



(22) Date de dépôt/Filing Date: 1996/04/29

(41) Mise à la disp. pub./Open to Public Insp.: 1996/11/02

(45) Date de délivrance/Issue Date: 2007/03/27

(30) Priorité/Priority: 1995/05/01 (US08/431,633)

(51) Cl.Int./Int.Cl. *B65B 25/00* (2006.01),
B29D 11/00 (2006.01), *B65B 35/36* (2006.01),
B65B 35/38 (2006.01), *B65B 5/08* (2006.01),
B65B 55/22 (2006.01), *B65G 47/74* (2006.01),
B65G 49/00 (2006.01)

(72) Inventeurs/Inventors:

MADSEN, NIELS JORGEN, DK;
HOLLEY, WILLIAM EDWARD, US;
LEPPER, JOHN MARK, US;
MARTIN, WALLACE ANTHONY, US;
WANG, DANIEL TSU-FANG, US;

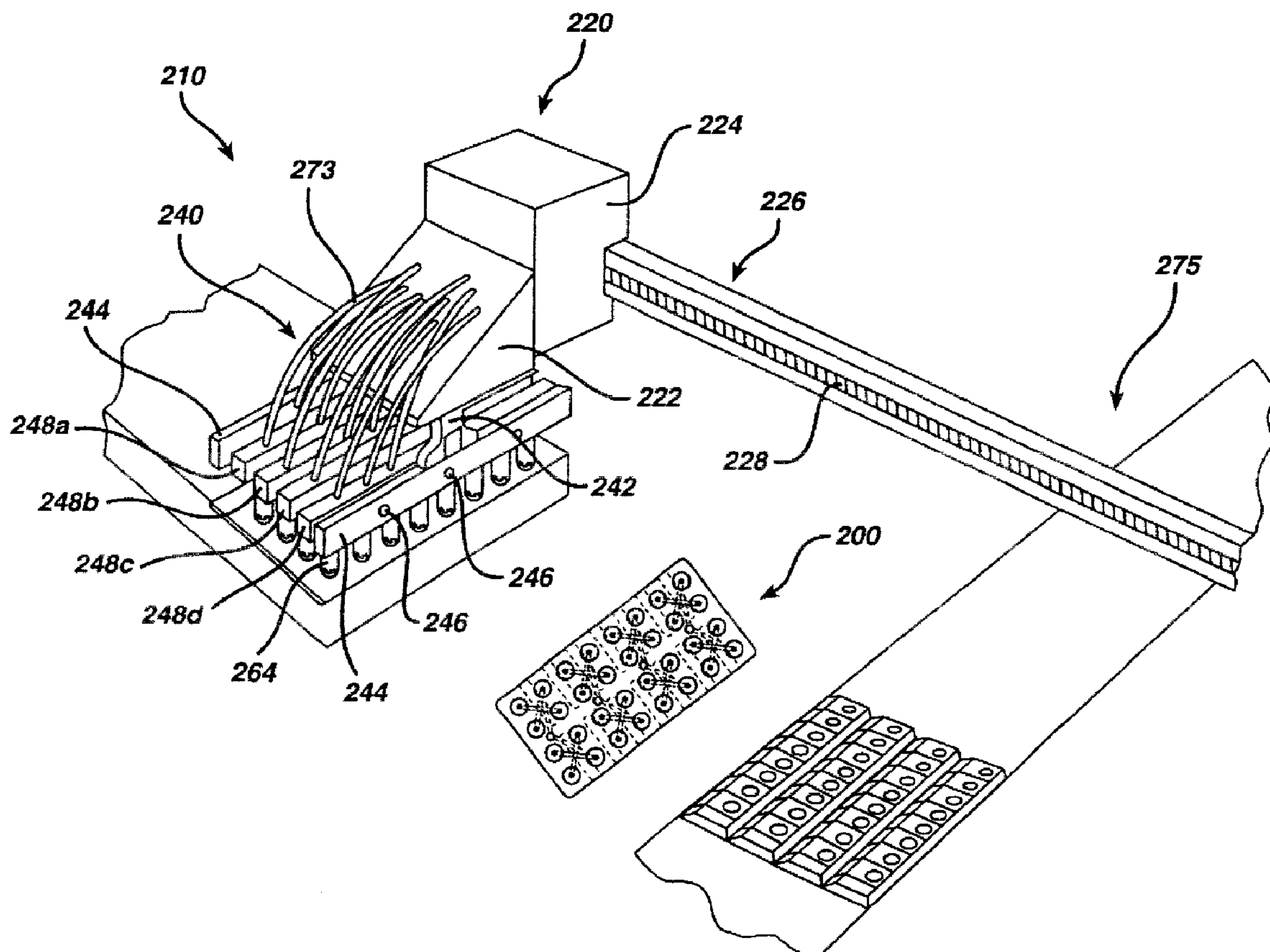
...

(73) Propriétaire/Owner:

JOHNSON & JOHNSON VISION PRODUCTS, INC., US

(54) Titre : DISPOSITIF DE TRANSFERT DE VERRES DE CONTACT

(54) Title: CONTACT LENS TRANSFER DEVICE



(57) Abrégé/Abstract:

The present invention, which relates to the transfer of contact lenses in post hydration processing of the lenses. A lens transfer and insertion assembly removes contact lenses from lens hydration pallets, alters their spatial distribution, and deposits them into packaging elements. The lenses are transferred with fluid and retained on the transfer assembly by surface tension.

(72) **Inventeurs(suite)/Inventors(continued):** KINDT-LARSEN, TURE, DK; EDWARDS, RUSSELL JAMES, US;
GUNDERSEN, BORGE PETER, DK; RAVN, THOMAS CHRISTIAN, DK; KEENE, DARREN SCOTT, US

(74) **Agent:** OGILVY RENAULT LLP/S.E.N.C.R.L.,S.R.L.

ABSTRACT

1

The present invention, which relates to the transfer of contact lenses in post hydration processing of the lenses. A lens transfer and insertion assembly removes contact lenses from lens hydration pallets, 5 alters their spatial distribution, and deposits them into packaging elements. The lenses are transferred with fluid and retained on the transfer assembly by surface tension.

10

15

20

25

30

35

CONTACT LENS TRANSFER DEVICE

1

10 BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the field of manufacturing contact lenses. More particularly, the present invention relates to an apparatus which removes contact lenses from a first set of pallets, inserts them into corresponding packaging elements on a second set of pallets, and transports the lens-packaging elements through inspection and final package sealing assemblies.

20

2. Description of the Prior Art

The molding of hydrophilic contact lenses is disclosed in U.S. Patent No. 4,495,313 to Larsen; U.S. Patent No. 4,640,489 to Larsen, et al.; U.S. Patent No. 4,680,336 to Larsen et al.; U.S. Patent No. 4,889,664 to Larsen et al.; and U.S. Patent No. 5,039,459 to Larsen et al., all of which are assigned to the assignee of the present invention.

These prior art references disclose a contact lens production process wherein each lens is formed by

35

1 sandwiching monomer or monomer mixture between a front
curve (lower) mold section and back curve (upper) mold
section, carried in a two by four mold array. The
monomer is polymerized, thus forming a lens which is
5 then removed from the mold sections and further treated
in a hydration bath and packaged for consumer use.

U.S. Patent Nos. 5,080,839 and 5,094,609
disclose respectively a process for hydrating contact
lenses and a chamber for hydrating contacts lenses
10 formed with a monomer or monomer mixtures disclosed in
the forgoing patents. The process disclosed in these
patents significantly reduce the thruput time by
hydrating the lens and releasing the lens from the mold
cavity with deionized water and a small amount of
15 surfactant without any salts, so that the time consuming
ionic neutralization of the polymer from which the lens
blank is made does not occur during the hydration
process. When deionized water is used, the final step
of the process is to introduce buffered saline solution
20 into the final package with the lens and then seal the
lens within the package so that the final lens
equilibrium (ionic neutralization, final hydration and
final lens dimensioning) is accomplished in the package
at room temperature or during sterilization.

25 U.S. Patent No. 4,961,820, also assigned to
the assignee of the present invention, discloses a final
package for a contact lens, wherein the package is
formed from a transparent plastic material such as
polypropylene and a foil laminate that is heat sealed
30 thereto.

-3-

While U.S. Patent Nos. 5,080,839 and 5,094,609 contemplate that the entire hydration process and transfer to final packaging may take place in a fully automated fashion, and while the chamber and process described in the foregoing patents enabled automated handling of the lens during hydration, suitable automated equipment to transport the lenses at high production rates and maintain low discard rates of manufactured lenses due to delay and dehydration thereof was not readily available or taught by the prior art.

SUMMARY OF THE INVENTION

A manufacturing assembly line may include apparatuses for both the manufacture of a product and of packaging therefor. In addition, apparatuses may be provided which are directed to the insertion of the product into the packaging and/or to the inspection of the product. In addition, recent developments in the inspection of contact lenses produced in accordance with the foregoing methods has enabled automated lens inspection, as taught in European Patent No. 604 179, entitled "Ophthalmic Lens Inspection Method and Apparatus", assigned to the assignee of the present invention. Further, recent developments in the hydration and automated handling of wet contact lenses, as taught in U.S. Patent No. 5,476,111, entitled "Apparatus for Hydrating Soft Contact Lenses" also assigned to the assignee in the present invention, has enabled automatic robotic handling of lenses during hydration, and prior

-4-

1 to the inspection thereof by the automated lens
inspection system.

Automated manufacturing processes often
include steps which are particularly sensitive to
5 interruption. For example, with respect to the
manufacture of contact lens mold sections, the
successful molding of thermoplastic elements having
sufficiently correct optical surfaces requires that
temperature fluctuations in the molding station remain
10 steady. Other apparatuses in manufacturing lines,
however, are subject to frequent interruption; requiring
resupplies of materials, substitution of parts, etc.
For example, materials for manufacturing packaging
materials may be supplied in segmented rolls which, once
15 depleted must be replaced.

The design of a fabrication line, which includes
apparatuses of both type, must provide buffer zones in which
parts being manufactured continually by one apparatus may be
held temporarily as another is interrupted for a short time.
20 It is therefore, a goal of those in the art to provide one
or more accumulators or buffer zones for use in fabrication
lines to even out such fluctuations. Again, with specific
respect to the manufacture of contact lenses, recent
developments are disclosed in U.S. Patent No. 5,578,331,
25 entitled "Automated Apparatus for Preparing Contact Lenses
for Inspection and Packaging", also assigned to the assignee
of the present invention, in which a buffer station is
incorporated into the production line, for the purposes of
30 permitting continuous function of some apparatuses, while
other

35

-5-

1 apparatuses are interrupted. .

5 The present invention is directed to the portion of the contact lens assembly line in which: a pallet of packaging elements are filled with a quantity of deionized water; a set of contact lenses, which have been molded, hydrated, and washed, are removed from a pallet and inserted into their respective packaging elements; the combined set of packaging elements and respective lenses are transported to a buffering station; the set of elements are transferred to a low vibration conveyor line; the contact lenses are inspected for flaws; the deionized water is removed from the packages; the combined elements are removed from their pallets, the packages containing flawed lenses are deposited on a conveyor line which deposits the elements in a collection bin, and the packages containing correct lenses are deposited on a good line; the lenses on the good line are consolidated into a regular array and transported onto a pallet; and a quantity of saline solution is introduced into the packages and a foil cover is heat sealed to the package.

25 More specifically, with respect to the assemblies which carry out the processes introduced above, and which comprise the apparatuses of the present invention, the deionized water injector assembly is a device for injecting a quantity of deionized water into packaging elements on a pallet. This deionized water injector assembly is mounted above a conveyor line along which pallets of regularly arrayed packaging elements are transported from a remote fabrication location to

30

1 the second location where they receive contact lenses.
The spatial distribution of the regular array of the
packaging elements is specifically established to match
the optical array in the inspection station.

5 The lens extraction and insertion assembly of
the present invention is a lens transfer device which
lifts lenses from hydration pallets at a first location
and deposits them, along with an additional dose of
deionized water, into the packaging elements at the
10 second location. In addition to transferring the
lenses, the device also alters the spatial distribution
of the lenses from their orientation in the hydration
pallets to an orientation which corresponds to the
packaging elements (and the lens inspection station).

15 More specifically with respect to the means by
which the lenses are extracted from the hydration
pallets and transferred to the packaging elements, the
hydration pallets comprise a set of concave recessions
in which the lenses are disposed, along with a quantity
20 of deionized water. The bottom of the recessions
comprise at least one hole through which a fluid may be
ejected, therein lifting the wet lenses out of the
recessions. The lens transfer assembly comprises a set
of elongate finger elements which extend downward, each
25 finger element having a convex lens transfer surface
onto which the lifted lens may be secured via surface
tension. The convex lens transfer surface of the finger
is further designed with an annular raised skirt around
the tip which prevents the lens from sliding out of the
30 desired position during transfer. The lenses which have
been transferred to the convex lens transfer surfaces on

1 the fingers of the lens transfer device, may have small
bubbles of air on their exposed surface. The small
bubbles, if permitted to remain on the surface of the
lens through the inspection process may interfere with
5 proper inspection, and cause the lens to be improperly
determined to be bad, and discarded unnecessarily. At
least one jet of air is blown onto each lens for the
purposes of removing the air bubbles from this exposed
surface.

10 The fingers of the lens transfer assembly are
set out in rows on parallel beams which are slidably
mounted on guide rails. The parallel beams are coupled
together via piston/ cylinder elements, and are drawn
together once the lenses have been extracted and the
15 bubble blow off step have been carried out. This action
alters the relative separation of the lenses with
respect to one axis, so that the lenses will be arrayed
to match the array provided by a lens inspection pallet.

The lens transfer assembly then is linearly
20 translated to the second location, into position above
the inspection pallet. The fingers of the lens transfer
assembly are further designed with an interior conduit,
extending from a small orifice in the lens transfer
surface of the finger to a reservoir of deionized water,
25 through which deionized water may be selectively
ejected. With the fingers, and the lenses secured
thereto, in position above the packages, a small jet of
deionized water is ejected through each orifice, therein
decoupling the contact lenses from the lens transfer
30 surfaces and depositing them into the packages that were
loaded in the inspection carrier.

-8-

The pallet and the package elements which now contain contact lenses are then transported via a conveyor belt to a buffering station. More specifically, the pallets are transported to a segregating apparatus, which directs alternating pallets onto parallel conveyor lines. The conveyor lines extend a sufficient distance, from their first ends to their remote ends, that a significant temporal delay may be accommodated, and the lenses stored without requiring stopping the molding line which requires a long start up time.

The buffering station taught in U.S. Patent No. 5,578,331, entitled "Automated Apparatus for Preparing Contact Lenses for Inspection and Packaging", is positioned after the inspection station, at a point in the manufacturing line where the packages containing the lenses have been drained of deionized water. Deprived of a liquid environment, the lenses are permitted to stand for no longer than 15 minutes before rejection thereof. Moving the buffering station to a point in the line at which the lenses remain bathed in deionized water permits indefinite holding without damaging the lenses.

At the remote end of the buffering station, at the ends of the parallel conveyor lines along which the pallets may be stored, there is an integrator assembly which integrates alternate pallets from the two conveyor lines to continue toward the next station. More specifically, the parallel conveyor lines of the buffering station have, mounted to their end (the end toward which the pallets are transported), a device

1 which selectively merges the two streams of pallets so
that they may pass onto the next conveyor.

In the embodiment of the buffering station
which is described more particularly below with respect
5 to the Figures, the conveyor lines which transport the
pallets to the buffering station and which extend after
the buffering station are co-linear and immediately
adjacent to a first one of the two parallel conveyor
lines. The segregator device, therefore, first allows a
10 single pallet to advance onto the first buffer line, and
then transfers the next pallet to the parallel second
buffer line. In a similar, but inverse fashion, the
integrator device operates by permitting one pallet from
the first buffer line to pass, then transports a pallet
15 from the second buffer line to the conveyor line which
continues beyond the buffering station so that it may
follow, and then begins anew by allowing the next pallet
from the first buffer line to pass.

In alternative variations of this apparatus,
20 the segregator and integrator devices continually or
selectively divide and consolidate the stream of pallets
along the two buffer lines. In the first variation, the
stream of pallets is divided by the segregator and
consolidated by the integrator at all times during the
25 operation of the manufacturing line. In the alternate
variation, the segregator and integrator are engaged
only under circumstances when the subsequent stations
have been interrupted. The segregator of this
alternative variation would operate only during
30 interrupted times; the integrator would function past
the resumption of the subsequent assemblies until there

1 are no more pallets on the second buffer line. It is
understood that there are a variety of alternative
buffering algorithms which the segregator and integrator
5 devices may utilize for separating and bringing together
the pallets, all of which are equivalent in function and
exist within the scope of this invention.

The stream of pallets which continue from the
buffering station are transported to a pickup location.
At this location the pallets are lifted off the conveyor
10 line by a low vibration pallet transfer assembly and
placed on a low vibration conveyor. The low vibration
conveyor transports the pallets through the inspection
station wherein a determination is made of the optical
properties of the hydrated and packaged lenses. It is
15 understood that the proper inspection of the lenses may
not occur if the perceived optical properties of the
lenses are distorted by air bubbles which have adhered
to the surface of the lenses. Waves and disturbances
within the deionized water in the packages have a
20 similar distortion effect, causing false determinations
of defects. The low vibration conveyor line, therefore,
provides a means for minimizing the distortions
resulting from water disturbances.

It is understood, however, that in order to
25 maintain the same rate of product flow through the
system, the reduction in speed of the stream of pallets
along the low vibration conveyor line must be
compensated by a corresponding increase in the density
of the pallets moving therealong. The low vibration
30 pallet transfer assembly, therefore, places successive
pallets adjacent to one another on the low vibration

1 line, such that the spacing between the pallets is
substantially reduced from the previous conveyor lines.

Determination of the optical correctness of
each lens in each pallet is stored in the memory of a
5 controller/processor so that subsequently a means for
separating the good lenses from the bad may be utilized.
First, however, the pallets, which contain packages
filled with deionized water are transported to a water
extraction assembly. Only after the optical correctness
10 of the lenses has been determined may the proper saline
solution be introduced into the package. The delay in
introducing the saline solution until after the lenses
have been inspected permits the line to proceed much
more quickly, as, as stated above, the optical and
15 physical characteristics of the lens requires several
hours in the saline solution to equilibrate. It is
understood that this equilibration is advantageously
carried out in the sealed packages, once the lenses have
been removed from the manufacturing line.

20 In the inspection station, a light beam or
pulse is directed from sources onto the lens-packages,
received by a vertical lens unit, and directed and
focused on a screen to produce an image of the lens.
The image is converted to an electrical information
25 signal which is processed to determine if the lens is
acceptable for consumer use. The lens inspection
results are stored in the programmable logic controller
which coordinates subsequent consolidation and transfer
assemblies.

30 After inspection, the pallets are lifted into
a water extraction assembly which is mounted above the

- 12 -

conveyor line. A device for deionized water extraction from packages containing contact lenses is taught in European Patent No. 0 618 063, entitled "Solution Removal Nozzle", which is also assigned to the assignee of the
5 present invention.

Once the water has been removed, the packages are transported along the conveyor line to a lens-package pickup point. At this location the packages are lifted by a lens-package transfer assembly from the pallets and
10 moved to alternative conveyor lines. More particularly, there are alternative variations of the lens-package transference assembly; a first in which the lens-package elements are all removed from the pallets, and a second in which only those packages which contain a correct lens
15 are removed. It is understood that the first variation transports the packages over to a reject conveyor line, and pauses during transport to deposit any incorrectly formed lenses and the packages in which they are disposed. The assembly then transports the remaining
20 correctly formed lenses and packages to the good conveyor line. In the second variation, the lens-package transfer assembly removes only the properly formed lenses and packages from the pallets and transports them to the good conveyor line. Any rejected lenses are then removed from
25 the inspection pallets in a subsequent collection procedure. In either variation, it is understood that the determinations made by the inspection assembly, which were stored in memory by a processor/controller are herein acted upon by the lens-package transfer assembly.

1 More specifically, with respect to the lens-
package transfer assembly, a set of bellowed fingers,
extending downward from a vacuum manifold are first
positioned directly above the packages on a pallet. By
5 descending from a position above, bringing the tips of
the fingers into contact with the packages, and drawing
a vacuum in an interior open volume, the packages are
secured to the lens-package transfer assembly. As
stated above, the processor/controller may either
10 control the selective pickup of the optically correct
lens-packages, or the assembly may pick up all of the
lens-packages. In either case, the desired lens-
packages are transported to the good conveyor line,
where the vacuum is released and the lens packages are
15 dropped from the tips of the fingers.

