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(54) LIGHTED DISPLAY CASE WITH REMOTE LIGHT SOURCE

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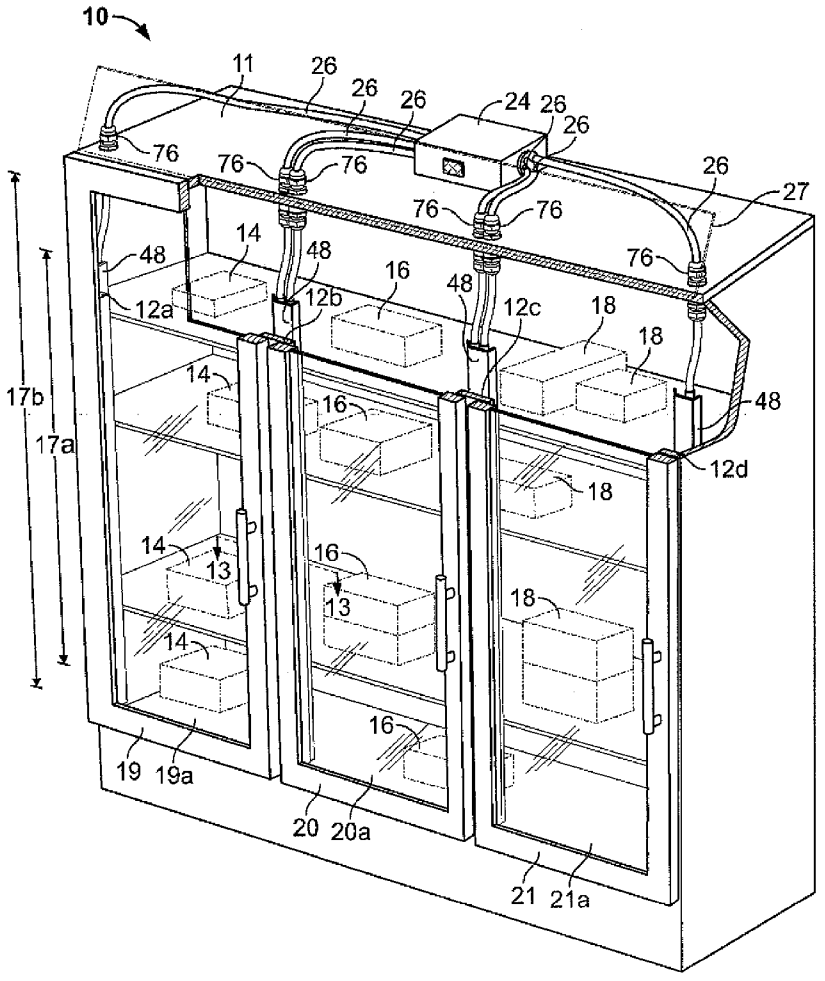
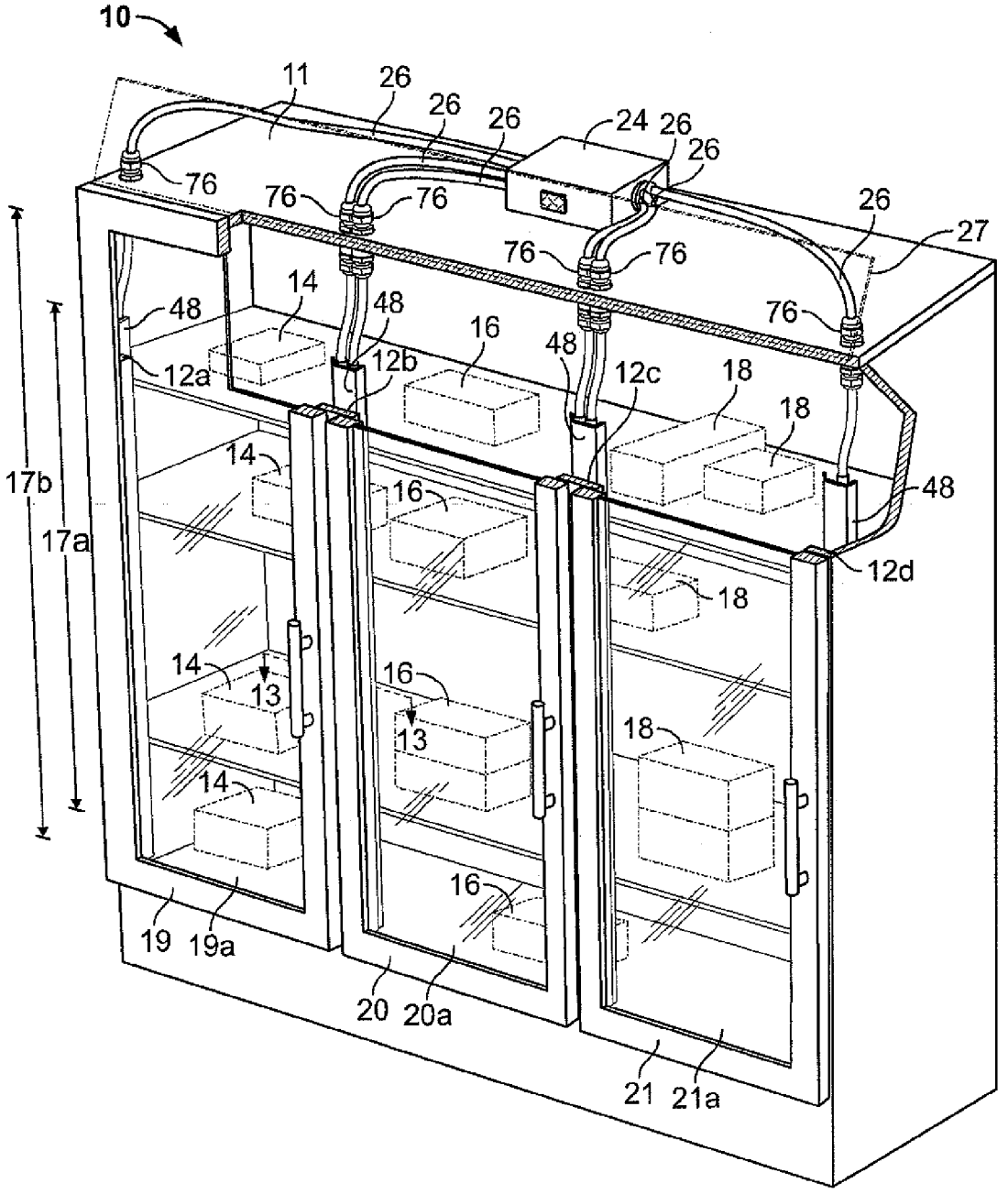
(52) **U.S. Cl.** **362/125**

(57) **ABSTRACT**

Lighted display case with remote light source comprises a container having contents for display. A solid fiber optic luminaire is at least partially mounted within the container, having an elongated side-light emitting portion for emitting light from the side of the luminaire onto contents in an interior of the display case. The side-light emitting portion comprises an extractor of light arranged to preferentially extract light from the luminaire and direct the light to at least one target area of said contents. The portion may be rotatable about its own longitudinal axis. A single side-light emitting portion may be arranged to illuminate a target area on one of its lateral sides, and another target area on another lateral side. A single lamp may provide light to first and second luminaires arranged to illuminate a target area on one of its lateral sides, and another target area on another lateral side.




10
11
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76
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14
12a
12b
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12d
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17b
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19a
20
20a
21
21a

