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(54) **Title**: OPHTHALMOSCOPE FOR OBSERVING AN EYE

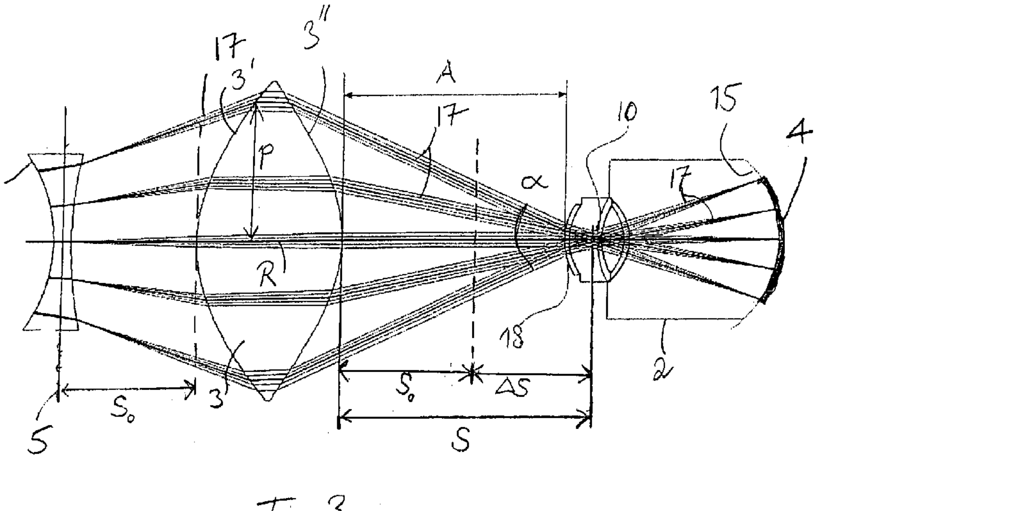

Fig. 3

(57) **Abstract**: The invention relates to an ophthalmoscope (1) for observing an eye (2) comprising a converging first lens system (3) for generating a real intermediate image of a region (4) in the eye (2) in an intermediate image plane (5) as well as an observation apparatus (6) having an imaging optics (7) for imaging the real intermediate image in an imaging plane (8) in the observation apparatus (6) and for imaging an aperture (9) of the observation apparatus (6) in a pupil (10) of the eye (2) wherein between the first lens system (3) and the imaging optics (7) of the observation apparatus (6) a diverging second lens system (13) is provided for enlarging a working distance (A) between the first lens system (3) and the pupil (10) and for enlarging a field angle (α). Further, the invention relates to a method of observing an eye (2).

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Ophthalmoscope for observing an eye

The invention relates to an ophthalmoscope for observing an eye and a method of observing an eye.

The observation of an eye, particularly of a fundus of the eye, usually serves for making a diagnosis of diseases of the eye as well as for the treatment of such diseases. In particular, age-related macular degeneration or diabetic retinopathy belong to these diseases. An early recognition of these diseases by diagnostic methods such as direct observation of the retina by a physician, fundus images, fluorescence images or optical coherence tomographies need special optical technologies since the fundus of the eye must be observed and imaged through a small opening of an eye pupil, respectively.

For the treatment of diseases of the retina frequently a laser irradiation is carried out on symptomatic regions of the retina. For this treatment a laser radiation must be coupled into the eye through the eye pupil and focused on the location to be radiated. During such a treatment the observation of the retina is necessary, as well.

Optical elements used directly at the eye for this purpose play a decisive role for the accuracy of an optical image of the fundus of the eye. For the observation of the fundus of the eye a slit lamp is used by standard. Using an ophthalmoscoping lens as explained for example in US 5,526,189 the fundus of the eye is imaged in an intermediate image plane. This intermediate image plane is viewed with a stereo microscope. The illumination of the fundus of the eye is carried out by a slit illumination which is coupled into the eye via the ophthalmoscoping lens. Critical disadvantages of such a fundus observation by means of a slit lamp, on the one hand, is a restriction toward a slit-shaped field of view on the retina as well as reflections of the illumination on the ophthalmoscoping lens and on a cornea of the patient which overlay the image of the fundus as interfering artefacts.

Furthermore, for the documentation of an examination or a treatment, respectively, it is necessary to store images of the fundus of the eye. To this end, for example fundus cameras and indirect ophthalmoscopes, respectively are used. In doing so, a converging lens system of the ophthalmoscope creates an intermediate image of the fundus of the eye which is imaged in an imaging plane by an imaging optics provided downstream, and in this imaging plane mostly an electronic photosensitive sensor is arranged.

With the observation of the fundus of the eye with an indirect ophthalmoscope the following parameters and boundary conditions are relevant. A field angle which is characterized by a maximum angle that two light beams starting from the eye and being imageable in the imaging plane by means of the ophthalmoscope may enclose between them, which should be as large as possible to allow a visual field of the fundus of the eye as large as possible, a size of the light sensitive sensor, and a construction size of the imaging optics of the ophthalmoscope which should be as compact as possible to keep the distance between the physician and the patient to be treated as small as possible (smaller than an arm length). In addition, relevant parameters are an imaging quality as high as possible, a diameter of the pupil of the examined eye which is smaller than 4 mm as a rule upon a preferably non-mydriatic examination, a working distance between the ophthalmoscope and the eye defined by a distance between the cornea of the eye and a surface of an entrance lens of the ophthalmoscope facing the eye which should be as large as possible so that other optical elements can be placed between the ophthalmoscope and the eye without any problems, and furthermore a larger distance between the ophthalmoscope and the nose and forehead of a patient is achieved to obtain a greater freedom of movement for the ophthalmoscope. The mentioned requirements are closely interconnected so that changes of one of these parameters have effects on the other parameters.

