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(51) INT CL:
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(56) Documents Cited:

GB 2477264 A	**WO 2006/098618 A1**
JP 020296212 A	**US 20100165288 A1**
US 20080030678 A1	**US 20070091257 A1**

(58) Field of Search:
INT CL **G02B**
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(54) Title of the Invention: **Adjustable spectacles**
Abstract Title: **Spectacles with laterally adjustable dual lenses to vary focal length**

(57) A pair of spectacles 1 has a frame 2 and a pair of combined lenses 8a-b carried by the frame. Each combined lens has an adjustable focal length and may be adjusted by movable actuators 10a-b and has two lens elements 14, 16 arranged one behind the other along an optical axis 12a-b of the combined lens. An adjustment mechanism is arranged to move the two lens elements laterally relative to one another to vary the focal length whereby each lens element is movable in a direction opposite to the other lens element and transverse to the optical axis. In this manner the optical axis remains substantially fixed relative to the frame. The adjustment mechanism comprises at least one frame-connected rotatable element, such as lugs (44, 46, Figure 6) engaging at least one lens element and, when in use, urges a lateral movement of the lens element.

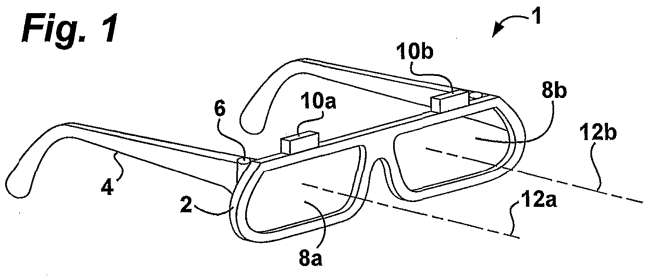

Fig. 1

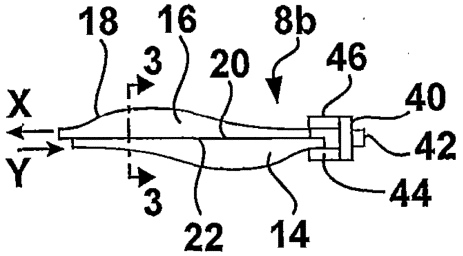

Fig. 2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

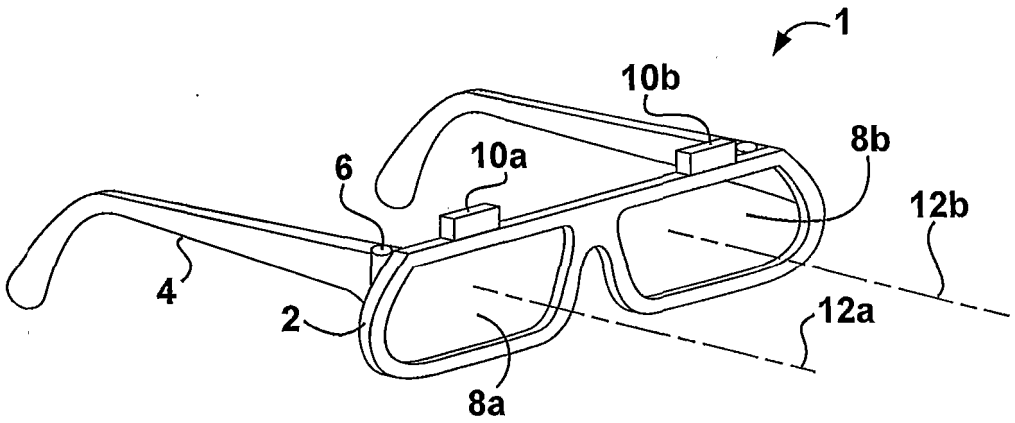

Fig. 1

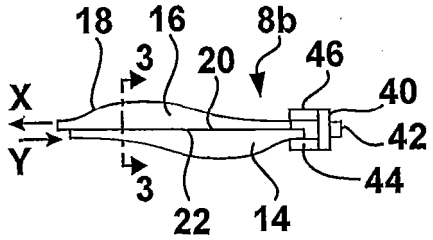

Fig. 2

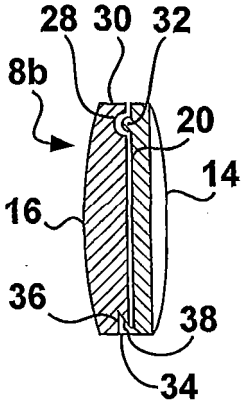

Fig. 3

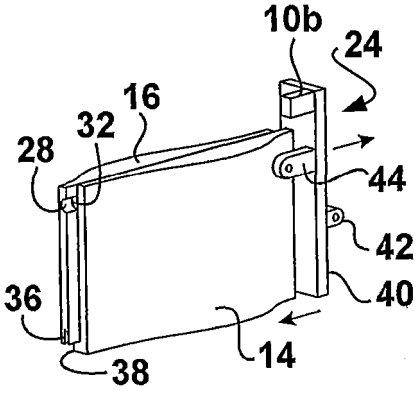

Fig. 4

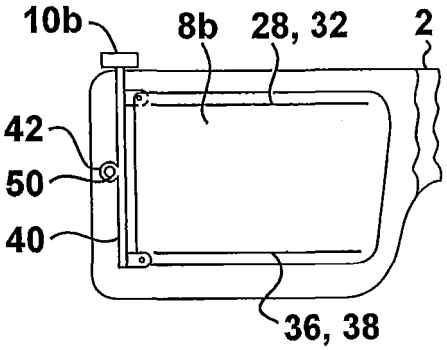

Fig. 5

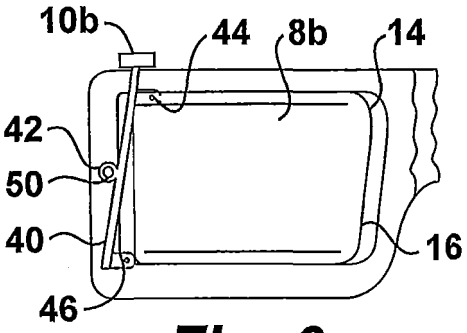

Fig. 6

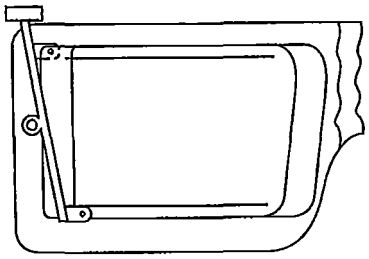

Fig. 7

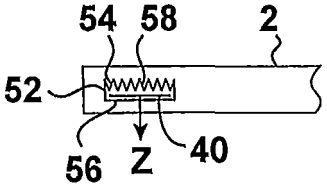

Fig. 8

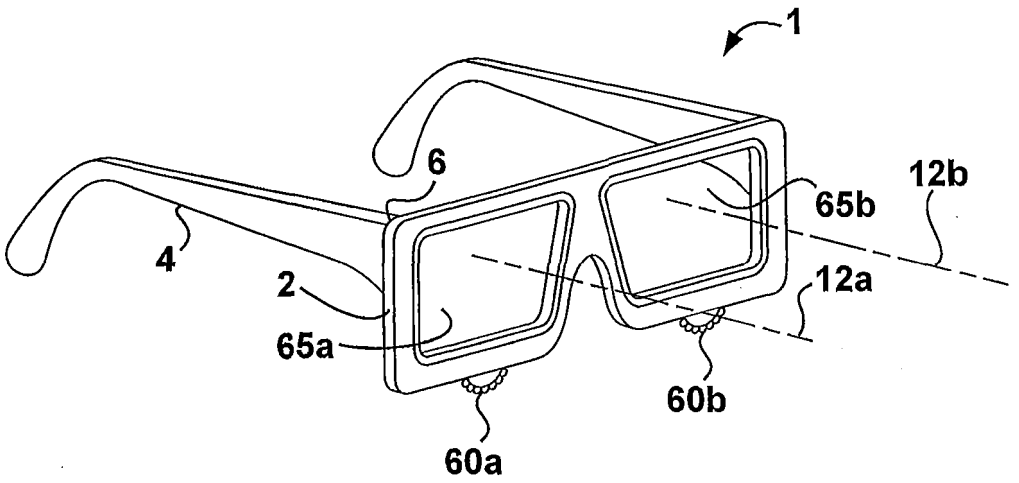

Fig. 9

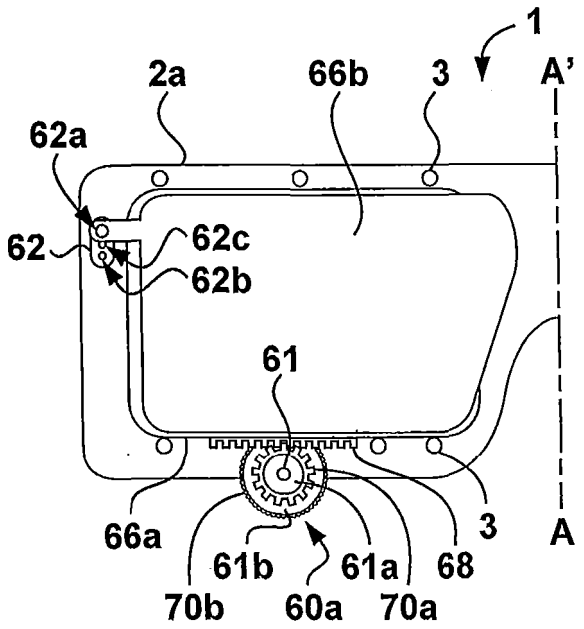

Fig. 10

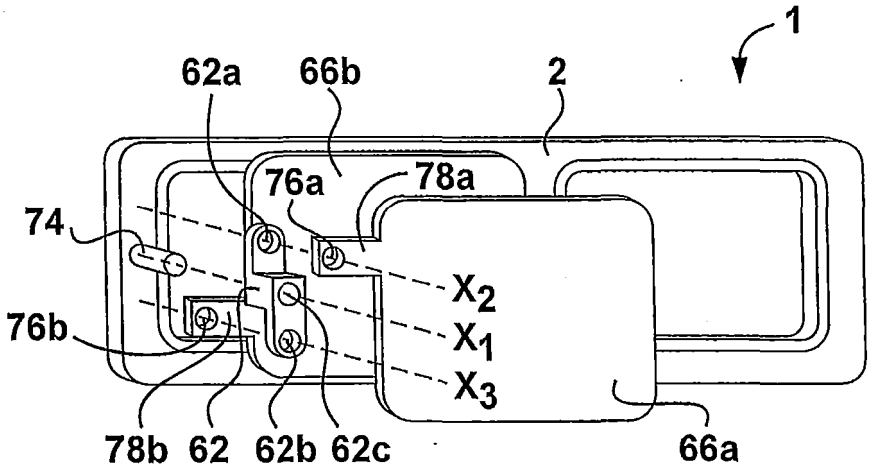

Fig. 11

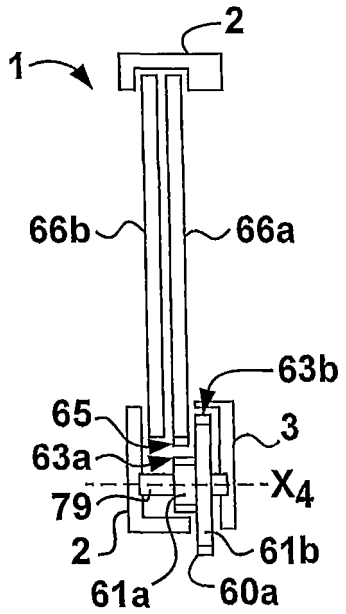

Fig. 12

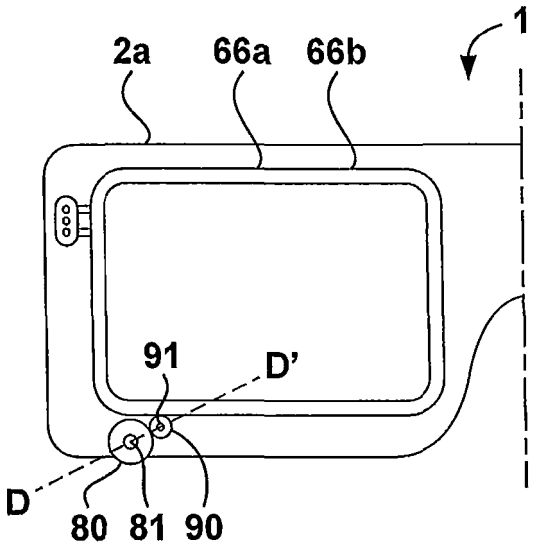

Fig. 13

ADJUSTABLE SPECTACLES

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates generally to the field of spectacles. In particular, the invention relates to spectacles provided with a frame and a pair of combined lenses arranged to have an adjustable focal length.

2. Description of the Related Art

[0002] Spectacles, also called glasses or eyeglasses, are commonly in the form of a frame bearing lenses. They are worn in front of the eyes and supported on the nose and over the ears, although other designs are well-known as well. Spectacles are normally used for vision correction, eye protection, or for protection from UV rays.

