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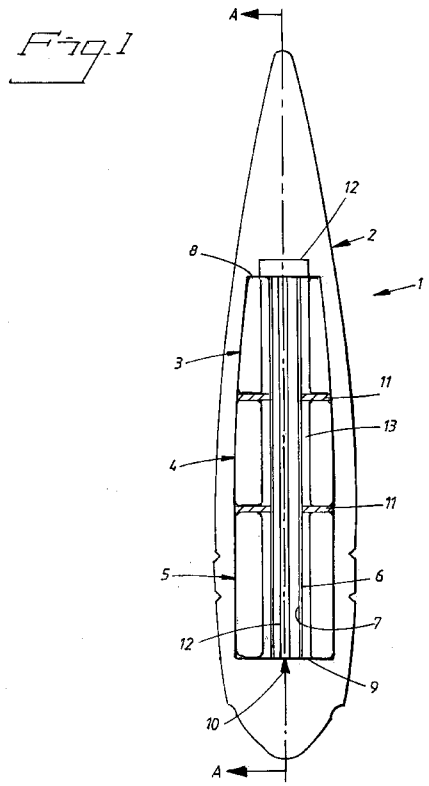
(54) Title: ACTION DEVICE FOR DIFFERENT ACTION EFFECTS AND PROCESS FOR THE SAME



(57) Abstract: The invention relates to an action device (1), especially intended for incorporation in a shell (2), for the achievement of at least one action effect, such as smoke effect, light effect, explosive effect or combinations thereof, the action device (1) comprising at least two action charges (3, 4, 5), arranged one behind the other along a common centre axis A-A between two end faces (8, 9) disposed in the shell (2), and the action device (1) also comprising an initiation device (10). The action device is characterized in that the initiation device (10) is fixedly disposed in a container (7), which container (7) is arranged coaxially and rotatably between the two end faces (8, 9) about the common centre axis A-A into different rotational positions X_1, X_2, X_3, X_4 for selective initiation of one or more action charges (3, 4, 5).

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ACTION DEVICE FOR DIFFERENT ACTION EFFECTS AND PROCESS FOR THE SAME

The present invention relates to an action device, especially intended for incorporation in a shell, for different action effects, for example smoke effect, light effect, explosive effect or combinations thereof, the action device comprising at least two action charges, arranged one behind the other along a common centre axis A-A between two end faces disposed in the shell, the action device also comprising an initiation device.

Action devices for the achievement of different action effects are normally arranged with a plurality of action charges for different action effects. Typically, at least one initiation device is provided for each action charge, the action device being arranged such that the action charges can be initiated simultaneously or individually, in sequence or with different delays, depending on the action effect to be achieved.

US 4 658 727 discloses an action device comprising a plurality of action charges, in which each of the action charges comprises at least one initiation device. The initiation devices are coupled to a control and monitoring unit for controlling which action devices are to be initiated with regard to a combat target. The arrangement in US 4 658 727 comprising a plurality of initiation devices implies a number of drawbacks, for example the risk of malfunction and accidental initiation is high. Malfunction can lead to failed initiation and propagation of undetonated action charges. A plurality of initiation devices also implies a complex arrangement with high cost.

Aim of the invention and its distinguishing features

A main object of the present invention is an action device and a process for the action device, intended for a shell, comprising at least two action charges, axially arranged one behind the other in an action casing in which the action parts are designed for different action effects, the risk of accidental initiation or malfunction having been minimized.

A further object of the present invention is a less complex arrangement having few constituent components, low weight and low cost. The said objects, and other aims not listed here, are satisfactorily met within the scope of that which is stated in the present independent patent claims.

Thus, according to the present invention, an action device has been provided, especially intended for incorporation in a shell, for the achievement of at least one action effect, such as smoke effect, light effect, explosive effect or combinations thereof, the risk of accidental initiation and malfunction being small, in which the number of constituent components is few, in which the weight is low and in which the cost is small.

