PATENTS ACT 1952 611763

APPLICATION FOR A STANDARD PATENT

I\We,

DYNAMIT NOBEL AKTIENGESELLSCHAFT

of 5210 TROISDORF
FEDERAL REPUBLIC OF GERMANY

hereby apply for the grant of a standard patent for an invention entitled:

AFTER FIRING SAFETY DEVICE ... IN A PROJECTILE WITH PERCUSSION FUSE

which is described in the accompanying complete specification

Details of basic application(s):

| Number of basic application | Name of Convention country in which basic application was filed | Date of basic application |
|---|---|---|
| P3739368.5 | DE | 20 NOV 87 |

My/our address for service is care of GRIFFITH HACK & CO., Patent Attorneys, 601 St. Kilda Road, Melbourne 3004, Victoria, Australia.

DATED this 24th day of October 1988

DYNAMIT NOBEL AKTIENGESELLSCHAFT

GRIFFITH HACK & CO.

TO: The Commissioner of Patents.

1003823 24/10/88

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Australian Patent Declaration Form

Forms 7 and 8

AUSTRALIA

Patents Act 1952

# DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

no. 24192/88

Name(s) of Applicant(s)

In support of the application made by DYNAMIT NOBEL AKTIENGESELLSCHAFT

for a patent for an invention entitled PRE-BARREL SAFETY MECHANISM ON A PROJECTILE WITH PERCUSSION FUSE

Title

PLEASE ADD NAME AND TITLE OF PERSON SIGNING LEGIBLY

Name(s) and address(es) of person(s) making declaration

I/We, Dipl.-Ing. Wilfried Schulz (Proxy)
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do solemnly and sincerely declare as follows:—

1. I am/we are the applicant(s) for the patent, or authorised by the abovementioned applicant to make this declaration on its behalf.

2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following date(s) by the following applicant(s) namely:-

Country, filing date and name of Applicant for the or each basic application

in Germany on 20th November 19 87
by Dynamit Nobel Aktiengesellschaft
in _____ on _____ 19 _____
by _____

3. The said basic application(s) was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

4. The actual inventor(s) of the said invention is/are

Name(s) and address(es) of the or each actual inventor

Uwe Brede, Boenerstr. 32, 8510 Furth, Germany
Ernst Jensen, Wiesengrundstr. 23, 8510 Furth, Germany
Helmuth Werner, Vacher Strasse 3, 8510 Furth, Germany

5. The facts upon which the applicant(s) is/are entitled to make this application are as follows:-

See reverse side of this form for guidance in completing this part

The said applicant is the assignee of the said inventors

**DECLARED** at Troisdorf this 23rd day of November 19 88

Wilfried Schulz
(Wilfried Schulz)

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(56) Prior Art Documents
US 4026216
FR 1198830
US 4467723

(57) Claim

1. An after-firing safety device in a non-spinning projectile having a percussion fuse, said device comprising a tension spiral spring set surrounded by a cage, said spring set occupying a space formed between a detonator and a percussion pin to such an extent that contacting of the detonator by the percussion pin is precluded, and the spiral spring set is afforded the possibility of relaxing only after firing of the projectile by displacement of the cage due to acceleration of the projectile, said space becoming available and thereby making movement of the detonator possible, said spiral spring set comprising several spiral springs wound up in series in respectively opposite directions and being inserted within the cage.

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Form 10

COMPLETE SPECIFICATION

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Complete Specification-Lodged:
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TO BE COMPLETED BY APPLICANT

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Complete Specification for the invention entitled:
AFTER-FIRING SAFETY DEVICE IN A
PROJECTILE WITH PERCUSSION FUSE

The following statement is a full description of this invention including the best method of performing it known to me:-

# AFTER-FIRING SAFETY DEVICE ON A PROJECTILE WITH PERCUSSION FUSE

The present invention relates to an after-firing or pre-barrel safety device in a projectile equipped with a percussion fuse.

Described in U.S. Patent 4,467,723 (equivalent to DE 35 01 450) is an after-firing safety mechanism for practice ammunition, in which the igniter is kept in such a position by means of a locking pin that the firing pin cannot contact the igniter and thus initiation of the active charge does not take place in this state. The locking pin, delayed after the firing, is ejected by means of gas pressure, a pyrotechnic gas generator being necessary therefor, which generator is initiated by way of a delay-action igniting system with transmission section, upon firing of the ammunition. This device is comparatively expensive to manufacture.

