July 22, 1969 A. TUMA ET AL 3,457,132

APPARATUS FOR SEVERING AND SEALING WEBS OF HEAT SEALABLE PACKAGING MATERIAL IN A SINGLE OPERATION

Filed Dec. 20, 1965 7 Sheets-Sheet 1

FIG. 1

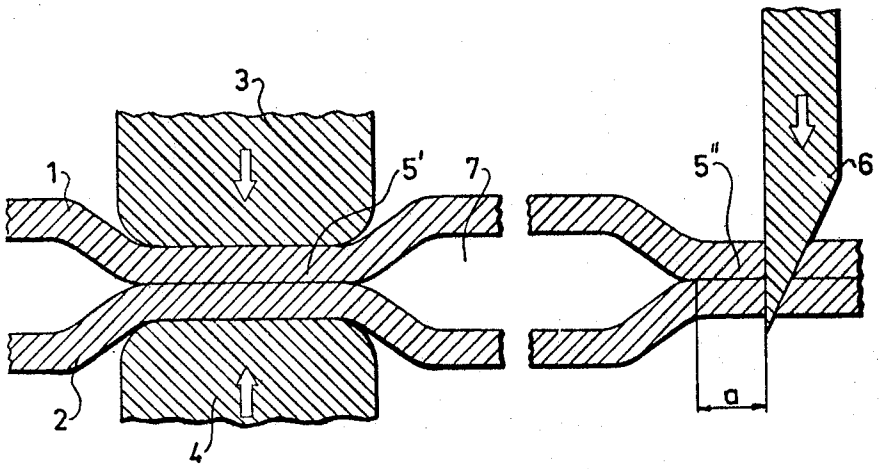
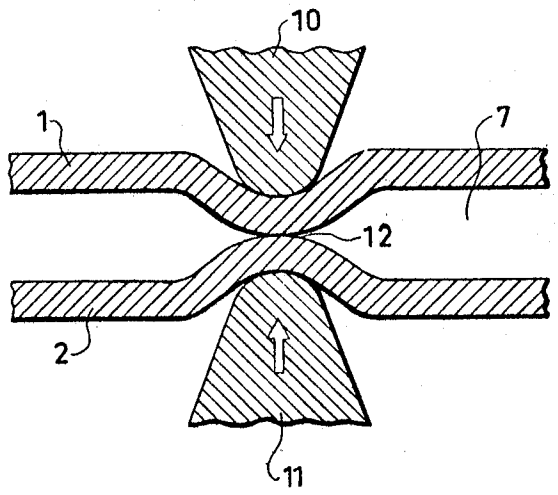


FIG. 2



INVENTORS
ALEX TUMA
BO E. GAFVERT

BY Earle R. Marden
ATTORNEY

FIG. 3

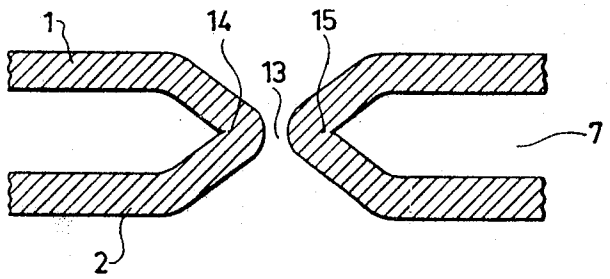


FIG. 4

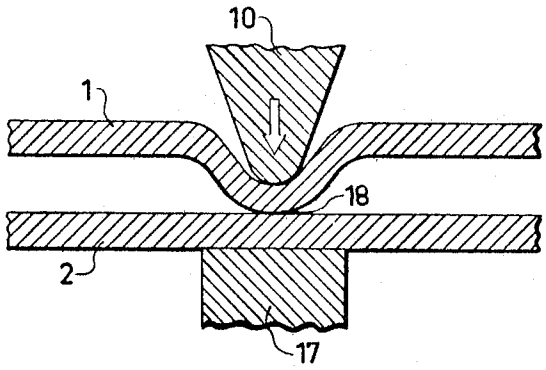
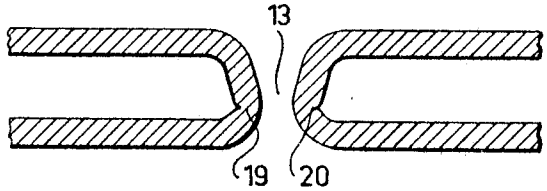


