LOW-LEVEL LIGHT THERAPY DEVICE WITH SPECIFIC WAVELENGTHS FOR PREVENTION AND TREATMENT OF OPHTHALMIC CONDITIONS

FIELD OF THE INVENTION

This invention relates to the health of the eye and surrounding tissue via a novel implementation of low-level light therapy with chosen wavelengths of visible light for the at-home or in clinic treatment of various inflammatory or bacterial related eye conditions and maintenance.

DESCRIPTION OF RELATED ART

Current medical device related treatments for inflammatory conditions of the eyelid include Lipiflow, Nulids, warm compresses, metal spatulas, and dry eye masks. Lipiflow is used by clinicians to remove blockages in meibomian glands. Nulids and metal spatulas work by scarping blockages from the meibomian glands of the eyelid and can be very uncomfortable for the patient to perform. Warm compresses and dry eye masks do not have high levels of patient compliance. Other treatment methods include steroids and antibiotics.

Patent XXX relates to an existing low light methods and systems for treatment of meibomian gland dysfunction and dry eye disease. Light of photo-modulating parameters is applied to the eyelid to increase the production of collagen and elastin, improve tone of the eyelid, and increase secretion of meibum oil. This system does not utilize blue light in treatment.

There is not a device that currently addresses bacterial related eye conditions and inflammatory eye conditions using low light therapy.

SUMMARY OF THE INVENTION

Low-level light therapy has a broad array of applications. Based on the specific wavelength of light radiation, various physiological pathways can be activated. This invention uses two wavelengths of low-level light: one in the visible red spectrum and one in the visible blue spectrum. The exposure of these visible wavelengths to the eye and/or surrounding tissues can promote the health of the eye, including gentle heating and disinfection of bacteria. The activation of these pathways have a broad array of potential applications in the field of ophthalmology, including both preventative and therapeutic uses.

In one general aspect, the medical device consists of a left temple, a right temple, and a frame. These parts may be connected via hinges, screws, pins, and metal inserts.

In another general aspect, the frame may consist of a custom-made printed circuit board (PCB), in which relevant circuitry and the red and blue LEDs may reside. These components are powered via pogo pins that establish an electrical connection between one of the temples and the frame.

In still another general aspect, light from the LEDs may be guided to the user's eyes via snoots. For many applications of this treatment, snoots may need to guide light away from the eye opening and towards the surrounding tissues (i.e. the eyelids). Snoots may exist in various shapes and sizes in order to customize the invention to the user's unique facial features. Daily light treatment may be used to treat or prevent a variety of conditions of the eye.

In still another general aspect, the snoots may be adhered to the inside portion (closest to the user's face) with adhesive strips. These adhesive strips may come with different bonding strengths in order to establish either temporary (during selection of the snoots) or permanent (after final snoot selection) bonds between the snoot and the frame.

In a further general aspect, the "controls" of the device may be placed inside one of the temples. The "controls" may consist of one or more of the following features: a battery, a printed circuit board (PCB), a microcontroller, a button/switch, and an indication LED.

In another general aspect, the battery residing in one of the temples may be rechargeable.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is a perspective view of the inside/back of LumiSpecs glasses;

Fig. 1B is an exploded view of the LumiSpecs glasses shown in FIG. 1A;

Fig. 1C is a perspective view of the outside/front of LumiSpecs glasses;

Fig. 1D is a perspective view of the pogo pins and hinge mechanism of LumiSpecs glasses;

Fig. 2A is a perspective view of the outside of the straight snoots;

Fig. 2B is a perspective view of the inside of the straight snoots; and

Fig. 3A is a perspective view of the inside of the angled snoots;

Fig. 4 is a planar view of the printed circuit board which resides in the frame;

Fig. 5 is a planar view of the printed circuit board which resides in the right temple.

Reference numerals in the drawings correspond to numbers in the Detailed Description for ease of reference.

DETAILED DESCRIPTION

With reference to Figs. 1(A-D), the device is shown in its final assembly. In Fig. 1A, parts 150-600 outline the major parts of the device in Fig. 1A. The LEDs are located on the inside of parts 500 and 510, soldered onto a printed circuit board. These LEDs direct light through parts 300 and 310 (the snoots) towards the user's eyelids.

