March 22, 1949. W. B. VOLKMANN 2,464,908

ELECTRICAL INSULATING SUPPORT

Filed Nov. 20, 1944

Fig. 1.

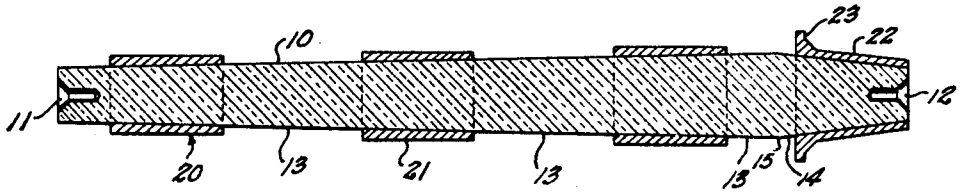


Fig. 2.



Fig. 3.

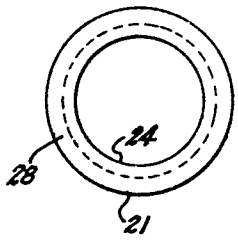


Fig. 4.

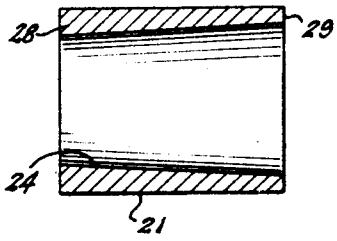
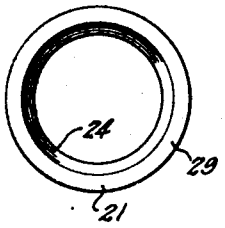


Fig. 5.



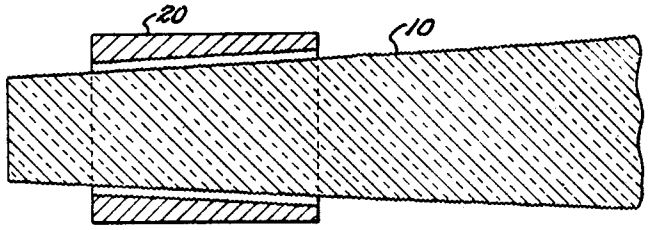


Fig. 6.

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ELECTRICAL INSULATING SUPPORT

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1 Claim. (Cl. 174—177)

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This invention relates to improvements in methods for making metal insulator parts for electrical devices and to the insulator made thereby, and particularly to the method of securing a metal part to a ceramic support and the insulating support made thereby.

There are many uses for articles made in part of materials such as a ceramic, and particularly steatite, on which must be fixed parts of a different material such as a metal. Metal parts have been commercially applied to ceramic parts by first coating portions of the ceramic with an electrically conductive material, by one of the well-known methods, and building up such coating by electro-depositing metal thereon or by spraying or sputtering the metal thereon. Electro-depositing is, however, limited in the materials which may be used without special equipment and the observance of special precautions. Only some metals may be sprayed or sputtered or similarly deposited on a ceramic part and then only if means are employed to prevent adhesion of the metal on surfaces which are not to be coated, or if the metal is removed from such surfaces after the coated portions are built up to the required dimensions. All of the above processes require a high degree of skill, are slow and costly, and require shaping and finishing of the metal parts in place on the ceramic part. Further, in each of the above methods, the grain or texture of the metal is determined by the process of its application and may not be suitable to the final use.

Shrinkage of metal parts such as rings or sleeves on a ceramic part is generally avoided because the parts are usually so small that the total amount of metal shrinkage is too minute for successful adhesion of the parts unless the dimensions of the parts are kept within closer limits than are economical in present day manufacturing practice. Further, the heat and pressure involved in the shrinkage method cause a high percentage of breakage of the ceramic part due to heat and mechanical shock.