For example, selecting a cost-effective sensor having a diagonal of about 0.5 inch or smaller, then an intermediate image of the fundus of the eye must be usually imaged highly reduced in size onto this sensor. This either necessitates a great construction length of the imaging optics by which the distance between the physician and the patient is enlarged or the use of optical elements having short focal distances which however are in conflict with achieving a high imaging quality. To achieve a working distance as large as possible one may select an objective of the ophthalmoscope having a large focal distance. However, since the size of the intermediate image also scales with the focal distance of the objective the larger intermediate image is no longer completely detectable by the sensor with unchanged optics provided downstream. Thus, either a larger sensor has to be selected which highly enhances costs of the ophthalmoscope, or the optics provided downstream in turn as described must be able to achieve a severe reduction in size of the intermediate image which either requires a longer form of construction or the use of heavily refracting optical elements including the disadvantages mentioned above.

In addition to the creation of an intermediate image it is the object of the objective of an ophthalmoscope to allow a Maxwellian illumination upon which an apparatus pupil which usually is given by an aperture of the imaging optics is imaged into the pupil of the eye to be examined. Maxwellian illumination, also referred to as pupil imaging, allows the spatial separation of an observation beam path and an illumination beam path on the cornea of the eye in the vicinity of the pupil of the eye. By this spatial separation of the mentioned beam paths it is guaranteed that reflections on the cornea of the eye and on surfaces of the objective in the fundus image do not superimpose the reflection from the fundus of the eye, i.e. the observation beam which carries the decisive image information from the eye. Furthermore, the pupil imaging allows a particularly large field angle since a particularly large region of the eye may be imaged on the sensor of the ophthalmoscope. However, pupil imaging requires an accurately adjusted working distance. If the ophthalmoscope is positioned too far from the eye the aperture is imaged in front of the eye outside of the pupil. By this, the field angle is reduced, and moreover amounts of stray light will not be removed from the observation beam path as described above.

Thus, the present invention is based on the object to propose an ophthalmoscope for the observation of an eye, in particular of a fundus of the eye, by which a large working distance and large field angle may be achieved but wherein the construction length of the ophthalmoscope shall be as compact as possible, and wherein at the same time a pupil imaging as good as possible shall be achieved. Furthermore, image quality as high as possible shall be achieved with a sensor being as small as possible. In addition, a correspondingly advantageous method for the observation of an eye shall be proposed.

This object is solved according to the invention by an ophthalmoscope and a method having the features of the independent claims. Advantageous embodiments of the invention are subject-matter of the dependent claims.

The ophthalmoscope according to the invention for observing an eye comprises a converging (positively refracting) first lens system for generating a real intermediate image of a region in the eye in an intermediate image plane as well as an observation apparatus having imaging optics for imaging the real intermediate image in an imaging plane in the observation apparatus, and for imaging an aperture of the observation apparatus in a pupil of the eye wherein between the first lens system and the imaging optics a diverging (negatively refracting) second lens system is provided for enlarging a working distance between the first lens system and the pupil, and for enlarging a field angle.

The first lens system comprises at least one converging (positively refracting) lens, and furthermore the second lens system comprises at least one diverging (negatively refracting) lens. Both lens systems may also comprise further lenses.

By a converging (positively refracting) lens system a system of at least one lens is to be understood which converges a beam of rays of light beams running parallel to each other and passing through the positively refracting lens system. By a negatively refracting lens system a system of at least one lens is to be understood which refracts and diverges such a beam of rays passing this lens system.

By the arrangement of the diverging second lens system according to the invention it is achieved that the working distance necessary for achieving the pupil imaging is enlarged, wherein the working distance is defined as above by a distance between the cornea of the eye and a surface facing the eye of an entrance lens of the first lens system facing the eye. In particular, the working distance being achievable by the invention is larger than the distance between this surface and a focus of the first lens system facing the eye which corresponds to the working distance of a conventional ophthalmoscope without the second lens system. As already mentioned above, an enlarged working distance is advantageous in that other devices such as a contact lens can easily be placed between the ophthalmoscope and the eye. Further, a larger field angle can be achieved and a larger clearance of motion is made for the ophthalmoscope since particularly the distance to the nose and forehead of the patient will be enlarged as well.

In a further development being distinguished by particularly good optical image characteristics it is provided that the intermediate image plane is arranged inside the second lens system, in a first interstice between the first lens system and the second lens system, or in a second interstice between the second lens system and the imaging optics.

If the second lens system comprises exactly one lens then the intermediate image plane is located inside of the second lens system if the intermediate image plane passes through the respective lens. If the second lens system includes several of lenses then the intermediate image plane is located inside of the second lens system if the intermediate image plane is located between these both lenses or at least is passing through one of these both lenses. The same applies to the first lens system and the imaging optics. The intermediate image plane is in the first interstice between the first and the second lens systems if it is located between a surface of the second lens system facing the first lens system and a surface of the first lens system facing the second lens system, however, is located inside of neither the first nor the second lens systems. The intermediate image plane is in the second interstice between the second lens system and the imaging optics if it is located between a surface of the second lens system facing the imaging optics and a surface of the imaging optics facing the second lens system, however, is located neither inside of the second lens system nor inside of the imaging optics.

In one embodiment it is provided that the second lens system comprises exactly one diverging lens and the intermediate image plane is arranged inside of this lens. By the use of a single diverging lens in the intermediate image plane a working distance larger than usually will be achieved. On the other hand, the focal distance of the first lens system for imaging the intermediate image in the intermediate image plane remains unchanged such that firstly the intermediate image plane is not shifted by the second lens system, and secondly the intermediate image is not enlarged so that there is no need for the imaging optics provided downstream to be adapted to the second lens system.

