COMBINATION NIGHT-DAY SIGNALING DEVICE
James P. Flynn, Midland, Mich., assignor to The Dow Chemical Company, Midland, Mich., a corporation of Delaware
Filed May 27, 1968, Ser. No. 732,271
Int. Cl. C06D 3/00
U.S. Cl. 116—114
6 Claims

ABSTRACT OF THE DISCLOSURE

The present invention relates to a bicompartimentalized signaling device containing in one compartment a combination of smoke dye monopropellant, and containing in the other compartment a pyrotechnic composition consisting of a polymeric binder fuel system, fuel, oxidizer, and light-producing agent.

BACKGROUND OF THE INVENTION

Heretofore, signaling devices have presented certain problems. No single device has been truly adequate for use both during the day and at night, thereby necessitating the need for both a daytime device and a night signaling device. Additionally, many commonly employed signaling devices such as the railroad “fuzee” flare tend to crumble upon impact and therefore must be insulated from shock and handled with care.

A principal object of the present invention is to provide a combination signaling device which can be used either at night or during the day.

Another object of the present invention is to provide a durable signaling device which is resistant to the type of shocks and jolts which commonly occur in the long time interim before use when the device resides aboard a railroad car, automobile or other structure.

Additionally, it is an object of the present invention to provide a signaling device which can withstand long storage periods.

Still another object of the present invention is to provide a signaling device which in a preferred form can be fabricated by the relatively simple method of mixing the desired ingredients and casting or extruding them into the desired form as opposed to the slow, costly, cumbersome and dangerous process of compressing the ingredients into a pyrotechnic munition.

These and other objects and advantages readily will become apparent when read in conjunction with the appended drawings.

FIGURE 1 is a side elevation of one embodiment of a container operable in the device of the present invention which is suitable for holding a smoke dye composition.

FIGURE 2 is a top view of the container of FIGURE 1.

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 2.

FIGURE 4 is a perspective view of a device of the present invention in operating position for use as a daytime smoke flare or signaling device.

FIGURE 5 is a perspective view of the device of FIGURE 4 in position for use as a night light producing flare or signaling device.

SUMMARY OF THE INVENTION

Generally the unique combination night and day signaling device of the present invention comprises a bicompartiment unit having an combination a first container containing a smoke dye producing composition, a second container containing a pyrotechnic flare composition and a support member which holds the first and second containers in slidable engagement.

The term “support member” as used in the present application refers to a tubular structure which may be of any shape such as, for example, cylindrical, hexagonal, rectangular, and the like. The support member can consist essentially of a relatively mechanically strong heat and flame resistant material such as, for example, steel, aluminum, other metals, certain types of plastics, heat and flame resistant laminates and the like.

Each of the containers has an external wall configuration such that these members slidably engage the inner wall of the support member; usually, each container is of the same general flame resistant characteristics as the support member.

The smoke dye producing assembly is a vented structure, usually having a through passage extending axially along its entire length. The container for the pyrotechnic flare assembly has one closed end and one open end.

Generally the support member will have attached thereto a means for securing the device when it is ignited such as a spring clamp, or a spike which can be thrust into the ground.

In fabricating the device, the pyrotechnic flare unit is inserted open-end first into one end of the support member and the smoke generating unit is inserted into the other end of this support. It should be understood that the order of insertion of the containers into the support member is not critical and that the only requirement is that the open face of the flare composition unit must be adjacent the smoke dye container.

Conveniently, the smoke generating composition and pyrotechnic flare composition are in the form of solid propellant grains. This facilitates ease of manufacture since the composition can be poured, cast, rammed or otherwise introduced into the respective container and be secured therein, if curing is necessary, thereby to provide directly the corresponding smoke dye or flare assembly.

This device can be fitted with any of a variety of light and smoke producing compositions as are known to one skilled in the art.

Following insertion of the component containers in the tubular container holder to complete the fabrication of the present invention, and immediately preceding use thereof, said component containers are positioned within said support member much as the tubes of a telescope are adjusted, by sliding the smaller component containers within the larger diameter support member.

If the present invention is to be used as a daytime signaling device, the component container tubes are separated as far as possible while maintaining both in the tubular container holder. The pyrotechnic flare munition is ignited by commonly employed means such as attaching an ignitacord brand igniter thereto. The resulting combustion products from the pyrotechnic flare composition serve as a source of heat energy which passes to the exterior surface of the signaling device through vents of the dye containing grain thereby to vaporize the dye smoke and propel it to the exterior of the signaling device where it assembles into a cloud which can easily be seen in the daytime.

