Nov. 20, 1962 A. L. LYTLE 3,064,576

PYROTECHNIC FLARE ARRANGEMENT

Filed July 3, 1961

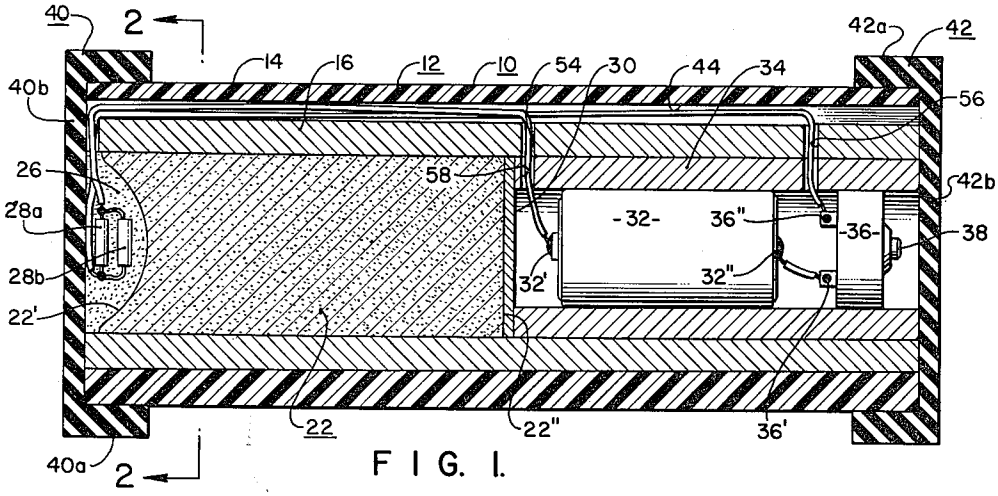


FIG. 1.

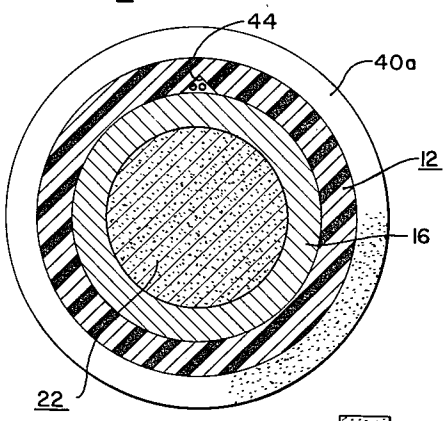


FIG. 2.

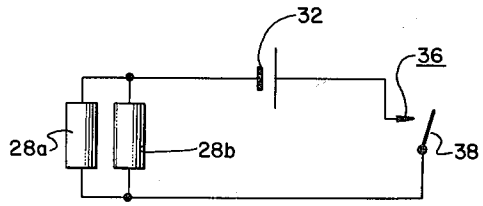


FIG. 3.

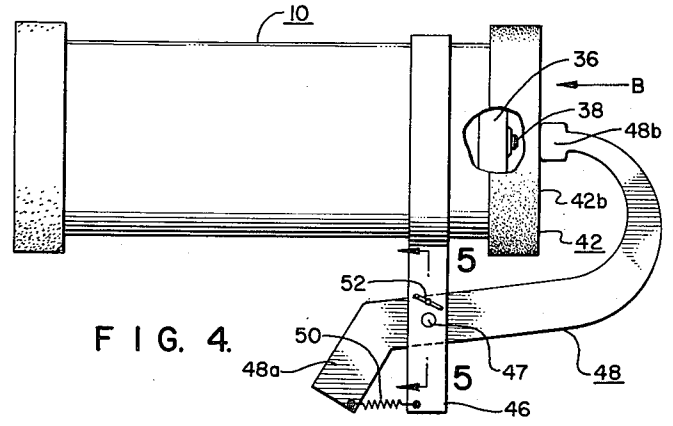


FIG. 4.

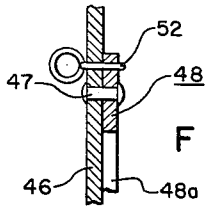


FIG. 5.

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PYROTECHNIC FLARE ARRANGEMENT

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This invention relates to the pyrotechnic flare art and, more particularly, to new and improved underwater pyrotechnic flares.

