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Lynn

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[54] **FIRE CONTROL MECHANISM FOR FIREARMS**

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[52] **U.S. Cl.** ..... **42/84,** 33/241, 102/19.2, 102/38, 102/70.2 R

[51] **Int. Cl.** **F41c 19/12,** F42b 5/08, F42c 11/00

[58] **Field of Search** ..... 42/84; 89/1 R; 102/8, 19.2, 102/38, 70.2 R

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Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—C. T. Jordan
Attorney, Agent, or Firm—Christie, Parker & Hale

[57] **ABSTRACT**

A fire control mechanism for firearms having projectiles loaded in superimposed relation includes a separate arming device associated with each projectile. Each arming device is responsive to changes in gas pressure, heat buildup, or the like, generated when the projectile immediately ahead of it is fired to thereby automatically arm the primer of the next projectile in the firing order. The armed primer is then in a condition capable of being activated by the firearm triggering mechanism to fire its corresponding projectile. In one embodiment, each arming device and primer are integral with the projectile. In another embodiment, each arming device and primer combination is incorporated into a separate wafer, and the wafers are disposed between the superimposed projectiles. In a preferred form of the invention, the fire control mechanism is incorporated into a variety of special purpose firearms, such as survival rifles or missile launchers suitable for throw-away use.

24 Claims, 17 Drawing Figures

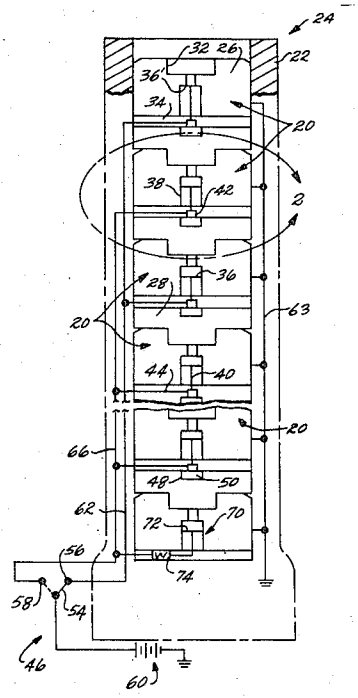


FIG. 1

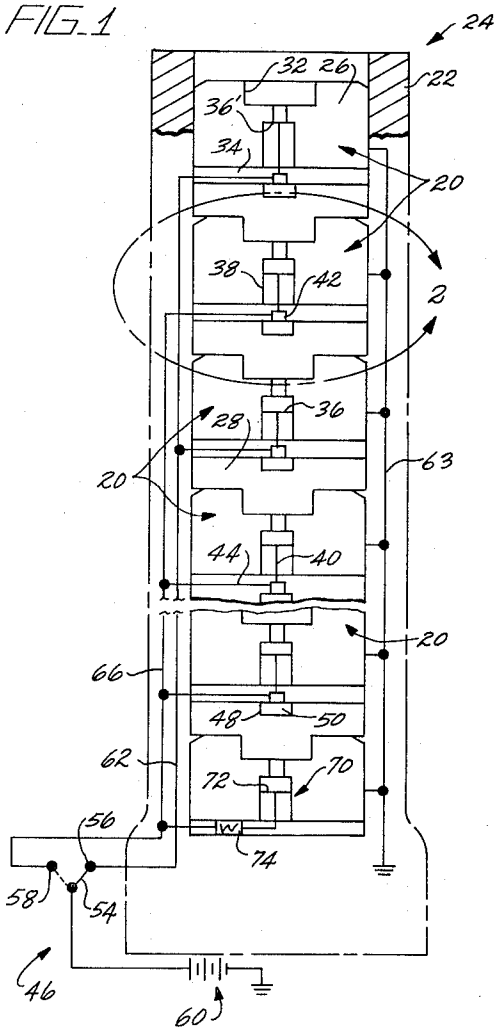


FIG. 2

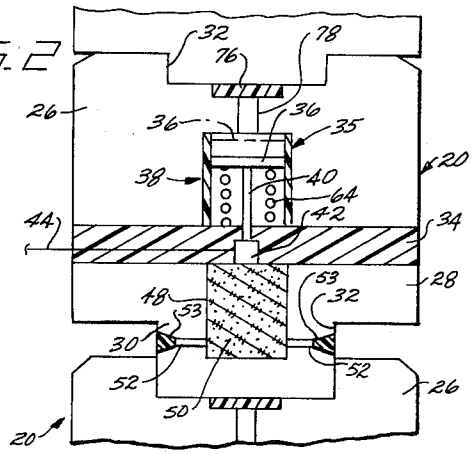


FIG. 3

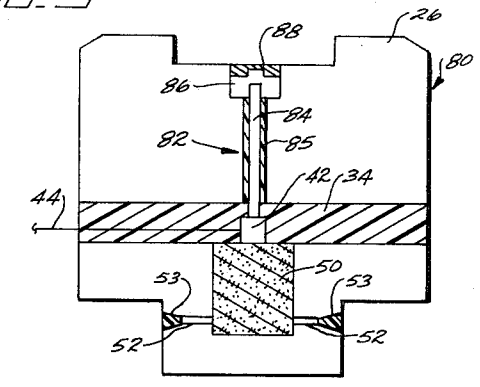


FIG. 4

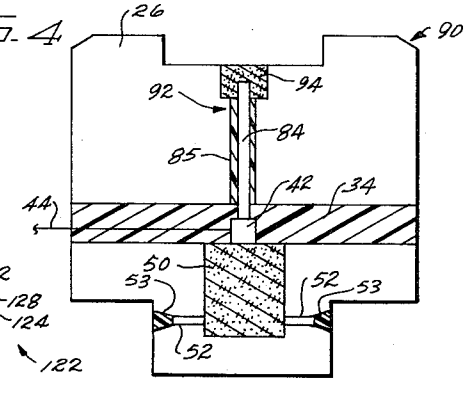


FIG. 11

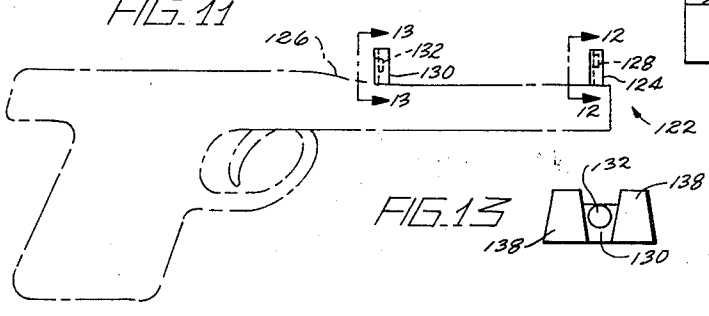


FIG. 13

FIG. 12

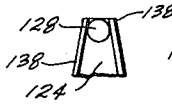
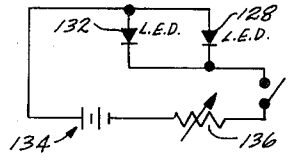


