(54) Title: FLUORESCENT CONTACT LENSES

(57) Abstract: A contact lens comprises at least one fluorescent colorant dispersed therein or a contact lens comprises at least one conventional colorant and at least one fluorescent colorant. Methods of making and inspecting the contact lens are also provided.
FLUORESCENT CONTACT LENSES

The present invention relates to colored contact lenses. In particular, the present invention relates to contact lenses having a fluorescent colorant.

BACKGROUND

Color has been added to contact lenses to achieve cosmetic effects upon the eyes of the people wearing the contact lenses. For example, a colored contact lens appears to change the eye color of the people wearing the contact lenses. The colored contact lens can make the eye appear to be a different natural color or to be a color that does not occur naturally in human eyes.

Presently, colored contact lenses are tinted with dyes either by reacting a dye with the contact lens polymer or entrapping the dye within the matrix of the contact lens polymer. Contact lenses made with these techniques have several drawbacks. First, the dye is often added in a step after the contact lens has been manufactured. This adds cost to the product. Second, the dye can only absorb light and the cosmetic effect is limited. For example, using the known techniques, lenses colored with a dye can make blue eyes appear green, but they cannot make dark eyes appear to be a lighter color. Also, using the known techniques, people cannot achieve dramatic eye color changes.

Recently, to address these limitations, some manufacturers have printed opaque pigments on the contact lens in an intermittent pattern. The colored and uncolored parts of the pattern combine to achieve the appearance of an eye color change for people having a wide range of natural eye colors. This technology as it is presently practiced has limitations. For example, the pigments used in the process function only by absorbing and reflecting light. What is needed is contact lens that addresses this and other limitations.
SUMMARY

The contact lenses of the present invention address at least some of the limitations of prior contact lenses.

In one aspect of the invention, a contact lens comprises at least one conventional colorant, and at least one fluorescent colorant, such that the fluorescent colorant fluoresces when exposed to visible light or UV radiation, thereby providing cosmetic effects.

In another aspect of the invention, a method of making a fluorescent contact lens comprises preparing an ink comprising a fluorescent colorant and a conventional colorant, and transferring the ink to the contact lens.

In another aspect of the invention, a method of making a fluorescent contact lens comprises mixing a fluorescent colorant with a monomer; polymerizing the monomer; and forming a contact lens from the polymerized monomer.

In another aspect of the invention, a method of making a fluorescent contact lens comprises reacting at least one fluorescent colorant with a monomer to form a fluorescent monomer; polymerizing the monomer; and forming a contact lens from the polymerized monomer.

In another aspect of the invention, a method of inspecting a contact lens comprises providing a contact lens comprising at least one fluorescent colorant dispersed in the lens; irradiating the lens to induce fluorescence; detecting a fluorescing area on the lens; and analyzing the area for defects.

The present invention provides the foregoing and other features, and the advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiments. The detailed description is merely illustrative of the invention and does not limit the scope of the invention, which is defined by the appended claims and equivalents thereof.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Generally, a contact lens having at least one fluorescent colorant dispersed in the lens is provided. Also, a contact lens having at least one conventional colorant and at least one fluorescent colorant is provided. Methods of making the lenses are also provided. A method of inspecting the lenses is provided.

DEFINITIONS

"Colorant" means either a dye or a pigment or a mixture thereof.

"Dye" means a substance that is soluble in a solvent and that is used to impart color. Dyes are typically translucent and absorb but do not scatter light. Dyes can cover both optical regions of contact lenses and non-optical regions of contact lenses.

"Fluorescence" means luminescence caused by absorption of visible light or ultraviolet radiation at one wavelength followed by nearly immediate emission, usually at a longer wavelength. Fluorescent emission ceases almost immediately when the light or incident ultraviolet radiation stops.

"Monomer" means low molecular weight compounds that can be polymerized. Low molecular weight typically means average molecular weights less than 700 Daltons. The term "monomer" also refers to medium and high molecular weight compounds or polymers, sometimes referred to as macromonomers, (that is, typically having number average molecular weights greater than 700) containing functional groups capable of further polymerization.

