United States Patent

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[54] **SMALL ARMS WEAPON AND SMALL ARMS RANGES**

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[52] **U.S. Cl.** **89/134,** 89/135, 273/101

[51] **Int. Cl.** **F41j 1/20**

[58] **Field of Search** .....42/1 R, 1 A, 84; 89/1, 28 R, 89/28 A, 28 B, 28 C, 41 B, 41 C, 41 ME, 41 L, 134, 135, 150; 124/32; 273/101, 101.1, 102 R, 102.1 R

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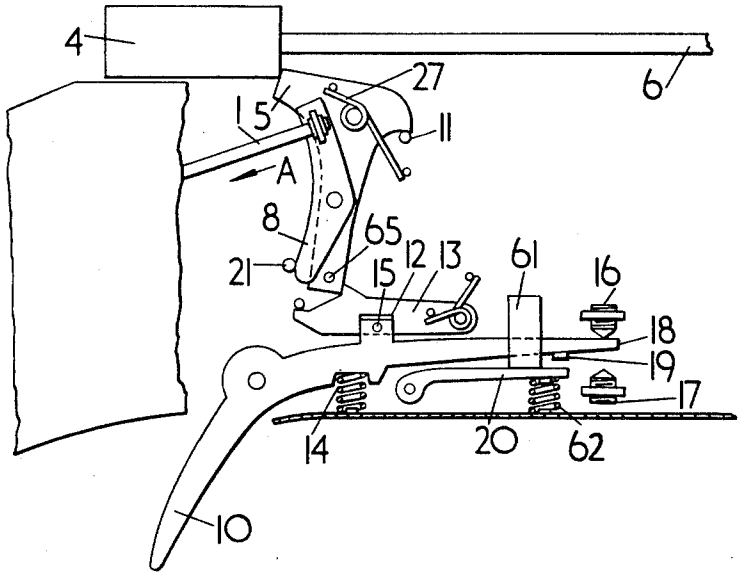
[57] **ABSTRACT**

A small arms range has at least one weapon, a target, and at least one transmitter which transmits a beam in the general direction of the or each weapon. The or each weapon has a receiver connected to an interlock system which prevents the weapon being fired unless the receiver is receiving a beam. The range is encircled by a guard beam the receiver of which is also connected to the interlock system. The interlock system prevents the weapon being fired as soon as anyone enters the range.

12 Claims, 8 Drawing Figures



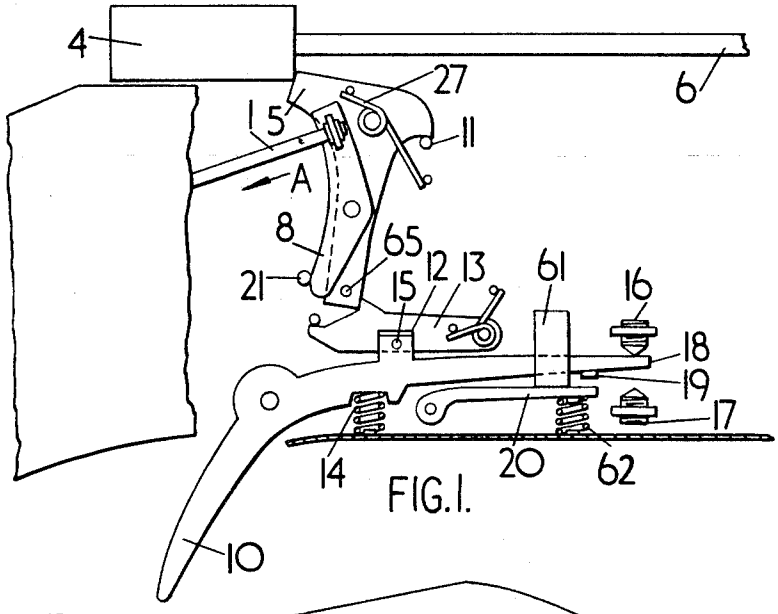


FIG. 1.

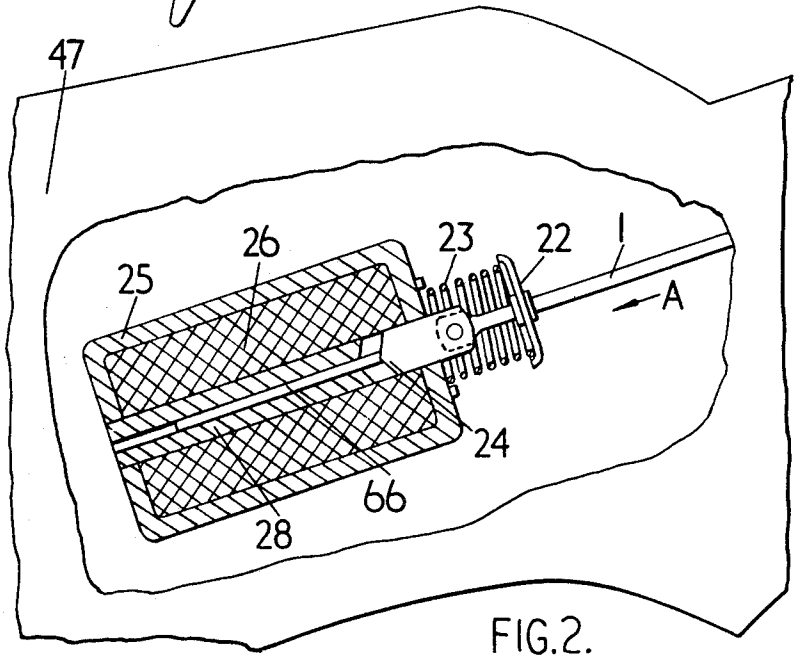


FIG. 2.

