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(54) Method for a multiple hollow charge and a multiple hollow charge for implementing the method

(57) The present invention relates to a method for a multiple hollow charge and a multiple hollow charge (10) for implementing the method. According to the invention, an increased effect is brought about in connection with or after penetration of a protection by virtue of the fact that the hollow-charge jets (18, 19) from at least a first and a second hollow charge (11 and, respectively, 12) are caused to collide on or after penetration of the protection.

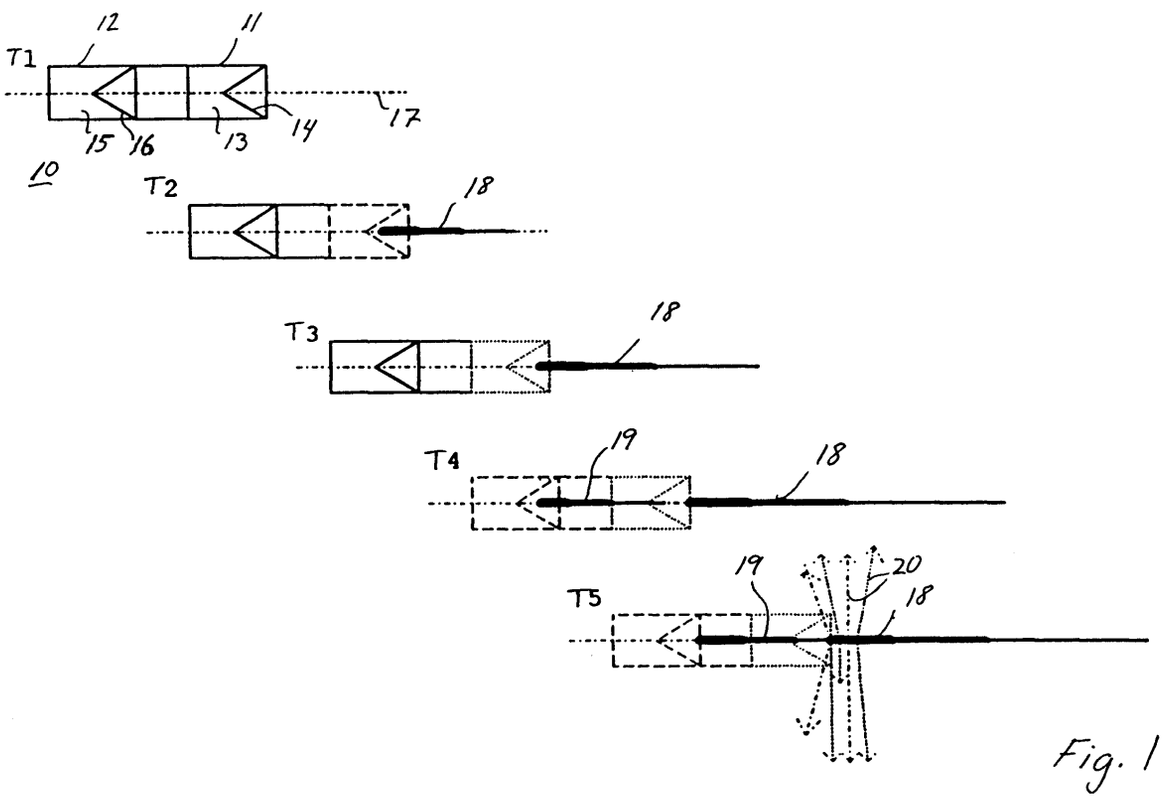

Fig. 1

EP 1 087 203 A1

Description

[0001] The present invention relates to a method for a multiple hollow charge for bringing about an increased effect on or after penetration of protection, and a multiple hollow charge comprising at least a first and a second hollow charge arranged so as to act in essentially the same direction against a protection in order to penetrate the same, which hollow charges comprise an explosive charge with a liner, and which multiple hollow charge comprises means of detonation of the hollow charges, a hollow-charge jet for action against the protection being formed from each charge on detonation of a hollow charge. In this context, hollow-charge jet relates to both extending jets and jets which have the nature of a projectile.

