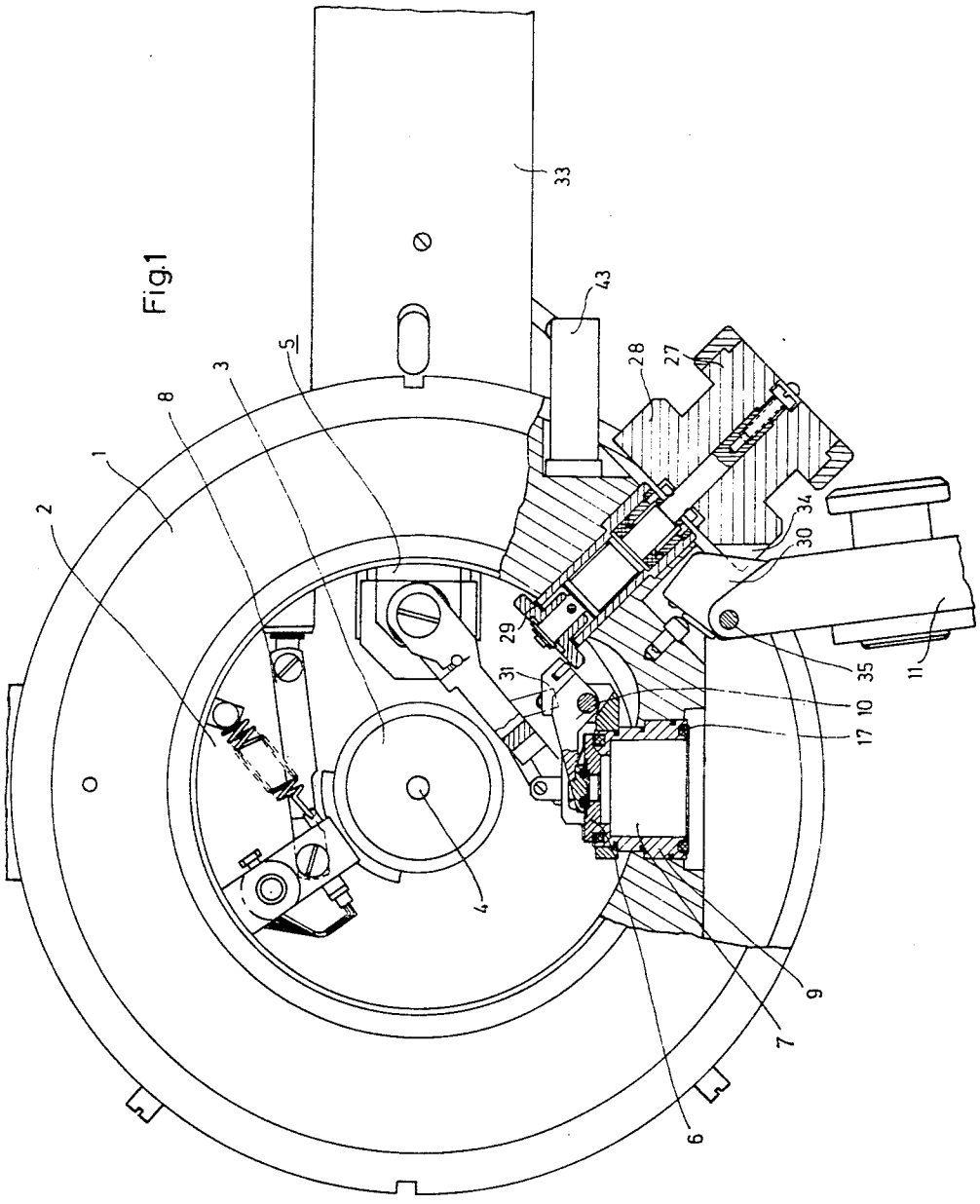
Dec. 9, 1969 A. ASMUS ETAL 3,483,373

AIRLOCK ASSEMBLY FOR CORPUSCULAR RAY DEVICES

Filed July 24, 1967 4 Sheets-Sheet 1