FIG. 5



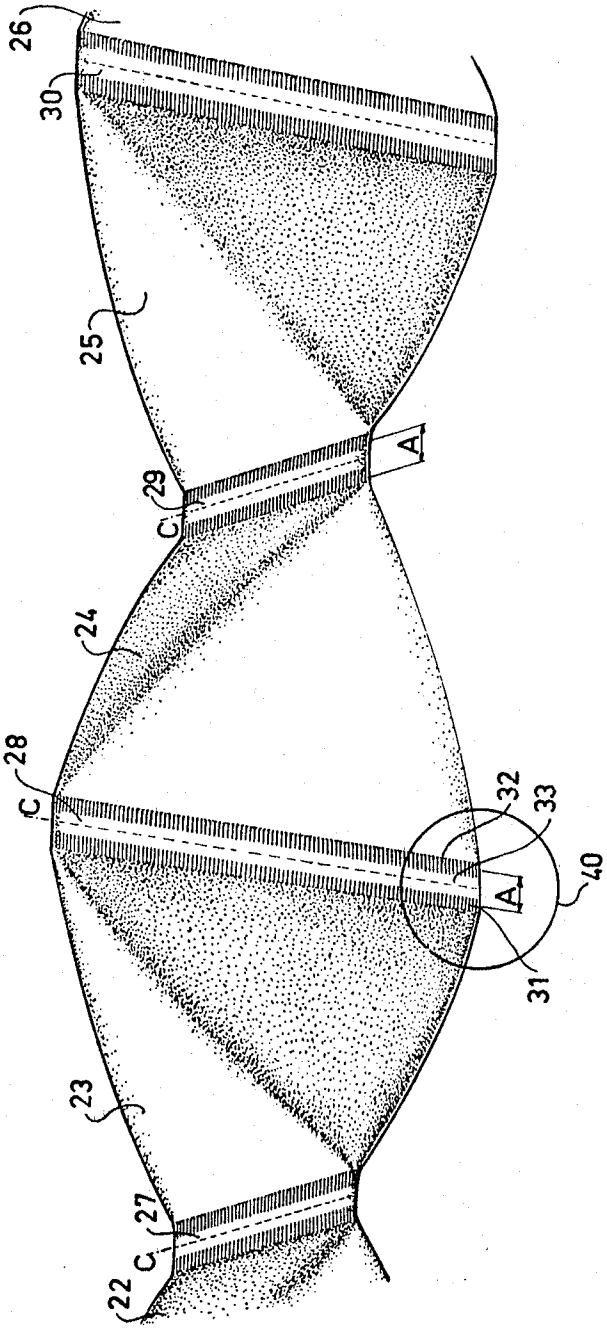
INVENTORS
ALEX TUMA
BO E. GAFVERT
BY Earle R. Marden
ATTORNEY

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FIG. 6



INVENTORS
ALEX TUMA
BO E. GAFVERT

BY Earle R Marden
ATTORNEY

FIG. 7

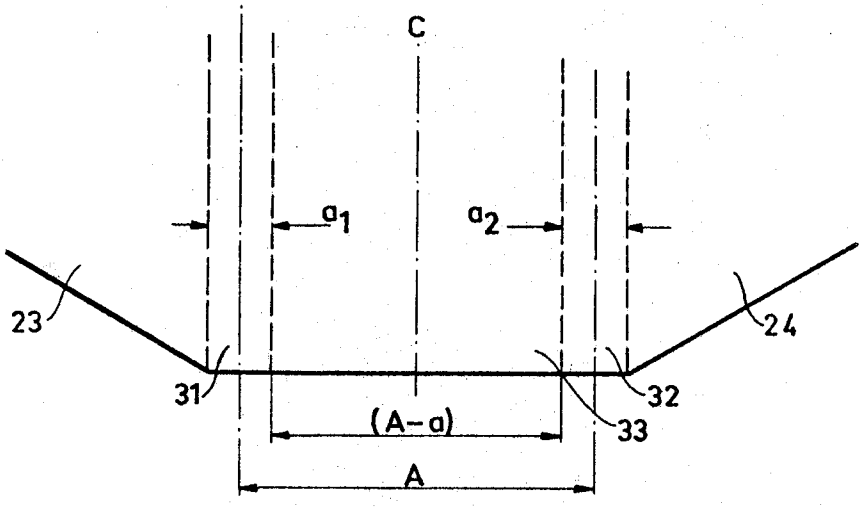


FIG. 8

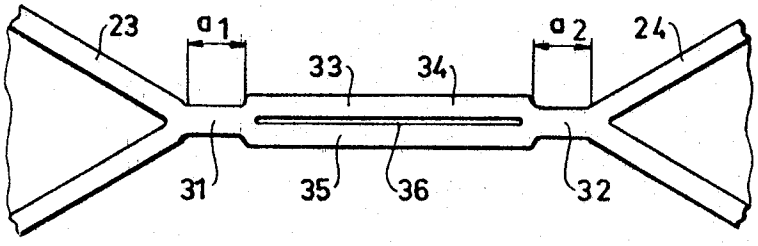
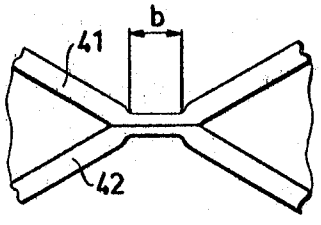