"Pearlescence" means having a pearly luster; resembling a pearl in physical appearance; or having a nearly neutral slightly bluish medium gray color.

"Pigment" means a powdered substance that is suspended in a liquid in which it is relatively insoluble. Pigments are used to impart color. Because pigments are in the form of a suspension, they tend to have an opacity quality. That is, they reflect light and obstruct the passage the light. For this reason, it is preferred that pigments are located in non-optical regions of a contact lens.
"Polymer" means a material formed by polymerizing one or more monomers.

CONVENTIONAL COLORANTS

All conventional dyes and pigments safe for use in contact lenses can be used to practice the present invention. Conventional dyes include but are not limited to those disclosed in U.S. Patent No. 4,865,439, which is hereby incorporated by reference in its entirety. U.S. Patent No. 4,865,439 identifies reactive dyes that are reacted with hydroxyethyl methacrylate so that the sulfate group of the dye is replaced by an ether linkage to the poly(hydroxyethyl methacrylate).

- Reactive Black 5 [2,7-naptha-lenedisulfonic acid, 4-amino-5-hydroxy-3,6-bis[(4-[(2-(sulfooxy)ethyl)sulfonyl)phenyl]azo]-tetrasodium salt] (CAS Reg. No. 17095-24-8);
- Reactive Blue 21 [copper, (29H,31H-phtalocyaninato(2-)-N²⁹,N³⁰,N³¹,N³²)-, sulfo(4-[(2-sulfooxy)ethyl]sulfonyl)phenylamino)sulfonyl derivatives] (CAS Reg. No. 73049-92-0);
- Reactive Orange 78 [2-naphthha-lenesulfonic acid, 7-(acetylamino)-4-hydroxy-3[(4-[(2-sulfooxy)ethyl]sulfonyl)phenyl]azo)-] (CAS Reg. No. 68189-39-9);
- Reactive Yellow 15 [benzensulfonic acid, 4-(4,5-dihydro-4-[(2-methoxy-5-methyl-4-[(2-(sulfooxy)ethyl)sulfonyl)phenyl]azo)-3-methyl-5-oxo-1H-pyrazol-1-yl)-] (CAS Reg. No. 60958-41-0); and
- Reactive Blue No. 19 [2-anthracene-sulfonic acid, 1-amino-9,10-dihydro-9,10-dioxo-4-[(3-[(2-(sulfooxy)ethyl)sulfonyl)phenyl]amino)-, disodium salt] (CAS Reg. No. 2580-78-1)

Other conventional dyes that are contemplated for use with this invention include but are not limited to those listed in U.S. Patent Nos. 4,468,229; 4,553,975; and 5,534,038, which are hereby incorporated by reference in their entireties.
Other conventional colorants are listed in 21 CFR Part 73 Subpart D and 21 CFR Part 74 Subpart D. These subparts are incorporated by reference in their entirety. Pearlescent pigments may also be included in the contact lenses as a conventional pigment.

Preferred conventional pigments include, for blue, phthalocyanine blue (pigment blue 15, C.I. 74160), and cobalt blue (pigment blue 36, C.I. 77343). C.I. is the color index number, which is well understood in the art. For green, preferred pigments include phthalocyanine green (pigment green 7, C.I. 74260) and chromium sesquioxide. For yellow, red, brown, or black, various iron oxides are preferred. For violet, carbazole violet is preferred. See U.S. Patent No. 5,272,010, which is hereby incorporated by reference in its entirety.

Of course, blends of such colorants are used to achieve the desired shade. To increase the opacity of a color coat, titanium dioxide or other opaquing agents may be used. Opaquing agents, which are considered to be pigments within the present specification and claims, can be blended with the other pigments into the color coat. See U.S. Patent No. 4,963,159, which is hereby incorporated by reference in its entirety.

