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Nelsen

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[54] VOICE CONTROLLED TARGET RELEASE SYSTEM

[76] Inventor: **Thomas Sloan Nelsen,** 616 Foothill Rd., Stanford, Calif. 94305

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[52] **U.S. Cl.** ..... **307/154,** 124/32, 124/34, 317/147, 317/148.5 B

[51] **Int. Cl.** **F14c 19/12**

[58] **Field of Search** ..... 317/147; 340/148; 124/32, 34; 46/244 C; 102/19.2; 307/154

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Primary Examiner—L. T. Hix

Attorney—Flehr, Hohbach, Test, Albritton & Herbert

[57] **ABSTRACT**

Trap system in which the release of clay targets is controlled electronically in response to the shooter's verbal command. Means is included for distinguishing the shooter's commands from other acoustical disturbances. The system will accommodate a number of shooters at different locations, and means is included for introducing a random 0–3 second delay for skeet shooting. The system is adapted for drawing its operating power from an existing trap machine, and it can be used as a direct substitute for the push-button used to actuate the target release mechanism in many such machines.

17 Claims, 8 Drawing Figures

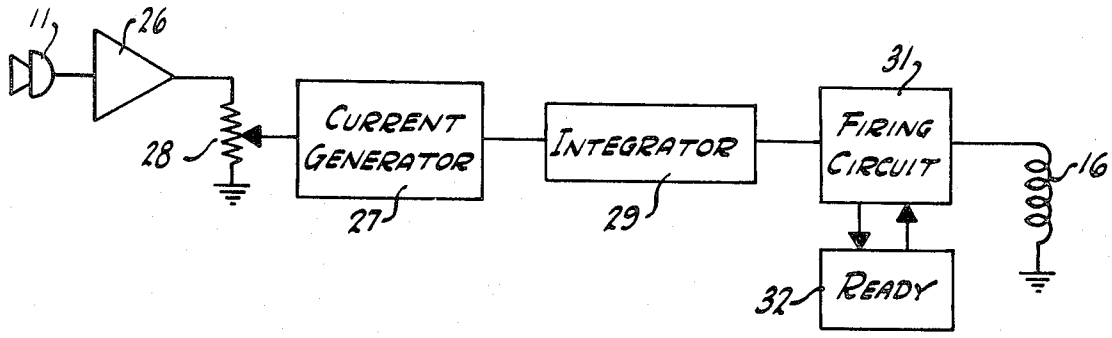
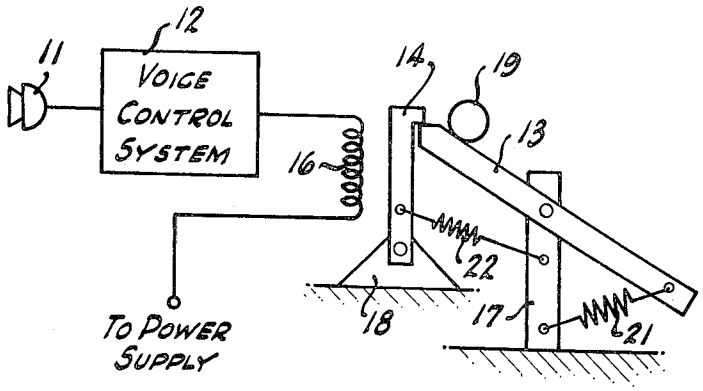


