April 8, 1969 J. R. GAMBLE 3,437,554

JOINT CONSTRUCTIONS

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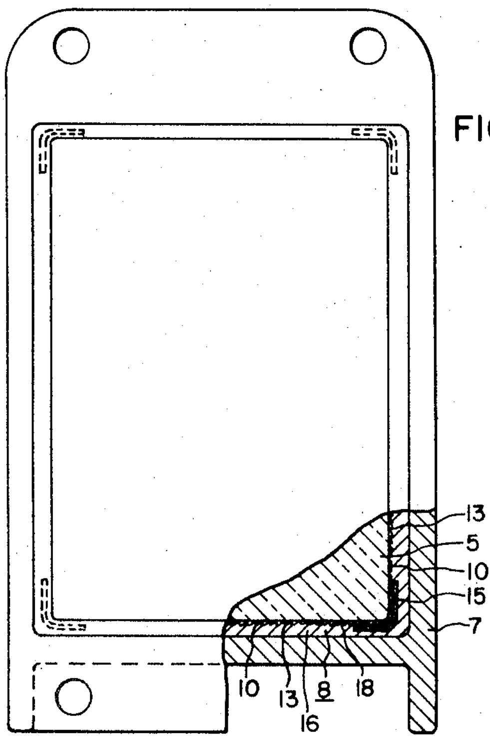



FIG.2.

