July 1, 1930. S. LEBENSART 1,769,848

IGNITION DEVICE FOR PROJECTILES

Filed April 1, 1927 3 Sheets-Sheet 1

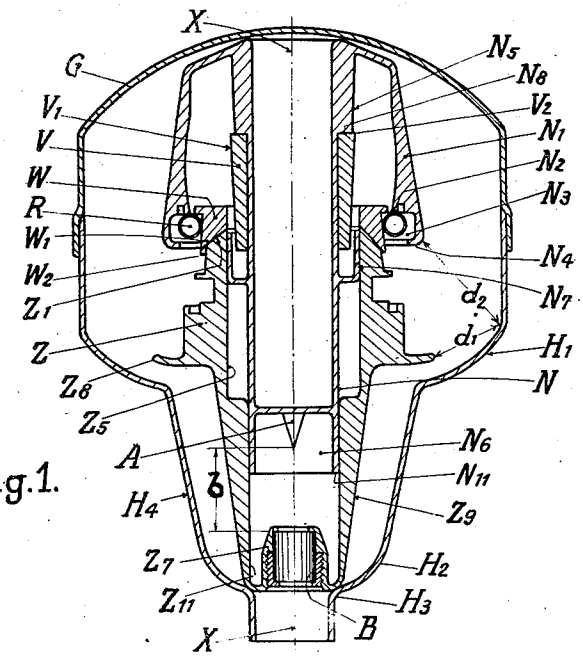

Fig.1.

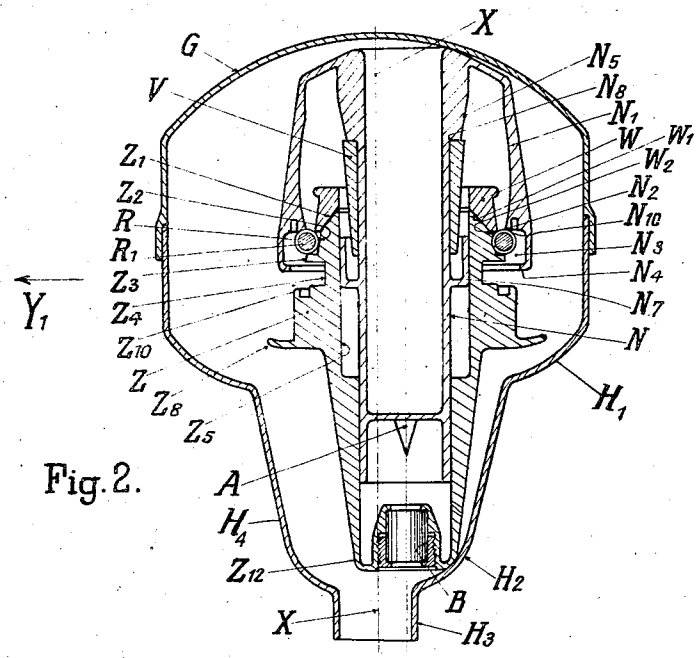

Fig.2.

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IGNITION DEVICE FOR PROJECTILES

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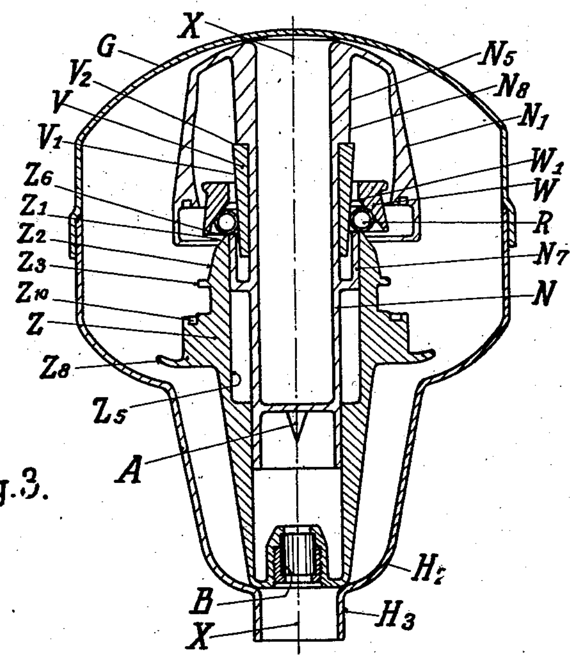

Fig. 3.