To employ the signaling device at night, the open end of the pyrotechnic flare container is pushed into close proximity with the smoke dye grain and is ignited by commonly used means such as those described directly hereinabove. The resulting light producing combustion products exit through the hollow core and end vents of the dye container simultaneously igniting the smoke dye composition. The resulting flare can be easily seen at night and fully fulfills its function as a night signaling device.
While the pyrotechnic flare composition is a fully adequate night signaling device by itself, the incineration of at least part of the dye composition decreases the flame size, total quantity and intensity of the light energy produced, thereby to provide a highly useful night signaling device.

DESCRIPTION OF PREFERRED EMBODIMENT

A preferred embodiment of the present day and night signaling device is shown in the figures of the drawing. This comprises in combination a cylindrical tubular support member 10, a first container 12 for holding a smoke dye composition and a second container 14 in which is placed a flare composition. The inner diameter of the support 10 and outside wall diameters of containers 12 and 14 are such that these provide for sliding engagement of the containers 12 and 14 within support 10.

Container 12 is fitted with a smoke dye composition 16, usually in the form of a solid monopropellant grain. As shown in Figure 3, the grain and container provide a through passage 18 extending axially along the length of the grain and a multiplicity of lateral passages 20 communicating with the exterior side wall 22 of the container 12 and axial through passage 18. Conveniently, the container is about 2 inches high and has an exterior diameter of about 1 inch. Ordinarily, the through passage 18 and lateral passages are about 3/16 inch in diameter. These dimensions are not critical to the operability of the device. Further, it is to be understood that the size, arrangement and number of the through passages 18 and lateral passages 20 can be varied, if desired.

The flare container 14 usually is of a similar construction as container 12 except that it has one closed end 24 and one open end 26 and does not have vent passages.

Custard or extrudable solid propellant smoke dye and flare compositions are preferred for use in the present invention since these can be introduced and cured directly into monopropellants in the containers which serve as a mold. After curing, the vents, i.e. through passages, of the smoke dye unit can be drilled or otherwise formed therein.

Preferred flare and smoke dye compositions are those which emit a red light and red smoke dye respectively. However, other color compositions can be used for specific operations if required or desired.

One particularly suitable pyrotechnic composition consists by weight of from about 1 to about 60 percent of strontium nitrate (Sr(NO₃)₂), from about 1 to about 60 percent of an alkali metal or ammonium chloride, perchlorate, nitrate, or mixtures thereof, as oxidizer, from about 16 to about 70 percent of a member selected from the group consisting of sulfur, thiourea, tetramethylenethiourea dinitrile, tetraethylthiamium dinitrile, monoaminoamidinitrile nitrate, ethylenebis(aminoamidinum)dinitrate, 1-amino-2,5-hydrazinetrizazole nitrate, 1-amino-2,5-hydrazinotetrazol dinitrate, thiosemicarbazonate, ethylenebis(thiosemicarbazide), thio(2-carboxy)hydrazide, aminotriamidinitrile and dinitriourea, as fuel, and from about 18 to about 30 percent of an epoxy-based polymer cured with an amine wherein the relative weight ratio of epoxy-based resin to amine ranges from about 7 to 1. The amine curving agent can be diethylentriamine, ethylenediamine or a polyalkylene polyamine.

Preferably said pyrotechnic composition consists by weight of from about 40 to about 50 percent strontium nitrate, from about 10 to about 20 percent of a member selected from the group consisting of lithium perchlorate and lithium chloride, from about 4 to about 16 percent of a member selected from the group consisting of sulfur and thiourea, and from about 20 to about 25 percent of an epoxy-based polymer cured with an amine wherein said epoxy-based resin is non-halogenated and has a molecular weight ranging from about 400 to about 1200 and said amine is a member selected from the group consisting of ethylene diamine and diethylene triamine.

