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Protective Filter Module

The present invention relates to a protective filter module which is utilized especially in an ophthalmic therapeutic and diagnostic instrument. The protective filter
5 module functions to protect the eyes of the treating physician or viewer from applied laser radiation.

In ophthalmology, so-called laser slit lamps are known with which the ophthalmologist can treat the most varied eye illnesses of the patient. Here, laser radiation of different
10 wavelengths is used depending upon the required application.

Various arrangements can be utilized to couple the laser radiation into the slit lamp in the direction of the patient. However, for all known arrangements, the assurance must be provided that no damaging laser radiation reaches the eye of
15 the treating physician when applying the particular laser radiation. This can be caused, for example, by reflected radiation or even from scatter radiation. For this reason, it is conventional to provide a so-called physician protective filter in the viewing beam path of the slit lamp. This
20 protective filter is substantially transparent for the visible range of the electromagnetic spectrum; however, the filter is as opaque as possible in the range of the laser wavelength used.

For a motor-actuated physician protective filter, which
25 is only pivoted into the viewing beam path when applying the desired laser radiation, it has been up to now conventional to build in a separate unit having the motorized physician protective filter. This unit is built in between the body of the slit lamp microscope and the binocular tube.

30 Physician protective filter units of this kind are known, for example, from United States Patent 4,549,787 and German Patent 3,519,378. However, an increase of the working

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distance between patient and physician results as a disadvantage of these arrangements. The increase in working distance resulted because of the more voluminous, that is, longer housing of the laser slit lamp.

5 Furthermore, the lever-linkage mechanisms of the physician protective filter unit disclosed in United States Patent 4,549,787 and German Patent 3,519,378 are relatively complex and therefore cause high manufacturing costs.

10 It is therefore the task of the present invention to provide a protective filter module for an ophthalmic therapeutic and diagnostic instrument which is as compact as possible and which avoids the above-mentioned disadvantages of the state of the art and which is especially simple to manufacture.

The invention is a combination of an ophthalmic therapeutic and diagnostic instrument and a protective filter module for protecting the eyes of a viewer from applied laser radiation generated in said instrument by a laser and having a laser radiation wavelength. The combination includes: a housing of the instrument having a predetermined overall structural length and defining mutually adjacent viewing beam paths along which at least some of the laser radiation can pass; the housing defining an interface transverse to the beam paths; the protective filter module being insertable into the housing at the interface without increasing the overall structural length; the protective filter module including a base and a protective filter pivotally mounted on the base so as to be rotatable between a first position wherein the filter is in the viewing beam paths and a second position wherein the protective filter is outside of the beam paths; and, a line-and-pulley mechanism coupled to the laser and connected to the protective filter for pivoting the protective filter



between the first and second positions.

The protective filter module according to the invention can be integrated directly into the housing of the particular ophthalmic therapeutic and diagnostic instrument such as a slit lamp because of the compact configuration of the module. No unwanted increase of the overall structural length of the instrument results from this; instead, a constant working distance between patient and physician results. Building in the protective filter module of the invention has no negative effects especially for a retrofit of conventional diagnostic slit lamps to laser slit lamps.

It has been advantageously shown that the configuration of the invention makes possible a significantly simpler manufacture and assembly of the protective filter module when compared to systems known up to now. This is so because the entire protective filter module can be viewed as a self-contained group. The use of cost-effective components is especially possible in this context.

Further advantages as well as details of the protective filter module according to the invention will become clear from the following description of an embodiment taken together with the drawings.

FIGS. 1a to 1c show an arrangement of the protective filter module according to the invention in the housing of an ophthalmic therapeutic and diagnostic instrument; and,

FIGS. 2a and 2b each show a perspective view of an embodiment of the protective filter module of the invention.

FIGS. 1a to 1c show the arrangement of the protective filter module 1 of the invention in the housing 2 of an ophthalmic therapeutic and diagnostic instrument. This instrument is configured as a conventional slit lamp in the illustrative embodiment. Of the slit lamp, only the slit lamp

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microscope is shown; that is, the illustration of the slit illumination as well as the slit lamp mechanics has been omitted.

The slit lamp microscope includes an optical configuration which is essentially known. This includes one or two main objectives which are, however, not visible in FIGS. 1a to 1c. The slit lamp microscope further includes a downstream Galilei magnification changer which is actuated via a rotary knob 3 on the housing 2 of the slit lamp.

The protective filter module 1 of the invention is mounted at the viewing end of the housing 2 of the slit lamp microscope. The protective filter module 1 is so made that it can be integrated directly into the housing 2 of the slit lamp microscope without an increase of the overall structural length of the instrument. This means that the protective filter module 1 is built so compactly that it can be mounted between a boundary surface of the housing 2 of the slit lamp microscope and the magnification changer and does not project beyond this boundary surface.

