April 13, 1965 H. KIPFER 3,177,810

IMPACT FUZE

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Fig. 1

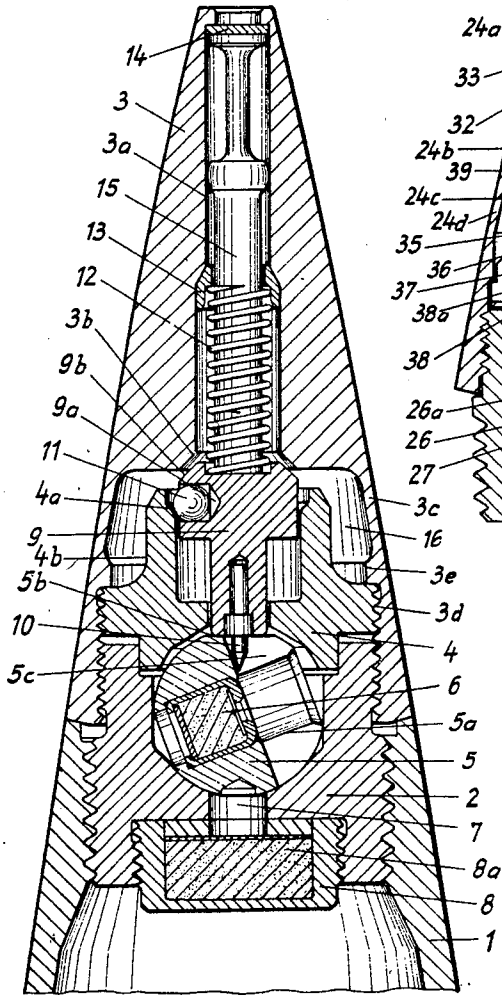
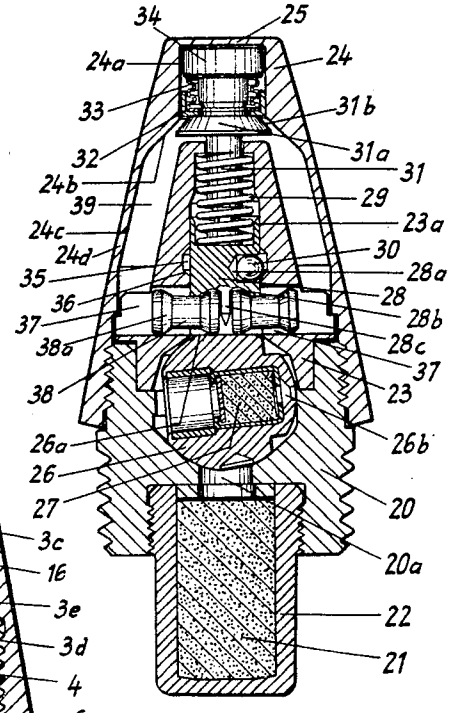


Fig. 6



INVENTOR
HUGO KIPFER
BY Wenderoth, Lind & Ponack
ATTORNEYS

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Fig. 2

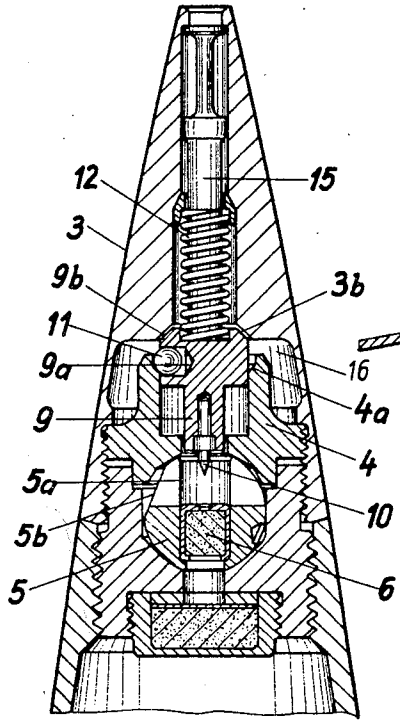
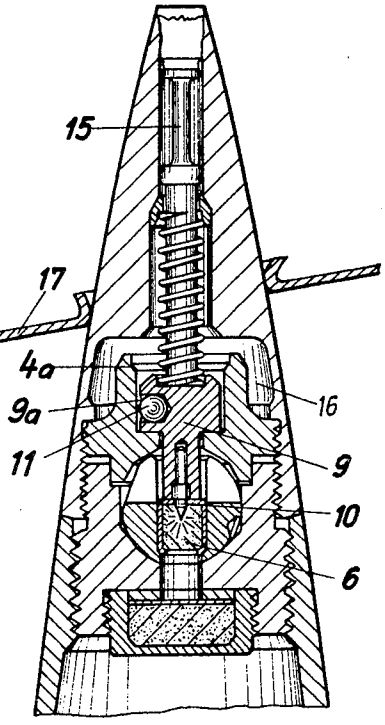


