

**APPARATUS AND METHOD FOR
STERILIZATION AND SECONDARY PACKAGING**

CROSS-REFERENCE TO THE RELATED PATENT APPLICATION

This application is a continuation-in-part application of Serial No. 08/257,788; filed on June 10, 1994.

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for the sterilization and secondary packaging into cartons of arrays of blister packages, each of which package contains at least one hydrophilic contact lens immersed in a sterile aqueous solution. More specifically, the invention is directed to an apparatus adapted to provide for the assembly of arrays of blister packages which are suitably transported in batches of predetermined quantities within one or more trays while positioned on suitable transport racks. These trays are transported on the racks to a sterilization chamber for sterilizing the arrays of blister packages, particularly the lens-containing interiors thereof, and from which the sterilized arrays of blister packages are then transported to a locale for implementing the secondary packaging thereof into sealable cartons. In addition to the foregoing, the invention is also directed to a method of sterilizing and implementing the secondary packaging into cartons of predetermined quantities of arrays of blister packages, each of which blister package contains a hydrophilic contact lens immersed in a sterile aqueous solution, so as to provide a sterile environment for the arrays of blister packages.

1 The packaging of hydrophilic contact lenses in
a sterile aqueous solution is well known in the contact
lens manufacturing technology. Particularly, packaging
5 arrangements of that type generally consist of so-called
blister packages adapted to be employed for the storage
and dispensing of the hydrophilic contact lenses for use
by a medical practitioner or a consumer who intends to
wear the contact lenses. Such hydrophilic contact
10 lenses, which may be disposable after a single period of
wear or short-term use, are inexpensively manufactured
from suitable hydrophilic polymeric materials; for
example, copolymers of hydroxyethylene methacrylate
(HEMA) containing from about 20% to 90% or more of
15 water, depending upon the polymer composition. These
contact lenses are generally stored immersed in a
sterile aqueous solution, ordinarily consisting of an
isotonic saline solution, in order to prevent
dehydration and to maintain the lenses in a ready-to-
wear condition.

20 A blister package of the foregoing type
normally comprises a base member which is molded from a
suitable injection-molded or thermoformed plastic
material; for instance a polyolefin, such as
polypropylene, and incorporates a cavity adapted to
25 house the contact lens in the aqueous solution. The
cavity is sealingly closed by a label-forming cover,
preferably in the form of a flexible multi-layered
laminated foil or suitable plastic film structure which
may incorporate a silicon oxide barrier material in
30 order to provide the so-called blister package. This
type of packaging arrangement has found widespread use
in view of the inherently advantageous storing

1 properties thereof and easy-to-dispense nature of the
package by simply peeling the foil from the base member
enabling a user to gain ready access to the contact lens
which is contained in the cavity of the base member.

5 For example, a blister package which is adapted to
provide a sterile sealed storage environment for a
disposable, essentially single-use hydrophilic contact
lens, which is normally worn for about 8-18 hours within
10 any 24-hour period, wherein the lens is immersed in a
sterile aqueous solution within the package is described
in U.S. Patent No. 4,691,820 to Martinez; which is
assigned to the common assignee of the present
application, and the disclosure of which is incorporated
herein by reference.

15 In the above-mentioned U.S. patent, the
blister package for storing and dispensing a hydrophilic
contact lens includes an injection-molded or
thermoformed plastic base portion or member
incorporating a molded cavity which is surrounded by an
20 outstanding planar flange extending about the rim of the
cavity. A flexible cover sheet, such as a laminated
foil is adhered to the surface of the flange so as to
sealingly enclose the cavity in a generally liquid-tight
manner. The surface of the covering foil may constitute
25 a label and be imparted suitable printing indicia
informative of the product stored in the blister
package, the name and address of the manufacturer, and
also incorporate various decorative designs and logos as
desired; and also provide for changeable information,
30 such as lot numbers, fitting parameters, expiration
dates and the like in addition to the foregoing, such as
may be required by FDA regulations.

1 At this time, a novel and unique concept has
been developed through a design for packaging
arrangements of the blister package type, particularly
for the containment of hydrophilic contact lenses in a
5 sterile aqueous solution, wherein a plurality of base
members for such blister packages, each having a cavity
for containing a hydrophilic contact lens in the sterile
aqueous solution, are adapted to be positioned in a
contiguous array and sealingly covered by a single or
10 unitary flexible cover sheet, the latter of which is
preferably in the form of a multi-layered flexible
laminate web having a foil or a plastic film
incorporating a silicon oxide barrier material. In this
instance, the laminated or plastic material cover sheet
15 is provided with weakening lines, preferably in the form
of perforations, extending intermediate each of the
respective base members so as to enable individual
segments of the foil-member to be detached along the
weakening lines and in conjunction with the therewith
20 associated base member separated from the remaining
array when it is desired to gain access to the contact
lens contained in the separated blister package without
adversely affecting the integrity of the packaging.
This type of arrayed multiple interconnected blister
25 package structure enables the compact packaging of a
plurality of such arrays, each possessing a specified
number of contact lens-containing base members
interconnected by a single flexible cover sheet, within
the confines of a suitable sealed container, such as a
30 rigid paperboard carton. In the carton there may be
compactly stored a plurality of arrays of blister
packages which, under circumstances, may comprise