The action device according to the invention comprises at least two action charges, arranged one behind the other along a common centre axis A-A between two end faces disposed in the shell, and the action device comprises an initiation device.

The invention is characterized in that the initiation device is fixedly disposed in a container, which container is arranged coaxially and rotatably between the two end faces about the common centre axis A-A into different rotational positions X_1, X_2, X_3, X_4, for selective initiation of one or more action charges.

According to further aspects of an action device according to the invention:

- the action device also comprises a tubular container arranged coaxially about the container between the two end faces, the action charges being disposed on the outer side of the tubular container and separated with intervening barriers to prevent flashover ignition between the action charges, and gas discharge holes are disposed on the container and gas intake holes are disposed on the tubular container, which gas discharge holes and which gas intake holes are arranged such that they overlap one another when the container is rotated into set positions X_1, X_2, X_3, X_4, corresponding to the position for one or more action charges,

- the initiation device comprises a pyrotechnic composition configured as a pyrotechnic strand axially disposed in the container between the two end faces, and the pyrotechnic strand can be selectively initiated between the end faces,

- the initiation device comprises one or more laser fuses,

- the action charge comprises a fuel, an oxidizing agent and additive for generating different action effects,

- the action charge comprises a coherent porous fuel structure,

- the oxidizing agent is stored separate from the fuel up to initiation of the action charge,

- the oxidizing agent is stored in the container, the container being pressurized for transfer of

the oxidizing agent to the porous fuel structure when the gas discharge holes and the gas intake holes overlap one another,

- the gas intake holes in the tubular container are larger than the gas discharge holes in the container for rapid transfer of gas to fuel,

- a rotary member is disposed on the container for rotating the container into different rotational positions X_1, X_2, X_3, X_4,

- the rotary member comprises an electrical unit coupled to a central control and monitoring unit for remote-controlled rotation,

- the additive comprises phosphorous-treated nanoporous zinc for achievement of a smoke effect,

- the additive comprises nanoporous magnesium for achievement of a light effect,

- the porous fuel structure comprises picric acid for increased reactivity between the fuel and the oxidizing agent.

Thus, according to the present invention, there has also been provided a process for an action device, especially intended for incorporation in a shell, for the achievement of at least one action effect, which action device comprises at least two action charges, arranged one behind the other along a common centre axis A-A between two end walls disposed in the action device, and the action device also comprises an initiation device.

The process is characterized in that the initiation device is disposed in a container, which container is arranged coaxially and rotatably about the common

centre axis A-A between the two end faces for different rotational positions X_1, X_2, X_3, X_4 for selective initiation of one or more action charges.

According to further aspects of the process according to the invention:

- the at least one action effect achieved by setting of the different rotational positions X_1, X_2, X_3, X_4 comprises smoke effect, light effect, explosive effect and a combination of smoke effect and light effect.

Advantages and effects of the invention

The invention implies a number of advantages and effects.

The use of just one initiation device implies fewer components compared with if a plurality of initiation devices are used. This, in turn, reduces the complexity and cost of the action device. A large number of rotational positions implies many possible action effects. Separate storage of fuel and oxidizing agent up to initiation implies safe handling during destruction and/or recovery by eliminating the risk of accidental initiation. Handling in connection with loading, storage and transport is simplified, as well as in the recovery and/or destruction of spent action devices. The fact that fuel and oxidizing agent are separate obviates the need for these to be separated. Separate storage of the fuel and oxidizing agent implies that propagation of uninitiated action charges is prevented. Only once fuel and oxidizer are mixed, i.e. when the shell is fired from a gun barrel and the initiation device has been activated, does the action device present a risk.

