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(54) CONTAINER AND TESTING METHOD

(71) We, HOECHST AKTIENGESELLSCHAFT, a Body Corporate organised according to the laws of the Federal Republic of Germany, of 6230 Frankfurt/Main 80, Postfach 80 03 20, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a container and to a method of performing a leakage test on the container. The invention is concerned with containers formed wholly or partly of an electrically insulating material, e.g., a plastics material.

In the storage of liquid, mixed liquid and solid, or pasty foodstuffs, e.g., ready-made meals, soups and vegetables, packed in plastics containers, especially in light-weight containers consisting of composite films comprising layers of metal, e.g., aluminium, the impermeability of the package is of high importance for the shelf life of the packed goods. The goods in a container which should be sealed therein may undergo a loss in durability and/or quality, if the container, especially its closure, i.e., the sealed seam, is not absolutely tight.

It has been proposed to check the tightness of the seal of light-weight containers made of composite films comprising a thermoplastic, heat-sealable layer and an aluminium layer by measuring the thickness of the thermoplastic heat-sealable layer in the region of the seam; for this purpose, however, the aluminium layer must be removed, so that the container can no longer be used. Therefore, this testing method must be limited to samples taken at random during production. It has also been proposed to measure the thickness of the heat-sealed seam from the outside. German Offenlegungsschrift No. 24 34 823, e.g., assumes that leaky sealed seams in plastics containers may be caused by one of the following reasons: inclusion of a foreign body in the area of the heat-sealed seam, inadequate energy supply during the production of the seam, and insufficient quantity of heat-sealable material during the production of the container. Since all these causes lead to deviations in the distance between the outer surfaces of the heat-sealed seam, an incorrectly sealed container may be detected by comparing the actual value of this distance with the theoretical value and the faulty container singled out. On the other hand, since the heat-sealed seam normally extends over a relatively large area of the container, testing its thickness is not possible throughout the area, or expensive apparatus is required. Any leakages formed at random in the heat-sealed seams, by causes other than those listed above, often take the form of tiny pores or capillaries which cannot be detected by this test method because of deviations in thickness which are beneath the sensitivity of measurement of the apparatus used. Moreover, if leakages occur outside the heat-sealed areas, they also cannot be detected by this test method.

The present invention is concerned to provide a container which may be subjected, after filling, to a quick and easily performable leakage test that also covers the regions outside the sealed seams and does not involve destruction of the container.

The present invention provides a container, at least the inner surface or the outer surface of the wall of which is of an electrically insulating plastics material impermeable to liquids and comprising or containing an electrically conductive elongate member having a portion within the container which, when there are liquid or pasty goods in the container, is in contact with or may be caused to contact the goods and a portion which projects from the container when the container is closed, the elongate member comprising an electrically conductive film strip which comprises a heat-sealable plastics material having an electrically conductive material dispersed therein. The invention also provides such a container which contains electrically conductive

goods and has been closed.

The container according to the invention is capable of being subjected to a non-destructive leakage test.

Advantageously, the wall of the container or at least its inner surface is of an electrically insulating material, at least where contact is made with the member; the outer surface of the container is also preferably of an electrically insulating material. Both surfaces are preferably of a plastics material. The member comprises a strip of electrically conductive film, and will be referred to hereinafter as a conductive film strip.

The container may be of any shape and may be in the form of a can or of a bag. Suitable types of bags are, e.g., flat bags, flat-bottom bags, gusseted bags crossbottom bags, or stand-up bags. Alternatively, the container may be a thermoformed tray.

The container may be made of a thermoplastic heat-sealable plastics film, e.g., a polyethylene film, but is preferably a composite film with a heat-sealable inner layer, e.g., a polyethylene or polyvinylidene chloride layer. Most advantageously, however, the container consists of a composite film comprising an aluminium layer, with a polyethylene film on the inside as the heat-sealable layer, and an outer layer of cellulose film, polypropylene or polyester film, e.g., polyethylene terephthalate film.

For example, the contatiner may be a semi-rigid stand-up bag, such as the one disclosed in German Patent No. 12 81 140.

This bag consists of two sheets of film, and a bottom portion connected therewith which is folded in a manner such that the bottom portion forms a "W" with the sheets of film. The two sheets of film and the bottom portion are connected by two lateral welding seams and two oblique welds, the oblique welds extending from a horizontal weld along the base of the bag to the lateral welding seams and ending on the lateral welding seams at the level of the bottom of the bag.