FIG. 9



INVENTORS
ALEX TUMA
BO E. GAFVERT
BY Earle R Marden
ATTORNEY

FIG. 10

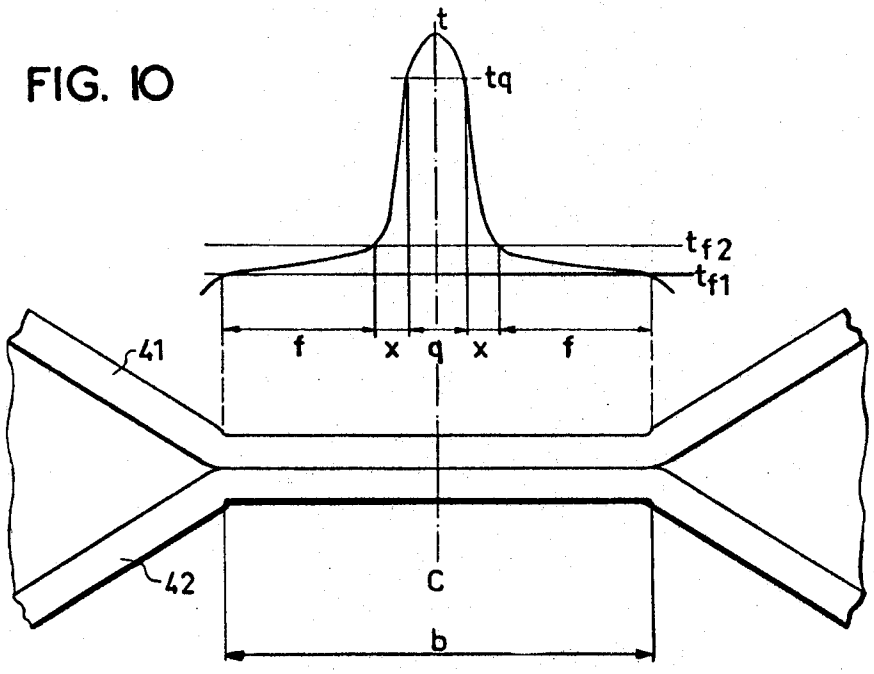
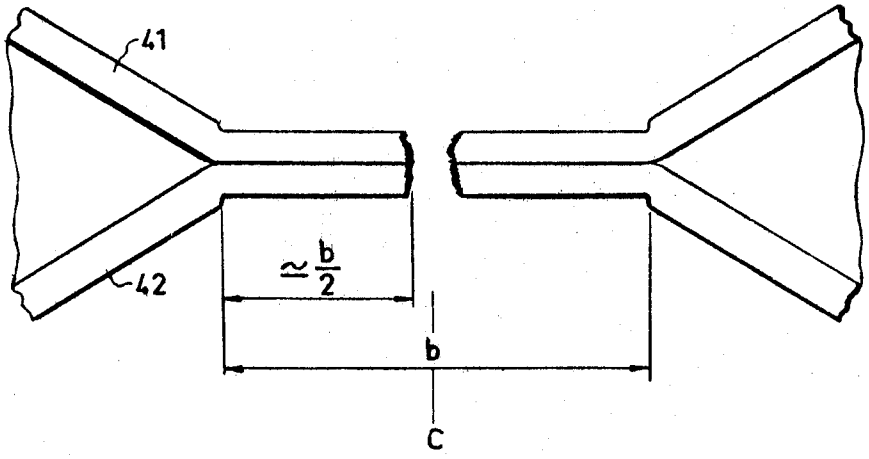


FIG. 11



INVENTORS
ALEX TUMA
BO E. GAFVERT
BY Earle R Marden
ATTORNEY

FIG. 12

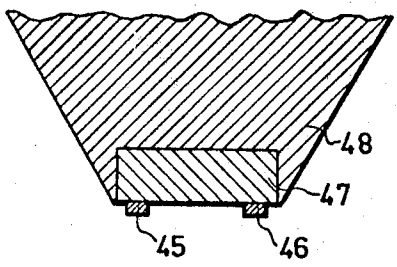


FIG. 13

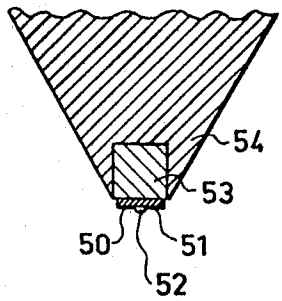


FIG. 14

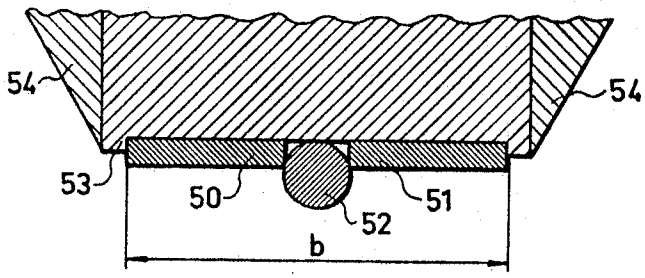
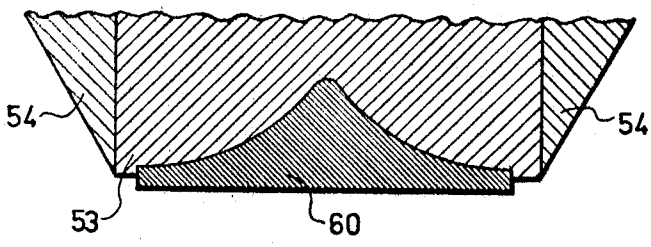


