April 25, 1967 H. SCHMIDT ETAL 3,316,402

ARRANGEMENT FOR EXCHANGING POLE PIECE SYSTEMS IN CORPUSCULAR RADIATION APPARATUS

Filed Jan. 20, 1964 4 Sheets-Sheet 1

Fig. 1a

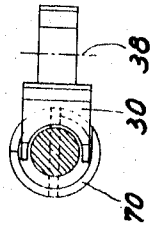
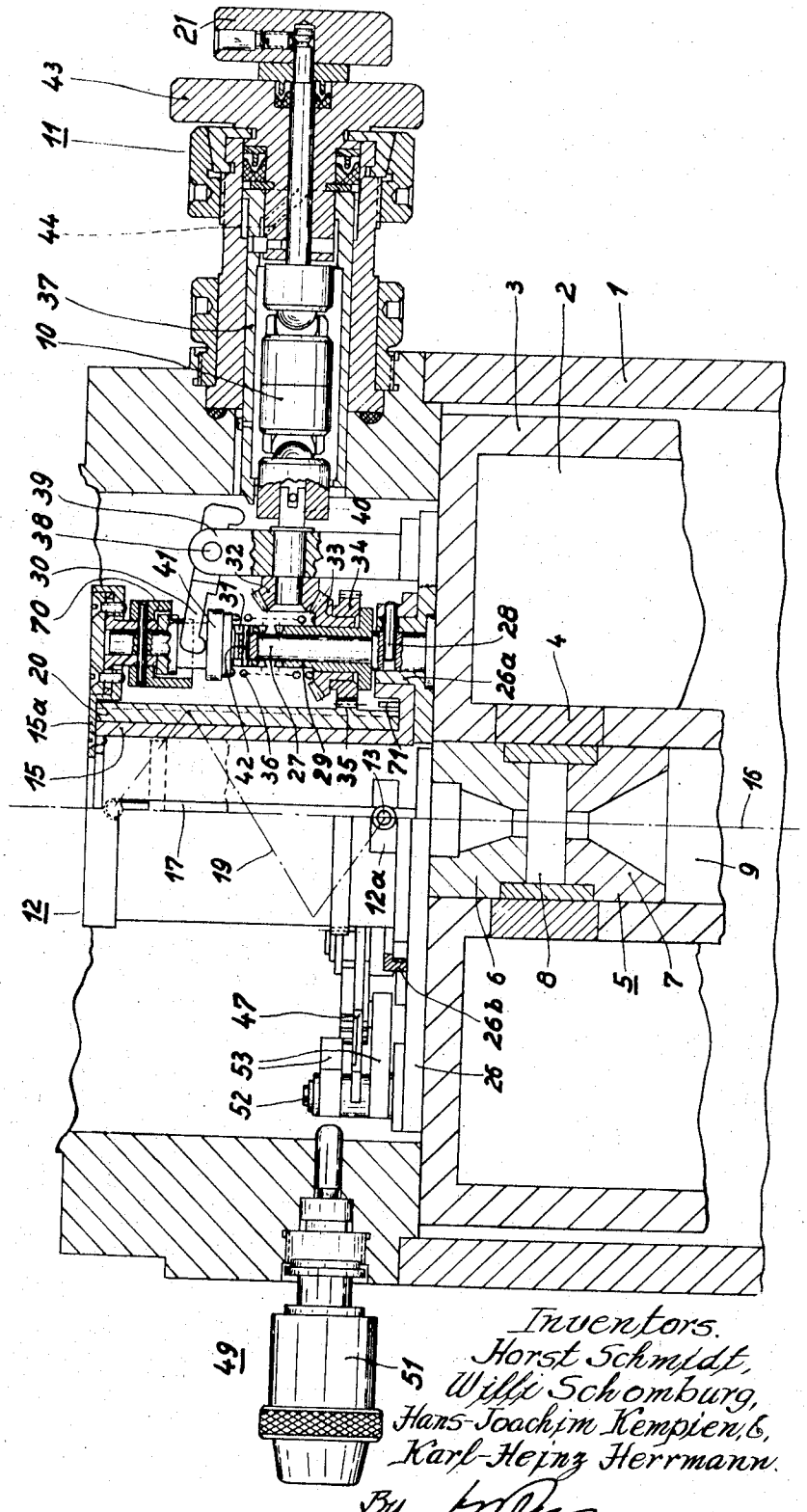


Fig. 1



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Filed Jan. 20, 1964 4 Sheets-Sheet 2

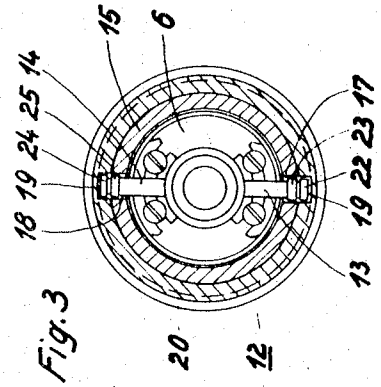

Fig. 3

Fig. 2

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ARRANGEMENT FOR EXCHANGING POLE PIECE SYSTEMS IN CORPUSCULAR RADIATION APPARATUS