Pyrotechnic flares have been utilized in underwater applications for such purposes as underwater illumination for photography, fish hunting, and the like. In addition, the combustion of a pyrotechnic flare under water has often been effective in repelling predatory fish such as sharks. However, the pyrotechnic flares utilized in the past in these and other underwater applications have not always proven completely satisfactory. Often they have exhibited a tendency to leak and thereby become inoperative when exposed to water pressures in excess of comparatively minimal values and also to corrode when stored near or exposed to water. Further, such flares have often required auxiliary equipment to initiate flare operation. Thus, there has long been a need for an underwater flare that both remains watertight and is easily operable at water depths on the order of one hundred feet and also withstands repeated exposures to such water submersion without corroding and still remains operative. Further, it is often desired that the flares be completely self-contained and inexpensive as well as light in weight and comparatively compact to provide ease in storage, handling and use.

Accordingly, it is an object of this invention to provide an improved pyrotechnic flare.

It is another object of this invention to provide an operable underwater pyrotechnic flare that remains watertight and operable in water depths up to one hundred feet or more.

It is still another object of this invention to provide an inexpensive underwater pyrotechnic flare that is compact and self-contained.

These and other objects and the above desiderata are achieved in applicant's inventtion by providing a compact flare assembly that includes, within a waterproof flare case means, both a pyrotechnic charge and electricity energized squibs for initiating combustion of the pyrotechnic charge. Also included in the flare case are an electrical power source, such as a flashlight battery, and a switch means for energizing the squibs. The flare case means is closed at one end by a combustible diaphragm which provides a first watertight seal and at the other end by a flexible diaphragm which provides a second watertight seal, thereby effecting a completely watertight flare assembly. The flexible diaphragm permits operation of the switch means by a force applied external to the flare case means.

In another embodiment of applicant's invention, a handle and trigger means are included with the pyrotechnic flare and are coupled externally to the flare case. The handle and trigger means permit the user to operate the flare with only one hand thus leaving the other hand free.

The above and other embodiments of this invention are more fully disclosed in the following detailed description with reference to the accompanying drawings wherein similar reference characters refer to similar elements and in which:

FIGURE 1 is a cross sectional view of an underwater pyrotechnic flare according to applicant's invention;

FIGURE 2 is a transverse cross sectional view of the pyrotechnic flare shown in FIGURE 1 taken along the line 2—2;

FIGURE 3 is a schematic diagram of the electrical arrangement of the pyrotechnic flare shown in FIGURE 1; and

FIGURES 4 and 5 illustrate another embodiment of applicant's invention.

Referring now to FIGURE 1, there is shown an underwater pyrotechnic flare, generally designated **10**. A substantially tubular case means **12** is comprised of an outer shell means **14** and an inner shell means **16**. The outer shell means **14** is preferably nonmetallic to eliminate the corrosive effects associated with underwater operation and exposure. Phenolic resin impregnated tubing has been utilized satisfactorily for the outer shell means **14**. The inner shell means **16** may be fabricated, for economy, of compressed cardboard and the outer surface of the inner shell **16** should provide a comparatively tight fit against the inner surface of the outer shell **14**. While the embodiment illustrated in FIGURE 1 shows the inner shell **16** substantially axially coextensive with the outer shell **14** from a discharge end **18** to a switch end **20**, it will be appreciated that the inner shell **16** may be discontinued at any axial point where it no longer is required. Further, the inner shell **16** may in some applicaitons be eliminated and the arrangement of the elements described below may be included directly in the outer shell **14**.

A pyrotechnic flare charge **22** is contained within the case means **12** on the interior of the inner shell means **16**. The flare charge **22** has a first end **22′** adjacent one end, the discharge end **18**, of the case means **12** and a second end **22″** at a predetermined separation from the first end **22′** to provide a preselected axial length of the flare charge **22**. In the preferred embodiment of this invention, the flare charge **22** is of the "cigarette" burning variety, that is, it burns progressively from the first end **22′** to the second end **22″**. The axial length is selected to correspond to a desired burning time of the flare **10** and, since the pyrotechnic flare charge **22** burns at a known axial rate, the axial length of the flare charge may be selected to provide a desired flare combustion time. If desired, other types of pyrotechnic charges, such as star cored and the like, may be utilized and the appropriate pyrotechnic charge dimensions may be adjusted to provide the desired burning time.

