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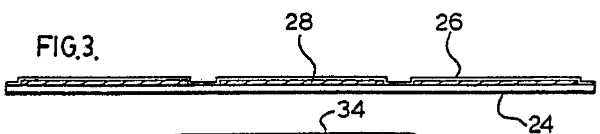
(54) Container and blank for, and method of, microwave heating.

(57) A susceptor bag (20) for microwave heating of food products, such as french fries, fish sticks, apple turnovers and burritos, is formed from a single flexible sheet comprising a layer (16, 28) of metal or other electroconductive material having microwave susceptor thickness, supported on a paper substrate material (12, 24). The flexible sheet is folded on itself to form a sleeve (20) which houses and engages the food product. The thin metal layer (16, 28) is provided only in the regions where the food is located. The metal layer (16, 28) usually is overlied by a polymeric film layer (14, 26) or a release coating. By providing the thin metal (16, 28) upon application of microwave energy, the interior of the food product (30) becomes heated to a desired edible temperature while the exterior becomes crispened by thermal energy generated by the thin metal layer.

FIG.3.



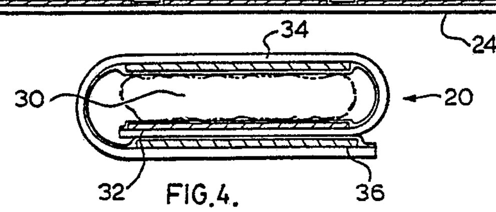


FIG.4.

EP 0 365 247 A2

CONTAINER AND BLANK FOR, AND METHOD OF, MICROWAVE HEATING

The present invention is concerned with a sleeve or bag for microwave heating of food products for consumption.

It is known that very thin metal films can be employed to convert a portion of microwave energy incident thereon to thermal energy and this phenomenon has been employed in the microwave heating of a variety of foodstuffs for consumption. One such structure is disclosed in U.S. Patent No. 4,641,005. The development of such thermal energy during microwave cooking can be beneficial with certain products, where an exterior crispness is desirable.

Often simple microwave cooking rapidly heats the product to a temperature at which the interior is edible while little affecting the outer shell. Normally, when it is attempted to reconstitute frozen french fries, for example, the resulting french fries tend to have a soggy exterior, as a result of moisture being driven away from the interior of the french fries by the microwave energy.

In accordance with the present invention, there is provided a novel container structure to permit food products to be heated by microwave energy while thermal energy also is applied to the exterior surface. Among the food products which can be packaged in the novel container structure are elongate food products, such as fish sticks, french fries, burritos, egg rolls and spring rolls, as well as other shaped products, such as puff pastries and apple turnovers. By employing the novel container in the microwave heating of such products, not only is the interior of the elongate food product heated to the desired edible temperature but the exterior is crispened, to provide a more acceptable tasting product.

In accordance with one aspect of the present invention, a novel container structure comprises a flexible sleeve or bag for housing a foodstuff for heating therein by the application of microwave energy. The flexible sleeve is formed of overlying and coincident layers of a flexible structure comprising a discontinuous thin layer of electroconductive material supported on a paper substrate material and having a thickness such as to permit a portion of microwave energy incident thereon to be converted to thermal energy. The thin layer is provided on the substrate only in those regions of the interior of the sleeve intended to contact the foodstuff in the bag.

The requirement that the thin layer of electroconductive material be present only in the regions of the interior of the sleeve intended to contact the foodstuff arises from the fact that, upon exposure to microwave energy, the thin layer heats up to a high temperature which, but for the heat sink of the foodstuff, may cause scorching or even burning of the paper substrate.

The thin layer of electroconductive material supported on the substrate usually is provided with an overlying layer, so that the thin layer does not directly contact the foodstuff. Such overlying layer may comprise a heat-resistant release layer, such as a silicone, or a polymeric film layer. In the former case, the thin electroconductive material layer is provided supported on the substrate by directly applying the thin layer to the paper layer by any convenient procedure, such as by sputtering or electron beam coating of stainless steel. The thin material layer may be provided in the desired pattern on the substrate or may be applied over the whole surface of the substrate and then inactivated in the region where thermal energy is not desired to be produced.

When the overlying layer comprises a polymeric film layer, the thin layer of electroconductive material often conveniently first is provided on the polymeric film layer, such as by vapor deposition of aluminum. Selective demetallization of the aluminum may be employed to provide the non-heating regions, such as by employing aqueous alkaline etchant, as described, for example, in U.S. Patents nos. 4,398,994, 4,552,614 and 4,610,755, the disclosures of which are incorporated herein by reference. The combination of the thin metal film on polymeric film layer then is laminated to the paper layer, and thereby the thin metal layer becomes supported on the paper substrate.