Filed Jan. 20, 1964 4 Sheets-Sheet 3

Fig. 4

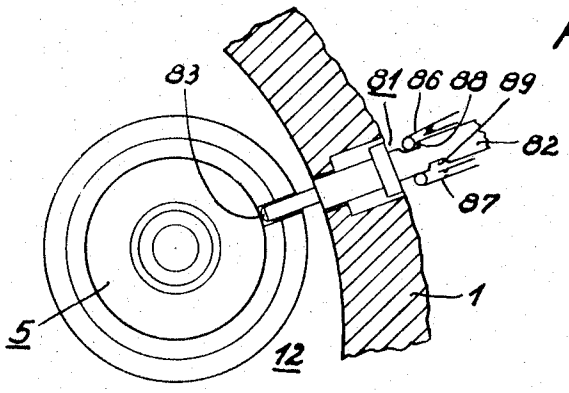


Fig. 5

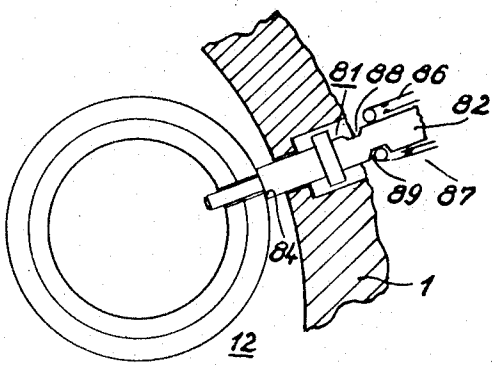
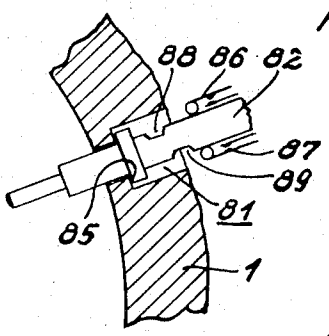


Fig. 6



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ARRANGEMENT FOR EXCHANGING POLE PIECE SYSTEMS IN CORPUSCULAR RADIATION APPARATUS

Filed Jan. 20, 1964 4 Sheets-Sheet 4

Fig. 7

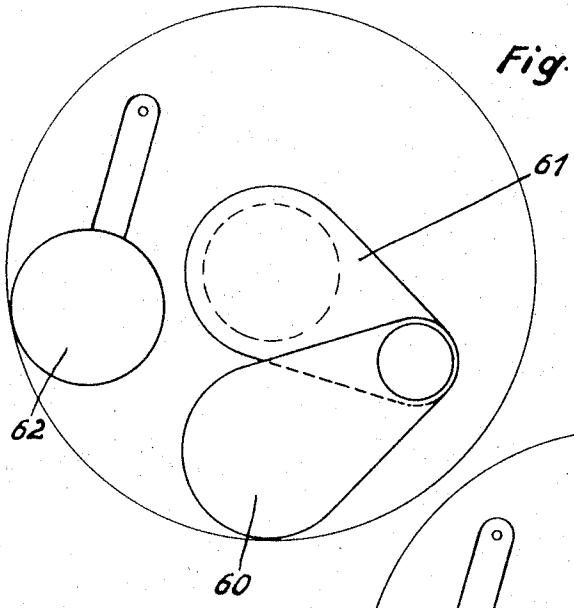


Fig. 8

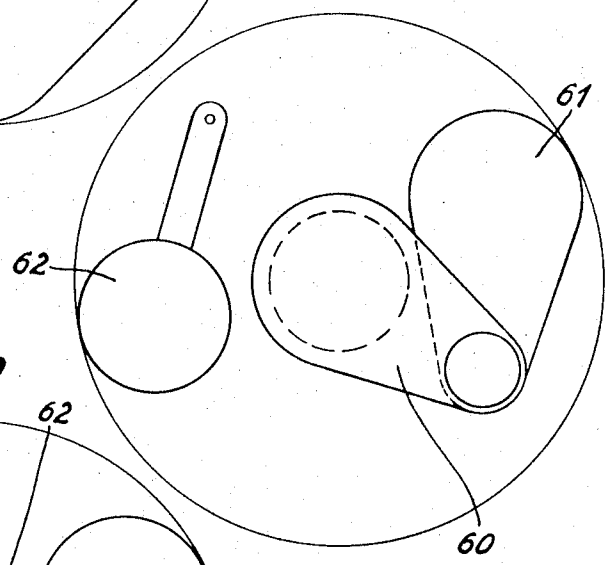
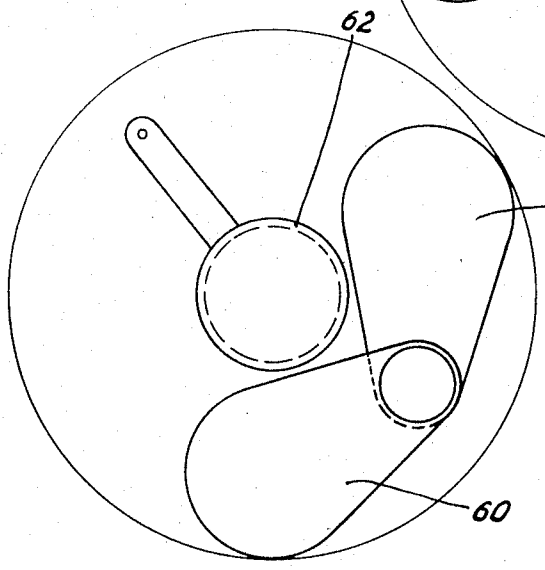


