The bottom coil 120 is directed at the reflector 112 such that the reflected solar energy is focused upon the bottom coil 120. In order to minimize heat transfer losses from radiation and convection, a heat shield 122 is provided about the coils 118, 120. The heat shield 122 may be formed from a ceramic material. Additionally, an inside of the heat shield 122 may be coated with a highly reflective material so that incident rays are reflected to the coils 118, 120. The heat shield 122 includes a pair of apertures 124, 126 for permitting the solar energy to pass into the absorber 114 to the top and bottom coils 118, 120. Fluid is conveyed to the tubing 116 through the coils 118, 120 and out of absorber 114 for absorbing the directed solar energy and transferring it to the heat exchanger.

Referring now to Figure 8, the collector 102 is illustrated schematically to illustrate ray traces that enter the collector 102. The focal point for the lens 110 is the top aperture 124 of the heat shield 122. As illustrated in Figure 9, this feature permits a coil 118 that is larger than the aperture 124. Likewise, the focal point for the reflector 112 is the aperture 126 of the heat shield 122 so that the bottom coil 120 can be larger than the aperture 126. By providing the focal points at the apertures 124, 126, the size of apertures is minimized as well as convected and radiated heat loss.

Referring again to Figure 8, ray trace A enters the lens 110 and is reflected off the reflector 112 through the aperture 126 to the coil 120 as illustrated in Figure 9. Figure 9 illustrates a ray trace of a similar angle A'. Ray traces A and A' intersect after entering through the aperture 126 for an enlarged target, such as the bottom coil 120, for maximizing absorption.

Referring again to Figure 8, ray traces A and B illustrate how various rays that enter the lens 110 are directed to the reflector 112 and reflected to the bottom aperture 126 of the heat shield 122. Ray trace C illustrates how the lens 110 directs light at the top region of the collector 102 to enter the top aperture 124 of the heat shield and engage the top coil 118 as illustrated in Figure 9. Likewise, a ray of a similar angle C' is illustrated to depict how the ray traces intersect after entering the heat shield 122 providing an enlarged top coil 118 for optimizing absorption. The intercrossing of the rays into the heat shield 122 permits minimized apertures 124, 126 for reducing heat loss.

Simulation of the collector 102 has revealed ninety-five percent efficiency of absorption, with the bottom coil 120 significantly hotter than the top coil 118 since most of the collected solar energy is reflected off the reflector 112 to the bottom coil 120. Upward motion of hot air caused by convection about the bottom coil 120 is impeded by the upper coil 118. The outlet tubing 116 from the heat shield 122 is insulated to prevent conducting of heat from the tubing 116 to the heat shield 122.

Referring now to Figure 10, another collector 128 is illustrated, which is similar to the prior embodiment. The collector 128 includes a partially spherical container wall 130 with a parabolic dish reflector 132. A transparent glass panel 134 is provided at a window 136 for permitting solar energy to pass through the panel 134. As illustrated by the ray traces in Figure 10, the solar energy passes through the glass panel 134 and is reflected off the reflector 132 to its focal point. An absorber 138 is provided with a bottom aperture 140 at the focal point of the reflector 132. The solar energy passes through the bottom aperture 140 and impinges a single coil 142 for absorption of the solar energy. The absorber 138 includes a heat shield 144 that is enclosed at the top and includes the bottom aperture 140 for reducing convected heat loss from raising hot air within the heat shield 144. The collector 128 does not employ a Fresnel lens. Simulations have shown that the Fresnel lens 110 and the top coil 118 can be removed with minor reduction and efficiency of the absorber 138 in the embodiment. Thus, significant cost can be saved with a minor loss in efficiency.

Referring now to Figures 11 and 12, the collector 128 is illustrated supported by a partially spherical wire frame 146 that includes an array of contact pads 148 that provide an area contact to the exterior wall 130 of the collector 128. A lower wire frame 150 is mounted to the wire frame 146 and includes contact pads 152 for supporting the reflector 132. As illustrated in Figure 12, a plurality of cross supports 154 extend across the window 136 for supporting the glass panel 134, which may be a unitary panel or provided by a plurality of panels. The absorber 138 is mounted to the cross supports 154 by a series of brackets 156 to be oriented at the focal point of the reflector 132. According to another embodiment that does not employ the container wall 130 or glass panel 134, the brackets 156 may extend from the reflector 132.

A pair of actuator assemblies 158 connect the wire frame 146 to an annular stand 160 that supports the collector 128 upon an underlying support surface. The actuator assemblies 158 permit the collector 128 to be rotated about a vertical axis and a horizontal axis as illustrated by the arcuate arrows in Figure 12. The actuator assemblies 158 also are utilized for lifting the collector 128. A pair of trunion pivot and drive gear motors 162 are each provided on one of the actuator assemblies 158 for rotating the collector 128 about the horizontal axis. A pair of elevation lift jack screw and gear motors 164 are each provided on one of the actuator assemblies 158 for lifting the collector 128 in the vertical direction. Ball bearings and precision shafting are provided between the actuator assemblies 158 and the wire frame 146 for providing alignment and reducing friction at the engagement.

According to another embodiment that omits the container wall 130 and the glass panel 134, a fiberglass mast can be provided with an actuator assembly for adjustably supporting the reflector 132. The reduction in components permits a simplification of the support structure. Tubing for the absorber 138 can be conveyed, through the mast, through the brackets 156 on the reflector 132, and through the absorber 138.

Figure 13 illustrates an enlarged view of the absorber 138. Inlet fluid is pumped through tubing 166 that provides the single coil 142 for absorbing solar energy that passes through the bottom aperture 140. After absorption of the solar energy, the fluid exits the heat shield 144 through the tubing 166 at another end.

Referring again to Figure 10, the collector 128 may include a dual coil absorber with top and bottom apertures such as in the prior embodiment.

Instead of utilizing a Fresnel lens for directing light to the top coil, a second parabolic reflector 168 may be provided to reflect any incident light within the collector 128 to a top aperture of the absorber 138.

Referring now to Figure 14, one of the actuator assemblies is illustrated enlarged for greater detail. The stand 160 includes an annular plate 170 and an internal cylindrical wall 172. Each actuator assembly 158 is supported upon a base 174 that includes a series of rollers 176 that engage the plate 170 and the cylindrical wall 172 for providing rotary bearing support to the actuator assemblies 158 upon the stand 160. A motor drive 178 is provided on each actuator assembly 158 for driving the collector 128 about a vertical axis.

Figure 15 is a perspective view of the collector 128 illustrated raised upon the lift jack screw and gear motors 164 of the actuator assemblies 158 and rotated about the trunion pivot and drive gear motor 160 and the actuator assemblies 158. The actuator assemblies 158 provide a large range of flexibility so that the collector 128 can track the source of solar power.

While embodiments of the invention have been illustrated and described, it is not intended that these embodiments illustrate and describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A collector for solar energy comprising:

a generally parabolic dish reflector for reflecting the solar energy, the reflector having a focal location;

an absorber supported on the collector at the focal location of the reflector for absorbing the solar energy;

a pump for circulating fluid through the absorber; and

a heat exchanger for transferring thermal energy from the fluid in the absorber to a utilization device.

