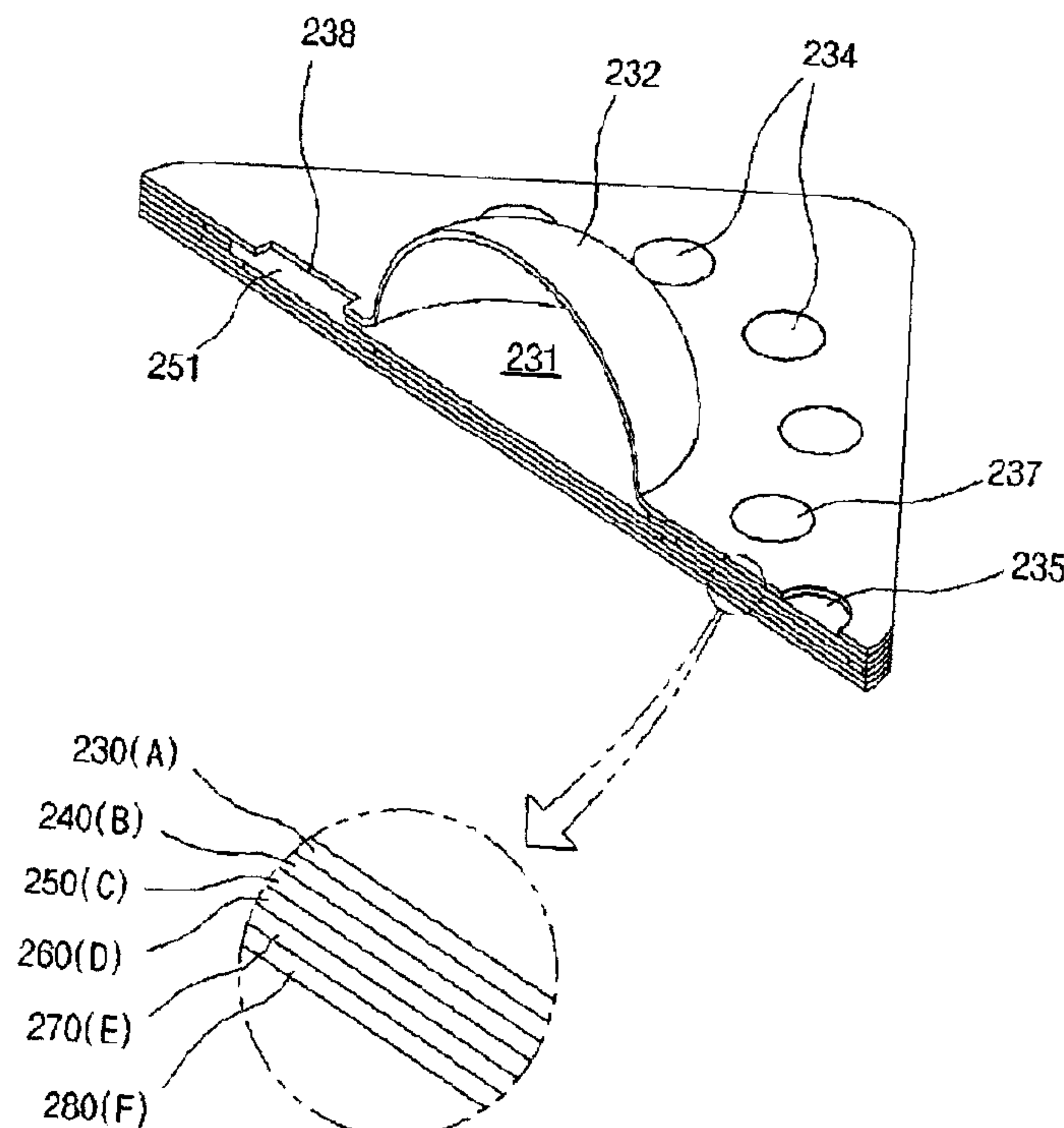




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(54) Titre : INDICATEUR DE TEMPERATURE CRITIQUE PRECIS
(54) Title: PRECISE CRITICAL TEMPERATURE INDICATOR



(57) Abrégé/Abstract:

A precise critical temperature indicator includes an upper section or layer containing a central button with an open bottom end containing a reagent, lower section carrying a developing medium or wick separated from the reagent, and a base carrying the developing material for mounting the indicator on a frozen or refrigerated product. When the product is mounted on the product, the button is pressed to release the reagent, and, when the temperature of the product reaches or exceeds a predetermined critical temperature, the reagent migrates along the developing medium to provide a visual indication that the critical temperature has been reached.



ABSTRACT

A precise critical temperature indicator includes an upper section or layer containing a central button with an open bottom end containing a reagent, lower section carrying a developing medium or wick separated from the reagent, and a base carrying the developing material for mounting the indicator on a frozen or refrigerated product. When the product is mounted on the product, the button is pressed to release the reagent, and, when the temperature of the product reaches or exceeds a predetermined critical temperature, the reagent migrates along the developing medium to provide a visual indication that the critical temperature has been reached.

PRECISE CRITICAL TEMPERATURE INDICATOR

FIELD OF INVENTION

This invention relates to a critical temperature indicator and in particular to a precise critical temperature indicator including an activating button containing a temperature sensitive developing material or reagent, a developing material member or wick forming a passage for the reagent and a developing portion of the wick which receives reagent to enable the convenient activation of the indicator using the activating button, and confirmation of the exact temperature sensing indication.

BACKGROUND OF THE INVENTION

A typical prior art critical temperature indicator was made available under the 3M trade-mark "Monitor Mark". The 3M critical temperature indicator includes a developing material layer for diffusion at or above a predetermined temperature into a wicking layer which absorbs a solvent from the developing material layer. The developing material layer is a temperature sensor layer mixed with ink and a fatty acid or paraffin, and the wicking layer is made of, e.g., absorbent paper or non-woven fiber. A barrier layer is located between the developing material layer and the wicking layer. A base layer and a double faced tape layer are connected to the bottom of the developing material layer. An indicating layer including windows is located on the wicking layer. The indicating layer above the wicking layer includes a longitudinal row of windows. A transparent cover is mounted on the indicating layer. Tabs are provided at aligned ends of the wicking layer, the indicating layer and the cover.

In use, the temperature indicator is attached to a refrigerated product using the double faced adhesive tape, the tabs are removed and the barrier layer is drawn from between the developing material layer and the wicking layer, whereby the developing material and wicking layers contact each other. Thereafter, the temperature indicator begins to operate as the
5 developing material melts, infiltrates the wicking layer and migrates length thereof to indicate the storage states of the products.

The temperature indicator is relatively large due to migration of the developing material in a longitudinal direction. Care must be taken when removing the tabs between the developing material layer and the wicking layer. It is difficult to automate the manufacturing
10 of the product. Since the developing material is stored in a state exposed to the atmosphere, it must be refrigerator or cooled for more than an hour to a temperature below the melting temperature of the fatty acid or paraffin before being use. If care is not taken and melting occurs when the indicator is exposed to normal room temperatures, some of the developing material adheres to the barrier layer when the barrier layer is removed. The developing
15 material slowly migrates as it gradually gets farther away from the starting point. Such a strip type of temperature indicator has a relative large error range of temperature indication.

Another prior art temperature indicator is described in US Patent No. 7,232,253 (US Published Application 2004/0240324, published on Dec. 2, 2004). The indicator includes a first reservoir, a migration medium and activating means for bringing liquid from the first
20 reservoir into contact with the migration medium, whereby, after activation, the liquid migrates through the migration medium producing a color change therein. Activation is achieved using a second reservoir between the first reservoir and the migration medium,

whereby, after activation, the liquid travels relatively rapidly from the first reservoir to the second reservoir and then migrates relatively slowly along the length of the migration medium over time.

The patented device can provide a visible indication of product life span, but the liquefied development material migrates to a liquid conduit and then activates in a longitudinal direction in contact with the migration medium in dual paths. Thus, it is difficult to measure the exact elapsed time. Furthermore, since a weak seal blocks the liquid conduit, the dish-shaped portion of the activation reservoir including a first storing portion must be broken in order to operate the device. However, the weak seal often ruptures due to the user carelessness, resulting in the escape of liquid therefrom, and confirmation of the exposed time to a cooling environment is difficult.

For the above described reasons, there is a need for a critical temperature indicator having an operating mechanism which enables confirmation of the product condition from delivery to the changing of the product. It is preferable that the critical temperature indicator be structurally simple, enabling mass production and easy to attach to a small frozen or refrigerated products.

SUMMARY OF THE INVENTION

An object of the invention is to provide a precise critical temperature indicator in the form of a unitary, laminated body enabling contact between an upper developing material and a lower developing medium or wick to be arbitrarily controlled and a manufacturing method therefor.

Another object of the invention is to provide a critical temperature indicator in the form of a unitary body including an activating button filled with a developing material or reagent, and a wick defining a migration passage for the reagent to enable confirmation of an exact temperature of a product and a manufacturing method therefor.

5 Yet another object of the invention is to provide a critical temperature indicator enabling contact of an activating button filled with a development material with a wicking member separate therefrom to be arbitrarily controlled, and a manufacturing method therefor.

Another object of the invention is to provide a structurally simple critical temperature indicator, which can be automatically mass produced and which can be stored at normal room
10 temperatures, enabling convenient handling thereof.

According to one aspect, the critical temperature indicator comprises a precise critical temperature indicator comprising an upper section including a planar body, a deformable button with an open bottom end extending upwardly from the center of said body; a solid reagent which melts at a predetermined critical temperature in said button; a window in said
15 body spaced apart from said button; a frangible seal closing the bottom end of the button; a base having the same dimensions as said body and connected to the planar body at a location external to said window; a wick on the base including a central seat beneath the button and an arm extending outwardly from and around the seat, and a soluble dye or pigment on the arm, whereby, when the indicator is mounted on a frozen or refrigerated product and the button is
20 depressed, the seal is broken and the reagent moves to the seat, and, when the temperature of the product reaches the critical temperature, the reagent melts and migrates with the dye or

pigment to the other end of the wick and provides an indication visible through said window that the temperature of the product is at or above the critical temperature.

The method of manufacturing the critical temperature indicator comprises the steps of preparing an upper sheet of a plurality of developing material members including a domed activating button on a single sheet, and forming first and second compartments and a passage into the activating button with developing material; mounting a lower sheet including a plurality of developing medium members or wicks on a base; and applying a synthetic ink such as a polyester ink to first and second print layers to form a developing material contacting portion and a developing material migration path.

Another embodiment of the invention is a precise critical temperature indicator comprises a precise critical temperature indicator comprising an upper section including a planar body, a deformable button with an open bottom end extending upwardly from the center of said button, a liquid reagent containing a pigment in said button, a migration passage for the reagent extending diametrically from the button, an inner annular first compartment spaced apart from and in fluid communication with the button, an outer annular second compartment parallel to and spaced apart from the first compartment, at least one indicator window in said body between said second compartment and an outer side edge of the body, a seal between the inner and outer compartments; a development medium layer beneath said upper section including a migration passage for the liquid reagent extending radially outwardly from said outer compartment and around the planar body to a location beneath said indicator window; and a base for mounting the indicator on a frozen or refrigerated product.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded, perspective view of a prior art critical temperature indicator;

FIG. 2 is a perspective view of the main elements of a temperature indicator according to one embodiment of the invention;

5 FIG. 3 is an exploded, perspective view of the main elements of the temperature indicator of FIG. 2;

FIG. 4 is a perspective views of an assembled critical temperature indicator according to an embodiment of the invention;

FIG. 5 is an exploded, perspective view of the indicator of FIG. 4;

10 FIGS. 6 and 7 are cross-sectional views of a critical temperature indicator including a housing;

FIG. 8 is a cross section of a critical temperature indicator mounted on the cover of a medicine bottle;

15 FIGS. 9, 10 and 11 are exploded, perspective views of elements of a critical temperature indicator according to another embodiment of the invention;

FIGS. 12 and 13 are partly sectioned, perspective views of elements of a critical temperature indicator according to another embodiment of the invention;

FIGS. 14, 15 and 16 are perspective views of elements of a critical temperature indicator according to another embodiment of the invention;

20

FIG. 17 is a perspective view illustrating elements used in the manufacture of a large number of critical temperature indicators;

FIG. 18 is a partly sectioned, perspective view of a critical temperature indicator according to another embodiment of the invention;

5 FIG. 19 is a series of top views of elements of a critical temperature indicator, according to another embodiment of the invention;

FIG. 20 is a series of top and side views of a critical temperature indicator illustrating operation thereof according to another embodiment of the invention;

10 FIG. 21 is a perspective view of a critical temperature indicator according to another embodiment of the invention;

FIG. 22 is a cross-sectional view of a critical temperature indicator according to another embodiment of the invention; and,

FIG. 23 is a cross-sectional view of a critical temperature indicator according to another embodiment of the invention.

15 As shown in Fig. 1 and described hereinbefore, the 3M critical temperature indicator 10 includes a developing material layer 11 for diffusion at or above a predetermined temperature into a wicking layer 12 which absorbs a solvent from the developing material layer 11. The developing material layer 11 is a temperature sensor layer mixed with ink and a fatty acid or paraffin, and the wicking layer 12 is made of, e.g., absorbent paper or non-woven
20 fiber. A barrier layer 13 is located between the developing material layer 11 and the wicking layer 12. A base layer 14 and a double faced tape layer 15 are connected to the bottom of the

developing material layer 11. An indicating layer 16 including windows is located on the wicking layer 12. The indicating layer 16 includes a longitudinal row of windows 16'. A transparent cover 17 is mounted on the indicating layer 16. Tabs 18 are provided at aligned ends of the wicking layer 12, the indicating layer 16 and the cover 17.

5 In use, the temperature indicator 10 is attached to a refrigerated product using the double faced adhesive tape 15, the tabs 18 are removed and the barrier layer 13 is drawn from between the developing material layer 11 and the wicking layer 12, whereby the developing material and wicking layers contact each other. Thereafter, the temperature indicator 10 begins to operate as the developing material 11 melts, infiltrates the wicking layer 12 and
10 migrates the length thereof to indicate the temperature of the product.

DETAILED DESCRIPTION OF THE INVENTION

With reference to Figs. 2 and 3, one embodiment of the precise critical temperature indicator includes a sensor 20. The sensor 20 includes a unitary body or housing defined by an upper section 21 and a base 33 made of a transparent plastic of the blister pack type or a
15 vinyl film.

The upper section 21 includes a cylindrical lower portion 24 and a smaller diameter upper cylindrical portion 25. An annular plate 22 is spaced apart from the bottom of the lower portion leaving a gap 23. A small web 26 connects the plate 22 to the lower portion 24.

A container 41 formed of a plastic such as a blister pack plastic is located in the upper
20 cylindrical portion 25 of the upper section 21. The container 41 is filled with developing material or reagent 42 such a fatty acid ester or silicon oil which melts at a critical

temperature. The container 41 is sealed by a bottom seal 43 made of a frangible material such as silver foil, which breaks when the developing material 42 is pressed downward by the upper cylindrical portion 25 or by an activating button 55 (Figs. 5 to 8). An annular support 44 for the container 41 and the seal 43 is located beneath the container. An annular opaque top indicator plate 51 (Fig. 5) with windows 53 is mounted on the sensor 20, and a mounting plate 52 formed of double faced adhesive tape is attached to the base 33 of the indicator.

A developing medium or wick 47 is located on the base 33 beneath the container 41. The wick 47 is made of an absorbent paper or a non-woven fiber. The wick 47 is in the shape of a flat spiral including a circular central seat 46 for positioning the wick in the base 33. A flat spiral arm 45 extends outwardly from one side of the seat 46. The flat spiral arm 45 is defined by partial concentric circles or polygons. The top or bottom surface of the arm 45 is impregnated with a dye or pigment which migrates along the arm when the dye is dissolved by the developing medium.

The base 33 is made of the same plastic as the upper section 21. The base 33 includes a flat spiral recess defined by a circular central portion 35 having an area similar to or equal to that of the lower cylindrical portion 24 of the upper section 21, a generally C-shaped area 36 extends around the central area 35 with a gap 34 therebetween and a gap 37 connecting the area 36 to the central area 35. The gaps 3 and 23 permit a flange 72 (Fig. 8) on a cap 71 to be passed through the indicator, as described in detail below.

As shown in Figs. 4 and 5, a precise critical temperature indicator 50 is assembly as a one-piece body. The indicator 50 includes the opaque top plate 51 on the sensor 20 and the mounting plate 52 on the bottom of the base 33. The plate 51 includes at least one window 53

defined by a hole near the outer edge thereof. The plate 51 may be defined by an opaque paint applied to the plate 22 of upper section, leaving an unpainted area defining the window 53.

