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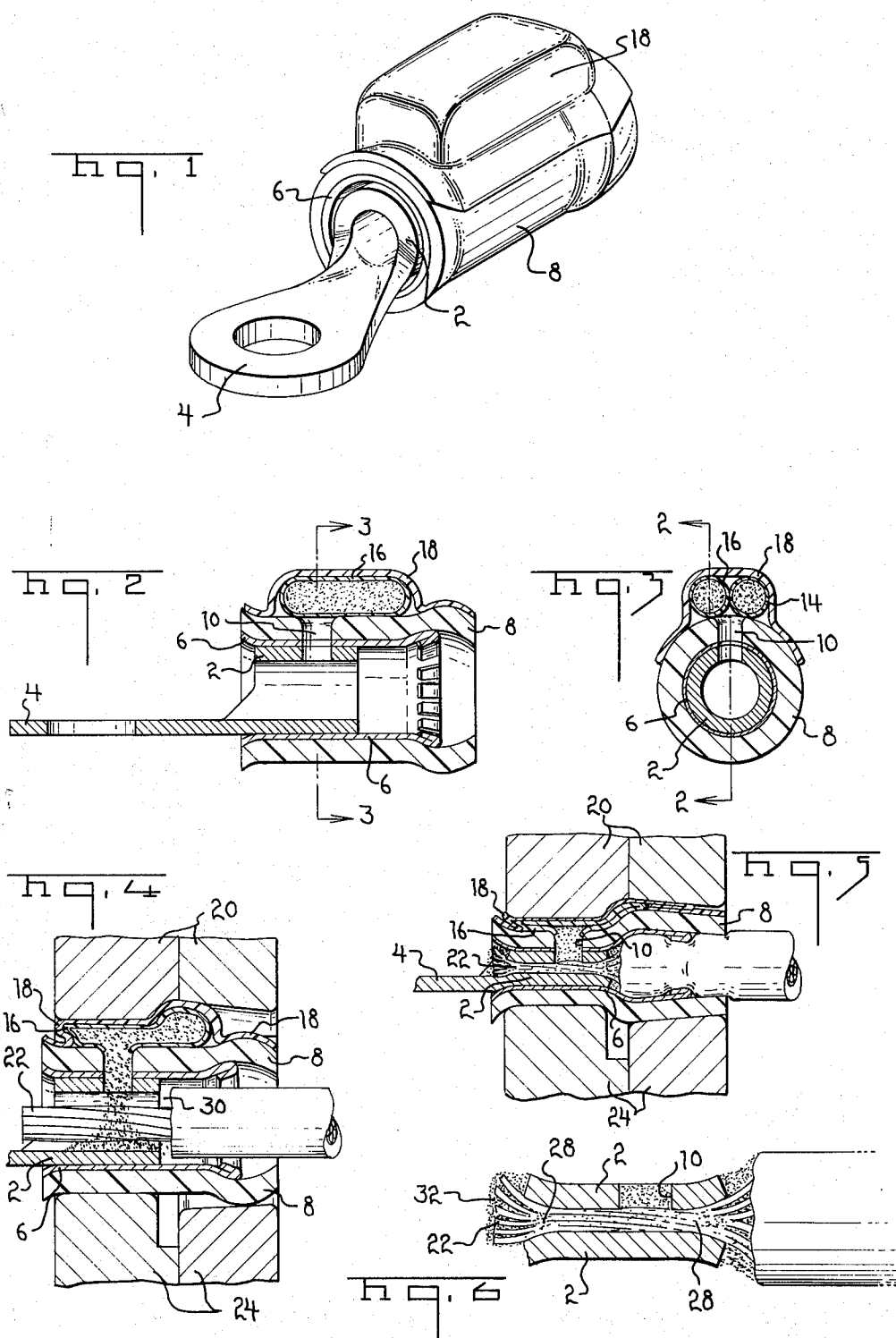
M. S. FRANT ETAL

