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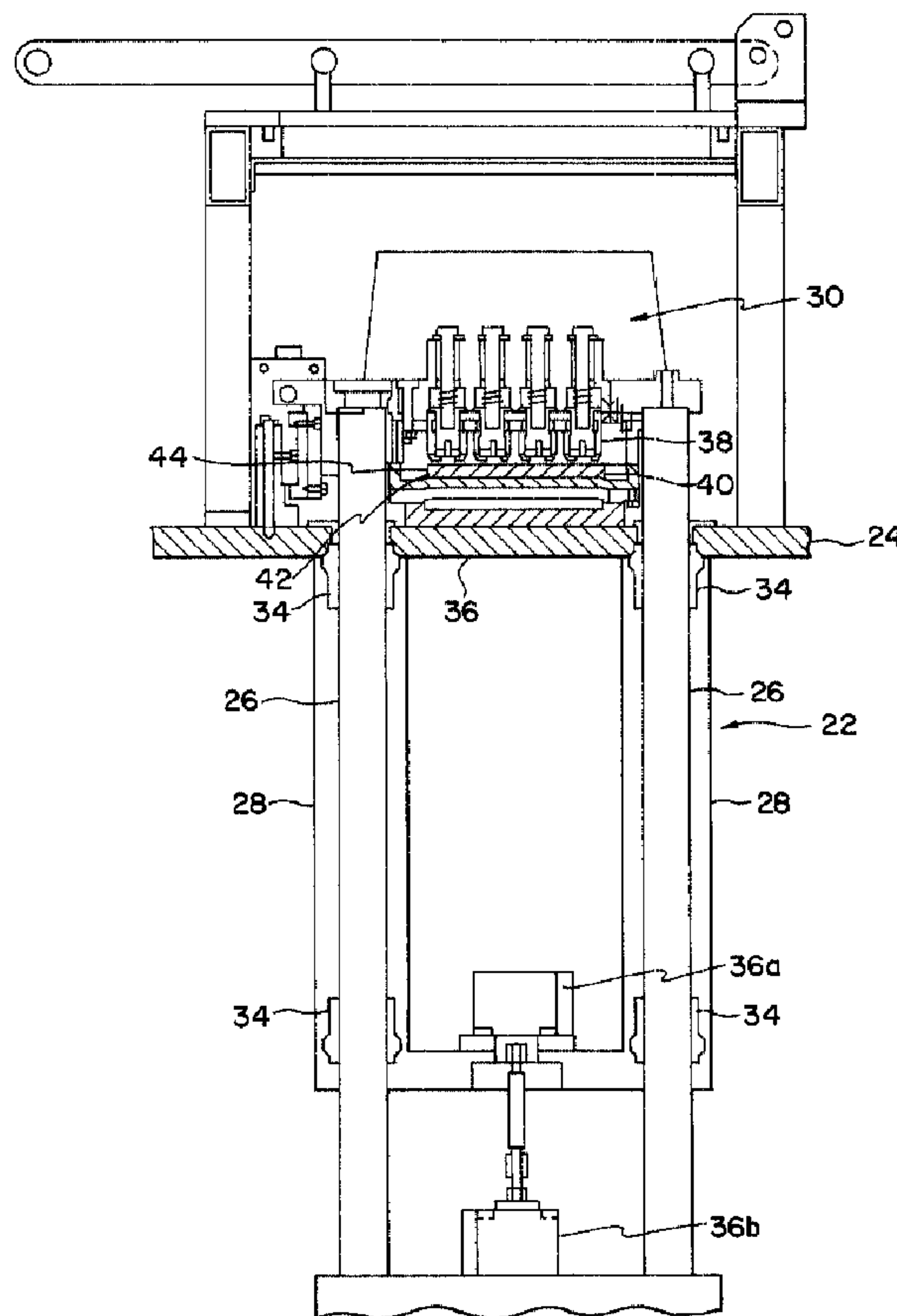
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(57) Abrégé/Abstract:

A method of and apparatus for employing a surfactant which is provided in order to assist in the release from each other of mold components of a multi-part mold employed in the molding of polymeric articles; for instance, such as a hydrophilic contact lens,

(57) **Abrégé(suite)/Abstract(continued):**

upon completion of the molding process for the polymeric articles. The surfactant is applied in the form of a film or coating on surface portions of one of the mold components in order to facilitate the disengagement between the mold components during demolding, and the removal of excess polymeric molding material adhesively deposited on surfaces thereon.

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ABSTRACT OF THE DISCLOSURE

A method of and apparatus for employing a surfactant which is provided in order to assist in the release from each other of mold components of a multi-part mold employed in the molding of polymeric articles; for instance, such as a hydrophilic contact lens, upon completion of the molding process for the polymeric articles. The surfactant is applied in the form of a film or coating on surface portions of one of the mold components in order to facilitate the disengagement between the mold components during demolding, and the removal of excess polymeric molding material adhesively deposited on surfaces thereon.

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**METHOD AND APPARATUS FOR  
APPLYING A SURFACTANT TO MOLD SURFACES**

**BACKGROUND OF THE INVENTION**

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**1. Field of the Invention**

The present invention relates to a method of employing a surfactant which is provided in order to assist in the release from each other of mold components of a multi-part mold employed in the molding of  
10 polymeric articles; for instance, such as a hydrophilic contact lens, upon completion of the molding process for the polymeric articles.

The method pursuant to the invention also contemplates the application of the surfactant in the  
15 form of a film or coating on surface portions of one of the mold components in order to facilitate the disengagement between the mold components during demolding, and the removal of excess polymeric molding material adhesively deposited on surfaces thereon;  
20 which, for example, may be in the shape of rings formed externally of the respective mold cavities for the contact lenses, and which are formed through the displacement of polymeric material from the mold cavity.

Moreover, pursuant to a further aspect of the  
25 invention, there is provided a novel and unique apparatus which is adapted to effectuate the application of a coating or film containing a surfactant to surfaces of a mold component for molding hydrophilic polymer articles, especially such as hydrophilic contact lenses  
30 or the like. Accordingly, any excess molding material encountered during the molding of the contact lenses

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1 which is expelled from the mold cavities and resultingly  
adhesively deposited in the shape of rings on surface  
portions between the mold components located externally  
about the mold cavities, can be easily and cleanly  
5 removed upon heat separation of the mold components in  
view of the presence of the surfactant coating or film.  
This also facilitates the essentially undamaged removal  
of the molded articles from the mold cavities during  
separation of the components thereof upon completion of  
10 the molding process for the articles.

An extensive array of methods is currently  
employed in this technology in carrying out the  
manufacture of hydrophilic polymer articles, such as  
hydrophilic contact lenses, through the implementation  
15 of a considerable variety of processes; among which  
there are included spin casting, static cast molding,  
lathing, combinations of casting and lathing, and  
particularly frequently, through the use of two-part  
molds. In the utilization of separable two-part molds  
20 for the molding of hydrophilic contact lenses, upon  
completing the molding step it is of critical importance  
to be able to release the hydrophilic contact lenses  
from their surface engagement with and adherence to the  
mold parts, or at least one of the mold halves, without  
25 causing any damage to the contact lenses upon separating  
the mold parts, which would render the lenses unusable.  
Various concepts employed for effectuating the release  
of hydrophilic contact lenses from surfaces of molds,  
particularly two-part molds which are intended to be  
30 physically separated, are through the employment of  
laser or infrared heat mold part separating devices, the

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use of external heat and/or the application of heated gas, hot air or steam. However, all too frequently, damage is sustained by the contact lenses during removal thereof from the molds in that the material of the mold parts may exhibit a tendency to adhere and inhibit easy release upon effectuating separation of the mold parts. This potential damage which generally renders the contact lenses unable to meet necessary quality and/or inspection standards may consist of tears, nicks or other surface defects formed in the contact lenses, prevalent of which there may be the so-called "piece of material" (POM) defects caused by excess polymer debris or particles produced during molding permanently adhering to the contact lenses upon mold separation.

Generally, such mold parts for hydrophilic contact lenses consist of a curvilinear (concave/convex) center or front curve mold part adapted to form, in cooperation with a mating base mold curve part, a two-part mold for the contact lenses. Hydrophilic contact lenses of the type considered herein are usually constituted from a hydrophilic polymer, preferably a HEMA-based polymer (hydroxyethylmethacrylate), although other suitable monomers may comprise hydroxy ethyl acrylate (HEA), hydroxy propyl methacrylate, hydroxy propyl acrylate and hydroxy trimethyl ethylene acrylate, among numerous other applicable materials.

The components of the mold within which the hydrophilic polymer contact lenses are molded may consist of suitable pallets each including a plurality of cavities receiving mold parts having female and/or male base surfaces or curvilinear wall portions for the

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1 formation of the curved contact lenses and an annular  
rim portion extending thereabout. The molds as  
described, for instance in the molding technology, may  
be constituted from suitably selected conventional  
5 plastic materials, whereby the hydrophilic polymer  
articles; i.e. the contact lenses, will possibly adhere  
to one of the mold parts through the presence of mold  
parts having different properties or being formed of  
different materials. The mold parts may consist of  
10 plastic materials such as polyethylene, polypropylene,  
polystyrene, polyvinyl chloride among other suitable  
plastic mold materials, as is known in the technology.

