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

**CROSS-REFERENCE TO RELATED APPLICATION**

5           This application is a continuation-in-part patent application of Serial No. 08/258,263; filed June 10, 1994.

**BACKGROUND OF THE INVENTION**

10 **1. Field of the Invention**

          The present invention relates to a method of employing a surfactant which is provided in order to assist with the release from each other of mold components of a multi-part mold employed in the molding of polymeric articles; for instance, such as hydrophilic contact lenses, 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 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; 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 invention, there is provided a novel and unique apparatus which is adapted to effectuate the application

1 of a coating or film containing a surfactant to surfaces  
of mold components for molding hydrophilic polymer  
articles, especially such as hydrophilic contact lenses  
or the like. Accordingly, any excess molding material  
5 encountered during the molding of the contact lenses  
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  
10 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  
15 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  
20 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  
25 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  
30 causing any damage to the contact lenses upon separating  
the mold parts, which would render the lenses unusable.

1 Various concepts employed for effectuating the release  
of hydrophilic contact lenses from surfaces of molds,  
particularly two-part molds which are intended to be  
physically separated, are through the employment of  
5 laser or infrared heat mold part separating devices, the  
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  
10 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  
15 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.

20 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  
25 lenses of the type considered herein are usually  
constituted from a hydrophilic polymer, preferably a  
HEMA-based polymer (hydroxyethyl methacrylate), although  
other suitable monomers may comprise hydroxy ethyl  
acrylate (HEA), hydroxy propyl methacrylate, hydroxy  
30 propyl acrylate and hydroxy trimethyl ethylene acrylate,  
among numerous other applicable materials.

1           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  
5 male base surfaces or curvilinear wall portions for the  
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  
10 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  
15 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,  
20 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  
25 cooperating mold components, and which form ring-shaped  
elements of the preferably 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  
30 deposited. These rings make separating of the mold  
cavities difficult, resulting in mold breakage and

1 damage to the lenses. Further, the rings, or fragments  
thereof, become uncontrollable debris in automated  
production lines, contaminating both the production line  
and the final lens package. Moreover, the foregoing can  
5 also conceivably cause a perfectly "good" contact lens  
to be 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  
10 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  
15 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.  
20 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 and the disclosures  
of which are incorporated herein by reference.

The release of hydrophilic contact lenses from  
25 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  
30 bath employed in the molding cavities for molding the  
hydrophilic polymeric structures or contact lenses. The

1 surfactant which is dispersed in the hydration bath in  
concentrations not exceeding 10% by weight aids in  
facilitating release of the lenses from adherent  
contiguous mold surfaces being separated, with the  
5 function of such surfactant being to reduce the surface  
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  
10 adherent during molding. Numerous types of surfactants  
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  
15 polymer articles from adherent mold surfaces which are  
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  
20 contact lenses from the mold surfaces prior to hydration  
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  
25 between the mold component, whereby the rate of damage  
being encountered by the contact lenses upon mold  
separation and removal from the molds is still  
unacceptably high and is not readily controllable to a  
degree affording a satisfactory economic manufacturing  
30 environment.

1 SUMMARY OF THE INVENTION

Accordingly, in order to improve upon the ability of such hydrophilic polymeric articles, especially hydrophilic polymer contact lenses, of being inherently releasable in an undamaged state from the 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 lenses which are ordinarily constituted from a HEMA-based plastic material, wherein a plurality of stamping heads each 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 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 a second mold part defining 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 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 part, such as a flange surface, contemplates the positioning of at least one mold pallet or a pair of