Fig. 9



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3,316,402

ARRANGEMENT FOR EXCHANGING POLE PIECE SYSTEMS IN CORPUSCULAR RADIATION APPARATUS

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Claims priority, application Germany, Feb. 15, 1963, S 83,762
20 Claims. (Cl. 250—49.5)

The invention disclosed herein is concerned with an arrangement for use in connection with corpuscular radiation apparatus, especially electron microscopes, for respectively inserting and removing pole piece systems or parts thereof.

It is in connection with magnetic pole piece lenses such as are employed in corpuscular radiation apparatus, especially electron microscopes, frequently required to remove the pole piece system or parts thereof, from the bore of the lens in which such system or parts thereof are disposed and to insert therein in a given case another pole piece system or parts thereof.

This happens, for example, when it is undesired to use for the changing of the focal distance an alteration of the magnetic flux produced, for example, in a winding, or to use only the alteration of such flux, but to have also the possibility of stage-by-stage adjustment of the focal distance by alteration of the geometry of the parts of the lens carrying the magnetic flux and affecting the corpuscular radiation, that is, the possibility of stage-by-stage adjustment of the pole piece system.

In order to carry out direct diffraction investigations which are to be effected, for example, with the aid of electron microscopes, it is, moreover, required to remove the entire pole piece system from the bore so as to provide for the passage of a diffraction cone which is as large as possible.

The removal or exchange, respectively, of pole piece systems or parts thereof, is as such known. In the case of pole piece lenses which are constructed so that the pole piece systems or the parts thereof which are to be removed, are arranged above or below the parts of the lens serving for producing the magnetic flux, there may be used a so-called pole piece turret, employed in connection with many electron microscopes, which turret contains a plurality of pole piece systems or parts thereof and which permits by rotation about an axis extending eccentrically to the axis of the corpuscular radiation, to position such pole piece systems or part thereof selectively with respect to the path of the radiation.

It is also known to use a holder for a plurality of pole pieces, in which the pole piece systems are successively arranged for selective disposal thereof in the path of the radiation by shifting the holder.

It is not necessary that there are in such arrangement always involved complete pole piece systems comprising respectively two pole pieces; it is also known to assign to the pole piece lens, for the stage-by-stage alteration of the focal distance thereof, a fixed pole piece and to selectively position opposite thereto a second pole piece which is with respect to the pole piece bore and/or gap dimensioned according to the desired focal distance.

The use of such pole piece exchange arrangements which enable to carry out a shifting of the pole systems or parts thereof in a plane transverse to the axis of the corpuscular radiation is, however, limited to lenses in connection with which the pole piece systems or the parts which are to be removed, are positioned outside of the lens parts serving for producing the magnetic flux. However, so far as the magnetic conditions are concerned,

those lenses have been found to be particularly advantageous in connection with which the respectively inserted pole piece system is disposed within the lens parts which produce the magnetic flux, the latter laterally surrounding the inserted pole piece system.

It is known to use in connection with lens constructions of the above indicated type, yoke-like means for conducting the flux to the pole pieces of permanent magnet lenses in order to carry out a stage-by-stage focal distance alteration. However, a corresponding arrangement is in view of the magnetic conditions unfavorable primarily owing to the appearance of a strong external magnetic field.

In accordance with another proposed solution for the problem, there are to be provided a plurality of pole piece systems arranged serially in the path of the radiation, which systems are movable in the direction of the radiation axis by means of a drive which is operatively controlled from the outside of the vacuum space, so as to place the respective systems selectively in operation. However, such arrangement does not permit removal of the pole piece systems from the pole piece bore, as is required for effecting direct diffraction investigations, and enables to carry out the stage-by-stage focal distance variation only within certain limits.