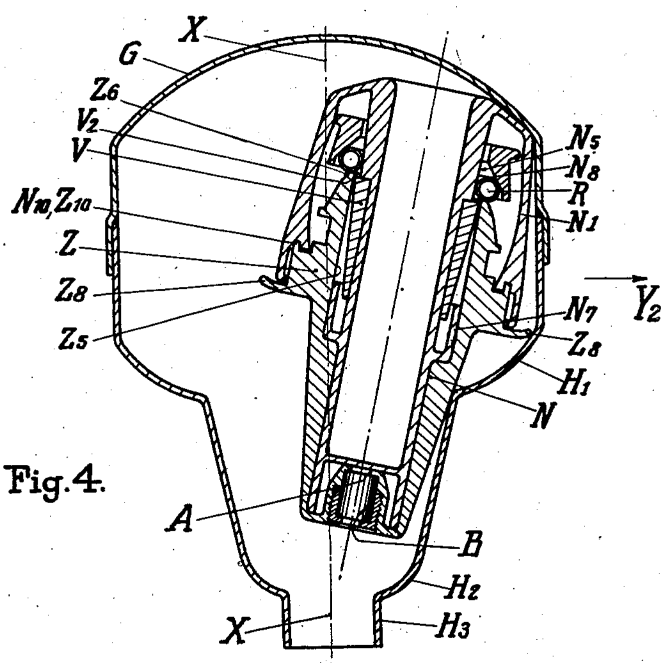

Fig. 4.

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IGNITION DEVICE FOR PROJECTILES

Filed April 1, 1927 3 Sheets-Sheet 3

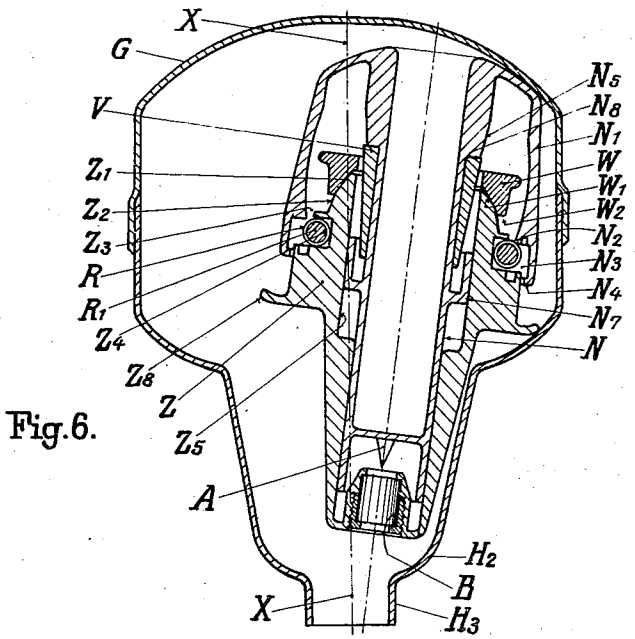

Fig.6.

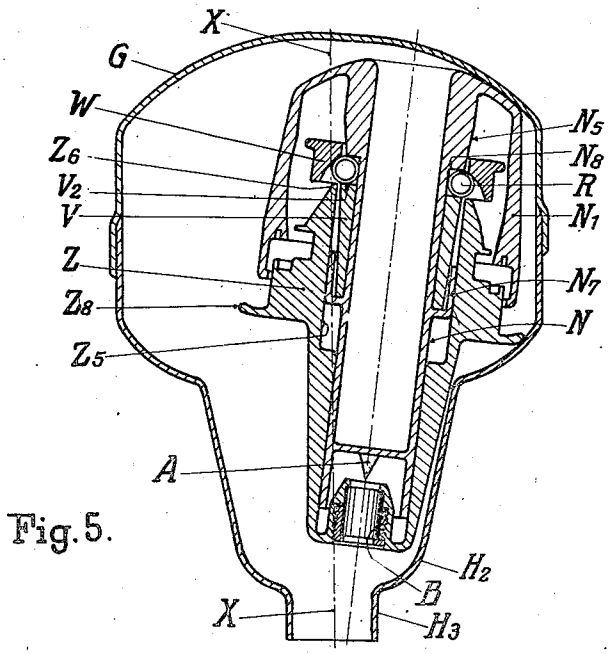

Fig.5.

