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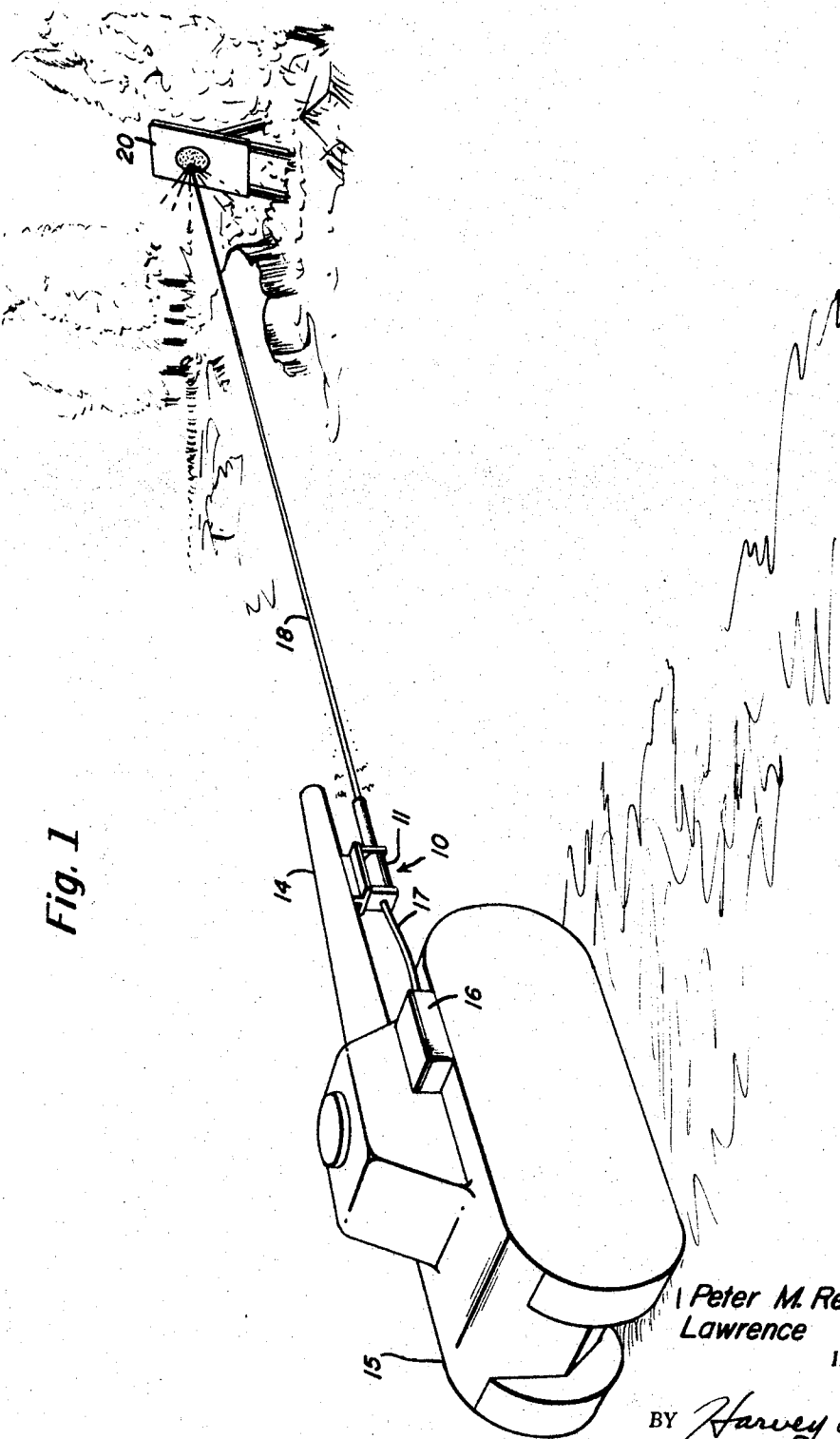
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LASER, WEAPON SIMULATOR

