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Percussion fuse

The present invention relates to a percussion fuse for a shell.

- 5 Percussion fuses for shells typically have a fuse body, which can be mounted on a shell and in which a detonator system having a priming charge for igniting a main charge of the shell and a firing pin for piercing the priming charge of the detonator system when striking a target are provided.
- 10 When striking a target substantially in a perpendicular manner, the head end of the fuse body presses on the firing pin and moves it in the direction toward the detonator system, so that the priming charge is pierced. When striking a target in a flat manner, however, the fuse body is generally deformed, whereby the firing pin may be
- 15 destroyed, which results in the firing pin no longer being moved in the direction toward the detonator system in order to pierce the priming charge. This problem of a conventional percussion fuse is illustrated by way of example in Figure 3. As illustrated, the firing pin has in the fuse body 12 a pin head 25 and a pin rod 26, wherein the pin head 25 is arranged in the front region of the fuse body 12 behind a covering plate 21 and the pin rod 26 has at the rear end a piercing tip 27 for piercing the priming charge
- 20 in the detonator system 16. As illustrated in the partial figure sequence A, B, C, D, a flat striking, that is to say a striking of the fuse against a target at a shallow angle - in particular in contrast to an acute angle - brings about a partial deformation of the front portion of the fuse body 12, which results in a tilting of the pin head 25 in the direction toward the impact surface, which in turn may bring about a bending and/or jamming of
- 25 the pin rod 26 in the fuse body 12, so that the pin rod 26 is no longer pressed correctly in the direction toward the detonator system 16 and consequently can no longer pierce

the priming charge in the detonator system. Then, of course, the detonation of the main charge of the shell also does not take place.

5 The object of the invention is therefore to provide an improved percussion fuse which can bring about the piercing of the priming charge by the firing pin even when striking a target in a flat manner.

10 This object is achieved by a percussion fuse for a shell having the features of claim 1. Particularly advantageous embodiments and developments of the invention are set out in the dependent claims.

15 The percussion fuse of the invention has a fuse body, which can be mounted on a shell, wherein the fuse body has a head portion, which faces away from the shell and has a head end, a base portion, which faces the shell, and a longitudinal axis, and a detonator system having a priming charge in the base portion of the fuse body. The
20 percussion fuse also has a firing pin in the head portion of the fuse body, wherein the firing pin has a pin rod, a pin head at an end of the pin rod facing the head end of the fuse body and a piercing tip at an end of the pin rod facing the detonator system, wherein the firing pin can be moved in the direction toward the detonator system when
25 the percussion fuse strikes a target, so that the piercing tip of the firing pin pierces the priming charge in the detonator system. According to the invention, additionally provided is a pressure element, which is arranged loosely (in the sense of not being fixed) in the head portion of the fuse body between the head end of the fuse body and the pin head of the firing pin, wherein the pressure element is configured and arranged
30 in the head portion of the fuse body in such a manner it can tilt relative to the fuse body and relative to the pin head of the firing pin, so that, in the event of a deformation of the head portion of the fuse body when striking a target, it can press on the pin head of the firing pin without tilting the pin head relative to the longitudinal axis of the fuse body.

30 The additional pressure element is tilted in the event of a deformation of the head portion of the fuse body, but as a result of the decoupling thereof from the pin head retains the orientation of the pin head, and therefore also the pin rod, in an upright position, that is to say prevents, for example, a tilting of the pin head and a resultant bending or jamming of the pin rod. As a result of this additional pressure element, it can

therefore be ensured even when the percussion fuse strikes a target in a flat manner that the firing pin remains functional and can pierce the priming charge in the detonator system. This ensuring of the functionality of the percussion fuse even when striking a target in a flat manner can be achieved by means of the additional pressure element as a result of a simple and cost-effective construction. In many conventional construction variants of percussion fuses, even a simple insertion of the special pressure element is sufficient, without the fuse body and the firing pin having to be significantly modified.

The percussion fuse of the invention can in principle be used for any types of shell. Furthermore, the percussion fuse of the invention is not limited to any specific detonator systems with a priming charge.

