May 22, 1945. W. G. ROMAN 2,376,815

MOLDED LIGHTNING-ARRESTER BLOCKS

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Fig. 1.

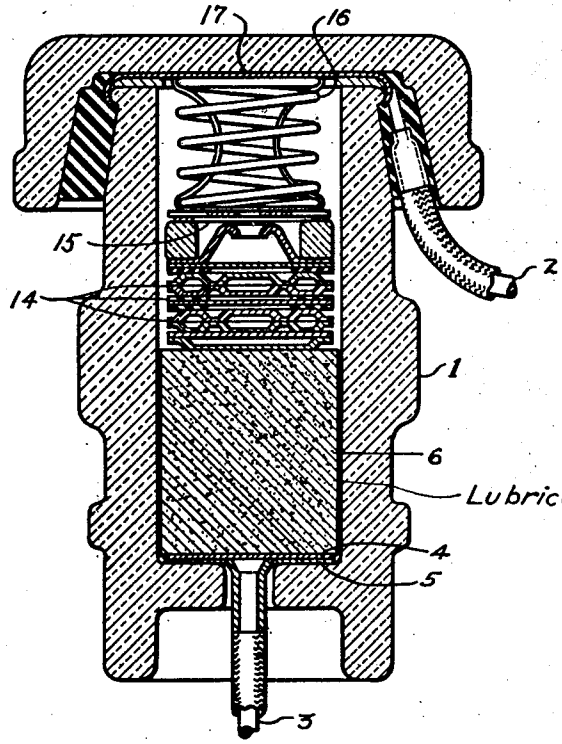
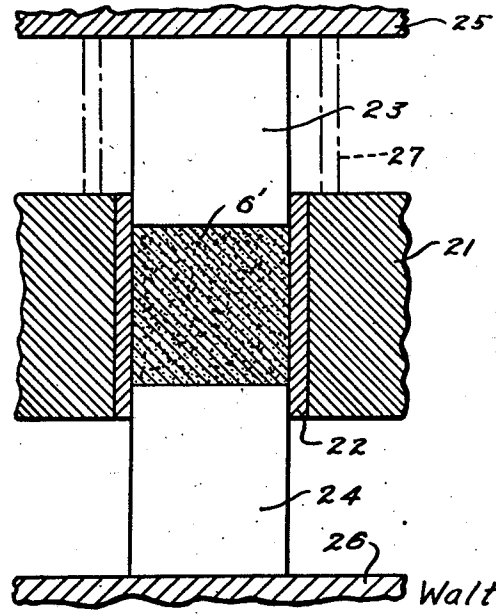


Fig. 2.



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MOLDED LIGHTNING-ARRESTER BLOCK

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8 Claims. (Cl. ~~201—76~~) 252-490

My invention relates to hard, molded compositions, and it has particular relation to high-pressure-molded compositions of this nature, having special electrical characteristics which adapt them for use as the valve-element of a lightning arrester.

Heretofore, lightning-arrester blocks have been made from silicon-carbide crystals, or other particulate semi-conducting material, and a relative non-conducting binder. Formerly, this binder was commonly clay, but more recently, a sodium-silicate binder, or water-glass, has been found to give better results, from the standpoint of desirable lightning-arrester characteristics. In either case, the mixture had to be molded, under considerable pressure, in a hydraulic press; then it had to be forced out of the mold by the application of hydraulic pressure; and then the molded blocks had to be subjected to a heat-treatment for hardening the binder. When the binder was a clay, the heat-treatment consisted of a firing-operation at a high temperature hot enough to vitrify the clay so as to make it a binder. When the binder is sodium silicate, the heat-treatment consists in the use of only a moderate oven-temperature, of the order of 175° C., to dry the excess-moisture out of the mixture and set the sodium-silicate binder.

Since the silicon carbide is a highly abrasive material, the operation of forcing the compressed blocks out of the mold resulted in considerable wear on the mold, even though a hardened steel liner was utilized therein, and it also resulted in occasional damage to the arrester-blocks, in getting them out of the mold.

The first object of my present invention was to facilitate the removal of the tightly compressed block from the mold, by incorporating, in the mixture of powdered raw-materials of the block, a small amount of a relatively non-conducting lubricating-material, which was thoroughly mixed in with the ingredients of the block, and which materially reduced the amount of pressure necessary to press the compressed blocks out of the mold, and to considerably reduce the damage, both to the mold and to the blocks.

