

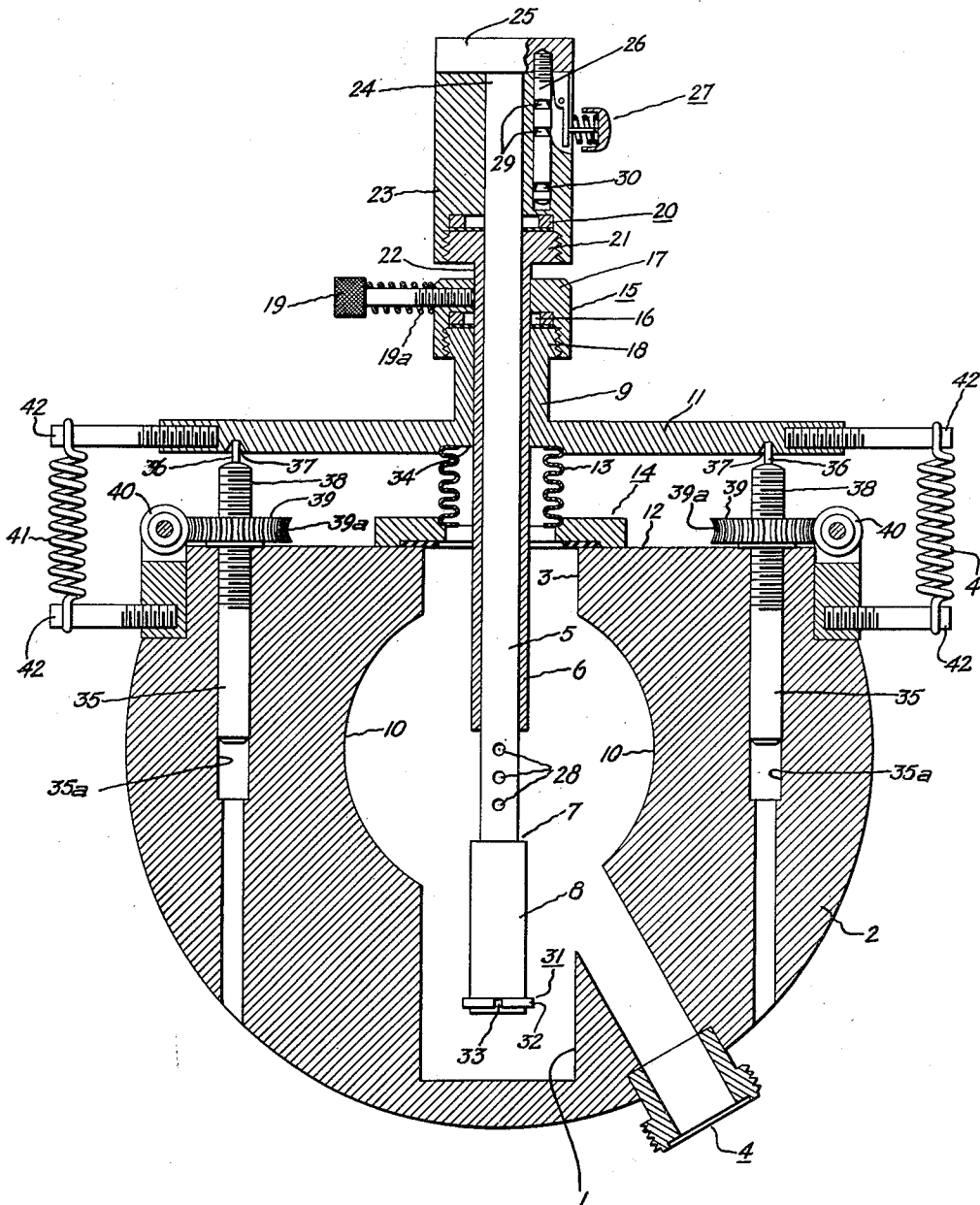
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INTRODUCTION OF SPECIMENS INTO DISCHARGE VESSELS

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INTRODUCTION OF SPECIMENS INTO
DISCHARGE VESSELS

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This invention relates to apparatus for introducing specimens into a discharge vessel and, more particularly, to apparatus for introducing specimens into an electron microscope or a diffraction camera.

If the vacuum is broken when a specimen is changed within an electron microscope, or similar apparatus requiring internal evacuation under operational circumstances, it may not only take an appreciable time to re-evacuate the apparatus, but, in addition, since parts of the apparatus may become contaminated by airborne impurities, a considerable time may be required to recondition the apparatus after re-evacuation has been completed. Accordingly, it has been proposed to introduce specimens into the vacuum through a form of airlock or into a separate space which can be sealed off from the main chamber and evacuated separately. However, even in such arrangements, a too great volume of air may be introduced into the system while a specimen is being changed. Moreover, the operations involved in changing the specimen may not be as simple as is desirable.