The invention is concerned with the problem and object of providing an arrangement which is adapted for use in connection with corpuscular radiation apparatus, especially electron microscopes, for removing pole piece systems or parts thereof from the bore of a magnetic pole piece lens and for inserting such systems or parts thereof into the bore of such magnetic pole piece lens, which lens is provided with parts for producing the magnetic flux, such parts being disposed so as to laterally surround the pole piece system to be respectively inserted or removed. An arrangement which satisfies the requirements of the invention provides control means which are operable by drives disposed above and/or below the pole piece lens and extending through the vacuum housing of the corpuscular radiation apparatus, which permit a longitudinal motion of the respective pole piece system or parts thereof in the direction of the corpuscular radiation axis, when the corresponding pole piece system or parts thereof are in the radiation path, while permiting a pivotal or rotating motion of the pole piece system or parts thereof transverse to the radiation axis, when such system or parts thereof are by the longitudinal motion removed from the bore. The magnetic lens may be of the electromagnetic or of the permanent magnet type.

The control means employed for this purpose may be used for producing by the longitudinal and rotating motion of the respective pole piece system in its entirety, a free bore for direct diffraction investigations; however, the control may likewise be used to effect the longitudinal and rotating motion of only one pole piece of the respective pole piece system, so as to provide for a coarse-stage alteration of the focal distance of the pole piece lens. The free bore can also serve as a lens of long focal distance, an intermediate image screen rotated into the path of the radiation forming thereby the diaphrgm. The provision of a plurality of the corresponding control means will permit an exchange of pole piece systems or parts thereof.

In an advantageous embodiment of the invention, the control means employed are arranged at the upper surface and/or the lower surface of the pole piece lens body and are connected with their drives by means of links which permit motion of the pole piece lens. This constructional principle offers the possibility of moving the pole piece lens in desired directions in a plane transverse to the corpuscular radiation axis, without affecting the control means provided according to the invention and without hindering the lens motion by the control means, respectively.

The control means employed advantageously contain a holder for the respective pole piece system or parts thereof, such holder including a device connected with one of the drives, for effecting the longitudinal motion of the respective pole piece system or parts thereof, and being also pivotally movable by means of a rotary device respectively assigned thereto, which rotary device is connected with one of the drives, for executing the pivotal rotary motion of the respective pole piece system or parts thereof. Accordingly, while only the pole piece system or the movable parts thereof partake, in this embodiment of the invention, in the longitudinal motion, the rotary motion is effected by the holder as well as by the parts of the pole piece system held thereby.

In this embodiment of the invention, the holder may be substantially formed by a guide bushing for receiving the respective pole piece system or parts thereof after removal from the bore, which bushing is secured against rotation about the corpuscular radiation axis and provided with longitudinal slots extending in the direction of the radiation axis, as well as a threaded sleeve surrounding the bushing, which sleeve is by a drive connected there with rotatable with respect to the radiation axis and provided with an inner thread of preferably high pitch. The action of the inner thread effects the longitudinal motion upon rotation of the threaded sleeve in cooperation with cam-like extensions at the respective pole piece system or parts thereof, such extensions projecting through the longitudinal slots formed in the guide bushing.

The cam-like extensions are in the region of the longitudinal slots and in the region of the inner thread advantageously provided with rollers so as to keep the friction as slight as possible.

It is endeavored, in connection with corpuscular radiation apparatus in which the object or specimen and the corpuscular radiation are in a vacuum, to operate with as few as possible lead-throughs extending through the vacuum housing. In accordance with a further feature of the invention, there is for this purpose provided a rotary or pivotal device including a coupling which permits to utilize the drive for the longitudinal motion also for effecting the rotary motion.

This variant of the invention, which requires only one drive and therefore only one vacuum-tight lead through, advantageously provides an arrangement comprising a shaft at the holder and the drive, which shaft extends parallel to the radiation axis and is fixedly connected with the guide bushing, such shaft carrying a first driven rotatable coupling or clutch part which is by the action of a lever engageable with a second clutch part which partakes in the rotation of the shaft, so that the actuation of the drive effects the rotary motion of the holder instead of the rotation of the threaded sleeve.

The drive for the longitudinal and for the rotary motion also contains the actuating means for the lever, thus likewise contributing toward far reaching avoidance of vacuum-tight lead-throughs.

Adjustable stops which are arranged at the pole piece lens body or else upon a base plate fastener thereon, which carries the shaft for the clutch parts, serve for limiting the rotary motion in the two mutually oppositely oriented directions.

It is frequently desired to observe with the aid of an intermediate image screen and a window in the vacuum wall of the apparatus, an intermediate image above the projective lens. The invention therefore proposes to provide an intermediate image screen which lies in engagement with the holder by the action of a spring and which is responsive to the rotary or pivotal motion of the holder from the radiation axis, pivotally moved or rotated into the radiation path by the action of the spring.