It was unexpectedly found, however, that the added lubricating-material not only made it possible to utilize lower pressures, in compressing the material in the mold, and still obtain the necessary electrical characteristics and life of the arrester, but also resulted in superior, and more uniform electrical properties, less critically affected by unavoidable variations in the course of the shop-practice, with respect to all of the electrical properties of the finished product, besides making the block-length come out more uniformly—with smaller variations dependent upon the precise percentage of water in the mixture during the molding operation, or with respect to the precise molding-pressure. By the addition of the lubricating ingredient, I was enabled to reduce the molding-pressure, in a typical block, from 38 tons to 20 tons, obtaining a block having a lower discharge-voltage, which was practically unaffected by minor shop-variations in moisture-content and molding-pressure, besides also having a lower, and more uniform cut-off voltage, and an increased maximum surge-current discharge-capacity.

An unexpected, but perhaps a most important effect of my invention, is therefore to improve the characteristics of the block and to make these characteristics less critically affected by unavoidable minor variations in the shop-practice. While these results and effects were not at first anticipated, I believe, now, that they are a result of the lower molding-pressure which was needed in order to compress the particles into the close juxtaposition necessary for successful binding and desirable electrical properties, and this lower molding-pressure resulted from the reduced friction in causing the particles to slide over one another, as the material was being compressed in the mold. I believe that the high molding-pressures, previously used, resulted in a considerable amount of crushing of the silicon-carbide particles, into a finer powder than the form in which the material was first put into the mold, so that the resulting molded block had, in it, a larger quantity of fine-grained silicon-carbide particles than would have been expected from the size of powder-particles originally put into the mold. I believe that this crushing of the silicon-carbide particles, due to the excessive molding-pressures heretofore utilized, was sensitively affected by the stiffness of the mix, or its precise water-content, and by the precise amount of molding-pressure. It is also probable that this crushing was a random and unpredictable phenomenon, depending upon the precise hardness of the particular batch of silicon carbide which was being used at any moment, this hardness being subject to a certain amount of uncontrolled commercial variation.

I believe that the reduced crushing, which I obtain with my reduced molding-pressures, is the principal reason for the superior, and more uniform electrical characteristics of the finished block, but whatever may be the cause, I find that

blocks made in accordance with my present invention, have a more uniform and high electrical performance, as compared to blocks without the additional lubricating material.

The use of a reduced molding-pressure also results in considerably less damage to the molds, because of the reduced pressure between the molded block and the side-walls of the mold, during the operation of pressing the block out of the mold, after the compressing operation; and the presence of the lubricating material also contributes to a reduction in the friction and abrasion, during the removal of the blocks, as well as the reduction in the frictional pressure.

With the foregoing and other objects in view, my invention consists in the compositions, parts, combinations and methods hereinafter described and claimed, and illustrated in the accompanying drawing, wherein;

Figure 1 is a vertical sectional view of a lightning arrester embodying my invention in a preferred form, and

Fig. 2 is a diagrammatic sectional view illustrative of the molding operations.

In Figure 1, I show a practical form of embodiment of my invention, in a lightning-arrester utilizing a porcelain housing 1 having a line-terminal 2 entering at the top, and a ground-terminal 3 at the bottom. The porcelain housing 1 is hollow, containing, at its lower end, a terminal-electrode 4 which is properly sealed to the bottom of the housing by a sealing-gasket 5. Disposed over this bottom terminal-electrode 4 is my improved lightning arrester block 6, constituting the valve-element of the arrester, and consisting of a large percent of particles of an abrasive semi-conducting material, preferably a carbide, and preferably consisting essentially of silicon-carbide crystals, held together with a suitable relatively non-conducting binder, said binder being preferably a mixture of sodium silicate and water, known as water-glass.

In accordance with my invention, the block 6 also contains a relatively small admixture of a substantially non-binding and relatively non-conducting lubricant-material, preferably clay, although I might also utilize, as the lubricant, various other materials including soap, oils, greases, etc. The lubricant which is added to the mix should not be in a sufficient quantity to interfere seriously with the bonding properties of the sodium-silicate or other bond which is used. Experience has shown that the product is not very critical as to the precise amount of lubricant which is added, good results having been obtained by the addition of from 1 to 6% of clay to the original mixture, before molding. The mixture is then molded under high pressure, by which I mean a pressure of the order of 20 tons, more or less, and baked, as previously described, the silicon-carbide binder being a material which is hardened at a low baking-temperature which is considerably lower than the firing-temperature which is necessary to vitrify the clay, so that the clay which I have added to the mix is not vitrified into a binder, but retains its clayey characteristics, as a lubricant.

