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METHOD AND MEANS FOR ELECTRICALLY ISOLATING MARINE PROPELLERS

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2 Sheets-Sheet 1

FIG. 1.

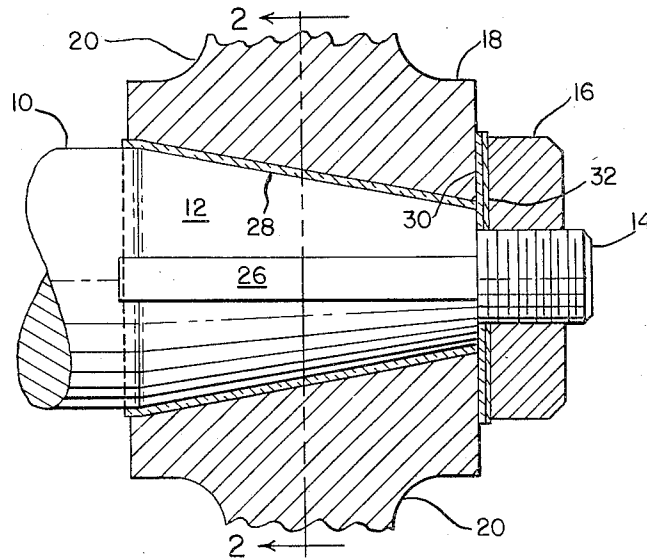


FIG. 2.

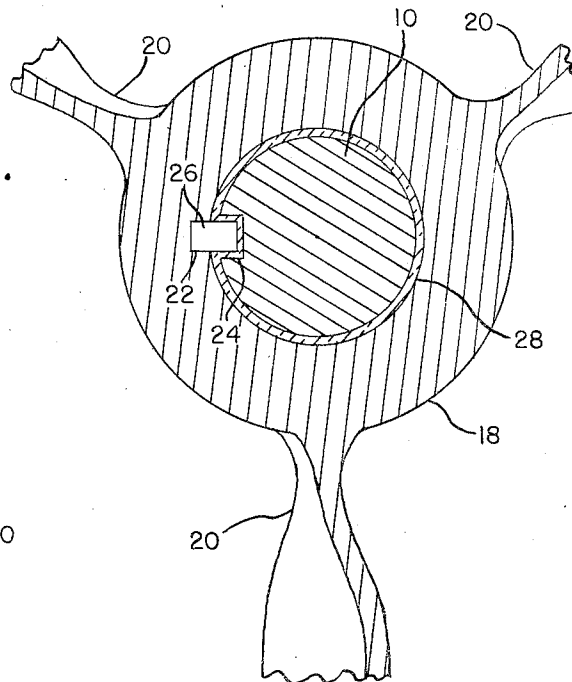
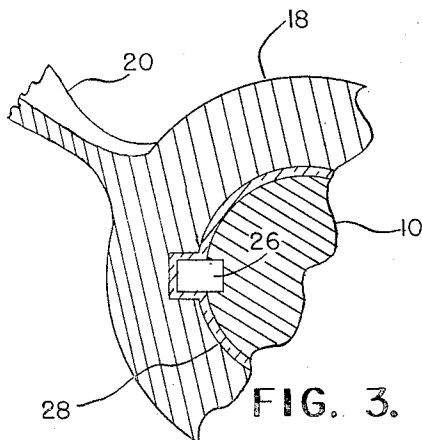


FIG. 3.

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FIG. 4.

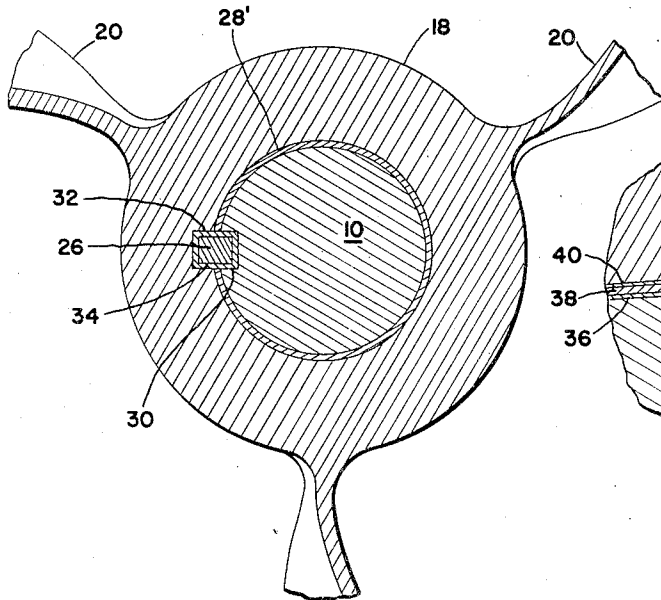


FIG. 5.

