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Ashford

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[54] **UMPIRES RAY GUN FOR USE IN WEAPON TRAINING SYSTEMS**

[75] Inventor: **David William Ashford,** Farnborough, England

[73] Assignee: **The Solartron Electronic Group Limited,** Farnborough, Hampshire, England

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[52] **U.S. Cl.** **273/101.1,** 35/25

[51] **Int. Cl.** **F41j 5/02**

[58] **Field of Search** 273/101.1, 101.2; 35/25; 356/4

[56] **References Cited**

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Primary Examiner—Richard C. Pinkham
Assistant Examiner—Marvin Siskind
Attorney, Agent, or Firm—Roylance, Abrams, Berdo & Kaul

[57] **ABSTRACT**

A hand held ray gun for use in weapon training systems transmits a beam modulated in a first mode to allow an umpire directing the beam on a responsive target to check that the radio responder on the target is responding to the beam and operates in a second mode of modulation, selected by means of a manually operated switch, to allow the umpire to transmit a coded signal to 'kill' the target vehicle, for example by disabling its electrical supply system.

6 Claims, 4 Drawing Figures

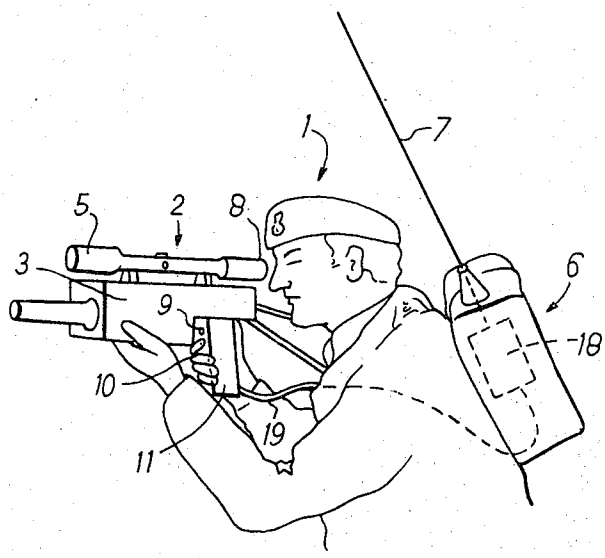


FIG. 1

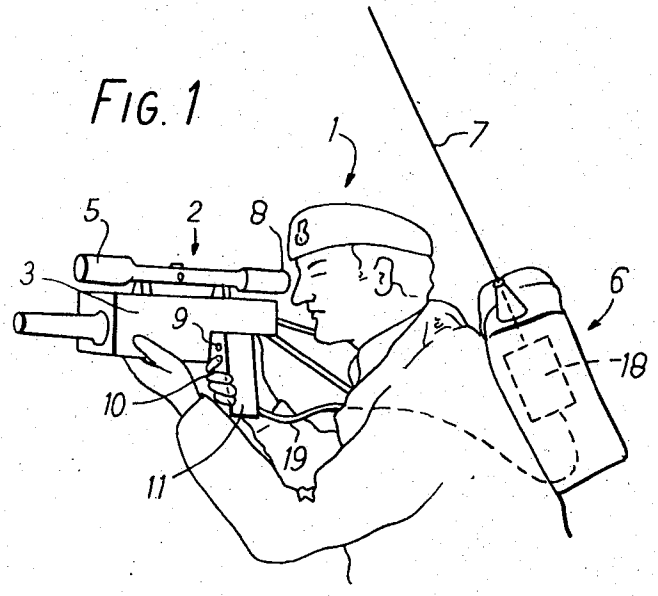


FIG. 2

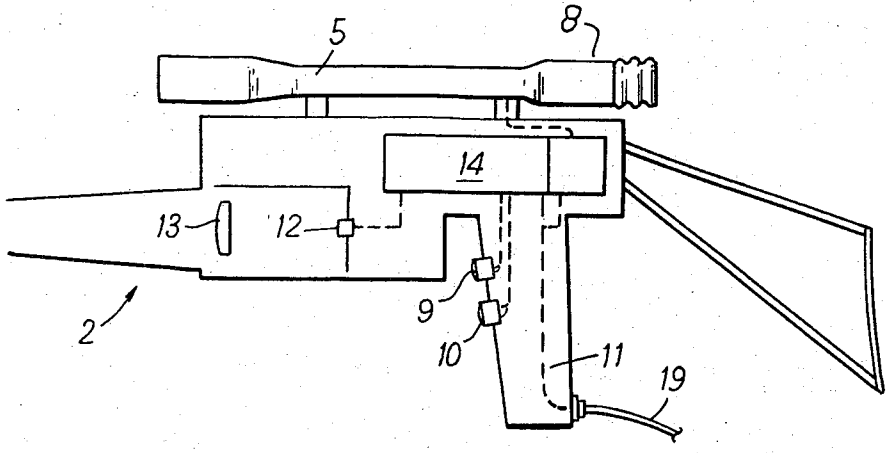
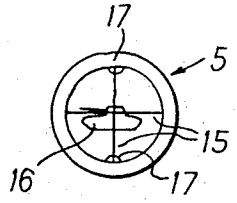


