US010619827B1

(12) **United States Patent**
**Todd**

(10) **Patent No.: US 10,619,827 B1**
(45) **Date of Patent: Apr. 14, 2020**

(54) **MODULAR CONTROLLABLE LIGHTING FIXTURES**

(71) Applicant: **BML Productions, Inc.**, Secaucus, NJ (US)

(72) Inventor: **Eric Todd**, Old Tappan, NJ (US)

(73) Assignee: **BML PRODUCTIONS, INC.**, Secaucus, NJ (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/653,404**

(22) Filed: **Oct. 15, 2019**

(51) **Int. Cl.**

| | |
|---|---|
| ***F21V 14/02*** | (2006.01) |
| ***F21V 23/06*** | (2006.01) |
| ***F21V 21/26*** | (2006.01) |
| ***F21V 21/108*** | (2006.01) |
| *F21V 29/77* | (2015.01) |
| *F21Y 103/33* | (2016.01) |
| *F21Y 103/10* | (2016.01) |

(52) **U.S. Cl.**
CPC ..... ***F21V 14/02*** (2013.01); ***F21V 21/108*** (2013.01); ***F21V 21/26*** (2013.01); ***F21V 23/06*** (2013.01); *F21V 29/773* (2015.01); *F21Y 2103/10* (2016.08); *F21Y 2103/33* (2016.08)

(58) **Field of Classification Search**
CPC ..... F21V 14/02; F21V 21/108; F21V 21/26; F21V 23/06; F21V 29/773; F21V 21/00; F21V 23/00; F21V 21/14; F21V 14/00; F21V 17/00; F21V 17/06; F21V 17/04; F21V 17/10; F21V 19/00; F21V 19/001; F21V 19/003; F21Y 2103/33; F21Y 2103/10
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 4,392,187 | A | 7/1983 | Bornhorst | |
| 6,120,164 | A | 9/2000 | Libin et al. | |
| RE43,017 | E | 12/2011 | Belliveau | |
| 9,404,641 | B2 | 8/2016 | Belliveau et al. | |
| 2010/0320932 | A1* | 12/2010 | Ma | F21S 10/00 315/294 |

(Continued)

OTHER PUBLICATIONS

AliExpress.com, "2pcs/lot Top quality fantastic LED BAY15D P21/5W 1157 or P27/7W 3157 led car light brake light 30smd 5630 5730 tail light" (Printed Sep. 23, 2019).

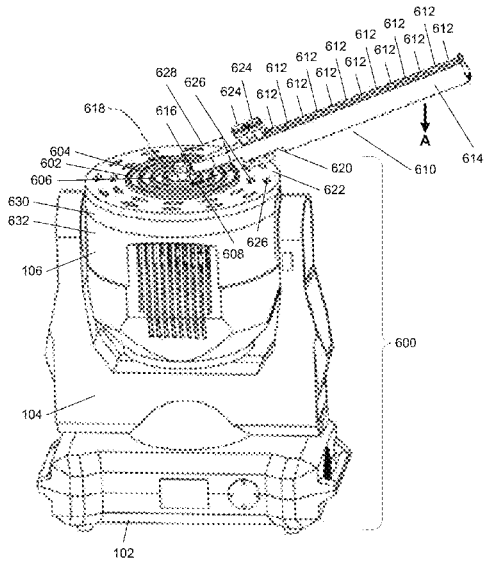
(Continued)

*Primary Examiner* — Bao Q Truong
(74) *Attorney, Agent, or Firm* — Weitzman Law Offices, LLC

(57) **ABSTRACT**

A lighting fixture involves a base, at least one yoke, and a shaft, a lighting head is coupled to the at least one yoke, wherein the lighting head is controllably rotatably movable. The lighting head has a first extent at a lighting output side. A transition plate has multiple connection ports through which power can pass from the lighting head to a lighting array, comprising one or more lighting modules. The lighting array has a second extent that is greater than the first extent of the lighting head. The lighting head includes an electrically conductive coupling which will allow the transition plate to be rotated relative to the lighting head, through at least one revolution, while maintaining a continuous electrical path between the lighting head and lighting array when a particular lighting array is coupled to the transition plate and the transition plate is coupled to the lighting head.

**28 Claims, 35 Drawing Sheets**



(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 2015/0016106 | A1* | 1/2015 | Belliveau | F21V 14/02 362/233 |
| 2016/0356439 | A1* | 12/2016 | Inskeep | F21L 4/08 |
| 2017/0074489 | A1* | 3/2017 | Jurik | F21S 10/007 |
| 2019/0041048 | A1* | 2/2019 | Martin | A01G 9/249 |

OTHER PUBLICATIONS

Elation Professional, EPV762 MH User Manual (pre-2019).

* cited by examiner

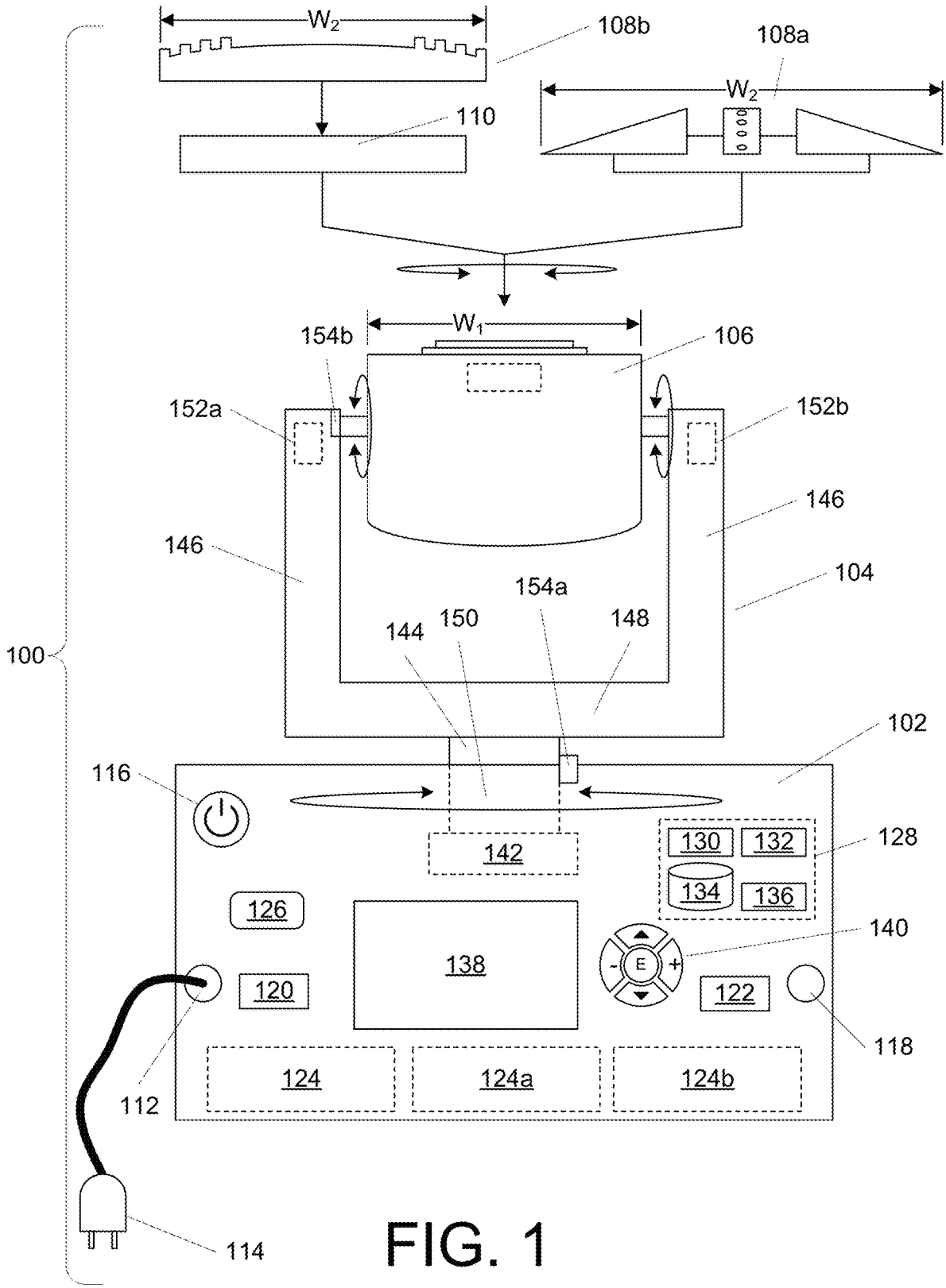

W2
108b
108a
W2
110
W1
154b
106
152a
152b
146
146
104
154a
144
150
148
100
102
116
142
130
132
128
134
136
126
138
140
120
122
118
124
124a
124b
112
114

FIG. 1

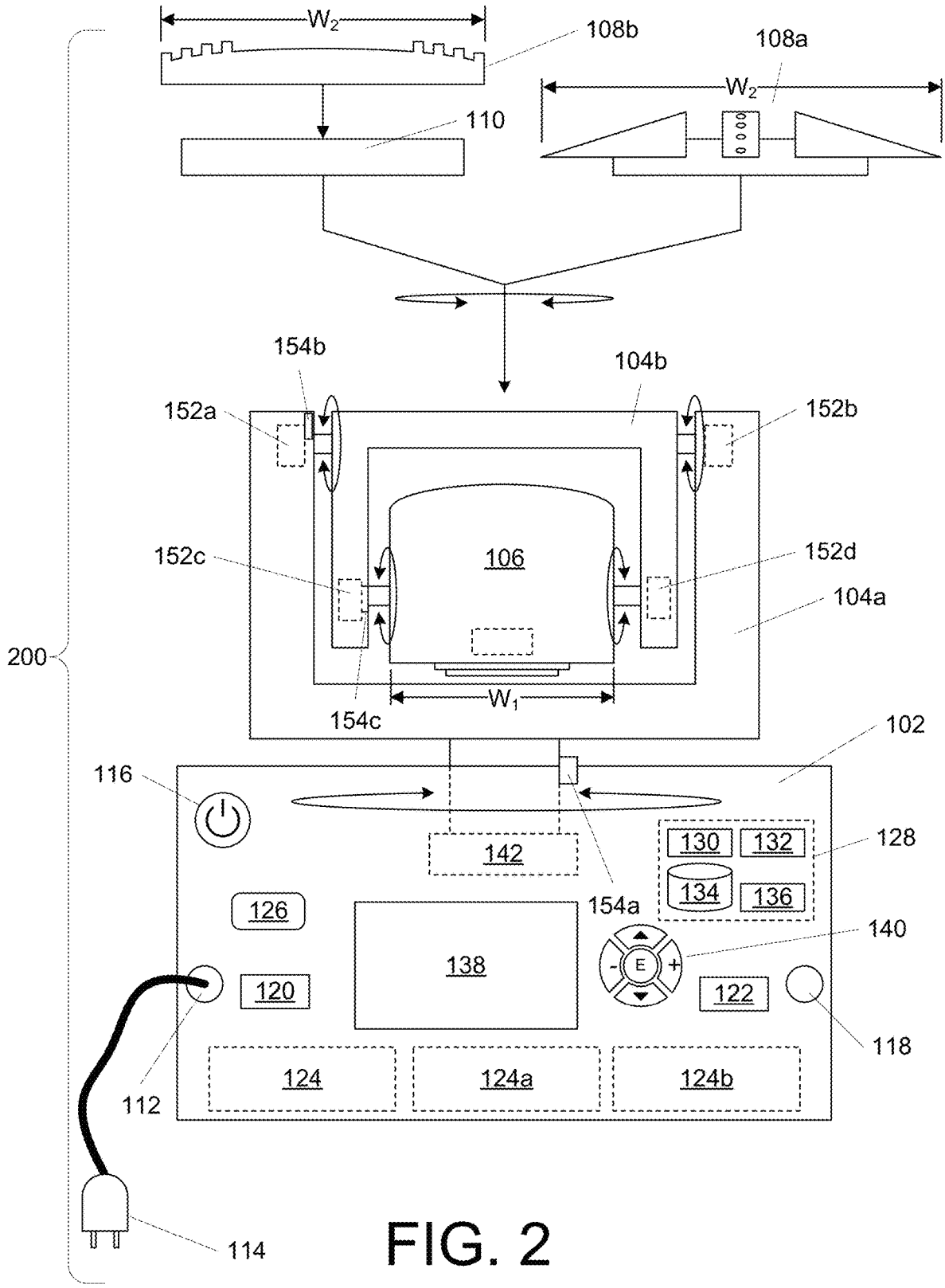

W2
108b
108a
W2
110
154b
104b
152a
152b
106
152c
152d
104a
200
W1
154c
102
116
142
130
132
128
134
136
126
154a
140
138
E
120
122
118
124
124a
124b
112
114

