Sept. 24, 1940. H. O. MÜLLER 2,215,794

DEVICE FOR SLUICING BODIES INTO VACUUM CHAMBERS

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Fig. 1

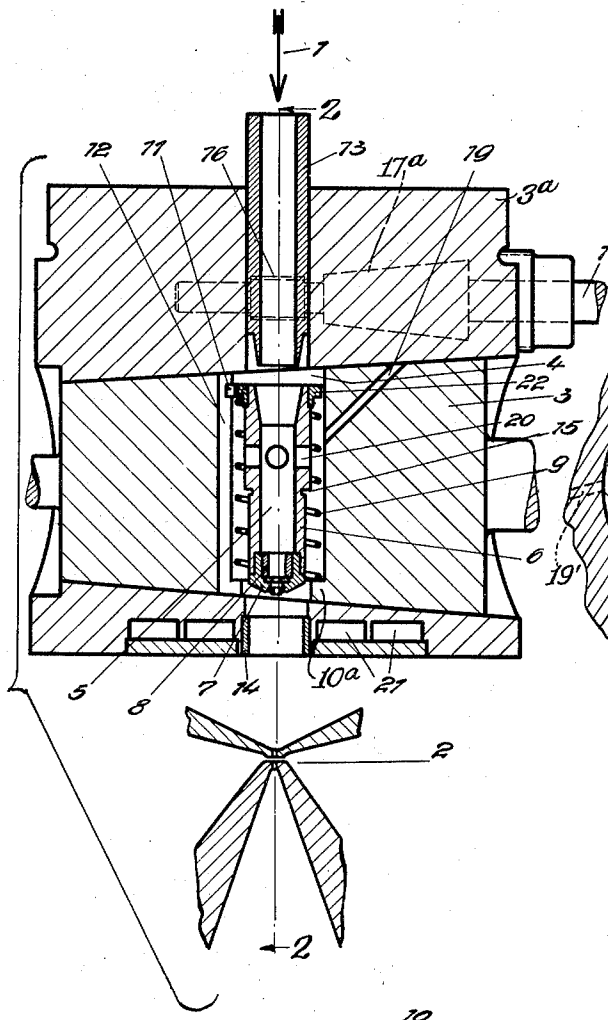


Fig. 2

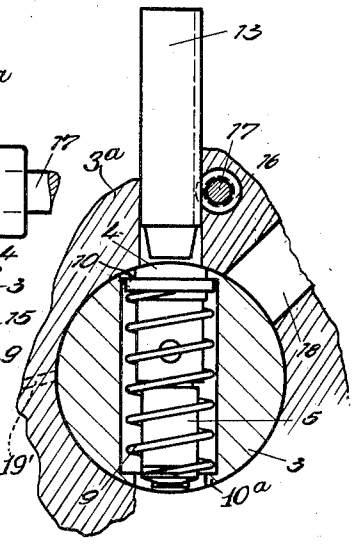
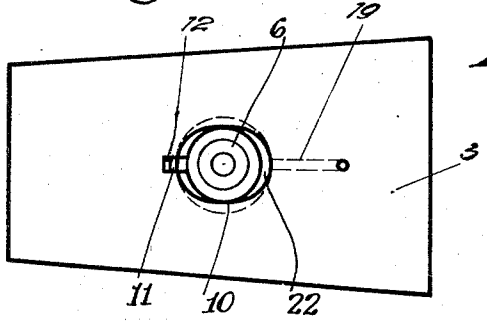


Fig. 3



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DEVICE FOR SLUICING BODIES INTO VACUUM CHAMBERS

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7 Claims. (Cl. 250—160)

This invention relates to a device for sluicing bodies into vacuum chambers particularly employed in devices involving electron beams.

It has already been proposed to sluice bodies into vacuum vessels by means of a device in which the plug bore of a cock is designed in the form of an ante-chamber for the objects to be introduced and which chamber is traversed by the ray. Such devices may be employed to particular advantage in electron microscopes. The invention relates to such device for sluicing bodies into a vacuum chamber, improved however in such a manner that on the one hand the object may be easily replaced and that on the other hand very short distances may be employed between the object and the objective.

According to the invention the object is held in a cartridge which may be displaced within the cock plug and pushed partly out of the plug into a given position against the force of a spring tending to normally hold it within the plug. The cartridge may be pushed out of the bore of the plug towards the objective in the operating position of the plug by means of a rack and pinion device and be held in its desired position by stops. In the case of a device for sluicing bodies into vacuum chambers designed as above described it is therefore possible to displace the object in the vacuum chamber and to bring it within a very short distance of the objective. Lenses of a very short focal length may therefore be employed.

