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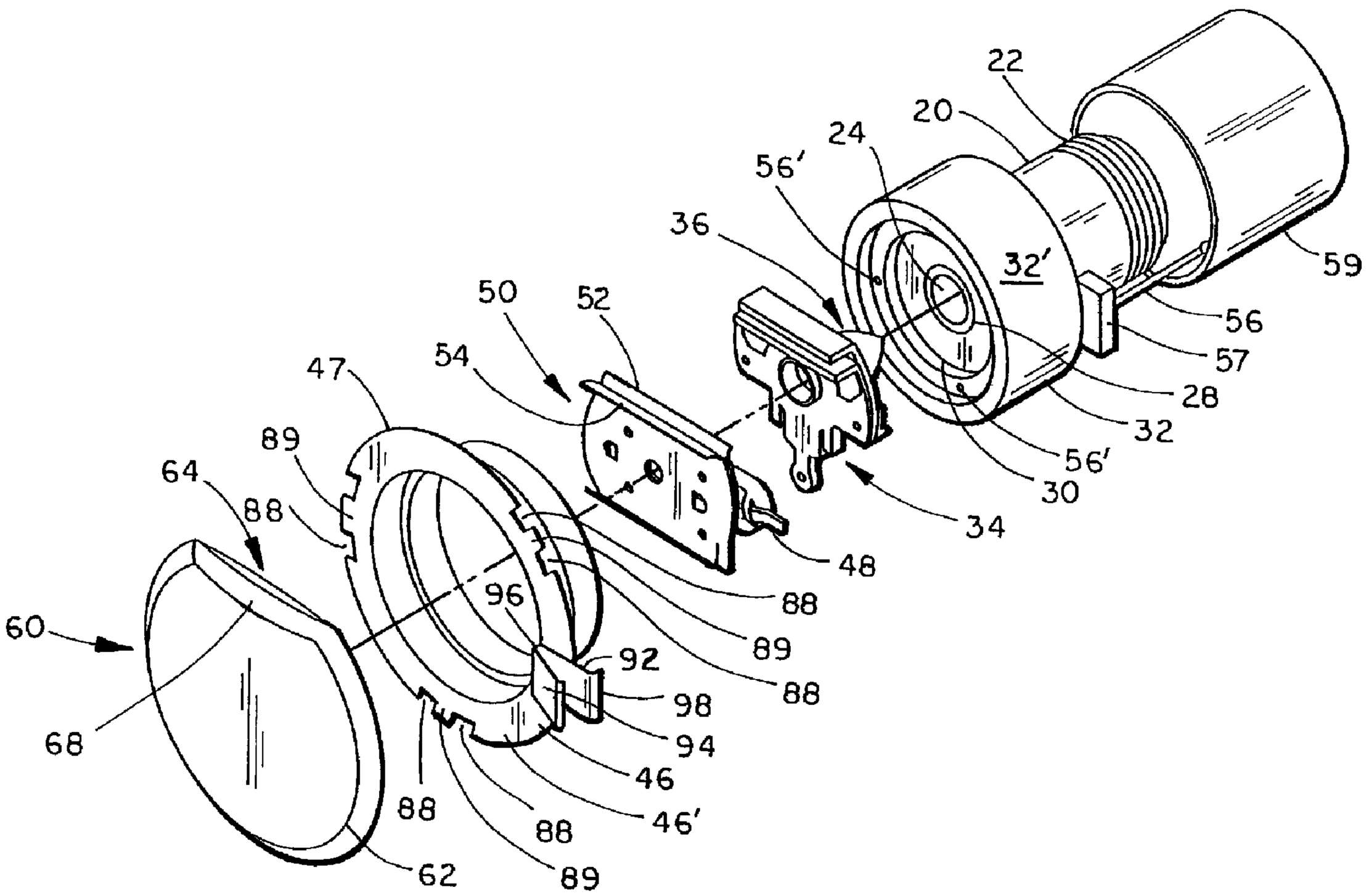
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(54) Titre : TETE DE SPRINKLEUR DISSIMULEE
(54) Title: CONCEALED SPRINKLER HEAD



(57) Abrégé/Abstract:
A concealed sprinkler head comprises a housing having an annular flange and a central opening, a thermally sensitive trigger assembly in fluid communication with the central opening and a cover plate including a body member having a periphery, a center and at least one mounting tab projecting from the periphery towards the center. The at least one mounting tab is attached to the

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(57) Abrégé(suite)/Abstract(continued):
annular flange by a fusible material, and at least a section of the periphery is configured to enable the passage of air into the central opening and towards the thermally sensitive trigger assembly. The periphery has a generally semi-circular arcuate edge section and a generally linear edge section. The generally linear edge section defines an air passageway section.

ABSTRACT

A concealed sprinkler head comprises a housing having an annular flange and a central opening, a thermally sensitive trigger assembly in fluid communication with the central opening and a cover plate including a body member having a periphery, a center and at least one mounting tab projecting from the periphery towards the center. The at least one mounting tab is attached to the annular flange by a fusible material, and at least a section of the periphery is configured to enable the passage of air into the central opening and towards the thermally sensitive trigger assembly. The periphery has a generally semi-circular arcuate edge section and a generally linear edge section. The generally linear edge section defines an air passageway section.

CONCEALED SPRINKLER HEAD

BACKGROUND OF THE INVENTION

The present invention relates generally to fire protection sprinkler systems, and more particularly, to a cover plate for a concealed fire sprinkler head.

Sprinkler heads have long been used in automatic fire extinguishing systems in order to controllably disperse a fluid in order to suppress or extinguish a fire in a designated area. Typically, the fluid utilized in automatic fire extinguishing systems is water, however, systems have also been advanced to disperse other fire extinguishing fluids. In one common design, sprinkler heads include a solid metal base with a central orifice having an inlet connected to a pressurized supply of water or other fire extinguishing fluid. A deflector, spaced from the sprinkler body, alters the trajectory of the water in an optimum pattern when discharged from the central orifice. In many conventional sprinkler heads, the deflector is fixedly spaced from the outlet by a pair of rigid arms and mounted on a boss joining the arms. A thermally sensitive trigger assembly is positioned between the deflector, boss and the central orifice outlet and sealingly engages a sealing assembly, which under non-activated conditions, prohibits water flow from the outlet. When the temperature reaches a preselected value indicative of a fire, the trigger assembly releases the sealing member and permits the expulsion of water from the outlet.

In another common design, often referred to in the industry as a concealed, recessed or flush sprinkler head, the structure in which the sprinkler body is positioned has a recess or cavity, sized to enable the insertion of the sprinkler body. The deflector is movably supported proximate to the outlet, with in a cavity formed in the sprinkler body. A housing is attached to, and extends beyond the bottom region of the sprinkler body and includes an annular flange positioned about the exterior perimeter of the cavity in which the sprinkler body is located. A sealing assembly, located within the interior of the sprinkler body, seals the outlet of the sprinkler body and is maintained in a closed position by a pair of pins or actuators depending from the bottom of the sprinkler body. The pins are held in an inwardly biased or closed position by a thermally sensitive trigger assembly, positioned between the sprinkler body and the bottom of the housing, which is thermally responsive in the temperature range indicative of a fire. Under normal temperatures, the presence of the thermally sensitive trigger assembly

prohibits fluid flow through the central orifice. When the temperature within the designated area rises to a preselected value due to the presence of fire, the thermally sensitive trigger assembly fuses, or ruptures, causing the pins to move in an outward direction, and in consequence, results in the movement of the deflector away from the outlet of the sprinkler body, with its movement halted a preselected distance within the interior of the designated area. Activation of the thermally sensitive trigger assembly also releases the sealing assembly, enabling pressurized fluid to travel through the sprinkler body and be expelled therefrom. Once expelled from the outlet, the fluid impacts the deflector, and its trajectory is altered in an optimum pattern.

Concealed sprinkler heads are commonly equipped with a concealing cover plate which is coupled to the housing. When the deflector is expelled from the housing, it dislodges the cover plate, causing its motion away from the sprinkler head. Under normal conditions, the cover plate conceals the interior of the sprinkler body from view, and in most instances, completely encloses the bottom of the housing.

As the thermally sensitive trigger assembly in a concealed sprinkler is normally positioned above the annular flange, or, at least co-planar therewith, the presence of a cover plate reduces the air flow received by the thermally sensitive trigger assembly. As the air flow rate impacting the thermally sensitive trigger assembly is reduced, the heat transfer rate to the thermally sensitive trigger assembly also decreases. In consequence of the reduced air flow rate, the thermally sensitive trigger assembly is elevated to the preselected activation temperature at a slower rate, and reduces the response time of the sprinkler head.

In response to slow activation times, cover plates have been provided with a plurality of central openings or slots, often formed in surfaces projecting from the center of the cover plate, to permit the heat to pass therethrough and impact the thermally sensitive trigger assembly. These airway openings, however, draw attention to the cover plate and diminish the cover plate's ability to perform its function of providing an aesthetic cover that does not visually detract from the ceiling or sidewall in which the sprinkler head is positioned.

Consequently, there is a need for a cover plate which conceals the sprinkler head interior, provides an aesthetic, low profile cover, permits heat to be directed to the thermally responsive trigger assembly, and is configured to be immediately and effectively dislodged from the housing in response to a fire.

SUMMARY OF THE INVENTION

Accordingly, in one aspect there is provided a concealed sprinkler head comprising:

a housing having an annular flange and a central opening;

a thermally sensitive trigger assembly in fluid communication with said central opening; and

a cover plate including a body member having a periphery, a center and at least one mounting tab projecting from said periphery towards said center, said at least one mounting tab attached to said annular flange by a fusible material, and at least a section of said periphery configured to enable the passage of air into said central opening and towards said thermally sensitive trigger assembly, wherein said periphery has a generally semi-circular arcuate edge section and a generally linear edge section, said generally linear edge section defining an air passageway section.

According to another aspect there is provided a concealed sprinkler head comprising:

a sprinkler body having a central orifice with an inlet and an outlet, said inlet configured for attachment to a fire extinguishing fluid supply line;

a deflector movably mounted to said sprinkler body;

a sealing assembly for sealing said outlet;

a thermally sensitive trigger assembly configured to releasably urge said sealing assembly into sealing engagement with said outlet;

a housing attached to said sprinkler body and having a bottom extending beyond said outlet, said thermally sensitive trigger assembly positioned between said outlet and said bottom of said housing; and

a cover plate removably mounted to said bottom of said housing, said cover plate having a periphery, wherein at least a section of said periphery is formed with at least one passageway section configured to enable air to travel between said passageway section and said bottom of said housing and towards said thermally sensitive trigger assembly, wherein said periphery of said cover plate has a generally semi-circular arcuate edge section and a generally linear edge section, wherein said generally linear edge section defines said at least one passageway section.

These and other objects, advantages, purposes and features of the invention will become apparent upon review of the following specification in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of the cover plate and concealed sprinkler head according to a preferred embodiment of the invention;

FIG. 2 is a perspective view of the cover plate of FIG. 1, shown in the assembled position;

FIG. 3 is a cross-sectional view taken along line III-III of FIG. 2;

FIG. 4 is a plan view of the cover plate of FIGS. 1-3;

FIG. 5 is a bottom view of the cover plate of FIGS. 1-4;

FIG. 6 is a sectional view taken along line VI-VI of FIG. 5;

FIG. 7 is a side view of a spring according to the invention;

FIG. 8 is a sectional side view of a cover plate attached to a concealed sprinkler head located within a cavity according to an alternative preferred embodiment;

FIG. 9 is a perspective view of a cover plate shown in the assembled position, according to another alternative preferred embodiment;

FIG. 10 is a sectional view taken along line X-X of FIG. 9;

FIG. 11 is the same view as FIG. 9 of a cover plate according to another alternative preferred embodiment;

FIG. 12 is a sectional view taken along line XII-XII of FIG. 11;

FIG. 13 is a bottom view of a housing according to an alternative preferred embodiment;

FIG. 14 is a sectional view taken along line XIV-XIV of FIG. 13;

FIG. 15 is a perspective view of a cover plate according to another alternative preferred embodiment;

FIG. 16 is a plan view of a cover plate according to yet another alternative preferred embodiment;

FIG. 17 is a bottom view of the cover plate of FIG. 16;

FIG. 18 is a bottom view of a housing according to another alternative preferred embodiment; and

FIG. 19 is a sectional view taken along line XIX-XIX of FIG. 18.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is directed to a unique cover plate for use in conjunction with a concealed or recessed sprinkler head. The cover plate of the present invention permits heated air to travel therethrough and impact the thermally sensitive trigger assembly to thereby increase the response time of the recessed sprinkler head, while maintaining a low profile, sleek aesthetic appearance which does not detract from the side wall or ceiling structure in which it is placed. The present invention will now be described with reference to the accompanying drawings wherein the like reference numerals correspond to like elements in the several drawings.

