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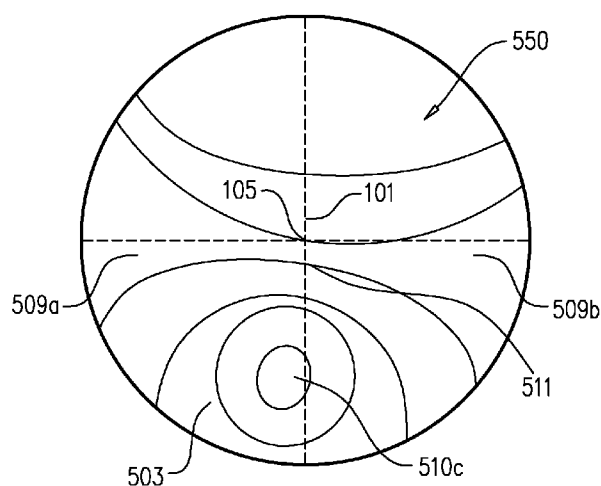


FIG. 5B

(57) **Abstract:** An ophthalmic lens is presented being configured for a user's prescribed optical power P_0 for far vision correction. The lens comprises: a fitting position; a first region corresponding to a far measuring position having the prescribed optical power P_0 a second region corresponding to a near measuring position. The lens is configured with an optical power addition profile such that an optical power, P_f , at the fitting position, located at a distance D_f not exceeding 10 millimeters below the far measuring position, is different from the optical power P_0 by di , being $0.3D \leq di \leq 0.8D$ (D is diopter). The optical power addition profile thereby providing an improved intermediate distance vision of the lens.



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OPHTHALMIC LENS

TECHNOLOGICAL FIELD

The invention is in the field of optical lens design and is relevant for ophthalmic lenses configured for use in near, intermediate and far viewing distances.

BACKGROUND

5 Ophthalmic lenses are widely used to provide vision assistance to wearers by correcting various refractive errors, which are the most frequent eye problems encountered by individuals of all ages. Refractive errors include (i) myopia or near-sightedness, a condition in which objects at a far distance (e.g., at a distance greater than 20 feet) appear blurred; (ii) hyperopia or farsightedness in which in which objects at a
10 near distance (e.g., at a distance less than 2 feet) appear blurred; (iii) astigmatism in which objects at near distance, far distance as well as intermediate distance appear blurred; and (iv) presbyopia that includes loss of the ability of the eye to focus on near objects. These and other refractive errors can be corrected, for example, by ophthalmic lenses such as those used in eyeglasses.

15 Various vision impediments of an individual, such as near-sightedness, far-sightedness, astigmatism can be corrected using lenses with suitable prescribed optical power for far vision. However, individuals in their day-to-day activity observe objects and scenes located in various distances, from near distance (e.g. during reading), intermediate distance (e.g. during computer and office work) to far distance. The
20 individual's eye sight can adjust itself to view objects at near distances using the eyes ability to vary its optical power and thus focus onto objects at different distances.

Various conditions, such as aging of the eye, might result in reduced flexibility of eye lens (crystalline lens) and difficulty of focusing on objects at near distances. Prescriptions for presbyopes can contain one prescribed optical power for far vision, and
25 another, different, prescribed optical power for near vision. To this end, multifocal lenses

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may be used to provide the presbyopic eyeglasses wearer with a single eyeglasses for their normal daily routine. Generally, a multifocal lens includes two or more regions of different optical powers to help an individual see objects at all distances after the individual loses the ability to naturally change the focus of his/her eyes due to age.

5 Presbyopic patients can also benefit from progressive multifocal lenses, or progressive addition lenses (PALs) that can correct near, intermediate and far vision. PALs provide gradual variation of optical power between the prescribed optical power for far distances and the prescribed optical power for near distances. More specifically, PAL is designed to define far and near vision zones of the individual's prescribed optical
10 powers for far and near vision corrections, and a so-called "progressive corridor" zone between them, along which the optical power addition gradually varies to permit uninterrupted vision for intermediate distances. Generally, the positions of the lens' zones intended for far and near viewing distances are determined by estimated line of sight of the wearer for common uses such as walking for far viewing distance and reading for near
15 viewing distance.

Over the past few decades, together with the increase in use of computers, the use of intermediate viewing distance (typically between 50-60 centimeters (cm) and up to 3 meters (m)) is increasing, which often requires optical power different than that suitable for far or near viewing distances. In many cases a user/wearer of glasses may need to
20 change pairs of spectacles at high frequency, together with moving center of attention from a computer screen to a person standing in front of him and *vice versa*. Various lens designs aim to provide suitable configuration of optical power variation across the lens to provide a single lens capable of providing the optical powers required by many wearers for various uses, in order to reduce the wearers' need for changing spectacles and allow
25 the use of a single pair of glasses for various applications. Office type PAL designs are available from various lens design suppliers including, for example, Essilor Digitime, Zeiss OfficeLens, Hoya TACT, Workstyle V+, Rodenstock Ergo, and Seiko PC Wide which are generally commercially available and provide a single lens design for both intermediate and near viewing distances.

30 US Patent No. 5,710,615 describes a progressive power multifocal lens designed by attaching importance to an intermediate vision and a near vision in such a manner as to ensure broad intermediate vision viewing portion and near vision viewing portion and to have a well-balanced viewing zone among the distance, near and middle portions,

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whereby a resultant image of an object is little varied or fluctuated, especially, in lateral directions.

GENERAL DESCRIPTION

As indicated above, many eye-glasses wearers typically utilize far vision
5 correction (optical power prescribed for far vision), while utilizing the accommodative capability of the eyes to focus on objects that are relatively close (i.e. at near vision distance of 30-50 centimeter and/or intermediate distance between 50-60 centimeters (cm) and up to 3 meters (m)).

Also, as indicated above, office type PAL designs are commercially available and
10 provide a single lens design for both intermediate and near viewing distances. However, the trade-off in these lenses is a limited far zone, in terms of optical power and location within the lens and most designs are limited to the range of 1 – 3 m.

The present invention provides a novel approach for the ophthalmic lens configuration, which is aimed at significantly improving mid distance vision (e.g., for
15 computer and smartphone use). The principles of the invention can be applied to a single-vision lens as well as to a progressive addition lens (PAL), i.e. the invention provides for significantly improving the mid distance vision while maintaining prescribed far vision correction and maintaining good near vision (in case of the single-vision lens), or maintaining prescribed far and near vision corrections (in case of PAL). In this
20 connection, it should be understood that an ophthalmic lens configured according to the present invention may be designed for individuals who mainly require far vision correction, or individuals requiring both far and near vision corrections. In other words, the lens has prescribed far vision optical power, while may or may not have specifically prescribed optical power for the user for near vision. Also, the lens' design provides for
25 reducing effort needed from the wearers' eyes in passing between far, intermediate and near vision zones.

The above is achieved in an ophthalmic lens of the invention by a novel configuration of an optical power addition profile across the lens. In this connection, the following should be noted: An ophthalmic lens typically has a first region corresponding
30 to, and located around, a far measuring position (**FMP**) mainly used for far vision, and a second region of the lens corresponding to a near measuring position (**NMP**) on the lens surface mainly used for near vision; and also has a fitting position (**FP**).

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The fitting position **FP** is a point of intersection of a line of sight for a user with the lens surface. Thus, the term “fitting point” or “fitting position” **FP** relates to a point on a lens as mounted in a spectacle frame, aligned with the patient's center of the pupil in its distance viewing position when the patient is looking straight ahead. In the conventional “single vision” lens’ design, the **FP** practically coincides with the **FMP**. In the conventional PALs, the **FP** although being distanced from the **FMP** has practically no optical power addition with respect to the **FMP**.

It should be understood that the above mentioned far and near measuring positions **FMP** and **NMP** correspond to geometric locations on the lens surface typically used by a user when observing far and near located objects. The **NMP** (also sometimes termed as the near reference point), is used herein consistently as set forth in ANSI 3.21.3 standard and indicates the point on a lens as specified by the manufacturer at which the addition of power is measured.

However, as indicated above, the lens of the present invention may be designed for an individual requiring only far vision correction. Therefore, the terms “*far measuring position*” (**FMP**) and “*near measuring position*” (**NMP**) should be properly distinguished from the terms “*far vision distance*” and “*near vision distance*”, as well as “*far vision correction*” and “*near vision correction*”. More specifically, in some embodiments of the invention the optical power addition profile of the lens is also configured to provide near vision optical power correction in accordance with the user’s prescription thus resulting in a progressive addition lens (PAL) configuration; while in some other embodiments, the optical power addition profile of the lens is configured to serve as a generally “single vision” lens having prescribed optical power only for the far vision distance.

The inventors of the present invention have found that designing an optical power addition profile of the lens such that the far measuring position **FMP** is properly distanced from a fitting position **FP** and that at the fitting position **FP** the lens has a predetermined optical power addition as compared to that of the far measuring position **FMP**, can significantly improve the intermediate distance vision, while maintaining good far and near vision properties of the lens.

Thus, the ophthalmic lens of the present invention, which is configured for a user’s prescribed optical power P_0 for far vision correction, includes: a fitting position **FP**; a first region corresponding to a far measuring position **FMP** having the prescribed

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optical power P_0 and being located at a distance D_l not exceeding 10 millimeters (mm) above the fitting position **FP**; a second region corresponding to a near measuring position **NMP**, wherein the lens is configured with an optical power addition profile such that an optical power, P_f , at the fitting position **FP** is different from the prescribed optical power P_0 by d_i being $0.3D \leq d_i \leq 0.8D$ (D is diopter).