3,243,758

SEALING OF CRIMPED CONNECTIONS

Filed March 12, 1962

2 Sheets-Sheet 1



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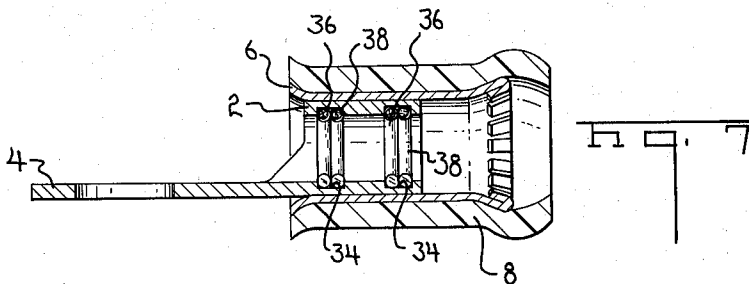
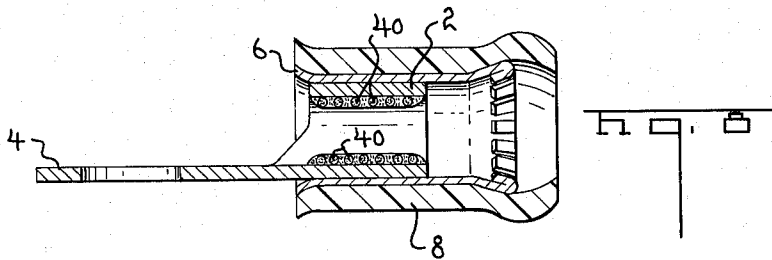
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3,243,758

SEALING OF CRIMPED CONNECTIONS

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This invention relates to crimped electrical connections.

An object of the invention is to provide a crimped electrical connection having an improved resistance to adverse environments. A further object is to provide a crimped electrical connection having improved electrical conductance. A further object is to achieve improved reliability as regards both electrical and mechanical properties of crimped electrical connections. A still further object is to extend the range of wire sizes which can be crimped onto a given connector.

These and other objects of the invention are achieved by providing a film of a room temperature polymerizable monomer, or low molecular weight polymer, mixed with a suitable hardener (i.e., a material which causes polymerization of the monomer upon mixing therewith) at the interface of the wire and connector ferrule during crimping. The monomer or other polymer and hardener mixture is of a nature such that it will wet the surface of the wire and ferrule and effect an improvement in the electrical conductance of the crimp and has a viscosity such that upon crimping it is forced from the areas of extreme crimping pressure. In the finished crimped connection then, these areas of extreme pressure, which constitute the actual areas of electrical contact, are surrounded by the resin and hardener mixture which subsequently becomes firm and hard as the resin polymerizes. The mixture may be applied by merely dipping the end of the wire in a vessel containing the mixture or the resin and the hardener may be separately packaged in or on the connector ferrule in rupturable packaging means. In the latter case, the crimping of the connector causes rupturing of the packaging and mixing of the resin and hardener which is then spread over the interface as described above. Preferred materials for the practice of the invention are room temperature polymerizable polyester and epoxy resins which have the ability to bond to metal surfaces and which improve the electrical conductance of crimped connections. These materials will polymerize rapidly after the crimp is made and will form a continuous impervious matrix in surrounding relationship to the contact areas of the crimp. At the same time, these materials, after polymerization, remain sufficiently tough to withstand mechanical abuse such as vibration without fracture and without breaking the seal of the crimp.

In the drawing:

FIGURE 1 is a perspective view of an electrical terminal having a resin and hardener separately packaged thereon in accordance with the invention.

FIGURE 2 is a longitudinal cross sectional view of the terminal of FIGURE 1.

FIGURE 3 is a view taken along the lines 3-3 of FIGURE 2.

FIGURES 4 and 5 are views illustrating the mixing and distribution of the resin and hardener during crimping.

FIGURE 6 is a cross sectional view of a crimped connection in accordance with the invention, the insulating sleeve having been omitted from this view in the interest of simplicity.

FIGURES 7 and 8 are longitudinal cross sectional views of alternative embodiments of the invention.