1 interleaved pairs of and superimposed arrays of blister
packages and wherein; for example, each array consists
of five or even larger quantities of interconnected
5 blister packages with each of the latter having a single
disposable contact lens housed therein. The carton may
store six superimposed arrays of blister packages, for a
total of thirty contact lenses; or in effect, a 30-day
supply of contact lenses for respectively one eye of a
10 user, although it is possible to contemplate to provide
for cartons storing a 5-, 10-, 15-, 20-, or 25-day
supply of contact lenses, or even other quantities. A
packaging arrangement for contact lenses of that type
which is in the form of arrays of interconnected blister
packages is disclosed in applicant's copending U.S.
15 Patent Application No. 08/257,796; filed June 10, 1994;
entitled "Packaging Arrangement for Contact Lenses"
(Attorney Docket No. 9014, VTN-0090), which is commonly
assigned to the assignee of the present application and
the disclosure of which is incorporated herein by ---
20 reference.

The blister packages which are formed through
the intermediary of this structure comprise a plurality
of contiguously arranged injection-molded base members
each containing a cavity for housing a hydrophilic
25 contact lens in a sterile aqueous solution, and wherein
the resultant array of such base members; for example,
five (5) base members, is adapted to be sealingly
covered and interconnected by a single multi-layered
flexible laminated foil or web which also forms a common
30 label, preferably of the type disclosed in applicant's
copending U.S. Patent Application No. 08/106,386, filed
August 13, 1993, entitled "Method of Double-Sided

1 Printing of a Laminate and Product Obtained Thereby"
(Attorney Docket No. 9013; VTN-0098) assigned to the
common assignee of the present application, and the
disclosure of which is incorporated herein by reference.

5 In the foregoing disclosure, the multi-layered
laminated foil includes an outer layer of a plastic film
material, such as a polyolefin and preferably polyester,
which is adhesively bonded to the surface of a
supporting metallic foil, such as aluminum, although a
10 layer of silicon oxide could be utilized instead of the
metallic foil, and in which the outer layer is double-
sided printed; in effect, on both opposite surfaces.
The surface of the outer plastic film layer which faces
towards and is adhered to the metallic foil is imprinted
15 with suitable indicia and legends which may consist of
permanent information regarding the manufacturer and the
product, logos, instructive material, and decorative and
advertising indicia relative the product in the blister
package; whereas the opposite or exterior surface of the
20 outer plastic film material layer may include suitable
changeable information, such as expiration dates, lot
numbers, fitting parameters, lens power, and other data
specific to the packaged product. The interior surface
of the outer plastic film material layer, when desired,
25 may be imprinted through the intermediary of suitable
lithographic printing, either in single color or multi-
colors and also provided with an appropriate printed
background; whereas the changeable information specific
to the product which is imprinted on specific areas of
30 the outwardly facing surface of the outer film layer,
may be printed thereon through thermal transfer

1 printing, as described in detail in the above-referenced
copending U.S. Patent Application No. 08/106,386.

SUMMARY OF THE INVENTION

5 In order to accomplish the foregoing
sterilization of the arrays of blister packages,
particularly of the product or contact lens-containing
interiors thereof, and to thereafter implement their
secondary packaging into sealable cartons, the inventive
10 apparatus contemplates the utilization of a novel
conveyor system in which the foregoing is achieved in an
essentially automated mode of operation. Specifically,
the apparatus provides for the conveyance of a system of
racks each supporting a plurality of trays, each of
15 which tray is adapted to house therein a specific
quantity of arrays of blister packages, such as are
disclosed in the copending U.S. Patent Application No.
08/257,796 (Attorney Docket No. 9014; VTN-0090), wherein
the arrays of blister packages are conveyed through the
20 intermediary of a transfer mechanism into a respective
tray so as to fill spaces in the latter arranged in
specified rows and columns. A plurality of such array-
filled trays may be loaded into a rack by being axially
shifted and vertically layered in the rack, and with the
25 rack then conveyed along a predetermined path. A
further conveyor is adapted to convey the rack
containing the trays with the arrays of blister packages
therein into a sterilization chamber, such as an
autoclave, in which the arrays of blister packages are
30 collectively sterilized. Subsequent to the
sterilization procedure having been completed, the rack
containing the trays with the sterilized arrays of

1 blister packages is transported by a further conveyor
from the sterilization chamber towards a tray unloading
arrangement in which the trays are sequentially unloaded
5 arrays of blister packages to be removed therefrom in
pairs. These pairs of arrays are inverted relative to
each other and interleaved so as to be sequentially
transported to a secondary packaging machine for packing
and sealing specified quantities of the sterilized
10 paired arrays of blister packages into cartons. The
secondary packaging machine causes the specified
quantities of interleaved arrays of blister packages to
be advanced in succession into a cartoner having open-
ended cartons therein adapted to receive the arrays of
15 blister packages. Thereupon, each of the filled cartons
is closed and sealed in the cartoner in sequential steps
and transported to further stations for suitable
additional handling, such as labeling, bar coding,
weighing and possible accumulation for boxing and
20 warehousing, as may be required. The emptied trays are
then reinverted and repositioned on an indexing
conveyor, reloaded into an empty rack and transported
therein to a return conveyor so as to be in conditions
of readiness for unloading the trays, refilling the
25 latter at the tray filling location with arrays of
blister packages which are to be sterilized, and loaded
into an empty rack for transport to the sterilization
chamber.