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Patented July 1, 1930 1,769,848

UNITED STATES PATENT OFFICE

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IGNITION DEVICE FOR PROJECTILES

Application filed April 1, 1927, Serial No. 180,277, and in Austria July 28, 1926.

The present invention relates to an improved fuse equipped with at least one automatic safety device; and it is especially intended for hand grenades and similar projectiles. The automatic operation of the safety devices, in such projectiles, must occur regardless of the direction of the external forces of movement.

In known ignition devices of this kind, it has been proposed to actuate the safety devices by means of an inertia body in the form of a ball; and in order to transmit the inertia action from the ball to the safety parts, various connecting parts, movable in one direction only, have been provided. These parts augment to an enormous extent the action of the ball in their own direction of movement; but on the other hand, the action of the ball in the transverse direction is materially diminished by friction and impact occurring in the movement of the ball. Consequently, the operation of the safety device is not sufficiently uniform in the different directions; and under unsatisfactory conditions, the ball may even become self-checking in transverse directions. This defect, however, is overcome by the present invention, which also provides other advantages.

The accompanying drawings represent an ignition device of the impact type, but merely by way of example.

In said drawings, Figure 1 is a vertical sectional view of a grenade embodying the invention, with the various parts in normal position of rest; Figs. 2 and 3 are similar views showing the position of the parts when the grenade is being projected, and during flight, respectively, while Fig. 4 shows the parts at the end of impact; Fig. 5 represents the safety position of the parts in case the grenade has gone blind; and Fig. 6 shows the parts in latched position brought about by the projectile being subjected to a sudden shock at too near a distance to the gun or the thrower.

The ignition elements are the firing-pin A and the cap B. The safety element consists essentially of an annular spring R, having a constant tendency to contract, while the inertia body, which actuates the safety devices, is constituted mainly by two sleeves N and Z which are slidable axially on each other and are also guided and controlled in their transverse movements by the curved surfaces G, H^1 and H^2 formed on the casing of the device.

The projectile may be thrown by hand, or it may be fired or hurled from a gun or other weapon, in any desired direction relatively to the axis of the projectile, thus producing a relative axial movement of the two inertia sleeves N and Z. Depending upon the particular axial direction in which the grenade is thrown, one or the other sleeve will move (Fig. 2), in consequence of its inertia; while if thrown in an axially oblique direction, for instance, in the direction of the arrow Y^1 in Fig. 2, both sleeves move simultaneously in consequence of their sliding contact with the curved guide surfaces G, H^1 and H^2. Thus, with an axial projection, the inertia of only one sleeve acts, while with a transverse or oblique projection, that of both sleeves. However, with an oblique projection, one component of the inertia force is mostly lost; also, with all non-axial directions, greater friction and impact checks occur. In the transverse and oblique directions, therefore, the greater inertia is diminished by the negative influences, so that a practically constant effect results in the operation of the parts in every direction of projection.

In consequence of the axial movement of inertia of the sleeves N and Z relatively to each other, the spring ring R is forced, during the act of projection, past the bottom edge W^2 of a ring W by the edge or shoulder N^2 provided on sleeve N, so that it snaps over the edge W^2 and seats against an inclined intermediate surface Z^2 on sleeve Z, as shown in Fig. 2.

The diameter of the lateral flange Z^3 which terminates the intermediate inclined surface Z^2 is such that the spring ring R comes to bear against said flange under the influence of the inertia forces set up by projection, and is not forced over the flange. In the resulting position of the sleeves N and Z, as well as of the firing-pin A and cap B, ignition cannot occur, being prevented by the safety

spring R when the latter is in the position shown in Fig. 2.

