

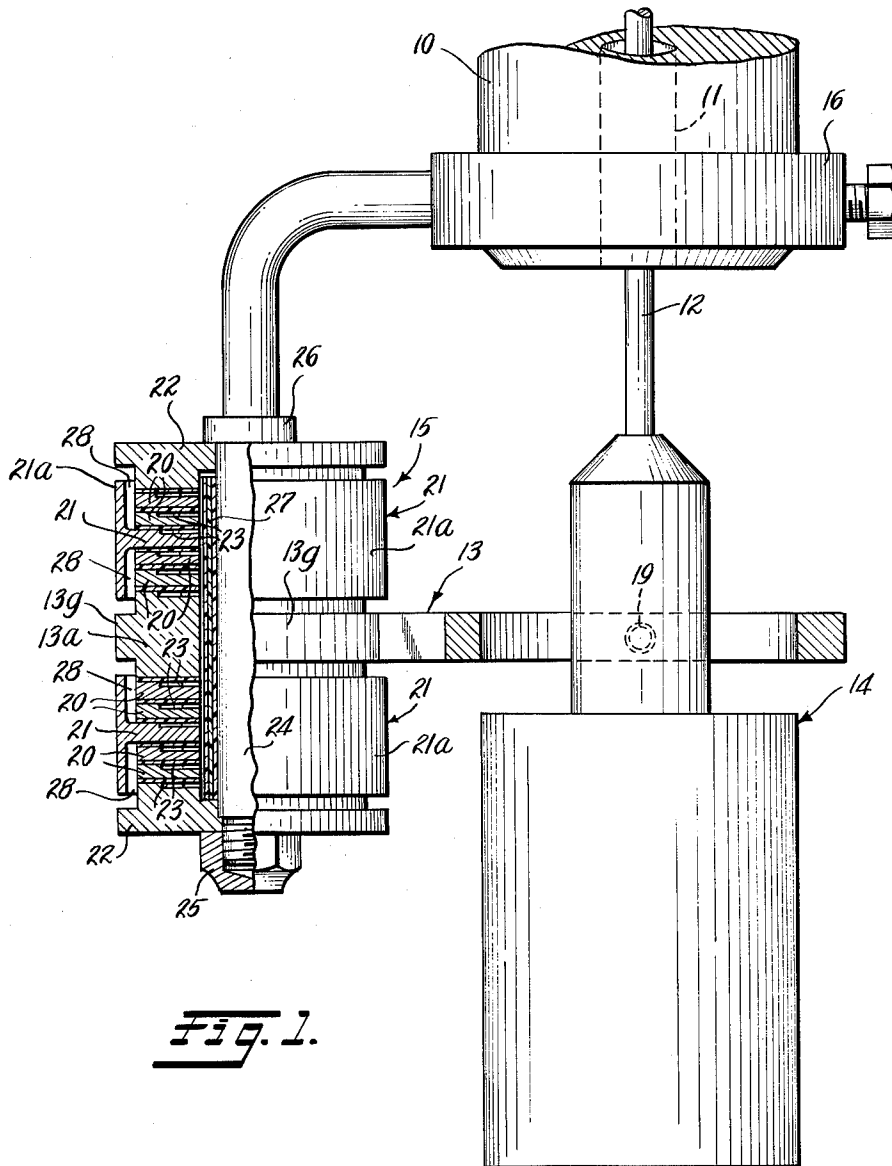
Sept. 21, 1965

K. FLACHOWSKY ETAL
INSULATING SUPPORTING MEMBER FOR ELECTRODES
IN GASEOUS PROCESSING DEVICE

3,207,941

Filed May 9, 1960

2 Sheets-Sheet 1



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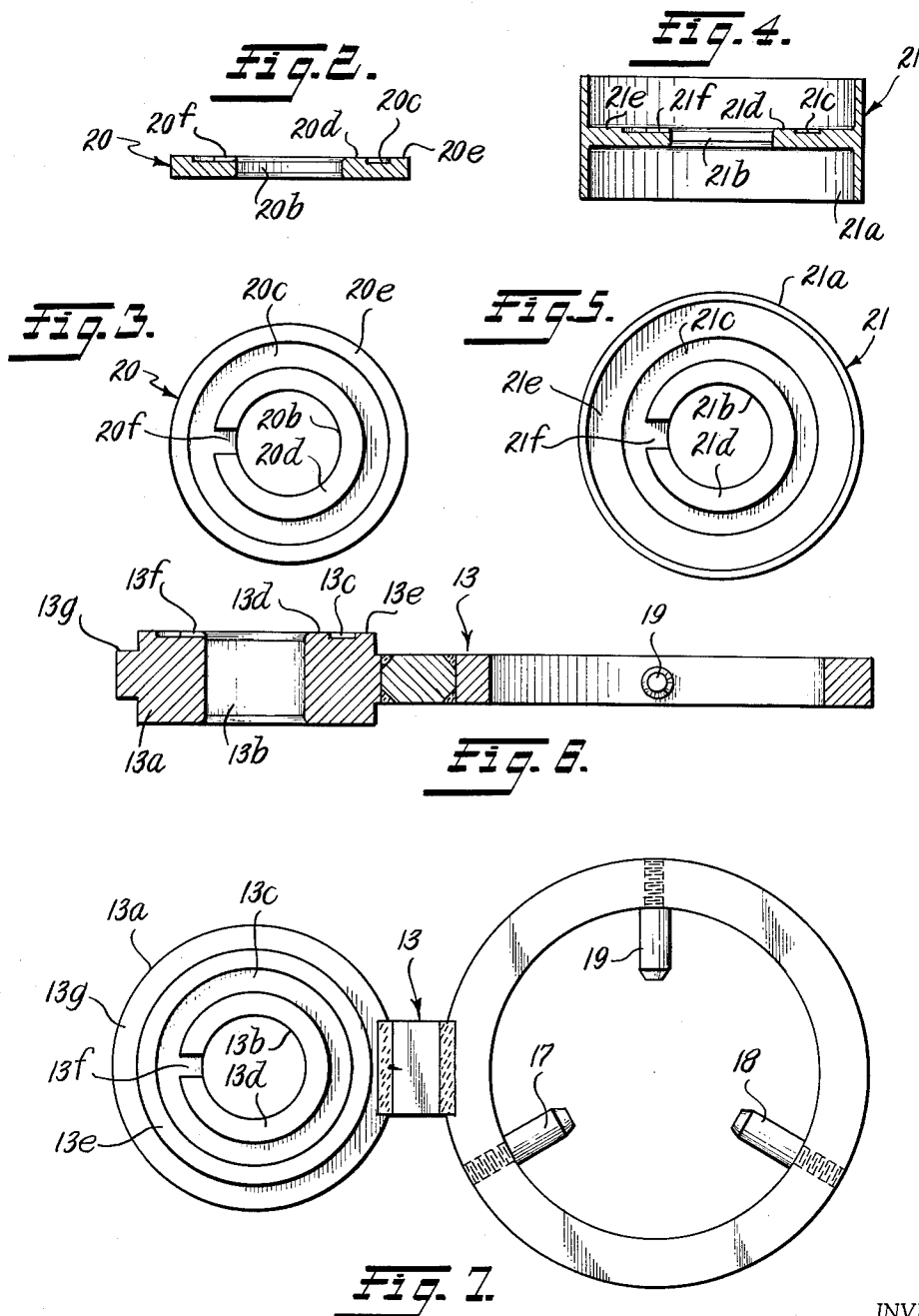
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1

INSULATING SUPPORTING MEMBER FOR ELECTRODES IN GASEOUS PROCESSING DEVICE

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73,033/59

11 Claims. (Cl. 313—268)

The present invention relates to an insulating supporting member between energized structural units in an ionized gas atmosphere which is equipped with narrow protective gaps before the critical contact points between metal and insulating materials.