Another particularly suitable pyrotechnic composition consists by weight of from about 45 to about 65 percent of strontium nitrate (Sr(NO₃)₂), from about 10 to about 15 percent of an alkali metal or ammonium chloride, perchlorate, nitrate, or mixtures thereof, as oxidizer, from about 0.1 to about 10 percent of a member selected from the group consisting of sulfur, thiourea, tetramethylenethiourea dinitrile, tetraethylthiamium dinitrile, monoaminoamidinitrile nitrate, ethylenebis(aminoamidinum)dinitrile, 1-amino-2,5-hydrazinetrizazole nitrate, 1-amino-2,5-hydrazinotetrazol dinitrate, thiosemicarbazonate, amino nitroguanidine and diothiohurea, as fuel, from about 0.1 to about 10 percent particular magnesium, and from about 15 to about 25 percent of a low molecular weight amine modified polyglycol cured with a flexible epoxy based resin wherein the epoxide equivalent/amine equivalent ratio ranges from about 0.75 to about 1.25 based on that ratio required stoichiometrically for complete cross-linking, i.e. a ratio of 1. Suitable amine modified polyglycols are members selected from the group consisting of amine terminated polyglycols and perchorlate modified amine terminated polyglycols.

The pyrotechnic flare components of the present invention are generally admixing the polymeric binder and the curing agent to form a liquid or semi-viscous homogeneous mixture into which the solid ingredients, e.g. fuel, oxidizer and strontium nitrate, are blended. The so-formed blend is agitated until homogeneous and cast or extruded into a container member and cured at from about 25°C to about 80°C for from about 1 to about 24 hours to yield a pyrotechnic flare component of the present invention.

The resulting cured flare grain is invented by any of a variety of commonly employed ignition systems known to one skilled in the art.

A particularly suitable smoke dye composition consists by weight of from about 60 to about 80 percent of particular methylaminoanthraquinone (hereinafter described as MAAQ) and from about 5 to about 15 percent of a monopropellant selected from the class consisting of nitrocellulose and nitroglycerine and from about 5 to about 15 percent of the same epoxy-based polymeramine curing agent system as was employed in the pyrotechnic flare component of the present invention described hereinabove. Generally efficiency in dissemination increases as the particle size of the methylaminoanthraquinine decreases. Preferably the methylaminoanthraquinone particles should be less than about 2 millimeters in size.

The smoke generating composition of the present invention is fabricated by wetting out the red MAAQ dye with the epoxy-based polymer. To the so-wetted mixture of MAAQ and polymer are added the curing agent and the oxidizer and fuel components of the monopropellant; the resulting mixture is agitated until substantially homogeneous and pressed into an open-ended container otherwise substantially identical to the container employed to hold the pyrotechnic flare composition described hereinabove.

The so-formed MAAQ component of the present invention is cured by heating at from about 25°C to about 80°C for from about 1 to about 24 hours, after which temperature is allowed to drop to ambient temperature.

Side and end vents then can be produced in the MAAQ-occupied container by drilling through the container wall and into the cured grain to intersect with the passage running axially through said grain.

As shown the device described hereinabove will consist of component containers which are cylindrical and substantially equal in size and which are composed of steel.

It is to be understood that the following examples merely illustrate the present invention and are not intended as limits thereof.
EXAMPLE 1

A combination night-day signaling device of the type disclosed by the present invention was fabricated as described hereinbelow.

(A) A pyrotechnic red flare component was prepared by mixing about 4 grams of P-2000 diamine (a Dow brand amine-terminated polyglycol with about 16 grams of methylaminoanthraquinone (MAAQ) thereby wetting the MAAQ thoroughly. To the so-wetted MAAQ polymer mixture was added about 5 grams of nitroglycerine, and about 1 gram of D.E.R. 432 epoxy resin and the resulting mixture was agitated until substantially homogeneous. The so-homogenized mixture was extruded by commonly employed means into a steel open-ended cylindrical container having a diameter of about 1 inch and cured at about 25°C. for about 15 hours to produce the pyrotechnic flare component of the present invention. The smoke-producing component of the present invention was produced by mixing about 3 grams of P-2000 diamine terminated polyglycol with about 16 grams of methylaminoanthraquinone (MAAQ) thereby wetting the MAAQ thoroughly. To the so-wetted MAAQ polymer mixture was added about 5 grams of nitroglycerine, and about 1 gram of D.E.R. 432 epoxy resin and the resulting mixture was agitated until substantially homogeneous. The so-homogenized mixture was extruded by commonly employed means into a steel open-ended cylindrical container having a diameter of about 1 inch and cured at about 25°C. for about 15 hours to produce a hard, non-crumbly, void-free grain.