2. The collector of claim 1 wherein the absorber further comprises tubing supported at the focal location of the reflector for absorbing the solar energy, and the pump circulates fluid through the absorber.

3. The collector of claim 2 wherein the tubing is coiled at the focal location to enhance the surface area of the absorber.

4. The collector of claim 2 wherein the tubing is formed into a first coil facing away from the reflector and a second coil facing the reflector.

5. The collector of claim 2 wherein the absorber further comprises a heat shield for minimizing heat loss from the absorber from convection and radiation.

6. The collector of claim 5 wherein the heat shield has an aperture formed therethrough for permitting the solar energy pass through the aperture to the tubing.

7. The collector of claim 2 further comprising a heat sink mounted upon the tubing for receiving the solar energy and for conducting the solar energy to the tubing.

8. The collector of claim 1 wherein the utilization device further comprises a torque converter comprising:

a drum;

a radial array of blades extending inward from the drum;

a rotor driven about a shaft within the drum; and

a radial array of tangential nozzles extending from the rotor in fluid communication with the heat exchanger for dispensing condensed steam from the nozzles at the stator blades thereby driving the rotor for rotation about the shaft.

9. The collector of claim 8 wherein the drum is mounted for rotation relative to the torque converter such the dispensed condensed steam drives the drum for counter-rotation relative to the rotor.

10. The collector of claim 1 wherein the heat exchange fluid further comprises a refrigerant.

11. The collector of claim 1 further comprising:

a stand for supporting the collector upon an underlying support surface; and

a wire frame mounted to the stand for supporting the collector.

12. The collector of claim 11 wherein the frame is operably connected to the stand for rotation about two axes and translation along one of the two axes.

13. The collector of claim 1 further comprising a second parabolic reflector oriented facing the first reflector and the absorber for reflecting incident rays from the reflector to the absorber.

14. The collector of claim 1 further comprising a generally hollow partially spherical container mounted to the reflector, having a window spaced apart from the reflector for permitting solar energy to enter the container.

15. The collector of claim 14 further comprising a fluid contained within the container in contact with the tubing.

16. The collector of claim 14 further comprising a collecting lens oriented at the window for focusing the solar energy.

17. The collector of claim 16 wherein the collecting lens further comprises a Fresnel lens.

18. The collector of claim 16 further comprising a heat sink mounted upon the tubing disposed beneath the collecting lens for receiving the focused solar energy from the collecting lens and for conducting the solar energy to the tubing.

19. The collector of claim 14 further comprising a fan oriented within the container for forcing fluid within the container about the tubing for even distribution of the collected solar energy.

20. A collector for solar energy comprising:

a partially closed hollow partially spherical container having a window for permitting solar energy to enter the container, and the container having a reflective inner surface for retaining solar energy within the container;

central tubing supported in the container;

a pump for circulating fluid through the tubing;

a heat exchanger for transferring thermal energy from the fluid in the tubing to a utilization device; and

a fan oriented within the container for forcing fluid within the container about the tubing for even distribution of the collected solar energy.

21. The collector of claim 20 further comprising a collecting lens for focusing the solar energy.

22. A collector for solar energy comprising:

a partially closed hollow partially spherical container having a window for permitting solar energy to enter the container, and the container having a reflective inner surface for retaining solar energy within the container;

central tubing supported in the container;

a pump for circulating fluid through the tubing;

a heat exchanger for transferring thermal energy from the fluid in the tubing to a utilization device; and

a fluid contained within the container in contact with the tubing.

23. The collector of claim 22 wherein the fluid further comprises air.

24. The collector of claim 22 further comprising a collecting lens for focusing the solar energy.

25. A collector for solar energy comprising:

a closed hollow partially spherical container having a window for permitting solar energy to enter the container, and the container having a reflective inner surface for retaining solar energy within the container;

central tubing supported in the container;

a pump for circulating fluid through the tubing;

a heat sink mounted upon the tubing for receiving the focused solar energy and for conducting the solar energy to the tubing; and

a heat exchanger for transferring thermal energy from the fluid in the tubing to a utilization device.

26. The collector of claim 25 further comprising a collecting lens for focusing the solar energy, wherein the heat sink is mounted upon the tubing beneath the collecting lens for receiving the focused solar energy from the collecting lens and for conducting the solar energy to the tubing.

27. The collector of claim 25 wherein the heat sink further comprises a generally conical heat sink.

28. The collector of claim 25 wherein the heat sink includes a series of apertures formed therethrough for permitting a fluid to pass through the heat sink.

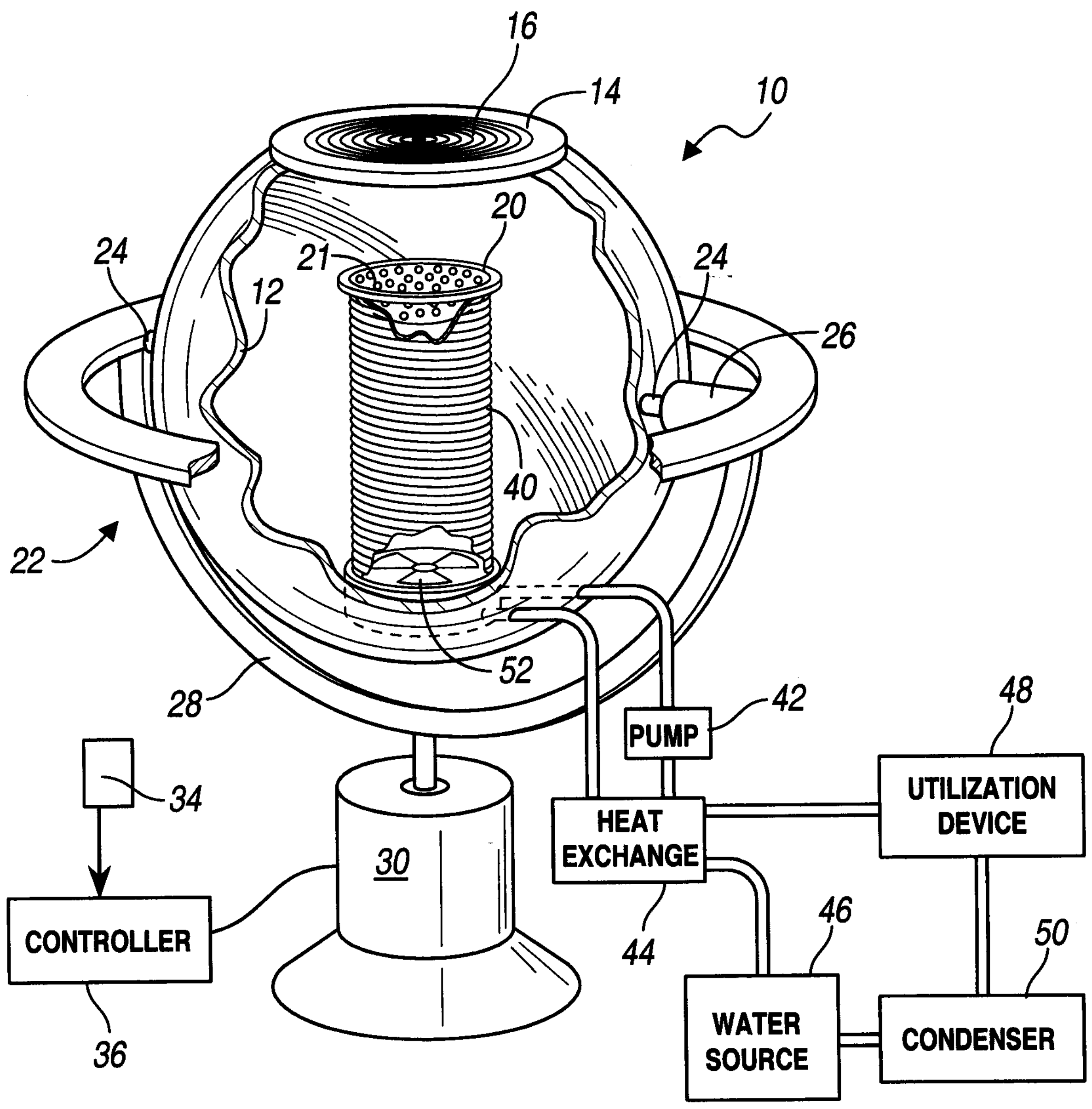
16
14
10
20
21
24
12
24
26
40
22
52
28
42
PUMP
48
UTILIZATION DEVICE
34
HEAT EXCHANGE
30
CONTROLLER
44
46
50
36
WATER SOURCE
CONDENSER