Fig.1



AIRLOCK ASSEMBLY FOR CORPUSCULAR RAY DEVICES

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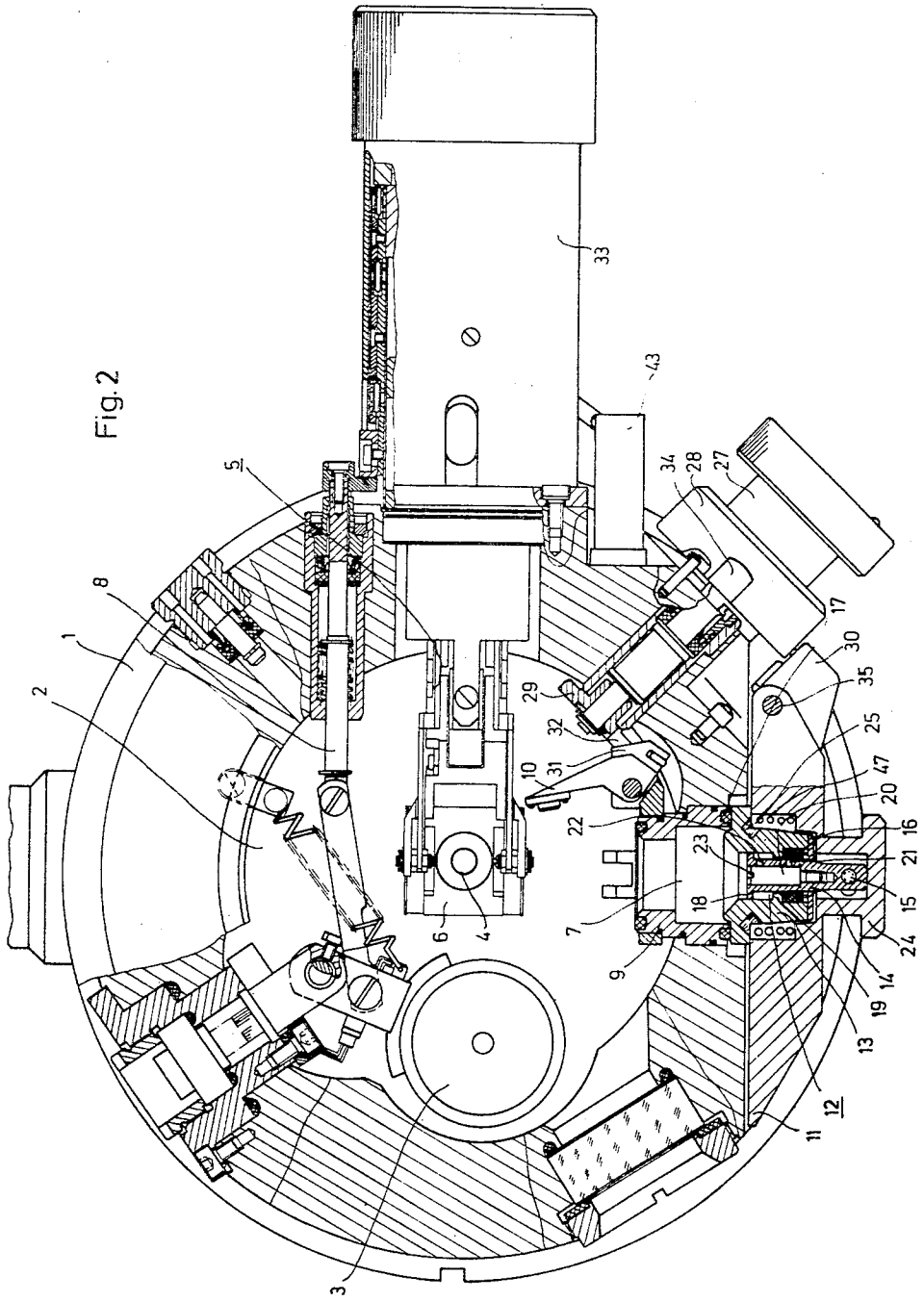
Fig. 2



