

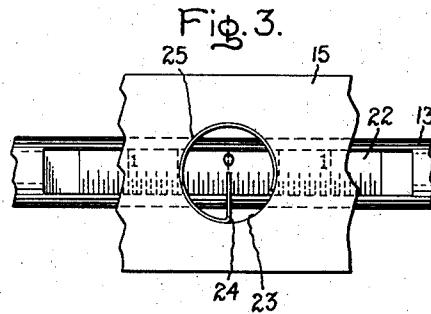
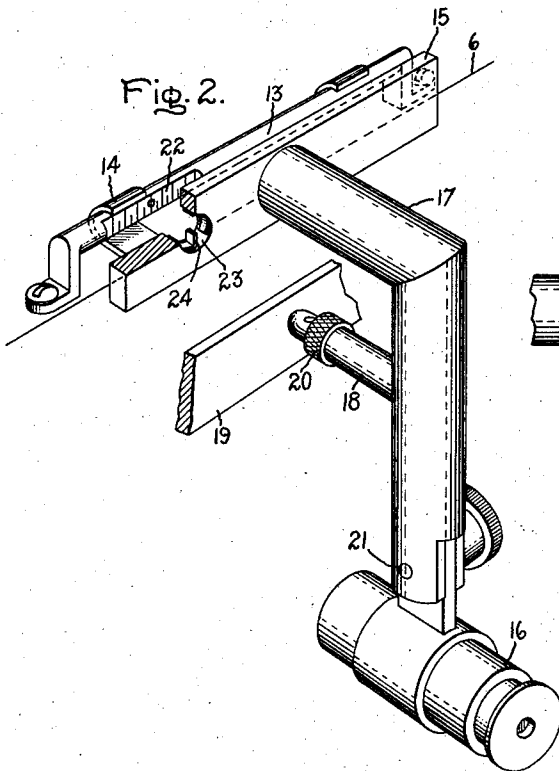
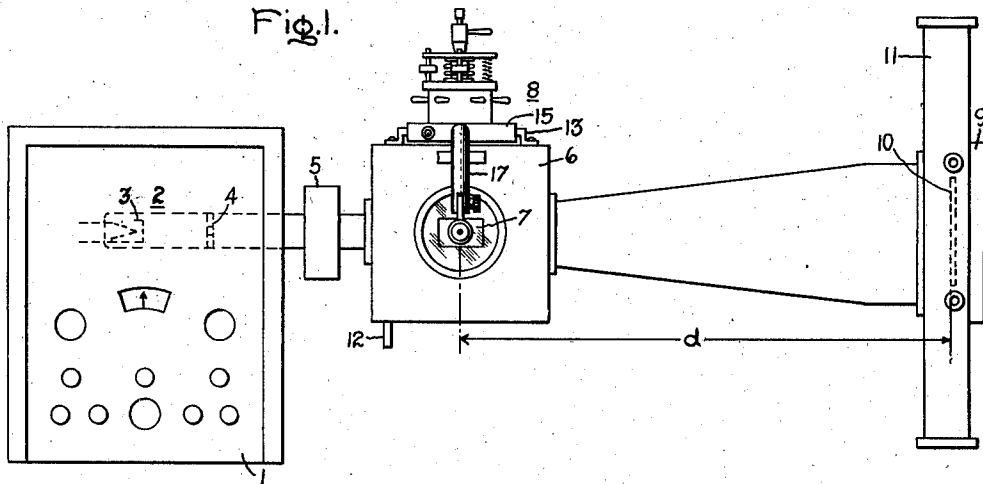
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C. H. BACHMAN

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INDEXING TELESCOPE FOR ELECTRON DIFFRACTION INSTRUMENTS

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Inventor:
Charles H. Bachman,
by *Morton D. Mone*
His Attorney.

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INDEXING TELESCOPE FOR ELECTRON
DIFFRACTION INSTRUMENTSCharles H. Bachman, Scotia, N. Y., assignor to
General Electric Company, a corporation of
New York

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4 Claims. (Cl. 250—49.5)

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My invention relates to electron optical instruments and, in particular, to electrical equipment in which a beam of electrons is impinged on an object being examined and the nature and construction of the object are determined by the diffraction pattern obtained.

In the study of crystalline structures, it is known that, if a beam of electrons of fixed velocity is reflected from the structure, a diffraction pattern is obtained which is characteristic of the crystal. With knowledge of the electron velocity and pattern dimensions, it is possible to determine both the type of crystal and the lattice constant of the crystal, i. e., the distance between adjacent particles in the crystal. When the diffraction pattern is recorded on a photographic film, a permanent record is produced from which information concerning the nature of the examined crystalline structure may be obtained provided the velocity of the electrons of the reflected beam and the distance of the crystalline structure from the photographic film are known.