1 mold pallets 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 a plurality of  
5 stamps each of which is adapted to engage respectively  
one of the surfaces or flange portions extending about  
the front curves located on the mold pallet or pallets.  
A pad arrangement which comprises a reservoir of the  
surfactant; for instance, a polymeric surfactant such as  
10 Tween 80, includes a plurality of discrete pads adapted  
to be moved beneath the stamping head and permitted to  
remain there while the stamps of the stamping head are  
moved downwardly into contact with each therewith  
associated pad, and then retracted upwardly to allow the  
15 pad to be moved out from beneath the stamping head. The  
foregoing contacting between the stamps of the stamping  
head and the therewith aligned surfactant-impregnated  
pad arranged in the surfactant reservoir resultingly  
causes each stamp to be wetted with the surfactant; in  
20 effect, the Tween 80 surfactant. Thereafter, the  
stamping head is moved downwardly towards the mold  
pallet or pallets so as to enable the stamps to each  
respectively contact a therewith aligned surface or  
flange extending about a respective front curve  
25 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 stamps is then  
retracted upwardly and the machine sequences to the next  
30 mold pallet or pair of pallets of front curves of a two-  
part contact lens mold while concurrently advancing the

1 preceding surfactant-coated front curves on their mold  
pallet or pallets towards a station of the machine in  
which there is implemented the assembly of the back  
curve onto the front curve.

5           Pursuant to a specific aspect of the  
invention, the discrete pads for enabling the stamps to  
be wetted with the surfactant includes an upwardly  
opened reservoir extending substantially across the full  
width of the collective stamps, and whereby each of the  
10 individual or discrete pads is adapted to be at least  
partly immersed in surfactant in the reservoir so as to  
absorb the surfactant and enable to be wicked upwardly  
through each of the pads. A cover plate sealingly  
covers the upwardly opened area of the reservoir and has  
15 a plurality of apertures formed therein commensurate  
with the number of pads and associated stamps adapted to  
contact the latter, so as to form a sealing cover  
structure preventing any of the surfactant from spilling  
out of the reservoir. This is effectuated in that a  
20 seal is interpositioned between the perimeter of the  
reservoir and the lower surface of the cover plate, and  
the apertures in the cover plate contact the  
circumferential edges of each of the pads along their  
upper surfaces. In order to enable visual inspection of  
25 the reservoir so as to be able to ascertain the level or  
quantity of surfactants contained therein, at least  
portions of the surface portion of the cover plate, the  
latter of which is generally constructed of a metallic  
material, may be constructed from a transparent  
30 material, preferably such as Lexan (registered  
trademark).

1           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  
cavity has previously been filled with HEMA molding  
5 material for the contact lens and then subsequently  
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  
10 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  
15 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  
20 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  
25 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  
30 rate of the HEMA ring without any damage being  
encountered by the contact lenses.

1           In accordance with another advantageous  
feature of the invention, the stamping head provides for  
a resiliently mounted multiple stamp structure enabling  
each individual stamp to "float" or be shiftable to some  
5 extent independently of the displacement of the other  
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  
10 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.

15           As set forth herein, in accordance with a  
specific aspect of the invention, as contained in the  
reservoir in a predetermined discretely spaced position,  
each pad for applying the surfactant to an associated  
one of the stamps of the stamping head may utilize a  
20 material structure to constitute a substantially porous  
pad; for example, a polyethylene pad; each pad  
preferably, although not necessarily, being an  
essentially cylindrical member of a surfactant-  
absorptive material which is intended to absorb  
25 surfactant from the reservoir and wick it towards the  
top of the respective pad when the latter is contacted  
by the downwardly displaced stamps during application or  
wetting with surfactant. A nylon filter, for instance,  
having a mesh size within the range of about 0.50 to 2.0  
30 microns, and preferably of a 1.2 micron mesh size, is  
supported on the top surface of respectively each porous

1 pad, and acts as a metering device so as to permit only  
a very minor quantity of the surfactant to pass  
therefrom through the nylon membrane filter to the  
contacting surfaces on the stamps of the stamping head  
5 for forming a thin surfactant layer or wetted surface  
thereon. This enables for highly precise control to be  
exercised over the amount of surfactant being passed  
through the nylon filter to the stamps and, thereafter  
upon withdrawal of the pad, to be subsequently deposited  
10 by the stamps on the surfaces or flanges extending about  
the front curves which are positioned on the mold  
pallet.

