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(54) **ELECTRONIC EYEWEAR AND DISPLAY**

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G02C 11/00 (2006.01)

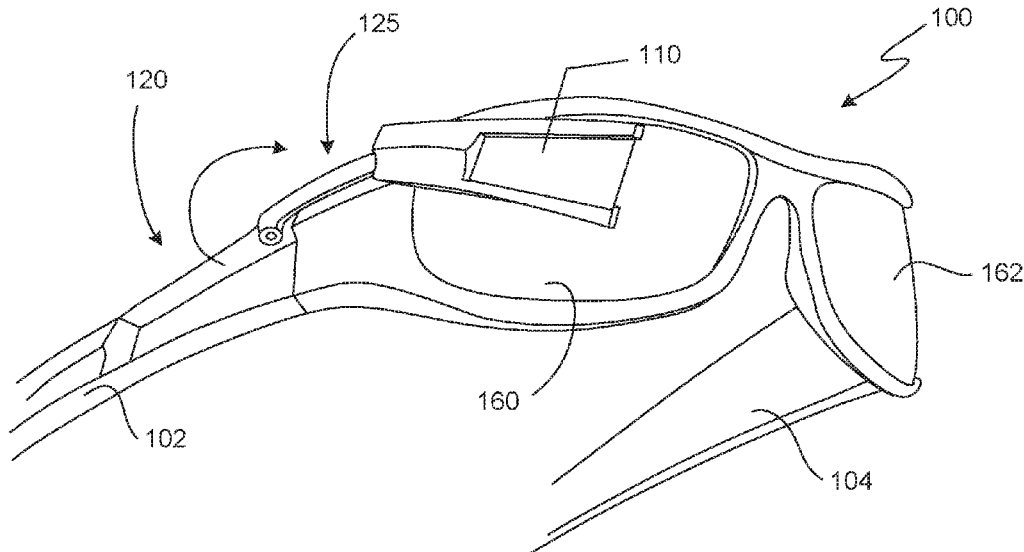
(57) **ABSTRACT**

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Novel eyewear apparatuses including a display are disclosed. In one embodiment, the apparatus also includes a frame. The frame includes a side region that includes an extendable arm. The first end of the extendable arm is attached to the frame and a second end of the extendable arm is attached to the display. The side region includes a cavity, where the extendable arm is adapted to retract back. The extendable arm is further adapted to extend out of the cavity and orient the display to be visually observable by a user of the eyewear apparatus. In another embodiment, the apparatus includes a concave reflective and an image source. The image source and the concave reflective surface are oriented to enable a user of the eyewear apparatus to view at least an image from the image source as reflected by the concave reflective surface.

(58) **Field of Classification Search**
CPC G02C 11/10; G02B 27/0176; G02B 2027/0138; G02B 2027/0178; G02B 2027/0159; G02B 2027/0181; G02B 27/0179
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8 Claims, 10 Drawing Sheets



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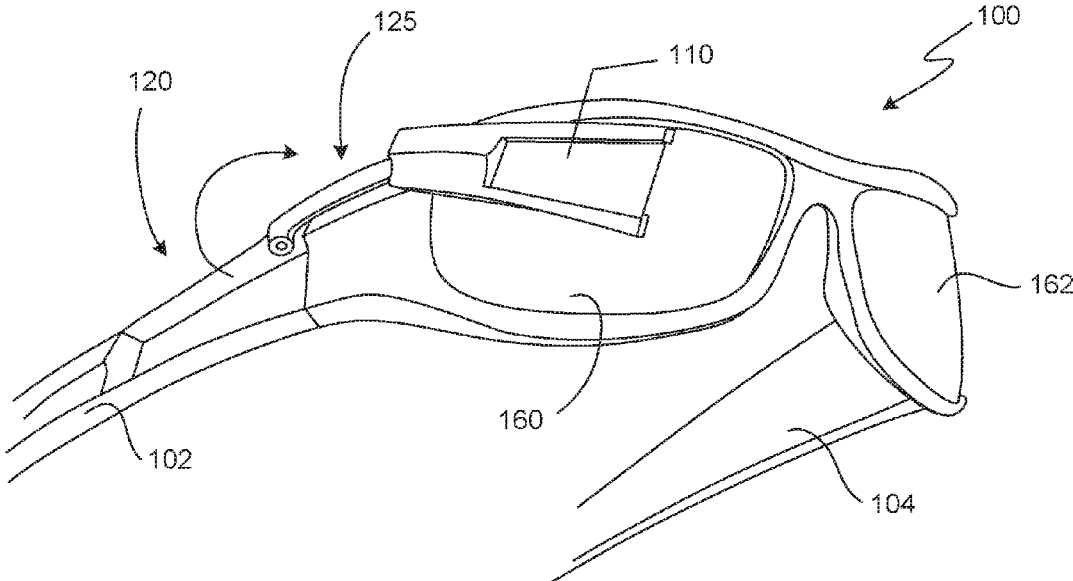


