United States Patent

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[54] **FIBER OPTICAL TARGET PRACTICE SYSTEM**
9 Claims, 4 Drawing Figs.

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[51] **Int. Cl.** **F41j 5/00**
[50] **Field of Search** ..... 273/101.1; 35/25; 350/96; 240/6.41, 10.62, (Inquired); 250/227, 206, 221, 222, 231

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ABSTRACT: The specification of this application describes a target practice system which includes an optical arrangement by which light may be directed from a gun towards a target. The target includes a photosensitive means connected to initiate a scoring display system. The source of light for the gun is located at a point remote from the gun and light from the source is conveyed to the gun through a fiber optical conducting system. The source generates flashes of light in a gas tube which is fired by an electrical signal as an incident to alteration in light flux in an optical subsystem. The subsystem includes a second light source and fiber optic circuitry for conducting light from the second source through the gun and thence to light-sensitive circuitry in which the initiating pulse is generated. Means are provided within the gun for altering the light flow through the gun in response to actuation of the trigger mechanism. In the embodiment described in detail in this specification, the initiating pulse is generated by the secondary optical system upon the occasion of interruption of light flow through the secondary fiber optical circuit.

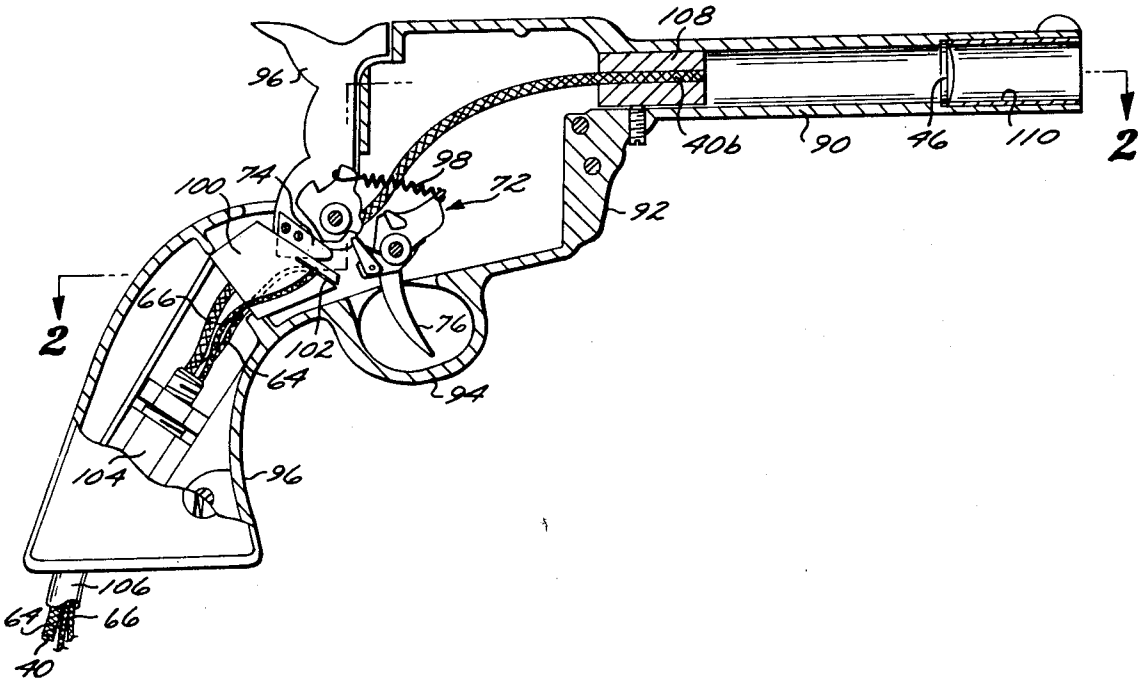


FIG. 1

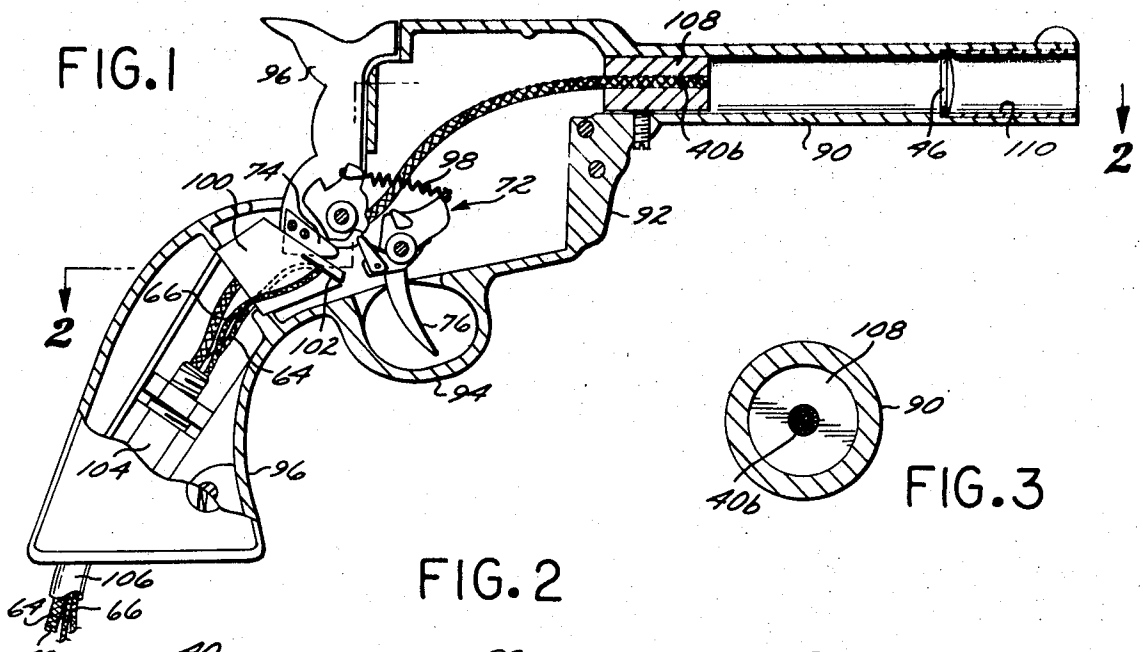
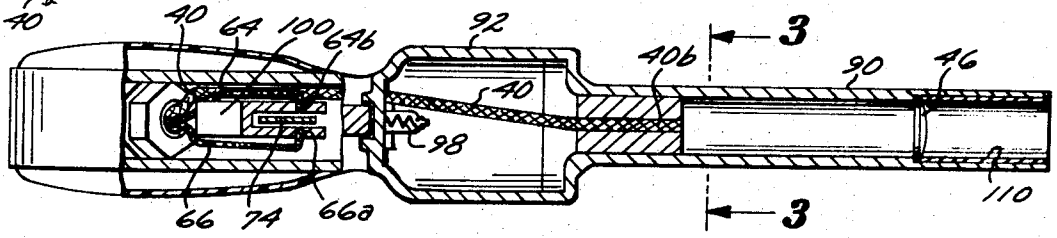