Considering an example of the invention, where the ophthalmic lens is designed as a generally “single vision” lens for far vision correction, the optical power addition profile across the lens is between 0.3 Diopter (D) and up to 1D, thus providing slight assistance enabling the wearer to view objects at near and intermediate distances over a single vision lens configuration with reduced eye accommodation amplitude. In this connection it should be noted that the term *single vision* as used for the purposes of the present application is to be interpreted broadly as relating to a lens having the prescribed optical power around the **FMP** and having optical power addition of no more than 1D. Such lenses are generally used to provide increased comfort to users and reduce eye strain and fatigue.

As described above, progressive addition lenses (PALs) provide optical power varying between the prescribed optical power for far vision P_0 in the far vision zone (at and possibly around the far measuring position **FMP**) and prescribed optical power P_n for near vision herein defined by corresponding optical power addition at the near vision zone (at and possibly around the near measuring position **NMP**). More specifically, the optical power at the near measuring position **NMP** is $P_n = P_0 + d_n$ where d_n is the optical power addition over the optical power P_0 , and typically $d_n > d_i$ irrespective of whether the near vision requires correction or not.

The inventors have found that there is a need for a lens providing effective optical characteristics for intermediate vision, while retaining functionality of at least the prescribed far vision correction required for far vision tasks.

The prescribed optical power is defined as the diopter correction required by the individual for a given set of eyewear. In this connection, it should be noted that such a prescription may be defined as the value measured by a lens-meter, while the lens is oriented with a zero tilt with respect to the lens-meter, or may be defined as the calculated ‘as worn’ prescription, which is the diopter correction required for the individual/patient to compensate for the tilt in the lens induced by the eyewear. Generally, the optical power

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prescribed for far vision P_o may be any optical power (typically ranging between +14D and -25D) in accordance with the wearer's requirements.

The ophthalmic lens of the invention provides a near vision zone (near vision measurement position) with optical power addition d_n selected to provide desired near vision optical power $P_n = P_o + d_n$ (either as prescribed for near vision correction or to enable suitable near vision for the wearer). For example, considering the generally "single vision" lens, the optical power addition profile within the surface of the lens may be configured to provide optical power addition d_n in a range of 0.25D and 0.8D (e.g. around 0.5D) measured at the **NMP**.

10 In addition to the near vision zone of the ophthalmic lens (being configured as single vision or PAL) the assisting features of the lens according to the present invention provide further variable optical power addition at an intermediate vision zone. The intermediate vision zone of the lens is a zone located between FMP and NMP and is generally suitable for use in an indoor office or driving setting, or for work with screens
15 such as computer screens and mobile devices. The intermediate vision zone provides optical power addition characterized by optical power addition d_i at the fitting position (FP) and selected to provide wearers with vision assistance and comfort when viewing objects at distances laying between the near vision and far vision as described in more details further below. Generally, according to some embodiments of the invention, the
20 optical power addition profile provides optical power addition d_i in a range of 0.3D and 0.8D. at the fitting position. More specifically, for single vision lens the optical power addition d_i may be in the range of 0.3D - 0.5D or 0.3D - 0.4D, and for PAL configuration d_i may be in the range of 0.3D - 0.8D, e.g. 0.4D - 0.8 D or 0.4D - 0.6D, or 0.3D - 0.6D.

Generally, in the conventional Office-Type PALs, addition of an intermediate
25 vision zone requires a trade-off limiting the far vision zone, in terms of absolute value of optical power and the zone size and location within the lens. Some existing designs can only provide vision correction for vision distances in the range of 1 - 3 meters and do not provide full far vision correction, or the far vision is located high above the FP (with FMP situated 10mm or higher above the FP). The ophthalmic lens of the present invention is
30 configured to provide far, near and intermediate zones at suitable locations within a range of eye comfortable gaze angles, as well as allowing to maintain proportions that enable the designed optical correction to fit into most conventional frames after edging.

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Thus, the present invention provides a novel lens configuration having a general prescribed optical power P_0 (e.g. for far vision correction) and an optical power addition profile selected for maintaining required near vision optical power (e.g. prescribed near vision correction or not) and an intermediate vision assistance. Corresponding measurement positions for far and near vision optical power and vertical profile of the optical power addition are configured to provide a region of the lens providing vision assistance for intermediate distances that is significantly better than that provided by the conventional lenses including single vision lenses and progressive addition lenses (PALs).

10 This allows an individual to utilize a single pair of glasses for viewing objects at far distances (over 3 meters and often more than 6 meters from the wearer) in accordance with the prescribed optical power P_0 , while providing good vision for near distances (typically 40 cm or less) and intermediate distances (typically between 50 cm and about 3 meters). Moreover, the lens of the present invention is configured to provide the optical power for far, near and intermediate vision at regions corresponding to gaze angles of observation selected in accordance with common use of the corresponding ranges. In this connection, it should be noted that near vision region is generally located at the lower part of the lens suitable for reading; far vision region is located at a top region of the lens suitable for viewing distant scenes (e.g. driving, walking, running), within the limits of comfort associated with tilt of gaze angle above and below the horizon; and intermediate vision region is located at the central region, between the far region and the near region of the lens, e.g. suitable for computer and/or mobile device use.

The ophthalmic lens of the present invention, configured as an improved single-vision lens or as an improved PAL, comprises a far measuring position (**FMP**), near measuring position (**NMP**) and a fitting position (**FP**) arranged within a primarily used region of the lens with respect to gaze angles of the user's eyes (effective region) to provide effective vision improvement for these three distance ranges, and is configured with a prescribed optical power for far vision and optical power addition of near and intermediate visions. The **FMP** is located at a distance that is equal or preferably less than 10 mm from the fitting position along the vertical axis (typically about 6 mm above the fitting position) and has an optical power P_0 as prescribed for the wearer for far vision (typically within the range of -25D to +14D). The optical power addition profile across

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the lens thus introduces a desired, vision assisting, optical power addition at the fitting position and at the **NMP**.

In the PAL configuration, the vertical addition power profile between the far and the near vision zones is configured to provide comfortable vision for intermediate
 5 distance objects such as computers, smart phones, tablets etc. The optical power addition d_i at the fitting position is generally in a range of 0.4D and 0.8D above the prescribed far vision power, and the optical power addition at the **NMP**, d_n , is selected to provide total optical power as prescribed to the user for near vision. The lens configuration of the invention may reduce various physiological computer vision related problems such as
 10 Computer Vision Syndrome.

In the single vision configuration, the optical power addition profile is selected to provide vision assistance to improve comfort and allow eye relaxation in use for near and intermediate distance vision. The optical power addition d_i at the fitting position is selected to be in a range of 0.3D - 0.5D and the optical power addition at the **NMP**, d_n , is
 15 selected to be in a range of 0.4D and 0.8D to provide additional comfort and reduce eye strain in focusing onto different near and intermediate distances.

Thus, the present invention in its one broad aspect provides an ophthalmic lens configured for a user's prescribed optical power P_0 for far vision correction, the lens comprising: a fitting position (FP); a first region corresponding to a far measuring
 20 position (FMP) having said prescribed optical power P_0 ; a second region corresponding to a near measuring position (NMP); wherein said lens is configured with an optical power addition profile such that an optical power, P_f , at said fitting position, located at a distance D_f not exceeding 10 millimeters below said far measuring position, is different from the optical power P_0 by d_i being $0.3D \leq d_i \leq 0.8D$ (D is diopter), said optical power
 25 addition profile thereby providing an improved intermediate distance vision of the lens.

In some embodiments, an optical power P_n at the **NMP** is determined as $P_n = P_0 + d_n$, wherein $d_n \geq 0.4D$.

The ophthalmic lens may be configured as a progressive addition lens, where an optical power addition d_i satisfies a condition $0.4D \leq d_i \leq 0.8D$, and an optical power P_n at
 30 the **NMP** is determined as $(P_0 + d_n)$ is selected as prescribed for the user's near vision correction. For example, the optical power addition d_i in such lens satisfies a condition $d_i = 0.5D \pm 0.12D$.

In some embodiments, optical power addition profile across a surface of the lens is configured such that the optical power addition does not exceed 1D. The optical power addition d_i may satisfy a condition $0.3D \leq d_i \leq 0.5D$ and optical power addition at the **NMP**, d_n , satisfies a condition $0.4D \leq d_n \leq 0.8D$. The fitting, far and near measuring positions may
 5 be arranged in a spaced-apart relationship along a line.

In some embodiments, the distance D_l between the far measuring position and the fitting position is $5 \leq D_l \leq 8$ mm.

In some embodiments, the optical power addition profile has a substantially linear portion in a zone between the far measuring position and the fitting position; and/or has
 10 a substantially linear portion in a zone between the **NMP** and the fitting position.

The lens may have a curvature profile selected to provide the above-described optical power addition profile. Such curvature profile may be defined by curvature variations in at least a back surface of the lens. Alternatively or additionally, the desired optical power addition profile curvature can be defined by curvature variations on the
 15 front surface of the lens, or on both the front and back surfaces of the lens. Alternatively or additionally, the desired optical power addition profile may be provided by a material composition of the lens providing a corresponding refractive index profile.

