435/608 XR 3,466,761 233

Sept. 16, 1969 R. G. STINCHCOMB 3,466,761

HIT INDICATOR ARRANGEMENT

Filed Feb. 3, 1967 2 Sheets-Sheet 1

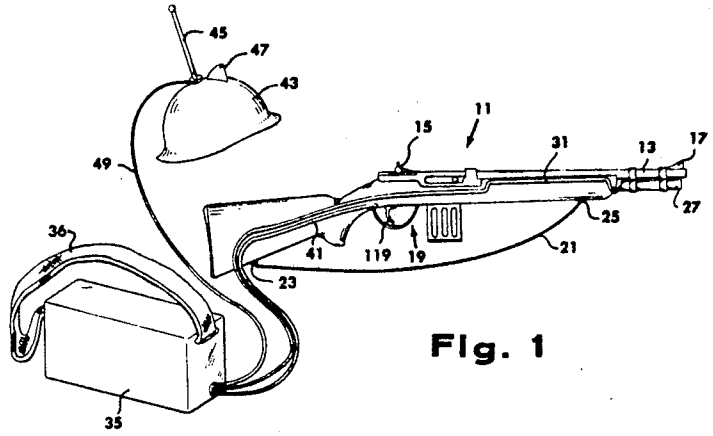


Fig. 1

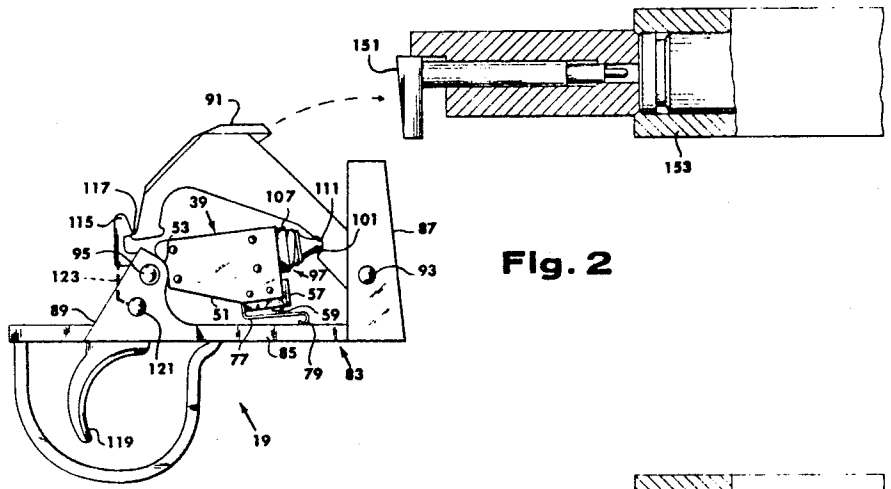


Fig. 2

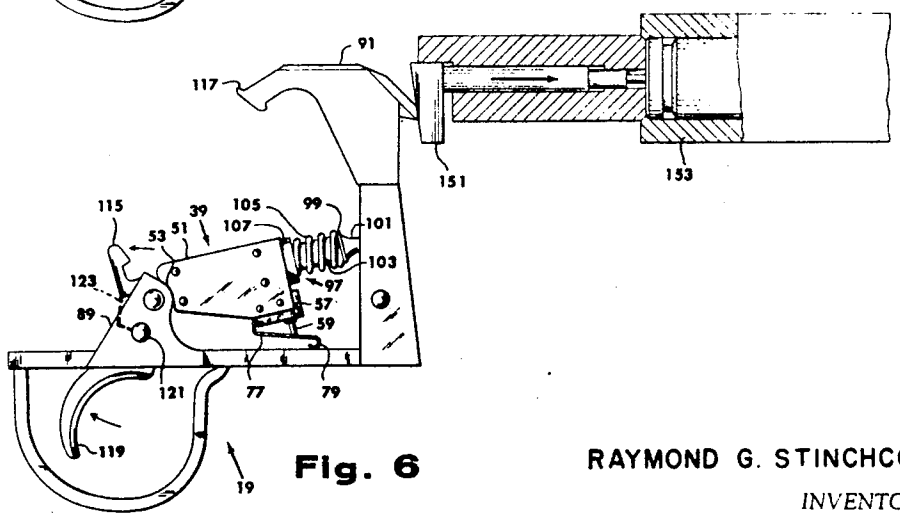


Fig. 6

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HIT INDICATOR ARRANGEMENT

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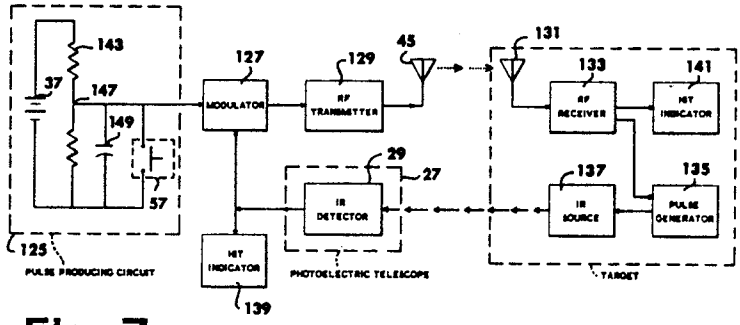


Fig. 7

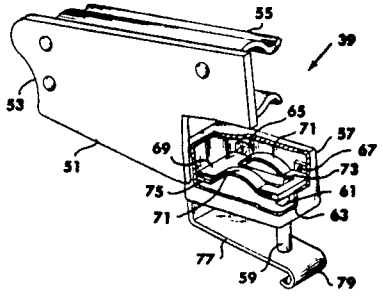


Fig. 4

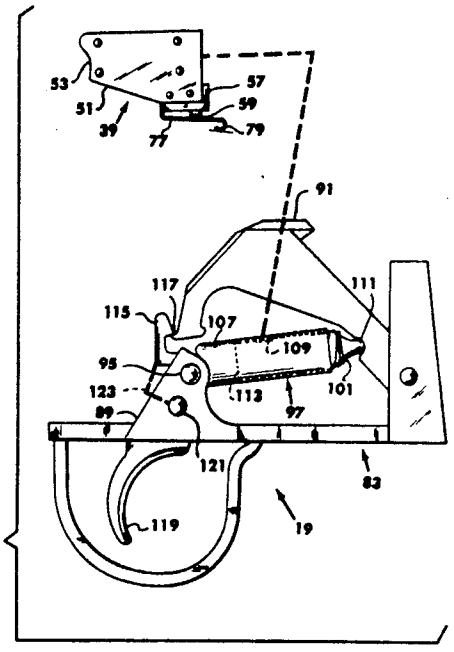


Fig. 3

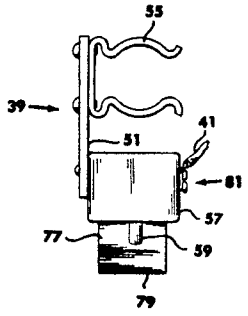


Fig. 5

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United States Patent Office 3,466,761 Patented Sept. 16, 1969

3,466,761

HIT INDICATOR ARRANGEMENT

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Int. Cl. F41g 3/26; A63f 9/02; H04b 1/00
U.S. Cl. 35—25 11 Claims

ABSTRACT OF THE DISCLOSURE

A hit indicator arrangement is disclosed for simulated hit-kill field practice which permits the use of a standard rifle with pulse initiating means attachable to the trigger assembly for initiating a target interrogation pulse when the trigger is squeezed. The arrangement is an improvement particularly applicable to hit indicator arrangements as shown in U.S. Patent No. 3,104,478.

In a hit indicator system of the type disclosed in U.S. Patent No. 3,104,478, apparatus is attached to a rifle so that when a rifleman fires his rifle at a target a pulse is produced which causes an omnidirectional radio frequency target interrogation signal to be transmitted. The radio frequency signal causes an infrared source mounted on the target to radiate a signal. If the rifle is properly aimed, a photoelectrically responsive element, disposed at, or near, the focal plane of a telescopic lens arrangement, such being hereinafter referred to as a photoscope or photoelectric telescope, which is attached to the rifle, will receive the infrared signal and produce an electrical output signal which may desirably cause the apparatus to produce another radio frequency signal which informs the target that a hit has been scored. In addition, or alternatively, the weapon-connected apparatus may desirably produce a signal informing the rifleman that a hit has been scored.

