United States Patent

Davidson

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[54] FLARE BODY

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[73] Assignee: **Aktiebolaget Bofors,** Bofors, Sweden

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[30] **Foreign Application Priority Data**

June 10, 1968 Sweden.....7796/68

[52] **U.S. Cl.**.....**102/37.8,** 102/102

[51] **Int. Cl.**.....**C06d 1/10**

[58] **Field of Search**.....102/37.8, 35, 102, 103

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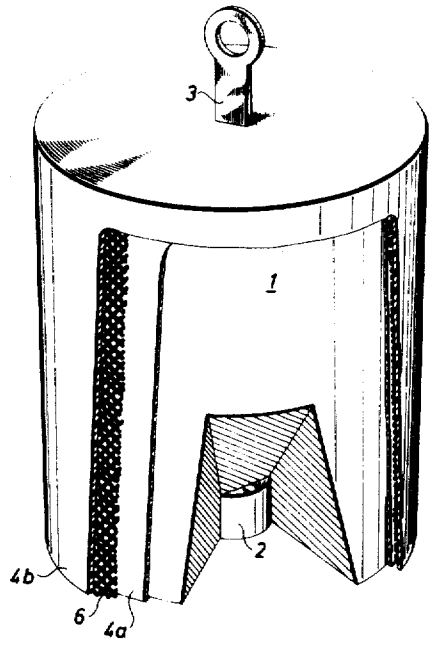
[57] **ABSTRACT**

A flare has a cylindrical body composed of a solid combustible flare composition. One of the end walls of the body is covered with a non-combustible and heat-resistant covering and the side wall of the body is encompassed with a non-combustible and highly heat-resistant wire netting along its entire length. The netting ends substantially flush with the other end wall of the body. Ignition of the flare composition is started at this other end wall. The wire netting prevents direct access of combustion flames to the side wall of the body thereby impeding premature burning at localized areas of the side wall. It also provides a multitude of passages for the flow of fresh combustion air to the burning composition so that the same is gradually and uniformly consumed whereby the luminous efficiency of the flare is markedly increased.