An actuating member is advantageously provided for inhibiting the action of the spring so as to hold the intermediate image screen in its position outside the radiation path when the holder for the pole piece system and parts thereof is rotated to remove the corresponding parts from the radiation paths. The corresponding device comprises an angle lever disposed between the actuating member and the intermediate image screen, one leg of which is connected with the actuating member and the other leg with a fork-like guide at a pivotally journalled carrier for the image screen.

The various objects and features of the invention will appear from the appended claims and from the description thereof which is rendered below with reference to the accompanying drawings.

FIG. 1 shows a vertical section through parts of a corpuscular radiation apparatus which are of interest in connection with the invention;

FIG. 1*a* represents a detail of the arrangement according to FIG. 1;

FIG. 2 is a horizontal section taken at the level of the parts shown in FIG. 1;

FIG. 3 shows the holder;

FIGS. 4 to 6 indicate a contact arrangement for respectively controlling the energization of the pole piece system and the position of such system and/or the position of the holder therefor; and

FIGS. 7 to 9 show in schematic views three operating positions of holders included in a modified embodiment of the invention.

Referring now to the drawings, a numeral **1** indicates the housing which incloses the vacuum chamber of the corpuscular radiation appartus, containing an electromagnetic pole piece lens which represents, for example, the projective of an electron microscope. The energizing winding **2** which produces the magnetic flux is surrounded by the lens body **3** proper which serves for the guidance of the flux. The lens body **3** is provided with a recess **4** therein which lies in a plane extending transversely to the magnetic flux lines and is filled with non-magnetic material, for example, brass, which compels the magnetic flux to pass into the pole pieces **6** and **7** which form the pole piece system **5**, and define the lens gap **8** in which is effected the influencing of the corpuscular radiation by the magnetic field of the pole piece lens.

The arrangement according to the invention solves the problem of removing from the bore **9** the entire pole piece system **5** and to reinsert it again, so as to provide a possibility of producing diffraction exposures with a free bore. For the solution of this problem, there is provided an arrangement, above the pole piece lens **3**, which is connected with the drive **11** by way of links **10**, such links permitting a coordinate motion of the pole piece lens. This arrangement includes a holder **12** (see FIG. 3) which holds the pole piece system **5** by means of cam-like extensions **13** and **14** projecting therefrom. The holder **12** is substantially formed by the guide bushing **15** which receives the pole piece system **5** after removal from the bore **9**, such bushing being in a manner to be presently described secured against rotation about the radiation axis **16** and provided with longitudinal slots **17, 18**. The holder **12** also comprises the sleeve **20** which is provided with a two-pitch thread, such threaded sleeve surrounding the guide bushing **15** and being rotatable about the radiation axis **16** by means of the drive **11** which is actuated by the knob **21**.

It will be seen that rotation of the threaded sleeve **20** causes by the action of its inner thread **19** a longitudinal motion of the pole piece system **5** owing to the cooperation of the cam-like extensions **13, 14** with the inner thread **19**, whereby the guidance of the extensions **13, 14** in the longitudinal slots **17, 18** prevents a rotation of the pole piece system **5** by the guide bushing **15** which is secured against rotation about the radiation axis **16**.

The extensions **13, 14** carry rollers, **22, 23** and **24, 25**, respectively, in the region of the longitudinal slots **17, 18** and the inner thread **19**, so as to hold the frictional forces which have to be overcome, as small as possible.

The guide bushing **15** as well as the threaded sleeve

20 are at their lower ends provided with recesses 12*a* which are so dimensioned that the holder 12 can be rotated from the radiation path when the pole piece system 5 is inserted in the bore 9. The extensions 13 and 14 will then engage the lens body 3 while the rollers 22 and 24 lie free, so that they can again be gripped by the guide bushing 15.

The guide bushing 15 embraces the shaft 27 which is likewise arranged upon the base plate 26, thus securing the guide bushing against rotation about the radiation axis 16. The shaft 27 is disposed between the holder 12 and the drive 11 and extends in parallel with the radiation axis 16. The shaft 27 is by means of a pin 28 and the journal or bearing part 15*a*, which is secured to the guide bushing, connected with the latter for rotation therewtih.

The first coupling or clutch half 29 is rotatably disposed on the shaft 27, such first clutch part being by means of the lever 30 connectible with the second clutch part 31 which is non-rotatably disposed upon the shaft 27. Accordingly, the second clutch part 31 is firmly seated on the shaft 27 while the first clutch part 29 can rotate responsive to actuation of the drive 11, since the rotary motion of the drive is transmitted by the gear wheels 32, 33 to the first clutch part 29 and by means of the gear wheels 34, 35 to the threaded sleeve 20.

