

Dec. 15, 1942.

H. O. STOELTING

2,305,577

RESISTOR

Filed Aug. 4, 1940

Fig. 1

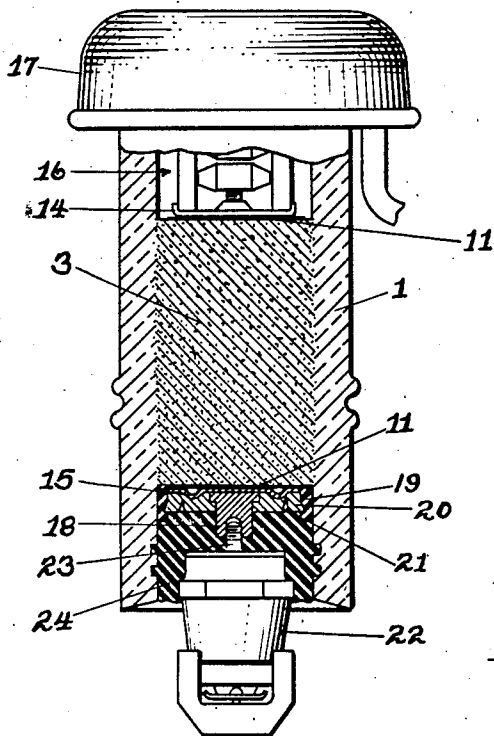


Fig. 2

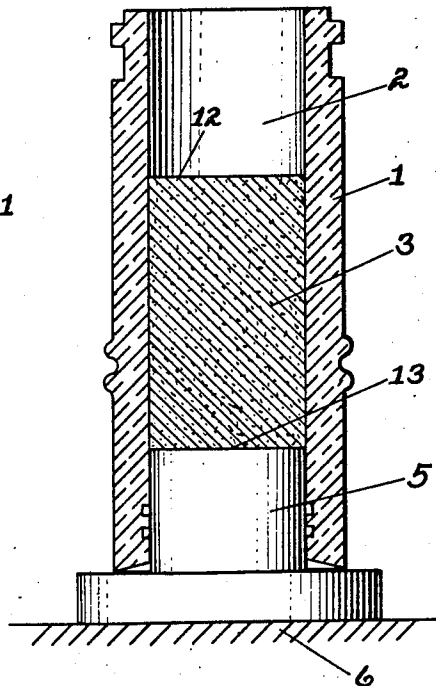
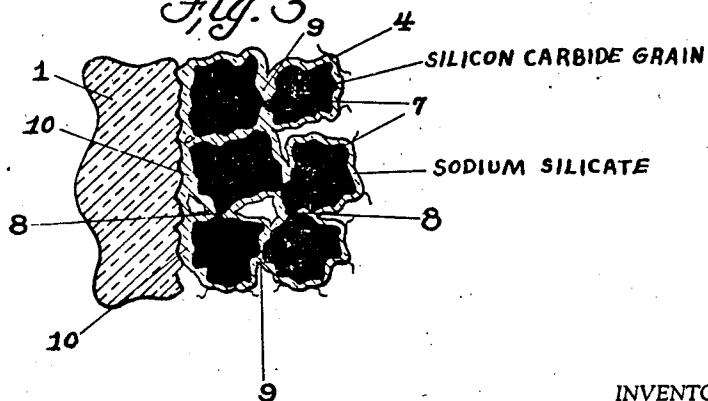


Fig. 3



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## RESISTOR

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7 Claims. (Cl. 201-763)

This invention pertains to lightning arresters of the type which comprises a spark gap in series with a resistor of silicon carbide, or the like, enclosed within a housing of glass or porcelain.

As is well known, the function of the silicon carbide resistor is to effect extinction of the arc occurring across the spark gap following a surge discharge—which arc, once started by the surge, might detrimentally be maintained by the power current in the absence of some effective counter provision.

Failures of lightning arresters of the above-mentioned type have heretofore been quite common as a result of flashovers occurring between the inner surface of the housing and the mass of silicon carbide resistor material—which phenomenon frequently destroys the further usefulness of the arrester and may even cause the housing thereof to rupture. The object of this invention is to prevent such flashovers and thus avoid consequent impairment or destruction of the arrester.

Prior to the present invention, lightning arrester resistors have been made of comminuted silicon carbide bonded with sodium silicate (water glass) and converted to a solid state by dehydration or substantial dehydration; and efforts have been made to prevent flashover by painting the exteriors of such bodies with non-conductive materials such as shellac and, alternatively, by filling the space between the resistor and interior of the housing with various non-conductive compounds as disclosed, for example, in Hill United States Patent 2,018,672 and Kellogg United States Patent 2,050,334. According to my observations and those of other experts in the art whom I have consulted, none of the expedients above referred to have proved highly successful in preventing flashovers under conditions ordinarily to be expected; but, I have found through exhaustive tests in the laboratory, confirmed by practical operating experience, that flashovers can definitely and consistently be prevented by firmly bonding the resistor element to the interior of the housing with sodium silicate; and by "bonding" I mean effecting an actual adherence of the sodium silicate bonding agent to the housing wall so that there remains no infinitesimal space between the resistor and housing along which a flashover can occur.