 In either case, the array of lens-packages
which are ultimately deposited onto the good conveyor
line are not necessarily in a regular array, as they
were on the pallet (having had the incorrectly formed
20 lens-package elements removed). The good line,
therefore, also carries out a consolidating function,
whereby the lens-packages are brought back together into
a regular distribution. More specifically, the conveyor
line carries the articles into separate corral
25 structures. A first lens-package is conveyed between
converging guide rails (which align the lens-package
along one axis of motion), and into a corral. The first
lens-package in line is stopped by a gate at the distal
end. The next lens-package follows the lead one and is
30 stopped by coming in contact with the first. Once a
predetermined number of lens-packages have entered the

1 corral, and a regular array of lens-packages has been established, the lens-packages are removed from the conveyor line and deposited onto a final packaging pallet.

5 More particularly, the lens-package elements are removed from the corral, into which they have been directed by a conveyor line, by a rotating lens-package transfer assembly. This assembly comprises an array of bellowed fingers, similar in most respects to those of
10 the lens-package transfer assembly, which lift the array of lens-package elements and places them onto pallets. The assembly further includes a rotational motion which rotates the array of elements to match the orientation of the pallets used for primary packaging.

15 Once the lens-packaging elements have been deposited onto these pallets, they enter into a saline dosing and sealing assembly. More specifically, the pallets are incrementally translated into position beneath a saline solution deposition unit. This unit
20 comprises a row of fluid dispensers which fill the packages with saline solution. As the pallets are incrementally registered beneath the fluid dispensers, a buffered saline solution is injected into each of the packages and each of the lenses begins its equilibration
25 process, matching the tonicity of a human eye (which has an equivalent salinity).

Once the packages have been filled with saline, the pallets continue forward and are sealed with a foil wrapper. More particularly, with respect to the
30 device which applies and seals the foil wrapper to the package, an elongate section of foil wrapper material is

1 advanced through a printer (for printing information
pertaining to the particular lens specifications). The
foil is then cut into sections which are sized to fit
across the tops of an array of packaging elements. The
5 foil sections and the lens-package assemblies are
advanced into alignment with one another. A vacuum
gripper head grasps a foil section and descends to the
package elements, placing the section in contact
therewith. Once the foil wrapper is in position, a
10 sealing mechanism is brought into contact with the
packages and heat seals the foil to the package in a
single high temperature short cycle sealing operation.
The sealed packages are then advanced beyond the sealing
assembly where they may be stored during equilibration,
15 and ultimately packaged for distribution.

BRIEF DESCRIPTION OF THE DRAWINGS

The advantages and assemblies of the present
invention set forth in the foregoing summary of an
20 automated apparatus for combining, inspecting and
sealing contact lenses and packaging elements may be
more readily understood by one skilled in the art with
reference being had to the following detailed
description of the preferred embodiments, taken in
25 conjunction with the accompanying drawings, wherein like
elements are designated by identical reference numerals
throughout the several views, and in which:

Figure 1 is a perspective view of a packaging
element in which a contact lens may be inserted, and
30 which serves as both a receptacle for the lens during

1 inspection, and a portion of the primary contact lens
package.

5 Figure 2 is a perspective view of an
inspection pallet used to transport a plurality of the
packaging elements illustrated in Figure 1 through
several assemblies and stations of the present
invention.

10 Figures 3a and 3b are elevation views, side
and front views respectively, of an apparatus which
fills packaging elements on a pallet with a quantity of
degassed deionized water.

Figure 4 is a top view of the hydration pallet
in which the hydrated and washed lenses are presented at
the first location.

15 Figures 5a, 5b, and 5c are side, top, and
perspective views, respectively, of the lens transfer
and insertion assembly which removes the molded contact
lenses from the hydration pallet, alters their relative
spacing, and places the contact lenses in the packaging
20 elements.

Figure 6 is a side view of a finger element of
the lens transfer and insertion assembly onto which the
lenses are disposed.

25 Figure 7 is a cross-sectional view of the air
bubble removal fluid ejection mechanism for removing
bubbles from the exterior surface of the contact lenses.

Figure 8 is a top view of the pallet transfer
unit which transfers pairs of pallets from the lens
transfer conveyor line to the buffer conveyor line.

30

35

1 Figure 9 is a perspective view of the buffer station through which the pallets carrying the lens-packaging elements are directed.

5 Figure 10 is a perspective view of the segregator device which is disposed at the entrance to the buffering station.

 Figure 11 is a perspective view of the integrator device which is disposed at the exit of the buffering station.

10 Figure 12 is an overview showing the assembly station locations of the post hydration apparatus of the present invention, including the inspection station and the deionized water extraction assembly.

15 Figure 13 is a perspective view of the low vibration pallet transfer assembly which transports the pallets carrying the lens-packaging elements from one conveyor line to the low vibration inspection conveyor line.

20 Figure 14 is a perspective view of the first rotating lens-package transfer assembly which removes the packages and lenses from the inspection pallets and deposits the optically correct lens-packages on the good conveyor line.

25 Figure 15 is a perspective view of the good conveyor line which further serves to consolidate the lens-packaging elements into a regular array.

30 Figure 16 is a perspective view of the second rotating lens-package transport assembly which removes regular arrays of lens-packaging assemblies from the good conveyor line and deposits them in pallets for saline injection and foil sealing.

-18-

1 Figure 17 is a conceptual diagrammatic
illustration of the saline solution injector and foil
sealing assembly.

5 Figure 18 is a side view of the saline
solution injector and foil sealing assembly.

 Figure 19 is a perspective view of the saline
solution injecting subassembly.

10 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

 The present invention was designed for and is
particularly adapted for use in the post hydration
processing section of an automated contact lens
production facility. Contact lenses molded in an
15 automated production line, such as that described in
U.S. Patent No. 5,804,107, entitled "Consolidated
Contact Lens Molding"; hydrated in a hydration system as
described in U.S. Patent No. 5,476,111, entitled
"Apparatus for Hydrating Soft Contact Lenses"; and
20 automatically inspected as described in European Patent
No. 604 179, entitled "Ophthalmic Lens Inspection Method
and Apparatus" are particularly benefitted by the
present invention.

 The present invention shall be herein
25 described with respect to its specific assemblies and
apparatuses, and to the Figures illustrating these
features. More specifically, the present invention shall
be described, with reference to the following several
30 assemblies:

35

1 First, the deionizing water injection assembly
which fills the packaging elements prior to the lenses
being inserted therein;

5 Second, the lens transfer and insertion
assembly which receives the lenses from hydration
pallets, alters their spatial distribution, and injects
them into the packaging elements;

10 Third, the buffering station, and the
segregator and integrator devices included therein,
which provide a buffering region for temporarily holding
a group of lens-packaging pallets during interruption of
subsequent assemblies;

15 Fourth, the low vibration lens-package
transport, inspection, and water extraction assemblies
which removes the inspection pallets from a conveyor
line and inserts them onto the low vibration inspection
assembly conveyor line, determines which lens-packages
are optically correct, and then removes the deionized
water from the packages;

20 Fifth, the lens-package transfer assembly,
which removes the lens-package elements from the pallet
and deposits those lens-packages which were determined
to be optically correct onto a good conveyor line;

25 Sixth, the good conveyor line and rotating
lens-package transfer assembly, which conveyor line
consolidates the optically correct lens-package elements
into regular arrays, and the lens-package transfer
assembly extracts the arrays, rotates the elements in
the horizontal plane, and transports them to another
30 line of pallets; and

-20-

Seventh, the saline solution injector and foil sealing assemblies, which introduce the appropriate saline solution into the lens-packaging elements and heat seals a foil label onto the top of the packaging element for shipping and identification.

THE DEIONIZING WATER INJECTION ASSEMBLY

Referring now to Figure 1, a suitable packaging element 10 is illustrated in a perspective view. This packaging element is more fully described in European Patent No. 0 604 177. The packaging element 10 may be formed by injection molding or be thermally formed of plastic sheet material, such as polypropylene. The packaging element 10 includes an essentially rectangularly shaped platform portion 12, which may be visually divided into laterally distinct portions 14a and 14b by registration notches 16a and 16b which are formed in opposing sides of the platform portion. The first portion 14a defines a concave recession 24 which is particularly well suited for receiving therein and transporting a contact lens and fluid. The second portion 14b is generally flat, providing an ideal location for contact with a vacuum lifting means in that it provides a stable surface to seat against.

The package carrier is further defined by a wall portion 18 which descends at an angle, outwardly and downwardly from the platform portion 12 at one end thereof, forming an angled flange member. Descending downwardly from the corners platform portion 12, at the

1 opposing ends thereof, are a pair of registration
flanges 20 and 22, only one of which is visible in the
view shown in Figure 1. The registration flanges 20 and
22 are used, in conjunction with the angled flange 18
5 and registration notches 16a and 16b, to align the
packaging element 10 during robotic handling. In
particular, the notches 16a and 16b are provided on
either side of the platform 12 so that they may
cooperate with registration pins on various carrier
10 pallets. Flange structures 18, 20, and 22 mate with the
topological structure of pallets onto which the
packaging elements are disposed, therein providing
additional securing means for holding the element on the
pallet.

15 As stated above, the first portion 14a of the
platform includes a concave recession 24 which is of an
essentially semi-spherical configuration, generally in
conformance with a curvilinear shape of a contact lens
(not shown). The contact lenses are therefore, adapted
20 to be stored in the recession 24, in a sealed condition
while immersed in a suitable sterile aqueous solution,
in a manner similar to that described in U.S. Patent No.
4,691,820 to Martinez; which is assigned to the assignee
of the present invention, the disclosure of which being
25 incorporated herein by reference thereto. The
perpendicular extent of the wall portion 18 which
descends outwardly and downwardly from the platform
member 12 is equivalent to the height or depth of
recession 24 therein providing self alignment of the
30 packaging element.

1 The concave recession 24 also includes a
plurality of small gripping marks 26 which are used to
assist in holding a contact lens in the centered
position in the recession 24 during the removal of
5 deionized water at the deionized water extraction
assembly which will be more fully described, with
reference to the appertaining Figures hereinafter.

 The outer edge of the recession 24 includes a
raised annular rim 28 which is provided for enhancing
10 the efficacy of the heat sealing of the foil label in
the foil sealing assembly which hermetically seals the
contact lenses and packaging elements for commercial
distribution. A cut-out 30 is used to facilitate
gripping the foil wrapper when it is removed by a
15 consumer to access and use the lens contained therein.

 Referring now to Figure 2, an inspection
pallet on which the packaging elements are transported
to the deionized water injection assembly, through the
lens transfer assembly, the lens inspection assembly,
20 and the deionized water extraction assembly, to the
lens-package transfer assembly, is shown in a
perspective view. Pallet 40 includes a first and second
parallel rows 42,44 of cavities 46 which are shaped to
receive the underside of the recession 24 of the
25 packaging element 10. The parallel rows 42,44 of
cavities are separated by a channel 48 which is defined
by two walls 50a,50b. The wall corresponding to row 44
descends downwardly and outwardly, the angulation of the
slant being specifically set to receive flatly thereon,
30 the descending wall portion 18 of each packaging element
10 disposed on row 44. The outer edge 54 of row 42 is

1 similarly slanted to receive thereon the wall portions
18 of the packaging elements 10 disposed on row 44.

The pallet is further provided with a pair of
elongated notches 56,58 for receiving the registration
5 flanges 20,22 of the packaging element. The elongated
notches 56,58 further provide a positive grip surface
for transferring means that lift, rotate, and transport
the pallet.

In addition, the pallet 40 includes
10 registration pins 52 which engage the packaging elements
at the lateral edges. These registration pins 52 engage
the registration notches 16a,16b of the packaging
elements 10 to provide additional accuracy in their
registration, specifically with respect to the
15 longitudinal axis of the pallet. The combination of
slanted walls 50b and 54, grooves 56 and 58, and the
registration pins 52, which each couple with
corresponding features of the packaging elements,
provide particularly effective means to ensure against
20 rotational skewing.

The inspection pallet 10 is further provided
with three registration openings 60, on either side of
the pallet 40, which are used by means associated with
assemblies of the present invention to transport, and
25 lock the pallet in place, during operation thereof.

As suggested by Figure 2, the packaging
elements 10 are fabricated in sets of sixteen, and are
disposed on pallets 40 in predetermined arrays,
typically 2 X 8. The pallets and packages are
30 transported, via a conveyor line, to the deionized water

1 injection assembly in sets of two, oriented to define
therebetween an array which is 4 x 8.

Referring now to Figures 3a and 3b, the
deionized water injection assembly 100 is shown in a
5 front side view and a lateral side view. This assembly
100 comprises four separate elements: a water dispensing
head 110; a set of coordinated vertically oriented stops
120a,b; a pallet positioning device 130; and a water
overflow drain unit 140. The water dispensing head 110
10 translates up and down with respect to a conveyor line
102 and to the pallets 40 thereon. The coordinated
vertically oriented stops 120a,b are utilized to stop
the advancing pallets 40, and feed one pair of pallets
per cycle. The pallet positioning device 130 receives
15 the pair of advancing pallets 40, advances itself and
the pallets horizontally to a first water dispensing
location, then to a second dispensing location. Once
the packages have been filled, after the second
location, the pallet positioning device 130 translates
20 vertically which permits the pallets 40 continue to
advance along the conveyor 102. The positioning device
130 reciprocates back into position to receive a next
set of advancing pallets 40. The water overflow drain
unit 140 is positioned beneath the conveyor line,
25 vertically aligned with water dispensing head 130, for
catching waste water from the dispenser.

As illustrated in Figure 3a, the set of
coordinated vertically oriented stops 120a,b advancing
pallets 40, prior to dosing. Each of the stops 120a,b
30 includes a vertically aligned plate 122 having one of
its facial planes perpendicular to the axis of motion of

1 the conveyor line 102. The plate 122 is coupled to a
piston/cylinder 124, the selective vertical actuation of
which advances the plate 122 into the stream of pallets
40 advancing along the conveyor line 102.

5 As illustrated in Figures 3a and 3b the
deionized water dispensing head 110 includes a
horizontally disposed reciprocating support plate 112.
The support plate 112 has sixteen holes 116 arrayed in a
4 x 4 matrix. The top of the plate 112 receives a set
10 of sixteen flexible hoses 114, for example tygon tubing
or other fluid conduit, for delivering deionized water
to a set of sixteen narrow and elongate teflon tubes 118
which extend downwardly from the bottom of the plate 112
and are particularly well suited to delivering precise
15 doses of deionized water therethrough. Teflon is a
particularly desirable material for such a use as water
generally does not adhere to teflon surfaces in large
droplets which may fall therefrom at inappropriate times
in the deposition cycle.

20 The plate 112 is coupled, at a lateral edge,
to a piston/cylinder 111, which may be actuated to raise
and lower the head 110 (and the teflon tubes 118) in
accordance with a predetermined deionized water
deposition cycle which is more fully described
25 hereinbelow.

Beneath the conveyor line, vertically aligned
with water dispensing head 130, is a water drain unit
140 which is so disposed to catch any excess water which
may emanate from the dispenser during purge cycle or
30 cycle misfeeds. The water drain unit comprises a basin
142 having a sloped base, therein forming a funnel-like

1 shape, directing water therein toward a hole 144 in the
base. The hole 144 is coupled to a drainage tube 146
which carries the drainage water away from the assembly
to a remote location.

5 The fourth element of the deionized water
injection assembly 100 comprises a pallet positioning
device 130. This element receives a pair of advancing
pallets 40 and first holds them in position beneath the
deposition head 110 in a first position so that the
10 first sixteen recesses 24 of the packaging elements may
be filled with deionized water. Once the first sixteen
recesses 24 have been filled, the pallet positioning
device 130 translates horizontally to a second position,
thereby repositioning the pallets 40 at a second
15 position beneath the deposition head 110. At this
position the second sixteen recesses 40 of the pair of
pallets 40 receive a quantity of deionized water. Once
the second step of water deposition has taken place, the
registration device release the pallets, rises to allow
20 the pallets to advance beneath it, and reciprocates back
to the pallet receiving location (the first location).

More specifically with respect to the elements
of the pallet positioning device 130, the positioning
device comprises a pair of spaced apart arms 131,132
25 which extend laterally across the conveyor line 102, and
which are ideally spaced for receiving and holding pairs
of pallets 40 which advance down the conveyor line 102.
The arms 131,132 are coupled at their lateral ends 133
to vertically oriented piston/cylinder 134 which raises
30 and lowers the arms 132 in accordance with the timing of
the deposition cycle.

1 In addition to the vertically oriented
piston/cylinder 134, the arms 131,132 are coupled
together via an elongate spar member 135 and a
horizontally disposed piston/cylinder 136. Actuation of
5 the piston/cylinder 136 causes the arms 131,132 to move
relative to one another. Specifically, arm 131, which
is positioned in front of the deposition head, up stream
from the deposition head with respect to the flow of the
conveyor line 102, remains stationary as the other arm
10 132 is directed farther downstream from the deposition
head 110, therein moving the pair of pallets 40, into
the second deposition position.

 In operation the entire assembly functions in
accordance with a predetermined timing schedule,
15 beginning with the advance of a pair of pallets 40 along
the conveyor line 102, toward the assembly. Once a pair
of pallets 40 have passed the first of the coordinated
vertical stops 120a, plates 122 are raised, so that
additional pallets 40 may be restrained from continuing
20 into the water dosing location.

 The two pallets 40 continue to advance until
they reach the second of the coordinated vertical stops
120b, at which point the pallet positioning device 130
descends into position holding the pallet in the first
25 deposition position. Deionized water is then injected
via the teflon tubes 118 into the first sixteen recesses
24 of the pallets. Once the water has been injected,
vertical stop 120b is retracted and the horizontally
oriented piston/cylinder 136 of the positioning device
30 130 is actuated, thereby advancing the pallets 40 to the
second deposition position. Once the second set of

-28-

sixteen recesses 24 have been filled with deionized water, the arms 131,132 are raised by vertically oriented piston/cylinder 134, and the horizontally oriented piston/cylinder 136 is retracted.

5 Once the first pair of pallets 40 have advanced past the assembly 100, vertical stop 120a is lowered to permit the next pair of pallets through the dispensing station, and the second set of vertical stops 120b are raised. After the second pair of pallets
10 have advanced, the vertical stops 120b are raised to stop the following pallets 40 from entering, and the cycle repeats.

 Once the packaging elements 10 have each received a quantity of deionized water, the packaging
15 elements and pallets are transferred along the conveyor line to a lens loading location where each recess 24 receives a contact lens by a loading assembly described hereinbelow.

20 THE LENS TRANSFER AND INSERTION ASSEMBLY

 Referring now to FIG. 4, a contact lens hydration pallet 200 is shown in a top view wherein phantom lines correspond to internal structures of the hydration pallet. The hydration pallet 200 comprises 32
25 semi-spherical recesses 202 in which contact lenses are transported through a series of extraction stations, which are described more fully in U.S. Patent No. 5,476,111, entitled "Apparatus for Hydrating Soft Contact Lenses", also assigned to the assignee of the
30 present invention.

1 The hydration pallet 200 has a plurality of
conduits 206 which extend upwardly from the top surface
of the pallet. These conduits 206 are coupled, via
internal branch conduits 208, to small holes 204, one of
5 which is disposed at the bottom of each recess 202, at
the bottom thereof. The holes 204 are thereby coupled
in gas and/or fluid flow communication with an external
supply, whereby a fluid or gas may be selectively
introduced between the surface of the recess 202 and a
10 lens disposed therein. The selective introduction of
this gas or fluid, via the hole 204, is used to propel
the lenses upward so that they may each adhere to
corresponding convex lens attachment surface of the
finger elements of the lens transfer assembly as
15 described hereinbelow.

Referring now to Figures 5a, 5b, and 5c, the
contact lens transfer assembly 210 is shown in side, top
and perspective views, respectively. The assembly 210
generally comprises a head element 240 and a dual axis
20 linearly translating mounting unit 220. First, with
respect to the dual axis linearly translating mounting
unit 220, a mounting bracket 222 is coupled at its lower
horizontal surface 222a to the head element 240. The
mounting bracket 222 is, in turn, mounted to a base
25 element 224, in relation to which, the mounting bracket
222 may be raised or lowered by means of a vertically
oriented translation mechanism. It is understood that a
variety of means may be employed for the raising and
lowering of the mounting bracket 222 including an
30 articulated robot. However, a preferred mechanism

1 comprises an IKO ball screw drive system to reciprocally
translate the head from position to position.

As illustrated in Figure 5c, the base element
224 is mounted to a horizontal track 226, along which it
5 translates in accordance with the actuation of a motive
means. In Figure 5c the motive means 228 is shown to be
a ball screw drive, however, it is understood that a
variety of alternative translation means may be employed
to provide an equivalent function. For example, the
10 translation means may comprise a hydraulic or pneumatic
piston/cylinder device, or it may comprise a scissoring
arm assembly. The ball screw is preferred for its
accuracy, mechanical simplicity, long term operability,
and efficiency.

15 With respect to the head element 240, a
coupling element 242 is affixed at its upper end to the
lower surface of the mounting bracket 222. The lower
end of the coupling element 242 is mated to a pair of
guide plates 244 which are substantially parallel and
20 held in spaced relation to one another by cross bars
246. Slidably mounted on the cross bars 246, also in
spaced apart relation to one another, is a set of four
horizontal support beams 248. The support beams 248
slidably mounted on the cross bars 246 so that they may
25 be drawn together or spread apart in accordance with
their appropriate positioning.