With further reference to Fig. 1A, part 150 (the connecting screws and screw inserts) are used to connect the hinge complexes (part 200) to the front frame (part 500), the hinge complexes (part 200) to the left and right temples (parts 410 and 600) right temple pieces (parts 400 and 410) and the frame pieces (parts 500 and 510) together. The screw insert is heat-set into the plastic to ensure a firm connection. For this invention, M2 x 0.4 mm threaded brass screw inserts and passivated 18-8 stainless steel screws were used.

With reference to Fig. 1A, part 200 is the hinge complex that consists of the three main components: the dual hinge, the single hinge, and a screw. The single-hinge fits into the gap in the dual hinge, which allows the screw to connect the complex. These hinges allow for a smooth opening/closing mechanism of the device.

With further reference to Fig. 1A, parts 300 and 310 are the snoots that direct the light from the LEDs on the printed circuit board to the user's eyelids. Part 300 will direct light onto the upper eyelid, and part 310 will direct light onto the lower eyelid. On the back of the snoots are adhesive strips of varying strength depending on the usage of the device. During prescription and calibration of the device, the attending physician will use a weak adhesive that comes on the snoot to identify the correct snoots for the individual's facial structure. Once the correct snoot is identified, a permanent adhesive is applied to the back of the snoot, and the attachment to the back frame (part 510) is permanently established.

These snoots come in a variety of sizes, but all have an opening of approximately 9 mm in length and 4 mm in width at the beginning of the light incidence and approximately 20 mm in length and 4 mm in width at the emergence of the light from the device. The snoots will have an angle of incidence of around 30 degrees to properly angle the light onto the area of interest.

With further reference to Fig. 1A, parts 400 and 410 are the two connecting bodies to encapsulate the temple printed circuit board (Fig. 1B 710 and Fig. 5), the microcontroller (Fig. 1B 700), and the battery (Fig. 1B 720). Parts 400 and 410 are attached via two screw + screw insert complexes (part 150). These parts come together to sit on the user's right ear to secure the device. In addition, a silicone ear tip will be used for user comfort and will slide onto the extending protuberance on part 410.

With reference to Fig. 1A, parts 500 and 510 are the two connecting bodies to encapsulate the frame printed circuit board (Fig. 4). These parts will sit on the user's face via the nose bridge incorporated into these parts.

With a final reference to Fig. 1A, part 600 is the left temple. Similarly, to parts 400 and 410, the part will sit on the user's left ear to secure the device. A silicone ear tip will also be placed on the protuberance from part 600 for the same functionality.

CLAIMS

The invention claimed is:

1. A portable apparatus for the treatment and prevention of ophthalmic disorders, the apparatus comprising: at least one light source applying light to the outer surface of the eyelids of a subject, said light consisting of one or more wavelengths from 475 ± 25 nm or 685 ± 65 nm, said light having predetermined photomodulating parameters programmable for different treatment modalities.

2. The apparatus of claim **1** wherein the light source is an assembly of LEDs with some LEDs emitting light with wavelengths of 475 ± 25 nm and others emitting light with wavelengths of 685 ± 65 nm.

3. The apparatus of claim **1** further comprising a light-guiding attachment to target the emitted light to the subject's eyelids.

4. The apparatus of claim **1** including a rechargeable power source.

5. The apparatus of claim **1** wherein the light can be turned on and off by the subject.

6. The apparatus of claim **1** in which said light is applied for 500 ± 300 seconds per treatment.

7. The apparatus of claim **1** housing electrical components to power and modulate the light sources.

ABSTRACT

Provided are systems and methods for treating and preventing ocular disorders. The methods involve delivering light with a set of photomodulating parameters to the outer surface of the eyelids. The light is applied on a frequent basis for a sufficient amount of time to provide therapeutic benefits, some of which include clearing blockages in meibomian glands, strengthening the eyelid skin, and enhancing mitochondrial performance in photoreceptor cells. Particular apparatuses are included to direct the light to the eyelids, and electrical components control the light sources while providing the subject with the ability to turn the device on and off.