FIG. 3

FIG. 2



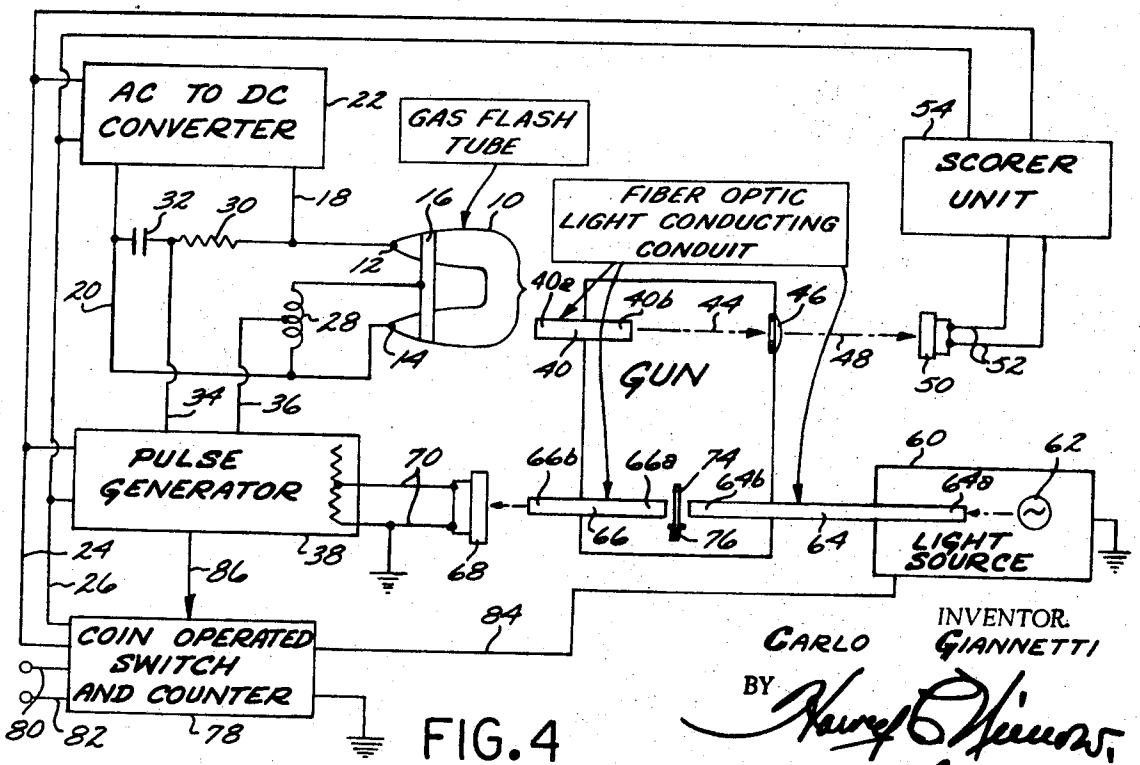


FIG. 4

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FIBER OPTICAL TARGET PRACTICE SYSTEM

This invention relates to improvements in optical target practice systems.

An object of the invention is to provide a reliable and safe target practice system for installation in public amusement places. One of its important objects is to provide a system which introduces no increase in risk of harm to the user of the system, no matter how he uses or misuses it. A related object is to provide a system which requires minimum attention of an attendant and which will be safe and effective and reliable in installation having no attendant.

An initial increment of safety is provided in target systems by dispensing with bullets and using light beams instead. For practical reasons, the light must originate in the gun and be directed toward the target. It must be confined to a narrow beam and to a short time period. Because of these boundary conditions, successful operation demands that a very high-intensity light source be used. The flashing of a gas discharge tube provides an adequate source of light. However, very high electrical voltages are required to fire such tubes and this high potential is a source of danger. It is an object of the invention to provide the requisite high-intensity light flash within the gun without the need to apply high electrical potentials to the gun. This object is realized in part by the provision of an optical system in which light of short duration and high intensity is generated externally to the gun and is transported to the gun in a flexible optical system from whence it can be "shot" toward the target. The light source is initiated by actuation of the trigger mechanism of the target gun. Alternative means may be employed for this purpose. Thus, the trigger mechanism of the gun may be made to operate an electric switch in a low-voltage electrical control circuit. Any safety hazard in the use of such an electrical control is minimized by restricting the system to low voltages. In another embodiment, the one selected for illustration in the drawing, the light "shot" is accomplished by a subsystem which includes a fiber optic network for conveying light from a remote point to the gun and back. Means actuated by the trigger mechanism of the gun alters light flow in the control subsystem and the high-intensity flash "shot" is initiated as a function of that alteration in light flow. In connection with this embodiment, another object of the invention is to provide a target practice system in which no electrical energy is applied to the target gun.

Another object is to provide a system in which the electrical and electronic functions of light generation, "shot" counting, on-off switching (including any coin-operated switching) and integration of the "shot" initiation and scoring functions are all accomplished at a remote point out of harm's way.

A major advantage of the invention resides in the fact that the target gun need only include optical and mechanical elements. The result is increased ruggedness and reliability.

These and other objects of the invention will be apparent upon examination of the following description of one embodiment of the invention, it being understood that various modifications may be made in the embodiment shown and that other embodiments are possible without departing from the invention or the spirit of the appended claims. In the drawings:

FIG. 1 is a side view in cross section of a target gun suitable for use in target practice systems embodying the invention;

FIG. 2 is a top view, partly in cross section, of the target gun of FIG. 1;

FIG. 3 is a sectional view, taken on line 3–3 of FIG. 2; and

FIG. 4 is a schematic of an optical target practice system embodying the invention and incorporating the gun of FIG. 1.