When the metal parts were pressed on ceramic parts, the abrasive action of the ceramic on the metal, while being pressed in place, removed so much metal instead of expanding the metal part as a whole that a tight fit of the metal part on the ceramic could not be obtained. Metal plating of the ceramic, to prevent abrasion of the metal part or lubrication of the ceramic to reduce the abrasive effect thereof on the metal, is not successful and is not permissible if metal parts must be electrically isolated. However, after many experiments I have discovered that, if the ceramic and

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metal parts are correspondingly tapered by a small amount, the metal parts may be pressed on the ceramic parts without fracturing the ceramic material, and the abrading action of the ceramic may be utilized in forming the metal part to the exact size of that portion of the ceramic on which the metal is to be seated. Such abrading may occur for a slight distance beyond the point of first contact of the tapered surfaces and secures a good mechanical interlocking of the ceramic and metallic mating surfaces. The action is somewhat similar to the "freezing" or seizing of an unlubricated bearing.

It is therefore an object of the present invention to provide a process for fixing parts of different materials to each other by utilizing the abrasive action of one of the parts on another part to seat the one part at a predetermined location on the other part.

Another object of the invention is to fix parts on each other by adhesion only and by employing the abrasive action of one of the parts on the other part for finally forming the surfaces mating with each other.

Another object of the invention is to provide a process for securing together parts of different materials of which one of the materials is abrasive of the other, the process involving the corresponding shaping of the parts and then pressing the parts together to utilize the abrasive action in the final shaping of the one part to the exact size of the other part.

Another object of the invention is to provide a process for securing together parts of materials of which one material is normally abrasive of the other material, the process involving the corresponding shaping of the parts and roughening at least one of the parts and then pressing the parts together to utilize the abrasive action, for a short distance ahead of the final location of one part on the other part, in the final shaping of the one part for exact mating of the parts.

Another object of the invention is to provide an article composed of a part of a material abrasive to another part of a different material, the several parts having mating tapered surfaces matched to each other by the abrasion of the parts during assembly.

Another object of the invention is to provide an article composed of relatively brittle material having an abrasive surface and relatively elastic material mating parts, the several parts having correspondingly tapered surfaces matched to each other by abrasion of the elastic material parts by the mating surface of the brittle material part.

Another object of the invention is to provide an article composed of finished metal parts having tapered surfaces corresponding to the tapered surface of a ceramic part and mated thereto by the abrasive action of a roughened tapered surface of the ceramic part on the smooth tapered surface of the metal parts.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawing, in which:

Fig. 1 is a section taken along the axis of a completed article composed of a ceramic first or inner part and a plurality of metallic second or outer parts;

Fig. 2 is an enlarged perspective view of the first or inner part to show the roughened tapered surface for abraiding the second or outer parts;

Fig. 3 is an enlarged view of one end of the second or outer metal parts;

Fig. 4 is an enlarged sectional view of the second or outer part taken on a plane through the axis thereof;

Fig. 5 is an enlarged view of the other end of the outer or second part; and

Fig. 6 is an enlarged fragmentary view in section through the axis of a ceramic first or inner part, with its roughened surface and a second or outer part of a material other than a ceramic and with one of its surfaces roughened to mate with the roughened surface of the first part.

Referring to the drawing by reference numerals, the particular embodiment described herein is an insulating supporting shaft or rod which may be used as a shaft for condensers, as a tie rod for the panels of an electrical device, or for many other purposes where it is desired to electrically insulate metal parts. The core or inner part **10** is shown as being made as a substantially cylindrical or rod-like member of other cross-sectional shape and of a ceramic material suitable to the final use of the article. The part **10** is formed with centering holes **11** and **12** in the ends thereof by which such part may be mounted while it is being ground or otherwise shaped to provide tapered surfaces **13** and **14**, the tapered surfaces joining at the line **15**. The two tapered surfaces are shown as extending in opposite directions from the line **15**, but obviously only a single tapered surface may be utilized. The surface **13** is shown as being tapered uniformly over its entire length but such taper may be divided into a number of different portions tapered by different amounts. The degree of taper is not material and may vary from .01 to .025 inch per foot of length. The grinding or other shaping is preferably so done as to retain or increase the roughness of the surface which is normally produced in the shaping of the part. At any rate, no polishing or smoothing is done which would diminish the roughness of the shaped surface.