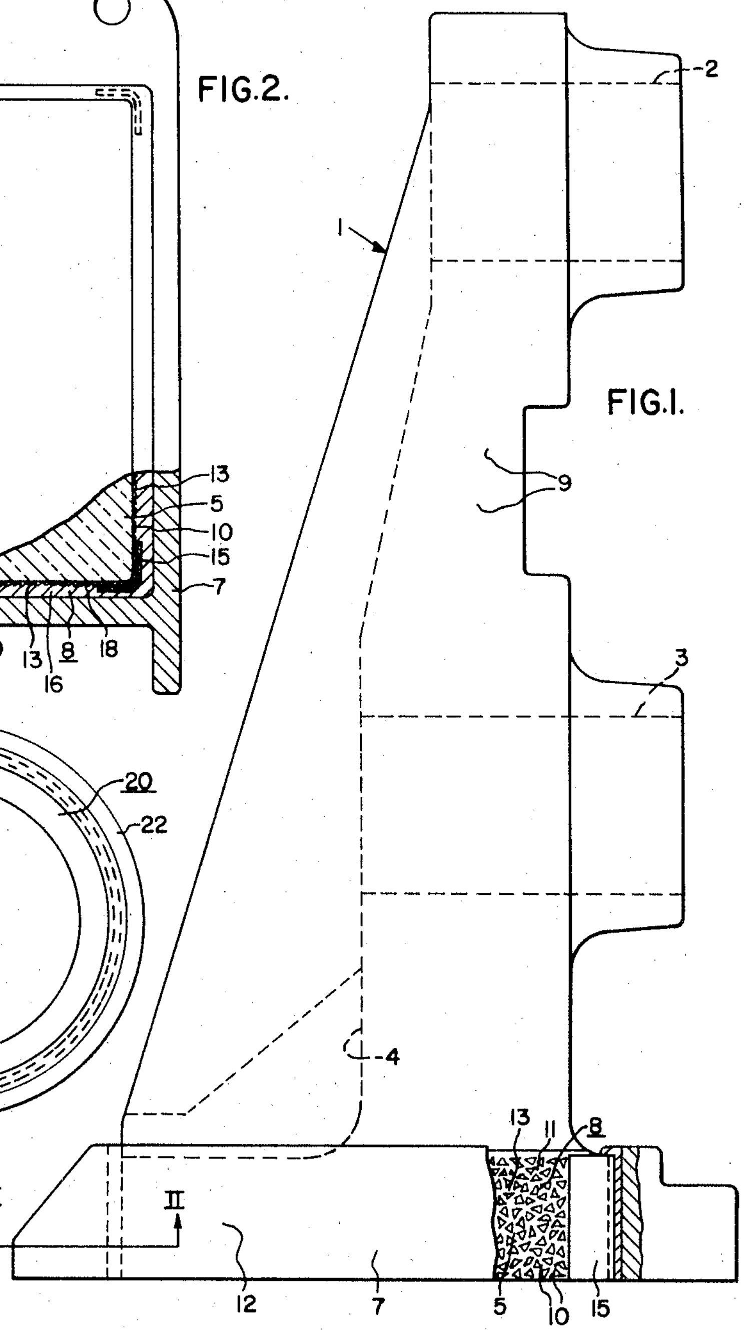



FIG.1.

FIG.3.

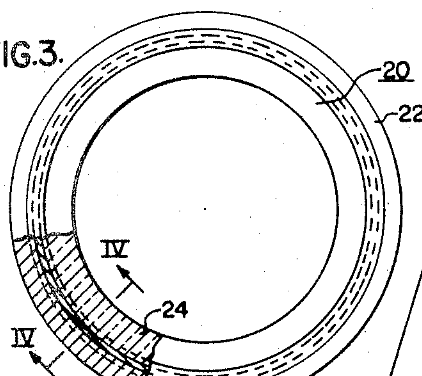



FIG.4.

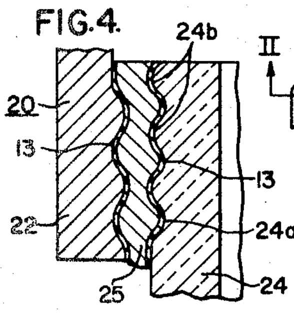
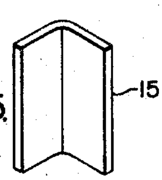



FIG.5.

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United States Patent Office

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3,437,554

# JOINT CONSTRUCTIONS

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Continuation-in-part of application Ser. No. 420,421, Dec. 22, 1964. This application Jan. 26, 1965, Ser. No. 433,529

Int. Cl. C09j *1/00;* C03c *27/04*

U.S. Cl. 161—206 15 Claims

## ABSTRACT OF THE DISCLOSURE

An improved joint construction is provided between a ceramic body and a surrounding metallic flange structure secured thereto. A permanently-tacky resilient cushioning layer of a silicone adhesive is applied to the ceramic body, so as to be interposed between the ceramic body and the contiguous cement poured in the intervening space between the inner ceramic body and the surrounding metallic flange support member.

For a rectangular ceramic body, additionally, corner pads of an asbestos material are pressed firmly to the corner positions of the ceramic body and no alloy is permitted to penetrate behind the corner pads.

This invention relates to joint constructions generally and, more particularly, to a joint construction between a ceramic body and an adjacently-disposed metallic support member.

This application is a continuation-in-part of my copending application filed Dec. 22, 1964, Ser. No. 420,421 and now abandoned.

A general object of the invention is to provide an improved joint between a ceramic body, such as a porcelain body, and a metallic support therefor so that the ceramic body may be employed in an assembled unit.

As well known by those skilled in the art, in many types of equipment, such as switchgear, terminal bushings, lightning arresters, circuit breakers, etc. there is need for use of a ceramic, or porcelain body for providing a casing construction. In more detail, a circuit breaker may require a hollow porcelain casing to surround the arc-extinguishing elements, and preferably, the hollow porcelain casing must have an annular end flange member secured to an extremity of the porcelain casing so as to structurally attach the porcelain casing to a ground frame, an end line terminal member, etc. The support flange must be attached by a joint to the porcelain casing which will resist vibration, shock and will not loosen over long periods of time.

