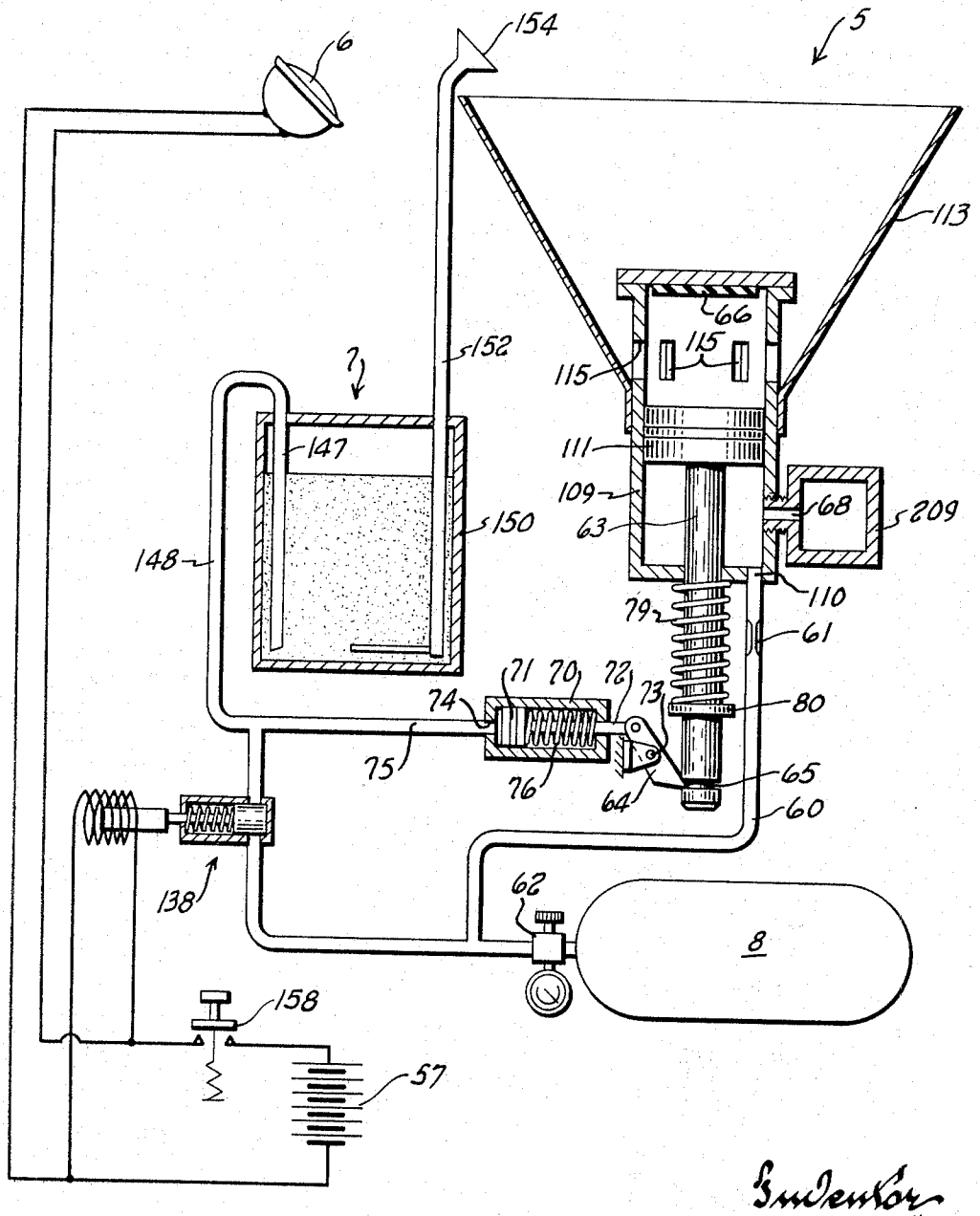
Aug. 8, 1967 J. A. I. ÖHLUND 3,334,425

WEAPON FIRE SIMULATOR

Filed July 8, 1965 2 Sheets-Sheet 1

Fig. 1.