In some embodiments, a width W_f of the first region in which residual cylindrical aberration does not exceed 0.5D and the mean power does not deviate from the prescribed
 20 far power P_o by more than 0.25 D, is $6\text{mm} \leq W_f \leq 50$ mm. Such width W_f of the first region may be $35 \leq W_f \leq 50$ mm.

In some embodiments, a width W_n of the second region in which residual cylindrical aberration does not exceed 0.25D and the mean power does not deviate from the prescribed near power P_n (or 0.4 – 1.0 D when no near power is prescribed), by more
 25 than 0.25 D, is $3.5 \leq W_n \leq 13\text{mm}$. e.g. $7 \leq W_n \leq 13$ mm or $3.5 \leq W_n \leq 8.1$ mm.

In some embodiments, the lens is configured such that maximum peripheral aberration is in a range of 1.2D and 3.5D, e.g. is in a range of 1.5D and 2.2D.

In some embodiments, the lens is configured such that maximum power gradient does not exceed 0.2D/mm; or does not exceed 0.25D/mm.

30 In some embodiments, the lens is configured such that a corridor region between the first and the second regions has a varying width such that a minimal width of the corridor, where residual cylindrical aberration does not exceed 1D, is in a range of 3mm and 16mm, e.g. in a range of 3mm and 7.3mm, or in a range of 6 mm and 16 mm.

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According to another broad aspect of the invention, it provides an ophthalmic lens configured for a user's prescribed optical power P_0 for far vision correction, the lens comprising: a fitting position, a **FMP** having said prescribed optical power P_0 , and a **NMP**, wherein the lens comprises an optical power addition profile increasing along a convergence path between said **FMP** and said **NMP** through said fitting position located between them, such that at said fitting position said optical power addition is in a range of 0.2D and 0.4D and at the **NMP** said optical power addition is in a range of 0.4D and 0.8D.

In such lenses, the **FMP** is located at a distance D_I not exceeding 10 mm above the fitting position. The optical power addition profile may be configured such that optical power addition does not exceed 1D. The **NMP** may be located at a distance of 9-17 mm below the fitting position and inset nasally by 0 – 3mm. Such lenses may be configured for adding near and intermediate vision comfort to users.

In yet a further broad aspect of the invention, it provides a progressive addition lens (PAL) having a fitting position (FP), a far measuring position (FMP) located at a distance D_I not exceeding 10 mm above said fitting position, and a near measuring position (NMP) located below said fitting position; said PAL having an optical power profile defining optical power P_0 at the FMP corresponding to the optical power prescribed for a user for far vision, and optical power P_n at the NMP corresponding to the optical power prescribed for said user for near vision, wherein optical power varies in between said FMP and said NMP such that optical power at said FP is in a range of $(P_0+0.4D)$ and $(P_0+0.8D)$.

In such lenses, the NMP may be located at a distance of 9-17 mm below the fitting position and inset nasally by 0 – 3mm.

25 BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

30 **Fig. 1** illustrates an example of a centration chart marking measuring positions on an uncut ophthalmic lens

Fig. 2 illustrates schematically the gaze viewing angles through a lens;

Fig. 3 is a graph exemplifying optical power addition profiles along a convergence path of the lens according to the technique of the invention configured as progressive multifocal lens for prescribed optical power additions of 1.5, 2.0 and 2.5 D;

Fig. 4 is a graph of an optical power addition profile along a convergence path of the lens according to some embodiments of the invention configured as a single vision (optical power) lens providing relaxed and comfortable vision for near and intermediate distances;

Figs. 5A and 5B are schematic contour plots of optical power addition profile of the conventional PALs (**Fig. 5A**) and for a lens configured according to some embodiments of the present invention (**Fig. 5B**) and indicating main regions of the lens;

Fig. 6 schematically illustrates contour line plots of residual cylindrical aberrations as generally observed in progressive multifocal lens and indicating main region of the lens;

Figs. 7A and 7B exemplify contour lines of optical power addition profiles (**Fig. 7A**) and corresponding contours of residual cylindrical aberrations (**Figs. 7B**) in a lens according to some embodiments of the invention providing optical power addition of 2.5D at the NMP; and

Figs. 8A and 8B exemplify contour lines of residual cylindrical aberration in lenses configured according to the present invention and providing optical power addition of 1.5D and 2.0D respectively at the NMP.

DETAILED DESCRIPTION OF EMBODIMENTS

As indicated above, the present invention provides a novel configuration for ophthalmic lenses, being progressive addition lens or single vision lens. The ophthalmic lens according to the invention is configured with an optimized / improved optical power addition profile to, while providing a wearer with prescribed optical power for far vision and near vision, creates selected vision assisting features to assist the wearer in intermediate distance vision.

Reference is made to **Fig. 1** illustrating main measuring positions on an ophthalmic lens, and to **Fig. 2** schematically illustrating various gaze angles through the lens. **Fig. 1** illustrates an uncut ophthalmic lens **100** (right eye lens seen from the Eye Care Practitioner's (ECPs) perspective, in this example) having a geometrical center **GC 107**, horizontal and vertical axis **HA 130** and **VA 140** respectively, and markings for

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Fitting position **FP 105**, Far measuring position **FMP 101** and near measuring position **NMP 110**. The **FP 105** is typically located along the vertical axis **VA 140**, being on, or a few millimeters (mm) above, the geometrical center **GC 107** (typically between 0 and 4 mm above the **GC 107**) and may be shifted along the horizontal axis by a few millimeters
5 from the **GC 107**. Generally the **FP 105** is located directly in front of the wearer's pupil when gazing in horizontal direction at a distant object. Additionally, the **NMP 110** is located at a predetermined distance **D2 122** below the **FP 105** and typically shifted inwards from the **VA 140** nasally, and the **FMP 101** is located at a predetermined distance **D1 120** above the **FP 105** and generally on the **VA 140**. A bi-linear line connecting the
10 **FMP 101**, **FP 105** and **NMP 110** is termed as convergence path. In some configurations, the convergence path, may roughly relate to the path of each eye while looking at scene in front of the wearer with both eyes.

In this connection it should be noted that measuring positions and fitting position of the lens are typical landmark locations on the lens, generally provided by lens
15 manufacturers per design, indicating positions at which the prescribed power should be measured. The **FP 105** typically refers to a point on the lens located on the line of sight of a wearer when the wearer is looking straight ahead at an object at infinite distance. The fitting position is typically marked on the uncut lens and may be located at the geometric center of the lens or within a distance of about 4 mm above the geometric center of the
20 lens. The **FMP 101** and **NMP 110** are selected in accordance with optical design of the lens to provide suitable optical power for far and near visions for the wearer.

The **FMP 101** and near measuring position may be determined in accordance with surface analysis of the lens, providing selected coordinates for the location of these positions with respect to the **FP 105**. Alternatively the location of the **FMP 101** and
25 **NMP 110** may be determined in accordance with eye-point analysis of the lens. In eye-point analysis, both surfaces of the lens are considered as line of sight and ray-tracing from objects in a scene, through both surfaces of the lens and to the wearer's eyes. Generally, optical measurements of the lens may be done by surface and/or eye-point techniques, however to simplify the description of the present application, the structure
30 of the lens of the invention is herein described based of surface measurement values.

Generally the **NMP 110** is located at distance **D2 122** in a range of 9 and 17 mm below the **FP 105**, and may be shifted nasally from the vertical axis **VA 140** by 0-3 mm along the surface of the lens **100**, to comply with the eyes' convergence when gazing at

nearby objects. Further, according to the present invention, the **FMP 101**, is located on the convergence path, and distance **D1 120** above the fitting position **FP 105**, where **D1 120** is less than 10 mm. In some embodiments, **D1 120** is in a range of 5 and 8 mm.

Fig. 2 illustrates the gaze angles required in order to view through various
5 positions on the lens. As shown, the lens **207** is generally positioned at a certain distance from the wearer's eye referred to as the back vertex distance **BVD 202** in a range of 11 and 18 mm, and typically about 13 mm. The different viewing positions on the lens surface correspond to different rotations of the eye. In this case, the **BVD 202** is measured from the back side of the lens **205** (back vertex sphere) to the corneal apex in front of the
10 pupil (edge of the eye). Typically, the **FP 105** is selected to be at angle 0^0 with respect to the horizon, providing horizontal line of sight **215**. For most people, the maximal upper vertical gaze angle **205** and maximal lower vertical gaze angle **210** of the eye shown in **Fig. 2** are typically at angles of 25^0 **205** and -30^0 **210** respectively. The vertical gaze angle **208** is shown, corresponding to the **FMP 101** as positioned in the ophthalmic lens
15 of the current invention, at an angle of between 13^0 and 22^0 . Thus, a location of the **FMP 101** of the lens **100** according to the present invention at a distance **D1** that does not exceed 10mm (typically in a range of 6 and 10 mm) above the fitting position actually provides corresponding angular rotation of less than 22^0 (for a **BVD 202** of about 13mm and an eye diameter of about 24mm). This enables the wearer to utilize the **FMP 101** for
20 distant vision while avoiding discomfort involved in high gaze angles resulting in extreme eye rotations. Further, the lenses are often glazed/edged around 13 mm above the **FP 105** for fitting into eyeglasses frames and thus regions of the lens located over 13 mm above the **FP 105** do not take part in optical activity of the lens. More specifically, over 40% of lenses are edged at a distance of less than 13mm above the **FP 105**. If the **FMP 101** is the
25 closest position to the **FP 105** for far vision correction, and located at, for example, 10mm above the **FP 105**, the potential far vision zone can extend up to 3mm above the **FMP 101**, offering a versatile Far vision zone.

