Jan. 28, 1969 J. A. I. OHLUND 3,423,848

WEAPON COUNTERFIRE SIMULATOR

Original Filed Sept. 4, 1963 Sheet 1 of 4

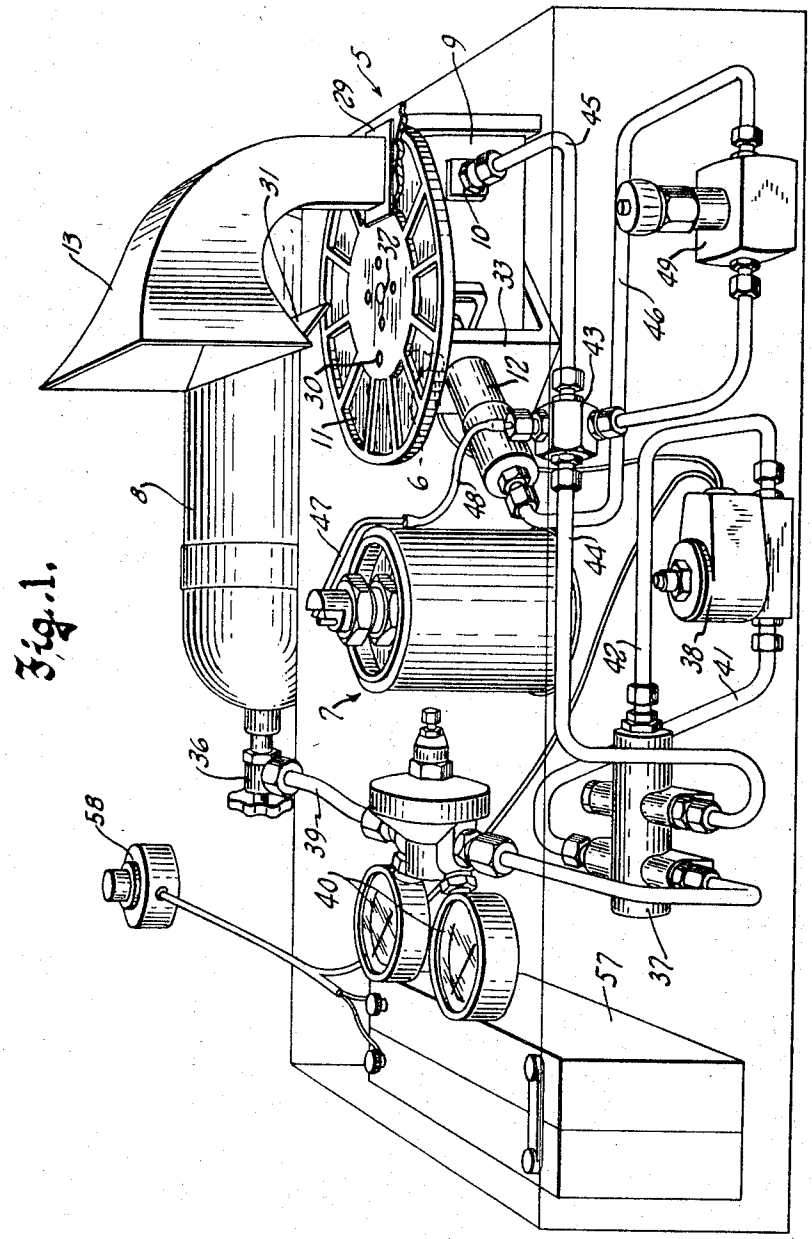


Fig. 1.