Further advantages and effects according to the invention will emerge from a study and consideration of

the following detailed description of the invention, including a number of its most advantageous embodiments, patent claims and the appended drawing figures, in which:

Fig. 1 shows a longitudinal section of an action device disposed in a shell,

Fig. 2 shows a partial enlargement of an action charge according to the action device in Figure 1,

Fig. 3 shows two circular segments: one of the cylindrical container and one of the tubular container in Figure 2, the hole configuration for the gas discharge holes in the cylindrical container and the configuration for the gas intake holes in the tubular container being evident in respect of different rotational positions X_1, X_2, X_3, X_4 of the cylindrical container.

Detailed description

The action device 1 according to Figures 1 and 2 is disposed in a shell 2, between the nose portion of the shell 2 and the rear portion of the shell 2. The action device 1 comprises three action charges 3, 4, 5 designed for three different action effects: a front action charge 3 comprising a fuel 17, an oxidizing agent 18 and an additive for achievement of a smoke effect, an intermediate action charge 4 comprising a fuel 17, an oxidizing agent 18 and an additive for achievement of a light effect, and a rear action charge 5 comprising a fuel 17, an oxidizing agent 18 and an additive for achievement of an explosive effect. The action charges 3, 4, 5 are arranged one behind the other along the longitudinal axis A-A of the shell 2, the front action part 5 being disposed closest to the nose portion of the shell. The three action charges 3, 4, 5 are disposed in the shell 2 in the space which is delimited by a tubular container 6 disposed in the

shell 2, along the centre axis A-A of the shell, the outer case of the shell 2, and two end faces 8, 9, a front 8 and a rear end face 9.

The action charges 3, 4, 5 are separated with intervening barriers 11 to prevent flashover ignition. The tubular container 6 is fixedly mounted on the two end faces 8, 9. The intervening barriers 11 are mounted between the tubular container 6 and the outer case of the shell 2. The shape and size of the action charges 3, 4, 5 are chosen such that an air gap is formed between the action charges 3, 4, 5 and the tubular container 6, so as thereby to enable a flow of gas in the axial direction over the action charges 3, 4, 5. The action device 1 comprises a container 7, preferably cylindrical, arranged axially around the tubular container 6. In the cylindrical container 7 there is disposed an initiation device 10 between the two end faces 8, 9. The cylindrical container 7 is arranged rotatably into different rotational positions X about the common centre axis A-A. On the cylindrical container 7 there is arranged a rotary member 12 for rotation of the cylindrical container 7 into the said positions X. The rotary member 12 can be designed for manual rotation, prior to firing, but can also be designed for remote-controlled rotation by virtue of the rotary member 12 comprising an electrical unit coupled to a control and monitoring unit disposed in the shell 2, also referred to as a CPU (Control Process Unit).

In response to a signal from the CPU of the shell, during travel of the shell 2 towards a target, the rotary member 12 is activated, whereupon the cylindrical container 7 is rotated into a rotational position X corresponding to an action effect with regard to a combat situation. Alternatively, the rotary member 12 can be pre-programmed for rotation into a set rotational position X after a predetermined time. The

rotary member 12 can be arranged such that rotation of the cylindrical container 12 is possible only after the shell has been fired. The basic position can be such that the rotary member 12, after firing, assumes a rotational position X for an explosive effect. From the explosive effect position, the CPU of the shell 2 can subsequently deliver a signal for rotation of the rotary member 12, clockwise or anti-clockwise, corresponding to a smoke and light effect. Alternatively, certain predetermined rotation angles can be used, the rotation angles corresponding to specific action effects. The rotation can also be realized electromagnetically with the aid of an electromagnetic device, for example a solenoid, or an electric step motor, or mechanically with a mechanically pretensioned device, for example a biased spring, or with some other rotary device.

The cylindrical container 12 comprises a plurality of gas discharge holes 14 distributed over the envelope surface of the cylindrical container 12, according to a set pattern. In the same way, the tubular container 6 comprises a plurality of gas intake holes 15 arranged according to a set pattern. The tubular container 6 is arranged in contact with the cylindrical container 7, side against side, to prevent leakage between the containers 12, 6.

