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SIGNAL DEVICE AND COMPOSITION THEREFOR

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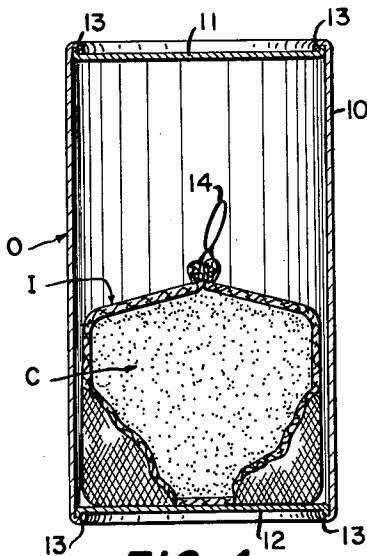


FIG. 1.

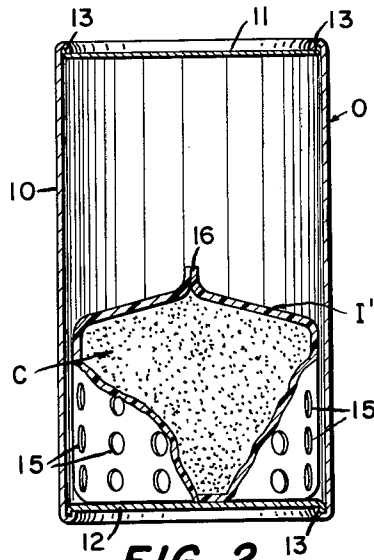


FIG. 2.

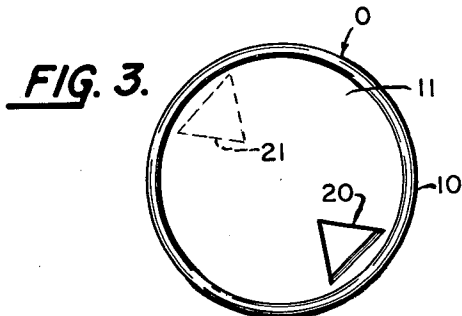


FIG. 3.

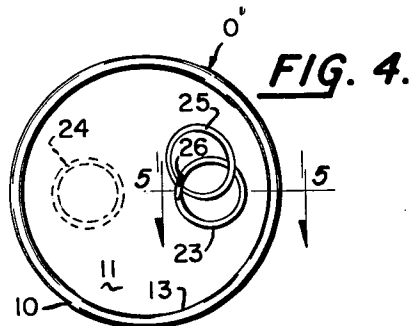


FIG. 4.

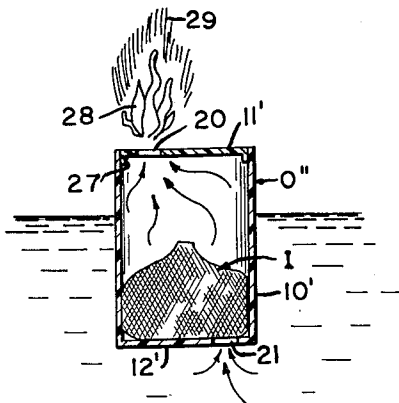


FIG. 6.

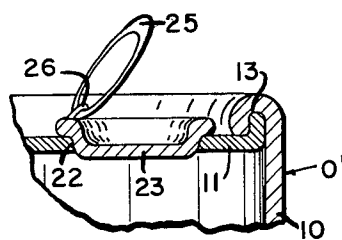


FIG. 5.

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SIGNAL DEVICE AND COMPOSITION THEREFOR

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This invention relates to signal devices and to compositions useful therein. More particularly, this invention relates to signal devices and compositions therefor which are used to produce both a flame and smoke signal, i.e., a signal which is visible both in the day time and at night, and which are adapted to be automatically activated when placed in water, thus being of particular use on boats.

When a boat, particularly a pleasure craft, becomes disabled or wrecked, it is often desirable to produce a signal which will attract the attention of someone who will come to the rescue. Since boating accidents often involve the spillage of fuel, a signal flare, of the type used on railroads, is undesirable, because it must be ignited and held by the person on the boat, thereby introducing the possibility of ignition of spilled fuel. Other previous devices for the purpose have been too complicated in construction and therefore too costly, or are subject to other objections, such as lack of reliability because of deterioration of material, or lack of usefulness because of complicated procedures necessary to place in operation.