In the embodiment of FIGURE 1, a terminal having a tongue 4 and a cylindrical ferrule portion 2 is provided with a metallic sleeve 6 in surrounding relationship to the

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ferrule and a plastic insulating sleeve 8 surrounding the sleeve 6. Pre-insulated terminals of this type are commonly known to the art and are adapted to be crimped onto the ends of wires inserted into the ferrule portion 2. In accordance with this embodiment of the invention, separate containers 14, 16 of a suitable monomer and hardener are mounted on the surface of the sleeve 8 by means of a plastic covering member 18. These containers are disposed adjacent to an opening 10 which extends through the sleeves 6, 8 and the ferrule 2. The containers 14, 16 may be of any suitable material and are advantageously of plastic tubing such as polyethylene, polypropylene or polyester.

In use, the end 22 of a wire is inserted into the ferrule and the terminal is crimped by crimping dies 20, 24 which engage the capsules 14, 16 on the surface of sleeve 8. Upon initial crimping (FIGURE 4), these capsules are ruptured and their contents are admixed and flow through the opening 10 into the interior of ferrule 2 and wet the surface of the wire and the internal surface of the ferrule. Upon further crimping and as the ferrule and wire are pressed into intimate relationship to each other, they are cold forged thereby forming fresh metal-to-metal "virgin" contacts free of oxidation, and the resin and hardener mixture is compressed and squeezed out of, or expressed from, the contact areas of extreme pressure as shown in FIGURE 5. The mixture then surrounds these areas and shortly after crimping polymerizes to form a tough impervious sealing matrix for protecting the electrically conducting portion of the crimp from oxidation and other types of corrosion.

The minimum amount of resin and hardener required for the practice of the invention is the amount sufficient to form a continuous seal in at least one of the zones of contact indicated at 28 in FIGURE 6 on each side of the center of the crimp. The opening 10 is plugged or sealed by the mixture remaining therein so that additional seals at 28 will function to isolate the contact portions of the crimp from hostile environments such as corrosive gases or liquids. The actual amount of hardener and monomer required for this effect is quite small since the wires and ferrule are substantially compressed and are in intimate contact with each other as a result of the crimping. This minimum requirement is the same for crimps made with open-U type ferrules as with cylindrical ferrules of the type shown in FIGURE 6.

Where the invention is used with preinsulated connectors and insulated wire as in FIGURES 1-6, it is feasible to seal the entire end of the wire as well as the crimp itself by using a slight excess of monomer and hardener. Thus, in FIGURE 4, it will be noted that a small gap 30 remains between the end of the insulation and the end of the ferrule (this gap being exaggerated in the drawing in the interest of clarity). If an excess of monomer and hardener is used, some of the mixture will be expressed into and fill this gap and will also exude into the insulating sheath surrounding the wire strands. Upon curing or polymerization of this mixture, the gap is thus effectively sealed and the possibility of corrosion in the vicinity of the gap is obviated. At the other end of the ferrule 2, the expressed mixture will also surround the exposed strands and isolate them from the atmosphere as shown at 32.

As is shown by the examples presented below, the sealing effect achieved substantially improves the ability of the crimped connection to withstand corrosive atmospheres such as salt spray. Additionally, the presence of the monomer and hardener at the terminal and wire interface has the effect of imparting an improved initial conductance to the crimped connection as compared with untreated connections of the same type, as discussed below.

The beneficial effects of using a room temperature polymerizable monomer can also be achieved by simply depositing a small amount of the monomer and hardener mixture on the wire and/or in the terminal barrel immediately prior to crimping. In the case where terminals are being crimped in an automatic or semi-automatic applying machine, this can conveniently be done by means of a separate station adjacent to the crimping station of the crimping press, for example, by means of a nozzle arranged to eject a small amount of the mixture. Alternatively, the end of the wire can be dipped in a vessel containing the monomer and hardener mixture immediately prior to crimping. Where the terminals or connectors are being applied by a hand tool, however, and are in loose-piece form, a packaging arrangement such as shown in FIGURE 1 or as described below is preferable from the standpoint of convenience.

