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(54) Title: THERAPEUTIC EYEWEAR

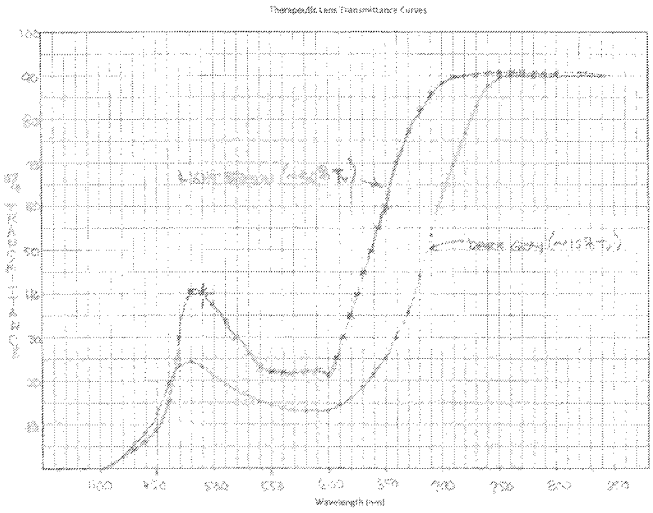


Fig. 4

(57) Abstract: The embodiments disclosed herein relate to a transparent material to provide protection to a person's eyes from harmful wavelengths of the light spectrum, overall visual comfort, or improved vision such as color enhancement, target recognition and other functions, while selectively transmitting more of certain wavelengths of the light spectrum that have a therapeutic benefit such as healing or general mood modifier. The transparent material may be a lens or a shield which is disposed in front of the wearer's eyes.

WO 2013/066493 A1

# THERAPEUTIC EYEWEAR

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefits of Provisional Patent Application Serial Number 61/556,081, filed on November 4, 2011, the entire contents of which are expressly incorporated herein by reference.

## STATEMENT RE: FEDERALLY SPONSORED RESEARCH/DEVELOPMENT

Not Applicable

## BACKGROUND

The embodiments disclosed herein relate to eyewear that preserves natural therapeutic effects (i.e., possible physiological benefits) of sunlight while providing eye protection and visual performance and comfort.

Prior art eyewear has been designed to provide physical protection to the user and improve vision for a variety of uses. For example, ultra violet and shortwave blue/violet light can damage the eye. Protective lenses have been designed to block or significantly limit exposure to these parts of the light spectrum. Prior art eyewear has been designed with a variety of lens filtrations to reduce transmittance of these ranges of known harmful light through the lens of the eyewear, but may impair some of the natural therapeutic effects of sunlight. Prior art eyewear has also been developed to provide comfort and improved vision for sports, target recognition, color enhancement, driving, and computer viewing among other uses. Additionally, eyewear may also incorporate photo chromic and polarization lens treatments to reduce glare. Examples of prior art transmission curves for brown, green and neutral gray lenses are shown in Figures 1-3.

People have a circadian rhythm which defines a person's normal day/night body clock. Circadian rhythm is predominantly affected by light exposure. Hence, anything that affects exposure to light can potentially alter that person's normal day/night body clock. For example, the following can affect a person's exposure to light, namely, 1) being indoors without sufficient natural light levels during the day, 2) being exposed to too low of a range of sunlight, and 3) travel across multiple time zones. It can also be affected by wearing sunglasses.

A person's circadian rhythm can be visualized as a sinusoidal wave. There is a wavelength indicated by time between peak to peak or valley to valley. There is a phase which is indicated by the position of the peak or valley within a particular day / night time period. Also, there is an amplitude of the sinusoidal wave indicating the height or strength of the circadian rhythm. By modifying a person's exposure to light, the wavelength, phase and intensity of the person's circadian rhythm can be altered. For example, exposure to light in the evening can affect the phase of the circadian rhythm by delaying the onset of melatonin secretion (and sleep). Phase shift is the principle behind adapting to jet lag.

Accordingly, there is a need in the art for an improved eyewear.

## SUMMARY

The embodiments disclosed herein address the needs discussed above, discussed below and those that are known in the art.