One drawback to this structure is that, when the sleeve sits on the bottom wall of a microwave oven during microwave heating of the foodstuff contained within the sleeve, some of the thermal energy generated by the lower layer of electromagnetic material tends to be conducted away by the microwave oven wall, thereby producing uneven browning and crisping.

This problem may be overcome by placing a corrugated cardboard or the like insulator between the lower surface of the sleeve and the microwave oven wall. However, this is sometimes inconvenient and, in accordance with one embodiment of the invention, the problem is overcome by providing an additional layer of electroconductive material having heat susceptor thickness at the side intended to be the lower surface, so that the heat otherwise lost is compensated for by the heat generated by the additional layer of electroconductive or semi-conductive material.

The sleeve of the invention may be used to package the foodstuff and may be sealed at the manufacturing location of the foodstuff. Alternatively, the sleeve of the invention may be provided in the form of an open-ended bag, which then may be employed in the domestic environment for heating the foodstuff inserted into the sleeve by the consumer. In one embodiment of such an open-ended sleeve, the open end is pre-folded over to assist the sleeve to stay closed after the consumer has placed the foodstuff in the sleeve.

The invention is described further, by way of illustration, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a blank for forming a heat susceptor sleeve in accordance with one embodiment of the invention;

Figure 2 is a perspective view of a blank for forming a heat susceptor sleeve in accordance with another embodiment of the invention;

Figure 3 is a sectional view of the blank of Figure 2, taken along line A-A of Figure 2;

Figure 4 is a sectional view of the sleeve formed from the blank of Figures 2 and 3 enclosing a food product for microwave heating;

Figure 5 is a perspective view of one form of heat susceptor sleeve with folded-over end for domestic use;

Figure 6 illustrates inserting a foodstuff, such as a burrito, into the sleeve of Figure 5;

Figure 7 is a sectional view of the heat susceptor sleeve of Figure 5 with the burrito positioned therein;

Figure 8 is a plan view of a blank for forming a heat susceptor sleeve in accordance with a further embodiment of the invention;

Figure 9 is a detail view of the heat susceptor sleeve formed from the blank of Figure 8; and

Figure 10 is a perspective view of a heat susceptor sleeve formed from the blank of Figure 8.

Referring first to Figure 1, there is shown therein a blank 10 from which a heat susceptor sleeve or bag may be formed by folding the blank in two so as the layers overly and are coincident with one another to enclose a desired foodstuff, and then sealing the edges.

The blank 10 comprises a paper substrate layer 12, an upper polymeric film layer 14 and a discontinuous thin layer 16 of electroconductive material located between the paper layer 12 and the polymeric film layer 14.

The discontinuous thin layer 16 is provided on the substrate layer 12 only in those regions which are intended to engage the outer surface of the foodstuff, so as to avoid scorching and perhaps burning in the regions that are not contacted by the foodstuff.

The polymeric film layer 14 may be replaced by a layer of heat-resistant release material, which may be provided only in the locations of the discontinuous layer 16, if desired. An additional paper layer may be provided overlying the polymeric film layer or other layer 14.

If desired, an additional thin layer of electroconductive material may be provided on the polymeric film layer to be coincident with all or a portion only of one or more of the discontinuous layers of electroconductive or semi-conductive material to obtain thereby a multiple heating effect from the overlying layers of electroconductive material.

Alternatively, an additional thin layer of electroconductive material may be adhered to the outer wall of the structure to effect such augmentation of heating, for example, in the form of a patch comprising the thin layer laminated between a polymeric film layer and a paper layer.

The layer 16 and any additional layer of such material most conveniently may be provided by an electroconductive metal or alloy thereof, preferably aluminum or stainless steel, although other electroconductive materials, such as carbon black and certain metal oxides, may be employed. In the following further discussion of the invention, the layer 16 will be described as being of metal.

The discontinuous layer 16 may be of any desired thickness capable of converting a portion of microwave energy incident thereon into thermal energy. In effect, the thickness of the electromagnetic material is such as to cause that material to become semi-conductive. For aluminum, which is the metal commonly employed when a polymeric film layer 14 is employed, the thickness generally is one corresponding to an optical density of about 0.08 to about 3.0, preferably about 0.1 to about 0.8 and most preferably about 0.2 to about 0.5. For stainless steel, which is the metal commonly employed when a release coating is provided on the metal layer 16, the thickness generally is one corresponding to a resistance of about 50 to about 5000 ohms, preferably about 100 to about 2000 ohms. These parameters also apply to the metal layers of heat susceptor thickness referred to in the additionally illustrated embodiments described below.

It often occurs that the microwave cooking of the food product provides a cooked product prior to the time that there has been sufficient crispening of the outer surface. As described in U.K. patent application Serial No. 8827709.0 filed November 28, 1988, ("Shield-Met"), assigned to the applicant herein and the disclosure of which is incorporated herein by reference, as the thickness of the metal layer increases beyond that at which maximum heating is observed, heating is retained but reflection of an increased portion of the microwave energy also results, so that the amount of microwave energy passing through the metal film to effect heating of the foodstuff is decreased.