In the accompanying drawing is shown an embodiment of the invention. In these drawings—

Fig. 1 represents in central sectional elevation and semi-diagrammatically the sluicing portion of an electron microscope.

Fig. 2 represents a cross section of the plug and a sectional elevation of adjacent cock portions on the line 2—2 in Fig. 1, and

Fig. 3 represents a view of the cock plug from the top in Fig. 1.

The beam of cathode rays enters the sluicing device in the direction of the arrow 1 in Fig. 1. 2 denotes the magnetic lens of the type disclosed in detail in the copending application of von Borries et al., Serial No. 223,458. The device is provided with a rotatable cock plug 3 transversely disposed in cock body 3a and having itself a transverse bore 4. This bore, as shown in Figs. 1 and 2, contains the cartridge 5 for the reception of the object. The cartridge 5 consists of the substantially cylindrical tube 6 which is closed at the end facing the objective 2 by the object holder proper consisting of the parts 7 and 8. The object to be examined, for instance a thin layer pervious to cathode rays, is so attached to parts 7 and 8 that it covers the central aperture of these parts. The cathode ray, after having penetrated the object layer, passes through the central aperture of the lens 2 and thus is subjected to an electron-optical bias serving, in particular, to produce a magnified electron-optical image of the object.

The tube 6 is threaded at its upper end into the holding ring 22 which is pressed against the shoulders 10 of the plug bore 4 (Fig. 2) by the spring 9. This spring is seated at its other end against an annular shoulder 10a. The holding ring 22 is secured against rotation by means of the screw 11 disposed to slide in the groove 12 of bore 4 (Fig. 3). To introduce the ring 22 the upper opening of the bore 4 of the plug has an oval shape. The ring 22 is introduced edgewise and is then turned into its proper position within the bore 4. The spring 9 tends to hold the cartridge tube 6 in the position shown. Tube 6 with its object holder 7, 8 may be displaced from the position shown in Fig. 1 by way of the bushing 14 towards the objective 2 against the force of this spring with the aid of the movable tubular rack 13. The movement of the latter is limited by the shoulder 15 of tube 6 which comes into engagement with the bushing 14. To provide a centering adjustment the lower end of the tube 13 is given a conical shape and the upper opening of the tube 6 is correspondingly shaped for this purpose. Tube 13 may be actuated by means of the pinion 16 and the shaft 17 sealed by a cone-shaped bearing 17a shown in dash lines in Fig. 1. Pinion 16 meshes with the rack 13a of the tube 13. To replace the object, the object cartridge 6 is moved back into the bore 4 of the plug by moving tube 13 into the position shown. By turning the plug 3 a few degrees clockwise in Fig. 2 the upper portion of the object cartridge is brought opposite to the charging opening 18 so that the object holder proper may be removed by a suitable instrument not shown here and another object may be inserted into the holder; thereupon the plug is first rotated counterclockwise sufficiently far so that its bore 4 is hermetically closed and a communication is established between bore 4 and a vacuum antechamber (not shown) by way of duct 19 in the plug and duct 19a in the cock body. It is preferable that this duct 19 ends in a plane perpendicular to the axis of rotation of the plug which is located outside the sluicing passage 18, for instance to the right of bore 4 as shown in Fig. 1. In this manner it is possible to exhaust the sluice chamber within a relatively small angle

of rotation of the plug registry, since the covering of the parts of ducts 19 and 19' necessary therefor can thus be attained within a small angle of plug rotation.

After the sluice chamber is exhausted the plug 3 is rotated clockwise back to the position shown in Figs. 1 and 2 and the object is moved downwardly into the proper position with respect to the lens 2 with the aid of the tube 13. The transverse bores 20 arranged in the tube 6 serve to facilitate the evacuation of the tube 6. 21 are cooling ducts by means of which it is possible to maintain the surroundings of the object at a low temperature.

What is claimed is:

1. A device for sluicing objects into the vacuum chamber of an electron microscope having a lens for electron-optically biasing a beam of cathode rays, comprising a cock body arranged in front of said lens with respect to the direction of said beam and having a central bore forming a passage for said beam, a revolvable plug disposed in said cock body and having a relatively large bore arranged to be in alignment with the bore of said cock body when said plug is in operative position, an object holder disposed in said plug bore in the direction of said beam and having means for accommodating the object, operating means associated with said cock body and operable from outside for moving said object holder in the direction of said beam toward said lens to a desired focal position, and a charging bore in said cock body registrable with said plug bore for exchanging the object when the plug has been turned to present said object holder to said charging bore.