In order to remove the molded hydrophilic  
contact lenses from the respective mold cavities,  
15 separation of the mold halves or portions is  
implemented, and the formed contact lenses may then be  
removed from the mold cavities. Due to excess portions  
of the polymeric material of the hydrophilic contact  
lenses which are expelled from the mold cavities of the  
20 cooperating mold components, and which form ring-shaped  
elements of the HEMA-based polymer from which the  
contact lenses are made surrounding the exteriors of the  
mold cavities, and exhibit tendencies to strongly adhere  
to the mold surfaces on which the rings are deposited.  
25 These rings make separating of the mold cavities  
difficult, resulting in mold breakage and damage to the  
lenses. Further, the rings, or fragments thereof,  
become uncontrollable debris in automated production  
lines, contaminating both the production line and the  
30 final lens package. Moreover, the foregoing can also  
conceivably cause a perfectly "good" contact lens to be

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1 rejected after demolding due to the formed HEMA-ring or  
a portion thereof remaining on the front curve of the  
mold. This results in uneconomical production  
conditions being encountered during the manufacture of  
5 such contact lenses.

## 2. Discussion of the Prior Art

In order to implement the high-speed and mass-  
produced molding of such hydrophilic contact lenses,  
there have been developed two-part molds incorporating  
10 pallet-supported mold structures; for example, as  
disclosed in U.S. Patent No. 4,640,489 to Larsen, and  
wherein methods of forming shaped polymeric hydrogel  
articles, such as hydrophilic contact lenses, are also  
elucidated in the disclosures of U.S. Patent Nos.  
15 4,680,336 and 5,039,459 to Larsen et al., wherein the  
last-mentioned two patents are assigned to the common  
assignee of the present application.

The release of hydrophilic contact lenses from  
20 adherent mold surfaces subsequent to the completion of  
the contact lens molding process can be facilitated or  
improved upon, as is set forth in the disclosure of U.S.  
Patent 5,264,161 to Druskis et al. In that instance,  
surfactants are introduced in solution into a hydration  
25 bath employed in the molding cavities for molding the  
hydrophilic polymeric structures or contact lenses. The  
surfactant which is dispersed in the hydration bath in  
concentrations not exceeding 10% by weight aids in  
facilitating release of the lenses from adherent  
30 contiguous mold surfaces being separated, with the  
function of such surfactant being to reduce the surface

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5 tension properties of water or liquids, and to thereby  
reduce the level of adherence between components  
consisting, on the one hand, of the contact lenses and,  
on the other hand, the mold surfaces which become  
adherent during molding. Numerous types of surfactants  
10 are disclosed in this patent publication, particularly  
such as polymeric surfactants including polyoxyethylene  
sorbitan mono-oleates, and which are especially suitable  
for releasing in an undamaged state any hydrophilic  
polymer articles from adherent mold surfaces which are  
15 constituted of plastic materials. Nevertheless, the  
utilization of surfactants in suspension in a liquid  
hydration bath does not provide the desired control over  
the release of the hydrophilic polymer articles or  
contact lenses from the mold surfaces prior to hydration  
20 in the bath and, in particular, does not readily afford  
an easy removal of HEMA-based rings of molding material  
formed in adherence with mold surfaces extending about  
the mold cavities, or a more effortless separation  
between the mold component, whereby the rate of damage  
being encountered by the contact lenses upon mold  
25 separation and removal from the molds is still  
unacceptably high and is not readily controllable to a  
degree affording a satisfactory economic manufacturing  
environment.

#### SUMMARY OF THE INVENTION

30 In one embodiment, the present invention  
provides an apparatus for applying a surfactant to at  
least one surface of a mold part of a two-part mold  
having said first mold part engageable with a cooperative  
second mold part for the molding of polymer articles,  
wherein said surfactant assist in the release between  
said first and second mold parts and enables removal of  
excess polymer molding material adherent to said at least  
one surface of said first mold part; said apparatus  
comprising:

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5 a) a support means mounting at least one said first mold part being movable to a predetermined location in said apparatus;

b) applicator means including at least one surfactant applicator being arranged in spaced relationship above said support means, said at least one surfactant applicator being positionable in vertical alignment with said at least one first mold part;

10 c) means mounting a pad member containing a surfactant being interposable between said applicator means and said support means for said at least one first mold part;

d) actuating means for imparting a vertical downward displacement to said applicator means to cause said at least one surfactant applicator to contact said pad member and assume a quantity of said surfactant therefrom, said actuating means thereafter imparting a vertical upward displacement to said applicator means; and

20 e) means for displacing said pad member from the interposition thereof in said apparatus between said applicator means and said at least one first mold part, said actuating means for said applicator means displacing said applicator means downwardly to an extent such that the surfactant-wetted surface portions of said at least one surfactant applicator contact said at least one surface of said first mold part so as to impart a coating of said surfactant thereto.

30 In another embodiment, the present invention provides a method for applying a surfactant to at least one surface of at least one first mold part of a two-part mold utilized for the molding of polymer articles so as to facilitate disengagement between said first mold part from a second mold part and the removal of any excess molding material present on said at least one surface on said first mold part, said method comprising the steps of:

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a) moving a support means mounting said at least one first mold part to a predetermined location;

5           b) arranging applicator means including at least one surfactant applicator in spaced relationship above said support means, and positioning said at least one surfactant applicator in vertical alignment with said at least one first  
10 mold part;

c) coating said at least one surfactant applicator with a layer of surfactant; and

d) displacing said applicator means downwardly to an extent such that surfactant-wetted  
15 surface portions of said at least one surfactant applicator contact the at least one surface on said at least one first mold part to impart a coating of said surfactant to said surface.

Accordingly, in order to improve upon the  
20 ability of such hydrophilic polymeric articles, especially hydrophilic polymer contact lenses, of being inherently releasable in an undamaged state from the

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1 mold cavities of mold structures in which they are  
molded, the present invention contemplates the provision  
of a stamping station in a mold filling and assembling  
machine for the formation of hydrophilic polymer contact  
5 lenses which are ordinarily constituted from a HEMA-  
based plastic material, wherein a stamping head includes  
at least one stamp for applying a thin layer or film of  
a polymeric surfactant; in this instance, preferably a  
polyethylene oxide sorbitan mono-oleate, commercially  
10 sold under the tradename "Tween 80", to surface regions  
extending about the front curve of a mold part for the  
forming of contact lenses. This surfactant layer, in  
essence, assists in the separation of a mold part  
defining a base curve adapted to matingly cooperate with  
15 the front curve for molding a contact lens, and in the  
removal of excess molding material forming a HEMA-based  
ring extending externally of the mold cavity for each  
contact lens from any potential adhesion to the  
surfactant-coated mold part surface during demolding of  
20 the lens.

Pursuant to the invention, the novel stamping  
station which provides for the application of a thin  
layer of the polymeric surfactant to the surface  
portions extending about the front curve of the mold  
25 part, such as a flange surface, contemplates the  
positioning of a mold pallet containing the front curves  
of a two-part mold (which are adapted for subsequent  
mating with mold parts for molding the contact lens base  
curves) directly beneath a stamping head consisting of  
30 one or more stamps each adapted to engage respectively  
one of the surfaces or flange portions extending about

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1 the front curves located on the mold pallet. A pad  
which is impregnated with the surfactant; for instance,  
a polymeric surfactant such as Tween 80, is moved  
beneath the stamping head and permitted to remain there  
5 while the stamps of the stamping head are moved  
downwardly into contact with the pad, and then retracted  
upwardly to allow the pad to be moved out from beneath  
the stamping head. The foregoing contacting between the  
stamps of the stamping head and the surfactant-  
10 impregnated pad resultingly causes each stamp to be  
wetted with the surfactant; in effect, the Tween 80  
surfactant. Thereafter, the stamping head is moved  
downwardly towards the mold pallet and enables the  
stamps to each respectively contact a therewith aligned  
15 surface or flange extending about a respective front  
curve positioned on the mold pallet, thereby depositing  
a very thin layer or film of the surfactant of  
controlled thickness onto the surface about each  
respective front curve. The stamping head with the  
20 stamps is then retracted upwardly and the machine  
sequences to the next mold pallet of front curves of a  
two-part contact lens mold while concurrently advancing  
the preceding surfactant-coated front curves on their  
mold pallet towards a station of the machine in which  
25 there is implemented the assembly of the back curve onto  
the front curve.

The application of a uniform thin layer or  
film of the surfactant to the various flange surfaces  
extending about each front curve of which the molding  
30 cavity has previously been filled with HEMA molding  
material for the contact lens and then subsequently

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1 matingly engaged by an associated base curve mold part  
after applying the surfactant, and on which flange  
surfaces there are deposited and adhered thereto HEMA-  
based rings of excess material from the molding material  
5 for each of the contact lenses, facilitates that  
subsequent to molding each contact lens can be removed  
from the respective mold cavity thereof during  
separation of the mold parts. The layer of surfactant  
which is applied or stamped onto the flange surface of  
10 the front curve may preferably, although not  
necessarily, be within the range of about 0.05 to  
0.50 mg of surfactant for each front curve. This  
separation of the mold parts; in effect, between the  
front curves and base curves, is rendered easier due to  
15 the presence of the surfactant layer between the engaged  
circumferential edge surfaces of the respective front  
curve and base curve mold parts. Moreover, the  
surfactant on the flange or surface portion of the front  
curve mold part to which the HEMA-based ring of excess  
20 contact lens molding material expelled from the mold  
cavity adheres, reduces the degree of adhesion and  
enables the ready removal of the HEMA-based ring from  
each respective surface about the front curve, which  
during demolding results in a better than 95% removal  
25 rate of the HEMA ring without any damage being  
encountered by the contact lenses.

In accordance with another advantageous  
feature of the invention, the stamping head provides for  
a resiliently mounted multiple stamp structure enabling  
30 each individual stamp to "float" or be shiftable to some  
extent independently of the displacement of the other

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1 stamps in view of a spring-biased mounting construction  
for each stamp. This, in effect, will ensure that an  
even amount of pressure is applied to the surfaces or  
flanges extending about each front curve supported on  
5 the mold pallet upon being contacted by a respective  
stamp having a surfactant-wetted surface previously  
imparted thereto by the pad, so as to cause a uniformly  
thick layer or film of an equal amount of surfactant to  
be applied about each of the respective front curves.