Referring now to the drawings, a concealed sprinkler head 10 normally contains a sprinkler body 20 having an upper section 22. Upper section 22 is externally threaded, allowing removable attachment to a fire extinguishing fluid supply line, normally in the form of a pipe, and positioned within a sidewall or ceiling. This pipe is in fluid communication with a source of pressurized fire extinguishing fluid. A central orifice 24 is formed in sprinkler body 20, allowing the movement of fluids from an inlet through an outlet 28. A cavity 30, defined by

annular member 32 of sprinkler body 20, extends beyond outlet 28. Sprinkler body 10 movably supports a fluid deflector 34, and a sealing assembly 36 placed in sealing engagement with outlet 28 during normal, non-activated conditions. A housing 40 is fixedly attached to the exterior surface 32' of annular member 32. Housing 40 depends beyond annular member 32 of sprinkler body 20 and includes a central opening 42 and a bottom 44 formed with an annular flange 46. Annular flange 46 is substantially orthogonal to housing 40 and is dimensioned to conceal the recess or cutout section 102 formed within sidewall 100 into which sprinkler body 20 is inserted (FIG. 3).

A pair of arms or levers 48 depend from outlet 28 of sprinkler body 20. Pins 48 are normally biased in an outward direction but are held together in an inwardly biased position by a thermally sensitive trigger assembly 50. Thermally sensitive trigger assembly 50 receives the lower end of levers 48 and holds the same in a state of tension so that deflector 34 remains in its preselected position proximate to sprinkler body 20, and sealing assembly 36 remains in sealing engagement with outlet 28 during non-activated conditions. A cylindrical member 59 is positioned over upper region 22 of sprinkler body 20 and rests on edge 32" of annular member 32. Cylindrical member 59 prevents the intrusion of debris into upper region 22.

Thermally sensitive trigger assembly 50 may be any trigger assembly commonly known in the art. For example, thermally sensitive trigger assembly 50 includes one or more plates 52 and, 54, joined by heat fusible material, such as a suitable solder. Plates 52, 54 are each formed with an aperture which receives and holds the ends of levers 48 in the closed position. In the closed or non-activated position, thermally sensitive trigger assembly 50 will be positioned either within cavity 30 of annular member 32 or within a central opening 42 of housing 40, a preselected distance from bottom 44. When subjected to a preselected temperature, the fusible material will fuse, causing the release of plates 52, 54. Upon release, levers 48 move to their outwardly biased position which releases sealing assembly 36, and results in the expulsion of deflector 34 from its position proximate to outlet 28. Pins or guide rods 56, slidably positioned within apertures 56' formed in sprinkler body 20 are attached to deflector 34 and halt the progression of deflector 34 such that it is supported a preselected distance within the protected area. A pair of wrench ears 57 extend from sprinkler body 20 and permit an operator to secure sprinkler head 10 to a piping system (not shown) with a wrench or other suitable tool. Thereafter, pressurized water or other fire extinguishing fluid travels through sprinkler body 20 and into the protected area to suppress or extinguish a fire. The previous description of sprinkler

head 10 is illustrative of a concealed sprinkler head. A suitable sprinkler head for use with this invention is disclosed in U.S. Patent No. 6,367,559, and entitled Double-Blade Deflector for Side Wall Sprinkler. However, it will be understood that other configurations for sprinkler head 10 may be used without departing from the spirit and scope of the present invention. It will be further understood that although sprinkler head 10 has been described as a concealed side wall sprinkler head, the present invention is equally applicable to concealed sprinkler heads mounted within a ceiling or other horizontal body.

A cover plate 60 is mounted to external surface 46' of annular flange 46 of housing 40. Cover plate 60 includes a periphery 62 having formed therein at least one passageway section 64, configured to enable heated air to pass through the gap or interstice 66 formed between air passageway 64 and annular flange 46 and travel through central opening 42 of housing 40 and impact thermally sensitive trigger assembly 50. Passageway section 64 is disposed further away from annular flange 46 than the adjacent periphery section of cover plate 60. In a preferred form, passageway section 64 is at least one lip 68 formed along periphery 62 of cover plate 60 and projecting in a direction away from annular flange 46. Preferably, lip 68 forms a substantially linear crease 70 in cover plate 60, and includes an arcuate edge 72. Cover plate 60 has a central section 74 which is preferably substantially planar. The planar aspect of central section 74 of cover plate 60 maintains the low profile appearance of cover plate 60. Also, preferably, periphery 62 includes a rim 76 angled towards annular flange 46 of housing 40, while lip 68 is formed with a rim 67 projecting towards sidewall 110. Cover plate 60 may be formed of any conductive material commonly utilized in the art, such as, for example brass, and is preferably substantially circular in shape. Cover plate 60 is dimensioned to substantially conceal central opening 42 of housing 40, and thus prohibits the interior of sprinkler head 20 from being seen when in the assembled position. Preferably, lip 68 exhibits a preselected angle α of between approximately 15° and 75°, more preferably between approximately 30° and 65°, and most preferably, approximately 45°.

Alternatively, as depicted in FIGS. 16 and 17, passageway section 64 is defined by a cutout section 65 formed in periphery 62. Preferably, cutout section 65 is generally planar while the remainder of periphery 62 is substantially arcuate in shape. Unlike lip 68, cutout section 65 does not include an arcuate edge, and thus defines passageway section 64 to enable heated air to

pass between passageway section 64 and annular flange 46, and travel through central opening 42 of housing 40 and impact thermally sensitive trigger assembly 50.

Formed along edge 80 of rim 76 are one or more mounting tabs 82. Mounting tabs 82 are placed in spaced relation, and extend inwardly towards the center of cover plate 60. Mounting tabs 82 have a general C-shape with a contact member 84 generally parallel to inner surface 61 of cover plate 60, and a pair of end members 86 depending substantially orthogonally from contact member 84 and towards inner surface 61. Annular flange 46 of housing 40 defines a mounting surface for cover plate 60 and is formed with one or more sets of notches 88 placed in spaced relation. Each pair of notches 88 define a contact surface 89 therebetween. The number of contact surfaces 89 formed in annular flange 46 corresponds to the number of mounting tabs 82 formed in cover plate 60. To couple or attach cover plate 60 to annular flange 46, a suitable fusible material, such as a solder, having a known fusing temperature is placed on contact surface 89 of annular flange 46, and cover plate 60 is aligned such that contact members 84 will be in alignment or registry with contact surfaces 89. The fusible material employed is application specific as fusible materials have different fusing temperatures, and thus will be within the purview of one with ordinary skill in the art.

In an alternative preferred embodiment, as shown in FIGS. 13 and 14, housing 40' includes a generally cylindrical section 130 and an outwardly flared or angled ledge 134 formed at bottom 132. Cylindrical section 130 may have one or more tabs 131 projecting within central opening 130'. The purpose of tabs 131 is to provide frictional engagement between cylindrical section 130 and exterior surface 32' of annular member 32 and prevent inadvertent removal of housing 40' from annular member 32. A generally horizontal annular flange 136 extends from ledge 134. When housing 40' is in position, wall 102' of cutout section 102 terminates prior to ledge 134, and thereby forms an annulus 138. Annular flange 136 has a plurality of cut-out sections 140, each having an edge 142. Depending from each outer edge 142 of cut-out section 140 is a generally L-shaped member 144. L-shaped member 144 includes a planar contact section 146 which defines a contact surface to which contact member 84 of cover plate 60 is joined by the use of an appropriate fusible material. Contact section 146 of L-shaped member 144 resides in a horizontal plane spaced from the plane defined by annular flange 136. Formed in ledge 134 are a plurality of throughholes 139. Each throughhole 139 is located proximate to a cutout section 140. The purpose of throughholes 139 is to provide an air exhaust passageway, enabling heating air to contact horizontal section 146 and be exhausted into annulus 138.

Providing an air flow passageway through which heated air contacts horizontal sections 146 of L-shaped members 144, contact members 84, and the fusible material therebetween, and is subsequently evacuated from housing 40' through throughholes 139 increasing the air flow rate. This increase in the air flow increases the rate at which the fusible material achieves the fusing temperature, and assures the timely separation of cover plate 60 from housing 40'.

When employing cover plate 60 having a passageway section 64 defined by cutout section 65, a housing 40", as shown in FIGS. 18 and 19, is preferably employed. Housing 40" includes an upper section 150 and a larger diameter lower section 152. Upper section 150 preferably includes one or more tabs 131. Extending from bottom region 154 of lower section 152 is an annular flange 156. Annular flange 156 includes one or more sets of notches 88 placed in space relation with each pair of notches 88 defining a contact surface 89 therebetween. Unlike housing 40, housing 40" includes a cutout section 158 formed in annular flange 156. Preferably, cutout section 158 is slightly arcuate. When cover plate 60, having cutout section 65 is used in conjunction with housing 40", cover plate 60 is attached to housing 40" in the manner discussed above, so that cutout section 158 of annular flange 156 is in substantial registry with cutout section 65 of cover plate 60. The substantial registry between cutout sections 65 and 158 provide an aesthetically attractive appearance while enabling air to pass through the passageway section 64 defined by cutout section 65 and travel towards thermally sensitive trigger assembly 50.

In order to assure the effective thrusting or dislodgment of cover plate 60 from housing 40, once the fusible material achieves the requisite fusing temperature, a spring 90 is positioned between cover plate 60 and exterior surface 46' of annular flange 46. In a preferred form, spring 90 includes a substantially linear first section 92 and a substantially linear second section 94 joined together at a preselected angle β by an arcuate bridge section 96. First section 92 of spring 90 is slightly greater in length than second section 94, and both have at their free ends an angled tab 98, 98', respectively, extending in substantially the same direction. In the assembled position, tab 98 is in abutting contact with, or in proximity to, edge 47' of annular flange 46, while tab 98' is substantially contoured to the inner surface of rim 76. The angle B formed by spring 90, in the non-compressed state, is between approximately 10° and 30°, more preferably between approximately 15° and 25°, and most preferably approximately 20°.

Spring 90 is positioned between annular flange 46 and cover plate 60 such that surface 92' of first section 92 is in abutting contact with exterior surface 46' of annular flange 46 with

arcuate tab 98 contoured about edge 47 of annular flange 46, while surface 94' of second section 94 is positioned on edge 76' of rim 76, with tab 98' abutting first section 92 of rim 76. When cover plate 60 is attached to annular flange 46, first section 92 will be urged into proximity with second section 94 of spring member 90. That is, the angle β defined by spring member 90 in the assembled position will be less than that in its non-compressed, unassembled position, and in consequence, will place spring member 90 in compression. When the fusible material positioned between annular flange 46 and cover plate 60 fuses, the compressive force of spring 90 will vigorously thrust cover plate 60 away from annular flange 46 and thereby assure the timely separation of cover plate 60 upon activation of sprinkler head 10.

Turning now to FIG. 8, in an alternative preferred embodiment, a cover plate 60' includes a peripheral rim 103 projecting away from annular flange 46. In this embodiment, rim 76 formed in cover plate 60 is absent and cover plate 60' is of a generally uniform cross section having an interior surface 104 and an exterior surface 106. Center section 108 has a slightly larger diameter than central opening 42 of housing 40 so as to enable the attachment of cover plate 60' to annular flange 46 by application of a fusible material 106 at discrete, non-continuous points on interior surface 104. An interstice or open area 109 is formed between interior surface 104 and annular flange 46 by the application of fusible material 106. This interstitial area 109 provides a pathway for air to enter central opening 42 and travel towards thermally sensitive trigger assembly 50.

With reference to FIGS. 9 through 12, in another alternative preferred embodiment, a cover plate 60" is formed having a plurality of undulations or arcuate sections 110 formed therein projecting from the plane defined by exterior surface 112. Undulations 110 define ridges 114 on the interior surface 104 and periphery 62 of cover plate 60". Each ridge 114 provides a passageway section 64' enabling heated air to pass therethrough and towards thermally sensitive trigger assembly 50. In a preferred form, as shown in FIGS. 9 and 10, there are a plurality of undulations 110 extending in a radial pattern from the center of cover plate 60". In a preferred alternative, as shown in FIGS. 11 and 12, undulations 114 are formed in a longitudinal pattern. As with cover plate 60', cover plate 60" is attached annular flange 46 by the application of a fusible material 106 on interior surface 104 at discrete, non-continuous points between undulations 110.

