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(54) Title: OPHTHALMIC SYSTEM FOR CORRECTING SIGHT DEFECTS

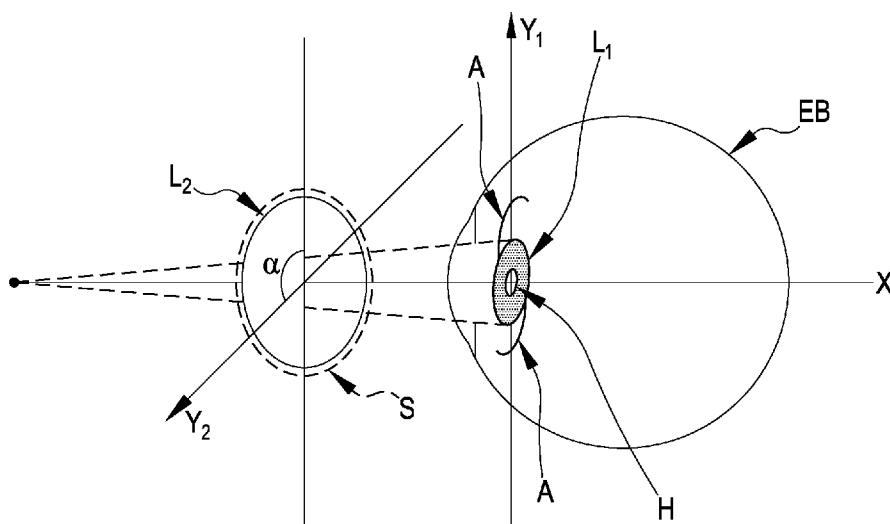


FIG.1

(57) Abstract: An ophthalmic system for correcting sight defects provides a first polarized lens (L₁), suitable to be integrated to the eye (EB), provided with a central part (H) transparent to the light suitable to perform the function of a pinhole, and further provides a second polarized lens (L₂) suitable to be mounted externally to the eye (EB) in optical coupling with the first lens (L₁). This ophthalmic system allows to correct sight defects without limiting the vision of the patient on which it is applied.



OPHTHALMIC SYSTEM FOR CORRECTING SIGHT DEFECTS

BACKGROUND OF THE INVENTION

5 The present invention relates to an ophthalmic system intended for correcting sight defects of the human eye.

PRIOR ART

10 In an eye without defects the light rays incident on the cornea are projected onto the retina in an orderly manner through the dioptric system of the eye. The retina transforms the light rays into electric pulses that are transmitted to the brain through the optic nerve.

15 If there are defects in the cornea, these light rays are irregularly deflected and cause an incorrect formation of the image by the retina with a resulting reduction in the quality of the subject's vision.

Currently, in order to address the problems described above, there are some devices,
20 which are or are not implantable inside the eye, that are based on the pinhole principle.

With regard to implantable devices, an intraocular lens measuring a few millimetres
25 in diameter is made which incorporates a donut-shaped light-proof mask with a small central hole of just over a millimeter through which the light passes.

The small central hole constitutes a pinhole and its effect is to limit the angles from
30 which the rays that contribute to form the image arrive, allowing only the direct rays to concentrate in the most sensitive part of the retina, called fovea, consequently improving eyesight, for example in the case of myopia, presbyopia, astigmatism, and corneal defects.

However, these implantable devices have some drawbacks.

During surgery to perform the implantation of the device or for interventions following the implant, the light-proof mask prevents the surgeon from seeing the bottom of the eye and forces him to resort to special equipment to have intraocular
5 vision and thus to intervene on the eye.

The use of special equipment complicates and lengthens the surgical operation and in any case does not provide a satisfactory view.

10 There is than to be noted that visual field of the patient is considerably limited by such a type of device since the vision of the patient occurs always and only through the pinhole given the presence of the light-proof mask.

OBJECT OF THE INVENTION

15

The object of the present invention is to overcome the aforementioned drawbacks.

