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A stacking element for packages in the form of a tray, said stacking element including a main portion in the form of a web (10b) having opposed substantially parallel planar faces of pre-selected width(s) and length(s), said web being provided around part or all of its perimeter with means (46, 50) co-operatively engageable with one or more sleeves (20) of pre-selected height(s) capable of forming walls of packages of which said stacking elements form lids and/or bases, and optionally, including means for ventilation (84) of contents of said packages. Also a two-part stacking element in the form of a tray, the first component (66) including a main portion in the form of a web (57), bounded by flanges (62), said flanges having ventilation means (88) and said web having ventilation means (84), the second component of the stacking element including a web with ventilation means and fluid flow deflection means (104). The second component being load supportive and fitting inside the first component.
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PACKAGING

This invention relates to systems for packaging or stacking packages. More specifically, it relates to components of packages, cartons or containers and package stacking systems, to package stacking systems themselves, to methods of assembling or constructing said packages and systems, and to methods of environment or atmosphere control for contents of packages, cartons or containers.

Throughout the description and claims of this specification the term "package" shall be understood to include packages, cartons, containers, boxes, cases, unitised shelves and like receptacles.

Conventionally, package stacks may be assembled by stacking individual packages in sets of columns or by cross- stacking wherein individual packages in a stack are not in a superimposed registered relationship with packages above and/or below them. The strength and stability of such stacks is related to the strength of the individual packages and the forces acting between the individual packages.

Conventional packaging systems may employ either integral packages or multi-piece packages. It has been found that packaging that uses paper or corrugated cardboard for the horizontal elements or portions, whether in the form of regular slotted containers (RSC) (short or full flap variant), die-cut cartons, trays or lids, half slotted containers (HSC), wrappers, carry packs, styles using container forming and glueing machinery, or pads and sheets, is faced with the dilemma of having to use cost-effective material and yet maintain suitability for stacking of packages. Other problems that may be encountered by such packaging include retention of the contents of the packages through a number of diverse product applications and coping with diverse atmospheric and environ
mental conditions and varying horizontal and vertical structural requirements. It is believed that the use of this invention will lead to substantial reductions in the amount of material consumed and waste material produced during the course of manufacture of packages as well as provide packages adapted to satisfy at least substantially the foregoing requirements.

While packaging constructed of plastics materials may appear to be attractive, there are disadvantages associated with high tooling costs, with high initial investments, with difficulties relating to lack of collapsibility of the packaging, and with logistics. A typical example of these problems may be seen in the use of plastic containers for milk cartons. The empty containers take up as much room as filled containers.

It is believed that this invention, by separating the horizontal and vertical aspects of packaging, can enable advantages to be taken in employing differing horizontal and vertical technologies.

It is an object of this invention to provide means for packaging wherein the horizontal and vertical components of packages can be separately manufactured for later assembly, thereby enabling the components to be transported and/or stored economically and with efficient use of space.

It is another object of this invention to provide means for packaging wherein improvement in control of environment or atmosphere within packages may be facilitated.

According to one aspect of the invention there is provided a stacking element (or stacking mould) in the form of a tray, said stacking element including a main portion in the form of a web having opposed substantially parallel planar faces of pre-
selected width(s) and length(s), said web being provided around part or all of its perimeter with means co-operatively engageable with one or more sleeves of pre-selected height(s) capable of forming walls of packages of which said stacking elements form lids and/or bases.

In use the said webs of the stacking elements are substantially horizontal. Throughout the description and claims of this specification the terms "upper", "lower", "upwardly", "downwardly", "below", "above", "inner", "outer" and the like, when referring to a stacking element, have reference to that stacking element wherein said web is substantially horizontal. The stacking elements may be constructed of plastics, wood, metal(s), cardboard, or combinations of the foregoing. Furthermore, the stacking elements may be formed in one piece or from a number of components. When functioning as a base, said stacking element should be strong enough to avoid excessive vertical displacement of the web. To this end said web may include ribbing, ridging or other structural-strengthening features.

Said stacking elements, optionally said webs, may be provided with means for ventilation. Said means for ventilation may include vents or openings in said stacking elements(s) or web(s) for passage of fluids (gases and/or liquids).

In one form of the above aspect of the invention, said means co-operatively engageable with one or more sleeves includes one or more lips or flanges (hereinafter referred as "flanges") of pre-selected height(s) extending upwardly of the plane of the upper face of said web and, optionally, one or more flanges of pre-selected height(s) depending downwardly from the plane of the lower face of said web. Each of said flanges may extend around all or part of the
perimeter of said web and each of said flanges may
vary in height at different locations around the
perimeter of said web.

In another embodiment of the invention, said
means co-operatively engageable with one or more
sleeves includes a one or more recesses of pre-selected
width(s) and depth(s) depending downwardly from the
plane of the upper face of said web and one or more
flanges of pre-selected height(s) on the outer side of
said recess(es) extending upwardly of the bottom of
said recess and, optionally, terminating at pre-
selected height(s) above the plane of the upper face of
said web. Said recess(es) and/or flange(s) may extend
around all or part of the perimeter of said upper face.

Said means may also include one or more upwardly
extending inner flanges of pre-selected height(s)
extending around all or part of the perimeter of said
upper face, the outer face(s) of said inner flange(s)
optionally being in the same plane(s) as the inner
wall(s) of said recess(es). Preferably, the height(s)
of said inner flange(s) above said upper face is
significantly less than that of the outer lip or
flange.

In yet another embodiment, said means co-
operatively engageable with one or more sleeves further
includes one or more recesses of pre-selected width(s)
and depth(s) extending upwardly of the plane of the
lower face of the said web and one or more flanges of
pre-selected height(s) on the outer side of said
recess(es) and optionally terminating at pre-selected
distance(s) below the plane of the lower face of said
web. Said recess(es) and/or flange(s) may extend
around all or part of the perimeter of said lower face.
Said means may also include one or more downwardly
depending inner flanges of pre-selected height(s)
extending around all or part of the perimeter of said
lower face, the outer face(s) of said inner flange(s) optionally being in the same plane(s) as the inner wall(s) of said recess(es).

