United States Patent

Held

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[54] IGNITION SYSTEM FOR WARHEAD

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[30] **Foreign Application Priority Data**

Oct. 16, 1968 Germany ..... P 18 05 467.6

[52] **U.S. Cl.** ..... **102/70.2 A**, 102/21.6

[51] **Int. Cl.** **F42c 11/04**, F42c 15/40, F42c 19/06

[58] **Field of Search** 102/70.2, 18, 68

[56] **References Cited**

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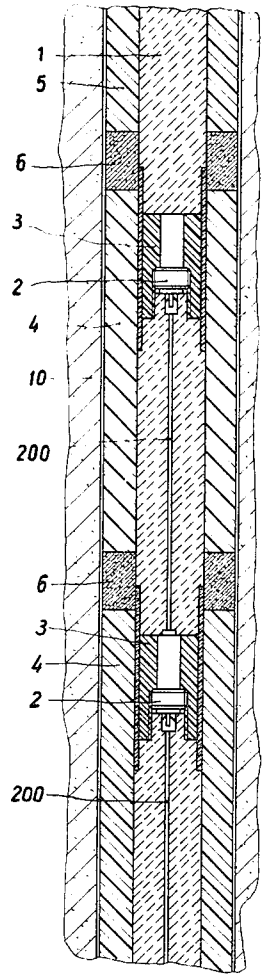
[57] **ABSTRACT**

An ignition system, for the simultaneous ignition of several charges arranged in different cross-sectional planes of an elongated warhead and extending perpendicular to the longitudinal center line of the warhead, includes a rod displaceable along the longitudinal center line, relative to the cross-sectional planes, and having two possible positions spaced longitudinally from each other. The rod has, at locations therealong, and in cross-sectional planes corresponding to the cross-sectional planes of the warheads, devices operable to ignite the charges. The corresponding cross-sectional planes of the warhead and the rod coincide in one of the two possible positions of the head. These two positions can be termed, respectively, the "ignition locked" position and the "ignition released" position.