The lens **100** is configured with a selected base optical power (far optical power), generally selected as the optical power prescribed for far vision, and assisting features
30 including optical power addition profile providing assistance in near and intermediate distance vision to the wearer as will be described in further detail below. The optical power addition profile can be defined by curvature variations on the front surface of the lens, or on both the front and back surfaces of the lens. Alternatively or additionally, the

desired optical power addition profile may be provided by a material composition of the lens providing a corresponding refractive index profile.

The final lens structure is configured with optical power such that different regions along the lens affect light passing therethrough along optical paths corresponding to gaze directions through these regions with selected optical power. The lens **100** is configured with prescribed far vision optical power P_f at the **FMP 101**, which for the purposes of the present application presents a basic optical power P_0 of the lens according to which an optical power addition profile is defined to improve the lens performance as described above. The optical power addition profile provides the optical power $P_n = P_0 + d_n$ at the **NMP 110** (e.g. prescribed for near vision correction in the PAL case or 0.4 – 1.0 D in the single vision configuration), where d_n is the value of the optical power addition at the near measuring position.

The optical power addition profile is such that the value of the optical power addition increases from the **FMP 101** towards the **NMP 110** such that at the **FP 105** the optical power addition is d_i providing the optical power $P_i = P_0 + d_i$ at the fitting position, selected to provide intermediate distance vision assistance. According to some embodiments of the present invention, the ophthalmic lens (**100** in Fig. 1) is configured with optical power addition profile such that the optical power addition d_i is in a range of 0.3D - 0.5D for the single vision lens configuration or is in a range of 0.3D - 0.8D for the progressive multifocal lens configuration.

The single vision lens may be intended for use by pre-presbyopic individuals. Although not requiring near vision correction, such individuals may benefit from optical power addition for near and intermediate visions for office related use. To this end, the lens may be configured with optical power prescribed for far vision P_0 and with optical power addition for near vision at the **NMP** being 0.4D-0.8D (e.g. 0.5D) and optical power addition of 0.3D-0.5D at the **FP** for assistance in intermediate distance vision. This is to provide assistance for relaxed and comfortable office related vision. Further, in such embodiments, the lens configuration may be symmetrical in the **VA 140**, i.e. the **NMP 110** may be around the horizontal center of the lens such that the left and right eye are substantially similar.

According to some other embodiments, the lens may be configured as a **PAL**. More specifically, the optical power addition at the **NMP 110** d_n may be about 1D or

higher in accordance with wearer needs, or as prescribed to the wearer for near vision. The optical power addition profile provides optical power at the **NMP 110** determined as $P_n = P_0 + d_n$ and corresponds to that prescribed for the wearer for near vision (e.g. P_n has a value in a range of 1D and 4D). In these embodiments, the lens is configured with addition

5 optical power providing prescribed optical power for far and near vision at the **FMP 101** and **NMP 110** respectively, and addition optical power d_i of about 0.4D-0.8D at the **FP 105** to provide wearers with vision assistance for intermediate distances such as computer screen, smart phone etc.

Reference is made to **Fig. 3** exemplifying the optical power variation (optical

10 power addition profile) along the convergence path of the lens, configured as PAL, for the lens configuration where the optical power additions d_n at the **NMP** are of **1.5D 309**, **2.0D 307** and **2.5D 305** over the far vision optical power P_0 . As shown, the **FMP 101** location **320** is at a distance of 5-10 mm above the **FP 105** has the basic optical power P_0 (i.e. no optical power addition). The **NMP's** location **315** may be at a distance of

15 9-17 mm below the **FP 105**.

It should be noted that the optical power variation of up to 0.25D around the desired optical power profile may occur due to manufacturing tolerances. From the **FMP 101** along the convergence path, the optical power addition increases (substantially linearly in some examples), to provide optical power addition d_i **310** of about 0.4D-0.8D

20 at the **FP 105**. Between the **FP 105** and the **NMP 110** the optical power addition further varies (substantially linearly, possibly with a different slope) to provide the desired optical power addition for near vision at the **NMP 105**. This is shown for optical power addition values d_n of 1.5D, 2.0D and 2.5D. As indicated above, a typical distance from the upper rim of the frame to the **FP 105** is 13 mm, and the lens is typically cut at a height

25 of about 13 millimeter above the **FP 101** and at a certain distance (e.g. about 15-30 mm) below the **FP 101**. As shown, the optical power variation may preferably be bi-linear along the convergence path, while some variations from linearity may be provided in accordance with the optical design. It can also be seen in this specific example, that the optical power addition d_i **310** at the **FP 101** may be generally independent of the optical

30 power addition for near vision measuring position d_n . More specifically, as shown in the figure, the optical power addition d_i in **FP 101** is about 0.5D for the optical power addition d_n at the **NMP 110** of 1.5D, 2.0D and 2.5D.

Reference is made to **Fig. 4** exemplifying similar optical addition power variation **405** along the convergence path of the lens, for a single vision lens configuration. In this example, the lens is configured with optical power P_0 at the **FMP 101** as prescribed for far vision correction, and provides optical power addition d_i **310** of about 0.3D-0.5D at the **FP 105**, with optical power addition d_n of about 0.5D at the **NMP 110**. The lens is thus configured with optical power properties assisting intermediate distance vision, without requiring accommodation of the eye thus reducing strain on the eye, and visual fatigue. This configuration advantageously assists users in relieving the accommodation required for long hours of near and intermediate vision use (e.g. office and computer work) although not requiring prescribed optical power for near vision (pre-presbyopes). In this configuration, the optical power addition d_n at the **NMP 110** may be 0.4D-0.8D (typically 0.5D or 0.66D) and the optical power addition d_i **310** at the **FP 105** of about 0.3D-0.5D.

Reference is made to **Figs. 5A and 5B** schematically illustrating a map of the optical power contours of a conventional progressive multifocal lens **500** and an ophthalmic lens according to the present invention **550**. The schematic illustration of **Fig. 5B** shows a contour map corresponding to both the PAL configuration having near vision correction prescribed to the user, and the single vision configuration providing an optical power addition between 0.4 and 0.8D at the **NMP 110** for reducing the eye fatigue. For simplicity, only schematic contour lines are shown and described. Generally, the top region of the lens (i.e. far vision zone) is configured with optical power prescribed for far vision correction, and a region around the **NMP 510c** (near vision zone) is configured with optical power for near vision correction. The technique of the invention utilizes a relatively wide corridor **511** providing intermediate optical power addition d_i (e.g. 0.3D-0.5D or 0.3D-0.8D) at the **FP 105**. In this specific example, the **FP 105** is located at the geometrical center of the lens. It should be noted that the optical power addition profile is generally a continuous profile varying from basic optical power P_0 towards a maximal optical power around the **NMP 110**.

Generally, the optical power addition profile (introducing variations in optical power of the lens) causes unavoidable cylindrical aberrations, mainly located in peripheral regions of the lens, e.g. regions **509a** and **509b**, by design. The optical power addition profile is configured such that an optical power addition d_i at the **FP 105** provides vision assistance for intermediate vision within a corridor zone **511**, while the **FMP 101**

is located at distance of less than about 10mm or less at a comfortable gaze angle for use for far vision.

Fig. 6 is a schematic general illustration of contour plot of cylindrical aberrations generated in a progressive addition lens (PAL) as a result of a gradual optical power variation. As shown, the lens design provides far-viewing region/zone **501** around the **FMP 101**, near viewing region/zone **503** around the **NMP 110**, and a corridor region **511** that are all substantially free of cylindrical aberrations. As for the side regions of the lens **509a**, **509b** and **510a** and **510b**, they are typically regions of distortions, i.e. have relatively large gradients of optical power variation and may provide noticeable cylindrical aberrations. The corridor region **511** is typically defined as a lens region located between the far zone **500** and the near zone **503** along the convergence path and having cylindrical aberrations of less than (generally, not exceeding) 0.5D and preferably less than 0.25D.

According to the present invention, the optical power of the lens continuously increases along the corridor region **511** such that the mean power is equal or greater than the prescribed far vision optical power P_0 , and the optical power addition is typically no greater than the selected addition d_n at the **NMP 110** (e.g. prescribed far vision correction optical power P_0 plus the prescribed optical power addition d_n providing the optical power for near vision correction). The optical power addition profile is configured to provide the corridor region **511** of the lens with less than 1D astigmatism or less than 0.5D astigmatism, or less than 0.25D astigmatism.

