Oct. 9, 1973 O. W. CHRISTENSSON 3,764,443

APPARATUS FOR HEAT SEALING A CLOSURE ON A PACKAGE COMPRISING A DIE WITH SLOPING SIDES

Original Filed Aug. 20, 1970 2 Sheets-Sheet 1

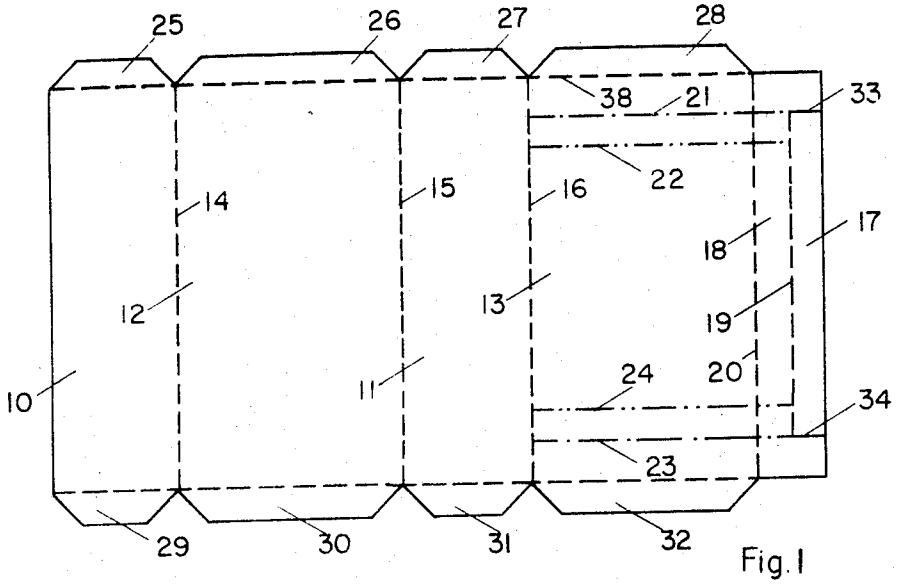

Fig. 1

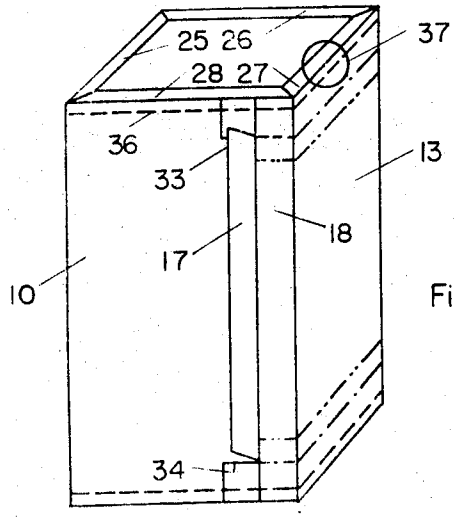

Fig. 2

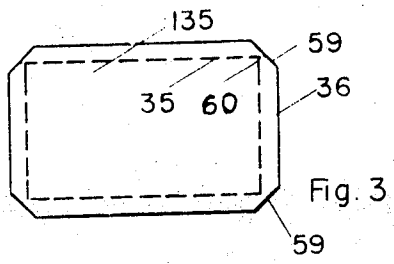

Fig. 3

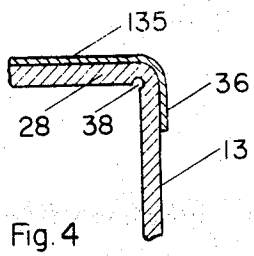

Fig. 4

INVENTOR

OD W. CHRISTENSSON

BY Larson, Taylor and Hinds

ATTORNEYS

Oct. 9, 1973 O. W. CHRISTENSSON 3,764,443
APPARATUS FOR HEAT SEALING A CLOSURE ON A PACKAGE COMPRISING A DIE WITH SLOPING SIDES
Original Filed Aug. 20, 1970 2 Sheets-Sheet 2

