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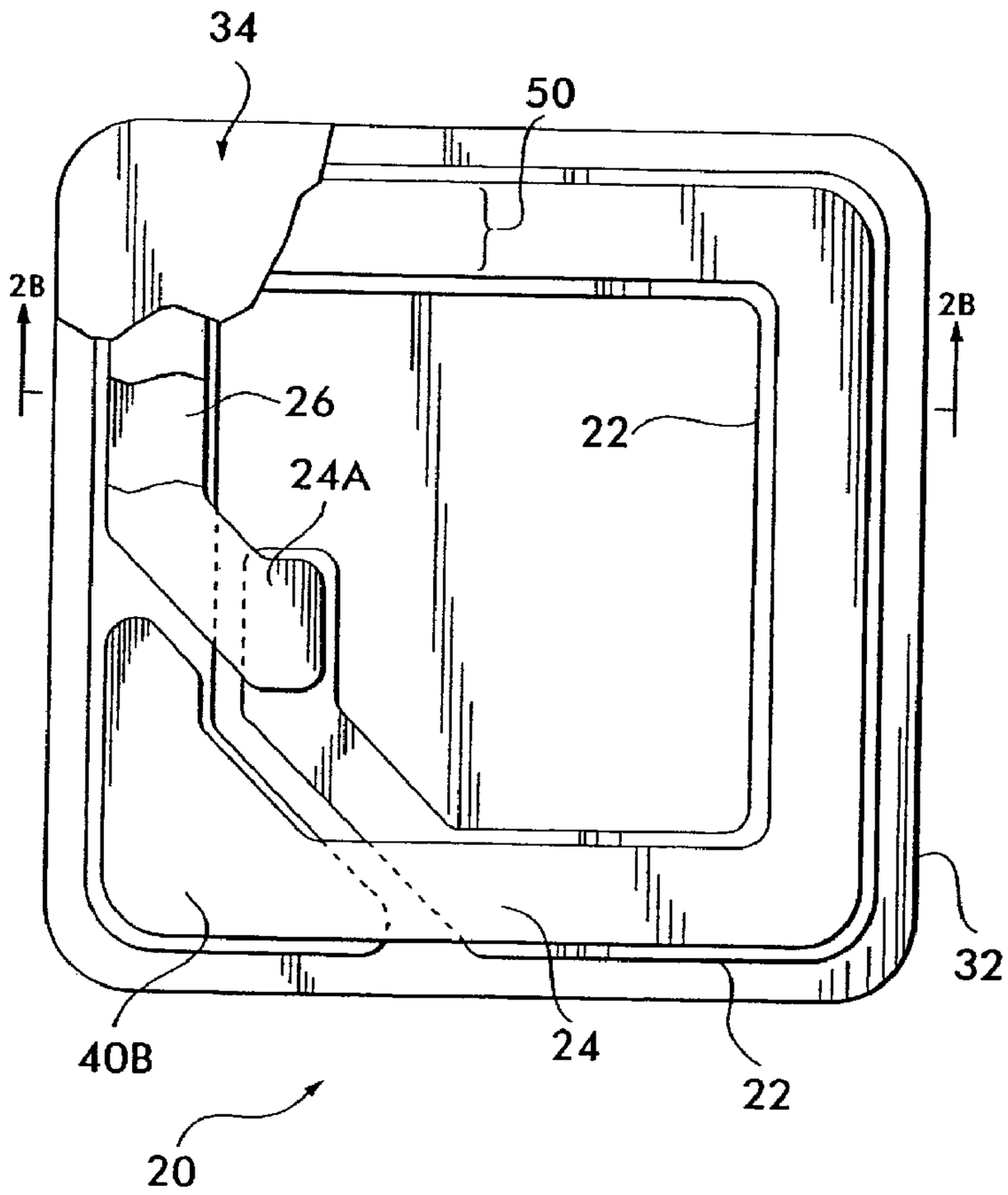
(54) Titre : PROCEDE ET APPAREIL DE PROTECTION DE PRODUITS CULINAIRES
(54) Title: METHOD AND APPARATUS FOR PROTECTING CULINARY PRODUCTS



(57) Abrégé/Abstract:
A microwave-resistant and waterproof security tag for use with food products, especially meat products. The security tag includes a pair of single, open loop conductive traces in between which is disposed a similarly-shaped dielectric layer. This combination is

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(57) Abrégé(suite)/Abstract(continued):
encapsulated within plastic membranes or covers that are sealed at their common edges. The preferred embodiment includes rectangularly-shaped single, open loop conductive traces with rounded corners and with one end of each trace forming a capacitor plate. The width of each trace is at least 1/10 of the length of the security tag.

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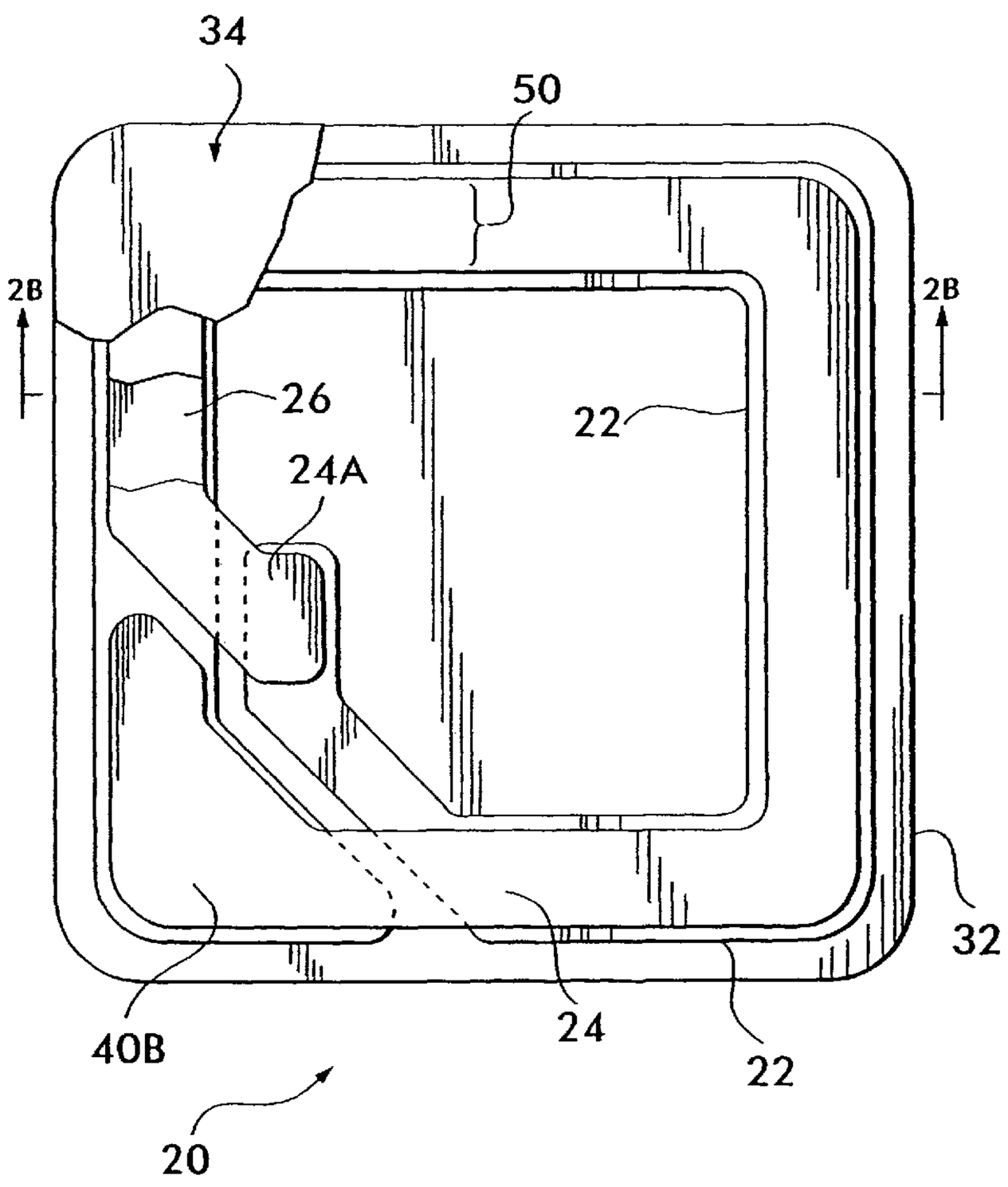

(57) Abstract: A microwave-resistant and waterproof security tag for use with food products, especially meat products. The security tag includes a pair of single, open loop conductive traces in between which is disposed a similarly-shaped dielectric layer. This combination is encapsulated within plastic membranes or covers that are sealed at their common edges. The preferred embodiment includes rectangularly-shaped single, open loop conductive traces with rounded corners and with one end of each trace forming a capacitor plate. The width of each trace is at least 1/10 of the length of the security tag.