This principle can be employed in the present invention to slow the rate of heating of the filling of a foodstuff while the exterior is heated by the thermal energy generated from the thin metal layer to provide a crisp exterior to the foodstuff. In this way, a fully-cooked but not overcooked foodstuff may be provided having a crisp exterior. For example, where aluminum is the metal, the thickness may correspond to an optical density of greater than about 0.8 to obtain the microwave shielding effect. This principle also may be applied to the embodiments described below with respect to the other Figures of drawings.

Referring now to Figures 2 to 4, there is illustrated therein the provision of a heat susceptor sleeve 20 from a blank 22. The blank 22 has a substantially similar structure to blank 10, having a paper substrate layer 24, a polymeric film layer 26 and a discontinuous thin metal layer 28.

In this embodiment, however, the discontinuous metal layer 28 comprises three segments or domains rather than the two segments or domains illustrated in the Figure 1 embodiment. Two of the adjacent segments 28 are of the same dimensions, corresponding to the outer surface of the foodstuff intended to be contacted by the two segments 28 while the third segment may be of the same dimension as the other two, or of a lesser dimension as illustrated.

The blank 22 is folded about a foodstuff 30, in three panels 32, 34 and 36, so that panel 36, containing the third segment of the discontinuous metal layer 28 is coincident with and overlies panel 32, and is end sealed to complete the enclosure. By reason of the overlapping panels 32 and 36, there are provided two metal layers 28 on one side of the foodstuff 30, intended to contact the floor of the microwave oven, and one metal layer 38 on the other.

When the foodstuff 30 is heated by incident microwave radiation, more heat is generated by the underlying overlapping metal layers than by the single overlying metal layer. Some of the energy produced by the outer metal layer in the overlapping layers is absorbed by the microwave oven bottom wall and the remainder augments the energy produced by the inner metallic layer in the overlapping layers.

As noted earlier, the outer metal layer may be of a lesser dimension than the inner metal layer, so that the augmented heating is obtained only in a portion of the overlapping panels, for example, with a puff pastry or an apple turnover, where additional heating is required to the filling only, to provide the final cooked product.

When the foodstuff 30 is exposed to microwave radiation, a portion of that radiation is converted to thermal energy by the thin metal layers, as described above, while the microwave energy passing through the sleeve 20 heats the filling of the foodstuff 30. The thermal energy produced by the thin metal layers results in crispening of the outer crust of the product and assists in cooking the foodstuffs 30 to the required temperature for consumption.

In the illustrated embodiment, the extent of overlapping of the panels 32 and 36 is such as to provide approximately one-third overlap, which provides an overlapping region of approximately the same dimension as the non-overlapping region. Depending on the food product being heated, the ratio of overlapping region to non-overlapping region may be varied, generally from about 25:75 to about 75:25.

In place of a third integral panel 36, an additional metal layer may be provided by a separate element, such as a panel comprising the metal layer supported on paper or polymeric film or laminated between layers of polymeric film paper, adhered to the outer surface of one side of a bag structure, such as illustrated in Figure 1.

Turning now to consideration of Figures 5, 6 and 7, there is illustrated therein an embodiment of the invention of a preformed sleeve for domestic use. As noted earlier, the present invention may be employed not only to provide pre-packaged foodstuffs from a manufacturer, as described above with respect to Figures 1 to 4, but may also provide a sleeve 40 for domestic use, whereby the consumer positions the desired foodstuff in the sleeve or bag.

The sleeve 40 is of construction similar to the embodiment of Figures 2 to 4, except that it is provided in the form of a sleeve which is sealed at three edges 42, 44, 46 but which is open at one end edge 48, to facilitate insertion of the foodstuff into the sleeve 40. The open edge 48 is prefolded over at 50. The prefolding over of the open edge 48 enables the sleeve 40 to be readily opened to receive a foodstuff 52, such as an eggroll, for cooking and then to be easily and properly folded again to provide closure of the sleeve 40 at that end. This arrangement ensures that there is uniform contact between the interior of the bag in the region of the discontinuous metal layers and the outer surface of the foodstuff, to provide even browning and crisping of the foodstuff.

The sleeve 40 is formed from a single sheet with overlapping panels, as seen in the sectional view of Figure 7, in analogous manner to the structure illustrated in Figures 2 to 4. As may be seen, an outer paper substrate 54 has three segments or domains 56 of thin metal coinciding in shape and location to the foodstuff 52, and an overlying polymeric film layer 58.

Figures 8 to 10 show the application of the principles of the invention to a french fry bag, with an alternative manner of sealing of the bag. Figure 10 shows the bag 60 with an open end in the folded-over configuration shown in Figure 5, to permit the same to be used domestically. The structure equally may be sealed enclosing the french fries at the factory level. French fries are commonly available in a cooked frozen form. The french fry bag of the invention enables microwave reconstitution of such frozen french fries to be effected.