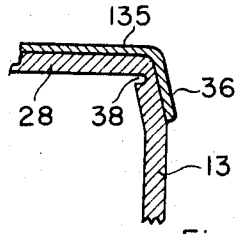

Fig. 5

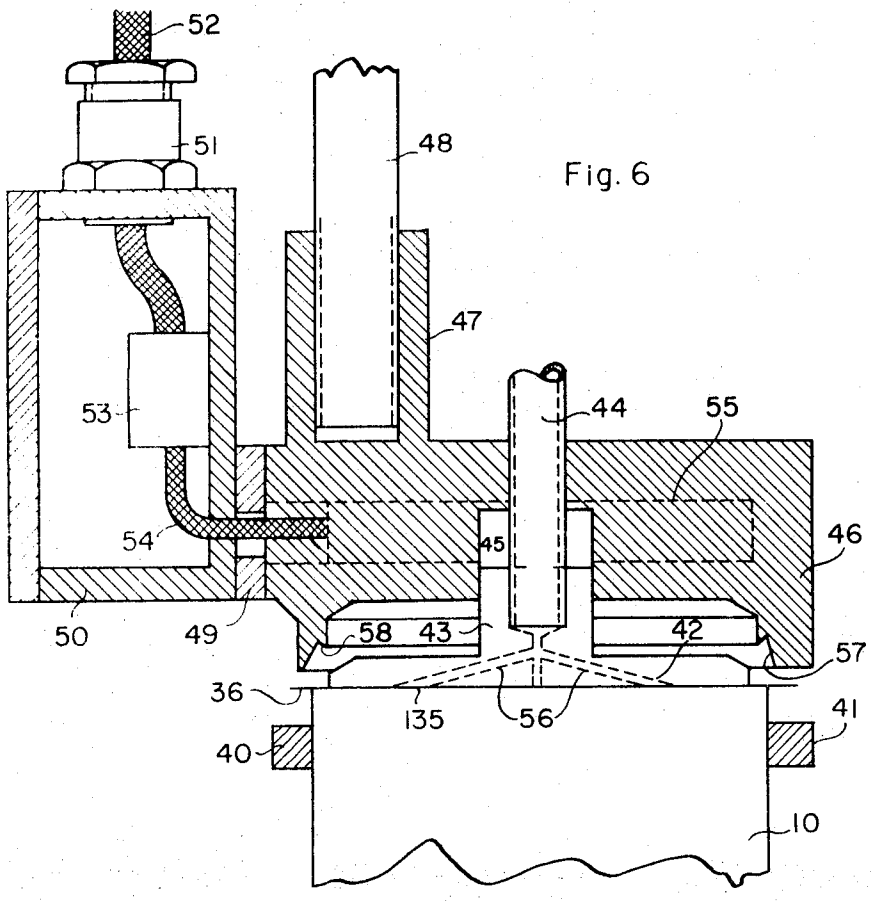

Fig. 6

INVENTOR
OD W. CHRISTENSSON
BY Larson, Taylor and Hinds
ATTORNEYS

United States Patent Office 3,764,443 Patented Oct. 9, 1973

3,764,443

APPARATUS FOR HEAT SEALING A CLOSURE ON A PACKAGE COMPRISING A DIE WITH SLOPING SIDES

Od Wikar Christensson, Bromma, near Stockholm, Sweden, assignor to Christenssons Maskiner & Patenter Aktiebolag, Bromma, near Stockholm, Sweden

Original application Aug. 20, 1970, Ser. No. 65,491, now Patent No. 3,647,133. Divided and this application Sept. 24, 1971, Ser. No. 183,398

Int. Cl. B30b 15/34; B65b 7/06

U.S. Cl. 156—581 2 Claims

ABSTRACT OF THE DISCLOSURE

A package of polygonal cross-section having a thin end closure closing at least one end. The closure extends over onto and is attached to the sides of the package. Air tightness is improved by attaching the closure such that the end of the package is bent inwardly at least at the corner, in somewhat the form of a frustrum pyramid. An apparatus for closing such a package comprises a heatable tool having inwardly sloping sides to press the end closure onto the edge of the package end and concurrently force the end into the frustrum pyramid shape.

This is a division, of application Ser. No. 65,491 filed Aug. 20, 1970 now Pat. No. 3,647,133.

FIELD OF THE INVENTION

This invention relates to packages, preferably for dry and frozen materials, and particularly to closures and manner of applying such closures.

