Aug. 27, 1963 S. L. VAN DEN BROEK ETAL 3,102,194

SHUTTER FOR ELECTRON MICROSCOPES

Filed Sept. 3, 1959 2 Sheets-Sheet 1

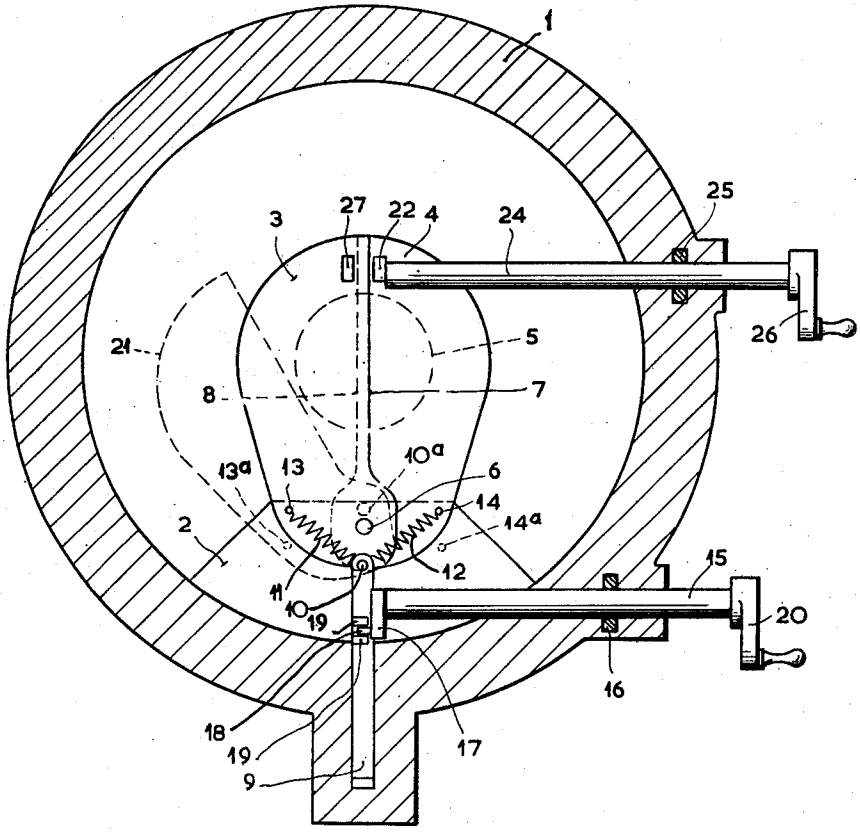

FIG. 1

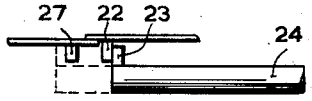

FIG. 2

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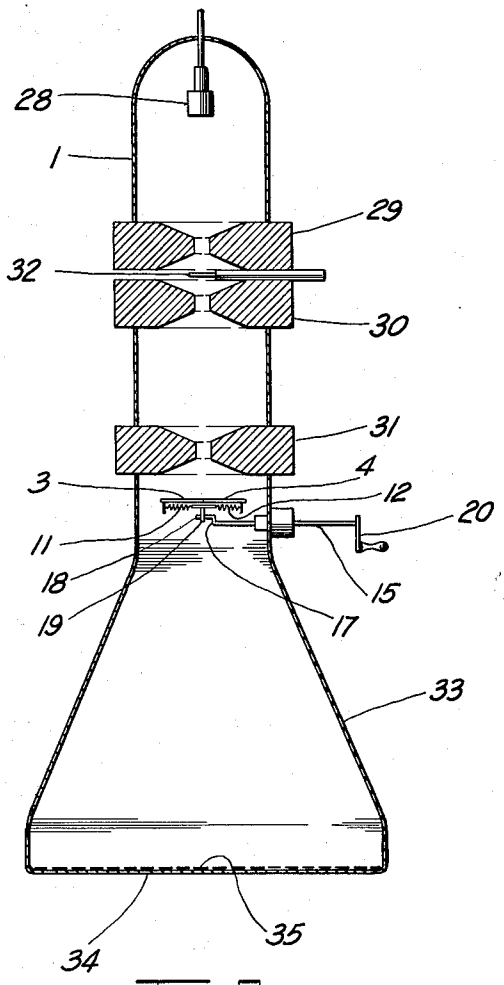

Fig. 3.

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SHUTTER FOR ELECTRON MICROSCOPES

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This invention relates to shutters for electron microscopes and similar instruments operating with corpuscular rays.

Such a shutter serves to intercept the charged particles travelling towards the receiving area (photographic film or fluorescent screen) so long as exposure of the film or screen is not wanted.

The shutter according to the invention allows passage at will of a portion of the projecting beam or the whole of the beam. The user is thus enabled to take a photograph with a portion of the beam of rays and, at a later moment, with the other portion of the beam or with the whole of the beam. By comparison of the two portions of the image which appear side by side on the film it is thus possible to observe any variations which may have occurred in the object during the period between the two exposures.

