

[54] PROGRAMMABLE LASER MARKSMANSHIP TRAINER

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[51] Int. Cl. **A63f 9/02**

[58] Field of Search **35/25; 273/101.1, 102.2**

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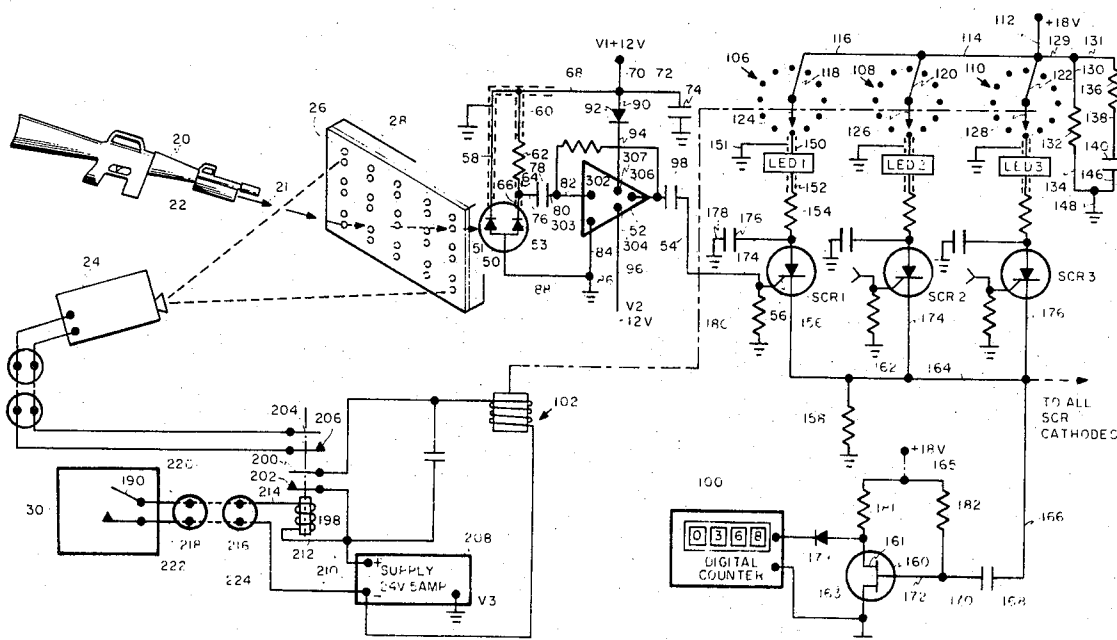
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[57]

ABSTRACT

A marksmanship training system employing a screen for viewing a program of slides of different battle scenes each with a target portion in the projected image oriented in relation to one or more of a plurality of light detectors supported behind the screen in a matrix and each capable of being actuated by a laser attached to a weapon being fired to actuate an associated hit indicating lamp and cumulative hit counter. A slide projector and a sequential detector switching means are simultaneously actuated from a common programming means to vary projected images and target areas located therein by sequentially projecting slides and sequentially varying connected light detectors.