Filed Feb. 21, 1967

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Fig. 1



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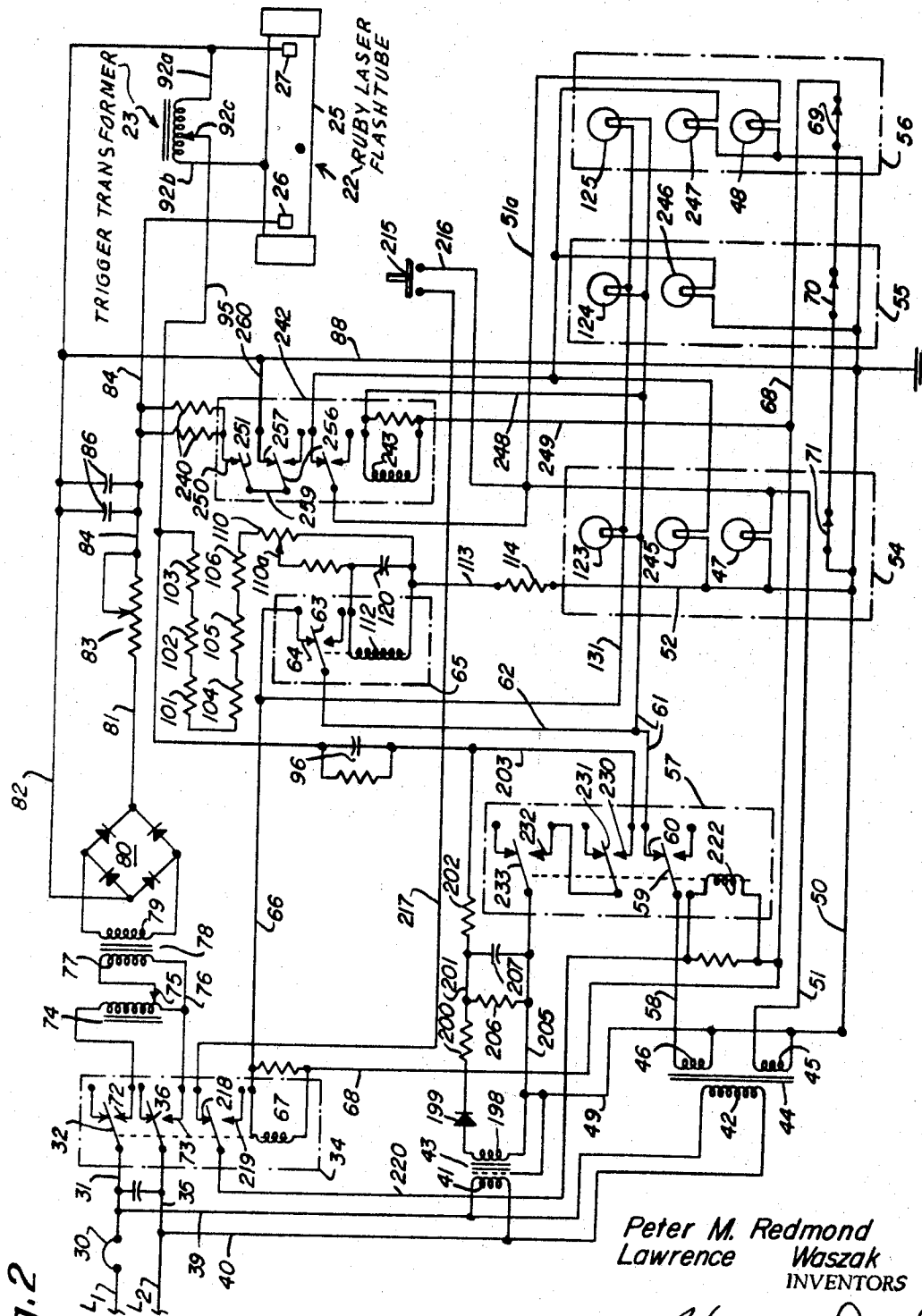
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LASER, WEAPON SIMULATOR

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5 Claims

ABSTRACT OF THE DISCLOSURE

A laser, weapon (tank gun) simulator, comprising a gun barrel mounted laser and optics device and associated xenon flashtube power supply including safety means for automatically discharging the flashtube firing capacitors in the event of power failure, and means for disabling the trigger circuit during charging of the firing capacitors to the preclude any possible premature attempt to fire the laser.

