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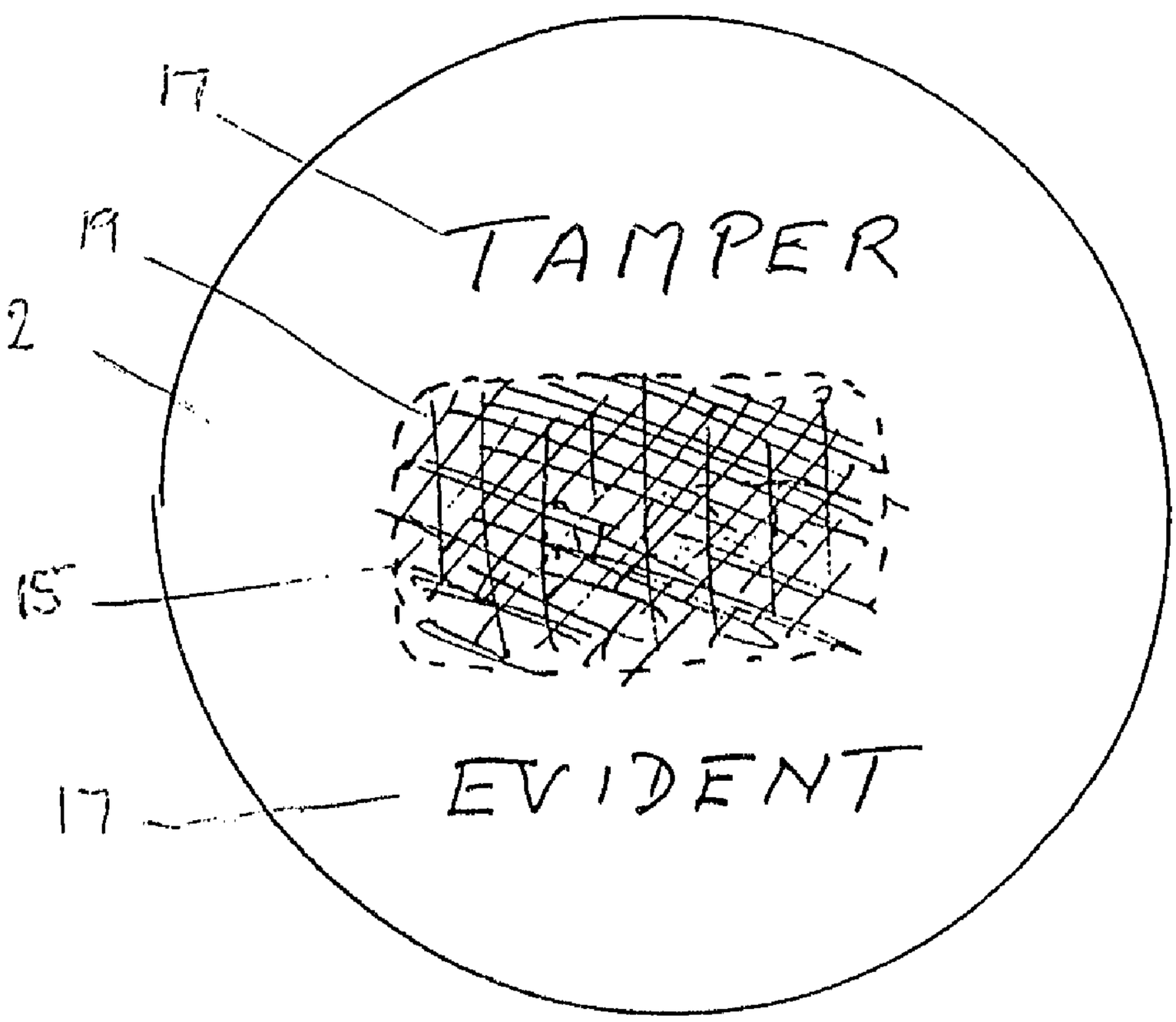
(54) Title: CONTAINER



(57) Abrégé/Abstract:
Provision is made on a container to indicate whether the container has been tampered with. Release of a vacuum from within the container causes a lid of the container to become convex. This causes a coating on the lid to craze and therefore produce a visible change.

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ABSTRACT

CONTAINER

Provision is made on a container to indicate whether the container has been tampered with. Release of a vacuum from within the container causes a lid of the container to become convex. This causes a coating on the lid to craze and therefore produce a visible change.

CONTAINER

The present invention relates to a container, particularly one whose contents are to remain safely sealed from the environment, and especially to one having means for rendering tampering evident.

There is a great need for some means of reliably determining whether a seal on a container has broken, either through mere failure or by deliberate tampering. This is particularly so in the case of containers for food, drinks and medicines (which term includes medicaments not taken by mouth). If a seal is broken the container or its contents could be contaminated by environmental bacteria by oxidation or by deliberate poisoning or by adding glass etc. Whilst in many cases simple failure of a seal may be noticeable, tampering may be more difficult to detect. This is because an attempt may be made to reform the seal to avoid detection.

Many attempts have been made to design containers such that a broken seal will be permanently observable. The following examples may be noted.

Some containers, such as beer cans, are made such that

they are in effect destroyed when they are opened. Unobservable tampering is difficult, but such containers cannot be resealed by the legitimate user after partial use of their contents.

Various proposals have been made for containers, such as bottles, with screw-caps. For example, a cap may be provided with a band at its base, joined to the remainder of the cap through a line of weakness. The band is prevented from rotating or from rising up the screw thread when the cap is unscrewed, and as a result it becomes detached from the remainder of the cap. In another technique a paper label is stuck across a stopper such that the movement of the stopper causes the paper to be torn. Heat-shrink sleeves have been shrunk around the tops of bottles so as to enclose the stopper. Removal of the stopper requires the shrunk sleeve to be cut away. A more expensive technique is to trap the stopper by means of a wire frame around the bottle top, the ends of the wire being locked by means of a solder seal.

Unfortunately, each of these techniques has its disadvantages, such as cost or ease of repair after tampering.

We have now discovered that a conformational change in a part of a container may be made to occur when an attempt is made to open the container to the environment, and that conformational change can be rendered observable.

Thus, the present invention provides a container comprising a first part and a second part that can be brought together to close the container to the environment, in which:

the first part can have a first conformation when it is brought together with the second part, which first conformation changes to a second conformation on opening of the container; and

with the proviso that where the conformational change is reversible it produces an optical and/or tactile change that is not reversed on reversal of said conformational change.

The first part of the container preferably comprises a lid, by which term we include caps and stoppers etc. The second part preferably comprises a can, box, jar, flexible pack or bottle. By conformational change, we include any suitable change of shape, form or

arrangement of parts. We prefer, however, that the change is a change in the curvature of a wall, particularly a change from concave (as viewed from the outside of the container) to substantially flat or convex. The conformation change is preferably flexure.

The invention also provides an article for use in environmental sealing which has a first conformation when providing an environmental seal which changes to a second conformation on breaking of the seal, the conformational change causing a change in light-scattering and/or light-reflectance at a visible or machine-readable portion (which need not be an external surface) of the article. In general, the portion at which scattering or reflectance occurs will be an intermediate surface or layer of a multi-layer coating on the article.

The invention further provides a label for applying to a container as an indicator of subsequent tampering which comprises:

(a) a first layer bearing a visible and/or machine-readable mark; and

(b) a second layer overlying the first layer, the second layer being capable of undergoing a change of light-scattering and/or light-reflectance on conformational change of the label.

The invention may also provide apparatus for use in machine-reading such a label, optionally having means indicating that the label cannot be read. For example it may have an output indicating that a sale should not take place or that a product has been tampered with.

A tamper-evident container may be produced by either of the following methods.

A first method comprises:

(a) applying a material to a part of the container; then

(b) causing a conformational change to that part of the article and consequently to the material, and closing the container to the environment; then

(c) treating the material such that reversal of the conformational change causes an optical and/or tactile change in the material.

Step (c) may comprise embrittlement, and it may be caused by cross-linking. It is desirable that such treatment be carried out after the conformational change has been made to the container since prior to treatment the material may be flexible.

In another embodiment the method comprises:

(a) causing a conformational change to a part of the container and closing the container to the environment; then

(b) applying to that part of the container a material such that reversal of the conformational change causes an optical and/or tactile change in the material that is not reversed thereby.

Apparatus, such as production line may be provided for use in the methods of the invention. Such apparatus preferably includes means for closing a container, means for applying a label or material in other form, and means for treating the material for example with

UV or other irradiation to make it brittle etc. The apparatus may also include means for fitting the container and for making a vacuum inside.

The material may be applied as part of a label or as a three-dimensional pre-form, formed for example by injection-moulding.

Whilst the invention will have many uses, it will be described with particular reference to vacuum-packing of food in jars. The first part of the container is therefore a lid and the second part is the jar itself. Food is placed inside the jar, the jar and the food are then heated to sterilise them, the lid is placed over the jar, and the jar and food allowed to cool. On cooling a vacuum (which term of course includes a partial vacuum) is created within the jar causing the outside of the lid to become concave. This is the so-called first conformation referred to above. Thus, we prefer that the conformational change is of a surface of the first part that is in pressure communication with, and more preferably directly faces, the inside of the container.

The presence of a vacuum within the container is an accepted indication that an environmental seal has been maintained. Nonetheless, in its broader terms the invention includes conformational changes brought about by any change of pressure difference across a surface of the first part that is in communication with the inside of the container.

In the simple case of a lid being deformed by a vacuum within the container, the conformational change may be reversible. In itself, therefore, the presence of a concave lid is no guarantee that the container has not been tampered with. This is simply because the tamperer could reheat the container, replace the lid and let it cool thus recreating the concave lid.

The invention is able to deal with this problem as follows.

In one embodiment the first part is provided with a material thereon that is forced to undergo an optical and/or tactile change as the lid relaxes from its concave shape to a substantially flat or convex shape. This is the change referred to above as being from the first conformation to a second conformation. We prefer that the second conformation be stable and that

the first conformation be unstable and maintained only, for example, by the internal vacuum.

The material may comprise a coating that follows the surface of the lid (or other first part) when in the first and when in the second conformation. The resulting conformational change of the material will cause an optical and/or tactile change.

In another embodiment, the material may be held adjacent (but at least partially separated from) the lid such that the lid impacts the material on change from the first to the second conformation, the impact causing the optical and/or tactile change. In this case the lid may have a localised pop-up portion that is retracted when in the first conformation and extended when in the second conformation.

We prefer that the conformational change causes the material to craze, i.e to produce many generally small cracks. Crazing is one way by means of which a change of light-scattering and/or light reflectance can be made to result from the conformational change. It will, in general, not be reversed, even if the conformational change is reversible. We prefer a high density of crack-initiation sites is produced. We

also prefer that stress is reduced over a wide area, and not for example through a small number of large cracks.

In order that crazing result from the conformational change, we prefer that the material be brittle. If it is not brittle when it is applied to the lid, it can be made brittle by a process such as cross-linking. This may be carried out by irradiation or by chemical means etc.

The optical change may be enhanced by the provision of a colourant, such as a micro-encapsulated dye that is dispersed by the conformational change. The dye may then travel along cracks in the material by capillary action.

In another embodiment the conformational change causes stress-clouding of the material, or the material becomes disbonded from the first part possibly creating scattering of light at the newly-created interface.

It may be desirable to prevent the material from leaving the lid, especially after crazing, and a

transparent, preferably flexible, coating may be provided for this purpose, over or under the material.

A variety of chemical formulations may be used as the material that provides the optical and/or tactile change. At present a preferred material comprises a wax/resin blend. A variety of such materials are available and the desired melting point, brittleness, hardness and colour may be chosen. At present preferred blends are those marketed by Wilkins Cambell & Co Ltd under the trade marks 6565, 6545 and 6566.

Other materials may be used depending upon the technique by means of which they are applied to the container. Melting and resolidification may be used in the case of hot-melt adhesives, such as polyamides and ethylene vinylacetates etc. Various cross-linkable or curable materials may be used, such as epoxy materials which may be chemically cross-linked and polyimides which may be cross-linked using ultra-violet light. Other suitable polymeric materials include polystyrenes, polypropylenes and poly-urethanes. These materials are preferably used without plasticizers, and with inert fillers such as talc or chalk.