9 Claims, 5 Drawing Figures



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2 Sheets-Sheet 1

Fig.1

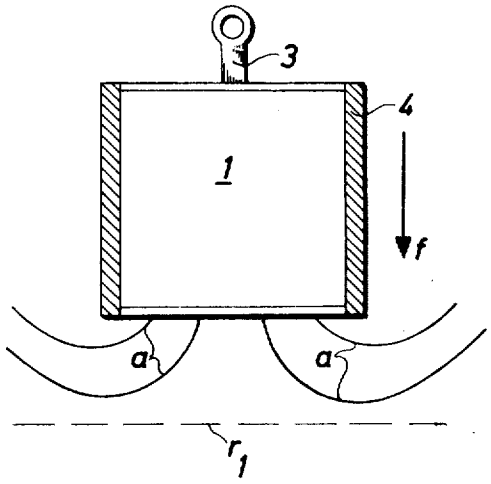

Fig.2

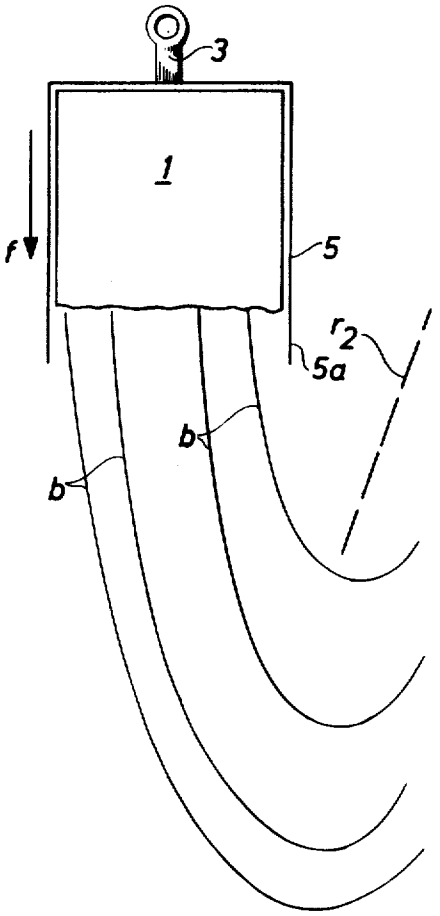

Fig.3

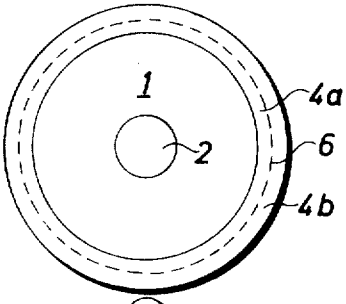

Fig.4

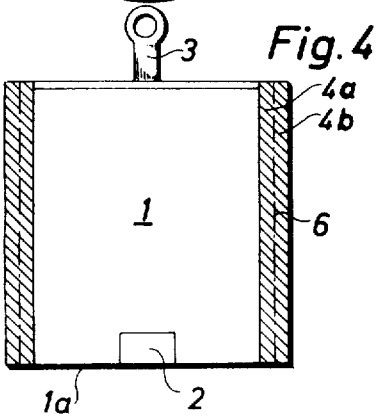

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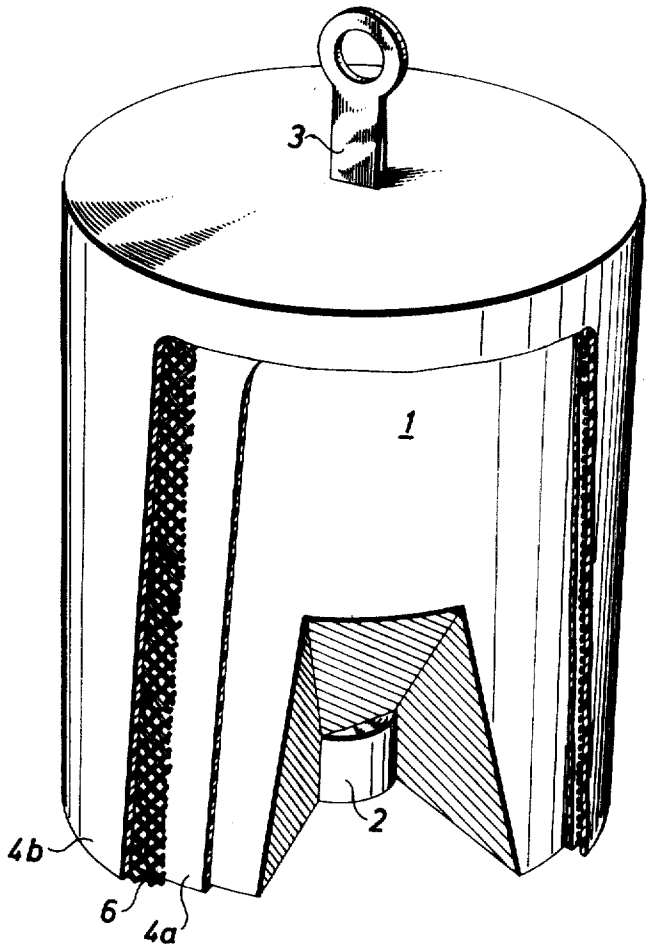
Fig. 5



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FLARE BODY

The present invention relates to an improvement in flare bodies, i.e. bodies having a normally pressed flare composition comprising e.g. magnesium and an oxygen producing substance. These bodies, after having been carried to a considerable height above the ground by means of a projectile or an airplane and ignited, fall towards the ground in a parachute during which time the flare composition generates light in order to illuminate the ground surface.

Such flare bodies are well known and initially a pressed flare composition was used which was ignited at one end by activating of an ignition device in any suitable manner. However, by using only a pressed flare composition it was not possible to obtain a uniformly progressing combustion. This is due to the fact that the ignited and burning flare composition during the downward movement has such a great velocity relative to the surrounding atmosphere (e.g. a drop velocity of 5 m/sec.) that while the combustion is started at the end of the flare composition facing the ground the flame which occurs during the combustion sweeps upwardly along the flare composition and causes ignitions at non-desired places on the flare composition.

