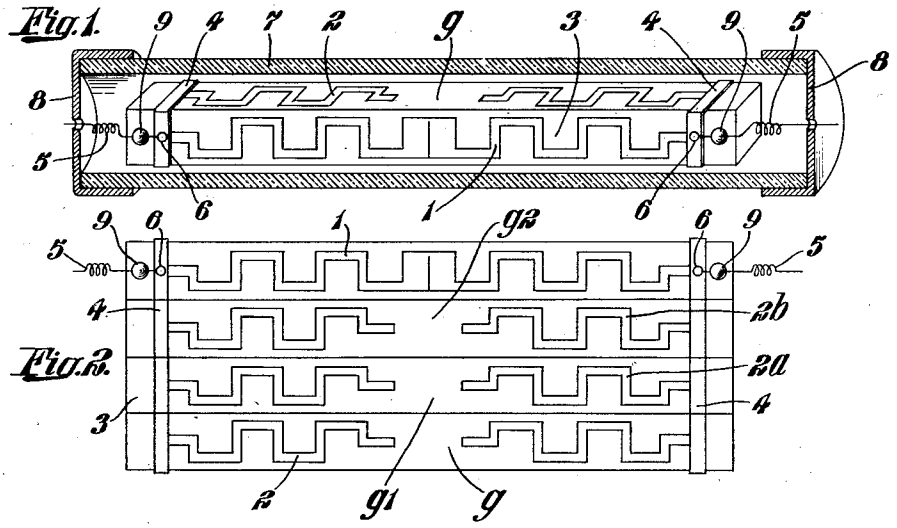
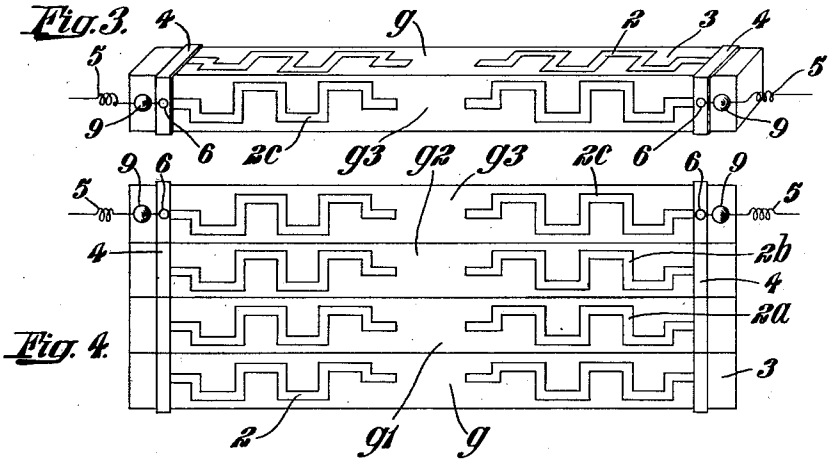
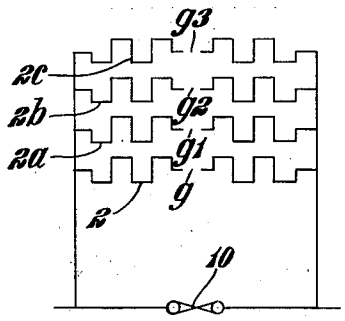
June 30, 1942. E. BABLER 2,288,428

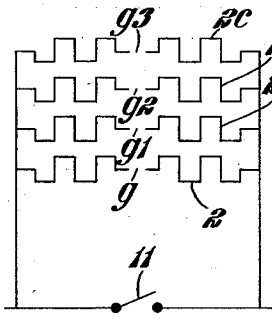
DEVICE FOR PROTECTING ELECTRICAL APPARATUS FROM VOLTAGE SURGES

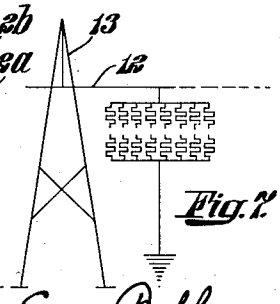
Filed June 5, 1940











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DEVICE FOR PROTECTING ELECTRICAL APPARATUS FROM VOLTAGE SURGES

Egon Babler, Brighton, England

Application June 5, 1940, Serial No. 338,856
In Great Britain June 20, 1939

8 Claims. (Cl. 200—115)

This invention relates to an improved device for protecting electrical apparatus from voltage surges.

One object of the invention is the provision of an improved device for minimising voltage surges generated in any electrical circuit.

Another object is the provision of an improved device for use in connection with circuit interrupters in which the controlled circuit is inductive, in order to minimise the voltage surges consequent upon the interruption of such inductive circuit.

Another object is the provision of an improved device for use in connection with overhead cables to minimise the voltage surges caused, for example, by lightning discharges.

Other objects and advantages will appear hereinafter.