The conductive film strip may be of any desired shape, but care must be taken that it contacts, or can be made to contact, the goods contained in the container, on the one hand, and projects from the closed container, on the other hand. The conductive film strip may project from the closed filling hole or from any other point of the container. For reasons of economy, the width and thickness of the film strip should be maintained as low as possible. Preferably, however, the width and thickness are so selected that, taking into consideration the size and weight of the container, the filled and closed bag may be suspended by the projecting portion of the film strip or picked up thereby by a gripping appliance.

The conductive film strip comprises a thermoplastic heat-sealable material, especially a polyolefin, e.g., polyethylene of relatively high density or polypropylene, or of a copolymer thereof (especially a copolymer of ethylene or propylene with a copolymerisable monomer), with an electrically conductive material being dispersed in the material.

A thermoplastics, heat-scalable film may be directly sealed to the inner coating of the container. The conductive material is advantageously mixed with the raw material before the plastics film is manufactured; preferably, it consists of carbon black and/or graphite particles.

The conductive film strip may be inserted, e.g., by introducing it through the opening of the container until it touches the goods contained in the container before closure. When the opening is closed, the conductive film strip is firmly attached to the inside surface of the container in the region of the closure seam, especially by heat-sealing. Alternatively, the conductive film strip may be joined to the inside surface of the container and/or along one of the lateral edges thereof, for example by heat-sealing. Preferably, the conductive film strip is applied to one side of the container. In this case, the filling aperture is preferably on the other side of or at the other end of the container. If the container is made of a composite film comprising a metal layer, e.g., an aluminium layer, direct contact between the metal layer and the conductive film must be avoided. On the other hand, since the metal layer is normally covered on both surfaces by coatings of insulating plastics material, it is exposed only at the lateral edges of the composite film, i.e., at the cut edge of the opening. Therefore, in the area of the edge of the composite film, the conductive film strip may be surrounded by a dielectric cover or coating, preferably a coating of a heat-sealable thermoplastic material, especially a polyethylene coating, which may be easily heat-sealed both to the inside wall of the container and to the conductive film strip. At least the cut edge of the conductive film strip contacting or contactable with the goods in the container must be free from this electrical insulation, i.e. the dielectric cover or coating, so that direct contact between the goods and the conductive film strip is ensured.

The construction of the container according to the invention makes it possible to carry out a non-destructive leakage test on it when it has been filled and closed. The present invention accordingly also provides a method of testing a package constructed in accordance with the invention that con-

tains electrically conductive goods and has been closed, which comprises applying an electrical potential between a portion of the elongate member projecting from the container and the outer surface of the container, and detecting the current flow.

The outer surface of the container is, as indicated above, preferably of a plastics material.

The invention also comprises a method of testing and/or controlling the integrity against leakage of the contents of a series of containers as herein before defined that contain electrically conductive goods and have been closed which comprises applying an electrical potential difference between the outer surface and the elongate member of each container, detecting the current passing therebetween, comparing the current with a reference value, and separating containers showing current values below the reference from those showing values above it, and/or varying the conditions of filling or closing the containers.

In the case of a leak in the container, the resistance drops noticeably, thus causing a perceptible increase in the current passage, the current flowing over the conductive film strip, through the goods contained in the container, and through the leak.

It will be appreciated that the liquid or pasty goods must be such as to be electrically conductive; this is, in fact, normally the case. The detecting apparatus will be chosen or adjusted according to the conductivity of the package and the goods.

Thus, the method of the invention is based on a measurement of a possible change in the flow of electrical current. For example, the value measured may be amplified and supplied to limit value switches by means of which certain operations, e.g., singling out the faulty package(s) control of the filling machine, increase of the energy supplied to the heat-sealing tools, or a change in the production speed, may be initiated, when a certain limit value is reached. If desired, the measured and amplified value may be fed to a second amplifier stage connected with an indicator unit.

Preferably, the method is conducted in such a manner that the container is immersed in a bath containing an electrically conductive liquid, taking care that the portion of the conductive film strip projecting from the container does not come into contact with the liquid in the bath. The electrical insulation mentioned above, which may be in the form of a cover or coating surrounding the conductive film strip and protecting it from the conductive liquid, is provided mainly for this purpose. In this manner, a short-circuit between the conductive film strip and the conductive liquid is avoided.

This preferred embodiment of the inventive process allows a particularly quick leakage control of the entire surface of the container or a portion thereof, depending on how far the container is immersed in the conductive liquid. Immersion of the container may be effected, e.g., by using a holder which grips the container by its conductive film strip and passes it through and/or lowers it into the bath. If the conductive film strip projects from the bottom of the container, the seal of the filling hole, which is particularly critical, will be subjected to a very thorough control, because in this case the entire weight of the contents of the container rests on this seal.