[0003] Refractive errors of the eye (such as myopia, hyperopia or astigmatism) can be alleviated with corrective lenses, which modify the effective focal length. A lens defines a specific focal length depending on its characteristics (e.g. thickness, convexity/concavity). In order to correct the vision of patients with refractive errors and supply them with the proper lenses, an ophthalmologist or optometrist must make a prescription of lenses according to each eye of each patient.

[0004] Some locations such as underdeveloped areas and poorer parts of the world do not have the proper equipment and/or skilled personnel to provide inhabitants having vision problems with the care that they may require. It has been estimated that this concerns hundreds of millions of people worldwide. Efforts have been made to correct the vision problems of these people, for example by supplying low cost glasses in a range of focal lengths. Even though such fixed focal length glasses can be manufactured extremely cheaply, the logistics of distribution in remote areas is so difficult that it remains very difficult to ensure that an individual will eventually receive spectacles offering adequate correction for both eyes.

[0005] The principle of varying the refractive power of a two part combined lens by relatively moving the lens parts is already known in the art. US 3,617,116 and US 3,507,565

disclose combined lenses arranged one behind the other along an optical axis to obtain a desired sphere or cylinder prescription within a relatively wide predetermined prescription range. These documents suggest that when the desired refractive power is settled, then the two lens parts may be fixedly secured by e.g. cementing.

[0006] Based on this principle, an alternative solution to affordable vision correction is to supply low-cost adjustable spectacles. Such low-cost adjustable spectacles can be produced and supplied in large volumes. An untrained wearer may then set the right focus themselves for each eye by moving the lens parts, without the need for trained ophthalmologist or optometrist. WO 2006/098618 discloses spectacles provided with combined lenses where the wearer can adjust the focal length by a mechanism that moves the lenses across each other. By moving both lens elements an equal amount, the optical axis of the lens remains in the same position with respect to the spectacles frame. The mechanism disclosed requires at least one cam element that can interact with at least one of the