June 24, 1958 R. A. WHITE 2,840,750

HIGH FREQUENCY CORONA SHIELD

Filed Aug. 24, 1953

Fig.1.

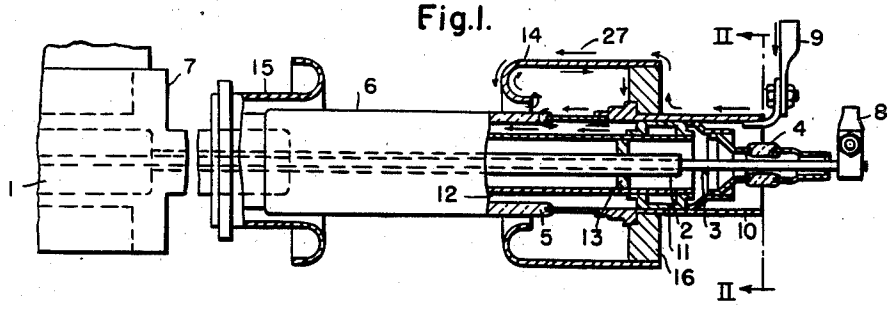


Fig.2.

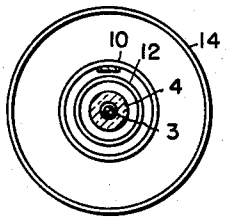


Fig.4.

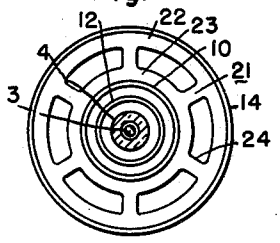


Fig.3.

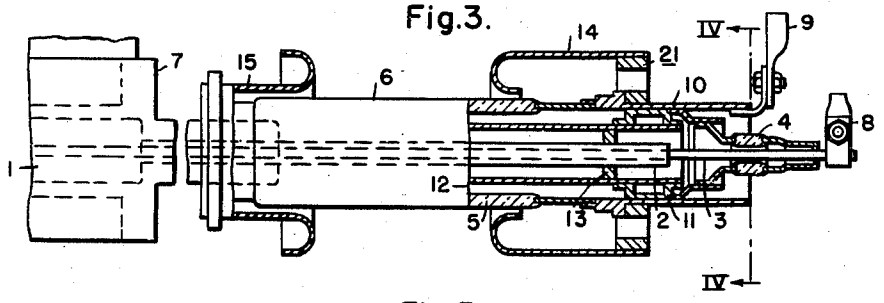
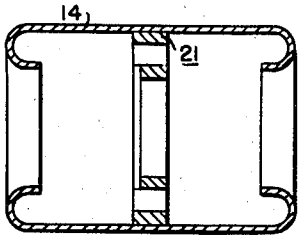


Fig.5.



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United States Patent Office 2,840,750
Patented June 24, 1958

2,840,750

HIGH FREQUENCY CORONA SHIELD

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Application August 24, 1953, Serial No. 375,885

4 Claims. (Cl. 313—313)

My invention relates to corona shields and, in particular, relates to corona shields for magnetrons and other electrical equipment operating at extremely high frequencies. I herein illustrate its principles by applying them to a magnetron which generates ultra-high-frequency currents and is powered by a source of the order of 100 thousand volts, so that corona shields are provided to avoid concentrated electric fields in the neighborhood of its input leads.

Figure 1 shows the structure and configuration of the corona shielding used in the prior art for the high potential leads into a magnetron of the type just mentioned. The cylindrical cathode **1** is supported on a pair of concentric in-leads **2** and **3** which extend through suitable seals **4** and **5** along the axis of a tubular glass neck **6** extending from the vacuum-tight container **7** of the magnetron. The general structure of such magnetrons is too well known in the art to require detailed description here, but it may be said that the inner wall of the generally cylindrical container **7** constitutes the anode, so that the anode-to-cathode potential difference of around 100 thousand volts produces a strong electric field in the neighborhood of the in-leads **2** and **3**. Cathode heating current is furnished to the inner cathode lead **3** by a line-wire **8**, the other line-wire **9** being connected to the metal cylinder **10** which is part of the seal **5**. Cylinder **10** connects through a metal collar **11** to metal sleeve **12** which is spaced from cathode-lead **2** by a metal ring **13**. Since the potential difference between cathode leads **2** and **3** is only a few volts, all of the above-enumerated parts which are connected to them are at a potential difference of around 100 thousand volts from the anode **7** to which the glass neck is sealed. An intense electric field thus exists between the above-enumerated parts **1, 2, 3, 5, 8** to **13** and the parts connected to anode **7**. The high vacuum inside the magnetron gives the gaps between parts of opposite polarity therein a high dielectric strength, but where the electric fields traverse space outside the tube concentrations of the field at corners and points would produce corona discharges were this not guarded against by providing corona shields such as **14** and **15** in Fig. 1.

