

PATENT SPECIFICATION

(11) 1 383 963

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- (21) Application No. 15517/72 (22) Filed 4 April 1972
 (23) Complete Specification filed 4 July 1973
 (44) Complete Specification published 12 Feb. 1975
 (51) INT CL² F42B 4/02, 4/26
 (52) Index at acceptance F3A E1A2 E1A3
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(54) IMPROVEMENTS IN AND RELATING TO PYROTECHNIC DEVICES

(71) We, PAINS-WESSEX LIMITED, a British Company of High Post, Salisbury, Wiltshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pyrotechnic devices from which a smoke-producing device may be ejected to act as a smoke marker. For example, the smoke-producing device may be ejected from an aircraft or helicopter, in order to mark a position at ground or sea level below, or to indicate wind speed and direction as it falls.

The invention provides a pyrotechnic device which comprises a discharge tube, a casing contained in the discharge tube, an ejection charge contained in the discharge tube for ejecting the casing therefrom, means for igniting the ejection charge, and in which the casing contains a mass of smoke-producing composition and the whole or a substantial part of the length of a delay train via which the composition is arranged to be ignited, one end of the delay train being exposed by means of an opening in the casing to the ejection charge, the casing has closure means for a smoke outlet removable in response to the pressure of combustion gases in a part of the casing other than at the end adjacent to the ejection charge, and the casing is buoyant.

The casing is ejected from the discharge tube and the end of the delay train is ignited when the igniting means is operated and the ejection charge is ignited. The device is especially suitable for marking a position at ground or sea level since, for any particular length of delay train, the smoke-producing composition will not be ignited until the device is near to the ground or sea, respectively, or has actually landed, provided that the device is dropped at or below a certain height above the ground or sea; consequently most of the smoke will be produced at the position it is desired to mark.

Advantageously, the casing further has a [Price 33p]

small opening, preferably in the portion of the casing that will be above water when floating, for enabling gases produced by the burning delay train to vent to the atmosphere. The provision of such an opening, which is small to tend to prevent water entering the casing extinguishing the burning, prevents an undesirable pressure build-up in the casing occurring while the delay train is burning; such a pressure build-up might cause faster burning of the delay train and consequently premature ignition of the smoke-generating composition. The opening may be covered by a flap to permit gas egress but to tend to prevent water ingress.

Care must be taken that the flame from the ejection charge cannot enter the casing and impinge directly on the smoke-generating composition. Preferably this is achieved by there being a seal between the said one end portion of the delay train and the first-mentioned opening in the casing, the seal preferably being formed by means of an adhesive. At least a part of the first-mentioned opening may be internally screw-threaded and the delay train may have been screwed into the opening. The screw-threaded portion may be formed in the casing or in a member of synthetic resin-bonded paper or the like secured to the casing.

Advantageously, the delay train is a safety fuse. Preferably, the safety fuse has a gas-impermeable sleeving; this tends to prevent premature ignition of the smoke-producing composition due to any hot gases which may permeate through the walls of the safety fuse, and enables good utilisation of space in the casing to be achieved in that the smoke-producing composition can if desired be packed closely around the safety fuse.

Advantageously, the smoke-producing composition is situated towards the end of the casing that is adjacent to the ejection charge, and there is a void region in the casing towards the end remote from the ejection charge to provide buoyancy for the casing and to act as a cooling chamber for

the smoke. The positioning of the smoke-producing composition in this way tends to prevent the composition being dislodged as the casing is fired from the discharge tube.

- 5 The end of the smoke-producing composition that is nearer to the ejection charge is advantageously supported on one or more layers of solid material lining the end of the casing adjacent the ejection charge. Preferably, a layer of non-inflammable material is positioned between the smoke-producing composition and the end of the casing that is adjacent to the ejection charge. The delay train may be coiled into one or more loops in the void region if desired to provide an increased delay without an increase in the size of the casing.

- 10 Advantageously, there is provided a capsule containing an intermediate charge (which may be gunpowder) secured to the opposite end of the delay train to that exposed to the ejection charge; this facilitates ignition of the smoke-producing composition, which may be ignited directly, or indirectly via igniter composition.

- 15 Advantageously, the smoke outlet comprises an opening in the casing at the end remote from the ejection charge. The closure means may be of the kinds that are displaced in one piece, consumed, or ruptured.