The means by which the support beams 248a-d
may be moved relative to one another is provided by a
pair of piston/cylinders 250, 252. The embodiment of
30 Figure 5b shows the first piston/cylinder 250 couples
the two inner beams 248b, c, and the second

1 piston/cylinder 252 couples the two outer beams 248a,d.
As shown in Figure 5b, the second piston/cylinder is
mated directly to a bracket 254 on one of the outer
beams 248a, and mated to a linkage plate 256 which
5 couples the piston/cylinder 252 to bracket 260 which is
attached to outer beam 248d. The first piston/cylinder
250 is coupled directly to brackets 262a,262b which are
in turn mated to the two inner beams 248b,c.

Extending downward from each support beam
10 248a-d are a plurality of finger elements 264, to which
the lenses adhere during transfer. In the preferred
embodiment, there are thirty-two fingers 264, mounted in
a 4 x 8 array of four beams and eight fingers per beam,
which correspond to the thirty-two recesses 202 of the
15 lens hydration pallet 200. Selective actuation of the
piston/cylinders 250,252, which causes the beams to move
relative to one another, causes the relative spacing of
the finger elements 264 to be altered.

Referring now also to Figure 6, a side view of
20 a finger element 264 is provided. The finger element
264 comprises an elongate shape having a convex lens
attachment surface 266, the curve of the surface 266
generally corresponding to the curvature of the concave
surface of a contact lens. A central bore 268 extends
25 through the finger 264 from the top 270 to the lens
transfer surface 266. This bore 268 is included for the
selective ejection of a fluid therethrough, which fluid
may be deionized water, as will be discussed below with
respect to the deposition of a lens into a corresponding
30 packaging element 40.

1 The end of each finger 264 includes an annular
slotted skirt 272 which separates the curvate shape of
the lens transfer surface 266 from the generally
cylindrical shaft portion 274 of the finger 264. This
5 slotted skirt 272, which includes alternating vertically
oriented slots 272a and skirt elements 272b helps retain
the lens on the attachment surface 266 and prevents it
from sliding, or otherwise moving out of a desired
position. The vertically aligned slots 272a are designed
10 to provide a channel through which a fluid or gas which
is directed upwardly at the lens transfer surface may
flow smoothly. The skirt elements 272b are provided to
prevent a contact lens from sliding off the lens
transfer surface when said fluid or gas is directed at
15 the surface.

 A circular mounting disc 271 is disposed about
the cylindrical shaft of the finger 264, at a position
remote from the tip 266. The mounting disc 271 may be
coupled to the upper or lower surface of the
20 corresponding support beam 248, such that the top of the
finger 264 may be coupled to an external supply of fluid
such as deionized water with the lens transfer surface
266 extending downward. In either case, the tops 270 of
the fingers 264 are coupled to tubes 273, which are
25 preferably flexible, and which may selectively supply
fluids such as air or deionized water to the central
bore 268 in accordance with the predetermined operation
of the assembly.

 As illustrated in Figure 5c, in operation a
30 hydration pallet is advanced along the lens conveyor
line 275 to a position directly beneath the lens

1 transfer assembly 210. The dual axis linearly
translating mounting unit 220 lowers the head array 240
so that the lens transfer surfaces of the fingers 264
are positioned directly above the recesses 202 of the
5 pallet. Once in position, a quantity of air is directed
through the conduits 206, 208 in the plate. This air
floats the contact lenses out of the recesses 202, and
onto the lens attachment surfaces 266 of the fingers
264. As the lenses have been carried in the pallet
10 through several extraction stations prior to arriving at
the lens transfer assembly 210, the lenses and recesses
202 of the pallet have residual deionized water thereon.
This deionized water assists the lenses in adhering to
the surface 266 of the finger 264 via surface tension.
15 While the lens will adhere to the curved lens attachment
surface 266 with or without an additional surfactant, a
surfactant may be added to more efficiently wet the
surfaces together and promote retention of the lens by
virtue of the surface tension of the deionized water and
20 the surrounding atmospheric pressure. In the transfer,
it is desirable to position each of the finger tips 266
within 1.5 mm of the lens to ensure a direct and precise
transfer.

Occasionally the outer surface of the lens may
25 have bubbles of air, in the deionized, water attached to
it. If the bubbles remain, and are not dissolved, or
otherwise removed from the lens, subsequent inspection
of the optical correctness of the lenses will be
compromised. Degassed ionized water is used in the
30 hydration apparatus to minimize bubble formation, and in
order to ensure that air bubbles are removed from the

1 surface of the lens, when the head element 240 and
fingers 264 are raised, the mounting assembly transports
them to a bubble blow off unit 280 disposed between the
hydration conveyor line 275 and the packaging element
5 pallet line 102.

Referring now to Figure 7, a cross-sectional
view of finger 264 carrying a lens and a recess 282 of
the bubble blow off unit 280 is shown. The bubble blow
off unit 280 comprises a plate 284 having a regular
10 array of recesses 282 therein. The regular array of
recesses 282 is designed to match the spacing of the
fingers 264 of the lens transfer assembly head 240. The
base of the recess 282 includes a through hole 286,
which forms the mouth of a conduit 288 which extends
15 downward to an air supply means. Selective ejection of
air through the conduit is directed at the lens which is
adhered to the lens attachment surface 266 of the finger
264. The force of the jet of air may cause the lens to
migrate across the attachment surface 266, however, the
20 slotted skirt 272 prevents the lens from sliding more
than a portion of one lens radius from the center
position. The jet removes the bubbles from the lens
surface so that the inspection process will not falsely
identify such air bubbles as fabrication errors in the
25 lens itself.

Once the bubble removal process has been
carried out, the piston/cylinders 250,252 are actuated
to bring the beams 248 together. This change in
relative distribution of lenses perpendicular to the
beams 248 (whereby the four rows of eight fingers are
30 brought closer to one another, but the spatial

1 separation of fingers within the rows remains unchanged)
is necessary because the distribution of packaging
elements on the inspection pallet 40 is set in
accordance with the inspection station apparatus, which
5 is not the same as the relative spacing of the lenses
during molding or hydration.

Once the piston/cylinders 250,252 have set the
fingers 264, and the lenses thereon, into the properly
distributed array, the horizontally oriented translation
10 means 228 transports the head element 240 and the lenses
to a position above the pallet 40 on conveyor line 102.
With the lenses are positioned above their corresponding
recesses 202, a quantity of deionized water is
discharged from the tip of the finger, via the central
15 bore 268, into the space between the lens and the lens
attachment surface. This quantity of deionized water is
sufficient to disrupt the surface tension adhesion of
the lens to the surface, causing the lens to be carried
along with the water into the package element 10.

20 The contact lenses and lens-package elements
are carried on the pair of inspection pallets 40, by the
conveyor 102 to the next station which is the buffering
station. The fingers of the lens transfer assembly then
return to their open spatial array, and the head element
25 240 is reciprocated back to its receiving position above
the hydration conveyor line 275, and awaits the next
batch of contact lenses.

THE BUFFERING STATION (SEGREGATOR & INTEGRATOR DEVICES)

30 The process of manufacturing contact lenses is
in large part determined by the handling requirements of

1 the lenses themselves. For example, one of the most
important restrictions around which all of the molded
article handling assemblies are designed is that the
optical surfaces should not be touched. The handling
5 requirement which is most relevant to the present
assembly is that the lenses, once hydrated, must not be
allowed to remain dry for more than 15 minutes.

As is the case with most manufacturing line
machinery, the assemblies of the present invention,
10 which together form the post lens hydration apparatus,
require periodic maintenance and/or refilling with
materials used in manufacturing. For example, the
primary packaging station (the saline solution injector
and foil sealing assemblies) requires periodic
15 replacement of the foil material which is heat sealed to
the packaging elements. The performance of other
assemblies, however, are susceptible to being
interrupted. However, the molding assemblies need to be
kept in continuous operation for proper equilibration
20 which is critical for optimal yield quantities.

In order to ensure that certain assemblies be
permitted to run continuously, and still provide for
periodic maintenance or resupply of other stations, one
or more buffering station are necessary. The ideal
25 position for a buffering station must be one where the
lenses remain in an aqueous environment. The buffering
station of the present invention is positioned between
the lens transfer assembly and the inspection station.

The pallets 40, which have been filled with
30 deionized water, and into which contact lenses have been
deposited, each define a 2 x 8 array. In pairs, the

1 pallets define a 4 x 8 array. At the lens insertion
station (the lens transfer assembly) the pairs of
pallets are advanced side by side; the elongate axis
defined by the columns of 8 recesses, of each pallet
5 being parallel to the direction of motion of the
conveyor line.

Referring now to Figures 8, 9, 10 and 11,
which are perspective views of the buffering station,
including the segregator unit, and the integrator unit,
10 respectively. As illustrated in Figure 9, the buffer
station comprises first, second, third, and fourth
segments 304, 308, 312, 316 of a conveyor line, each of
which is disposed for movement of pallets in the same
direction. A segregator unit 320 is positioned after
15 the first segment 304, and an integrator unit 340 is
positioned before the fourth segment 316. The second
and third segments 308, 312 run parallel to one another,
each beginning at the segregator unit 320 and ending at
the integrator unit 340.

20 A first segment 304 of the buffer conveyor
line is disposed perpendicularly to the lens transfer
conveyor line 102 which advances the pallets from the
lens transfer assembly, as set forth above. Referring
specifically to Figure 8, the end of the lens transfer
25 conveyor line 102 and the beginning of the first segment
304 of the buffer conveyor line, and the lateral pallet
transfer unit 306 which transfers the pallets 40 from
the former to the latter are shown in a top view. As
the pairs of pallets 40 reach the end of the lens
30 transfer conveyor 102 they are stopped from advancing by
a guide 300. The pallets 40 are then pushed by a push

1 plate 302 from the lens transfer conveyor line 102, onto
the first segment 304 of the buffer conveyor line.

More particularly with respect to the motion
of the pusher plate 302, the pusher plate 302 includes
5 an arm 303 extending from its back portion which is
motively coupled to a slide element 305 which is
disposed beyond the wall element 300. Selective
actuation of the slide element 305 in the forward
direction provides the linear lateral motion of the
10 pusher plate 302 and transfers the pallets 40 to the
first segment 304 of the buffer conveyor. Reverse
actuation of the slide element 305 reciprocates the
pusher plate 302 into position to receive the next pair
of pallets 40. It is understood that a variety of
15 mechanisms may be employed which provide the appropriate
motion of the pusher plate; examples being a ball screw
drive, hydraulic, pneumatic, or air piston/cylinder
elements, or mechanical scissoring devices.

As the pairs of inspection pallets 40 are
20 transferred to the first segment 304 of the buffer line,
they are translated from a parallel relationship to a
tandem relationship, because the segment 304 is oriented
perpendicularly with respect to the lens transfer
conveyor 102. The pair is now advanced in tandem with
25 one pallet following the other, each having its elongate
axis oriented perpendicularly with respect to the
direction of motion of the first segment 304 of the
buffer conveyor.

The pallets 40 are advanced in tandem to the
30 segregator unit 320 which permits alternating pallets
40, for example the first of the pairs, to advance

1 linearly onto a second segment 308 of the buffer
conveyor line; the second segment 308 of the buffer
conveyor line being co-linear with the first segment
304. A vertical stop mechanism 310a, which is similar
5 in form and function to the vertical stop 120 of the
deionized water injection assembly, is disposed before
the segregator 320 to permit only one pallet of the pair
onto the segregator 320. With respect to the second
pallets of the pairs, the segregator 320 transfers them
10 to the third segment 312 of the buffer conveyor, which
runs parallel to the second segment 308.

Vertical stops 310b, 310c which are disposed on
the second and third segments 308, 312 of the buffer
conveyor line, are positioned to prevent premature
15 advancement of the pallets 40 on the conveyors until
transfer is completed.

The segregator 320 is continuously engaged,
providing both a constant spacing of individual pallets
40 from one another, and providing a dual track holding
20 line for the pallets 40 during interruptions in the
subsequent assemblies of the manufacturing line. The
pallets 40 thereby form parallel lines extending along
the second and third segments 308, 312 for distances
which are determined to be sufficient to store the
25 number of pallets 40 which will be produced during
normal service interruptions in the manufacturing line,
as for example twenty minutes.

At the distal ends of the second and third
segments 308, 312, an integrator unit 340 is provided to
30 merge the two streams of pallets 40 so that they may
advance, in a regularly spaced unitary stream, along the

1 fourth segment 316 of the buffer conveyor, to the
inspection station. Again, vertical stops 310d, 310e are
positioned at the ends of the segments 308, 312
respectively, and are engaged to ensure that only one
5 pallet 40 enters the integrator at a given time.

The integrator 340 remains engaged during
normal operation of the manufacturing line, but is
disengaged to stop the advance of any further pallets 40
when an interruption occurs. During this time, the
10 pallets 40 which continue to advance from the lens
transfer assembly are stored in parallel lines on the
second and third segments 308, 312 of the buffer
conveyor. Once the interruption ends, the integrator
340 is reengaged and merges the stored pallets in a
15 continuous stream. A final vertical stop 310f is
disposed at the outlet of the integrator 340 to prevent
premature advancement or skewing on the powered
conveyor, and to enable spacing between pallets 40 on
the fourth segment 316, as they enter the inspection
20 station.

Referring specifically to Figure 10, which is
a perspective view of the segregator unit, particular
attention is provided to the features and function of
the segregator 320. A housing 321, which is an inverted
25 L-shaped member is mounted to the lateral edge of the
conveyor line, at the coupling point of the first and
second segments 304, 308. Extending outward from the L-
shaped member 321 are a pair of substantially parallel
guide rails 323. The rails 323 are received by a
30 stationary plate 327 which is mounted to the outside
lateral edge of the third segment 312 of the buffer

1 conveyor. A first moving plate 329 is slidably mounted
to the guide rails 323 such that the plane of this first
plate 329 is aligned vertically and parallel to the
direction of conveyor motion. This first plate 329
5 reciprocates from a first position between the second
and third conveyor segments 308,312 and a second
position at the stationary plate 327. A second moving
plate 331 is similarly mounted to the guide rails 323,
and to a motive means (not shown) such that it may be
10 reciprocated from a position at the outside lateral edge
of the second conveyor segment 308 to a position between
the second and third segments 308,312. The first and
second plates 329,331 are maintained in a spaced apart
relation such that a pallet 40 may be transferred
15 therebetween, from the first segment 304 to the third
segment 312 upon selective reciprocation of the plates
329,331 along the guide rails 323.

In operation, as can be inferred from Figure
10, the reciprocation of the plates 329,331 is
20 selectively controlled such that alternating pallets are
transferred to the third segment 312. It is understood
that a variety of motive means and/or coupling means may
be utilized for reciprocating the plates 329,331
together, for example the guide rails may comprise a
25 threading and the mounting of the plates 329,331 thereto
comprises a nut which may be translated along the guide
rails 323 by the rotation thereof. A separate, but
equivalent, design includes an air piston/cylinder
mounted within the L-shaped member 321 which is coupled
30 to the driving plate 331 and which reciprocates it. In
such a design, a coupling means, for example a fixed rod

1 mated to both plates 329,331, must be utilized to slave
the motion of plate 329 to the motion of the dive plate
331.

Referring now to Figure 11, which is a
5 perspective view of the integrator unit, a detailed
description of the features and functions of the
integrator unit is provided. Similar in many respects
to the segregator unit 320, the integrator is
essentially the same device which operates in reverse.
10 A housing element 341, which is L-shaped and mounted to
the outside lateral edge of the second segment 312 of
the buffer conveyor. A pair of guide rails 343 extend
outward from the housing member 341 and are received by
a stationary plate 347, mounted to the outside lateral
15 edge of the third segment 312 of the buffer conveyor. A
set of spaced apart moving plate 349, 351 are slidably
mounted to the guide rails 343 such that the planes of
these plates 349,351 are aligned vertically and parallel
to the direction of conveyor motion. The second moving
20 plate 351 is coupled to a motive means (not shown) such
that it may be reciprocated from a position at the
outside lateral edge of the second conveyor segment 308
to a position between the second and third segments
308,312. The first and second plates 349,351 are
25 maintained in a spaced apart relation such that a pallet
40 may be transferred therebetween, from the third
segment 312 to the fourth segment 316 upon selective
reciprocation of the plates 349,351 along the guide
rails 343.

30 In operation, as can be inferred from Figure
11, the reciprocation of the plates 349,351 is

1 selectively controlled such that alternating pallets,
one from the second segment 308 followed by one from the
third segment 312, advance to the fourth segment 316.
It is understood that a variety of motive means and/or
5 coupling means may be utilized for reciprocating the
plates 349,351 together, for example the guide rails 343
may be threaded matable to a threaded hole or nut in the
plates 349,351. A separate, but equivalent, design
includes an air piston/ cylinder mounted within the L-
10 shaped member 341 which is coupled to the driving plate
351 and which reciprocates it. In such a design, a
coupling means, for example a fixed rod mated to both
plates 349,351, must be utilized to slave the motion of
plate 349 to the motion of the drive plate 351.

15 THE LOW VIBRATION LENS-PACKAGE TRANSPORT ASSEMBLY, THE
INSPECTION ASSEMBLY, AND THE WATER EXTRACTION ASSEMBLY

Referring now to Figure 12, a top view
diagrammatic of the present invention is provided. As
20 is illustrated, the lens transfer station 299, where the
lenses are transferred to the packaging elements on the
inspection pallets 40 is sequentially followed by the
buffering station 399. The pallets, having advanced
through the buffering station are transferred through a
25 conveyor station 499 to the inspection station 599, by a
low vibration conveyor assembly as described
hereinbelow.

Figure 13 is a perspective view of the low
vibration transfer assembly which transfers the
30 inspection pallet from conveyor 316 to the inspection
station. When a pallet 40 has passed through the

1 integrator unit of the buffer assembly and has passed
down the fourth segment of the buffer conveyor, it is
translated to a staging area 325 as illustrated in
previously described Figure 9. At this staging area 325
5 an overhead double axis transport carrier reciprocates,
picks up the single pallet 40 for transfer to the
automatic lens inspection station as illustrated in
Figure 13. The overhead transport is a double axis
Hauser Transport Mechanism, and is used to isolate the
10 automatic lens inspection system from the remainder of
the post-hydration line.

It is important that vibrations of the lenses
and the deionized water be minimized during this
transport, and through the entire inspection line so
15 that water waves are avoided, as they can cause optical
distortions which, in turn, may cause false
determinations of lens quality. By utilizing a double
axis transport mechanism, the pallet can be gently
conveyed to the automatic lens inspection system, and
20 thereby avoid such vibrations which that might otherwise
impair the inspection results.

After the first pallet has been lifted from
the staging area, the next pallet may be advanced into
the staging area to be carried onto the inspection line
25 conveyor. The double axis transport mechanism
transports the pallets from the buffer conveyor, where
the pallets are advanced at a given speed and spacing,
to the inspection line, where the speed of the pallets
is substantially slowed to avoid vibration. It is
30 necessary, therefore, for the spacing of the pallets on
the inspection conveyor to be substantially closer

1 together so that the inspection conveyor may accommodate
the same number of pallets in a given time.

5 The low vibration pallet transfer assembly 400
comprises a pair of pallet grasping plates 402a,402b
which are mounted, in spaced relation to one another, to
corresponding blocks 404a,404b. One of the grasping
plates 402a is slidably mounted to its block 404a such
that selective actuation of an extending mechanism
(housed within block 404a) widens or reduces the spacing
10 between the two grasping plates 402a,402b. The blocks
404a,404b are mounted to a common wall element 406 which
is slidably mounted to a base element 408. A second
motive mechanism (also not shown) is disposed within the
base element 408 and coupled with the common wall 406
15 such that the wall 406 can be selectively raised and
lowered. The base element 408 is mounted to a
horizontal track 410 having a translating means for
reciprocating the entire assembly from a position above
the staging area 325 to the inspection station conveyor
20 line 420.

In operation, the low vibration pallet
transfer assembly 400 reciprocates to the staging area
325 to receive a pallet 40. The common plate 406 is
lowered, thereby positioning the pallet grasping plates
25 402a,402b adjacent to the lateral edges of the pallet
40. The motive element within the block 402a is
actuated to draw the plates closer, therein bringing the
inner surfaces of the plates 402a,402b in contact with
the pallet 40. Once the pallet has been grasped
30 securely by the lateral plates 402a,402b, the common
wall 406 is raised, and the pallet is transported to the

- 46 -

Inspection station conveyor line, which is disposed perpendicularly to the forth segment 316 of the buffering conveyor line. Once in position above the inspection conveyor line 420, the pallet 40 is lowered onto the line released by
5 actuation of the plate widening mechanism. The pallet is then carried into the inspection station. Once the pallet is transferred to the low vibration lens transfer assembly 400 rises and reciprocates back to the staging area 325 to receive the next pallet 40.

