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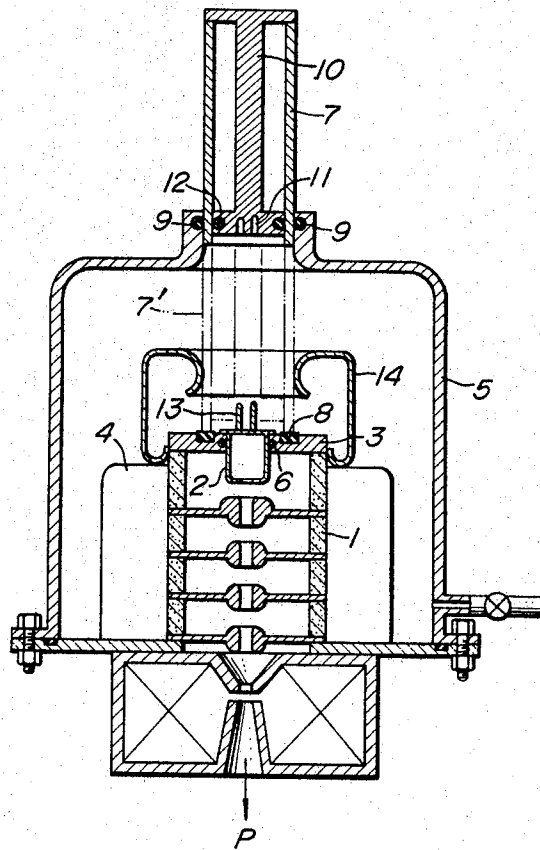
SHINJIRO KATAGIRI ET AL
DEVICE FOR EXCHANGING ELECTRON SOURCES IN
ELECTRICAL DISCHARGE DEVICES

3,476,972

Filed April 5, 1968

2 Sheets-Sheet 1

FIG. 1 PRIOR ART



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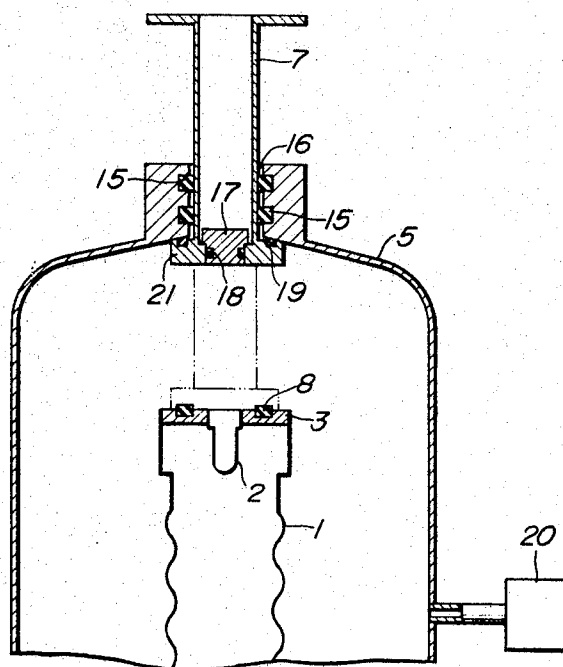
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FIG. 2



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DEVICE FOR EXCHANGING ELECTRON SOURCES
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3 Claims

ABSTRACT OF THE DISCLOSURE

An article exchanging device having two annular members which have a slit to cause a gas in a high-pressure vessel to leak therefrom and are disposed at a gap between an opening in the wall of the vessel and a cylindrical member for exchanging an article in the vessel therethrough. A gasket is disposed on a flange of the cylindrical member so as to keep a gas-tight relationship in the abutting area between the flange and the lower face of said opening in the wall of the vessel.

BACKGROUND OF THE INVENTION

This invention relates to a device for exchanging articles in high-pressure vessels, and more particularly to an improvement in the structure of a device of the kind described for preventing the danger of bursting that might occur in the vessel.