FIG. 2

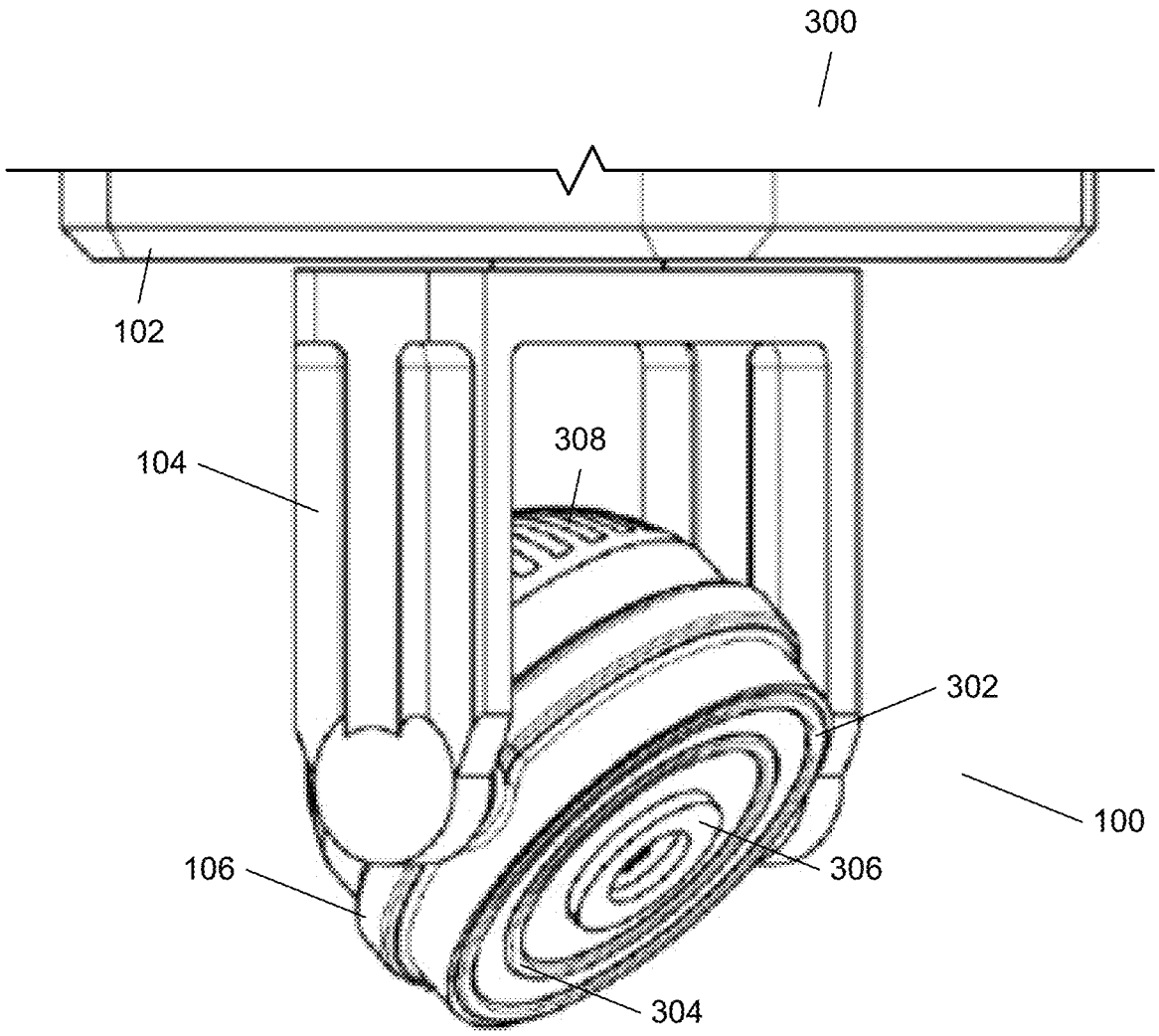



FIG. 3

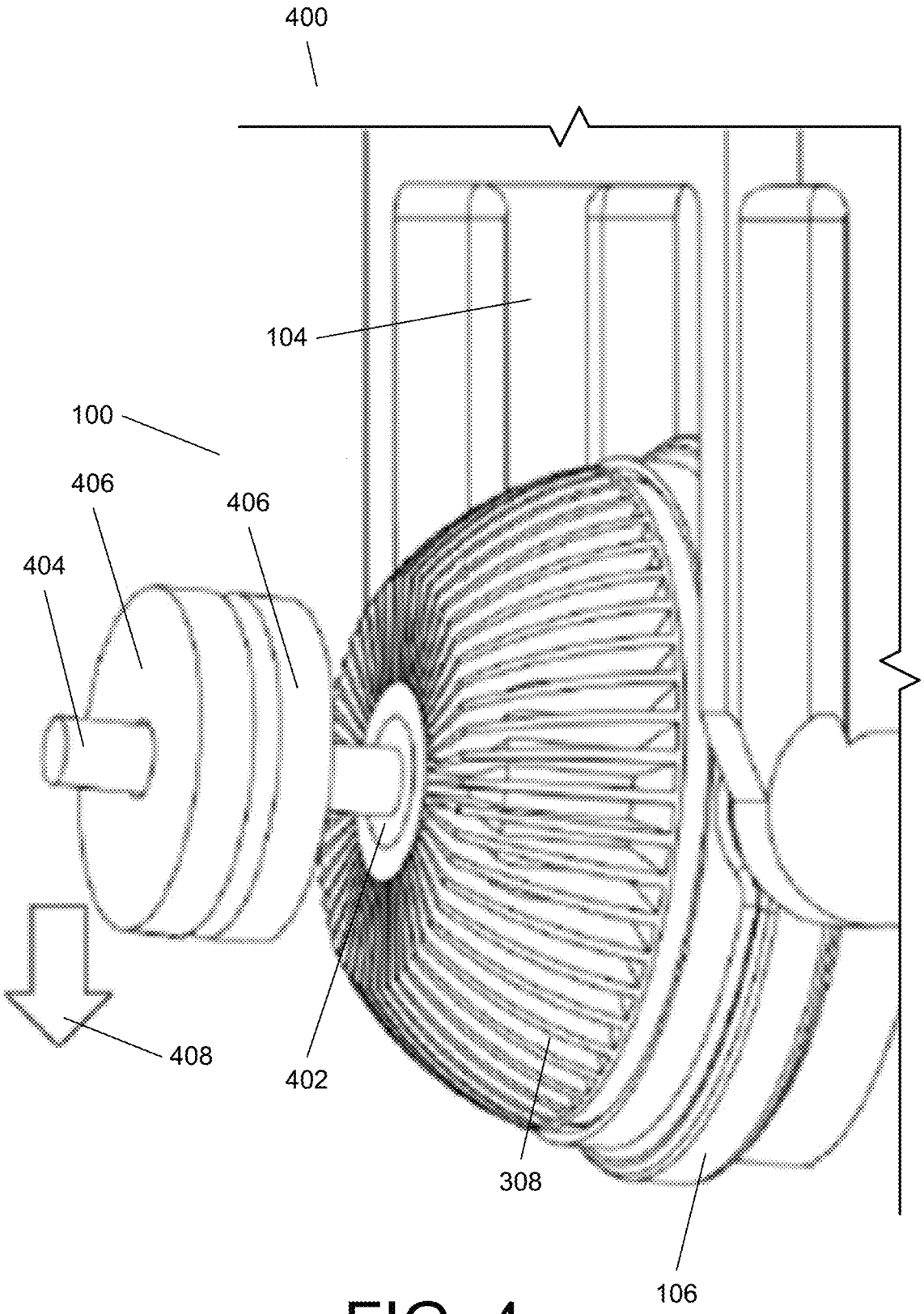



FIG. 4

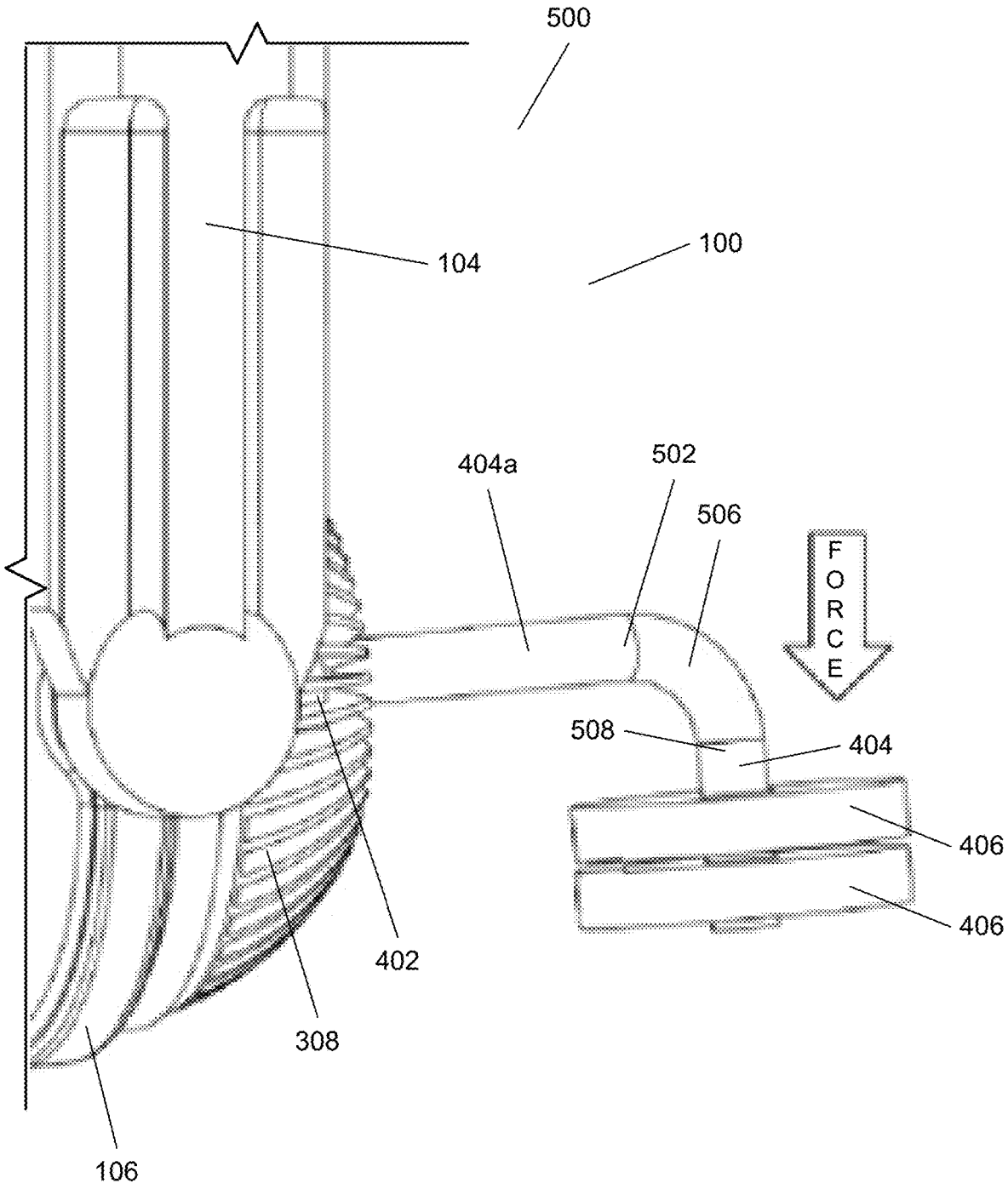



FIG. 5

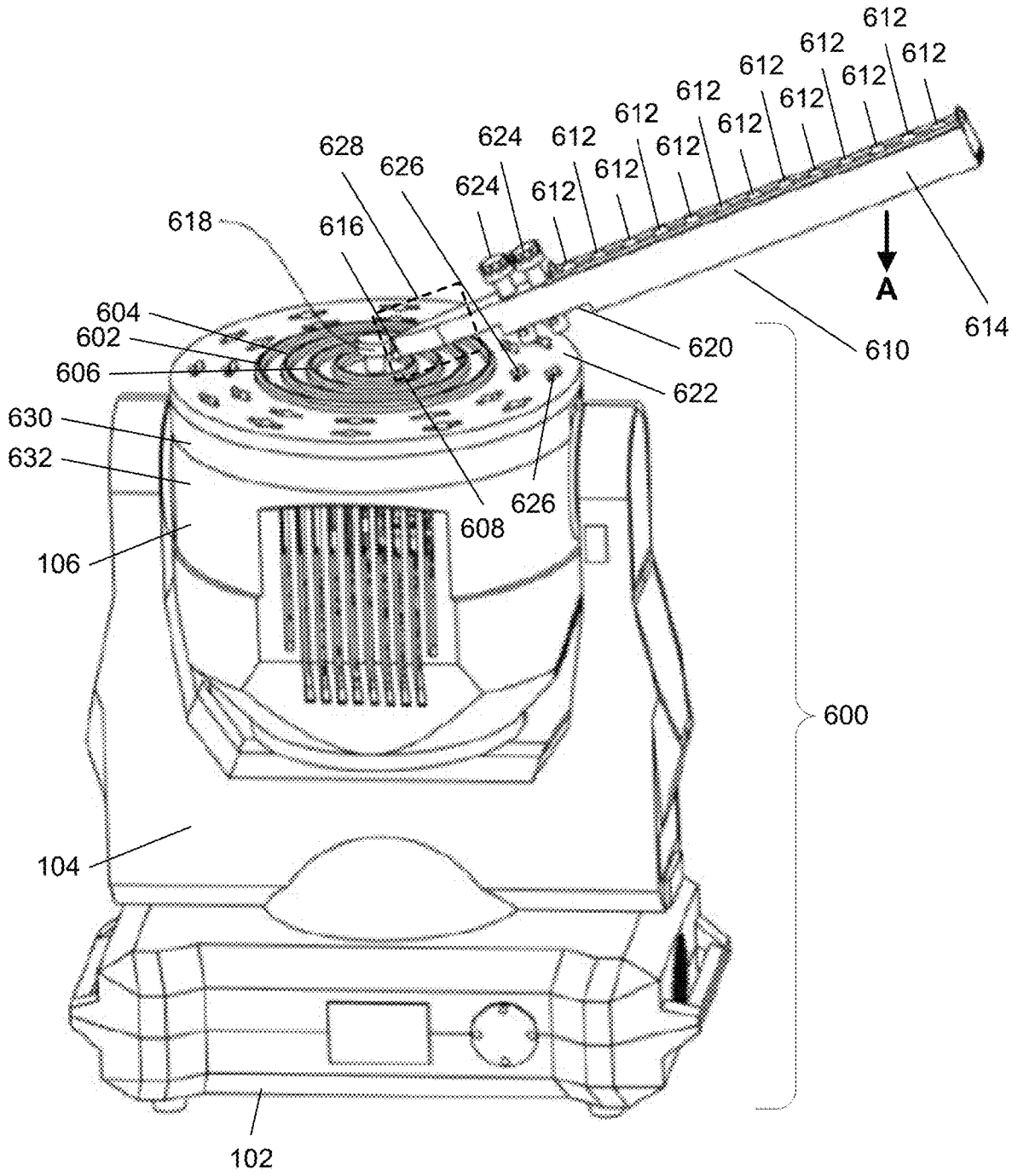
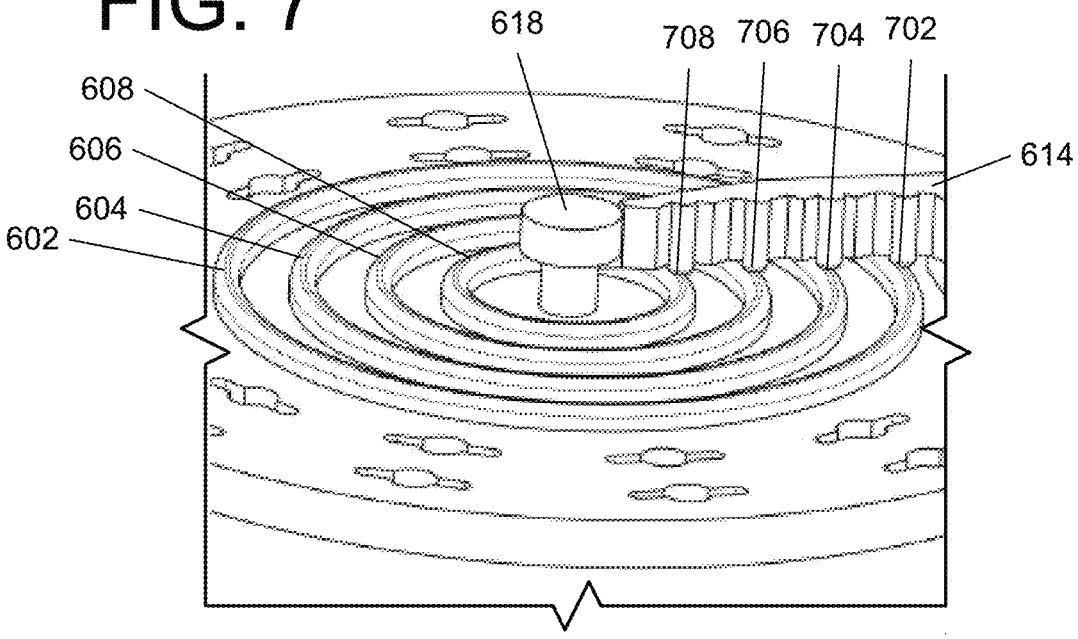

612
612
612
612
612
612
612
612
612
612
612
624
624
628
626
618
616
604
602
606
630
632
106
104
102
608
626
620
622
610
614
A
600

FIG. 6

FIG. 7


618
708
706
704
702
608
606
604
602
614

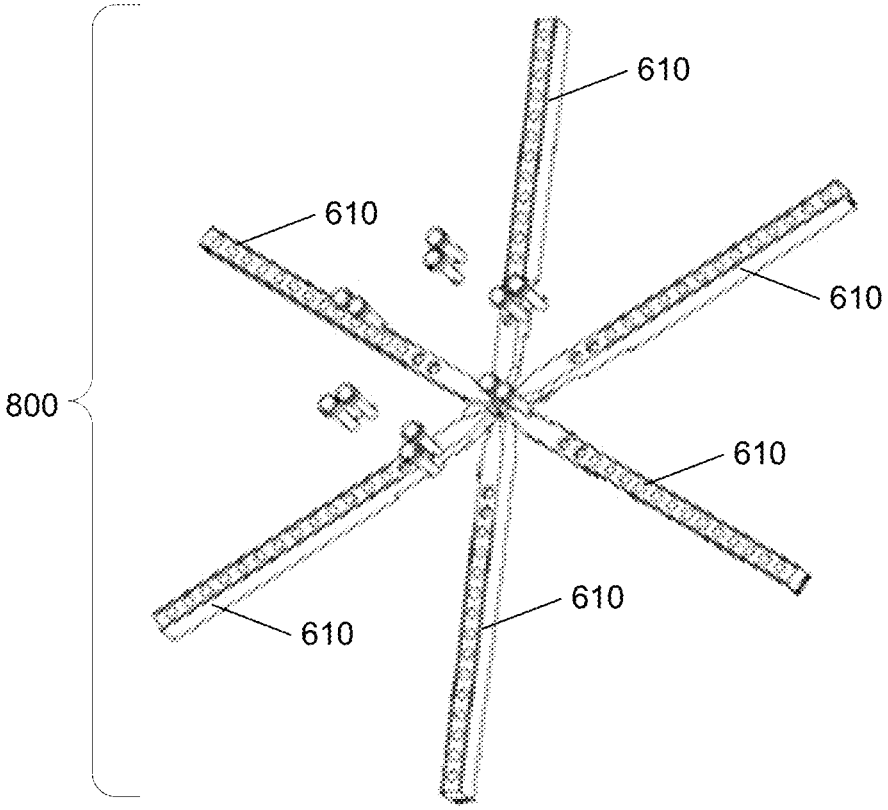

610
610
610
610
610
610
800

FIG. 8

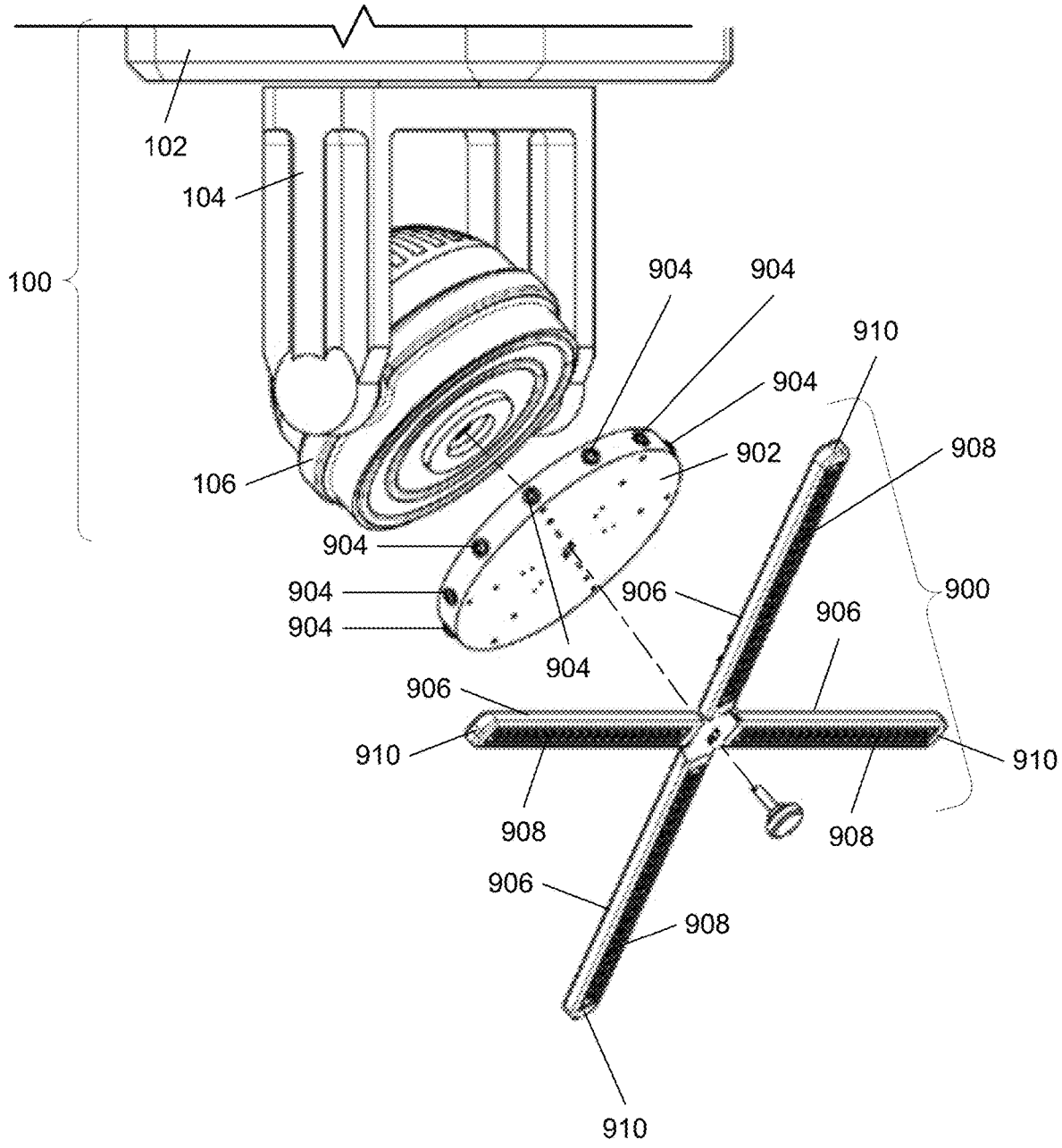

102
104
100
106
904
904
904
904
904
904
902
910
908
900
906
906
906
910
910
908
908
906
908
910

FIG. 9

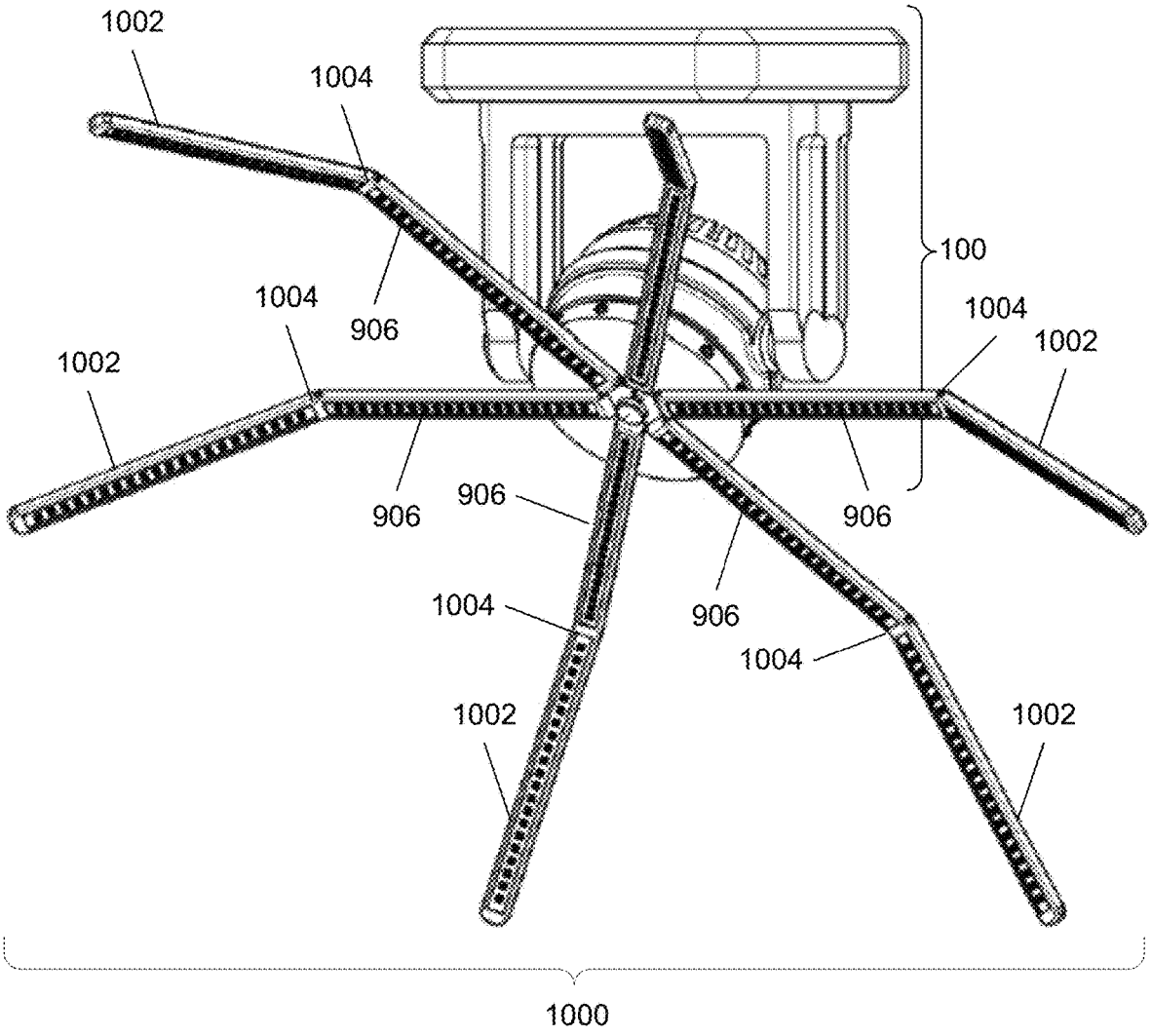

1002
1004
100
1004
906
1004
1002
1002
906
906
906
1004
906
1004
1002
1002
1000

FIG. 10

FIG. 11

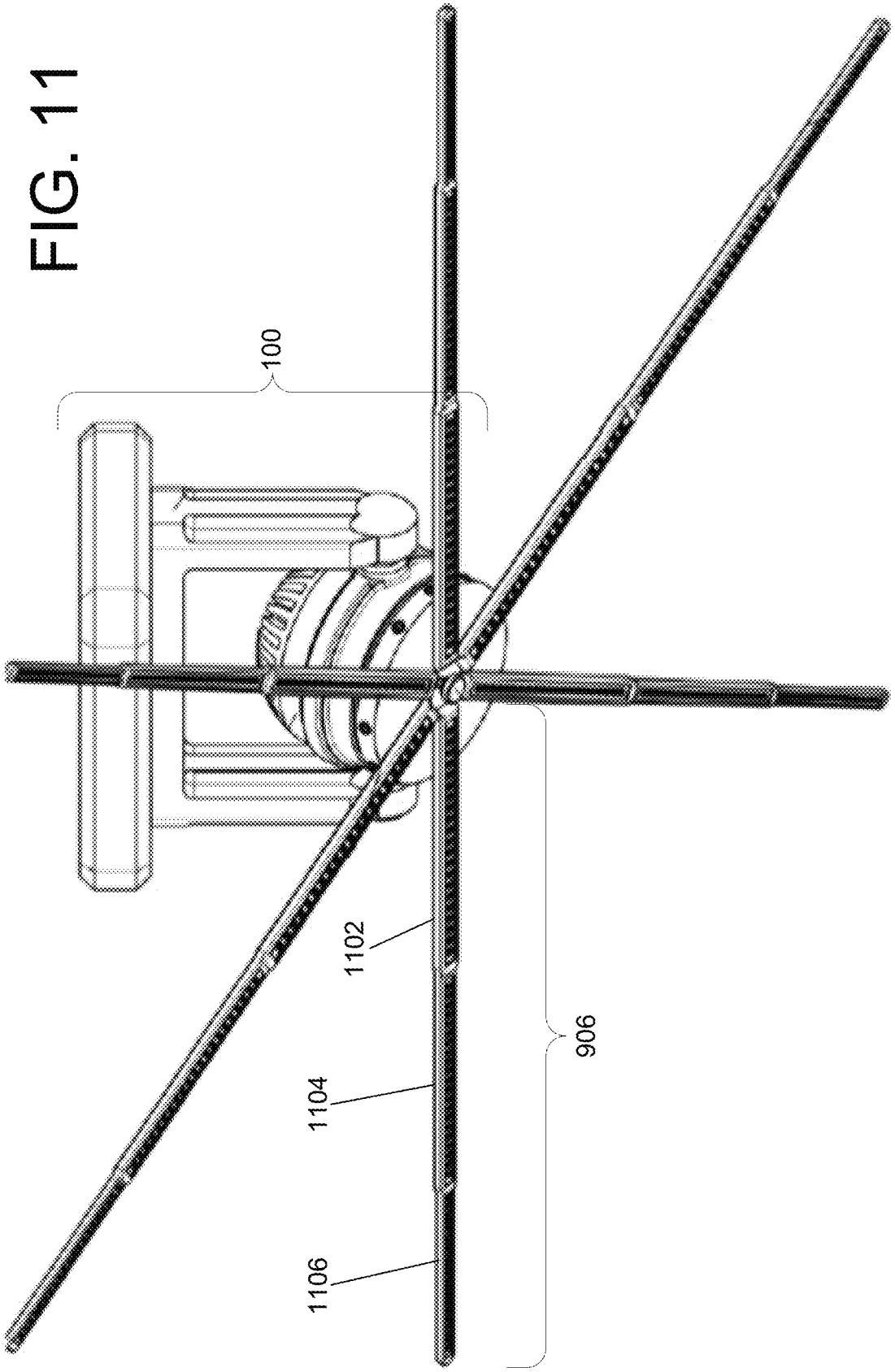


FIG. 12

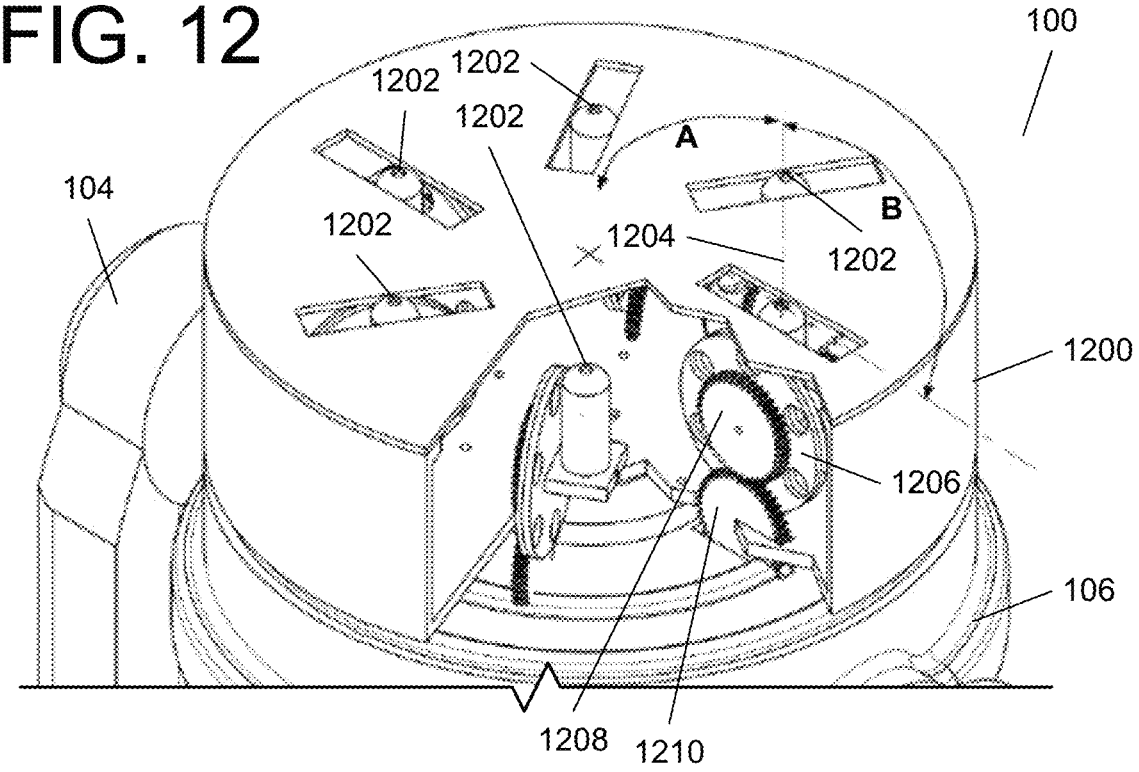
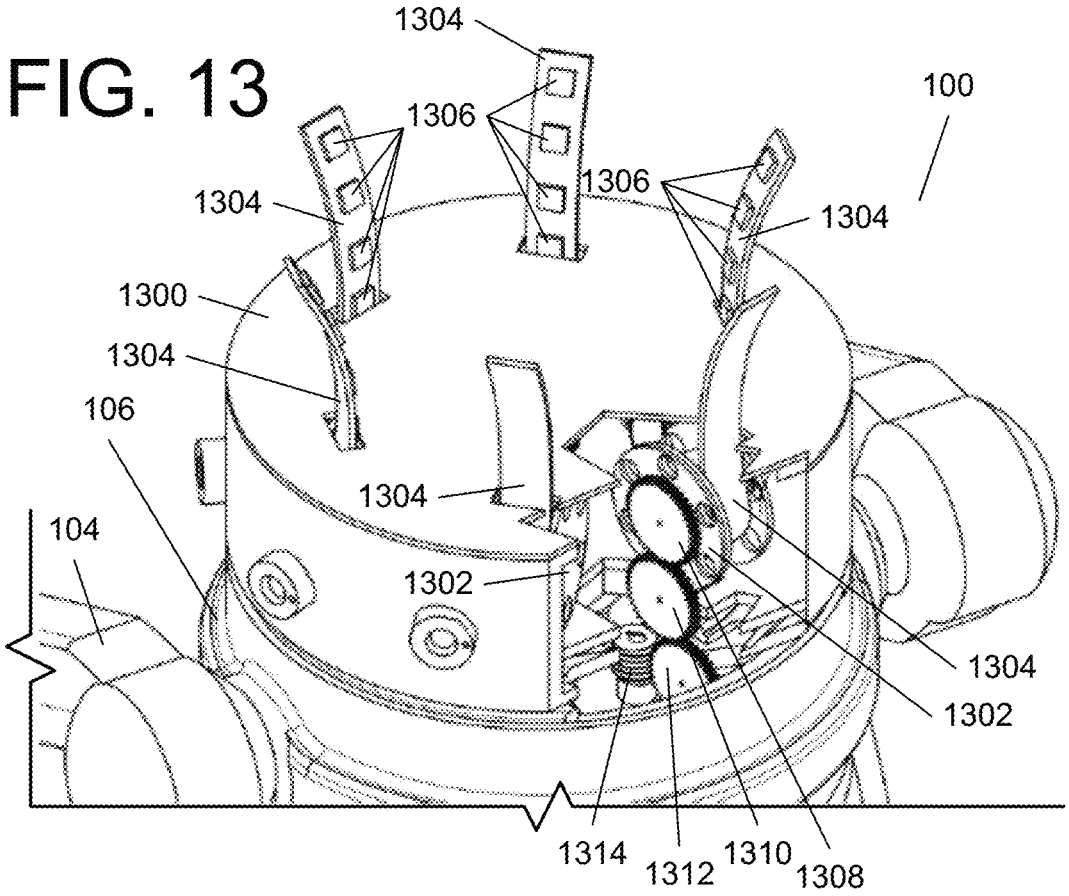