FIG. 1

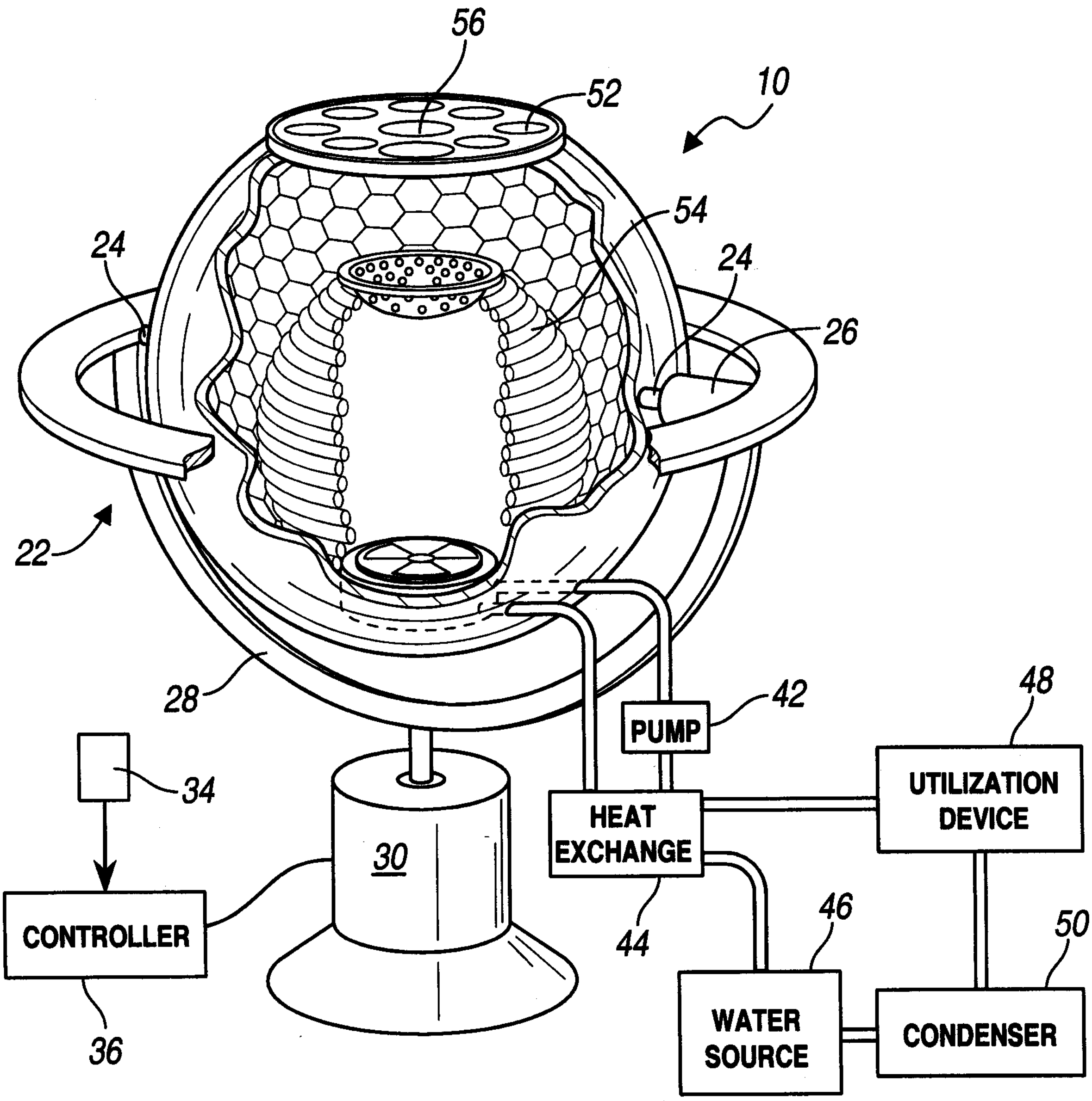
56
52
10
54
24
24
26
22
28
PUMP
42
48
UTILIZATION DEVICE
34
HEAT EXCHANGE
30
CONTROLLER
44
46
50
36
WATER SOURCE
CONDENSER

