United States Patent

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[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] **PAYOUT COIL IMPREGNATED WITH CONDUCTIVE ADHESIVE**
7 Claims, 2 Drawing Figs.

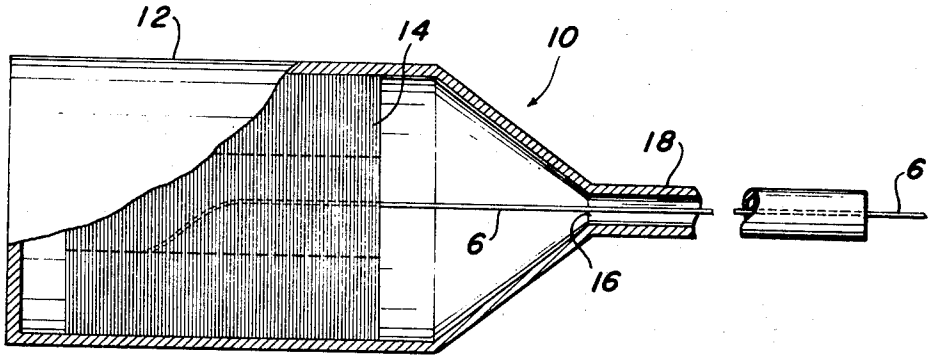
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[51] **Int. Cl.** **F42b 19/06**
[50] **Field of Search** 114/21; 174/235; 244/3.12

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ABSTRACT: A wire-guided torpedo payout coil including a container which has an exit opening; a coil of insulated wire disposed within the container with a portion of the wire extending through the exit opening; and the voids within the coil of wire being filled with a conductive adhesive, such as an adhesive mixture of silicone fluid and graphite, such as carbon black.



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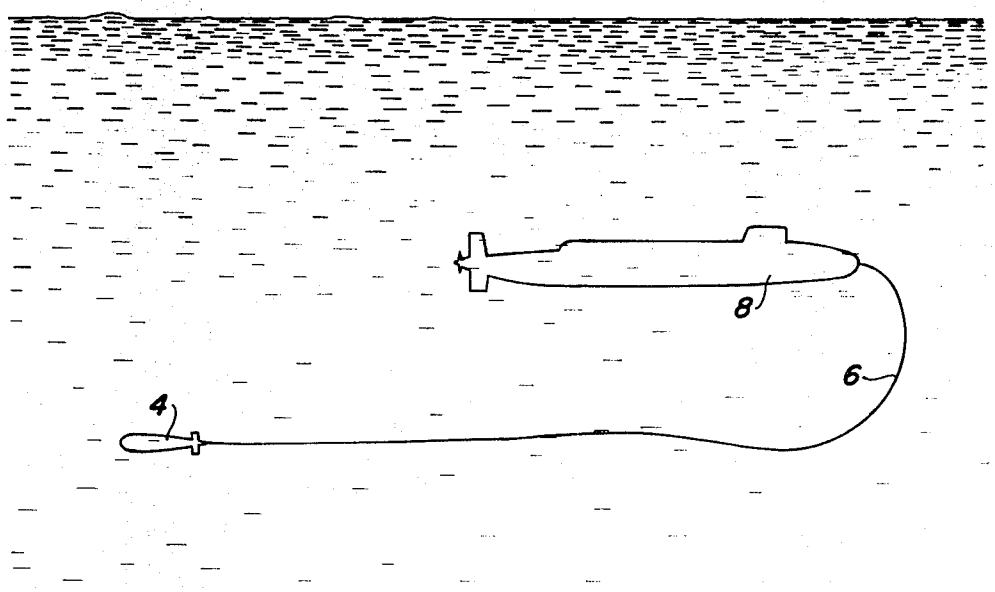


FIG. 1

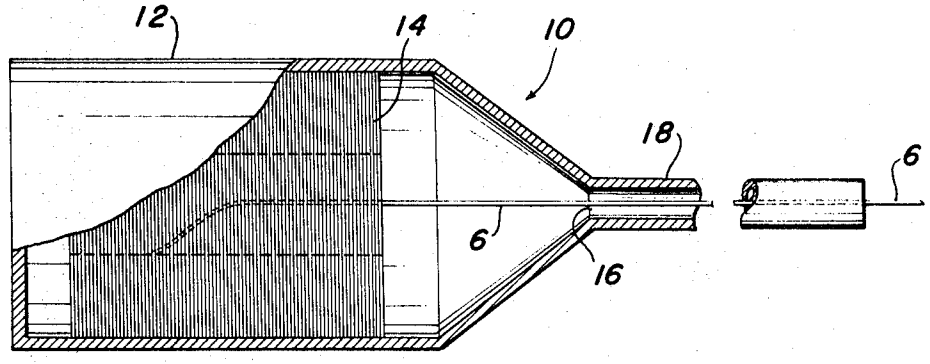


FIG. 2

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PAYOUT COIL IMPREGNATED WITH CONDUCTIVE ADHESIVE

In the wire-guided torpedo concept control signals are telemetered from a mother vehicle over a very fine insulated wire to a torpedo. Since it is anticipated that both the vehicle and the torpedo are moving in the water the wire is disposed in a coil at both locations. Accordingly, as either or both the vehicle or torpedo move in the water the wire is freely payed out and lays substantially motionless in the water so that there is practically no strain thereon.