Conventional dyes and pigments are commercially available from companies such as Minnesota Mining and Manufacturing Company. Conventional dyes and pigments can comprise from about 5% to about 95% by weight of an ink that is printed on contact lenses. Preferably, conventional dyes and pigments comprise about 10% to about 80%, more preferably from about 20% to about 70% of the ink that is printed on contact lenses.

**FLUORESCENT COLORANTS**

Dyes and pigments that fluoresce when excited in a contact lens enhance the cosmetic effect that the contact lens has on the eyes of the wearer. Preferred fluorescent pigments fluoresce when exposed to ultraviolet radiation or visible light.

Preferred fluorescent pigments include but are not limited to those pigments that are commercially available through the Day-Glo Color
Corporation under the trade names of AURORA PINK, NEON RED, ROCKET
RED, FIRE ORANGE, BLAZE ORANGE, ARC YELLOW, SATURN YELLOW,
SIGNAL GREEN, HORIZON BLUE, CORONA MAGENTA, STRONG
CORONA MAGENTA, and STRONG SATURN YELLOW. Particularly
preferred fluorescent pigments are the BLAZE ORANGE and the SIGNAL
GREEN.

Alternative fluorescent pigments may be organic or inorganic, and
include but are not limited to those disclosed in U.S. Patent Nos. 4,632,773
and 4,702,524, which are hereby incorporated by reference in their entireties.

Fluorescent dyes (in addition to fluorescent pigments) may be used to
prepare the contact lenses of the present invention. U.S. Patent No.
4,695,399, which is hereby incorporated by reference in its entirety, describes
fluorescent dyes. Certain organic dyes have the property of fluorescing under
ultraviolet radiation. The fluorescence of these organic dyes is associated with
the individual dye molecules. For the individual molecules to fluoresce
efficiently, they must be dissolved in fairly low concentrations in a solvent for
the dyes. Due to the nature of the dyes used, it is preferred to have an
organic medium or carrier to put them into solution. The type of material that
meets these requirements for a carrier for the dyes is a transparent organic
contact lens resin. Fluorescent dyes are stable to indoor light or conditions of
outdoor light.

Fluorescent pigments can comprise from about 5% to about 95% by
weight of an ink that is printed on contact lenses. Preferably, fluorescent
pigments comprise about 10% to about 80%, more preferably from about 50%
to about 65% weight of an ink that is printed on contact lenses.

PATTERNS ON CONTACT LENSES

Coloring agents can be printed on the contact lens in many different
patterns to achieve desired cosmetic effects. Fluorescent pigment can be
mixed together with convention pigment and/or conventional dyes and applied
as a single coloring agent. In this case, the fluorescent pigment tends to
brighten the conventional dye or conventional pigment. This single coloring agent can be applied uniformly throughout the lens or in various patterns described below, as well as those disclosed in U.S. Patent Nos. 5,936,705; 5,414,477; and 5,272,010, which are hereby incorporated by reference in their entirety.

Alternatively, the fluorescent colorants and the conventional colorants can be applied separately. If applied separately, a first coloring agent can be printed alongside a second coloring agent. Alternatively, the first and second coloring agents can be printed over one another in layers. Third layers, fourth layers, etc. can be added.

In a preferred embodiment, the first coloring agent is either a fluorescent colorant, a mixture of fluorescent colorants or a mixture of at least one fluorescent colorant with at least one conventional colorant.

In a preferred embodiment, the second coloring agent is either a conventional colorant, a mixture of conventional colorants, or a mixture of at least one fluorescent colorant with at least one conventional colorant.

The striking effect of a fluorescent colorant can be made to appear more natural by substantially overlapping the fluorescent colorant (or mixtures of colorants containing at least one fluorescent colorant) with conventional colorants. This can be done by printing dyes or pigments onto lenses in layers. The first coloring agent can be overlapped by a second coloring agent, or the second coloring agent can be overlapped by the first. Third layers, fourth layers, etc. could optionally be added.