The embodiments disclosed herein relate to an eyewear which disposes a transparent material (e.g., lens or shield) in front of a person's eyes to provide protection and/or vision enhancement to the person. The eyewear may also selectively allow certain wavelengths of light through the transparent material to preserve the therapeutic benefits (i.e., possible physiological benefits) of sunlight to the person while enhancing the colors humans are predisposed to prefer. By way of example and not limitation, the spectrum of light in the wavelength range of 600nm to 900nm and/or 450nm to 510nm may be allowed to selectively pass through the transparent material in substantially larger amounts than other wavelength ranges. By way of example and not limitation, the average light transmittance for the range 450nm to 510nm should be 2 or more times greater than the average light transmittance for the range 400nm to 450nm and 20% or more than the average light transmittance for the range 500nm to 600nm. Additionally, the average light transmittance for the range 600nm to 900nm should be 5 or more times greater than the average light transmittance for the range 400nm to 450nm and 2 or more times greater than the average light transmittance for the range 500nm to 600nm. As used herein, "nm" refers to nanometer. The transparent material may have a particular light transmittance profile characteristic within those ranges (i.e., 450nm-510nm and/or 600nm-900nm).

More particularly, an eyewear is disclosed. The eyewear may comprise a lens or shield which selectively allows more of certain natural therapeutic wavelengths of light therethrough while substantially blocking harmful wavelengths of light. The average light transmittance of the lens or shield at a wavelength range of 450nm to 510nm may be substantially greater than (e.g., 2 or more times) an average light transmittance of the lens or shield at a wavelength range of 400nm to 450nm. Also, light transmittance may have a relative maximum at around 460nm to 490nm (preferably around 470nm to 480nm), centered within the range of 450nm to 510nm. Light transmittance through the lens or shield may increase beginning at or about 600nm,reaching a level of 2 or more times the overall lens Tv between 650nm to 850nm.

Light transmittance may be substantially attenuated (e.g., more than 50 %, preferably more than 65%) in the range of 510nm-600nm to achieve the desired overall visible Tv, with minimum transmittance at any wavelength within the range of 510nm to 600nm no less than .2Tv transmittance.

An overall light transmittance value of the lens or shield may be 8 % to 15% for use of the lens or shield in bright environments. An overall light transmittance value of the lens or shield may be 16% to 25% for use of the lens or shield in moderately lit environments. An overall light transmittance value of the lens or shield may be 25% to 50% for low light daytime outdoor environments

## BRIEF DESCRIPTION OF THE DRAWINGS

These and other features and advantages of the various embodiments disclosed herein will be better understood with respect to the following description and drawings, in which like numbers refer to like parts throughout, and in which:

Figure 1 illustrates an example of prior art transmittance curve for a brown lens;

Figure 2 illustrates an example of prior art transmittance curve for a green lens;

Figure 3 illustrates an example of prior art transmittance curve for a neutral gray lens;

Figure 4 illustrates transmittance curves for a dark gray tint and a light brown tint incorporating one or more various aspects discussed herein; and

Figure 5 is a table of values for the transmittance curves shown in Figure 4.

## DETAILED DESCRIPTION

The embodiments of the lens or shields discussed herein relate to a corrective or a non corrective lens or shield which may be designed to selectively attenuate unwanted glare and harmful light and enhance vision while simultaneously enhancing transmittance of certain wavelengths of light for providing therapeutic benefits to the wearer.

In the embodiments disclosed herein, an eyewear with a lens or shield treated or formulated to provide a therapeutic effect to the wearer by allowing selective wavelength ranges of light to substantially transmit through the lens or shield. The eyewear may be a sunglass, goggle, visor or facemask or other device which provides a transparent material in front of the wearer's eyes. The eyewear may be worn about the wearer's head and held in place with left and right temples that wrap over the wearer's ears. The eyewear may be a face mask with a strap that encircles the wearer's head to secure the facemask to the wearer's head. The eyewear may be a goggle with a strap that secures the eyewear to the wearer's face. Regardless of the type of eyewear, the eyewear has one or more lens which is disposed in front of the wearer's eyes or one shield disposed in front of both eyes of the wearer.

The lens or shield may be fabricated from various materials known in the art or developed in the future. By way of example and not limitation, the lens or shield may be manufactured from a transparent material including but not limited to glass, polycarbonate, CR-39 (i.e., allyl diglycol carbonate), acrylic, polyurethane, nylon and triacetate. The lens or shield may have a curved configuration, a flat configuration, a combination of flat and curved configurations. Moreover, the lens or shield may be optically correct so as to mitigate distortion of objects viewed through the lens or shield. The lens or shield may be a non-corrective or a corrective lens or shield.