An alternative embodiment of the ophthalmoscope according to the invention provides that the intermediate image plane in the first interstice is arranged in close vicinity to a surface of the second lens system facing the first lens system or that the intermediate image plane in the second interstice is arranged in close vicinity to a surface of the second lens system facing the imaging optics. In this way, a radiation power inside of the second lens system can be reduced. In particular, upon laser treatment of the eye this is advantageous in that the second lens system is protected from excessive radiation intensity of the laser which inside of the intermediate image plane is higher than usual. Especially for the treatment of the fundus of the eye a therapeutic laser beam is namely focused onto the fundus of the eye to achieve a radiation power in the fundus of the eye as high as possible. Focusing laser beam onto the fundus of the eye simultaneously means focusing the laser onto the intermediate image plane.

In order to simultaneously achieve a working distance as large as possible between the eye and the first lens system, not to change the position of the intermediate image plane, and if possible not to enlarge the intermediate image, in one embodiment it is provided that the intermediate image plane in the first interstice is arranged in a distance of 1 mm to 20 mm toward a surface of the second lens system facing the first lens system or that the intermediate image plane in the second interstice is arranged in a distance of 1 mm to 20 mm toward a surface of the second lens system facing the imaging optics. In another embodiment the mentioned distance is between 5 millimetres and 15 millimetres.

An embodiment of the ophthalmoscope of the type represented herein provides that the second lens system comprises at least two lenses wherein the intermediate image plane is arranged in an interstice between the at least two lenses. Again, in this way a reduction of a radiation power of a therapeutic laser beam inside of this lens material of the second lens system can be made, and at the same time a large working distance can be achieved.

In another configuration of the invention at least one lens contained in the second lens system is tilted relative to the intermediate image plane. In this way, an amount of stray light can be eliminated from the observation beam, and imaging quality of the ophthalmoscope can be improved. Preferably, a corresponding rotational angle between the tilted lens and the intermediate image plane is in a range between 0° and 45°. In a further development the rotational angle is within a range between 5° and 15°. Alternatively or additionally also lenses contained in the first lens system may be tilted accordingly.

In an embodiment of the invention, there is provided that the first lens system comprises a lens having a curved surface wherein the surface is formed aspherically. This is for the purpose of an optimization of the pupil imaging and the fundus imaging by means of a number as small as possible of optical surfaces. Such an optimization is particularly advantageous by means of aspherical surfaces since aspherical shaping of the lens surface allows a local optimization for every viewing angle. In doing so, local radii of curvature of the aspherical surfaces may be adapted according to an entrance height of a beam of rays. Here, the entrance height of the beam of rays is defined as the distance between a symmetry axis (relative to a rotational symmetry) of the lens and an entrance point of the beam of rays into the lens.

Optimization of imaging characteristics of the ophthalmoscope by means of aspherical lens surfaces compared with optimization by means of additional spherical lenses has the advantage of saving additional lens surfaces (optical surfaces) and thus of avoiding additional reflections of light on these surfaces.

In an alternative embodiment of the invention it is provided that the second lens system comprises a lens having a curved surface wherein this surface is shaped aspherically. In turn, aspherical shaping this lens is for the purpose described above. In a preferred embodiment the first and the second lens systems each comprise a lens having such an aspherically shaped surface.

In a further development of the invention it is provided that the observation apparatus comprises a light sensitive sensor which is arranged in the image plane for generating electric image signals. Such a sensor is applicable to allow digital image processing. Such an ophthalmoscope equipped with digital image processing offers a plurality of auxiliary diagnostic functions which shall not be further explained in detail herein.

An advantageous embodiment of the ophthalmoscope provides that the ophthalmoscope does not include any mirror, beam splitter, and/or any other lens in the intermediate region between the first and the second lens systems. In this way, a construction as simple and cost-effective as possible is feasible which furthermore is distinguished by a particularly high image quality since a reduction of stray light and unwanted reflections of light will be achieved by saving optical surfaces. For the same reason another embodiment of the invention provides that the ophthalmoscope does not comprise any mirror, beam splitter, and/or any other lens in an interstice between the eye and the first lens system.

An especially simple embodiment of the invention which is distinguished by a high imaging quality and a low amount of stray light provides that in addition to imaging of the region in the eye in the intermediate image plane and in the imaging plane no further imaging of the eye is provided.

The method of observing an eye according to the invention with an ophthalmoscope of the type represented herein provides that an observation beam reflected in the eye is imaged by a first lens system of the ophthalmoscope as an intermediate image in an intermediate image plane and the intermediate image is imaged by imaging optics of an observation apparatus of the ophthalmoscope in an imaging plane wherein the observation beam is diverged in a beam path between the first lens system and the imaging optics by a second lens system, and wherein furthermore an aperture of the observation apparatus is imaged in a pupil of the eye. In one embodiment this method is carried out with an ophthalmoscope of the type proposed herein.

In the following, the invention will be described in greater detail according to specific embodiments.

Figure 1 shows imaging of a fundus of an eye by means of an ophthalmoscope of the type proposed herein;

Figure 2 shows pupil imaging by means of an ophthalmoscope of the type proposed herein;

Figure 3 shows an ophthalmoscope of the type proposed herein with an intermediate image plane inside of a lens of the second lens system;

Figure 4 shows an ophthalmoscope of the type proposed herein with a lens tilted relative to the intermediate image plane;

Figure 5 shows an ophthalmoscope of the type proposed herein with an intermediate image plane in a first interstice between the first and the second lens system;

Figure 6 shows an ophthalmoscope of the type proposed herein with an intermediate image plane inside of the second lens system.