In the embodiment of FIGURE 7, the connector ferrule is provided with internal annular grooves 34 in which there is mounted short lengths of tubing 36, 38 containing the resin and hardener. Again, upon crimping these containers are ruptured and their contents are admixed and flowed over the interface between the wire and the connector.

FIGURE 8 shows an embodiment of the invention in which the internal surface of the ferrule is coated with an epoxy resin as described below which has had its surface polymerized so that the container or packaging means is composed of epoxy resin itself. Such surface polymerization of an epoxy can be achieved merely by passing boron trifluoride, BF_3 , over the surface of the resin. In this instance, the hardener is contained in discrete capsules 40 which in turn are disposed in the resin matrix. Again, upon crimping the polymerized surface is broken and the monomer and hardener are admixed and flowed over the surface of the wire and ferrule.

Alternative packaging arrangements for containing the resin and the hardener within the terminal ferrule can be used if desired. For example, the resin and hardener can be packaged in extremely small capsules rather than the relatively large containers of FIGURE 8, and the smaller capsules can be mounted on the internal wall of the ferrule by means of a suitable adhesive.

The invention can be practiced with any polymerizable resin which has good shelf life and which will flow freely over the wire and ferrule interface at the time of crimping, a room temperature polymerizable resin being preferred. As is apparent from the examples given below, various forms of epoxy resins have given good results and there is a wide choice of epoxy and hardener compositions available for the practice of the invention. In general, these epoxy resins may be characterized as being formed from compounds that have ethylene oxide groups at both ends of the molecule, so that they are capable not only of chain formation but also of cross linking, thus leading to a wide variety of insoluble and infusible substances. At this time the most common materials are made by the condensation of epichlorohydrin with 4,4'-propylidenediphenol, ethylene glycol, glycerol, and related hydroxyl containing compounds. These materials cure into resins without the formation of volatile by-products when reacted with organic bases, acids and anhydrides and a number of compounds containing active hydrogens. Many of the materials currently available are described in the book "Epoxy Resins" by Harry Lee and Curtis Neville, McGraw-Hill, 1957, particularly in chapters 1 and 2.

Following is a discussion of some aspects of crimped connections and a proposed explanation of the beneficial effects of the instant invention. We, however, do not wish to be bound to this explanation or to be limited by it.

It has been found that under some conditions, particularly those involving alternating temperature cycles, the resistance values of crimped connections may increase

by an amount which is of significant proportions. Where the crimped connection is employed in a corrosive environment, such deterioration appears to take place more rapidly than is otherwise the case. It is believed that this deterioration is caused by one or both of two mechanisms. One such deteriorating mechanism is the expansion and contraction which occurs during temperature cycling causing minute voids to be created between the wire and terminal barrel or between wire strands. It is quite possible that an oxide film would be formed in these voids and that upon cooling this film would prevent the termination from closing completely. A process of this type would logically be self-perpetuating and a second exposure to temperature cycling would cause deterioration beyond that of the first cycling.

Another mechanism which possibly contributes to deterioration of crimped connections is that voids will exist on each side of a crimp and extend, like fissures, towards the zone of maximum crimp pressure. These voids may act as capillary wicks for moisture and corrosive salts enabling penetration close to the area of actual metal to metal contact. Again, corrosion at the ends of these voids or fissures would probably be self-perpetuating and lead to further corrosion with passage of time.

It is believed that where a room temperature polymerizable resin is used in accordance with the invention, the fissures at each end of the contact areas of the crimp are filled and sealed so that corrosive gases and liquids are denied access to these areas. The epoxy type materials used have the ability to maintain this seal under relatively extreme fluctuations of temperature so that the seal is not broken when the temperature of the crimped connection rises as where a current overload is applied. Additionally, the epoxy resins apparently remain bonded to the connector ferrule and the wire and their sealing function is unimpaired if the crimped connection is subjected to vibration tests. The ability of the epoxies to withstand both temperature cycling and vibration is shown in some examples given below in which crimped connections were exposed to these conditions and then subjected to salt spray testing. In all cases, crimps in accordance with the invention did not deteriorate during the salt spray tests even though they were subjected to these tests after temperature cycling or vibration. In the same tests, untreated crimped connections did deteriorate as a result of salt spray. Thus, the polymerized epoxy, although hard and impervious, apparently does not fracture or chip when stressed under extraordinary conditions of electrical connector usage.