The greatly improved performance of lightning arresters in accordance with the present invention is the proximate result of the manufacturing method employed which brings about a bond between the resistor and housing which apparently

is chemical in nature and not merely a physical adhesion; and this successful method consists in introducing a wet mixture of silicon carbide and sodium silicate into the housing and tamping the same while wet and plastic into the space it is intended to occupy, in intimate contact with the housing, and then dehydrating or substantially dehydrating the mass by baking—which method brings about an attachment between the resistor and housing which is inseparable except by dissolving the sodium silicate bonding agent.

The invention will now be described in detail with reference to the accompanying drawing.

In the drawing:

Fig. 1 is an elevational view, partly in section, showing an improved lightning arrester.

Fig. 2 is a longitudinal sectional view of a housing illustrating the manner in which the mass of resistor material and sodium silicate binder is put in place.

Fig. 3 is a greatly enlarged fragmentary view showing the bonded relationship of the valve material and the housing.

Like parts are designated by the same reference numerals throughout the several views.

Fig. 1 shows a lightning arrester including a tubular cylindrical housing 1, made of porcelain, glass, or other suitable insulating material and having a bore 2 extending longitudinally throughout the length thereof.

Numeral 3 indicates the resistor element which comprises a mass of comminuted silicon carbide or other suitable material having an average grain size of the order of 40 mesh and held together as a solid mass by a binder 4 of sodium silicate—see Fig. 3.

It is sometimes found desirable to add to the sodium silicate binder a small amount of reducing agent such as potassium permanganate to prevent excessive evolution of hydrogen gas which might otherwise interfere with proper bonding of the comminuted silicon carbide. A water repellent, such as zinc oxide or clay may also be added to the mixture of silicon carbide and water glass.

Before the housing 1 is packed with the mixture of valve material and water glass, the housing is mounted on a cylindrical plug 5 extending a predetermined distance into the bore 2 of the housing 1. The plug is supported in any suitable manner at 6.

A predetermined amount of the prepared valve material is packed into the housing 1 against the plug 5, by any suitable tamping device, not

shown, within a predetermined distance from the upper end of the housing.

After the mixture is packed in the housing, the latter is removed from the plug and placed in an oven for drying—substantially all of the moisture of the water glass being thus removed.

Fig. 3 shows approximately the bonding relationship of the silicon carbide grains 7 with respect to each other and with respect to the housing 1 after completion of the drying operation.

It may be noted that each silicon carbide grain is firmly held within a film or layer of sodium silicate as indicated at 4, and point contact is made at places between the grains as shown at 8.

It is observed that each of the grains is united or bonded by the sodium silicate to the adjacent grains as indicated at 9, thereby forming a homogeneous mass.

It is still further shown that the homogeneous mass of valve material is bonded by the sodium silicate to the housing 1 as shown at 10.

By providing a predetermined amount of zinc oxide, clay, or other suitable material in the bonding agent, the valve material after being treated by heating has a water repellent characteristic. This water repellent characteristic eliminates the necessity of immediately sealing the unit after the heating operation, which would otherwise be necessary in order to prevent the absorption of moisture by the resistor element.

It also locks in the resistor element any moisture remaining therein after the heating operation. Should the moisture be permitted to escape after the arrester goes into service, the various metal parts of the arrester would become damaged by corrosion, thereby interfering with the proper operation of the arrester.

It may also be noted that the resistor element is protected from moisture during service should the sealing portions of the arrester begin to leak.

After the drying operation a thin film of copper 11, commonly used in the art, is sprayed in a well known manner on the exposed end surfaces 12 and 13 of the resistor element 3 which provides a better electrical contact between the resistor element and the terminal elements 14 and 15 mounted thereon.

A spark gap 16 is mounted on the upper end of the resistor material 3, making contact therewith through the sprayed copper surface 11 and the terminal plate 14.

The upper end of the housing 1 is sealed against moisture by the cap 17 more fully described and shown in the application of Ralph H. Earle, Serial Number 269,065, filed April 21, 1939, for an Isolator.

The lower end of the resistor element 3 is sealed by means of the terminal plate 15 in contact against the film of copper 11, an anchor nut 18 mounted in contact with the plate 15, a circular rubber gasket 19, and a metal alloy 20, such as tin and lead, poured around the nut 18 and within the rubber gasket as shown. After the metal has cooled it is forced outwardly at 21, against the rubber gasket, by an appropriate wedging tool, not shown, thereby providing a positive sealing against moisture.