FIG-1



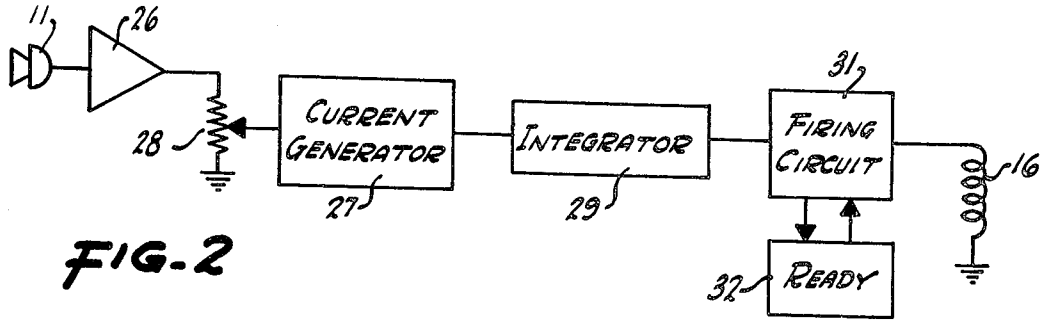


FIG-2

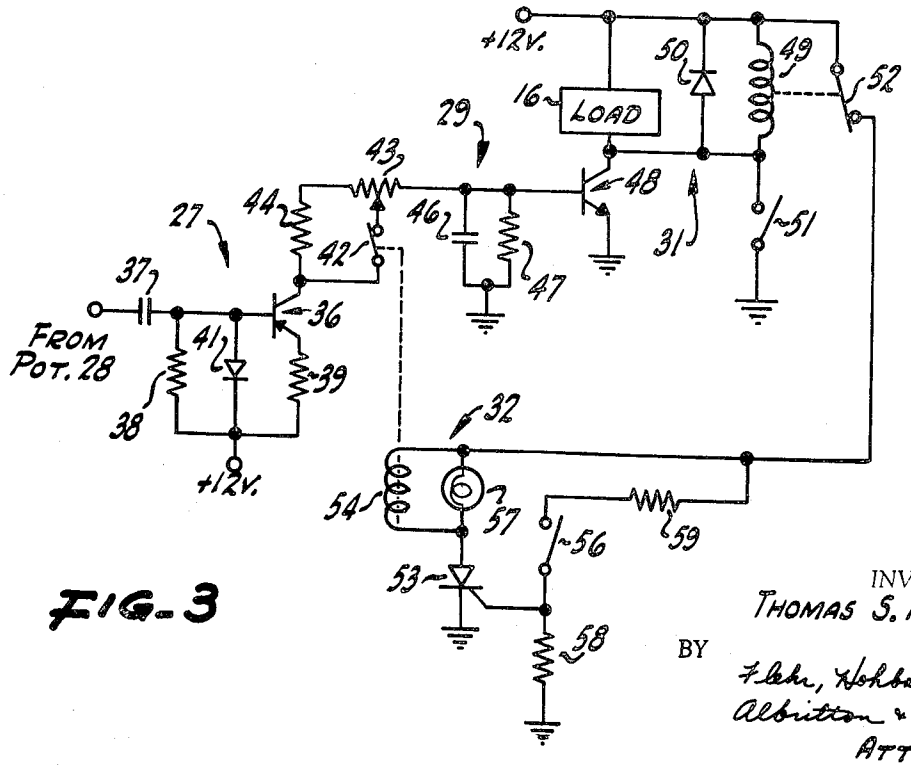


FIG-3

INVENTOR.
THOMAS S. NELSEN

BY

Fleht, Hohbach, Test, Albritton & Herbert

ATTORNEYS

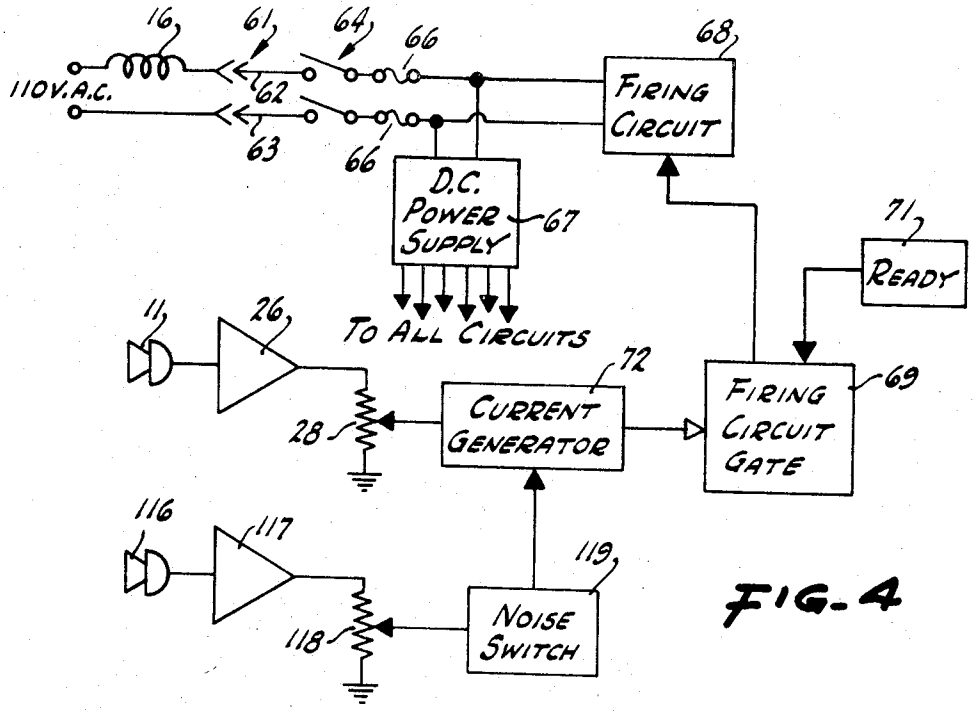


FIG-4

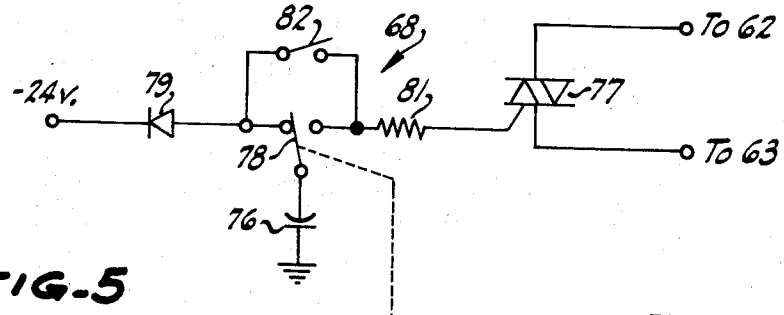
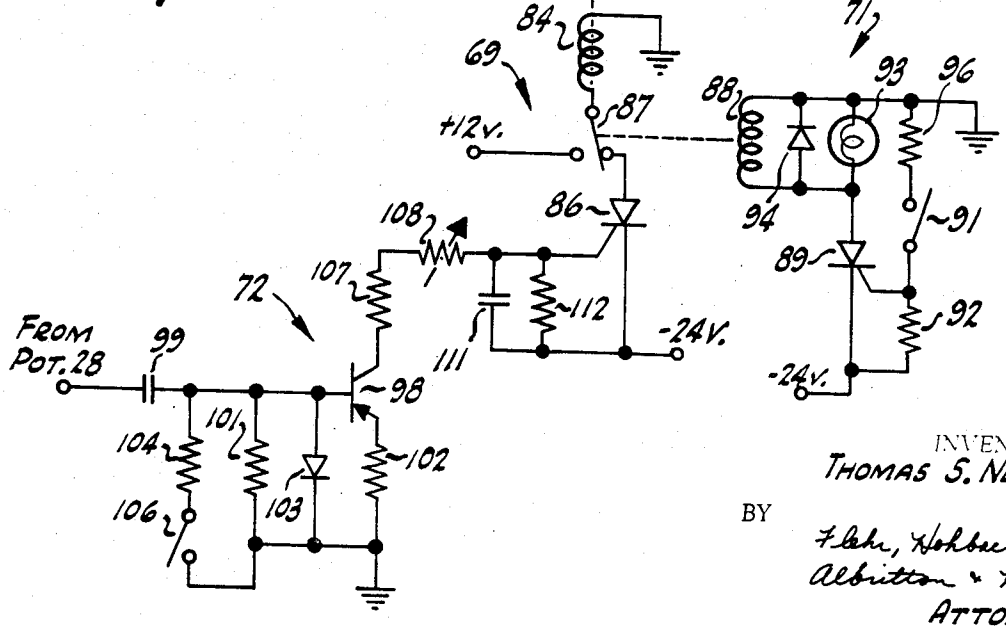