10 As set forth herein, in accordance with a  
specific aspect of the invention, the pad for applying  
the surfactant to the stamps of the stamping head  
utilizes a unique material structure in that a  
substantially porous polyethylene pad; for example, of a  
15 thickness of within the range of approximately 0.25 to  
0.50 inches and possessing a 10 micron average pore  
size, and supported on a liquid-impervious base, is  
employed to wick the surfactant from the bottom of the  
pad to the top of the latter when contacted by the  
20 downwardly displaced stamps. A nylon filter, for  
instance, having a mesh size within the range of about  
0.50 to 2.0 microns, and preferably of a 1.2 micron mesh  
size, is supported on the top surface of this porous  
polyethylene pad, and acts as a metering device so as to  
25 permit only a very minor quantity of the surfactant to  
pass therethrough from the pad to the stamps of the  
stamping head for forming a thin surfactant layer or  
wetted surface thereon. This enables for highly precise  
control to be exercised over the amount of surfactant  
30 being passed through the nylon filter to the stamps and,  
thereafter upon withdrawal of the pad, to be deposited

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by the stamps on the surfaces or flanges extending about the front curves which are positioned on the mold pallet.

5 In comparison with the prior art, such as is represented by U.S. Patent No. 5,264,161 to Druskis et al., which only discloses utilizing surfactants which are in suspension in a bath solution for improving upon the release of molded polymer articles from molds during separation, the present invention provides an improved  
10 control over the amounts of surfactant being in a novel manner distributed over and deposited on the applicable surface areas about the front curve mold part, thereby enabling removal of HEMA-based rings of molding material adheringly deposited about the front curves, with only a  
15 minimal danger of damage to the lenses being encountered, thereby also rendering the entire procedure and apparatus highly cost effective and economical in the manufacture of contact lenses of uniformly high quality.

20 Accordingly, it is an object of the present invention to provide an arrangement for depositing controlled amounts of a surfactant on mold surfaces to facilitate the separation of the mold parts, such as between front curves and base curves, enabling the  
25 removal of HEMA-based rings of excess molding material adhering to mold surfaces about the front curves, and thereby essentially eliminating contamination of the production line and the packages upon completion of the lens molding procedure.

30 Another object of the present invention resides in the provision of a method for depositing thin

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1 films of surfactants on mold part surfaces to assist in  
the separation during demolding of the mold parts, such  
as between front curves and base curves utilized for the  
molding of contact lenses, enabling the removal of HEMA-  
5 based rings of excess molding material adhering to mold  
surfaces about the front curves, and facilitating an  
essentially undamaged release of the molded contact  
lenses, utilizing the arrangement as described herein.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Reference may now be had to the following  
detailed description of an exemplary embodiment of a  
stamping arrangement utilized for the application of a  
polymeric surfactant to surface portions extending about  
15 the front curves of a mold structure for molded  
polymeric articles, particularly such as hydrophilic  
polymer contact lenses, facilitating separation of the  
mold parts and removal of any HEMA-based rings of  
molding material adhering thereto, taken in conjunction  
20 with the accompanying drawings; in which:

Figure 1 illustrates a top plan view of a  
typical mold pallet of a two-part mold for selectively  
supporting thereon either the back or front curves  
employed for the molding of hydrophilic polymer contact  
25 lenses;

Figure 2 illustrates a perspective view of a  
frame assembly of front curves for the molding of  
contact lenses;

Figure 3 illustrates a sectional, generally  
30 diagrammatic view through an assembled front curve and

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1 base curve arrangement for molding hydrophilic polymer  
contact lenses;

Figure 4 diagrammatically illustrates a side  
elevational view of a stamping station for the  
5 application of a surfactant to a stamping head and  
thereafter for the deposition of a film of the  
surfactant onto surface portions on the front curves  
positioned on a contact lens molding pallet;

Figure 5 illustrates a side view of the  
10 mechanism for moving the stamp pad under the stamping  
head of Figure 4;

Figure 6 illustrates, on an enlarged scale, a  
sectional detail of a single stamp of the stamping head  
of Figure 4; and

15 Figure 7 illustrates, on an enlarged scale, a  
sectional detail of a brush-like single surfactant  
applicator, in a detail similar to that shown in  
Figure 6.

## 20 DETAILED DESCRIPTION

Referring now in more specific detail to  
Figures 1 to 3 of the drawings, there is illustrated a  
mold frame or pallet 10 of a suitable rigid material  
having recesses 16 which are adapted to mount front  
25 curve flanges 18 for molding, in cooperation with  
suitable base curves 19 each jointly forming therewith a  
two-part mold, in this instance, a plurality of eight  
hydrophilic polymer contact lenses (not shown). As is  
well known in the art as mentioned hereinabove, the  
30 material employed for the hydrophilic contact lenses

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1 maybe constituted of a HEMA-based (hydroxyethyl-methacrylate) or equivalent material.

As shown in Figure 2, the mold frame 14 comprises individual concave mold units 12 forming  
5 injection points for the molding material for the plurality of contact lenses which are to be molded, and is adapted to mate with convex mold units of a two-part mold. The frame structure of mold front curves of the  
10 contemplated in Figures 1 and 3, although surfactant may be applied thereto in the same manner, as described hereinbelow.

Each concave mold unit 12 defines a front curve 18 for the containment of a monomer material for  
15 the subsequent molding of a contact lens, as shown in Figure 3. Extending about the front curve is an integral flange 18a, joined to the front curve by means of an annular lip 18b extending about the mold cavity filled with HEMA-based lens molding material.

20 In order to provide the complete two-part mold, a second mold part comprising a base curve 19 is subsequently adapted to be matingly superimposed on the front curve 18, after the latter is supplied with a molding monomer, so as to form a molding cavity 20 for  
25 forming a contact lens therebetween, with the base curve 19 peripherally being seated on the annular lip 18b. The base curve 19 includes a radially outwardly extending annular flange 19a, and when parts 18, 19 are assembled, forms an annular gap with flange 18a, between  
30 which there is received excess HEMA-based molding material expelled from the molding cavity 20 so as to

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form a HEMA-ring which adheres to the adjoining flange surfaces.

5 Generally, the mold parts 18 and 19 are constituted of a suitable plastic material, such as a polyolefin including low, medium and high-density polyethylene, polypropylene, polystyrene, or other plastics which are adapted for this purpose; i.e. molding hydrophilic polymer contact lenses. Preferably, the mold part 19 is thinner and more flexible than the mold part 18. Specifics of such mold constructions, including the front curves and base curves for molding contact lenses, are known in the technology, having reference to U.S. Patent No. 4,640,489 to Larsen, and are not discussed in more specific detail herein except as applicable to the invention.

15 Referring now in greater specificity to the drawings as represented in Figures 4 through 6, there is illustrated a stamping station for applying a thin film or layer of a surfactant to the flange 18a surface of each respective front curve 18 which is located in each depression 12, 16 of, respectively, the mold pallet 10 of Figure 1 or mold pallet 14 of Figure 2. However, caution should be exercised to avoid applying surfactant to the lip 18b itself about the mold cavity, inasmuch as touching the lip with surfactant may cause a defect in the lens which is to be molded. The application of the surfactant layer or film to the surface 18a of the front curves 18 on the mold pallet 10 is intended to assist in the separation therefrom of the subsequently applied base curves 19 during demolding and in removing the HEMA-based rings which are adherent primarily to the

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1 surface of flanges 18 between the annular mold part  
flanges 18a, 19a at a demolding station subsequent to  
completion of the lens molding procedure, so as to  
reduce potential damage to the contact lenses being  
5 released from the mold cavities 20.

As illustrated in Figure 4, the stamping  
station includes a frame structure 22 having a support  
member or base 24 on which there are positioned a  
plurality of spaced downwardly depending upright guide  
10 columns 28. These stationary columns 28 have slide  
members 26 vertically slidable therein for supporting  
components for a stamping head unit 30 so as to be  
vertically displaceable along the guide columns. The  
stamping head unit 30 is mounted for vertical  
15 reciprocation proximate the upper end of the columns 28  
through the intermediary of suitable guide bushings 34  
and the slide members 28, and wherein the vertical  
displacement is implemented through suitable actuating  
elements or drive units which are not described in  
20 further detail herein, and which, if desired, may be  
operated from a suitable control and sensor unit 36 on  
base 24 to activate cylinders 36a and 36b.

The stamping head unit 30 includes mounted  
thereon a plurality of stamps 38 each adapted to be  
25 moved in vertical reciprocatory movement in a  
coordinated manner in conjunction with the stamping head  
unit 30, wherein the number of stamps 38 is correlated  
with the number of front curves 18 located in the mold  
depressions 12, 16 formed in the respective mold pallet  
30 10 or mold frame 14. Each stamp 38 consists of a  
composition of about 90% urethane and 10% silicone in at

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1 least the portions thereof which are adapted to contact  
the front curves on the mold pallet 10.

Adapted to be positioned in spaced  
relationship below the lower end of each stamp 38 of the  
5 stamping head unit 30 when the latter is in a raised  
position, is a horizontally shiftable pad member 40.  
The pad member 40 is basically a cushion which is  
constituted of a suitable porous material, such as  
porous polyethylene having an average 10 micron pore  
10 size, and which is impregnated with a solution  
containing a surfactant, the latter of which may be  
present in a highly concentrated state. The lower  
surface of the stamping pad member 40 is supported on a  
base 42 consisting of a liquid-impervious material. The  
15 upper surface of the pad member 40 is covered by a  
filter 44, preferably of nylon, having a mesh size  
within the range of about 0.5 to 2.0 microns so as to  
act as a metering device and allow only relatively small  
quantity of surfactant to pass therethrough as the  
20 surfactant is wicked from the bottom of the pad member  
40 to the top upon the pad member being pressingly  
contacted by the bottom ends of the stamping heads 38,  
as described hereinbelow.

