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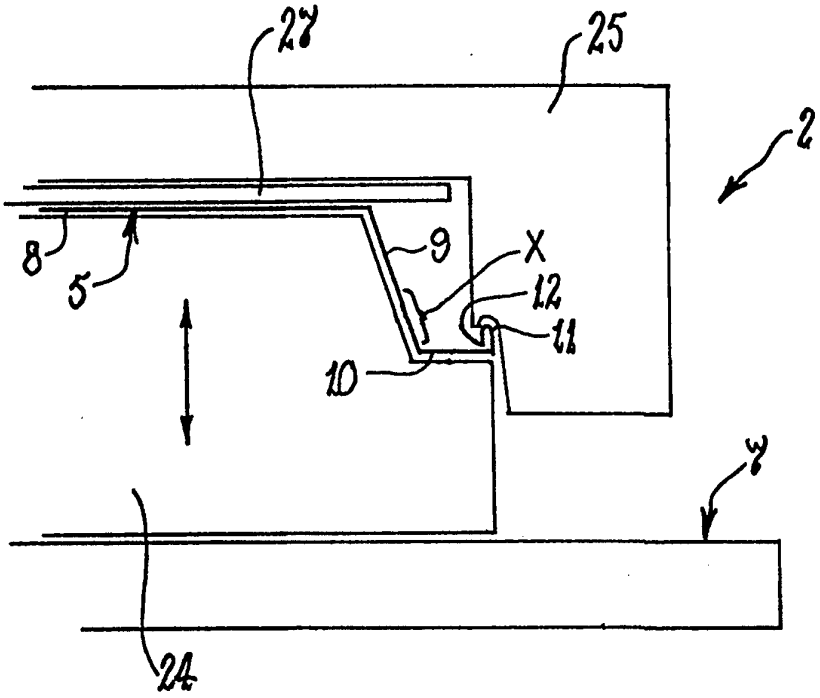
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(54) Title: PACKAGING

(57) Abstract

A method of producing a plastic tray (5) having a peripheral edge region (11) terminating in a terminal edge (12) which is deformed inwardly out of a wrap path around the tray (5) is disclosed. The peripheral edge region (11) of the tray (5) is heated to render it malleable. The region (11) is deformed by bringing an appropriately configured die into engagement with the malleable region (11) and rolling the region (11). The region (11) is then cooled such that it sets and hardens in the deformed condition. In a preferred form, the tray (5) is heated by heating the die (25) which is used to roll the edge region (11). This invention also extends to a method of attaching the two elements of a two-piece tray to each other and to apparatus for carrying out the method of the invention.



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PACKAGING

This invention relates broadly to packaging. More specifically this invention relates to trays for packaging which are wrapped in plastic film or plastic wrap, methods of producing such trays, and apparatus for producing such trays.

It will be convenient to hereinafter describe the invention with particular reference to plastic trays used for the packaging of foodstuffs such as red meat, fish, poultry, garden produce and the like although it is to be understood that the invention is capable of broader application. Typically food to be packaged would be placed on such a tray and then wrapped in polythene wrap or film to seal it off from the atmosphere and preserve its freshness until sale.

In this specification, the term "tray" shall not be limited to flat or shallow containers. Further the term shall not be limited to containers having four straight edged sides. For example, it is specifically envisaged that the trays defined in this specification might contain chickens and that the tray might be configured to conform with the outline of the shape of the chicken.

In this specification, the term "plastic" shall be construed to include any group of materials, synthetic or natural, which may be shaped when soft and then hardened, including resins, resinoids, polymers, cellulose derivatives, casein materials and proteins.

In the past, foam trays, for example of expanded polystyrene foam, have been widely used for the packaging of foodstuffs. As foam is a relatively soft material and the edges of the tray are rounded, the terminal edges thereof do not have a tendency to cut plastic film within which the trays are wrapped. However the disposal of these trays after use is not environment friendly. Foam cannot be recycled and if it is burnt, environmentally damaging gaseous compounds can be released into the atmosphere. Consequently there is a trend away from the use of foam trays to the use of plastic trays which can be recycled. Generally all plastic trays used in packaging are formed by a thermoforming operation. However, such trays have a sharp terminal edge

forming the periphery thereof with an unfortunate tendency to tear or cut through plastic film within which the trays are wrapped. As far as the Applicant is aware it has thus far not been possible to negatively form an article in a thermoforming operation. That is it has not been possible to provide a tray which has a terminal edge which does not form the peripheral edge of the tray. Put another way it has not been possible to provide a tray in which the terminal edge faces away from the path transversed by plastic film which is wrapped around the tray (hereinafter referred to as the wrap path.

This problem of the sharp terminal edge tending to cut or tear the wrap within which the tray is wrapped leads to substantial productivity losses. For example, up to 25% of trays may need to be wrapped twice. Further trays which appear to be suitably wrapped may have wrap weaknesses which have not yet manifested themselves as tears but with the potential to tear and break en route to the point of sale of the packaged trays. This can lead to spoiling food within the packaged trays.

It would therefore be advantageous if a method and an apparatus could be found for providing these trays with a peripheral edge region which reduced the tendency of the wrap to tear.

Accordingly it is an object of this invention to devise a method and an apparatus for producing a tray which overcomes at least some of these disadvantages.

According to a first aspect of this invention there is provided a method of producing a plastic tray having a peripheral edge region terminating in a terminal edge which is deformed such that the terminal edge is displaced out of a wrap path around the tray, the method including:

providing a plastic tray having a peripheral edge region terminating in a terminal edge;

heating the peripheral edge region of the tray such that said peripheral edge region becomes malleable and the remainder of the tray remains non-malleable; and

deforming the peripheral edge region of the tray by bringing an appropriately configured deforming means into engagement with said peripheral edge region of the tray to displace the terminal edge out of the wrap path, the deforming being effected by relative movement between the tray and the deforming means.

Typically the method includes cooling the peripheral edge region of the tray such that it sets and hardens with the terminal edge displaced out of the wrap path.

Preferably the step of heating the peripheral edge region of the tray includes producing a sharp transition from malleable to non-malleable plastic which forms a fold line about which said peripheral edge region is deformed. This assists in crisply defining the fold line along which the peripheral edge region of the tray is folded.

In one embodiment said deforming means is a die and said heating the peripheral edge region of the tray includes heating the die which in turn heats the peripheral edge region of the tray when brought into heat conductive contact therewith. In this embodiment, deforming the peripheral edge region includes rolling the peripheral edge region. Preferably the edge region around the full periphery of the tray is rolled substantially simultaneously.

Advantageously the die is configured such that upon engagement with the tray, it heats the peripheral edge region of the tray, and when the peripheral edge region is malleable, it rolls the peripheral edge region of the tray.

Preferably heating the peripheral edge region of the tray includes creating a temperature gradient across the peripheral edge region, the temperature being hotter adjacent the terminal edge and decreasing inwardly therefrom.

Advantageously the temperature gradient across the peripheral edge region is obtained by configuring the die such that it is in heat conductive contact with part of the peripheral edge region of the tray longer than other parts thereof.

In a most preferred form rolling the peripheral edge region of the tray includes moving the tray into engagement with the die.

In an alternative embodiment the heating comprises blowing hot air over the peripheral edge region of the tray. In this alternative embodiment the portion of the tray laterally inwardly of the peripheral edge region is shielded from the hot air blast.

Further in accordance with this alternative embodiment the deforming means includes a former and a complementary engagement formation, the former being moved into engagement with the complementary engagement formation to deform the peripheral edge region. In this alternative embodiment, the cooling includes actively cooling the peripheral edge region of the tray using cooling water.

This invention also extends to a plastic tray produced by the methods described above.

According to a second aspect of this invention there is provided a method of joining two tray members to each other to form a unitary two-piece tray the method including:

providing base and cover members each having a peripheral edge region terminating in a terminal edge;

mounting the cover member in a superimposed relationship on the base member such that the peripheral edge regions of the two trays are substantially in alignment with each other;

heating the peripheral edge regions of the base and cover members such that said peripheral edge regions become malleable and the remainder of the base and cover members remain non-malleable; and

deforming the peripheral edge regions of the base and cover members laterally inwardly, by bringing an appropriately configured deforming means into engagement with said peripheral edge regions, so as to crimp the two peripheral edge regions to each other to form a unitary two-piece tray.

Advantageously the terminal edges of respectively the cover and base members are also displaced out of the wrap path.

This invention also extends to a two-piece plastic tray including:

a base member, and

a cover member mounted in superimposed relationship on the base member, each said member including a peripheral edge region terminating in a terminal edge,

wherein the peripheral edge regions of the base and cover members are crimped together so as to form a unitary two-piece tray.

