EXEMPLARY CLAIM

16. A flare device for use with an explosively actuated mine anchor-line cutter, comprising a buoyant flare, and means for attaching the flare to such a cutter, said means being separable from the cutter by the firing of the cutter under water to sever an anchor-line, whereby the flare will be released, the flare including a gas-producing chemical, water-pressure responsive means sealing the chemical away from water as long as the flare is in deep water, and means for moving said water-pressure responsive means out of said sealing position when the flare rises out of said deep water.
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BUOYANT SIGNAL FLARE

This invention relates to the cutting of the lines by which explosive mines are anchored in bodies of water, and more particularly to buoyant signal flares carried by such tools and released by them when the lines are cut.

In my copending Pat. application, Ser. No. 591,368, filed June 14, 1956, I have shown and described several different signal flares that can be used with mine-anchor line cutters of the explosively actuated type. When such a cutter encounters a mine-anchor line, the cutter is fired and the line is cut. Simultaneously, the flare is released from the cutter and floats to the surface. As it is released from the cutter, a chemical carried by the flare is exposed to the surrounding water. The wet chemical is one that generates a gas that will burn the moment the chemical reaches the air above the water. The purpose of the flare is to provide a floating torch that will show that a mine has been cut loose and has risen to the surface nearby. Of course, the flare has its principal utility when mine sweeping is done at night. At such times, there is always the danger of a floating mine, which has been cut loose, being lost or being run into by another ship in the mine sweeping fleet, due to the fact that the darkness hides the mine. Although the flares shown in my copending application are satisfactory in general, it has been found that when they are released in deep water, an undesirable amount of the gas-generating chemical is consumed before the float reaches the surface of the water. This shortens the length of time that the flare will burn above the water and may also reduce the size of the flame. Also, when the float has to rise from a great depth, it may take too long, with the result that it does not reach the surface as soon as desired. In addition to the distance that the float must travel, the chemical has a longer time in which to become soaked with water, which may retard ascent.

It is among the objects of this invention to provide a signal flare which will rise to the surface of a body of water very rapidly and which will not start to release gas until the flare is near the surface.

In accordance with this invention, a buoyant signal flare is provided with a tubular passage having an exposed end. Slidably mounted in the exposed end of the passage is a sealing plug that is held therein by the pressure of water against the plug as long as the flare is in deep water. However, as the flare rises toward the surface of the water, it reaches a point where the water pressure against the plug is overcome by the pressure in the opposite direction of a spring. The spring then pushes the plug out of the passage so that water can reach a chemical in the passage. The chemical is the kind that, when wet, will produce a gas that will burst into flame when it reaches the air above the water. It is therefore necessary to keep the chemical dry until the flare is near the surface of the water. For best results, the float with which the flare is provided is a hollow sphere.

The invention is illustrated in the accompanying drawings, in which

FIG. 1 is a fragmentary plan view of the cutting end of a mine-anchor line cutter provided with my improved flare;

FIG. 2 is an enlarged fragmentary front view of the cutter, showing part of it and the flare broken away in section;

FIG. 3 illustrates a released flare floating on a body of water and producing flames;

FIG. 4 is a fragmentary horizontal section through a modified cutter and flare, and

FIG. 5 shows the flare floating and producing flames.

Referring to FIGS. 1 and 2 of the drawings, a stabilizing fin 1 has its longitudinal axis extending in the direction in which the cutter is pulled through the water by a sweep line 2 extending backward and laterally from a mine sweeper (not shown) in a wellknown manner. The front edge of the fin is inclined to its longitudinal axis the same degree as the sweep line. This front edge is provided at its opposite ends with integral ears 3 that hook over the sweep line. Bolts 4, extending through the fin and each ear, hold the fin on the sweep line.

Rigidly mounted on the front portion of the fin is the metal frame 6 of the cutting tool. The longitudinal axis of the frame extends across the fin, and the frame is set back from the front corner of the fin so that only a small amount of the frame extends across the inclined front edge of the fin. The front side of this outwardly projecting portion of the frame is provided with a recess 7 that extends lengthwise of the frame. The frame also is provided with a longitudinal bore extending inwardly from the inner end of the recess, and this bore normally contains a cutting chisel 8 that is held in retracted position by a shear pin 9 extending through it and the surrounding frame.

The end of the frame beside the recess is provided with a slot 11 for receiving a tongue 12 on one end of a guide member 13. The tongue and frame are provided with aligned transverse passages, through which a shear pin 14 extends. The guide member 13 extends across the end of the recess 7 to form an anvil 15 and then the guide turns and extends along the front side of the recess toward the chisel. At a point spaced from the chisel, the guide is inclined forward away from the frame to form a finger 16 that will intercept a mine-anchor line and direct it into the cutting notch formed by recess 7 between the guide and frame.