lenses by direct and permanent coupling of a notch with a groove of the lens. This document teaches a mechanism that moves the lens elements with respect to one another but the design of the mechanism makes no provision for showing a fashionable or discrete design of spectacles to wear. The mechanism is also relatively big and outstanding in the design of the spectacles, making it more susceptible for dirt or particles to enter in or around the mechanism and its openings and clog certain areas in or around the mechanism. This would seriously impede the workings of the mechanism and thus the functionality of the spectacles. The adjustment mechanism also does not provide in more precise adjusting of the focal length of the lenses, only direct adjustment by hand motion. The present invention and its embodiments give a solution to one or more of the before mentioned shortcomings.

BRIEF SUMMARY OF THE INVENTION

[0007] According to the present invention there is disclosed a pair of spectacles provided with a frame and a pair of combined lenses carried by the frame, each combined lens having an adjustable focal length and comprising two lens elements arranged one behind the other along an optical axis of the combined lens, and an adjustment mechanism arranged to move the two lens elements laterally relative to one another to vary the focal length, each lens

element being movable in a direction opposite to the other lens element and transverse to the optical axis of the lens elements whereby the optical axis remains substantially fixed relative to the frame. The adjustment mechanism comprises at least one frame-connected rotatable element engaging at least one lens element for urging a lateral movement of the at least one lens element.

[0008] The adjustment mechanism preferbaly comprises at least one control lever pivotally connected within the frame of the spectacles for transferring a lateral movement of one lens element of the combined lens to a lateral movement of the other lens element in the opposite direction. The control lever may be connected to an outer edge of each lens element of a combined lens. When the rotatable element is turned, one of the lens elements is moved in a lateral direction, and the lever to which it is connected is rotated around its pivot which results in lateral movement of the other lens element in the opposite direction. If each lens element is correctly shaped, this will lead to the optical axis remaining in the same relative position with respect to the frame. By moving both lens elements in directions opposite to each other, the focal length of the combined lens is adjusted.

