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(54) A projectile fitted with at least one stand-off means.

(57) A projectile (1) fitted with at least one stand-off means (8, 9), having two shaped explosive charges (2, 3). The stand-off means (8, 9) includes an ejectable rod (9) with an impact sensor (15) which is in signal operative connection with a fuze (4) for initiating one of the charges. The rod (9) is in an ejected position excentrically orientated relative to the longitudinal axis (10) of the projectile and is preferably inclined inwards towards this.

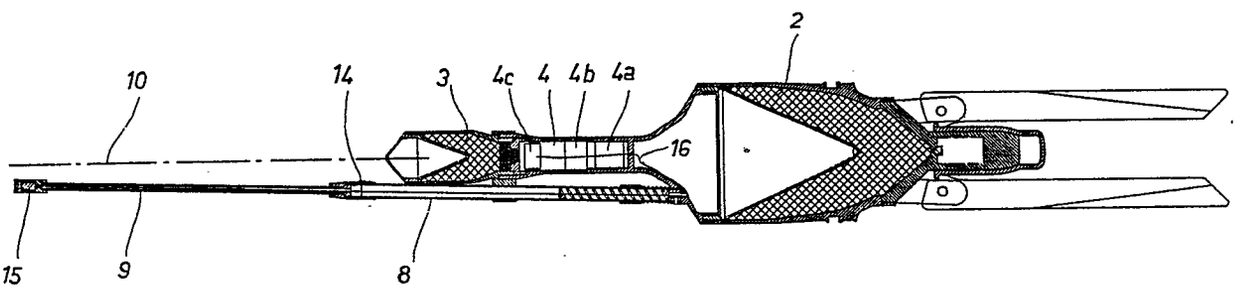

FIG. 3

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A projectile fitted with at least one stand-off means

TECHNICAL FIELD

The present invention relates to a projectile, for instance a shell or a robot missile, fitted with at least one stand-off means, the projectile having at least one explosive charge and a fuze for initiating the charge, the stand-off means including a rod with an impact sensor for sensing the impact of the rod against a target, the impact sensor and the fuze being operatively interconnected for signal transmission therebetween.

The invention relates more specifically, but not exclusively, to an explosive armour shell or robot missile having two shaped explosive charges arranged in a tandem-relationship and adapted for action against tanks which have protective structure for protection against shaped explosive charge jets, so called reactive protective armour.

BACKGROUND PRIOR ART

The prior art concerning reactive armour was summarized in a lecture at the "Eight International Symposium on Ballistics" on the 23rd to 25th October, 1984, in Orlando, Florida, USA. The title of the lecture was "Interaction of Shaped-Charge Jets with reactive Armor", and the lecture was published in a public available report from said symposium.

Reactive armour of the kind mentioned has been put into practice, and has been fitted to various tanks. In order to destroy reactive-armour tanks by means of shaped-charge effects, the explosive armour shell must have two shaped charges arranged in a tandem-relationship. The first shaped charge will penetrate the reactive armour structure, whereas the second shaped charge will penetrate the main armour structure.

The prior art concerning explosive armour shells having two shaped charges is disclosed in the patent specification of FR-7514091 and EP-0 193 427. Also the patent specification of DE-3 010 917 shows some possible constructions for action against reactive armour.

The function of an interaction between a protective reactive armour fitted to a tank and an attacking explosive armour shell having two shaped charges, below referred to as the pre-penetrator and the main charge, respectively, is as follows:

- If the explosive armour shell will indicate the presence of a target, it will initiate the pre-penetrator which forms a shaped-charge jet which penetrates and initiates the explosive substance of the reactive armour.
- The reactive armour panel will expel its plates in a direction perpendicular to the surface of the plates. Since the trajectory of the explosive armour shell will, with a high grade of possibility, not coincide with the trajectory of the expelled plate of the reactive panel, some edge of the plate will intersect the trajectory of the shell.
- When the plates have been expelled a sufficient distance, i.e. when the plate edge has intersected the trajectory of the shell, the main charge is to be initiated in order to form a shaped-charge jet which penetrates the main armour structure of the tank

From above it is evident that if the pre-penetrator will be initiated close to the reactive armour plate, there is a great risque that the expelled plate will collide with the main charge prior to the initiation thereof. In this case there will be a misfunction of the main charge.