BRIEF DESCRIPTION OF THE INVENTION

20 This object is achieved by an ophthalmic system for correcting sight defects according to the first claim.

BRIEF DESCRIPTION OF THE DRAWINGS

25 To better understand the invention, a description is given below of two non-limiting exemplary embodiments thereof, illustrated in the attached drawings in which:

fig.1 is a schematic view of an ophthalmic system according to the invention in an operating position;

30 fig.2 is a schematic view of the ophthalmic system of fig. 1 in another operating position;

figs 3,4,5 show the operating principle of the ophthalmic system of fig.1;

fig.6 is a schematic view of another ophthalmic system according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

5 The ophthalmic system of figs 1,2 provides an intraocular implantable lens L_1 and an external lens L_2 aligned with the lens L_1 .

The lens L_1 is circular and suitable for being implanted in a human eye EB.

10 This lens L_1 is a polarized lens with a small non-polarized central circular part H, i.e. transparent to light. To achieve this, this central part H is not polarized in the polarization treatment of the lens L_1 ; alternatively, to make the central part H, a through hole can be made in the lens L_1 .

15 The non-polarized central part H is suitable to perform the function of a pinhole, as will be explained below.

The central circular part H preferably has a diameter between 1mm and 2mm.

20 The lens L_1 is further equipped with appendices A which keep the lens L_1 in position inside the eye EB.

The lens L_2 is also polarized.

25 This lens L_2 can be circular and mounted in a rotary manner on a support S, indicated in the figures in dashed line, so as to have its optical axis lying substantially on the same optical axis as the lens L_1 ; this common optical axis is indicated in the figures with X.

30 The support S can be part of the frame of a pair of glasses. The lens L_2 can for example be rotated on the support S through a ring not shown.

The mode of operation of the lenses L_1 and L_2 seen above is described below with reference to figs 3-5.

The lenses L_1 and L_2 are schematically depicted as two polarized rectangular plates and the non-polarized part H of the lens L_1 is not illustrated. The polarization axis of the lens L_1 is indicated with Y_1 and the polarization axis of the lens L_2 is indicated with Y_2 .

Fig.3 illustrates the geometric condition in which the angle α between the two polarization axes Y_1 and Y_2 is equal to 0° . In this case the light passes through the two lenses L_1 and L_2 with a slight attenuation due to the intrinsic light absorption of the two lenses L_1 and L_2 .

Fig.4 illustrates the geometric condition in which the angle α between the two polarization axes Y_1 and Y_2 is between 0° and 90° . In this case the light that passes through the two lenses L_1 and L_2 undergoes a greater attenuation which increases as the angle α increases.

Fig.5 illustrates the geometric condition in which the angle α between the two polarization axes Y_1 and Y_2 is equal to 90° . In this case the light attenuation is maximum because the light is completely absorbed by the two lenses L_1 and L_2 .

Fig.1 refers to the geometric condition of fig.5 with total light attenuation. In this case the non-polarized central portion H performs the function of pinhole.

Fig.2 refers instead to the geometric condition of fig. 4 with partial attenuation of the light.

In fig.6, in place of the intraocular implantable lens L_1 , an external contact lens L_{1E} is used in the ophthalmic system, with polarization absent in a small central part H as provided for the lens L_1 . The operating principle of this solution is exactly the one seen above with progressive light attenuation.

The lenses L_1 and L_{1E} can be provided with dioptric power or not.

The lens L_2 can also be provided with dioptric power or not.

The ophthalmic system disclosed and illustrated in the two embodiments has several advantages.

5

In the first embodiment with implantable intraocular lens L_1 , during surgery to implant the device or for subsequent operations, the lens L_1 is permeable to light and allows the surgeon to see the bottom of the eye without resorting to special equipment.

10

The surgery is so simple and of a shorter duration.

In both embodiments, the patient's visual field is not absolutely limited by the lens with pinhole. In fact, by rotating the lens L_2 , the patient can adjust the light passing through the polarized part of the intraocular lens L_1 or of the contact lens L_{1E} so as to widen the visual field and not limit it to the pinhole. The patient can also remove the lens L_2 always with the aim of widening the visual field.