8 Claims, 7 Drawing Figures



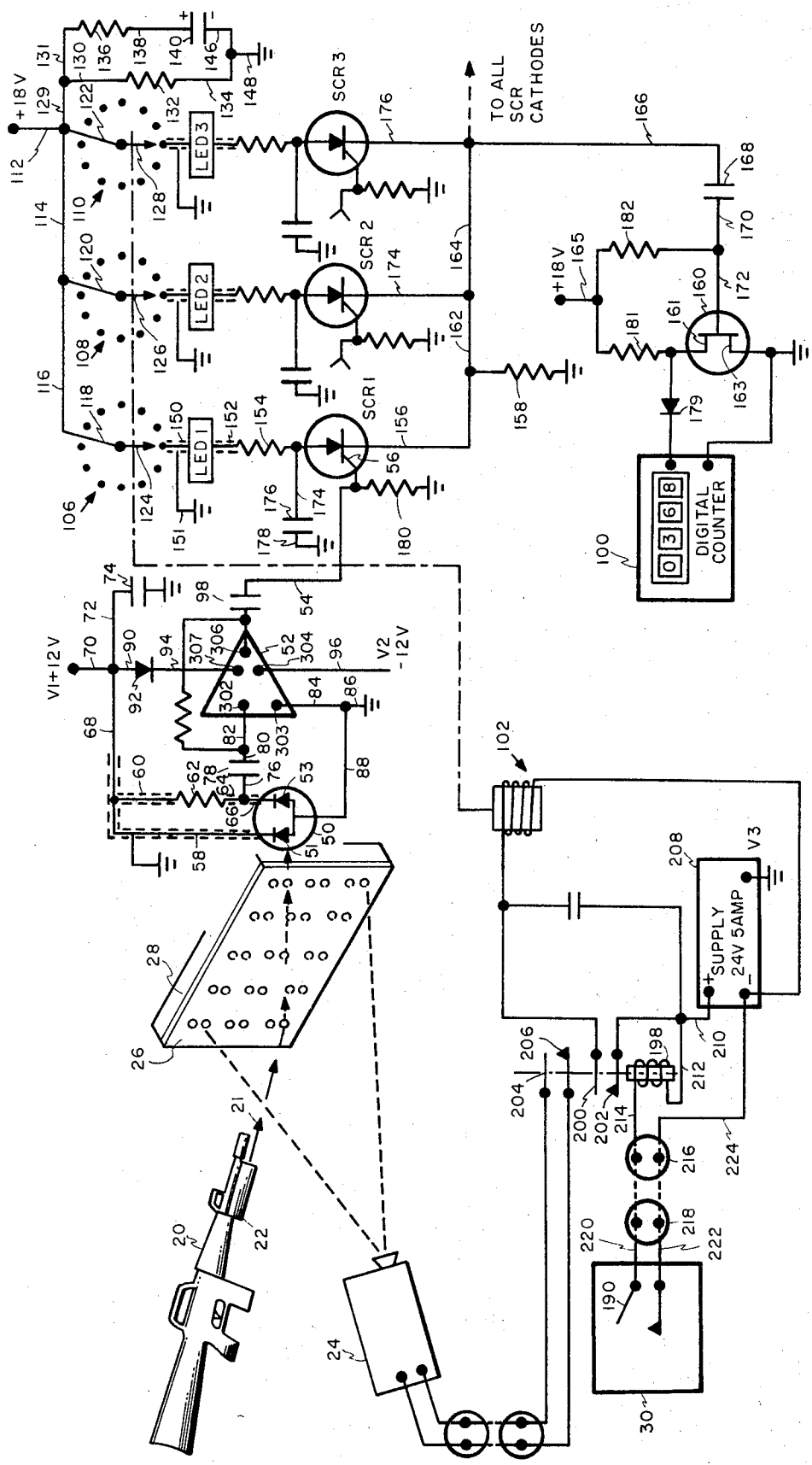


FIG. 1

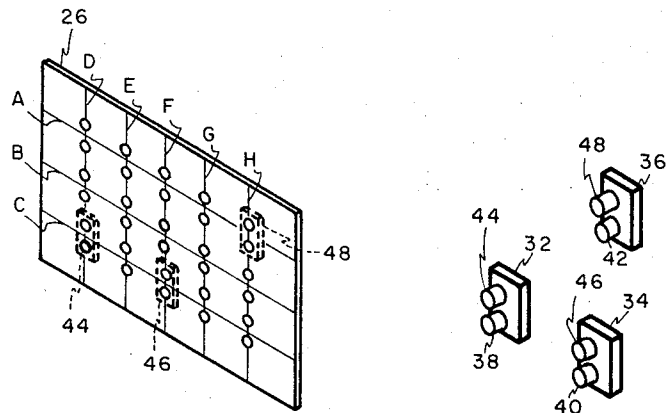


FIG. 2

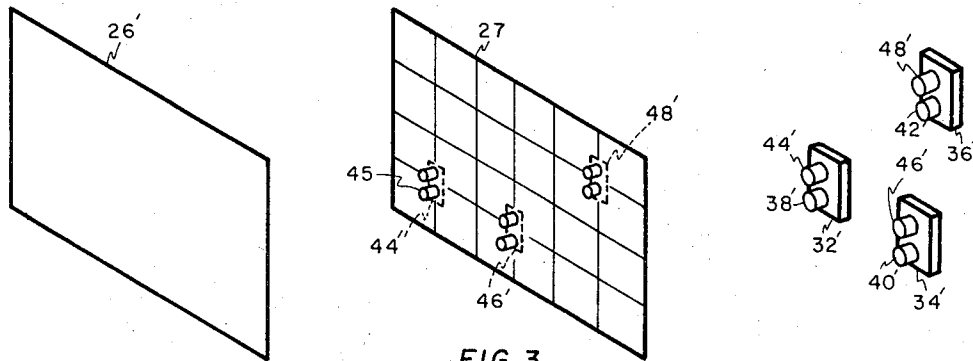


FIG. 3

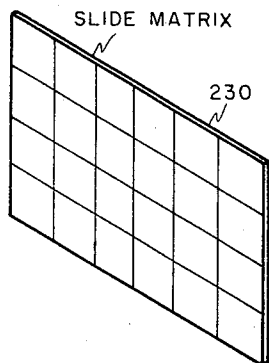


FIG. 4

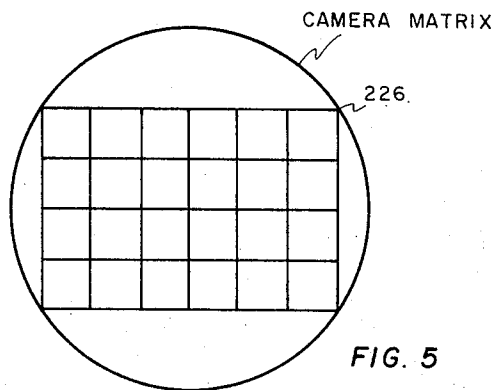
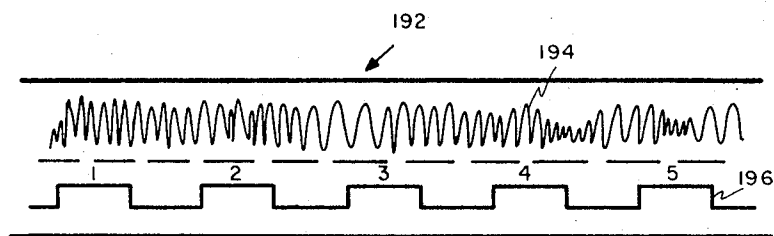
