United States Patent

[11] 3,588,108

[72]	Inventor	Peter Thomas Ormiston Farnborough, England
[21]	Appl. No.	717,802
[22]	Filed	Apr. 1, 1968
[45]	Patented	June 28, 1971
[73]	Assignee	The Solartron Electronic Group Limited Farnborough, England
[32]	Priority	Apr. 11, 1967
[33]		Great Britain
[31]		16490/67

[54] **WEAPON-TRAINING SYSTEMS**
13 Claims, 7 Drawing Figs.

[52] U.S. Cl. **273/101.1,** 273/102.2, 356/4, 35/25

[51] Int. Cl. **F41g 7/00**

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

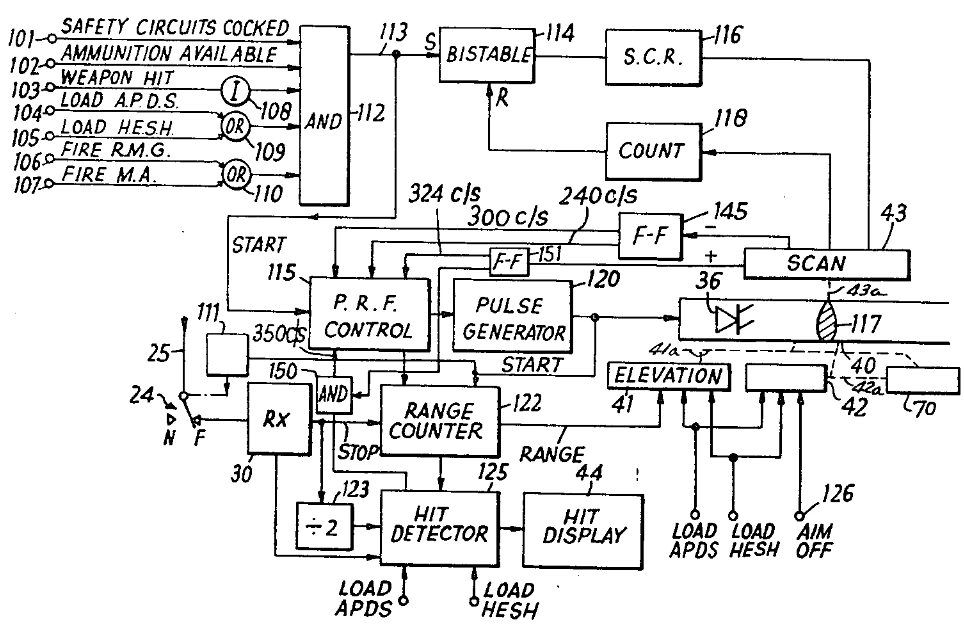
[56] References Cited

UNITED STATES PATENTS

3,464,770	9/1969	Schmidt	356/4
3,466,761	9/1969	Stinchcomb	273/101.2X
3,483,636	12/1969	Knapp et al.	35/25
2,629,598	2/1953	Hooker	273/101.1
3,243,896	4/1966	Immarco et al.	273/101.1X
3,257,741	6/1966	Cameron et al.	273/101.1X

Primary Examiner—Anton O. Oechsle
Assistant Examiner—Marvin Siskind
Attorneys—William R. Sherman, Stewart F. Moore and Jerry M. Presson

ABSTRACT: A weapon-training system for assessing the accuracy of an aim in which an electromagnetic source, preferably a laser, is linked to an aiming device such as a sighting telescope for aiming at a target. The system includes a detector on the target for receiving the radiation and an indicator to provide information concerning the accuracy of the am. The linkage between the aiming device and the source includes a servomotor and a mechanical linkage for depressing the elevation of the beam with respect to the orientation of the aiming device as a function of the distance between the source and detector. The linkage may also include a servomotor and a mechanical linkage for altering the azimuth of the beam in response to information concerning relative movement of the detector.