An additional significant advantage of using an epoxy resin in a crimped connection is that the epoxy confers a substantial improvement to the tensile strength of the connection. In one example given below, it is shown, that, if a connector is purposely undercrimped so that the tensile strength and electrical conductance would be expected to be inferior, good tensile properties can be obtained if an epoxy resin is used in the crimp. The epoxy apparently has the ability to bond to the terminal and wire and carry a substantial portion of any forces applied to the connection. This feature of the invention permits the design of crimpable electrical connectors without the necessity of achieving the required tensile strength by means of the crimp itself; in other words, if the design criteria would dictate a form of crimp which would not give good strength properties, the deficiency would be cured by the use of epoxy resin in the crimp. Additionally, this added strength benefit of the epoxy provides a convenient safeguard in cases where a crimp is improperly formed through carelessness or defective tooling or connectors. Where an epoxy is present, good results can be achieved not withstanding improper crimping.

The beneficial results of the invention are apparently achieved by virtue of the presence of the monomer and hardener at the crimp interface at the time of crimping. It has been found, for example, that mere post encapsula-

tion of a crimped electrical connection does not achieve a lowering of the initial contact resistance, as shown in the examples given below.

In the statistical tables in these examples, data are presented on the average values observed and the 95% confidence limits on each side of the average. These 95% confidence limits were determined by methods explained on pages 18-20 of "Statistical Methods for Chemists," W. J. Youden, John Wiley & Sons, New York, 1951.

EXAMPLE I

A control group of crimped terminations was prepared by using a conventional pre-insulated closed-barrel (i.e., having a cylindrical barrel or ferrule) tin plated connector on a #14, 7-stranded unplated copper wire. Twenty such specimens were prepared. A second group was prepared in exactly the same manner except that the wire was immersed in an uncatalyzed epoxy resin, known commercially as Shell Epon 828, just before crimping. A third group was prepared by immersing the wire before crimping in a polyfunctional alkyl amine, tetraethylene triamine, which is often used as an epoxy hardener. The fourth group was prepared by mixing the commercially prepared resin described above with tetraethylene triamine, immersing the wire into the mixture, withdrawing it almost immediately, and then crimping the wire into the terminal barrel. In the same fashion, five other combinations of commercially available epoxy resins and hardeners were pre-mixed and applied to the wire just before the crimping operation. Resistance readings were taken within 24 hours of the crimping operation and before exposure to any adverse environment. The wires and terminations were then hung overnight in 4% salt spray (ASTM Method B 117-54T) after which the wires were removed, connected into a single string and a 150% current overload (48 amperes) was applied for 8 hours. This cycle was repeated for 5 days and the resistance values again measured. The cycles were then repeated for an additional 7 days, after which the test was discontinued because of the complete failure of the control group. The results are shown in Table I.

TABLE I

Treatment	Cycles	Average MV Drop at 32 Amps.
Standard pre-insulated terminal only	0	8.4±0.9
	5	28 ±0
	12	44 ±8
Pre-insulated terminal plus Epoxy A	0	6.3±0.3
	5	7.1±0.4
	12	7.8±0.4
Pre-insulated terminal plus Epoxy B	0	5.6±0.3
	5	6.3±0.2
	12	6.8±0.2
Pre-insulated terminal plus Epoxy C	0	6.1±0.3
	5	6.9±0.3
	12	7.1±0.3
Pre-insulated terminal plus Epoxy D	0	5.8±0.5
	5	6.6±0.7
	12	6.9±0.4
Pre-insulated terminal plus Epoxy E	0	6.1±0.2
	5	7.1±0.6
	12	7.6±0.3
Pre-insulated terminal plus Epoxy F	0	7.1±0.2
	5	7.8±0.7
	12	7.6±0.5
Hardener only (triethylene tetramine)	0	5.4±0.2
	5	7.3±1.5
	12	13.2±0.4
Resin only (Shell Epon 828)	0	5.8±0.2
	5	6.8±0.3
	12	15.8±1.0

Epoxy A consisted of Shell Epon Resin 828, a liquid having an epoxide equivalent of 175-210 and an average molecular weight of 350-400, hardened by DMP-30 (tridimethylaminomethylphenol).

