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SPECIMEN HEATING DEVICE FOR AN ELECTRON MICROSCOPE
SPECIMEN HOLDER MADE OF A SINGLE PIECE OF MATERIAL

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FIG. 1

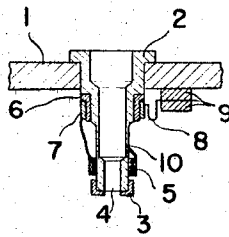
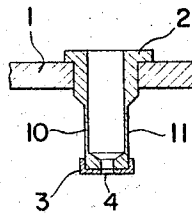


FIG. 2



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SPECIMEN HEATING DEVICE FOR AN ELECTRON MICROSCOPE SPECIMEN HOLDER MADE OF A SINGLE PIECE OF MATERIAL

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1 Claim. (Cl. 250—49.5)

The present invention relates to electron microscopes and more particularly to a new specimen heating device with highly advantageous features for heating specimens to be observed by electron microscopes.

Heretofore, for heating specimens mounted in electron microscopes and observing phenomena such as the state of the specimens at high temperatures and the variations of the states of the specimens due to temperature variation, the conventional specimen heating devices used have generally been of the type in which, between a furnace structure for heating and a part for fixing this structure to a moving stage, a material possessing different properties, for example, a thermal insulator such as a ceramic material, is interposed. Consequently, the thermal resistance at the joint surfaces between the furnace structure and the insulator in such devices tends to become non-uniform, the thermal expansions of these materials become irregular, and the specimen is shifted substantially out of position. As a result, the resolution is lowered, and, moreover, a long time period is required for the specimen to stop shifting.

It is a general object of the present invention to overcome such difficulties as described above.

More specifically, it is an object of the invention to provide a specimen heating device suitable for use in electron microscopes, which has a simple construction and high performance, in which the above described adverse effects due to temperature are eliminated.

It is another object to provide a specimen heating device as above stated which is adaptable to miniaturization, has relatively low heat loss, and moreover, causes no disturbance to the electron beam of the electron microscope.

The foregoing objects have been achieved by the present invention, which, briefly described, resides in a specimen heating device for electron microscopes and like apparatuses, which essentially comprises a specimen holder integrally formed from a single kind of metal, without joints in its structure, with a configuration advantageous for reducing heat loss and means to heat specimens mounted at the lower end of the holder in its interior.

The nature, principles, and details of the invention will be more clearly apparent by reference to the following description of preferred embodiments of the invention, when taken in conjunction with the accompanying drawing in which like parts are designated by like reference characters, and in which:

FIGURE 1 is a sectional view showing one embodiment of the specimen heating device according to the invention; and

FIGURE 2 is a similar sectional view showing another embodiment of the invention adapted to effect heating through utilization of electron bombardment.

In the first embodiment of the invention as shown in FIGURE 1, a hollow specimen holder 2 is mounted on and through the center of a specimen moving stage 1 coaxially with the optical axis of an electron microscope. The specimen holder 2, which is formed to be symmetri-

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cal with respect to the optical axis, has a cap 3 fitted onto the lower end thereof and is adapted to hold a specimen 4. Furthermore, this holder 2, throughout its structure from its part contacting the moving stage 1 to its part adapted to hold the specimen 4 is formed integrally from one and the same metal material, there being no intermediate joints in the said structure.

As the heating means, a heating coil 5 is provided about the lower part of the holder 2 at a level such as to produce the most effective heating of the specimen 4. One end of this coil 5 is grounded to the holder 2, and the other end is connected to a slip ring 7 fitted over an electrical insulator 6 about the holder 2 below its part contacting the moving stage 1. An electrical contact member 8 which is adapted to contact firmly against the slip ring 7 is secured over an electrical insulator 9 to the moving stage 1. Thus, as is apparent, by applying a voltage across the moving stage 1 and the contact member 8, a current can be caused to flow through the heating coil 5 by way of the moving stage 1, the holder 2, the slip ring 7, and the contact member 8.

It is to be observed that the holder 2 is formed at its middle portion 10 to have a thin wall thickness so as to reduce dissipation of heat due to thermal conduction.

By the above described construction and arrangement of parts according to the invention, the holder 2 is formed coaxially and symmetrically with respect to the optical axis and, moreover, is formed integrally of the same metal without any joints between different materials. Accordingly, when heating is carried out by means of the heating coil 5, the thermal expansion of the holder 2 is symmetrical with respect to the optical axis without any shifting of the specimen. Furthermore, by fabricating the portion 10 of thin wall thickness of the holder 2 with ample length in the longitudinal direction, it is possible to reduce the heat loss to a degree equivalent to that in the case when a conventional insulating material such as a ceramic is used. As an additional refinement, heat loss due to radiation can be suppressed by finishing the external surface of the holder as a mirror surface.

Furthermore, since the holder 2 is formed integrally of a single kind of metal without joints within its structure, its entire structure can be miniaturized, and, at the same time, since charged particles generated as a result of bombardment by a portion of the electron beam of the microscope are not charged up in the holder, the electron beam is not disturbed by the charged particles.

While the foregoing description relates to the case wherein heating of the specimen is accomplished indirectly by a coil 5, the specimen heating may be accomplished also by providing a stepped part 11 in the interior of the lower end of the holder as indicated in FIGURE 2 and projecting the electron beam of the microscope onto this part to cause heating by electron bombardment. In FIGURE 2, the other reference characters are respectively the same as those in FIGURE 1.

As is apparent from the foregoing description, the present invention affords a specimen heating device of simple construction and high performance, wherefore the invention is effectively applicable to electron microscopes and like apparatuses.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention as set forth in the appended claim.

What is claimed is:

A specimen heating device for electron microscopes consisting essentially of a specimen moving stage; a hollow specimen holder mounted on and moving through

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the center of said stage coaxially and symmetrically with the optical axis of the electron microscope, said holder being of a single kind of material and devoid of intermediate joints; a cap at the lower end of said specimen holder adapted to hold a specimen; a heating coil provided about the lower part of said holder near said specimen, one end of said coil being grounded to said specimen holder; a first electrical insulator below the part of said specimen holder which contacts said moving stage; a slip ring fitted over said insulator, the other end of said coil being connected to said slip ring; a contact member, firmly contacting said slip ring, provided on said moving stage; a second electrical insulator being interposed between said contact member and said moving stage; means for applying a voltage across said moving stage and said contact member thus causing a current to flow through said heating coil by way of said stage, holder, slip ring and contact

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member; said specimen holder having a thin wall between said specimen and said moving stage to reduce heat dissipation due to thermal conduction.

References Cited by the Examiner

UNITED STATES PATENTS

2,423,158	7/1947	Runge et al.	250—49.5
2,771,568	11/1956	Steigerwald	250—49.5
3,151,241	9/1964	Herrmann et al.	250—49.5

FOREIGN PATENTS

730,203	5/1955	Great Britain.
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