FIG. 1

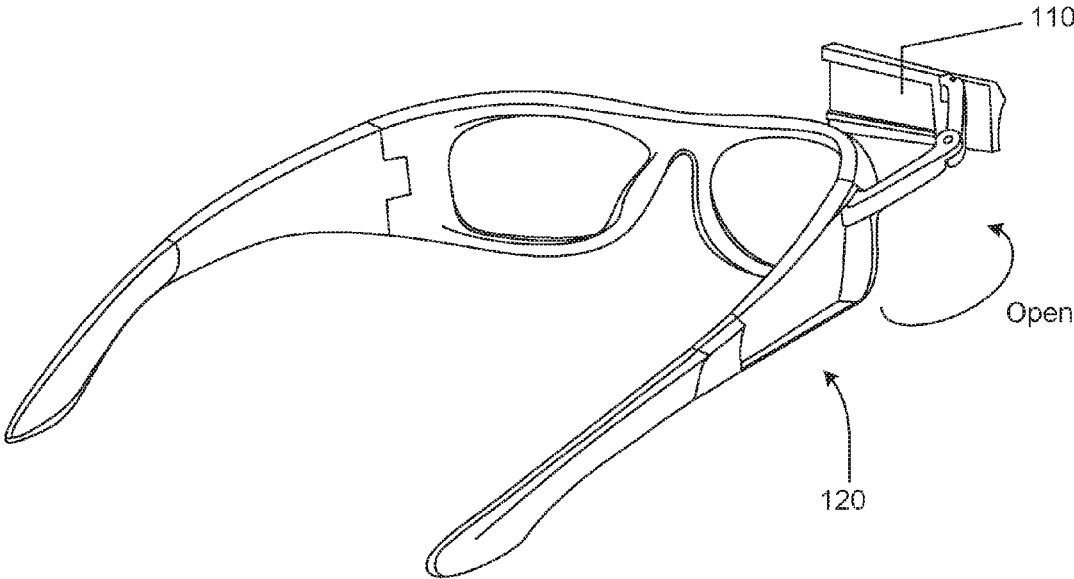


FIG. 2

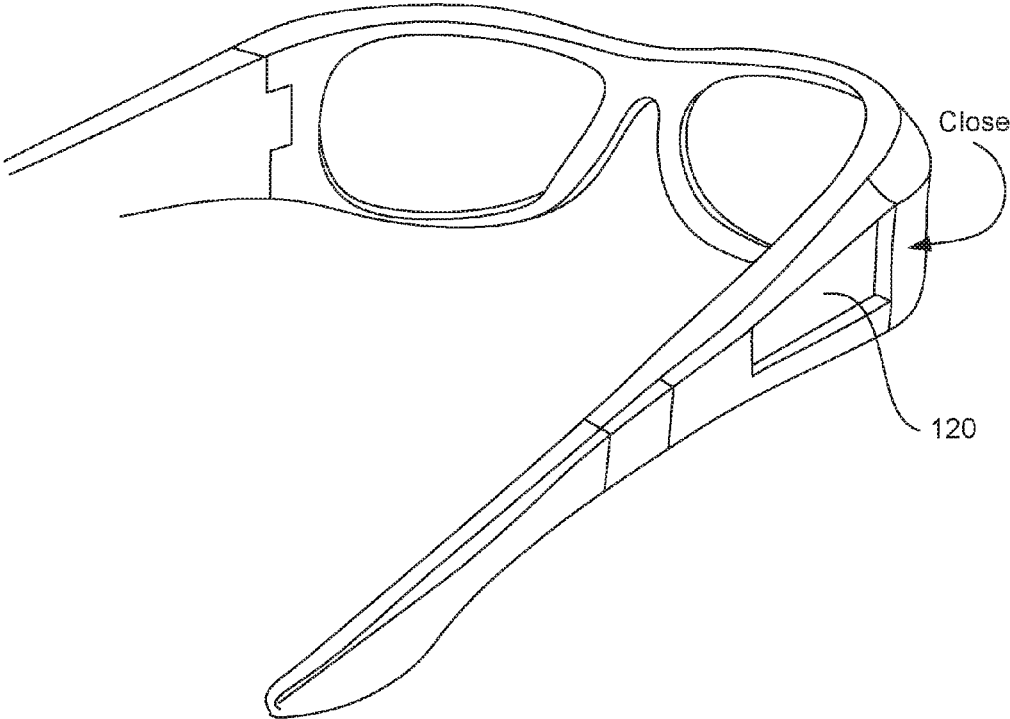


FIG. 3

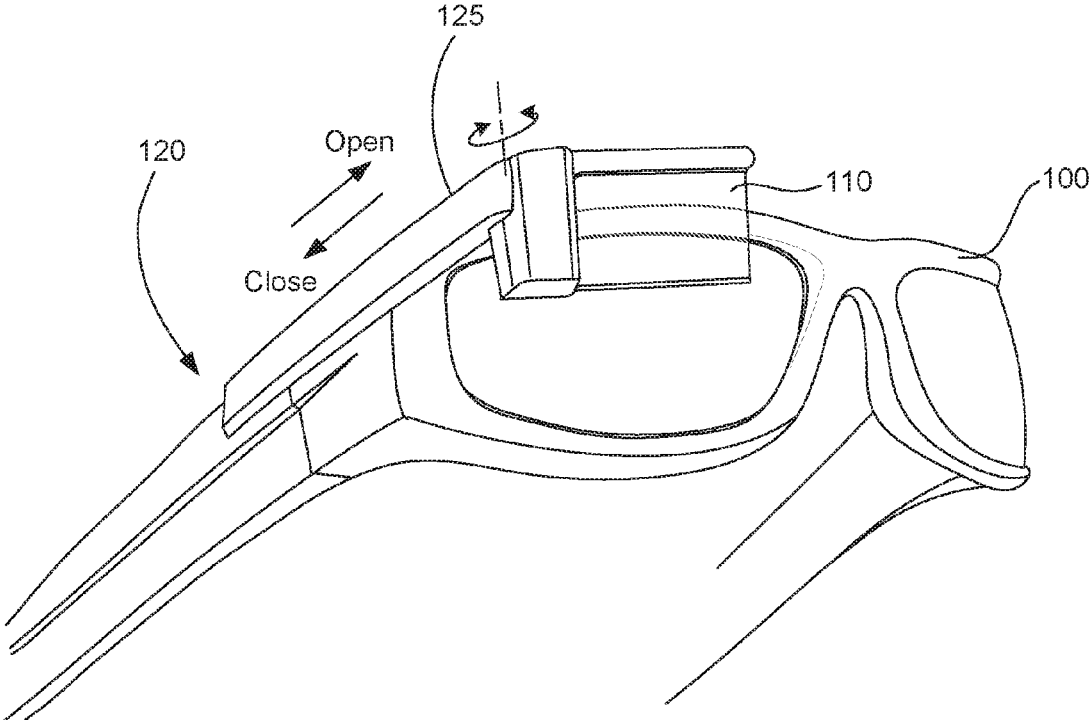


FIG. 4

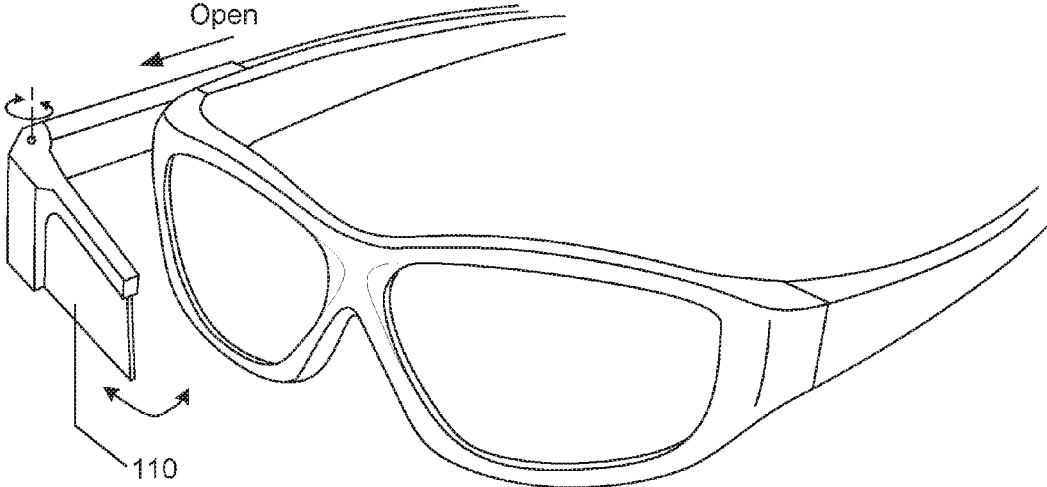


FIG. 5

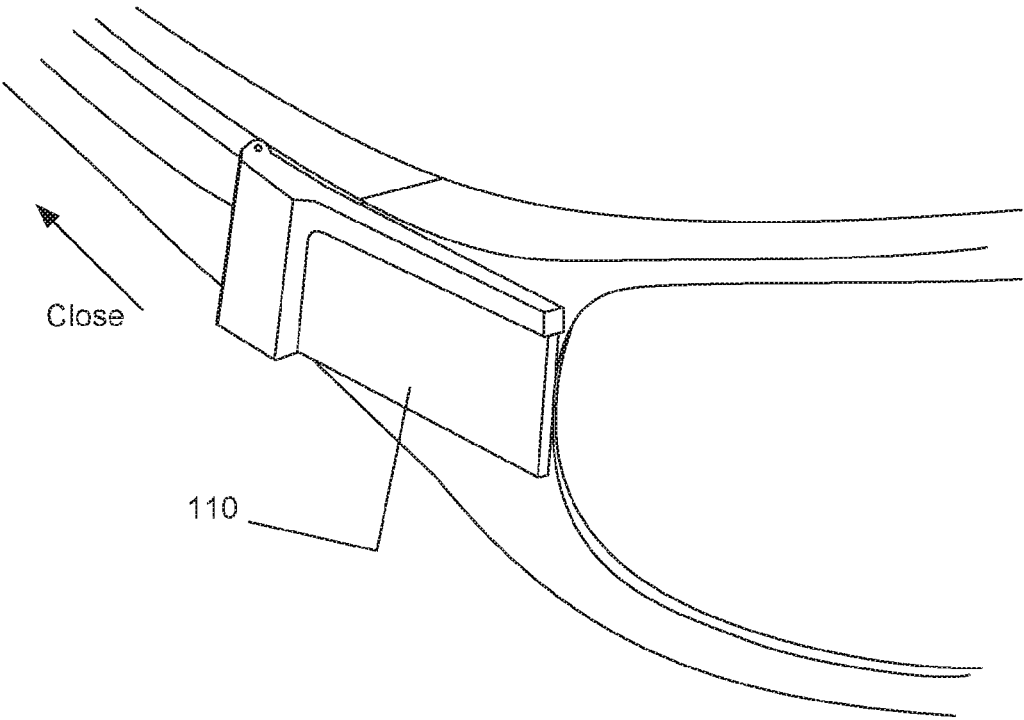


FIG. 6

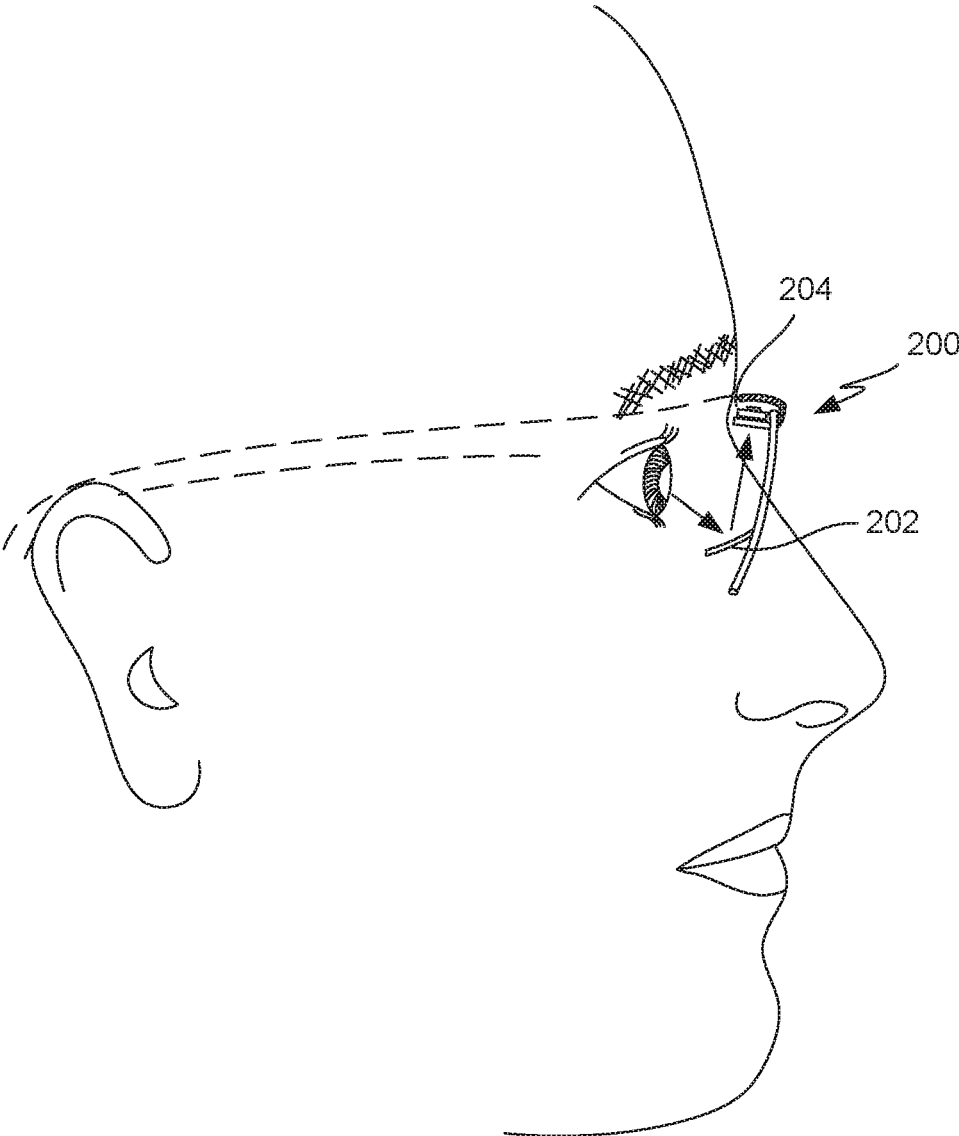


FIG. 7

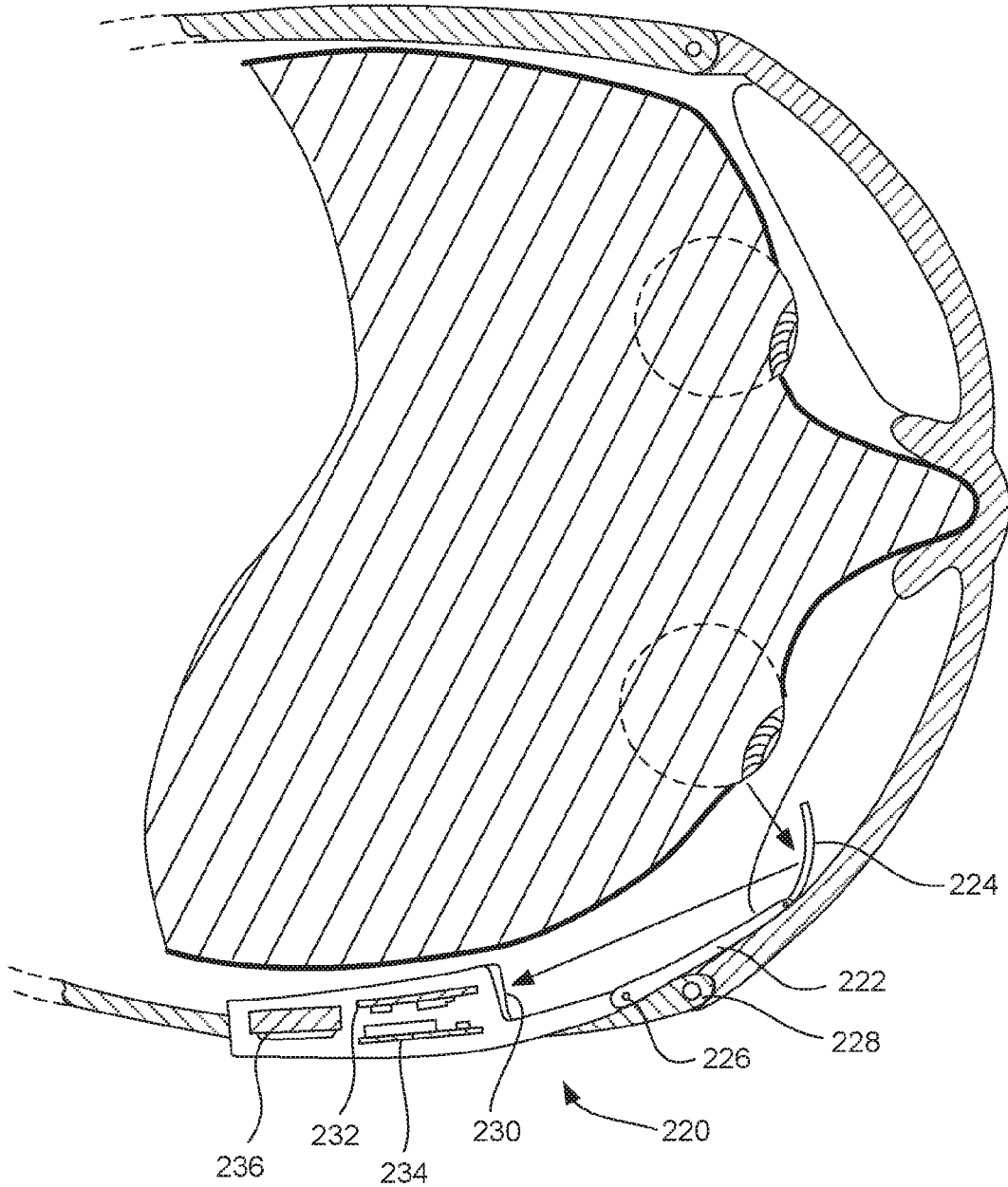


FIG. 8A

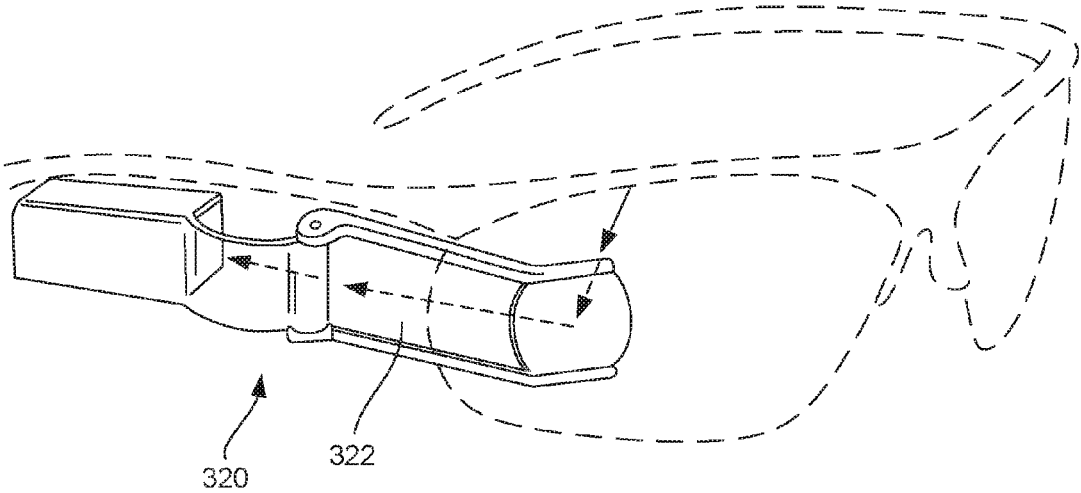


FIG. 8B

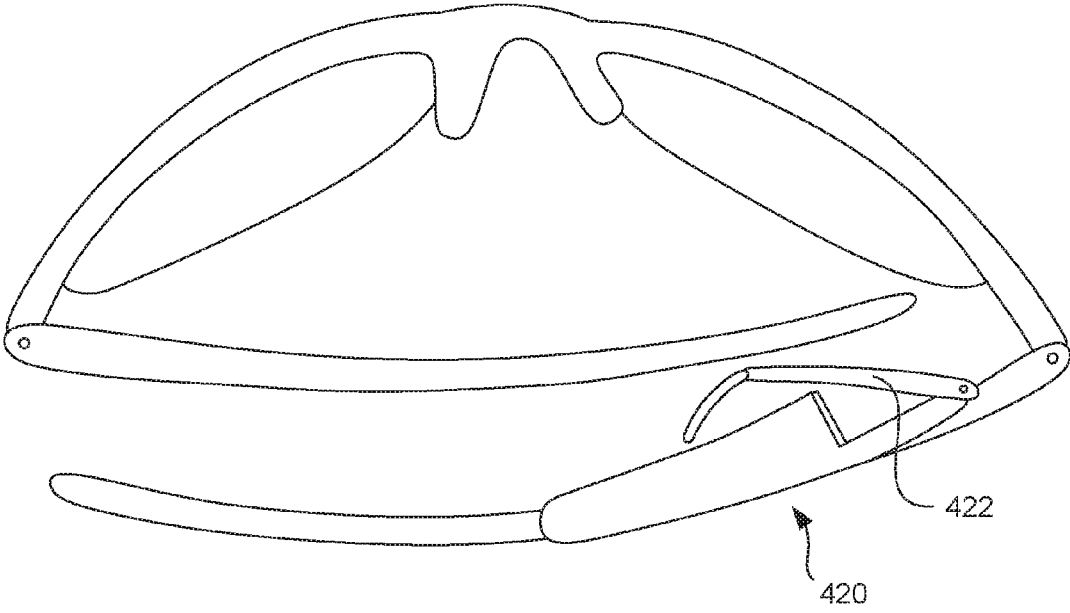


FIG. 9

ELECTRONIC EYEWEAR AND DISPLAY**CROSS-REFERENCE TO RELATED APPLICATIONS**

The patent application claims priority to U.S. Patent Application No. 61/792,702, entitled, "Electronic Eyewear and Display," filed Mar. 15, 2013, and U.S. Patent