When a mine-anchor line 18, across which the sweep line and fins have been dragged, is caught in the cutting notch, it is cut by the chisel which is driven against it by the force of an explosion from a cartridge (not shown) removably mounted in the frame at the inner or rear end of the chisel. During cutting, the mine line is backed up by the front and back walls of the cutting notch, and by the anvil 15 in the path of the chisel. To explode the cartridge, a firing mechanism is mounted in the inner end of the frame. This mechanism forms no part of this invention and is not shown, but it can be seen in U.S. Pat. No. 2,422,506. It includes a plunger 19 slidably mounted in a guiding slot 20 extending lengthwise of the back side of the frame. Connected to the rear end of the plunger is a rod 21 that is slidably mounted in a bore through a block 22 rigidly mounted in slot 20 behind the cutting notch. The plunger is urged toward the inner end of the frame by a coil spring 23 circling the rod and compressed between the plunger and block 22. The plunger normally is held in retracted position, with the spring compressed, by means of a trip pin 24 of small diameter extending through guide member 13, across the cutting notch, through the frame and into a transverse opening 25 in the plunger rod.

When a mine-anchor line 18 enters the cutting notch, it engages the trip pin 24, the front end of which is held
in fixed position by engagement of its head with guide member 13. As the anchor line bends the pin toward anvil 15, the rear end of the pin is pulled out of the plug, thereby releasing the plug. The released plunger actuates the firing mechanism, as described in detail in said patent, and the cartridge is detonated. The force of the explosion builds up until it is sufficient to cause the cutting chisel to shear off pin 9.

The chisel then shoots forward, and in cutting the anchor line it also shears off the portion of trip pin 24 in the cutting notch. Shear pin 14, which connects guide member 13 to the frame, is strong enough to hold the anvil in place until the chisel has severed the anchor line. The impact of the chisel against the anvil then causes the tongue 12 of guide member 13 to shear off pin 14 and slide out of frame slot 11. Release and loss of the guide member in this manner is justified because, otherwise, the next mine-anchor line might catch in the cutting notch, where it would not be cut.

As soon as a mine-anchor line is cut, the mine that is thereby released rises to the surface of the water and floats there until detonated in some suitable manner. It is a feature of this invention that the presence of the mine floating on the water is clearly indicated at night when the mine otherwise might not be seen. Accordingly, a buoyant flare is carried by the cutter in such a manner that it will be released when the cutter is fired and will rise to the surface with the mine, where it will immediately burst into flame and serve as a beacon.

The flare shown in FIGS. 1, 2 and 3 includes a float 30 that preferably is a hollow spherical shell. The float may be made conveniently from two flanged hemispherical metal cups welded together. It is provided with a circular opening from which an integral collar 31 projects radially. Extending across the inside of the float and most of the way through the collar, is a sleeve 32 having an open outer end and a closed inner end. The inner end may be provided with an integral rivet 33 that extends through a hole in the float and is upset to hold the sleeve tightly in place. Slidably mounted in the outer end portion of the sleeve is a plug 34, inward movement of which is limited preferably by a shoulder 35 that engages the end of the sleeve. The plug is supposed to seal the end of the sleeve, and to make certain that a good seal will be produced, the plug may be provided with a circumferential groove, in which a sealing ring 36 is compressed for sealing engagement with the inner surface of the sleeve.

Disposed inside of sleeve 32 is the chemical 37 that generates the gas which produces the flame of the flare. This chemical is calcium phosphide, which may contain calcium carbide. When such a chemical becomes wet, it immediately generates a gas. The calcium phosphide gas will burst into flame in the presence of oxygen, but the calcium carbide gas must be ignited by the first gas. The calcium carbide is used in order to provide a bright, steady signal flame, because calcium phosphide gas produces an intermittent flame that is not very bright. Of course, the plug in the end of the sleeve keeps the chemical dry until it is to be used. Preferably, the chemical is disposed in a tubular receptacle 38 that may be integral with the inner end of the plug and coaxial with it. The side wall of the receptacle is perforated for entrance of water and escape of gas. The inner end of the receptacle may be closed by a stopper 39. If there is any likelihood of the chemical sifting out through the perforated tube, the chemical can be held in a mesh bag (not shown). To prevent plug 34 from leaving the sleeve when the flare is not in use, the float collar 31, the sleeve and the plug are all provided with registering openings, through which a safety pin 40 extends.