In the following, the invention will be illustrated by reference to the drawings which show, by way of example only, three embodiments of the inventive container designated as Figs. 1, 2, and 3. Figs. 1 and 2 show also the testing method.

Fig. 1 shows, in section, a container consisting of composite films indicated generally by the reference numerals 1 and 2 which comprise a metal layer 3, an inner heat-sealable layer 4, and an outer layer 7. In the vicinity of the heat-sealed seam, a conductive film strip 6 extending into goods 5 contained in the container is covered by electrically insulating material 8. The container, which is closed against the ingress or egress of liquids, is positioned in a basin 9 filled with a conductive liquid 10. The liquid 10, on the one hand, and the portion of the film strip projecting from the container, on the other hand, are connected with the two poles of a direct current source Q. The circuit also contains an indicator unit G which measures or detects the current passage.

Referring now to the embodiment of the container shown in Fig. 2, the container is provided with a heat-sealed seam 11 by which the aperture is closed after filling. A conductive film strip 6 passes through the container and its contents 5 at the opposite end from and parallel to the heat-sealed seam 11. The film strip 6 visibly projects from the lateral edges of the container and is exposed in recesses 12 in the composite film. The container, which is closed against the ingress or egress of liquids, is partially immersed with its sealed seam 11 in a basin 9 containing a conductive liquid 10. By means of the indicator unit G the current passage from the source Q between the conductive liquid 10 and the conductive film strip 6 is checked. In principle, it is sufficient for measurement if only one recess is provided in the composite film, so that the film strip is bared only at one of the lateral edges of

the container. — The reference numerals 3, 4 and 7 have the same meanings as in Fig. 1.

Fig. 3 shows, in section, a further container constructed in accordance with the invention, the reference numbers having the same meanings as in Figs. 1 and 2. The container in this case is a container provided with a stable bottom St. The container is closed against the ingress or egress of liquids.

WHAT WE CLAIM IS:

1. A container, at least the inner surface or the outer surface of the wall of which is of an electrically insulating plastics material impermeable to liquids and comprising or containing an electrically conductive elongate member having a portion within the container which, when there are liquid or pasty goods in the container, is in contact with or may be caused to contact the goods and a portion which projects from the container when the container is closed, the elongate member comprising an electrically conductive film strip which comprises a heat-sealable plastics material having an electrically conductive material dispersed therein.

2. A container as claimed in claim 1, wherein the conductive material is carbon black or graphite particles.

3. A container as claimed in claim 1 or claim 2, wherein the elongate member comprises a polyolefin.

4. A container as claimed in claim 3, wherein the polyolefin is polypropylene, a high density polyethylene or a copolymer of propylene and ethylene.

5. A container as claimed in claim 3, wherein the polyolefin is a copolymer of ethylene or propylene with a copolymerizable monomer.

6. A container as claimed in any one of claims 1 to 5, wherein the wall is a plastics/metal/plastics laminate.

7. A container as claimed in claim 6, wherein the metal is aluminium.

8. A container as claimed in any one of claims 1 to 7, wherein the portion of the elongate member which when the container is closed bridges the interior and the exterior is surrounded by an insulating covering or coating.

9. A container as claimed in claim 8, wherein the bridging portion of the member is positioned at a heat-sealed seam and/or in the region of a cut edge of the material forming the container.

10. A container as claimed in claim 8 or claim 9, wherein the insulating covering or coating is a heat-sealable plastics material.

11. A container as claimed in any one of claims 1 to 10, which has at least one recess at a lateral edge in which recess a projecting portion of the member is exposed.

12. A container as claimed in any one of claims 1 to 11 which has a stand-up base.

13. A container as claimed in claim 12, in which the stand-up base has oblique welds extending from a bottom weld to lateral welding seams of the container, the oblique welds ending on the lateral welding seams at the level of a W-shaped bottom formed in the flat-folded state of the container.

14. A container as claimed in claim 1, substantially as described with reference to and as illustrated by any one of the accompanying drawings.

15. A container as claimed in any one of claims 1 to 14, having at least a portion of the elongate member mounted in fixed relation to at least a portion of the container wall.

16. A container as claimed in claim 15, wherein the member is heat-sealed to the container wall.

17. A container as claimed in any one of claims 1 to 16 which contains electrically conductive goods, the container having been closed.

18. A container as claimed in claim 17, substantially as described with reference to and as illustrated by any one of the accompanying drawings.

19. A method of testing the integrity of a container which comprises placing electrically conductive goods in a container as claimed in any one of claims 1 to 16, closing the container and applying an electrical potential difference between a portion of the elongate member outside the container and at least a portion of the outer surface of the container and detecting any resulting current flow.