The first end **22′** of the flare charge **22** is provided with a recessed portion **24** adjacent the discharge end **18** of the case means **12**. A first fire mixture **26** is provided in the recessed portion **24** and in ignition relationship to the flare charge **22**. While the first fire mixture **26** is illustrated in FIGURE 1 as a powder, it may also take the form of a coating applied directly to the recessed portion **24** of flare charge **22**. A pair of squibs **28*a*** and **28*b*** are also included in the recessed portion **24** of the flare charge **22** and are in ignition relationship to the first fire mixture **26**. The pair of squibs **28*a*** and **28*b*** are of the electrically energized type and upon application of a predetermined electrical voltage, the squibs ignite thereby igniting the first fire mixture **26** which provides ignition to the flare charge **22**.

There are many pyrotechnic flare charge materials that are suitable for utilization as the pyrotechnic charge **22** in an underwater flare. For example, applicant has found that a pyrotechnic flare charge **22** composed of thirty-eight parts by weight barium nitrate, nine parts by weight flaked aluminum, two parts by weight flaked magnesium, four parts by weight sulfur, and one and one half parts by weight castor oil has provided satisfactory operation when utilized in conjunction with a first fire mixture **26** comprised of ten percent boron and ninety percent barium chromate.

A bulkhead means **30** is provided adjacent the second

end 22'' of the flare charge 22 to separate the flare charge 22 from the remainder of the flare assembly. The bulkhead 30 may be, for example, a disc of cardboard fitting against the inside surface of the inner shell 16.

A source of electrical energy, such as battery means 32 shown on FIGURE 1, is provided inside the case means 12 and is separated from the flare charge 22 by the bulkhead 30. A precharged capacitor or any of the electrical energy sources may be utilized to energize the squibs 28*a* and 28*b* as well as the battery 32. To position the battery means 32 and to prevent relative movement thereof, a liner means 34 may be included to frictionally engage both the inside surface of inner shell 16 and the outside surface of battery means 32. The liner means 34 may be contoured to the particular shape of the battery 32 and inner shell 16. A flashlight battery of the one and one half volt type has provided satisfactory operation of such a flare. The squibs 28*a* and 28*b*, of course, must be selected so as to be compatible with the electrical output characteristics of the battery 32.

A switch means 36 is provided adjacent the switch end 20 of the case means 12. In the preferred embodiment of applicant's invention, this switch means 36 is of the normally open type wherein circuit continuity to the squibs is provided by momentarily depressing plunger means 38.

A first diaphragm 40 is utilized to seal the discharge end 18 of the flare 10. The diaphragm 40 is generally cup shaped and is fabricated from a substantially combustible material such as rubber, plastic, or the like. The diaphragm 40 fits over the discharge end 18 of the flare 10 and a body portion 40*a* is bonded to the outside of the outer shell 14 to effect a watertight seal therebetween. A second diaphragm 42, also generally cup shaped, is utilized to seal the switch end 20 of the flare 10. The diaphragm 42 has a body portion 42*a* and a base 42*b* and at least the base 42*b* is fabricated from a flexible material such as rubber. The body portion 42*a* fits over the switch end 20 and is bonded to the outside surface of outer shell 14 to effect a watertight seal therebetween.

Referring now to FIGURE 2, there is shown a transverse cross sectional view of the flare 10 illustrated in FIGURE 1. A generally V shaped groove 44 is provided on the inside surface of outer shell 14 and the wire means connecting switch 36 and battery 32 with the pair of squibs 28*a* and 28*b* are positioned in the groove 44. This construction permits a substantially tight fit between the inner shell means 16 and the outer shell means 14 and eliminates the necessity for providing access to the squibs 28*a* and 28*b* through the flare charge 22. Other shaped grooves than V shaped and other positions for such a groove could be provided. For example, a groove could be provided in the outer surface of the inner shell 16 as well as in the position shown on FIGURE 2. The flare 10 may be fabricated in any desired geometrical shape and is not limited to the circular shape illustrated.

FIGURE 3 is a schematic representation of an electrical circuit utilized in the flare 10 illustrated in FIGURE 1. The squibs 28*a* and 28*b* are connected in parallel with the battery means 32. The switch 36, which is connected in series with the squibs 28*a* and 28*b* and the battery 32, is a normally open type switch and, upon depression of the plunger 38, the circuit to the squibs 28*a* and 28*b* is completed thereby energizing the squibs.