FIG. 1

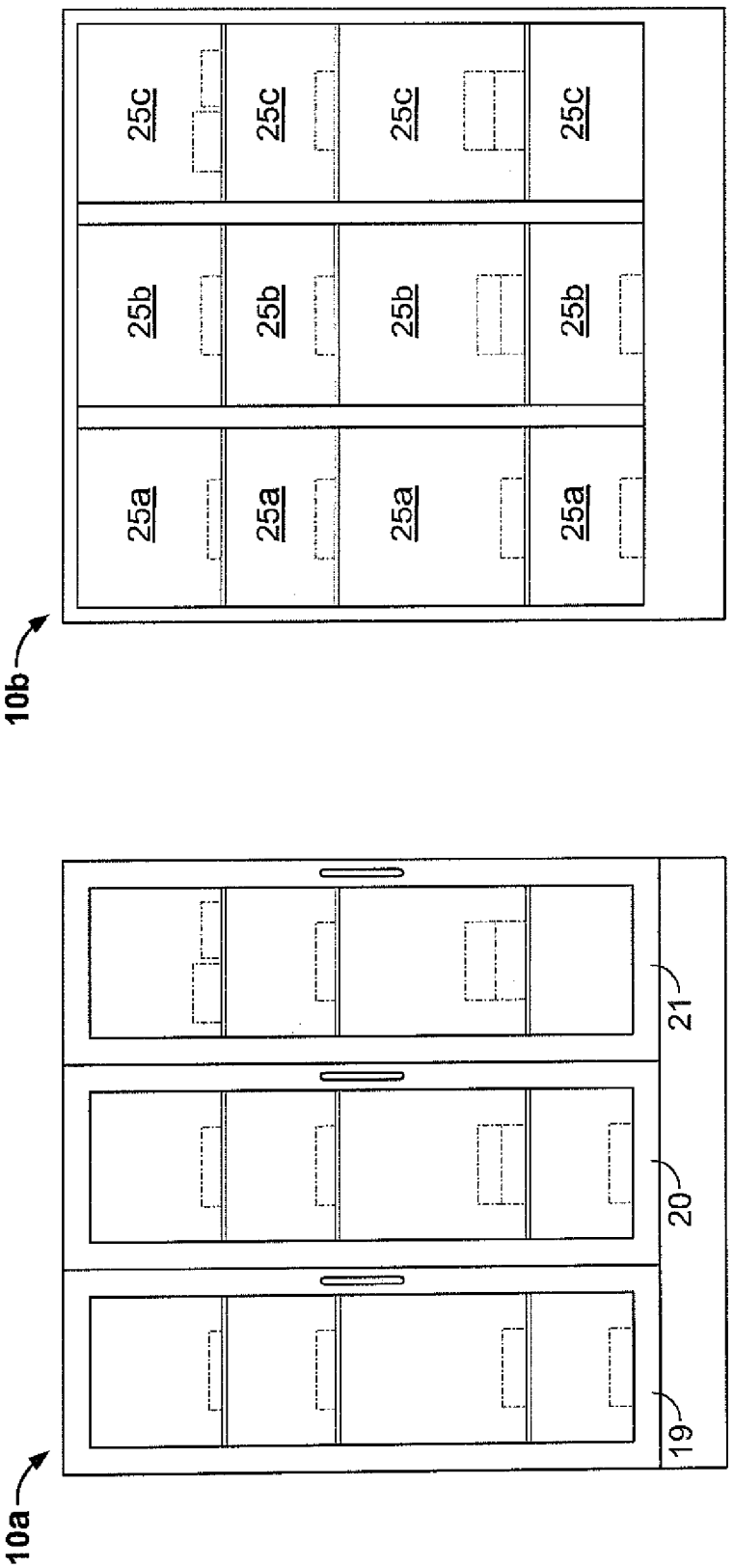


FIG. 2

FIG. 3

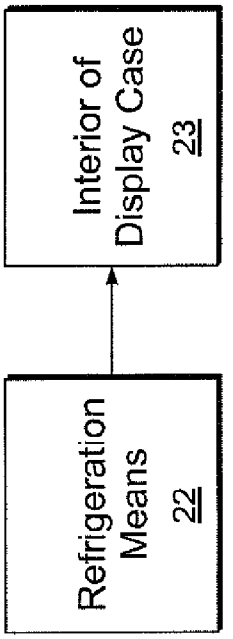


FIG. 4

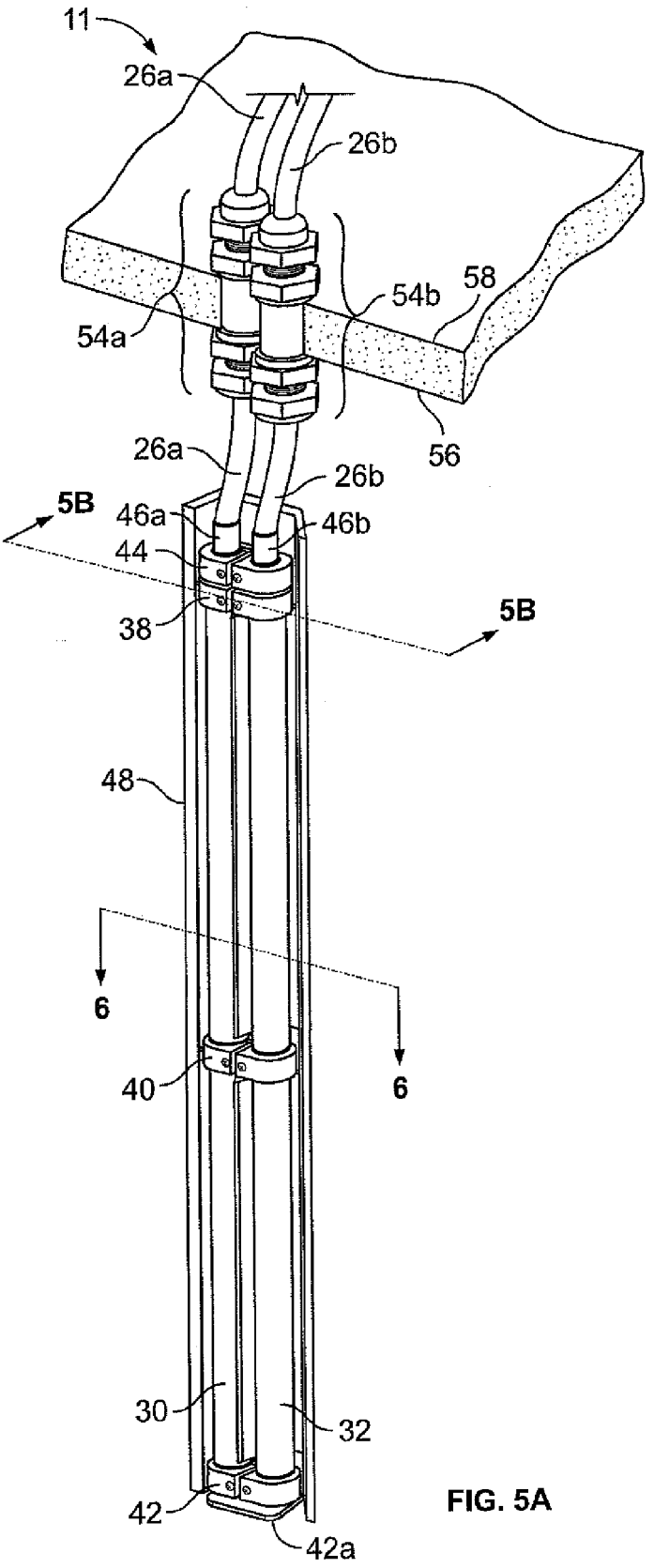

11
26a
26b
54b
58
54a
56
26a
26b
5B
46a
46b
44
38
5B
48
6
6
40
30
32
42
42a

FIG. 5A

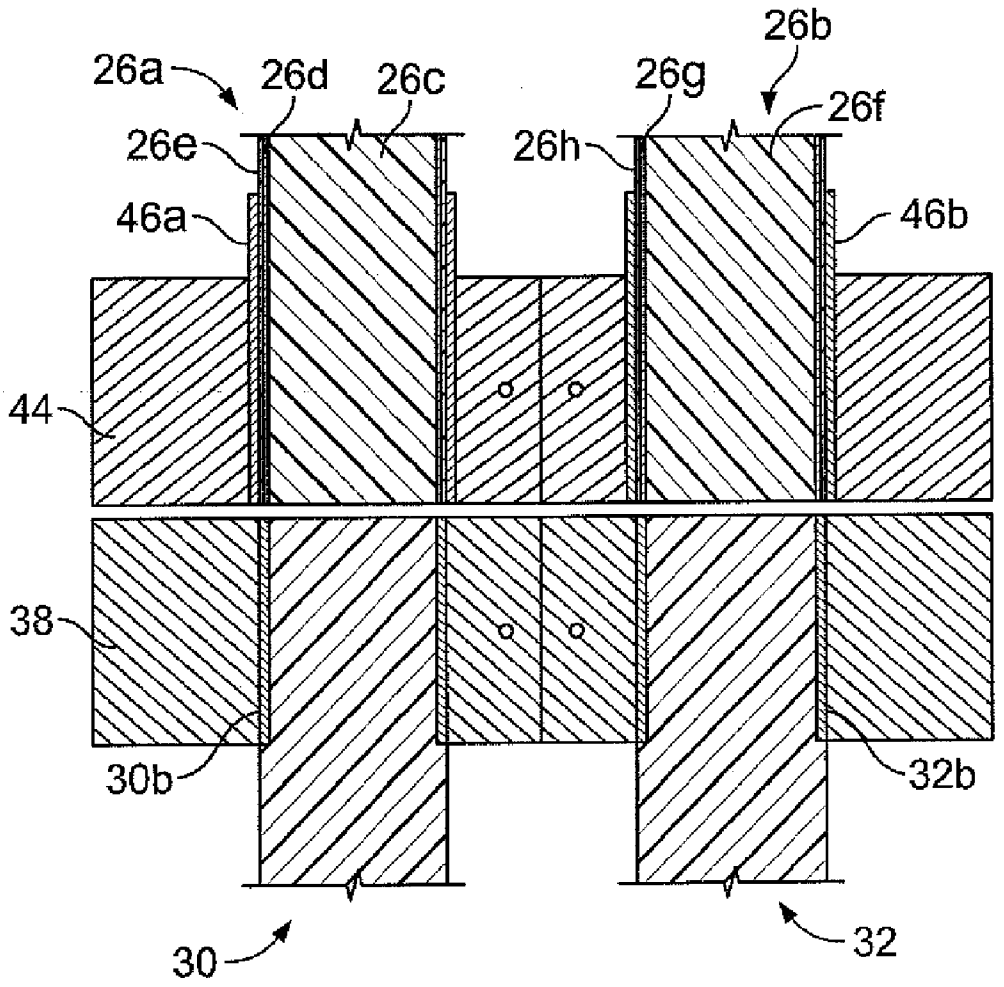
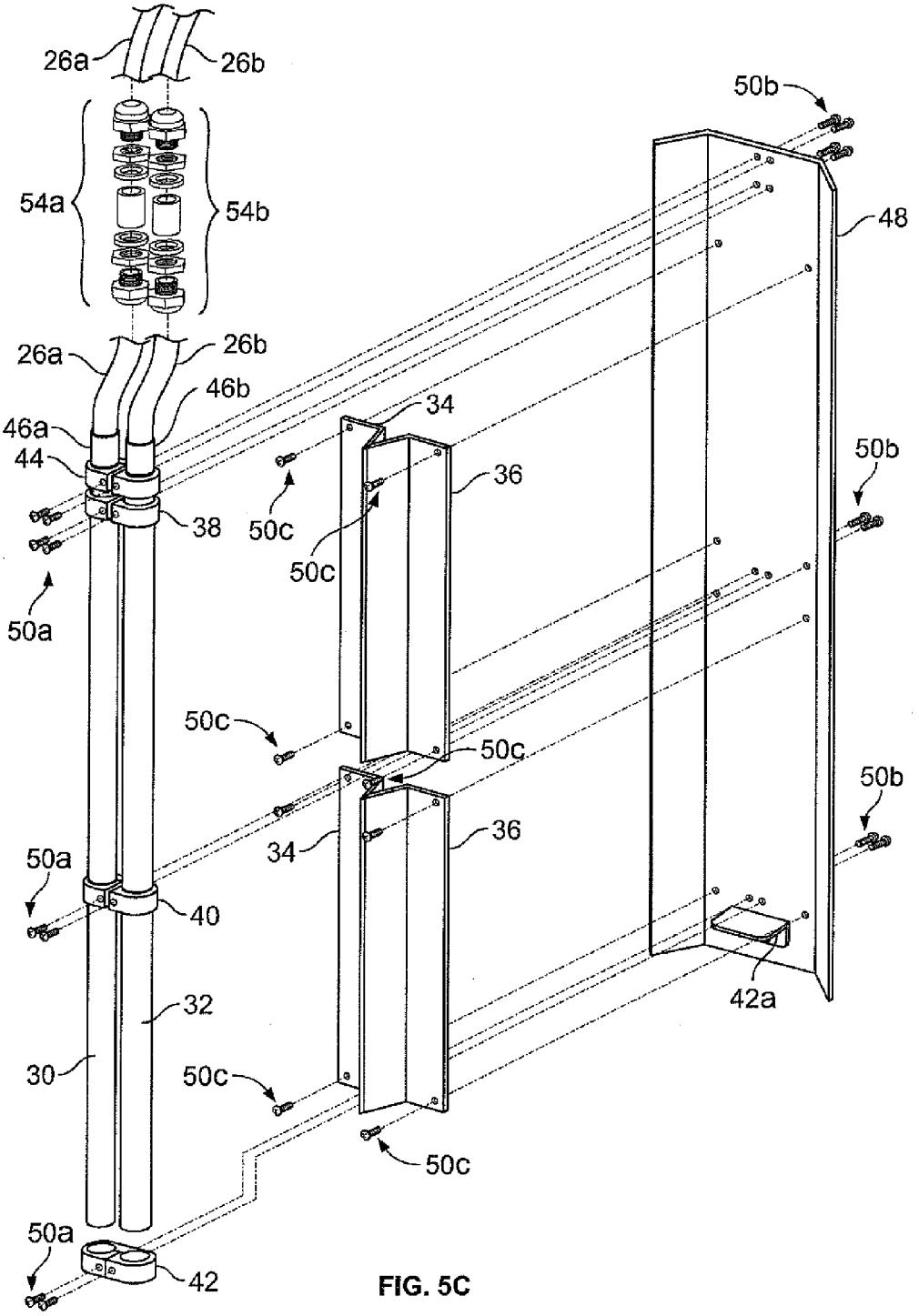


FIG. 5B


26a
26b
54a
54b
26a
26b
46b
46a
44
38
50a
50c
50c
34
36
50b
48
50b
50c
50c
50b
50a
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36
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32
30
50c
50c
42a
50a
42

FIG. 5C

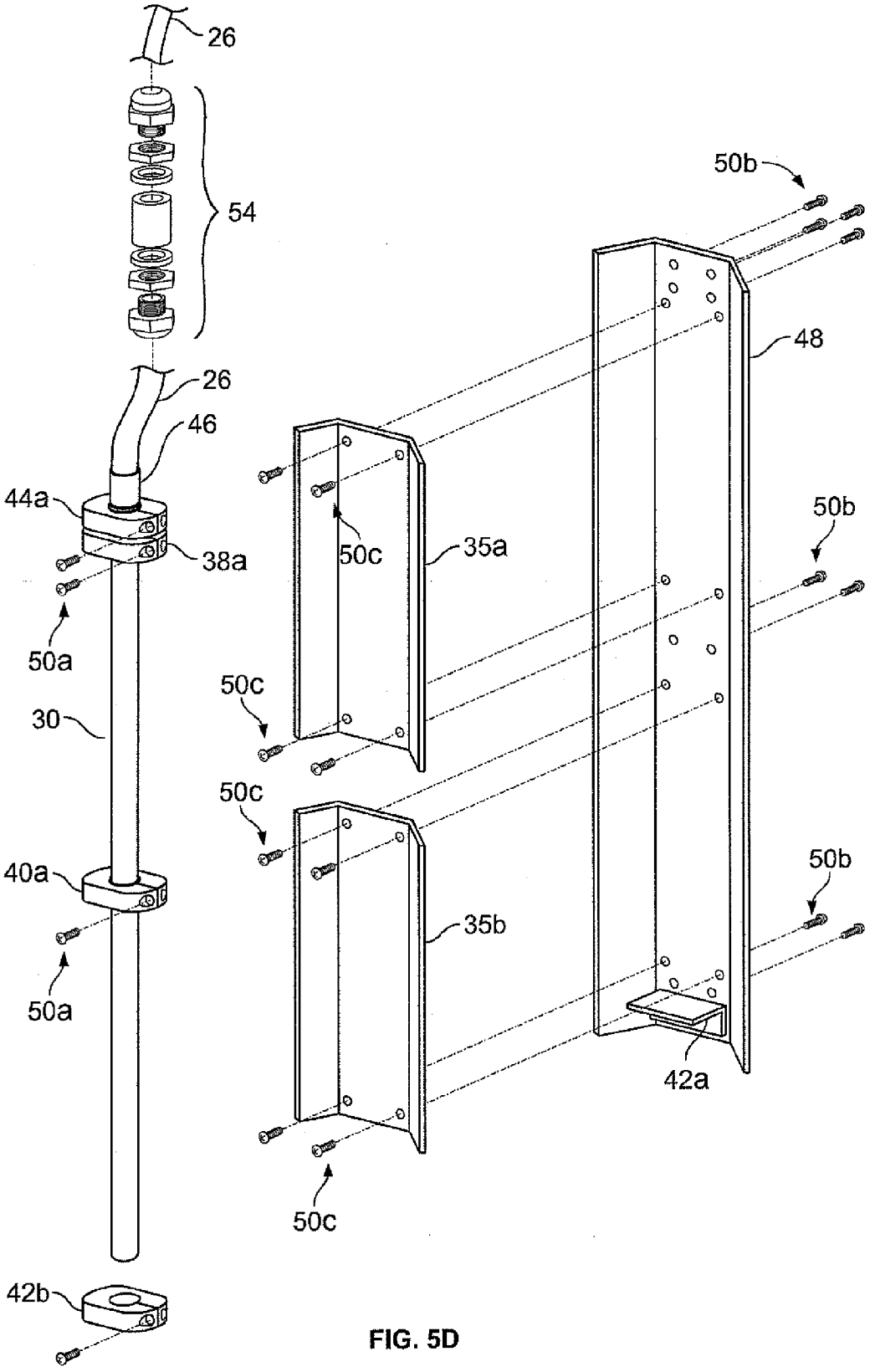

26
54
26
46
44a
38a
50a
30
40a
50a
42b
50b
48
50b
50c
35a
50c
50c
35b
50b
42a
50c