In still another embodiment, said means co-operatively engageable with one or more sleeves extending below the plane of the web may take the form of a downwardly depending flange of pre-selected height(s) extending around all or part of the perimeter of the lower face of said web. It is believed that this form enables ready forming and/or stacking of packages especially where the sleeves are prevented from collapsing inwardly by the contents of said packages.

Advantageously said flange(s) and/or recess(es) may be provided with means such as ribbing or ridging to assist in co-operative engagement of sleeves.

The aforesaid recess(es) may be adapted to accommodate one or more corrugated cardboard sleeves of any flute size or combination of flutes. In use said sleeve(s) form the vertical sides of package(s). Alternatively, said sleeve(s) may be constructed from solid fibre, plastics, metal(s), wood, wax-coated, wax-impregnated, or plastics-coated cardboard, wax-coated, wax-impregnated or plastics-coated corrugated cardboard, or combinations of the foregoing, preferably including some form of moisture barrier. Said sleeve(s) may be single piece or multi piece and may be joined, unjoined, multi-joined, jointed, creased, hinged, juxtaposed, overlapping, or be made up of any number of desired components. A joined sleeve may be glued, chemically bonded, taped, stitched, geometrically internally connected (eg., having components slotting or snapping together), overlapping (ie., having portions of said sleeve overlapping), or otherwise joined or assembled. Said sleeve(s) may be
vented to permit passage of fluids through assembled package(s). Flutes in fluted or corrugated cardboard may be sealed, or left open to permit those flutes to act as "chimneys" for the venting of fluids, optionally, in co-operation with venting means provided in stacking elements.

Where the sleeve comprises cardboard, especially in dipped or cascade-waxed applications, the separating of the vertical and horizontal technologies of packaging will permit the manufacture of sleeves without creases across corrugations or across the cross-machine paper direction. This leads to the conserving or maintaining of sleeve strength, and, in waxed applications, the capability to employ more rigid waxes than conventionally used on containers with flaps. This is believed to be of major significance in relation to stacking strength or box compression strength, resistance to bulge, provision of extra ventilation, prevention of produce damage, and grammage of paper required for sleeves.

The aforesaid recess(es) may include allowances for extra thickness(es) in sleeves resulting from joins, joints or overlapping of sleeve components. Where present, the lower recess of a stacking element may be adapted so that it grips the sleeves slightly less firmly than does the upper recess. This is believed to facilitate the function of the stacking element when acting as a package lid. Where sleeves comprising cardboard, corrugated cardboard or other deformable material are to be employed the geometry of said recesses may be adapted to conform with the profile of the sleeves in the regions where the sleeves are bent or creased or folded. This is believed to enable the sleeves to retain strength and thereby permit reuse of the sleeves.

The stacking elements or said means co-
operatively engageable with one or more sleeves may be provided with a plurality of hand grips or holes or other means to facilitate separating, lifting and stacking of packages formed by said stacking element(s) and said sleeve(s). Said holes or other means may also be adapted to co-operatively connect with previously mentioned venting means to provide a system for environment control within the packages or stack of packages.

According to another aspect of the invention there are provided packages comprising stacking elements and sleeves as hereinbefore described.

Alternatively, the invention, when utilising non-vented stacking elements and sleeves, may be employed to control the atmosphere within packages by substantially restricting atmospheric access to the contents of containers formed by those stacking elements and sleeves.

Said stacking elements as hereinbefore described may be capable of use in column-stacked packaging. It can be seen that recesses of the stacking elements serve to hold the sleeves in a vertical orientation such that the maximal strength of the sleeves under compression is preserved. Any significant departure from the vertical orientation leads to bending and weakening of the sleeves and can render them unfit for further use. Column-stacked packages comprising stacking elements and sleeves according to the invention are believed to exhibit relatively high degrees of structural integrity, stability and palletisation efficiency.

Means such as rubber pillars, rubber pillows or air cushions may be inserted in the regions between sleeves and stacking elements to reduce the transmission of vibrations and mechanical shocks to the contents of packages. This is advantageous where
stacks of packages are being transported and where the contents are fragile or easily damaged, for example, biscuits or fresh fruit, vegetables or other produce.

Thus, according to a further aspect of the invention, there are provided means for forming column-stacked packaging, using stacking elements and sleeves hereinbefore described.

According to another aspect of the invention said stacking elements may be provided with means for receiving and holding either fixedly or releasably means adapted to link adjacent columns of column-stacked packages. Said receiving and holding means may take the form of a plurality of holes or slots provided in the outer flanges of said stacking elements adapted to receive linking means in the form of pegs linked by coil springs of pre-selected length and strength. Alternatively, said linking means may take the form of straps of extendible or inextendible material provided with pegs protruding therefrom at pre-selected intervals. Alternatively the stacking elements may be provided with means for engaging co-operatively linking means in the form of clips. By linking stacking elements in adjacent columns of column-stacked packages, it is believed that improvements in the structural integrity of column-stacked packaging over the prior art may be achieved. Alternatively, said stacking elements may be adapted to co-operatively engage each other substantially in the same horizontal plane. This so-called "geometrical linking" may be achieved by incorporating suitable means into the outer parts of said stacking elements.

According to a further alternative aspect of the invention, the stacking elements as hereinbefore described may be provided with means to enable cross-stacking of packages. Such cross-stacking may permit the achievement of a relatively high degree structural
integrity in assemblies of packages.

Manipulation or variation of package volumes
may be achieved by alteration of the height of
sleeve(s) while maintaining the pre-selected width(s)
and length(s) of the stacking element(s).