FIG. 15



INVENTORS
ALEX TUMA
BO E. GAFVERT
BY Earle R Marden
ATTORNEY

FIG. 16

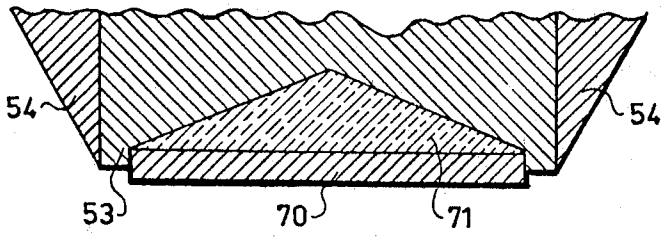


FIG. 17

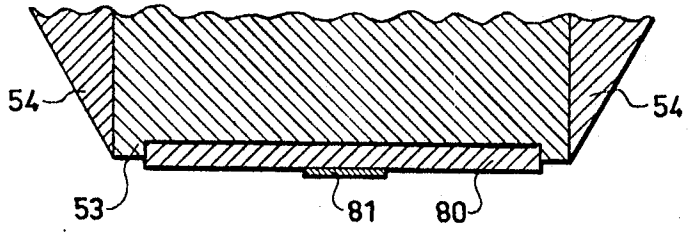


FIG. 18

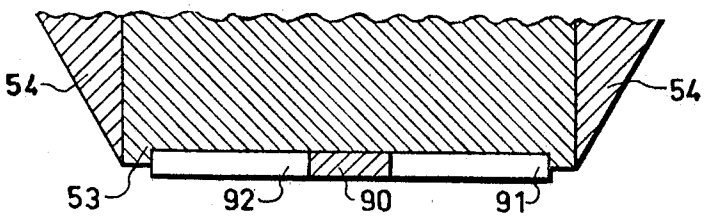
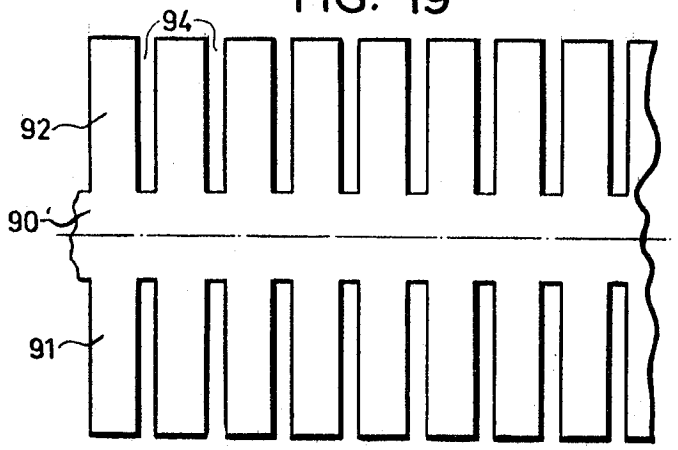


FIG. 19



INVENTORS
ALEX TUMA
BO E. GAFVERT
BY Earle R. Marden
ATTORNEY

United States Patent Office 3,457,132 Patented July 22, 1969

3,457,132

APPARATUS FOR SEVERING AND SEALING WEBS OF HEAT SEALABLE PACKAGING MATERIAL IN A SINGLE OPERATION

Alex Tuma, Loddekopinge, and Bo E. Gafvert, Lund, Sweden, assignors to AB Tetra Pak, Lund, Sweden, a company of Sweden

Filed Dec. 20, 1965, Ser. No. 515,076
Claims priority, application Sweden, Dec. 28, 1964, 16,728/64
Int. Cl. B65b 7/14; B32b 31/26
U.S. Cl. 156—515 5 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus to heat seal and sever two webs of heat sealable material in one operation by the use of a heated member which has a differential surface temperature in contact with the web material.

The present invention refers to improvements in the art of detaching flat materials and sealing two such materials, or two parts of such a material, to each other. The invention refers especially to detaching and sealing materials composed of heat sealing plastic, or materials having at least one surface of heat sealing plastic. More particularly, the invention refers to a method of detaching and sealing webs of packaging materials in a single operation.

For reasons of economy there is an endeavour for example in making packages, or blanks for packages, to reduce the consumption of materials to the utmost minimum. With a given thickness of material the ratio of the package surface area necessary for each package to the volume of product which can be confined within the package affords an index for the fixation of the price of the whole package. Certain parts of the packaging material of some packages have no pure package forming fuction to perform but derive from the process of manufacturing the package. For example, bags or bag-shaped blanks of packages having an interior surface of heat sealing plastic and being closed at their edges by heat sealing get so called fins along the seals. Packages intended especially for packing liquids and made from a tubular, partially liquid-filled package blank by such a procedure that the tube walls are being compressed by appropriate means and heat sealed in directions at right angles to the tube axis, are also provided with such fins. These are clearly seen in Swedish Patent No. 123,250. The fins provide a margin of safety to avoid cutting off of the two transverse joints at detaching the finished packages from the tubular blank.

