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Description

Shock-Insusceptible Smoke Projectiles

The present invention relates to a smoke projectile in accordance with the preamble of claim 1.

Smoke projectiles having the form of smoke grenades or so-called smoke cups are fundamentally known, e.g., from DE 28 41 815 C2. In accordance with this prior art, a projectile charge consists of smoke cups stacked one above the other in discharging direction in the shell jacket and comprised of a closed metal casing and a smoke composition charge accommodated therein on the basis of hexachloroethane, zinc oxide and metallic powder. The smoke active mass is ignited with the aid of so-called priming cartridges and lit in the flight of the projectile, with the projectile then releasing vapors of smoke upon impact on the ground.

The significance of smoke generation in military terms is to interrupt the line-of-sight connection between an object to be projected and an attacker.

Concurrently with the further development of modern weapons systems it became necessary to also obtain interruption of the line-of-sight in the infrared range.

To this end, combined smoke composition charges on the basis of red phosphorus were used which result in interruption of the line-of-sight in both the visible and infrared ranges.

Smoke projectiles for the self-protection of military vehicles are commonly launched from dischargers, where the smoke active mass is projected about 25 meters ahead of the vehicle and initiated. The smoke effect taking place is to interrupt the line-of-sight for the opponent to the vehicle to be protected in the visual and infrared ranges so as to prevent an opponent's weapon from taking effect. The introduced smoke measure has

to take effect as quickly as possible. Desired reaction times for building the smoke screen following initiation of the smoke active mass are within approx. 1 - 2 seconds.

The smoke projectiles for the protection of military vehicles as described at the outset include an ammunition body having active masses incorporated into it. As a result of actuating the firing key in the vehicle, an ejector charge is ignited in the ammunition by means of an electrical primer which ejects the active mass, or submunition, from the discharger. By means of a pyrotechnical delay element, which equally was initiated by the ejector charge, the active mass is lit, still in flight, after lapse of the delay time, or a separator charge is initiated as in other systems. In the case of smoke projectiles including a separator charge, a pressure is generated in the submunition on the trajectory, which pressure ruptures the metal sheath enclosing the active mass, lights the smoke active mass contained therein, and ejects it from the sheath. Any existing smoke projectile systems of the prior art comprising ammunitions with separator charges present the drawback that the pressed pellets of smoke active mass ignited on the trajectory are susceptible to shock on impact. Following separation of the containers, the ignited active mass pressed pellets drop to the ground from heights of up to 12 meters. Upon impact on the ground, the impact velocity is as high as 16 m/s.

Due to the deceleration impulse acting at impact, the flame front is disrupted, and the active mass pressed pellets are extinguished almost completely. The same phenomenon is observed in the case of a candle having its rear side hit against a surface while in the burning condition. Several seconds pass by until the proper combustion progression required for smoke generation is re-established. This time span, referred to as the "gap" in international usage, may be as long as 15 seconds. Line-of-sight interruption is not provided until the proper combustion progression required for smoke generation is re-established, and the vehicle to be protected hence is exposed to an opponent's attack without defence.

The reason for these dangerous delays of up to 15 seconds between ignition and smoke formation is founded in the fact that the prior-art active mass pressed pellets comprise about 90% of smoke active mass on the basis of red phosphorus having an igniter charge pressed thereon. The pressed pellets are initiated at their surface by the igniter charge during separation. The ignited charge then lights up the smoke composition charge located underneath. The combustion behavior of the pressed pellets thus has to be rated an end burner. The combustion velocity may at given dimensions be accelerated within certain limits by increasing the oxygen donor content, however a variation of the oxygen donor content is subject to narrow limits, for otherwise smoke will not be formed any more on the one hand, and the detonation tendency will increase on the other hand, so that the smoke active mass ceases to release smoke or at the least fails to form smoke in a sufficient concentration.

Starting out from this prior art it accordingly was an object of the present invention to furnish a smoke projectile allowing to significantly reduce the gap period, to thereby afford protection for the vehicle to be protected as quickly as possible.

This object is attained through the characterizing features of claim 1.

In the smoke projectile in accordance with the invention, at least part of the smoke active mass includes regions having an increased concentration of at least one igniter charge, wherein the regions have a diameter distinctly smaller than the diameter of the smoke active mass.

Accordingly in the present invention, the igniter charge is not pressed on in surface contact as in the prior art, but the smoke projectile of the invention contains a pressed pellet of active mass provided with so-called nests of at least one igniter charge. These nests are regions having an increased concentration of at least one igniter charge mixture and are embedded into the smoke active mass proper.

The smoke projectile of the invention may, for example, have a first layer comprising smoke active mass including regions of increased concentration of at least one igniter charge, and underneath this layer provided with igniter charge nests, the smoke active mass proper is arranged as a main smoke active mass in a second layer.

Based on practical considerations, the igniter charge, other than in the prior art, is not pressed on but mixed at certain mixing ratios of smoke active mass and igniter charge, and this mixture is press compacted jointly with the pure smoke active mass that was introduced into the pressing mold in advance.