Reference is also made to **Figs 7A and 7B** showing contour maps for optical power addition profile (**Fig. 7A**) and resulting cylindrical aberrations profile (**Fig. 7B**) of a lens configured as a PAL according to some embodiments of the present invention having optical power addition d_n of 2.5D at the **NMP 110**. As shown, the lens according to this example provides an intermediate optical power addition d_i around the **FP 105** with a relatively wide corridor, with a minimum width **EC 705**, suitable for assistance in intermediate distance vision. This is while the far vision region around **FMP 101** (which is located at a distance equal to or less than 10mm above the **FP 105**) defines an effective far vision region/zone while occupying the central region of the lens, around the **FP 105**, for intermediate vision. The far vision region, surrounding the **FMP 101**, may vary in width W_f in accordance with specific optical power prescribed to the user and additional parameters of the selected lens, as described above. Generally, the far vision zone/region

width is typically defined as a horizontal width of a region around the **FMP 101** having optical power that does not deviate from the prescribed optical power P_0 for far vision correction by more than 0.25D, and is free of unwanted aberrations greater than 0.5D. The far vision region may be relatively narrow (as compared to the conventional lens structures), having width of about 9-20 mm, or configured to be relatively wide (e.g. in lenses designed for driving use) providing width of 38-50 mm. Generally, the width of the far vision region may be between 16-50 mm for single vision lens and between 9-50mm for the PAL configuration. It should, however, be noted that the far vision zone of the lens is sufficiently wide to maintain acceptable visual performance. The technique of the invention provides the lens with minimal corridor width **EC 705** of about 4-20 mm for intermediate distance vision, surrounding the **FP** of the lens, as exemplified in **Fig. 7B**. Generally, the minimal width of the corridor **EC** is defined herein for the corridor having cylindrical aberration below 1D.

The shape of the rear surface and/or front surface of the lens can be determined using a computer implemented method and includes determining a size and/or shape of the far/intermediate zone, a size and/or shape of the near vision/intermediate zone, length and width of the transition region or corridor. This technique is described for example in US2015253587, assigned to the assignee of the present application and incorporated herein by reference. Such computer implemented method may be configured to optimize the sizes and/or shape of the various regions of the lens (e.g., far, near, transition region) such that the resulting lens provides the prescribed prescription power with reduced aberrations. The computer implemented method may be configured to determine a length and width as well as shape of the transition region such that the resulting lens is a lens having the properties discussed herein. The determined shape of the lens can be used to shape, for example, the rear surface of a lens blank using freeform manufacturing technology. Accordingly, the lens design that provides the prescribed spherical, cylindrical and prism powers for quasi progressive lenses can be obtained using software methods and reproduced on one or more surfaces of a lens blank with available freeform manufacturing equipment. The optical addition profile curvature can be disposed entirely on the front or convex surface, entirely on the back, or concave surface or partly on the convex surface and partly on the concave surface using freeform manufacturing technology. Freeform manufacturing technology can also be referred to as direct or digital surfacing and is capable of producing complex surface shapes.

Another example of a method for generating a surface of a progressive lens is described in US patent no. 6,786,600, assigned to the assignee of the present application and incorporated herein by reference. According to this method, a progressive surface is generated from stored delta data and a substantially spherical or toric surface is calculated on-the-fly. The delta data is the remainder surface after subtracting from a calculated surface a spherical or toric surface according to the prescription sphere power and cylindrical power. As long as the optical regions and the distorted regions (regions with cylindrical aberrations) of the deltas do not overlap, the deltas can be summed. At the optical regions the sum of the optical properties of all the deltas is obtained, while in the distorted regions an aberration interference which depends on the vector sum of the cylindrical aberration is obtained.

Table 1 presented below exemplifies preferred ranges for some features describing the lens configuration according to some embodiments of the present invention.

Table 1

	Addition optical power d_n for NMP [Diopter]	Range
Near Zone Width	0-2	8.2-12.85
	2-3.5	7.2-10.2
Far Zone Width [mm]	0-2	16.8-48.8
	2-3.5	6.8-35.45
Fitting Point Width	0-2	6.55-19.5
	2-3.5	4.2-5.9
Minimum Corridor Width (EC) [mm]	0-2	7.45-16.2
	2-3.5	5.95-7.15
Max Astigmatism [D]	0-2	1.26-2.36
	2-3.5	2.69-3.44
Power Gradient [D/mm]	0-2	0.08-0.168
	2-3.5	0.16-0.194

The variation of the feature parameter/value may depend of the selected optical power addition d_n being below 2D (0-2D addition) or in a range of 2D-3.5D. It should be noted that these measurements are provided as non-limiting examples and that the technique of the invention is not limited to any specific basic power, as well as any specific optical power addition for the **NMP**; the invention may also provide PAL with

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optical power addition greater than 3.5D, e.g. 4D - 4.5D. Generally, the Near Zone width (a region around the **NMP** suitable for near vision) is defined by a horizontal line passing through the **NMP** or by a centroid having optical power less than the maximal optical power addition of the lens (generally prescribed for near vision) by no more than 0.25D.

5 The Far Zone width (a region around the **FMP** suitable for far vision with the prescribed far vision correction) is defined by the length horizontal line through the FMP having cylindrical power below 0.5D, and having optical power that deviates from the prescribed far power P_0 by no more than 0.25D. The Fitting Point Width (intended to be used mainly for viewing intermediate objects, e.g. tablets, desktop computers, etc.) is defined as the

10 width of the corridor at the **FP** in a region where residual cylinder power is below 0.5 D. The Minimum Corridor Width is measured at the vertical position at which the corridor width is narrowest, having cylindrical power below 1D. Further, the lens according to the present invention has optical power profile having substantially lower power gradients in the intermediate zone, relative to conventional PALs due to the elongated progressive

15 corridor, ensuring comfortable vision for wearers. The Power Gradient is defined as the maximum power gradient in the optical addition profile over the lens.

In addition to **Fig. 7B** showing contour map of cylindrical aberration in the PAL according to the present invention when configured with optical power addition of 2.5D for near vision, **Figs. 8A and 8B** show contour maps of cylindrical aberration

20 corresponding to addition optical power of 1.5D **800** and 2.0D **810** respectively, and the **EC 705**, which is relatively wide, and varies with addition optical power. As shown in these figures, and also shown in **Fig. 7B**, the optical power addition profile is configured such that residual cylindrical aberrations mainly occupy lower periphery region of the lens surface **509a, 509b**, which are not frequently used, thus reducing the aberrations at

25 effective lens regions (i.e. those that are commonly used by a wearer). As a result, the corridor, serving for intermediate vision, and the far and near vision zones, are relatively wide. It should be noted that the contour map for optical power addition profile is substantially similar to that exemplified in **Fig. 7A** with the required variation in optical power addition values.

30 Generally, it should also be noted that the lens properties exemplified above in **Figs. 7A and 7B** (as well as those of **Figs. 8A and 8B**) should be interpreted broadly. More specifically, the optical power addition profile used in single vision lens according to the present invention is substantially similar in contour to that exemplified in **Fig. 7A**,

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with required variations in optical power addition values. In particular, as indicated above, in the single vision embodiments, the optical power addition d_n at the **NMP** is selected to be lower than (or possibly equal to) 1D, and is typically of 0.4D-0.8D. Additionally, the optical power addition d_i at the **FP** is selected to be about 0.3D-0.5D.

5 In addition to the above-described features of the lens for intermediate distance vision improvement, the ophthalmic lens of the present invention may be configured for improved vision in driving conditions. In this configuration, the ophthalmic lens (generally configured as PAL) is further modified to widen the far vision zone while keeping the optical power there as close as possible to optical power P_0 prescribed for the
10 far vision correction, and maintaining good intermediate and near vision properties. More specifically, as shown in the figure, the optical power addition profile is configured in a substantially similar manner, as described above, along the conversion path of the lens, while providing wide far vision region at a cost of slightly reducing the width of the near vision region.

15 Additionally, as shown, the lens design according to this embodiment might result in a non-symmetrical configuration, such that right and left lenses are not mirror duplications of each other. The non-symmetrical configuration provides intermediate vision region with a relative lateral shift, which is a left shift in countries where drivers are instructed to drive on the left side of the road (as exemplified herein), or a right shift
20 in countries where drivers are instructed to drive on the right side of the road. This is to provide improved vision assistance for operation of the car's console. Thus, for the left-driving countries, the intermediate vision region is shifted temporally in the left lens and nasally in the right lens, and *vice versa* in the right-driving countries.

25 Table 2 presented below exemplifies preferred ranges for selected features/parameters of the lens according to some embodiments of the invention, generally directed for use in driving activities.

Table 2

	Addition optical power d_n for NMP [Diopter]	Range
Near Zone Width [mm]	1.5	7.0-8.1
	2	3.5-4
Far Zone Width [mm]	1.5	40-47
	2	39-48
Fitting Point Width [mm]	1.5	13-14
	2	10-15
Minimum Corridor Width (EC) [mm]	1.5	6.5-7.3
	2	3-4.5
Max Astigmatism [D]	1.5	1.84-1.94
	2	1.5-2.2
Power Gradient [D/mm]	1.5	0.144-0.152
	2	0.166-0.248

In Table 2, similarly to Table 1, the different values of the lens' parameters may be associated with the selected values of the optical power addition d_n , typically prescribed for the driver/wearer's near vision correction. In this specific example, the parameters are given for optical power addition profiles providing d_n of 1.5D and 2D. It should be noted that these measurements are provided as non-limiting examples and that the technique of the invention is not limited to any specific example, and may also provide PAL with optical power addition greater than 3.5D, such as 4D -4.5D. Generally, as shown in Table 2, the Near Zone width is greater than or equal to 3mm and typically up to about 8-10 mm, while the near vision region is wider for lower optical power addition. The width of the near zone is defined by a horizontal line passing through the **NMP** or as a centroid providing optical power that is less than the maximal optical power addition (generally prescribed for near vision) by no more than 0.25D. Contrary to the near vision region, the Far Zone in these embodiments is configured to be relatively wide, i.e. to be about 39-50 mm in width. The Far zone is defined, similarly to the near zone, as a horizontal region around the **FMP** having cylindrical power/aberrations below 0.5D. The Fitting Zone width is determined in a region where residual cylinder power is below 0.5 D, and preferably below 0.25 D. The width of the intermediate zone is that of the narrowest point of the corridor determined as a region having cylindrical power below 1D. Further, the lens according to the present invention is configured with certain maximal optical power gradient, to provide wearers with more comfortable vision.