9 Claims, 8 Drawing Figures



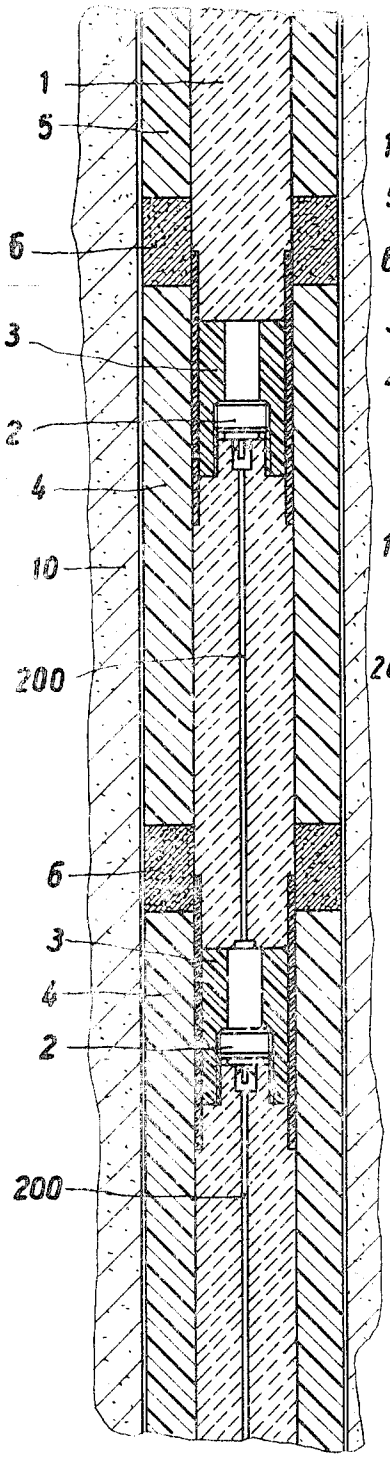


Fig. 1

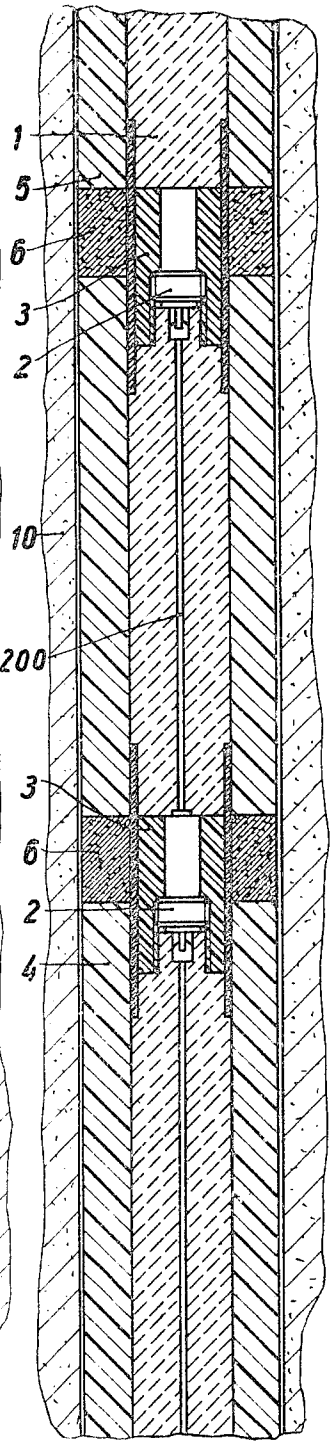


Fig 2

Fig. 5

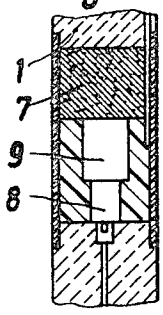


Fig. 4

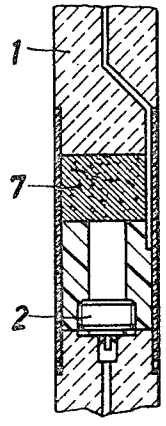
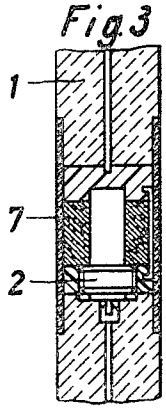


Fig. 3



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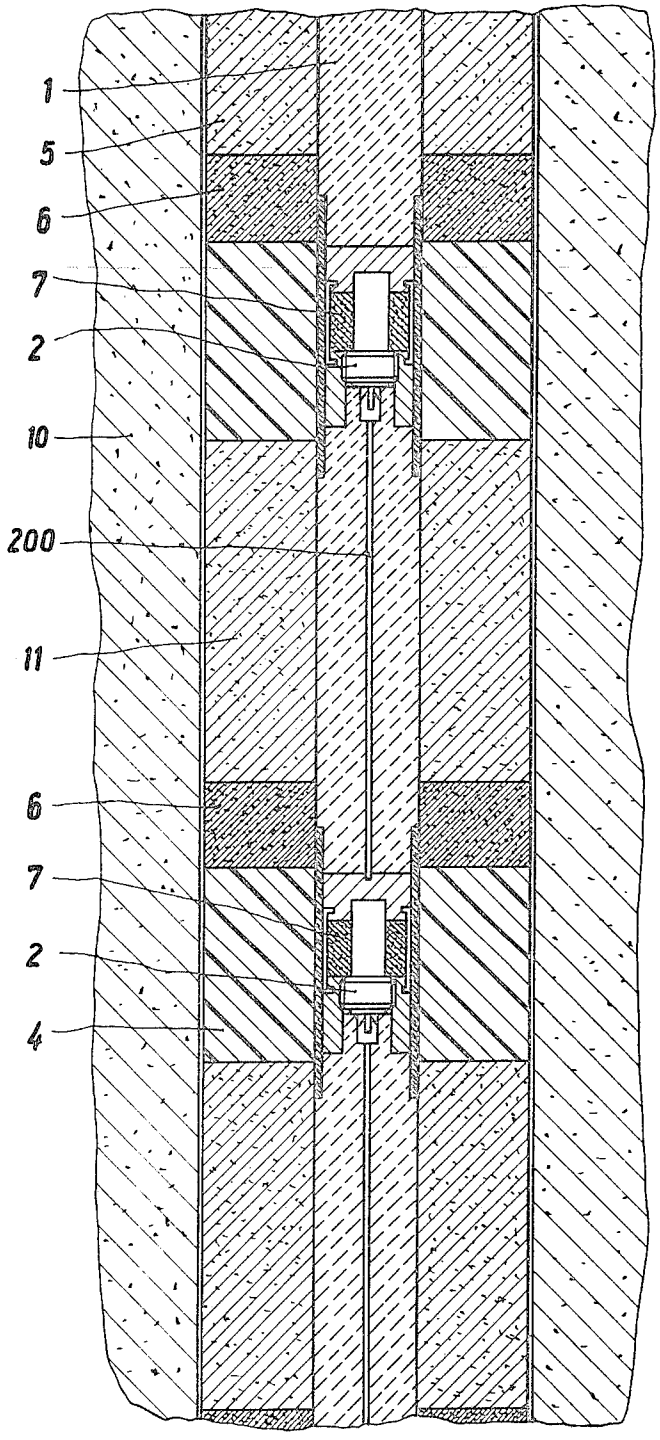