The stamping pad member 40 is supported on a  
25 horizontally shiftable carriage structure 50, as shown  
in Figure 5, which is operable at a predetermined  
elevation below the lower ends of the stamps 38 on the  
stamping head 30, so as to be horizontally movable into  
position below the stamps 38 between the upright guide  
30 columns 26 or, alternatively, moved outwardly thereof  
when not needed. The carriage structure 50 includes a

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- 1 horizontally shiftable carriage 52 having a recessed  
portion 54 housing the pad member 40, with the bottom of  
the recess 54 either comprising or supporting the  
liquid-impervious base 42, as mentioned hereinabove.
- 5 The horizontal shifting motion may be imparted to the  
carriage 52 and, resultingly, to the pad member 40, by  
means of a suitable actuating cylinder 56 which is  
operatively connected with the carriage 52.

The foregoing carriage structure 52 is located  
10 at an elevation or height above a mold pallet track (not  
shown), along which mold pallets 10 or 14 are adapted to  
be sequentially advanced into position below the  
stamping head unit 30 in order to enable the stamp 38 to  
apply a thin film or coating of surfactant to the  
15 surfaces 18a, 18b of the front curves 18 positioned  
thereon before being transported further in connection  
with the forming of the contact lenses.

#### OPERATION OF THE APPARATUS

- 20 In order to facilitate the deposition of a  
thin film layer of surfactant onto the flange surface  
18a of the front curves 18 on the mold pallet 10 or  
frame 14 which has been positioned below the stamping  
head unit 30, the stamping head unit 30 is maintained in  
25 a fully raised position on slide members 26. This is  
implemented by means of a lifting cylinder arrangement  
36a, 36b acting on slide members 26 so as to be  
vertically movable within the guide columns 28. The  
extent of vertical movement may be controlled by a  
30 suitable control and sensor arrangement. The pad member  
40 is interposed in spaced relationship between a

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1 molding pallet 10 or 14 and the lower ends of the stamps  
38 on the stamping head unit 30, which components are  
vertically superimposed with each other in spaced  
relationship. This interposition of the pad member 40  
5 is carried out by shifting the carriage 52 so as to  
locate the pad member 40 beneath the stamps 38.  
Thereafter, the stamping head unit 30 is actuated so as  
to cause the stamps 38 to be displaced downwardly into  
predetermined contact with the upper surface of the  
10 filter 44 on the pad member 40, whereby a certain amount  
of surfactant is expelled upwardly through the nylon  
filter 44 and deposited on the lower downwardly facing  
surface of each stamp 38, forming a thin layer or  
coating of the surfactant thereon.

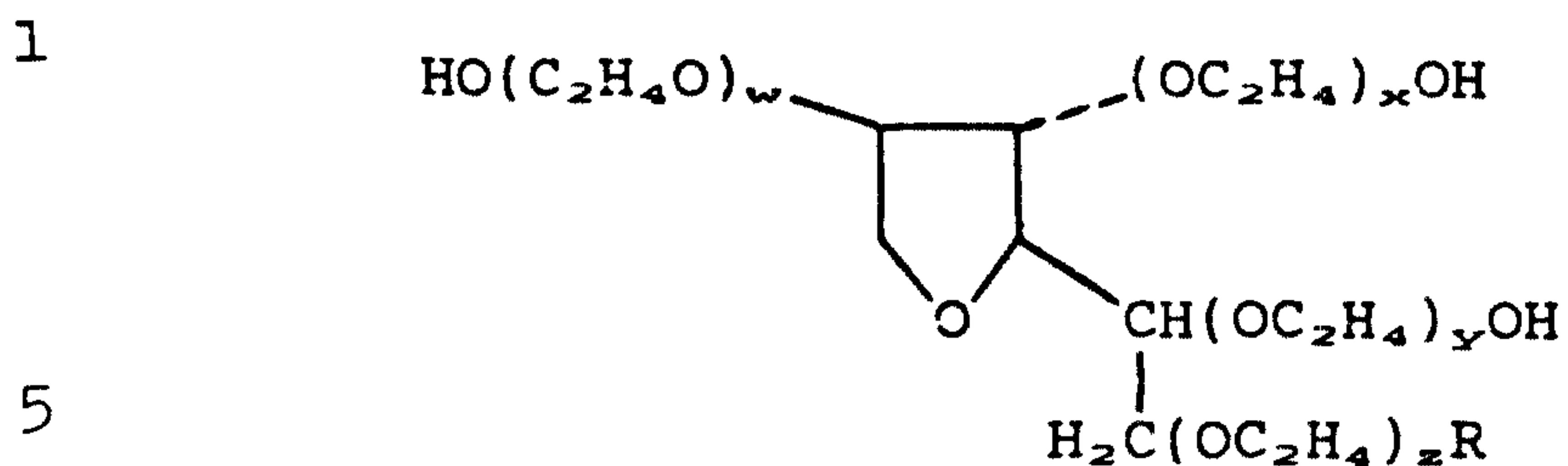
15           The surfactant with which the pad member 40 is  
impregnated may be a solution with an almost 100%  
concentrated strength of surfactant dispersed therein so  
as to enable forming a layer thereof on the therewith  
contacting surfaces of the stamps 38. Preferably, the  
20 surfactant is constituted of Tween 80 (registered  
trademark); i.e. a Polysorbate 80. This is basically  
polyethylene oxide sorbitan mono-oleate or the like  
equivalent, and consists of an oleate ester of sorbitol  
and its anhydrides copolymerized with approximately 20  
25 moles of ethylene oxide for each mole of sorbitol and  
sorbitol anhydrides; of generally the formula:

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[Sum of w, x, y, z is 20; R is (C<sub>17</sub>H<sub>33</sub>)COO]

10 In order to ensure that a uniform layer or very thin film of the surfactant is deposited on the surface 18a of each of the front curves 18 which are located on the mold pallet 10 or 14, each stamp 38 is individually resiliently mounted through the provision of a suitable biasing spring 66, preferably such as

15 encompassing coil springs which are supported in the stamping head unit 30, ensuring that notwithstanding manufacturing tolerances, a uniform pressure will be subsequently exerted by the stamps against all

20 contacting surfaces 18a, 18b on the front curves 18 which are located on the mold pallet. Thereafter, upon the surfactant being wicked up through the pad, expelled through the nylon filter 44 and deposited on the lower surface of each stamp 38, the stamping head unit 30 and stamps 38 are displaced upwardly, and the stamping pad

25 member 40 with its carriage 52 is moved horizontally out of the stamping station from its position between the guide columns 26, thereby freeing the space between the stamps 38 and the therewith aligned front curves 18 on mold pallet 10 or 14. In order to prevent the front

30 curves 18 from being pulled away from pallet 10 or frame 14 when the stamps 38 are raised, a shield 70

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surrounding the stamps and which is at its upper end spring-biased against the bottom of a plate, is pressed against the mold curve flanges 18a and moves upwardly independently and subsequent to the upward movement of the stamps 38. Thereafter, the stamping head unit 30 is again shifted downwardly along the vertical guide columns 26 until the stamps 38 have their surfactant-wetted lower end surfaces contact the surfaces 18a, 18b on the front curves 18, thereby depositing a thin layer or film of the surfactant thereon, with such layer being at a uniform thickness on each respective front curve surface 18a, 18b due to the resilient biasing forces being exerted by each of the springs 66 acting on the individual stamps 38.

Thereafter, the stamping head unit 30 is again moved vertically upwardly along guide columns 26, and a subsequent molding pallet 10 or frame 14 mounting front curves 18 advanced into the stamping station of the apparatus, while the preceding molding pallet 10 or frame 14 which has the front curve surface thereon already treated with the surfactant is advanced out of the stamping station so as to be mated with base curves 19, as is known in the art. The process may then be repeated with the subsequently introduced front curves 18 on mold pallets 10 or frames 14 in the same continuous manner.

The foregoing structure enables the deposition of a thin and uniform layer or film of the surfactant onto specified flange surface 18a of the front curves 18 so as to enable easier subsequent separation of the base curves 19 therefrom and removal of the HEMA-based ring

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1 material excessed during the molding of the hydrophilic  
polymer contact lenses, upon completion of the molding  
sequence, and in the absence of damage being encountered  
by the molded contact lenses being released from the  
5 separated mold parts.

Although the invention has been primarily  
described in connection with the deposition or  
application of the surfactant through the intermediary  
of a stamping apparatus and method, other kinds of  
10 deposition of the surfactant to surfaces on the front  
mold curves readily suggest themselves to one of skill  
in the art. Instead of the surfactant being stamped, it  
is possible to contemplate the application of the  
surfactant to the surfaces of the mold part through the  
15 intermediary; for example, of painting or brushing,  
printing, wiping, dripping, dipping, among other  
possible methods.

As illustrated in the detail or fragmentary  
drawing of Figure 7, in lieu of a stamp 38 as shown in  
20 Figure 6, there may be provided a brush 80 adapted to  
contact specific surface portion 18a of a front curve  
mold portion 18. Moreover, rather than supplying  
surfactant to the bristles of brush 80 by contacting  
with a pad member, such as pad member 40 which is  
25 impregnated with surfactant, it is also possible to  
contemplate connecting the brush 80 with a supply of  
surfactant through a suitable conduit or flexible tubing  
connection leading to a supply source for the  
surfactant. This would eliminate the necessity for the  
30 provision of a pad member, while concurrently

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1 simplifying the structure and functioning of the  
apparatus for surfactant deposition.