As seen, the blank 62 for the french fry bag comprises a paper substrate 64, a polymeric material film layer 66 coextensive with the paper layer 64 and a discontinuous metal layer 68, comprising three panels 70, 72 and 74. The metal panels are provided only in locations which contact french fries packaged in the french fry bag, as seen in the close-up of Figure 9. The polymeric film layer 66 may be replaced by a layer of release material over the thin metal panels.

The metal layer 68 is provided in a thickness which permits the conversion of a portion of microwave energy incident thereon to be converted to thermal energy, so as to crispen the outer surface of the french fries as they are heated by the microwave energy.

The portions of the blank containing metal panels 70 and 74 are folded over and are sealed together to form a longitudinal seal 76 extending for the length of the bag 60 approximately centrally-located in one face, while the ends also are sealed, or one end is left open, depending on the use. The provision of the longitudinal seal 76 is an alternative arrangement to the edge sealing illustrated with respect to the embodiments of Figure 1.

As noted earlier, as a result of heat transfer to the oven wall, the upper metal panels 70, 74 tend to heat up more than the lower metal panel 72 when microwave energy is applied during reconstitution of the frozen french fries. To compensate for this, an additional outer metal layer may be provided, as discussed above, or the upper metallic panels 70, 74 may be provided with a lower density of metal than the lower metal panel 72, so that less heat is generated from the microwave energy in the upper panels. This alternative also may be employed in the embodiment of Figure 1.

This effect may be achieved by using a screening demetallization in the regions of the sheet which are to provide the metal panels 70, 74, as described in copending United States patent application Serial No. 353,206 filed April 12, 1989, owned by the applicant herein and the disclosure of which is incorporated herein by reference.

The materials and dimensions of such materials discussed above with respect to the embodiment of Figure 1 apply equally with respect to the embodiment of Figures 8 to 10. In the various Figures, the thickness of the various layers is not shown to scale.

In summary of this disclosure, the present invention provides a novel heat susceptor structure in the form of a bag uniquely capable of being employed in the microwave heating of food products. Modifications are possible within the scope of this invention.

In addition to the broad aspects of the invention set out in the introduction of the specification, there are also provided a number of further broad aspects of the invention, as follows.

In acccordance with the invention in one aspect, there is provided a method of heating food comprising the steps of placing food in a container formed by a flexible structure comprising a discontinuous thin layer of electrically conductive material supported on a substrate, applying microwave energy to the food in the container to heat the food, and causing a portion of the microwave energy incident upon the container to be converted to thermal energy by the discontinuous thin layer of electroconductive material substantially only in regions where the food is located in the container.

There is further provided in accordance with the invention a flexible container for microwave heating of food in the container, the container being formed by a flexible structure comprising a discontinuous thin layer of electrically conductive material which is supported on a substrate material and which has a thickness such as to permit a portion of microwave energy incident thereon to be converted to thermal energy, the discontinuous thin layer being positioned on the substrate material only in selected regions which are such as to be likely to be in close proximity in operation with food placed in the container.

In one arrangement, the container has upper and lower major faces joined at side edges of the major faces, each said selected region extending over a substantial area of one of the major surfaces, but leaving at least some side edges free of the layer of electroconductive material.

Finally, there may also be provided in accordance with the invention, a blank for forming a flexible container for microwave heating of food in the container, the blank being formed by a flexible structure comprising a discontinuous thin layer of electrically conductive material which is supported on a substrate material and which has a thickness such as to permit a portion of microwave energy incident thereon to be converted to thermal energy, the discontinuous thin layer being positioned on the substrate material only in selected regions which are such as to be likely to be in close proximity in operation with food placed in a container formed from the blank.

Claims

1. A container structure, which comprises a flexible sleeve for housing a foodstuff for heating therein by the application of microwave energy and formed of overlying and coincident layers of a flexible structure comprising a discontinuous thin layer of electroconductive material supported on a paper substrate material and having a thickness such as to permit a portion of microwave energy incident thereon to be converted to thermal energy, the discontinuous thin layer being positioned on the substrate material only in those regions of the interior of the sleeve intended to contact the foodstuff.

2. The container claimed in claim 1 formed from a single sheet of said flexible structure having a first dimension corresponding to a first dimension of the container and a second dimension corresponding to twice a second dimension of the container.

3. The container claimed in claim 2 having an additional thin layer of the electroconductive material located adjacent an outer surface of the structure which is coincident with and has a dimension which is the same as or less than one of the thin electroconductive material layers.