Referring back now to FIGURE 1, operation of the flare is commenced by deflecting the base portion 42*b* of the diaphragm 42 towards the switch 36. Since the diaphragm is flexible, the deflecting force is maintained until the plunger 38 is depressed, thereby energizing the squibs 28*a* and 28*b*. When these squibs are energized, they ignite the first fire mixture 26 which in turn ignites the flare charge 22 along the recessed portion 24. The initial combustion of the first fire mixture 26 also burns away the base portion 40*b* of diaphragm 40 which allows the products of combustion of flare charge 22 to be expelled from the flare 10. Combustion of the flare charge 22 proceeds in an axial direction from the discharge end 18 towards the bulkhead 30 at a predetermined rate. During this combustion, the flare case 12 may be either totally or partially consumed by the burning flare charge 22 in the regions coextensive therewith. Combustion of the flare is complete when a flare charge 22 burns down to the end 22'' adjacent the bulkhead 30. Utilization of the first fire mixture 26 has been found to be unnecessary with certain combinations of squibs and pyrotechnic charge mixtures. Thus, the squibs may be utilized to ignite the recessed portion 24 directly. In utilizing this arrangement, it is often advantageous to treat the surface of the recessed portion 24 with an easily ignitible coating to provide rapid combustion initiation.

In fabricating the flare 10, the switch 36 is spaced sufficiently far from the diaphragm 42 so that depression of the base portion 42*b* of the diaphragm 42 by water pressure at the desired operational depth does not actuate the switch 36 and thereby inadvertently actuate the flare.

Since the flare 10 illustrated in FIGURE 1 is intended to be utilized only once, economic factors dictate that not only should the materials utilized therein be comparatively inexpensive but also the method of manufacturing the flare 10 should be as economic as possible. The method of manufacture described below has been found by applicant to result in comparatively low manuturing costs. The flare charge 22 is first mixed and blended by well-known techniques to provide a substantially homogeneous mixture. This mixture is then consolidated in the inner shell means, the bulkhead 30 having previously been installed in the inner shell 16 at a preselected position.

The V shaped groove 44 is cut into the inside surface of the outer shell 14 and a pair of wire means are laid therein. The pair of wire means are cut to extend beyond the ends of the outer shell 14 a sufficient length to allow assembly as herein described. One of the wire means extending beyond one end of the outer shell 14 is threaded through the wall of inner shell 16 in first aperture 54 and the other wire means extending beyond the same end is threaded through the wall of the inner shell 16 in second aperture 56. The inner shell 16 containing the consolidated flare charge 22 is then inserted in the outer shell 14 commencing with the end containing the recessed portion 24 of the flare charge 22. If required, a light lubricant such as paraffin may be coated onto the outside surface of inner shell 16 to facilitate assembly. During the insertion of the inner shell 16 into the outer shell 14, the pair of wire means are continually pulled through the apertures 54 and 56, respectively, to maintain them in the V groove 44.

The battery means 32 is inserted in liner means 34 where it is retained in a preselected axial position. One of the pair of wires is inserted through third aperture 58 in liner 34 and soldered to first terminal 32' of battery 32. A coupling wire is soldered to a second terminal 32'' of battery 32 and to a first contact 36' of switch means 36. The other of the pair of wires is inserted through fourth aperture 60 in liner 34 and soldered to a second contact 36''. The switch means 36 is then inserted in liner means 34 where it is retained in a preselected position relative to the end of liner means 34. The liner 34 containing the battery means 32 and switch 36 is inserted into the inner shell 16 until the apertures 58 and 60 are registerably aligned with apertures 54 and 56, respectively. If desired, axial grooves may be cut through the walls of inner shell 16 and liner 34 instead of the apertures 54, 56, 58 and 60 to facilitate insertion and positioning of the pair of wire means.

The pair of squibs 28*a* and 28*b* are then connected in parallel to the ends of the pair of wires extending beyond the discharge end 18 of the flare 10. First fire mixture 26 is added in the recessed portion 24 of the flare charge 22 and the squibs 28*a* and 28*b* are packed in the first fire

mixture 26. Once the squibs 28*a* and 28*b* have been connected, extreme care must be exercised to prevent inadvertent operation of the switch 36 during the remainder of the flare assembly. A plug means (not shown) may be utilized for this purpose and may be inserted over the switch 36 to prevent depressing the plunger 38.