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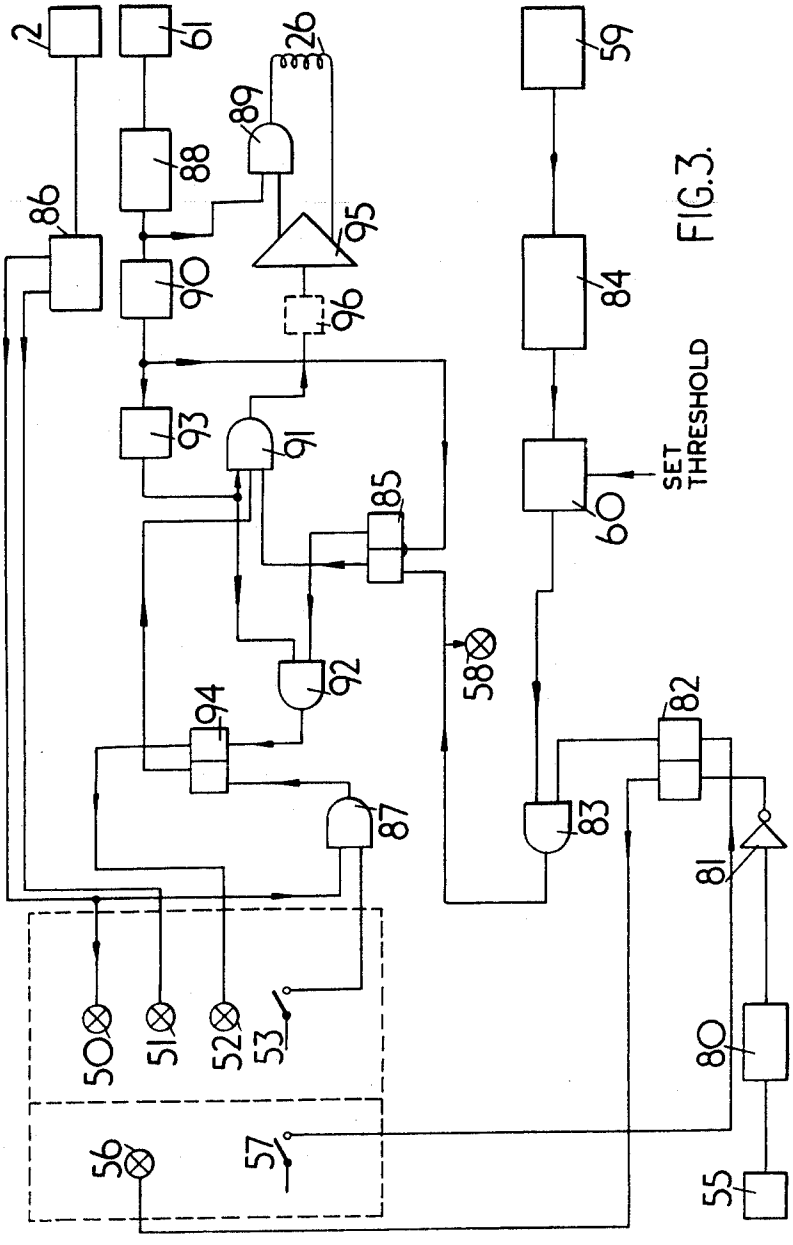

FIG.3.

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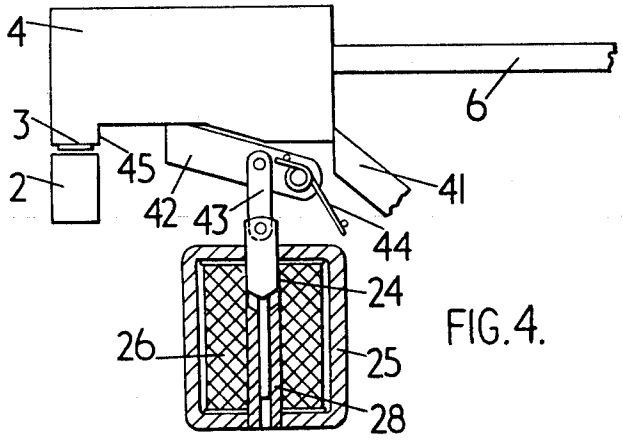

FIG. 4.

