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A. A. KNUDSON.
MEANS FOR PREVENTION OF WEAKENING PROPELLER SHAFTS
BY ELECTROLYSIS.

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NO MODEL.

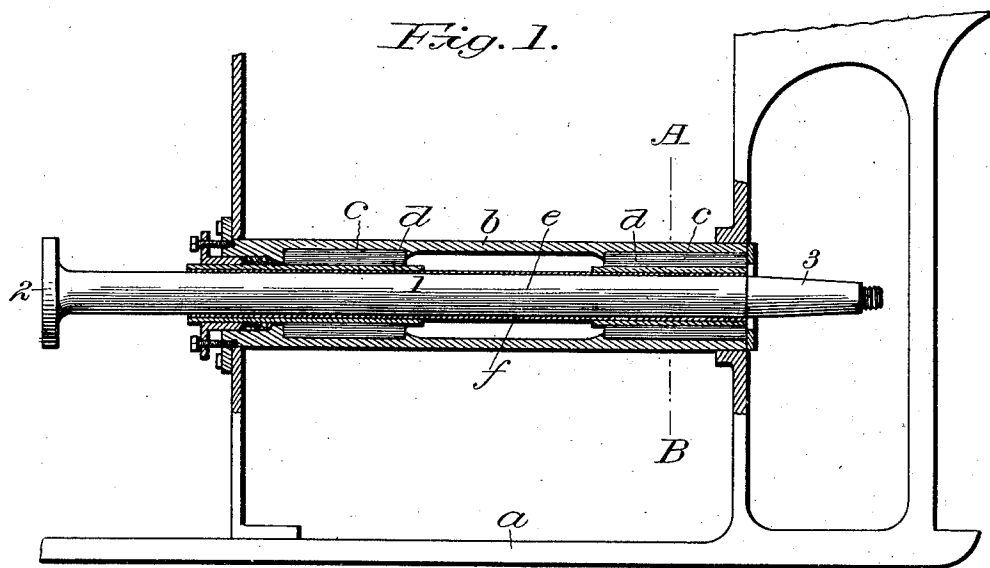
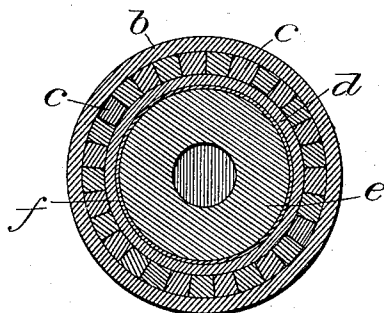


Fig. 2.



Witnesses

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MEANS FOR PREVENTION OF WEAKENING PROPELLER-SHAFTS BY ELECTROLYSIS.

SPECIFICATION forming part of Letters Patent No. 727,381, dated May 5, 1903.

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To all whom it may concern:

Be it known that I, ADOLPHUS A. KNUDSON, a citizen of the United States of America, and a resident of the borough of Brooklyn, New York city, in the State of New York, have invented a new and useful Improvement in Means for Prevention of Weakening of Propeller-Shafts by Electrolysis, of which the following is a specification.

It has long been known that where dissimilar metals—such as brass or other alloys of copper, hereinafter termed “bronze,” and iron or steel, hereinafter termed “steel”—are placed in close proximity to each other and immersed in sea-water, or sea-water is allowed to flow or penetrate between them, galvanic action or electrolysis will result, causing a disintegration or reduction in weight of the electropositive metal. In such cases where the respective metals are steel and bronze, for example, the steel being electropositive to the bronze, the two are chemically acted upon by the sea-water, and a current of electricity leaves the electropositive metal for the negative metal. In conformity with a law of electrical action wherever currents leave a metal under such conditions or under conditions similar to those above described such metal is more or less reduced and weakened. In the construction of modern war-ships and ships of the merchant marine this action has been recognized as the cause in many instances of the weakening of what is termed the “tail-shaft,” which carries the screw-propeller, and as the explanation of accidents to the tail-shaft resulting in the loss of the propeller and the serious delay of the vessel. The action in this case is due to the employment of one or more “liners,” of bronze, upon the tail-shaft, of steel, and the penetration of the sea-water between the shaft and the respective liners and its chemical and electric contact with the electrically opposite metals or alloys—that is to say, with metals of different polarity. Such liners are commonly shrunk upon the shaft, and thus made secure thereon with or without the aid of rivets extending through the walls of the shaft into the customary longitudinal bore. Whether or not such rivets are employed, it is impracticable to render the joints between

the shaft and the respective liners water-tight, and the sea-water eventually penetrates between the two metals, as above stated, and produces the electrolytic action. The electrolytic action in this case manifests itself in various ways, but mainly and most seriously in what is termed “annular nicking,” where the ends of the respective liners are opposed to the shaft. Such annular nicking obviously invites cracks and frequently results in a break in a shaft and the loss of the propeller. By such an accident the lives of the passengers are placed in great danger, and serious financial loss to the owners of the ship is involved. Various means have been proposed for preventing such weakening of propeller-shafts by electrolysis; but, so far as I am advised, the difficulty has heretofore remained without a known remedy that is effective.

