

May 9, 1939.

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GLAZED CERAMIC INSULATOR AND THE LIKE

Filed Dec. 20, 1938

Fig.1.

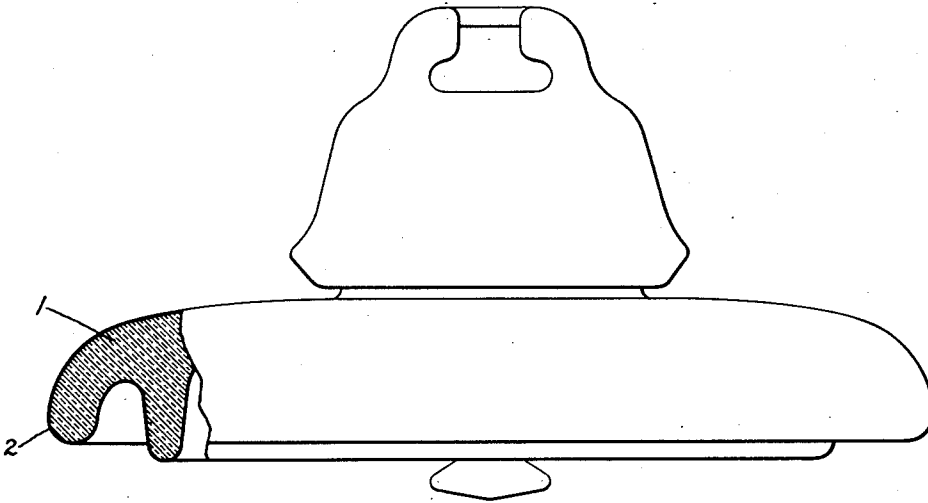
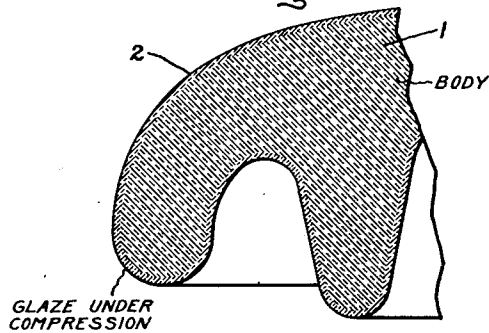


Fig.2.



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UNITED STATES PATENT OFFICE

2,157,100

GLAZED CERAMIC INSULATOR AND THE LIKE

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Application December 20, 1938, Serial No. 246,869

5 Claims. (Cl. 174-209)

This application is a continuation in part of my application for Glazed ceramic insulator and the like, Serial No. 132,130, filed March 20, 1937.

The present invention relates to glazed ceramic insulators. An important application of my invention is to glazed porcelain insulators and it is this application which I have elected to specifically illustrate and describe herein. It is to be understood, however, that my invention is not limited necessarily to insulators made of glazed porcelain as other ceramic materials may be used in carrying out my invention.

It has been known in connection with the manufacture of glazed porcelain insulators that the glaze should "fit" the body of the insulator, i. e., that the glaze and body should be so balanced as to avoid tension in the surface of the insulator, this being desirable in that it was found to add physical strength to the insulator and to tend to avoid crazing. This is discussed in my paper entitled "The Influence of Glaze on Insulator Strength" published in the General Electric Review for March, 1929, vol. 32, page 136.

Since that time, I have carried on extensive research work in connection with glazed porcelain insulators and I have discovered that by utilizing a glaze which has a coefficient of expansion substantially less than that of the body of the insulator, I am enabled to produce insulators substantially stronger physically than those produced heretofore. In instances, I have been enabled to increase the physical strength of insulators 300 to 400%.

In carrying out my invention, I utilize preferably for the body of the insulator a porcelain having a low coefficient of expansion and in connection therewith, I utilize a glaze so compounded that when the body and glaze are fired and cooled together, the glaze will shrink less than the body whereby the glaze is thrown into compression. In this connection, it will be understood that when fired and cooled, the glaze and body combine to a large extent chemically and the glaze becomes an integral part of the body, the two being fused together. In cooling from the point where the materials lose their viscosity, (a temperature of the order of 1000° F.) the body shrinks more than the glaze and at all temperatures in the normal operating range for insulators or similar structures for which the material may be used, the glaze is under compression with respect to the body. By normal operating range, I mean the temperature ranges met with in the normal use of the insulators or similar structures.

pansion is important since it means that when the finished insulator is subjected to the temperature changes met with in regular use, the least amount of expansion and contraction occurs so that the stresses set up due to temperature changes are kept low.

Also, it is important that the insulator structure be free or substantially free from internal strains. This result, I obtain by firing the insulator on a long firing curve after it is glazed. For example, I may utilize a firing curve whereby the insulator is gradually heated to a temperature of the order of 1240° C. over a period of approximately 54 hours, after which it is cooled gradually to room temperature over a period of approximately 40 hours. It is known that surface compression can be obtained in glass by quick cooling as exemplified by the familiar "Prince Rupert's Drop". This renders glass tough. However, in such glass, the interior is under substantial strain. When such glass does break, it practically explodes, or at least shatters badly. Such a condition obtaining in an insulator would render it unsuited for insulator use. Because of the two ply nature of a structure comprising a body and a glaze, I am enabled to obtain surface compression and yet have the body of the insulator substantially free from appreciable strains.

In the drawing, Fig. 1 is a side elevation, partly broken away, of an insulator embodying my invention, and Fig. 2 is a fragmentary sectional view.