Epoxy B consisted of the same Shell Epon 828 and diethylene tetramine.

Epoxy C consisted of Ciba Araldite 440, a halogen-containing flame-retardant epoxy resin, and diethylene triamine.

Epoxy D consisted of the same Araldite 440 resin and triethylene tetramine.

Epoxy E consisted of the same Araldite 440 and amino-ethylpiperazine.

Epoxy F consisted of the Shell Epon 828 described above with Bakelite ZZI-0814, an aliphatic amino-ethylene oxide adduct, as the hardener.

From Table I it may be seen that under these test conditions the control samples are useless after 12 such cycles, whereas any of the crimped terminations containing epoxy resin are still stable. In fact, the resistance values after corrosion are below the initial values for control terminals which had not been subjected to the adverse environment.

Further, it can be seen that such results cannot be obtained by using either the resin or the hardener alone, but that both must be present in order to obtain the benefits of this invention. The amine catalyst gives initially improved performance but not subsequent protection.

EXAMPLE II

In order to test the effects of epoxies on the performance of machine applied crimps, a series of tests were run using ring-tongue terminals having open-U type ferrules as shown generally in U.S. Patent 2,600,012. In this series of tests 20 tin plated terminals were crimped onto wires without additives. An additional group of 20 terminals was crimped into wires and an epoxy, Araldite 440 mixed with triethylene tetramine, was provided in the crimp. A third group of unplated terminals were crimped onto wires without treatment and a fourth group of unplated terminals containing Araldite 440+TETA were also crimped onto wires. All groups of terminals were subjected to a 150% overload test for 44 hours and the millivolt drop reading was recorded before the tests and at the conclusion of the tests. Table II presents the data obtained in these tests.

TABLE II

Terminal	Initial Reading, MV.	Final Reading
Tin plated terminal, no additive	21.0±1.5	28.0±5.8
Tin plated terminal, containing Araldite 440 plus TETA	17.9±0.4	17.5±0.3
Unplated brass terminal, no treatment	23.0±1.9	35±10
Unplated brass terminal, containing Araldite 440 plus TETA	17.6±0.6	17.3±0.4

It can be seen from these tests that the use of an epoxy in the crimp significantly reduces the initial resistance values of the crimped connections and for both plated and unplated terminals results in an extremely stable crimp as compared with crimps not having epoxy therein. It is also noteworthy that unplated terminals having epoxy resin in the crimp performed better than the tin plated terminals without epoxy. Under the conditions of this series of tests then, the epoxy would permit the elimination of tin plating as a means of stabilizing crimped connections under conditions of current overload. The data of Table II also clearly show that epoxy resins confer an improvement in the initial electrical conductance of the crimped connection.

EXAMPLE III

In order to determine the effect of the use of an epoxy resin in a crimped connection involving a solid rather than a stranded wire, three groups of 20 pre-insulated closed barrel crimped connections with solid wires were prepared, one group comprising crimped connections between pre-insulated closed barrel terminals and stranded wires, the second group comprising pre-insulated closed barrel terminals with solid wires, and the third group comprising pre-insulated closed barrel terminals crimped onto solid wires but having epoxy (Araldite 440) plus TETA present at the crimp at the time of crimping. The crimped connections of this group were then subjected to an alternating salt spray and current overload tests

as described in Example I. The data from these tests are shown in Table III.

TABLE III

Terminal	No. of Cycles	Millivolt Drop at 32 Amps.
Standard pre-insulated terminal with stranded wire.....	0	15.2±0.4
	20	20±4
	30	25±9
Standard pre-insulated terminal, solid wire, no treatment.....	0	14.9±0.3
	20	25±2.5
	30	1.40
Pre-insulated terminal with solid copper wire and Epoxy 440 plus TETA.....	0	14.1±0.2
	20	14.5±0.6
	30	14.5±0.3

¹ Range 20-56.

