

Shutter assembly

The present invention relates to a shutter assembly of a UV microscope slider comprising a base plate including an aperture for passing a light path of a UV light source.

Conventional microscopes using a UV light source generally have a mechanical shutter in which an aperture is closed and opened by means of a slider which is manually actuated. In a closed position of the slider, it is locked in an engaging recess formed in an edge portion of the shutter. Such a shutter is used in microscopes having a light source with a long start-up time so that the light source is not to be switched off, if the microscopes should be operated, for example, for a moment by another light source. Such shutter assemblies are installed in conventional miniature cameras and can be supplementary installed in UV microscopes. However, the supplementary installation of the shutter assemblies in a UV microscope is very expensive and such shutter assemblies have long time exposures which lead to bleach out the fluorescent dye and warm up the specimen. Therefore, the conventional shutter assemblies do not allow short time exposures at a fluorescent signal.

The object of the present invention is to provide a shutter assembly of a UV microscope slider which allows short time exposures at a fluorescent signal, i.e. a quick locking and releasing of the light path of the UV light source, and which allows a simple supplementary installation on conventional UV microscopes.

According to the present invention, this is achieved by a shutter assembly of a UV microscope slider, comprising a base plate including an aperture, a first and second sliding plate each having an opening and a first and second end and being arranged in an overlapping relationship, the first ends of the sliding plates being slideably mounted to the base plate, a two arm lever rotatably connected to the base plate and

pivotably connected to the second ends of the sliding plates, and an electromagnetical actuator pivotably connected to the lever, wherein the sliding plates are overlappingly slideable moveable in opposite directions along longitudinal directions from an opening position into a closing position by operating the actuator to align the aperture of the base plate with the openings of the sliding plates.

The arrangement of the first and second sliding plates in an overlapping relationship und the installation of the electromagnetical actuator in a shutter assembly of UV microscope slider according to the present invention open up the possibility to allow short time exposures which are necessary to photographically imaging fluorescent colors. This prevents the bleaching of the fluorescent dye and warming up of the specimen in microscopical operations. Such a shutter assembly can be easily installed in a UV microscope since the "On/Off" slider is changed by the operator only.

The shutter assembly according to the present invention may be used for all types of light-microscopes (transmission and inverted microscopes) which are attached to an ultra violet light source. In addition, the shutter assembly according to the present invention may be used for microinjection and in vivo studies to check whether the injected dye or the expressed dye is present. The shutter assembly is designed for fitting into a normal commercial microscope slider and can be triggered manually, wherein the trigger is mostly shock free. The shutter can be attached by means of an electro-mechanical switch, wherein a semiautomatical use is possible by triggering with existing software, and timers can be attached to control the trigger.

The present invention provides an integration of a commercial camera shutter into a modified existing hand driven microscope slider which controls On/ Off for UV-light. The electrical controlling of the shutter assembly may be manually provided and attached to an electromechanical switch, wherein the

switch may be operated on 4,5 to 6 V and triggered by a pulse on a key.

According to a preferred embodiment of the present invention,
5 the actuator is a rotatable electromagnet being energizable to move into one direction of said longitudinal directions of the sliding plates and being biased by a return spring in a direction opposite to said one direction. This preferably allows to bias the overlapping sliding plates into a direction
10 of the closing position to lock the aperture of the base plate, so that the light path can not pass the aperture. If the shutter assembly is operated to partially or completely pass the UV light path through the aperture of the base plate, the rotatable electromagnet is energized to move into a
15 direction of the opening position. Thus, a simple controlling of the shutter assembly is achieved by easily operating electrical components.

Further, the actuator can be a solenoid which is energizable
20 in a direction to the opening position and is not energizable and biased by a return spring in a direction to the closing position. Such a solenoid may be easily attached to the lever for moving the first and second sliding plates and may be installed in a small space, so that the shutter assembly
25 including the actuator can have a minimized size.

Preferably, the pivot connection of the actuator to the lever includes a coupling rod having two ends, the one end thereof being pivotably mounted to the actuator and the other end
30 thereof being pivotably mounted to said one arm of the lever. The coupling rod allows a simple and reliable transmission mechanism to transmit the driving force of the actuator onto the link mechanism of the first and second sliding plates. The coupling rod performs a reciprocating movement by pivoting the
35 two ends of the coupling rod around the pivot connections of the actuator and the lever.

If the one arm of the lever is longer than the other arm of

the lever, the sliding plates can be moved with different speeds in said opposite directions. By this geometry of the lever, the transformation ratio of the shutter assembly according to the present invention can be varied with

5 different speeds of the overlapping sliding plates to achieve various proportions between the time exposures at the fluorescent signal and the amount of the alignment of the aperture of the base plate with the openings of the sliding plates.