Another class of materials that may be used includes lacquers, which may be applied in solution. On evaporation of the solvent the material cures.

The material may be used in conjunction with a visual and/or machine-readable mark. A widely used example of a machine-readable mark is a bar code. The materials may be used as a coating over or under the mark such that a change in light-scattering and/or light-reflectance of the material alters the appearance of the mark. The container may carry a second mark that is substantially unaffected by the conformational change, the first-mentioned mark together with the second mark conveying a different message from that conveyed by the second mark alone. The change may, for example, be deletion of the word "not" from a message such as "tamper not evident".

The invention may be used together with one or more other means of detecting or resisting tampering, for example, a heat-shrink sleeve or a label or other layer etc may at least partially cover the second part of the container such that its rupture is required to separate the first and second parts.

The invention is further illustrated with reference to the accompanying drawings in which:

Figure 1 is a cross-section through a bottle;

Figure 2 is a cross-section through a can;

Figure 3 is a cross-section through a vacuum-packed plastics container;

Figures 4(a) and 4(b) show conformational change of a lid;

Figures 5(a) and 5(b) are perspective views of the top of a can;

Figures 6(a) and 6(b) are plan views of the top of a can;

Figures 7(a), 7(b) and 7(c) show ways of attaching a material to a container;

Figures 8(a), 8(b) and 8(c) show a label, and flow diagrams for its manufacture and use;

Figures 9(a), 9(b) and 9(c) show a pop-out disc, and flow diagrams for its manufacture and use; and

Figures 10(a), 10(b) and 10(c) show a pop-out disc moulding and its manufacture and use.

Figure 1 shows a glass or plastics bottle or other container 1 having a cap 2 sealed thereto. The bottle 1 contains food 3 that has been heat sterilised. The cap is shown in its so-called first configuration.

Note the concave shape 4 when viewed from the outside. The concave shape 4 results from a vacuum 5 inside the container. An outer surface of the cap has been coated with a material, such as a lacquer, that will craze when the cap 2 is released from its concave configuration. This will, of course, occur when the container is opened, at the cap or elsewhere and the vacuum is released. The cap 2 may be provided alone or it may be used with another closure part such as cover 6. Cover 6 may be transparent such that the state of the lacquer 7 may be viewed without its removal.

Figure 2 shows a tin can 8 having a lid 2 sealed to it by means of a sealed seam 9. The tin contains a perishable foodstuff 3 under vacuum 5. The lid is in the first conformation having a concave portion 4 due to the vacuum 5. Before generation of the vacuum 5 the lid was substantially flat or convex. On release of the vacuum the elastic energy in the lid will cause it to spring outward and become again flat or convex.

The concave portion 4 has on it a mark 10 such as a bar code or visual message. That mark is covered by a material 7 as illustrated in figure 1. If desired, a transparent layer may be provided over the material 7

as shown by the dotted line. This transparent layer may be provided to prevent fragmentation and removal of material 7 after crazing.

Figure 3 shows a plastics vacuum pack 11 containing perishable goods 3 under vacuum 5. An insert 12 is placed on the goods 3. The insert has perforations or is otherwise constructed such that pressure within it equals the pressure within the pack 3. The insert which, together with the film 2, constitutes the so-called first part of the invention, has a concave portion 4 resulting from the vacuum 5 within the pack 11. On release of the vacuum 5 the presently concave portion of the insert 12 pops outwards and becomes substantially flat or convex. This causes the lacquer 7 to craze as described above. Preferably the top of the insert is aligned with the top edges of the pack 11 in order that the film 2 can cause concave portion 4 to be formed in the insert as the vacuum 5 develops in the pack 11.

Figure 4(a) shows a lid 2 having a coating of a lacquer 7 in its concave conformation brought about by vacuum 5. The arrows 13 represent some agency such as ultra-violet light which causes the lacquer 7 to cure and become brittle after the concave conformation has

been achieved. In figure 4(b) the vacuum 5 has been released and the lid has popped upwards and become convex. This has caused the lacquer 7 to become crazed and to scatter or reflect light.

Techniques other than irradiation by ultra-violet light can be used. For example, the lacquer or other material 7 may be melted by the application of heat and allowed to cool to become a brittle solid which can be caused to craze in a way that is not reversed by any reasonable treatment. In a further alternative the material 7 is applied in solution and the solvent removed whilst the lid 2 is in the concave conformation.

The concave portion of the lid may bear some mark, as mentioned above, or it may merely be coloured in a colour that is distinctive from that of the crazed or otherwise altered material 7.

Figure 5(a) shows the presence of a bar code 14 on a lid 10 of a can 8. The material 7 may be coated above or below the bar code 14. When the material 7 is clear the code can be read easily, but after crazing as shown in figure 5(b) the material become crazed as shown at 15 and the code 14 can no longer be read.

This lack of ability of the bar code to be read will cause the goods to be rejected at the point of sale. The fault in the goods will be readily apparent to both buyer and seller. The crazing will not be reversed on resealing.

Figures 6(a) and 6(b) show how a message can be altered in meaning by crazing of material 7 to produce a generally opaque covering 15. A first mark 7 and two second marks 17 are shown on a lid 2. Before the conformational change the message read "tamper not evident" and after the conformational change, brought about by loss of vacuum within the container, the message reads "tamper evident".

Figure 7(a) shows a moulding that may be produced off-line, i.e separately from container manufacture and filling. The moulding is then bonded to the first part of the container after the first and second parts have been secured together and, if necessary, an internal vacuum has been generated. The moulding 18 comprises a central part 19 having an adhesive coating 20 around the button 23 and if desired a hot foil 21 on its opposite side. A stress ring 22 or other line of weakness is provided so that a conformational change of the first part of the container acting on

button 23 causes a central part of the moulding to pop-up to produce a visual and tactile change. The hot foil 21 provides a further security feature since it will become visibly fragmented. This would prevent a tamperer re-melting the moulding in an attempt to recreate its original shape. The adhesive 20 may additionally have the function of providing some flexibility such that thermal expansion and contraction of the container or changes due to changes of humidity etc. do not put undue strain on the moulding. The material chosen for the part 19 is not critical and many thermoplastic or other polymeric materials will be suitable.

In Figure 7(b) a moulding 24 is produced on a lid 2 of a container by means of an injection moulding head 25. In this case the moulding operation will generally be carried on-line. As before, the moulding may incorporate a line of weakness as shown by the "V" shaped grooves in cross-section. The line of weakness may allow a portion, such as a central disc, to pop out and become detached from the remainder of the moulding.

Figure 7(c) shows a self-adhesive paper label comprising a paper backing 26 having a hot foil coating 21. The area 24 is acted on by the first part of the container when it changes its conformation. The label may be butt cut or otherwise provided with a line of weakness to provide a pop-out disc above the area 24. Diagonal cuts 27 may be made to allow the label to conform to the lid of the container. Instead of hot foil 21, or additional to it, a brittle material may be provided. The brittle material and/or the hot foil are ruptured as the part 24 of the label is displaced by the conformational change of the lid.

Figure 8(a) shows a wax/resin pop-out disc manufactured as a label pre-form. A release layer such as a paper backing strip 28 carries a series of labels 29. The backing strip and labels may be supplied as a roll. Figure 8(a) shows the label in plan view and in longitudinal cross-section. The longitudinal cross-section shows a wax/resin 30 within a cavity of a label stock 31, individual labels being defined by the butt cuts 32. The labels are temporarily adhered to the backing strip by means of a pressure-sensitive or other adhesive 33.

Figure 8(b) describes a manufacturing process for the disc of figure 8(a) and figure 8(c) describes a method of application of the disc. Figures 8(b) and 8(c) are self-explanatory.

Figure 9(a) shows a wax/resin pop-out disc having an injection-moulded plastics rim together with a security foil. Preferred dimensions in millimetres are shown. The disc is preferably substantially circular in plan view and the drawing is a cross-section through a diameter. The wax/resin body 30 of the disc is coated with a hot foil 21. An annulus of the disc comprises a ring 34 coated on its lower edge with an adhesive 33. The conformational change of a lid on which the disc is bonded causes the wax/resin 30 to pop up leaving behind the rim 33. Figures 9(b) and 9(c) show manufacturing and application methods appropriate to the disc of figure 9(a).

Figure 10(a) shows a pop-out disc formed as a moulding 35 having a wax coating 36 thereon. Again the disc is substantially circular in plan view, a cross-section of its diameter being shown. A rim 34 of the disc is joined to the central portion by means of an attachment spoke 37 or other line of weakness. An annular groove 38 at the line of weakness may be

filled with the wax 36. The rim of the disc is bonded to a lid by means of adhesive 33. Dimensions in millimetres for one particular embodiment are shown, and for many cases we prefer ranges of from 0.5 to 2.0 times to those shown.

Figures 10(b) and 10(c) show manufacturing and application methods appropriate to the disc of figure 10(a).

Claims

1. A method for packing food in a container which is tamper-indicating, which comprises the steps of:

providing a container including a body and a closure for application to the body which closure includes a flexible end panel having a sealing state indicating area which is capable of flipping from a seal indicating position to a non-seal indicating position due to the release of energy stored in the panel;

placing food inside the body and heating the body and the food therein;

applying the closure to the body while the container and food are hot and allowing them to cool and develop a vacuum therein, whereby the sealing state indicating area is caused to flip to its seal indicating position in which energy is stored in the panel; and

wherein the sealing state indicating area has applied to it a hardenable material which is caused to become brittle after the sealing state indicating area has flipped to its seal indicating position so as to provide a brittle layer which provides an irreversible tamper indicating system which is actuable by the indicating area flipping to its non-seal indicating position whereupon the brittle layer is caused to rupture and provide an indication that the container has been opened.

2. The method of claim 1, in which in the seal indicating position, the end panel is concave or substantially flat when viewed from the outside of the container and the non-seal-indicating position is respectively substantially flat or convex.

3. The method of claim 1 or 2, wherein the brittle layer comprises a material which has been cross-linked in order to render it brittle.

4. The method of claim 3, wherein the brittle layer comprises a material which is a photo-curable resin or lacquer.

5. The method of any preceding claim, wherein the brittle layer has a colourant therein that is dispersed when the area flips from its seal indicating position to the non-seal-indicating position.

6. The method of any preceding claim, wherein the tamper-indicating system includes indicia means underlying the brittle layer so that when the brittle layer ruptures the visibility of the indicia is altered.

7. The method of any preceding claim, wherein the food within the container is heat sterilized.

8. The method of any preceding claim, wherein the body is a glass bottle and the closure is a cap seal to the bottle.

9. The method of any of claims 1 to 6, wherein the body is a plastics bottle and the closure is a cap sealed to the bottle.

10. The method of any of claims 1 to 7, wherein the body is a can and the closure is a lid sealed to the can.

11. A container including a body, a closure sealingly applied to the body, a flexible end panel comprised in the closure that has an area that when the container is opened flips from a seal-indicating position to a non-seal indicating position due to release of internally stored energy within the end panel, and a tamper indicating system carried by

the end panel that comprises a brittle layer irreversibly rupturable in response to flipping of the end panel area to provide an indication that the container has been opened; characterized in that:

the brittle layer comprises a material which is a ultra-violet-light-photo-curable resin or lacquer and has been cross-linked to render it brittle.

12. A container including a body, a closure sealingly applied to the body, a flexible end panel comprised in the closure that has an area that when the container is opened flips from a seal-indicating position to a non-seal-indicating position due to release of internally stored energy within the end panel, and a tamper indicating system carried by the end panel that comprises a brittle layer irreversibly rupturable in response to flipping of the end panel area to provide an indication that the container had been opened; characterized in that:

the brittle layer has been cross-linked to render it brittle and has a colourant therein that is dispersed when the area flips from its seal indicating position to the non-seal-indicating position.

13. A container including a body, a closure sealingly applied to the body, a flexible end panel comprised in the closure that has an area that when the container is opened flips from a seal-indicating position to a non-seal indicating position due to release of internally stored energy within the end panel, and a tamper indicating system carried by the end panel that comprises a brittle layer irreversibly rupturable in response to flipping of the end panel area to provide an indication that the container has been opened; characterized in that:

the brittle layer has been cross-linked to render it brittle and tamper-indicating system includes indicia means under-lying the brittle layer so that when the brittle layer ruptures the visibility of the indicia is altered.