FIG. 14



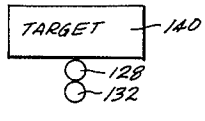


FIG. 15

FIG. 5

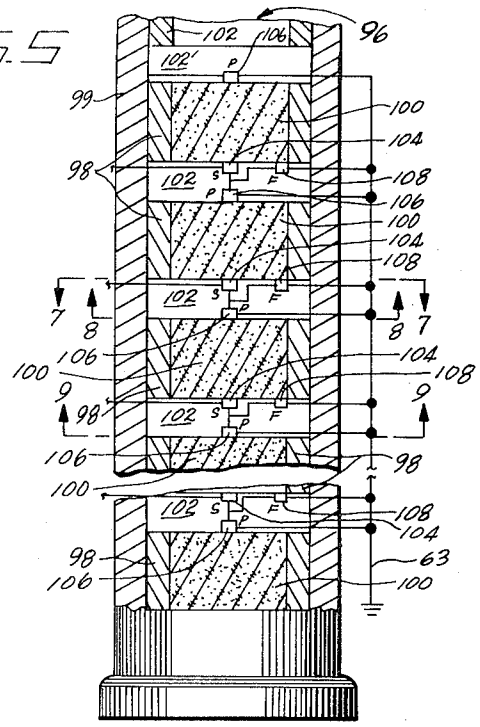


FIG. 6

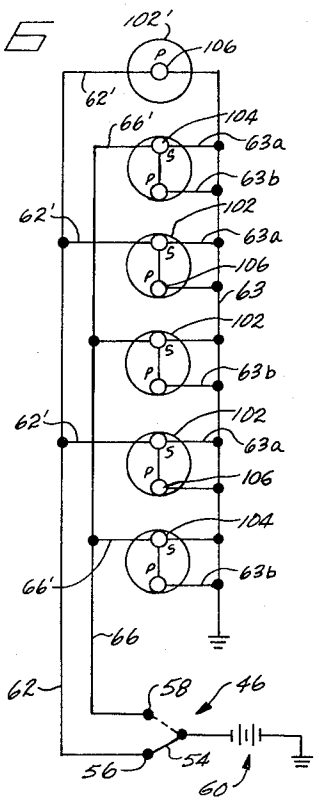


FIG. 7

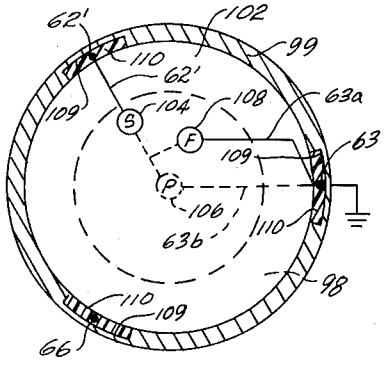


FIG. 8

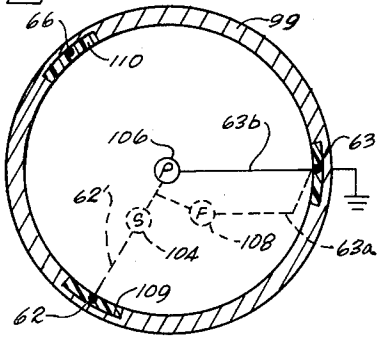


FIG. 10

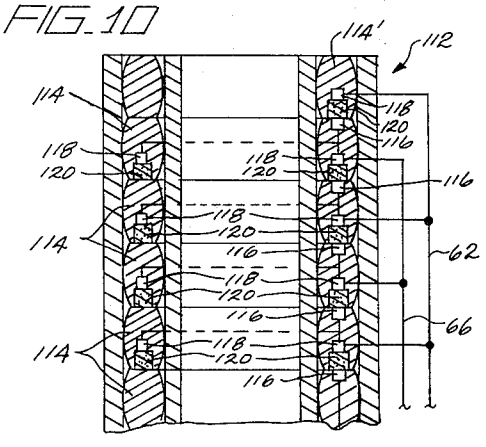


FIG. 9

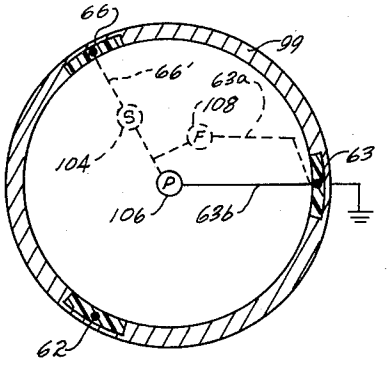
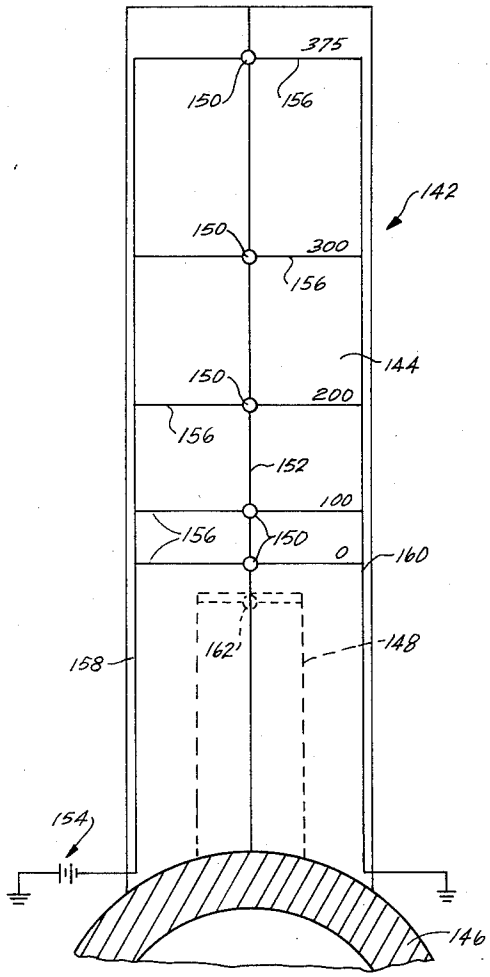


FIG_16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150
156
142
150
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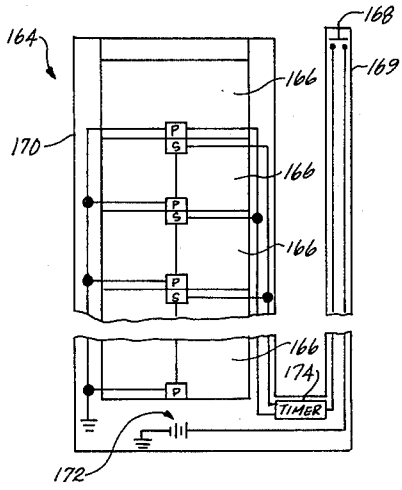
146

FIG_17


164
168
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TIMER
172

FIRE CONTROL MECHANISM FOR FIREARMS

BACKGROUND OF THE INVENTION

This invention relates to firearms, and more particularly to an improved system for firing cartridges adapted for superimposed loading.

Conventional firearms, especially those adapted for semi-automatic or automatic firing, generally include several relatively complex mechanisms which add to the cost of manufacturing the firearms, and which also reduce the firearm's reliability and speed of operation. For example, firearms adapted for semi-automatic or automatic use generally have relatively complex feeding mechanisms, including many reciprocating parts, cams, plungers, and the like, for sequentially feeding cartridges to the firing chamber of the weapon. Complex electrical and mechanical systems also are generally used in conventional firearms for sequentially arming and firing the cartridges. Prior art mechanisms for arming and firing superimposed cartridges are especially complicated and costly to manufacture, and also lower the reliability and slow down the speed of operation of the weapon.

SUMMARY OF THE INVENTION

This invention provides an improved cartridge firing system for firearms in which cartridges are loaded in superimposed relation. The system is relatively simple in construction, which lowers the cost and enhances the reliability and operating speed of the firearm. Moreover, the system inherently eliminates such common items as bolts, receivers, and other costly mechanisms with reciprocating parts for feeding cartridges, and the like.

Briefly, the fire control system includes a string of projectiles to be loaded in superimposed relation in a firearm, and a normally unarmed primer associated with each projectile. Each primer is responsive to an impulse for igniting an explosive charge in its corresponding projectile to propel the projectile only when the primer is in an armed condition. A sensor associated with each primer switches the primer from its unarmed condition to its armed condition in response to propulsion of the projectile immediately ahead of it in the firing order. Triggering means supply one of the impulses to each primer to ignite the explosive and fire the projectile when the primer is in its armed condition.

Thus, the fire control system of this invention simplifies substantially the construction of a weapon capable of semi-automatic or automatic firing. The projectiles are fired by a triggering system which may simply comprise an electrical circuit and a switch. The system provides such a reduction in the cost of manufacturing weapons that special purpose weapons for throwaway use are feasible. Such special purpose weapons may typically include grenade launchers, or survival rifles.