10

According to the present invention, the first ends of the sliding plates each can have a latch extending in parallel to a longitudinal direction of the sliding plates and including an elongated slit in which a bolt mounted to the base plate is
15 slideably and pivotably engaged. The elongated slits of the latches provide a defined movement of the sliding plates when actuating the sliding plates by means of the actuator via the two arm lever. Following the movement of the lever, the bolts of the base plate are sliding within the elongated slits, and
20 the first ends of the sliding plates are pivoted in proportion to the pivot motion of the second ends of the sliding plates. Additionally, the sliding movement of the sliding plates is defined and limited by the bolts within the elongated slits.

25 Preferably, the second ends of the sliding plates each have a latch extending inclined and facing away from the longitudinal direction of the sliding plates in a plane of the sliding plates. This allows a further variation of the speeds for moving the sliding plates in opposite directions and,
30 therefore, to adjust the proportions between the time exposures at the fluorescent signal and the amount of the alignment of the aperture of the base plate with the openings of the sliding plates, as desired. Additionally, the two arms of the lever are elongated, so that the forces for actuating
35 the sliding plates can be decreased.

According to another preferred embodiment of the present invention, the openings of the sliding plates are formed

symmetrically to the longitudinal direction of the sliding plates and define a cross-sectional shape of a semicircle and an isoscele triangle. By such a design of the openings, a special regulation of the passing UV light can be performed to provide predetermined patterns of the UV light passing the aperture and the openings of the sliding plates. The cross-section of the openings can be aligned in different directions. By forming such an irregular cross-section shape of the openings of the sliding plates, no proportionality between the time exposures at the fluorescent signal and the amount of the alignment of the aperture of the base plate with the openings of the sliding plates is provided.

It is preferred to form the isoscele triangles of the cross-sectional shape of the openings of the first and second sliding plates so that they face each other. In this embodiment, the alignment of the aperture with the openings of the sliding plates can be defined in an exactly defined way from a smallest light passing area in the isoscele triangle portion up to a largest light passing area in the semicircle portion of the openings of the sliding plates.

The present invention is further described by way of a preferred embodiment as disclosed in the drawings.

Fig. 1 is a schematical front view of a shutter assembly of a UV microscope slider according to a preferred embodiment of the present invention;

Fig. 2 is a front view of a first sliding plate of the shutter assembly of fig. 1;

Fig. 3 is a front view of a second sliding plate of the shutter assembly of fig. 1;

Fig. 4 is a front view of overlapping first and second sliding plates of fig. 1 in an opening position;

Fig. 5 is a front view of overlapping first and second sliding plates of fig. 1 in another opening position; and

Fig. 6 is a front view of a UV microscope using the shutter assembly according to the present invention.

With reference to figs. 1 to 3, a shutter assembly of a UV microscope according to a preferred embodiment of the present invention comprises a base plate 1 including an aperture (not shown), and a first sliding plate 2 and a second sliding plate 3 each having an opening 4 and being arranged in an overlapping relationship. The openings 4 of the first and second sliding plates 2, 3 are formed symmetrically to the longitudinal direction of the sliding plates 2, 3 and define a cross-sectional shape of a semicircle and an isosceles triangle, wherein the isosceles triangles are formed so as to face each other. The diameter of the aperture of the base plate 1 is approximately equal to that of the semicircle of the openings 4. The one ends of the sliding plates 2, 3 each have a latch 5 extending in parallel to the longitudinal direction of the sliding plates 2, 3 and including an elongated slit 6 in which a bolt 7 mounted to the base plate 1 is slideably and pivotably engaged. The latches 5 of the sliding plates 2, 3 are arranged opposite to the longitudinal axis of the sliding plates 2, 3 in their overlapping relationship. The other ends of the sliding plates 2, 3 each have a latch 8 extending inclined and facing away from the longitudinal direction of the sliding plates 2, 3 in a plane thereof. As shown in figs. 2 and 3, the latch 8 of the first sliding plate 2 is longer than the latch 8 of the second sliding plate 3. An L-shaped two arm lever 9 is rotatably connected to the base plate 1, wherein the L-shaped arm 10 is longer than the straight arm 11. The free end of the L-shaped arm 10 of the lever 9 is pivotably connected to the free end of the latch 8 of the first sliding plate 2, and the free end of the straight arm 11 of the lever 9 is pivotably connected to the free end of the latch 8 of the second sliding plate 3, so that the lever 9 forceably moves both the first and second

sliding plates 2, 3 in an overlapping relationship. The shutter assembly further comprises a coupling rod 12 having two ends, the one end thereof being pivotably mounted to the end of the L-shaped arm 10 of the lever 9 and the other end thereof being pivotably mounted to a rotatable electromagnet 13 to perform a reciprocating movement by pivoting the two ends of the coupling rod 12 around the pivot connections of the L-shaped lever arm 10 and the electromagnet 13. The rotatable electromagnet 13 is energizable to move into a direction of an opening position of the sliding plates 2, 3 and is biased by a return spring (not shown) in an opposite direction of a closing position of the sliding plates 2, 3. The electromagnet 13 is fixedly mounted to the base plate 1 adjacent to the side of the lever 9 with a small distance therebetween.