FIG-5

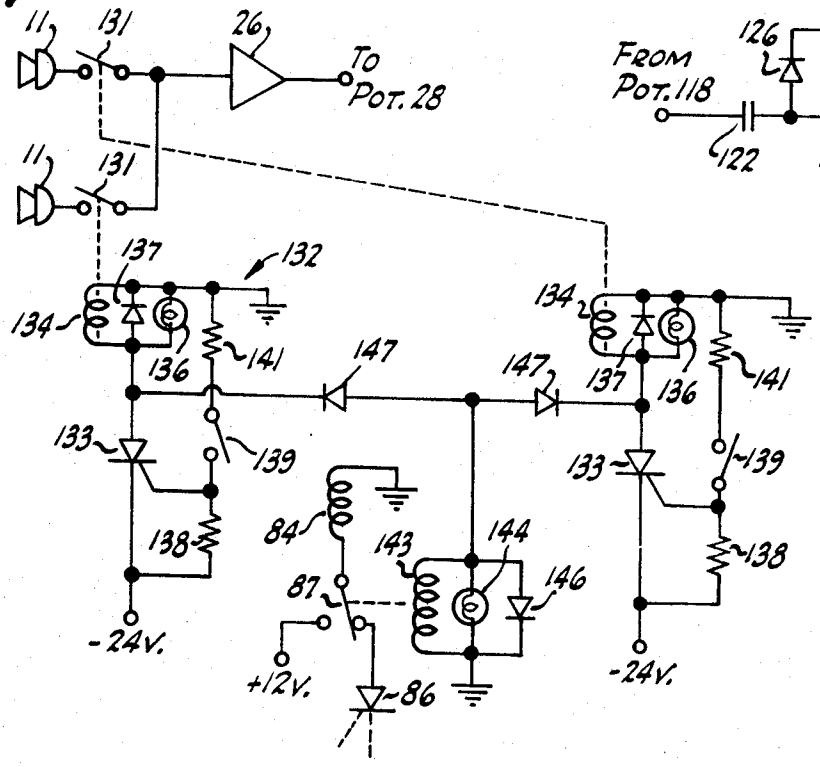


INVENTOR.
THOMAS S. NELSEN

BY

Fleht, Hohbach, West, Albritton & Herbert
ATTORNEYS

FIG-7



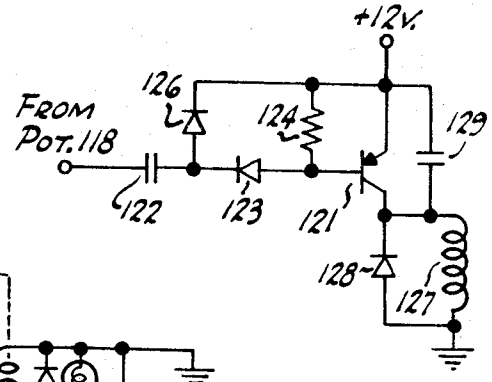


FIG-6

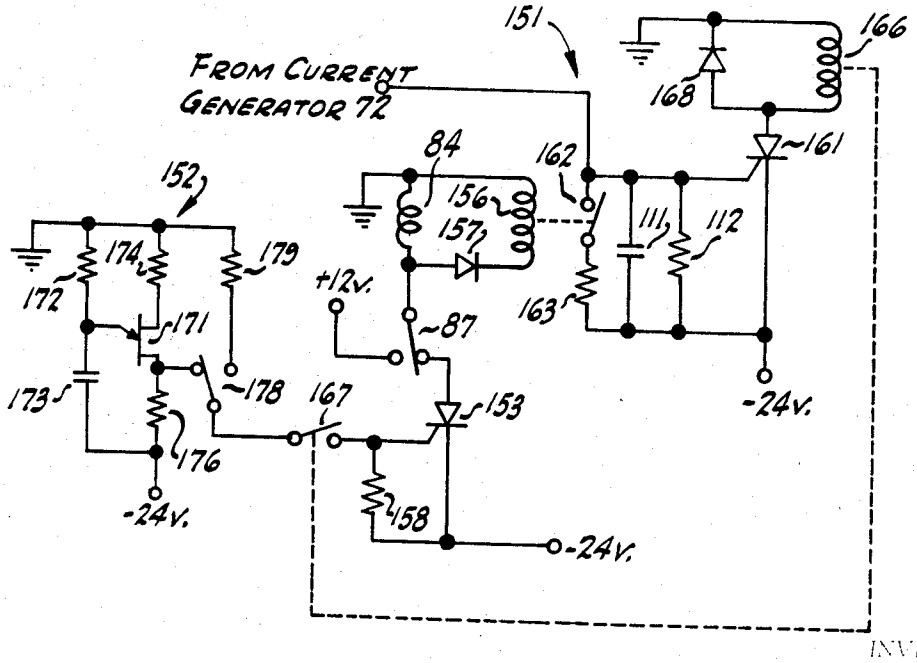


FIG-8

INVENTOR.
THOMAS S. NELSON

BY

Fleht, Hohbach, Test, Albritton & Herbert
ATTORNEYS

VOICE CONTROLLED TARGET RELEASE SYSTEM

BACKGROUND OF THE INVENTION

This invention pertains generally to trap and skeet shooting and more particularly to a voice controlled system for releasing clay targets in response to a shooter's command.

Mechanical traps for the release of clay targets have undergone many improvements since the original hand operated designs. These improvements have included power cocking of the release arm by means of an electric motor and gear box mechanism, automatic loading of a target on the throwing arm, and electric release by means of a solenoid. The solenoid is typically controlled by means of a push button switch located remotely of the trap. These features allow unattended operation of the trap until the supply of targets is exhausted.

Trap systems of the above character require a trap attendant or "puller" to operate the push-button switch in response to the shooter's command. The puller is expected to release the target with a minimum of delay after the shooter calls "pull" or makes some other sound recognizable to the puller. All "pulls" should be uniform in delay with respect to the shooter's call, not 40 milliseconds one time and one-half second the next. Trap attendant responses which are delayed unduly are known as "slow pulls," and they are sufficient reason for a target to be rejected by the shooter. "Fast pulls" are equally undesirable to the shooter. These arise when the trap boy, in his anxiety to respond promptly, anticipates the shooter's call and releases the target permaturely.

Since human reflex times vary, release times vary among trap attendants. In addition, the trap attendant is frequently required to keep score in addition to being alert for the shooter's commands. During competition, the human errors in the release of clay targets seem to multiply, particularly as shooters and trap personnel tire.

There is, therefore, a need for a new and improved trap system which overcomes the foregoing and other problems encountered with trap systems heretofore provided.

SUMMARY AND OBJECTS OF THE INVENTION

In the system of the present invention, the release of clay targets is controlled electronically in response to the shooter's verbal command, and the need for the trap attendant is eliminated. A time delay is built into the system to approximate the reflex time of a good trap attendant, and the release times are nore uniform than has heretofore been possible with even the best attendant. Means is included for distinguishing the shooter's commands from disturbances such as noise of short duration and the noise of nearby gun shots. The system will accommodate a number of shooters at different locations. If desired, a random time delay can be introduced between the shooter's command and the release of the target for skeet shooting. In one embodiment, the system draws its operating power from the trap throwing machine, and it can be substituted directly for the manual switch assembly commonly used on such machines without the need for rewiring.