It is known that all structural units formed of energized metal parts and insulating bodies and arranged in an ionized gas atmosphere within a discharge container present substantial difficulties inasmuch as destruction occurs at the points of contact between metal and insulating bodies due to the attack by electrical discharges. For this reason it is common practice to provide, in such structural units, a narrow protective gap delimited by metallic walls before the most critical contact points between metal and insulating material, the said gaps obstructing the penetration of electric discharges so pronouncedly, particularly of glow discharges, that the contact point in question is protected against discharges at a normal operating gas pressure within the discharge container. Such precautions must particularly be taken with discharge containers designed for processes employing high-intensity glow discharges. In particular, the current lead-in through the metallic walls of such discharge containers must in such cases be designed in accordance with the above-cited requirements since trouble-free and reliable operation of such discharge containers cannot otherwise be guaranteed. Accordingly, a number of proposals have been made for the design of such current lead-ins, by way of example in the Swiss Patents Nos. 291,928, 291,337, 310,967 and 333,695.

With the above-mentioned current lead-ins, an energized interior lead is generally enclosed by an insulator and the provision of sufficiently narrow cylindrical protective gaps ensures that all critical contact points between metal parts and insulating bodies are protected against the attack by a destructive glow discharge. The said embodiments have proved satisfactory in operation, but they necessitate high-precision manufacture since the width of such protective gaps commonly measures between .3 and .6 mm.

It should be ensured that the gap width over the entire length of the annular gap is uniform, which involves observance of narrow tolerances. It has therefore also been proposed (Swiss Patent No. 310,960) to make the mutual centering of the coaxial walls forming an annular gap adjustable. These rigid requirements similarly apply not only in respect of current lead-ins but with all insulating supporting members between energized structural members within such a discharge vessel.

The present invention has for its object to provide an insulating supporting member which avoids the requirements relating to mechanical precision and accurate assembly although a narrow protective gap is located before the critical contact surfaces between metal and insulating material. The insulating supporting member according to this invention is characterized by the fact that the narrow protective gap is designed as a flat gap between flat metal surfaces which are forced against one another with insulating bodies inserted between them, which are also flat.

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According to this invention, such a supporting member is employed particularly to hold an energized interior lead which extends through the bore of a metallic hollow body. It is characteristic that the structural members serving to hold and center the interior lead within the bore are attached to the hollow body itself by means of insulating supporting bodies forming the subject-matter of this invention.

The use of flat gaps instead of coaxial annular gaps has been proposed in individual cases (cf. Swiss Patent No. 333,695) but these gaps are never flat gaps between flat metal surfaces forced against one another with flat insulating bodies inserted.

A number of embodiments of this invention are discussed in greater detail in conjunction with the drawings in which:

FIG. 1 is an elevation of the supporting means of an interior lead along the bore of a metallic hollow body, shown partly in section;

FIGS. 2 and 3 are a cross-section and, respectively, a plan view of an embodiment of a metal plate employed in the supporting member according to FIG. 1;

FIGS. 4 and 5 are a cross-section and plan view of a further embodiment of a metal plate similar to that shown in FIGS. 2 and 3;

FIGS. 6 and 7 are a cross-section and a plan view of the centering member for the support according to FIG. 1.

The design of the present insulating supporting member between energized structural units will now be discussed in greater detail in its application to the support of an energized interior lead in the bore of a metallic hollow body, although the invention is naturally not limited thereto.

In the embodiment according to FIG. 1, a metal tube 10 with the bore 11 houses an energized interior lead 12 which carries a voltage, relative to the tube 10, such as an alternating voltage of 500 volts. The interior lead 12 is suspended, in insulated relationship, from the upper end of the tube 10, an insulating supporting member (not shown) of the type disclosed being employed for the purpose. At the lower end of the tube 10 shown in FIG. 1, a centering member 13 centers the interior lead 12 and, respectively, the cylindrical biasing weight 14 relatively to the bore 11 of the tube 10. The centering member 13 is here attached to the clamping collar 16 bolted to the tube 10, attachment being effected by an insulating supporting member 15. Centering of the interior lead 12 relatively to the bore 11 of the tube 10 is effected in the manner known by means of the pointed set-screws 17, 18, 19 shown in FIG. 7. Such centering of the interior lead 12 relatively to the bore 11 of the tube 10 by means of a centering member 13 which is rigidly attached to the tube 10 offers the advantage that the position of the interior lead 12 in the tube 10 is independent of its transverse movements and its longitudinal elongation. Practice has shown that, in nitriding steel tubes by means of a high-intensity electric glow discharge in a nitrogenous atmosphere, accurate centering of the interior lead 12 in the bore 11 is of much importance. Obtention of such centering, however, requires a reliable and easily assembled insulating supporting member 15, which requires no servicing, of which the design is disclosed hereunder.

