

Sept. 24, 1963

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HIT INDICATOR APPARATUS

3,104,478

Filed Dec. 5, 1960

3 Sheets-Sheet 1

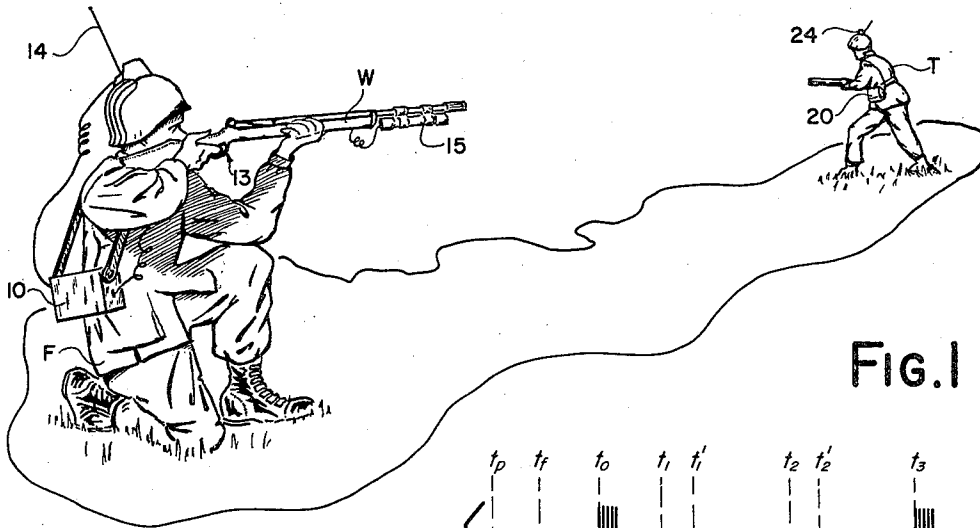


FIG. 1

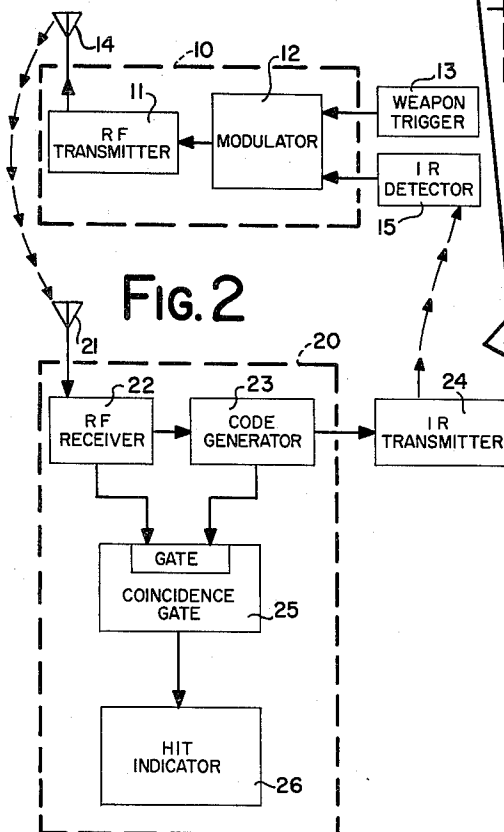


FIG. 2

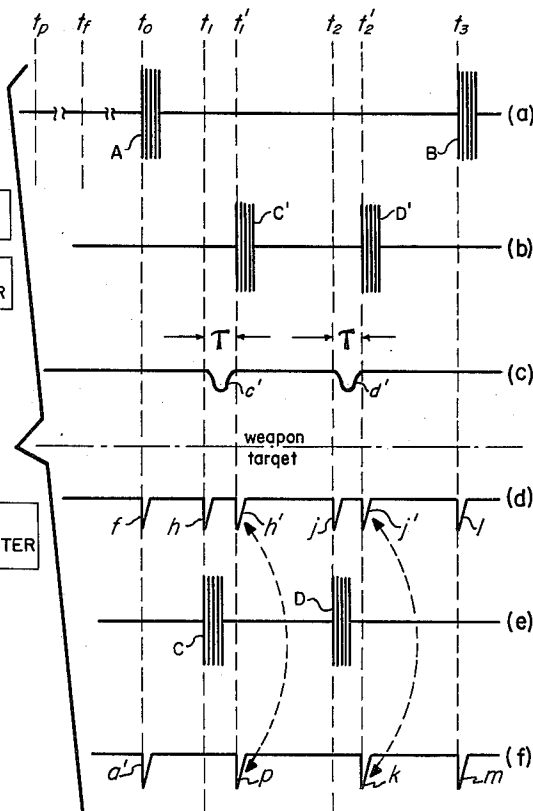


FIG. 5

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3 Sheets-Sheet 2

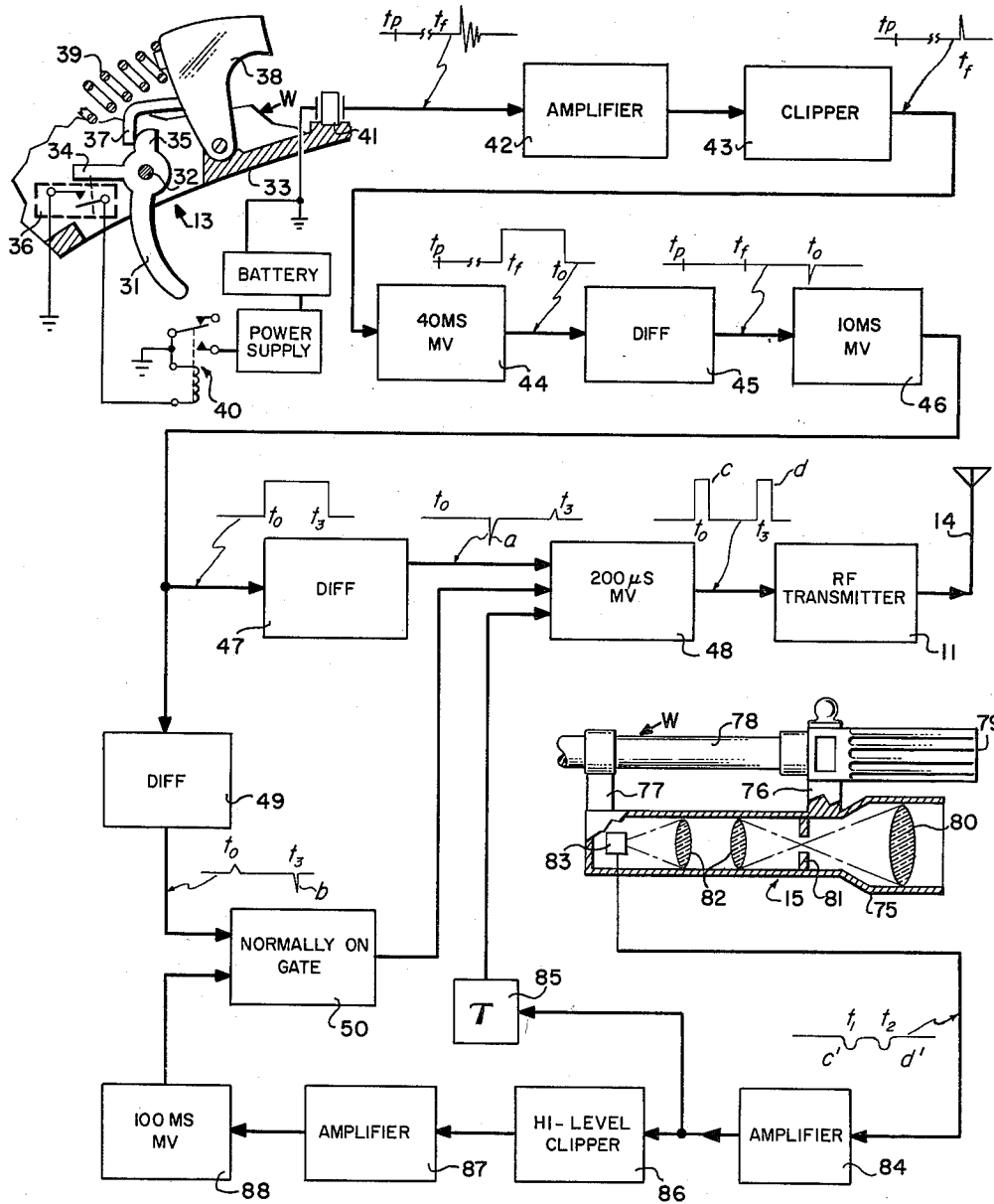


FIG. 3

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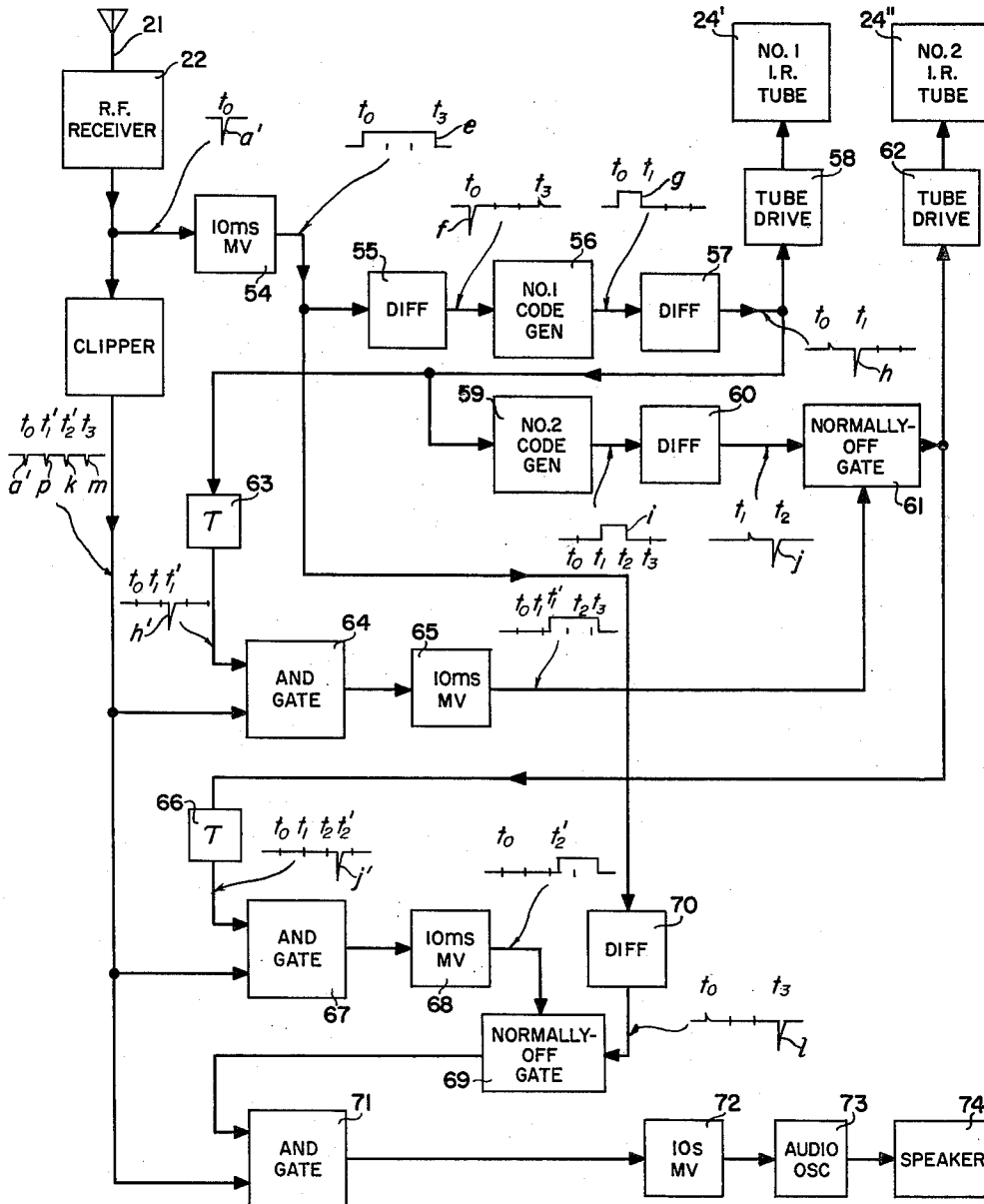


FIG. 4

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HIT INDICATOR APPARATUS

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Filed Dec. 5, 1960, Ser. No. 73,777
13 Claims. (Cl. 35-25)

This invention relates to training apparatus, and more particularly, to apparatus for training military personnel engaged in simulated land combat.

One of the objects of simulated land combat is to afford an infantryman an opportunity to gain the "feel" of his weapon by providing situations which require him to aim and fire at personnel, vehicles, and fortifications. By providing a battlefield environment under which the infantryman experiences the noise and blast effects occasioned by his firing at a target coupled with return