In an apparatus such as a high voltage charged particle accelerator of conventional construction, it is common practice to enclose associated equipment such as a high voltage supply and an accelerating tube section within a metallic tank for the purpose of minimizing any danger to human beings and to reduce the space required for installation. The tank is then filled with an insulating gas at a high pressure above one atmosphere in order to provide a high degree of insulation. When a heated filament, for example, is used as an electron source in such an apparatus, there may arise a necessity of exchanging the same for a new one in the event of the breakdown or deterioration of such a filament. According to a conventional manner of replacing such a filament, the metallic tank is detached from the apparatus to expose and exchange the defective electron source which is disposed on the top of the accelerating tube. This exchanging operation of the electron source, however, involves troublesome manipulations including dismounting and remounting of the tank as well as increased costs due to loss of the insulating gas. In order to overcome the above drawbacks and other difficulties, an article exchanging device such as, for example, one disclosed in United States Patent No. 3,268,759 has been employed hitherto.

The device for exchanging articles disclosed in the United States patent has a structure as shown in FIG. 1. Referring to FIG. 1, a high voltage charged particle accelerator comprises an accelerating tube 1 on the top of which an electron source 2 or an electron gun is mounted by means of a supporting member 3 of annular shape for supporting thereon the electron source 2. The accelerating tube 1 is surrounded by a high voltage supply 4, and all these accelerator elements are contained in a metallic tank or vessel 5 the interior of which is maintained at a high pressure with a gas of insulating nature such as sulfur hexafluoride, Freon or the like enclosed therein. In order to ensure a gas-tight relationship between the high pressure portions of the apparatus filled with the insulating gas and the accelerating tube 1 whose interior is maintained in a high vacuum condition, a

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rubber gasket 6 is disposed at a portion where the electron source 2 is fitted to the supporting member 3.

The device for exchanging articles comprises a generally cylindrical member 7 which is disposed on the top of the metallic vessel 5 on the side opposite the electron source 2 and movable into and out of the metallic vessel 5 to move toward and away from the electron source 2. The cylindrical member 7 has an internal diameter of such a dimension that the electron source 2 can be adequately accommodated therewithin. When urged inwardly into the vessel 5 toward the electron source 2, that is, toward the article exchanging position, the cylindrical member 7 finally abuts the supporting member 3 on the top of the accelerating tube 1 in a manner that the lower annular face thereof encircles the electron source 2. The inwardly urged or lowered position of the cylindrical member 7 is shown by dotted lines 7'. A rubber gasket 8 maintains a gas-tight relationship in the abutting area between the lower annular face of the cylindrical member 7 and the supporting member 3 at the lowered position of the cylindrical member 7, and a rubber gasket 9 maintains a gas-tight relationship in the abutting area between the vessel wall and the outer peripheral surface of the cylindrical member 7 at any position of the cylindrical member 7. A piston 10 is vertically slidably disposed within the cylindrical member 7 and has a plurality of recesses 11 bored in the bottom thereof, which recesses 11 have such a configuration that they will snugly fit over a plurality of projections or pins 13 of complementary configuration provided on the electron source 2 so as to carry the electron source 2 with the piston 10 for the exchanging operation. A rubber gasket 12 maintains a gas-tight relationship at all times in the abutting area between the peripheral surface of the piston 10 and the inner wall of the cylindrical member 7. The electron source 2 is surrounded by a corona shield 14 for high voltage.

In operation for the exchange of the electron source 2 with the article exchanging device having the structure described above, the cylindrical member 7 is actuated by a suitable external means (not shown) to be lowered from the normal inoperative position shown by solid lines and is finally secured at the position of dotted lines 7', where the lower face of the cylindrical member 7 bears against the rubber gasket 8 disposed on the supporting member 3 mounting thereon the electron source 2. The interior of the cylindrical member 7 is thereby isolated from the surrounding gas chamber and any flow of gas thereinto is positively shut off, thus establishing an isolated article exchanging passage within the vessel 5. Under this condition, application of high voltage is stopped and atmospheric pressure is supplied into the accelerating tube 1. The piston 10 is then lowered by a suitable means (not shown) until the recesses 11 fit on the pins 13 provided on the electron 2 for carrying the defective electron source 2 with the piston 10. The piston 10 carrying thereon the electron source 2 is subsequently pulled upwardly to take out the electron source 2. A new electron source 2 is fitted on the bottom of the piston 10 in place of the defective one, and the piston 10 is again lowered within the cylindrical member 7 to mount the new electron source 2 at the predetermined position on the supporting member 3 at the top of the accelerating tube 1 to complete the exchanging operation.