The lever 30 effects upon actuation thereof, against the force of the spring 36, operative engagement of the second clutch half 31 with the first clutch half 29, thus forming over the second clutch half 31 a firm coupling between the first clutch half 29 and the shaft 27. Accordingly, operative actuation of the drive 11 will not effect rotation of the threaded sleeve 20 and therewith a longitudinal motion of the pole piece system 5, but a rotary swinging displacement of the entire arrangement about the shaft 27. Reference 26*b* indicates a guide bar. The pin 28 moves within a recess in the extension 26*a* of the base plate 26. The holder 12 with the journal part 15*a* assumes as a consequence of the swinging motion the dash line position 15'*a* (FIG. 2), thus freeing the radiation path.

The lever 30 is operatively affected by the actuating bushing 37 in the drive 11 and is thereupon angularly displaced about the axis 38 in the support 39, which also serves as a guide for the drive shaft 40 of the drive 11, thereby causing its two arms to press against the collar 41 of the second clutch half 31, which is by means of the pin 42 connected with the shaft 27, so as to shift the second clutch part downwardly against the pressure of the spring 36, the pin 42 being thereby guided within elongated slots.

The actuating bushing 37 can be moved by means of the second knob 43 of the drive 11, in the direction transverse to the axis 16 of the radiation beam, the rotary motion of the knob 43 being thereby translated, by the action of the thread 44, into the shifting motion of the bushing 37.

It will be apparent that means for securing the holder 12 against rotary swinging motion, which means are effective so long as the pole piece system 5 is still within the bore 9, may also be provided upon moving the pole piece system angularly with respect to the bore 9. In the illustrated embodiment, there is for this purpose provided a depressor member 70 which is held by a pin, and the bottom end of which is profiled so that the lever 30 can move into the illustrated position only when the holder 12 is moved into the radiation path. FIG. 1*a* shows the bottom of the depressor 70 as well as the shape of the lever 30.

As can be seen from FIG. 2, there may be provided stops 45 and 46 for limiting the swinging motion, such stops being formed by eccentric screws and arranged in the base plate 26 or in the pole piece lens body 3, respectively.

A stop 71 (FIG. 1) is provided for limiting the rotary motion of the threaded sleeve 15, such stop 71 cooperating with a corresponding stop (not shown) at the threaded sleeve 20.

It is often desired to observe the image produced by the corpuscular radiation, for example, above the projective lens of an electron microscope. This purpose is in the illustrated embodiment served by the intermediate image screen 47. This screen lies by the action of the spring 48 against the holder 12 and is after rotation (pivotal swinging motion) of the holder 12 from the radiation axis, rotated by the action of the spring 48 into the radiation path, that is, into the position 47' indicated in FIG. 2.

There is often the desire to have neither the pole piece system nor the intermediate image screen in the radiation path. The invention therefore provides an actuating member 49 which is effective to inhibit the action of the spring 48 so as to hold the intermediate image screen in the position outside of the radiation path even when the holder 12 is rotated into the position indicated in FIG. 2 by 15'*a*. This actuating member 49 substantially comprises the shaft 50 and the sleeve knob 51 connected therewith, which shaft can be secured in operated position shown in dash lines (FIG. 2), by rotation of the knob 51 after pressing the shaft into the operating position.

The position of the shaft 50 shown in FIG. 2 in dash lines, corresponds to the position of the lever, shown in full lines, in which position the intermediate image screen 47 is held outside of the radiation path. Between the actuating member 49 and the intermediate image screen 47 is disposed the angular lever 53 which is rotatable about the axis 52, one arm of this lever being arranged for engagement by the shaft 50 and the other arm cooperating with the forked guide 54 of the carrier 56 for the intermediate image screen 47, which carrier is rotatable about the axis 55.

It is often desirable to operate with relatively weakly dimensioned drives. It is for this purpose necessary that the magnetic flux be at least weakened when the pole piece system or parts thereof are to be moved in longitudinal direction, that is, when they are during the motion thereof under the influence of the force caused by the magnetic field. An advantageous embodiment of the invention provides, in connection with an electromagnetic pole piece lens, contacts which are actuated by the described operating means, such contacts effecting during the longitudinal motion at least a reduction of the number of ampere turns of the pole piece lens. The number of ampere turns are during the longitudinal motion generally reduced to the value 0.

The reduction of the number of ampere turns can be effected by the contacts either by reduction of the number of turns of the energizing winding at constant energizing current (switching over in the range of the winding) or by reduction of the energizing current at constant number of turns. It is understood, of course, that the contacts may be circuited so that both measures can be simultaneously applied.

The same or additional contacts may also be utilized to serve for the actuation of a device for indicating the position of the pole piece system or parts thereof, respectively, and/or for indicating the respective position of the holder. Such utilization of contacts is, of course, not limited for use in connection with an electromagnetic lens.

The contacts have advantageously a plurality of positions which are operative to effect a reduction of the number of ampere turns when the pole piece system is rotated out of the radiation path for the purpose of obtaining great focal length, while operatively switching in the full ampere turns when the pole piece system is in the radiation path with the holder rotated out of the radiation path, and effecting again at least a reduction of the ampere turns during the longitudinal motion of the pole piece system, so as to reduce the loading of the drives as much as possible.