Figure 3 shows two circular segments: one showing the hole configuration 14 of the cylindrical container 7 and one showing the hole configuration 15 of the tubular container 6. The gas discharge holes 14 and the gas intake holes 15 are arranged such that a rotation of the cylindrical container 7 into a rotational position X_1 implies that only gas intake holes 15 of the kind corresponding to the position for the action charge 3 are overlapped. Other gas intake holes 15 are not overlapped, in which case the transfer of gas to the action charges 3 and 4 is prevented. In the

rotational position X_2, all gas discharge holes 14 corresponding to the action charges 3 and 5 are blocked. In the rotational position X_3, all gas discharge holes 14 corresponding to the action charges 3 and 4 are blocked and, in the rotational position X_4, all gas discharge holes 14 corresponding to action charge 5 are blocked. The gas discharge holes 14 and the gas intake holes 15 are preferably round, but can also have a different shape, for example oval. It has also proved advantageous for the gas intake holes 15 to have a cross-sectional area which is greater than the cross-sectional area of the gas discharge holes 14. This ensures a good passage of gas, even if the overlap is not exact.

The initiation device 10 comprises a pyrotechnic composition 16, configured as a strand between the end faces 8, 9, the pyrotechnic strand 16 being connected to an electrical ignition device on one of the end faces 8, 9, not shown. Upon activation of the initiation device 10, a gradual combustion of the pyrotechnic strand 16 takes place along its surface, whereupon hot combustion gases flow radially out from the strand 16 towards the cylindrical container 7.

In an alternative embodiment, the initiation device 10 can comprise one or more lasers axially arranged inside the cylindrical container 12, directed towards the gas discharge holes 14.

For certain fuel and oxidizer compositions, it has proved particularly favourable to have gas-tight openable seals arranged over the gas intake holes 15, preferably in the form of plastics films or bursting plates, to prevent influence from ambient air and moisture. In a special embodiment, not shown, the gas intake holes 15 are initially closed and are only opened in response to the exceeding of a predetermined pressure increase, which pressure increase is caused by

flowing gas. By rotating the cylindrical container 7 into one of the rotational positions X_1, X_2, X_3, X_4, it is thus possible to selectively choose which of the action charges 3, 4, 5 is/are to be activated.

The action device 1 in the figure comprises three different action charges 3, 4, 5, configured such that the following action effects are possible: initiation of the action charge 3 for generation of a smoke effect, initiation of the action charge 4 for generation of a light effect, initiation of the action charge 5 for generation of an explosive effect, initiation of the action charges 3 and 4 for generation of a smoke and light effect, initiation of the action charges 3 and 5 for generation of a smoke and explosive effect, and initiation of the action charges 4 and 5 for generation of a light and explosive effect. By increasing the number of action charges, it is possible to increase the number of action effects.

The fuel bodies 17 of the action charges 3, 4, 5 are preferably constituted by a coherent porous structure, comprising aluminium, silicon, carbon, vanadium, beryllium, magnesium, zinc, iron, or mixtures thereof. The porous fuel bodies in the action charges 3, 4, 5 are configured for fastest possible absorption of an oxidizing agent 16, preferably by the fuel bodies 17 being arranged in the form of thin discs at a set distance apart, so as thus to increase the contact area between fuel 17 and oxidizing agent 18. The porous fuel bodies have a porosity lying, preferably, within the range 60-95% by volume.

Depending on the desired action effect, different admixtures in the action charges 3, 4, 5 are required. For the achievement of a smoke effect, it has proved advantageous if the fuel structure 17 of the action charge 3, 4, 5 comprises phosphorous-treated nanoporous zinc. For the achievement of a light effect, it is

advantageous if the fuel structure 17 comprises nanoporous magnesium. A flash effect can be achieved with nanoporous magnesium. An explosive effect is promoted by admixtures of nanoporous aluminium. Different techniques for the achievement of different action effects are however described in the literature, so that these are not further touched upon here.