As set forth recently in U.S. patent application filed Aug. 16, 1964, Ser. No. 387,919, now U.S. Patent 3,307,004 issued Feb. 28, 1967 to Samuel Bottonari, entitled, "Circuit Interrupters," and assigned to the assignee of the instant application, the entire pole-support for a circuit interrupter to support the contact assemblies is provided by a molded porcelain support. To fixedly secure the porcelain pole-support to a lower base frame, a rectangular metallic support flange is secured to the base portion of the porcelain pole support. This joint between the pole-support and the encirling rectangular metallic flange support must resist shock stresses induced by breaker operation for long periods of time. Reference may be had to Delevoy et al. Patents 3,086,097 and 3,086,098 issued Apr. 16, 1963, for similar insulating pole-support constructions for circuit breakers, in which a rather complex integral molded member which may be of a high-strength porcelain may be utilized for the main insulating frame of the circuit breaker. Rigid attachment of such an insulating frame is required without the hazard that under shock conditions the main procelain frame will loosen and subject operating personnel to the hazard of electrical shock. To effect this end, namely resisting indefinitely loosening of the metallic flange support from the main porcelain support body, the improved mechanical joint of the instant invention is directed. I have discovered that the interposition of a somewhat resilient, or cushioning layer, within the metallic-porcelain joint proper has a remarkable effect of not only improving shock resistance, but, more importantly, adding to the mechanical strength and life of the joint.



Another object of the invention is an improved method for forming a metallic-porcelain joint.

Still a further object of the invention is the provision of an improved joint about an irregularly shaped porcelain body, that is a porcelain body having one or more corner portions, which, as I have discovered, are more susceptible to the creation of failure cracks, which ultimately result in breakdown of the joint proper.

Another object of the invention is to interpose a permanently-tacky and extremely viscous material, in thin layer form, in the joint between a support flange and the adjacent supported porcelain body to resist shock and to improve mechanical strength.

The bonding material may be Portland cement, Mineralead, Babbit metal, or any other type of suitable cement.

Further objects and advantages will become apparent hereinafter with reference to the following detailed description, taken with reference to the drawing, in which:

FIGURE 1 is a side elevational view of a porcelain pole-support for a circuit breaker of the type illustrated in the aforesaid U.S. Patent 3,307,004, illustrating in broken-away fragmentary manner, the improved joint between the base of the porcelain pole-support and the surrounding metallic flange support;

FIG. 2 is an inverted plan, or bottom view of the flanged porcelain pole-support, with a fragmentary cross-sectional view being taken along the line II—II of FIG. 1, illustrating the corner padding construction;

FIG. 3 illustrates an end view of a lightning-arrester porcelain casing and the annular support flange secured thereto by the improved joint construction of the present invention;

FIG. 4 is a considerably enlarged fragmentary sectional view taken along the line IV—IV of FIG. 3; and,

FIG. 5 is a perspective view of the corner pad used in the improved joint construction.

With reference to the drawing and more particularly to FIG. 1 thereof, the reference numeral **1** designates a porcelain pole-support suitable for circuit-breaker use. The porcelain pole-support **1** has molded therein support openings **2**, **3**, through which contact foot and stud assemblies (not shown) may be fixedly mounted. The pole-support **1** is generally of channel-shaped configuration, having a connecting integral web portion **4**, through which the aforesaid support openings **2** and **3** are provided.

The base portion **5** of the porcelain pole-support **1** has a rectangular configuration, and encircling the aforesaid rectangular base portion **5** is a metallic rectangular flange support member **7**. The improved joint **8** between the metallic support frame **7** and the porcelain body **1** constitutes the essence of the present invention.

After the body **1** is molded and dried, a first glaze coating **9** is applied over the entire body **1** with the exception of the bottom of the base **5**, which has a wax layer applied thereto as this is the firing surface.

In the joint construction **8** of FIGS. 1 and 2, sand **10**, having a mesh size of say 14–18 mesh, for example, is poured on a second glaze layer **11** having a fish glue mixed therein, together with a certain part of glycerin.

The glaze and fish-glue mixture **11** is painted by brush around the vertical base face portions **12** and while this glaze coating **11** is still wet, the aforesaid sand **10** is poured by hand over such coating **11** and a certain portion of the sand **10** adheres thereto. Thus, prior to the kiln firing operation of the porcelain body **1**, a layer of sand **10** is provided all around the four vertical faces **12** of the rectangular base **5**. As will be obvious, the sand particles **10** assist in the formation of the subsequent joint **8**.