- 20 The discharge tube may have a percussion primer for igniting the ejection charge, and may be such that it can be fired by a signal pistol or other type of firing device. If desired, however, the ejection charge could be operated electrically, as described for example in the Applicant's British Patent Specification No. 1,317,254 and this would enable the device to be fired from a remote position. For example, the means for igniting the ejection charge could comprise an electric fuse-head igniter (sometimes referred to as an electric match).

- 25 A pyrotechnic signal device constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing, which is an axial cross-section of the device.

- 30 Referring to the drawing, the device comprises a discharge tube in the form of a cartridge case 1, and an aluminium casing 2 and a gunpowder ejection charge 3 housed in the discharge tube. The casing 2, including of course its contents, is buoyant.

- 35 The casing 2 houses two annular pellets of smoke-producing composition 4 and a delay train in the form of a Bickford fuse 5. The smoke-producing composition is situated towards the lower end (as seen in the drawing) of the casing, and there is a void region towards the upper end of the casing. One end 6 of the fuse 5 extends through an opening in the casing 2 and is exposed to the ejection charge 3. The other end 7 of the

fuse has a capsule 8 containing gunpowder (or other suitable intermediate charge) secured to it. The capsule is pushed over the end portion of the fuse and secured to it with adhesive or adhesive tape. The casing 2 is lined with an inhibiting layer 9 in the form of a rolled paper tube.

The lower end portion of the fuse 5 is screwed into an internally screw-threaded opening in a synthetic resin-bonded paper disc 11. An epoxy adhesive, for example, Araldite (Registered Trade Mark), is applied to the join of the fuse and the opening, and the disc 11 is secured to the lower end of the casing 2 by Araldite, so as to firmly secure the fuse 5 to the casing 2 and to form a seal between the fuse and the opening in the lower end of the casing which prevents entry of the flame from the ejection charge into the casing. A millboard disc 10 is secured by adhesive to the fuse 5 and to the casing 2. In this way the fuse 5 is firmly secured to the casing and is not dislodged when the ejection charge ignites. It has been found that a convenient way of securing the fuse in position during manufacture is to screw it into the disc 11 and seal it in with adhesive, insert the fuse through the opening in the casing 2, secure the disc 11 to the casing with adhesive, and then to fit the millboard disc over the free end of the fuse and secure that to the fuse and casing.

A layer of non-inflammable material 12 (for example, an inert filling such as clay) is positioned above the millboard disc 10. It has been found in practice that omission of this inert filling can cause premature ignition of the smoke-producing composition.

The upper end of the casing 2 is defined by a disc 13 which is held in position by the bent-over upper ends of the aluminium casing 2. The disc 13 has a small opening 14 for preventing a pressure build-up when only the fuse 5 is burning. It is above water when the casing is floating and is too small to prevent sufficient water entering the casing to extinguish combustion. The disc 13 has a larger opening 15 which forms a smoke outlet and which is closed by closure means in the form of a push-in cup 15b of plastics material; other forms of closure means may be employed, for example, a disc sealed over the opening 15.

Annular discs 16 of primed cambric cover the faces of the pellets 4 of smoke-producing composition. The lower disc 16 is spaced from the inert filling 12 by a thin millboard disc 17, and a perforated metal disc 18 is positioned against the upper primed cambric disc 16. The primed cambric discs 16 assist in igniting the smoke-producing composition. A collar 19 maintains the perforated metal disc 18 in contact with the uppermost primed cambric disc 16, which in

turn maintains the primed cambric disc 16 in contact with the upper surface of the smoke-producing pellet 4, which is coated with a layer of igniter composition (not shown), when it is being ignited.

The Bickford fuse 5 is covered along the greater part of its length with a plastics sleeve 20; the sleeve 20 extends from adjacent the upper end of the gunpowder capsule 8 and terminates in the clay 12, which presses the sleeve hard against the fuse 5 and tends to prevent the escape of combustion gases from this end of the sleeve 20.

There is a slight clearance between the fuse 5 and the adjacent surfaces of the pellets 4 which facilitates the burning of the pellets, but the pellets 4 may be in close fit with the fuse 5 if desired.

The lower end of the discharge tube 1 is rimmed and has a centre fire percussion cap 21 recessed therein, and its external configuration and dimensions are such that it can be fired from a Very pistol.

The upper end of the cartridge case 1 is closed by a disc 22. Other forms of cartridge case can of course be employed.