20. A method of testing the integrity of a container as claimed in claim 17 or claim 18, which comprises applying an electrical potential difference between a portion of the elongate member outside the container and at least a portion of the outer surface of the container and detecting any resulting current flow.

21. A method as claimed in claim 19 or claim 20, which comprises at least partially immersing the container in a conductive liquid without contacting the liquid with an exposed portion of the member.

22. A method as claimed in claim 19 or claim 20, carried out substantially as hereinbefore described.

23. A method as claimed in claim 20, carried out as described with reference to and as illustrated by Fig. 1 or Fig. 2 of the accompanying drawings.

24. A method of testing and/or controlling the integrity against leakage of the

contents of a series of containers as defined in claim 17 or claim 18, which comprises applying an electrical potential difference between the outer surface and the elongate member of each container, detecting the current passing therebetween, comparing the current with a reference value, and separating containers showing current values below the reference value from those showing values above it, and/or varying the conditions of filling or closing the containers.

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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1

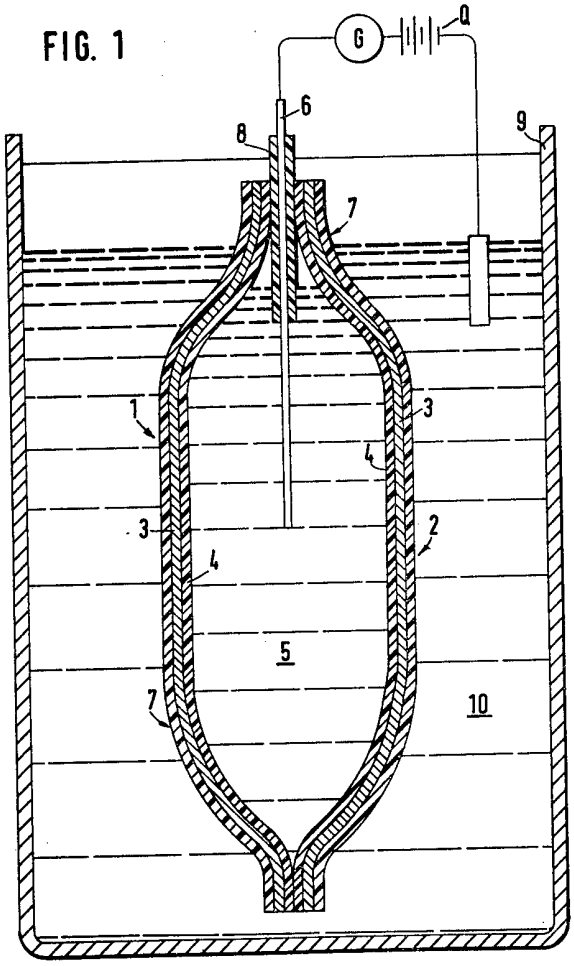
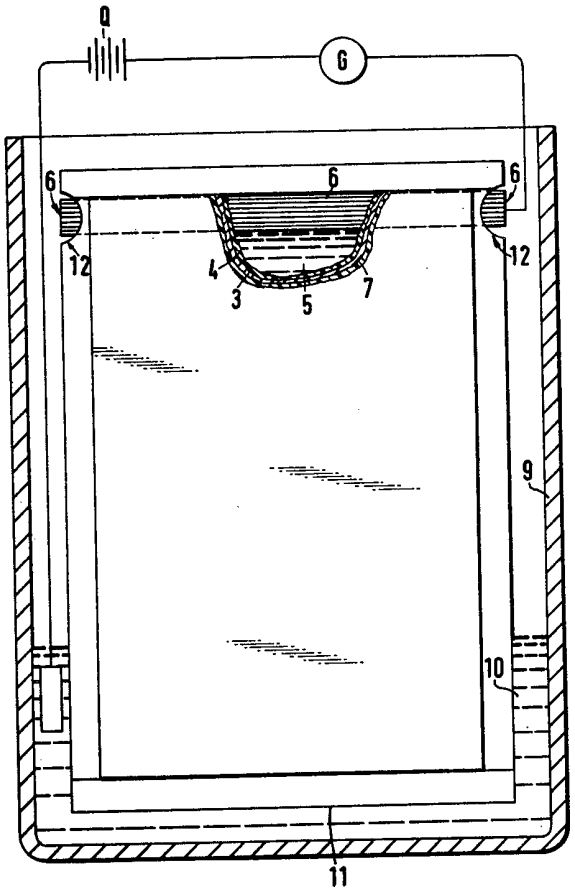


FIG. 2



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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

FIG. 3