10 In the Automatic Lens Inspection System, the inspection pallets 40 are conveyed through the system as a pulse of light is directed through the lens-packages and contact lenses, and focused on a camera to generate an image of the lens
15 therebelow. Preferably, the camera includes an array of pixels, each of which generates a respective one electric signal proportional to, or representing, the intensity of the light incident on the pixel. Those electric signals are then digitally processed to determine if the lens is acceptable for consumer use. Suitable procedures for processing or analyzing
20 the electric signals from the pixel array are disclosed in European Patent Nos. 0 604 179 and 0 604 174, entitled "Ophthalmic Lens Inspection Method and Apparatus" and "Method and System for Automatically Inspecting Ophthalmic Lenses", respectively. Separate systems are utilized to inspect the
25 sixteen lenses carried in a pallet. After completing the test for the last bank of lenses, the Automatic Lens Inspection System sends a datablock with the vision inspection results to the programmable logic controller used to consolidate the

-47-

lenses for packaging. This information is used by the lens-package transfer assembly as described below.

After the lenses have been inspected by the automatic lens inspection system, the pallet is lifted by
5 second double axis overhead transport and placed on conveyor for transport to the deionized water removal station (which is station 699 in Figure 12). The deionized water is removed by a specially configured nozzle, as described in European Patent No. 0 618 063, entitled
10 "Solution Removal Nozzle". As described earlier, the deionized water is used to center the lens within the package carrier during the inspection process, but is removed prior to packaging, to enable a precise dosing of a buffered saline solution in the final package, as will
15 hereinafter be described in detail.

After removal of the deionized water, the lenses, package carriers and inspection pallet are transported to the lens-package transfer assembly which removes the packaging elements and lenses therefrom, deposits the
20 optically incorrect lens-packages (as determined by the inspection station) on a conveyor for bad lenses, and deposits the correct lens-packages on good conveyor.

The First Rotating Lens-Package Transfer Assembly

Referring now to Figure 15, the lens-package
25 transfer assembly is shown in a perspective view, in position above a pallet of lens-packages which have had

1 the deionized water removed therefrom. The assembly 500
comprises a reciprocating support 502 coupled at the
lower end of a vertical shaft 504. The shaft 504 is, in
turn, coupled at its upper end to a rotation means 506
5 whereby the shaft 504 and the support 502 may be
selectively rotated by 90 degrees in accordance with the
predetermined positioning of a pallet 40 or the
orientation of the conveyor (see Figure 16) onto which
the lens-packages are deposited. It is understood that
10 the rotating means 506 may comprise an air cylinder
having stops which, for example, correspond to a 90
degree rotation so that the shaft may be reciprocated
between two orientations which are perpendicular.

The rotating means 506 is disposed within a
15 mounting platform 501, which is in turn coupled to a
dual axis transport subassembly (the horizontal track
thereof is identified as element 503 in Figure 15). The
dual axis transport subassembly transports the support
502 from a first location to a second location, for
20 example, from a position above the water extraction
conveyor line to a position above the consolidating
conveyor line (which is described more fully with
reference to Figure 16).

Extending downwardly from the support 502 are
25 a set of resilient bellowed fingers 508 having a
generally elliptical shape. The fingers 508 each have
an open tip 510 at their lower ends which forms an
entrance into a central volume which extends the length
of the finger. The upper ends of the fingers 508 are
30 coupled to the vacuum tubes 512 such that the central
volume of the fingers are in sealed gas flow relation to

1 tubes 512 which are individually coupled to a vacuum
source (not shown). Each tube is separately valved; the
valves being independently controlled by a processor in
accordance with signals received from the inspection
5 station with respect to which lens-packages contain
correct lenses. Selective activation of the vacuum
source would, therefore, provide a low pressure suction
at the tips 510 of the finger 508. When this low
pressure suction is employed, the tips 510 of the
10 fingers may be placed onto a flat surface, therein
sealing the central volume, and securing the flat
surface to the finger 508.

In operation, a pallet 40 having lens-
packages, from which the deionized water has been
15 removed, is transported to the first location, the lens-
packages being substantially aligned with the fingers
508 of the first rotating lens transfer assembly 500.
The fingers 508 are directed downward until their tips
510 contact the flat surface portion 46b of the
20 packaging element, forming a sealing interface
therewith. Selective actuation of the valves
controlling the drawing of a vacuum within each finger
508 causes the package elements and lenses to be lifted
from the pallet. It is understood that all of the lens-
25 packages may be removed from the pallet 40 and
subsequent actuation of the valves may be utilized to
deposit the incorrectly molded lenses on a separate,
bad, conveyor, and the optically correct lenses on the
good conveyor, or in the alternative, only the good
30 lenses are transferred, and the rejected lenses are
later removed from the inspection pallet by an

1 alternative means. This procedure can be used to
increase (shorten) the cycle time of the transfer
device.

5 Once the appropriate lens-packages are removed
from the pallet 40, the manifold 502 and fingers 508 are
rotated 90 degrees by the rotating means 506 while
simultaneously being reciprocated upward and laterally
by the dual axis transport subassembly. The fingers 508
are repositioned over the consolidating conveyor, at
10 which point the vacuum within the fingers 508 which are
holding lens-packages is released, and the lens-packages
are deposited on the conveyor.

Once the optically correct lens-packages have
been so deposited, the assembly 500 reciprocates back to
15 extract a new set of lens-packages from the next
inspection pallet 40.

CONSOLIDATING CONVEYOR AND SECOND ROTATING LENS-PACKAGE ASSEMBLY

20 The first rotating lens-package transfer
assembly 500 deposits the optically correct lens-
packages onto the consolidating conveyor 602 as shown in
Figure 16. The consolidating conveyor comprises a belt-
type motive surface 604 onto which the two rows of lens-
25 packages are transported. The conveyor surface 604 is
divided into parallel longitudinal channels 605 by a
guide wall 606. As shown in Figure 16, the rows of
lens-packages may not be regularly distributed on the
conveyor surface when they are deposited.

30 The lens-packages are transported along the
conveyor until the lead packages contact a moveable gate

1 element 610. The gate element 610 interferes with the
continued transport of the lead lens-packages in each of
the channels 605. As the progression of the lead lens-
packages is halted, the packages which follow
5 subsequently come into contact with the lead packages,
therein being consolidated into a regularly spaced
array. A sensor block is disposed above the conveyor
surface 604, at a location upstream from the gate
element 610. An additional sensor may be located at a
10 distance wherein a specific number of lens-packages may
be aligned therebetween in a staging position 609. For
example, the array of lens-packages which is positioned
between the wall element 608 and the sensor element 610
in the embodiment illustrated in Figure 16 is 2 x 5.
15 Gate element 610 provides for a controlled flow of only
the correct number of lens packages necessary to
complete the 2 x 5 array in the staging position.

Referring now also to Figure 17, a perspective
view of the second rotating lens-package transfer
20 assembly 650 is shown. Once a full 2 x 5 array of lens-
packages are disposed in this staging position 609, a
second rotating lens-package transfer assembly 650
lowers a set of suction fingers which remove the array,
rotates, and transports the lens-packages to a pallet of
25 the saline solution injector and foil sealing assembly.

More specifically with respect to the second
rotating lens-package transfer assembly, the assembly
comprises features which are similar in most respects to
the first lens-transfer assembly 500. The assembly
30 includes a support 652 which is mounted to the lower end
of a rotating shaft 654. The upper end of the shaft 654

1 is coupled to a rotating means (not shown) which rotates
the support through 90 degrees in the horizontal plane.
Extending downwardly from the support 652 is an array of
regularly spaced fingers 658, the tips 660 of which are
5 hollow so that a vacuum may be drawn therethrough. This
vacuum is used to securely hold the lens-package
elements during transport. The fingers 658, which are
hollow so as to form a conduit through which the vacuum
may be drawn, are coupled to tubes 662, at the support
10 652 for the purposes of supplying the vacuum pressure to
the finger tips 660.

The rotating shaft 654 is coupled, through the
rotating means, to a mounting platform 651. The
mounting platform is, in turn, mounted to a dual axis
15 motive means (track 653 comprises the horizontal axial
component along which the mounting platform translates.
In operation the assembly is positioned above the
consolidating conveyor 602, at the staging position 609,
as the array of lens-packages is consolidated. Once the
20 sensor elements have determined that a full 2 x 5 array
of lens-packages has been formed, the manifold 652 and
fingers 658 are lowered by the dual axis motive means.
A vacuum is drawn in the finger tips 660 once the lens-
packages are contacted in order that a secure grip on
25 the lens-packages may be maintained. The manifold 652
and fingers 658 are then raised, rotated, and translated
to a position above the pallet stream of the next
assembly.

As with the first rotating lens-package
30 transfer assembly 500, the rotating means and the dual
axis motive preferably comprise, respectively, an air

1 cylinder with 90 degree stops, and a pair of
perpendicular IKO ball screw mechanisms.

THE SALINE SOLUTION INJECTOR AND FOIL SEALING ASSEMBLY

5 Referring now to Figures 18, 19 and 20,
various perspective views of the saline solution
injector and foil sealing assembly 700 are shown.
Figure 18 is a schematic device layout of the assembly
including a conveyor loop 702 having a plurality of
10 pallets 704 spaced therealong. The pallet stream is
intermittently driven such that the pallets stop at the
various subassembly stations which are sequentially
spaced along the conveyor 702.

The related assemblies and subassemblies which
15 cooperate to provide saline and heat sealed covers to
previously unsealed lens-packages include the second
rotating lens-package transfer assembly 650 disposed at
the front of the conveyor 704, the saline injector
subassembly 750 positioned adjacent to the front of the
20 conveyor, a short distance downstream from the transfer
assembly 650, a foil pick and place unit 777 which
receives the foil from a printing machine, and a heat
seal unit 780 which seals the foil to the packages.

Each of the fixed pallets 704 is particularly
25 designed to support a 2 x 5 array of individual lens-
packages. It should be appreciated, however, that
alternative embodiments of this assembly can be
designed, in accordance with the number of fingers of
the second lens-package transfer assembly 650, and the
30 size of the staging position 609 of the consolidating

1 conveyor, to accommodate a different number of rows and
a different number of packages in each row.

With specific reference to Figure 20, at the
saline solution injector subassembly 750, the lens-
5 packages are filled with a saline solution which has a
tonicity compatible with the human eye. Stationary
pallets 704 are advanced, with lens-packages thereon,
beneath a horizontal beam 752. The beam 752 is coupled
at a lateral end to a mounting base 754 which is
10 adjacent to the conveyor loop 702. A 1 x 5 array of
dosing tubes 756 extend downward from the beam 752, and
are supplied with saline solution by saline conduits
758, each of which is supplied by a separate dosing pump
(not shown).

15 Upon incremental advance of the pallets 704
into a position aligned with the dosing tubes 754, the
dosing pumps are actuated so that a precise dosage of
saline solution is deposited into the packaging recesses
24. Each contact lens is thereby completely immersed in
20 saline solution. The rate of pumping of saline solution
and the diameter of each dosing tube 756 is chosen such
that no saline solution splashes from any of the
recesses of the packages, which is very important as any
saline solution splashed onto the annular rim 28 would
25 interfere with subsequent foil sealing operations.

The optical verification probes (not shown)
may be mounted in front of the saline injector
subassembly to verify that lens-packages are present in
the advancing pallet 704 so that the dosing tubes 756 do
30 not dispense saline solution into empty pallets.
Additional sensors may be similarly mounted along the

-55-

conveyor, downstream from the saline injector 750, to detect the presence of the proper measured dose of saline solution in each lens-package. A variety of such sensors are available, and are taught in U.S. Patent No. 5,644,895, entitled "Packaging Arrangement", for example the sensor may be a reflective sensor as is commercially available from Omron, or it could be a proximity sensor or could be a fiber optic probe, as commercially available from Keyence as model 24W-V25R, used with an amplifier, model 24W-AA1C. Each detector checks and verifies for a proper height of saline solution in each lens-package.

Referring again to Figure. 18, and also to Figure 19, at a subsequent foil pick and place station 775, a pair of strips of laminar foil are placed over the 2x5 array of package bases, each foil strip covering a 1x5 column of packaging elements. The foil strips have printed thereon all identification indicia required for the final package. The laminar top cover sheets are produced by a foil labeling machine pursuant to the disclosure of European Patent No. 0 646 471, entitled "Method of Double-Sided Printing of a Laminate and Product Obtained Thereby". The foil labeling machine extends at a right angle to the linear packaging machine, as indicated by the FOIL arrow in Figure 18. The pair of foil strips are received from the labeling machine and placed by a foil pick and place unit over the top of each 1x5 row of the 2x5 array of package bases.

1 An optional mechanical chucking station 777,
positions each foil strip to ensure that it is properly
positioned and aligned relative to the lens-packages in
the pallet 704. In addition, a subsequent cover
5 presence verification station may be used to verify the
correct general positioning of each foil strip.

 At a subsequent station 780 the foil strips
are heat sealed to the lens-packages. More
specifically, a set of heated seal heads, mounted at
10 spaced intervals along the length of heating head plate
782, and supported by a pneumatic cylinder or press 784,
presses the foil strips against the lens-packages such
that the foil and the annular rims 28 of the packaging
elements are squeezed between the heated seal heads and
15 the pallet 704.

 A final optical inspection station (not shown)
may be located downstream of the heat sealing station
780, including a plurality of optical detector probes
for examining the outer edges of each sheet of laminated
20 foil strips on the array of lens-packages to ascertain
that the foil is properly and precisely positioned and
heat sealed relative to the array of lens-packages.

 At the position which is farthest downstream,
a robotic assembly 790, having a plurality of vacuum
25 suction cups removes the sealed 1x5 array of packages
from the pallet 704, and transports them to an output
position.

 While the several assemblies, embodiments and
variations of the present invention for post hydration
30 handling of contact lens-packaging elements are
described in detail herein, it should be understood that

1 the disclosure and teachings of the present invention
will suggest many alternative designs to those skilled
in the art. The scope of the present invention is,
therefore, understood and intended to be limited only by
5 the claims recited hereinbelow.

10

15

20

25

30

35

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An automated apparatus for transporting a plurality of contact lenses from a first
5 processing location to a second processing location, said apparatus comprising:

a plurality of elongate finger elements, each element having a convex lens transport surface defined thereon;

a lens transfer carriage, said carriage having an array of said elongate finger elements which receive the contact lenses at a first location;

10 at least one reciprocating drive to alter the spatial relationship of the array;

a translation device to transport the carriage and the lenses to a second processing location;

15 an orifice defined within said convex lens transport surface for injecting a fluid between a one of said plurality of contact lenses and said transport surface to deposit said contact lenses into a lens carrier at said second processing location; and

a controller for actuating said reciprocating carriage, said translation device and said reciprocating drive to effect transfer of said plurality of contact lenses from said first processing station to said second processing station.

2. The apparatus as set forth in claim 1, wherein said lens transfer carriage further comprises:

20 a set of horizontal guide rails;

a plurality of beam elements, slidably mounted in parallel on at least one of said horizontal guide rails; and

said reciprocating drive coupled to said plurality of beam elements for reciprocating said beam elements along said guide rails with respect to one another.

3. The apparatus as set forth in claim 2, wherein said plurality of finger elements are disposed in a plurality of linear arrays, with a linear array extending downwardly from each of said beams, each of said plurality of fingers further comprising:

5 an elongate shaft, having an upper and lower end with the convex lens transfer surface at the lower end of the shaft,

a slotted annular skirt disposed along the shaft adjacent to said lower end, for maintaining the contact lens at a predetermined position.

4. The apparatus as set forth in claim 1, wherein said apparatus further comprises:

10 a second translation mechanism which cooperates with said first translation apparatus to reciprocate said carriage along a first and a second axis of movement.

5. The apparatus as set forth in claim 2, wherein each of said finger elements further comprises a central bore, extending from an upper end of said finger element to said orifice in said lens transport surface, for receiving therethrough, and selectively ejecting therefrom, a quantity of fluid.

15

6. The apparatus as set forth in claim 1, wherein said apparatus further comprises, at said first processing location, a lens pallet having:

20 a lens pallet plate having a plurality of lens holding recesses, each of said lens holding recesses aligned with said lens transport surfaces and having at least one recess hole therein, in which lens holding recesses a contact lens may be disposed; and

a plurality of internal pallet conduits within said plate, with a pallet conduit extending from each of said recess holes to a fluid source, whereby selective ejection of fluid through the pallet conduits causes a contact lens in said lens holding recess to be ejected therefrom and received by an associated lens transport surface.

25 7. The apparatus as set forth in claim 6, further comprising an air jet unit positioned between said first and said second location, said air jet unit comprising:

an air jet plate having a plurality of a spaced air jet recesses therein, said regular spacing corresponding to the array of said elongate finger elements;

at least one air jet hole in each of said recesses;

5 at least one conduit extending from a remote air reservoir to each air jet hole in each of said air jet recesses; and

an air pressure means for selectively directing air from said air reservoir through said at least one conduit, and out of said air jet holes, and at contact lenses which are secured to the lens transfer surfaces of said finger elements for removal of any bubbles thereon.

10 8. An assembly for extracting an array of contact lenses from a hydration pallet, changing the spatial relationship of the array of contact lenses, and depositing said contact lenses into packaging elements, said assembly comprising:

a mounting bracket including a plurality of horizontal guide rails;

15 a plurality of beam elements, slidably mounted in parallel on said plurality of horizontal guide rails;

at least one drive assembly coupled to said beam elements for reciprocation thereof along said guide rails between a compact spacing and a wide spacing;

a plurality of finger elements disposed in a linear array, extending downwardly from at least one of said beam elements, each of said finger elements comprising;

20 an elongate shaft, having an upper and lower end,

a central bore, extending from said upper end to said lower end, for receiving therethrough a quantity of fluid, and selectively ejecting from said lower end said quantity of fluid,

a lens transfer surface at the lower end of the shaft for receiving, and securely holding, thereon a contact lens,

a slotted annular skirt disposed along the shaft adjacent to said lower end, for maintaining the contact lens at a predetermined position; and

5 a dual axis translation mechanism for reciprocating said mounting bracket along a vertical axis and a horizontal axis.

9. A contact lens transfer assembly, said assembly comprising:

at least one beam element, said beam element facilitating transfer of contact lenses between two locations;

10 a finger element, said finger element including an elongate shaft having a lens transfer surface on a first end and a means for attaching said shaft to said beam element on a remote second end;

said elongate shaft including a slotted annular skirt adjacent to said first end; and

15 a central bore extending through said elongate shaft for introducing a fluid between said lens transfer surface and a contact lens secured thereon to release said lens.

10. A contact lens transfer assembly as set forth in claim 9, wherein said lens transfer surface is shaped to conform to a concave surface of a contact lens so that said contact lens can be secured to the lens transfer surface by surface tension.

20 11. A contact lens transfer assembly as set forth in claim 9, wherein said slotted annular skirt includes:

at least one skirt element which prevents a contact lens from sliding off the lens transfer surface when a fluid or gas is directed at said lens transfer surface, and

25 a set of vertically aligned slots defined by said skirt element through which fluid or gas directed upwardly at the lens transfer surface may flow.

12. A method of automatically transporting contact lenses from a first processing location to a second processing location, said method comprising the steps of:

positioning an array of elongate finger elements above an array of lens carrier cavities at said first processing location, each of said cavities having a contact lens therein,
5 each of said finger elements having a lens transfer surface defined thereon;

injecting a fluid into each of said cavities having a contact lens therein to eject said lens from its associated cavity and transfer the contact lens to an associated lens transfer surface;

transporting said array of elongate finger elements to said second processing location;

10 releasing the contact lenses into a set of lens carriers at said second processing location; and

automatically controlling said positioning, injecting, transporting and releasing steps with a controller to effect automatic transfer of the contact lenses from the first processing location to the second processing location.