100
1202
1202
1202
A
B
104
1202
1204
1202
1200
1206
106
1208
1210

FIG. 13


1304
100
1306
1306
1304
1304
1300
1304
106
1304
104
1302
1304
1302
1314
1312
1310
1308

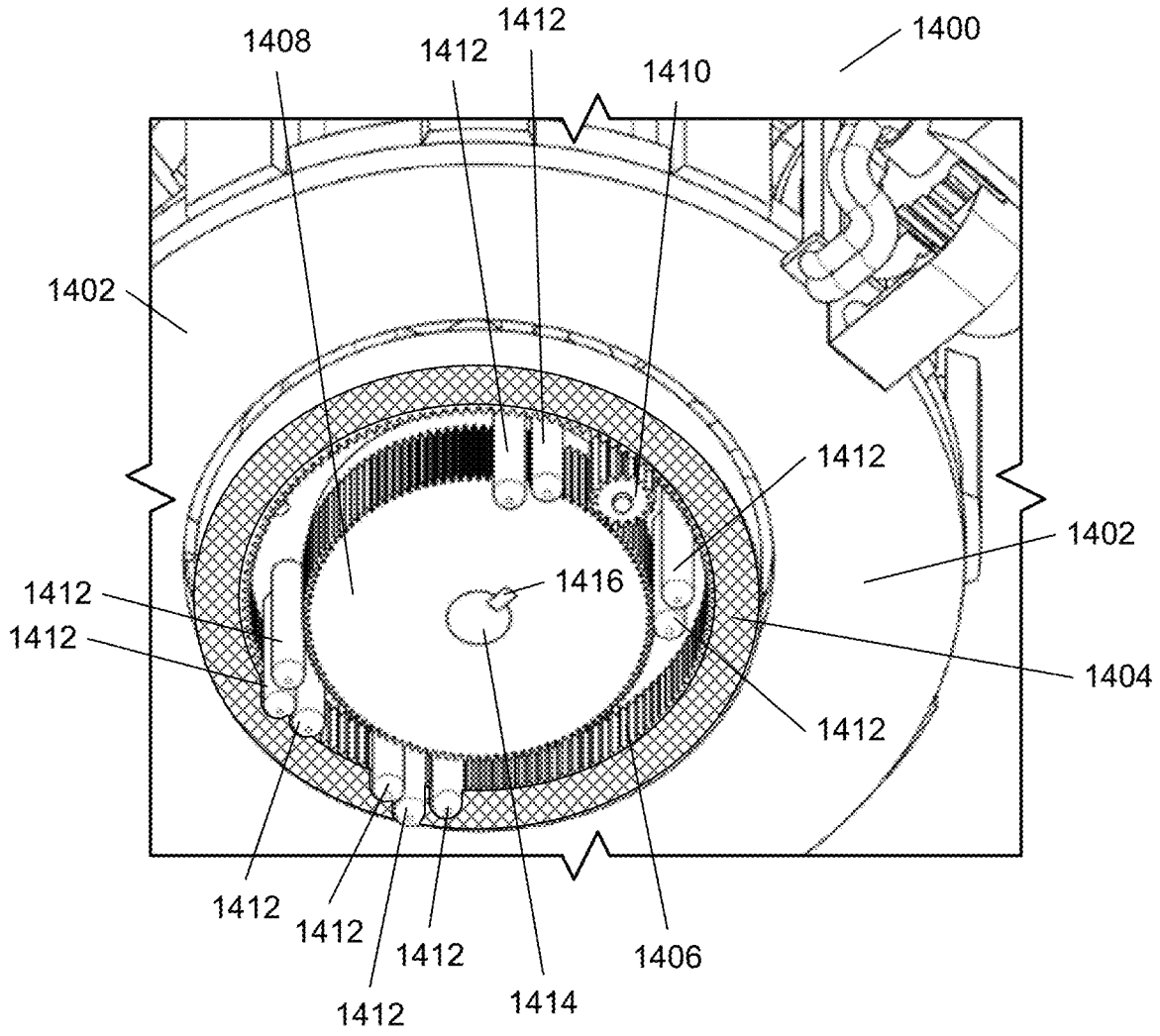

1408
1412
1412
1410
1400
1402
1412
1402
1412
1416
1412
1404
1412
1412
1412
1412
1412
1406
1414

FIG. 14

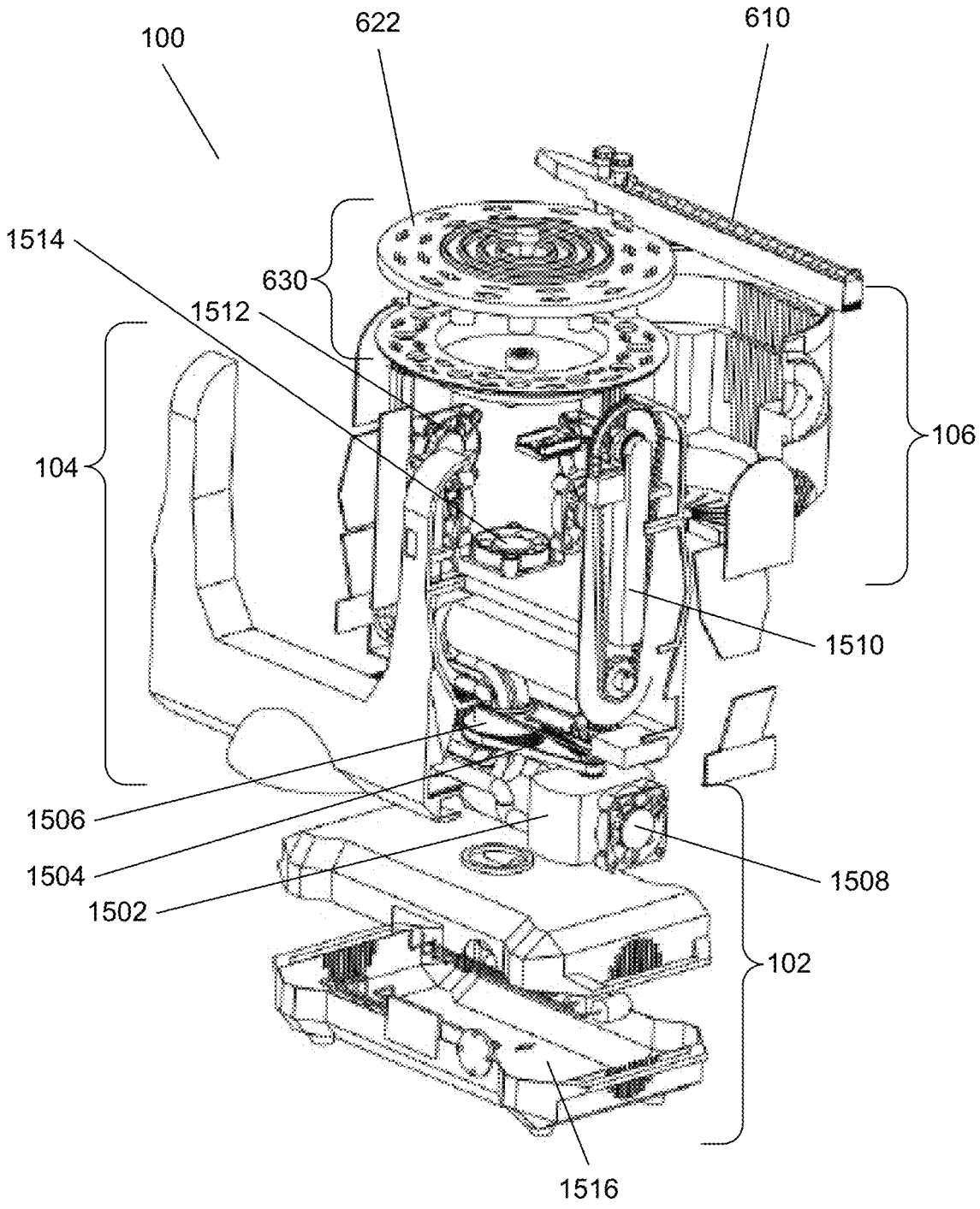

100
622
610
1514
630
1512
104
106
1510
1506
1504
1502
1508
102
1516

FIG. 15

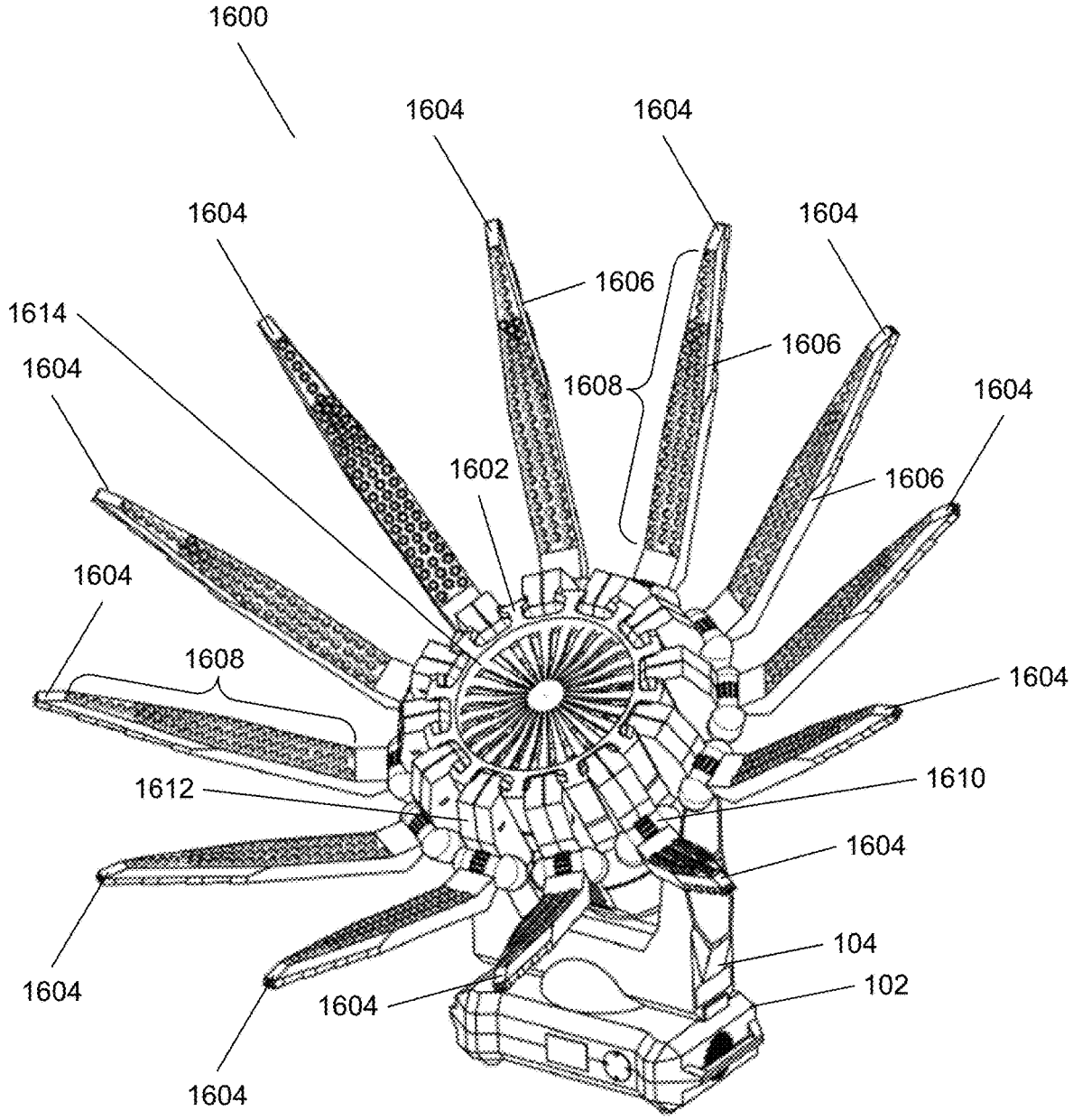

1600
1604
1604
1604
1604
1606
1614
1606
1604
1608
1604
1602
1606
1604
1608
1604
1612
1610
1604
104
1604
102
1604
1604

FIG. 16

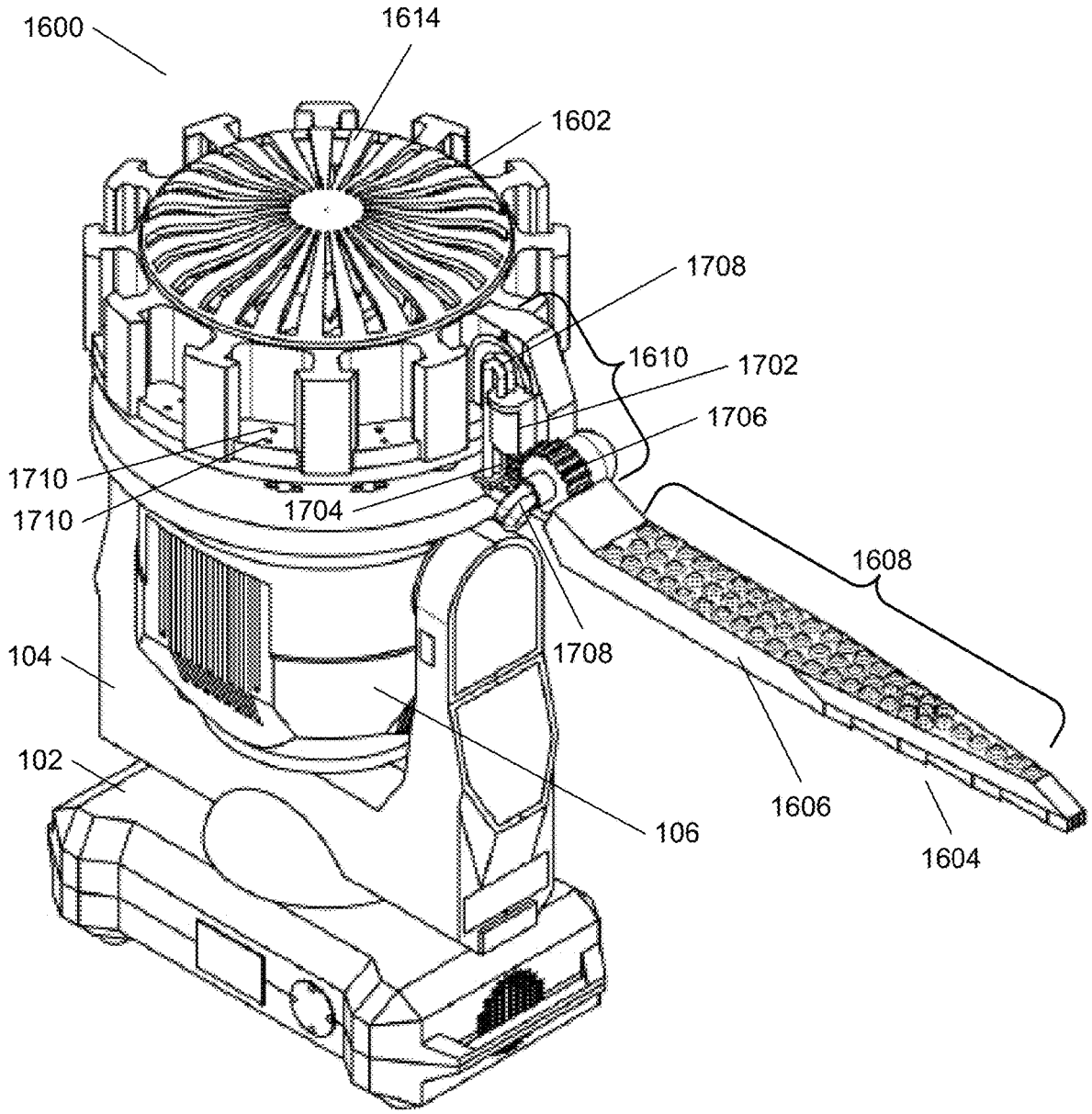

1600
1614
1602
1708
1610
1702
1706
1710
1710
1704
1608
104
1708
102
106
1606
1604

FIG. 17

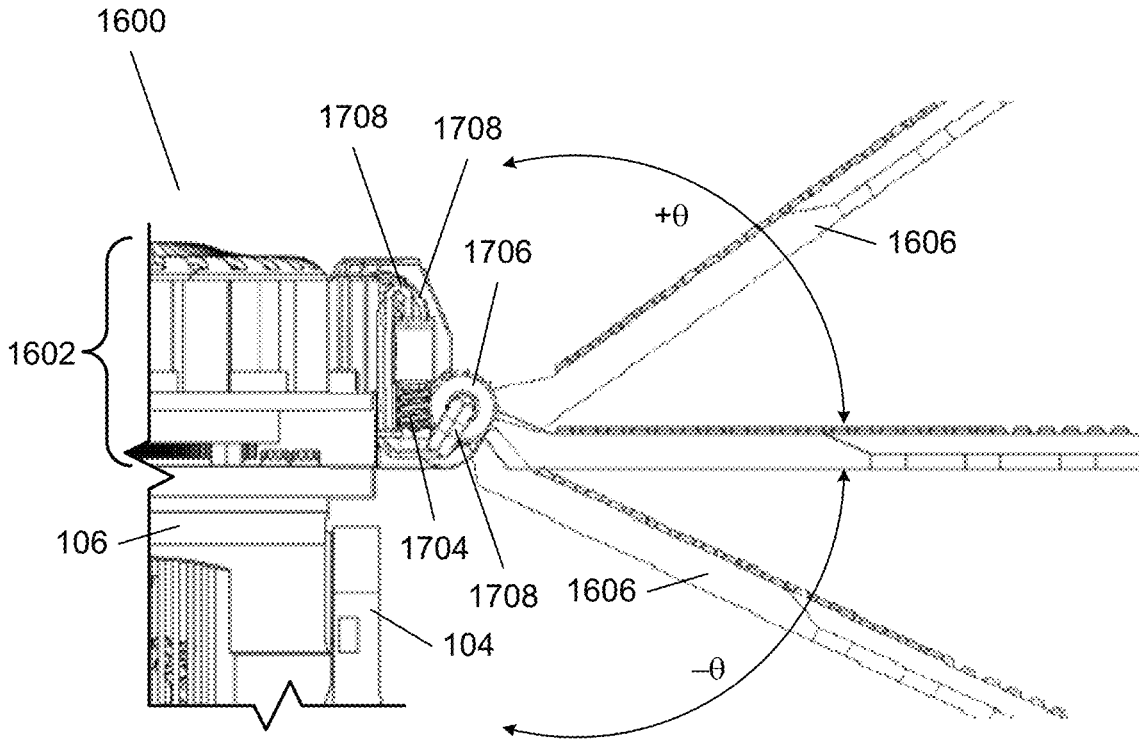



FIG. 18

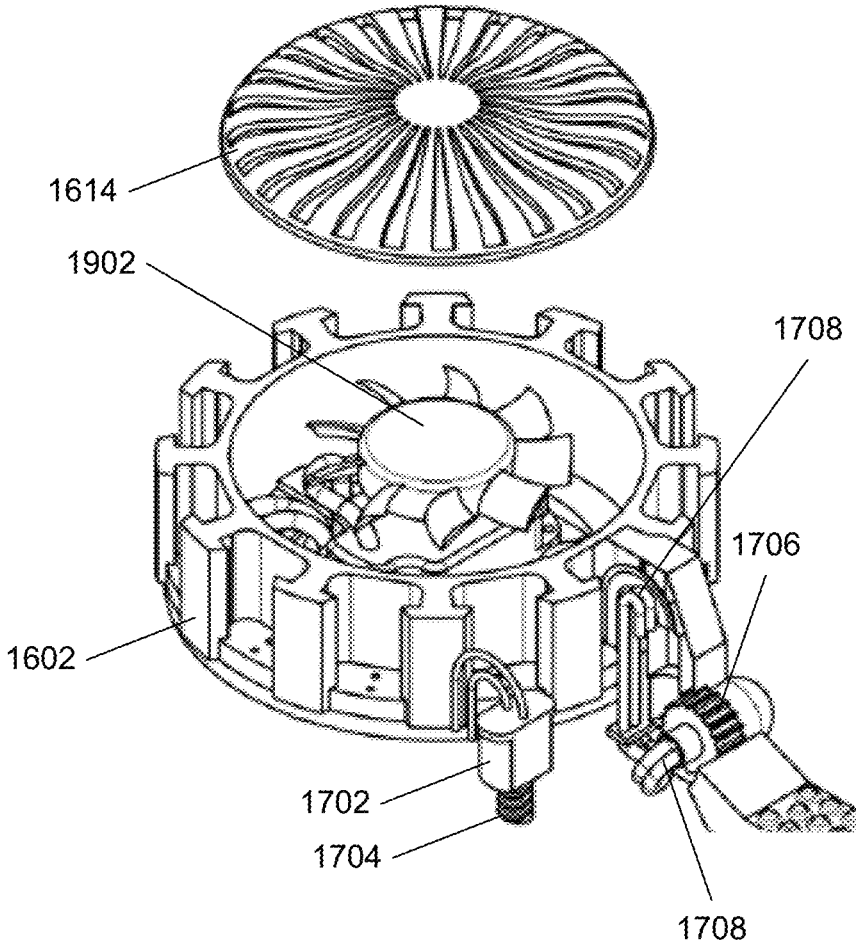



FIG. 19

FIG. 20

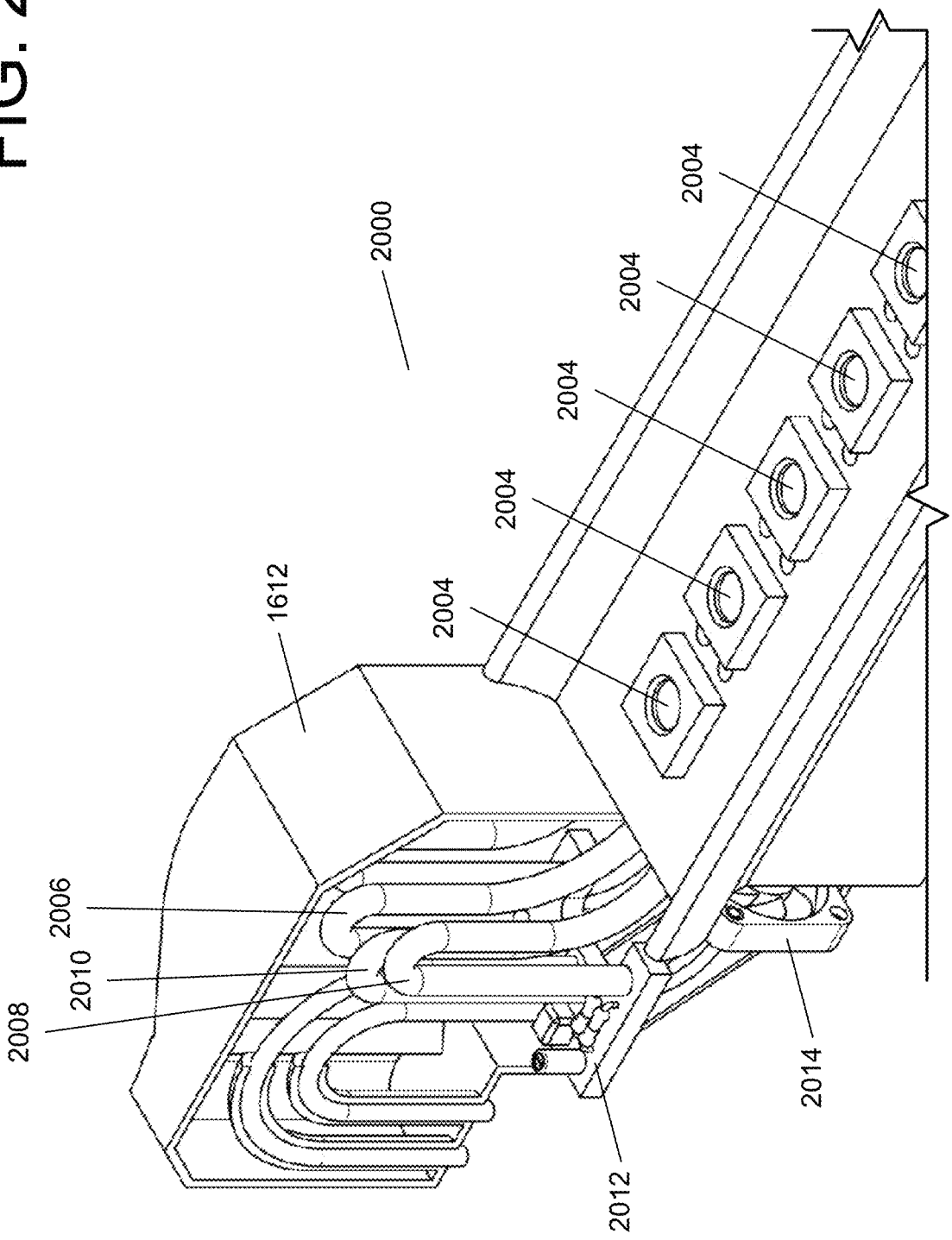
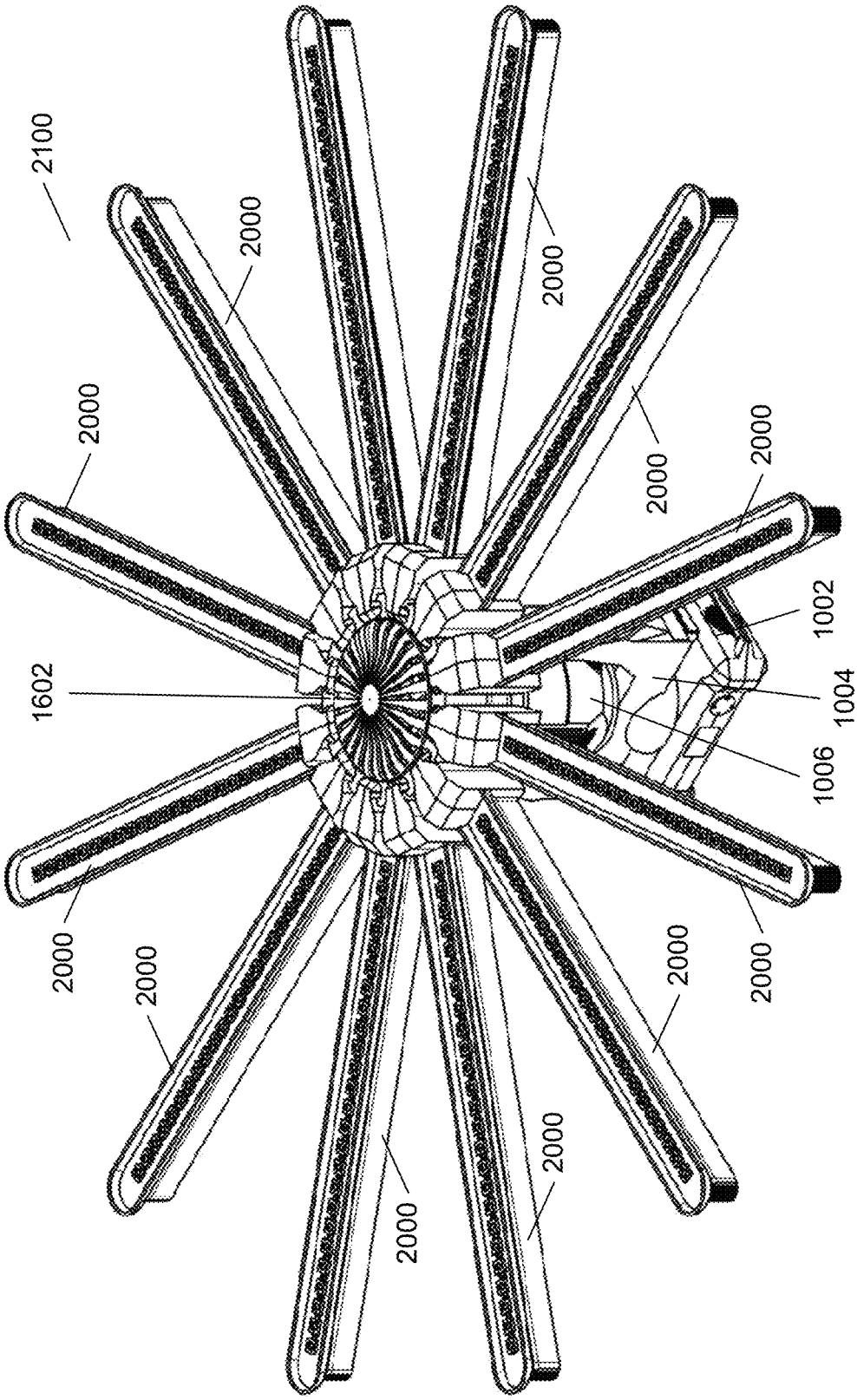


