METHOD OF SOCKETING STRANDS
Continuation-in-part of application Ser. No. 439,458, Mar. 12, 1965. This application June 11, 1968, Ser. No. 736,110
Int. Cl. F16g 11/00; B29d 3/00; B29h 9/02
U.S. Cl. 264—263

3 Claims

ABSTRACT OF THE DISCLOSURE
A method of socketing ropes or strands of wire or natural or synthetic fibers, or combinations thereof, in which a cold setting resin is mixed with a controlled amount of particulate elemental thermally conducting metal powder, such as aluminum, the mixed composition being thereafter poured into a socket surrounding the separated strands or fibers therein so as to fill the voids between the strands or fibers whereupon the composition is hardened.

BACKGROUND OF THE INVENTION
The present application is a continuation-in-part of my application Ser. No. 439,458 now abandoned, filed Mar. 12, 1965, and relates to the socketing of ropes or strands of wire or natural or synthetic fibers.

Strands or ropes, whatever their composition, are frequently employed in such a manner that the securing of a terminal attachment at one or both ends thereof, in lieu of a soft or thimbled eye splice, is necessary. At times, it is necessary that the attachment be made on location, in circumstances which prohibit the employment of a naked flame or source of heat. In some cases, the material from which the rope is made will not permit the use of a molten casting material, e.g., zinc or white metal.

In such cases, it is desirable to employ a cold setting material which is capable of satisfying the requirements for field application or socketing under conditions which prohibit the use of molten casting materials or the use of an external heat source. Such cold setting materials are commercially available and include such groups of chemically gelated synthetic resins as cold setting mixtures based upon epoxy resins, cold setting mixtures based upon polyester resins, and cold setting mixtures based upon acrylic resins.

It has been found that when synthetic resins in the above noted categories are cast in relatively large conic masses, as distinct from sheet or small geometric forms, severe stress differentials are set up within the gelated resin which are of sufficient severity to produce both transverse and longitudinal stress cracking to the point of virtual disintegration.

SUMMARY OF THE INVENTION
It is an object of the present invention to provide a method of socketing ropes or strands of wire or natural or synthetic fibers using a cold setting synthetic resin, which method controls the rate of chemically induced exothermic reaction within the mass of synthetic resin once polymerization has commenced.

Another object of the present invention is to provide a method of socketing ropes or strands of wire or natural or synthetic fibers utilizing a cold setting resinous mixture having controlled amounts of thermally conducting particulate metal powder such as aluminum admixed therewith.

Another object of the present invention is to provide a method of socketing as above described which insures that the distribution of heat caused by the exothermic reaction is evenly distributed throughout the resinous mass as gelation proceeds.

A further object of the present invention is to provide a method of socketing as above described which induces a steady heat loss from the interior of the resinous mass once the exothermic reaction reaches an optimum.

A further object of the present invention is to provide a method of socketing as described, which method prevents the premature gelation of random areas within the resinous mass and the subsequent formation of areas of high stress intensity which, eventually, become visible as intermingled transverse and longitudinal stress cracks.

Another object of the present invention is to provide a method of socketing which improves the value of the gelated and cured resin, particularly its resistance to failure under high compressive loads.

In carrying out the above objects of the present invention, a synthetic resin selected from the group of chemically gelated synthetic resins including cold setting mixtures based upon epoxy resins, cold setting mixtures based upon polyester resins, and cold setting mixtures based upon acrylic resins, is mixed with a thermally conducting particulate elemental metal powder such as aluminum to give a homogeneous resin mixture having an aluminum powder range of 55% to 60% by weight. The homogeneous resinous mixture is thereafter poured into a socket which surrounds the rope or separated strands of wire or fibers, with the individual filaments comprising the separated strands being further separated so that the resinous mixture fills the voids between the individual separated filaments. The resinous mixture is thereafter allowed to harden after which the socket may be suitably secured to an article as desired and a loading force applied to the rope.

BRIEF DESCRIPTION OF THE DRAWING
FIGURE 1 illustrates a rope comprised of strands of wire or natural or synthetic fibers having an end portion prepared for pulling into an end termination piece or socket;

FIGURE 2 illustrates the rope of FIGURE 1 having the prepared end portion drawn within the end termination piece or socket; and

FIGURE 3 illustrates the step of pouring the resinous mixture into the end termination piece or socket having the prepared end portion of the rope therein.

DESCRIPTION OF PREFERRED EMBODIMENTS
As used herein, the term "socketing" refers to the affixing of a rope comprised of strands of woven wire or natural or synthetic fibers to an end termination piece such as a yoke, or clevis, or the like, such that a generally axial tension force may be applied to the rope and thereby to an object to which the termination piece is attached. Referring to the drawing, and particularly to FIGURE 1, a portion of a cable or rope is indicated at reference numeral 10 and comprises conventionally woven strands of wire or natural or synthetic fiber elements shown as being separated in brush fashion at 12.