15

The materials with which to make the lenses must obviously be suitable for the function and the location of the lenses, and be suitable for polarization treatment.

20

There is also to be noted the simplicity and therefore the low cost of the ophthalmic system seen.

Clearly, the ophthalmic system seen can be applied to one or both the eyes of a patient.

25

Variations on and/or additions to what has been described above and illustrated in the attached drawings may be provided.

30

In general, the lens with the central hole transparent to the light is integrated to the human eye, i.e. is inserted into the eye or applied to the eye, and the other lens is mounted externally to the eye in an optical coupling with the first lens.

The shape of the lenses can be different from the shape illustrated.

5 The support of the rotatable external lens can be of any type, also monocular, and not necessarily a frame of glasses.

The polarized lens mounted externally to the eye can also be a non-rotatable lens, i.e. a fixed lens can be used.

CLAIMS

1. Ophthalmic system for correcting sight defects comprising a first polarized lens (L_1, L_{1E}) suitable to be integrated to the eye (EB), provided with a central part (H) transparent to the light suitable to perform the function of a pinhole, and further comprising a second polarized lens (L_2) suitable to be mounted externally to the eye (EB) in optical coupling with the first lens (L_1, L_{1E}).
5
2. Ophthalmic system according to claim 1, wherein the second lens (L_2) is rotatable with respect to the first lens (L_1, L_{1E}).
10
3. Ophthalmic system according to claim 1 or 2, wherein the first lens (L_1, L_{1E}) and the second lens (L_2) are arranged along a common optical axis (X).
4. Ophthalmic system according to any one of claims 1-3, wherein the first lens is an intraocular lens (L_1) implantable in the eye (EB).
15
5. Ophthalmic system according to any one of claims 1-3, wherein the first lens is a contact lens (L_{1E}) applied to the eye.
20
6. Ophthalmic system according to any one of claims 1-5, wherein the central part (H) transparent to the light is a non-polarized part of the lens (L_1, L_{1E}).
7. Ophthalmic system according to any one of claims 1-5, wherein the central part (H) transparent to the light is formed by a through hole of the lens (L_1, L_{1E}).
25
8. Ophthalmic system according to any one of claims 1-7, wherein the central part H has a diameter between 1mm and 2mm.
9. Ophthalmic system according to any one of claims 2-8, wherein the second lens (L_2) is rotatably mounted on a frame.
30
10. Ophthalmic system according to claim 9, wherein said frame is a frame of

glasses.

11. Ophthalmic system according to claim 9 or 10, wherein the rotation of the second lens (L_2) is carried out by means of a ring.

5

12. Ophthalmic system according to any preceding claim, wherein at least one of said first and second lens ($L_1, L_{1E}; L_2$) is provided with a dioptric power.