FIG. 21


2100
2000
2000
2000
2000
2000
2000
1002
1004
1006
1602
2000
2000
2000
2000
2000
2000

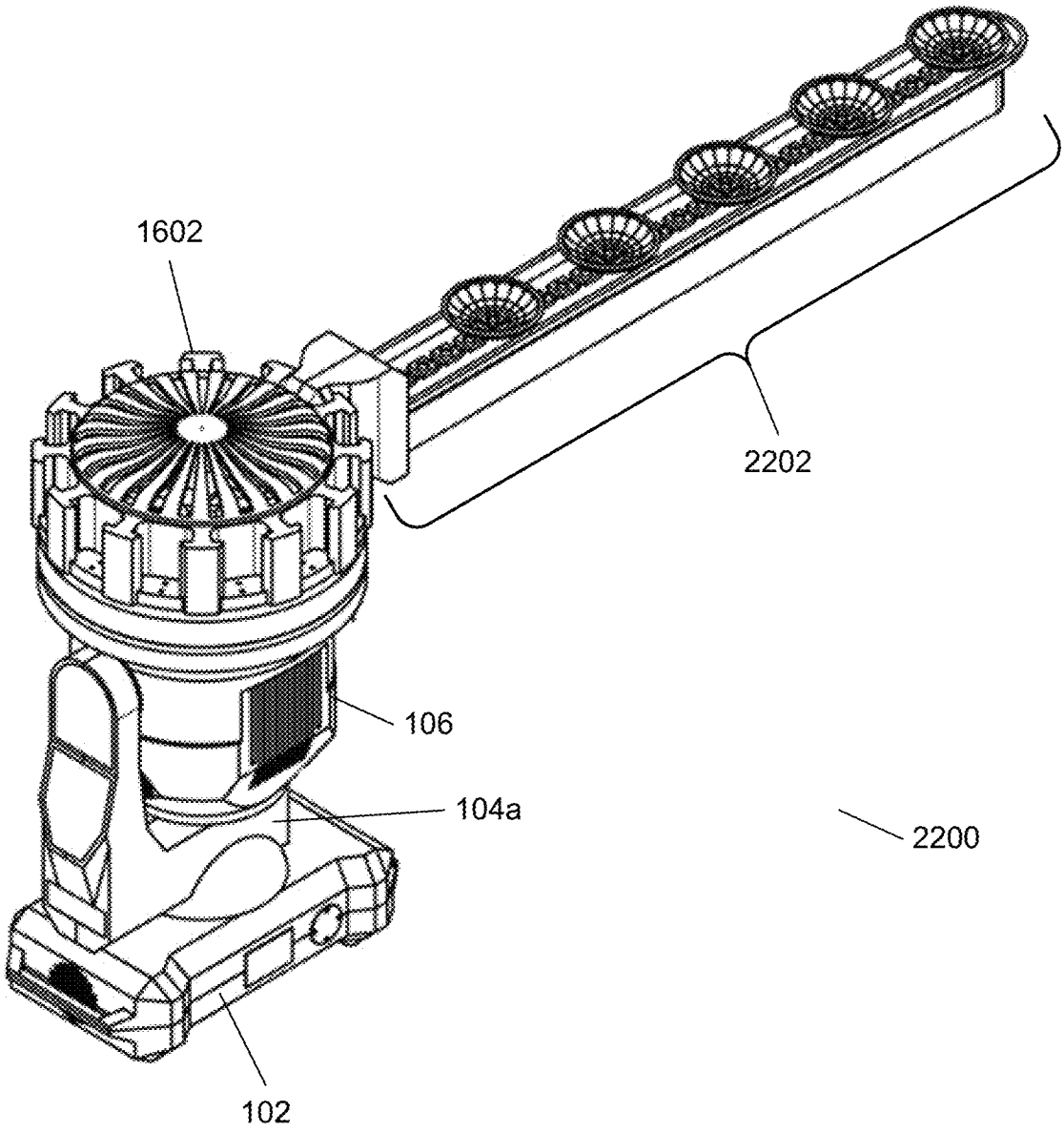
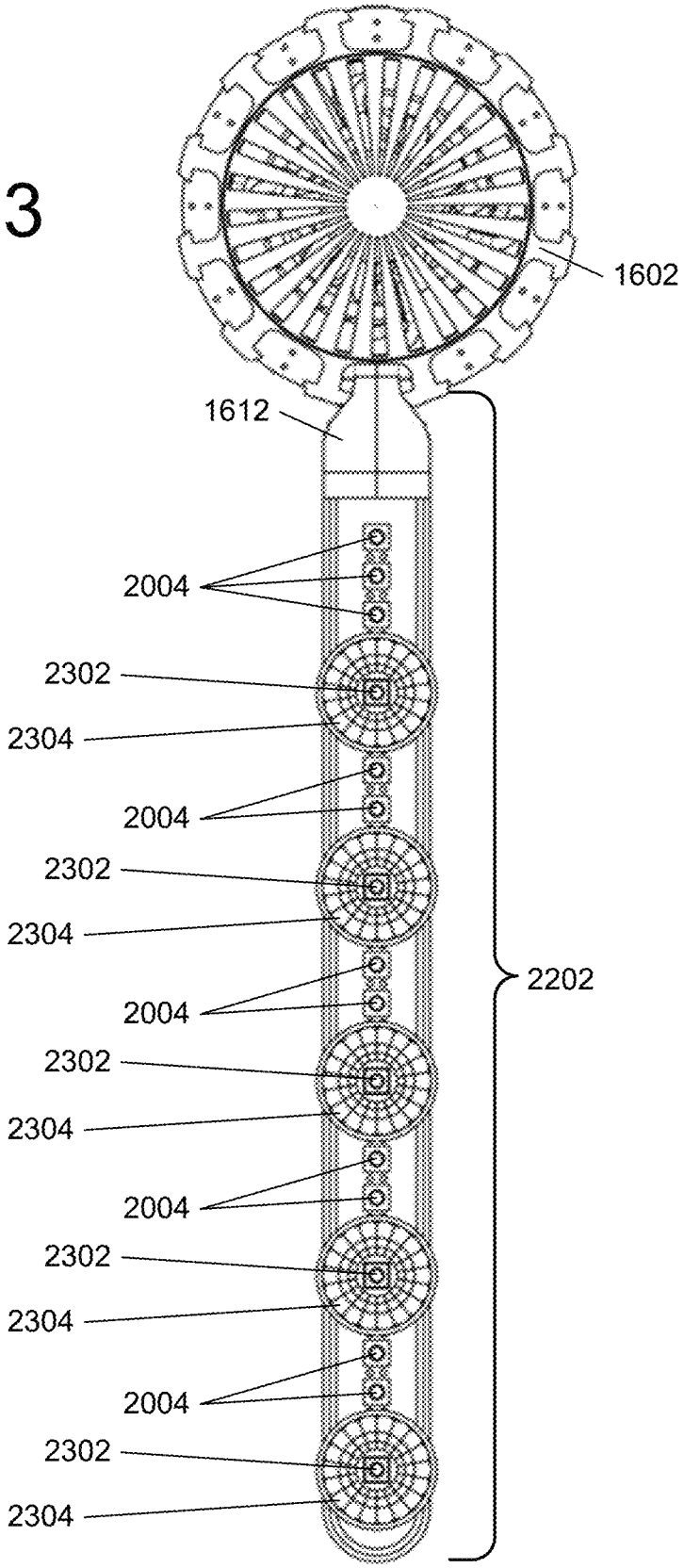



FIG. 22

FIG. 23


1602
1612
2004
2302
2304
2004
2302
2304
2004
2302
2304
2004
2302
2304
2004
2302
2304
2202