FIG. 5D

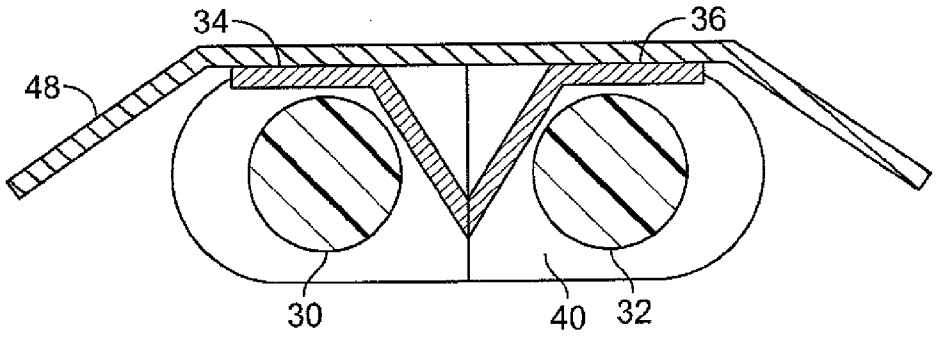


FIG. 6

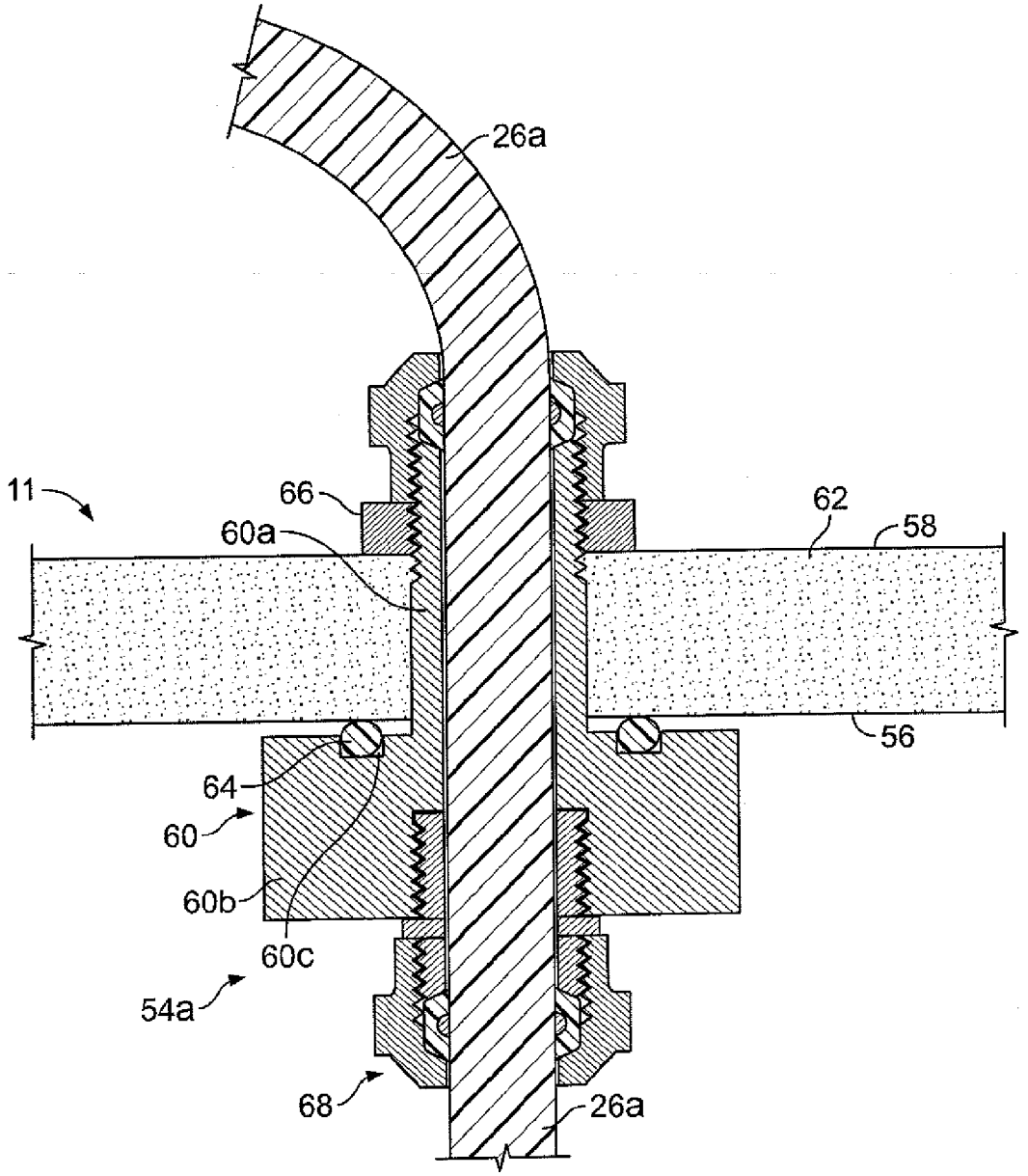


FIG. 7

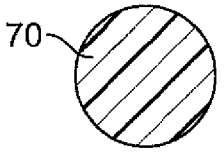


FIG. 8A

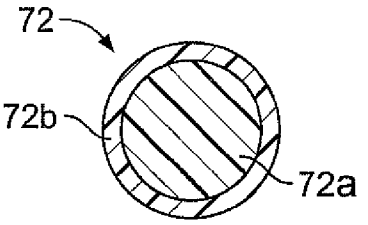


FIG. 8B

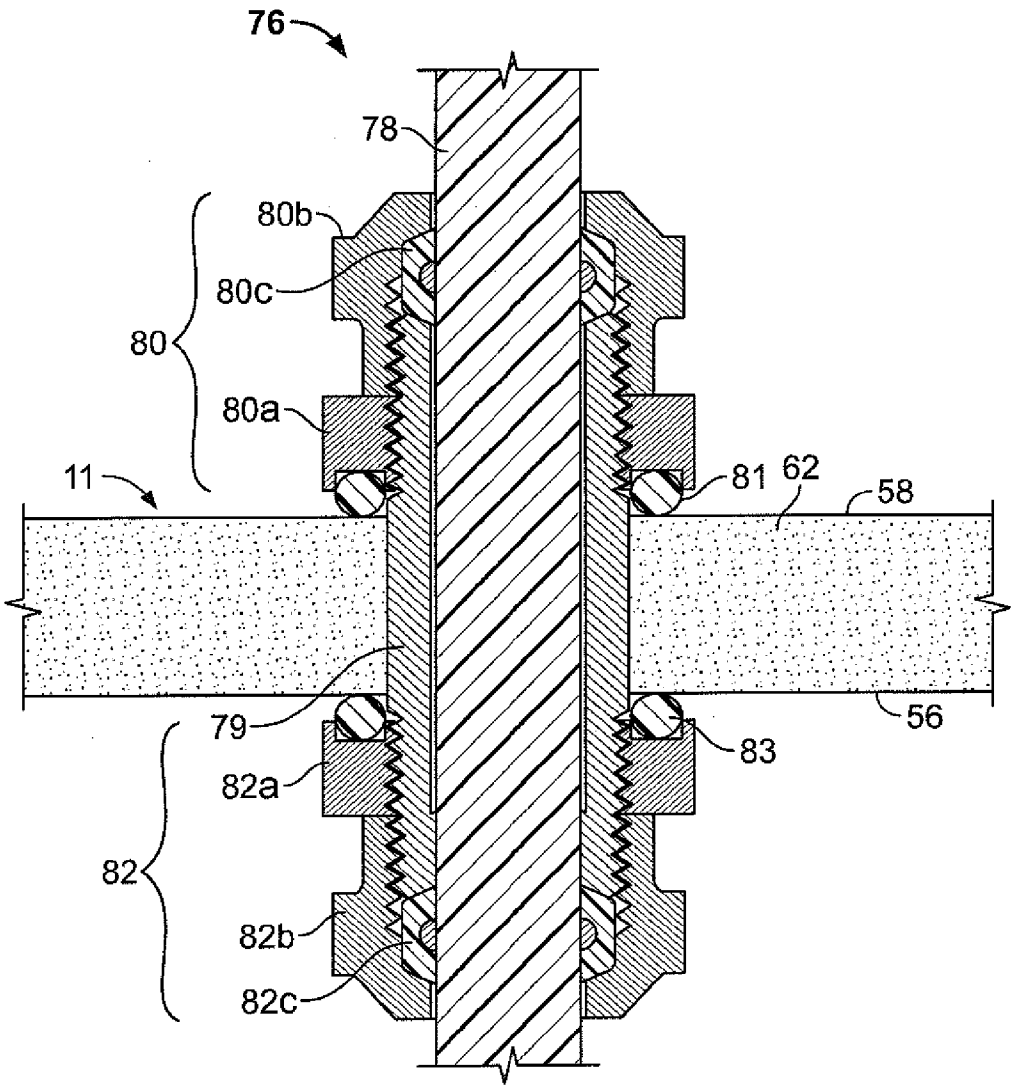


FIG. 9

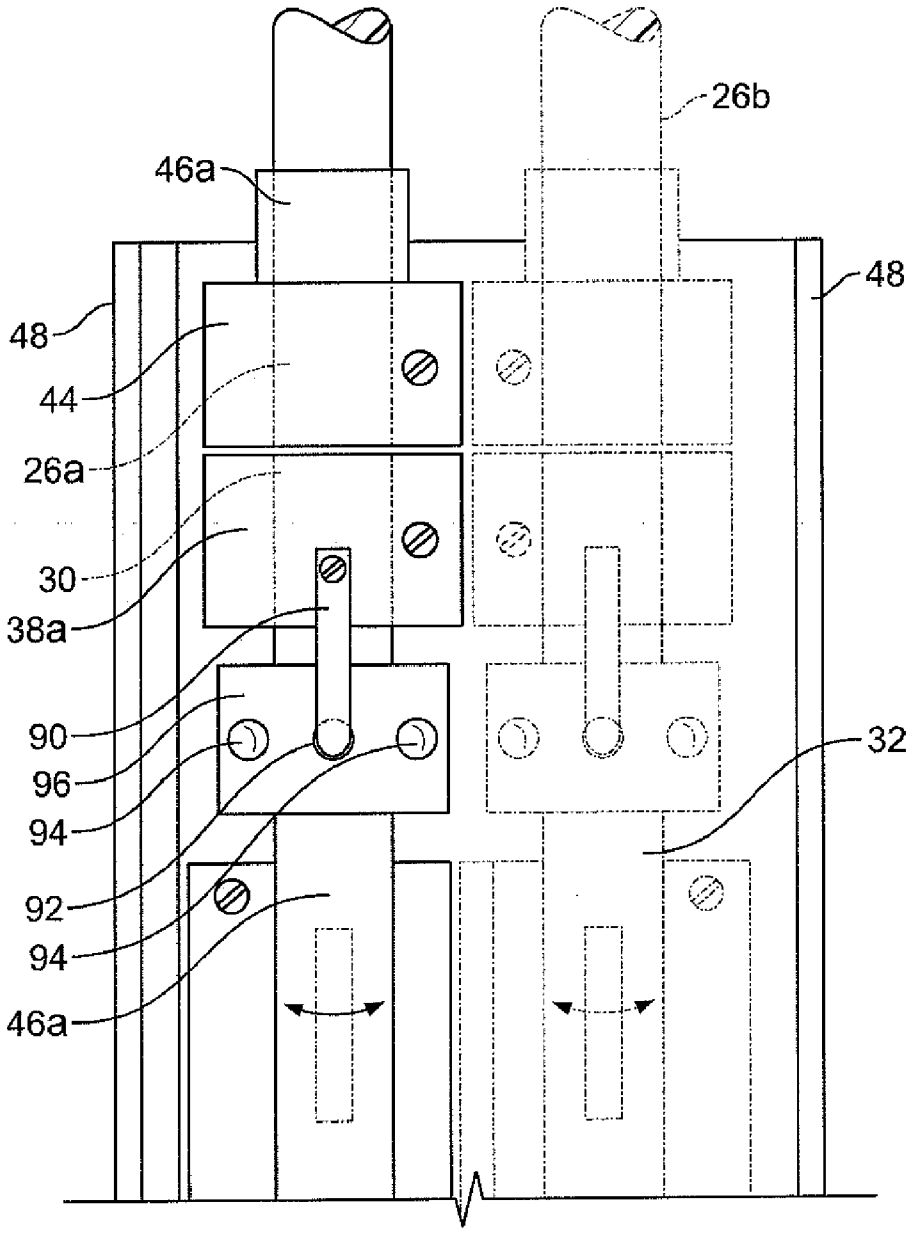


FIG. 10

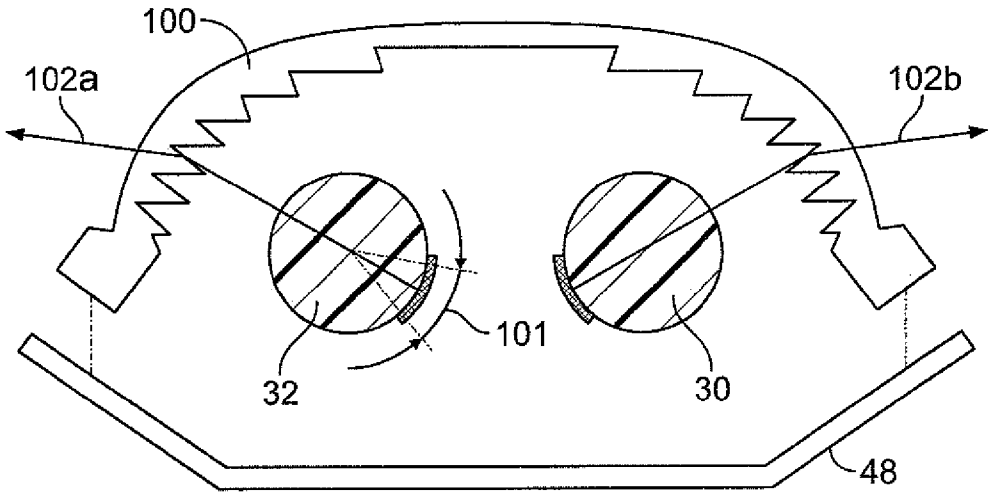


FIG. 11

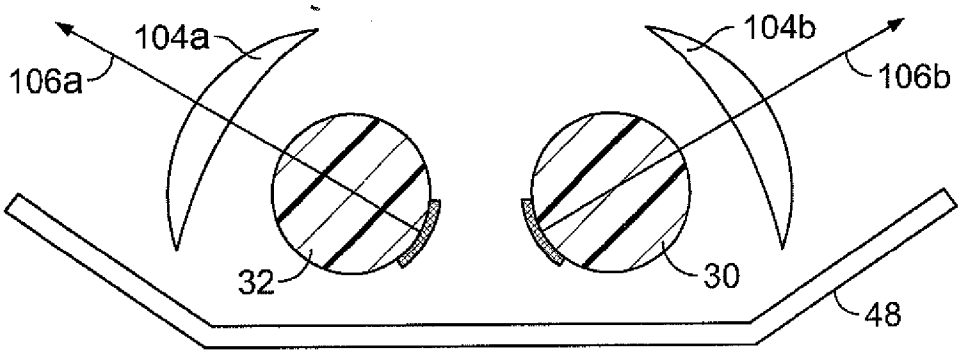


FIG. 12

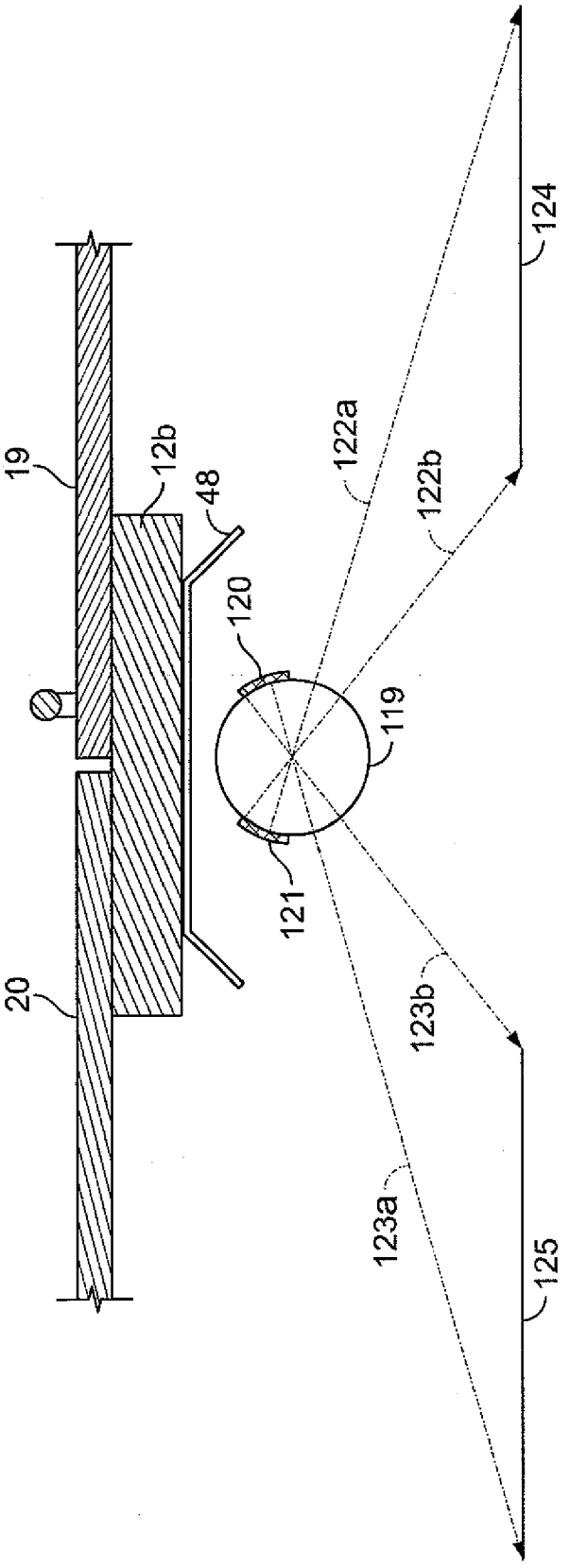


FIG. 13

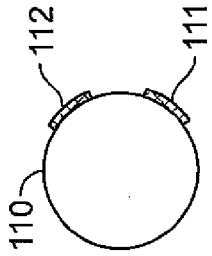


FIG. 14B

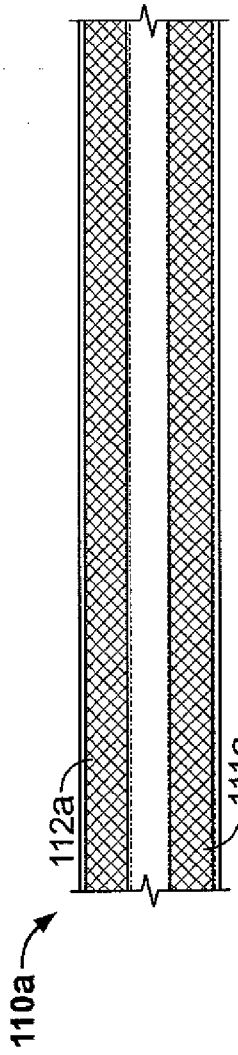


FIG. 14A

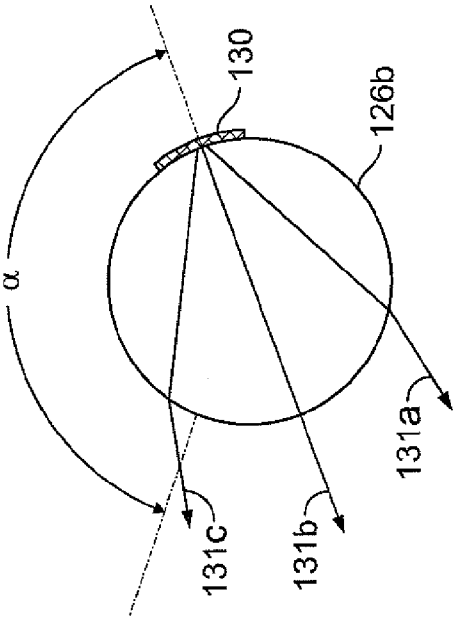


FIG. 14D

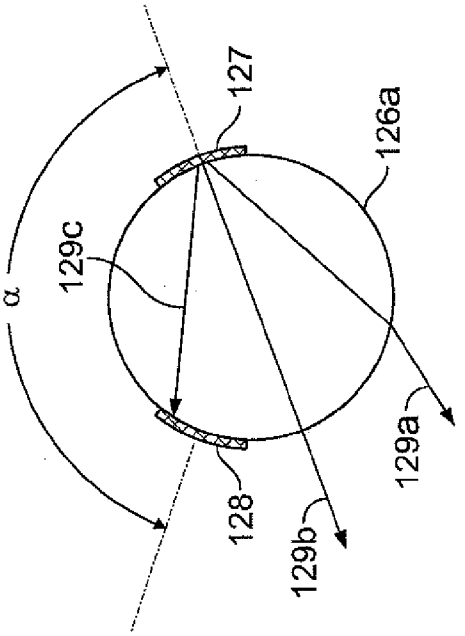


FIG. 14C

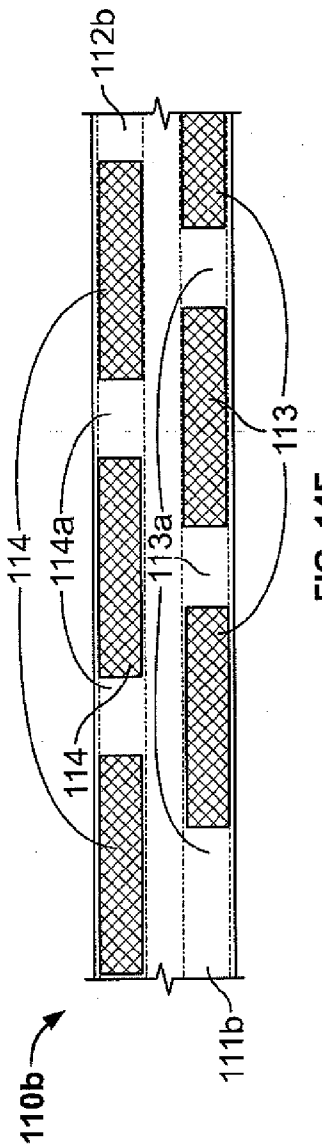