Due to the fact that the active masses (smoke active mass and igniter charge) are present in granulated form prior to pressing, what is formed is a pressed pellet of active mass comprising a layer of smoke active mass and an overlying layer of smoke active mass including nests of igniter charge. The pressed pellet thus produced is also ignited during separation. Other than in the prior art, however, it is not the end face that burns, but starting out from the surface the igniter charge nests inside the active mass. The igniter charge nests (hot spots) burning in the active mass burn with a larger free surface. As a result of the igniter charge nests burning within the smoke active mass, the pressed pellet becomes insusceptible to impact on the ground and thus to shock. At the same time, higher energy is consequently introduced into the smoke active mass, and the combustion velocity increases without requiring to this end an increase of the oxygen donor content in the active mass that would otherwise be necessary.

Reaction of the smoke projectile pressed pellets of the invention is spontaneous, so that the above described gap between separation and onset of the smoke effect approaches Zero.

As a particular advantage, the combustion period may at given masses and dimensions of the pressed pellets be adjusted through the ratio of smoke active mass and igniter charge in the mixed charge on the one hand, or at a given ratio for the mixed charge on the other hand, e.g. 2:1 (smoke

active mass to igniter charge) may be adjusted on the basis of the mass ratio of mixed charge and pure smoke active mass.

An important precondition applying to the present invention is the relationship of the combustion velocities D of smoke active mass and igniter charge:

$$D_{AS} \gg D_{NW}$$

with AS standing for igniter charge, and NW standing for smoke active mass.

In the smoke projectile in accordance with the invention, the flame front is shifted from the surface into the active mass by introducing igniter charge nests into the active mass (mixed charge). The flame front accordingly is closed in or screened so as to be no longer torn off by the delay impulse during impact on the ground. The pressed pellets of active mass accordingly continue to burn in the absence of any slump, and line-of-sight interruption thus is ensured by the resulting smoke generation from activation of an ammunition until completion of combustion.

In a particularly advantageous manner, igniter charge nests are distributed to a depth of up to 50% of the overall height of the active mass.

The concentration in the regions/nests of igniter charge may amount to as much as 100% of the igniter charge mixture.

In accordance with the invention it is preferred if the smoke active mass is based on red phosphorus, as hereby infrared line-of-sight interruption takes place on top of visual line-of-sight interruption.

In the smoke projectiles of the invention, the smoke active mass itself and the mixed charge of smoke active mass and igniter charge nests preferably is in the form of a pressed pellet.

It is particularly preferred if the smoke active mass contains nests of igniter charge having a mixing ratio of smoke active mass and igniter charge of approx. 5:1 to 1:5, in particular of approx. 2:1.

It is another advantage of the instant smoke projectile that the burn time is adjustable through selection of the mixing ratio of smoke active mass and igniter charge and/or through the concentration of the nests.

It is a central point of the invention that the smoke projectile is not susceptible to shock following ignition, i.e. substantially insusceptible to impact on the ground, so that the flame front will not be extinguished any more on impact, and the smoke screen builds up without a gap within 0 to 2 seconds.

A preferred embodiment of the smoke projectile of the invention comprises a mixed charge of smoke active mass with igniter charge nests which is arranged in several layers.

In another embodiment of the present invention, the nests of igniter charge inside the smoke active mass present a gradient-type concentration profile, with the concentration being highest in the direction of ignition.

The gradient-type concentration profile may, for example, be represented as a preformed stepp gradient, with the one gradient step arranged in the direction of ignition comprising igniter charge nests, whereas the further steps facing away therefrom contain about 100% smoke active mass.

Here it is moreover preferred if the single steps of the gradient also have the form of pressed pellets.

Further advantages and features of the present invention become apparent through the description of an embodiment and through the drawing, wherein:

Fig.-1 is a longitudinal sectional view of a smoke active mass in accordance with the prior art in schematic representation; and

Fig. 2 is a schematic longitudinal sectional view of a smoke projectile in accordance with the invention.

In Fig. 1, 1 designates a smoke projectile which comprises a smoke active mass 2 and associated igniter charge 3. The igniter charge 3 is lit on the ignition side 4 with the aid of a primer as an igniting means which is not designated more closely in Fig. 1, to then burn in the combustion direction represented by an arrow in Fig. 1. The igniter charge 3 then in flight ignites the smoke active mass 2.

In the example of Fig. 1, igniter charge 3 and smoke active mass 2 are arranged annularly around a center passage 5.

In accordance with the prior art, the igniter charge 3 is pressed on the smoke active mass 2 in surface contact. The combustion behavior of the pressed pellet according to the prior art in accordance with Fig. 1 acts as an end burner. As soon as the prior-art smoke projectile impacts on the ground, the flame front is inhibited or extinguished almost entirely, resulting in a delay of up to 15 seconds after which the smoke is then actually released. This causes a dangerous gap that may be utilized by an attacker for a successful attack on the vehicle to be protected.

In contrast, Fig. 2 shows a schematic longitudinal sectional view of a smoke projectile in accordance with the invention, in which identical parts are provided with the same reference symbols.

Other than in the prior-art embodiment, the active mass of the smoke-generating pellet of the invention contains a mixed charge 6 which contains igniter charge nests 7.