BACKGROUND AND SUMMARY OF THE INVENTION

Within the packaging industry, attention to a continuously increasing rate has been directed toward the task of achieving economical manufacture, and especially toward achieving economies in consumption of materials. One of the most opportune areas in which such economies may be achieved is in the design of the package blanks such that there will be a minimum wastage of material when the blanks are stamped out from a given piece of material, such as cardboard. Wastage of material commonly occurs in the corner surfaces and the like between the side surfaces of a package and its adjacent parts forming the closing flaps. The more closely a package blank approaches a completely rectangular outer contour, the less will be the wastage of material, and the greater will be the number of package blanks which may be stamped from the given piece of cardboard or the like.

Packages, however, must be reasonably tight. In many cases, such as where a vacuum exists inside of the package, complete tightness is required, and it is difficult to achieve this complete tightness while also effecting a reduction in the amount of material used. In other cases, although such complete tightness may not be required, it nevertheless is important to obtain the best possible tightness under the circumstances. This is especially so in those packaging instances where it is important to prevent passage of moisture from or to the interior of the package. For instance, when dried products are packaged, it is important to prevent moisture entering the package from the outside air, and when frozen products are packaged, it is important to prevent leakage of moisture or liquid from the package. Such dried products might include cakes, roasted nuts, chips, etc. An example of a frozen product would include ice cream, for instance. An example of deep frozen products would include many different kinds of cooked vegetables, which may be frozen in liquid in order to retain their moisture consistency.

Exemplary of packages which have been developed in an effort to achieve economies of material while at the same time achieving satisfactory tightness is a package of polygonal, preferably rectangular cross-section, which is produced by folding a piece of cardboard along given creasing lines, whereby pasting flaps are arranged at the upper and perhaps also at the lower end of the package, an end closing piece of a thinner, easily bendable material being attached to the pasting flaps. In a package of this type, it is especially important to ensure tightness at the sides and the corners, where the cardboard of the sides meets the end closing piece. For achieveing improved tightness in these areas, various solutions have been proposed. Included among these is a procedure wherein the closing flaps on the main part of the package, which is made of cardboard, are cut in inclined directions at their ends, so that the slanting edges will contact each other when the cardboard blank has been folded into its form, polygonal in cross-section. The cardboard piece may be made from cardboard covered by plastic on at least one side, but preferably on both sides, and the plastic by which the cardboard piece is covered may be heat weldable. Thereby the end closing parts may also comprise a thin foil of heat closable or weldable plastic. However, even in packages constructed in this manner, it has been found that the required tightness often is not achieved. Investigations have shown that this shortcoming apparently stems from the extremely small, but nevertheless relatively substantial, openings occurring at the corners of the package. The slot between the slanting flaps apparently acts as an air passage, directly into or from the corner, and the mouth of this air passage situated in the corner is not covered satisfactorily by the plastic foil lying over the package. It has, therefore, further been proposed to make the plastic foil bigger than the end surface of the package part made of cardboard, whereby an end piece of the plastic foil will be available to be folded down onto the package sides. In this way, one would except that a substantially better tightness would be achieved, but surprisingly enough, the tightness still is often unsatisfactory. Further investigations in this area form the basis of the instant invention.

To weld the plastic foil over the mouth of the package, it is necessary that the foil will be heated, at least in those areas which are to be welded. Upon heating, the plastic foil is weakened and made formable, but simultaneously it is subjected to temperature extension or expanision movement, which will not correspond to any similar extension of the central parts of the foil piece, and this will cause folding of the edge part of the plastic foil, folded around the upper and the lower edge of the package. When welded, this edge part will attach to the upper edge of the cardboard close to its mouth by such a strong bond that no sliding in the bond will be possible upon the subsequent cooling of the plastic foil. The consequence will be that folds will be created in the plastic foil, which on the one hand are so small that they generally cannot be observed by the naked eye, but which, on the other hand, together represent a sufficient path between the interior of the package and the exterior air that communication will be created to a disturbing degree.

As a result of the investigation, and the detection of the apparent reason for the lack of tightness, a basic remedying feature of the present invention was developed, namely, during the welding when the plastic is still in a weak and formable state, to force the utmost edge part of the cardboard as well as the plastic foil inwardly under such a pressure that the folding tendency of the plastic foil will cause a flattening, by which the channels, which would otherwise be created, are avoided.