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METHOD AND APPARATUS FOR PROTECTING CULINARY PRODUCTS

SPECIFICATION

BACKGROUND OF THE INVENTION

1. FIELD OF INVENTION

The current invention discloses a security tag for use with food items that are sold. This invention is specifically designed for foods such as meats, fish, and delicatessens. However, it is envisioned this security tag can be used with any food product.

2. DESCRIPTION OF RELATED ART

Examples of security tags for products are shown in U.S. Patent Nos. 5,142,270 (Appalucci, et al.); 5,182,544 (Aquilera, et al.); 5,754,110 (Appalucci, et al.); 5,841,350 (Appalucci, et al.); 5,861,809 (Eckstein, et al.) and 6,400,271 (Davies, Jr., et al.). In particular, another patent owned by Checkpoint System, Inc. of Thorofare, NJ is U.S. Patent No. 5,241,299 (Appalucci, et al.), which discloses an RF (Radio Frequency) tag that has a polymeric layer sandwiching an RF circuit. This tag's coating provides both protection to the circuitry from water and shock. As can be appreciated by those skilled in the art, the purpose of the security tag is to activate security alarms in the store should a customer attempt to leave the store without purchasing the product. If the item is purchased, the security tag is deactivated (usually at the point of sale) to prevent setting off the alarms when the customer leaves the store; thus, the functional life of the security tag is completed.

Food products sold by stores also now include such security tags and many of these food products are microwavable. To prevent the customer from microwaving the deactivated security tag, a warning is typically provided that instructs the customer to discard the packaging before microwaving the food product. However, where the customer forgets or ignores the warning, or where the security tag is located somewhere other than the outside packaging (e.g., in the tray of a meat product), it is desirable to provide a security tag that enhances microwave safety.

With particular respect to meat products, recent occurrences of mad cow disease now make the tracking of meat products even more important. Thus, there is a need for providing RFID tags that can properly operate with regard to meat packaging.

BRIEF SUMMARY OF THE INVENTION

A security element that is microwave-resistant wherein the security element comprises: a first conductive trace (e.g., aluminum, copper, etc.) forming a single open loop; a second conductive trace (e.g., aluminum, copper, etc.) forming a single open loop; a dielectric layer (e.g., a polymer) forming a single open loop and positioned between the first and second conductive traces; wherein the first and second conductive traces are electrically-coupled at a location that penetrates the dielectric layer; and wherein the first conductive layer, the second conductive layer and the dielectric layer are encapsulated within plastic layers (e.g., polypropylene).

A method for providing a security tag associated with meat or fish product packaging having a soaker pad therein. The method comprises the steps of: providing a security tag that is encapsulated to be waterproof and wherein the security tag includes a pair of single open loop conductive traces that are separated from each other by a dielectric layer and wherein the first and second conductive layers are electrically coupled at a location through the dielectric layer; and disposing the security tag within the soaker pad.

A method for providing a security tag associated with meat or fish product packaging having a label thereon. The method comprises the steps of: providing a security tag that is encapsulated (e.g., sealed within plastic layers) to be waterproof and wherein the security tag includes a pair of single open loop conductive traces (e.g., aluminum, copper, etc.) that are separated from each other by a dielectric layer (e.g., a polymer) and wherein the first and second conductive layers are electrically coupled at a location through the dielectric layer; applying an adhesive to one side of the security tag; and securing the security tag on the label.

A method for testing a security tag to determine if it is microwave-resistant. The method comprising the steps of: (a) providing sample food products (e.g., meat products such as beef, chicken, pork, or fish, etc.) that are packaged in a conventional manner and includes associating the security tag under test with each of the sample food products packages; (b) subjecting the sample food products to cold temperatures (e.g., freezing, partially frozen, refrigeration, etc.) for a predetermined period of time (e.g., 24-48 hours);

(c) placing each of the sample food product packages along with their respective security tags under test into respective microwave ovens; (d) activating each of the microwave ovens on high power for three minutes and wherein each microwave has a respective microwave configuration (e.g., 800 watts/0.8 ft^3 , 1000 watts/1.2 ft^3 and 1200 watts/1.6 ft^3);

(e) observing the sample food products being heated in the microwave ovens to see if any sparking or arcing occurs during heating; (f) repeating steps (d) and (e) for a predetermined number of times

(e.g., eighty); and (g) determining that said security tag is microwave resistant if no sparking or arcing occurs after completing step (f).

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

The invention will be described in conjunction with the following drawings in which like reference numerals designate like elements and wherein:

Fig. 1 is an enlarged, partial plan view of the culinary tag of the present invention with the upper adhesive layer omitted;

Fig. 2A is an exploded view of the tag of Fig. 1;

Fig. 2B is a cross section view of the tag of Fig. 1 taken along line 2B-2B;

Fig. 3 is a cross-sectional view of the culinary tag of the present invention inserted within a soaker pad of a food (e.g., meat) package;

Fig. 4 is an enlarged front view of a prior art Series 410 tag;

Fig. 5 is an enlarged rear view of the Series 410 tag of Fig. 4;

Fig. 6 is a side view of a food package showing the culinary tag positioned inside the soaker pad of a meat package; and

Fig. 7 is a side view of a food package showing the culinary tag positioned in an alternative location such as on the wrap of the food package;

DETAILED DESCRIPTION OF THE INVENTION

One of the key features of the tag 20 of the present invention is that it enhances microwave safety. Since the current tag 20 is envisioned to be used in the culinary art, it is necessary that the tag be resistant to microwave energy. As mentioned earlier, it is envisioned that customers may accidentally place this tag in their microwave ovens which may create a safety hazard. In particular, as is known, microwave ovens emit microwave energy which will induce an electric current through a circuit within the microwave field. In the case of a security tag, the current will be induced along the antenna trace. When the voltage becomes great enough the electric current can arc across the antenna traces creating sparks, heat, and possibly fires. The tag 20 of the present invention addresses this problem to create a microwave safe tag that can function after being exposed to microwave energy.

In addition to generating a microwave safe tag, the tag has several unique uses. The tag of the current invention can be created with plastics of varying rigidity and melting temperatures.

Different plastics have varying advantages in terms of safety, flexibility, and cost. Polypropylene is the preferred material for the tag.

The tag 20 of the present invention is designed to work with foods of all types. A major reason RF tags have not become commonplace in the food retail industry is many tags contain toxic chemicals. The tag 20 of the present invention is devoid of any such materials. One preferred use of this tag is in the meat packing industry. The tag 20 can potentially be packaged with the meat by placing onto the foam meat tray. Additionally, the tag 20 may be attached to a plastic wrap of the food product, e.g., the wrap that surrounds and protects the meat and tray. In addition to the meat packing industry, this tag 20 can be used with any food product whether or not the food can be microwaved. Non-limiting examples of some of these uses are in cereal, candy, dairy, products, chips, and noodles.

The tag 20 is non-toxic, even when heated. Moreover, the tag 20 uses plastic materials which do not emit noxious fumes when heated, do not form noxious liquids when melted, and do not contaminate foods in any manner. The materials used to construct the tag are F.D.A. approved materials for use with food products. In the event the tag is heated in a conventional oven, the tag will melt slightly and become inactive, but will not damage the food.