One opening about ½ inch in diameter and running parallel to the cylinder wall was drilled through the center of the cylindrical MAAQ containing component to form a central axial passageway therethrough. Three other openings were drilled laterally through the steel casing and intervening MAAQ component intersecting with said central axial passage, and continuing on to perforate the steel casing on the opposite side of said grain.

(C) The pyrotechnic flare component and the red MAAQ smoke component fabricated as described hereinabove were both inserted into a steel cylindrical support member about 4 inches in length so that the open-end (non steel-encased end) of the pyrotechnic composition was positioned adjacent to the inserted MAAQ containing component about 2½ inches from the adjacent face of said MAAQ component. The MAAQ containing component was positioned so that the lateral passages or side vents were open to the exterior of the signaling device, e.g., said lateral passages were unobstructed by the wall of the support member (as depicted in FIGURE 4).

The pyrotechnic flare component was initiated with an Ignitacord Brand Igniter and ignited causing the red MAAQ containing smoke to exit through the vents in the MAAQ component thereby to produce a voluminous easily-seen red smoke cloud. The red flare from the ignited pyrotechnic component was not visible as it was enclosed within the cylindrical support member. EXAMPLE 2

Another combination night-day signaling device was constructed as described in Example 1. The device was then tested by positioning the pyrotechnic and MAAQ components next to each other, in a manner such that the side vents of the MAAQ component were encased in the support member and so that the open face of the pyrotechnic component almost touched the adjacent face of the MAAQ component. The pyrotechnic component was then ignited as described in Example 1, and the resulting red flare was able to pass through the center passageway in the MAAQ component due to the close proximity of the burning face of the red pyrotechnic flare component and said adjacent red MAAQ smoke component.

The so-produced brilliant red flare exiting from the MAAQ component end of the combination night-day signaling device was easily seen and its intensity was clearly equivalent to presently employed railroad signal flares. Various modifications can be made in the present invention without departing from the spirit or scope thereof for it is understood that I limit myself only as defined in the appended claims.

1. A combination night-day signaling device comprising in combination a support member, a first container, and a second container, said support member defining a passageway extending axially therethrough, each of said first and second containers having an exterior wall which mates with the interior wall of said support member thereby to provide a sliding engagement between said exterior wall of said first and second containers and said interior wall of said support member, said first container being open at one end and closed at the other and containing a flare composition, said second container containing a smoke dye composition and having a central core passageway extending axially therethrough, said second container and smoke dye composition being fitted with a plurality of openings extending laterally inward from the exterior surface and intersecting with the central core passageway of said second container, and each of said first and second containers providing a telescopic sliding engagement with said support member in a manner such that the open end of said first container is adjacent to said second container.

2. The device as defined in claim 1 wherein said support member and each of said first and second container members defines a cylinder.

3. The device as defined in claim 1 wherein each of said first and second container members is about one-half the length of said support member.

4. The device defined in claim 1 wherein the smoke dye composition is a red smoke composition and occupies from about 20 to about 80 percent by volume of said second container.

5. The device defined in claim 1 wherein said support member, said first container and said second container consist essentially of a relatively mechanically strong, heat and flame resistant material.

6. The device defined in claim 1 wherein said support member, and said first and second container members are composed essentially of steel.

References Cited

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,059,767</td>
<td>3/1913</td>
<td>Peter</td>
<td>149—45</td>
</tr>
<tr>
<td>1,265,205</td>
<td>5/1918</td>
<td>Juel</td>
<td>149—19</td>
</tr>
<tr>
<td>1,404,653</td>
<td>1/1922</td>
<td>Russ</td>
<td>149—70 XR</td>
</tr>
<tr>
<td>2,403,656</td>
<td>7/1946</td>
<td>Grobstein</td>
<td>149—3</td>
</tr>
<tr>
<td>2,651,567</td>
<td>9/1953</td>
<td>Clauser et al.</td>
<td>149—3</td>
</tr>
<tr>
<td>2,989,024</td>
<td>1/1961</td>
<td>Tralongo</td>
<td>116—124</td>
</tr>
<tr>
<td>3,167,050</td>
<td>1/1965</td>
<td>Johnson</td>
<td>116—124</td>
</tr>
</tbody>
</table>

LOUIS J. CAPOZI, Primary Examiner

U.S. Cl. X.R.

102—37,52