Surmounting the valve-element part 6 of the arrester is a series-gap device which may be of any known or desired form. In the particular form of arrester which I have chosen for illustration, the series-gap device is shown as comprising a quench-gap portion 14, which is, in turn, surmounted by a spark-gap or switching-gap structure 15 which is, in turn, surmounted by a spring 16 which holds the various parts together under pressure, said spring bearing up against a line-terminal electrode 17 at the top of the casing.

In Fig. 2, I have diagrammatically indicated the molding process by which a mixture 6' of powdered silicon carbide, sodium silicate, and clay, with about 6% of water, is placed within a cylindrical steel mold 21 having a cylindrical hardened-steel liner 22, within which the mix 6' is placed. Upper and lower hardened-steel plungers 23 and 24 are then inserted into the mold, with the mix 6' in between, and the plungers 23 and 24 are pressed together in a powerful hydraulic press 25—26, which compresses the material into the desired density, which experience has shown to give the required electrical characteristics for any given batch of silicon carbide, of any given coarseness of grain. Upon the completion of the compressing step, the upper plunger 23 is removed and replaced by a so-called "stripper," which consists of a cylindrical tubular member 27 which presses against the top of the mold 21, and permits the molded material 6' to be pressed out of the mold by the lower plunger 24, upon the application of hydraulic pressure, again. After the compressed cake 6' has been taken out of the mold, it is dried in an oven, and ready for use.

While I have described my invention in a preferred form as to materials, processes, structures and combinations, and while I have explained it in terms of my present theories or beliefs as to its operation, it is to be understood that my invention is not limited to any particular theory or understanding, and that it is susceptible of a fairly wide variety of applications and embodiments, some of which have been outlined hereinabove. I desire, therefore, that my appended claims shall be given the broadest construction consistent with their language.

I claim as my invention:

1. A lightning-arrester valve-element comprising a hard, high-pressure-molded composition, molded at a pressure of the order of 20 tons, more or less, said composition including an abrasive particulate semi-conducting material, a relatively non-conducting binder therefor, and a relatively small quantity of a substantially non-binding and relatively non-conducting lubricating material which has lubricating properties in the finished device.

2. A lightning-arrester valve-element comprising a hard, high-pressure-molded composition, molded at a pressure of the order of 20 tons, more or less, said composition including an abrasive particulate semi-conducting material, a relatively non-conducting sodium-silicate binder therefor, and a relatively small quantity of a relatively non-conducting lubricating material which does not become a strong, hard binding-material at drying-temperatures of a range suitable for hardening the sodium-silicate binder.

3. A lightning-arrester valve-element comprising a hard, high-pressure-molded composition, molded at a pressure of the order of 20 tons, more or less, said composition including an abrasive particulate semi-conducting material, a binder therefor, and a relatively small quantity of clay, the binder being of a material which is capable of being hardened into a binding-material at a temperature lower than the firing-temperature which is necessary to vitrify the clay and thus make it a binder.

4. A lightning-arrester valve-element compris-

ing a hard, high-pressure-molded composition, molded at a pressure of the order of 20 tons, more or less, said composition including an abrasive particulate semi-conducting material, a sodium-silicate binder therefor, and a relatively small quantity of clay which has lubricating properties in the finished device.

5. A molded product having electrical characteristics suitable for lightning-arresters, said product resulting from the process of mixing together silicon-carbide crystals and water-glass, with a small quantity of a non-binding and relatively non-conducting lubricant-material, molding at a molding-pressure of a number of tons, and drying at a moderate oven-temperature of the order of 175° C. until the excess-moisture is driven out and the water-glass binder is set, the lubricant-material remaining lubricating and non-binding after the drying operation.

6. The invention as defined in claim 5, characterized by said lubricant-material being clay.

7. The method of making a molded product having electrical characteristics suitable for lightning-arresters, said method including mixing together silicon-carbide crystals and water-glass, with a small quantity of a non-binding and relatively non-conducting lubricant-material, molding at a molding-pressure of a number of tons, and drying at a moderate oven-temperature of the order of 175° C. until the excess-moisture is driven out and the water-glass binder is set, the lubricant-material remaining lubricating and non-binding after the drying operation.

8. The invention as defined in claim 7, characterized by said lubricant-material being clay.

WALTER G. ROMAN.