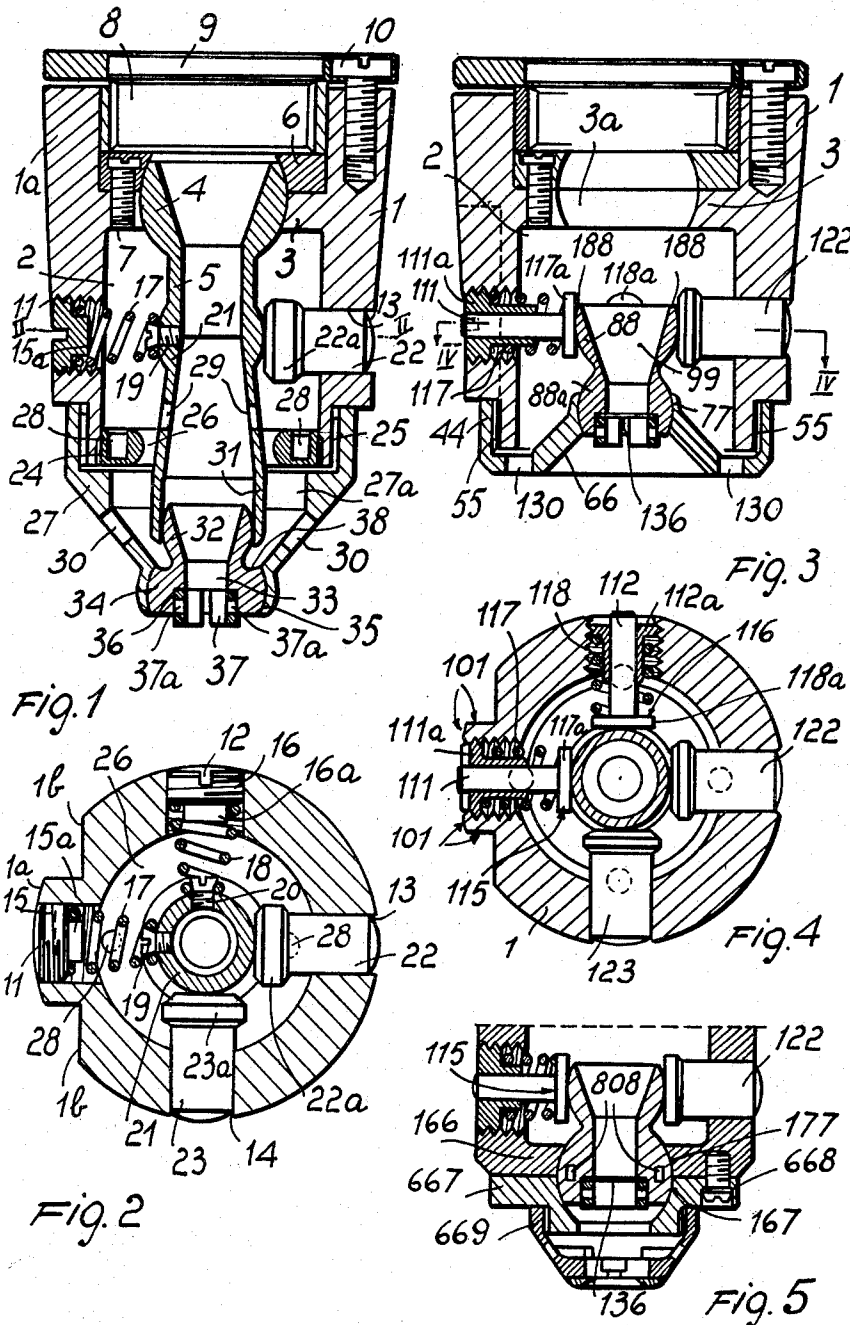


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GONIOMETRIC APPARATUS FOR ORIENTATION OF
A SPECIMEN IN AN ELECTRON MICROSCOPE
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GONIOMETRIC APPARATUS FOR ORIENTATION OF A SPECIMEN IN AN ELECTRON MICROSCOPE

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2 Claims. (Cl. 250—49.5)

The present invention relates to a goniometric apparatus allowing orientation and tilt of a specimen to be tested on an electron microscope.

The main object of the present invention consists in providing a goniometric apparatus that is simple in construction and that allows a large angular variation to be imparted to the specimen with respect to the electron beam.

