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HIGH VOLTAGE RESISTOR

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FIG. 1

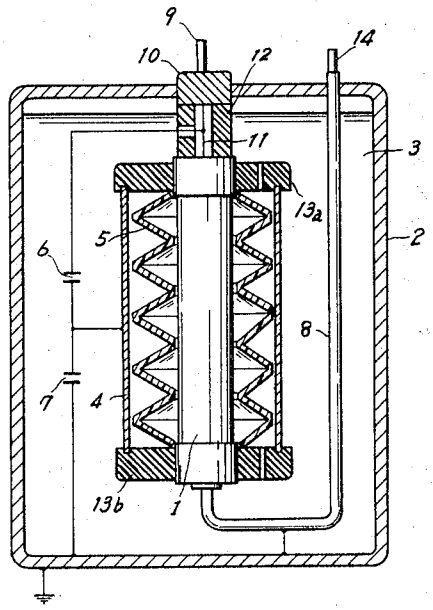


FIG. 2

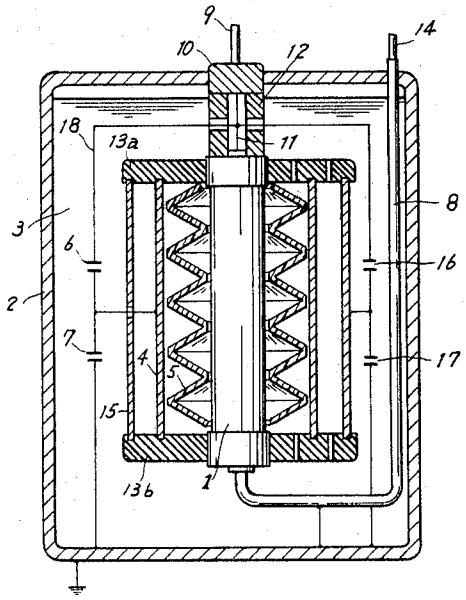
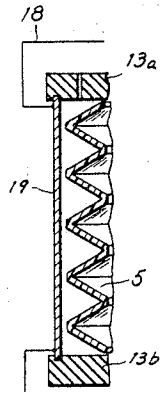


FIG. 3



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HIGH VOLTAGE RESISTOR

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Continuation-in-part of application Ser. No. 511,984, Dec. 3, 1965. This application Apr. 30, 1968, Ser. No. 725,379

Claims priority, application Japan, Dec. 10, 1964, 39/69,554

Int. Cl. H01c 1/02

U.S. Cl. 338—231 10 Claims

ABSTRACT OF THE DISCLOSURE

A high voltage resistor including a resistor immersed in oil and surrounded by a cylinder of electrically conductive material. Between the resistor and cylinder is an insulating corrugated baffle for restraining movement of the oil when a voltage is applied to the cylinder, to reduce noise and change in voltage value between the input and output of the resistor. A second cylinder of conductive material can be positioned around the first cylinder and connected in the same manner. In an embodiment of the invention, the first cylinder can be made of a suitable resistance material connected directly to the input and grounded whereby the potential drop across the resistor and the cylinder can be equalized to substantially eliminate oil turbulence and corona discharge.

This application is a continuation-in-part of our United States patent application Ser. No. 511,984 filed Dec. 3, 1965, now abandoned.

This application relates to a high voltage resistor which is particularly useful in a negative feedback circuit used to maintain the stability of a high voltage source. Such a voltage source may be used as the electron accelerating voltage in an electron gun used in an electron microscope or electron diffraction apparatus. In such apparatus the voltage should not vary more than one part in a million.

Resistors used in negative feedback circuits have high resistance values and extremely high voltages are applied to them. Consequently, leakage currents develop between the input and output leads of the resistor across the outer surfaces of the resistors. To reduce these leakage currents the resistors are immersed in tanks of oil.

However, the extremely high voltage between the input and output leads cause movement of the oil and this movement produces changes in electrostatic and electromagnetic fields existing in the oil around the resistor, and these changes in the electrostatic and electromagnetic fields create changes in the value of the resistor which are known as noise, and this noise changes the value of the voltage between the input and output value of the resistor.

We have invented a high voltage resistor which is immersed in oil and in which movement of the oil surrounding the resistor is greatly reduced as compared to similar conventional resistors.

In the accompanying drawings, we have illustrated two presently preferred embodiments of the invention in which:

FIGURE 1 is a vertical section through one embodiment of our invention;

FIGURE 2 is a vertical section through a second embodiment of our invention; and

FIGURE 3 is a partial vertical section of another embodiment of our invention.

Referring to FIGURE 1 of the drawing, a resistor **1** having a high resistance value is placed in a tank **2** which is grounded and filled with insulating oil **3** and which is

made of iron, copper, aluminum, etc. A cylinder **4** of electrically conducting material such as iron, copper, aluminum, etc. surrounds the resistor. A corrugated baffle **5** of insulating material extends between the resistor **1** and the cylinder **4**. Discs **13***a* and **13***b* of insulating material support and position the resistor **1**, the cylinder **4** and the baffle **5** with respect to each other as shown in FIGURE 1.