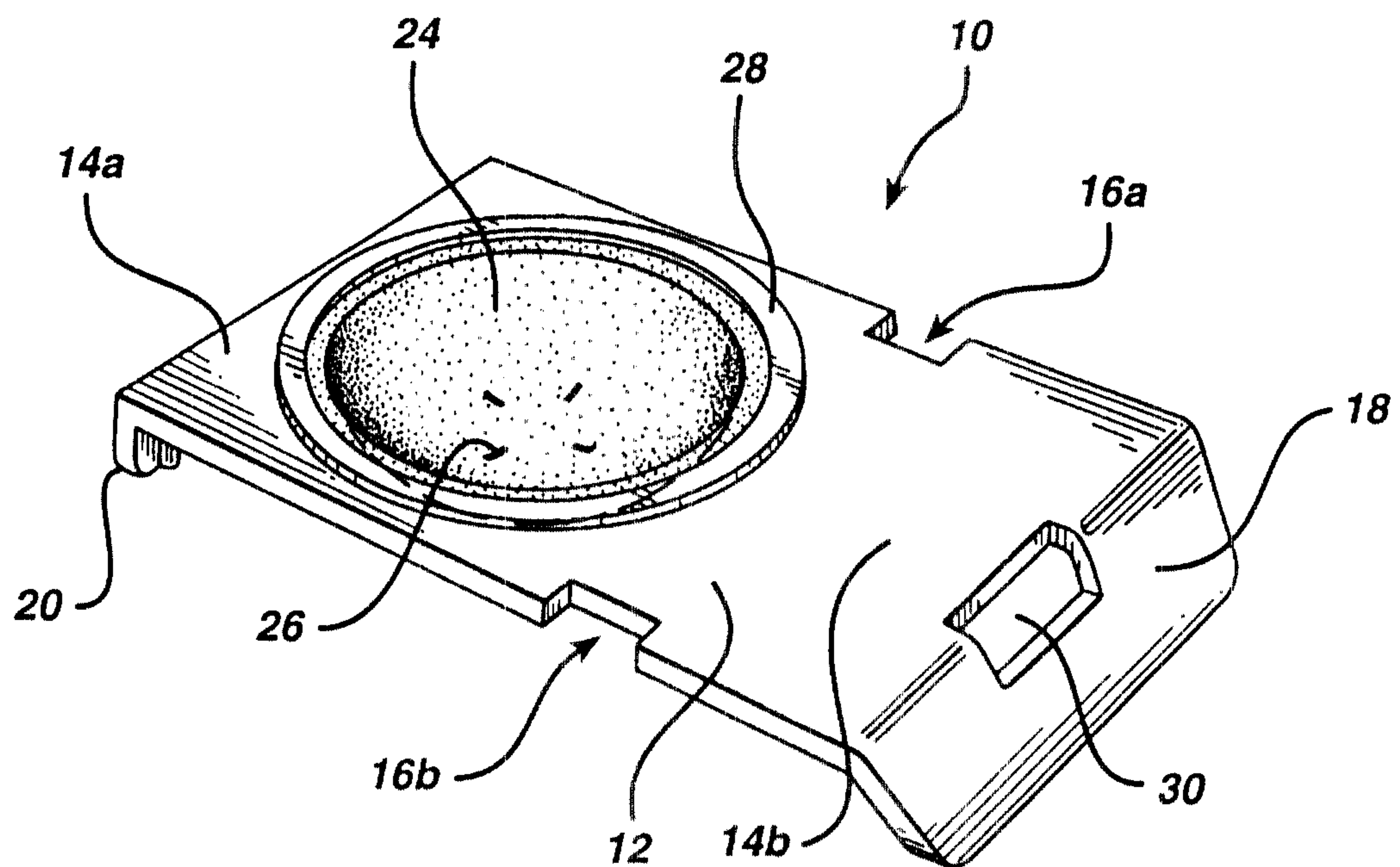
15 13. The method as set forth in claim 12, which further comprises the step of changing the spatial dimensions of said array of said elongate finger elements after said contact lenses have been transferred to said lens transfer surfaces.

14. The method as set forth in claim 12, wherein said method further comprises:

20 ejecting a quantity of air from an orifice defined in each of said cavities beneath each contact lens to propel it onto said lens transfer surface.

15. The method as set forth in claim 14, wherein said step of ejecting a quantity of air from beneath each contact lens is followed by a step of directing a jet of air at each contact lens to remove any air bubbles which are present on a surface of said contact lens.

FIG. 1



PATIENT AGENTS

Archie Ogilvy Renault

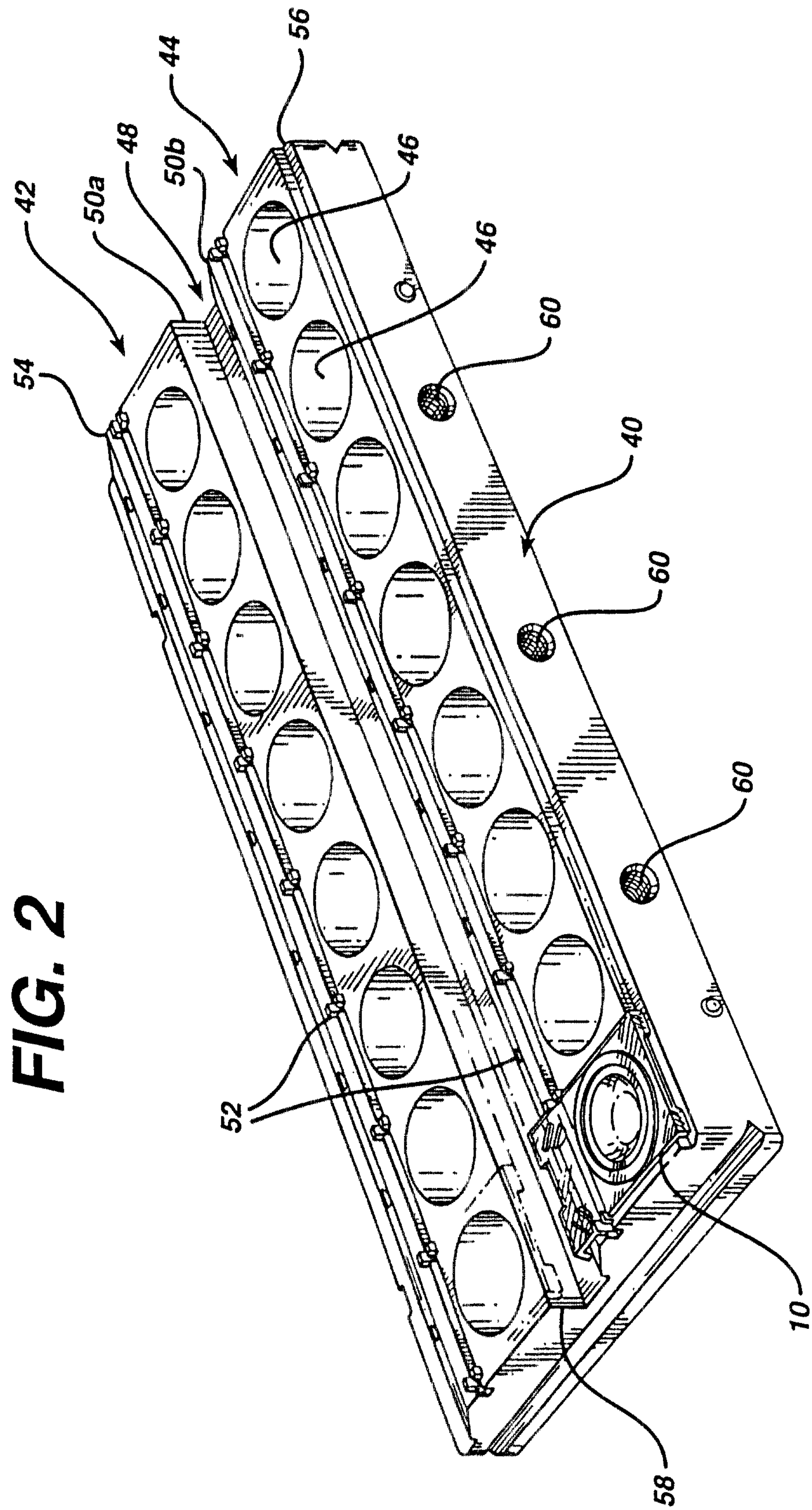


FIG. 2

PATENT AGENTS

Dwight Ogilvy Kenault

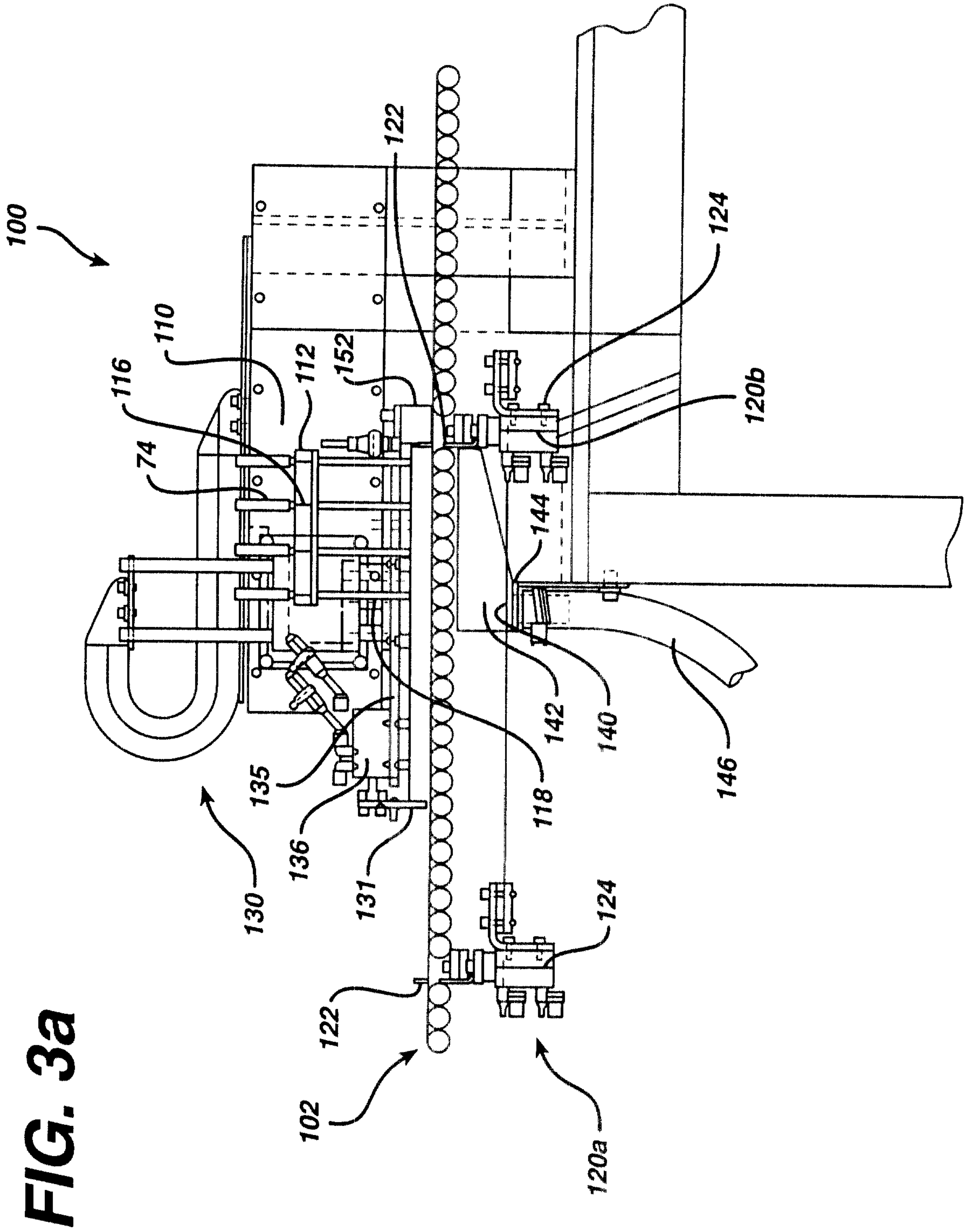
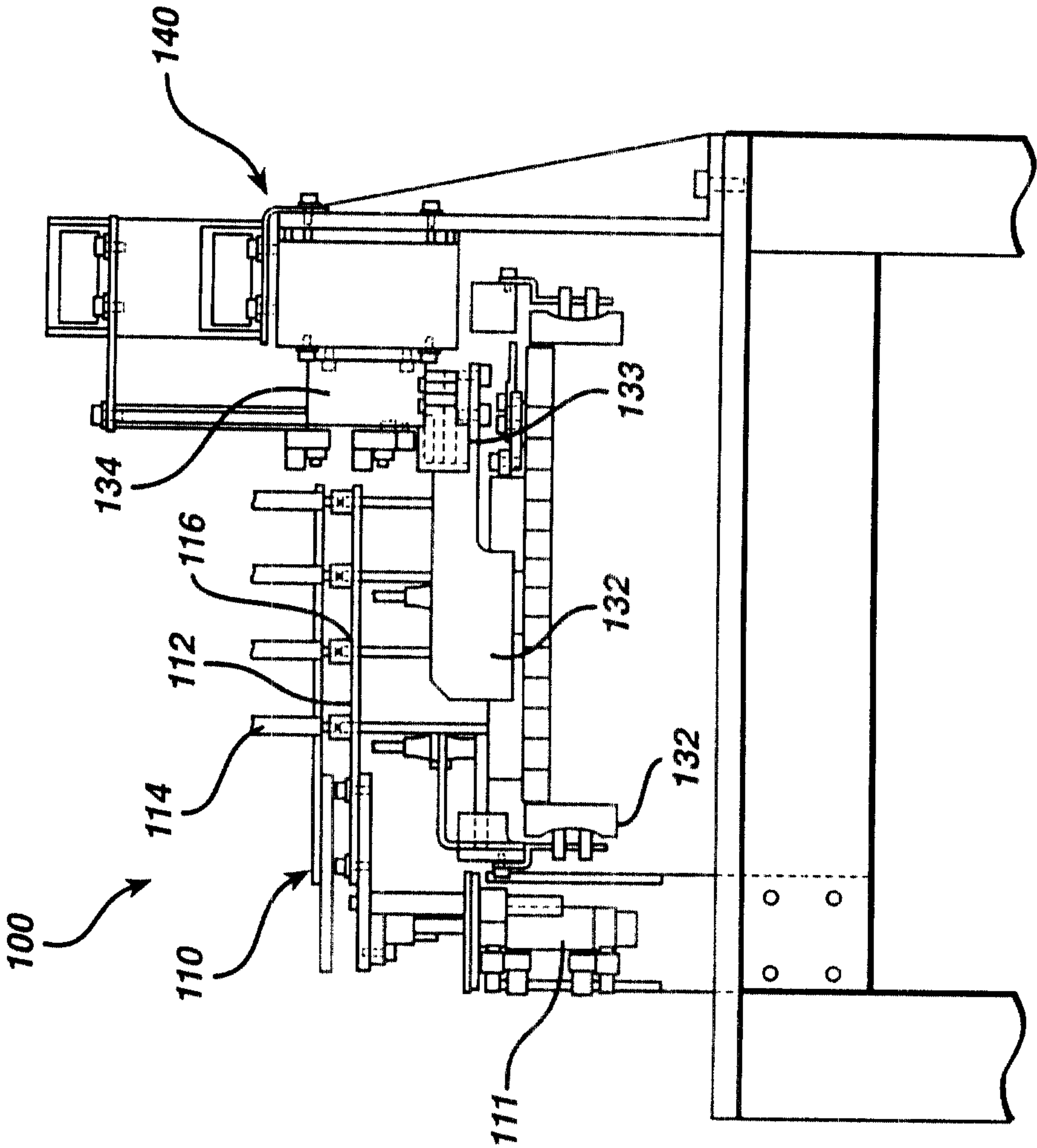