Alternatively, the fuel bodies 17 can comprise a fine-grained powder instead of a porous coherent structure, which fine-grained powder can comprise, for example, silicon, carbon or vanadium, beryllium, magnesium, iron, or mixtures thereof. The fuel powder 17 is compacted into powder bodies 17 having a high porosity and a structure which, upon contact with a gaseous or liquid oxidizing agent 18, can be initiated.

In a special embodiment, the coherent highly porous fuel structure is coated with an additive to facilitate the initiation of the fuel/oxidizer mixture. The additive can comprise, for example, a fine-grained zirconium powder mixed with primer, for example picric acid, the primer/zirconium mixture being fed to the pore structure of the fuel body 17. In a second special embodiment, the highly porous fuel structure is coated with a pyrophorous substance which, upon contact with an oxidizing agent 18, leads to spontaneous combustion.

In a further special embodiment, oxidizing agent 18 is stored separate from the fuel 17 up to initiation of the action charge 3, 4, 5. The oxidizing agent 18 is stored in the cylindrical container 7, in the space 13 between the initiation device 10 and the inner limit face of the cylindrical container 7. The oxidizing agent 18 is expediently contained in a gas 18, which gas 18 is pressurized, so that the gas 18, in the event of an overlap, allows the oxidizing agent 18 to be transferred from the cylindrical container 7 to the action charge 3, 4, 5.

The cylindrical container 7 is configured such that it withstands lengthy storage of corrosive oxidizing agent under increased pressure. Examples of suitable materials include stainless steel, but other materials too can be used, for example ceramics and plastics. The oxidizing agent 18 is preferably constituted by a gaseous or liquid substance, for example oxygen, nitrous oxide, nitric acid, hydrogen peroxide, or a mixture of liquid oxygen and liquid fluorine (FLOX), or a dinitramide salt dissolved in a solvent.

In order to prevent degradation of the action charges 3, 4, 5 as an effect of lengthy storage, it is advantageous for the action charges 3, 4, 5 to be encapsulated with thin gas-tight and liquid-tight layers, for example plastics films.

After the rotary member 12 has been activated and the oxidizing agent 18 has been absorbed in the porous fuel bodies 17, the action charge 3, 4, 5 is initiated by activation of the initiation device 10. The initiation device 10 is preferably initiated after a set time delay to ensure absorption of all the oxidizing agent 18. The time delay can be pre-programmed, for example by coupling of the initiation device 10 to a time relay or to a pyrotechnic delay composition. Alternatively, the initiation device 10 can be coupled to an activation sensor controlled by the CPU of the projectile. The speed with which the oxidizing agent 18 is absorbed in the porous fuel bodies 17 is in the first place determined by the gas pressure in the cylindrical container 7, the porosity of the fuel bodies 17, the mobility of the oxidizing agent 18, and the number and size of the gas discharge and gas intake holes 15, 16.

Alternative possibilities for use of the action device

The action device according to the invention is especially intended for incorporation in a shell or projectile intended for firing from a gun barrel, the choice of action effect, for example smoke, light or explosive effect or combinations thereof, being manually set with the aid of a rotary member. Alternatively, the rotary member can be pre-programmed with the aid of a programming unit, or else the rotary member 12 can be activated during travel of the shell towards a target. The action device can also be incorporated in robots, missiles, in different types of mines, or in devices for civilian use in which different action effects are sought, for example in firework devices or in explosive devices.

Patent claims

1. Action device (1), especially intended for incorporation in a shell (2), for the achievement of at least one action effect, such as smoke effect, light effect, explosive effect or combinations thereof, the action device (1) comprising at least two action charges (3, 4, 5), arranged one behind the other along a common centre axis A-A between two end faces (8, 9) disposed in the shell (2), and the action device (1) also comprising an initiation device (10), characterized in that the initiation device (10) is fixedly disposed in a container (7), which container (7) is arranged coaxially and rotatably between the two end faces (8, 9) about the common centre axis A-A into different rotational positions X_1, X_2, X_3, X_4 for selective initiation of one or more action charges (3, 4, 5).