[0002] Multiple hollow charges and in particular tandem hollow charges of the above type have been known for a long time, see for example GB 2 239 694. In the known multiple hollow charges, the component hollow charges act one after another in essentially one and the same hole on penetration of a protection. This means that the penetration capacity of the charges is added completely or partly.

[0003] The object of the present invention is to increase the effect in connection with or after penetration of a protection, in particular armour protection. This is achieved according to the method of the invention by causing a first hollow-charge jet from a first hollow charge and a second hollow-charge jet from a second hollow charge to collide in connection with penetration of the protection. In this context, the expression in connection with penetration of the protection means a period of time which lasts from a point in time immediately before penetration to a point in time immediately after penetration. In the event of collision having started immediately before penetration of the protection, it is a prerequisite that the collision procedure continues at least during parts of the penetration phase. The hollow charge according to the invention comprises means for causing the hollow-charge jets from at least the first and second hollow charges to collide in connection with penetration of the protection.

[0004] When the hollow-charge jet formed last collides with jet parts from the jet formed first, such as a slug, tail fragments or other parts with lower velocity than the tip of the hollow-charge jet formed last, on or after passage through the protection, the material from both the jets is spread. The spread material results in an increased effect according to one or more of the principles below.

- Production of a radial spread of splinters from fragments which collide, which increases the conventional fragmentation effect within a protected space, both because the number of splinters increases and because the splinters are sent out in other directions than is usual, that is to say from the inside of the protection.
- If the collision takes place within the (armour) protection, the conventional hole diameter is greatly increased on account of the radial force component caused by the collision. This produces an increased quantity of secondary splinters and thus a better effect. This phenomenon is particularly accentuated if the collision takes place close to the inside of the protection, that is to say at the end of the penetration process. The conventional effect in the form of splinters increases if the hole diameter increases.
- Combustion, alloying and other exothermic reactions are improved by various mechanisms. The spread of material leads to an improved oxygen supply and greater reaction surfaces. Furthermore, the energy supplied when the collision takes place can be sufficient to start reactions. The reactions have an effect within the spaces fired upon, in the form of an increase in temperature, pressure, hot splinters and smoke and so forth.

[0005] There are a number of possibilities for causing two hollow-charge jets to collide on or after penetration of the protection.

[0006] According to an advantageous embodiment, a control arrangement is adapted to initiate the second hollow charge depending on the initiation of the first hollow charge so as to cause the hollow-charge jets of the hollow charges to collide.

[0007] According to another advantageous embodiment, the geometrical distances between component hollow charges are dimensioned so that the faster part of the second jet catches up the slower part of the first jet on or after penetration of the protection.

[0008] According to other advantageous embodiments, the hollow charges have a different geometrical shape and/or different explosive properties as a result of the use of different explosive substances, initiation principles or the like.

[0009] Examples follow below of parameters which can be varied so as to change the properties of a hollow charge, including the mass/velocity of the hollow charge and the slug:

- the angle of the hollow-charge cone (the liner),
- the material thickness of the hollow-charge cone,
- the density of the hollow-charge cone,
- use of explosive substances with different detonation pressures,
- a greater or smaller quantity of explosive substance in the charge and the distribution of the explosive substance in relation to parts of the cone/the liner and the point of initiation,
- the selection of density and to a certain extent the thickness of the case of the charge,
- the initiation principle (central initiation/peripheral initiation).

[0010] The component charges are preferably of the jet-forming or projectile-forming type.

[0011] The ignition sequence of the hollow charges can be either that the front charge of two hollow charges is ignited first or that the rear charge is ignited first. In the latter case, according to one embodiment, the jet of the front hollow charge can also be included in a sectional area, which is to a greater or lesser extent empty, in the jet of the rear hollow charge. In this embodiment, parts other than the tip and tail of the hollow charges can be made to participate initially in the collision between two jets.