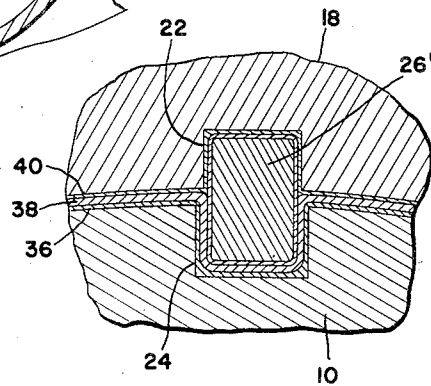
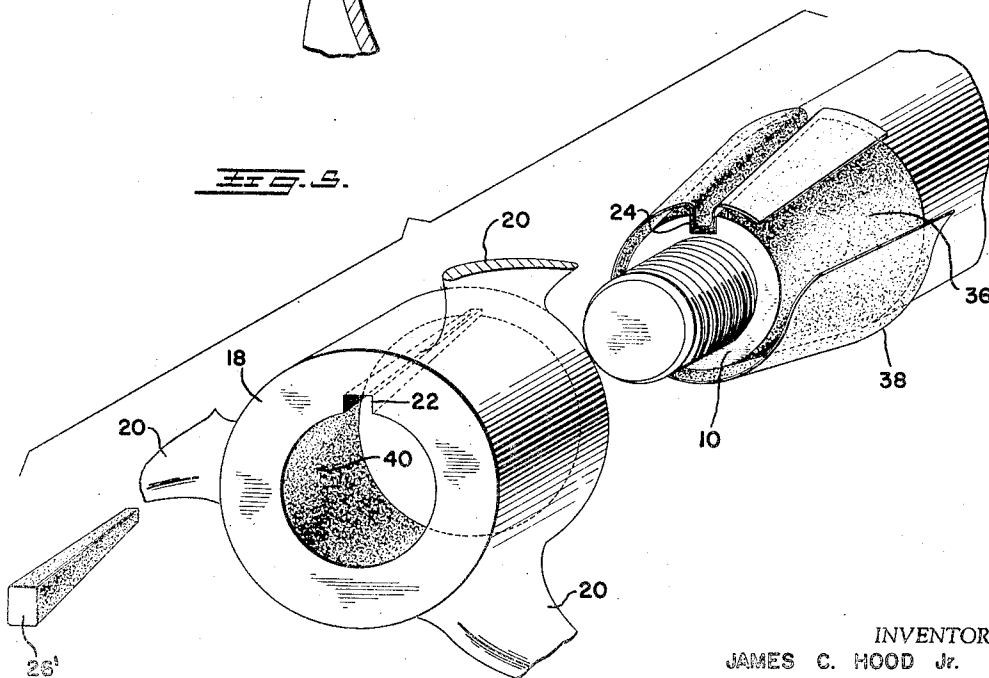


FIG. 6.



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METHOD AND MEANS FOR ELECTRICALLY ISOLATING MARINE PROPELLERS**James C. Hood, Jr., Linesville, Pa., and Herman S. Preiser, North Springfield, Va.****Application June 29, 1956, Serial No. 595,029****8 Claims. (Cl. 170—173)****(Granted under Title 35, U.S. Code (1952), sec. 266)**

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.

The present invention relates to insulating sleeves and more particularly to a plastic laminate sleeve used in the electrical isolation of metallic parts forming a galvanic circuit in the propelling apparatus of a marine vessel and a method of applying the same to said apparatus.

This application is a continuation-in-part of the applicants' copending application Serial No. 490,709, filed on February 25, 1955, entitled, "Plastic Sleeve for Electrically Isolating Marine Propellers," now abandoned.