In comparison with the prior art, such as is  
represented by U.S. Patent No. 5,264,161 to Druskis  
15 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  
control over the amounts of surfactant being in a novel  
20 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  
minimal danger of damage to the lenses being  
25 encountered, thereby also rendering the entire procedure  
and apparatus highly cost effective and economical in  
the manufacture of contact lenses of uniformly high  
quality.

Accordingly, it is an object of the present  
30 invention to provide an arrangement for depositing  
controlled amounts of a surfactant on mold surfaces to

- 1 facilitate the separation of the mold parts, such as  
between front curves and base curves, enabling the  
removal of HEMA-based rings of excess molding material  
adhering to mold surfaces about the front curves, and  
5 thereby essentially eliminating contamination of the  
production line and the packages upon completion of the  
lens molding procedure.

Another object of the present invention  
resides in the provision of a method for depositing thin  
10 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-  
based rings of excess molding material adhering to mold  
15 surfaces about the front curves, and facilitating an  
essentially undamaged release of the molded contact  
lenses, utilizing the arrangement as described herein.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

- 20 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  
the front curves of a mold structure for molded  
25 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  
with the accompanying drawings; in which:

- 30 Figure 1 illustrates a top plan view of a  
typical mold pallet of a two-part mold for selectively

1 supporting thereon either the back or front curves  
employed for the molding of hydrophilic polymer contact  
lenses;

5 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  
diagrammatic view through an assembled front curve and  
base curve arrangement for molding hydrophilic polymer  
10 contact lenses;

Figure 4 diagrammatically illustrates a top  
plan view of a stamping station for the application of a  
surfactant to stamps on a stamping head and thereafter  
for the deposition of a film or quantity of the  
15 surfactant onto surface portions on the front curves of  
mold parts positioned on contact lens molding pallets;

Figure 5 illustrates an elevational sectional  
view of the stamping station and mechanism for  
selectively moving a stamp pad arrangement and molding  
20 pallets under the stamping head, taken along line 5-5 in  
Figure 4;

Figure 6 illustrates a top plan view of the  
surfactant reservoir containing the pads of the stamp  
pad arrangement;

25 Figure 7 illustrates a sectional view taken  
along line 7-7 in Figure 6;

Figure 8 illustrates, on an enlarged scale, a  
fragmentary detail of the reservoir taken along line 8-8  
in Figure 6; and

30

35

1                Figure 9 illustrates, generally  
diagrammatically, an alternate embodiment of a stamp for  
applying the surfactant to the lens mold.

5    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  
10 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  
15 material employed for the hydrophilic contact lenses  
maybe constituted of a HEMA-based (hydroxyethyl-  
methacrylate) or equivalent material.

As shown in Figure 2, another embodiment or  
modification of a mold frame or pallet 14 comprises  
20 individual concave mold units 12 forming 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 two-part  
25 mold are somewhat different than those contemplated in  
Figures 1 and 3, although surfactant may be applied  
thereto in the same manner, as described hereinbelow;  
and other variations thereof also readily lend  
themselves for use with the inventive apparatus and  
30 method.

1           Each concave mold unit 12 defines a front  
curve 18 for the containment of a monomer material for  
the subsequent molding of a contact lens, as shown in  
Figure 3. Extending about the front curve is an  
5 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.

In order to provide the complete two-part  
mold, a second mold part comprising a base curve 19 is  
10 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  
forming a contact lens therebetween, with the base curve  
19 peripherally being seated on the annular lip 18b.  
15 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  
which there is received excess HEMA-based molding  
material expelled from the molding cavity 20 so as to  
20 form a HEMA-ring which adheres to the adjoining flange  
surfaces.

Generally, the mold parts 18 and 19 are  
constituted of a suitable plastic material, such as a  
polyolefin including low, medium and high-density  
25 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,  
30 including the front curves and base curves for molding  
contact lenses, are known in the technology, having

1 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.

