



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.05.2001 Bulletin 2001/19

(51) Int Cl.7: **F42B 39/14**

(21) Application number: **00850175.1**

(22) Date of filing: **25.10.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(72) Inventors:
• **Karlsson, Hans**
633 47 Eskilstuna (SE)
• **Gustav, Karlstedt**
633 53 Eskilstuna (SE)

(30) Priority: **05.11.1999 SE 9904017**

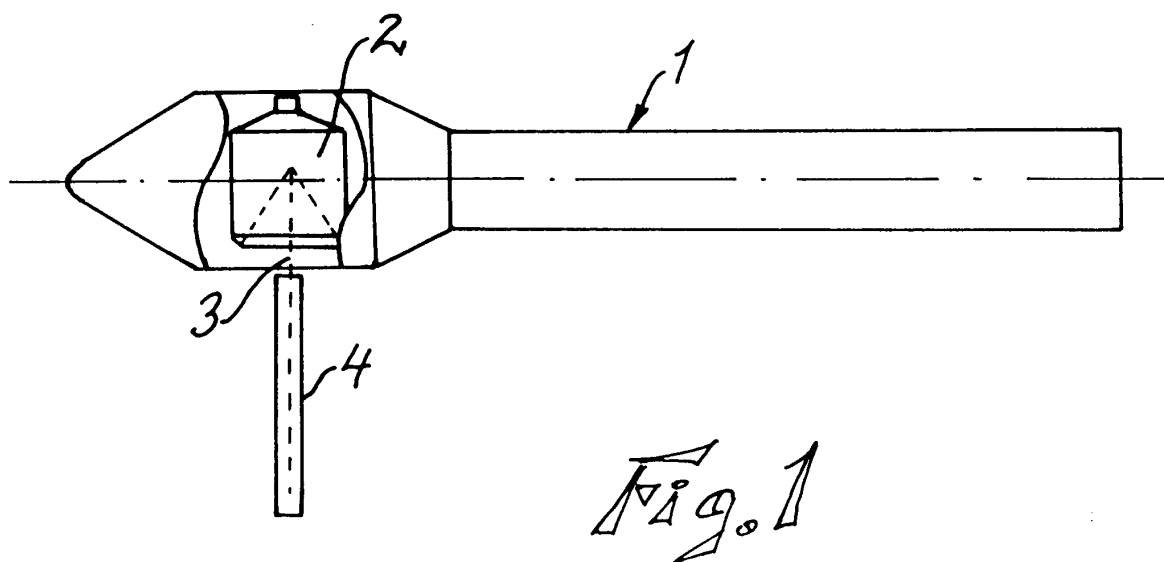
(74) Representative: **Falk, Bengt**
Bofors Support AB
Patents and Trademarks
691 80 Karlskoga (SE)

(71) Applicant: **Bofors Carl Gustaf AB**
691 80 Karlskoga (SE)

(54) **Method and device to reduce the risk of the spread of an unintentional local initiation in an ammunition store containing shaped charges**

(57) The present invention relates to a method and a device to prevent the unintentional initiation of a shaped charge (2) caused by fire or other means resulting in the initiation spreading to other adjacent charges and causing a sympathetic detonation. The invention is

characterised by an expendable body (4, 10-13) made of a material which is resistant to shaped charges and which is of sufficient length to prevent the shaped charge jet penetrating through the expendable body in the direction of effect (3) of the jet (2).



Description

[0001] The present invention relates to a method and a device to prevent the unintentional initiation of a shaped charge caused by fire or other means spreading to other explosive charges in the vicinity and causing a sympathetic detonation.

[0002] The invention is especially suitable for implementation in the storage and transportation of anti-armour weapons with transverse shaped charges, that is such weapons which have one or more shaped charges with a direction of effect which is transverse the longitudinal direction of the weapon. Such anti-armour weapons are already in service and they are expected to become increasingly common as modern armoured vehicles with their improved armour protection consisting of both active and passive types at present and for the foreseeable future are obviously easier to combat from above where for both practical and weight reasons the armour is weakest

[0003] During storage and transportation it is always the case that several similar weapons will be packed closely together in unit loads on pallets or simply lying next to each other. In the case of fire or other external influence that results only in a limited effect a small number of shaped charges can be unintentionally ignited. The shaped charge jets from these weapons can then in their turn initiate one or more adjacent charges with the result that an event which originally entailed limited damage results in a mass sympathetic detonation. The risk of such an occurrence is regarded as especially large in the case of transverse shaped charges where for practical reasons the direction of effect of the shaped charges is towards an adjacent weapon when several such weapons are lying next to each other.

