Sept. 2, 1969 J. M. McMANUS 3,465,284

MULTIPIN CONNECTOR

Filed May 5, 1965 2 Sheets-Sheet 1

FIG. 1.

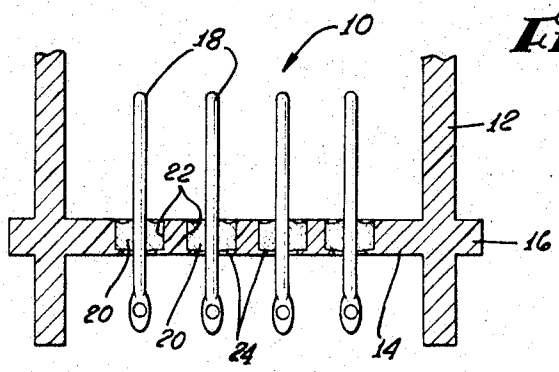


FIG. 2.

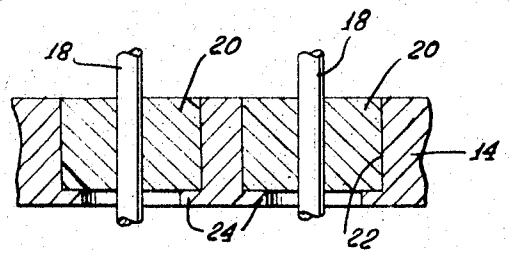


FIG. 3.

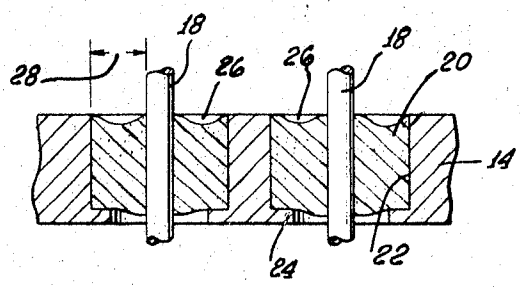
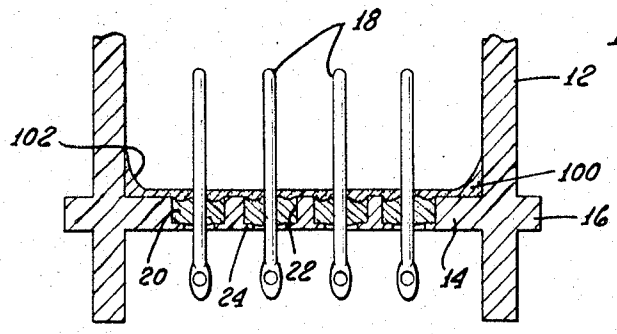


FIG. 4.



INVENTOR.
JOSEPH M. McMANUS
By Smyth, Roston & Pavitt
ATTORNEYS.

Sept. 2, 1969 J. M. McMANUS 3,465,284

MULTIPIN CONNECTOR

Filed May 5, 1965 2 Sheets-Sheet 2

FIG. 5.

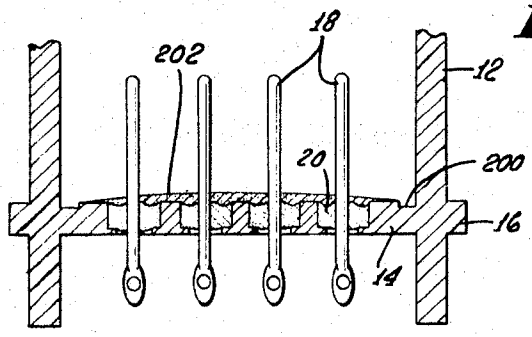


FIG. 6.

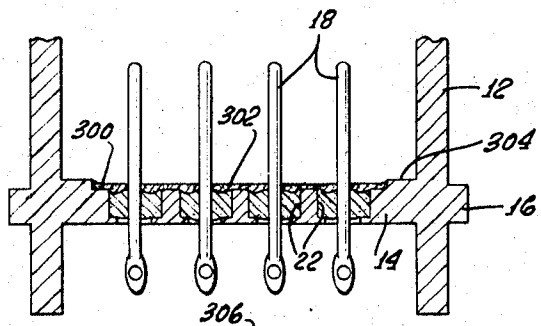


FIG. 7.