2. Action device (1) according to Claim 1, characterized in that the action device also comprises a tubular container (6) arranged coaxially about the container (7) between the two end faces (8, 9), the action charges (3, 4, 5) being disposed on the outer side of the tubular container (6) and separated with intervening barriers (11) to prevent flashover ignition between the action charges (3, 4, 5), and in that gas discharge holes (14) are disposed on the container (7) and gas intake holes (15) are disposed on the tubular container (6), which gas discharge holes (14) and which gas intake holes (15) are arranged such that they overlap one another when the container (7) is rotated into set positions X_1, X_2, X_3, X_4, corresponding to the position for one or more action charges (3, 4, 5).

3. Action device (1) according to Claim 1 or 2, characterized in that the initiation device (10) comprises a pyrotechnic composition configured as a

pyrotechnic strand axially disposed in the container (7) between the two end faces (8, 9), and in that the pyrotechnic strand can be selectively initiated between the end faces (8, 9).

4. Action device (1) according to Claim 1 or 2, characterized in that the initiation device (10) comprises one or more laser fuses.

5. Action device (1) according to any one of the preceding claims, characterized in that the action charges (3, 4, 5) comprise a fuel (17), an oxidizing agent (18) and an additive for generating different action effects.

6. Action device (1) according to Claim 5, characterized in that the fuel (17) comprises a coherent porous fuel structure.

7. Action device (1) according to Claim 5 or 6, characterized in that the oxidizing agent (18) is stored separate from the fuel (17) up to initiation of the action charge (3, 4, 5).

8. Action device (1) according to Claim 6 or 7, characterized in that the oxidizing agent (18) is stored in the container (7), the container (7) being pressurized for transfer of the oxidizing agent (18) to the porous fuel structure (17) when the gas discharge holes (14) are overlapping.

9. Action device (1) according to Claim 2, characterized in that the gas intake holes (15) are larger than the gas discharge holes (14) for rapid transfer of gas to fuel (17).

10. Action device (1) according to any one of the preceding claims, characterized in that a rotary member (12) is disposed on the container (7) for rotating the

container (7) into different rotational positions X_1, X_2, X_3, X_4.

11. Action device (1) according to Claim 10, characterized in that the rotary member (12) comprises an electrical unit coupled to a central control and monitoring unit for remote-controlled rotation of the cylindrical container (7).

12. Action device (1) according to Claim 5, characterized in that the additive comprises phosphorous-treated nanoporous zinc for achievement of a smoke effect.

13. Action device (1) according to Claim 5, characterized in that the additive comprises nanoporous magnesium for achievement of a light effect.

14. Action device (1) according to Claim 5 or 6, characterized in that the porous fuel structure (17) comprises picric acid for increased reactivity between the fuel (17) and the oxidizing agent (18).

15. Process for an action device (1), especially intended for incorporation in a shell (2), for the achievement of at least one action effect, which action device (1) comprises at least two action charges (3, 4, 5), arranged one behind the other along a common centre axis A-A between two end walls (8, 9) disposed in the action device, and in that the action device (1) comprises an initiation device (10), characterized in that the initiation device (10) is disposed in a container (7), in that the container (7) is arranged coaxially and rotatably about the common centre axis A-A between the two end faces (8, 9), in that different rotational positions X_1, X_2, X_3, X_4 for selective initiation of one or more action charges (3, 4, 5) are set for achievement of the said action effect.

16. Process for an action device (1) according to Claim 15, characterized in that the at least one action effect achieved by setting of the different rotational positions X_1, X_2, X_3, X_4 comprise(s) smoke effect, light effect, explosive effect and a combination of smoke effect and light effect.