The apparatus of this invention comprises a rod slidable in a closely fitting tubular sleeve, which, in turn, is hermetically sealed in a slidable manner through the wall of a vacuum chamber. The rod is provided with one or more apertures near its inner end within which specimens may be retained. Attached to the inner end of the rod is a cylindrical extension which has substantially the same external diameter as the external diameter of the tubular sleeve. This arrangement is such that when the rod is pulled outwardly it slides within the sleeve until the apertures are covered thereby, and the extension abuts the end of the sleeve, whereupon the rod and the sleeve slide together in the opening of the chamber wall to a position in which only the rod extension seals the opening. Thereafter, the sleeve may be slid outwardly on the rod to expose the aperture or apertures therein.

In such an arrangement, with a good sliding fit between the rod and the sleeve, and between the sleeve and the wall of the chamber, the only air introduced into the chamber when changing a specimen is that contained within the aperture or apertures in the rod. Since the volume of these holes may be made very small, e. g., of the order of a few hundredths of a cubic centi-

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meter, the introduced into the chamber may be pumped away in a few seconds. Moreover, specimen contamination is prevented because the apertures within the rod are covered by the sleeve during the specimen withdrawal.

The extension or enlarged inner end of the rod may be provided with means which engage the inner surface of the wall of the vacuum chamber and operate to prevent the rod from being pulled completely out of the opening in the wall. In the event the rod is provided with two or more apertures for supporting specimens, the rod and sleeve may have locating means, e. g., the rod may be notched for cooperation with a catch secured on the sleeve so that with the sleeve in standard position, any of the apertures may be located in operative position within the chamber. In order to facilitate positioning of the specimen within the vacuum chamber, the rod and sleeve may be mounted so that the end of the rod can be moved across the chamber.

The features which I desire to protect herein are pointed out with particularity in the appended claims. The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing which shows in partial cross section, a view of specimen introducing apparatus suitably embodying the invention.

Referring particularly now to the drawing, there is shown a keyhole-shaped chamber 1, which is defined by a metallic member 2, having an opening 3 therein. Member 2 may be considered as forming a portion of the discharge vessel of an electron microscope or a diffraction instrument which may be internally evacuated by a suitable vacuum pump (not shown) connected in conventional fashion to a pump lead 4 communicating with chamber 1.

Means for introducing specimens into chamber 1 comprises a rod 5, which is an accurate sliding fit within an accurately formed tubular sleeve 6. Cylindrical rod 5 is longer than tubular sleeve 6 and is provided at its inner end 7 with a cylindrical member 8 which forms an extension thereof and has an external diameter substantially equal to the external diameter of tubular sleeve 6. Tubular sleeve 6 is, in turn, formed to be an accurate sliding fit within a collar 9 which

extends radially of the wall portions 10 of chamber 1 from opening 3. Collar 9, which may be formed integrally with a beam member 11, the purpose of which will be more fully described hereinafter, is sealed to the upper external wall portion 12 of member 2 by means of a flexible metal bellows 13 and a rubber packed gland seal 14, mounted as shown. Collar 9 is hermetically sealed to tubular sleeve 6 by means of a rubber packed gland seal 15, located in an enlarged part 16 of the bore of collar 9 and retained by a nut 17 screwed on to the end 18 of the collar. Collar 9 is also provided with a locking screw 19 loaded with spring 19a and operable to clamp tubular sleeve 6 in any desired position relative to collar 9. In addition, locking screw 19 serves to prevent tubular sleeve 6 from being drawn through collar 9 by atmospheric pressure when chamber 1 is evacuated.

In a similar manner, rod 5 is slidably vacuum sealed to tubular sleeve 6 by means of a rubber packed gland seal 20, positioned between an enlargement 21 on the outer end 22 of tubular sleeve 6 and a nut 23 secured thereon. The outer end 24 of rod 5 is formed with a cylindrical head 25 and with a notched rod 26 which extends from head 25 into the body of nut 23 where it is engaged by a spring pressed catch 27. Near the end 7 of rod 5 there are provided a number of axially spaced apertures or holes 28, which preferably extend through the rod at right angles to its axis and which serve to accommodate specimens to be examined. Notched rod 26 and spring catch 27 are so disposed that, with tubular sleeve 6 located appropriately within collar 9 such that it terminates on the near side of the discharge vessel axis, the notches 29 locate rod 5 relative to tubular sleeve 6 so that any of the apertures can be positioned individually in alignment with the axis of the vessel. It will be understood that the axis of the vessel, as generally employed in electron microscopes and diffraction cameras, is perpendicular to the plane of the paper and approximately in the center of the portion of chamber 1 having the illustrated partially circular cross section.