Referring now in greater detail to the  
5 embodiment of a stamping station as represented in  
Figures 4 through 8, and particularly the representation  
of Figures 4 and 5, there is illustrated a stamping  
station 30 for applying a thin film or layer of a  
surfactant of the type described hereinbelow, to the  
10 flange surface 18a of each respective front curve which  
is located in each depression 12, 16, respectively, of a  
pair of contiguous end-to-end positioned mold pallets 10  
as shown in Figure 1 or mold pallets 14 as shown in  
Figure 2. Other types of mold pallets, of course,  
15 readily lend themselves to the invention, and the  
embodiments of the mold pallets are considered to be  
only as being generally representative by way of  
example.

Caution should be exercised to avoid applying  
20 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  
25 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 surface of flanges 18 between the  
annular mold part flanges 18a, 19a at a demolding  
30 station subsequent to completion of the lens molding

1 procedure, so as to reduce potential damage to the  
contact lenses being released from the mold cavities 20.

As illustrated in Figures 4 and 5, the  
stamping station 30 includes a frame structure 32 having  
5 a support member or base 34 on which there are  
positioned a plurality of spaced downwardly depending  
upright guide columns 36. These stationary guide  
columns 36 have slide members 38 vertically slidable  
therein for supporting components for a stamping head  
10 unit 40 so as to be vertically displaceable along the  
guide columns. The stamping head unit 40 is mounted to  
enable vertical reciprocation of the stamps, as  
described below, proximate the upper end of the columns  
36 through the intermediary of suitable guide bushings  
15 42 and slide members 38, and wherein the vertical  
displacement is implemented through suitable actuating  
elements or drive units, such as hydraulic or pneumatic  
actuators, which are not described in further detail  
herein, and which, if desired, may be operated from a  
20 suitable control and sensor unit (not shown).

The stamping head unit 40 includes mounted  
thereon a plurality of stamps 50 each adapted to be  
moved in vertical reciprocatory movement in a  
coordinated manner in conjunction with retainer plate  
25 element 52 mounted on the stamping head unit 40, wherein  
the number of stamps 50 is correlated with the number of  
front curves 18 located in the mold depressions 12, 16  
formed in the respective mold pallet 10 or mold frame  
14. Each stamp 50 consists of a rubber or composition  
30 of about 90% urethane and 10% silicone in at least the

1 portions thereof which are adapted to contact the front  
curves on the mold pallet 10 or 14.

Mounted on the main frame of the apparatus so  
as to be horizontally slidable into and out of position  
5 beneath the stamping head unit 40 is a stamp pad  
arrangement 60 which is fastened to a frame structure 62  
at opposite ends thereof through the intermediary of  
suitable fastener members, and whereby the entire frame  
structure 62 including the stamp pad arrangement 60 may  
10 be selectively moved into and out of position beneath  
the stamping head unit 40 through the activation of a  
pneumatic cylinder 64 and piston device 66 attached  
thereto at one end thereof.

In this instance, the apparatus of the  
15 stamping station 30 is of a width so as to be able to  
accommodate two of the mold pallets or frames 10 or 14  
in contacting end-to-end relationship, in order to  
simultaneously accommodate sixteen mold curve parts, as  
is clearly indicated in Figure 5 of the drawings, and  
20 with the stamp pad arrangement 60 being of a  
commensurate length and width in plan view, as shown in  
Figures 4 and 5.

In the present instance, in a modification of  
the apparatus illustrated in the parent application,  
25 Serial No. 08/258,263, rather than having a continuous  
stamping pad which is impregnated with the surfactant,  
the stamp pad arrangement 60 disclosed herein consists  
of a reservoir 70 in the form of an upwardly opening  
trough-like structure, possibly containing up to a 6-  
30 week supply of surfactant, in which there are fixedly  
mounted a plurality of stamp pads 72, each generally of

1 circular cross-section or cylindrical shape, reference  
being had specifically to Figures 6 through 8 of the  
drawings showing the detailed structure of the stamping  
pad arrangement 60. The reservoir 70 is basically  
5 constituted of a metallic material, such as for example,  
a stainless steel, having a rectangular configuration,  
mounted by means of suitable fasteners 74 to the  
actuating frame structure 62 which, in turn, is  
connected to the pneumatic cylinder 64 and, in a  
10 rectangular recessed portion 76 thereof includes a  
plurality of the generally cylindrical stamp pads 72  
mounted or supported on upstanding pins 78.