FIG. 3a

PATENT AGENTS

Awakey Ogilvy Renault

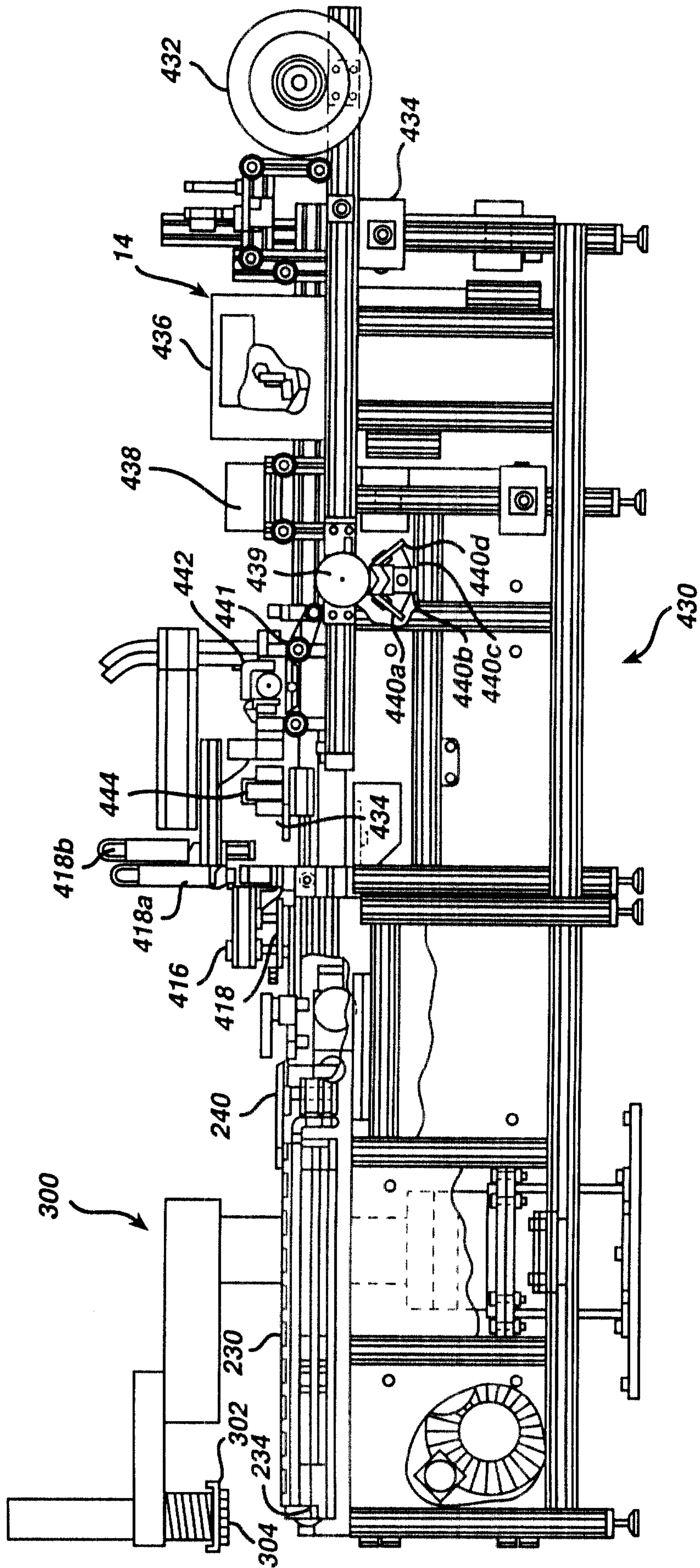
FIG. 3b



PATENT AGENTS

Awabey Ogilvy Renault

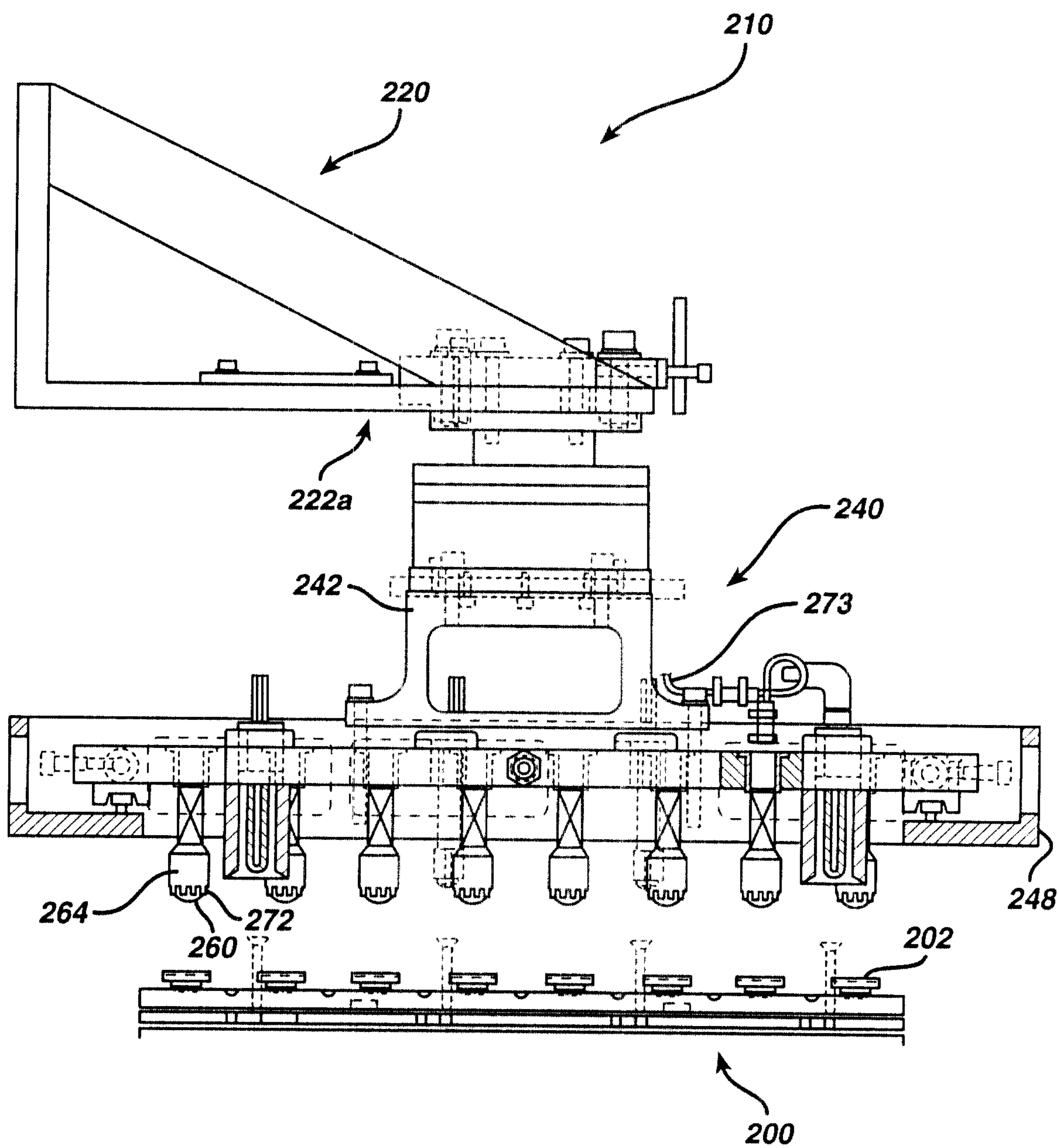
FIG. 4



PATENT AGENTS

Rowley Ogilvy Renault

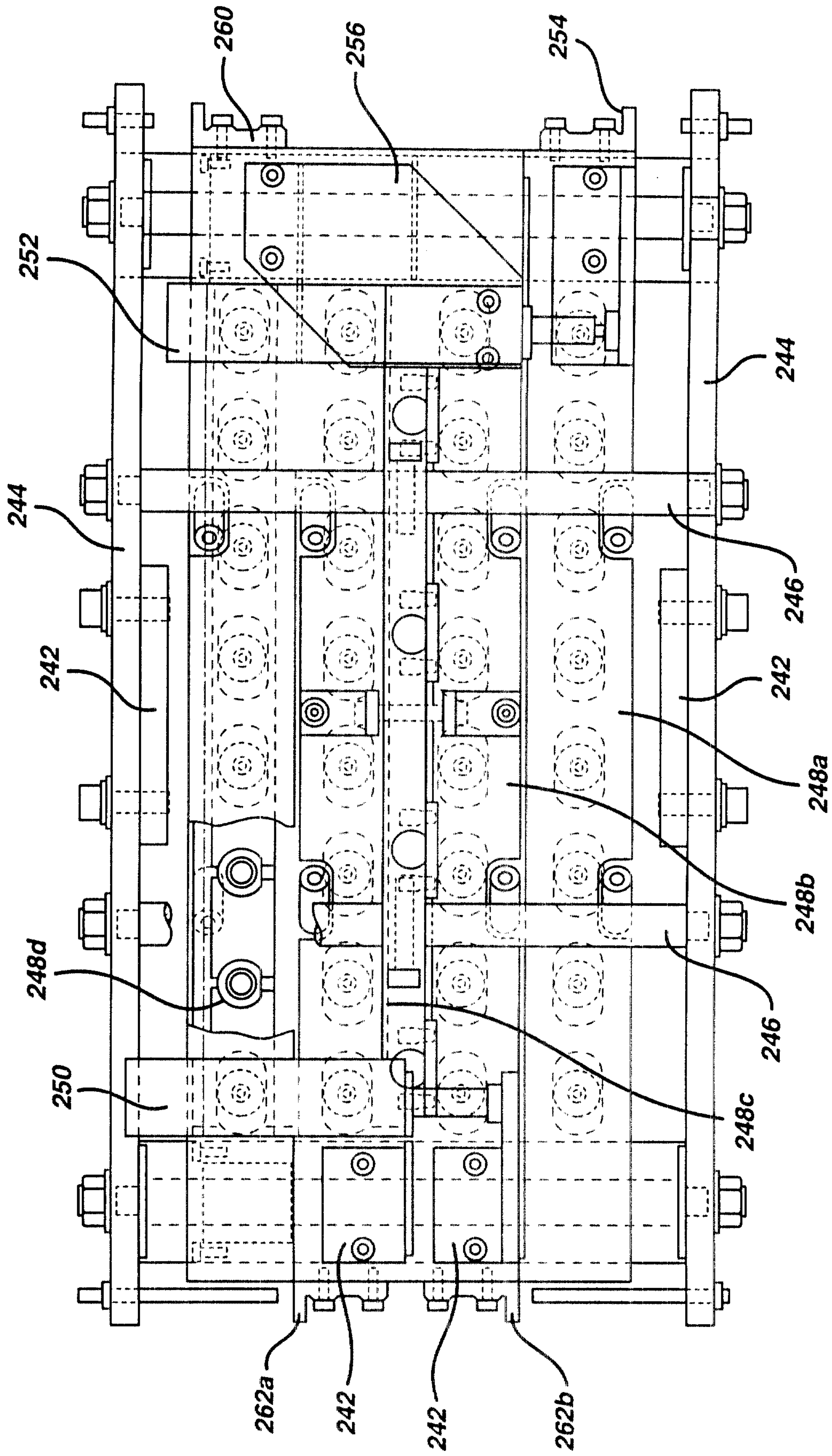
FIG. 5a



PATENT AGENTS

Swales Ogilvy Renault

FIG. 5b



PATENT AGENTS

Swathey Ogilvy Renault

PAULI CELL

Arthur Ogilvy Knapp

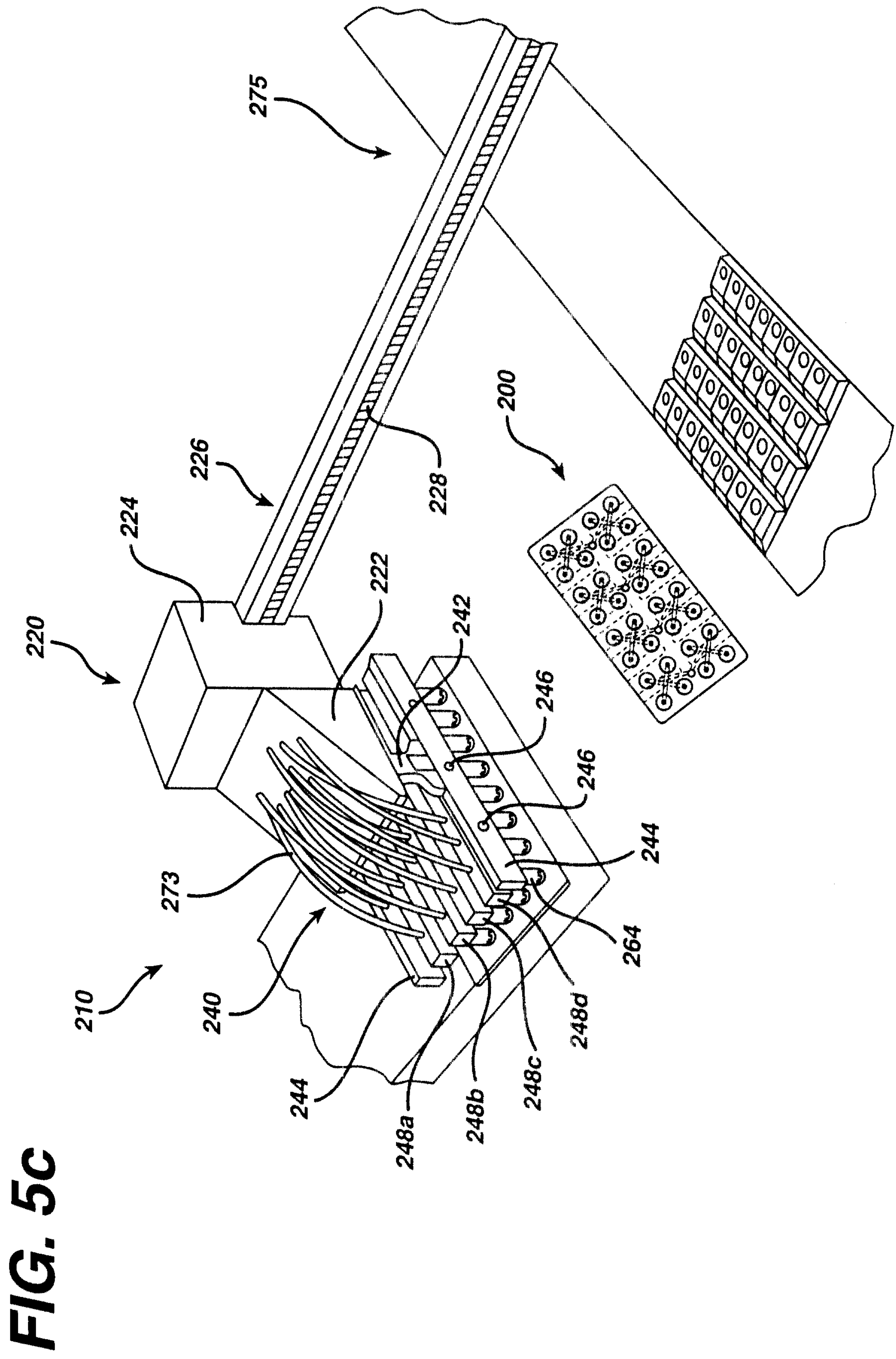
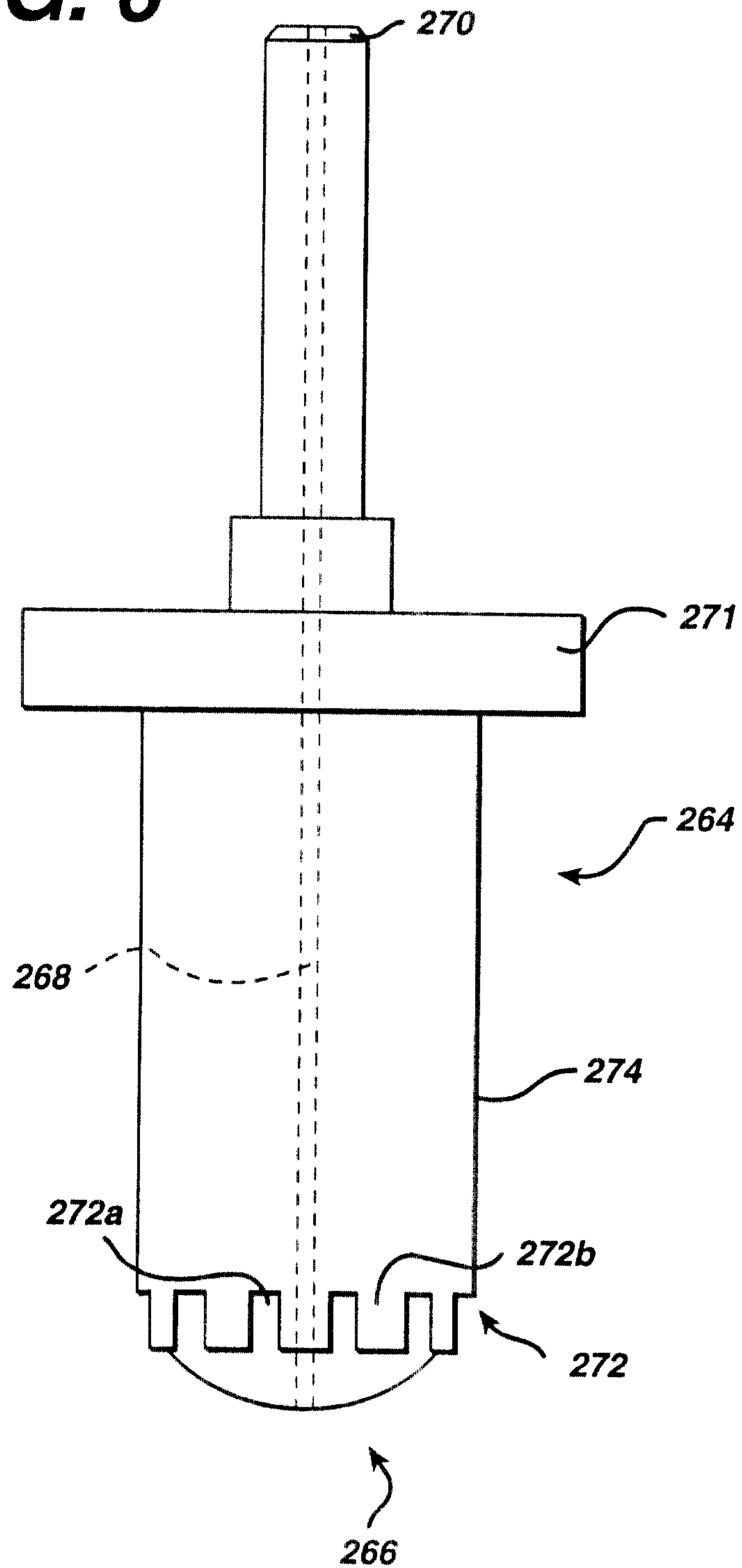