FIG. 3



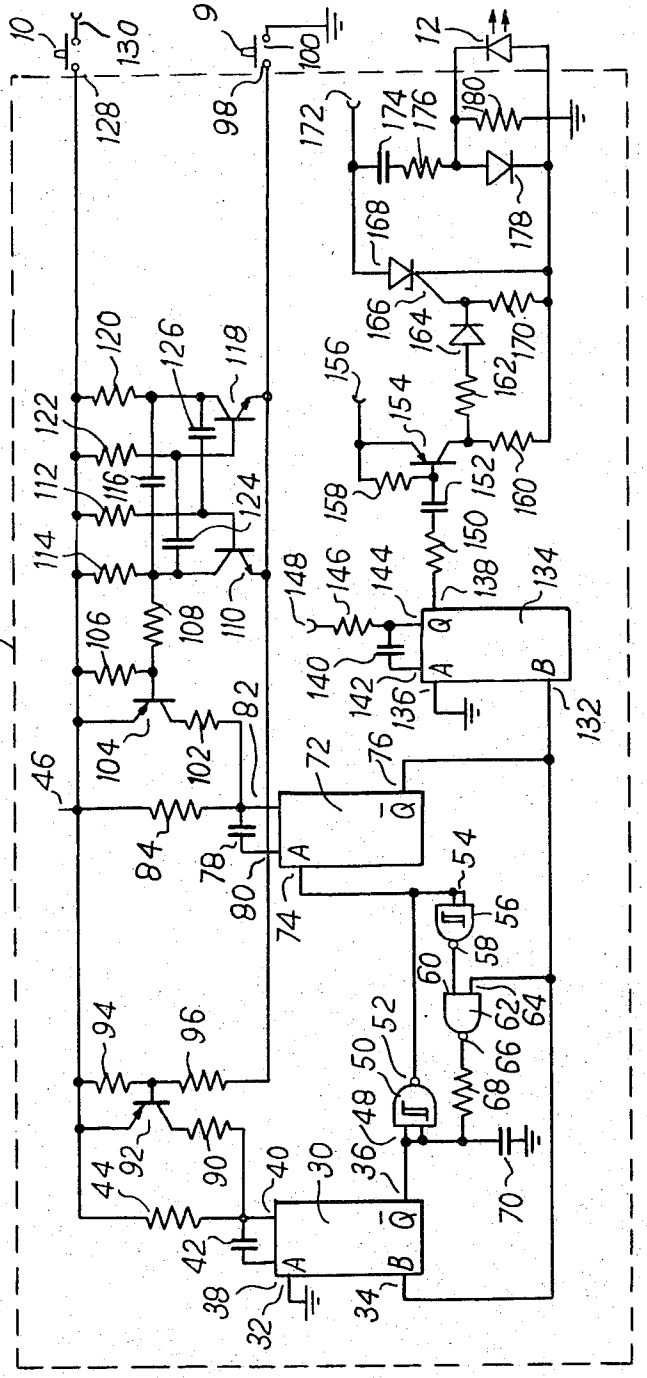

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FIG. 4

UMPIRES RAY GUN FOR USE IN WEAPON TRAINING SYSTEMS

This invention relates to ancillary equipment for weapon training systems and particularly, but not exclusively, for those in which a narrow beam of electromagnetic radiation is used to simulate the line of fire from a gun on an attacking vehicle and in which detectors mounted on a target detect such radiation and, by means of a radio link, signal back to the attacking vehicle that they are under fire or have been hit.

One such system is described in our U.S. Pat. No. 3,588,108 and although this system permits more effective training of tank crews in tactical exercises by allowing one tank to disable another by accurate simulated fire rather than by relying entirely on the judgement of umpires, which is frequently late and necessarily arbitrary, it has been found that there is still a need for umpires. Umpires need to be able to check, at a distance, that a tank crew's weapon training equipment is switched on and is operating in the target mode. The role of the umpire would be greatly enhanced moreover if he were able to disable any tank at will, thus, for example, simulating the effects of air strikes or mine fields.

Ray guns, such as are described in U.S. Pat. No. 2,070,529 are of course well known but these do not provide for operation in more than one mode nor do they provide for transmission from the target to show that equipment on the target is working without actually effecting a "kill."

With this need in mind there is provided according to the invention apparatus for use with a responsive target forming part of a weapon training system, said target being equipped with detecting means for detecting the incidence of electromagnetic radiation and with transmitting means operably connected to said detecting means for transmitting radio signals in response to said incident radiation and with a selective circuit connected to receive signals from said detecting means and responsive to at least one mode of modulation of said radiation corresponding to a "kill" signal, said apparatus comprising in combination a source for providing a collimated beam of electromagnetic radiation, modulating means co-operating with said source for modulating said beam in at least first and second