4. The container claimed in claim 1 formed from a single sheet of the flexible structure having a first dimension corresponding to a first dimension of the container and a second dimension corresponding to twice a second dimension of the container, whereby, when the single sheet is folded, the container has a single thin layer of electroconductive material to one side and multiple thin layers of electroconductive material to the other.

5. The container claimed in any one of claims 1 to 4 wherein the flexible structure comprises an outer paper substrate, an outer polymeric film layer of the same dimension as the paper substrate and a discontinuous thin layer of electroconductive material therebetween.

6. The container claimed in any one of claims 1 to 5, wherein the electroconductive material layer is provided by stainless steel having a thickness corresponding to a resistance of 50 to 5000 ohms, preferably 100 to 2000 ohms.

7. The container claimed in any one of claims 1 to 5, wherein the electroconductive material layer is provided by aluminum having a thickness corresponding to an optical density of 0.08 to 3.0, preferably 0.1 to 0.8, more preferably 0.2 to 0.5.

8. The container claimed in any one of claims 1 to 7 which is sealed having the foodstuff ready for the application of microwave energy thereto for heating and crisping the same.

9. The container claimed in any one of claims 1 to 7 which is open at one end but otherwise sealed to permit the foodstuff to be placed therein for the application of microwave energy thereto and the open end is prefolded over.

10. A blank for the container claimed in any one of claims 1 to 9 comprising a planar laminate structure of an outer polymeric film layer, an outer paper substrate layer and a discontinuous layer of electroconductive material therebetween in two or three separate domains.

11. A method of heating food comprising the steps of placing food in a container (20, 40) formed by a flexible structure (10, 22, 62) comprising a discontinuous thin layer (16, 28, 56, 68) of electrically conductive material supported on a substrate (12, 24, 54, 64), applying microwave energy to the food (30) in the container (20, 40) to heat the food, and causing a portion of the microwave energy incident upon the container to be converted to thermal energy by the discontinuous thin layer (16, 28, 56, 68) of electroconductive material substantially only in regions where the food (30) is located in the container (20, 40).

12. A flexible container for microwave heating of food in the container, the container (20, 40) being formed by a flexible structure (10, 22, 62) comprising a discontinuous thin layer (16, 28, 56, 68) of electrically conductive material which is supported on a substrate material (12, 24, 54, 64) and which has a thickness such as to permit a portion of microwave energy incident thereon to be converted to thermal energy, the discontinuous thin layer (16, 28, 56, 68) being positioned on the substrate material (12, 24, 54, 64) only in selected regions which are such as to be likely to be in close proximity in operation with food (30) placed in the container (20, 40).

FIG.1.

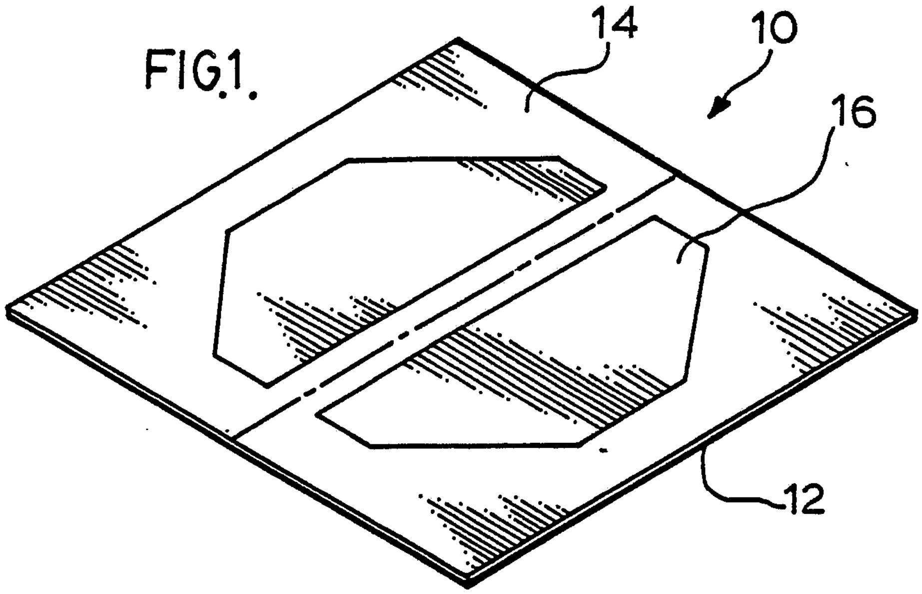


FIG.2.