The lens or shield may have one or more treatments applied to the lens or shield to provide for a light transmittance profile of the lens or shield so that the treated lens or shield has a therapeutic effect while providing protection to the wearer's eyes. By way of example and not limitation, the treatment of the lens or shield may occur during processing of the lens or shield. Additives may be incorporated into the base material of the lens or shield in order to alter the

transmittance profile of the lens or shield. Alternatively or additionally, the treatment of the lens or shield may include vapor deposition, dying the lens or shield, coating the exterior surface(s) of the lens or the shield, applying a film to the lens or the shield or any other process known in the art or developed in the future. Preferably, all such treatments should result in an aesthetically pleasing appearance or tint. Moreover, the treatment may also provide for enhancement of a particular color such as blue, orange, red, etc. as needed based on the environment in which the lens or shield is used.

Red and near-infrared wavelengths are able to pass through human tissue and have a beneficial effect on cells by stimulating the cells. This type of stimulation of the cells may immediately create more ATP (i.e., adenosine triphosphate) which has also been referred to as cellular energy and also increase DNA and RNA activity. These effects have been reported and appear to occur only in injured cells. The treated lens may provide for transmittance of light in the wavelength range of 600nm to 900nm, and more preferably provides for transmittance of light at least in the range of 610nm to 850nm. The lens or shield is treated so as to have a particular light transmittance profile as discussed herein to provide therapeutic benefits to the wearer.

The lens treatment may provide for an increasing amount of light transmittance within the 600nm to 900nm range and at least in the 610nm to 850nm range. By way of example and not limitation, the light transmittance at the lower limit (e.g., 600nm or 610nm) of the range may be lower compared to a peak transmittance within the range of 650nm to 850nm. By treating the lens or shield so as to have this characteristic and treating the lens to provide for other functions such as reduced glare, the eyewear may be useful for allowing the wearer to receive the therapeutic and healing benefit of being exposed to this range of light while taking advantage of the protection, comfort and/or other functions of the eyewear as discussed herein.

Additionally or alternatively, the lens or shield may be treated to have a greater light transmittance within the range of 450nm – 510nm compared to the range of 400nm to 450nm. By way of example and not limitation, the average light transmittance within the range of 450nm to 510nm may be greater than the average light transmittance within the range of 400nm-450nm. Moreover, the light transmittance may have a relative maximum at 460-490 nm and preferably at 470-

480nm, centered within the range of 450nm to 510nm. By allowing more light to pass through the lens at this wavelength range which may be referred to as the long-wave blue spectrum, the wearer's circadian rhythm may be positively impacted. The wearer may feel more energetic and refreshed. They may also feel more enjoyment of outdoor colors people are predisposed to prefer such as blue skies. When exposed to this wavelength range of light, the wearer's daily sleep/wake rhythm may also be more generally in sync and the wearer's mood and health may be better overall.

The lens or shield may be treated to selectively allow light transmittance within the 600nm-900nm range as discussed above. Alternatively or additionally, the lens or shield may be treated to selectively allow light transmittance within the 450nm – 510nm range as discussed herein. Accordingly, the lens or shield may be designed to selectively allow beneficial wavelengths of light to reach the wearer's eyes and facial tissue while providing protection, visual performance and/or comfort in common outdoor environments.

More particularly, in an embodiment of the lens or shield, the same may be designed by selecting base raw materials of the lens or shield and/or treating the lens to have the characteristics described herein. The lens or shield may block UV or substantially all (e.g., more than 96 %, preferably more than 99%) wavelengths below about 400nm.

In the wavelengths from 400nm to 450nm, the lens or shield may have a light transmittance value of 0% to 10%, preferably less than 5% average for that range. The wavelengths 400-450nm are known as "high-energy visible" rays and have been shown to damage and age the skin. It is also implicated as a risk factor for age-related macular degeneration, the leading cause of blindness in people over fifty. The low transmission from 400nm to 450nm also aids in the contrast enhancement and clarity qualities of the lens. The lens or shield may allow an increased amount of light to pass through the lens at the 450nm to 510nm range. For example, the average light transmittance of the lens or shield at the 450nm to 510nm range may be greater than the average light transmittance of the lens or shield at the 400nm to 450nm range. Preferably, the light transmittance of the lens at the 450nm wavelength may be 10%T or less (e.g., less than 5%T).