If coloring agents are printed alongside each other, the first coloring agent is printed in a first region on the lens, and the second coloring agent printed on a second region on the lens. The regions can be mutually exclusive, or they can overlap, at least in part. For example, a lens could be printed where a conventional color can be seen alongside a fluorescent orange or fluorescent green in a particular pattern. This adds highlights to the conventional print. Preferably, the regions overlap substantially. That is, at least 50% of one region is overlapping the other region.
The patterns that the coloring agents form on the contact lenses are preferably comprised of zones, and the zones may be comprised of shaped pigmented regions within the zones. The shaped region may further be comprised of dots. Examples of zones include: a single annular iris color zone with irregular inner and outer borders, multiple concentric annular zones, annular zones with outer and inner starbursts, and a single iris zone but irregular in structure along multiple radial lines.

Examples of shaped pigmented areas within zones include circular areas, ovular regions, irregular elongated regions in worm-like shapes, radial segments, and combinations of these shapes.

Other patterns have inversion marks or others marks to allow the lens fitter to measure lens rotation on the eye. These lenses could benefit from fluorescent pigments. These inversion marks are sometimes difficult to visualize when they are on colored lenses. The use of a fluorescent pigment could allow a lens fitter to spot these marks more easily.

MAKING FLUORESCENT LENSES

There are several ways of making the contact lenses of the present invention. The following sections disclose a few of the preferred methods of tinting and printing and printing on tinted lenses.

TINTING

There are many ways to tint contact lenses, only a few of the more preferred ways are described below. The preferred methods described below are intended to be exemplary, not limiting. One way to tint is to make a fluorescent monomer, optionally add other monomers, optionally add conventional colorants, and then polymerize the fluorescent monomer.

Another way is to mix fluorescent colorants into one or more monomers, optionally add conventional colorants, and then polymerize the monomer.

The polymerization can occur in a mold such as a casting cup so that the shaping of the lens and the polymerization occur simultaneously.

Alternatively, the polymerization can occur first, and the resultant polymer can
be shaped into a contact lens using any method known in the art, including using a lathe. These methods are well known in the art. Any of the well-known techniques may be used, for example those described in U.S. Patent Nos. 4,158,089 and 4,182,802, which are hereby incorporated by reference in their entirety. Optionally, fluorescent or conventional colorants can be printed onto the tinted lenses using inks as described later in this patent specification.

Preferred monomers include but are not limited to those listed in U.S. Patent No. 4,963,159, which was incorporated by reference above. Particularly preferred monomers include substituted or unsubstituted C<sub>1</sub> to C<sub>6</sub> alkyl esters of acrylic or methacrylic acid, such as methyl methacrylate, ethyl methacrylate, hydroxyethyl methacrylate, and methyl acrylate, and the like.

Non-limiting examples of tinting follow.

EXAMPLE 1: TINTING BY MAKING FLUORESCENT MONOMERS, THEN POLYMERIZING

A fluorescent molecule with an appropriate functional group (for example, fluorescein isothiocyanate and other isocyanate derivatives of fluorescein) is reacted with a monomer with an appropriate functional group (such as 2-hydroxyethyl methacrylate ("HEMA")). The isothiocyanate group of the fluorescein reacts with the hydroxyl group of the HEMA when heated to a temperature of from about 40°C to about 60°C for a time greater than 12 h, preferably greater than 24 h. The HEMA-fluorescein molecule is polymerized as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEMA</td>
<td>98.0</td>
</tr>
<tr>
<td>HEMA- fluorescein molecule</td>
<td>1.2</td>
</tr>
<tr>
<td>Ethyleneglycol dimethacrylate (&quot;EDMA&quot;)</td>
<td>0.5</td>
</tr>
<tr>
<td>Azobisisobutyronitrile</td>
<td>0.3</td>
</tr>
</tbody>
</table>
The ingredients are mixed together and placed in a 0.75" glass tube closed at one end. The tube is capped and placed in a water bath, which is heated to at least 30°C, preferably at least 35°C for at least 24 h, preferably at least 72 h. The polymer is removed from the glass tube and a contact lens is made from it by methods well known in the industry such as using a lathe.