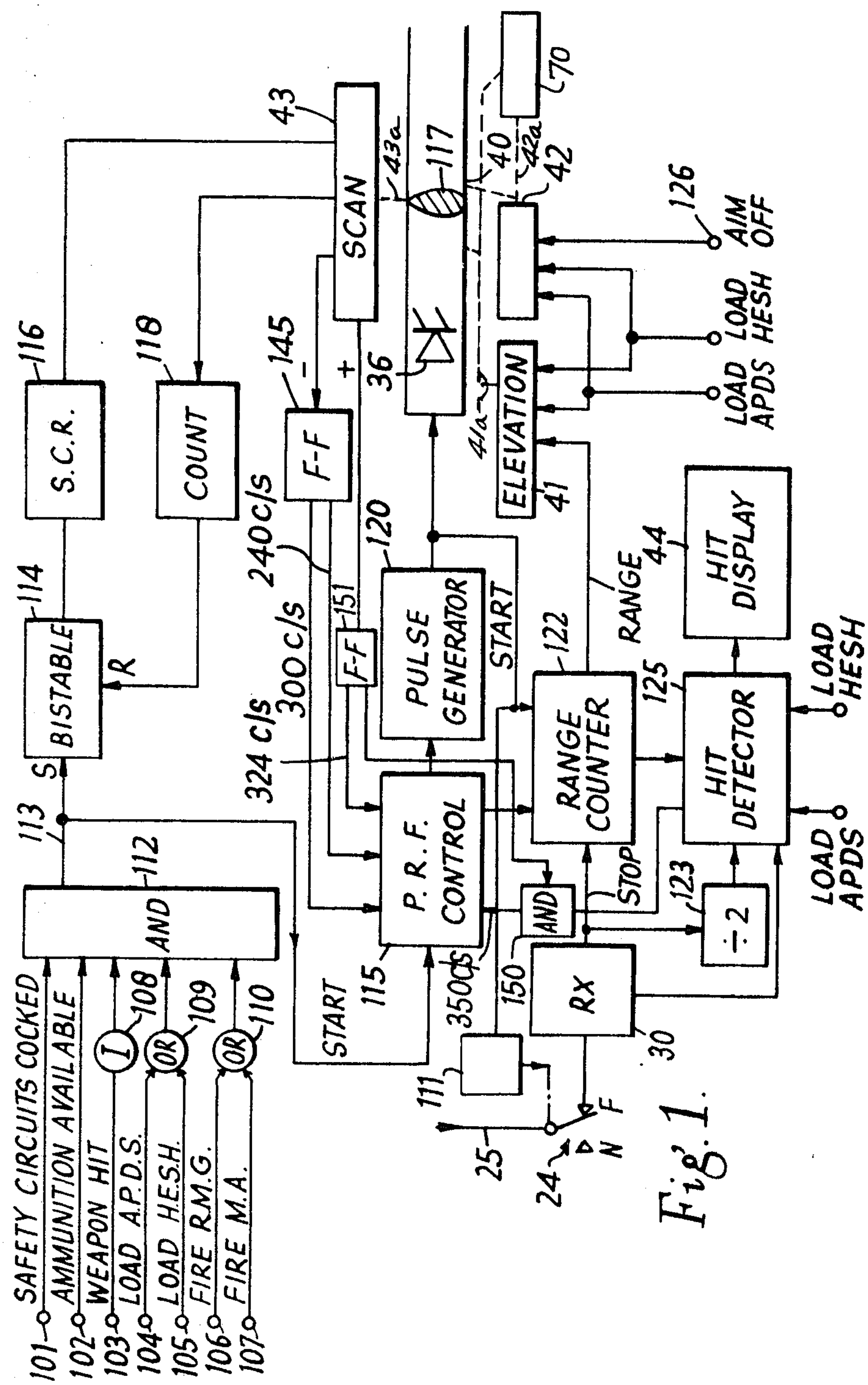
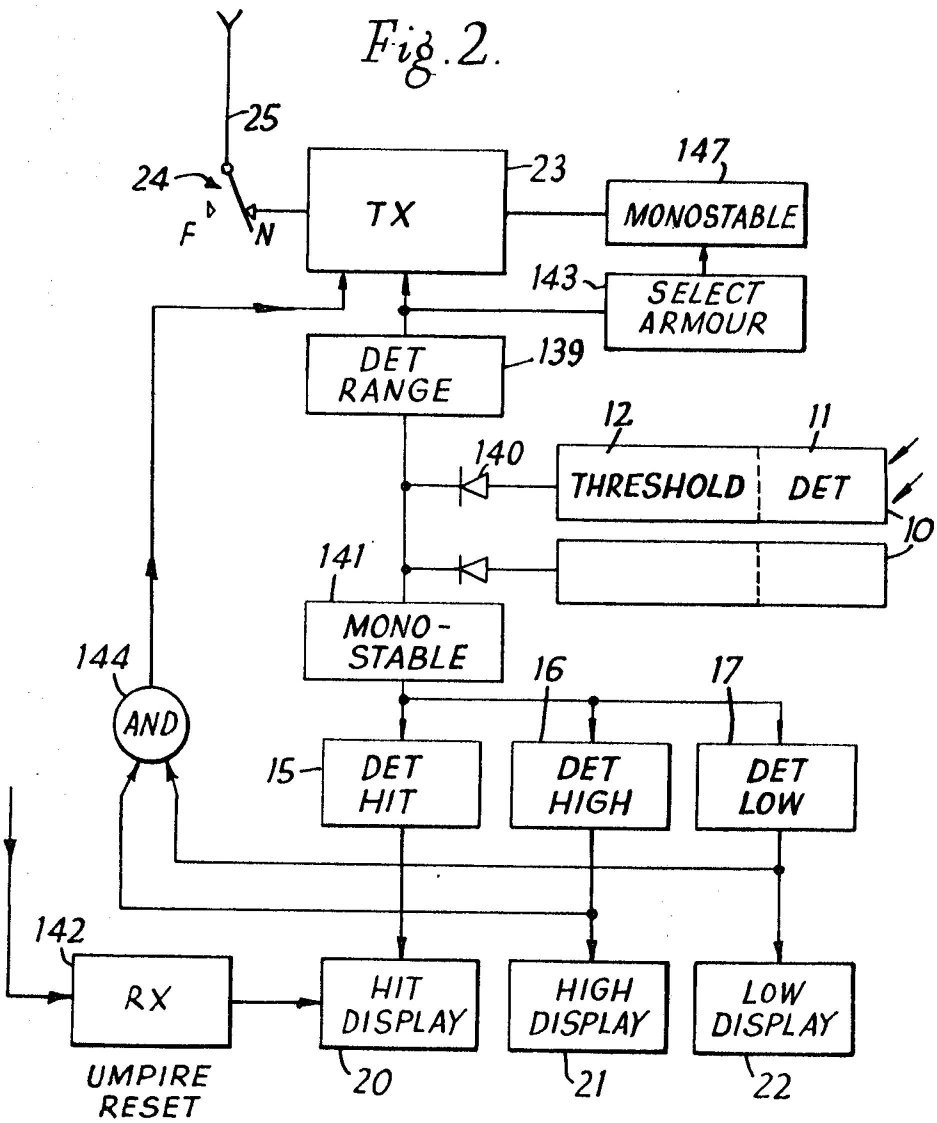


Fig. 1.

INVENTOR
PETER THOMAS ORMISTON

Fig. 2.