In the range of 450nm to 510nm, light transmittance of the lens or shield may have a relative maximum at around 460nm to 490nm (preferably at around 470-

480nm). The lens or shield may substantially attenuate light (e.g., more than 50 %, preferably more than 65%) in the range of about 510nm to 600nm to achieve the desired overall visible Tv, with minimum transmittance in the range of 510nm to 600nm being no less than .2Tv transmittance so that the wearer is still able to distinguish the red, yellow and green colors of a traffic signal.

The lens or shield may allow for increasing light transmittance starting at about 600nm and continuing through the red and near infrared light. Preferably, average light transmittance through the lens or shield in the range 650nm to 850nm will be 2 or more times the overall lens Tv.

The lens or shield may also be designed for an intended use or environment. For example, for bright environments, the lens may be manufactured to have a Tv 8-15%. For moderate light environments, the lens may be manufactured to have a Tv 16-25%. For low light environments and situations, the lens may be manufactured to have a Tv 25-50%.

The lens or shield may also be treated with other treatments such as polarization and/or photochromic treatments for reduction of undesireable glare and/or adaptability to changing light conditions. The lens or shield may also be treated with a coating for performance related purposes such as hydrophobic coatings, oliophobic coatings, extrahard coat, antifog coatings, anti-scratch coatings. Additionally or alternatively, aesthetic related coatings (e.g., mirror) may be treated on the lens or shield. The blue, green and red transmittance zones may be adjusted to achieve different lens colors that are for functional and/or cosmetic considerations so that the lens or shield may be perceived as copper, rose, brown, gray, green/gray or other colors. The lens or shield may also be enhanced by addition of multilayer dielectric antireflective coatings to improve overall lens / shield transmittance, reduce reflections and improve contrast. The lens or shield may also be enhanced to include dielectric mirror (non absorbing) coatings to achieve filtration or cosmetic objectives.

The color of the lens or shield may be defined by the transmittance profile discussed herein. Moreover, the color of the lens or shield may be designed to be aesthetically pleasing. Additionally, the color of the lens or shield and/or the transmittance profile may be selected to improve a visual experience of the wearer, improve identification of traffic signal colors, chromatic contrast and/or to positively

modify a mood of the wearer and/or to facilitate repair of the wearer's skin and/or eye.

Referring now to Figure 4, by way of example and not limitation, transmittance curves for the various embodiments disclosed herein are illustrated. For example, the curve for the dark gray tint may have an overall Tv of about 15%, whereas the curved for the light brown tint may have an overall Tv of about 30%. The lens may be treated or formulated to provide for other Tv values and tint colors. Figure 5 illustrates the tabular data for the graphical representation shown in Figure 4. More particularly, the transmittance curve illustrates a transmittance peak at around 480 nm within the range between 450 nm to 510nm. Moreover, the transmittance curve begins to increase at about 600nm to at least about 650nm. In Figure 4, the transmittance curve increases to about 750nm.

The lens or shield may be designed to increase visual identification of objects and colors (e.g., traffic signal colors).

It is also contemplated that the various aspects discussed herein of the transmittance profile may be incorporated into other objects such as a window of a building or car. It may be incorporated into a front transparent plate of a television set, computer screen, video monitor.

The above description is given by way of example, and not limitation. Given the above disclosure, one skilled in the art could devise variations that are within the scope and spirit of the invention disclosed herein, including various ways of treating or formulating the lens or shield. Further, the various features of the embodiments disclosed herein can be used alone, or in varying combinations with each other and are not intended to be limited to the specific combination described herein. Thus, the scope of the claims is not to be limited by the illustrated embodiments.

WHAT IS CLAIMED IS:

1. An eyewear comprising:

a lens or shield which selectively allows therapeutic wavelengths of light therethrough while blocking harmful wavelengths of light.

2. The eyewear of Claim 1 wherein an average light transmittance of the lens or shield at a wavelength range of 450nm to 510nm is substantially greater than an average light transmittance of the lens or shield at a wavelength range of 400nm to 450nm.

3. The eyewear of Claim 2 wherein the average light transmittance of the lens or shield at the wavelength range of 450nm to 510nm is 2 or more times the average light transmittance of the lens or shield at the wavelength range of 400nm to 45nm.

4. The eyewear of Claim 1 wherein light transmittance through the lens or shield increases beginning at or about 600nm and an average light transmittance in the range of 650nm to 850nm is about 2 or more times an overall lens Tv of the lens or shield.

5. The eyewear of Claim 2 wherein the light transmittance of the lens at 450-510nm is 20% or more than an average light transmittance for the range of 500nm-600nm, and light transmittance through the lens or shield increases beginning at or about 600nm and an average light transmittance for the range between 650nm to 850nm is 2 or more times an average overall light transmittance of the lens or shield.