At the torpedo location the payout coil is disposed within a container which has an exit opening. In many applications a long slender tube about one-fourth inch in diameter extends aft in the torpedo from the exit opening of the container, and wire from the payout coil extends therethrough to the mother vehicle. Normally the container and the coil of wire disposed therein are submerged in a salt water environment and sea water will nonuniformly penetrate the voids within the coil of wire. It can readily be visualized that when the torpedo is being controlled at a speed of about 30 knots the wire is uncoiling quite rapidly and thereafter spins within the sea water in the container until it travels through the slender tube. In order to prevent multiple turns of the wire from uncoiling simultaneously from the coil during payout the prior art teaches the use of a rubber base adhesive which binds the individual turns of wire of the coil. This adhesive is applied in a wet state to the wire as the coil is being wound and it only partially fills the void space between the turns of wire. As a result sea water penetrated the voids within the coil nonuniformly and the payout-restraining force of the coil was somewhat nonuniform.

As a result of this variation of sea water penetration into the coil, it has been very difficult to predict the electrical characteristics of the coil during payout. The shunt capacity of the coil varies during payout since the sea water nonuniformly penetrates the voids left in the coil by the rubber base adhesive. It would be highly desirable if the very fine filament wire of the coil would behave like a coaxial conductor with the outer conductor conductive enough to provide a shunt capacity for the coil which is substantially fixed over the frequency band which is used for communication between the mother vehicle and the torpedo. As a means to provide this advantage we have tried a wire with a very thin copper sheath. However, this process is quite expensive.

As mentioned hereinabove one of the disadvantages of utilizing a rubber base adhesive for the coil of wire is that the restraining force is nonuniform during payout. This is due again to the partial filling of the rubber base adhesive within the voids of the coil of wire. Still another serious disadvantage of using the rubber base adhesive is that when torpedoes are operated at speeds greater than 30 knots the adhesive often collects in a large mass in the payout tube of the coil container and imposes an undesirable restraining force on the very fine filament wire as it is payed out through the tube. At speeds of 40 knots and above this force has been sufficient to break the wire and cease communication between the mother vehicle and the torpedo. Yet another problem with the rubber base adhesive is the low ratio of tack force to peel force on the individual turns as they are payed out from the coil. A high tack force is desirable to that adjacent turns will not uncoil simultaneously. A low peel force is desirable so that little force is required to peel the individual turns from the coil. With the rubber base adhesive the peel force has been too high and when speeds of 40 knots or greater are involved breakage of the wire is quite probable.

We have overcome the aforementioned problems associated with the use of rubber base adhesives by impregnating the payout coil with a conductive greaselike material. Specifically, we have discovered that a mixture of silicone fluid and carbon black has worked quite satisfactorily in overcoming the aforementioned problems. With a proper mixture of silicone fluid and carbon black all voids within the payout coil are filled and the ratio of tack force to peeling force on the individual turns is kept quite high as they pay out. The peeling force is significantly less than that which is characteristic to the rubber base adhesive. The conductive particles within the mixture establish the turn-to-turn capacitance of the coil and provides shunt capacitance over the entire length of the wire within the coil so that the capacitance effect of the coil is substantially uniform during payout. We have found that acetylene carbon black is especially desirable in the mixture for this purpose. No mechanical difficulties have been experienced with the mixture since the fluid mixture imposes no restraining force on the wire as it is payed out through the slender tube.

An object of the present invention is to overcome the aforementioned problems associated with prior art torpedo payout coils.

Another object is to provide a torpedo payout coil which imposes substantially no electrical and/or mechanical problems to communication between a mother vehicle and the torpedo even though the torpedo is controlled at speeds greater than 40 knots.

Still another object is to provide an adhesive-impregnated torpedo payout coil wherein the adhesive completely fills the voids within the coil and minimizes undesirable capacitance effects of the coil to communications between the mother vehicle and the torpedo.

A further object is to provide an adhesive-impregnated torpedo payout coil wherein the adhesive provides desirable electrical conditions and does not impose undue restraining force on the wire as it is payed out from the torpedo.

Still a further object is to provide adhesive-impregnated coils of insulated wire which have predictable electrical characteristics.

Other objects and many of the attendant advantages of this invention will be readily appreciated as it becomes better understood by reference to the description and accompanying drawings which follow.

FIG. 1 is an ocean view of a mother vehicle controlling a wire-guided torpedo.

FIG. 2 is a side view partially in cross section of a torpedo coil payout apparatus.