In the case of another after-firing safety device described in U.S. Patent 4,225,608 (equivalent to DE 27 35 575) there is a central passage on a contact fuse for a spin projectile, which passage is initially closed by means of a blocking disc, whereby a percussion pin is prevented from being able to contact a detonator or from being able to burn through a pyrotechnic burning section. The opening of this central passage is achieved by a band winding being opened under the influence of the centrifugal force and accordingly a rotation of the tension disc, in opposition to the direction of rotation of the projectile, results in a deflection of the blocking disc out of the region of the central passage. The band winding is coaxially contained in an annular cage, whose internal passage forms the central passage and the annular space of which is dimensioned such that it receives the blocking disc when the band winding is opened, whilst partially or completely freeing the central passage.

Such a device does not always result in the central passage being sufficiently freed; moreover the arming takes place too quickly and too inaccurately.

In French Patent 1,198,830 is described a safety device on a non-spinning round with a percussion fuse in which the percussion needle is held at a distance from the bearer of the priming charge (detonator) by means of a band in the form of a spiral spring wound in one direction which is in turn fixed in a tensioned state by means of a cage extending over it.

On firing, the cage is displaced axially forwards by the propulsion gases in such a way that the spiral spring is released and can relax radially outwards, abutting the inner wall of a cavity of increased diameter of the cage. This cavity adjoins the front region of the cage, which fixes the tensioned spring and has a correspondingly smaller diameter. The diameter of the cavity is so dimensioned that the relaxed spiral spring no longer arrests the percussion needle, i.e. no longer holds the two parts capable of movement in relation to each other in the detonation chain comprising the percussion needle and the detonator apart from each other. The percussion needle, on impact with the target, can therefore move forward towards the detonator and bring about the initiation of it. A disadvantage in this case is the fact that removal of the safe state by the band which is wound in one direction only takes place very rapidly and can be varied only within very narrow limits.

A barrel safety device for spinning rounds with percussion ignition is known from U.S. Patent 4,026,216 (equivalent to DE 2,457,947) in which a three-part bundle of bands is provided, the inner band lying adjacent to locking balls for locking a contact pin of the detonation chain and being made of such a material as to withstand the radial pressure of the locking balls without suffering any deformations. As the main band, the middle band determines

the barrel safety and the outer band transport safety in particular. The main band is here preferably wound in the direction of the spin and the other two bands in the direction opposite to the spin. The bundle of bands is in this case opened exclusively by the centrifugal force acting fully on the spinning round after is has left the muzzle, the barrel safety being determined by the main band, and thus within very narrow limits.

The known devices do not provide a precise safety device on the percussion fuse of non-spinning rounds which operates over an adjustable or prolonged period of time.

The present invention attempts to overcome one or more of the above problems.

According to the present invention there is provided an after-firing safety device in a non-spinning projectile having a percussion fuse said device comprising a tension spiral spring set surrounded by a cage, said spring set occupying a space formed between a detonator and a percussion pin to such an extent that contacting of the detonator by the percussion pin is precluded, and the spiral spring set is afforded the possibility of relaxing only after firing of the projectile by displacement of the cage due to acceleration of the projectile, said space becoming available and thereby making movement of the detonator possible, said spiral spring set comprising several spiral springs wound up in series in respectively opposite directions and being inserted within the cage.

The present invention further provides an after-firing safety device in a non-spinning projectile with a percussion fuse, said device comprising a multi-part coiled band winding assembly wherein individual windings are in each case wound up in opposite directions, said windings in a safety condition retaining two mutually movable parts of a fuse train at a spacing from each other and also releasing the movement thereof in an armed condition, said windings comprising a spiral spring set surrounded in the safety condition by a cage that can be displaced due to

acceleration of the projectile in the event of discharge, wherein, after release of the spiral spring set by the cage, an unwinding process takes place in such a way that initially an outermost spiral spring of the spring set is relaxed progressively from the outside towards the inside and thereby successively sets each of the remaining springs of the spring set into rotation such that there occurs upon transition to each successive spiral spring of the remaining springs in the spring set a standstill and a subsequent reversal of the direction of rotation of the respective remaining springs of the spring set.

This barrel safety device is intended for percussion fuses of non-spinning rounds. The wound bundle of spiral springs surrounded by the cage prevents, through its presence in the space between the two parts of the fuse train, the approach of the percussion needle to the detonator. When the cage, on firing, moves above the bundle of spiral springs on account of its inertia, the extreme position of the outer spiral spring begins to lose its tension immediately. The relaxation of the tension of the spiral springs proceeds in sequence from the outside inwards, never distributed simultaneously over the entire length of the spring. According to an embodiment of the invention, a plurality of spiral springs is wound one over the other, the direction of winding changing with each spiral spring. Through this there is in each case a stabilization and a reversal of the rotations of the remainder of the bundle of springs on the transition from one spiral spring to another; the procedure with the next spiral spring thus begins in each case again at zero. The result of this is that considerable retardations can already be created reliably and reproducibly with three spiral springs wound in opposite directions. This removal of the safe condition takes place independently of any rotational movement of a round, on account of which the

barrel safety measure is suitable for non-spinning rounds.