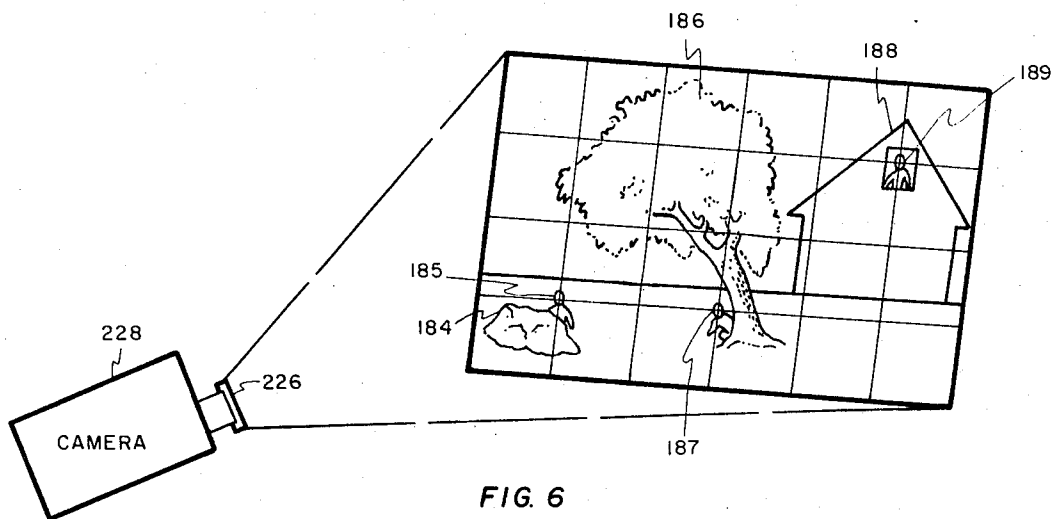


FIG. 5



PROGRAMMABLE LASER MARKSMANSHIP TRAINER

BACKGROUND OF THE INVENTION

This invention relates to marksmanship training devices of the type utilizing a laser affixed to an actual or mockup weapon for simulating real ammunition and a target with light detecting means for actuating a hit indicator means.