FIG. 2

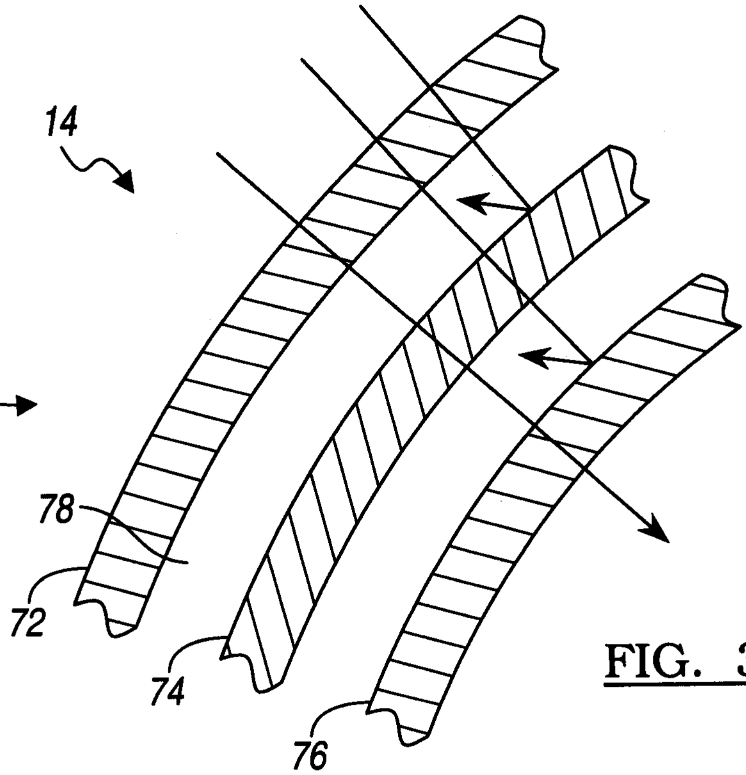

FIG. 3

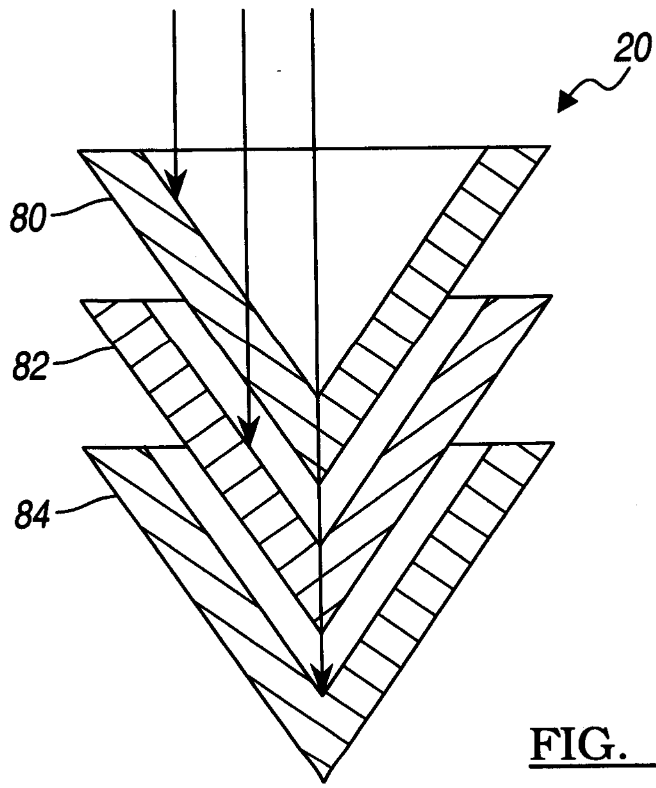

FIG. 4

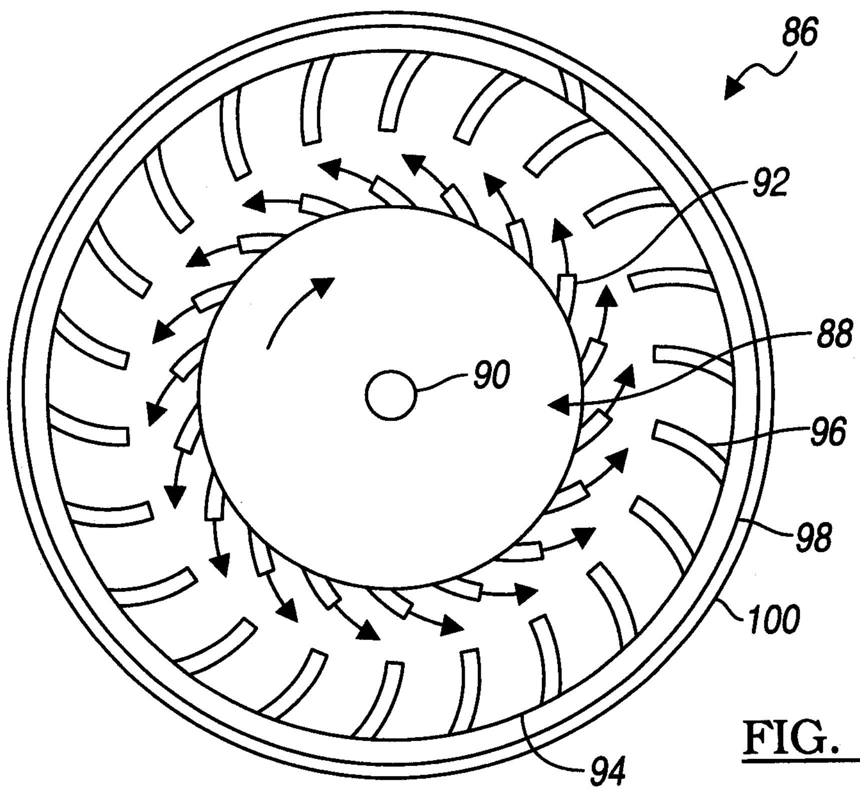

FIG. 5

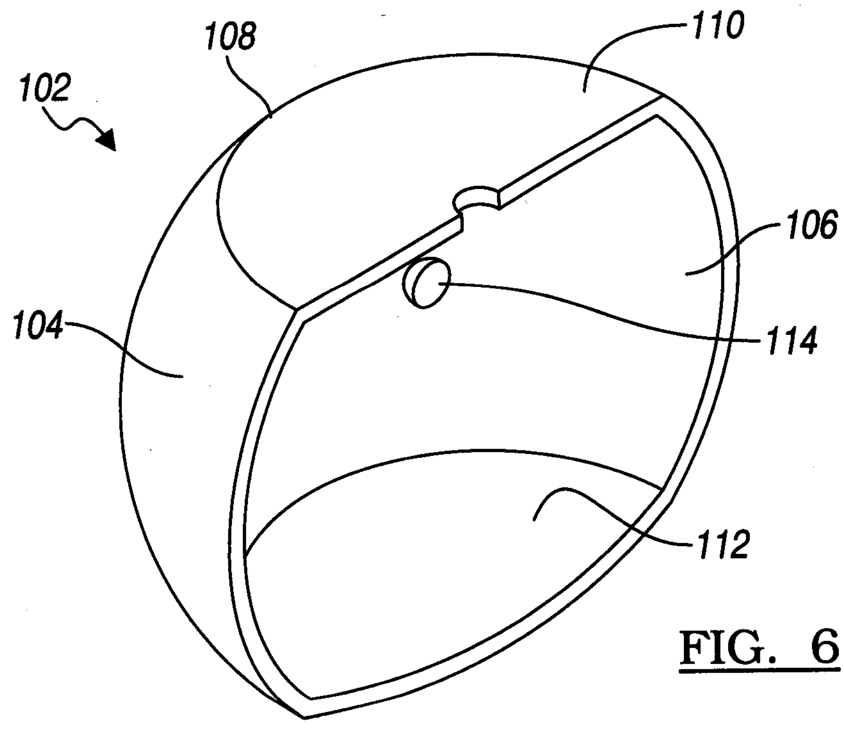

FIG. 6

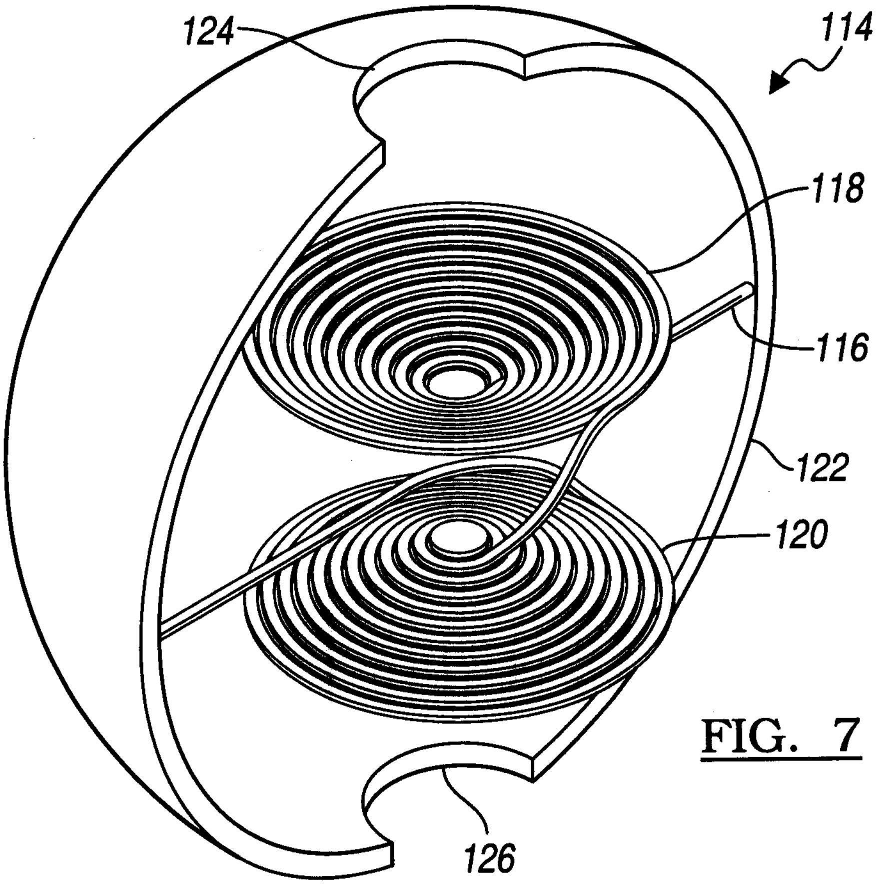