In assembly, sprinkler head 10 is first assembled in accordance with normal industry procedure and inserted with the cavity 102. Thereafter, a fusible material is applied to mounting

tabs 82 of cover plate 60, or interior surface 104 of cover plate 60', 60", and attached to annular flange 46, 46a. Subsequently, spring 90 is positioned between exterior surface 46' of annular flange 46, 46a and rim 76 of cover plate 60 or interior surface 104 of cover plate 60' or 60". Once spring 90 is in position, housing 40 and cover plate 60, 60', or 60" is attached to sprinkler body 20.

When using housing 40' having annular flange 136, a cover plate 120 may be attached thereto (Fig. 14). Cover plate 120 has a rim 122 spanning the entire periphery and is otherwise structurally similar to cover plate 60. Thus, in cover plate 120, passageway section 64 is absent. The L-shaped members 144 depending from annular flange 136, when attached to cover plate 120, space cover plate 120 a pre-selected distance from exterior surface 46', and thereby creates a circular passageway or interstice through which heated air may travel towards thermally sensitive trigger assembly 50 and towards the fusible material positioned between contact sections 146 of L-shaped members 144 and contact members 84 of cover plate 120.

The above detailed description is of the preferred embodiments only. Changes and modifications in the specifically described embodiments can be carried out without departing from the principles of the invention. Therefore, the invention is intended to be limited only by the scope of the appended claims as interpreted according to the principles of patent law including the doctrine of equivalents.

What is claimed is:

1. A concealed sprinkler head comprising:

a housing having an annular flange and a central opening;

a thermally sensitive trigger assembly in fluid communication with said central opening; and

a cover plate including a body member having a periphery, a center and at least one mounting tab projecting from said periphery towards said center, said at least one mounting tab attached to said annular flange by a fusible material, and at least a section of said periphery configured to enable the passage of air into said central opening and towards said thermally sensitive trigger assembly, wherein said periphery has a generally semi-circular arcuate edge section and a generally linear edge section, said generally linear edge section defining an air passageway section.

2. The concealed sprinkler head of claim 1, wherein said annular flange is formed with a cutout section, said cutout section being in substantial registry with said generally linear edge section when said cover plate is attached to said annular flange.

3. A concealed sprinkler head comprising:

a sprinkler body having a central orifice with an inlet and an outlet, said inlet configured for attachment to a fire extinguishing fluid supply line;

a deflector movably mounted to said sprinkler body;

a sealing assembly for sealing said outlet;

a thermally sensitive trigger assembly configured to releasably urge said sealing assembly into sealing engagement with said outlet;

a housing attached to said sprinkler body and having a bottom extending beyond said outlet, said thermally sensitive trigger assembly positioned between said outlet and said bottom of said housing; and

a cover plate removably mounted to said bottom of said housing, said cover plate having a periphery, wherein at least a section of said periphery is formed with at least one passageway section configured to enable air to travel between said passageway section and said bottom of said housing and towards said thermally sensitive trigger assembly, wherein said periphery of said cover plate has a generally semi-circular arcuate edge section and a generally linear edge section, wherein said generally linear edge section defines said at least one passageway section.

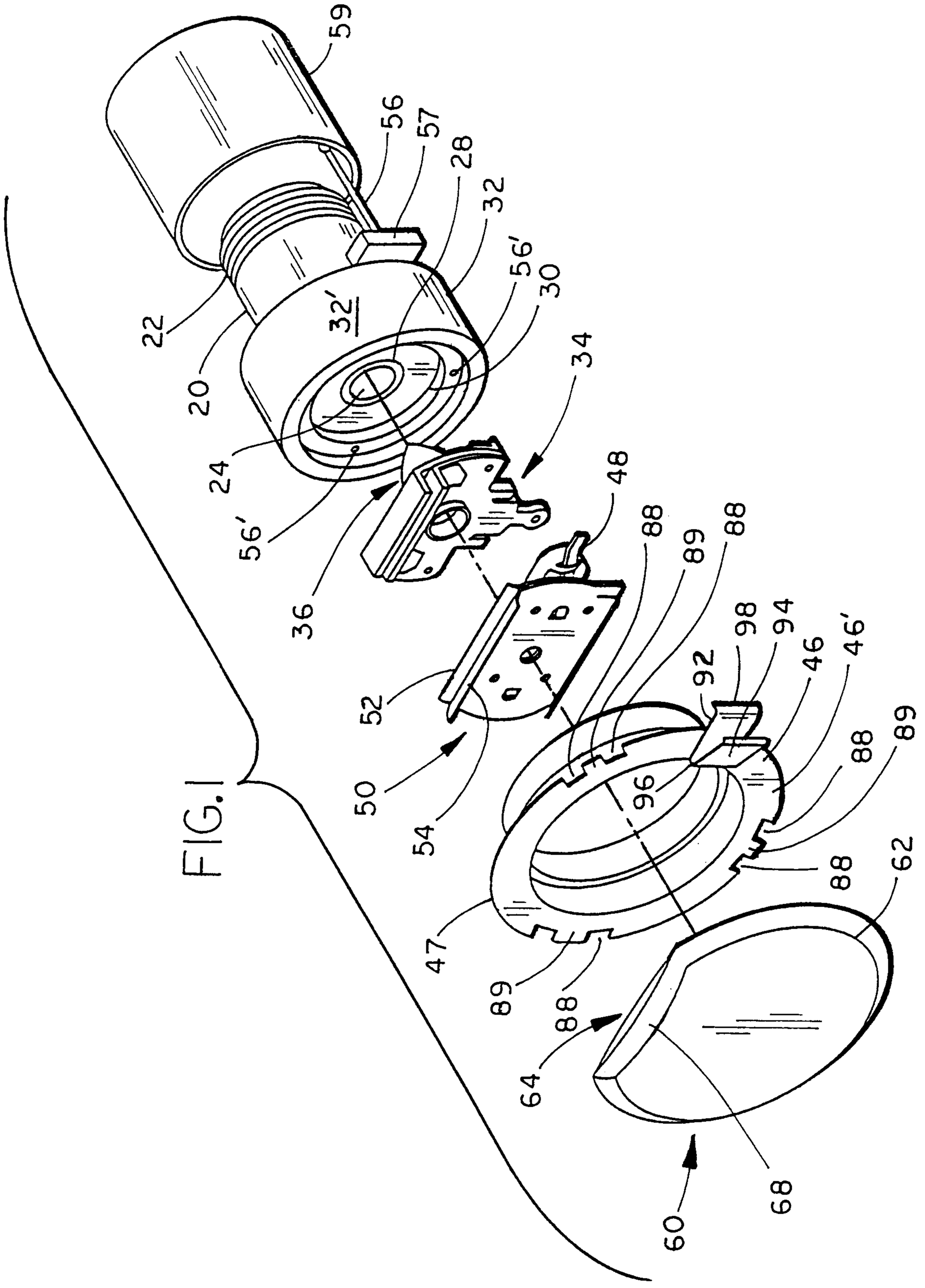

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56'
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62
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60
68