Fig. 3



INVENTOR
HUGO KIPFER
By Mendenhall, Lind & Ponack
ATTORNEYS

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Fig. 4

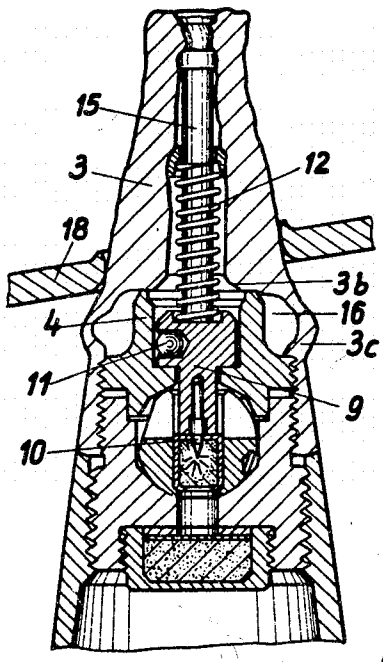
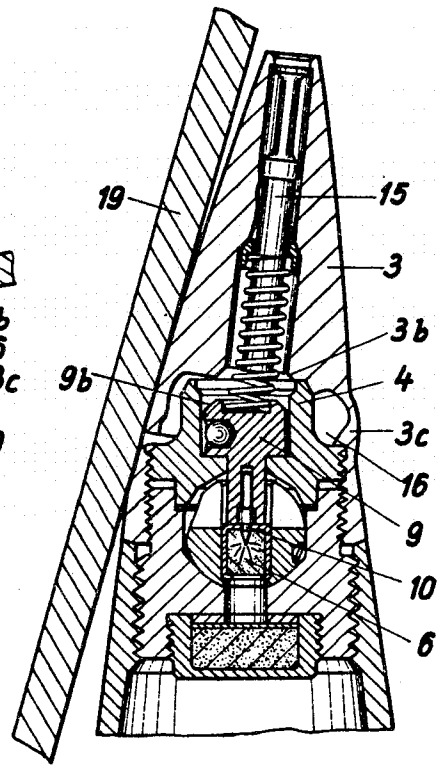


Fig. 5



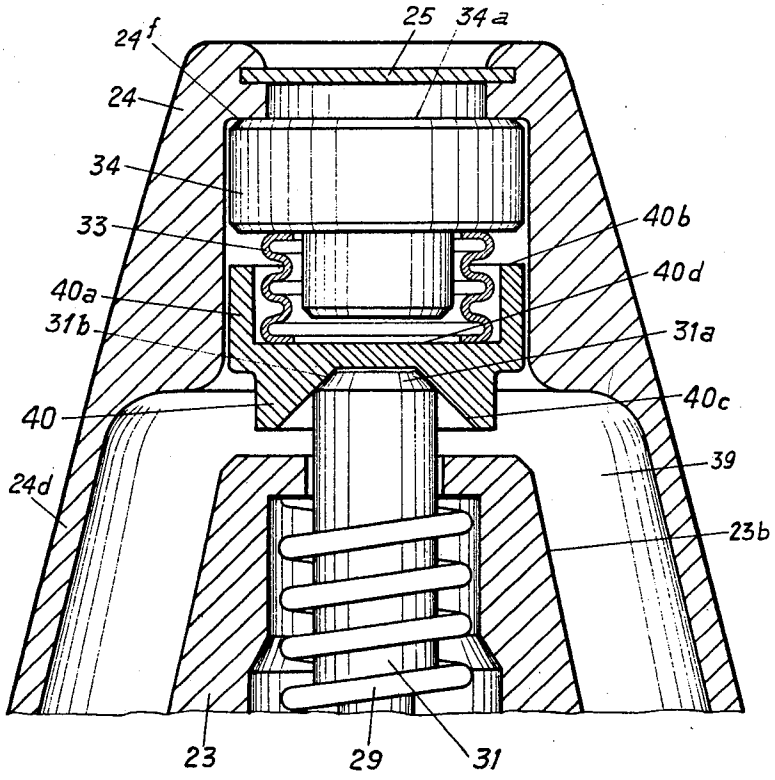
INVENTOR
HUGO KIPFER
By Mendenhall, Lind & Ponack
ATTORNEYS