Preferably, the pressure element has a rear side which faces the firing pin and which is configured in a dome-like form. In this way, the rear side of the pressure element can remain in contact with the pin head of the firing pin even when the pressure element is tilted (that is to say both when striking a target in a perpendicular manner and when striking a target in a flat manner), preferably even in the region of the longitudinal center axis of the fuse body, along which axis the firing pin can be moved in the direction toward the detonator system. The dome or the curvature thereof may be spherical or aspherical. The curvature may rise over an elliptical or angular base surface. The base surface may in particular be circular or square. The curvature may comprise a planar region in the region above the centroid of the area of the base face. The planar region is preferably located symmetrically about the theoretically highest point of the dome if it were not to comprise any planar region. Advantageously, the planar region of the rear side – or in other words the planar region of the dome-like surface of the rear side – is less than 30%, in particular less than 25%, of the overall surface area of the dome-like surface. The spherical or aspherical surface profile of the rear side of the pressure element may also be formed by a large number of planar elements, so that the dome-like rear side is formed by a polyhedron.

The side, facing the pressure element, of the pin head of the firing pin is preferably formed in a substantially planar manner. In this way, the tilting of the pressure element relative to the pin head can be better ensured. As a result of the dome-like configuration of the rear side of the pressure element and the planar configuration of

the side of the pin head facing the pressure element, when the fuse strikes a target at a shallow angle, because of its loose or unfixed arrangement, the pressure element can virtually roll on the side of the pin head facing the pressure element whilst at the same time applying pressure to the pin head – or in other words whilst at the same time
5 passing on the deformation of the head portion of the fuse body in a linear manner, that is to say in the direction of the longitudinal axis of the fuse body, via the pressure element to the pin head. If the rear side of the pressure element has a planar region as described above, a planar contact between the pressure element and the side of the pin head facing the pressure element can be produced - in spite of a loose
10 arrangement of the pressure element - so that the pressure element is tilted only when the fuse strikes a target at a shallow angle.

The front side, facing the head end of the fuse body, of the pressure element may, for example, be configured in a substantially planar manner. In this instance, the pressure
15 element may, for example, be in the form of a hemisphere or be configured in a virtually lenticular manner with a planar face as a front side and an aspherical or spherical or faceted surface as a rear side, wherein both the “hemisphere” and the “lens” may comprise a planar region on the rear side thereof, as described above.

However, it is also possible for the front side of the pressure element to comprise two planar regions, wherein one planar region is raised in a stepped manner with respect to the other planar region. The planar region of the front side which is raised in a stepped manner may in this instance be located opposite an above-described planar region of the rear side or, in other words: regardless of whether the rear side comprises a planar
20 region or not, the region of the front side which is raised in a stepped manner is preferably arranged opposite the (theoretically) highest point of the dome-like rear side, wherein the region is in particular orientated symmetrically relative to this point. As a result of the planar region which is raised in a stepped manner, a contact region between the head end of the fuse body and the pressure member may be produced,
25 but affords the advantage in comparison with a substantially completely planar front side that a degree of contact between the head end can be produced but is smaller in terms of surface area, so that, when the fuse strikes in a flat manner, a tilting movement of the pressure element is more easily possible.
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However, the front side of the pressure element facing the head end of the fuse body may, for example, also be configured in a similar manner to one of the above-described rear sides of the pressure element. For example, it is thereby possible for the pressure element to have a spherical form, an elliptical form, an oval form, the form of a polyhedron in each case on the front and rear side or different combinations, such as, for example, a spherical form on the front side and an elliptical or aspherical form on the rear side, etc.

The pressure element preferably has a solid shaped body made of a metal material. In this way, the pressure element is dimensionally stable and, even when the fuse body is deformed when striking a target, can maintain its shape and consequently its functionality. For reasons relating to weight, the pressure element is, for example, produced from aluminum.

In one embodiment of the invention, the fuse body has in the head portion thereof a channel in which the firing pin is arranged and guided and in which the pressure element is also located. If the pin rod has a smaller width than the pin head of the firing pin, this channel preferably has a first channel portion for guiding the pin head and the pressure element and a second channel portion for guiding the pin rod, wherein the second channel portion is narrower than the first channel portion. Furthermore, the firing pin and the channel preferably extend substantially coaxially with respect to the longitudinal center axis of the fuse body. The channel or the first and second channel portion thereof are preferably formed in a substantially cylindrical manner, preferably substantially coaxially with respect to the longitudinal axis of the fuse body.