[0009] The rotatable element is preferably circular, for example substantially shaped as a wheel, with an edge of the wheel engaging an edge of at least one lens element. A central axis of the rotatable element may be connected to the frame of the spectacles to permit rotation. The edge of the wheel may engage the outer edge of the lens element by friction between the touching surfaces. The manner in which the friction is realised can be different, for example smooth or roughened surfaces touching each other to generate sufficient friction to cause lateral movement of the lens element when the rotatable element is rotated. The rotatable element may include a toothed wheel which engages an edge of at least one lens element having corresponding teeth. Other rotatable elements are also possible, like a sliding element engaging the lens element at its outer edge.

[0010] The rotatable element may comprise at least a first portion and a second portion, wherein the first portion engages the lens element and the second portion has an adjustment portion adjacent to an edge of the frame for manual adjustment of one of the combined lens. The second portion is used for adjustment of the leneses by hand, by turning the rotatable

element. The first portion is used for transferring the rotation of the rotatable element to the lens element. By changing the diameters of the two portions, the precision of adjustment of the lenses can be varied. For example, when the first portion engaging the lens element has a smaller diameter than the diameter of the second portion used for adjustment by hand, a relatively small lateral movement of the lens element will result from a relatively large rotation of the rotatable element. This makes it easier to achieve precise adjustment of the lenses.

[0011] The rotatable element is preferably at least partially enclosed by the frame of the spectacles. The rotatable element is preferably positioned within the frame so that it is virtually out of sight when looking at the spectacles from the front. This improves the appearance of the spectacles, reduces the chances that it will be unintentionally moved when no adjustment of the spectacles is intended, and protects the mechanism from dirt and moisture. The rotatable element is preferably positioned so that at least 75% of the rotatable element is hidden inside the frame. The rotatable element for each combined lens may be positioned at a bottom edge of the frame below the combined lens. This places the adjustment mechanism where it can be conveiently adjusted, for example using a thumb to rotate one or both of the rotatle elements to adjust the combined lenses.

[0012] The control lever is preferably pivotable at its centre about a fixed point within the frame and connects with the two lens elements adjacent to its respective ends. In this configuration, the two lenses of each combined lens may be moved by equal amounts in opposite directions when adjusted. This configuraiton assists in achieving adjustment of the focal length of the lenses while maintaining the focal axis of the lenses in a stationary position with respect to the frame.

[0013] At least one stud is placed within the frame of the spectacles surrounding the at least two lens elements for support and guidance for lateral movement of the lens elements. The small studs or beams may extend in a direction substantially perpendicular to the plane of the lens, parallel to the optic axis. The studs do not impede lateral movement of the lens elements, but can aid in guiding the lateral movement and providing structural support for the spectacles.

[0014] The lens elements may have planar surfaces that face one another in an abutting relationship. In the past, adjustable focal length lenses have been known in which each lens has a planar surface and a curved surface and where the curved surfaces have been arranged facing one another. In such an arrangement the lens that performs selective refraction is effectively an air gap of variable shape between the two lenses. The presently proposed arrangement places the planar surfaces of the lenses together whereby the selective refraction of the light takes place primarily at the two outer surfaces. During adjustment, the planar surfaces may slide against one another. In a particular embodiment related to the first embodiment of the invention the lens elements may be separated by a film of liquid or gel, preferably a high viscosity liquid or gel, e.g. a silicone oil or gel. The close spacing of the lenses is believed to be advantageous in preventing the entry of dirt and particles in between the lenses. The high viscosity liquid assists to lubricate the interface between the lens elements and provide a stick slip effect to keep the position of the lens elements fixed against unintended adjustment of the lens. The liquid also assists in preventing dust from entering between the lens elements, and may be selected to reduce the changes in refractive index as light passes through the lens elements and the gap between them and improve light transmission between the lens elements.

[0015] One or more guide rails may be provided which connect the two lens elements together and guide their lateral movement. By providing a guide rail as part of the combined lens an improved guiding structure may be achieved which may be independent of the shape of the frame. Furthermore, the lenses may be more easily joined together prior to insertion in the frame and may be held more firmly together as a unit. In particular, the guide rail is moveable with respect to the frame and can move together with one or both of the lens elements. In this context, a guide rail is intended to include any structure that serves to guide one lens element with respect to the other in a lateral direction. In general the guide rail will be straight, although curved or angled guide rails are not excluded. At least part of the guide rail may be carried by one of the lens elements and may have a channel cross-section which receives a complementary protrusion or protrusions carried by the other lens element. The complementary protrusion may also be in the form of a rail which fits into the channel.

Alternatively, the protrusion may be in the form of one or more pegs or followers of appropriate size to be guided by the channel.

[0016] The guide rail may be formed to connect the lens elements as a click connection. In the case that the guide rail is a channel arranged on a first lens element, it may have a C-shaped section that links with a mushroom shaped protrusion or rail on the other element in a snap-fit arrangement. The skilled person in the field of plastic moulding will be well aware of the necessary shapes and tolerances required to achieve such a snap or click connection. Joining the lens elements together may thus be relatively simple. It will be understood that as an alternative to a click connection, the two lens elements may be joined by sliding a follower laterally onto the guide rail. This manner of connection may be used for a dove-tail like embodiment.

[0017] The use of such a guide rail allows it to be integrally formed with at least one of the lens elements. This is particularly simple if the lenses and rail are made by injection moulding techniques. In the past, lenses were formed of glass and precision ground to the desired shape. Modern adjustable focal length lenses may be made with sufficient accuracy for a fraction of the cost by injection moulding. A preferred material for such a procedure is polycarbonate although the skilled person in this field will be well aware of alternatives and there advantages.