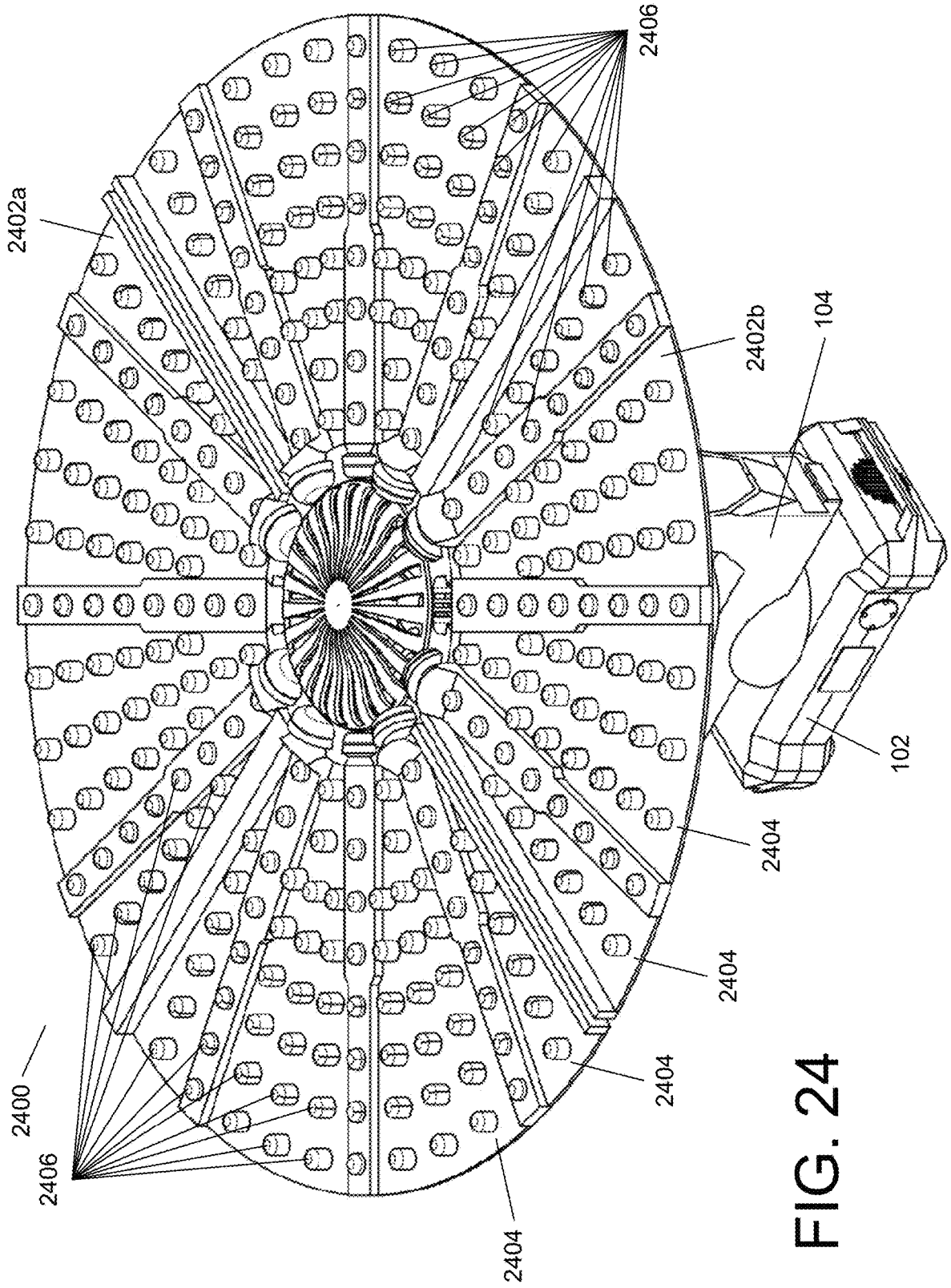



FIG. 24

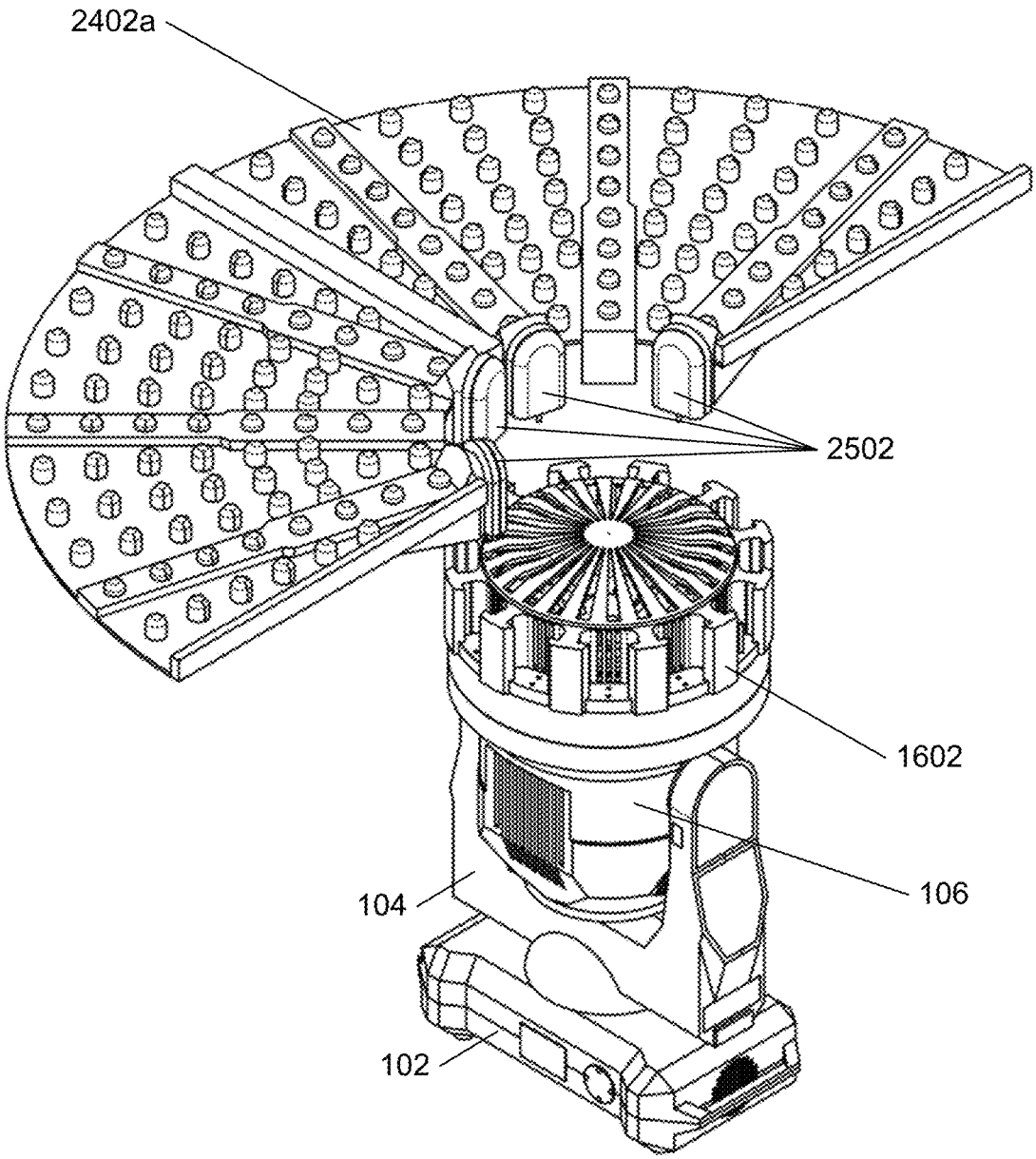



FIG. 25

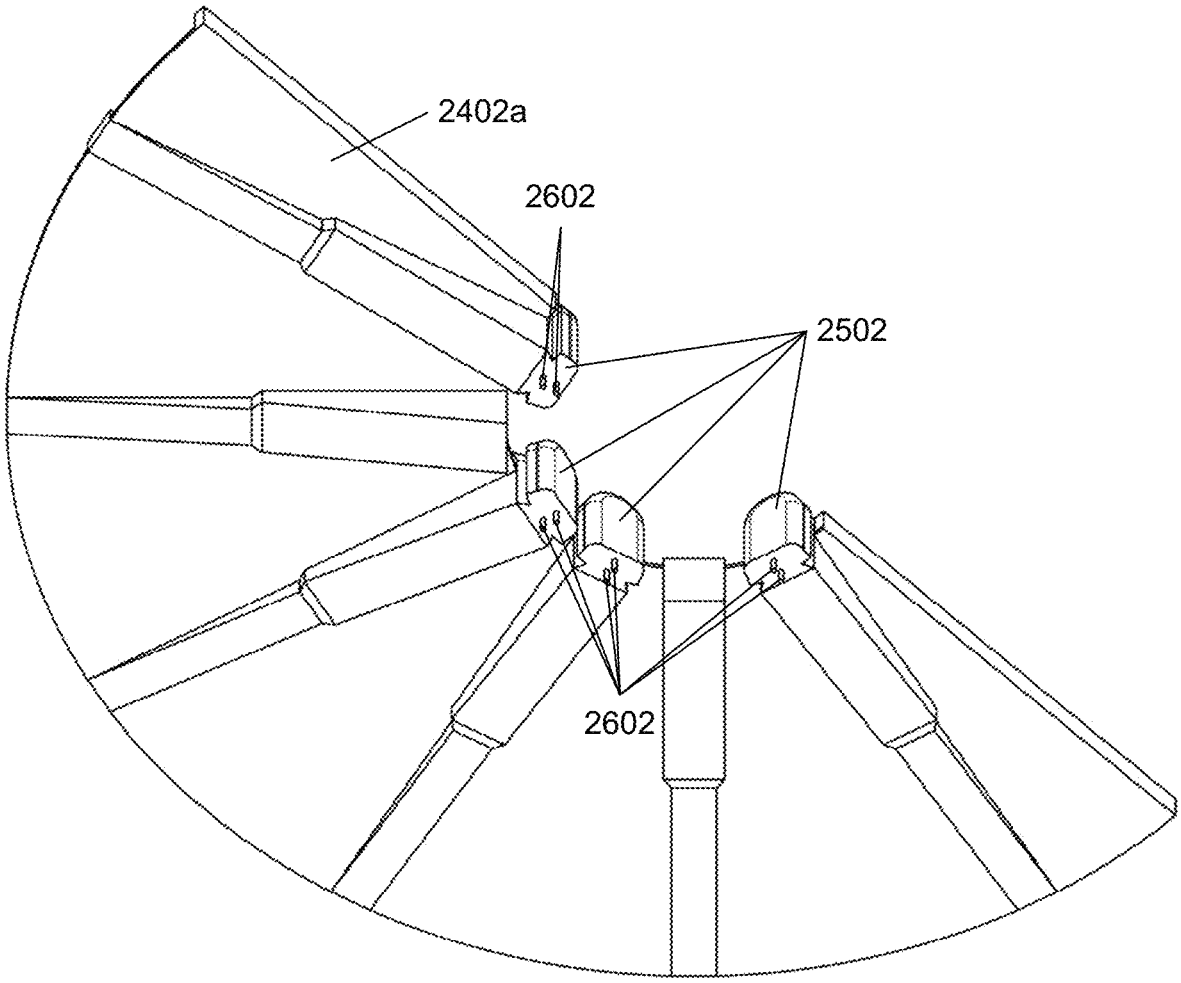



FIG. 26

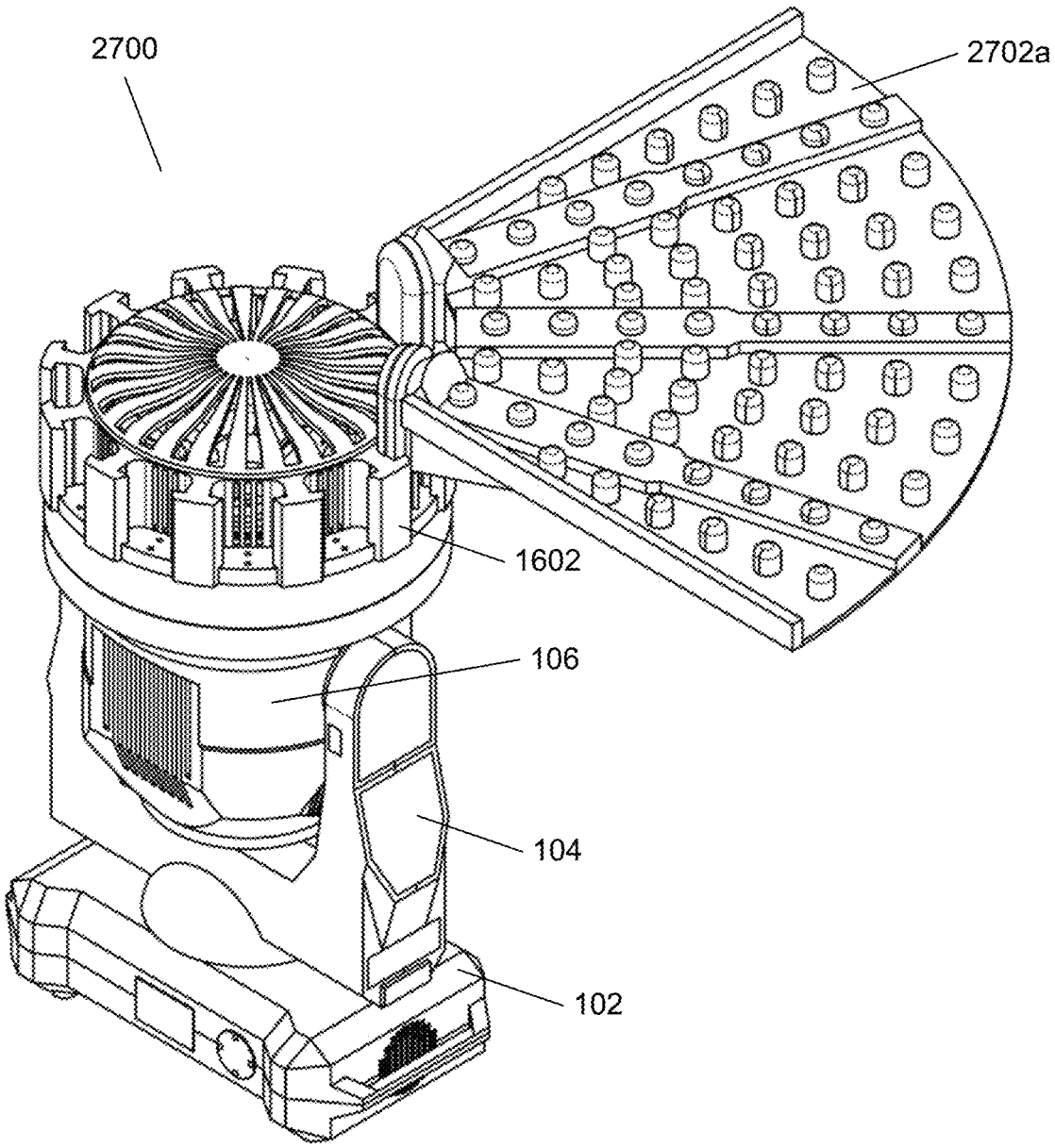



FIG. 27

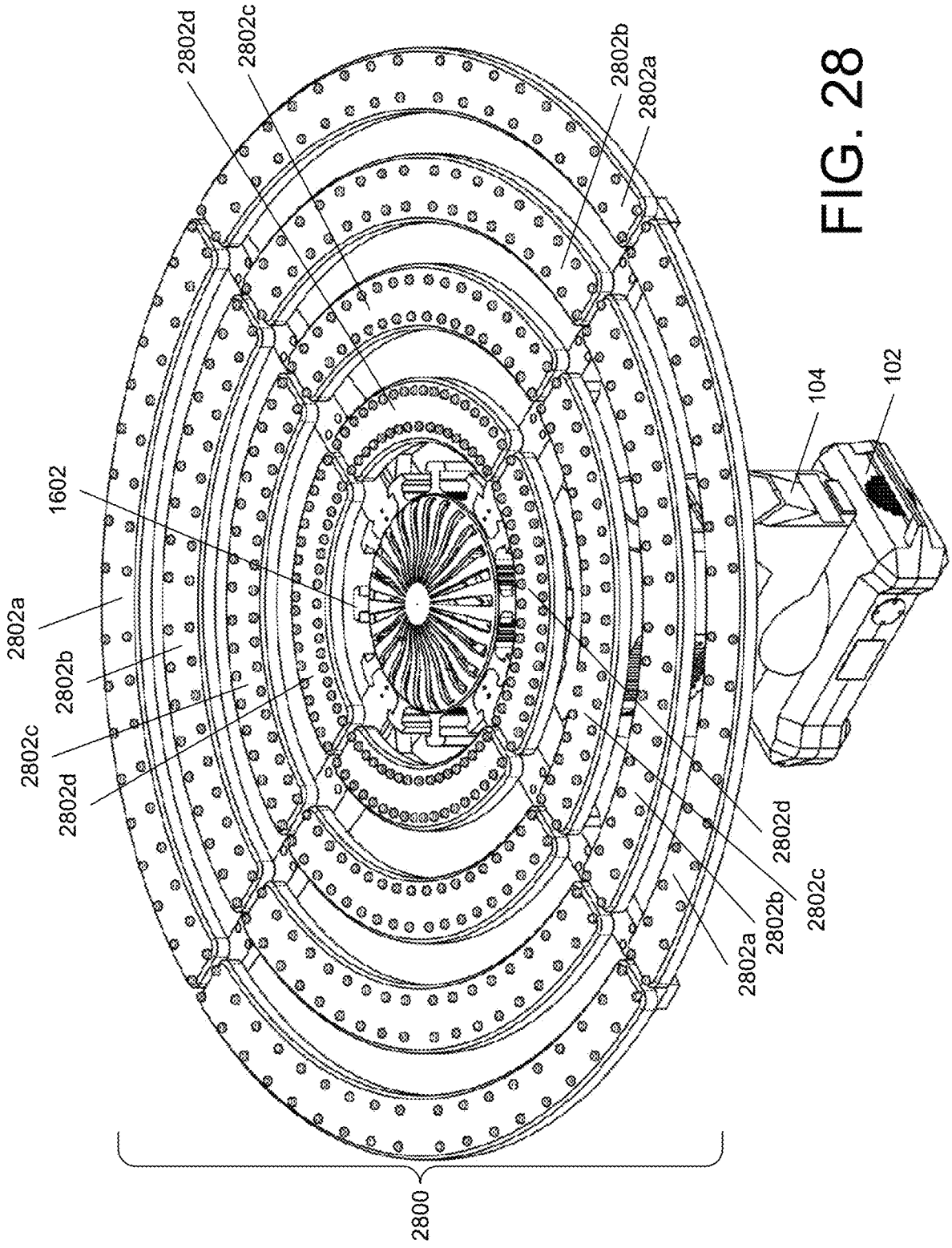

2802d
2802c
2802b
2802a
104
102
1602
2802a
2802b
2802c
2802d
2802d
2802c
2802b
2802a
2800

FIG. 28

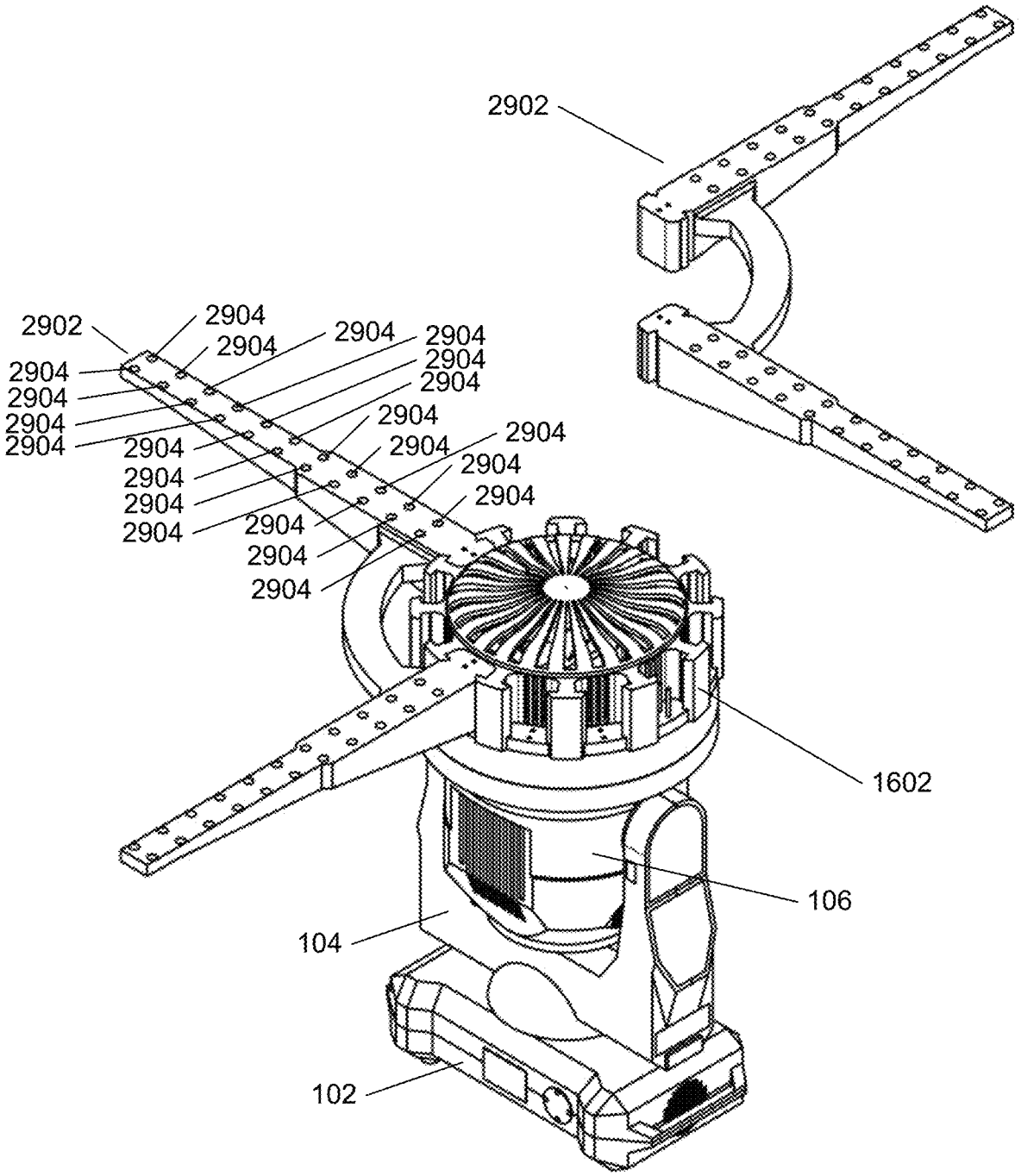

2902
2902
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
2904
1602
106
104
102

FIG. 29

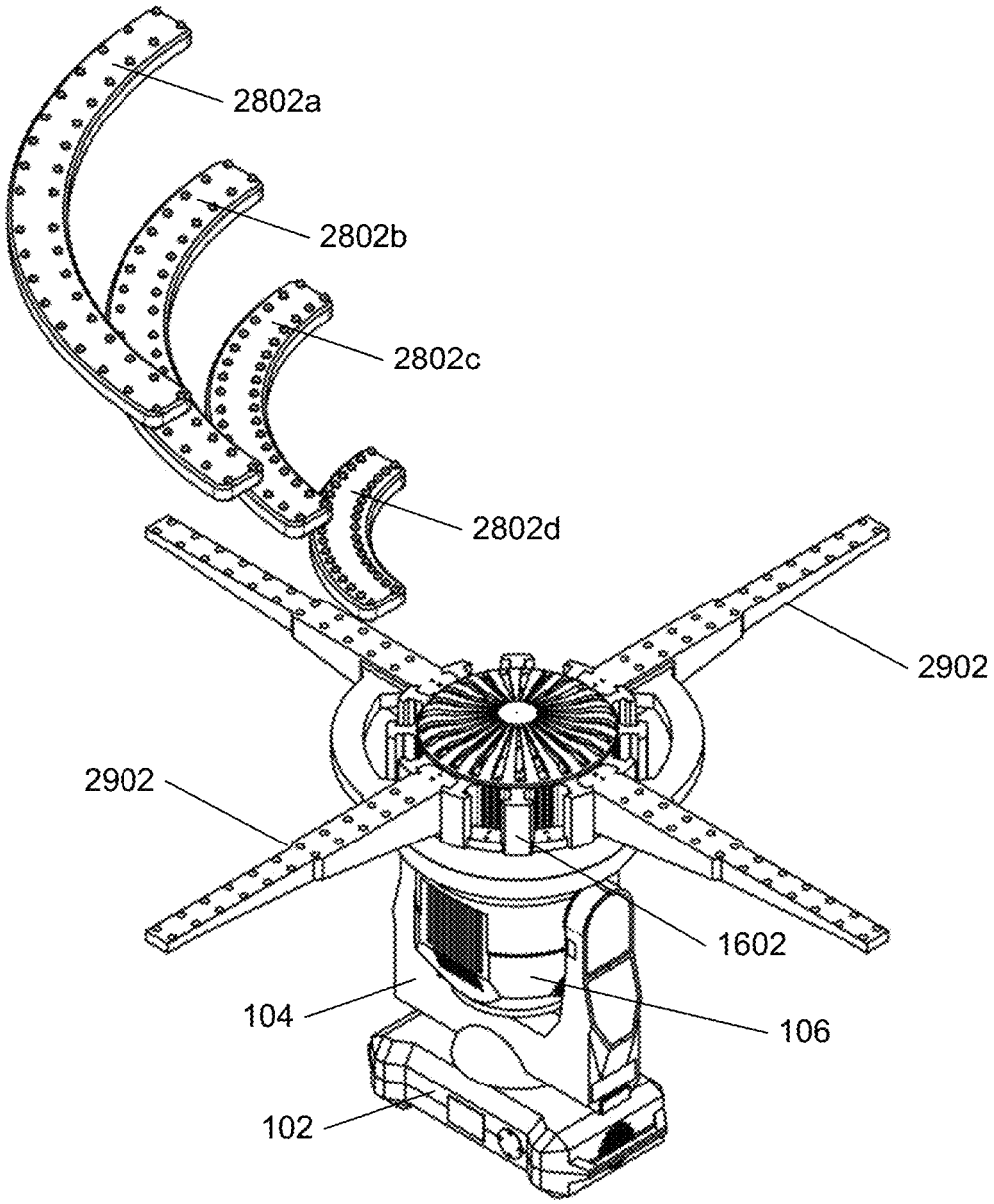



FIG. 30

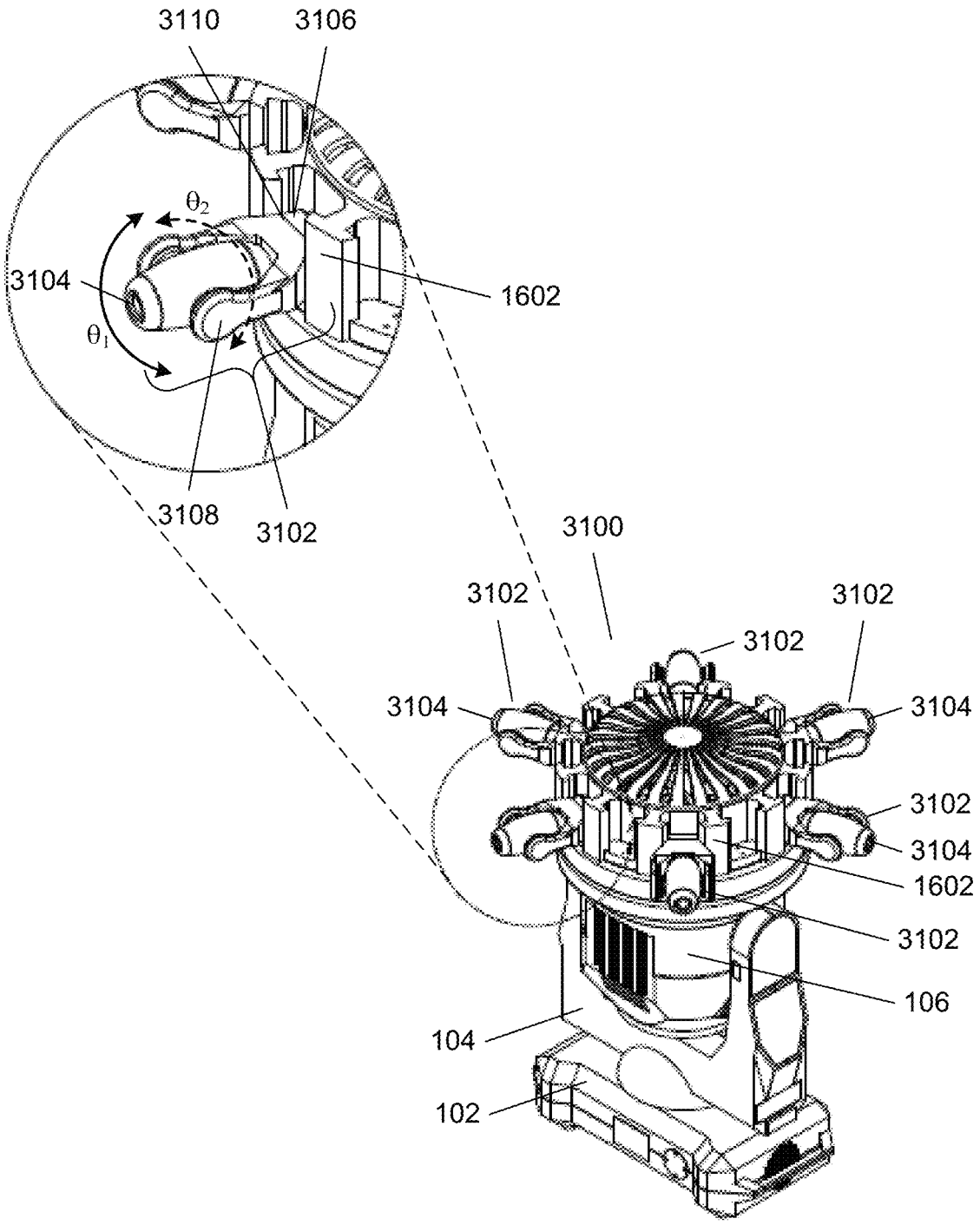
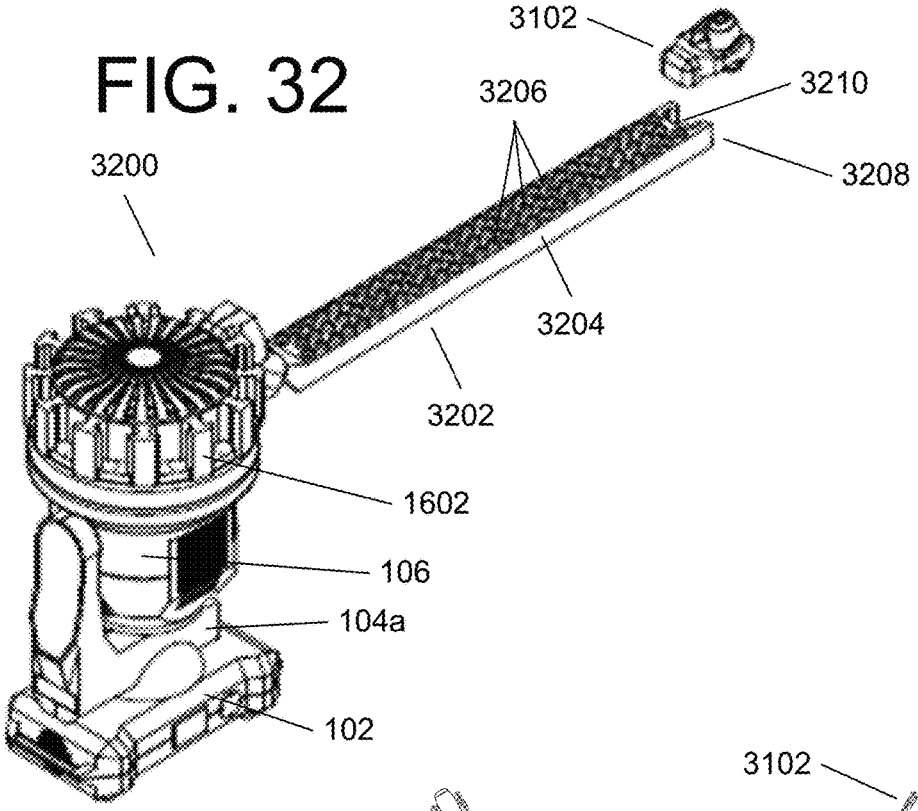

3110
3106
$\theta_2$
3104
1602
$\theta_1$
3108
3102
3100
3102
3102
3102
3104
3104
3102
3104
1602
3102
106
104
102