Referring now to the drawing there is shown in FIG. 1 a torpedo 4 which is guided by a very fine insulated wire 6 from a mother vehicle, such as a submarine 8. In the after portion of the torpedo is a wire payout apparatus which is illustrated generally at 10 in FIG. 2. This payout apparatus 10 may include a container 12 and a coil 14 of the very fine insulated wire 6 disposed therein. The coil 14 illustrated is an inside payout-type coil, however, it could, if desired, be the outside payout type of coil. The aft end of the container 12 may neck down to an exit opening 16 where there is mounted a slender tube 18 which also extends in the aft direction. A portion of the wire 6 from the coil 14 extends through the tube 18 and thence to the submarine 8 which telemeters signals via the wire for controlling the torpedo. The payout apparatus 10 is mounted in the aft portion of the torpedo and the interior of the container 12 is normally flooded with sea water. The submarine may have a similar payout apparatus as the payout apparatus 10 shown in FIG. 1.

All voids within the coil 14 are filled with a conductive binder which is a mixture of fluid and conductive particles. We have found that a mixture of silicone fluid and carbon, such as carbon black, works quite satisfactorily for our intended purposes. The best results were achieved when the carbon black was acetylene carbon black. Acetylene carbon black has long slender molecules which easily contact one another within the silicone fluid so that a desired mixture can be prepared which easily fills all of the voids within the coil 14 and provides good shunt capacitance between all portions of the wire within the coil. A mixture of silicone fluid and acetylene carbon black can be easily prepared with the following desirable parameters: (1) a viscosity of 300 poises at a temperature of 77° F. and at a shear rate of 50 reciprocal seconds as determined by Federal Test Method Standard No. 791, Method 306.4; (2) a worked penetration of 250 to 290 at

77° F. as determined by Federal Test Standard No. 791, Method 311.6; and (3) a DC resistance of 20 ohm-centimeters at 77° F. when the resistance of a sample of the mixture is tested in a DC bridge or its equivalent. We have found a mixture of silicone fluid and acetylene carbon black in the following ratio to meet the aforementioned parameters:

7 parts by weight silicone fluid such as GE SF96(100) (100 centistokes viscosity); and

1 part by weight acetylene carbon black such as Shawinigan acetylene black (100 percent compression).

The ingredients must be thoroughly combined so that the mixture is homogeneous.

In the preparation of the payout coil **14** the wire is wound on an ordinary spooling machine and mixture of silicone fluid and acetylene carbon black is extruded onto the wire just prior to the spooling operation. The process would be the same whether the coil of wire is of the inside or outside payout type. Because of the desirable characteristics of the mixture all voids within the coil **14** will be filled with the conductive adhesive mixture and impregnation will be complete.

In the operation of the coil apparatus **10** wire **6** is uncoiled from the coil **14** and travels through the tube **18** as the torpedo moves through the water in response to telemetered commands from the submarine. Because of the complete impregnation of the coil **14** the inductance and capacitance characteristics of the coil are predictable and impose substantially no interference on communications between the mother ship and the torpedo. The complete penetration of the conductive adhesive also results in a uniform restraining force as the wire is payed out through the tube **18**. At speeds of the torpedo greater than 40 knots the mixture of conductive adhesive has imposed no appreciable restraining force on the wire **6** as it travels through the slender tube **18**. Apparently, the mixture of conductive adhesive readily mixes with the water during payout and has no tendency to collect in mass form at the entrance of or along the tube **18**.

The present invention is useful in combination with any coil of wire which is used for communication purposes whether the coil is in or out of the water or in or out of a container. A coil of wire impregnated with the aforementioned mixture can be easily tested out of water and its electrical integrity can be thus ascertained.

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 that the invention may be practiced otherwise than as specifically described.

We claim:

1. In a wire-guided torpedo payout coil apparatus:
a container which has an exit opening;
a coil of insulated wire disposed within the container with a portion of the wire extending through said exit opening; and
the voids within the coil of wire being filled with a conductive adhesive.

2. The combination as claimed in claim **1** wherein:
a slender tube is mounted to the container and extends from said exit opening; and
a portion of the wire extending through said slender tube.

3. The combination as claimed in claim **2** wherein:
the conductive adhesive is a mixture of silicone fluid and carbon.

4. The combination as claimed in claim **3** wherein:
the carbon is carbon black.

5. The combination as claimed in claim **4** wherein:
the carbon black is acetylene carbon black.

6. The combination as claimed in claim **5** wherein the parameters of the mixture of conductive adhesive are substantially as follows:
a viscosity of 300 poises at a temperature of 77° F. and at a shear rate of 50 reciprocal seconds;
a worked penetration of 250—290 at 77° F.;
DC resistance of 20 ohm-centimeters at 77° F.

7. The combination as claimed in claim **6** wherein:
the silicone fluid is approximately 7 parts by weight and the acetylene carbon black is approximately 1 part by weight.