US007736024B2

(12) **United States Patent**
Gordin et al.

(10) **Patent No.: US 7,736,024 B2**
(45) **Date of Patent: Jun. 15, 2010**

(54) **GEARED TILT MECHANISM FOR ENSURING HORIZONTAL OPERATION OF ARC LAMP**

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(73) Assignee: **Mucso Corporation**, Oskaloosa, IA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 45 days.

(21) Appl. No.: **12/165,212**

(22) Filed: **Jun. 30, 2008**

(65) **Prior Publication Data**

US 2009/0002993 A1 Jan. 1, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/332,938, filed on Jan. 17, 2006, now Pat. No. 7,452,108.

(60) Provisional application No. 60/644,536, filed on Jan. 18, 2005, provisional application No. 60/644,639, filed on Jan. 18, 2005, provisional application No. 60/644,747, filed on Jan. 18, 2005, provisional application No. 60/644,534, filed on Jan. 18, 2005, provisional application No. 60/644,720, filed on Jan. 18, 2005, provisional application No. 60/644,688, filed on Jan. 18, 2005, provisional application No. 60/644,636, filed on Jan. 18, 2005, provisional application No. 60/644,517, filed on Jan. 18, 2005, provisional application No. 60/644,609, filed on Jan. 18, 2005, provisional application No. 60/644,516, filed on Jan. 18, 2005, provisional application No. 60/644,546, filed on Jan. 18, 2005, provisional application No. 60/644,547, filed on Jan. 18, 2005, provisional application No. 60/644,638, filed on Jan. 18, 2005, provisional application No. 60/644,537, filed on Jan. 18, 2005, provisional application No. 60/644,637, filed on Jan. 18, 2005, provisional application No. 60/644,719, filed on Jan. 18, 2005, provisional application No. 60/644,784, filed on Jan. 18, 2005, provisional application No. 60/644,687, filed on Jan. 18, 2005.

(51) **Int. Cl.**
F21V 19/02 (2006.01)

(52) **U.S. Cl.** **362/285**; 362/418; 362/263

(58) **Field of Classification Search** 362/350, 362/263, 285–287, 418, 419, 422–425
See application file for complete search history.

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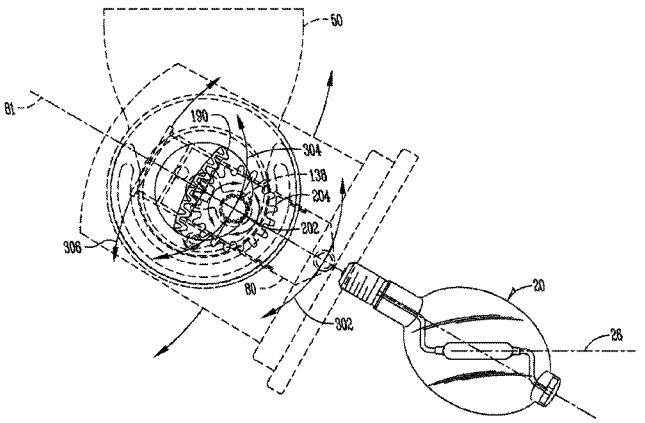
Primary Examiner—Bao Q Truong
(74) *Attorney, Agent, or Firm*—McKee, Voorhees & Sease, P.L.C.

(57) **ABSTRACT**

An apparatus and method for keeping a high intensity discharge arc tube relatively horizontal in a light fixture regardless of aiming orientation of the light fixture towards a target. In one aspect, the light source is mounted in an independently pivotal yoke in the light fixture. A gearing arrangement automatically proportionally pivots the light source relative to any pivoting motion of the fixture over a range of motion such that a selected light source orientation can be approximately maintained regardless of aiming orientation of the fixture.

7 Claims, 52 Drawing Sheets



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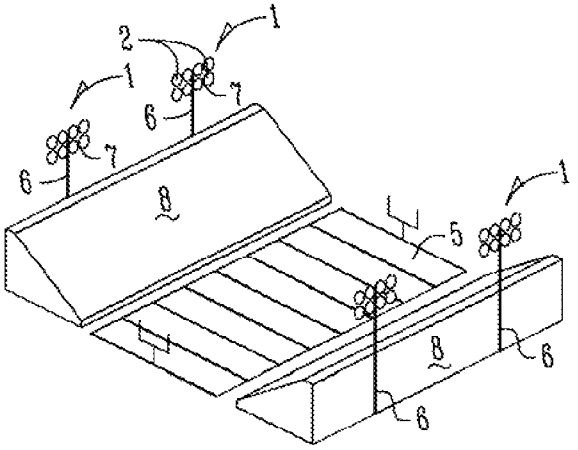

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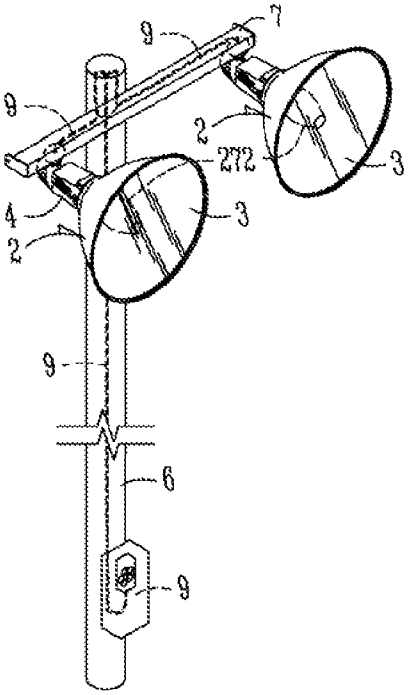


Fig. 1B

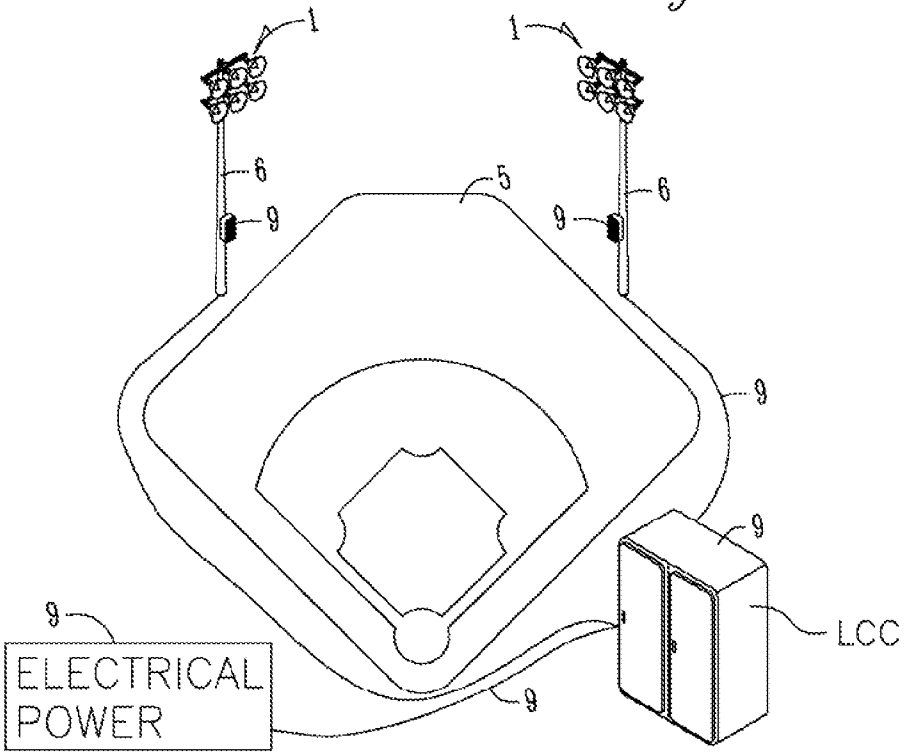


Fig. 1C

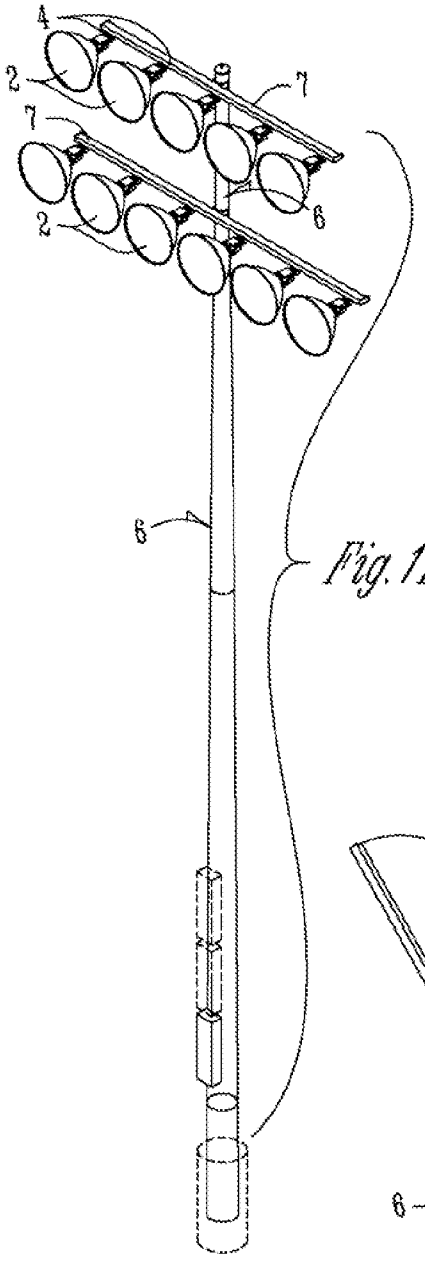
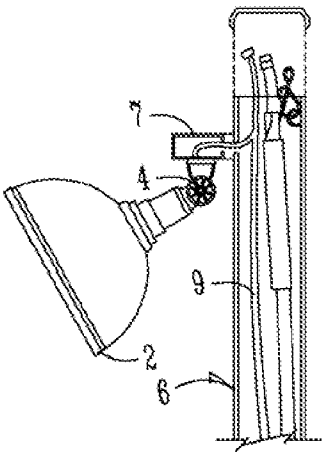


Fig. 1D



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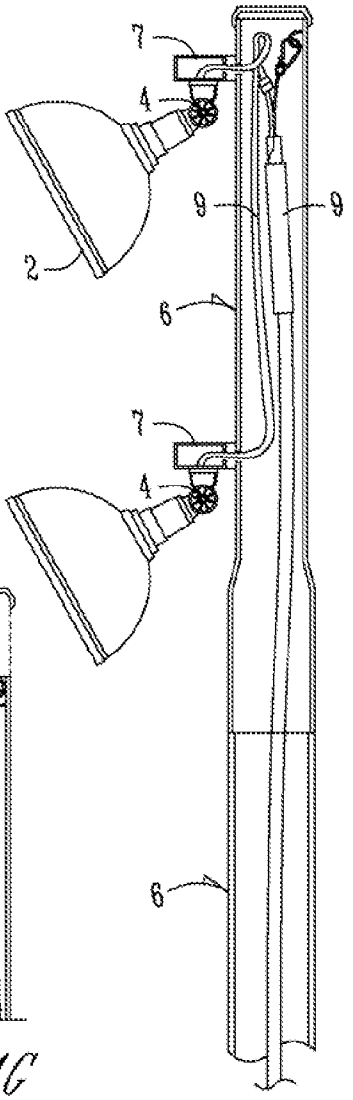


Fig. 1E

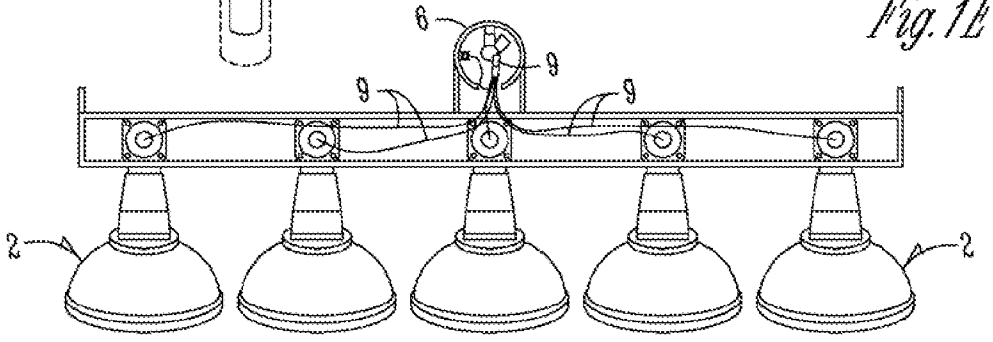
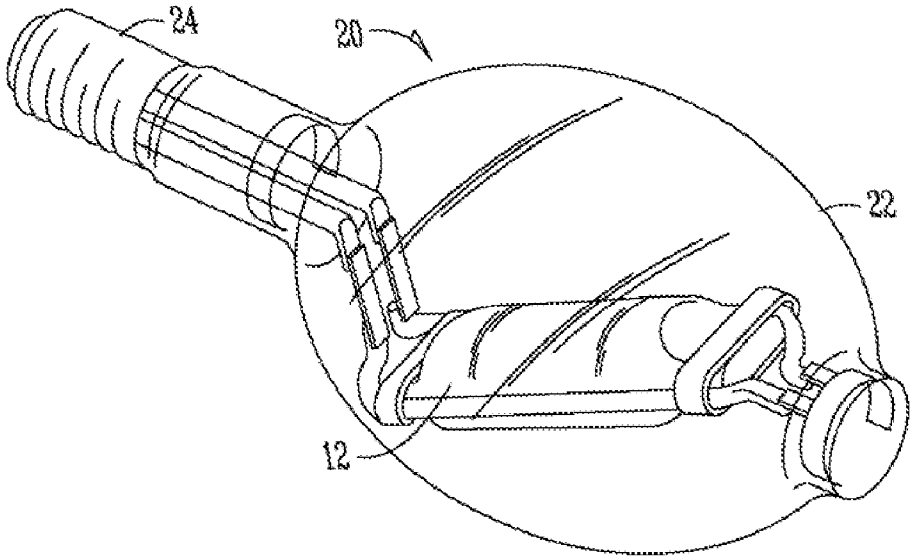


Fig. 1F



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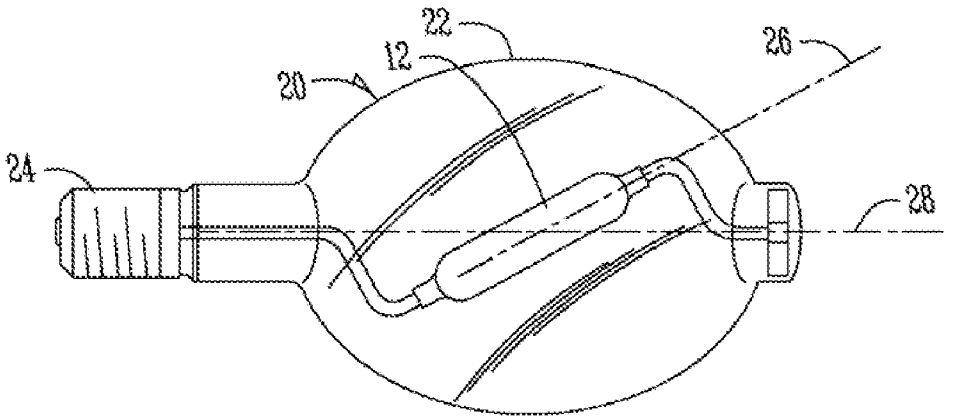
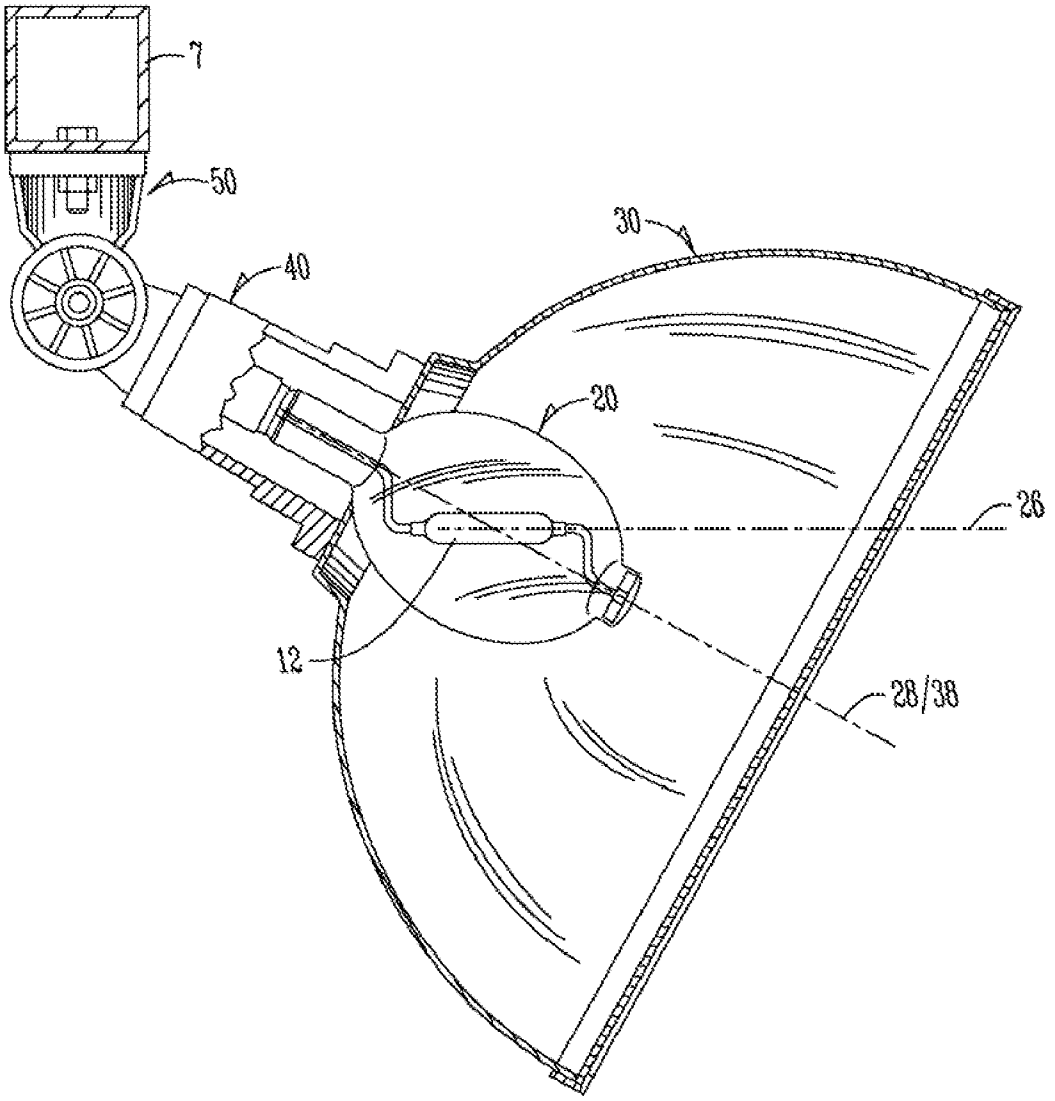


Fig. 2B



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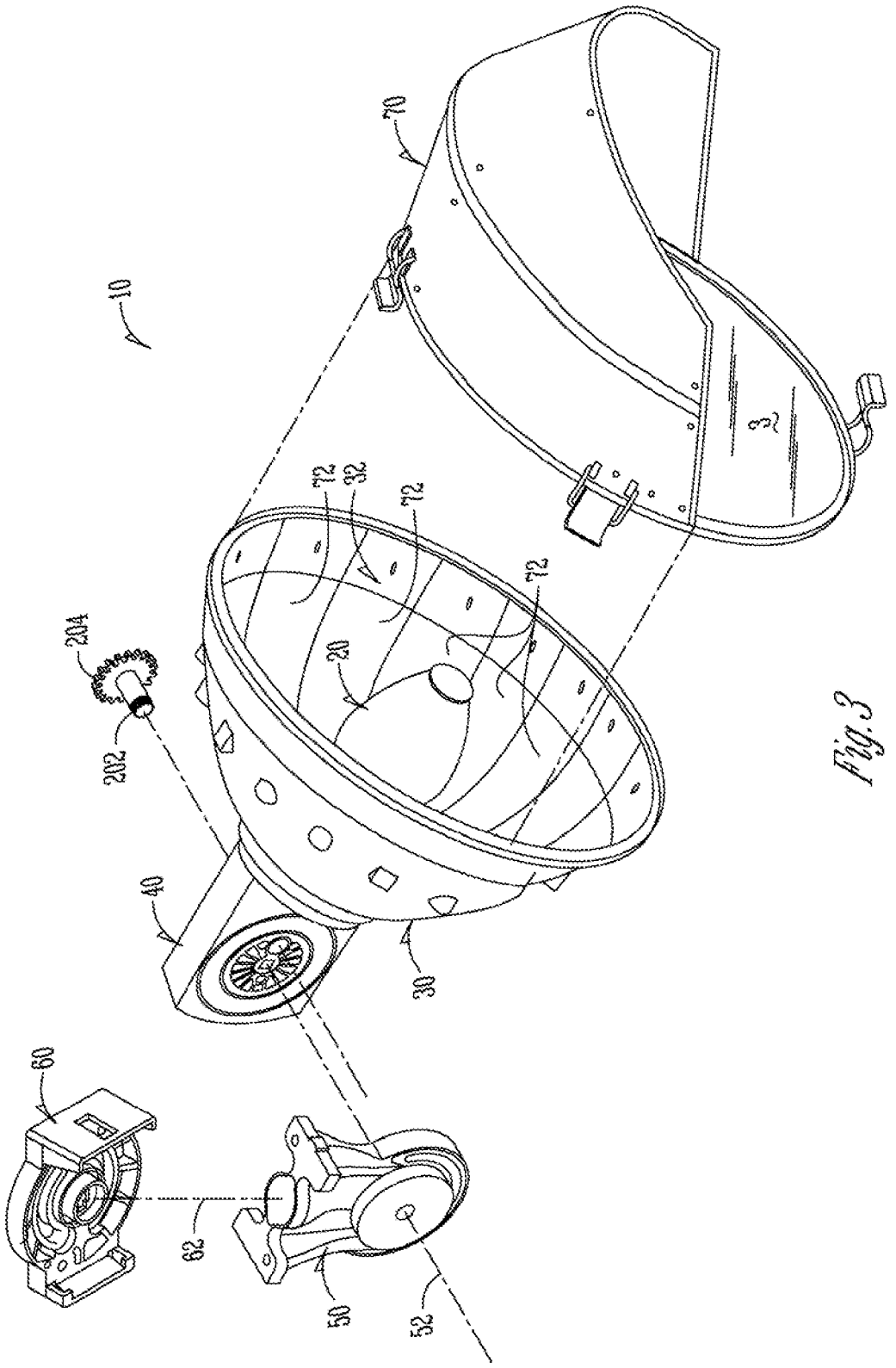

