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(12) # EUROPEAN PATENT APPLICATION

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(54) **Method of fixing a metallic insert in a porcelain electrical insulator and an insulator produced by such a method.**

(57) A metallic insert is fixed in a porcelain electrical insulator body by vibrating an uncured polymer concrete comprising an admixture of acicular aggregate and a synthetic resin binder therefor against at least one outer surface of the metallic insert and curing the polymer.

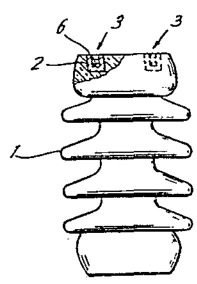

FIG. 1

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Croydon Printing Company Ltd.

"METHOD OF FIXING A METALLIC INSERT IN A PORCELAIN ELECTRICAL INSULATOR AND AN INSULATOR PRODUCED BY SUCH A METHOD"

The need to attach electrical components such as wires and the like to insulator bodies is usually satisfied by bolting the component to the body. The insulator bodies are usually made of porcelain and any threads in such porcelain bodies are so difficult to produce that they are rarely, if ever, made. If they were produced for some specific reason, a bolt or other fastener inserted in these threads easily strips the threads so that the attached component readily pulls loose from the insulator body. To make attachments to porcelain, it is conventional to cement a metal cap to the insulator body and to attach the electrical components to the metal cap.

The conventional metal caps have three major disadvantages, namely they present a large area of the conductive metal, the cap is the most expensive part of the insulator structure, and the incompatibility of the thermal characteristics of the metal and the porcelain gives rise to additional problems. Despite these disadvantages, the metal cap has been considered necessary and is in widespread commercial use.

It has now been discovered that the metal cap and its associated disadvantages can be eliminated by replacing it with a metallic insert which is bonded into the porcelain insulator by means of a polymer concrete which comprises an acicular aggregate and a synthetic resin binder. The metallic insert cannot be positioned in the porcelain insulator as the latter is prepared because the high firing temperature would destroy the insert.

According to the invention, there is provided a method of fixedly positioning a metallic insert in a porcelain electrical insulator body, comprising vibrating an uncured polymer concrete comprising an admixture of acicular aggregate and a synthetic resin binder therefor against at least one outer surface of the metallic insert and curing the polymer.

It is thus possible to provide a superior insulator body having one or more metallic inserts cemented therein so that the conventional metal caps can be eliminated.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a cross-section of a typical embodiment of this invention; and

Figure 2 is a plan view of a metallic insert used in this invention.

A porcelain insulator body 1 is prepared in a conventional manner except that the body is provided with one or more recesses 2 which are arranged to receive a metallic insert 3. The metallic inserts 3 can be made of any suitable metallic material such as steel or aluminium and can be formed into any desired shape. For example, the insert 3 can be cylindrical and the recess 2 can be of complementary annular shape. Since the main purpose of the insert 3 is for attaching electrical conductors to the insulator 1, the insert 3 preferably has a central hollowed-out portion 4 which is threaded at 5. The outer surface of the insert 3 is preferably knurled.

The insert 3 is bonded into the recess or cavity 2 of the insulator 1 by a polymer concrete 6 which is a mixture of a curable resin and an acicular aggregate.

The polymer can be any curable resin, preferably electrical insulation grade, which will bind the aggregate particles together and will substantially fill the porosity when it is hardened. Accordingly, epoxy resins, polyester resins, polyurethane resins, polyolefin resins, silicon resins and the like can be used. The polymer is chosen from commercially available products on the basis of its physical aspects, electrical characteristics, hydrophobic characteristics, ability to bind the aggregate and handle-ability. The preferred polymer is an electrical insulation grade epoxy resin. It will be understood by those skilled in the art that the polymer can contain a curing agent which is arranged to be effective in other than ambient conditions. For example, it is preferred to formulate the epoxy resin polymer with a suitable hardening agent and a catalyst, such as an anhydride or amine, which cures the epoxy resin at elevated temperature. It is also preferred to use a polymer which has a modulus of elasticity in the range of about 2-10 x 10^6 psi (about 1.4-7 x 10^5 kg/cm^2) because it permits some mismatch in the thermal expansion characteristics of the porcelain insulator and the metallic insert.

The majority of the aggregate particles, i.e. greater than 50%, are acicular particles. Preferably the acicular particles constitute about 65-75% of the aggregate. Any electrically insulating material which can be obtained in acicular shape can be used and it has been found that electrical grade porcelain when crushed forms an excellent acicular aggregate with all of the desired properties. The remainder of the aggregate can be those materials which are normally used as fillers in synthetic organic polymer insulations. The conglomeration of materials forming the aggregate should have a variety of particle sizes to reduce the amount of volume which will have to be filled by the binder portion of the concrete. Preferably at least two different particle sizes of acicular material are used.