The insulating supporting member is of a columnar design and, as the longitudinal section of FIG. 1 shows, it is symmetrically assembled on either side of the centering member 13. The centering member 13 is provided with a ring 13a having a bore 13b (cf. FIG. 6) which forms the center of the supporting member. Arranged on either side of the ring 13a are two flat metal disks 20, then the metal disk 21 with the edge 21a, two further metal disks 20 and finally an end plate 22 each. The metal disks 20

and 21 are each provided with a coaxial bore 20b and, respectively, 21b, which possesses the same diameter as the bore 13b in the ring 13a of the centering member. The two metal disks 20 adjacent to the ring 13a form, with their flat sides facing each other, a flat gap 23 due to a mica ring of .2 to .5 mm. thickness inserted between the two metal surfaces facing each other. A similar mica ring of which the inner diameter is identical with the diameter of the bores 13b, 20b and 21b and of which the outer diameter must be smaller than the outer diameter of the metal disks is provided between the individual adjacent metal disks 20 and 21, and the top and bottom metal disk 20 and the end plates 22. In this manner six flat gaps 23 are formed on both sides of the ring 13a of the centering member 13.

The complete supporting member is held together by means of a clamping stud 24 of which the free end carries a thread and a nut 25 with the aid of which the base-plate 22 and all metal disks 20 and 21 as well as the ring 13a are forced against the cover-plate 22 which in turn rests on a shoulder 26 of the clamping stud 24. In order to increase the voltage safety, the clamping stud 24 is surrounded by a cylindrical insulator 27 in the interior of the supporting member which, however, is not called upon, as FIG. 1 shows, to take up tensile or compressive stresses and on whose dimensions no great tolerance demands are made.

The narrow flat gaps 23 between the facing flat surfaces of the stacked metal disks and, respectively, of the ring 13a and the cover and base-plate 22 have their width determined solely by the flat inserted mica insulator rings. As is well known, such insulating rings formed of mica can be machined to close tolerances and they are available in all thicknesses desired. Since such mica rings can be produced with uniform thickness along their entire dimension without any difficulty whatever, the width of the flat gaps along their entire dimension will be constant without particular centering measures, provided that the boundary metal surfaces are perfectly flat. Since these metal surfaces, however, are produced on lathes, no particular precision is demanded to meet this condition. Also assembling such an insulating supporting member according to FIG. 1 and the above specification, no particular precision is required since all metal parts can be stacked consecutively on the clamping stud 24 provided with the insulating tube 27 in order finally to be forced together by means of the nut 25.

In the embodiment of the insulating supporting member shown in section in FIG. 1, the flat surfaces of the metal disks 20, 21 and 22 facing each other and of the metal ring 13a are represented as flat faces. A supporting member so constructed has proved entirely satisfactory in operation when flat mica insulator rings of .3 to .4 mm. thickness were used, the dimensions approximately corresponding to those in FIG. 1.