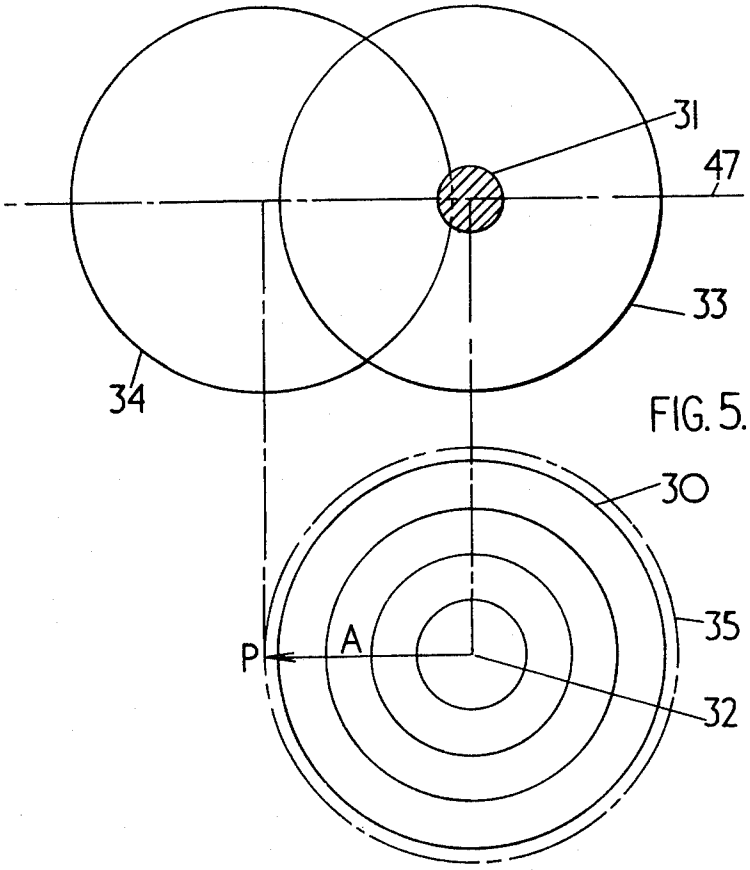

FIG. 5.

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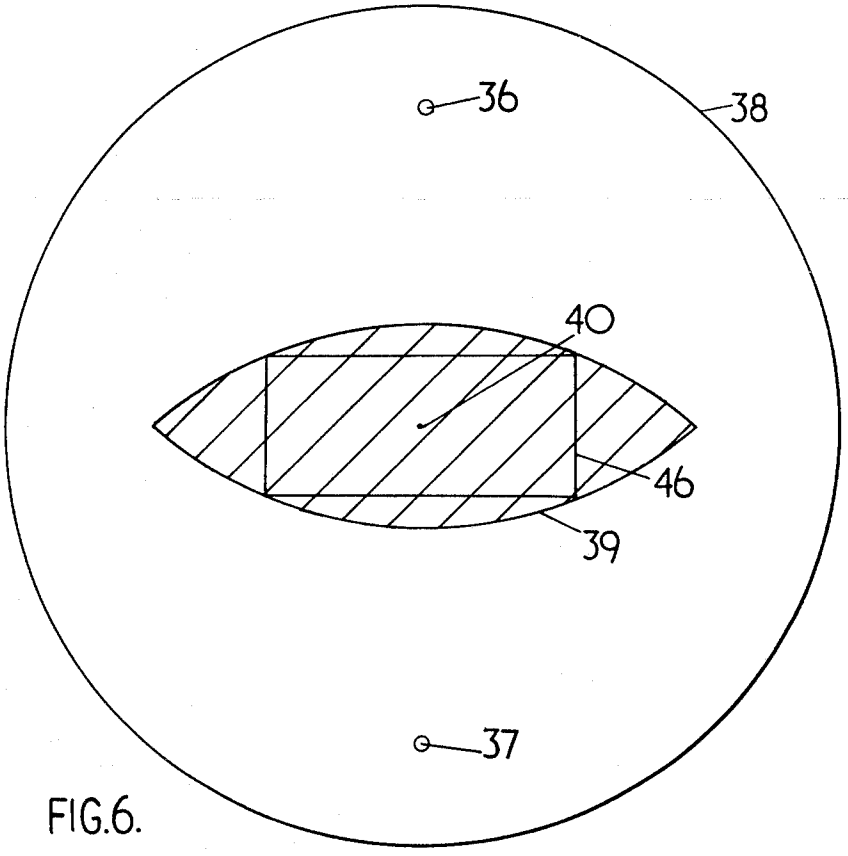

FIG.6.

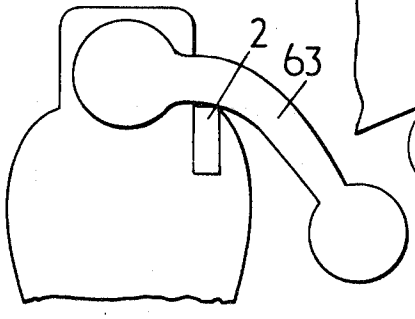

FIG.7.

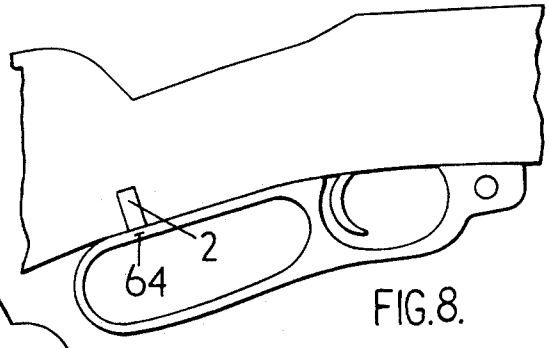

FIG.8.

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SMALL ARMS WEAPON AND SMALL ARMS RANGES

This invention relates to small arms weapons and small arms ranges. It is intended that the term "small arms" shall include shotguns.