To prevent this disadvantage it has been proposed to use an insulation which surrounds the flare composition at all sides except the surface facing the ground and at which the combustion starts. By selecting this insulation, which normally consists of a plastic material with a filler of MgO or asbestos, in a suitable manner it is possible to obtain that the flames which are actuated by the air flow sweeping around the flare composition do not cause an ignition of the flare composition at other sections than that facing the ground. By means of the insulation it has been possible to obtain a combustion which if the flare composition consists of a circular cylinder with end faces at right angles to the axis of the cylinder takes place in axial direction and with substantially constant and equal velocity over the whole burning surface which moves successively in the direction of the axis of the cylinder and which thus is substantially plane and perpendicular to the axis of the cylinder.

The more regular combustion of the flare composition obtained by the use of the insulation has led to an increased light output or more correctly to an increased total amount of light during the burning time, but further investigations have shown that smoke which occurs during the combustion of the flare composition is primarily present between the burning surface and the ground, that is between the flame and the ground so that the intended illumination of the ground below the flare composition does not become as high as expected.

When for various reasons the flare composition together with the surrounding insulation is encased in a sleeve or a casing of steel which surrounds the flare composition in substantially the same way as the insulation, i.e. leaves free only the end surface of the flare composition of the circular cylindrical flare body facing the ground, there is obtained a considerable increase of the total light amount produced during the burning time. The reason therefore seems to depend on the fact that by the combustion of the flare composition in the previously mentioned conventional way with the burning surface substantially plane and perpendicular to the axis of the cylinder, the surrounding steel casing will successively project with its free edge in front of the burning surface and thus a kind of nozzle which directs the flame produced at the combustion in the direction of the axis of the cylinder and out from the steel casing. Expressed in another way it can be said that by the combustion of the flare composition within a steel casing there is obtained a fierce flame projecting from the steel casing. It has been observed that on account of the movement of the flare body relatively to the surrounding atmosphere this fierce flame will be deflected at its outer free end by means of the earlier mentioned air flow and that the main portion of the smoke produced during the combustion will be situated at the "back side" of the deflected fierce flame, i.e. that side of the free end of the fierce flame facing away from the ground. As there is no more any smoke between the burning surface or

flame and the ground, considerably improved conditions are obtained and the last mentioned construction of flare bodies has been used to a great extent with very good results.

In attempts to reduce the weight of the flare body, which by using the steel casing is increased considerably relative to what would have been necessary if only active material had been used, i.e. the flare body only consists of the flare composition. Such decrease in weight is very desirable on account of the fact that in this case further decreases in weight can be obtained because the used parachute can have decreased dimensions and thus less weight and in spite thereof maintain the same velocity of fall. It has suprisingly been found that results which have been obtained with a steel casing can be achieved by substituting the steel casing (and in certain cases also the insulation) by a net of suitable metal which surrounds the cylindrical surface of a flare composition for instance in the form of a circular cylinder.

What is especially characteristic for the invention is stated in the claims and the invention is further explained in connection with the following description of an embodiment shown on the attached drawing.

FIG. 1 shows diagrammatically the conditions during the burning time of a prior flare body and provided with an insulation.

FIG. 2 shows in the same way the conditions during the burning time of another prior art flare body and provided with a steel casing.

FIG. 3 is a bottom view of a flare body according to the present invention from the end provided with the ignition device and for sake of clarity with the insulation and wire-net overdimensioned.

FIG. 4 is a side section view of the flare body according to FIG. 3.

FIG. 5 is a perspective view, partly cutaway, of the flare body FIG. 4.