fire from the target, realistic and valuable training is achieved. This conventional training would be materially improved were there some way to indicate that a target had been hit without relying on the judgment of a field observer.

It is, therefore, an object of this invention to provide apparatus of the class described which indicates to the firer, the target and an observer, that the weapon was aimed at the target when the weapon was fired. It is a further object of this invention to provide apparatus of the class described which is able to distinguish between different weapons and targets so that hits by light arms fire do not "kill" an armored target. It is a still further object of this invention to provide apparatus of the class described which does not require weapon modification, and which operates in such a manner that neither weapons nor targets can be spotted visually or aurally.

Briefly, the apparatus of this invention accomplishes the above described objects by providing a dual channel closed loop, utilizing both infrared and radio frequency transmission and reception. A radio frequency transmitter at the weapon radiates an omnidirectional RF interrogation signal when the firer actuates the trigger of the weapon. All targets within the range of the RF transmitter are interrogated. An infrared transmitter at each target responds to the interrogation signal by radiating, omnidirectionally, a coded infrared answer signal which identifies each target. At the weapon, a directional phototelescope responsive to infrared energy and boresighted with the weapon, receives infrared energy only from the particular target at which the weapon is aimed when the trigger is actuated. The RF transmitter at the weapon is responsive to the output of the phototelescope and is caused to radiate an omnidirectional RF verification signal which corresponds to and occurs in time substantially coincident with the answer signal of the particular target. A comparison circuit at each target compares the occurrence of its code signal with the occurrence of the verification signal. Only at the particular target at which the firer pointed his weapon when he actuated the trigger will the code and verification signals be coincident. A visual or aural indicator is responsive to the coincidence of these signals to provide an indication of a hit on the target. An output from the phototelescope on the weapon of the firer is an indication to the firer that he has scored a hit.