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

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

1. An apparatus for applying a surfactant to  
at least one surface of a mold part of a two-part mold  
having said first mold part engageable with a  
5 cooperative second mold part for the molding of polymer  
articles, wherein said surfactant assist in the release  
between said first and second mold parts and enables  
removal of excess polymer molding material adherent to  
said at least one surface of said first mold part; said  
10 apparatus comprising:

a) a support means mounting at least one said  
first mold part being movable to a predetermined  
location in said apparatus;

b) applicator means including at least one  
15 surfactant applicator being arranged in spaced  
relationship above said support means, said at least one  
surfactant applicator being positionable in vertical  
alignment with said at least one first mold part;

c) means mounting a pad member containing a  
20 surfactant being interposable between said applicator  
means and said support means for said at least one first  
mold part;

d) actuating means for imparting a vertical  
downward displacement to said applicator means to cause  
25 said at least one surfactant applicator to contact said  
pad member and assume a quantity of said surfactant  
therefrom, said actuating means thereafter imparting a  
vertical upward displacement to said applicator means;  
and

30 e) means for displacing said pad member from  
the interposition thereof in said apparatus between said

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1 applicator means and said at least one first mold part,  
said actuating means for said applicator means  
displacing said applicator means downwardly to an extent  
such that the surfactant-wetted surface portions of said  
5 at least one surfactant applicator contact said at least  
one surface of said first mold part so as to impart a  
coating of said surfactant thereto.

2. An apparatus as claimed in Claim 1,  
wherein said applicator means comprises stamping means  
10 and said surfactant applicant comprises a stamp.

3. An apparatus as claimed in Claim 2,  
wherein said actuating means raises said stamping means  
upwardly into the initial position thereof subsequent to  
imparting the layer of said surfactant to said at least  
15 one surface of said first mold part; and operative means  
displaces said support means for said at least one first  
mold part and successively conveys a further mold  
support mounting at least one said first mold part into  
said location in said apparatus.

20 4. An apparatus as claimed in Claim 2,  
wherein said means mounting said pad member comprises  
operative means for alternately positioning said pad  
member beneath said stamping means and withdrawing said  
pad member from said location in said apparatus to  
25 enable said at least one stamp to advance downwardly  
into contact with said at least one surface of said at  
least one first mold part.

5. An apparatus as claimed in Claim 2,  
wherein said pad member comprises a porous polyethylene  
30 member having an average 10 micron pore size, said

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1 member being impregnated with a solution containing said  
surfactant.

6. An apparatus as claimed in Claim 5,  
wherein an upper surface of said porous polyethylene  
5 member facing said at least one stamp of said stamping  
means is covered by a filter having a mesh size with  
openings within the range of about 0.5 to 2.0 microns.

7. An apparatus as claimed in Claim 6,  
wherein said filter is a nylon filter controlling the  
10 amount of surfactant wicked through said member and  
expelled upwardly through said filter response to being  
contacted by said at least one stamp so as to deposit a  
predetermined quantity of said surfactant on contacting  
surface portions of said at least one stamp.

15 8. An apparatus as claimed in Claim 2,  
wherein at least the surface portions of said at least  
one stamp contacting said pad member for assuming  
surfactant therefrom is constituted from a compound  
comprising about 90% urethane and 10% silicone.

20 9. An apparatus as claimed in Claim 2,  
wherein a plurality of said first mold parts are mounted  
on said support means, each said first mold part  
comprising a front curve for molding a hydrophilic  
polymer contact lens and an encompassing flange portion,  
25 each said mold means being operatively aligned with  
respectively one said stamp whereby contact between said  
front curve and an associated stamp transfers a thin  
film of said surfactant to a facing surface on said  
flange portion about said front curve from said stamp  
30 thereby at a subsequent demolding operation facilitating  
detaching of a second mold part comprising a base curve

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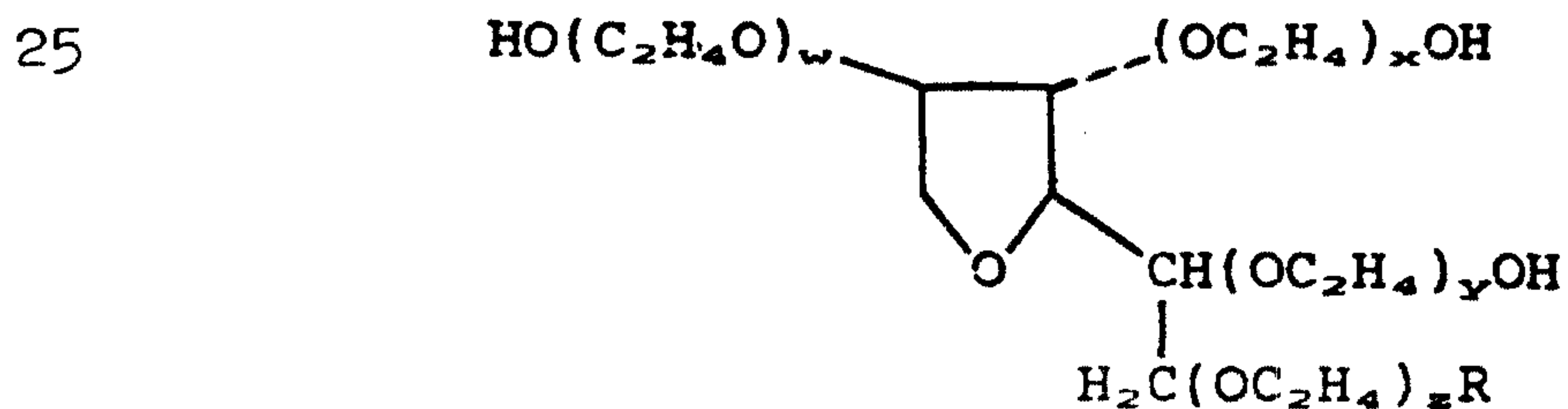
1 for said lens and a ring of excess molding material  
adhesively deposited on the surfaces of said flange  
portion about said front curve.

10. An apparatus as claimed in Claim 9,  
5 wherein said support means for said first mold parts  
comprises a mold pallet.

11. An apparatus as claimed in Claim 9,  
wherein spring means resiliently mount each said stamp  
on said stamping means to enable each said stamp to  
10 floatingly displace relative to each other upon  
contacting said respective front curve so as to ensure  
an even contact to be applied to each said front curve  
and impart a uniform layer of said surfactant to each  
said front curve.

15 12. An apparatus as claimed in Claim 1,  
wherein said surfactant comprises a polyethylene oxide  
sorbitan mono-oleate.

13. An apparatus as claimed in Claim 1,  
wherein said surfactant comprises an oleate ester of  
20 sorbitol and its anhydrides copolymerized with  
approximately 20 moles of ethylene oxide for each mole  
of sorbitol and sorbitol anhydrides, of generally the  
formula:



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[Sum of w, x, y, z is 20; R is  $(\text{C}_{17}\text{H}_{33})\text{COO}$ ]

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1           14. An apparatus as claimed in Claim 1,  
wherein said surfactant applicator comprises a brush.

          15. A method for applying a surfactant to at  
least one surface of at least one first mold part of a  
5 two-part mold utilized for the molding of polymer  
articles so as to facilitate disengagement between said  
first mold part from a second mold part and the removal  
of any excess molding material present on said at least  
one surface on said first mold part, said method  
10 comprising the steps of:

          a) moving a support means mounting said at  
least one first mold part to a predetermined location;

          b) arranging applicator means including at  
least one surfactant applicator in spaced relationship  
15 above said support means, and positioning said at least  
one surfactant applicator in vertical alignment with  
said at least one first mold part;

          c) coating said at least one surfactant  
applicator with a layer of surfactant; and

20           d) displacing said applicator means  
downwardly to an extent such that surfactant-wetted  
surface portions of said at least one surfactant  
applicator contact the at least one surface on said at  
least one first mold part to impart a coating of said  
25 surfactant to said surface.

          16. A method as claimed in Claim 14, wherein  
said applicator means comprises stamping means and said  
surfactant applicator comprises a stamp.

          17. A method as claimed in Claim 16, wherein  
30 said stamping means is raised upwardly into the initial  
position thereof subsequent to coating said surfactant

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on said at least one first mold part; and displacing said support means from and inserting a successive support means into position at said location.

18. A method as claimed in Claim 16,  
5 comprising alternately positioning a pad member beneath said stamping means and withdrawing said pad member from said location to enable said at least one stamp to advance downwardly into contact with said at least one surface on said at least one first mold part.

10 19. A method as claimed in Claim 18, wherein said pad member comprises a porous polyethylene member having an average 10 micron pore size, said member being impregnated with a solution of said surfactant.

15 20. A method as claimed in Claim 19, wherein an upper surface of said porous polyethylene member is covered by a filter having a mesh size with openings within the range of about 0.5 to 2.0 microns.

20 21. A method as claimed in Claim 20, wherein said filter is a nylon filter controlling the amount of surfactant wicked through said base and passed outwardly through said filter in response to pressure exerted thereon by said at least one stamp upon being contacted thereby so as to deposit a predetermined quantity of said surfactant on said at least one stamp.

25 22. A method as claimed in Claim 16, wherein at least the surface portions of said at least one stamp contacting said pad member for assuming surfactant therefrom is constituted from a compound comprising about 90% urethane and 10% silicone.

30 23. A method as claimed in Claim 16, wherein a plurality of said first mold parts are mounted on said

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support means forming a pallet, each said first mold parts comprising a front curve and encompassing flange portion for molding a hydrophilic polymer contact lens, each said first mold parts being operatively aligned with respectively one said stamp whereby contact between the facing surface on said flange portion of the front curve and an associated stamp transfers a thin film of said surfactant to said surface from said stamp, thereby facilitating subsequent release of a second mold part forming a base curve for molding said leans and a ring of molding material adhesive deposited on said flange surface.