30 Accordingly, it is an object of the present
invention to provide an apparatus for the sterilizing
and secondary packaging of specified quantities of
arrays of blister packages, with each blister package

1 containing a contact lens immersed in a sterile aqueous solution.

5 A more specific object of the present invention is to provide an apparatus of the type described in which a procedure for filling trays with specified quantities of the arrays of blister packages is implemented in an automated manner, pluralities of the filled trays transported on a rack to a sterilizing chamber, and thereafter transported to an unloading
10 arrangement for discharging the arrays of blister packages with their sterilized contents from the racks, emptying the trays and effectuating an orientation of the arrays of blister packages and thereafter packaging specified quantities thereof into sealable cartons.

15 Still another object of the present invention is to provide an apparatus of the type described in which there are carried out the functions of unloading empty trays from a rack, wherein the trays are adapted to be filled with arrays of blister packages,
20 positioning the arrays for filling into the trays, loading the filled trays into a further previously empty rack, transporting the rack with the array-filled trays into a sterilizing chamber, thereafter transporting the rack containing the trays with the sterilized arrays of
25 blister packages to an arrangement in which individual of the trays are successively inverted to facilitate orientation and discharge of paired arrays at a rack unloading station, with the arrays of sterilized blister packages then being conveyed to a cartoner for filling
30 cartons with the packages; while the emptied trays are rotated into their original positions, loaded into an

1 empty rack and conveyed there towards the initial rack
unloading and tray filling workstation.

Yet another object of the present invention is
to provide a method of sterilizing and secondary
5 packaging into cartons of arrays of blister packages,
each containing a contact lens immersed in a sterile
aqueous solution through utilizing of the apparatus as
described herein.

A more specific object of the invention is to
10 provide a method for the sterilization and secondary
packaging into cartons of a plurality of arrays of
blister packages in which the method is implemented
through the utilization of automated conveyor and
sterilization apparatus in a highly efficient and
15 precise mode of operation.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference may now be had to a preferred
embodiment of the apparatus for sterilization and
20 secondary packaging constructed pursuant to the
invention, particularly as directed to the packaging of
contact lenses in a sterile environment, taken in
conjunction with the accompanying drawings; in which:

Figure 1 is a generally diagrammatic plan view
25 of the sterilization and packaging apparatus pursuant to
the invention;

Figure 2 is a perspective view of a typical
array of interconnected blister packages;

Figure 3 is a side elevational view, in
30 section, of a plurality of interleaved paired and
superimposed arrays of blister packages, as intended to
be arranged in a carton;

1 Figure 4 is a perspective view of the carton,
with the end flaps in an opened condition;

5 Figure 5 is a perspective view of the carton
in use, shown with the cover having been opened to
enable access to the contents of the carton;

Figure 6 is a view taken along line 6-6 in
Fig. 1;

Figure 7 is a top plan view of a rack
unloader;

10 Figure 8 is a top plan view of a tray loading
workstation;

Figure 9 is a side elevational sectional view,
taken along line 9-9 in Fig. 8;

15 Figure 10 is a perspective view of a typical
tray for the receipt of arrays of blister packages;

Figure 11 is a top plan view of a conveyor
segment for transporting racks carrying array-filled
trays towards a sterilization chamber;

20 Figures 12 and 13 are, respectively, side and
end elevational views of an arrangement for drawing
racks into and out from the sterilization chamber;

Figure 14 is a side view of a rack unloader
utilized at a tray unloading workstation;

Figure 15 is a top plan view of Fig. 14;

25 Figure 16 is a schematic top plan view of a
cartoning machine for the sterilized arrays of blister
packages;

30 Figure 17 and 18 are, respectively, side and
end views of the tray unloading and orienting
arrangement for the cartoning machine; and

Figure 19 illustrates, in elevation, a
schematic detail of the cartoning machine of Fig. 16.

1 DETAILED DESCRIPTION

Referring now in more specific particularity to the drawings, as shown in the overall view of Figure 1, there is disclosed a generally schematic plan view of the overall operating structure of an apparatus 10 for implementing the sterilization and secondary packaging into cartons of pluralities of superimposed paired and interleaved arrays of blister packages employed for the containment of contact lenses in a sterile environment.