The reservoir 70 is covered by a single  
generally rectangular flat plate member 80, which may  
15 also be constituted of a suitable metal such as  
stainless steel and which has a peripheral sealing  
member 82, such as an O-ring, positioned to extend  
between the upper perimeter of the reservoir, which may  
have a suitable groove 84 formed therein for receiving  
20 the O-ring or sealing member 82, and the lower surface  
of the plate member 80 whereby upon the plate member 80  
being fastened to the reservoir 70 through suitable  
fasteners 88, such as screws or the like. Apertures 90  
are formed in the plate member 80, located to be aligned  
25 and commensurate in number with each of the stamp pads  
72, and dimensioned to contact the upper circumferential  
surfaces of the latter, as shown in Figure 8, and  
thereby form a complete sealing arrangement for the  
surfactant contained in the reservoir 70.

30 In order to provide visual capability of  
inspection that there is an adequate supply of

1 surfactant in the reservoir 70 able to be absorbed by  
the stamp pads 72, at least one or two surface portions  
94 of the metallic plate member 80 may be cut out and  
suitable plates 96 of a transparent plastic material,  
5 such as Lexan (registered trademark), fixedly positioned  
in the cut-out areas.

The upper surface of each stamp pad 72 is  
covered by a filter 100, preferably of nylon, having a  
mesh size within the range of about 0.5 to 2.0 microns  
10 so as to act as a metering device and allow only a  
relatively small quantity of surfactant to pass  
therethrough as the surfactant is wicked from each stamp  
pad 72 to the top thereof upon pads being pressingly  
contacted by the bottom ends of the stamps 50 of  
15 stamping head unit 40, as described hereinbelow.

The shiftable stamp pad and reservoir  
structure 70, 72 through the horizontally displaceable  
nature thereof, as shown in Figure 4 of the drawings, is  
adapted to be moved between the upright columns 36 and  
20 slide members 38 into position below the stamps 50 or  
moved outwardly away therefrom when not needed.

The foregoing stamp pad and reservoir  
arrangement 60, 70 and its actuating structure 64, 66 is  
located at an elevation or height above a mold pallet  
25 track (not shown in detail) along which the pairs of  
mold pallets 10 or 14 are adapted to be sequentially  
advanced into position below the stamping head unit 40,  
as shown in Figure 5, in order to enable each of the  
stamps 50 to apply a thin film or coating of surfactant  
30 to the respective surfaces 18a, 18b of the front curves  
18 located on the pallets before being transported

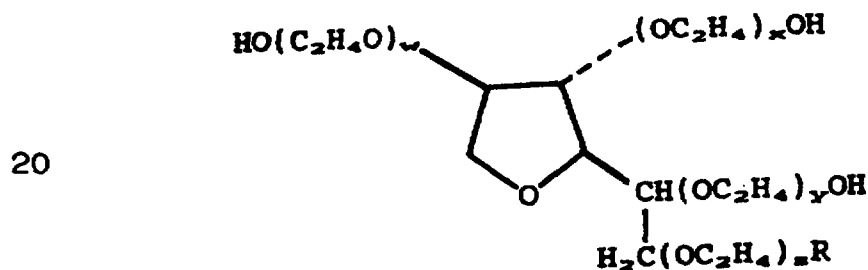
- 1 further along the lens manufacturing system in  
connection with the forming of the contact lenses.

OPERATION OF THE APPARATUS

- 5 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 40, the stamping head unit 40 is maintained in  
10 a fully raised position on slide members 38. This is  
implemented by means of a suitable lifting cylinder  
arrangement (not shown) acting on slide members 38 so as  
to be vertically movable within the guide columns 36.  
The extent of vertical movement may be controlled by a  
15 suitable control and sensor arrangement (not shown).  
Each stamp pad 72 in its reservoir 70 is interposed in  
spaced relationship between a molding pallet 10 or 14  
and the lower ends of the stamps 50 on the stamping head  
unit 40, which components are vertically aligned with  
20 each other in spaced relationship. This interposition  
of the stamp pads 72 is carried out by shifting the  
frame structure 62 through operation of cylindrical-  
piston device 64, 66 so as to locate the reservoir 70  
beneath the stamps 50. Thereafter, the stamping head  
25 unit 40 is actuated so as to cause the stamps 50 to be  
each displaced downwardly into predetermined contact  
with the upper surface of a membrane filter 100 on an  
associated stamp pad 72, whereby a certain amount of  
surfactant is expelled upwardly through the nylon filter  
30 100 and deposited on the lower downwardly facing surface