The invention consists broadly of an electrically conductive path with a gap in it, said path being connected between two points across which a high potential difference is likely to be developed owing to a voltage surge, the gap being such that an arc will strike across it before the potential difference rises to a dangerous point and the conductive path being adapted to be immediately destroyed by said arc.

In order that the invention may be the more clearly understood a number of devices in accordance therewith will now be described, reference being made to the accompanying drawing wherein:

Figure 1 is a perspective view of a surge protecting device in combination with a circuit interrupter of a type where a thin film of electro-conductive material is secured to a base of electro-non-conductive material, without the presence of organic matter between said film and said base, the casing being shown in section.

Figure 2 is a developed view of said surge protecting device and circuit interrupter, the casing being omitted.

Figure 3 is a perspective view of a surge protecting device for use with some outside apparatus, the casing being omitted.

Figure 4 is a developed view of the same.

Figure 5 is a diagrammatic view of the device shown in Figures 3 and 4 when used for protecting the circuit of an outside circuit interrupter of the fuse type.

Figure 6 is a diagrammatic view of the device shown in Figures 3 and 4 when used for protecting the circuit of an outside circuit interrupter of the switch type.

Figure 7 is a diagrammatic view of two of the devices shown in Figures 3 and 4 when used together for protecting the circuit of an overhead cable.

Referring to Figures 1 and 2, these illustrate an embodiment of the invention as applied to a circuit interrupter 1 of the type above referred to in my application Serial No. 223,033 and described and claimed in Letters Patent No. 2,263,752 granted to me under date of November 25, 1941. These circuit interrupters operate upon overload to interrupt the circuit with great rapidity, and, if the controlled circuit is inductive, this gives rise to transient voltage surges of very high value. This may cause arcing across parts of the apparatus outside said circuit interrupter, and such arcing may have disastrous consequences to the apparatus.

In order to protect the apparatus against these voltage surges, I connect, in parallel with the circuit interrupter 1, a surge protector in the form of a metallic layer 2 which may be identical with that constituting the circuit interrupter except that it is formed with a gap *g* of, say, one inch. The effect of this is that, as soon as the voltage surge reaches a sufficiently high value, an arc strikes across this gap *g*. This instantly checks the voltage rise and effects the destruction of the said metallic layer 2 thereby interrupting the arc. The rapid interruption of this arc may generate a second voltage surge of less violence than the first, and to check this second surge a second surge protector in the form of a metallic layer 2*a* with a gap *g*1 may be provided also in parallel with the circuit interrupter 1 and identical with the first surge protector. The second surge protector will not come into operation until after the first is destroyed. In some cases it may be desirable to employ one or more additional surge protectors such as the layer 2*b* with the gap *g*2. Gaps of different width may be used for the different surge protectors.

In construction, the circuit interrupter 1 together with the surge protectors may be constructed on a base 3 consisting of a square section rod of alumina, say seven or eight inches in length, the circuit interrupter proper 1 being applied to one face of the rod and the three layers 2, 2*a*, 2*b* being applied on the other three faces. As in the type of interrupter above referred to, the layer constituting the circuit interrupter 1 is so thin that it is destroyed by arcing at less than the rupturing current. The layers 2, 2*a*, 2*b* constituting the surge protectors may be of the same thickness. The application of the layers

1 and 2, 2a, 2b may be effected by coating and firing a metallic layer which may consist of platinum, iridium, silver, gold or any other metal or alloy which lends itself to the purpose, upon the electro-conductive base, or by cathode sputtering, condensation of evaporated metals in vacuum, chemical deposition or other known methods. The circuit interrupter 1 may take various forms for controlling the conductivity of the electro-conductive film and its total length may be increased by the layer following a zig-zag path. The layers 2, 2a, 2b of the surge protectors also preferably follow a zig-zag path, the gaps g, g1, g2 being about mid-way of the length as shown.

Common terminals are provided at the two ends of the rod 3, said terminals consisting, in a manner similar to those described in said prior specifications, of electro deposited layers 4 of, say, copper encircling said rod 3 near its two ends, and covering the ends of the layers 1, 2, 2a, 2b. Connecting wire ends 5 are then soldered at 6 on to these copper layers 4 and the whole device is mounted in a cylindrical insulating tube 7 having terminal end caps 8 and filled with sand, said device being supported in said container by means of said wires 5 being secured to the end caps as shown, the connection of said wires to the device being rendered the more secure by means of small portions of cement 9 securing said wires to the rod 3, all as described in said prior specifications.

The rod 3 should be of inorganic material and preferably no inorganic material is associated with the layers, except possibly a protective coating of varnish upon the conductor film.

The invention may also be applied to any other form of circuit breaker or under any conditions where a spark gap may be an advantage. Thus, referring to Figures 3 and 4, these illustrate an embodiment of the invention adapted for use in connection with any outside apparatus likely to cause the generation of voltage surges in the circuit. The device illustrated in these figures is the same as that illustrated in Figures 1 and 2 except that the circuit breaker 1 is dispensed with and its place taken by a fourth surge protector consisting of a layer 2c with a gap g3. Otherwise the same references as in Figures 1 and 2 are applied to similar parts.