FIG. 1

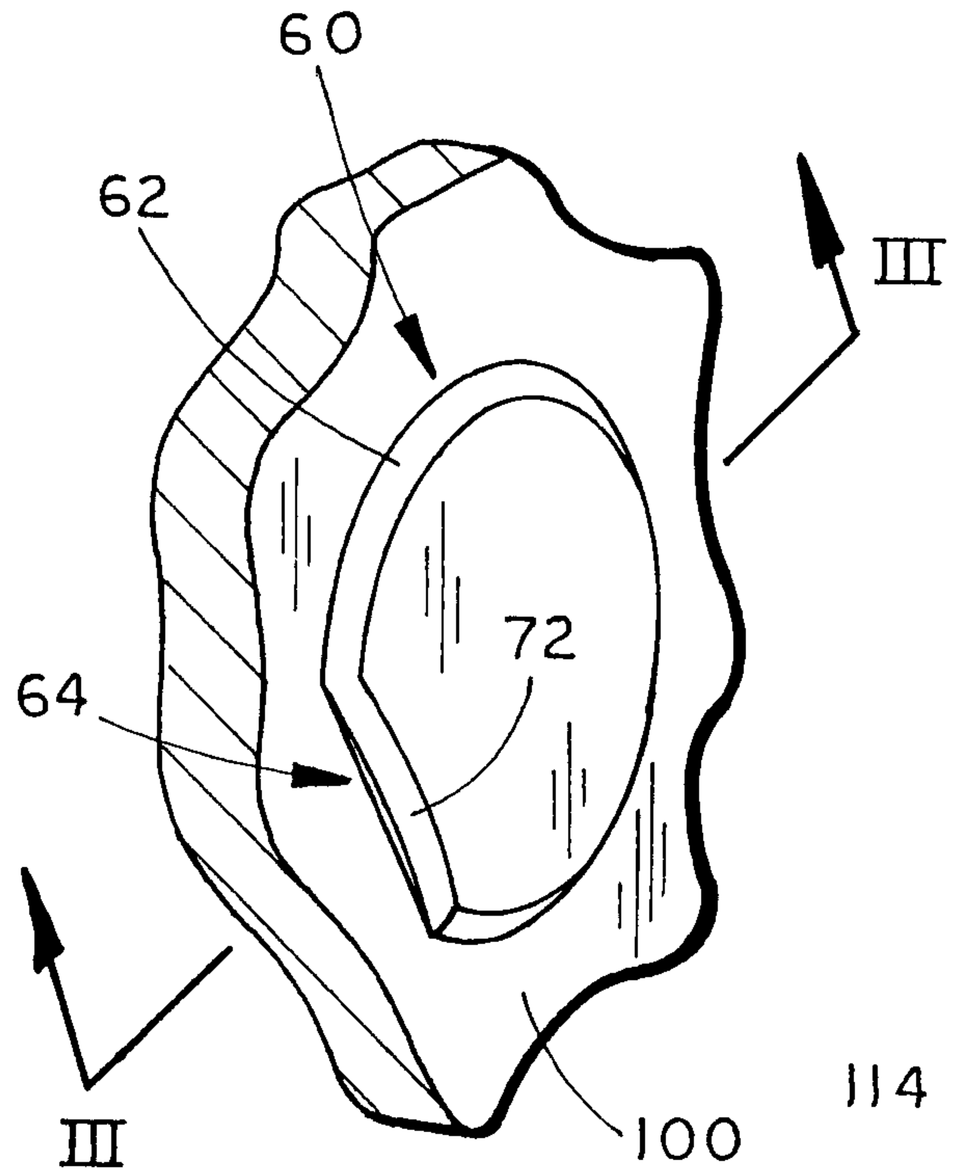


FIG.2

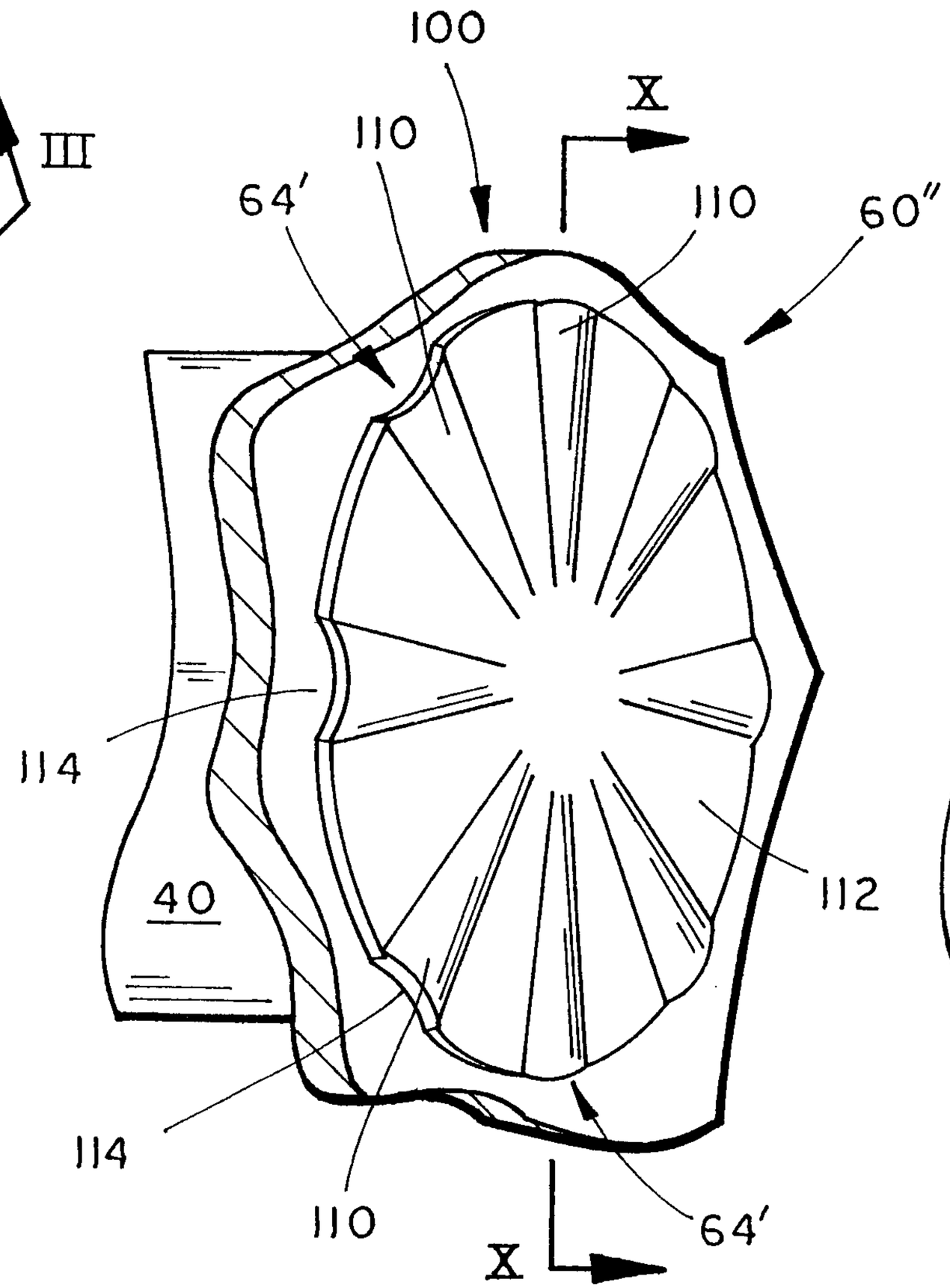


FIG.9

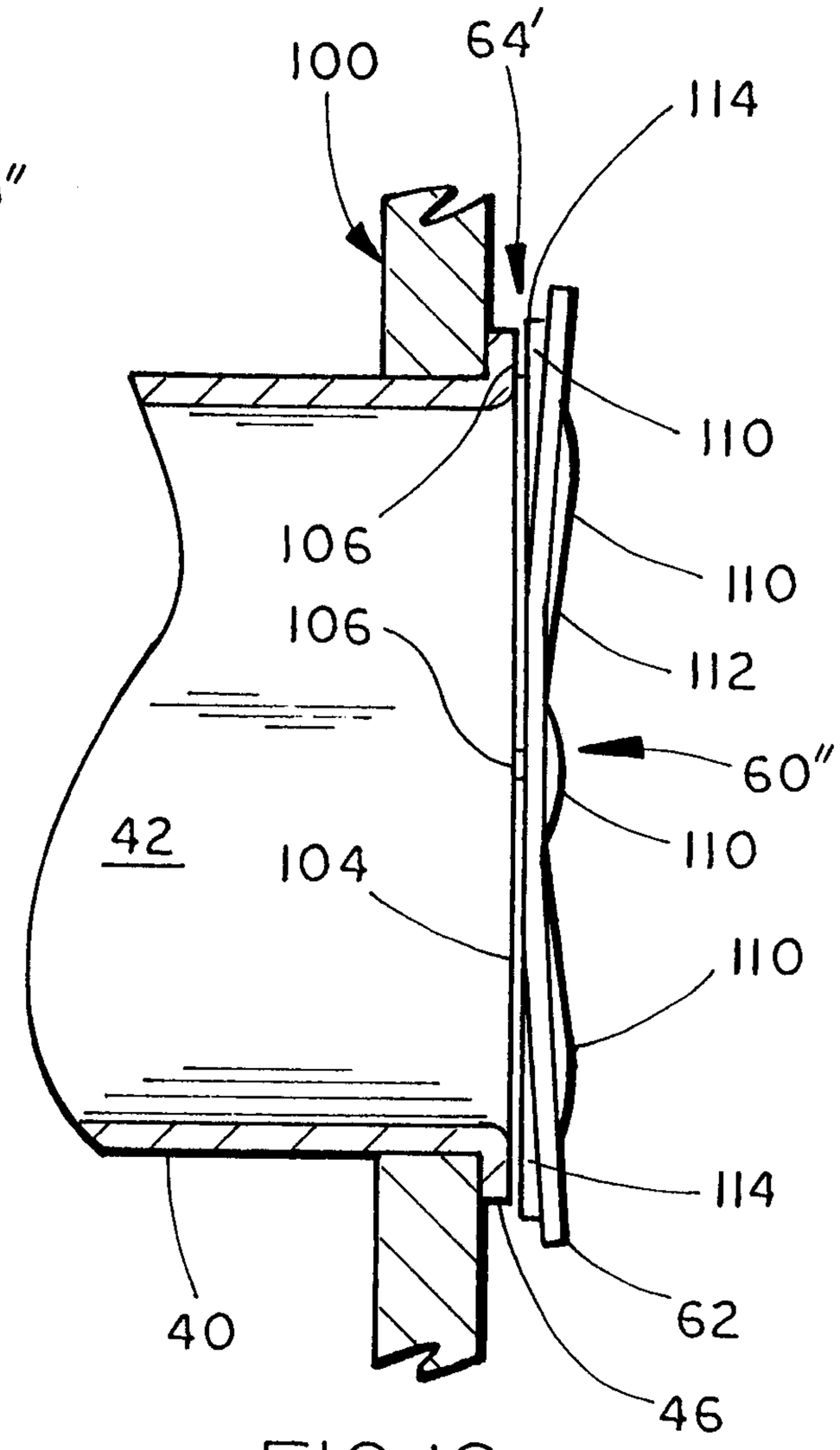


FIG.10

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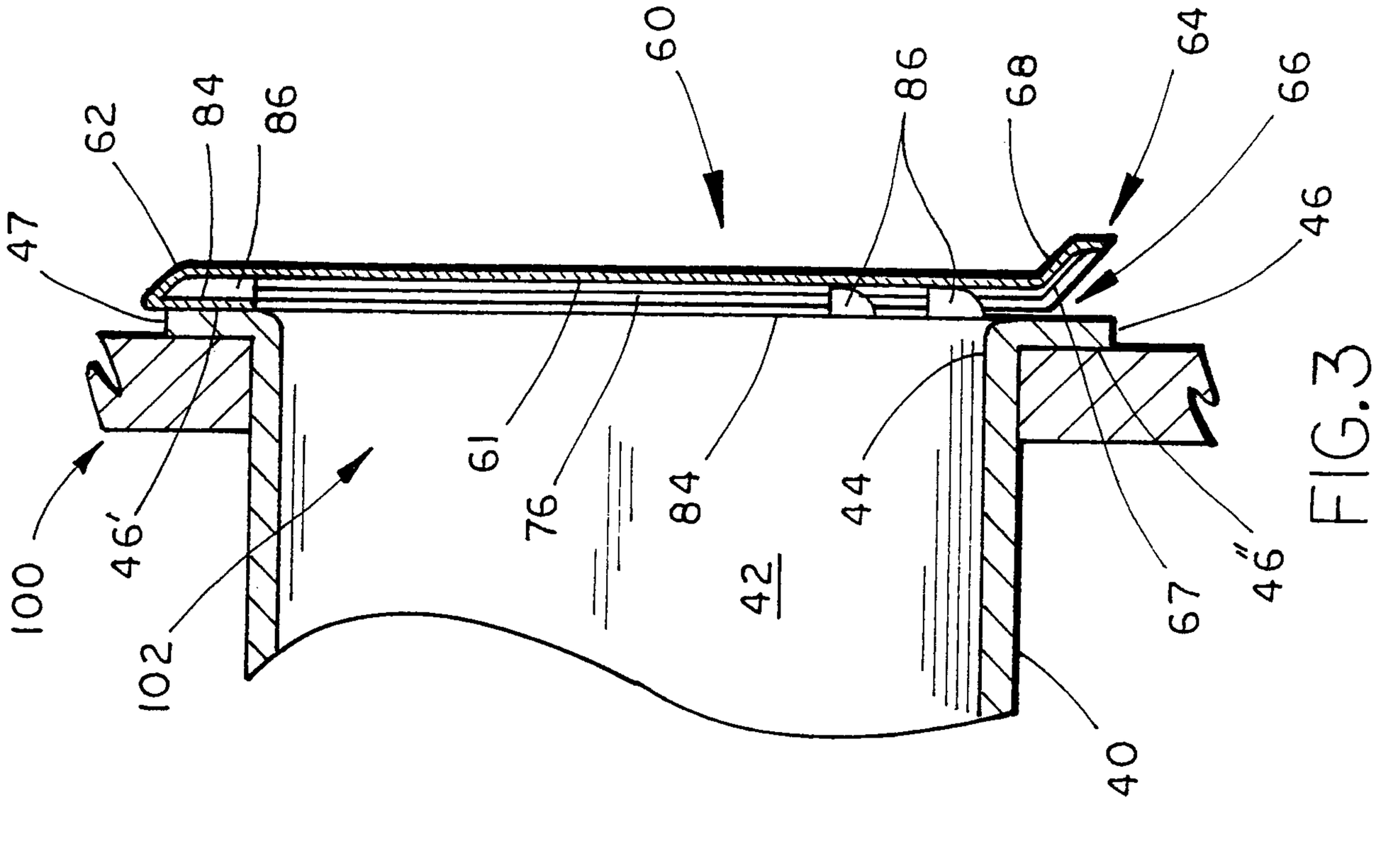

62
84
86
60
86
68
64
66
47
46
61
76
84
44
46'
46"
67
100
102
42
40

FIG.3

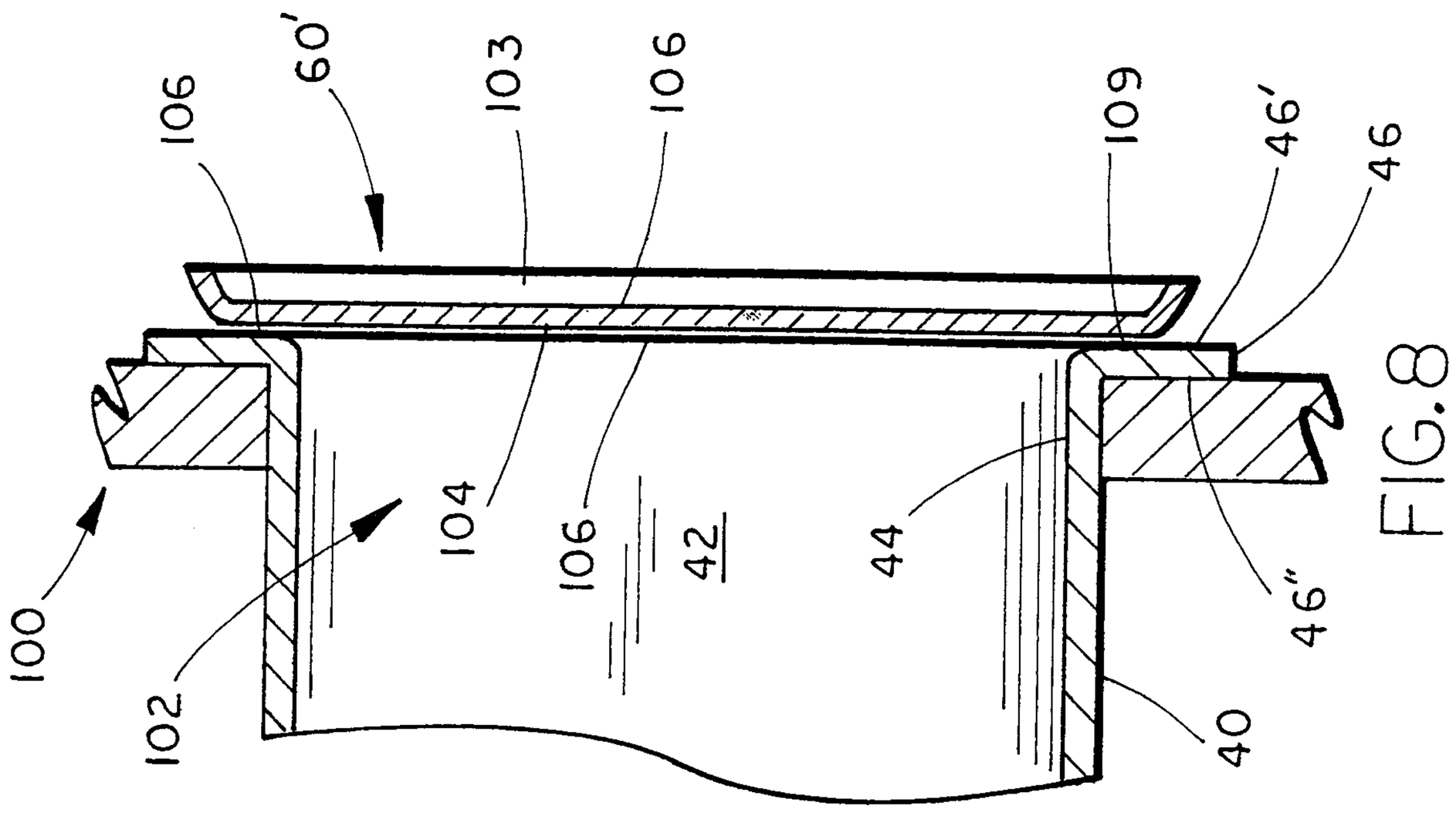

106
60'
103
106
109
46'
46
104
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44
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102
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FIG.8