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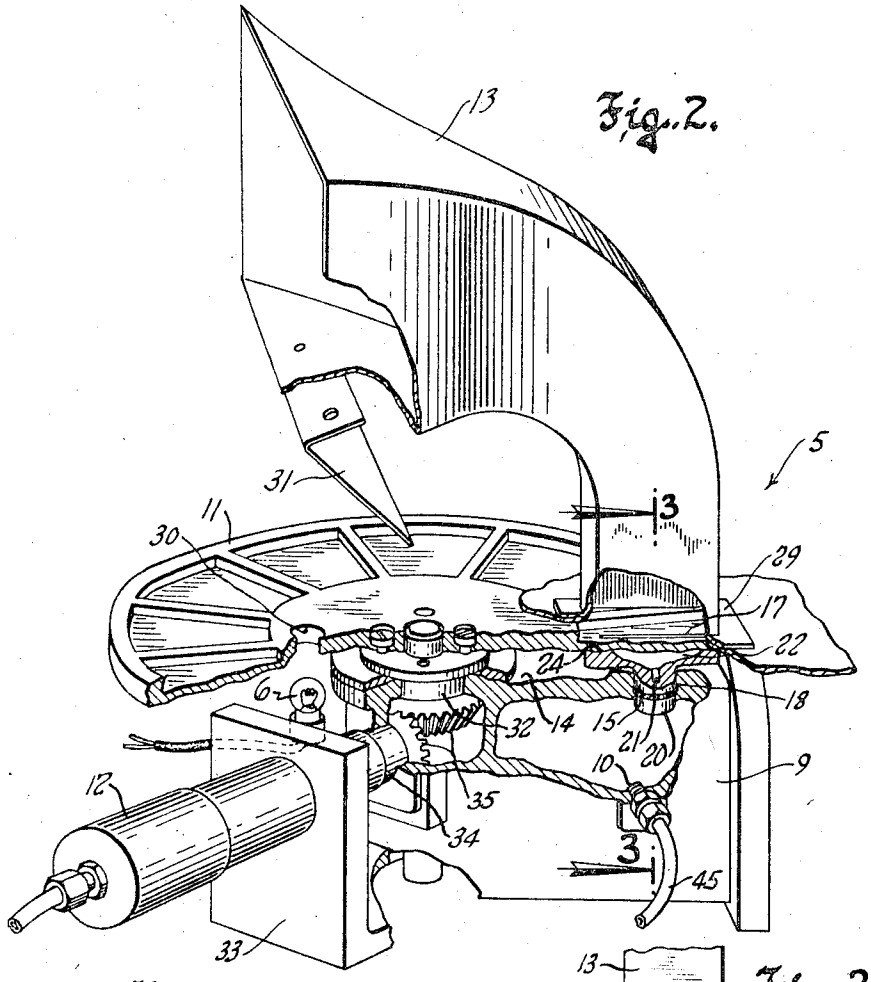


Fig. 2.

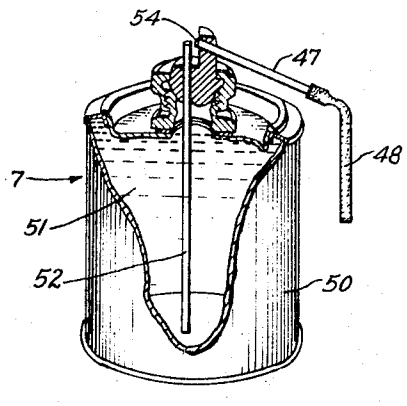


Fig. 6

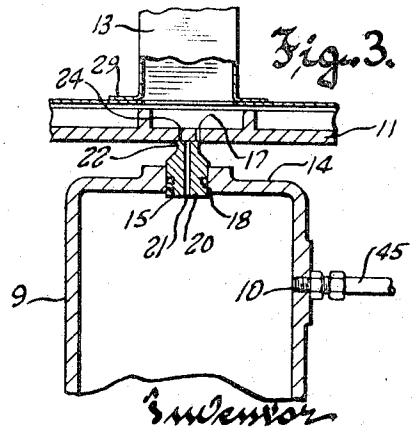


Fig. 3.