In an exemplary case, one chooses as the igniter charge mixture a mixture having the following ingredients as described, e.g., in EP 106 334 A2:

magnesium powder	12.00% (wt.)
iron blue	9.00% (wt.)
boron, amorphous	2.39% (wt.)
powder-type chloroparaffin	8.00% (wt.)
finely ground black powder	47.00% (wt.).

In the exemplary case, this igniter charge mixture is mixed with a smoke mixture in a mass ratio of 2:1 (smoke mixture : igniter charge mixture) and then granulated.

As the smoke active mass one uses in the exemplary case one in accordance with EP 106 334, which may have the following ingredients:

red phosphorus	55% (wt.)
cesium nitrate	23% (wt.)
zirconium/nickel alloy 70 : 30	12% (wt.)
polybutadiene binder	10% (wt.)

It is, as a matter of fact, also possible to use other smoke active masses, e.g. those as disclosed in DE 30 31 369 A1 and containing a chlorine donor, metal oxide and ammonium chloride as well as 5 - 40% (wt.) of thiourea, 20 - 70% (wt.) of ammonium perchlorate, 1 - 3% (wt.) of aluminum powder having a grain size of less than 100 μm , and 5 - 30% (wt.) of binding agent. Further smoke active masses are, for example, those described in DE 199 36 054 A1 and making use, e.g., of hexachloroethane as the chlorine donor.

According to the present invention, the igniter charge is not pressed on in surface contact like in the prior art, but mixed in a mixing ratio of 2:1 of smoke active mass and igniter charge, and this mixture is pressed jointly with pure smoke active mass filled into the pressing mold in advance.

Due to the fact that the smoke active mass and the igniter charge active mass are present in granulated form prior to press compacting, a pressed pellet of active mass comprised of a layer of smoke active mass and an overlying mixed layer of smoke active mass with so-called nests of igniter charge is formed.

A pressed pellet thus obtained is also ignited during separation of the smoke ammunition. Other than with the smoke ammunition of the prior art, it is not the end face that burns, but four igniter charge nests burn starting out from the combustion side with a much larger free surface in comparison with the prior art. As a result of the igniter charge nests burning inside the smoke active mass, the pressed pellet becomes insusceptible to impact on the ground because the introduction of igniter charge nests into the smoke active mass shifts the flame front from the surface into the smoke active mass. The flame front accordingly is closed in or screened and is no longer torn off by the delay impulse during impact on the ground. As a result, the pressed pellets of smoke active mass burn through without a slump, and line-of-sight interruption from activation of the ammunition until completion of combustion is ensured through the related smoke generation. In particular, gaps virtually do not occur any more, but the smoke emanates within 1 - 2 seconds at the longest, to thus be available momentarily, as it were, and in a concentration ensuring secure line-of-sight interruption without a gap.

Thus with the present invention, smoke projectiles are for the first time available which do not give rise to dangerous gaps even with a ground impact velocity of up to 16 m/s.

The smoke projectile of the invention may be formed into ammunitions for all customary launchers of most variegated calibers, such as 66 or 76 mm.

Claims

1. A smoke projectile comprising a sheath, igniting means, an ejector charge and a smoke active mass,

characterized in that

at least part of said smoke active mass includes regions having an increased concentration of at least one igniter charge, wherein said regions have a diameter distinctly smaller than the diameter of said smoke active mass.

2. A smoke projectile according to claim 1, characterized in that said regions are nests of igniter charge distributed to a depth of the entire active mass.
3. A smoke projectile according to claim 1 or 2, characterized in that the concentration in said regions is up to approx. 100% igniter charge.
4. A smoke projectile according to any one of claims 1 to 3, characterized in that said smoke active mass is on the basis of red phosphorus.
5. A smoke projectile according to any one of claims 1 to 4, characterized in that said smoke active mass itself and said mixed charge of smoke active mass and igniter charge nests have the form of pressed pellets.
6. A smoke projectile according to any one of claims 1 to 5, characterized in that said smoke active mass contains nests of igniter charge having a mixing ratio of smoke active mass and igniter charge of approx. 5:1 to 1:5, in particular approx. 2:1.
7. A smoke projectile according to any one of claims 1 to 6, characterized in that the burn time is adjustable through selection of the mixing ratio of smoke active mass and igniter charge and/or through the concentration of said nests.

8. A smoke projectile according to any one of claims 1 to 7, characterized in that it is not susceptible to shock following ignition.
9. A smoke projectile according to any one of claims 1 to 8, characterized in that it includes a mixed charge of smoke active mass with igniter charge nests arranged in several layers or one layer.
10. A smoke projectile according to any one of claims 1 to 9, characterized in that said nests of igniter charge have inside said smoke active mass a gradient-type concentration profile, with concentration being highest in the direction of ignition.
11. A smoke projectile according to claim 10, characterized in that said gradient-type concentration profile constitutes a preformed step gradient, with the gradient step arranged in the direction of ignition including igniter charge nests, whereas the further steps facing away therefrom contain approx. 100% smoke active mass.
12. A smoke projectile according to claim 11, characterized in that the single steps have the form of pressed pellets.