The cutting-off of the finished packges has been carried out by means of special knives which have been synchronized with the sealing means. With the high rates here concerned, viz. one or more packages a second, extreme difficulties are involved in providing mechanical means capable of detaching every package at exactly the same place in the transverse seals. Even if one succeeds in making the cutting means perfect, the difficulties arising through the pulling and turning of the packaging material remain to be solved. Therefore, up to the present time one has had to work with rather great margins of safety in cutting off the packages from the tube blank, whereby said fins arose.

Earlier one has observed the great losses of material caused by the fins and tried to solve the problem by mechanical means, the sealing jaws being provided with knives for the purpose of obtaining an increased synchronization of sealing and cutting operations. Theoretically, by the use of these means the width of the fins can be

reduced, but the method has not been able to be realized with good results, inter alia depending on the fact that during the short period of time which is available for each individual sealing operation one has not been able to provide a good seal, on one hand, and mechanically to cut off the package along the provided seal on the other hand.

An object of the invention is to cut off a material without using mechanical cutting tools.

Another object of the invention is to seal materials having surfaces of heat sealing plastic brought together one against the other.

A further object of the invention is to provide for sealing and detaching a material in a single operation.

Furthermore, it is an object of the invention to avoid appreciable losses of material in making packages and to provide packages which are more satisfactory from a hygienic point of view.

Still another object is to produce packages having improved tightening characteristics.

As disclosed in Swedish Patent No. 123,250, packages may be produced starting from a flat web material which is formed to a tube which is filled with a liquid filling product. In this case the tube is formed into tetrahedral packages which, in the case the material having a surface of plastic facing the interior of the package, being heat sealed and detached from the tube by cutting in the region between the transverse seals. During the tube forming operation, now that plastic covered material is utilized, the longitudinal joint of the tube is also longitudinally sealed by heat sealing. At the crossing between a longitudinal joint and a transverse joint of a finished package a narrow channel easily arises which is very difficult to tighten. A further object of the invention, therefore, is to tighten this channel.

Thus, the present invention refers to a method of detaching and sealing webs of packaging materials for the manufacture of packages. The method is characterized by the fact that two surfaces of material are brought together and compressed against each other in a long and narrow region within which the detaching and sealing is intended to be carried out, whereupon the walls of the material are burnt and/or fused off within a longitudinal zone of said long and narrow region, at the same time as those parts of the walls of the material which are disposed within a certain region on both sides of the burning-off zone and which are pressed against each other are heat sealed. According to a modification of the method, the walls of the material are detached and sealed by means of waves of ultra high frequency instead.

The invention also refers to a device for carrying out the method, said device including a long and narrow heated sealing and detaching member having a width which is at least equal to said long and narrow region. Said member is characterized by the fact that in a zone extending along the whole length of the member and having substantially the same width as the burning-off and/or fusing-off zone it has a temperature which is equal to or exceeds the burning-off and/or fusing-off temperature of the packaging material, while the parts of the member on both sides of this zone are heated only to a temperature suitable for heat sealing the material, or that provisions are made for producing a flow of heat to the material appropriate for heat sealing the latter.

According to an embodiment of the invention a heated member is pressed against the material in the region in which the sealing and cutting is intended to be carried out. The member has an extension along the length thereof which is equal to or greater than the length of the desired seal. Along the whole extension of the member the central part has a higher temperature than the lateral

parts, or provisions have been made for producing a stronger flow of heat to the material which engages the central part of the member for the purpose of being cut through. The purpose is to exceed the burning-off and/or fuse temperature of the material in the part of the material which engages the region around the central axis of the member, while those parts of the material which are to form the seals do not exceed the burning-fusing temperature. Owing to this the walls of material are rapidly burnt-off and/or fused-off along the central axis of the member, while the parts on both sides thereof, which are subjected to a pressure from the lateral parts of the member which are heated to a temperature not exceeding the burning-fusing temperature of the material, whereby good heat sealing can be provided at the same time as said burning-off and/or fusing-off is effected. Fusing-off applies for example to plastic or metallic materials, while burning-off applies to more fibrous materials, such as paper. For simplicity the common name will be used hereinafter for both methods.

Contrary to what might be expected, experiments have shown that no appreciable discolouring of the cut edges appears. Because the high temperature can be concentrated to a small region the colouring of the material, which probably cannot be entirely avoided, will be confined to the region nearest the cut edges or in certain cases confined to the cut edges themselves. The colour becomes completely black. No transition from completely black to dark brown and gradually to lighter brown can be discovered by the naked eye, and therefore the narrow black cut surface cannot be considered esthetically unattractive.