In order to attach this flare to the cutter, preferably to its anvil 15, the outer side of the anvil is provided with a spherical recess 42 for receiving part of the spherical float, and with a bore 43 for receiving the float collar. The anvil is also provided with a slot 44 to receive the safety pin 40, which should not be removed until after the float has been attached to the cutter. The outer portion of the float is held in a metal cup 45, the open side of which fits against the wall of the anvil recess. The circular edge of the cup is soldered to the anvil at 46. The side wall of the cup preferably is provided with slots 47 extending inward from its edge.

When the cutter is fired, the chisel is driven through a mine-anchor line in the cutting notch and against the anvil with tremendous force. The shock of this impact easily breaks the soldered joint 46 between the flare cup 45 and the anvil, and it also causes the segments of the cup between its slots to flare out to completely free it from the flare. The cup immediately separates from the anvil and thereby releases the flare, which quickly rises to the surface of the water. To guard against any possibility of the flare not separating from the anvil, a strong coil spring 48 may be compressed between plug 34 and the anvil by mounting the spring in a bore 49 in the anvil behind the plug.

As the flare rises toward the surface, the plug is maintained in place in the sleeve by the pressure of the surrounding water. However, a few yards below the surface of the water, where the water pressure is slight, that pressure is overcome by the pressure of a coil spring 51 against the inner end of the plug. This spring encircles the tubular receptacle 38 for the chemical and may have its outer end bent and projected through a hole in the side of the receptacle. The inner end of the spring is secured to the sleeve in any suitable manner, such as by pressure of the last turn of the spring radially outward against the sleeve. This pressure can be produced by expanding the last turn before the spring is inserted in the sleeve. As soon as the plug is forced out of the sleeve by the spring, the chemical in the tube is wet by the surrounding water and starts to generate gas. This gas rises to the surface and bursts into flame as it strikes the air. The flare floats with most of tube 38 suspended from it by the spring, as shown in FIG. 3.

It will be seen that no matter at what depth the flare is released, it will not start to generate gas until it is near the surface, whereby the gas is conserved until that time. In the deeper water, the water pressure against the plug is greater than the pressure of spring 51 against its inner end, so the plug cannot come out of the sleeve. Only when the flare reaches relatively shallow water is the plug discharged and the chemical exposed to the water. By using a float formed from a hollow metal shell, the float is very buoyant and will rise through the water faster than if the float were cork or a similar material. The advantage is that the signal becomes active sooner than heretofore.

In the modified embodiment of the invention disclosed in FIGS. 4 and 5, the hollow float 55 is provided with two diametrically opposite openings, and a sleeve 56 extends through it and projects from both openings. The sleeve and float are soldered together to seal the
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The cup 57 that receives the outer half of the float is provided with a radial well 58 for receiving the adjoining end of the sleeve. Slidably mounted in each end of the sleeve is a plug 59, encircled by a sealing ring 60. The plugs are held in place initially by safety pins 61. Extending toward each other from the two plugs are perforated tubular receptacles 62 joined to the plugs. These tubes contain the gas-generating chemical 63. Encircling each tube is a coil spring 64 that is fastened to the outer end of the tube and secured to the central part of the sleeve against an internal shoulder 65.

When the cutter is fired and the flare is released from cup 57 and the recess in the anvil 66, the flare will rise through deep water where the plugs will be held in place by water pressure. As the float approaches relatively close to the surface, the pressure of the springs in the sleeve will push the plugs out of it. The chemical in the two receptacles will then become wet and will start generating gas that will burst into flame as it reaches the surface, as shown in FIG. 5. An advantage of this particular form of float is that if, for any reason, one plug would stick in the sleeve, it is a practical certainty that the other plug would be pushed out and therefore the flare would operate anyway.

When the floats disclosed herein are made of metal, they should be nonmagnetic, such as aluminum. It is highly desirable that the float be light enough to cause the flare to rise through the water at a speed at least as great as 5 feet per second. Generally, mine sweeping is done at a depth of about 50 feet and at that depth and up to about 10 feet or less from the surface, the springs in the released floats should be strong enough to push the plugs out of the sleeves against the water pressure holding them in place. Before the floats reach the surface, however, the springs will overcome the water pressure against the plugs and push them out to admit water to the chemical. Of course, the plugs will be held in place at depths greater than 50 feet, and the entire flare is designed to withstand pressures at depths at least as great as 100 feet.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A buoyant signal flare provided with a tubular passage having an exposed end, the flare including a sealing plug slidably mounted in said end of the passage and held therein by the pressure of water against the plug when the flare is in deep water, a spring in said passage for pushing the plug out of it when the flare rises from deep water, and a chemical in said passage that will produce a self-igniting gas when wet by water after the plug has been pushed out of the passage.