[0018] There may be provided at least two guide rails arranged adjacent to upper and lower edges of the lenses. The rails are arranged parallel to one another and ensure both improved guiding and also better retention of the lenses. The top and bottom guide rails may be identical. Alternatively, one of the rails may be for guiding while the other additionally provides for connection of the elements e.g. by incorporating a click connection as described above.

[0019] In order to adjust the focal length of each combined lens, the adjustment mechanism may comprise at least one movable actuator external to the frame. The moveable actuator may be gripped by a user and moved until a desired focal length is achieved. Preferably the actuator passes through the frame in a manner in which the entry of dust and dirt is prevented, e.g. through a seal. The actuator may be relatively discreet such that it is not seen during use

and also such that it is not easily disturbed, whereby the focus would be upset. Alternatively, the actuator may be arranged for removal after initial setting such that the focus is then fixed and cannot further be adjusted.

[0020] In a form of the adjustment mechanism there is provided a lever, which is pivotable at its centre about a fixed point on the frame and connects adjacent its respective ends with the two lens elements. The lever can then rotate about its pivot to cause respective movement of the two lens elements in opposite lateral directions. If each lens element is correctly shaped, this will lead to the optical axis remaining in the same relative position with respect to the frame. Although a moveable actuator may be located at any position within the lens-lever mechanism, a preferred location for the actuator is at one end of the lever. This may thus protrude outwardly through the frame and may be provided with a knob or grip for manual actuation.

[0021] The adjustment mechanism can preferably be blocked by a blocking arrangement to prevent unintentional changes to the lens positions. This allows the lens elements to be set in a chosen position and ensures that they remain in that location. The blocking arrangement may comprise interlocking teeth located on the frame, preferably on an internal surface thereof. The locking teeth may interact with further teeth located on the adjustment mechanism. The skilled person will understand that although reference is given to teeth, at least on one of the interacting parts, a single tooth may be provided. The blocking arrangement may also comprise a spring loaded element arranged to engage and disengage with the interlocking teeth. This spring loaded element is preferably provided on the adjustment mechanism.

[0022] The present invention is not limited to its different embodiments but certain or all features of each embodiment can also be combined in any way to improve either functionality, fashion or other outstanding features of the spectacles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The features and advantages of the invention will be appreciated upon reference to the following drawings showing embodiments of the invention, in which:

[0024] FIG. 1 is a perspective view of a pair of spectacles according to a first embodiment of the invention with moveable actuators;

[0025] FIG. 2 is a plan view of one combined lens from the spectacles of FIG. 1;

[0026] FIG. 3 is a section through the combined lens of FIG. 2 along line 3-3;

[0027] FIG. 4 is a perspective view of the combined lens of one of the lenses of FIG. 1;

[0028] FIGS 5-7 are cut-away views of the spectacles of FIG. 1 showing operation of the combined lens;

[0029] FIG. 8 is a plan view of part of the frame of FIG. 1;

[0030] FIG. 9 is a perspective view of a pair of spectacles according to a second embodiment of the invention with a rotatable element;

[0031] FIG. 10 is a cut-away view of half of the spectacles of FIG. 9 showing the rotatable element and the control lever;

[0032] FIG. 11 is a perspective view of the connection of the control lever with the two lens elements in more detail;

[0033] FIG. 12 is a cut-away view of the rotatable element showing in more detail the connection to the different diameters and the connection to one of the lens elements; and

[0034] FIG. 13 is a cut-away view of the spectacles of FIG. 9 showing the interaction of two rotating elements with the combined lens;

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0035] The following is a description of certain embodiments of the invention, given by way of example only and with reference to the drawings. Referring to FIG. 1, there is shown a pair of spectacles 1 according to a first embodiment of the invention. Spectacles 1 include a frame 2 having arms 4 pivotally attached thereto at hinges 6 in a conventional manner. The frame 2 carries combined lenses 8A and 8B. Combined lenses 8A, 8B are of adjustable focal length as will be described here below. Adjustment of the focal length takes place using moveable actuator 10A, 10B located on an upper edge of the frame 2. For better

understanding, the actuator is shown to be relatively large, although the skilled person will understand that in actual practice it may be significantly smaller as it needs only be used infrequently. Furthermore, although shown externally to the frame 2, the actuator may be located within the frame 2 and may be actuated using a suitable tool. The combined lenses have optical axes 12A, 12B. During adjustment of the focal length as will be described below, the relative positions of the lens axes 12A and 12B remain substantially constant. This is important, since for correct vision, the optical axis should align substantially with the distance between a wearer's eye centres.

[0036] FIG. 2 shows a plan view of a possible embodiment for the combined lens 8A of FIG. 1. The lens comprises two lens elements 14, 16 located one in front of the other. Each lens element 14, 16 has a graduated surface 18 and a planar surface 20. The planar surfaces 20 abut against one another in a face-to-face relation. A thin film 22 a high viscosity liquid may be used between the two lens elements. This liquid may assist to lubricate the interface between the lens elements and provide a stick slip effect to keep the position of the lens elements fixed against small knocks causing unintended adjustment of the lens. The liquid also assists in preventing dust from entering between the lens elements, and may be used to reduce effects of changes in refractive index as light passes through the lens elements and the gap between them and improve light transmission between the lens elements. Adjustment mechanism 24, comprising lever 40 and pivot 42, is attached to lens elements 14, 16 by lugs 44, 46. As will be further described below, displacement of the adjustment mechanism 24 causes lens element 14 to move in direction X and lens element 16 to move an equal distance in direction Y, and vice versa. A combined lens 8A may also be made with the lens elements having a curved surface in a face-to-face relation rather than a planar surface, or lens elements with both surfaces having a graduated surface.