The encircling or outer parts are shown as sleeves **20** which have a substantially cylindrical outer surface, as at **21**, or may be formed with a conical outer surface, as at **22**, or with an outer surface shaped in any other manner desired, and may be formed with a flange **23** or other portion extending outwardly from the body of the sleeve. It will be understood that the outer parts may be either slit or solid and may have apertures through the wall so long as sufficiently rigid to secure the abrasive action described hereinafter. The inner surfaces **24** of the sleeves are tapered to correspond to the tapering of the surfaces **13** and **14** of the ceramic on which the sleeves are to be severally seated. Hence, when the outer surfaces

21 of the sleeve are cylindrical, as shown in Fig. 4, the one end **28** of the sleeve has a relatively thick wall while the other end **29** of the sleeve has a relatively thin wall. The diametric dimensions of the tapered inner surface **24** of the sleeves are slightly less than the diametric dimensions of the tapered surface of the ceramic part **10** at the location at which the sleeves are to be seated, that is, the sleeve aperture is made slightly under size relative to the size of the core portion on which the sleeve is to be seated.

The sleeves are now placed on the ceramic part, and the tapered surface of the ceramic and the sleeve contact each other for a slight distance, preferably of the order of one-eighth inch, ahead of the desired final seated location of the sleeve on the ceramic. Pressure is then applied to the sleeve to move the sleeve along the tapered surface of the ceramic toward its desired location. As the sleeve moves into its final seated position, the abrasive surface of the ceramic cuts or tears away sleeve material to the exact amount required to fit the sleeve on the ceramic at its desired seat. As soon as the sleeve has been pressed to the desired position, the pressure is interrupted and the sleeve then remains firmly fixed on the ceramic due to the interlocking of the minute projections on the mating ceramic and sleeve surfaces. It will be understood that the abrading action enhances the degree of roughness of the softer metal and promotes the interlocking of its surface projections with the projections of the ceramic surface.

After the several sleeves have been positioned on the ceramic, it is desirable that the portions of the ceramic between the sleeves be polished to remove metallic particles left thereon by the abrasion of the metallic sleeve during the pressing operation. It will be understood that any further shaping of the ceramic, such as grinding the unsleeved tapered surfaces to a cylinder, grooving, and so forth, may also now be done without danger of breakage of the finished article. It will be understood to those skilled in the art that the sleeves **20** may be used as anchors to which are secured the plates of a condenser, the panels of an electrical device, or other elements which are to be supported and electrically insulated. The sleeve **22** may likewise be used as the inner race of a bearing or a support for an actuating member by which movement is imparted to the shaft or rod.

If a material other than steatite, or a similar ceramic, is used for the core or inner part, and a material such as one of the known plastics is used for the outer parts or sleeves, it may be desirable to roughen the tapered surfaces of both parts as shown in enlarged detail in Fig. 6. Such roughening may be done during the tapering operations and will be carried only to such a degree as to leave the sleeve taper slightly under the size of the ceramic taper at the desired location for final seating of the sleeve thereon.

The present method of manufacture is applicable to any material in which one material is abrasive of the other, and particularly when at least one of the materials is relatively brittle or inelastic. When metal or other elastic material sleeves are used, abrasion of the tapered surface of the sleeve matches such sleeve surface so closely to the ceramic taper that the sleeve is expanded as a whole, thus utilizing both the resilience of the metal and the adhesion between the surfaces to hold the parts in assembled relation. It has been found that the present seating of the metal sleeves on the ceramic part is of such

nature that the force required to cause slipping of a sleeve from its seat on the ceramic is much greater than the force required to secure slipping of a metal part formed on a ceramic part by either electro-deposition, spraying or sputtering, or other mounting methods now in practical use.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the spirit of the invention or from the scope of the appended claim.

I claim:

An electrical insulating support comprising a rod-like ceramic member of an abrasive material, and a plurality of metallic sleeves of a material abradable by said insulating member, said member having a roughened, tapered, peripheral surface, said sleeves having inner surfaces tapered to correspond with the taper of said member and roughened by said peripheral surface when said sleeves are set in predetermined location on said member whereby they are retained in such predetermined location by friction only, the diametric dimensions of the inner surface of each of said sleeves being slightly less than the diametric dimension of the tapered peripheral surface of said insulating member which a sleeve will overlap when such sleeve is in its predetermined location on the insulating member.

WILLY B. VOLKMANN.

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