The spiral springs are preferably dimensioned so that after the relaxation of tension the inside diameter has become so large that the detonator can be moved unimpeded in the direction of the percussion pin. The time during which detonation may not occur may be adjusted very precisely by simple means through the parameters spring length, spring thickness and tension, which are determined by the diameter of the cage and the pretreatment of the spring, as well as by the friction of the band layers against each other.

It is preferred that the ~~pre-barrel~~ after-firing safety mechanism is rendered safe during transport by securing the cage in an axial direction by means of a lateral locking pin.

A disc-shaped permanent magnet with magnetization essentially in the disc plane may be provided above and/or below the set spiral spring, so that rotation of the set of springs is braked upon release. In this way the safety time can be extended.

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a section through the projectile head;

Figure 2 shows a top view of a set of springs;

Figure 3 shows a projectile head with magnetic brake;

Figure 4 shows a set of springs with corrugated end of the outermost spring.

Figure 1 shows a projectile head 1 with the ~~pre-barrel~~ after-firing safety mechanism according to an embodiment of the invention. The left-hand half of the figure illustrates the safe position; in the right-hand half, the pre-barrel safety mechanism is shown when deactivated and the axially movable detonator 2 has struck against percussion pin disc 4 on account of its inertia when striking against percussion pin 3.

In the safe state, the set 6 of the spiral springs surrounded by a cage 5 in the form of a circular ring, extends into the space between percussion pin 3 and the front side of the detonator 2 to such a degree that even with maximum accelerations any contact of the percussion pin 3 against the detonator 2 is precluded on account of the rigidity of the set 6 of springs. In the left-hand part of the figure a locking pin 7 serving as a safety mechanism during transportation of the projectile can further be seen. As long as this pin 7 is not drawn out, the cage 5 cannot move even in the case of the greatest acceleration and therefore ignition is impossible. Before loading, the pin 7 is removed.

In the event of firing, on account of the acceleration of the projectile, the cage 5 will slide backwards over the detonator 2. As soon as the set of springs is no longer surrounded by the cage 5, release of the wound-up set 6 of springs begins.

The set 6 of springs wound up from three individual springs 8, 9, 10 is illustrated more clearly in Figure 2. The inner dot-dash line 11 indicates the internal diameter of the cage 5 and corresponds approximately with the outer diameter of the detonator 2. The outer dot-dash line 12 indicates the outer diameter of the cage 5 and the internal wall of the projectile head and denotes the maximum available space into which the set of springs 6 can expand. The space is of such a size that, in the released state of the set of springs 6, the inner approximately circular space 13 has become so large that the front part of the

detonator 2 can be allowed through.

In Figure 2 is shown the situation where the cage 5 has just slid onto the detonator and release of the set of springs 6 commences. The beginning 14 of the spring 8 rests externally against the wall 12 of the projectile and the rest of the set 6 of springs endeavours to unwind rotationally along the wall 12 of the newly generated larger free space. The set 6 of springs rotates with increasing speed of rotation, but still with closed inner wound core up to the end of the spring 8.

The springs 9, 10 which are still tightly wound at this moment, rotate with such high speed that initially no unwinding of the central 9 and inner 10 springs are possible, because the central spring 9 must first change its direction of rotation before it is able to unwind. Only after rotation of the set 6 of springs have terminated can the upper layer of the central spring 9 be loosened from the still fixed remainder of the spring set. Unwinding of the central spring 9 follows, as the spring, as in the case of the outer spring 8, is applied outwardly against the released spring 8 and begins to rotate in the opposite direction. The innermost spring 10 remains firmly tensioned until the set of springs comes to a stop anew and the beginning of the spring 10 resting against the expanded spring 9 begins to be released and to rotate.

At the end of the release, the end of the spring 10 rests in quite close contact on the inside, against the annular set of springs which has enlarged in diameter and the central opening 13 is so great that even the spring 10 can no longer hinder the axial movement of the detonator 2.

The time which passes until the tensioned set 6 of springs has expanded to form a larger, again annular set of springs, depends upon various quantities and can be adjusted very easily. The length, the tensional force and the friction of the spring layers with respect to each other are important. The release and thus also the rotation of the set of springs can be braked magnetically

in an advantageous manner, the result of this being a lengthening of the safety time.