[0012] The invention is described in greater detail below with reference to the appended drawings, in which Figure 1 snows diagrammatically the activation of a multiple hollow charge of the tandem type at five points in time to illustrate the collision procedure, and Figure 2 shows diagrammatically a multiple hollow charge with a control arrangement.

[0013] The multiple hollow charge 10 shown in Figure 1 comprises a first and a second hollow charge 11 and, respectively, 12. The first hollow charge 11 comprises an explosive charge 13 with an associated liner 14, and the second hollow charge 12 comprises an explosive charge 15 with a liner 16. The central axes of the hollow charges coincide on a common centre line 17. No detonators are shown but are assumed to be included according to any conventional solution.

[0014] Both the hollow charges can be of the projectile-forming type (IV) or of the jet-forming type (III). It is also possible for one hollow charge to be of the projectile-forming type and the other to be of the jet-forming type.

[0015] The activation procedure is described below.

[0016] At time T1, the multiple hollow charge is underway towards its target but neither of the hollow charges 11, 12 of the multiple hollow charge has as yet been ignited.

[0017] At time T2, the front charge 11 detonates. A hollow-charge jet 18 is generated.

[0018] At time T3, the jet 18 has moved forward a little in the trajectory.

[0019] At time T4, the rear charge 12 is ignited and a hollow-charge jet 19 is generated. The charges follow essentially the same trajectory towards the target.

[0020] At time T5, the jet 19 of the rear charge has caught up with the front hollow-charge jet 18 and a collision occurs between the faster parts of the rear hollow-charge jet and the rear parts of the front hollow charge, such as the slug, tail and other slow-moving parts. The hollow-charge jets 18, 19 penetrate or have at this time T5 penetrated a protection (not shown), for example armour protection on a tank. Arrows 20 indicate that great radial forces occur.

[0021] A procedure in which the front hollow charge is ignited before the rear charge has been described above. In the event that the rear hollow charge instead is ignited first, it must in some known way be ensured that the rear charge ignited first is allowed completely or partly to pass through the front charge. This does not form part of the invention and is therefore not described further. Refer to SE B 8205973-4 for examples of such charges.

[0022] The multiple hollow charge shown in Figure 2 is constructed in the same way as the multiple hollow charge shown in Figure 1 apart from that fact that a control arrangement 21 has been included between the two hollow charges. The control arrangement 21 delays the generation of the jet produced last of two hollow-charge jets to such an extent that the tip of the hollow-charge jet produced later catches up the slower parts of the hollow charge produced first in connection with penetration of the protection.

[0023] The delay between the ignition of two hollow charges can be brought about in many different ways. The decisive factors are inter alia the geometrical and other conditions in the charges and the distance from the charges to a predetermined collision point or a predetermined collision area in the vicinity of which a target to be combated is located.

[0024] An example of bringing about a delay is described in the abovementioned SE B 8205973-4. In this case, the delay is determined by the time it takes for the slug of relatively great diameter of the hollow-charge jet produced first to move to a predetermined position in order to initiate in this case the front charge. Other examples of known art are to use the delay which arises when a shock wave is made to travel a given predetermined distance in the shell structure or to include electronic delay circuits which prevent/delay initiation of charge two. Such delays can also be brought about by pyrotechnic or explosive elements or mechanical arrangements. Combinations of the above delay methods can also be used.

[0025] The invention is not limited to the exemplary embodiments described above, but a number of alternative embodiments are possible within the scope of the appended patent claims. The multiple hollow charge can thus comprise more than two hollow charges. The hollow charges can be ignited in reverse order, that is to say a rear charge before a front charge and so forth. Furthermore, the hollow charges can have different calibres, different geometries moreover and contain different materials.

Claims

1. Method for a multiple hollow charge (10) for bringing about an increased effect on or after penetration of protection, characterized in that a first hollow-charge jet (18) from a first hollow charge (11) and a second hollow-charge jet (19) from a second hollow charge (12) are caused to collide in connection with penetration of the protection.

2. Method according to the preceding patent claim, characterized in that the geometrical distances between component hollow charges (11, 12) are dimensioned so that the faster part of the second jet (19) catches up the slower part of the first jet (18) on or after penetration of the protection.