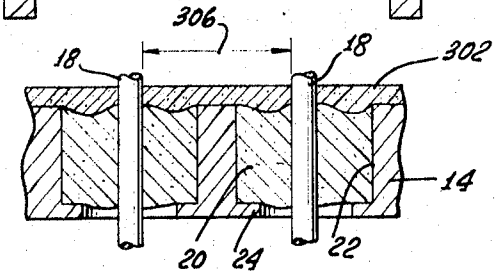
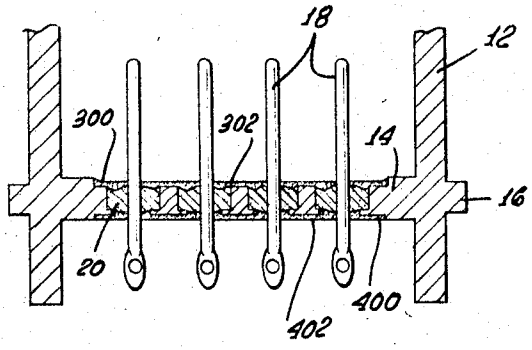


FIG. 8.



INVENTOR.
JOSEPH M. McMANUS
By Smyth, Roston & Pavitt
ATTORNEYS.

United States Patent Office 3,465,284
Patented Sept. 2, 1969

3,465,284

MULTIPIN CONNECTOR

Joseph M. McManus, Pasadena, Calif., assignor to Physical Sciences Corporation, Arcadia, Calif., a corporation of California

Filed May 5, 1965, Ser. No. 453,418
Int. Cl. H01r 13/52, 33/06; H01j 5/26
U.S. Cl. 339—196 9 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a multipin connector. More specifically, the invention relates to multipin connectors wherein the individual pins are sealed in position through a crosswall by the use of first insulating members and wherein the first insulating members and the crosswall are covered by a second insulating material so as to provide a multipin connector which is more resistant to the deleterious effects of moisture than prior art multipin connectors.

It is often desirable to use multipin connectors in areas where the atmosphere contains a high degree of moisture. In using connectors in such high moisture areas, it is important to maintain as high a leak path as possible from the individual pins of the connector. In addition, multipin connectors are used in high radiation areas where it is the custom to periodically wash down the equipment which has been subjected to the radiation in order to wash away any radioactive particles which may be adhering to the equipment. In washing down the equipment, the multipin connectors are exposed to large amounts of moisture and, in many instances, large quantities of water may actually collect within the connector.

The multipin connectors of the prior art use ceramic beads to seat, support and insulate the individual pins. Before firing, the ceramic material is composed of many small particles which are held together in a particular form by an adhesive material. The ceramic material is actually formed in the shape of small beads which surround the pins and the ceramic beads and pins are positioned within a series of small cavities located in a crosswall of the connector. The connector is then heated to sinter the ceramic material. As a last step, the ceramic material is fired at a very high temperature so that the ceramic particles melt and flow together.

The ceramic material occupies a smaller volume when in the fired form than the ceramic material did when in the compressed powder form. The decrease in volume of the ceramic material produces a cavity surrounding each pin within the connector at positions between the pins and the closest portion of the crosswall. The cavity has the appearance of a depression in the ceramic material encircling each pin. Moisture collects within these cavities and when the moisture evaporates, mineral deposits are left behind in the cavities. Ultimately, the mineral deposits can build up and form leak paths between the pins and the crosswall. When the resistance of the leak paths is sufficiently low, the connector is no longer usable.

As a first attempt to moisture proof the connector, it was decided to fill the cavities surrounding the individual pins with an insulating material. However, it was difficult to determine the exact amount of insulating material needed to fill the cavities and if insufficient insulating material were used the cavity would still be present, only to a smaller degree. The next approach to filling in the cavities was to cover the entire crosswall with insulating material. However, it was found that not only would the insulating material spread over the crosswall, but the insulating material would also climb the inner wall of the

connector through capillary action. This additional insulating material inside the connector shell restricted the mating of the connector with its complementary male or female connector.

The use of the insulating material to fill the cavities and cover the crosswall was generally a good approach to the problem, so it was felt that means should be tried to prevent the spread of the insulating material to the inner wall of the connector. One method which was tried was the use of a groove surrounding the group of pins. It was felt that the groove would provide a place for excess insulating material to spill. However, it was discovered that, first, the groove was difficult to machine. Second, the groove actually acted as a barrier instead of a spillway and the insulating material tended to collect at the center of the crosswall to form a domed cover of insulating material. It was again found difficult to determine the exact amount of insulating material necessary, and the dome of insulating material could have varying heights. The dome of insulating material also interfered with the mating of the connector with a complementary male or female connector. The various methods mentioned above, although exhibiting certain difficulties, proved at least partially successful in moisture proofing the connector.