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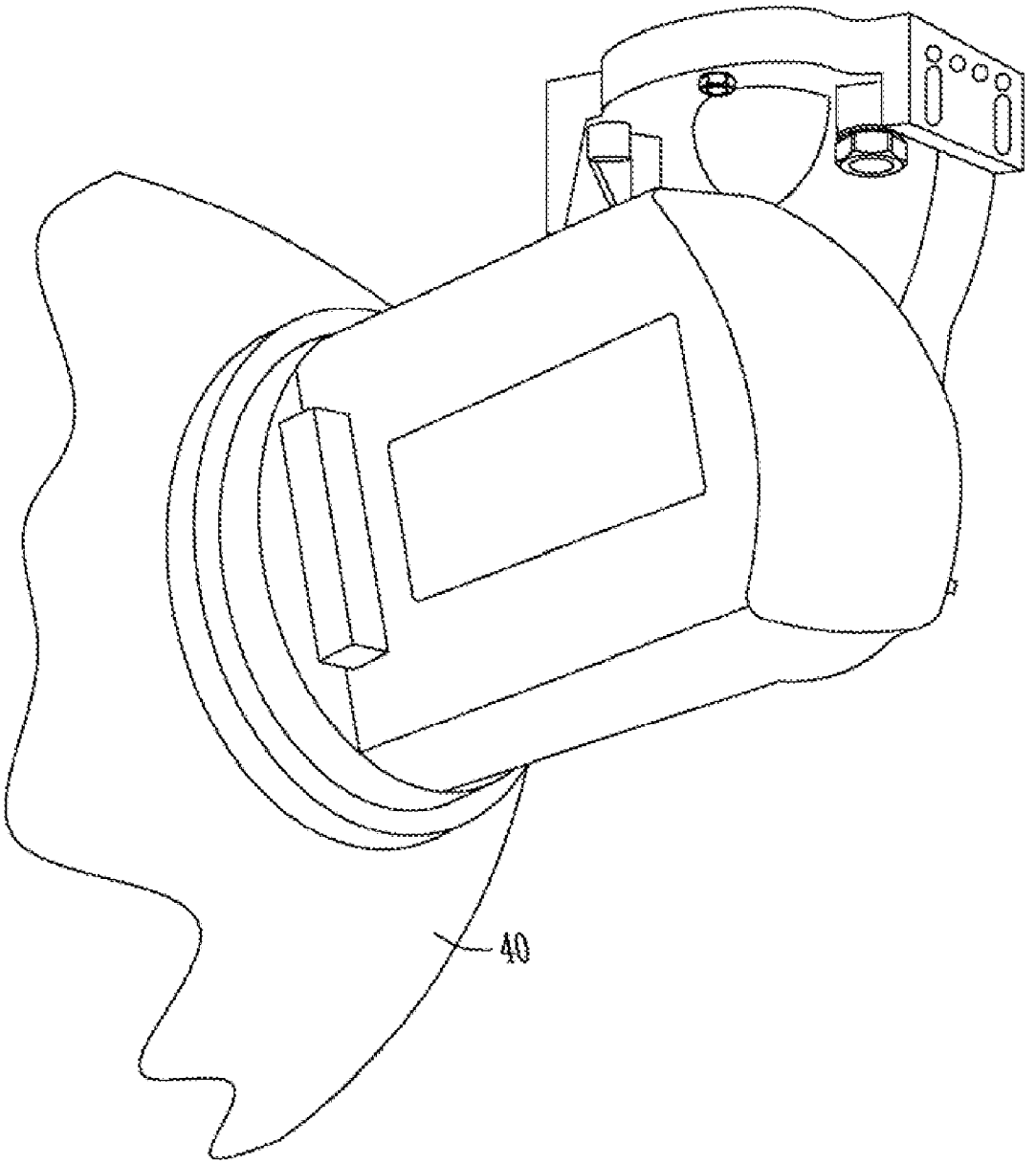

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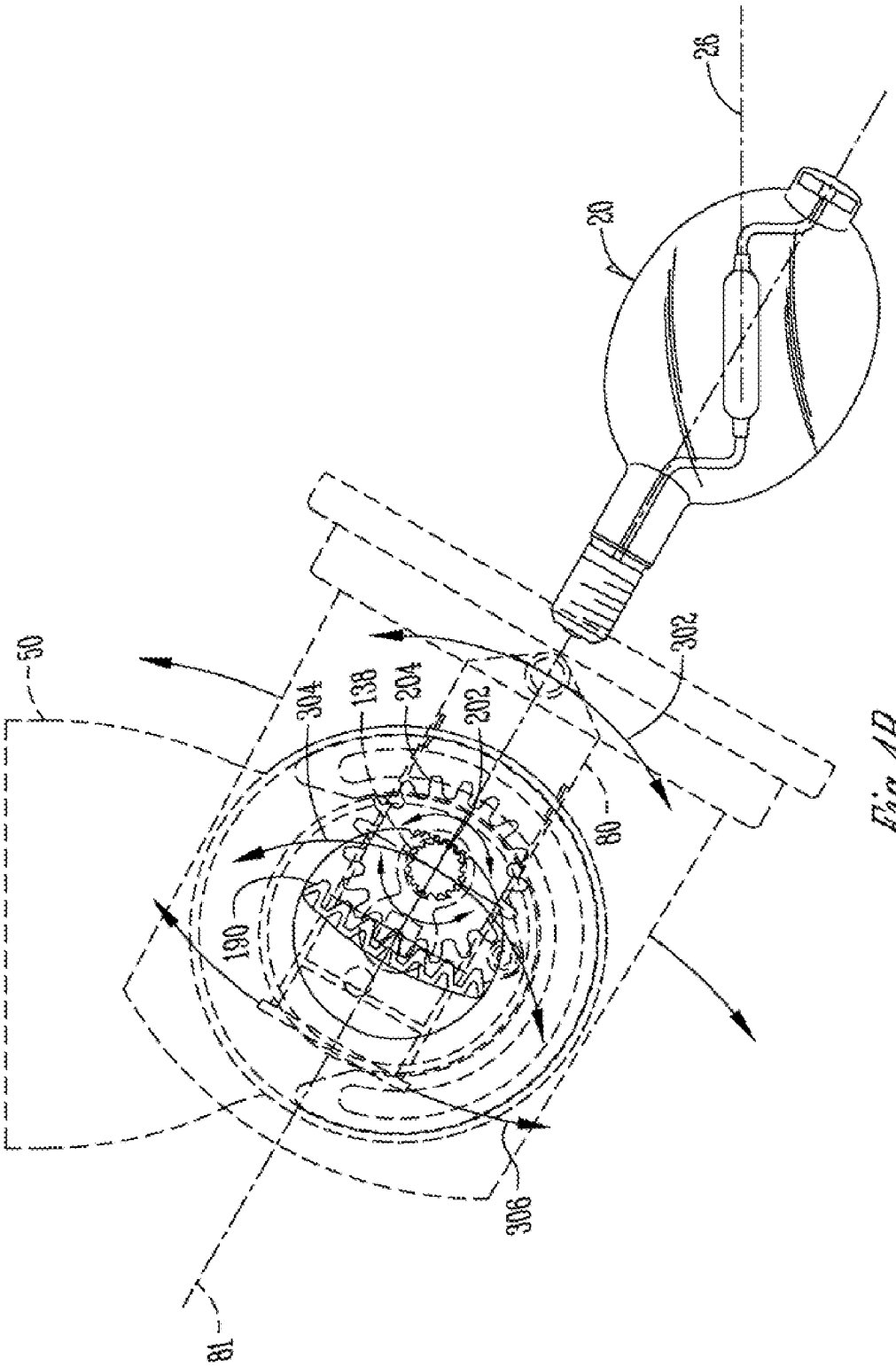

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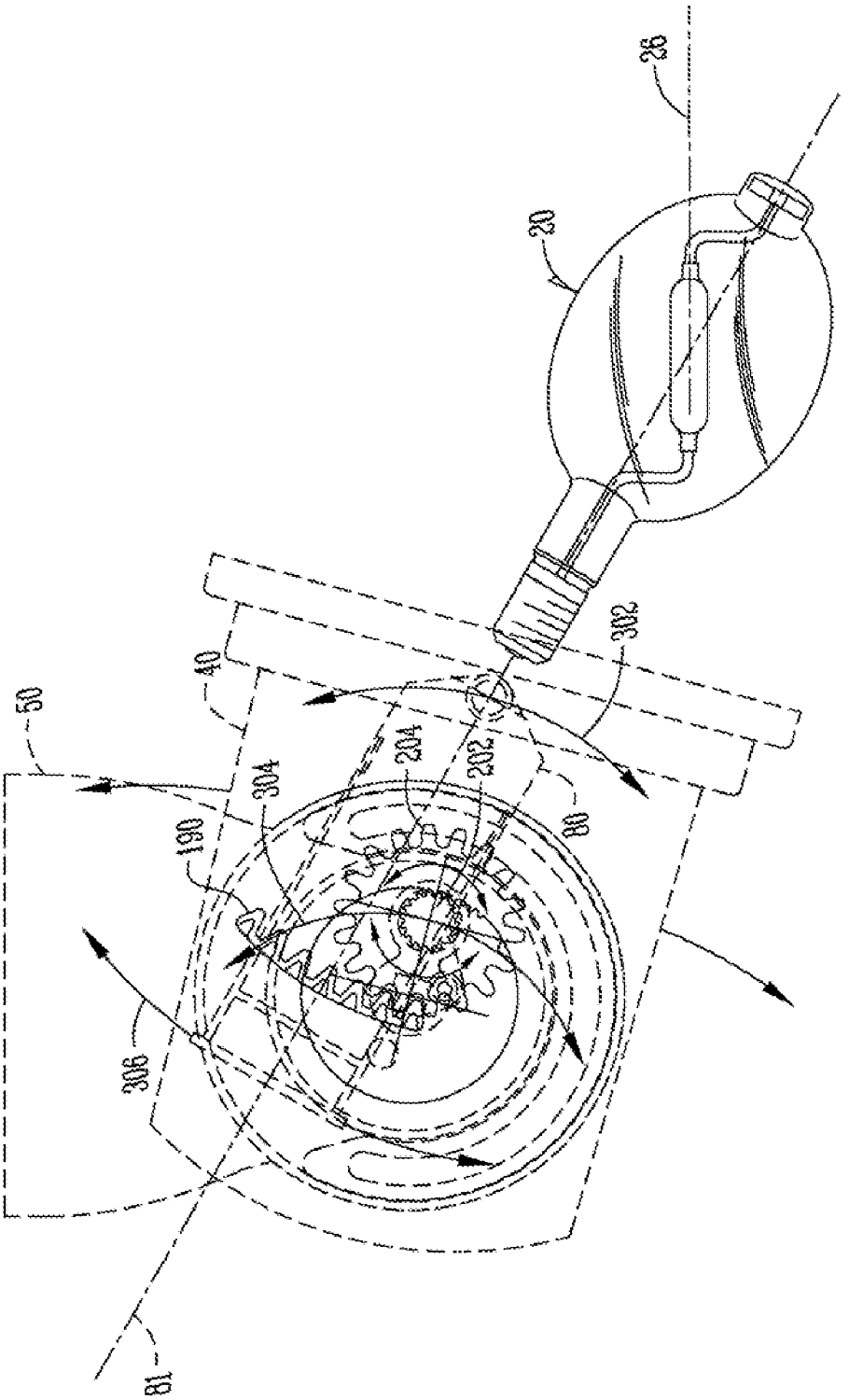


Fig. 4C

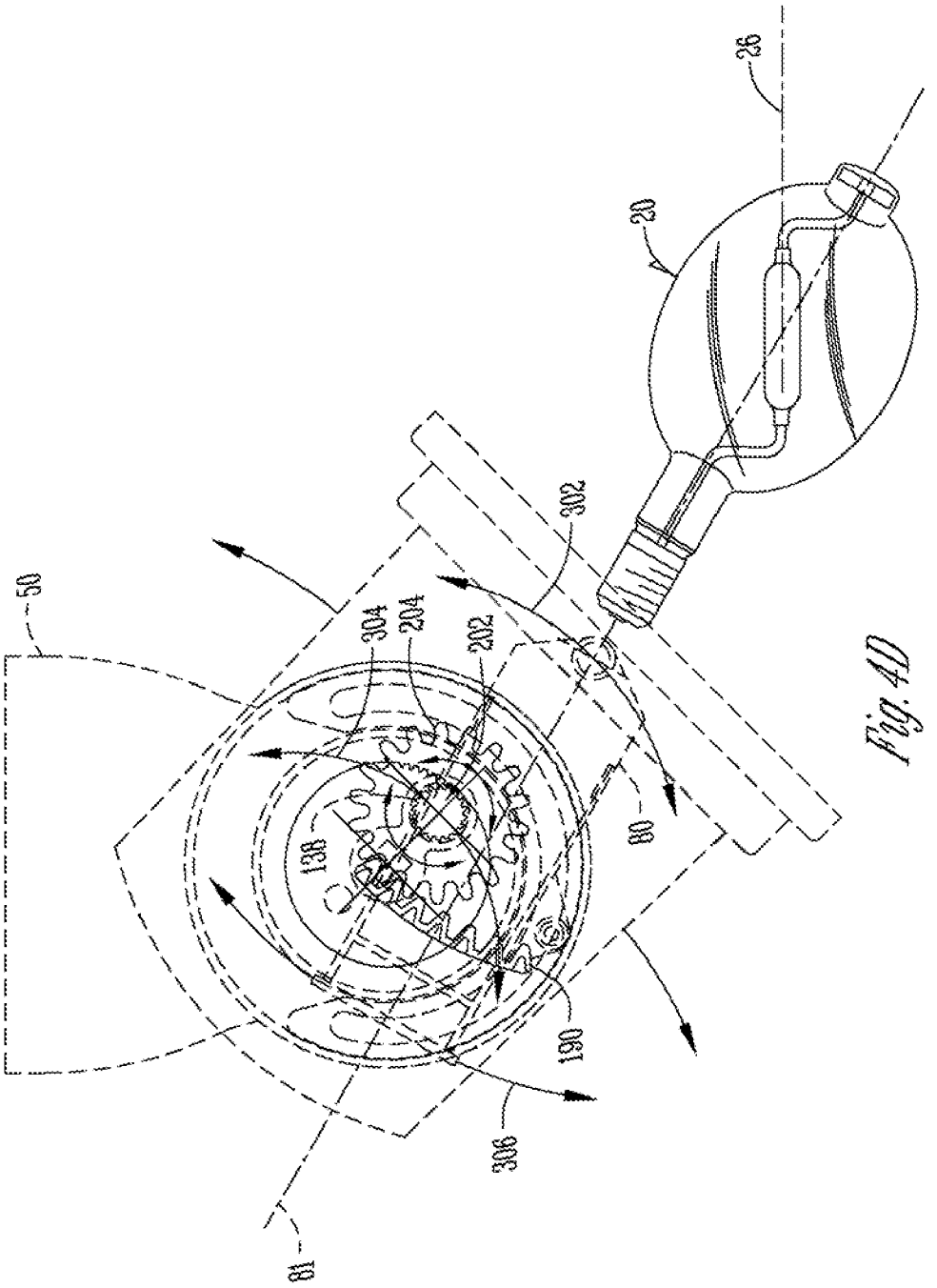


Fig. 4D

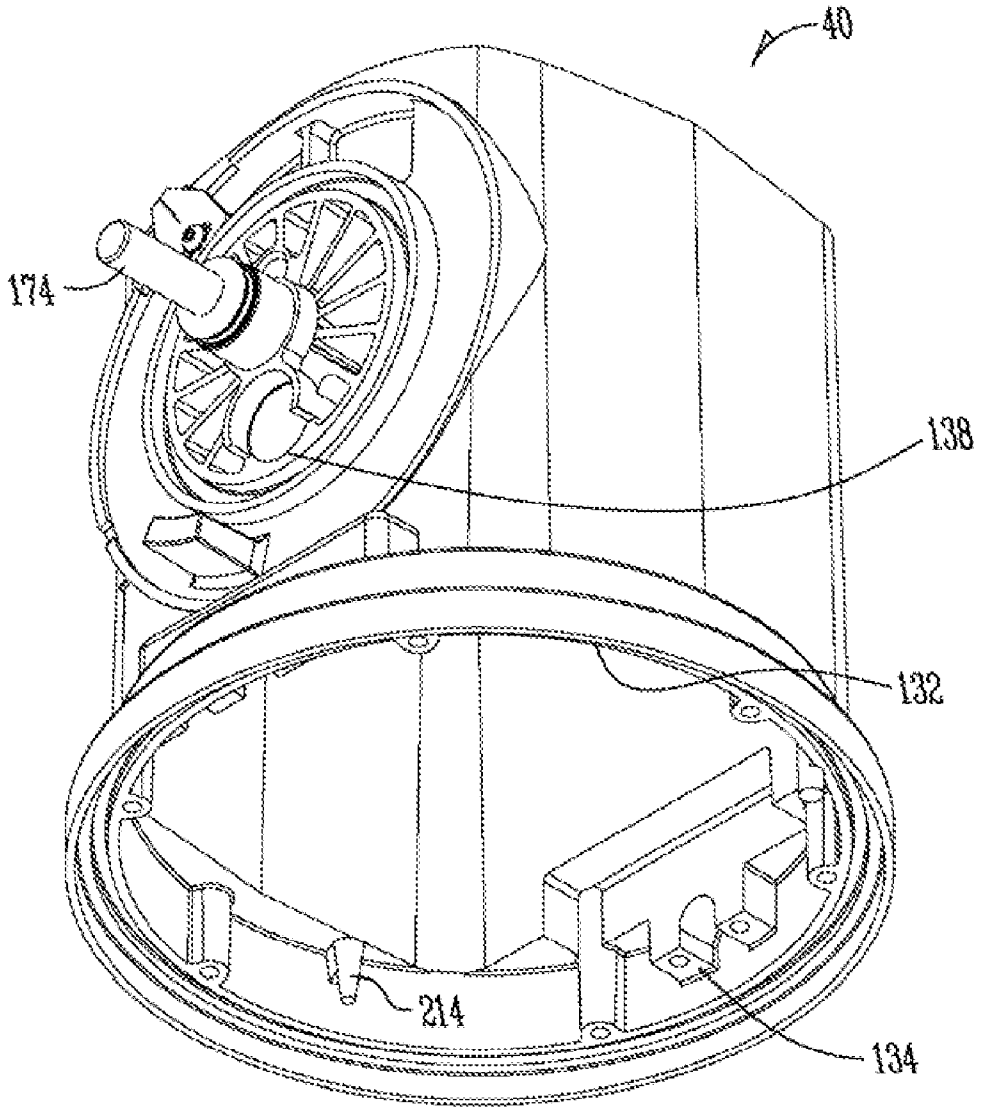
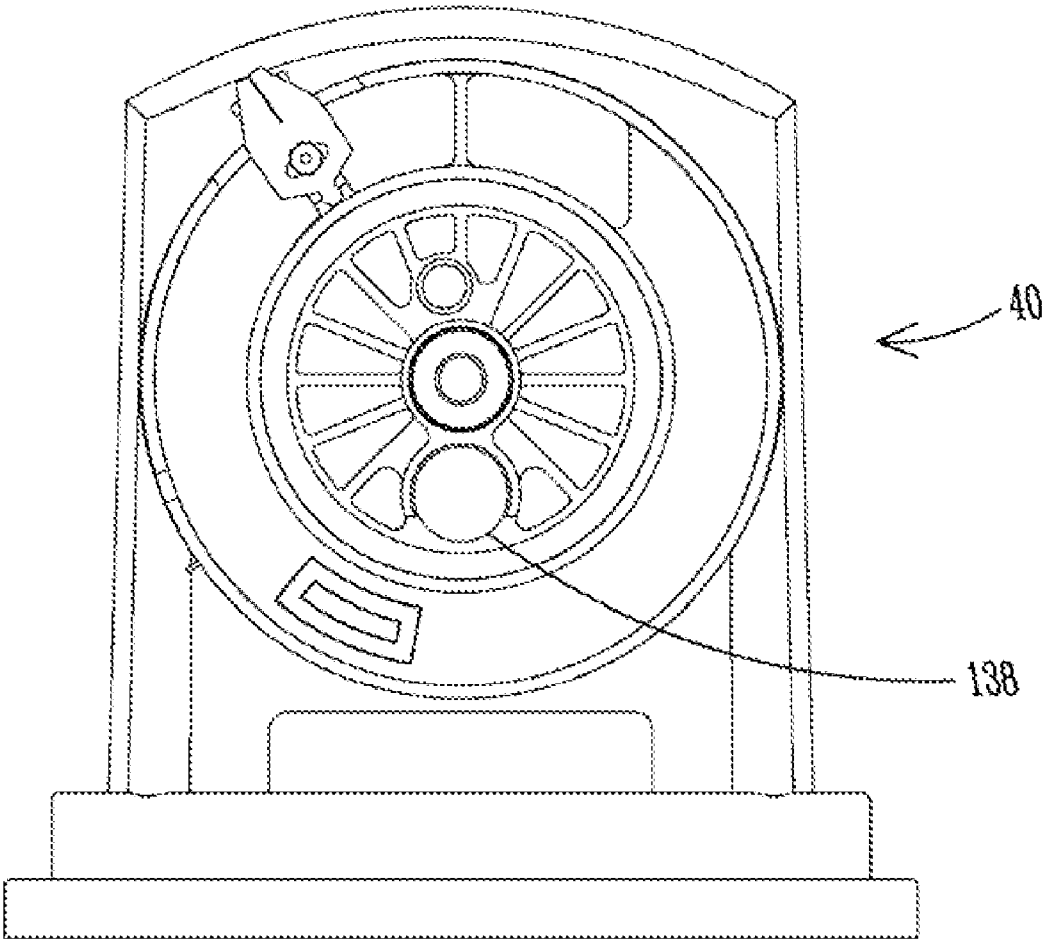
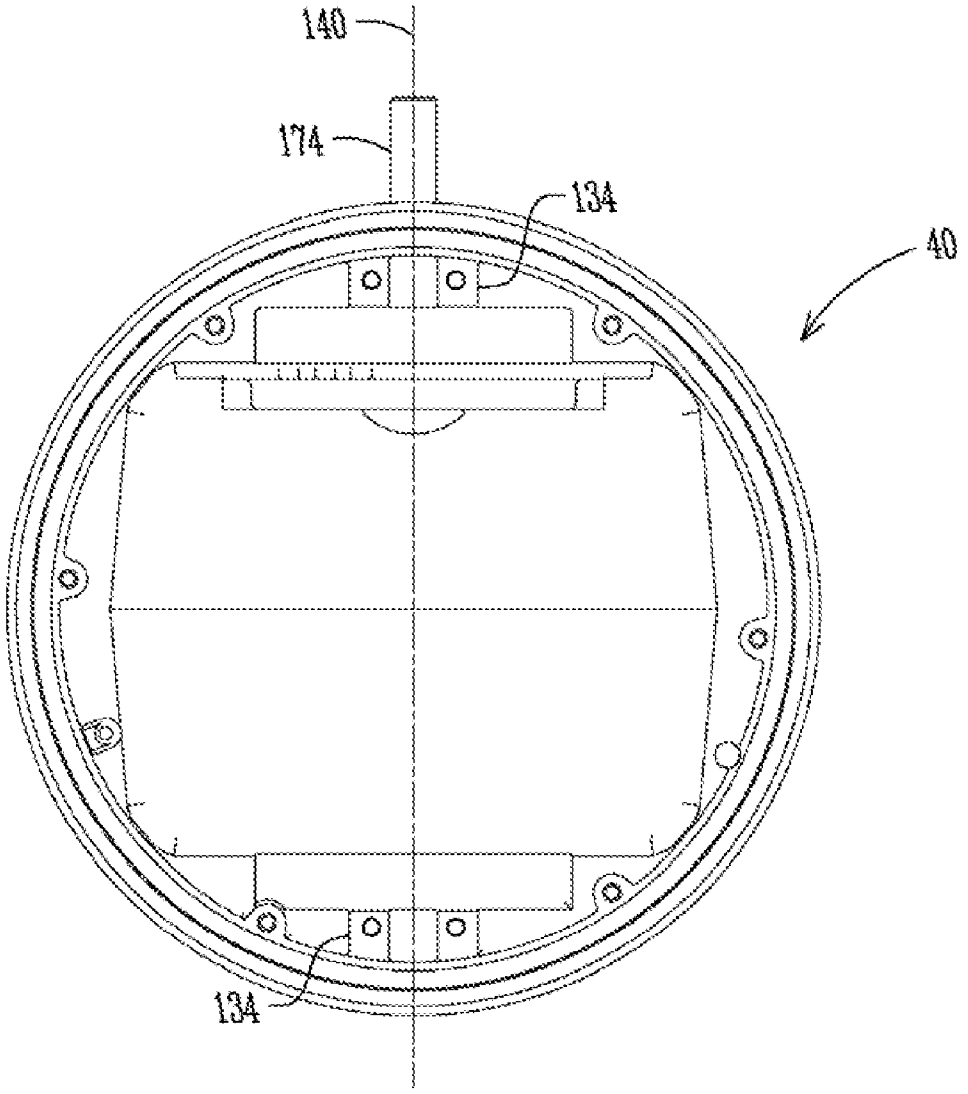