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AIRLOCK ASSEMBLY FOR CORPUSCULAR RAY DEVICES

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Fig.5

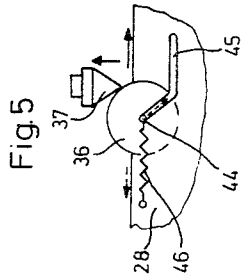


Fig.3

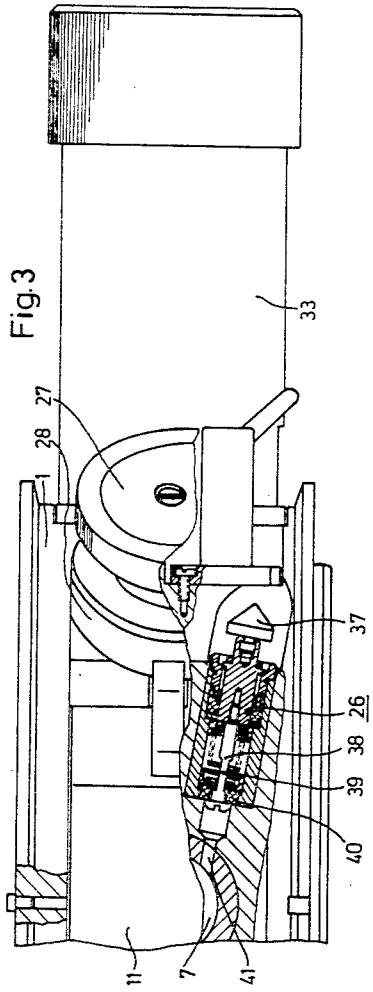


Fig.4

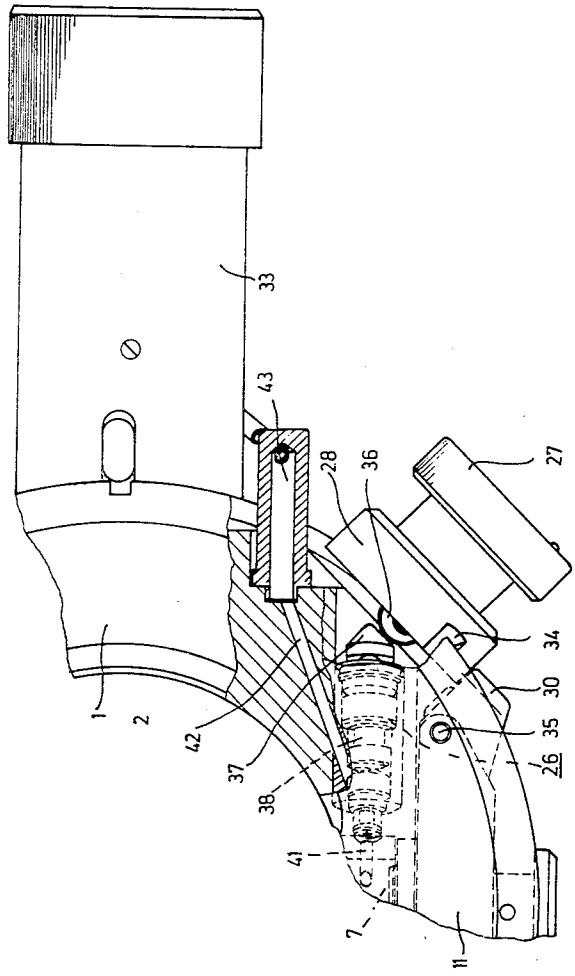
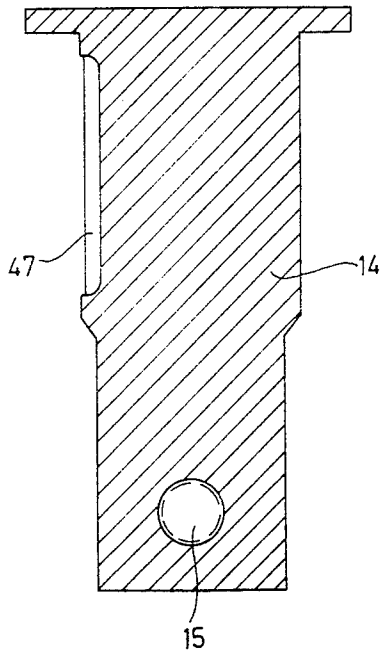


Fig. 6



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AIRLOCK ASSEMBLY FOR CORPUSCULAR RAY DEVICES

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Int. Cl. H01j 37/18
U.S. Cl. 250—49.5 10 Claims

ABSTRACT OF THE DISCLOSURE

An airlock assembly to be used especially in connection with the introduction of an object into and the removal of an object from the evacuated interior of a corpuscular ray device. The assembly includes a chamber-defining means which forms an airlock chamber, this chamber-defining means having opposed inner and outer ends. An inner door means coacts with the inner end of the chamber-defining means for opening and closing the chamber, and an outer door means coacts with the outer end of the chamber-defining means also for opening and closing the airlock chamber. The inner door means can be moved to its open position only when the outer door means is in a closed position closing the chamber, while the outer door means can be moved to its open position only when the inner door means is in a closed position closing the chamber. A rotary releasable lock means is provided for locking the inner door means in its closed position when the outer door means is released for movement to its open position and for locking the outer door means in its closed position when the inner door means is released for movement into its open position. The outer door means carries a valve means which communicates with the airlock chamber for admitting air into the latter during an initial increment of opening movement of the outer door means, this valve means responding automatically to the initial increment of opening movement of the outer door means for admitting air into the airlock chamber. This latter valve means includes an outer cylindrical member which engages the outer end of the chamber-defining means in a fluid-tight manner when the outer door means is in its closed position, and the valve means further includes a valve plunger which extends coaxially into and is surrounded by the outer cylindrical member, a sealing means being surrounded by the outer cylindrical member and surrounding the plunger to provide for a sealed slidable movement of the latter with respect to the outer cylindrical member. This plunger of the valve means extends outwardly beyond the cylindrical member thereof and has outwardly beyond the cylindrical member an operative connection with the outer door means resulting in automatic displacement of the plunger outwardly of the cylindrical member during the initial increment of opening movement of the outer door means. A passage means is carried by the plunger for admitting air through this passage means into the chamber only during this initial increment of opening movement of the outer door means, and this passage means is closed when the outer door means is in its closed position. The outer door means also carries an evacuating valve means for placing the airlock chamber in communication with a source of vacuum when the evacuating valve means is in an open position. A rotary releasable lock means coacts with the inner and outer door means for locking the inner door means in its closed position when the outer door means is released for opening movement and for locking the outer door means in its closed position when the inner door means is released for opening movement, and a transmission means coacts with this rotary lock means and with the evacuating valve means for displacing the latter to its open position only when the releasable lock means locks the outer door means in its closed position.

Our invention relates to airlock assemblies to be used in connection with the introduction of an object into and removal of an object from the evacuated interior of a corpuscular ray device.

