Feb. 10, 1942. J. HILLIER 2,272,843

ELECTRON MICROSCOPE SPECIMEN CHAMBER

Filed July 31, 1940 2 Sheets-Sheet 1

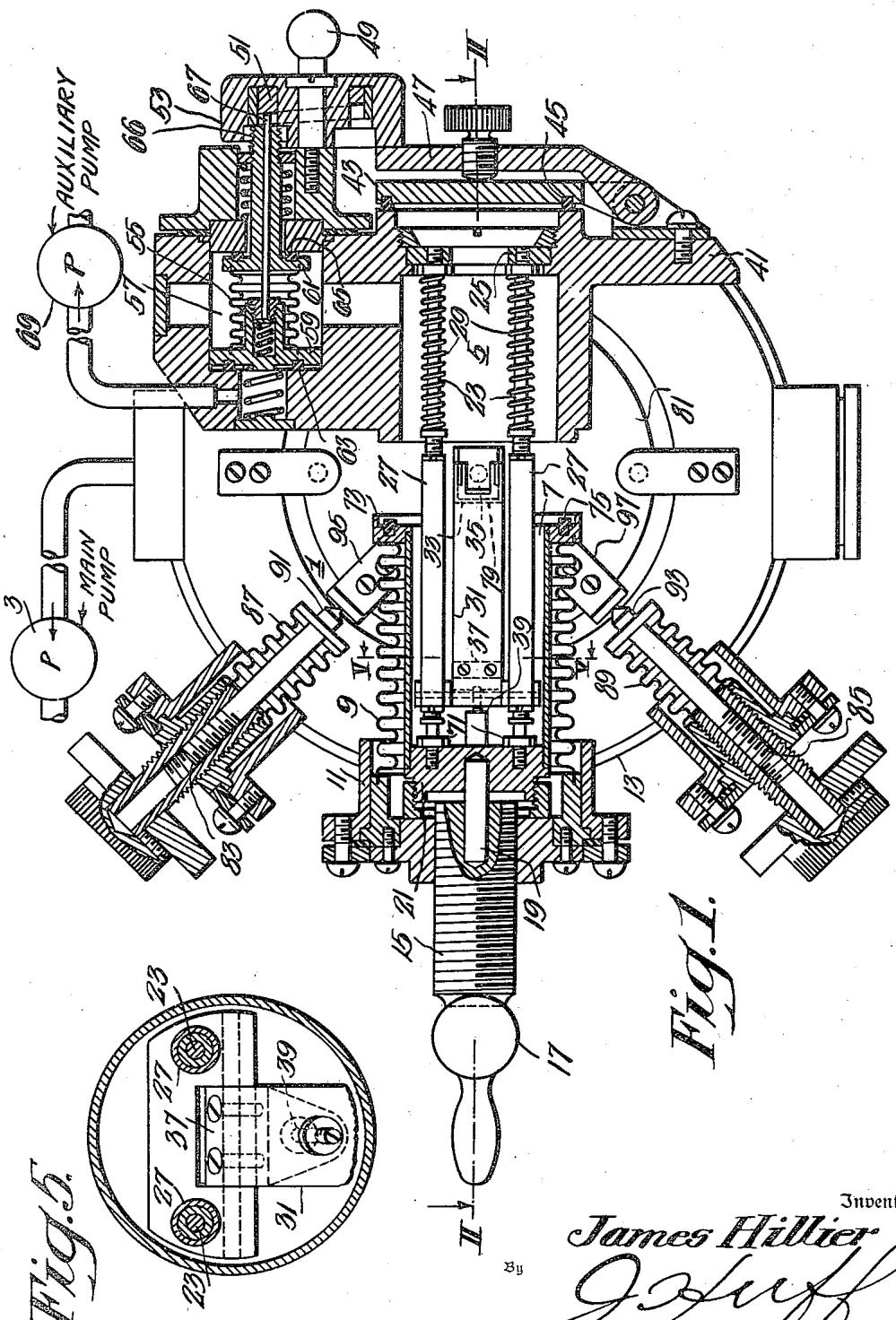

Fig. 1.

Fig. 5.