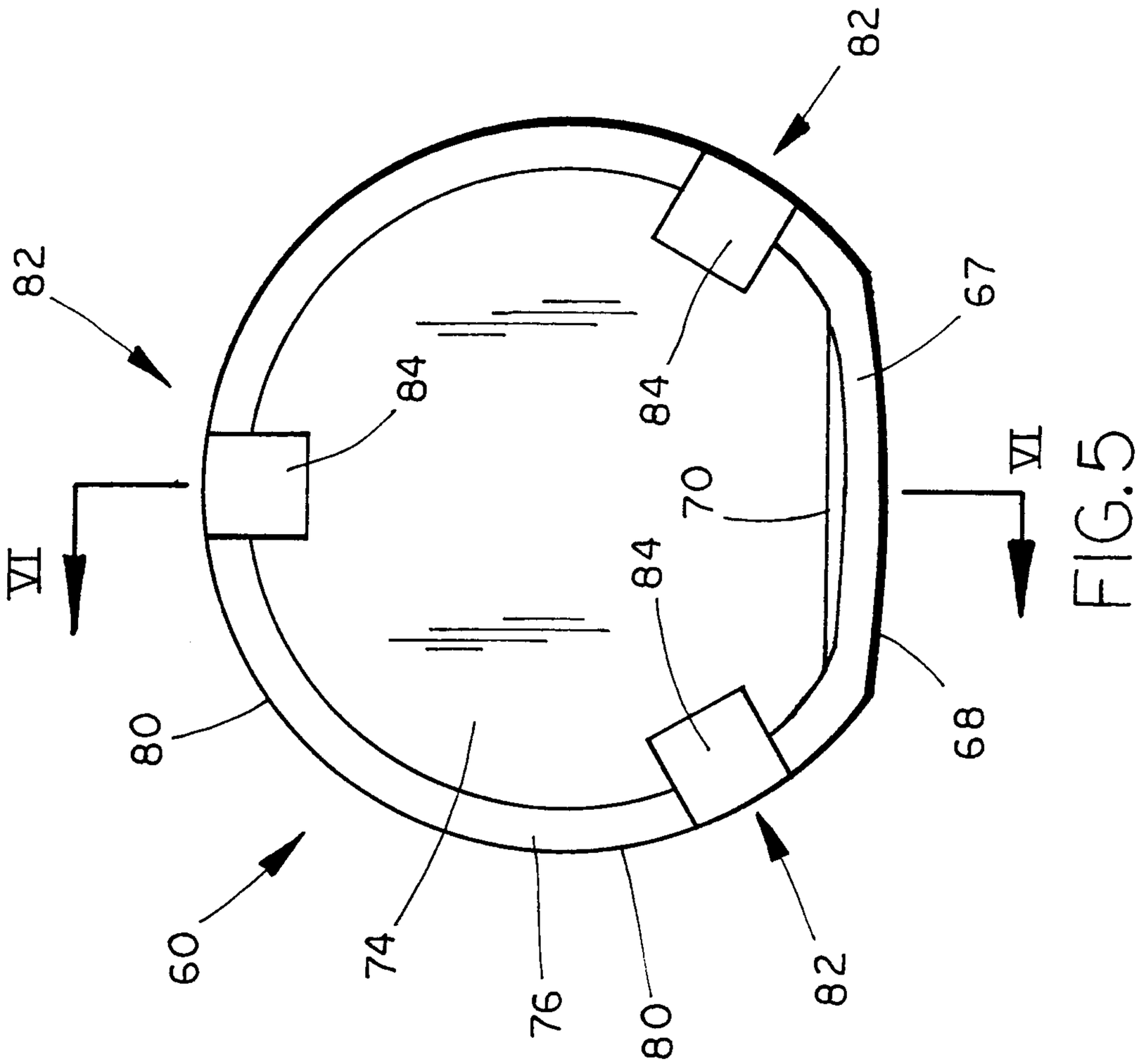


FIG.5

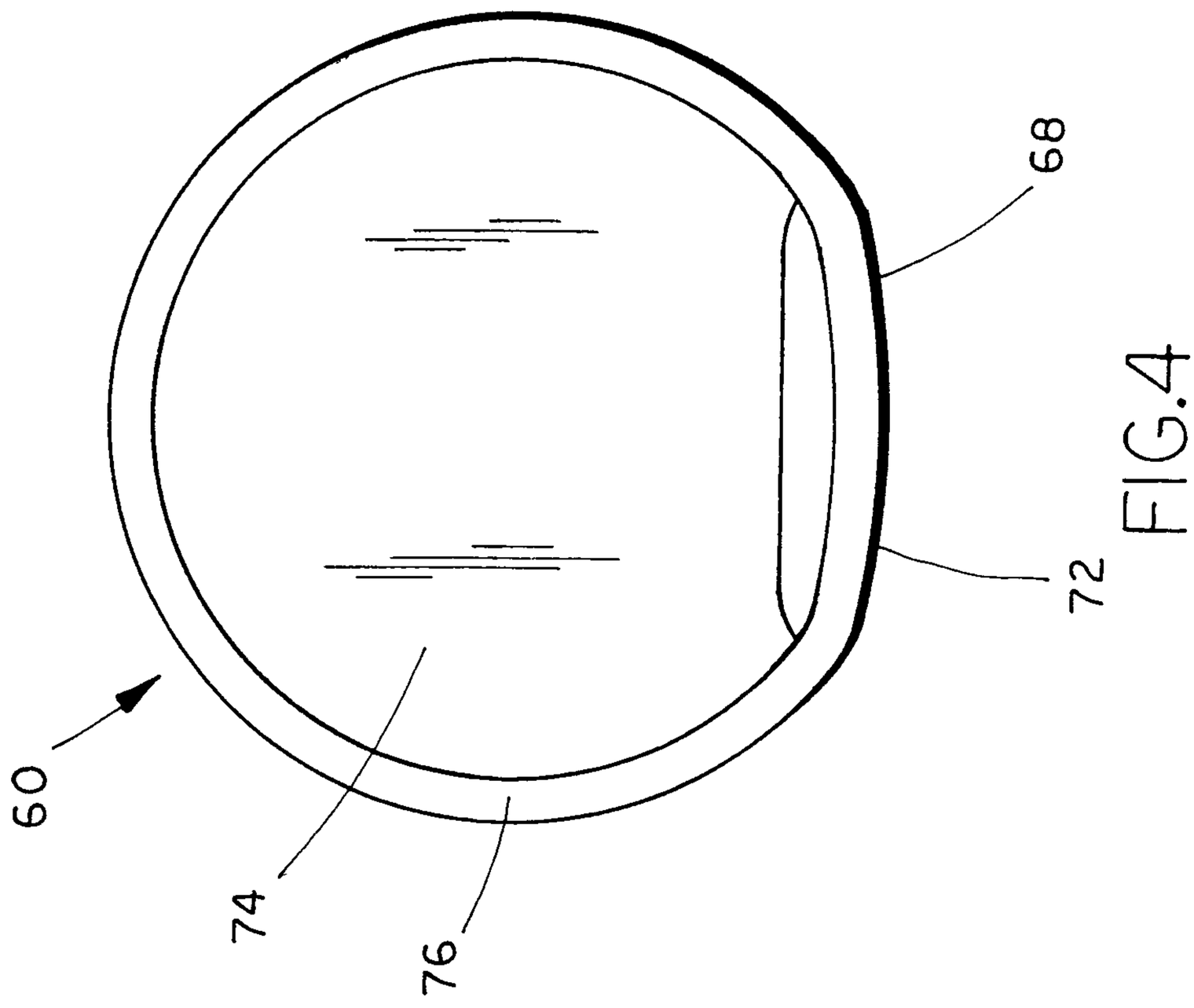


FIG.4

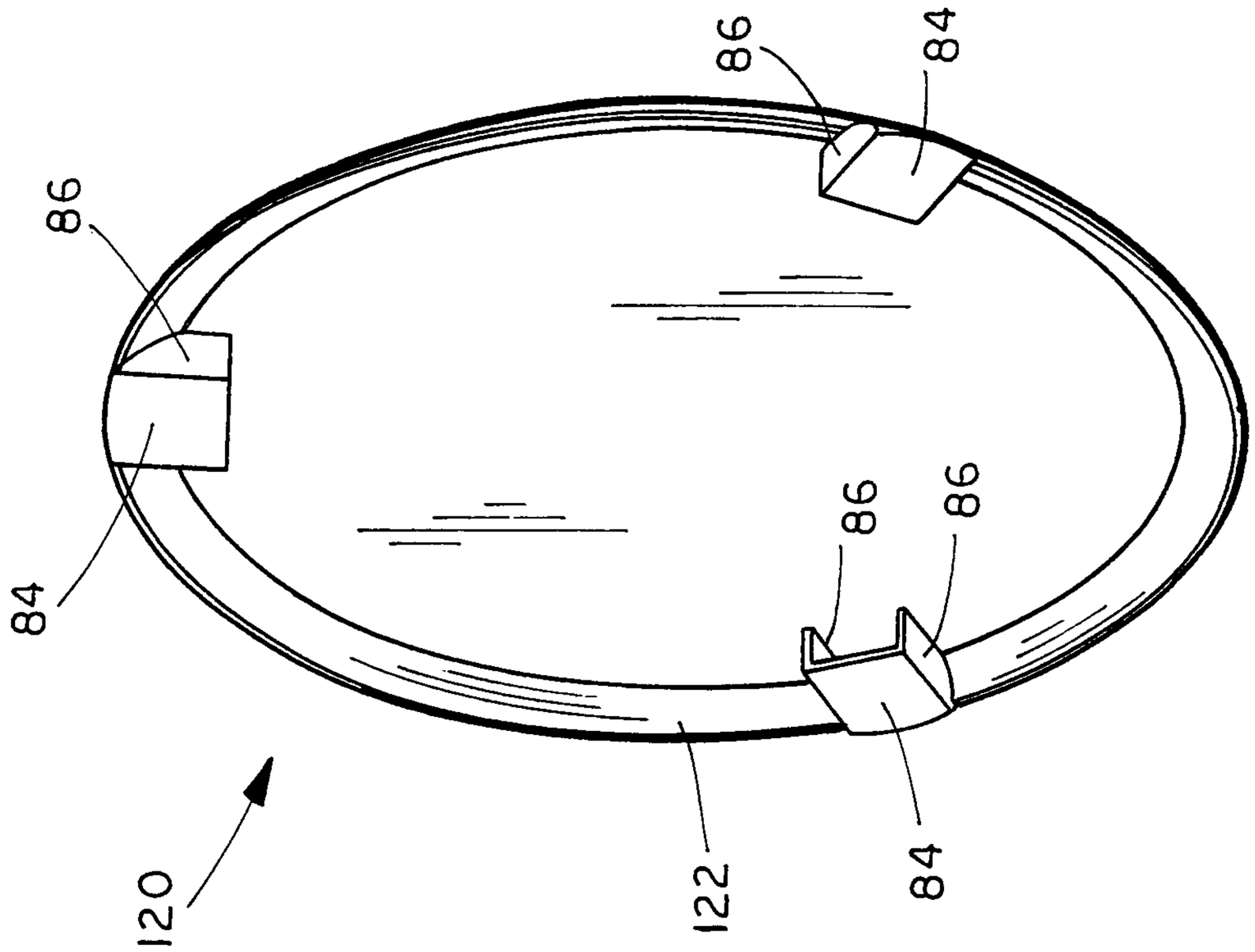


FIG.5

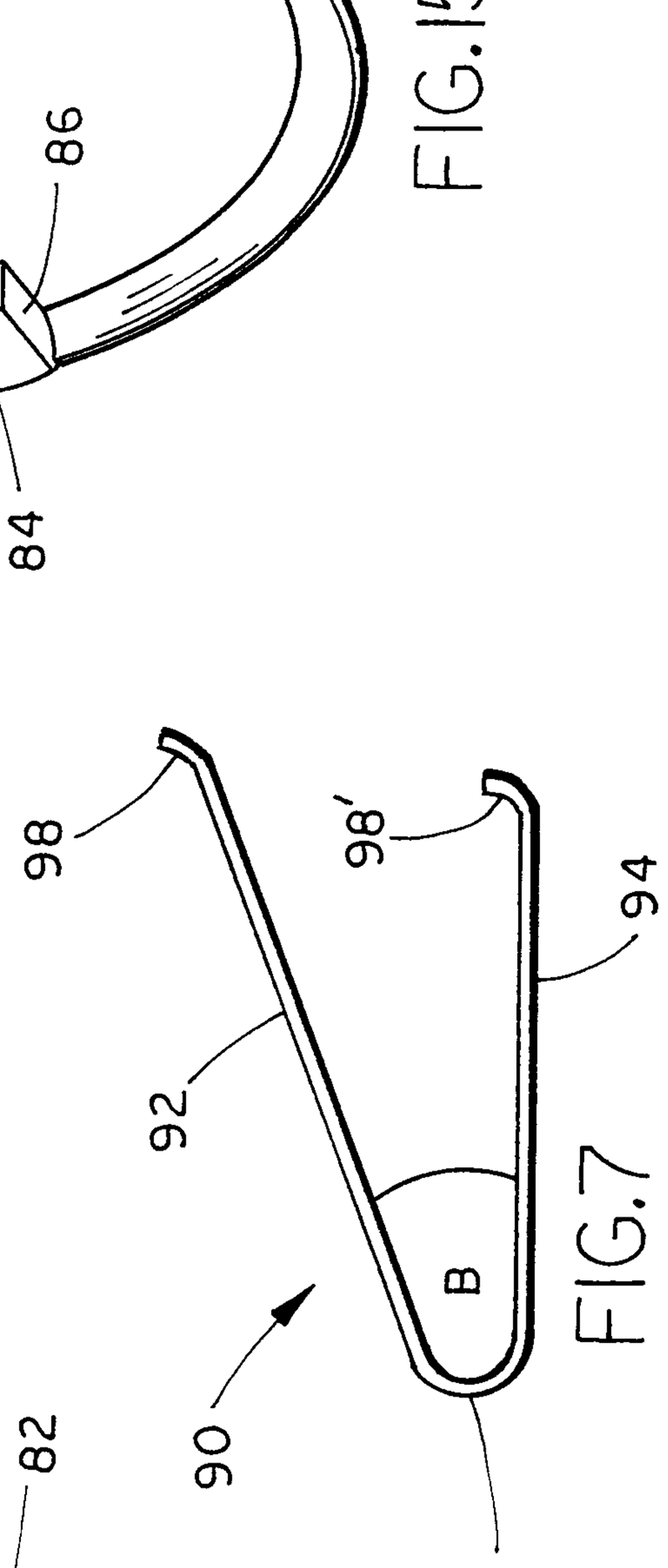


FIG.7

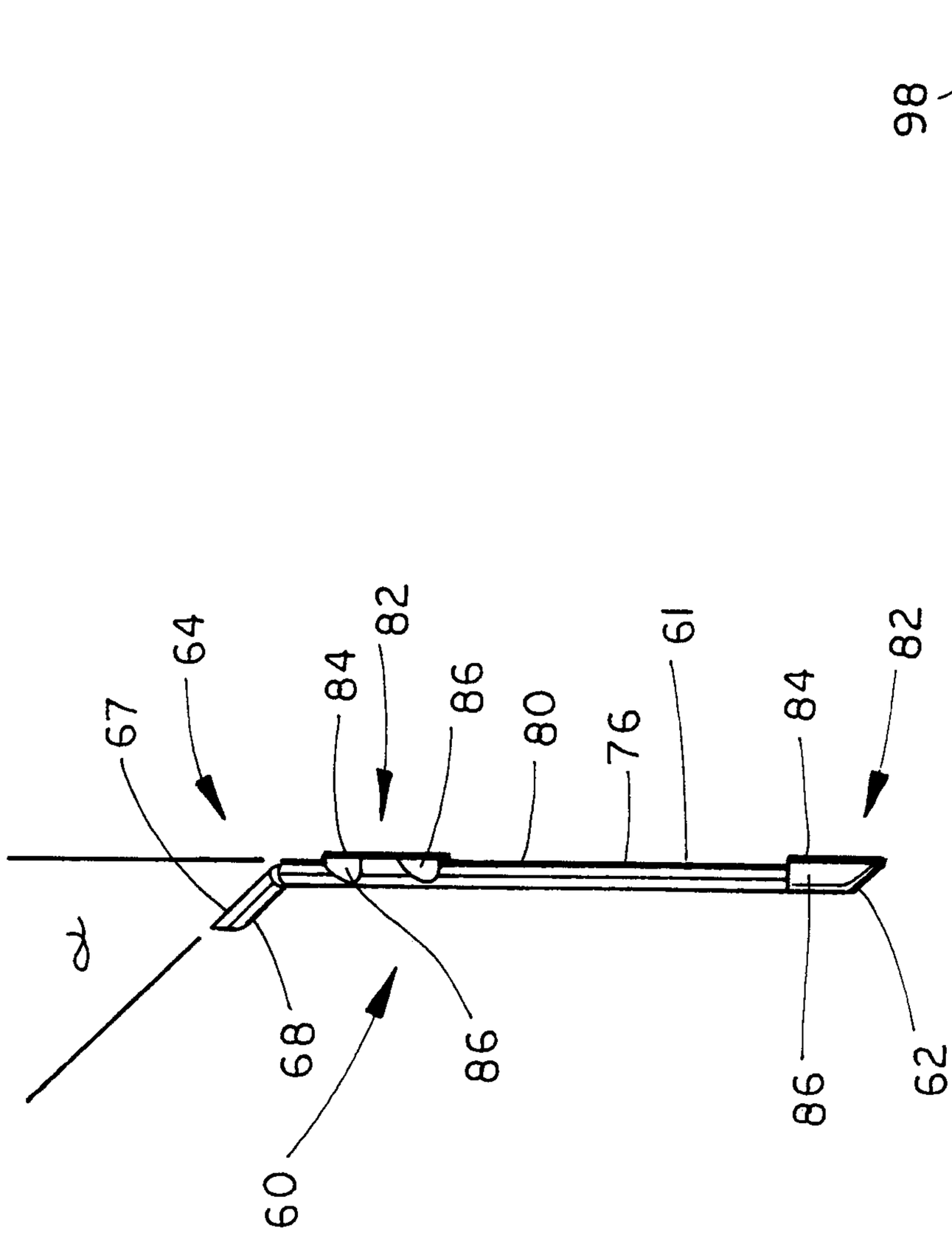