As the grenade begins its free flight, after leaving the hand or the gun or other weapon, the inertia forces set up by projection cease to act and then the spring ring R contracts to a smaller diameter, moving along the beveled or conical surfaces Z^2 and Z^1, on the upper end of sleeve Z and forcing ahead of it, as it moves, the edge or shoulder N^2 on the bottom of the outer member N^1 of sleeve N, with the result that a relative displacement of the two sleeves takes place. If the sleeves do not occupy in the casing at that time the axial position indicated by the line X—X, they will be returned to that position by the spring which finally comes to rest in contact with the tapered outer surface V^1 of a sleeve V which fits over sleeve N and remains there during the entire flight until impact occurs, during which time it holds the sleeves N and Z in a position in which pin A and cap B are separated longitudinally (Fig. 3). The sleeve V is loose on sleeve N and, as shown, is of inverted frusto-conical form, and its upper or larger base V^2 normally fits in a seat N^3 provided for it in sleeve N and projects slightly beyond the same, thus producing a shoulder or edge over which the spring ring R will snap under certain conditions, as explained hereinafter.

The previously-mentioned ring W loosely encircles sleeve V under ordinary conditions, so that it is free to move in the annular space between sleeve N and its outwardly and downwardly bent portion N^1. Its surface W^1 is inclined or tapered and it is also provided with a bottom edge or shoulder W^2 against which the spring ring R bears during its upward sliding movement along the inclined surfaces Z^2 and Z^1 on sleeve Z, in consequence whereof ring W will likewise be forced slightly forward with sleeve N, and ring R will move within the confines of ring W, as indicated in Fig. 3.

When impact takes place, the ignition elements A and B are caused to approach each other, independently of the direction or angle of impact, by way of example a lateral impact, in the direction of the arrow Y^2 is assumed in Fig. 4. Due to the continued approach of said elements, the percussion cap is ignited and explosion then takes place by reason of the sparks from the cap encountering the detonator cap inserted in the casing at H^3 but not shown.

As will be seen from Fig. 4, the spring ring R, at the moment of impact, snaps behind the edge or shoulder V^2 of the sleeve V and comes to a stop in engagement with the tapered surface N^5 of sleeve N just above the sleeve V; and if, for any reason, the shot is blank or blind, or if the parts have remained uninjured, the spring R will move, after the impact and in consequence of its elasticity, into the stop position of Fig. 5 in which it is disposed in the space between the face of the seat N^3 and the upper base V^2 of sleeve V. Due to the pressure thus exerted on the upper edge Z^6 of the sleeve Z, and to the reaction on the sleeve N, the spring then acts to withdraw the pin A from the cap B. When the spring is in this stop position, the edge Z^6 of sleeve Z cannot pass it, and any subsequent ignition movement is prevented, in consequence, once and for all.

In the event that the projectile, before, during or after firing or projection, but before the spring R comes into its flight position (Fig. 3), is subjected accidentally to a blow or shock, then the sleeves Z and N move inwardly relatively to each other, just as they do in the act of projection and on impact after flight. However, since the dynamic effects are different on impact than they are in projection, the spring, at the impact or blow, snaps over the flange Z^3 and seats in a groove Z^4 which is formed in the surface of sleeve Z immediately below flange Z^3; and in this latched position (Fig. 6) all danger of accidental ignition is overcome, since inward telescoping of the sleeves Z and N, sufficient for ignition, is prevented.

The drawing does not show any hand-released safety device for transportation, but such a device can readily be provided and can be of any desired type.

To permit the operation of the ignition elements A and B by movements of the same inertia bodies N, Z, etc., which also operate the safety devices, an abnormally-great play or lost-motion travel, indicated by the lines b, d^1, d^2 (Fig. 1), is provided, amounting to at least 4½ mm.; and the said inertia bodies have to undergo these movements before the counter-action of the ignition elements A and B begins.

With a lost-motion or path of travel d^1, d^2, in a transverse or oblique direction which is so abnormally great, the ignition cap B would also normally undergo very great lateral movements, so that the passage of ignition sparks to the fixed detonator cap mounted in seat H^3 would be unreliable. To overcome this defect, the said cap B is located as far as possible from the center of gravity of the compound inertia body and, furthermore, the tapered lower portion H^4 of the side wall of the casing forms a stop which allows only a limited transverse movement of cap B. But, in order to still obtain a sufficiently long control of the inertia body at the side of cap B, a special intermediate guide flange Z^8 is provided on the sleeve Z, by means of which that sleeve is controlled by the cooperating curved guide surface H^1 of the casing. The sleeve Z can be controlled entirely by this flange Z^8, or it can be controlled partly by said flange and partly by the curved or rounded lower end Z^{12}, Fig. 2, of the sleeve Z which coacts

with the curved guide surface H^2 of the casing.

