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J. W. ROMMERTS

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ELECTRON MICROSCOPE

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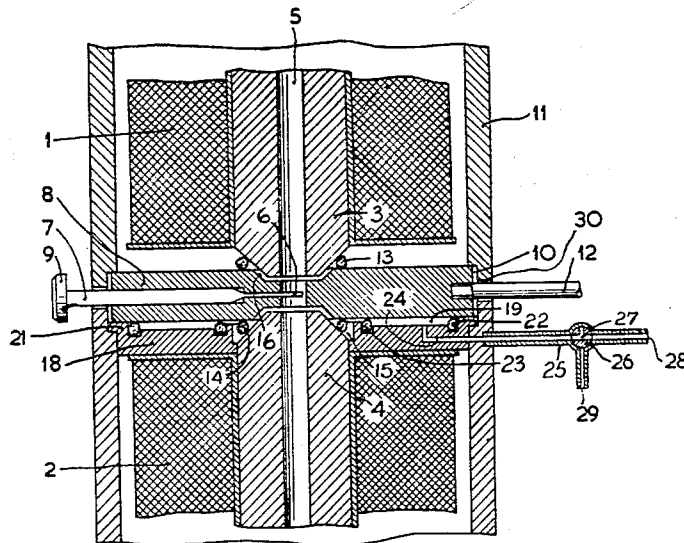


FIG. 1

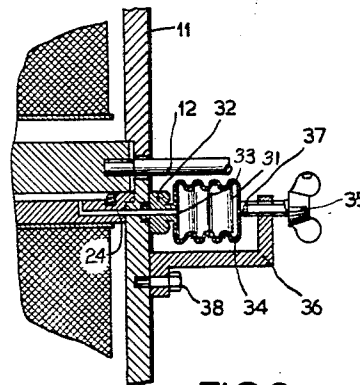


FIG. 2

INVENTOR
JAN WILLEM ROMMERTS

BY

Frank R. L. J. J.
AGENT

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Jan Willem Rommerts, Eindhoven, Netherlands, assignor to North American Philips Company Inc., New York, N.Y., a corporation of Delaware

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In electron microscopes the object holder is adapted to be moved in order to enable the object which is arranged in the ray path to be displaced in every lateral direction with respect to the axis of the ray beam. This invention relates to an arrangement in which the object is arranged in a flat disc and between this disc and two stationary parts bounding the ray beam channel and airtight seal is provided so that this seal does not impede the lateral movement of the flat disc.

Generally, the displacement of the object is limited to a few tenths of a millimetre. With a magnifying power of 10,000 the image of each tenth part of a millimetre becomes one metre, so that with a screen diameter of 10 cms. images can be produced of 10 different portions of the object when the latter is moved through this distance. It will be appreciated that substantially any displacement of the object, be it ever so slight, is visible on the image screen of the electron microscope. A rapid sequence of such movements results in lack of definition of the image. Therefore, an electron microscope must be arranged so that no vibration can penetrate to the object holder and if care is also taken that the holder is not caused to vibrate relatively to the microscope casing, the following causes of lack of definition are also eliminated.

Frequently the portion of the object which is to be registered photographically is adjusted in the ray beam by displacing the flat disc in which the object is disposed by means of an adjusting mechanism the rotary knobs of which are disposed adjacent the pick-up screen. The knobs are connected by long rods to radially movable rods of adjusting screws which move the disc. Play in pivots and screw connections is absorbed by springs. It has been found that the adjustment frequently changes owing to the fact that, when the disc is displaced, the equilibrium of forces is not re-established immediately but after a slight time interval.

After completion of the adjustment lack of definition of the image can also be produced by displacement of the object owing to the generation of heat in the energizing coils of the magnetic lenses by which the temperature of the wall is raised so that the wall expands. Generally the adjusting mechanism is secured to the wall so that the expansion thereof may slightly change the position of the object.

It is an object of the present invention to avoid these disadvantages. According to the invention, in an electron microscope provided with an object holder consisting of a flat disc in which the object is arranged and by means of which the object disposed in the ray path can be displaced in any lateral direction, means are provided by which a difference in the pressures on each side of the flat disc is produced pneumatically or hydraulically so that the flat disc is clamped in the axial direction against a stationary part of the microscope.