It is an object of this invention to provide a small arms weapon suitable for use in a small arms range and a small arms range in which the likelihood of an accident is reduced.

According to this invention there is provided a small arms weapon which includes a receiver connected to an interlock system, the arrangement being that it is impossible to fire the weapon unless the receiver receives a signal beam.

In a convenient arrangement a small arms range has one or more small arms weapons in accordance with this invention and, adjacent to the target, one or more signal transmitters which transmit a beam in the general direction of the or each weapon.

The or each weapon cannot be fired unless it is pointing towards the target when it will receive a signal beam and so cannot be fired in a direction away from the target and this feature obviously reduces the possibility of accidents. Furthermore the or each weapon cannot be fired if the beam from the signal transmitter is interrupted and this is obviously a safety feature as it is impossible to fire the or each weapon when a person is in the line of fire.

Preferably the or each receiver has an annular sensor which surrounds the barrel of the weapon.

This arrangement is particularly safe as it may be arranged that the interlock system will not permit the weapon to be fired unless all parts of the sensing device are illuminated by the beam or beams.

The or each beam may conveniently be an infra-red beam.

A small arms range in accordance with this invention may be provided with means capable of detecting the presence of human beings.

Such means may conveniently comprise a plurality of infra-red or laser beam transmitters which co-operate with mirrors and receivers to establish guard beams to encircle the dangerous part of the range, and also transmitters and detectors of electromagnetic or ultrasonic signals which encircle the dangerous part of the range. The receivers or detectors are connected to the interlock system of the or each weapon and are arranged to prevent the weapon being fired when the receivers do not receive a beam or the detectors detect a disturbance of the electromagnetic or ultrasonic signals. This arrangement clearly reduces the risk of accident.

Preferably the beam receiver mounted on the or each weapon accepts only a sharply defined narrow cone of radiation, the angle of acceptance being related to the number and disposition of beam transmitters. Where one beam transmitter is provided for each target, the angle of acceptance should be equal to the angle subtended at the firing point by the maximum dimension of the target.

This arrangement has the advantage that the field of fire is confined to the target area.

Preferably the or each beam receiver is mounted so that the longitudinal axis of the accepted cone is at an angle to the longitudinal axis of the weapon barrel.

This angle should be such that the section of the accepted cone at the plane of the target, subsequently termed the field of acceptance, lies clear of the target area when the weapon is aimed at the center of the target.

A beam transmitter is accordingly positioned above, below or to the side of the target at the center of the field of acceptance when the weapon is aimed at the center of the target.

The minimum angular separation between the beam transmitter and the target and hence the angle at which the beam receiver is mounted on the weapon barrel will be determined by the characteristics of the weapon and the interlock system, and should be such as to ensure that no shot can strike the beam transmitter.

According to a feature of this invention, there is provided a weapon which is intended to be fired only at objects in the sky and which has a receiver which accepts only a narrow beam of sky light. The weapon cannot be fired at any opaque object, which reduces the risk of accident.

An interlock system may be constructed in many ways.

Already known are firearms having electric or electromagnetic firing mechanisms. All firearms in which firing is controlled by electrical means may be suitable to be adapted for the purpose of this invention.

Preferably the or each receiver is connected to a control circuit to which a proximity sensor is also connected, the proximity sensor being arranged to sense the movement of the trigger or other component of the firing mechanism, the output of the control circuit either being used to cause the weapon to fire or being used to position a stop member in relation to a component of the firing mechanism of the weapon.

In a convenient arrangement, the trigger when pulled causes a signal to pass to a control circuit. When the signal beam or beams are being received, the control circuit energizes an electromagnet which causes a sear to be withdrawn to release a spring-urged striker or other mechanism causing the weapon to fire.

The control circuit may alternatively energize an electromagnet which directly impels a striker to fire the cartridge or the control circuit may cause the weapon to fire by passing an electric current through an electrically fired cartridge primer.

In an alternative arrangement which is applicable to many existing weapons, a firearm having a mechanical firing mechanism and a mechanical trigger release is employed.

When the trigger of such a weapon is pulled, there will in general follow a sequence of mechanical actions performed by one or a number of cooperating components. The proximity sensor is accordingly arranged to inform the control circuit at the commencement of movement by a convenient component of the firing mechanism which does not move until the trigger has passed that point at which the weapon is committed to fire in the absence of the interlock system.

The interlock system is arranged normally to engage with and arrest a convenient component of the firing mechanism at an instant chronologically later in the firing sequence than the instant at which movement is detected by the proximity sensor.

When the control circuit receives a signal from the proximity sensor indicating that the weapon is committed to fire, and when the or all the signal beams are being received, the control circuit energizes an electromagnet or other motor device which forms part of the interlock system, causing the interlock system to release that component of the firing mechanism that it would normally arrest, so that firing can take place.

The release mechanism of the interlock system will accordingly be designed to complete its operation within the period of time which elapses from the moment when movement of the firing mechanism is signalled to the control circuit until the moment when the interlock system, if not released, will arrest the firing mechanism. This period will usually be of the order of a thousandth of a second.