Fig. 5A



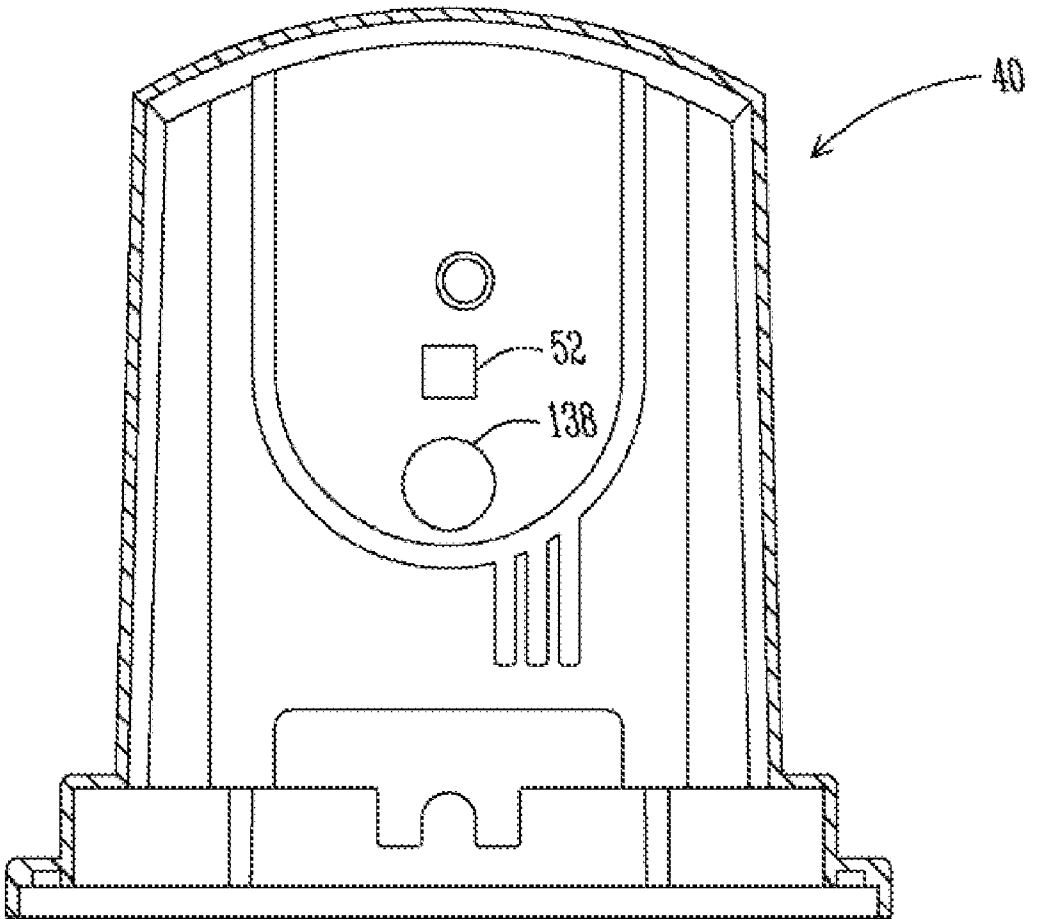
FRONT VIEW

Fig. 5B



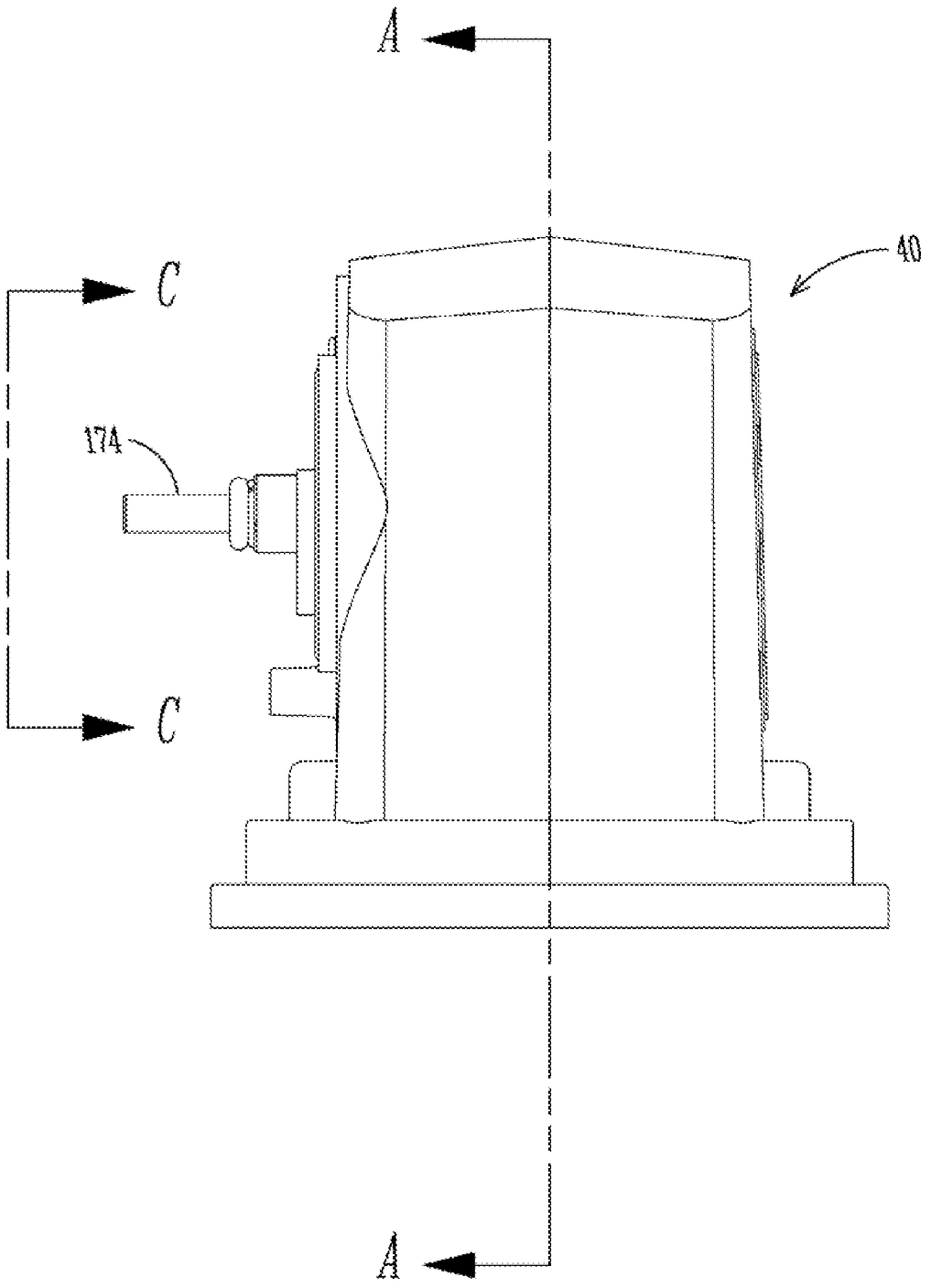
TOP VIEW

Fig. 5C



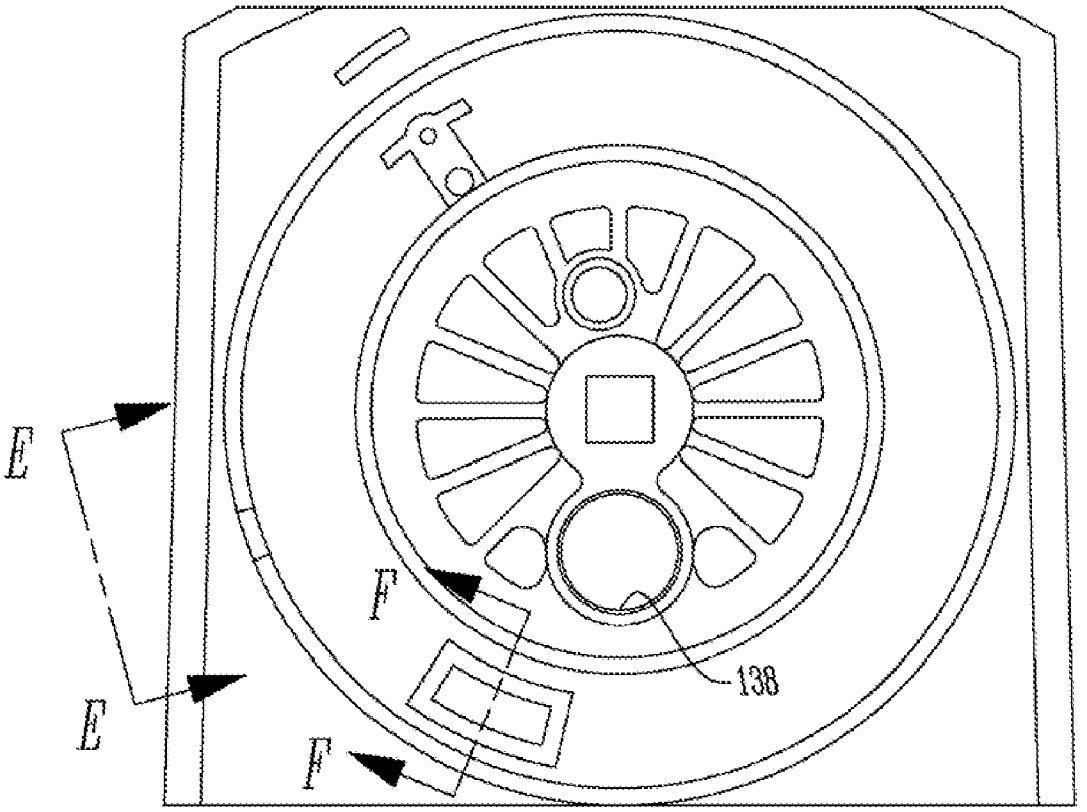
SECTION A-A

Fig. 5D



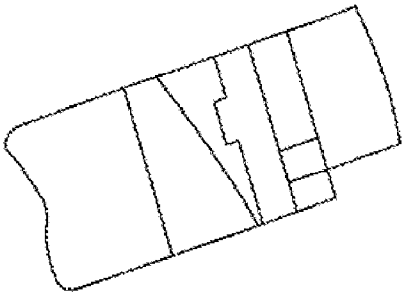
SIDE VIEW

Fig. 5E



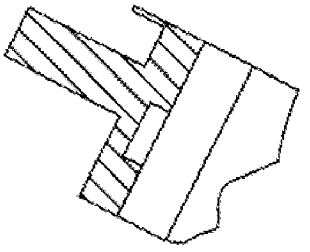
VIEW C-C

Fig. 5F



VIEW E-E

Fig. 5H



SECTION F-F

Fig. 5I

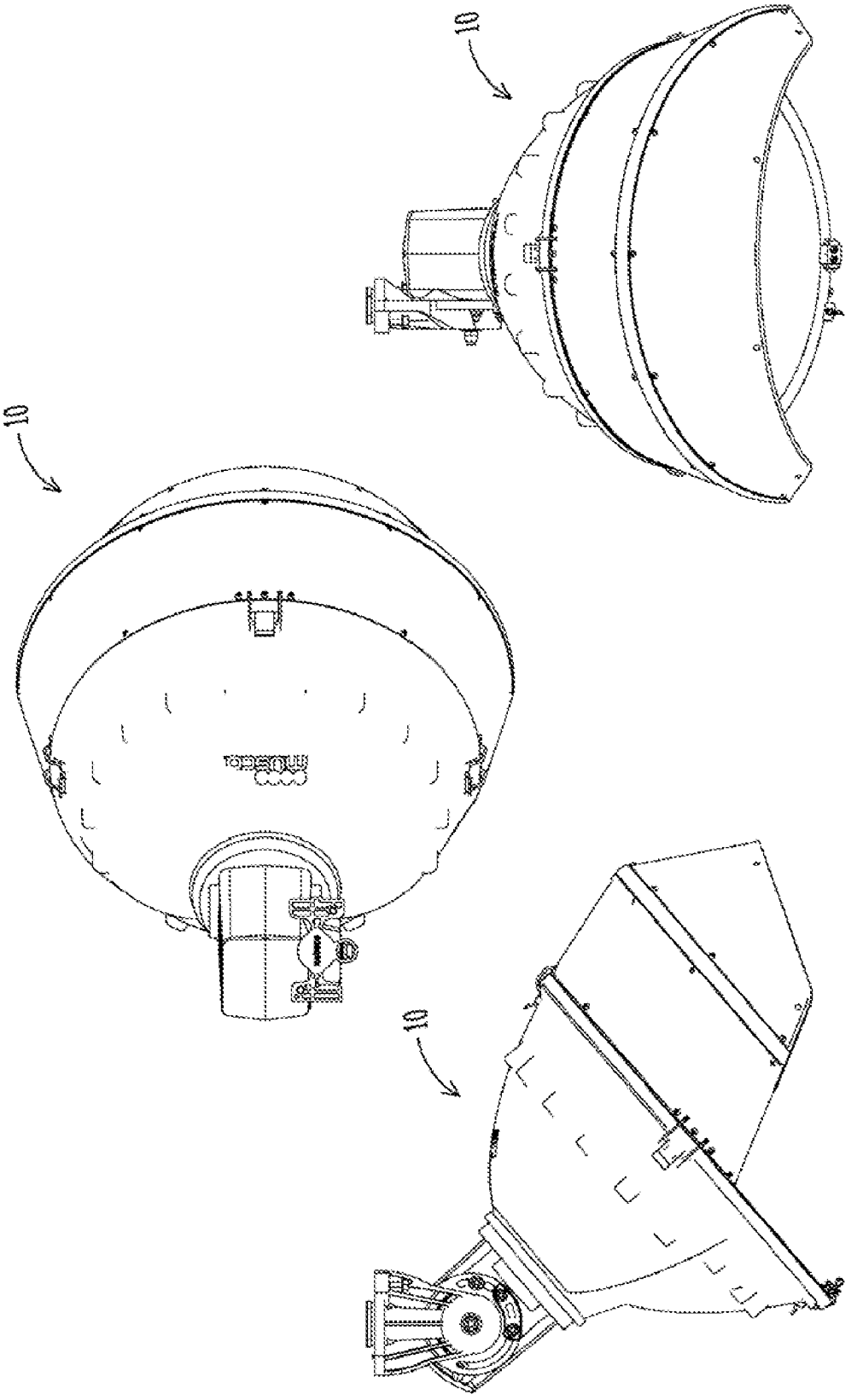


Fig. 5G1

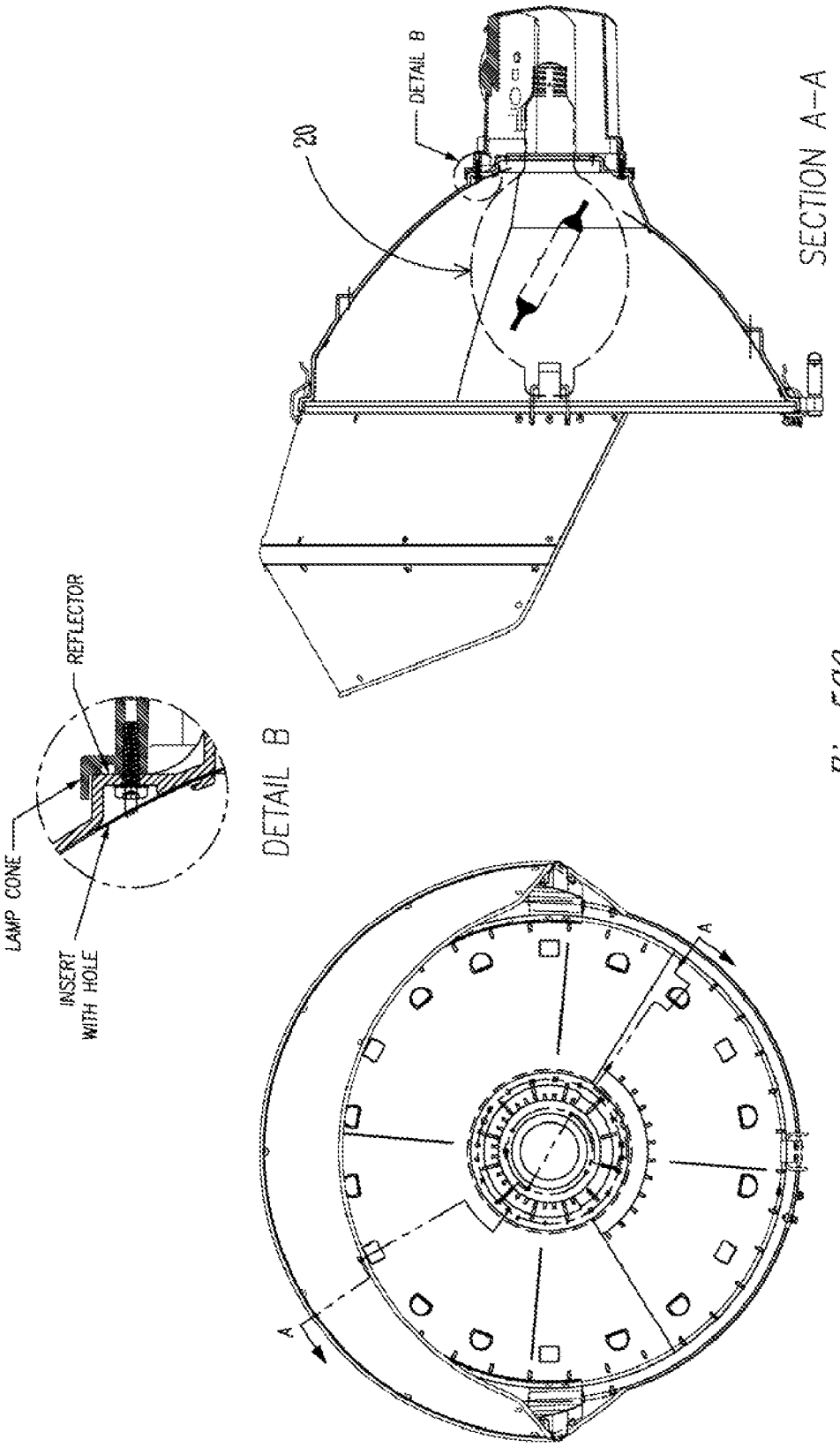

DETAIL B
20
SECTION A–A
REFLECTOR
LAMP CONE
INSERT WITH HOLE
DETAIL B
A
A

Fig. 5G2

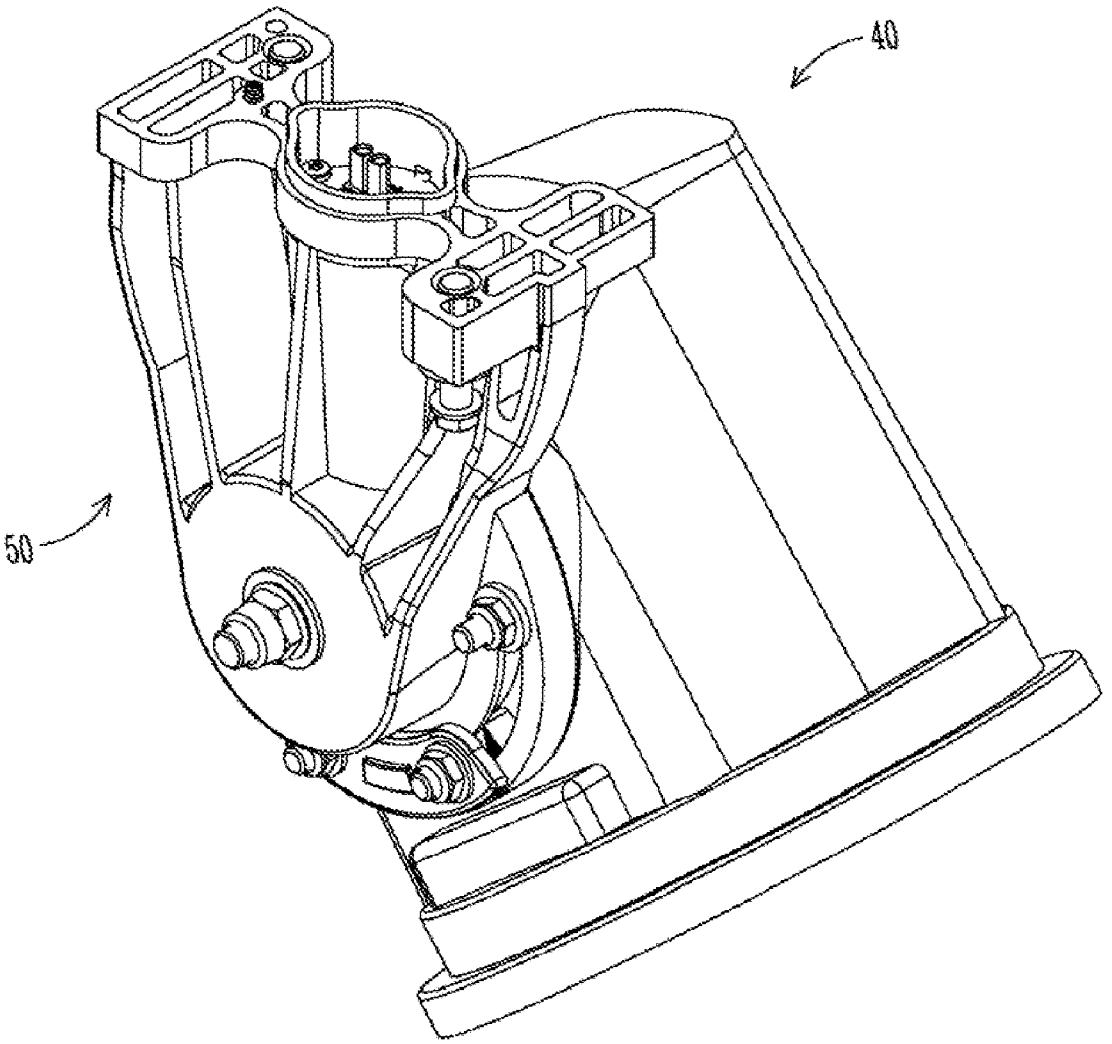
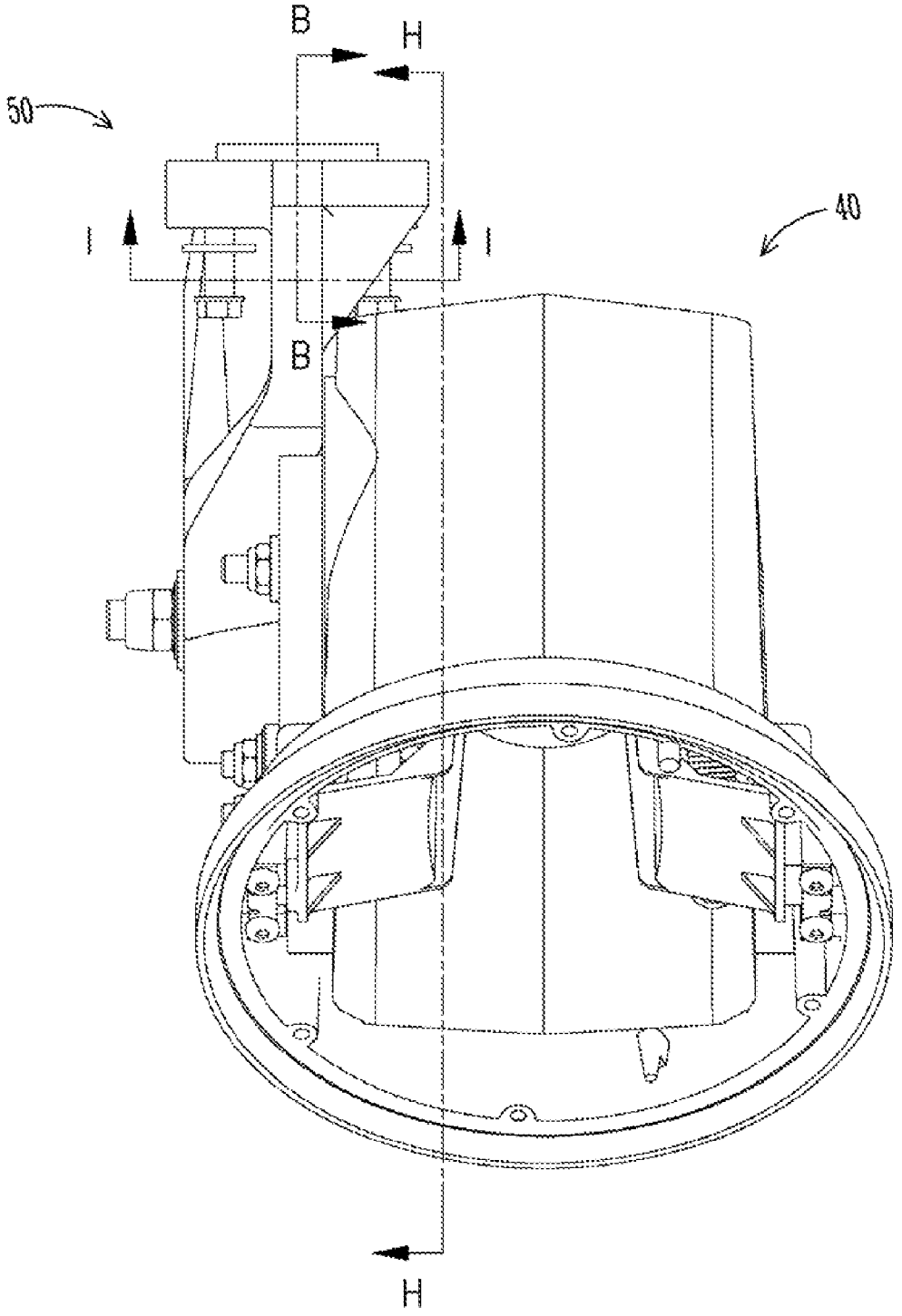
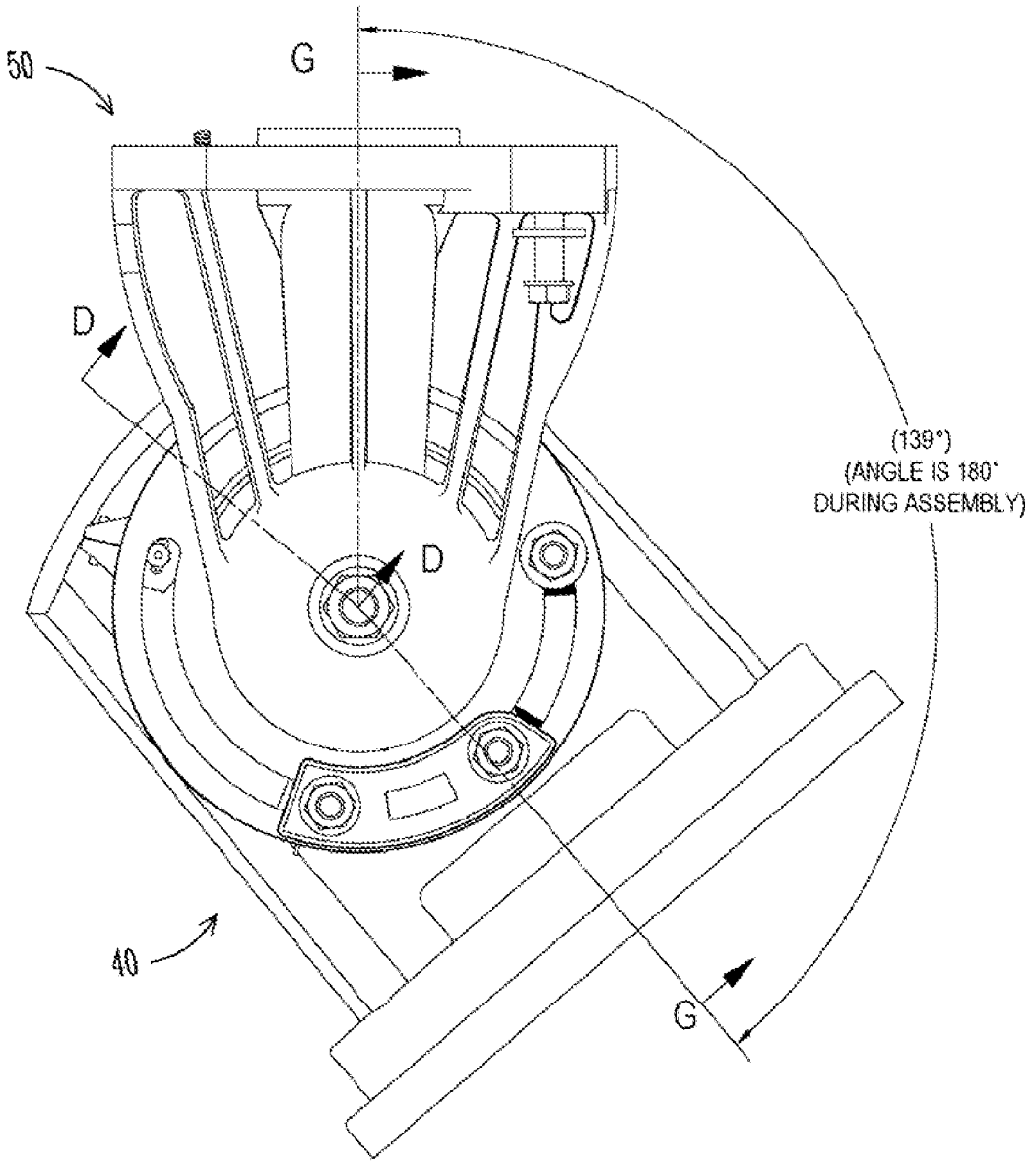