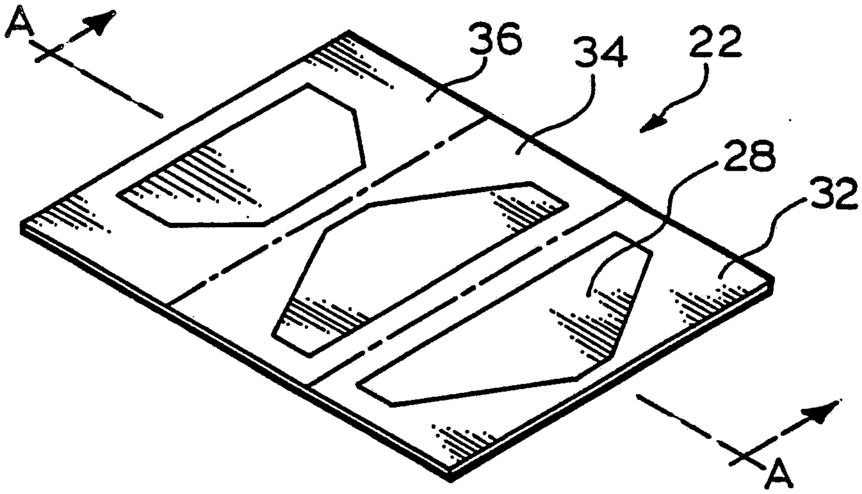
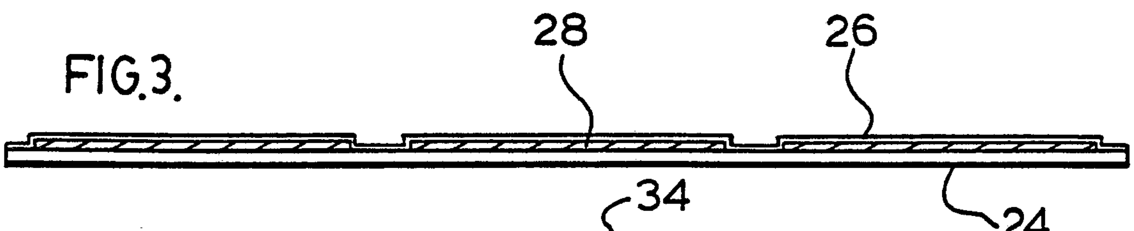


FIG.3.



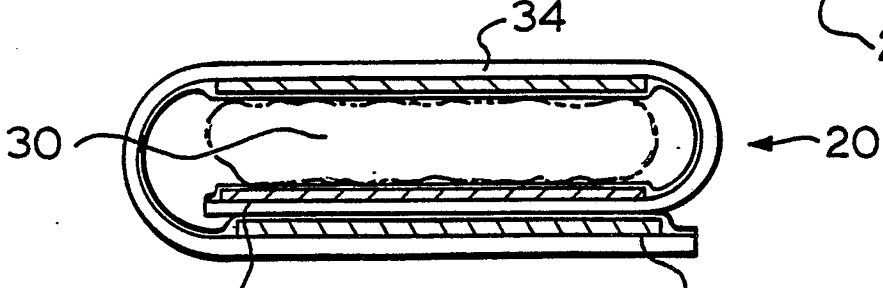


FIG.4.

FIG.5.

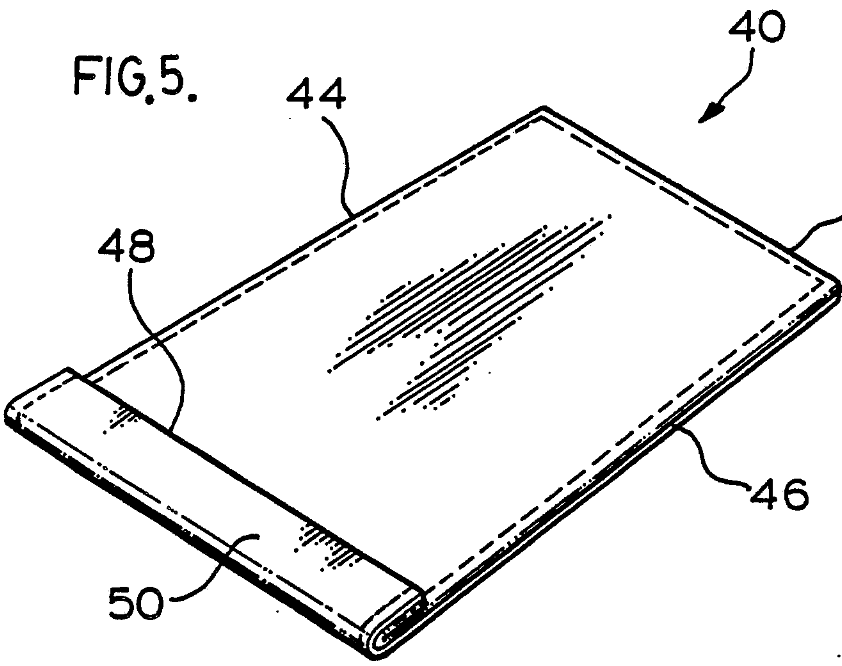


FIG.6.