It is obvious that the chance of efficient function depends on the magnitude of all parameters involved. For instance the size of the reactive panel, the velocity and the angle of the expelling of the plates, the velocity of the missile as well as the stand-off distance from the target at which the pre-penetrator is initiated, will affect the function. Because the designer of the explosive armour shell cannot control the first two parameters, he has to optimize the two latter parameters in order to achieve maximum functional efficiency.

The stand-off distance from the target for initiation of the explosive armour shell should be at least 0.5 to 1.5 m - taking into account presently known constructions of reactive armour - in order to achieve great functional efficiency for a shell with two shaped charges. It is with presently available technique difficult to arrange an initiation device which indicates presence of a target at these distances. The technical possibilities now available is to provide a rod at the front of the explosive armour shell, or a proximity fuze. Presence of a target may be detected on the basis of a signal transmitted from the proximity fuze, the signal being reflected against the target, or measuring anomalies in the terrestrial magnetic field caused by the target.

Proximity fuzes of aforementioned kind have drawbacks, they can for instance be disturbed and rendered inefficient by the target, and the target may have various surface coverings and camouflage. The magnetic signature have also a short range around the target. Proximity fuzes are also expensive. For these reasons, the use of proximity fuzes in explosive armour ammunition is restricted and not desirous.

The presently most common construction consists of rods in various arrangements, for instance

according to the patent specifications GB-957 956 or EP-0 227 622 and 0 236 553. The GB specification shows rods in an explosive armour shell having a single shaped charge, but nethertheless illustrates the situation well. The rod is arranged in such a manner that upon indication of a target the shaped charge will be initiated and form a shaped-charge jet. This will pass the interior of the rod such that it will first penetrate the reminiscences of the initiation device in the rod, and thereafter penetrate the armour of the target. The shaped-charge jet will loose some of its energy when passing the tip of the rod, said loss of energy thereby diminishing the energy available for penetration of the armour of the target.

When using a rod in an explosive armour shell having two shaped charges, the tip of the rod will cause a reduction in efficiency of the jet of the pre-penetrator, which reduction will become a more serious drawback. The reason is that one wishes to give the pre-penetrator greatest possible caliber and capacity in order to be able to positively penetrate reactive armour. For weight and volume reasons and for the reason that the pre-penetrator must not damage the main charge upon detonation, it is desirable to make the pre-penetrator as little as possible. The pre-penetrator should also be located as far away as possible from the main charge in order to avoid damages caused by the pre-penetrator upon detonation.

The rod should have a length of 0.5 to 1 m as mentioned above, and should, for outer-ballistic reasons, be as thin as possible. The rod will then, in the trajectory of the shell, be elastical to such a great extent that the shaped-charge jet of the pre-penetrator will penetrate the wall of the rod. Also in this case energy will be lost, which otherwise would have been useful for penetration of the target.

It is very difficult to transport, handle and load an explosive armour shell having a rod with a length of 0.5 to 1 m. Therefore, the rod must be designed in such a manner that it will be unfolded or extended after the shell has been fired from the weapon. This may be arranged by dividing the rod into a number of tube-shaped parts having different diameters, the parts being inserted into each other. A spring may force the rod into its full length.

The length of the rod in its quiescent state will, for practial reasons, be 0.1 to 0.3 m. When this folded rod is mounted at the tip of the explosive armour shell difficulties will also arise in transporting, handling and loading the shell.