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Aug. 8, 1967 J. A. I. ÖHLUND 3,334,425

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Filed July 8, 1965 2 Sheets-Sheet 2

Fig. 2.

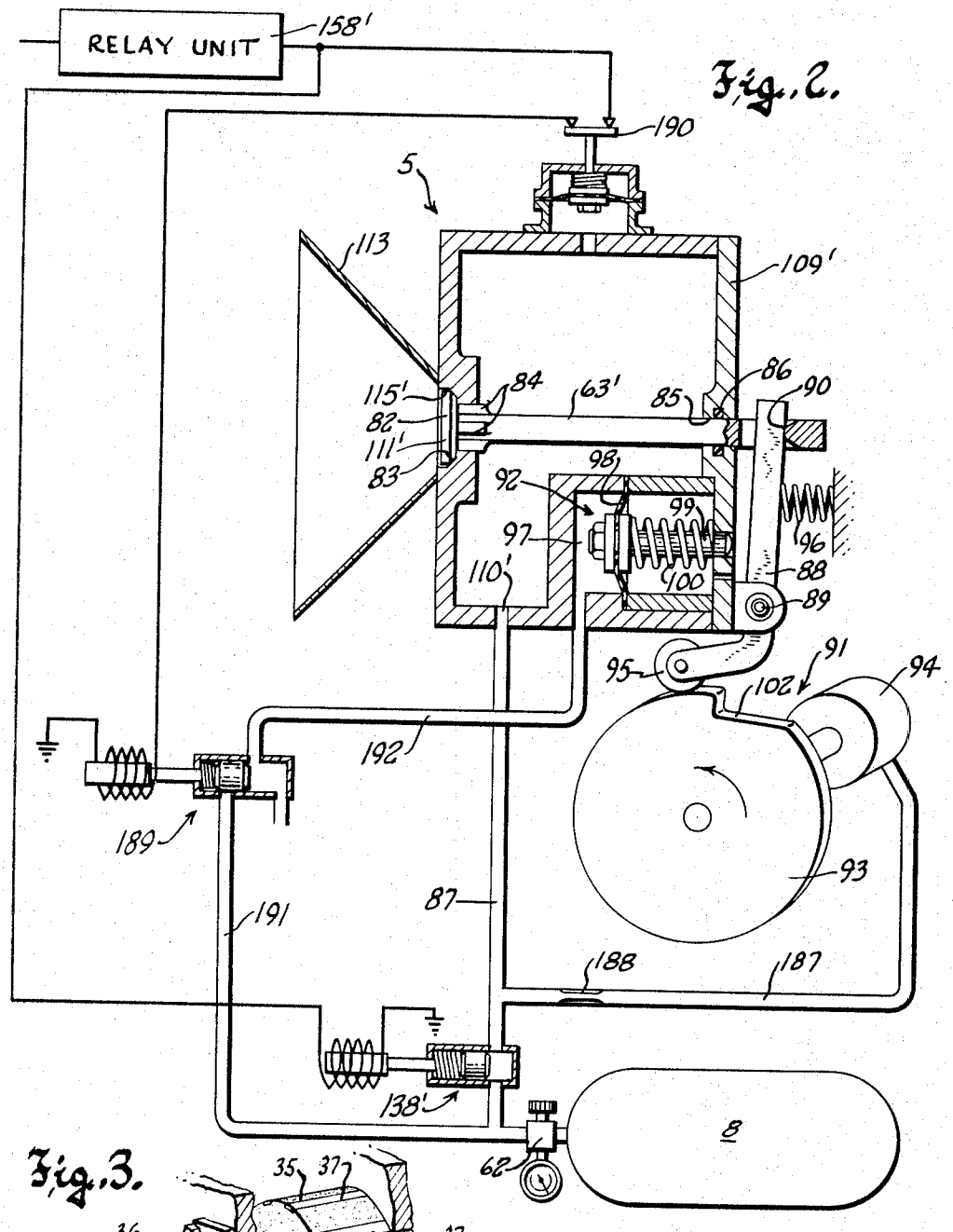
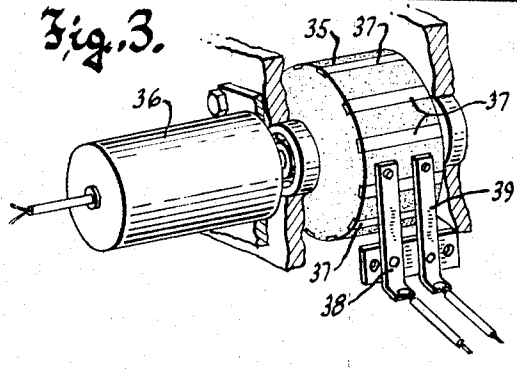