This arrangement has the advantage of avoiding a danger which arises if the release mechanism of the interlock system works independently of the trigger release, and is actuated whenever the weapon is swung away from the beam. It may then occur that the interlock system will be in some intermediate position at the time of firing, and will barely engage with the firing mechanism. The weapon will then be in an unsafe condition. A second advantage is that the interlock system acts at all times when the trigger is not pulled in the manner of a safety device, to prevent accidental discharge.

Various small armsweapons and a small arms range in accordance with this invention will now be described, by way of example only, with reference to the accompanying drawings of which:

FIG. 1 is a schematic view of part of a bolt-operated explosive cartridge weapon;

FIG. 2 is a schematic view of another part of the weapon shown in FIG. 1;

FIG. 3 is a diagram of an interlock control circuit;

FIG. 4 is a schematic view of a further bolt-operated explosive cartridge weapon;

FIG. 5 is a schematic view of a target, a beam transmitter, and the field of acceptance of a beam receiver;

FIG. 6 is a schematic view of two beam transmitters and the field of acceptance of a beam receiver;

FIG. 7 is a schematic cross-section of the weapons shown in FIGS. 1 and 4; and

FIG. 8 is a schematic view of a lever-operated explosive cartridge weapon.

The weapons are intended to be used on a firing range having at least one weapon, a target and at least one infra-red transmitter which is located near the target and which transmits a beam towards the weapon or weapons. The location of the weapon or weapons lies within a fixed zone and the or each weapon can be maneuvered to point in any direction.

The or each weapon may be explosive cartridge weapon, a gas powered weapon or a spring operated air weapon.

An annular infra-red receiver surrounds the barrel of the or each weapon and is connected to an interlock system including an interlock circuit.

FIG. 1 shows part of the mechanism of a bolt-operated explosive cartridge weapon, FIG. 2 shows the interior of the butt of the same weapon, and FIG. 7 is a schematic cross-section of the same weapon. FIG. 3 is a diagram of the logic elements of an interlock circuit suitable for the weapon of FIG. 1.

Referring to FIG. 1, a striker 6 and a striker head 4 are urged in the direction of the breech (not shown) by a striker spring (not shown) and are normally restrained by a pivoted sear 5 which is urged by a spring 27 in the sense to bear against a stop 11. A pivoted trigger 10 extends to form an operating lever 18 which is normally urged by a trigger spring 14 in the sense to bear against a stop 16. A pivoted arm 20 of magnetic material is normally urged by a spring 62 towards a proximity sensor 61.

FIG. 2 shows an electromagnet 26 mounted in a butt 47 of the weapon shown in FIG. 1. The electromagnet 26 has a field yoke 25, a tubular core 28 and an armature 24 of ferromagnetic material. A guide rod 66 of non-magnetic material is attached to the armature 24, which is linked to a rod 1.

A lightly stressed spring 23 acting upon a cup 22 attached to the rod 1 normally causes a thrust to be transmitted to a pivoted lever 8 (FIG. 1), which is urged to rotate in the sense to bear on a stop 21.

FIG. 7 shows a proximity sensor 2 which co-operates with the metal of a bolt lever 63 to generate a signal indicating that the bolt is locked.

When the trigger 10 is pulled, a lipped projection 12 on the operating lever 18 engages a pin 15 on a pivoted spring-urged catch 13, drawing the catch 13 clear of the path of rotation of the sear 5.

Continued movement of the trigger 10 causes a projection 19 on the operating lever 18 to meet the arm 20, and an increased resistance will be felt at the trigger by the firer. When this has been overcome an extremely slight further movement of the trigger causes the arm 20 to move away from the proximity sensor 61, which then transmits a firing signal to the control circuit.

The weapon will now fire only if the or all the signal beams enter the beam receiver at all points on the annulus and within the specified angle of acceptance, so causing the beam receiver photo detector 59 (FIG. 3) to generate a signal exceeding the level determined by the threshold unit 60, and will also fire only if the proximity sensor 2 in co-operation with the bolt lever 63 generates a signal to indicate that the bolt of the weapon is locked.

The interlock circuit then causes a current pulse to energize the electromagnet 26, which attracts the armature 24 and pulls the rod 1 in the direction of the arrow A, causing the pivoted lever 8 to rotate in the sense to bear against a pin 65 on the arm of the sear 5, which in turn rotates in the same sense until the striker head 4 is not longer restrained and the weapon fires.

The pivoted catch 13 is a safety feature which inhibits firing at all times when the trigger 10 is not pulled, by restraining the sear 5.

The proximity sensor 2 in co-operation with the bolt lever 63 prevents the control circuit from responding to the trigger when the bolt is not locked, and so avoids the danger that the striker head might engage with the sear at a moment when the sear was partially withdrawn, leaving the weapon capable of discharging when subjected to shock or vibration. This is a further safety feature.

The use of a proximity sensor rather than a make or break switch to provide a firing signal improves consistency and reliability, and hence safety.

FIG. 3 is a diagram of the logic elements of the interlock control circuit suitable for the weapon and will be

described in detail. Indicators **50** and **51** are provided to show whether the bolt of the weapon is locked and unlocked respectively, and also an indicator **52** to show whether the trigger has been pulled when the signal beam or beams are not being received. In this event, the circuit prevents further firing until a switch **53** is operated.

The circuit includes a beam sensor **55** to guard the dangerous part of the range. When the beam is broken, an indicator **56** gives an indication and firing cannot take place until the beam is again unbroken and a resetting switch **57** is operated.