Figure 1 shows a schematic representation of a specific embodiment of an ophthalmoscope 1 of the type proposed herein for observing an eye 2. The ophthalmoscope 1 comprises a converging first lens system 3 for generating a real intermediate image 5 of a region 4 in the eye in an intermediate image plane 5 as well as an observation apparatus 6 having an imaging optics 7 for imaging the real intermediate image 5 in an imaging plane 8 inside of the observation apparatus 6 and for imaging an aperture 9 of the observation apparatus 6 in a pupil of the eye 4. The imaging optics 7 in this specific embodiment includes two converging lenses 11, 12. For achieving a higher imaging quality, in more complex embodiments instead of the single lenses 11 and 12 respective lens systems are provided which may comprise a number of lenses.

Further the ophthalmoscope comprises a diverging second lens system 13 wherein the intermediate image plane 5 runs inside of this second lens system 13. In the embodiment represented herein the second lens system 13 comprises one single diverging lens 13.

The beam path schematically shown in Figure 1 serves for the illustration of a pupil imaging, i.e. the imaging of the aperture 9 onto the eye pupil 10 wherein one divergent beam of rays 14 starting from the aperture 9 is focused on the pupil 10. An especially large region 4 in the eye is illuminated and observed, respectively, by the pupil imaging. A size of the region 4 immediately corresponds to a large field angle α. In the embodiment represented herein the field angle is 50° which corresponds to a region 4 having a diameter of about 16 mm on a fundus 15 of the eye.

In this embodiment the first converging lens system 3 contains one single converging lens 3 which so represents the entrance lens of the ophthalmoscope 1 which is shaped aspherically for improving the imaging characteristics of the ophthalmoscope under large observation angles (field angles) α. The ophthalmoscope

1 further comprises a light sensitive sensor 16 which is arranged in the imaging plane 8 for generating electric image signals. Further the ophthalmoscope comprises a digital image processing unit (not shown herein) for carrying out image processing functions.

In Figure 2 the exemplary ophthalmoscope 1 already described above according to Figure 1 is shown once again. In Figure 2 the situation of a fundus imaging is illustrated which is distinguished due to the fact that a beam of rays starting from the fundus 15 of the eye is imaged by the first converging lens system 3 in the intermediate image plane 5. In the further beam path this beam of rays is parallelised by the first converging lens 11 of the imaging optics 7, spatially limited by the aperture 9 (aperture diaphragm), and subsequently imaged by the second converging lens 12 in the imaging optics 7 in the imaging plane 8 onto the sensor 16.

The first lens system 2 and the second lens system 13 of the ophthalmoscope 1 described herein thus are applicable to simultaneously depict the fundus 15 of the eye 2 onto the sensor 16 of the observation apparatus 6 and to depict the aperture 9 in the pupil 10 which is located behind the cornea 18 of the eye 2 inside of the eye 2.

Moreover, by the diverging lens 13 contained in the second lens system a working distance between the first lens system and the eye 2 is enlarged as will be explained from the following figures in greater detail.

In this embodiment the intermediate image plane 5 is arranged inside of the lens system 13. In alternative embodiments the intermediate image plane (5) is located in a first interstice (19) between the first lens system (3) and the second lens system (13) or in a second interstice (19´) between the second lens system (13) and the imaging optics (7).

In Figure 3 a section of an ophthalmoscope described according to Figure 1 and Figure 2 is shown. In Figure 3 the beam paths of a plurality of beams of rays 17 starting from the observed region 4 on the fundus 15 of the eye 1 are sketched in. At first, starting from the fundus 15 of the eye they pass through the pupil 10 and exit from the eye 1. Afterwards they impinge at first onto the converging lens system 3 (of the entrance lens) focusing them in the intermediate image plane 5.

The beams of rays 17 exiting from the eye 4 consist of collimated light beams such that the single beams of rays are focused by the converging lens system 3 in a focal plane 5 of the first lens system 3 being identical with the intermediate image plane 5. Thus, a distance labelled as S_0 between the intermediate image plane 5 and a surface 3´ of the converging lens system 3 facing the intermediate image plane 5 approximately corresponds to a focal plane of the lens system 3.

Further, the converging lens 3 is shaped aspherically as already described above. In this way, even those beams of rays 17 which impinge the converging lens 3 with a large entrance height P are imaged onto the intermediate image plane 5 such that preferably the entire region 4 is optically conjugated with the intermediate image plane 5. The entrance height is defined as the distance between the entrance point of the respective beam of light and a symmetry axis R of the lens.

By the arrangement of the diverging lens 13 in the intermediate image plane 5 the working distance A between a surface 3´´ of the first lens system 3 facing the eye and a cornea 18 of the eye is enlarged. Without this diverging lens 13 the working distance which is necessary for the pupil imaging would correspond approximately to the distance S_0 between the surface 3´ of the lens system 3 facing the intermediate image plane 5. By the addition of the diverging lens system 13 the beams of rays 17 are bundled in a distance S, being a focal length of the ophthalmoscope, upstream of the first lens system, which is larger than S_0 by a value ΔS. Thus, a larger working distance A between the surface 3´´ of the converging lens 3 facing the eye 1 and the cornea 18 of the eye is resulting. Such an enlarged working distance A allows an observer of the eye 2 to move the ophthalmoscope without any restriction of the nose or frontal bone in front of the eye 1.

In Figure 4, in turn a section of a specific embodiment of an ophthalmoscope of the type herein presented is represented in section and schematically. The difference to the ophthalmoscope described according to Figure 3 is the tilting of the diverging second lens system 13 relative to the intermediate image plane 5 by an angle β. In the present case the angle β of tilting is 9.5°. The tilting has the positive effect of an elimination of reflections of light from the beam path of the ophthalmoscope such that the reflections of light might not lead to a degradation of image quality of an image of the region 4.