It is a primary object of my invention to provide a new and improved electron diffraction instrument.

It is another object of my invention to provide new and improved means for measuring distances within an evacuated electron optical instrument.

One of the features of my invention is the use in an electron diffraction instrument of an index mark which is spaced at a predetermined distance from a photographic film and a telescope arrangement adjustable through measurable distances with respect to the index mark for determining the point of incidence of an electron beam upon an object being examined, so that the distance of that point from the photographic film may be measured with greater accuracy.

Other objects of my invention will appear from the following description of the invention and the novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. My invention, however, both as to its organization and method of operation together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 is a side view, partly in section, of a portion of an electron diffraction instrument suitably embodying the invention; Fig. 2 is an enlarged perspective view of the indexing telescope of the instrument of Fig. 1; and Fig. 3 is an enlarged side view of a portion of the sighting arrangement of Fig. 2.

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Referring to Fig. 1, I have there shown a portion of an electron diffraction instrument which includes an operating panel 1 behind which is disposed an electron gun 2 comprising a filamentary source of electrons 3 and an apertured anode 4. Electrons emitted from the filament 3 are defined into a beam by the anode 4 and focussed by means of a focussing yoke 5. A specimen or object to be examined is supported within a specimen chamber 6 on a suitable specimen support 7. The position of the specimen may be controlled by means of a manipulator 8 which is constructed and arranged to adjust the position of the specimen through three mutually perpendicular directions, as well as two axes of rotation. A manipulator of this type is described in the application of Igor B. Bensin, Serial No. 627,952, filed concurrently herewith.

The electron beam, after reflection from the specimen to be examined, is allowed to fall upon a fluorescent screen 9 to form a diffraction pattern thereon. When the pattern has been suitably established, as evidenced by viewing the fluorescent screen 9, a photographic plate 10 may be lowered from a magazine 11 into the path of the beam to obtain a permanent record of the diffraction pattern. The portions of the electron diffraction instrument thus far described are physically combined to form a unitary structure which may be evacuated through any suitable means, such as the tubulation 12, by a vacuum pump (not shown).

The beam of electrons of fixed velocity emitted from the electron gun 2 is caused to be reflected from or passed through a very thin layer of crystalline material. A re-grouping of the electrons of the beam is accomplished by the ordered crystalline structure being examined. This re-grouping may be explained by applying diffraction theory to the wave nature of the electrons. When these deflected electrons are allowed to fall upon the fluorescent screen 9 or the photographic plate 10, a pattern is obtained which is characteristic of the crystalline structure being studied. From the known velocity of the electrons and the dimensions of the pattern, it is possible to determine both the type of crystal and its lattice constant. For such determinations, it is essential that the distance from the point at which the electrons are either reflected from or passed through the crystalline substance to the photographic plate 10 be determined with great accuracy. This distance, which is designated by the letter "d" in Fig. 1, is the value used in the calculations for obtaining the diffraction character-

istics of the crystal. Since both the specimen being examined and the photographic plate are inside a vacuum system of rather complex shape, considerable difficulty is encountered in measuring this value with any great degree of accuracy. In accordance with my invention, means are provided for measuring this distance by comparing the location of the point of impingement of the beam of electrons with respect to a fixed point on the outside of the diffraction instrument whose distance from the photographic plate has been previously determined.

The improved arrangement for measuring the distance d in Fig. 1 is illustrated in the perspective view of Fig. 2 and comprises a tubular scale bearing rod 13 which is fixed on the upper side of the specimen chamber 6 and arranged parallel to the axis of the electron instrument. Attached to the rod 13 by means of a pair of hangers 14 is a sliding frame 15. The frame 15 supports a telescope 16 which is suitably attached to the frame 15 by means of a hanger rod 17. The third leg support 18 is attached to the rod 17 and bears upon a plate 19 affixed to the outside of the specimen chamber 6. By adjustment of the third leg support 18 by means of a knurled adjustment screw 20, the hanger rod 17 and frame 15 may be rotated through a small angle about the rod 13. Furthermore, the telescope 16 may be rotated about a pivot 21 affixed within the rod 17.

