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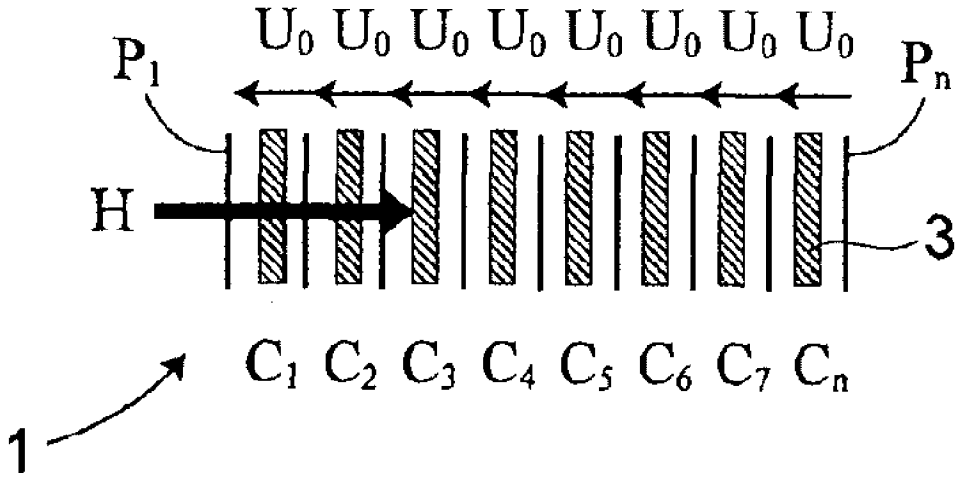
(54) Titre : MODULE DE PROTECTION D'UN OBJET, EN PARTICULIER CONTRE LES PROJECTILES A CHARGES CREUSES

(54) Title: PROTECTIVE MODULE FOR AN OBJECT IN PARTICULAR AGAINST HOLLOW CHARGE PROJECTILES



(57) Abrégé/Abstract:
Suggested is a protective module (1) for the protection of an object, in particular against hollow charge projectiles, comprising several sequentially or super-posed attached plates (P_1 to P_n) for the formation of several capacitances (C_1 to C_n), with preference given to dielectric ceramics (3) tied in between plates (P_1 to P_n), whereby the protective module (1) can consist of several adjacent to each other arranged protective part modules (10).

ABSTRACT

(Fig. 2)

Protective Module for an Object in particular against Hollow Charge Projectiles

Suggested is a protective module (1) for the protection of an object, in particular against hollow charge projectiles, comprising several sequentially or super-posed attached plates (P_1 to P_n) for the formation of several capacitances (C_1 to C_n), with preference given to dielectric ceramics (3) tied in between plates (P_1 to P_n), whereby the protective module (1) can consist of several adjacent to each other arranged protective part modules (10).

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PROTECTIVE MODULE FOR AN OBJECT IN PARTICULAR AGAINST HOLLOW CHARGE PROJECTILES

The invention concerns the design of electrical armor for a stationary or movable object as protection specifically against hollow charge missiles.

Hollow charges present a threat even for (wheeled) vehicles. A hollow charge is a specific arrangement of violent explosive (frequently on nitropenta, or hexogen/ octogen-basis) around a cone-shaped or semi-spherical metal insert, and is particularly suitable for penetration of armor-plating. It is employed accordingly as reinforcement-breaking ammunition. The cone-shaped metal insert is surrounded by an explosive with an opening facing in the forward direction. If the charge is ignited, a spike is formed of cold-worked metal, starting from the tip of the metal core, which penetrates the target at very high velocity, followed by a slower ram or tappet, which forms the principal mass.

Simple known hollow charge protection devices are so-called SLATs, which are attached to the vehicles. A preferably detachable SLAT protective design is disclosed in DE 10 2007 036 393 A1. A protective screen of the same kind is also described in DE 10 2007 002 577A1. Another protective device is published in DE 103 10 952 A1.