After attaching it to a frozen or refrigerated product (not shown); the indicator 50 is operated by pressing the cylindrical portion 25 downwardly to break the seal 43 and thereby deposit the reagent 42 into the hollow center of the support 44. Thus, the reagent 42 is deposited on the seat 46 of the wick 47. When the temperature of the reagent 42 is above a critical temperature, the melted liquid migrates along the arm 45 of the wick 47. The dye on the wick 47 is dissolved and also migrates along the wick arm 45. The location of the dye on the arm 45 is indicative of the time elapsed since the temperature exceeded the critical temperature. After a predetermined elapsed time, the dye appears in the first indicator window 53 (Fig. 5) indicating the current state of the product.

Another embodiment of the invention, shown in Figs. 6 and 7 is an indicator 60 including a temperature sensor 20 mounted in an opaque, rigid plastic housing defined by a cap 61 and a baseplate 62. An activating button 55 is mounted in and extends through a central hole 64 in the cap 61. The button 55 rests on the top of a temperature sensor 20. The button 55 includes a bottom flange 56 for centering the cap in the housing. The cap 62 has an open bottom end for receiving the temperature sensor 20 and the baseplate 62. An indicating window 63 is provided near the peripheral side edge of the top of the cap 61.

The embodiment 70 of the invention shown in Fig. 8 includes a temperature sensor 20 in a cap 71 for mounting on the cover 76 for a container such an injection medicine bottle or a medicine vial. For such purpose, the cap 71 includes flanges 72 extending outwardly from the bottom of a cylindrical body. The flanges 72 extend into holes 75 in the cover 76 and are bent

to connect the cap 71 to the cover 76. The cylindrical side wall of the cap 71 extends downwardly beyond the top of the cover 76. An indicator window 73 is provided at a predetermined location in the top of the cap 71. The activating button 55 extends upwardly into a hole 74 in the center of the cap 71.

5 The embodiment of the indicator shown in Figs. 9 to 11 is a laminated indicator assembly including an upper layer 130 made of a transparent blister pack plastic or a vinyl film and a developing medium layer 150 including a lower portion through which a developing material or reagent migrates.

10 The upper layer 130 includes a cylindrical activating button 131 with a hemispherical top end and annular, inner and outer compartments 132 and 133 of two different diameters spaced apart from and concentric with the activating button 131. Radially extending passages 135 connect the activating button 131 to the inner compartment 132, the outer compartment 133 and an indicator window 136 located in the upper layer between the outer compartment and the outer edge of the upper layer. The activating button 131 and the inner compartment 15 132 and the passages 135 are filled with a reagent or developing material. Semi-annular webs 137 extend between the bottoms of the passages 135 between the button 131 and the inner compartment 132. The webs 137 are connected to a developing medium or wick 151 on a developing medium or wicking layer 150 using heat, an ultrasonic wave or adhesive.

20 The developing medium layer 150 includes the developing medium 151 and a baseplate 152 connected to the upper layer 130 for protecting the developing medium 151. The developing medium 151 is designed to contact the button 131, the first compartment 132 and a circular developing material contact area 155 including a passage described below. An inner

print layer 154 defines a boundary between the inner and outer compartments 132 and 133 adjacent to the outer edge of the developing material contact area or seat 155, and the webs 137 are connected to the inner compartments 132. The second developing material contact area 153 includes developing material migration passages 156 defined by concentric circles separated by an inner print layer 157 as shown in Figs 9 and 11. The inside of the outer print layer 157 is connected to the outer edge of the outer compartment 133, and the outside of the layer 157 is connected to the bottom of the developing material layer 130.

The inner and outer print layers 154 and 157 are made of a polyester ink, silicon ink, urethane ink, PVC ink, nylon ink or an epoxy ink. The print layers 154 and 157 can be replaced with a silica coated sheet or a filter paper cut in a predetermined pattern. The developing material or reagent can be a fatty acid oil, paraffin or silicon oil in which soluble pigments are dissolved.

Figs. 12 and 13 show an indicator 120 including a developing material layer 130 connected to a developing layer or base 150. The layer 130 includes an activating button 131, radially extending migration passages 135 and an inner compartment 132 filled with a developing material or reagent 140. The bottom of an annular trough between the inner and outer compartments 132 and 133 is attached to an inner print layer 154 (Figs. 9 - 11) and the outer compartment 133 is empty. The outer periphery of the outer compartment 133 is attached to the outer print layer 157. The webs 137 and the annular outer planar area 134 of the housing are attached to the base using e.g., heat, an ultrasonic wave or adhesive.

As best shown in Figs. 13 and 14, the indicator is operated by pressing the button 131 which causes the release of the area between the inner and outer compartments 132 and 133

from the base 150. The developing material 140 migrates into and fills the second compartment 133. The material 140 migrates along the larger annular passage 156 to an area beneath the indicator window 136. The area of the print layer beneath the window changes color after a predetermined elapsed time. As shown in Fig. 15, a plurality of windows 136 may
5 be provided in an area outside of the passage 133 on the annular outer area 134 to enable migration of the developing material 140 to be confirmed. As shown in Fig. 16, a plurality of spaced apart indicator windows 136 define an arc on the area 134 enable confirmation of the migration of the reagent 140.

As shown in Fig. 17, temperature indicators are manufactured as follows:

10 a sheet of a plurality of developing material members is prepared using a single sheet of a plastic material such as blister pack material. A developing material or reagent 140 is loaded into activating buttons, inner compartments and passages on the developing material member. Another sheet is attached to the developing material sheet. First and second print layers are printed using a synthetic ink such as a polyester ink to form a reagent contact portion and a
15 reagent migration passage. A developing medium member 150 is positioned on the member 130 and the two members are connected using heat, ultrasonic waves or an adhesive. Finally, the individual indicators are separated.

Referring to Figs. 18 and 19, another embodiment of the invention includes a unitary
20 body including a developing material member 230(A). The top developing material member 230(A) is made of a plastic such as polyethylene or PVC includes a central hemispherical activating button 232 containing a reagent 231. A plurality of indicator windows 233 and 234

define arcs (Fig. 19) spaced apart from and around the activating button 232. The left and right windows 233 and 234 permit temperature indication to be developed in two directions.

An adhesive layer 240(B) attaches a barrier layer 250(C) to the bottom of the developing material layer 230(A). The barrier layer 250(C) is made of PE, polypropylene (PP), polyolefin or aluminum. The adhesive layer 240(B) is not applied to areas beneath the activator button 232 and a speed adjustment window 251 in the barrier layer 250(C). Thus, the adhesive layer has a migration passage 241 (Fig. 19) between the developing material layer 230(A) and the barrier layer 250(C).

The developing medium layer 260(D) is made of a microporous film and includes an annular passage 261 (Fig. 19) beneath the speed adjustment window 251, and a final developing region 262 at an end of the developing passage 261 diametrically opposed to the speed adjustment window 251. The barrier layer member 250(C) is heat-pressed to the developing material layer 230(A).

The indicator also includes a print layer 270(E). The print layer 270(E) includes a red area aligned with the speed adjustment window 251, a blue indicator area to the left and right beneath the indicator windows 233 and 234, a yellow color on both sides of the indicator window 235 at the final developing area 262, and a red indicator window beneath the developing area 262. The print member 270(E) may be formed as a separate layer or on a base layer 280(F).

As illustrated in Fig. 20, the indicator is attached to frozen or refrigerated product (step 1). When the activating button 232 is pressed, the developing material 231 migrates along the passage 241 and through the speed adjustment window 251 to the indicator window 238

indicating the beginning of an operation (step 2). The developing material 231 is then applied to the developing passage 261 opposite the area 262 and migrates in both directions to start the developing thereof (step 3). The developing material 231 continues to be developed causing the left and right indicator windows 233 and 234 to turn blue (steps 3 and 4). Then the indicator windows 236 and 237 turn yellow (step 5) to warn the user and finally turn red, indicating that the temperature of the frozen or refrigerated product is at the danger level. Thus, the indicator provides temperature indications from the beginning to the final step.

A method of manufacturing the indicator includes the steps of preparing a base sheet including a plurality of base layers 280(F), a print sheet including a plurality of print layers 270, a developing medium sheet made of a microporous film with a plurality of developing medium layers 260(D) with development passages 261 and a barrier sheet including a plurality of barrier layers 250(C) with speed adjustment windows 251, heat-connecting the sheets to form the development passage 261 and to combine the layers in a single sheet; applying an adhesive to all portions of the combined sheets except for an inner circular area and indicator windows of the developing passage 261 on a plurality of barrier layers 250(C); and heat-depositing a sheet including a plurality of the developing material members 230 to receive the developing material 231 on the adhesive layer.

The embodiment of the invention shown in Figs. 21 and 22 includes a unitary, laminated body. The indicator 220 is similar to the first embodiment of the invention except for a developing material top layer 230. The layer 230 includes a central hemispherical activating button 232 filled with a developing material 231 and a plurality of indicator windows. The windows include left windows 233, a warning indication window 237, right

indicator windows 234, another warning indicator window 236 and a danger indicator window 235, enabling temperature indication to be developed in two directions. A migration passage 231a extends from the button 232 to a buffer compartment 239 for receiving the developing material 231 and for absorbing shock due to pressing of the activating button 232. It is
5 preferable that the activating button 232 contains developing material or reagent 231 mixed with an ink and a soluble pigment.

As shown in Fig. 23, when the button 232 is pressed, reagent passes through the migration passage 231a to the buffer compartment 239. The buffer compartment 239 absorbs some shock caused by the button pressing. The migration passage 231a includes a weak area
10 having a relative small contact between the activating button 232 and the buffer compartment 239.

Another embodiment of the method of manufacturing includes the steps of preparing a base sheet including a plurality of bases 280(F), a print sheet including a plurality of print layers 270(E) for temperature indication, a developing medium sheet including a plurality of
15 developing medium layers including developing passages (Fig. 19) made of a microporous film, a barrier member sheet including a plurality of barrier layers 250(C) containing speed adjustment windows 251; combining the sheets to form a unitary structure using heat; applying adhesive to all portions except for the inner circular portions of the developing passages 261 and indication windows on the boundary layers and heat-depositing a top sheet including a
20 plurality of developing material layers 230(A) having hemispherical buttons 232 for receiving the developing material 231.

CLAIMS:

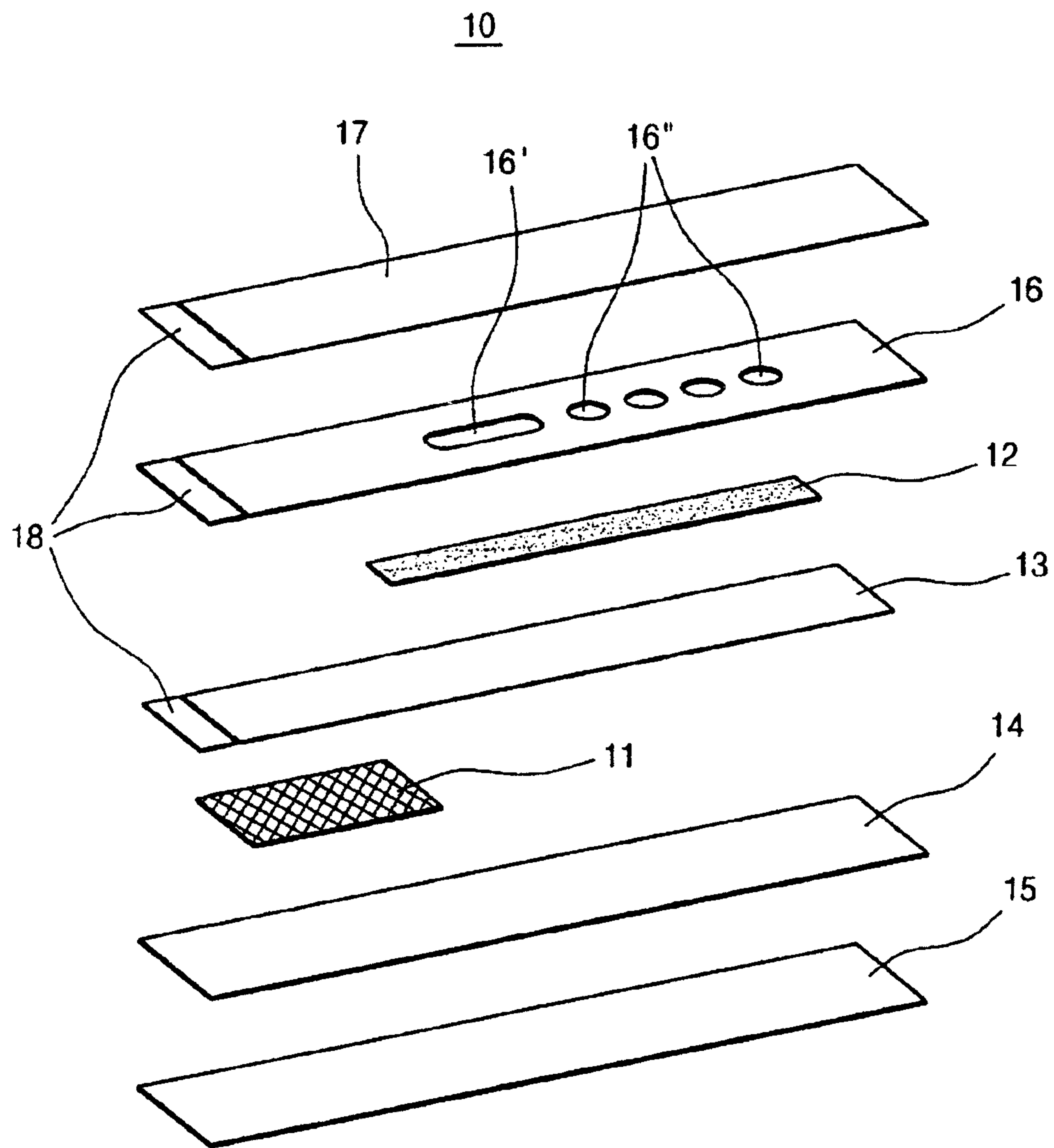
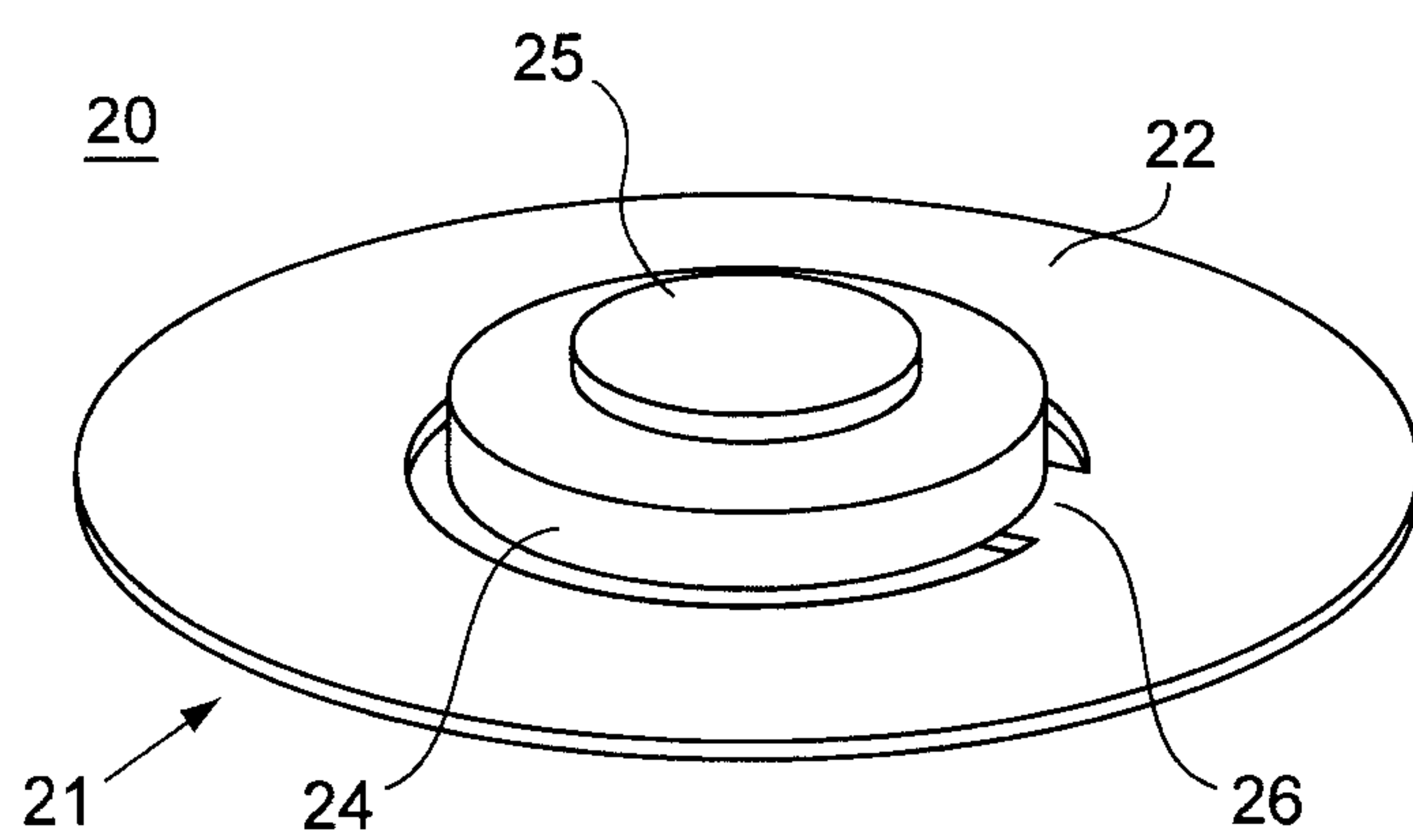
1. A precise critical temperature indicator comprising an upper section including a planar body, a deformable button with an open bottom end extending upwardly from the center of said body; a solid reagent which melts at a predetermined critical temperature in said button; a window in said body spaced apart from said button; a frangible seal closing the bottom end of the button; a base having the same dimensions as said body and connected to the planar body at a location external to said window; a wick on the base including a central seat beneath the button and an arm extending outwardly from and around the seat, and a soluble dye or pigment on the arm, whereby, when the indicator is mounted on a frozen or refrigerated product and the button is depressed, the seal is broken and the reagent moves to the seat, and, when the temperature of the product reaches the critical temperature, the reagent melts and migrates with the dye or pigment to the other end of the wick and provides an indication visible through said window that the temperature of the product is at or above the critical temperature.
2. The temperature indicator of claim 1, wherein said wick arm defines a flat spiral around said seat.
3. The temperature indicator of claim 2, wherein said button includes a small cylindrical upper portion, and a larger cylindrical bottom portion.
4. The temperature indicator of claim 3, including a container for said reagent in said bottom portion of the button, wherein said seal is a frangible foil closing the bottom of the container.