FIG. 14E

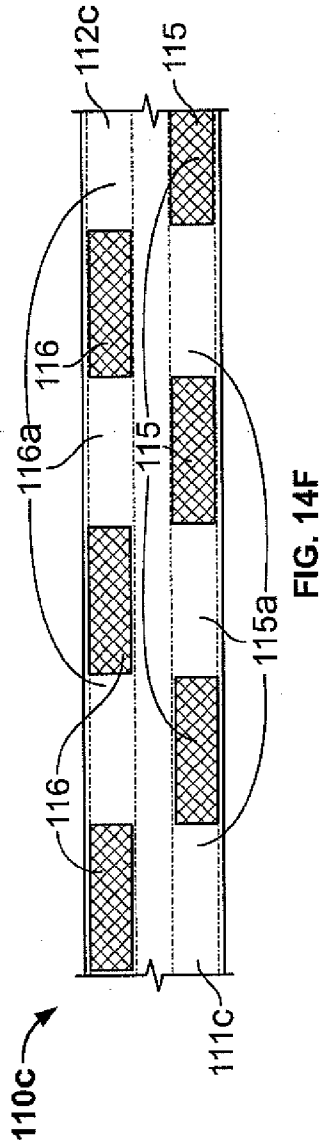


FIG. 14F

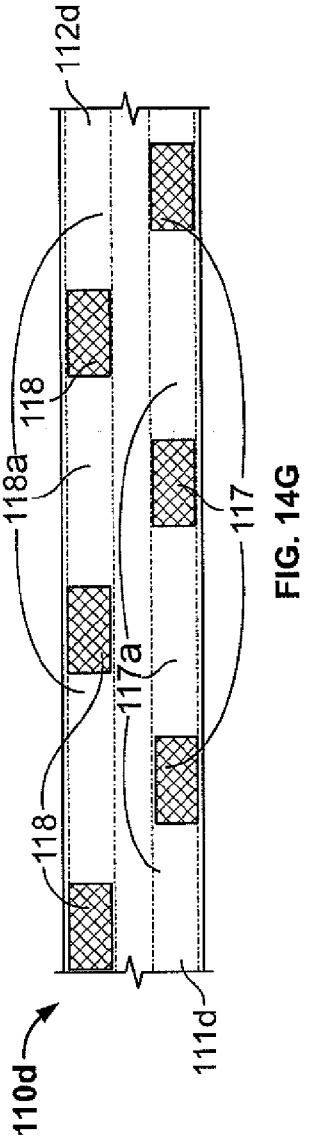


FIG. 14G

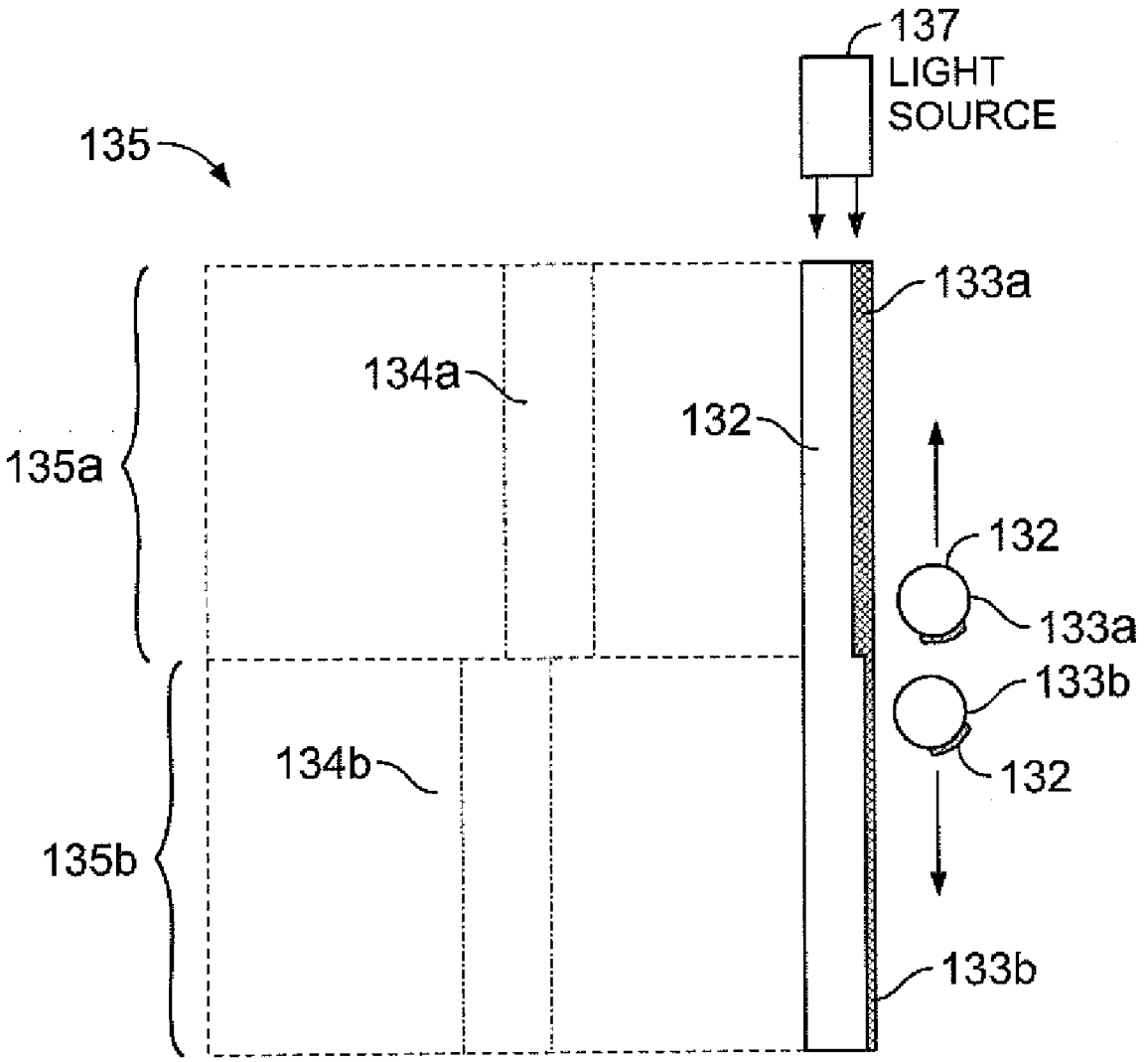

137
LIGHT
SOURCE
135
133a
134a
132
135a
132
133a
133b
134b
132
135b
133b

FIG. 15A

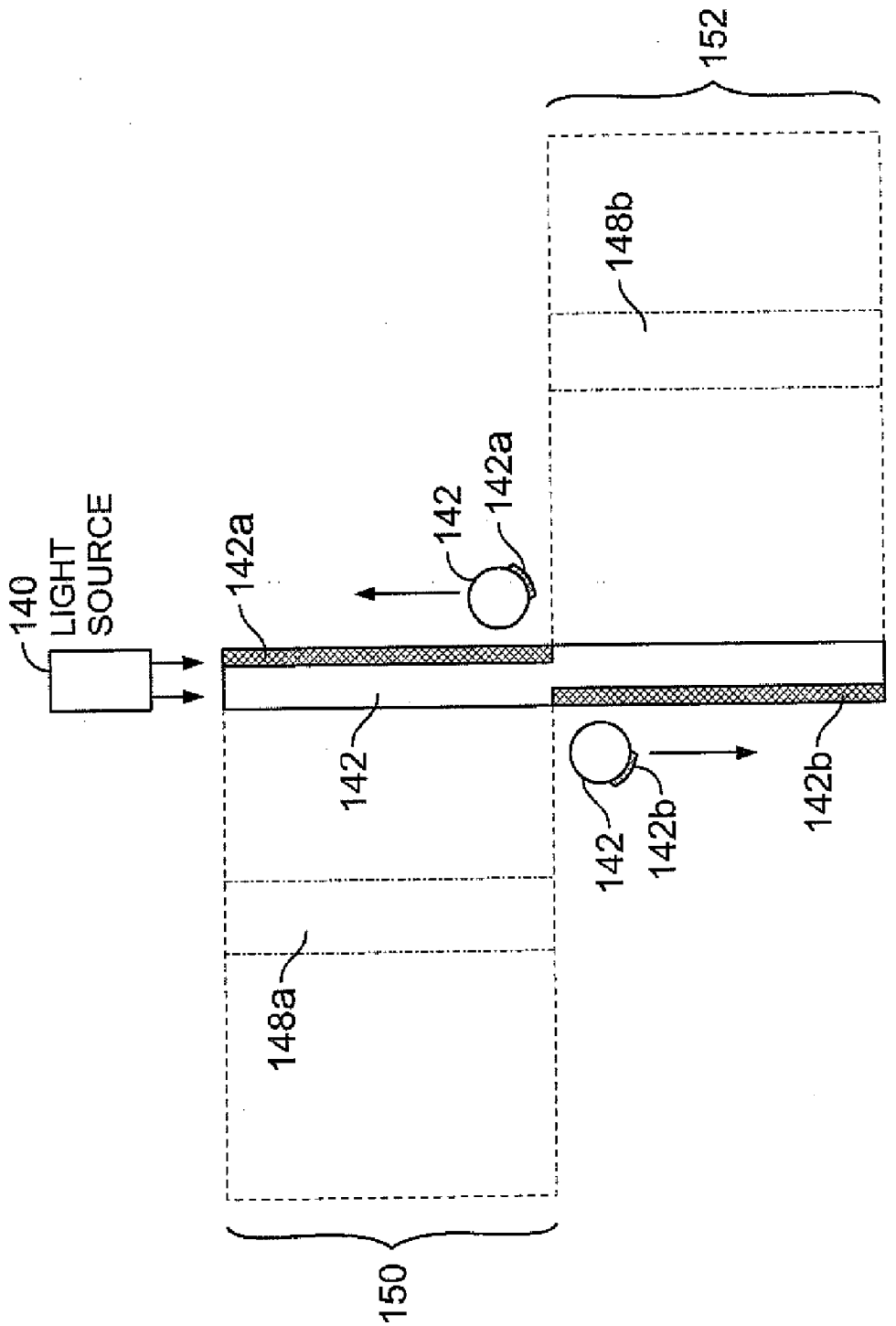
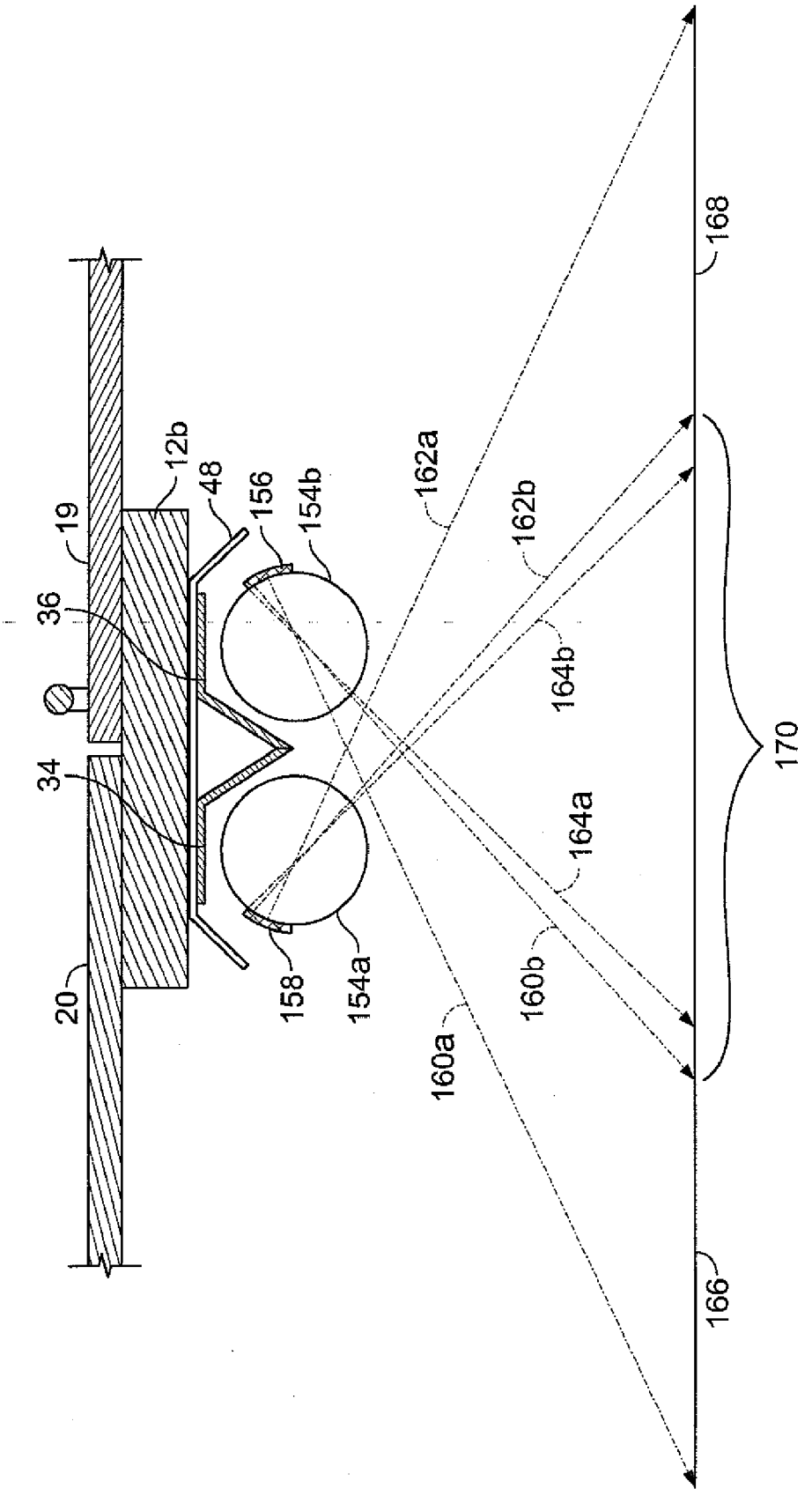

140
LIGHT SOURCE
142a
142
142a
148b
152
142
142b
142b
148a
150

FIG. 15B


168
12b
48
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154b
162a
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162b
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164b
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164a
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160b
158
154a
160a
20
166