Our invention is particularly useful in connection with the movement of an object into and out of the evacuated interior of an electron microscope. However, our invention also is capable of being used with other corpuscular ray devices such as ion microscopes and diffraction devices, as well as for moving diaphragms, pole shoes, or other components of the device into and out of the evacuated interior thereof.

Airlock assemblies of the above type conventionally are provided with an airlock chamber having inner and outer ends with which inner and outer doors respectively coact for alternately closing and opening the airlock chamber in a fluid-tight manner. Thus, it is known to provide at the outer door a valve for admitting air into the airlock chamber after the inner door is closed and before the outer door is opened. With known corpuscular ray devices, a push-type of pressure valve is used for this purpose, so that after a plunger of the valve is pushed to a position opening the valve there will be communication between the outer atmosphere and the airlock chamber. Aside from the fact that a valve structure of this type can easily result in an inadvertent admission of air into the airlock chamber, resulting in damaging entrance of air into the evacuated interior of the corpuscular ray device when the inner airlock door is open, such a valve structure requires an additional manually engageable member to be actuated in order to admit air into the interior of the airlock chamber.

Similar disadvantages are encountered in connection with the evacuating valve structure and for evacuating the airlock chamber after the outer door is closed and before the inner door is opened. This evacuating valve provides communication between the interior of the airlock chamber and a source of vacuum such as a pre-evacuated container of a vacuum installation of the corpuscular ray device. Conventional evacuating valves of this type must also be actuated by additional manually engageable members which are accessible to the operator, so that difficulties are encountered in connection with the airlock operations if actuation of the evacuating valve is overlooked.

A primary object of our invention is to provide a structure which will avoid the above drawbacks of the conventional airlock assemblies.

In particular, it is an object of our invention to provide a construction which can be used either separately in connection with eliminating the drawbacks of either the valve for introducing air into the airlock chamber and the evacuating valve, or our invention can also be used for both of these valves.

In particular, in connection with the valve for introducing air into the airlock chamber, it is an object of our invention to provide a construction which does not require any special manually-engageable member for this purpose and which will operate automatically during the initial increment of opening movement of the outer airlock door for displacing the valve to a position where it admits air into the airlock chamber.

Also, it is an object of our invention to provide a construction which will control the manner in which air flows into the interior of the airlock chamber.

Thus, it is an object of our invention to provide a construction which will reliably prevent inadvertent actuation

of the valve which admits air into the airlock chamber.

Also, either independently of the air-admitting valve or in conjunction therewith, it is an object of our invention to provide a construction which does not require any additional manual engageable member and which will operate automatically to actuate an evacuating valve during actuation of a structure which locks the outer door in its closed position and which is capable of releasing the outer door for movement to its open position when this lock structure is actuated to lock the inner door in its closed position. Thus, when this lock structure is actuated to lock the outer door in its closed position, the evacuating valve is, in accordance with our invention, displaced to an open position placing the interior of the airlock chamber in communication with a source of vacuum.

Yet anotther object of our invention is to provide for a construction of this latter type a transmission means which coacts with the locking structure and with the evacuating valve to transmit movement of the locking structure to the evacuating valve for opening the latter only when the locking structure is moved in a direction for locking the outer door in its closed position, while the transmission means does not transmit any movement from the lock structure to the evacuating valve when the lock structure is displaced in a reverse direction releasing the outer door for opening movement and locking the inner door in its closed position.

In accordance with our invention the air-admitting valve means includes an outer cylindrical member which engages the outer end of the chamber-defining means, which defines the airlock chamber, in a fluid-tight manner when the outer door means is in its closed position. This latter cylindrical component of the valve means for admitting air into the airlock chamber surrounds a valve plunger which extends coaxially into the cylindrical member and which is surrounded by a sealing means which is in turn surrounded by the cylindrical member and which provides a fluid-tight axial sliding of the plunger with respect to the outer cylindrical member. Outwardly beyond the cylindrical member this plunger is operatively connected with the outer door means to be displaced outwardly with respect to the cylindrical member during the initial increment of opening movement of the outer door means. The latter plunger is provided with a passage means through which communication is provided between the outer atmosphere and the interior of the airlock chamber after the plunger has been displaced outwardly with respect to the cylindrical member by a given amount, and this passage means is maintained closed when the plunger is in an inner end position extending to its maximum extent into the outer cylindrical member when the outer door means is in its closed position.

Although the latter passage means can take the form of a groove or other suitable profiling situated at the exterior surface of the valve plunger, this groove or profiled structure bridging the seal around the plunger during the initial increment of opening movement of the outer door during outward displacement of the plunger with respect to the cylindrical member, it is preferred to provide a passage means in the form of an axial bore extending along the interior of the plunger from its inner end and communicating with a transverse bore which extends from the axial bore through a wall portion of the plunger and which is closed by the sealing means when the plunger is in its inner end position, this transverse bore becoming situated outwardly beyond the seal during the initial increment of opening movement of the outer door means so as to provide in this way a communication through this passage means between the outer atmosphere and the interior of the airlock chamber.