As will be discussed in detail later, the tag 20 of the current invention also has a polymeric layer sandwiching an RF circuit. Finally, depending on the plastic chosen the tag of the current invention is water-resistant or waterproof.

As shown most clearly in Fig. 2A, the tag 20 comprises a first coil layer 22 comprising a single open loop and a second coil layer 24 also comprising a single open loop that are separated by a dielectric layer (e.g., any polymer) 26 that matches the shape of the first and second coil layers 22/24. The term "single open loop" means that the trace forms only one loop (e.g., there are no concentric inner or outer coil loops as there are in Fig. 4); and whereby the trace has endpoints that are not connected; these coil layers may comprise any conductive material, preferably aluminum, copper, etc. First 28 and second 30 adhesive layers are then applied to the respective coil layers 22/24. Polypropylene layers 32 and 34 are secured around the tag 20 by the adhesive layers 28/30. Finally, a third adhesive layer 36 is provided so that the tag 20 can be secured to a portion of the wrapping/packaging of the food product. The first and second coil layers 22/24 are electrically-coupled at contact points 22A and 24A by a crimping action that pierces the dielectric layer at region 26A. To make up for the lower inductance value of the coil layers 22/24 since they each only comprise a single open loop, large capacitor plates 40A and 40B are used; region 26B of the dielectric layer 26 forms the dielectric between these capacitor plates 40A/40B. It should be

understood that the majority of the capacitance is distributed capacitance that is provided by the combination of the single open loop conductive traces 22/24 sandwiching the dielectric layer 26; the large capacitor plates 40A/40B provide a tuning provision for the tag 20.

As shown most clearly in Fig. 1, each coil layer trace 22/24 comprises three elbows (42-46) and is connected to a respective capacitor plate 40B and 40A, respectively. An elbow 42, 44 and 46 is defined as a change in direction of the trace of at least 60 degrees. By way of example only, the elbows 42-46 typically have a radius of curvature of .15 in. Each of the capacitor plates 40A and 40B form a fourth elbow of the respective coil layer trace (22/24), thereby giving the traces 22/24 a square appearance. As mentioned earlier, the pair of traces 22/24 are separated by a dielectric layer 26. As mentioned earlier plastic membrane or layers 32/34 encapsulate the tag 20. Multiple methods can be used to form these layers 32/34 onto the tag 20 including using adhesives 28/30 to bond two plastic pieces 34/36 together to surround the tag 20, melting two pieces of plastic together to surround the tag 20, and molding the plastic around the tag 20. In the first two methods, a seal is formed around the edges of the plastic to prevent water from entering the circuit. This can be seen most clearly in Fig. 2B where the plastic layers 34/36 comprise an overlap that are sealed together.

Many plastics can melt or produce noxious fumes when microwaved. Polypropylene is one preferred material for the tag 20 of the present invention because it is a FDA-approved material suitable to be used in conjunction with microwavable foods. Another advantage of polypropylene is that it is flexible and can be used in lamination devices easily. Depending on the attributes needed, various plastics could be substituted for polypropylene. Some uses of this tag 20 may require a more flexible or rigid plastic, or one providing more waterproofing capabilities.

It should be noted that although a somewhat rectangular configuration for the coil layers 22/24 are used, it is within the broadest scope of the present invention to include any shape of a single trace.

The tag 20 of the present invention was originally designed for use with the meat packing industry. Meat is an expensive product in retail stores and has widely not been successfully protected by RF technology. The delicate RF circuitry does not work if it is exposed to blood or water. Additionally, most conventional tags cannot produce a strong enough signal when covered with the meat product. The plastic casing (e.g., layers 32/34) of the tag 20 provides a novel solution to this problem and allows the tag 20 to be hidden in the soaker pad (also known as "towelette") found under most meat products. It is contemplated that this tag 20 could be placed adjacent the towelette. Additionally, meat products without towelettes can be protected. The general method for

packaging the meat product is therefore encapsulating a tray, the tag, the towlette, and the meat with a plastic wrap. The most preferred embodiment is having the wrap sealing the meat in the tray, with a tag on the top of the wrap.

In particular, Fig. 3 depicts the tag 20 positioned in between a soaker pad 10 that is formed by an upper portion 10A and a lower portion 10B. Each soaker pad portion comprises an absorbent paper layer 11 in contact with the polypropylene layers 32 and 34. The absorbent paper layer 11 is then covered by a perforated polypropylene layer 12. Fig. 6 provides an overall view of a packaged meat product showing the position of a soaker pad 10 including the tag 20 of the present invention disposed therein. In particular, the soaker pad 10 is positioned inside a tray (e.g., polystyrene) or holder 13. The meat product 14 is then placed on top of the soaker pad 10. A transparent cover (e.g., cellophane or shrink wrap, etc.) 15 is then secured over the meat product 14 and sealed to the tray 13. Alternatively, the tag 20 may comprise a part of the label that specifies the product details for the customer; the label is typically bonded (e.g., adhesively-secured) to the transparent cover 15. In particular, the tag 20 may be adhesively secured to the label (or alternatively, may be formed as a part of the label, etc.), as shown in Fig. 7.

The tag of present invention can be used to protect other products that are currently very difficult to protect because of moisture, health concerns, or microwave safety. An embodiment of this tag can be created with a waterproof seal that allows that tag to remain submerged in a liquid, such as wine or milk. This would provide a tag that cannot be removed, while providing all the benefits of RF protection, and without damaging the product.

It is additionally contemplated that tags of this invention can be used in dairy products, cereal, frozen foods, bread, and pastas. While these foods can be protected by using conventional RF technology, limitations of those tags prevented the tags from being placed in direct contact with the food because of signal strength problems, health problems, or microwave safety. The tags of the current invention fulfill the long-felt need to solve these problems, and can effectively protect consumable items in a way not previously possible.

The preferred dimensions of the tag 20 are selected to give maximum output of the tag 20 while solving the four problems surrounding the RF food protection industry. These problems are microwave safety, waterproof capability, protection of the food from tag contamination, creation of a tag that can minimize the effects of RF interference caused by the food. The following dimensions are disclosed by way of example only, and in some cases the dimensions could be modified in order to satisfy particular food product needs but without deviating from the scope of the invention. The dimensions of the tag 20 are approximately 1.72 inches by 1.72 inches. The

width (also referred to as "line width") of the first coil layer 22 is approximately 0.20 inches; the line width of the second coil layer 24 is approximately 0.26 inches. The conductive trace (i.e., coil layer) width should be at least 1/10 of the length of the tag 20. The capacitor area is 0.2191 square inches. The thickness of layer 24 is approximately 50 microns and the thickness of the layer 22 is approximately 38 microns. The thickness of the dielectric layer 26 is approximately 2.5 microns. By way of example only, the frequency the tag 20 returns the resonant signal is 8.2 MHz. The Q of the tag ("quality factor," which is a measure of frequency selectivity or sharpness of the peak of a resonant circuit) is approximately 88-90.

To verify the strength of the tag's response signal, the assignee of this application, namely, Checkpoint Systems, Inc., of Thorofare, NJ, has established a "gold standard"or reference which one can compare the performance of the tag 20 of the present invention. In particular, the gold standard is the measure of a transceiver's measured signal strength of a Series 410 tag, sold by Checkpoint Systems, Inc. (see Table 1, as well as Figs. 3-4) versus the tag 20 of the present invention. Typically, an RF tag returns a certain EM-field when it is energized by a transmitter. The strength of a magnetic field is measured in Gauss or Teslas. The magnetic field generated by the tag induces a current across an inductor which resides in the antenna of the receiver. The induced current is run across a load which creates a voltage difference across the load. This voltage should be approximately 1 GST (gold standard tag) for a series 410 tag.

The tag of the current invention generates a signal 1.7 times more powerful than the Series 410 tag. Thus the tag 20 of the current invention has a power of 1.7 GST because the transceiver measures a 1.7 voltage difference for this tag and 1.0 GST for a series 410 tag.