In one embodiment of the invention, a primer and a corresponding ignition sensor are integral with each projectile. In another embodiment, each primer and ignition sensor combination is incorporated into a separate arming device, and the arming devices are disposed between each pair of projectiles in the firing order. Preferably, such arming device comprises a wafer having an electrical primer adapted to be switched to a conductive state when ignition of the previous projectile in the firing order is sensed by its respective sensor.

The fire control system of this invention makes it especially suitable to use caseless cartridges, although a number of projectiles mounted in a single cartridge, or clip, can be used.

Preferably, the primer is an electrical device which fires its corresponding projectile in response to an electrical impulse from the firearm triggering means. In this form of the invention, each ignition sensor arms its respective primer by switching it to an electrically conductive state when ignition of the previous projectile is sensed. Electrical conductors coupled to the triggering system for operating the primers and sensors preferably are embedded in the barrel of the firearm, although they also can be carried in a case which houses the projectiles.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will be more fully understood by referring to the following detailed description and the accompanying drawings in which:

FIG. 1 is a fragmentary schematic elevation view, partly in section, showing an arming and firing control system for projectiles loaded into a firearm in superimposed relation;

FIG. 2 is an enlarged fragmentary schematic elevation view, partly in section, showing a pressure-release switch for arming a primer of the projectile shown within the circle 2 of FIG. 1;

FIG. 3 is a schematic elevation view, partly in section, showing an alternate embodiment of a projectile in which a pressure switch is used for arming the primer;

FIG. 4 is a schematic elevation view, partly in section, showing a further alternate embodiment of a projectile in which a chemical reduction switch is used for arming the primer;

FIG. 5 is a fragmentary schematic elevation view, partly in section, showing an alternate arming and firing system for projectiles loaded in a superimposed relation;

FIG. 6 is a schematic electrical diagram of the triggering system for the arming and firing system shown in FIG. 5;

FIG. 7 is a schematic plan elevation view, partly in section, taken on line 7—7 of FIG. 5;

FIG. 8 is a schematic plan elevation taken on line 8—8 of FIG. 5;

FIG. 9 is a schematic plan elevation view taken on line 9—9 of FIG. 5;

FIG. 10 is a fragmentary schematic elevation view, partly in section, showing a further alternate arming and firing system for airfoil projectiles loaded in superimposed relation in a firearm;

FIG. 11 is an elevation view showing a gun sight system;

FIG. 12 is an elevation view taken on line 12—12 of FIG. 11;

FIG. 13 is an elevation view taken on line 13—13 of FIG. 11;

FIG. 14 is a schematic electrical diagram of the gun sight system of FIG. 11;

FIG. 15 is a schematic diagram illustrating the operation of the gun sight system of FIG. 11;

FIG. 16 is a schematic elevation view showing an alternate gun sight system; and

FIG. 17 is a schematic elevation view showing a land mine having superimposed rounds.

DETAILED DESCRIPTION OF THE PRERERRED EMBODIMENTS

FIG. 1 schematically illustrates a string of cartridges 20 loaded in superimposed position in a barrel 22 of a firearm 24. The term "superimposed" is used herein to describe the condition in which a series of cartridges are loaded into a case or clip, or a barrel of a firearm so they are aligned in a collinear relation relative to each other along the axis of the case, clip, or barrel.

As shown best in FIG. 2, each cartridge 20 includes a projectile 26 at the forward end of the cartridge, and a tail portion 28 having an outwardly projecting shoulder 30 of reduced diameter shaped to fit into a cooperating recess 32 of the projectile located immediately behind it in the firing order. The cooperating shoulder and recess aid in properly aligning the projectiles in their superimposed relation. Projectile 26 and tail portion 28 are made of a material, such as copper, aluminum, or steel, which is capable of conducting electric current. An insulator body 34 made of an electrically insulative material, such as nylon, plastic or the like, is sandwiched between projectile 26 and tail portion 28. In use, insulator body 34 also serves as a seal for sealing off the interior of the barrel below it so that the energy caused by the propellant charge will be absorbed into its corresponding projectile.

Projectile 26 and tail portion 28 are rigidly interconnected by fastening means (not shown) extending through insulator body 34.

A pressure-release switch 35 embedded in projectile 26 includes a contact 36 made of an electrically conductive material. Contact 36 is slidably disposed in a tubular insulator housing 38. When the contact is in an unarmed condition as shown in FIG. 2, it is located at an intermediate portion of insulator housing 38. A flexible contact arm 40 carried by the contact is attached to a primer 42 which, in turn, is embedded in insulator body 34. Contact arm 40 is made of an electrically conductive material such as aluminum or steel woven wire. An elongated conductor wire 44 embedded in insulator body 34 is part of a primer triggering circuit 46 (see FIG. 1) for applying an impulse of electric current to the primer to fire the projectile.

A propellant cap 48 embedded in the tail portion of the cartridge packs a propellant or explosive 50, such as gun powder. Preferably, primer 42 is the type which ignites explosive 50 when an impulse of electric current passes through it, although mechanical primer means can be used without departing from the scope of the invention. Vent holes 52 extend laterally from the propellant cap through shoulder 30 of projectile tail portion 28 for releasing the gas pressure produced by firing of the projectile. A plug 53 prevents gas which might by-pass seal 34 from prematurely setting off propellant charge 50.