April 13, 1965 H. KIPFER 3,177,810

IMPACT FUZE

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Fig. 7



INVENTOR
HUGO KIPFER
By Mendenock, Lind & Povack
ATTORNEYS

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3,177,810

IMPACT FUZE

Hugo Kipfer, Zurich, Switzerland, assignor to Machine Tool Works Oerlikon, Administration Company, Zurich-Oerlikon, Switzerland

Filed May 18, 1961, Ser. No. 111,045
Claims priority, application Switzerland, May 18, 1960, 5,678/60
2 Claims. (Cl. 102—73)

The present invention relates to an impact fuze for projectiles having a pusher slidably guided in the direction of the axis of the fuze in a guide body and in operation driving the percussion pin into the detonator cap, the forward pusher end face of which pusher in the cocked position is in direct juxtaposition to a slide face connected to the hood of the fuze.

It is a primary object of the invention to prevent failure of an impact fuze of the type referred to owing to being so quickly and so extensively deformed upon impact that the percussion pin cannot move at all or at least not with the speed required for detonating the detonator cap.

It is also an object of the invention to prevent failure of a fuze forming the tip of a slim projectile owing to the hood surrounding the impact pin and reaching from the tip of the fuze to the percussion pin being radially compressed and thus jamming the said impact pin.

It is another object of the invention to prevent failure of the fuze owing to being pushed off the projectile and being thrown away upon impact of the projectile on the target at an angle, before the detonation of the explosive charge of the projectile can be initiated by the fuze.

It has been attempted hitherto to realise these objects by suitable construction and choice of material of the critical parts of the fuze so as to obviate these deformations or to delay them until detonation is initiated. These measures have however proved only partly effective or only at certain impact velocities of the fuze.

The present invention is based on the discovery that contrary to the opinion held hitherto, the deformations or ruptures of parts of the fuze are to be favoured or provoked by suitable formation of a zone of intentional deformation, and the displacements of the fuze components relative to one another caused by these deformations to be used for initiating the detonation.

With these and other objects in view which will become apparent later from this specification and the accompanying drawings I provide an impact fuze for projectiles comprising in combination: a fuze body, a guide body fixedly mounted in said fuze body, a pusher guided slidably in the direction of the fuze axis in the said guide body, having a pusher end face, a hood fixedly mounted on said fuze body and having a slide face directly connected to it, the said pusher face in the cocked position of the fuze being immediately opposite the said slide face, and comprising a percussion pin in driven connection with the said pusher component, the said pusher face upon lateral displacement of the said slide face undergoing a rearward movement, the said hood having an intentional deformation zone arranged behind the said pusher face and slide face, and a clearance space being provided between the said deformation zone and the outer surface of the said guide body.

Preferably the said clearance space is provided in the radial direction between the said deformation zone and in the axial direction ahead of the outer surface of the said guide body.

It is also preferred that the said slide face forms a conical recess co-axial with the fuze axis.

These and other features of my said invention will be clearly understood from the following description of three

embodiments thereof given by way of example with reference to the accompanying drawings, in which:

FIGURES 1 to 5 are longitudinal sections of the tip of a projectile having a fuze according to a first embodiment, in various operational positions, viz:

FIGURE 1 in the transport position;

FIGURE 2 in the cocked position;

FIGURE 3 in the detonation position when hitting a weak target, and

FIGURES 4 and 5 when hitting a strong target.

FIGURE 6 is a longitudinal section like FIGURE 1 of a fuze according to a second embodiment;

FIGURE 7 is a longitudinal section of the tip of a fuze according to a third embodiment.