Preferably the peripheral edge regions of the base and cover members are deformed downwardly and laterally inwardly by said crimping such that the terminal edges thereof are displaced laterally inwardly out of the wrap path.

Preferably the peripheral edge region which is deformed laterally inwardly has a width of at least 2 mm.

Advantageously the cover member is water permeable and the base member is water impermeable. This may be accomplished by having a plurality of apertures defined in the cover member. Moisture absorbent means may be sandwiched between the base and cover members for absorbing moisture on the tray. In a most preferred form the moisture absorbent means comprises a particulate moisture absorbing material contained within a water permeable bag.

Further said base member typically defines a first plurality of spaced reinforcing rib formations and the cover member typically defines a second plurality of spaced reinforcing rib formations extending transversely to said first plurality of rib formations.

This invention also extends to a plastic tray including a peripheral edge region terminating in a terminal edge, wherein the peripheral edge region is deformed laterally inwardly such that the terminal edge is displaced out of a wrap path around the tray.

According to a third aspect of this invention there is provided apparatus for producing a plastic tray including a peripheral edge region terminating in a

terminal edge, wherein the peripheral edge region is deformed laterally inwardly such that the terminal edge is displaced out of a wrap path around the tray, including:

heating means for heating the peripheral edge region of the tray to a temperature at which it is malleable; and

an appropriately configured deforming means for deforming the peripheral edge region of the tray and displacing the terminal edge of the tray out of the wrap path, the deforming means being moved relative to the tray to engage said tray and effect said deforming.

In one embodiment, the deforming means includes a die for deforming by rolling the peripheral edge region of the tray. Preferably in this embodiment, the heating means acts to heat the die which heats the peripheral edge region of the tray by being brought into heat conductive engagement therewith.

Advantageously the die is configured so as to engage the edge region of the tray around the full periphery thereof and to roll said peripheral edge region substantially simultaneously in a single step.

Preferably the die is configured so as to heat the peripheral edge region of the tray when it initially engages the tray to a temperature at which the edge region is malleable, and thereafter to roll the peripheral edge region of the tray.

Preferably this embodiment also includes an ejector for detaching the tray from the heated die once the deforming has been carried out.

In an alternative embodiment, the heating means includes a hot air blast which is directed onto the peripheral edge region of the tray. In this embodiment the deforming means includes a former and a complementary deforming formation, the former being movable relative to the complementary deforming formation. In this embodiment the former is typically a rigid body comprising a plurality of linear or straight edge portions and a plurality of corner portions. Alternatively in a closely related embodiment, the former comprises an inflatable tube or hydraulic cylinder.

Further in this embodiment it is preferable that the apparatus includes shield means for shield that portion of the tray laterally inwardly of the peripheral edge region, from the hot air blast.

Advantageously the apparatus of this embodiment also includes cooling means for actively cooling the peripheral edge region of the tray. Such cooling means typically includes cooling water which is passed over the former.

Apparatus for producing a plastic tray in accordance with this invention can manifest itself in many different forms. Several example embodiments are described in detail below. These examples are provided merely for the purposes of providing an enabling disclosure and the particularity of the drawings is not to be understood as superseding the generality of the preceding description. In the drawings:

Fig 1 is a schematic sectional front elevation of an apparatus for performing the invention in accordance with a first embodiment of the invention, prior to the deforming operation taking place;

Fig 2 is a schematic sectional front elevation of the apparatus of Fig 1 after the deforming operation has taken place;

Fig 3 is a schematic sectional front elevation of an apparatus for performing the invention in accordance with a second embodiment of the invention, prior to the deforming operation taking place;

Fig 4 is a schematic sectional front elevation of the apparatus of Fig 3 after the deforming operation has taken place;

Fig 5 is a schematic sectional front elevation of an apparatus for performing the invention in accordance with a third embodiment of the invention, prior to the deforming operation taking place;

Fig 6 is a schematic sectional front elevation of the apparatus of Fig 5 after the deforming operation has taken place;

Fig 7 is a schematic sectional front elevation of an apparatus for performing the invention in accordance with a fourth embodiment of the invention, prior to the deforming operation taking place;

Fig 8 is a schematic sectional front elevation of the apparatus of Fig 7, after the deforming operation has taken place;

Fig 9 is a perspective view of apparatus in accordance with the first embodiment;

Fig 10 is a perspective view of the leading edge of the apparatus of Fig 9 showing the manner in which the straight or linear edge and corner former portions are brought into sequential engagement with the tray edge;

Fig 11 is an exploded perspective view of the apparatus of Figs 9 and 10;

Fig 12 is a schematic sectional view of an edge of a thermoformed tray which is particularly suitable for use in implementing this invention;

Fig 13 is a schematic sectional view of the edge of the tray of Fig. 12 after it has been deformed out of the wrap path in accordance with the invention.

Fig. 14 is a top perspective view of a two-piece tray in accordance with an embodiment of this invention;

Fig. 15 is a bottom perspective view of the tray of Fig. 14; and

Fig. 16 is a cross-sectional view of the tray of Figs. 14 and 15, the section through XVI-XVI.

In Fig 1 of the drawings, reference numeral 1 refers generally to apparatus according to the invention for carrying out the method of the invention.

The apparatus 1 comprises broadly heating means in the form of a hot air duct 2 through which hot air is blasted, deforming means in the form of a former 3 and an anvil 4. The anvil 4 is a deforming formation which is complementary in shape to said former 3. Cooling means (not shown) in the form of water cooling are also provided.

A plastic tray 5 to be deformed by the apparatus 1 is mounted on a substantially planar support surface 7. The tray 5 has a base 8, a sloping side wall 9 extending up from the base 8, a peripheral rim 10 extending around the top of the side wall 9, a peripheral edge region indicated by the numeral 11 and

a sharp razor-like terminal edge 12. The peripheral edge region 11 is heated and deformed in carrying out the method of this invention. This is discussed in more detail below.

The former 3 is a solid block slidable along the support surface 7 towards and away from the anvil 4. The former 3 may be driven by any suitable mechanical drive means. Such drive means are well known to persons skilled in the art and as such will not be described in any further detail here.

The hot air duct 2 is positioned above the peripheral edge region 11 of the tray 5 and directs hot air blown through the duct 2 onto the edge region 11. The hot air may be provided by any suitable hot air supply means. Such air supply systems are well known to persons skilled in the art and as such will not be described in any further detail here.

The anvil 4 is formed by a clamping foot 13 pivotally mounted on a clacker box 14. This pivotal mounting enables the anvil to be removed from underneath the peripheral edge region 11 when the peripheral edge region 11 has been deformed.

In use, a thermoformed plastic tray 5, typically having a sharp terminal edge 12, is inverted and mounted on the support surface 7 with the clamping foot 13 placed over the underside of the rim 10 of the tray 5. Hot air is then blown through the hot air duct 2 heating up the peripheral edge region 11 of the tray 5. The configuration of components at this stage of the operation is shown in Fig 1. When the plastic material of the tray reaches the temperature at which it becomes malleable, 150 to 250°C, the former 3 is brought into operative engagement with the peripheral edge region 11 deforming it. In the fully deformed position the operative surface of the former 3 is adjacent the complementary operative surface of the anvil 4. The structural features of the former are described in more detail below. The hot air blast is then interrupted and the peripheral edge region 11 of the tray 5 is cooled so that it sets in the deformed configuration. The configuration of components at this stage of the operation is shown in Fig 2.

The former 3 is then moved outwardly away from the peripheral edge region 11 and the clamping foot 9 is pivoted inwardly and upwardly relative to the clacker box 14 to free it from the deformed peripheral edge region 11. The tray 5 is then removed from the support surface 7 and the cycle is repeated with another tray 5.

The cycle time for the entire operation would be of the order of three to five seconds. Of this the cooling time would be a half to three quarters of a second. The cycle time is obviously dependent upon the aggressiveness of the heating of the edge region 11 of the tray 5, the rate at which the edge region 11 is cooled, and the gauge of the tray 5 being subjected to the post-forming treatment. Obviously the greater the rate of heat transfer for both heating and cooling operations, the shorter will be the cycle time. A short cycle time is obviously desirable as this will enable more containers to be treated per unit time.

Figs 9 to 11 illustrate the apparatus of the first embodiment in some detail using the same reference numerals as in Figs 1 and 2.

The apparatus 1 has a rectangular box-like appearance. There are four hot air ducts 2 directing air along the four edges 12 of the rectangular tray 5. Each of the ducts 2 fans outwardly from a round pipe cross-section at its upper end to an elongate slot cross-section at its lower end which extends along the length of the tray edge 12. As discussed above cooling water is used to cool and harden the deformed peripheral edge region 11. The cooling water is circulated through pipes 30 mounted on the former 3 thereby acting to cool the former 3 which in turns cools the region 11.