Further characteristics and advantages of the invention will be more clearly understood from the following examples of realization thereof which will be described with reference to the accompanying diagrammatic drawings, in which:

FIG. 1 illustrates how sealing and detaching has been carried out in the past;

FIGS. 2 and 3 disclose the principle of the invention;

FIGS. 4 and 5 disclose the principle of the invention with a device slightly different from that illustrated in FIG. 2;

FIG. 6 illustrates how tetrahedral liquid -filled packages have been sealed in the past;

FIG. 7 shows, on an enlarged scale, a detail of FIG. 6 enclosed by a circle;

FIG. 8 is a section through a sealing spot produced according to an earlier practised method;

FIG. 9 shows how two materials according to the invention have been joined together in order to be sealed and cut;

FIG. 10 shows the sealing spot according to FIG. 9 on an enlarged scale together with a temperature diagram;

FIG. 11 illustrates a seal according to the invention;

FIG. 12 is a section through a sealing jaw as earlier used;

FIG. 13 is a section through a sealing jaw according to the invention; and

FIGS. 14 to 19 are details of sealing and cutting means according to the invention, FIG. 19 being a detail of FIG. 18 as viewed from the bottom.

In FIG. 1, which illustrates the earlier generally used method of sealing and cutting two web materials, the two materials are designated by 1 and 2. These may consist of heat sealing plastic or at least have an inner surface of heat sealing plastic, i.e., the surface towards the package to be formed. Heat sealing therefore also includes high frequency sealing. It may furthermore consist of materials which may be sealed by means by ultrasonic sound. Furthermore, the materials may be provided with an adhesive paste on the innersides in those regions which are to form a seal.

The sealing is carried out by means of two sealing jaws **3** and **4** movable in relation to each other. By moving the jaws together the materials **1** and **2** are compressed in a

region 5' which has a relatively great extension. Depending on the material **1** and **2** being used, the jaws **3**, **4** are for example heated to sealing temperature. They may further emit high frequency electromagnetic signals in order to provide a suitable sealing temperature. Furthermore one may beat the two materials together at a high frequency according to the ultrasonic principle or simply move pasted surfaces together. Whichever principle is utilized the result is a seal 5'. Between two adjacent seals 5' and 5'' a space **7** is obtained which may be utilized for example for packaging purposes, the concept "package" being taken in its broadest sense.

The separation of two adjacent packages from each other proceeds such that with a cutting member **6**, for example a knife, a cut is made through the wall of the material, said cut extending from edge to edge in the sealing region 5''. In order to guarantee that the cut is actually made in the sealing region this must have an appreciable width, said width constituting a margin of safety at the cutting operation. Thereby a fin is formed having a width *a*, said fin having no direct function to perform in the package but is a remanant from the packaging process only.

FIG. 2 shows how these fins and the accompanying losses of material can be avoided according to the invention and furthermore how special mechanical cutting members are avoided. Two movable members **10** and **11** are used which are diagrammatically shown in FIG. 2. These members compress the materials **1**, **2** in a region **12**, which is of much less extension than the corresponding region 5' in FIG. 1. The members **10**, **11** are made in an appropriate way depending on the actual packaging material **1**, **2**. They may thus emit sound of ultra high frequency. By pressing the members **10**, **11** firmly against each other the ultrasonic sound will be most intense in the central part of the region **12**, while the adjacent parts receive a slightly weaker sound energy. By appropriate balancing of pressures, design of the members **10**, **11** and sound intensity, the materials **1**, **2**, as will be seen from FIG. 3, may be caused to burst in a region **13** corresponding to the central part of the region **12**, while the materials **1**, **2** in the adjacent parts **14**, **15** are sealed to each other. The sealing is fixed by allowing the members to remain in engagement for a short time after performing the cutting operation. The provisions may also be supplemented by a heating of the lateral parts of the cutting edges.

If the members **10**, **11** are instead heated to a high temperature, the materials are heat sealed in the regions **14** and **15**, while burning-off takes place in the central region **13**. This depends on the fact that the flow of heat to the central portion is very much stronger than to the surrounding portions, whereby the burning temperature of the material is reached or exceeded in the said central region, while the temperature in the seals to be formed reaches a suitable sealing temperature only. How the members **10**, **11** may be designed for achieving good results to produce strong seals will be shown in the following figures.

FIG. 4 shows a slightly different sealing and cutting method. There is in this case only one movable member **10**, while the member **11** illustrated in FIG. 2 has been replaced by a stationary back support **17**. The material **1** is pressed against the material **2** opposite the back support **17**. The cutting and sealing energy is transferred from the member **10** in the way mentioned earlier. The back support **17** may be passive, i.e., have a counteracting function only. The result obtained is, as will be seen from FIG. 5, a cutting-off of the materials **1**, **2** in the region **13** corresponding to the central part of the region **18** and sealing of the materials **1** and **2** in the regions **19** and **20**, which are slightly offset towards the back support **17**.