Background of the invention

This invention relates to weapon simulators, and more particularly to a laser, weapon firing simulator for use in the training of tank gunners.

Heretofore, there was no suitable training apparatus which would provide highly realistic simulation of the visual effect of an actual round fired against a target without marking the target with bullet holes or other references for the gunner to use in estimating his aiming error.

Further, there had been lacking training devices which would require no modifications or revisions to existing tank equipment and which would facilitate the simulation of standard tank operating procedures.

Summary of invention

In answer to the above cited needs, it is a principal object of the invention to provide a laser, weapon simulator suitable for use in training tank gunners and which would provide the advantages of good visual simulation of hits, freedom of marks or damage to the target, and compatibility with standard tank gunnery procedures such as loading time, and the like.

Another object of this invention is the provision, in a laser, weapon simulator including a gas filled flashtube having discharge electrode means and trigger electrode means, of a power supply therefor comprising storage capacitor means for providing the input to the discharge electrodes of the flashlamp, means for charging the storage capacitor means to a predetermined level of charge, a trigger circuit for providing a relatively high voltage to the trigger electrode means for firing the flashtube, and means for automatically disabling the trigger circuit during charging of the storage capacitor means whereby premature attempts to fire the flashtube are prevented.

Brief description of the drawings

The invention may further be said to reside in certain combinations and arrangements of parts by which the foregoing objects and advantages, as well as others, are obtained as will be understood from the following detailed description when read in conjunction with the accompanying sheets of drawings forming part of this specification, and in which:

FIG. 1 is an elevational view of a laser, weapon simulator embodying the invention shown in a position of use in association with a tank gun and target; and

FIG. 2 is a diagrammatic illustration of the circuitry of the laser, weapon simulator of FIG. 1.

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Description of the preferred embodiment

In the form of the invention illustrated in the drawings and described hereinafter there is provided a laser, weapon simulator generally indicated at 10 and comprising a laser unit 11 mounted on the gun barrel 14 of the gun of a tank 15. The simulator further comprises a housing 16 conveniently mounted on the tank 15 and containing power supply circuitry for firing laser means contained in the unit 11. The power supply circuitry is connected by suitable conductor means 17 to the laser unit 11, and by other conductor means to a trigger switch within the tank normally used to fire the tank gun.

Briefly, and as will be described more fully hereinafter, the laser unit 11 of the simulator 10 may be activated upon closing of the gun trigger switch to project a laser beam 18 of highly coherent red light in a direction determined by aiming of the gun barrel 14, such as at a target 20. The target 20 is provided with a reflective surface which when hit by the laser beam 18, produces a momentary flash resembling that of an actual projectile hit.

The laser unit 11 comprises a gas filled flashtube such as a xenon flashtube 22 and a trigger transformer 23 (FIG. 2), together with a ruby laser element and associated reflectors and optical system (not shown) for producing the laser beam 18. As will be readily understood by those skilled in the art to which the invention pertains, the xenon flashtube 22, when suitably energized, produces sufficient light energy to cause the ruby element to lase and emit a beam of highly coherent light energy.

With reference to FIG. 2, the description will now be directed to the power supply and triggering circuitry which provides the two inputs required by the xenon flashtube 22 which comprises a transparent envelope 25 containing a suitable gas such as xenon, discharge electrodes 26 and 27, and a trigger electrode 28.

The circuitry receives electrical power via conductor lines L_1 and L_2 from a suitable source such as a conventional 117 volt A.C. source. Such a source may be external to the tank 15 with which the apparatus is to be used or, may be derived from the 28 volt D.C. electrical system of the tank 15 by means of a conventional D.C. to A.C. inverter means.