A safety device with a magnetic brake is represented in Figure 3. In the left-hand half, as in Figure 1, the safe state is represented; the right-hand half shows the state on impact: the percussion pin 3 has, on braking, penetrated the detonator 2, which has moved forwards. The parts are denoted by the same reference numerals as in Figure 1. The percussion pin disc 4 is here bent upwards a little. It accommodates a permanent magnet as an annular disc 15. It is magnetized such that the direction of magnetization essentially runs in the annular plane and the two poles are formed on the disc such that they lie opposite each other and the lines of force run mainly perpendicular to the spiral springs of the set 6 of springs.

In Figure 4 a somewhat modified set 6 of springs is represented. The beginning 16 of the outermost spiral spring 8 is corrugated. As a result the outermost winding of the spiral spring is prevented from slipping between cage and detonator during the process in which the cage is drawn off the set of spiral springs.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An after-firing safety device in a non-spinning projectile having a percussion fuse, said device comprising a tension spiral spring set surrounded by a cage, said spring set occupying a space formed between a detonator and a percussion pin to such an extent that contacting of the detonator by the percussion pin is precluded, and the spiral spring set is afforded the possibility of relaxing only after firing of the projectile by displacement of the cage due to acceleration of the projectile, said space becoming available and thereby making movement of the detonator possible, said spiral spring set comprising several spiral springs wound up in series in respectively opposite directions and being inserted within the cage.

2. An after-firing safety device according to claim 1, wherein a magnetized plate is provided above and/or below the spiral spring set.

3. An after-firing safety device according to claim 1 or 2, wherein the spiral spring set comprises three spiral springs.

4. An after-firing safety device in a non-spinning projectile with a percussion fuse, said device comprising a multi-part coiled band winding assembly wherein individual windings are in each case wound up in opposite directions, said windings in a safety condition retaining two mutually movable parts of a fuse train at a spacing from each other and also releasing the movement thereof in an armed condition, said windings comprising a spiral spring set surrounded in the safety condition by a cage that can be displaced due to acceleration of the projectile in the event of discharge, wherein, after release of the spiral spring set by the cage, an unwinding process takes place in such a way that initially an outermost spiral spring of the spring set is relaxed progressively from the outside towards the inside and thereby successively sets each of the remaining springs of the spring set into rotation such

that there occurs upon transition to each successive spiral spring of the remaining springs in the spring set a standstill and a subsequent reversal of the direction of rotation of the respective remaining springs of the spring set.

5. An after-firing safety device according to claim 4, wherein the spiral spring set comprises three spiral springs.

6. An after-firing safety device according to claim 4 or 5, wherein a magnetized plate is provided above and/or below the spiral spring set.

7. An after-firing safety device substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

DATED THIS 28TH DAY OF MARCH, 1991.

DYNAMIT NOBEL AKTIENGESELLSCHAFT
By Its Patent Attorneys:

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.