The former 3 which extends circumferentially around the tray edge 12 is divided up into a plurality of portions. Four straight edge or linear portions 34, 35, 36, 37 extend along the straight edges of the tray 5 and four corner portions 38, 39, 40, and 41 are positioned at the corners of the tray 5. The linear portions 34-37 of the former 3 are sized to overlap the corner radius of the tray 5. Thus there is some overlap of tray edge region covered by respectively the linear

portions 34-37 and the corner portions 38-41. This overlap is very useful in rounding off the tray edge in the corner region satisfactorily as otherwise it has a tendency to form sharp points. Once the peripheral edge region 11 of the tray 5 has been heated to a malleable state, the linear portions 34-37 are actuated by being brought into deforming engagement therewith. As discussed above, the linear portions 34-37 overlap the corner radius of the tray 5 causing the peripheral edge region 11 in the corner radius to taper upwardly in the configuration shown by numerals 42 in Fig 10. The straight edge or linear portions 34-37 are then retracted back from the tray edge and the corner portions 38-41 actuated and brought into engagement therewith. The linear and corner portions cannot be actuated to engage the tray edge simultaneously as there is overlap between the two. When the corner portion engages the tray edge, it engages the tapered corner and deforms it into a neat tray edge corner having a smooth blended form with a rounded profile.

Another particularly desirable feature is the maintaining of the support surface 7 at ambient temperature or even colder to maintain some rigidity in the rim 10 of the tray 5 when hot air is blown through the duct 2. This is important to get the region 11 to bend at the correct point, that is without bending the rim 10. The contact of the rim 10 with the cold surface 7 counteracts the heating by the hot air. Further the upper side of the rim 10 is shielded by the clackerbox 14 and clamping foot 13 which is interposed between the hot air blast and the rim 10. It is desirable that some rigidity be maintained in the laterally outer portion of the rim 10 as this is the point around which the peripheral edge region 11 is folded. Further the rigidity of the rim 10 also acts as a brake to the former portions 34-41 defining the end of the stroke thereof. If the rim 10 is too hot and malleable it will simply be deformed by the advancing former portions 34-41.

Fig 11 in addition to the features shown in the earlier drawings, shows conduits 45 conduiting compressed air to the clacker box 14 for moving the feet 13 of the clackerbox 14 inwardly and out from under the rim 10 of the tray 5.

The embodiment illustrated in Figs 3 and 4 is very similar to that shown in Figs 1 and 2. Unless otherwise specified, the same reference numerals have been used to refer to the same components as in Fig 1. The only difference between these two embodiments lies in the configuration and action of the former 3. As it is brought into engagement with the peripheral edge region 11 of the tray 5, which in this embodiment is horizontally extending, the edge region 11 is curled or rolled upwardly and around so as to form the curved or rounded edge for the tray. The end result is substantially the same as with the first embodiment.

The third embodiment illustrated in Figs 5 and 6 is also very similar to that shown in Figs 1 and 2. Unless otherwise specified, the same reference numerals have been used to refer to the same components as in Figs 1 and 2. The only difference between these two embodiments lies in the substitution of the inflatable tube 20 for the former 3. The tube 20 is inflated with air and as it is inflated expands thereby deforming the edge region 11 of the tray as shown in Fig 6. Such tubes or bladders are well known to persons skilled in the art and as such they will not be described any further here. This embodiment is the most desirable from a maintenance point of view because it does not have any mechanically moving parts.

The fourth embodiment illustrated in Figs 7 and 8 is similar to the embodiment illustrated in Figs 1 and 2. Accordingly where appropriate, the same reference numerals have been referred to the same components as in Figs 1 and 2.

In Fig 7 the tray 5 is positioned upside down on a support 24. The support 24 is spaced beneath a deforming means which is a downwardly facing die 25 substantially in alignment therewith. The die 25 is configured so as to heat and deform the peripheral edge region 11 of the tray 5 by rolling, when it is brought into contact therewith. The die 25 may be heated by any suitable heating means. Such heating means will be well known to persons skilled in the

art and are not discussed further in the specification. One particularly suitable heating means for heating the die is electrical heating.

The support 24 is configured to complement the basic shape of the tray 5 to support the tray 5 when it makes contact with the die 25. It is particularly preferable that the support 24 supports the sidewall 9 of the tray 5 towards the rim end 10 thereof. This region is shown by numeral X in Fig. 7. The providing of the appropriate support is important to prevent inward deformation of the tray 5. If such support is not provided, the edge of the tray 5 may end up being uneven and/or distorted. The support 24 is moved towards the die 25 to the position shown in Fig. 8 to deform the peripheral edge region 11. Any suitable drive means may be used to achieve this. As the various drive means that are available will be well known to persons skilled in the art, they are not discussed further in the specification. One particularly suitable drive means is provided by a piston and cylinder assembly (not shown).

An ejector 27 for detaching the trays 5 with deformed edges from the die 25 is located within the interior of the die 25. The operation of the ejector 27 is discussed in more detail below.

In use, carrying out the method of the invention, an inverted tray is provided or mounted on the support 24. At this point the terminal edge 12 forms the peripheral edge of the tray 5. The support 24 is then moved upwardly towards the die 25 by actuating the piston and cylinder assembly. As a result, the peripheral edge region 11 of the tray 5 is brought into contact with the die 25. This heats the peripheral edge region 11 of the tray making it malleable and then deforms or rolls the peripheral edge region 11 of the tray 5 such that the edge 12 is displaced out of the wrap path. This position is illustrated in Fig. 8.

The support 24 is then retracted downwardly away from the die 25. Generally the tray 5 would remain in contact with the die 25 after the support 24 was lowered or retracted. This is because the malleable plastic of the peripheral edge region 11 tends to adhere to the hot die 25. The ejector 27 which is sandwiched between the base 8 of the tray 5 and the die 25 is then urged

downwardly away from the die 25 to detach the tray 5 from the die 25 causing it to drop onto the support 24. Any suitable means can be used for urging the ejector 27 downwardly. As such mechanisms are well known in the art they are not discussed further in the specification. Separation of the tray 5 from the die 25 facilitates cooling of the peripheral edge region 11 of the tray 5 allowing it to harden in a deformed condition.

Typically the die 25 is in the form of a full rectangle when viewed in plan view and is designed to roll or deform the entire peripheral edge region 11 of the tray 5 in a single step.

Fig. 12 illustrates the profile of the edge of a thermoformed tray which is somewhat different to that illustrated in the preceding drawings. As with the other trays, the tray in Fig. 12 has a rim 10, a peripheral edge region 11 and a terminal edge 12. However, the profile of the rim 10 leading into the edge region 11 is more curved than the corresponding region of the tray in Fig. 1.

As can be seen in Fig. 13 this gives the finished tray product a more rounded peripheral edge region which is preferable to the edge region shown in Fig. 2.

Optionally the implementation of this invention may involve pre-heating the peripheral edge region 11 of the tray 5 before the tray 5 is fed into the apparatus of Figs. 7 and 8. The pre-heating is effected by a heater comprising an electric heating element formed into the shape of the periphery of the tray 5 around the full perimeter thereof. The heating element is arranged to be closely spaced, for example about 3mm, away from the edge 12 of the tray 5 during said pre-heating. By pre-heating the tray 5 immediately before it is brought into contact with the die 25, the cycle time for the deforming of the tray edges can be reduced. The electric heating elements described above are well known to persons skilled in the art and as such will not be described in any further detail here.

Naturally if the deforming or rolling of the edge of the tray is carried out at the site of the thermoforming of the tray, such pre-heating step is generally unnecessary.

One particularly suitable plastic from which the trays can be made softens at between 100°C and 150°C and becomes molten near 200°C. Obviously however other plastics can also be used in carrying out this invention and such other plastics may soften and become molten at temperatures different to those specified above.

Figs. 14 to 16 illustrate a two-piece tray indicated generally by reference 50 which can be treated, like a one-piece tray according to the method and by the apparatus described above.

The tray 50 comprises broadly a water impermeable base member 51 and a complementary water permeable cover member 52. The members 51 and 52 are thermoformed from plastic and as such the individual members prior to attachment generally have a sharp terminal edge forming the outer periphery thereof such as that indicated by numeral 12 in Fig.1 The cover member 52 is superimposed over the base member 51. The peripheral edge regions of the two members 51 and 52 are tightly crimped together by the deforming operation described above with reference to Figs. 1, 2, 9, 10 and 11 to attach the two members to each other to form a unitary article. As a result, the terminal edges 12 of the two members 51 and 52 are folded downwardly inwardly well out of the wrap path and the tray 50 presents a less aggressive edge 54 to the wrap path 55. The crimping or deforming of the edges 12 of the two elements 51 and 52 out of the wrap path 55 performs the dual function of attaching the two members 51 and 52 to each other and providing a tray with a peripheral edge 54 which does not damage plastic wrap.