Arranged on the rod 13 is an indicia or scale 22 and there is provided in the frame 15 a slight hole 23. At the level of the scale 22 and disposed within the sight hole 23 is a pointer or sighting vane 24 which enables an observer to read the scale 22 accurately to within less than one-half millimeter. Preferably the vane 24 is formed from a circular piece of suitable spring material 25 inserted in the sight hole 23 and the vane 24 is terminated short of the length of the diameter of this circle. Moreover, the dimensions of the vane in the direction of the scale is sufficient that the scale reading may be determined accurately by sighting along the top edge of the vane. This portion of the structure of Fig. 2 is shown in enlarged view in Fig. 3. As may be seen in Fig. 3, in the center of the scale 22 there is provided the reference mark 0, whose distance from photographic plate 10 is determined with great accuracy in the construction of the electron diffraction instrument. The remaining numerals on the scale 22 are read with reference to this predetermined distance.

In the operation of my improved sighting device for the electron diffraction instrument described, a specimen to be observed is placed in position upon the support 7 through the sight door in the specimen chamber 6. Thereafter the instrument is sealed and evacuated and an electron beam is caused to fall upon the specimen. The position of the specimen relative to the beam may be varied by means of the manipulator 8 until a desired pattern on the fluorescent screen 9 is obtained. Thereafter the film 10 is lowered into position and the permanent record of the diffraction pattern obtained. The exact spot upon which the electron beam falls upon the specimen is observed through the telescope 16. In finding the point of incidence on the specimen, the frame 15 may be moved along the scale rod 13. During this positioning, the frame 15 and arm 17 may be rotated through a small angle by adjustment of the thumb screw 20. Likewise the telescope may be varied in angular position by rotation about the pivot 21. When the point of incidence

of the electron beam on the specimen is observed to be centered on the cross hairs of the telescope 16, the reading on the scale 22 is observed by sighting along the top edge of the vane 24. Proper use of this edge for sighting minimizes parallax. The value of the reading thus observed is added to or subtracted from the known distance of the point 0 on the scale 22 to the film 10 to give the distance d with extreme accuracy. In the instrument itself, the point 0 on the scale 22 may be fixed at a distance of approximately 50 centimeters from the photographic film 10. It is necessary to determine the point of incidence of the electron beam on the specimen to an accuracy of approximately .2 millimeter.

In obtaining diffraction patterns of some materials, it is not possible to observe the point of incidence of an electron beam on the material. In such instances, it is usually desirable to coat the object with fluorescent material in the vicinity of the position where observations are to be made. By careful manipulation of the electronic beam and the frame 15 carrying the telescope 16, the beam may be moved over the fluorescent material to the desired spot and the exact position of that spot with respect to the photographic film obtained with considerable accuracy.

One of the advantages of my improved sighting arrangement is that the frame 15 may be easily removed from the rod 13 during periods when a specimen is being introduced into the specimen chamber. Thereafter, the frame 15 may be replaced without any loss of accuracy in measuring the distance d .

An additional important advantage of my invention consists in the sighting arrangement by which all observations are made by sighting along the top of the vane 24. In this arrangement, the top of the vane 24 defines a plurality of points spaced apart in a direction transverse to the scale 22. By sighting across these points toward the scale 22, an accurate reading of the scale may be obtained. This arrangement thus, not only eliminates parallax, but also does not require the usual juxtaposition of scale and index edge. In fact, by sighting along the top of the vane 24, accurate readings may be obtained even though the scale 22 is viewed at an angle and the vane 24 is spaced from the scale by a substantial distance.

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since various modifications may be made, and I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The combination in an electron optical instrument of means including an evacuated structure for producing a beam of electrons, means for supporting a specimen to be examined in the path of said beam, a reference point located on said structure, and means for measuring the distance between said point and the point of incidence of said beam on said specimen.

2. The combination in an electron optical instrument of means including an evacuated structure for producing a beam of electrons, means for supporting a specimen to be examined in the path of said beam, a reference point located on said structure, and means for measuring the distance between said point and the point of incidence of said beam on said specimen comprising

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a scale associated with said reference point, optical means for observing said point of incidence, and an indicator movable over said scale and connected with said optical means.

3. The combination in an electron optical instrument of means including an evacuated structure for producing a beam of electrons, means for supporting a specimen to be examined in the path of said beam, a reference point located on said structure, and means for measuring the distance between said point and the point of incidence of said beam on said specimen, said means comprising a scale associated with said reference point, optical means for observing said point of incidence, and an indicator movable over said scale, said optical means being adjustable with respect to said specimen and being mechanically connected with said indicator.

4. An electron diffraction instruction comprising an evacuated container, a viewing screen located at one end of said container, means for projecting a beam of electrons on said screen, means for supporting a specimen to be examined in the path of said beam to produce a diffraction pattern of said specimen on said screen, said con-

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tainer having a reference point located thereon at a predetermined distance from said screen, and means for measuring the distance between said point and the point of incidence of said beam on said specimen.

CHARLES H. BACHMAN.

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