6. The eyewear of Claim 5 wherein the lens or shield blocks substantially all wavelengths below 400nm.

7. The eyewear of Claim 6 wherein light transmittance through the lens or shield increases as the wavelength increases from 400nm to 450nm.

8. The eyewear of Claim 5 wherein the light transmittance has a relative maximum at 460nm to 490nm within the range of 450nm to 510nm.

9. The eyewear of Claim 8 wherein the light transmittance has a relative maximum at 470nm to 480nm within the range of 450nm to 510nm.

10. The eyewear of Claim 5 wherein light transmittance is substantially attenuated in the range of 510nm-600nm with a minimum transmittance within the range of 510nm to 600nm no less than .2Tv transmittance.

11. The eyewear of Claim 5 wherein an overall light transmittance value of the lens or shield is 8 % to 15%.

12. The eyewear of Claim 5 wherein an overall light transmittance value of the lens or shield is 16% to 25%.

13. The eyewear of Claim 5 wherein an overall light transmittance value of the lens or shield is 25% to 50%.

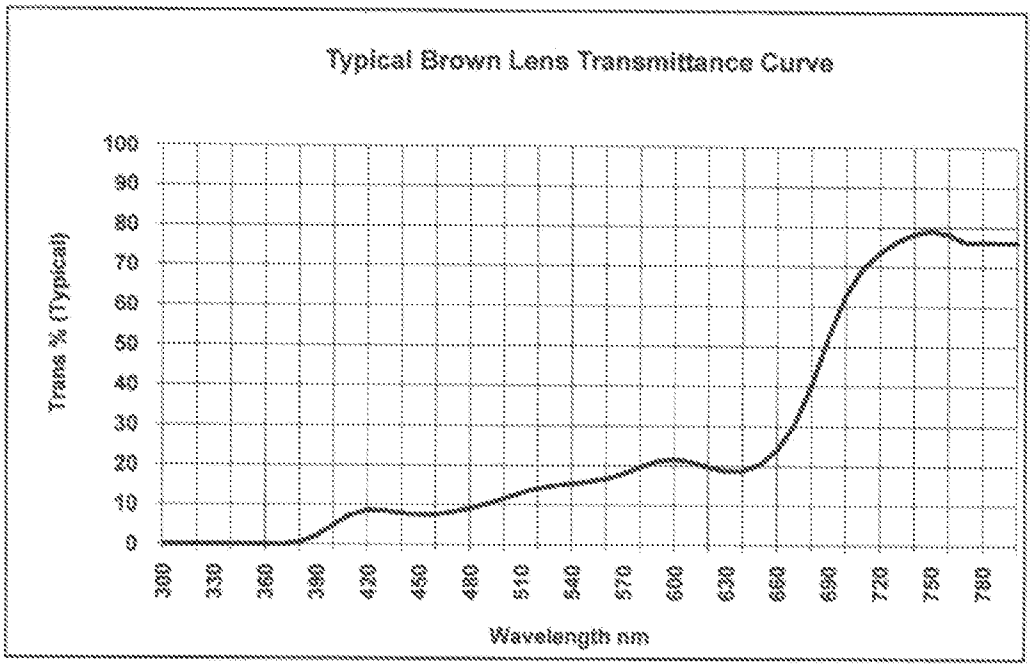



Fig. 1

(PRIOR ART)