Prior to separating the individual strands or fibers 12 of the rope 10, a socket member or clevis, indicated generally at 14, is placed over the end portion 16. The socket or clevis 14 includes a generally conical shaped wall portion 16 defining a conical cavity 18 therein, termed the "basket," and having a generally axially aligned aperture 20 through the lower end portion thereof. The socket or clevis 14 includes a pair of longitudinal extending opposed arm portions 22 having axially aligned apertures 24 therethrough. The axially aligned
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apertures 24 comprise means to receive a bolt means for connecting the clevis to another article or apparatus (not shown) such as an anchor stud or other actuating member in a conventional manner.

An end length of the rope 10 equal to the clevis basket length A (FIGURE 3) is measured from the outer end of the rope, and a serving means 26, comprising a metallic wire or other suitable cord, is wound around the rope to limit unravelling of the individual strands or wires, the serving means being applied in a conventional manner. The outer diameter of the wire comprising the serving means 26 is such that the serving means will be received within the aperture 20 in the clevis 14 when the clevis is moved upwardly to enclose the outer end of the rope. Preferably, the serving means 26 has a longitudinal length corresponding to the longitudinal length of the aperture 20 in the clevis 14 so as to engage the full length of the aperture. The adjacent convolutions of the wire comprising the serving means 26 are conventionally soldered or otherwise affixed so as to maintain an integral sleeve about the rope 10.

After applying the serving means 26 about the rope 10, the outer end strands or fibers are separated such that the individual wires or fibers form the brush portion 12 which is cleaned of all oil and grease by employing a suitable solvent or other conventional means.

When the individual wires or fibers comprising the outer brush portion 12 of the rope 10 are cleaned and dried, the socket or clevis 14 is moved to a position wherein the serving means 26 is disposed within the aperture 20 and the brush portion of the rope is disposed within the conical-shaped basket portion. The serving means 26 serves to maintain the rope generally concentrically within the clevis 14.

Preferably, a temporary sealant 28, for example, clay, putty or Plasticine, is applied about the rope 10 adjacent to the aperture 20 in the lower end portion of the clevis 14 to prevent ingress of the casting agent while in its fluid state, as will become more apparent hereinafter.

After separating the wires or fiber elements comprising the rope 10 as above described, and positioning the clevis 14 such that the brush portion of the rope is disposed within the conical cavity 18 of the clevis, the rope is ready to be affixed to and within the clevis by pouring the selected casting agent material into the conical cavity 18 such that the casting material fills the voids between the separated wires or fiber elements therein. Noting FIGURE 3, the casting material, indicated at 32, may be poured from a suitable container 30.

The casting material 32 comprises a commercially available cold setting material selected from such groups of chemically gelated synthetic resins as cold setting mixtures based upon epoxy resins, cold setting mixtures based upon polyester resins, and cold setting mixtures based upon acrylic resins. By way of example, two formulas for cold setting materials which may be used for the casting material 32 are set forth.

Example No. 1

The first example employs two grades of polyester resin which are commercially available, along with the requisite catalyst and accelerator, from Bakelite Limited, of England. The aluminum powder should not be coarser than 200 mesh. FIGURE 3 has been found to be permissible. The aluminum powder in the below formula is 15 micron size and is commercially available from F. W. Berk & Co., Limited, of England. The preferred formula is:

<table>
<thead>
<tr>
<th>Parts by weight</th>
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<tbody>
<tr>
<td>Resin SR. 17449</td>
</tr>
<tr>
<td>Resin SR. 17438</td>
</tr>
<tr>
<td>Catalyst Q. 17447</td>
</tr>
<tr>
<td>Accelerator Q. 17448</td>
</tr>
<tr>
<td>Aluminum powder</td>
</tr>
</tbody>
</table>

The resin SR. 17449 is a styrene solution of unsaturated polyester. The resin SR. 17438 is a styrene solution of unsaturated alkyd. The catalyst Q. 17447 comprises sodium peroxide in styrene and provides the oxygen within the resin mixture to permit polymerization and, hence, gelation of the resin. The accelerator Q. 17448 is a cobalt naphthenate in styrene.

To prepare this mixture for casting, weigh or measure the specified quantities of the two resins into a clean, dry container, stirring slowly but thoroughly to ensure a homogeneous mixture free from entrapped air. Add the catalyst Q. 17447, then the accelerator Q. 17448, stirring all the time to ensure that all the components are in one phase. Finally, while still stirring, add the requisite amount of aluminum powder to obtain a homogeneous mixture containing 50 parts by weight aluminum.

Example No. 2

Example No. 2 employs only one polyester resin. Such polyester resin, together with the requisite catalyst and accelerator, is commercially available from Scott Bader Limited, of England, and the aluminum powder is commercially available from F. Q. Berk & Co. Limited, of England.