The present invention thus is directed to a package of polygonal, preferably rectangular, cross-section, which is produced by folding a piece of cardboard along given creasing lines, whereby inwardly directed pasting flaps are provided at the upper and perhaps also at the lower end of the package, to which an end closing piece of a thinner, easily bendable material is attached. The pasting flaps on the main part of the package, which is made of cardboard, are cut in an inclined direction at their ends, so that the sloping ends will at least approximately contact each other when the cardboard blank is folded into its form, polygonal in cross-section. The end closing part comprises a thin foil of a heat sealable material, preferably of plastic, which may be welded to the preferably also plastic-covered cardboard of the package, and the end closing piece extends beyond the edge of the cardboard part of the package by a free edge part, which is intended to be folded down onto the cardboard sides and to be attached to them.

According to the invention, the free edge of the end closing piece along with the part of the cardboard piece of the package corresponding thereto, which was initially composed of four even sides, has, at least at the corners of the package but preferably all around the package, after the forming of the package, in connection with the welding of the end closure to the cardboard, been formed as a short frustrum of a pyramid with its sides sloping inwardly in the direction toward the end of the package, so that a flattening has taken place of the edges of the end closure, which were extended due to the heating to welding temperature, and consequently the tightness has been improved. The invention also relates to an arrangement for the production of such a package.

According to the invention, as it relates to such an arrangement, the arrangement contains a welding tool provided with inwardly turned sloped sides of such a form that they will simultaneously by pressure from their sloping sides provide the deformation of the upper part of the package during re-formation of this part to its frustrum pyramidal form and add heat for providing the fixture of the free edge of the end closure to the side of the package by welding.

The invention will be further described below in connection with a preferred embodiment thereof illustrated in the attached drawings, but it is to be understood that the invention is not limited to this specific embodiment or form of execution, but that different modifications may occur within the framework of the invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the cardboard blank of the package after it has been stamped out and creased.

FIG. 2 illustrates in perspective a finished package according to the previously proposed method for its closing.

FIG. 3 is a plan view of the end closing part.

FIG. 4 shows in increased scale a section through the edge part of the package which has been surrounded in FIG. 2 by a circle.

FIG. 5 shows the corresponding corner or edge part, modified according to the present invention.

FIG. 6 shows a tool for effecting the closure of FIG. 5.

The package blank according to FIG. 1 contains two short sides **10** and **11** and two long sides **12** and **13**, separated by means of creasing lines **14, 15** and **16**. Further there is a closing flap, comprising two parts **17** and **18** mutually separated by means of a creasing line **19** and connected to the long side **13** by means of a second creasing line **20**. The part **18** is intended to form the closing flap proper, which should be attached to the edge of the short side **10** when the package has been folded into its form rectangular in cross-section, whereas the part **17** is intended as a grip tongue for opening the package. For making the opening of the package easier, a perforation device is also made. This may be of any kind known per se, and it may comprise cuts, arranged in pairs, which however do not run completely through the thickness of the cardboard. In each couple of such lines the one is cut in from the front side of the cardboard and the other one from the back side. For illustrating this, the line cut from the outer side of the cardboard has been indicated in the drawing by means of a line, composed alternatively by one dash and one dot, whereas the line cut into the inner side of the cardboard has been indicated by alternatively one dash and two dots. The two lines **21** and **22** or **23** and **24** consequently will give a tearing device easy to open, at the opening of which the cardboard will be slotted between the two lines, contained in one single pair of such lines.

At each end of the four sides **10, 11, 12** and **13** of the package, further pasting flaps **25–28** and **29–32**, respectively, are arranged. These flaps are cut in sloping direction in their ends, so that when the package is folded into its form rectangular in cross-section, the edges will contact each other at 45° angles, as seen in FIG. 2.

In order that the part **17** shall serve as a grip tongue for an easy opening of the package, it should be free from the package in other parts than along the creasing line **19**, and for this reason, at the stamping of the package blank cuts **33** and **34** are arranged at the ends of the inner part of the grip tongue **17**. The short pieces of the part **17** outside of these cuts therefore are attached to the surface of the closing flap **18** without perforation or creasing.