Table 1

CHECKPOINT SYSTEMS, INC. #410 TAG
Front Area Etched= .5807 sq. in
Back Area Etched = 1.6814 sq in.
Design Frequency = 8.4MHz
Final Frequency = 8.2 MHz
Q Range = 70-75
Capacitance 141.2 pF
Inductance = 2.495 μH
number of turns = 8

Coil line width =.034 in.
Spacing between coils = .01 in.
Width of margins = .1 in.
Circuit Dimensions = 1.55 in. x 1.65 in.

As mentioned earlier, one of the key features of the tag 20 of the present invention is that enhances microwave safety. Currently, if a tag is placed inadvertently inside of a microwave oven (e.g., the user forgets to remove the food packaging which contains the security tag), the tag will be energized by the applied microwaves. Energy is stored in the tag's capacitor and throughout the traces (the antenna.) Because the traces have a resistance (though minor) there is a voltage difference between one trace and another. If the tag receives a large amount of energy, as it would if it were microwaved, the small distance between the traces and large voltage difference may cause electric arcing to occur. This can lead to fires if the electrical arc comes near or into contact with a flammable substance. To prevent this from happening, the tag 20 of the present invention is designed to have only one trace. To account for the loss in surface area of the trace, a very thick trace 50 (Fig. 1) is used. To further reduce arcing, the elbows 42-46 of the layers 22/24 are rounded rather than pointed.

Microwave energy is characterized as "high intensity" which is defined as energy greater than 1100 watts, and prolonged exposure greater than four minutes (limited exposure is a time of less than three minutes). For a tag to be considered "microwave safe" it cannot emit sparks when subjected to high power, prolonged microwave energy. When the tag 20 of the current invention is described as being "microwave resistant", this means that the tag 20 continues to operate after exposure of a limited duration of high power microwave energy when used with its intended purpose.

To demonstrate that the security tag 20 of the present invention enhances microwave safety, the Assignee of the present invention engaged a testing and certification company, namely, TÜV Rheinland of North America of Youngsville, North Carolina, a certification company, to prepare a novel test of the tag 20 of the present invention. It is believed that before then, there was no standard test for the microwave safety of a security tag.

The microwave test involves using different styles of meat that are cut into 0.5 lb (beef) and 1 lb (pork & chicken); the poundage being determined by the amount of moisture content within that particular meat. The tag 20 of the present invention is placed on the outside or

inside the soaker pad of each meat package and then they are packaged using Styrofoam meat trays and shrink-wrap. The packages are then placed in a freezer for a 24 – 48 hour period. Every cut and style of meat has a minimum of 3 duplicates (one for each type of microwave). The meat product including the tag 20 on the label is then placed in (three packages, same weight, cut & style) and is placed into three different microwaves (see microwave types & power levels below) for 3 minutes on high power (i.e., the maximum power level of the microwave oven). The test is considered a success, if after 3 full minutes at high power in the microwave the tag 20 of the present invention has not arced or sparked. This test is performed roughly 80 times per microwave type (3 types see below) or 240 total tests.

1) **Microwave Oven Wattage /cu ft** – all testing must be performed using each of the following microwave specifications (or configuration):
    A) 800 watts /0.8 cu ft (GE microwave oven)
    B) 1000 watts / 1.2 cu ft (Sharp microwave oven)
    C) 1200 watts / 1.6 cu ft (Panasonic microwave oven)

2) **Type of Meat** – all 3 types of meat listed below must be used in all of the testing.
    A) Beef
    B) Chicken
    C) Pork

3) **Style of Meat** -all 3 styles of meat listed below must be used in all of the testing
    A) Solid Mass
        1) Beef – Filet, Beef Patties, Roast
        2) Chicken – Boneless Breast, Cutlets
        3) Pork – Tenderloin, Roast, Boneless Chops
    B) Small Pieces
        1) Beef – Cubes, Shish Ka Bob
        2) Chicken – Nuggets, Wings
        3) Pork - Sausage
    C) Meat with Bones
        1) Beef – T-Bone, NY Strip, Ribeye
        2) Chicken – Legs, Wings, Breast
        3) Pork – Ribs

4) **State of Food**
    A) Frozen
    B) Partially Frozen
    C) Refrigerated

5) **Weight of Food**
    A) 0.5 lbs with Beef when security tag is on the outside of the packaging
    B) 1 lb with Pork and Chicken when security tag is on the outside of the packaging
    C) .5 lbs with Beef, Chicken or Pork when security tag has been integrated into a meat soaker pad

6) Location of Security Tag

A) Underneath Barcode (Outside)
B) Corners (upper right, lower right, upper left, lower left)
C) Middle of Package (Outside)
D) Underneath Meat (Soaker Pad)

7) Power Level

A) High Power

It should be understood that the security tag microwave-resistant testing was conducted using meat food products. However, it is within the broadest scope of the present invention that a similar test method can be applied to other food products, such as fish (0.5 lb), shellfish, etc.

While the invention has been described in detail and with reference to specific examples thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

CLAIMS

1. A security element that is microwave-resistant, said security element comprising:

a first conductive trace forming a first single open loop conductor;

a second conductive trace forming a second single open loop conductor;

a dielectric layer forming a single open loop insulator and positioned between said first and second conductive traces;

said first and second conductive traces being electrically-coupled at a location that penetrates said dielectric layer; and

wherein said first conductive trace, said second conductive trace and said dielectric layer are encapsulated within plastic layers.

2. The security element of Claim 1 wherein said first and second single open loop conductors and said single open loop insulator each comprise at least three elbows.

3. The security element of Claim 2 wherein each of said at least three elbows defines a change in direction of said conductive trace of at least 60 degrees.

4. The security element of Claim 2 wherein said first conductive trace and said second conductive trace each comprise four elbows and wherein one of said elbows forms a capacitor plate.

5. The security element of Claim 4 wherein each of said capacitor plates is approximately 0.2191 square inches.

6. The security element of Claim 4 wherein a ratio of a width of either of said conductive traces to a length of said security element is at least 1 to 10.

7. The security element of Claim 2 wherein each of said at least three elbows comprises a rounded corner.

8. The security element of Claim 7 wherein each of said at least three elbows has a radius of curvature of approximately 0.15 inches.

9. The security element of Claim 1 wherein said plastic layers comprises polypropylene.

10. The security element of Claim 1 wherein said dielectric layer comprises a polymer.

11. The security element of Claim 1 wherein said first and second conductive traces comprise aluminum.

12. The security element of Claim 1 wherein plastic layers comprise:

a first plastic layer adhesively-secured to said first conductive trace;

a second plastic layer adhesively-secured to said second conductive trace; and

wherein said first plastic layer and said second plastic layer each comprise overlap regions that are sealed together.

13. The security element of Claim 1 wherein said first and second conductive traces and said dielectric layer form an electrical circuit that resonates at 8.2 MHz.

14. The security element of Claim 13 wherein said electrical circuit has a quality factor (Q) of approximately 88-90.

15. The security element of Claim 1 wherein said first and second conductive traces are crimped to form said electrical coupling.

16. The security element of Claim 13 wherein said element emits a response signal having a power that is approximately 1.7 times the power of a response signal of a security element having multiple loop conductive traces.

17. A method for providing a security element associated with meat or fish product packaging having a soaker pad therein and a label on the packaging, and wherein said method minimizes a risk of the security element arcing if the meat or fish product packaging is placed within a microwave, said method comprising:

forming a first single open loop conductor having rounded corners using a first conductive trace on a substrate;

positioning a single open loop dielectric layer on top of said first conductive trace;

positioning a second conductive trace comprising a second single open loop conductor having rounded corners on top of said dielectric layer;

electrically-coupling said first and second conductive traces by penetrating said dielectric layer at a given location; and

encapsulating said first conductive layer, said dielectric layer and said second conductive layer within plastic layers.

18. The method of Claim 17 further comprising a step of positioning said security element within the soaker pad.

19. The method of Claim 17 further comprising a step of securing said security element to the label on the packaging.

20. The method of Claim 17 wherein said steps of forming a first single open loop conductor and a second single open loop conductor having rounded corners comprises forming at least three rounded corners in said first conductive trace and said second conductive trace.