FIG. 16

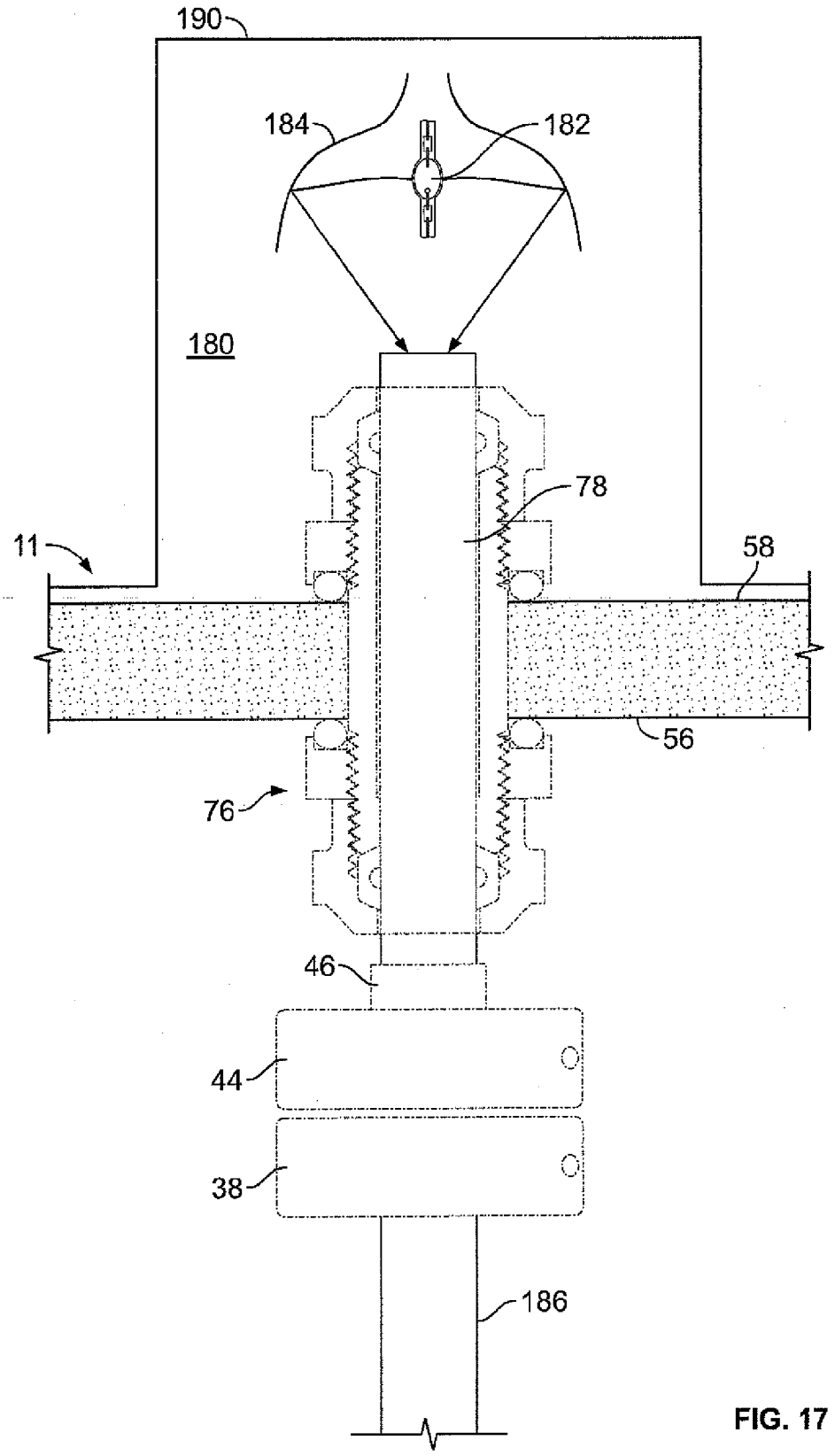

FIG. 17

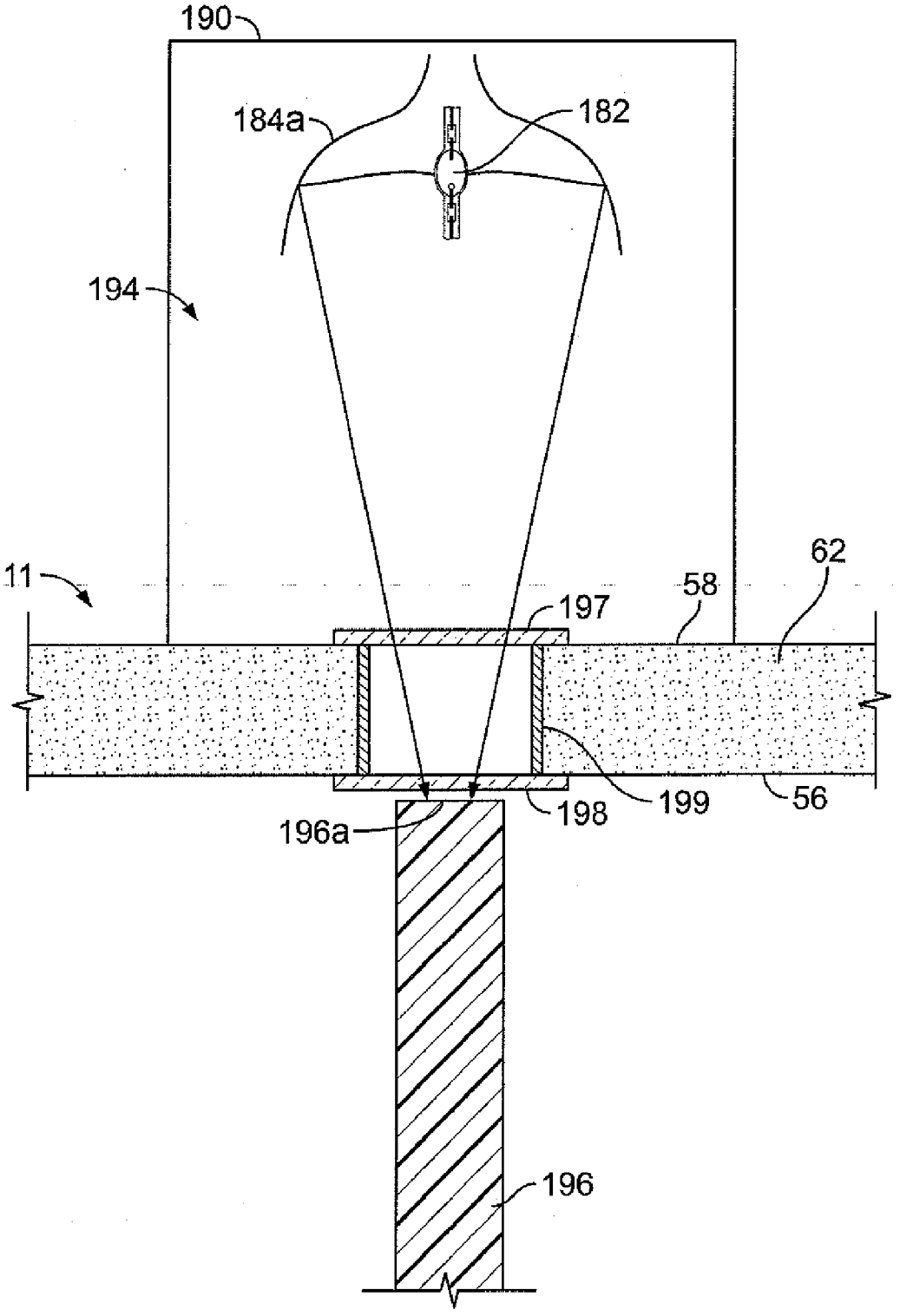

FIG. 18

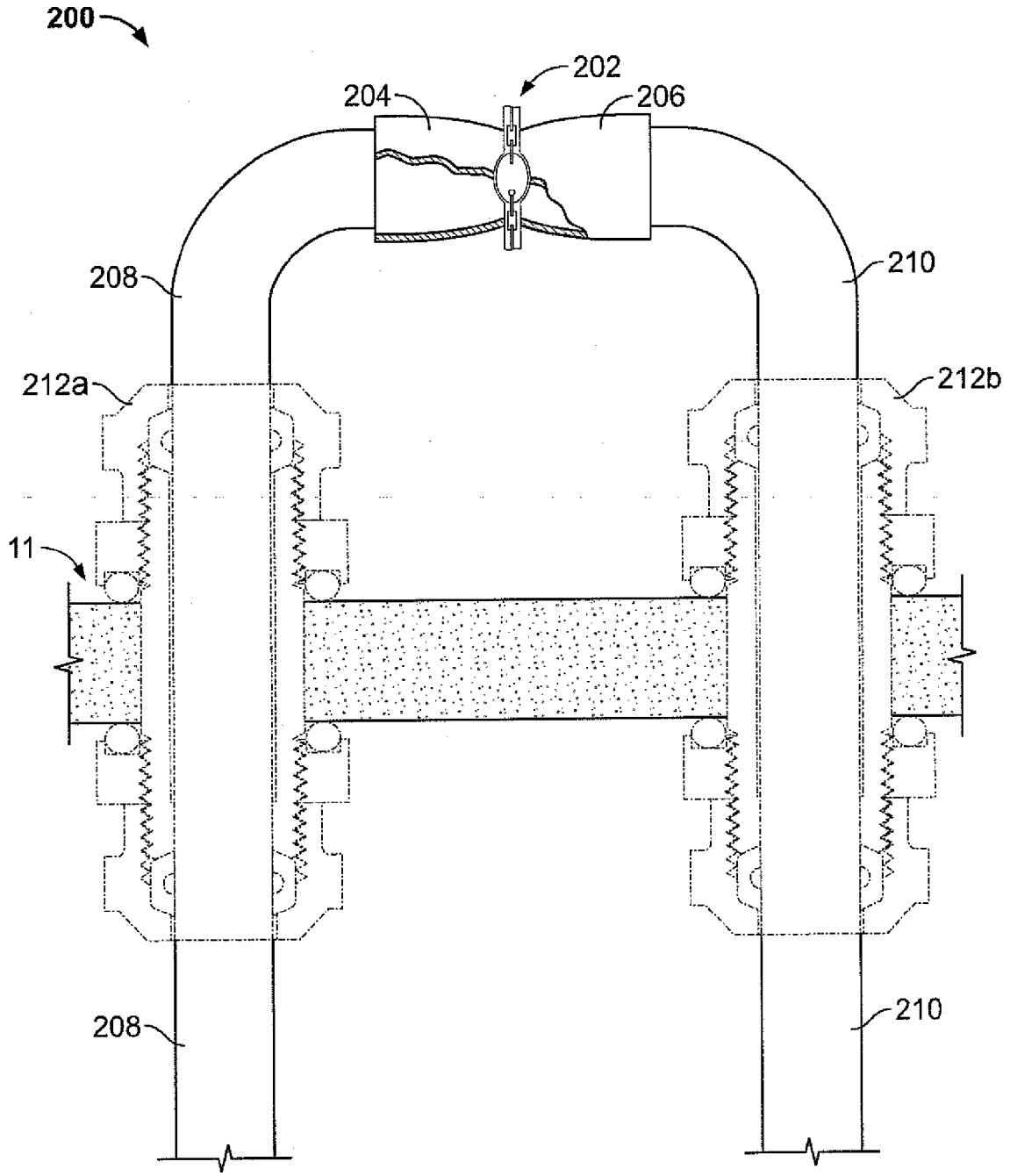

FIG. 19

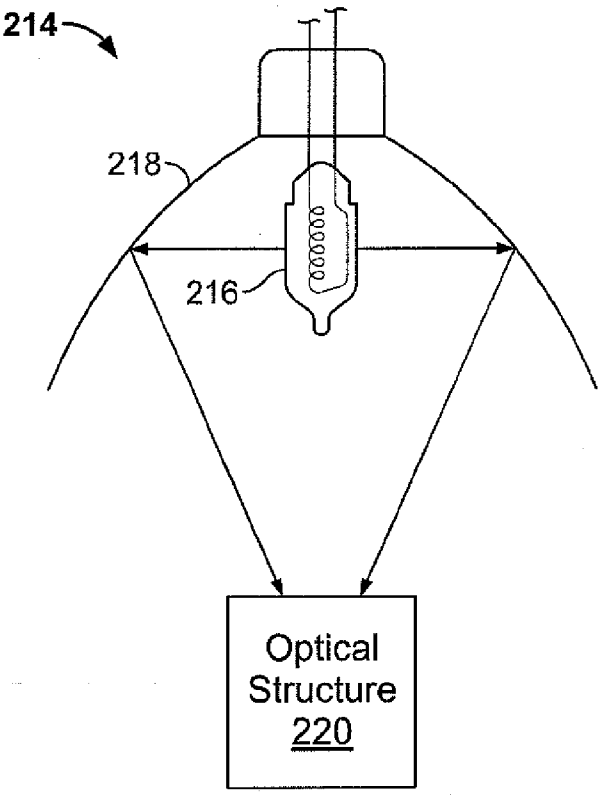
214
218
216
Optical Structure 220

FIG. 20

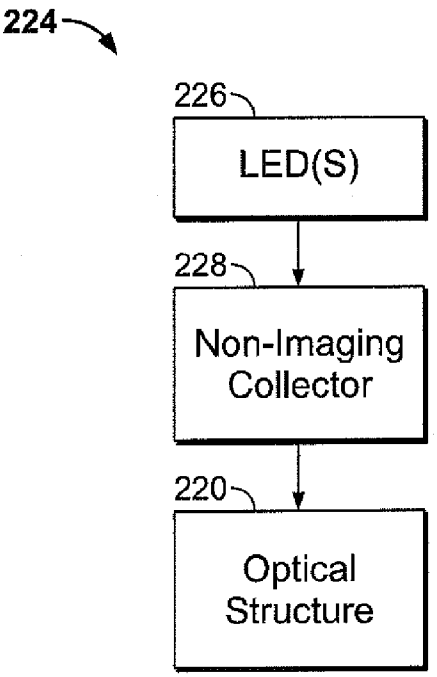
224
226
LED(S)
228
Non-Imaging Collector
220
Optical Structure