Additional solutions are, for example, active reaction reinforcements, which are hurdled against different projectiles, such as is known, for example, from DE 10 2005 056 178 A1. The line-up of a multitude of reactive protective elements in water vehicles is the subject of DE 10 2007 022 767 A1. DE 10 2007 060 611 A1 deals with a fluid armor-plate arrangement.

A protective module is covered in DE 10 2005 021 348 B3 for the protection of objects with electricity against threats, specifically due to hollow charges.

In the meantime, other so-called electrical armor plates are also employed as a protective system. Due to this type of electrical reinforcement, the range of effectiveness of a hollow charge beam can clearly be reduced. This kind of concept consists of an arrangement of plates, an access line, and a loading device (See, e.g., Fig. 1). If the hollow charge beam H (i.e., width of the hollow charge) reaches the reinforcement, it shorts out the capacitor by contacting the upper and lower (anterior/posterior) plate. The capacitor discharges the electric circuit, as a result of which, due to the high electricity, a strong magnetic field is formed around the hollow line beam, which in turn has an effect on the charged particles of the hollow charge beam in the form of strong forces. This results in the enlargement of the diameter of the hollow charge beam, which consequently reduces the penetration performance of the hollow charge beam itself. Depending upon the type of design, the principle can be modified, for example, by means of a series connection of several plates, or

by providing dielectric fluids between the plates, or by alternating dielectric fluids and ceramics between the plates.

It is important for the principle effectiveness of the electrical armor that the short-circuit between the two plates is created as quickly as possible with high electricity (i.e., high current). The process is often slowed down based on the inductivity of the rise in electricity in the access line, so that the rise in electricity over time may then amount to several 10 µs. Another deficit is that the short-circuit will not start to flow until the two plates are connected via the hollow charge beam (i.e., the width of the hollow charge). This may lead to a situation where the anterior front of the hollow charge beam is not influenced by the short-circuit because the initial speed of the electricity is not quick enough.

It is the object of the invention to produce an earlier reaction on the hollow charge beam by shorter/lower increase velocities.

In one aspect, there is provided a protection module for protecting an object from hollow charge projectiles, comprising a plurality of protective part modules that are divided into protective areas, each protective area comprising one or more stacks of plates, wherein the protective part modules are electrically connected to each other, wherein each pair of successive plates in each stack forms a capacitor, and wherein each of the capacitors is charged with a charging voltage.

In one aspect, there is provided an object with a protective module as described above.

The invention is based on the idea of dividing the capacitance of an otherwise utilized central capacitor over a multitude of plate capacitors so that the capacitance of the capacitor is realized via a multitude of plate capacitors, which are formed between the sequentially arranged protective plates. Each individual capacitor is charged with a tension U_o (i.e., a voltage). If the hollow charge beam now influences the protective plate, quick electric rise is possible because of the short "access line" when the beam electrically connects the plates of the first capacitor with each other and, thus, only the first capacitor is short-circuited, as a result of which the hollow charge beam represents almost the only inductivity of the shorted circuit. A reaction can, thus, quickly take place in the front of the beam. Due to each further penetration of the protective element or protective module, successive additional capacitors are shorted. The loading instrument preferably is located within the vehicles, or the object, that is to be protected. The protective module, which is formed of many protective plates, is charged by means of a co-axial HV cable. Voltage division can take place in the loading device as well as in the protective module.

In refining the inventive concept, it has shown itself as beneficial for increasing the capacity (capacitance) if dielectric ceramics are tied-in between the individual plates of the capacitors.

The electricity increase and the amplitude are now determined only by the parameters of the hollow charging beam, the first capacitance C and the loading tension U_o. Because both the inductivity as well as the capacitance of the shorted circuit are lower than it is in the case with traditional applications, this small circuit presents a clearly lower increase in velocity. The plate distance can also be selected smaller than traditional plates because several are arranged in sequence. This also contributes to an earlier influence on the tip of the hollow charge beam.

Another not insignificant benefit is provided in that the central capacitor is eliminated and no longer requires its own place in the vehicle.

The protective module may be constructed from several protective module components. This has the benefit that the less important areas that need to be protected can present fewer plates, so that the entire protective module becomes lighter in weight. Another benefit that can be achieved with part-modules is the ability of exchanging defective part-modules.