An indicator **58** is provided which at all times shows when the signal beam (which is received by the photodetector **59**) and the range guard beam are being received so that firing may take place. This indicator **58** facilitates the adjustment of the unit **60** which determines the threshold of response to the signal beam or beams.

In detail the output signal of the range guard beam sensor **55** is applied to a shaper **80** which only produces an output signal when a beam is incident on the sensor **55**. The output of the shaper **80** is applied through an inverter **81** to a bistable **82**. In the absence of any signal from the shaper **80**, i.e., in the case when someone enters the dangerous area, the bistable **82** is triggered to its stable state in which it does not apply a signal to an AND gate **83** so that gate **83** produce an output signal.

The other output of the bistable **82** is applied directly to the indicator **56** and obviously this indicator **56** is energized only when there is no output signal from the shaper **80** that is to say when someone has entered the dangerous area. The reset switch **57** applies a signal to the other input of the bistable **82** and serves to trigger it back to its quiescent state. The output of the photodetector **59** is applied through a demodulator and signal processor **84** to the threshold unit **60** which has already been described. The threshold unit **60** only produces an output when a beam is incident on the photodetector **59** that is to say when the weapon is correctly aimed. This output signal is applied to the other input of the AND gate **83** so that the AND gate **83** produces an output signal only when the appropriate beams are incident on the range guard beam sensor **55** and the photodetector **59** that is to say when no one has entered the dangerous zone and when the weapon is correctly aimed. The output signal of the AND gate **83** is applied to the indicator **58** which has already been described and to a control input of a J-K monostable **85**. The application of this signal to the monostable **85** does not cause it to be triggered but enables it to be triggered when a pulse is applied to its pulse input.

The output of the proximity sensor **2** which detects whether or not the bolt is correctly locked is applied to a shaping circuit **86** which is a bistable which is in a particular state only when the bolt is correctly locked and is in the opposite state when the bolt is not correctly locked. One output of the shaping circuit **86** is connected to the indicator **50** which indicates when the bolt has been locked and this output is also applied to an AND gate **87**. The other output of the shaping circuit **86** is applied to the indicator **51** which has already been described and which indicates when the bolt has not been correctly locked.

The proximity sensor **61** produces an output signal when the trigger is pulled and this output signal continues to be generated until the trigger reverts to its datum position. This signal is applied to a shaping circuit **88** the output of which is fed to an AND gate **89** and to a differentiating circuit **90**. It will be seen that differentiating circuit **90** produces an output signal at the instant that the trigger is pulled. This output pulse of the differentiating circuit **90** is applied to the pulse input of the monostable **85** which thereupon produces an output pulse. In the event that the monostable **85** is receiving the output signal of the AND gate **83** the pulse applied to it from the differentiating circuit **90** causes the monostable **85** to produce an output pulse in opposite directions on its two outputs. One output of the monostable **85** is fed to an AND gate **91** and assuming that the AND gate **83** did produce an output signal the signal applied from the monostable **85** to the AND gate **91** is in the sense to cause it to produce an output signal. The other output of the monostable **85** is fed to an AND gate **92**. The pulse output signal of the differentiating circuit **90** is also applied through a delay circuit **93** to a further input of the AND gate **91** in the sense to cause that AND gate to produce an output signal and is also fed to the AND gate **92**. The AND gate **92** is so arranged that it only produces an output signal in the event that the trigger is pulled when the proximity sensor **61** produces an output signal when at least one of the sensors **55** and **59** is not producing an output signal that is to say either when the weapon is incorrectly aimed or when someone has entered the dangerous zone. The output signal of the AND gate **92** is applied to one input of a bistable **94** one output of which is fed to the third input of the AND gate **91**. This signal applied to the AND gate **91** is in the sense to cause that AND gate **91** to produce an output signal unless the AND gate **92** produces an output signal that is to say unless the trigger has been pulled when at least one of the sensors **55** and **59** is not producing an output signal. The output of the AND gate **91** is fed through a drive amplifier **95** which drives the firing mechanism or solenoid **26** through the AND gate **89**. As will be appreciated the AND gate **89** is opened when the proximity sensor **61** produces an output signal that is to say when the trigger is pulled. A delay circuit **96** may be included between the AND gate **91** and the drive circuit **95**. It will be appreciated from the preceding description that the solenoid **26** will be operated if proximity sensor **2** produces an output signal indicating that the bolt has been locked, if the range guard beam sensor **55** produces a signal indicating that no person has entered the dangerous zone, if the photodector **59** produces a signal indicating that the gun is correctly aimed and that no person is in the line of fire and if the proximity sensor **61** produces a signal indicating that the trigger has been pulled.

The other output signal of the bistable **94** is applied to the indicator **52** and it will be appreciated that the indicator **52** is only energized when the bistable **94** is triggered from its bistable state that is to say when the AND gate **92** produces an output signal. As has already been explained the AND gate **92** only produces an output signal when the trigger is pulled when at least one of the sensors **55** and **59** is not producing an output signal.

When the switch 53 is closed it applies a signal to the bistable 94 through the AND gate 87 which serves to trigger the bistable 94 back to its quiescent state. The AND gate 87 is only open when the bolt of the weapon is correctly locked.