In certain applications, particularly on discharge containers with a negative pressure in the range of only a few mm. Hg, it has proved to be of advantage if at least one of the flat surfaces of the metal disks facing one another is provided with an annular coaxial recess. By way of example, FIGS. 2 and 3 show a metal disk 20 so designed and provided with the coaxial recess 20c in one of the flat sides, which recess subdivides this flat surface into a narrower annular area 20d and a wider annular area 20e. The bore 20b communicates with the annular recess 20c via a radially arranged channel 20f. Correspondingly, one of the flat sides of the metal disk 21 may be designed in the manner shown in FIGS. 4 and 5, the annular recess 21c again subdividing the flat surface into a narrower inner annular area 21d and a wider outer annular area 21e. The radial channel 21f again connects the annular recess 21c with the bore 21b of the metal disk. In the embodiment disclosed and shown in FIG. 1, the metal disk 21 has its periphery provided with an edge 21a arranged normal to the disk plane. As shown by

FIG. 1, the diameter of these metal disks 21 and the inner diameter of the edge 21a are larger than the outer diameter of the metal disks 20. Accordingly, the edge 21a extends beyond the end faces of those metal disks 20 (FIG. 1) which are arranged on either side of the metal disk 21 and form, with these end faces, an annular gap 28 of which the width, however, is larger than that of the flat gap. As seen in FIG. 1, the annular gap 28 ensures that the narrow flat gaps 23 do not open directly into the inner space of the discharge container so that greater security against the undesired penetration of dusted metal particles and the like is obtained.

The metal disk 13a of the centering member 13 has one of its flat surfaces provided with an annular recess 13c as shown in FIGS. 6 and 7. This recess subdivides this flat surface into a narrower annular area 13d and a wider annular area 13e. Here again, the annular recess 13c communicates with the bore 13b via a radial channel 13f. The periphery of the metal ring 13a is provided with a radially projecting bead 13g of which the outer diameter, as shown in FIG. 1, approximately coincides with the outer diameter of the edge 21a of the metal disks 21. This bead 13g, as seen in FIG. 1, forms a further protection against the penetration of foreign bodies into the annular gap 28.

Employing the metal disks 20 and 21 shown in FIGS. 2 through 5, and with a design of the one flat surface of the metal ring 13a according to FIGS. 6 and 7, assembly of the insulating supporting member is effected in such a manner that of the surfaces of adjacent metal disks which face one another and form a flat gap between themselves, one flat side is provided with an annular recess and a radial channel. In this case, the mica ring determining the distance between adjacent metal disks should possess the same dimensions as the annular area 20d and 21d and, respectively, 13d, obviously without taking into account the radial channels 20f, 21f and, respectively, 13f. An insulating supporting member so designed provides the advantage that the inner space 27 only partially filled by the cylindrical insulating body between the bores 20b, 21b and, respectively, 13b and the clamping stud 24 communicates, via the individual radial channels 20f, 21f and, respectively, 13f with the annular recesses and, via the narrow flat gaps 23 as well as the wide annular gaps 28, with the interior space of the discharge container. This enables the gas present in the interior of the insulating supporting member to be removed when the discharge container is evacuated so that any gas discharge of the mica rings in operation cannot cause disturbances.

An insulating supporting member constructed in accordance with the principle of FIG. 1 with metal disks according to FIGS. 2 through 5 and a centering member according to FIGS. 6 and 7 has proved effective in the continuous operation of a discharge container operating with high-intensity glow discharges. The tubes 10 were heated to a temperature between 400 and 500° C. so that the insulating supporting member 15 possessed approximately the same temperature. Despite this high temperature and an operating voltage of up to 700 volts (peak load) between the interior lead 12 and the tube 10, no breakdowns by surface conduction and no other disturbances were witnessed, and even after hundreds of hours of operation no detrimental dusting of the narrow flat gap and, respectively, of the end faces of the metal disks 20 have been observed.

Naturally the insulating supporting member is only a design example in the embodiment according to FIG. 1. If desired, such a supporting member may be designed without the interior bores 20b, 21, 13b if clamping is effected not by a clamping stud 24 but by a frame-type stirrup which encloses the complete supporting member, forcing it together from the two sides. The supporting member in a design similar to that shown in FIG. 1 may also be employed to suspend energized bodies if the centering member arranged on one side of the metal disk 13

is replaced by holding stirrup attached to a corresponding metal ring so that a lead suspended from the supporting member will place it under tensile stress in the axial direction.