Fig. 1

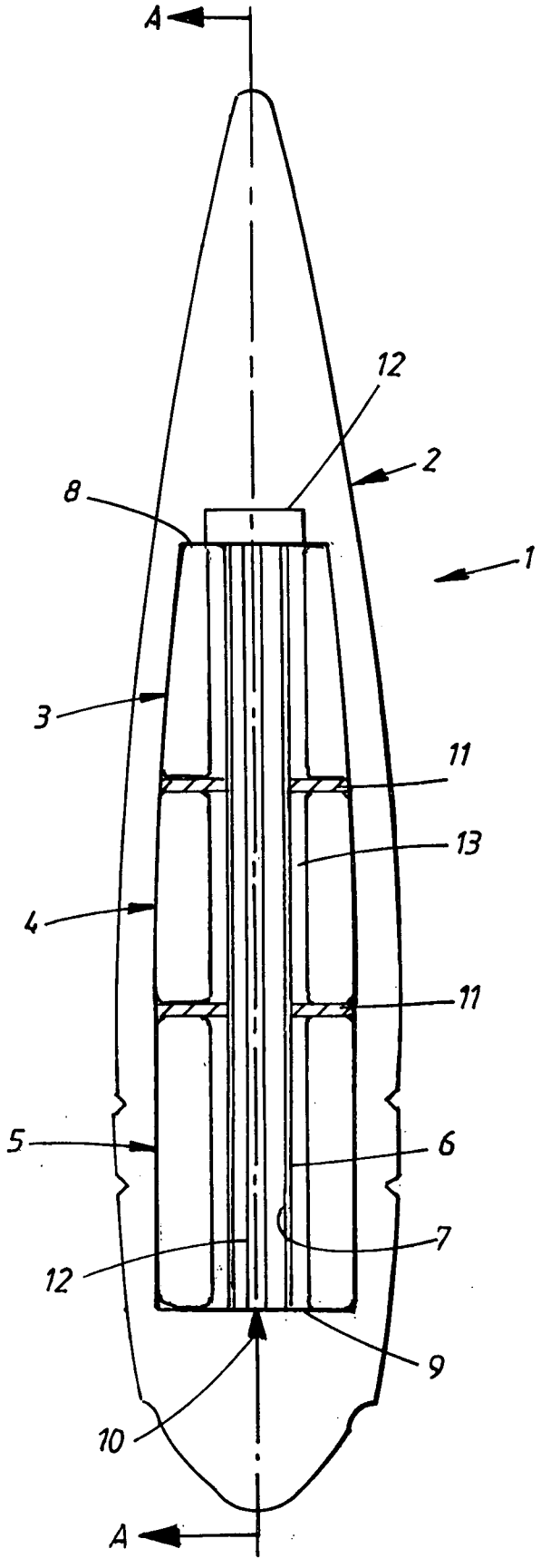


Fig. 2

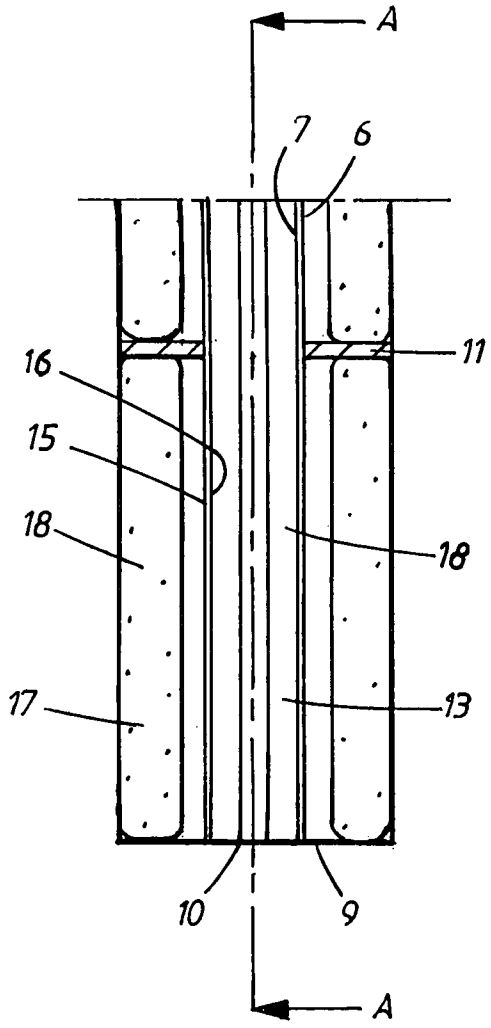
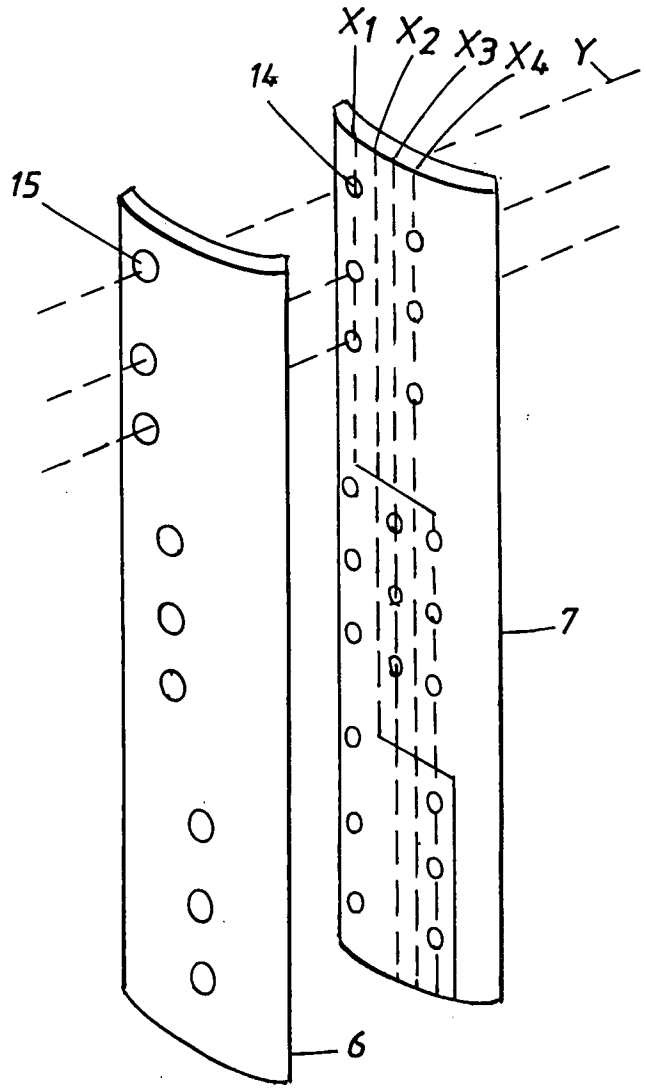


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2009/000412

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F42B, F42C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4848239 A (WILHELM), 18 July 1989 (18.07.1989) --	1-16
A	EP 0706026 A1 (ROCKWELL INTERNATIONAL CORPORATION), 10 April 1996 (10.04.1996) --	1-16
A	GB 2274905 A (RAUFOSS AS), 10 August 1994 (10.08.1994) --	1-16
A	US 4729316 A (EVRARD ET AL), 8 March 1988 (08.03.1988) --	1-16

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search	Date of mailing of the international search report
12 January 2010	13 -01- 2010
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hans Nordström / MRo Telephone No. +46 8 782 25 00

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1307445 A (SOCIETE E. LACROIX), 21 February 1973 (21.02.1973) --	1-16
A	DE 3823628 A1 (MESSERSCHMITT-BÖLKOW-BLOHM GMBH), 18 January 1990 (18.01.1990) -- --------	1-16

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F42B 12/02 (2006.01)
F42B 4/14 (2006.01)
F42C 15/192 (2006.01)
F42C 15/34 (2006.01)

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