FIG. 6 shows a number of tetrahedral packages **22**, **23**, **24**, **25** and **26** and how these are sealed according to a prior method. According to the method of forming such

packages one starts usually from a web of paper material, at least the side of the paper which is to form the inner side of the finished package having a surface of heat sealing plastic. The web material is formed to a vertical tube which is longitudinally sealed and filled with a liquid product. The lower part of the tube is closed and sealed by a transverse sealing of the kind shown in FIG. 6. As the seals are made the individual packages are detached from the tube by cuts in or between two adjacent seals in a way which will be described. As mentioned earlier the cutting-off of the finished packages from the tube is made by means of special mechanical cutting members or knives. These require a certain margin of safety to insure that the cut will not occur in a line beside that desired, whereby the sealing is weakened or leakage arises. Between two adjacent packages **23** and **24** there have therefore been produced two relatively narrow sealing zones **31** and **32** with an intermediate non-sealed zone **33** which is comparatively broad. Along the central line C, the zone **33** having served as a margin of safety, the two packages have thereupon been detached from each other by mechanical cutting members. The region enclosed by the circle **40** is enlarged in FIG. 7. It will be seen therefrom that the width a_1 of the sealing zone **31** and the width a_2 of the sealing zone **32** are substantially equal in size or equal to the width a. The length A is the mutual pitch of the sealing zones, and the length (A–a) is the margin or tolerance within which the cutting member is allowed to work.

FIG. 8 is a section through a sealing region produced according to the prior method. The region **33** between two sealing zones consists of two walls **34** and **35** of material nonsealed to each other. Between these walls there is formed a small narrow space **36** which cannot be avoided with this prior method. When packaging a liquid a small amount of the product liquid accumulates here, which at the sealing operation tends to be pressed against the sealing zones **31** and **32**, whereby absolute tightening is imperiled.

When cutting off the walls **34**, **35** of material the space **46** with the liquid contained therein will come into contact with the surrounding air. If the product consists for example of milk or any other substrate, there is a great risk that said space will soon form a colony of bacteria, depending inter alia on the fact that the liquid attracts insects. From aseptic points of view this entails great risk, because the contents of the package proper will thereby easily be infected when opened.

There has been an attempt to eliminate these drawbacks by sealing the whole region **33**, whereby the zones **31**, **33** and **32** will present a single integral sealing zone. This will have an appreciable width, which results in the filling product not being completely squeezed out at the sealing process but will be embedded in the seal. When packaging milk according to this method one has, for example, found small portions of the filling product in the seals, which naturally is a great risk.

FIG. 9 shows how two materials **41**, **42** have been compressed for the purpose of being sealed and cut off according to the invention. The scale of FIG. 9 is the same as in FIG. 8. It will thus be seen that the width b of the sealing zone to be formed is substantially equally broad as one of the sealing zones a_1 or a_2.

With reference to FIG. 10, the principles of efficient sealing and cutting by means of heat will be explained. As heat sealing is particularly described here and in the continuation, it should be noted that the present invention is not limited to heat sealing technique, but that other sealing processes are also within the scope of the invention.

FIG. 10 is an enlargement of FIG. 9. The walls **41**, **42** of material may consist of heat sealing plastic or, for example, of paper material having opposite surfaces of plastic. The materials may furthermore be laminated. The method has even been tested on laminates including aluminum foils with good results.

The walls **41**, **42** are moved together and compressed from both sides by members, not shown, at least one which is movable. One member may thus be stationary, forming a back support. Furthermore, at least one member is heated, the flow of heat to the sealing and burning-off region having the characteristic appearance shown in the temperature distribution curve in the upper part of the figure.

The flow of heat is a maximum on the central axis C of the sealing zone. This maximum is situated above the burning temperature t_q of the material. In the zone q which corresponds to the part of the curve located above the t_q line, the material will therefore be burnt off. This zone may be made very narrow by making the curve very pointed.

The temperature t_{f1} is the lower heat sealing temperature of the plastic layer, and the temperature t_{f2} is the upper heat sealing temperature thereof. Between these two temperatures the curve shows a flat portion, slightly rising from the lower to the higher temperature. By this slight rising the finished seal gets exceedingly good strength and tightening characteristics. The sealing zones are designated by the letter f. Between the sealing zones and the burning-off zones there are smaller transition zones x. In these zones there exists risk of discolouring of the material. The zones may, however, be made very narrow, whereby the discolouring can hardly be detected by the naked eye.

In FIG. 11 there is diagrammatically illustrated a section through a sealing spot. The part of the material which is burnt off is relatively small, and therefore the width of each seal is negligibly less than $b/2$. A seal made in this way has, as already mentioned, proved to be very strong and tightening. The good tightness depends inter alia on the fact that also the tube which, with the prior sealing methods, was formed at the crossing between a longitudinal joint and a transverse seal according to this method is filled by molten plastic which thereupon solidifies. The sealing of this tube preferably occurs in the part of the sealing zone which is located nearest the burning-off zone. Here the temperature is higher than in the rest of the sealing zone, see the curve in FIG. 10, whereby the plastic will be more fluid and capable of flowing cut into all cavities.