Such devices are particularly useful in reducing time of training, cost of equipment and cost of repair and replacement of equipment. Targets are not destroyed using this type of system, and the trainee may obtain instant scoring without necessity for complicated radio or electronic links to relay back the firing results. Attempts have been made to use this type of equipment for training on both stationary and moving targets. Moving targets have been moved or actuated by mechanical means such as by attachment to a carrier device. Attempts at realism have been made by providing a plurality of pop-up type targets programmed or operated by an instructor to train for rapid response location and destruction of target.

SUMMARY OF THE INVENTION

This invention is an improvement over the aforementioned devices in providing a greater degree of realism in the training exercise to simulate actual specific battle conditions in the way of battle condition scene and target location in the scene such that the training effect is close to actual experience under such simulated battle conditions.

A further object is to provide an immediate, accurate scoring means for indicating the marksmanship skill of the trainee as training progresses, with the further advantage of allowing several trainees to train simultaneously.

In accordance with one preferred embodiment of this invention, the above described advantages are obtained by incorporating in a projector screen a matrix of a plurality of adjacent light detector and hit indicator means, an SCR switching system for actuating the hit indicator means and a hit counter means, means for taking a plurality of slides of different battle conditions in a manner such that when projected the target area in the image therefrom will coordinate with the light detector matrix to place a light detector in each target area of the battle scene and programmable means for simultaneously advancing the slides in the projector and conditioning selected detectors for operation corresponding to the target area of a projected battle image, and matrix means for coordinating the taking of the slide film to get the target in a matrix area and the orientation of the projector and screen to align the projector with the matrix of light detectors associated with the projector screen.

DESCRIPTION OF THE DRAWING

FIG. 1 is a side perspective view of a rifle, attached laser, box mounted target screen, projector and programmable means for the slide projector and conditioning of detector elements forming part of the target screen, all constituting one preferred form of the subject invention. Also shown in FIG. 1 are block and schematic diagrams of elements housed in the box on which the screen is mounted and provided to explain details of structure and operation of the invention;

FIG. 2 is an enlarged exploded view of a screen, support and targets constituting one aspect of the invention;

FIG. 3 is an enlarged exploded view of an alternate form of screen, support and targets;

FIGS. 4 and 5 are enlarged views respectively of a slide view matrix and a camera matrix;

FIG. 6 is a perspective view showing the employment of a camera with matrix to film an image in a manner to coordinate specific targets and the matrix, and

FIG. 7 is an elevated view of a portion of a dual track tape for the program means showing the waveform of background battlefield sounds and the waveform of activating pulses.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, there is provided in accordance with the invention a weapon, in this case an automatic rifle 20, a laser 22 attached to the rifle barrel, a 35 mm slide projector 24, both aimed at a target screen 26 which is supported on a box 28 and program means including a programmable tape cassette 30 which is employed to provide background battle sound and to provide pulse signals for programming the slide projector and target light detectors as will be described hereinafter.

Referring for the moment to FIG. 2, the screen 26 in this embodiment is formed of a pegboard-like piece of masonite or material suitable for acting as a support or holder for pairs of detectors and associated LED's and on which one side can be painted to reflect a projected image. It is to be noted that the holes form a matrix on the intersecting lines A, B, C and D, E, F, G, H. The detectors and LED's may be in the form of modules as shown at 32, 34 and 36 having detectors 38, 40 and 42 and LED's 44, 46 and 48. The dotted outline on the back side of screen 26 shows the modules 44, 46 and 48 in position with the detectors and LED in pairs of adjacent holes of the screen as support means.