In a preferred embodiment, the microscope has a partition arranged parallel to and in close proximity to the flat disc which acts as the object holder. The side

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of this partition facing the holder is provided with an annular recess which is bounded by sealing rings between the partition and the disc. A duct in which the pressure can be varied opens into the space so defined. When the microscope is evacuated by means of an evacuation device, the duct can communicate with this device. A three-way cock inserted into the pipe providing this communication enables the duct to be connected in one position of the cock to the evacuation device and in the other position to the space outside the microscope.

Furthermore, the supply duct and the space can be filled with a liquid, the supply duct being connected to a container for the liquid in which the pressure can be varied. This pressure variation can be effected by means of a mechanical pressure device or by means of compressed air.

In order that the invention may readily be carried into effect, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows the part of an electron microscope containing the flat disc in which the object is arranged, and

Fig. 2 is a detail comprising an embodiment of a device by which a pressure difference is transmitted to the disc by means of a liquid.

Referring now to Fig. 1, magnet coils 1 and 2 serve to produce the magnetic fields for energizing pole pieces 3 and 4 of magnetic material disposed one on each side of the object to be irradiated. The pole pieces are provided with a passage 5 for the electron beam, their ends being slightly spaced apart. In the intermediate space there is arranged an object 6 an image of which is to be formed by means of an electron beam on a pick-up screen or a photographic plate or film which are not shown in the drawing. The object 6 is secured to a holder comprising a thin rod 7 which is inserted into a bore of a flat disc 8. Opposite the apertures 5 of the pole pieces 3 and 4, the disc 8 has a central bore for the passage of the electron beam. The rod 7 is provided with a knob 9 which projects beyond the microscope and by means of which the object can be removed from the bore of the flat disc in order to be replaced by another.

If an image is to be produced of an object portion other than that located centrally of the beam, the object is displaced. To this end the flat disc 8 bears in a groove 10 provided in the wall 11 of the microscope, the diameter of this groove slightly exceeding that of the disc 8, so that the latter has a certain amount of clearance in every direction in a plane at right angles to the beam axis. The means by which the required displacement of the flat disc can be effected are known per se, the figure showing only a radially extending connecting rod 12 by which the adjusting motion is transmitted to the disc 8.

Care must be taken to prevent air from penetrating into the beam channel 5 on movement of the disc 8. The beam channel 5 extends through the pole pieces 3 and 4 and is sealed between them and the disc 8. Sealing can be effected by means of rubber rings 13 and 14 of circular cross-section. On each side of the space containing the object the disc 8 is provided with a central recess 15 and 16 respectively into which the conical ends of the pole pieces 3 and 4 extend. The recesses are slightly wider than the conical ends, so that they do not impede the movement of the disc.

The flat disc is arranged parallel to a partition 18 of the microscope housing which fits within the groove 10 of the wall 11. This partition is made of non-magnetic material. The partition 18 is provided with an annular recess 19 so that it is in contact with the flat disc 8 along a narrow circumferential rim 21 only. At its inner and outer peripheries the recess 19 is provided with

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rubber rings 22 and 23 which provide the seal between the disc 8 and the partition 18. Provision is made of a duct 24 which opens into the space 19 between the disc 8 and the partition 18 and passes through the wall 11. The duct is connected to a pipe 25 containing a three-way cock 26. Through the pipe 25 and a passage 27 in the cock 26 the duct 24 can be connected to a suction pipe 28 which is connected to a device for evacuating the beam channel in the microscope. When the cock 26 is turned to the left through an angle of 90°, the duct 24 and the pipe 25 are connected to an air inlet 29.

When the adjustment of the object is to be changed, so that the flat disc 8 must be displaced, the three-way cock 26 is in the position in which the duct 24 and consequently the space 19 are filled with air. Thus, displacement of the disc 8 can be normally effected by means of the adjusting means through the rod 12. When the object is correctly positioned, the three-way cock 26 is turned to the right through 90° so that the space 19 is connected to the pipe 28 and evacuated. Owing to the difference between the pressures on both sides of the disc 8, the latter is firmly clamped to the partition 18 and this ensures that the required adjustment is accurately maintained during registration.

With a view to ready mounting of the microscope the wall 11 is divided in two parts along a plane 30.

In Fig. 2, a liquid container 31 is connected to the wall 11 of the microscope by means of a screw cap 32 so that the aperture 33 and the duct 24 are aligned. The space 19, the duct 24 and the container 31 are filled with a liquid. The wall 34 of the container 31 is corrugated and consequently the container is slightly compressible. The pressure is exerted by means of a wing bolt 35 which is screwed in a holder 36 and engages an embossed portion 37 of the container 31. The holder 36 is secured to the wall 11 by means of a bolt 38. The pressure exerted by means of the wing bolt 35 is transmitted to the disc 8 by the liquid and presses this disc firmly into the groove in the microscope wall 11.