FIG.6

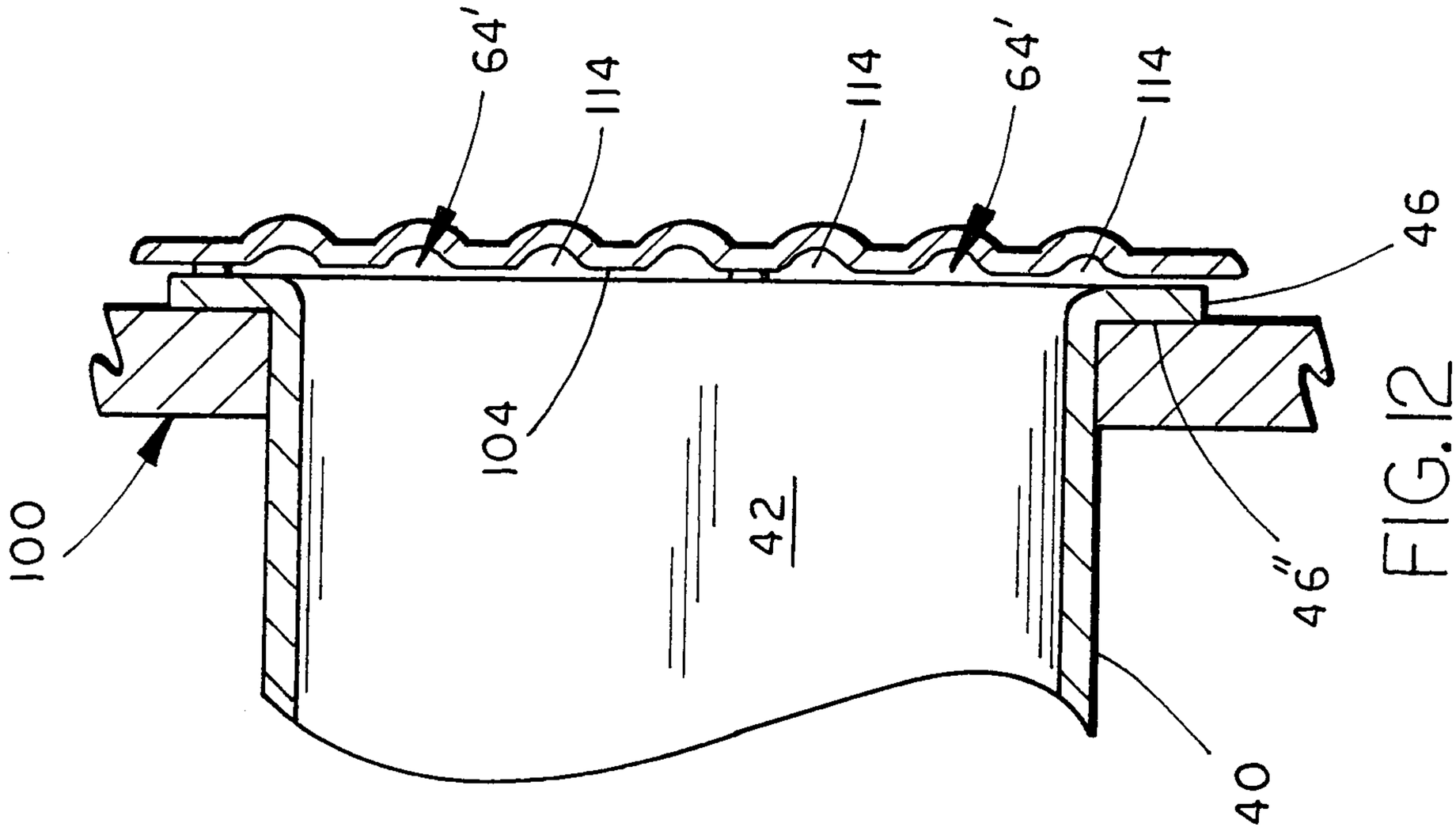


FIG. 12

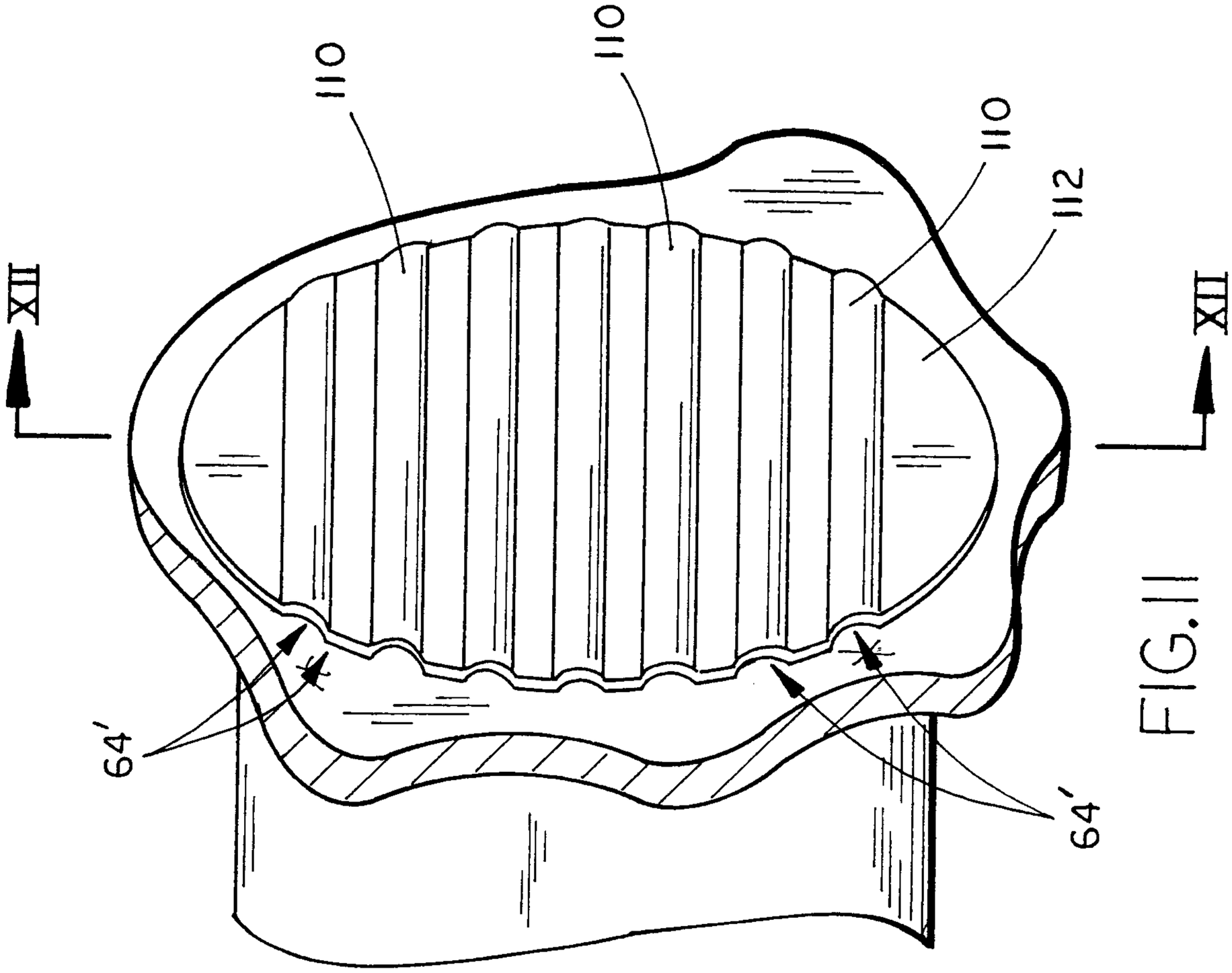


FIG. 11

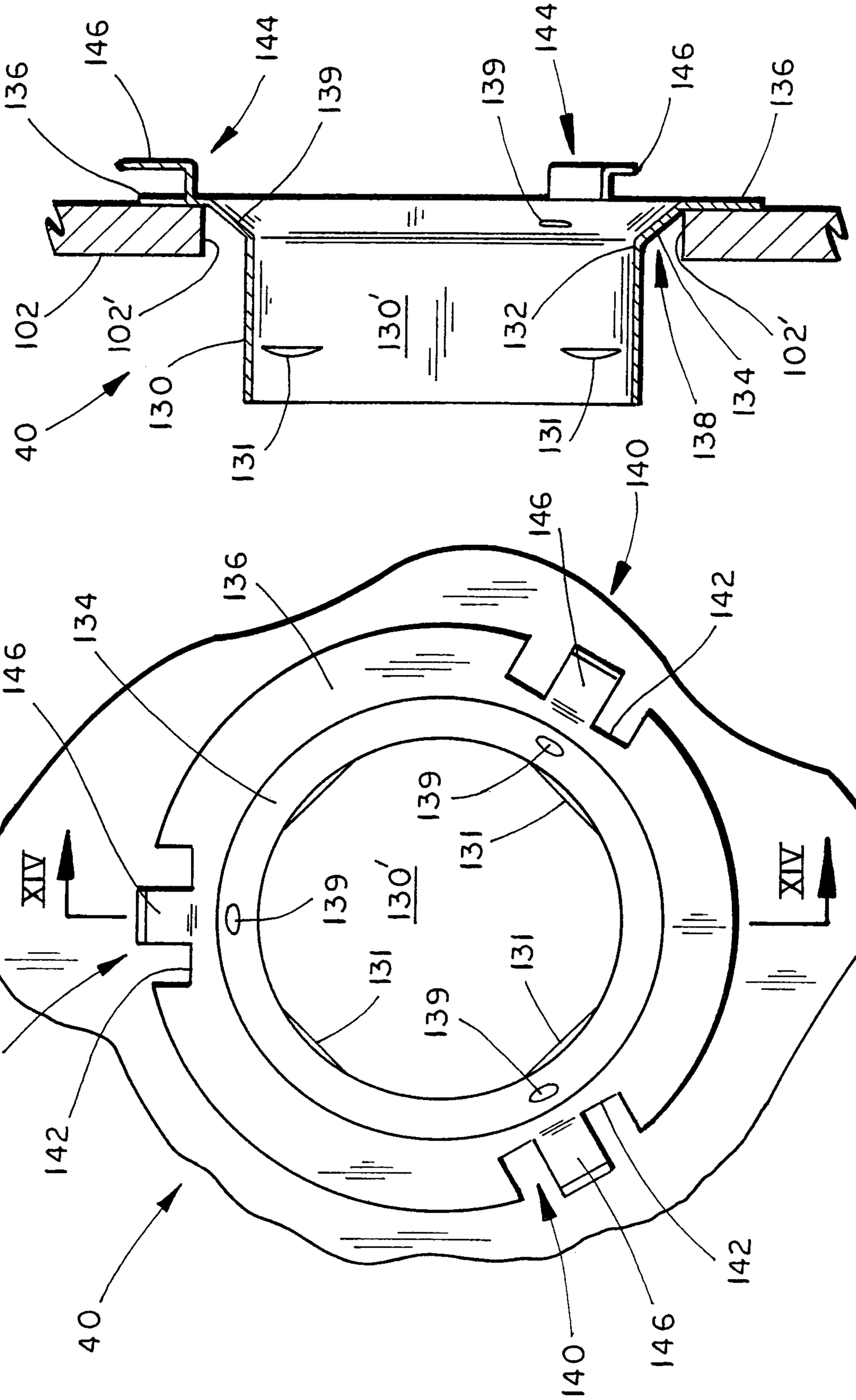

136
146
144
139
139
144
146
136
102
102'
130
130'
132
40
131
131
138
134
102'
140
146
142
XIV