A gap device 22, more fully described and shown in the above noted application, is secured to the nut 18 by the screw 23, and a suitable sealing compound 24 is packed around the gap device within the lower end of the housing 1.

From the foregoing description it is apparent that the objects of this invention have been at-

tained by providing an overvoltage protective device comprising a resistor element united with the housing to form a homogeneous mass, thereby increasing the life usefulness of the device.

I claim:

1. An over-voltage protective device comprising a housing of glass or porcelain having a bore, and a resistor fitting said bore and firmly bonded thereto by a solid, non-plastic, substantially desiccated, non-conductive binder so as to form a unified structure with said housing, said resistor constituting a partition completely obstructing said bore and consisting of a solid, sintered, substantially desiccated, non-plastic, homogeneous, compact mass comprised of many discrete portions of valve material intimately bonded together with a substantially desiccated, non-conductive binder which permeates said mass, said valve material being characterized by high impedance when subjected to relatively low voltage and relatively low impedance when subjected to relatively high voltage.

2. An over-voltage protective device comprising a housing of glass or porcelain having a bore, and a resistor fitting said bore and firmly bonded thereto by a solid, non-plastic, substantially desiccated, non-conductive, silicate binder so as to form a unified structure with said housing, said resistor constituting a partition completely obstructing said bore and consisting of a solid, sintered, substantially desiccated, non-plastic, homogeneous, compact mass comprised of many discrete portions of valve material intimately bonded together with a substantially desiccated, non-conductive silicate binder which permeates said mass, said valve material being characterized by high impedance when subjected to relatively low voltage and relatively low impedance when subjected to relatively high voltage.

3. An over-voltage protective device comprising a housing of glass or porcelain having a bore, and a resistor fitting said bore and firmly bonded thereto by a solid, non-plastic, substantially desiccated, non-conductive binder so as to form a unified structure with said housing, said resistor constituting a partition completely obstructing said bore and consisting of a solid, sintered, substantially desiccated, non-plastic, homogeneous, compact mass comprised of comminuted silicon carbide intimately bonded together with a substantially desiccated, non-conductive binder which permeates said mass.

4. An over-voltage protective device comprising a housing of glass or porcelain having a bore, and a resistor fitting said bore and constituting a partition therein completely obstructing said bore, said resistor comprising a compact mass of comminuted silicon carbide, the discrete particles of which are intimately bonded together by a binder consisting principally of sodium silicate which binder permeates said mass and functions also to bond said mass firmly to the surface of said bore, said mass being a non-plastic, substantially desiccated solid.

5. The method of producing an intimate bond between a resistor of the class described and a surface defining the bore of a glass or porcelain housing for said resistor, which bond is substantially proof against flashover between said bore surface and said resistor and wherein said resistor comprises a solid, non-plastic, compact mass consisting of many discrete portions of valve material intimately bonded together by a non-conductive binder which permeates said mass and contacts said bore surface, said method consist-

ing in preparing a wet, pliable, intimate mixture of said valve material and said binder, in liquid form, compacting a mass of said mixture in place in said bore so as to effect an intimate contact between the mass of said wet mixture and the surface defining said bore while at the same time shaping said mass into a partition completely obstructing said bore and thereafter baking said mass together with said housing until said mass is sintered and substantially desiccated.

6. The method of producing an intimate bond between a resistor of the class described and a surface defining the bore of a glass or porcelain housing for said resistor, which bond is substantially proof against flashover between said bore surface and said resistor and wherein said resistor comprises a solid, non-plastic, compact mass of comminuted silicon carbide bonded together with a binder consisting principally of a silicate which permeates said mass and contacts said bore surface, said method consisting in preparing a wet, pliable, intimate mixture of comminuted silicon carbide and a liquid silicate, compacting a mass of said mixture in place in said bore so as to effect an intimate contact between the mass of said wet mixture and the surface defining said bore while at the same time shap-

ing said mass into a partition completely obstructing said bore and thereafter baking said mass together with said housing until said mass is sintered and substantially desiccated.

7. The method of producing an intimate bond between a resistor of the class described and a surface defining the bore of a glass or porcelain housing for said resistor, which bond is substantially proof against flashover between said bore surface and said resistor and wherein said resistor comprises a solid, non-plastic, compact mass of comminuted silicon carbide bonded together with a binder consisting principally of sodium silicate which permeates said mass and contacts said bore surface, said method consisting in preparing a wet, pliable, intimate mixture of comminuted silicon carbide and liquid sodium silicate, compacting a mass of said mixture in place in said bore so as to effect an intimate contact between the mass of said wet mixture and the surface defining said bore while at the same time shaping said mass into a partition completely obstructing said bore and thereafter baking said mass together with said housing until said mass is sintered and substantially desiccated.

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