124
114
118
116
122
120
126

FIG. 7

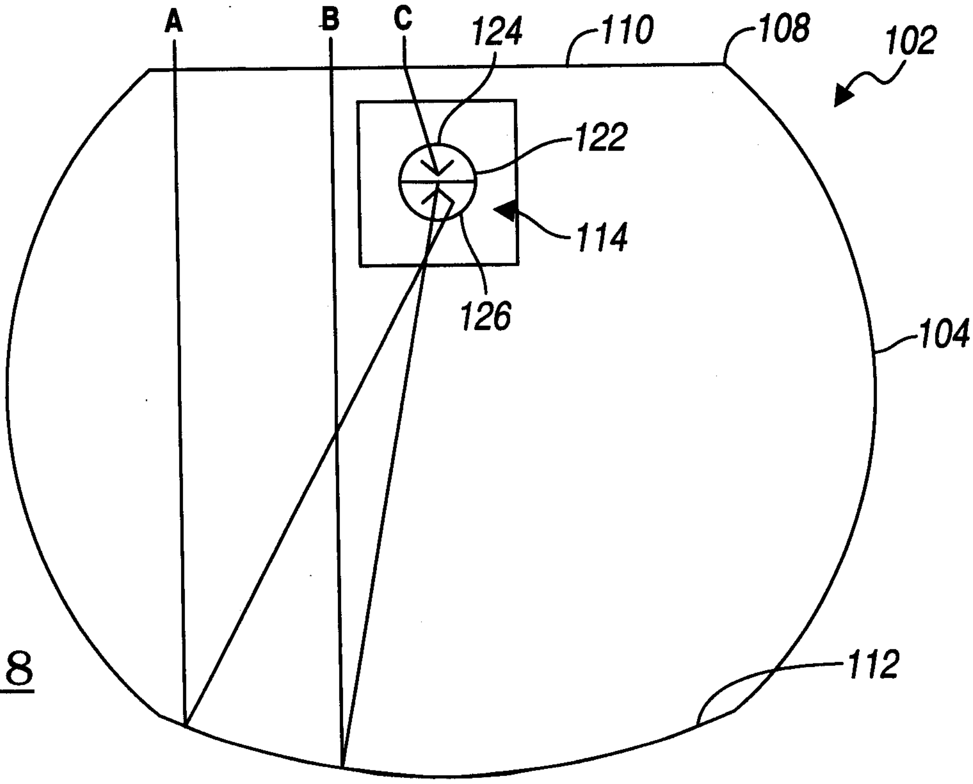
A
B
C
124
110
108
102
122
114
126
104
112

FIG. 8

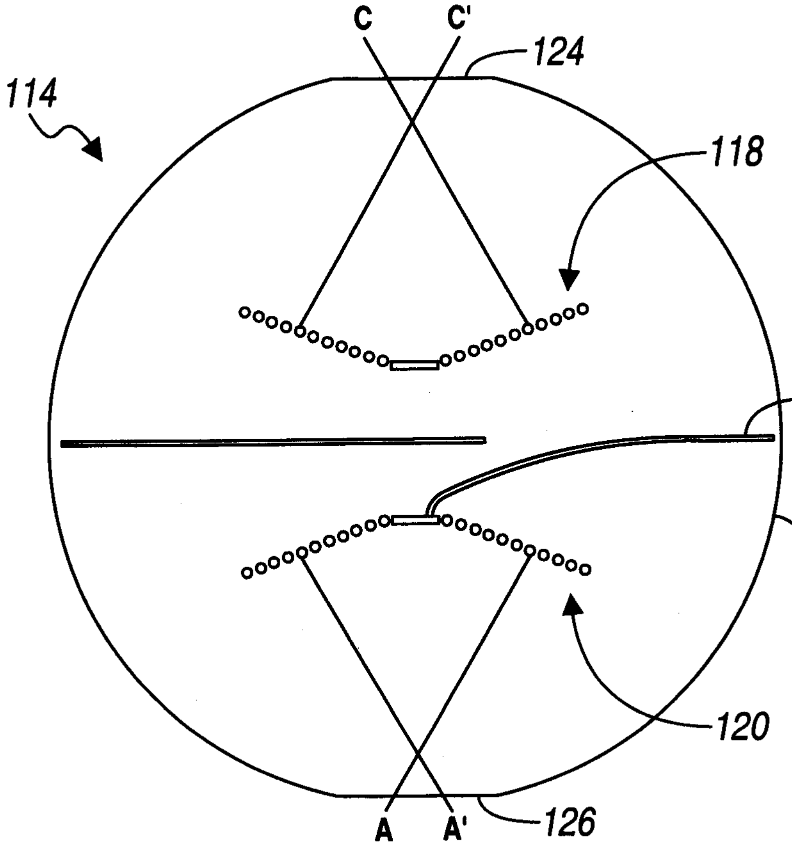
C
C'
124
114
118
116
122
120
126
A
A'