10 As illustrated in Figure 1, there is disclosed a conveyor system including a plurality of roller conveyors for the conveyance of racks each adapted to receive a plurality of trays containing arrays of blister packages in order to enable conveyance thereof into a sterilization unit comprising a sterilization chamber. Thereafter conveyance thereof is implemented towards a secondary packaging machine for receiving the sterilized arrays of blister packages from the trays, with the latter being unloaded from the transport racks, and for packaging predetermined quantities of arrays of blister packages into cartons in a rapid and sequential and fully automated mode of operation, as detailed hereinbelow.

25 As shown in Figure 2 of the drawings, each array of blister packages 12 consists of five adjacently located base members 14 each possessing a cavity 16 for the containment of a contact lens immersed in a sterile aqueous solution, and with the array 12 being sealingly covered by a single printed label-forming flexible laminated cover sheet 18, so as to be separable along perforation lines into individual blister packages, each respectively containing a single contact lens.

1 The base members 14, each of which possesses a
flange 20 at one end thereof, are constructed as
disclosed in copending U.S. Patent Application No.
08/257,796 (Attorney Docket No. 9014, VTN-0090) when
5 positioned in a carton 22 as illustrated in Figure 3
arranged in inverted interleaved pairs of arrays 12,
shown in the drawing as consisting essentially of six
arrays in this particular instance, filling a carton 22
as shown in Figure 4 in the direction of the arrow H,
10 whereby the end flaps of the carton are adapted to be
closed in sequence to form the carton of Figure 5. The
latter is illustrated with the opening of the reclosable
top flap having been effected thereof at some subsequent
time so as to enable access to the individual blister
15 packages 12 therein by a medical practitioner or user of
the contact lenses.

 Reverting specifically to Figures 1, 6 and 14
of the drawings, a sterilization conveyor arrangement 30
of the apparatus 10 includes a first horizontal conveyor
20 unit 32 along which racks 34, 42 each having a plurality
of levels adapted to respectively receive and support in
rows a number of upwardly-opening compartmented trays 50
adapted for the transport of arrays of blister packages
12.

25 As illustrated in Figure 14, each of the racks
34 is basically a rectangular open-ended frame structure
having horizontal supports 36 and 38 and uprights 40,
and are adapted to be conveyed along the conveyor 32 to
a first workstation A, with a first rack 34 having been
30 previously filled with empty trays 50 each intended to
respectively receive a quantity of arrays of blister
packages 12. Located in front of the rack 34 at the

1 workstation A is a further initially empty rack 42 which
is adapted to receive trays 50 which have been filled
with blister packages 12 at the workstation A, the
latter of which is adapted to receive arrays from a
5 blister package manufacturing and sealing facility.

The rack 34 at workstation A, and the rack 42
which is located ahead thereof are both positioned on
respective lifting devices 52, 54, each having foldable
scissors-type legs 56, 58, and which may be
10 pneumatically operated and which are designed to index
each of the racks 34, 42 vertically upwardly and
downwardly by one tray level as required during the tray
unloading, tray filling, and tray loading procedure at
workstation A of the apparatus 10.

15 For that purpose, the apparatus 10 is provided
with a first rack unloader 60 at workstation A including
a horizontal pusher 62, as shown in Figs. 6 and 7, which
is adapted to apply a pushing action against one of the
adjacently located trays 50 in an aligned level of rack
20 34 so as to cause a tray 50 at the opposite end of that
particular row of trays in the rack 30 to be slid of the
rack 34 onto a tray loading arrangement 70, as
illustrated in Figs. 8 and 9 of the drawings, for
sequentially filling each respective unloaded tray 50
25 with arrays of blister packages 12.

The tray loading arrangement 70 at workstation
A includes a vacuum-actuated array-gripping device 72
for placing successive arrays of blister packages 12 on
a conveyor surface 74 for transporting the arrays 12
30 towards a vertical chute 76. This enables each array 12
to slide downwardly with the chute under the effect of

1 gravity or its own weight to be able to drop into a tray
50 located below the lower discharge end 78 of chute 76.

5 The arrays of blister packages 12 are filled
into the tray 50 located at tray loading arrangement 70,
whereby the tray 50, as shown in Figure 10, consists of
a rectangular upwardly-opening box-like structure having
a plurality of vertical partitions 80 forming parallel
compartments 82 therebetween, into each of which one of
the arrays of blister packages 12 is fed from the chute
10 76. The arrays 12 are filled into each successive
compartment 82 between adjacent partitions so as the
tray 50 is indexed forwardly by a suitable pusher device
84 towards the forwardly located rack 42 so as to be
ultimately in alignment with one level thereof. As each
15 tray 50 is filled with arrays of blister packages 12,
upon each compartment 82 having been filled with an
array 12 a pusher element 88 as shown in Fig. 1, will
slide the tray into the therewith aligned level of the --
rack 42 associated therewith, while a subsequent empty
20 tray 50 unloaded from rack 34 is advanced to tray
loading arrangement 70 so as to provide a succession of
array-filled trays 50 to be conducted into and fill each
level of rack 42. Upon the level having been filled
with trays 50 each containing a specified quantity of
25 arrays of blister packages; for example forty-two arrays
12 in compartments 82, the previously lifted racks 34,
42 which were initially fully raised by the lifting
devices 52, 54, are each indexed downwardly by one tray-
supporting level so as to enable the next higher level
30 or row of rack 42 to be filled with trays 50 containing
arrays of blister packages 12. This sequence of
operation is repeated until the loaded tray-filled rack

1 42 is transported onto a further conveyor 90 upon
reaching its fully loaded lowermost position, and then
laterally moved relative to conveyor 32 along the
conveyor 90 towards and a sterilization chamber 92 at a
5 workstation B.