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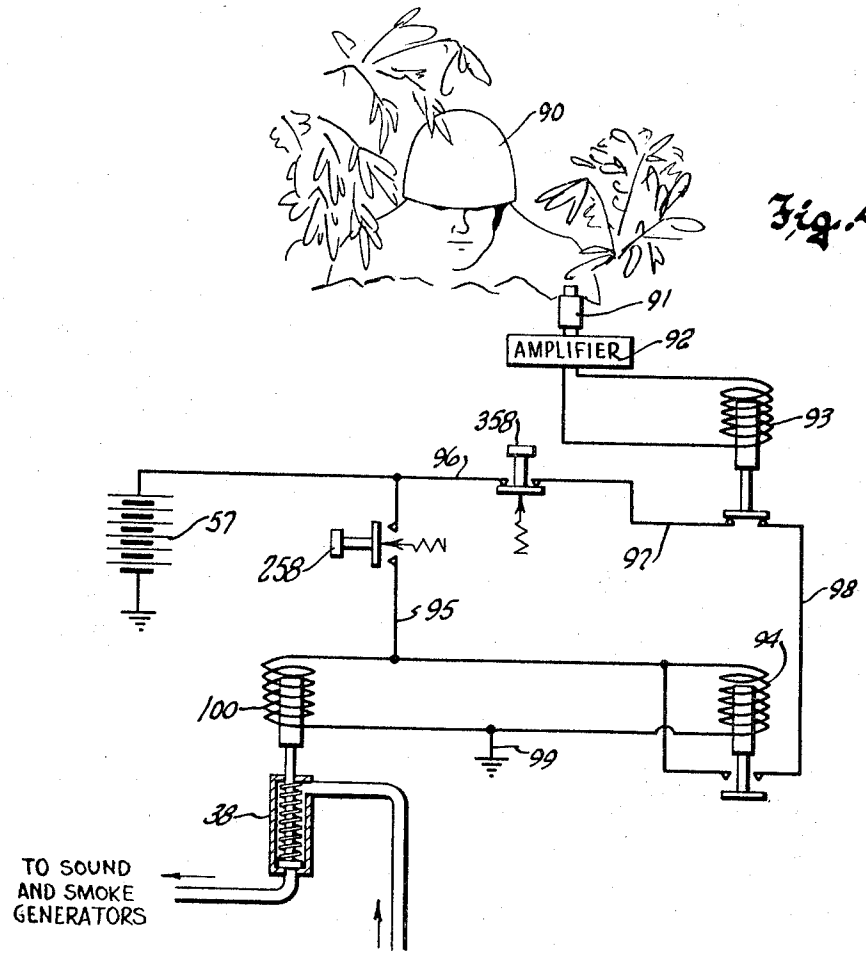


Fig. 4.

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WEAPON COUNTERFIRE SIMULATOR

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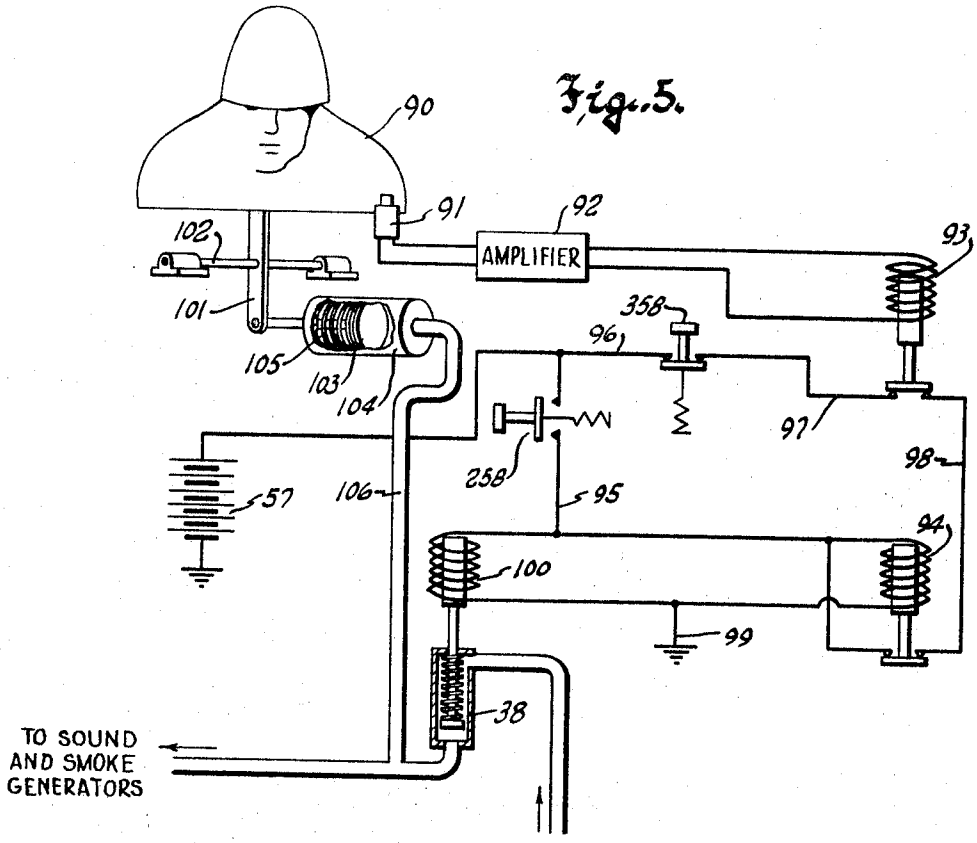


Fig. 5.