XIV
140
142
146
40

FIG.14

FIG.13

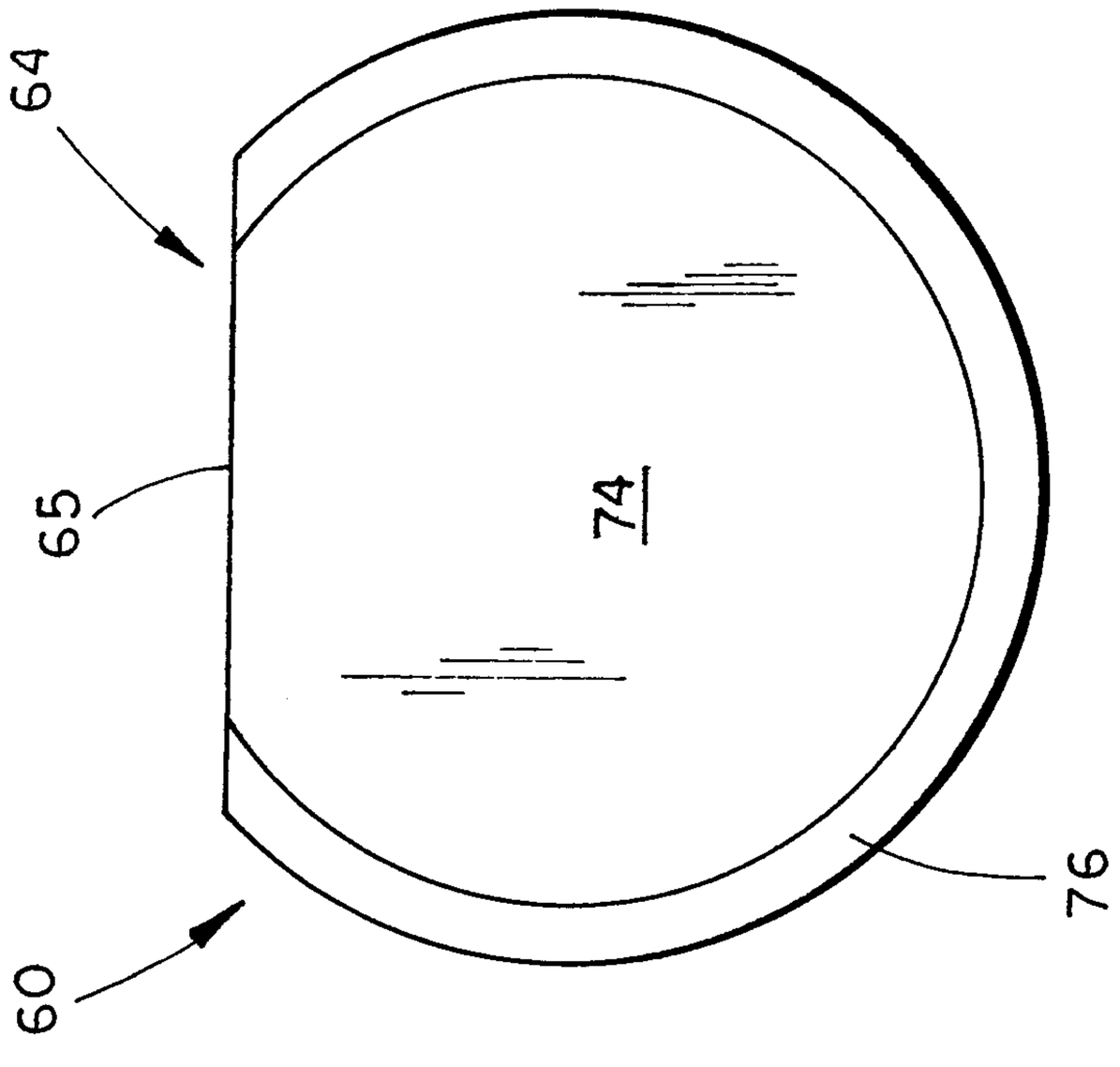


FIG.16

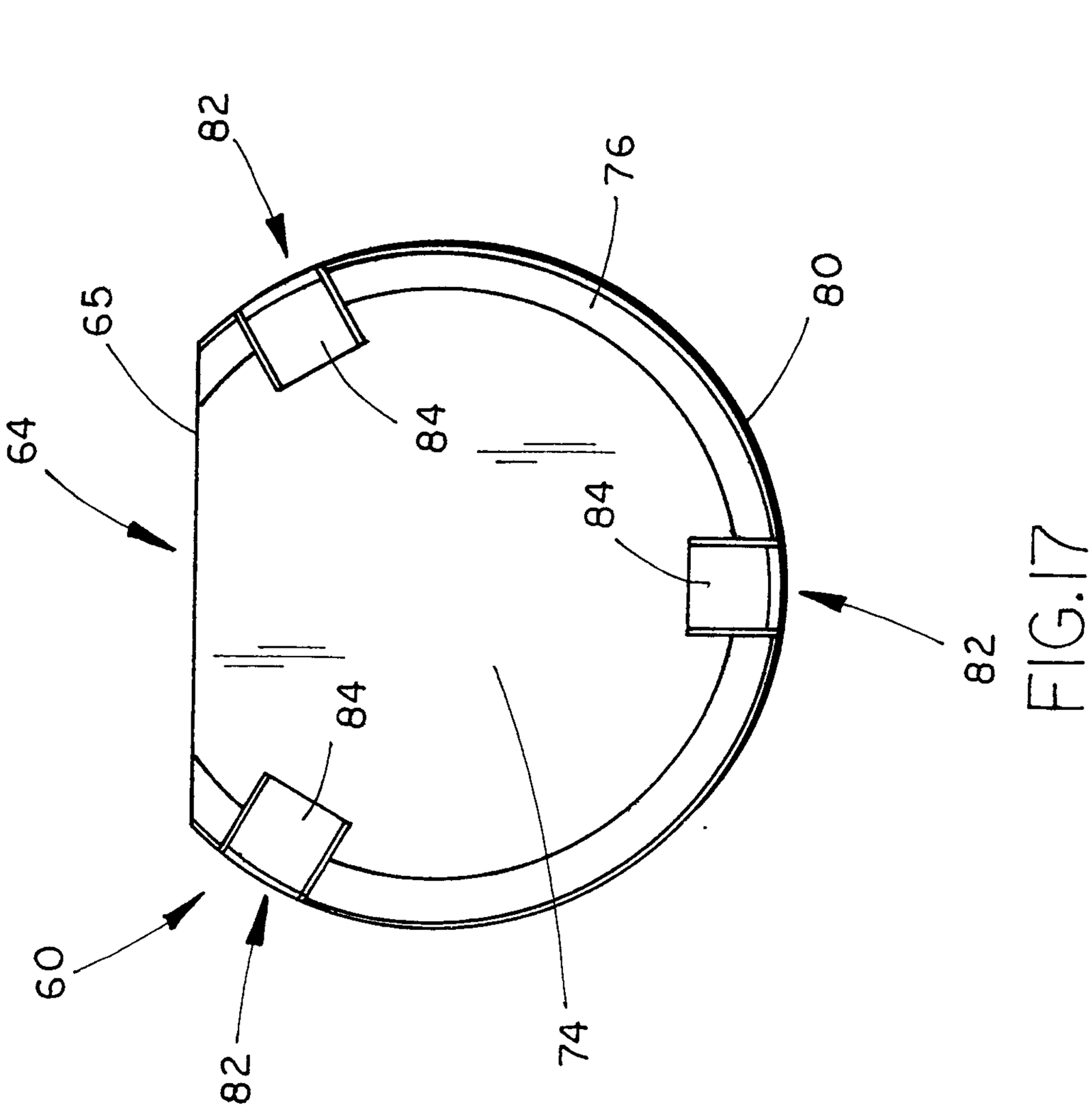


FIG.17

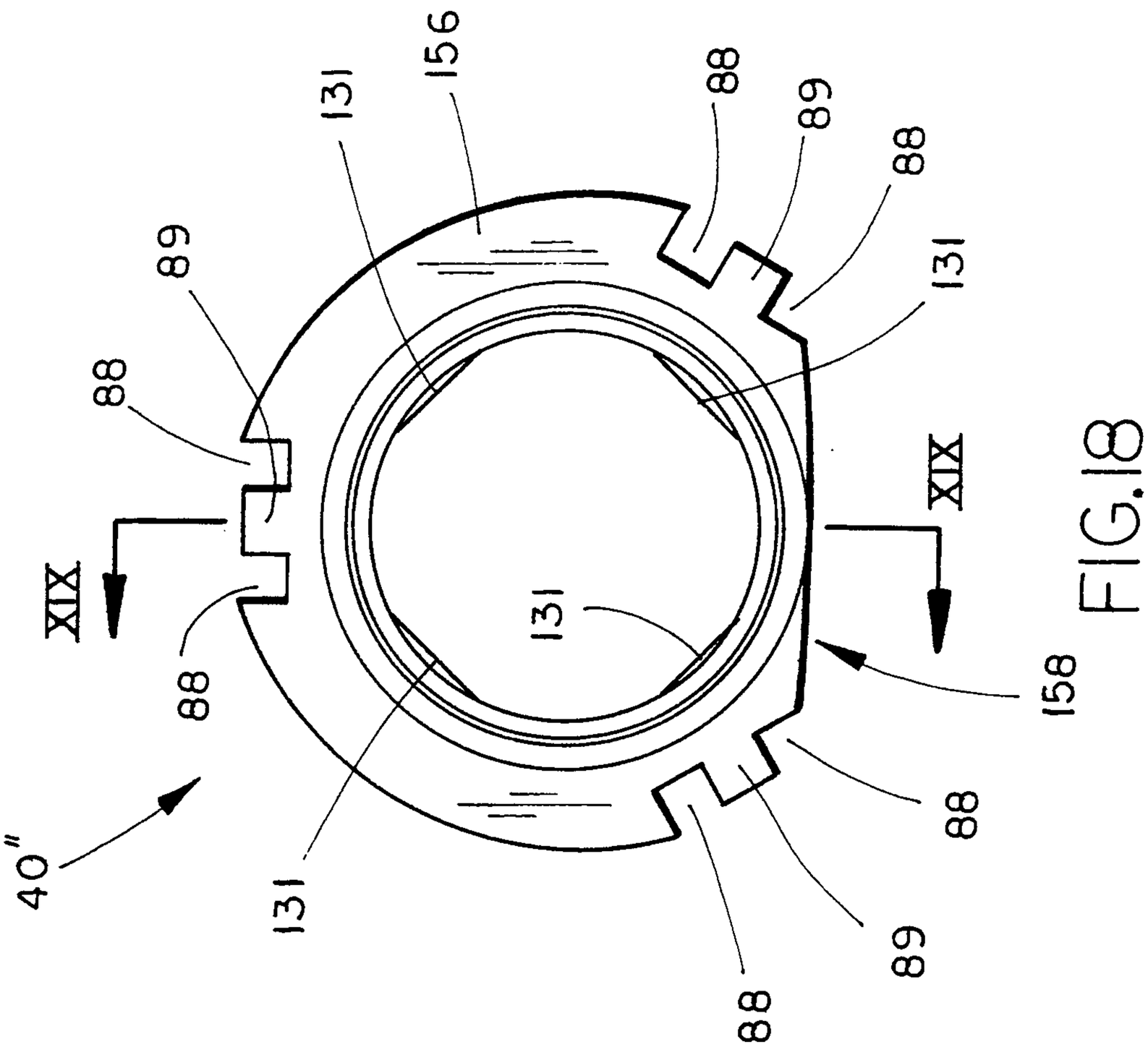

131
156
88
89
88
131
89
88
XIX
131
XIX
158
88
40"
131
88
89