A still further object consists in providing an apparatus that ensures a high positioning accuracy and that allows the same positioning to be repeated without any difficulty and with safety.

A further object consists in providing a goniometric apparatus requiring, when in use, no changes of the existing microscope and allowing the maintenance of the specimen in the usual observation plane, thus avoiding resolving power losses.

Another object consists in providing an apparatus that for its actuation requires but duplication of or combination with the standard tilt devices with which the microscope onto which the apparatus is being installed is equipped.

Another object consists in allowing the specimen to be conveniently and readily pre-set at the outside of the magnetic field of the objective in order to preserve it from the influence of the latter, directed to disturb the properties of a specimen having magnetic characteristics.

Another object consists in providing proper orientability degree of the specimen in any direction and in permitting a remarkable observation angle to be obtained in order to increase informations that on using the electron microscope may be derived from e.g. a crystalline material.

A further, but not last, object consists in providing a goniometric apparatus having the possibility of creating, by means of suitable coils, a magnetic field of appropriate features in order to obtain a larger number of information on the magnetic materials being tested.

Further features and advantages of this invention will become evident from the following description of some preferred but not exclusive embodiments of the apparatus according to the invention, which are illustratively but not limitatively shown in the accompanying drawing, in which:

FIG. 1 is a sectional view of a goniometric apparatus taken along a plane passing through the axis thereof and through the axis of a part of the actuating means, the figure showing the apparatus not in its resting position, but with tubular members coaxial with the hollow body forming the casing;

FIG. 2 is a sectional view taken along the line II—II of FIG. 1;

FIG. 3 is a longitudinal sectional view in remarkably enlarged scale with respect to the true size of a modification of the apparatus, taken along a plane passing through the axis of the apparatus to better point out the position of the component parts and to show how supporting of the orientable member is carried out in order to keep the specimen plane out of the influence of the magnetic field of the lens;

FIG. 4 is a sectional view taken along line IV—IV of FIG. 3; and

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FIG. 5 shows a detail relative to a technical solution to accommodate the orientable member of the apparatus in a receptive capsule, such technical solution practically representing an embodiment of the retaining means which is different from the one shown in previous figures, but which is in conformity with the same principle of spherical pivoting of the orientable member.

Such solution is to be preferred whenever by means of two pairs of coils the creation of an auxiliary local magnetic field of variable intensity and direction is desired at the specimen plane for more profound study of its magnetic properties.

Referring to the accompanying figures, in which identical elements are always designated with same reference numbers, there are: a first substantially frustoconical body 1, having a cylindrical bore or cavity 2 interrupted by an annular projection 3, into which the spherical portion shaped joint 4 is engaged.

Said joint 4 is provided on one end with the tubular member 5 and is connected to the frustoconical hollow body 1 by means of a ring 6 and screws 7 (only one shown in figures); it is clear that joint 4 and the spherical surface portion or seat defined by the annular projection 3 and ring 6 overlying it form a ball joint adapted to allow tubular member 5 to be rotated in any direction relative to the axis of the frustoconical body. On the ring 6 fixed on the flange 3 there is supported a sleeve 8, threaded and held by a second ring 9 by means of screws 10 (only one shown in figures) screwed in threaded holes provided in the upper end of the hollow body 1; said sleeve constitutes a connection means of the apparatus to a microscope.

On the frustoconical body 1 holes 11, 12, 13 and 14 are provided, the axis of which coincide with two diameters perpendicular to one another and lying in the same plane.

In adjacent and threaded holes 11 and 12 registering screws 15 and 16 for conic coil springs 17 and 18 are screwed, one end of said springs engaging with cylindrical portions 15a and 16a of the screws and the other end engaging with screws 19 and 20 screwed into threaded holes radially formed on the maximum diametrical plan of boss or protuberance 21. The boss portion 21 is substantially formed by rotation of a circular segment around the axis of the tubular body 1. Hole 11 is built in a rib 1a, projecting from the face 1b adapted to form a guide for insertion of apparatus into the microscope.

Cylinder or pin like members 22 and 23 are arranged in slidable engagement within holes 13 and 14. The cylinder members 22 and 23 have each on their ends facing the axis of the body 1 a head 22a and 23a the end faces whereof are tangential to the boss portion 21 of the tubular member 5. It is clear that the above mentioned cylinder members and springs provide means adapted to tilt in any direction the tubular member 5 on which they act upon the setting of the apparatus into the seat provided on the microscope therefor and after putting into contact said cylinder members with known micrometrical screws provided on the microscope through which the cylinder members are controlled.