EXAMPLE V

Three groups of twelve standard pre-insulated tin plated terminals of the size intended for AWG #14 wire were crimped onto 10-inch lengths of 7-strand wire. The first group was untreated, and the other two groups were treated with epoxy resins as noted in Table V. All samples were aged approximately one week and the resistances were then determined. All samples were then subjected to a standard vibration test (MIL Spec. 7928-C) both parallel and perpendicular to the axis and the resistances again determined. Finally all samples were subjected to one week of salt spray in order to determine if the epoxy in the crimps had failed as a result of the salt spray. The data from this series of tests is presented in Table V.

TABLE V

Treatment		Millivolt Drop at 32 Amps.		
		Before Vibration	After Vibration	After one week salt spray
Standard pre-insulated terminal, no treatment.	Aver. ±95% limits....	4.1±0.2	4.8±0.7	5.1±0.8
	Min.-Max. readings....	3.8-4.3	4.0-8.0	4.0-8.1
Standard pre-insulated terminal containing Shell Epon epoxy resin #828, and diethylene triamine.	Aver. ±95% limits....	3.9±0.2	4.1±0.2	4.1±0.2
	Min.-Max. readings....	3.5-4.2	3.7-4.8	3.8-4.9
Standard pre-insulated terminal containing Ciba Araldite Epoxy Resin #440 and diethylene triamine.	Aver. ±95% limits....	3.8±0.2	3.7±0.2	3.7±0.1
	Min.-Max. readings....	3.4-4.2	3.2-4.0	3.4-4.0

It will be noted from these data that where epoxy is used with a solid wire, the crimped connection remains extremely stable throughout the current overload and salt spray test cycle while solid wire crimped connections without the epoxy deteriorate drastically. The crimped connections with solid wire where epoxy was present at the time of crimping proved to be highly superior to the crimped connections with stranded wire where epoxy was not present. The data of this series of tests thus shows that highly satisfactory crimps can be obtained with solid wires if epoxy is used, and without specialized crimp configurations as have heretofore been commonly used.

EXAMPLE IV

Three groups of machine-applied terminals having originally open-U type ferrules as described above in Example II were crimped onto wire ends. All terminals of this group were tin plated. One group was crimped onto stranded wires with no treatment. A second group was crimped onto a solid wire with no treatment and the third group was crimped onto solid wire and epoxy resin 440+TETA provided at the crimped interface. The terminals of these groups were subjected to the 44 hour 150% current overload test described in Example II. The data from these tests are shown in Table IV.

TABLE IV

Termination	Initial Reading	Final Reading
Tinned terminal, stranded wire, no treatment.....	21.0±1.5	28.0±5.8
Tinned terminal, single strand wire, no treatment.....	20.8±1.5	35±10
Single solid strand, tinned terminal, containing epoxy resin 440 plus TETA.....	19.1±0.5	18.6±0.4

These data again show that highly successful crimped connections can be obtained with solid wire under conditions which have heretofore been considered difficult.

Since the crimped connections containing epoxy resin did not deteriorate after exposure to salt spray these data show that crimps containing epoxy resin are not adversely affected by vibration.

EXAMPLE VI

Three groups of terminals having open-U type ferrules as described generally in U.S. Patent 2,600,012 were crimped onto the ends of wires and were purposely loosely crimped by the same amount so that inferior tensile properties would normally be expected. One group of terminals were untreated, a silicone grease was provided in the second group, and an epoxy resin was provided in the third group. After crimping the pull-out strengths (i.e., tensile strengths) of the crimps were determined. The data obtained are presented in Table VI.

TABLE VI

Termination	Pull-out force in lbs. plus 95% Conf. limits
No treatment.....	45±12
Containing silicone grease.....	30±6
Containing epoxy resin.....	77±11

The minimum acceptable pull-out strength for the wire and terminal used in this series of tests is 60 pounds. The use of an epoxy resin thus confers a substantial improvement on the pull-out strength of a crimped connection and will operate to correct deficiencies in the crimping operation. The improvement is not, however, obtained with a silicone grease.