It is to be clearly understood that the aforesaid glaze and fish-glue mixture **11** is not necessary where the initial glaze layer **9** does not dry too soon and the sand particles **10** may adhere to the initial glaze coating **9**.

In practice however, due to the somewhat rapid drying of the initial glaze coating **9**, it is preferable to apply the second glaze coating **11** with fish glue additive and glycerin so that the sand **10** may have firm adherence to the base faces **12** of the porcelain body **1**.

As is customary, the porcelain body **1** is fired in a kiln for a period of approximately a week, and when withdrawn from the kiln and slowly cooled is ready for the subsequent joint process of the instant invention.

After kiln firing, the sanded surfaces **12** of the porcelain body **1** are brush coated with a layer of a tacky viscous material **13**, which is permanently tacky and provides a resilient cushioning layer in the joint **8**. The viscous and tacky coating material **13** is a plastic material, that is, over a wide range of temperatures, adherent, impervious to moisture and capable of forming a smooth thin-layer. Suitable formulations will be set forth hereinafter. The coating **13** serves to reduce stresses at or adjacent the interface between the adjoining Babbit metal, as described hereinafter. A coating material that is permanently tacky is desirable in carrying out my invention. The coating **13** must be capable of adhering to the base faces **12** of the base **5** of the porcelain body **1** and also to the contiguously-poured Babbit metal, or Mineralead, or high-melting point sulfur cement, or Portland cement.

In the joint construction **8** of FIGS. 1 and 2, the galvanized malleable iron flange support **7** and porcelain body **1** (following the firing operation and coating **13** operation) is preheated to 250°±5° F. for a minimum of 8 hours preferably overnight, before assembly.

The porcelain body **1** is removed from the preheater immediately prior to the assembly. Four impregnated asbestos tape sections **15** are placed in position over the base corners and pressed firmly in place. The tape sections are cut from a .062 x 1.5 inch asbestos tape and impregnated with the silicone adhesive **13**. The tape is dried and cut to 1-inch lengths. The cut pieces are folded to .5 x 1.5. The tape sections **15** are placed in the corner positions and pressed firmly into position. I have discovered that it is important that the alloy **16** cannot penetrate behind them. Strength values were found to be reduced when the alloy was allowed to penetrate behind the asbestos pads. The asbestos pads act to obviate the possibility of having stress concentrations on the corners of the porcelain pole unit **1**.

The malleable iron base **7** is taken from the preheater and tightened into position in a jig, not shown. The porcelain pole unit **1**, together with the corner padding **15** is also placed in a jig for correct alignment with respect to the metallic flange support **7**.

An alloy **16**, such as Babbit metal at a temperature of say 700°+25°−10° F. is poured about the base **1** while the pole support **1** and the metallic flange **7** are still hot. The alloy **16** is cast in one pour.

The assembled device with the attached flange support **7** is removed from the jig fixtures and the assembly is permitted to cool slowly to room temperature.

The Babbit alloy **16** may have the following formulation:



Lead base Babbit metal in ingot or bar form as follows:

| Chemical composition: | Percent |
|---|---|
| Tin | 7.0–9.0 |
| Antimony | 13.0–15.0 |
| Copper | .50–.80 |
| Impurities, total, max. | .15 |
| Aluminum and zinc | None |
| Lead | Remainder |

Another formulation for an acceptable alloy is as follows:

Lead base Babbit metal in ingot or bar form as follows:

| Chemical composition: | Percent |
|---|---|
| Tin | 4 |
| Antimony | 9 |
| Copper | .5 |
| Impurities, total, max. | .15 |
| Aluminum and zinc | .3 |
| Lead | Remainder |

The improved joint construction of the present invention may be applied to the porcelain-metallic flange constructions of lightning arrester casings **20**, such as shown in FIGS. 3 and 4 of the drawings. Reference may be had to U.S. patent application Ser. No. 407,012 filed Oct. 28, 1964, by Kennon et al. for a description of such a type of structure.