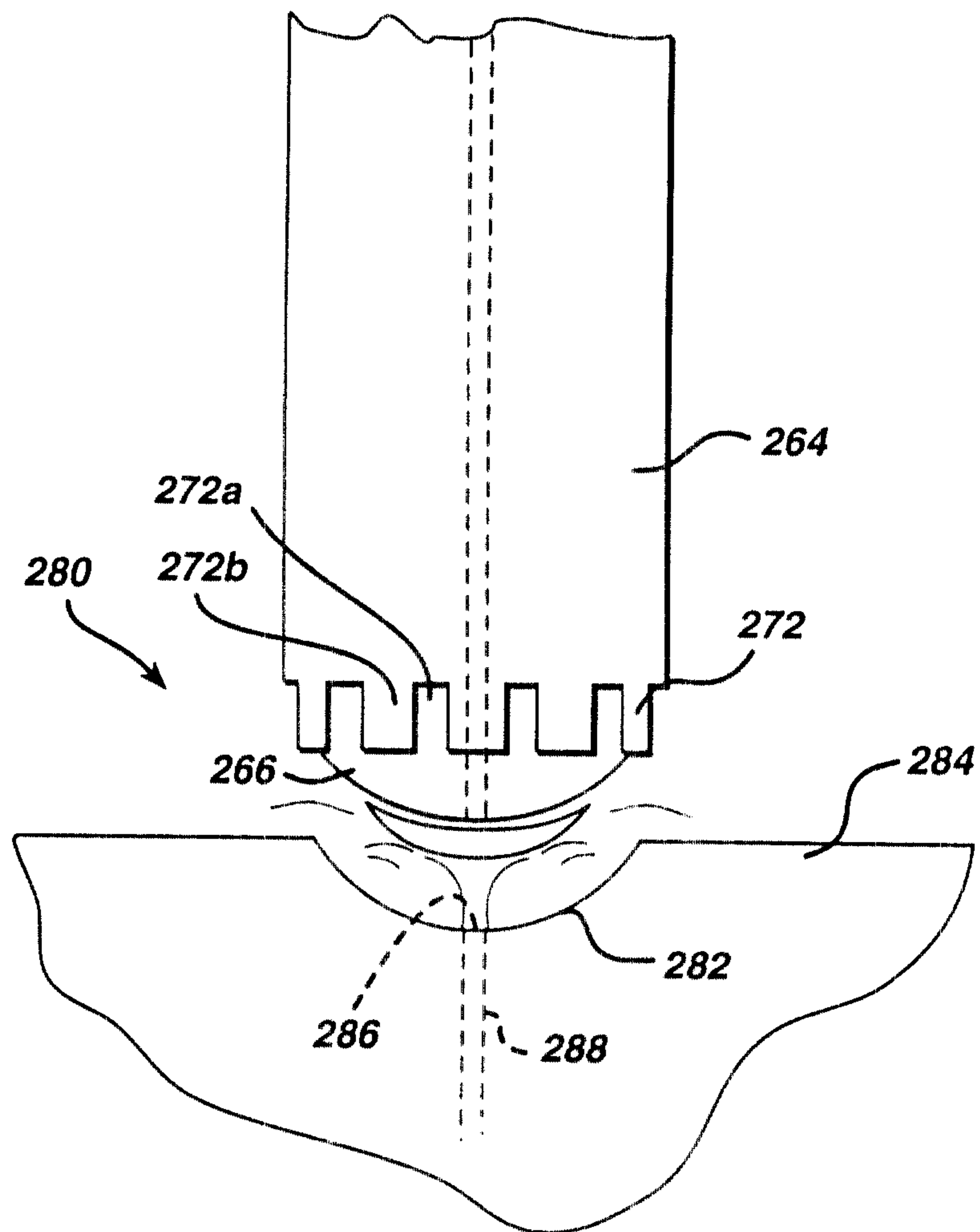
FIG. 6



PATENT AGENTS

Swabe, Ogilvy Renault

FIG. 7

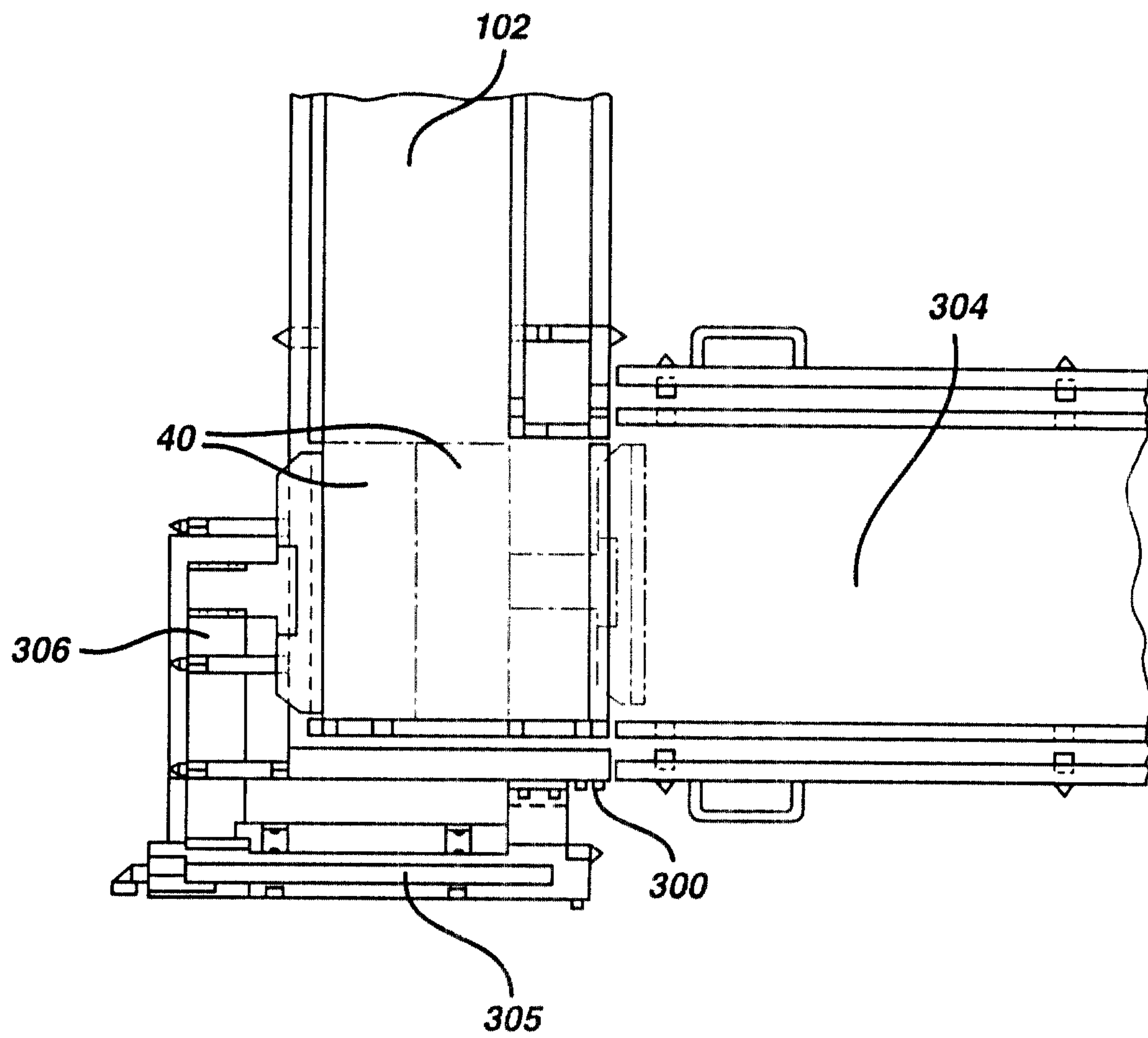


PATENT AGENTS

Swabeys Ogilvy Renault

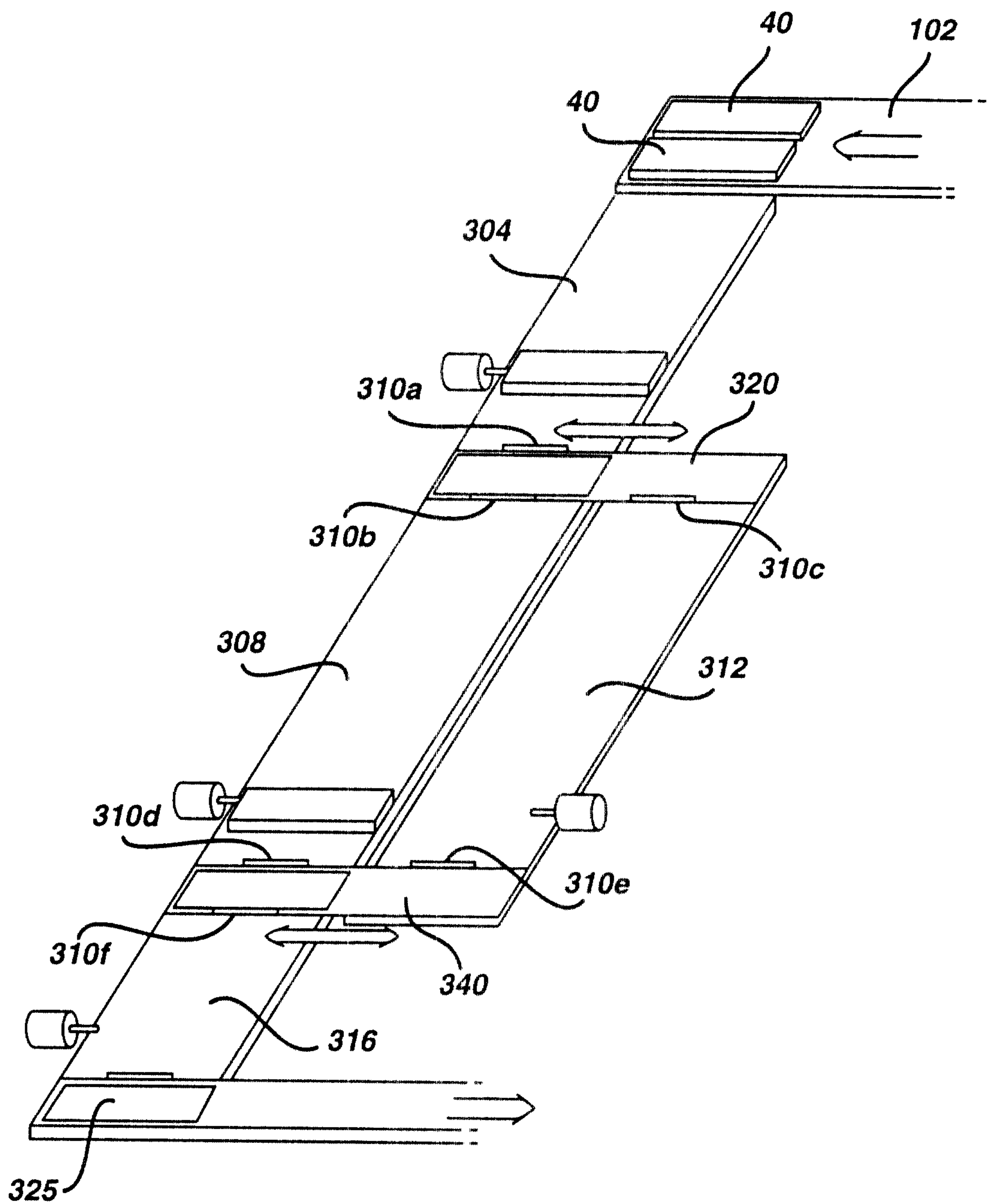
Notary Public for the Province of Ontario

FIG. 8



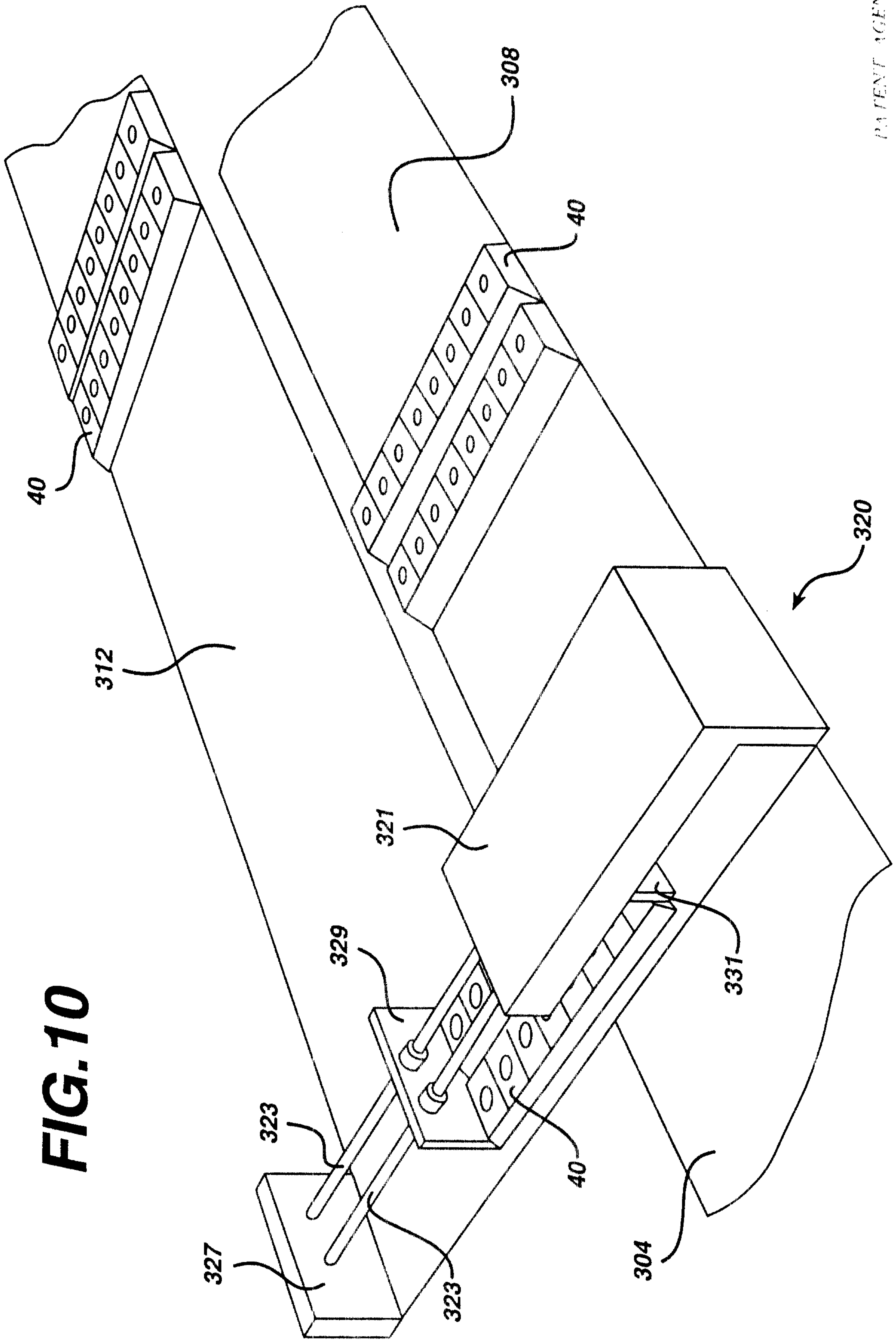
PATENT AGENTS

Swales Ogilvy Renault

FIG.9

Awakey Ogilvy Renault

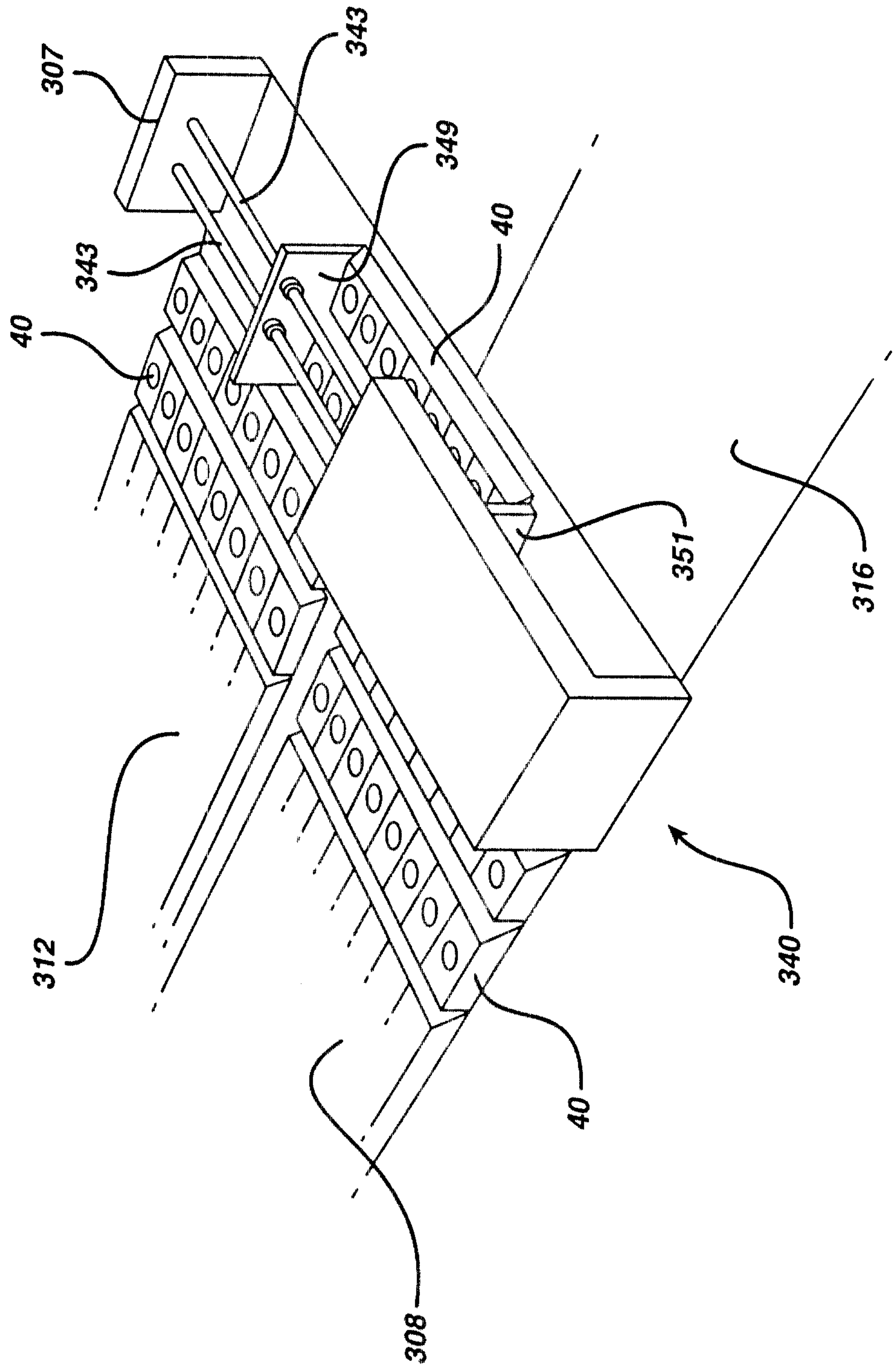
FIG. 10



PATENT AGENTS

Awakey Ogilvy Kenneally

FIG. 11



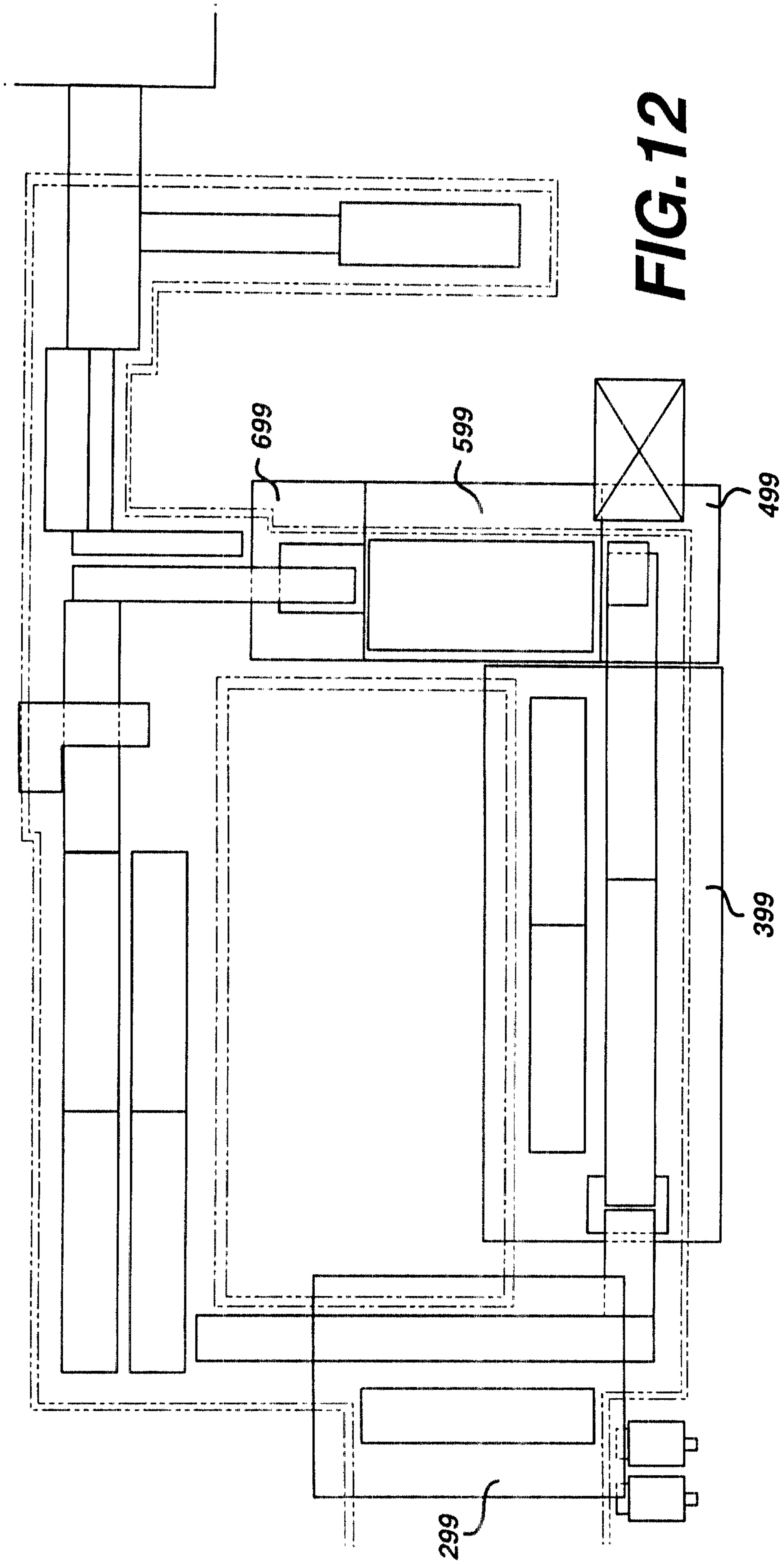
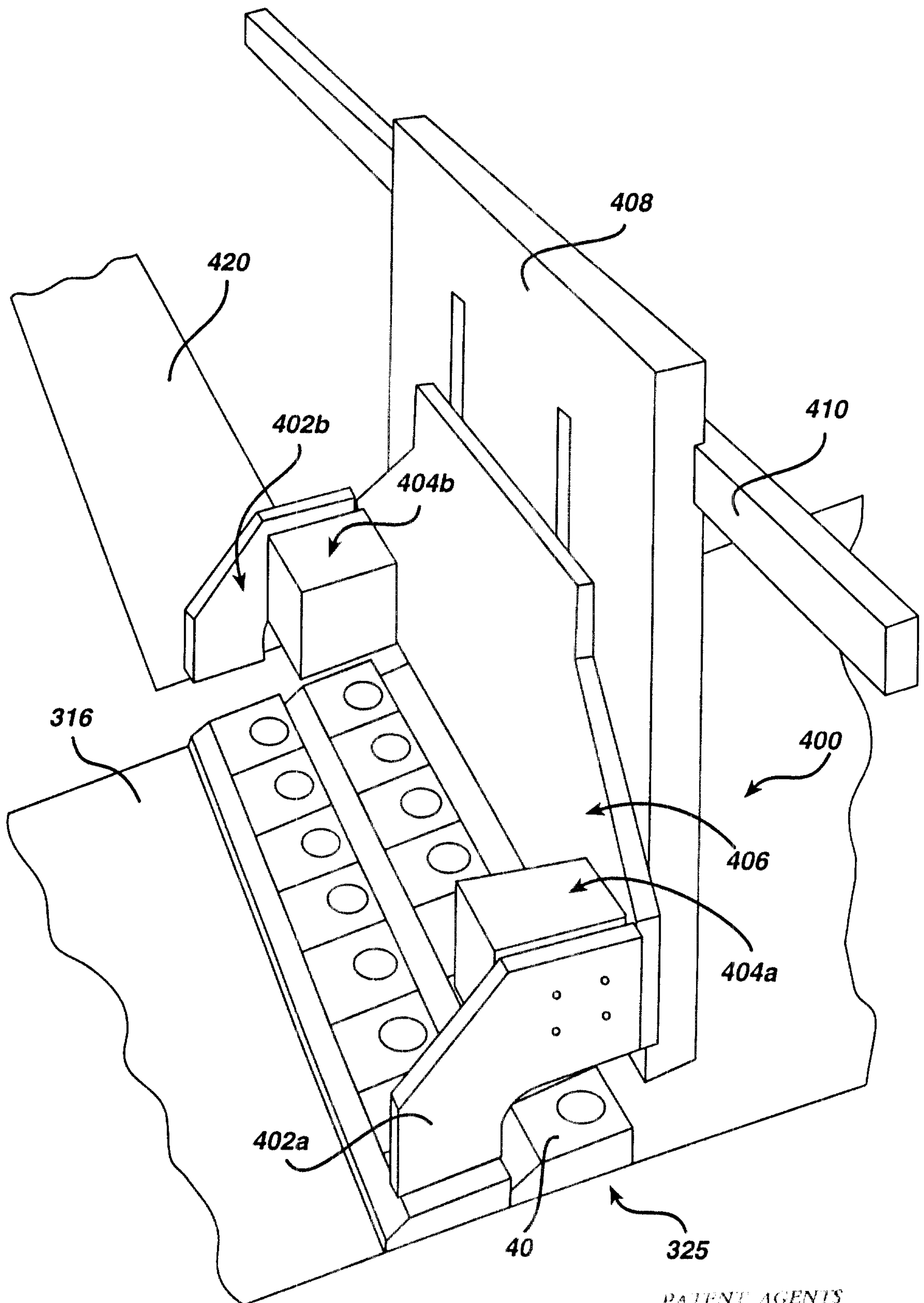