Cartridges 20 preferably are "caseless" cartridges, i.e., they eliminate the use of metal cartridge cases which house each projectile and which are left in the barrel after the projectile is fired. However, the present invention can be adapted for use with a single elongated case or clip (not shown) in which the entire string of cartridges is disposed.

The arming and firing system preferably is adapted for semi-automatic use in which cartridges are fired sequentially, with each cartridge being fired by a separate activation of triggering system 46. Referring to FIG. 1, the triggering system preferably includes a single-pole, double-throw switch 54 operated by the trigger (not shown) of the firearm. Switch 54 is movable between a first electrical contact 56 and a second electrical contact 58. When switch 54 is engaged with electrical contact 56, electric current generated by a power supply 60 passes through a first electrical conductor 62 extending from first contact 56 lengthwise along the barrel of the firearm to a conductor 44 of the particular cartridge to be fired.

A given cartridge can be fired only when it is "armed," and only one cartridge is in an armed condition at a given time, that cartridge being the front cartridge in the string. Reference to FIG. 1 shows that the electrical contact 36' of the front cartridge is in a different position from the contacts associated with the remaining cartridges in the string. Contact 36' is shown in an armed condition, in which it is not insulated from the electrically conductive body of its corresponding projectile. When the contact is in this position, the contact grounds the triggering circuit through the body of the projectile and a ground wire 63 so that electric current can pass from the power supply through conductor 62 and conductor 44 to primer 42 to fire the cartridge.

In use, each pressure-release switch 35 senses the firing of the projectile located immediately ahead of it in the firing order, and automatically switches to an armed position in response to firing of the projectile. Thus, at any given time the primer of the front cartridge in the barrel is in an armed condition ready to be fired.

Each pressure-release switch 35 operates as follows. The firing of a given cartridge causes a build up of pressure in the barrel, and after the cartridge leaves the barrel, a sudden reduction in gas pressure in the barrel is generated. This pressure reduction causes electrical contact 36 to move forward (upward in FIG. 2) under the biasing force of a spring 64 located in insulating housing 38. The moving contact comes to rest in an armed position against the face of the projectile body at the forward end of housing 38, as represented in phantom line at 36 in FIG. 2. Thus, when it is desired to fire the next cartridge in the firing order, switch 54 is moved to second contact 58, and electric current passing through a second electrical conductor 66 now activates the previously armed primer and fires the next projectile. The firing of the second projectile automatically arms the third projectile, so that when switch 54 is returned to first contact 56, the third projectile is immediately fired, and so on, until all projectiles are fired. When the last projectile is fired, a pressure-release switch (represented schematically at 70 and identical in construction to switch 35) closes, i.e., its electrical contact 72 moves to a current-conducting position in response to the pressure reduction caused by firing of the last projectile. When switch 70 is closed, a warning device (represented schematically at 74) is activated to notify the operator of the weapon that all cartridges have been fired.

Each pressure-release switch 35 also includes a plastic seal 76 at its front end for preventing the leakage of pressure caused by the firing of the projectile immedi-

ately in front of it from damaging the pressure-release switch. The seal escapes from the cartridge, under sudden reduction of pressure after its neighboring cartridge is fired, to expose a tubular non-conductive rod **78** below it which opens into the front of insulative housing **38.**

FIG. **3** shows a cartridge **80** having an alternative device **82** for sensing when a previous projectile is fired and switching to an armed position. Sensing device **82** is a pressure switch which includes an electrically conductive rod **84** extending from primer **42** to a point spaced from the forward end of the cartridge. The tip of rod **84** projects into the hollow interior of an annular recess **86** at the front of the cartridge. Rod **84** is surrounded by a tubular body **85** of a non-conductive material such as nylon. A slidable electrically conductive cap **88** covers the opening to recess **86.**

In use, the build up of pressure in the barrel of the firearm due to the firing of the previous projectile forces cap **88** against the tip of rod **84.** This grounds the triggering circuit through the body of projectile **26,** and thereby arms the cartridge so that an electrical impulse passing through conductor **44** can activate primer **42** and fire the projectile.

FIG. **4** shows a cartridge **90** having a further alternate device **92** for sensing when a previous projectile is fired. Sensing device **92** is a chemical reduction switch which includes a plug **94** of a combustible, fuseable composition which is conductive in the fused state. The composition can be a mixture of lead or tin with selenium in proportions approaching stoichiometric equivalency. However, other similar mixtures can be used as long as they switch from a non-conductive to a conductive condition when fused in response to the heat generated by ignition and firing of the projectile immediately ahead of it.

The sensing and arming devices shown in FIGS. **2** through **4** are shown by way of example only, since other means for sensing the activation, ignition, and/or firing of the nextadjacent cartridge can be used without departing from the scope of the invention.

The fire control system of this invention simplifies substantially the construction of semi-automatic and automatic weapons, since complex feeding mechanisms and arming devices, and their attendant reciprocating parts and the like, are eliminated. Because of the reduced simplicity of the weapon of this invention, weapons such as grenade launchers, can be made at relatively low cost. Moreover, it is feasible to make firearm **24** in the form of a special purpose weapon, such as a missile launcher capable of throw-away use.