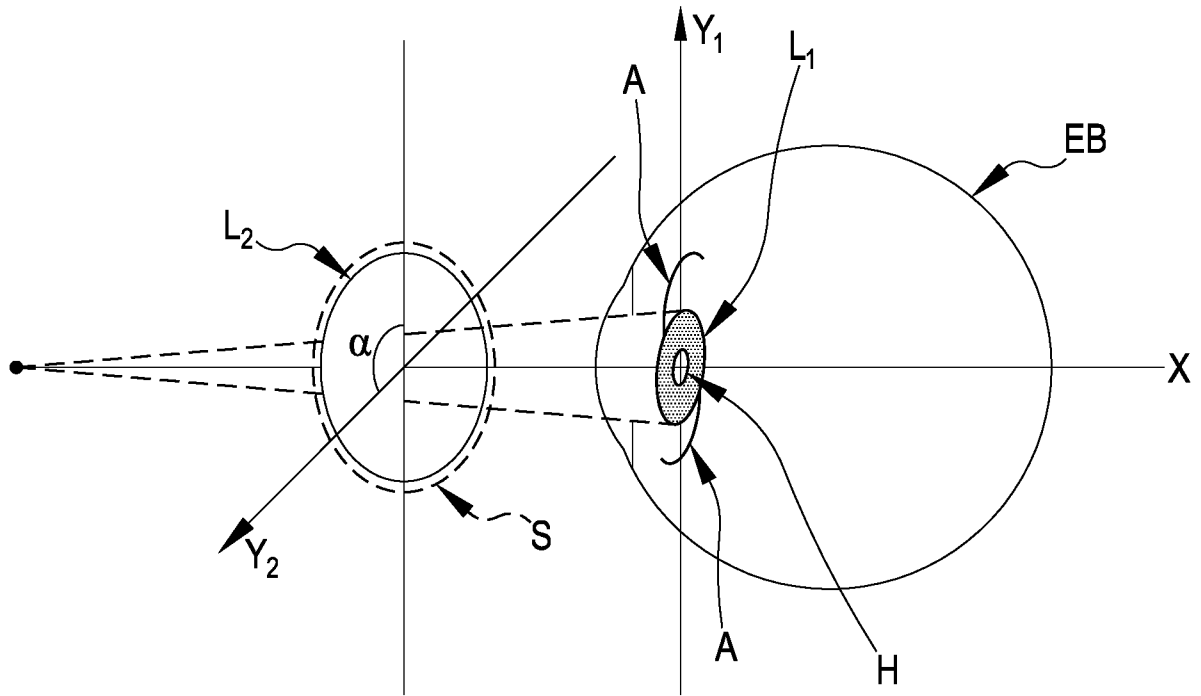


FIG.1

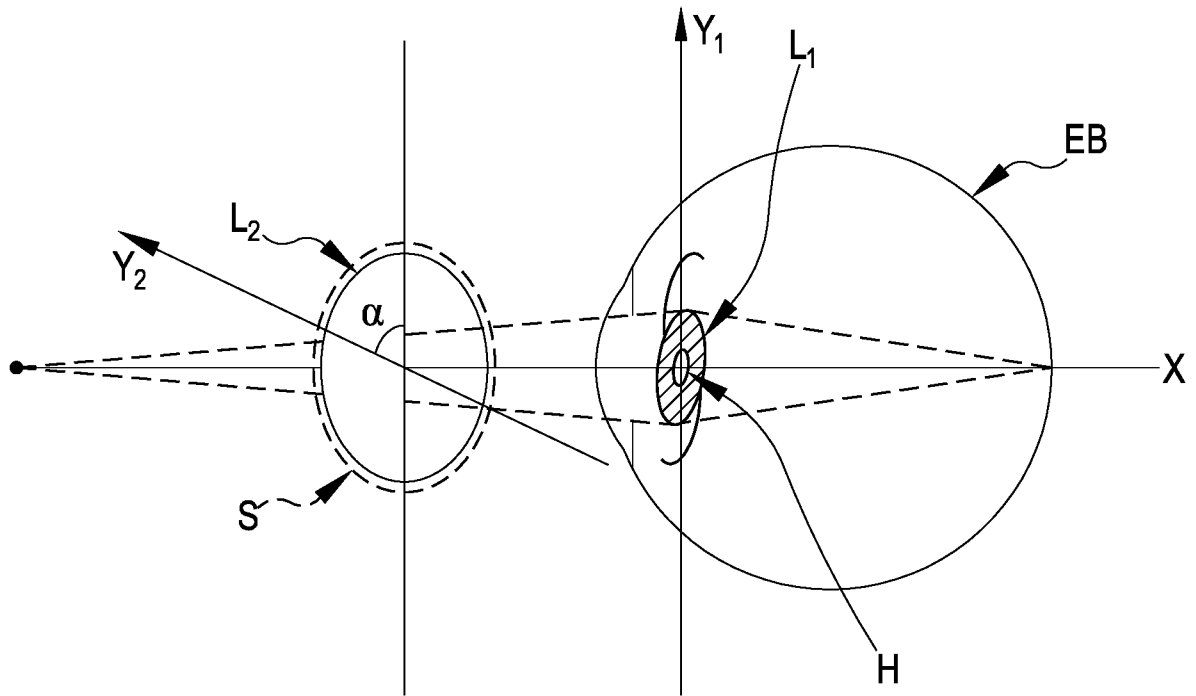


FIG.2

FIG.3