2. A flare according to claim 1, in which said chemical is disposed in a receptacle connected to the inner end of said plug, and the receptacle is provided with an opening for entrance of water when said passage is opened.

3. A flare according to claim 2, in which said receptacle is tubular and in axial alignment with said plug, and said spring is coiled around the receptacle and permanently connects it with the rest of the flare.

4. A flare according to claim 1, including a float containing said passage and chemical and spring.

5. A flare according to claim 4, in which said passage is formed by a sleeve mounted in the float.

6. A flare according to claim 1, including a hollow float and a sleeve mounted in the float and projecting therefrom, said sleeve forming said passage and containing said plug and spring and chemical.

7. A buoyant signal flare provided with a tubular passage having exposed ends, the flare including sealing plugs slidably mounted in the ends of the passage and held therein by the pressure of water against them when the flare is in deep water, resilient means in said passage for pushing the plugs out of it when the flare rises from deep water, and a chemical in said passage that will produce a self-igniting gas when wet by water after the plugs have been pushed out of the passage.

8. A flare according to claim 7, including a float and a sleeve extending through it to form said passage.

9. A flare according to claim 8, including a hollow spherical float provided with a pair of diametrically opposite openings, and a sleeve extending through the float and projecting from said openings and sealed therein, said sleeve forming said passage and containing said plugs and resilient means and chemical.

10. A signal flare device for use with an explosively actuated anchor line cutter, comprising a buoyant flare provided with a tubular passage having an exposed end, means for attaching the flare to such a cutter, said means being separable from the cutter by the firing of the cutter under water to sever an anchor line, whereby the flare will be released, a sealing plug slidably mounted in said end of said passage and retainable therein by the pressure of water against the plug as long as the released flare is in deep water, a spring in said passage for pushing the plug out of it when the released flare rises from deep water, and a chemical in said passage that will produce a self-igniting gas when wet by water after the plug has been pushed out of the passage.

11. A signal flare device according to claim 10, including a coil spring compressible between said flare and cutter for pushing the flare away from the cutter when said attaching means is separated from the cutter.

12. A mine anchor line cutter assembly comprising an explosively driven chisel, an anvil in front of the chisel, the side of the anvil opposite to the chisel being provided with a recess, a concave flare holder fitting against said side and forming therewith a chamber, means connecting the holder to the anvil, a float in said chamber, a sleeve mounted in the float and projecting therefrom into said recess, a sealing plug slidably mounted in the projecting end of the sleeve and held therein by the inner wall of said recess, said connecting means being separable from the anvil to release the float when the chisel is driven against the anvil in cutting an anchor line in deep water, said plug carried by the released float having an outer end exposed to water pressure, a spring in said sleeve for pushing the plug out of it when the float rises from said deep water far enough for the pressure of the spring to overcome the water pressure against the plug, and a chemical in said sleeve that will produce a self-igniting gas when wet by water after the plug has been pushed out of the sleeve.

13. A buoyant signal flare comprising a receptacle, a chemical in the receptacle that will produce a self-igniting gas when wet by water, water-pressure responsive means sealing said receptacle while the flare is in
deep water, and means for moving said sealing means when the flare is in shallow water to open said receptacle.

14. A buoyant signal flare comprising a receptacle, a chemical in the receptacle that will produce a self-igniting gas when wet by water, water-pressure responsive means sealing said receptacle while the flare is in deep water, and a spring operatively connected with said sealing means to retract said means when the flare is in shallow water, whereby to open said receptacle.

15. A buoyant signal flare provided with a passage having an exposed end, the flare including a sealing member held in sealing relation with said end of the passage by the pressure of water against said member when the flare is in deep water, a spring for removing the sealing member from said sealing relation when the flare rises from deep water, and a chemical in said passage productive of a self-igniting gas when wet by water after said passage has been opened.

16. A flare device for use with an explosively actuated mine anchor-line cutter, comprising a buoyant flare, and means for attaching the flare to such a cutter, said means being separable from the cutter by the firing of the cutter under water to sever an anchor-line, whereby the flare will be released, the flare including a gas-producing chemical, water-pressure responsive means sealing the chemical away from water as long as the flare is in deep water, and means for moving said water-pressure responsive means out of said sealing position when the flare rises out of said deep water.

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