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AD-D001 896

IMPREGNATED AND ENCAPSULATED
WIRE ROPE AND CABLE

DEPARTMENT OF THE NAVY

24 FEBRUARY 1975

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National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

ADD 001896

Serial Number 552,085

Filing Date 24 FEBRUARY 1975

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AD D 001896

1 IMPREGNATED AND ENCAPSULATED WIRE ROPE AND CABLE

ABSTRACT OF THE DISCLOSURE

A stranded cable having corrosion preventive lubrication permanently entrapped within the interstices between the individual strands comprising the cable and encapsulated with an adherent plastic bonded film sheathing in a manner which substantially prevents air pocket formation between the lubrication impregnated cable and the plastic sheath.

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

This invention relates to cables and in particular to helically twisted stranded cables which are impregnated with corrosion preventive lubricant and thereafter encapsulated within a plastic sheathing.

Naval aircraft control cables, such as rudder and throttle control cables, exhibit severe deterioration caused by corrosion, wear and fretting. Corrosion comes about by exposure to humid air and saltsprays; wear progresses as the cables move over pulleys; and fretting occurs as the working control cables flex thereby inducing the individual strands of the cable to rub against each other. Cable deterioration not only reduces flight safety and aircraft flight performance characteristics but also requires extensive replacement of the cables after an undesirably short service life of approximately six months or less. To combat cable deterioration, a currently used cable protection method requires that control cables be

1 subjected to a hot dipping process using a preservative compound. This
method has several drawbacks, however, chief among them being that it
does not maintain adequate lubrication between the individual strands of
the control cables. Furthermore, the currently used cable protection
5 method does not provide for internal and/or external abrasion resistance
or adequate corrosion protection.

SUMMARY OF THE INVENTION

Accordingly it is an object of this invention to provide a method
of cable protection which reduces fretting, increases corrosion resistance
10 and reduces wear. It is a further object of this invention to provide a
stranded cable having lubrication permanently entrapped within the inter-
stices of the strands comprising the cable. It is a further object of
this invention to provide a permanently lubricated, stranded cable having
a closely adhering plastic integument thereon and having substantially no
15 air pockets between the stranded cable and the plastic integument. These
and other objects are achieved as follows.

A stranded cable is degreased and thereafter totally immersed
within a mixture of hexane and lubricant. The immersed cable is placed in
a pressure chamber for a predetermined time to thereby drive the lubricant
20 into all the interstices between the individual strands. After the hexane
has evaporated, the cable surface is wiped clean of excess lubricant and
thereafter provided with a corrosion inhibiting primer. After the primer
has dried, a thermoplastic polymer is applied to the primed cable and
thereafter heat cured to form a closely adhering bonded film integument or
25 sheathing which encases the lubrication impregnated cable.

1 Other objects, advantages and novel features of the invention
will become apparent from the following detailed description of the
invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIG. 1 is a partially cut away view of a cable comprising a
plurality of helically twisted strands encased in an adherent plastic
bonded film sheathing; and

FIG. 2 is a cross section taken at line 2-2 of FIG. 1 showing
the interstices of the cable substantially filled with entrapped lubrica-
10 tion and corrosion preventive.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 there is shown a metallic cable 10 having
six helically twisted outer strands 12 composed of individual wires 14.
The strands 12 are helically twisted about a wire core 16. The cable 10
15 includes an adherent plastic bonded film sheathing 18 which completely
encapsulates the strands 12.

FIG. 2 is an enlarged and exaggerated view of a typical cross
section of the cable shown in FIG. 1. Corrosion preventive lubricant 20
occupies the interstices between the wires 14 comprising the wire core 16
20 and the strands 12 and also occupies the interstices between the individual
strands 12 and the wire core 16. The adherent plastic integument or sheath-
ing 18 surrounds the entire periphery of the cable 10 and serves, among
other things, to entrap the corrosion preventive lubricant 20.

The method of making the article shown in FIGS. 1 and 2 is set
25 forth below.