2. A device for sluicing objects into the vacuum chamber of an electron microscope having a lens for electron-optically biasing a beam of cathode rays, comprising a cock body arranged in front of said lens with respect to the direction of said beam and having a central bore forming a passage for said beam, a revolvable plug disposed in said cock body and having a relatively large bore arranged to be in alignment with the bore of said cock body when said plug is in operative position, a tubular cartridge disposed within said plug bore and containing means for holding the object, operating means disposed within the cock body and operable from outside for moving said cartridge in the direction of said beam toward said lens to a desired focal position, stops for limiting said movement of said cartridge, and a charging bore in said cock body registrable with said plug bore for exchanging the object when the plug has been turned to present said cartridge to said charging bore.

3. A device for sluicing objects into the vacuum chamber of an electron microscope having a lens for electron-optically biasing a beam of cathode rays, comprising a cock body arranged in front of said lens with respect to the direction of said beam and having a central bore forming a passage for said beam, a revolvable plug disposed in said cock body and having a relatively large bore arranged to be in alignment with the bore of said cock body when said plug is in operative position, a cartridge disposed within said plug bore and containing means for holding the object, a spring for normally retaining said cartridge within said plug, operating means disposed within said cock body and operable from outside for moving said cartridge against the tension of said spring in the direction of said beam toward said lens to a desired focal position, and a charging bore in said cock body registrable with said plug bore for exchanging objects when the plug has been turned to present said holding means to said charging bore.

4. A device for sluicing objects into the vacuum chamber of an electron microscope having a lens for electron-optically biasing a beam of cathode rays, comprising a cock body arranged in front of said lens with respect to the direction of said beam and having a central bore forming a passage for said beam, a revolvable plug disposed in said cock body and having a relatively large bore arranged to be in alignment with the bore of said cock body when said plug is in operative position, a movable tubular cartridge disposed within said plug bore for holding the object, a hollow push rod movably disposed in said central bore of said cock body, means operable from outside for moving said holder in the direction of the electron beam towards said lens to a desired focal position, and a charging bore in said cock body registrable with said plug bore for exchanging the object when the plug has been turned to present said cartridge to said charging bore.

5. A device for sluicing objects into the vacuum chamber of an electron microscope having a lens for electron-optically biasing a beam of cathode rays, comprising a cock body arranged in front of said lens with respect to the direction of said beam and having a central bore forming a passage for said beam, a revolvable plug disposed in said cock body and having a relatively large bore arranged to be in alignment with the bore of said cock body when said plug is in operative position, a spring-biased cartridge slidably arranged in said plug bore so as to have the tendency to remain within said plug bore, said cartridge having means for holding the object, a hollow push rod movably disposed in said central bore of said cock body, means operable from outside for moving said holder in the direction of the electron beam towards said lens to a desired focal position, said rod and said cartridge having correspondingly formed cone-shaped ends designed to engage each other when effecting said movement, and a charging bore in said cock body registrable with said plug bore for exchanging said object-holding means.

6. A device for sluicing objects into the vacuum chamber of an electron microscope having a lens for electron-optically biasing a beam of cathode rays, comprising a cock body arranged in front of said lens with respect to the direction of said beam and having a central bore forming a passage for said beam, a revolvable plug disposed in said cock body and having a relatively large bore arranged to be in alignment with the bore of said cock body when said plug is in operative position, a tubular cartridge disposed in said plug bore and containing means for holding the object, a ring threaded to one end of said cartridge and slidingly disposed in said plug bore, a stop at one end of said plug bore serving as an abutment for said ring to limit the outward movement of the holder at that bore end, a spring in said plug bore disposed to normally hold said ring against said stop, operating means disposed within the cock body and operable from outside for moving said cartridge out of the other end of said plug bore toward said lens to a desired focal position, and a charging bore in said cock body registrable with said plug bore for exchanging said object-holding means.

7. A device for sluicing objects into the vacuum chamber of an electron microscope having a lens for electron-optically biasing a beam of cathode

rays, comprising a cock body arranged in front of said lens with respect to the direction of said beam and having a central bore forming a passage for said beam, a revolvable plug disposed in said cock body and having a relatively large bore arranged to be in alignment with the bore of said cock body when said plug is in operative position, an object holder disposed in said plug bore in the direction of said beam and having means for accommodating the object, operating means associated with said cock body and operable from outside for moving said object holder in the direction of said beam toward said lens to a desired focal position, a charging bore in said cock body registrable with said plug bore for exchanging the object when the plug has been turned to present said holder to said charging bore, and a venting duct in said plug disposed at an inclination to said plug bore and terminating at one end in said plug bore and at the other end at the peripheral plug surface in a plane at right angles to the plug axis and removed from the plane in which the charging bore in said cock body is located.

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