Fig. 3.



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United States Patent Office 3,334,425
Patented Aug. 8, 1967

3,334,425

WEAPON FIRE SIMULATOR

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Filed July 8, 1965, Ser. No. 470,470
11 Claims. (Cl. 35—25)

This application is a continuation-in-part of my copending application, Ser. No. 306,578, filed Sept. 4, 1964, now Patent No. 3,238,642.

This invention relates to military training apparatus and refers more particularly to a device for simulating the firing of weapons.

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.

Another object of the present invention is to provide a simulator of the character described which produces not only a sound closely imitative of that of actual firing of a weapon, but which also simultaneously produces a flash and a puff of smoke closely imitative in appearance of actual weapon fire.

Another and more specific object of this invention is to provide a simulator of the character described wherein a sound imitative of weapons fire is produced when pressurized gas from a pressure chamber, delivered thereto from a bottle or tank of compressed gas, is abruptly released through an outlet in the pressure chamber that is controlled by a movable element, and wherein actuation of the movable element can be controlled by an operator who may be stationed remotely from the device.

It is also a specific object of this invention to provide a remotely controllable weapon fire simulator of the character described having a pressure chamber communicable with a source of pressurized gas and an element in the pressure chamber which is movable under the force of pressure gas in the chamber from a position blocking an outlet in the chamber to a position opening said outlet, said element being releasable from a remote location and by its rapid gas propelled motion when released providing for abrupt expulsion of pressure gas from the chamber through said outlet with a noise simulating the firing of a weapon.

Another specific object of this invention is to provide a weapon fire simulator of the type comprising a pressure gas chamber having an outlet which is controlled by a valve element that normally blocks flow of pressure gas out of the outlet, wherein the valve element is responsive to the pressure of gas in the chamber to be moved thereby

from its normal to its open position, so that the valve element can be controlled by a simple latch device which releasably holds it in its normal position, and so that the normal position of the valve element can be such that the valve element is already in motion toward its open position when it first begins to clear the outlet, thereby providing for such rapid opening of the outlet as produces an abrupt outrush of gas from the pressure chamber whereby the sound of weapon fire is very realistically simulated.

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 more or less diagrammatic view of an embodiment of the weapons fire simulator of this invention particularly intended for simulating the firing of large bore weapons;

FIGURE 2 is a more or less diagrammatic view of another embodiment of the weapons fire simulator of this invention; and

FIGURE 3 is a perspective view of a control device intended to effect intermittent simulated firing of a device 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 comprises a pressure chamber 109 having an inlet 110 through which pressurized gas from the tank or bottle 8 is introduced, a valve element 111 which controls the release of gas from an outlet 115 in the pressure chamber, and a hopper or horn 113 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.