FIG. 31

FIG. 32


3102
3210
3206
3208
3200
3204
3202
1602
106
104a
102

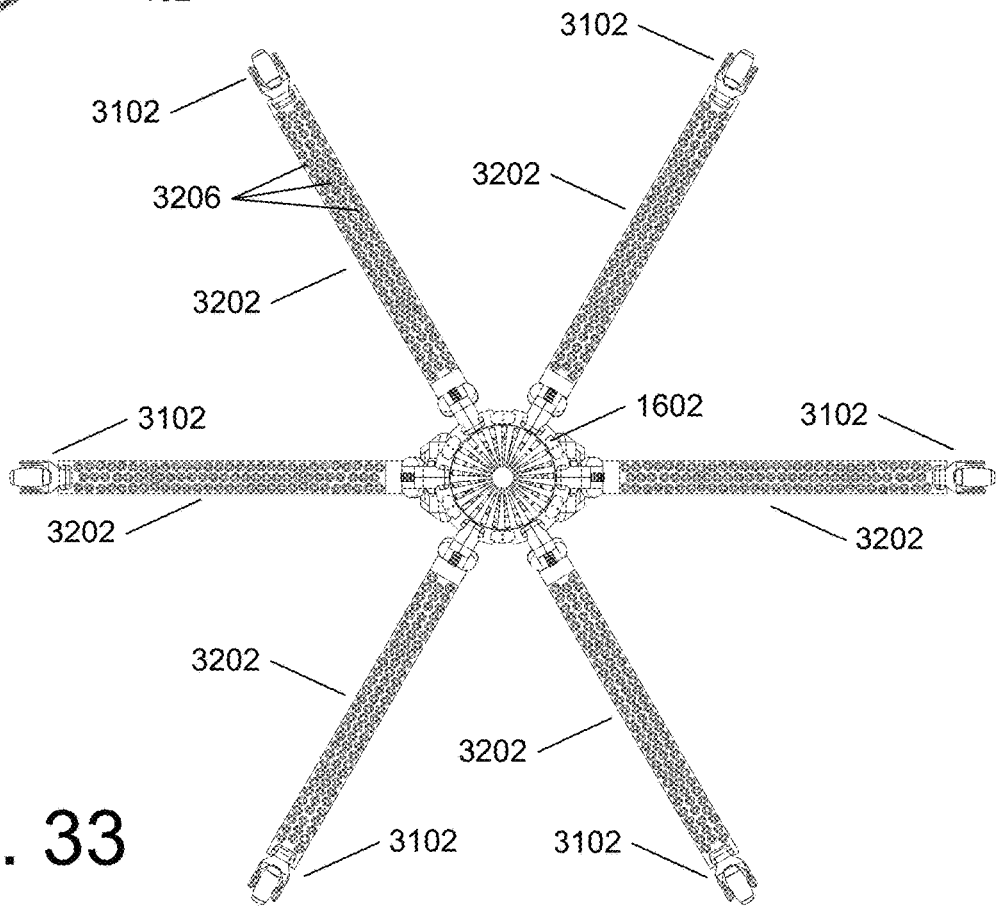

3102
3102
3202
3206
3202
3102
1602
3102
3202
3202
3202
3202
3102
3102

FIG. 33

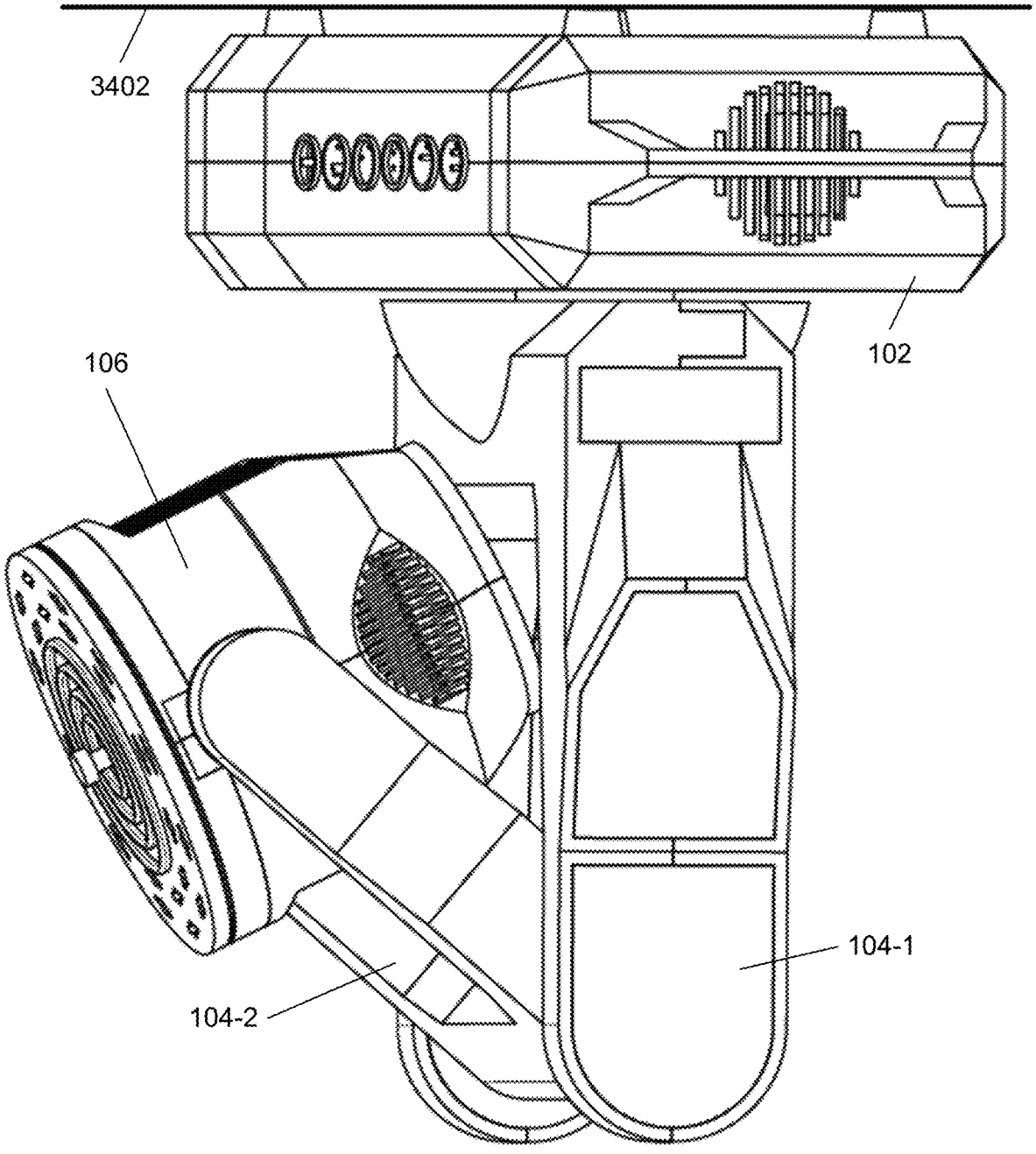



FIG. 34

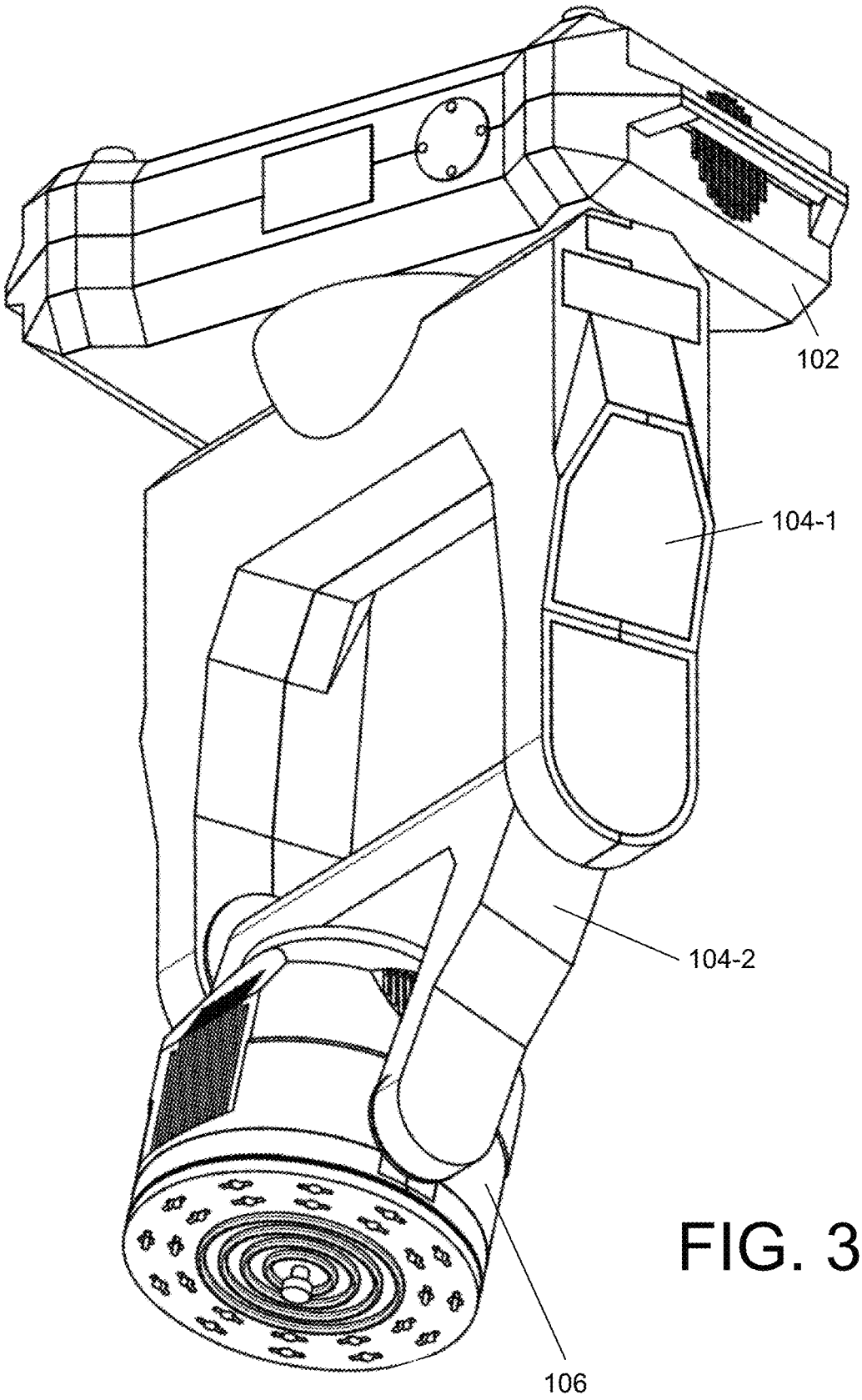



FIG. 35

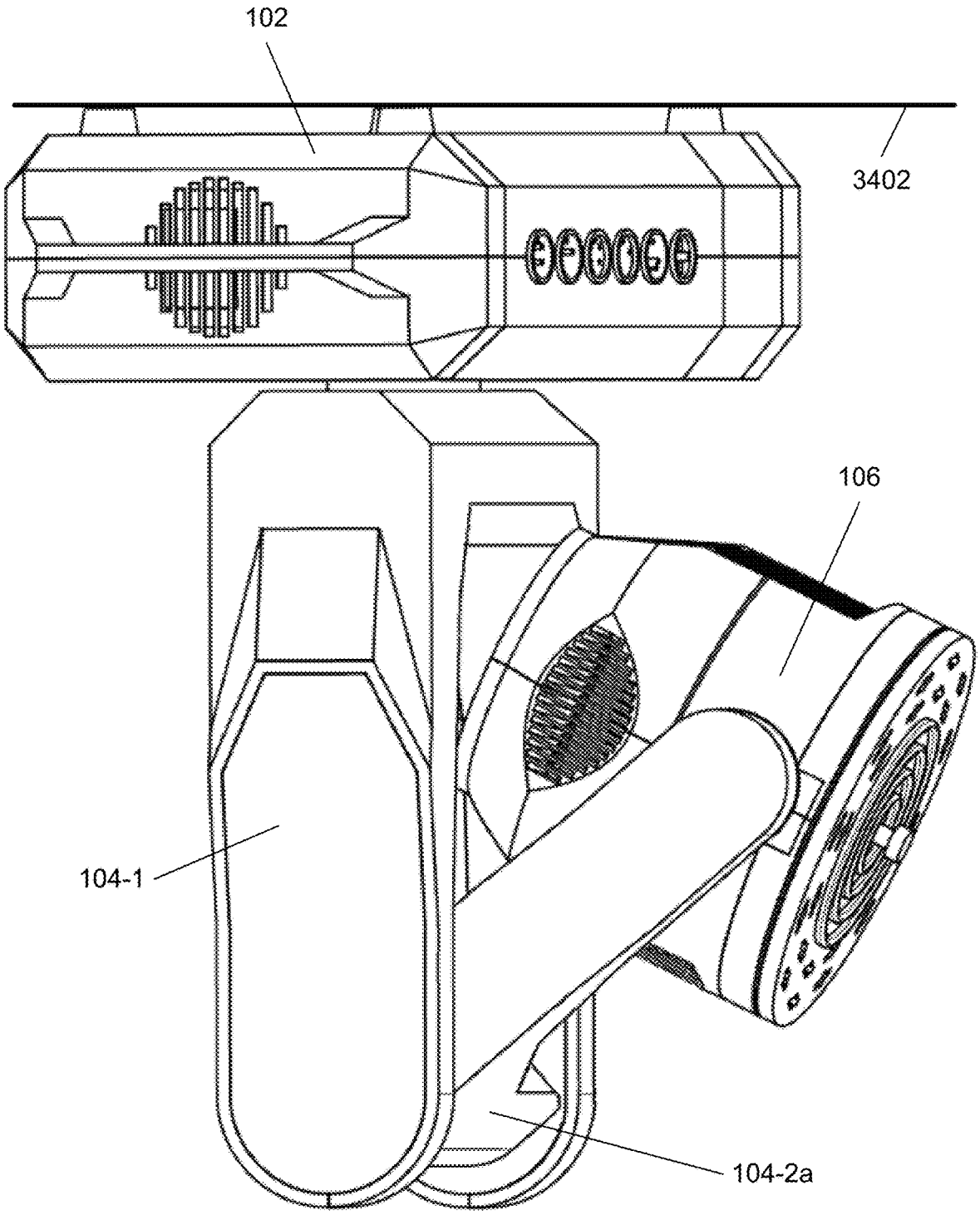



FIG. 36

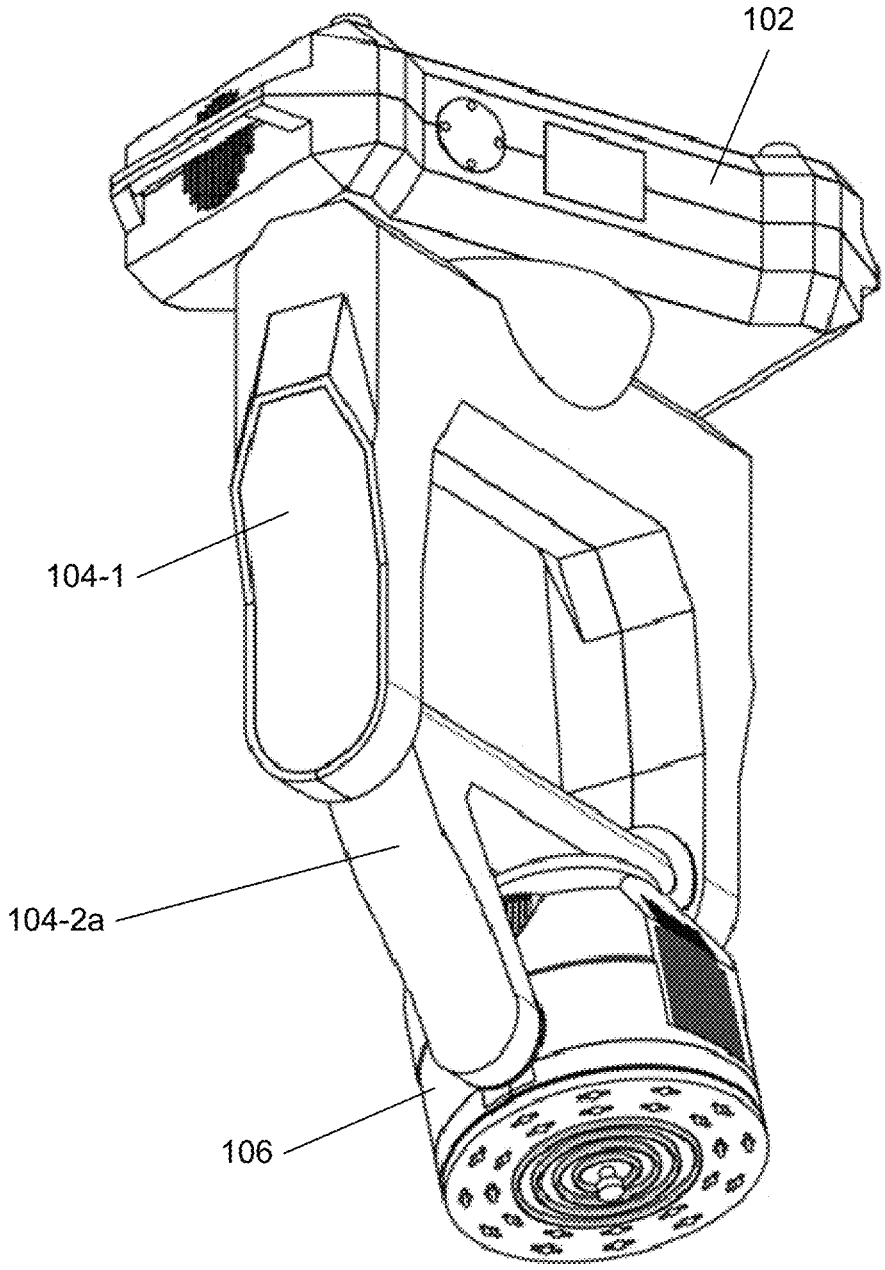



FIG. 37

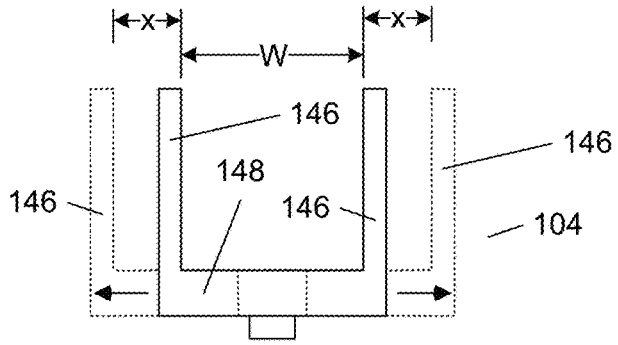



FIG. 38A

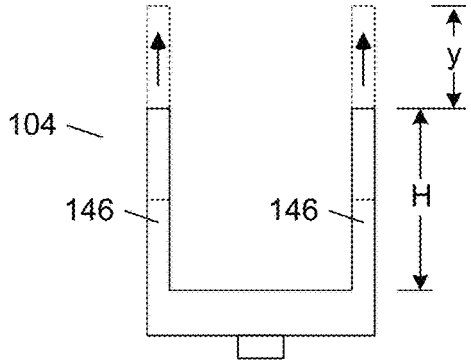



FIG. 38B

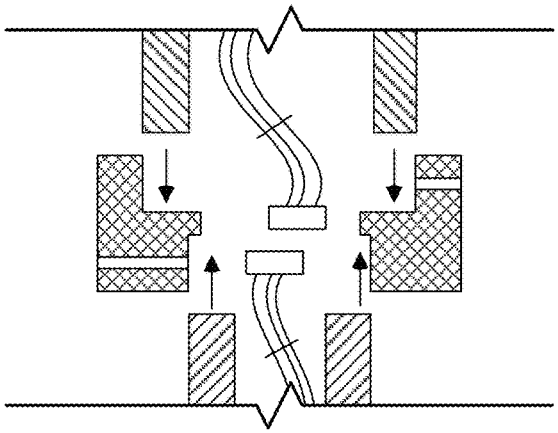


FIG. 39

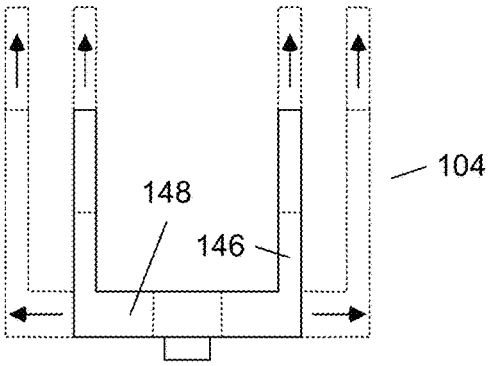



FIG. 38C

# MODULAR CONTROLLABLE LIGHTING FIXTURES

## FIELD OF THE INVENTION

This disclosure relates generally to lighting and, more particularly, to lighting equipment.

## BACKGROUND

Lighting and light shows are often used in different commercial and non-commercial venues to create, augment, or enhance the mood at an event or venue, such as for live events, television shows, concerts, plays, amusement park lighting, product launches, trade shows, experiential events, public-facing presentations, and the like. In order to do so, moving light fixtures, also referred to a automated lighting fixtures, are often used and, depending upon the specific event and lighting type desired, different size, types, forms or formats of lighting fixtures may be required.

In many cases, the lighting involved is not venue specific and permanently installed at the venue. Rather, the lighting is more commonly transported to a particular venue or location, set up for the event, and thereafter taken down and moved to a new venue for a new event or returned to a lighting rental provider. When moving to a new venue, each lighting fixture must be carefully packed or installed in a portable truss structure or array to transport while preventing damage during travel. Moreover, given the diverse lighting requirements that can be called for, in order to satisfy these diverse needs, a great deal of storage space, and lighting unit specific transporting cases, may be required to accommodate all the different size, types, forms or formats of lighting fixtures. Generally, the larger the lighting fixture, front lens or aperture, the more difficult they are to transport in rolling truss frames or other enclosed or partially enclosed structures.

## SUMMARY

One aspect of this disclosure involves a lighting fixture including a base, at least one yoke, comprising at least one arm and a shaft, the at least one yoke being coupled to the base via the shaft, and controllably, rotatably, moveable relative to the base via at least a first motor. The lighting fixture further includes a lighting head coupled to the at least one yoke, wherein the lighting head is controllably rotatably movable, relative to the at least one arm of the at least one yoke, via at least a second motor. The lighting head has a first extent at a lighting output side. The lighting fixture also includes a transition plate having multiple connection ports through which power can pass from the lighting head to a lighting array. The lighting array includes one or more lighting modules and has a second extent that is greater than the first extent of the lighting head. The lighting also head includes an electrically conductive coupling which will allow the transition plate to be rotated relative to the lighting head, through at least one revolution, while maintaining a continuous electrical path between the lighting head and lighting array when a particular lighting array is coupled to the transition plate and the transition plate is coupled to the lighting head.

Another aspect involves a transition plate for coupling to a lighting head of a lighting fixture. The transition plate includes a first surface, dimensioned for coupling to a lighting head of a lighting fixture, a second surface, dimensioned and shaped with at least two connection locations so as to allow at least one lighting module to be removably physically and electrically coupled to the transition plate at either of the at least two connection locations. The first surface includes at least one electrical contact element that will allow for electrical power to be uninterruptedly transferred from a contact on the lighting head to at least one lighting array, when the at least one lighting array is coupled to the transition plate and is controllably rotated, relative to the lighting head, through multiple revolutions.

The advantages and features described herein are a few of the many advantages and features available from the representative examples presented herein and are presented only to assist in understanding the invention. It should be understood that they are not to be considered as limitations on the scope defined by the claims, or limitations on equivalents to any part of the claims. For instance, some of the advantages or aspects described herein are mutually contradictory, in that they cannot be simultaneously present in a single implementation. Similarly, some advantages may be applicable to one described aspect, and inapplicable to others. Thus, features and advantages described should not be considered dispositive in determining equivalence. Additional features and advantages arising from the teachings herein will become apparent from the following description, from the drawings, and/or from the claims.



## BRIEF DESCRIPTION OF THE DRAWINGS

This disclosure is further described in the detailed description that follows, with reference to the drawings, in which:

FIG. **1** illustrates, in simplified form, a generic representation of modular controllable lighting fixture according to the teachings herein;

FIG. **2** illustrates, in simplified form, an alternative generic representation of modular controllable lighting fixture according to the teachings herein;

FIG. **3** illustrates, in simplified form, a portion of an example variant fixture showing a small portion of a base, and one example variant lighting head coupled to an example yoke;

FIG. **4** illustrates, in simplified form, an alternative view of a portion of the lighting fixture of FIG. **3**, more particularly, part of the side opposite the concentric rings;

FIG. **5** illustrates, in simplified form, an other alternative view of a portion of the lighting fixture of FIG. **3**;

FIG. **6** illustrates, in simplified form, another example lighting fixture according to the teachings herein;

FIG. **7** illustrates a partial cutaway view of a portion of the fixture and lighting module sub unit of FIG. **6** after the two have been coupled together;

FIG. **8** illustrates, in simplified form, an example lighting module made up of six of the sub units of FIG. **6**;

FIG. **9** illustrates, in simplified form one example of a portion of lighting fixture and lighting module that uses a transition plate to allow the lighting module to properly physically and electrically mate with the lighting head of the fixture;

FIG. **10** illustrates, in simplified form another example of a lighting fixture to which an alternative lighting module has been coupled;

FIG. **11** illustrates, in simplified form another example of a lighting fixture to which an other alternative lighting module has been coupled;

FIG. **12** illustrates, in simplified form, a partial cutaway view of a portion of a lighting fixture coupled to one alternative example of another transition plate;

FIG. **13** illustrates, in simplified form, a partial cutaway view of a portion of another configuration lighting fixture coupled to one alternative example of yet another transition plate;

FIG. **14** shows an underside view of a portion of one example transition plate along with a cutaway portion of a lighting head;

FIG. **15** is a partial exploded view of the example lighting fixture of FIG. **6** so that some of the example internal components can be seen;

FIG. **16** illustrates, in simplified form, a more complex lighting fixture according to the teachings herein;

FIG. **17** illustrates, in simplified form, the lighting fixture of FIG. **16** following removal of all but one of the lighting modules;

FIG. **18** is a side view of a portion of the lighting fixture of FIG. **17**;

FIG. **19** is a partial exploded perspective view of the transition plate and part of the arm removed from the lighting fixture of FIG. **16**;

FIG. **20** illustrates, in simplified form, a partial perspective view of an alternative lighting module suitable for use with the transition plate of FIG. **16**;

FIG. **21** illustrates, in simplified form, an alternative lighting fixture that shares the same base, yoke, lighting head and transition plate as the fixture of FIG. **16**;

FIG. **22** illustrates, in simplified form, another lighting fixture that shares the same basic components as shown in the fixtures of FIGS. **16** and **21**, except the yoke has a single arm and the lighting modules of FIG. **16** and FIG. **21** have been replaced with yet another different style lighting module;

FIG. **23** is a top view of the transition plate and lighting module of FIG. **22**;

FIG. **24** illustrates, in simplified form another lighting fixture that, again, uses the same basic components described herein, but now includes a lighting unit made up of two identical, arcuate (or substantially semicircular) lighting modules;

FIG. **25** is a partially exploded perspective view of the fixture of FIG. **24**, with one of the lighting modules removed;

FIG. **26** is a view that shows the underside of the lighting module of FIG. **24**

FIG. **27** shows a partially exploded view of a portion of a fixture with an alternative lighting module that is similar to the lighting module of FIG. **24**, except that it covers 90 degrees of arc;

FIG. **28** illustrates, in simplified form, a perspective view of yet another lighting module that is compatible with the transition plate described above;

FIG. **29** is a partially exploded view of the fixture and transition plate of FIG. **28**, after removal of the lighting sub units;

FIG. **30** is another partially exploded view of the supporting arms of FIG. **29**;

FIG. **31** illustrates, in simplified form, another lighting fixture that uses the same basic fixture components and transition plate previously described and includes individual lighting modules of a single lighting element each;

FIG. **32** illustrates, in simplified form, a lighting fixture that shares the same basic components base, single arm yoke, lighting head, and transition plate as in some of the previous fixtures, to which has been coupled a lighting module in the form of an arm having three linear rows of lighting elements;

FIG. **33** illustrates, in simplified form, a top view of an example of a compound lighting module made up of the transition plate and six complex lighting modules made up of pairs of the individual lighting modules of FIGS. **32** and **31**;

FIG. **34** shows an example basic lighting fixture, constructed according to the teachings herein, mounted to a ceiling or other overhead support;

FIG. **35** shows the same lighting fixture of FIG. **34**, except that the secondary yoke has been pivotably moved so that the lighting head is nearly fully extended;

FIGS. **36-37** illustrate a lighting fixture similar to that of FIGS. **34-35**, except that, in FIGS. **36-37**, the secondary yoke has a single arm;

FIGS. **38A-38C** illustrate, in simplified form, yokes that are extensible/retractable and suitable for use as described herein; and

FIG. **39** illustrates, in simplified form, one example approach that allows for swapping of yokes with a common base.

## DETAILED DESCRIPTION

With lighting fixtures, particularly those utilized to enhance performances, live events, television shows, concerts, plays, amusement park lighting and the like, innovation is key. Among users of such lighting fixtures, once something new and improved comes out, those in the industry race to both acquire the newest technology and often sell off older equipment to: fund the purchase of the newest technology, free up storage space, or simply to keep only the most current technology on hand. New lighting fixtures come out all year long and it is extremely cost prohibitive to try and keep up by purchasing newer, costly, lighting fixtures only to find that, shortly thereafter, a better or different fixture comes out that becomes more popular than what was purchased. It is difficult even for the largest of rental companies to keep up with the ongoing evolution of lighting fixtures before their existing fixtures are even paid for. Thus, if a new lighting fixture is introduced that would produce certain special/customized lighting effects that their current lighting could not do there is no choice but to purchase an entirely new lighting fixture.

In contrast, with modular controllable lighting fixtures based upon the teachings described herein, changing to a new form of lighting or adding new special/customized lighting effects is easy and does not require replacing an entire lighting fixture, since the basic assembly is maintained and only the new lighting elements need be added. In addition, unlike conventional automated lighting fixtures, the modular nature of controllable lighting fixtures constructed based upon the teachings described herein allows for more compact storage for transporting purposes.

As used herein, the term "yoke" is intended to have its conventional configuration of two arms but is also intended to be construed to include a single arm or support, offset from its shaft or another yoke to which it is connected.

Turning now to the figures, FIG. **1** illustrates, in simplified form, a generic representation of modular controllable lighting fixture **100** according to the teachings herein.

The modular controllable lighting fixture **100** is generally made up of a base **102**, at least one yoke **104** and a lighting head **106**. As will be described in greater detail below, the lighting head **106** is constructed so that any of multiple alternative lighting modules **108***a*, **108***b* can be coupled to the lighting head **106** either directly (as with the lighting module **108***a*) or indirectly via a transition plate **110**.

