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.

This invention relates to torpedoes, and more particularly to a protective nose cap structure for torpedoes which must be launched under such conditions that they strike the water at relatively high speeds.

The tactical situations in which modern anti-submarine torpedoes are expected to be used make it desirable that they be delivered to the suspect target area very quickly after sonar determination of target location, and corresponding various techniques have been devised for fast delivery which, however, force the torpedoes to strike the water at the suspect area at relatively high speeds. By way of example, anti-submarine torpedoes may be launched from aircraft which fly at relatively high speeds and which tend to deliver the torpedoes at high water-entry speeds, or they may be launched under other conditions or by other means which tend to produce even greater terminal airspeed velocities of the torpedo.

While parachute coupling mechanisms, designed to couple a parachute to the torpedo propeller shaft and to disconnect automatically upon water entry, have made it possible to employ parachutes with such torpedoes and thus to provide retardation during torpedo airspeed, the water entry shock at the desired terminal torpedo airspeed (90 knots in a typical instance) may still be great enough to seriously damage various items of electro-acoustic, electronic and electro-mechanical equipment carried by the unprotected torpedo, and to thus render the torpedo ineffective. The torpedo structure and its internal equipment items could of course be individually redesigned to possibly withstand such water entry shock, but this would obviously be an undesirable line of attack.

Various attempts appear to have been made to provide some form of protective means to prevent physical damage to the nose section of the torpedo, the target-sensing electro-acoustic transducer therein being an immediately vulnerable item. Such attempts have heretofore failed to provide a structure which is able not only to protect the transducer and surrounding nose section against physical damage, but also able to effect practical reduction of water entry shock so that internal torpedo equipment items will not be injured, and also able to fragment away, following water impact, so that the target-sensing action of the transducer will not be obstructed.

The present invention overcomes the above-mentioned problems and meets all of the necessary conditions by providing a protective nose cap fabricated of material having sufficient crushing strength to satisfactorily reduce water entry shock, preventing physical damage to the nose section and transducer mounted therein, and further having structural characteristics which have been found to provide fragmenting action which satisfies the remaining important requirement of eliminating the nose cap from the transducer face.

Accordingly, the principal object of the present invention is to provide a protective nose cap for a torpedo, adapted to prevent physical damage and injurious shock to the torpedo during water entry, and to thereafter break away from the torpedo.

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 illustrates, in an exploded view, the forward portion of a homing torpedo and an exemplary protective nose cap associated therewith according to the present invention;

Figs. 2 to 4 are sectional views detailing other embodiments of protective nose caps in accordance with the present invention;

Figs. 5 and 6 are outline illustrations of protective nose caps having modified external configurations suitable to provide special airfield or water-entry characteristics; and

Fig. 7 pictures a torpedo striking the water at high velocity, its protective nose cap crushing and shattering upon water impact.

Referring first to Fig. 1 of the drawing, the nose cap 10 shown therein is preferably fabricated of a cellular material, sometimes referred to as foam material, hard enough in texture to provide a suitable compressive strength, say about 150 p.s.i. (pounds per square inch) for use with small torpedoes (about 10 inches in diameter and weighing about 250 pounds) which just prior to water impact may have a terminal airspeed speed of about 90 knots. By way of example as to the nose cap, a cellular material commercially available under the trade name "Strux," made of cellulose acetate, has been found quite satisfactory. Another readily available and very suitable material is "Rubix," a hard cellular rubber. However, any other material having the combined properties of sufficient crushing strength and fragility should of course also prove suitable.

A typical embodiment of the invention is illustrated in the exploded view given as Fig. 1, wherein nose cap 10 may be generally ellipsoidal for streamlining the torpedo during airspeed, or may have any other configuration deemed suitable from both aerodynamic and water entry standpoints. Nose cap 10 is here shown as having a generally hemispherical outer surface configuration, and a base which bears directly against the outer face of the transducer 11 which is carried at the forward end 12 of the torpedo nose section 14, the nose cap in this instance being secured to torpedo 16 by means of three low-strength plastic screws 18 which thread into correspondingly tapped jack-screw holes (not shown) in the torpedo nose rim 20 which surrounds the transducer. At water entry, and after the nose cap has effectively served its purpose of protecting the nose section and reducing water-entry shock, the nose cap detaches itself from the torpedo preferably by fragmenting into several pieces as a result of a quick build-up of pressure between the nose cap and the torpedo face or within the nose cap itself as later described.