This latter control is especially advantageous for initiating the movement of the inertia bodies in the case of oblique impact, in which the loss of energy by impact is great and it is difficult to get the inertia bodies started. But when said bodies are controlled near one end only, they are, in case of oblique impact, easily tilted, thereby initiating the movement, which then continues in consequence of the energy resulting from the tilting.

In the device illustrated, the sleeve Z is guided or controlled first by its rear end Z^{12} and then by its intermediate part or flange Z^8. The guide surface at the side of the cap B is, accordingly, divided into two parts H^1 and H^2 which are relatively displaced axially and at least one of which forms an annular surface. Then the ignition elements A, B are located in the space between the two parts H^1 and H^2 in the tapered portion H^4, in consequence of which the part H^2 acts only at the beginning as a guide surface, since after a certain minimum extent of the side movement, the flange Z^8 comes into contact with the part H^1 (Fig. 4), which then takes care of the further guiding. In consequence of this arrangement, the sleeves N and Z make no movement which is strictly lateral to the axis X—X, but on the contrary make only a tilting or swinging movement, so that the end of the inertia body N, Z containing the ignition cap moves laterally to a considerably less extent than the opposite end of the said inertia body. The passage of sparks from the cap B to the detonator cap is therefore always assured (Fig. 4).

As is obvious, the inertia body (considered as a whole) and its parts make different relative movements under different conditions and, therefore, in order that the action may be reliable and always the same under like conditions, the relatively-movable parts of the inertia body must be accurately guided relatively to each other at least during their operative action. The sleeves N and Z constitute the main parts of the inertia body, in the movement and action of the latter, and the guiding of these parts relatively to each other must, in particular, be accurate. To this end, in the form illustrated, as great a length of guiding surface as possible is provided on the sleeves N and Z; both of them being extended on the side of the ignition cap in the form of a tapered prolongation.

In order to avoid a still further increase in the length of the ignition device, the cap B (or its carrier Z^7) is formed as an inwardly-projecting socket, which is surrounded by the guide portion Z^{11} of sleeve Z; and as a further consequence of this, the pin A is not located at the end of the sleeve N but at a certain distance back therefrom in a recess N^6, so that the pin is surrounded by the hollow case N^{11} which thus serves both to guide one end of sleeve N in sleeve Z and to protect the pin from injury which might occur in storage, mounting, etc.

The same object of reliable, direct, firm and sufficiently prolonged guiding is attained by the annular trough-shaped flange N^7 provided on sleeve N and which slides in the guideway Z^5 of sleeve Z and receives the movable sleeve V. This flange N^7, as well as the parts Z^{11} and N^{11}, all form, as will be seen, hollow guides which enclose other parts.

In the construction illustrated, there are three automatic safety devices, viz: the projection device, the shock latch and the stop or "off" latch. All three have a common safety or latch member, i. e., the spring ring R, which takes different positions for its various actions.

To protect the spring from compression by the forces acting upon it in its safety and latch positions, and to render these forces operative, rigid core-pieces R^1 are inserted in the spring to take up the pressure loads.

In the position illustrated in Fig. 1, the spring seats in a cage N^3, located at the lower end of the turned-back portion N^1. The bottom wall N^4 of this cage leaves between it and the ring W only a narrow free annular space, so that the spring cannot get out of the cage without a relative movement of the parts forming the cage. The top wall of the cage is formed by the edge N^2, which is of smaller diameter than the outer wall of the cage; the result being, on the one hand, that the spring is constrained to work with the edge N^2 until it takes the flight position (Fig. 3) and, on the other hand, in consequence of the width of the cage, the spring is given sufficient space for its expansion movement while on the outwardly-tapering sleeve V.