[0037] FIG. 3 is a cross-sectional view through combined lens 8A along the line 3-3 of FIG. 2 where the lens includes a guide element. As may be seen, in this embodiment the lens element 16 has a guide channel 28 adjacent to an upper edge 30 of the lens 8A. The guide channel 28 receives a complementary protrusion 32 on lens element 14. The guide channel 28 is C-shaped in cross-section and the protrusion 32 has a slightly mushroom shape. Both the

channel 28 and protrusion 32 extend over substantially the full lateral width of their respective lens element 14, 16 and function as a guide rail. Additionally, due to the C-shaped cross section, the guide channel 28 also serves to hold the lens elements 14 and 16 together. Adjacent a lower edge 34 of the combined lens 8A, both lens elements are provided with interfacing guide rails 36, 38. Guide rails 36, 38 are of partially dove-tailed cross-section and also extend over the full width of the lens. The skilled person will recognize that there is no necessity for each rail, channel or protrusion to extend over the full width given that the required guiding function is adequately achieved, that the C-shaped and dove-tailed guide elements may be used together or separately or other shapes or types of guide elements may be used, or that the guide elements may be omitted altogether, particularly when the frame 2 adequately performs a guiding function.

[0038] FIG. 4 depicts the combined lens 8A in perspective view illustrating the interaction between the guide channel 28, protrusion 30 and guide rails 36, 38 and showing the adjustment mechanism 24. As can be seen, the adjustment mechanism comprises a lever 40 having a pivot 42 close to its centre. At the uppermost end of the lever 40 is provided an actuator 10B. A lug 44 is located at an upper part of the lever 40 and connects to the lens element 14. Another lug 46 (partially obscured) is located at a lower end of the lever 40 and connects to the lens element 16. The lugs 44, 46 may be connected to the lens elements in various ways of which the skilled person will be familiar. Most preferably, the connection will be a pin and hole connection allowing relative rotation. The pin may be integrally moulded with the lens elements and the lug may be recessed slightly into the lens element in order to reduce the space required within the frame 2.

[0039] Operation of the adjustment mechanism 24 will be further described with reference to FIGS 5-7. According to FIG. 5, there is shown the combined lens 8B of FIG. 4, viewed in the direction of sight of a user. The lens 8B is mounted in the frame 2, which is partially cut away to reveal the adjustment mechanism 24. Pivot 42 is mounted on a pin 50 provided within the frame 2. The pin 50 may be integrally moulded with the frame 2 or may be a separate part, e.g. a metal pin used in a plastic frame. The pin 50 allows the lever 40 to rotate at the pivot 42. The guiding channel 28 and rails 36, 38 are indicated adjacent the upper and

lower edges 30, 34 respectively. In the position according to FIG. 5, the actuator 10B is in a neutral position and the lever 40 is substantially vertical. This may correspond to a setting of the lens elements with a diopter of -3.

[0040] In FIG. 6, the actuator 10B has been moved to the right, causing the lever 40 to rotate clockwise around pin 50. Lug 44 pushes lens element 14 towards the right. Lug 46 pulls lens element 16 an equal amount towards the left. This causes the diopter of the combined lens 8B to increase to a value of up to – 6.

[0041] In FIG. 7, the actuator 10B has been moved in the opposite direction towards the left. This causes the lever 40 to rotate in an anti-clockwise direction. In this case, lug 44 pulls lens element 14 towards the left while lug 46 pushes lens element 16 an equal amount towards the right. This causes the diopter of the combined lens 8B to decrease to a value of around -0.5. Adjustment of the combined lens 8A takes place in a similar way.

[0042] FIG. 8 shows a top view of a portion of the frame 2 with the actuator 10B removed. An upper part of the lever 40 protrudes through the frame 2 via a slot 52. The slot 52 is provided with optional interlocking teeth 54 along one of its sides and a resilient seal 56 along the opposite side. The lever 40 may be also provided with a number of teeth 58. In use, the resilient seal presses the lever 40 against the side of the slot 52 causing the teeth 58 to engage with the interlocking teeth 54. Once engaged, the teeth 54, 58 prevent undesired movement of the adjustment means. In order to adjust the focal length of the combined lens 8B, the actuator 10B must be moved against the pressure of the seal 56 in the direction of arrow Z. The seal 56 also helps to keep the slot 52 closed, preventing the introduction of dirt into the frame 2 interior.

[0043] FIG. 9 shows a pair of spectacles 1 according to a second embodiment of the invention. Spectacles 1 include a frame 2 having arms 4 pivotally attached thereto at hinges 6 in a conventional manner. The frame 2 carries combined lenses 65A and 65B of adjustable focal length. These may be constructed according to the first embodiment and with some or all of the features described above and shown in FIGS. 2-4, but with an adjustment mechanism as will be described below. Adjustment of the focal length takes place by turning rotatable elements 60A and 60B. Note that the rotatable elements 60A and 60B are depicted

in the drawings as having a relatively large size, but in practice they may be significantly smaller as they need only be used infrequently. Rotatable elements 60A, 60B may be made sufficiently small and recessed within the frame so that they protrude below the edge of the frame by only a small amount or do not protrude at all. This prevents the rotatable elements from resting against the cheeks of the wearer or otherwise becoming an obstruction, and hides the rotatable elements from view so that the spectacles have an attractive appearance and the adjustment mechanism is hidden and does not spoil the look of the spectacles. The combined lenses have optical axes 12A, 12B. During adjustment of the focal length as will be described below, the relative positions of the lens axes 12A, 12B remains substantially constant. This is important, since for correct vision, the optical axis should align substantially with the distance between a wearer's eye centres.