The purpose of such hit indicator systems is to permit the tactical field training of personnel on a realistic basis. As it is highly desirable that the hit indicator system be used with a standard rifle, such as an M–14 rifle, it is desirable that the pulse initiating device be attachable to the rifle without modification of the rifle or the use of special tools. Accordingly, it is a feature of this invention to provide a pulse initiating device which can be easily installed on a standard rifle by a rifleman without the need for special tools.

To conduct the tactical field training of personnel on as realistic a basis as possible, blank ammunition is used in the rifles. However, the loud noise and/or the reactive forces resulting from the cartridge firing often causes the rifle to be moved through flinching and/or recoil force action to some degree and thereby disturbs the aim of the rifle. As a result, the photoscope attached to the rifle may not receive the infrared signal from the target and thus a hit will not be registered even though the rifle was on target at the time of firing and would have scored a hit with live ammunition. Therefore, it is highly desirable that the infrared target signal be received at the rifle before the firing of the rifle can disturb the aim of the rifleman. Preferably it should be received before the hammer strikes the firing pin. In order for this to be accomplished, the signal sequence should begin with or very shortly after the release of the hammer by the hammer sear of the rifle. Accordingly, it is a feature of this invention to provide a pulse initiating arrangement which will produce an electrical pulse for initiating generation of an interrogation signal pulse very shortly after the rifleman squeezes the trigger.

In accordance with the present invention there is provided a pulse initiating device having a bracket adapted to fasten onto the hammer actuator plunger housing of the trigger group assembly of a rifle. Attached to the bracket is an over-center toggle action switch which is connected as a part of a pulse producing circuit that supplies a pulse to a modulator which causes a radio frequency signal to be transmitted. The switch is actuated as a function of the motion of the plunger housing and has a first electrical conductance condition when the trigger group assembly is in a cocked position and a second electrical conductance condition during the firing action of the trigger group assembly. As the trigger group assembly changes from a cocked position to the firing position, the switch is operated so as to initiate a pulse by the pulse producing circuit which causes the radio frequency signal to be transmitted.

Still other objects, features and attendant advantages will become apparent to those skilled in the art from a reading of the following detailed description of one physical embodiment constructed in accordance with the invention, taken in conjunction with the accompanying drawings where:

FIG. 1 is a schematic illustration of an embodiment of the invention as applied to a rifle hit indicator arrangement.

FIG. 2 is a schematic view in side elevation of the rifle trigger group arrangement embodying a pulse iniating device according to the invention, and showing the position of the parts when the hammer is in a cocked position.

FIG. 3 is an exploded view of the rifle trigger group arrangement showing the pulse initiating device and the position of the parts when the hammer is in a cocked position.

FIG. 4 is a side elevation view of the pulse initiating device which is attachable to the trigger assembly of the weapon.

FIG. 5 is an end view of the pulse initiating device.

FIG. 6 is a view similar to that of FIG. 2, showing the position of the parts when the hammer is in the firing position.

FIG. 7 is a circuit schematic of an electrical network embodying the invention.

Referring now in detail to the figures of the drawings, as shown in FIG. 1 the equipment which will normally be worn and carried by a rifleman during simulated tactical field training when employing a hit indicator system according to U.S. Patent No. 3,104,478, and the present invention includes a rifle generally indicated at **11** with a muzzle **13**, aiming elements **15** and **17**, a trigger group assembly generally indicated at **19**, and a sling **21** attached to the rifle as by fasteners **23** and **25**. A photoscope **27** containing an infrared detector **29**, shown in FIG. 7, is rigidly clamped to the muzzle **13** of the weapon **11** and electrically connected by means of a conductive cable **31** attached to the side of the weapon **11**, to a portable pack **35** having a strap **36** and containing a battery pack **37** and electrical apparatus used in a hit indicator system of the type described in the referenced patent. Mounted in the trigger group assembly **19** of the weapon **11** is a pulse initiating device **39** (see FIGS. 2–6) which is connected by conductive cable **41** to the portable pack **35**. Also shown in FIG. 1 is a helmet **43** upon which is mounted an omnidirectional radio frequency antenna **45** and an infrared source **47**, both of which are connected by means of conductive cable **49** to the portable pack **35**.