Since the binder is usually the most expensive material in the polymer concrete, it is preferred to keep its concentration in the binder-aggregate admixture as low as practical. In general, the aggregate will be about 75 -95% of the admixture, preferably about 80-90%.

It has been found necessary to mix the binder and the aggregate under a vacuum in order to eliminate large voids and express air in the final product and to ensure a complete wetting of the aggregate with a binder resin. A vacuum above 27 inches of mercury, and preferably about 29-30 inches of mercury, has been found to be appropriate. For ease of handling, it is preferable to conduct the mixing under elevated temperature conditions which are below the curing temperature of the binder. Generally temperatures of about 50-125°C and preferably about 70-90°C are suitable if an epoxy resin arranged to cure at about 150°C is utilized. The time of mixing is not critical and optimum time intervals can be readily established by a few simple experiments. It is not necessary to vacuum cast this material since it has been found that the existance of a plurality of small voids does not detract from the insulator performance of this product, although such vacuum casting can be done if complete absence of voids is necessary.

The polymer concrete 6 is placed in the recess 2 and the insert 3 is vibratorily inserted therein.

Alternatively, the insert and concrete arrangement can be prepared in a suitable mould and the resulting larger insert inserted into the recess 2 and bonded therein with additional polymer concrete or a different cement. It is necessary to vibrate the insert in the concrete and it is believed that this results in the alignment of the acicular aggregate in such a way as to form a strong cement-insert bond. Such a bond is strengthened considerably when the insert has an irregular outer surface. The amplitude of vibration is not critical and can be varied as desired as long as it is not so violent as to trap air in the admixture. This can be readily ascertained by observation and a just sufficient amplitude should be applied to give mobility to the mass. It is preferred to conduct the vibration at the same temperature as the mixing of the aggregate and binder but any temperature below the curing point of the binder can be employed if desired. Vibration is continued for a length of time which is a function of the amplitude and the temperature conditions. Vibration should be continued at least until the extrudition of binder resin on the surface of the admixture can be observed, and preferably until such extrudition has substantially ceased. Such observation of extrudition of a vibrating mixture is similar to that encountered when vibrating Portland cement concrete.

When vibration is complete, the admixture is cured by raising the temperature to or above the curing temperature of the resin binder. As is known in the art, voiding can be eliminated during curing by applying slight pressure to the admixture.

It is possible to embed steel, aluminium or other metallic inserts into cavities in fired porcelain insulators by the use of an electrical polymer concrete which contains an acicular aggregate as its major constituent. This is possible due to the relative closeness of the linear coefficient of expansion of the porcelain insulator and the concrete and the fact that only a modest amount of heat is required to cure the polymer concrete. It is not possible to position inserts in a porcelain insulator where needed in a casting operation because the porcelain firing temperature would destroy the insert. Additionally, electrical flashover voltage levels can be greater than that of conventional arrangements by burying most of the insert beneath the surface of the insulator. Indeed, it is preferred to have the top surface of the insert 3 substantially flush with the surface of the insulator 1.

It will further be appreciated that the inserts 3 place very high shear stresses on the concrete 6 during tension or cantilever loading because only a small surface area of the concrete 6 is in contact with the inserts 3. The shear strength of the polymer concrete used permits a proportional decrease in the area required to distribute the shear forces.

Porcelain insulators were prepared having recesses to accept a metallic insert. 148 parts of a hydantoin epoxy resin (XB-2793 from Ciba Geigy Corp.), 174 parts of methyl tetrahydrophthalic anhydride, 0.75 parts benzoyl dimethylamine, 4 parts of Modaflow flow additive in 50% of the epoxy, 756 parts of 16-mesh porcelain, 396 parts of through 30 on 100 mesh porcelain and 510 parts of 325 mesh crushed quartz were combined in a Ross blender and mixed under approximately 30 inches of mercury vacuum at 90°C for four minutes. The porcelain insulators were placed on a vibratory table and the vibration begun. The recesses were filled with the admixture while vibrating and a steel insert having a hollow threaded centre and a medium knurl surface was placed into the admixture at the desired point. Thereafter, the cement was cured for 3.5 hours at 150°C. Repetitive thermocycle testing over a range of -40° to +150°C was accomplished without any failures. Stressing the insert resulted in failure of the concrete rather than insert. Similarly, all torsion testing exceeded the thread strength of the insert at 172 ft. lbs. and in some cases, deheading the hex bolt at less than this value.