FIG. 12 shows a section through a sealing jaw which is used in making the seals shown in FIGS. 6–8 according to the prior method. The seals are then produced by the two narrow strips **45**,**46**, which are heated to an appropriate sealing temperature. The strips **45**, **46** are fastened in a base **47** which is releasably secured in the material **48**.

FIG. 13 shows diagrammatically in a section through a device according to the invention the main components of a sealing and cutting jaw which is used in carrying out the method according to the present invention. The sealing member **50** and **51** with the cutting member **52** therebetween, which may consist of part of the former, are preferably fastened in a support piece **53**, which is releasably secured in the material **54**.

In FIG. 14 the lower details of FIG. 13 are shown at an enlarged scale. According to this embodiment the cutting member consists of a strongly heated wire **52**, which is located between two metal strips **50** and **51** heated to a slightly lower temperature than the wire **52**. The heating takes place by applying an electric voltage across the wire **52** and the strips **50** and **51**. The voltage may be constant or, which is often more convenient, of impulse character.

Stronger heating of the wire **52** than the strips **50**, **51** may be provided in substantially two ways. One method is to adapt the cross sectional areas of the wire and the strips in a suitable way. The other method is to make the wire **52** and the strips **50**, **51** from different materials.

As is well known, the energy developed as heat in a resistive conductor is inversely proportional to the resistivity of the conductor and direct proportional to the cross sectional area thereof. According to the embodiment

shown in FIG. 14 the wire **52** is thus made according to this principle from a material having substantially much less resistivity of specific resistance than the strips **50, 51.** Information about materials which possess the desired electrical characteristics may be obtained in ordinary manuals in the art. According to the other principle the wire is given substantially greater cross sectional area than the strips, or more correctly, it is given a diameter which is greater than the thickness of the strip, whereby the power developed per unit of width will be substantially greater in the wire than in the strips. What is meant by unit of width will be evident from the fact that the distance *b* is referred to as the width of the member.

FIG. 15 shows another embodiment of the sealing or burning-off members. These have been made as an integral piece **60** which is of substantially greater thickness in the central portion, i.e., the portion which corresponds to the zone *q* in FIG. 10. Hence, according to this embodiment, the principle is to adapt the cross sectional areas of the sealing and cutting-off portions in an appropriate way.

A certain radiation of heat will of course take place between the members **60** and the environment **53.** This radiation may however be compensated for by increasing the electric current through the member **60** or, as in the figure, by making the thickness of the member considerable, at least in the central portion. In the embodiment according to FIG. 16 it is instead preferred to isolate a strip **70** thermally from the environment by a heat insulation **71.** This may be made heavier in the central portion, whereby the temperature of the strip **70** will be greater here. Possibly, the insulation may be concentrated entirely to the central zone or designed in any other suitable way.

According to the embodiment shown in FIG. 17 a strip **80** is provided, the lateral portions of which serve as heat sealing means. On this strip, at the central portion thereof, there is provided a narrower strip **81** which serves as detaching means for the material to be detached. The resistivity of this strip **81** is substantially less than that of the heat sealing strip **80.**

Finally, FIGS. 18 and 19 show still another embodiment. FIG. 19 illustrates the sealing and detaching means as seen from the bottom of FIG. 18. The electric current is conducted through the central portion **90.** This is thereby heated strongly, so that burning-off of the material to be sealed takes place. At the same time a heat transport takes place towards the lateral portions **91, 92,** which consist of a great number of teeth separated by spaces **94.** The lateral portions are thereby heated to a suitable sealing temperature.

The arrangements shown in FIGS. 14–19 may of course be combined in several ways. For example, in a number of cases, more particularly when detaching relatively thick laminated materials, it may be necessary, as in FIG. 14, to make the detaching member slightly projecting (wire **52**). In order to facilitate the detachment of the material the method may be combined with a pulling in of the material. As this pulling already exists in most packaging machines, as has been mentioned before, no additional means for producing this pulling generally need to be provided.

That which is claimed is:

1. Apparatus to sever and seal webs of packaging heat sealable material for the manufacture of packages comprising: means supplying at least two webs of heat sealable material to said apparatus with a portion of one of said webs overlying a portion of the other of said webs, and a long, narrow severing and sealing member operably associated with said webs of material, the central longitudinal portion of said member being heated to a temperature at least equal to the fusing temperature of said webs of material while the longitudinal portions of said member adjacent said central longitudinal portion are heated to a temperature lower than the temperature of said central portion whereby said member when brought into compressive contact with said webs of material will sever said webs of material and heat seal the severed edges of said webs to each other.

2. The structure of claim **1** wherein said central portion of said member is a wire and said adjacent portions are metal strips.

3. The structure of claim **1** wherein said central portion of said member is thicker than said adjacent portions.

4. The structure of claim **1** wherein said member is a flat metal strip, said member having insulation adjacent thereto, said insulation adjacent said central portion being greater than the insulation adjacent said adjacent portions.

5. The structure of claim **1** wherein said central portion of said member is a metal strip and said adjacent portion being projections extending in both directions therefrom.

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PHILIP DIER, Primary Examiner

U.S. Cl. X.R.

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