A high voltage input lead **9** extending through a bushing **10** of insulating material which extends through the top of the tank **2** is connected to one end of the resistor **1** through wire **11**.

An insulator **12** surrounds the wire **11** and supports the insulating disc **13***a*.

An output lead **14** is connected to the other end of the resistor **1** and extends through the oil **3** in the tank **2** out through the top of the tank. The lead **14** has a grounded shield **8** to reduce noise.

Two capacitors **6** and **7** have a common connection with the cylinder **4**. The other lead of the capacitor **6** is connected to the input wire **11**, and the other lead of capacitor **7** is grounded by connection to the tank **2**.

By reason of the connections just described the voltage between the resistor **1** and the cylinder **4** is approximately one half that existing between the resistor and the tank **2**. The movement of oil between the resistor and the cylinder is proportionately reduced and changes in electrostatic and electromagentic fields induced by movement of oil are correspondingly reduced. The baffle **5** further reduces the movement of oil.

FIGURE 2 shows a second embodiment of our invention which is the same as FIGURE 1 except that a second cylinder **15** of conductive material is positioned in the tank **2** around the first cylinder **4**. Voltage is applied to the cylinder **15** through capacitors **16** and **17** and lead **18** in the same manner that a voltage is applied to the cylinder **4**.

Since cylinders **4** and **15** are at the same potential, there 's no movement of the oil between them. Therefore, no changes in electrostatic and magnetic fields around the cylinder **4** are induced and noise is reduced to zero.

FIGURE 3 shows a partial vertical section of another embodiment of our invention in which a cylindrical resistance material **19**, which is, readily available on the market is used instead of the electrically conducting material **4** in FIGURES 1 and 2. In this case, the input lead **18** is connected directly to the upper end of the cylinder and the lower end of the cylinder is grounded by connection with the tank (not shown). No capacitor is used. If cylinder **19** is made of a suitable resistance material, the potential drop across the resistor and the cylinder can be equalized, thus enabling the potential gradient of the space between the resistor and the cylinder to be almost zero in the radial direction. As a result, corona discharge and oil turbulence are almost eliminated.

In addition to achieving voltage stability, our resistor has the further advantage that for a given capacity resistor the size of the oil tank can be reduced. It is not necessary to make the tank large in order to obtain a high value of resistance for the oil.

While we have described certain presently preferred embodiments of our invention, it is to be understood that they may be otherwise embodied within the scope of the appended claims.

We claim:

1. A high voltage resistor comprising,
   (A) a resistor;
   (B) input and output leads connected to said resistor;
   (C) a tank containing oil in which said resistor is positioned and through which said leads extend;
   (D) an electrically conductive cylinder positioned in said oil and surrounding said resistor;

(E) a baffle positioned between the resistor and the cylinder to restrain movement of oil between the resistor and cylinder; and

(F) means for applying a voltage to said cylinder which is less than the voltage between said input and output leads.

2. A high voltage resistor as described in claim 1 in which the means for applying voltage to said resistor comprises two capacitors, each capacitor having a lead connected to said cylinder, the other lead of one of said capacitors being connected to the input lead and the other lead of the other capacitor being connected to ground.

3. A high voltage resistor as described in claim 1 and having electrically insulating means for closing the ends of said cylinder to fully enclose said resistor.

4. A high voltage resistor as described in claim 1 and having a second cylinder surrounding the first cylinder and means for applying a voltage to said second cylinder which is less than the voltage between said input and output leads.

5. A high voltage resistor as described in claim 1 and having a second cylinder surrounding the first cylinder and means for applying a voltage to said second cylinder which is equal to the voltage applied to the first cylinder.

6. A high voltage resistor as described in claim 4 and having electrically insulating means to close the ends of both cylinders and fully enclose said resistor.

7. A high voltage resistor as described in claim 4 in which the means for applying a voltage to the second cylinder comprises two capacitors, having a common connection with said second cylinder, one of said capacitors being connected to the input lead and the other of said capacitors being connected to ground.

8. A high voltage resistor comprising,

(A) a resistor;

(B) input and output leads connected to said resistor;

(C) a tank containing oil in which said resistor is positioned and through which said leads extend;

(D) a cylinder of resistance material positioned in said tank and surrounding said resistor;

(E) a baffle positioned between the resistor and the cylinder to restrain movement of oil between the resistor and the cylinder; and

(F) leads for connecting said cylinder to said input lead and to ground.

9. A high voltage resistor as described in claim 8 and having electrically insulating means for closing the ends of said cylinder to fully enclose said resistor.

10. A high voltage resistor as set forth in claim 8 and having a second cylinder surrounding the first cylinder, means for applying a voltage to said second cylinder and electrically insulating means to close the ends of both cylinders and fully enclose said resistor.

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U.S. Cl. X.R.

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