14. The container of claim 11, 12 or 13, in which in the seal indicating position, the end panel is concave or substantially flat when viewed from the outside of the container, and the non-seal-indicating position is respectively substantially flat or convex.

15. The container of any of claims 11 to 14, in which there is present food, drink or medicine.

16. The container of any of claims 11 to 15, which is under vacuum.

17. The container of any of claims 11 to 16, the contents of which are sterile.

18. The container of any of claims 11 to 17, wherein the body is a glass bottle and the closure is a cap sealed to the bottle.

19. The container of any of claims 11 to 17, wherein the body is a plastics bottle and the closure is a cap sealed to the bottle.

20. The container of any of claims 11 to 17, wherein the body is a can and the closure is a lid sealed to the can.

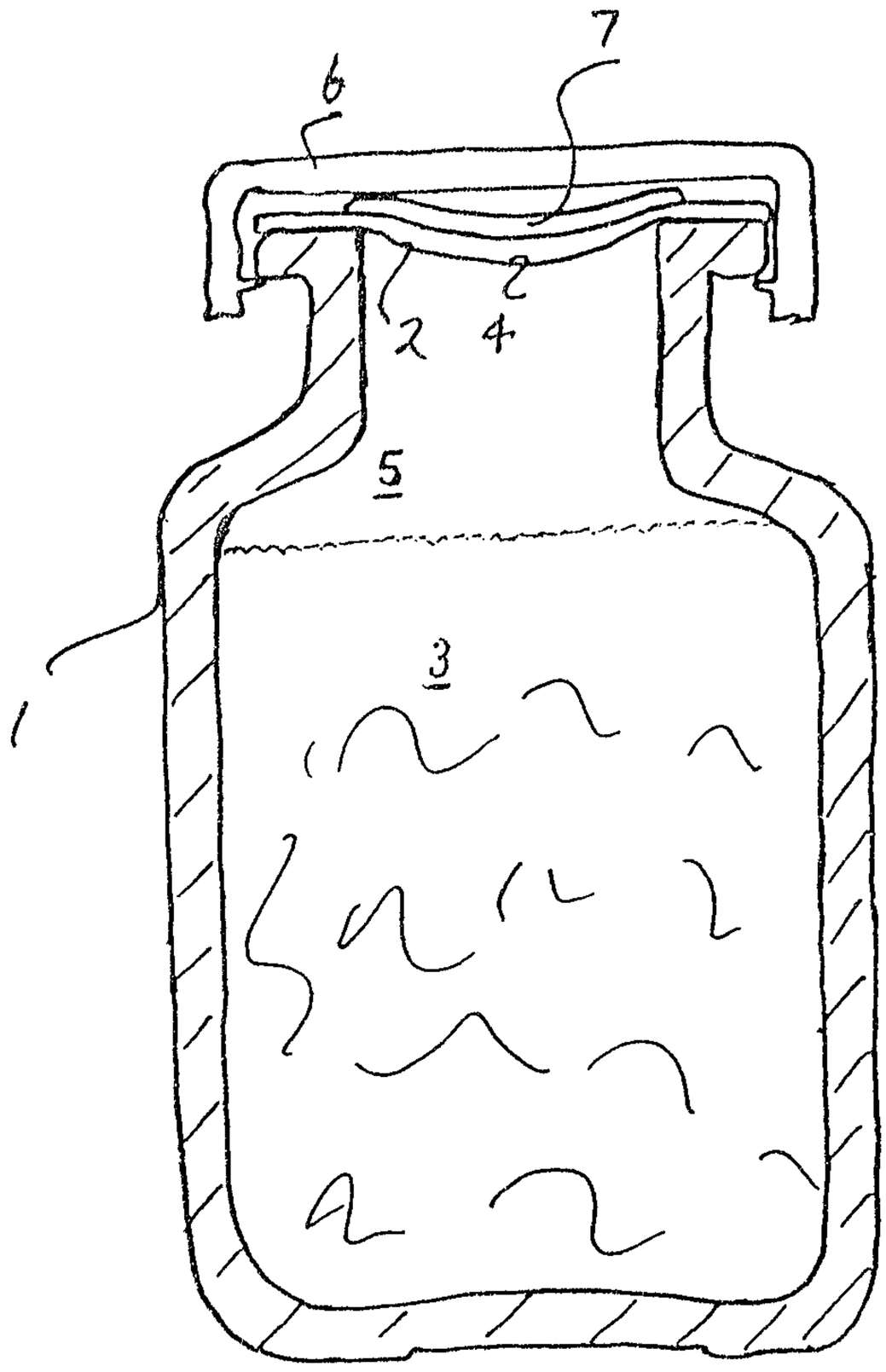


Figure 1

A. N. Sachs

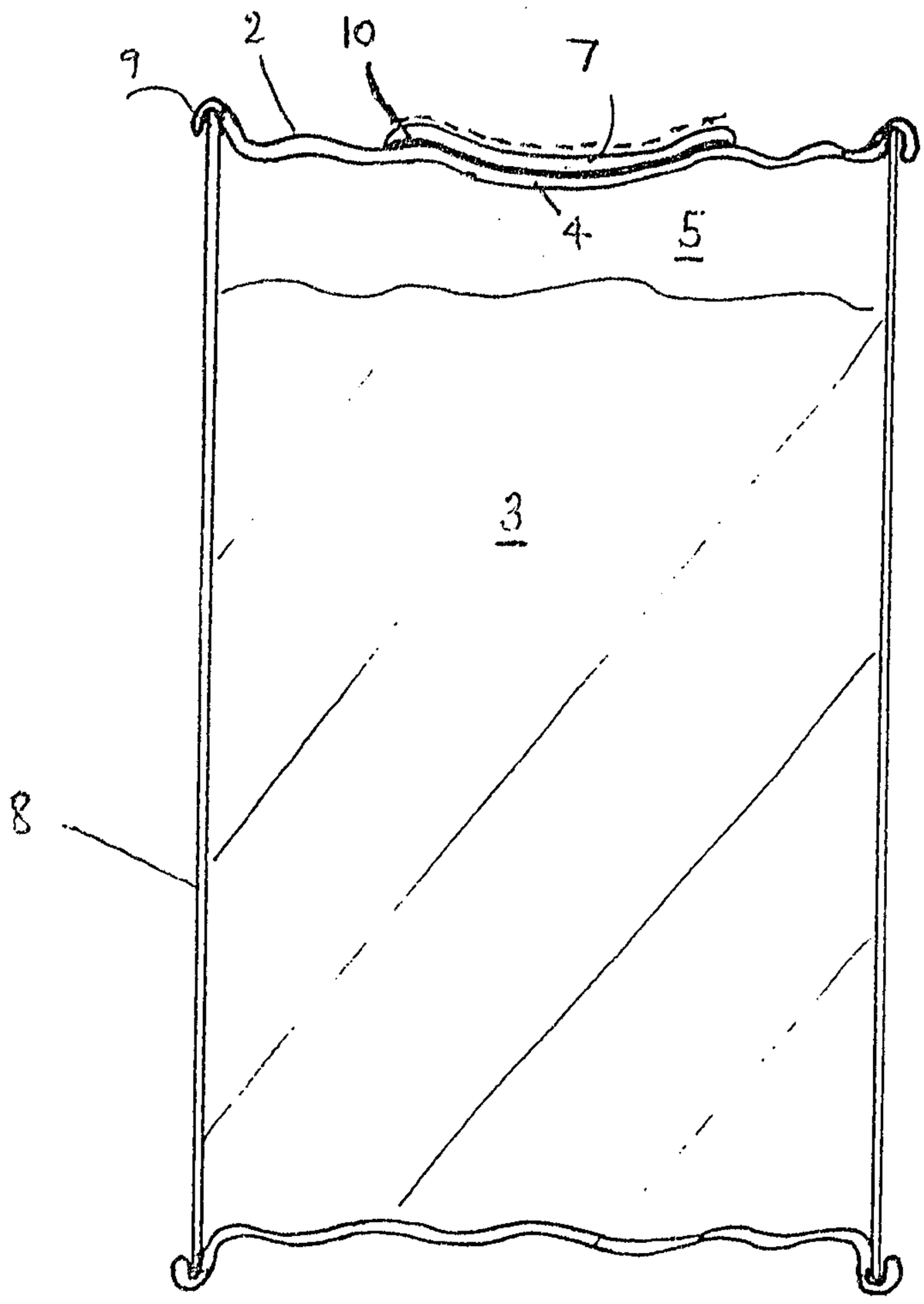


Figure 2

A. W. Sachs

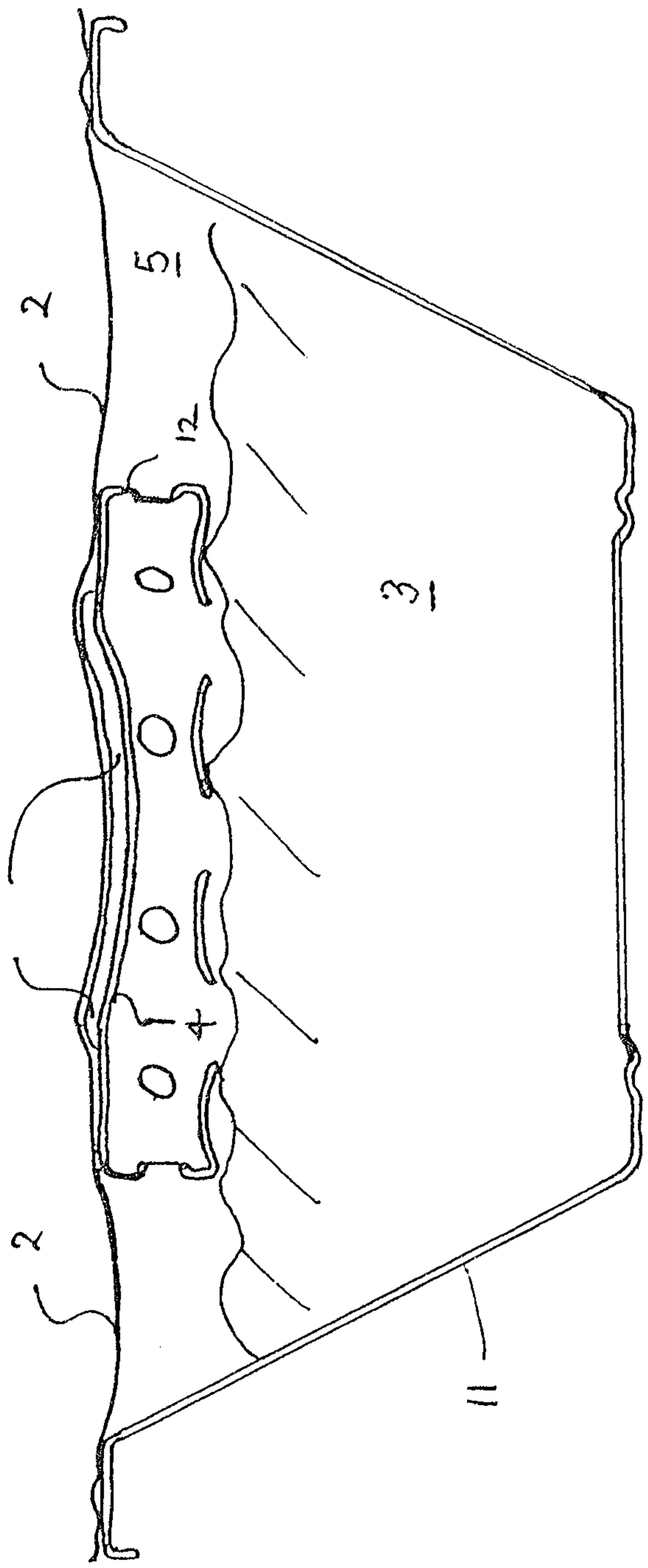


Figure 3

A. N. Sadik

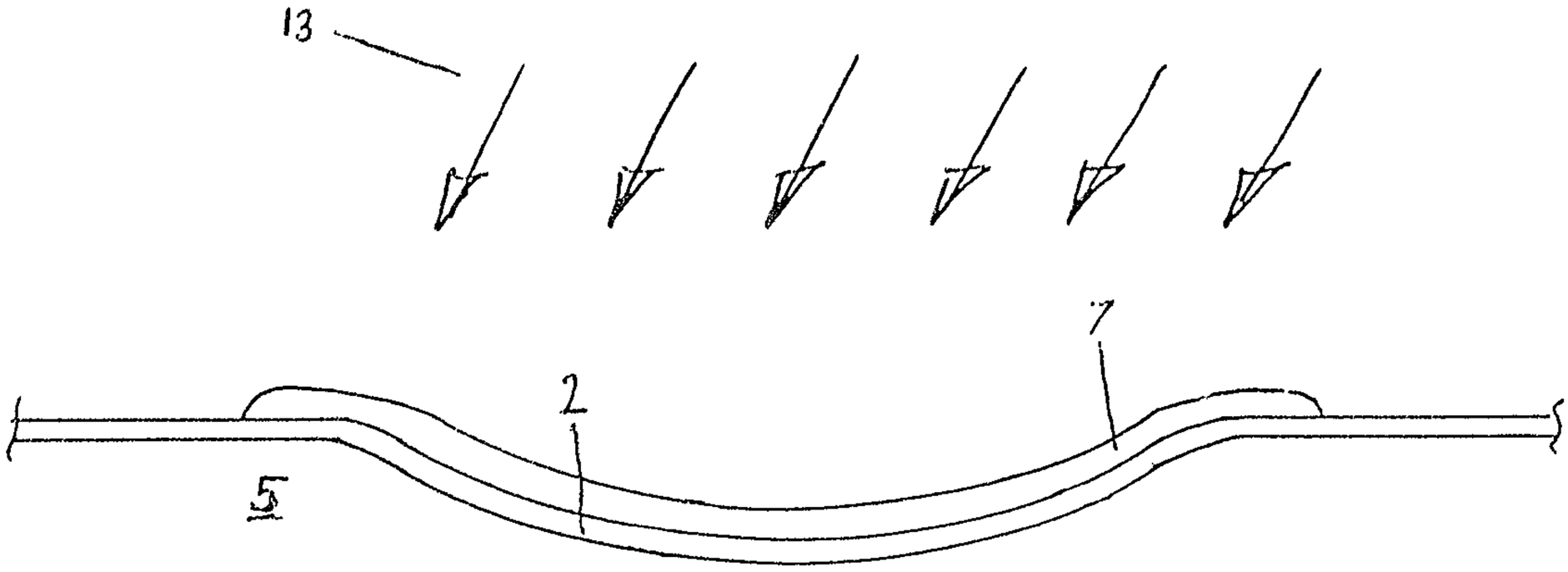


FIGURE 4(a)

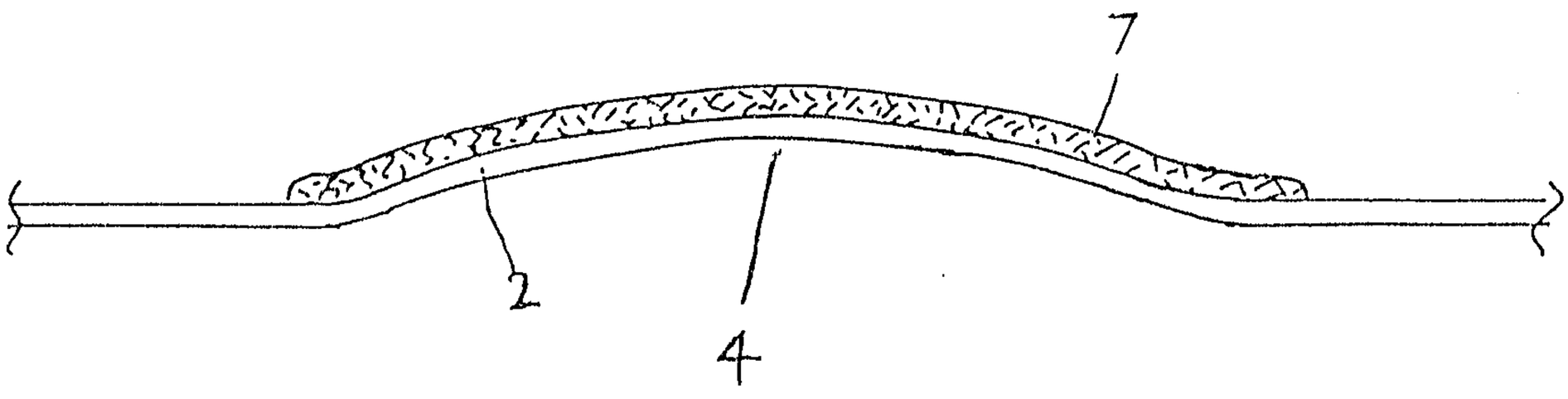


Figure 4(b)

A. N. Sachdeva

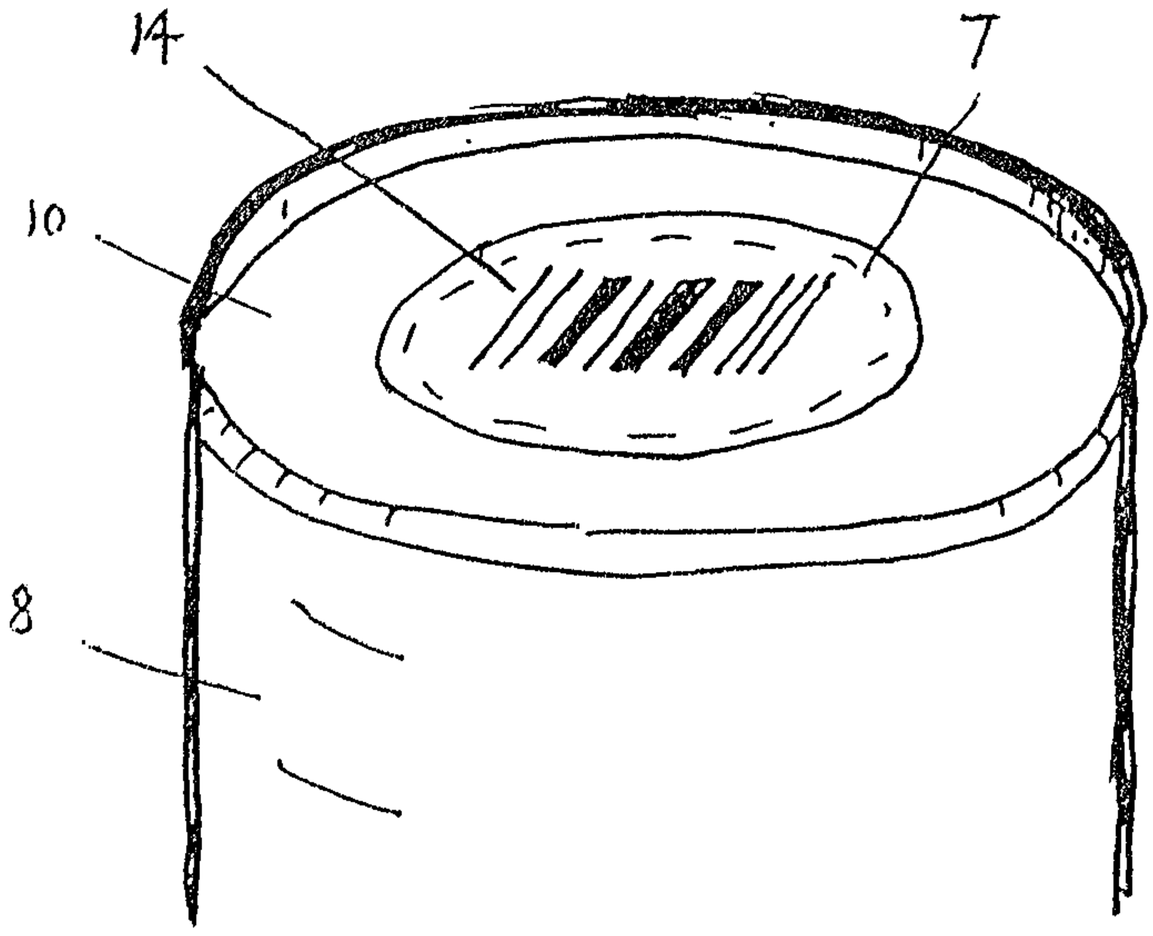


Figure 5(a)

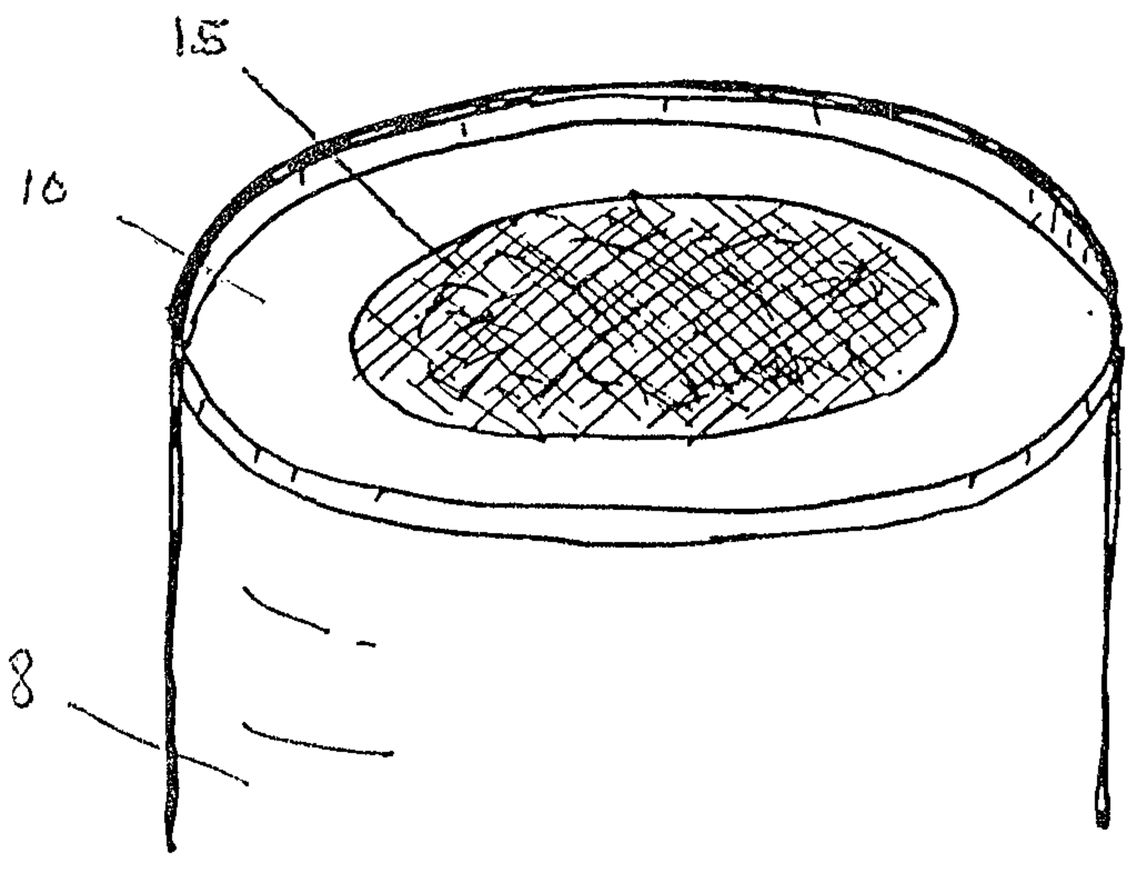


Figure 5(b)