Among the objects of this invention are to provide a novel signal device; to provide such a device which will automatically be activated upon being placed in water and therefore is particularly useful on boats; to provide such a device which, when stored on a boat, will not introduce a fire hazard; to provide such a device which is simple in construction and easy to place in operation; to provide such a device which does not require separate ignition; to provide such a device which requires no special equipment for use, other than normally found on a boat; to provide such a device which contains a signal producing composition which will spontaneously produce both smoke and flame upon contact with the water; to provide such a device which will prevent the signal composition from being lost or discharged from the device upon initial contact with water; to provide such a device which will maintain the signal composition in condition for use for long periods of time; to provide such a device which will float in the water while producing the signal; to provide a novel signal composition which is particularly useful in the signal device of this invention; to provide such a composition which is readily maintained in condition for use for long periods of time; to provide such a composition which is self-activating upon contact with water; and to provide such a device and a composition therefor which will produce a signal of both flame and smoke which will last for an extended period of time.

Additional objects and the novel features of this invention will become apparent from the description which follows, taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevation, with certain parts in vertical section or broken away for clarity of illustration, of a signal device constructed in accordance with this invention;

FIG. 2 is a side elevation similar to FIG. 1, illustrating an alternative embodiment of the device of this invention;

FIG. 3 is a top plan view of the device of FIG. 1, after certain holes have been produced in an outer container thereof, prior to being thrown into the water;

FIG. 4 is a top plan view of a further alternative device of this invention;

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FIG. 5 is a fragmentary, vertical section, on an enlarged scale, taken along line 5—5 of FIG. 4; and

FIG. 6 is a side elevation of the device of this invention floating in water and producing a smoke and flame signal, with a further alternative outer container of the device in vertical section.

A signal device constructed in accordance with this invention, as illustrated in FIG. 1, may comprise an outer container O, which is conveniently similar to a can formed of tin plate and normally used for storage of processed food; and an inner container I, disposed in the outer container and filled or substantially filled with a signal composition C, preferably the novel composition of this invention, described later. The outer container O is conveniently provided with a cylindrical side wall 10, a top 11 and a bottom 12, the side wall being connected at each end to the top and bottom, respectively, as by interlocking flanges 13. The outer container O, may, of course, be formed of plastic or any other suitable material which is water impervious, so that no water can leak therethrough. The inner container I may be a sack formed of fabric having a plurality of small holes or interstices therein, which will prevent the particles of the signal composition C from falling through, but which provide sufficient permeability that water can enter the sack and gases produced by the reaction of the water with the particles of the signal composition C can pass through the sack. The inner container or sack I is conveniently provided with a draw string 14 which, after the desired amount of the signal composition has been placed therein, is pulled tight and tied, as shown. In the alternative device of this invention, illustrated in FIG. 2, the outer container O is conveniently similar to the outer container O of FIG. 1, while the inner container I' is a sack formed of an impervious material, such as plastic, provided with a plurality of holes 15 for the entry of water and discharge of reaction gases. The size of the holes 15 is exaggerated in FIG. 2 for clarity of illustration, since the holes 15 should be smaller in size than the particles of composition C, to prevent the particles from leaking out of the inner container. The top edge 16 of the inner container I' is brought together at the center and closed in a suitable manner, as by being tied or heat sealed.

Just prior to being thrown in the water, a hole 20 is punched, or otherwise produced in any suitable manner, in the top 11 of the outer container O, adjacent one edge, and a similar hole 21 is similarly produced in the bottom 12 of the outer container, adjacent the outer edge but preferably laterally opposite the upper hole 20, for a purpose described later. The holes 20 and 21 are conveniently produced by a conventional opener, normally used to produce one or more holes in the top of a conventional can, to permit a liquid to be poured therefrom. Such openers are normally found on a boat, although one may be stored with the signal devices. The signal devices of this invention are conveniently stored in a cabinet, or in a special rack, which may have a cross section similar to that of the outer container O and is adapted to permit one signal device at a time to be pulled therefrom, as in the manner of racks for dispensing packages of cigarettes, cases of snuff, and the like.

In the alternative outer container O', illustrated in FIGS. 4 and 5, the top 11 is provided with a hole in which a removable plug 23 is adapted to fit tightly, while the hole for the plug 23 is disposed adjacent one side of the container, and a similar plug 24, in the bottom of the container, is disposed adjacent the opposite side, as in FIG. 4. For removing the plugs 23 and 24, each may be provided with a ring 25, attached to the plug by a bracket 26, the ring normally lying flat against the plug and the container top or bottom, as in FIG. 4, but being movable to a more upright position, as in FIG. 5, for

insertion of a finger of the user therein, whereby the plug 23 may be pulled from the top and the plug 24 then pulled from the bottom of the container, and the container then thrown into the water.