Application No. 61/868,676, entitled, "Electronic Eyewear and Display," filed Aug. 22, 2013, both of which are hereby incorporated herein by reference.

FIELD OF THE DESCRIBED EMBODIMENTS

The described embodiments relate generally to electronic eyewear. More particularly, the described embodiments relate to apparatuses, methods and systems for electronic eyewear that includes a display.

BACKGROUND OF THE INVENTION

It is desirable to have methods, systems and apparatuses for providing electronic eyewear that includes a display.

SUMMARY OF THE INVENTION

In one embodiment, an eyewear apparatus includes a display and a frame. The frame includes a side region that includes an extendable arm. The first end of the extendable arm is attached to the frame and a second end of the extendable arm is attached to the display. The side region includes a cavity, where the extendable arm is adapted to retract back. The extendable arm is further adapted to extend out of the cavity and orient the display to be visually observable by a user of the eyewear apparatus.

In another embodiment, an eyewear apparatus includes a concave reflective and an image source. The image source and the concave reflective surface are oriented to enable a user of the eyewear apparatus to view at least an image from the image source as reflected by the concave reflective surface. In one embodiment, the apparatus includes a lens. The concave reflective surface can be integral with the lens. In another embodiment, the apparatus includes a frame. The concave reflective surface can be in the frame. In another embodiment, the frame includes an extendable arm with a first end and a second end. The first end of the extendable arm is configured to be attached to the frame, and the concave reflective surface is configured to be in the vicinity of the second end. Yet another embodiment includes a lens, an additional image source and an additional concave reflective surface, with the additional source and surface being located at opposite sides of the lens. In one embodiment, the eyewear apparatus is in a module.