The most successful structure for producing a moisture-proof connector and for overcoming the difficulties mentioned above is in the use of a multipin connector which has a large cavity formed in the crosswall. Within the large cavity are a series of small cavities in which the ceramic beads are positioned. The connector uses a series of small cavities positioned within a larger cavity which is recessed in the crosswall of the connector.

The ceramic beads and pins are positioned within the small cavities and the ceramic beads are fired in the usual manner. The larger surrounding cavity then is filled with insulating material. The insulating material fills all of the small cavities and, in addition, provides a layer of insulating material completely across the large cavity. Since the large cavity is recessed below the highest point of the crosswall, the insulating material is also below this highest point. The insulating material, therefore, does not interfere with the mating of the connector with a complementary male or female connector, even though slightly different amounts of insulating material may be required for any individual connector.

The use of the small cavities positioned within a large cavity overcomes the difficulties of the insulating material spreading up the connector wall through capillary action and, also, does not produce a dome-shaped structure which may interfere with the mating. The insulating material may be of the same material as the ceramic beads, or the insulating material may be made of a low-viscosity thermo-setting resin system. The thermo-setting resin system type of insulating material is desirable since it does not have an affinity for water. A second embodiment of the structure mentioned above uses two large cavities in opposite sides of the crosswall. Insulating material is introduced in both cavities to moisture proof the connector even further.

When moisture is introduced within the connector according to the present invention, the insulating material, if designed properly, has a tendency to repel this moisture. Even when some moisture does collect within the connector, the use of the covering of insulating material increases the leak path from the individual pins. This is true since the leak path now is between the individual pins, rather than between an individual pin and the crosswall.

The connector, according to the present invention, therefore, does not break down due to the deposition of mineral deposits as do the connectors of the prior art.

The invention of the present invention application also relates to a specific thermo-setting resin system which can operate over extreme temperature conditions. This is important when the connectors are used, for example, in areas where high radiation is present, since extreme temperatures and high radiation are often found in the same location. The present invention provides a particular insulating material which is adapted to be used for the insulating material of the connectors described above, but the insulating material may be used in other applications which require extreme temperature conditions.

A further explanation of the invention relating to the connector and the thermo-setting material are given in conjunction with the description of the following figures wherein:

FIGURE 1 is a cross-sectional view of a prior art ceramic bead multipin connector;

FIGURE 2 is a detailed view of the positioning of the ceramic bead prior to firing;

FIGURE 3 is a detailed view of the positioning of the ceramic bead subsequent to firing;

FIGURE 4 is a cross-sectional view of a multipin connector using an insulating material wherein capillary action has taken place;

FIGURE 5 is a cross-sectional view of a multipin connector using a groove to prevent the capillary action;

FIGURE 6 is a cross-sectional view of a multipin ceramic bead connector using small cavities positioned within a large cavity;

FIGURE 7 is a detailed view of the ceramic beads covered by the insulating material of FIGURE 6; and

FIGURE 8 is a cross-sectional view of a multipin connector using two large cavities.

FIGURE 1 illustrates a multipin ceramic bead connector **10** constructed according to the prior art. The connector **10** includes an outer shell **12** and a crosswall member **14** extending across the shell which serves as a supporting base. A flange **16** extends away from the shell **12** and is used for mounting the connector. A series of pins **18** are supported by a plurality of ceramic beads **20** within cavities **22** in the supporting base **14**. A lip **24** extends within the cavity **22** to support the ceramic bead **20** until the bead is fired.

In FIGURE 2, a detailed view of the crosswall or supporting base **14** having the ceramic bead **20** contained within the cavity **22** is shown. As can be seen in FIGURE 2, where the ceramic bead is shown in its unfired form, the lip **24** maintatins the ceramic bead **20** from falling through the cavity **22**.

FIGURE 3 illustrates the same detailed view as is shown in FIGURE 2. However, in FIGURE 3 the ceramic bead has been fired to insulate, seal and support the pin **18**. As can be seen in FIGURE 3, when the ceramic bead is fired, it displaces a smaller volume than in its unfired form, and the ceramic bead, therefore, sags to form a cavity **26** which surrounds the pin **18**. The cavity **26** is a likely place for moisture to settle and, even when the moisture evaporates, the mineral deposits which are left behind produce a leak path between the pin **18** and the sidewall of the cavity **22**. This leak path is shown by the arrow **28** in FIGURE 3.