It is important to note that it is possible to determine from the output of the photocell of the firer which of a plurality of targets is hit, since each target has its own optical code. Furthermore, the target can be made to identify itself only to weapons with the proper interrogating pulse, thereby preventing light arms fire from "destroying" an armored vehicle or fortification. Selection of omnidirectional radio and optical transmitters, and a directional optical detector achieves the desirable

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result of preventing sunlight or stray radiation from producing false hit indications, since a closed radio-optical loop is utilized.

The more important features of this invention have thus been outlined rather broadly in order that the detailed description thereof that follows may be better understood, and in order that the contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will also form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for designing other structures for carrying out the several purposes of this invention. It is important, therefore, that the claims to be granted herein shall be of sufficient breadth to prevent the appropriation of this invention to those skilled in the art.

In the drawing:

FIGURE 1 shows opposing infantrymen utilizing the present invention.

FIGURE 2 is a schematic showing components associated with the weapon of the infantryman firing and with the opposing infantryman.

FIGURE 3 is a more detailed schematic showing how the components at the weapon operate.

FIGURE 4 is a more detailed schematic showing how the components at the target operate.

FIGURE 5 shows the time at which various signals occur at the weapon and target.

Referring now to FIGURE 1, there is shown a tactical situation likely to arise during a training maneuver. Infantryman F has spotted enemy T, aimed weapon W and pulled the trigger to fire a blank round. Provided that weapon W is properly aimed, target T would be declared a casualty. A block diagram of the apparatus of this invention by which a hit on target T is detected (or more accurately, by which there is detection of proper aiming and firing of weapon W), is shown in FIGURE 2.

Equipment carried by the firer F and associated with the weapon is designated generally at 10, while the equipment carried by the target T and associated with the target is indicated generally at 20. The firer F also carries target equipment and target T also carries weapon equipment so that the terms "firer" and "target" are actually relative. However, since the equipment is identical, discussion will be limited to the weapon equipment of firer F and the target equipment of the target T. As shown in FIGURE 2, weapon equipment 10 includes RF transmitter 11 controlled by modulator 12. Actuation of weapon trigger means 13 when firer F pulls the trigger of weapon W causes modulator 12 to pulse transmitter 11. This causes omnidirectional antenna 14 to radiate a short burst of RF energy that serves to interrogate all targets within the range of transmitter 11 that are vulnerable to a shoulder rifle.

Antenna 21 at target T picks up the RF interrogation pulse which is detected by RF receiver 22. The detected interrogation pulse triggers code generator 23 which produces a code unique to each target. Such code causes infrared transmitter 24 to emit omnidirectional IR answer pulses which serve to identify target T. It should be understood that each target carries equipment 20, and each target interrogated by the firer responds by transmitting its own unique IR answer pulses.

IR detector 15 mounted on weapon W and boresighted therewith is highly directional. Thus, it is responsive only to IR energy radiated from the direction in which the firer has aimed his weapon when the trigger was pulled, since the time interval between interrogation and answer is very small compared with reactions of the firer. As shown in FIGURE 1, weapon W is aimed at target T

so that detector 15 picks up the answer pulses from target T. Thus, an output from detector 15 tells that the firer has hit a target; investigation of the output identifies such target.

To indicate to the target that a hit has been made, the coded IR answer pulses received by detector 15 at the weapon are re-broadcast to all targets by transmitter 11. The RF pulses so re-broadcast are termed herein, "verification pulses." Such pulses are detected by RF receiver 22 substantially in coincidence with IR answer pulses from target T. All other targets receive the verification pulses out of coincidence with their respective answer pulses. Detected verification pulses from receiver 22 are compared with the code pulses generated by code generator 23 in coincidence circuit 25. When the verification pulses are in time coincidence with the code pulses, circuit 25 produces an output to initiate bit indicator 26 carried by the target. Indicator 26 may take the form of a buzzer, light or pyrotechnic display, or any combination thereof.

FIGURES 3 and 4 show details of the apparatus carried by the firer and target respectively. Referring now to FIGURE 3, trigger means 13 of weapon W has trigger actuator 31 pivotally mounted on pin 32 attached to stock 33. Actuator 31 has switch extension 34 and sear extension 35 rigidly attached thereto at right angles. Extension 34 contacts normally open microswitch 36 mounted in stock 33 when the trigger actuator is in its normal position. Extension 35 is slideably engaged with sear 37 integrally connected to hammer 38 which itself is pivotally mounted in stock 33. Hammer spring 39 biases the hammer toward the chamber of the weapon (not shown) but sear 37 engaged with extension 35 serves to releasably retain hammer 38 in position ready to fire a cartridge in the chamber. Trigger mechanism 13 is only shown schematically to illustrate how the hit detection apparatus is initiated, and it should be understood that the actual configurations of the trigger actuator, hammer and spring are such that hammer 38 is actually prevented from moving until actuator 31 is squeezed.