INVENTOR
PETER THOMAS ORMISTON

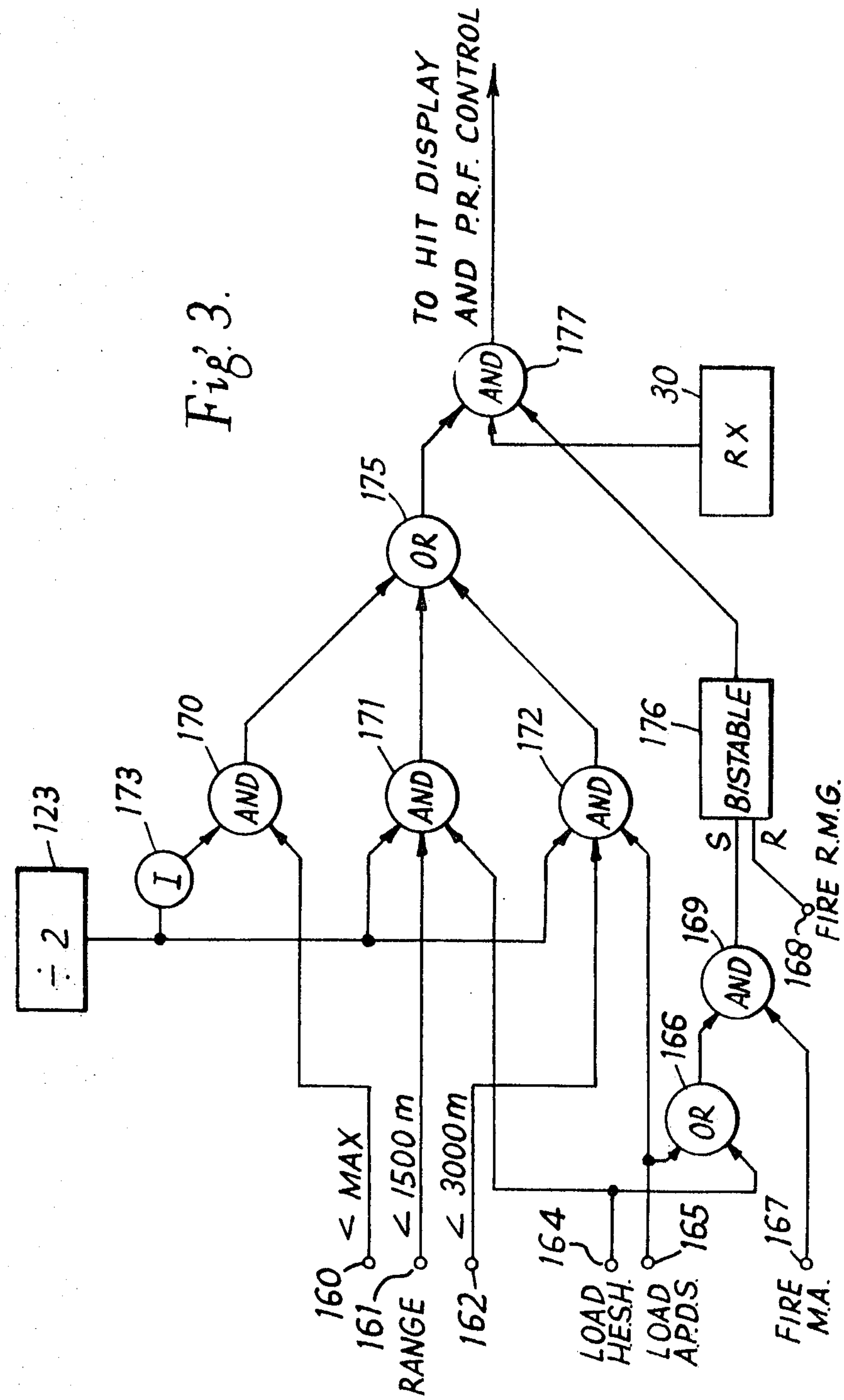


Fig. 3.

INVENTOR
PETER THOMAS ORMISTON

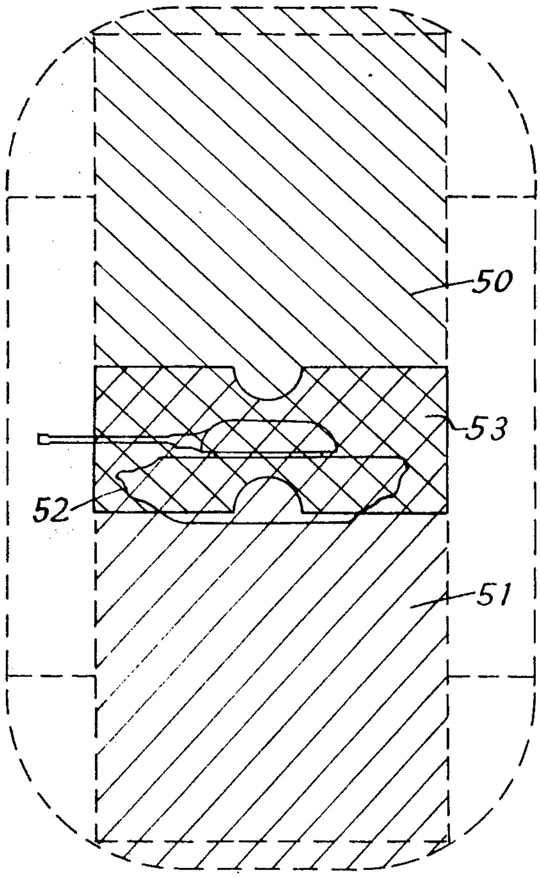


Fig. 4.

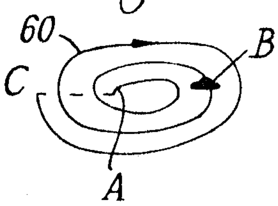


Fig. 5.

