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THERMIT REACTION UNDERWATER FLARE

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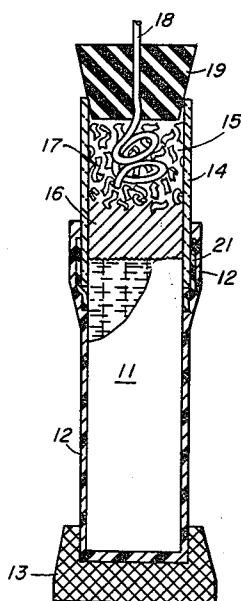
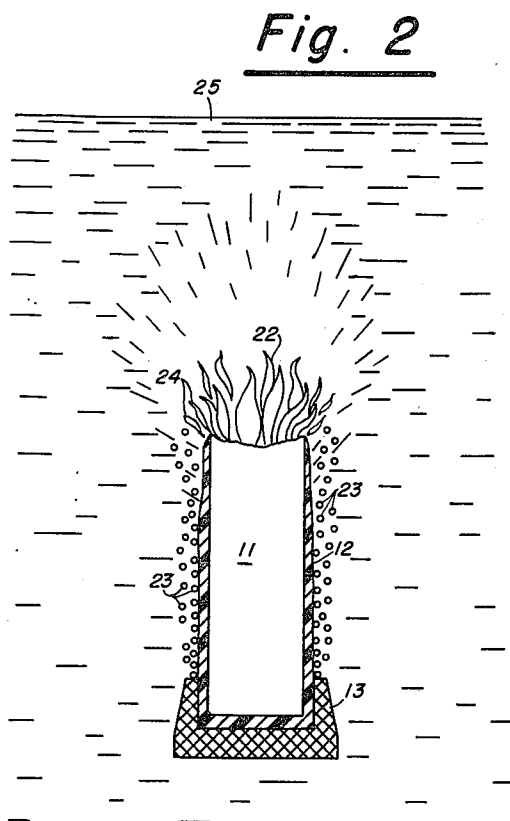


Fig. 1



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THERMIT REACTION UNDERWATER FLARE

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(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 marine torches or flares of both the floating and underwater varieties but especially the latter wherein the incendiary material must be resistant to quenching when submerged.

In the past, marine flares of the floating type are readily extinguished in choppy water or rough weather. Combustible flares adapted for burning in a submerged position are generally considered impractical. A submerged flare, one that would continue to burn at greater depths, is desirable for casting the silhouette of submerged objects toward the surface or in a lateral direction whereby the objects may be detected by search. The practice has been to encase the flare compound in a metallic tubing. As the burning surface recedes into the metallic tube its luminosity is reduced and from a lateral point is practically indiscernable.

Briefly, the structure comprises a flare compound having a thermite reaction and includes a moulding powder whereby the compound is compressed under high pressure to form a solid cohesive stick of flare compound and moulding powder, and thus provide an uncased flare body. The solid body eliminates the necessity of encasing the flare in a protective tubing, whereby its effective luminosity is greatly improved. The body is coated with a soluble protective coating which forms an inflammable hydrogen gas envelope surrounding the body during dissolution. The upper end of the body is provided with a device for igniting the flare. Means for weighting the flare to assure submergence and maintaining the flare in an upright position, is provided at the lower end of the flare.

The general object of the invention is to provide a flare adapted to burn, even though submerged.

Another object is to provide a flare compound which can be compressed into a solid cohesive stick of flare compound and moulding powder, and thus provide an uncased flare body having sufficient strength to withstand the operating stresses and submergence without enclosing the body in a metallic supporting tube or casing.

A further object is to provide a water protective coating for the flare body which is soluble within a predetermined time period.

Another object is to provide a flare coating which generates a layer of gas surrounding said body for protection of the flare body and burning surface underwater.

Still another object is to generate a gaseous envelope by dissolution of the protective coating applied to the flare body whereby the body portion and the upper burning portion of the flare is protected from the surrounding water body in which it is submerged by a curtain of rising gas.

Another object is to provide a soluble protective coating on said body, compounded of elements which will chemically react with water and generate a gas highly combustible and luminous, whereby said gas will ignite as it rises and contacts the upper or burning end of the flare.

Still another object is to provide a soluble compound for the body coating having a rate of dissolution and a predetermined thickness whereby the rate of burning of the flare and rate of dissolution of the coating, will be coordinated to provide protection throughout the period of combustion.

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A further object is to provide a water tight ignition chamber firmly connected to the flare body during the preliminary period of igniting the flare but normally detached by heat from the burning flare as its combustion progresses.