FIG. 9

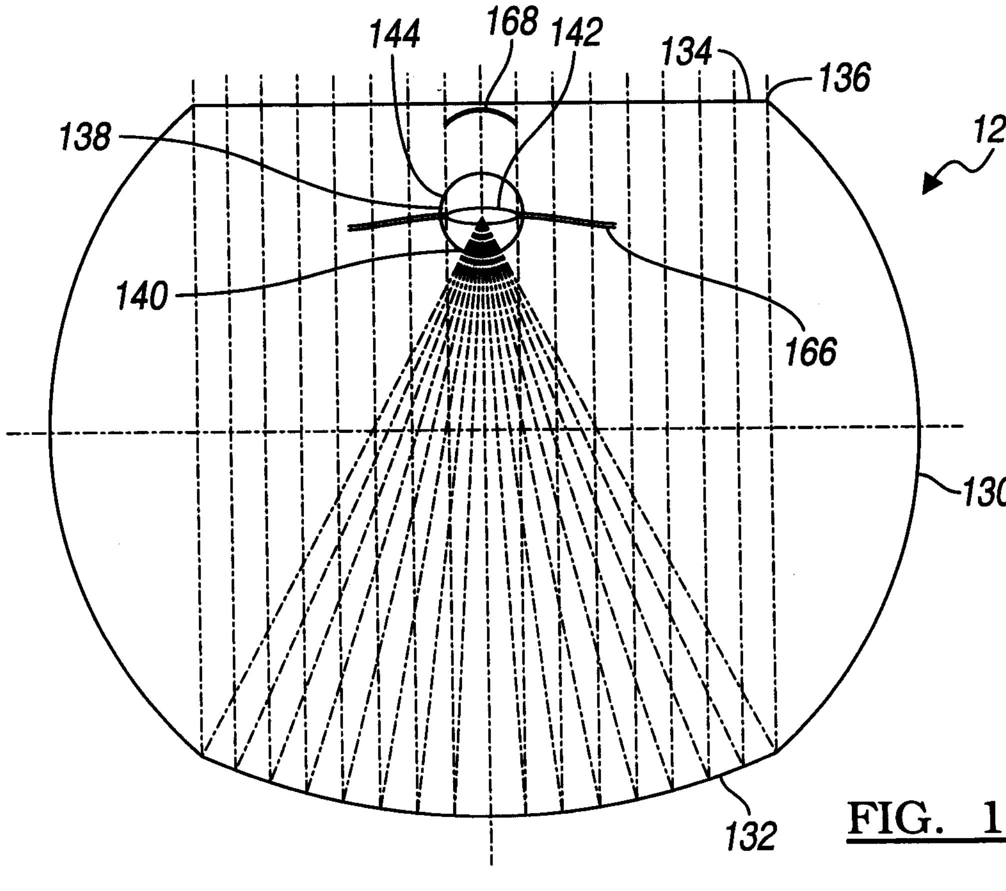
144
168
142
134
136
128
138
140
166
130
132

