United States Patent

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[73] Assignee **Westinghouse Electric Corporation Pittsburgh, Pa.**

[54] **BREAKDOWN POTENTIAL CONTROL ASSEMBLY FOR GAS FLOW-THROUGH ELECTRICAL DISCHARGE DEVICE**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **315/108,** 313/209, 315/111, 356/86
[51] **Int. Cl.** **H01j 61/10,** H01j 61/24
[50] **Field of Search** ..... 313/210, 209; 356/86; 315/108, 111; 250/83.6 FT

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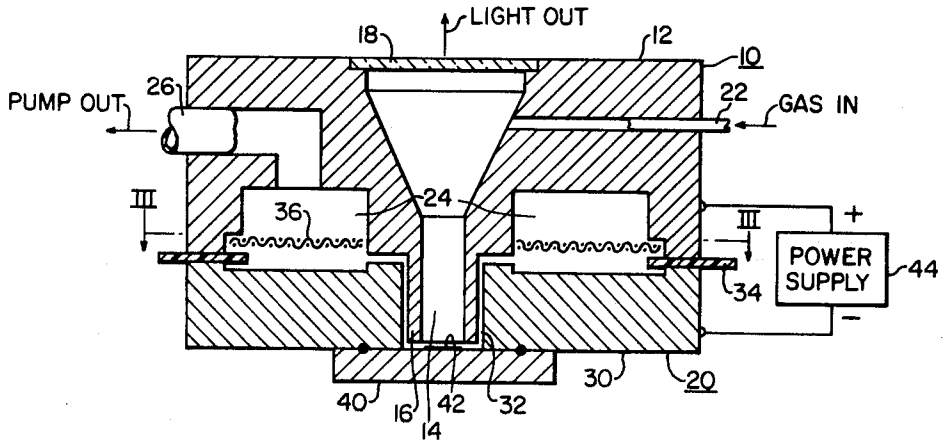
ABSTRACT: An electrical discharge device having a circulating gas medium and which incorporates gas permeable electrode members for permitting increased pumping speed of the circulating gas to thereby reduce the gas pressure while maintaining the desired distance between electrodes to obtain an increase in the breakdown potential.



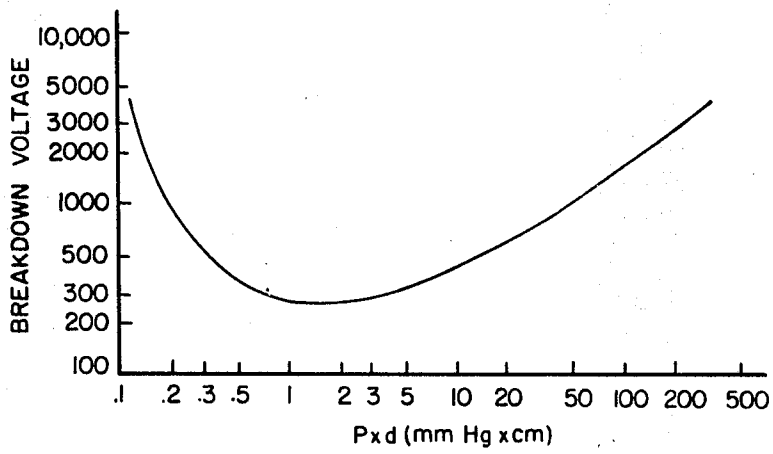


FIG. 1.

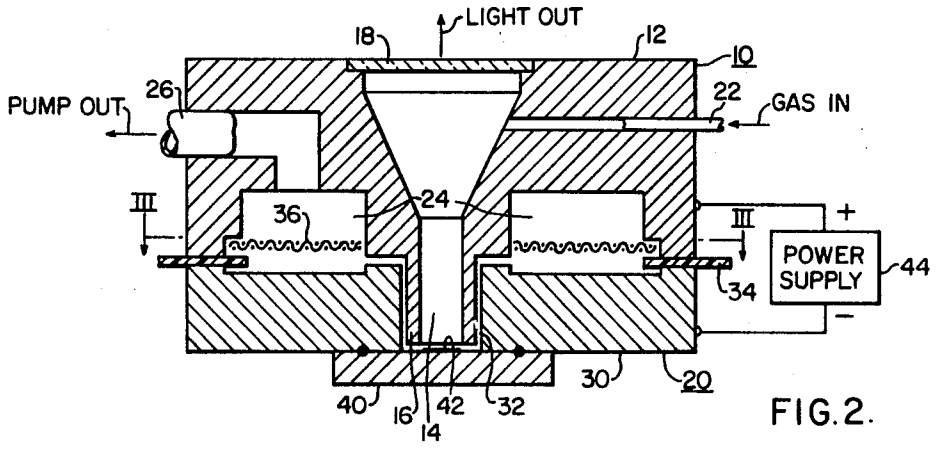


FIG. 2.