[0004] The present invention now offers a solution to this problem based on the fact that each shaped charge jet created by a detonating shaped charge is normally so well concentrated that it affects only the area in the immediate vicinity of the jet's main axis while the material around this area remains unaffected. In accordance with this invention, during storage or transportation the shaped charges are provided with expendable bodies which are made of a material which is resistant to shaped charges and which have their longitudinal axes accurately directed so as to coincide with the effect direction of the shaped charges and whose lengths are such that they exceed the maximum penetration depth of the shaped charge jets in the material in question. The expendable bodies can be made of steel or heavy metal for example but a body made of steel must have a greater length than a body made of heavy metal. 'Heavy metal' here refers to metals or metal alloys with a density higher than that of steel. As regards the cross-sectional area of the expendable body, it must be adapted to the lateral propagation of the shaped charge jet in question so that it is certain that the entire jet has effect only within the expendable body and does not break

through the sidewall formed. The appropriate expendable body cross sections and lengths in accordance with the invention for various shaped charges and in various materials can be calculated using computer programs that are already available. In accordance with one development of the invention the expendable body can be given different dimensions at different sections in one longitudinal direction based on the calculated lateral and longitudinal propagation of the shaped charge jet. It can thereby have a form of a truncated cone elongated in one direction or the other or a combination of cylinder and truncated cone or other form with varying cross-section. In accordance with one version of the invention the expendable body itself can be surrounded by a tubular protecting part for example a steel tube that is capable of gathering any radial spray which occurs at penetration. The said tube can also gather the shaped charge jet in the event it should break through the side of the expendable body.

[0005] Using expendable bodies in accordance with the invention which are correctly designed and accurately directed, an unintentional initiation of one or more shaped charges in a unit load will result only in the energy of the initiated shaped charge jet being consumed by forming a hole in the expendable body and of course by causing a certain amount of heat in the shell thus formed.

[0006] The method and design in accordance with the invention are especially suitable for implementation in connection with unit loads where the expendable bodies can be included as part of the packing material. As the attitude of the expendable bodies is so important it can be advantageous for each charge or charge packaging to be fitted with a suitable guide which ensures that the expendable body is correctly directed when the charges are packed in each unit load. If such a guide is added it shall not have a design that causes interference with the active function of the charge.

[0007] The invention is described in the subsequent patent claims and is now described in more detail in combination with the following figures of which

Figure 1 shows the basic principle of the invention
 Figure 2 shows a three-dimensional through-view of a unit load
 Figure 3 shows section III-III in Figure 2
 Figure 4 shows section IV-IV in Figure 2
 Figure 5 shows another version of the expendable body shown in Figure 1 and
 Figure 6 shows a partly sectioned version of the expendable body shown in Figure 1.

[0008] All the figures show one or several projectiles 1 intended for rechargeable anti-armour weapons. Each such projectile includes a shaped charge 2 which is transverse the direction of flight. How the projectiles are designed otherwise is of less interest in this context but they can be expected to include propulsion rocket mo-

tors, target sensors and possibly a guidance system. The projectiles are normally in individual containers which are not shown in the figures. The reference to charges for rechargeable anti-armour weapons in the figures is only one example. The invention can be used for all types of shaped charges or weapons fitted with shaped charges, for example anti-armour weapons of disposable type.

[0009] Figure 1 illustrates the basic idea behind the invention. An expendable body 4 made of material which is resistant to shaped charge jets has been fitted as close as possible outside the projectile with the said expendable body's longitudinal direction centred around the direction of effect 3 of the shaped charge. The length of the expendable body 4 is selected in relation to the material it is made of so as to ensure that the shaped charge if initiated shall not pass through the entire length of the body. As the capability of the shaped charged jet to penetrate another material depends on how concentrated the jet is and that for this reason every effort is made to produce charges which cause well-concentrated jets, the cross section of the expendable body does not need to be greater than that required to cover the lateral propagation of the jet which means that if the shaped charge is unintentionally ignited while the expendable body is in place the jet from the shaped charge will function only in the expendable body and there cause a longitudinal hole surrounded by thin but unbroken sidewalls. From the above it is clear that the attitude of the expendable body is of decisive importance for the function of the invention. The intention is that the unintentionally ignited shaped charge shall use up all its energy to create a hole in the expendable body instead of initiating the other charges in the vicinity. All that is required in order to implement the invention therefore is a well-directed expendable body in the form of a rod of steel, heavy metal or other material which is resistant to the jet from a shaped charge. By making the expendable body of compacted pulverised metal the possibility of the body being converted to a projectile when affected by the shaped charge jet is avoided as an expendable body made of such material will instead be reduced to powder.