The base **102** houses various components involved in powering and control of the modular controllable lighting fixture **100**. Depending upon the particular implementation, a given modular controllable lighting fixture constructed according the teachings herein will have at least some of the following aspects, but need not have them all. Those aspects include, but are not limited to, a power input connector **112** via which power can be received via a plug **114** or another modular controllable lighting fixture (e.g., through "daisy chaining" of two or more lighting fixtures), a power on/off button or switch **116**, a power out connector **118** via which power can be provided to another lighting fixture (not shown) through "daisy chaining" them together. Depending upon the particular implementation, input power can be obtained from a conventional single phase 110/115 or 220/250 volt outlet, 3 phase outlet, or analogous outlets if configured for use outside the United States.

The base **102** of the modular controllable lighting fixture **100** also may include a data input **120** connector via which program and/or control data can be provided to the modular controllable lighting fixture **100**, and a data output **122** connector via which the modular controllable lighting fixture **100** can provide data to another modular controllable lighting fixture or an external control computer, or data can be read from this modular controllable lighting fixture **100**. Additionally, or alternatively, data input **120** and data output **122** can be handled via a wireless controller and appropriately placed wireless receivers such that a wired connection is unnecessary. In addition, with some variants, power on/off for the modular controllable lighting fixture **100** can be handled via the wired or wireless data connection such that a power button or switch is redundant or unnecessary. Likewise, additionally or alternatively, the wireless controller can be used to send data and/or control signals to a lighting array (or one or more of its sub components) so that the need for data or control wiring within the fixture **100** for controlling display by the lighting array is reduced and/or eliminated.

The base **102** further typically includes at least one power supply **124** (typically a switching power supply), typically up to a 2000 Watt power supply rated for up to 20 amp current draws. In addition, the base **102** advantageously includes space to add one or more additional power supplies **124***a*, **124***b* so that the same lighting head **106** can be used with higher power drawing lighting modules without the need to purchase an entirely new fixture. Optionally, the base **102** can further include a direct current (DC) input receptacle **126** via which an additional portable or permanent DC power supply can be connected to provide additional power if needed for the specific configuration. To potentially accommodate later use of high powered lighting array components and/or assemblies, at manufacture the lighting fixture can be internally wired with wiring of sufficient gauge to accommodate that higher power draw so that the base and/or yoke need not be rewired or discarded. In some implementations, power supplies that convert alternating current (AC) to DC may be omitted if DC power can be supplied directly to the base **102** for lighting arrays that only require DC.

The base of the modular controllable lighting fixture **100** may also include an internal microcomputer/microcontroller/motherboard **128** made up of, for example, one or more processors **130**, memory **132**, non-transitory storage **134** and I/O **136**. The microcomputer/microcontroller/motherboard **128** can be used, for example, to program complex lighting effects "on the fly" or to run pre-programmed lighting effects directly, or based upon data received by the modular controllable lighting fixture **100**. This may involve, for example, incorporating an implementation in accordance with the Remote Device Management (RDM) and/or Architecture for Control Networks (ACN) standards. RDM is a protocol that allows for bi-directional communication between a lighting system controller or other computer-based system controller and attached RDM compliant devices over a standard digital multiplex (DMX) line to allow configuration, status monitoring, and management of implementing devices, at present, according to the "ANSI E1.20-2010, Remote Device Management Over DMX512 Networks" standard. Architecture for Control Networks (ACN) is a suite of network protocols for control of entertainment technology equipment, particularly as used in live performance or large-scale installations, for example, lighting, audio or special effects equipment, at present, according to the "ANSI E1.17-2010, Entertainment Technology—Architecture for Control Networks" standard. ACN runs over most IP transports including Ethernet and Wi-Fi (802.11) networks as well as optical fiber and/or coaxial cabling.

The base **102** may also include a display **138** via which information about the operation or programming of the modular controllable lighting fixture **100** can be viewed, for example, the "starting address" of the fixture **100** and/or the channel the fixture **100** is running on. The display may also be used to display other information such as data flow to/through the fixture **100**, power consumption and/or current draw (which, due to the interchangeability of different lighting modules and ability to add one or more additional power suppl(y/ies), can provide important information, hours of operation or other measurements). The display **138** can also be used to input information, for example, if it incorporates a touch screen. Additionally, or alternatively, any other appropriate form of input (e.g., keyboard. touch pad, joystick, etc.) can be provided, along with other auxiliary or ancillary connectors, for example, a USB or other receptacle to connect another device (e.g., a phone or other unit to perform programming, upgrade software or run diagnostics). As shown, the input **140** is a type of toggle input found on may remote control hand units.

Internally, the base **102** also typically includes one or more servo or stepper motors **142** that are used to rotate the yoke **104** through some arc which, depending upon the particular implementation, can be any arc up to a full 360 degrees or more.

Finally, the base **102** will typically include one or more heat sinks and/or conventional fans (not shown), and associated fenestrations/venting, to transfer heat from the internal components out of the base **102**.

A yoke **104** of the lighting fixture **100** is made up of a shaft **144**, at least one, but more typically two, arm(s) **146**, and a crossbar **148** that couples the shaft **144** to the arms **146**. As alluded to above, a portion **150** of the shaft **144** is coupled to the one or more servo or stepper motors **142** in a conventional manner, for example, by one or more gears, linkages, belts, chains, etc. to controllably, and accurately, rotate the yoke **104** to specific and/or random positions.

Alternatively, in some implementations, the servo or stepper motors **142** can be contained within the yoke **104** instead of being within the base **102**.

In addition, the yoke **104** arms **146** may contain at least one, and more likely two, servo or stepper motors **152***a*, **152***b* that are coupled to the lighting head **106** (again, conventionally, via, for example, by one or more gears, linkages, belts, chains, etc.) to enable the lighting head **106** to be controllably moved through an arc, typically of at least

270 degrees, but which could be in the vicinity of 330 degrees and, in some less common cases, 360 degrees. Alternatively, the at least one, and more likely two, servo or stepper motors **152***a*, **152***b* that are coupled to the lighting head **106**, can be located within the lighting head **106**. In general, the angle range for movement is not limited as a technical matter, but rather is more a function of the size of the base **102** and the fact that, beyond a certain amount of arc in either direction, the projected light will be blocked by the base **102** or a particular lighting module will contact some other part of the fixture **100** or the component (e.g., truss, wall, ceiling, support, frame, beam, gantry, etc.) to which the fixture **100** is mounted.

Optionally, the yoke **104** may also include one or more locking mechanisms **154***a*, **154***b*. The locking mechanisms **154***a*, **154***b* each are a type of latch that will, for example, lock the yoke **104** in place (mechanism **154***a*) relative to the base **102** and/or lock the lighting head **106** in place (mechanism **154***b*) relative to the yoke **104**, to prevent movement (and potential damage) of some part of the fixture **100** during handling, packing, unpacking or transport. FIG. **2** illustrates, in simplified form, an alternative generic representation of modular controllable lighting fixture **200** according to the teachings herein. The lighting fixture **200** of FIG. **2** is similar to the lighting fixture of FIG. **1** except that it has two yokes **104***a*, **104***b*, one of which is connected to the base **102** as in FIG. **1**. However, unlike the fixture **100** of FIG. **1**, the first yoke **104***a* is coupled to the lighting head **106** via a second yoke **104***b*. In addition, in this configuration, the at least one, and more likely two, servo or stepper motors **152***a*, **152***b* are coupled to the second yoke **104***b* (again, conventionally, via, for example, by one or more gears, linkages, belts, chains, etc.) to enable the second yoke **104***b* to be controllably moved through an arc of, typically, up to 360 degrees. Likewise, the second yoke **104***b* includes at least one, and more likely two, servo or stepper motors **152***c*, **152***d* that are coupled to the lighting head **106** (again, conventionally, via, for example, by one or more gears, linkages, belts, chains, etc.) to enable the lighting head **106** to be controllably moved through an arc as described in connection with FIG. **1**. Alternatively, the second yoke **104***b* can be connected to the first yoke **104***a* via a motor driven drive shaft. Similarly, locking mechanisms **154***a*, **154***b*, **154***c* can be provided to lock the yokes **104***a*, **104***b* in place during handling, packing, unpacking or transport. Advantageously, by having two yokes **104***a*, **104***b*, one within the other, as can be seen in FIG. **2**, the lighting fixture **200** can be more compact when not in use, and can have a greater "reach" when in use, allowing for greater movement, and accommodation, of larger format lighting modules, which is particularly useful when the lighting array may otherwise be impeded by the structure to which it is attached or some nearby structure.

Referring now to both FIG. **1** and FIG. **2**, a key advantage of lighting created according to the teachings herein is that, despite the fact that the lighting heads **106** have a given extent (width or diameter) $W_1$ measured at the lighting output side, such lighting allows for use of lighting arrays that, when coupled to the lighting head **106** have a greater overall extent $W_2$ than at least the lighting head **106** and, in many implementations, the width of the yoke arms (if two arms) or, if a single yoke arm, between a single yoke arm and its implied mirror image.

FIG. **3** illustrates, in simplified form, a portion **300** of an example variant fixture **100** showing a small portion of a base **102**, and one example variant lighting head **106** coupled to an example yoke **104**. As shown, the lighting head **106** includes two concentric, electrically conductive rings **302**, **304** via which power can be provided to one or more lighting modules (not shown), when coupled to the lighting head **106**. This configuration allows a lighting array to be rotated relative to the lighting head **106** without interruption of the flow of electricity.

In addition, the lighting head **106** may also include internal lighting control circuitry and or wiring to allow for specific control of the lighting of components of a connected lighting module. As shown, the lighting head **106** of FIG. **3** also optionally includes a third ring **306**, via which data signals can be provided to a connected lighting module to specify or control whether individual lights of a connected lighting module should be on or off at a given point in time, even if the lighting module (or some component(s) thereof) may moving relative to the lighting head **106** at the time. Advantageously, depending upon the particular implementation, the specific number of rings that will be present can be set to accommodate whatever power, control, and/or data is or may be used. Thus, additional rings may be provided to allow for, for example, concurrent use of different voltage levels and/or different concurrent data signals. Moreover, depending upon the particular implementation, optional controllable switching inside the lighting head, can allow for a given ring of the lighting head **106** to provide power for one type of lighting module, and by changing the switching, that same ring can be used to provide a low voltage data signal for a different type of lighting module. Still further, although the rings **302**, **304**, **306** are shown as being within the peripheral boundary (i.e., extent $W_1$) of the lighting head **106**, any one or more of the rings **302**, **304**, **306** could alternatively be located at the periphery, or even on (or at some specified distance from) the outer surface of the lighting head, for example, to accommodate even larger lighting modules while maintaining electrical conductivity during rotation, or to serve as auxiliary support(s) for one or more lighting elements or modules that are not intended to rotate.

Still further, the lighting head **106** may include other conventional components, such as one or more cooling fan(s) and/or fins or heat sink(s) and, for example, ventilation fenestrations **308**.

Finally, as will be discussed below, the lighting head **106** may include a coupling (not shown) on a side opposite the concentric rings, to which counterbalance weight(s) may be attached to counterbalance different lighting modules that might be coupled to the lighting head **106**. This can reduce the torque applied to, and prolong the life of, the motor(s) and/or enable smoother operation of the lighting fixture **100**.

FIG. **4** illustrates, in simplified form, an alternative view of a portion **400** of the lighting fixture **100** of FIG. **3**, more particularly, part of the side opposite the concentric rings. As can now be seen, this side includes a coupling **402** to which a rod **404** or other element may be connected. The rod **404** or other element is shaped so as to be able to variably optionally accept one or more weights **406** to offset/counterbalance **408** (in whole or part) weight modification incurred by interchanging, or attachment of one or more, lighting modules and/or a transition plate or adapter as will be described below. As shown, the rod **404** or other element is a single straight round bar.

FIG. **5** illustrates, in simplified form, an other alternative view of a portion **500** of the lighting fixture **100** of FIG. **3**. As can be seen from FIG. **5**, for some lighting modules, it may be impractical or undesirable to counterbalance a given lighting array by merely adding weight to the lighting fixture **100**. Advantageously, with some implementations of the lighting fixtures constructed in accordance with the teach-

ings herein, different length and/or orientations of rods or other elements can be connected to the coupling **402** so as to use the effect of a longer moment arm and less weight to offset (in whole or part) the weight of an attached lighting module and/or to make sure that a longer rod **404***a* and weights **406** do not interfere with the particular lighting modules attached to the lighting fixture **100**. As shown in FIG. **5**, an end **502**, opposite the end **504** of the longer rod **404***a* that connects to the coupling **402**, is connected to an extension joint **506** (in FIG. **5**, shown as angled 90 degrees), which, in turn, is connected to an end **508** of the short rod **404**. Advantageously, with different implementations, other size/length/shape extension joints (straight, curved, angled, etc.) can be used, as can different size/length/shape rods in order to provide sufficient weight offset within an acceptable amount of space and without interfering with the operation of any part of an attached lighting module.

As mentioned previously, the lighting fixture is optimally constructed so that any of multiple (2 or more) different modular light arrays (bearing in mind that different configurations of the same basic modular light array are intended to be considered different modular light arrays) can be physically and electrically coupled to a lighting head **106**, as mentioned above, so as to advantageously create, in effect, different lighting fixtures and provide different lighting effects, from the same basic lighting fixture. Of course, one need only use just one removable light array with a given lighting fixture **100**, although, obviously, some advantages will be sacrificed.

In simplified overview, a lighting module, as that term is used herein, is made up of multiple lighting sub units that can individually be coupled to/decoupled from a lighting head **106**. Each of the multiple lighting sub units is made up of at least one lighting element (e.g., a light bulb (e.g., incandescent, halogen, fluorescent, high intensity discharge, etc.), a light emitting diode (LED), a laser diode, etc.) or an OLED or other display), a supporting structure, and any appropriate electrical and/or data path(s) needed to so that power (and/or data) can get from the lighting head **106** to the particular lighting element(s). A lighting module can also be or include a video display. Optionally, a lighting module can further include some structure(s) for cooling the lighting elements (e.g., ventilation fenestrations, fins, heat sink(s), a fan, etc.). Depending upon the particular implementation, the lighting elements can be placed anywhere on the lighting module (i.e., on a single surface or on multiple surfaces).

FIG. **6** illustrates, in simplified form, another example lighting fixture **600** according to the teachings herein. As shown, the lighting head **106** includes four concentric connection rings **602**, **604**, **606**, **608** through which, in this example, power and data can be transferred to a sub unit **610** of a lighting module. The sub unit **610** is made up of multiple lighting elements **612** and an associated supporting structure **614**. As shown in FIG. **6**, the supporting structure **614** physically couples to the lighting head **106** by hooking part of an end **616** of the supporting structure **614** under a retaining post **618** and pivoting the supporting structure in the direction of arrow "A" until a recessed surface **620** in the supporting structure **614** abuts a surface **622** of the lighting head **106**, at which point, one or more locking screws **624** can engage matingly corresponding openings **626** to lock the sub unit **610** into place. Alternatively, in some implementations, other fastening elements, for example, magnets, clips, etc. can be used in addition to, or in place of, locking screws.

At this point it is worth noting that some variants can be constructed such that one portion **630** of the lighting head **106** is rotatable relative to another portion **632** of the lighting head, in order to allow the sub unit(s) **610** to rotate relative to that "fixed" portion **632**. In such a case, even if the two portions **630**, **632** are part of the lighting head, the rotateable portion **630** is deemed to be a transition plate as will be described below.

FIG. **7** illustrates a partial cutaway view of a portion (**628** of FIG. **6**) of the fixture **600** and lighting module sub unit **610** of FIG. **6** after the two have been coupled together. As can be seen in the cutaway of FIG. **7**, the supporting structure **614** includes conductive contacts **702**, **704**, **706**, **708** that correspond to, and form a conductive path with, the rings **602**, **604**, **606**, **608** to allow for, in this case, power **602**, **608**, **702**, **708** and data, **604**, **606**, **704**, **706** to pass between the lighting head **106** of FIG. **6**. and the sub unit **610**.

FIG. **8** illustrates, in simplified form, an example lighting module **800**, in this example, made up of six of the sub units **610** of FIG. **6**. It should now be appreciated that, based upon the opening **626** in the surface **622** of the lighting head **106** of FIG. **6**, advantageously, as few as one of these sub units **610** and as many as twelve of these sub units **610** could be used with the same lighting fixture **600**. Thus, from even this simple fixture **600**, multiple different lighting configurations and/or beam spreads, can be created, and/or effects produced, without the need to purchase an entirely new lighting fixture. Accordingly, it should be understood that, depending upon the particular transition plate design, any number of lighting modules can be used provided there is sufficient physical space for them. Still further, by creating a transition plate with multiple surfaces **622** arranged in tiers, even more lighting modules can potentially be attached than could otherwise be attached.

Now, in some cases, there may be a need or requirement for a particular lighting array that may not be directly compatible with the lighting head of the particular implementation for some reason. Advantageously, in accordance with the teachings herein, the lighting array may still be able to be accommodated through use of a removable transition plate. In simplest form, where it is not part of the lighting head merely to provide rotational capability, the transition plate is simply a device that mechanically and electrically provides two sides, one side compatible with the physical and/or electrical connections of the lighting head and the other side compatible with the physical and/or electrical connections of the particular lighting array. More complex transition plates may include additional lights, motors, gears, computer controls, mirrors, or other desirable components. Advantageously, the transition plate provides significant flexibility because, depending upon the circumstances: a) various sub units can be attached prior to transport as a pre-configured arrangement, and then the transition plate with its sub units can be attached to the lighting head on site, or b) different sub units can be transported separately and compactly, and configured on the transition plate on site. Moreover, the transition plate approach allows for the lighting fixture to be installed first, at one point in time and, at a different time thereafter, a transition plate with a particular configuration of sub units can be attached and, at a still later time, that configuration of sub units can be replaced by a new configuration of sub units without removing the lighting fixture, or a wholly different transition plate (with its associated lighting) can be substituted. Still further, the modular nature arising from the use of the transition plate allows for flat pack shipment of components and/or more compact packaging for transport.

FIG. **9** illustrates, in simplified form one example of a portion of lighting fixture **100** and lighting module **900** that

uses a transition plate **902** to allow the lighting module **900** to properly physically and electrically mate with the lighting head **106** of the fixture **100**. As shown, the transition plate **902** *f* FIG. **9** includes a series of additional lighting modules **904** about the periphery. Depending upon the particular implementation, these additional lighting modules **904** may be independently controlled (individually or as a group) independent of the lighting elements of the lighting array **900**. As shown, each arm **906** of the lighting module **900** includes an arrangement of multiple lighting elements **908** longitudinally along the length of each arm **906**. Likewise, depending upon the particular implementation, the lighting elements **908** may be individually controlled, or controlled in groups.

Advantageously, as noted above, each arm **906** is individually removably coupled to the transition plate **902**, so that different numbers, sizes or lengths of arms **906** can be used with the same lighting head **106**.

In addition, some implementations of the arms **906** can optionally include a removable end cap **910** that will expose connections (physical and/or electrical) and allows an extension arm, containing additional lighting elements, to be attached to the end of an arm **906**, either longitudinally, to simply be a linear extension of the arms **906**, at a fixed angle, or via a movable hinge, swivel or pivot, to allow the extension arms to be positioned at different angles relative to the arms **906**. Still further, some additional variants of the arms **906** or extension arms can include a small servo or stepper motor or other mechanism (e.g., cabling) that can be used to move an extension arm during a lighting show in order to create a specific lighting effect.

FIG. **10** illustrates, in simplified form another example of a lighting fixture **100** to which an alternative lighting module **1000** has been coupled. As shown, this lighting module **1000** includes six of the arms **906** of FIG. **9**, in which the end caps have been removed and extension arms **1002** have been attached. Depending upon the particular implementation, the extension arms **1002** can be fixed in position, or can be movable during use, via, for example using a motorized a movable hinge, swivel or pivot **1004**, a cam, gears, or an arrangement of one or more cables that allows the extension arms **1002** to be moved during use.

FIG. **11** illustrates, in simplified form another example of a lighting fixture **100** to which an other alternative lighting module **1100** has been coupled. As shown, each arm **906** of this lighting array is made up of two or more (as shown, three) telescoping, lighting elements-containing, segments **1102**, **1104**, **1106**. Again, depending upon the particular implementation, the segments may be constructed so that they can be manually extended and fixed in place, or they can be repositioned, using a small servo or stepper motor or other mechanism (e.g., cabling), during set up or when in use.

Having described some of the basic different types of configurations of lighting that can be implemented using some different example combinations of lighting fixture, transition plate, and lighting modules, it is to be appreciated that, by applying the teachings herein, much more sophisticated configurations can readily be constructed that allow for great variations in lighting capabilities, using a single lighting fixture **100**.

In that regard, FIG. **12** illustrates, in simplified form, a partial cutaway view of a portion of a lighting fixture **100** coupled to one alternative example of another transition plate **1200** which, itself, incorporates a lighting array and can advantageously be used with a lighting fixture **100** as described herein. As a side note, it should be understood that, advantageously, in some cases, a transition plate that contains lighting elements can be used, by itself, in connection with a lighting fixture as described herein. The transition plate **1200** shown therein includes six lighting elements **1202** that can each be controllably pivoted from vertical **1204** in the directions of the arrows labeled "A" and "B". The pivoting is accomplished, in this example, by virtue of the lighting elements **1202** being connected to a retaining disk or spool **1206** using a pair of gears **1208**, **1210**; rotational movement of the first gear **1210** via a stepper motor or servo causing opposite rotational movement of the second gear **1208** and corresponding movement of the lighting element **1202**.

FIG. **13** illustrates, in simplified form, a partial cutaway view of a portion of another configuration lighting fixture **100**, in this example, coupled to one alternative example of yet another transition plate **1300**. As shown, this transition plate **1300** includes a series of spools **1302** around each of which are wrapped a lighting strip **1304** containing a set of lighting elements **1306**. A gear train, in this example, made up of three gears **1308**, **1310**, **1312** is driven by a worm gear **1314** to cause the associated lighting strip **1304** to extend from, or retract into, the interior of the transition plate **1300**. Depending upon the particular implementation, the lighting strips can actually extend into, or retract from, arms (not shown) that provide support for the lighting strips **1304**. Alternatively, in use, the portion of the lighting strips that are outside the interior of the transition plate **1300** can be unsupported so that, for example, they can swing freely if the transition plate **1300** is rotated relative to the lighting head and/or if the lighting head is moved relative to the yoke(s) **104** and/or base **102**.

Alternatively, with respect to FIG. **12** or FIG. **13**, in lieu of gears, other elements can be used to cause light element movement, such as solenoids, linkages, guides, slides, Geneva mechanisms etc., by themselves or in combination with each other or one or more gears.

FIG. **14** illustrates, in simplified form, an example mechanism that can be used to rotationally move a transition plate relative to a lighting head to which it is attached.

More particularly, FIG. **14** shows an underside view of a portion **1400** of one example transition plate **1402** along with a cutaway portion **1404** of a lighting head, as described herein, taken through a plane parallel to a junction between the transition plate **1400** and lighting head, with the part of the lighting head that was cut through indicated by cross-hatching. As shown, there is a ring gear **1406** that is affixed to, or part of, the lighting head and another ring gear **1408** that is affixed to, or part of, the transition plate **1402**. A pinion gear **1410** is positioned in between the two ring gears **1406**, **1408** and coupled to a motor either in the lighting head (not shown) or in the transition plate **1402** such that rotation of the pinion gear **1410** will cause the transition plate to rotate. Of course, other variant implementations can use, for example, a single ring gear on one of the transition plate or lighting head and a pinion gear on the other of the transition plate or lighting head such that, direct rotation of the pinion gear causes the transition plate to rotate. Still other example implementations can use crank arrangement, to convert some form of linear motion into rotational motion, or a simple shaft **1414** locked to a gear or other element by a key **1416**, a chain drive, belt drive, or any other approach suitable for rotating a transition plate relative to the lighting head to which it is attached, the important aspect being the ability to rotate the transition plate through more than 360 degrees, not the specific mechanism used to do so.

In addition, as can be seen in FIG. **14**, similar to FIG. **7**, the transition plate **1402** includes contacts **1412** through which power and/or data can pass between the lighting head **160** and lighting elements that are coupled to the transition plate **1402**. The contacts **1412** are spring loaded such that they will ride on the conductive rings of the lighting head during rotation of the transition plate **1402**, irrespective of the orientation of the lighting head **106** relative to the base **102** of the lighting fixture **100**. Of course, some variants can be constructed such that the conductive rings are on the transition plate and the contacts **1412** are on the lighting head. Again, the important aspect is the ability to provide for electrical conductivity (for power and/or data) between the lighting head **106** and a connected transition plate that will remain continuous while the transition plate rotates, not the particular components by which this is accomplished. FIG. **15** is a partial exploded view of the example lighting fixture **100** of FIG. **6** so that some of the example internal components can be seen, for example, a motor **1502** within the base **102** that uses a belt drive **1504** about a pulley wheel **1506** to rotate the shaft of the yoke **104**. At least one fan **1508**, located in the base **102** keeps the motor **1502** cool. A motorized chain drive **1510** (i.e., chain connecting at least two gears) resides in the yoke **104** and is used to rotate the lighting head **106** relative to the yoke **104**.