Referring to FIG. 4 of the drawings there is shown a means for generating a high-intensity flashing light which in this embodiment comprises a three-terminal, high-intensity, gas flash tube **10**. This gas discharge flash tube, representative types of which are numbered GE-151 and Kemlite UD6-T2, has a positive electrode **12** and a negative electrode **14** and a starter electrode **16**. High-voltage direct current electrical energy is supplied to the tube **10** by positive line **18** and negative line **20** from a high-voltage, DC, power supply **22** labeled AC TO DC CONVERTER. Alternating current input to unit **22** from AC supply lines **24** and **26** is stepped up in voltage, rectified, and then filtered in unit **22**. The tube is fired to create a flash of light by applying a pulse of electrical energy to a starter network which consists of an inductor **28** connected from the starter electrode **16** to the negative terminal **14** and a resistor **30** and capacitor **32** connected in series combination from positive terminal **12** to negative terminal **14**. The pulse signal is applied by lines **34** and **36**. Both of these lines originate at a pulse generator **38**. Line **34** is connected to the junction between resistor **30** and capacitor **32**. Line **36** is connected from the pulse generator to a tap on the inductor **28**.

The numeral **40** designates a means for conducting light from the source to the gun. Advantageously, this means comprises, as shown, an optical conductor comprising a bundle of elongate, light conducting fibers. The fibers are enclosed together in a sheaf to form a long flexible light conducting circuit called a "fiber optic light conducting conduit" or "fiber optic conductor". The input end **40***a* of the fiber optic conductor **40** is fixed in position to receive light flashes from the tube **10** and to conduct them to the other end **40***b* of the fiber optic conductor **40**. End **40***b* is mounted within the target gun **42** so that light emanating from the fiber optic conductor **40** is directed by a beam **44** to a lens system **46** (which here comprises a single lens) and thence by a beam **48** in the direction in which the target pistol is pointed. In the drawing the beam **48** is shown directed at a target at which is disposed a light sensitive means for converting received light into electrical signals. Here, a photocell **50** is disposed at the target and electrical signals generated when high-intensity light flashes are received by the photocell are transmitted by lines **52** to a score unit **54**. In the preferred form, the score unit comprises an optical display system rendered responsive to receive electrical signals from the solar cell **50** when the remainder of the system is activated.

The pulse generator **38** is one of the elements in a subsystem for generating the initiating pulse to the flasher tube **10**. The subsystem comprises a light source **60** in which power is supplied to an incandescent lamp **62**. Light from this lamp is introduced into one end **64***a* of an optical fiber conductor **64** whose other end **64***b* is fixed at one point within the target gun **42**. Another fiber optic conductor **66** is arranged to carry light from the target gun to an external point where it is directed at a light-sensitive device having an electrical output which serves as an input to the pulse generator **38**. More specifically, the input end **66***a* of the fiber optic conductor **66** is disposed at a second point within the target gun **42** spaced from said first point and oriented so that light emanating from the end **64***b* of conductor **64** is directed into the input end **66***a* of conductor **66**. Light emanating from the other end **66***b* of the optical conductor **66** is directed, in the embodiment selected for illustration, to a solar cell **68** whose electrical output is connected by lines **70** to the input circuit of pulse generator **38**.

In a preferred form the pulse generator comprises a pulse transformer a secondary winding of which comprises the pulse generator output circuit. The primary winding of the transformer is connected to semiconductor devices connected so that an electrical signal, which changes the bias supplied to an initial one of them, is differentiated by one of them and amplified by others of them prior to application to the primary winding of the pulse transformer. This description fits pulse generators well known in the art and selection of a suitable pulse generator is well within the skill of artisans in the art. Advantageously, the pulse generator is of a type which provides an output pulse in response to a significant change in the voltage drop across lines **70**. This means that the pulse generator will be effective to develop an initiating pulse for the flash tube **10** whether the triggering signal is developed as the sudden application of light to the solar cell **68** or is developed as an interruption of light to solar cell **68**.

The latter type of signal is preferred for a number of reasons including the very important reason that it enables electronic

monitoring of continued operation of the incandescent lamp **62**. Accordingly in the preferred form of the invention selected for illustration in the drawing, the triggering mechanism of the target gun **42**, which is generally designated **72** in FIG. **1**, comprises a vane **74** which momentarily interrupts the passage of light from fiber optic conductor **64** to fiber optic conductor **66** when the trigger **76** of the gun is pulled to "fire" the gun.