It is in general an object of the present invention to provide a new and improved system for releasing a target from a trap in response to a shooter's command.

Another object of the invention is to provide a system of the above character in which each target is released at a uniform time after the shooter's command.

Another object of the invention is to provide a system of the above character which includes means for distinguishing the shooter's command from acoustical disturbances such as noise and gun shot noise.

Another object of the invention is to provide a system of the above character which can accommodate a plurality of shooters at different locations.

Another object of the invention is to provide a system of the above character which includes means for delaying the release of the target for a random time after the shooter's command.

Another object of the invention is to provide a system of the above character which derives its operating power from the trap machine and can be substituted directly for the manual switch commonly used on most trap and skeet fields without need for rewiring the traps or fields.

Additional objects and features of the invention will be apparent from the following description in which the preferred embodiments are set forth in detail in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a combined block diagram and schematice illustration of one embodiment of a voice controlled trap system incorporating the present invention.

FIG. 2 is a block diagram of one embodiment of a voice controlled system incorporating the present invention.

FIG. 3 is a schematic diagram of a portion of the trap system illustrated in FIG. 2.

FIG. 4 is a block diagram of one embodiment of a trap system incorporating the present invention and deriving its operating power from the trap machine itself.

FIG. 5 is a schematic diagram of a portion of the system illustrated in FIG. 4.

FIG. 6 is a schematic diagram of one embodiment of a noise switch which can be used in the system illustrated in FIG. 4.

FIG. 7 is a schematic diagram of one embodiment of a channel selecting network for selectively connecting a plurality of microphones to the system of the present invention.

FIG. 8 is a schematic diagram of one embodiment of a system for delaying the release of a target for a random period of time following the shooter's command.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates the invention in block and schematic form. The voice control portion of the system is illustrated by a microphone 11 and a block 12. This portion of the system is described in detail below. The pertinent elements of an electrically controlled trap machine which can be used in the invention are illustrated schematically. These elements include a throwing arm 13, a release arm 14 and a solenoid coil 16. The throwing and release arms are pivotally mounted to fixed members 17 and 18, respectively, which typically might constitute parts of the machine frame. Clay targets, as illustrated at 19, are placed on a throwing arm,

and a resilient member 21 cooperates with the throwing arm for hurling the targets. The release arm 14 engages the throwing arm and holds it in a cocked position. A resilient member 22 urges the release arm into contact with the throwing arm. When energized, the solenoid coil 16 draws the release arm 14 away from the moving arm, releasing the target 19. In trap machines of this type, the energization of the solenoid coil is commonly controlled by means of a push-button switch. In at least one embodiment, the voice control portion of the present invention is intended to be a direct, plug-in replacement for this switch.

FIG. 2 illustrates one embodiment of a voice control system which includes means for distinguishing the shooter's command from noise and other acoustical disturbances. In this embodiment, the microphone 11 is connected to the input of an amplifier 26. The microphone serves to convert the sound waves produced by the shooter's command to electrical signals which are amplified in the amplifier 26. In the preferred embodiment, the amplifier is tuned to provide a frequency response band on the order of 300 to 3,000 Hz, and the microphone is chosen to be relatively insensitive to frequencies below about 300 Hz.

The output of the amplifier is applied to the input of a current generator 27 through a potentiometer 28. The potentiometer provides means for adjusting the gain or sensitivity of the system to compensate for factors such as variations in the intensity of the shooter's voice and microphone placement.

The current generator 27, described hereinafter in detail, produces an output current which is proportional to the magnitude of the signal produced by the shooter's command. The output of the current generator is integrated by an integrator 29 to provide a signal whose magnitude represents both the magnitude and the duration of the input signal. The output of the integrator is applied to a firing circuit 31 which energizes the solenoid coil 16 when the integrator output reaches the level desired for releasing the target. A ready circuit 32 inhibits the operation of the firing circuit until the shooter is ready to fire.

The current generator 27, integrator 29, firing circuit 31 and ready circuit 32 are shown in detail in FIG. 3. The current generator includes an PNP transistor 36, and the output of the potentiometer 28 is applied to the base of this transistor through a coupling capacitor 37. Biasing is provided by means of resistors 38 and 39 which are connected from the base and emitter, respectively, to a source of positive voltage, such as +12V. The output of the current generator is taken from the collector of the transistor 36 through a set of relay contacts 42 and a potentiometer 43. The contacts 42 are controlled by the ready circuit 32, and the potentiometer provides means for adjusting the level of the output from the current generator when the contacts 42 are closed. A fixed resistor 44 is connected between the collector of the transistor 36 and one end of the potentiometer 43. When the contacts 42 are opened, the output of the current generator is limited by the resistor 44.

The output side of the potentiometer 43 is connected to the integrator 29 which comprises an integrating capacitor 46 and a bleeder resistor 47. The values of the capacitor 46 and the resistor 47 are chosen such that the shooter's command causes the capacitor 47 to be charged to the level necessary for actuating the firing circuit 31, but noise signals do not.

The firing circuit 31 includes an NPN switching transistor 48, the base of which is connected to the output of the integrator 29. The emitter of this transistor is grounded, and the collector is connected to one side of the coil 16 which is designated as the "load" in FIG. 3. The other side of the coil or load 16 is connected to the source of positive voltage. The collector of the transistor 48 is also connected to one end of the relay coil 49, and the other end of this coil is connected to the source of positive voltage. A clamping diode 50 is connected across the coil 49. A normally open push-button switch 51 is connected between the collector of the transistor 48 and ground to provide means for energizing the solenoid coil 16 and relay coil 49 to fire the target manually, if desired. When energized, the coil 49 opens a normally closed set of contacts 52.

The source of positive voltage is connected to the ready circuit 32 through the normally closed contacts 52. The ready circuit includes a silicon controlled rectifier 53, a relay coil 54, and a ready switch 56. The cathode of the silicon controlled rectifier is grounded, and the anode is connected to the source of positive voltage through the relay coil 54. The relay coil controls the operation of the contacts 42 in the output of the current generator in such manner that these contacts are closed when the coil 54 is energized. An indicator lamp 57 is connected across the coil 54 to provide a visual indication that the system is ready to fire. A biasing resistor 58 is connected between the gate of the SCR and ground. The ready switch 56 is connected between the gate of the SCR and the source of positive voltage through a current limiting resistor 59. In the preferred embodiment, this switch is a normally open push-button switch which is disposed at a convenient location for operation by the shooter.