21. The method of Claim 20 wherein said step of forming at least three rounded corners in said first and second conductive traces comprises forming four rounded corners on each conductive trace and wherein one of said corners forms a capacitor plate.

22. The method of Claim 17 wherein said steps of forming a first single open loop conductor and a second single open loop conductor having rounded corners comprises forming each of said rounded corners using a radius of curvature of approximately 0.15 inches.

23. The method of Claim 17 wherein said steps of forming a first single open loop conductor and a second single open loop conductor comprises forming each of said conductors using a ratio of width to length of at least 1 to 10.

24. The method of Claim 17 wherein said step of encapsulating said first conductive layer, said dielectric layer and said second conductive layer within plastic layers comprises:

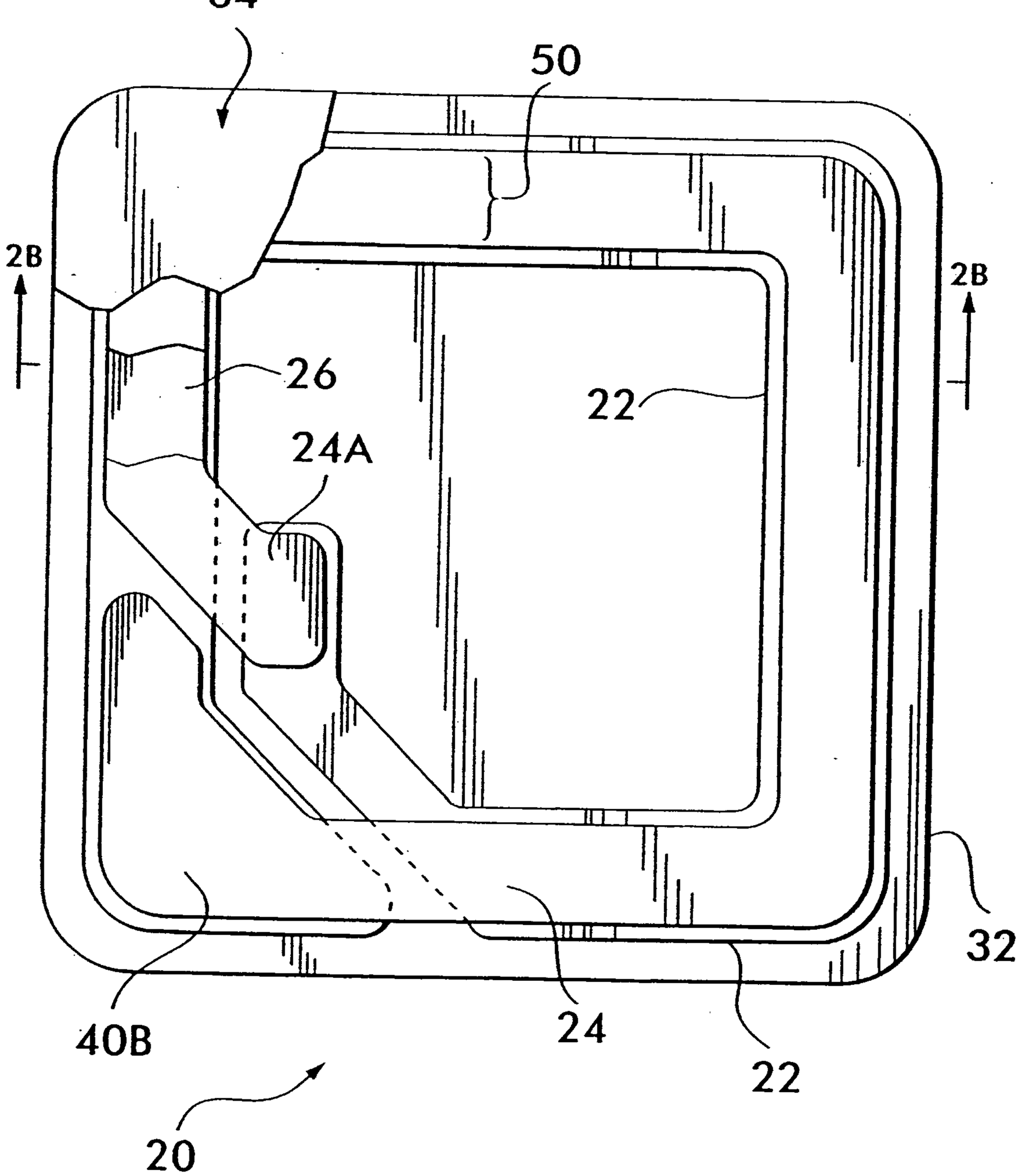
adhesively securing a first plastic layer over said first conductive trace to form a first overlap region;

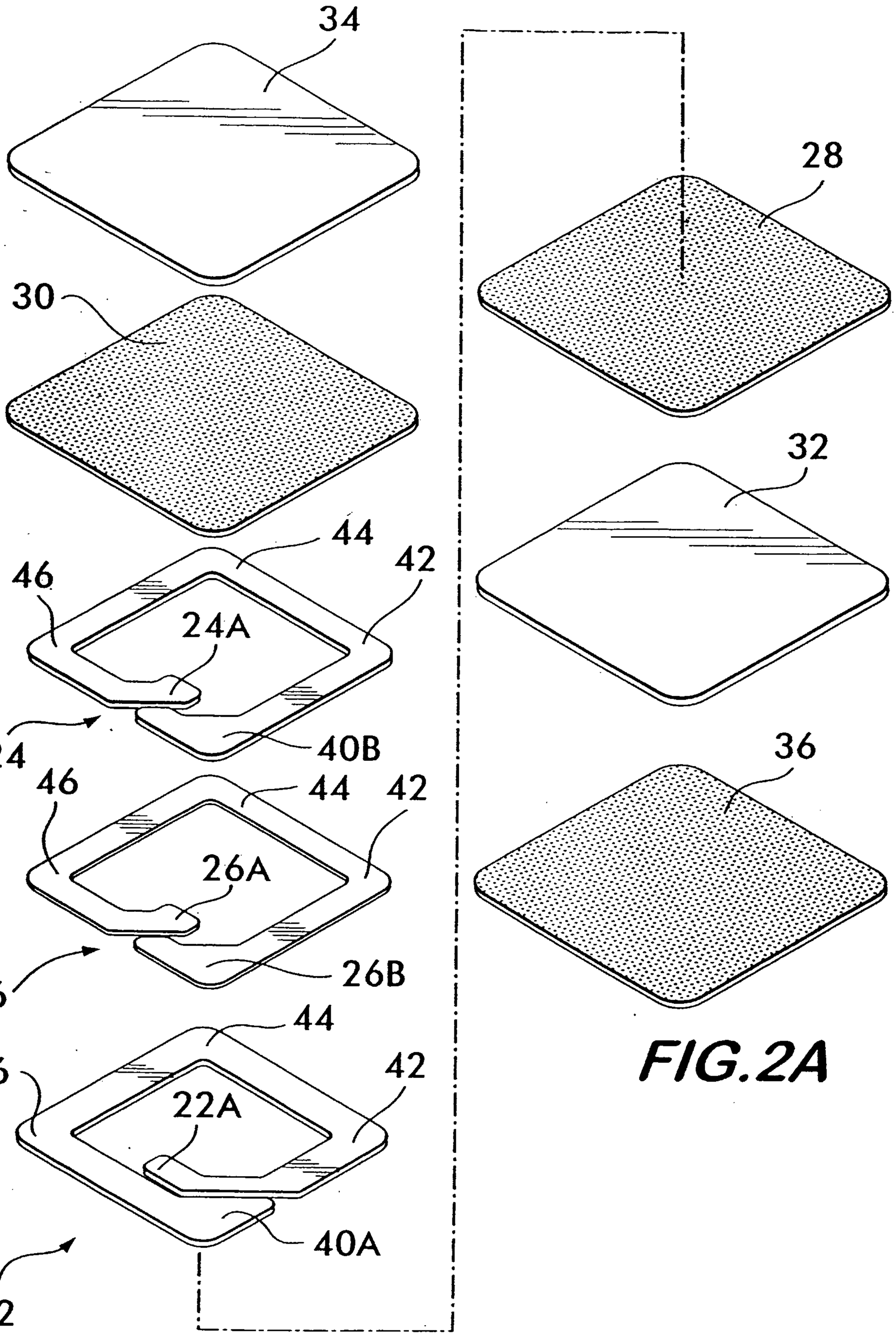
adhesively securing a second plastic layer over said second conductive trace to form a second overlap region; and

sealing together said first overlap region and said second overlap region.