FIG. 21

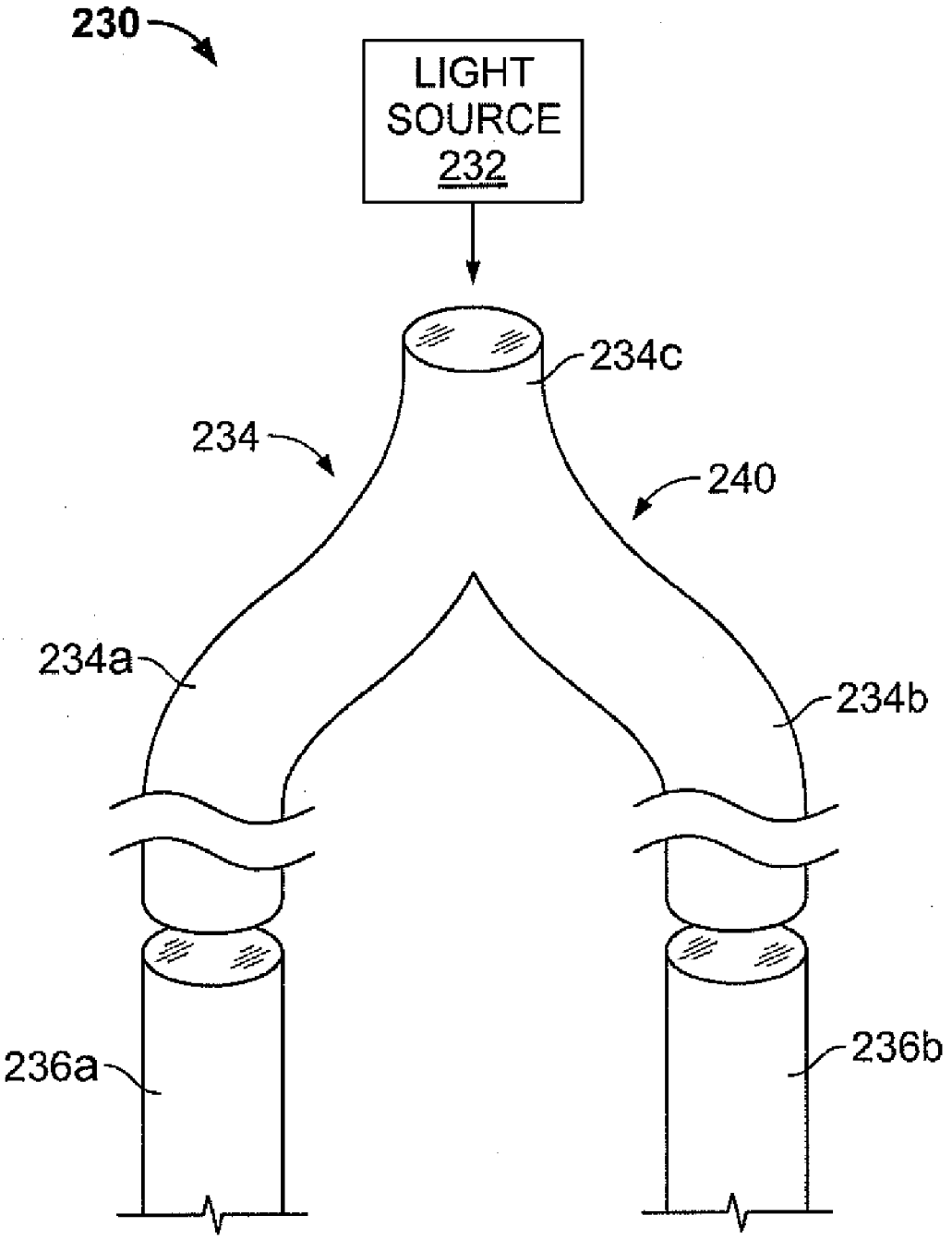

FIG. 22

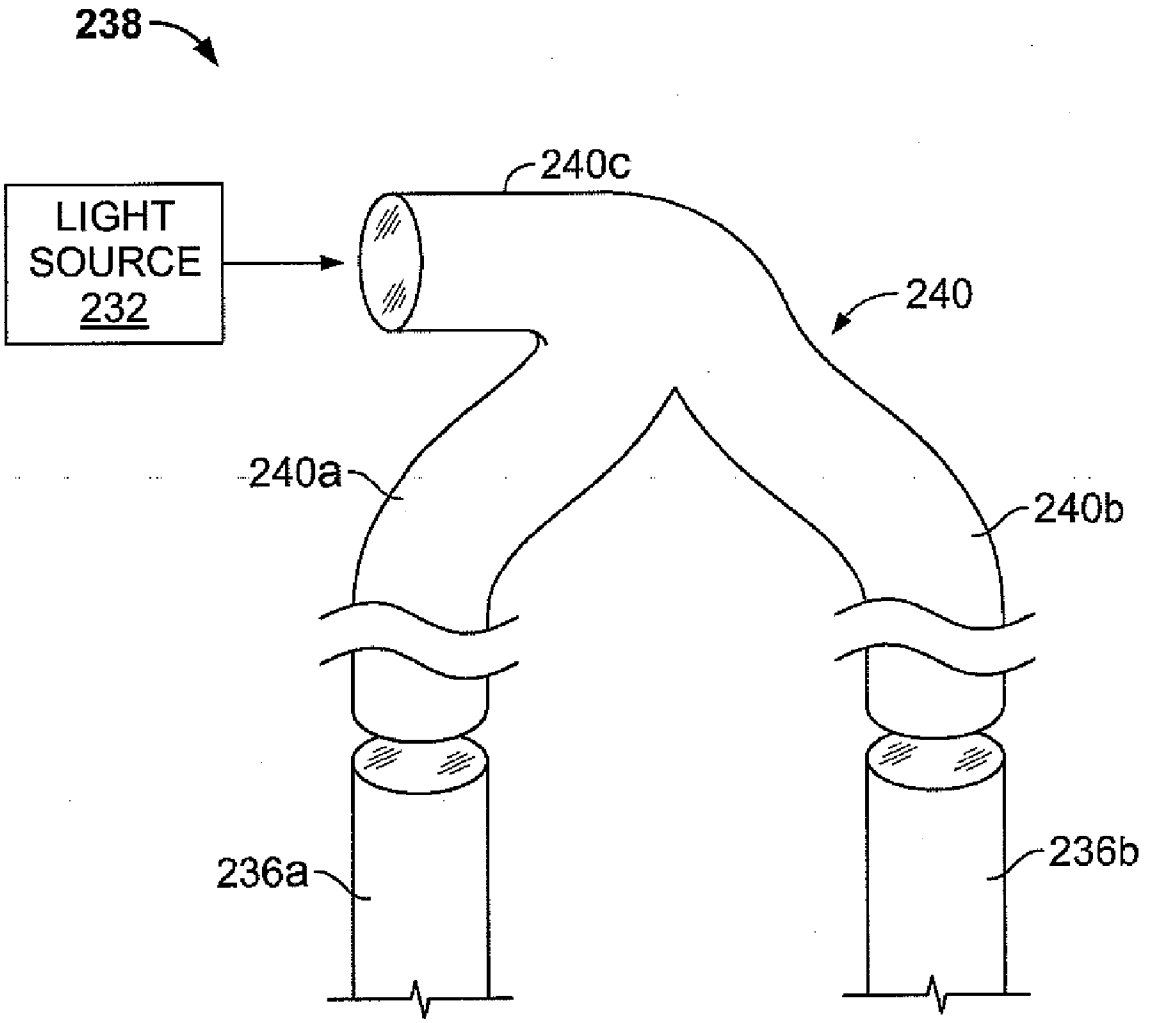

FIG. 23

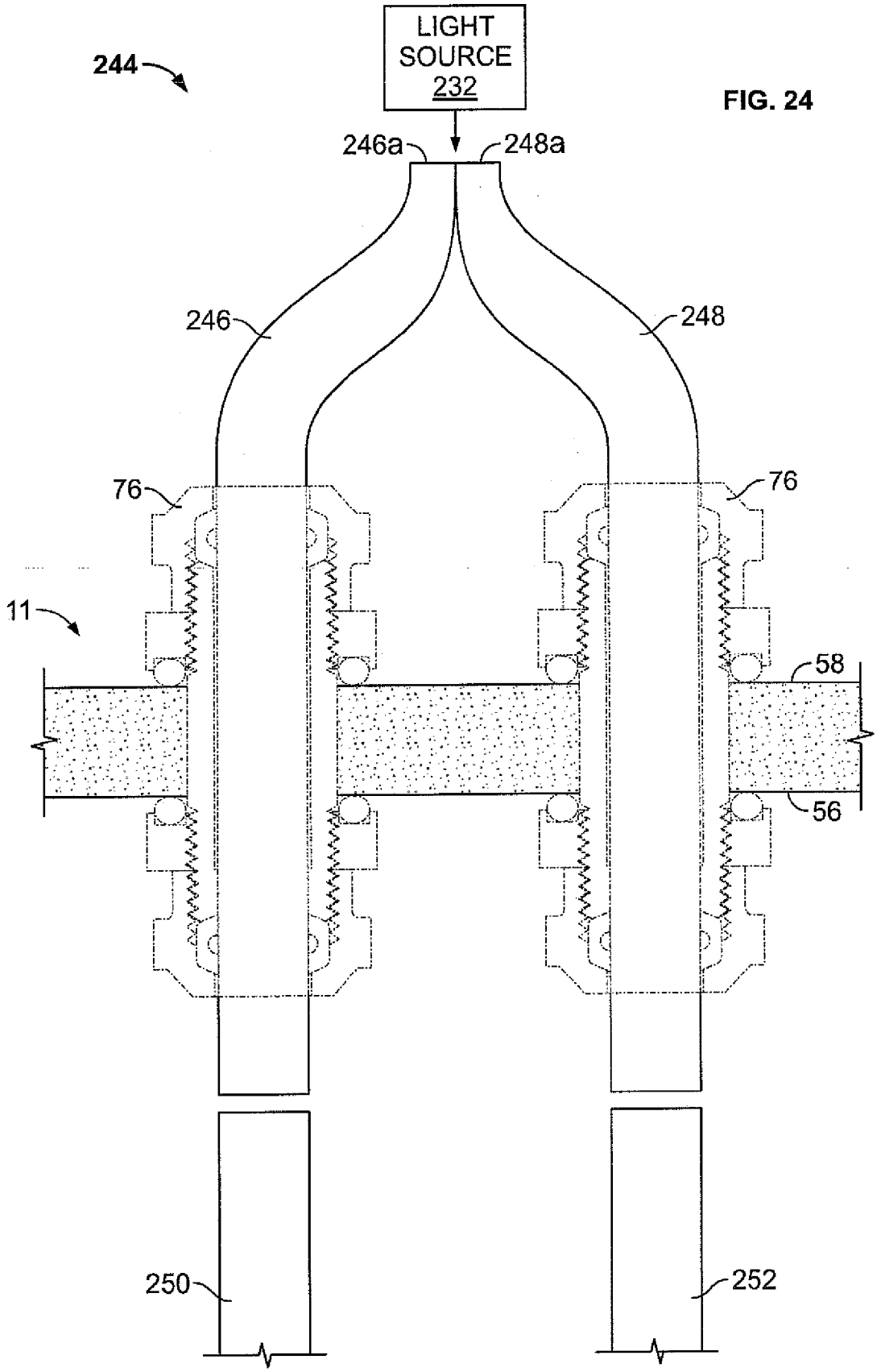

FIG. 24

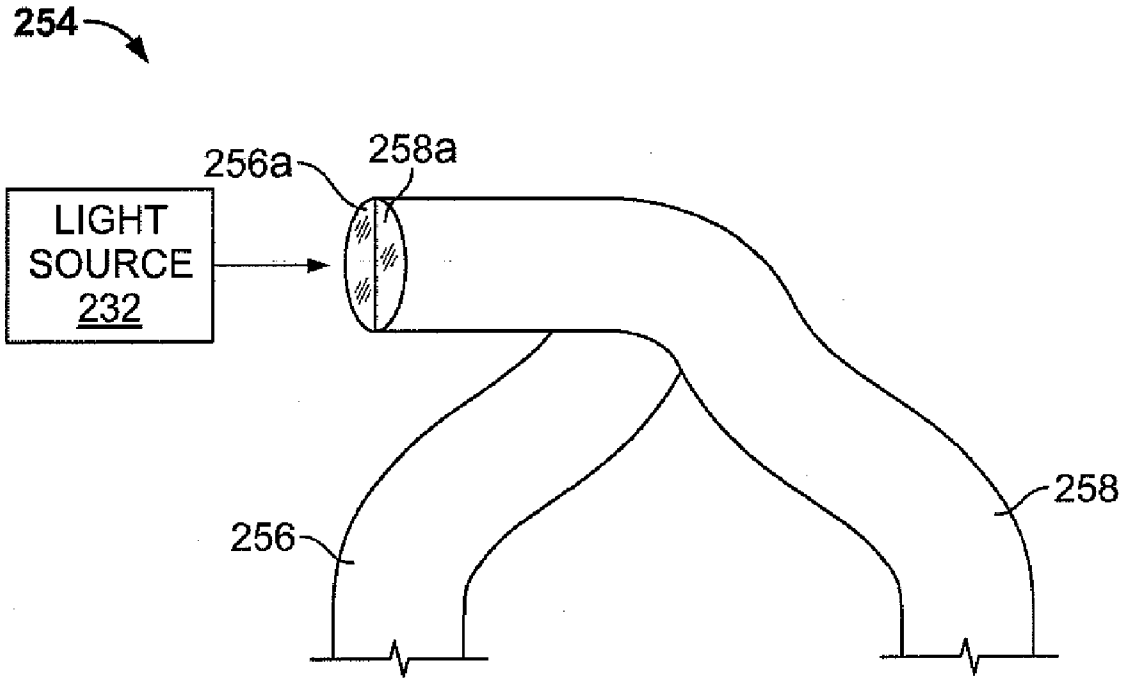

FIG. 25

LIGHTED DISPLAY CASE WITH REMOTE LIGHT SOURCE

FIELD OF THE INVENTION

[0001] The present invention relates to a lighted display case with a remote light source. More particularly, the invention relates to such a display case in which light for illuminating contents of the case is provided by a fiber optic luminaire.

BACKGROUND OF THE INVENTION

[0002] Traditional display cases used to display retail merchandise or items of value such as in a museum often employ fluorescent or (filamented) halogen lamps to light the items. Such lamps have various disadvantages for lighting tightly confined spaces. Among these is the fact that fluorescent tubes emit light in all directions and emit moderate levels of ultraviolet light. When taken together with their ballasts, the complete lighting system can produce a significant amount of heat, especially when confined in an enclosure. Halogen or incandescent lamps similarly have the disadvantages of directing a large amount of heat into the display area. Although a halogen lamp is often accompanied by a special dichroic reflector which concentrates visible light but not infrared light in the forward direction, the confined nature of a display case often ends up trapping this undirected infrared energy anyway. This usually results in an excessive heat buildup or the necessity to remove this heat by energy-demanding means such as air conditioning or forced air convection. Even when no special measures are taken to transport the unneeded heat away, the heat is usually an inconvenience at best and a nuisance at worst to the customers or patrons who must view the contents of the case.

[0003] The need exists for an energy-efficient way to light the merchandise or items contained in a display case while not introducing any harmful ultraviolet or unnecessary infrared energy into the display area, and to forgo the need to introduce costly heat-control devices.

[0004] Fluorescent tubes, while more energy-efficient than tungsten-halogen lamps, have other disadvantages as well. They are fragile and contain hazardous substances such as mercury and phosphors. If broken, the glass shards are a severe safety hazard. Due to the manner in which such tubes must be mounted in the typical display case, changing the tubes can be an awkward and labor-intensive operation requiring the careful removal and reinsertion of a fragile item in a confined space. Tungsten-halogen lamps, though compact, are numerous when employed in a typical display case. As a result, they need to be replaced much more frequently than their fluorescent counterparts resulting in either an uneven lighting situation when they fail, or a costly manual maintenance operation to replace the failed lamps with great promptness.

[0005] The need exists to allow for a convenient way to maintain or re-lamp a display-case lighting system which does not suffer from these disadvantages.

BRIEF SUMMARY OF THE INVENTION

[0006] The disclosed invention provides the foregoing benefits and others such as requiring less electrical power to provide comparable amounts of light even apart from the maintenance and energy transport consideration outlined above.

SUMMARY OF THE INVENTION

[0007] In accordance with one form of invention, a lighted display case with remote light source is presented which comprises a container having contents for display. A solid fiber optic luminaire is at least partially mounted within the container. The luminaire has an elongated side-light emitting portion for emitting light from the side of the luminaire onto contents in an interior of the display case. The side-light emitting portion comprises an extractor of light arranged to preferentially extract light from the luminaire and direct the light in at least one radial direction along the length of the side-light emitting portion to at least one target area of said contents along a longitudinal axis of the side-light emitting portion. The extractor of the light comprises first and second light-extraction regions.

[0008] In a first embodiment, the container has first and second view ports intended to allow persons outside the container to view contents displayed in the interior of the container. The first view port is on one lateral side of the side-light emitting portion and the second view port is on a second lateral side of said portion. A light-delivery system provides light to the fiber optic luminaire, having a light source mounted remotely from the container. The luminaire is arranged to illuminate first and second separate target areas of said contents of the display case. The first target area is visible through the first view port and the second target area is visible through the second view port. The first and second target areas are illuminated by the first and second light-extraction regions. The first and second light-extraction regions are spaced from each other around a perimeter of the side-light emitting portion taken orthogonally to main optical axis of said side-light emitting portion.

[0009] In a second embodiment, the lighted display case remote light source is presented which comprises a container with a view port intended to allow persons outside the container to view contents displayed in the interior of the container. The side-light emitting portion of the luminaire is rotatable about its own longitudinal axis for directing the aim of the light emitted therefrom to various radial directions about said axis.

[0010] In the third embodiment, a lighted display case with remote light source is presented which comprises a container having contents for display. First and second solid fiber optic luminaires are at least partially mounted within the container. Side-light emitting portions of the first and second luminaires are mounted parallel to each other and are respectively positioned to illuminate a target area on one side of the luminaires and a laterally adjacent target area on another side of the luminaires.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] In the drawings, like reference numerals refer to like parts.

[0012] FIG. **1** is a perspective view of a lighted display case, shown partially cutaway.

[0013] FIGS. **2** and **3** are simplified front views of the display case of FIG. **1** in reduced size.

[0014] FIG. **4** is a block diagram of refrigeration means for the interior of the display case of FIG. **1**.

[0015] FIG. **5**A is a front view of a pair of fiber optic luminaires and associated parts shown apart from the display case of FIG. **1**.

[0016] FIG. **5**B is a detail, sectional view taken at Arrows **5**B-**5**B in FIG. **5**A.

[0017] FIG. **5**C is an exploded view of the structures shown in FIG. **5**A.

[0018] FIG. **5**D is an exploded view similar to FIG. **5**C but showing a single fiber optic luminaire and associated parts shown separate from the display case of FIG. **1**.

[0019] FIG. **6** is a sectional view taken at Arrows **6**-**6** in FIG. **5**A.

[0020] FIG. **7** is a vertical cross section of a feed-through and associated structure of FIG. **5**A.

[0021] FIGS. **8**A and **8**B are cross sections of different types of luminaires.

[0022] FIG. **9** is a vertical cross section of a feed-through and associated structure that is alternative to that shown in FIG. **7**.

[0023] FIG. **10** is a perspective view a preferred arrangement for joining fiber optic structures to luminaires, taken at the upper end of a luminaire.

[0024] FIG. **11** shows a cross section of a pair of luminaires, together with a transparent cover for the luminaires.

[0025] FIG. **12** is a cross section similar to FIG. **11** but showing a different type of transparent cover for the luminaires.

[0026] FIG. **13** is a detail view of a modified luminaire and associated structure taken at Arrows **13**-**13** in FIG. **1**.

[0027] FIG. **14**A is a side view of a luminaire.

[0028] FIG. **148** is sectional view of a luminaire such as shown in FIG. **14**A

[0029] FIGS. **14**C and **14**D are cross sectional views of luminaires.

[0030] FIGS. **14**E-**14**G are side views of luminaires.

[0031] FIGS. **15**A-**15**B are simplified views of view ports of the display case of FIG. **1** and associated luminaires.

[0032] FIG. **16** is a detail view of a luminaire and associated structure taken at Arrows **13**-**13** in FIG. **1**.

[0033] FIG. **17** is a detail view, partially in section, of a light-delivery system that may replace the feed-through and associated light-delivery structures shown in FIG. **1**.

[0034] FIG. **18** is a detail view, partially in section, of another light-delivery system that may replace the feed-through and associated light-delivery structures shown in FIG. **1**.

[0035] FIG. **19** is a simplified detail view, partially in section, of another light-delivery system that may replace the feed-through and associated light-delivery structures shown in FIG. **1**.

[0036] FIG. **20** is a simplified detail view, partially in section and partially in block diagram form, of another light-delivery system that may replace the feed-through and associated light-delivery structures shown in FIG. **1**.

[0037] FIG. **21** is a simplified detail view in block diagram form of another light-delivery system that may replace the feed-through and associated light-delivery structures shown in FIG. **1**.

[0038] FIG. **22** is a simplified detail view of another light-delivery system that may replace the feed-through and associated light-delivery structures shown in FIG. **1**.

[0039] FIG. **23** is similar to FIG. **22**, showing a variation of that figure.

[0040] FIG. **24** is a simplified detail view, partially in cross section and partially in block diagram form, of another light-delivery system that may replace the feed-through and associated light-delivery structures shown in FIG. **1**.

[0041] FIG. **25** is similar to FIG. **24**, showing a variation of that figure.

DETAILED DESCRIPTION OF THE INVENTION

[0042] FIG. **1** shows a display case **10** for illuminating contents of the case, such as contents **14**, **16** and **18**. Case **10** includes a closed container **11** and fiber optic luminaires (not shown) behind structural members **12***a*-**12***d* for achieving the foregoing purpose of illumination. The term "fiber optic" luminaire is intended to cover an acrylic rod luminaire that receives light directly from a light source as well as indirectly through a fiber optic cable or other structure. Preferably, case **10** includes doors **19**, **20** and **21** having respective view ports **19***a*, **20***a* and **21***a*. These view ports preferably comprises transparent windows, as shown, but could comprise a doorway when doors **19**, **20** or **21** are opened for viewing contents of the display case. The luminaires extend vertically over dimension **17***a*, whereas the maximum dimension of a view port (e.g., **19***a*) is dimension **17***b*. As can be seen dimension **17***a* is at least the majority of dimension **17***b*. Rather than including windows **19***a*, **20***a* and **21***a* on doors, display case **10***a* of FIG. **2** shows doors **19**, **20** and **21** lacking windows; and FIG. **3** shows display case **10***b* lacking doors and instead having openings **25***a*, **25***b* and **25***c* allowing access to contents. As shown in FIG. **1**, an illuminator **24** is preferably mounted atop container **11**, with flexible fiber optic cables **26** leading to the luminaires (not shown). A facade **27**, shown in phantom, may shield illuminator **24** and fiber optic cables **26** from view.

[0043] Referring to FIG. **4**, interior **23** of display case **10** (FIG. **1**) is preferably refrigerated to below about 7 C for unfrozen refrigeration of contents, and below about −7 C for frozen refrigeration of contents. This may be accomplished by conventional refrigeration means **22** for cooling interior **23** of display case **10** of FIG. **1**.

[0044] FIGS. **5**A, **5**B, **5**C and **6** show fiber optic luminaires **30** and **32**. Referring to FIG. **1**, such a pair of luminaires may be contained between doors **19** and **20**, or between doors **20** and **21**. As shown in FIG. **5**A, left-hand luminaire **30** illuminates a target area (not shown) to the left of the luminaire, and right-hand luminaire **32** illuminates a target area (not shown) to the right of luminaire **32**. As

shown in FIGS. **5**C and **6**, each luminaire may be provided with respective reflectors **34** and **36**. Such reflectors may be diffuse or specular. Reflectors **34** and **36** may be separate from each other or integral to each other. As shown in FIG. **5**C, luminaires **30** and **32** may be held in place with upper clamp **38**, middle clamp **40** and lower clamp **42**. Clamps **38**, **40** and **42** maintain desired lateral positions of the associated clamped portions of the luminaires. In addition, lower clamp **42** includes a horizontally inclined plate **42***a* for maintaining the vertical positions of the luminaires.

[**0045**] As best shown in FIG. **5**B, the luminaires may be provided with claddings within the clamps, such as clamp **38**. In particular, FIG. **5**B shows a cladding **30***b* that may surround luminaire **30** within clamp **38**; cladding **30***b* having a lower refractive index than the core of the luminaire. Similarly, a cladding **32***b* may surround luminaire **32** within clamp **38**; cladding **32***b* having a lower refractive index than the core of the luminaire. The luminaires may be provided with similar cladding in their portions held within the other clamps, such as clamps **40** and **42** shown in FIG. **5**A.

[**0046**] Clamp **44** (FIG. **5**A-**5**C) holds the lower portions of fiber optic cables **26***a* and **26***b* centered respectively above luminaires **30** and **32**. As best shown in FIG. **5**B, clamp **44** cooperates with sleeves **46***a* and **46***b* for aligning the bottom portions of fiber optic cables **26***a* and **26***b*. Sleeves **46***a* and **46***b* are preferably made of metal, and additionally serve to prevent kinking of the bottom portions of the fiber optic cables. As shown in FIG. **5**B, cable **26***a* comprises a core **26***c*, a cladding **26***d* of lower refractive index than core **26***c* and a protective jacket **26***e* of PVC or vinyl, for instance. Similarly, cable **26***b* comprises a core **26***f*, a cladding **26***g* of higher refractive index material and a protective jacket **26***h* of PVC or vinyl, for instance.

[**0047**] A channel **48** may be conveniently used for mounting the luminaires in a display case. As shown in FIG. **5**C, clamps **38**, **40**, **42** and **44** may be secured to channel **48**, by bolts **50***a*, which is in turn secured to a structural member **12***b* or **12***c* (FIG. **1**) by bolts **50***b*. The foregoing clamps secure the luminaires and their input fiber optic cables in position. Reflectors **34** and **36** may be secured to channel **48** by bolts **50***c*. Thus, channel **48** may be conveniently used for mounting the luminaire arrangement within a display case, either as an original mounting or a retrofit mounting.

[**0048**] As shown in FIG. **5**A, feed-throughs **54***a* and **54***b* are used for feeding fiber optic cables **26***a* and **26***b* through the ceiling of container **11**. In particular, these feed-throughs preferably seal cables **26***a* and **26***b* to at least the internal wall **56** of the container. It is preferred that feed-throughs also seal the cables to external wall **58** of the container.