**EXAMPLE 2: DISPERISING FLUORESCENT COLORANTS IN MONOMER, THEN POLYMERIZING**

In this non-limiting example, a vat contains HEMA. EDMA, Blaze Orange, and Azobisisobutyronitrile are added to the vat at room temperature, and the ingredients are mixed together until the contents of the vat are substantially uniform. Optionally, a fluorescent pigment is crushed into substantially spherically shaped granules having a diameter of about 2 microns.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEMA</td>
<td>99.3</td>
</tr>
<tr>
<td>EDMA</td>
<td>0.5</td>
</tr>
<tr>
<td>Blaze Orange</td>
<td>0.1</td>
</tr>
<tr>
<td>Azobisisobutyronitrile</td>
<td>0.1</td>
</tr>
</tbody>
</table>

This mixture is added to a mold, the monomers are polymerized, and Blaze Orange dispersed throughout the polymer. The polymer is formed into contact lenses using any method well known in the art.

**PRINTING: MAKING AN INK & PRINTING THE INK ON A LENS**

One way to make the contact lenses of the present invention involves making an ink and printing the ink onto the contact lenses. The fluorescent pigment or dye, as well as the conventional pigment or dye, can be made into inks and printed on the surface of the contact lens.

Alternatively, the ink can be printed on a removable surface of a mold such as a casting cup, and the lens can be cast around the removable
surface. Then, when the contact lens is removed from the mold, the removable surface sticks to the contact lens. This method is disclosed in U.S. Patent 5,034,166, which is hereby incorporated by reference in its entirety.

Table 3 shows various ink pastes contemplated for use with this invention.

| Ingredient                  | Paste Color | | | | | |
|-----------------------------|-------------|---|---|---|---|---|---|
| Ethyl lactate               | 24.00       | 24.00 | 23.98 | 28.53 | 30.00 | 30.55 | 30.00 | 25.00 |
| Binder solution             | 56.05       | 56.05 | 61.65 | 62.93 | 62.32 | 60.75 | 56.73 | 55.00 |
| Blaze orange                | 19.95       |       |       |       |       |       |       | 10.70 |
| Iron oxide black            | 14.37       |       |       |       |       |       |       |       |
| Phthalocyanine blue         | 8.50        | 0.04 | 0.07 | 1.36 | 0.71 | 1.36 |       |       |
| Chromium oxide              |             |       |       |       |       |       |       |       |
| Iron oxide yellow           |             |       |       |       |       |       |       | 5.21  |
| Iron oxide red              |             |       |       |       |       |       |       | 1.72  |
| Titanium dioxide            |             | 0.68 | 7.94 | 9.95 | 7.94 |       |       |       |
| Phthalocyanine green        |             | 2.52 |       |       |       |       |       |       |
| Carbazole violet            |             | 0.09 |       |       |       |       |       |       |
| Signal green                |             | 19.95|       |       |       |       |       |       |
| Total                       | 100         | 100  | 100  | 100  | 100  | 100  | 100  | 100  |

The pastes in Table 3 containing fluorescent pigments are Blaze Orange and Signal Green from the Day-Glo Color Corporation. Ink pastes such as the ones in Table 3 can be converted into ink by adding ingredients such as adhesion promoters, solvents, or monomers.

After converting these fluorescent pastes into an ink, the ink can be printed directly on contact lenses or on a removable surface on a mold used to form contact lenses.

In addition, the fluorescent inks could be printed as a mere part of the total printing done on the lenses. For example, one could print an inner starburst pattern with Blaze Orange or Signal Green, an outer pattern with blue, and the outermost pattern with black. Furthermore, the fluorescent pastes can be used in the innermost or in the outermost starburst patterns.

In embodiments where ink is printed directly on the contact lens, an activation solution is preferably included in the ink formulation. A typical activation solution comprises from about 60% to about 95% by weight of one
or more substituted (with hydroxy, alkoxy, halogens, low alklys, etc.) or unsubstituted lower alkyl methacrylates, from about 5% to about 25% of a color adhesion promoter, and from about 0.01% to about 3% of free radical initiator. Table 3 shows a typical activation solution. Preferred weight percentages are from about 70% to 90% methacrylates, from about 10% to 20% of a color adhesion promoter, and from about 0.1% to about 1% of free radical initiator.