FIG. 4 shows the striker 6 and striker head 4 of a further bolt-operated explosive cartridge weapon. The trigger (not shown) is mechanically connected to a sear 41. FIG. 7 is a schematic cross-section of the same weapon. The control circuit of FIG. 3 is suitable for the weapon of FIG. 4.

An electromagnet 26 having an armature 24 is connected by a link 43 to a rotatable catch 42. An elongated recess 45 in the striker head 4 is suitably shaped to engage with the shaped end of a catch 42. A spring 44 normally urges the catch 42 in the sense to remain in contact with the recess 45 and so to arrest the striker head 4 at all times when the electromagnet 26 is not energized.

When the trigger is pulled, the sear 41 is withdrawn, and the striker 6 and striker head 4 are urged by the striker spring (not shown) in the direction of the breech (not shown). A proximity sensor 61 in co-operation with some magnetic material 3 generates a signal when the striker head commences to move. This signal is also applied to an interlock circuit (FIG. 3) and when this signal is present, together with the output signal from the receiver indicating that the or all the signal beams are being received and also the signal from the proximity sensor 2 indicating that the bolt is locked, the interlock circuit energizes the electromagnet 26 causing the catch 42 to be withdrawn.

The interlocking device of the weapon shown in FIG. 4 and which includes the interlock circuit will allow the striker 6 to fire the cartridge (not shown) only when the trigger is pulled and only when the or all the signal beams are being received.

It is to be noted that the electromagnet 26 is a fail safe device in that should the electromagnet 26 fail the spring 44 holds the catch 42 in position in which it prevents the firing of the weapon. A further safety feature is that the ferromagnetic materials of the field yoke 25, core 28 and armature 24 may be permanently magnetized so that the armature 24 is repelled at all times when the electromagnet 26 is not energized, thereby reinforcing the action of the spring 44.

The proximity sensor must produce a signal rapidly and may be a tuned circuit so that the magnetic material 3 forms part of the tuned circuit.

The weapon or weapons of the range must be modified so that when the interlocking device shown in FIG. 4 is operated the weapon can be recocked without reloading should these functions normally be interconnected.

FIG. 8 is a schematic view of a lever-operated explosive cartridge weapon including one of the interlock systems previously described. The proximity sensor 2 co-operates with a lever 64 to indicate that the action of the weapon is locked.

In the case of a gas powered weapon the interlocking device could be arranged to actuate a separate valve which would serve to release or control the compressed gas should the interlock circuit not receive the required signals at the instant when the trigger is pulled.

The proximity sensor and all the other components of the interlock system including the interlock circuit and the electromagnet may be included in a single sub-assembly.

The electromagnet may be energized with a large current pulse greater than its continuous load-carrying capacity. Such a pulse may be obtained, as is known, by discharging a capacitor. This arrangement has the advantage that it is impossible for the electromagnet to be continuously energized and this is clearly a safety feature.

All weapons may be provided with a further mechanical and electrical interlock to ensure that the or each weapon cannot be reloaded if they have not been fired when the trigger is pulled as a result of the interlock system operating.

FIG. 5 is a schematic view of a circular target 30, a beam transmitter 31 and the field of acceptance of a beam receiver 33 as seen from the firing point. The beam receiver is so mounted on the weapon that the beam transmitter 31 lies central in the field of acceptance 33 when the weapon is aimed at the center 32 of the target 30.

If the aim of the weapon is now deflected in the direction A, a point of aim P is reached when the corresponding field of acceptance 34 of the beam receiver begins to exclude the transmitter 31, so that the beam signal falls to the level at which the threshold unit of the interlock circuit ceases to allow firing. The point P therefore lies on the limit of the field of fire 35 which is seen to correspond closely to the target 30. The beam transmitter 31 is clearly excluded from the field of fire. Further transmitters may be disposed on the horizontal line 47 to extend the field of fire in a lateral sense.

FIG. 6 is a schematic view of two beam transmitters 36, 37 at equal distances above and below the center 40 of a target area 46. The field of acceptance of the beam receiver when the weapon is aimed at the center 40 of the target area 46 is shown by the circular area 38. The beam receiver is mounted with its axis parallel to that of the barrel for short ranges and flat trajectories. When the interlock circuit threshold unit 60 (FIG. 3) is so adjusted that beams from both transmitters 36, 37 must be received to operate the interlock circuit, the field of fire will be as represented by the shaded area 39. Both transmitters 36, 37 are excluded from the field of fire 39. The arrangement shown on FIG. 6 may be rotated through 90° to provide a field of fire suitable for vertically elongated targets.

The annular infra-red receiver may comprise a number of small photoelectric receivers each of which has a separate lens and which are distributed around the barrel of the gun. Alternatively the annular receiver may be a specially constructed annular photoelectric receiver comprising a number of silicon phototransistors or other photoelectric detectors mounted on a common base, and incorporating a corresponding number of lenses. Such a specially constructed annular photoreceiver may be moulded from a single annular piece of glass or plastics. A further possibility is the use of a plurality of optic fibers and lenses which surround the barrel of the gun and which conduct rays received from all round the barrel of the gun to a photoelectric detector. It is desirable that a filter be included in the receiver optical system, so that the

receiver shall respond only to infra-red light, and to no other part of the light spectrum.