At that time, the now empty rack 34 from which
the empty trays 50 have been unloaded (so as to be
filled with arrays 12 at arrangement 70 and then
inserted into rack 42) is moved forwardly on conveyor
10 into the tray loading position previously occupied by
rack 42 at workstation A, and a subsequent rack
containing empty trays 50 is advanced along the conveyor
32 into position in alignment with the rack unloader 60
while raised into its highest position by lifter 52,
15 while the rack 24 ahead thereof is also raised by
lifting device 54, so as to enable the tray loading
sequence to be repeated.

As the rack 42 containing the trays 50 filled
with arrays of blister packages 12 is conveyed on the
20 conveyor 90 into position in front of sterilization
chamber 92, as shown in Figs. 11 through 13 of the
drawings, the rack 42 is located beneath a frame
structure 110 straddling the sides thereof and extending
above its uppermost level or upper frame. A hook-like
25 gripping finger 112 which is attached to a retractable
and extendable belt member 114 is adapted to engage the
upper frame structure of rack 42 distant from the
sterilization chamber 92. A drive unit (not shown) is
adapted to retract the belt member 114, thereby causing
30 the gripping finger 112 to draw the rack 42 into the
sterilization chamber 92, and then to release from the
rack 42 so as to enable the chamber to sealingly close

1 and commence sterilizing operation on the contents of
the arrays 12 located therein.

5 Upon the completion of the sterilization
cycle, the rack 42 with the sterilized trays 50 of
arrays of blister packages 12 is then pulled out of the
chamber 92 by means of the gripping finger 112 engaging
the upper edge of the framework of the rack with
extension of the conveyor belt 114 so as to position the
10 rack 42 in operative connection with a further conveyor
120 leading towards a secondary packaging or cartoning
workstation C.

As the rack 42 containing the sterilized trays
50 with the arrays of blister packages 12 is advanced to
be positioned adjacent a secondary packaging machine 120
15 at workstation C it is raised by a lifting device 122
similar to device 52 into the highest position so that
the lowermost row of trays 50 in rack 42 is in
horizontal alignment with a rack unloader 126 having a
pusher arm 128, and which is similar to previously
20 discussed rack unloader 60 both as to structure and
function. Ahead of rack 42 is another rack 34 which has
been previously unloaded and which is now in an empty
condition and which is also in a fully raised position
by means of a lifting device 130 of the type previously
25 described, as shown in Fig. 1.

At that location, rack unloader 126, which, as
mentioned, in structural and operational principle is
identical or similar to the rack unloader 60 employed at
workstation A, causes a pusher 134 to slide a fully
30 loaded tray 50 containing the sterilized arrays of
blister packages 12 onto an unloader device 140, as
shown in Fig. 17 where the tray 50 is rotatably inverted

1 180°, such that the openings of each of the spaces or
compartments 82 containing the sterilized arrays 12 face
downwardly, although the latter are prevented from
falling out of the tray 50 by means of a retaining plate
5 member 140 positioned therebeneath.

The inverted tray 50 is then indexed forwardly
by a pusher cylinder 142 by a distance of two adjacent
compartment widths so as to enable two adjacent arrays
12 to fall downwardly into a chute 144, such downward
10 displacing movement being aided by a vertical pusher 146
engaging simultaneously into two openings (not shown)
formed in the bottom of each compartment 82 the tray and
in alignment with each compartment containing an array
of blister packages. The chute 144 is configured so as
15 to cause the two falling arrays 12 to pass on opposite
sides of a guide 146 and with a trough bottom 148
configured so that the arrays 12 assume a horizontal
position inverted relative to each other in interleaved
pairs, such as shown in Fig. 3 of the drawings.

20 Upon a predetermined number of pairs of arrays
of blister packages 12 being superimposed on each other,
for example, such three pairs of arrays for a total of
30 blister packages, a pusher member will advance the
superimposed arrays of blister packages towards a
25 conveyor leading towards the generally diagrammatically
illustrated secondary packaging or cartoning machine 150
at workstation C; having reference to Fig. 16 of the
drawings.

30 As each inverted tray 50 is fully emptied of
sterilized arrays 12, the rack 50 is advanced to a rack-
loading arrangement 154, whereby the empty tray 50 is
again rotated 180° into its original upwardly-opening

1 position, and a pusher arm 156 is adapted to slide the
empty tray 50 into the therewith aligned level of the
empty rack 34 located adjacent thereto. This procedure
is repeated until the level of the empty rack 34 is
5 filled with empty trays 50 whereupon the rack is indexed
downwardly by one further level through actuation of the
lifting device 130 on which it is supported.
Concurrently, the rack 42 which has the array-filled
trays 50 unloaded therefrom is also indexed downwardly
10 by its lifting device 122 so as to enable the subsequent
higher level of array-filled trays 50 to be sequentially
pushed outwardly by the rack unloader 126 towards the
now vacant tray inverting mechanism.