Cartridge **20** can be used as the lead projectile in the firing order. In this instance, it is essentially a self-contained caseless cartridge that can be fired mechanically or electrically in conventional firearms. In a firing order comprised of projectile **80** or **90,** the lead projectile should be a pressure-release cartridge such as cartridge **20,** or a switchless or pre-armed cartridge.

FIG. **5** shows an alternate embodiment of the invention in which a firearm **96** contains superimposed cartridges **98** loaded in a barrel **99** of the firearm. In the system shown in FIG. **5,** the cartridges are shown to be in the form of airfoil missiles, each airfoil being a ring-shaped body having powder **100** disposed within its center. The airfoil cartridge is shown by way of example only, as other types of cartridges, or rounds, may be used with the arming and firing system of FIG. **5** without departing from the scope of this invention.

The fire control system for the weapon shown in FIG. **5** includes a series of longitudinally spaced apart arming devices, each in the form of a separate wafer **102** disposed between each adjacent pair of cartridges **98.** Each wafer is a relatively flat piece of narrow dimension. (The wafers **102** shown in FIG. **5** are proportionally greater in thickness than in real life for the purpose of clarity.) Each wafer (with the exception of the front wafer **102'** in the weapon) preferably carries a pressure and/or heat sensitive switch (represented schematically at **104**) and an electrically activated primer (represented schematically at **106**) for firing the particular cartridge located below it in the firing order. Water **102'** includes a pre-armed primer only, the pressure and/or heat sensitive switch being omitted. Each switch **104** is connected to ground wire **63** through a corresponding fuse **108** which keeps the electrical circuit from going to ground through switch **104** in the event there is a leak in pressure in the barrel. Each fuse also acts as a safety against static electricity setting off the primer prematurely by keeping the primer ground until it is armed. The fuse melts from the heat generated by firing of the immediately preceding round.

Each switch **104** can be any type of switch sensitive to the ignition and/or firing of the cartridge immediately ahead of it in the firing order. It is preferred to use a pressure-sensitive switch, such as switch **82,** described above, for switching to an electrically conductive condition in response to the buildup of pressure caused by the firing of the projectile immediately ahead of it. When each switch is in its closed condition, it arms its corresponding primer so that an impulse of electric current passing to the armed primer via the switch will ignite the explosive and fire the cartridge. Thus, progressive firing of the front cartridge in the barrel sequentially arms the primer of the next cartridge so that the front cartridge in the barrel is always in an armed condition ready to be fired, while the remaining cartridges are held in an unarmed condition.

The fire control system shown in FIG. **5** is operative by an electrical circuit used in conjunction with triggering system **46,** as illustrated schematically in FIG. **6.** Alternating switches **104** in the firing order are electrically connected to first conductor **62** via respective conductors **62',** while the remaining alternating switches **104** are electrically connected to second conductor **66** via respective conductors **66'.** A separate conductor **63a** couples each switch to ground through a respective one of the fuses **108** (not shown in FIG. **6** for clarity). A separate conductor **63***b* couples each primer to ground. The alternating switching arrangement illustrated in FIG. **5** (and FIG. **1**) prevents the automatic actuation of each primer in succession, which would be the case if all primers were electrically coupled with a common conductor running from switch **54.** The alternating coupling of primers to the two conductors **62** and **66** assures that the leading projectile only will be fired each time switch **54** is actuated.

As an alternative, the triggering system can be modified to include a switch (not shown) for effectively connecting the primers in series to provide an automatic firing system for the cartridges.

FIGS. **7** through **9** illustrate a preferred method of arranging conductors **62, 63,** and **66** in the barrel **99** of

firearm 96. The three conductors preferably are embedded in three equidistantly spaced apart grooves 109 formed in the inner wall of the barrel. Each conductor preferably is embedded in a corresponding body of non-conductive material, such as fiberglass, disposed in the groove. This method of mounting the conductor wires is shown by way of example only, since other methods can be used without departing from the scope of the invention. For example, the three conductor wires can extend through longitudinally aligned bores (not shown) passing through the cartridges, or through longitudinally aligned grooves (not shown) formed in the exterior walls of the cartridges and extending the length of the cartridges. The wires also can be attached to the outside, or the inside, of a multiple-firing cartridge case or clip used to enclose the cartridges. In the latter instance, annular body 99 shown in FIGS. 7 through 9 would represent the cartridge case or clip.

FIG. 10 shows a further alternative form of the invention in which the barrel of a firearm 112 includes superimposed annular airfoil cartridges 114. Each airfoil includes its own integral sensing device (represented schematically at 116) for sensing activation, ignition and/or firing of the cartridge immediately ahead of it in the firing order. Each switch is electrically coupled with several primers 118 embedded at several suitable radially spaced apart locations in the airfoil body. Each primer is operative to ignite a respective embedded explosive cap 120 when armed by its corresponding sensing device and when it receives an impulse of electric current from the triggering system.