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Thus, the present invention provides an ophthalmic lens configured as a single vision lens or as a PAL which provides significant mid vision improvement for any required far vision correction, while maintaining good near vision (for single vision lens) or providing required near vision correction (for PAL). The lens design is configured for
5 use in various environments and provides wearers with assisting features due to the specifically designed optical power addition profile of the lens. The technique of the present invention enables wearers to maintain a single pair of glasses for most of their daily activities, including e.g. street use requiring vision of distant objects, reading use as well as uses requiring vision of intermediate distance such as office work, as well as
10 driving conditions.

CLAIMS:

1. An ophthalmic lens configured for a user's prescribed optical power P_0 for far vision correction, the lens comprising: a fitting position (FP); a first region corresponding
5 to a far measuring position (FMP) having said prescribed optical power P_0 ; a second region corresponding to a near measuring position (NMP); wherein said lens is configured with an optical power addition profile such that an optical power, P_f , at said fitting position, located at a distance D_f not exceeding 10 millimeters below said far measuring position, is different from the optical power P_0 by d_f being $0.3D \leq d_f \leq 0.8D$ (D is diopter),
10 said optical power addition profile thereby providing an improved intermediate distance vision of the lens.
2. The ophthalmic lens of claim 1, wherein an optical power P_n at the near measuring position is determined as $P_n = P_0 + d_n$, wherein $d_n \geq 0.4D$.
3. The ophthalmic lens of claim 1 or 2, configured as a progressive multifocal lens,
15 where an optical power addition d_i satisfies a condition $0.4D \leq d_i \leq 0.8D$, and an optical power P_n at the near measuring position is determined as $(P_0 + d_n)$ is selected as prescribed for the user's near vision correction.
4. The ophthalmic lens of claim 3, wherein the optical power addition d_i satisfies a condition $d_i = 0.5D \pm 0.12D$.
- 20 5. The ophthalmic lens of claim 1 or 2, wherein said optical power addition profile is configured such that the optical power addition across a surface of the lens does not exceed 1D.
6. The ophthalmic lens of claim 5, wherein the optical power addition d_i satisfies a condition $0.3D \leq d_i \leq 0.5D$ and optical power addition at said near measuring position d_n
25 satisfies a condition $0.4D \leq d_n \leq 0.8D$.
7. The ophthalmic lens of claim 5 or 6, wherein said fitting position, said far measuring position, and said near measuring position are arranged in a spaced-apart position along a line.
8. The ophthalmic lens of any one of claims 1 to 7, wherein said distance D_f between
30 the far measuring position and the fitting position is $5 \leq h \leq 8$ millimeters.

9. The ophthalmic lens of any one of claims 1 to 8, wherein said optical power addition profile has a substantially linear portion in a zone between said far measuring position and said fitting position.
10. The ophthalmic lens of any one of claims 1 to 9, wherein said optical power addition profile has a substantially linear portion in a zone between said near measuring position and said fitting position.
11. The ophthalmic lens of any one of claim 1 to 10, having a curvature profile selected to provide said optical power addition profile.
12. The ophthalmic lens of claim 11, wherein said curvature profile is defined by curvature variations in at least a back surface of the lens.
13. The ophthalmic lens of any one of claims 1 to 12, having a material composition selected to provide a refractive index profile providing said optical power addition profile.
14. The ophthalmic lens of any one of claims 1 to 13, wherein a width W_f of said first region having residual cylindrical aberration not exceeding 0.5D is $6\text{mm} \leq W_f \leq 50\text{ mm}$.
- 15 15. The ophthalmic lens of claim 14, wherein the width W_f of said first region is $35 \leq W_f \leq 50\text{ mm}$.
16. The ophthalmic lens of any one of claims 1 to 15, wherein a width W_n of the second region having residual cylindrical aberration not exceeding 0.25D is $3.5 \leq W_n \leq 13\text{mm}$.
- 20 17. The ophthalmic lens of claim 16, wherein said width W_n of the second region is $7 \leq W_n \leq 13\text{ mm}$.
18. The ophthalmic lens of claim 16 wherein said width W_n of the second region is $3.5 \leq W_n \leq 8.1\text{ mm}$.
19. The ophthalmic lens of any one of claims 1 to 18, configured such that maximum peripheral aberration is in a range of 1.2D and 3.5D.
- 25 20. The ophthalmic lens of claim 19, wherein the maximum peripheral aberration is in a range of 1.5D and 2.2D.
21. The ophthalmic lens of any one of claims 1 to 20, configured such that maximum power gradient does not exceed 0.2D/mm.
- 30 22. The ophthalmic lens of any one of claims 1 to 20, configured such that maximum power gradient does not exceed 0.25D/mm.
23. The ophthalmic lens of claim 22, configured for improving vision of user during driving activities.

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24. The ophthalmic lens of any one of claims 1 to 23, wherein a corridor region between the first and the second regions has a varying width such that a minimal width of the corridor, where residual cylindrical aberration does not exceed 1D, is in a range of 3mm and 16.2mm.
- 5 25. The ophthalmic lens of claim 24, wherein said minimal width of the corridor is in a range of 3mm and 7.3mm.
26. The ophthalmic lens of claim 24, said minimal width of the corridor is in a range of 5.95mm and 16.2mm.
27. An ophthalmic lens configured for a user's prescribed optical power P_0 for far vision correction, the lens comprising: a fitting position, a far measuring position having said prescribed optical power P_0 , and a near measuring position, wherein the lens comprises an optical power addition profile increasing along a convergence path between said far measuring position and said near measuring position through said fitting position located between them, such that at said fitting position said optical power addition is in a range of 0.3D - 0.5D and at the near measuring position said optical power addition is in a range of 0.4D and 0.8D.
- 10 28. The ophthalmic lens of claim 27, wherein said far measuring position is located at a distance D1 not exceeding 10 millimeters above said fitting position.
29. The ophthalmic lens of claim 27 or 28, wherein said optical power addition profile is configured such that optical power addition does not exceed 1D.
- 20 30. The ophthalmic lens of any one of claims 27 to 29, wherein said near measurement position is located at a distance of 9-17 millimeter below said fitting position.
31. The ophthalmic lens of any one of claims 27 to 30, configured for adding near and intermediate vision comfort to users.
- 25 32. A progressive addition lens (PAL) having a fitting position, a far measuring position located at a distance D1 not exceeding 10 millimeters above said fitting position, and a near measuring position located below said fitting position; said PAL having an optical power profile defining optical power P_0 at the far measuring position corresponding to the optical power prescribed for a user for far vision, and optical power P_n in the near measuring position corresponding to the optical power prescribed for said user for near vision, wherein optical power varies in between said far measuring position and said near measuring position such that optical power at said fitting position is in a range of $(P_0+0.4D)$ and $(P_0+0.8D)$.
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33. The ophthalmic lens of claim 32, wherein said near measurement position is located at a distance of 9-17 millimeters below said fitting position.

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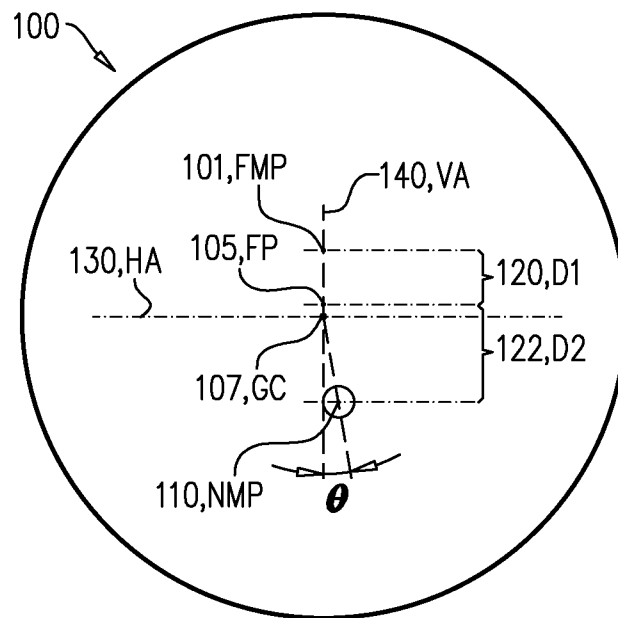