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3,423,848

WEAPON COUNTERFIRE SIMULATOR

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Original application Sept. 4, 1963, Ser. No. 306,578, now Patent No. 3,238,642, dated Mar. 8, 1966. Divided and this application June 9, 1965, Ser. No. 462,556
U.S. Cl. 35—25 4 Claims
Int. Cl. F41g 3/26

ABSTRACT OF THE DISCLOSURE

A source of pressure gas is connected, through an electromagnetically actuated valve, with a pneumatic sound generator that simulates counterfire from a target, a smoke generator that provides visual simulation of counterfire, and a pneumatic actuator for a target element. The valve responds to an impulse signal from an impact responsive transducer on the target element to cut off the supply of pressure gas to the sound and smoke generators, thereby terminating simulated counterfire, and simultaneously to depressurize the pneumatic target actuator so as to let the target element swing down under bias from an upright to a concealed position.

This invention relates to military training apparatus and refers more particularly to a device for simulating the firing of weapons against a trainee engaged in target practice.

This application is a division of my co-pending application Ser. No. 306,578, filed Sept. 4, 1963, now Patent No. 3,238,642.

In military gunnery practice and field exercises, it is often desirable to simulate the firing of weapons from a fictitious enemy position so as to increase the realism of the exercise and to accustom troops undergoing training to the sights and sounds of actual combat. The most realistic means heretofore available for simulating fire from an enemy was the firing of blank ammunition from the supposed enemy position or positions, but blank ammunition was costly, especially if it was used to a realistic extent with automatic weapons and large bore guns. The use of blank ammunition had another very important disadvantage in that it required that men be stationed at the weapons from which it was fired, and hence the troops undergoing training could not be permitted to fire live ammunition at the gun emplacements of the fictitious enemy.

With these considerations in mind, it is the principal object of the present invention to provide a simulator of weapons fire which can be suitably emplaced on terrain in which gunnery practice or field exercises are to take place, and which can be remotely controlled so that the simulator of this invention can comprise a target at which those undergoing training can fire with live ammunition without endangering other personnel.

It is also a specific object of this invention to provide a remotely controllable weapon fire simulator of the character described, which can be started in operation at the will of an operator who is stationed remotely from the device and which can be automatically "put out of action" in a realistic manner when a target associated with the simulator is struck by a missile, to thus provide a realistic means for scoring gunnery or target practice.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiments

of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate several complete examples of physical embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

FIGURE 1 is a perspective view of a simulator adapted for use with the apparatus of this invention and which is intended to imitate the firing of small bore automatic weapons;

FIGURE 2 is a fragmentary perspective view of a part of the simulator shown in FIGURE 1, portions being shown cut away to illustrate details of construction;

FIGURE 3 is a vertical sectional view taken on the plane of line 3—3 in FIGURE 2;

FIGURE 4 is a more or less diagrammatic view of an embodiment of a control apparatus of this invention adapted for cooperation with the simulator shown in FIGURES 1–3 whereby the same is rendered responsive to hits placed upon a target, the apparatus being shown in its inoperative condition; and

FIGURE 5 is a view similar to FIGURE 4 but showing a modified embodiment of the control means embodying a target, the apparatus being shown in its operative condition in which it causes the simulator to produce simulated firing; and

FIGURE 6 is a view partly in perspective and partly in section of the simulated smoke generator of the apparatus of this invention.

Referring now more particularly to the accompanying drawings, the apparatus of this invention generally comprises a sound generator **5**, which simulates the noise of weapon fire, a light bulb **6** which is employed to simulate the appearance of the flash from the muzzle of a weapon, a simulated smoke generator **7** which produces puffs of simulated smoke concurrently with the production of detonations and light flashes, and a pressure bottle or tank **8** containing compressed air, carbon dioxide or other gas under high pressure and which is connected with the sound generator **5** and the simulated smoke generator **7** through certain control elements described hereinafter.