With these and other objects in view, as will hereafter more fully appear, and which will be more particularly pointed out in the appended claims, reference is now made to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a front elevation in section, showing a preferred embodiment of the invention.

FIG. 2 illustrates a submerged flare in cross section during the process of burning.

Referring to the drawings, a cross section of the complete flare is illustrated in FIG. 1 wherein the numeral 11 indicates the cohesive stick of flare compound and moulding powder, or uncased flare body. Said body 11 has its upper end fixed in the ignition chamber tube 14. The joint between the flare body 11 and the ignition tube 14 is covered by an elastic sleeve 21 to make the joint water tight and at the same time strengthen the connection.

The body 11 is protected by a soluble coating 12 comprising any compound capable of forming a combustible gas and preferably a compound formed of polyethylene glycol impregnated with magnesium amalgam. Said compound 12 may be made of any material soluble in cold water providing it does not react with the impregnated chemical, such as the magnesium amalgam, before submergence.

Said protective coating compound 12 not only covers the lower end or bottom of the body 11 but the sides thereof, and is extended above and over the sleeve 21 and terminates against the side of ignition tube 14. Although the coating 12 is soluble in cold water, its melting point is high enough to preserve it under normal atmospheric temperatures but will melt when subjected to the burning flare temperature.

At the lower end of the body 11 a cup 13 is fastened by means of the coating 12 to the body 11. In addition to the general physical protection cup 13 provides for the flare, it also acts as a weighted base 13 for supporting the flare in an upright position during submergence and while resting on the ocean bottom.

The device for igniting the upper end of the flare 11 includes the ignition chamber 15 within the tube 14 for housing the ignition powder 16 and quick match 17 adjacent the upper end of the flare body 11. A time fuse 18 is strung through the central hole in stopper 19 and terminates in the quick match 17 adjacent the ignition powder 16. The upper end surface of the flare cartridge 11 is scratched to provide a better contact with powder 16 and assure ignition of the flare compound.

The quick match 17 is a mixture of gun cotton or nitrocellulose in ethyl acetate. This viscous solution is then poured criss-cross on tissue paper and, while still wet, is sprinkled generously with thermite ignition powder. After drying, the tissue paper is cut up in strips to form the quick match 17.

Conventional flare compounds usually contain aluminum and magnesium powder and these powders were also included in the present compound. However in the proposed device, a thermite reaction is desired wherein 3000° C. heat is generated, in which case additional aluminum and magnesium powder are required. The thermite reaction greatly increases the temperature of the combustion surface of the flare. This reaction inherently produces greater luminosity on the combustion surface and incidentally increases the resistance to quenching by water. Thermite, as defined in Webster's Collegiate Dictionary, is "a trademark for a mixture of aluminum in fine grains,

with an oxide of a chemically weaker metal, usually iron. It is used in welding."

A preferred flare compound, used for practicing the invention includes:

	Percent
Mg 200 mesh (atomized) -----	15
Mg 80 mesh -----	20
Mg turnings -----	5
Al 200 mesh (atomized) -----	10
Al 30 mesh -----	15
Fe ₃ O ₄ -----	10
Ba(NO ₃) ₂ -----	20
Thermit starting powder -----	5

A further improvement is evident by producing the flare in the form of a solid cohesive stick of flare compound and moulding powder, and thus provide an unencased flare body. The preferred form or compound to accomplish this was found to include twenty percent by weight of plastic moulding powder and preferably Teflon moulding powder. The flare compound as described above is mixed with 20% by weight of Teflon moulding powder and then compressed by a pressure of approximately 12,750 pounds per square inch. The percentage of Teflon moulding powder may be varied from 20% to 50% which variations may afford additional control of the burning rate and brilliance. Said "Teflon" moulding powder is sold by the Du Pont Corporation and is protected by the trademark "Teflon" for tetrafluoroethylene resin.

The protective coating 12 covering the body 11 must incorporate various features. Briefly the inventor preferred a coating of waxy material which is soluble in cold water and of low melting point. Said material must be capable of being heavily impregnated with a chemical which reacts with water to form a gas which is highly combustible and luminous. The waxy material used, is preferably polyethylene glycol, molecular weight 4,000, and was heavily impregnated with mercury amalgam of magnesium. The wax readily dissolves in cold water, thus providing water contact with the magnesium amalgam which in turn decomposes the water rapidly, evolving hydrogen gas (nascent hydrogen) which is extremely reactive and in turn generates enormous heat upon again forming molecular hydrogen (H₂). This gas rises in myriads of bubbles surrounding the flare body including the combustion area. This gas tends to prevent water entering the flare combustion surface and when ignited by contact with the burning surface, it also burns fiercely adding both heat and luminosity to the flare flame. In fact the flare compound 11 and protective coating 12 may be varied in ingredients and proportions whereby the luminosity would be provided by the burning gas of a preferred color, the thermite reaction flare body serving mainly as a continuous igniter for the gases produced.