According to FIGURE 1 a hood 3 is attached to the fuze body 2, which is screwed to the shell 1 of the projectile, this hood securing a guide body 4 centered in the fuze body. In a cavity bounded by the bodies 2 and 4 the spherical rotor 5 is mounted which is provided with a bore 5*a* containing the detonator cap 6. A bore 7 establishes communication between the cavity of the fuze body 2 and the booster charge 8*a*, which is contained in a capsule 8 inserted in the rear of the fuze body.

The guide body 4 is centrally drilled through. A face 5*b* milled on the rotor 5 is directed in the transport position transversely of the longitudinal fuze axis, and is abutted by the rear end face of a cylindrical pusher 9, which is movably guided in the guide body 4 and to which the percussion pin 10 is fixedly connected which plunges rearwardly into a slot 5*c* of the rotor 5. In radial bores 9*a* of the pusher 9 ball-shaped centrifugal bodies 11 are housed spaced at regular pitch from one another, the outward path of which bodies is bounded in the transport position by the inner edge of the ramp-shaped support face 4*a* of the guide body 4.

The edge of the pusher 9 protruding forward beyond the guide body 4 is chamfered and forms a pusher slide face 9*b*. The pusher 9 is subjected to the bias of the self-destruction spring 12 which bears on the hood 3 through the bushing 13, in the bore 3*a* of which hood the impact pin 15 is guided. In the transport position the latter is held immovably between the end face of the pusher 9 and a pill 14 arranged behind the tip of the hood 3 consisting of a material melting at a comparatively low temperature.

The bore 3*a* of the hood 3 guiding the impact pin 15 issues rearwardly into the clearance space 16 bounded by the skin 3*c* of the hood, the transition of said bore being shaped as a conical annular face 3*b* and being so arranged, that in the transport position of the fuze the pusher face 9*b* of the pusher, which has approximately the same cone angle with respect to the longitudinal axes of the fuze, lies at a certain distance behind it. This distance is so dimensioned that the self-destruction mechanism can just cover its axial functional path unhampered. The outer diameter of the forward part of the guide body 4 is smaller than the inner diameter of the skin 3*c* of the hood surrounding it so that the clearance space 16 is enclosed between these two components 4 and 3*c* of the fuze. This skin of the hood lying ahead of the internal screw tapping 3*d* is provided as an intentional deformation zone, and is accordingly made very thin-walled and with uniform wall thickness up to its transition into the flange ring 3*e*, serving as an abutment. The skin 3*c* has approximately the same wall thickness also at the forward end of the internal screw tapping 3*d* behind the flange ring 3*e*.

From this construction follows the manner of operation of the fuze: after the firing of a rifled projectile provided with the fuze the heat generated at its tip owing to the damming-up of the air effects the heating of the fusion pill 14, which accordingly melts after the projectile has

covered a certain flight path, the molten material being thrown off. Since the impact pin 15 is consequently no longer arrested immovably, the rotor 5 can erect itself under the action of the centrifugal force, until the axis of the bore 5*a* containing the detonator cap 6 coincides with the longitudinal axis of the fuze. In this erection movement the pusher 9 and accordingly also the impact pin 15 are pushed forward by the rotating abutment face 5*b* of the rotor 5 so far, that the pusher slide face 9*b* abuts the face 3*b* of the hood 3, or at least reaches its direct vicinity. The pusher 9 is then arrested in this position by the centrifugal bodies 11 abutting the ramp-shaped face 4*a* of the guide body 4 under the action of the centrifugal force: the fuze is consequently cocked (FIGURE 2).

The function of the self-destruction mechanism is known: when owing to air friction the rotational speed of the projectile has dropped so far that the force of the self-destruction spring 12 exceeds the axial component directed opposite to it of the reaction generated by the centrifugal force and transmitted by the abutment face 4*a*, the pusher 9 is thrown back and by the percussion pin 10 connected to it the detonator cap 6 is pierced, the detonation of which is transferred by the booster charge 8*a* to the explosive charge (not shown) of the projectile. Thereby the self-destruction is initiated.

By FIGURES 3 to 5 the functioning of the fuze in various impact situations is illustrated.