5. The temperature indicator of claim 4, including an annular support between the base and the seal, the support extending around the top surface of the wick seat and forming a passage for the reagent from the container to the seat.
6. The temperature indicator of claim 5, including an opaque, rigid plastic housing containing said upper section, the container, the support and the base, the housing including a cap containing said at least one window in a top surface thereof, and a baseplate beneath said base, the baseplate carrying an adhesive layer for mounting the indicator on a frozen or refrigerated product.
7. The temperature indicator of claim 6, wherein said adhesive layer is a sheet of double faced tape mounted on the bottom of the baseplate of said housing.
8. A precise critical temperature indicator comprising an upper section including a planar body, a deformable button with an open bottom end extending upwardly from the center of said button, a liquid reagent containing a pigment in said button, a migration passage for the reagent extending diametrically from the button, an inner annular first compartment spaced apart from and in fluid communication with the button, an outer annular second compartment parallel to and spaced apart from the first compartment, at least one indicator window in said body between said second compartment and an outer side edge of the body, a seal between the inner and outer compartments; a development medium layer beneath said upper section including a migration passage for the liquid reagent extending radially outwardly from said outer compartment and around the planar body to a location beneath said indicator window; and a base for mounting the indicator on a frozen or refrigerated product.

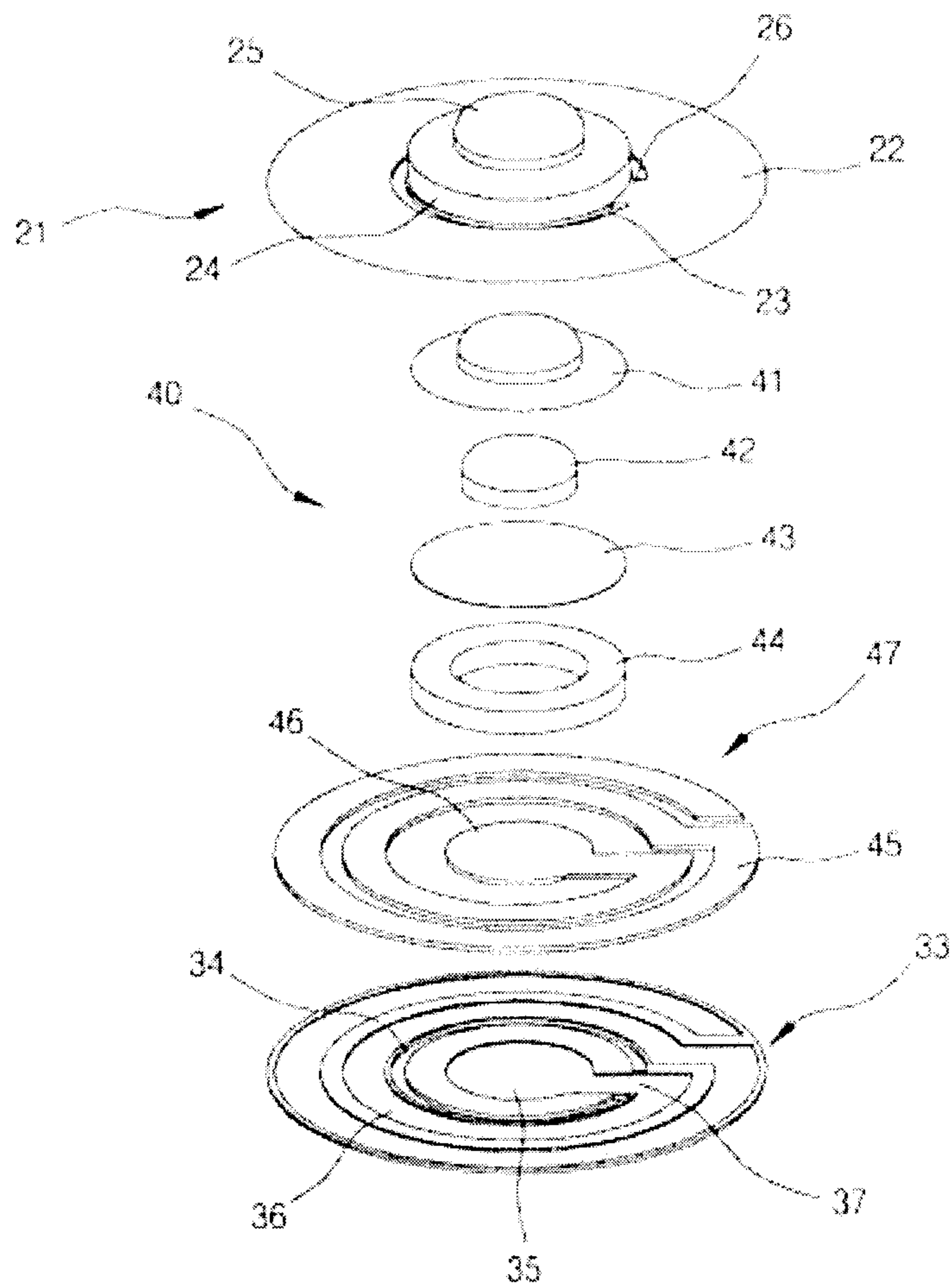
9. A precise critical temperature indicator comprising a laminated body including an upper layer, a deformable button with an open bottom end extending upwardly from the center of said upper layer, a liquid reagent in said button, a plurality of indicator windows in said upper layer extending in an arc around the button; a barrier layer beneath the upper layer; a migration passage between said upper and barrier layers extending outwardly from the button; a speed adjustment window at an outer end of said migration passage in said barrier layer; a developing medium layer beneath said barrier layer; an annular passage on said developing material layer for the reagent; a final development area in said passage diametrically opposed to said speed adjustment window; a print layer beneath said developing material layer for receiving reagent from said passage and a base for mounting the indicator on a frozen or refrigerated product.

10. The temperature indicator of claim 9, wherein the print layer contains a plurality of different colored areas beneath said indicator by windows for monitoring the migration of the reagent color along the print layer.

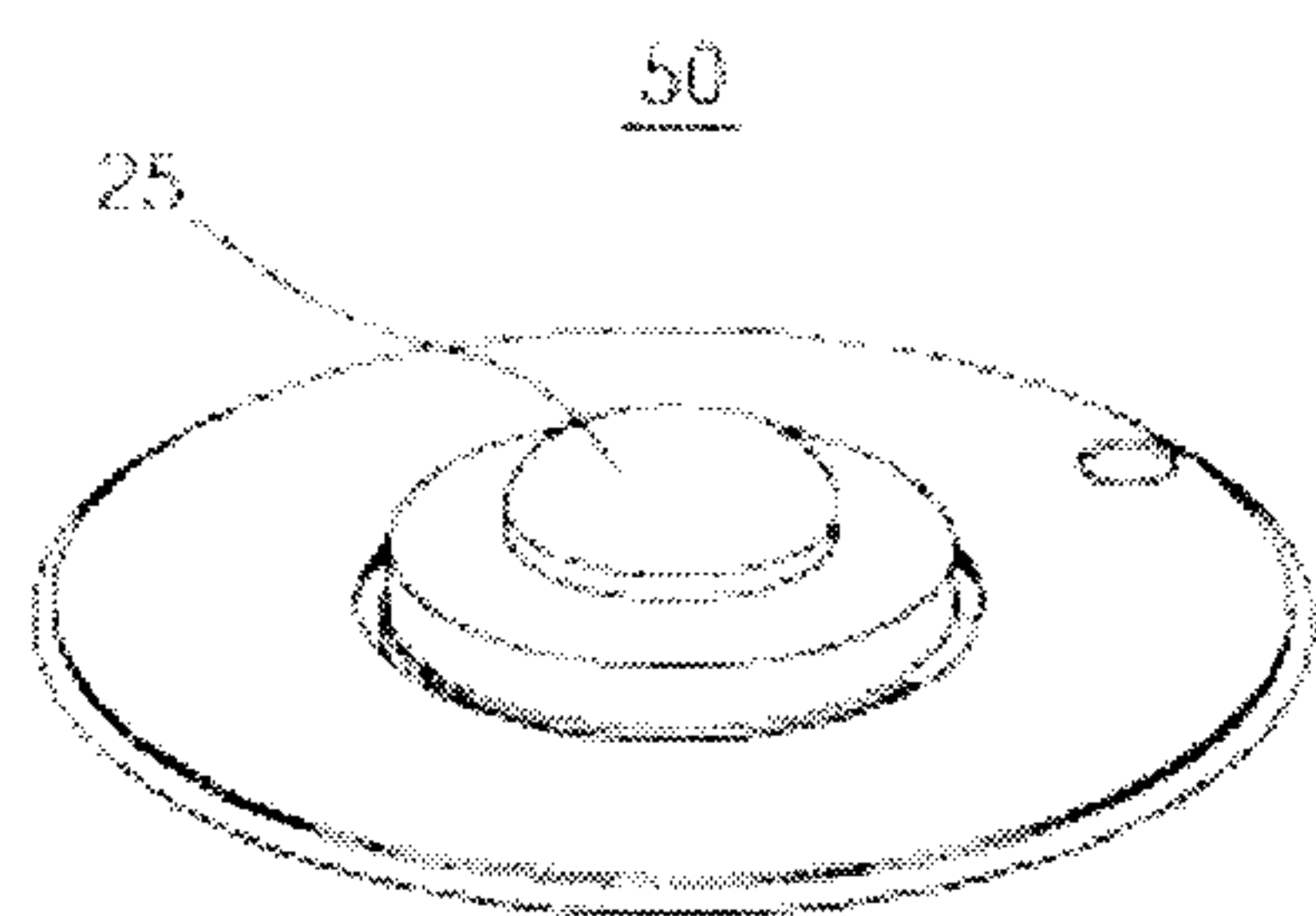
PRIOR ART

**FIG. 1****FIG. 2**

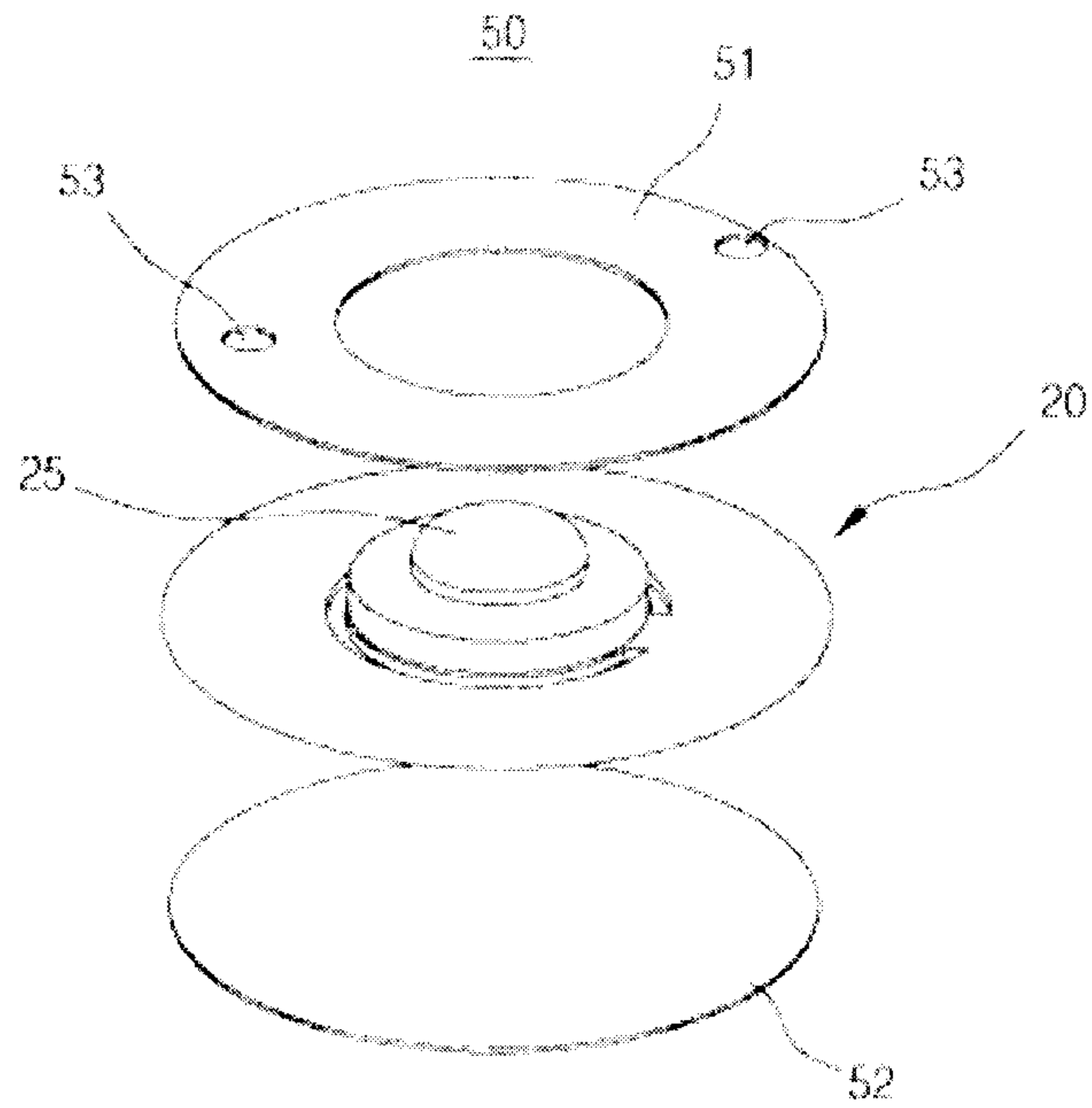
[Fig. 3] [Amendment by Rule 26 19.02.2010]