Within a relatively short period of time this leak path **28** exhibits a low resistance due to the collection of the mineral deposits in the cavity **26**. When the resistance of the leak path is low enough, the connector is essentially shorted. One solution to the problem would be to fill the cavities **26** with insulating material so that the moisture would not collect in these areas. However, since it is almost impossible to determine the particular amount of insulating material which would be needed for the individual cavities **26**, a complete covering of the supporting base **14** with insulating material is a more practical solution.

In FIGURE 4, a multipin ceramic bead connector is shown, substantially identical to the connector shown in FIGURE 1, and accordingly identical items are given identical reference numbers. However, in FIGURE 4 a coating of insulating material **100** is placed over the supporting base **14**. Unfortunately, when the connector is heated in order to set the insulating material **100**, the insulating material **100**, due to capillary action, spreads up along the inner wall of the connector shell **12**, as shown at position **102**. This coating of insulating material at position **102** sometimes prevented a proper mating of the connector with a complementary connector. The embodiment of the invention shown in FIGURE 4, therefore, is only partially satisfactory.

FIGURE 5 illustrates an alternative solution to the problem encountered with the connector of FIGURE 4. In FIGURE 5, a groove **200** is cut in the supporting base **14** at a position encircling the pins **18** and adjacent the shell **12**. A covering of insulating material **202** is then placed on the supporting base **14** in order to fill the cavities. This particular structure also has certain difficulties. First, it is difficult to machine the groove **200** in the supporting base **14**, and, also, the groove **200** produces a weakened structure at a point adjacent to the connector shell. More importantly, the insulating material **202**, because of the barrier imposed by the groove **200**, forms a dome-shaped insulating covering **202** and this dome-shaped insulating covering **202** interferes with the mating of the connector with a complementary connector.

FIGURE 6 illustrates a structure which overcomes the difficulties encountered with the embodiments shown in FIGURES 4 and 5. The embodiment of FIGURE 6 uses a large cavity **300** in the supporting base **14**. The cavity **300** is large enough to encompass all of the smaller cavities **22** which are used to support the ceramic beads **20**. The structure of FIGURE 6 then is a series of small cavities, to support the ceramic beads, all contained within a larger cavity, which larger cavity is part of a supporting base contained within the connector shell. Insulating material **302** is then placed in the cavity **300** to fill in the cavity **300**.

The above construction gives several important advantages. First, the construction produces the desired result of filling in the small cavities **26**, as shown in FIGURE 3, where moisture has a tendency to collect and form a leak path. In addition, the structure of FIGURE 6 does not prevent a proper seating of a complementary connector since the supporting base **14** has an upper wall **304** at a fixed distance from the base of the cavity **300**, and the complementary connector always seats against the wall **304**. The insulating material **302** never is higher than the height of the wall **304** and, therefore, the insulating material does not interfere with the seating of a complementary connector. The structure of FIGURE 6 is also as rigid as the connectors of the prior art since the supporting base **14** is not thinned in the area adjacent the outer shell **12**.

As can be seen in FIGURE 7, an important advantage of the structure of FIGURE 6 is that the leak path from the individual pins **18** is no longer between the pin and the sidewall of the cavity **22** as shown by arrow **28** in FIGURE 3, but the leak path is now increased to equal the distance between the pins **18**, as shown by the arrow **306**. This leak path shown by the arrow **306** is greatly increased over the leak path of the prior art connectors, and even if moisture does collect along the surface of the insulating material **302**, the amount of time that is required for the connector to short out is increased due to the increased length of the leak path.

FIGURE 8 illustrates an additional embodiment of the invention similar to the embodiment shown in FIGURE 6. The embodiment of FIGURE 8 includes the cavity **300** in the crosswall **14** as is shown in FIGURE 6, and the cavity **300** is also filled with an insulating material **302**. In addition, the embodiment of FIGURE 8 includes a cavity **400** in the crosswall **14**, opposite to the cavity **300**. The cavity **400** is filled with insulating material

402 for the same reasons as the insulating material 302. It is to be appreciated that the embodiments of FIGURES 4 and 5 may also include additional insulating material for the same purpose as the insulating material 402. It is also to be appreciated that combinations of the embodiments of FIGURES 4, 5 and 6 may be used to provide the double insulation of FIGURE 8.