To enable a user to activate the system by insertion of a coin and also to deactivate the system after a predetermined number of flashes have been initiated or "shots" have been fired, the system is provided with a coin-operated switch and counter unit **78**. This unit is interposed between external supply lines **80** and **82** and the system AC source lines **24**, **26** and **84**. Signals indicative of the generation of initiating signals in pulse generator **38** are applied by a line **86** to the counter circuitry of the coin-operated switch and counter **78**.

In operation of the system, upon insertion of a coin or upon operation by an attendant, the coin-operated switch and counter **78** applies alternating electrical power from supply lines **80** and **82** to internal supply lines **84**, **24** and **26**. Incandescent lamp **62** in light source **60** is illuminated and light from this lamp is transmitted into and along the fiber optic conductor **64** to said first point of the gun. There it eminates from the conductor and enters fiber optic conductor **66** at said second point within the gun. This light is transmitted along the fiber optic conductor **66** and eminated from end **66*b*** to impinge upon the solar cell **68**. This provides an electrical output which is applied by line **70** to an input in the pulse generator **38**. The pulse generator generates an initiating pulse which is applied to line **86** to the counters in coin-operated switch and counter **78** and is applied by lines **34** and **36** to the firing circuit of the gas discharge tube **10**. An arc discharge through the xenon gas of this flash tube produces a very high-intensity light flash which is received at the input end **40*a*** of the fiber optic conductor **40**. Light is conducted along this conductor to end **40*b*** where it eminates and is directed to a lens system **46** from which a beam **48** emerges in the direction in which the target gun **42** is pointed. When, as shown in FIG. **1**, the light beam **48** impinges upon a solar cell **50** located at the target, an electrical output signal is generated at the solar cell and is conducted by lines **52** to a scorer unit **54**. This unit **54** includes means for indicating that the target has been struck by the light beam **48**.

A preferred form of trigger-actuated, light-interrupting mechanism is shown in FIG. **1** of the drawings incorporated in a revolver-type handgun. This gun comprises a frame including a barrel **90**, a revolver chamber section **92**, a trigger guard **94** and a handle frame section **96**. The trigger mechanism **72** is conventional. It includes a trigger **76** and a hammer **97** interconnected by a spring **98**. Together the trigger and hammer mechanism are arranged so that when the trigger is squeezed the hammer is forced back, counterclockwise in FIG. **1** until a trip point is reached. At this point spring **98** pulls the hammer **97** forward to the position it is shown to have in FIG. **1**. The mechanism is arranged so that the last portion of hammer movement in the counterclockwise direction just prior to tripping of the hammer, is accomplished rapidly regardless of the rate at which the trigger is squeezed.

While this mechanism is advantageously employed because it is conventional, other structural arrangements may be employed. It is necessary only that some element within the gun be displaced rapidly as the trigger is squeezed whether the trigger be squeezed rapidly or slowly. That rapidly moving element is used to interrupt the light traveling from conductor **64** to conductor **66**. In FIG. **1** interruption is accomplished by vane **74** which is attached to lower rear portion of the hammer **96**. The vane **74** is disposed in a slot formed in the plane of the direction of vane and hammer movement, in a light conductor holder member **100**. The holder comprises a generally trapezoidal piece made from flat stock which is retained in position by conformations on the inner surface of the handle portion **96** of the revolver frame. Slots **102**, formed in the forward edge of holder **100** laterally of the holder from its bottom edge, accommodate the ends **64*b*** and **66*a*** of the fiber optic conductors **64** and **66**, respectively. After insertion and alignment of the conductors the holder is deformed to hold the conductor ends firmly within the slots **102**. Thus arranged, light from conductor end **64*b*** is beamed across the slot and enters end **66*a*** of conductor **66** unless interrupted by the vane.

The three optical conductors **64**, **66** and **40** are brought together within the handle of the revolver in a structure **104** which comprises the terminus of a sheath **106** which contains the fiber optic conductors and extends with them to the electronic sections of the system.

The end **40*b*** of the fiber optic conductor **40** is housed in the central bore of a plug **108**. The plug is aligned in the initial portion of the gun barrel **90** adjacent the revolver section **92** of the frame. It is aligned with the barrel so that light eminating from end **40*b*** travels along the center line of the barrel and passes through the center of the columinating lens **46**. This lens is disposed in the barrel normal to the direction of light travel and to the axis of the barrel. The outer end of the barrel is recessed to form an inner opening of larger diameter at the end of the barrel and to form a shoulder upon which the margin of lens rests. The lens is fixed in this position by a sleeve **110** which is pressed into the end of the barrel against the outer margins of the lens. FIG. **3** illustrates the axial alignment of the end **40*b*** of the fiber optical conductor and of the plug **108** with the gun barrel **90**.