Again, in Figure 5 a specific embodiment of the ophthalmoscope of the type proposed here is represented in section and schematically. Unlike the embodiments described according to the Figure 1 to Figure 4 in this case the intermediate image plane 5 is arranged in a first interstice 19 between the first lens system 3 and the second lens system 13. A distance X between the intermediate image plane 5 and a surface 13´ of the second lens system 13 facing the intermediate image plane 5 is about 2 mm in the present embodiment. This is advantageous in that in the case of laser treatment of the fundus 15 of the eye of the eye 2 a radiation power inside of the second lens system 13 is reduced compared to the radiation intensity inside of the intermediate image plane 5. Furthermore, the surface is shaped aspherically. Further, in an intermediate region 21 between the first lens system 3 and the eye 2 any other mirrors, beam splitters, or lenses are not provided.

In Figure 6 another embodiment of an ophthalmoscope of the type proposed herein is represented in section and schematically. Unlike the ophthalmoscope described according to Figure 5, the second lens system 13 of this embodiment comprises two diverging lenses 13´´. The intermediate image plane 5 is arranged in intermediate region between the both diverging lenses 13´´ inside of the second lens system 13. Its advantage is in turn the reduction of radiation power inside of the diverging lenses 13´´ of the second lens system 13 for the protection of these lenses 13´´ against a too high radiation intensity, for example in the case of a laser treatment of the fundus 15 of the eye.

The distances S_o, ΔS, S, and X are each defined along an optical axis 20 of the ophthalmoscope.

List of reference characters:

1	ophthalmoscope
2	eye
3	first lens system
3´	surface of the first lens system facing the intermediate image plane
3´´	surface of the first lens system facing the eye
4	region of the eye
5	intermediate image plane
6	observation apparatus
7	imaging optics
8	imaging plane
9	aperture
10	pupil
11	first lens of the imaging optics
12	second lens of the imaging optics
13	second lens system
14	observation beam
15	fundus of the eye
16	sensor
17	observation beam
18	cornea
19	interstice
20	optical axis
21	interstice
α	field angle
β	tilting angle
A	working distance
S	focal length
S_o	distance between intermediate image plane and

first lens system

ΔS difference between S and S_o

R symmetry axis of the first lens system

P entrance height

Claims:

1. An ophthalmoscope (1) for observing an eye (2), particularly a fundus (15) of the eye (2), comprising a converging first lens system (3) for generating a real intermediate image of a region (4) in the eye (2) in an intermediate image plane (5) as well as an observation apparatus (6) having an imaging optics (7) for imaging the real intermediate image in an imaging plane (8) in the observation apparatus (6) and for imaging an aperture (9) of the observation apparatus (6) in a pupil (10) of the eye (2),
characterized in that
between the first lens system (3) and the imaging optics (7) of the observation apparatus (6) a diverging second lens system (13) is provided for enlarging a working distance (A) between the first lens system (3) and the pupil (10) and for enlarging a field angle (α).

2. An ophthalmoscope (1) as claimed in claim 1, characterized in that
said intermediate image plane (5) is arranged inside of said second lens system (13), in a first interstice (19) between said first lens system (3) and said second lens system (13), or in a second interstice (19´) between said second lens system (13) and said imaging optics (7).

3. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that

said second lens system (13) comprises exactly said one diverging lens (13) and said intermediate image plane (5) is arranged inside of this lens (13).

4. An ophthalmoscope (1) as claimed in any one of the preceding claims in combination with claim 2, characterized in that
said intermediate image plane (5) is arranged in said first interstice (19) in close vicinity to a surface (13´) of said second lens system (13) facing said first lens system (13) or that said intermediate image plane (5) is arranged in said second interstice (19´) in close vicinity to a surface (13´´) of said second lens system (13) facing said imaging optics (7) for reducing a radiation power inside of said second lens system (13) at a simultaneously large working distance (A).

5. An ophthalmoscope (1) as claimed in any one of the preceding claims in combination with claim 2, characterized in that
said intermediate image plane (5) is arranged in said first interstice (19) in a distance of 1 mm to 20 mm to a surface (13´) of said second lens system (13) facing said first lens system or that said intermediate image plane (5) is arranged in said second interstice (19´) in a distance of 1 mm to 20 mm to a surface (13´) of said second lens system facing said imaging optics (7) for reducing a radiation power inside

of said second lens system (13) at a simultaneously large working distance (A).

6. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that at least said one lens (13) contained in said second lens system (13) is tilted relative to said intermediate image plane (5) for suppressing of stray light.

7. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that said one lens contained in said second lens system is tilted relative to said intermediate image plane (5) by an angle (β) in a range between 0° and 45°.

8. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that said first lens system (3) comprises a lens (3) having a curved surface (3´) which is aspherically shaped for improving of imaging characteristics of said first lens system.

9. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that said second lens system (13) comprises a lens (13) having a curved surface (13´) which is aspherically shaped for improving of imaging characteristics of said second lens system.

10. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that

said observation apparatus (6) comprises a light sensitive sensor (16) which is arranged in said imaging plane (8) for generating electric image signals.

11. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that said ophthalmoscope (1) does not comprise any mirror, beam splitter, and/or any other lens in said first intermediate region (19) between said first and said second lens systems (3, 13).