The naval and merchant fleets have been confronted with a serious problem of corrosion of shafting, struts, rudders and stern areas of vessels, and this problem has become acute because of the modern practice of utilizing metals of different types in these areas of the vessel. This disease of deterioration can be traced to two prime sources of infection; namely, cavitation defects at the stern and galvanic corrosion currents existing between the bronze propeller members and the steel members comprising the hull and the shafting.

The concept of preventing electrolytic action by breaking a galvaic circuit is old. The prior art discloses use of insulating bushings between a rotary shaft and a metallic housing for the bushings which support the rotating shaft. The bushings eliminate electrolytic action occurring between the shaft and bearing in which sea water serves as an electrolyte for completing the circuit.

This invention is directed to and eliminates the problem of galvanic corrosion associated with the propeller hub, shafting and stern of a ship. It is accomplished by isolating the propeller hub and attached blades from the shaft by interposing an insulating material between the hub and shaft taper. This insulating material consists of a plastic member which serves to remove the large cathodic area of the propeller from the steel shaft and hull system (anodic areas) thereby reducing the galvanic corrosion normally taking place between these parts.

It is therefore an object of the invention to provide a plastic insulator for insulating contacting metals in an electrolyte.

Another object of the invention is the provision of a plastic sleeve for isolating a propeller and blades from the shaft and other stern parts of a ship.

Still another object of the invention is the provision of a plastic sleeve for electrically isolating a propeller hub and blades from a keyed shaft and other stern parts of a ship.

A further object of the invention is the provision of a plastic sleeve for prohibiting galvanic corrosion of a hull and other stern components of a ship in metallic contact with the more noble propeller.

A still further object of the invention is the provision of a sleeve of molded glass cloth laminated material serving as an insulator between a propeller hub and shaft

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and for providing ease of assembly in mounting the hub on the propeller shaft.

An additional object is to provide a simple and inexpensive method of applying an electrically insulating sleeve to the propeller shaft of a ship so as to electrically insulate said shaft from a propeller mounted thereon.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a view in elevation, partly in section, showing the position of a plastic sleeve relative to a propeller hub and tapered shaft;

Fig. 2 is a view taken on line 2—2 of Fig. 1 showing the arrangement of the plastic sleeve in a keyway formed in the propeller shaft body;

Fig. 3 is a view showing a modification of the sleeve shown in Fig. 2;

Fig. 4 is a sectional view showing a modification of the sleeve and key shown in Figs. 2 and 3;

Fig. 5 is a perspective view, showing a preliminary stage of assembly, of a modification of the plastic sleeve, tapered shaft and propeller hub arrangement of Figs. 1—4; and

Fig. 6 is a sectional view, in assembled form, of the structure shown in Fig. 5.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Figs. 1 and 2, a propeller shaft 10 provided with a reduced portion 12 tapering inwardly towards the end of the shaft. The shaft is provided with an extension 14 which is exteriorly threaded for receiving a nut 16 rigidly securing propeller hub 18 to the shaft. The hub is of the usual streamlined contour having openings extending around its periphery for receiving a plurality of blades 20 which are either fixed or rotatably mounted therein. Both the hub and the shaft are respectively provided with channel-like openings 22 and 24 which, when aligned, are adapted to receive a key 26 for preventing relative rotary movement of the hub on the shaft.

Interposed between the tapered end 12 and hub 18 for prohibiting galvanic corrosion is a thin sleeve of polyester-glass laminate 28. The insulation is made complete by a washer 30 composed of the same material, and being backed by a metallic disc 32 which prevents the plastic from tearing when the bolt 16 is tightened on the shaft. The laminate consists of from three to five layers of an .006"—.008" thick glass cloth thoroughly impregnated with a thermosetting resin. The laminate sleeve is made in matched metal molds so as to be of uniform thickness and consistency in material.

It will be noted that the modification of Fig. 2 shows the type of sleeve that is molded with a keyway adapted for fitting the channel formed in shaft 10. When this type of sleeve is used the parts are assembled by placing the sleeve on the tapered shaft so that the channel of the sleeve snugly fits the keyway provided in the shaft. Key 26 is inserted therein and the propeller hub subsequently pressed on the tapered end of the shaft with pressures of in the neighborhood 30,000 p.s.i. Washer 30 and nut 16 are then attached for completing the assembling operation.