In order to ensure the free movability of the pressure element even when the head portion of the fuse body is deformed, the pressure element is preferably configured in such a manner that the diameters of the pressure element in all directions are smaller than the width of the channel.

In one embodiment of the invention, the fuse body has at the head end thereof an access opening for mounting the firing pin, wherein the access opening is closed by a covering plate after the firing pin has been inserted into the fuse body. The pressure element is also inserted through this access opening into the fuse body and is then loosely arranged between the covering plate and the pin head of the firing pin.

The above features and advantages and other features and advantages of the invention will be better understood from the following description of a preferred non-limiting exemplary embodiment with reference to the appended drawings. In the
5 schematic drawings:

Fig. 1 shows a longitudinal sectioned view of a percussion fuse according to an exemplary embodiment of the invention;

Fig. 2 shows four drawings to illustrate the deformation path of the percussion fuse of Figure 1 when striking a target in an oblique manner; and
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Fig. 3 shows four drawings to illustrate the deformation path of a conventional percussion fuse when striking a target in an oblique manner.

Figure 1 illustrates by way of example the structure of a percussion fuse using the example of an explosive projectile. Figure 1 shows the structure in the rest state or in
15 the flight state of the percussion fuse 10, that is to say prior to the percussion fuse 10 striking a target.

The percussion fuse 10 has a fuse body 12, which is produced, for example, from
20 aluminum. The fuse body 12 has a front head portion 12a in the flight direction 13, with a head end 12b, and a rear base portion 12c in the flight direction 13. Provided on the base portion 12c of the fuse body 12 is a securing device 14, by means of which the fuse body 12 can be secured to the body of the shell. As indicated in Figure 1, the
25 securing device 14 has, for example, a thread for screwing the fuse body 12 into a shell cavity. Depending on the type of shell, however, the securing device 14 of the fuse body 12 may also be configured differently.

The fuse body 12 has a longitudinal center axis 18, which also defines an axial
30 direction of the fuse body 12. The flight direction 3 of the shell and the percussion fuse 10 is substantially parallel or coaxial relative to this longitudinal axis 18.

Provided in the base portion 12c of the fuse body 12 is a priming charge space 15, which, for example, is formed in a substantially cylindrical manner and is arranged substantially coaxially relative to the longitudinal direction 18. A detonator system with

a priming charge 16 is received in this priming charge space 15. The detonator system 16 has, for example, an ignition chain. The priming charge of the detonator system 16 can be mechanically activated through a piercing opening 17, wherein the piercing opening 17 is provided in the region of the longitudinal axis 18 on the side of the
5 detonator system 16 facing the head portion 12a. The activated priming charge of the detonator system 16 can then activate the main charge of the shell.

Provided in the head portion 12a of the fuse body 12 is a channel 22, which is arranged substantially coaxially relative to the longitudinal direction 18 and which serves for
10 receiving and guiding a firing pin 24. The firing pin 24 has a pin rod 26, a pin head 25 at the end of the pin rod 26 facing the head end 12b of the fuse body 12 and a piercing tip 27 at the end of the pin rod 26 facing the detonator system 16. The piercing tip 17 serves to activate the priming charge by being introduced into the piercing opening 17 of the detonator system 16. The pin head 25 of the firing pin 24 is in this exemplary
15 embodiment wider than the pin rod 26. The channel 22 in the head portion 12a of the fuse body 12 therefore has a wider first channel portion 22a for receiving and guiding the pin head 25 and a narrower second channel portion 22b for receiving and guiding the pin rod 26. The first and the second channel portions 22a, 22b are both formed in a substantially hollow-cylindrical manner. The firing pin 24 and the channel 22 are in
20 each case orientated substantially coaxially relative to the longitudinal axis 18. The firing pin 24 can be moved in the channel along the longitudinal axis 18, so that, when the percussion fuse 10 strikes a target, it can be moved in the direction toward the detonator system 16 by means of pressure on the pin head 25, so that the piercing tip 27 is introduced into the piercing opening 17 of the detonator system 16 in order to
25 activate the priming charge.

As illustrated in Figure 1, the head portion 12a of the fuse body 12 has at the head end 12b thereof an access opening 20, through which the firing pin 24 can be inserted into the channel 22 of the fuse body 12. After the mounting of the firing pin 24, this access
30 opening 20 is then closed and sealed by means of a covering plate 21.