The first diaphragm 40 is inserted over the discharge end 18 and the body portion 40*a* is bonded to the outer surface of the outer shell means 14 to effect a watertight seal therebetween. If desired, the end 18 of the case 12 may also be bonded to the base portion 40*b* of first diaphragm 40. Similarly, the second diaphragm 42 is inserted over the switch end 20 and the body portion 42*a* is bonded to the outer surface of outer shell 14. The end 20 of the case 12 may be bonded to the base portion 42*b* of the diaphragm 42. Any plug means utilized to prevent actuation of switch 36 must be removed before second diaphragm 42 is installed. Applicant's underwater pyrotechnic flares manufactured by the above method have proven watertight and reliably operable at water depths of one hundred feet or more. The degree of flexibility of the second diaphragm 42 and the separation of the switch means 36 therefrom are selected to be compatible with the desired operational depths.

To provide ease of operability, applicant has found it advantageous to incorporate a handle and trigger mechanism in the flare 10. One such arrangement is illustrated in FIGURE 4. A handle 46 is coupled to the outside surface of outer shell 14 in a manner to prohibit relative movement therebetween. A trigger means 48 is pivotally connected to the handle 46 by pivot pin 47 and a light spring means 50 interconnects the handle 46 and the trigger means 48 to retain them in a preselected relative position. A pin means 52 is provided as a locking mechanism between the trigger means 48 and handle means 46 to prevent inadvertent actuation of the flare 10.

In operation of this embodiment, the pin means 52 is withdrawn to allow pivotal motion between the trigger 48 and the handle 46. A grip portion 48*a* of the trigger 48 is moved in the direction of arrow A which moves a hammer portion 48*b* of the trigger means 48 in the direction of arrow B. This depresses the base portion 42*b* of second diaphragm 42 until the plunger 38 of switch 36 is depressed.

In this embodiment of the invention the base portion 42*b* of second diaphragm 42 may be coupled to the hammer portion 48*b* of trigger 48. As the trigger 48 is locked by pin means 52, the water pressure will not depress the second diaphragm 42 and then the possibility of inadvertent operations is thereby eliminated.

FIGURE 5 shows a partial end view of the embodiment shown in FIGURE 4, illustrating one arrangement for coupling the locking pin 52 between the handle 46 and the trigger 48. The handle 46 and trigger 48 are preferably installed after completion of the flare assembly described above.

This completes the description of applicant's underwater pyrotechnic flare arrangement and a preferred method of manufacturing same. However, those skilled in the art will find many variations and adaptations of applicant's invention. Therefore, the foregoing description of the various embodiments of applicant's invention together with the accompanying drawing are intended to be illustrative and not limiting and the appended claims are intended to cover all variations and adaptations within the true scope and spirit of this invention.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. In combination: a substantially tubular waterproof case means having a discharge end and a switch end; a flare charge contained with said case means and having a recessed portion adjacent said discharge end of said case means; a first fire mixture contained within said recessed portion of said flare charge and in ignition relationship thereto; a pair of electrically energized squibs contained within said recessed portion and in ignition relationship to said first fire mixture; a battery means contained within said case means; wire means connecting said pair of squibs in parallel to said battery means; bulkhead means coupled to said case means for separating said flare charge from said battery means; normally open switch means connected in series with said battery means and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled thereto to effect a watertight seal therebetween; and a generally cup shaped, flexible second diaphragm means fitting over said switch end in watertight sealing relationship to said switch end of said case means whereby depressing said second diaphragm a preselected distance closes said switch means.

2. In combination: a substantially tubular waterproof case means having a discharge end and a switch end comprising a phenolic resin impregnated outer shell and a cardboard inner shell contained therein, said inner shell axially coextensive with said outer shell, and a substantially V shaped axial groove in the interior surface of said outer shell; a flare charge having a predetermined burning time contained within said inner shell means; a pair of electrically energized squib means contained within said inner shell means and in ignition relationship to said flare charge for igniting said flare charge; a source of electrical energy contained within said inner shell for energizing said pair of squibs; wire means extending axially in said V shaped groove for connecting said pair of squibs in parallel to said source of electrical energy; bulkhead means extending transversely across said inner shell means for separating said flare charge from said source of electrical energy means; switch means contained within said inner shell means and in switch operable relationship to said switch end and connected in series with said source of electrical energy and said pair of squib means whereby closing said switch energizes said pair of squib means; and sealing means coupled to said discharge end and said switch end of said case means in watertight sealing relationship to said case means.