The further alternative outer container O' of FIG. 6 is formed of plastic, having side walls 10', which may be integral with a top 11' or a bottom 12', while the bottom or top, as the case may be, is attached to the side walls after filling. As shown, the bottom 12' is integral with the side walls 10' and the top 11' is sealed to the side walls, as by a waterproof cement around a flange 27 after the inner container is inserted therein. Holes 20 and 21 may be produced in the top and bottom, as before. Because of its affinity for water vapor or moisture, the inner container I is filled and also placed in the outer container in a dry atmosphere or in the presence of a dry inert gas, such as nitrogen or carbon dioxide. However, since the outer container O is water impervious, the device can be stored for long periods, without deterioration of the signal composition.

As soon as the holes 20 and 21 in the outer container O of FIG. 3 or O' of FIG. 6 are produced or the plugs 23 and 24 of the container O' of FIGS. 4 and 5 are removed, the container is immediately thrown into the water, where it will tend to float in the position of FIG. 6. The weight of the signal composition C will tend to maintain the container upright in the water, while water entering through the hole 21 in the bottom contacts the signal composition C, as indicated by the arrows of FIG. 6. The gases produced by the reaction of the water with the signal composition will emerge through the interstices in the inner container I and will fill the interior of the outer container, as indicated by the arrows, and will be discharged through the upper hole 20, which is above the water. The signal composition C is adapted to produce gases which both ignite on contact with the air and also produce flames 28 and smoke 29. It will be understood that the flames 28 will extend upwardly for a considerable distance and that the smoke 29 will form a dense cloud which rises upwardly, such as up to 100 feet or more. In order to insure that the outer container O will float in the water, with the upper end always above water, so that the gases issuing from hole 20 will immediately contact the air, the amount of the composition C placed in the inner container I or I' is preferably equal to about one third to one half of the total volume of the outer container. In addition, the size of the holes 20 and 21 in container O or O' and the holes produced by removal of the plugs 23 and 24 of the container O' should be proportional in size to the size of the outer container and the amount of signal composition contained therein. Thus, the holes should be sufficient in size to admit the water relatively freely and permit the free discharge of reaction gases, but not so large as to permit water to flood the interior of the container and cause it to sink. Thus, for an outer container having a diameter of 2 1/8 inches and a height of 5 1/2 inches, with a capacity of approximately 9 fluid ounces and having therein approximately four ounces by weight of the signal composition C, holes 20 and 21 are appropriately isosceles triangles having a base of 5/8 inch and an altitude of 7/16 inch. Such a hole is readily produced by a conventional opening device, as indicated above. A circular hole of equivalent area, such as produced by the removal of plugs 23 and 24 of container O', would have a diameter of approximately 0.38 inch. Of course, considerable variation in the size of the holes, from a relative standpoint, is permissible, since the above-mentioned triangular holes are also satisfactory for an outer container having a diameter of 2 1/8 inches and a height of 3 1/2 inches, adapted to contain six fluid ounces and having therein approximately three ounces, by weight, of the signal composition C.

As will be evident, as the water enters the lower hole 21 and contacts the signal composition inside the inner container I, the reaction gases produced will prevent the

flooding of the interior of the outer container, thereby maintaining it in a floating position. Of course, the water will tend to creep upwardly in the outer container, as more and more of the signal composition in the lower portion of the inner container is reacted, thus tending to cause the outer container to sink somewhat lower in the water, but with holes of proper size, the reaction will be complete before the container sinks below the water. It is also desirable to limit the size of the upper hole 20, since water is not always quiescent and wave action and the like may tend to toss the container around quite a bit. Thus, a minimum of water should enter the container by splashing. Actually, a hole 20 of somewhat smaller size than hole 21 is sufficient to permit the discharge of the reaction gases, but it is much more convenient to produce these holes of the same size, when the same instrument is used. However, the hole produced by removal of the upper plug 23 of the outer container O' may be smaller than the hole produced by removal of the lower plug 24.

The signal composition C, as indicated previously, should react with water to produce gases which, upon discharge from the outer container, will spontaneously ignite in the atmosphere and produce both flame and smoke. The composition of this invention is particularly adapted for such use and comprises a mixture of a magnesium aluminum phosphide with calcium phosphide, the latter being in an amount in excess of 5% and up to about 20% of the magnesium aluminum phosphide. Thus, a composition containing 5% of calcium phosphide produced reaction gases, in the device of this invention, which would burn only sporadically, where as a composition containing 10% of calcium phosphide would operate satisfactorily, but the flame did not continue as long as the smoke. Similarly, a composition containing 20% of calcium phosphide produced a flame when there was no longer any smoke, thus being suitable for a night signal. The optimum percentage of calcium phosphide was thus determined as approximately 15%, since with such a percentage, the flame and smoke continued for approximately equal periods of time.