Operating power for the circuits shown in FIG. 3 and the amplifier 26 is conveniently supplied by a conventional source of direct current. The output of this source is preferably regulated.

Operation and use of the circuits shown in FIG. 3 can now be described briefly. Initially, let it be assumed that the system is ready to fire. When the shooter calls "pull," the current generator delivers a charging current through the contacts 42 and potentiometer 43 to the integrating capacitor 46. When this capacitor charges to the threshold voltage of the level required to the transistor 48, this transistor turns on, energizing the solenoid coil 16 and the clay target is released by the trap machine. The turning on of the transistor 48 also energizes the relay coil 49, opening the contacts 52 and interrupting the flow of current to the ready circuit 32. This interruption turns off the silicon controlled rectifier 53, thereby de-energizing the relay coil 54 and extinguishing the indicator lamp 57. When the coil 54 is de-energized, the contacts 42 open, and the output of the current generator 27 is now directed through the resistor 44. When so directed, the current is not sufficient to maintain the charge on the capacitor 46, and the transistor 48 turns off as soon as the charge previously built up on the capacitor is dissipated. Thus, the solenoid coil 16 and the relay coil 49 are de-energized.

When the relay coil 49 is de-energized, the contacts 52 close, and power is again supplied to the ready circuit 32. However, the resistor 58 holds the SCR off until it is turned on again by closing the push-button

switch 56. When the shooter is ready for the release of the next target, he closes the switch 56 momentarily, turning on and latching the SCR 53. This illuminates the lamp 57 and energizes the relay coil 54, closing the contacts 42. The system is now ready to fire again.

The integrator 29 provides means for distinguishing the shooter's command from other disturbances such as noise of short duration. As is discussed above, the resistor 47 acts as a bleeder on the capacitor 46, preventing signals of limited magnitude or duration from charging the capacitor to the level which will turn on the firing circuit transistor 48. The potentiometer 43 provides means for adjusting the sensitivity of the system.

FIG. 4 shows an embodiment of the invention which derives its operating power from an electrically operated trap machine. The release solenoid coil 16 in such machines is commonly operated by 110 volts a.c. Energization of this coil is commonly controlled by means of a push-button switch which is located remotely of the machine and connected thereto by a connecting cable. This embodiment of the invention is adapted to be plugged into the jack on the trap machine which normally receives the connecting cable for the push-button switch.

This embodiment includes a connecting cable 61 which is connected to the trap machine in place of the release push-button. This cable includes a first conductor 62 which is connected to one side of a source of alternating current through the solenoid coil 16 and a second conductor 63 which is connected directly to the other side of the source of alternating current. As long as the current drawn through the solenoid coil 16 is below the level which will release the target, operating power for the voice control portion of the system can be "stolen" from the trap machine through the conductors 62 and 63. If desired, the cable 61 can also include a ground conductor.

An on-off switch 64 and fuses 66 are connected in series with the conductors 62, 63 which carry the alternating current. A D.C. power supply 67 is connected for receiving input power from these conductors. Ths supply includes conventional means for converting the alternating current to low level D.C. for operating the remainder of the system. In the preferred embodiment, the D.C. supply delivers operating voltages of +12 and −24 volts. The power requirements of the supply and the rest of the system are such that the current they draw through the solenoid coil 16 is less than the level required to actuate the solenoid and release the clay target.

Means is provided for connecting the conductors 62 and 63 together to energize the solenoid and release the target in response to the shooter's command. This means includes a firing circuit 68, a firing circuit gate 69 and a ready circuit 71 which are described hereinafter in detail. As in the embodiment described previously, the shooter's command is converted to an electrical signal by a microphone 11, and this electrical signal is amplified by an amplifier 26. The output of the amplifier is applied to the input of a current generator 72 through a potentiometer 28, and the output of the current generator controls the operation of the firing circuit gate.

The firing circuit 68, firing circuit gate 69, ready circuit 71 and current generator 72 are shown in detail in FIG. 5. The firing circuit includes a capacitor 76, a triac 77, and bistable latching relay contacts 78. One side of the capacitor 76 is connected to ground, and the other side of the capacitor is connected to the movable arm of the relay contacts. With the relay contacts in the position shown, the capacitor is connected for being charged with current from the power supply 67 through a diode 79. With the relay contacts in the other position, the capacitor is connected to the gate of the triac 77 through a resistor 81. The terminal 1 and the terminal 2 of the triac are connected to the conductors 62 and 63. Means is included for firing the triac to energize the solenoid and release the target manually, if desired. This means includes a normally open push-button switch 82 connected in parallal with the contacts on the relay between the diode 79 and resistor 81.

The operation of the relay contacts 78 is controlled by a relay coil 84 in the firing circuit gate 69. This gate also includes a silicon controlled rectifier 86 and another set of relay contacts 87. The coil 84 and contacts 78 make up a bistable latching relay. The position of this relay is determined by the polarity of a switching signal applied to the coil 84. As illustrated, one end of the coil 84 is grounded, and the other end of this coil is connected either to a source of positive voltage or a source of negative voltage, depending upon the position of the contacts 87. With the contacts 87 in the position illustrated, the free end of the coil 84 is connected to the anode of the SCR 86. The cathode of this SCR is connected to a source of −24 volts. With the contacts 87 in the other position, the free end of the coil 84 is connected directly to a source of +12 volts.

The position of the relay contacts 87 is controlled by a relay coil 88 in the ready circuit 71. This circuit also includes a silicon controlled rectifier 89 and a ready switch 91. One end of the coil 88 is connected to ground and the other end is connected to the anode of the SCR 89. The cathode of the SCR is connected to a source of −24 volts, and a resistor 92 is connected between the gate of the SCR and the −24 volt source. This resistor biases the SCR in its off condition. An indicator lamp 93 and clamping diode 94 are connected in parallel with the relay coil 88. One terminal of the ready switch 91 is connected to the gate of the SCR, and the other terminal of this switch is connected to ground through a resistor 96. The switch 91 is a normally open push-button switch which the shooter can operate to fire the SCR and energize the relay coil 88. When this coil is energized, the contacts 87 are in the position shown.