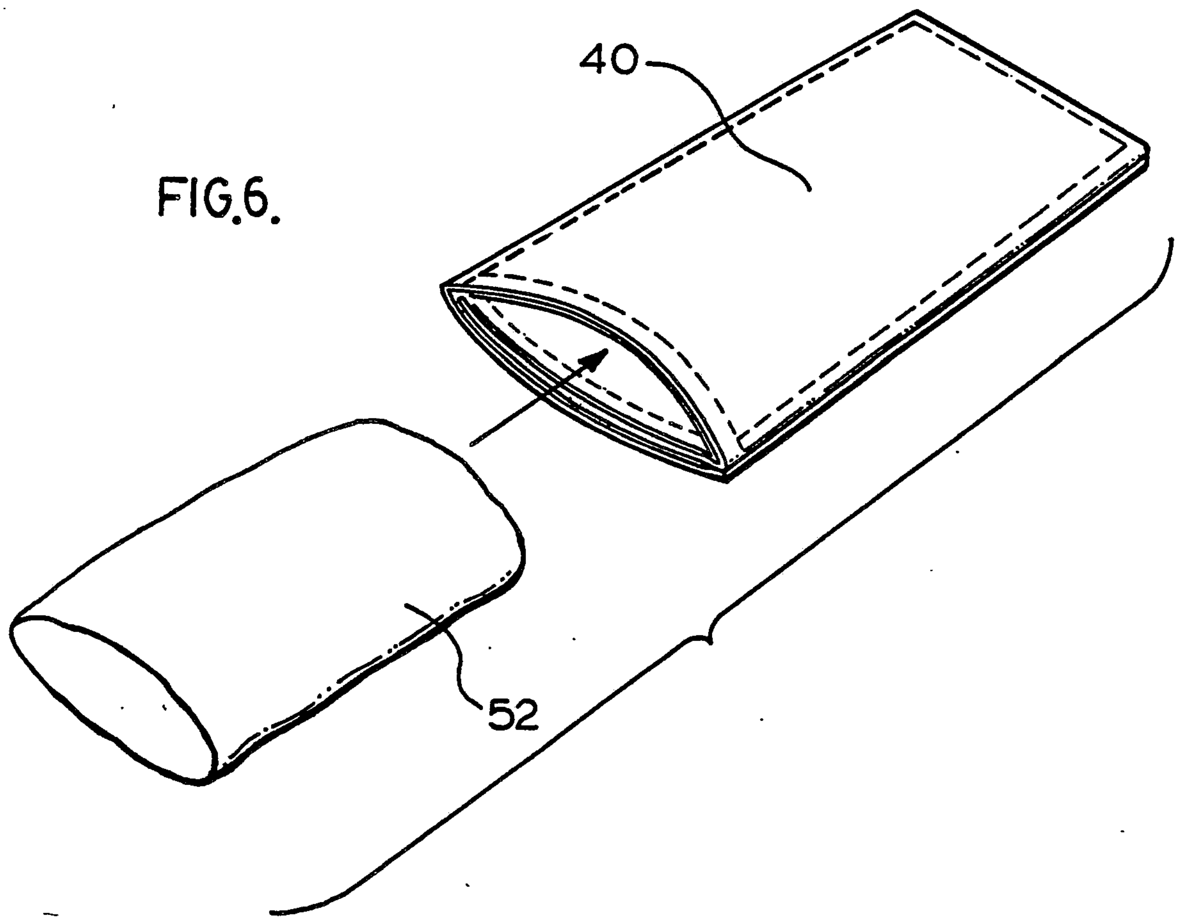


FIG.7.

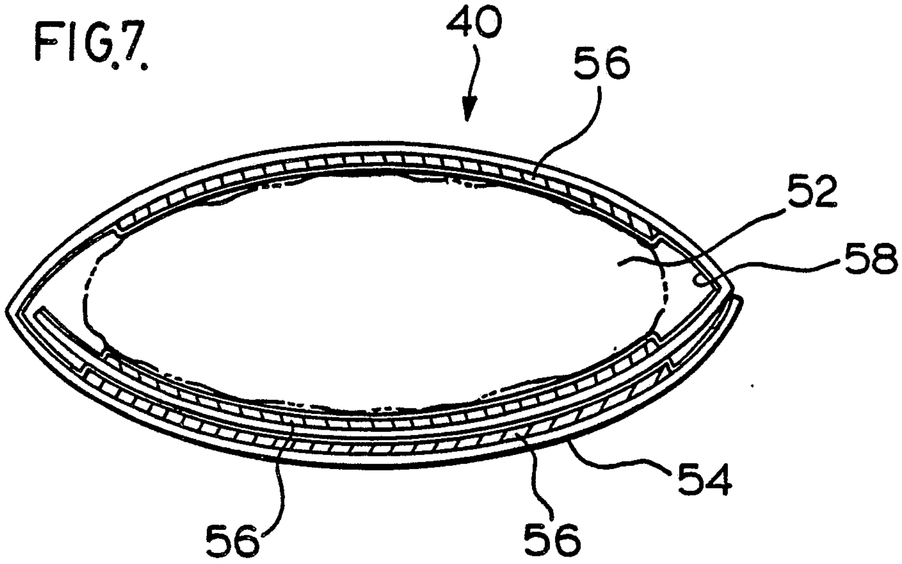


FIG.8.