In a modified form as shown in FIG. 3, the screen and holder can be separate to present a solid screen 26', a holed support 27, and modules 32', 34' and 36'. The unit is otherwise as described for FIG. 2. The screen 26' is translucent to reflect a projected image but pass a laser ray to actuate the light detector units. The light detector units are selected to be sensitive to the infra-red portion of the light spectrum, as will be produced by the laser beam.

Referring to FIG. 1, the screen 26 forms the face of a box 28 in which the electrical components associated with the detector and LED's are housed. Thus in FIG. 1 is shown details of a detector and its associated amplifier which serve an associated SCR. More particularly there is shown a light detector 50, which in this case is a silicon photo diode having diodes 51 and 53 providing an input to an associated amplifier 52 to provide an output on a line 54 connected to the gate 56 of an associated SCR 1. The cathodes of diodes 51 and 53 are interconnected by shielded lines 58, 60, resistor 62 and shielded lines 64 and 66. Lines 58 and 60 connect via lines 68 and 70 to a positive 12 volt source indicated and via line 68, a line 72, and capacitor 74 to ground indicated. The output signal of the detector 50 is passed via line 76, capacitor 78 and lines 80 and 82 to one input terminal 302 of the amplifier 52. The other input terminal 303 is connected to ground indicated via

lines 84 and 86 to the anode of diodes 51 and 52 and via lines 84 and 88. Power is supplied to the amplifier 52 from a +12 volt source indicated via line 70, line 90, diode 92, and line 94 to amplifier terminal 306 and from a -12 volt source indicated via a line 96 to amplifier terminal 304. The output terminal 306 of amplifier 52 is connected via coupling capacitor 98 and line 54 to the gate 56 of SCR 1.

The SCR 1 when gated acts as a switch for energizing its associated LED 1 indicated and for providing an output pulse to a digital counter 100. Energy to the LED 1 (and all LED's) is obtained through a programmer means which in this case is a 12-position three-pole stepping solenoid indicated generally at 102 and which, as indicated by dotted line 104, drives the three-pole switching means indicated at 106, 108 and 110. In the position of the switch shown in FIG. 1, positive voltage, indicated as +18 V, is applied to terminal 1 of each of the poles 106, 108 and 110 via lines 112, 114, 116, 118, 120, 122 and wiper arms 124, 126 and 128. The positive 18 volt source indicated is also connected to ground via lines 112, 129, 130, resistor 132, lines 134 and 148, as well as by lines 112, 131, resistor 136, line 138, polarized capacitor 140 and lines 146 and 148. The circuit thus described is a charging network which, when the solenoid is switched, prevents transient voltage from inadvertently triggering one of the SCR's. Each of the switching elements 106, 108 and 110, i.e., each pole of the stepping solenoid, has 12 positions as shown for element 106. Elements 108 and 110 are numbered identically and therefore the numbers have been left off to avoid confusion caused by excessive numbering on the drawing. A plus 18 volt source is not critical as the circuit described will operate on a 12 to 24 volt source.

Considering LED 1 and its associated SCR 1, one side of LED 1 is connected by a shielded wire 150 to step one of switch pole 106 and the wire shield is grounded by a wire 151 as indicated. The other side of LED 1 is connected by a shielded wire 152 and through a current limiting resistor 154 to the anode side of SCR 1. The cathode side of SCR 1 is connected by line 156 and resistor 158 to ground indicated. Resistor 158 forms a collecting resistor to develop a suitable voltage for gating an FET 160 to which the cathode of SCR 1 is connected via line 156 and lines 162, 164, 166, coupling capacitor 168 and lines 170 and 172. The anode of SCR 1 is connected to ground indicated by line 174, coupling 176 and line 178 to reduce spurious signal effect on SCR 1. The gate 56 of SCR 1 is connected through biasing resistor 180 to provide a proper bias input signal on the gate 56 of SCR 1.

SCR 2 is connected in identical manner to position 1 of switch element 108 through LED 2, to ground through collector resistor 158 and to the gate of FET 160 through lines 174, 164, 166, capacitor 168 and lines 170 and 172. In the same manner SCR 3 is connected through LED 3 to position 1 of switch element 110, to ground through resistor 158, and to the gate of FET 160 via line 176 and the remaining elements as indicated.