With a construction of this latter type it is possible to control the flow of air into the airlock chamber by situating in the interior of the axial bore of the plunger a threaded pin having a predetermined play at its threaded mounting providing in this way a controlled flow of air in a throttled manner into the airlock chamber, but it is preferred to use a simple pin having a predetermined clearance in the axial bore so as to control in this way the flow of air into the airlock chamber.

In connection with the evacuating valve, it is preferred to provide a construction where the lock means releases the inner airlock door for opening movement only after the evacuating valve is closed, since in general the airlock chamber is in communication with a pre-evacuated container of the vacuum installation through the evacuating valve and the device is operated at a high vacuum.

The transmission means between the lock means for alternately locking and unlocking the inner and outer doors and the evacuating valve preferably takes the form of suitable projections, such as cams, cam-discs, or the like, of the lock means which coact with a normally closed plunger of the evacuating valve to displace this latter plunger to its open position when the lock means is actuated to lock the outer door in its closed position. However, it is preferred to use instead a projection in the form of at least one roller supported for rotary movement by the releasable lock means which is turned in opposite directions in connection with the alternate locking and unlocking of the airlock doors. A spring means coacts with this roller to render the latter effective for transmitting movement between the lock means and the evacuating valve plunger only when the lock means is turned in a direction which brings about locking of the outer door means in its closed position, this spring means yielding when the lock means is turned in an opposite or reverse direction so that no movement is transmitted at this time between the releasable lock means and the evacuating valve plunger.

Our invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a transverse partly sectional plan view taken in a horizontal plane which passes through the column of an electron microscope at the elevation of the axis of the airlock chamber thereof;

FIG. 2 is a sectional plan view taken in the same plane as FIG. 1 but showing more details in section and also showing the parts in a position different from that of FIG. 1;

FIG. 3 is a partly sectional fragmentary side elevation of the column of an electron microscope, showing the structure of an evacuating valve for evacuating the airlock chamber;

FIG. 4 is a fragmentary partly sectional plan view showing further details of the structure of FIG. 3;

FIG. 5 is a schematic illustration of the direction-responsive transmission means of our invention for actuating the evacuating valve only when the releasable door-locking means is displaced in one of a pair of opposed directions.

In the example of our invention which is illustrated in the drawings, it is assumed that the column **1** of the illustrated electron microscope surrounds and encloses an evacuated hollow interior **2** while there is situated in the plane of FIGS. 1 and 2 a ray-deflecting system **3** for the purpose of preliminarily deflecting an electron ray **4**, the structure further including an airlock means **5** for displacing an unillustrated specimen cartridge carried by the carrier plate **6** as by being threaded onto the latter, for example. The construction of the ray-deflecting means **3** and the airlock **5**, which brings about movement of the specimen cartridge in opposed directions out of the region of the electron ray **4** (FIG. 2) and into the airlock chamber **7** (FIG. 1) as well as in the reverse direction, are of no interest in connection with our invention. Also, the mechanism **8** which displaces the deflecting means **3** so that it does not interfere with the movement of the airlock means **5** is of no particular interest in connection with our invention and is therefore not further described.

A cylindrical member 9 which is carried in a fluid-tight manner by an annular wall part of the column 1 forms a chamber-defining means which defines the cylindrical airlock chamber 7. A pawl 10 coacts with the plate 6 to form with the latter and inner door means for closing and opening the airlock chamber 7 at the inner end of the chamber-defining means 9. The structure also includes an outer door means 11 coacting with the outer end of the chamber-defining means 9 for opening and closing the chamber 7, this door 11 being swingable about a pivot 35.

The air-admitting valve means 12 which is illustrated in FIG. 2 is carried by the outer door means 11 and includes an outer cylindrical component 13 and an inner valve plunger 14 which extends coaxially into and is surrounded by the cylindrical member 13, the latter being spaced from the plunger 14. Except for its connection by way of a screw 15 to the outer door means 11, the plunger 14 is freely movable in an inner opening of the outer door means 11 which mechanically holds the plunger 14 at the region of its outer end by way of the screw 15. The cylindrical component 13 and the plunger 14 are freely movable axially one with respect to the other, and for this purpose the component 13 is seated on and surrounds the plunger 14 by way of a seal 16 which is surrounded by the cylindrical member 13 and surrounds the plunger 14 so as to provide a fluid-tight slidability of the plunger 14 with respect to the cylindrical member 13.

In the closed position of the outer door means which is illustrated in FIG. 2, the cylindrical part 13 of the valve means 12 engages in a fluid- or vacuum-tight manner the outer end of the chamber-defining means 9, a sealing ring 17 being situated between the chamber-defining means and the valve member 13 at the outer end of the chamber-defining means 9 while the member 13 is pressed toward the latter by the closed outer door means 11. As soon as the outer door means 11 commences its opening movement, and during an initial increment of this opening movement of the outer door means 11 is transmitted through the screw 15 to the plunger 14 so as to withdraw the latter outwardly of the cylindrical part 13 until a stop 18 of the plunger 14 engages a stop 19 of the cylindrical member 13, and the component 13 will remain in its position illustrated in FIG. 2 until these stops engage each other because it is pressed by the outer air pressure tightly against the outer end of the chamber-defining means 9.