Referring now to one form of the protective device in greater detail as illustrated in Fig. 2, the nose cap 22 may again be substantially hemispherical in external configuration to reduce air drag, and may be fabricated of cellular material by a molding or casting process, or by being shaped from a homogenous block of cellular material, or shaped from a block made by weakly bonding segmental sections of such material. Integral flanged extension 24 serves to reinforce the nose cap in the regions of holes 26 which accommodate the plastic screws for nose cap mounting as mentioned above, and further bears
the nose cap to the continuing nose section of the torpedo.

Fig. 3 illustrates a modified nose cap structure 28 having an axial hole 30 formed therein, found to result in fragmentation of the fragile nose cap 28, upon water entry, even when fabricated as a homogeneous mass rather than being built up from loosely bonded segmental sections.

Fig. 4 illustrates a further modified nose cap structure 32 similar to that described with reference to Fig. 3, differing therefrom in having a continuous external surface as provided by means of a thin plug 34, which may be of like material and loosely bonded within axial hole 30 to remain in place during flight but to rupture away from sealing position upon water impact.

The particular external configuration which may be employed in any of the nose cap embodiments disclosed herein has been found to affect the extent of protective shock reduction, although not critically, also the aerodynamic characteristics of the torpedo, and the initial path followed by the torpedo as a result of the particular type of water dispersion which takes place at water impact. For example, the conical nose cap 36 shown in Fig. 5 and the truncated conical nose cap 38 shown in Fig. 6 have been found to provide somewhat less reduction of water entry shock than the hemispherical nose caps shown in the preceding figures, but the truncated nose cap configuration shown in Fig. 6 (and probably as a result of its flat face) improves torpedo dynamic performance at water entry in that it reduces the initial depth of dive as is often desirable. The particular characteristics exhibited by a torpedo fitted with a nose cap as described are thus dependent, in part, upon the external configuration of the nose cap as indicated above, but nose caps fabricated of fragile material having sufficient crushing strength as described will in all instances prevent nose damage, provide very significant reduction of water entry shock, and finally break away from the torpedo as illustrated pictorially in Fig. 7.

The disclosed fragile nose caps constitute a major contribution in the field of torpedoes, for they make it possible to deliver torpedoes to a suspect target area, by launching from aircraft or by other means, with even greater terminal velocities and correspondingly shorter delivery time than heretofore, without danger of physical damage to the nose section of the torpedo and to the transducer carried thereby, and with eminently satisfactory reduction of water entry deceleration and shock forces.

It will now also be understood that the effectiveness of the disclosed nose cap in reducing water-entry shock is apparently a function of the crushing strength of the material involved in its construction.

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. In combination with an underwater missile of the type adapted for air flight delivery in nose first attitude into water at a velocity sufficient to produce water impact shock forces upon its nose, which, transmitted to components of the missile would be of a magnitude injurious to same, the improvements, comprising: means affixed to said missile axially ahead of said nose and adapted to impact the water prior to impact by said nose and absorb sufficient impact energy to reduce the shock forces transmitted to said components to non-injurious magnitude, said means comprising a circular nose cap formed of a unitary mass of fragile cellular material adapted to receive a portion of the impact energy and dissipate same through internal work within the mass, the mass being of such construction that the impact forces are effective to crush it in a direction axially of the torpedo and rupture same into a plurality of fragments adapted to move outwardly from said axis in various angular directions and free of the missile.

2. Apparatus in accordance with claim 1 wherein said mass is fabricated from foamed plastic material.

3. Apparatus in accordance with claim 1 including an axially disposed cylindrical void in said mass opening at the rear end of same and adapted to facilitate the rupture into fragments.

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