The circuit comprising the FET 160, an isolating diode 179, biasing resistor 181, and load resistor 182, constitutes an actuating circuit for the digital counter 100. Thus, the drain 161 of FET 160 is connected through biasing resistor 181 and line 165 to a positive 18 volt source of power and to the digital counter 100

via the diode 179 to bias the counter to activation. The other side of counter 100, as well as the source 163 of the FET 160, are connected to ground indicated. Load resistor 182 connects to lines 165 and 172 to complete a load circuit from voltage source to ground via the FET.

Considering the circuit of FIG. 1 as thus far described, there is provided a plurality of SCR's (SCR's 1, 2 and 3 being illustrated for example) which act as switching means for activating associated LED's (LED's 1, 2 and 3 being shown as associated with SCR's 1, 2, and 3) and a common counter 100. However, such activation occurs only when switching elements 106, 108 and 110 have their wiper arms in position to apply positive voltage to the anode of the SCR's and only when the laser beam indicated at 21 activates a light detector associated with that SCR.

Each light detector and its associated LED represents a target area of the screen on which a battle scene will be projected from a slide film. An example of such a scene is shown in FIG. 6, wherein there is shown a rock 184, tree 186, and housing 188. Also in the scene are enemy personnel heads 185, 187 and 189 projecting respectively from the rock, tree, and a window of the house. Each of the heads are targets which lie at separate detector locations on the matrix of light detectors. These three targets could correspond for example to positions 1 of the switches 106, 108 and 110, and hence to corresponding LED's 1, 2 and 3 and SCR's 1, 2 and 3. From another slide at say position 2 of the elements 106, 108 and 110 corresponding to slide 2, three different targets might be used which would involve different LED's, SCR's and light detectors.

In FIG. 1, to simplify the drawing, only one operational amplifier and associated light detector circuit is shown. Also only the SCR circuits and associated LED's for one switch position is shown. It is to be understood that each target position has its own detector, operational amplifier, LED and SCR driver circuit.

Referring again to FIG. 1, it is necessary to sequentially project the several slides in projector 24 and at the same time advance the stepping solenoid 102 to condition the light detectors, LED's and SCR's for operation in accordance with the target arrangement in each slide being shown. Such a programming means is provided by the programmable tape cassette 30 which is a standard commercial item having an internal relay as indicated by the contacts 190. Referring to FIG. 7, the tape cassette is provided with a dual track tape 192 having on one edge the recording of battle sound as indicated at 194 and on the other edge a series of pulse outputs 196 spaced say 5 seconds apart to sequentially actuate the cassette relay 190 as the tape progresses. If the relay contacts 190 had sufficient current carrying capacity it could directly actuate simultaneously projector 24 and stepping solenoid 102. However, to provide a more reliable system, an additional relay 198 having one set of contacts 200 and 202 for actuating the stepping solenoid 102 and another set of contacts 204 and 206 for actuating the projector 24 is provided. Thus, solenoid 198 is supplied with positive voltage from a 24 volt source 208 via lines 210 and 212, the opposite side of the relay 198 being connected to the negative terminal (indicated) of source 208 via line 214, plug 216, jack 218, relay 190, and lines 220, 222 and 224.

It is to be understood that in taking films of a battle scene and the targets therein, the targets must be located in the scene such that when the film is projected on the screen each target will coincide with a light detector of the matrix of light detectors. To accomplish this a matrix, as for example camera matrix 226 in FIG. 5, is formed on glass or film corresponding to the light detector matrix and is attached to a reflex camera 228 (FIG. 6) so that in taking a film the targets and matrix may be lined up. In FIG. 6, targets I, J and K are thus lined up on the matrices shown before the film is exposed. In other cameras the matrix glass could be attached to the view finder of the camera.

In the same manner when a slide is to be projected on the screen, behind which there is a matrix of light detectors, the projector must be properly positioned to align the projector with the target screen. To accomplish this a matrix slide film 230 as shown in FIG. 4 is made which, when the projector is properly aligned, will cause the projected matrix to overlay and coincide with the actual light detector matrix. This film is initially placed in the projector to align the projector with the screen before the target slides are projected.