Other aspects and advantages of the present invention will become apparent from the following detailed description, which, when taken in conjunction with the accompanying drawings, illustrates by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an electronic eyewear that includes a display, according to an embodiment of the invention.

FIG. 2 shows an alternate view of the electronic eyewear of FIG. 1 that includes the display, according to an embodiment of the invention.

FIG. 3 shows the electronic eyewear of FIGS. 1 and 2, wherein the display is at least partially embedded in a temple region of the electronic eyewear, according to an embodiment of the invention.

FIG. 4 shows an electronic eyewear that includes a display, according to an embodiment of the invention.

FIG. 5 shows an alternate view of the electronic eyewear of FIG. 4 that includes the display, according to an embodiment of the invention.

FIG. 6 shows the electronic eyewear of FIGS. 4 and 5, wherein the display is at least partially embedded in a temple region of the electronic eyewear, according to an embodiment of the invention.

FIG. 7 shows an embodiment of an electronic display apparatus for eyewear that includes a concave reflective surface and an image source.

FIG. 8A-8B show different embodiments of an electronic display apparatus for eyewear that includes an extendable arm that is extended.

FIG. 9 shows an embodiment of an electronic display apparatus for eyewear that includes an extendable arm that is retracted.

Same numerals in FIGS. 1-9 are assigned to similar elements in all the figures. Embodiments of the invention are discussed below with reference to FIGS. 1-9. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as the invention extends beyond these limited embodiments.

DETAILED DESCRIPTION OF THE INVENTION

One embodiment includes an electronic eyewear with a display. The electronic eyewear includes a side region and a front region, and the display can be attached to the side region of the eyewear. In one embodiment, the side region includes a temple region. In another embodiment, the eyewear includes a front region with two sides, and two side regions, one connected to each side of the front region.

In different embodiments, an electronic eyewear can be, for example, a pair of sunglasses, fit-over glasses, prescription glasses, safety glasses, goggles, such as ski goggles, and "frame-less" glasses; an auxiliary frame, and a swim mask; and an electronic apparatus wearable by a user in the vicinity of one or both eyes of the user.

In one embodiment, the electronic eyewear includes at least a front region and a side region. The front region is configured to be in front of the user wearing the electronic eyewear. The side region is configured to be on a side of the user wearing the electronic eyewear.

FIG. 1 shows a block diagram of an electronic eyewear according to one embodiment. For this embodiment, the electronic eyewear includes a frame **100** that includes a pair of temples or arms **102, 104**; and a lens holder adaptable to hold one or more lenses (for example, lenses **160, 162**). In one embodiment, a "frame-less" glasses can be an eyewear with two lenses connected by a bridge, with each lens also connected to an arm or temple.

While two lenses **160, 162** are depicted in FIG. 1, the electronic eyewear can include a single eye-piece forming goggles rather than the standard lenses of glasses. As an example, the lens could be a single wrap-around lens. For an embodiment, the frame **100** is adaptable to hold one or more lenses, such as, lenses **160, 162**.

In another embodiment, the frame **100** includes a connecting piece between lenses such as in a pair of frame-less glasses.

As shown, the frame **100** further includes a display **110**. For example, at least one of the arms **102**, **104** includes a region **120** that includes an extendable arm **125**, wherein a first end of the extendable arm **125** is attached to the temple region **120** and a second end of the extendable arm **125** is attached to the display **110**.

An embodiment includes an eyewear apparatus. The eyewear apparatus includes a frame, and a display. For an embodiment, the frame includes a side region that includes an extendable arm, wherein a first end of the extendable arm is attached to the frame and a second end of the extendable arm is attached to the display.

For an embodiment, a temple region **120** or a side region of the eyewear includes a cavity, wherein the extendable arm **125** is adapted to retract back to the cavity, and can fit within or substantially within the cavity. For an embodiment, the extendable arm **125** is further adapted to extend out of the cavity and orient the display **110** to be visually observable by a user of the eyewear apparatus. For an embodiment, the extendable arm **125** includes at least one rotatable joint, allowing adjustment of a distance between the display **110** and the one or more lenses **160**, **162**.

For an embodiment, the extendable arm **125** includes at least one rotatable joint, allowing adjustment of an orientation of the display **110** relative to the one or more lenses. For an embodiment, the extendable arm **125** includes at least one rotatable joint, allowing adjustment of an orientation of a viewing plane of the display **110** relative to a frontal plane of the one or more lenses, or relative to a frontal plane of the lens holder. For an embodiment, a retracted state of the electronic eyewear includes the extendable arm **125** retracted into the cavity. For an embodiment, a user-activated action causes the extendable arm **125** to pop out, or to extend out, of the cavity. In one embodiment, the extendable arm **125** can be user-adjusted.

For an embodiment, an extendable arm includes two or more pieces, wherein at least two of the pieces are connected at endpoints, wherein the pieces rotatably adjust at the endpoints. For an embodiment, a first piece rotatably connected to the temple region and a last piece is rotatably connected to the display.

For an embodiment, at least one conductor extends through the extendable arm, electronically connecting the display to a controller location within the eyewear.

For an embodiment, the display **110** includes an LCD display.

For an embodiment, the display **110** includes a projection screen. For an embodiment, the apparatus further includes a projector for displaying images on the projection screen.

For an embodiment, the apparatus further includes light-guide optical element operative to display images on the display.