When folded the package blank according to FIG. 1 into a package, the four sides **10, 11, 12** and **13** are bent perpendicularly to each other, and the flaps **25–28** and **29–32** are folded inwardly at least approximately at right angles to the levels of the sides concerned. The inner side of the flap **18** and/or the outer side of the edge of the side **10** is provided with paste, glue or some other means for joining together the package, and one then has a package, shaped as shown in FIG. 2, after the flaps **25–32** have been provided in the way indicated below with their end closing parts. One will see that the tearing tongue is inclined at a small angle, so that this tongue is easily available for opening the package.

In practice it will occur as a rule that the package has been produced by a given manufacturer of packages, delivering the package in evenly collapsed state to the enterprise, which will pack its products therein. Thereby it is quite natural, that the package is folded around full 180° along the creasing lines **14** and **16**, whereas, on the other hand, the creasing lines **15** and **20** are left unfolded, whereafter the gluing by means of the flap **18** takes place. The user of the package thereafter has to break it up into its form, rectangular in cross-section, before closing it in the below indicated way.

It is especially suitable to make the package blank from a carboard, covered on both sides by a thermo-plastics. The attachment along the flap **18** then takes place by plastics welding under addition of heat.

An end closure is show nin FIG. 3. This end closure is made from a rather thin and easily bendable and formable material, preferably also a plastics, which is heat weldable. It is applied over the still open mouth of the package according to FIG. 2, so that the dotted lines **35** will correspond to the creasing edges between the sides **10–13** of the package and the flaps **25–28** or **29–32**, respectively, connected to them. One has cut the plastics piece somewhat bigger than the upper side of the package, so that it will have an edge all around to be folded down against the sides of the package. In this way one could by a minimum of stamping waste material provide a package, which one believed when carefully closed to be hermetically tight. To the question of this tightness we will return below.

FIG. 4 shows in enlarged scale the piece of FIG. 2, which has been surrounded by the circle **37**. The creasing

line 38, as one will see, is folded about a 90° angle, so that the side 13 and the flap 28 will be normal to each other connected by a slight rounding, and the end closure 135 will be attached to the flap 28 and the folded down edge part 36 to the side 13.

The tightness, which was expected to be created in a package according to the above, however, did not happen to occur. The investigations forming basis of the present invention have produced at least one explanation thereof. When welding the end closure 135 made of plastic to the package, it must be heated in the welded part to welding temperature. For practical reasons one cannot heat all the piece 135 to this temperature, because it would in such a case be so weak, that it could thereafter no longer be kept in an even position over the mouth of the package. A great difference in temperature will therefore exist during the welding procedure, between the interior parts of the end closure 135, on the one hand, and the edge part 36 of same piece, on the other hand. This difference in temperature causes heat elongation of the edge parts, by which they are folded in wave form. The plastic is so weak and plastic, that after the welding is completed, and cooling is added, these waves will not again be equalized, but they will remain, and openings will therefore be created between the folded down edge parts 36 of the plastic and the carboard inside of this edge. At least, it is through these openings that the communication will later on be created between the interior of the package and the space outside of the package, so that said package will be untight.

The invention provides that one should press the extending edge parts 36 of the end closure inwardly onto the corresponding uppermost or lowermost edge part of the package side all around the package by means of a tool with a sloping pressure surface, so that the surplus of plastics in the edge parts 36 is pressed evenly under influence of an inwardly acting, wedge-formed applied pressure from a tool, and an outwardly acting pressure in the form of the resistance of the cardboard material against deformation, so that after completed welding of the parts of the end closure placed outside of the upper side of the cardbord, this specific edge part of the package will be inclined inwardly in the form of a thin frustrum pyramid. The section through this pyramid is shown in FIG. 5 in a scale, corresponding to the one used in FIG. 4. The reference numerals are the same ones as used in FIG. 4. One will especially observe, that by the pressure of the uppermost edge part of the package sides no deformation needs to be created regarding the flaps 25–28, because all of this deformation may be received in the creasing line 38.

The arangement used for causing the fixture of the end closure, of course, will either be the same or different at the lower end and at the upper end of the package. This depends upon the fact that the package is usually empty when it is closed at its lower end, but it is filled, when closed at its upper end. Consequently, one may if desired put a mandrel into the package when closing the lower end, but one would use suction nozzles at the closure of the upper end of the package. The closing of the end of the package under insertion of a mandrel is extremely well known, and therefore no specific descrpition thereof would be required, but it is probable that it has not earlier happened that one used suction nozzles for keeping out the upper piece against being sucked down into the package, and therefore the arrangement according to FIG. 6 has been shown using this procedure.