At its lower end frustoconical body 1 has threads 24 and 25, respectively adapted to engage a ring 26 providing a retainer or limit stop for the tubular member 5 and a second frustoconical body 27 with a bore 27a forming the body of the whole apparatus with the former frustoconical body.

It will be understood that the terms "upper" and "lower" ends as used in this application are only of indicative nature and do not limit the invention to a vertical position of the apparatus.

On limit stop ring 26 holes 28 are formed, such holes being adapted to allow the disassembling of the ring itself

and air passage for extracting air from the apparatus by means of a vacuum pump. Holes 29 on tubular member 5 and holes 30 on second frustoconical body 27 are provided for the same purpose.

Tubular body 5 has a lower cylindrical portion 31 adapted to engage and guide spherical portion 32 forming the top end of the second tubular member 33; it is clear that the spherical portion 32 of the second tubular member 33 located in the cylindrical portion 31 of the tubular member 5, provides an articulated connection between the two tubular members.

The second end 34 of the second tubular member 32 is in the form of a spherical portion, thus providing a joint adapted to be located in the spherical seat 35, provided at the minor base of the frustum of cone forming the lower portion of the hollow body. The above said joint is held in position by subjecting the edges of the seat to a drawing operation.

In a diametrical plane of lower joint and perpendicular to the axis of the tubular member there is an abutment 36, onto which specimen supporting means fit, said means being held in position by open conical ring 37 having invitation guide means for its positioning, said ring having holes 37a into which means for removing same may engage.

On the second tubular member 32, and between the two spherical portions forming the same there is an annular groove 38, said groove allowing a larger angular motion between the two tubular members.

The operation of the described apparatus, when it is inserted into per se known pole pieces of objective lens, is as follows:

After the specimen is positioned, the apparatus is put into its seat provided on the microscope and then the angle between the electron beam and the plane onto which said specimen is set may be varied within wide limits by actuation of known micrometrical screws engaging the described cylinder members of the apparatus, said screws being provided on the microscope body.

Referring to the modification shown in FIGURES 3-5, said goniometric apparatus consists of a substantially frustoconical body 1, also adapted to be applied to a microscope. In fact, said body 1 is practically the same as the one previously described and this may be deduced examining some details, as, for instance, spherical seat 3a provided inside the annular projection 3 besides the inner bore 2 of body 1 for the setting of the first tubular member, said first tubular member being omitted in the present representation since this embodiment is not therewith concerned. The characteristic feature of such modification is instead shown in the lower portion of FIG. 3.

Referring to such portion, there will be seen a body 44, screwable at 55 on said upper hollow body 1 and extending inwardly to the apparatus by means of a conical wall 66, at the top of which there is provided, for instance, by drawing, a spherical surfaced receptive seating 77, into which the corresponding spherical joint 88a provided on the orientable member 88 is received, said joint being orientable in all directions.

It will be appreciated that said spherical seat should not necessarily be obtained by drawing. In fact, referring to FIG. 5, it will be seen that the receptive seat itself contains in a different embodiment a spherical socket portion 177 centrally located in a ring 166, provided in hollow body 1 itself, and a second spherical socket portion 167 which is upset with respect to the former and provided on a removable ring 667 and to the same suitably fixed by means of screws 668, or the like. In another embodiment there is even provided a set of longitudinal cuts through the body of the receptive seat, the cuts extending according to planes passing through the axis thereof, said cuts being adapted to allow larger elasticity of seating and trip insertion of the joint 88a and, furthermore, a greater ad-

herence on the same joint located in it. Such embodiment allows also the joint to be extracted in case of need.

It has already been pointed out that the specimen plane 136 substantially corresponds with the geometric diametrical plane of joint 88a perpendicular to the axis of member 88. Thus, it appears evident that, since the supporting conical wall 66 is quite recessed inside the upper hollow body 1, said specimen plane will be sufficiently displaced from the magnetic field of the objective, as the top portion of the apparatus is practically equal to the one used in the previous embodiment.

It will be understood that said common portion of the apparatus is such that it may be in either case indifferently adopted. While the first embodiment was conceived just to be introduceable in the known pole pieces of the microscope lens, the present embodiment is instead accomplished to keep the specimen far from said field of influence in order to carry out just the so-called technique of observation "out of focus" of magnetic specimens.