[0044] FIG. 10 shows a rear view (from the wearer's point of view) of half of the pair of spectacles 1, divided by separation line A-A' and dissecting the frame to show the internal structure. One lens element 66A is connected to the control lever 62 at connection point 62A and one lens element 66B is connected to 62B. The control lever 62 pivots around point 62C mid-way between connection points 62A and 62B. Via this construction, a lateral movement of one lens element will induce a lateral movement of the other lens element in the opposite direction. Preferably the lateral movement of each lens element is equal and the lens axes are maintained in the same position relative to the frame.

[0045] Lens element 66A interacts with rotatable element 60A via interlocking teeth 68 and 70A, with teeth 68 formed on a lower edge of lens element 66A and teeth 70A formed on rotatable element 60A. Thus, rotation of the rotatable element 60A is translated into lateral movement of the lens elements 66A. In this embodiment, rotatable element 60A has two portions having different diameters, with teeth 70A formed on the inner smaller diameter portion 72A and teeth 70B forming an adjustment portion on the outer larger diameter portion 72B. The lower portion of rotatable element 60A protrudes slightly below the bottom edge of the frame so that teeth 70B are accessible to the user to manually turn the rotatable element 60A, This can most conveniently be achieved with the user's thumbs engaging with teeth 70B. The rotatable element may also be positioned so that its lower portion with teeth 70B

does not protrude below the frame but is slightly recessed, so that but the user's thumb (or finger) is still able to engage with the teeth by pressing against the lower edge of the frame. Rotatable element 60A rotates about pin 61, which is connected to the frame 2.

[0046] Also shown are a number of studs 3, which protrude inwards from the frame portion 2a to support the lens elements while permitting lateral movement of the lens elements. The number of studs 3, which can be applied to the spectacles 1, is not limited to the number shown in FIG. 10. Nor are the dimensions of the elements limited to the dimensions of the elements used in FIG. 10.

[0047] FIG. 11 shows in more detail a perspective view of the two lens elements 66A and 66B and how they are connected to the control lever 62. The control lever 62 is pivotally connected by a pin 74 going through the central axis hole 62C of the control lever 62. The pin 74 is connected to the frame portion 2a of the spectacles 1. The pin 74 and the central axis hole are aligned along axis line X1. Lens element 66A is pivotally connected to control lever 62 by pin 76C through hole 62A of the control lever 62 and a hole 76A in a protrusion 78A connected to lens element 66A. Both holes 62A and 76A and pin 76C are aligned along axis line X2. Lens element 66B is pivotally connected to control lever 62 by a pin 76D through hole 62B of the control lever 62 and a hole 76B in a protrusion 78B connected to lens element 66B. Both holes 62B and 76B and the pin 76D are aligned along axis line X3. The dimensions of the holes 62A, 62B, 62C, 76A, 76B, the control lever 62, the protrusions 78A and 78B, the pins 74, 76C 76D, and the lens elements 66A and 66B, as the frame 2 of the spectacles 1 are not limited to the dimensions or arrangement shown in the drawings.

[0048] To adjust the spectacles, the user turns the rotatable element 60A which acts to move the lens element 66A laterally. When lens element 66A moves laterally to the right, control lever 62 rotates counter clockwise, thus urging lens element 66B to move laterally to the left by a corresponding amount, as can be appreciated from FIG. 11. Similarly, lateral movement of lens element 66A to the left will result in moving lens element 66B to the right.

[0049] FIG. 12 shows a cross sectional view through the axis of the rotatable element 60A, showing in more detail the different portions 61A and 61B of the rotatable element, and the connection of lens element 66A with the rotatable element 60A both located within the frame

2 of the spectacles 1. The axis of the rotatable element 60A is shown as axis line X4. The rotatable element 60A has two portions 72A and 72B with different diameters , with portion 72A being smaller in diameter than 72B. Portion 72A has teeth 70A which interlock with teeth 68 attached to or formed on lens element 66A. Portion 72B also has an adjustment portion 70B for manually rotating the rotatable element for adjusting the focal length. The adjustment portion 70B may comprise teeth, or a roughened or smooth surface suitable for manual adjustment. Portions 72A and 72B are rotatably connected to the frame 2 via pin 61. The shape and the distances between the elements are not limited to those shown in FIG. 12.

[0050] When the user adjusts the spectacles by turning the rotatable element 60A, portion 72A and 72B rotate together, but the difference in diameter between the two portions results in the lens element being moved over a relatively small distance compared to movement of the adjustment portion 70B, so that a fine adjustment of the lens can be made by a relatively coarse adjustment of the rotatable element 60A. By varying the diameter ratio of the two portions, the adjustment precision, in terms of relative lateral displacement of the lens element, can be controlled. Though only two portions 61A and 61B are shown in FIG. 12, the invention is not limited to only two or a minimum of two. For example, a combination of rotatable elements may be utilised such as interlocked rotatable elements 80 and 90 placed in a relatively inclined line D-D' drawn through their axis 81 and 91 as shown in FIG. 13.

[0051] The adjustment mechanism has been described for one combined lens, but it should be understood that each combined lens is provided with an adjustment mechanism so that both lenses can be individually adjusted to suit each eye of the wearer.

[0052] Thus, the invention has been described by reference to certain embodiments discussed above. It will be recognized that these embodiments are susceptible to various modifications and alternative forms well known to those of skill in the art, and features described for one embodiment of the invention may also be used for the other embodiment. For example, the lens elements of the second embodiment may have a graduated surface and a planar surface, with the planar surfaces abutting against one another in a face-to-face relation. A thin film a high viscosity liquid or gel may be used between the two lens elements (whether they have abuting planar surfaces or not), to lubricate the interface between the lens

elements and provide a stick slip effect to keep the position of the lens elements fixed against unintended adjustment of the lens. The liquid or gel may be selected to more closely match the refractive index of the lens elements to improve light transmission through the lens. Although a generally rectangular lens shape has been depicted, the lenses and frame 2 may be modified to various shapes including round, oval and oblong.