According to still another aspect of the
invention there is provided a method for environment or
atmosphere control wherein assemblies of column-stacked
or cross-stacked packages according to the present
invention provided with ventilation means as aforesaid
are subjected to changes in environment or atmosphere
by placing an atmosphere containment means such as a
hood over the assembly and introducing a preselected
environment or atmosphere at a potential sufficiently
high enough to displace the ambient environment or
atmosphere. Such a method may permit the introduction
of desired gases or liquids and may be used for such
methods of environment control as forced-air cooling,
hydro cooling, vacuum cooling, cold-air cooling,
fumigation with pesticides, or introduction of ripening
control agents.

In order that the invention may be more
clearly understood, reference is made to the accompany-
ing non-limiting drawings in which:

Figure 1 is a perspective view of a stacking
element according to the invention together with a
partially cut away perspective of a sleeve;

Figure 2 is a partial section through the
stacking element shown in Figure 1;

Figure 3 is a perspective view of another
embodiment the invention;

Figure 4 is a partial section through the
embodiment shown in Figure 3;

Figure 5 is a partially cut-away perspective
view of another embodiment of the invention;
Figure 6 is a partial section of the embodiment as shown in Figure 5 in use with sleeves;

Figure 7 is an exploded perspective view of yet another embodiment of the invention;

Figure 8 is a partial cross-section of the embodiment shown in Figure 7;

Figure 9 is a perspective view of the upper surface of a first component of two-part stacking element according to the invention;

Figure 10 is a perspective view of the lower surface of the component shown in Figure 9;

Figure 11 is a perspective view of the upper surface of a second component of a two-part stacking element according to the invention;

Figure 12 is a plan view of the upper surface of the component shown in Figure 11;

Figure 13 is a perspective view from underneath of an assembled two-part stacking element comprised of components depicted in Figures 9 to 12;

Figure 14 is a partial section through an assembled two-part stacking element as shown in Figure 13;

Figure 15 is a partial perspective view of a corner of the embodiment shown in Figure 11;

Figure 16 is a partial sectional view of the component shown in Figure 11 in the region of a cold air inlet (as hereinafter described);

Figure 17 is a partial sectional view of the component shown in Figure 9 in the region of a cold air inlet (as hereinafter described);

Figure 18 is a partial section of an assembled two-part stacking element illustrating airflow in the region of a cold air inlet (as hereinafter described);

Figure 19 is a perspective view from above of another embodiment according to the invention;
Figure 20 is a plan view from above of the embodiment shown in Figure 19;

Figure 21 is a perspective view from beneath the embodiment shown in Figures 19 and 20;

Figure 22 is a plan view from beneath the embodiment shown in Figures 19 to 20;

Figure 23 is a partial section of the embodiment shown in Figures 19 to 22;

Figure 24 is a perspective view of an insert which may be used in conjunction with the embodiment shown in Figures 19 to 23.

Figure 25 is a perspective view from beneath of the embodiment as shown in Figures 19 to 22 with inserts shown in Figure 2 inserted therein;

Figure 26 shows a locking clip which may be used with the embodiment shown in Figures 19 to 22;

Figure 27 depicts the relationship between the locking clip shown in Figure 26 and the aforesaid embodiment;

Figure 28 is a partial elevation of two embodiments linked together by the locking clips shown in Figure 26;

Figure 29 is a partial elevation of two embodiments linked side by side by the locking clip shown in Figure 26;

In Figure 1, the stacking element comprises a web 10, having an upper surface 12 provided with ridging or ribbing 22 and bounded by an upwardly extending inner flange 14, a recess 16, and an upwardly extending outer flange 18. The recess 16 is of such a width that it can receive and co-operatively engage with a sleeve 20. The stacking element may be provided with a similar arrangement of flanges and recess on the underside.

In Figure 2, web 10 is provided with ridging or ribbing 22 and 23 on upper and lower surfaces 12 and
24. The thickness of web 10 can thereby be reduced while structural strength is maintained. Flanges 14 and 18 define recess 16 which may co-operatively engage sleeve 20. Similarly, flanges 26 and 30 define recess 28 which may co-operatively engage another sleeve 20. In this embodiment the bottoms of the recesses 16 and 28 are, respectively, above and below the levels of the respective surfaces of the web and are level with the respective upper and lower extremities of ribbing 22 and 23. The strength of the stacking element at the points where the most pressure may be expected is thereby maintained. If required, a plate may be placed over ridging 22 to support deformable loads.

In Figure 3, the upper surface 12a of web 10a is bounded by an inner flange 32 of pre-selected and constant height. That flange is bounded by a recess 34 and then an outer flange 36, said outer flange terminating at the same height above upper-surface 12a as inner flange 32.

In Figure 4, upper and lower surfaces 12a and 24a of web 10a are bounded by inner flanges 34 and 38. These inner flanges are in turn bounded, respectively, by recesses 34 and 40 and outer flanges 36 and 42. The bottoms of recesses 34 and 40 are located at planes below the levels of the respective surfaces of the web. A stacking element such as that depicted in this embodiment may be constructed from self-skinning plastic expanding foam, possibly structural foam. In such a case the central core of the stacking element would be a solid core of foam. Stacking elements constructed in accordance with this embodiment sit flat when stacked and take up little room.

In Figure 5, a inner flange 44 bounds the upper surface 12b of web 10b. The inner flange is bounded by a recess 46. The bottom of recess 46 is located in a plane above the plane of surface 12b.
Recess 46 is bounded on its outer edge by outer flange 48. This outer flange is higher than inner flange 44. A recess 50 extends upwardly of lower surface 24b of web 10b. This recess is intended substantially for location purposes and not for lateral support of sleeves and is sized accordingly. The base of the stacking element is formed by the lower surface of the web and lower part 52 of the outer flange 48. It is believed that this embodiment may permit of reductions in flange thickness and substantially eliminate warpage.

In Figure 6, upper surface 12b of the web 10b is bounded by inner flange 44 which in turn is bounded by recess 46 and outer flange 48. Lower surface 24b is bounded by recess 50 extending upwardly of lower surface 24b. Recess 50 is bounded by lower part 52 of outer flange 48. The lower extremity of lower part 52 terminates in the same plane as lower surface 24b. Recesses 46 and 50 are of such width as to accommodate sleeves 20. The embodiment according to figures 5 and 6 may sit flat and may be stored without taking up too much room.