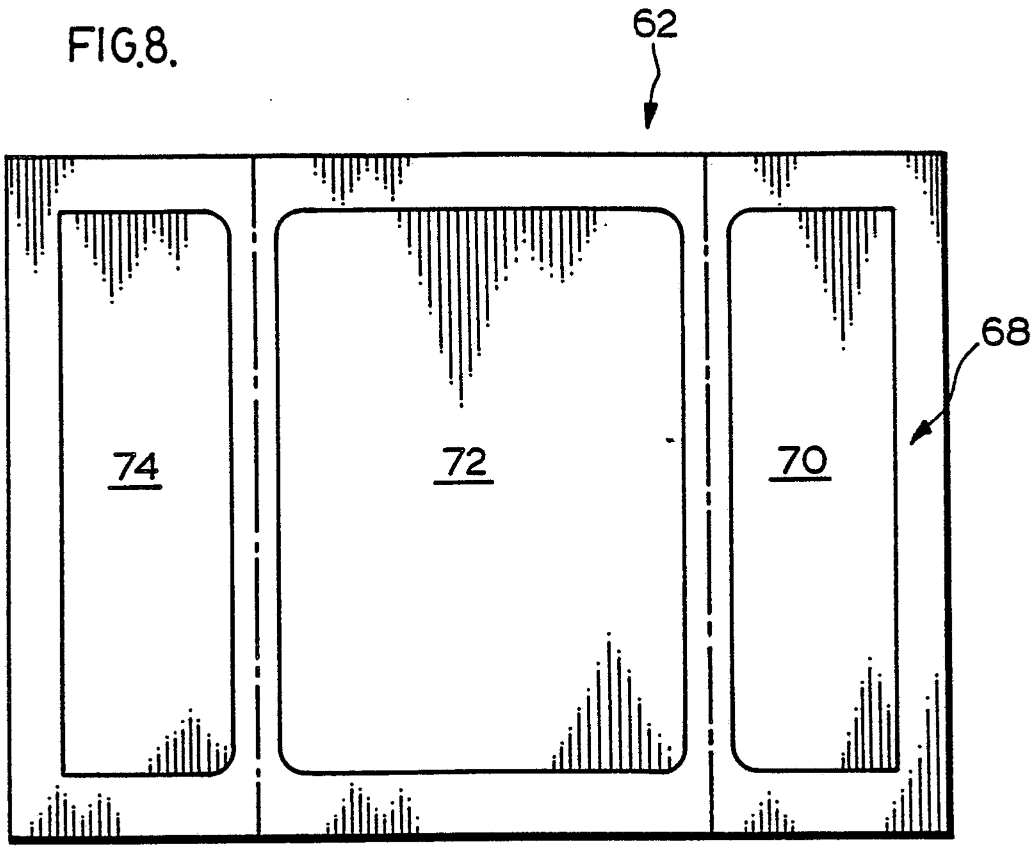


FIG.9.

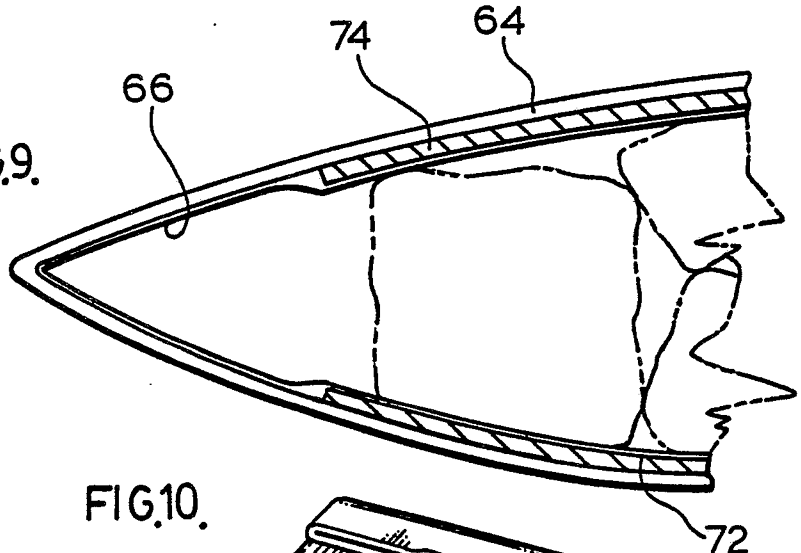


FIG.10.