1 A predetermined length of cable 10 comprising a plurality of
helically twisted metallic strands 12 is first degreased and cleansed by
submersion in hot trichloroethylene at 180° F. to 250° F. for approxi-
mately one hour. Alternatively the cable 10 may be cleansed in a vapor
5 degreasing tank for approximately fifteen to sixty minutes depending on
cable size. Cleansing removes foreign particles and contaminants which
may induce corrosion.

 The cleansed and degreased cable is then immersed in a slurry
contained in a conventional pressure chamber. The slurry is a mixture
10 of a conventional solvent and a thickened, high temperature, synthetic
hydrocarbon grease. The solvent is preferably hexane, heptane or equiva-
lent and comprises 30% to 50% of the slurry. The chamber is sealed and
the pressure in the chamber is raised to approximately 70 to 100 psi air
or nitrogen pressure depending on chamber structure and kept at that level
15 for approximately one and one half hours. (Impregnation time may be reduced
by increasing the applied pressure.) Pressurization of the immersed cable
10 drives the grease into the interstices between the individual strands 12
comprising the cable and simultaneously drives out the entrapped air,
thereby impregnating the grease between the cable strands 12 and wires 14.

20 After the cable has been impregnated it is removed from the
pressure chamber and allowed to air dry for approximately one hour or dry
in an oven purged with nitrogen for approximately 15 minutes at approximately
400° F. Air drying allows the solvent to evaporate leaving behind the grease.
Any excess grease on the exposed exterior surface of the cable is wiped off
25 with a lint free cloth moistened with hexane or other solvent so as to make

1 the cable surface appear clean to the eye. The entire outer surface of
the cable may optionally be provided with a corrosive preventing primer
by spraying or other suitable means and allowed to dry for approximately
one hour.

5 Using a conventional electrostatic deposition method, nylon
powder is applied to the exposed outer surface of the impregnated cable.
The nylon coated cable is cured in an oven at 400° F. to 500° F. for
approximately three minutes to thereby form a closely adhering sheathing
two to seven mils thick. (The grease does not melt because it is a high
10 temperature grease.) It should be noted here that the nylon powder is
applied to a metallic surface which is not clean in the conventional sense.
Even so, the nylon forms a continuous coating which closely adheres to the
exposed exterior surfaces of the impregnated cable. This is a surprising
and wholly unexpected result completely contrary to prior art teachings
15 which generally teach that the metallic substrate must be meticulously
cleansed before applying nylon powder.

The exact interface between the impregnated cable strands 12,
primed or unprimed, and the nylon encapsulation 18 is not clearly definable.
The nylon is not bonded to the metal surface in the conventional sense;
20 rather, the nylon closely adheres to the cable surface by insinuating itself
into the grooves formed by the exposed exterior surfaces of the individual
helically wound strands 12 of the cable. Since the nylon powder is directly
deposited on the exposed exterior surface the impregnated cable 10 and
thereafter heat cured, substantially no air pockets remain between the cured
25 nylon encapsulation and the cable surface. Elimination of air pockets is

1 most desirable since residual air pockets are sources of corrosion and
because air pockets act as reservoirs for lubricants pumped away from
internal areas of the cable 10 by the relative motion of the individual
strands 12 as the cable 10 is worked. Elimination of air pockets or void
5 spaces permits retention of the corrosion preventive lubricant in the
critical interstitial areas of the cable 10.

The nylon powder or other suitable thermoplastic polymer may be
applied to the cable by use of a conventional fluid bed technique rather
than by use of the electrostatic deposition technique. As in the electro-
10 static deposition technique, air pockets are substantially eliminated
since the nylon powder is again directly deposited on the exposed exterior
surfaces of the impregnated cable 10.

By grease is meant a grease or lubrication having a melting point
in excess of 400° F. and exhibiting no corrosion characteristics in the
15 "ASTM" rust preventive properties test, ASTM D1743.

A grease suitable for use in this invention is a thickened synthetic hydro-
carbon oil base grease such as that set forth in Military Specification
MIL-G-81322. Use of high temperature grease prevents its liquification
during the curing of the nylon powder.

20 By primer is meant a corrosive preventing primer suitable for
brush, dip or spray application and capable of curing at approximately 77° F.
within one hour. A primer suitable for use in this invention is Rilsan #104
primer, manufactured by Rilsan Corp., Glen Rock, N. J. Another suitable
primer is that set forth in Military Specification MIL-P-23377C.