If desired, it is also possible to release locking screw 19 and rotate tubular sleeve 6, together with rod 5, in order to tilt the plane containing the specimen relative to the axis of the vessel. A pointer and scale (not shown) may be provided so that the angle of tilt may be determined.

When it is desired to change a specimen retained within apertures 28, tubular sleeve 6 is kept locked within collar 9 by locking screw 19 and rod 5 is pulled outwardly by means of head 25 so that the extension 8 abuts the inner end of tubular sleeve 6 and apertures 28 are positioned in covered relationship within the bore of tubular sleeve 6. In this position, a notch 30 upon rod 26 engages catch 27 to lock rod 5 and tubular sleeve 6 together. Then if locking screw 19 is backed off to release tubular sleeve 6 within collar 9, rod 5 and tubular sleeve 6 may be moved outwardly together until only extension 8 of rod 5 is located within collar 9 and gland seal 15.

In order to prevent tubular sleeve 6 and rod 5, along with extension 8, from being withdrawn completely out of collar 9, a portion 31 of enlarged diameter is provided near the inner end of extension 8. Portion 31 may comprise a split snap ring 32 retained within a circumferential recess 33 in extension 8. After rod 5 and tubular sleeve 6 have been withdrawn such that snap

ring 32 abuts the inner end 34 of collar 9, catch 27 may be released from notch 30 and tubular sleeve 6 moved outwardly of rod 5 to expose the aperture or apertures in rod 5. This allows the convenient changing or inspection of specimens retained therein. Tubular sleeve 6 may then be slid back upon rod 5 to cover apertures 28, whereupon rod 5 and tubular sleeve 6 together may be pushed inwardly through collar 9 into chamber 1. Thereafter, further inward movement of rod 5 relative to tubular sleeve 6 and collar 9 will expose apertures 28 for examination of specimens as desired.

From the foregoing description of the invention, it will readily appear to those skilled in the art that the changing of specimens is effected quickly and easily. Moreover, it will be observed that easy access to specimens may be obtained with the introduction of a minimum volume of air into chamber 1 and that specimen contamination by passage through gland seals is eliminated.

In order to provide for scanning movement of a specimen within chamber 1, collar 9, as has been heretofore mentioned, may be formed integrally with a beam 11 which extends transversely of both the axis of collar 9 and that of the discharge vessel. Beam 11 is supported at each end by means of rods 35 which have a sliding fit within holes 35a bored into member 2, as shown, at essentially right angles to the vessel axis. At their outer ends, rods 35 are provided with integral pins 36 which fit into V-shaped notches 37 in beam 11 and which, in conjunction with corresponding receptive portions of notches 37, may have some peripheral variation to prevent rotation of rods 35. Along their outer ends, rods 35 are provided with threads 38 which engage nuts 39 having gear teeth 39a formed along the outer periphery thereof, as indicated. Suitably located worms 40, attached to member 2, are positioned to engage the gear teeth 39a of nuts 39. It will now be observed that, with beam 11 held against rod 35 by means of tension springs 41 attached between studs 42, rotation of worms 40 will cause tubular sleeve 6 to tilt, whereby the inner end of rod 5 may be moved across chamber 1 at essentially right angles to the vessel axis to obtain a desired scanning movement of specimens retained within apertures 28.

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 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. A discharge vessel having an opening in the wall thereof; and a cylindrical specimen introducing means slidably and hermetically sealed within said opening, said means including a tubular sleeve, a cylindrical rod having a sliding fit within said tubular sleeve and at least one aperture near the inner end thereof, and a cylindrical member forming an extension of the inner end of said rod, said cylindrical member having an outside diameter substantially equal to the outside diameter of said tubular sleeve.

2. A discharge vessel having an opening in the wall thereof; and an externally accessible specimen introducing means slidably and hermetically sealed within said opening, said means including

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a tubular sleeve, a cylindrical rod having a sliding fit within said tubular sleeve and at least one aperture near the inner end thereof, said rod having a length greater than the length of said tubular sleeve, and a cylindrical member forming an extension of the inner end of said rod, said cylindrical member having an outside diameter substantially equal to the outside diameter of said tubular sleeve.

3. A discharge vessel having an opening in the wall thereof; a cylindrical specimen introducing means slidably and hermetically sealed within said opening, said means including a tubular sleeve, a cylindrical rod having a sliding fit within said tubular sleeve and at least one aperture near the inner end thereof, and a cylindrical member forming an extension of the inner end of said rod, said cylindrical member having an outside diameter substantially equal to the outside diameter of said tubular sleeve; and means for moving said specimen introducing means transversely to the axis of the vessel to provide a specimen scanning movement.