Fig. 5J1



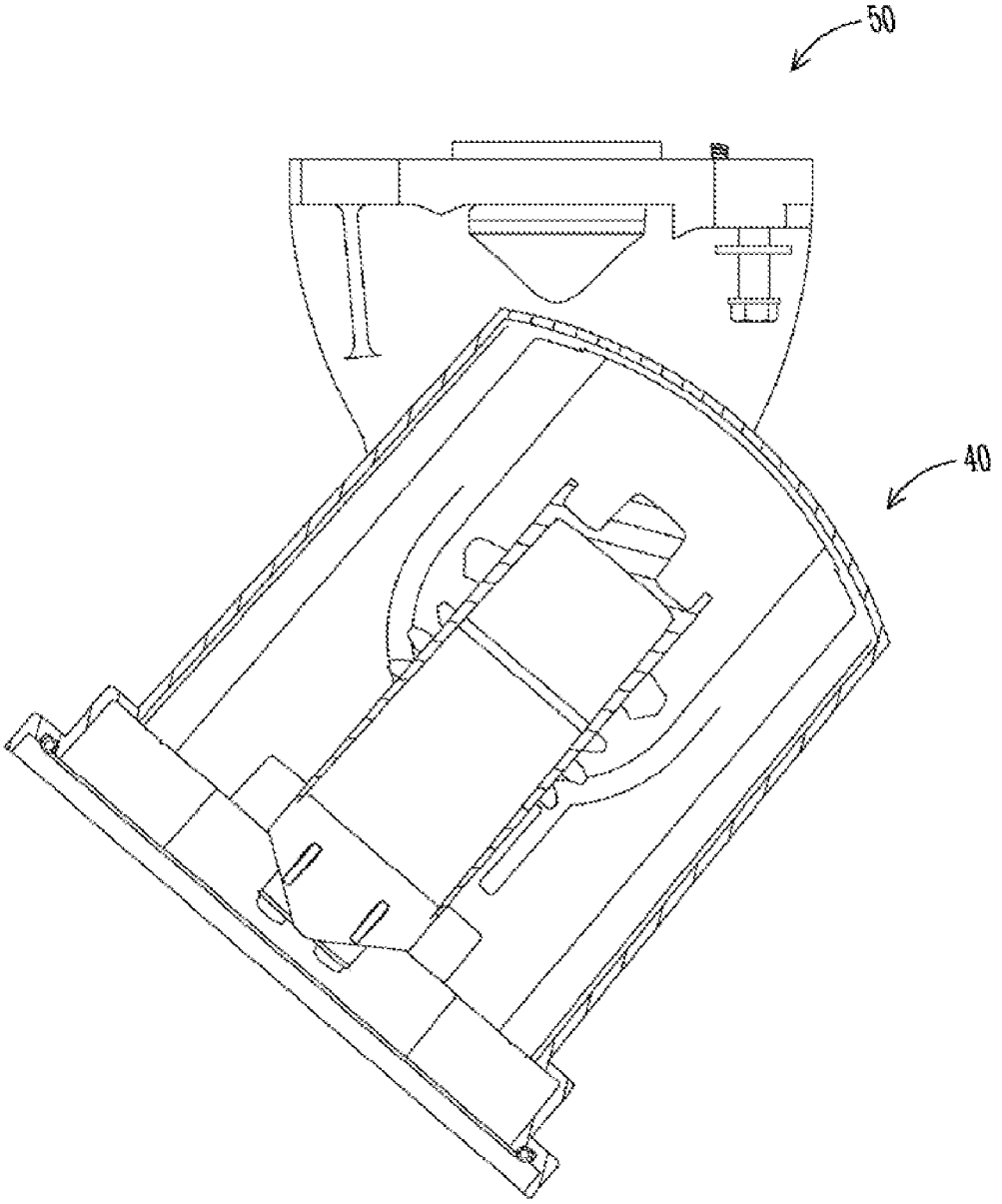
FRONT VIEW

Fig. 5J2



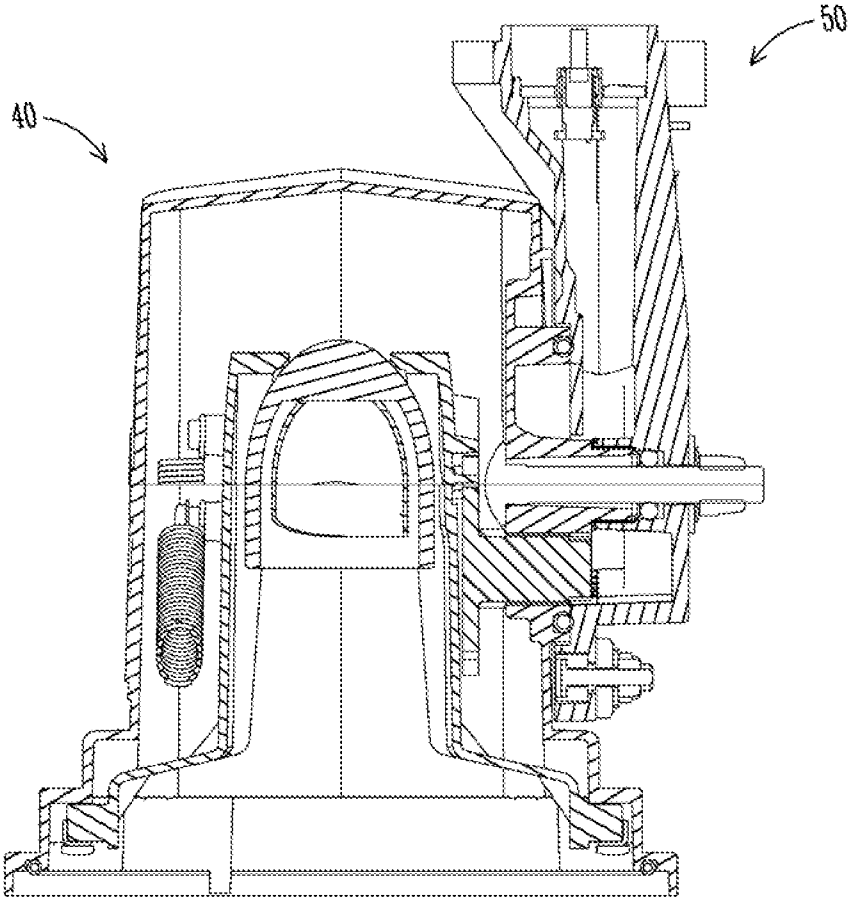
SIDE VIEW

Fig. 5J3



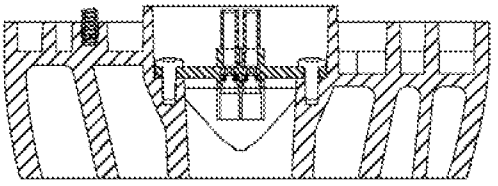
SECTION H-H
SHOWN AIMED AT 47° VERTICAL

Fig. 5J4



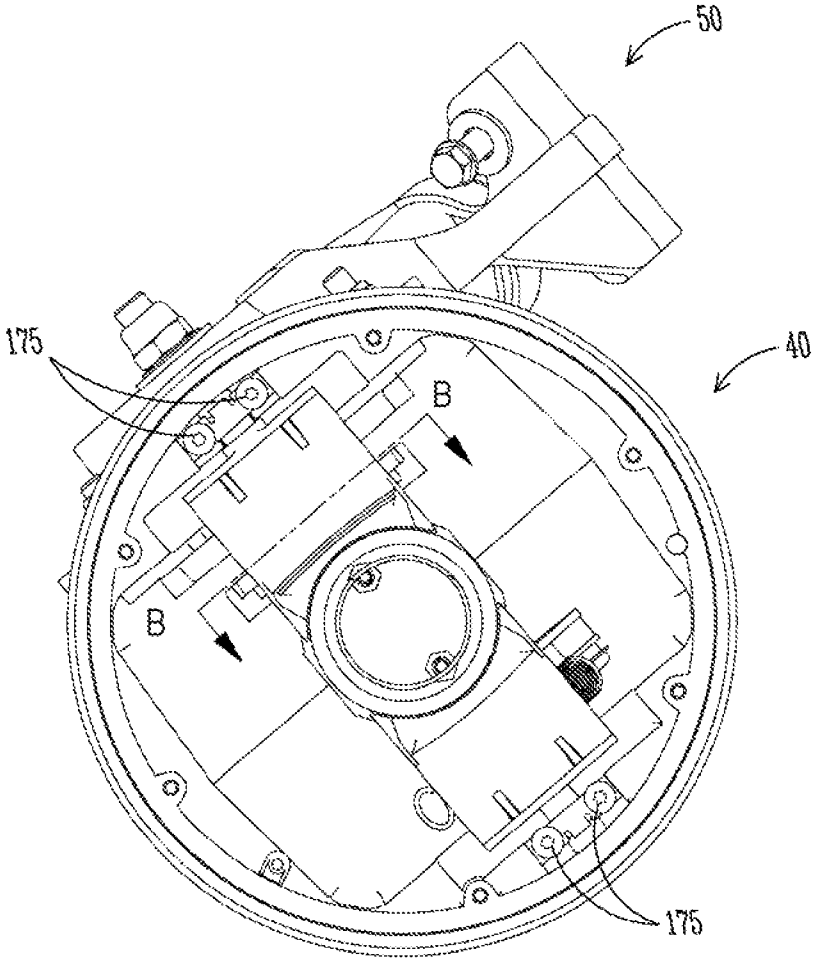
SECTION G-G

Fig. 5I5



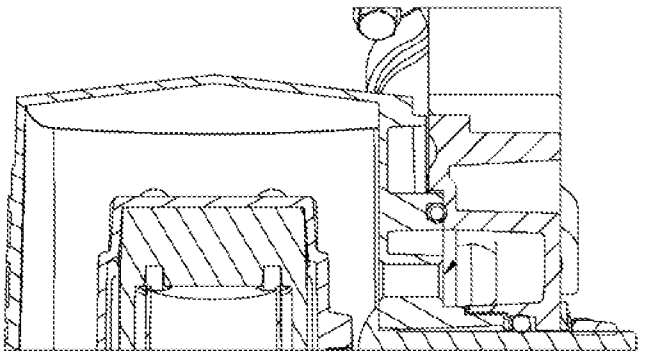
SECTION B-B

Fig. 5I6



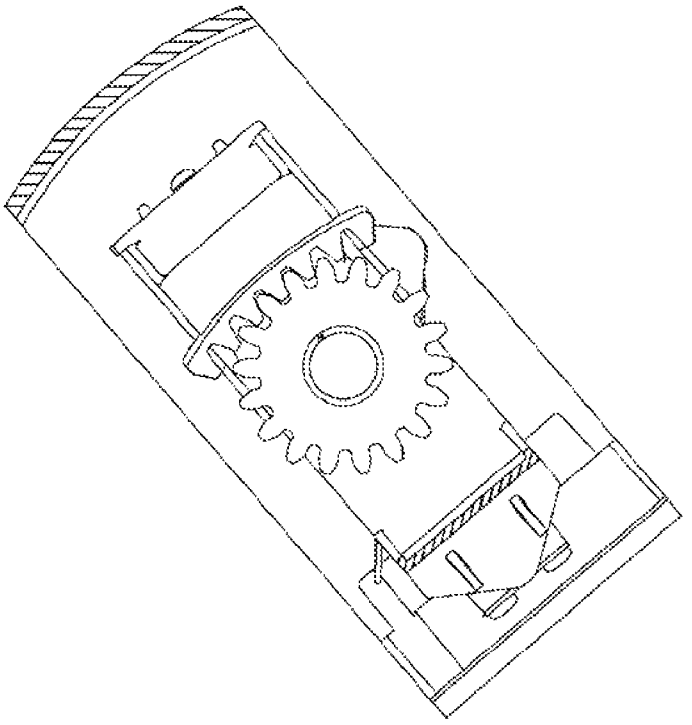
BOTTOM VIEW

Fig. 5J7



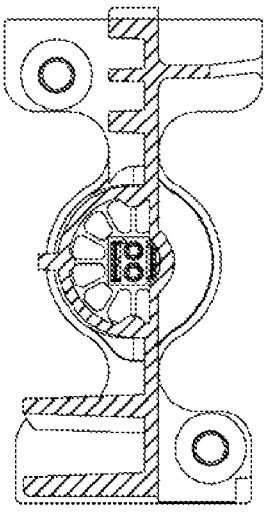
SECTION D-D

Fig. 5J8



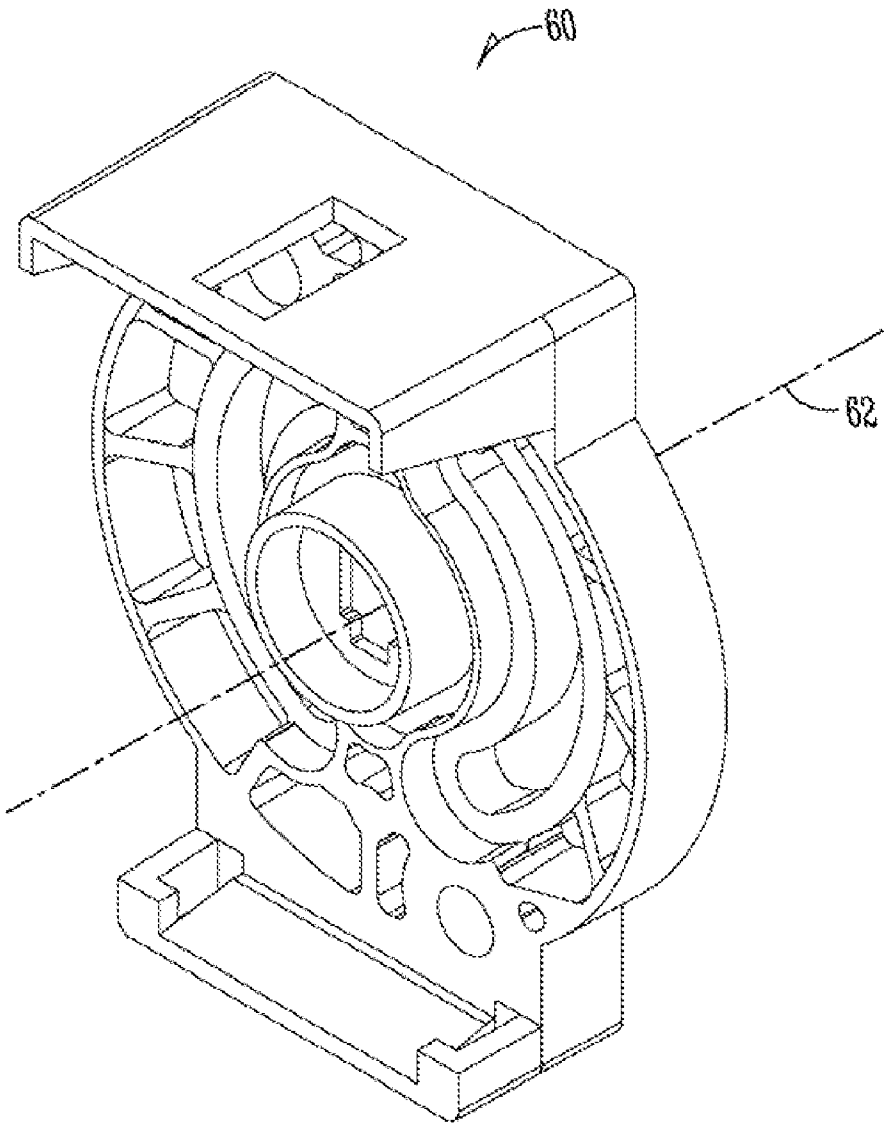
SECTION B-B

Fig. 5J9



SECTION I-I

Fig. 5J10



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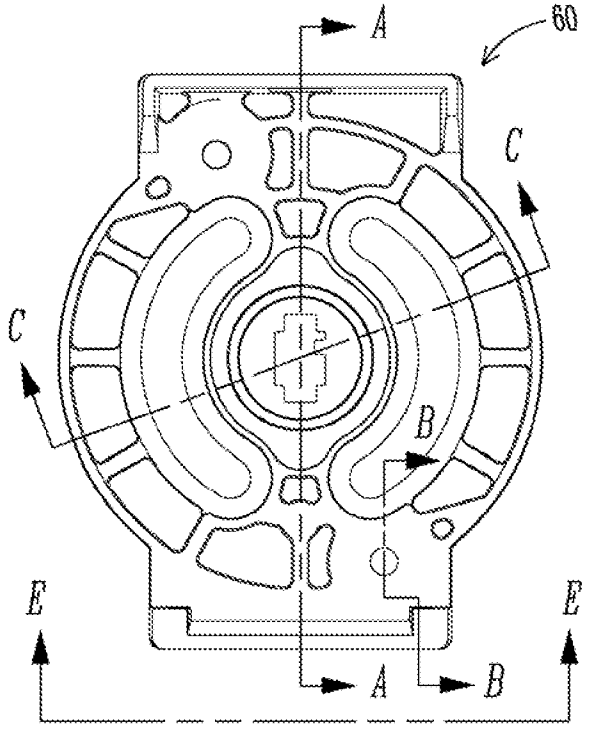
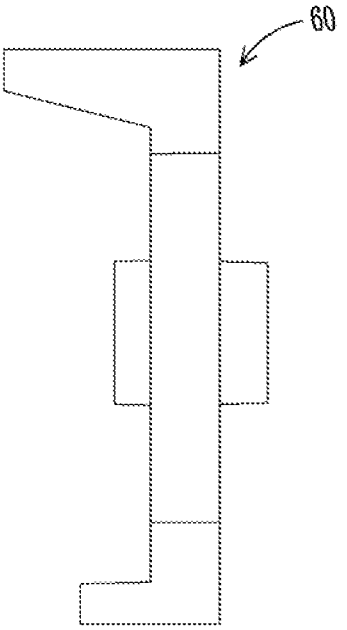
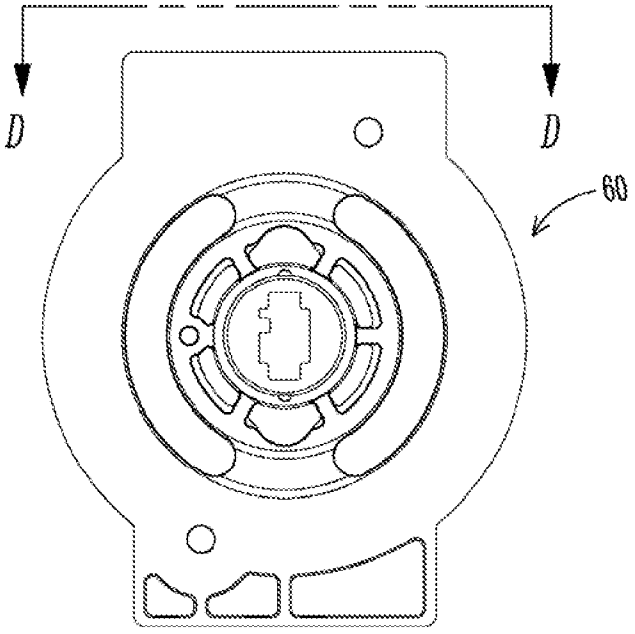