Inventor
James Hillier
By
Attorney

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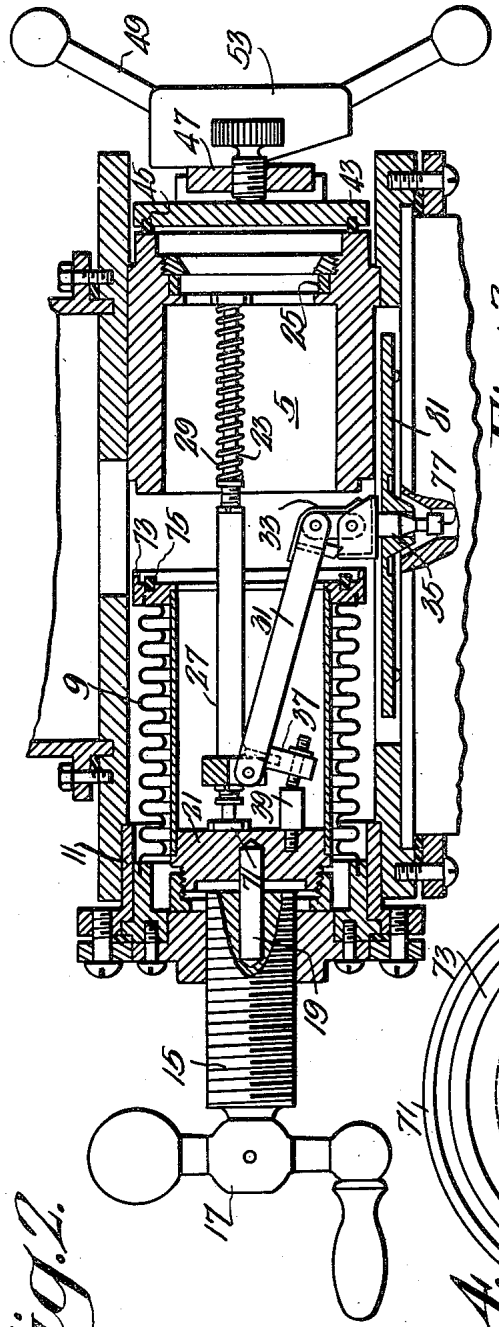

Fig. 2.

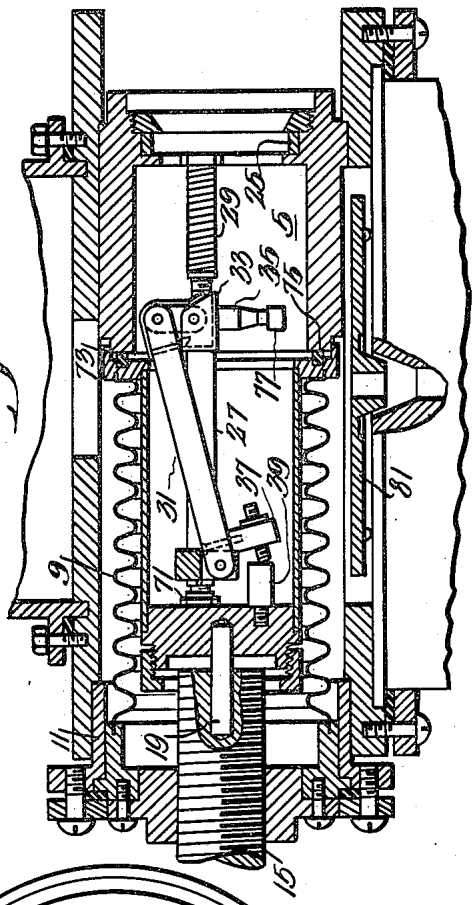

Fig. 3.

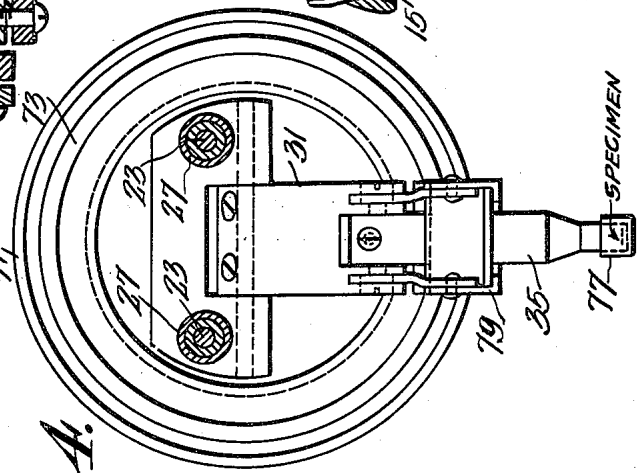

Fig. 4.

Inventor
James Hillier
By
Attorney

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ELECTRON MICROSCOPE SPECIMEN CHAMBER

James Hillier, Collingswood, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application July 31, 1940, Serial No. 348,912

7 Claims. (Cl. 250—49.5)

This invention relates to improvements in the specimen chambers of electron microscopes and especially to a specimen chamber with provisions for maintaining the main vacuum of the microscope during the insertion and removal of specimens.

The electron microscope includes a main chamber which is evacuated by means of a suitable vacuum pump. Inasmuch as the main chamber requires several minutes for evacuation, it is desirable to provide means whereby the specimen to be examined may be inserted within the microscope without impairing the main vacuum. This may be done by arranging an auxiliary chamber which can be shut off from the main chamber and separately evacuated.