[**0049**] FIG. **5**D shows a single luminaire **30** and associated structures for use in the FIG. **1** display case to the left of door **19** or to the right of door **21**—that is, at the left-most or right-most ends of the display case. Non-specular (diffusive) reflector **35***a* and **35***b* may have a different shape from non-specular reflectors **34** and **36** of FIG. **5**C. Other than the possible use of a differently shaped reflector and the use of only a single luminaire, the structures of FIG. **5**D are similar to those in FIG. **5**C. Of course, single-luminaire clamps **38***a*, **40***a* and **42***b* are used in FIG. **5**D rather than the double-luminaire clamps **38**, **40** and **42** in FIG. **5**C. Similarly, a single-cable clamp **44***a* is used in FIG. **5**D rather than the double-cable clamp **44** in FIG. **5**C.

[**0050**] FIG. **7** shows feed-through **54***a* for feeding flexible fiber optic cable **26***a* through a wall (e.g., ceiling) of container **11**. Feed-though **54***a* comprises a penetrating member **60** having a relatively narrow portion **60***a* passing through internal and external walls **56** and **58** (and thermal insulation **62** therebetween). This feed-through further comprises a relatively enlarged portion **60***b* with an upwardly (or axially) facing channel **60***c* for holding an O-ring **64** or bead of silicone or other sealant material. An externally threaded portion of relatively narrow portion **60***a* threadedly receives a nut **66** with sufficient tension as to compress O-ring **64** and seal enlarged portion **60***b* against internal wall **56**. Meanwhile, a conventional compression fitting **68** is used to seal cable **26***a* against enlarged portion **60***b*.

[**0051**] Luminaires **30** and **32** may preferably comprise solid fiber optic structures, such as an acrylic polymer rod. FIG. **8**A shows a solid, single-strand luminaire **70**, whereas FIG. **8**B shows an alternative single-strand luminaire **72** having a core **72***a* and lower refractive index cladding **72***b* such as a fluoropolymer. Although the luminaires of FIGS. **8**A and **8**B are shown with circular cross sections, high volume (and hence low cost) molding of luminaires with other cross sections can be carried out. Other cross sections could impart more directionality out light output to a luminaire than with a circular cross section.

[**0052**] FIG. **9** shows a preferred feed-through **76** for feeding through container **11** a fiber optic structure **78**. Fiber optic structure **78** may be a glass or quartz rod used to thermally isolate the heat of a lamp (and ballast) from the interior of container **11** or from a thermally sensitive luminaire (not shown) that receives light from structure **78**. Alternatively, fiber optic structure **78** could be an extension of a luminaire upwardly (in the orientation shown) through the ceiling of container **11**, or a flexible fiber optic cable that feeds light to a luminaire (not shown) in the interior of the container.

[**0053**] Feed-through **76** comprises a central cylindrical penetrating part **79** ensheathing fiber optic structure **78**, upper and lower compression fittings **80** and **82**, and O-rings **81** and **83**.

[**0054**] Compression fitting **80** includes a threaded nut **80***a* pressing compressible O-ring **81** into sealed relation against external wall **58** of container **11** and penetrating part **79**. Compression fitting **80** further includes a threaded nut **80***b* for compressing resilient material **80***c* into sealed relation against penetrating part **79** and fiber optic structure **78**. Compression fitting **80** cooperates with compression fitting **82**, whose parts **82***a*, **82***b*, **82***c* and O-ring **83** correspond to parts **80***a*, **80***b*, **80***c* and O-ring **81** of compression fitting **80**. In particular, O-rings **81** and **83** become compressed only when nuts **80***a* and **82***a* are rotated until they are sufficiently close to each other.

[**0055**] As just described, feed-through **79** seals fiber optic structure **78** against both internal and external walls **56** and **58** of the container.

[**0056**] FIG. **10** shows a pair of luminaires **30** and **32** that are rotatable about their respective axes. This allows each luminaire to be rotated as desired for moving the peak illuminance laterally across contents of the display case of FIG. **1**. This is especially desirable as the contents to be displayed are moved deeper into the display case or shal-

lower into the case. As the contents are so moved, the location of the peak illuminance can be shifted so as to properly illuminate the contents. Preferably, the luminaires will be releasably held in a desired position. Means for accomplishing this would include electro-mechanical means for holding the luminaire in position, frictional means for holding the luminaire in position, or mechanical means such as the use of a set screw for holding the luminaire in position.

[0057] More preferably, luminaires will be releasably held in any of several predetermined positions, such that the luminaires can be rotated by hand alone into any of such positions. Such releasable holding can be accomplished as follows. In FIG. **10**, luminaire **32** is shown in phantom, and its description will be omitted since it may use the same type of arrangement for being rotated as luminaire **30**. As in FIG. **5**A, a clamp **44** holds the lower end of fiber optic cable **26***a*. Cable **26***a* could be replaced with a glass or quartz rod, for example. Clamp **44** cooperates with sleeve **46***a* protecting the lower end of the cable. A clamp **38***a*, modified from clamp **38** shown in FIG. **5**A, has a resiliently biased arm **90** whose lower portion comprises a detent **92**, which may be shaped in the form of a semi-sphere, for instance. Detent **92** may be pressed into any of various holes **94** extending outwardly along band **96**. In this way, a user can easily grasp the luminaire and rotate detent **92** into any of holes **94**, for instance, which will be held in such hole by resiliently biased arm **90**. However, the user can use manual (hand) force to rotate the luminaire into another predetermined position, where it will be releasably held until another manual force again rotates the luminaire. Typically, holes **94** would be more closely spaced than shown in FIG. **10**.

[0058] FIG. **11** shows luminaires **30** and **32** together with a transparent cover **100**. Transparent cover **100** protects the surface of the luminaires from soiling or injury. Beneficially, transparent cover **100** may also comprise, or be associated with, a lens, such as the Fresnel lens shown. As a Fresnel lens, transparent cover **100** redirects representative light rays **102***a* and **102***b* as the rays pass through the lens, as shown. Such reorientation of the light rays permits steering of the peak of light distribution deeper or shallower into the display case as desired. The transparent cover can additionally act as a light diffuser to minimize direct views of the luminaire and to soften specular images of the luminaire that may be seen as reflections in the contents of the display case.

[0059] Secondary optics, such as a Fresnel lens, becomes especially valuable when the intensity (lumens/steradian) from a round rod luminaire is insufficient to achieve a desired target surface illuminance. This typically occurs when the angle of light hitting the target surface area is large, which is typical when the freezer door is wide (e.g., 91 cm) and the distance to the target surface is small (e.g., 10 cm). The Fresnel lens can increase the intensity of the light directed toward the target surface and thereby increase the target surface illuminance. With a round rod luminaire, the peak intensity occurs when the radial paint stripe width (e.g., the illustrated radial angle **101** for a light extractor) is approximately 20 to 30 degrees, so the Fresnel lens is often used with narrow paint stripes.

[0060] FIG. **12** shows luminaires **30** and **32** with respective transparent covers **104***a* and **104***b*. Transparent covers **104***a* and **104***b* may comprise an optical lens for making the light distribution from the luminaires, e.g., rays **106***a* and **106***b*, more sharply peaked.

[0061] FIGS. **13**-**14**C concern the use of a single luminaire to illuminate two laterally adjacent target areas, and a problem of light blocking that might occur in such luminaire.

[0062] FIG. **13** shows a portion of the display case of FIG. **1** with doors **19** and **20**. In a variation from the display case of FIG. **1**, only a single luminaire **119** is mounted on channel **48**, which is secured to structural member **12***b*. The figure also shows luminaire **119** with light-extraction regions **120** and **121** of the side-light emitting portion. Light rays (e.g. **123***a* and **123***b*) from light-extraction region **120** illuminate a desired target area **125**, while the light rays (e.g. **122***a* and **122***b*) illuminate a laterally adjacent desired target area **124**.

[0063] Using a single luminaire as in FIG. **13** requires more lumens of light to be supplied to the luminaire than to each of the two luminaires shown in FIG. **5**A, for instance. Typically, a larger diameter luminaire would be used for the FIG. **13** embodiment.

[0064] FIG. **14**A shows a luminaire **110***a* shows with light-extraction regions **111***a* and **112***a*, arbitrarily shown as cross-hatched. FIG. **14**B shows a luminaire generally designated **110**, to refer to luminaire **110***a* of FIG. **14**A, for instance. FIG. **14**B also shows a pair of light-extraction regions generally designated as **111** and **112**, to refer to regions **111***a* and **112***a* in FIG. **14**A, for instance. The light-extraction regions **111***a* and **112***a* are arranged longitudinally along the length of the luminaire **110***a*. As used herein, a single light-extraction region provides illumination to a single continuous target area along some part of the length of the luminaire. In accordance with an aspect of the invention, the light is extracted from the side-light emitting portion by light-extraction regions **111***a* and **112***a* to illuminate a pair of respective pair of laterally adjacent target areas (not shown).

[0065] In FIG. **14**A, light-extraction regions **111***a* and **112***a* are continuous along the length of the luminaire. The extraction efficiency within a light-extraction region may be constant within each region or may vary within the region. Spatial variations in extraction efficiency are used to adjust the distribution of light at the target. In many geometries of light-extraction regions **111***a* and **112***a*, light rays (not shown) from one light-extraction regions are blocked by the other light-extraction region, resulting in re-scattering or absorption of the light rays that would otherwise fall on a desired target area. This blockage problem is shown in FIGS. **14**C and **14**D in connection with luminaires **126***a* and **126***b*.

[0066] In FIG. **14**C, luminaire **126***a* has two adjacent light-extraction regions **127** and **128** arranged in a manner to illuminate two separate target areas of the contents of the display case. Light-extraction means **127** illuminates a target area to its left, whereas light-extraction region **128** illuminates a target area to its right. The light-extraction regions **127** and **128** are spaced from each other around a perimeter of said side-light emitting portion taken orthogonally to main optical axis of said side-light emitting portion. In particular light-extraction regions **127** and **128** are spaced from each other at an angle of α around the perimeter of the

side-light emitting portion. Generally, the light rays (e.g. **129***a* and **129***b*) from the light-extraction region **127** illuminate the desired target area, but a portion of light rays (e.g. **129***c*) from the light-extraction means **127** are blocked by the other light-extraction region **128**. These blocked light rays are re-scattered by the light-extraction means **128** with some absorption. These re-scattered light rays (not shown) add with the light rays (not shown) from the light-extraction region **128** to illuminate the target area to the right of that region. Typically, the amount of light rays blocked depends upon the angular separation a between the light-extraction regions **127** and **128**. As the angle α increases, the amount of blockage of the light rays tends to increase.

[**0067**] FIG. **14**D shows a luminaire **126***b* with a single light-extraction region **130**. The light-extraction region **130** illuminates a desired target area of the contents of the display case with light rays (e.g. **131***a*, **131***b*, and **131***c*). The light-extraction region formed in the same relative position as light-extraction region **127** of FIG. **14**C. In the absence of an adjacent light-extraction region, light-extraction region **130** illuminates the desired target area with light rays (e.g. **131***a*, **131***b*, and **131***c*) without any blockage as in FIG. **14**C.

[**0068**] Returning to FIG. **14**A, the blocked light rays (not shown) by the adjacent light-extraction region adds to the illuminance on the respective target area being illuminated by the light-extraction region blocking the light rays. Some of the light rays (not shown) from light-extraction region **111***a* are being blocked by the light-extraction region **112***a* and some of the light rays (not shown) are being blocked by the light-extraction region **111***a*. This blockage problem can be solved by dividing the light-extraction region **111***a* and **112***a* in longitudinal segments along the length of the luminaire in such a manner such that the blockage is reduced considerably, resulting in increase of the illuminance on the desired target area.

[**0069**] FIG. **14**E shows a luminaire **110***b* with light-extraction regions **111***b* and **112***b*. To overcome the above-mentioned blockage problem, the light-extraction regions are spatially divided into segments with gaps between the segments along the length of the luminaire **110***b*. Light-extraction region **111***b* is spatially divided into segments **113** with a gap **113***a* between adjacent segments. Similarly, light-extraction region **112***b* is spatially divided into segments **114** with a gap **114***a* between adjacent segments. The longitudinal dimension of gaps **113***a* and **114***a* is at least 20 percent of the length of the neighboring segments **113** and **114** respectively. The segments **113** are aligned in such a manner so that each gap **113***a* is at least 20 percent of the longitudinal dimension of a segment **114** at the same point along the longitudinal axis of luminaire **110***b*.

[**0070**] The longitudinal dimension of gaps **113***a* and **114***a* of FIG. **14**E and similar gaps discussed in the following figures are preferably greater than the radial width of their respective light-extraction region along the length of the luminaire. More preferably, the longitudinal dimensions of such gaps are greater than twice the radial width of their respective light-extraction region along the length of the luminaire. Further, the target areas illuminated by the light-extraction regions (e.g., **110***a*, **110***b*, FIG. **14**E) are spaced from the luminaire by at least 5 times the longitudinal dimension of such gaps. This is to assure that the light-extraction regions appear as continuous from the viewpoint of the target areas.

[**0071**] FIG. **14**F shows a luminaire **110***c* with light-extraction regions **111***c* and **112***c*. The light-extraction regions are spatially divided into segments **115** and **116**, respectively. The segments **115** and **116** have respective gaps **115***a* and **116***a* between them. The segments **115** and **116** are arranged in such a manner so that the longitudinal dimension of the gaps **115***a* and **116***a* is equivalent to the longitudinal dimension of the adjacent segment of the adjacent light-extraction region.

[**0072**] FIG. **14**G shows a light luminaire **110***d* with light-extraction regions **111***d* and **112***d*. The light-extraction regions are spatially divided into segments **117** and **1185** respectively. The segments **117** and **118** have gaps **117***a* and **118***a* between them, respectively. The gaps **117***a* and **118***a* are relatively longer than the gaps between the segments in FIGS. **14**E and **14**F. This kind of spatial division of the light-extraction regions greatly reduces the blockage of the light by the adjacent light-extraction region, which results in an increase of illuminance on the desired target area.

[**0073**] The light extractor on a luminaire can be arranged to preferentially extract light from the luminaire and direct such light in multiple radial directions along the length of the side-light emitting portion. This is shown in FIGS. **15**A and **15**B.

[**0074**] FIG. **15**A is a simplified view of view port **19***a* and associated luminaire of the display case **10** of FIG. **1**. A desired target area **135** is illuminated by luminaire **132**. The luminaire receives light from a light source **137**, which is extracted by light-extraction region **133** comprising portions **133***a* and **133***b*, arbitrarily shown cross-hatched. Light-extraction portion **133***a* of luminaire **132** illuminates a vertically upper portion **135***a* of target area **135** with a peak illuminance **134***a*. Light-extraction portion **133***b* illuminates lower portion of target area **135** with a peak illuminance **134***b*. Target area **135** is vertically continuous. To the right of vertically oriented luminaire **132** there are shown a cross section of the luminaire with light-extraction portion **133***a*, for describing the upper half of the luminaire, and a cross section of the luminaire with light-extraction portion **133***b* describing the lower half of the luminaire. These cross sections help to more clearly show the relative radial positions of light-extraction portions **133***a* and **133***b* on the luminaire. Such radial displacement of portion **133***b* relative to portion **133***a* results in the shift of peak illuminance **134***a* to peak illuminance **134***b* on the target area **135**.

[**0075**] FIG. **15**B is a simplified view of view ports **20***a* and **21***a* of the display case **10** of FIG. **1** and an associated but modified luminaire. A light source **140** provides light to a luminaire **142**. In luminaire **142**, a light-extraction region **142***a* illuminates a target area **150** at the upper left of the luminaire, having a peak illuminance **148***a*. A second light-extraction region **142***b* illuminates a separate target area **152** at the lower right of the luminaire, having a peak illuminance **148***b*. The single luminaire of FIG. **15**B can illuminate target areas on different lateral sides of the luminaire. The cross sections of luminaire **142** on either side of the vertically shown luminaire more clearly show the radial displacement of light-extraction regions **142***a* and **142***b* from each other.

[**0076**] A preferred light extractor comprises a layer of paint exhibiting Lambertian extraction and having a binder with a refractive index about the same as, or greater than that

of, a core. Suitable light-extraction particles are added to the paint, such as titanium dioxide or many other materials as will be apparent to those of ordinary skill in the art. Preferably, the paint is an organic solvent-based paint.

[0077] Extractors of paint output most of their light in a preferred radial direction from an elongated luminaire. A textured type of extractor could alternatively be used, wherein the surface of the luminaire is textured by molding, laser etching, or chemical etching. Some textured extractors can extract light with a higher directionality than paint, but may introduce artifacts into the light output, which requires a diffuser to mask from view.

[0078] Preferred light-extractors and formulation of gradients of their efficiency along an elongated luminaire, and along a radial perimeter of a luminaire are described in the following U.S. patent applications having some common inventors with the present application, and assigned to the same joint owners as the present application:

[0079] U.S. patent application Ser. No. 11/366,711 filed 2 Mar. 2006 for Luminaire with Improved Lateral Illuminance Control by W. Cassarly et al.

[0080] U.S. patent application Ser. No. 11/108,279 filed 18 Apr. 2005 for Efficient Luminaire with Directional Side-Light Extraction by W. Cassarly et al.