In operation, as above mentioned, the rotatable electromagnet 13 is biased in the direction of the closing position of the sliding plates 2, 3, i.e. the aperture of the base plate 1 is aligned with the openings 4 of the sliding plates 2, 3 in such a way that no UV light is passed. If the electromagnet 13 is energized, the coupling rod 12 is drawn to overlappingly slideably move the sliding plates 2, 3 in the direction of the opening position such that the top portions of the isoscele triangles of the openings 4 of the sliding plates 2, 3 will overlap to form a small trapezoidal cross-section shape for passing the UV light, as shown in fig. 5. If the coupling rod 12 is further drawn by energizing the electromagnet 13, the overlapping portions of the isoscele triangles of the openings 4 of the sliding plates 2, 3 will enlarge to form a larger trapezoidal cross-section shape for passing the UV light, as shown in fig. 4. By further drawing the coupling rod 12 by energizing the electromagnet 13, the overlapping portions of the openings 4 of the sliding plates 2, 3 extend to the semicircles of the openings 4 until the aperture of the base plate 1 is completely aligned with the finally overlapping openings 4 of the sliding plates 2, 3. In this state, the light path of the UV light may completely pass the aperture

and the openings 4. Since the latches 8 formed on the second ends of the sliding plates 2, 3 and the arms 10 and 11 of the lever 9 each have different lengths, the sliding plates 2, 3 can move with different speeds in the opposite directions so that the degree of alignment of the aperture of the base plate 1 with the openings 4 of the sliding plates 2, 3 can be variably regulated and controlled by the operation of the electromagnet 13 in a short time.

Fig. 6 shows a UV microscope using the shutter assembly according to the present invention. The UV microscope comprises an objective lens 14 directed to a specimen 15, a chromatic beam splitter 16, a long pass barrier filter 17, and an eye piece 18. A mercury lamp 19 and an excitation filter 20 are arranged in an angle to the chromatic beam splitter 16. The shutter assembly according to the present invention is arranged between the mercury lamp 19 and the excitation filter 20 to allow short time exposures at a fluorescent signal from the mercury lamp 19. The UV light emitted by the mercury lamp 19 is projected to the specimen 15 via the chromatic beam splitter 16 and the objective lens 14. The shutter assembly according to the present invention can be easily changed by a conventional "On/Off"-slider.



Claims:

1. A shutter assembly of a UV microscope slider,
comprising a base plate (1) including an aperture, a first and
5 second sliding plate (2, 3) each having an opening (4) and a
first and second end and being arranged in an overlapping
relationship, the first ends of the sliding plates (2, 3)
being slideably mounted to the base plate (1), a two arm lever
(9) rotatably connected to the base plate (1) and pivotably
10 connected to the second ends of the sliding plates (2, 3),
and an electromagnetical actuator pivotably connected to the
lever (9), wherein the sliding plates (2, 3) are overlappingly
slideable moveable in opposite directions along longitudinal
directions from an opening position into a closing position by
15 operating the actuator to align the aperture of the base plate
(1) with the openings (4) of the sliding plates (2, 3).

2. The shutter assembly according to claim 1, wherein the
actuator is a rotatable electromagnet (13) being energizable
20 to move into one direction of said longitudinal directions of
the sliding plates (2, 3) and being biased by a return spring
in a direction opposite to said one direction.

3. The shutter assembly according to claim 1, wherein the
25 actuator is a solenoid which is energizable in a direction to
the opening position and is not energizable and biased by a
return spring in a direction to the closing position.

4. The shutter assembly according to any of claims 1 to
30 3, wherein the pivot connection of the actuator to the lever
(9) includes a coupling rod (12) having two ends, the one end
thereof being pivotably mounted to the actuator and the other
end thereof being pivotably mounted to said one arm (10) of
the lever (9).

35

5. The shutter assembly according to any of claims 1 to
4, wherein said one arm (10) of the lever (9) is longer than
the other arm (11) of the lever (9) so as to move the sliding



plates (2, 3) with different speeds in said opposite directions.

5 6. The shutter assembly according to any of claims 1 to 5, wherein the first ends of the sliding plates (2, 3) each have a latch (5) extending in parallel to a longitudinal direction of the sliding plates (2, 3) and including an elongated slit (6) in which a bolt (7) mounted to the base plate (1) is slideably and pivotably engaged.

10

7. The shutter assembly according to any of claims 1 to 6, wherein the second ends of the sliding plates (2, 3) each have a latch (8) extending inclined and facing away from the longitudinal direction of the sliding plates (2, 3) in a plane
15 of the sliding plates (2, 3).

8. The shutter assembly according to any of claims 1 to 7, wherein the openings (4) of the sliding plates (2, 3) are formed symmetrically to the longitudinal direction of the
20 sliding plates (2, 3) and define a cross-sectional shape of a semicircle and an isoscele triangle.

9. The shutter assembly according to claim 8, wherein the isoscele triangles of the cross-sectional shape of the
25 openings (4) of the first and second sliding plates (2, 3) are formed so as to face each other.