According to the invention, the shutter comprises two halves, one of which may be opened, whereas the other remains closed until a later moment.

It is desirable that this latter moment can be chosen at will so that the observer not only knows how much time has elapsed between the two exposures, but also can choose this period according to requirements as a function of the behavior of the object.

Similarly as a unitary shutter, the shutter according to the invention may comprise a spring in which the energy required for opening or closing the shutter is stored beforehand.

In one efficacious embodiment of the shutter according to the invention, the halves are opened and closed by means of two springs, which are applied to a point of one half of the shutter and to a point of the other half of the shutter, respectively, and applied, at their other ends, to a part which can be displaced from without between two extreme positions in which the springs exert opposite torques upon the halves of the shutter. In this embodiment a lock is required which may likewise be operated from without and which in one position prevents one half of the shutter from being turned out of the closed position and which in another position allows such a movement.

With regard to this lock there are several possibilities. There may be provided a lock for blocking only one half of the shutter. This is sufficient if it is not necessary to take two complementary photographs. If, however, it is intended to make such photographs, it is possible to provide a separate lock for each half of the shutter. As an alternative, a single lock may be designed so that it can block at will one half of the shutter or the other.

In order that the invention may be readily carried into effect, one embodiment of the last-mentioned device will now be explained in detail, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a cross-sectional view of the housing of an electron microscope with a flat plane at right angles to the longitudinal axis of the housing near the shutter;

FIG. 2 shows a detail of the shutter, as viewed in a direction at right angles to the longitudinal axis of the housing of the microscope; and

FIG. 3 is a digrammatic view of an electron microscope

showing the location of the shutter relative to the receiving area.

In the figure, reference numeral 1 indicates part of the steel housing of the microscope which is exhausted during use. On the inner wall there is arranged a table 2 which carries the shutter comprising the halves 3 and 4, each in the form of a metal plate. A dotted line 5 indicates the cross-section of the projecting beam of electrons, the axis of which coincides with that of the cylindrical housing 1. In the closed condition of the shutter, the plates 3 and 4 in common intercept the whole of the beam so that electrons cannot reach the projection surface (photographic film or luminescent screen).

The plates 3 and 4 can pivot upon a shaft 6 and, in this example, are located one on the other so that their edges 7 and 8 slightly overlap.

The wall 1 has an opening in which a rod 9 is slidable. Springs 11 and 12 are applied to rod 9 at 10, the other end of spring 11 being applied to plate 3 at 13 and the other end of spring 12 being applied to plate 4 at 14. A shaft 15 which is passed hermetically through the wall 1 (16 indicates diagrammatically a seal which may be obtained by means of a rubber ring) crosses the rod 9 at right angles. One extremity of shaft 15 is provided with a lateral arm 17 which carries a driving pin 18. The latter is enclosed between two cams 19 provided on rod 9. At its portion projecting from the housing 1, the shaft 15 carries a crank 20 by means of which the shaft can be rotated. Upon rotation, the driving pin 18 pushes against one of the cams 19, thus causing displacement of rod 9.

As reckoned from the position shown, upon rotation of shaft 15, the point of application 10 of the springs is displaced towards shaft 6, the springs 11 and 12 thus being stretched more strongly until they are aligned. When the displacement of rod 9 is continued, the sense of rotation of the torques exerted upon the plates by the springs is inverted.

The torque which is then exerted upon plate 3 by spring 11 causes rotation of this plate about shaft 6 until it has assumed the position indicated by dotted line 21. In this case, point 10 lies at 10*a* and point 13 lies at 13*a*. The left-hand half of the beam of electrons is then passed. Undue deflection of the plate may be prevented by providing an abutment (not shown).

The plate 4 is not set into movement as yet, since an abutment 22 engages a lateral arm 23 of a shaft 24 which is hermetically passed (by means of a seal 25 shown diagrammatically) through the wall 1. At its end projecting to the exterior, shaft 24 carries a crank 26 by means of which it can be rotated. Upon such rotation, the lateral arm 23 moves away from abutment 22 and the half 4 of the shutter is opened by the action of spring 12. Point 14 then lies at 14*a*.

It will be evident that precautions must be taken to prevent the shafts 15 and 24 from being drawn to the interior as a result of the difference in pressure between inside and outside the wall 1. Since such precautions are common practice in the structure of electron microscopes, it is not necessary to give them special consideration in this specification.

The shaft 24 can slide over a limited distance. When the arm 23 is remote from the plates 3 and 4, it is thus possible to move the shaft inwards to an extent such that, in the closed position of the half 3 of the shutter, the arm 23 lies behind an abutment 27 (see the dotted line in FIGURE 2). The lock comprising the parts 23, 24 and 26 then blocks plate 3 and the half 4 of the shutter is opened upon inward displacement of rod 9. The half 3 of the shutter then keeps closed for the time being to assume the dotted position only when the lateral arm

23 leaves the abutment 27 due to rotation of shaft 24 by means of crank 26.