The modification of Fig. 3 is similar to that of Fig. 2 with the exception that the sleeve is molded in such fashion to fit the keyway provided in hub 18. In this construction, the sleeve is molded around the metal key so as to make fitting of the sleeve and key into position an integrated operation.

The modification of Fig. 4 is similar to that of Figs. 2 and 3 with the exception that the insulating sleeve 28' is of a size such that it covers the portion of the shaft

10 which is adapted to be overlaid by hub 18, but minus the keyway lining portion shown in the modifications of Figs. 2 and 3. The sleeve 28' instead of being completely tubular, is provided with a longitudinally extending slot of the same width as keyways 30 and 32 in the shaft and propeller hub respectively, and adapted to coincide therewith in the manner shown.

The key 26 is insulated from the adjacent walls of the respective keyways 30 and 32 by means of a plastic sleeve 34 of either the same or similar material as sleeve 28', and adapted to fit within both keyways 30 and 32 in the manner shown in Fig. 4. In this construction the hub is assembled on the shaft, with the respective keyways in alignment, and the keyway insulator sleeve 30 is placed within said keyways, as shown; the key 26 is then placed within the sleeve 34 and driven into place. This modification, as can be seen in Fig. 4, serves to completely electrically insulate the shaft 10 from the hub 18, and also the key 26 from both the shaft and the hub.

The modification shown in Figs. 5 and 6 differs from those described above in that the insulating sleeve is formed directly on the shaft 10 in a manner hereinafter described, instead of being pre-molded.

The method for forming the modification of Figs. 5 and 6 is known as the wet-lay-up method, and consists of applying a coating of thermosetting resin 36 to the tapered portion of a shaft 10 and the keyway formed therein, followed by the application of a proper size layer of glass fabric 38 on top of the resin; the combination is then subjected to heat sufficient to cause the resin to set and thereby hold the glass fabric on the shaft. It is pointed out that either a polyester or an epoxy resin may be used.

One example of a suitable resin mixture comprises an epoxy resin, such as bisphenol-epichlorohydrine plastic compound, combined with a suitable hardener such as either an amine or an acid type catalyst system, said mixture also containing a small amount of poly-sulfide rubber compound. Listed below are a number of commercially available epoxy resins along with their accompanying hardening agents:

Epoxy Resin	Hardener
Shell Epon 828.....	Diethylene Triamine.
Ciba 502.....	Piperidine (Acid type catalyst).
Hysol ERL 2774.....	Hysol ZYL 0803.

The following is an example of an epoxy resin mixture used in carrying out the applicants' method; the proportions are by weight:

	Percent
Epoxy resin—Hysol ERL 2774	62
Hardener—Hysol ZYL 0803	33
Thiokol (polysulfide rubber compound)—LP-3.....	5

As previously pointed out, a polyester resin may be used instead of an epoxy resin. A suitable polyester resin is one comprising a mixture of unsaturated polybasic acid and polyhydric alcohol, said mixture being cross linked with a suitable chemical agent such as styrene. The following are given as examples of the mixture referred to above:

(1) Mixture of ethylene glycol and either maleic acid or anhydride.

(2) Mixture of ethylene glycol and either phthalic acid or anhydride.

Polyester resins of the above type are available under the following tradenames:

Marco 28-C
Laminac 4110
Selectron 503

One method of applying an insulating sleeve to non-keyed propeller shaft in accordance with this invention consists of the following steps:

(1) The propeller hub and shaft are roughened with, for example, an aloxite cloth, and then cleaned with a solvent.

(2) A thin coat 36 of epoxy resin, mixed in the proportions set forth above, is applied to the shaft and hub and then cured with heat lamps.

(3) After suitable setting period, a single layer of glass cloth 38, for example, style 181, finish Volan A, is cut to fit the tapered section of a shaft. Another coat of resin is applied to the shaft, and the glass cloth is set in the resin, the cloth being worked by hand to free entrapped air and to insure a good fit. The resin is again cured with heat lamps or the like.

(4) After the resin has thoroughly hardened, the overlapping glass fabric seam, if any, is sanded smooth.

(5) Both the shaft and the hub are again coated with epoxy resin and the two parts are assembled; the assembly is heated for 36 hours by infra-red heat lamps, or the like, and a suitable interval is allowed for the resin to set, after which the assembly is ready for use.