Upon initially squeezing actuator 31, extension 34 moves away from switch 36 thereby causing switch 36 to close prior to release of sear 37. The closing of switch 36 defines time t_0 as shown in the time diagrams of FIGURE 5, and causes relay 40 to close thereby providing power to all the circuits in the weapon. The leads from the power supply to such circuits are omitted from the drawing for reasons of clarity in illustrating the novel portion of the invention. For a shoulder rifle, release of the hammer occurs about 20 milliseconds after the trigger is squeezed. If transistorized circuits are used, there is sufficient time for all circuits including transmitter 11 to reach operating condition. As the firer continues to squeeze actuator 31, extension 35 eventually slides off sear 37 whereby spring 39 drives the hammer to firing position. Firing of a cartridge or the impact of the hammer causes barium titanate crystal 41 fixed to stock 33 to vibrate whereby a damped oscillatory signal commencing at time t_1 appears at the output of the crystal. The vibration of the weapon imparts a vibration to IR detector 15, and to prevent spurious outputs therefrom, a forty millisecond delay after firing or release of the hammer is interposed between time t_1 and time t_0 , the latter being the time at which the targets are interrogated. This is accomplished by amplifying the output of crystal 41 in amplifier 42, and then clipping the peak signal in clipper 43 to produce a trigger spike at time t_1 . This signal triggers multivibrator 44 whereby a square pulse of 40 millisecond duration is produced. This pulse is differentiated at 45 so that the trailing edge of the 40 millisecond pulse produces a trigger pulse at time t_0 . Pulse A triggers multivibrator 46 whereby a square pulse is produced, such pulse starting at t_0 and ending 10 milliseconds (ms.) later at t_3 . The last-mentioned square pulse is differentiated at 47 so that the leading edge produces a pulse a at time t_0 that trig-

gers multivibrator 48 whereby a 200 microsecond (μ s.) interrogation plus c is produced. Pulse c modulates RF transmitter 11 causing 200 μ s. RF interrogation pulse A to be radiated from antenna 14. The 10 ms. pulse is differentiated at 49 so that the trailing edge produces a pulse b at time t_3 that passes through normally "on" gate 50 and triggers MV 48 ten milliseconds after the leading edge of pulse b has triggered MV 48. In this manner, RF terminal pulse B is radiated ten milliseconds after pulse A. In the above-described manner, two RF pulses of 200 μ s. duration and 10 milliseconds apart are transmitted omnidirectionally from antenna 14 each time the firer has squeezed the trigger sufficiently far to unsear the hammer. FIGURE 5(a) shows the signals transmitted from the weapon each time the firer actuates the trigger. It is pointed out the firer need not fire each time the trigger is squeezed just as is the case were the apparatus of this invention not used. If the firer changes his mind and releases the trigger actuator prior to firing, switch 36 is opened and relay 40 opens, thereby disconnecting the power from the circuit elements.

The target reaction to RF interrogation pulse A can be understood by referring to FIGURE 4. Consider first the effect of pulse A when firer F has not properly aimed his weapon at target T. Since pulse A is radiated omnidirectionally, it is received at antenna 21 regardless of an error in aim. Pulse A is detected in receiver 22 and converted to initial receiver pulse a' that occurs at time t_0 . Pulse a' triggers multivibrator 54 whereby the latter produces a 10 ms. square pulse e commencing at time t_0 and ending at time t_3 . Pulse e is coincident with the 10 ms. pulse produced by MV 46 at the weapon. Pulse e is differentiated at 55 so that its leading edge produces code pulse initiator f at time t_0 . Pulse f triggers code generator 56, which is a multivibrator having an adjustable time constant. Generator 56 produces square pulse g commencing at time t_0 and ending at time t_1 . Pulse g is differentiated at 57 so that its trailing edge produces a first code pulse h at time t_1 . Pulse h triggers tube drive 58 which pulses tube 24'. Tube 24' is a gas filled tube that radiates a pulse of energy largely in the near-visible spectrum when a pulse of high voltage is impressed on the tube. Drive 58 may be any suitable means for applying a high voltage for a short time and may take the form of a capacitor caused to discharge by pulse h . By using a filter over tube 24', only infrared energy is radiated as IR answer pulse C in response to pulse h . Tube 24' is located on an exposed portion of the target (the helmet of an infantryman, for example), and IR answer pulse C is radiated omnidirectionally at time t_1 .

Pulse h also triggers code generator 59 which is similar to code generator 56. Generator 59 produces square pulse i commencing at time t_1 , and ending at time t_2 . Since t_2 must occur prior to t_3 , the time constants of generators 56 and 59 are adjusted so that their total does not exceed 10 ms. Pulse i is differentiated at 60 so that its trailing edge produces a second code pulse j at time t_2 . If normally off gate 61 is not opened at time t_2 , pulse j cannot trigger tube drive 62 which serves to pulse tube 24'' and cause second IR answer pulse D to be radiated from the target.