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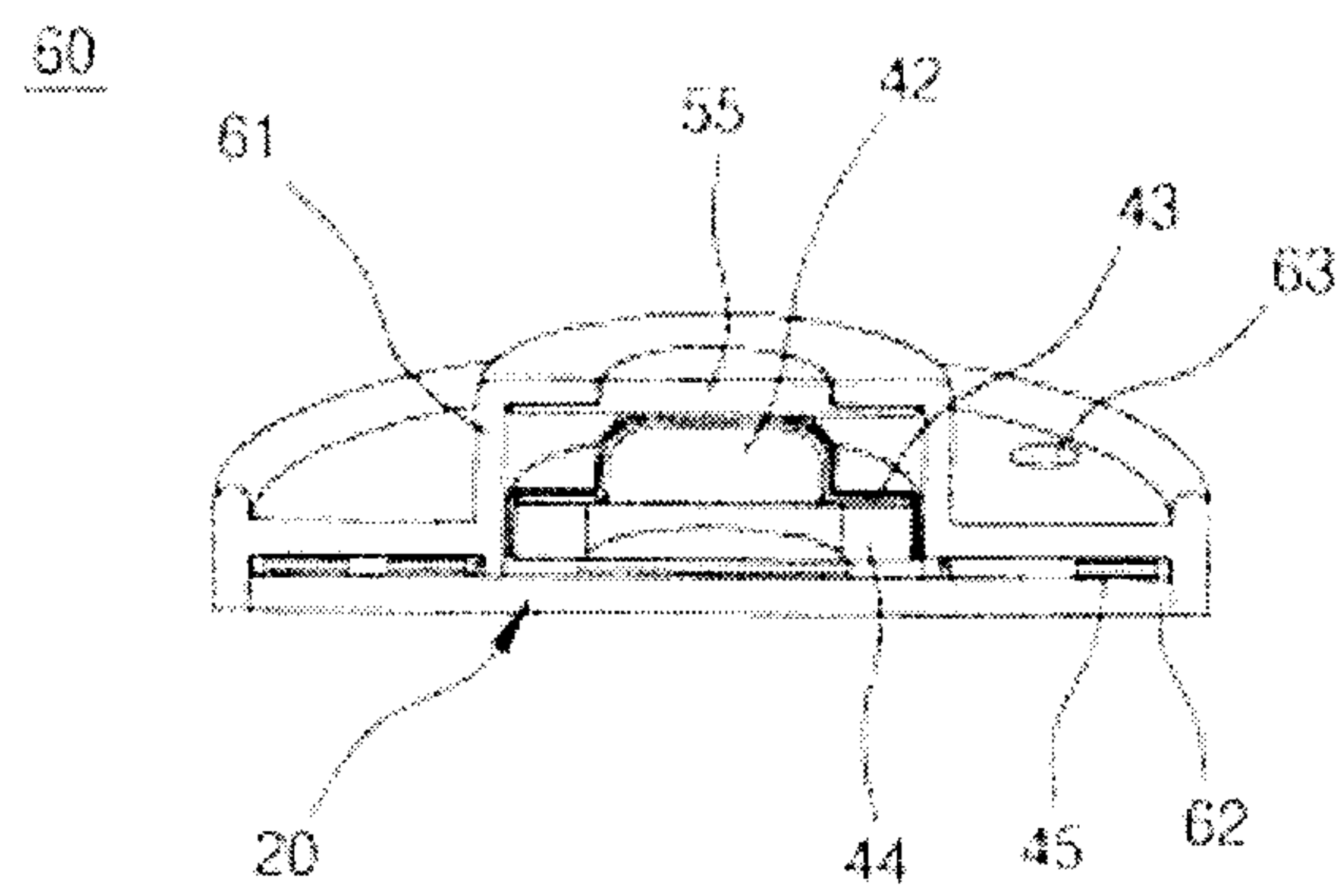
[Fig. 4] [Amendment by Rule 26 19.02.2010]



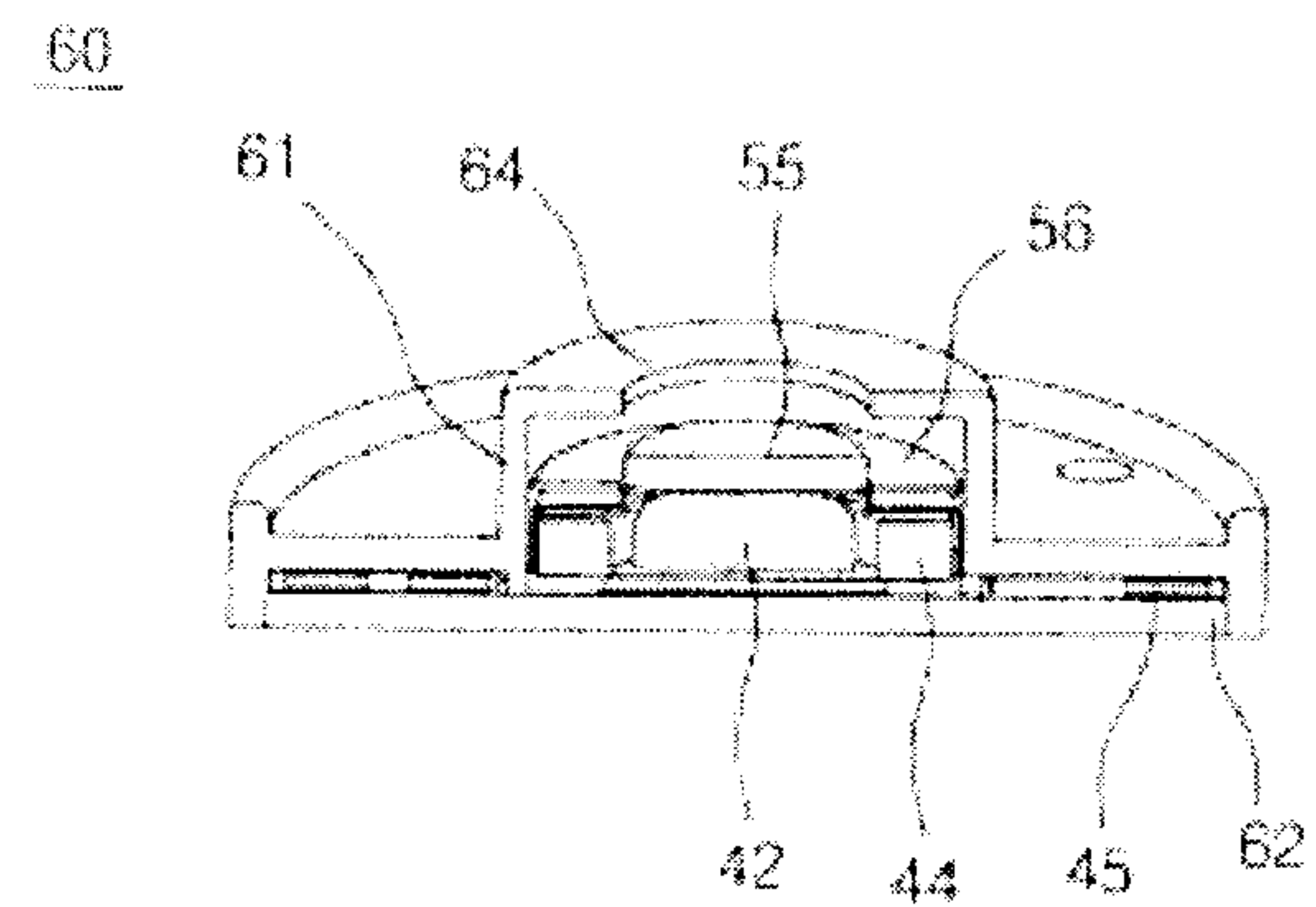
[Fig. 5] [Amendment by Rule 26 19.02.2010]

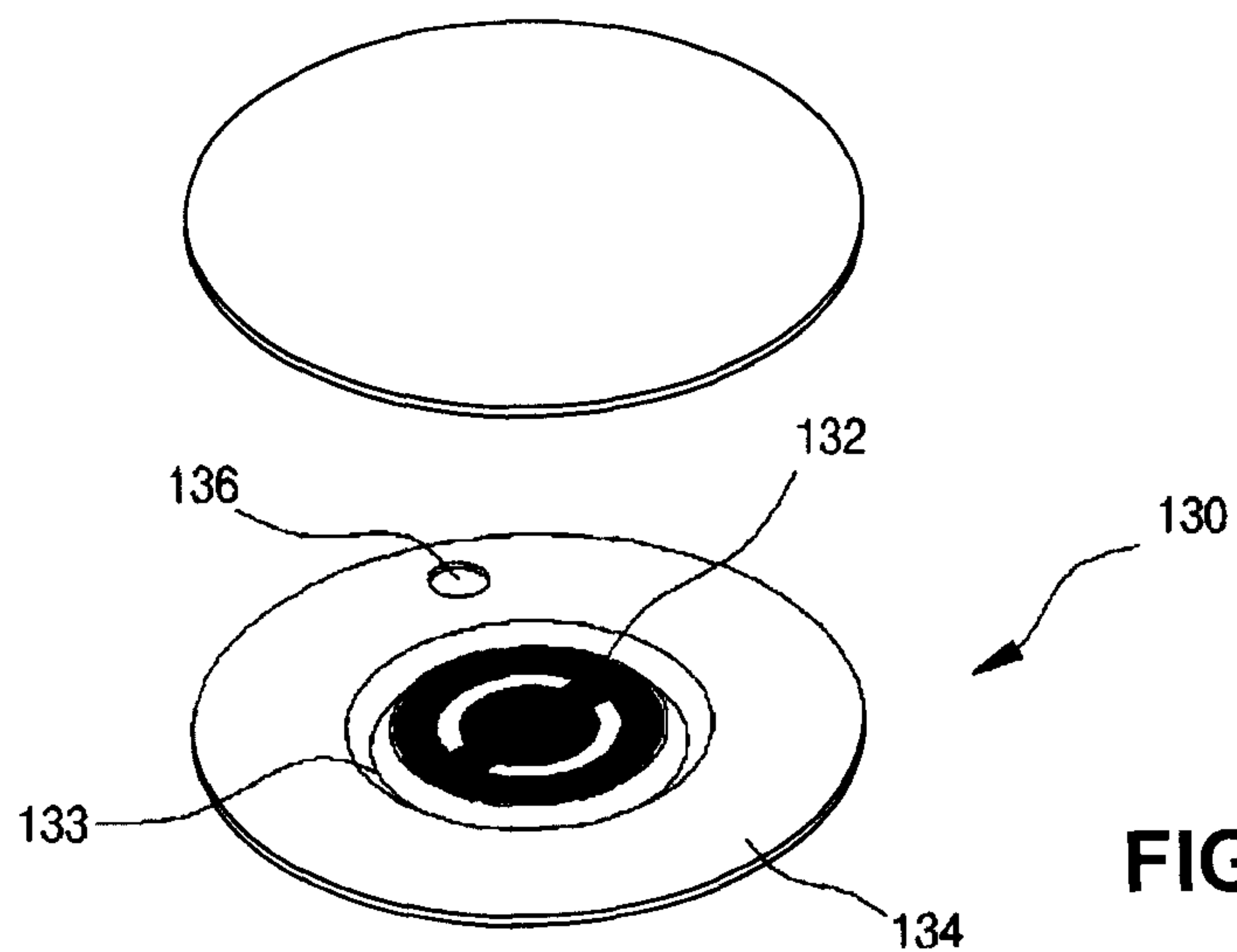
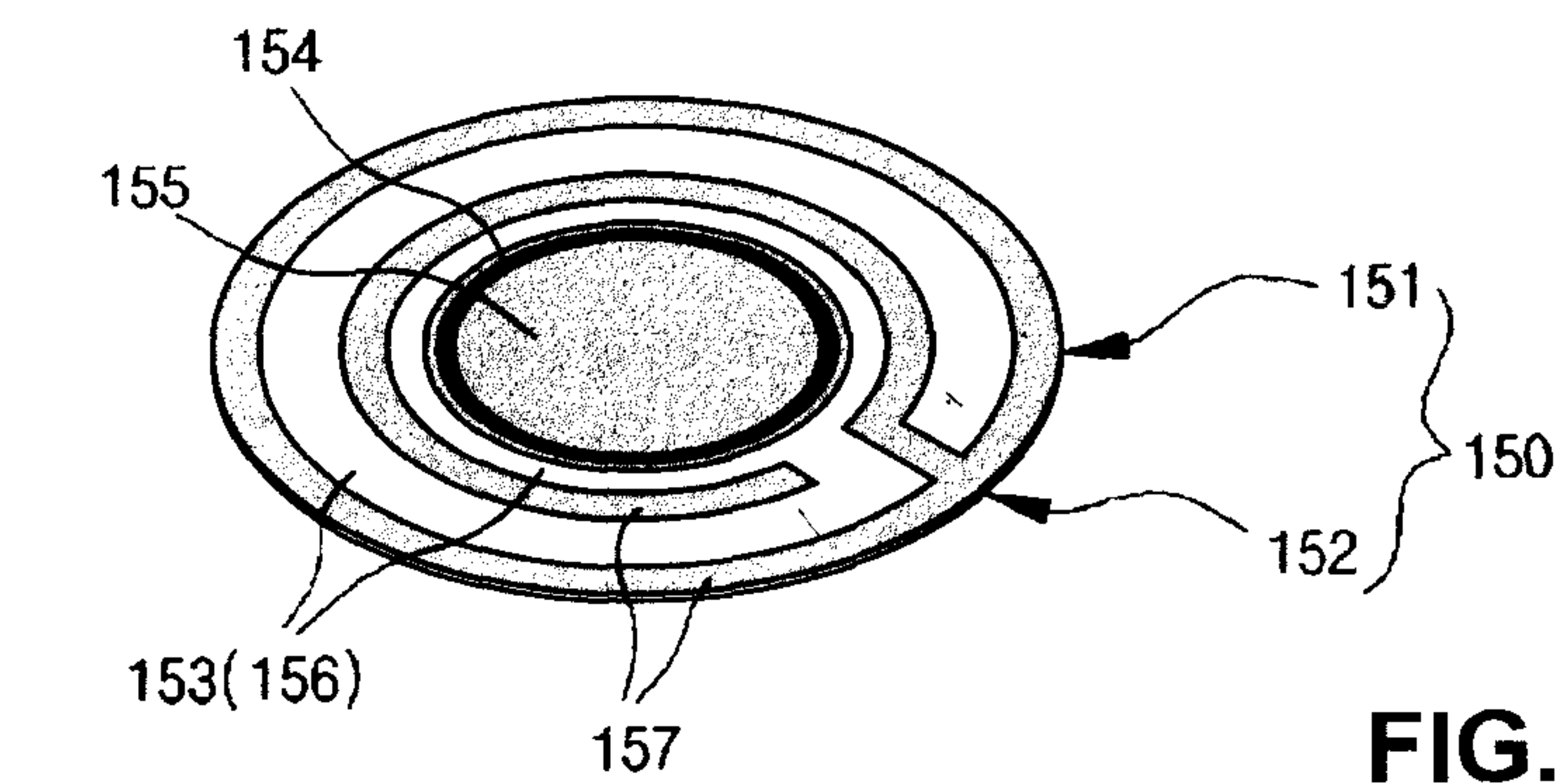
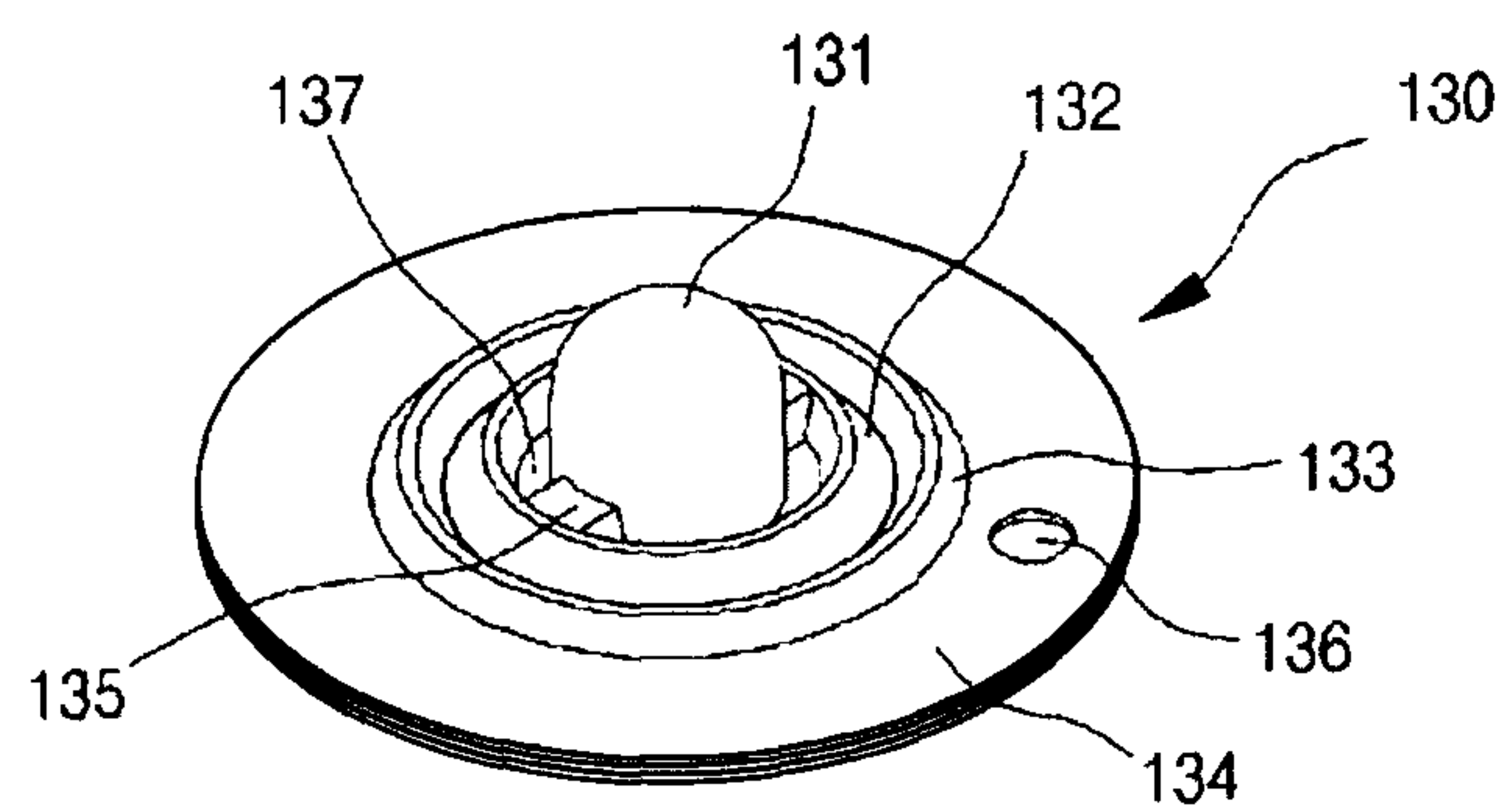
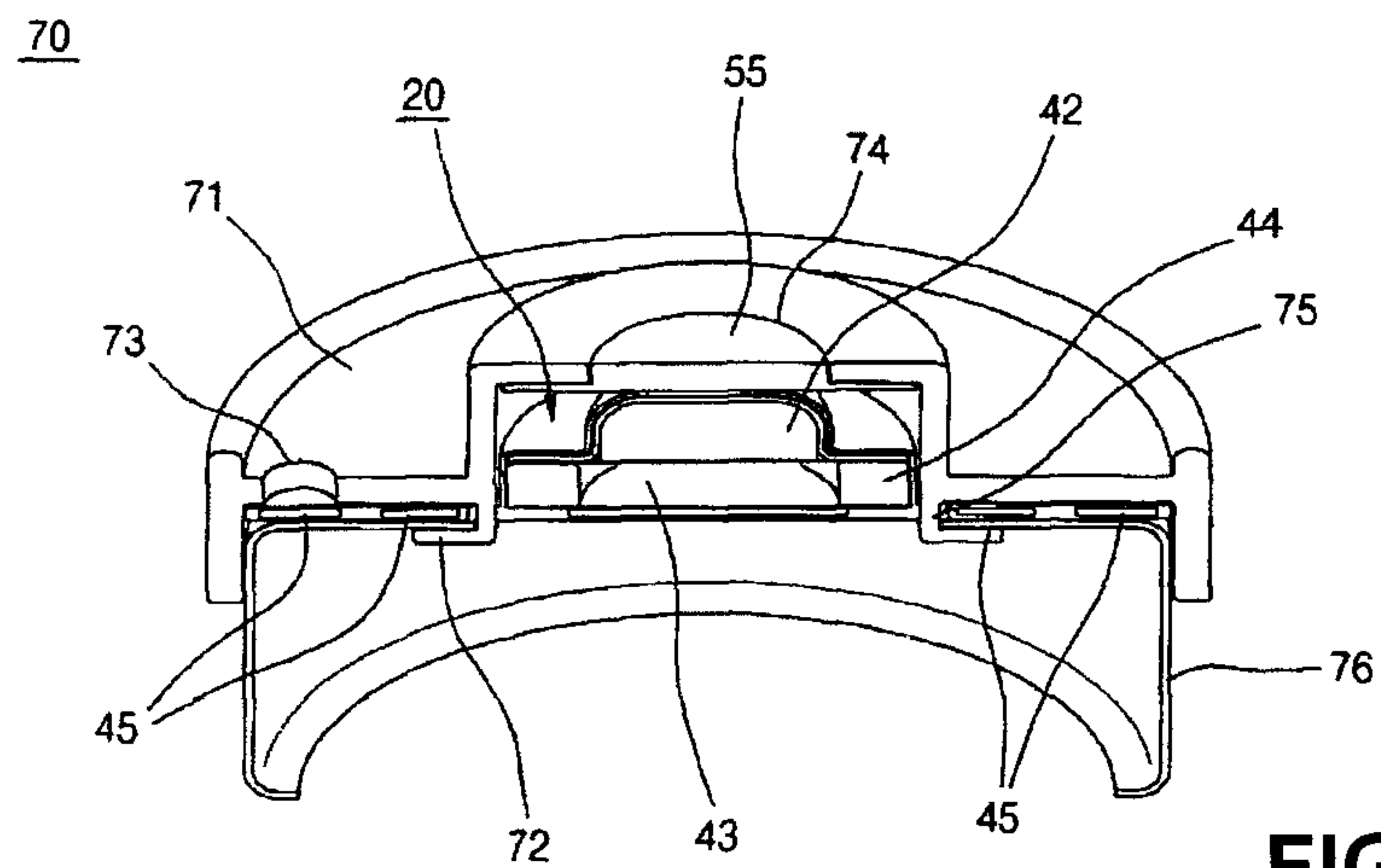