The sleeve V is movable endwise on the sleeve N to an extent which, though limited, is still great enough to allow the spring to pass between it and the seat or shoulder N^8 which, together with the upper end or base V^2 of sleeve V, forms a recess wherein the spring seats in its latching or safety (blind shot) position (Fig. 5). This seat or recess is kept closed by the action of the spring itself in its flight position (Fig. 3), and is also unclosed by the spring in its movement from its ignition position (Fig. 4) into the blind shot safety position (Fig. 5). To this end, the surfaces V^1 and N^5 are tapered in the same direction, that is, towards the sleeve Z, so that the spring is given a tendency to move towards sleeve Z.

Before the spring R can enter into the groove Z^4, it must be forced over the edge of flange Z^3, since it previously lies in the annular space between said flange and the edge W^2 of ring W, into which space it

initially moves on being forced downward from engagement with said ring. If this takes place very rapidly, for instance in case of an impact, the spring has no time to spring deeply enough into the aforesaid space between the parts W^2 and Z^3 so that it slides over part Z^3 into the safety groove Z^4, Fig. 6; but if the spring slides downwardly relatively slowly, for instance in case of ordinary throwing, it contracts fully until it comes to a seat on said flange Z^3. To force it now over the edge of the flange is relatively difficult or even impossible.

By the above described construction, there is provided a resistance against the entry of the spring into the latch position, Fig. 6, which depends upon the speed of movement of the spring in such a way that the said resistance becomes less as the speed of said spring increases.

Without the annular space between edge W^2 and flange Z^3, the transverse surface of the flange would form a resistance to the entry of the spring into the latch position, which would be independent of the velocity of movement of the spring.

In order to make the resistance path as small as possible and, at the same time, to attain in a simple way precision of operation of the device, the transverse flange Z^3 is given such size and is so located that the spring R only comes into contact with the edge of said flange.

To prevent an accidental, even if only a slight, sliding of the spring beyond its latching groove Z^4, an annular rib Z^{10} is provided behind said groove, with which a similar rib N^{10} formed on the bottom face of shoulder N^2 is adapted to interlock on impact (Fig. 4).

The invention is not limited to ignition devices of the impact type, but can also be employed to a certain extent in time fuses. The two sleeves, operating the projection safety device, could operate, for example, a friction ignition wire in their movement from the position of Fig. 2 to that of Fig. 3, which wire would start a flame igniter. But even in impact igniters, the sleeves N and Z need not necessarily act as the inertia body which actuates also the ignition elements A, B, as those elements could be mounted and arranged on some other parts than the sleeves and which could be suitably connected with the safety parts.

I claim as my invention:

1. In a projectile, the combination of ignition devices; a universally-movable inertia body for operating the same comprising two slidably related members movable relatively to each other consequent upon the inertia produced by the action of external forces on the projectile; and a safety device comprising a contractible and expansible spring ring encircling the inertia body to be controlled by the operation thereof and itself controlling the operation of the ignition devices.

2. A projectile, according to claim 1, in which one member of the inertia body is formed with an annular groove to receive the spring ring under predetermined conditions, whereby the relative movement of the two members is prevented.

3. A projectile, according to claim 1, in which the spring ring is provided with at least one internal stiffening member.

4. A projectile, according to claim 1, in which the edges of the parts constituting the inertia body are formed as guide surfaces for controlling the movements of the spring ring.

5. A projectile, according to claim 1, in which one member of the inertia body comprises spaced outer and inner annular parts, the space between which is adapted to slidably receive another member of said body, whereby, in the relative movement of said members, the spring ring is actuated.

6. A projectile, according to claim 1, in which one member of the inertia body is formed with an annular groove to receive said ring under predetermined conditions, whereby the relative movement of the two members is prevented; and in which means are provided for resisting the entrance of the ring into such groove.

7. A projectile, according to claim 1, in which one member of the inertia body is formed with an annular groove to receive said ring under predetermined conditions, whereby the relative movement of the two members is prevented; and in which a transversely-disposed member is provided on the grooved member to resist the entrance of the ring into such groove.