DRAWINGS

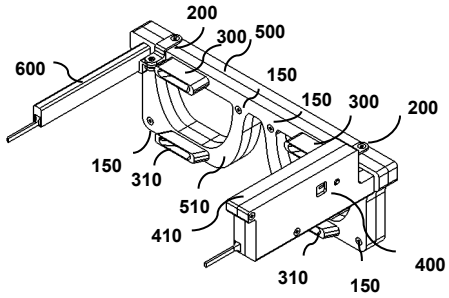

Fig. 1A

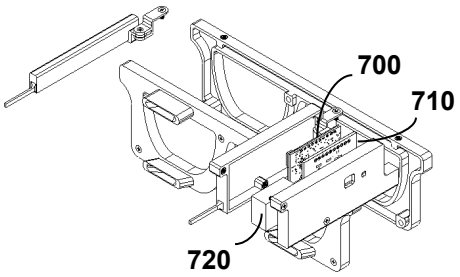

Fig. 1B

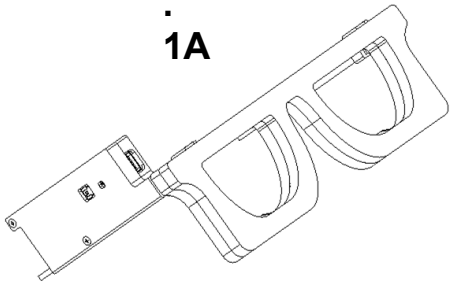

Fig. 1C

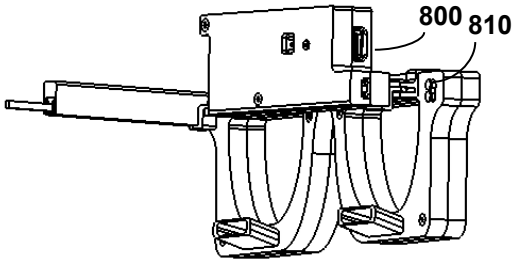

Fig. 1D

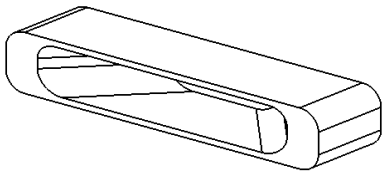

Fig. 2A

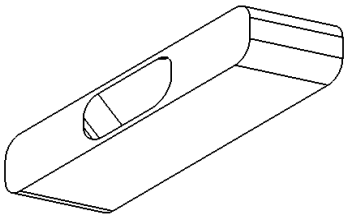

Fig 2B

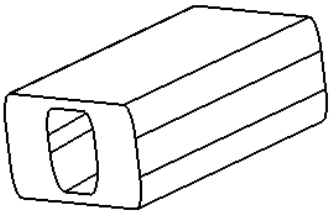

Fig 3A

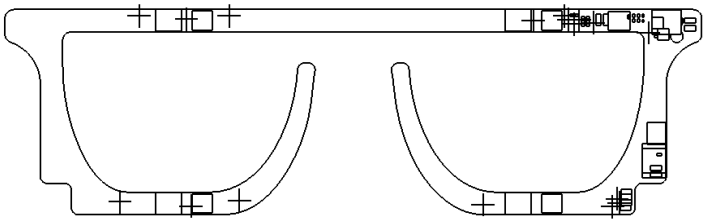

Fig. 4

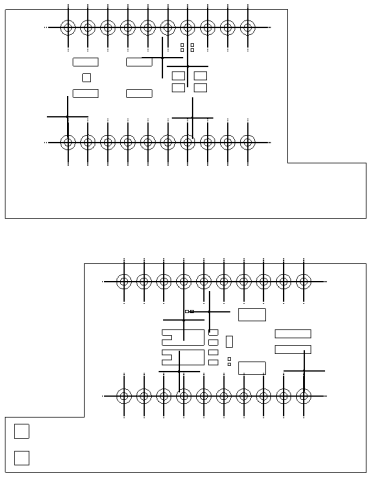

Fig 5