1 of each stamp 50, forming a thin layer or coating of the surfactant thereon.

The surfactant contained in reservoir 70 with which each pad 72 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 50. Preferably, the 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 moles of ethylene oxide for each mole of sorbitol and sorbitol anhydrides; of generally the formula:



[Sum of w, x, y, z is 20; R is  $(C_{17}H_{33})COO$ )

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 50 is individually resiliently imparted to the action of a suitable biasing spring 104, preferably such as a coil

1 spring encompassing part of a stamp rod 106 supporting  
the stamp 50 at a lower end thereof, thereby ensuring  
that notwithstanding manufacturing tolerances, a uniform  
pressure will be subsequently exerted by the surfactant-  
5 wetted stamps 50 against all contacting surfaces 18a,  
18b on the front curves 18 which are located on the mold  
pallets. Upon the surfactant having been wicked up  
through each stamp pad 72, expelled through the  
respective nylon filter 100 and deposited on the lower  
10 surface of each stamp 50, the stamping head unit 40 and  
stamps 50 are displaced upwardly, and the stamp pad  
arrangement 60 with its reservoir 70 is moved  
horizontally by means of the piston-cylinder device 64,  
66 out of the stamping station 30 from its position  
15 between the guide columns 36, thereby freeing the space  
between the stamps 50 and the therewith aligned front  
curves 18 on mold pallet 10 or 14. Thereafter, the  
stamps 50 and the stamping head unit 40 are again  
shifted downwardly along the vertical guide columns 36  
20 by means of slides 38 until the stamps 50 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  
25 each respective front curve surface 18a, 18b due to  
resilient biasing forces being exerted by each of the  
springs 110 acting on the respective stamps 50.

Subsequently, the stamps of the stamping head  
unit 40 are again moved vertically upwardly and a  
30 subsequent set of molding pallets 10 or frames 14  
mounting front curves 18 advanced into the stamping

1 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  
5 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  
10 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  
material excessed during the molding of the hydrophilic  
15 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  
separated mold parts.

Although in the foregoing described embodiment  
20 of the apparatus, each rubber stamp 50 is shown as a  
dished element fastened to its associated shaft or rod  
element 106 and actuating construction by means of a  
screw member 112, having specific reference to Figure 5  
of the drawings; pursuant to an alternative embodiment,  
25 as shown in Figure 9 of the drawings, rather than being  
fastened by means of a screw element, each rubber stamp  
120 may comprise an annular ring, with a widening or  
wedge-like annular flange portion 122 adapted to be  
forced into a similarly configured complimentary groove  
30 structure 124 formed in the end of its support rod 126,  
thereby clampingly engaging the rubber stamp while

1 eliminating the need for any screw member, the latter of  
which could conceivably loosen or fall off during  
continuous and repetitive operation of the apparatus.  
This press-fitted engagement of the resilient rubber  
5 stamp 120 by its flange 122 in the groove 124 ensures  
the firm engagement thereof while eliminating a  
loosenable fastening component and simplifying the  
structure thereof.

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

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1 WHAT IS CLAIMED IS:

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 assists 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) 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 an upwardly opening  
20 reservoir containing a surfactant being interposable between said applicator means and said support means for said at least one first mold part at least one pad member arranged in said reservoir for absorbing surfactant from said reservoir;
  - d) actuating means for imparting a vertical  
25 downward displacement to said applicator means to cause said at least one surfactant applicator to contact said at least one pad member and assume a quantity of said surfactant therefrom, said actuating means thereafter  
30 imparting a vertical upward displacement to said applicator means; and



1           e) means for displacing said reservoir  
mounting means from the interposition thereof in said  
apparatus between said applicator means and said at  
least one first mold part, said actuating means for said  
5 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  
10 surfactant thereto.