FIG.18

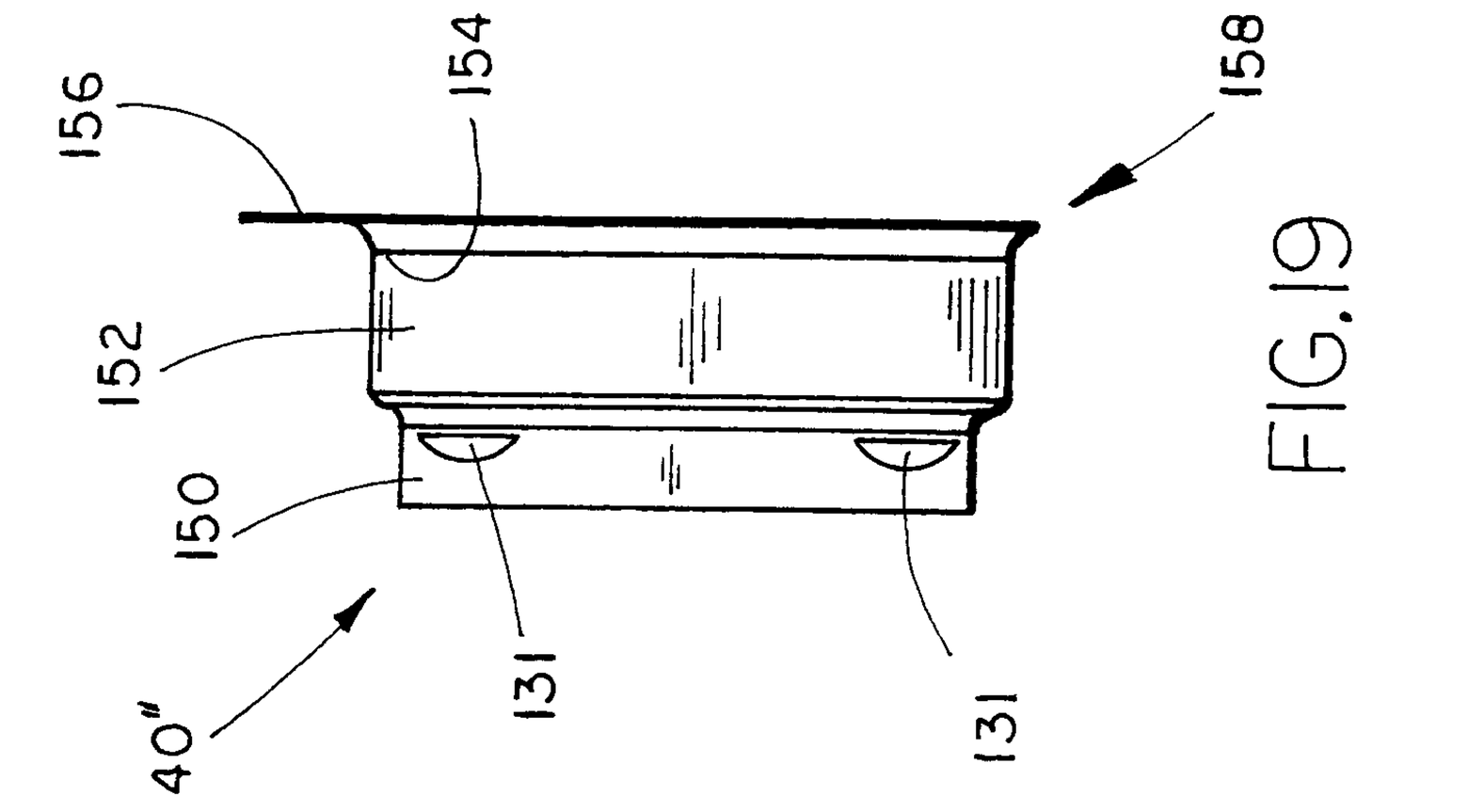
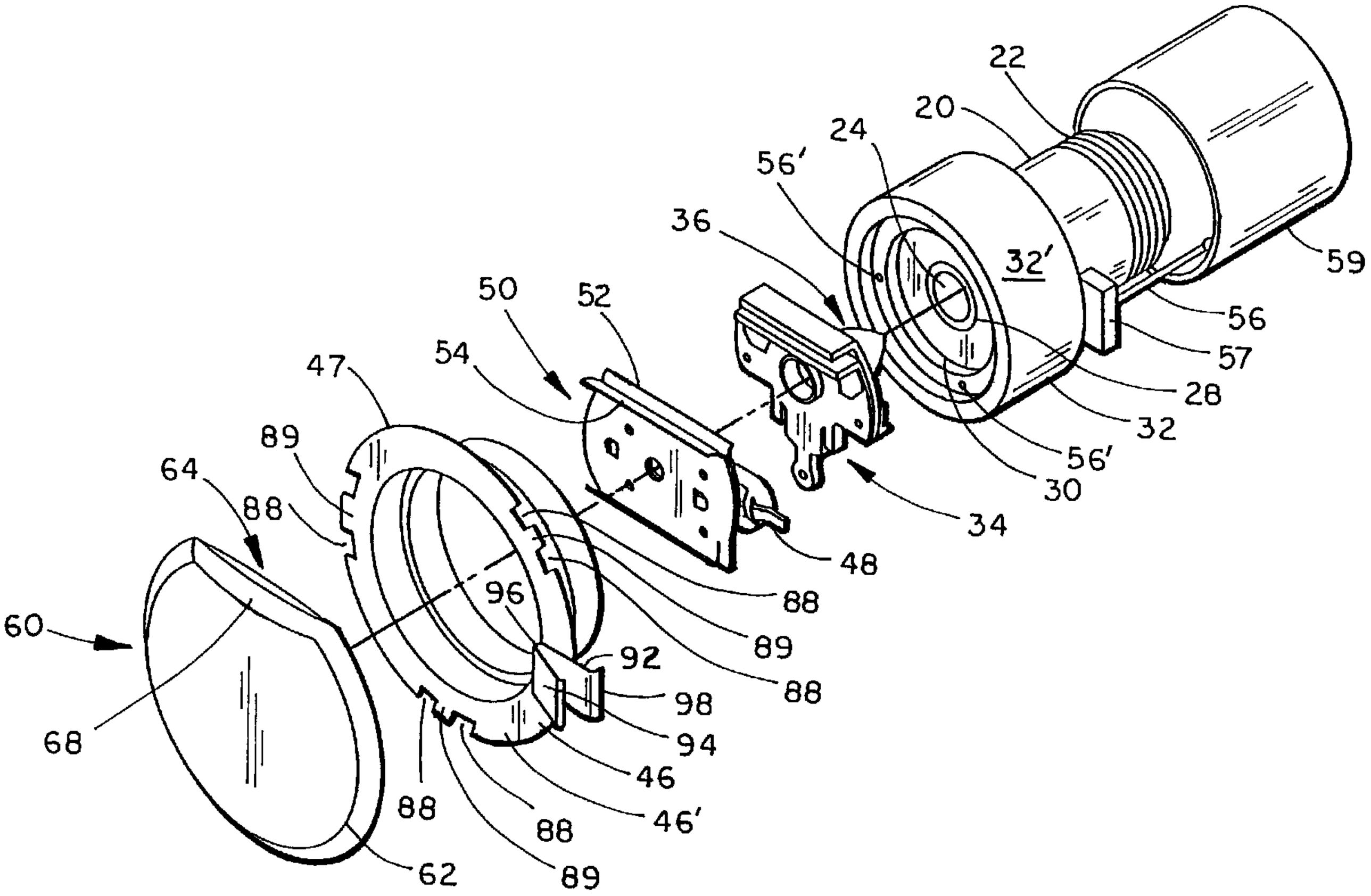

156
154
158
152
150
40"
131
131

FIG.19


22
20
24
56'
36
32'
59
50
52
56
54
57
47
28
89
32
64
56'
30
88
34
48
96
88
89
92
88
98
94
46
46'
60
88
88
68
89
62