As shown in FIGS. 2–6 the pulse initiating device generally indicated at **39**, includes a bracket **51** with a narrow curved portion **53** which is used to properly position the pulse initiating device **39** in the trigger group

assembly **19**. A clip **55** is riveted to the upper part of the bracket **51** and is adapted to fasten the pulse initiating device **39** onto the trigger group assembly **19** of the rifle **11**. Riveted to the lower part of the bracket **51** is an over-center toggle action switch **57**, such a Microswitch, with an actuating feeler pin **59** slidably extending through a hole **61** in the switch housing **63**. As shown in FIG. 4, in the cutaway portion of the housing **63** can be seen a pair of fixed terminals **65** and **67** attached to the side of the housing **63**. A movable contact **69** is connected by a pair of curved leaf springs **71** and a center leaf tension member **73** to the fixed terminal **67**. The center leaf **73** is held under tension by the curved leaf springs **71**. The curved springs **71** normally press the movable contact **69** against a fixed contact **75** extending from terminal **65**. One end of the pin **59** engages the center leaf tension member **73**, and pressure on the opposite end of the pin **59** will cause the pin **59** to press the movable contact **69** away from the fixed contact **75** with a quick snap action separation being effected by the over-center toggle action of the switch **57**. Attached to one end of the housing **63** of the switch **57** and bent beneath it is a leaf spring **77** which has a rolled portion **79** on the end. Connected to the two fixed terminals **65** and **67**, but on the external side of the housing **63** of the switch **57** are a pair of connectors generally indicated at **81** by which the conductive cable **41** is attached to the fixed terminals **65** and **67** of the switch **57**.

As illustrated in FIGS. 2 and 3, in which an illustrative conventional trigger group assembly **19** of the rifle **11** is shown in a cocked position with the pulse initiating device **39** attached thereto, the illustrative trigger group assembly **19** includes a housing assembly generally indicated at **83** and having a flat horizontal portion **85**, a vertical bracket **87**, and a support bracket **89**. A hammer **91** is pivotally attached to the vertical bracket **87** of the housing assembly **83** as by a pin **93**. Pivotally mounted as by a pin **95** to the support bracket **89** of the housing assembly **83** is a hammer actuator generally indicated at **97**. The hammer actuator **97** includes a plunger **99** having a head **101** and a rod **103**, a compression spring **105**, and a cylindrical plunger housing **107**, having a bore **109**. The head **101** of the plunger **99** engages a cupped recess **111** formed in the hammer **91**. The plunger rod **103** is contained inside the spring **105**, one end of which engages the bottom portion of the head **101** of the plunger **99**. Both the spring **105** and the plunger **99** are disposed inside the bore **109** of the cylindrical plunger housing **107** with the other end of the spring **105** resting against the bottom **113** of the bore **109**. The plunger housing **107** itself is pivotally mounted to the support bracket **89** of the housing assembly **83** as by the pin **95**.

The pressure exerted against the hammer **91** by the spring **105** and plunger **99** in combination resiliently biases the hammer **91** clockwise as viewed in FIGS. 2, 3 and 6, toward the firing position as illustrated in FIG. 6. Holding the hammer **91** in a cocked position, as shown in FIG. 2, is a sear **115** which engages a hook **117** on the end of the hammer **91**. Sear **115** is pivotally attached to the support bracket **89** of the housing assembly **83** by the pin **95**. A trigger **119** is also pivotally attached to the housing support bracket **89** by a pin **121** and is suitably mechanically connected as in a conventional manner to the sear **115**, as indicated by the broken line **123**, so as to cause the sear **115** to release the hammer **91** when the trigger **119** is pivoted clockwise. These trigger group elements per se are desirable conventional, being in the illustrative embodiment of those found in the M–14 and NATO rifles, and accordingly only the parts of the trigger group assembly **19**, necessary for an understanding of this invention, are shown and described herein, it being appreciated that the invention may be employed in conjunction with various other trigger group assemblies, making suitable obvious modifications as may be necessary or desirable.

Pulse initiating device **39** is attached to the plunger housing **107** by means of clip **55**. The bracket **51** is positioned on the plunger housing **107** so that the narrow curved portion portion **53** of the bracket **51** rests against the support bracket **89** of the housing assembly **83**. In the cocked position, as shown in FIG. 2, the rolled end **79** of the leaf spring **77** rests against the top surface of the flat, horizontal portion **85** of the housing assembly **83**. In this position, the leaf spring **77** exerts pressure on the bottom end of the pin **59** which in turn causes the opposite end of the pin to press against the center leaf tension member **73**, thereby forcing the contacts **69** and **75** apart to an open circuit condition.