The German patent specification DE 31 37 198 shows a rod which in its idle position is folded into an internal cavity in front of the explosive shaped charge. The rod is in the shape of a helically wound steel spring tape. In order to extend the rod it must first be rotated about 90 degrees and can then be extended by the spring force inherent in the tape. This rod has a serious drawback in that it can only be extended to a length corresponding to the dimension of about one calibre of the shell, i.e. about 0.08-0. 15 m. This is quite insufficient for the projectile according to the present invention, where rods of the size 0.5-1 m are required.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a projectile of the kind indicated by way of introduction in which the above disadvantages have been eliminated. This object will be achieved by providing the projectile in accordance with the invention with the characterizing features set forth in claim 1.

The projectile according to the invention offers the following advantages:

- The rod may be made thinner, since no centre hole is required for the passage of the shaped-charge jet from the pre-penetrator through the centre of the rod.
- Since the rod may be made thinner, there will be less outer-ballistic consequences for a rod having like length.
- The initiation means in the tip of the rod or in the wall of the rod will not be located in the way of the shaped-charge jet of the pre-penetrator.
- Since the rod, in its idle position, need not be located in the tip of the explosive armour shell, but may be located by the side of the pre-penetrator, one will achieve a shorter shell. This will be less bulky, and consequently easier to pack up, transport, handle and load.
- The pre-penetrator may be located far away from the main charge, which offers more energy for the shaped-charge jet of the pre-penetrator and less risque for damages to the main charge.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a longitudinal section of an explosive armour shell according to the invention having two shaped charges and a stand-off means shown in its rest position.

Figure 2 shows, on an enlarged scale, the stand-off means and a front portion of the shell according to Figure 1.

Figure 3 illustrates the shell according to Figure 1 with the stand-off means in an operative position.

PREFERRED EMBODIMENT

Figure 1 shows a fin-stabilized explosive ar-

mour shell 1 with axiallly tandem-arranged shaped charges, i.e. a main charge 2 and a pre-penetrator charge 3, below referred to as the pre-penetrator. The pre-penetrator 3 is intended, in a way known per se, to make a pre-penetration of a target, for instance penetrate a reactive armour that is arranged in front of the target, thus facilitating for the main charge to thereafter penetrate a main armour in the target.

The pre-penetrator 3 is supported together with an initiation means (fuze) 4 for the pre-penetrator by a front shell casing element which forms a supporting means in the form of a supporting sleeve 5, which rearwardly is transformed into a funnel-shaped sleeve portion 6 for mating the caliber with a rear shell casing element 7 which has a substantially larger caliber than the sleeve 5 and which houses the main charge 2.

The initiation means 4 contains an electric generator 4a which, upon acceleration of the shell due to ejection of the shell from a barrel not shown, will generate an electric current to an electrical capacitor 4b which is connected to an electrical detonator 4c for ignition of the pre-penetrator 3.

Rigidly mounted to the funnel-shaped sleeve portion 6 is, for instance by means of a screw-connection, a guiding tube 8, in which an elongated stand-off means is axially movable, the stand-off means being in the form of a rod shaped, narrow element, for instance a rod 9 of metal or a plastic. The guiding tube 8 is disposed excentrically with respect to the longitudinal axis 10 of the projectile, i.e. it is inclined, as seen in the firing direction 11 of the projectile, inwards towards the longitudinal axis 10 of the projectile. Upon ejection of the rod 9 from the guiding tube 8, as is shown in Figure 3, the tip of the rod 9 will thereby be located almost straight in front of the projectile, however displaced a certain distance from the longitudinal axis 10 of the projectile such that any sensor and initiation equipment arranged in the tip of the rod will not disturb the shaped-charge jet of the pre-penetrator 3.

The rod 9 is ejectable to the operative position shown in Figure 3 by means of a spring 12 disposed at the bottom of the guiding tube 8. The rod 9 is secured by means of a ball lock 13 which consists of a locking sleeve 13a being movable axially against the action of the spring 12, and a locking ball 13b, the rod in its ejected position (Figure 3) being lockable by a spring tongue 14 fitted to the guiding tube 8. In the tip of the rod there is a combined impact sensor and initiation means 15 which via an electric cable 16 is operatively connected to the initiation means 4 for signal transmission thereto. The rod 9 is, therefore, in the embodiment shown, hollow in order to be able to house the cable 16.