[Fig. 6] [Amendment by Rule 26 19.02.2010]



[Fig. 7] [Amendment by Rule 26 19.02.2010]





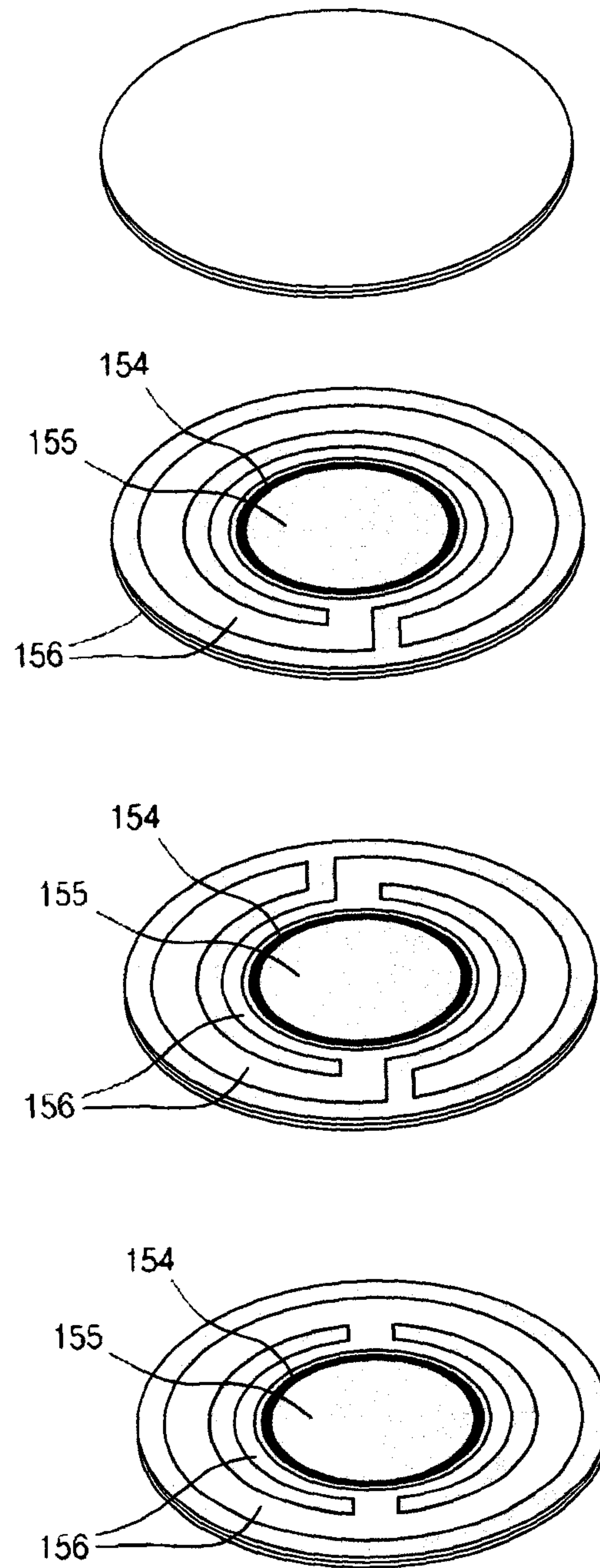


FIG. 11

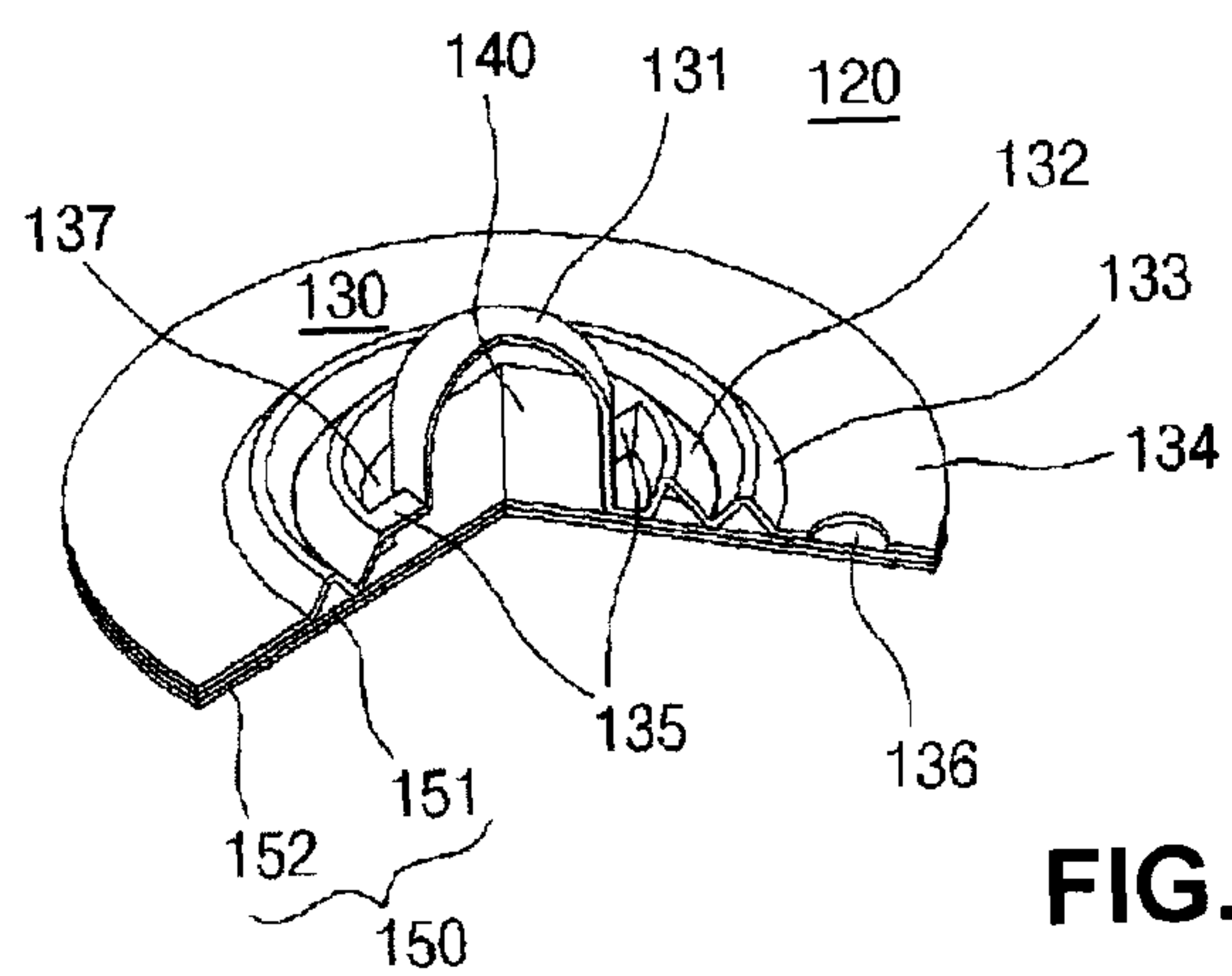


FIG. 12

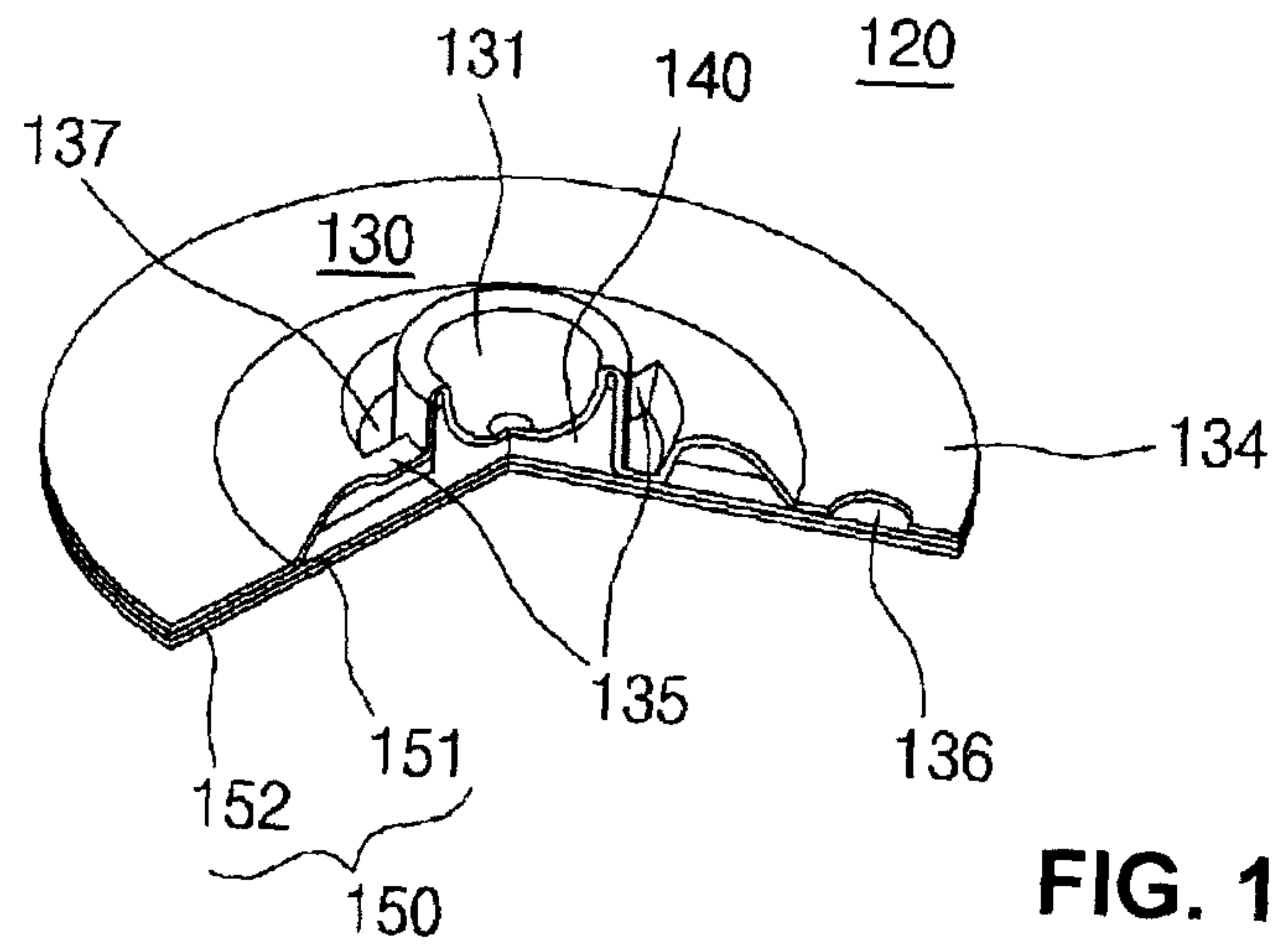


FIG. 13

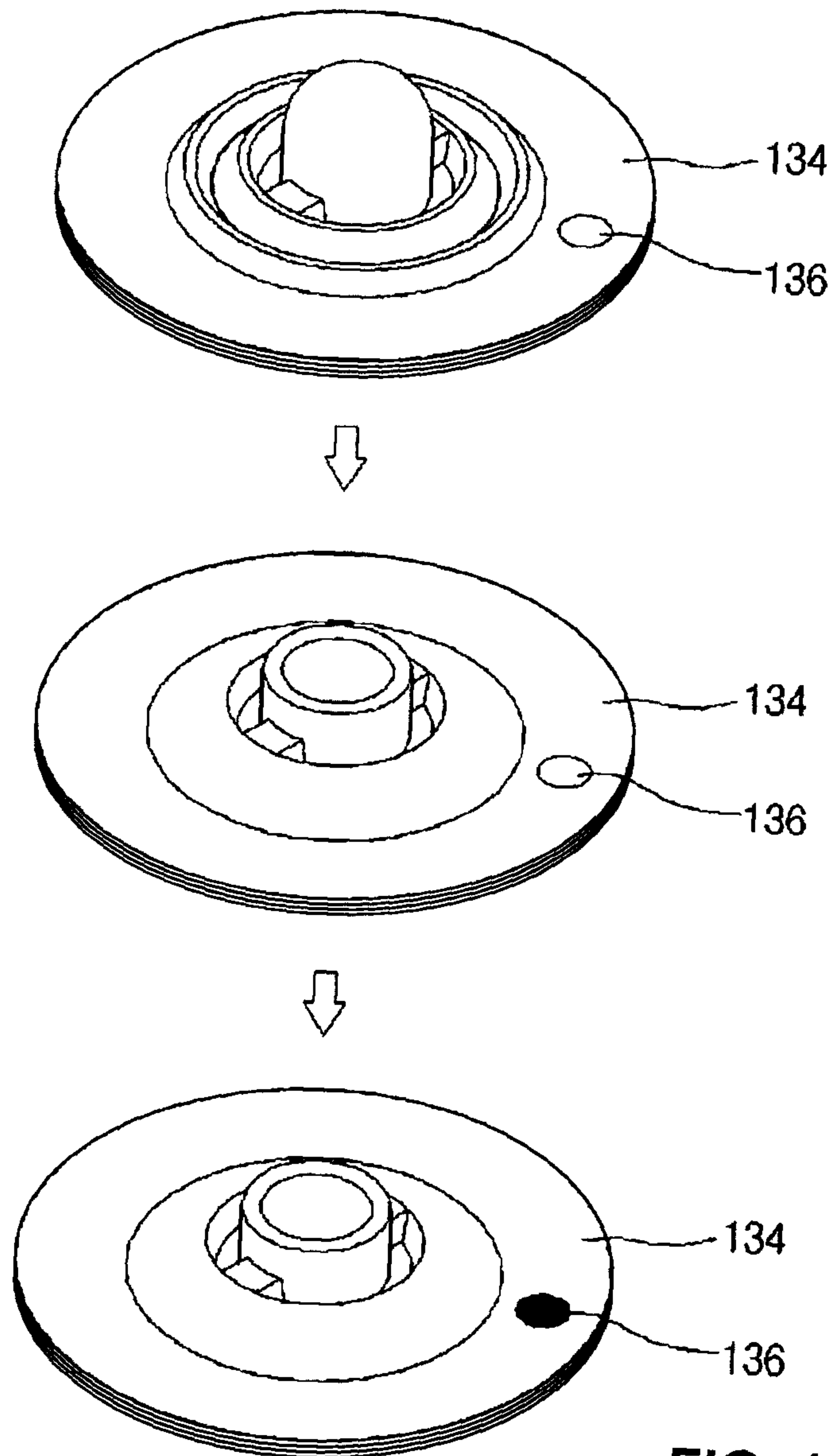


FIG. 14

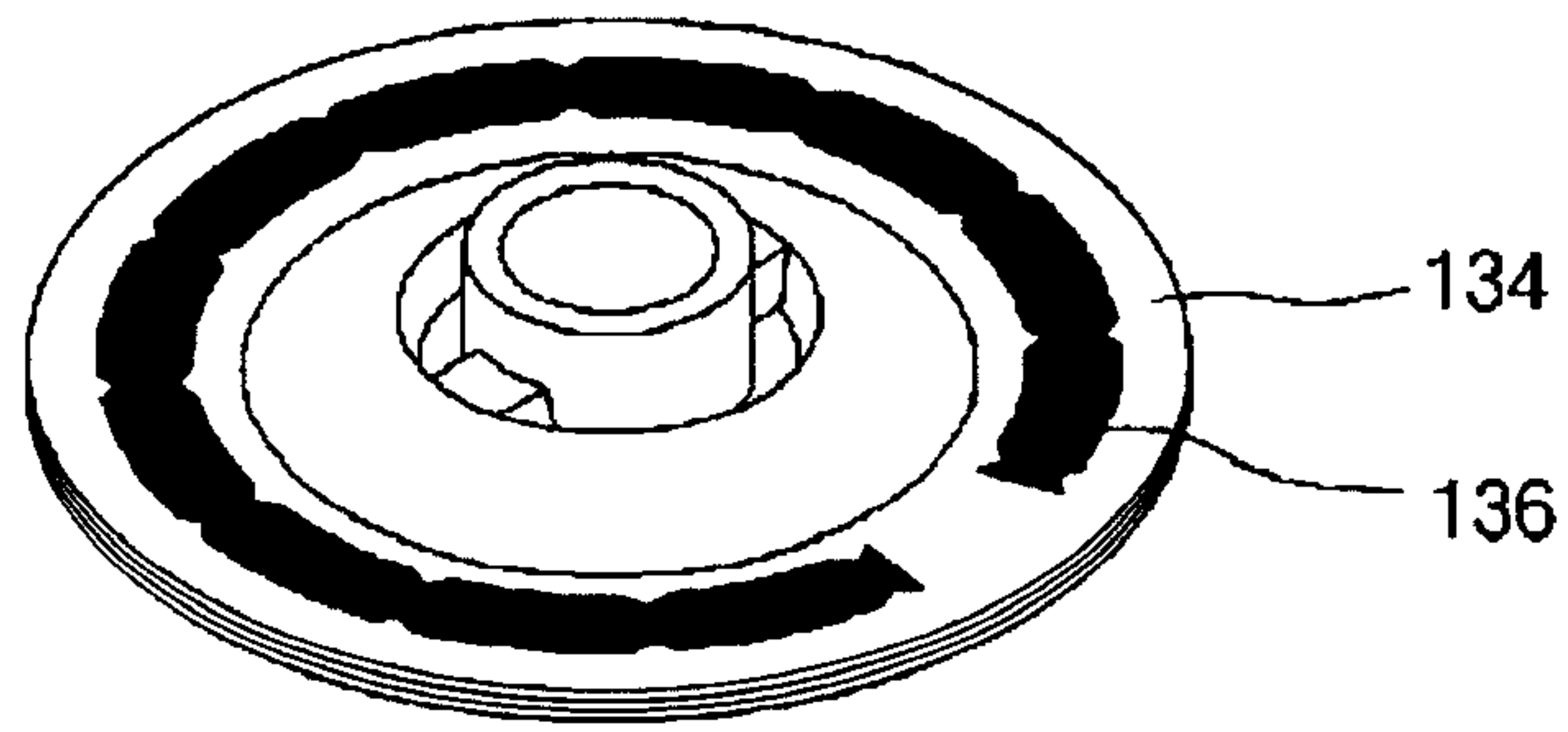
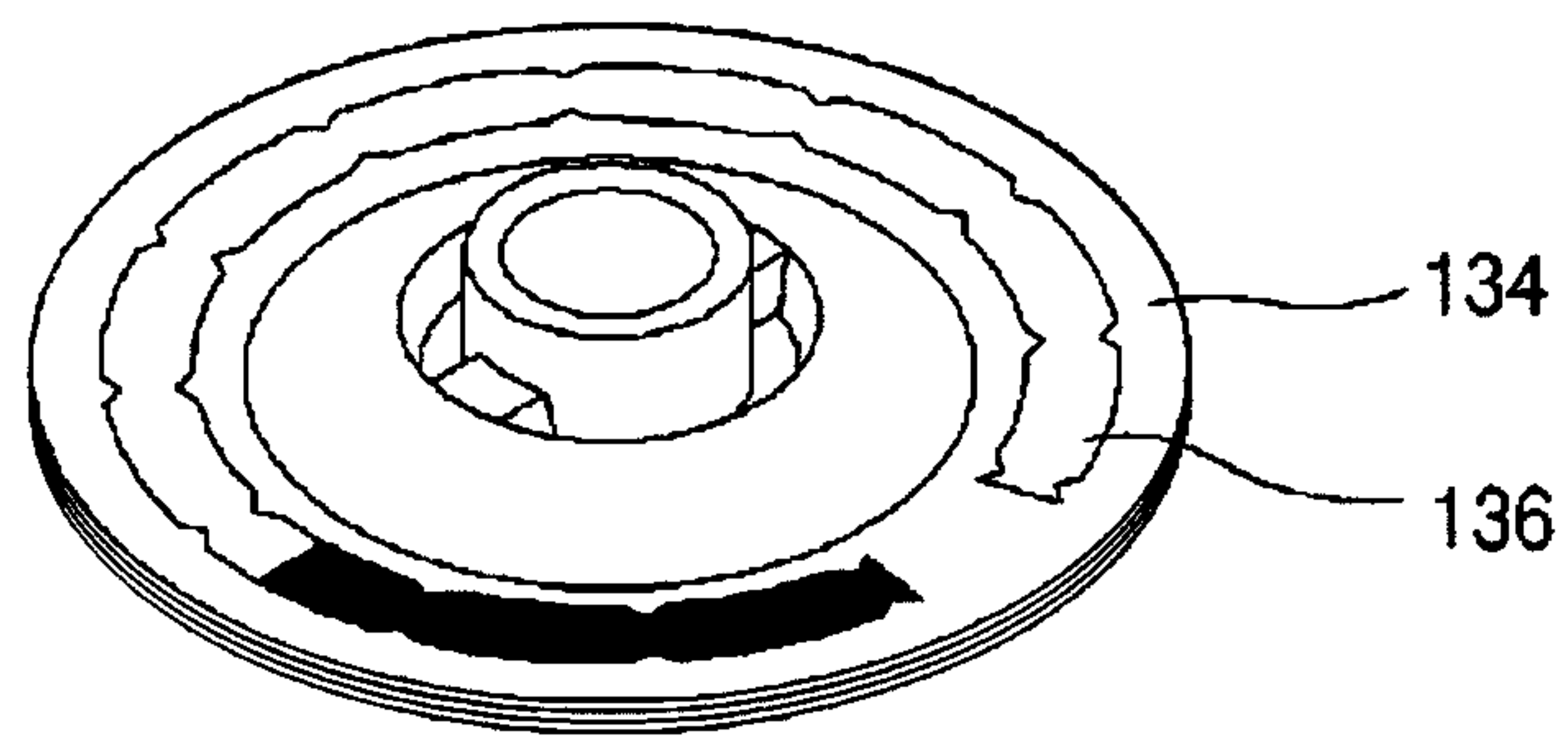
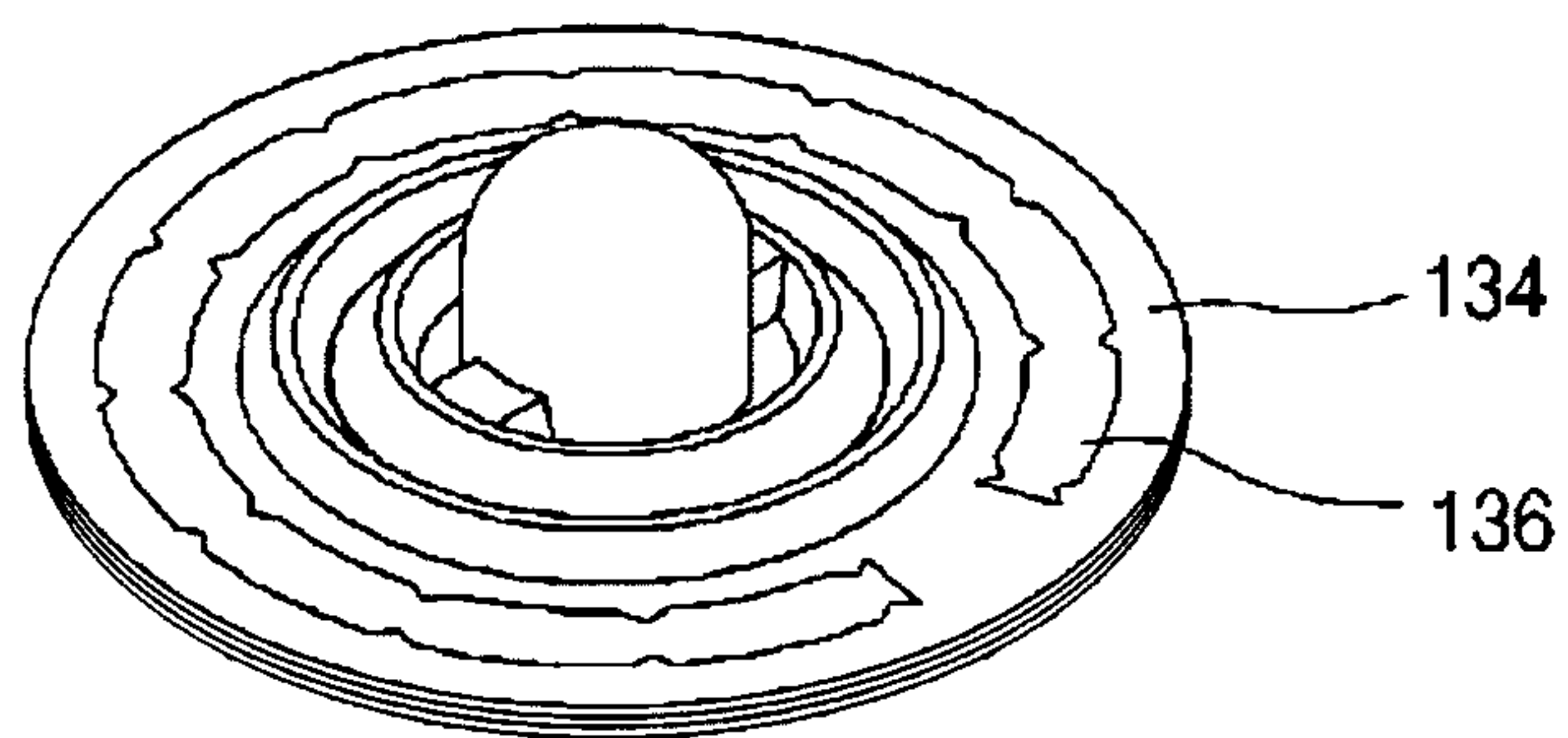