In figure 7, the two-part stacking element depicted comprises two identical components, each component comprising a web 10c having a surface 12c bounded by a recess 54 of uniform width and depth depending downwardly from the plane of surface 12c, recess 54 being bounded on its outer side by upwardly extending flange 56 the upper edge of which terminates in the same plane as surface 12c. The under surface 57 of the web component is provided with ribbing 58 to provide strength without increasing weight as well as providing welding or seating areas for the two components. The provision of empty volumes within the stacking element may enable ventilation means to be incorporated within stacking elements. Said ventila-
tion means may communicate with sleeves or with the outside environment. Provision may be made for "vertical ventilation" or "cross-ventilation". The two components may be welded or otherwise fixed together to provide a single stacking element capable of functioning both as a base and as a lid for packages.

In figure 8 two components as previously described are depicted in partial cross-section. The empty volume 60 may be seen clearly. 61 denotes the weld line(s) that may be formed by ribbing 58 (not shown).

In figure 9, 12d denotes the upper surface of a web of a stacking element bounded by flanges 62, 64, 66 and 68 of preselected heights. The height of flange 68 above the plane of surface 12d is less than the height of flanges 62, 64 and 66 above the plane of surface 12d. This permits the provision of an entry port for the introduction of jointed or foldable sleeves and for the introduction of the contents of the ultimately formed package in a packing process or processes which process or processes may be automated. Flanges 62, 64 and 66 are provided with stacking lugs 70, 72, 74 and 76 on their upper edges and at their lower edges are provided with complimentary cut-outs 78 and 80 (the others not being shown) to accommodate the stacking lugs of similar stacking elements during storage of unused stacking elements. Disposed adjacent to the perimeter of the web are a number of recesses 82, said recesses being preselected varying depths below the plane of surface 12d and forming funnels for holes 84 through the thickness of the web to provide ventilation and/or drainage means in conjunction with the flutes of corrugated cardboard sleeves or other sleeves provided with corrugation when said sleeves are located against the inner faces of flanges 62, 64, 66 and 68. Adjacent to or near to the corners of the
component, flanges 62, 64, 66 and 68 are provided with a number of vertically oriented parallel grooves 86 each of which said grooves is provided with a cold air inlet hole 88 of pre-selected size passing through the wall of the flange to permit ingress or egress of fluid to the space(s) underneath the web. Where two stacking elements in the same horizontal plane are touching, it is anticipated that the grooves 86 will still provide access for fluid to pass through cold air inlet holes 88.

In Figure 10, the underside of the web is provided with a number of snap lock fittings 90 and a cold air deflector 92. The height of the snap lock fittings 90 is less than the height of the cold air deflector 92. In use this feature permits air or other fluids to travel along channels (as hereinafter described) towards to the cold air deflector 92. Around the perimeter of the underside of the web are provided a number of ridges 94 of preselected height(s). The purpose of these ridges is to ensure that in use sleeves do not block access of fluids, generally air, to venting holes 84.

In figure 11, 96 denotes the plane of the upper surface of a compression tray 97 being a second component of a two-part stacking element. On the upper surface of the compression tray are provided cold air inlet manifolds 98, cold air inlet channels 100, cold air deflection region 102, baffles 104 and baffle supports/turbulence creators 105 and cut-outs 106. The baffles are, optionally, load supportive.

In figure 12, 96, 98, 102, 104 and 106 are as hereinbefore described. This plan view illustrates the arrangement of the cold air inlet manifold, cold air inlet channels, baffles and baffle support/turbulence creators. In use cold air flows in via cold air inlet manifolds 98 along cold air channels 100 to cold air
deflection region 102 where air flow is then diverted by the cold air deflector (not shown here) and flows along channels defined by baffles 104. The provision of cut outs 106 permits equalization of pressure between channels formed by baffles 104.

In figure 13, 64, 66, 68, 70, 74, 76, 78, 80, 86, 88, 96, 97 and 104 are as hereinbefore described. 118 represents the upwardly extending walls of inlet manifold 98 (not shown here). The gap 120 between the second component 97 and the first component permits the insertion of sleeves, preferably corrugated cardboard sleeves, between the two components, the gap being so sized as to permit of co-operative engagement of the sleeves by the assembled stacking element. In use, fluids, including air, may flow inwardly or outwardly of the internal volume contained by the components of the stacking element via that part of the gap 120 that is not occluded by the sleeves.

In figure 14, 12d denotes the upper-surface of the web of a first component of a stacking element, 96 denotes the upper surface of the web of a second component 97 of a stacking element, 66 denotes a flange, and 82, 84 and 94 are as hereinbefore described. 108 denotes flutes in corrugated cardboard sleeves. In use heated air is free to flow outwardly of the region 119 between the webs via opening 121 and into hole 84 and upwardly through flutes 108 joining other air flowing upwardly through flutes 108.

In figure 15, 98 denotes cold air inlet manifolds as hereinbefore described, 104 denotes baffles as hereinbefore described, 110 denotes inner side walls of inlet manifold 98, 112 denotes upper ridging defining the outer extremities of inlet manifold 98, 114 denotes support ridging at centre of inlet manifold 98, 116 defines the lower face of inlet manifold 98 and 118 defines the outer side walls of
inlet manifold 98. The upper surface of the inlet manifold is defined by the lower surface of the web of the first component of the stacking element. In use air, preferably cold air, is free to flow inwardly of the stacking element via the region defined by plane 116 and ridges 112 and 114. Colder air, being denser, then flows downwardly and along channel 100 as depicted by flow line 115 until it reaches cold air deflector (not shown here) it is then diverted into other channels by baffles 104. As it does so it gains heat from the stacking element transmitted from contents of the package formed by the sleeves and the stacking element.

In Figure 16, 96, 114, 116, and 118 are as hereinbefore described. 89 denotes a hollowed extension of cold air inlet hole 88.