It will be recalled that the insulating gas is enclosed within the vessel 5 at a high pressure above one atmosphere, and the contact area between the vessel wall and other outer peripheral surface of the cylindrical member 7 is maintained in the gas-tight relationship by the rubber gasket 9. Accordingly, in such an article exchanging device, the power of an electric motor or the like must be used in order to lower the cylindrical member 7 since a

considerably large force is required to cause the downward movement of the cylindrical member 7. Furthermore, the operation of the kind described above which must be carried out under such a high pressure condition is very dangerous in view of a liability to giving rise to a bursting accident due to erroneous manipulation, and the operation also requires a considerable degree of skill.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to obviate the occurrence of a bursting or like dangerous accident in an article exchanging operation within the high-pressure vessel of the kind described above.

Another object of the present invention is to provide convenient means of very simple structure for preventing the occurrence of a dangerous accident as described above.

A further object of the present invention is to provide means for relieving the shock imparted to the supporting member when the cylindrical member abuts the supporting member in the article exchanging operation.

Still another object of the present invention is to provide means for re-collecting or recovering the insulating gas prior to the article exchanging operation.

In accordance with the present invention which attains the various objects described above, there is provided a device for exchanging an article in a vessel filled with a gas at high pressure having a tubular member and article exchanging means, said tubular member being adapted to slide through an opening in the wall of said high-pressure vessel so that at the innermost position of said tubular member the end face thereof engages a fixed supporting member within said vessel upon which said article to be exchanged is mounted, said tubular member being in a gas-tight sealed relationship within said high-pressure vessel, said article exchanging means being adapted to effect the exchange of said article through said tubular member; wherein the improvement which comprises at least one annular member having a slit to permit leakage therethrough of the gas in said vessel, said annular member being disposed at a gap between said tubular member and said opening in the wall of said vessel, and at least one sealing member for keeping the gas-tight sealed relationship between said tubular member and said vessel, said sealing member being disposed in the abutting area between the upper face of the outer part of the lower end portion of said tubular member and the lower peripheral face of said opening in the wall of said vessel at the outermost position of said tubular member.

These and other objects, advantages and features of the present invention will become obvious from the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic sectional view through the principal parts of a high voltage charged particle accelerator equipped with the prior art article exchanging device described previously.

FIG. 2 is a diagrammatic sectional view through the principal parts of a high voltage charged particle accelerator equipped with an article exchanging device embodying the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The improved device embodying the present invention comprises a generally tubular or cylindrical member 7 which is slidably received in an opening in the wall of a high-pressure vessel 5 with a very narrow annular gap 16 defined therebetween. The cylindrical member 7 is movable toward and away from a fixed supporting member 3 supporting thereon an electron source 2 which is mounted on the top of an accelerating tube 1. The outer part of the lower end portion of the cylindrical member 7 is flanged as at 21, and a gasket 8 of rubber or like material

maintains a gas-tight relationship between the lower face of the flanged outer part of the lower end portion 21 of the cylindrical member 7 and the supporting member 3 at the lowered position of the cylindrical member 7.

Two rings 15 for guiding the sliding movement of the cylindrical member each having a very fine slit (not shown) therein are disposed at the gap 16 defined between the cylindrical member 7 and the opening in the wall of the vessel 5 so as to allow for free leakage of an insulating gas in the vessel 5 through the slits at the time when the electron source is exchanged. A removable lid 17 closes the central aperture in the end portion of the cylindrical member 7, and a gasket 18 of rubber or like material maintains a gas-tight relationship between the lid 17 and the inner wall of the cylindrical member 7. The lid 17 may be removed when it is desired to exchange the electron source 2 for a new one, and a suitable means (not shown) may be inserted through the cylindrical member 7 to effect the desired article exchanging operation. A gasket 19 of rubber or like material is disposed on the upper face of the flanged outer part of the lower end portion 21 of the cylindrical member 7 in order that it engages the lower peripheral face of the opening in the wall of the vessel 5 at the normal outermost position of the cylindrical member 7 in order to thereby maintain a gas-tight relationship between the vessel 5 and the cylindrical member 7. A device 20 for re-collecting the gas in the vessel 5 is suitably connected to the latter as shown.