The plunger 14 is provided with a passage means through which air can enter from the exterior into the interior of the chamber 7, and in the illustrated example this passage means takes the form of an axial bore 20 which extends axially along the interior of the plunger 14 from its inner end. In addition, the illustrated passage means includes a pair of transverse bores 21 and 22 extending from the axial bore 20 through a pair of wall portions of the plunger 14, respectively. In the closed position of the outer door means 11, which is shown in FIG. 2, both of the transverse bores 21 and 22 are in the region of the evacuated chamber 7, and at least the transverse bore 21 is surrounded and closed by the seal 16 so that the passage means 20–22 cannot at this time communicate with the outer atmosphere. However, this latter communication is indeed provided as soon as, as a result of a small initial increment of opening movement of the outer door means 11, the plunger 14 is displaced outwardly with respect to the cylindrical component 13 to an extent which is sufficient to situate the transverse bore 21 outwardly beyond the region of the seal 16.

A flow-control means is provided in the illustrated embodiment of our invention to control the manner in which air flows into the chamber 7, and for this purpose the illustrated flow-control means includes a pin 23 having an outer diameter which in conjunction with the inner diameter of the bore 20 controls the speed with which the air flows into the chamber 7. Thus, through this throttling expedient it is possible to reduce the speed of flow of air into the chamber 7 to an extent sufficient to prevent any damage to the object. Any suitable transverse bridge member or the like can extend across the inner end of the bore 20 and is fixedly carried by the plunger 14 while carrying the flow-controlling pin 23 which extends axially of and coincides with the axis of the plunger 14.

It is particularly advantageous, even for reasons of saving of material, to situate the valve means 12 in the illustrated manner in an opening of the outer door means 11 which is located in the region of the actuating knob 24 of the outer door means 11. Thus, with this construction it is possible to take advantage of the thickness of the outer door which is in any event available because of the presence of the actuating knob 24 in order to achieve a space for the situation of the air-admitting valve means 12.

The structure is also provided with a lead ring 25 carried in the illustrated manner by the component 13 in order to provide protection against radiation. This lead ring 25 provides during the initial increment of opening movement of the outer door an entrance of exterior air into the opening of the outer door 11 which accommodates the valve means 12, so that in the above-described manner the cylindrical component 13 is reliably maintained pressed against the seal 17 in a tight manner by the outer air-pressure until the passage means 20–22 becomes effective to admit air into the chamber 7.

A spring 47 surrounds the component 13 and presses against an outer flange of the latter and a shoulder of the door 11 so as to reliably provide a tight application of the component 13 to the chamber-defining means 9 upon closing of the outer door 11. The strength of the spring 47 is designed so that when the outer door 11 is released for opening movement this spring 47 will automatically open the outer door through the increment required to render the passage means effective to admit air into the chamber 7.

FIGS. 3 and 4 illustrate an automatically actuated evacuating valve means 26 for evacuating the interior of the airlock chamber 7. For this purpose a rotary releasable lock means 27 which is shown in detail in FIGS. 1 and 2 is made use of. As is well known, care must be taken to see to it that the inner door means, formed by the illustrated components 6 and 10, in the illustrated example, must be closed before air is admitted into the chamber 7, so that during this admission of air into the chamber 7 there will be no possibility of entrance of air into the evacuated chamber 2 of the device. It is also required that the inner and outer door means can be alternately opened depending upon their opposed positions. For this purpose the rotary lock means 27 is provided with a pair of suitably profiled lock components 28 and 29, the lock member 28 coacting with a stop 30 of the outer door 11 while the lock member 29 coacts with a freely rotatable roller carried by a stop 31 of the pawl 10 of the inner door means.

In the operating position of the device which is illustrated in FIG. 2, the profiled lock member 28 locks the outer door 11 in its closed position while the inner lock member 29, by way of its cutout 32, releases the inner door means for opening movement as a result of the freedom of the pawl 10 to move into the cutout 32 which is aligned with the pawl 10 at this time. The inner door means is opened in a manner which is of no particular interest to our invention by actuating of the airlock means 5 through the rotary drive 33 which is provided for this purpose, whereupon the component 6 is displaced from the position thereof shown in FIG. 1, thus resulting in movement of the pawl 10 into the position thereof which is shown in FIG. 2.

If it is now required to remove a specimen cartridge from the evacuated interior of the device, then the inner

door means **6**, **10** must again be placed in the position of FIG. 1 before the outer door means **11** is opened. The components **6** and **10** are displaced into their position tightly closing the chamber **7** in a vacuum-tight manner, as shown in FIG. 1, upon actuation of the rotary drive **33**. However, before the rotary lock means **27** is turned through 90° from the position thereof shown in FIG. 2, so that the cutout **34** of the lock member **28** will become aligned with the stop projection **30** of the outer door **11** to release the latter for opening movement by swinging about pin **35**, the opening of the outer door means **11** is prevented. After the rotary lock means **27** is, however, turned in this manner through 90° the inner lock member **29** engages the stop **31** of the pawl **10** so that the outer door means **11** can only be opened after the inner door means **6**, **10** has reliably reached its fully closed position.