Although I have shown and described certain specific embodiments of my invention I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim:

1. In an optical target practice system, in combination:

a target gun including a trigger mechanism and optical means for receiving light from a source and transmitting it in a direction determined by the direction in which said target gun is pointed;

a flashing light source remote from the gun and responsive to an initiating signal to apply a flash of light to said optical means of said gun;

initiating means responsive to abrupt alteration in light flux quantity for applying an initiating signal to said flashing light source;

a source of continuous light; and

means for conducting light from said source of continuous light to said gun and thence to said initiating means; and

light flux alteration means responsive to actuation of said trigger mechanism for altering abruptly the light flux conducted from said source of continuous light to said initiating means whereby a flash of light is caused to be directed in the direction in which said target gun is pointed.

2. The invention defined in claim **1**, in which said optical means of said gun comprises a lens system mounted in the barrel of said gun and a fiber optic light-conducting conduit mounted within said gun to direct light through said lens system.

3. The invention defined in claim **1**, in which said flashing light source comprises a gas flash tube and an alternating current to high unidirectional voltage converter having its output connected across said flash tube and circuit means for applying an electrical initiating pulse to said flash tube.

4. The invention defined in claim **1**, in which said means for conducting light from said source of continuous light and thence to said initiating means includes a fiber optic light conduit extending from said source of continuous light to a first point within said gun and a fiber optic light conduit for receiving light at a second point spaced from said first point and conducting it to said initiating means; and in which said light flux alteration means comprises an opaque vane mounted within said target gun and responsive to actuation of said trigger mechanism to interrupt the passage of light from said first point to said second point momentarily.

5. The invention defined in claim 1, in which said initiating means comprises a light-sensitive cell for generating a signal of uniform character in response to uninterrupted light from said source of continuous light and responsive upon interruption of said light to provide an initiating signal to said flashing light source.

6. The invention defined in claim 1, in which said optical means comprises a lens system and the fiber optic light conducting conduit effective to direct conducted light through said lens system; and in which said flashing light source comprises a gas tube effective on being flashed to direct a flash of light to said fiber optic conduit, and an AC to high voltage DC converter having its output connected across said gas tube; said initiating means being responsive to interruption of light for generating and applying to said gas tube an electrical pulse effective to fire said tube; said means for conducting light comprising a fiber optic conduit positioned to receive light from said source of continuous light and extending to a point within said gun, and further comprising a fiber optic conduit commencing at a second point within said gun spaced from said first point and effective to conduct light from said second point to said initiating means.

7. In an optical target practice system, in combination:

a flashing light source responsive to an initiating signal for generating a flash of light;

a target gun including a trigger mechanism and optical means for receiving light from said flashing light source and transmitting it in a selected direction;

a second light source; means for providing an initiating signal to said flashing light source comprising an initiating signal generating means responsive to alteration in flux from said second light source to generate said initiating signal, and means for conducting light from said second light source to said initiating signal generating means; and

means responsive to actuation of said trigger mechanism for altering the light flux passing through said means for conducting light from said second source.

8. An optical target practice system, in combination:

a flashing source responsive to an alteration in light input flux for providing a flash of light;

a target gun including an optical system for directing light applied thereto in the direction in which said gun is pointed and further comprising a trigger mechanism;

fiber optic means for transmitting light from said flashing light source to said optical system of said target gun;

a second fiber optic system for transmitting light flux to an input of said flashing light source; and

means actuated by said trigger mechanism for altering the light flux supplied by said second fiber optic system to said flashing light source.

9. In an optical target practice system, in combination:

a target gun including a trigger mechanism and optical means for receiving light from a source and transmitting it in a direction determined by the direction in which said target gun is pointed;

a flashing light source responsive to an initiating signal to apply a flash of light to said optical means of said gun;

initiating means responsive to abrupt alteration in light flux quantity for applying an initiating signal to said flashing light source;

a source of continuous light;

means for conducting light from said source of continuous light to said gun and thence to said initiating means; and

light flux alteration means responsive to actuation of said trigger mechanism for altering abruptly the light flux conducted from said source of continuous light to said initiating means whereby a flash of light is caused to be directed in the direction in which said target gun is pointed.