To understand how gate 61 is opened, it must be recalled that pulse h occurs at time t_1 . Pulse h is delayed a fixed time τ in delay device 63 to produce companion pulse h' at time t_1' where $t_1' = t_1 + \tau$. Assume, now, that an RF signal is received by the target at time t_1' , and converted to a second receiver pulse p . Pulses p and h' are applied to "and" gate 64, and since they are coincident, gate 64 produces an output at time t_1' which triggers multivibrator 65 whereby the latter produces a 10 ms. square pulse which opens gate 61 from t_1' to $t_1' + 10$ ms. Thus, pulse j occurring at time t_2 passes through gate 61 if receiver 22 detects an RF signal at time t_1' . Pulse j is also delayed a fixed time τ in delay device 66 to produce companion pulse j' at time t_2' where $t_2' = t_2 + \tau$.

Assume, now, that an RF signal is received by the target

at time t_2' , and converted to a third receiver pulse k . Pulses k and j' are applied to "and" gate 67 and since they are coincident, gate 67 produces an output at time t_2' which triggers multivibrator 68 whereby the latter produces a 10 ms. square pulse which opens normally "off" gate 69 from t_2' to $t_2' + 10$ ms. Returning now to MV 54, pulse e is differentiated at 70 so that the trailing edge produces pulse l at time t_3 . Pulse l passes through gate 69 if receiver 22 detects an RF signal at time t_2' .

Assume, now, that an RF signal is received by the target at time t_3 , and converted to a final receiver pulse m . Pulses m and l are applied to "and" gate 71, and since they are coincident, gate 71 produces an output at time t_3 which triggers multivibrator 72 whereby the latter produces a 10 second square pulse which occurs from t_3 to $(t_3 + 10)$ seconds. This 10 second square pulse activates audio oscillator 73 to produce at speaker 74 an audible buzzing sound that lasts for 10 seconds and serves to indicate that the target has been hit.

Recall now the assumptions that gave rise to a hit after reception of the original interrogation pulse: reception of RF signals by the target at times t_1' , t_2' and t_3 . Obviously, it is possible for a combination of circumstances to arise wherein numerous personnel engaged in maneuvering cause RF signals to be transmitted at t_0 , t_1' , t_2' , and t_3 . However, the time interval involved is only 10 milliseconds, so that the likelihood of four such events occurring is so remote that it can safely be ignored.

Consider now the effect of interrogation pulse A when firer F has aimed his weapon at target T. In response to interrogation pulse A, target T transmits IR answer pulse C which is received by IR detector 15 only if weapon W is aimed at the target. Referring now to FIGURE 3, detector 15 has tubular case 75 with mounting lugs 76 and 77 by which the case is attached to barrel 78 of weapon W adjacent muzzle 79. Objective lens 80 is inserted in the forward portion of case 75. Rearward of lens 80, is field stop 81 placed in the focal plane of lens 80 in order to limit the field of view of detector 15. Lenses 82 focus the light entering lens 80 onto phototransistor or photodiode 83. The optical configuration including the diameter of the objective lens and its focal length, and the size of the opening in the field stop are determined by the particular target against which weapon W is to be used. Thus, detector 15 is highly directive and suitable filters cause element 83 to respond only to IR energy originating within the limited field of view. In this manner, detector 15 produces an output pulse only if weapon W is pointed at a target when the trigger is actuated. In this regard, it should be mentioned that the time interval between actuating the trigger and causing a target to send an answer signal is only a few milliseconds.

IR answer pulse C is converted by detector 15 to pulse c' which of course occurs at time t_1 . Pulse c' is amplified at 84 and delayed in delay device 85 the same amount that pulse h at the target is delayed, to produce a pulse that occurs simultaneously with pulse h' at the target. This delayed pulse triggers MV 48 which pulses transmitter 11 such that a 200 μ s. RF verification pulse C' coincident with pulse h' is radiated from the weapon. Likewise, IR answer pulse D is converted by detector 15 to pulse d' and rebroadcast as RF verification of pulse D' . It should be noted that the time interval between code pulse h and its companion pulse h' is the same as the time interval between answer pulse C and verification pulse C' . Thus, weapon W sends out pulses A and B related in time as shown in FIGURE 5(a), each time the trigger of the weapon is actuated. Pulses A and B are converted to pulses a' and m in receiver 22 at the target. Pulse a' initiates the code sequence whose time relationship is shown in FIGURE 5(d). IR answer pulse C is broadcast first, and if weapon W receives pulse C, it rebroadcasts RF verification pulse C' . Pulse C' is converted to pulse p and compared with the companion pulse h' of code pulse h that caused IR answer pulse C to be sent. Since pulses h'

and p are coincident, the target broadcasts IR answer pulse D. In the same manner, the weapon transmitter rebroadcasts this as RF verification pulse D' . Pulse D' is converted to pulse k and compared with the companion pulse j' of code pulse j that caused IR answer pulse D to be sent. Since pulses j' and k are coincident, terminal RF pulse B, when converted to pulse m is permitted to actuate speaker 74. This occurs, because at gate 71, pulse l coincides with pulse m .