The previously known flare body according to FIG. 1 has a flare composition 1 and it is assumed that it has burnt for so long a time that the used ignition device does not remain. A holding means 3 is provided for the connection of the flare body to a parachute (not shown) and the insulation adapted for obtaining a uniform progressing combustion and which for instance consists of plastic material with a filler in the form of for instance MgO or asbestos is designated 4. It is to be observed that the thickness of the insulation is very exaggerated. The flames occurring during the combustion are deflected outwardly by the influence of the drag and this is diagrammatically shown by the lines *a*. The produced smoke is indicated by the dotted line r_1 and it is evident that smoke is located between the flare body and the ground, as the descent-direction of the flare body is substantially (except for swinging movements or the like) that indicated by the arrow f. It is obvious that the insulation protects the rear sections of the flare body from being ignited by the flames shown by the lines a.

In FIG. 2 there is shown in the same manner as in FIG. 1 the conditions at a flare body with a connection means 3, a flare composition 1 and a surrounding steel casing 5. After a certain burning time there is obtained a remaining edge portion 5*a* of the steel casing which edge portion extends beyond the burning flare composition 1 and causes the formation of a fierce flame diagrammatically shown by the bent lines *b*. The drag - also in this case the descent-direction is indicated by the arrow *f* - causes a deflection of the outer free end of the fierce flame and the occurrence of the produced smoke behind the deflected fierce flame, as is diagrammatically indicated by the dotted line r_2. Thus it is clear that by using a steel casing there is no considerable amount of smoke between the burning flare composition and the flame and the ground. This is the reason of the already mentioned good efficiency or the great total amount of light from flare bodies according to FIG. 2. For the sake of completeness it is pointed out that in FIG. 2 insulation has not been shown.

As previously mentioned it has been found that a surprising improvement is achieved if instead of a steel casing there is

used a net or mesh of metal with a considerable ability to withstand high temperatures, for instance stainless steel. It has been found that by the application of a steel net directly around a flare composition and without using an insulation, the advantage of a fierce flame, as mentioned in connection with FIG. 2, is obtained and with the produced smoke placed behind the fierce flame deflected by the influence of the drag. This is a very surprising result and the physical conditions are not fully understood. Thus the following explanation does not in any way restrict the invention but is only mentioned in order to try to give such a good picture of the conditions as at present is possible.

It is likely that a wire net with suitable mesh and wire thickness is not only able to act as a nozzle but also may assist the fierce flame, flowing out through the forward opening in the wire net, to draw secondary air through the meshes of the wire net. The effect hereof is that probably a certain turbulence which improves the combustion, arises in the burning zone immediately in front of the end surface of the flare composition, and that the oxygen in the drawn in air causes a more complete combustion of the material of the flare composition which in the present case preferably has a deficit of oxygen (relative to the amount of magnesium in the flare composition) and that for this reason a greater total amount of light is produced for a certain amount or weight of the flare composition than if for instance there is excess of oxygen in the flare composition.

Thus, by the use of a wire net in accordance with the invention a surprising improvement is obtained, but it has been found that there is a certain tendency of irregular combustion and a possibility that in spite of the fierce flame a further ignition of the flare composition can occur at for instance the rear portion.

According to a further aspect of the present invention the metal wire net is combined with an insulation known per se, which now can be made comparatively thin. An embodiment of a flare body of this kind is shown in FIGS. 3, 4 and 5 in which there is a flare composition 1, an ignition device 2 and a connection means 3. The flare composition is at the cylinder surface surrounded by metal wire net 6 which by means of an insulation layer 4a is separated from the flare composition 1. This insulating layer 4a may be thin. According to a preferred embodiment the metal wire net is moulded into the insulation which thus consists of a first layer 4a between the net 6 and the flare composition and a second layer 4b outside the net 6. Said insulation may consist of the same plastic material with filler in the form of MgO or asbestos, as is already mentioned. In FIG. 3 which is an end view of the embodiment shown in FIG. 4 it is to be seen that the flare body is in the form of a circular cylinder. However, it is to be observed that it is not necessary to use a cylinder but also other shapes of cylinders can be used. If considerable irregularities regarding the combustion process can be allowed it is possible also to use other shapes of the flare composition, which however must have a free surface 1a with an ignition device 2 so that it can be ignited and burn and leave a usable light flow. However, it ought to be pointed out that the invention is not limited to flare bodies with the flare composition in the shape of a cylinder or a circular cylinder, although these shapes are the most commonly used.