L_1 is connected by a circuit breaker 30 and a conductor 31 to a contactor 32 of a power relay 34, while line L_2 is connected by a conductor 35 to a contactor 36 of the relay 34. It should be noted at this point that all relays are shown in the drawings in their de-energized positions.

Conductor 31 and line L_2 are also connected by conductors 39 and 40 to convey A.C. electrical power directly to the primary windings 41 and 42 of transformers 43 and 44. The transformer 44 comprises secondary windings 45 and 46, each providing 12.6 volts A.C. thereacross. The winding 45, which is utilized to energize two power indicator lamps 47, 48, has one end thereof connected by a conductor 49 to a conductor 50 representing ground in the circuitry. The other end of the winding 45 is connected by conductors 51, 51a to each of the lamps 47, 48 which are in turn connected by conductors 52, 53 to the ground conductor 50. The lamps 47, 48 are mounted on a power supply panel and on a trainer's panel represented by broken lines at 54 and 56. A third, loader's panel, 55 is not provided with a power indicator lamp.

The winding 45 is further used for energization of a firing relay 57, the purposes of which will be made apparent as the description proceeds.

The winding 46 is utilized to energize the power transformer 34. Thus, a circuit may be traced from one end of secondary winding 46 through a conductor 58, a contactor 59 and contact 60 of the firing relay 59, conductors

61, 62, a contactor 63 and contact 64 of a sampling relay 65, a conductor 66, solenoid 67 of power relay 34, a conductor 68, interlock switches 69, 70 and 71 associated with panels 56, 55 and 54 to ground conductor 50.

The resulting energization of power relay 34 effects movement of contactors 32 and 36 thereof into engagement with contacts 72 and 73, respectively. Contacts 72 and 73 are connected to the input leads of a "Variac" transformer 74, the output leads 75, 76 of which are connected to the primary winding 77 of a charging power supply transformer 78.

The secondary winding 79 of transformer 78 has its output leads connected to the input junctions of a four diode, full wave rectifier bridge network 80. The rectified output of the network 82, which is on the order of 2000 volts D.C. in this example, appears on conductors 81 and 82. Conductor 81 is connected to one end of a variable resistor 83, which is in turn connected by a conductor 84 to one side of each of a pair of parallel connected storage capacitors 86, and also to the discharge electrode 26 of the xenon flashtube 22. The conductor 82 is connected by conductors 88, 89 to the ground conductor 50, and is connected also to the other ends of capacitors 86, to electrode 27 of the flashtube 22, and to one end lead 92a of the winding 92 of the trigger transformer 23. The other end lead 92b of the trigger transformer winding is connected to the trigger electrode 28 of the flashtube 22, while the intermediate lead 92c is connected by a conductor 95 to one side of a trigger charge storage capacitor 96, the function and purpose of which will later be described more fully.

The state of charge on the capacitors 86 is sensed by a sampling circuit comprising a series of resistors 101, 102, 103, 104, 105, and 106 connected between conductor 84 and one end of the resistor of a potentiometer 110, the end of which is connected by a conductor 111 to one lead of the solenoid 112 of sampling relay 65, and by a conductor 113, a resistor 114, and conductor 52 to the ground conductor 50. The other lead of solenoid 112 is connected through a resistor 117 to the wiper arm 110a of potentiometer 110.

As the charge potential on the storage capacitors 86 increases current flow through the solenoid 112 increases. When the proper predetermined charging level for finding the flashtube 22 is reached at the capacitors 86, the relay 65 will be actuated to open contacts 63, 64 thereof, thereby breaking the energization circuit for solenoid 112 to prevent actuation of the relay 65 by transients. The predetermined level of charge at which the relay 65 will be actuated may be varied by adjustment of the potentiometer.