The preferred magnesium aluminum phosphide has the approximate formula $Mg_3P_2 \cdot 2AlP$, while the calcium phosphide utilized has the approximate formula CaP , it being understood that the proportions of magnesium, aluminum and phosphorous in the magnesium aluminum phosphide may be varied and that the approximate formula may differ somewhat from the preferred. The magnesium aluminum phosphide may be separately and then mixed with the calcium phosphide in the desired proportions, or the composition may be made so that the magnesium aluminum phosphide and the desired proportion of calcium phosphide is produced at the same time. In the latter instance, the product is ground to a size which will not leak through the bag or inner container but sufficiently small to insure adequate reaction. Thus, grinding to a size of between -4 and +40 mesh has been found to be suitable. To make the preferred magnesium aluminum phosphide, magnesium in the form of chips, such as less than 1/8 inch in size, is mixed with an aluminum powder, as about -200 mesh, and a red phosphorous powder, as about -100 mesh, then ignited. The highly exothermic reaction thus initiated produces the desired magnesium aluminum phosphide, such as when 72 lbs. of magnesium chips, 54 pounds of aluminum powder and 124 pounds of red phosphorous powder are mixed together. To produce calcium phosphide in the above mixture simultaneously, lime and red phosphorous in equal proportions, amounting to twice the desired percentage by weight of calcium phosphide, are added to the reaction mixture, the heat of reaction producing calcium phosphide. When the calcium phosphide is made separately, lime and red phosphorous are mixed, then heated to a temperature of 600° C. or above. It will be understood, of course, that the composition thus produced does not contain magnesium aluminum phosphide and calcium

phosphide as pure products, since some contaminants are present. In fact, the reaction of lime and red phosphorous produces approximately equal amounts of calcium phosphide and calcium pyrophosphate. Thus, the latter exists as an impurity in the mixture and is not considered when the percentage of calcium phosphide is determined.

The reaction of water with magnesium aluminum phosphide produces a gas consisting predominantly of phosphine or PH_3 ; in fact, determinations made have indicated that there is approximately 99% of PH_3 and 1% of P_2H_4 produced. Phosphine, i.e., PH_3 , oxidizes in the air to P_2O_5 , i.e. phosphorous pentoxide, which produces a dense smoke and is rated as 100 on the smoke screen obscurity scale, but phosphine will not ignite in air at less than 100°C . Thus, the small amount, i.e. 1%, of P_2H_4 produced by the reaction of water with magnesium aluminum phosphide is insufficient for the spontaneous ignition of the reaction gas in air. However, the reaction of calcium phosphide with water produces predominantly P_2H_4 , which will ignite spontaneously in air and also produces P_2O_5 , with only a small amount of PH_3 . Both PH_3 and P_2H_4 produce a bright flame when burning, in addition to the smoke, so that the ignition of the reaction gases from the preferred composition, within the ranges indicated previously, produces not only a dense smoke but also a flame, which at night can be seen for a considerable distance. Of course, the dense smoke can be seen in the daytime for a considerable distance. It will be evident, of course, that the calcium phosphide should be intermixed throughout the magnesium aluminum phosphide, so that as the water contacts successive portions of the signal composition, there will be sufficient P_2H_4 to sustain the ignition of the entire amount of gas produced by the reaction, as the signal composition is consumed. Thus, when the calcium phosphide is produced separately and then mixed with the magnesium aluminum phosphide, the mixing should be rather thorough. The lack of sufficient P_2H_4 , except for sporadic production thereof, apparently occasioned the sporadic burning only of the reaction gases produced when only 5% of calcium phosphide was present with the magnesium aluminum phosphide. It will be noted, of course, that the more than 5% to approximately 20% of calcium phosphide is on the basis of calcium phosphide and that inert or partially inert ingredients may be present, such as the calcium pyrophosphate produced in the reaction between lime and red phosphorous.