The rotary releasable lock means **27** serves, in the manner illustrated in connection with FIGS. 3–5, to actuate a transmission means which in turn transmits movement from the rotary lock means **27** to the evacuating valve means **26**, this transmission means acting in response to operation of the lock means **27** for actuating the valve means **26** only when both the outer and the inner doors are closed after a new specimen cartridge has been situated in the chamber **7**. This transmission means includes in the illustrated example a projection in the form of a freely rotatable roller **36** carried by the rotary lock means **27** and coacting with the pointed tip **37** of the plunger **38** of the evacuating valve **26** so as to press this plunger to the left, as viewed in FIG. 3, through a distance sufficient to cause the reduced diameter portion **39** of the plunger **38** to extend through and beyond the vacuum seal **40** so as to bridge the latter while providing through the seal a clear space surrounding the reduced diameter portion **39**. In this way the passage **41** which communicates with the chamber **7** and with the inner end of the valve means **26** is placed in communication through the valve means with a passage **42** which communicates with a pre-evacuated container or other suitable evacuated stage of the vacuum system through a conduit **43**. As is particularly apparent from FIG. 3, a spring of the valve means **26** holds the latter in a normally closed position which is shown in FIG. 3, and when the plunger **38** of the valve means **26** is displaced to the left by the action of the roller **36** of the transmission means on the tip **37** of the plunger **38**, in opposition to the spring of the valve, the reduced diameter portion **39** will bridge through the bore of the seal **40** to provide a communication between the chamber **7** and the source of vacuum through the passages **41** and **42** which communicate with each other when the valve means **26** is in its open position.

As has already been noted above, the pre-evacuating of the airlock chamber **7** is only required and desired when an object is to be introduced into the evacuated interior of the device. For this purpose the rotary releasable lock means **27** is turned in a clockwise direction from the position of FIG. 1 into the position of FIG. 2 through 90°. In this way the rotary lock means **27** is displaced in a direction which locks the door **11** in its closed position. In order to provide for a transmission of the movement of the lock means **27** to the valve means **26** by way of the coaction between the roller **36** and the plunger **38** only during this latter movement of the lock means **27**, the roller **36** is supported in the manner shown in FIG. 5 so as to be acted upon by a spring means which will render the transmission means **36**, **37** effective only during movement of the lock means **27** in that direction which locks the outer door while preventing this transmission of movement during movement of the lock means **27** in the reverse direction. Thus, as may be seen from FIG. 5, the roller **36** is supported for rotary movement on a pin **44** which is guided for movement in a groove **45** of the lock member **28**. A spring **46**, which forms in connection with the groove **45** the above-mentioned spring means, engages the pin **44** on which the roller **36** is rotatable so as to urge this pin **44** to the left end of the slot **45**. Thus, during the above-mentioned clockwise turning of the lock means **27**, when it is displaced in the direction of the right-hand solid horizontal arrow of FIG. 5, the pointed tip **37** of the valve plunger coacts with the roller **36** and the spring **46** to maintain the roller at the upper left end of the guide slot **45** so that at this time the movement of the lock means **27** will indeed be transmitted to the plunger so as to displace the latter to its position opening the valve **26** and thus placing the interior of the chamber **7** in communication with the source of vacuum when the outer door means **11** is locked in its closed position. On the other hand, during the reverse movement of the lock means **27**, when it is displaced in the direction of the left-hand dotted arrow of FIG. 5, the pointed tip **37** of the plunger will act on the roller **36** to displace the pin, in opposition to the spring **46** which yields at this time along the guide slot **45** away from the left-end thereof, as viewed in FIG. 5, so that at this time the transmission means remains incapable of transmitting motion from the rotary lock means to the valve plunger, and the valve remains in its closed position. The rotary lock means **27** can be provided at its exterior with suitable markings for indicating the direction of movement for actuating the evacuating valve means **26**.

Although the above-described structure of our invention is used for both the air-admitting valve and the evacuating valve to provide in general an airlock operation which is to a very large extent automatic, it is also possible to use either one of the valve constructions by itself with advantage. Thus, in the case where the structure includes an extremely small airlock chamber **7**, a pre-evacuation thereof before opening of the inner door means can be eliminated.

Of course, our invention is also capable of being used in a device where components such as diaphragms, pole shoe parts, or the like are to be introduced into and removed from the interior of the device during operation thereof.

Referring to FIG. 5, it will be seen that during clockwise turning of the lock member **28** when it moves in the direction of the horizontal solid arrow of FIG. 5, the roller **36** will move past and beyond the tip **37** of the valve plunger, before the lock means **27** reaches the position of FIG. 2 where the inner door means is unlocked, so that in this way the evacuating valve means **26** necessarily assumes its closed position before the lock means releases the inner door means for opening movement.

As indicated in FIG. 6 at **47**, plunger **14** may bear one or more grooves on its exterior surface instead of having axial bore **20** and transverse bores **21** and **22**.