modes, said first mode being adapted to activate said transmitting means to transmit without activating said selective circuit, and said second mode being adapted to activate said selective circuit on the target as a "kill" signal, manually operable switch means connected to said modulating means for selecting at will each of said modes of modulation and for causing the beam to be transmitted in said selected mode, aiming means connected to said source and aligned with said beam for aiming said beam at said target, radio receiving means for receiving the radio signals transmitted from said target in response to radiation from said beam incident on said target and indicating means connected to said receiving means for indicating that the detecting means on the target has detected the incidence of the beam.

The invention will now be described by way of non-limitative example by reference to the attached drawings, in which:

FIG. 1 shows a soldier umpire using equipment according to the invention.

FIG. 2 shows diagramatically further detail of the "umpire's gun" which forms part of the equipment.

FIG. 3 shows a view through the sight which forms part of the "umpire's gun."

FIG. 4 shows in greater detail the modulator depicted in FIG. 2.

Referring now to FIG. 1, a soldier, 1, is holding an "umpire's gun," 2, which comprises a body, 3, containing a source (not shown in this figure) which in operation provides a modulated collimated beam of electromagnetic radiation, and a sight, 5, aligned with said beam so that the user can aim the beam accurately towards a target (not shown in this figure).

A back pack, 6 contains a radio receiver 18 connected to an aerial, 7. The back pack also contains power supplies for the umpire's gun, 2, to which it is connected by a cable 19. The radio receiver 18 is connected to indicating lamps (not shown in this figure) placed at the eye piece, 8, of the sight.

Press button switches 9 and 10 are provided on the stock 11 of the umpire's gun for "firing" the gun in each of its modes of operation.

Referring now to FIG. 2 there is shown diagramatically and in part section the umpire's gun 2 in FIG. 1. The source of the modulated collimated beam of electromagnetic radiation comprises a convex collimating lens 13 and a Gallium Arsenide laser diode 12 situated substantially on the optical axis and in the focal plane thereof.