With reference to FIGS. 3 and 4 it will be noted that an annular support flange ring **22** is attached to the extremity of a porcelain casing **24**. The metallic ring **22** and upper surface **24*a*** of the porcelain casing **24** are coated with the resilient adhesive **13**. Here, no sand is employed and the ribs or corrugations **24*b*** assist in providing a firm attachment.

After the flange support **22** and casing surface **24*a*** have been coated with the adhesive **13**, the parts are placed in alignment jig devices and a suitable high-melting-point sulfur cement **25** is used to cast the parts together. Here, the porcelain casing **24** is preheated, but not the support flange **22**.

The formulation of the Mineralead cement is as follows:

| Material: | Content, percent |
|---|---|
| Refined sulfur, min. | 55 |
| Inert aggregate | 35–45 |
| *Plasticizer, max. | 3 |

*Note.—Suitable nonvolatile plasticizer in sufficient quantity so that cement conforms to requirements of this specification.

(4) Inert aggregate composition.—The chemical compositon of the inert aggregate shall conform to the following:

| Chemical: | Content, percent |
|---|---|
| Carbon | 1.0–2.0 |
| $SiO_2$ | 97.0–98.5 |
| $Al_2O_3$ | 0.3–0.7 |
| $Fe_2O_3$ | 0.1–0.5 |
| CaO | None |
| MgO | None |
| $K_2O$ | None |
| $Na_2O$ | None |
| NaCl or other inorganic halides | None |

Instead of Mineralead, a portland cement could be used in the lighting arrester casing construction of FIGS. 3 and 4.

In the pole-unit support **1** and the arrester attachment of FIGS. 3 and 4, the coating of the adhesive material **13** is approx. 3 mils. The layer thickness of the adhesive **13** may, however, vary from 1 to 15 mils, although the thicker layers may be somewhat prone to "slippage," as a limiting factor.

A stable tacky viscous coating material suitable for carrying out this invention is an organopolysiloxane composition comprising from 5 to 70 percent by weight of a benzene soluble resin copolymer of $SiO_2$ units and $R_3SiO_{1/2}$ units where R is an alkyl radical of less than 4 carbon atoms or a phenyl radical, and where the ratio of $R_3SiO_{1/2}$ units to $SiO_2$ units is from .6:1 to .9:1 inclusive, and 95 to 30 percent by weight of a diorganopolysiloxane having the general formula $R'_2SiO$, where R' is methyl or phenyl and having viscosity of at least 1,000,000 cs. at 25° C., and at least 90 percent of the total number of R and R' radicals being alkyl.

Organosiloxane adhesives particularly suitable for use in the practice of the present invention are preferably a mixture of methylsiloxanes, one component being an elastomeric siloxane comprising repeating

$$-\underset{\large CH_3}{\overset{\large CH_3}{\overset{|}{\underset{|}{Si}}}}-O-$$

units in a chain terminated by $(CH_3)_3$—Si— groups, wherein the ratio of $(CH_3)$ to Si groups is close to 2, but may be either slightly greater than 2, or slightly less, and the other component being a resinous methylsiloxane having from at least one to substantially less than 2 methyl groups per silicon atom. From 10% to 90% by weight of each component may be present in the mixture. The molecular weights are such that a 37% solution of the organopolysiloxanes in xylene has a viscosity of 3000 to 8000 centipoises at 25° C. Catalysts for curing the mixture of organopolysiloxanes comprise lead carboxyl salts, for example, lead naphthenate, lead acetate and lead propionate, in amounts of from about 0.001% to 2%. Benzenoid hydrocarbon solvents may be employed to dissolve the organopolysiloxanes for instance benzene, toluene or xylene, to produce solutions of from 30 to 40% concentration. A 38% to 40% solution gives goods results.