As already mentioned the action of the metal net is especially advantageous in connection with the use of a thin insulation and a flare composition having a deficit of oxygen as regards the oxygen-containing material in the flare composition in comparison to the amount of magnesium or possibly a substance of another metal or another compound which forms the material intended for the combustion.

As an example of the improvement obtained by the present invention it may be pointed out that by a flare body having a diameter of 70 mm and an initial length of 90 mm and a circular cross section and using only one plastic insulation a total light yield of about 8 millions candela seconds, while the use of a steel casing or a steel casing in combination with an insulation - a hitherto much used embodiment - produces an average light yield of about 20–22 millions candela seconds. By using a net of stainless steel with a diameter of about 0.25–0.10 mm and meshes of 1.0–2.0 mm, i.e. corresponding to 14–18 mesh, or meshes of 0.5 mm light yield values of more than 30 millions candela seconds have been obtained. A favorable result has also been achieved with meshes as small as 35 mesh.

No formula for the relationship between the mesh of the wire net and other factors has been ascertained but it has been found that the optimal mesh can be easily ascertained by simple experiments in each case. It is evident that the already mentioned suction of secondary air through the wire net is prevented and that the wire net is more easily choked up with narrow meshes while too wide meshes do not cause such a nozzle-action of the wire net as intended.

As non-limiting statement it can be mentioned that for flare bodies with circular cross-section and having a diameter of 60–100 mm, the optimal values for the wire net are normally obtained by using a thread having a diameter of 0.25–1.0 mm. and a free mesh of about 1.0–2.0 mm.

It can also be mentioned that except for the already stated advantages by the use of a wire net a further advantage resides in the fact that the smaller mass of the wire net and the strong cooling to which a wire net is subjected to when the residue of the flare body is dropping after the flare composition has finished to burn, considerably reduces the risk of an ignition of the ground where the rest of a flare body falls in comparison with a flare body having a steel casing.

The invention has been described in connection to flare bodies intended to be carried by parachutes, but of course the invention may also be preferably used for flare bodies used in another way.

I claim:

1. A flare comprising an elongate body composed of a solid combustible flare composition, said body having end walls normal to the longitudinal axis of the body;

a non-combustible and heat-resistant cover on one of said end walls;

a non-combustible and heat-resistant wire netting encompassing the side of the body along the length thereof and terminating substantially flush with the other end wall of the body; and

ignition means at said other end wall for initiating combustion of the flare composition at said end;

a protective heat-insulating layer interposed between the wire netting and the flare composition encompassing the netting and the composition along the lengths thereof, said protective layer being composed of a mixture of plastic and a heat-insulating filler material,

said wire netting and protective layer upon ignition of the composition preventing direct access of combustion flames to the side of the body thereby impeding premature burning at localized areas of the side, said netting also providing a multitude of passages for the flow of fresh combustion air to the burning body thereby causing a gradual an uniform consumption of the body thus increasing the luminous efficiency of the flare.

2. The flare according to claim 1 wherein said filler material is magnesium oxide.

3. The flare according to claim 1 wherein said filler material is asbestos.

4. The flare according to claim 1 and comprising a heat-insulating protective layer encompassing the outside of said wire netting along the length thereof, said layer being composed of a mixture of plastic and a heat-insulating filler material.

5. The flare according to claim 4 wherein said filler material is magnesium oxide.

6. The flare according to claim 4 wherein said filler material is asbestos.

7. The flare according to claim 1 wherein said wire netting is embedded in a protective layer covering both sides thereof, said layer being composed of a mixture of a plastic and a heat-insulating filler material.

8. The flare according to claim 1 wherein said wire netting consists of stainless steel wires.

9. The flare according to claim 1 wherein said wire netting is formed of wires having a diameter of 0.25 to 1 mm and has free meshes about 0.5 to 2.00 mm^2.

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