25. The method of Claim 17 wherein said step of electrically-coupling said first and second conductive traces by penetrating said dielectric layer at a given location comprises crimping.

FIG.1

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24A
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26B
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22A
40A
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FIG.2A

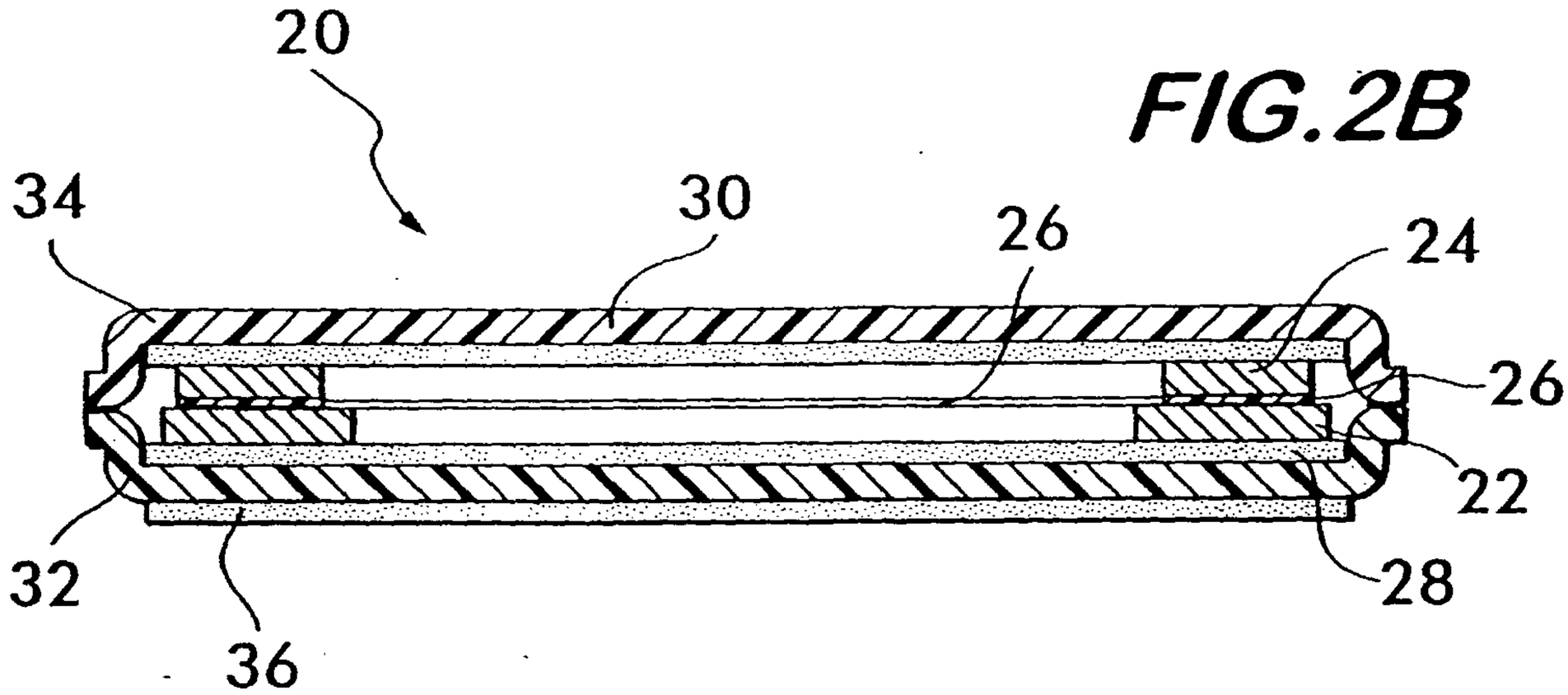


FIG.2B

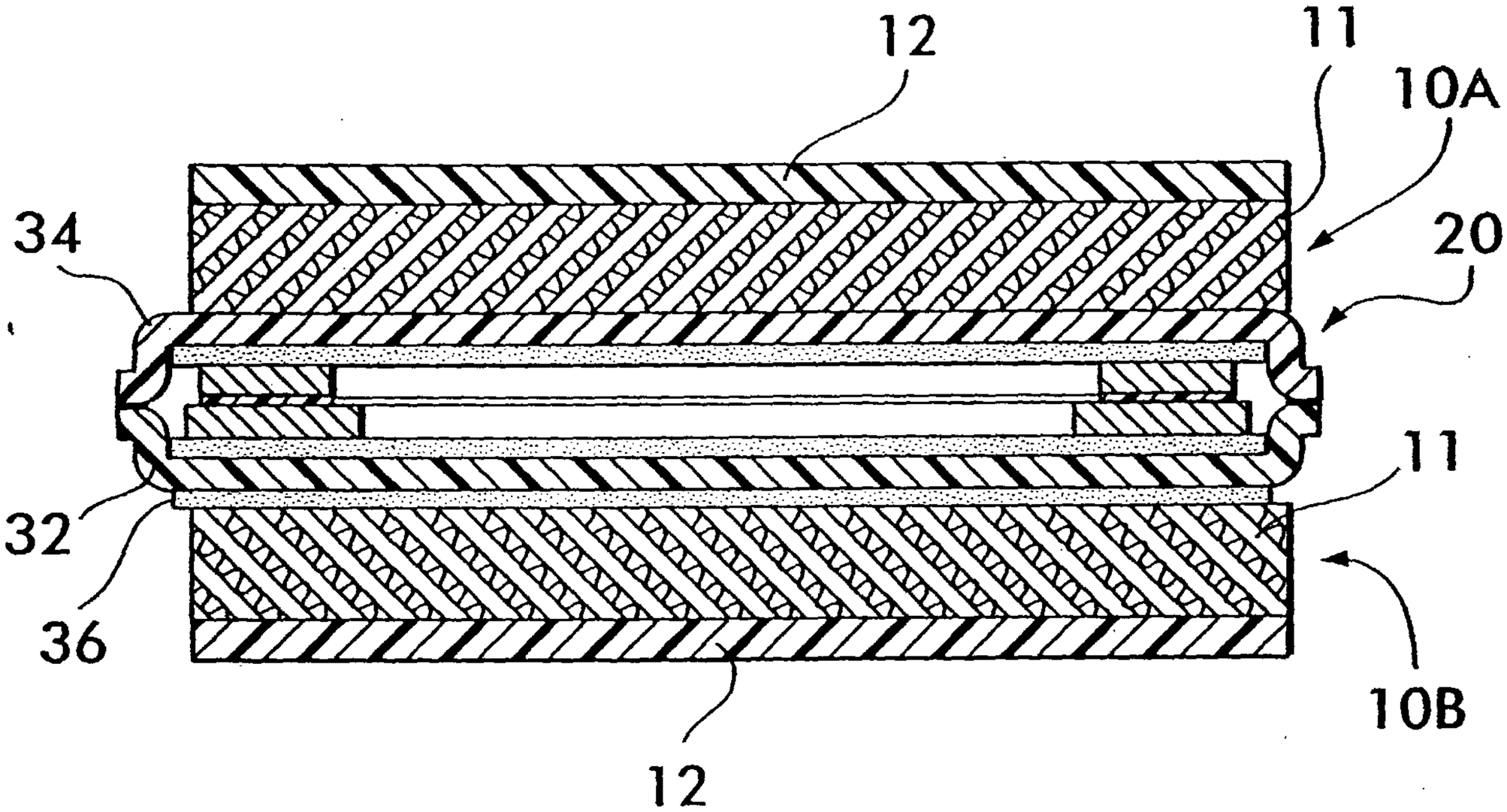
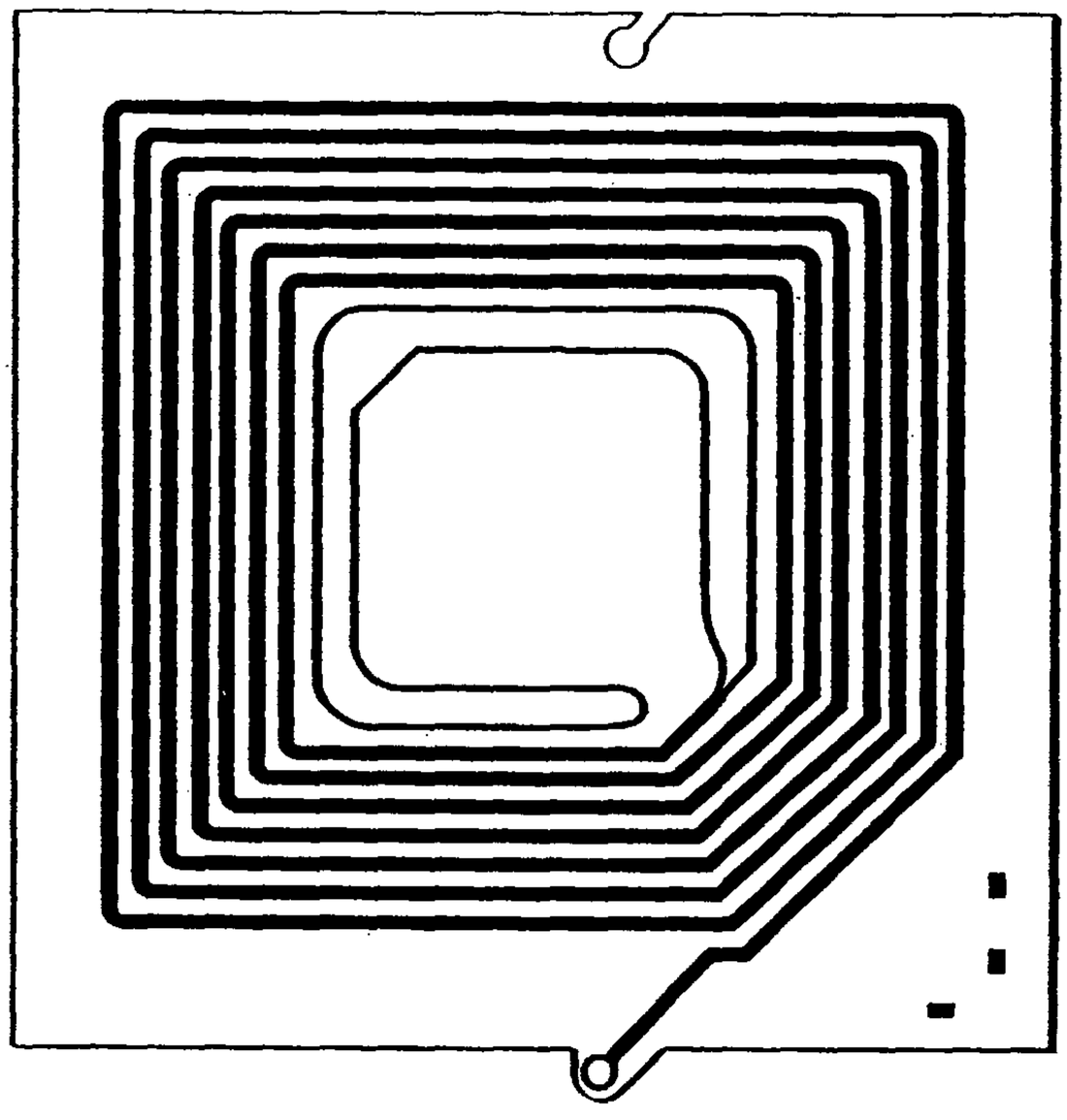