In one embodiment, the different attributes of the different embodiments of the electronic eyewear can be programmable, such as via switches on the corresponding eyewear, or wirelessly via a remote control, or both. Examples of switches on a frame can include a knob, a slider or a small dial on the corresponding frame to program the electronic eyewear.

FIG. 2 shows an alternate view of the electronic eyewear of FIG. 1 that includes the display, according to an embodiment.

FIG. 3 shows the electronic eyewear of FIGS. 1 and 2, wherein the display is at least partially embedded in, or concealed within, a temple region of the electronic eyewear, according to an embodiment.

FIG. 4 shows an electronic eyewear that includes a display, according to an embodiment.

FIG. 5 shows an alternate view of the electronic eyewear of FIG. 4 that includes the display, according to an embodiment.

FIG. 6 shows the electronic eyewear of FIGS. 4 and 5, wherein the display is at least partially embedded in, or concealed within, a temple region of the electronic eyewear, according to an embodiment.

In one embodiment, the electronic eyewear includes at least one focusing lens between the display and an eye of the wearer. The focusing lens helps focus the image from the display to the eye. The focusing lens can be a Fresnel lens. In one embodiment, the electronic eyewear includes at least one lens as in a lens of a pair of glasses; and the focusing lens is built into the at least one lens.

In one embodiment, electronics for the electronic eyewear is in an eyewear frame. In another embodiment, the electronic eyewear with the corresponding electronics, such as the control circuitry, can be in a secondary frame, which is attachable to a primary frame via different mechanisms, such as magnets. The primary frame can include a pair of prescription lenses. To illustrate, there can be a housing or a chassis holding prescription lenses, with the electronic eyewear provided on the outside, such as via a clip-on.

In one embodiment, the electronic eyewear with the corresponding control circuitry and power source can be in a fit-over frame that can fit over another frame.

In one embodiment, the electronic eyewear can include prescription lenses providing focal correction, such as bifocal, tri-focal, prism, etc.

In one embodiment, the electronic eyewear is rechargeable or includes power sources, such as a battery, to allow the eyewear to perform its operation over a duration of time, such as a few hours.

One embodiment further includes monitoring if the user is wearing the eyewear. In one embodiment, the electronic eyewear includes a time sensor that times at least one of how long and how frequently the user wears the eyewear. For an embodiment, the time sensor is attached to, integral with, or being a part of the electronic eyewear. For an embodiment, information related to the monitoring/sensing of the eyewear is stored, such as in the eyewear. For an embodiment, after stored, the monitoring information can be later retrieved, for example, by a doctor or physician to allow the physician to determine or gauge the compliance (e.g. duration of time of wearing the eyewear) by the user with a therapy suggested by the doctor or physician. The retrieval can be performed through a wire connection (e.g. via an electrical connector at the eyewear) or wirelessly (e.g. via an infrared sensor or a wireless transceiver at the eyewear).

In one embodiment, a motion detector is used as the "being worn" sensor. A threshold can be set, such that if the amount of motion exceeds the threshold, the eyewear is assumed to be worn. The motion detector can, for example, be achieved by a mechanical means or an accelerometer.

In another embodiment, the "being worn" sensor includes two thermal sensors. One sensor can be at approximately the middle or close to one end of an arm, such as in a region that touches the head of the user wearing the eyewear. The other sensor can be at the other end of the arm, such as close to lens holder of the eyewear. If the temperature differential between the two sensors is beyond a certain preset value, the

eyewear would be assumed to be worn. The differential is presumed to be caused by a person wearing the eyewear.

In yet another embodiment, the eyewear includes at least one hinge, and the hinge is configured to allow an arm of the eyewear to be foldable. In one embodiment, the “being worn” sensor includes a stress sensor at the hinge of the arm. The assumption is that when the eyewear is worn, the hinge is typically slightly stretched because typically, the width of the head of the user is slightly wider than the width between the arms when the two arms are in the extended positions. If the value of the stress sensor is beyond a certain preset value, the eyewear would be assumed to be worn.

In a further embodiment, the “being worn” sensor can be a switch. For example, at the hinge between an arm and its corresponding lens holder, there is a switch. When that temple is fully extended outwards, the switch is turned on. The switch can be a pin. When the temple is fully extended outwards, the pin is pressed. When both arms are fully extended outwards, in one embodiment, the eyewear would be assumed to be worn by the user.

In one embodiment, the electronic eyewear includes one or more lenses based on liquid crystal lens technologies.

In one embodiment, the electronic eyewear may be secured from the back with a functional strap, such as a lanyard. In one embodiment, the lanyard may contain the electronics, such as control circuitry and power source, of the electronic eyewear. This can provide additional ergonomic qualities and securing for active users.

FIG. 7 shows an embodiment of an electronic display apparatus for eyewear **200** includes a concave reflective surface **202** and an image source **204**. The image source **204** could include a liquid crystal display (LCD) or a light emitting diode type of display (LEDD), with a circuit board having electronics attached. The image source **204** and the concave reflective surface **202** can be configured to be oriented to enable a user of the electronic display apparatus to view at least an image from the image source **204** as reflected by the concave reflective surface **202**.

In one embodiment, the electronic display apparatus for eyewear is adapted or configured for an electronic eyewear.

In one embodiment, the electronic display apparatus for eyewear includes at least one lens. In one embodiment, at least a portion of a concave reflective surface is integrated with the at least one lens. For example, the at least one lens can include a transparent portion and the at least a portion of the concave reflective surface. In another embodiment, such as for a pair of sunglasses, the at least one lens can include a near-transparent portion and the at least a portion of the concave reflective surface. In yet another embodiment, the at least one lens can include a substantially non-reflective portion (which could be transparent or near-transparent) and the at least a portion of the concave reflective surface.

At least a portion of the concave reflective surface and at least a portion of the image source can be located on opposite sides of the at least one lens. For example, the at least a portion of the concave reflective surface is at an upper portion of the at least one lens, while the at least a portion of the image source is at the vicinity around a lower portion of the at least one lens. In another example, at least a portion of the concave reflective surface and at least a portion of the image source are located in the vicinity on a same side of the at least one lens.