The conductivity of the SCR 86 in the firing circuit gate is controlled by the output of the current generator 72. This generator is generally similar to the current generator illustrated in FIG. 3. However, this generator operates from a source of negative voltage. The output of the potentiometer 28 is applied to the base of this transistor through a coupling capacitor 99. Biasing is provided by means of resistors 101 and 102 which are connected to ground from the base and emitter of this transistor. A clamping diode 103 is connected between the base and ground, as are a resistor 104 and a normally open switch 106. The resistor 104 and switch 106 constitute an inhibiting gate which prevents the operation of the current generator when certain noise signals are present. This noise inhibiting feature is discussed hereinafter in detail. The output of the current generator is taken from the collector of the transistor 98 through a fixed resistor 107 and a variable resistor 108.

The resistors 102 and 107 determine the maximum current available from the generator, and the resistor 108 provides means for adjusting the level of the output current up to the maximum.

The output of the current generator 72 is connected to an integrator consisting of a capacitor 111 and a resistor 112 connected between the gate of a SCR 86 in the firing circuit gate and the source of −24 volts. The values of this capacitor and resistor are chosen to be such that short duration noise signals will not fire the SCR 86.

Operation and use of the circuits shown in FIG. 5 can now be described briefly. Initially, let it be assumed that all of the switches and relay contacts are in the positions illustrated. In this situation, the capacitor 76 is charged to the level of the negative voltage supply through the contacts 78 and diode 79. When the shooter calls "pull," the current from the generator 72 charges the capacitor 111 to the level necessary to fire the SCR 86. This energizes the relay coil 84 in such manner that the contacts 78 are switched to their other position, connecting the capacitor 76 to the gate of the triac 77. At this point, the charge from the capacitor 76 fires the triac, connecting the circuits 62 and 63 together. This action of the triac turns off the D.C. power supply 67, interrupting the holding current to the SCR's 86 and 89 in the firing circuit gate and holding circuit, respectively. With the SCR 89 turned off, the relay coil 88 is de-energized, and the contacts 87 connect the free end of the relay coil 84 to the source of +12 volts. When the charge stored in the capacitor 76 is exhausted and the triac turns off, the D.C. power is restored. The coil 84 then moves the contacts 78 back to their original position, connecting the capacitor 76 to be recharged from the source of −24 volts.

In order to make the system ready for firing again, the shooter must depress the push-button switch 91 to turn on the SCR 89 in the ready circuit. This will energize the relay coil 88, moving the contacts 87 back to the position shown. The lamp 93 provides a visual indication of the position of the contacts 87 and, hence, the readiness of the system.

The capacitor 111 and resistor 112 function in a manner similar to the integrator 29 in FIGS. 2 and 3 to distinguish the shooter's command from noise of short duration and prevent such noise from firing the SCR 86 and releasing the target.

The embodiment shown in FIG. 4 also includes means for distinguishing the shooter's command from other acoustical disturbances, including the sound of nearby gunshots. This means includes a second microphone 116 which is located remotely of the shooter's microphone 11. The output of the microphone 116 is applied to an amplifier 117, and the output of this amplifier is applied to a noise gain control 118. The noise signal from the gain control 118 is applied to a noise switch 119 which controls the operation of the noise gate consisting of the resistor 104 and switch 106 in the current generator 72. The microphone 116 is placed far enough away from the shooter that it does not respond to his voice command. The microphone 116, amplifier 117 and gain control 118 can be similar to those used in the main voice channel. However, the components used in the noise channel should provide a gain, frequency response and speed equal to or greater than the corresponding characteristics in the main voice channel.

The noise switch 119 is shown in detail in FIG. 6. This switch includes a PNP transistor 121, and the noise signal from the potentiometer 118 is coupled to the base of this transistor through a coupling capacitor 122 and a diode 123. The emitter of this transistor is connected to the source of +12 volts, and a biasing resistor 124 is connected between the base and emitter. A second diode 126 is connected from the junction of the capacitor 122 and diode 123 to the emitter of the transistor. The diodes 123 and 126 rectify the noise signal delivered to the transistor 121. A relay coil 127 is connected between the collector of the transistor 121 and ground. When energized, this coil closes the switch contacts 106 in the noise gate of the current generator 72. A clamping diode 128 is connected across the coil 127.

When the rectified noise signal equals or exceeds the threshold voltage of the transistor 121, this transistor turns on, energizing the coil 127 and closing the noise gate contacts 106 in the current generator. The closing of these contacts inhibits the operation of the current generator, thereby disabling the firing circuit until the noise switch and gate open again.

The components in the noise switch are chosen to provide an attack time which is fast compared to the operation of the integrator at the gate of the SCR 86. In the preferred embodiment, the noise gate is actuated in a time of one millisecond or less, whereas several millseconds are required to charge the integrator capacitor 111 to the firing level of the SCR 86.

Although a fast attack time for the noise rejection channel is desirable for proper operation, a fast release time would be undesirable. Accordingly, a capacitor 129 is connected between the collector and emitter of the transistor 121 to prolong the release time of this circuit. In the preferred embodiment, this capacitor is chosen to provide a release time on the order of 15–20 msec. This prolonged release time prevents rapid tracking of noises such as reverberating gun shots and provides smooth nonoscillating operation of the noise rejection channel.

Operation and use of the noise rejection channel can now be described briefly. Noises such as reverberating gun shots from adjacent fields are received by both the shooter's microphone 11 and the noise microphone 116 with substantially equal intensities. The portion of the signal in the noise channel operates the noise gate and inhibits the operation of the current generator before the SCR 86 in the firing gate circuit can fire. With the gain controls 28 and 118 adjusted properly, the shooter's voice produces a substantially stronger signal in the voice channel than in the noise channel. Thus, the shooter's voice actuates the SCR 86, but not the noise switch 119, and the target is released in the normal manner. The addition of the noise rejection channel does not detract from the action of the current generator and integrator in discriminating against noises of short duration. Thus, with the noise rejection channel in operation, the system includes means for distinguishing the shooter's command from noises of long and short duration.

The noise rejection channel of FIG. 4 can also be used with the system shown in FIG. 2 if a noise gate similar to the resistor 104 and switch contacts 106 are added to the current generator 27.

Means is provided for selectively connecting a plurality of microphones 11 to the system to permit its use by

a plurality of shooters at different stations. A channel selector switch 131 is provided for connecting each of the microphones to the input of the amplifier 26. Each of the switches 131 is controlled by a channel selector network 132 which is similar to the ready circuit 71 shown in FIG. 5. These networks provide means for selectively connecting one of the microphones 11 to the amplifier and at the same time performing the function of the ready circuit.