EXAMPLE VII

In order to determine the effectiveness of epoxy resins on tin plated aluminum terminals and aluminum wires, a first group of such terminals were crimped onto AWG #8 wires in the presence of a joint stabilizing compound comprising a grease mixed with nickel particles as dis-

closed in U.S. Patent 2,869,103. A second group of identical terminals were crimped onto wire ends and a mixture of epoxy resin and hardener and nickel particles was employed for stabilization. Initial millivolt drop readings were determined for all samples which were then subjected to 100-day temperature cycling test in which they were heated to 100° C., left overnight at that temperature, allowed to cool to room temperature for two hours, heated to 100° C., maintained at that temperature for 6 hours, cooled again to room temperature for 2 hours, and then heated to 100° C. and maintained at that temperature over night. The data from this test are presented in Table VII.

TABLE VII

Treatment	Millivolt Drop Readings (recorded at 55 amps.)	
	Initial	After 100 days
Control (as described in U.S. Patent 2,869,103). Freshly-catalyzed epoxy resin plus nickel powder	5.5±0.1	18.8±0.5
	4.9±0.1	16.7±0.5

¹ 25% of valves were greater than 11 millivolts.

² Maximum valve 9.2 millivolts.

The invention is thus applicable to aluminum wires to replace the greases normally used in crimped aluminum connections.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

We claim:

1. An electrical connector comprising a ferrule portion adapted to be crimped onto a wire, a room temperature polymerizable monomer and a hardener for said monomer, said connector including rupturable packaging means containing said monomer and said hardener adjacent to, and discrete from, each other, said packaging means being constructed and mounted on said connector so as to be rupturable upon initial crimping of said connector whereby said monomer and hardener are mixed and flowed over the surface of said wire and ferrule portion, and subsequently the resulting monomer and hardener mixture is forced from areas of extreme pressure at the interface of said wire and ferrule portions whereby the fresh contact areas of the resulting crimped connection are surrounded and sealed by said mixture after polymerization.

2. An electrical connector comprising a ferrule portion adapted to be crimped onto a wire, a liquid treating system having a plurality of components which is activated by a mixing of the components, rupturable packaging means containing said components adjacent to, and discrete from, each other, said packaging means being shaped and mounted on said connector so as to contain the components in sufficiently small, adjacent, and discrete amounts so that upon crimping the components are ef-

fectively mixed and flowed to the contact areas formed of and between said wire and the interior of said ferrule portion, whereby contact areas of the resulting crimped connection are surrounded and sealed by said mixture after activation.

3. A connector as set forth in claim 2 wherein said components are a resin and a hardener which upon mixing form an activated polymerizing resin.

4. A connector as set forth in claim 2 wherein said packaging means containing said components is a plurality of separate capsules.

5. A connector as set forth in claim 3 wherein the packaging means comprises a coating of said resin applied to the interior of said ferrule portion and is contained within a polymerized film of said resin and further having dispersed in said unpolymerized resin discreet capsules of said hardener.

6. A connector as set forth in claim 4 wherein said resin comprises an epoxy resin.

7. A connector as set forth in claim 3 wherein said packaging means comprises capsules containing at least one of said resin and said hardener.

8. A connector as set forth in claim 3 wherein said packaging means comprises capsules containing at least one of said resin and said hardener, said capsules being disposed in said ferrule portion.

9. A connector as set forth in claim 3 wherein said resin comprises an epoxy resin.

10. A connector as set forth in claim 3 wherein said ferrule portion is cylindrical and has an orifice extending therethrough, said packaging means being disposed on the external surface of said ferrule portions and adjacent to said orifice whereby, upon application of crimping dies to said ferrule portion, said packaging means is ruptured and said resin and hardener are released and forced through said orifice thereby being mixed and flowed into the interior of said ferrule.

11. Apparatus as set forth in claim 3 wherein said packaging means comprises plastic tubing containing said resin and said hardener, said tubing being disposed within said ferrule portion.

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