This cycle of operation is repeated until the
15 previously empty forward located rack 34 is filled with
empty trays 50, and then advanced by conveyor system 160
towards the workstation A so as to be in readiness for
repeating the previously described sequence of
operation.

20 As shown in detail in Fig. 6, this represents
the view taken along line 6-6 in Fig. 1, shown on a
somewhat enlarged scale, and illustrating each of the
racks 34, 42 at workstations A and C in their fully
elevated or raised positions on the respective lifting
25 devices associated therewith.

Hereby, at workstation A, the rack 34 is shown
in the process of being unloaded by the pusher of the
rack unloading device, while another rack in its
elevated position is shown in readiness for being
30 unloaded proximity with the secondary packaging or
cartoning machine.

1 Upon the rack 42 being fully loaded at
workstation A with trays 50 containing arrays of blister
packages 12, or conversely, the rack 34 being filled
5 with empty trays at workstation C, the lifting device
for the racks are in their lowermost positions, as shown
by the phantom lines at each location, and the racks are
then adapted to be conveyed along the horizontal
conveyor system into their respective further operative
positions or locations.

10 Reverting to the secondary packaging or
cartoning machine 150, the latter is shown in Fig. 16,
and is as detailed hereinbelow.

 As is illustrated in the plan view of Fig. 16,
the secondary packaging machine or cartoning arrangement
15 150 includes a series of conveyor sections, and also
includes a vertical chute structure 170 containing a
supply of open-ended but flat-folded or lay flat cartons
22 of the type illustrated in Figure 3 through 5 of the
drawings, with the ends of the carton being in an opened
20 condition. This particular chute structure and carton
feed arrangement is illustrated more clearly in the
detail drawing of Figure 19.

 Adjacent to but spaced from the vertical chute
structure 170 containing the open-ended lay flat cartons
25 22 is the tray unloading workstation C.

 A pusher element advances the six arrays 12,
or in effect, three interleaved array pairs at the
bottom of trough 148 shown in Fig. 17 towards a further
conveyor 180 which is essentially offset but at the same
30 level as the lower end of the chute structure 170
containing the stack of flattened cartons 22.
Thereafter, a carton 22 which is opened by a pneumatic

1 pulling element 182, as illustrated in Fig. 19 into its
fully opened position as shown in phantom lines is drawn
downwardly and indexed into a chute or conveyor 186 into
5 alignment with an open end of the carton, and is then
pushed or slid axially into the carton 22.

The carton 22 with the paired arrays 12
contained therein is then advanced along a further
conveyor run 188 which includes mechanisms causing the
end and side flaps of the carton to be folded inwardly
10 into closed position, and thereafter is transferred to a
further conveyor for upward movement through a gluing
apparatus 194 which causes the glue flaps to be folded
down into glued and sealed condition, thereby completing
the closed and sealed carton structure.

15 From there, the carton 22 is conveyed to a
labeling station wherein a jet printer 196 imprints
information on the carton relative to the
characteristics of the contact lenses contained in the
blister packages of the arrays 12, and then is conveyed
20 to a further station for applying a bar code strip to
the carton surface pertaining to other information which
may be required.

As illustrated in the drawing Fig. 16, the
sealed carton 22 is then positioned on a horizontal
25 conveyor run 202 so as to pass a weight checking station
200 which will provide information over the correct
weight of the filled carton 22 containing the arrays of
blister packages 12, indicative that the appropriate
amount of arrays is contained therein.

30 The conveyor run 202 then advances the closed
bar code labeled, imprinted and weight checked carton
towards an accumulating area 210 in which an entire

1 sequence of cartons may be collected and manually placed
into a larger box or container for further storage or
warehousing.

5 The foregoing procedure is implemented
whereby, for instance, each tray 50 may possess 42
compartments each adapted to house, respectively one
array of blister packages 12, and with each rack 34, 42
being constructed with eight vertically stacked levels
or rows adapted to each receive eight trays 50 in
10 contiguous side-by-side relationship; in effect, for a
total of sixty-four (64) trays 50 each containing forty-
two (42) arrays of blister packages 12 for simultaneous
conveyance into the sterilizing chamber 92.

15 While there has been shown and described what
are considered to be preferred embodiments of the
invention, it will, of course, be understood that
various modifications and changes in form or detail
could readily be made without departing from the spirit
of the invention. It is, therefore, intended that the
20 invention be not limited to the exact form and detail
herein shown and described, nor to anything less than
the whole of the invention therein disclosed as
hereinafter claimed.