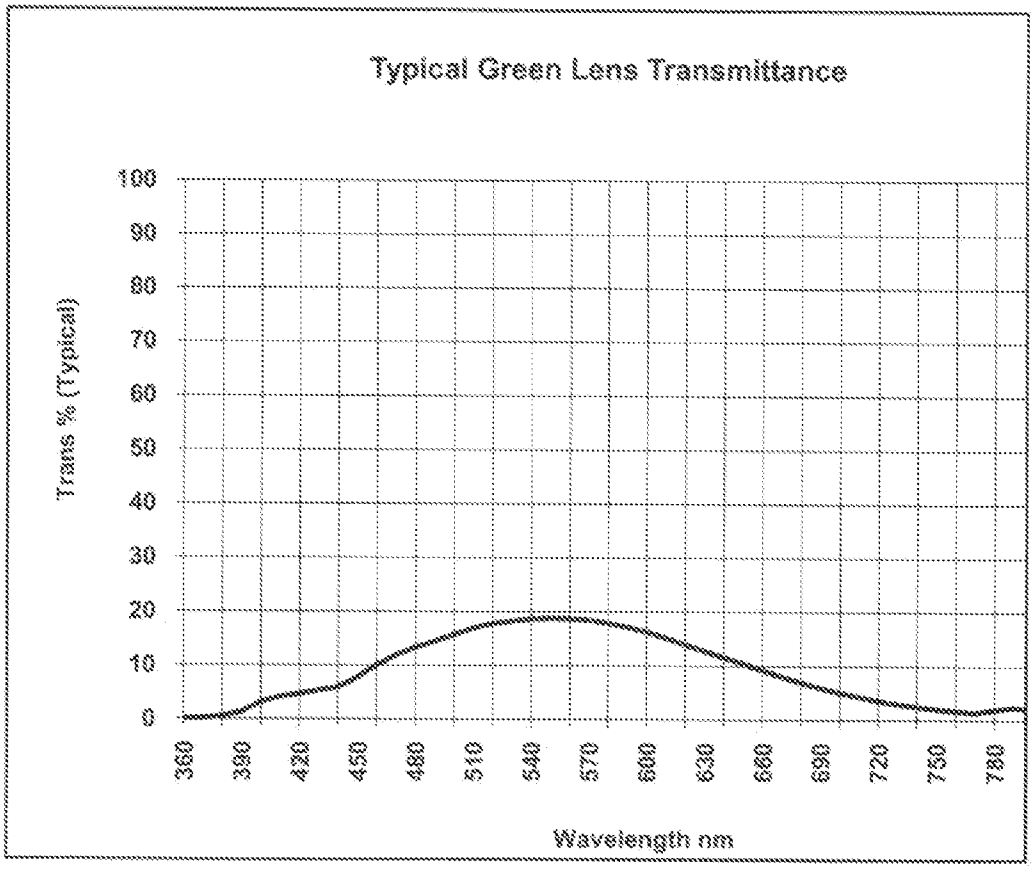



Fig. 2
(PRIOR ART)