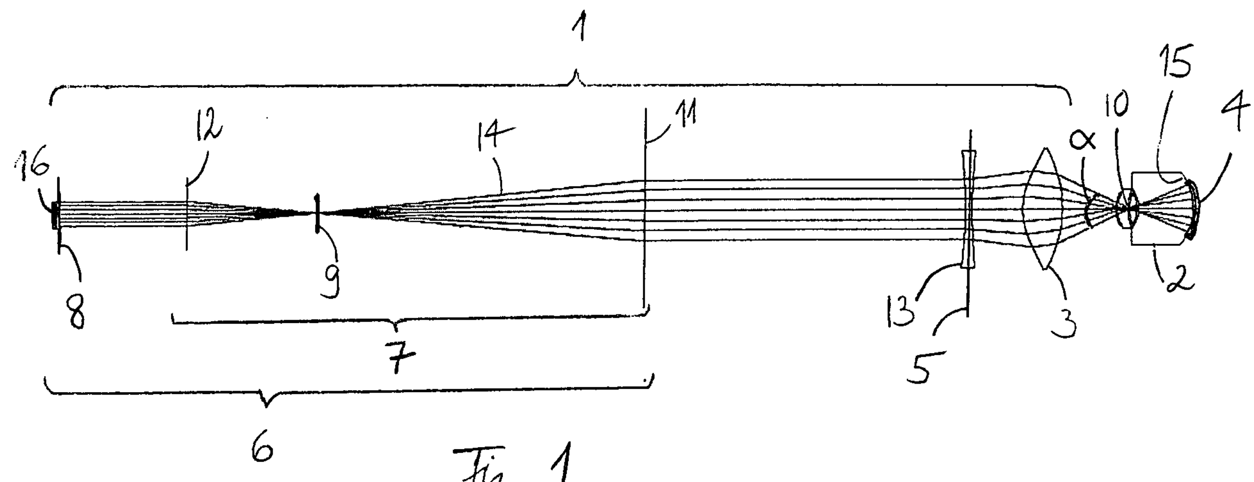
12. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that said ophthalmoscope (1) does not comprise any mirror, beam splitter, and/or any other lens in an intermediate region (21) between the eye (2) said first lens system (3, 13).

13. An ophthalmoscope (1) as claimed in any one of the preceding claims, characterized in that in addition to the imaging of said region (4) in the eye (2) in said intermediate image plane (5) and in said imaging plane (8) any other images are not provided.

14. A method for observing an eye (2), particularly a fundus (15) of the eye, with an ophthalmoscope (1), characterized in that an observation beam (17) reflected in the eye (2) is imaged by a first lens system (3) of said ophthalmoscope (1) as intermediate image in an intermediate image plane (5) and said intermedi-

ate image (5) is imaged by said imaging optics (7) of said observation apparatus (6) of said ophthalmoscope (1) in said imaging plane (8) wherein said observation beam (17) is diverged in a beam path between said first lens system (3) and said imaging optics (7) by said second lens system (13), and wherein further an aperture (9) of said observation apparatus (6) is imaged in a pupil (10) of an eye (2).

15. A method as claimed in claim 14, characterized in that
said method is carried out with said ophthalmoscope (1) as claimed in any one of the claims 1 to 13.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11
α
10
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4
8
9
13
3
2
5
7
6

Fig 1.

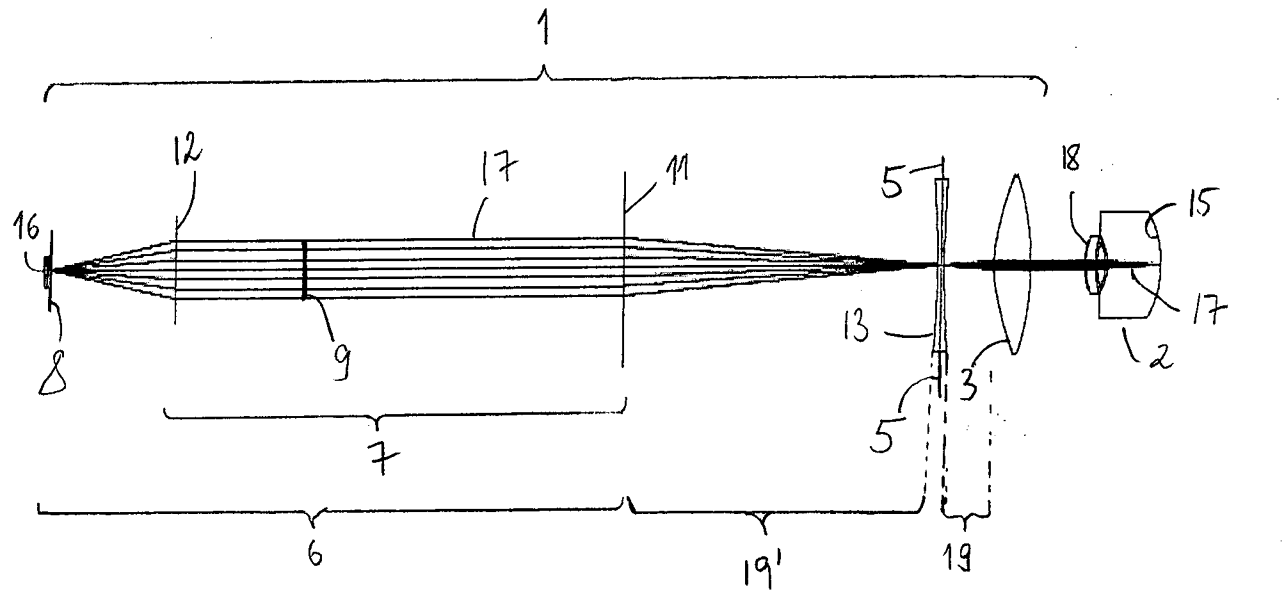
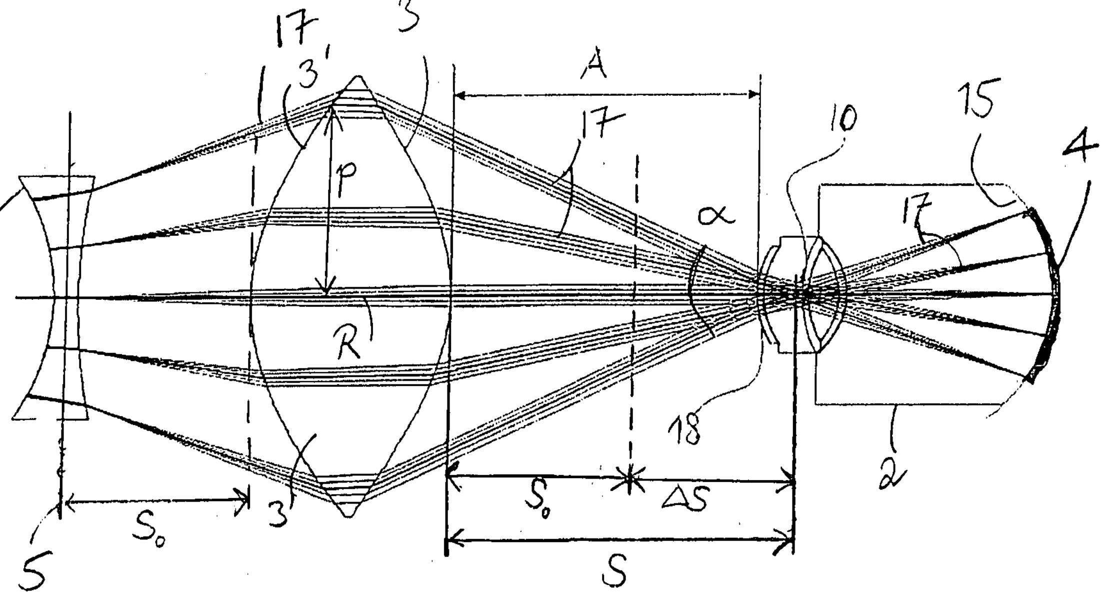