25

30

35

1 **WHAT IS CLAIMED IS:**

1. An apparatus for the sterilization of
arrays of interconnected blister packages each
containing a contact lens in a sterile environment;
5 comprising:

(a) a plurality of racks transportable
between a series of workstations;

(b) a conveyor arrangement for transporting
said racks between said series of workstations;

10 (c) a plurality of trays for receiving said
arrays of blister packages, each of said trays being
selectively loadable into and unloadable from said
racks;

(d) means positioning first and second of
15 said racks at a first said workstation, said first rack
being empty and said second rack containing a plurality
of said trays in an empty condition;

(e) unloading means at said first workstation
for unloading individual of said empty trays in
20 predetermined sequence from said second rack;

(f) means at said first workstation for
filling each said unloaded empty tray with a plurality
of said arrays advancing the array-filled tray into
alignment with said empty first rack and loading each
25 said tray into said first rack in predetermined
sequence;

(g) conveyor means advancing said tray-filled
first rack towards a second said workstation comprising
a sterilizing chamber;

30 (h) means engaging said rack at said second
workstation for conveying said rack into said
sterilizing chamber, and said engaging means withdrawing



1 said rack from said sterilizing chamber subsequent to
sterilizing of the arrays in said trays; and

(i) further conveyor means advancing said
first rack from said sterilizing workstation to a third
5 workstation for unloading said trays from said rack and
removing the sterilized arrays of blister packages
therefrom.

2. An apparatus as claimed in Claim 1,
wherein each said tray comprises an upwardly opening
10 box-like structure having a plurality of adjacent
elongate compartments each adapted to receive
respectively one said array of blister packages at said
first workstation.

3. An apparatus as claimed in Claim 2,
15 wherein said filling means comprises a vacuum-assisted
structure for lifting successive of said arrays and
depositing said arrays into a chute communicating with
successive of said compartments upon said tray being
indexed forwardly at said first workstation.

4. An apparatus as claimed in Claim 1,
20 wherein pusher means loads each successive of said
array-filled trays into said first rack.

5. An apparatus as claimed in Claim 1,
wherein said first and second racks each possess a
25 plurality of vertically spaced levels each adapted to
respectively support a plurality of said trays in
contiguous positions.

6. An apparatus as claimed in Claim 5,
wherein lifting means at said first workstation support
30 said first and second racks for indexed vertical
displacement so as to facilitate unloading empty trays
from successive levels of said second rack and



1 concurrently loading array-filled trays into successive
levels of said first rack.

7. An apparatus as claimed in Claim 6,
wherein said lifting means comprise pneumatically-
5 actuated structures operatively associated with and
supporting said first and second racks for incrementally
raising and lowering said racks in alignment with the
levels supporting the trays in each of said racks.

8. An apparatus as claimed in Claim 1,
10 wherein said unloading means for said empty trays at
said first workstation comprises a horizontally
displaceable pusher member engaging into said second
rack and contacting one of said trays to slidably
unload a tray at the opposite end of said rack towards
15 said tray filling means.

9. An apparatus as claimed in Claim 1,
wherein said means for engaging and conveying said rack
into said sterilizing chamber comprises a gripping
element engaging an upper edge of said rack distant from
20 said sterilizing chamber; and retractable means for
drawing said gripping element towards said sterilizing
chamber so as to position said rack in said chamber and
thereafter releasing said gripping element from said
rack.

10. An apparatus as claimed in Claim 9,
25 wherein said gripping means withdraws said rack from
said sterilizing chamber upon completion of a
sterilization cycle.

11. An apparatus as claimed in Claim 10,
30 wherein conveyor means transports said rack and
sterilized arrays in said trays to a rack unloading



1 station for transporting said trays to a cartoning arrangement.

5 12. An apparatus as claimed in Claim 10, wherein said rack unloading station comprises pusher means for successively sliding individual trays from said rack onto a platform; means for inverting said tray; indexing means for advancing said inverted tray so as to dispense pairs of arrays therefrom.

10 13. An apparatus as claimed in Claim 12, wherein a downwardly extending chute receives said pairs of array; means at an outlet of said chute for orienting said pairs of arrays into interleaved pairs, and collecting predetermined quantities of said interleaved pairs of arrays.

15 14. An apparatus as claimed in Claim 12, wherein said cartoning arrangement comprises a chute for dispensing cartons having open ends; and conveyor means for transporting predetermined quantities of pairs of said arrays into successive of said cartons.

20 15. An apparatus as claimed in Claim 14, wherein conveyor means transports said cartons and arrays contained therein through apparatus for closing the end flaps of said cartons.

25 16. An apparatus as claimed in Claim 15, wherein further conveyor means transports said cartons through a glueing device for sealing closing glue flaps on said cartons so as to form a sealed carton structure.

30 17. An apparatus as claimed in Claim 16, wherein a jet ink printer imprints information on said cartons.



1 18. An apparatus as claimed in Claim 16,
wherein labeling means adheres strips of bar coded
information to said cartons.

5 19. An apparatus as claimed in Claim 16,
wherein weight checking means weighs each said carton
and the contents therein.