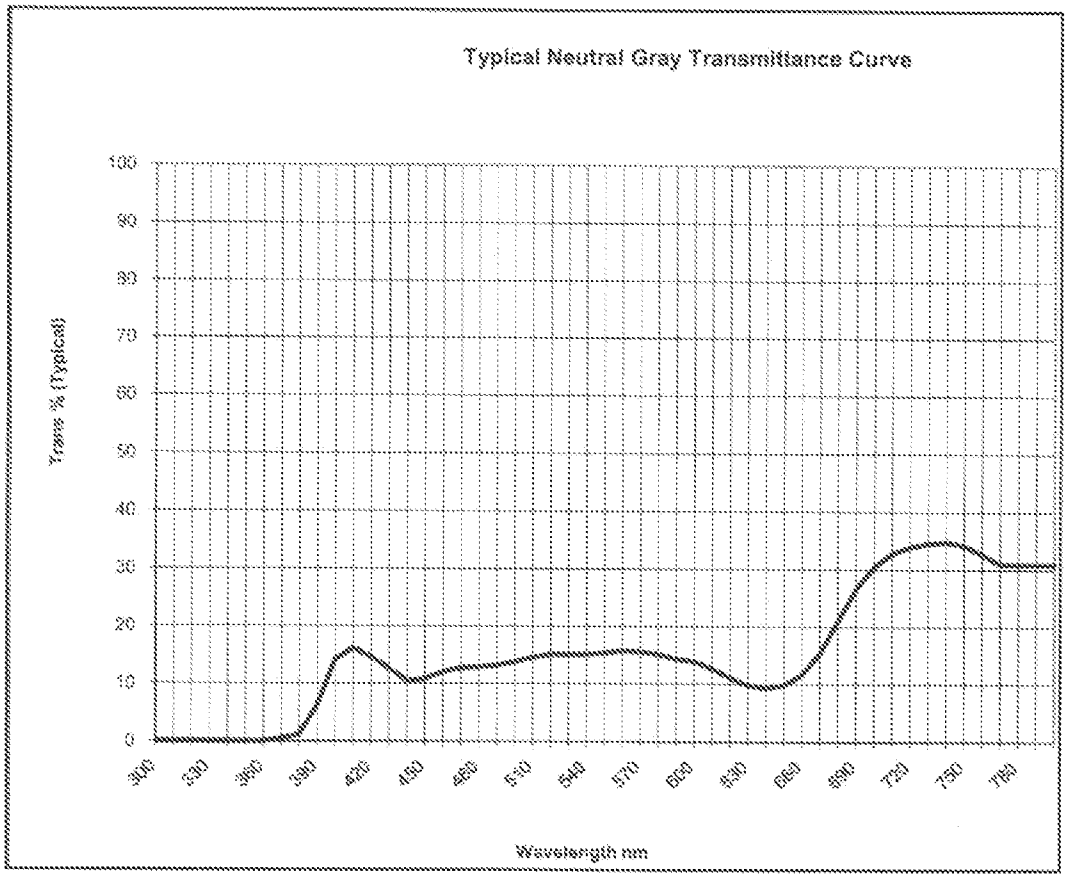



Fig. 3
(PRIOR ART)

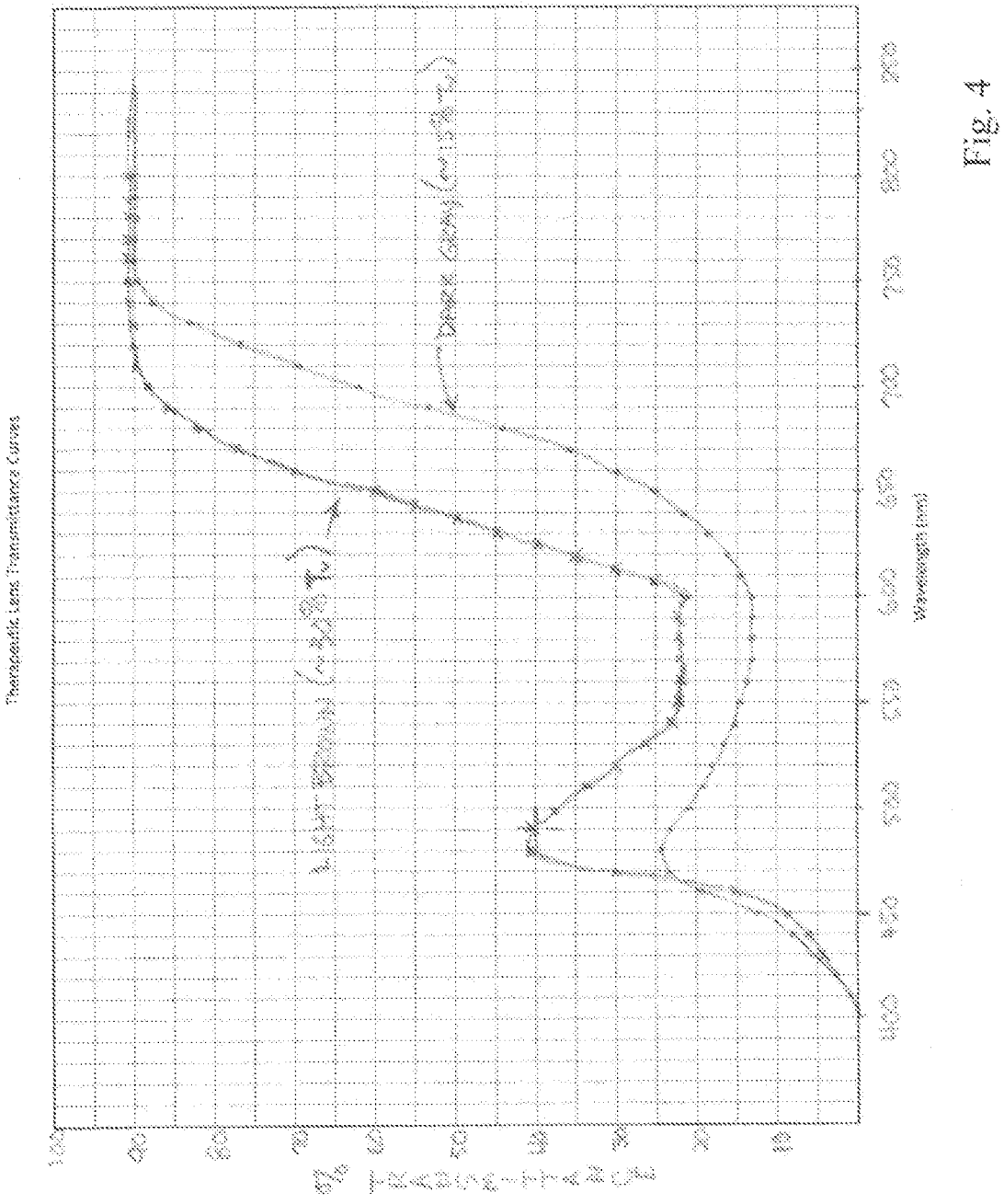

Transmittance (%)
Wavelength (nm)
100
90
80
70
60
50
40
30
20
10
0
400
420
440
460
480
500
520
540
560
580
600
620
640
660
680
700
720
740
760
780
800