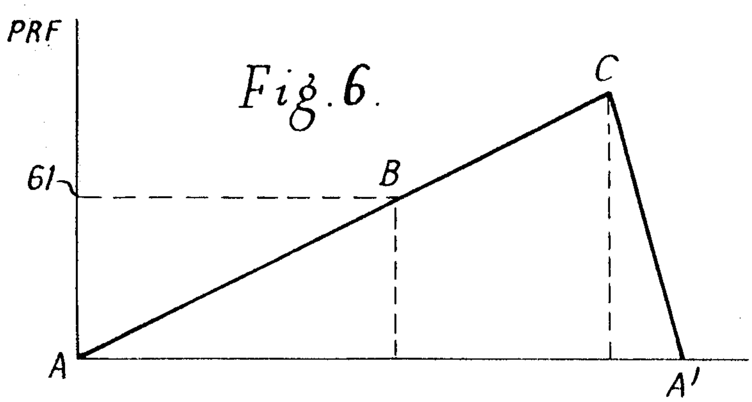
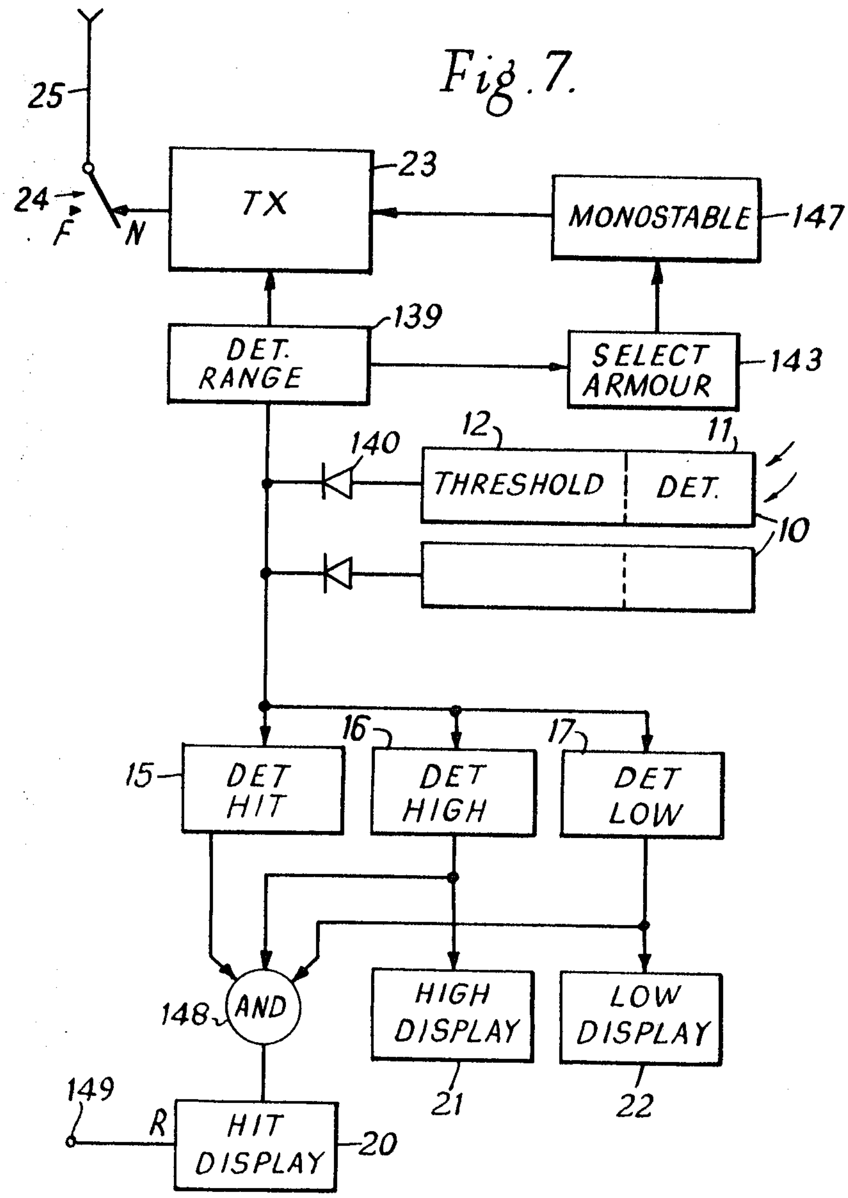


Fig. 6.

INVENTOR
PETER THOMAS ORMISTON

Fig. 7.



INVENTOR
PETER THOMAS ORMISTON

WEAPON-TRAINING SYSTEMS

This invention relates to a weapon-training system in which a pupil aims a weapon at a target, and it is required to assess the accuracy of the aim at the moment of firing.

According to the invention, there is provided a weapon-training system for assessing the accuracy of an aim, comprising aiming means for aiming at a target, a source adapted in operation to provide a beam of electromagnetic radiation, a linkage between the aiming means and the source for orienting the source in an orientation related to the orientation of the aiming means, a detector mounted on the target and adapted in operation to receive the beam when the aiming means is aimed with a predetermined accuracy, and an indicator adapted to provide in operation information concerning the accuracy of the aim.

The aiming means will generally be sights mounted on a full-scale model of an armament. The weapon and target may be separated by realistic distances, or the target may be a scale model at a similarly scaled down distance from the weapon. Each of several targets may carry detectors, and each weapon may itself be mounted on a target.

It is preferred to use visible or infrared radiation, and for this purpose the source may conveniently be a laser, or a gallium arsenide diode.

The linkage preferably includes means for depressing the elevation of the beam produced by the source with respect to the orientation of the aiming means in response to information concerning the range of the target. The linkage may also include means for adjusting the relative orientation of the source and the aiming means in response to information concerning the speed of movement of the target in a direction perpendicular to the line joining the weapon to the target.

In order to provide information concerning the range of the target, a weapon-training system as described above further comprises a time-measuring circuit adapted in operation to receive a signal from the source and a signal from the detector and to provide a measure of the time of travel of the beam from the weapon to the target and hence to provide a measure of the range of the target from the weapon.

Alternatively, in order to provide information concerning the range of the target, a weapon-training system as described above further comprises a radar transmitter and receiver mounted on or near the weapon for measuring the range of the target from the weapon.

Information concerning the range of the target and the accuracy of the aim may be transmitted from the target to the weapon through a radio transmitter mounted on or near the target and a receiver mounted on the weapon. Other information, concerning, for example, the speed and heading of the target, may also be transmitted in this way.

The detector is responsive to radiation emitted by the source, and may be a photomultiplier or a semiconductor detector. The detector system may need to cover a large solid angle and a number of individual detectors may be required. The signal-to-noise ratio of such a system can be improved by successively switching in circuit each of the detectors of the system. Alternatively a single detector mounted in a scanning system may be used. When such a scanning system is used, the source must emit a beam of radiation for at least a full scanning or switching cycle, and the indications of the accuracy of the aim may be correspondingly delayed.