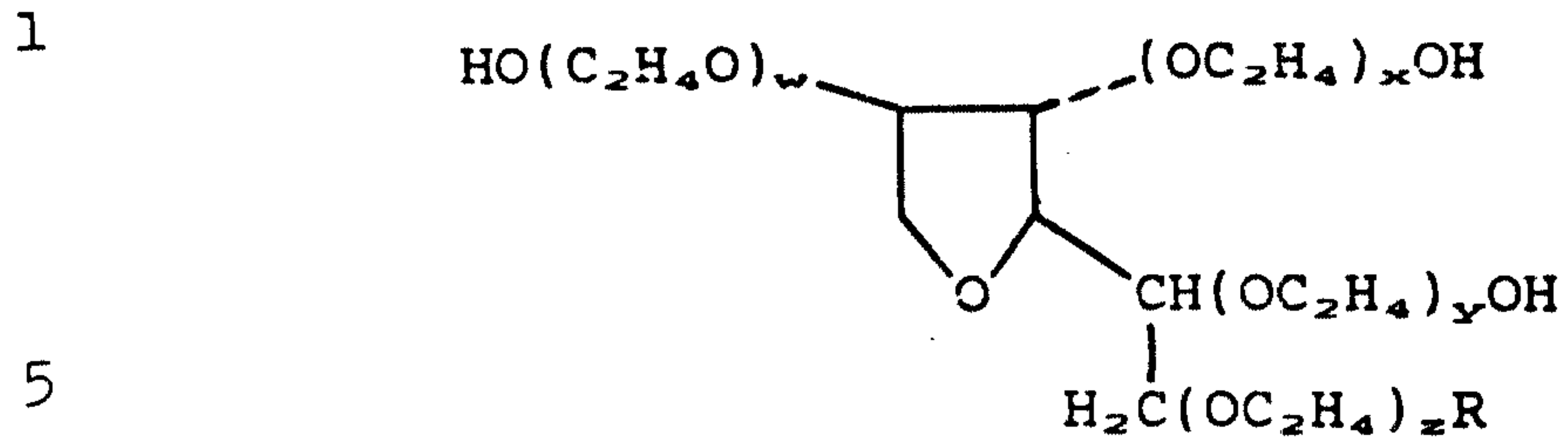
24. A method as claimed in Claim 22, wherein each said stamp is resiliently mounted on said stamping means to enable each said stamp to floatingly displace relative to each other upon contacting said respective surface in the flange about the front curve so as to ensure an even contact to be applied thereto and to impart a uniform coating of said surfactant to each said surface.

25. A method as claimed in Claim 15, wherein said surfactant comprises a polyethylene oxide sorbitan mono-oleate.

26. A method as claimed in Claim 15, wherein said surfactant comprises an oleate ester of sorbitol and its anhydrides copolymerized with approximately 20 moles of ethylene oxide for each mole of sorbitol and sorbitol anhydrides, of generally the formula:

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[Sum of w, x, y, z is 20; R is (C<sub>17</sub>H<sub>33</sub>)COO]

27. A method as claimed in Claim 15, wherein  
10 about 0.05 to 0.50 mg of surfactant is applied to each  
said surface of said one mold part.

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FIG. 1

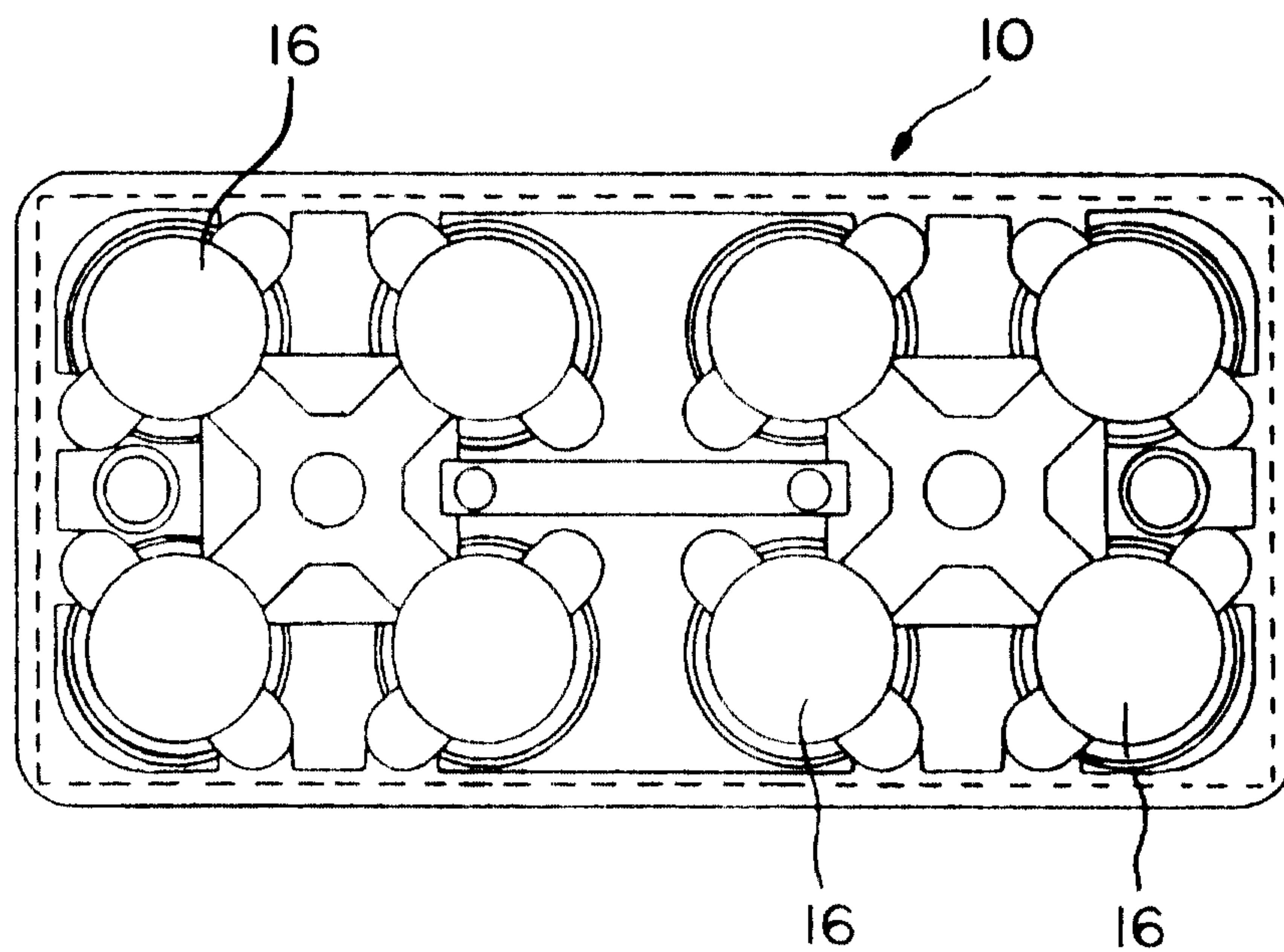
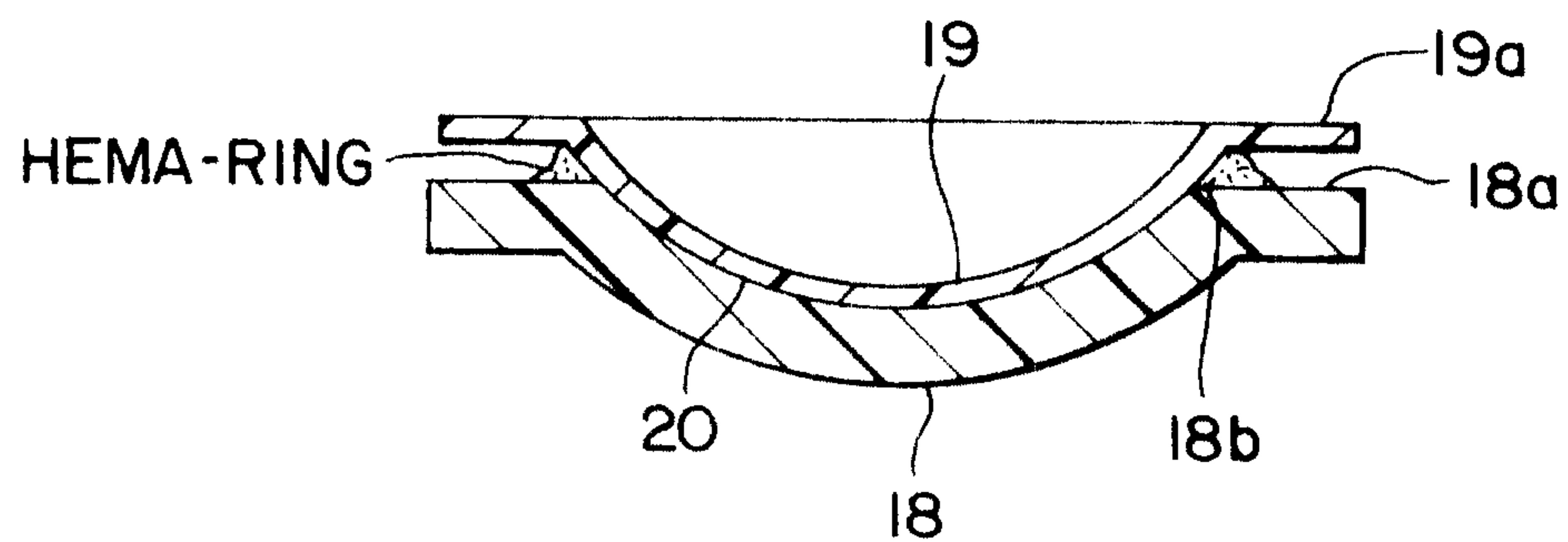