Delay τ is introduced because receiver 22 is saturated by IR transmitter 24 during transmission of answer signals. Therefore, weapon W transmits an RF verification pulse a short time after transmission of an IR answer pulse. However, by suitable choice of shielding, filters, weapon and target frequencies, etc., delay τ can be reduced to zero.

The above described system permits a large number of personnel to engage in a training operation. Each target has its own two pulse code, and can be identified by the time interval between the coded answer pulses and their position in the 10 ms. interval.

To require the firer to aim accurately, the sensitivity of amplifier 84 is adjusted so that no output is obtained unless the input exceeds a minimum value. This prevents a firer who points his weapon toward the target but aims too low from obtaining a hit. An aim that is too high when the target is close is also prevented from actuating speaker 74. Suppose pulse c' exceeds the lower limit of response of detector and the upper limit at which clipper 86 is set. The output of clipper 86 is a spike which after amplification at 87 triggers multivibrator 88. The output of MV 88 is a 100 ms. square pulse whose duration is from t_1 to $t_1 + 100$ ms. Gate 50 is closed by this pulse during its existence. Since t_3 occurs in the interval between t_1 and $t_1 + 100$ ms., pulse b coincident with the trailing edge of the output of MV 46 cannot trigger MV 48. Thus, pulse B cannot be sent to the target, and pulse m is not existent when pulse l is applied to "and" gate 71. Therefore, speaker 74 cannot be actuated.

What is claimed is:

1. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a first transmitter for sending signals, means to cause said first transmitter to send an interrogation signal when the trigger is actuated, receiver means to detect all signals sent by said first transmitter, code circuit means responsive to the detected signal corresponding to said interrogation signal for initiating a train of code signals, a second transmitter for sending answer signals in response to and coincident with certain of the code signals in said train, said code circuit means producing a corresponding companion signal for each of said certain code pulses, each companion signal having a predetermined time relationship to the code signal to which it corresponds, detector means for detecting answer signals, means to prevent said detector for detecting answer signals at all positions of the weapon except where it is pointed at the target, the detected signal corresponding to an answer signal, causing said first transmitter to send a verification signal, the time relationship between an answer signal detected by said detector means and the resulting verification signal being the same as the time relationship between the code signal responsible for the last-mentioned answer signal and the companion signal which corresponds to the last-mentioned code signal, indicating means operable by a coincidence signal for indicating that the weapon is pointed at the target when the trigger is actuated, and means to produce said coincidence signal only if said receiver detects verification signals from said first transmitter in coincidence with said companion signals.

2. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a first transmitter for sending signals, means to cause said first transmitter to send an interrogation

signal when the trigger is actuated, receiver means to detect all signals sent by said first transmitter, code circuit means responsive to the detected signal corresponding to said interrogation signal for producing a code signal, a second transmitter for sending an answer signal in response to and coincident with said code signal, said code circuit means producing a companion signal that corresponds to said code signal and bears a predetermined time relationship therewith, a detector for detecting answer signals, said detector capable of detecting answer signals only if the weapon is pointed at the target, the detected signal corresponding to an answer signal causing said first transmitter to send a verification signal that bears a predetermined time relationship thereto that is the same as that between said code signal and its companion signal, indicating means operable by a coincidence signal for indicating that the weapon is pointed at the target when the trigger is actuated, and means to produce said coincidence signal only if said receiver detects a verification signal in coincidence with said companion signal.

3. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a first transmitter at the weapon for sending signals, means to cause said first transmitter to send an interrogation signal when the trigger is actuated, a second transmitter at the target for sending an omnidirectional answer signal in response to said interrogation signal, directional detector means for detecting said answer signal only if the weapon is pointed at the target, operable means for indicating that the weapon is pointing at the target when the trigger is actuated, and means for operating said operable means only when said directional detector means detects an answer signal.

4. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a transmitter at the weapon for sending signals, means to cause said weapon transmitter to send an interrogation signal when the trigger is actuated, code means responsive to said interrogation signal for producing a code signal and a companion signal that bear a predetermined time relationship, a transmitter at the target for sending an omnidirectional answer signal in response to and coincident with said code signal, directional detector means for detecting said answer signal only if the weapon is pointed at the target when said target transmitter sends an answer signal, said weapon transmitter being responsive to a detected answer signal for sending a verification signal that bears a predetermined time relationship thereto that is the same as that between said code signal and its companion signal, operable means for indicating that the weapon is pointing at the target when the trigger is actuated, and means for operating said operable means only if said verification signal coincides with said companion signal.

5. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a transmitter at the weapon for sending an interrogation signal to said target upon actuation of said trigger, a transmitter at the target for sending an answer signal to said weapon in response to an interrogation signal, said answer signal being delayed in time with respect to said interrogation signal, means located at the weapon for causing the weapon transmitter to send a verification signal to said target only if the weapon is aimed at the target when the trigger is actuated, said verification signal being substantially coincident in time with said answer signal, operable means for indicating that the weapon is aimed at the target when the trigger is actuated, and means for operating said operable means only when said verification signal is substantially coincident in time with said answer signal.