Fig. 4

| Therapeutic Lens Transmittance Data | | |
|---|---|---|
| Wavelength | Dark Gray | Light Brown |
| | | |
| 400 | 0.0% | 0.0% |
| 410 | 1.1% | 1.1% |
| 420 | 2.5% | 2.5% |
| 430 | 5.5% | 4.5% |
| 440 | 7.8% | 6.1% |
| 450 | 12.4% | 8.4% |
| 460 | 19.5% | 15.0% |
| 470 | 22.9% | 30.0% |
| 480 | 24.2% | 40.4% |
| 490 | 23.3% | 40.1% |
| 500 | 20.7% | 37.5% |
| 510 | 19.2% | 33.3% |
| 520 | 18.0% | 30.0% |
| 530 | 16.6% | 26.1% |
| 540 | 15.1% | 22.9% |
| 550 | 14.8% | 22.4% |
| 560 | 13.5% | 22.3% |
| 570 | 13.2% | 22.4% |
| 580 | 13.3% | 22.2% |
| 590 | 13.2% | 22.3% |
| 600 | 13.1% | 21.9% |
| 610 | 14.8% | 27.0% |
| 620 | 16.3% | 35.1% |
| 630 | 18.4% | 44.2% |
| 640 | 21.5% | 52.3% |
| 650 | 25.0% | 60.0% |
| 660 | 30.0% | 70.0% |
| 670 | 35.7% | 77.5% |
| 680 | 44.2% | 82.5% |
| 690 | 53.5% | 85.9% |
| 700 | 62.1% | 88.1% |
| 710 | 69.8% | 89.8% |
| 720 | 77.0% | 90.0% |
| 730 | 83.0% | 90.0% |
| 740 | 87.5% | 90.0% |
| 750 | 90.0% | 90.0% |
| 760 | 90.0% | 90.0% |
| 770 | 90.0% | 90.0% |
| 780 | 90.0% | 90.0% |
| 790 | 90.0% | 90.0% |
| 800 | 90.0% | 90.0% |

| Therapeutic Lens Transmittance Data | | |
|---|---|---|
| Wavelength | Dark Gray | Light Brown |
| | | |
| 810 | 90.0% | 90.0% |
| 820 | 90.0% | 90.0% |
| 830 | 90.0% | 90.0% |
| 850 | 90.0% | 90.0% |
| 860 | 90.0% | 90.0% |
| 870 | 90.0% | 90.0% |
| 880 | 90.0% | 90.0% |
| 890 | 90.0% | 90.0% |
| 900 | 90.0% | 90.0% |

Fig. 5

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/054254

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G02C 7/10 (2012.01)
USPC - 351/159.65
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)
IPC(8) - A61N 5/06; G02B 5/20; G02C 7/00, 02, 10 (2012.01)
USPC - 351/159.01, 159.6, 159.65; 607/95

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)
PatBase, Google Patents, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 2002/0140901 A1 (REICHOW et al) 03 October 2002 (03.10.2002) entire document | 1-13 |
| Y | US 2011/0090453 A1 (CHEN et al) 21 April 2011 (21.04.2011) entire document | 1-13 |
| A | US 5,926,310 A (TAMURA et al) 20 July 1999 (20.07.1999) entire document | 1-13 |
| A | US 2010/0118263 A1 (TAMURA et al) 13 May 2010 (13.05.2010) entire document | 1-13 |
| A | US 2008/0065177 A1 (CASPER et al) 13 March 2008 (13.03.2008) entire document | 1-13 |

☐ Further documents are listed in the continuation of Box C. ☐

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 07 November 2012 | 26 NOV 2012 |
| Name and mailing address of the ISA/US<br>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents<br>P.O. Box 1450, Alexandria, Virginia 22313-1450<br>Facsimile No. 571-273-3201 | Authorized officer:<br>Blaine R. Copenheaver<br>PCT Helpdesk: 571-272-4300<br>PCT OSP: 571-272-7774 |

Form PCT/ISA/210 (second sheet) (July 2009)