8. In a projectile, the combination of ignition devices; a universally-movable inertia body for operating the same comprising two slidably related members movable relatively to each other consequent upon the inertia produced by the action of external forces on the projectile; and an annular safety device encircling the inertia body to be controlled by the operation thereof and itself controlling the operation of the ignition devices.

9. A projectile, according to claim 8, in which one member of the inertia body is formed with an annular groove to receive the safety device under predetermined conditions, whereby the relative movement of the two members is prevented.

10. A projectile, according to claim 8, in which the edges of the members of the inertia body are formed as guide surfaces to control the movements of the annular safety device.

11. A projectile, according to claim 8, in which one member of the inertia body is formed with an annular groove to receive the safety device under predetermined condi-

tions, whereby the relative movement of the two members is prevented; and in which means are provided for resisting the entrance of the safety device into such groove.

12. A projectile, according to claim 8, in which one member of the inertia body is formed with an annular groove to receive the safety device under predetermined conditions, whereby the relative movement of the two members is prevented; and in which a transversely-disposed member is provided on the grooved member to resist the entrance of the safety device into such groove.

13. A projectile, according to claim 8, in which one member of the inertia body comprises spaced outer and inner annular parts, the space between which is adapted to slidably receive another member of said body, whereby, in the relative movement of said members, the safety device is actuated.

14. In a projectile, the combination of a casing; ignition devices enclosed therein; a safety device in said casing actuated by the external throwing forces for preventing ignition during throwing; a universally-movable inertia body in the casing for actuating and releasing the safety device regardless of the direction of said throwing forces with relation to the axis of the projectile, said inertia body comprising two slidably related members movable relatively to each other consequent upon the inertia produced by said throwing forces; and means for guiding the inertia body in its transverse movements.

15. In a projectile, the combination of a casing; ignition devices enclosed therein; a universally-movable inertia body in said casing for operating the ignition devices and comprising two slidably related members movable relatively to each other consequent upon the inertia produced by the action of the external throwing forces exerted upon the projectile; means for guiding said body in its transverse movements; and a safety device in the casing actuated by said external throwing forces for preventing ignition during throwing and itself actuated and released by the members of the inertia body regardless of the direction of said external forces with relation to the axis of the projectile.

16. In a projectile, the combination of a casing; ignition devices enclosed therein; a safety device in said casing for preventing ignition during throwing; a universally-movable inertia body in the casing for actuating and releasing the safety device regardless of the direction of the external throwing forces with relation to the axis of the projectile, said inertia body comprising two telescoping members mounted for relative sliding movement consequent upon the inertia produced by said throwing forces; and means for guiding the inertia body in its transverse movements.

17. A projectile, according to claim 15, in which at least one part of the safety device is located between the two members of the inertia body, whereby such part is caused to partake at least partially of the relative movements of said members.

18. In a projectile, the combination of ignition devices; a safety device actuated by the external throwing forces for preventing ignition during throwing; a universally-movable inertia body for actuating and releasing the safety device regardless of the direction of said throwing forces with relation to the axis of the projectile, said inertia body comprising two slidably related members movable relatively to each other consequent upon the inertia produced by said throwing forces; and a casing wherein the ignition devices and the inertia body are enclosed, said casing having portions thereof constituting guides for coaction with said body to control its transverse movements.

19. A projectile, according to claim 18, in which the guide portions of the casing are constructed to impart a combined tilting and lateral movement to the inertia body.

20. In a projectile, the combination of a casing; ignition devices enclosed therein; a safety device in said casing for preventing ignition during throwing; a universally-movable inertia body in the casing for actuating and releasing the safety device regardless of the direction of the external throwing forces with relation to the axis of the projectile, said inertia body comprising two telescoping members mounted for relative sliding movement upon each other consequent upon the inertia produced by said throwing forces, one of said members having a long lost-motion movement to execute before ignition is effected; and means for guiding the inertia body in its movements.

21. In a projectile, the combination of a casing; ignition devices enclosed therein; a safety device in said casing for preventing ignition during throwing; a universally-movable inertia body in the casing for actuating and releasing the safety device regardless of the direction of the external throwing forces with relation to the axis of the projectile, said inertia body comprising two slidably related members movable relatively to each other consequent upon the inertia produced by said throwing forces; means for guiding the inertia body in its transverse movements; and abutments, additional to said guiding means, against which said body strikes in its transverse movement and is thereby stopped at the point where it is struck, while at other points it is caused to execute a swinging movement.