In the embodiment of the invention illustrated in FIGURE 1, which is particularly intended to simulate the firing of large bore weapons, the pressure chamber 109 comprises a cylinder having a pressure gas inlet 110 at one end thereof and the outlet ports 115 in its side wall, near its other end. The inlet 110 is communicated with the bottle 8 of compressed gas by means of a duct 60 having a suitable throttling restriction 61. The outlet of the bottle, to which the duct 60 connects, can be provided with a manually operable valve 62.

The valve element 111 comprises a piston having a coaxial rod 63 that projects from the inlet end of the cylinder 109 and which is slideable in the cylinder to and from a normal position intermediate the ends of the cylinder, in which position the piston blocks communication between the inlet 110 and the outlet ports 115. The piston is held in this position by means of a releasable latch 64 that is engaged in a groove or notch 65 in the rod, so that pressure can gradually build up behind the piston as gas

flows from the bottle 8 to the cylinder through the throttling restriction 61.

When a simulated firing is to take place, the latch 64 is disengaged from the piston rod 63, and under the biasing force of pressurized gas in the inlet end of the chamber the piston 111 abruptly slides to the other end of the cylinder, uncovering the outlet ports 115 as it does so and permitting the pressurized gas to escape through them into the more or less conical horn or hopper 113 which surrounds the outlet end of the cylinder. It will be seen that the latch 64 normally holds the piston spaced some distance from the outlet ports 115, so that upon release of the latch the piston is substantially accelerated before it begins to uncover those ports and therefore it fully opens them very rapidly, thus insuring an abrupt outrush of gas from the cylinder 109 by which the firing of a weapon is very realistically simulated. A disc 66 of rubber or the like at the outlet end of the cylinder serves as a bumper or snubber to damp the impact of the piston against the cylinder end wall, and it will be observed that the outlet ports 115 are spaced from the outlet end of the cylinder by a distance at least equal to the axial length of the piston so that the outlets will be cleared by the piston when the latter engages the bumper.

If desired, a supplementary gas chamber 209 can be attached to the cylinder 109, communicated with its interior through an opening 68 near its inlet end. The supplementary container can be readily replaceably threaded into the cylinder wall to permit different sized supplementary containers to be fitted, for varying the pressure gas volume of the pressure chamber 109 and thus adjusting its sound output.

The latch 64 is swung to and from its piston rod engaging position by means of a pneumatic latch actuator comprising a cylinder 70 in which a piston 71 is slideable. A coaxial rod 72 on the latch actuator piston 71 projects through one end of its cylinder 70 and is pivotally connected at its free end with one end of the latch 64, which comprises a lever that is medially fulcrumed about a fixed pivot 73. An inlet 74 to the latch actuator cylinder 70 is near the end thereof that is opposite the piston rod, and is communicated with the pressure bottle 8 by means of a duct 75 controlled by a solenoid valve 138. A spring 76, which surrounds the piston rod 72 inside the cylinder 70 and reacts between the piston 71 and the rod end of the cylinder, biases the piston toward the inlet end of the cylinder and hence toward a position in which the latch 64 is engaged in the notch or groove 65. When the solenoid valve 138 is opened to admit pressurized gas to the latch actuator cylinder 70, such gas moves the piston 71 against the bias of its spring 76 to release the latch, in turn allowing the pressure chamber piston 111 to move toward the outlet end of its cylinder 109 in response to the pressure of gas therein, as described above.

After all pressurized gas is released from the pressure chamber 109, the piston 111 is automatically returned to its normal or latched position by means of a compression spring 79 that surrounds the piston rod 63 and reacts between the adjacent end of the pressure chamber and a flange or washer 80 fixed on the rod. The latch 64, which acts like a pawl, automatically reengages when the piston 111 returns to its normal position, thus readying the apparatus for another detonation as soon as gas pressure in the chamber 109 reaches a high enough value.

The solenoid valve 138 can be manually controlled by a normally open momentary contact switch 158, connected in series with the solenoid valve and a battery 57. Since the switch 158 is intended to be closed only briefly when the simulator is "fired," it can also control the energizing circuit for the light 6, so that the light flashes concurrently with each energization of the solenoid valve and hence with each detonation.