EXAMPLE I

A suitable formulation consists of 50 parts by weight of an organosiloxane copolymer composed of

$$(CH_3)_3SiO_{1/2}$$

units, and $SiO_2$ units having an average of about 1.2 methyl units per silicon atom in the copolymer, 50 parts of a dimethylsiloxane having a viscosity in excess of 10,000,000 cs. at 25° C., having a plasticity of 55, and 2.5 parts of benzoyl peroxide. Lead naphthenate may be substituted for the benzoyl peroxide in this example.

A coating material of this type retains its physical and chemical properties over a wide range of temperatures and where such ranges are attained in short periods of time and is particularly adapted for use in coating electrical members that are subjected to severe changes in temperature.

Other suitable silicon formulations are set forth in U.S. Patent 2,736,721.

A particularly desirable adhesive coating **13** is a silicon adhesive sold by Dow Corning Coporation of Midland, Mich. under the trade name Dow Corning 271 adhesive. This is a pressure-sensitive silicone adhesive which remains tacky and flexible at service temperature from −80° to over 500° F.

The improved joint construction of the present invention has resulted in a marked increase in cantilever strength. For example, using the type of joint construction of the present invention, the cantilever load that would cause failure increased from a range of 1600–2900 pounds to a range of 4200 pounds to 6600 pounds. Also, the flexibility and cushioning effect provided by the silicon adhesive **13** results in a desirable increase of the pole-unit **1** to resist shock and vibration stresses.

As an indication of the important commercial uses of the present invention, it is to be observed that approximately 6,000 pole-units **1**, incorporating the improved joint **8**, have gone out into commercial use, and



have been found to satisfy a long-existing want for an insulating support capable of resisting shock and vibration, and providing the desirable insulating qualities which are afforded by the use of porcelain. The aforesaid figure is concerned only with circuit breaker activity, and other uses, for example the lighting-arrester applications, as set forth in FIGS. 3 and 4 constitute a further important active field of use for the present invention.

Although there has been set forth specific joint constructions, and methods of providing the same, it is to be clearly understood that the same were merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the invention.

I claim as my invention:

**1.** An improved ceramic-metallic joint construction including a coating of a silicon adhesive on the ceramic body for providing a permanently flexible layer, and an interposed cement between the ceramic body and the surrounding metallic flange support.

**2.** A joint construction including a porcelain body and a surrounding metallic support flange, a 1 to 15 mil coating of a silicone adhesive on the porcelain body for a permanently flexible and resilient layer and an interposed body of cement.

**3.** In combination, a porcelain body having one or more corner portions, a resilient corner pad for covering a corner portion in contiguous relation to said corner portion, an adjacent metallic supporting flange, and a cement interposed between the porcelain body and the metallic supporting flange.

**4.** A porcelain-metallic joint including a porcelain body having a surface coating of a material which is an organopolysiloxane composition comprising from 5 to 70 percent by weight of a benzene soluble resin copolymer of $SiO_2$ units and $R_3SiO_{1/2}$ units where R is an alkyl radical of less than 4 carbon atoms or a phenyl radical, and where the ratio of $R_3SiO_{1/2}$ units to $SiO_2$ units is from .6:1 to .9:1 inclusive, and 95 to 30 percent by weight of a diorganopolysiloxane having the general formula $R'_2SiO$, where R' is methyl or phenyl and having a viscosity of at least 1,000,000 cs. at 25° C., and at least 90 percent of the total number of R and R' radicals being alkyl, a surrounding metallic flange support, and a cement interposed between said surface coating and the surrounding metallic flange support.

**5.** A porcelain-metallic joint including a porcelain body having a surface coating of an adhesive material which has a formulation consisting of 50 parts by weight of an organosiloxane copolymer composed of

$$(CH_3)_3SiO_{1/2}$$

units, and $SiO_2$ units having an average of about 1.2 methyl units per silicon atom in the copolymer, 50 parts of a dimethylsiloxane having a viscosity in excess of 10,000,000 cs. at 25° C., having a plasticity of 55, and 2.5 parts of benzoyl peroxide, a surrounding metallic flange support, and a cement interposed between said surface coating and the surrounding metallic flange support.