When the projectile according to FIGURE 3 hits a target 17 of low resistance to penetration, the impact pin 15 abutting the pusher 9 is pushed back. Thereby it throws the percussion pin 10 connected with the pusher 9 against the detonator cap 6, whereby the detonation of the explosive charge of the projectile is effected, the centrifugal bodies 11 of the pusher 9 being guided by the abutment face 4*a* into the bores 9*a* and accordingly leaving thier locking position.

When the target offers a greater resistance to penetration, the forward portion of the hood 3, as illustrated in FIGURE 4, is radially compressed when penetrating the target, and the impact pin 15 is so jammed that it can no longer act on the pusher 9. At the same time however the hood is also upset in the longitudinal direction and pushed back relative to the guide body 4, which action is made possible by the deformation of the intentionally weakened skin 3*c* of the hood. In this movement the hood 3 pushes with its face 3*b* the pusher 9 back at its slide face 9*b*. Thereby the centrifugal bodies 11 leave their locking position, whereafter the self-destruction spring 12 co-operates in driving the pusher 9 and percussion pin 10 in a rearwardly directed movement.

FIGURE 5 shows the fuze upon impact on a target 19 under a small angle to the target surface. The pressure acting laterally and rearwardly at the impact by deformation of the hood 3 effects here likewise the jamming of the impact pin 15 and moreover a turning off of the hood transversely of the longitudinal axis about a point lying within the skin 3*c* of the hood behind the slide face 3*b*. This turning off, which in the extreme case precedes the complete throwing off of the hood is made possible by the yielding or even incipient rupture of the skin 3*c* of the hood at a place facing the target. Owing to the cavity 16 existing between the skin 3*c* of the hood and the guide body 4 this turning off causes such a shifting of the hood 3 relative to the guide body 4, that the pusher 9 receives at the slide face 9*b* a rearward drive as described hereinabove with reference to FIGURE 4, and the percussion pin 10 consequently pierces the detonator cap 6.

By this deformation deliberately attained by the design of the fuze according to the invention and by the movement of the hood 3 the detonation is accordingly initiated, before a deformation of the fuze components lying further back can take place upon further penetration into the target and may jam or make impossible the movement of the percussion pin 10.

In the second embodiment of a fuze according to the invention illustrated in the transport position in FIGURE 6 a capsule 22 containing a booster charge 21 is screwed into the fuze body 20, into which moreover the guide body 23 is inserted. The hood 24 screwed to the fuze body 20 and sealed at its forward end by a diaphragm 25 secures the guide body 23 in its position. The spherical rotor 26 containing the detonator cap 27 and having an aperture 26*b* arranged co-axially with the detonator cap is mounted in the cavity formed by the fuze body 20 and the guide body 23 which is in communication with the booster charge 21 through the bore 20*a*.

In the central bore 23*a* of the guide body 23 the percussion pin 28 is inserted slidably, which is under the bias of the self-destruction spring 29 abutting the guide body 23, and contains the centrifugal bodies 30 in radially directed bores 28*a*. The transmitter body 31 bears on the percussion pin 28 and protrudes so far with its approximately frusto-conical head 31*a* from the guide body 23, in which it is guided, that it can yet perform a rearwardly directed movement relative to the same.

Between the sleeve 32 abutting the head 31*a* of the transmitter body 31 and the inertia body 34, which is arranged behind the diaphragm 25 and like the sleeve 32 is movably guided in the bore 24*a* of the hood 24, the safety element 33 is built in. In the guide body 23 an annular groove 35 is cut, which is bounded rearwardly by the inclined abutment face 36. Moreover in the guide body 23 two bores 37 issuing into the central bore 23*a* are provided, whose axes lie on one and the same diameter and whose rearmost generatrices lie at the same level as the face 26*a* of the rotor 26 directed perpendicular to the longitudinal axis of the fuze.

Two locking bodies 38 are designed as cylinders diverging conically at both ends 38*a* to larger diameters. Each of these locking bodies 38 rests with one of its ends 38*a* on the face 26*a* of the rotor 26, while its other end extends into one of the bores 37. The percussion pin 28 abuts the locking bodies 38, whose ends 38*a* directed towards the longitudinal axis of the fuze engage into the annular groove 28*b*, which is machined into the end face from which the point 28*c* of the percussion pin 28 projects. By this arrangement the locking bodies 38 are arrested in their position, whereby they secure the rotor 26 in the position illustrated by abutting the face 26*a* thereof.