FIG. 15

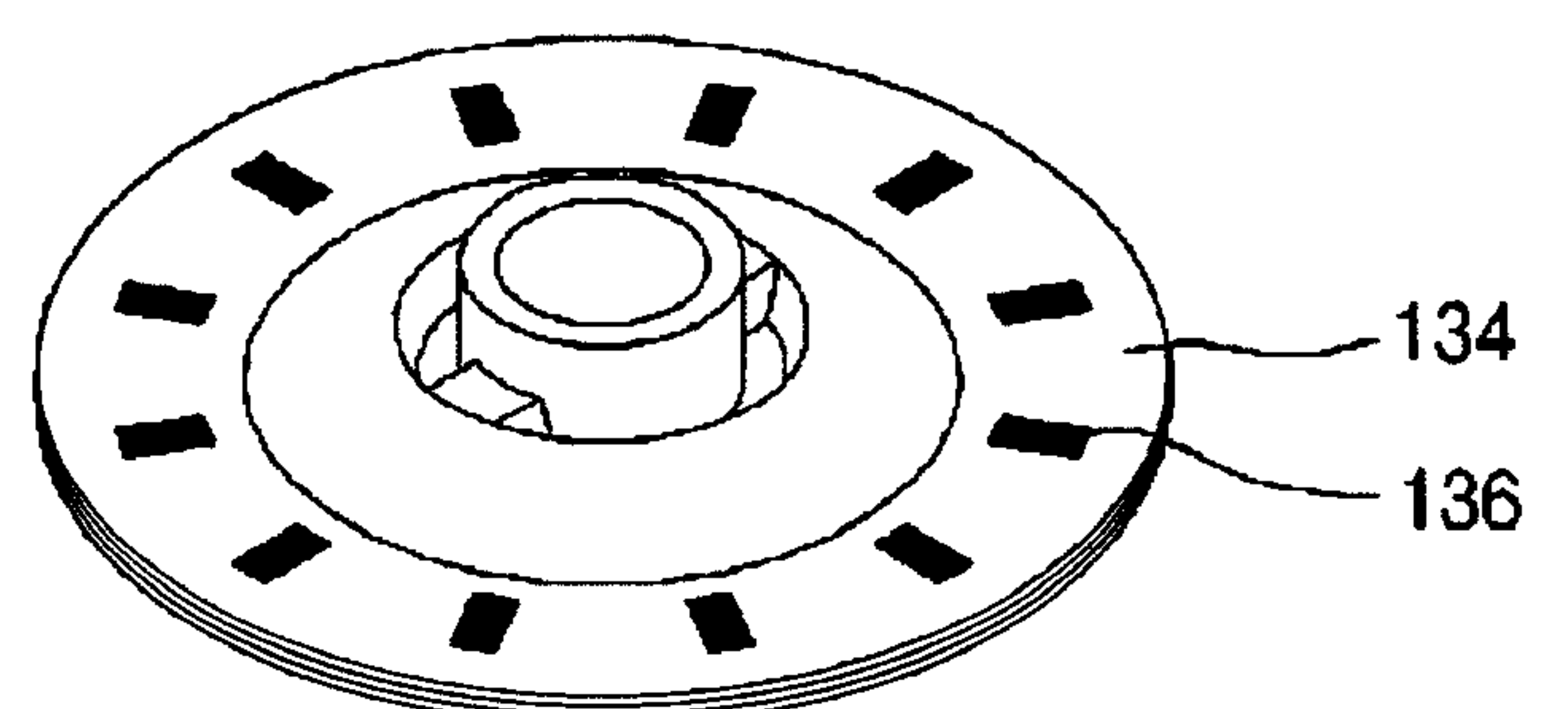
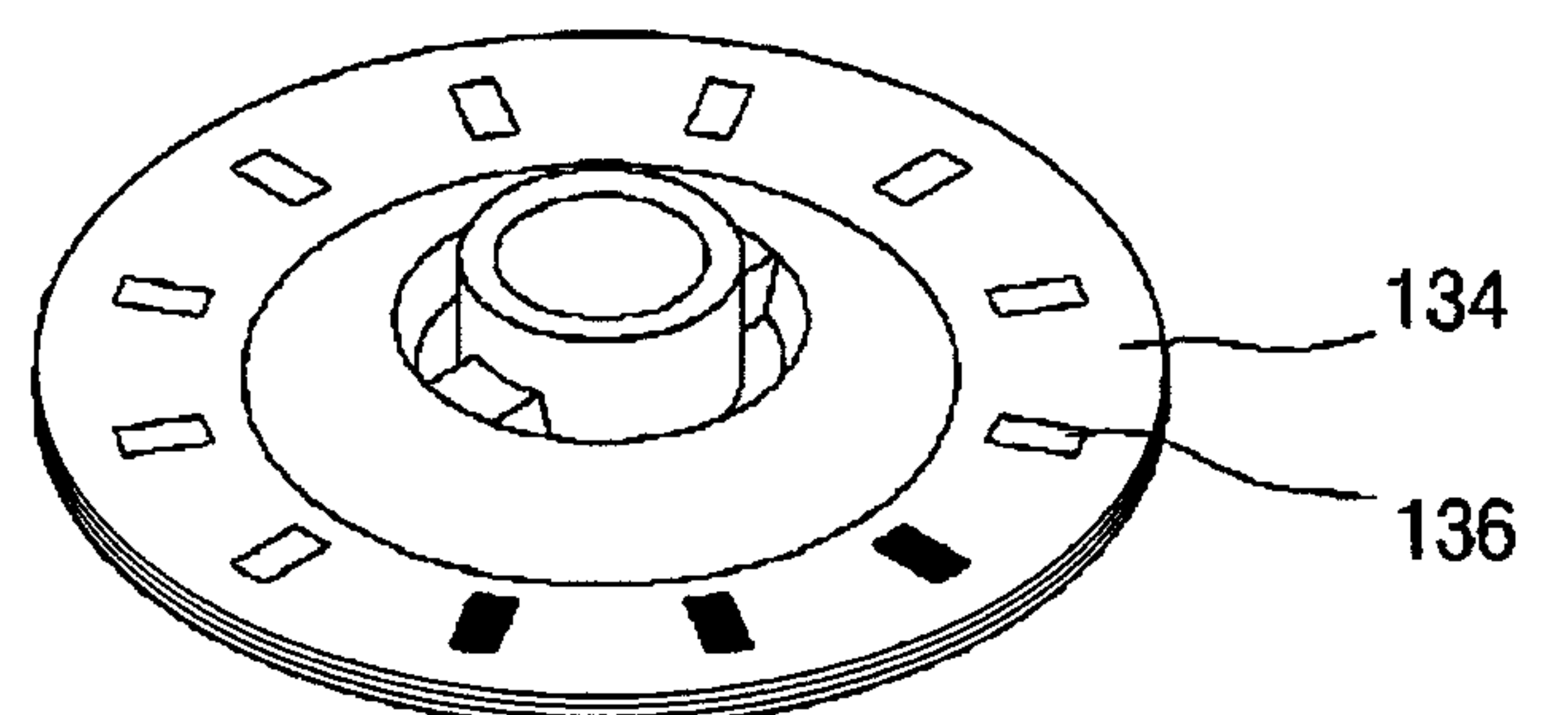
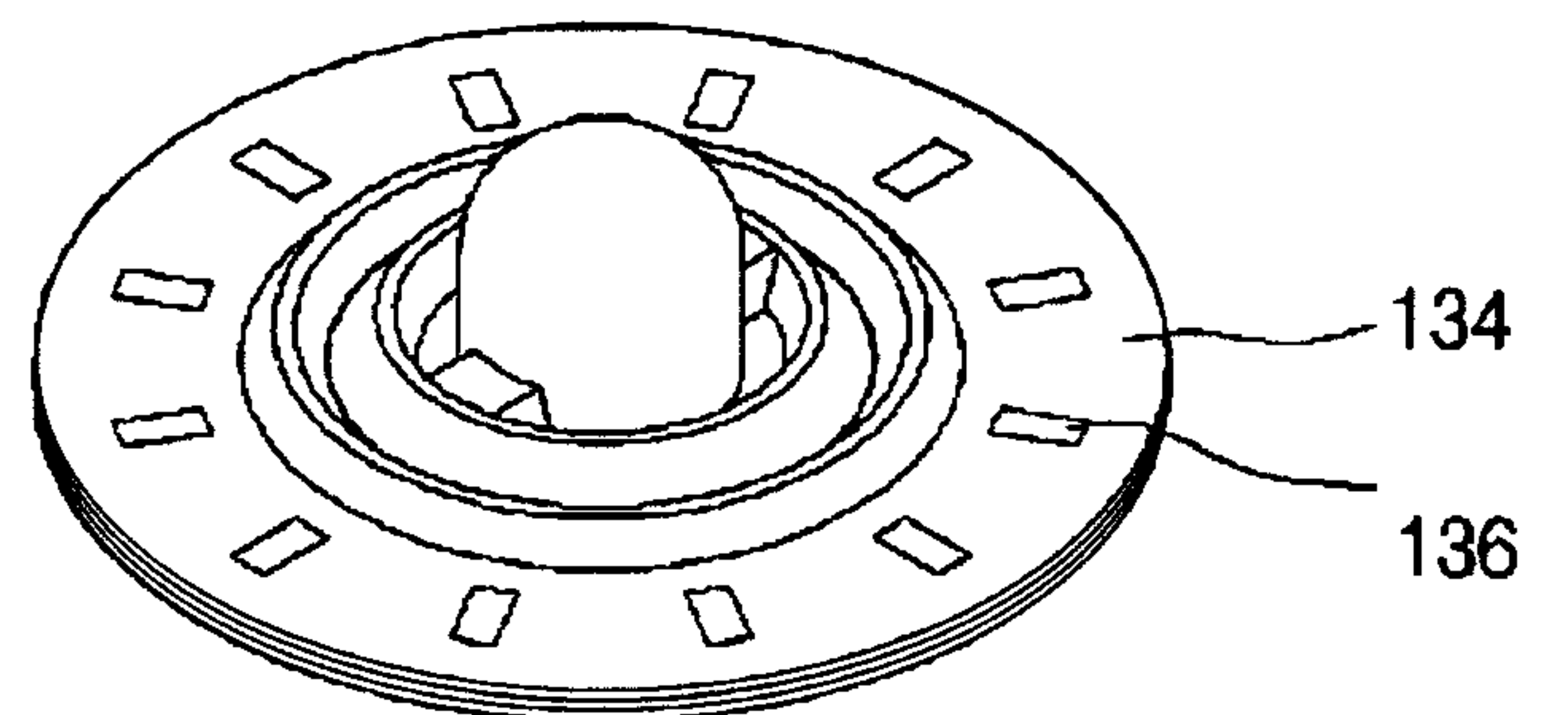


FIG. 16