It is an object of the present invention to provide means for inserting and removing a specimen to be examined within an electron microscope. Another object is to provide means whereby the specimen chamber of an electron microscope is provided with interlocking controls to prevent the unintentional operation thereof. Another object is to provide means whereby the specimen chamber of an electron microscope is provided with a door through which the specimens may be inserted and in which the controlling valves are operated by the door lock.

The invention will be considered in connection with the accompanying drawings in which Figure 1 is a view partly in section of the specimen chamber of the invention; Figure 2 is a sectional view taken along line II—II of Fig. 1; Figure 3 is a sectional view corresponding to Fig. 2 with the specimen cradle raised; Figure 4 is an end view of a portion of the specimen chamber; and Figure 5 is a sectional view taken along line V of Fig. 1. In describing the drawings similar reference numerals will be applied to similar elements.

Figure 1.—The main chamber 1 of an electron microscope is connected to a main vacuum pump 3. It should be understood that the microscope per se is not the subject matter of this invention and since the microscope is well known to those skilled in the art no attempt has been made to show the entire microscope structure. The specimen chamber includes the stationary portion 5 and the movable portion 7 which is included within a flexible metallic bellows 9. The bellows 9 is fixedly mounted to a member 11 which is suitably fastened to the wall 13 of the main microscope cylinder. The member 11 is threaded for the screw 15 which is operated by handle 17. A rod 19 in the end of the screw 15 engages a block 21. A pair of rods 23 are mounted on the block and are also secured to a plate 25 which will be hereinafter described. A pair of sleeves 27 are slidably mounted on the rods respectively and are frictionally retained in position by the biasing springs 29 which are also mounted on the rods. Thus the rods form parallel guides on which the sleeves 27 move. Under the influence of the biasing springs 29, the sleeves move forward or rearward in response to the movements of the block 21 which is driven by the screw 15. Fig. 2 represents the extreme rearward position and Fig. 3 represents the extreme forward position of the block and sleeves. A lever 31 is pivotally mounted on the block just below the pair of rods. On one end of the lever is mounted a cradle 33 which carries the specimen holder 35. On the other end of the lever an adjustable stop 37 is arranged to engage a pin 39 which is fastened to the block 21.

The fixed portion of the specimen chamber 5, within which the rods 23 are mounted, is made up of a casing 41 which is suitably hermetically sealed to the main chamber wall 13. The portion of the chamber to the right of the rod mounting includes a door 43. The door is preferably provided with a gasket 45 which forms a vacuum tight seal. The door, which is hinged, is locked in position by means of a locking member 47. The locking member 47 is also in the form of a door which cooperates with a locking handle 49. The handle serves the dual purpose of securing the locking member 47 in its closed position and at the same time rotating a double cam 51. When the locking member 47 is closed, a knurled screw located opposite the center of the inner door 43 engages and forces the door tightly against its gasket 45, thereby locking the door 43 in place. The cam is positioned within the outer portion 53 of the locking member. The rotation of the cam acts upon valves which will now be described. A bellows 55 is locked within a recess 57. On opposite ends of the bellows are secured discs 59, 61. These discs are preferably arranged to include gaskets 63, 65 which engage the opposite ends of the recess 57 to form thereby a three way valve.

When the outer portion of the cam 51 is turned a sleeve 66 is pushed inwardly. This movement opens the valve formed by the right hand disc 61 to thus admit air into the auxiliary chamber as will be hereinafter described. When the cam is turned in the reverse direction a rod 67, lo-

cated with the bellows 55, is operated by the inner portion of the cam 51 to permit the valve formed by the disc 59 to open, thus connecting the auxiliary vacuum pump 69 to the specimen chamber. Before the last mentioned valve 59 is opened, the first mentioned valve 61 is closed. When both valves are closed, the specimen chamber is disconnected from the auxiliary pump and is connected to the main pump 3.

Having described the essential arrangement of the invention, its operation will be considered by reference to Figures 2 and 3. As the screw 15 is turned in a clockwise direction the block member 21 is forced to the right. This causes the pin 39 to engage the stop 37 because during the initial forward movements of the block 21 the sleeves 27 stay in their initial position and hence the pin 39 initially engages stop 37 as shown in Fig. 2 and finally brings the stop 37 to the position shown in Fig. 3. As the stop is forced outwardly the lever 31 is raised upwardly until the cradle 33 and specimen holder 35 are raised into a position for entry into chamber 5. After the lever has been raised additional stops 71 on the member 21 engage the sleeves 27 so that they are forced along the rods 23 to compress the biasing springs 29. This movement of the screw 15 will also force the movable member including the bellows 9 to the right until its end 73 including the gasket 75 engages the exposed end of the chamber 5 to form thereby an airtight joint and an airtight specimen chamber.