Each of the channel selector networks 132 includes a silicon controlled rectifier 133 and a relay coil 134 which operates the switch 131 associated with the particular channel. The relay coil is connected between the anode of the SCR and ground. When energized, the coil closes the associated selector switch, turning on the microphone for the channel. An indicator lamp 136 and a clamping diode 137 are connected in parallel with the relay coil. The cathode of the SCR 133 is connected to a source of −24 volts, and a resistor 138 is connected between the gate and cathode of the SCR. A normally open switch 139 and a resistor 141 are connected in series between the SCR gate and ground. This switch provides means for the shooter to turn on the microphone at his station, and it also serves as a ready switch.

When the channel selector networks 132 are used in connection with the circuits shown in FIGS. 4 and 5, the ready circuit 71 is not needed. In this situation, the relay coil 88 and indicator lamp 93 of the ready circuit are replaced by a single coil 143 and indicator lamp 144 which can be controlled individually by the different channel selector networks. The coil 143 operates the relay contacts 87 in the firing circuit gate 69 in the same manner as did the coil 88. A clamping diode 146 is connected in parallel with the coil 143 and lamp 144, and one end of each of these elements is connected to ground. The other ends of these elements are connected through steering diodes 147 to the anodes of the SCR's 133 in each of the channel selector networks. These diodes prevent the SCR in one selector network from energizing the relay coil 134 in another such network.

Operation and use of the channel selector networks can now be described briefly. When a shooter is ready to fire, the switch 139 in the network for this particular station is closed, turning on the SCR 133 and energizing the relay coil 134 to close the switch 131. Thus, the microphone at his station is connected to the input of the amplifier, and the lamp 136 is illuminated, indicating that the shooter at the particular station is ready to fire. When the SCR fires, the relay coil 143 is energized, moving the contacts 87 to the position illustrated. The lamp 144 is illuminated, indicating that the system is ready for the shooter's command. After the target has been released, the power supply is turned off momentarily, interrupting the flow of current to the SCR's and turning them off. This de-energizes the relay coils 134 and 143, making the system available to the next shooter who can then manifest his readiness by closing the switch 139 in the selector network for his station.

While only two microphones and selector networks are shown in FIG. 7, the system will accomodate any desired number of channels. For example, a microphone and selector network can be provided for each station on a trap field. The switches 139 and indicator lamps 136 can be located at each station, a common location or both, as desired.

In the international form of the clay target sport commonly known as skeet, a random duration delay varying from 0 to 3 seconds is introduced to add difficulty to the sport. In other words, the target may be released promptly in response to the shooter's call, or may be released any time up to 3 seconds thereafter. Means for generating this random delay electronically is shown in FIG. 8. This means includes a delay firing gate 151 and a free running oscillator 152. The delay gate 151 can be used in the circuit shown in FIGS. 4 and 5 in place of the firing circuit gate 69.

The delay gate 151 is formed in two sections, one of which includes a silicon controlled rectifier 153. The anode of this SCR is connected to the relay contacts 87 in the same manner as the anode of the SCR 86 in the firing circuit gate 69. The contacts 87 can be controlled by either the relay coil 88 in the ready circuit 71 or the relay coil 143 in the multiple channel selector networks, as described hereinbefore. In this embodiment, a relay coil 156 and a diode 157 are connected in series across the relay coil 84. The polarity of the diode 157 is such that the coil 156 is energized only when the coil 84 is energized from the source of +12 volts. The cathode of the SCR 152 is connected to the source of −24 volts, and a resistor 158 is connected between the gate and the cathode of the SCR.

The second stage of the delay gate 151 includes a silicon controlled rectifier 161. The input circuit of this SCR is similar to the input circuit of the SCR 86 in the firing gate circuit in that the cathode is connected to the source of −24 volts, and the integrating capacitor 111 and resistor 112 are connected between the gate and cathode. As before, the capacitor 111 is charged by current from the current generator 72. An inhibiting gate consisting of relay contacts 162 and a resistor 163 is also connected between the gate and cathode of the SCR 161. The relay contacts 162 are operated by the relay coil 156 in the first stage of the delay gate in such manner that these contacts are closed when the coil is energized. Another relay coil 166 is connected between the anode of the SCR 161 and ground. This coil controls the operation of a set of relay contacts 167 between the output of the oscillator 152 and the gate of the SCR 153. A clamping diode 168 is connected across the relay coil 166.

The oscillator 152 includes a unijunction transistor 171. A timing resistor 172 is connected between the emitter of this transistor and ground, and a timing capacitor 173 is connected between the emitter and the source of −24 volts. A biasing resistor 174 is connected between the base 2 and ground, and an output resistor is connected between the base 1 and the −24 volt source. The values of the timing resistor 172 and capacitor 173 are chosen such that the oscillator has a period of 3 seconds, that is, a positive pulse is produced at the base 1 every 3 seconds.

Means is provided for selectively connecting the random delay into the system. This means includes a manually operable single pole, double throw switch 178, the movable contact of which is connected to the gate of the SCR 153 through the relay contacts 167. With the switch 178 in the position shown, the delay is turned on, and the output of the oscillator 152 is connected to the gate of the SCR 153. With the switch 178 in the other position, the delay is turned off, and the

gate of the SCR 153 is connected to ground through a resistor 179.

Operation and use of the random delay circuit can now be described briefly. Initially, let it be assumed that the random delay switch is in its on position, that is the position illustrated. Prior to the time the shooter manifests his readiness, the relay contacts 87 will connect the relay coils 84 and 156 to the source of +12 volts. In this situation, the relay contacts 162 are closed, preventing the SCR 161 from firing. When the shooter manifests his readiness by closing the ready switch, the relay contacts 87 move to the position illustrated, de-energizing the coil 156 and opening the contacts 162. Thereafter, when the shooter calls "pull," the SCR 161 fires, energizing the relay coil 166. When this coil is energized, the contacts 167 close, connecting the output of the oscillator 152 to the gate of the SCR 153. The next pulse following the closure of the contacts 167 fires the SCR 153, energizing the relay coil 84 from the source of −24 volts and releasing the target in the manner described hereinbefore. The amount of delay before the target is released depends upon the timing of the closure of the contacts 167 relative to the cycle of the oscillator 152. Since the oscillator is free running and the shooter's calls are randomly spaced with respect to the 3 second period of this oscillator, a random delay of 0 to 3 seconds is provided. As before, when the target is released, the power supply is turned off momentarily, turning off all the SCR's in the circuit. Thus, the further release of targets is prevented until the shooter closes the ready switch.