The hood 24 internally diverges conically rearward of the bore 24*a*, a certain distance being kept also in this embodiment between this conical inner surface 24*b* and the conical pusher face 31*b* of the head 31*a* of the transmitter body 31, which has about the same angle of conicity. The conical inner surface 24*b* is equivalent to the surface 3*b* in FIG. 1. The conical surface 24*b* starts at a less steep angle and further back makes transition into a part 24*c* of the internal surface forming the wall surface of the hood skin 24*d* proper, which is designed with a constant wall thickness up to a point near contact with the guide body 23. The outer diameter of the, for example, frusto-conical portion 23*b* of guide body 23 is so selected, that a cavity 39 is enclosed between it and the skin 24*d* of the hood.

The manner of operation of this fuze is briefly as follows:

Upon firing the projectile carrying the fuze the inertia body 34 is thrown back, whereby it contacts the end face of the sleeve 32 after having shortened the safety element 33 by upsetting the same. After the firing the locking bodies 38 remain arrested in the transport position by the inertia of the fuze components arranged ahead of them and abutting them. After the projectile has left the barrel, i.e. when no accelerating gas pressure acts on the projectile any more, the centrifugal and locking bodies 30 and 38, respectively, leave the positions illustrated in FIGURE 6 under the action of the centrifugal force.

With their conical surfaces in conjunction with the centrifugal bodies **30** sliding upward along the abutment face **36** of the guide body **23** the locking bodies **38** on their outward movement pull the percussion pin **28** with the transmitter body **31** forward so far that the conical pusher face **31***b* of the head **31***a* of the transmitter body **31** abuts the internal conical surface **24***b* of the hood **24**, or has at least reached its immediate vicinity. When the percussion pin **28** has reached this forward end position, it is arrested by the centrifugal bodies **30** abutting the face **36**. The locking bodies **38** moreover still move completely outward in the transverse bores **37**, and thereby release the face **26***a* of the rotor **26**, which may now erect itself under the action of centrifugal force, until its bore containing the detonator cap **27** coincides with the longitudinal axis of the fuze, and the aperture **26***b* lies behind the point **28***c* of the percussion pin **28**. Thereby the fuze is cocked.

The initiation of the detonation of the cap **27** upon impact then takes place in a manner analogous to that illustrated in FIGURES 3 to 5 as follows:

Upon impact on a target of low resistance to penetration the inertia body **34** is thrown against the head **31***a* of the transmitter body **31** which bears on the percussion pin **28** and transmits the blow to the same. With greater resistances of the target and large angles measured between the axis of the projectile and the surface of the target, the hood **24** is upset at its skin **24***d* designed as an intentional deformation zone, so that its conical surface **24***b* hits the head **31***a* of the transmitter body **31** and knocks the same and the percussion pin **28** back.

Upon an impact of the fuze at a small angle to the target surface the hood **24** is turned about a point lying behind the conical slide face **24***b*, whereby this face imparts to the head **31***a* of the transmitter body **31** a rearwardly directed impulse, so that the percussion pin **28** is then thrown against the detonator cap **27**, and initiates the detonation.

FIGURE 7 illustrates a modification of the tip of the fuze according to FIGURE 6 while in the transport position. In these two FIGURES 6 and 7 corresponding fuze components are denoted by the same characters. For example in FIGURE 7 the hood is likewise denoted **24**, the self-destruction spring **29**, the guide body **23** the inertia body **34**, the diaphragm **25** and the safety element **33**.

An intermediate body or impact means **40** is put on the frusto-conical forward end **31***a* of the transmitter body or pusher **31**, the rear end of which intermediate body is countersunk conically at **40***c*, the cone angles of this bore **40***c* and of the chamfer **31***b* of the head **31***a* being substantially equal. The forward sleeve-shaped end **40***a* of the intermediate body **40** is movably guided in the bore **24***a* of the hood **24**. Between the bottom **40***d* of the intermediate body and the inertia body **34** a safety element **33** is built in. The inertia body **34** has a face **34***a* which contacts the face **24***f* of the hood without clearance and thereby secures safety in transport.