These advantageous features of the invention will now be described with reference to examples which are schematically indicated in FIGS. 4 to 6 which illustrate the contact positions for three different positions of the pole piece system **5** and two different positions of the holder **12**.

Referring now to FIGS. 4 to 6, there is a contact arrangement **81** provided in the vacuum housing of the corpuscular radiation apparatus, comprising an actuating plunger **82** forming three positional parts **83**, **84** and **85** for cooperation, respectively, with the holder **12** and the pole piece system **5**, in corresponding positions thereof. The holder **12** is provided with an appropriately shaped recess for receiving the inner end of the plunger **82**.

It is assumed in connection with FIG. 4 that the pole piece system and the holder **12**, which have been described with reference to FIGS. 1 and 2, have been rotated out of the radiation axis, that is, that the bore **9** (FIG. 1) has been freed, for example, for the purpose of obtaining a long focal distance. Since there is now required only half of the ampere turns, the contact **86** is responsive to engagement of the positional part **83** with the pole piece system **5**, closed by engagement of one spring thereof in the recess **88** of the plunger, while the contact **87** is outside of the recess **89** and therefore open.

FIG. 5 illustrates the case in which the pole piece system **5** is disposed within the bore **9** of the pole piece lens while the holder **12** is rotated out of the radiation path. The full ampere turns are operatively connected by the contact **87** owing to the position of the plunger part **84** in engagement with the holder **12** peripherally thereof, the contact **87** being accordingly closed while contact **86** is open.

FIG. 6 shows the contact position during the longitudinal or axial motion of the pole piece system, that is, when the pole piece system **5** as well as the holder **12** are disposed in the radiation path of the corpuscular radiation apparatus. The corresponding parts, namely, the pole piece system and the holder have therefore been omitted in FIG. 6. The plunger **82** is by a suitable spring (not shown) moved so that its positional part **85** engages a corresponding shoulder formed in the vacuum housing **1**, the recesses **88** and **89** being now in position in which both contacts **86** and **87** are open.

It is understood, of course, that the contact arrangement, which has been shown only schematically, can be widely varied so as to meet given conditions.

The invention is not inherently limited to the described and illustrated embodiment. For example, it may be desirable to provide in addition to the control means such as shown in FIGS. 1 and 2, above the pole piece lens, a second similar control means underneath the pole piece lens, so as to enable selective positioning of two pole piece lens systems with respect to the bore **9**. It is likewise possible to effect the removal from the bore **9** of only one pole piece of the system or to exchange such pole piece individually instead of the entire pole piece system. It is also possible to provide in a given case a plurality of the described arrangements respectively above or underneath the pole piece lens. The clutch may likewise be differently constructed.

It is so far as the principle is concerned also possible, as indicated in FIGS. 7 to 9, to provide above or below the lens two holders **60**, **61**, equipped with appropriate devices for rotating them into three different positions. Thus, the holder **61** may be positioned in the radiation path (FIG. 7) or the holder **60** may be brought into the operating position (FIG. 8) or both holders **60**, **61** may be rotated out of the operating position and the intermediate image screen **62** may be placed into position in the radiation path (FIG. 9). In such an arrangement, each holder may be appropriately constructed as a handling or gripping device for rotating a pole piece system or parts thereof out of alignment with the radiation path, releasing such system or parts at the end of the rotary or swinging motion, and thereupon gripping another pole piece system for insertion in the radiation path.

The invention offers the possibility of removing pole piece systems or parts thereof from the bore of a pole piece lens or inserting them into the bore, even in cases in which known devices operating with a simple rotary or swinging motion are inapplicable owing to the particular construction involved. The control means according to the invention are disposed outside the magnetic circuit of the pole piece lens and therefore do not effect any influences that could disturb the operation thereof.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and desired to have protected by Letters Patent.

We claim:

1. In an arrangement for use in a corpuscular ray device, in particular an electron microscope, for the insertion of a pole shoe system or parts thereof into the bore of that portion, which produces the magnetic flux, of a magnetic pole shoe lens laterally surrounding an inserted pole shoe system, and the removal of such system or parts thereof from such bore, the combination of control means for imparting a longitudinal motion in the direction of the radiation axis to such a pole piece system or parts thereof, control means for imparting to such pole piece system or parts thereof, when removed from the bore, a rotary angular motion transverse to the radiation axis, and drive means for said control means operative to actuate said first-mentioned control means for respectively effecting insertion of the pole piece system or parts thereof into the bore of said pole piece lens and removal therefrom, and to actuate said second mentioned control means for respectively effecting movement of the pole piece system or parts thereof away from and towards the radiation axis, following removal thereof from the bore of said pole piece lens.

2. An arrangement according to claim **1**, comprising link means connected with the drive means for said control means which permit motion to be imparted to the pole piece system.