It is to be noted that the solenoid valve 138 does not control flow of gas to the pressure chamber 109. Instead, gas flows to said chamber continuously, through the throttling restriction 61, so long as the manually controllable valve 62 is open. However the solenoid valve does control flow of pressure gas to the simulated smoke generator 7, which comprises a container 150 for powdered material, having an inlet tube 147 extending downwardly thereinto and terminating near its bottom and having an outlet tube 152 extending upwardly from near its bottom and terminating in a nozzle 154 spaced above the top of the container. The inlet tube 147 is connected with a pressure gas duct 148 which branches from the duct 75 that connects the solenoid valve 138 with the latch actuator, and hence pressure gas flows into the container whenever the solenoid valve is opened, driving powdered material upwardly in the outlet tube 152 and expelling it through the nozzle 154 as a simulated puff of smoke.

If desired, the simulator shown in FIGURE 1 can be automatically caused to "fire" repeatedly, at intervals, by means of the apparatus illustrated in FIGURE 3, which comprises a drum 35 of insulating material, driven for rotation about its axis by means of an electric motor 36. A series of axially extending conductor strips 37 is arranged at circumferentially spaced intervals on the cylindrical surface of the drum, to be engaged by a pair of brushes 38 and 39. Whenever the drum rotates to a position in which the two brushes are simultaneously engaged with a strip 37, a circuit is completed through the brushes, and hence the apparatus just described can be connected into the electrical circuit of the simulator of FIGURE 1 in place of switch 158, the circuit connections being made to the brush terminals instead of to the switch terminals. A suitable switch controlled energizing circuit for the motor 36 will of course be provided, or the drum 35 can be driven by an air motor connected to the bottle 8 and controlled by a suitable valve.

The embodiment of the invention illustrated in FIGURE 2 is particularly well suited for simulating the sound of automatic weapons fire, and is thus well adapted for use as a weapons counterfire simulator for target practice in conjunction with the apparatus disclosed and claimed in my copending application Ser. No. 462,556, filed June 9, 1965, and also disclosed in the parent of that and the present application, the above mentioned Serial No. 306,578, now Patent No. 3,238,642.

The apparatus illustrated in FIGURE 2 again comprises a pressure chamber 109' having an outlet port 115' controlled by a pressure responsive valve element 111' and an inlet port 110' communicated with a pressure gas source 8. In this case the pressure gas chamber 109' can be of any suitable shape, and its inlet and outlet ports can be at any suitable locations so long as they are spaced from one another.

The pressure responsive valve element 111' is in the form of a poppet valve having an elongated rearwardly extending stem 63'. It is axially movable to and from a normal position in which its head 82 blocks the outlet port 115', the mouth of that port being formed as a valve seat 83 cooperable with the head.

Directly behind its head 82 the valve element has a plurality of circumferentially spaced apart axially extending lands 84 which cooperate with the outlet port to afford sliding guidance to the valve element while permitting substantially unrestricted flow of pressure gas out of the pressure chamber through said port at times when the valve element is in its open position. These lands also enable pressure gas in the chamber 109' to exert force upon the rear surface of the valve element head, by which the valve element is urged away from its seat. The rear end portion of the stem 63' of the valve element projects out of the pressure chamber through a bore 85 therein that is opposite the outlet port 115', coaxially aligned therewith, and smaller in diameter than the outlet port. The projecting rear end portion of the stem, as explained hereinafter, provides for connection of the valve element with latch means by which the valve element is normally maintained in its closed position and by which it can be

abruptly released for pressure gas propelled travel to its open position. An O-ring **86** or the like provides a gas-tight seal around the stem **63'** where it passes through the wall of the pressure chamber.