[0010] While Figure 1 shows the basic principle of the invention, Figures 2-4 show proposals as to how the invention can be used when four projectiles 5-8 are packed together on a transport container 9. Of these projectiles, numbers 5 and 6 are positioned along the container outer edges with their front sections containing the shaped charges turned in the same direction but with a small longitudinal shift to provide space for the projectiles and expendable bodies 10 and 11 which extend across a large portion of the width of the container allowing expendable bodies 10 and 11 to be relatively long and for this reason enabling them to be made of cheaper steel, while the other two projectiles 7 and 8 facing the other direction have been fitted with expendable bodies 12 and 13 which in the example shown have

less space at their disposal and it is therefore suggested that these should be made of more expensive heavy metal. In the example shown it is assumed that the guides for the positions of the expendable bodies are included in the container 9 fittings.

[0011] Figure 5 illustrates another version of the expendable body here designated 14 and designed with consideration to the anticipated propagation of the shaped charge in longitude and therefore has the form of a cylinder and a truncated cone directly combined. Another shaped charge can require the reverse form or only a truncated cone facing in one direction. The cylinder and the truncated cone can have a circular or non-circular cross-section.

[0012] Figure 6 shows another version of the expendable body 15 surrounded by a concentric metal tube 16 for gathering any lateral jet spray. Combinations of the features of Figures 5 and 6 are of course possible.

Claims

1. A method to prevent the unintentional initiation of a shaped charge (2) caused by fire or other means from resulting in the spread of the initiation to adjacent charges **wherein** an expendable body (4, 10-13) made of material that is resistant to shaped charge jets is fitted around the direction of effect (3) of each shaped charge (2) and is accurately centred and lying in the direction of the said shaped charge and is of a length that exceeds the maximum penetration length of the shaped charge jet in the material in question and that this expendable body (4, 10-13) is secured in the above stated position and with unchanged attitude as long as the shaped charge is in store or being transported.
2. Method as claimed in Claim 1 **wherein** the said expendable body (4, 10-13) is arranged with the end facing the charge (2) as close to the charge as the design and individual packaging of the charge permit.
3. Method as claimed in Claim 1 and 2 **wherein** shaped charges (2) which are close to each other in unit loads (9) or in storage are arranged so that their respective directions of effect (3) and expendable bodies (4, 10-13) extend past each other.
4. Method as claimed in Claim 3 **wherein** the shaped charges (2) to be arranged in unit loads (9) or placed in storage are adjusted longitudinally and/or transversely so that between, in front of or behind them space is created for expendable bodies (4, 10-13) which shall prevent the unintentional initiation of one charge spreading to other charges and causing a sympathetic detonation.

5. Device in accordance with the method in any of the Claims 1-4 to prevent an unintentional initiation caused by fire or other means of a shaped charge (2) resulting in a spread of the initiation to other adjacent explosive charges **wherein** the said device consists of a centred expendable body (4, 10-13) in the direction (3) of the shaped charge (2) extending around the jet caused at the detonation of the charge and made of material which is resistant to shaped charges and whose length in the direction of the jet (3) exceeds that of the maximum penetration of the jet in the material in question. 5 10
6. Method as claimed in Claim 5 **wherein** the said expendable body (4, 10-13) has the form of an extended rod with a cross section which is adapted to the strength of each shaped charge. 15
7. Method as claimed in Claim 5 **wherein** the expendable body (4, 10-14) has a cross section that varies in its own longitudinal direction. 20
8. Method as claimed in Claims 5-7 **wherein** the expendable body (15) is surrounded by a concentric body (16) of a material which can absorb spray which is caused at penetration and/or fragments in the event the shaped charge jet should break through the side of the expendable body. 25
9. Method as claimed in Claims 5-8 **wherein** the said expendable bodies (4, 10-15) are made of metal. 30
10. Method as claimed in Claims 5-9 **wherein** the said expendable bodies (4, 10-15) are made of heavy metal. 35
11. Method as claimed in Claims 9 or 10 **wherein** the said expendable bodies are made of compacted pulverised metal. 40

45

50

55