The object of the present invention is to render impossible the galvanic action or electrolysis above described, and thus to prevent so weakening the propeller-shaft.

The invention consists in certain novel combinations of parts hereinafter set forth and claimed.

A sheet of drawings accompanies this specification as part thereof.

Figure 1 of the drawings represents a longitudinal section through the stern bearing of a modern vessel, exposing to view the tail-shaft. Fig. 2 represents a cross-section on a larger scale at A B, Fig. 1.

Like reference letters and numbers indicate like parts in the two figures.

The framework *a* at the keel of the ship is provided with the customary stern tube or casing *b*, of cast-iron, provided internally with bearings *c*, of lignum-vitæ. Within these bearings liners *d*, which may be of the customary bronze, are secured upon the tail-shaft *e*, of steel, in any known or improved manner.

The body 1 of the shaft between the customary flanged inner end 2, by which it is driven, and its tapered outer end 3, to which the hub of the propeller is fitted and upon which said hub is fastened, may be and preferably is cylindrical or substantially cylindrical throughout and of substantially the

larger diameter of the tapered end, so as to facilitate passing the liners *d* into place over said tapered end in the operation of shrinking or shrinking and riveting them upon the shaft.

To render impossible any electrolytic action between the steel shaft and the bronze liners, I provide said body of the shaft with a closely-adhering and impermeable covering *f*, preferably of copper and necessarily of a metal or alloy of the same or substantially the same polarity as the liners. There must be no possible penetration of the sea-water within such covering, and to accomplish this result in a simple and practical way the tail-shaft *e* is electroplated with the copper, the entire surface of the body 1 of the shaft *e* being preferably and conveniently covered. The two metals in close contact with an interposed film of sea-water are in this arrangement copper and bronze instead of steel and bronze, as heretofore, and as copper and bronze are quite similar when considered electrically there can be no galvanic action between the shaft and the liners and no corrosion of the steel shaft by electrolysis. The same effect would obviously be produced where the tail-shaft and liners are of other metals of different polarity by a shaft-covering *f* of any other metal that is of the same or substantially the same polarity as that of the liners. Such modifications of the invention will suggest themselves to those skilled in the art.

Another method of applying this invention that would accomplish the same result in substantially the same way and under some circumstances be more desirable is as follows: After electroplating the tail-shaft with copper to form the shaft-covering a harder metal or alloy than copper, such as bronze or German silver, is superposed by electroplating to form the liners. By this means liners are obtained which are, in effect, part of the shaft itself as compared with liners attached to the shaft, as above described. Such liners formed by electroplating may be hardened to render them more durable by placing the plated shaft in a lathe and passing a

roller or burnishing-tool over it, so as to compress the bearing-surfaces.

The term "liners" as hereinafter employed is intended to mean one or more of such liners, the term "metals" to include both metals and alloys, the term "steel" to include both iron and steel, and the term "bronze" to include brass and other alloys of copper, as aforesaid.

Having thus described said improvement, I claim as my invention and desire to patent under this specification—

1. The combination with a tail-shaft, for a marine propeller, of a closely adherent and impermeable covering of a different metal, from said shaft, and liners of the same or substantially the same polarity as said covering, and separated from the tail-shaft by said covering, for the prevention of electrolytic action between said tail-shaft and liners.

2. The combination with a tail-shaft, for a marine propeller, constructed of steel of a closely adherent and impermeable covering of copper, and the customary liners of bronze, for the purpose of preventing electrolytic action between said shaft and liners.

3. The combination with a propeller-shaft of steel provided with an electroplating of copper, and liners of the same or substantially the same electric polarity as said electroplating, and separated from the steel of the propeller-shaft by said electroplating, for the prevention of the weakening of said shaft by electrolysis.

4. The combination with the tail-shaft of a marine propeller, and with the liners of such tail-shaft, of a closely adherent and impermeable covering for the body of the tail-shaft, composed of a metal of the same or substantially the same polarity as that of the liners, and interposed between the respective liners and the tail-shaft, whereby any weakening of the tail-shaft by electrolysis is prevented, substantially as hereinbefore specified.

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Witnesses:

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