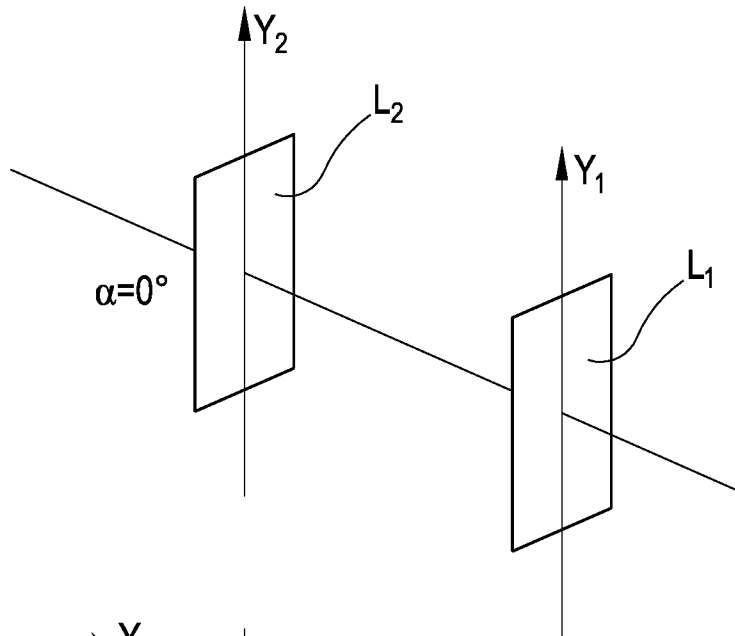


FIG.4

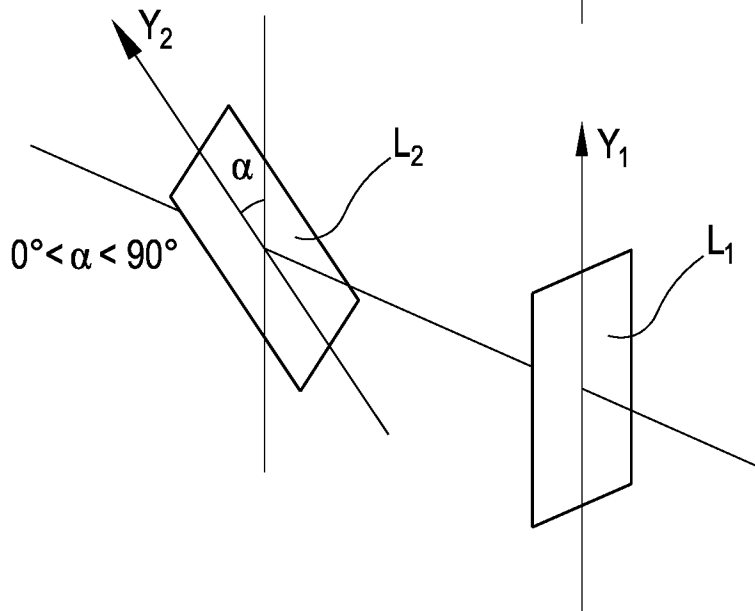
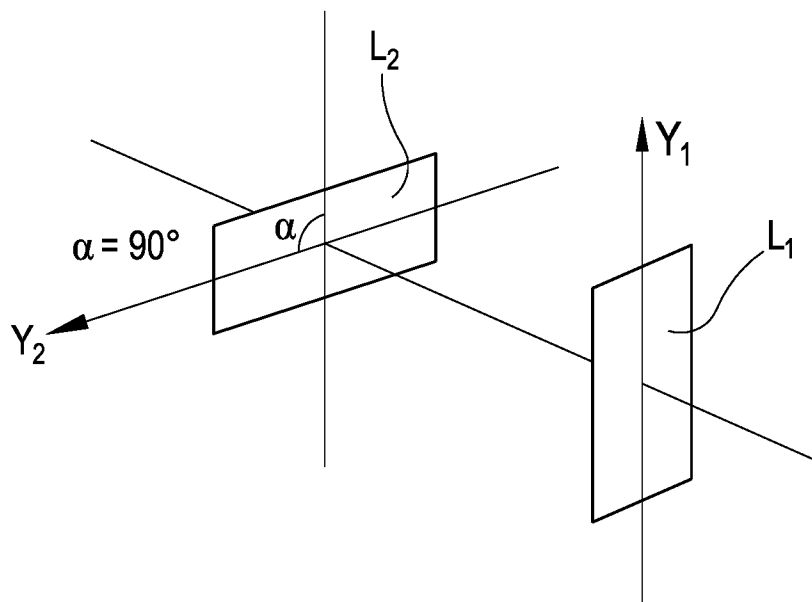