FIG. 1

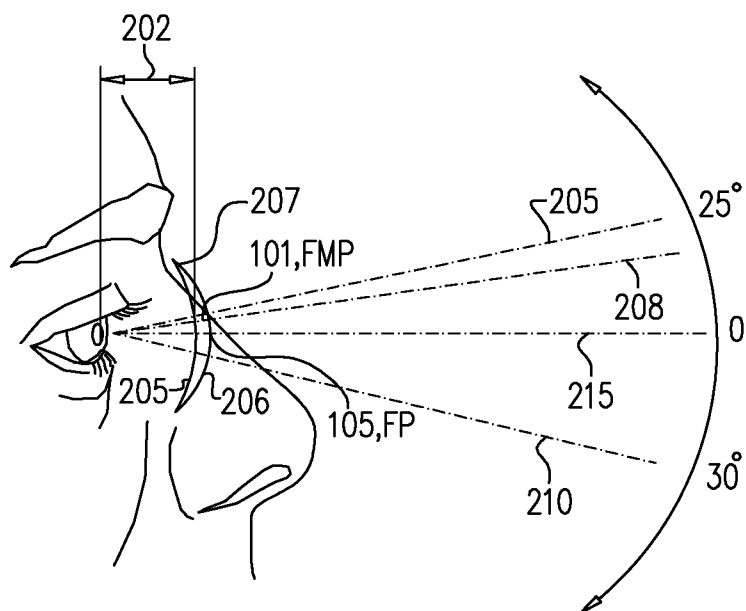


FIG. 2

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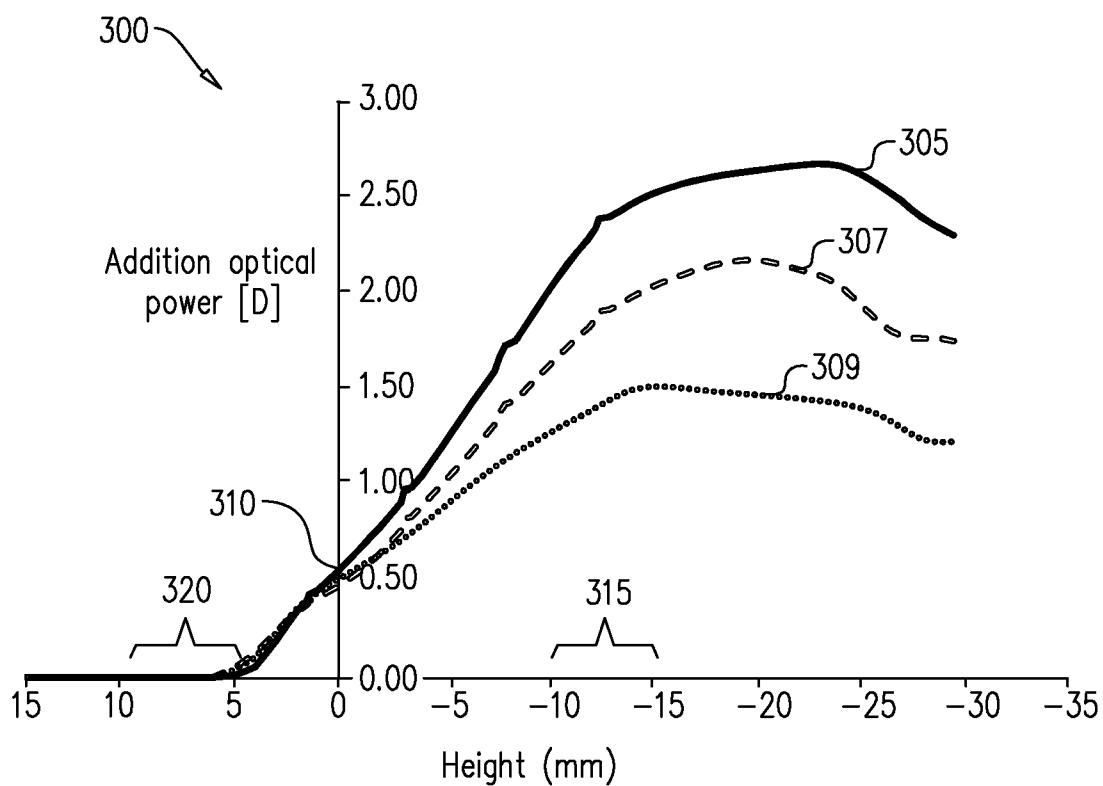


FIG. 3

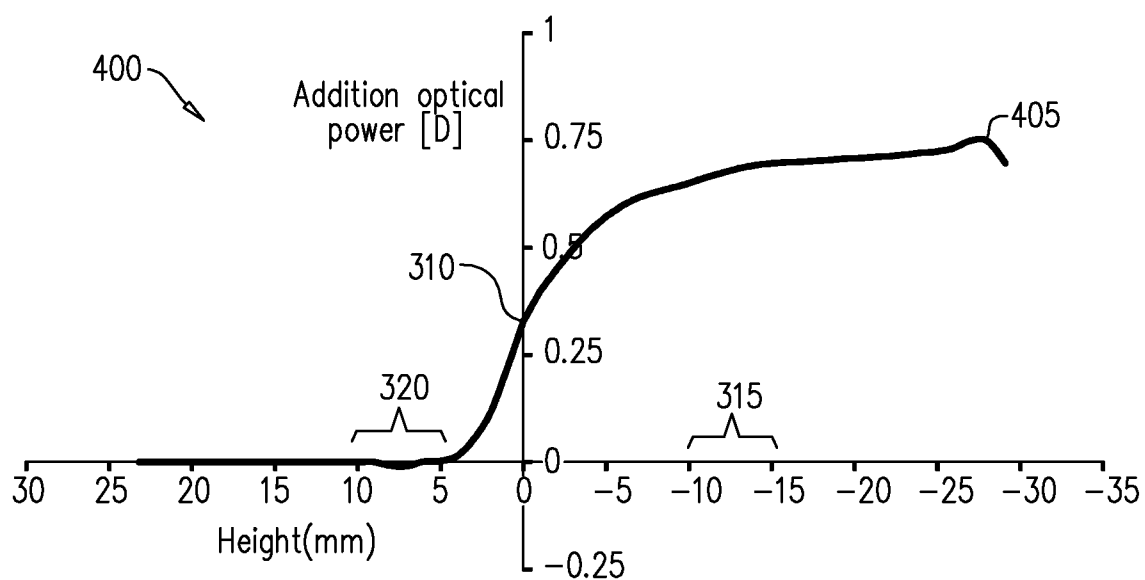


FIG. 4

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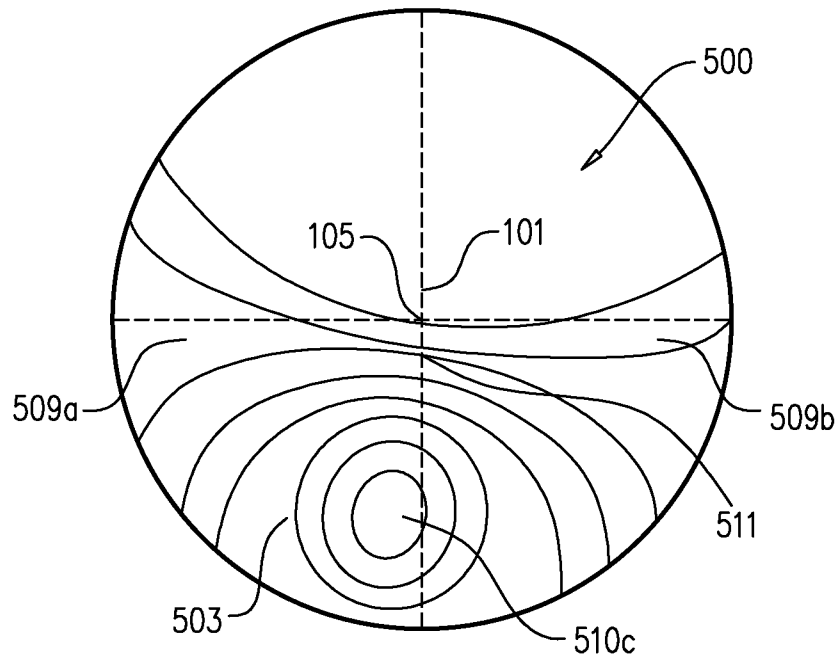