FIG. 12

SECRET

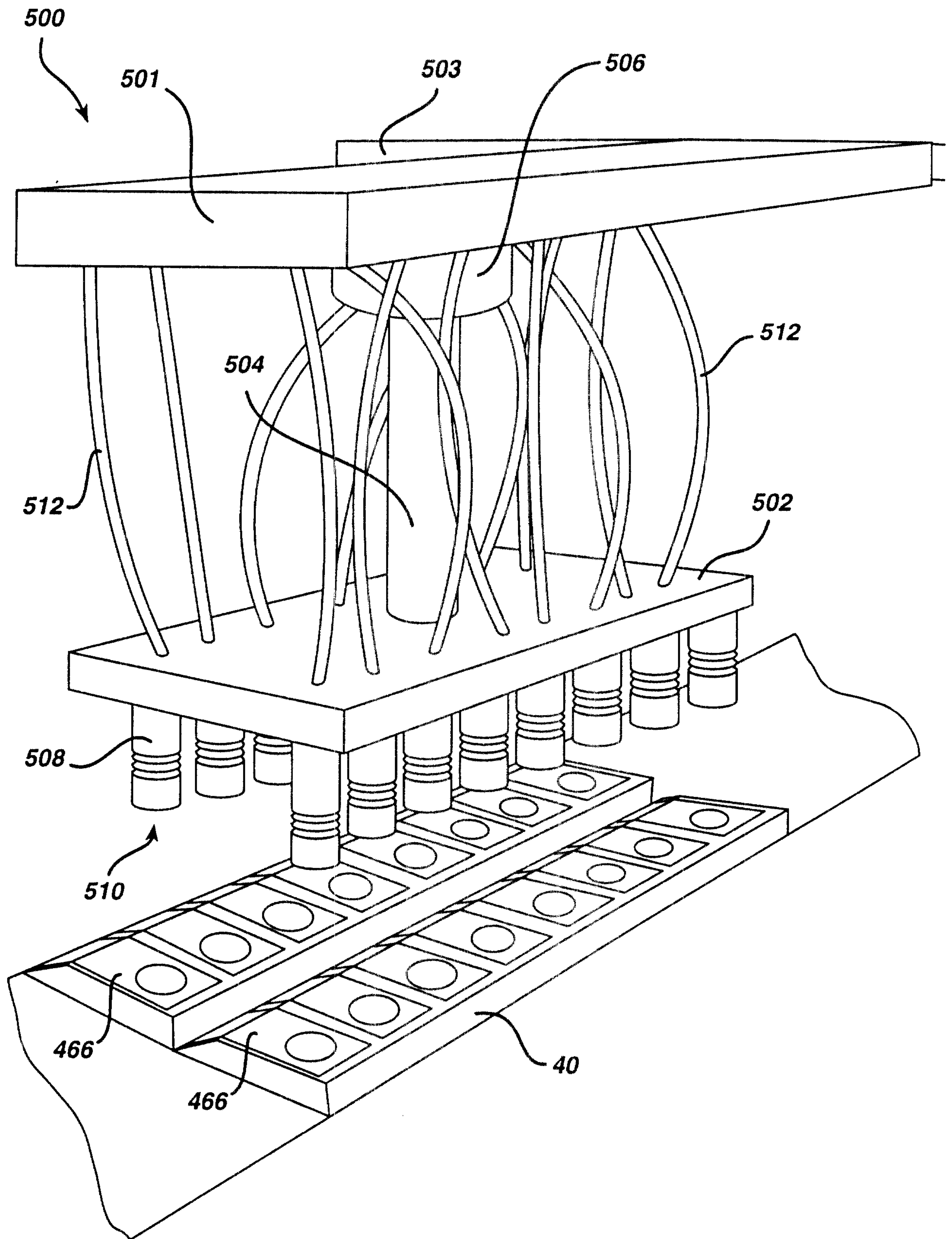
Archie Ogilvy Kenwell

FIG. 13



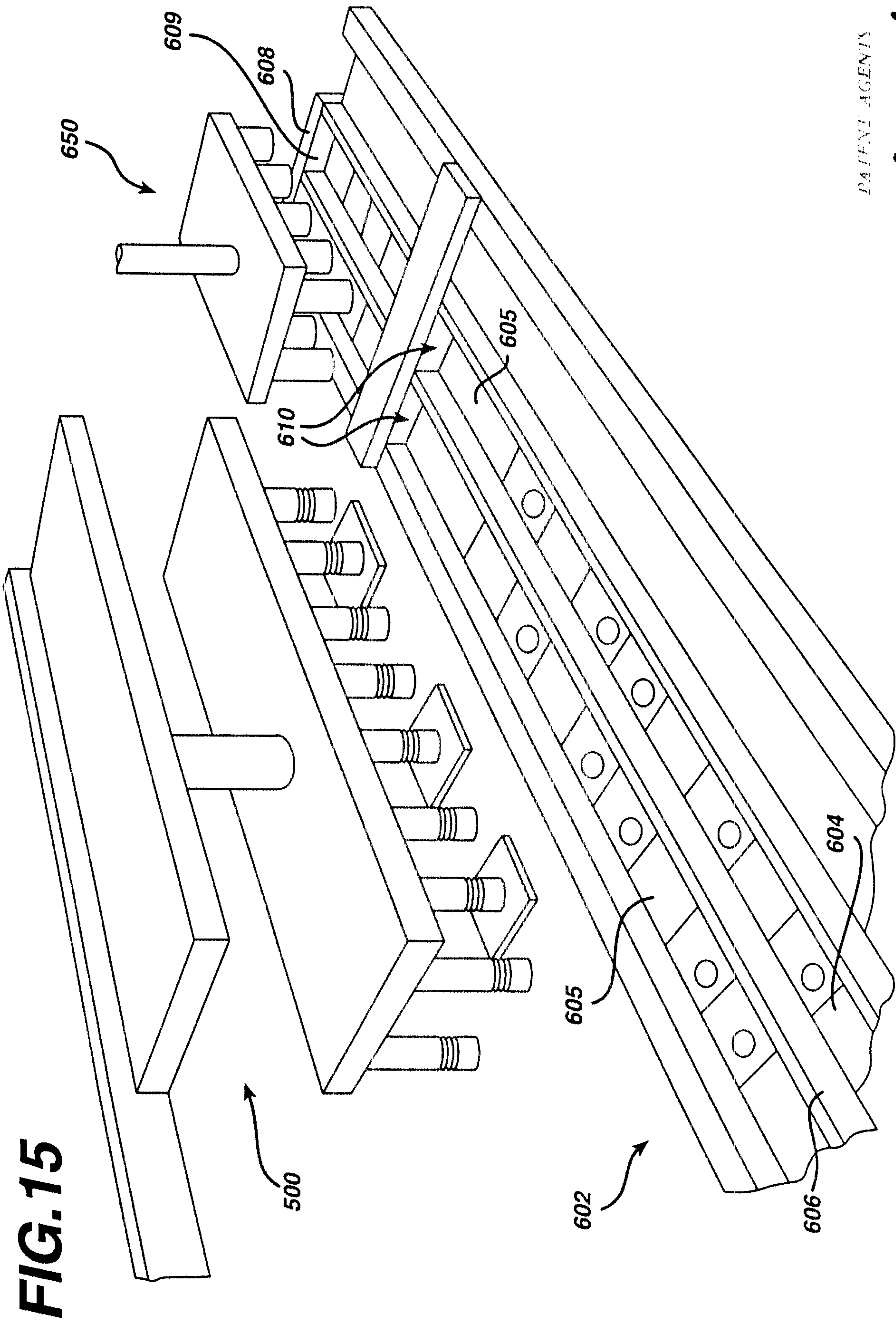
PATENT AGENTS

Rowley Gilroy Renault

FIG. 14

PATENT AGENTS

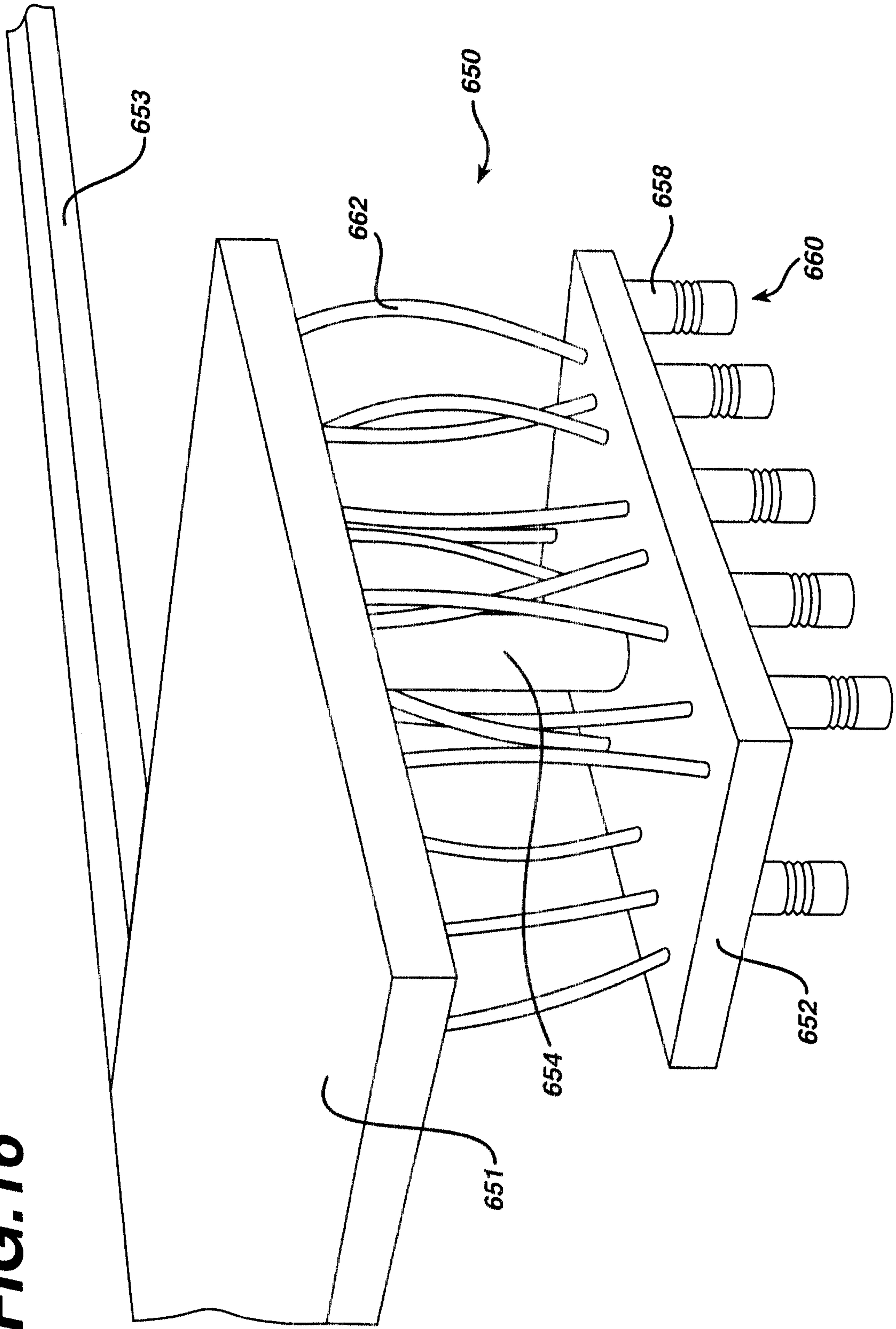
Rwabeq Ogilvy Renault



PATENT AGENTS

Arvinko Ogilvy Renault

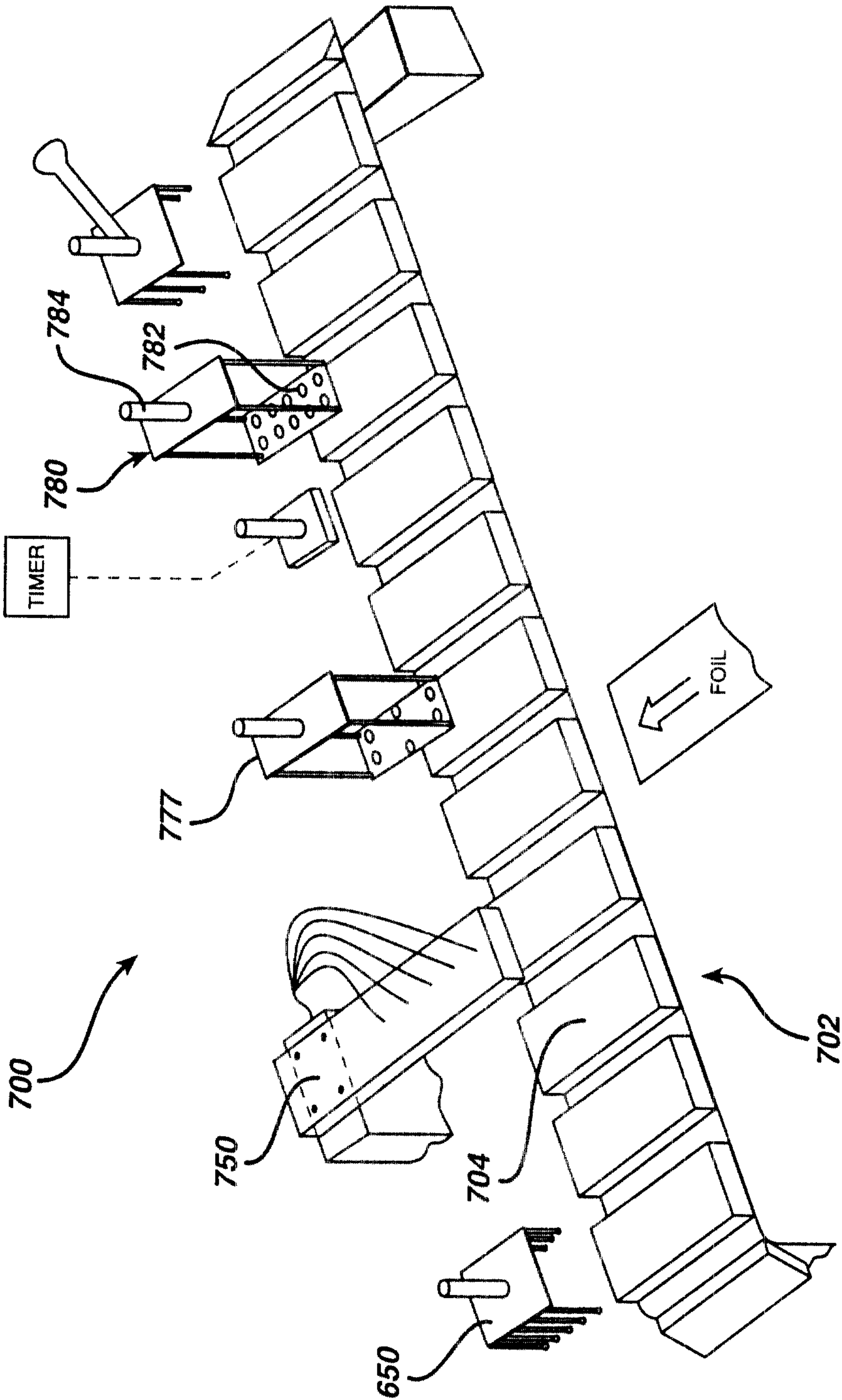
FIG. 16



PATENT AGENTS

Rowley Ogilvy Renault

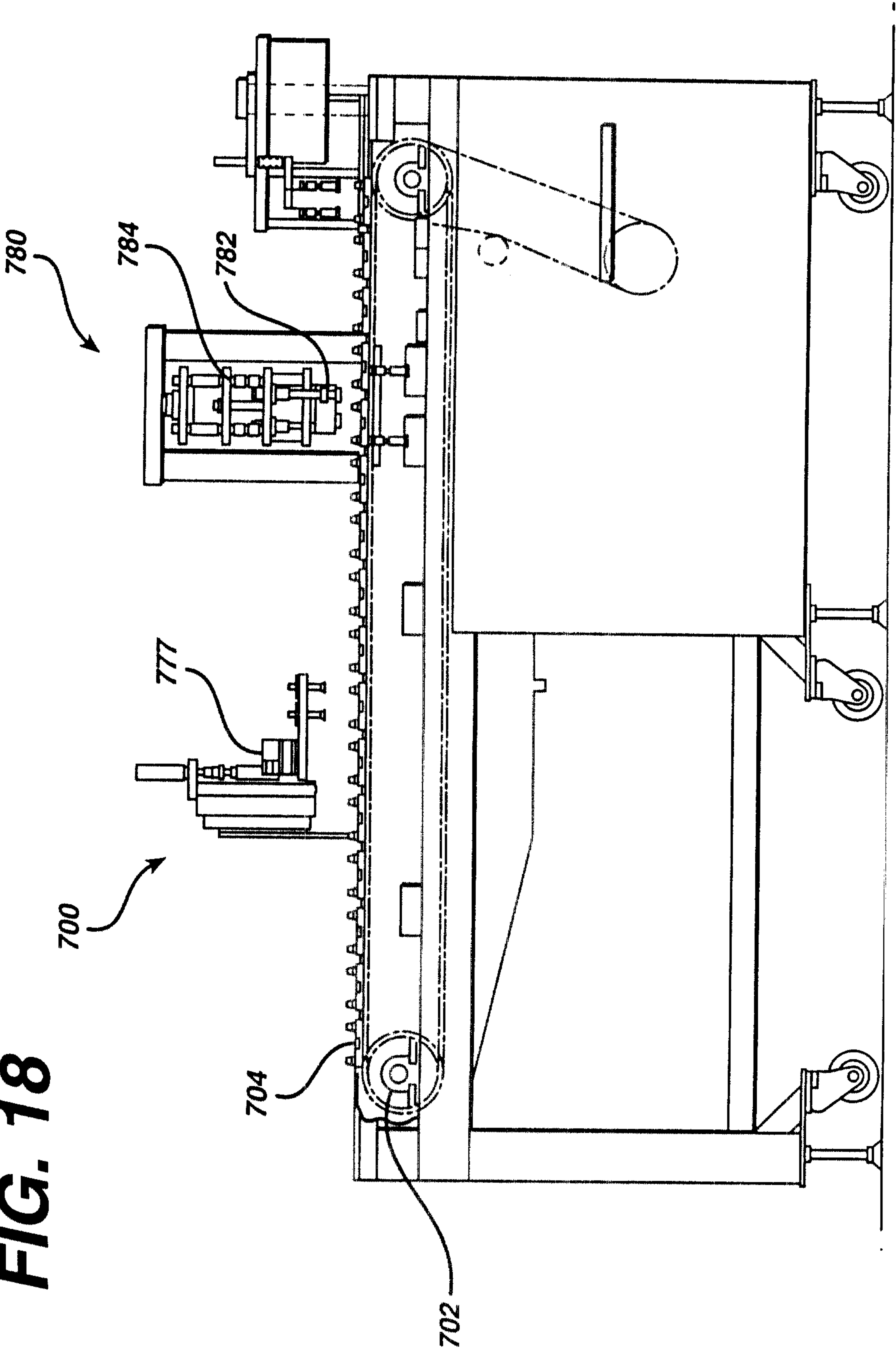
FIG. 17



PATENT AGENTS

Russell Ogilvy Kenault

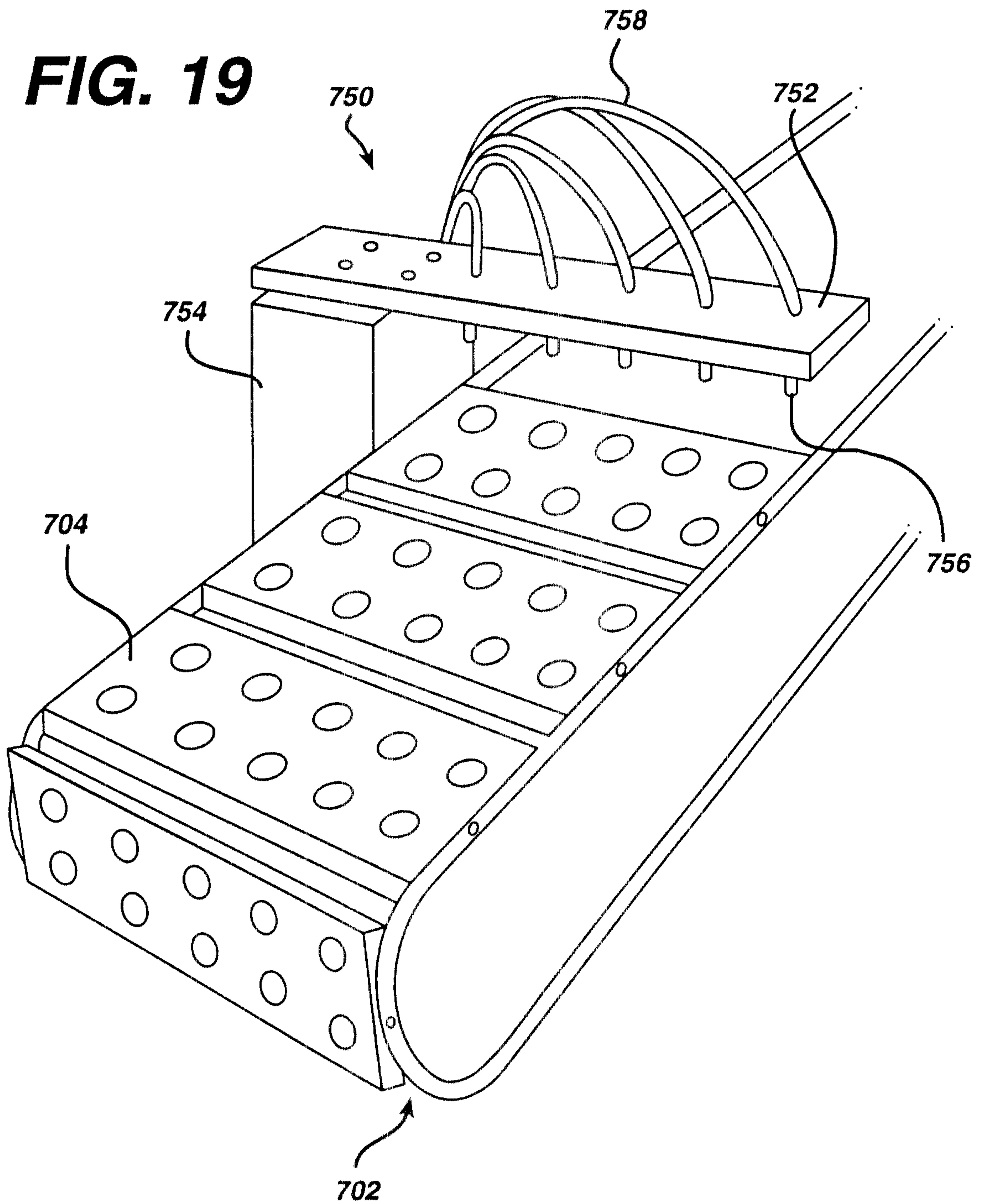
FIG. 18



PATENT AGENTS

Awakey Ogilvy Renault

FIG. 19



PATENT AGENTS

Dwight Ogilvy Renault