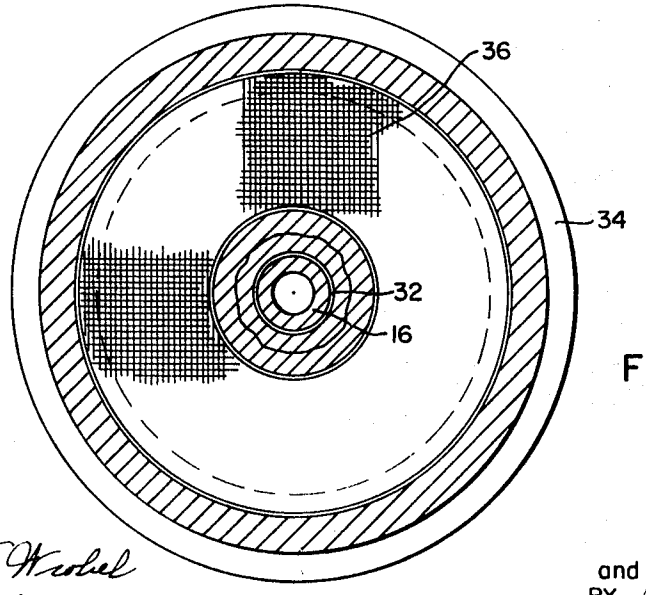


FIG. 3.

WITNESSES

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BREAKDOWN POTENTIAL CONTROL ASSEMBLY FOR GAS FLOW-THROUGH ELECTRICAL DISCHARGE DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to electrical discharge devices in which a circulating gas medium is provided within the device. In such structures, it is normally desired that a low breakdown potential exists between a selected portion of the electrode configuration within the gas medium while the remaining portion of the configuration is such that the breakdown potential is substantially higher than the selected portion.

Electrical breakdown in gas filled electrical devices is dependent on the effective spacing between the two surfaces to which an electrical potential difference is applied and the pressure of the gas between the surfaces. The breakdown potential versus pressure x distance relationships for various gases and mixtures are generally known and described by a family of curves called the Paschen curves. A typical curve is shown in FIG. 1 of the drawing. The Paschen curve indicates that the breakdown will occur most readily at a specific value of pressure x distance and higher voltages are necessary to initiate electrical breakdown as the product of pressure x distance becomes less or as the product becomes greater. In many devices, the desired breakdown surface region operates near the minima of the Paschen curve and the remaining structure normally will operate to the left of the minima. A decrease in pressure or spacing results in a higher breakdown potential as to the remaining surfaces of the device which is of course the desired result.

In a gas flow type device, a pressure gradient will form between the input and the exit of the gas system. For a given gas pumping system, the pressure between the electrodes of the device is dependent on the dimensions of spacing. The increase of spacing between the electrodes will attain a more efficient pumping speed and hence lower values of pressure but the increase in spacing will reduce breakdown potential.

SUMMARY OF THE INVENTION

This invention relates to an electrical discharge device utilizing a gas flow medium in which a member of sufficient permeability is utilized between two electrode members of different potential to permit easy pumping of the gas medium but sufficiently impermeable to still maintain the desired distance spacing and low breakdown by means of the porous member positioned therebetween. BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference may be had to the preferred exemplary embodiment shown in the accompanying drawing, in which:

FIG. 1 is a graphic illustration of a Paschen curve Pd versus breakdown potential for a suitable circulating gas medium such as Argon;

FIG. 2 is a sectional view of a glow discharge type device incorporating the teachings of this invention; and

FIG. 3 is another view of FIG. 2 illustrating the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring in detail to FIG. 1, there is illustrated a glow discharge type of device, the device includes an anode **10**, and a cathode **20**. The anode **10** comprises a block **12** of a suitable electrically conducting material such as brass having a central opening **14** therein. An anode extension **16** is also provided which extends downwardly and is tubular in cross section. The central opening **14** is closed off at the upper portion of the anode by a window **18** and the window **18** is vacuum sealed to the anode block **12**. The central opening **14** includes the opening in the anode extension **16**. A tubular conduit or opening **22** is provided in the anode block **12** to introduce a suitable gas into the central opening **14**. An annular groove **24** is provided on the lower surface of the anode block **12** surrounding the tubular extension **16** and the central opening **14**. The annular groove or cavity **24** is provided with a conduit **26** for exhausting or pumping out the gas from the device. A suitable gas such as argon is continually circulated through the device by means of a suitable pumping means.