The space within the bellows and within the chamber 5 is thus hermetically sealed from the main chambers of the microscope. Because of the vacuum within the auxiliary chamber it is impractical to open the doors 43, 47 without first admitting air into the chamber. This is done by turning the lock 49 until the outer cam 51 forces the valve 61, 65 to the left to admit air into the chamber. It will be observed that the rod 67 maintains the valve 59, 63 closed so that the auxiliary pump 69 is shut off. It is then possible to open the outer door 47 which releases the inner door 43. The specimen holder 35 may then be removed from the chamber by means of any suitable instrument such as a pair of forceps. The specimen is inserted in the small cap 77 which is removably mounted on the end of the specimen holder.

The reverse process, namely, returning the specimen holder to within the microscope, includes the following steps: First, the specimen holder 35 is inserted within the cradle 79. Next, the inner and outer doors are closed. The handle 49 is turned to lock both doors 43 and 47 and at the same time to shut the valve 61, 65 and open the valve 59, 63. This permits the auxiliary pump to evacuate the auxiliary chamber. After the auxiliary chamber has been evacuated the screw 15 is turned in a counter-clockwise direction so that the bellows 9 is moved to the left. As the bellows moves to the left the biasing springs 29 force the sleeve 27 to the left until they reach the end of their travel. After the sleeves have moved as far to the left as the stops permit, the member 21 will continue to move toward the left carrying with it the pin 39. The movement of the pin 39 causes the lever 31 to pivot and thus the specimen cradle and holder move downwardly until the cradle rests on the plate 81 which locates the specimen at the proper depth within the microscope. The specimen may be moved laterally by the adjusting screws 83, 85 which operate through metallic bellows 87, 89, respectively. Plungers 91, 93 engage the angles 95, 97 to move the plate 81 and with it the specimen holder. Since the movements of the specimen are less than about a sixty-fourth of an inch, it has been found that the play in the lever 31 and other parts is sufficient to permit the required movement. Since it is not necessary to run the auxiliary pump when the specimen is being observed the valve 59, 63 has been arranged so that a movement of the cam 51 will close the valve thereby disconnecting the auxiliary pump.

Thus the invention has been described as a mechanism for inserting specimens within an electron microscope. The specimen is inserted into the main chamber of the microscope through an auxiliary chamber which may be evacuated independently. A door to the auxiliary chamber is provided with a lock which operates the valve controlling the admittance of air of the evacuation of the auxiliary chamber. For convenience the specimen holder is supported by a cradle which may be lifted from its normal position into the auxiliary chamber at a point where it may be conveniently removed for the insertion or removal of the specimen.

I claim as my invention:

1. A specimen chamber for an electron microscope including in combination means including a bellows for forming an airtight auxiliary chamber, means for moving said bellows into and out of engagement with a portion of said auxiliary chamber, means mounted on a portion of said moving means for supporting a cradle, a specimen holder mounted on said cradle, means operated by said moving means for raising and for moving said cradle supporting means into said portion of the auxiliary chamber, and a vacuum tight door arranged to provide access to said auxiliary chamber.

2. A specimen chamber for an electron microscope including in combination a movable member including a recess, a fixed member including a recess, means for bringing said movable member into engagement with said fixed member so that said recesses form an airtight chamber, a specimen holder, a lever mounted on said movable member and arranged to support said specimen holder, means including said movable member for engaging said lever to raise and to move said specimen holder within said airtight chamber, and an airtight door mounted externally of said microscope and arranged to provide access to said auxiliary chamber.

3. A specimen chamber of the character of claim 2 including a valve arranged to connect said auxiliary chamber to an auxiliary pump or to the outside air, a lock for said door, and means connecting said lock to said valve so that the door and valve positions are interlocked.

4. A specimen chamber of the character of claim 2 including a lock for said door, a valve for connecting said chamber to the outside air, to an auxiliary pump or to shut off the auxiliary pump, and means interconnecting said lock and said valve.

5. A specimen chamber for an electron microscope including a stationary member, a movable member, said members including recesses forming a specimen chamber when the members are brought together, means for making said chamber airtight, a door external to said microscope opening into said chamber for the insertion of specimens, a holder for said specimens, means for moving said holder upon movement of said

movable member, and means including said last mentioned means for lowering said specimen holder into a predetermined position within said microscope.

6. A specimen chamber of the character of claim 5 including means providing an airtight connection external to said microscope for moving said specimen holder laterally with respect to said predetermined position.

7. A specimen chamber of the character of claim 5 including a three position valve for connecting said chamber to the outside air, to an auxiliary pump and to close said auxiliary chamber to said auxiliary pump, a lock for said door and means interconnecting said valve and lock.

JAMES HILLIER.