Fig.6

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Fig. 7

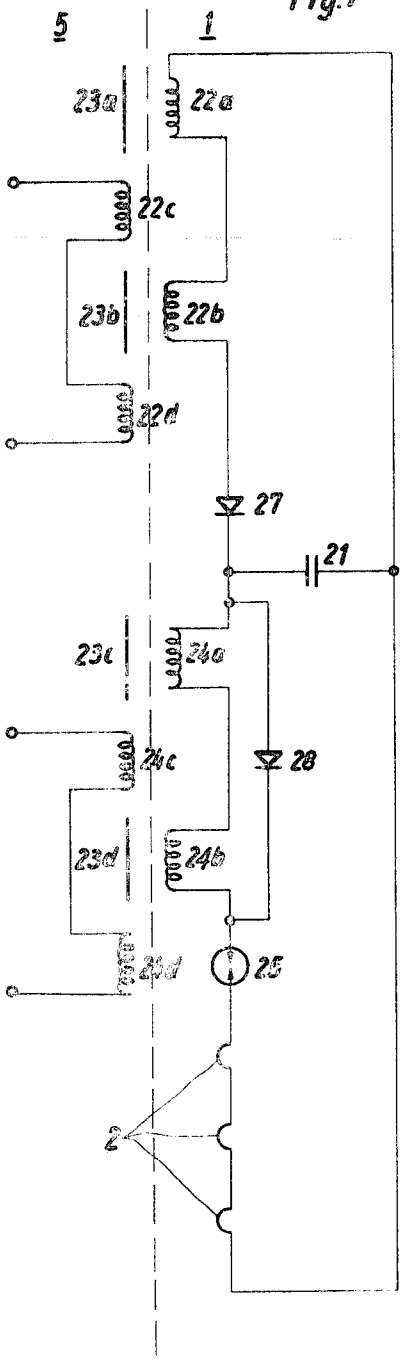
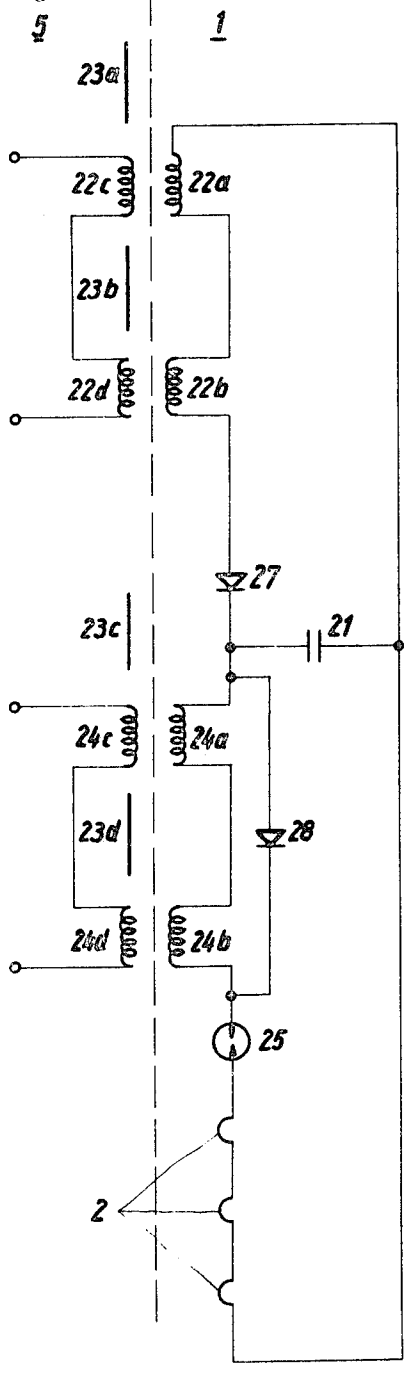


Fig. 8



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IGNITION SYSTEM FOR WARHEAD

BACKGROUND OF THE INVENTION

A proposed warhead has hollow charges distributed in different cross-sectional planes of the warhead, substantially uniformly over the circumference of the warhead. Thereby there is achieved a fragmenting effect distributed substantially uniformly in all directions, during the simultaneous ignition of all the charges inside a warhead, with the high piercing effect caused by the hollow charges. An important problem of these warheads is the accurate simultaneous ignition of all the charges.