The or each transmitter may conveniently be a gallium arsenide infra-red emitter, provided with suitable lenses to direct an infra-red beam towards the firing point. It may be arranged that the transmitter transmits a modulated signal and the interlock circuit incorporates a demodulator which is responsive to only one or more fixed frequencies and only one type of modulation.

Where a number of targets are arranged to be fired at by a number of marksmen standing in close proximity, the transmitter or transmitters associated with each target may with advantage be modulated in a different way from the transmitter or transmitters associated with the other targets on the range. The interlock circuit of each weapon will accordingly incorporate a demodulator responsive only to the frequency or type of modulation present in the signal beam or beams from the transmitter or transmitters associated with the target allotted to that weapon and marksman.

This arrangement has the advantage that no weapon may be fired at any target other than the one allotted.

Signal beams for the purposes of this invention may also be produced by illuminating the target area with a source or sources of visible, infra-red or ultra-violet light.

The targets or the background accordingly have surfaces capable of reflecting a sufficient proportion of the incident illumination to constitute a signal beam.

This arrangement has the advantage that no limitation is placed upon the size, number or movement of the targets, provided that they remain within the area illuminated by the source or sources provided. A further advantage is that the weapons need not lie within a fixed zone.

In a convenient arrangement, gas discharge tubes or other sources of illumination are supplied with alternating current at a frequency different to the frequency of the current supplied to all other sources of illumination within or about the range, the interlock circuits having demodulators responsive only to the intended frequency.

Alternatively, the targets are illuminated by a source or sources having an output peaked at one or more points in the infra-red, visible or ultra-violet spectrum. The beam receiver optical system is accordingly provided with filters which selectively favor this type of illumination. These light sources may also be modulated as previously described.

Light sources producing the spectra associated with the elements sodium and mercury may conveniently be employed.

When the weapon or weapons are removed from the range they will be inoperable as they will not operate unless they receive a signal beam. However it would be relatively easy to apply a signal to the output of the photoelectric receiver to simulate the reception of a beam signal. In order to make it more difficult to operate the weapons removed from the firing range it may be arranged that the transmitter transmits a modulated signal and the receiver incorporates a demodulator which is responsive to only one or more fixed frequencies and only one type of modulation.

The interlock circuit may be constructed so that it will not energize the electromagnet unless it receives a special signal over a radio link or line.

Alternatively electric components may be incorporated into the interlock circuit such that if an attempt is made to render the weapon operable by the application of random voltages to the accessible circuits the electric components will suffer irreversible breakdown. These components may be simple fuses or any other components having a predictable breakdown point and which will not be affected by the receipt of normal signals.

In order to make the weapons even more difficult to operate when removed from the firing range it may be arranged that the weapons are energized from a non-standard supply e.g., AC at 400 c/s and that the electronic circuit of the weapon will not operate on 50 c/s AC or on DC. Furthermore special components may be introduced which will break down as soon as an incorrect power supply is connected to the weapon.

I claim:

1. A small arms range having at least one small arms weapon, a target, a beam transmitter and a beam receiver, one of the group comprising the beam transmitter and the beam receiver being included in the small arms weapon and the other being located adjacent the target, the beam transmitter transmitting a signal beam in the general direction of said beam receiver, the small arms weapon including a trigger, sensing means for sensing actuation of the trigger, and an interlock system to which the beam receiver and the sensing means are connected and which, upon actuation of the trigger, prevents the weapon being fired unless the beam receiver receives the signal beam transmitted by the beam transmitter.

2. A range as claimed in claim **1** wherein said beam receiver is included in the weapon.

3. A range as claimed in claim **2** wherein said receiver comprises an annular sensor which surrounds the barrel of the weapon.

4. A range as claimed in claim **1** wherein said beam is an infra-red beam.

5. A range as claimed in claim **2** wherein said receiver accepts only a sharply defined narrow cone of radiation.

6. A range as claimed in claim **5** wherein said receiver is mounted so that the longitudinal axis of the accepted cone is at such an angle to the longitudinal axis of the weapon barrel that the interlock system prevents the weapon from firing any shot that might strike the beam transmitter.

7. A range as claimed in claim **1** wherein the weapon comprises a firing mechanism, wherein the interlock system comprises a control circuit to which said receiver is connected, and wherein the sensing means comprise a proximity sensor connected to said control circuit, the proximity sensor cooperating with a component of the firing mechanism, the output of the control circuit controlling the firing of the weapon.

8. A range as claimed in claim **1** which comprises detecting means for detecting the presence of opaque objects.

9. A range as claimed in claim **7**, wherein said detecting means comprise a plurality of cooperating transmitters, mirrors and receivers which establish guard beams which encircle the dangerous part of the range.

10. A range as claimed in claim 8 wherein said receivers of the detecting means are connected to the interlock system of said weapon and prevent the weapon being fired when they do not receive beams.

11. A range as claimed in claim 2 wherein said beam receiver accepts only a sharply defined narrow cone of radiation, the angle of acceptance of which is equal to the angle subtended at the firing point by the maximum dimension of the target.

12. A small arms range having at least one small arms weapon, a target, and two beam transmitters adjacent to opposite sides of the target, each beam transmitter transmitting a signal beam in the general direction of said weapon, the small arms weapon including a beam receiver and an interlock system to which the receiver is connected and which prevents the weapon being fired unless the beam receiver receives the signal beams transmitted by the beam transmitters.

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