Table 4: Example Activation Solution

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEMA</td>
<td>75.7</td>
</tr>
<tr>
<td>2-Ethoxyethyl methacrylate</td>
<td>8.5</td>
</tr>
<tr>
<td>Azo-bis-isobutyronitrile</td>
<td>0.4</td>
</tr>
<tr>
<td>Hexamethylene diisocyanate</td>
<td>15.4</td>
</tr>
</tbody>
</table>

In Table 4, the methacrylates are HEMA and 2-ethoxyethyl methacrylate, the color adhesion promoter is hexamethylene diisocyanate, and the free radical initiator is azo-bis-isobutyronitrile. Other well-known methacrylates, color adhesion promoters, and free radical initiators that are well known in the art may be used to practice this invention.

Generally, the ink can contain other materials in addition to those listed above for aiding in printing. Examples include solvents and binder polymers and adhesion promoters. Preferred solvents include tetrahydrofuran, alcohol, ketone, or another polar solvent, advantageously cyclohexanone or cyclopentanone. Preferred binder polymers are disclosed in U.S. Patent No. 4,668,240, which is hereby incorporated by reference in its entirety.

Preferred inks contain from about 10% to about 90% by weight of pigment, preferably from about 20% to about 85%. Preferred inks contain from about 10% to about 90% by weight of solvent, preferably from about 20% to about 80%. Preferred inks contain from about 20% to about 80% by weight of binder solution, preferably from about 30% to about 70%. Preferred
inks contain about 1% to about 30% by weight of adhesion promoter, preferably from about 10% to about 20%.

EXAMPLE 3: PRINTING

Referring to Table 3, the Blaze Orange and Signal Green pastes were formulated with a solution of a polymeric binder polymer solution (about 90% 2-hydroxyethyl methacrylate and 10% ethoxyethyl methacrylate in about 50% w/w cyclopentanone) and an activation solution that contains hexamethylene diisocyanate and printed on the surface of a contact lens. Inks comprising conventional colorants were also printed on the lens. The printed lens was heated to about 85°C for 45 minutes to allow the diisocyanate to react with the hydroxyl groups of the binder polymer to entrap the colorant at the surface of the contact lens. The lenses were viewed under a lamp capable of irradiating them with UVA radiation. The fluorescent colorant on the lenses fluoresced under these conditions and added a new dimension to their cosmetic appeal.

Other ways of making lenses according to the present invention include combining the dispersion-during-polymerization method with the printing-ink-on-a-lens method. For example, a first coloring agent could be mixed with a monomer, and from that a contact lens is formed with the first coloring agent dispersed in the lens. Then, a second coloring agent could be printed over the surface of the lens containing the first coloring agent.

INSPECTING CONTACT LENSES HAVING FLUORESCENT PIGMENT

The contact lenses of the present invention can easily be inspected for defects. See U.S. Patent No. 5,633,504, which is hereby incorporated by reference in its entirety. In short, a method of inspecting a contact lens is provided. The method comprises providing a contact lens comprising at least one conventional colorant and at least one fluorescent colorant, such that the fluorescent colorant fluoresces upon exposure to light or radiation on an area of the lens. The method further comprises irradiating the lens to induce fluorescence on the lens. The method further comprises detecting an image.
of the fluorescing area. Finally, the method comprises analyzing the image for defects.

SCOPE

It should be appreciated that the lenses and methods of the present invention are capable of being incorporated in the form of a variety of embodiments, only a few of which have been illustrated and described above. The invention may be embodied in other forms without departing from its spirit or essential characteristics. For example, printing inks containing mixtures of coloring agents in various layers on a contact lens, whether or not that contact lens has a coloring agent already dispersed in it, is within the scope of this invention.