FIGS. 11 through 15 illustrate the construction and operation of a gun sight system 122 which is especially suitable for use at night or in conditions of low light intensity. The system includes a frontal post sight 124 mounted at the front of a weapon 126. The post sight mounts a first light emitting diode 128 at its top on the side facing the shooter of the firearm. A rear V-sight 130 carries a second light emitting diode 132 located at the top of the V, and on the side of the post nearest the shooter. Preferably, the rear sight is movable lengthwise relative to the firearm so its longitudinal position can be adjusted. Each light emitting diode is coupled electrically to a power supply 134. Electric current flowing through each diode will cause it to emit a point source of light energy. A variable resistor or potentiometer 136 adjusts the intensity of the light emitted by each diode. Each sight has rearwardly projecting sides 138 which shield the light emitting diode from view from the side.

As shown best in FIG. 15, the diodes preferably are vertically aligned relative to each other such that the light image of the first diode is located immediately above the light image of the second diode when the barrel of the firearm is held in a position which will hit a target 140.

FIG. 16 shows an alternate gun sight system 142 which is especially suitable for use at night or in conditions of low light intensity. The gun sight system comprises an upright rear sight 144 mounted at an intermediate location on a gun barrel 146 and spaced rearwardly of a front sight 148 located at the end of the gun barrel. Rear gun sight 144 preferably comprises a relatively flat elongated member made of transparent material. Both gun sights preferably are foldable, i.e., they pivot relative to the gun barrel to an upright position shown in FIG. 16 when in use, and fold down to a position in the general plane of the gun barrel when not in use.

A series of vertically spaced apart light emitting diodes 150 carried on the rear gun sight are aligned along a centrally disposed vertical axis or hairline 152. The light emitting diodes are arranged so they face the shooter of the gun, with the emitted light being shielded by suitable means from the front and side of the sight. Light emitting diodes 150 are connected to a parallel electrical circuit arrangement so as to receive electrical current generated by a power supply 154. Each light emitting diode in the circuit is connected to a respective conductor 156, and all conductors 156 are connected between a vertically extending electrical lead 158 extending from the power supply and a second vertically extending ground wire 160. Lead 58 and ground wire 160 preferably are embedded in opposed grooves (not shown) formed in the outer vertical edges of the gun sight.

Front gun sight 148 also comprises a flat elongated member which carries a light emitting diode 162 near its top. Light emitting diode 162 is located on the vertical centerline of the front gun sight.

Rear gun sight 144 includes a range scale marked on its front surface so as to face the shooter of the gun. The markings on the scale represent the distance or range that a projectile will be fired by the gun when a given light emitting diode on the rear sight is aligned in a given manner with light emitting diode 162 of the front gun sight. For example, the shooter can hit a target at 200 feet by tipping the gun barrel upwardly and looking through the transparent front sight to align the central light emitting diode 150 with light emitting diode 162.

FIG. 17 shows a land mine 164 embodying the principles of this invention. The land mine preferably is a counting and multi-firing time-delay mine having superimposed rounds 166. The mine includes a pressure-sensitive movable pin 168 disposed in a vertically disposed rigid pipte 169 secured to the body 170 of the mine. The pin serves as a switch in an electrical triggering circuit connected to a power supply 172.

In use, when the pin is actuated by the presence of an object in the area where the mine is located, the pin completes the triggering circuit to supply current to the primer of the first explosive round in the mine to fire the round. As noted in the other embodiments of the invention described above, firing of the first round will automatically arm the primer of the next round, and so forth.

Preferably, pin 168 is coupled to the triggering circuit through a latch relay (not shown) or the like to maintain a closed circuit condition at the pin once the pin has been actuated. In the mine shown in FIG. 17, the rounds are connected to the triggering circuit through a timer 174 which provides a pre-set time delay between firing of each round. Thus, the land mine automatically fires when sensing pressure and thereafter sequentially fires subsequent rounds at preselected time intervals.

As an alternate embodiment, the timer can be eliminated, and the triggering circuit adjusted so that each individual round is fired only when pin 168 is actuated.

As a further alternate embodiment, the latch relay discussed above is deleted, and switch 168 closes only when it is actuated. Preferably, the timer includes a

counter which counts a specified number of times switch **168** closes before actuating the timer to fire a given round. The timer also can be overridden by the switch being actuated to fire instantaneously.

I claim:

1. A fire control system comprising a string of projectiles to be loaded in superimposed relation in a barrel of a weapon to define a tandem firing order, each projectile having an explosive for firing the projectile when the explosive is activated to thereby propel the projectile; a separate normally unarmed primer associated with the explosive of each projectile, each primer being capable of being armed and being responsive to an impulse for activating its associated explosive only when in the armed condition; sensing means associated with each primer, each sensing means being capable of switching its associated primer from the unarmed condition to the armed condition in response to propulsion of the projectile located in the firing order immediately ahead of the particular projectile with which the sensing device and primer are associated; and triggering means for supplying one of said impulses to each armed primer to activate the explosive and fire the projectile.

2. Apparatus according to claim **1** in which each primer includes a movable contact having unarmed and armed positions, and in which the sensing means comprises a separate pressure-release mechanism associated with each projectile and sensitive to the change in gas pressure produced by ignition of the explosive in the projectile immediately ahead of it in the firing order for moving the contact from its unarmed position to its armed position in response to said pressure change.

3. Apparatus according to claim **1** in which each primer is operable in response to the passage of electric current therethrough to ignite the explosive, and in which electric current is allowed to pass through the primer only when the primer is switched to the armed condition by the sensing means, the triggering means being operative to apply electric current to the armed primer to fire the projectile.