The indicator may be mounted on the weapon or the target, or at some other convenient location; or indicators may be mounted at two or more of these positions.

The indicator will generally indicate a hit when this occurs, but may also indicate a near miss. For this purpose the beam may be scanned through a small arc or cone. If a pulsed laser is used as the source, the pulse repetition frequency may be varied as the beam is scanned. The detector then detects a signal having a particular pulse repetition frequency, this being related to the accuracy of the aim. Alternatively the beam may be moved from an upper position to a lower position, the pulse repetition frequency having one value when the beam is in the upper position and another value when the beam is in the lower position. The detector picks up alternate bursts of both pulse repetition frequencies only if it lies in the overlap, or direct hit zone.

Various embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a block circuit diagram of a weapon system;

FIG. 2 is a block circuit diagram of a target system;

FIG. 3 is a block circuit diagram of the hit detector of the weapon system shown in FIG. 1;

FIG. 4 shows the scanning scheme used in operating the system of FIG. 1;

FIGS. 5 and 6 illustrate another scanning scheme; and

FIG. 7 is a block circuit diagram of an alternative target system.

The weapon system of FIG. 1 and the target system of FIG. 2 together form a weapon-training system. Frequently it is convenient for a weapon system and a target system both to be mounted at the same location or on the same vehicle.

The weapon system illustrated in FIG. 1 comprises seven information inputs **101—107**, which are described in more detail below. These inputs are applied to an AND gate **112** the output of which is connected to the SET input of a bistable **114** and to a pulse repetition frequency control circuit **115** (hereinafter referred to as the p.r.f. control **115**).

The set output of the bistable **114** is connected through a silicon-controlled rectifier **116** to a scanning servo **43**. The servo **43** is coupled by a mechanical linkage **43*a*** to the lens **117** of a gallium arsenide diode laser comprising a gallium arsenide diode **36** in a mounting **40**, and rotates the lens, thereby causing the beam to scan over a small cone. The mounting **40** moves with the aiming means **70**, so as to point in approximately the same direction as the aiming means; the difference in the orientations of the mounting **40** and the aiming means being controlled by an elevation servo **41** and an aim-off servo **42** through mechanical linkages **41*a*** and **42*a***. A binary counter **118** counts the number of rotations of the lens and resets the bistable **114** after a predetermined number of revolutions of the lens **117**.

The laser **36** is fired by a pulse generator **120**. The pulse generator **120** is connected to the output of the p.r.f. control **115** which controls the pulse repetition frequency of the laser pulses. The p.r.f. has inputs from microswitches connected to the scanning servo **43**, and an input from a hit detector **125** through an AND gate **150**. Flip-flops **145** and **151** are connected to the microswitches so that different inputs of the p.r.f. control are enabled successively during the alternate rotations of the lens **117**.

A radio receiver **30** can be connected through the switch **24** to an aerial **25**. The output of the receiver **30** and the output of the pulse generator **120** are both connected to a range counter **122** comprising a clock pulse generator connected to a 3-bit counter. The output of the range counter is connected to an elevation servo **41** which moves the laser mounting **40**.

The output of the receiver **30** is connected both through a category count divide-by-two circuit **123** and directly to the hit detector **125**. The output of the hit detector **125** is connected to a hit display **44** and to the AND gate **150**.

An aim-off servo **42** is also connected to control movement of the mounting **40** in accordance with information on an aim-off input **126**.

The target system illustrated in FIG. 2 has a plurality of detector heads **10** of which only two are shown. Each detector head comprises a photocell or semiconductor device **11** mounted on the outside of the target vehicle to receive radiation emitted by weapons. Each detector is connected to a threshold circuit **12**, and a diode **140** is connected to the output of each of the threshold circuits **12**.

The output of the threshold circuits **12** is applied to a monostable **141**, the output of which is connected to a hit detector **15**, a high detector **16** and a low detector **17**. These are connected respectively to a hit display **20**, a high display **21** and a low display 22. A radio receiver 142 is connected to the hit display 20 so that the umpire can reset the hit display if desired.

The outputs of the high detector 16 and of the low detector 17 are passed to an AND gate 144, the output of which is applied to a transmitter 23 which is connected through a switch 24 to an aerial 25. The outputs of the threshold circuits 12 are also connected through a detect ranging circuit 139 to the transmitter 23.

A select armor circuit 143 is connected to the output of the detect ranging circuit 139, and has its output connected to a monostable 147, the output of which is connected to the transmitter 23.

If, as is usually the case, a weapon system and a target system are both mounted together in the same vehicle or location, the switches 24 and aerials 25 shown in FIGS. 1 and 2 can be the same switch and aerial.

The operation of the weapon system of FIG. 1 and the target system of FIG. 2 will now be described.

A true signal is applied to the input 101 when the safety circuits are closed and the gun is cocked. The input 102 is connected to the output of a counter which indicates the amount of ammunition available. Each time a round is fired one unit is subtracted from the counter. Input 103 is true only when the vehicle has been 'hit' by another weapon, and is thus operative only when a target system is mounted at the same location. Input 103 is connected to an inverter 108, the output of which is true unless the vehicle has been 'hit.'

Inputs 104 and 105 are true if the gun has been loaded with either an armor piercing discarding sabot (A.P.D.S.) or a high explosive squash head shell (H.E.S.H.) respectively. Inputs 104 and 105 are applied to an OR gate 109 the output of which is applied to the AND gate 112.

Inputs 106 and 107 are true if the 'fire ranging machine gun' (R.M.G.) or 'fire main armament' (M.A.) buttons are pressed on the weapon. The inputs 106 and 107 are applied to an OR gate 110 the output of which is also applied to the AND gate 112.

When the weapon is in a condition for firing and one of the Fire buttons is depressed, a START signal is generated on line 113. The start signal sets the bistable 114 and starts the scanning servo 43 rotating. The counter 118 resets the bistable 114 after two complete rotations of the lens 117.

