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ELECTRIC DEVICE WITH ELECTRON BARRIER

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This invention relates to a means for enabling the full electric strength of an insulating medium of an electrical device to be realized, without loss due to local surface weaknesses. Its application is to electric cables, condensers, and insulating windings of other electric devices; more particularly it consists of a sheet of novel material applied to the surfaces of the insulating medium.

The characteristics of this electron barrier are: (1) ability to suppress ionization; (2) high permeability to gases so as to permit thorough and efficient drying of the insulating medium; (3) high permeability to liquids so as to permit thorough and efficient impregnation of the insulating medium; (4) chemical inertness with respect to adjacent materials with and without applied electric stress; (5) absence of gas adsorption so as to preclude the possibility of gas evolution under electric stress.

It is well known that the energy of electrical discharge from metallic conductors into dielectrics may be greatly reduced by interposing, between the metal and dielectric, a layer which possesses high energy absorption characteristics by virtue of high dielectric loss.

I have discovered that this desirable result may be obtained by employing a layer of material which exhibits a high work function, the work function being a measure of the electric energy required to detach electrons. An electron barrier consisting of a layer of material which exhibits a high work function represents a far more efficient means than the former of obtaining the benefits of this electrical phenomenon, because it accomplishes the ionization suppressing function through a low loss impedance rather than through a high loss resistance. The practical effect of such a layer is to suppress or reduce the destructive energy of electric discharges which occur in dielectrics at conductor surfaces, particularly in vacuous pockets, by substantially restricting the charging current of an electric device to a low loss condensive path. This, of course, increases the life of the dielectric, particularly if subjected to occasional over voltages.

Work function is measured in volts, these volts representing the potential level that must be attained to produce electron emission in vacuo. For metals or carbon the value is between 3 and 6 volts, whereas for good insulation, it is substantially infinite up to the breakdown point.

The foregoing and other features of my invention will now be described in connection with the accompanying drawing forming part of this specification in which I have represented an

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electric device embodying my electron barrier in its preferred form, after which I shall point out in the claims those features which I believe to be new and of my own invention.

In the drawing:

Figure 1 is a part section showing my invention as applied to an electric device.

Figure 2 is a graph of a charging current wave of an electric device in which my invention is not used.

Figure 3 is a similar graph of a charging current wave of an electric device in which my invention is used.

Figure 4 is a curve showing how drying time of insulation may be affected by the use of my invention.

In the carrying out of my invention I place my electron barrier 11 between the insulation 12 and the conductors 13.

While the structure details of the several electric devices in which my electron barrier is employed in the carrying out of my invention vary greatly, the electron barrier is always interposed between the conductor and its associated insulation.

For the purposes of this invention an intermediate value of work function, several times as great as that for metals, is required, since the aim is to reduce and equalize electron emission rather than to dam it. Due to experimental difficulties in determining work function in terms of volts, I have adopted a more practical procedure using a cathode ray oscillograph. Comparing, by this means, the high energy content of discharge from metal. with that from my electron barrier, I find the latter is markedly less. Thus the oscillograms of Figures 2 and 3 were obtained by photographing the 60 cycle charging current waves, as reproduced by a cathode ray oscillograph. The oscillogram shown in Figure 2 is typical of the electric discharge across a gaseous void between a highly conducting metal conductor and a high resistivity, low-power-factor insulation. The oscillogram shown in Figure 3 is similarly typical of the discharge across a gaseous void between a highly conducting metal conductor covered with my electron barrier and the same high resistivity, low-power-factor insulation. It will be noted that, in the construction without the electron barrier, both the peak values and the R. M. S. value of the discharge are many times those characteristic of the design which does possess the electron barrier. The oscillogram in Figure 2 shows that this type of discharge, not only contains more energy as