FIG. 3



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PATENT AGENTS

*Swanbey Ogilvy Renault*

FIG. 7

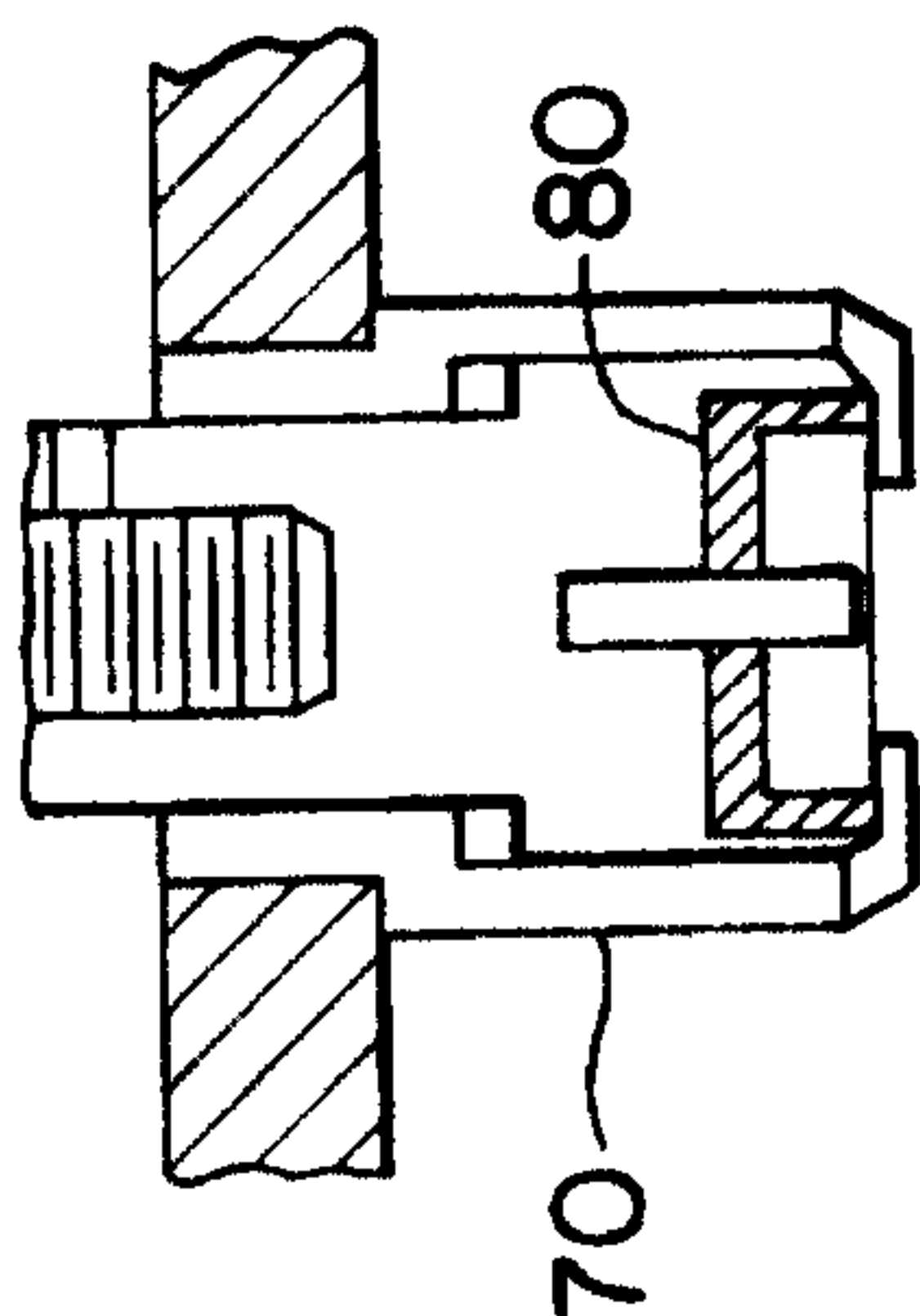


FIG. 6

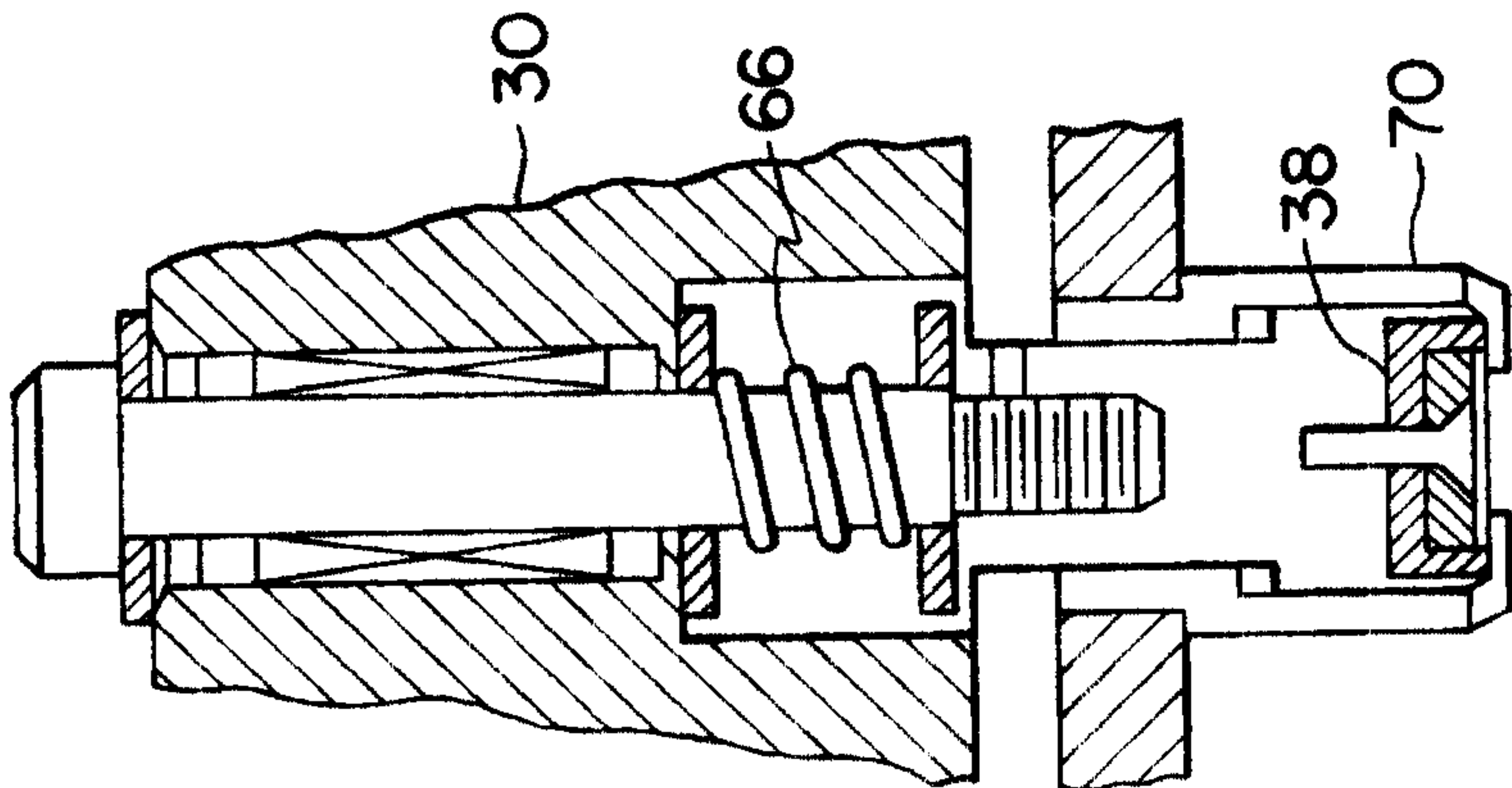
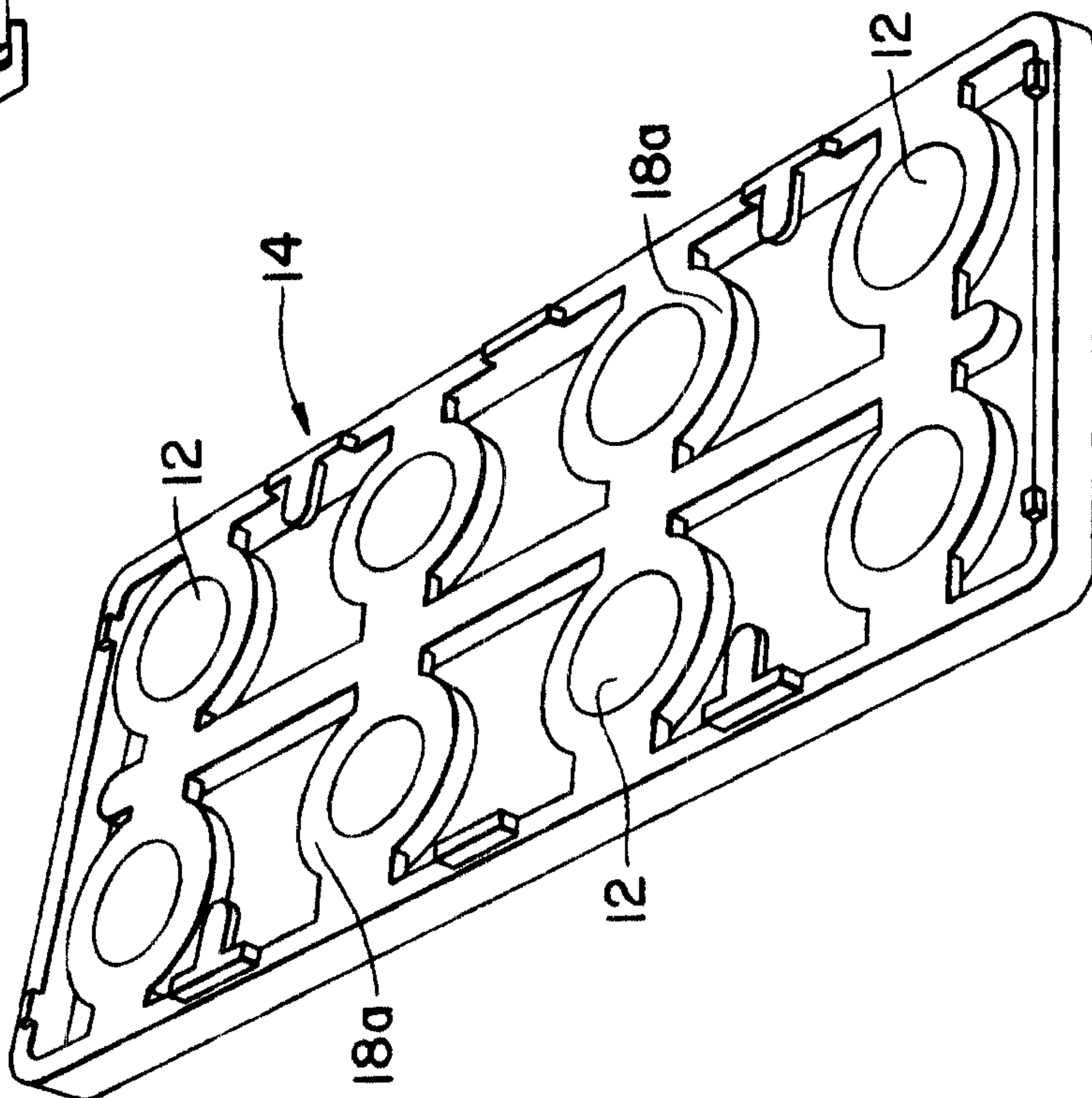