When not in article exchanging operation, the cylindrical member 7 is kept at its outermost position at which the upper face of the flanged outer part of the lower end portion 21 thereof engages the lower peripheral face of the opening in the wall of the vessel 5, and the insulating gas is sealed at high pressure within the vessel 5 by the gaskets 18 and 19. The gasket 19 may be disposed on the lower peripheral face of the opening in the wall of the vessel 5 in the abutting area between such a face and the upper face of the flange outer part of the lower end portion 21 of the cylindrical member 7 in place of the illustrated position on the flanged outer part of the lower end portion 21. In the article exchanging operation, the cylindrical member 7 is lowered from its normal non-operative position shown by solid lines to its innermost position as shown by dotted lines to establish an article exchanging passage. The lid 17 is then removed and the article exchanging means is inserted into the cylindrical member 7 to effect the desired article exchanging operation. Since, in such an operation, the gas in the vessel 5 leaks outwardly through the slit in the rings 15 and through the gap 16 as the cylindrical member 7 is lowered from its outermost position, the cylindrical member 7 can easily be lowered into the vessel 5 without being encountered with any resistance, thus eliminating the need for the use of electrical driving power or the like in the prior art device while utterly obviating the danger of a bursting accident or the like pointed out previously. Furthermore, a very small amount of atmospheric air can only flow into the vessel 5 or a very small amount of gas can only flow out of the vessel 5 because the slit and the gap 16 are very narrow and thus the atmospheric air can only contact with the gas in a very small area. The allowable amount of gas that may leak out of the vessel 5 can be minimized when a gas having a specific gravity higher than that of atmospheric air is employed.

Furthermore, in view of the fact that a pressure at substantially the atmospheric pressure prevails within the vessel 5 during the article exchanging operation, the gasket 8 need not be of special gas-tight grade and may be dispensed with. Even with the absence of the gasket 8, the mixture between the gas and the atmospheric air at this portion would be quite negligible. The gasket 8 may preferably have a cushioning effect in order to prevent damage to the supporting member 3 when the latter

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is abutted by the cylindrical member 7, and in this respect, the gasket 8 may preferably be made of sponge rather than rubber.

The means for taking out the article through the cylindrical member 7 may be a piston 10 employed in the prior art device or may be any other suitable means. For example, the lid 17 is removed and a rod of suitable length having a hook at one end thereof may be inserted into the cylindrical member 7 so that the article such as an electron source may be hooked thereby to be taken out of the vessel 5. Where the internal pressure of the vessel 5 is considerably high, the gas re-collecting device 20 may be operated to re-collect or recover the gas in the vessel 5 prior to the article exchanging operation so as to reduce the internal pressure to approximately the atmospheric pressure, and then the article exchanging operation described above may be made to advantage.

From the foregoing description, it will be appreciated that the improved device according to the present invention has remarkable practical advantages over the prior art device in that the possibility of occurrence of a bursting accident or like danger is completely eliminated and an article such as an electron source can very easily be exchanged.

We claim:

1. In combination with a device for exchanging an article in a vessel filled with a gas at high pressure having a tubular member and article exchanging means, said tubular member being adapted to slide through an opening in the wall of said high-pressure vessel so that at the innermost position of said tubular member the end face thereof engages a fixed supporting member within said vessel upon which said article to be exchanged is mounted, said tubular member being in a gas-tight sealed relationship within said high-pressure vessel, said article

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exchanging means being adapted to effect the exchange of said article through said tubular member; the improvement which comprises at least one annular member having a slit to permit leakage therethrough of the gas in said vessel, said annular member being disposed at a gap between said tubular member and said opening in the wall of said vessel, and at least one sealing member for keeping the gas-tight sealed relationship between said tubular member and said vessel, said sealing member being disposed in the abutting area between the upper face of the outer part of the lower end portion of said tubular member and the lower peripheral face of said opening in the wall of said vessel at the outermost position of said tubular member.

2. A device according to claim 1, which further comprises a sealing member disposed on the supporting member so as to absorb the shock imparted to the latter when the tubular member is caused to contact with the supporting member.

3. A device according to claim 1, which further comprises means for re-collecting the gas in the high-pressure vessel.

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