The sound generator shown in FIGURES 1 and 2, which is intended to simulate the sound of firing of an automatic weapon, is that which is disclosed and claimed in my aforesaid copending application, and exemplifies the type of sound generator which can be incorporated in the apparatus of the present invention. In general, it comprises a pressure chamber **9** having an inlet **10** through which pressurized gas from the tank or bottle **8** is introduced, a rotatable disc **11** which controls the release of gas from the pressure chamber, a pneumatic motor **12** which rotates the disc, and a hopper or horn **13** into which pressure gas discharges from the chamber and which functions in the manner of a megaphone to concentrate and direct the sound in a desired direction.

Through one wall of the pressure chamber **9**, preferably its top wall **14**, there is a bore **15** which is spaced from the inlet **10** and which preferably extends parallel to the rotational axis of the disc **11** and is spaced therefrom. The disc has a large enough radius so that it overlies the bore **15**, and it has an opening **17** which is adapted to align with the bore in one rotational position of the disc. The underside of the disc is spaced a short distance above the top wall **14** of the pressure chamber, but except at times when the opening **17** in the disc is aligned with the bore **15**, a sealing element **18** cooperates with the disc and the top wall of the pressure chamber to prevent the escape of pressurized gas from the chamber.

In the embodiment of the simulator here illustrated, the sealing element **18** comprises a plunger **20** which is

slideable in the bore **15** with a close fit and which has an axial passage or hole **21** extending through it. Externally of the bore **15**, in the space between the top wall **14** of the chamber and the disc **11**, the plunger is somewhat enlarged in one lateral direction and reduced in the other lateral direction to provide an outlet nozzle **22** which has the shape of a long narrow rectangle as seen from the upper end of the plunger (compare FIGURES 2 and 3). In the outlet nozzle **22** the passage **21** through the plunger diverges upwardly in the first mentioned lateral direction so that at the upper end of the plunger the mouth of the passage has a shape and size that closely conform to those of the opening **17** in the disc. The rim of the outlet nozzle **22** (i.e., the upper end of the plunger) provides a coplanar sealing surface **24** all around the mouth of the passage **21** through the plunger, which sealing surface can engage the underside of the disc **11**.

The nozzle portion of the plunger is so designed as to have a cross sectional area somewhat smaller than that of the bottom end of the plunger; hence pressurized gas exerts a net upward biasing force upon the plunger to normally maintain its top surface **24** sealingly engaged with the disc. It will be apparent that the value of this biasing force for a given gas pressure in the pressure chamber can be predetermined by selection of the proper relationship of the respective cross sectional areas of the bottom end of the plunger and of its upper nozzle portion, so that the plunger causes minimal friction against the disc to impede rotation thereof but at the same time makes a good seal with the disc.

The horn **13** is mounted, as by means of a suitable bracket **29**, with its inner end substantially aligned with the bore **15**. Hence when the disc **11** is rotated to the position in which the opening **17** therein aligns with the hole or passage **21** in the sealing element, pressurized gas from the pressure chamber can abruptly escape into the horn, producing a loud report which closely simulates the sound of a weapon being fired.

The light bulb **6** is also mounted in the structure that comprises the pressure chamber, beneath the rotatable disc, spaced from the bore **15**, and at a different radial distance from the disc axis than the opening **17** in the disc. Hence the disc can be provided with another opening **30**, so located as to align with the light bulb at the same time that the opening **17** comes into alignment with the opening **21** in the sealing element, thus briefly uncovering the light to produce a simulated muzzle flash concurrently with production of a detonation. A suitable reflector **31**, preferably mounted on the horn, projects the flash from the light bulb in an appropriate direction.

The disc **11** is mounted on an upright shaft **32** that is carried in suitable bearings in the structure that defines the pressure chamber, and the pneumatic motor **12** can be mounted, as by means of a bracket **33**, to have its shaft **34** at right angles to the disc shaft **32** and connected thereto by bevel gearing **35**.

Pressurized gas can be conducted from the bottle **8** to the pressure chamber **9** and to the pneumatic motor **12** by way of a manually controllable valve **36** and a distributor valve **37**, the latter being under the control of a solenoid valve **38** (see FIGURE 1). The bottle, which can have the manual valve **36** at its outlet, is connected with the distributor valve **37** by means of a duct **39** in which there can be connections for pressure gages **40**. The solenoid valves **38** is connected with the distributor valve by means of ducts **41** and **42**.