If desired, the mouth of the outlet port **115'** in the pressure chamber can be formed, as shown, as a counterbore extending a distance outwardly from the seat **83** and of such diameter that the head **82** of the valve element has a close sliding fit in it, so that said port is not opened until the valve element has moved some distance off of its seat and is out of said counterbore. In that event, engagement of the head **82** of the valve element against the seat **83** will merely seal the chamber, and actual opening of the chamber outlet port will only occur after the valve head comes out of said counterbore. The valve element, when released, will then be accelerated along the counterbore so that it opens the outlet port very rapidly to permit the desired abrupt outrush of pressure gas therefrom.

When the apparatus is in operation, pressurized gas is constantly charged into the pressure chamber **109'** from the pressure source or tank **8** by way of a duct **87** which communicates the tank with the chamber. A manually adjustable valve **62** provides for control of the rate of pressure gas flow out of the tank, and a solenoid operated on-off valve **138'** in the duct **87** provides for starting and stopping operation of the device.

The latch means by which the valve element **111'** is normally held in its closed position comprises, in this case, a cam mechanism **91** and a pneumatic actuator **92**, both of which cooperate with a lever **88** which is medially fulcrumed upon a fixed pivot **89** and which has one of its arms engaged against an abutment **90** on the projecting rear end portion of the valve element stem, defined by a transverse slot therethrough.

Simulating the sound of automatic weapons fire requires that the valve element **111'** be released at regular intervals, and the timing of such release of the valve element is provided for by the cam mechanism **91**, which comprises a cam **93**, a pressure gas motor **94** that rotatably drives the cam, and a cam follower roller **95** on the lever **88**, spaced from the pivot **89** and maintained in following relation to the periphery of the cam by means of a spring **96** that reacts between the lever and fixed structure on the simulator.

Promptly after each simulated detonation, the valve element **111'** must be returned to and held in its seated position so that the chamber **109'** can be fully pressurized in time for the next release of the valve element by the cam mechanism; and the function of thus closing the valve element is performed by the pneumatic actuator **92**, which comprises, in general, a small pressure chamber **97**, a diaphragm **98** which provides one wall of said pressure chamber, a plunger **99** coaxially secured to the diaphragm to be moved in one axial direction thereby, and a return spring **100** by which the plunger is biased in the opposite direction.

At its end remote from the diaphragm the plunger **99** abuts against the lever **88** at one side of the pivot **89**, to provide a connection, through the lever, between the pneumatic actuator and the valve element whereby the force of gas pressure upon the diaphragm **98** is effective to urge the valve element to its closed position. When gas pressure is relieved in the small chamber **97**, only the cam mechanism is effective to maintain the valve element in its closed position.

Around most of its circumference the cam **93** has a uniform radius, but it has one or more smaller radius steps **102** onto which the cam follower **95** moves very abruptly as the cam rotates. When the cam follower is on the uniform radius portion of the cam periphery, it acts, through the lever **88**, to hold the valve element **111'** in its closed position, but when the cam follower moves onto the step **102** it frees the lever to swing with forward motion of the valve element, thus releasing the valve element for rapid motion to its open position under the force of pressure gas in the chamber **109'**.

The pneumatic motor **94** by which the cam is rotatably driven is communicated with the pressure gas tank **8** by way of a duct **187** which branches from the duct **87** and which includes a throttling restrictor **188**; hence pressure gas constantly flows to the motor **94** as well as to the pressure chamber **109'** when the apparatus is in operation. The solenoid actuated on-off valve **138'**, which controls flow of pressure gas into the branching ducts **87** and **187**, is connected with a relay unit **158'** or similar switching mechanism by which the solenoid valve can be energized to its open position when the apparatus is to operate and de-energized and closed when simulated firing is to cease.