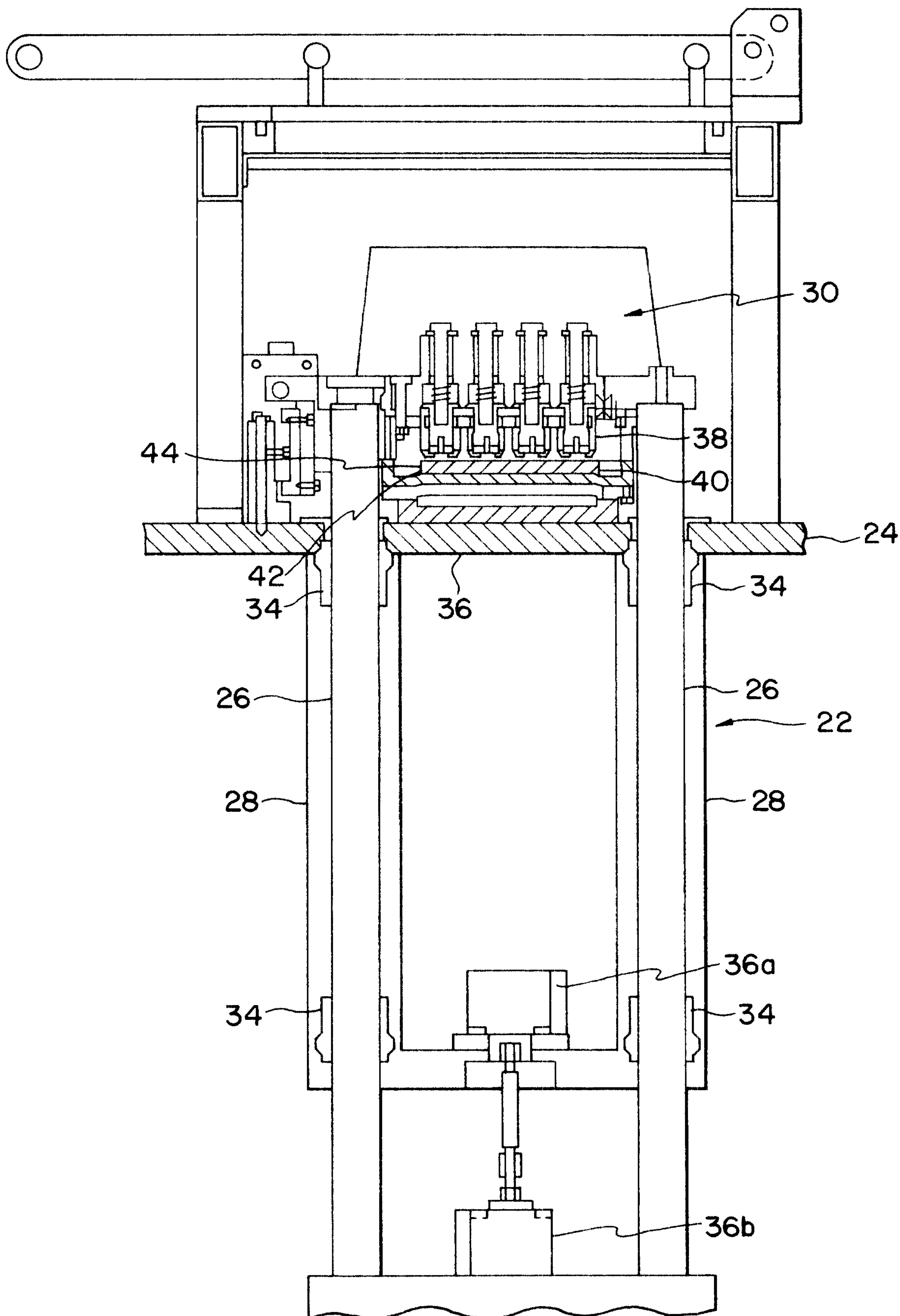


FIG. 2



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FIG. 4

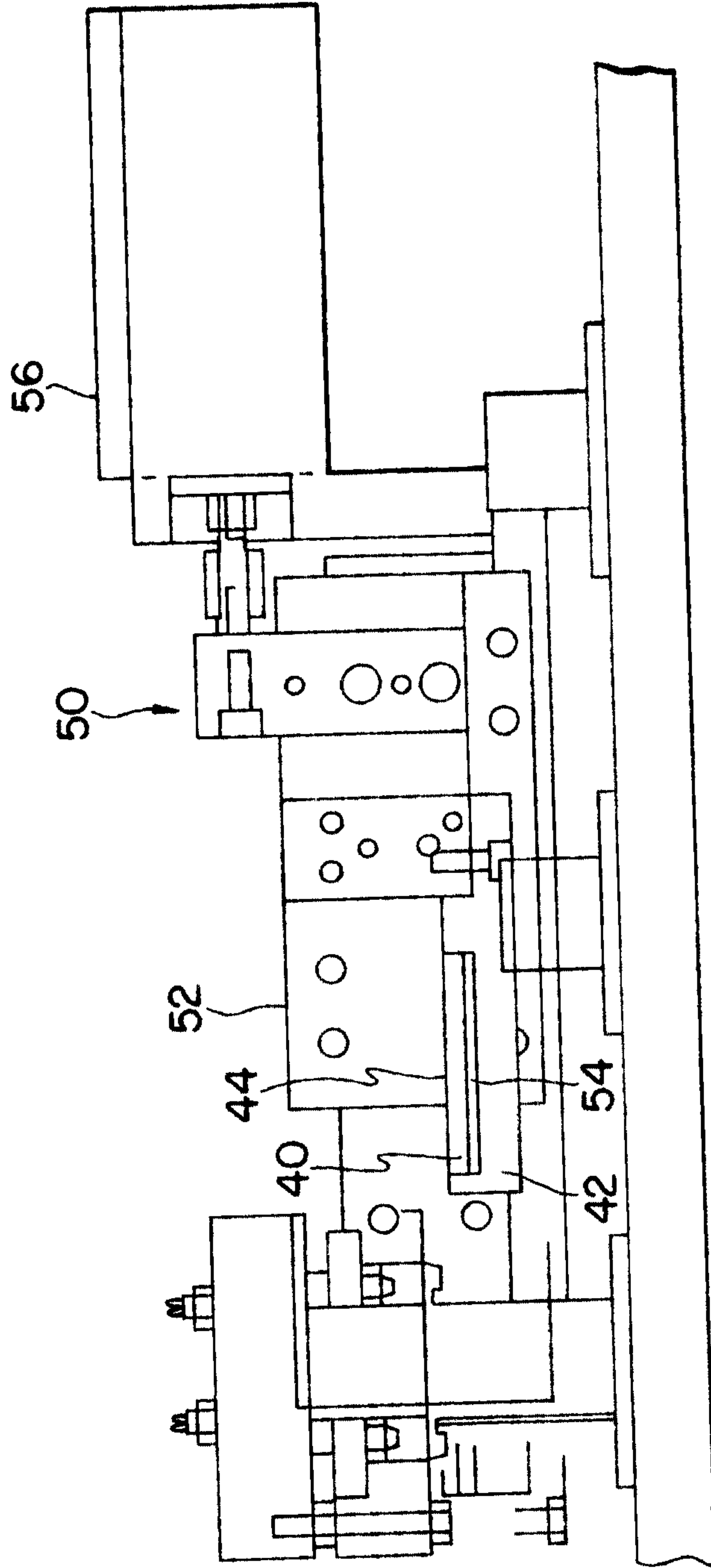


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FIG.5



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