The scanning scheme used is illustrated in FIG. 4. The pulsed laser beam is shaped as a rectangle and is moved in a circular path. The p.r.f. is given a first value when the beam is in the upper quadrant 50 and a second value when in the lower quadrant 51. Over the two lateral quadrants the beam is not pulsed. The detector on the target 52 picks up alternate bursts of both the first and second p.r.f.'s only if it lies in the overlap or direct hit zone 53. This zone is roughly rectangular with two indentations of little importance. It will be appreciated that many more areas may be employed than the two quadrants used in the apparatus illustrated, so that the degree of accuracy of the aim may be more accurately determined. For example, nine such areas may be employed forming a 3×3 'checkerboard' type of scan, each area having a different p.r.f. allotted to it. Then the target may detect different combinations of the nine p.r.f. to indicate that the target lies between the centers of two or more scanning areas.

When the lens 117 starts rotating, for the first half-cycle the beam is scanned in the lower quadrant 51. This is detected by a microswitch in the servo 43 and a signal is applied through a flip-flop 145 to the p.r.f. control, and sets the pulse repetition frequency at the ranging frequency of 240 c./s.

Simultaneously with the sending of a pulse on the laser beam, the clocked counter 122 is started.

On the target, the 240 c./s. ranging signal is detected by the detectors 10 and applied to the detector circuits 15, 16, 17 and 139. The detector circuits 15, 16 and 17 do not respond to the 240 c./s. signal, but the detect ranging circuit 139 does and applies a signal to the transmitter 23.

If the target armament is considered to be 'soft,' the select armor circuit 143, which comprises a switch, is open and the single pulse from the circuit 139 is transmitted. If the target armament is considered to be 'hard,' the select armor circuit 143 is closed and a pulse is applied to the monostable 147. This pulse is transmitted a predetermined time interval after the first pulse. Information concerning the nature of the target armament may be fed in by a manually operable switch.

The receiver 30 on the weapon is connected to the aerial 25 by the switch 24 which is moved to the fire (F) position for 20μ sec. intervals following each successive laser pulse, i.e. at the p.r.f. of the pulse generator 120 for a period of, say 1½ seconds. Normally the switch 24 is in the normal (N) position, and if there is a target system at the same location, the target transmitter 23 is connected to the aerial 25. The receiver 30 receives the signal from the target's ranging detector 139 and stops the counter 122. The time for which the clocked counter 122 is counting is proportional to the distance between the weapon and the target. The counter 122 applies a signal dependent upon this range to the elevation servo 41. The servo 41 is a step-and-hunt servo and comes to rest on the contact which is activated by the counter 122. The servo 41 thus rotates a cam which lifts the mounting 40 thus depressing the laser beam by the required tangent elevation. The amount of depression can be adjusted in accordance with the type of ammunition used, and Load A.P.D.S. and Load H.E.S.H. inputs are provided to the elevation servo 41.

The output of the receiver 30 is also applied to a divide-by-two circuit 123. The circuit 123 counts the number of pulses received from the transmitter, a single pulse indicating a soft skin and a double pulse indicating a hard skin. This information is applied to the hit detector 125.

The lens 117 is then rotated so that the laser beam falls in the upper quadrant 50 of FIG. 4, and the p.r.f. control 115 generates a p.r.f. of 324 c./s. On the target, the detect high circuit 16 is responsive to this p.r.f. and applies a signal to the high display 21 and the AND gate 144. The detector circuits 16 and 17 both contain hold circuits to hold the signal at their outputs for a predetermined period.

For the succeeding half-rotation of the lens 117 the p.r.f. control generates a p.r.f. of 300 c./s. On the target, the detect low circuit 17 is responsive to this p.r.f. and applies a signal to the low display 22 and the AND gate 144.

Thus it can be seen with reference to FIG. 4, that if the target lies in the direct hit zone 53, both the 324 c./s. and the 300 c./s. will be received, and signals will be applied to both detectors 21 and 22 and to both inputs of the AND gate 144. If the target falls within the upper or the lower quadrant alone, the respective high or low display will be activated only.

If the target is in the direct hit zone, the AND gate 144 applies a signal to the transmitter 23. The receiver 30 applies the signal directly to the hit detector 125.

The hit detector 125 only operates when the 'Fire main armament' button has been pressed and does not respond to the 'Fire R.M.G.' button. In the event of the main armament being fired, and a signal being received by the receiver 30 indicative of a direct hit, a signal is passed to the hit display 44, and to the AND gate 150, which is opened by flip-flop 151 during the final half-turn of the lens 117, and sets the p.r.f. to the direct-hit frequency of 350 c./s. This p.r.f. is transmitted on the laser beam during the final half-turn of the lens 117, and is detected by the detect hit circuit 15. The output of the detect hit circuit 15 is applied to the hit display 20 which disables the armament and/or propulsion of the vehicle. If the weapon and target systems are mounted in the same vehicle, the output of the hit display 20 may be applied to input 103.

The receiver 142 receives signals transmitted by the umpire, who can thereby reset the hit display 20.

The detector circuits 15, 16, 17 and 139 may conveniently comprise reed relays responsive to the respective frequencies. The monostable 141 ensures that a sufficiently powerful signal is applied to the detector circuits 15, 16 and 17.

The weapon system may also allow for aim-off of the gun, which is done to allow for movement of the target in a direction perpendicular to the line joining the target to the weapon. A signal dependent upon the speed of the target is fed to an input 126 which is connected to the aim-off servo 42 to move the holder 40 sideways with respect to the gunsights. The sights are normally marked on either side of the main marks in miles per hour to allow for the speed of the target. The aim-off angle will be seen to be proportional only to the speed of the target and not dependent on its range. The gunner will not score a hit unless he aims on the mark corresponding to the speed of the target.

The information concerning the speed of the target may be provided in a number of ways. One of these is to provide a dial on the weapon graduated in miles per hour which is set by a referee on the weapon. Another is to provide the weapon mounting with a tachometer or rate gyro to measure the speed of rotation of the weapon in following the target. Alternatively each target may transmit over the transmitter 23 information of its speed and heading, for example by coded multiple response pulses.