From the foregoing, it will be evident that the signal device of this invention fulfills to a marked degree the objects hereinbefore set forth. The device is relatively simple and, due to the imperforate outer container, will permit the signal composition to be stored for any desired length of time, as long as water or moisture does not enter the container. The inner container, which is perforate or provided with interstices, preferably at least slightly smaller than the particles of the signal composition, permits water entering the outer container to react with the signal composition, without causing the signal composition to be blown out of the outer container at the first production of gas. The perforate inner container, of course, permits the gaseous products of the reaction to be expelled into the outer container, while the upper hole in the outer container permits the gaseous reaction products to be discharged into the air, for ignition therein. The use of a small inner container, which conveniently fills approximately one third to one half of the outer container, insures that the outer container will float upright in the water, so that the top of the outer container will be above the water level and the reaction gases will be expelled through the upper hole. The production of holes in the bottom and top of the container, at laterally opposite points adjacent the sides of the container, increases the stability of the container in the water. The use of a hole of limited extent in the bottom of the con-

tainer prevents too much water from rushing into the container, while the use of a hole of limited extent in the top of the container limits the amount of water which might splash into the container, due to wave action and the like. The holes in the top and bottom of the container are also readily produced, since holes may be produced by a conventional opening device which is found on almost all boats. Or, a removable plug, conveniently provided with means, such as rings, for removing the same, may also be utilized, without the necessity of any additional implements. The device of this invention is easy to store and occupies a minimum of space, since a container $2\frac{1}{8}$ " in diameter and $5\frac{1}{2}$ " high may contain a sufficient amount of signal composition to produce flame and smoke for about one half hour.

The signal composition of this invention also fulfills to a marked degree the requirements and objects hereinbefore set forth. By using approximately 15% by weight of calcium phosphide, in proportion to the magnesium aluminum phosphide and ignoring inert ingredients, the flame and smoke will normally last for approximately the same period of time, so that the composition is useful equally during the day and during the night. Of course, the amount of calcium phosphide may be increased, such as up to 20%, so as to provide a flame lasting longer than the smoke, particularly useful for use at night.

It will be understood that the shape of the container may be varied, although a cylindrical container appears to operate more satisfactorily than other shapes. Also, the position of the holes in the top and bottom of the container may be varied, although holes in laterally opposite positions tend to stabilize the container while in the water.

Although certain preferred embodiments of this invention have been illustrated and described, it will be understood that other embodiments may exist and variations may be made therein, without departing from the spirit and scope of this invention.

What is claimed is:

1. A device for producing a signal, comprising an imperforate outer container; a pervious inner container containing a signal composition comprising an intimate mixture of finely divided magnesium aluminum phosphide and finely divided calcium phosphide, said calcium phosphide comprising more than 5% and up to approximately 20% by weight of said magnesium aluminum phosphide, said signal composition being adapted to react with water to produce gaseous reaction products which will ignite upon contact with the atmosphere and will produce flame and smoke, said inner container occupying less than one half of the volume of said outer container so that when placed in water, said outer container will tend to float with the inner container and signal composition in the lower portion thereof, said outer container being adapted to have holes produced in the top and bottom thereof whereby water will enter said bottom hole for reaction with said signal composition and the gaseous products of reaction will be expelled through said top hole.

2. A signal producing device, as defined in claim 1, wherein said calcium phosphide comprises approximately 15% of said magnesium aluminum phosphide.

3. A device for producing a smoke and flame signal upon placement in water, comprising a cylindrical outer container adapted to have holes produced in the ends thereof at laterally opposite positions; and a pervious inner container disposed within said outer container and containing a signal composition comprising a mixture of relatively finely divided magnesium aluminum phosphide and calcium phosphide, said calcium phosphide being in the proportions, by weight, of greater than 5% and up to approximately 20% of said magnesium aluminum phosphide, said signal composition being adapted to react with water to produce reaction products, which will spontaneously ignite in air and produce both smoke and

flame, said inner container occupying approximately one third of the volume of said outer container.

4. A composition of matter which, upon reaction with water, produces gases which ignite spontaneously and produce both smoke and flame upon contact with the atmosphere, consisting essentially of relatively finely divided magnesium aluminum phosphide and relatively finely divided calcium phosphide, said calcium phosphide comprising, by weight, greater than 5% and up to approximately 20% of said magnesium aluminum phosphide and being intimately mixed therewith.

5. A composition of matter, as defined in claim 4, wherein said magnesium aluminum phosphide has the approximate formula $Mg_3P_2 \cdot 2AlP$.

6. A composition of matter, as defined in claim 4, containing calcium pyrophosphate.

7. A composition of matter, as defined in claim 4,

wherein said calcium phosphide comprises approximately 15% of said magnesium aluminum phosphide.

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