The stand-off means 9 functions in the following manner.

When the explosive armour shell upon firing through a barrel, not shown, accelerates through this, the sleeve 13a of the ball lock 13 will move rearwardly relative to the shell, the ball 13b thereby releases the rod 9, which thereby will be forced forwards relative to the shell under influence of the spring 12. When the rod 9 has been ejected forwards to its terminal position, shown in Figure 3, the spring tongue 14 will lock the rod in the ejected (expelled) position. The initiation means 4 of the pre-penetrator has, during the acceleration within the barrel, been armed, and the generator 4a has charged the capacitor 4b in a way known and therefore not described here.

When the tip of the rod 9 reaches the target, the sensor and initiation means 15 will be deformed, causing a current circuit to close, thereby initiating the initation means 4 via the cable 16, such that its capacitor 4b will be discharged via the cable 16 to the detonator 4c of the initiation means 4. Thus, the pre-penetrator 3 will be initiated and form a shaped-charge jet which penetrates the reactive armour of the target, or its main armour if it has got no reactive armour.

Modifications of the invention are possible by providing the projectile with two or more stand-off means of the above kind, if complete outer-ballistic balance is required.

The rod may also be designed with such a length that it in its idle position extends so far rearwardly that it extends by the side of the main charge. The invention is neither limitied to an inclined rod, but this may alternatively be oriented in parallel with the longitudinal axis of the projectile.

Although the shown shell is fin-stabilized it may be given a slight rotation, for instance by means of a so called slipping girdle. The shell may alternatively be rotation-stabilized.

Also if the illustrated stand-off means is located at the outer side of the shell, it is possible to at least partially house it in a nose cone, not shown, which extends concentrically around the supporting sleeve 5 and the pre-penetrator 3.

Claims

1. A projectile fitted with at least one stand-off means, the projectile (1) having at least one explosive charge (3) and a fuze (4) for initiating the charge, the stand-off means (8, 9) includes a rod (9) with an impact sensor (15) for sensing the impact of the rod against a target, the impact sensor and the fuze being operatively interconnected for signal transmission therebetween, **characterized** in that the rod (9) is axially movable in a

guiding tube (8) which is orientated excentrically relative to the longitudinal axis (10) of the projectile, and that the rod is forwardly-ejectable from said guiding tube to an ejected position (Figure 3) where the rod is orientated excentrically relative to the longitudinal axis (10) of the projectile (1).

2. Projectile according to claim 1, **characterized** in that the guiding tube (8), as seen in the firing direction (11) of the projectile, is inclined inwards towards the longitudinal axis (10) of the projectile.

3. Projectile according to claim 2, **characterized** in that it is provided with a supporting means (5, 6) which supports the explosive charge (3), the guiding tube (8) being mounted on the outer side of the supporting means (6).

4. Projectile according to any preceding claim, **characterized** in that it is provided with a main explosive charge (2) disposed behind said explosive charge (3), said first-mentioned explosive charge being designed to carry out a pre-penetration in the target in order to facilitate the penetration of the main explosive charge into the target.

5. Projectile according to claim 4, **characterized** in that the two explosive charges (2, 3) are shaped explosive charges.