A.N. Sadd

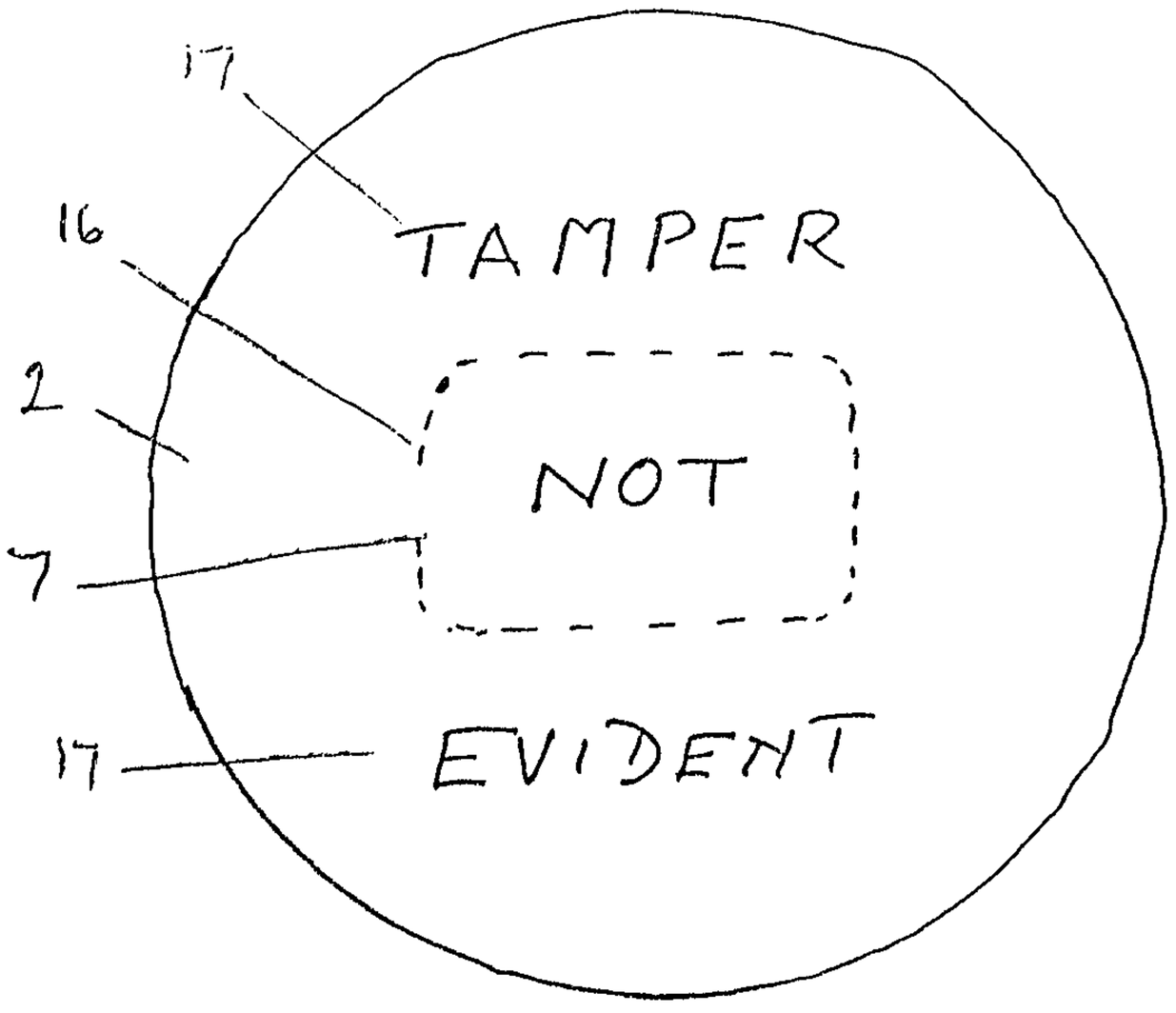


Figure 6(a)

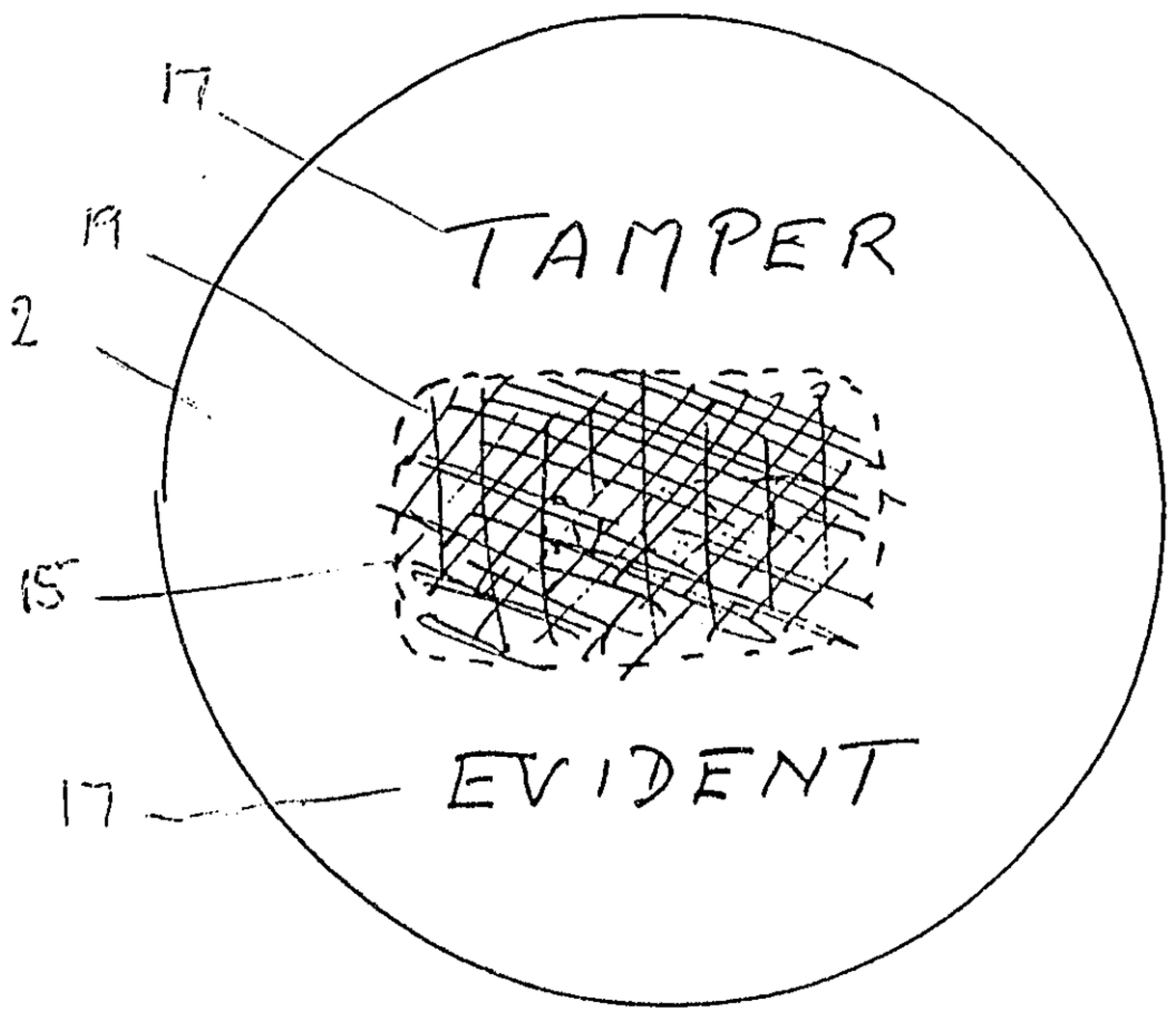


Figure 6(b)

A. W. Sadler

Figure 7a

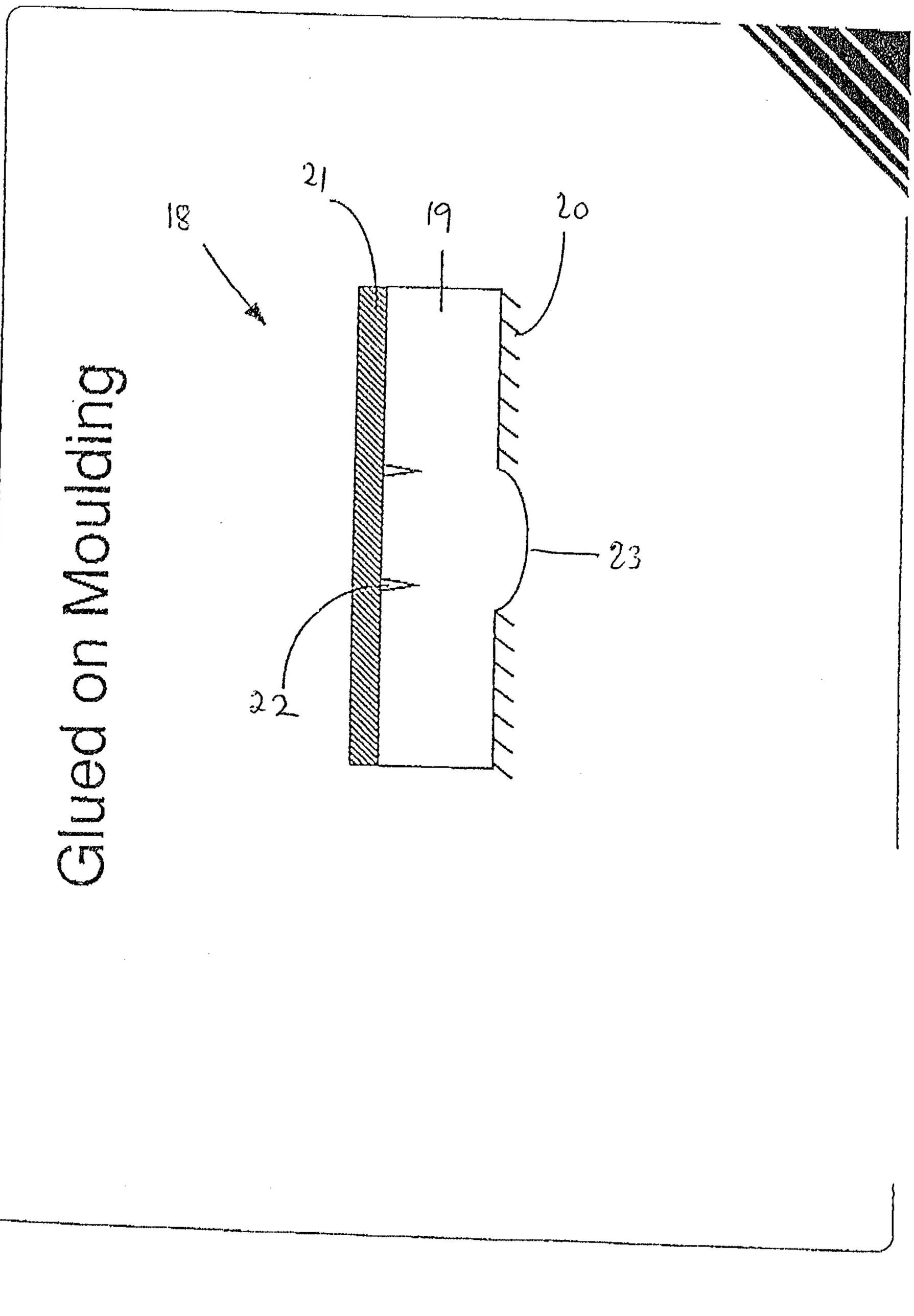
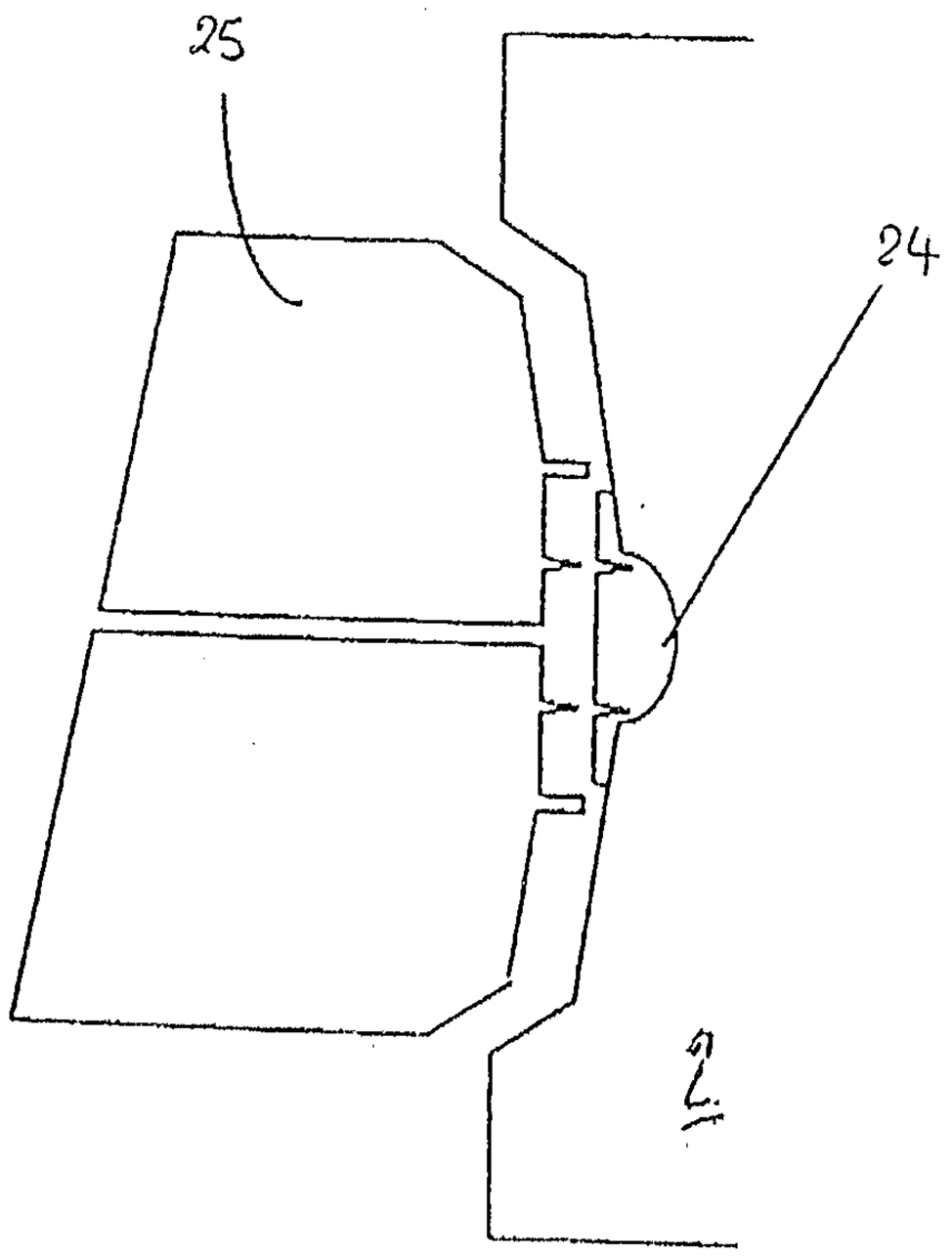