When the solenoid valve effects opening of the distributor valve, the latter permits flow of pressurized gas from the duct **39** to a manifold or T **43**, by way of a duct **44**; and from the tee such gas flows to the inlet **10** of the pressure chamber **9** by way of a duct **45**, and also to the pneumatic motor **12** by way of a duct **46**, and to the inlet **47** of the simulated smoke generator **7** by way of a duct **48**. A manually adjustable throttling valve **49** in the duct **46** provides for regulation of the speed of the motor **12** and thus enables adjustment of the frequency of simulated firing.

The simulated smoke generator **7** comprises, as best seen in FIGURE 6, a container **50** in which there is a store of air dispersable material such as fine powder or suitably colored liquid. A delivery tube **52** extends downward in the container, nearly to its bottom, and projects above the top of the container to cooperate with an eduction nozzle **54** which discharges obliquely across the top of the delivery tube and which has its inlet **47** connected with the pressure gas duct **48**, as mentioned above. Thus material is expelled from the container and atomized so long as the solenoid valve **38** is energized to permit pressure gas to flow to the simulated smoke generator. Preferably the eduction nozzle **54** and the outlet of the delivery tube **52** are so positioned relative to the light beams from the reflector **31** that the simulated smoke is illuminated by the flashes of reflected light.

It will be apparent that the "firing" of the simulator can be manually controlled by means of a control switch **58** located remotely from the simulator, so that an operator of the device is not endangered by bullets fired at it, but under these circumstances it would be difficult for the operator to judge the accuracy of fire aimed at the simulator. The invention therefore contemplates automatic means for interrupting or discontinuing operation of the device when a hit is made on a target associated with it.

FIGURE 4 illustrates such a control device, comprising a target board **90**, which is preferably cut out to an outline of some suitably realistic shape and which is easily camouflaged or partly camouflaged so as to make it difficult to see. The target board is mounted in an upright position, close to the location of the simulator to be controlled, and to it is attached a transducer **91** of known type which generates an electrical impulse signal in response to the impact of a missile upon the target board.

Signals from the transducer **91**, as amplified by an amplifier **92**, are fed to a normally closed relay **93** in an energizing circuit for the solenoid valve **38**. The energizing circuit also includes a battery **57** or some other suitable power source, a holding relay **94**, and a normally closed manually operable switch **358**. When simulated firing is to be produced by the device, the operator briefly closes a manually operable normally open momentary contact switch **258** to energize the holding relay **94** through a shunt circuit comprising a conductor **95** which connects the coil of the holding relay with said switch **258**, and through it with the battery. The switch **258** can be released after a brief closure because the holding relay **94** thereafter maintains itself energized through a circuit that includes, in series, the battery **57**, a conductor **96**, the normally closed switch **358**, another conductor **97**, the contacts of the normally closed relay **93**, a third conductor **98**, the contacts of the holding relay, and a ground connection **99**. The winding **100** of the solenoid valve is connected in parallel with the coil of the holding relay **94** hence the solenoid valve is energized at all times that the holding relay is closed, and simulated firing therefore takes place at such times. If the operator for any reason wishes to discontinue simulated firing, he momentarily opens the normally closed switch **358**, thus breaking the energizing circuit to the holding relay **94** and the solenoid valve, and simulated firing will not recommence until he again closes the normally open switch **258**.

If the target board is struck by a missile while the holding relay **94** and solenoid valve **38** are energized, the amplified signal from the transducer **91** which is produced in consequence of a hit upon the target board **90** energizes the normally closed relay **93**, which has its winding connected across the output of amplifier **92**, and thus interrupts the energizing circuit to the holding relay **94** and the solenoid valve winding **100**, terminating simulated firing immediately. The operator can thereafter

cause simulated firing to be resumed by momentarily closing the switch **258**.