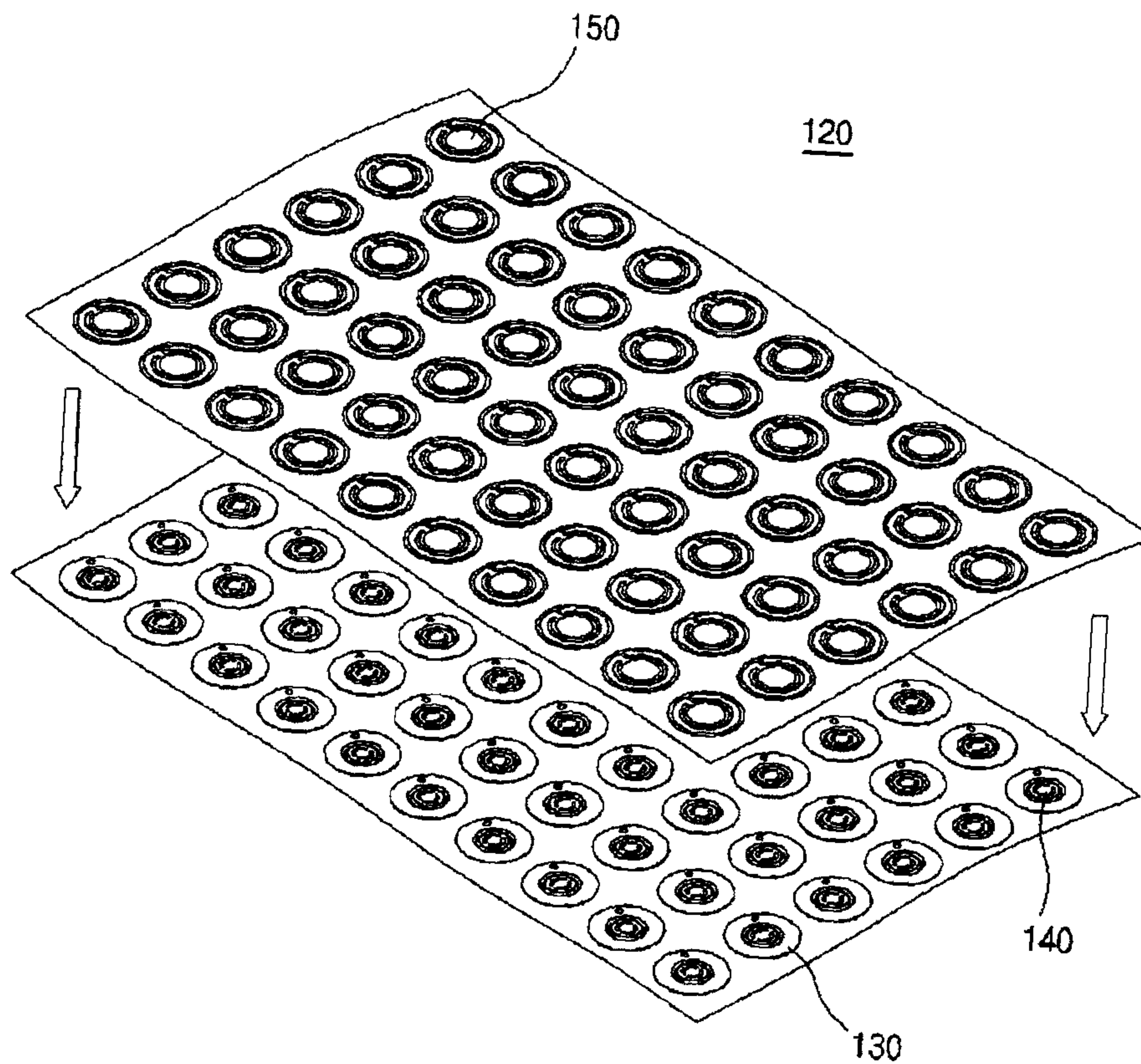


FIG. 17

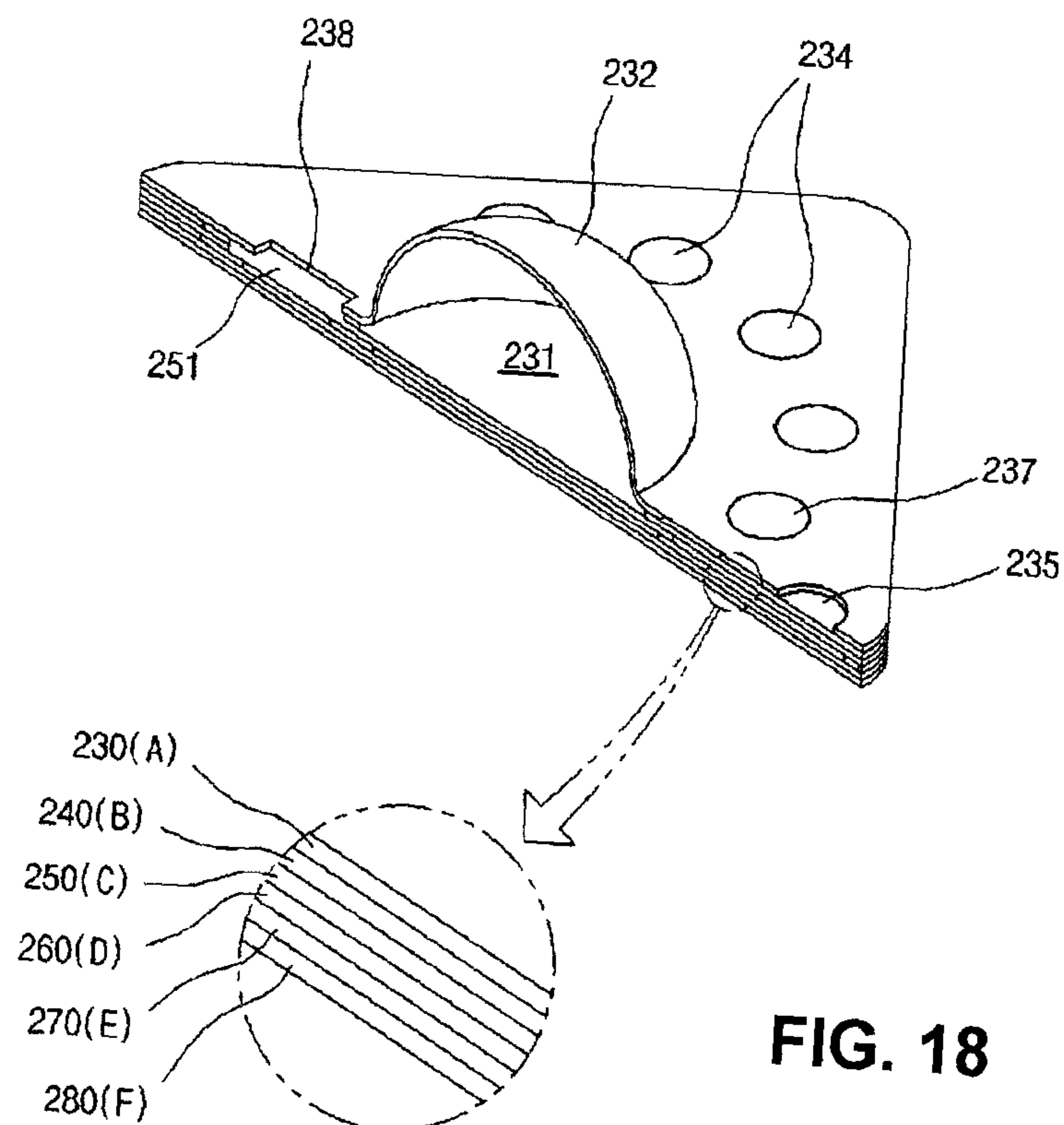
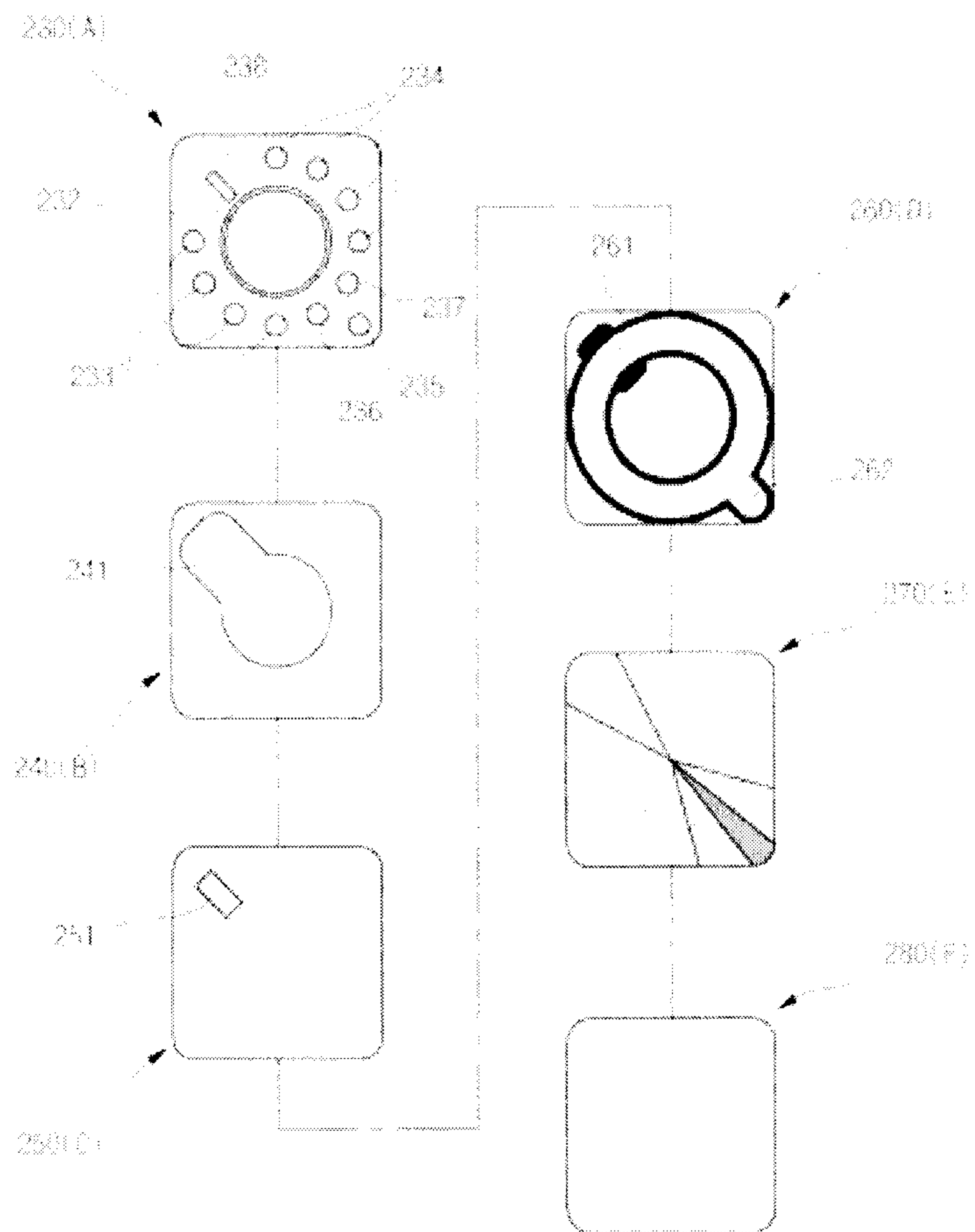
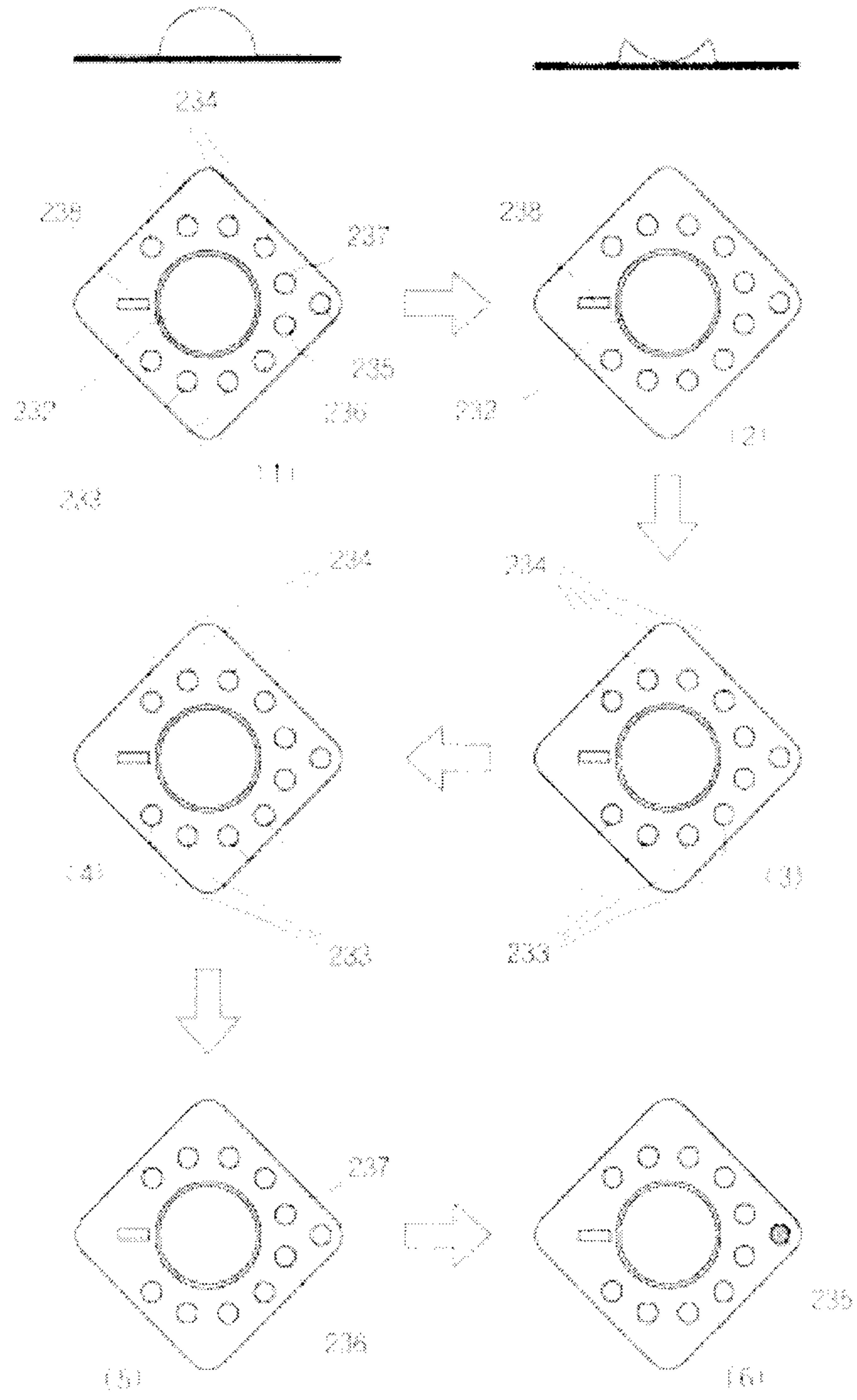