In yet another embodiment, the at least one lens is configured to be located between the image source and the concave reflective surface, and is configured to enable a user of the eyewear apparatus to view at least an image from the image source as reflected by the concave reflective surface.

In one embodiment, the electronic display apparatus for eyewear includes a frame, and at least a portion of the concave reflective surface is in or integral with the frame. The apparatus also can include at least one lens. In one embodiment, at least a portion of the concave reflective surface, or at least a portion of the image source, or both, are at the frame. The at least a portion of the concave reflective surface, and the at least a portion of the image source both can be located in the vicinity of the opposite sides of the at least one lens. For example, the at least a portion of the concave mirror is at the frame, adjacent to an upper portion of the at least one lens; and the at least a portion of the image source is at the frame, adjacent to a lower portion of the at least one lens.

FIGS. **8a** and **8b** show different embodiments of an electronic display apparatus for eyewear including an extendable arm that are extended. For example, FIG. **8a** shows an embodiment **220** of an electronic display apparatus for eyewear that includes an extendable arm **222**. The electronic display apparatus for eyewear can also include a frame with a side region, wherein at least a portion of an image source is in the side region of the frame. The extendable arm has a first end and a second end. The first end of the arm **222** is configured to be attached to the frame, and a concave reflective surface **224** is configured to be attached in the vicinity of the second end. In one embodiment, the frame includes one or more lenses, such as in a pair of glasses.

In FIG. **8a**, the extendable arm **222** is configured to be on the inside of the frame, and when extended, the concave reflective surface **224** is positioned behind at least one of the lenses, in between the at least one lenses and the user wearing the frame.

In the embodiment shown in FIG. **8a**, the extendable arm **222** includes a pivot **226**. The pivot **226** can be configured to be behind the pivot **228** of the frame when the frame **228** is worn.

In another embodiment, an extendable arm is on the outside of a frame, and when extended, the concave reflective surface is in front of at least one of the lenses. In this embodiment, the at least one of the lenses is located in between the concave reflective surface and the user when the extendable arm is extended.

In one embodiment, the electronic display apparatus for eyewear includes more than one image source. In another embodiment, the electronic display apparatus for eyewear includes more than one concave reflective surfaces. For example, each image source can be configured to operate with a corresponding concave reflective surface. For each image source and the corresponding concave reflective surface, at least a portion of the image source and at least a portion of its corresponding concave reflective surface can be located in the vicinity of the opposite sides of at least one lens.

FIG. **8b** shows an embodiment **320** of an electronic display apparatus for eyewear including an extendable arm **322** that is extended. FIG. **9** shows an embodiment, **420** of an electronic display apparatus for eyewear including an extendable arm **422** that is retracted.

In one embodiment, an electronic display apparatus for eyewear is configured to be in a module. FIGS. **8A** and **8B** show such an example. In the example shown in FIG. **8a**, the module **220** can include an image source, such as a LCD **230**, with circuit boards, **232** and **234**, and a battery **236**. In another embodiment, the module can be integrated into a frame, such as the frame of a pair of glasses.

The various embodiments, implementations and features of the invention noted above can be combined in various ways or used separately. Those skilled in the art will understand from the description that the invention can be equally applied to or used in other various different settings with respect to various combinations, embodiments, implementations or features provided in the description herein.

Numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will become obvious to those skilled in the art that the invention may be practiced without these specific details. The description and representation herein are the common meanings used by those experienced or skilled in the art to most effectively convey the substance of their work to others skilled in the art. In other instances, well-known methods, procedures, components, and circuitry have not been described in detail to avoid unnecessarily obscuring aspects of the present invention.

Also, in this specification, reference to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment can be included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Further, the order of blocks in process flowcharts or diagrams representing one or more embodiments of the invention do not inherently indicate any particular order nor imply any limitations in the invention.

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of this specification or practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope and spirit of the invention being indicated by the following claims.

What is claimed:

- 1. An eyewear apparatus, comprising:
 - a frame with a front and at least a side; and
 - a display;
 wherein the side couples to an extendable arm,
 wherein the side comprises a cavity,
 wherein the extendable arm comprises at least a first piece and a second piece, with one end of the first piece

connected to the side via a first hinge, with the display connected to the second piece, the two pieces being connected by at least a rotatable joint to at least allow adjustment of an orientation of the display relative to the front of the frame,

wherein the extendable arm is adapted to retract back to the cavity, and when retracted, the extendable arm fits substantially in the cavity and the display is also substantially in the cavity,

wherein the extendable arm is further adapted to extend out of the cavity and orient the display to be visually observable by a user of the eyewear apparatus,

wherein the front is connected to the side via a second hinge,

wherein the first hinge includes a first rotating axis, wherein the second hinge includes a second rotating axis, and

wherein the first rotating axis of the first hinge is configured not to be collinear with the second rotating axis of the second hinge.

2. The apparatus of claim 1, wherein the extendable arm is caused to extend out of the cavity by a user-activated action, allowing the extendable arm to be user-adjusted.

3. The apparatus of claim 1, wherein at least one conductor extends through the extendable arm, electrically connecting at least an electrical component in the display to a controller located within the frame.

4. The apparatus of claim 1, wherein the display comprises a screen, and wherein the apparatus comprises a projector for at least displaying images on the screen.

5. The apparatus of claim 1, wherein the apparatus further comprises at least a light-guide optical element operative to enable at least viewing of images on the display.

6. An eyewear apparatus as recited in claim 5, wherein the extendable arm cannot telescope.

7. An eyewear apparatus as recited in claim 5, wherein the display comprises a screen.

8. An eyewear apparatus as recited in claim 7, wherein the apparatus comprises a projector for at least displaying the images on the screen.

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