3. An arrangement according to claim **1**, wherein said first-mentioned control means includes a holder for the respective pole piece system or parts thereof, a device cooperable with said holder and connectable with said drive means, for effecting the longitudinal motion of the respective pole piece system or parts thereof, and said second-mentioned control means comprises a rotary device cooperable with said holder and connectable with said drive means, for angularly rotating said holder to effect the angular rotation of the respective pole piece system or parts thereof.

4. An arrangement according to claim **3**, wherein said holder comprises a guide bushing for receiving the respective pole piece system or parts thereof after removal thereof from the bore, said guide bushing being secured against rotation about the radiation axis and being provided with longitudinal slots formed therein which slots extend in the direction of the radiation axis, and said first-mentioned device comprises a sleeve surrounding said guide bushing, said sleeve being provided with an inner thread and being operatively connectable to said drive means for rotation thereby about the radiation axis, said inner thread effective, upon rotation of the sleeve, the longitudinal motion of the pole piece system or parts thereof by cooperation with cam-like extensions at the respective parts which are to be longitudinally moved, which extensions project through the longitudinal slots formed in the guide bushing.

5. An arrangement according to claim **4**, comprising roller means carried by said cam-like extensions in the range of longitudinal slots and in the range of the inner thread.

6. An arrangement according to claim **5**, wherein the holder is at its lower end provided with recesses formed therein, for receiving the cam-like extensions, so that it

can be rotated away from the radiation path when the respective pole piece system or parts thereof are positioned in the radiation path.

7. An arrangement according to claim 6, comprising a clutch forming part of the rotary device, for enabling utilization of the drive for the longitudinal motion for effecting the rotary motion.

8. An arrangement according to claim 7, wherein said rotary device comprises a shaft disposed at the pole piece lens body between the holder and the drive, said shaft being fixedly connected with the guide bushing, a first clutch part positioned rotatably on said shaft and driven by said drive means, a second clutch part disposed on said shaft for rotation therewith, and a lever for moving the first clutch part into engagement with the second clutch part so as to effect upon actuation of the drive the lateral rotation of the holder instead of rotation of the threaded sleeve.

9. An arrangement according to claim 8, comprising actuating means for said lever forming part of the drive means for longitudinal motion and lateral rotation of the respective pole piece system or parts thereof.

10. An arrangement according to claim 9, comprising a member for holding the lever against actuation except when the holder has been moved in alignment with the radiation path.

11. An arrangement according to claim 10, comprising adjustable stop means disposed on the pole piece lens body for limiting the lateral swinging motion in both mutually oppositely oriented directions.

12. An arrangement according to claim 11, comprising an intermediate image screen, and a spring for holding said image screen in engagement with said holder and for moving it into the radiation path responsive to rotation of the holder out of the radiation path.

13. An arrangement according to claim 12, comprising control means for inhibiting the action of said spring to hold the intermediate image screen outside the radiation path.

14. An arrangement according to claim 13, comprising a rotatable carrier for said intermediate image screen, a fork-like guide for said carrier, and an angular elbow lever disposed between said last-mentioned control means and the intermediate image screen, one arm of said lever being in engagement with such control means and the other arm thereof cooperating with said fork-like guide.

15. An arrangement according to claim 1, for use in connection with an electromagnetic pole piece lens, comprising contact means for effecting a predetermined reduction of the number of ampere turns of the pole piece lens during the longitudinal motion of the respective pole piece system or parts thereof.

16. An arrangement according to claim 1, for use in connection with an electromagnetic pole piece lens, comprising contact means, and actuating means for causing said contact means to assume a plurality of operating positions, so as to effect, in one position, a predetermined reduction of the number of ampere turns when the pole piece system is moved away from the radiation path for obtaining a long focal length, while connecting in another position, the full number of ampere turns when the pole piece system is disposed in the radiation path and the holder moved from the radiation path, and effecting, in a further position, a predetermined reduction of the number of ampere turns during the longitudinal motion of the respective pole piece system or parts thereof.

17. An arrangement according to claim 16, wherein said contact means are disposed in the vacuum housing of the corpuscular radiation apparatus, comprising, for the actuation of said contact means, plunger-like means operatively controlled by parts governed by the operation of said control means.

18. An arrangement according to claim 1, comprising contact means responsive to the position of the respective pole piece system or parts thereof or the position of the holder, said contact means respectively effecting in predetermined positions of the named parts the operative connection of the number of ampere turns of the pole piece lens and providing means for controlling the operative actuation of an indicating device.

19. An arrangement according to claim 1, wherein said control means produce, by the longitudinal and angular motion of the respective pole piece system in its entirety, a free bore for direct diffraction investigations or for obtaining a long focal length.

20. An arrangement according to claim 1, wherein said control means are operative to effect the longitudinal and angular lateral motion of one pole piece of the respective pole piece system for the purpose of effecting a coarse-stage alteration of the focal length.

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