The hit detector 125 is shown in more detail in FIG. 3. The category count circuit 123 is connected to three AND gates 170, 171 and 172. The output of the category count is 0 if the target has a soft skin and is 1 if the target is heavily armored.

AND gate 170 provides an output if the target has a soft skin and is within the maximum range of the weapon.

AND gate 171 provides an output if the target is heavily armored, the weapon is loaded with high explosive ammunition (H.E.S.H.) and the target is within 1,500 metres of the weapon.

AND gate 172 provides an output if the target is heavily armored, the weapon is loaded with armor-piercing ammunition (A.P.D.S.) and the target is within 3,000 metres of the weapon.

For this purpose the range counter is connected to three inputs 160—162 of the hit detector, and provides a signal on these inputs if the range is less than Maximum, 1,500 metres, and 3,000 metres respectively. Load H.E.S.H. and Load A.P.D.S. terminals 164 and 165 are connected to terminals 105 and 104 respectively of FIG. 1.

An OR gate 175 provides an output if any of the three AND gates 170, 171, and 172 has a signal at its output, and passes a signal to one input of the AND gate 177. Another input of AND gate 177 is connected to a bistable 176. The bistable 176 is set when there is a signal at either of the terminals 164 and 165 and also at the fire main armament input 167. The bistable is reset by a signal on a fire R.M.G. input 168. Thus the hit detector does not respond when the ranging machine gun is fired. The terminals 167 and 168 are connected respectively to terminals 107 and 106 of FIG. 1, and the gate 166 may conveniently be the gate 109 of FIG. 1. Thus when the AND gate 177 is enabled by both the OR gate 175 and the bistable 176, it will pass the signal from the receiver 30 to the hit display 44 and through the AND gate 150 to the p.r.f. control 115.

Other scanning systems may be used. A similar effect to that described above, but allowing of faster scanning, may be produced by delaying each pulse in the lower quadrant by a fixed delay with respect to the pulses in the upper quadrant. The returning signal is then phase-modulated and can be demodulated by a pair of synchronous modulators to give "-high," "low" or "hit" indications.

An alternative scanning scheme, illustrated in FIGS. 5 and 6, provides more detailed information about the accuracy of the aim. The pulsed beam is scanned in a cone along the path 60 shown in FIG. 5. The p.r.f. is varied synchronously with the scan as shown in FIG. 6, between a value of 250 per sec. at A and 500 per sec. at C. The detector picks up only a small section of the p.r.f. spectrum, for instance a target at B picks up that part of the beam having a p.r.f. given by point 61. This information is relayed back to the gunner, who has a clear indication of the accuracy of the aim. The maximum p.r.f. is limited by the permissible dissipation of the source 36, and so the rate of scan is also limited if usable information about the p.r.f. is to be detected. The beam must therefore take at least about one second to scan from A to C.

The scanning system may be used in conjunction with a set of colored lamps on the target, lit singly or in combinations responsive to designated p.r.f.'s, and thus indicating the magnitude and/or the sense of a nearly direct hit.

The code used in relaying the information of the accuracy of a hit from the target to the weapon may be arranged to differentiate between various parts of the target and the angles at which the light beam is received, and hence to simulate the likelihood of a damaging hit on a nonuniformly armored vehicle.

This data may be processed at the target location, or at the weapon location, or partly at each, and may take into account the sum of hits and the type of simulated ammunition used.

An alternative target system is illustrated in FIG. 7. Much of the system is similar to that described with reference to FIG. 2 and will not be further described in more detail.

In the system shown in FIG. 7 the outputs of the detectors 15, 16 and 17 are connected to an AND gate 148, the output of which is connected to the input of the hit display 20. The high and low display 21 and 22 are connected directly to the detect high and detect low circuits 16 and 17. The hit display is provided with an input 149 for resetting by an umpire at the target location.

In use the laser beam is first pulsed with the ranging p.r.f. of 240 c./s. This is received by the detectors 11, detected by the detector 139 and transmitted by the transmitter 23. A single or a double pulse may be transmitted in accordance with information supplied to the select armor circuit 143.

The laser than transmits a p.r.f. of 324 c./s., and this is detected by the high detector 16, if the weapon is correctly aimed. The laser then transmits a p.r.f. of 300 c./s. which is detected by the low detector 17. The detectors 16 and 17 both comprise hold circuits which hold the AND gate 148 open.

The hit detector shown in FIG. 3 is modified in that the direct connection from the receiver 30 to the AND gate 177 is omitted. The AND gate 150 is thus opened whenever the target is within the appropriate range for the type of target skin and weapon ammunition, and when the fire main armament button has been pressed. The p.r.f. of 350 c./s. is then transmitted during the last half-turn of the lens 117.

This p.r.f. of 350 c./s. will be detected by the hit detect circuit 15 on the target, but will only be passed by the AND gate 148 if the target lies in the direct hit zone 53 (FIG. 4).

Although the detector circuits 15, 16 and 17 are shown as being on the target, it is also possible to have them mounted on the weapon, in addition to or instead of those on the target. The hit display 44 will normally not be included when the target system of FIG. 7 is used.

Many other arrangements may be provided which embody the invention. For example, the target system may be mounted on an aircraft or helicopter, to train the pilots thereof in evading ground fire. In such circumstances, it is found convenient to omit the range measuring system and the elevation servo from the weapon, and to use a source of infrared radiation. The output of the high and low detectors in the target is passed to an OR gate, the output of which illuminates a lamp indicating that an attack is in progress. When both the high and low detectors register, this indicates a hit, and a lamp is provided to indicate this to the pilot. A smoke generator may be mounted on the exterior of the craft to indicate a hit to the ground crew manning the weapon.

A simplified weapon system may be mounted on a rifle and a corresponding target system may be attached to an infantryman's helmet. In such a system, the source may be an injection laser, but any light source such as an incandescent or gas discharge lamp may be used. The firing signal is generated by a switch attached to the trigger mechanism.