In another conceivable variation of the invention, the protective partial modules can be connected with each other in such a fashion that, with a detected attack, the capacitor in the firing region can be supplied with additional voltage in order to, thus, increase the rise in velocity (flow of current). The issue may remain unanswered as to whether the capacitances release their tension (voltage) outside the detected impact point of the hollow charge projectile or whether a central source assumes the task.

The invention will be explained in more detail by means of an exemplary embodiment and with drawings.

Fig. 1 depicts a basic electrical design of an electrical armor according to the state of the art.

Fig. 2 depicts the basic electrical design of a protective module according to the invention.

Fig. 3 depicts, in frontal view, a variation of the design of the protective module in accordance with the present invention.

Fig. 2 shows the basic design of an electrical protective module 1, according to the invention, which consists of several sequentially arranged plates P_1, P_2 until P_n, for the formation of several capacitors C_1 until C_n. Electrical ceramics 3 are preferably inserted between the plates P_{1-n}.

Each of the capacitances C_1 until C_n is loaded up to a loading voltage U_o.

If the hollow charge beam or width H hits the first plate P_1, it shorts the first capacitor C_1 (i.e., P_1 and P_2). With each further penetration of the capacitors C_{2-n} by the hollow charge beam H, the plates are successively shorted, the hollow charge beam H is weakened, and the principal mass is rendered ineffective.

Fig. 3 depicts the division of the protective module 1, presented here as a sketched object 20, in different or sub-divided protective areas 10 and protective submodules 10'. The opportunity exists of designing two or more submodules to have the same shape, which permits simple exchangeability in case of defect. However, the submodules may also be designed with different shapes. The submodules 10' may be constructed in their design in the most important areas to be protected, thicker at an object 20 than in other areas.

In another preferred embodiment of the invention, the protective submodules 10' can be connected in such a fashion with each other that, with detected attack, the capacitors $C_{1\text{-}n}$ in the firing range 11 can be provided with additional voltage U in order to thus increase the current amplitude at these capacitors between the plates.

Also conceivable is another distribution of the capacitance to $C_{1(\text{-}n)}$, wherein the protective module 1 is, or the protective modules 10' are (respectively), tied in and with a central capacitor. The individual capacitor, or individual capacitors $C_{1(\text{-}n)}$, in this arrangement determines, or determine, the current increase in velocity at the start and is/are thereafter supplied by the central capacitor with the main current. It goes without saying that combinations are possible of this variation, and also of the previously described variation of the present invention.

CLAIMS:

1. A protection module for protecting an object from hollow charge projectiles, comprising a plurality of protective part modules that are divided into protective areas, each protective area comprising one or more stacks of plates, wherein the protective part modules are electrically connected to each other, wherein each pair of successive plates in each stack forms a capacitor, and wherein each of the capacitors is charged with a charging voltage.

2. The protection module according to claim 1, wherein dielectric ceramics are incorporated between the plates.

3. The protection module according to claim 1 or 2, wherein two or more of the protective part modules have the same shape.

4. The protection module according to any one of claims 1 to 3, wherein a number of the plates in two or more of the protective part modules is different.

5. The protection module in accordance with any one of claims 1 to 4, wherein the capacitors in a portion of the protection module being impacted by a projectile are supplied with additional voltage in order to increase the current amplitude.

6. The protection module according to claim 5, wherein the additional voltage is supplied by a central capacitor outside of the protection module.

7. The protection module according to claim 5, wherein the additional voltage is supplied by one or more of the capacitors outside the portion of the protection module being impacted by the projectile.

8. The protection module according to any one of claims 1 to 7, wherein protective areas protecting a part of the object that is less important than another part of the object have fewer plates than protective areas protecting the other part of the object.