The tray 50 would generally be of rectangular configuration having a rectangular base 56 surrounded by a low peripheral sidewall 57. A circumferential peripheral rim 58 projects outwardly away from the upper end of the side wall 57.

The tray generally also includes the further features of a first plurality of longitudinally extending rib formations 59 on the base member 51 and a second plurality of rib formations 60 extending perpendicularly to said first plurality of rib formations 59 on the cover member 52. Further, apertures 61 are defined in the cover member 52 to facilitate the passage of moisture therethrough. Water absorbent material 62, which is typically a granular material contained within a permeable bag, is sandwiched between the members 51 and 52 for absorbing exudate which issues from food carried on the tray 50 and drains through the apertures 61 in the cover member 52. The absorption of the moisture enables the tray and food packed thereon to retain a fresh aesthetically pleasing appearance for several days.

It is important to appreciate that all of the four apparatus embodiments illustrated in Figs 1 to 8 can be used to crimp the base and cover members 51 and 52 to each other to form the two piece trays.

An advantage of a method in accordance with the present invention is that it enables thermoformed plastic trays to be provided which are particularly suitable for wrapping in plastic film or wrap. This will lead to improved productivity in the wrapping of plastic trays. Further this invention enables the alteration to the trays to be carried out on a high volume assembly line scale at reasonable cost.

A yet further advantage of the method of this invention is that it facilitates the attachment of the two elements of a two-piece tray to each other to form a unitary tray assembly. It thus obviates the requirement of using adhesive to adhere the two-tray elements to each other. A two-piece tray according to this invention is aesthetically pleasing, has a peripheral edge which does not damage plastic wrap within which it is wrapped, and has a good mechanical strength. All these factors render it extremely suitable for use in food packaging.

A further advantage of a tray having a deformed peripheral edge region is that the region is far less prone to cracking than trays having untreated

peripheral edge regions. Without wishing to be bound by theory, Applicant believes that this is due to the heat treatment step in which the edge region is heated to a deformation temperature, and which has the effect of stress relieving the thermoformed plastic. This is analogous to the stress relieving of glass by a re-annealing process. Alternatively, the heat treatment step may also effect some beading of the plastic by melting.

A yet further advantage of the bending over the edge of the tray is that it mechanically strengthens the rim of the tray. Trays for food packaging are exposed to various forces during the handling and transport thereof. Trays in accordance with preferred embodiments of this invention have rims of increased mechanical strength and thus are far less prone to this bending and deformation.

A further advantage of the deforming of the edge of the tray is that it substantially eliminates the presence of microscopic "hairs" on the tray. Hairs are minute strands of plastic which are generated when the trays are cut immediately after the thermoforming operation. Customers of the trays, especially in the food industry regard these hairs as a potential hazard to consumers and are increasingly seeking trays that are free of these microscopic hairs.

It is to be understood that various alterations, modifications, and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the ambit of the invention disclosed herein.

CLAIMS:

1. A method of producing a plastic tray having a peripheral edge region terminating in a terminal edge which is deformed such that the terminal edge is displaced out of a wrap path around the tray, the method including:

providing a plastic tray having a peripheral edge region terminating in a terminal edge;

heating the peripheral edge region of the tray such that said peripheral edge region becomes malleable and the remainder of the tray remains non-malleable; and

deforming the peripheral edge region of the tray by bringing an appropriately configured deforming means into engagement with said peripheral edge region of the tray to displace the terminal edge out of the wrap path, the deforming being effected by relative movement between the tray and the deforming means.

2. A method according to Claim 1, including cooling the peripheral edge region of the tray such that it sets and hardens with the terminal edge displaced out of the wrap path.

3. A method according to Claim 2, wherein the step of heating the peripheral edge region of the tray includes producing a sharp transition from malleable to non-malleable plastic which forms a fold line about which said peripheral edge region is deformed.

4. A method according to Claim 3, wherein said deforming means is a die and wherein said heating the peripheral edge region of the tray includes heating the die which in turn heats the peripheral edge region of the tray when brought into heat conductive contact therewith.

5. A method according to Claim 4, wherein said deforming the peripheral edge region includes rolling the peripheral edge region.

6. A method according to Claim 5, wherein said rolling comprises rolling the edge region around the full periphery of the tray substantially simultaneously.

7. A method according to Claim 5 or Claim 6, wherein the die is configured such that upon engagement with the tray, it heats up the peripheral edge region of the tray, and when the peripheral edge region is malleable, it rolls the peripheral edge region of the tray.

8. A method according to any one of Claims 4 to 7, wherein said heating the peripheral edge region of the tray includes creating a temperature gradient across the peripheral edge region, the temperature being hotter adjacent the terminal edge and decreasing inwardly therefrom.

9. A method according to Claim 8, wherein said temperature gradient across said peripheral edge region is obtained by configuring the die such that it is in heat conductive contact with part of the peripheral edge region of the tray longer than other parts thereof.

10. A method according to Claim 9, wherein rolling the peripheral edge region of the tray includes moving the tray into engagement with the die.

11. A method according to any one of Claims 4 to 10, wherein said peripheral edge region is passively cooled by detaching it from the die, spacing it away from the die, and exposing it to convection cooling by surrounding air.

12. A method according to Claim 3, wherein said heating comprises blowing hot air over the peripheral edge region of the tray.

13. A method according to Claim 12, wherein that portion of the tray laterally inwardly of the peripheral edge region is shielded from the hot air blast.

14. A method according to Claim 13, wherein said deforming means includes a former and a complementary engagement formation, the former being moved into engagement with the peripheral edge region and the complementary engagement formation to deform said peripheral edge region.

15. A method according to any one of Claims 12 to 14, which includes actively cooling the peripheral edge region of the tray using cooling water.

16. A plastic tray produced by the method claimed in any one of Claims 1 to 15.

17. A method of joining two tray members to each other to form a unitary two-piece tray, the method including:

providing base and cover members each having a peripheral edge region terminating in a terminal edge;

mounting the cover member in a superimposed relationship on the base member such that the peripheral edge regions of the two trays are substantially in alignment with each other;

heating the peripheral edge regions of the base and cover members such that said peripheral edge regions become malleable and the remainder of the base and cover members remain non-malleable; and

deforming the peripheral edge regions of the base and cover members laterally inwardly, by bringing an appropriately configured deforming means into engagement with said peripheral edge regions, so as to crimp the two peripheral edge regions to each other to form a unitary two-piece tray.

18. A method according to Claim 17, wherein the terminal edges of respectively the cover and base members are displaced out of the wrap path.

19. A two-piece plastic tray, including:

a base member, and

a cover member mounted in superimposed relationship on the base member, each said member including a peripheral edge region terminating in a terminal edge,

wherein the peripheral edge regions of the base and cover members are crimped together so as to form a unitary two-piece tray.

20. A two-piece plastic tray according to Claim 19, wherein the peripheral edge regions of the base and cover members are deformed downwardly and laterally inwardly by said crimping such that the terminal edges thereof are displaced laterally inwardly out of the wrap path.

21. A two-piece plastic tray according to Claim 20, wherein the peripheral edge region of the base and cover members which is deformed laterally inwardly crimping the two members to each other, has width of at least 2mm.

22. A two-piece plastic tray according to any one of Claims 19 to 21, wherein the cover member is water permeable and the base member is water impermeable.

23. A two-piece plastic tray according to Claim 22, wherein the cover member has a plurality of apertures defined therein for permitting water to permeate therethrough.

24. A two-piece plastic tray according to Claim 22 or Claim 23, wherein moisture absorbent means are sandwiched between the base and cover members for absorbing moisture on the tray.

25. A two-piece plastic tray according to Claim 24, wherein the moisture absorbent means comprises a particulate moisture absorbing material contained within a water permeable bag.

26. A two-piece plastic tray according to any one of Claims 19 to 25, wherein said base member defines a first plurality of spaced reinforcing rib formations and the cover member defines a second plurality of spaced reinforcing rib formations extending transversely to said first plurality of rib formations.

27. A plastic tray including a peripheral edge region terminating in a terminal edge, wherein the peripheral edge region is deformed laterally inwardly such that the terminal edge is displaced out of a wrap path around the tray.