The preferred formula is:

<table>
<thead>
<tr>
<th>Parts by weight</th>
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<tbody>
<tr>
<td>Resin Crystic 189. M.V.</td>
</tr>
<tr>
<td>Catalyst paste H</td>
</tr>
<tr>
<td>Accelerator E</td>
</tr>
<tr>
<td>Aluminum powder</td>
</tr>
</tbody>
</table>

The Resin Crystic 189. M.V. is an unsaturated polyester resin of medium viscosity. The catalyst paste H comprises sodium peroxide in styrene. The accelerator E is cobalt naphthenate in styrene.

Since only one resin is employed, this eliminates one stage in the mixing operation. Apart from this, however, the mixing procedure is identical to that described in Example No. 1. Also, as in Example No. 1, the aluminum powder should not be coarser than 200 mesh.

In all chemically gelated resin systems, including the foregoing, the resin mixture should, before the actual casting operation, stand at normal atmospheric temperature—59 to 77 deg. Fahr. (15 to 25 deg. cent.)—until an initial reaction commences. A suitable thermal recording device is used to determine this reaction, and, when the gel point has registered a reading of 9 deg. Fahr. (5 deg. cent.) above that initially recorded, gelatin has been initiated and casting should proceed.

The actual casting operation comprises pouring the homogeneous aluminum filled resinous mixture in a steady stream down one side of the interior cavity 18 defined by the conical wall 16 of the clevis 14 until the voids between the separated wires or fiber elements are completely filled and the mixture is level with the uppermost ends of the separated wires or fibers.

When the above-described pouring is completed, the clevis, the retained wire strands or fiber elements of the rope and the homogeneous resinous mixture are allowed to stand undisturbed for about 20 minutes, after which initial loading may be applied to the length of rope without withdrawing the rope from the clevis. It will be understood that the clevis 14 will have been affixed to another apparatus or fixture during this period through inserting a suitable bolt through the apertures 24 and to such other apparatus.

It has been found that aluminum, when added to the selected resin as a particulate elemental powder having a particle size not coarser than 200 mesh in the proportions as above set forth, exhibits the following desirable characteristics in the final socketed rope and clevis:

(a) When added in suitable quantity to the selected resin, the resultant mixture possesses the requisite thermal conductive properties to produce the even thermal distribution needed within the resinous mass.
(b) The more evenly distributed exothermic reaction, resulting from the presence of the powdered aluminum, eliminates the formation of prematurely gelated areas and prevents the formation of focal stress points. The absence of stress points logically eliminates stress cracks.

c) The presence of aluminum does not exert any retardant or poisoning action upon the chemically initiated polymerization of the selected resin.

d) The compressional value of a gelated and cured resin is materially improved when a suitable quantity of aluminum is present. This is a very desirable quality in respect of any casing material employed in the socketing of ropes.

e) Because the aluminum acts as a pigment it produces two-fold protection against degradation from ultraviolet light.

(i) High reflectivity at the surface of the aluminum filled resin.

(ii) Impermeability of the internal mass.

(f) The surface of a resinous mass metallized with aluminum is chemically more inert in marine conditions, i.e., it is non-sacrificial. Hence, aluminum has a marked advantage over zinc which, in similar conditions, is sacrificial and would, in the course of time, permit the surface to become cellular.

While the above described method of socketing has been described in conjunction with the securing of a cable or rope within and to a socket or clevis 14 which is thereafter secured to another member or apparatus, it will be understood that the subject invention finds application in the socketing of cables and ropes to and within similarly shaped cavities of other devices.

It will be obvious to those skilled in the art that changes and modifications may be made in the above described preferred embodiments of my invention without departing from the invention in its broader aspects.

I claim:

1. A method of socketing a rope comprising wire strands or natural or synthetic fibers within a socket member having a cavity therein, comprising the steps of separating at least some of the strands or fibers adjacent an end of the rope, positioning said separated strands within the cavity of the socket, maintaining a cold setting resin mixture having particulate elemental aluminum powder homogeneously mixed therewith at a temperature of between about 59~77°F until an initial reaction commences, pouring said resin mixture into the socket cavity about the separated wire strands or fibers, said particulate aluminum powder being of a particle size such that it will pass through a 200 mesh, and allowing said resin mixture to solidify, said aluminum powder being present in an amount to effect even thermal distribution within the resin mixture and eliminate stress cracking in the solidified resin.

2. A method as defined in claim 1 wherein the aluminum powder is present in the range of 35%~60% by weight of the completed resin mixture.

3. A method as defined in claim 1 wherein the mixture of cold setting resin and particulate aluminum powder comprises approximately 45% by weight of aluminum powder.

References Cited

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