When a particular slide has three target areas the solenoid 102 will be in a position to condition for operation the three detectors corresponding to the three target areas. As soon as the laser 22 is directed to actuate one detector the corresponding LED adjacent that detector is energized, indicating a hit on that target. At the same time a hit count is introduced into the counter 100. If, during the 5 second period of projection of the particular slide a score is also made on two additional targets conditioned for actuation in relation to the same slide, then the two additional associated LED's would be lighted and two additional scores would be recorded in the counter 100.

Should outside light or excessive light from the projector tend to inadvertently actuate the detectors, a band pass filter as indicated at 45, FIG. 2, may be used on the detector to pass only the spectrum of laser beam light.

It is understood that the laser 22 may be any suitable laser system operated from a mock or actual weapon. A complete description of such a combination of laser and weapon is shown in our prior U.S. Pat. No. 3,657,826.

It is to be understood that instead of the stepping solenoid 102, other suitable means can be employed to selectively place in operable condition each LED when a hit has been scored on its associated detector. One such means would be a programmed computer means.

It will be appreciated by those skilled in the art that variations in the disclosed arrangement, both as to its details and as to the organization of such details, may be made without departing from the scope and spirit of the invention as disclosed hereinbefore and covered in the appended claims.

We claim:

1. A laser marksmanship trainer comprising:

- a. a weapon having firing means and a projectile barrel,
- b. a target screen,
- c. laser means actuated from said firing means and having a laser beam axis, said laser means being attached to said weapon with said beam axis parallel to said barrel to direct a laser beam to said target

when the weapon is aimed thereat and said firing means is operated,

- d. light sensitive detectors,
 - e. means for supporting said light sensitive detectors in a matrix behind said screen,
 - f. a plurality of photographic slides taken of scenes of different background and target locations and with a camera having a grid corresponding to said matrix to enable taking slides with selected targets in proper orientation to selected arrangements of said detectors in said matrix to provide thereby a plurality of slides each with different target locations and background oriented to said selected detector arrangements,
 - g. a slide projector to be loaded with said slides for sequentially projecting scenes from said slides,
 - h. a slide film made of said grid matrix for projecting on said screen to align said projector to said detector matrix,
 - i. sequential switching means for sequentially connecting for operation different selected of said detectors corresponding to different target locations,
 - j. a hit indicator associated with each detector and electronic actuator means for actuating each indicator from an associated detector, and
 - k. programmable means for actuating said slide projector and said sequential switching means in unison and coordination for projecting selected of said slides and simultaneously actuating corresponding detectors and associated hit indicators.
2. Apparatus according to claim 1,
- a. each of said hit indicators comprising a lamp means mounted adjacent its associated detector,
 - b. said electronic actuator means including an SCR for each lamp and its associated detector and amplifying means for each detector, each SCR being gated to ON condition from its associated detector and being connected in series with said lamp to act as a switch means therefor.
3. Apparatus according to claim 2, including
- a. a digital counter and activating circuit,
 - b. said activating circuit being connected to receive the output of said SCR and to operate said counter to record the total number of target hits per slide.

4. Apparatus according to claim 2,

- a. said sequential switching means comprising a multiposition, multiple stepping solenoid to provide for handling a plurality of slides each having a plurality of targets arranged with a background scene.

5. Apparatus according to claim 2,

- a. said screen having a plurality of small holes located one in front of each lamp and one in front of each detector to provide an unobstructed path for said laser beam to each of said detectors and an unobstructed view of said hit indicator lamp.

6. Apparatus according to claim 5, including

- a. bandpass filter means attached to cover each of said light detector means and selected to pass only the laser frequency light to said detectors to thereby avoid activating said detectors by light originating from said projectors.

7. Apparatus according to claim 2,

- a. said screen being translucent to pass sufficient laser light to activate said detectors but sufficiently

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reflective to provide for viewing a projected image.

8. Apparatus according to claim 6, including
a. bandpass filter means attached to cover each of
said light detector means and selected to pass only 5

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the laser frequency light to said detectors to
thereby avoid activating said detectors by light
originating from said projectors.

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