28. Apparatus for producing a plastic tray including a peripheral edge region terminating in a terminal edge, wherein the peripheral edge region is deformed laterally inwardly such that the terminal edge is displaced out of a wrap path around the tray, including:

heating means for heating the peripheral edge region of the tray to a temperature at which it is malleable; and

an appropriately configured deforming means for deforming the peripheral edge region of the tray and displacing the terminal edge of the tray out of the wrap path, the deforming means being moved relative to the tray to engage said tray and effect said deforming.

29. Apparatus according to Claim 28, wherein the deforming means includes a die for deforming by rolling the peripheral edge region of the tray.

30. Apparatus according to Claim 29, wherein the heating means acts to heat the die which heats the peripheral edge region of the tray by being brought into heat conductive engagement therewith.

31. Apparatus according to Claim 30, wherein the die is configured so as to engage the edge region of the tray around the full periphery thereof and to roll said peripheral edge region substantially simultaneously in a single step.

32. Apparatus according to Claim 30 or Claim 31, wherein the die is configured so as to heat the peripheral edge region of the tray when it initially engages the tray to a temperature at which the edge region is malleable, and thereafter to roll the peripheral edge region of the tray.

33. Apparatus according to any one of Claims 29 to 32, including an ejector for detaching the tray from the heated die once the deforming has been carried out.

34. Apparatus according to Claim 28, wherein the heating means includes a hot air blast which is directed onto the peripheral edge region of the tray.

35. Apparatus according to Claim 28 or Claim 34, wherein the deforming means comprises a former and a complementary deforming formation, the former being movable relative to the complementary deforming formation.

36. Apparatus according to Claim 35, wherein said former is a rigid body.

37. Apparatus according to Claim 36, wherein the former comprises a plurality of linear or straight edge portions and a plurality of corner portions.

38. Apparatus according to Claim 35, wherein said former is an inflatable tube or hydraulic cylinder.

39. Apparatus according to any one of Claims 34 to 38, including shield means for shielding that portion of the tray laterally inwardly of the peripheral edge region from the hot air blast.

40. Apparatus according to any one of Claims 34 to 39, including cooling means for actively cooling said peripheral edge region of the tray.