The laser diode 12 receives electrical pulses from a modulator 14 which may be operated in a plurality of modes, for example, by changing the frequency of pulses supplied to the laser 12. The required mode of modulation is determined by press switches 9 and 10. It is convenient to arrange for the laser to be fired in a first mode when one press button is pressed and in a second mode when both press buttons are pressed but it is evident that there are many different switches or arrangements of switches which could be used for these functions.

FIG. 3 shows the view through the eye-piece 8 of sight 5 when the umpire's gun 2 is correctly aimed at a target tank 16, being aligned with cross-hairs 15 of the sight 5. Indicator lamps 17 are provided in the sight 5 to give an indication to the soldier 1 without the need for him to move his eye from the eye-piece 8.

FIG. 4 shows further detail of the modulator 14 of FIG. 2. A monostable 30 which may conveniently be a type 74121 monostable multivibrator obtainable from ITT Semiconductors., Footscray, Kent., has an A terminal 32 which is connected to ground, a B terminal 34, a $\bar{Q}$ output 36 and timing terminals 38 and 40 between which a timing capacitor 42 is connected, terminal 40 being connected through resistor 44 to a common supply line 46.

The output 36 of monostable 30 is connected to the input 48 of a schmidt trigger 50 which may conveniently by type SN7413 obtainable from the same source as the monostable 30. Schmidt trigger 50 has an output 52 which is connected to the input 54 of a second similar schmidt trigger 56 which has an output 58. Output 58 is connected to one input 60 of a NAND gate 62 the other input of which 64 is connected to input 34 of multivibrator 30. The output 66 of NAND gate 62 is connected via resistor 68 to input 48 of trigger 50 the input 48 also being connected to ground via capacitor 70. A second monostable 72 identical to

monostable **30** has an A input **74** which is connected to input **54** of AND gate **56** and a $\bar{Q}$ output **76** which is connected to input **34** of multivibrator **30.** A timing capacitor **78** is connected between terminals **80** and **82** of monostable **72** and terminal **80** is connected by a resistor **84** to the supply line **46.**

The timing terminal **40** of multivibrator **30** is connected via a resistor **90** to the collector of a transistor **92** the emitter of which is connected to supply line **46** and the base of which is connected to the junction of resistors **94** and **96.** The other terminal of resistor **94** is connected to supply line **46** and the other terminal of resistor **96** is connected to terminal **98** of switch **9.** The other terminal **100** of switch **9** is connected to ground.

Terminal **82** of monostable **72** is connected through a resistor **102** to the collector of transistor **104** the emitter of which is connected to supply line **46** and the base of which is also connected to supply line **46** via resistor **106.** The base of transistor **104** is also connected via resistor **108** to the collector of transistor **110** the emitter of which is connected to terminal **98** of switch **9** and the base of which is connected through resistor **112** to supply line **46.** The collector of transistor **110** is also connected to supply line **45** via resistor **114.**

The collector of transistor **110** is also connected via capacitor **116** to the collector of a transistor **118** which is also connected via a resistor **120** to supply line **46.** The emitter of transistor **118** is connected to terminal **98** of switch **9** and its base is connected via resistor **122** to supply line **46.** A capacitor **124** is connected between the collector of transistor **110** and the base of transistor **118** and a capacitor **126** is connected between the collector of transistor **118** and the base of transistor **124.** The supply line **46** is connected to terminal **128** of switch **10** the other terminal **130** of which **130** is connected to a power supply (not shown).