In applying an insulating sleeve to a keyed shaft, the same steps are followed, with these modifications:

After step No. 4, the shaft and keyway provided therein are machined to proper dimensions, following which step 5 is carried out, with the keyway in the hub, and the key itself being resin coated.

In applying this method to a keyed shaft, the key 26' and respective keyways are provided with a modified double-tapered construction with rounded edges to permit easy driving without damage to the plastic sleeve. See Fig. 5.

It is pointed out that conventional propellers in use today require a keyed, tapered mechanical connection between the propeller hub and tail shaft. The key is necessary to insure foolproof mechanical linkage between propeller and shaft. The existence of this key and keyway makes it extremely difficult to electrically isolate the propeller from its shaft and still maintain foolproof mechanical linkage. This invention teaches the use of a laminated plastic sleeve for insulating a keyed shaft from a propeller hub and a method for applying the same to said shaft.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A device for electrically insulating parts of a propeller combination made of different conductive materials comprising, a propeller shaft made of a first metal, hub means having radially extending blades made of a second material rigidly affixed to said shaft, a pair of coating keyways respectively formed in said shaft and hub means and being provided with a key for preventing relative movement therebetween, a plastic insulating sleeve between said shaft and hub means, said plastic insulating sleeve on said shaft extending over the entire area of said shaft that is normally overlaid by the hub means, thereby electrically isolating said shaft from said hub means.

2. The combination according to claim 1 wherein said plastic insulating sleeve comprises a portion adapted to fit within the keyway provided in said shaft.

3. The combination according to claim 1 wherein said plastic insulating sleeve is shaped to fit over said key for separating said shaft from said hub means.

4. A device for electrically insulating parts of a propeller combination made of different conductive materials comprising a propeller shaft made of a first metal, hub means having radially extending blades and made of a second metal, said hub means being rigidly affixed to said shaft; a pair of coating keyways respectively formed in said shaft and hub means and being provided with a key for preventing relative movement therebe-

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tween; a plastic, electrically insulating sleeve on said shaft between the shaft and the hub means and covering the area of the shaft that is overlaid by the hub means, said sleeve comprising a portion that overlays one of the keyways, thereby electrically isolating said shaft from said hub means.

5. A device for electrically insulating parts of a propeller combination made of different conductive materials comprising, a propeller shaft made of a first metal, hub means having radially extending blades and made of a second metal, said hub means being radially affixed to said shaft; a pair of coacting keyways formed in said shaft and hub means respectively, a key located in both keyways for preventing relative movement between the shaft and hub; a plastic, electrically insulating sleeve on said shaft extending from one edge of the keyway in said shaft around the shaft to the opposite edge of said keyway and being free of contact with the walls of the keyway, said insulating sleeve covering the area of the shaft that is normally overlaid by the hub means; a second plastic, electrically insulating sleeve surrounding said key and serving to insulate said key from the walls of the keyway in the shaft and the keyway in the hub, whereby said shaft is electrically insulated from the hub and said key is insulated from the side walls of the respective keyways, thereby providing complete electrical insulation between said shaft and said hub.

6. A device for electrically insulating parts of a propeller combination made of different electrically conductive materials comprising, a propeller shaft made of a first metal, propeller hub means made of a second metal and rigidly affixed to said shaft, said shaft and said hub each being provided with a keyway, said keyways being aligned with one another; a key within said keyways, a plastic electrically insulating sleeve between said shaft and said hub, and covering the walls of the keyway in said shaft, said sleeve being resin bonded to said shaft, keyway and hub.

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7. A combination according to claim 6 wherein both keyways, and said key member, are of the double-tapered type and are provided with rounded edges, whereby driving of said key into said keyway is facilitated and damage to said plastic sleeve is prevented.

8. A device for electrically insulating parts of a propeller combination made of different conductive materials comprising a propeller shaft made of a first metal, a hub means having radially extending blades and made of a second metal, said hub means being affixed to said shaft; a pair of coacting keyways formed respectively in said shaft and said hub means, and a key in said keyways for preventing relative movement therebetween; a plastic, electrically insulating sleeve bonded on said shaft between the shaft and the hub means and covering the area of the shaft that is overlaid by the hub means, means bonding said hub to said sleeve whereby said hub member is bonded to said propeller shaft in electrically isolated relation thereto.

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