FIG.5



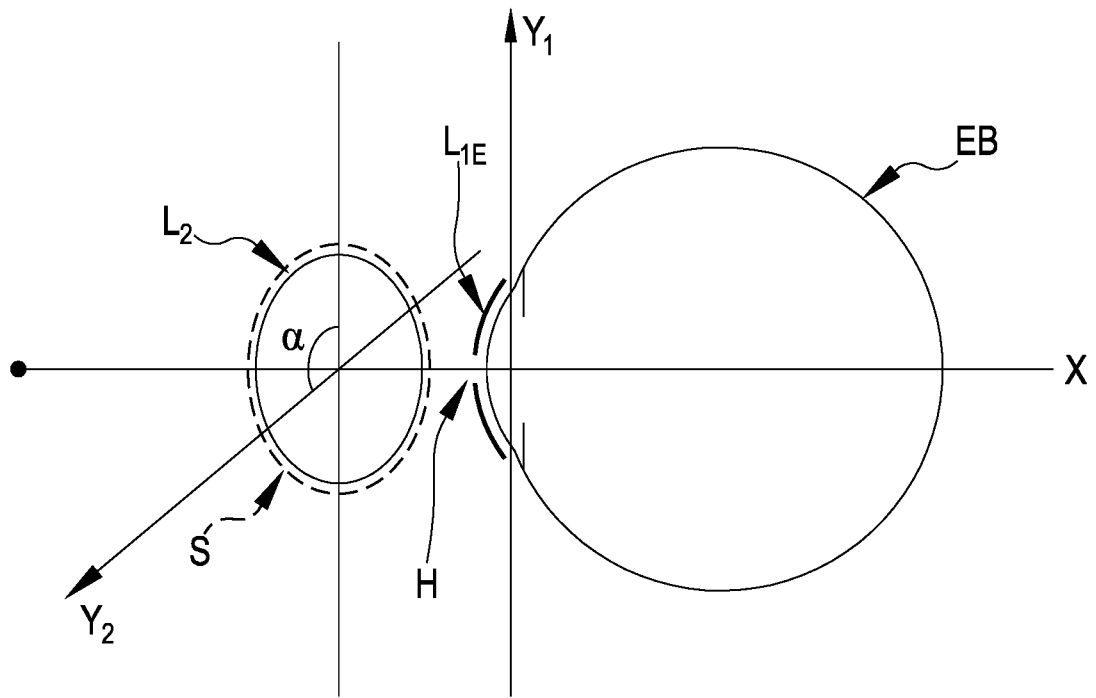


FIG.6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/052994

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A61F2/16
 ADD. A61F9/00 A61F9/02 G02C7/02 G02C7/12

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)
 A61F 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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 375 359 A2 (ALLERGAN INC [US]) 27 June 1990 (1990-06-27) abstract; figures 1-8 column 2, line 1 - column 7, line 54 -----	1-12
A	US 2006/259138 A1 (PEYMAN GHOLAM A [US]) 16 November 2006 (2006-11-16) abstract; figures 1-21 paragraphs [0055] - [0079] -----	1-12
A	US 5 245 367 A (MILLER DAVID [US] ET AL) 14 September 1993 (1993-09-14) abstract; figures 1-5 column 3, line 66 - column 7, line 45 -----	1-12

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search 7 November 2019	Date of mailing of the international search report 19/11/2019
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Mendelevitch, L
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/IB2019/052994

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