In operation, the pyrotechnic signal device is loaded into a Very pistol, and the Very pistol is fired. The device will usually be fired from an aircraft or helicopter. The percussion cap 21 is struck and this ignites the gunpowder ejection charge 3. This causes the disc 22 to be displaced and the casing 2 to be ejected from the cartridge case 1, and at the same time the flame from the ejection charge ignites the lower end of the Bickford fuse 5. It is important to note that the fact that the smoke outlet 15 is not positioned at the end of the casing adjacent the ejection charge, but rather is positioned at the end of the casing 2 remote from the ejection charge 3, prevents the cup 15b covering it from being displaced by the ignition of the ejection charge. If this were to happen, the flame from the ejection charge might ignite the smoke-producing composition prematurely and, if the device was dropped over water, the combustion might be extinguished due to an inrush of water through the smoke outlet. As the casing 2 falls, the fuse 5 progressively burns along its length. The sleeve 20, it has been found, tends to prevent premature ignition of the smoke-producing pellets 4 from occurring. Any gases from the burning fuse 5 which permeate through the walls of the fuse, which tends to happen in practice especially where the fuse is bent, pass along the length of the fuse 5 in the sleeve 20 and into the upper void region of the casing 2, and vent to the atmosphere via the aperture 14.

When combustion reaches the end 7 of the fuse 5, the gunpowder capsule 8 is ignited

by the fuse, and this ignites the uppermost primed cambric disc 16, and thus the upper smoke-producing pellet 4 via the igniter composition. The pressure of the gases produced by the burning gunpowder capsule 8 and/or those produced by the prime cambric, igniter substance or smoke-producing pellet 4, cause the cup 15b covering the smoke outlet 15 to be removed to allow egress of smoke.

The provision of the delay train enables the same quantity of smoke to be produced in the vicinity of a location on the ground or in the sea with a smaller quantity of smoke-producing composition than in a device in which the smoke-producing composition is ignited when the casing is ejected from the discharge tube, which enables both the size and cost of such a marker signal to be reduced and/or makes it easier to provide a buoyancy chamber therein.

The upper region of the casing 2 is, apart from the fuse 5, empty, and this provides a cooling chamber for the smoke-producing composition (especially desirable for coloured smoke-producing compositions), and renders the casing 2 buoyant, so that the device can be fired over water.

WHAT WE CLAIM IS:—

1. A pyrotechnic device which comprises a discharge tube, a casing contained in the discharge tube, an ejection charge contained in the discharge tube for ejecting the casing therefrom, means for igniting the ejection charge, and in which the casing contains a mass of smoke-producing composition and the whole or a substantial part of the length of a delay train via which the composition is arranged to be ignited, one end of the delay train being exposed by means of an opening in the casing to the ejection charge, the casing has closure means for a smoke outlet removable in response to the pressure of combustion gases in a part of the casing other than at the end adjacent to the ejection charge, and the casing is buoyant.

2. A device as claimed in claim 1, in which the casing further has a small opening in a portion of the casing which will be above water when the casing floats.

3. A device as claimed in claim 1 or claim 2, in which there is a seal between the said one end portion of the delay train and the first-mentioned opening in the casing.

4. A device as claimed in claim 3, in which the seal is formed by means of an adhesive.

5. A device as claimed in claim 3 or claim 4, in which at least a part of the first-mentioned opening is internally screw-threaded and the delay train has been screwed into the opening.

6. A device as claimed in claim 5, in which the screw-threaded portion is formed in a member of synthetic resin-bonded paper or

turn maintains the primed cambric disc 16 in contact with the upper surface of the smoke-producing pellet 4, which is coated with a layer of igniter composition (not shown), when it is being ignited.

5 The Bickford fuse 5 is covered along the greater part of its length with a plastics sleeve 20; the sleeve 20 extends from adjacent the upper end of the gunpowder capsule 8 and terminates in the clay 12, which presses the sleeve hard against the fuse 5 and tends to prevent the escape of combustion gases from this end of the sleeve 20.

15 There is a slight clearance between the fuse 5 and the adjacent surfaces of the pellets 4 which facilitates the burning of the pellets, but the pellets 4 may be in close fit with the fuse 5 if desired.

20 The lower end of the discharge tube 1 is rimmed and has a centre fire percussion cap 21 recessed therein, and its external configuration and dimensions are such that it can be fired from a Very pistol.

25 The upper end of the cartridge case 1 is closed by a disc 22. Other forms of cartridge case can of course be employed.