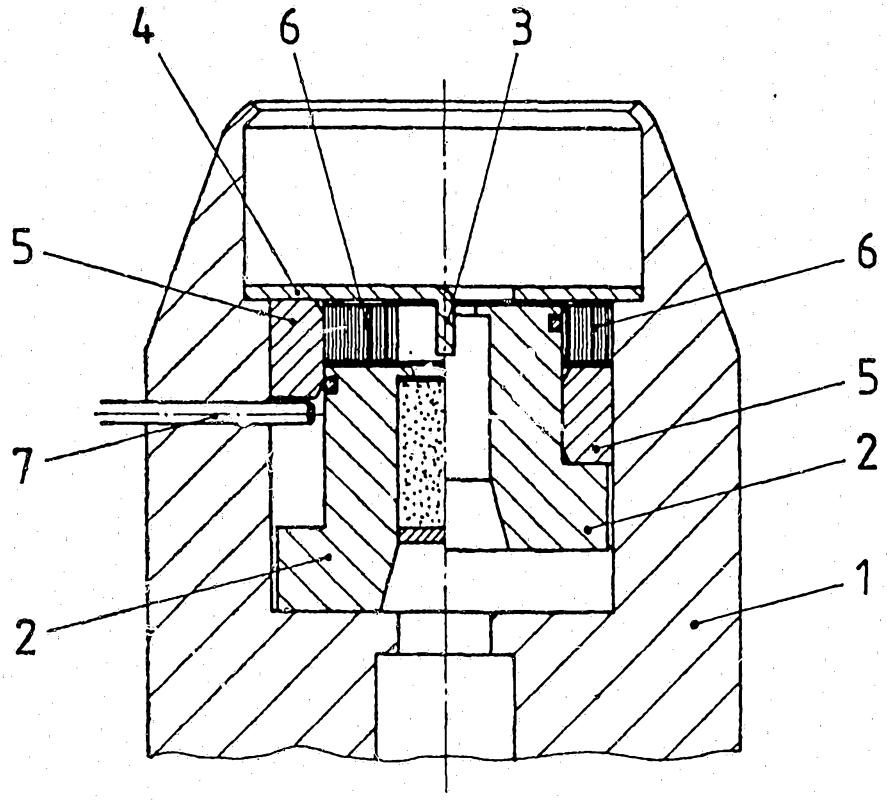


Fig. 1

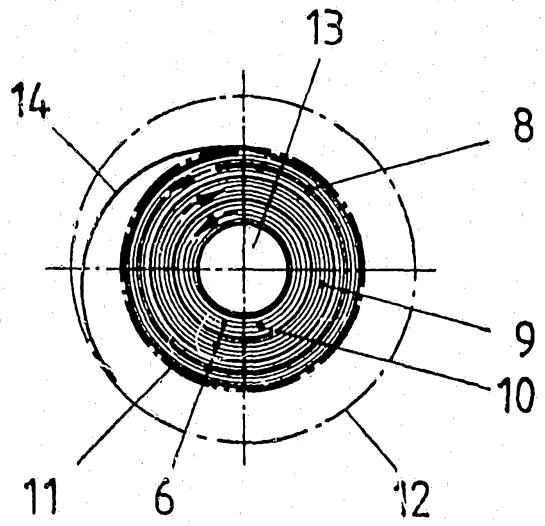


Fig. 2

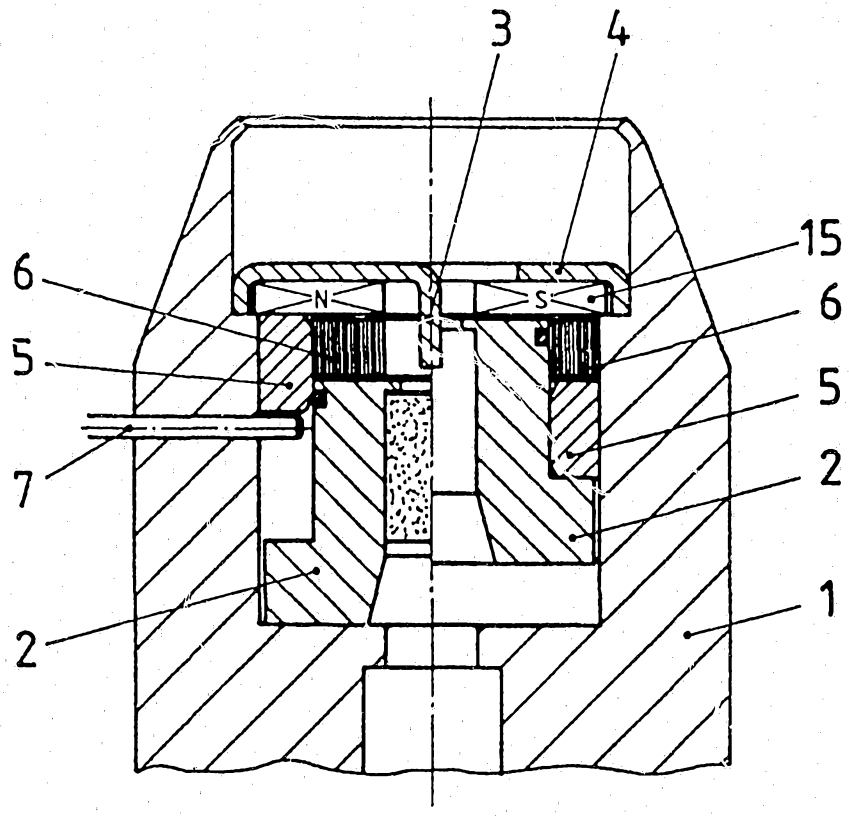


Fig. 3

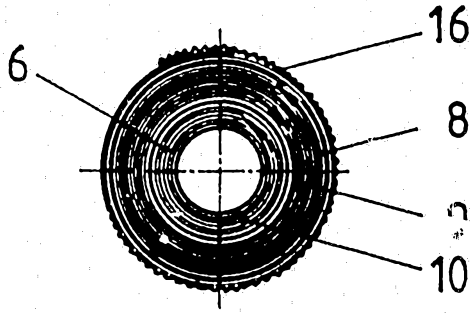


Fig. 4