SUMMARY OF THE INVENTION

This invention relates to an ignition system for the simultaneous ignition of several charges arranged in different cross-sectional planes of an elongated warhead, the planes extending perpendicularly to the longitudinal axis. More particularly, the invention relates to a simplified ignition system in which a principal element has an ignition locked position and an ignition released position.

The objective of the invention is to provide an ignition system for the simultaneous ignition of such warheads, and which is simple in design, safe in operation, and offers the simple possibility of locking the ignition system before use of the warhead and of unlocking it when the warhead is used. In accordance with the invention, a rod is provided which may be displaced along the longitudinal axis of the warhead relative to the cross-sectional planes, the rod being displaceable between two possible positions. This rod has devices, in corresponding cross-sectional planes, effecting the ignition of the charges. The cross-sectional planes of the warhead coincide with the corresponding cross-sectional planes of the rod in only one of the two possible positions of the rod.

By using such simply designed moving rod, it is possible to bring devices, arranged inside the rod, from a position of the rod where the ignition system is locked, by displacing the rod into its other position, where the ignition system is released, exactly into the cross-sectional planes of the warhead which contain the various charges of the warhead to be primed.

In accordance with a preferred embodiment of the invention, the devices arranged in the rod are electric detonators all of which detonate simultaneously at the time of the ignition. These electric detonators prime pyrotechnically, with the ignition system released, the charges of the warhead arranged in the same cross-sectional planes, and hence directly adjoining the detonators.

In accordance with a further feature of the invention, the electric elements necessary for transmitting electric ignition energy are so arranged in the rod that a transmission of the ignition energy, by means of inductive coupling of windings in the rod and windings in the surrounding warhead, is possible only in the released position of the rod with respect to the warhead. This arrangement has the effect, on the one hand, that the electric detonators in the rod are connected with each other and also with the necessary electric elements through optimum short lines, so that only minimum line inductances occur. On the other hand, an additional electric locking of the ignition system is effected in the locked position of the rod.

It will be appreciated that embodiments of the warhead can also have the electric detonators arranged stationary next to the charges of the warhead, and only the electric elements, for example, the transformer windings, are displaced by means of the rod with respect to the warhead from a locked position into an unlocked position.

An object of the invention is to provide an improved ignition system for the simultaneous ignition of all of the charges of an elongated warhead.

Another object of the invention is to provide such an ignition system which is simple in design, safe in operation, and provides for locking of the ignition system before use of the warhead and unlocking the ignition system when the warhead is used.

A further object of the invention is to provide such an ignition system including a rod movable between two positions, and carrying devices for effecting ignition of the charges in the warhead.

Another object of the invention is to provide such an ignition system in which ignition can be effected only in one of two possible positions of the rod and the ignition system is locked in the other of the two possible positions of the rod.

For an understanding of the principles of the invention, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIGS. **1** and **2** are longitudinal sectional views of a warhead having an ignition system including electric detonators arranged in the rod;

FIGS. **3**, **4** and **5** are longitudinal sectional views illustrating different arrangements of the detonators in the rod;

FIG. **6** is a longitudinal sectional view illustrating a different design of the warhead surrounding the rod; and

FIGS. **7** and **8** are schematic wiring diagrams illustrating an embodiment of the invention including electric elements arranged in the rod.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. **1** and **2** illustrate, diagrammatically, the inner part of the warhead which is not represented therein in full detail. The warhead consists, substantially, of the explosive material **10** and of coverings, which have not been shown, arranged on its surface in different planes or zones. A rod **1** extends along the longitudinal axis or center line of the warhead and carries electric detonators **2** in different cross-sectional planes. Only two of these detonators have been illustrated, for the sake of simplicity, and these are connected, in a manner not specifically illustrated, with an ignition circuit over an electric line **200**. The particular ignition circuit, supplying the ignition energy, has not been illustrated as these are known to the art.