At least one fan **1512** is also optionally located within the yoke **104** to keep the motorized chain drive **1510** cool. Similarly, the lighting head **106** includes at least one fan **1514** that is used to keep the components in the lighting head **106** and, in some implementations, the movable portion **630** (i.e., transition plate), cool.

With respect to the foregoing, it is to be understood here that any appropriate approach to keeping the components of the lighting fixture cool can be used; no particular arrangement or placement of fans or fenestrations is required. Likewise, no particular specific shape of the outer housings of the base **102**, yoke **104** and/or lighting head **106** are to be implied from the drawings or descriptions herein.

Likewise, the illustrated placement of motors is only intended to be exemplary, implementations can place the motor(s) anywhere convenient provided that they directly or indirectly (through other components such as gears, linkages, cables, belts, chains, etc.) can effect the relevant movement of the appropriate component(s).

Finally, as noted above, some implementations of the base **102** optionally include extra expansion space **1516** to allow for addition of additional power supplies (e.g., to match the power demands of particular lighting module configurations) or other components (e.g., controllers, microprocessors, wireless receivers, etc.) as appropriate for the particular implementation variant.

FIG. **16** illustrates, in simplified form, a more complex lighting fixture **1600** according to the teachings herein. As shown, this variant has a larger transition plate **1602** that, as shown, includes the capability to attach up to twelve individual lighting modules **1604**. Again, as an aside, the number of lighting modules is generally limited by the physical space and some transition plates can be constructed in a tiered configuration to allow for attachment of more lighting modules than could be attached in a single plane due to physical limits.

Each of the individual lighting modules **1604** is made up of an arm **1606** containing an array of lighting elements **1608** along a common surface of the arm **1606**. Each arm **1606** is connected to the transition plate **1602** by a controllable pivoting mechanism **1610** which is partially enclosed in a housing **1612**.

As fenestrated cover **1614** on the transition plate **1602** provides for passage of cooling air through the transition plate **1602**.

FIG. **17** illustrates, in simplified form, the lighting fixture **1600** of FIG. **16** following removal of all but one of the lighting modules **1604**. In addition, in FIG. **17**, one side of the housing **1612** has been removed so that the pivoting mechanism **1610** components can be viewed. With this configuration, pivoting of an arm **1606** is accomplished using a servo or stepper motor **1702** to rotate a worm gear **1704** which, in turn, rotates a fixed gear **1706** on the arm **1606** to cause the arm **1606** to pivot relative to the transition plate **1602**.

Also visible in FIG. **17** are the wires **1708** that that make up part of the electrical path to the lighting elements **1608** from the connectors **1710** on the transition plate **1602**.

The housing **1612** is ideally shaped so that arms **1606** inserted into the transition plate **1602** are held solidly in place during use (i.e., to prevent undesirable radial or tangential movement) when the transition plate **1602** is rotated.

FIG. **18** is a side view of a portion of the lighting fixture **1600** of FIG. **17**. FIG. **18** illustrates that the arm **1604** can pivot through a range of +/−0 relative to the position shown in FIG. **17** through use of the pivoting mechanism **1610** of FIG. **17**. As shown, the full range of sweep for this type of arm **1606** is in the range of approximately 230 degrees of arc.

FIG. **19** is a partial exploded perspective view of the transition plate **1602** and part of the arm **1606** removed from the lighting fixture **1600** of FIG. **16**. In FIG. **19**, the fenestrated cover **1614** has been removed to reveal an internal fan **1902** that is used to cool the transition plate **1602** and, in some variant implementations, to aid in cooling any lighting modules coupled to the transition plate **1602**.

FIG. **20** illustrates, in simplified form, a partial perspective view of an alternative lighting module **2000** suitable for use with the transition plate **1602** of FIG. **16**, where part of the housing **1612** has been removed to reveal the internal components. As shown, the lighting module **2000** is made up of an arm **2002** containing a linear array of individually controllable lighting elements **2004**. This arm **2002** incorporates two wires **2006**, **2008** along with a data line **2010** that is used to control, for example, whether a particular lighting element **2004** is on/off at a given time during use as specified by controller circuitry **2012**. In addition, the arm **2002** contains ventilation openings (not shown) that work in conjunction with a fan **2014** located within the lighting module **2000** to cool the lighting elements **2004**.

FIG. **21** illustrates, in simplified form, an alternative lighting fixture **2100** that shares the same base **102**, yoke **104**, lighting head **106** and transition plate **1602** as the fixture **1600** of FIG. **16**, but replaces the lighting module **1604** with the lighting module **2000** of FIG. **20**. Thus, the advantages and elegance of lighting fixtures employing the teachings herein can be more readily understood.

By employing the teachings herein, and using only the lighting modules **1604** of FIG. **16** and the lighting modules **2000** of FIG. **20**, numerous different permutations and combinations of lighting fixtures can be created, involving different numbers of lighting modules, their placement, patterned combinations of lighting modules **1604**, **2000** for use at different times without the need to purchase different individual conventional lighting fixtures for each different configuration.

FIG. **22** illustrates, in simplified form, another lighting fixture **2200** that shares the same basic components

described above (i.e., base **102**, yoke **104***a*, lighting head **106** and transition plate **1602**) and as shown in the fixtures of FIGS. **16** and **21**, but the fixture **2200** of FIG. **22** differs in that the yoke **104***a* has a single arm and the lighting modules **1604**, **2000** of FIG. **16** and FIG. **21** have been replaced with yet another different style lighting module **2202**.

FIG. **23** is a top view of the transition plate **1602** and lighting module **2202** of FIG. **22**. As can be seen, the housing **1612** of this lighting module **2202** is of a shape in common with the housings **1612** of FIG. **16** and FIG. **21**, and it contains a some of the linear series of lighting elements **2004**, but also contains individual lighting elements **2302** each located within an individual parabolic reflector/mirror **2304** in order to be able to present different lighting effects from those that the lighting modules **1604**, **2202** of FIG. **16** and FIG. **20** would provide.

Up to now, the various different configurations presented have involved lighting modules that were essentially individual linear arms. However, advantageously, lighting fixtures incorporating the teachings herein are not limited at all to those style configurations. As will now be seen, a significant advantage to the approaches described herein is that, by using a compatible connector configuration (e.g., size, shape and/or contacts) to what is present on a given transition plate, any of numerous different configuration lighting module(s) can be used without purchasing a new basic fixture **100**. Moreover, as a further advantage, to the extent that different voltages or additional power may be required for a given lighting module configuration, the expansion space within the base allows for incorporation of different or additional power supplies and, because the wiring within the basic lighting fixture **100** is generally well oversized, rewiring of the basic lighting fixture **100** will not typically be required. Still further, some implementations include modularized or readily accessible wiring within the base **102** and yoke(s) **104** so that, if rewiring is ever required, due to a need to accommodate higher power, or simply for purposes of repair, that can readily be accomplished as well.

FIG. **24** illustrates, in simplified form another lighting fixture **2400** that, again, uses the same basic components described above, but now includes a lighting unit made up of two identical, arcuate (or substantially semicircular) lighting modules **2402***a*, **2402***b*. Each lighting module **2402***a*, **2402***b* includes a series of radially extending rows **2404** of lighting elements **2406** which, as shown, also create a series of concentric circles. Depending upon the particular implementation, the lighting elements **2406** can be individually controllable, controllable by radial row, and/or controllable as circles, etc. to present entirely different lighting effects.

FIG. **25** is a partially exploded perspective view of the fixture **2400** of FIG. **24**, with one of the lighting modules **2402***b* removed in order to show the housings **2502** that are shaped to physically, matingly, conform to the corresponding recesses of the transition plate **1602**, include matingly corresponding electrical contacts that provide electrical connectivity to the transition plate contacts, and further contain the electrical circuitry to light the lighting elements.

FIG. **26** is a view that shows the underside of the lighting module **2402***a* of FIG. **24** to show the electrical contacts **2602** on the underside of the housings **2502**.

Although, FIGS. **24-25** illustrate substantially semicircular lighting modules **2402***a*, **2402***b*, it should be appreciated that other shapes, for example, arc segments could be used, whether spanning (at the periphery) more than 180 degrees, or less than 180 degrees. Indeed, based upon the fact that the transition plate **1602** of the previous few figures has 12 connection locations, lighting segments covering arcs of 30 degrees or more can be used.

By way of simple example, FIG. **27** shows a partially exploded view of a portion of a fixture **2700** with an alternative lighting module **2702***a* that is similar to the lighting module **2402***a* of FIG. **24**, except that it covers 90 degrees of arc (i.e., a quarter of a circle).

Still further, individual lighting module segments of different sizes can be created for use individually and/or in various permutations or combinations to create diverse lighting effects.

FIG. **28** illustrates, in simplified form, a perspective view of yet another lighting module **2800** that is compatible with the transition plate **1602** described above. As shown, this lighting module **2800** is made up of individual quarter-arc lighting sub units **2802***a*, **2802***b*, **2802***c*, **2802***d* that include their own sets of lighting elements, so they can be used individually, or in various permutations and combinations, and which, in full combination as shown, visually form four concentric rings.

FIG. **29** is a partially exploded view of the fixture **100** and transition plate **1602** of FIG. **28**, after removal of the lighting sub units **2802***a*, **2082***b*, **2802***c*, **2802***d* in order to show the underlying supporting arms **2902**. As shown, the supporting arms **2902** include terminal portions **2904** that are shaped for physical compatible connection to the transition plate, and further include, on the underside, electrical connections (not shown) that are plug-compatible with the electrical connectors on the transition plate **1602**. In addition, the supporting arms contain connection points **2904** that are used to form a physical and electrical connection between any attached lighting sub units **2802***a*, **2082***b*, **2802***c*, **2802***d* and power and/or data from the transition plate **1602**.

FIG. **30** is another partially exploded view of the supporting arms **2902** of FIG. **29**, showing four different individual lighting sub units **2802***a*, **2082***b*, **2802***c*, **2802***d* aligned for attachment to the supporting arms **2902** via the connection points **2904** of FIG. **29**.

Up to now, the various implementation examples have focused on lighting modules made up of multiple lighting elements. However, that is not a requirement. Advantageously, the teachings herein enable creation of lighting fixtures involving two or more lighting modules, where the individual lighting modules contain a single lighting element such that the span (width) of the lighting head of the lighting fixture with either the lighting elements, and/or the lighting elements and transition plate combination, attached is larger than the span of the lighting head alone.

FIG. **31** illustrates, in simplified form, another lighting fixture **3100** that uses the same basic fixture components **102**, **104**, **106** and transition plate **1602** previously described and includes individual lighting modules **3102** of a single lighting element **3104** each.

The lighting modules **3102** include a coupling **3106** that is shaped so as to form a mating physical connection to allow it to couple to the transition plate **1602** as well as electrical contacts (not shown) that matingly couple to the corresponding connection points of the transition plate **1602**. Thus, as can be seen, for the configuration shown, as few as one and as many as twelve individual lighting modules **3102** of this type can be used, or can be mixed and matched with, for example, other lighting modules described herein. Moreover, depending upon the particular implementation, an individual lighting module **3102** need not be constructed so as to only be maintained in a fixed position. Rather, as is shown in the enlarged view of FIG. **31**, an individual lighting module **3102** can optionally be constructed so that

the lighting element **3104** is held by its own yoke **3108** that allows the lighting element **3104** to be pivoted through some angle $\theta_1$, either manually during set up or, using a small motor and/or gear or linkage arrangement, automatically (in a controlled or random manner) during use. Similarly, some implementations can further include an additional movable swivel joint **3110** that can allow the lighting element **3104** to be swiveled or rotated through an angle $\theta_2$, while it is in a pivoted position or being pivotably moved. Depending upon the particular implementation, the angle $\theta_1$ will typically be an angle of less than 270 degrees and, more likely, 180 degrees or less (although some can be implemented to pivot through angles of up to 360 degrees or more). In contrast, depending upon the particular implementation, the angle $\theta_2$ will typically allow for rotation of up to 360 degrees or more, but, of course, implementations that only provide for smaller rotations can be constructed as well.

Now, as briefly noted above, a further advantage available from some implementation variants is, through use of a common connection shape and electrical connections to those on a transition plate, two or more of the same or different lighting modules can be directly coupled to each other in order to create even more elaborate or unusual lighting or lighting effects.

FIG. **32** illustrates, in simplified form, a lighting fixture that shares the same basic components base **102**, single arm yoke **104***a*, lighting head **106**, and transition plate **1602** as in some of the previous fixtures, to which has been coupled a lighting module **3202** in the form of an arm **3204** having three linear rows **3206** of lighting elements. In addition, a remote end **3208** of the lighting module **3202** includes a connector **3210** that has a shape and electrical connection points in common with the transition plate **1602**. As a result, a further lighting module, in this example the lighting module **3102** of FIG. **31**, can be attached to the remote end **3208**. As an aside, when not in use, the remote end **3208** can be covered by a cap (not shown) if desired.

FIG. **33** illustrates, in simplified form, a top view of an example of a compound lighting module **3300** made up of the transition plate **1602** and six complex lighting modules made up of pairs of the individual lighting modules **3202**, **3102** of FIGS. **32** and **31**.

Up to now, the foregoing description has largely focused on the versatility of having a lighting fixture with common basic components (base, yoke(s), lighting head, transition plate(s)) that is constructed to accept one or more lighting arrays having an extent ($W_2$ of FIGS. **1-2**) that is larger than the extent ($W_1$) of the lighting head itself. However, as noted previously, through use of an additional yoke coupled to the main yoke, further advantages can be achieved, over an above compactness for transport. For example, through use of an additional yoke (which can be further extended to even a third or fourth yoke), larger, and/or more complex, lighting modules can be accommodated, particularly if, during use, the lighting modules will rotate or move. In addition, the addition of one or more additional yokes allows for translational movement of the lighting head (and consequently lighting modules) not previously available. Still further, even if the yokes will remain in fixed positions during use, through use of more than one yoke, greater mounting flexibility is available, since the additional translation capability can allow the fixture to potentially avoid what would be a mounting impediment for current automated lighting fixtures.

In this regard, FIG. **34** shows an example basic lighting fixture **3400**, constructed according to the teachings herein, mounted to a ceiling or other overhead support **3402**. More particularly, the fixture **3400** is made up of a base **102**, and lighting head **106** as described herein, but also includes a main yoke **104-1**, coupled to the base **102**, and a secondary yoke **104-2** coupled between the main yoke **104-1** and lighting head **106**. As shown, this fixture **3400** is in a substantially "retracted" position—meaning that the lighting head **106** is positioned close to the base **102**.

In contrast, FIG. **35** shows the same lighting fixture **3400** of FIG. **34**, except that the secondary yoke **104-2** has been pivotably moved so that the lighting head is nearly fully extended—meaning that the lighting head **106** is positioned almost as far from the base **102** as possible. In this manner, a large lighting module that could not be coupled to the lighting head because, in use, it would impact or be interfered with by the ceiling or overhead support **3402** can now be accommodated without repositioning the base.

FIGS. **36-37** illustrate a lighting fixture similar to that of FIGS. **34-35**, except that, in FIGS. **36-37**, the secondary yoke **104-2***a* has a single arm, instead of the two arms of the secondary yoke **104-2** of FIGS. **34-35**.

Advantageously, through use of multiple fixtures, each with multiple yokes, the lighting fixtures can be positioned at a venue such that they can individually provide their respective lighting for some time period and then the respective lighting arrays can be moved (without moving their respective bases **102**) to positions such that they can collectively act as a single lighting display (e.g., individual lighting arrays that are video display panels and provide independent images can be moved relative to each other so as to collectively form a single large, unified, display for some period of time, but can them be moved apart and, again, provide individual displays.

FIGS. **38**A-**38**C illustrate, in simplified form, yokes **104** that are extensible/retractable and suitable for use as described herein.

More particularly, FIG. **38**A illustrates, a yoke **104** that has a telescoping crossbar **148** that can be extended and/or retracted in order to change the spacing of the arms **146** so they can accommodate different width lighting heads **106** so that an entire family of lighting heads might potentially be used with the same yoke **104**.

In a related vein to that of FIG. **38**A, FIG. **38**B illustrates, in simplified form, a yoke **104** that has telescoping arms **146** so that different length lighting heads can be used with the same yoke **104**.

FIG. **38**C illustrates, in simplified form, a yoke **104** that incorporates the extensibility/retractability of both the crossbar **148** and arms **146** as shown in FIGS. **38**A-**38**B in a single yoke **104**.

With respect to FIGS. **38**A-**38**C, to the extent that wiring needs to pass through one or both arms to the lighting head (as occurs with current, conventional, lighting fixtures of this type, mating connectors (of a type/size/shape common to all possible configurations) can be used at the connection point between the yoke **104** and lighting heads **106** so that, depending upon the particular implementation, remain in a fixed position when the lighting head **106** moves relative to the yoke **104** or can, for example, pivot or swivel as needed.

Although the extension is shown for a yoke with two arms **146**, it should be understood that the foregoing is equally applicable to a yoke with a single arm, as well as to any of the individual yokes in implementations containing two or more yokes.

In addition, some implementations of the teachings described herein can be further modularized such that one yoke can be swapped for another, even with different shaft diameters or sizes. This can be handled as illustratively

shown in the cross section of FIG. **39** which illustrates, in simplified form, one example approach that allows for swapping of yokes **104** with a common base **102**. One portion **3902**, which can be a shaft of a yoke **104** or a component of the base to which the shaft of the yoke needs to connect, has a specific diameter/size and wiring **3904** that forms a part of, for example, the power path between the power suppl(y/ies) of the base **102** and a lighting head **106**. Another portion **3906**, which also can be a shaft of a yoke **104** or a component of the base to which the shaft of the yoke needs to connect, but is of a different size, likewise has wiring **3908** that forms another part of, for example, the power path between the power suppl(y/ies) of the base **102** and a lighting head **106**. A coupling **3910** that, on one side matches the size/shape of the first portion **3902** and on the other side matches the size/shape of the second portion **3906** can be interposed between the two portions **3902**, **3906** to join the portions together. Depending upon the particular implementation, different mechanisms can be used to lock the coupling **3910** to each portion **3902**, **3906**, for example, a set screw, locking pin, clip, or any other appropriate mechanism can be used that will hold the two together with sufficient strength during use, but can be released when a change is required. As shown, the coupling **3910** includes openings **3919** to accommodate the selected locking mechanism(s). In addition, and similar to the connection between the yoke **104** and lighting head **106**, removably mating connectors **3912***a*, **3912***b* can be used to allow for easy disconnection of one yoke and reconnection of another yoke without requiring rewiring of the fixture. Of course, it shoudl be understood that this approach can be used whether the shaft of the new yoke **104** is larger, smaller or the same size as the one it will replace.

Finally, a further advantage to the foregoing is that a family of modularized lighting fixtures of different sizes, weight handling capacity, and/or power capacity can be created. that can make use of some or all of a common family of lighting modules and/or lighting arrays, thereby addressing problems with current, conventional fixtures and new effects are desired or technology changes.

Having described and illustrated the principles of this application by reference to one or more example embodiments, it should be apparent that the embodiment(s) may be modified in arrangement and detail without departing from the principles disclosed herein and that it is intended that the application be construed as including all such modifications and variations insofar as they come within the spirit and scope of the subject matter disclosed.

What is claimed is:

**1**. A lighting fixture comprising

a base;

at least one yoke, comprising at least one arm and a shaft, the at least one yoke being coupled to the base via the shaft, and controllably, rotatably, moveable relative to the base via at least a first motor;

a lighting head coupled to the at least one yoke, wherein the lighting head is controllably rotatably movable, relative to the at least one arm of the at least one yoke, via at least a second motor, wherein the lighting head has a first extent at a lighting output side;

a transition plate having multiple connection ports through which power can pass from the lighting head to a lighting array, the lighting array comprising one or more lighting modules;

wherein the lighting array has a second extent that is greater than the first extent of the lighting head; and

wherein the lighting head includes an electrically conductive coupling which will allow the transition plate to be rotated relative to the lighting head, through at least one revolution, while maintaining a continuous electrical path between the lighting head and lighting array when a particular lighting array is coupled to the transition plate and the transition plate is coupled to the lighting head.

**2**. The lighting fixture of claim **1**, wherein at least one of the lighting head or the transition plate includes at least a third motor that will, when the lighting array is coupled to the lighting head, controllably move at least a part of the lighting array, relative to the transition plate, between a first position and a second position.

**3**. The lighting fixture of claim **1**, wherein the at least one yoke comprises:

a first yoke including the shaft and two auxiliary arms, and

a second yoke including the at least one arm;

wherein the second yoke is movably coupled to the two auxiliary arms of the first yoke.

**4**. The lighting fixture of claim **1**, wherein the lighting array comprises:

a lighting arm; and

multiple individual lighting elements positioned on the lighting arm.

**5**. The lighting fixture of claim **4**, wherein the lighting arm comprises at least two segments.

**6**. The lighting fixture of claim **5**, wherein one of the at least two segments is controllably movable relative to another of the at least two segments in a longitudinal direction.

**7**. The lighting fixture of claim **5**, wherein one of the at least two segments is controllably pivotably movable relative to another of the at least two segments.

**8**. The lighting fixture of claim **4**, wherein the lighting arm has a proximal end and a distal end and wherein lighting arm couples to the transition plate at the proximal end and includes a connector near its distal end to which an auxiliary lighting module can be attached.

**9**. The lighting fixture of claim **8**, wherein the auxiliary lighting module is independently moveable.

**10**. The lighting fixture of claim **1**, wherein the transition plate includes multiple movable lighting elements coupled thereto.

**11**. The lighting fixture of claim **1**, further comprising, to move the transition plate relative to the lighting head, at least a pair of ring gears, one ring gear of the pair is coupled to the transition plate and an other of the pair coupled to the lighting head, wherein the pair of ring gears are interconnected such that rotation of one ring gear of the pair causes rotation or the other ring gear of the pair.

**12**. The lighting fixture of claim **1**, further comprising:

a lighting module, including multiple lighting elements, electrically connected to the transition plate via one of the connection ports.

**13**. The lighting fixture of claim **12**, wherein the lighting module further comprises:

a motor; and

a pivot about which a portion of the lighting module can be moved by the motor.

**14**. The lighting fixture of claim **12**, wherein the lighting module further comprises:

a lighting segment having thereon, multiple lighting elements arranged in an arc.

15. The lighting fixture of claim 14, wherein the multiple lighting elements comprise an array of at least two rows of multiple lighting elements.

16. The lighting fixture of claim 12, wherein the lighting module further comprises:

a lighting segment having thereon, a linear array of at least two rows of multiple lighting elements.

17. The lighting fixture of claim 12, wherein the lighting module has a distal end and further comprises:

a connector on the distal end to which an additional lighting sub module can be physically and electrically connected.

18. The lighting fixture of claim 17, further comprising:

a lighting sub module physically and electrically connected to the lighting module at the distal end via the connector.

19. The lighting fixture of claim 18, wherein the lighting sub module includes a motor to move the lighting sub module relative to the lighting module.

20. The lighting fixture of claim 1, wherein the transition plate is removably coupled to the lighting head.

21. The lighting fixture of claim 1, wherein a first portion of the at least one yoke can be moved, form a first position to a second position, relative to a second portion of the at least one yoke.

22. A transition plate for coupling to a lighting head of a lighting fixture, the transition plate comprising:

a first surface, dimensioned for coupling to a lighting head of a lighting fixture,

a second surface, dimensioned and shaped with at least two connection locations so as to allow at least one lighting module to be removably physically and electrically coupled to the transition plate at either of the at least two connection locations,

wherein the first surface includes at least one electrical contact element that will allow for electrical power to be uninterruptedly transferred from a contact on the lighting head to at least one lighting array, when the at least one lighting array is coupled to the transition plate and is controllably rotated, relative to the lighting head, through multiple revolutions.

23. A lighting fixture comprising

a base;

at least one yoke, comprising at least one arm and a shaft, the at least one yoke being coupled to the base, and controllably, rotatably, moveable relative to the base;

a lighting head coupled to the at least one yoke, wherein the lighting head is controllably movable, relative to the at least one arm of the at least one yoke;

a removable transition plate having multiple connection ports through which power can pass from the lighting head to a lighting array, the lighting array comprising multiple lighting modules;

wherein the removable transition plate is removably coupled to the lighting head; and

a continuous electrical path between the lighting head and lighting array via the transition plate.

24. The lighting fixture of claim 23, wherein the lighting head has a first extent at a lighting output side; and the lighting array has a second extent that is greater than the first extent.

25. The lighting fixture of claim 23, wherein the removable transition plate is rotatable relative to the lighting head.

26. The lighting fixture of claim 23, wherein the at least one yoke comprises a first yoke coupled to the base and to a second yoke, and the second yoke is coupled to the lighting head.

27. The lighting fixture of claim 23, wherein the multiple lighting modules are individually removably coupled to the removable transition plate.

28. The lighting fixture of claim 23, wherein the at least one yoke is releasably coupled to the base via the shaft.

* * * * *