By arranging the specimen at a distance from the pole pieces of the lens a loss of the resolving power occurs, which in most cases is, however, of tolerable amount. It has been previously described how orientable member 88 is partially received in the described receptive seat. Now, it will be seen that inside and in the upper portion of the longitudinal hole, according to FIG. 3, it has a highly pronounced conical bore 99. This is made in order not to obstruct passage of electron beam during orientation of member 88.

Indeed such member is orientable in all directions in compliance with the type of spherical articulation engaging it and due to the fact that it is directly controlled by cylinders 122, 123 acting on a second spherical joint portion 188, said cylinders being radially guided along the walls of the hollow body and are driven by means of known hand-actuable control members, with which the existing microscopes are partially already equipped. On the same spherical joint portion 188, poppets 115 and 116, respectively, act always in direction of cylinders 122 and 123, such poppets being in turn under action of springs 117 and 118 and with their heads 117a, 118a directly abutting against the spherical joint portion while being guided by stems 111 and 112 slidable in respective sleeve supports 111a and 112a, directly screwed in the hollow body 1.

Similarly to the first embodiment, there are provided also in this embodiment guiding means generally designated at 101 for insertion of the apparatus into the microscope and holes 130 for air extraction from inside of the apparatus itself during the use thereof and for the insertion of a key for the extraction of nut 44.

Whenever in the specimen plane it is desired to create an auxiliary magnetic field, spherical joint member containing the plane of the specimen will be sufficiently large sized in order to achieve inside it small chambers 808 (FIG. 5) for arrangement of suitable coils.

At this point operation of such apparatus will be easily understood, as it is realizable that by suitable actuation on cylinders 122, 123, desired orientation of member 88 against the spring action is produced and this in full analogy with the previous embodiment.

In order to control the action of springs 117, 118, supports 111a, 112a, onto which they rest, may be more or less screwed.

It may be pointed out that the thus conceived apparatus can be conveniently utilized for the observation of specimens with an electron microscope at low temperatures. In fact, in such case and in order to reduce contamination deposits on the specimen and to thermally insulate the specimen itself, a screen 669 (FIG. 5) may be fitted on the apparatus, by engaging means provided on ring 667.

The present invention achieves its desired objects, being however susceptible to numerous modifications, within the scope of the invention.

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What is claimed is:

1. A device for orientably supporting specimens in electron microscopes, comprising a hollow body having a cavity, an upper end and a lower end and connecting means for connecting said hollow body to an electron microscope, an aperture at the upper end of said hollow body,

a first orientable tubular member within said hollow body and having a supported end and a free end, means in said cavity near said upper end for orientably supporting said supported end of said first tubular body,

an opening at the lower end of said hollow body, a second orientable tubular member within said hollow body and having a supported extremity and a free extremity,

means in said cavity near said lower end for orientably supporting said supported extremity of said second orientable tubular member,

said free end of said first tubular member and said free extremity of said second tubular member orientably engaging one with the other,

at least one transverse hole in said hollow body, at least one pin like control member slidable within said transverse hole and normally acting on one of said first and said second tubular members in a point distant from the supported ends thereof, spring means acting on said tubular member in opposition to said control member and means for connecting a specimen holder to said second tubular member.

2. A device for orientably supporting specimens in electron microscopes, comprising,

a hollow body having a cavity, an upper and a lower end and connecting means for connecting said hollow body to an electron microscope,

an aperture at the upper end of said hollow body,

a first orientable tubular member within said hollow body and having a longitudinal extension and a supported end and a free end,

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a spherical seat within said cavity of said hollow body near the upper end thereof, said spherical seat having an opening the axis of which extends in the longitudinal direction of said first tubular member in a normal position thereof, said first tubular member having a spherical portion rotatably engaging within said spherical seat,

a second orientable tubular member within said hollow body and having a longitudinal extension and a supported and a free extremity,

a second spherical seat within said cavity of said hollow body near the lower end thereof, said second spherical seat having an opening the axis of which extends in the longitudinal direction of said second tubular member in one normal position thereof,

said free end of said first tubular member and said free extremity of said second tubular member orientably engaging one with the other,

at least one transverse hole in said hollow body, at least one pin like control member slidable within said transverse hole and normally acting on said first tubular member in a point at a distance from said supported end thereof, spring means acting on said tubular member in opposition to said control member and means for connecting a specimen holder to said second tubular member, said second orientable tubular member having a spherical portion rotatably engaging within said second spherical seat.

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