The modified embodiment of the control apparatus illustrated in FIGURE 5 again comprises a target board **90** of suitable shape, which in this case, however, is mounted for tilting motion to and from an upright position, and which is adapted to swing down, parallel to the ground, when struck by a missile fired at it, so as to substantially disappear when hit. The target board is carried for such swinging motion on the upper end of a lever **101** that is medially fulcrumed on a fixed horizontal pivot support **102**. At its lower end the lever **101** is pivotally connected to a piston **103** which is slideable in a pneumatic cylinder **104**, and a compression spring **105** in the cylinder acts upon the piston to bias it in the direction to swing the target board to its lowered position. Pressurized gas, brought to the cylinder **104** by way of a duct **106** controlled by the solenoid valve **38**, moves the piston **103** against the bias of its spring **105**, thus causing the target board to be swung to its upright position. Hence the target board remains upright as long as the simulator is in operation.

The control circuit for the FIGURE 5 apparatus is essentially identical with that described above, and includes a transducer **91** secured to the target board and which emits an electrical impulse when the target board is struck. When energization of the solenoid valve **38** ceases, either as a consequence of a hit signal from transducer **91** or as a result of opening of the normally closed switch **358**, the flow of pressurized gas to the simulator and to cylinder **104** is of course cut off, and spring **105** acts to swing the target board down to its horizontal position simultaneously with termination of simulated firing by the simulator.

From the foregoing description taken together with the accompanying drawings it will be apparent that this invention provides a very realistic simulator of weapons counterfire which is well adapted to be remotely controlled and has special value for training purposes because it can be automatically "put out of action" by a hit scored on a target board associated with it.

What is claimed as my invention is:

1. In military training apparatus of the type comprising a target element having an impact responsive transducer operatively associated therewith for producing an electrical impulse signal in response to striking of the target element by a shot fired thereat:

(A) means providing a source of gas under pressure;

(B) a sound generator locatable near the target element and connectable with said gas source means for producing intermittent abrupt release of pressurized gas to simulate the sound of weapon counterfire;

(C) means comprising an electromagnetically actuated valve for establishing and disrupting communication between the sound generator and said gas source means;

(D) means providing an energizing circuit for said electromagnetic valve that is disruptable by an electrical impulse signal; and

(E) means so connecting the impact responsive transducer with said energizing circuit as to cause the electromagnetically actuated valve to disrupt communication between the gas source means and the sound generator in response to an electrical impulse signal from the transducer.

2. The military training apparatus of claim **1**, further characterized by:

(A) a container for air dispersable material having an inlet for gas under pressure and having an outlet through which such material can be expelled from the container entrained in gas under pressure; and

(B) means connecting the container inlet with said source of gas under pressure under the control of said electromagnetically actuated valve, so that material is expelled from the container into the air at times when the electromagnetically actuated valve is energized, to simulate the production of smoke concurrently with simulation of the sound of counterfire.

3. The military training apparatus of claim **1** further characterized by:

(A) means mounting the target element for movement between a visible position and a substantially concealed position;

(B) means biasing the target element towards its concealed position;

(C) gas pressure operated means for releasably holding the target element in its visible position against its bias; and

(D) means connecting said gas pressure operated means with said source of gas under pressure under the control of the electromagnetically actuated valve, so that the target element is caused to remain in its visible position whenever the electromagnetically actuated valve is energized and moves under bias to its concealed position in reponse to an impulse signal from the transducer.

4. In military training apparatus of the character described:

(A) means providing a source of gas under pressure;

(B) a sound generator connectable with said gas source means for producing intermittent abrupt release of pressurized gas to simulate the sound of weapon fire;

(C) means comprising an electromagnetically actuated valve for establishing and disrupting communication between the sound generator and said gas source means;

(D) an energizing circuit for said electromagnetic valve comprising the contacts of a normally closed relay;

(E) a target element mounted for motion between a substantially visible position and a substantially invisible position;

(F) an impact responsive transducer operatively associated with the target element for producing an electrical impulse signal in response to striking of the target element by a shot fired thereat;

(G) means so connecting the transducer with said energizing circuit for the electromagnetic valve as to effect disruption of communication between the gas source means and the sound generator in response to an electrical impulse signal from the transducer; and

(H) actuating means for the target element, operatively connected with said electromagnetc valve, for maintaining the target element in its visible position when the gas source is in communication with the sound generator and for moving the target element to its invisible position when such communication is disrupted, so that the target element moves to its invisible position substantially simultaneously with cessation of sound generation upon striking of the target element.

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U.S. Cl. X.R.

273—102.2