Readiness of the storage capacitors 86 is indicated by energization of indicator lamps 123, 124, 125 mounted at the power supply panel 54 and on loader's and trainer's panels 55 and 56. The lamps 123, 124, and 125 are connected in parallel across conductors 131 and 61 of which conductor 131 is connected by conductor 66 to contact 64 of relay 65, and conductor 61 is connected to contact 60 of relay 57. During charging of the capacitors 86 with the relay contacts 62, 64 closed, the conductors 131, 61 are short circuited, preventing energization of the lamps 123, 124 and 125. Energizing of relay 65 upon completion of charging of capacitors 86 will open contacts 62, 64 and remove the short, whereupon the lamps 123, 124 and 125 will be energized by current from the secondary winding 46 of transformer 44 to indicate readiness of the charge on those storage capacitors.

The resistor 83 may be adjusted to vary the charging time required for the capacitors 86 to reach their predetermined charge, which time may be representative of the loading time usually required for loading the actual tank gun.

As noted earlier, the xenon flashtube 22 requires two inputs. The input to the main lamp terminals 26, 27 is directly from the capacitors 86 which are discharged

through the lamp, and a triggering input to the trigger electrode 28. The input to the trigger electrode 28 is derived from storage capacitor 96 and trigger transformer 23, through a series of relay actions which will be described as the specification proceeds.

The storage capacitor 96 is adapted to be charged to about 300 volts by a charging circuit comprising a secondary winding 198 of transformer 43, one lead of which is connected to a rectifier diode 199 which is in turn connected through a resistor 200, a conductor 201, a resistor 202, and a conductor 203 to the storage capacitor. Connected in parallel between conductor 201 and a conductor 205 are a resistor 206 and a capacitor 207, conductor 205 being connected to the other end lead of the transformer winding 198, and by a conductor 209 to the ground conductor 50.

The diode 199, resistors 200, 206, and capacitor 207 comprise a half-wave rectifier and smoothing circuit whereby the capacitor 96 is supplied with a relatively smooth D.C. charging potential through the resistor 202. Because the capacitor 96 charges through resistor 202, which is selected to have a relatively high value, the charging time is relatively long. The effect is to present such a slowly rising D.C. to the trigger transformer 23 as to preclude firing of the flashtube 22 as a result of merely charging the capacitor 96. The time required for charging capacitor 96 will desirably be somewhat less than that required for charging the capacitors 86.

When the contacts of the power relay 34 are in their illustrated positions, that is to say the positions occupied when capacitors 86 are charged and the "Ready" lights 123, 124 and 125 are glowing, a trigger switch circuit is enabled. This trigger switch circuit includes a trigger switch 215 which may be the actual switch normally utilized for firing the tank gun and is normally open as shown.

Closing of the trigger switch 215 will complete a circuit for actuating the firing relay 57 and may be traced from one end of the secondary winding 45 of transformer 44 through conductors 51, 216, switch 215, a conductor 217, contacts 218, 219 of power relay 34, a conductor 220, the solenoid 222 of firing relay 57, conductor 68 and interlock switches 69, 70, 71 to the ground conductor 50 which is connected by conductor 49 to the other end of the secondary winding 45.

The relay 57 is thereby actuated to provide a discharge path for the capacitor 96, discharge of which will draw a current pulse through the portion of winding 92 of trigger transformer 23 between leads 92a and 92c thereof, which pulse will produce a voltage on the order of 18,000 volts at the trigger electrode 28 with respect to electrode 27. Such high voltage at the trigger electrode is sufficient to ionize the gas in the flashtube and initiate discharge of the capacitors 86 through the ionized gas between electrodes 26, 27 whereupon the flashtube will produce the light energy necessary for the desired laser action.

The discharge path provided by actuation of relay 54 for capacitor 96 may be traced from the capacitor 96 through conductor 203, contacts 230, 231 and contacts 232, 233 of relay 57, and conductors 205 and 49 to the ground conductor 50.