At this point, reference is made to the description of FIGS. 2a and 2b with respect to the detailed configuration of the protective filter module 1 of the invention as well as with respect to individual measures to minimize structural dimensions.

As can be seen in FIG. 1b, the housing 2 is closed via an end cover 4 utilizing a series of suitable threaded fasteners. This is done after the assembly of the protective filter module 1 of the invention in the housing 2 of the slit lamp microscope. The closure cover 4 simultaneously defines the interface for the binocular tube 5 which is provided. The binocular tube is mounted as shown in FIG. 1c. The binocular tube 5 is preferably connected to the end cover 4 via a

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detachable connection such as a bayonet connection or the like.

As can be seen especially with respect to the drawing of FIG. 1c, no increase of the overall structural length results which is not the case for the known arrangement of United States Patent 4,549,787. This is achieved by the arrangement of the protective filter module 1 of the invention directly in the housing 2 of the slit lamp microscope. The working distance therefore remains constant for the physician independently of whether the particular slit lamp is utilized as a diagnostic slit lamp or as a laser slit lamp.

The embodiment of the protective filter module 1 of FIGS. 1a to 1c is shown in perspective views in each of the FIGS. 2a and 2b. Here, the drawing of FIG. 2a corresponds to the built-in position as it is shown also in FIGS. 1a to 1c. In contrast, FIG. 2b shows the rear side of the protective filter module 1 with additional components especially the line-and-pulley mechanism which is provided.

The illustrated embodiment of the protective filter module 1 of the invention includes a base plate 6 which has various boxes (7a, 7b, 7c, 7d) via which the base plate 6 is mounted in the housing of the slit lamp microscope with the aid of suitable threaded fasteners. The actual protective filter 8 is mounted on the side of the base plate 6 facing toward the viewer. In the embodiment of FIG. 2a, the protective filter 8 comprises a dumbbell-shaped frame 9 in which the two protective filter inserts (10a, 10b) are detachably mounted. The protective filter inserts (10a, 10b) are mounted advantageously in the frame 9 with the aid of locking rings (not shown).

As suitable protective filter inserts (10a, 10b), for example, suitable glasses with or without optical effect can

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be used which are opaque for the laser wavelength used. However, the glasses are substantially transparent in the visible spectral range.

If, for example, an argon-ion laser (which emits substantially in the green spectral range) is utilized, then an absorption of this green spectral range occurs while the remaining spectral components are allowed to pass through.

The use of a dumbbell-shaped platelet made of suitable plastic material in lieu of the frame having integrated protective filter inserts is possible as an alternative to the illustrated embodiment of the protective filter. Here, the selected plastic material exhibits the above-mentioned transmission characteristic and absorption characteristic. Such a simple embodiment of the protective filter offers cost advantages and makes a simplified manufacture possible.

The protective filter 8 is rotatably journaled about an axis 11 which is orientated perpendicularly to the base plate 6. A suitable ball bearing can be used as a rotary bearing. In the illustration of FIG. 2a, the protective filter 8 is in the out-pivoted position; that is, both openings (12a, 12b) in the base plate are cleared for the stereoscopic viewing beam paths. In the active state (that is, when the laser radiation is applied), a rotational movement of the protective filter 8 of 90° about the axis 11 takes place so that the protective filter inserts (10a, 10b) are pivoted into the respective viewing beam paths and so that the back reflection of the laser radiation into the eye of the physician is prevented. The protective filter inserts (10a, 10b) are arranged in the frame 9.

When the laser radiation is activated, the protective filter 8 is moved into its in-pivoted position by an actuating element 13 as well as by a line-and-pulley mechanism coupled

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to the actuating element 13. Reference can be made to FIG. 2b with respect to an advantageous line-and-pulley mechanism for pivoting the protective filter 8 into the viewing beam path. FIG. 2b shows a rear view of the protective filter module 1 of the invention. The line-and-pulley mechanism permits especially a compact assembly of the entire protective filter module 1.

An actuating element 13 is provided on the rear side of the base plate 6 and is configured as a solenoid. The solenoid is mounted via a suitable attachment device 16. The actuating element 13 is coupled to the laser via a signal connection (not shown) and is activated when the laser is triggered and switched off when the laser is deactivated.