Another important advantage of the invention is that, although the ceramic material which is used for the beads 20 has certain advantages as to physical strength and insulating ability, this material does not repel moisture. It is possible with the embodiments of the invention to use as an insulating material any appropriate insulating material, including ceramic or glass, to cover the ceramic beads. However, it is desirable to use material which does not have an affinity for water. Accordingly, a particular thermo-plastic resin system was developed which has specific use for the insulating material used to cover the ceramic beads. However, this thermo-plastic resin system may also be used for other analogous insulating situations.

This particular thermo-setting resin system can withstand extreme temperatures and, actually, may be used between the temperatures of −320° F. to +530° F. The particular thermosetting resin system is produced by producing two basic components which are not mixed together until it is time to apply the entire resin over the ceramic beads. The first component of the resin system, referred to as Composition A, consists of a quantity of approximately 80% Bisphenol A (para,para'-isopropylidenediphenol)-Epichlorohydrin, Epoxide Equivalent 175–195, Viscosity Range 500–700 Centipoises (Brookfield), and 20% Bisphenol A (para,para'-isopropylidenediphenol)-Epichlorohydrin, Epoxide Equivalent 185–192, Viscosity Range 1000–1600 Centipoises (Brookfield). These quantities are approximate to withi nplus or minus 5%. The two materials are mixed together and hand stirred for approximately 5 minutes. The shelf life of this basis Composition A is 18 months in a sealed container.

The second basic component, referred to as Composition B, consists of approximately 97% methylbicyclo [2.2.1] heptene-2,3-dicarboxylic anhydride isomers and approximately 3% 2,4,6-tri(dimethylaminomethyl) phenol. These two components may also be varied plus or minus 5%. The two materials are also hand mixed for approximately 5 minutes or until the liquid assumes a medium amber hue which indicates it is stabilized. The shelf life of Composition B is dependent to some degree on storage conditions. If the mixture is stored at temperature below 55° F., crystallization may take place over a 3-month period. However, this condition may be corrected by heating the mixture for approximately 6 to 7 hours at 75° C. However, it is advisable that Composition B not be stored for more than 6 months.

The final step in producing the thermo-setting resin system is to mix approximately equal portions of Compositions A and B shortly before the insulating material is to be applied. The equal portions of Compositions A and B are mixed together for approximately 3 minutes. The resin system has a pot life of approximately 72 hours. However, a viscosity change occurs at about 12 to 14 hours and, in order to be safe, the resin system should be used within 8 hours. If it is desired, any standard epoxy paste dye may be added to Composition A to a maximum of 10% to tint the resin system any desired color. After the resin system is mixed, an appropriate amount of the material is placed within the connector. The resin system is cured or hardened by heating for approximately 1 hour at approximately 100° C. and is then post cured or aged by heating for approximately 4 hours at approximately 140° C.

The thermo-setting resin system as described above has particular utility with the connector of the invention, since this insulating material can withstand extreme temperature extremes. In addition, the insulating material does not have a great affinity for water, and this reduces the moisture collected on the surface of the insulating material, which increases the time in which a leak path develops from the pins of the connector.

It is to be appreciated that the thermo-setting resin system has been described for use with particular connectors. However, it should be apparent that the thermo-setting resin system may be used in other structures to provide an insulating function over extreme temperature conditions and is not limited to this particular structure. Also, it is to be appreciated that the connector of the present invention has been described with reference to particular embodiments. However, other adaptations and modifications of the invention may be made and the invention is only to be limited to the appended claims.

What is claimed is:

1. A multipin conductor including
an outer shell,
a crosswall located within and extending across the shell;
a plurality of openings spaced from each other and with each opening extending through the crosswall,
a plurality of pin members spaced from each other and extending through the openings in the crosswall,
first insulating members located in the openings in the crosswall with the insulating members surrounding the pin members to seat, support and insulate the pin members in the crosswall;
a groove in one side of the crosswall and with the groove enclosing the plurality of openings spaced from each other, and
second insulating material located within the outer shell and covering the crosswall in the area enclosed by the groove.

2. A multipin connector including
an outer shell,
a crosswall located within and extending across the shell;
a recessed area located in the crosswall to form a cavity;
a plurality of openings located in the cavity with the openings spaced from each other and with each opening extending through the crosswall,
a plurality of pin members spaced from each other and extending through the openings in the crosswall;
first insulating members located in the openings in the crosswall with the insulating members surrounding the pin members to seat, support and insulate the pin members in the crosswall, and
second insulating material located within the recessed area to fill in the cavity.