In operation, the pyrotechnic signal device is loaded into a Very pistol, and the Very pistol is fired. The device will usually be fired from an aircraft or helicopter. The percussion cap 21 is struck and this ignites the gunpowder ejection charge 3. This causes the disc 22 to be displaced and the casing 2 to be ejected from the cartridge case 1, and at the same time the flame from the ejection charge ignites the lower end of the Bickford fuse 5. It is important to note that the fact that the smoke outlet 15 is not positioned at the end of the casing adjacent the ejection charge, but rather is positioned at the end of the casing 2 remote from the ejection charge 3, prevents the cup 15b covering it from being displaced by the ignition of the ejection charge. If this were to happen, the flame from the ejection charge might ignite the smoke-producing composition prematurely and, if the device was dropped over water, the combustion might be extinguished due to an inrush of water through the smoke outlet. As the casing 2 falls, the fuse 5 progressively burns along its length. The sleeve 20, it has been found, tends to prevent premature ignition of the smoke-producing pellets 4 from occurring. Any gases from the burning fuse 5 which permeate through the walls of the fuse, which tends to happen in practice especially where the fuse is bent, pass along the length of the fuse 5 in the sleeve 20 and into the upper void region of the casing 2, and vent to the atmosphere via the aperture 14.

65 When combustion reaches the end 7 of the fuse 5, the gunpowder capsule 8 is ignited

by the fuse, and this ignites the uppermost primed cambric disc 16, and thus the upper smoke-producing pellet 4 via the igniter composition. The pressure of the gases produced by the burning gunpowder capsule 8 and/or those produced by the prime cambric, igniter substance or smoke-producing pellet 4, cause the cup 15b covering the smoke outlet 15 to be removed to allow egress of smoke.

70 The provision of the delay train enables the same quantity of smoke to be produced in the vicinity of a location on the ground or in the sea with a smaller quantity of smoke-producing composition than in a device in which the smoke-producing composition is ignited when the casing is ejected from the discharge tube, which enables both the size and cost of such a marker signal to be reduced and/or makes it easier to provide a buoyancy chamber therein.

80 The upper region of the casing 2 is, apart from the fuse 5, empty, and this provides a cooling chamber for the smoke-producing composition (especially desirable for coloured smoke-producing compositions), and renders the casing 2 buoyant, so that the device can be fired over water.

WHAT WE CLAIM IS:—

95 1. A pyrotechnic device which comprises a discharge tube, a casing contained in the discharge tube, an ejection charge contained in the discharge tube for ejecting the casing therefrom, means for igniting the ejection charge, and in which the casing contains a mass of smoke-producing composition and the whole or a substantial part of the length of a delay train via which the composition is arranged to be ignited, one end of the delay train being exposed by means of an opening in the casing to the ejection charge, the casing has closure means for a smoke outlet removable in response to the pressure of combustion gases in a part of the casing other than at the end adjacent to the ejection charge, and the casing is buoyant.

105 2. A device as claimed in claim 1, in which the casing further has a small opening in a portion of the casing which will be above water when the casing floats.

115 3. A device as claimed in claim 1 or claim 2, in which there is a seal between the said one end portion of the delay train and the first-mentioned opening in the casing.

120 4. A device as claimed in claim 3, in which the seal is formed by means of an adhesive.

125 5. A device as claimed in claim 3 or claim 4, in which at least a part of the first-mentioned opening is internally screw-threaded and the delay train has been screwed into the opening.

6. A device as claimed in claim 5, in which the screw-threaded portion is formed in a member of synthetic resin-bonded paper or



the like secured to the casing.

7. A device as claimed in any one of claims 1 to 6, in which the delay train is a safety fuse.

5 8. A device as claimed in claim 7, in which the fuse has a gas-impermeable sleeving.

9. A device as claimed in any one of claims 1 to 8, in which the smoke-producing composition is situated towards the end of the casing that is adjacent to the ejection charge, and there is a void region in the casing towards the end remote from the ejection charge.

10 10. A device as claimed in claim 9, in which the end of the smoke-producing composition that is nearer to the ejection charge is supported on one or more layers of solid material lining the end of the casing adjacent the ejection charge.

15 11. A device as claimed in claim 9 or claim 10, in which a layer of non-

inflammable material is positioned between the smoke-producing composition and the end of the casing that is adjacent to the ejection charge.

12. A device as claimed in any one of claims 1 to 11, in which there is provided a capsule containing an intermediate charge secured to the opposite end of the delay train to that exposed to the ejection charge.

13. A device as claimed in any one of claims 1 to 12, in which the smoke outlet comprises an opening in the casing at the end remote from the ejection charge.

14. A pyrotechnic device substantially as hereinbefore described with reference to, and as shown in, the accompanying drawing.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1975.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.



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