3. Method according to either of the preceding patent claims, characterized in that the component hollow charges (11, 12) are given a different geometrical shape in order that the faster part of the second jet will catch up the slower part of the first jet in connection with penetration of the protection.

4. Method according to any one of the preceding patent claims, characterized in that the component hollow charges (11, 12) are given different explosive properties as a result of the use of different explosive substances, initiation principles or the like in order that the faster part of the second jet will catch up the slower part of the first jet in connection with penetration of the protection.

5. Method according to any one of the preceding patent claims, characterized in that the delay of activation of the second hollow charge (12) in relation to the first hollow charge (13) is controlled so that the faster part of the second jet catches up the slower part of the first jet in connection with penetration of the protection.

6. Method according to any one of the preceding patent claims, characterized in that the rear charge (12) of two hollow charges is ignited before the front charge (11).

7. Method according to Patent Claim 6, characterized in that the jet (18) of the front hollow charge is included in a sectional area, which is to a greater or lesser extent empty, in the jet (19) of the rear hollow charge.

8. Method according to any one of Patent Claims 1-5, characterized in that the front charge (11) of two hollow charges is ignited before the rear charge (12).

9. Multiple hollow charge (10) comprising at least a first and a second hollow charge (11, 12) arranged so as to act in essentially the same direction against a protection in order to penetrate the same, which hollow charges comprise an explosive charge (13 and, respectively, 15) with a liner (14 and, respectively, 16), and which multiple hollow charge comprises means of detonation of the hollow charges, a hollow-charge jet (18, 19) for action against the protection being formed from each charge on detonation of a hollow charge, characterized in that the multiple hollow charge (10) comprises means (21) of causing the hollow-charge jets from at least the first and second hollow charge (11, 12) to collide in connection with penetration of the protection.

10. Multiple hollow charge according to Patent Claim 9, characterized in that the geometrical distances between component hollow charges (11, 12) are dimensioned in such a manner that the faster part of the second jet (19) catches up the slower part of the first jet (18) on or after penetration of the protection.

11. Multiple hollow charge according to any one of Patent Claims 9-10, characterized in that the component hollow charges (11, 12) have a different geometrical shape in order to cause the hollow-charge jets (18, 19) of the hollow charges to collide.

12. Multiple hollow charge according to any one of Patent Claims 9-11, characterized in that the component hollow charges (11, 12) have different explosive properties in order to cause the hollow-charge jets (18, 19) of the hollow charges to collide.

13. Multiple hollow charge according to any one of Patent Claims 9-12, characterized by a control arrangement (21) adapted to initiate the second hollow charge (12) depending on the initiation of the first hollow charge (11) in order to cause the hollow-charge jets (18, 19) of the hollow charges to collide.

14. Multiple hollow charge according to any one of Patent Claims 9-13, characterized in that the component hollow charges (11, 12) are of the jet-forming type or the projectile-forming type.