Electric detonators **2** are covered with a shock-wave absorbing material **3**. Rod **1** is surrounded by a sleeve **5** forming part of the warhead, and sleeve **5** consists substantially of a shock-wave absorbing material **4** which is interrupted in the different cross-sectional planes of the warhead by transmission charges **6** which thus adjoin directly the explosive charge proper **10** of the warhead.

In FIG. **1**, the ignition system embodying the invention is illustrated in its locked position, in which rod **1** is in one of its two possible positions with respect to the warhead. In this position, electric detonators **2** are displaced longitudinally relative to the transmission charges **6**, by a sufficient longitudinal spacing. If, due to an unforeseen incident, electric detonators **2** should be released in this locked position of rod **2**, the warhead itself cannot be detonated because the shock-waves, originating from the electric detonators **2**, are absorbed by the absorbent material **3** directly surrounding the electric detonators **2** and by the additional absorbent material **4** of sleeve **5**, adjoining material **3** in such locked position. Thus the detonators cannot prime the transmission charges **6** so that explosive charge **10** of the warhead cannot be ignited.

However, if rod **1** is moved into the unlocked position of the warhead, shown in FIG. **2**, and which may be termed the ignition released position, electric detonators **2** occupy the same cross-sectional planes as the respective transmission charges **6** and thus prime transmission charges **6** to ignite explosive charge **10** despite the surrounding absorbent material, when an ignition impulse, releasing the detonators **2**, appears. Since the electric transit times between the individual detonators **2** lie, in the unlocked position shown in FIG. **2**, directly in the planes containing the transmission charges **6**, an ignition of explosive charge **10** occurs substantially simultaneously in the different cross-sectional planes of the warhead. Thereby the

coverings, which have not been shown, arranged in these different crossnsectional planes, for example on the shell of the warhead, are broken off or fragmented simultaneously.

If detonators 2 develop only a relatively weak shock-wave upon release, the absorbent material 3 surrounding the detonators must be replaced by a reinforcing charge 7 inside rod 1, as shown in FIG. 3, so that a satisfactory priming of transmission charges 6 adjoining, in the respective cross-sectional planes, is insured.

Reinforcing charge 7 also can be arranged, if desired, in the manner shown in FIG. 4 and directly behind the electric detonators 2 inside rod 1.

If only weak electric ignition elements 8 are used instead of an electric detonator, as shown in FIG. 5, a flame detonator 9 must be associated with the respective electric detonators. These flame detonators transmit the weak energy, given off by ignition element 8, to reinforcing charges 7.

In order to accommodate a maximum amount of explosive 10 in a warhead, it is possible, as shown in FIG. 6, to fill the space between the transmission charges 6 and the absorbent material 4 inside sleeve 5 of the warhead with additional ring-shaped explosive charges 11. In this embodiment of the invention, the diameter of sleeve 5 can be made correspondingly greater, so that greater safety thicknesses are possible at the same time for the absorbent material 4 without the entire weight of the explosive charge of the warhead being reduced in an undesirable manner.

Since there are usually large spacings between electric detonators 2 inside rod 1, this space can be used for the electric elements necessary for ignition of detonators 2. For the ignition of commercial electric detonators there are required, for example, for a simultaneous response, voltages of about 600 V with a discharge capacity of 2 mμF. The length of the line between the condensers and the electric detonators should be as short as possible in order to obtain low inductances in the ignition circuit and thus steep electric pulses.

In accordance with a further feature of the invention, most of the electric elements required for the ignition circuit are arranged inside rod 1 itself. FIGS. 7 and 8 show an ignition circuit arranged in rod 1 and comprising a charging condenser 21, an overvoltage arrester 25 and electric detonators 2. The charging voltage required for the condenser is supplied to the ignition circuit from a voltage source, which has not been shown, by inductance and through transformers, whose primary windings 22*c* and 22*d* are arranged in the ignition circuit proper in rod 1. The transformer windings between rod 1 and sleeve 5 of the warhead, are divided into two oppositely wound parts 22*a* and 22*b*, and 22*c* and 22*d*, respectively, so that an alternating feed, superposed on the entire rod, cannot result in the appearance of a voltage at the output of windings 22*a* and 22*b*.