The Q output **76** of monostable **72** is connected to the input **64** of NAND gate **62** and to the B input **132** of a monostable **134,** which may also be type SN74121, and has an A input **136** connected to ground and a Q output **138.** A timing capacitor **140** is connected between timing terminals **142** and **144** of monostable **134** and terminal **144** is also connected via resistor **146** to a reference voltage **148.**

Q output **138** is connected via resistor **150** and capacitor **152** in series to the base of a transistor **154** the emitter of which is connected to power supply **156.** The base of transistor **154** is connected to power supply **156** via resistor **158** and the collector of transistor **154** is connected to ground via resistor **160.** The collector of transistor **154** is also connected via resistor **162** and diode **164** in series to the gate **166** of a silicon controlled rectifier SCR **168.** Gate **166** is connected via resistor **170** to ground. The cathode of SCR **168** is also connected to ground. The anode of SCR **168** is connected to a high voltage power supply **172** and to a capacitor **174,** the other terminal of which is connected via resistor **176** to the cathode of laser diode **12.** The anode of laser diode **12** is connected to earth. A protective diode **178** and a resistor **180** are connected in parallel across laser diode **12.**

Monostables **30** and **72** are coupled together to form a multivibrator the pulse repetition frequency f_1 of which is determined primarily by timing capacitors **42** and **78** and resistors **44** and **84.** The schmidt triggers **50** and **56** together with NAND gate **62** constitute a starting circuit to ensure that when power is supplied to the circuit by closure of switch **10** the circuit starts to oscillate. Monostable **134** is triggered by a pulse at the output **76** of monostable **72** to produce an output at Q output **138** which is amplified by transistor **154** and fires SCR **168.** SCR **168** then discharges capacitor **174** through laser diode **12** which emits a pulse of infra red energy. It will be seen that the PRF of pulses from laser diode **12** is determined by the oscillation frequency f of a multivibrator formed by monostables **30** and **72.**

This frequency f may be altered by switching in additional resistors **90** and **102** by means of transistors **92** and **104.** Unless switch **9** is closed the terminal **98** is floating and neither transistor **92** nor **104** nor **110** nor **118** are conducting. When switch **9** is closed terminal **98** is grounded applying power to transistors **92, 104, 110** and **118.** Transistor **92** is turned on and the effect of introducing resistor **90** into the timing circuit between terminal **40** and the power supply **46** is to change the frequency to a new higher frequency f_2.

Transistors **110** and **118** are cross coupled in known fashion to form a multivibrator and the potential at the collector of transistor **110** will alternate between ground and that of the supply terminal **46.** The effect of this is to switch on transistor **104** during those periods when transistor **110** is conducting and its collector is at ground potential. When transistor **104** is conducting resistor **102** is also brought into circuit between terminal **82** of monostable **72** and the supply **46;** its effect is to raise the frequency of oscillation to a higher value f_3.

Thus when switch **10** is operated the laser is fired at the first frequency f_1; when switches **9** and **10** are both operated the PRF of light pulses from the laser alternates between higher frequencies f_2 and f_3 at a rate determined by the time constants of the multivibrator formed by transistors **110** and **118.**

In operation detectors on the target **16** receive radiation from the beam and are connected to frequency selective circuits adapted to discriminate between signals representative of each of the modes of modulation selected by press buttons **9** and **10.** The first mode of modulation at the single frequency f_1 allows the soldier **1** to check that equipment on the target is switched on and is operating; a radio transmitter is mounted on the target and transmits when the beam is incident on the detectors. Signals from this radio transmitter are received by aerial **7** and radio receiver **18** which is connected to operate the lamps **17** in the eye piece **8** of the sight **5.** Thus a visual indication is provided in the eye piece that the detectors and transmitter on the target tank are operative.

The frequency f_1 is characteristic of the umpire's gun and is a different frequency from that employed in the weapon simulation system e.g. for attack. Accordingly frequency selective circuits in the target tank are arranged so that no indication is given in the target tank that the beam from the umpire's gun is incident upon it.

Frequencies f_2 and f_3 on the other hand are the characteristic frequencies used in the weapon simulation system for "attack" and for "kill." Protective circuits in the equipment on the target tank are arranged so that the target tank only responds to the "kill" frequency f_3 after it has already received a beam modulated at the "attack" frequency f_2. This has the effect of reducing the susceptibility of the equipment on the

target tank to spurious "kills" but it requires that the umpire's gun operates first at "attack" frequency f_2 and then at "kill" frequency f_3 in order to effect a "kill." This is provided by alternation between two frequencies f_2 and f_3 as described.