We claim:

1. In an airlock assembly especially for introducing an object into and removing an object from the evacuated interior of a corpuscular ray device, chamber-defining means defining an airlock chamber having inner and outer ends, inner door means coacting with said inner end of said chamber-defining means for opening and closing said chamber and outer door means coacting with said outer end of said chamber-defining means also for opening and closing said chamber, said outer door means opening said chamber only when the latter is closed by said inner door means and said inner door means opening said chamber only when the latter is closed by said outer door means, and valve means carried by said outer door means and coacting therewith for responding automatically to opening movement of said outer door means from its closed position to introduce air into said chamber, said valve means including an outer cylindrical member fluid-tightly engaging said outer end of said chamber-defining means when said outer door means is in said closed position thereof, an elongated valve plunger ex-

tending coaxially into and surrounded by said cylindrical valve member, said plunger having an outer end extending outwardly beyond said cylindrical member and operatively connected to said outer door means for movement outwardly of said cylindrical member during an initial increment of opening movement of said outer door means from said closed position thereof, sealing means surrounded by said cylindrical member and surrounding said plunger for providing a sealed sliding movement of said plunger axially with respect to said cylindrical member, and passage means carried by said plunger for admitting air along said passage means into said chamber during said initial increment of movement of said outer door means when said plunger is displaced outwardly with respect to said cylindrical member by the initial increment of opening movement of said door, said passage means being closed when said plunger is in an inner end position determined by the situation of said outer door means in said closed position thereof.

2. The combination of claim 1 and wherein said passage means is in the form of a groove situated at an exterior surface portion of said valve plunger.

3. The combination of claim 1 and wherein said plunger is formed with an axial bore extending inwardly along said plunger from an inner end thereof and with a transverse bore extending through a wall portion of said plunger and communicating with said axial bore thereof, said bores forming said passage means, and said transverse bore being closed by said sealing means when said outer door means is in said closed position thereof and being situated in an uncovered open position outwardly beyond said sealing means only when said plunger is pulled outwardly of said cylindrical member during said initial increment of opening movement of said outer door means.

4. The combination of claim 3 and wherein a flow-regulating means is situated in said axial bore of said plunger for regulating the flow of air therethrough.

5. The combination of claim 1 and wherein an evacuating valve means is also carried by said outer door means and communicates with said chamber when said outer door means is in said closed position thereof, said evacuating valve means having an open position placing the interior of said chamber in communication with a source of vacuum, rotary releasable lock means coacting with said inner and outer door means for releasably locking said inner door means when said outer door means is unlocked and released for opening movement and for releasably locking said outer door means when said inner door means is unlocked and released for opening movement, and transmission means coacting with said rotary lock means and with said evacuating valve means for automatically displacing the latter to said open position thereof when said releasable lock means is turned to a position locking said outer door means.

6. In an airlock assembly especially for introducing an object into and removing an object from the evacuated interior of a corpuscular ray device, chamber-defining means defining an airlock chamber and having opposed inner and outer ends, inner door means coacting with said inner end of said chamber-defining means for opening and closing said chamber and outer door means coacting with said outer end of said chamber-defining means also for opening and closing said chamber, said inner door means having an open position opening said chamber only when said outer door means is in a closed position closing said chamber and said outer door means having an open position opening said chamber only when said inner door means is in a closed position closing said chamber, rotary releasable lock means coacting with said inner and outer door means for releasably locking said inner door means in said closed position thereof while releasing said outer door means for movement to said open position thereof and for releasably locking said outer door means in said closed position thereof while releasing said inner door means for movement to said open position thereof, evacuating valve means communicating with said chamber for placing the latter in communication with a source of vacuum when said evacuating valve means is in an open position while said outer door means is in said closed position thereof, and transmission means coacting with said lock means and with said evacuating valve means for displacing the latter to said open position thereof only when said releasable lock means is moved to a position locking said outer door means in said closed position thereof.

7. The combination of claim 6 and wherein said rotary releasable lock means releases said inner door means for opening movement only after said transmission means displaces said evacuating valve means to closed position.

8. The combination of claim 7 and wherein said evacuating valve means includes a valve plunger which normally assumes a closed position closing said evacuating valve means, and said transmission means including a projection carried by said rotary lock means and coacting with said plunger for displacing the latter to an open position opening said evacuating valve means.

9. The combination of claim 8 and wherein said projection includes at least one roller carried for free rotary movement by said rotary lock means.

10. The combination of claim 9 and wherein a spring means coacts with said roller for providing transmission of movement through said roller from said rotary lock means to said plunger only when said rotary lock means is moved in a direction which locks said outer door means in said closed position thereof, said spring means yielding during movement of said rotary lock means in a reverse direction to prevent transmission of motion from said rotary lock means to said plunger of said evacuating valve means during movement of said rotary lock means in said reverse direction.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,483,373 Dated December 9, 1969

Inventor(s) Alexander Asmus et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, line 9, "S 10,505" should read -- S 105051 --.

SIGNED AND
SEALED
MAY 12 1970

(SEAL)
Attest:

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