FIG. 10

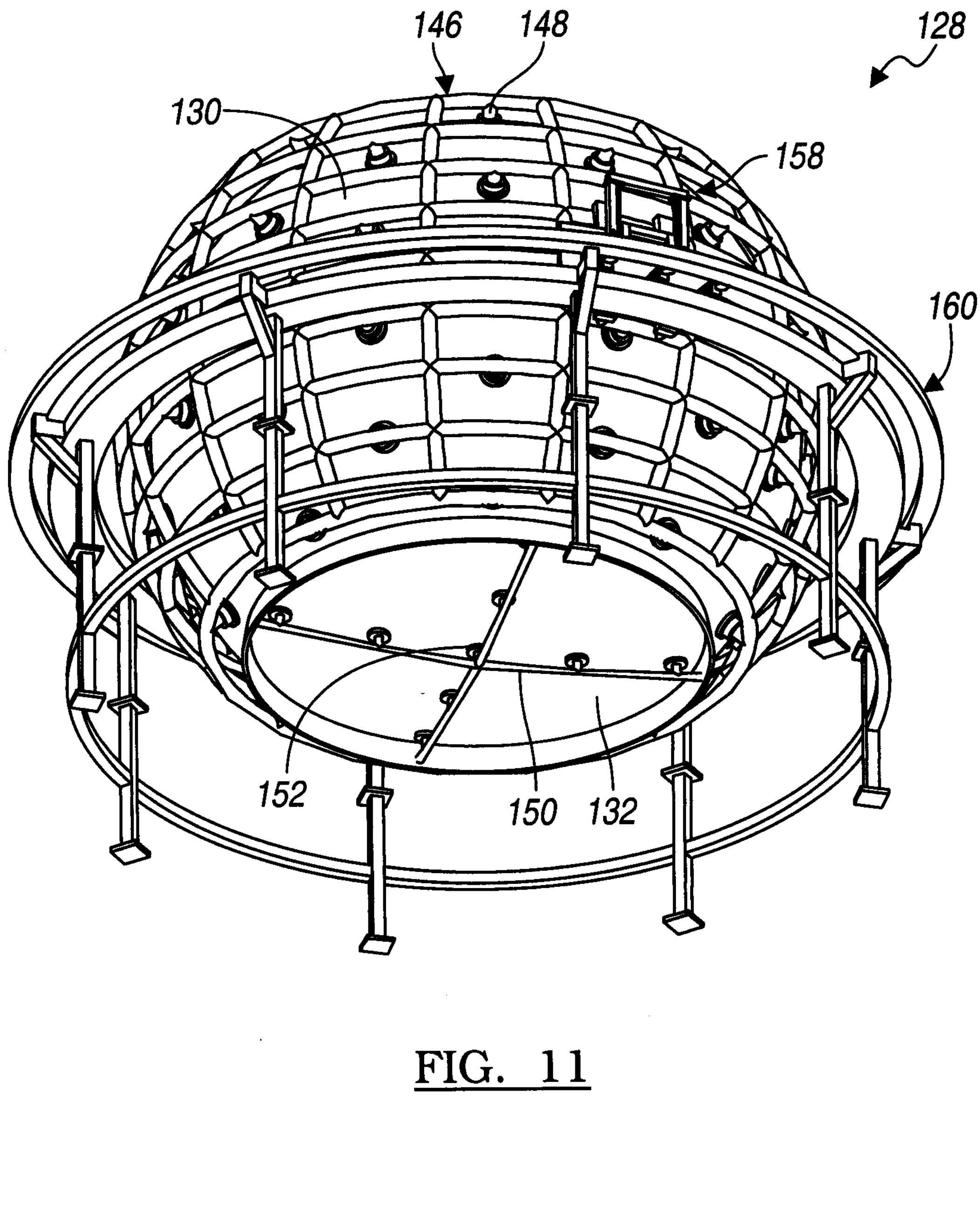

FIG. 11

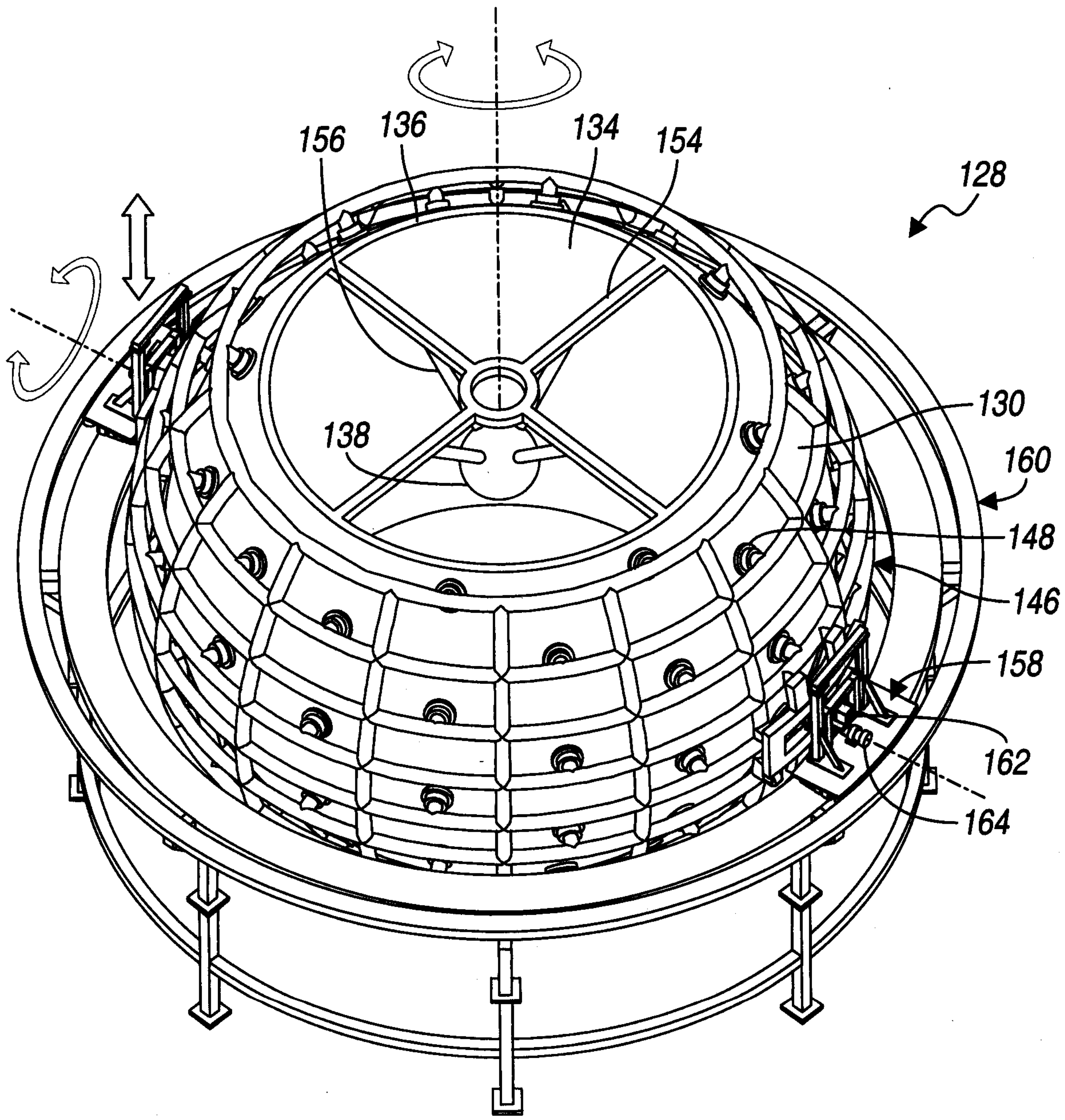

FIG. 12