FIG.3

FIG.4
(PRIOR ART)



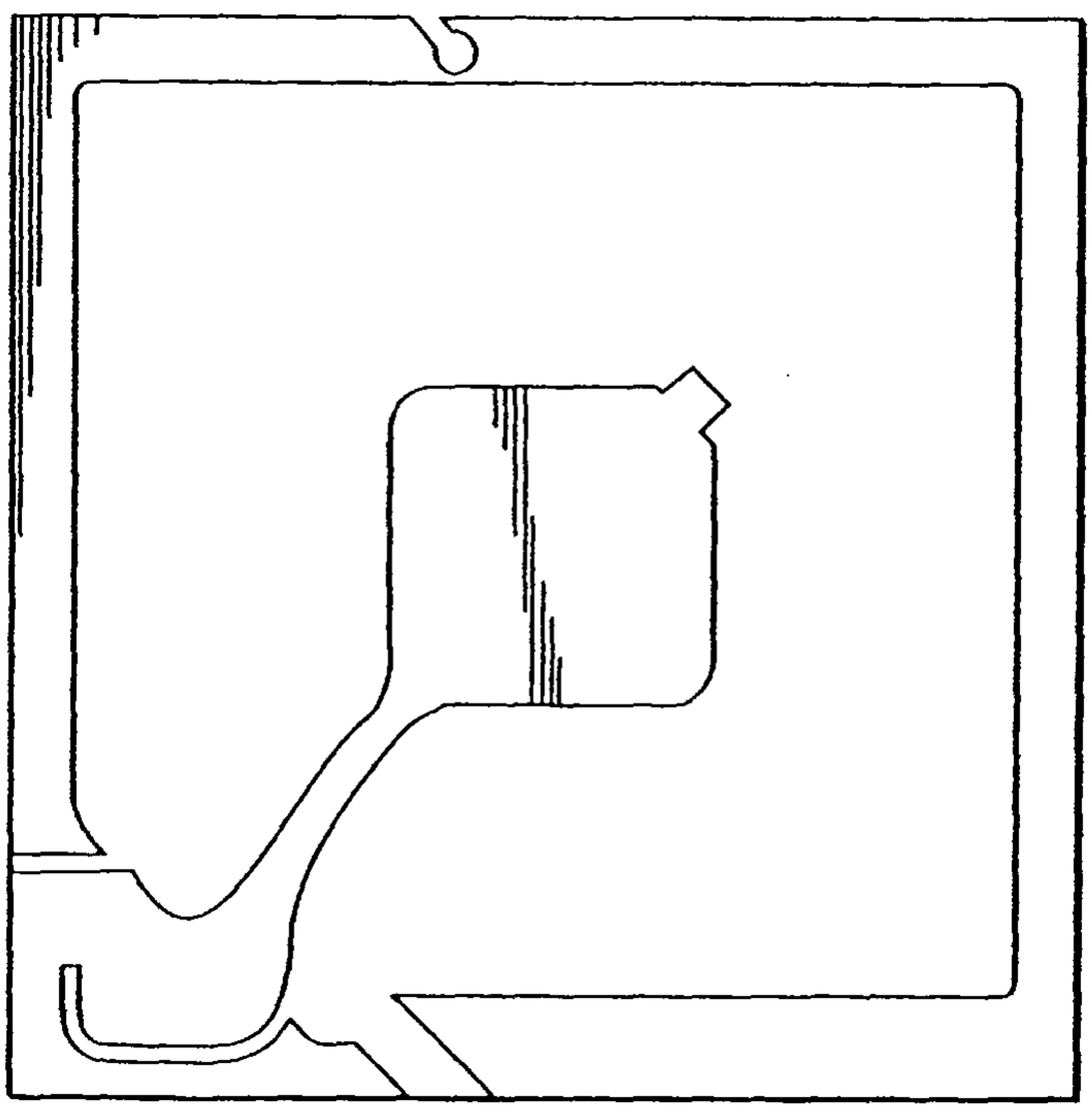


FIG.5
(PRIOR ART)