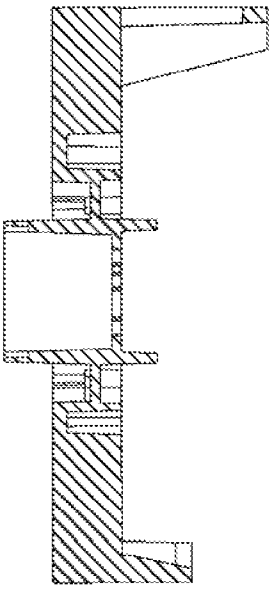
TOP VIEW
Fig. 6B



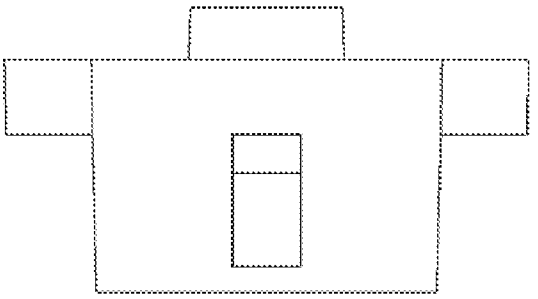
SIDE VIEW
Fig. 6C



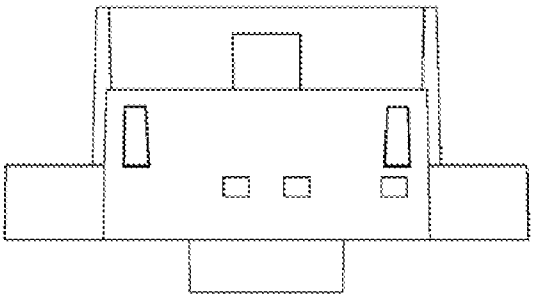
BOTTOM VIEW
Fig. 6D



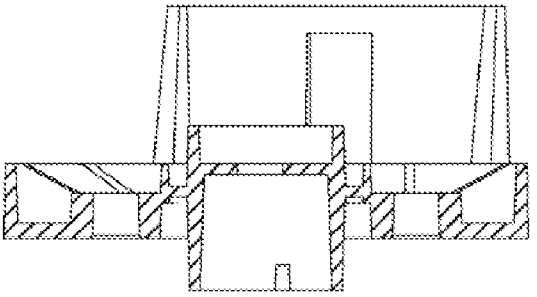
SECITON A-A
Fig. 6C



VIEW D-D
Fig. 6E



VIEW E-E
Fig. 6F



SECITON C-C
Fig. 6H

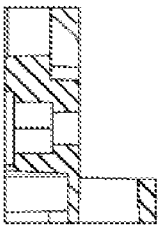


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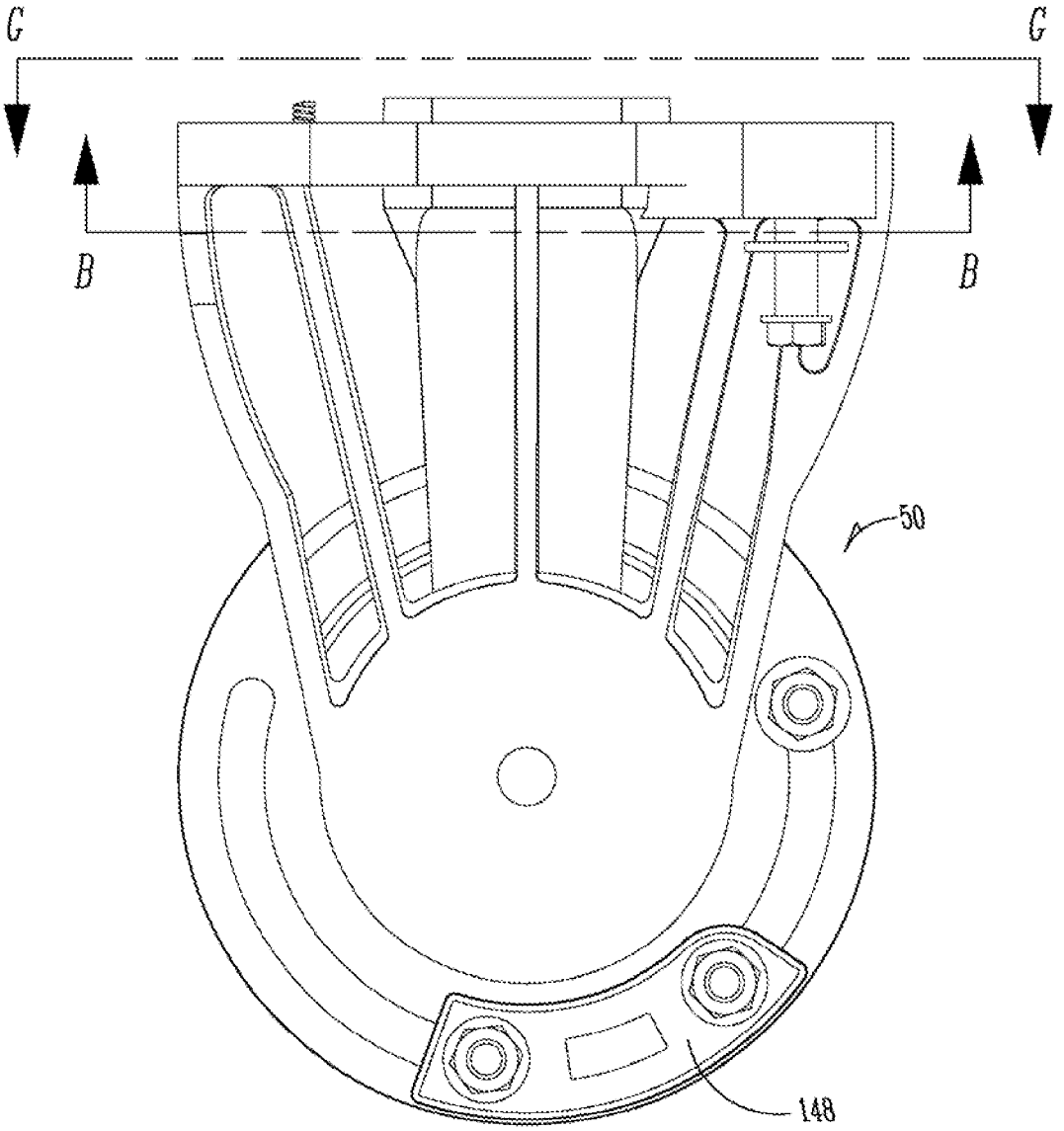
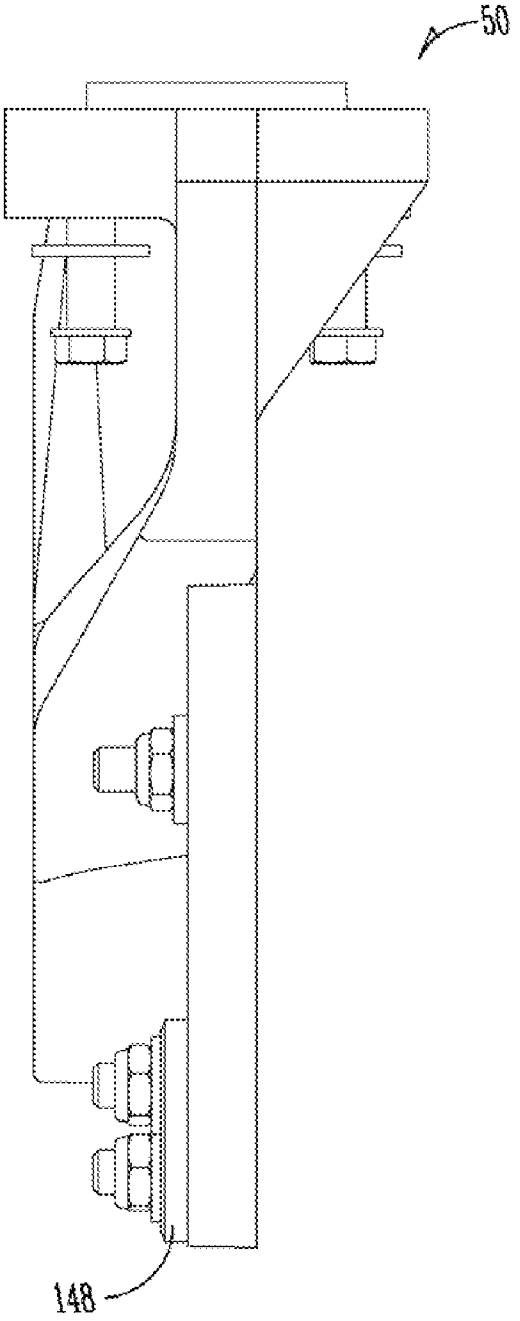
Fig. 6I



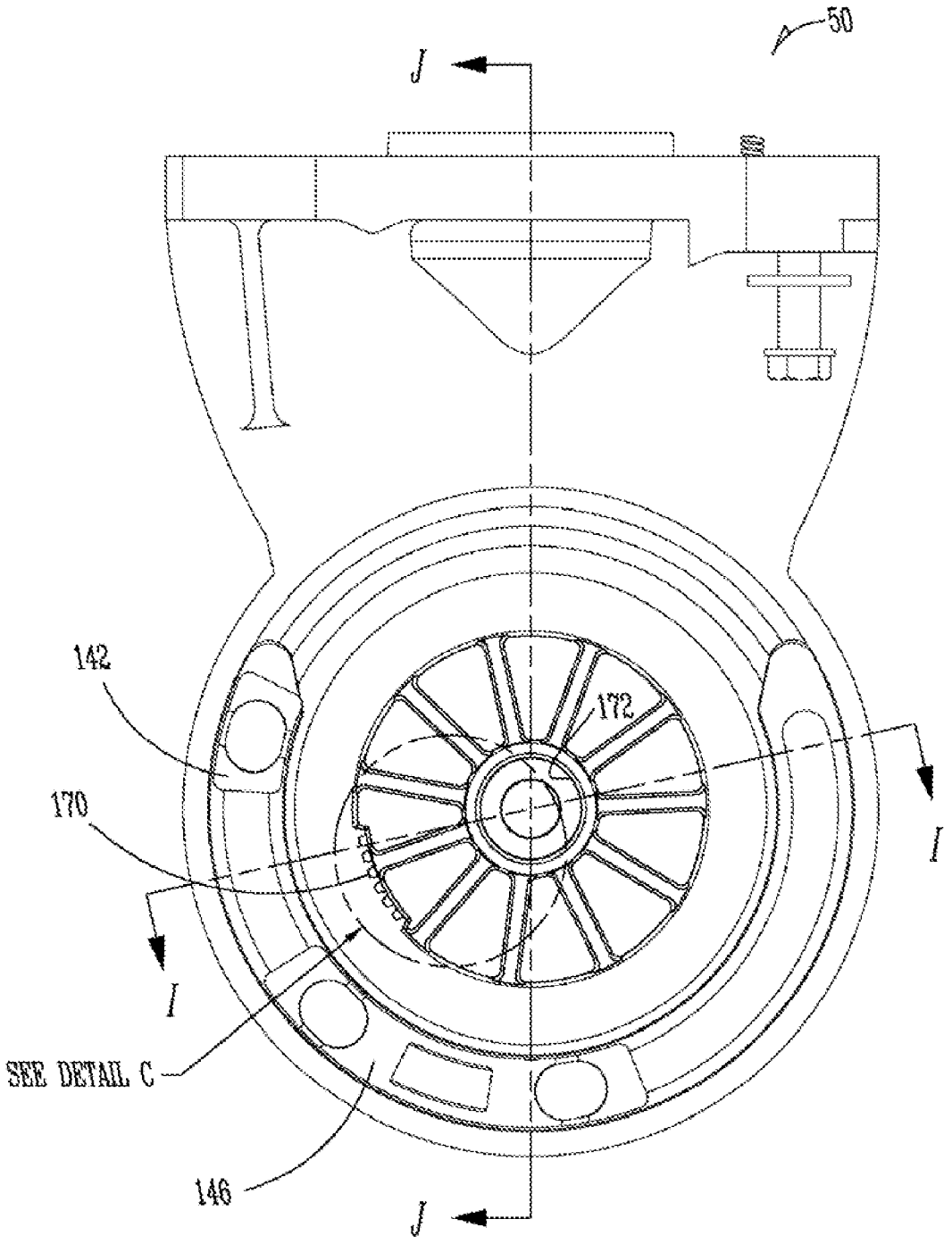
FRONT VIEW

Fig. 7A



SIDE VIEW

Fig. 7B



BACK VIEW

Fig. 7C

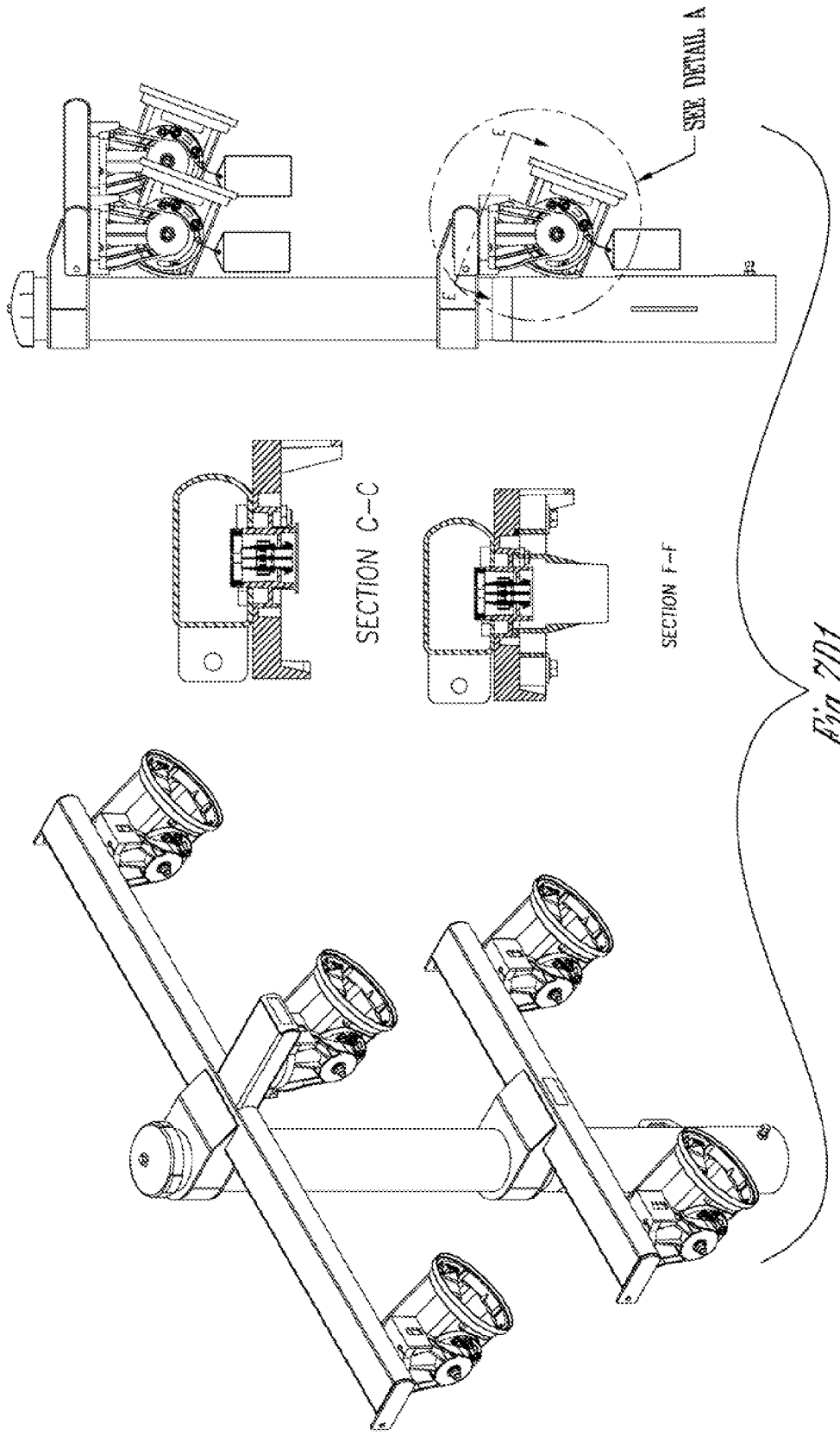
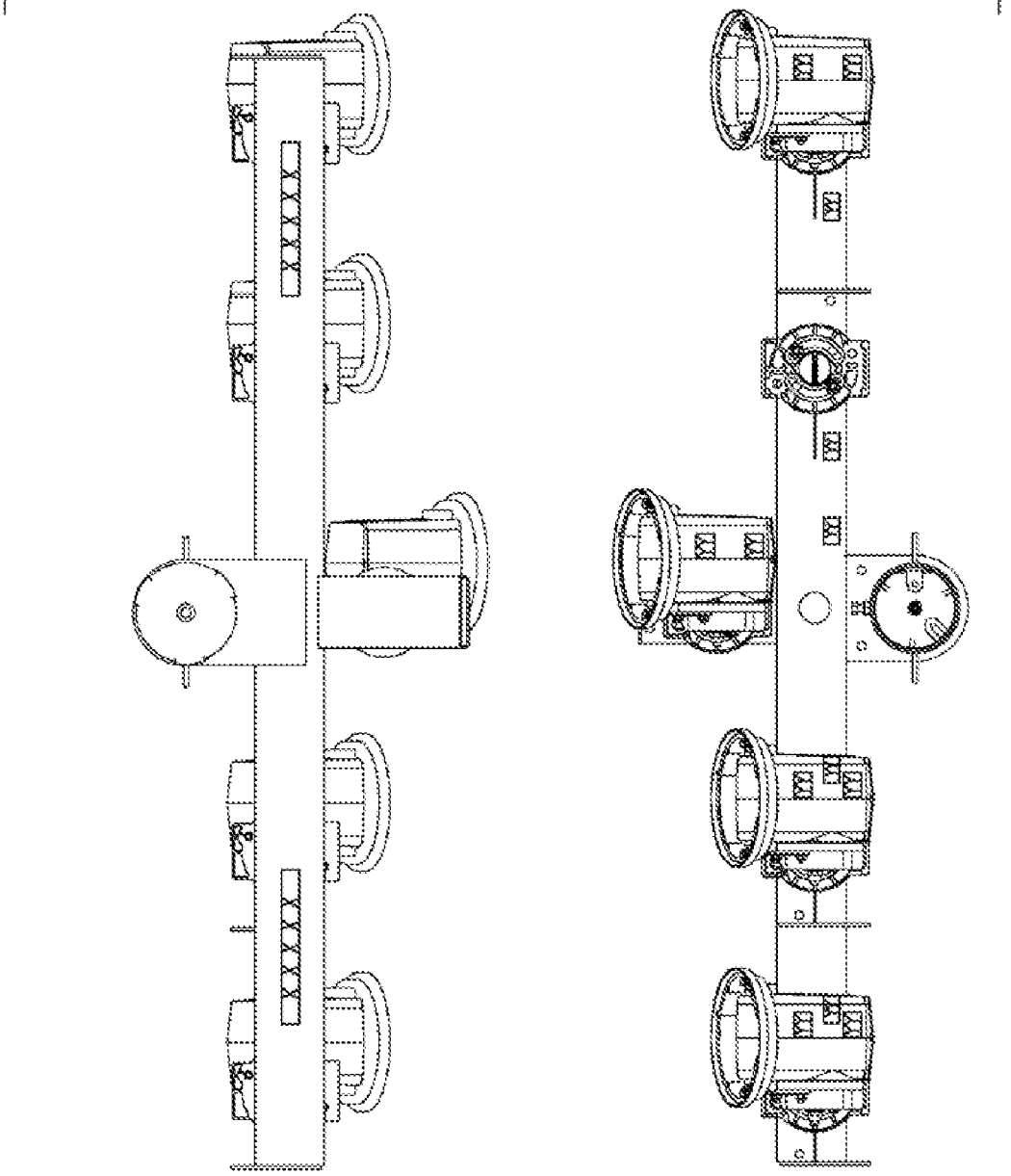