As shown in FIG. 3, the housing 1 contains an electron gun 28 and a number of magnetic lenses of which 29 indicates a condenser lens, 30 an objective lens and 31 a projection lens. Specimen holder 32 is shown between the lenses 29 and 30. The housing 1 has a flared end portion 33 which at its bottom 34 carriers a fluorescent layer 35 onto which an electron image is projected and transformed into a luminescent image. The shutter halves 3, 4 and the mechanism hereinbefore described for operating the shutter are positioned between projection lens 31 and fluorescent layer 35.

Although reference has been made to "halves of the shutter," this is not intended to mean that the two separately movable parts of the shutter are of equal size. The shutter may be designed so that one "half" intercepts a larger proportion of the electron beam than does the other, if such should be desirable for practical reasons.

In addition, for the use of the invention, it is possible to utilise means for the transmission of movement other than those described by way of example.

What is claimed is:

1. An electron microscope comprising an evacuated chamber in which a beam of charged particles travels toward a receiving area, and a shutter for intercepting at least a portion of the beam of charged particles before reaching the receiving area, said shutter comprising two blades each of which intercepts a portion of the beam of charged particles travelling toward the receiving area, each of said blades being rotatable about an axis remote from the beam of charged particles, and means for rotating said blades in the path of said beam to open and close the shutter including a tension spring connected to one blade and a separate tension spring connected to the other blade, a movable member coupled to the ends of the springs remote from each shutter blade, means to move the movable member from outside the chamber whereby the blades can be selectively rotated into a closed and open position, and lock means operable from outside the chamber for preventing rotation of one of the blades while the other blade is rotated.

2. An electron microscope comprising an evacuated chamber in which a beam of charged particles travels toward a receiving area, and a shutter for intercepting at least a portion of the beam of charged particles before reaching the receiving area, said shutter comprising two blades each of which intercepts a portion of the beam of charged particles travelling toward the receiving area, each of said blades being rotatable about an axis remote from the beam of charged particles, and means for rotating said blades about a common axis and perpendicular to the path of said beam to open and close the shutter including a tension spring connected to one blade and a separate tension spring connected to the other blade, a movable member coupled to the ends of the springs remote from each shutter blade, means to move the movable member from outside the chamber whereby the blades can be selectively rotated into a closed and open position, and lock means operable from outside the chamber for preventing rotation of one of the blades while the other blade is rotated.

3. An electron microscope comprising an evacuated chamber in which a beam of charged particles travels toward a receiving area, and a shutter for intercepting at least a portion of the beam of charged particles before reaching the receiving area, said shutter comprising two blades each of which intercepts a portion of the beam of charged particles travelling toward the receiving area, each of said blades being rotatable about an axis remote from the beam of charged particles, and means for rotating said blades about a common axis and perpendicular to the path of said beam to open and close the shutter

including a tension spring connected to one blade and a separate tension spring connected to the other blade, a movable member coupled to the ends of the springs remote from each shutter blade, means to move the movable member from outside the chamber including a shaft extending through the wall of said chamber and engaging said movable member to displace the same upon rotation of said shaft whereby the blades can be selectively rotated into a closed and open position, and lock means operable from outside the chamber for preventing rotation of one of the blades while the other blade is rotated.

4. An electron microscope comprising an evacuated chamber in which a beam of charged particles travels toward a receiving area, and a shutter for intercepting at least a portion of the beam of charged particles before reaching the receiving area, said shutter comprising two blades each of which intercepts a portion of the beam of charged particles travelling toward the receiving area, each of said blades being rotatable about an axis remote from the beam of charged particles, and means for rotating said blades about a common axis and perpendicular to the path of said beam to open and close the shutter including a tension spring connected to one blade and a separate tension spring connected to the other blade, a movable member coupled to the ends of the springs remote from each shutter blade, means to move the movable member from outside the chamber including a shaft extending through the wall of the chamber, an arm on said shaft, a driving pin on said arm, and a pair of cams on said movable member in engagement with said pin for displacing the movable member upon rotation of the shaft whereby the blades can be selectively rotated into a closed and open position, and lock means operable from outside the chamber for preventing rotation of one of the blades while the other blade is rotated.

5. An electron microscope comprising an evacuated chamber in which a beam of charged particles travels toward a receiving area, and a shutter for intercepting at least a portion of the beam of charged particles before reaching the receiving area, said shutter comprising two blades each of which intercepts a portion of the beam of charged particles travelling toward the receiving area, each of said blades being rotatable about an axis remote from the beam of charged particles, and means for rotating said blades about a common axis and perpendicular to the path of said beam to open and close the shutter including a tension spring connected to one blade and a separate tension spring connected to the other blade, a movable member coupled to the ends of the springs remote from each shutter blade, means to move the movable member from outside the chamber whereby the blades can be selectively rotated into a closed and open position, and lock means operable from outside the chamber for preventing rotation of one of the blades while the other blade is rotated, said lock means including a shaft extending hermetically through the wall of the chamber, said shaft being rotatable and slidable, a lateral arm within the chamber secured to said arm, and a pair of abutment members each associated with one of said blades positioned to engage said arm to prevent movement of the blade.

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