3. In combination: the arrangement defined in claim 2 wherein said flare charge is comprised of thirty eight parts by weight barium nitrate, nine parts by weight flaked aluminum, two parts by weight flaked magnesium, four parts by weight sulfur, and one and one half parts by weight castor oil.

4. In combination: the arrangement defined in claim 1 wherein said first fire mixture is comprised of ten percent by weight boron and ninety percent by weight barium chromate.

5. In combination: a substantially tubular waterproof case means having a discharge end and a switch end comprising a phenolic resin impregnated outer shell and a cardboard inner shell contained therein, said inner shell axially coextensive with said outer shell, and a substantially V shaped axial groove in the interior surface of said outer shell; a flare charge having a predetermined burning time contained within said inner shell means; a pair of electrically energized squib means contained within said inner shell means and in ignition relationship to said flare charge for igniting said flare charge; a source of electrical energy contained within said inner shell for energizing said pair of squibs; wire means extending axially in said V shaped groove for connecting said pair of squibs in parallel to said source of electrical energy; bulkhead means extending transversely across said inner shell means for separating said flare charge from said source of electrical energy means; normally open switch means connected in series with said battery means and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means; and a generally

cup shaped flexible second diaphragm means fitting over said switch end and coupled in watertight sealing relationship to said switch end of said case means whereby depressing said second diaphragm a preselected distance closes said switch means.

6. In combination: a waterproof nonmetallic case means; a flare charge contained within said case means comprising thirty eight parts by weight barium nitrate, nine parts by weight flaked aluminum, two parts by weight flaked magnesium, four parts by weight sulfur, and one and one half parts by weight castor oil; a first fire mixture contained within said case means comprising ten percent by weight boron and ninety percent by weight barium chromate and in ignition relationship to said flare charge; a pair of squibs contained within said case means and in ignition relationship to said first fire mixture; means coupled to said case means for energizing said pair of squibs; and sealing means coupled to said case means to effect a watertight seal therebetween.

7. In combination: a waterproof case means having a discharge end and a switch end; a flare charge contained within said case means; a pair of squibs contained within said case means and in ignition relationship to said flare charge; a source of electrical energy contained within said case means for energizing said pair of squibs; wire means contained within said case means connecting said pair of squibs in parallel to said source of electrical energy; normally open switch means contained within said case means and connected in series with said pair of squibs and said source of electrical energy whereby closing said switch means energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means; and a generally cup shaped, flexible second diaphragm means fitting over said switch end in watertight sealing relationship to said switch end of said case means whereby depressing said second diaphragm a preselected distance closes said switch means.

8. In combination: a substantially tubular waterproof case means having a discharge end and a switch end comprising a phenolic resin impregnated outer shell and a cardboard inner shell contained therein, said inner shell axially coextensive with said outer shell, and a substantially V shaped axial groove in the interior surface of said outer shell; a flare charge contained within said case means and having a recessed portion adjacent said discharge end of said case means; a first fire mixture contained within said recessed portion of said flare charge and in ignition relationship thereto; a pair of electrically energized squibs contained within said recessed portion and in ignition relationship to said first fire mixture; a source of electrical energy contained within said inner shell for energizing said pair of squibs; wire means extending axially in said V shaped groove for connecting said pair of squibs in parallel to said source of electrical energy; bulkhead means extending transversely across said inner shell means for separating said flare charge from said source of electrical energy means; normally open switch means connected in series with said battery means and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means; and a generally cup shaped, flexible second diaphragm means fitting over said switch end and coupled in watertight sealing relationship to said switch end of said case means whereby depressing said second diaphragm a preselected distance closes said switch means.

9. In combination: a substantially tubular waterproof case means having a discharge end and a switch end comprising a phenolic resin impregnated outer shell and a cardboard inner shell contained therein, said inner shell axially coextensive with said outer shell, and a substantially V shaped axial groove in the interior surface of said outer shell; a flare charge contained with said case means and having a recessed portion adjacent said discharge end of said case means; a first fire mixture contained within said recessed portion of said flare charge and in ignition relationship thereto; a pair of electrically energized squibs contained within said recessed portion and in ignition relationship to said first fire mixture; a source of electrical energy contained within said inner shell for energizing said pair of squibs; means frictionally engaging the inner portion of said inner shell and coupled to said source of electrical energy for maintaining said source of electrical energy in a predetermined portion; wire means extending axially in said V shaped groove for connecting said pair of squibs in parallel to said source of electrical energy; bulkhead means extending transversely across said inner shell means for separating said flare charge from said source of electrical energy means; normally open switch means connected in series with said source of electrical energy and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means; and a generally cup shaped, flexible second diaphragm means fitting over said switch end and coupled in watertight sealing relationship to said switch end of said case means whereby depressing said second diaphragm a preselected distance closes said switch means.