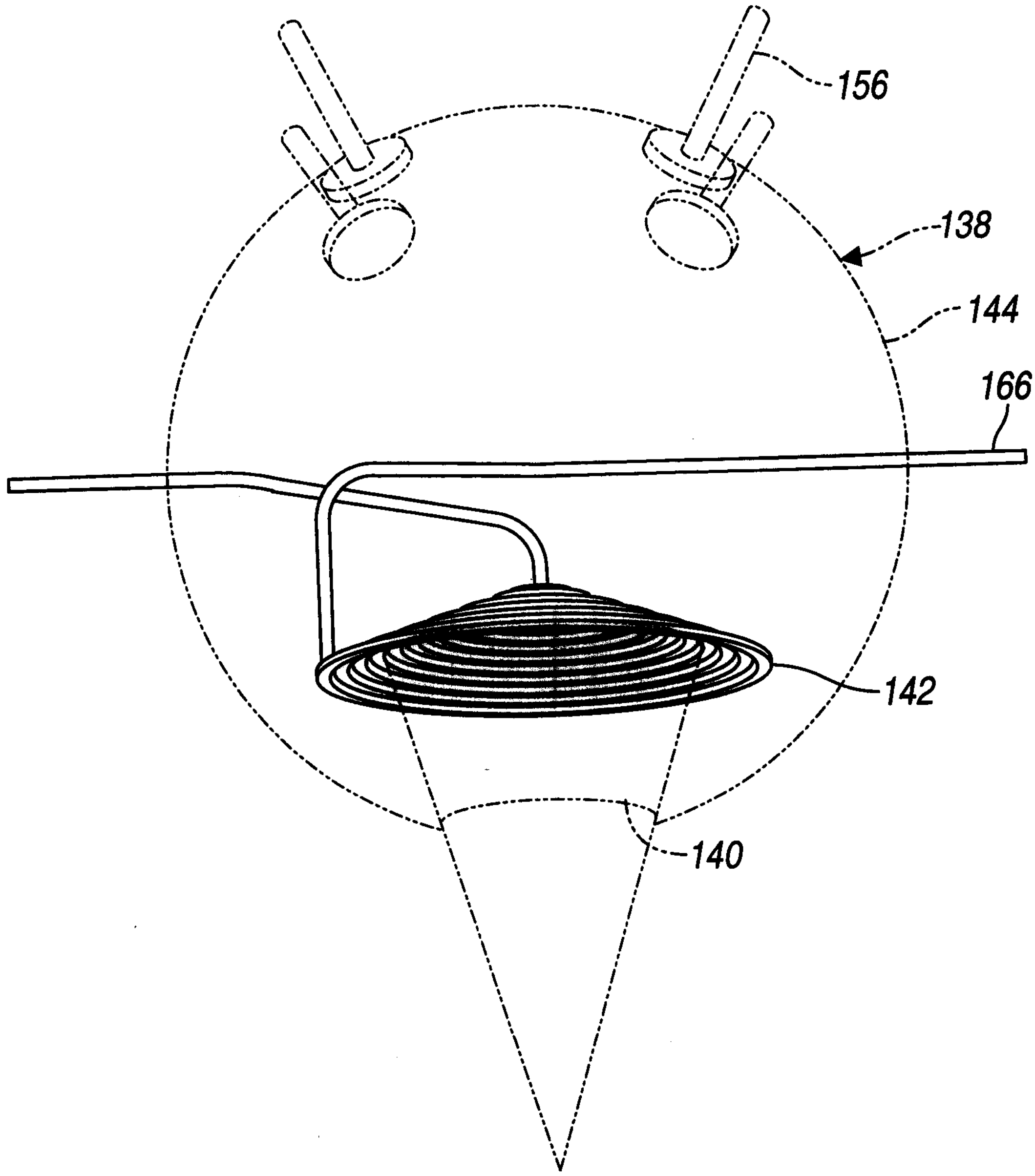

FIG. 13

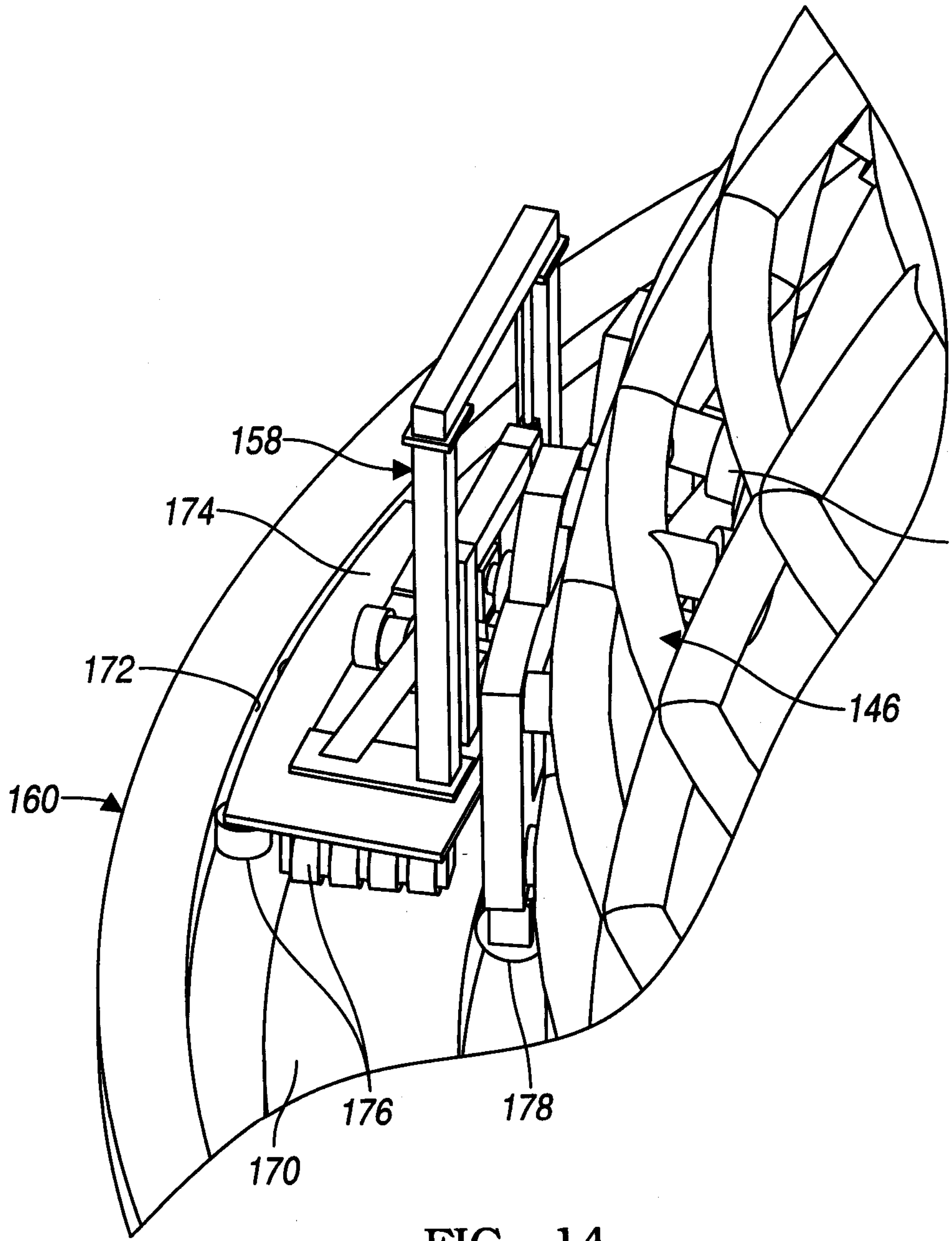

FIG. 14

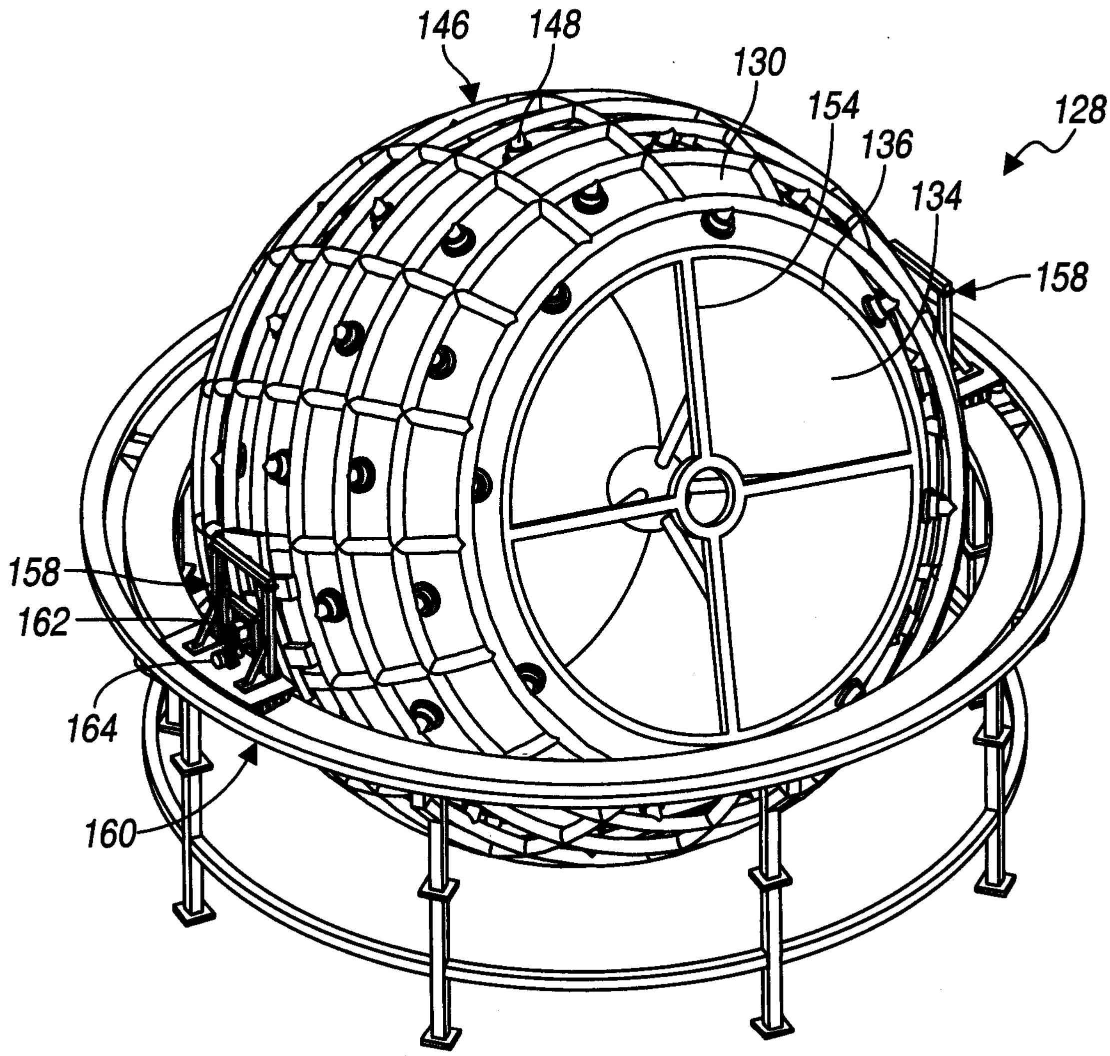

FIG. 15