4. Apparatus according to claim **3** in which the sensing means comprises a separate chemical reduction switch associated with each projectile and sensitive to heat generated by ignition of the propellent in the projectile immediately ahead of it in the firing order for switching the primer from a condition in which it is incapable of conducting electric current to a current conducting condition.

5. Apparatus according to claim **3** in which alternate projectiles in the firing order define a first set of projectiles, and those projectiles located between projectiles in the first set define a second set of projectiles, and in which the triggering means includes a switch movable between a first position and a second position, first electric circuit means for supplying electric current to the primers associated with the projectiles in the first set when the switch is in its first position, and second electric circuit means for supplying electric current to the primers associated with the projectiles in the second set when the switch is in its second position.

6. Apparatus according to claim **1** including separate arming devices located between adjacent projectiles in the firing order, each arming device including a separate one of said primers located nextadjacent the projectile immediately behind it in the firing order for arming said projectile, and a separate one of said sensing means located nextadjacent for projectile immediately ahead of it in the firing order for sensing propulsion of the projectile ahead of it and switching its corresponding primer to the armed condition.

7. Apparatus according to claim **1** in which each projectile has a front portion located nextadjacent the projectile immediately ahead of it in the firing order, each projectile having a separate one of said primers integral therewith, and a separate one of said sensing means integral therewith and located on the front portion of the projectile so it can sense ignition of the explosive in the nextadjacent projectile and switch its corresponding primer to the armed condition.

8. Apparatus according to claim **1** in which each projectile comprises a caseless cartridge.

9. Apparatus according to claim **1** in which each projectile comprises an airfoil missile.

10. Apparatus according to claim **1** in which the weapon comprises a firearm adapted for throw-away use.

11. Apparatus according to claim **10** in which each primer is operable in response to passage of electric current therethrough to activate the explosive, and in which electric current is allowed to pass through each primer only when the primer is switched to the armed condition by the sensing means, the triggering means being operative to apply electric current to the armed primer to activate the explosive.

12. Apparatus according to claim **11** in which alternating projectiles in the firing order define a first set of projectiles, and those projectiles located between the projectiles in the first set define a second set of projectiles, and in which the triggering means includes a switch movable between a first position and a second position, first electric circuit means for supplying electric current to the primers associated with the projectiles in the first set when the switch is in its first position, and second electric circuit means for supplying electric current to the primer associated with projectiles in the second set when the switch is in the second position.

13. Apparatus according to claim **12** in which the electric current for the first and second circuit electric circuit means are carried by first and second conductors, respectively, and in which the first and second conductors are embedded in the barrel of the firearm.

14. Apparatus according to claim **12** in which the projectiles are loaded into a clip disposed in the barrel, and in which the electric current for the first and second electric circuit means is carried by first and second conductors, respectively, and in which the first and second conductors are embedded in the clip.

15. Apparatus according to claim **1** in which the weapon comprises a land mine, and in which the triggering means is activated in response to pressure exerted by an object in the vicinity of the land mine.

16. Apparatus according to claim **15** in which the triggering means further includes a time delay for firing one cartridge at a preselected time interval after a preceding cartridge is fired.

17. Apparatus according to claim **1** in which the firing order defines a lead projectile having a primer, said primer being in an armed condition; and including means for activating the explosive associated with the primer.

18. Apparatus according to claim 17 in which the lead projectile is a caseless cartridge.

19. Apparatus according to claim 1 in which each primer and its associated sensing means are both integral portions of their respective projectiles to be propelled with the projectile when the latter is fired.

20. Apparatus according to claim 19 in which each primer includes a movable contact having unarmed and armed positions, and in which the sensing means comprises a separate pressure-release mechanism associated with each projectile and sensitive to the change in gas pressure produced by ignition of the explosive in the projectile immediately ahead of it in the firing order for moving the contact from its unarmed position to its armed position in response to said pressure change.

21. Apparatus according to claim 19 in which each primer is operable in response to the passage of electric current therethrough to ignite the explosive, and in which electric current is allowed to pass through the primer only when the primer is switched to the armed condition by the sensing means, the triggering means being operative to apply electric current to the armed primer to fire the projectile.

22. Apparatus according to claim 21 in which the electrical current is carried by electrical conductors contained within the barrel of the weapon.

23. Apparatus according to claim 21 in which the sensing means comprises a separate chemical reduction switch associated with each projectile and sensitive to heat generated by ignition of the propellant in the projectile immediately ahead of it in the firing order for switching the primer from a condition in which it is incapable of conducting electric current to a current conducting condition.

24. Apparatus according to claim 21 in which alternate projectiles in the firing order define a first set of projectiles, and those projectiles located between projectiles in the first set define a second set of projectiles, and in which the triggering means includes a switch movable between a first position and a second position, first electric circuit means for supplying electric current to the primers associated with the projectiles in the first set when the switch is in its first position, and second electric circuit means for supplying electric current to the primers associated with the projectiles in the second set when the switch is in its second position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,815,271 Dated June 11, 1974

Inventor(s) ROBERT W. LYNN

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 6, line 16, "Water" should read -- Wafer --.

Col. 8, line 16, "58" should read -- 158 --;

Col. 8, line 40, "pipte" should read -- pipe --.

Col.10, line 44, after "second" delete "circuit"
(Claim 13)

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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