41. Apparatus according to Claim 40, wherein said cooling means includes cooling water which is passed over said former.

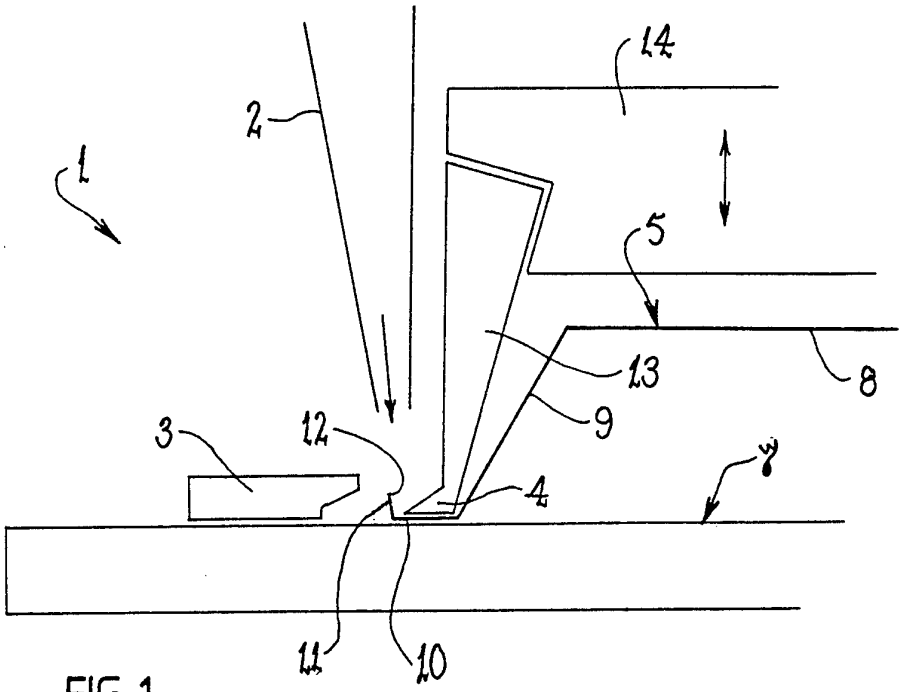


FIG 1

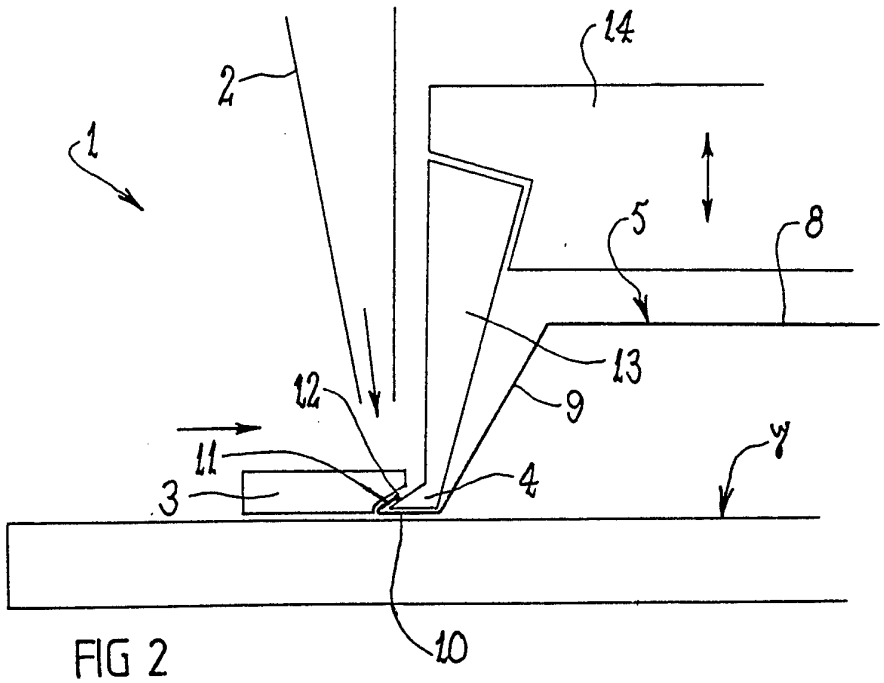


FIG 2

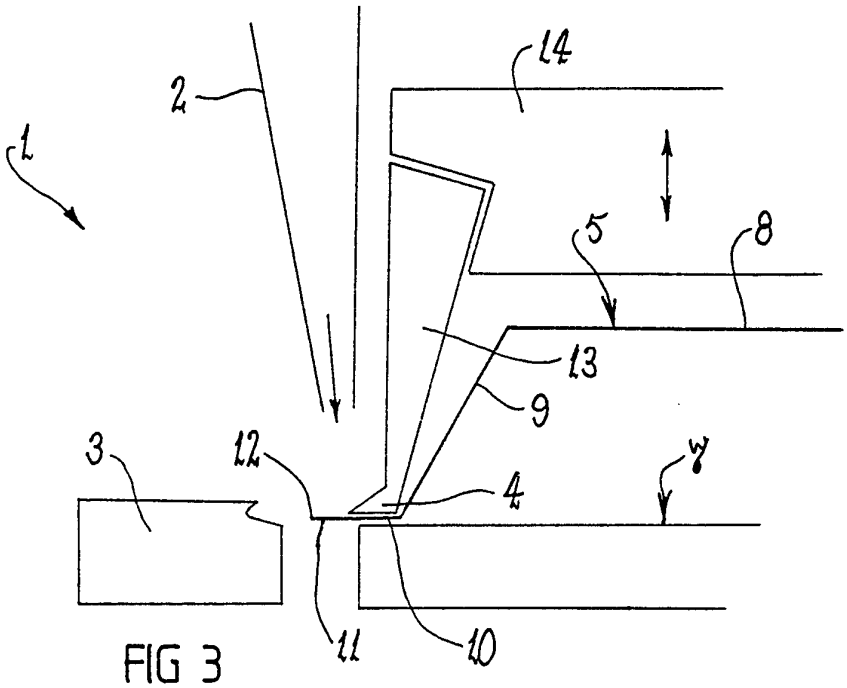


FIG 3

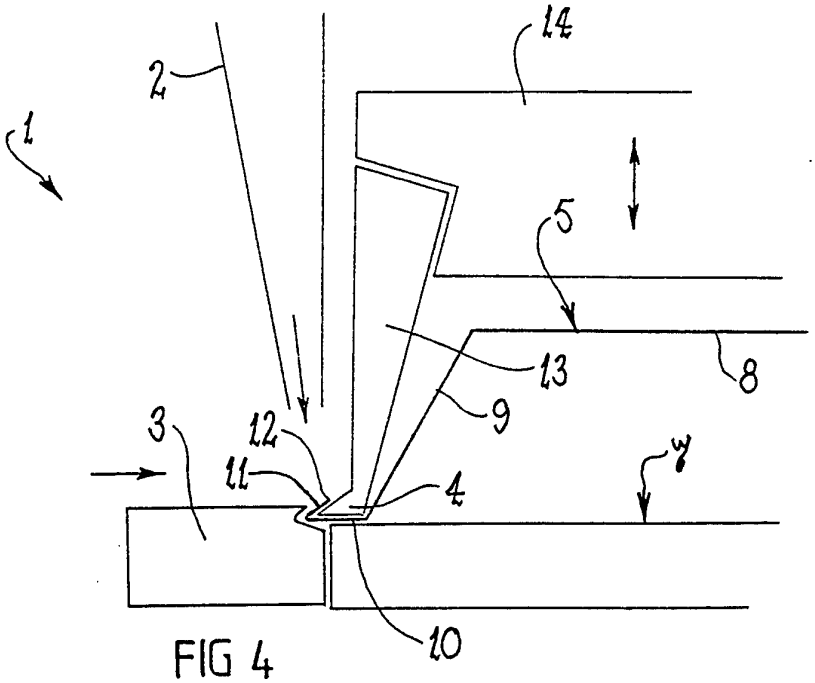


FIG 4

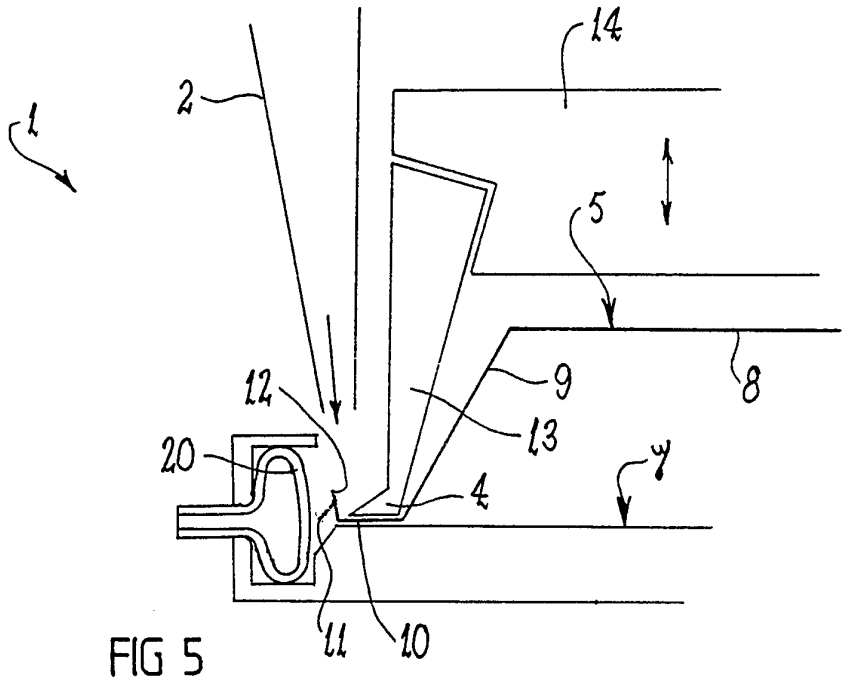


FIG 5

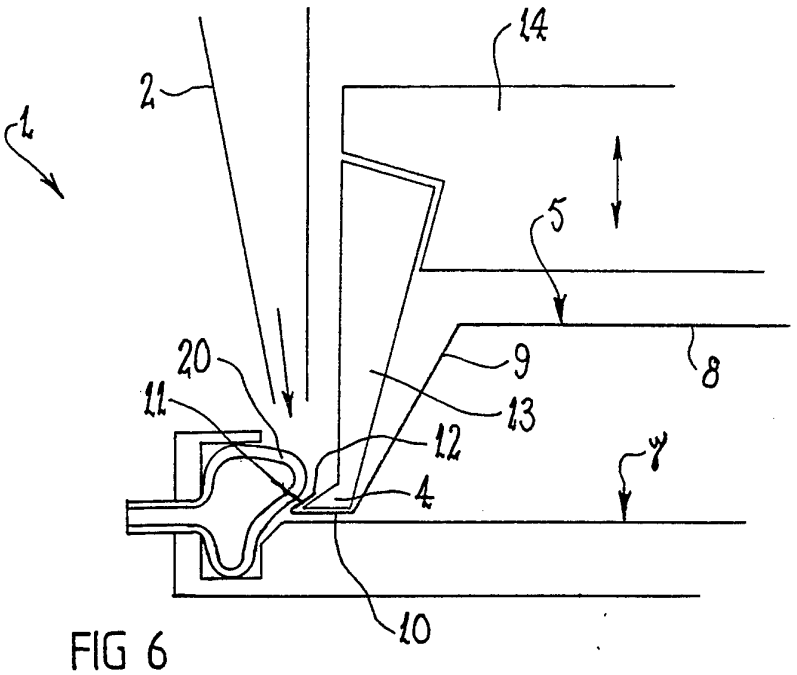


FIG 6

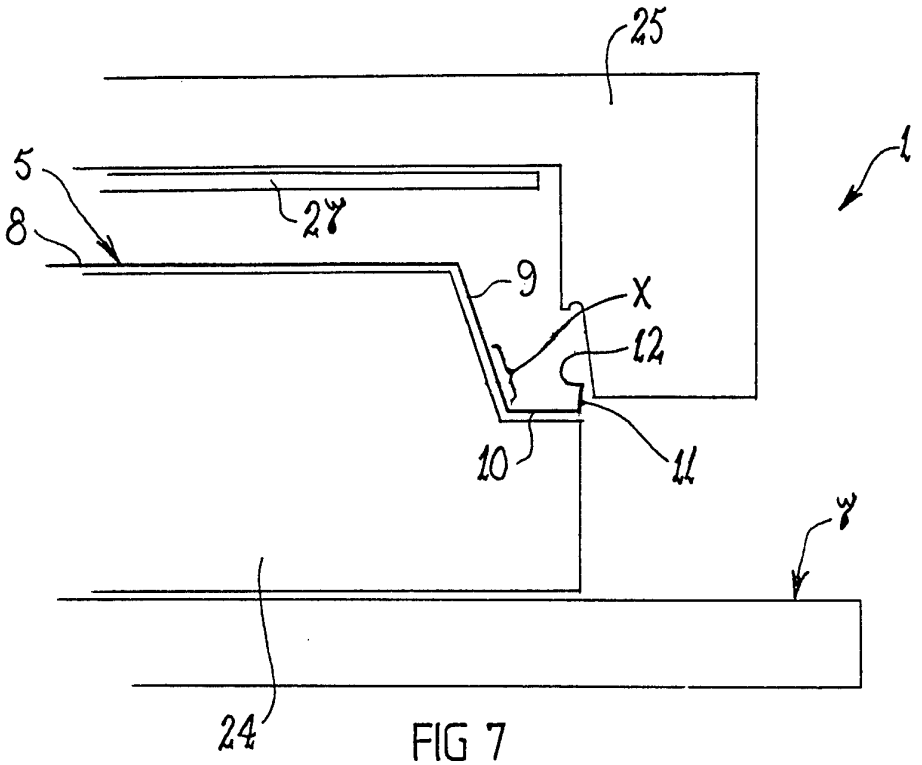


FIG 7

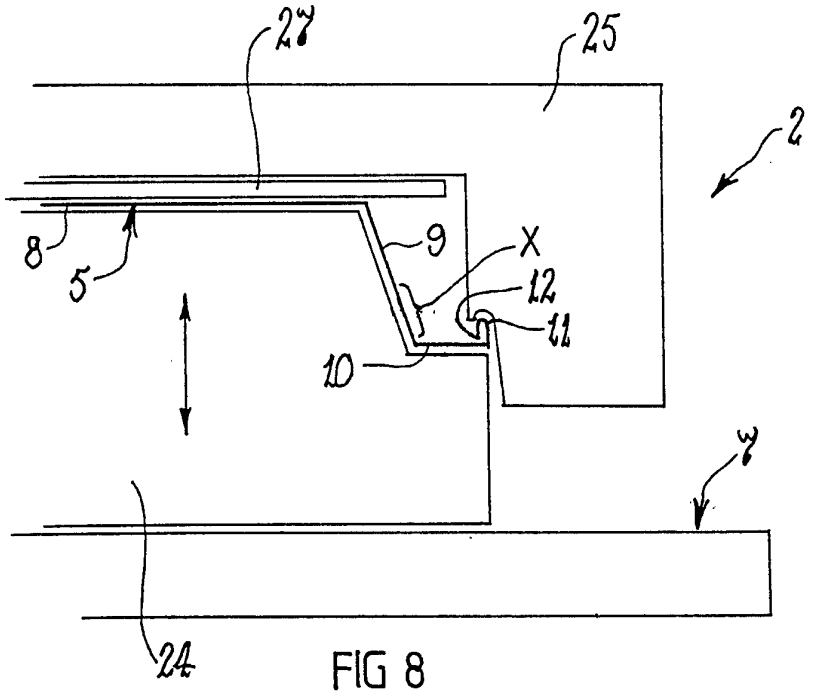


FIG 8

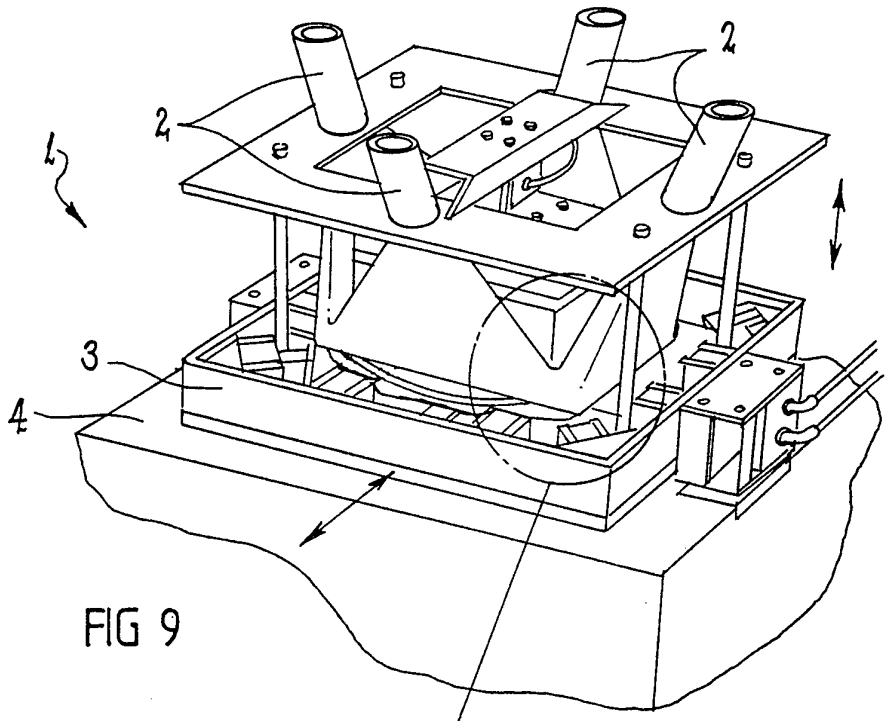


FIG 9

SEE FIG 10

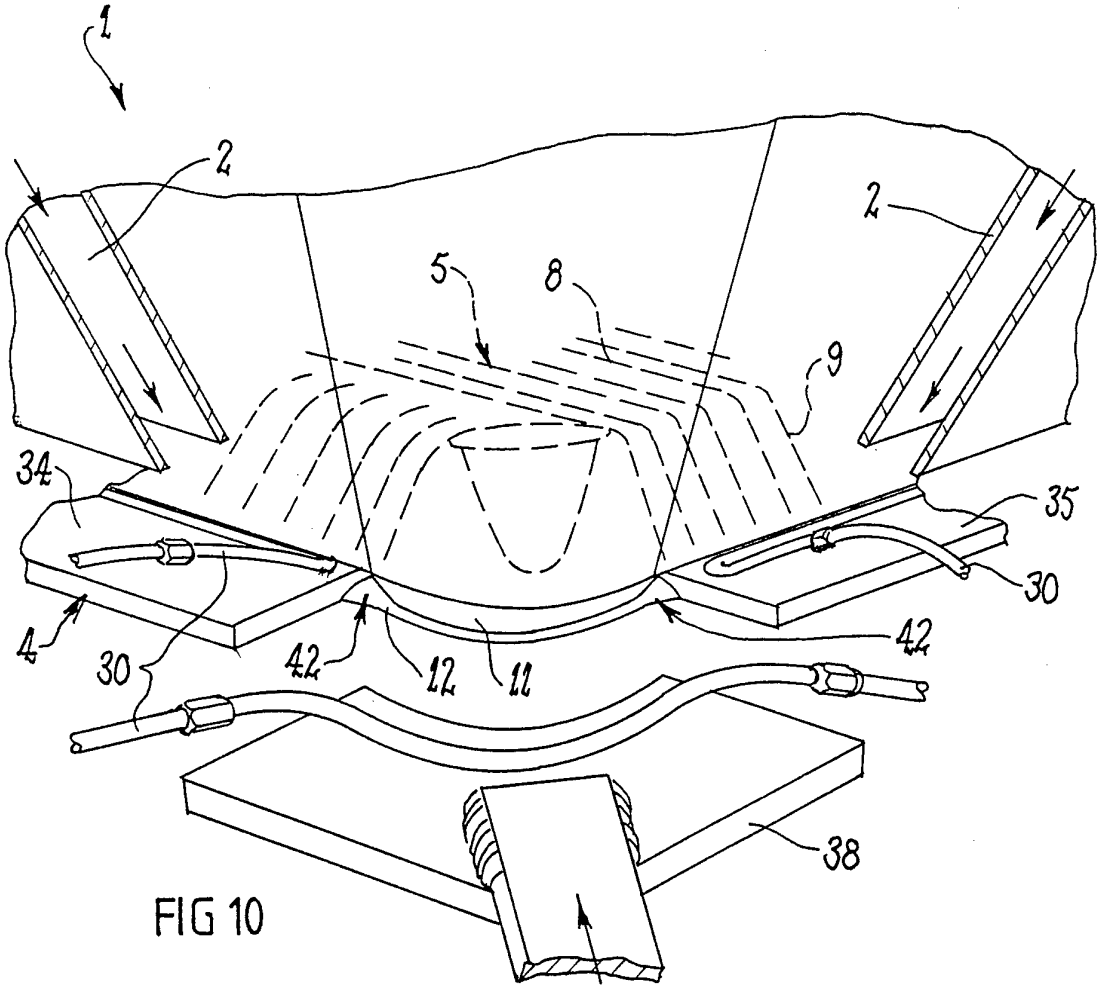


FIG 10

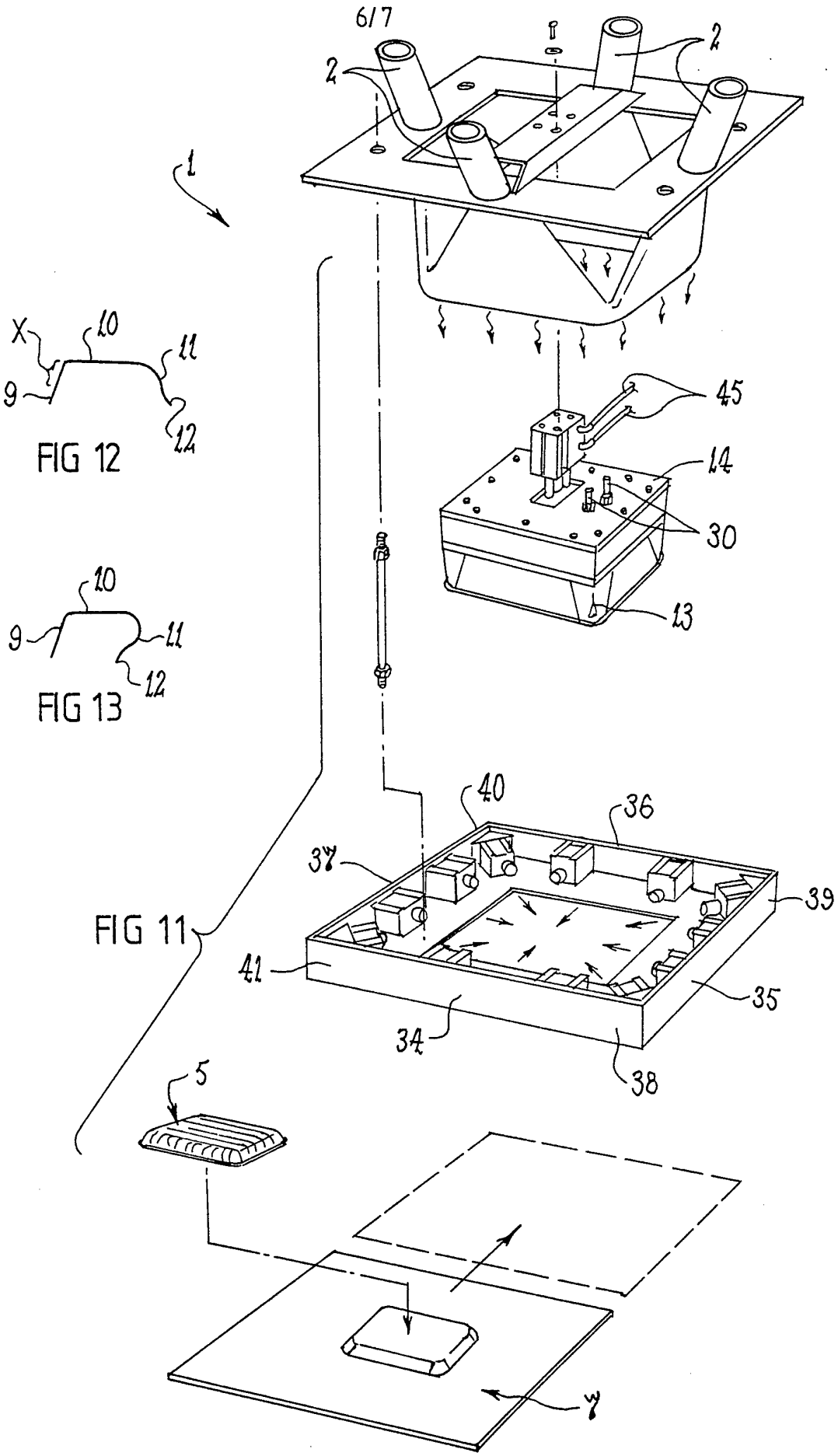


FIG 11

FIG 12

FIG 13

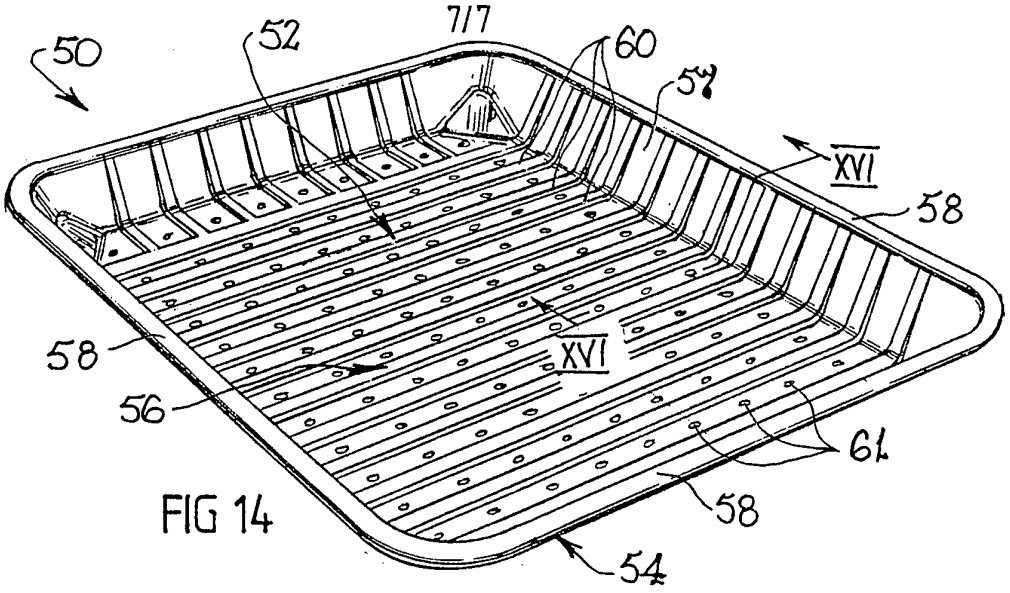


FIG 14

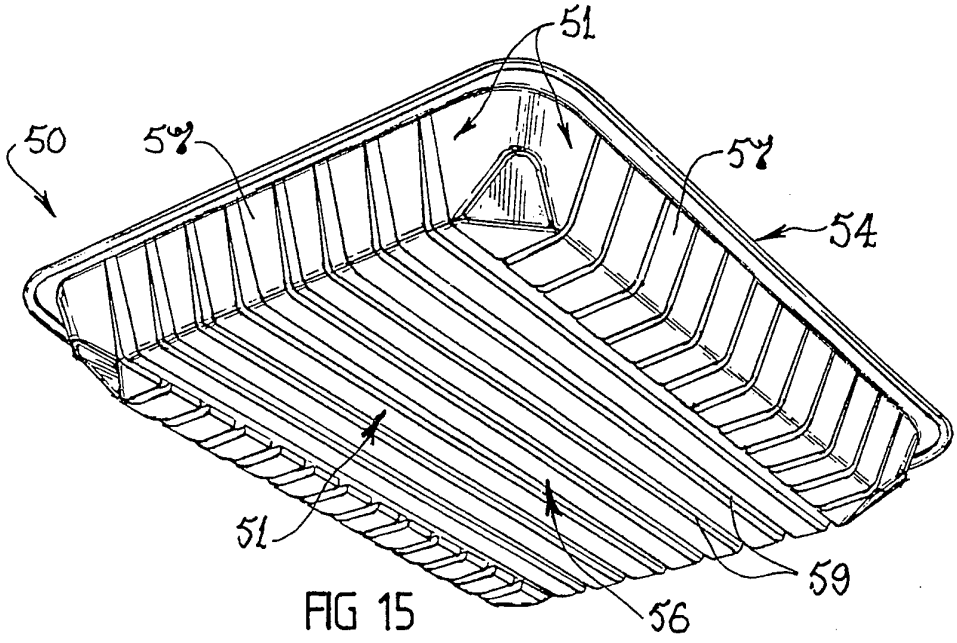


FIG 15

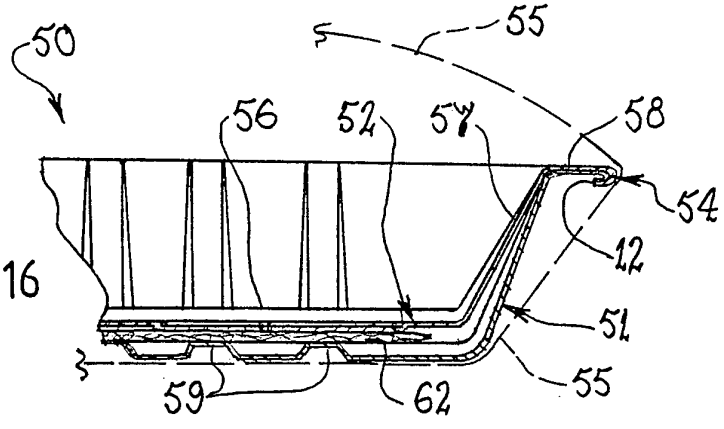


FIG 16

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 95/00404