**6.** The combination according to claim **3**, wherein the resilient corner pad is impregnated with a silicone adhesive material.

**7.** A porcelain-metallic joint including a porcelain casing and a surrounding metallic flange member, a coating of a silicone adhesive on the confronting faces of both the porcelain casing and the surrounding metallic flange member, and a cement interposed between the casing and flange member.

**8.** The method of providing a resilient porcelain-metallic joint including the steps of: coating the joint surface of the porcelain body with a layer of 1 to 15 mils of a silicone adhesive to provide a permanently resilient layer within the joint, and placing a cement within the interposed cavity between the porcelain body and the surrounding metallic support flange member.

**9.** The process of claim **8**, wherein the silicon adhesive is an organopolysiloxane composition comprising from 5 to 70 percent by weight of a benzene soluble resin copolymer of $SiO_2$ units and $R_3SiO_{1/2}$ units where R is an alkyl radical of less than 4 carbon atoms or a phenyl radical and where the ratio of $R_3SiO_{1/2}$ units to $SiO_2$ units is from .6:1 to .9:1 inclusive, and 95 to 30 percent by weight of a diorganopolysiloxane having the general formula $R'_2SiO$, where R' is mehtyl or phenyl and having a viscosity of at least 1,000,000 cs. at 25° C., and at least 90 percent of the total number of R and R' radicals being alkyl.

**10.** The process of claim **8**, wherein the silicone adhesive has a suitable formulation consisting of 50 parts of an organosiloxane copolymer composed of

$$(CH_3)_3SiO_{1/2}$$

units, and $SiO_2$ units having an average of about 1.2 methyl units per silicon atom in the copolymer, 50 parts of a dimethylsiloxane having a viscosity in excess of 10,000,000 cs. at 25° C., having a plasticity of 55, and 2.5 parts of benzoyl peroxide.

**11.** The process of claim **8**, wherein both the joint surfaces of the porcelain body and the surrounding metallic support flange member are coated with the said silicone adhesive.

**12.** A porcelain-metallic joint including a porcelain body having a surface coating of an adhesive material which comprises a mixture of from 10 to 90% by weight of each of an elastomeric methylpolysiloxane and a resinous methylpolysiloxane and having a viscosity of from 3000 to 8000 centipoises at 25° C. for a 37% solution in xylene, and up to 2% by weight of a lead carboxyl salt to catalyze the curing of the applied coating to an adherent elastic layer, a surrounding metallic flange support, and a mineral cement interposed between said surface coating and the metallic flange element.



**13.** An improved ceramic-metallic joint construction including a coating applied to a ceramic body of an adhesive material which comprises a mixture of from 10 to 90% by weight of each of an elastomeric methylpolysiloxane and a resinous methylpolysiloxane and having a viscosity of from 3000 to 8000 centipoises at 25° C. for a 37% solution in xylene, and up to 2% by weight of a load carboxyl salt to catalyze the curing of the applied coating to an adherent elastic layer, and an interposed cement between the ceramic body and the surrounding metallic flange support.

**14.** The joint construction of claim **13**, wherein the coating applied to the ceramic body is 1 to 15 mils in thickness.

**15.** The process of claim **8**, wherein the silicon adhesive is an adhesive material which comprises a mixture of from 10 to 90% by weight of each of an elastomeric methylpolysiloxane and a resinous methylpolysiloxane and having a viscosity of from 3000 to 8000 centipoises at 25° C. for a 37% solution in xylene, and up to 2% by weight of a load carboxyl salt to catalyze the curing of the applied coating to an adherent elastic layer.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,631,961 | 3/1953 | Antheil | 156—310 X |
| 3,071,217 | 1/1963 | Gould | 161—207 X |
| 3,242,376 | 3/1966 | Schultz | 200—144 X |

FOREIGN PATENTS

| | | |
|---|---|---|
| 833,800 | 4/1960 | Great Britain. |


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U.S. Cl. X.R.

156—329; 161—205, 207, 213; 200—144