10. In combination: a substantially tubular waterproof case means having a discharge end and a switch end; a flare charge contained within said case means and having a recessed portion adjacent said discharge end of said case means; a first fire mixture contained within said recessed portion of said flare charge and in ignition relationship thereto; a pair of electrically energized squibs contained within said recessed portion and in ignition relationship to said first fire mixture; a battery means contained within said case means; wire means connecting said pair of squibs in parallel to said battery means; bulkhead means coupled to said case means for separating said flare charge from said battery means; normally open switch means connected in series with said battery means and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means; a generally cup shaped, flexible second diaphragm means fitting over said switch end and coupled in watertight sealing relationship to said switch end of said case means whereby depressing said second diaphragm a preselected distance closes said switch means; handle means coupled to the external surface of said case means in regions adjacent said switch end; and trigger means pivotally coupled to said handle means whereby pivotal movement of said trigger means depresses said second diaphragm means thereby closing said switch means and energizing said pair of squibs.

11. In combination: a substantially tubular waterproof case means having a discharge end and a switch end comprising a phenolic resin impregnated outer shell and a cardboard inner shell contained therein, said inner shell axially coextensive with said outer shell, and a substantially V shaped axial groove in the interior surface of said outer shell; a flare charge having a predetermined burning time contained within said inner shell means; a pair of electrically energized squib means contained within said inner shell means and in ignition relationship to said flare charge for igniting said flare charge; a source of electrical energy contained within said inner shell for energizing said pair of squibs; wire means extending axially in said V shaped groove for connecting said pair of squibs in parallel to said source of electrical energy; bulkhead means extending transversely across said inner shell means

for separating said flare charge from said source of electrical energy means; switch means contained within said inner shell means and in switch operable relationship to said switch end and connected in series with said source of electrical energy and said pair of squibs whereby closing said switch energizes said pair of squibs; sealing means coupled to said discharge end and said switch end of said case means to effect a watertight seal therebetween; handle means coupled to the external surface of said case means in regions adjacent said switch end; and trigger means pivotally coupled to said handle means whereby pivotal movement of said trigger means closes said switch means.

12. In combination: a waterproof nonmetallic case means; a flare charge contained within said case means comprising thirty eight parts by weight barium nitrate, nine parts by weight flaked aluminum, two parts by weight flaked magnesium, four parts by weight sulfur, and one and one half parts by weight castor oil; a first fire mixture comprising ten percent by weight boron and ninety percent by weight barium chromate and in ignition relationship to said flare charge; a pair of squibs contained within said case means and in ignition relationship to said first fire mixture; a battery means contained within said case means; wire means connecting said pair of squibs in parallel to said battery means; bulkhead means coupled to said case means for separating said flare charge from said battery means; means contained within said case means for retaining said battery means in a predetermined position; means coupled to said case means for energizing said pair of squibs; and sealing means coupled to said case means to effect a watertight seal therebetween.

13. In combination: a waterproof nonmetallic case means; a flare charge contained within said case means comprising thirty eight parts by weight barium nitrate, nine parts by weight flaked aluminum, two parts by weight flaked magnesium, four parts by weight sulfur, and one and one half parts by weight castor oil; a first fire mixture comprising ten percent by weight boron and ninety percent by weight barium chromate and in ignition relationship to said flare charge; a pair of squibs contained within said case means and in ignition relationship to said first fire mixture; a battery means contained within said case means; wire means connecting said pair of squibs in parallel to said battery means; bulkhead means coupled to said case means for separating said flare charge from said battery means; means contained within said case means for retaining said battery means in a predetermined position; normally open switch means connected in series with said battery means and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means. a generally cup shaped, flexible second diaphragm means fitting over said switch end and coupled in watertight sealing relationship to said switch end of said case means whereby depressing said diaphragm a preselected distance closes said switch means; handle means coupled to the external surface of said case means in regions adjacent said switch end; and trigger means pivotally coupled to said handle means whereby pivotal movement of said trigger means depresses said second diaphragm thereby closing said switch means and energizing said pair of squibs.