The insulating material used for the insulating rings employed in the present insulating supporting member, which has proved to be reliable, was mica. On the other hand, other flat insulating bodies that may be produced to a thickness of .2 to .5 mm. may be employed, such as insulating sheets formed of a plastic or similar materials. However, it must be ensured that these insulating rings will accurately maintain their dimensions at the operating temperature employed. Thermoplastic insulating materials may therefore be used only if the operating temperatures of the supporting member are sufficiently low.

It is further pointed out that according to the principle of the supporting member according to FIG. 1 a current lead-in may readily, and without difficulty, be designed in which all narrow protective gaps, in contradistinction to the current lead-in disclosed in the above-cited patent specifications, are designed as flat gaps and not as annular gaps.

We claim:

1. In an insulated supporting member in a glow discharge container wherein said member is provided with a gap for protecting the insulation against the action of glow discharges, said gap comprising opposed metallic walls between the insulation and the interior of said container and being of such narrow width as to prevent glow discharge from taking place therein, the improvement comprising; said opposed metallic walls defining flat opposed surfaces having a flat insulator pressed therebetween.

2. In an insulated supporting member in a glow discharge container wherein said member is provided with a plurality of gaps for protecting the insulation against the action of glow discharges, said plurality of gaps comprising opposed metallic walls between the insulation and the interior of said container and being of such narrow width as to prevent glow discharge from taking place therein, the improvement comprising; said opposed metallic walls defining flat opposed surfaces having a flat insulator pressed therebetween.

3. A device as defined in claim 1 wherein said metallic walls are free of conductive connection to any source of electric potential.

4. A device as defined in claim 1 wherein said metallic walls comprise a columnar assembly of alternating flat metal disks and flat insulating bodies, said disks and bodies having aligned central bores through which a clamping stud extends to clamp said assembly together, said clamping stud being spaced from and out of contact with said disks.

5. A device as defined in claim 4 wherein said clamping stud comprises a portion of a lead-in conductor extending in insulated relationship through a wall of said container, said columnar assembly being adjacent an inner surface of said container.

6. A device as defined in claim 4 wherein said disks are of annular shape and said bodies are in the form of rings of insulation of smaller external diameter than said disks and the thickness thereof determining the width of said gaps.

7. A device as defined in claim 4 wherein said glow discharge takes place between two energized bodies; said columnar assembly including end plates insulated from said disks but electrically connected to said clamping stud which is in turn connected to one of said energized bodies, one of said disks being connected to the other of said energized bodies.

8. A device as defined in claim 1 wherein said metallic walls comprise a columnar assembly of alternating flat metal disks and flat insulating bodies, at least one of said disks being free of connection to any source of potential and projecting outwardly beyond the others and having an axially extending peripheral flange extending across but spaced outwardly from the peripheral edge of at least one of the other disks to define therewith a gap wider than the flat gap between disks and into which at least one of said flat gaps extends.

9. A device as defined in claim 4 wherein at least one of the flat surfaces of said metal disks is provided with an annular coaxial recess dividing said face into inner and outer areas, and a generally radial recess communicating between said annular recess and said central bore.

10. A device as defined in claim 1 wherein said flat insulator is formed of mica of predetermined thickness defining the width of said gap.

11. A device as defined in claim 2 wherein said plurality of gaps are defined by at least four metal surfaces and two flat insulators.

References Cited by the Examiner

UNITED STATES PATENTS

1,249,429	12/17	Lewis	313—325 X
1,287,725	12/18	May	313—325 X
2,219,614	10/40	Berghaus et al.	174—152 X
2,376,439	5/45	Machlett et al.	174—140 X
2,430,206	11/47	Beck et al.	313—325 X
2,473,819	6/49	Pittman	315—36

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BENNETT G. MILLER, *Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,207,941

September 21, 1965

Kurt Flachowsky et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 2 and 11, and in the heading to the printed specification, line 5, for "Horst Bordorf", each occurrence, read -- Horst Rordorf --.

Signed and sealed this 29th day of March 1966.

(SEAL)

Attest:

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Commissioner of Patents