Prior practice has been to form the shield **14** as a cuff of sheet metal with the end facing toward anode **7** curved inward forming a toroidal surface with a substantial radius of curvature, and its other end supported from the cylinder wall **10** by a solid annular collar **16**.

Pulsed currents of ultra-high frequency from the modulator or other circuits external to the magnetron flow along the outer cathode-lead **2** to the line-wire **9**, and by reason of the well-known skin effect, they are confined to a thin layer on the surface of the conductors which they traverse. The arrows **27** indicate the path of the high-frequency currents in the Fig. 1 structure and show that the current is forced by collar **16** to follow a long curved path over the surface and around the curved end of corona shield **14** as part of its journey.

Such a tortuous path offers a substantial impedance to the pulsed currents from which magnetrons operate and

even cause arc-over at points where parts of the curved path approach each other.

One object of my invention is, accordingly, to provide an improved type of corona shield for high-frequency electric circuits.

Another object is to provide a corona shield structure for components of high-frequency electric circuits which shall minimize the impedance in the path of such currents.

Another object is to provide a corona shield for high-frequency electrical conductors which shall minimize the danger of arc-over in the neighborhood of the shield due to impedance in the path of high-frequency currents along surfaces of the shield.

Still another object is to provide an improved structure for magnetron tubes carrying high-frequency currents.

Other objects of my invention will become apparent upon reading the following description taken in connection with the drawings, in which:

Figure 1 is a view, partly in longitudinal section, of a magnetron with corona shielding of the prior art type.

Fig. 2 is a section along lines II—II of Fig. 1.

Fig. 3 is a view, partly in longitudinal section, of a magnetron having corona shielding embodying my invention.

Fig. 4 is a section along lines IV—IV of Fig. 3; and

Fig. 5 is a view in longitudinal section of a modified form of my invention.

In accordance with my invention as applied in Fig. 3, the corona shield **14** is supported from the cylindrical wall **10** by a spider **21** comprising rings **22, 23** connected by spokes **24**. The high-frequency load currents are able to pass across the surface of ring **23** through the intervals between the spokes **24** and are no longer forced to follow the long re-entrant path along the surface and around the end of corona shield **14**. The above-described impedance in the path of the load current is thus eliminated and failure of corona protection by the shield **14** is avoided. I have shown the spider as having six spokes, but for certain purposes any number from one up will do.

In order to more perfectly shield the tube structure at the end remote from anode **7**, it may be desirable to extend the shield **14** to the right as shown in Fig. 5, giving its extended end the same curved rim as the left end has in Fig. 3. Fig. 5 shows such a shield.

While I have described an application of the principles of my invention to a magnetron, it will be recognized that they are equally applicable to supports for corona shields for other high-frequency devices; vacuum-type high-voltage capacitors may be pointed out as one example.

I claim as my invention:

1. A corona shield for linearly extending radio frequency conductors comprising a sheet of conductive material having an annular wall portion surrounding a radio frequency conductor, said wall portion having a diameter substantially greater than said conductor and a support therefor comprising an inner ring of conductive material engaging said conductor, and a plurality of conductive spoke members extending outwardly from said inner ring to support said annular wall portion.

2. A corona shield for linearly extending radio frequency conductors comprising a sheet of conductive material having an annular wall portion surrounding a radio frequency conductor, said wall portion having a diameter substantially greater than said conductor and a support therefor comprising an inner ring of conductive material engaging said conductor, and a plurality of radial conductive spokes extending outwardly from said inner ring to support said annular wall portion.

3. A corona shield for linearly extending radio frequency conductors comprising a sheet of conductive material having an annular wall portion surrounding a radio frequency conductor, said wall portion having a diameter substantially greater than said conductor and having an end bent over to form a toroidal surface of substantial radius of curvature, a support therefor comprising an inner ring of conductive material engaging said conductor, and a plurality of conductive spoke members extending outwardly from said inner ring to support said annular wall portion.

4. A corona shield for linearly extending radio frequency conductors comprising a sheet of conductive material having an annular wall portion surrounding a radio frequency conductor, said wall portion having a diameter substantially greater than said conductor and having an end bent over to form a toroidal surface of substantial radius of curvature, a support therefor comprising an inner ring of conductive material engaging said conductor, and a plurality of radial conductive spokes extending outwardly from said inner ring to support said annular wall portion.

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