The package 9 has been shown in FIG. 6 kept in place between a couple of arms 40 and 41. Of course, it may also be supported on a table, which has not been shown in the drawing. The end closure 135 extends in a way already described outside of the upper edge of the package 9. This end closure is kept in place by means of a suction nozzle device 42 with a head 43, carried by a hollow shaft 44, so that it can be displaced along with the head 43 within a cavity 45 in the welding head 46. The welding head 46 in its turn is carried by a head 47, in which a second control shaft 48 meshes. Further, welding head 46 carries by means of a thermally insulating piece 49 a coupling box 50, in which by means of the fixture 51 an electrical cable 52 is carried for feeding electrical current. The cable 52 runs to a connection plinth 53, from which conductors 54 run to one or a plurality of heater elements 55 in the interior of the welding head 46.

The arrangement now described functions in the following way: By means of the arms 40, 41 the arrangement has caught a package 9, which is, or is to be provided with an end closure 135, and has brought it into the position, in which it is shown in FIG. 6. The welding head 46 has made a swinging movement about its shaft 48, so that it has moved completely outside of the range of the caught package 9. The conduit in the interior of the shaft 44 is thereafter put under vacuum, after the welding head has been brought into position above a column of ready out and closures 135, so that the end closure is kept in correct position by the vacuum conduits 56. Thereafter the welding head 46 is again swung over the package 9 and is lowered down onto this package into a position as shown in FIG. 6.

Already earlier electrical current has been fed through the cable 52, the distribution plinth 53 and the cables 54 to the heater elements 55, so that the welding head 46 has assumed the temperature required for the welding. By means of the shaft 48 the welding head 46 is lowered down over the package 9 along with the end closure 135. Thereby the welding head 46 will by means of the wedge-formed, sloped surface 57 first press down the surplus part 36 of the end rollers 135 against the sides of the package 9 and thereafter press the upper edge part of these sides along with the free edge 36 of the end closure 135, so that a deformation will take place simultaneously with a compression of all the folds which could have been created in the edge part 36 of the end closure 135, and the package will in its upper part take the form which is shown in enlarged scale in FIG. 5.

It cannot be avoided that a given heat quantity is also transferred from the welding head 46 to the part of the end closure 135 which should remain even. The outermost parts of this even part of the end closure 135 therefore will also fold themselves under extension of surface, and it may then be important in some regular way to assume this folding action in order, when cooling the end closure again, to make the received part free. Amongst others, it is for this reason that the welding head has been provided inside of the sloped surface 57 with a teeth-formed border 58, running all around and so arranged that it will mesh inside of the edge of the package 9 and there weakly press the outermost part of the end closure 135 down for receiving its surface increased by heat development. This arrangement, however, has also a further purpose, which may be regarded at least as important, viz. to make sure that the welding bond between the edge 36 of the end closure 135 and the edge of the package 9 will extend around the upper edge and thereby exist against the edge part of the outer side of the package as well against the narrow closing flaps, which may accidentally by the pressure from the tooth 58 be bent somewhat downwardly, but after lifting up the welding head will again by the resilient force in the creasing lines assume their position perpendicular to the package sides.

When executing the invention as hitherto described, it has been found, however, that even now complete tightness could not be obtained in all treated packages. Certainly, the plurality of them have been tight to a satisfactory degree, but singular samples have, without the treatment having been in the slightest way different a proved to be untight. After substantial difficulty, it was found that this sporadically occurring untightness depended upon

a specific occurrence in the corners of the package in connection with the used welding temperature.

In the corners of the upper edge of the package the sides are bent by the welding head in 90° angle. At the sides, they extend however in straight line on each side of each welding point. The consequence thereof will be, that heat is fed to the singular welding point over an angle of only 90° at the corners, but on the other hand over an angle of 180° at the sides. The heat feeding at the corners will therefore be less per unit of weight of the plastics material in the end closure **135**. Simultaneously this end closure is bent down around the corner, so that a two-fold folding will be created, vis. firstly the folding, which also occurs at the sides, and which depends upon the heat enlargement of the material, and secondly also the folding required for receiving the surplus of material at the corners. The consequence will be, that one will simultaneously get a decreased feed of heat at the corners and a greater quantity of plastic receiving the heat which is fed, and that therefore the temperature of the plastics in the corner will be rather much lower than in the plastics along the sides. This in turn causes a risk of cold welding with consequent untightness.