When the trigger **119** is pivoted clockwise so as to cause the sear **115** to release the hammer **91**, the spring **105** acts on plunger **99** to swing the hammer **91** upward and forward to the firing position as shown in FIG. 6 where it strikes a firing pin **151** which in turn fires a cartridge **153**. As the hammer swings upward, the housing **107** also moves upward through a small angle, such as approximately 20°, and releases the pressure exerted on the pin **59** by the leaf spring **77**. As a result, the springs **71** press the contacts **69** and **75** together. The time at which the switch contacts **69** and **75** close may be set or varied as necessary or desired by adjustment or variation of any one or more of: the length and shape of the leaf spring **77** (including the curvature of the rolled portion **79** on the end of the leaf spring **77**), the initial extent of displacement of the contact **69** from the contact **75**, and the contact position of pin **59** in relation to the leaf spring **71** and the center leaf tension member **73**.

As shown in FIG. 7, the pulse initiating device switch **57** forms a part of a D.C. pulse producing circuit generally indicated at **125** that supplies a pulse to a modulator **127** which turns on a radio frequency transmitter **129** thereby causing a pulse signal to be transmitted omnidirectionally from the antenna **45**. This signal is received by an antenna **131** at the target and detected in a receiver **133**. The receiver **133** actuates a pulse generator **135** which causes the infrared source **137** to radiate a pulse signal. If the rifle **11** is properly aimed at the target, the infrared light signal is received by the infrared detector **29** which is contained in the photoscope **27**. The infrared signal impinging on the infrared detector **29** causes an electrical pulse to be supplied to both the modulator **127** and the hit indicator **139** of the rifleman. The pulse supplied to the modulator **127** causes another radio frequency signal to be transmitted to the target, which will actuate the target hit indicator **141**, thereby informing the target that a hit has been scored. The pulse supplied to the rifleman's hit indicator **139** will actuate it and inform the rifleman that a hit has been scored. This circuitry, with the exception of the antenna **45**, which is mounted on the helmet **43**, the photoscope **27**, which is mounted on the barrel **13** of the rifle **11**, the pulse initiating device **39** which is mounted in the trigger group assembly **19** of the rifle **11** and connecting cables **31**, **41** and **49**, may be suitably contained in the portable pack **35**.

The pulse producing circuit **125** consists of a power source **37** which may be of any suitable size and type, e.g. a 12 volt battery, with a voltage divider consisting of a pair of resistors **143** and **145** serially connected across the terminals of the source **37**. For purposes of illustration, the resistors **143** and **145** may be considered to be of equal value, and thus an average value of 6 volts will be maintained at the junction **147** between the resistors **143** and **145**. A capacitor **149** is connected in parallel across the resistor **145** and forms an RC charging circuit with resistor **143**. Normally the capacitor **149** charges to the average value maintained at the junction **147**. However, if the capacitor **149** is suddenly short circuited, it rapidly discharges thereby producing a sharp negative pulse at the junction **147**.

Connected in parallel across the capacitor **149** is the pulse initiating device switch **57**. The pulse initiating device switch **57** controls the charging and discharging of

the capacitor **149** by acting as either an open circuit or a short circuit. When the trigger group assembly **19** is in the cocked position and the switch contacts **69** and **75** are forced apart by the pressure exerted on the pin **59** by the leaf spring **77**, a constant voltage, that is the voltage at junction **147**, is applied to the modulator **127**. When the trigger group assembly **19** moves to the firing position the pressure forcing the switch contacts **69** and **75** apart is removed and the contacts spring together thereby short circuiting the capacitor **149** and supplying a sharp, negative pulse to the modulator **127** and thereby initiating the target interrogation signal sequence.