In the cocked position of the fuze, after the upsetting of the safety element **33** has taken place, the annular end face **40***b* of the intermediate body **40** abuts the inertia body **34**. By the erection of the rotor the spacing between the two faces **34***a* and **24***f* established by this upsetting is again abolished completely or nearly so by the advancing of the components **40** and **34**. Upon impact under large impact angles as measured between the longitudinal axis of the projectile and the target surface the initiation of the detonation takes place in the same manner as described for the fuze according to FIGURE 6 in that by shortening the hood **24** upon upsetting the intentional deformation zone **24***d* the consequential rearward movements of the inertia body **34** and of the intermediate body **40** are transmitted to the transmitter body or pusher **31** and accordingly to the percussion pin.

Upon impact of the fuze under small angles to the target surface the intermediate body **40**, which in certain circumstances may already have jammed, moves together with the hood **24**, as if they were integral with one another, relative to the transmitter body **31** and also transversely of the longitudinal axis of the fuze, whereby owing to the sliding of the conical surface **40***c* of the intermediate body **40** on the conical pusher face **31***b* of the head **31***a* the transmitter body moves back and thereby the point **28***c* of the precussion pin is thrown back against the detonator cap **27**, whereby consequently the detonation is effected. The two faces **40***c* and **31***b* in this case play the same part as the faces **3***b*, **9***b* and **24***b*, **31***b*, respectively in the two preceding embodiments.

While I have described herein and illustrated in the accompanying drawings what may be considered typical and particularly useful embodiments of my said invention I wish it to be understood that I do not limit myself to the particular details and dimensions described or illustrated; for obvious modifications will occur to a person skilled in the art.

What I claim as my invention and desire to secure by Letters Patent is:

1. An impact fuze comprising a front casing having an axial bore extending normally along the longitudinal axis of said fuze, impact means movable in said bore, an inclined rear inner end surface on said casing arranged symmetrically to said longitudinal axis, a rear casing extending along said axis, a thin axially collapsible casing part yieldingly connecting said front casing and said rear casing and defining an interior chamber so that upon an impact effected obliquely to said axis upon said front casing said front casing will deviate with reference to said rear casing out of the normal position into a position oblique to said longitudinal axis; guiding means supported by said rear casing and protruding axially into said chamber at a radial distance from said casing part; pusher means slidable in said guiding means between a rear position and a forward position, said pusher means being provided with a front end and a rear end, said front end comprising an end surface, which latter in said forward position extends into said rear inner end surface, said front end further forming an abutment for said impact means; and an ignition pin fixed to said rear end of said pusher to detonate the fuze upon movement of said pusher from said forward position to said rear position, whereby said rear inner end surface upon deviation of said front casing exerts a pressure on said end surface of said front end of said pusher to cause a shifting of said pusher into said detonation position at an impact effected obliquely to said axis moving said front casing out of normal position.

2. An impact fuze comprising a front casing having an axial bore extending normally along the longitudinal axis of said fuze, impact means movable in said bore, an inclined rear inner end surface movable in said casing cooperating with said impact means arranged symmetrically to said longitudinal axis, a rear casing extending along said axis, a thin axially collapsible casing part yieldingly connecting said front casing and said rear casing and defining an interior chamber so that upon an impact effected obliquely to said axis upon said front casing said front casing will deviate with reference to said rear casing out of the normal position into a position oblique to said longitudinal axis; guiding means supported by said rear casing and protruding axially into said chamber at a radial distance from said casing part; pusher means slidable in said guiding means between a rear position and a forward position, said pusher means being provided with a front end and a rear end, said front end forming an abutment for one end of said impact means; and extending into said rear inner end surface and an ignition pin fixed to said rear end of said pusher means to detonate the fuze upon movement of said pusher means from said

forward position to said rear position, whereby said rear inner end surface upon deviation of said front casing exerts a pressure on said front end of said pusher means to cause a shifting of said pusher means into said detonation position at an impact effected obliquely to said axis moving said front casing out of normal position, said impact means extending in said bore to a position adjacent the forward end of said front casing and elastic means are provided urging said impact means elastically and yieldingly against said pusher means.

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SAMUEL FEINBERG, *Primary Examiner.*

BENJAMIN A. BORCHELT, *Examiner.*