4. A discharge vessel having an opening in the wall thereof; an externally accessible specimen introducing means slidably and hermetically sealed within said opening, said means including a tubular sleeve, a cylindrical rod having a sliding fit within said tubular sleeve and at least one aperture near the inner end thereof, said rod having a length greater than the length of said tubular sleeve, and a cylindrical member forming an extension of the inner end of said rod, said cylindrical member having an outside diameter substantially equal to the outside diameter of said tubular sleeve; and means for moving said specimen introducing means transversely to the axis of the vessel to provide a specimen scanning movement.

5. A discharge vessel having an opening in the wall thereof, a tubular sleeve extending through said opening and terminating on the near side of the axis of said vessel, a cylindrical rod having a sliding fit within said tubular sleeve and at least one aperture near the inner end thereof, the apertured end of said rod extending beyond the inner end of said tubular sleeve and being adapted to retain at least one specimen within said at least one aperture in alignment with the vessel axis for irradiation by electrons, hermetic sealing means for slidably sealing said tubular sleeve within said opening whereby said tubular sleeve and said rod may be moved to and fro within said opening, means for sliding said rod within said sleeve to withdraw said at least one aperture into said sleeve, and a cylindrical member forming an extension of the inner end of said rod and having an outside diameter substantially equal to the outside diameter of said sleeve whereby said sleeve and said rod may be withdrawn through said hermetic sealing means to position said cylindrical member within said hermetic sealing means and permit access to said at least one aperture without admitting air through said opening into said discharge vessel.

6. A discharge vessel having an opening in the wall thereof, a tubular sleeve extending through said opening and terminating on the near side of the vessel axis, a cylindrical rod having a sliding fit within said tubular sleeve and at least one aperture near the inner end thereof, the apertured end of said rod extending beyond the inner end of said tubular sleeve and being adapted to retain at least one specimen within said at least one aperture in alignment with the vessel axis

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for irradiation by charged particles, hermetic sealing means for slidably sealing said tubular sleeve within said opening whereby said tubular sleeve and said rod may be moved to and fro within said opening, means for sliding said rod within said sleeve to withdraw said at least one aperture into said sleeve, a cylindrical member forming an extension of the inner end of said rod and having an outside diameter substantially equal to the outside diameter of said sleeve whereby said sleeve, said rod and said cylindrical member may be withdrawn through said hermetic sealing means to position said cylindrical member within said hermetic sealing means and permit access to said at least one aperture without admitting air through said opening into said discharge vessel, and a portion of increased diameter upon said cylindrical member near the inner end thereof for preventing said member from being completely withdrawn through said hermetic sealing means.

7. A discharge vessel having an opening in the wall thereof, a tubular sleeve extending through said opening and terminating on the near side of the vessel axis, means operable to retain said sleeve in such a position, a cylindrical rod having a sliding fit within said tubular sleeve and at least one aperture near the inner end thereof, the apertured end of said rod extending beyond the inner end of said tubular sleeve and the other end of said rod extending beyond the outer end of said tubular sleeve, said apertured end being adapted to retain at least one specimen within said at least one aperture in alignment with the vessel axis for irradiation by electrons, hermetic sealing means for slidably sealing said tubular sleeve within said opening whereby said tubular sleeve and said rod may be moved to and fro within said opening, hermetic sealing means for slidably sealing said rod within said tubular sleeve, means for sliding said rod within said sleeve to withdraw said at least one aperture into said sleeve, and a cylindrical member forming an extension of the inner end of said rod and having an outside diameter substantially equal to the outside diameter of said sleeve whereby said sleeve and said rod may be withdrawn through said first named hermetic sealing means to position said cylindrical member within said first named hermetic sealing means and permit access to said at least one aperture without admitting air through said opening into said discharge vessel.

8. A discharge vessel having an opening in the wall thereof, a tubular sleeve extending through said opening and terminating on the near side of the vessel axis, a cylindrical rod having a sliding fit within said tubular sleeve and a plurality of spaced apertures near the inner end thereof, the apertured end of said rod extending beyond the inner end of said tubular sleeve and being adapted to retain specimens in said apertures in alignment with the vessel axis for irradiation by electrons, the other end of said rod extending beyond the outer end of said tubular sleeve, hermetic sealing means for slidably sealing said tubular sleeve within said opening whereby said tubular sleeve and said rod may be moved to and from within said opening, means operable to retain said sleeve within said opening in a desired position, means adjacent said other end of said rod and being operable to position said rod within said sleeve such that each of said apertures may be individually aligned with the vessel axis to irradiate a specimen retained therewithin, means

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for sliding said rod within said sleeve to withdraw said apertures into said sleeve, and a cylindrical member forming an extension of the inner end of said rod and having an outside diameter substantially equal to the outside diameter of said sleeve whereby said sleeve and said rod may be withdrawn through said hermetic sealing means to position said cylindrical member within said hermetic sealing means and permit access to said apertures outside said discharge vessel without admitting air thereto.

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