14. In combination: a substantially tubular waterproof case means having a discharge end and a switch end comprising a phenolic resin impregnated outer shell and a cardboard inner shell contained therein, said inner shell axially coextensive with said outer shell, and a substantially V shaped axial groove in the interior surface of said outer shell; a flare charge contained within said case means and having a recessed portion adjacent said discharge end of said case means; a first fire mixture contained within said recessed portion of said flare charge and in ignition relationship thereto; a pair of electrically

energized squibs contained within said recessed portion and in ignition relationship to said first fire mixture; a source of electrical energy contained within said inner shell for energizing said pair of squibs; wire means extending axially in said V shaped groove for connecting said pair of squibs in parallel to said source of electrical energy; bulkhead means extending transversely across said inner shell means for separating said flare charge from said source of electrical energy means; normally open switch means connected in series with said source of electrical energy and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means; a generally cup shaped flexible second diaphragm means fitting over said switch end and coupled in watertight sealing relationship to said switch end of said case means whereby depressing said diaphragm a preselected distance closes said switch means; handle means coupled to the external surface of said case means in regions adjacent said switch end; and trigger means pivotally coupled to said handle means whereby pivotal movement of said trigger means depresses said second diaphragm thereby closing said switch means and energizing said pair of squibs.

15. In combination: a substantially tubular waterproof case means having a discharge end and a switch end comprising a phenolic resin impregnated outer shell and a cardboard inner shell contained therein, said inner shell axially coextensive with said outer shell, and a substantially V shaped axial groove in the interior surface of said outer shell; a flare charge contained within said case means and having a recessed portion adjacent said discharge end of said case means; a first fire mixture contained within said recessed portion of said flare charge and in ignition relationship thereto; a pair of electrically energized squibs contained within said recessed portion and in ignition relationship to said first fire mixture; a source of electrical energy contained within said inner shell for energizing said pair of squibs; means frictionally engaging the inner portion of said inner shell and coupled to said source of electrical energy for maintaining said source of electrical energy in a predetermined position; wire means extending axially in said V shaped groove for connecting said pair of squibs in parallel to said source of electrical energy; bulkhead means extending transversely across said inner shell means for separating said flare charge from said source of electrical energy means; normally open switch means connected in series with said source of electrical energy and said pair of squibs whereby closing said switch means electrically energizes said pair of squibs; a generally cup shaped, combustible first diaphragm means fitting over said discharge end and coupled in watertight sealing relationship to said discharge end of said case means; a generally cup shaped, flexible second diaphragm means fitting over said switch end and coupled in watertight sealing relationship to said switch end of said case means whereby depressing said diaphragm a preselected distance closes said switch means; handle means coupled to the external surface of said case means in regions adjacent said switch end; and trigger means pivotally coupled to said handle means whereby pivotal movement of said trigger means closes said switch means.

16. An underwater pyrotechnic flare comprising in combination: a case means having a discharge end and a switch end; a pyrotechnic flare charge contained within said case means; means contained within said case means for igniting said pyrotechnic flare charge said means including a normally open switch means spaced a predetermined distance from said switch end of said case means; sealing means coupled to said case means at said discharge end for providing a water tight seal therebetween and a generally cup-shaped flexible diaphragm

means fitting over said switch end of said case means and coupled in water tight sealing relationship thereto whereby depressing said flexible diaphragm said preselected distance closes said switch means and ignites said pyrotechnic flare charge.

17. An underwater pyrotechnic flare comprising in combination: in a case means having a discharge end and a switch end; a pyrotechnic flare charge contained within said case means; means contained within said case means for igniting said pyrotechnic flare charge said means including a normally open switch means spaced a predetermined distance from said switch end of said case means; sealing means coupled to said case means at said discharge end for providing a water tight seal therebetween, a generally cup-shaped flexible diaphragm means fitting over said switch end of said case means and coupled in water tight sealing relationship thereto whereby depressing said flexible diaphragm said preselected distance closes said switch means and ignites said pyrotechnic flare charge and trigger means coupled to the exterior of said case means adjacent said flexible diaphragm and in switch-operating relationship thereto whereby actuation of said trigger means moves said flexible diaphragm to depress said normally open switch means and thereby energize said pyrotechnic flare charge.

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