Fig. 7D1

Fig. 7D2



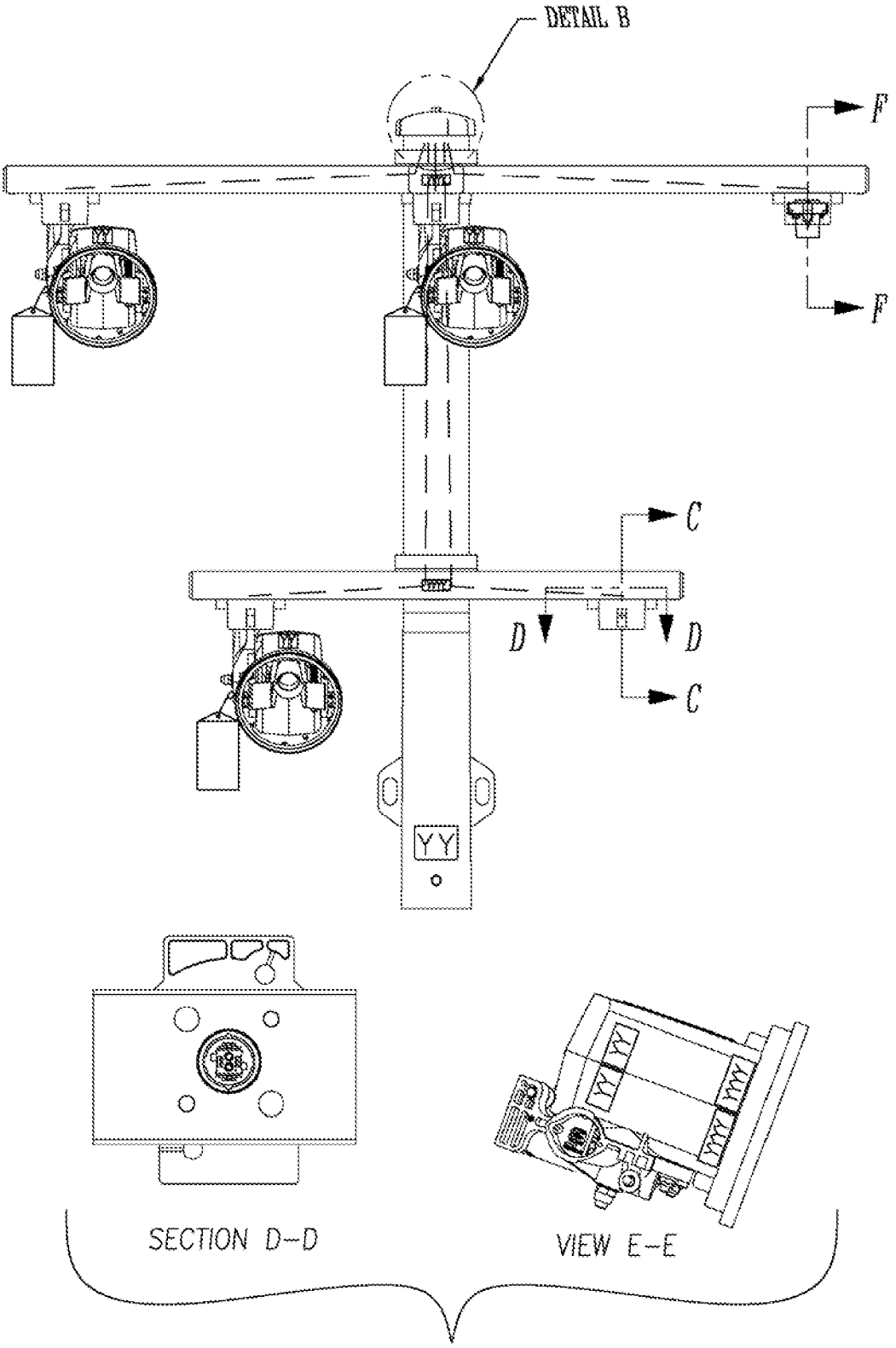


Fig. 7D3

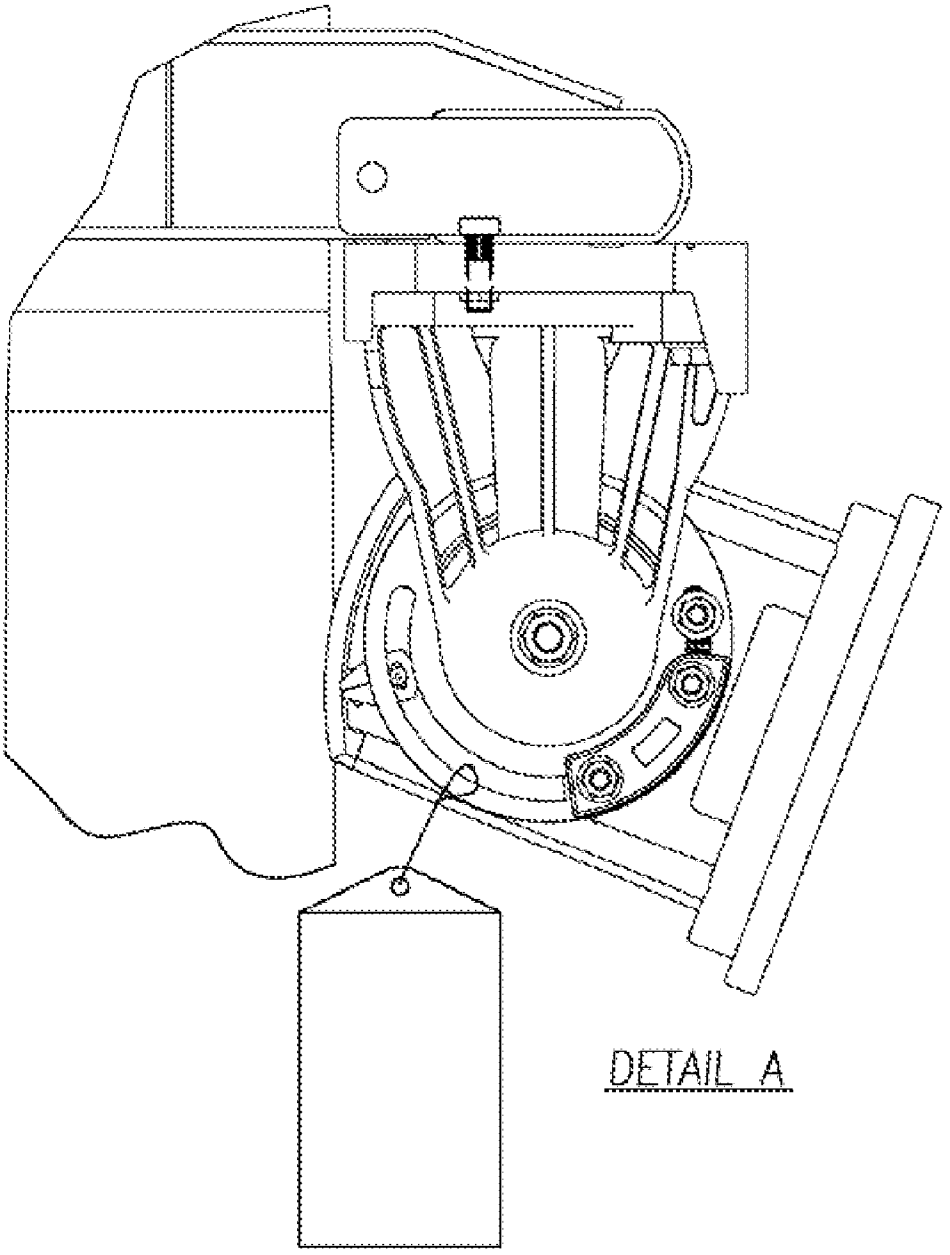
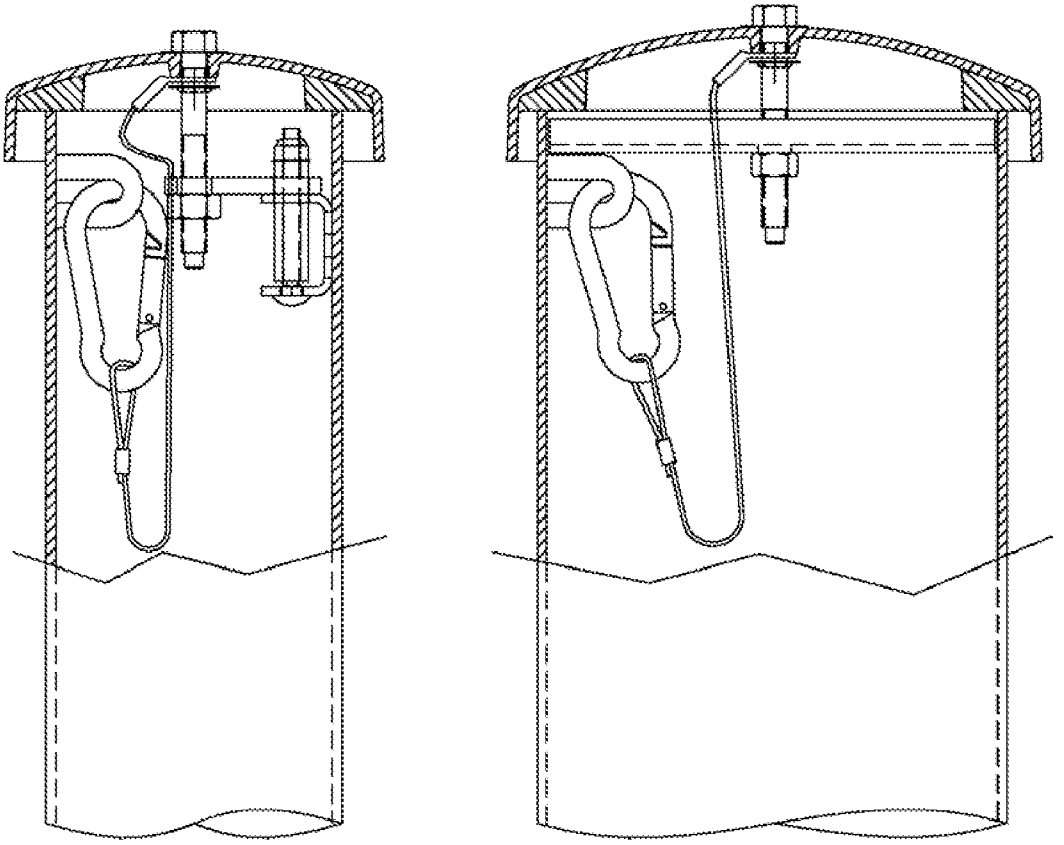
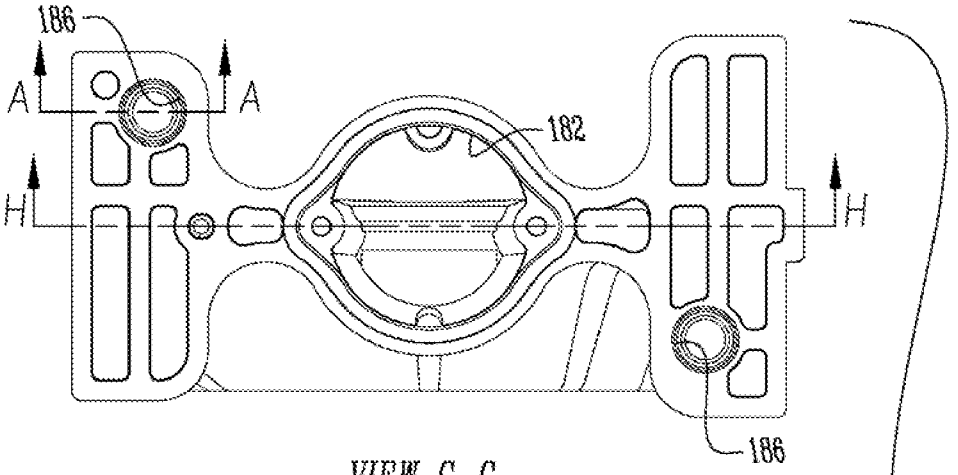


Fig. 7D4

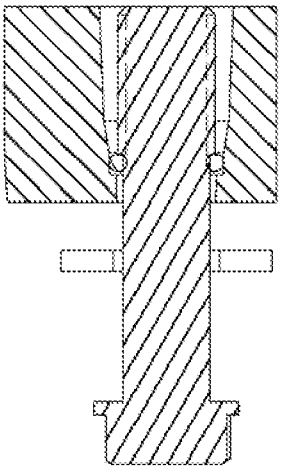


DETAIL B

Fig. 7D5

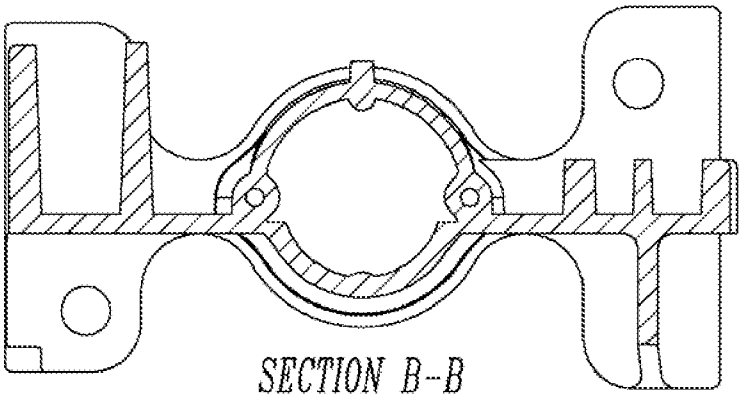


VIEW C-C



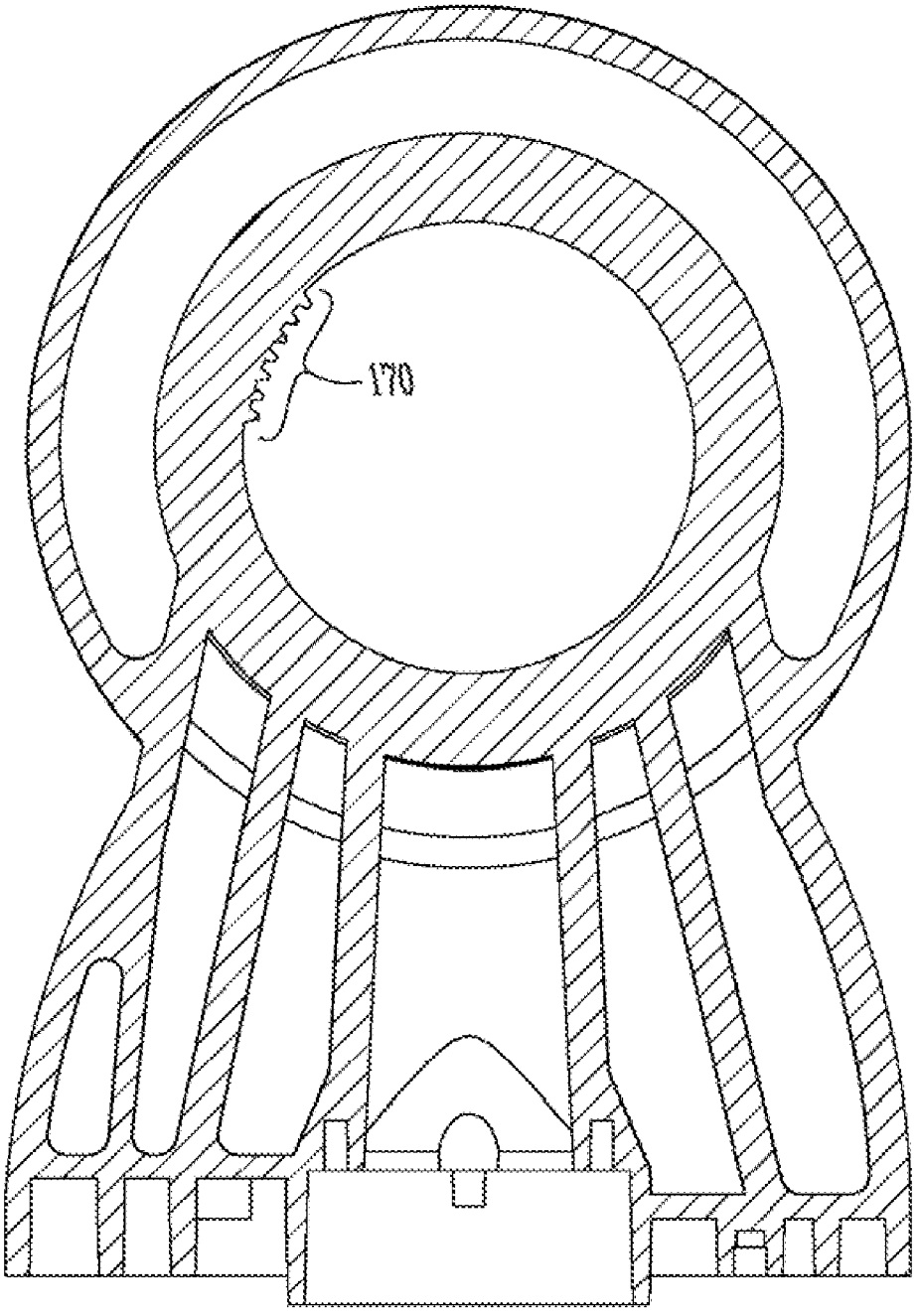
SECTION A-A

Fig. 7E



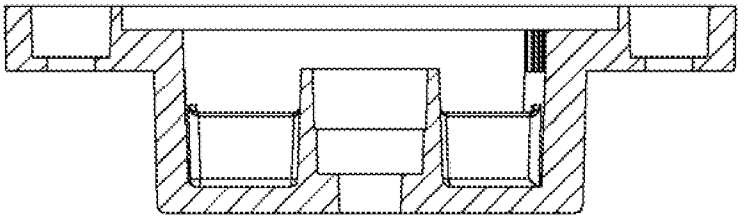
SECTION B-B

Fig. 7F



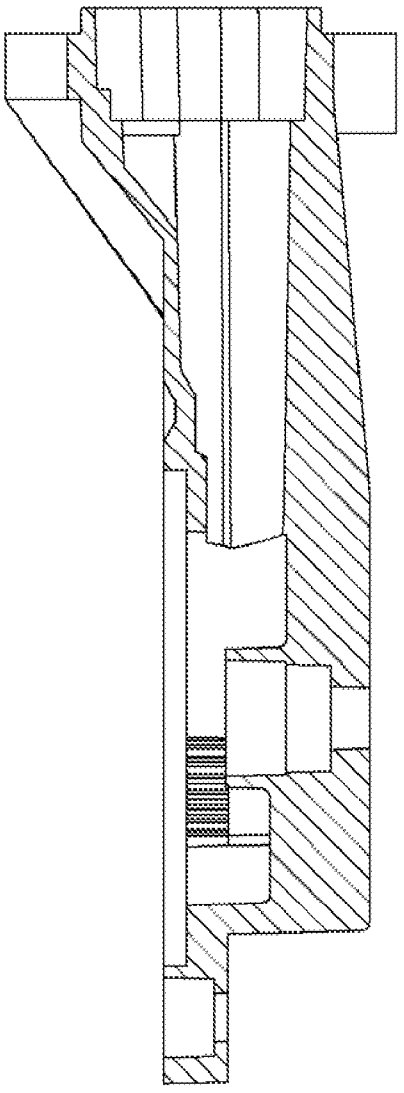
SECION H-H

Fig. 7G



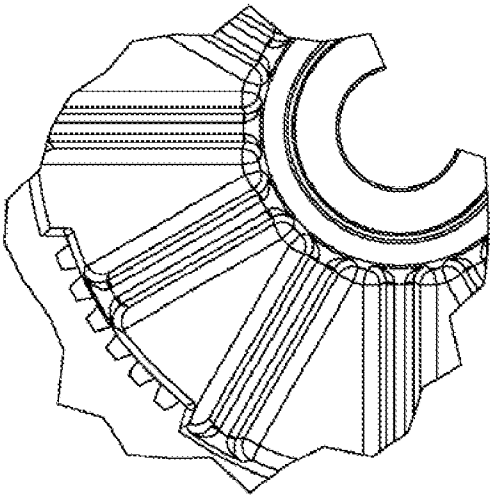
SECTION I-I

Fig. 7I



SECTION J-J

Fig. 7J



DETAIL C

Fig. 7H

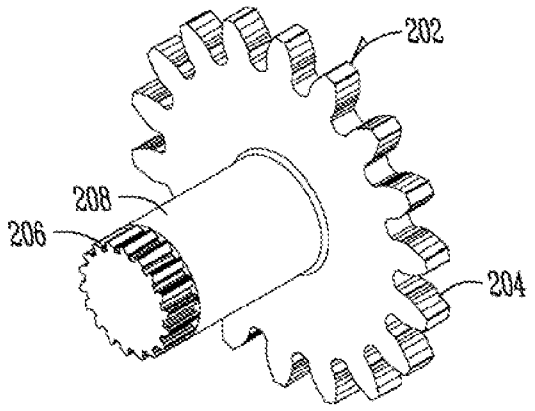
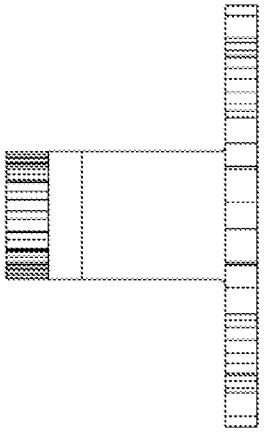
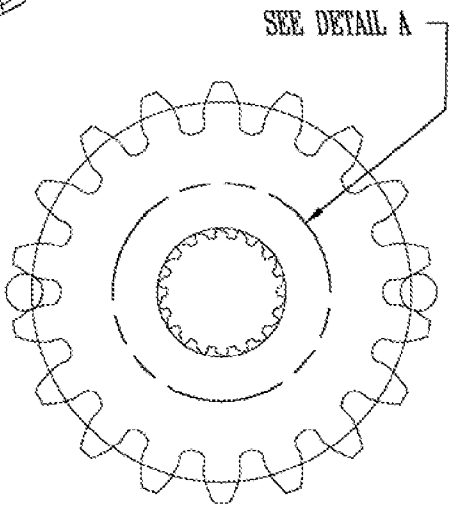


Fig. 8A



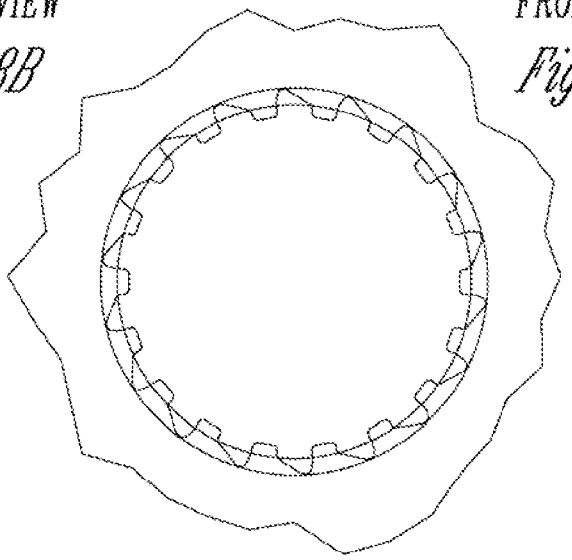
SIDE VIEW

Fig. 8B



FRONT VIEW

Fig. 8C



DETAIL A

Fig. 8D

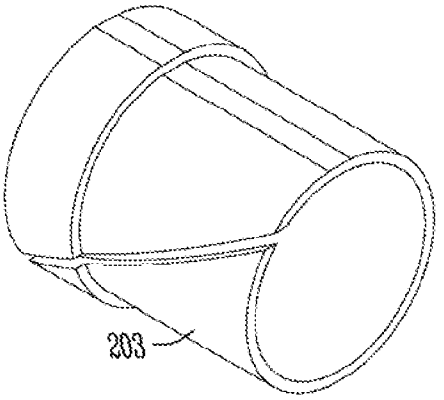
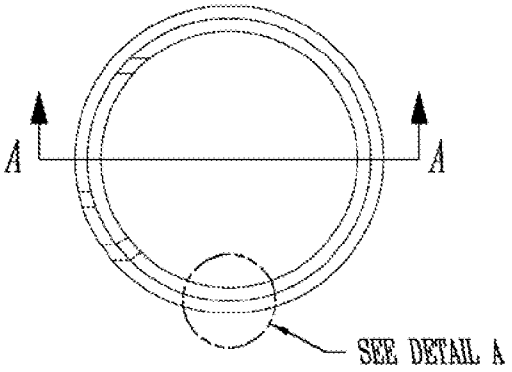
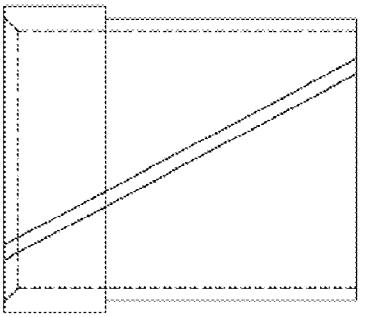


Fig. 9A



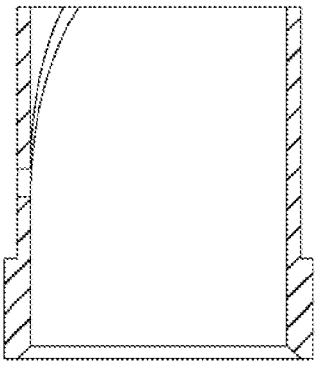
FRONT VIEW

Fig. 9B



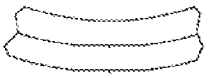
SIDE VIEW

Fig. 9C



SECTION A-A

Fig. 9D



DETAIL A

Fig. 9E

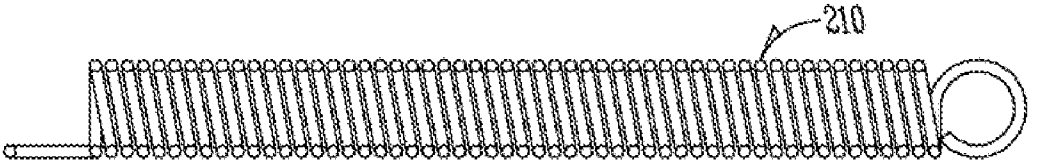


Fig. 10A

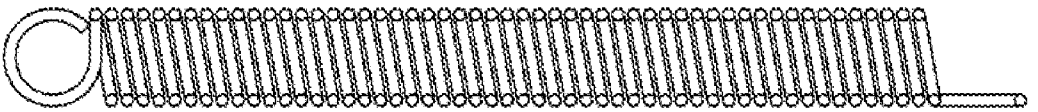


Fig. 10B

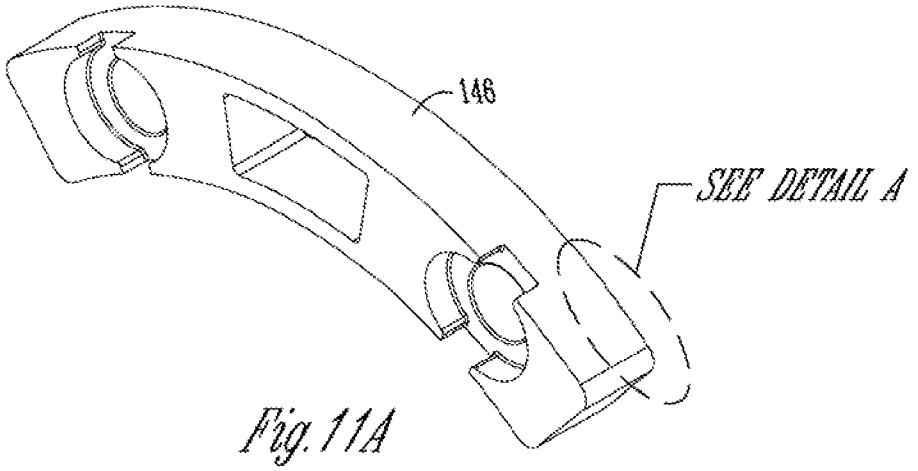


Fig. 11A

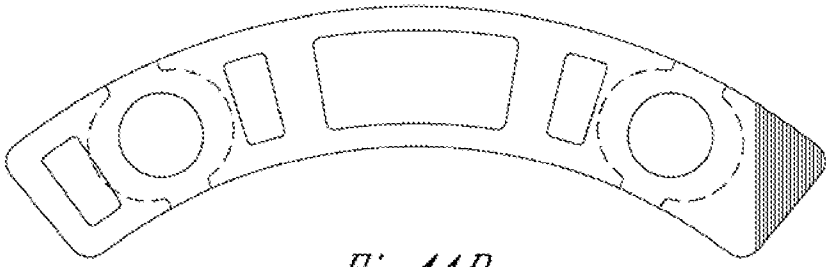


Fig. 11B

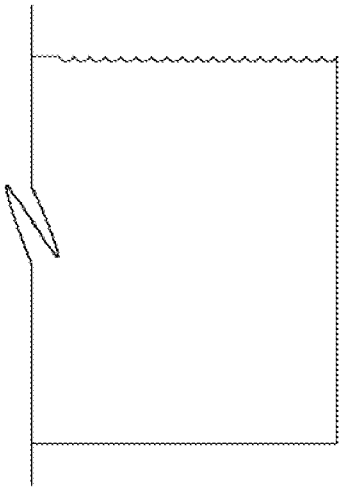


Fig. 11C

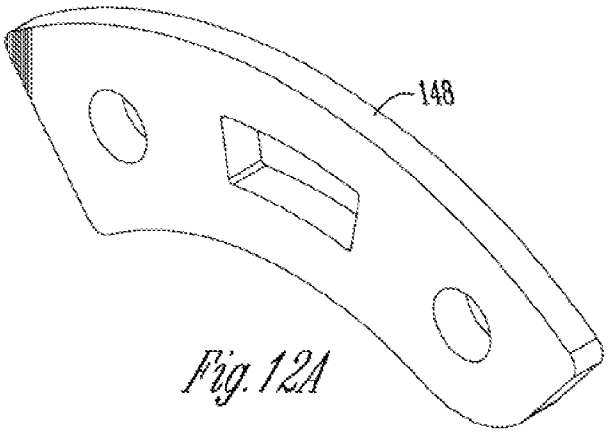
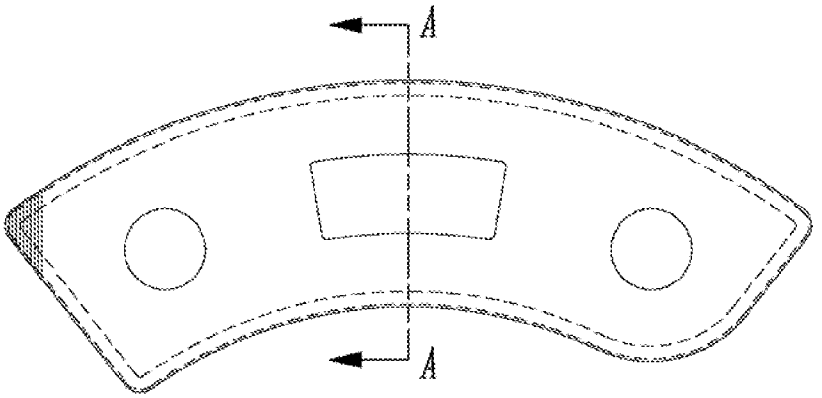
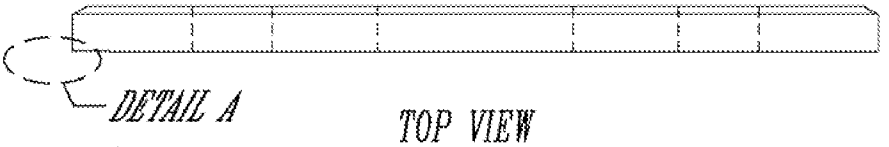