Various changes and modifications can be made in the process and products of this invention without departing from the scope thereof. The various embodiments described herein are for the purpose of further illustrating the invention but are not intended to limit it.

CLAIMS:

1. A method of fixedly positioning a metallic insert in a porcelain electrical insulator body, comprising vibrating an uncured polymer concrete comprising an admixture of acicular aggregate and a synthetic resin binder therefor against at least one outer surface of the metallic insert and curing the polymer.

2. A method as claimed in claim 1, wherein the vibrating contacting is effected within a recess in the surface of a porcelain electrical insulator.

3. A method as claimed in claim 2, wherein the uncured polymer concrete is introduced into the recess and the metallic insert is inserted into the uncured polymer concrete.

4. A method as claimed in claim 1, wherein the cured polymer concrete and the insert are cemented into a recess of a porcelain electrical insulator body after the curing.

5. A method as claimed in claim 4, wherein the recess and the cured polymer concrete and insert are of complementary annular configuration.

6. A method as claimed in claim 1, wherein the outer surface of the metallic insert is knurled.

7. A method of fixedly positioning a metallic insert in a porcelain insulator body, substantially as hereinbefore described with reference to the accompanying drawings.

8. A porcelain electrical insulator body having in a recess thereof a metallic insert whose outer surface is bonded to a cured polymer concrete of acicular aggregate and synthetic resin binder therein.

9. An insulator body as claimed in claim 8, wherein the metallic insert has a knurled outer surface and contains a threaded cavity therein.

10. A porcelain electrical insulator body substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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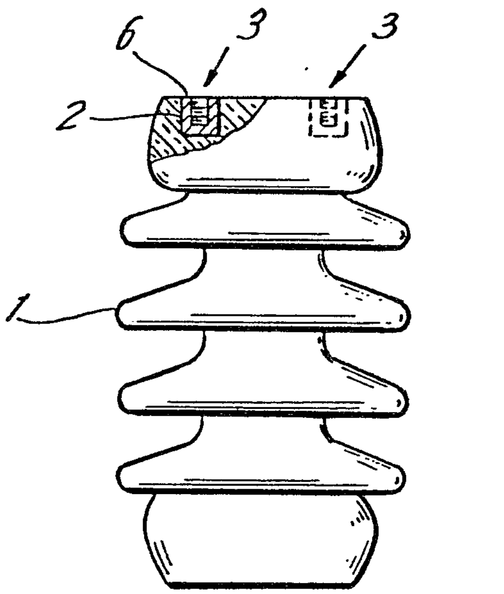

FIG. 1

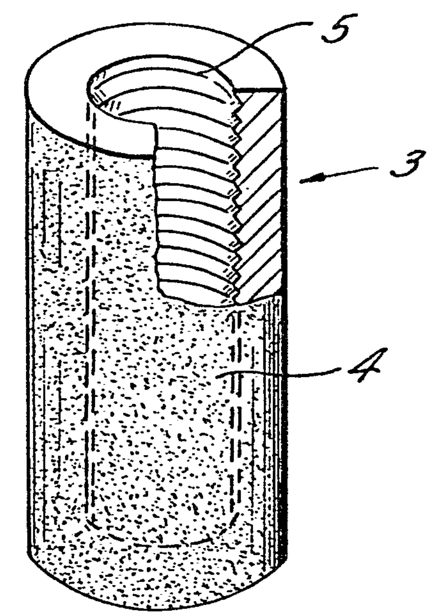

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

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Application number

EP 80302446.2

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	DE - A1 - 2 459 146 (FELTEN) * Totality * --	1-3	H 01 B 17/38
	DD - A - 40 362 (DENTAL NARODNI) * Totality * --	1-10	
	DD - A - 120 042 (SCHLEBECK) * Totality * --	1	
A	CH - A - 278 740 (OERLIKON) * Fig. 1 * --		TECHNICAL FIELDS SEARCHED (Int.Cl. 3) H 01 B 17/00 C 09 J 5/00 B 29 C 6/00
	KUNSTSTOFFE, Band 41, Heft 12 Dezember 1951, München K. MAYER HANS "Erfahrungen über die Verarbeitung und Anwendung von "Araldit" als Bindemittel und als Giessharz" Pages 457 - 462 * Pages 460, 461 * --	1-10	
	PLASTICS ENGINEERING HANDBOOK OF THE SOCIETY OF THE PLASTICS INDUSTRY, INC. 3rd Edition, 1960 REINHOLD PUBLISHING CORPORATION, NEW YORK * Page 366; fig. * ----	6,9	CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
X	The present search report has been drawn up for all claims		&: member of the same patent family, corresponding document

Place of search	Date of completion of the search	Examiner
VIENNA	22-10-1980	SCHMIDT

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