It will be noted that the solenoid 222 of the firing relay 57 is in series with contacts 218, 219 of the power relay 34 and the trigger switch 215. As long as relay 34 is energized, the condition thereof while capacitors 86 are charging, the circuit to the solenoid of the firing relay is open. Thus, the laser trigger circuit is disabled while capacitors 86 are charging, and a premature attempt to fire the laser is prevented.

As a safety feature, a pair of parallel connected resistors 240 and a relay 242 are provided, the purpose of which is to automatically discharge the capacitors 86 in the event of loss of power to the system, opening of any of the interlock switches 69, 70, 71, or loose or disconnected cables. Additionally, the relay 242 serves to ener-

gize one or more of emergency indicator lamps 245, 246, 247 in the event any of the interlock switches are opened.

When the circuit is operating normally, the relay 242 is energized by a circuit which may be traced from winding 46 of transformer 44 through conductor 58, contacts 59, 60 of relay 57, conductor 61, a conductor 248, solenoid 243 of relay 242, conductors 249 and 68, and interlock switches 69, 70 and 71 to the ground conductor 50. With the relay 242 energized the resistors 240 are connected between conductor 84 and an open contact 250 of the relay. When, for any of the above noted reasons, the relay 242 becomes de-energized, a discharge path for the capacitors 86 is established which may be traced from the capacitors 86 through conductor 84, resistors 240, contacts 250, 251 of relay 242, a conductor 254, contacts 256, 257 of the relay, and conductors 260 and 88 to the ground conductor 50.

From the foregoing detailed description, it will be appreciated that the aforementioned objects and advantages, as well as others evident from the description, have been attained by the laser, weapon simulator embodying the invention.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a laser, weapon simulator including a gas filled flashtube having discharge electrode means and trigger electrode means, a power supply therefor comprising:

first storage capacitor means connected to said discharge electrode means;
charging means for charging said first storage capacitor means over a predetermined time period to a predetermined potential;

second storage capacitor means;
transformer means connecting said second storage capacitor means to said trigger electrode means;

second charging means connected to said second storage capacitor means for charging thereof to a predetermined potential over a second predetermined time period;

trigger circuit means for discharging said second storage capacitor means so as to produce a current pulse in said transformer means; and

relay means having contacts in series with said trigger switch, said relay means being operative to disable said trigger circuit during charging of said first storage capacitor means, said relay means being responsive to attainment of said predetermined potential at said first storage capacitor means to close said contacts and enable said trigger circuit.

2. In a laser, weapon simulator, a power supply as defined in claim 1, and wherein said relay means comprises:

a power relay operative to alternatively connect and disconnect said first charging means to power input conductors; and

a sampling relay having a solenoid connected by resistor means to said first storage capacitor means so that current flow through said solenoid becomes sufficient to actuate said relay only upon attainment of said predetermined potential of said first storage capacitor means;

said power relay being operative in response to actuation of said sampling relay to disconnect said first charging means from said power input conductors.

3. In a laser, weapon simulator, a power supply as defined in claim 2, and further comprising:

indicator lamp means connected across lamp current supply conductor means; and

said sampling relay means comprising contact means operative to short circuit said lamp current supply conductor means during charging of said first storage capacitor means, and operative to open said short circuit upon energization of said sampling relay, whereby attainment of said predetermined potential at said first storage capacitor means is indicated by energization of said indicator lamp means.

4. In a laser, weapon simulator, a power supply as defined in claim 2 and further comprising:

a discharge relay having a solenoid connected to be energized as long as said power supply is receiving normal electric power and comprising contact means adapted to close upon loss of said normal electric power; and

additional resistor means connected in series with said contact means of said discharge relay between said first storage capacitor means and ground, whereby upon loss of normal power said first storage capacitor means will be discharged through said additional resistor means.

5. In a laser, weapon simulator, a power supply as defined in claim 3 and further comprising:

capacitor means connected across said solenoid of said sampling relay whereby actuation thereof by transient or spurious currents is prevented.

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U.S. Cl. X.R.

35—25; 273—101.1; 315—245; 331—94.5