In Figure 17, 12, 86, 88 and 90 are as hereinbefore described.

In Figure 18, 12, 86, 88, 90, 96, 116 and 118 are as hereinbefore described. Cooled or cold air is free to flow in through cold air inlet hole 88, extension 89 and cold air inlet manifold through the region defined by plane 116 and extension 89. The air then flows down channel 100 under snap lock fitting 90 which also acts as a turbulence creator.

It is believed that the embodiment described in Figures 9 to 18 may be used, in conjunction with sleeves, advantageously to store materials such as cheese, preferably cheddar cheese. The said embodiment may be constructed from plastics material, optionally by injection moulding. The sleeves may be comprised of waxed corrugated paper board or of other suitable material. The two-part stacking element may serve as a base, a lid and as a cheese plug as well as providing a means for supporting and retaining the sleeves which form the side walls of the packages. It is anticipated
that such packages may be used to mould and store 20kg cheese blocks in vertical columns.

Perceived advantages of packing using the embodiment described in Figures 9 to 18 are believed to include ease of assembly, ease of dismantling for cleaning, capability for multiple use, rapid cooling of package contents, and structural stability.

Cheddar cheese blocks at the commencement of the curing or maturation phase may be at a temperature of 30°C or more. It is advantageous that the temperature of the block be relatively rapidly reduced so that curing can occur in the desired manner throughout the whole cheese block to minimise or substantially reduce wastage. It is also advantageous that the dimension of the cheese blocks be substantially maintained during maturation, so that wastage in cutting up the matured cheese can be reduced. The embodiment described above has been designed to assist in cooling of the cheese block by encouraging the flow of air through the stacking elements and sleeves via the described system of cold air inlets, channels, deflection means, baffles, ventilation means and flutes. The said embodiment has also been designed to maintain substantially the dimensions of cheese blocks during maturation or ripening.

In use column-stacked packages according to the said embodiment containing cheese blocks at a temperature of about 30° may be placed in cool rooms where the air temperature may be from 0° to 5°. The air inside the hollow stacking element and in the flutes of the corrugated sleeves takes up heat from the cheese blocks. As it does so it becomes less dense and a pressure differential is established with respect to the air in the cool room.

The heated air tends to flow upwards and the sleeve and stacking elements have been designed to
assist this through the formation of "chimneys" running the height of the column. Heated air may enter the "chimneys" via ventilation means provided in each stacking element and the flutes of the corrugated sleeves provide the vertical shafts of the "chimneys". As the heated air rises, cooler air tends to enter the stacking element via the cold air inlet holes and cold air inlet manifolds. This cooler air can then pass along cold air inlet channels until it has reached the central region of the stacking elements. Up to this point the cooler air has been kept substantially isolated from the warmer air. In the central region the cooler air flow is diverted by the cold air deflector into a number of segments of the interior of the stacking element, wherein it may flow through a labyrinth of channels formed by baffles. The flow is directed generally towards the ventilation means provided around the perimeter of the stacking element. As the air flows along the cold air inlet channels and through the labyrinth it tends to increase in temperature by absorbing heat from the stacking elements which in turn absorb heat from the cheese blocks. The net result is believed to be an air flow though the columns leading to an increase in the cooling rates of the cheese blocks. While the air-flow velocity is some sections of the above system might be expected to be low and therefore predominantly laminar, the provision of flow-disturbing devices within stacking elements may be expected to promote turbulence and hence improved heat removal from the system.

With suitable modifications, optionally including the providing of means for applying a pressure differential or introducing fluid, the cooling process may be reversed to provide a method of heating the contents of the packages. As temperature control is an important aspect of cheese manufacture, the
advantages that may be gained by use of this invention are readily perceived.

The embodiment described in Figures 9 to 18 may also be capable of use in an automated or semi-automated packaging process, including a down-stacking process, wherein a sleeve, optionally in the form of a five-walled sleeve, is inserted substantially laterally into the stacking element, via the entry port, so that the central, or third wall, of the sleeve fits snugly against the opposing shorter flange extending upwardly of the web of the stacking element and the walls of the sleeve either side of the said central wall are sized to fit snugly against the longer flanges of the stacking element. The material to be contained in the package is then inserted into the open package via the entry port and the two outer walls of the sleeve are folded inwardly to form the last side wall of the package, optionally by overlapping of those walls. The top of the package is then formed by the positioning of another stacking element over the upper edges of the sleeve. The sleeve is held in place in part by the contents of the packages. The process may then be repeated with the last mentioned stacking element acting as the base of the next package.

Alternatively, the sleeve may be wrapped around the material to be packaged and the combined sleeve and material maybe deposited onto the stacking element, the sleeve being co-operatively engaged by the flanges of the stacking elements.

In Figure 19, 12e denotes the upper surface of a web of a stacking element according to the invention, 122 denotes venting holes in the web of the stacking element, 124 denotes a beveled or chamfered side wall surrounding the perimeter of upper surface 12e, 126 denotes inner flanges of pre-selected height disposed around the outer perimeter of chamfered wall
124, 128 denotes gripping ridges provided on the outer side of inner flanges 126. 130 denotes an outer flange of pre-selected heights including stacking lugs 134 and cut-outs 136. The inner surface of outer flange 130 is provided with gripping ridges 132 in a staggered relationship to gripping ridges 128. The purpose of such gripping ridges is more firmly grip sleeve(s) inserted between flanges 126 and 130 and to lessen the chance of accidental removal of said sleeve(s). The bottom of the recess between the flanges may be provided with channels to aid drainage of sleeves, especially corrugated sleeves, and to alleviate problems of moisture build up. 138 denotes lugs extending laterally of the shorter sides of flange 130, said lugs being provided with holes 140 for the engagement of locking clips when not in use (not shown here), holes 142 for pivoting of locking clips, and guiding projections 144 and 146. Lugs 138 in conjunction with cut-outs 136 may also provide means for handling of stacking elements by providing means for insertion of fingers. Cut out 148 and laterally projecting lug 150 also provide capability for lifting and separating stacking elements or stacked packages.