A pressure element 28 is also introduced into the channel 22 through the access opening 20. The pressure element 28 is then arranged between the pin head 25 and the covering plate 21 in the first channel portion 22a. The pressure element 28 is in this

case loosely arranged in the first channel portion 22a, that is to say not fixed to any element of the covering plate 21, fuse body 12 and pin head 25, so that it can tilt within the first channel portion 22a relative to the fuse body 12 and relative to the pin head 25 of the firing pin 24, as indicated by the curved arrows 29 in Figure 1.

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In the exemplary embodiment of Figure 1, the pressure element 28 is in the form of a hemisphere. That is to say, the pressure element 28 has a front side 28a, which faces the covering plate 21 and is substantially planar, and a rear side 28b, which faces the pin head 25 and is dome-like, in this instance spherical. In other embodiments of the invention, the front side 28a of the pressure element 28 may also be formed in a dome-like, for example spherical, manner, so that the pressure element 28 is spherical.

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The side of the pin head 25 facing the pressure element 28 is preferably formed in a substantially planar manner. In Figure 1, the pressure element 28 is in contact with the pin head 25.

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The pressure element is also preferably a solid (that is to say not hollow) shaped part, for example made of aluminum. The pressure element 28 is arranged substantially coaxially relative to the longitudinal axis 18. Furthermore, all the diameters of the pressure element 28 in all orientations are smaller than the width of the first channel portion 22a in the head portion 12a of the fuse body 12.

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In the event of the percussion fuse 10 striking a target in a substantially perpendicular manner, that is to say substantially parallel with the longitudinal axis 18, the head end 12b of the fuse body 12 is pressed in, so that the pressure element 28 presses with the rear side 28b thereof against the pin head 25. As a result, the firing pin 24 is moved in the direction toward the detonator system 16 and the piercing tip 27 is ultimately introduced into the piercing opening of the detonator system 16 in order to activate the priming charge in the detonator system 16. As can be seen in Figure 1, as a result of its dome-like rear side 28b in the central region of the longitudinal axis 18, the pressure element 28 presses against the pin head 25, so that the action of pressure extends in a linear manner, whereby the axial movement of the firing pin 24 through the channel 22 along the longitudinal axis 18 is assisted.

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The functionality of the percussion fuse 10 when striking a target in a flat manner is illustrated in Figure 2. The advantage of the construction of the percussion fuse 10 according to the invention can be seen in particular by comparing Figure 2 with Figure 3 described in the introduction for a conventional percussion fuse.

5 As the sequence of the partial figures A, B, C, D of Figure 2 illustrates, the head portion 12a of the fuse body 12 is further and further deformed in the region of the head end 12b in a similar manner to Figure 3. In contrast to the conventional construction, however, this deformation of the fuse body 12 does not bring about a tilting of the pin head 25 as a result of the additional pressure element, and consequently no bending or jamming of the pin rod 26, so that the firing pin 24 remains functional and can pierce the priming charge in the detonator system 16.

10 As a result of the deformation of the fuse body 12, the pressure element 28 is tilted within the first channel portion 22a in such a manner that the planar front side 28a thereof is orientated toward the target. Furthermore, the pressure element 28 is moved by striking during the deformation of the fuse body 12 slightly in the direction toward the base portion 12c of the fuse body 12. However, since the pressure element 28 is located loosely in the first channel portion 22a, the tilting of the pressure element 28 does not bring about any deformation of the first channel portion 22 and in particular also no tilting of the pin head 25 relative to the longitudinal axis 18. As can be seen from Figure 2, the dome-like rear side 28b of the pressure element 28 instead remains in contact with the planar upper side of the pin head 25 in the central region of the longitudinal axis 18 during the deformation of the fuse body 12. The pressure element 28 thereby always presses substantially centrally against the pin head 25, and in a substantially linear manner in the direction along the longitudinal axis 18, during the deformation of the fuse body 12. In this way, the firing pin 24 is moved in the longitudinal direction 18 through the channel 22 in the direction toward the detonator system 16 without tilting in any way transversely relative to the longitudinal axis 18.

30 As a result of the additional pressure element 28 in the fuse body 12, the impact sensing of the percussion fuse 10 can thus be improved or maintained even when striking a target in a flat manner. The functionality of the percussion fuse, and consequently the operational capability of the shell, can thus be significantly improved.