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: B29C 51/00, 51/20 B65D 1/34, 81/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC B29C 51/00, 51/20, 51/22, 17/00, 17/02, 17/04, 17/06, B65D 1/34, 81/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT: IPC as above and (tray# or plate#) and (edge# or peripheri or lip#)
JAPIO: as for DERWENT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB-B-1388710 (BLACKNELL BUILDINGS LIMITED) 26 March 1975 page 2, lines 51 - 90	1-18, 28-41
A	US,A,4889231 (FOOTS et al) 26 December 1989 figures 3,7 and 8	16
A	US,A,4349146 (HOLDEN) 14 September 1982 column 2, lines 40 - 56	16

[X] Further documents are listed in the continuation of Box C

[ ] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 October 1995	23 OCTOBER 1995
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	Authorized officer **L. Menz** Telephone No.: (06) 283 2431

INTERNATIONAL SEARCH REPORT

.ternational Application No.
PCT/AU 95/00404

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	AU,B,21308/92 (631520) (DRYPAC PTY LTD) 26 November 1992 figures 1 - 7	17-27
A	Derwent Abstract Accession No. 55335X/29 Class A32, JP,A,60-019476 (IGARASHI Y) 17 June 1976 abstract	1-18, 28-41
A	Derwent Abstract Accession No.73521A/41 ClassA32 (A13), JP,A,53-101065 (SEKISUI PLASTICS KK) 4 September 1978 abstract	1-18 28-41
A	Derwent Abstract Accession No.91295Y/51 Class A32 (A92), JP,A,52-135375 (OMORI KIKAI KOGYO) 12 November 1977 abstract	1-18, 28-41

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 95/00404

Box 1 Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

(i) Claims 1 - 18 and 28 - 41 claim a method and apparatus having a peripheral edge region terminating in a terminal edge which is deformed.

(ii) Claims 19 to 27 claim a tray having a peripheral edge region.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 95/00404

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
GB	1388710		
US	4889231	CA	2018291
US	4349146		
AU	21308/92		

END OF ANNEX