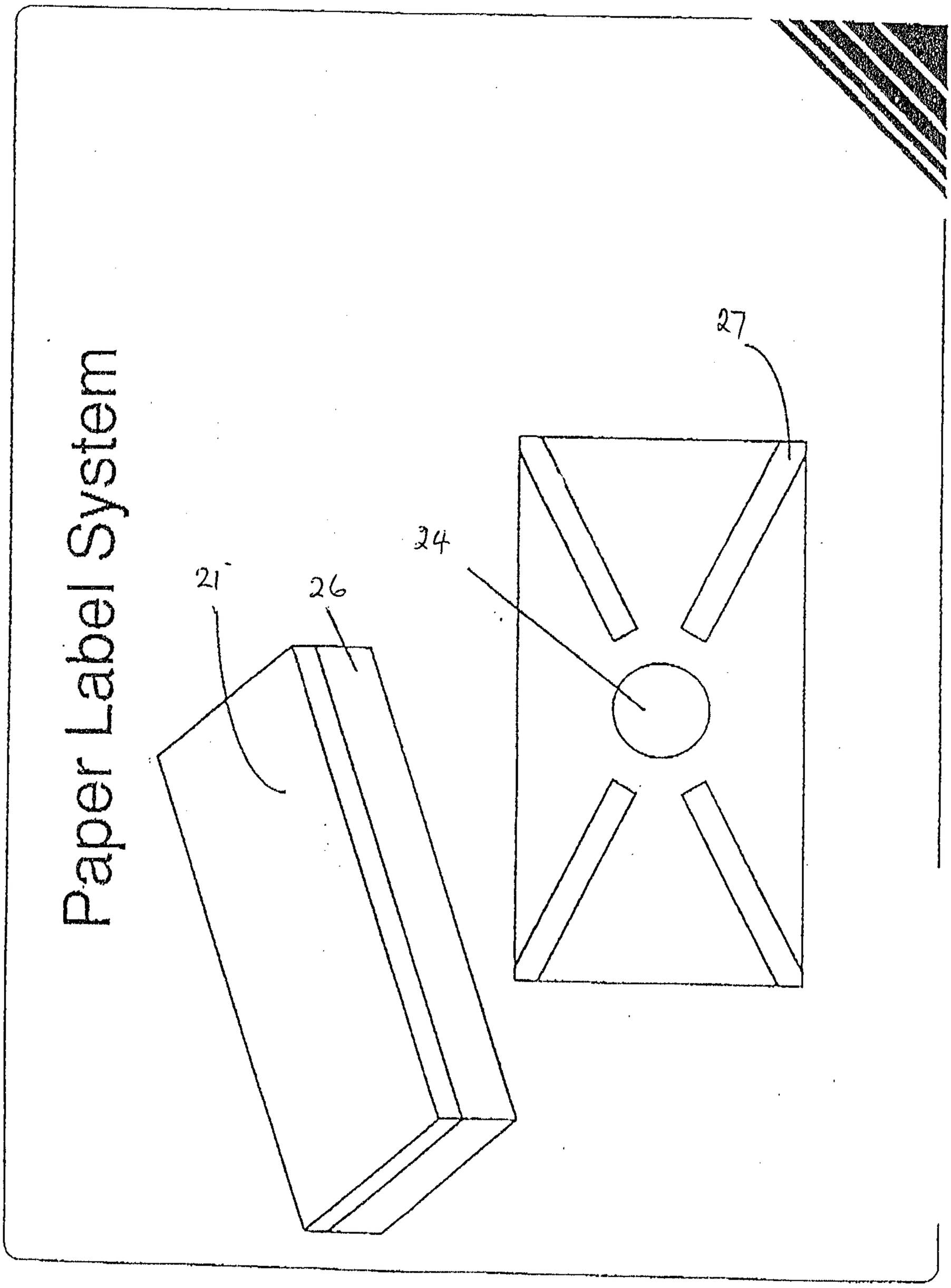
Figure 7b

Injection Moulded Button



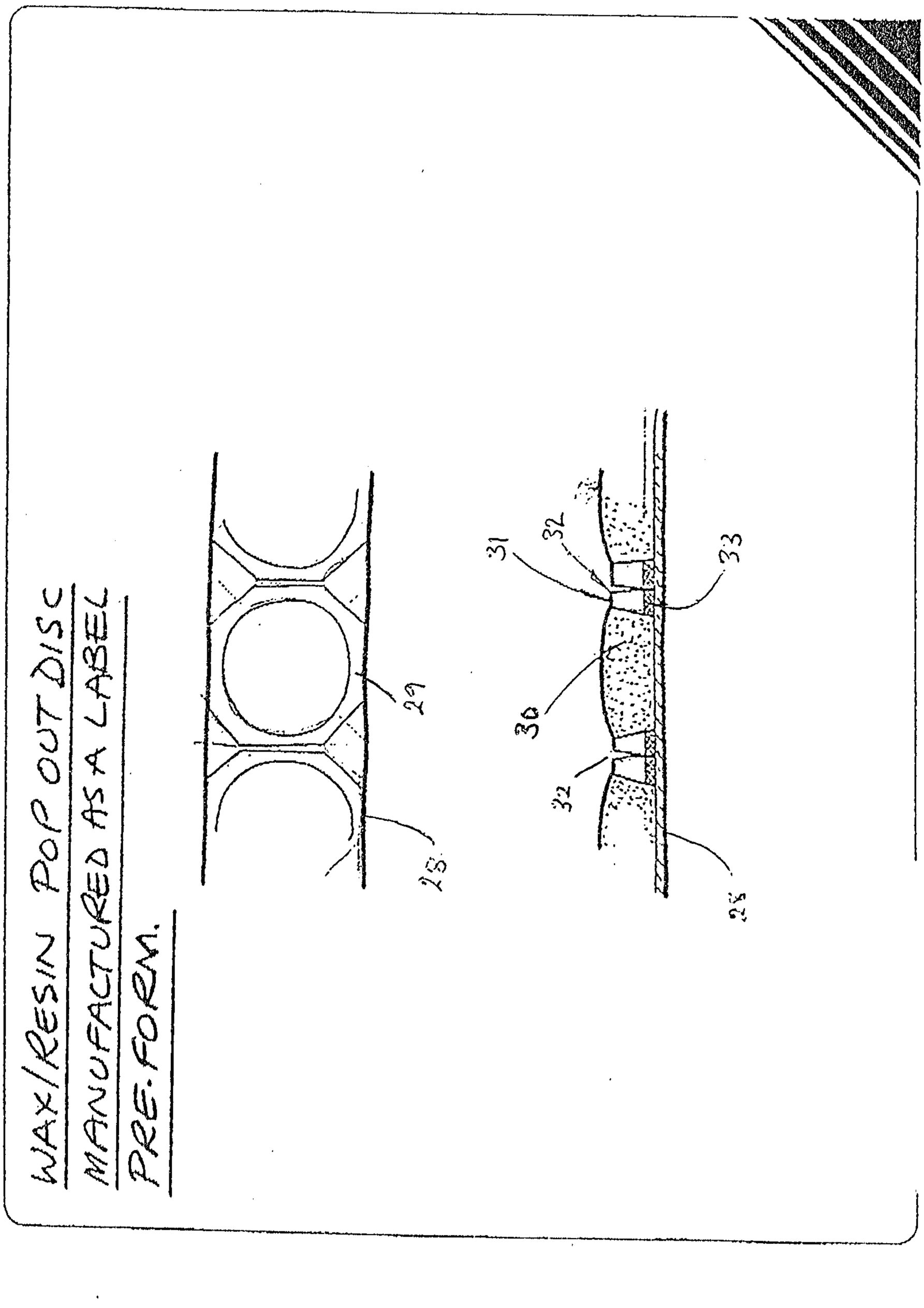
A. N. Sahil

Figure 7c



A. N. Sachil

Figure 8a



A. W. Dodd

Figure 8b

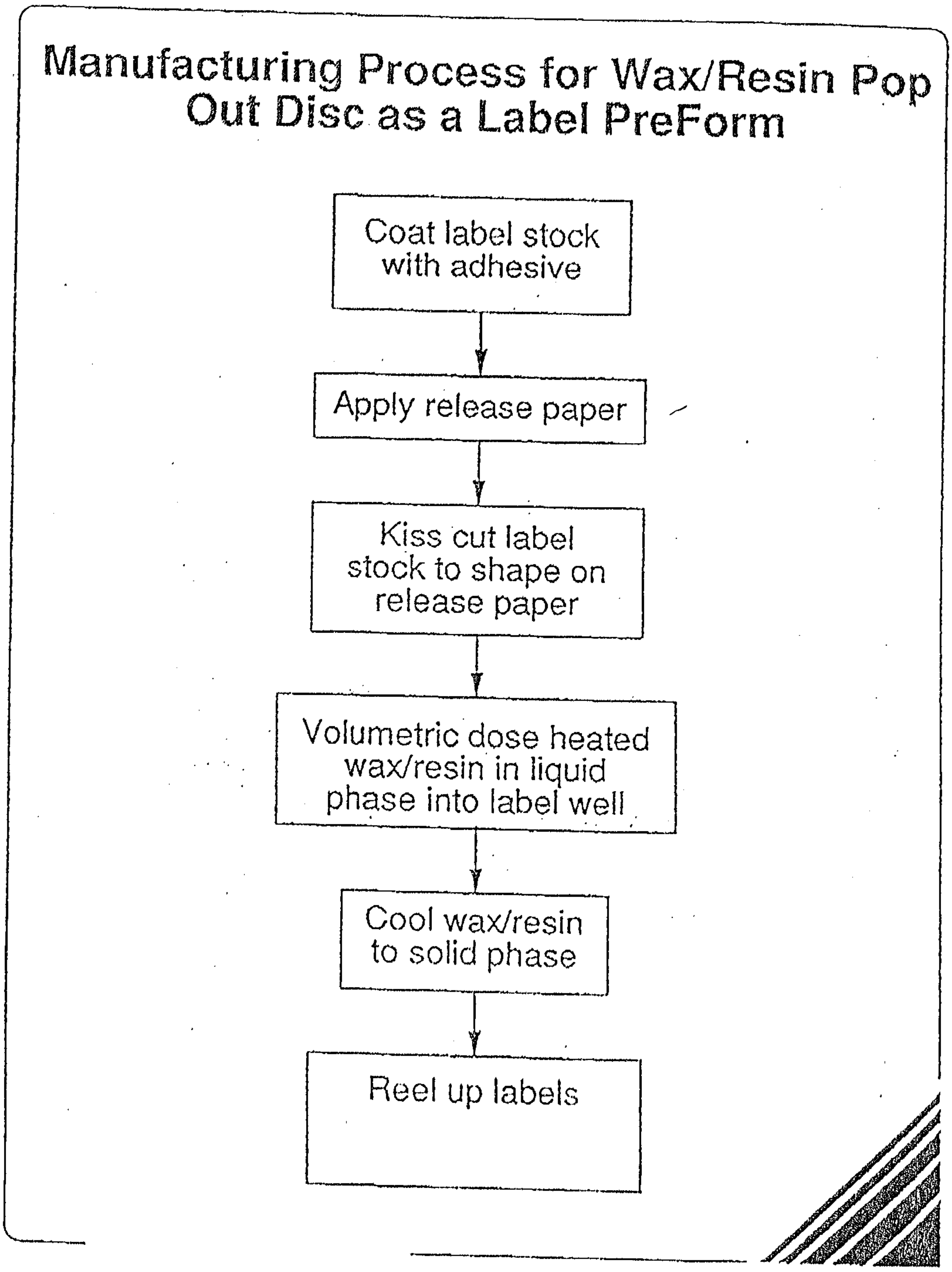

Manufacturing Process for Wax/Resin Pop Out Disc as a Label PreForm
Coat label stock with adhesive
Apply release paper
Kiss cut label stock to shape on release paper
Volumetric dose heated wax/resin in liquid phase into label well
Cool wax/resin to solid phase
Reel up labels

Figure 8c

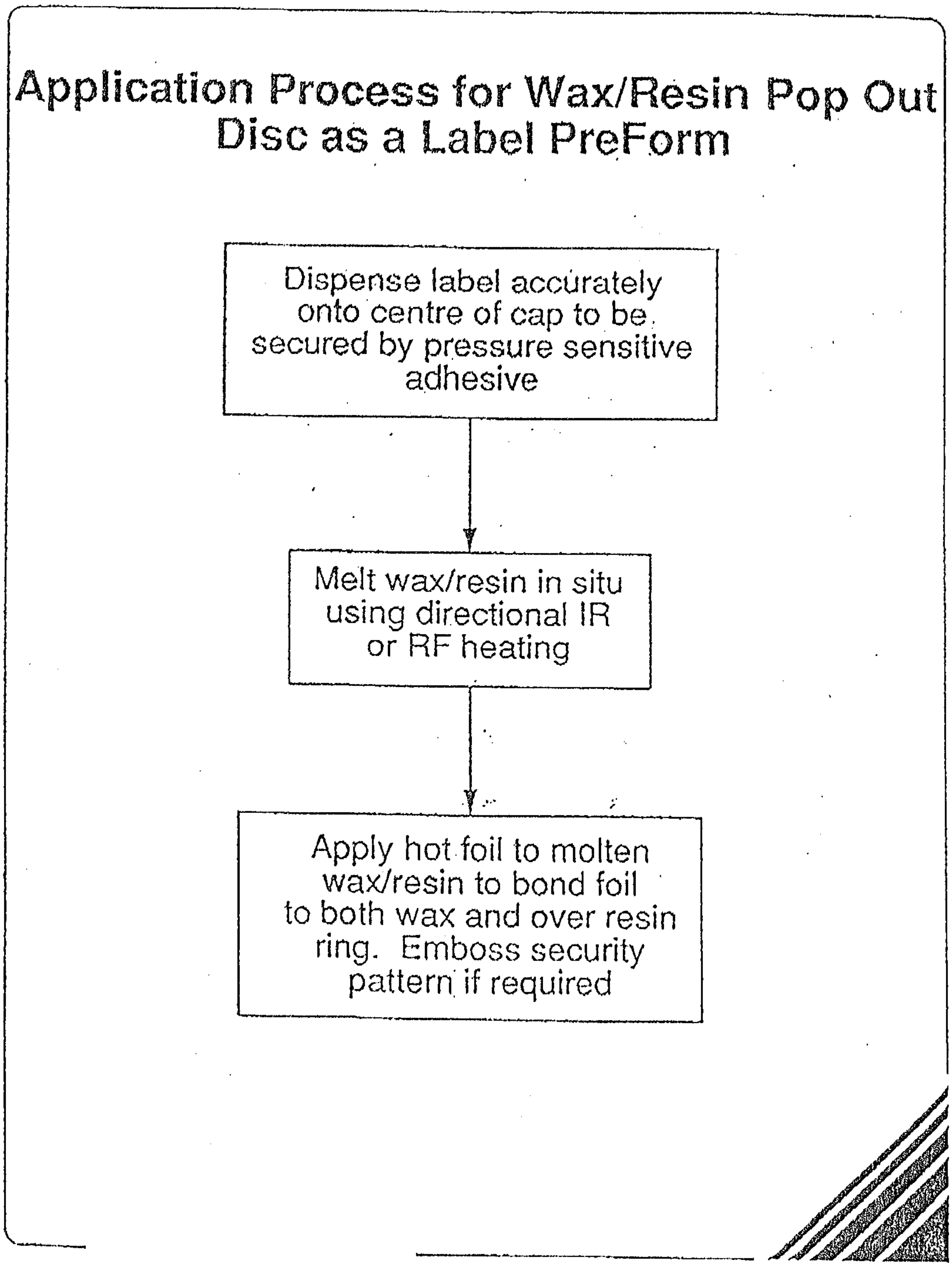
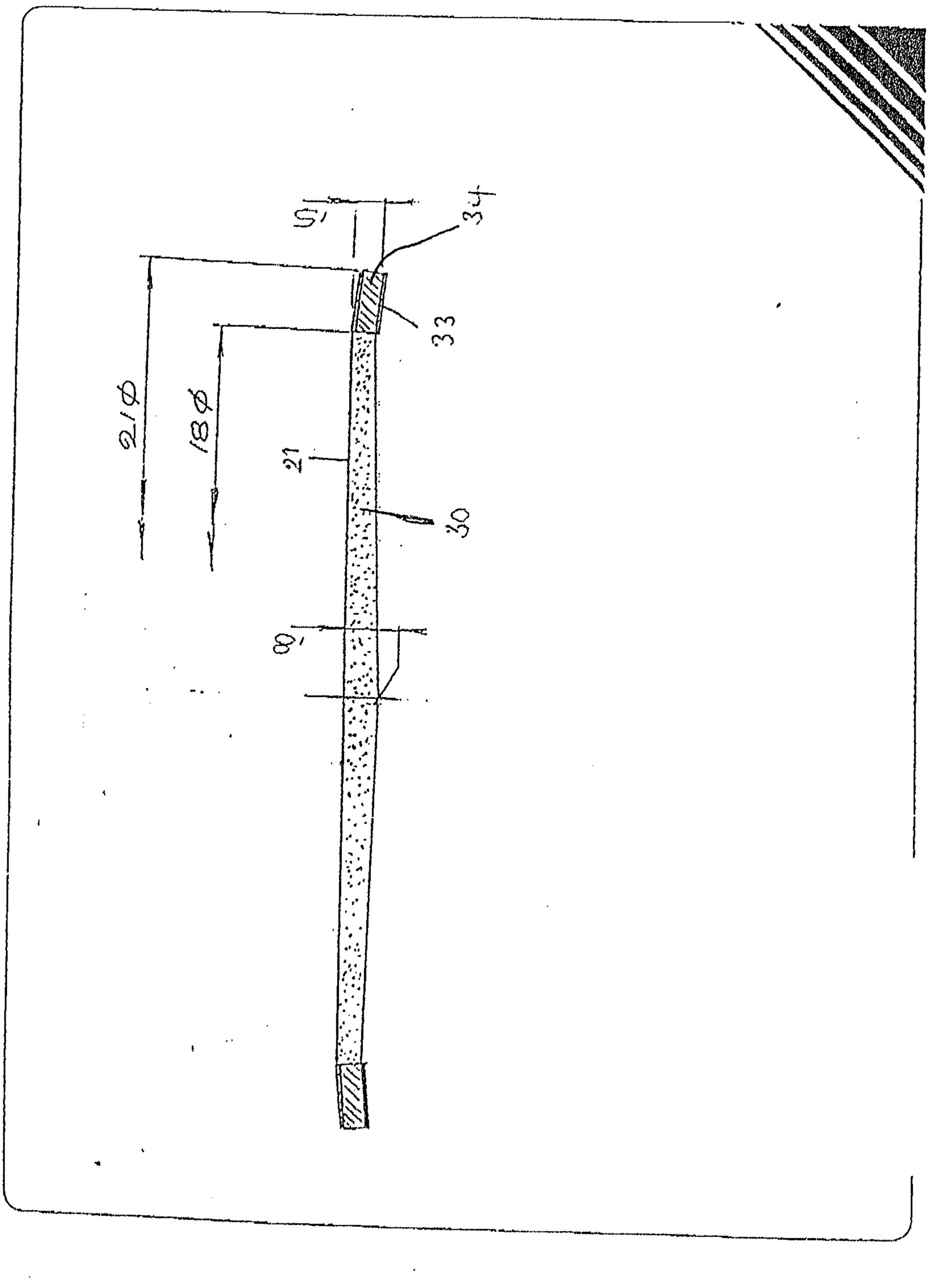

Application Process for Wax/Resin Pop Out Disc as a Label PreForm
Dispense label accurately onto centre of cap to be secured by pressure sensitive adhesive
Melt wax/resin in situ using directional IR or RF heating
Apply hot foil to molten wax/resin to bond foil to both wax and over resin ring. Emboss security pattern if required

Figure 9a



A. W. Sadler

Figure 9b

Manufacturing Process for Wax/Resin Pop Out Disc With Moulded Rim

Polymer injection moulded in multi-cavity tooling and ejected as individual parts

↓

Place rings into special purpose filling machine and volumetrically dose heated liquid wax/resin into centre of ring cast moulded in situ. Eject when wax/resin has cooled to solid phase