In operation, each rifleman participating in simulated tactical field training, employing a hit indicator system of the type described, will be wearing a helmet **43** upon which is mounted an omnidirectional radio frequency antenna **45** and an infrared source **47**. Each rifle **11** will have a photoscope **27** clamped onto the barrel **13** and a pulse initiating device **39**, of the type hereinbefore described, fastened onto the plunger housing **107** of the trigger group assembly **19**. The remainder of the electrical apparatus shown in FIG. 7 is preferably contained in a portable pack **35**, which will be carried by each rifleman by means of the strap **36**, and connected to the other elements of the circuit by means of the conductive cables **31**, **41** and **49**. While participating in the tactical field training a rifleman will normally carry his rifle **11** in a cocked position, as shown in FIG. 2. In this position, the hammer **91** is resiliently biased by the hammer actuator **97** and held by the sear **115** which engages the hook **117** on the end of the hammer **91**. The hammer actuator **97** is in a lowered position which causes the leaf spring **77** to exert pressure on the bottom of the pin **59** which in turn forces the contacts **75** and **69** of the pulse initiating device switch **57** apart. With the contacts **75** and **69** of the switch **57** thus forced apart, the switch **57** is open circuited and the capacitor **149** is charged from the source **37** of electrical energy through the resistor **143** to the average potential as determined by the junction **147** of the voltage divider.

During the course of the tactical field training, a rifleman will spot a target, take aim, and fire his rifle **11**. When he squeezes the trigger **119**, the sear **115**, which is mechanically linked to the trigger **119**, will release the hammer **91** which will then swing upward and forward as a function of the resilient biasing force exerted on it by the hammer actuator **97**, thereupon striking the firing pin **151** and driving it forward to fire the cartridge **153**. As the hammer **91** swings upwardly and forwardly, the hammer actuator **97** will also swing upward thereby removing the pressure exerted on the switch actuator pin **59** by the leaf spring **77**. As a result, the switch contacts **75** and **69** close and short circuit the capacitor **149** which rapidly discharges through the switch **57** causing a sharp negative pulse to be supplied to the modulator **127**. The modulator **127** turns on the radio frequency transmitter **129** and thereby causes a radio frequency target interrogation pulse signal to be transmitted omnidirectionally from the antenna **45** mounted on the helmet **43** of the rifleman. This signal is received at the target by an antennaa **131** and detected in a receiver **133**. The receiver **133** actuates a pulse generator **135** which causes the infrered source **137** attached to the target to radiate a pulse signal. If the refleman has properly aimed his rifle **11**, the infrared light signal will be received by the photoscope **27** clamped to the barrel **13** of his rifle **11**. The infrared detector **29** contained in the photoscope **27** converts the infrered light signal into an electrical pulse which is the supplied to both the modulator **127** and the hit indicator **139** of the ribeman. The pulse supplied to the modulator **127** causes another radio frequency pulse signal to be transmitted to the target which actuates the target hit indicator **141** thereby informing the target that a hit has been scored. The pulse supplied to the rifleman's hit indicator **139** actuates it and informs the rifleman that a hit has been scored. It is important to note that by utilizing the present invention the entire signal sequence may occur within a very short time after the trigger squeezing and before the firing of the cartridge, and preferably being completed before the firing of the cartridge.

While the invention has been illustrated and described with respect to a single preferred embodiment, it will be apparent to those skilled in the art that various modifications and improvements may be made without departing from the scope and spirit of the invention. For example, although a pulse producing circuit **125** has been disclosed which will supply a negative pulse to the modulator **127**, it will be obvious to others skilled in the art that the pulse producing circuit **125** can be modified so as to supply a positive pulse to the modulator **127**. Also, although a normally closed switch **57** has been used to illustrate the invention, it is obvious that a normally open switch can be used. Accordingly, it is to be understood that the invention is not to be limited by the illustrative embodiment, but only by the scope of the appended claims.

That which is claimed is:

1. In a simulated hit indicator arrangement including a rifle having a barrel with photoelectric target signal responsive telescope detector arrangement mounted thereon, and a trigger group assembly for firing a cartridge; a target-interrogating transmitter; and a receiver operatively connected to the output of said photoelectric telescope, the improvement comprising:

a pulse initiating device switch connected to said trigger group assembly and includirg a switch having a first electrical conductance condition in a first position and a second electrical conductance condition in a second position and being arranged in controlling relation to said transmitter,

said pulse initiating device switch being moved from said first position to said second position as a function of movement of a portion of said trigger group assembly during firing motion of the trigger group assembly, completion of change of conductance of said switch to said second electrical conductance condition being effected prior to firing of said cartridge by continued motion of said trigger group after movement of said switch from said first position to said second position.