2. An apparatus as claimed in Claim 1,  
wherein a cover member is fixedly positioned on said  
reservoir at least one aperture being formed in said  
cover member in alignment with said at least one pad  
15 member to enable said at least one surfactant applicator  
to contact said at least one pad member.

3. An apparatus as claimed in Claim 2,  
wherein said at least one pad member sealingly contacts  
against a lower surface of said cover member adjacent  
20 the circumference of said at least one aperture.

4. An apparatus as claimed in Claim 3,  
wherein seal means extends about said reservoir and a  
lower surface of said cover member so as to prevent  
surfactant from spilling out of said reservoir during  
25 operation of said apparatus.

5. An apparatus as claimed in Claim 4,  
wherein said seal means is positioned in a groove formed  
in the lower surface of said cover member.

6. An apparatus as claimed in Claim 4,  
30 wherein said seal means comprises an O-ring seal.



1           7. An apparatus as claimed in Claim 2,  
wherein said cover member comprises a flat plate having  
at least one transparent surface portion to enable  
visual viewing of the contents of said reservoir.

5           8. An apparatus as claimed in Claim 7,  
wherein said transparent surface portion is constituted  
of a rigid transparent plastic material.

          9. An apparatus as claimed in Claim 2,  
wherein a plurality of said first mold parts are mounted  
10 in predetermined spaced relationship on said support  
means each in vertical alignment with respectively one  
surfactant applicator of a plurality of said  
applicators, a plurality of said pad members being  
discretely located in said reservoir each in alignment  
15 with respectively one of said surfactant applicators,  
and a plurality of said apertures being formed in said  
cover member each in alignment with respectively one of  
said pad members.

          10. An apparatus as claimed in Claim 1,  
20 wherein said applicator means comprises stamping means  
and said at least one surfactant applicator comprises a  
stamp.

          11. An apparatus as claimed in Claim 10,  
wherein said actuating means raises said stamping means  
25 upwardly into the initial position thereof subsequent to  
imparting the layer of said surfactant to said at least  
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 further mold support  
30 means mounting at least one other said first mold part  
into said location in said apparatus.



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1           12. An apparatus as claimed in Claim 11,  
wherein said means mounting said at least one pad member  
comprises operative means for alternately positioning  
said at least one pad member beneath said stamping means  
5 and withdrawing said at least one pad member from said  
location in said apparatus to 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.

10           13. An apparatus as claimed in Claim 1,  
wherein said at least one pad member comprises a porous  
member absorptive of a solution in said reservoir  
containing said surfactant.

15           14. An apparatus as claimed in Claim 1,  
wherein an upper surface of said at least one pad member  
facing said at least one surfactant applicator means is  
covered by a membrane filter having a mesh size with  
openings within the range of about 0.5 to 2.0 microns.

20           15. An apparatus as claimed in Claim 14,  
wherein said membrane filter is a nylon filter  
controlling the amount of surfactant expelled upwardly  
through said filter response to being contacted by said  
at least one surfactant applicator so as to deposit a  
predetermined quantity of said surfactant on contacting  
surface portions of said at least one surfactant  
25 applicator.

30           16. An apparatus as claimed in Claim 1,  
wherein at least the surface portions of said at least  
one surfactant applicator contacting said at least one  
pad member operatively associated therewith for assuming  
surfactant therefrom is constituted from rubber or a



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1 compound comprising about 90% urethane and 10%  
silicone.

17. An apparatus as claimed in Claim 1,  
wherein a plurality of said first mold parts are mounted  
5 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,  
each said mold means being operatively aligned with  
respectively one of a plurality of said surfactant  
10 applicator whereby contact between said front curve and  
an associated surfactant applicator transfers a thin  
film of said surfactant to a facing surface on said  
flange portion about said front curve from said  
surfactant applicator so as to thereby at a subsequent  
15 demolding operation facilitating detaching of a second  
mold part comprising a base curve for said lens and a  
ring of excess molding material adhesively deposited on  
the surfaces of said flange portion about said front  
curve.