A fine line 18 is connected to a plunger 17 of the solenoid 13 and a drive movement is transmitted to the protective filter 8 via the fine line 18. The fine line 18 is attached to the plunger 17 of the solenoid and is guided over a first direction-changing pulley 19 to a drive pulley 20 for the protective filter 8. The fine line 18 is connected form-tight to the drive pulley 20 on the rotational axis 11 of the protective filter 8 to transmit the drive movement. The other end of the fine line 18 is provided with an eyelet 21 on which a spiral spring 22 is hooked in. The spiral spring 22 is secured to an attachment pin 23 on the base plate 6. Accordingly, when the laser radiation is activated, the plunger 17 of the solenoid is moved inwardly and this results in a rotational movement of the protective filter via the above-described line-and-pulley mechanism. At the other side, the protective filter is connected with the rotational axis 11, more specifically, with the drive pulley 20.

A defined pivoted-in position of the protective filter 8 is ensured by two stop pins (24, 25) arranged on the base

plate 6. The stop pins (24, 25) delimit the possible rotational movement of the protective filter 8 to a maximum of 90°.

As long as the solenoid receives a corresponding signal from the laser, the plunger 17 remains in this position and ensures that the protective filter 8 remains pivoted into the viewing beam paths. Thereafter, the filter is again moved to its rest position in the pivoted-out position by the effective return force of the tensioned spiral spring 22.

Furthermore, a sensor element 15 is mounted on the side of the base plate 6 which faces toward the viewer and which has the protective filter 8. The sensor element 15 is configured as a commercially available Hall sensor. A small magnet 14 is mounted on the frame 9 of the protective filter 8. This magnet 14 passes over the Hall sensor during the pivoting of the protective filter 8 into the viewing beam paths and so supplies a monitoring signal as to the actual status of the protective filter 8. The laser is triggered only when this monitoring signal as to the pivoted-in protective filter 8 is present.

The sensor element 15 used is preferably "fail-safe", that is, a correct monitoring signal for the pivoted-in protective filter 8 is only then emitted when the magnet 14 passes over the sensor element 15 and the sensor element 15 functions properly. Faulty signals as to the actual status of the protective filter 8 are thereby excluded.

In addition to the use of a Hall sensor as a sensor element 15, a monitoring device of this kind can, of course, also be realized with other sensor elements such as a known light barrier mounted on a fork-like structure etc.

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Claims:

1. The combination of an ophthalmic therapeutic and diagnostic instrument and a protective filter module for protecting the eyes of a viewer from applied laser radiation generated in said instrument by a laser and having a laser radiation wavelength, the combination comprising:

a housing of said instrument having a predetermined overall structural length and defining mutually adjacent viewing beam paths along which at least some of said laser radiation can pass;

said housing defining an interface transverse to said beam paths;

said protective filter module being insertable into said housing at said interface without increasing said overall structural length;

said protective filter module including a base and a protective filter pivotally mounted on said base so as to be rotatable between a first position wherein said filter is in said viewing beam paths and a second position wherein said protective filter is outside of said beam paths; and,

a line-and-pulley mechanism coupled to said laser and connected to said protective filter for pivoting said protective filter between said first and second positions.

2. The combination of claim 1, said line-and-pulley mechanism including: a line having a first end and a second end connected to said protective filter; a pulley mounted on said base for guiding said line; and, an actuating element connected to said first end of said line for applying a force thereto for moving said protective filter from one of said positions to the other one of said positions.

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3. The combination of claim 2, said actuating element being a solenoid.

4. The combination of claim 3, said base being a base plate having first and second sides; said protective filter being mounted on said first side; and, said line-and-pulley mechanism being mounted on said second side.

5. The combination of claim 2, further comprising a monitoring device for detecting which of said positions said protective filter is in.

6. The combination of claim 5, said monitoring device including a sensor element mounted on said base and a magnet mounted on said protective filter for coacting with said sensor element when said protective filter is in one of said positions.

7. The combination of claim 6, said magnet being mounted on said protective filter so as to coact with said sensor element when said protective filter is in said first position; and, said sensor element being a Hall sensor for generating a monitoring signal when said protective filter is in said first position.

8. The combination of claim 3, said line-and-pulley mechanism including a mounting pin mounted on said base; a spiral spring; a drive pulley mounted on said base for driving said protective filter between said first and second positions; a direction-changing pulley for said line; and, said line being guided over said

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direction-changing pulley and said drive pulley and being connected with said second end thereof to said spiral spring.

9. The combination of claim 8, said second end being defined by an eyelet hooked into said spiral spring.

10. The combination of claim 2, wherein said protective filter has a dumbbell-like shape.

11. The combination of claim 2, said protective filter including a frame having a dumbbell-like shape and defining two openings; and, filter inserts detachably mounted in said openings, respectively.

12. The combination of claim 2, said protective filter being a plastic plate having a dumbbell-like shape; and, said plastic plate being essentially transparent but essentially opaque for said radiation wavelength.

13. The combination of claim 2, wherein said instrument includes an objective and a viewing tube; and, said protective filter is integrated into said housing so that there is no increase in structural length measured between said objective and said viewing tube.

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