1
12
17
11
5
18
15
16
8
9
13
3
17
2
5
7
6
19'
19

Fig. 2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3'
3''
A
17
10
15
4
13
P
α
17
R
18
3
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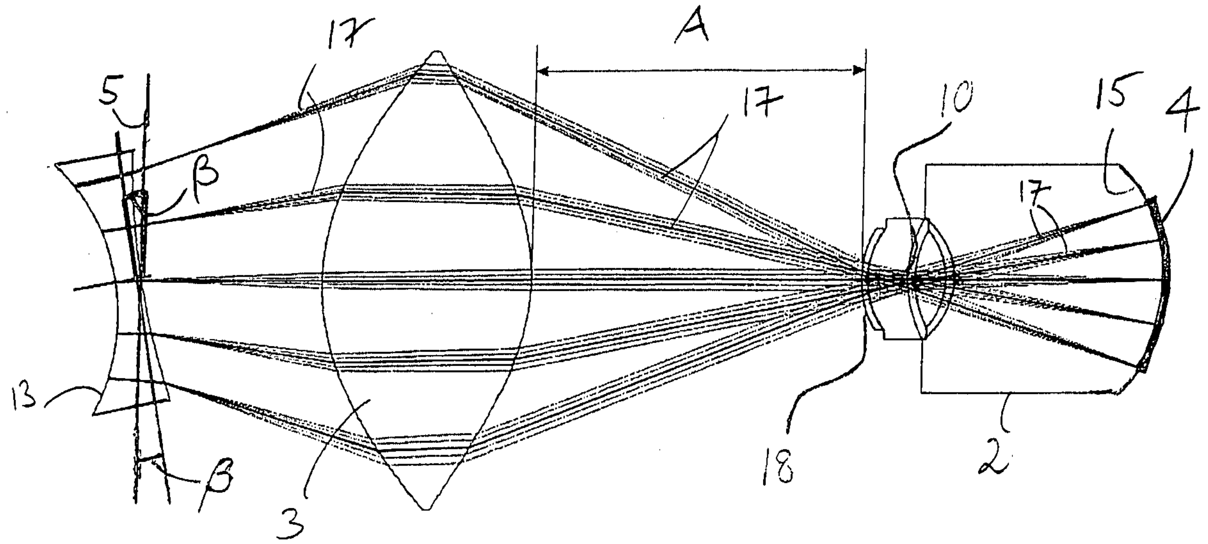
5
S_0
S_0
ΔS
S

Fig. 3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A
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10
15
4
5
β
17
13
β
3
18
2