FIG.6

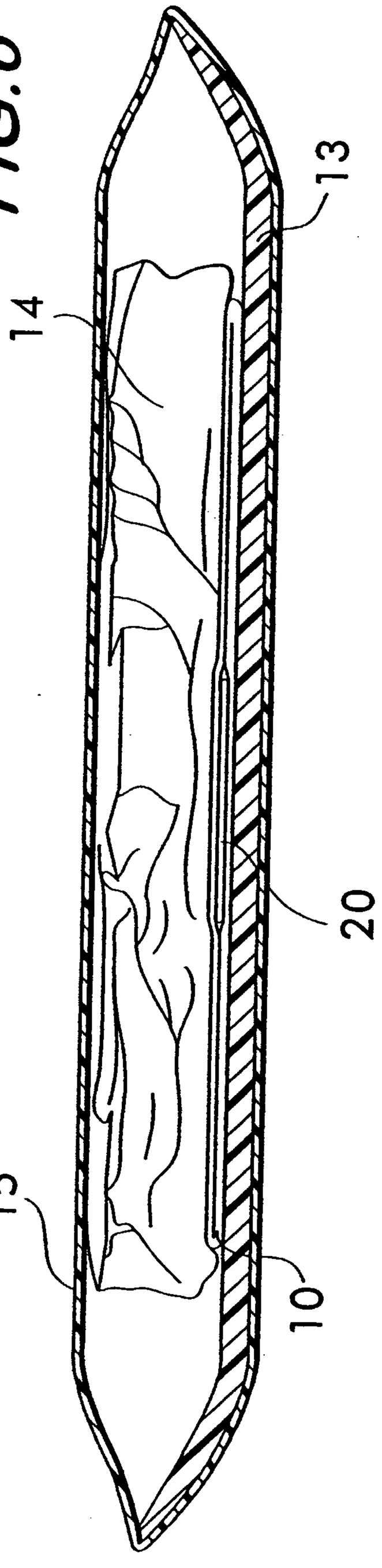
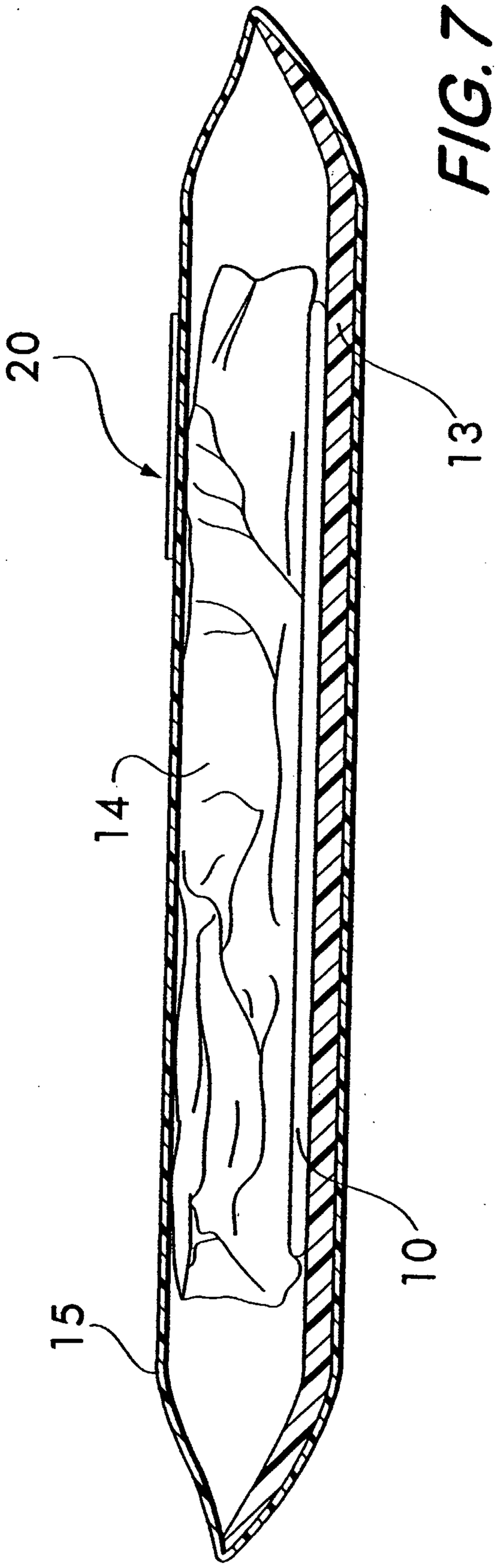
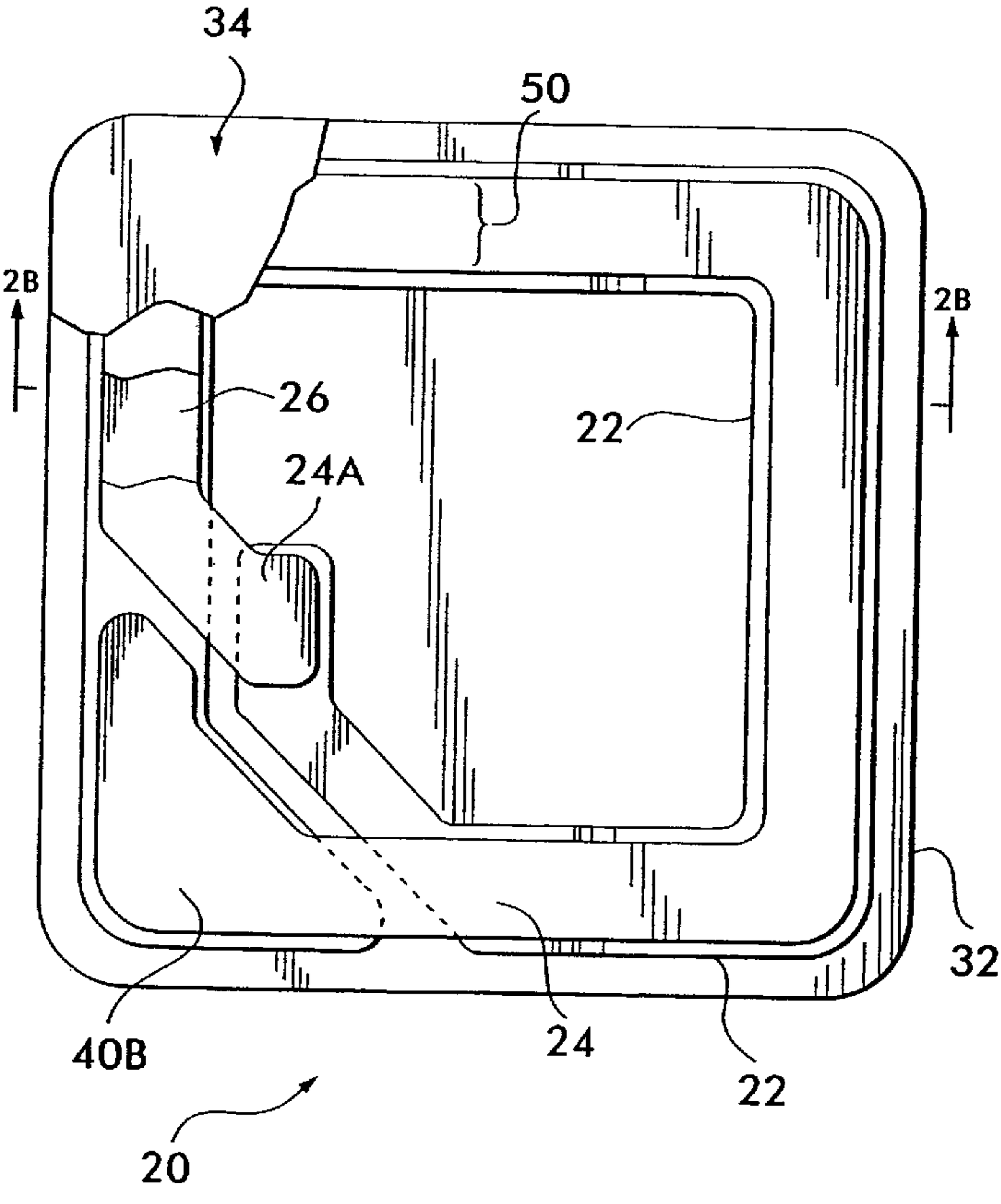


FIG.7

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