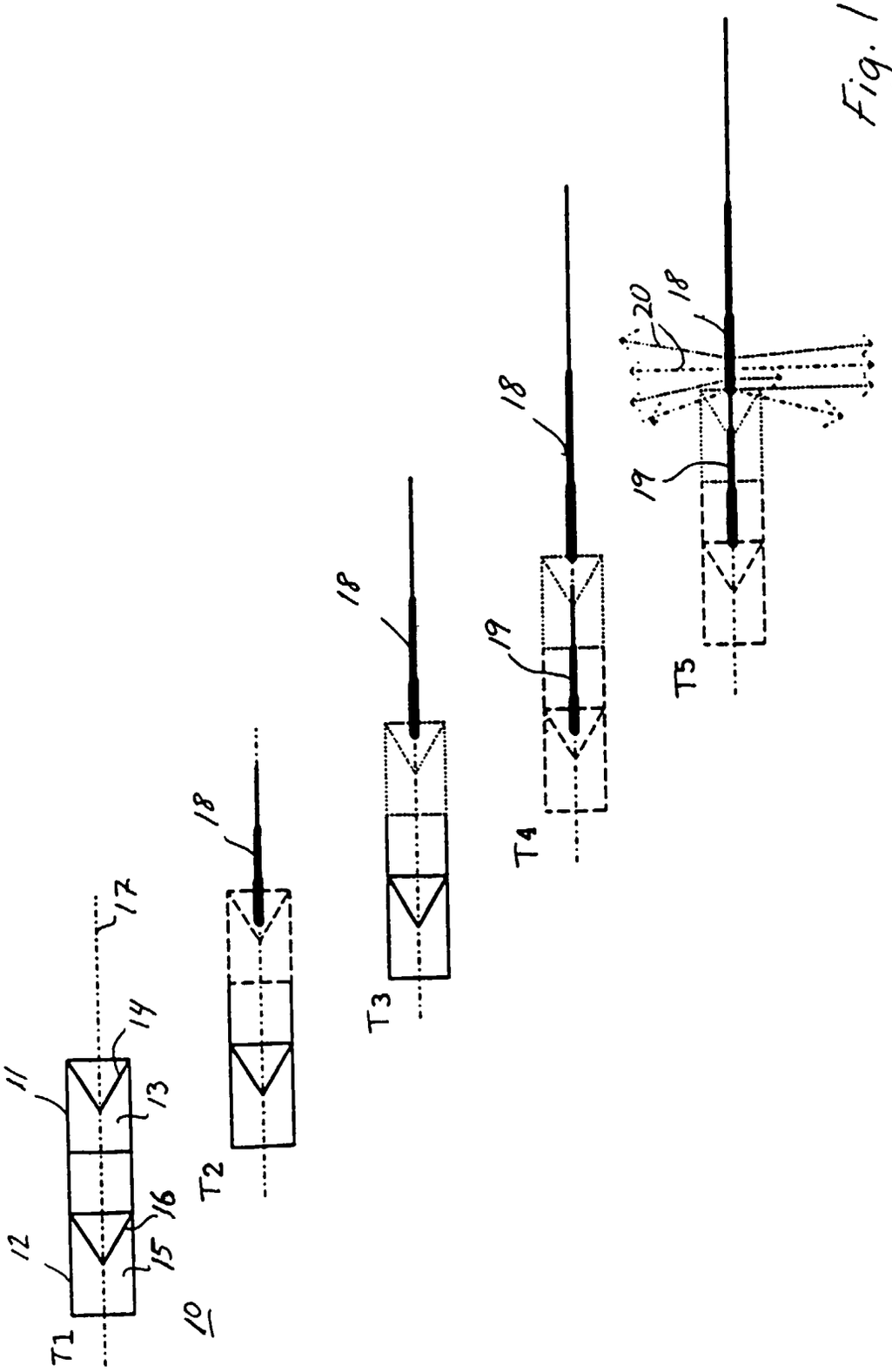

Fig. 1

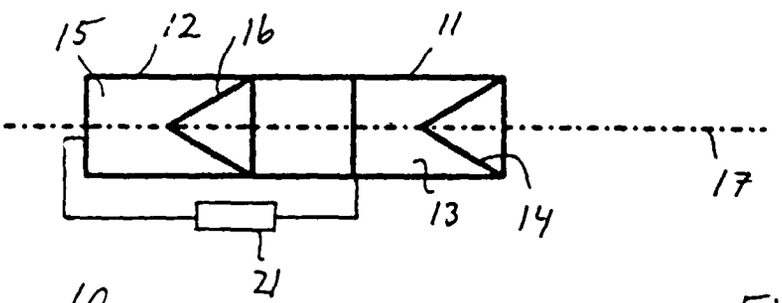

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 99 85 0141

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	FR 2 493 506 A (SERAT) 7 May 1982 (1982-05-07) * figures 1,3 * * page 1, line 21 - line 28 * * page 2, line 17 - page 3, line 21 *	1-6,9-14	F42B12/18
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 February 2000	Schwingel, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82