25 Application of the primer is optional but desirable in some applications.

1 Should the nylon encapsulation rupture during use of the cable 10, the
primer would react with the metallic strands 12 to protect the cable 10
from deleterious environmental effects. The primer reacts with the
metallic strands 12 to form a protective layer by sacrificial reaction
5 with the corroder.

By nylon powder is meant a conventional electrostatically
deposable thermoplastic polymer. A nylon powder suitable for use in
the present invention is Rilsan nylon 11 natural ES (RDP-15), manufactured
by Rilsan Corp., Glen Rock, N. J. The natural or unpigmented powder cures
10 to a transparent state which permits observation of the underlying cable
while in service. Other thermoplastic polymers, vinyl, or epoxy may also
be used for the plastic sheathing 18.

The method of impregnation and encapsulation is not limited to
metallic cables but may also be applied to cables comprising synthetic
15 fibers. For purposes of maintaining naval aircraft, pressure impregnation
of the grease is desirable since all aircraft maintenance stations have
pressure chambers. However, in lieu of pressure impregnation, the grease
may be impregnated by conventional vacuum techniques. Vacuum impregnation
of cables comprising synthetic fibers is preferred since pressure tends to
20 compress the synthetic strands to a greater extent than metallic strands
to thereby prevent complete impregnation of the grease within the cable
interstices.

The foregoing method of impregnating and encapsulating a stranded
cable is preferably applied to cables which have not yet been placed in
25 service. However, cables which have been used in service may also be

1 protected by the foregoing method if steps are taken to ensure removal
of residual preservative, moisture, salt-water, contaminants and corrosion
products prior to impregnating and encapsulating the cable.

5 From the foregoing it is clear that a superior cable and a method
for making it have been disclosed. Permanently entrapped lubrication
minimizes fretting as the cable is worked and the individual strands flex
against each other; corrosion is minimized by the joint action of a surface
applied primer and a closely fitting plastic sheathing; corrosion is further
minimized by ensuring that substantially no air pockets remain between the
10 cable and the plastic sheathing; and wear is minimized by the protective
action of the plastic sheathing which acts as a buffer between the cable
and pulleys, etc.

Obviously many modifications and variations of the present inven-
tion are possible in the light of the above teachings. It is therefore to
15 be understood that [REDACTED] the invention
may be practiced otherwise than as specifically described.
[REDACTED]

20

25

Fig.1.

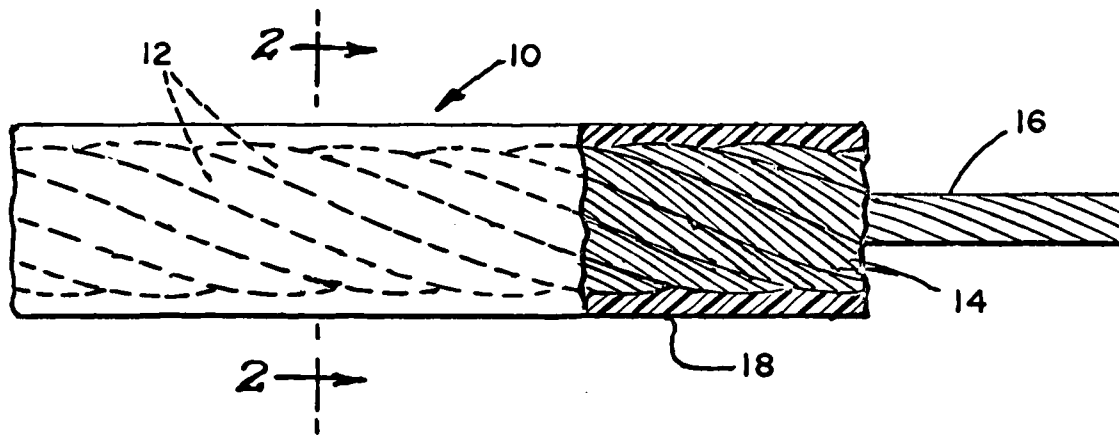


Fig.2.