In Figure 20, 12e, 122, 124, 126, 128, 130, 132, 138, 140, 142, 144, 146, and 150 are as aforesaid. This Figure illustrates the arrangement of venting holes 122 in the web. It also depicts the staggered relationship between gripping ridges 128 and 132.

In Figure 21, 130, 134, 136, 140, 142 and 146 are as hereinbefore described. 152 denotes a downwardly extending inner flange depending from the lower surface of the web. 154 denotes ridging within that inner flange also depending downwardly from the lower surface of the web. 156 denotes fins extending laterally outwardly from the outer surface of inner flange 152.
In Figure 22, 122, 130, 138, 140, 142, 152, 154 and 156 are aforesaid. This figure illustrates the relationship between the inner flange 152 and the ridging 154 and the venting holes 122. The ridging is sited beneath the venting holes but no so as to totally obscure those venting holes. This permits of ventilation of the contents of packages formed by this embodiment and sleeves.

In Figure 23, 12e, 126, 128, 130, 132, 152 and 156 are as hereinbefore described. As previously mentioned gripping ridges 128 and 132 are intended to increase the gripping of the sleeves inserted into the upper part of the stacking element. Fins 156 are intended to provide guidance or alignment means for the insertion of sleeves when the stacking element is acting as a lid. They also provides a strengthening feature for inner flange 152.

In Figure 24, the insert 158, which may be inserted into the spaces between the ridging 154 to provide further strengthening and to still permit ventilation, comprises ribs 160 and 162, clipping means 164 and cut-outs 166.

In Figure 25, 130,134,136, 140, 142, 146, 148, 150, 152, 154 and 156 are as hereinbefore described. 158 denotes inserts positioned in spaces between ridging 154. Sleeves used in conjunction with this embodiment may be provided with complementary cut-outs to facilitate disengagement of packages from stacks of packages.

In Figure 26, 160 denotes a locking clip comprising a bar 162, grip facilitating means 164, pivoting pin 166, engaging pin 168, and retaining lug 170. Pivoting pin 166 is longer than engaging pin 168 to enable the clip to be raised from an engaged position and pivoted to swing into another position.

In Figure 27, 130, 138, 140, 142, 144, 146,
160, 162, 164, 166, 168 and 170 are as aforesaid. When
not in use the engaging pin 168 is located in hole 140
and pivoting pin 166 is located in hole 142. The
locking clip may be raised and pivoted through angles
of up to 180 degrees. Guiding projections 144 and 146
provide location means for two preferred engagement
positions.

In Figure 28, 130, 134, 138, 152, 164, 166,
168 and 170 are as aforesaid. This drawing depicts
linking of two stacking elements at their shorted ends.
The bar of the locking clip is aligned substantially at
right angles to the adjacent flanges 130.

In Figure 29, 130, 134, 138, 148, 152, 166,
168 and 170 are as aforesaid. In this linking, the
longer sides of the stacking elements are side-by-side.
Both forms of linking described above include provision
for some misalignment of the stacking elements.

The embodiments depicted in Figures 19 to 23
and Figure 25 may be used for storage and transporta-
tion of produce, including agricultural produce. It is
anticipated that the stacking element may be con-
structed of plastics material or other durable material
and would be of such durability as to permit multiple
or repeated uses. Generally, it is anticipated that
the sleeve would be a five-sided corrugated board
sleeve which would be a non-returnable item. Preferab-
ly, the stacking element would be constructed of a
material such as injection moulded propylene co-polymer
or high density polyethylene.

An important factor in the packaging and
handling of fresh fruit and vegetables is that the
harvest produce is living. It continues to perform the
same chemical functions to maintain the same physiological systems which were present when it was attached to the plant. Respiration and transpiration continue
after harvest. This can lead to the loss of respira-
tion and transpiration products and the generation of heat. The above can lead to degradation of the produce. Ventilation of produce after harvest is advantageous in removing undesired transpiration and respiration products and heat. The stacking element described above provides for 5% or more venting which it is believed will enable relatively satisfactory through-stack ventilation without significant loss of structural strength and load carrying capability when packages according to the invention are assembled into stacks. It is also possible to provide ventilation holes in the sleeves to allow for cross flow ventilation. However, the ventilation holes in sleeves may be accompanied by a loss in structural strength of the sleeves. Another advantage of the provision of ventilation means is that with suitable modifications it permits of the change of the composition of the atmosphere around the produce including the introduction of atmospheres, either to prevent decay or ripening or to encourage ripening or to encourage cooling.

In use it is anticipated that the ridging on the under side of the stacking element will provide for vertical, horizontal and torsional strength in use and will lead to a minimising of the potential for distortion after moulding. It is advantageous in use that the sleeves, especially corrugated board sleeves, be relatively securely anchored within the recesses formed by the inner and outer flanges of the upper part of the stacking element so that they do not accidentally slip out. The bevelled or chamfered side wall around the upper part of the stacking element should permit relatively easy cleaning of the upper part of the stacking element where produce most often comes in contact with the stacking element. The provision of drainage channels in the recesses in the upper part of
the stacking element may permit drainage of the corrugated board walls and alleviate moisture build up thereby maintaining relatively full corrugated board strength. The outwardly projecting lugs at the corners of the stacking element are located such that a package formed by the stacking element and sleeves can be separated and/or lifted directly from a column of such packages.

A light weight clip, preferably of plastics, may be used to join columns of filled produce boxes at their corners so that stability of vertical columns is improved, whilst allowing for a limited of box alignment and an element of articulation due to normal pallet irregularities in both vertical and horizontal senses.