20 18. An apparatus as claimed in Claim 17,  
wherein said support means for said first mold parts  
comprises at least one mold pallet.

19. An apparatus as claimed in Claim 17,  
wherein spring means resiliently mount each said  
25 surfactant applicator on said applicator means to enable  
each said surfactant applicator to 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  
30 layer of said surfactant to each said front curve.

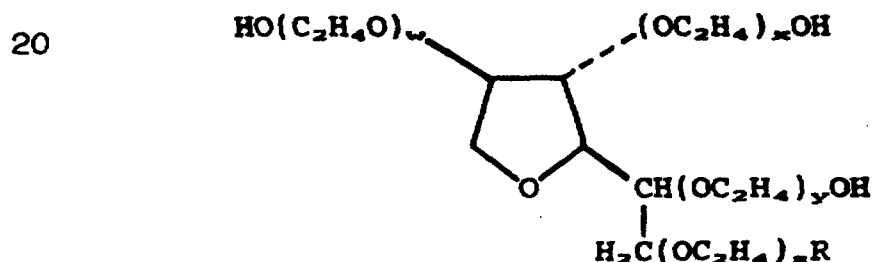


1           20. An apparatus as claimed in Claim 1,  
 wherein said at least one surfactant applicator  
 comprises an annular member mounted in an end surface of  
 said applicator means adapted to face said at least one  
 5 pad member and surface on said at least on first mold  
 part.

21. An apparatus as claimed in Claim 20,  
 wherein said end surface comprises an annular groove for  
 clampingly receiving said surfactant applicator.

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

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



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

24. A method for applying a surfactant to at  
 least one surface of at least one first mold part of a  
 30 two-part mold utilized for the molding of polymer  
 articles so as to facilitate disengagement between said



- 1 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:
- 5 a) moving 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  
above said support means, and positioning said at least  
10 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 by contacting at  
least one pad member located in a reservoir containing a  
15 supply of said surfactant;
- d) withdrawing said reservoir containing said  
at least one pad member to a position offset from said  
at least one surfactant applicator; and
- e) displacing said applicator means  
20 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  
surfactant to said surface.
- 25 25. A method as claimed in Claim 24, wherein  
said applicator means comprises stamping means and said  
at least one surfactant applicator comprises a stamp.
26. A method as claimed in Claim 25, wherein  
said stamping means is raised upwardly into the initial  
30 position thereof subsequent to coating said surfactant  
on said at least one first mold part; and displacing



1 said support means from and inserting at least one  
successive support means into position at said location.

27. A method as claimed in Claim 24,  
comprising alternately positioning at least one said  
5 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 28. A method as claimed in Claim 27, wherein  
said at least one pad member comprises a porous member  
absorptive of a solution of said surfactant.

29. A method as claimed in Claim 28, wherein  
an upper surface of said porous member is covered by a  
15 membrane filter having a mesh size with openings within  
the range of about 0.5 to 2.0 microns.

30. A method as claimed in Claim 29, wherein  
said filter is a nylon filter controlling the amount of  
surfactant passed outwardly through said filter in  
20 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.

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

30 32. A method as claimed in Claim 25, wherein  
a plurality of said first mold parts are mounted on said



1 support means forming at least one 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  
5 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  
10 release of a second mold part forming a base curve for  
molding said lens and a ring of molding material  
adhesive deposited on said flange surface.

33. A method as claimed in Claim 31, wherein  
each said stamp is resiliently mounted on said stamping  
15 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  
20 surface.

34. A method as claimed in Claim 24, wherein  
said surfactant comprises a polyethylene oxide sorbitan  
mono-oleate.

35. A method as claimed in Claim 24, wherein  
25 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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38. A method as claimed in Claim 37, wherein said cover member is provided with transparent surface portions to enable viewing of the contents of said reservoir.

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