Referring to the drawing, 1 indicates the body of the insulator and 2 indicates the glaze. The glaze may have a thickness of the order of .003" to .007". In Fig. 2 of the drawing, its relative thickness is greatly exaggerated.

For the body of the insulator, I have found the following mixture to be suitable to give a body having a very low coefficient of expansion:

	Percentage by weight
Flint.....	24.4
Potash feldspar.....	30
Kaolin.....	17.6
Ball clay.....	28

This mixture has approximately the following chemical composition:

	Percentage by weight
SiO ₂	72.65
Al ₂ O ₃	23.16
K ₂ O.....	3.08
Na ₂ O.....	.85
CaO.....	.14

Finished porcelain from this mixture has a coefficient of expansion of the order of 5.8×10^{-6} per degree C. between 20° C. and 700° C. It may be somewhat lower or higher than this value, depending on the character of the ingredients of the mixture.

For the glaze of the insulator, I have found the following mixtures for white and chocolate colors to be suitable to give glazes having coefficients of expansion lower than that of the body mixture given above:

	Percentage by weight	
	White	Chocolate
Flint.....	32.1	36
Feldspar.....	22.1	14
Whiting.....	14.5	17
Ball clay.....	12	10
Zinc oxide.....	5.2	
Magnesite.....	2.1	
Kaolin (fired).....	12	
Kaolin.....		16
Coloring oxides.....		7

The mixtures have approximately the following chemical compositions:

	Percentage by weight	
	White	Chocolate
SiO ₂	64	64.3
Al ₂ O ₃	14.8	13.6
K ₂ O.....	3.06	2.12
Na ₂ O.....	.5	.34
CaO.....	8.54	10.22
ZnO.....	5.65	
MgO.....	1.7	
Coloring oxides.....		7.8

In general, I have found to be satisfactory glaze mixtures wherein the percentage by weight of silicon dioxide is of the order of 65% of the mixture and five times the per cent by weight of K₂O+Na₂O+CaO.

It will be understood that the mixtures given above for the body of the insulator and for the glaze may vary, those given being only by way of example. An important thing is that the body mixture and glaze mixture be so correlated that in the finished structure the body shall have a low coefficient of expansion and the glaze a coefficient of expansion substantially less than that of the body. For example, a glaze having a coefficient of expansion of the order of 5 to 5.3×10^{-6} per degree C. is satisfactory for use with an insulator body having a coefficient of expansion of the order of 5.8×10^{-6} per degree C. Suitably correlated body and glaze mixtures having been determined upon, it is of course important in regular commercial manufacture to carefully maintain the formulas if good uniform results are to be obtained.

My experience indicates that best results are obtained by utilizing a glaze having a coefficient of expansion less than that of the body of the insulator by approximately 10%, although I have obtained satisfactory results utilizing a glaze having a coefficient of expansion less than that of the body of the insulator by only 5 to 7%. It is my present belief, based on my experimental work, that the coefficient of expansion of the glaze should be less than that of the body by not less than 5% nor more than 15% since if the differ-

ence is less than 5%, there is no appreciable change in the insulator strength and if the difference is more than 15%, crazing or cracking may occur. It is to be understood that by the term of the order of 10%, I means 10% or somewhat more or somewhat less than 10%, and that by the statement that the glaze has a coefficient of expansion substantially less than that of the body, I mean less by an amount sufficient to give increased strength in the finished insulator.

In making the mixture for the body of the insulator, I find it to be desirable to lawn the ball clay separately through a 160 mesh screen, after which the final mix is made, such mix containing approximately 40% water by weight. I then flow the final mix over an electromagnet and through 120 and 140 mesh screens. Next, the final mix is corrected to a density of 1.5 and to a desired standard viscosity by the addition of small quantities of acid or alkaline salts, after which it is pumped into filter presses to remove sufficient water to leave the mixture in a plastic state ready for processing. In its final plastic state, the mixture may contain about 20.5% of water by weight. Following this, the forming and drying of the insulator or other structure may be carried out by any of the known or usual methods, the structure being formed either by pressing or by casting. As pointed out above, after the structure is glazed, it is fired on a long firing curve, the structure being cooled gradually so that it will be thoroughly annealed and free from internal strains which might be occasioned by quick cooling.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An insulator having a body of ceramic material and a glaze of ceramic insulating material, said body having a coefficient of expansion of the order of 5.8×10^{-6} per degree centigrade, and said glaze having a coefficient of expansion of the order of 5.3×10^{-6} per degree centigrade, whereby said glaze is under compression with respect to the body.

2. An insulator having a body of ceramic material and a glaze, the latter being of ceramic insulating material, said glaze having a coefficient of expansion of the order of ten per cent less than that of the body of the insulator.

3. An insulator having a body of ceramic material and a glaze, the latter being of ceramic insulating material, said body having a coefficient of expansion of the order of 5.8×10^{-6} per degree centigrade, said glaze having a coefficient of expansion less than that of the body of the insulator by an amount of the order of ten percent.

4. An electrical insulator of glazed ceramic material, the body of the insulator having a coefficient of expansion of the order of 5.8×10^{-6} per degree centigrade, the glaze comprising ceramic insulating material, said glaze having a coefficient of expansion substantially less than that of the body, said glaze being under compression throughout the normal operating range of temperature of the insulator.

5. An insulator having a body of ceramic material having a low coefficient of expansion and a glaze, the latter being of ceramic insulating material having a coefficient of expansion substantially less than that of the body, said glaze being under compression throughout the normal operating range of temperature of the insulator.

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