6. Apparatus for indicating that a weapon having a trigger is pointed at a particular one of a plurality of targets when the trigger is actuated, comprising: a weapon transmitter for sending an interrogation signal to all

the targets upon actuation of said trigger, target transmitter means for sending answer signals in response to an interrogation signal, there being an answer signal sent for each target, each answer signal being delayed in time with respect to said interrogation signal, the delay of each answer signal being different from the delay of every other answer signal whereby a given target can be identified by the delay of its answer signal, a receiver for receiving answer signals, means for causing the weapon transmitter to send a verification signal to all the targets when said receiver receives an answer signal, said verification signal being substantially coincident in time with said last-mentioned answer signal, said receiver being capable of receiving an answer signal from a particular target only if the weapon is pointed at the particular target when the latter sends an answer signal, operable means for each target to indicate that the weapon is aimed at a particular target when the trigger is actuated, and means for operating the operable means of said particular target only when a verification signal is substantially coincident in time with the answer signal of said particular target.

7. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a weapon transmitter for sending an RF interrogation pulse upon actuation of said trigger, a source at the target for producing light of a certain frequency, means to cause said source to radiate a light in response to said interrogation pulse, means to cause said transmitter to send an RF verification pulse only if the weapon is aimed at the target when the light pulse is radiated, said verification pulse being substantially coincident in time with said light pulse, operable means for indicating that the weapon is aimed at the target when the trigger is actuated, and means for operating said operable means only when said verification pulse is substantially coincident in time with said light pulse.

8. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a weapon transmitter for sending an interrogation signal upon actuation of said trigger, a target transmitter responsive to an interrogation signal for sending an answer signal that is delayed in time with respect to said interrogation signal, means responsive to said answer signal only if the weapon is aimed at the target when said answer signal is sent for sending a verification signal substantially simultaneously with said answer signal, and means responsive to the substantial simultaneous occurrence of a verification signal and an answer signal for indicating that the weapon is aimed at the target when the trigger is actuated.

9. Apparatus for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated, comprising: a transmitter at the weapon for sending signals, means to cause said weapon transmitter to send an interrogation signal when the trigger is actuated, code means responsive to said interrogation signal for producing a train of code signals and a train of companion signals, there being one companion signal associated with each code signal with a predetermined time relationship therebetween, a transmitter at the target for sending omnidirectional answer signals in response and coincident with said code signals, directional detector means for detecting an answer signal only if the weapon is pointed at the target when said target transmitter sends an answer signal, said weapon transmitter being responsive to each answer signal that is detected for sending a verification signal that bears a predetermined time relationship thereto that is the same as the predetermined time relationship between the code signal coincident with said last-mentioned answer signal and the companion signal associated with said last-mentioned code signal, operable means for indicating that the weapon is pointing at the target when the trigger is actuated, and means for operat-

ing said operable means only if there is a verification signal coincident with each companion signal.

10. Apparatus of claim 9 including means for preventing said target transmitter from sending answer signals for code signals that follow the first occurring code signal if no verification signal is coincident with the companion signal associated with said first occurring code signal.

11. In combination, a first transmitter at one location for sending omnidirectional RF signals, means to cause said first transmitter to send an interrogation signal, a second transmitter at another location for sending an omnidirectional infrared answer signal in response to said interrogation signal, directional detector means at said one location responsive to infrared signals originating in the direction in which said detector means is pointed, said detector means detecting an answer signal only if it is pointed at said second transmitter when the latter sends an answer signal, operable means for indicating that the detector means is pointing at said second transmitter when said first transmitter sends an interrogation signal, and means for operating said operable means if said directional detector means detects an answer signal.

12. In combination, a first transmitter at one location for sending omnidirectional RF signals, means to cause said first transmitter to send an interrogation signal, means to convert said interrogation signal to a code signal delayed in time with respect to said interrogation signal and a companion signal having a fixed time relationship to said code signal, a second transmitter at another location responsive to said code signal for sending an omnidirectional infrared answer signal, directional detector means at said one location responsive to infrared signals originating in the direction in which said detector means is pointed, said detector means detecting an answer signal

only if it is pointed at said second transmitter when the latter sends an answer signal, said first transmitter being responsive to an answer signal detected by said detector means for sending a verification signal, the time relationship between said verification signal and said answer signal being the same as that between said companion signal and said code signal, and means responsive to the verification signal and the companion signal for producing a coincidence signal only if said verification signal and said companion signal occur at the same time.

13. A method for indicating that a weapon having a trigger is pointed at a target when the trigger is actuated comprising the steps of: transmitting an interrogation signal to the target when the trigger is actuated, sending an omnidirectional answer signal from the target in response to said interrogation signal, detecting said answer signal at the weapon only if the weapon is pointed at the target, and using the detected answer signal to operate indicating means.

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