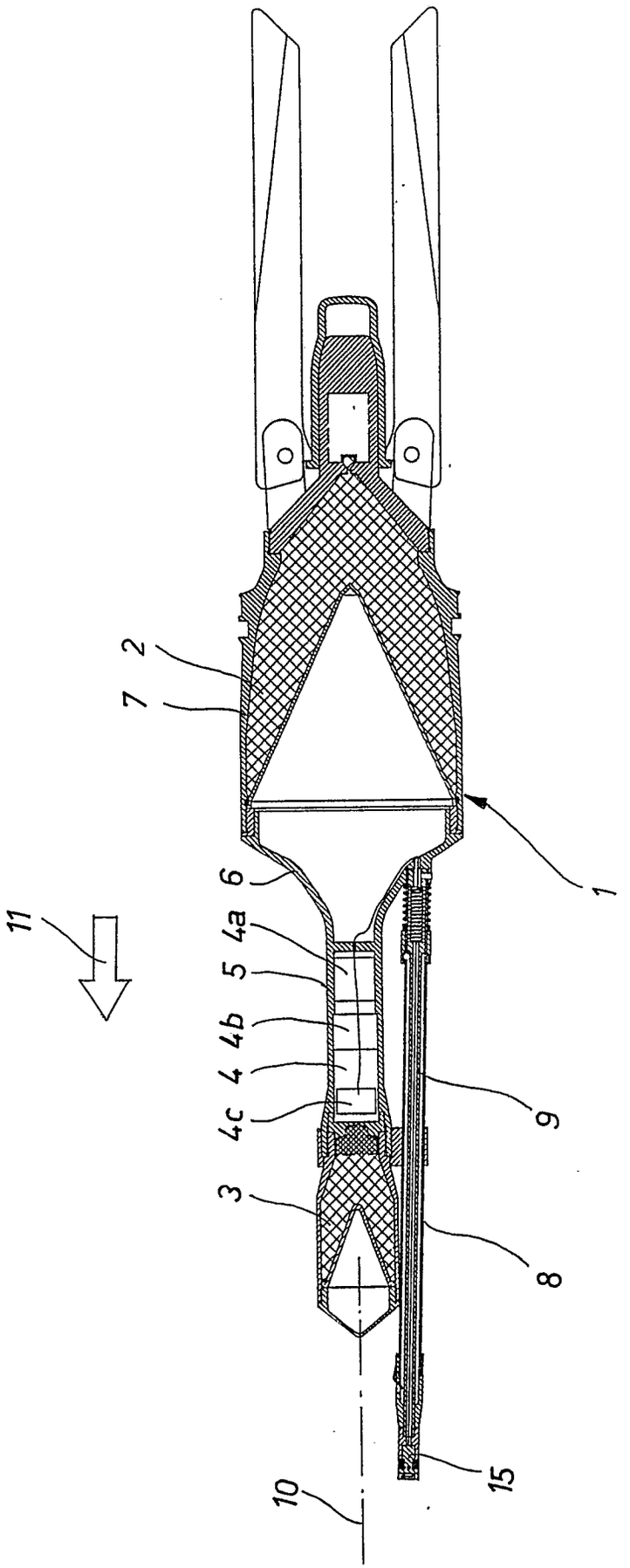

FIG. 1

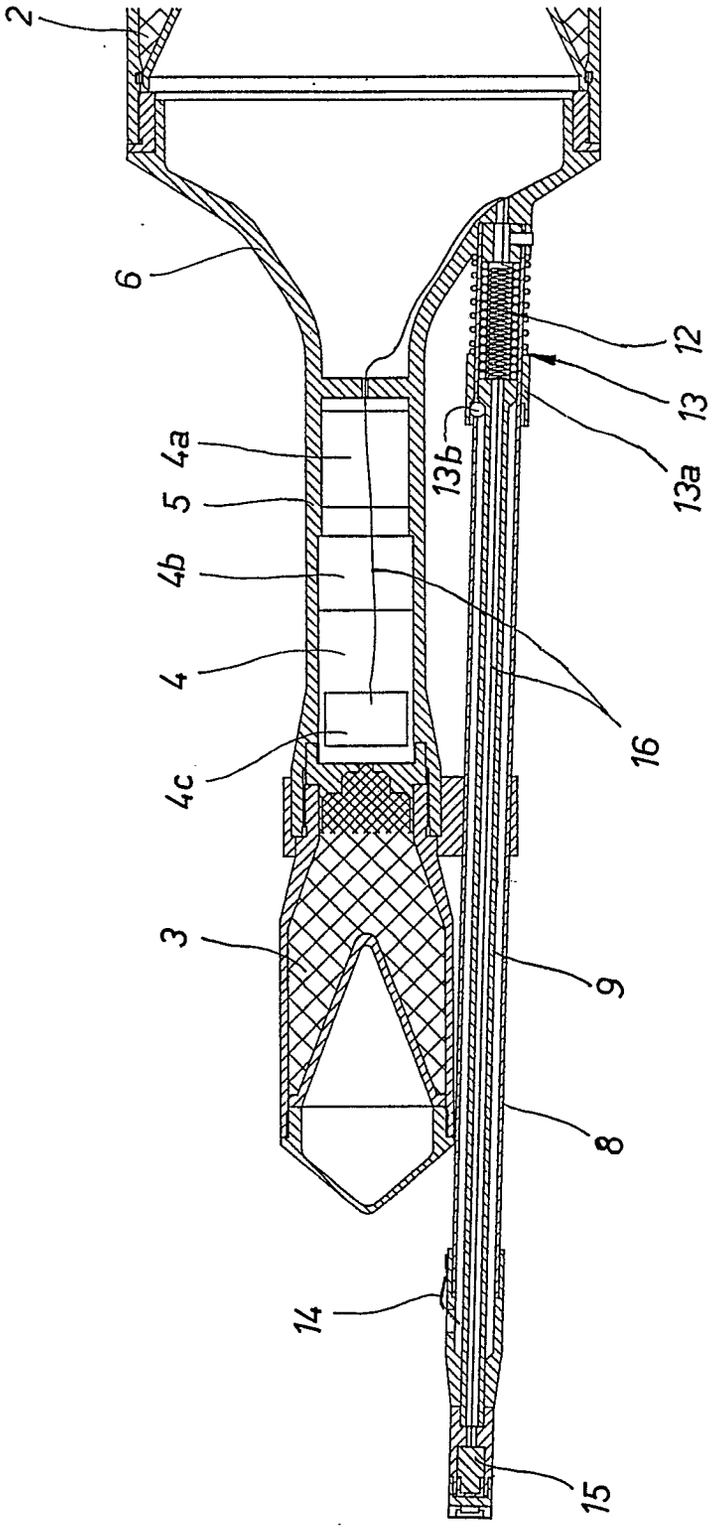