↓

Bag up rings and supply in protective outer cartons

Figure 9c

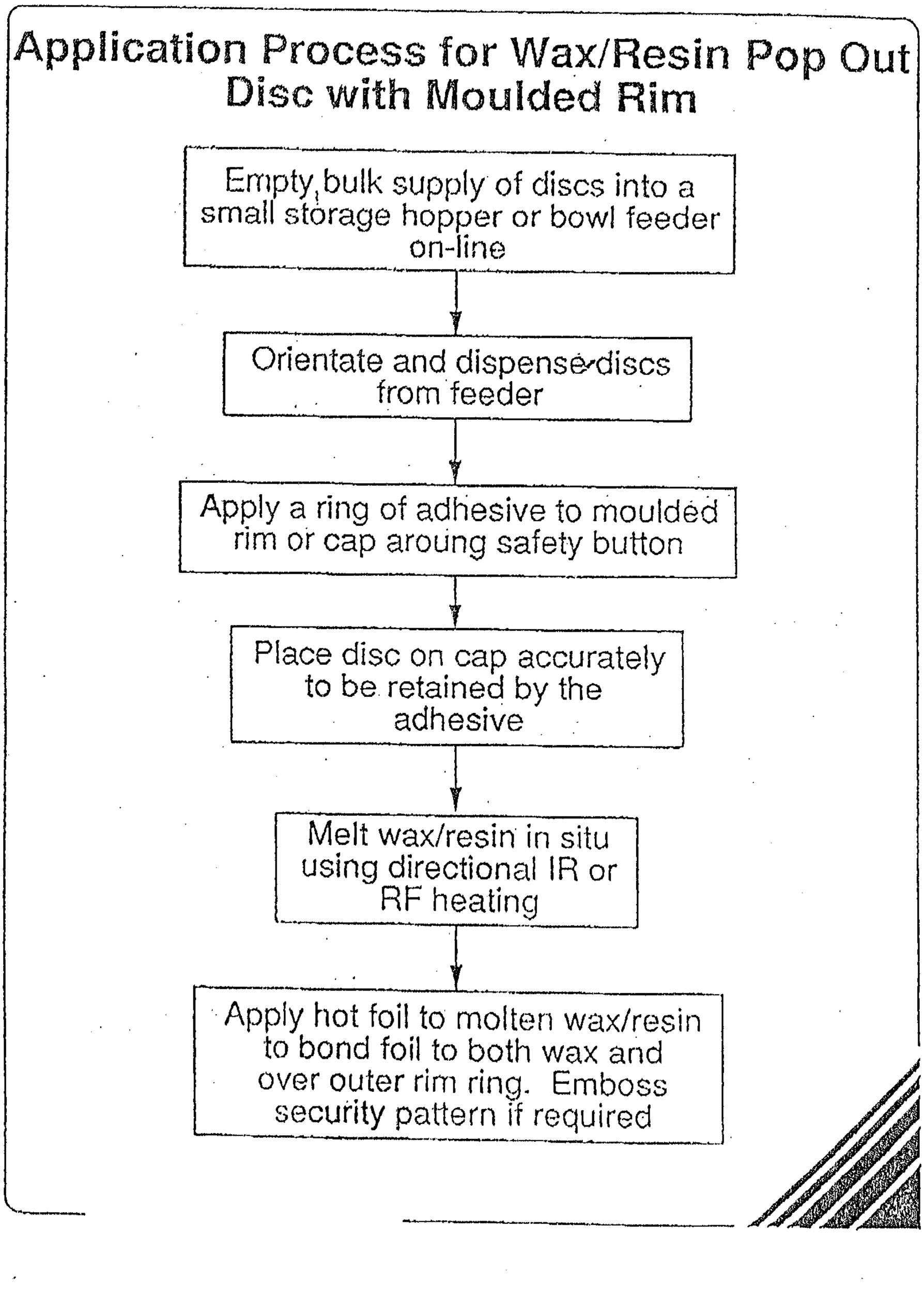
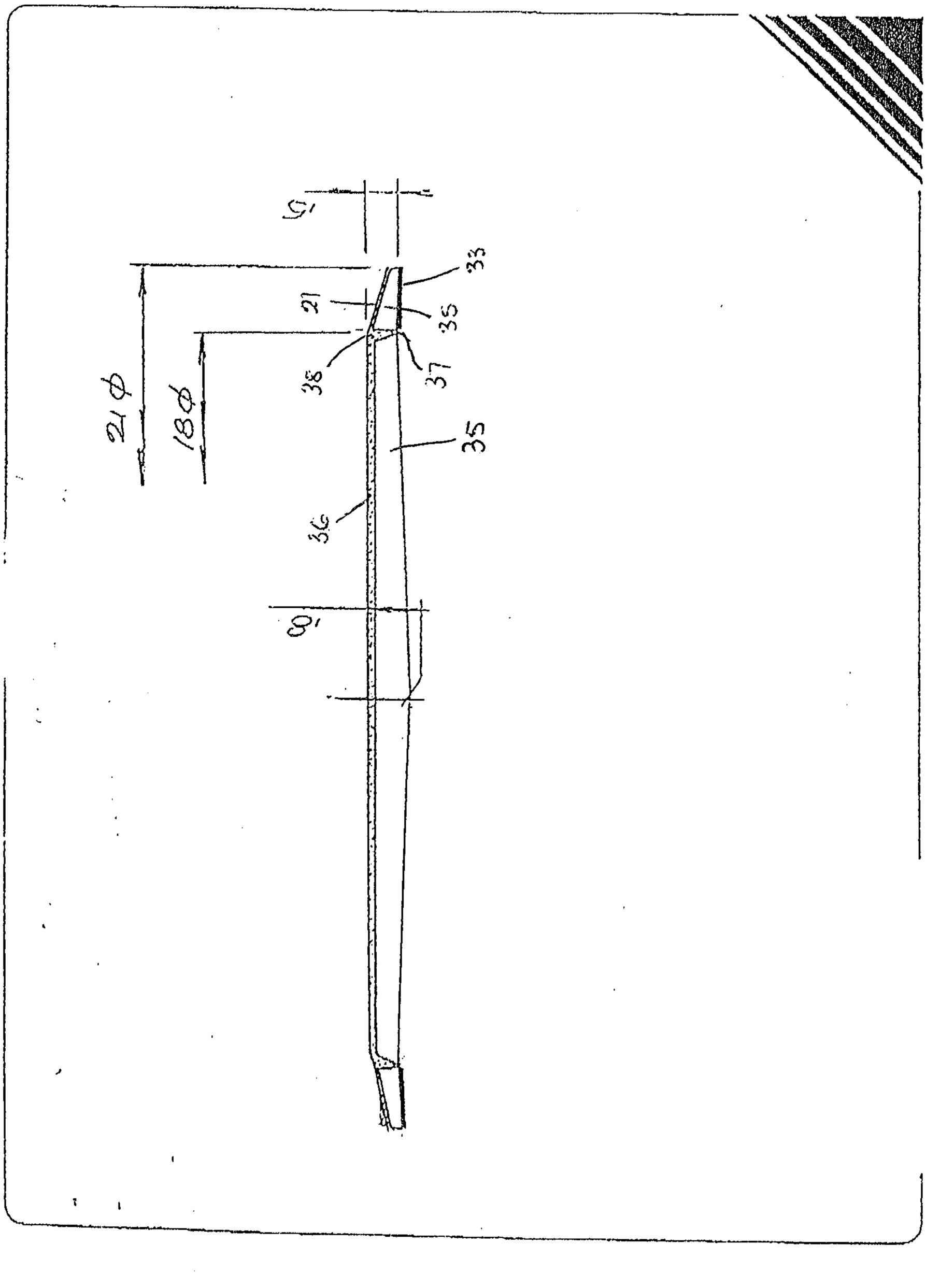

Application Process for Wax/Resin Pop Out Disc with Moulded Rim
Empty bulk supply of discs into a small storage hopper or bowl feeder on-line
Orientate and dispense discs from feeder
Apply a ring of adhesive to moulded rim or cap aroung safety button
Place disc on cap accurately to be retained by the adhesive
Melt wax/resin in situ using directional IR or RF heating
Apply hot foil to molten wax/resin to bond foil to both wax and over outer rim ring. Emboss security pattern if required

Figure 10a



A. N. Sadik

Figure 10 b

Manufacturing Process for Pop Out Disc Moulding with Wax Layer and Security Foil

Polymer injection moulded in multi-cavity tooling and ejected as individual parts

↓

Place mouldings into a special purpose machine to coat upper surface and fill stress ring with molten wax/resin

↓

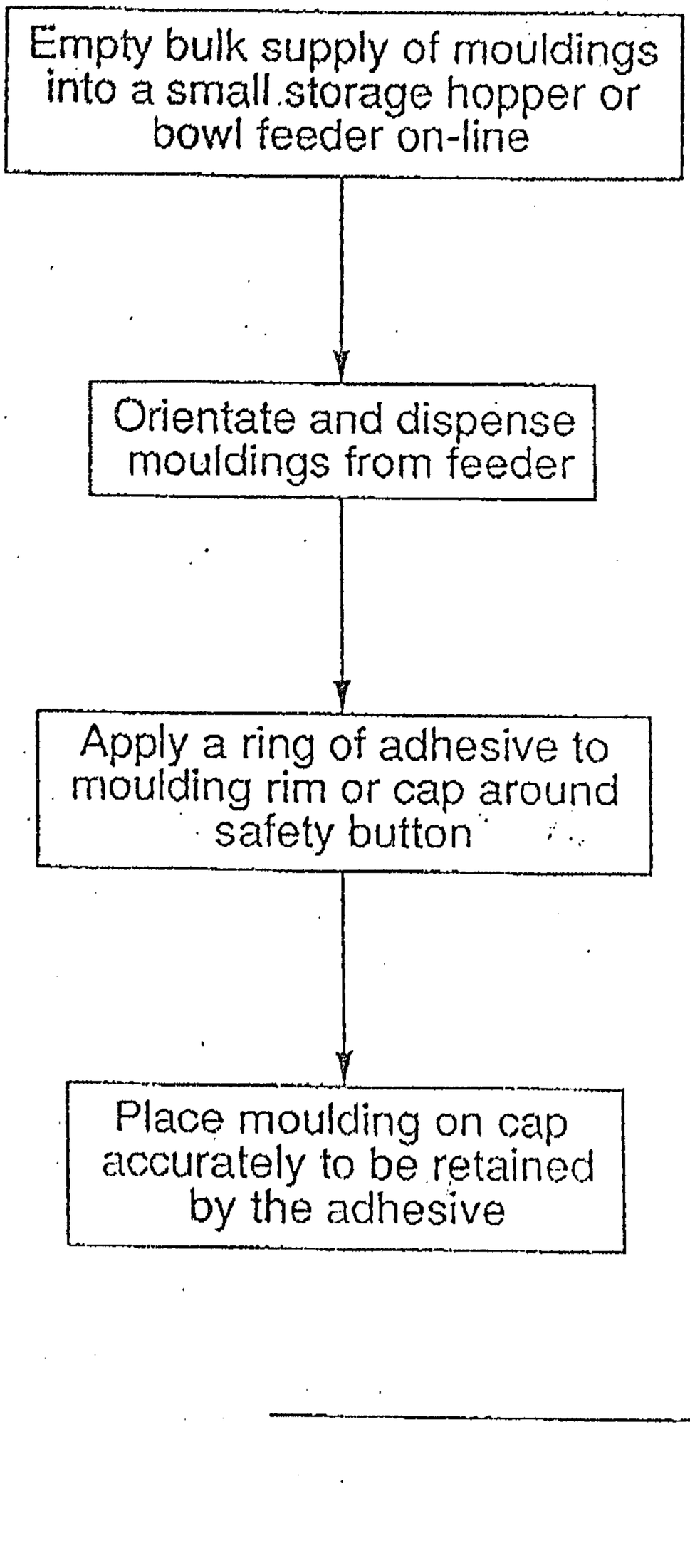
Apply hot foil to molten wax/resin to bond foil to wax and over outer rim of moulding. Emboss security pattern if required

↓

Bag up loose mouldings and supply in protective outer cartons

Figure 10 c

Application Process for Pop Out Disc Moulding with Wax Layer and Security Foil



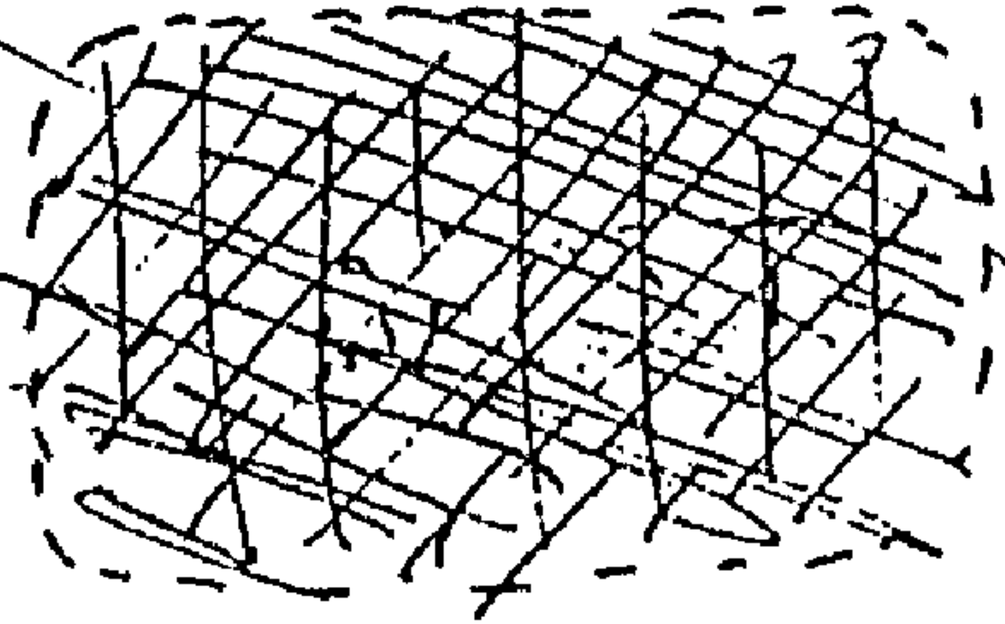
17

17

2

15

17



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