Figure 5 shows diametrically the device illustrated in Figures 3 and 4 connected in parallel with an outside fuse 10, and Figure 6 shows diametrically said device illustrated in Figures 3 and 4 connected in parallel with an outside circuit breaker 11 of the switch type. When the fuse is blown or the circuit breaker interrupted the surge protectors will function in the same way as heretofore described in connection with Figures 1 and 2.

Further the invention may be employed for protecting against voltage surges in devices other than circuit interrupters. For example in overhead cables carried by pylons, it sometimes happens that very high voltage surges are induced in the cables by lightning discharges, and these may be so high as to cause a break down in the insulators supporting the cables. One or more surge protectors as heretofore described could, at each of a number of points along a cable (say in the neighbourhood of the insulators), be connected between the cable and the earth, and, upon the voltage surge rising sufficiently high, such surge protector or protectors would function in precisely the same way as heretofore described, the difference residing only in the manner in which the surge is generated. Figure 7 illustrates diagrammatically an overhead cable 12 supported by a pylon 13 and having two of the devices illustrated in Figures 3 and 4 connected in parallel between said cable and the earth at a point near the pylon.

Although in the accompanying drawing a series of surge protectors forming a group have always been illustrated, it should be clearly understood that, in many cases, one single surge protector is all that is necessary.

What I claim and desire to secure by Letters Patent is:

1. A device for protecting electrical apparatus from voltage surges embodying therein an electro-non-conductive base, electric terminals carried by said base, layers of electro-conductive material carried by said base, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said layers being such as to be immediately destroyed in the event of arcing across said gap.

2. A device for protecting electrical apparatus from voltage surges embodying therein an electrical conductor, a circuit interrupter in the path of current flowing through said conductor, an electro-non-conductive base, electric terminals carried by said base connected with said electrical conductor upon opposite sides of said circuit interrupter, layers of electro-conductive material carried by said base, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said layers being such as to be immediately destroyed in the event of arcing across said gap.

3. A device for protecting electrical apparatus from voltage surges embodying therein an electrical conductor, an electro-non-conductive base, electric terminals carried by said base, a circuit interrupter comprising a thin metallic layer secured directly to said base and having the opposite ends thereof connected with said terminals respectively, said electric terminals being connected with said electrical conductor upon opposite sides of the layer of material forming said circuit interrupter, additional layers of electro-conductive material carried by said base, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said last named layers being such as to be immediately destroyed in the event of arcing across said gap, and the dimensions of the layer in said circuit interrupter being such as to be destroyed in the event of overload.

4. A device for protecting electrical apparatus from voltage surges embodying therein an electro-non-conductive base, electric terminals carried by said base, thin metallic layers of electro-conductive material secured directly to said base without the aid of organic matter, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said layers being such as to be immediately destroyed in the event of arcing across said gap.

5. A device for protecting electrical apparatus from voltage surges embodying therein an electro-non-conductive base, electric terminals carried by said base, layers of electro-conductive material carried by said base, said layers extending in a zigzag path whereby the length of said

layers is greater proportionately to the length of said base, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said layers being such as to be immediately destroyed in the event of arcing across said gap.

6. A device for protecting electrical apparatus from voltage surges embodying therein an electrical conductor, an electro-non-conductive base, electric terminals carried by said base, a circuit interrupter comprising a thin metallic layer secured directly to, extending in a zigzag path from end to end thereof and having the opposite ends thereof connected with said terminals respectively, said electric terminals being connected with said electrical conductor upon opposite sides of the layer of material forming said circuit interrupter, additional layers of electro-conductive material carried by said base, said layers extending in a zigzag path whereby the length of said layers is greater proportionately than the length of said base, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said last named layers being such as to be immediately destroyed in the event of arcing across said gap, and the dimensions of the layer in said circuit interrupter being such as to be destroyed in the event of overload.

7. A device for protecting electrical apparatus from voltage surges embodying therein an electro-non-conductive base having a plurality of facets extending lengthwise thereof, electric terminals carried by said base, layers of electro-conductive material carried by different facets of said base, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said layers being such as to be immediately destroyed in the event of arcing across said gap.

8. A device for protecting electrical apparatus from voltage surges embodying therein an electrical conductor, an electro-non-conductive base having a plurality of facets extending lengthwise thereof, electric terminals carried by said base, a circuit interrupter comprising a thin metallic layer secured directly to one of the facets of said base and having the opposite ends thereof connected with said terminals respectively, said electric terminals being connected with said electrical conductor upon opposite sides of the layer of material forming said circuit interrupter, additional layers of electro-conductive material carried by other facets of said base, one end of each layer being connected with an electric terminal and the other ends of said layers being spaced apart to form a gap, the dimensions of said last named layers being such as to be immediately destroyed in the event of arcing across said gap, and the dimensions of the layer in said circuit interrupter being such as to be destroyed in the event of overload.

EGON BABLER.