The described embodiments are to be considered in all respects only as illustrative and not restrictive, and the scope of the invention is therefore indicated by the appended claims rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are embraced to be within their scope.
CLAIMS

1. A contact lens comprising:
   a) at least one conventional colorant, and
   b) at least one fluorescent colorant, such that the fluorescent colorant fluoresces when exposed to visible light or UV radiation, thereby providing cosmetic effects.

2. The contact lens of claim 1 wherein the fluorescent colorant is selected from the group consisting of fluorescent orange, fluorescent green, fluorescent pink, fluorescent red, fluorescent yellow, fluorescent blue, fluorescent magenta, and mixtures thereof.

3. The contact lens of claim 1 wherein the conventional colorant imparts a color to the lens selected from the group consisting of black, green, hazel, blue, turquoise, and mixtures thereof.

4. The contact lens of claim 1 wherein the fluorescent colorant is mixed together with the conventional colorant to make a mixture, and the mixture is printed on the contact lens as a single coloring agent.

5. The contact lens of claim 4 wherein the mixture comprises:
   a) the fluorescent colorant, which is selected from the group consisting of fluorescent orange, fluorescent green, fluorescent pink, fluorescent red, fluorescent yellow, fluorescent blue, fluorescent magenta, and mixtures thereof; and
   b) the conventional colorant that imparts a color to the lens, which is selected from the group consisting of black, green, hazel, blue, turquoise, and mixtures thereof.

6. The contact lens of claim 1 wherein the fluorescent colorant is mixed together with the conventional colorant, and the mixture is dispersed in the contact lens as a single coloring agent.
7. The contact lens of claim 6 wherein the mixture comprises:
   a) the fluorescent colorant, which is selected from the group consisting of fluorescent orange, fluorescent green, fluorescent pink, fluorescent red, fluorescent yellow, fluorescent blue, fluorescent magenta, and mixtures thereof; and
   b) the conventional colorant that imparts a color to the lens, which is selected from the group consisting of black, green, hazel, blue, turquoise, and mixtures thereof.

8. The contact lens of claim 1 wherein:
   a) a first coloring agent is printed on a first region of the lens and a second coloring agent is printed on a second region of the lens;
   b) wherein the first coloring agent is selected from the group consisting of a fluorescent colorant, a mixture of fluorescent colorants, and a mixture of at least one fluorescent colorant with at least one conventional colorant; and
   c) wherein the second coloring agent is selected from the group consisting of a conventional colorant, a mixture of conventional colorants, and a mixture of at least one fluorescent colorant with at least one conventional colorant.

9. The contact lens of claim 8 wherein all fluorescent colorants are selected from the group consisting of fluorescent orange, fluorescent green, fluorescent pink, fluorescent red, fluorescent yellow, fluorescent blue, fluorescent magenta, and mixtures thereof; and all conventional colorants are selected from the group consisting of black, green, hazel, blue, turquoise, and mixtures thereof.

10. The contact lens of claim 8 wherein the first region and the second region are mutually exclusive.

11. The contact lens of claim 8 wherein the first region and the second region overlap, at least in part.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : Desp 5/00; G04C 7/04; G09K 11/02.
US CL. : 8/506, 507; 859/301.55; 351/160R, 162.
According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 8/506, 507; 859/301.55; 351/160R, 162.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used).

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>US 4,657,363 A (NEEFE) 14 April 0987, abstract, col 1, line 47 - col 3, line 58.</td>
<td>1-14 and 20-29</td>
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<tr>
<td>A</td>
<td>US 4,632,773 A (NEEFE) 30 December 1986, entire document.</td>
<td>1-29</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

- "A" Special categories of cited documents
  - "A" document defining the general state of the art which is not considered to be of particular relevance.
  - "G" earlier document published on or after the international filing date of the application.
  - "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified).
  - "O" document referring to an oral disclosure, use, exhibition or other means.
  - "P" document published prior to the international filing date but later than the priority date claimed.

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  - "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone.
  - "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
  - "A" document member of the same patent family.

Date of the actual completion of the international search: 30 JULY 2001
Date of mailing of the international search report: 31 AUG 2001

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Form PCT/ISA/910 (second sheet) (July 1998)