2. In a simulated hit indicator arrangement as defined in claim **1** wherein:

said pulse initiating device switch forms a part of a pulse producing circuit comprising a resistor and a capacitor serially connected across a source of electrical energy thereby forming a charging circuit for said capacitor,

said pulse initiating device switch permitting said capacitor to charge during one electrical conductance condition and causing said capacitor to discharge during the second electrical conductance condition, thereby causing a sharp electrical pulse to be produced upon change of said conductance conditions.

3. In a simulated hit indicator arrangement as defined in claim **1**,

said pulse initiating device switch being mounted on a movable element of said trigger group assembly and being movable with said element to effect motion thereof from said first position to said second position.

4. In a simulated hit indicator arrangement including a rifle having a barrel with photoelectric target signal responsive telescope detector arrangement mounted thereon, and a trigger group assembly for firing a cartridge; a target-interrogating transmitter; and a receiver operatively connected to the output of said photoelectric telescope, the improvement comprising.

a pulse initiating device switch connected to said trigger group assembly and including a switch having a first electrical conductance in a first position and a second

electrical conductance condition in a second position and being arranged in controlling relation to said transmitter,

said pulse initiating device switch being moved from said first position to said second position as a function of movement of a portion of said trigger group assembly during firing motion of the trigger group assembly, a completion of change of conductance of said switch to said second electrical conductance condition being effected prior to firing of said cartridge by continued motion of said trigger group after movement of said switch from said first position to said second position,

said trigger group assembly comprising a hammer and a spring-biased movable hammer actuator, said pulse initiating device switch being mounted on said hammer actuator and being operatively changed in conductance by movement of said hammer actuator and prior to said hammer firing said cartridge.

5. In a simulated hit indicator arrangement as defined in claim **4**,

said hammer actuator being pivotally mounted in said trigger group assembly and said pulse initiating device switch comprising a switch actuating element movably responsive to the pivotal movement of the hammer actuator to cause the switch to change from said first electrical conductance condition to said second electrical conductance condition prior to firing of said cartridge by said hammer.

6. In a simulated hit indicator arrangement as defined in claim **5**,

said pulse initiating device switch being electrically connected to a pulse producing circuit comprising a resistor and a capacitor serially connected across a source of electrical energy and thereby forming a charging circuit for said capacitor,

said pulse initiating device switch permitting said capacitor to charge during one electrical conductance condition and causing said capacitor to discharge during the second electrical conductance condition, thereby producing a sharp electrical pulse.

7. In a simulated hit indicator arrangement as defined in claim **5** wherein:

said spring-biased hammer actuator comprises a plunger which engages said hammer, a spring which encloses the plunger and engages it at one end, and a housing pivotally mounted in said trigger group assembly which engages the opposite end of the spring and encloses a portion of the plunger and the spring,

said pulse initiating device switch being removably secured to said hammer actuator housing.

8. In a simulated hit indicator arrangement as defined in claim **7**,

said pulse initiating device being removably secured to said actuator housing by a clip, and said pulse initiating device being shaped so as to properly position said pulse initiating device switch in the trigger group assembly when clipped onto the actuator housing.

9. In a simulated hit indicator arrangement as defined in claim **1**,

said pulse initiating device switch having an over-center toggle action which snaps the switch from one electrical conductance condition to the other electrical conductance condition when the switch operates.

10. In a simulated hit indicator arrangement including a rifle having a barrel with photoelectric target signal responsive telescope detector arrangement mounted thereon, and a trigger group assembly, including a hammer which strikes a firing pin, for firing a cartridge; and a receiver operatively connected to the output of said photoelectric telescope, the improvement comprising:

a pulse initiating device in controlling relation to a target-interrogating transmitter,

said pulse initiating device being responsive to movement of a portion of said trigger group assembly during the firing motion of the trigger group assembly to produce a pulse, said target-interrogating transmitter being responsive to said pulse to produce a target-interrogating signal prior to the firing of a cartridge by the hammer striking the firing pin.

11. In a simulated hit indicator arrangement as defined in claim **10**,

said target being responsive to said target-interrogating signal to effect a return electromagnetic signal for reception by the receiver of said photoelectric telescope, said return signal being transmitted and receivable by said telescope and receiver in a time span terminating prior to the firing of the cartridge.

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U.S. Cl. X.R.

273—101.2; 325—66, 164