Fig. 12A



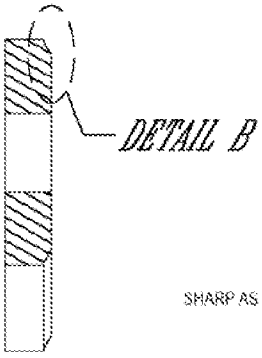
FRONT VIEW

Fig. 12B



TOP VIEW

Fig. 12C

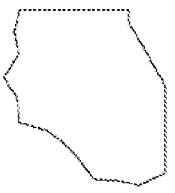


SECTION A-A

Fig. 12D

DETAIL A

Fig. 12E



DETAIL B

Fig. 12F

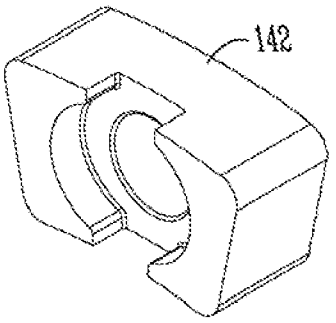
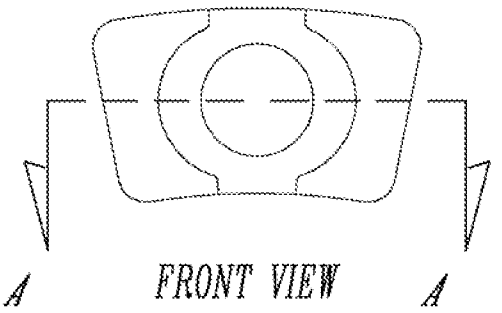
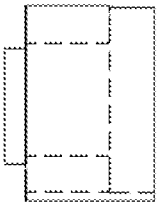


Fig. 13A



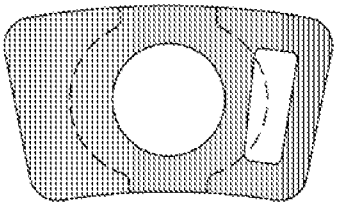
FRONT VIEW

Fig. 13B



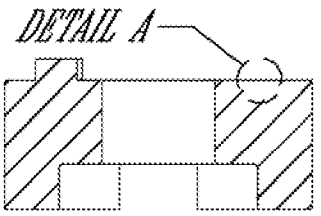
SIDE VIEW

Fig. 13C



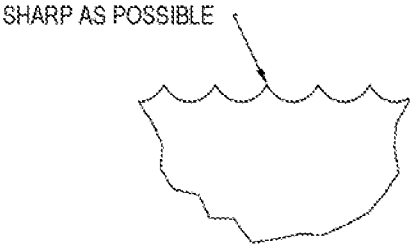
BACK VIEW

Fig. 13D



SECITON A-A

Fig. 13E



DETAIL A

Fig. 13F

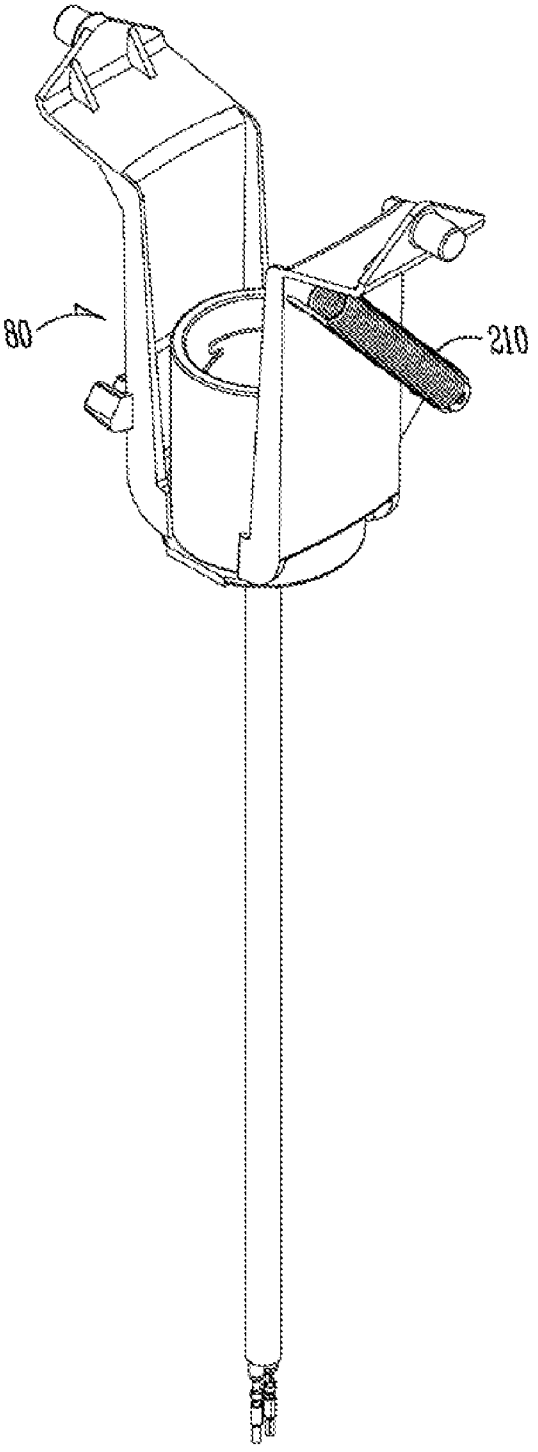


Fig. 14A

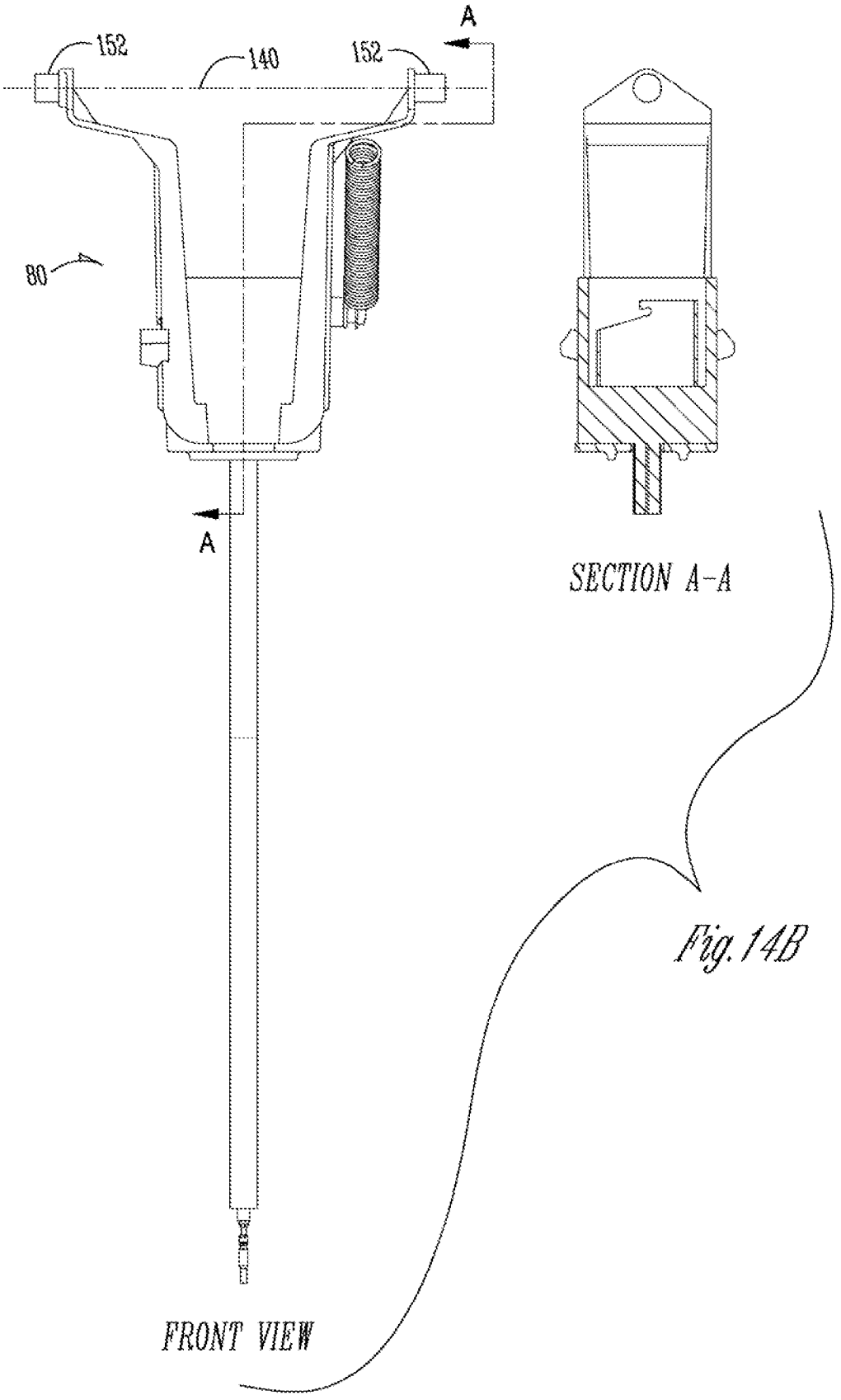
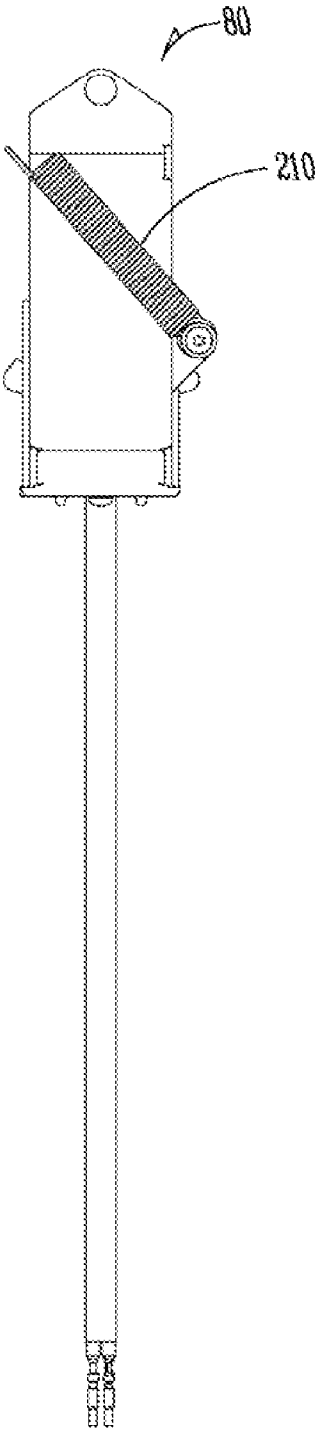


Fig. 14B



SIDE VIEW

Fig. 14C

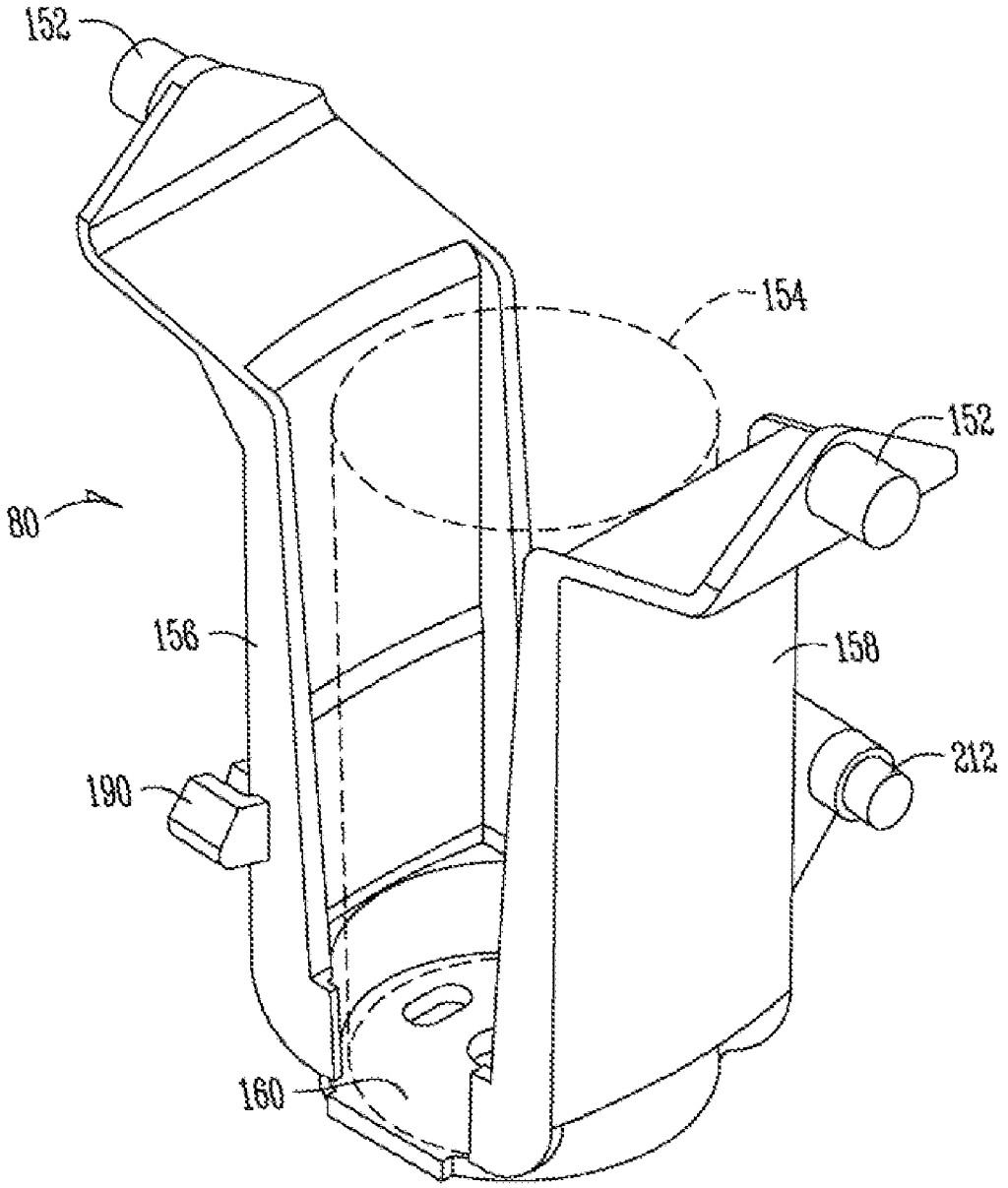
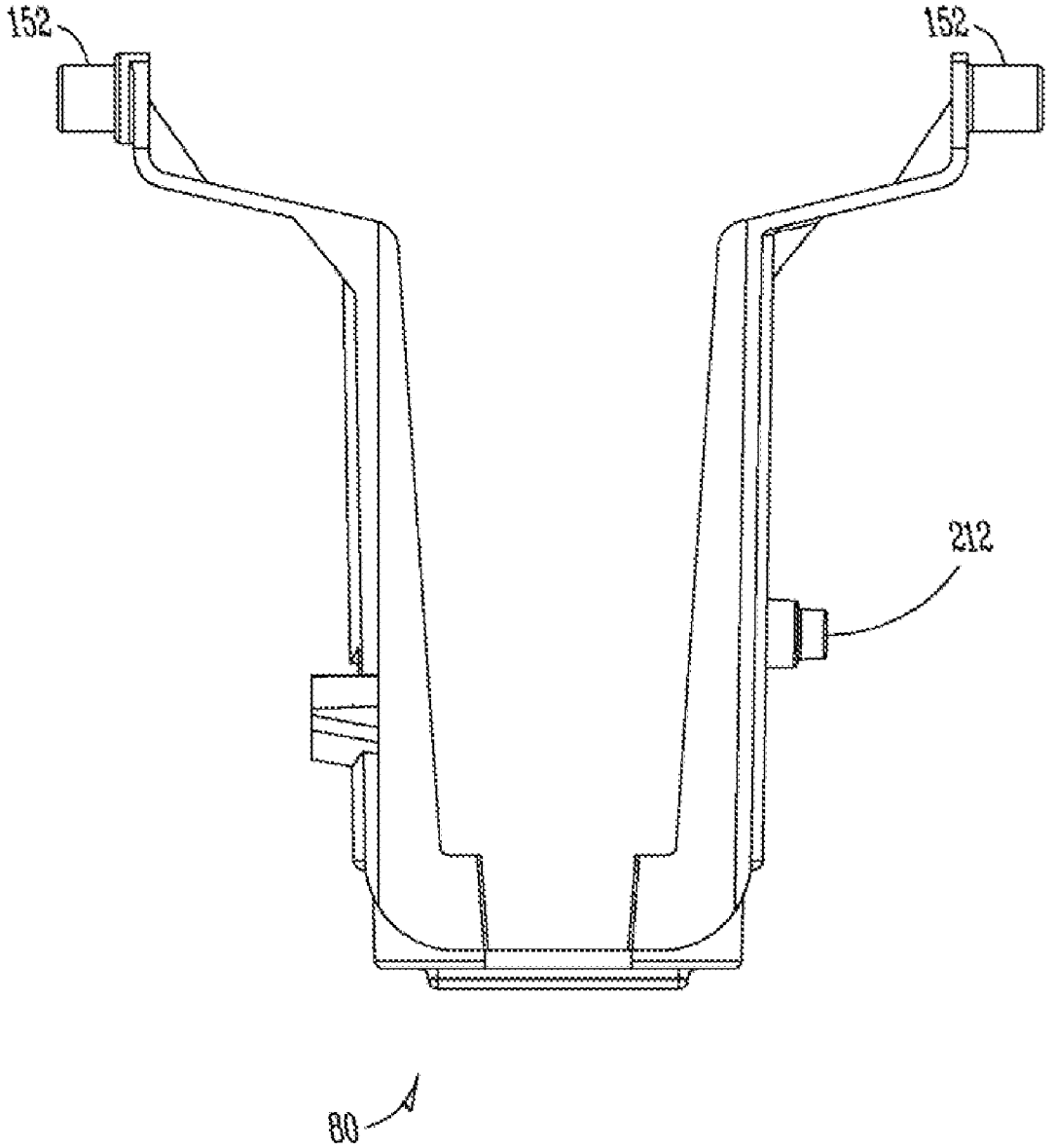
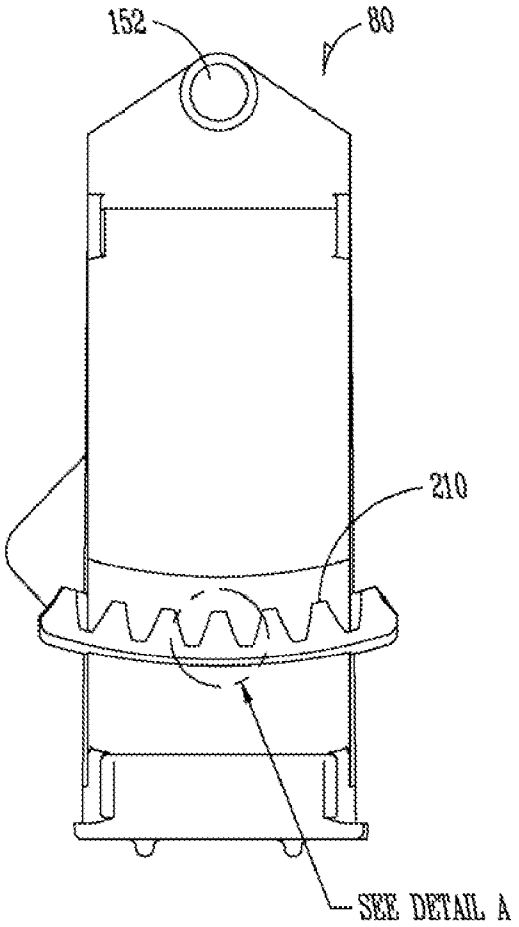