[0053] Further modifications in addition to those described above may be made to the structures and techniques described herein without departing from the spirit and scope of the invention. Accordingly, although specific embodiments have been described, these are examples only and are not limiting upon the scope of the invention.

WHAT IS CLAIMED IS:

1. Spectacles (1) provided with a frame (2) and a pair of combined lenses (66A, 66B) carried by the frame (2), each combined lens (8, 66) having an adjustable focal length and comprising:

two lens elements (8A, 8B, 66A, 66B) arranged one behind the other along an optical axis (Y1, Y2) of the combined lens (8, 66); and

an adjustment mechanism arranged to move the two lens elements (8A, 8B, 66A, 66B) laterally relative to one another to vary the focal length, each lens element (8A, 8B, 66A, 66B) being movable in a direction opposite to the other lens element (8A, 8B, 66A, 66B) and transverse to the optical axis (Y1, Y2) of the lens elements (8A, 8B, 66A, 66B) whereby the optical axis (Y1, Y2) remains substantially fixed relative to the frame (2); the adjustment mechanism comprising:

at least one frame-connected rotatable element (40, 60A, 60B) engaging at least one lens element (8A, 8B, 66A, 66B) for urging a lateral movement of the at least one lens element (8A, 8B, 66A, 66B).

2. Spectacles according to claim 1, characterised in that the adjustment mechanism comprises at least one control lever (44, 46, 62) pivotally connected within the frame (2) of the spectacles (1) for transferring a lateral movement of one lens element of the combined lens to a lateral movement of the other lens element in the opposite direction.

3. Spectacles according to claim 2, characterised in that the control lever is connected to an outer edge of each lens element of a combined lens.

4. Spectacles according to claim 1 or 2, characterised in that the rotatable element (60A, 60B) is substantially shaped as a wheel, wherein an edge of the wheel engages an edge of at least one lens element.

5. Spectacles according to any one of the preceding claims, characterised in that the rotatable element (60A, 60B) includes a toothed wheel which engages an edge of at least one lens element having corresponding teeth.

6. Spectacles according to any one of the preceding claims, characterised in that the rotatable element is substantially circular with a central axis, wherein the central axis is pivotally connected to the frame of the spectacles.

7. Spectacles according to any one of the preceding claims, characterised in that the rotatable element has at least a first portion (61A) and a second portion (61B), wherein the first portion (61A) engages the lens element and the second portion (61B) has an adjustment portion (70B) adjacent to an edge of the frame for manual adjustment of one of the combined lens.

8. Spectacles according to any one of the preceding claims, characterised in that the rotatable element is at least partially enclosed by the frame of the spectacles.

9. Spectacles according to any one of the preceding claims, characterised in that the rotatable element for each combined lens is positioned at a bottom edge of the frame below the combined lens.

10. Spectacles according to any one of the preceding claims, characterised in that the control lever is pivotable at its centre about a fixed point within the frame and connects with the two lens elements adjacent to its respective ends.

11. Spectacles according to any one of the preceding claims, characterised in that at least one stud (3) is placed within the frame of the spectacles surrounding the at least two lens elements for support and guidance for lateral movement of the lens elements.

12. Spectacles according to any one of the preceding claims, characterised in that each combined lens comprises at least one guide rail (36, 38) which connects the two lens elements together and guides their lateral movement.

13. Spectacles according to claim 11, characterised in that at least part of the guide rail is carried by one of the lens elements and has a channel cross-section (28) which receives a complementary protrusion (32) carried by the other lens element.

14. Spectacles according to any preceding claim, characterised in that the adjustment mechanism can be blocked by a blocking arrangement to prevent unintentional changes to the lens positions.

15. Spectacles according to claim 15, characterised in that the blocking arrangement comprises interlocking teeth located on the frame.

16. Spectacles according to any of the previous claims, characterised in that the lens elements have planar surfaces that face one another in an abuting relationship.

17. Spectacles according to any of the previous claims, characterised in that the lens elements are separated by a film of liquid or gel.

18. Spectacles according to claim 17, characterised in that the liquid or gel separating the lens elements comprises a high viscosity liquid or gel.

19. Spectacles according to claim 17 or 18, characterised in that the liquid or gel separating the lens elements provides a stick slip effect to maintain the position of the lens elements against unintended adjustment.

20. Spectacles according to any one of claims 17-19, characterised in that the liquid or gel separating the lens elements of the lens is adapted to reduce the changes in refractive index of light passing through the lens elements and the gap between them.

21. Spectacles according to any preceding claim, characterised in that the lenses are of polycarbonate.

INTELLECTUAL PROPERTY OFFICE

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Claims searched:	1-21	**Date of search:**	2 March 2012

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-3 at least	US2008/030678 A1 (VERENIGING VOOR CHRISTELIJK HO) see the figures and paragraphs 19-21
X	1-3 at least	WO2006/098618 A1 (STICHTING FOCUS ON VISION) see figures 1-3 especially
X	1 & 3 at least	US2007/091257 A1 (QUEXTA INC) see figures 7a-b and paragraphs 150-151
X	1-2 at least	JP02296212 A (TOYO MEDICAL KK) see abstract and figures 2-3
X	1 & 3 at least	GB2477264 A (GICI LABS LLP) see figures 10-15 and page 18, fifth paragraph
X	1 & 3 at least	US2010/165288 A1 (SHIM YOUNGTACK) see figures 1a-d and paragraphs 204-205

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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G02B

The following online and other databases have been used in the preparation of this search report

Online: EPODOC, WPI

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International Classification:

Subclass	Subgroup	Valid From
G02C	0007/08	01/01/2006