22. In a projectile, the combination of ignition devices; a safety device for preventing ignition during throwing; a universally-movable inertia body for actuating and re-

leasing the safety device regardless of the direction of the external throwing forces with relation to the axis of the projectile, said inertia body comprising two slidably related members movable relatively to each other consequent upon the inertia produced by said throwing forces; and a casing wherein the ignition devices and the inertia body are enclosed, said casing having annular guide portions for coaction with the inertia body at at least one point intermediate its ends to control the transverse movements of said body.

23. In a projectile, the combination of ignition devices; a safety device for preventing ignition during throwing; a universally-movable inertia body for actuating and releasing the safety device regardless of the direction of the external throwing forces with relation to the axis of the projectile, said inertia body comprising two slidably related members movable relatively to each other consequent upon the inertia produced by said throwing forces; and a casing wherein the ignition devices and the inertia body are enclosed, said casing having a plurality of guide portions for coaction with the inertia body to control the transverse movements thereof, said guide portions being positioned to act one after another on said body.

24. A projectile, according to claim 18, in which the point where ignition occurs is located between two guide portions.

25. In a projectile, the combination of a casing; ignition devices enclosed therein; a safety device in said casing for preventing ignition during throwing; and a universally-movable inertia body in the casing for actuating and releasing the safety device regardless of the direction of the external throwing forces with relation to the axis of the projectile, said inertia body comprising two telescoping sleeves slidable relatively to each other consequent upon the inertia produced by said throwing forces.

26. In a projectile, the combination of a universally-movable inertia body comprising two telescoping sleeves slidable relatively to each other consequent upon the inertia produced by the action of external throwing forces upon the projectile; a firing pin carried by one sleeve; a percussion cap carried by the other sleeve to be ignited by the firing-pin; a safety device for preventing ignition during throwing, said safety device being actuated and released by the inertia body regardless of the direction of said throwing forces with relation to the axis of the projectile; and a casing wherein the two sleeves of the inertia body, the parts carried thereby and the safety device are enclosed.

27. In a projectile, the combination of a universally-movable inertia body comprising two telescoping sleeves slidable relatively to each other consequent upon the inertia produced by the action of external throwing forces upon the projectile, one sleeve having an axial extension and the other sleeve having an inwardly-projecting socket; a firing-pin mounted in said extension; a cap disposed in said socket in line with said pin; a safety device for preventing ignition during throwing, said safety device being actuated and released by the inertia body regardless of the direction of said throwing forces with relation to the axis of the projectile; and a casing wherein the two sleeves of the inertia body, the parts carried thereby, and the safety device are enclosed.

28. In a projectile, the combination of ignition devices; a safety device for preventing ignition during throwing; a universally-movable inertia body for actuating and releasing the safety device regardless of the direction of the external throwing devices with relation to the axis of the projectile; and a casing wherein the ignition devices and the inertia body are enclosed, said casing having portions thereof constituting guides for imparting to said body a combined lateral and tilting movement.

29. In a projectile; the combination of ignition devices; a safety device for preventing ignition during throwing; a universally-movable inertia body for actuating and releasing the safety device regardless of the direction of the external throwing devices with relation to the axis of the projectile; and a casing wherein the ignition devices and the inertia body are enclosed, said casing having portions thereof constituting guides for imparting lateral movements of different extents to the opposite ends of said body.

30. In a projectile, the combination of ignition devices; a safety device for preventing ignition during throwing; a universally-movable inertia body for actuating and releasing the safety device regardless of the direction of the external throwing devices with relation to the axis of the projectile; and a casing wherein the ignition devices and the inertia body are enclosed, said casing having differently-curved portions thereof constituting guides for imparting lateral movements of different extents to the opposite ends of said body.

31. A projectile according to claim 28, in which the guide portions of the casing coact with the ends of the inertia body, and in which another portion of the casing constitutes a guide for coaction with an intermediate portion of said body.

In testimony whereof I affix my signature.

SALAMON LEBENSART.