When the protective circuit is overcome and a "kill" signal is detected by the frequency selective circuits receiving the signal from the detector on the target, a relay is operated to disable some or all of the functions of the target vehicle.

What is claimed is:

1. Apparatus for use with a responsive target forming part of a weapon training system the target being of the type having detecting means for detecting the incidence of electromagnetic radiation modulated in different modes and having transmitting means operably connected to said detecting means for transmitting radio signals in response to said incident radiation, and with a selective circuit connected to receive signals from said detecting means and responsive to a predetermined mode of modulation of said radiation corresponding to a "kill" signal, the apparatus comprising in combination

a support body;

radiation source means mounted on said body for providing a collimated beam of electromagnetic radiation;

modulating means co-operating with said source for modulating said beam in at least first and second modes, said first mode being selected to activate the transmitting means to transmit without activating the "kill" signal selective circuit, and said second mode being selected to activate said selective circuit on the target as a "kill" signal;

manually operable switch means connected to said modulating means for selecting at will each of said modes of modulation; and for causing the beam to be transmitted in said selected mode

aiming means connected to said source and mounted on said body and aligned with said beam for aiming said beam at the target;

radio receiving means for receiving the radio signals transmitted from the target; and

indicating means connected to said receiving means for indicating that the detecting means on the target has detected the incidence of the beam.

2. Apparatus according to claim 1 wherein said first and second modes of modulation are characterised by different modulating frequencies.

3. Apparatus according to claim 1 wherein one of said first and second modes of modulation is characterised by alternation between two modulating frequencies.

4. Apparatus according to claim 1 wherein the indicating means provides in operation an indication visible through the aiming means.

5. Apparatus for use with a responsive target forming part of a weapon training system the target being equipped with detecting means for detecting the incidence of electromagnetic radiation and with transmitting means operably connected to said detecting means for transmitting radio signals in response to said incident radiation, and with a selective circuit connected to receive signals from said detecting means and responsive to only certain modes of modulation of said radiation corresponding to a "kill" signal, said apparatus comprising in combination

collimating means;

laser diode means for co-operating with said collimating means to produce a collimated beam of laser radiation,

modulating means connected to said laser diode for delivering thereto pulses at selectable ones of a plurality of pulse repetition frequencies for modulating said beam in at least first and second modes, said first mode being selectable to activate said transmitting means to transmit without activating the selective circuit on the target and said second mode being characterized by alternation between two modulating frequencies and selectable to activate the selective circuit on the target as a "kill" signal;

manually operable switch means connected to said modulating means for selecting at will each of said modes of modulation and for causing the beam to be transmitted in said selected mode;

aiming means connected to said source and aligned with said beam for aiming said beam at said target;

a housing for supporting said collimating means, said laser diode means and said aiming means;

radio receiving means for receiving the radio signals transmitted from the target in response to radiation from said beam incident on the target; and

indicating means connected to said receiving means for indicating that the detecting means on the target has detected the incidence of the beam.

6. A weapon training system comprising

a responsive target having

means for detecting the incidence of modulated electromagnetic radiation,

selective circuit means connected to receive signals from said means for detecting for responding to a unique mode of modulation corresponding to a "kill" signal; and

transmitting means responsive to said means for detecting for transmitting radio signals indicative of the receipt of incident radiation modulated in a mode other than a "kill" signal made on said target; and

an umpire's "gun" comprising

a support body;

radiation source means mounted on said body for providing a collimated beam of electromagnetic radiation modulation means for modulating said beam in first and second modes,

said means for detecting being responsive to said first mode to transmit radio signals indicative of the incidence of radiation modulated in a mode other than said unique mode on said target,

said second mode being identifiable by said selective circuit means as a "kill" signal;

switch means connected to said modulating means for initiating transmission of a beam in a selected one of said modes;

aiming means on said body for directing the beam at said target;

radio receiver means for receiving radio signals from said transmitting means; and

indicating means connected to said receiving means for indicating that said means for detecting has detected the incidence of the beam.

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