 20. An apparatus as claimed in Claim 1,
wherein said sterilization chamber comprises an
autoclave.

10 21. An apparatus as claimed in Claim 16,
wherein conveyor means transports said cartons to an
accumulating area for collecting and boxing a plurality
of said cartons.

15 22. A method for the sterilization of arrays
of interconnected blister packages each containing a
contact lens in a sterile environment; said method
comprising:

 (a) transporting a plurality of racks between
a series of workstations;

20 (b) a plurality of trays for receiving said
arrays of blister packages being selectively loaded into
and unloaded from said racks;

 (c) positioning first and second of said
racks at a first said workstation, said first rack being
25 empty and said second rack containing a plurality of
said trays in an empty condition;

 (d) unloading at said first workstation
individual of said empty trays in predetermined sequence
from said second rack;

30 (e) filling at said first workstation each
said unloaded empty tray with a plurality of said arrays
advancing the array-filled tray into alignment with said



1 empty first rack and loading each said tray into said
first rack in predetermined sequence;

(f) advancing said tray-filled first rack
towards a second said workstation comprising a
5 sterilizing chamber;

(g) engaging said rack at said second
workstation for conveying said rack into said
sterilizing chamber, and withdrawing said rack from said
sterilizing chamber subsequent to sterilizing of the
10 arrays in said trays; and

(h) further advancing said first rack from
said sterilizing workstation to a third workstation for
unloading said trays from said rack and removing the
sterilized arrays of blister packages therefrom.

15 23. A method as claimed in Claim 22, wherein
each said tray comprises an upwardly opening box-like
structure having a plurality of adjacent elongate
compartments each adapted to receive respectively one
said array of blister packages at said first
20 workstation.

24. A method as claimed in Claim 23, wherein
said filling comprises actuating a vacuum-assisted
structure for lifting successive of said arrays and
depositing said arrays into a chute communicating with
25 successive of said compartments upon said tray being
indexed forwardly at said first workstation.

25. A method as claimed in Claim 22, wherein
successive of said array-filled trays are each loaded
into said first rack.

30 26. A method as claimed in Claim 22, wherein
said first and second racks each possess a plurality of
vertically spaced levels each adapted to respectively



1 support a plurality of said trays in contiguous
positions.

27. A method as claimed in Claim 26, wherein
at said first workstation said first and second racks
5 are activated for indexed vertical displacement so as to
facilitate unloading empty trays from successive levels
of said second rack and concurrently loading array-
filled trays into successive levels of said first rack.

28. A method as claimed in Claim 27, wherein
10 said lifting comprises activating pneumatically-actuated
structures operatively associated with and supporting
said first and second racks for incrementally raising
and lowering said racks in alignment with the levels
supporting the trays in each of said racks.

29. A method as claimed in Claim 22, wherein
15 the unloading of said empty trays at said first
workstation comprises operating a horizontally
displaceable pusher member for engaging into said second
rack and contacting one of said trays to slidably
20 unload a tray at the opposite end of said rack.

30. A method as claimed in Claim 22, wherein
engaging and conveying said rack into said sterilizing
chamber comprises a gripping element engaging an upper
edge of said rack distant from said sterilizing chamber;
25 and drawing said gripping element towards said
sterilizing chamber so as to position said rack in said
chamber and thereafter releasing said gripping element
from said rack.

31. A method as claimed in Claim 30, wherein
30 said rack is withdrawn from said sterilizing chamber
upon completion of a sterilization cycle.



1 32. A method as claimed in Claim 31, wherein
said rack and sterilized arrays in said trays are
transported to a rack unloading station for transporting
said trays to a cartoning arrangement.

5 33. A method as claimed in Claim 31, wherein
said rack unloading station comprises successively
sliding individual trays from said rack onto a platform;
inverting said tray; and indexed advance of said
10 inverted tray so as to dispense pairs of arrays
therefrom.

 34. A method as claimed in Claim 33, wherein
a downwardly extending chute receives said pairs of
array; orienting said pairs of arrays into interleaved
pairs, and collecting predetermined quantities of said
15 interleaved pairs of arrays.

 35. A method as claimed in Claim 33, wherein
said cartoning arrangement comprises dispensing cartons
having open ends; and transporting predetermined
quantities of pairs of said arrays into successive of
20 said cartons.

 36. A method as claimed in Claim 35, wherein
said cartons and arrays contained therein are
transported through apparatus for closing the end flaps
of said cartons.

25 37. A method as claimed in Claim 36, wherein
said cartons are conveyed through a glueing device for
sealing closing glue flaps on said cartons so as to form
a sealed carton structure.

30 38. A method as claimed in Claim 37, wherein
a jet ink printer imprints information on said cartons.



1

39. A method as claimed in Claim 37, wherein labeling means adheres strips of bar coded information to said cartons.

5

40. A method as claimed in Claim 37, wherein weight checking means weighs each said carton and the contents therein.

41. A method as claimed in Claim 22, wherein said sterilization chamber comprises an autoclave.

10

42. A method as claimed in Claim 37, wherein said cartons are transported to an accumulating area for collecting and boxing a plurality of said cartons.

15

20

25

30

35