On closure of the switch a delay-line store discharges into a laser, thus emitting a pulse of infrared light. The beam is focused so as to have a solid angle representative of the silhouette of the desired target at, say, two-thirds of the maximum desired range. When the detector is mounted on the infantryman's helmet it is desirable to allow a preset depression between the sight line and the mean axis of the beam, to compensate for the optical detector displacement from the center of mass of the target. When the weapon system is used in conjunction with a machinegun it may be necessary to use a repetitive laser-initiating switch such as a silicon-controlled rectifier driven by a multivibrator.

The target comprises detectors and an indicator mounted on a helmet. The detector system comprises a low noise amplifier with a reduced low-pass response to reject natural infrared radiation connected to a comparator and trigger circuit. The indicator may be a smoke generator or a lamp for example. A counter may be included to count the total number of hits received.

If the power supply for both a weapon system and a target system is located in the infantryman's helmet, and is connected thereto by a cable, the indicator can be arranged to disconnect the weapon power supply if the target is hit. The weapon can, however, still be used by another infantryman by connecting his own helmet to the weapon.

I claim:

1. A weapon-training system for use with a weapon system of a type including a weapon, the training system comprising the combination of means for aiming the weapon at a target, a source of a beam of electromagnetic radiation, a linkage between said aiming means and said source, said linkage orienting said source in an orientation related to the orientation of said aiming means, a detector responsive to said radiation, means for generating a signal in response to the output of the detector, a time-measuring circuit, means for starting said time-measuring circuit when said source is fired, and means for stopping said time-measuring circuit in response to the signal from said generating means, whereby said time-measuring circuit provides a measure of the time of travel of said beam from said source to said detector, means for providing information concerning the distance between said source and said detector, and wherein the linkage comprises means for changing the orientation of said beam with respect to the orientation of said aiming means in response to said information.

2. A system as claimed in claim 1, wherein said linkage comprises means for receiving information concerning relative movement of the target and weapon and means connected to said receiving means for altering the azimuth of said beam in response to said information.

3. A system as claimed in claim 1, wherein said linkage comprises means for scanning said beam through a small cone.

4. A system as claimed in claim 3, comprising means for modulating said beam synchronously with the scanning of said beam.

5. A system according to claim 1, wherein said linkage comprises means for scanning said beam through a small arc.

6. A weapon-training system for use in combination with a weapon system of a type having a weapon, means mounted on the weapon for aiming the weapon at a target, and a target system, said training system comprising a laser for directing a beam of radiation substantially along the path of weapon aim when fired, means for firing said weapon, means operating in response to said firing means to provide a START signal, means responsive to said START signal to fire said laser, a clocked counter, means responsive to said START signal to start said clocked counter, means for scanning said laser beam, means responsive to said START signal for commencing said scanning, means for modulating said laser beam synchronously with said scanning means, said scanning means moving the beam between two positions, there being a zone of beam overlap at the two positions, and said modulating means modulating said beam differently when in each of said two positions, means responsive to a target signal received from said target system and generated by said target system in response to said modulated laser beam for indicating the accuracy of an aim, means responsive to the target signal for stopping said counter, and means connected to said counter for adjusting the orientation of said laser beam in response to counter provided information concerning the distance between the weapon system and the target system, and the target system comprising a detector responsive to said laser beam, means connected to said detector for detecting said laser beam and for generating said target signal in response thereto, and means for modulating the generated target signal to simulate the nature of the protective armor of the target system.

7. A weapon-training system for use with a weapon system of a type having a weapon, the training system comprising: means for aiming the weapon at a target, a source of a beam of electromagnetic radiation, a detector responsive to said radiation, indicating means, said indicating means providing information concerning the accuracy of an aim, means for providing information as to the distance between said source and said detector, and means coupling said aiming means to said source for changing the elevation of said beam with respect to the orientation of said aiming means in response to said information.

8. A system as claimed in claim 7, wherein said information providing means comprises: means for generating a signal in response to the output of said detector, a time-measuring circuit, means for starting said time-measuring circuit when said source is fired, and means for stopping said time-measuring circuit in response to the signal from said generating means, whereby said time-measuring circuit provides a measure of the time of travel of said beam from said source to said detector.

9. A weapon-training system comprising: means for aiming the system toward a target, a source of a beam of electromagnetic radiation, linkage means coupled between said aiming means and said source for scanning said beam about a small cone, a detector responsive to incident radiation from said beam for producing an output signal, and indicating means responsive to said detector output signal for providing information concerning the accuracy of an aim.

10. A weapon-training system for use with a weapon system of a type having a weapon and means for aiming the weapon at a target, the training system comprising: a source of a concentrated beam of electromagnetic radiation, means for revolving said beam of electromagnetic radiation through an arcuate path, means coupled to the beam revolving means for frequency modulating said source in synchronism with the revolution of said beam, a detector responsive to incident radiation from said beam of some predetermined repetition frequency for producing an output signal representative of the accuracy of an aim at the target.

11 A weapon-training system for use with a weapon system of a type including a weapon, and means for aiming the weapon at a target, the training system comprising a source of coherent pulses of electromagnetic radiation, means coupled to said source of displacing said pulses between first and second aiming elevations with a zone of common overlap between the different elevations, means coupled to said source for modulating the pulse repetition frequency of the pulses in synchronism with the displacing means whereby the pulse frequency of the pulses has a different value in each elevation, and a detector responsive to both pulse frequencies in said zone of overlap for producing an output signal representative of an accurate aim at the target.

12. The system according to claim 11, which further comprises, means for adjusting the elevation of said source to simulate different types of weapon ammunition.

13. A weapon-training system comprising the combination of means for pointing the system toward a target, a source of a beam for electromagnetic radiation, linkage means connected to said source for scanning said beam through a small arc, a detector responsive to incident radiation from said beam for producing an output signal, and indicating means responsive to the output signal of said detector for providing information about the accuracy of an aim.