List of reference numerals

	10	Percussion fuse
	12	Fuse body
5	12a	Head portion of the fuse body
	12b	Head end of the fuse body
	12c	Base portion of the fuse body
	13	Flight direction
	14	Securing device
10	15	Priming charge space
	16	Detonator system with priming charge
	17	Piercing opening
	18	Longitudinal axis (defined axial direction)
	20	Access opening for mounting
15	21	Covering plate
	22	Channel
	22a	First channel portion
	22b	Second channel portion
	24	Firing pin
20	25	Pin head
	26	Pin rod
	27	Piercing tip
	28	Pressure element
	28a	Front side of the pressure element
25	28b	Rear side of the pressure element
	29	Tilting possibility of the pressure element

Patent claims

- 5 1. A percussion fuse (10) for a shell, having:
a fuse body (12), which can be mounted on a shell, wherein the fuse body (12) has
a head portion (12a), which faces away from the shell and has a head end (12b), a
base portion (12c), which faces the shell, and a longitudinal axis (18);
a detonator system having a priming charge (16) in the base portion (12c) of the
10 fuse body (12); and
a firing pin (24) in the head portion (12a) of the fuse body (12), wherein the firing
pin (24) has a pin rod (26), a pin head (25) at an end of the pin rod (26) facing the
head end (12b) of the fuse body (12) and a piercing tip (27) at an end of the pin rod
(26) facing the detonator system (16), wherein the firing pin (24) can be moved in
15 the direction toward the detonator system (16) when the percussion fuse (10)
strikes a target, so that the piercing tip (27) of the firing pin (24) pierces the priming
charge in the detonator system (16),
characterized by
a pressure element (28), which is arranged loosely in the head portion (12a) of the
20 fuse body (12) between the head end (12b) of the fuse body (12) and the pin head
(25) of the firing pin (24), wherein the pressure element (28) is configured and
arranged in the head portion (12a) of the fuse body (12) in such a manner that it
can tilt relative to the fuse body (12) and relative to the pin head (25) of the firing
pin (24), so that, in the event of a deformation of the head portion (12a) of the fuse
25 body (12) when striking a target, it can press on the pin head (25) of the firing pin
without tilting the pin head relative to the longitudinal axis (18) of the fuse body
(12).
- 30 2. The percussion fuse (10) as claimed in claim 1, in which the pressure element (28)
has a rear side (28b), which faces the firing pin (24) and is configured in a dome-
like manner.
- 35 3. The percussion fuse (10) as claimed in claim 2, in which a side, facing the pressure
element (28), of the pin head (25) of the firing pin (24) is formed in a planar
manner.

4. The percussion fuse (10) as claimed in one of the preceding claims, in which the pressure element (28) has a front side (28b), which faces the head end (12b) of the fuse body (12) and is configured in a planar or dome-like manner.
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5. The percussion fuse (10) as claimed in one of the preceding claims, in which the pressure element (28) has a solid shaped body made of a metal material.
6. The percussion fuse (10) as claimed in one of the preceding claims, in which the
10 fuse body (12) has in the head portion (12a) thereof a channel (22), in which the firing pin (24) is arranged and guided and in which the pressure element (28) is also located.
7. The percussion fuse (10) as claimed in claim 6, in which the pin rod (26) has a
15 smaller width than the pin head (25) of the firing pin (24), and the channel (22) has a first channel portion (22a) for guiding the pin head (25) and the pressure element (28) and a second channel portion (22b) for guiding the pin rod (26), wherein the second channel portion (22b) is narrower than the first channel portion (22a).
8. The percussion fuse (10) as claimed in claim 6 or 7, in which the firing pin (24) and
20 the channel (22) extend coaxially relative to the longitudinal center axis (18) of the fuse body (12).
9. The percussion fuse (10) as claimed in one of claims 6 to 8, in which the pressure
25 element (28) is configured in such a manner that the diameters of the pressure element (28) in all directions are smaller than the width of the channel (22).
10. The percussion fuse (10) as claimed in one of the preceding claims, in which the
30 fuse body (12) has at the head end (12b) thereof an access opening (20) for mounting the firing pin (24), wherein the access opening is closed by a covering plate (21), and wherein the pressure element (28) is arranged loosely between the covering plate (21) and the pin head (25) of the firing pin (24).