Flow of pressure gas to and from the small pressure chamber **97** of the pneumatic actuator is controlled by a two-position solenoid valve **189**, which is connected with the output circuit of the relay unit through a normally open diaphragm actuated switch **190** that closes when pressure in the main pressure chamber **109'** reaches a predetermined value. In the unenergized condition of the two-position solenoid valve, it provides for communication between the pressure gas tank **8** and the small pressure chamber **97**, by way of a duct **191** which communicates the tank with said solenoid valve and another duct **192** which communicates said solenoid valve with the small pressure chamber. Such pressurization of the small pressure chamber **97**, as above explained, causes the valve element **111'** to be moved to and held in its closed position, and thus allows the main pressure chamber **109'** to be charged with pressure gas immediately after a "firing" and even before the cam **93** can reach an angular position at which it is effective to held the valve element closed. However, by the time pressure in the main pressure chamber reaches the value at which it actuates the normally open pressure responsive switch **190**, the cam will have arrived at a position at which it is effective to hold the valve element closed, and the pressure responsive actuator can be rendered ineffective for that purpose so that the valve element can be released by the cam at the proper time. Hence when the pressure responsive switch closes and thereby energizes the two-position solenoid valve **189**, the latter assumes a position at which it blocks the duct **191** and vents the small pressure chamber to atmosphere, all as illustrated in FIGURE 2. When the step **102** of the cam **93** subsequently comes into alignment with the cam follower **95**, the valve element is of course released for rapid pressure gas propelled motion to its open position, producing the sound of firing a round of ammunition.

As soon as gas pressure in the main pressure chamber **109'** drops below the above mentioned predetermined value, the pressure responsive switch **190** opens, shifting the two-position solenoid valve **189** back to its position for charging pressure gas into the small pressure chamber **97**, to begin a repetition of the cycle. In the event pressure in the chamber **109'** should be below the value required for a satisfactory simulated detonation at a time when the cam follower **95** moves onto the step **102** on the cam **93**, as might happen if pressure in the tank **8** is low, the pneumatic actuator **92** will prevent the valve element **111'** from moving to its open position, permitting the cam **93** to make another revolution while the pressure chamber is charged.

From the foregoing description taken together with the accompanying drawings it will be apparent that this invention provides a very realistic remotely controllable simulator of weapons fire which is capable of reproducing the sound detonations of almost any type of recoil weapon and which also provides a realistic imitation of the appearance of a weapon being fired by producing a simulated muzzle flash and puff of smoke concurrently with the sound.

What is claimed as my invention is:

1. Apparatus for simulating weapon fire comprising:
(A) means providing a source of gas under pressure;
(B) means defining a pressure chamber having
(1) an inlet communicable with the source of gas under pressure and
(2) an outlet spaced from the inlet and through which gas under pressure can rapidly escape from the pressure chamber;
(C) a valve element movable in the chamber from a normal position blocking the outlet to an open position permitting gas to escape from the chamber through the outlet, said valve element having a pressure surface exposed to the portion of the chamber to which the inlet opens and which faces in the direction opposite to that in which the valve element moves from its normal to its open position, said surface thus rendering the valve element at all times responsive to pressure of gas in said portion of the chamber to be urged thereby towards its open position;
(D) latch means releasably engageable with a part on the valve element to hold the same in its closed position; and
(E) an actuator for said latch means by which the same can be disengaged from said part on the valve element to release the valve element for rapid gas propelled motion from its normal position to its open position.

2. The apparatus of claim 1 wherein said latch means comprises:
(A) a cylinder having an inlet communicable with the source of gas under pressure;
(B) a pressure responsive element in the cylinder movable in opposite directions to and from a latching position and responsive to the pressure of gas in the cylinder to be moved in one of said directions thereby;
(C) a spring biasing the pressure responsive element in the opposite direction of its motion; and
(D) a member connected with the pressure responsive element and engageable with said part on the valve element when the pressure responsive element is in its latching position to restrain the valve element against motion out of its normal position.