The cathode **20** is an annular member **30** of a suitable electrically conductive material such as brass which is provided with a central opening **32** and into which the anode extension **16** is inserted. The spacing between the outer surface of the tubular extension **16** and the inner surface of the opening **32** is about 0.010 inch even though the spacing can be more or less depending on desired pumping rate and gas flow. The cathode **20** is positioned and spaced from the anode **12** by a suitable insulating spacer **34**. The pressure in the systems might vary from 2 to 20 torr with a gradient through the system. The pumping cavity **24** is provided with a gas permeable member **36** in the form of a mesh of a suitable electrically conductive material such as brass or stainless steel or any other suitable conducting material. The mesh **36** has a mesh opening of about 0.010–0.100 inch and a wire diameter of about 0.010–0.100 inch. The member **36** is positioned to shield the inner surface of the cavity **24** within the anode block **12** from the cathode **20**. The member **36** permits the enhanced pumping speed of the gas through the device while maintaining the distance "d" between the cathode **20** and the anode **10**.

It is possible to utilize a porous plug plate, screening, or perforated plate members composed of materials of good electrically conductive materials or of lesser electrical conductivity such as insulators and semiconductors coated with suitable electrically conductive films or coatings. The member **36** is also not restricted to the flat parallel configuration illustrated but may take on other physical configurations such as cylindrical or circular. By controlling the rate of gas flowing into the device, by properly selecting the position of the pumping orifices, and by controlling the rate of pumping, a "pressure x distance" condition of low breakdown voltage can be made to occur in any region of the device while maintaining good electrical holdoff properties in other areas where electrical breakdown is undesirable. In so doing, a discharge can be made to occur only where desired.

In the specific device shown the cathode **20** is provided with a flat platelike member **40** on which a sample material **42** is provided, and the plate member **40** is sealed to the cathode block **20** by means of an O-ring type seal. The sample also may be the block **40** itself or an ingot or any slug with a flat surface. The desired area of discharge is located in the area of the location of the sample material **42** and glow emission is emitted from this area and the region within the tubular extension **16**. The light is emitted through the window **18**. A typical voltage is supplied between the cathode **20** and anode **10** by means of a power supply **44** and a typical voltage is about 200–3,000 v. The electrode **36** may operate at any suitable potential. In the specific device shown, the electrode **36** is connected to the anode **10**. It could also operate at cathode potential. By the construction illustrated the device is made to provide electrical breakdown in the region of the sample material **42** substantially near the minimum of a curve illustrated in FIG. 1. By providing the mesh electrode **36** within the pumping cavity the breakdown potential is maintained to the left side of the minimum portion of the curve and at a higher breakdown potential. For example, in the device illustrated the breakdown potential without the mesh electrode **36** might be of about 900 volts while the insertion of the mesh electrode **36** positioned at a distance from the cathode **20** of about 0.070 inch was such as to provide a breakdown potential of 2,800 volts.

We claim as our invention:

1. A glow discharge device comprising a first electrode and a second electrode, said first and second electrodes spaced apart and insulated from each other, said first and second electrodes comprising first portions between which an electric discharge is desired and second portions between which a discharge is undesired, means for circulating gas between said first and second electrodes, a gas permeable electrode posi-

tioned between said second portions of said first and second electrodes to permit a high circulating rate of said gas between said first and second electrodes while providing breakdown potential protection between said second portions of said first and second electrodes.

2. A glow discharge device comprising a cathode and anode and spaced apart, means for circulating a gas between said cathode and anode, said cathode having a centrally located opening, said anode having a tubular extension portion extending into said opening, the active portion of said cathode wherein an electrical discharge is formed to said anode positioned at the opposite end of said opening with respect to said anode and facing the end portion of said tubular extension of said anode and a gas permeable electrode positioned between a part of the inactive portion of said cathode wherein an electrical discharge is undesired and said anode to permit circulation of said gas while increasing the breakdown potential between said anode and said inactive portion of said cathode.

3. The device in claim 2 in which said cathode member is an annular member having a surface facing a surface of said anode, an annular cavity defined between a portion of said surface of said cathode and a portion of said surface of said anode and said permeable electrode member positioned within said annular cavity.

4. The device in claim 2 in which glow discharge occurs between said active portion of said cathode and said tubular extension of said anode and the spectral emission is emitted from the device through the opening in said tubular extension and a communicating opening in said anode, said opening in said anode provided with a window.

5. The device in claim 4 in which said gas follows a path in which it enters said communicating opening in said anode, passes through the opening in said tubular extension, passes through the annular passage between the outer surface of said tubular extension and the opening in said cathode, passes into an enlarged annular cavity formed between said cathode and anode and then to an exit port, said gas permeable electrode member positioned within said cavity to modify the breakdown potential within said cavity.