Fig. 14D



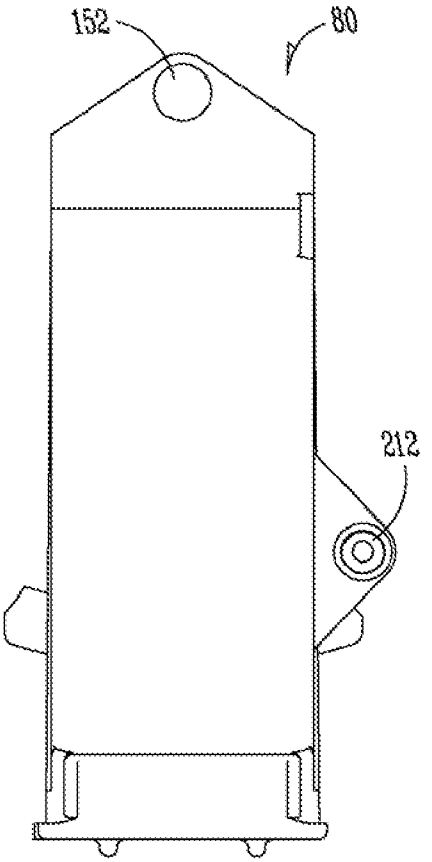
FRONT VIEW

Fig. 14E



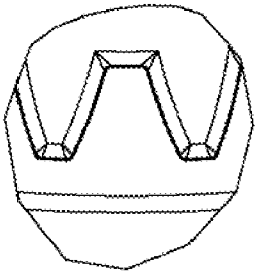
LEFT SIDE VIEW

Fig. 14F



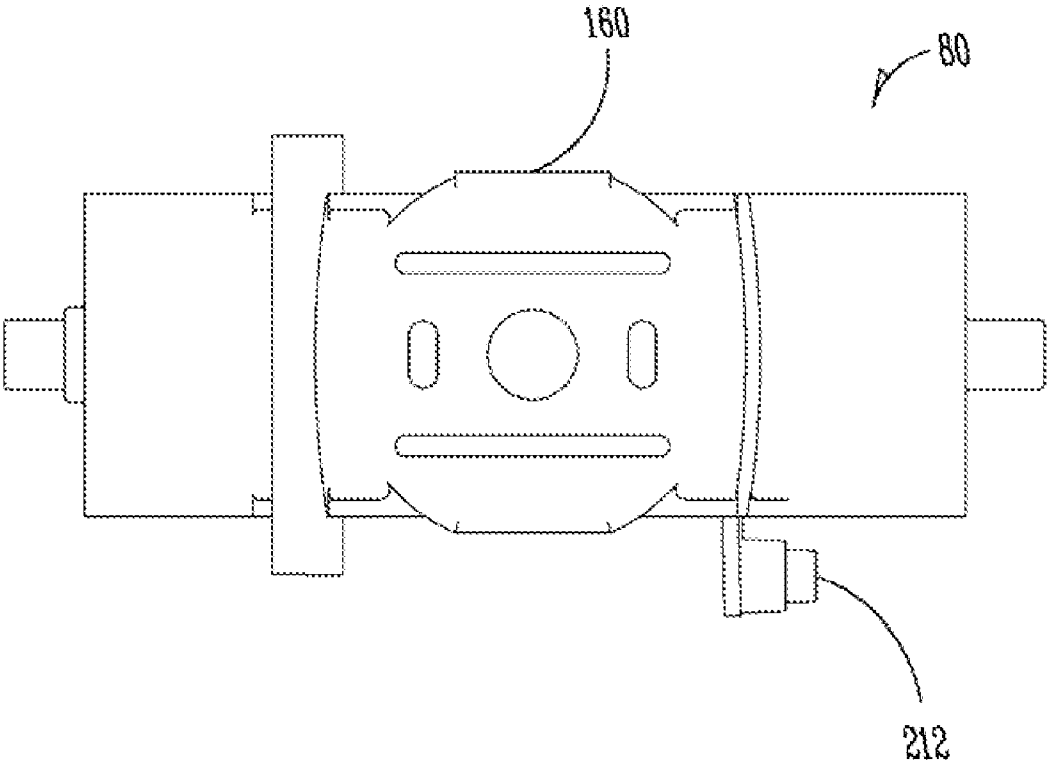
RIGHT SIDE VIEW

Fig. 14C



DETIAL A

Fig. 14H



BOTTOM VIEW

Fig. 141

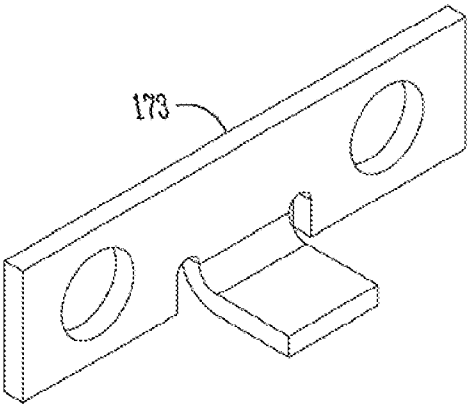
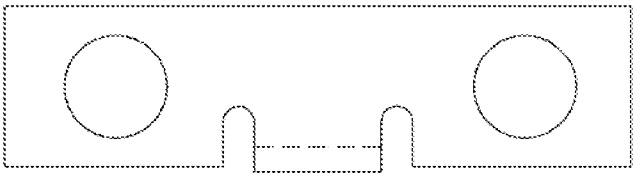
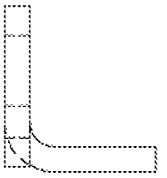


Fig. 15A



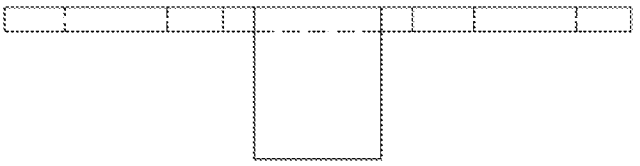
FRONT VIEW

Fig. 15B



SIDE VIEW

Fig. 15C



BOTTOM VIEW

Fig. 15D

GEARED TILT MECHANISM FOR ENSURING HORIZONTAL OPERATION OF ARC LAMP

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. Ser. No. 11/332,938 filed Jan. 17, 2006, which claims priority under 35 U.S.C. §119 of a provisional application U.S. Ser. No. 60/644,536 filed Jan. 18, 2005, all of which are incorporated by reference in their entirety. This application is also a non-provisional of the following provisional U.S. applications, all filed Jan. 18, 2005: U.S. Ser. No. 60/644,639; U.S. Ser. No. 60/644,747; U.S. Ser. No. 60/644,534; U.S. Ser. No. 60/644,720; U.S. Ser. No. 60/644,688; U.S. Ser. No. 60/644,636; U.S. Ser. No. 60/644,517; U.S. Ser. No. 60/644,609; U.S. Ser. No. 60/644,516; U.S. Ser. No. 60/644,546; U.S. Ser. No. 60/644,547; U.S. Ser. No. 60/644,638; U.S. Ser. No. 60/644,537; U.S. Ser. No. 60/644,637; U.S. Ser. No. 60/644,719; U.S. Ser. No. 60/644,784; U.S. Ser. No. 60/644,687, each of which is herein incorporated by reference in its entirety.

INCORPORATION BY REFERENCE

The contents of the following U.S. Patents are incorporated by reference by their entirety: Nos. 4,816,974; 4,947,303; 5,161,883; 5,600,537; 5,816,691; 5,856,721; 6,036,338.

BACKGROUND OF THE INVENTION

A. Field of the Invention

FIGS. **1**A-F generally illustrate a sports field lighting system (see also the patents incorporated by reference). There is room for improvement with such fixtures and how they are operated.

B. Problems in the Art

The problem of light loss from tilt factor in certain HID lamps is well known. The present applicant has created and patented several ways to operate an arc tube in a glass envelope in a generally horizontal position. See certain of above-cited patents which are incorporated by reference herein.

There is still room for improvement in this area. Some solutions require structure that must be manually adjusted after the fixture is elevated. This is subject to error and is labor intensive. Some solutions fix the relationship of the arc tube relative the fixture. However, in most sports lighting systems the fixtures vary in angular orientation to the ground. In these cases, it is not possible to insure that all arc tubes for the system end up installed in a horizontal position.

SUMMARY OF THE INVENTION

The present invention relates to an apparatus and method for automatically keeping the arc tube of an HID lamp in a pre-determined orientation relative the fixture. It comprises a mechanism that maintains the arc tube in the same general orientation to the reflector of a light fixture regardless if the orientation of the reflector relative to the fixture is changed.

In one aspect a gearing arrangement between a yoke holding the lamp, a mounting elbow for the fixture, and the reflector, presents a new way of looking at sports lighting. The invention pertains to apparatus, methods, and systems to effectively and more energy-efficiently deliver light to the target space, and reduce glare and spill light outside the target space.

It is therefore a principal object, feature, or advantage of the present invention to present a high intensity lighting fixture, its method of use, and its incorporation into a lighting system, which improves over or solves certain problems and deficiencies in the art.

An apparatus according to one aspect or the invention comprises a high intensity lighting fixture apparatus with a yoke adapted to hold the arc lamp so that its arc tube operates in a horizontal position, or as close as possible thereto, over most conventional operating positions for the fixture.

In another aspect of the invention, an arc lamp with an arc tube offset from the longitudinal axis of the lamp envelope is used in combination with the yoke. The arc tube offset can be at an aiming angle within the typical range of aiming angles for sports lighting. The yoke and associated structure would keep the arc tube at or about horizontal automatically even though the reflector is moved anywhere in that typical range.

These and other objects, features, advantages and aspects of the present invention will become more apparent with reference to the accompanying specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A-G generally illustrate a sports field lighting system (see also the patents incorporated by reference). There is room for improvement with such fixtures and how they are operated.

FIGS. **2**A-C illustrate a high intensity discharge arc lamp that is used with an exemplary embodiment of the present invention.

FIG. **3** is a diagrammatic, partial exploded view of a light fixture **10** according to an exemplary embodiment of the present invention.

FIGS. **4**A-D is a diagrammatic illustration of operation of an automatic tilt factor correction mechanism according to an exemplary embodiment of the invention.

FIGS. **5**A-J are various views of a bulb cone into which an HID lamp can be removably mounted and to which a reflector can be mounted.

FIGS. **6**A-I are various views of an elbow mount for connection to a cross arm on a pole.

FIGS. **7**A-J are various views of an elbow connectable to the elbow mount of FIG. **6**A and to the cone of FIG. **5**A.

FIGS. **8**A-D are various views of a gearing piece useful with the preferred embodiment.

FIGS. **9**A-E are various views of a bushing used with a bolt to pivotably connect the elbow and cone.

FIGS. **10**A-B show a spring used with the preferred embodiment.

FIGS. **11**A-C show a strap member used to lock the cone to the elbow.

FIGS. **12**A-F show additional straps used for such locking.

FIGS. **13**A-F show an end stop also used for adjustable locking of the angular orientation of the cone to the elbow.

FIGS. **14**A-I are various views of a yoke into which the HID lamp is mounted which can pivot angularly relative to the cone.

FIGS. **15**A-D are views of yoke retainers.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

A. Exemplary Apparatus

1. Lighting Fixture **10** Generally

FIG. **3** shows the basic components of sports lighting fixture **10** in exploded form.

Lamp cone **40** (360 Aluminum with polyester powder coat) pivots around axis **52** relative to knuckle **50**, which pivots around axis **62** relative to knuckle plate **60** which is fixed to cross arm **7** (see FIGS. **3** and **7**D**4**); alternatively, knuckle **50** may be fixed to cross arm **7** directly (see FIG. **2**C). Lamp cone **40** contains a socket **154** (shown diagrammatically in FIG. **14**A, commercially available) which is bolted to flat web **160** between arms **156** and **158** of yoke **80** (see FIG. **14**A). Lamp **20** (Musco Corporation LAMP™ brand lamp) has a threaded base **24** that can be screwed in and out of socket **154** (shown screwed into operating position in FIG. **3**) to install or remove lamp **20** from fixture **10** which may further comprise a reflector frame **30** (which may house individual reflector components **72**), a visor system **70**, and a lens **3**.

2. Lamp **20**

Arc lamp **20** is of the general type disclosed in Musco Corporation U.S. Pat. No. 5,856,721, incorporated by reference herein, with certain modifications. These types of lamps are used by Musco Corporation under the trademark Z-LAMP™ brand lamp and typically are 1000 watt or greater metal halide (MH) HID lamps. Its arc tube **12**, housed in lamp envelope **22**, is tilted obliquely along axis **26** across longitudinal axis **28** of arc lamp **20**. In operation, arc tube **12** is rotationally positioned in fixture **10** such that the longitudinal axis of arc tube **12** is as close to a horizontal plane as possible.

3. Yoke **80**

Yoke **80** is pivotally supported at the front of lamp cone **40** at pivot axis **140** (see FIG. **5**C arc tube **12**). Pivot pins **152** of lamp yoke **80** (see FIG. **14**A—and described in more detail below) slide longitudinally into mating receivers **134** (which define pivot axis **140**) on opposite sides of opening **132** to lamp cone **40** and are retained in place by yoke retainers **173** (FIGS. **15**A-D) by machine screws **175** in the pair of threaded bores on opposite sides of receivers **134** (see FIG. **5**J**7**).

Lamp socket **154** is mounted between arms **156** and **158** of yoke **80** via bolts, screws or other means through the back end **160** of yoke **80**. Yoke **80** therefore can pivot around an axis **140** defined by receivers **134** in lamp cone **40**. In combination with a setting of gearing, pivotable yoke **80** allows arc tube **12** of arc lamp **20**, which is supported by yoke **80**, to be maintained in a horizontal position independent of tilt of lamp cone **40**. FIGS. **4**A-D, along with FIGS. **5**A and **14**D, illustrate this total tilt factor correction feature of fixture **10**.

Pinion gear **202** (FIGS. **8**A-D) has a large gear portion **204** spaced parallel from a small gear portion **206** by shaft **208**. Shaft **208** is rotatably journaled in opening **138** in the side of lamp cone **40** (offset from the rotational axis of lamp cone **40** relative to knuckle **50**). A bushing **203** (plastic sleeve/bushing—FIGS. **9**A-E), provides a bearing surface for shaft **208** of gear **202** in opening **138** of lamp cone **40**.

When fixture **10** is assembled, small gear **206** engages gear rack **170** (see FIG. **7**G) formed in knuckle **50**. Large gear **204**, in turn, engages gear rack **190** fixed on one side of yoke **80** (see FIG. **14**G). Lamp cone **40** can rotate in a vertical plane around its pivot axis **52** (see FIG. **3**) relative to knuckle **50** to allow for different aiming angles for fixture **10** relative to the target. Because the front of yoke **80** (at its pivot axis **140**) is fixed relative to lamp cone **40**, yoke **80** also rotates in a vertical plane when lamp cone **40** does. If yoke **80** were completely fixed relative to lamp cone **40**, the longitudinal axis of lamp **20** would also rotate in a vertical plane. However, this would conflict with the preference to operate arc tube **12** in a horizontal plane regardless of aiming angle of the fixture.

Thus, fixture **10** compensates for this as follows. Gear rack **170** is fixed on knuckle **50**. Knuckle **50** is attached to knuckle plate **60** and rotational about axis **62** (see FIG. **3**), and knuckle plate **60** is fixed relative to cross arm **7**; alternatively, knuckle **50** may be fixed relative to cross arm **7** and omit knuckle plate **60** (see FIG. **2**C). The gearing and the parts involved with fixture **10** are selected so that pivotal movement of lamp cone **40** around axis **140** causes a proportional pivoting of yoke **80** around its different pivot axis **52**. Placement of yoke pivot axis **140** is intentionally chosen to be at or near the front plane of lamp cone **40**. When lamp cone **40** is rotated upward, the front of yoke **80** and pinion gear **202** raise with it, but large gear **206**, at the same, lifts the back free end of yoke **80** a proportional amount so that the orientation of lamp **20** and its arc tube **12** remains the same relative to horizontal.

When assembled, longitudinal axis **81** of yoke **80** is aligned or parallel with longitudinal axis **38** of lamp cone **40** (see FIGS. **2**C and **4**B-D). Thus, when lamp **20** is appropriately mounted on yoke **80**, its longitudinal axis would be oblique by the same angle to the longitudinal axes of lamp **20**, yoke **80** and lamp cone **40**. This is basically a reference position. If lamp cone **40**, for example, were tilted 30° down from horizontal relative to cross arm **7** when pole **5** is erected, yoke **80** would also have its longitudinal axis tilted down 30° from horizontal. This would put arc tube **12** in a horizontal plane.

This relationship allows a lamp such as Z-LAMP™ brand lamp **20** (FIGS. **2**A-C) to be utilized and operated at a horizontal position, so long as the angular offset of arc tube **12** relative to longitudinal axis **28** of arc lamp **20** is equal to the amount of tilt of lamp cone **40** from horizontal. Thus, if arc tube **12** is tilted 30° to the longitudinal axis of lamp **20** (see, for example, FIG. **2**B in which arc tube axis **26** is offset from lamp axis **28**), and lamp **20** is rotated into socket **154** of yoke **80** such that the yoke axes and lamp axes are in a vertical plane, arc tube **12** will be horizontal when lamp cone **40** is tilted 30° down from horizontal. As previously described, operation of arc tube **12** at horizontal will correct tilt factor.

However, because not all fixtures will be aimed at 30° down from horizontal, yoke **80** automatically adjusts to maintain the orientation of yoke **80** relative to horizontal for a selected range (e.g., 15° up to 47° down in steps in the plane of knuckle **50**) of pivoting of lamp cone **40** on either side of the reference position (e.g., 30° down).

This automatic tilt factor correction is further illustrated at FIGS. **4**A-D. If lamp cone **40** is tilted up several degrees from its 30° reference position relative to horizontal, pinion gear **202** will rotate in opening **138** of lamp cone **40** in a counter-clockwise direction as viewed in FIG. **4**C. Gear track **170** is fixed with respect to knuckle **50**, and with respect to space. The tilting of lamp cone **40** is about its rotational axis **52** (see FIG. **3**), which is also stationary in space. The front of lamp cone **40**, and thus the front of yoke **80**, will move upward in an arc (see reference number **302**, FIGS. **4**A-D). Pinion gear **202** likewise will move upward in an arc (ref. no. **304**). However, the counter-clockwise rotation of pinion gear **202** means large gear **204** will concurrently rotate counter-clockwise. Because large gear **204** is fixed relative to lamp cone **40**, the counter-clockwise rotation of large gear **204** will cause gear rack **190** to move in an a still third arc (ref. no. **306**) inside lamp cone **40** vertically upward separately from the vertical upward movement of lamp cone **40**. Thus, the back of yoke **80** will pivot upwardly along with gear track **190** an amount proportional to the amount lamp cone **40** is pivoted upwardly because gear rack **190** is fixed to yoke **80**. A similar proportional downward movement of the back of yoke **80** will be automatic when lamp cone **40** is pivoted downward (see FIG. **4**D). However, the amount of movement of the back of yoke **80** is less than the amount of movement of lamp cone **40** because the back of yoke **80** is closer to the pivot axis of lamp cone **40**.

In this embodiment, the range of tilt up and below horizontal (the arc tube reference position) is approximately +15 to −60°. This covers most conventional sports lighting aiming angles (95% of them at 30° beam and reference axes). It is noted that the guiding factor for operation of the automatic tilt factor correction is the pivot location of yoke **80**. It works as described because it is basically in the same plane as the junction between lamp cone **40** and reflector frame **30**. It would be more difficult to get precise correction if the yoke was pivoted to lamp cone **40** nearer the back of lamp cone **40**. While some change between the position of arc lamp **12** and reflecting surfaces **72** of fixture **10** occurs, it is relatively small. Thus minor re-aiming, if any is needed.

The gear ratios (large and small gears **204** and **206** have the same number of teeth are carefully selected such that there will be precise compensation for any upward or downward tilting of lamp cone **40** to maintain the same downward angular orientation of yoke **80**. In other words, despite yoke **80** being attached to, and moving with lamp cone **40** when it is pivoted away from its reference position, the gearing causes yoke **80** to pivot to maintain the same orientation relative to horizontal. Because lamp cone **40** pivots about a different axis than yoke **80**, selection of the gearing is critical to cause the right proportional movement of yoke **80**. Although the actual physical position of yoke **80** relative to lamp cone **40** will change somewhat, the orientation of yoke **80** stays parallel to its reference position. This will allow arc tube **12** of Z-LAMP™ brand lamp **20** to stay horizontal regardless of whether lamp cone **40** is in the reference position or some degree off of the reference position (within the range of the gearing).

To provide against play and to inject a biasing force relative to yoke **80**, an extension spring **210** (see FIGS. **10**A-B), attaches between post **212** of yoke **80** and post **214** at the front of lamp cone **40**. The spring is selected to maintain a suitable biasing force. It essentially pre-loads the gearing so there is not play in the gears or backlash. This increases the accuracy of the aiming. When maintenance on lamp **10** is performed, spring **120** can be easily disengaged by pulling it off of post **214**. The pitch diameter of the last few teeth on large gear **204** are cut off slightly greater than the pitch diameter of the other teeth. This makes that combination less sensitive to reengagement.

FIGS. **11**, **12**, and **13** show what is called straps and an end stop that can be clamped along the curved slot in knuckle **50** (see FIGS. **7**A-C). A projection from the side of cone **40** extends into that curved slot when cone **40** is pivotally connected to knuckle **50** by bolt **174**. The angular orientation of cone **40** relative to knuckle **50** can therefore be set by where strap pair **146**/**148** is clamped in position (as a lower end stop), and where end stop **142** is positioned and clamped in place (as an upper end stop). This combination provides more holding power to withstand torque forces than just relying on the tightening of bolt **174**. The straps and end stop can have structure that allow them to be clamped in place along the curved channel by tightening of bolts. Additionally, it allows for relatively easy release of the position for cone **40**. Two bolts on the straps for the bottom end stop can simply be released and that end strap pair slid away. This would allow, for example, a maintenance crew to go up and work on a fixture. The lower end stop straps could be released and the fixture tilted down to hang vertically while they worked on it. By leaving the upper end stop clamped into position, when finished, the workers just pivot the lamp and cone **40** back until into abutment with the upper end stop, slide the lower end stop strap pair into abutment with the projection or boss from the end cone that is in the slot, and retighten the screws. The original aiming of the fixture is therefore retained. It avoids having to do any re-aiming or calibrations.

As discussed above, one feature of the invention is maintaining an orientation of lamp **20** relative to some reference position substantially independent of the pivoting of cone **40**. As can be appreciated, the exemplary embodiment does this with the multiple pivot axes and gearing. This arrangement, however, while maintaining its substantially consistent orientation of the lamp with some external reference plane does cause slight movement of the lamp relative to the reflector that is attached to cone **40**. This can slightly alter the beam pattern from the fixture. For example, if cone **40** is tilted upwardly approximately 15° from a 30° down position, not only would the reflector connected to the cone tilt up 15°, the repositioning of the lamp inside the reflector would cause a beam shift an additional approximately 7½ more degrees up. Being aware of this, and compensating for this, is sometimes required. However, because of fairly known proportionalities once a configuration is selected, this can be built into the design of the system. It actually can be advantageous in that even though there might be some physical limit of how far up or down cone **40** can be adjusted (for example because of physical limitations in the structure of the fixture or for that matter, practical limitations), the beam shift created by that adjustment is proportionally more, thus giving a wider range of potential adjustments.

Further discussion of benefits of the total tilt factor correction structure and options for it can be found in the patents incorporated by reference herein.

It will be appreciated that the foregoing exemplary embodiment is given by way of example only and not by way of limitation. Variations obvious to those skilled in the art will be included in the invention. The scope of the invention is defined solely by the claims.

Utilization of the Musco Z-LAMP™ brand lamp is not necessarily required. By appropriate modification, a standard arc lamp could be utilized.

It will be appreciated that the combination of components shown in the figures is but one way in which adjustability between a mount for the fixture to a cross arm, and the fixture can be accomplished. The figures illustrate how, in the exemplary embodiment, an integration of the gearing and the adjustable yoke allows for compensation and maintenance of an orientation of the arc lamp regardless of orientation vertically of the cone in which the yoke is contained (over a reasonable range). The drawings are intended to show to one skilled in the art one combination. The general concept is to have some compensation or mechanism for the function and result of maintaining a certain orientation of the lamp.

What is claimed is:

1. A method of increasing useful light to a target area from lighting fixture including a high intensity discharge light source comprising:

a. installing the lighting fixture in operating position relative the target area; and

b. automatically approximately maintaining an orientation of the high intensity discharge light source relative to the target area regardless of orientation of the lighting fixture to the target area.

2. The method of claim **1** further comprising mounting the light source in a structure that is independently moveable relative to the lighting fixture.

3. The method of claim **2** wherein the independently moveable structure is pivotable relative to the light fixture.

4. The method of claim **3** wherein the independently moveable structure is pivotable relative to the light fixture on a separate pivot axis from that of the light fixture.

5. The method of claim 4 wherein any change of orientation of the light fixture, over a certain range, results in proportional pivoting of the independently moveable structure.

6. The method of claim 5 wherein the proportional movement is through gearing.

7. A lighting fixture for wide area lighting comprising a lamp cone adapted to receive high intensity discharge light source and a knuckle connectable to the lamp cone, the lamp cone being pivotable around a first pivot axis relative to the knuckle, comprising:

a. a lamp yoke in the cone to which a high intensity discharge light source can be mounted and which is pivotable around a second pivot axis;

b. a gearing combination operably connected to the lamp yoke to pivot the lamp yoke around the second pivot axis proportionally to any pivoting of the lamp cone relative the knuckle around the first pivot axis.

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