Fig. 4

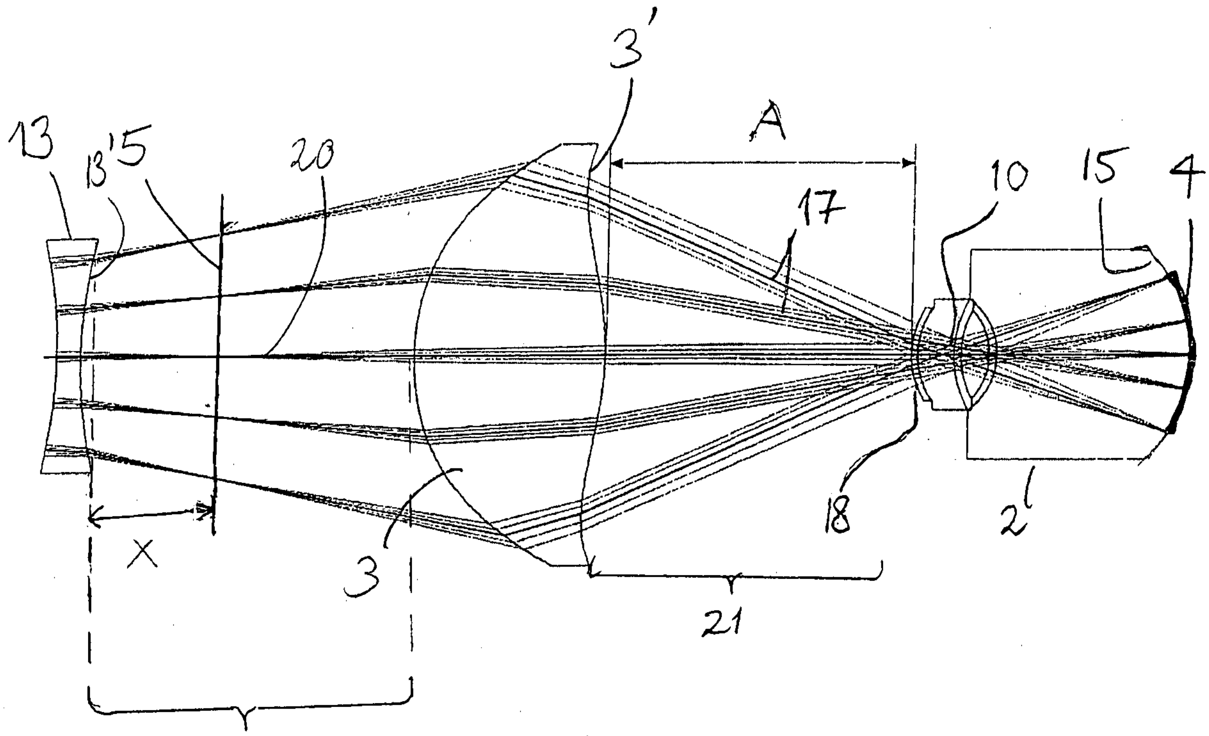

Fig. 5

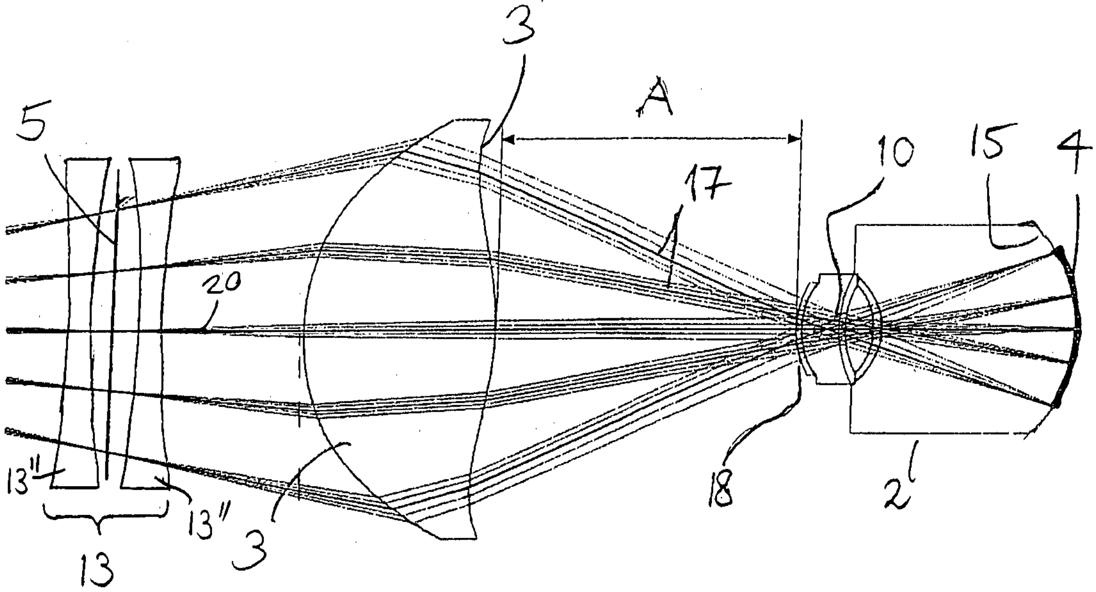

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/006037

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B3/12
ADD. A61F9/008

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)
A61B

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 30 01 244 A1 (CANON KK) 24 July 1980 (1980-07-24) figure 1 page 3, line 17 - line 19 page 8, line 34 - line 35 page 10, line 1 - line 2 -----	1-15
X	US 4 666 268 A (ITO YUJI [JP]) 19 May 1987 (1987-05-19) figure 2 column 2, line 41 - column 3, line 44 -----	1-15
A	WO 91/01703 A1 (SCIENT GENERICS LTD [GB]) 21 February 1991 (1991-02-21) figure 5 page 5, line 29 - line 37 page 9, line 3 - line 13 ----- -/--	1-15

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 October 2010	05/11/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Albrecht, Ronald

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	J-M PAREL ET AL: "REVIEW ARTICLE; The optics of the ophthalmoscope and related instruments" JOURNAL OF PHYSICS E. SCIENTIFIC INSTRUMENTS, IOP PUBLISHING, BRISTOL, GB, vol. 13, no. 12, 1 December 1980 (1980-12-01), pages 1242-1253, XP020016042 ISSN: 0022-3735 page 1247, line 12 - line 15 -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2010/006037

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
DE 3001244	A1	24-07-1980	US	4452517 A	05-06-1984
US 4666268	A	19-05-1987	JP	58152535 A	10-09-1983
WO 9101703	A1	21-02-1991	AU	6061090 A	11-03-1991
			EP	0485450 A1	20-05-1992
			JP	5500315 T	28-01-1993