3. A multipin connector including
an outer shell,
a crosswall located within and extending across the shell;
two recessed areas located in opposite sides of the crosswall to form oppositely disposed cavities;
a plurality of openings located in the cavities and extending from one cavity to the other cavity and with the openings spaced from each other and with each opening extending through the crosswall;
a plurality of pin members spaced from each other and extending through the openings in the crosswall;
first insulating members located in the openings in the crosswall with the insulating members surrounding the pin members to seat, support and insulate the pin members in the crosswall;
second insulating material located within one of the recessed areas to fill in one of the cavities, and
third insulating material located within the other of the recessed areas to fill in the other of the cavities.

4. In a multipin connector including an outer shell constructed to mate with a complementary connector,
a metallic crosswall located within and extending across the outer shell,
a plurality of openings spaced from each other and

with each opening receiving an insulating member, and

a groove in one side of the crosswall and with the groove enclosing the plurality of openings spaced from each other and with the groove operating as a barrier to insulation material covering the crosswall within the area enclosed by the groove.

5. In a multipin connector including an outer shell constructed to mate with a complementary connector,

a metallic crosswall located within and extending across the outer shell,

a recessed area located in the crosswall to form a cavity and with the cavities receiving insulation material covering the crosswall within the area enclosed by the cavities, and

a plurality of openings located within the cavity and with the openings spaced from each other and receiving insulating members.

6. In a multipin connector including an outer shell constructed to mate with a complementary connector,

a metallic crosswall located within and extending across the outer shell,

a pair of recessed areas located in opposite sides of the crosswall to form oppositely disposed cavities and with the cavities receiving insulating material to cover the crosswalls within the area enclosed by the cavities, and

a plurality of openings located within the cavities and extending from one cavity to the other cavity and with the openings spaced from each other and receiving insulating members.

7. The connector of claim 5 wherein the insulating material is a thermosetting resin system and wherein the thermo-setting resin system is composed of approximately equal parts of two compositions and wherein one composition includes a mixture of approximately 80% Bisphenol A (para,para'-isopropylidenedipheno)—Epichlorohydrin, Epoxide Equivalent 175–195, Viscosity Range 500–700 Centipoises (Brookfield) and approximately 20% Bisphenol A (para,para'-isopropylidenediphenol)—Epichlorohydrin, Epoxide Equivalent 185–192, Viscosity Range 1000–1600 Centipoises (Brookfield), and wherein the other composition includes a mixture of approximately 97% methylbicyclo[2.2.1]heptene-2,3-dicarboxylic anhydride isomers and approximately 3% 2,4,6-tri(dimethylaminomethyl phenol.

8. A multipin connector including

an outer shell,

a crosswall located within and extending across the shell,

a recessed area located in the crosswall to form a cavity,

a plurality of openings located in the cavity with the openings spaced from each other and with each opening extending through the crosswall,

a plurality of pin members spaced from each other and extending through the openings in the crosswall,

first insulating members composed of ceramic material located in the openings in the crosswall with the insulating members surrounding the pin members to seat, support and insulate the pin members in the crosswall, and

second insulating material composed of a thermo-setting resin system located within the recessed area to fill the cavity.

9. The multipin connector of claim 8 wherein the thermo-setting resin system is composed of approximately equal parts of two compositions and wherein one composition includes a mixture of approximately 80% Bisphenol A (para,para' - isopropylidenediphenol)—Epichlorohydrin, Epoxide Equivalent 175–195, Viscosity Range 500–700 Centipoises (Brookfield), and approximately 20% Bisphenol A (para-para'-isopropylidenediphenol)—Epichloro hydrin, Epoxide Equivalent 185–192, Viscosity Range 1000–1600 Centipoises (Brookfield, and wherein the other composition includes a mixture of approximately 97% methylbicyclo[2.2.1]heptene-2,3-dicarboxylic anhydride isomers and approximately 3% 2,4,6-tri(dimethylaminomethyl) phenol.

References Cited

UNITED STATES PATENTS

2,682,515	6/1954	Naps	260—830
2,970,182	1/1961	Miquelis	174—52
3,007,130	10/1961	Martin	339—218 X
2,735,829	2/1965	Wiles	260—830
3,234,320	2/1966	Wong	174—50.5
3,241,095	3/1966	Phillips	339—99 X

FOREIGN PATENTS

220,308	2/1959	Australia.

OTHER REFERENCES

Lee et al. Epoxy Resins, TP 986, E6L4, New York 1957, McGraw-Hill.

MARVIN A. CHAMPION, Primary Examiner

J. R. MOSES, Assistant Examiner

U.S. Cl. X.R.

174—50.61; 260—830