FIG. 2

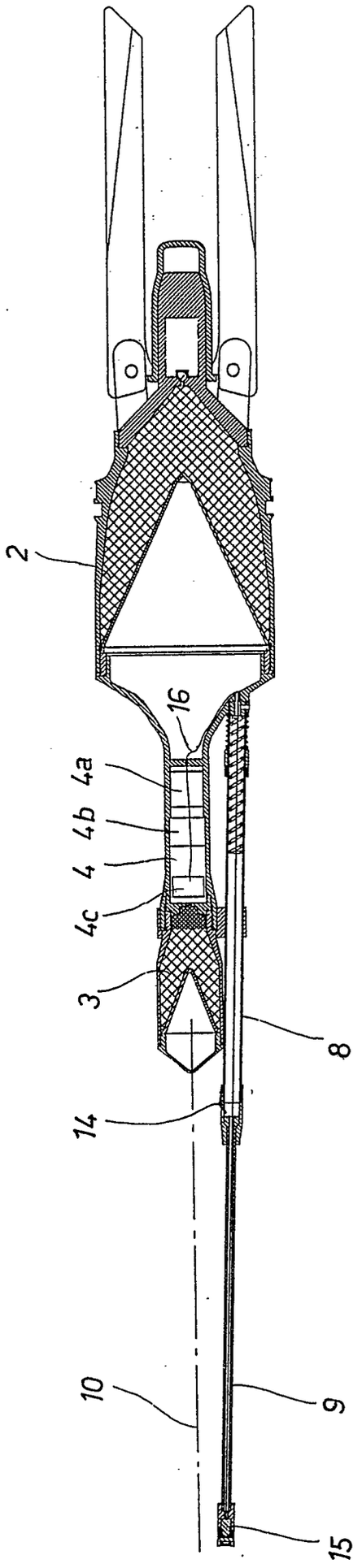

FIG. 3