[0081] The present joint owners of the foregoing applications and of the present application are Fiberstars, Inc. and Optical Research Associates. The entireties of the disclosures of the foregoing applications are hereby incorporated by reference.

[0082] FIG. **16** shows a portion of the display case of FIG. **1** with doors **19** and **20**, and illustrates a region of relatively low level light behind structural member **12***b*. As shown, luminaires **154***a* and **154***b* are mounted on channel **48**, which is secured to structural member **12***b*. Light rays (e.g. **160***a* and **160***b*) originating from a light-extraction region **156** on luminaire **154***b* illuminate a desired target area **166**. Target areas **166** and **168** lie in a plane parallel to the view port of doors **19** and **20**, the view ports being shown in FIG. **1** as **19***a* and **20***a*. Light rays (e.g. **162***a* and **162***b*) originating from light-extraction region **158** on luminaire **154***a* illuminate a desired target area **168**. In the arrangement shown, peak illuminance on target areas **166** and **168** is at least 50 percent greater than peak illuminance on non-target area **170** lying between the target areas in the same plane.

[0083] Various benefits arise because the luminaires in both FIGS. **13** and **16** are blocked from view for a person directly in front of the luminaire(s). In FIG. **13**, a person directly in front of the display case and luminaire **119** would not see luminaire **119** owing to the interposition of structural member **12***b* and channel **48**. By "directly in front" means a person viewing the luminaire along a plane intersecting the full length of the side-light emitting portion and being orthogonal to the plane of doors **19** and **20**. Similarly, in FIG. **16**, a person directly in front of the display case and luminaires **154***a* and **154***b* would not see the luminaires owing to the interposition of structural member **12***b* and channel **48**. By placing the luminaires out of direct view, a person is not subjected to bright light from the luminaires, providing an aesthetic advantage.

[0084] Additionally, the fiber optic luminaires more efficiently direct light onto desired target areas. This is due to their extraction of light in a highly directional manner. This can be appreciated from referring to light-extraction regions **120** and **121** (FIG. **13**) each of which covers a limited angle around the circumference of their associated luminaire **119**. Either a single light-extraction region would be used for directing light to a single target area, or both light-extraction regions would be used for directing light to two separate target areas as shown in FIG. **13**. Compared with a traditional fluorescent lamp, a fiber optic luminaire of one aspect of the invention will typically provide the same illuminance on target area(s) with fewer lumens of light. Thus, referring to FIG. **16**, a fiber optic luminaire of one aspect of the invention will provide relatively less light to non-target area **170** than will a fluorescent lamp.

[0085] Further, fiber optic luminaires of one aspect of the invention may deliver light to the target area more efficiently than fluorescent lamps since they can have smaller cross-sectional dimension(s) and are thereby less likely to block light which strikes a reflector. For instance, a fiber optic luminaire typically would be about 19 mm, or preferably 15 mm, or less in diameter (for a round luminaire) compared with 25-37 mm diameter for a typical fluorescent lamp. Because the reflector must often be placed close to the fluorescent lamp, a substantial amount of light will restrike the fluorescent lamp after hitting the reflector. The slimmer luminaire can better accommodate use of reflectors, such as reflectors **34** and **36**.

[0086] FIG. **17** shows a light-delivery system **180** that may replace the feed-through **76** and associated light-delivery structures shown in FIG. **1**. Light-delivery system **180** comprises an HID lamp **182** with a collector **184** for collecting light along a main optical axis coinciding with the main optical axis of a luminaire **186**. HID lamp **182** may comprise a metal halide lamp, by way of example. Collector **184** provides light to fiber optic structure **78**, which may be embodied in different forms as described above in connection with FIG. **9**. In the embodiment shown in FIG. **17**, fiber optic structure **78** provides light to a separate luminaire **186**. Structure **186** is secured by clamp **38** and the bottom portion of fiber optic structure **78** is secured by clamp **44** and sleeve **46**. Feed-through **76** is used in the same manner as in FIG. **9** above.

[0087] HID lamp **182** and collector **184** are conveniently protected by a housing **190** mounted atop container **11**. The housing may include an air intake with dust filter (not shown) and a hot air exhaust fan (not shown). This arrangement does not leave exposed outside the container any flexible fiber optic cables that could potentially be damaged if bent or kinked, for instance.

[0088] FIG. **18** shows another light-delivery system **194** that may replace the feed-throughs **76** and associated light-delivery structures shown in FIG. **1**. Light-delivery system **194** comprises an HID lamp **182** and collector **184***a*. However, collector **184***a* is configured and positioned to send light directly to a light-receiving surface **196***a* of a luminaire **196**, via a infra-red reflecting window **197**. Window **197** may be double-paned to further prevent introduction of heat into the interior of container **11**. Window **197** may be sealed to external wall **58** of the container by any suitable means, such as adhesive. A similar window **198** may be sealed to internal wall **56** of the container. If desired, a liner **199** may be inserted between windows **198** and **199** to protect insulation **62**.

[0089] FIG. **19** shows another light-delivery system **200** that may replace the feed-throughs **76** and associated light-delivery structures shown in FIG. **1**. In system **200**, an HID lamp **202** (e.g., metal halide) provides light that is collected by non-imaging collectors **204** and **206**. Non-imaging collectors **204** and **206** reduce the angular distribution of light they collect from HID lamp **202**. Thermal-isolating rods **208** and **210**, typically made of glass or quartz, receive light from collectors **204** and **206**, respectively. Rods **208** and **210** may be curved as shown to reorient light received by the rods more than 70 degrees, and preferably about 90 degrees as shown. Rods **208** and **210** may be fed downwardly though the upper surface of container **11** in the same manner as fiber optic structure **78** of FIG. **9** extends downwardly through container **11**. Feed-throughs **212***a* and **212***b* may be the same as feed-through **76** of FIG. **9**. Conveniently, rods **208** and **210** can supply light to adjacent luminaires which respectively direct light to contents of the container visible through respective view ports (e.g., **19***a*, **20***a*, FIG. **1**) in laterally adjacent doors of the container.

[0090] FIG. **20** shows another light-delivery system **214** that may replace the feed-throughs **76** and associated light-delivery structures shown in FIG. **1**. System **214** includes a halogen lamp **216** and a hollow, dichroic-coated non-imaging collector **218**. Non-imaging collectors do not require imaging, but can include imaging, as further described in William J. Cassarly, "Non-imaging Optics: Concentration and Illumination" in the OSA Handbook of Optics, Volume **3**, Chapter 2. Collector **218** couples light onto optical structure **220**. Optical structure **220** may comprise fiber optic structure **78** of FIG. **9**, or window **198** of FIG. **18**, by way of example.

[0091] FIG. **21** shows another light-delivery system **224** that may replace the feed-throughs **76** and associated light-delivery structures shown in FIG. **1**. System **224** includes one or more light-emitting diodes (LEDs) **226**, whose light is collected by a non-imaging collector **228**, which reduces the angular distribution of light collected from the one or more LEDs **226**. Collector **228** provides light to optical structure **220**, as described in connection with FIG. **20** above.

[0092] FIG. **22** shows another light-delivery system **230** that may replace the feed-throughs **76** and associated light-delivery structures shown in FIG. **1**. System **230** includes a light source **232**, such as an HID lamp and light collector, a fiber optic optical splitter **234** for apportioning light into to output arms **234***a* and **234***b* from an input arm **234***c*. Splitter **234** could be formed of glass or quartz if light source **232** emitted too much heat, or could be formed of the other materials mentioned above for forming fiber optic structures such as the luminaires. Optical splitter **234** provides light to luminaires **236***a* and **236***b*, which may be located completely within the container, or may extend upwardly through the top of the container, as does fiber optic structure **78** of FIG. **9**.

[0093] FIG. **23** shows another light-delivery system **238** similar to that shown in FIG. **22**, but showing a variation of system **230** of that figure. In particular, in system **238**, the input arm **240***c* of fiber optic optical splitter **240** is oriented more than 70 degrees (preferably about 90 degrees) from the main optical axis of luminaires **236***a* and **236***b*. This arrangement accommodates a different orientation of light source **232**.

[0094] FIG. **24** shows another light-delivery system **244** that may replace the feed-throughs **76** and associated light-delivery structures shown in FIG. **1**. System **244** includes a pair of fiber optic structures **246** and **248** that collectively present their input faces **246***a* and **246***b* to a light source **232**. Each of input faces **246***a* and **248***a* preferably have a half-round shape, so as to present a round shape to light source **232**. Each of structures **246** and **248** may have S-shapes as shown, before being fed through the top of container **11** with feed-throughs **76** as described above in connection with FIG. **9**. Structures **246** and **248** provide light to luminaires **250** and **252**.

[0095] FIG. **25** shows another light-delivery system **254** similar to that shown in FIG. **24**, but showing a variation of system **244** of that figure. In system **254**, light source **232** delivers light along a main optic axis that is angled more than 70 degrees (preferably about 90 degrees) from a main optical axis of a luminaire, which would be vertical for the display case of FIG. **1**. A pair of fiber optic structures **256** and **258** present their input faces **256***a* and **258***a* to light source **232**. The lower portions of structures **256** and **258** have been omitted, but such lower portions may conform to the lower portions of structures **246** and **248** of FIG. **24**.

[0096] While the invention has been described with respect to specific embodiments by way of illustration, many modifications and changes will occur to those skilled in the art. For instance, it will be routine in the art to incorporate infra-red or ultra-violet filters in the described fiber optic light-delivery systems where useful. Additionally, directions used herein, such as "top" or "downwardly," indicate directions that are exemplary, and are not to be construed as limiting. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true scope and spirit of the invention.

1. A lighted display case with remote light source, comprising:

a) a container having contents for display;

b) a solid fiber optic luminaire at least partially mounted within the container; the luminaire having an elongated side-light emitting portion for emitting light from the side of the luminaire onto contents in an interior of the display case; the side-light emitting portion comprising an extractor of light arranged to preferentially extract light from the luminaire and direct said light in at least one radial direction along the length of the side-light emitting portion to at least one target area of said contents along a longitudinal axis of the side-light emitting portion;

c) the extractor of light comprising first and second light-extraction regions;

d) the container having a first and second view ports intended to allow persons outside the container to view contents displayed in the interior of the container; the first view port being on one lateral side of the side-light emitting portion and the second view port being on a second lateral side of said portion;

e) a light-delivery system for providing light to the fiber optic luminaire; the light-delivery system having a light source mounted remotely from the container;

f) the luminaire being arranged to illuminate first and second separate target areas of said contents of the display case; the first target area being visible through the first view port and the second target area being visible through the second view port; the first and second target being illuminated by the first and second light-extraction regions; and

g) the first and second light-extraction regions being spaced from each other around a perimeter of the side-light emitting portion taken orthogonally to main optical axis of said side-light emitting portion.

2. The lighted display case of claim 1, wherein:

a) the container is open to its ambient; and

b) the interior of the container is maintained within 5 C of the temperature of the ambient.

3. The display case of claim 1, wherein:

a) the view ports having a maximum dimension; and

b) the side-light emitting portion of the luminaire extends across the majority of said maximum dimension.

4. The display case of claim 1, wherein the lamp comprises an HID lamp.

5. The display case of claim 1, wherein the extractor of light is arranged to preferentially remove light along the length of the side-light emitting portion in a plurality of radial directions along said longitudinal axis.

6. The display case of claim 1, wherein the container contains a structural member parallel to orthogonal plane of the view port to block the view of the luminaire inside the case to persons viewing the contents of the case along a plane intersecting the full side-light emitting portion and being orthogonal to the view port.

7. The display case of claim 1, wherein peak illuminance on the first and second target areas lying in a plane within the case, parallel to the view ports, is at least 50 percent greater than peak illuminance on a non-target area lying between the target areas in said plane.

8. The display case of claim 1, wherein:

a) the light-extraction regions are spatially divided in segments along the length with gaps between the segments; the longitudinal dimension of the gaps being greater than the radial width of their respective light-extraction region;

b) the majority of said segments are divided with gaps of at least 20 percent of the longitudinal dimension of neighboring segment along the length of the light-extraction regions; and

c) the majority of said segments have gap portion of the adjacent light-extraction region aligned with at least 20 percent longitudinal dimension of the respective segment along the length of the light-extraction regions.

9. The display case of claim 1, further comprising a transparent cover over the majority of the length of the side-light emitting portion of the luminaire.

10. The display case of claim 9, wherein the transparent cover comprises a diffuser for reducing glare from the luminaire.

11. The display case of claim 9, wherein the transparent cover comprises a Fresnel for directing light emitted from the foregoing portion into a more narrowed beam.

12. A lighted display case with remote light source, comprising:

a) a container having a view port intended to allow persons outside the container to view contents displayed in the interior of the container;

b) a solid fiber optic luminaire at least partially mounted within the container; the luminaire having an elongated side-light emitting portion for emitting light from the side of the luminaire onto contents in an interior of the display case; the side-light emitting portion comprising an extractor of light arranged to preferentially extract light from the luminaire and direct said light in at least one radial direction along the length of the side-light emitting portion to at least one target area of said contents along a longitudinal axis of the side-light emitting portion;

c) the extractor of light comprising first and second light-extraction regions;

d) a light-delivery system for providing light to the fiber optic luminaire; the light-delivery system having a light source mounted remotely from the container; and

e) the side-light emitting portion of the luminaire is rotatable about its own longitudinal axis for directing the aim of light emitted therefrom to various radial directions about said axis.

13. The display case of claim 12, wherein:

a) the view port has a maximum dimension; and

b) the side-light emitting portion of the luminaire extends across the majority of said maximum dimension.

14. The display case of claim 12, wherein the container contains a structural member parallel to orthogonal plane of the view port to block the view of the luminaire inside the case to persons viewing the contents of the case along a plane intersecting the full side-light emitting portion and being orthogonal to the view port.

15. The display case of claim 12, wherein the case comprising means for releasably holding the luminaire in any of a plurality of predetermined positions.

16. The display case of claim 14, wherein the means for releasably holding comprises a resiliently biased detent mechanism causing said side-light emitting portion to be releasably held in any of a plurality of predetermined radial positions.

17. The display case of claim 12, wherein the lamp comprises an HID lamp.

18. The display case of claim 16, wherein the light-delivery system includes at least one LED and a non-imaging optic for coupling light into a fiber optic structure that passes through a wall of the container.

19. The display case of claim 12, further comprising a transparent cover over the majority of the length of the side-light emitting portion of the luminaire.

20. The display case of claim 19, wherein the transparent cover comprises a diffuser for reducing glare from the luminaire.

21. The display case of claim 19, wherein the transparent cover comprises a Fresnel for directing light emitted from the foregoing portion into a more narrowed beam.

22. A lighted display case with remote light source, comprising:

a) a container having contents for display;

b) a first and second solid fiber optic luminaires at least partially mounted within the container; each luminaire having an elongated side-light emitting portion for emitting light from the side of the luminaire onto contents in an interior of the display case; the side-light emitting portion comprising an extractor of light arranged to preferentially extract light from the luminaire and direct said light in at least one radial direction along the length of the side-light emitting portion to at least one target area of said contents along a longitudinal axis of the side-light emitting portion;

c) the extractor of light comprising first and second light-extraction regions;

d) the container having a first and second view ports intended to allow persons outside the container to view contents displayed in the interior of the container; the first view port being on one lateral side of the sidelight emitting portion and the second view port being on a second lateral side of said portion;

e) a light-delivery system having a lamp for supplying light to the first and second luminaires;

f) the side-light emitting portions of the first and second luminaires being mounted parallel to each other and being respectively positioned to illuminate a target area on one side of the luminaires and a laterally adjacent target area on another side of the luminaires.

23. The display case of claim 22 wherein:

a) the view port has a maximum dimension; and

b) the side-light emitting portion of the luminaire extends across the majority of said maximum dimension.

24. The display case of claim 22, wherein the lamp comprises an HID lamp.

25. The display case of claim 22, wherein the container contains a structural member parallel to orthogonal plane of the view port to block the view of the luminaire inside the case to persons viewing the contents of the case along a plane intersecting the full side-light emitting portion and being orthogonal to the view port.

26. The display case of claim 22, further comprising a transparent cover over the majority of the length of the side-light emitting portion of the luminaire.

27. The display case of claim 27, wherein the transparent cover comprises a diffuser for reducing glare from the luminaire.

28. The display case of claim 27, wherein the transparent cover comprises a Fresnel for directing light emitted from the foregoing portion into a more narrowed beam.

29. The display case of claim 22, wherein the light-delivery system includes:

a) a collector mounted to the container for coupling light along a first optical axis that is angled more than 70 degrees from a main optical axis of the first luminaire; and

b) a corner-turning device at both ends of the coupler for turning the light from the first and the second optical axis to the said main axis of both said luminaires.

30. The display case of claim 25, wherein the collector comprises a non-imaging collector for reducing the angular distribution of light collected from the HID lamp by the foregoing collector.

31. The display case of claim 25, wherein the light-delivery system includes a first fiber optic structure sufficiently curved to receive light along the first optical axis and to transmit light along the main optical axis of the first luminaire that is more than 70 degrees angled from the first optical axis.

32. The display case of claim 25, wherein the light-delivery system further comprises

a) a second non-imaging collector for reducing the angular distribution of light collected by the foregoing collector; and

b) a second fiber optic structure sufficiently curved to receive light from second collector along a respective main second optical axis and to transmit light along the main optical axis of the second luminaire that is more than 70 degrees angled from the second optical axis.

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