The required pressure can be exerted mechanically, but also by means of compressed air.

What we claim is:

1. An electron microscope comprising an envelope housing an object chamber, an electron lens system arranged within said chamber comprising a pair of axially aligned tubular pole-pieces, a pair of axially aligned focussing coils, each of said coils surrounding one of said tubular pole-pieces, a disc interposed between the pole-pieces and having a central aperture therein, the surrounding portions of which interfit with corresponding surface portions of the tubular pole-pieces to form therewith a discharge path for an electron beam through said disc, a resilient sealing member connecting the adjoining surface portions of the disc and each pole-piece, means to position the disc transversely relative to the discharge path, a transverse partition member surrounding a portion of one pole-piece and defining with said disc a passageway for introducing a fluid medium between said disc and said partition, and means to control the pressure of said fluid in said passageway to thereby move said disc in an axial direction into abutting relationship with said transverse partition.

2. An electron microscope comprising an envelope housing an object chamber, an electron lens system arranged within said chamber comprising a pair of axially aligned tubular pole-pieces, a pair of axially aligned focussing coils, each of said coils surrounding one of said tubular pole-pieces, a disc interposed between the pole-pieces and having a central aperture therein, the surrounding portions of which interfit with corresponding surface portions of the tubular pole-pieces to form therewith a discharge path for an electron beam through said

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disc, a resilient sealing member connecting the adjoining surface portions of the disc and each pole-piece, means to position the disc transversely relative to the discharge path, a transverse partition member having an annular recess surrounding a portion of one pole-piece and defining with said disc an enclosed space, said partition being provided with a passageway connecting said enclosed space to the outside of the microscope through an aperture in the envelope, a resilient member in said annular recess connecting said partition and said disc, and means to introduce a fluid in said passageway and control the pressure thereof to thereby move said disc in an axial direction into abutting relationship with said transverse partition.

3. An electron microscope comprising an envelope housing an object chamber, an electron lens system arranged within said chamber comprising a pair of axially aligned tubular pole-pieces, a pair of axially aligned focussing coils, each of said coils surrounding one of said tubular pole-pieces, a disc interposed between the pole-pieces and having a central aperture therein, the surrounding portions of which interfit with corresponding surface portions of the tubular pole-pieces to form therewith a discharge path for an electron beam through said disc, a resilient sealing member connecting the adjoining surface portions of the disc and each pole-piece, means to position the disc transversely relative to the discharge path, a transverse partition member having an annular recess surrounding a portion of one pole-piece and defining with said disc an enclosed space, said partition being provided with a passageway connecting the enclosed space to the outside of the microscope through an aperture in the envelope, a resilient member in said annular recess connecting said partition and said disc, and three-way valve means in said passageway for selectively sealing said passageway, connecting said passageway to a device for evacuating the enclosed space, and to the outside of the microscope whereby the pressure in said enclosed space can be controlled to move said disc in an axial direction into abutting relationship with said transverse partition.

4. An electron microscope comprising an envelope housing an object chamber, an electron lens system arranged within said chamber comprising a pair of axially aligned tubular pole-pieces, a pair of axially aligned focussing coils, each of said coils surrounding one of said tubular pole-pieces, a disc interposed between the pole-pieces and having a central aperture therein, the surrounding portions of which interfit with corresponding surface portions of the tubular pole-pieces to form therewith a discharge path for an electron beam through said disc, a resilient sealing member connecting the adjoining surface portions of the disc and each pole-piece, means to position the disc transversely relative to the discharge path, a transverse partition member having an annular recess surrounding a portion of one pole-piece and defining with said disc an enclosed space, said partition being provided with a passageway connecting the enclosed space to the outside of the microscope through an aperture in the envelope, a resilient member in said annular recess connecting said partition and said disc, a vessel containing a fluid connected to said passageway on the outside of said envelope, and means to control the pressure of said fluid in said passageway to thereby move said disc in an axial direction into abutting relationship with said transverse partition.

References Cited in the file of this patent

UNITED STATES PATENTS

1,041,028	Church	Oct. 15, 1912
2,133,518	Huebner	Oct. 18, 1938
2,655,601	Verhoeff	Oct. 13, 1953