As it is anticipated that packages constructed according to the invention may be conveyed down such means as gravity skate-wheeled conveyors, the ridged base described above may not travel smoothly down the incline. This is because there are a number of different designs of skate-wheeled conveyors which present to the underside of a package a number of different wheel configurations. Provision of inserts which may be clipped into the compartments formed by the ribbing may alleviate this problem and may increase the strength of the stacking element. The insert is a simple light weight moulding, optionally of plastics material, with prongs extending and clipping through holes in the base of the web of the stacking element, the holes being offset in such a way that the inserts do not seriously interfere with ventilation of assembled packages. It is advantageous that the insert be removable for ease of cleaning and replacement. Another effect of the provision of such inserts is expected to be that the strength of the package would be thereby increased at points where the effects of
stress could be expected to be more readily experienced.

It is believed that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the stacking elements and sleeves and that changes may be made in the form, construction and arrangement of the stacking elements described without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the stacking elements hereinbefore described being nearly preferred embodiments thereof.
Claims:

1. A stacking element in the form of tray, said stacking element including a main portion in the form of a web having opposed substantially parallel planer faces of pre-selected width(s) and length(s), said web being provided around part or all of its perimeter with means co-operatively engageable with one or more sleeves of pre-selected height(s) capable of forming walls of packages of which said stacking elements form lids and/or bases.

2. The stacking element as claimed in claim 1 wherein said means co-operatively engageable with one or more sleeves includes one or more flanges of pre-selected height(s) extending upwardly of the plane of the upper face of said web around all or part of the perimeter of said web.

3. A stacking element as claimed in either of claim 1 or claim 2 wherein said means co-operatively engageable with one or more sleeves below the plane of the web may take the form of one or more flanges of pre-selected height(s) depending downwardly from the lower face of said web and extending around all or part of the perimeter of said lower face.

4. The stacking element as claimed in claim 1 wherein said means co-operatively engageable with one or more sleeves includes one or more recesses of pre-selected width(s) and depth(s) depending downwardly from the plane of the upper face of said web and one or more flanges of pre-selected height(s) on the outer side of said recess(es) extending upwardly of the bottom of the said recess(es), said recess(es) and/or flange(s) extending around all or part of the perimeter of said upper face of said web.

5. A stacking element as claimed in claim 4
wherein said means co-operatively engageable with one or more sleeves further includes one or more upwardly extending inner flanges of pre-selected height(s) extending around all or part of the perimeter of said upper face, the outer face(s) of said inner flange(s) optionally being in the same plane as the inner-wall(s) of said recess(es).

6. A stacking element as claimed in claim 1 wherein said means co-operatively engageable with one or more sleeves further includes one or more recesses of pre-selected width(s) and depth(s) extending upwardly of the plane of the lower face of said web and one or more flanges of pre-selected height(s) on the outer side of said recess(es), said recess(es) and flange(s) extending around all or part of the perimeter of said lower face.

7. A stacking element as claimed in claim 6 wherein said means co-operatively engageable with one or more sleeves further includes one or more inner flanges of pre-selected height(s) depending downwardly from the plane of the lower face of said web and extending around all or part of the perimeter of said lower face, the outer face(s) of said inner flange(s) optionally being in the same plane as the inner wall(s) of said recess(es).

8. A stacking element as claimed in any one of claims 1 to 7 wherein said flange(s) and/or recess(es) may be provided with further means to assist in co-operative engagement of sleeves.

9. A stacking element according to any one of claim 1 to 8 wherein said stacking element, including said web, is provided with means for ventilation.

10. A package comprising a stacking element as claimed in any one of claims 1 to 9 and one or more sleeves.

11. A package as claimed in claim 10 wherein said
sleeves are constructed from any one or more of solid fibre, plastics, metal(s), wood, wax-coated, wax-impregnated or plastics-coated cardboard, wax-coated, wax-impregnated or plastics coated corrugated cardboard and wherein said sleeve(s) may be single piece or multi-piece.

12. A package as claimed in either claim 10 or 11 wherein said sleeve(s) are provided with fluting to act as "chimneys" for the venting of fluids in co-operation with venting means provided in said stacking elements.

13. A package as claimed in any one of claims 10 to 12 wherein said sleeve(s) are provided with venting means to permit package of fluids through assembled packages.

14. Means for forming column-stacked packaging comprising stacking elements as claimed in any one of claims 1 to 9 and sleeves as claimed in any one of claims 10 to 13.

15. Packages as claimed in any one of claims 10 to 13 wherein cushioning means selected from rubber pillars, rubber pillows and air cushions are inserted in regions between sleeves and stacking elements.

16. A stacking element as claimed in any one of claims 1 to 9 wherein said stacking element is further provided with means for receiving and holding either fixedly or releasably linking means adapted to link adjacent columns of column-stacked packages.

17. A stacking element as claimed in claim 16 wherein said linking means comprise locking clips.

18. A stacking element as claimed in claim 16, wherein said stacking element is adapted to co-operatively engage other stacking elements substantially in the same horizontal plane.

19. A stacking element as claimed in any one of claims 1 to 9 wherein said stacking element is provided with means to enable cross-stacking of packages.
20. A method for environment or atmosphere control wherein assemblies of column-stacked or cross-stacked packages formed by stacking elements as claimed in any one of claims 1 to 9 or 16 to 19 and sleeves as claimed in any one of claims 10 to 13 are provided with ventilation means and are subjected to changes in environment or atmosphere by placing an atmosphere containment means over the assembly and introducing a pre-selected environment or atmosphere at a potential sufficiently high enough to displace the ambient environment or atmosphere.

21. A method for cooling the contents of packages as claimed in claim 20 wherein said method is selected from forced-air cooling, hydro-cooling, vacuum cooling, cold-air cooling.

22. A two-part stacking element in the form of a tray, the first component of said stacking element including a web bounded by a plurality of flanges of pre-selected height(s) said flanges being provided with ventilation means and said web being provided with ventilation means, the second component of said stacking element including a web provided with ventilation means and fluid flow deflection means.

23. A two-part stacking element as claimed in claim 22 wherein ventilation means of second component are load supportive.