Assuming that this explanation of the existing untightness was sufficient and reliable, it was thereafter obvious, that one had in order to get the same welding relations for the plastics in the corners of the end closure and along its sides firstly to increase the temperature at the corners of the welding head, secondly also to decrease the quantity of plastics contained in the corner formations of the end closure. The first one is practically not possible to provide, because the welding head must be made from a good heat conducting material, and by the good heat conduction an equalization of temperature will take place. On the other side it is possible to decrease the quantity of plastics in the corner formations by cutting them off in a way, shown in FIG. 3 at **59**.

Immediately, it proved that this visually unessential step caused the risk of leakage at the corners to be practically completely eliminated. By the cutting off, as a matter of fact, the heat consuming quantity of plastics was so strongly decreased, that the temperature exactly and surely would be above the limit temperature for cold welding, whereas it earlier balanced about this limit temperature and in some cases it was for reasons, which one could not find out, below this limit temperature, in other cases however above the limit temperature.

When deciding how far the corner cutting of the upper piece should take place one was guided by the following points of view: The stronger the corner cutting is, the less will the surplus of material be, which by assuming part of the welding heat causes a decrease of the welding temperature. Simultaneously, however, the distance from the corner **60** of the package to the cutting line **59** will be smaller, and this means that the surplus strip of plastics of the end closure in the corner will be less, with a risk that it will be too narrow and cause a leakage in another way than the above mentioned one. In tests it proved that one will get a good compromise between these two points of view counteracting each other by cutting the corner of the end closure so that the distance between the proper corner **60** of the package and the cutting line **59** will be about equal to ⅔ of the width of the surplus piece of the end closure along its straight sides.

In practical tests it has now proved that the leakage caused due to folding of the edge part **36** of the closure **135** will be most difficult at the corners, and therefore one has also investigated the action of only pressing in the package along with the edge part of the end closure at the corners. Curiously enough, it was found thereby that the risk for leakage along the sides of the package was essentially smaller. It is not quite clear, what the reaction to this may be, but one may assume that the folding at the sides at least in part has been caused by displacement tensions in the proper level of the plastics piece. By attaching the plastics piece in a more rigid way at the corner these displacement tensions are decreased, and one may in many a case achieve a completely satisfactory result without the middle part of the upper edges of the package sides being subjected to the sloped pressing. The invention therefore also shall comprise such a partial use of the inventional idea.

I claim:

1. An apparatus for the production of a package of the type having a base part of a polygonal cross-section closed at one end by a thin end closure which covers said end and is attached around the periphery of the base portion, said apparatus comprising a holding means for holding the base portion of the polygonal cross-section package, a means for holding the end closure over the end of the package while the package is held by the holding means, a welding tool provided with inwardly tapered, sloping sdes, said sloping sides sloping from an outer edge to an inner edge, wherein an extension of the outer periphery of said package beyond said one end taken in a direction parallel to the direction of relative movement between the welding head and the package, intersects the sloping sides between said inner and outer edges, so that said sloping sides constitute means for exerting a force against the exterior of the package and deforming the same inwardly at the part of the package adjacent the said one end, at least at the corners of the package, to form a frustrum of pyramidal form when the sloping sides are urged against the end closure and the said end of the package, and means for delivering heat to the tool to heat the end closure and cause it to be heat sealed to the sides of the base portion of the package by welding.

2. An apparatus according to claim **1**, including a border located inside of the said sloping surface for simultaneous depression of the edge part of the end closure immediately inside of the edge of the base portion of the package for attaching the end closure to pasting flaps inside of said edge.

References Cited

UNITED STATES PATENTS

3,549,440	12/1970	Adcock	156—69
3,367,808	2/1968	Edwards	156—272
2,413,449	12/1946	Hatch	156—69
3,383,256	5/1968	Carbone	156—69
3,475,243	10/1969	Scalora	156—69
3,449,183	6/1969	Zelnick	156—583

DOUGLAS J. DRUMMOND, Primary Examiner

U.S. Cl. X.R.

156—583; 53—373