FIG. 18

[Fig.19]



[Fig. 20]



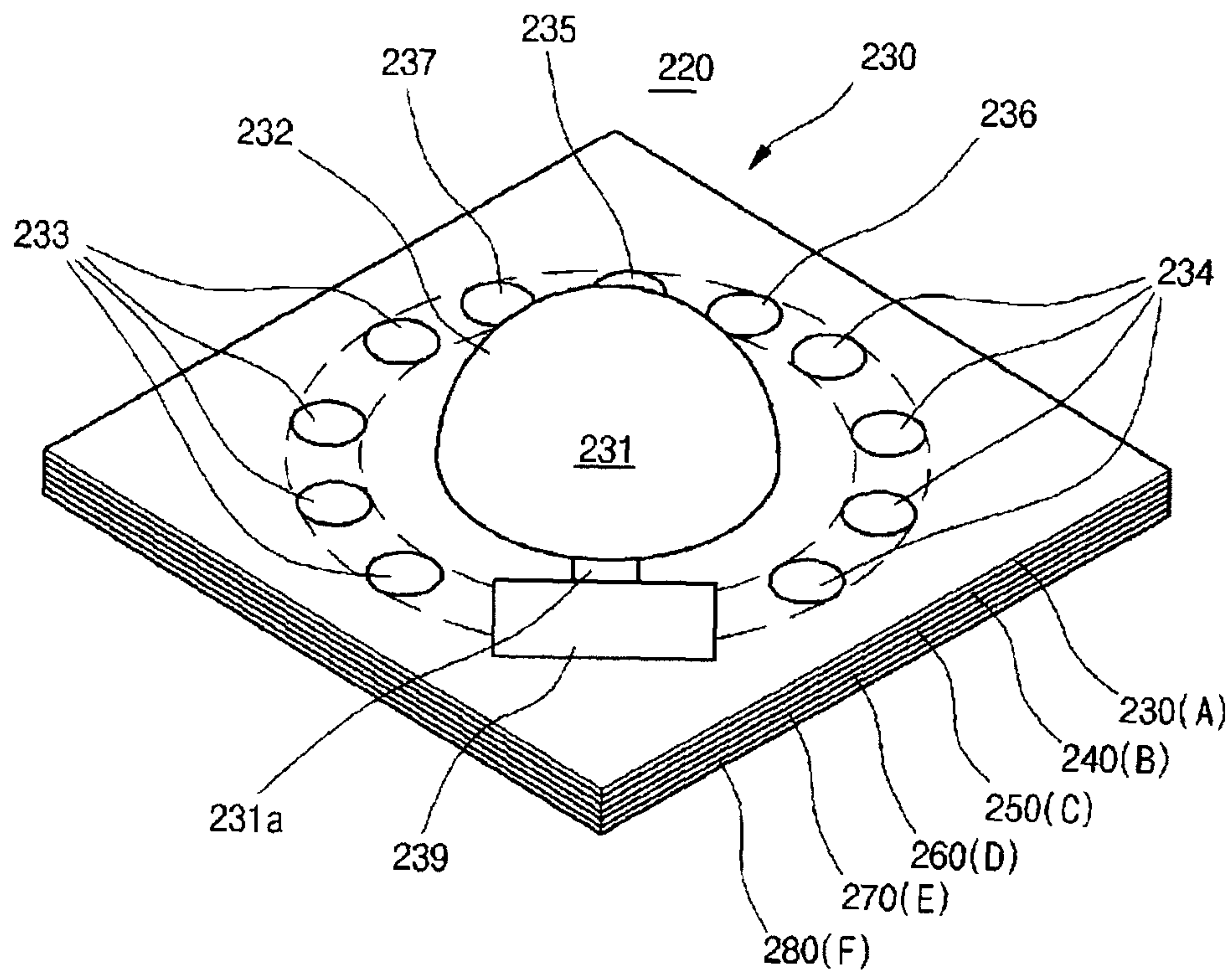


FIG. 21

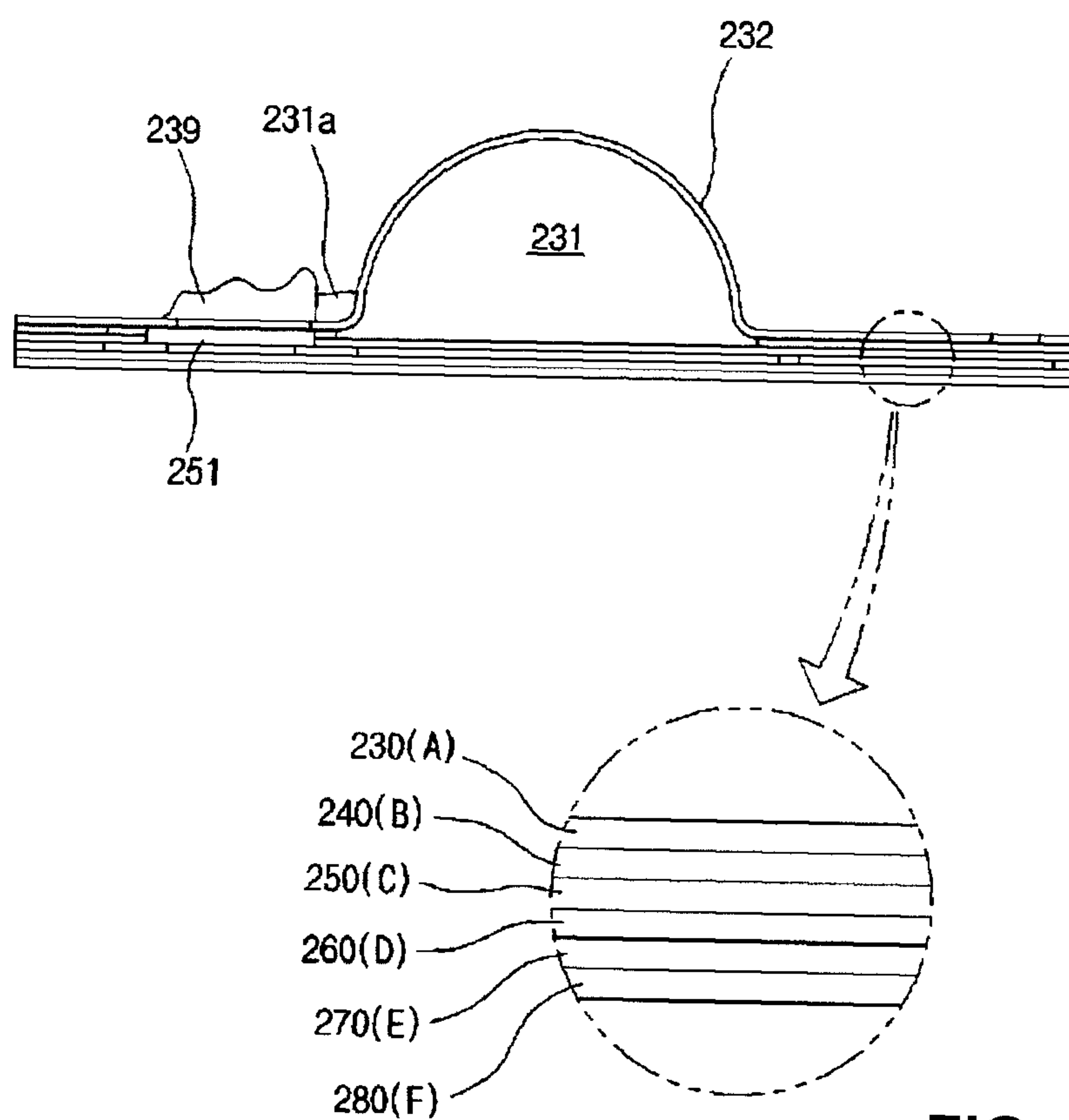


FIG. 22

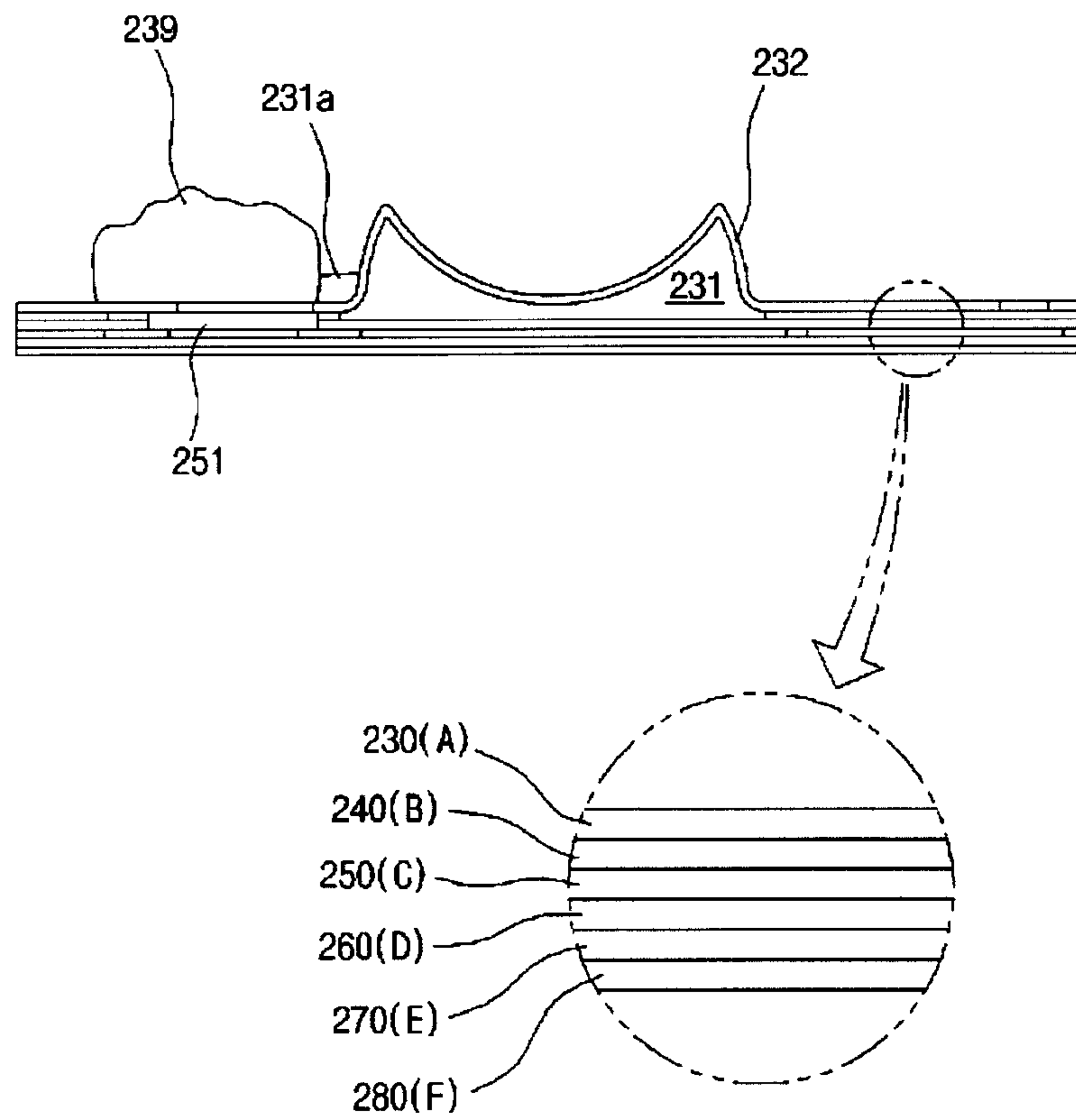


FIG. 23