9. An object with a protection module according to any one of claims 1 to 8.

10. The object according to claim 9, wherein the object is of a stationary or movable nature.

11. The object according to claim 9 or 10 having a central capacitor operably connected to the protection module.

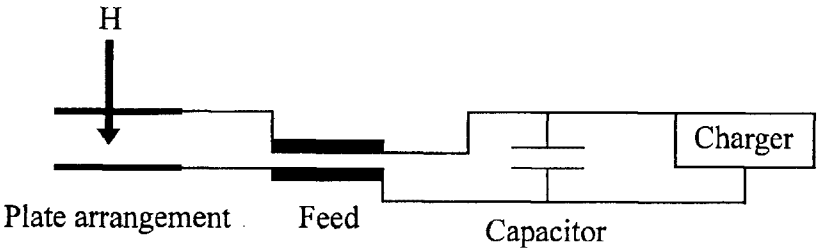


FIG. 1
PRIOR ART

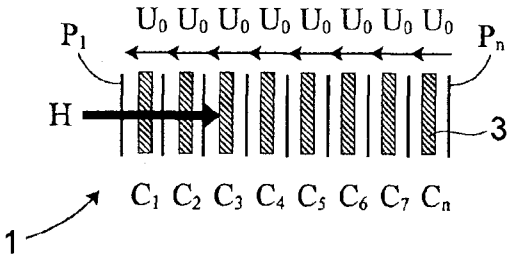


FIG. 2

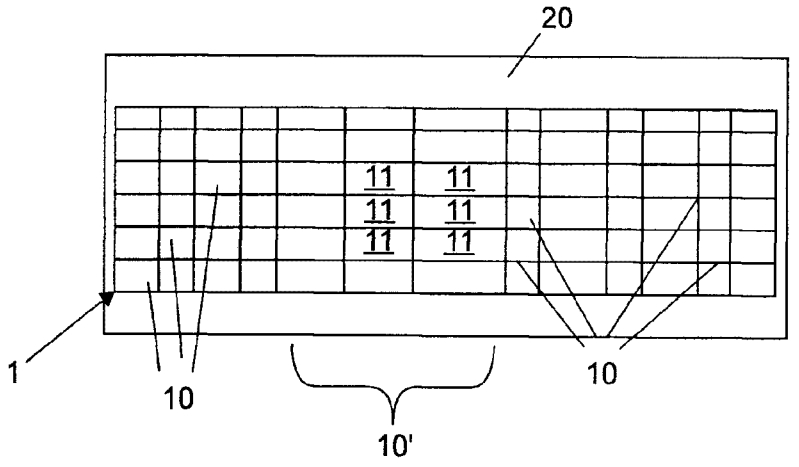
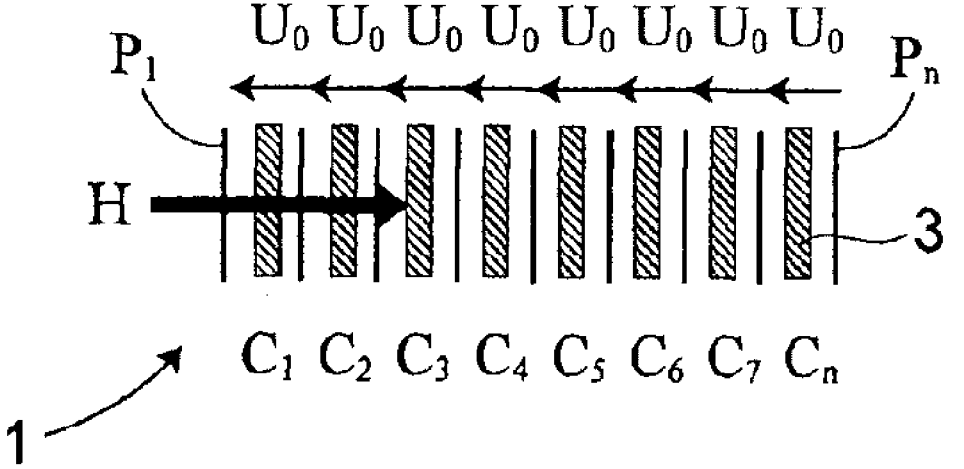


FIG. 3


U0 U0 U0 U0 U0 U0 U0 U0
P1
Pn
H
3
C1 C2 C3 C4 C5 C6 C7 Cn
1