Windings 22*a* and 22*b* are arranged at such a spacing from each other that they are surrounded, in the position of rod 1 represented in FIG. 7, by electrically conductive shields 23*a* and 23*b*. These shields may comprise, for example, copper or mu-metal bands. If rod 1 is now moved into the unlocked position shown in FIG. 8, windings 22*a* and 22*b* of rod 1 and windings 22*c* and 22*d* of the warhead are in the same cross-sectional planes, and voltage can be transmitted to the ignition circuit arranged in rod 1. The ignition pulse for the response of the overvoltage arrester 25 is transmitted through the medium of second transformer coils composed, in a similar manner, of four parts 24*a*, 24*b*, 24*c* and 24*d*.

In the locked position of the ignition system shown in FIG. 7, not only can ignition condenser 21 not be charged through transformer coils 22, but also an ignition impulse cannot be transmitted to transformer coils 24, since the shields 23*a* –23*d* of sleeve 5, opposite windings 22*a* and 22*b* as well as opposite windings 24*a* and 24*b* are arranged in rod 1 as short circuit windings.

However, if rod 1 is moved into the unlocked position shown in FIG. 8, the windings of rod 1 are arranged opposite the corresponding windings of sleeve 5 of the warhead. An alternating voltage 26 on the primary side of transformer coils 22 transmits a voltage to the secondary side, which charges condenser 21 in rod 1 through a rectifier 27. This charge, imparted to condenser 21, is not by itself sufficiently high to bring about a response of overvoltage arrester 25 connected in series with detonators 2. By an additional current surge to the primary side of transformer coils 24, a voltage peak is superposed on the charging voltage of the condenser, and this ignites the overvoltage arrester.

A diode 28, connected in parallel with windings 24*a* and 24*b*, prevents collapse of the charging voltage of condenser 21 before a sufficient ignition current reaches detonators 2. During the ignition of overvoltage arrester 25, condenser 21 is discharged through diode 28 and the series-connected electric detonators 2 with a very steep current rise, thus releasing detonators 2.

Due to the arrangement of the electric elements necessary for ignition in rod 1, it is possible to obtain very short, and thus low-inductance, lines, which permit a steep current rise for the rapid simultaneous response of the low-ohmic electric detonators.

While specific embodiments of the invention have been shown and described to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. An ignition system, for the simultaneous ignition of several charges arranged in respective different longitudinally spaced cross-sectional planes of an elongated warhead and extending perpendicular to the longitudinal center line of the warhead, said ignition system comprising, in combination, a rod of combustible material displaceable along the longitudinal center line of the warhead, relative to said cross-sectional planes, and having two possible positions; aid rod having, at locations therealong, in cross-sectional planes corresponding to said cross-sectional planes of said warhead, devices operable to ignite said charges; the corresponding cross-sectional planes of said warhead and said rod coinciding in one of said two possible positions of said rod.

2. An ignition system, as claimed in claim 1, in which said devices are electric detonators.

3. An ignition system, as claimed in claim 1, in which said devices are electric elements operable to transmit electric ignition energy.

4. An ignition system, for the simultaneous ignition of several charges arranged in respective different cross-sectional planes of an elongated warhead and extending perpendicular to the longitudinal center line of the warhead, said ignition system comprising, in combination, a rod of combustible material displaceable along the longitudinal center line of the warhead, relative to said cross-sectional planes, and having two possible positions; said rod having, at locations therealong, in cross-sectional planes corresponding to said cross-sectional planes of said warhead, devices operable to ignite said charges; the corresponding cross-sectional planes of said warhead and said rod coinciding in one of said two possible positions of said rod; said devices being transformer coils operable to supply ignition energy to an ignition circuit arranged in said rod.

5. An ignition system, as claimed in claim 2, including transmission charges arranged in said cross-sectional planes of said warhead; said warhead including a main explosive charge; and an absorbent material adjacent said main explosive charge in regions between said transmission charges

6. In ignition system, as claimed in claim 2, including an absorbent material surrounding said electric detonators in said rod.

7. An ignition system, as claimed in claim 2, including reinforcing charges in said rod adjacent said electric detonators.

8. An ignition system, as claimed in claim 2, including flame detonators each operatively associated with an electric detonator.

9. An ignition system, as claimed in claim 5, including annular explosive charges surrounding said rod between said transmission charges.

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