24. A stacking element as claimed in any one of claims 1 to 9 or claims 16 to 19 or claims 22 or 23 substantially as hereinbefore described with reference to any one or more of the Figures.
1. A stacking element in the form of tray, said stacking element including a main portion in the form of a web having opposed substantially parallel planer faces of pre-selected width(s) and length(s), said web being provided around part or all of its perimeter with means co-operatively engageable with one or more sleeves of pre-selected height(s) capable of forming walls of packages of which said stacking elements form lids and/or bases.

2. The stacking element as claimed in claim 1 wherein said means co-operatively engageable with one or more sleeves includes one or more flanges of pre-selected height(s) extending upwardly of the plane of the upper face of said web around all or part of the perimeter of said web.

3. A stacking element as claimed in either of claim 1 or claim 2 wherein said means co-operatively engageable with one or more sleeves below the plane of the web may take the form of one or more flanges of pre-selected height(s) depending downwardly from the lower face of said web and extending around all or part of the perimeter of said lower face.

4. The stacking element as claimed in claim 1 wherein said means co-operatively engageable with one or more sleeves includes one or more recesses of pre-selected width(s) and depth(s) depending downwardly from the plane of the upper face of said web and one or more flanges of pre-selected height(s) on the outer side of said recess(es) extending upwardly of the bottom of the said recess(es), said recess(es) and/or flange(s) extending around all or part of the perimeter of said upper face of said web.

5. A stacking element as claimed in claim 4
wherein said means co-operatively engageable with one or more sleeves further includes one or more upwardly extending inner flanges of pre-selected height(s) extending around all or part of the perimeter of said upper face, the outer face(s) of said inner flange(s) optionally being in the same plane as the inner-wall(s) of said recess(es).

6. A stacking element as claimed in claim 1 wherein said means co-operatively engageable with one or more sleeves further includes one or more recesses of pre-selected width(s) and depth(s) extending upwardly of the plane of the lower face of said web and one or more flanges of pre-selected height(s) on the outer side of said recess(es), said recess(es) and flange(s) extending around all or part of the perimeter of said lower face.

7. A stacking element as claimed in claim 6 wherein said means co-operatively engageable with one or more sleeves further includes one or more inner flanges of pre-selected height(s) depending downwardly from the plane of the lower face of said web and extending around all or part of the perimeter of said lower face, the outer face(s) of said inner flange(s) optionally being in the same plane as the inner wall(s) of said recess(es).

8. A stacking element as claimed in any one of claims 1 to 7 wherein said flange(s) and/or recess(es) may be provided with further means to assist in co-operative engagement of sleeves.

9. A stacking element according to any one of claim 1 to 8 wherein said stacking element, including said web, is provided with means for ventilation.

10. A package comprising a stacking element as claimed in any one of claims 1 to 9 and one or more sleeves.

11. A package as claimed in claim 10 wherein said
sleeves are constructed from any one or more of solid fibre, plastics, metal(s), wood, wax-coated, wax-impregnated or plastics-coated cardboard, wax-coated, wax-impregnated or plastics coated corrugated cardboard and wherein said sleeve(s) may be single piece or multi-piece.

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13. A package as claimed in any one of claims 10 to 12 wherein said sleeve(s) are provided with venting means to permit package of fluids through assembled packages.

14. Means for forming column-stacked packaging comprising stacking elements as claimed in any one of claims 1 to 9 and sleeves as claimed in any one of claims 10 to 13.

15. Packages as claimed in any one of claims 10 to 13 wherein cushioning means selected from rubber pillars, rubber pillows and air cushions are inserted in regions between sleeves and stacking elements.

16. A stacking element as claimed in any one of claims 1 to 9 wherein said stacking element is further provided with means for receiving and holding either fixedly or releasably linking means adapted to link adjacent columns of column-stacked packages.

17. A stacking element as claimed in claim 16 wherein said linking means comprise locking clips.

18. A stacking element as claimed in claim 16, wherein said stacking element is adapted to co-operatively engage other stacking elements substantially in the same horizontal plane.

19. A stacking element as claimed in any one of claims 1 to 9 wherein said stacking element is provided with means to enable cross-stacking of packages.
20. A method for environment or atmosphere control wherein assemblies of column-stacked or cross-stacked packages formed by stacking elements as claimed in any one of claims 1 to 9 or 16 to 19 and sleeves as claimed in any one of claims 10 to 13 are provided with ventilation means and are subjected to changes in environment or atmosphere by placing an atmosphere containment means over the assembly and introducing a pre-selected environment or atmosphere at a potential sufficiently high enough to displace the ambient environment or atmosphere.

21. A method for cooling the contents of packages as claimed in claim 20 wherein said method is selected from forced-air cooling, hydro-cooling, vacuum cooling, cold-air cooling.

22. A two-part stacking element in the form of a tray, the first component of said stacking element including a web bounded by a plurality of flanges of pre-selected height(s) said flanges being provided with ventilation means and said web being provided with ventilation means, the second component of said stacking element including a web provided with ventilation means and fluid flow deflection means.

23. A two-part stacking element as claimed in claim 22 wherein ventilation means of second component are load supportive.

24. A stacking element as claimed in any one of claims 1 to 9 or claims 16 to 19 or claims 22 or 23 substantially as hereinbefore described with reference to any one or more of the Figures.
**INTERNATIONAL SEARCH REPORT**

International Application No: PCT/AU 88/00252

I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl. 4 B65D 6/24

II. FIELDS SEARCHED

Classification System Classification Symbol

IPC B65D 6/24

AÜ: IPC as above, and B65D 19/-, 21/-

IPC: B65D 21/02 (73-88)

III. DOCUMENTS CONSIDERED TO BE RELEVANT

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IV. CERTIFICATION

Date of the Actual Completion of the International Search: 15 September 1988 (15.09.88)

Date of Making of this International Search Report: 23 September 1988 (23.09.88)

International Searching Authority: Australian Patent Office

Signature of Authorized Officer: R. KIRBY

Form PCT/ISA/210 (second sheet) January 1985

See notes on accompanying sheet
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.

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