FIG. 5A

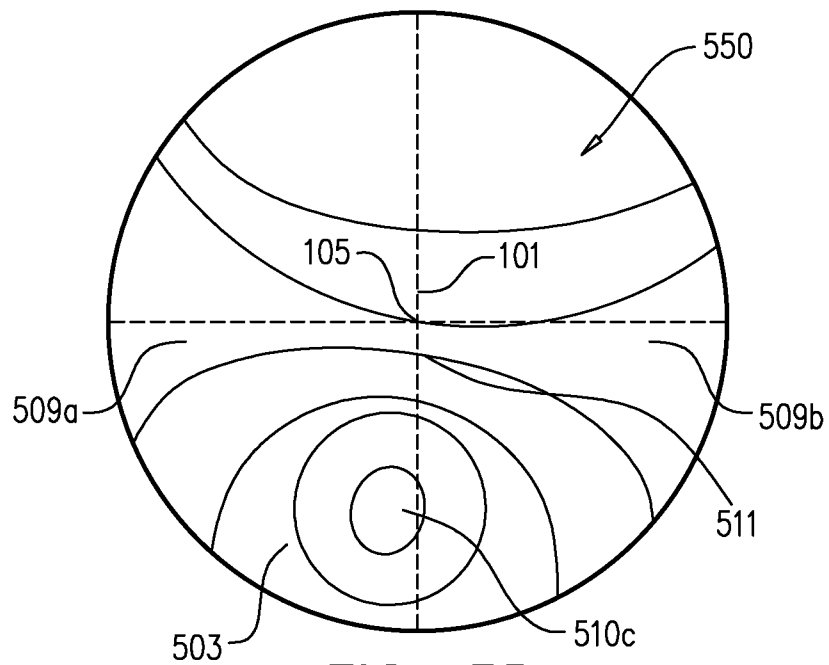


FIG. 5B

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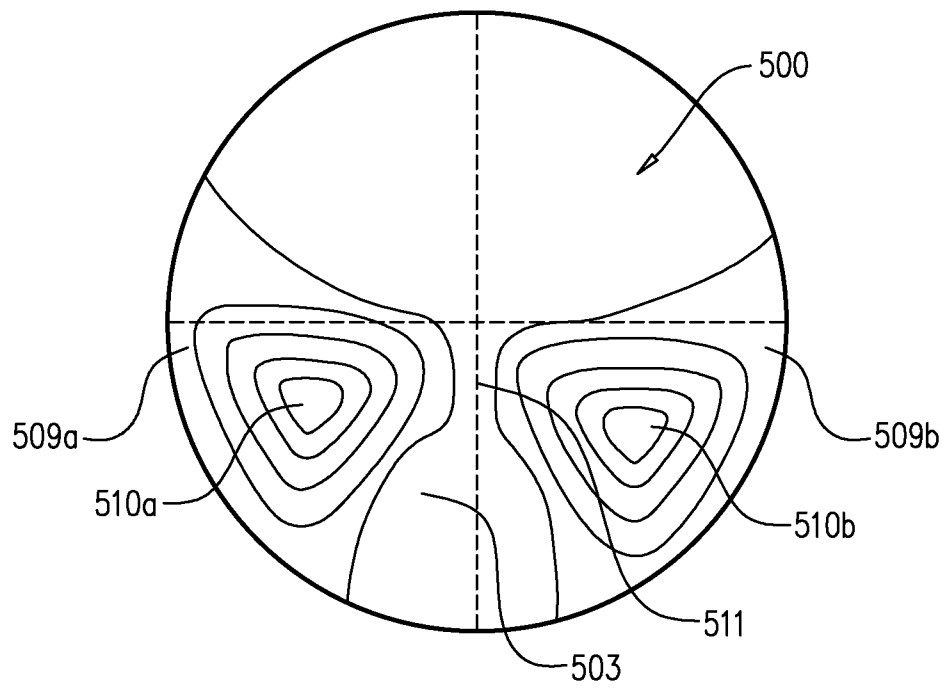


FIG. 6

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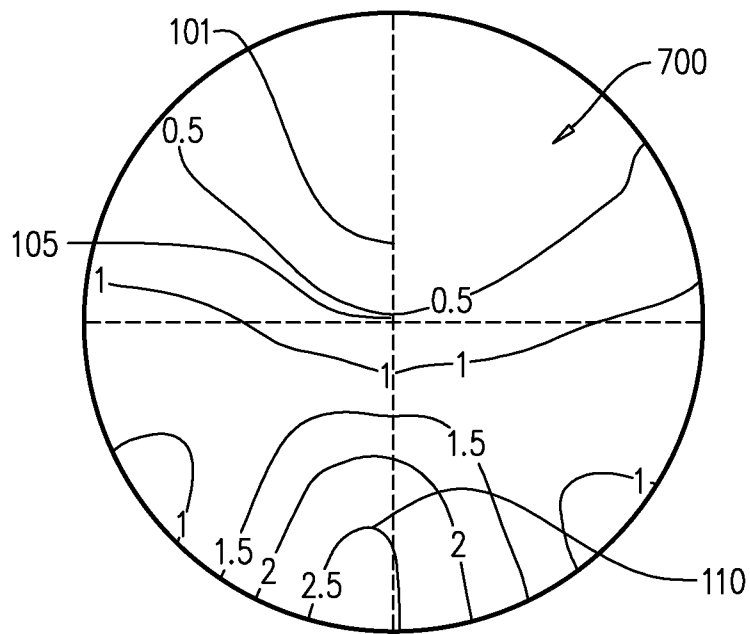


FIG. 7A

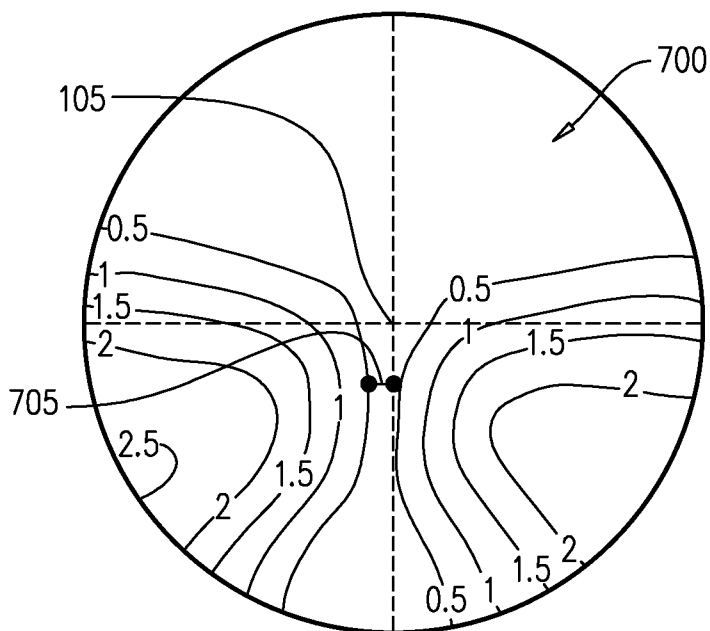


FIG. 7B

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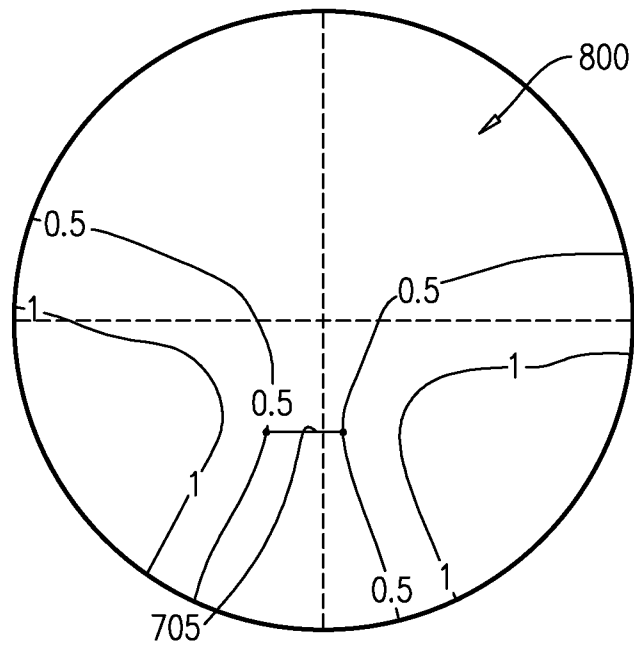


FIG. 8A

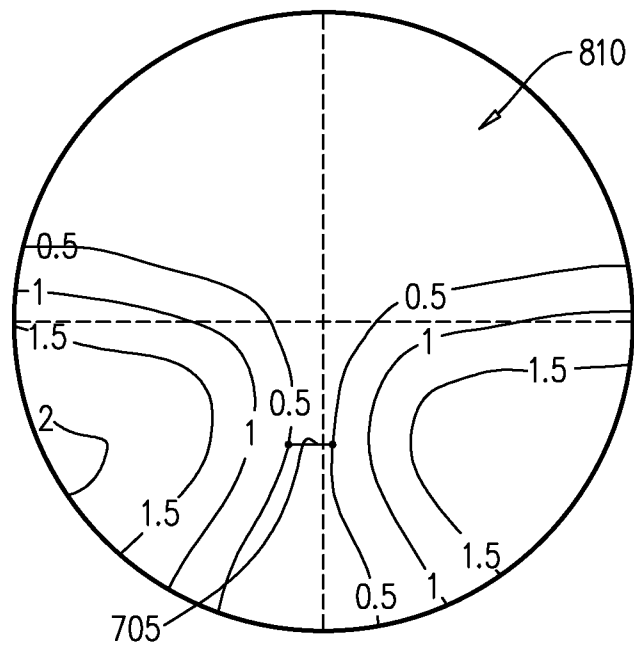


FIG. 8B

INTERNATIONAL SEARCH REPORT

International application No

PCT/IL2017/051301

A. CLASSIFICATION OF SUBJECT MATTER
 INV. G02C7/06
 ADD.

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)
 G02C

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	abstract; figures 2,4,5,6 -----	5,6,29
X	WO 01/25837 A1 (SOLA INT HOLDINGS [AU]; MORRIS MICHAEL ALAN [US]; FISHER SCOTT WARREN) 12 April 2001 (2001-04-12)	1-4,7,8, 11,28, 32,33
Y	page 4, line 5 - line 10; claims 10,20 -----	5,6,29
X	WO 2016/047713 A1 (HOYA LENS THAILAND LTD [TH]; ODAIRA TOMOHIRO [JP]; IZAWA YASUNORI [JP]) 31 March 2016 (2016-03-31)	1-4,7,8, 11,28,32
Y	figures 2-5 & EP 3 200 009 A1 (HOYA LENS THAILAND LTD [TH]) 2 August 2017 (2017-08-02) paragraphs [0044], [0045]; figures 2-5 ----- -/-	5,6,29



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

31 January 2018

Date of mailing of the international search report

07/02/2018

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Jestl, Markus

INTERNATIONAL SEARCH REPORT

International application No

PCT/IL2017/051301

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	paragraph [0065]; figures 4, 5C -----	5,6,29
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Y	abstract; figure 2 -----	5,6,29

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