The wax coating 12 keeps the water off the unburned part of the flare body and should be thick enough to maintain cover protection of the body 11 until it is completely burned. At the same time the coating 12 should be thin enough, so that, as the combustion surface moves down the body, the coating will have dissolved, or be so thin that the burning surface will melt it. It is therefore evident that the longer the flare, the longer will be the time period for burning. To meet the conditions set forth above as to coating thickness, in case of unusually long flares, the thickness of the coating 12 may be graduated between the top and bottom, otherwise, a uniform coating thin enough to be burned might dissolve toward the bottom before the flare is completely burned. On the other hand although an extra thick coating 12 would protect the bottom portion of a long flare, however such a coating might hinder combustion leaving the coating in the form of a tube surrounding the receding flare flame. As the flare burning progresses, the coating dissolution should be sufficient to have reduced its thickness whereby it can be readily consumed by the flare flame of thermite burning temperature.

In operation the time fuse 18 is ignited either electrically or manually and burns down into the ignition chamber 15 and contacts the quick match 17 adjacent the ignition powder 16 within the predetermined time period for which the fuse 18 is set. As the burning becomes vigorous after ignition and the top portion of the body is consumed, the ignition tube 14 and elastic support sleeve 21 will be burned free of the body 11 and the submerged flare will then continue to operate as illustrated in FIG. 2.

The water 25 contacts the soluble coating 12 causing the myriad of hydrogen bubbles 23 to be formed along the entire side surface of the body 11. As the bubbles 23 rise toward the top of the flare where the thermite reaction flame 22 is located, the gas bubbles 23 also are ignited thus adding the gas flame portion 24 to the body flame 22.

The above operation will continue as the flare sinks deeper into the water and will continue after the base 13 is resting on the bottom. The envelope of bubbles 23 rising along the side of the flare body will tend to assist the weighted base 13 and keep the body vertical as it submerges and even when resting on the bottom in an upright position.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. An underwater flare comprising a flare compound compressed into a solid body, an ignition chamber, the upper end of said body being inserted in said ignition chamber, a protective coating covering the sides and bottom of said body, said protective coating comprising a polyethylene glycol compound impregnated with magnesium amalgam and adapted to protect the unburned portion of said flare throughout the period of combustion, and means located in said chamber for igniting the upper end of said body.

2. A flare as set forth in claim 1 wherein the thickness of said soluble coating is varied between the top and bottom of the flare as uniformly graduated from a thin layer at the top to a thick layer at the bottom in proportion to its rate of dissolution and timed to coincide with the burning rate of said body and thus provide protection thereto until consumed.

3. An underwater flare comprising a body including a flare compound, means for igniting said compound, a soluble protective coating covering said body, said coating comprising a polyethylene glycol compound impregnated with magnesium amalgam and adapted to react chemically with water to form a gas envelope of nascent hydrogen surrounding said body, said gas being highly combustible and luminiferous whereby said gas is adapted to ignite when it contacts the burning surface of the flare for increasing both the heat and luminosity thereof and prevent quenching.

4. An underwater flare comprising an illuminating flare compound compressed into a cohesive stick adapted to burn underwater for a predetermined period, means for initially igniting said stick, a waxy protective coating soluble in cold water covering said stick, said protective coating is a polyethylene glycol compound impregnated with magnesium amalgam.

5. An underwater flare as described in claim 4 wherein said protective coating is gradually increased in thickness from the top to the bottom of the flare and upon dissolution will produce nascent hydrogen a highly combustible and luminiferous gas capable of igniting underwater when it contacts the burning surface of the flare for increasing both the heat and luminosity thereof and prevent quenching.

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6. A flare for producing intense illumination underwater comprising a body portion including a conventional illuminating flare compound of aluminum and magnesium, in combination with an igniter compound of ferri-ferrous oxide mixed with additional aluminum and magnesium in stoichiometric proportions for producing a thermite reaction, a plastic moulding powder mixed with said compounds and the mass compressed into a cohesive stick of flare compound, means for igniting said stick of flare compound whereby the flare flame remains in full view throughout the progressive combustion of the flare, a protective coating covering said stick of flare compound, said coating comprising a polyethylene glycol, molecular weight 4,000, heavily impregnated with mercury amal-

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gam of magnesium, whereby nascent hydrogen is evolved and rises vertically along said elongated body until ignited by the burning end of the flare thereby increasing the illumination and preventing quenching.

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