When the delay selector switch 178 is in its other position, the SCR 153 fires as soon as the contacts 167 close. In this situation, the gate of the SCR is connected to ground through the resistor 179.

In the embodiments described hereinbefore, the current generators and integrators provide means for delaying the release of the target for a uniform fixed period after the shooter's command. This delay is determined by the amount of time required to charge the capacitor in the integrator to the threshold voltage of the transistor or SCR to which it is connected. The charging rate of the capacitor is readily adjusted by adjusting the variable resistor in the output of the current generator or by changing the values of the resistor and capacitor in the integrator. Because it is electrically determined, the delay is very uniform, and in the preferred embodiment it is chosen to approximate the reflex time of an alert trap attendant.

It is apparent from the foregoing that a new and improved system for releasing clay targets in response to a shooter's command has been provided. While only the presently preferred embodiments have been described, as will be apparent to those familiar with the art, certain changes and modifications can be made without departing from the scope of the invention as defined by the following claims.

I claim:

1. In a voice operated control system for a target throwing machine having electrically actuated means for releasing a target, sound responsive means for converting a shooter's verbal command to an electrical signal, means responsive to the electrical signal for energizing the electrically actuated means to release a target, and means for delaying energization of the electrically actuated means for a predetermined time after the shooter's command to simulate the reflex time of a human attendant operating a trap machine in response to the command of a shooter.

2. In a voice operated control system for a target throwing machine having electrically actutated means for releasing a target, sound responsive means for converting a shooter's verbal command to an electrical signal, means for integrating the electrical signal to provide an output signal having a level dependent on the magnitude and duration of the electrical signal, means for energizing the electrically actuated means to release a target when the output signal reaches a predetermined level, additional sound responsive means disposed remotely of the first named sound responsive means, and means for preventing the electrically actuated means from being energized when sound sensed by the additional sound responsive means is above a predetermined level.

3. A system as in claim 1 wherein the means for energizing the electrically actuated means includes a capacitor in which energy is stored prior to the shooter's command and switching means responsive to the electrical signal for connecting the capacitor to the electrically actuated means.

4. A system as in claim 1 wherein the sound responsive means includes a plurality of microphones disposed at different shooting stations, together with means at each station for conditioning the system such that the means for energizing the electrically actuated means responds only to signals from the microphone at that station.

5. In a voice operated control system for a target throwing machine having electrically actuated means for releasing a target, sound responsive means for converting a shooter's verbal command to an electrical signal, means for energizing the electrically actuated means to release a target in response to the electrical signal, means for conditioning the system to prevent further energization of the electrically actuated means when the target is released, and manually operable means for restoring the system to a ready condition in which the electrically actuated means can again be energized in response to a shooter's command.

6. A system as in claim 5 further including visual means for indicating when the system is in its ready condition.

7. In a voice controlled system for a target throwing machine having electrically actuated means for releasing a target, sound responsive means for converting a shooter's verbal command to an electrical signal, means for energizing the electrically actuated means to release a target at a predetermined time after the shooter's command, and delay means and manually operable switch means for optionally delaying the energization of the electrically actuated means for a random time after the shooter's command.

8. A system as in claim 7 wherein the delay means includes gate means, oscillator means for delivering a periodic signal to the gate means, and means for applying an enabling signal to the gate means when the output signal from the integrating means reaches the predetermined level, said gate means being adapted for delivering a target release signal the first time the periodic oscillator signal reaches a predetermined level following application of the enabling signal.

9. A system as in claim 1 in which the electrically actuated means has an operating element which requires a predetermined minimum current for actuation and

the system is connected electrically in series with the operating element to obtain operating current from the machine through the element, said operating current being less than the minimum current required to actuate the element.

10. In a voice operated control system for a target throwing machine having electrically actuated means for releasing a target, microphone means for converting sound waves to an electrical input signal, means for generating a current which varies between predetermined maximum and minimum levels in accordance with the level of the input signal, manually adjustable means for setting the maximum level of the current, means for integrating the current to provide an output signal having a magnitude dependent on the magnitude and duration of the input signal, and means for energizing the electrically actuated means to release a target when the output signal reaches a predetermined level.

11. In a voice operated control system for a target throwing machine having electrically actuated means for releasing a target, said electrically actuated means requiring a predetermined minimum current for actuation, sound responsive means for converting a shooter's verbal command to an electrical signal, means for energizing the electrically actuated means to cause a target to be thrown in response to the electrical signal, and means for connecting the system electrically in series with the electrically actuated means so that the system receives operating current from the machine through the electrically actuated means, the operating current for the system being less than the minimum current required for actuation of the electrically actuated means.

12. A system as in claim 11 wherein the means for energizing the electrically actuated means includes a capacitor connected to be charged by the operating current supplied to the system and means responsive to the electrical signal for connecting the capacitor to the electrically actuated means.

13. A system as in claim 11 further including means fro delaying energization of the electrically actuated means for a predetermined time after the shooter's command to simulate the reflex time of a human attendant operating a trap machine in response to the command of a shooter.

14. In a voice operated control system for a target throwing machine having electrically actuated means for releasing a target, sound responsive means for converting a shooter's verbal command to an electrical signal, means for energizing the electrically actuated means in response to a control signal, and random delay means responsive to the electrical signal for delivering a control signal a random time after receipt of the electrical signal, whereby a target is released a random time after the shooter's command.

15. A system as in claim 14 together with manually operable switch means for optionally conditioning the delay means to deliver the control signal a predetermined time after receipt of the electrical signal.

16. A system as in claim 14 wherein the random delay means includes gate means for delivering a control signal upon conjoint receipt of two input signals, oscillator means for supplying a periodic input signal to the gate means, and means for applying an enabling input signal to the gate means in response to the electrical signal, whereby the time at which the control signal is delivered is determined by the timing of the shooter's command relative to the period of the signal supplied by the oscillator means.

17. In a voice operated control system for a target throwing machine, sound responsive means for converting sound waves at a shooting station to an electrical signal, means responsive to the electrical signal for conditioning the machine to release a target, additional sound responsive means for detecting sound from a location remote of the shooting station, and means for preventing the machine from being conditioned to release a target when the sound detected by the additional sound responsive means is above a predetermined level.

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