3. Apparatus for simulating weapon fire comprising:
(A) a cylinder having
(1) a pressure gas inlet near one end thereof and
(2) an outlet in its side wall, near to but spaced from its other end;
(B) a piston slideable in the cylinder between a normal position intermediate the ends of the cylinder, blocking communication between the inlet and outlet, and a gas releasing position adjacent said other end of the cylinder and clear of the outlet;
(C) means for charging gas under pressure into the inlet at a slow rate; and
(D) means for releasably holding the piston in its normal position, against the biasing force exerted upon it by pressure gas in the cylinder, so that upon release of the piston it can move rapidly to its gas releasing position in response to such bias and permit abrupt escape of gas from the cylinder through the outlet.

4. The apparatus of claim 3, wherein said means for releasably holding the piston in its normal position comprises:
(A) a coaxial rod on the piston projecting to the exterior of the cylinder through the first designated end thereof, said rod having an abutment thereon;
(B) a latch movable to and from a position of engagement against said abutment; and
(C) a controllable actuator for moving said latch away from its said position when a detonation simulating firing of a weapon is to be produced.

5. The apparatus of claim 4, further characterized by: spring means biasing the piston toward the first designated end of the cylinder, whereby the piston is automatically returned to its normal position after each simulated detonation.

6. The apparatus of claim 5 wherein said latch actuator comprises a pneumatic cylinder having a pressure gas inlet, further characterized by:
(A) a solenoid valve connected between a source of gas under pressure and the inlet of said pneumatic cylinder; and
(B) means comprising a normally open momentary contact switch providing an electrical energizing circuit for the solenoid valve.

7. The apparatus of claim 6, further characterized by:
(A) a simulated smoke generator comprising
(1) a container for air dispersable material, and
(2) means for entraining material from said container in pressurized gas to effect expulsion of such material from the container in simulated smoke puffs;
(B) means connecting said material entraining means with the solenoid valve, so that a simulated smoke puff is produced substantially concurrently with each detonation; and
(C) an electric light bulb connected in said energizing circuit to be lighted concurrently with each energization of the solenoid valve, thus producing a simulated muzzle flash.

8. A weapons fire simulator of the type comprising a pressure chamber having an inlet and an outlet, means for connecting said inlet with a source of gas under pressure, and means for alternately closing said outlet, to permit pressure gas to be charged into the pressure chamber, and abruptly opening said outlet to permit rapid escape of pressure gas therethrough for production of a sound simulating the firing of a round from a weapon, wherein said last named means comprises:
(A) A pressure responsive valve element movable in opposite directions toward and from a position blocking the outlet in the pressure chamber and which has a surface that faces into the chamber and in the direction of valve element movement toward said position, said surface rendering the valve element responsive to the pressure of gas in the chamber to be at all times biased away from said position thereby;
(B) latch means engageable with a part connected with the valve element for releasably holding the valve element in its said position; and
(C) an actuator for said latch means by which the same can be released from said part.

9. The weapons fire simulator of claim 8 wherein said latch means comprises:
(A) a rotatable cam having an abrupt step therein;
(B) a lever having an arm which is swingable in opposite directions and which has a motion transmitting connection with said part on the valve element; and
(C) a cam follower on said lever which is maintained in engagement with the cam.

10. The weapons fire simulator of claim 8 wherein:
(A) said latch means comprises a pair of interengageable parts, one of which is connected with the valve element for motion therewith and the other of which is movable relative to the first to and from a defined position of engagement with said first mentioned part at which said other part confines the first mentioned part against motion; and
(B) said actuator for the latch means comprises
(1) a second pressure chamber and
(2) a pressure responsive element which defines a wall of said second pressure chamber and which is movable in opposite directions and is urged in one of said directions by the pressure

of gas in said chamber, said pressure responsive element being connected with said other part to move the same to and from its said position; and

(3) spring means biasing the pressure responsive element in the opposite direction of its motion.

11. The apparatus of claim **1**, further characterized by: said outlet, the valve element and the latch means being so arranged that the valve element, upon release of the latch means, must move a distance from its normal position before beginning to open the outlet, to insure that the valve has rapid motion to its open

position by which it provides for abrupt outrush of gas from the pressure chamber.

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