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## (54) INSTALLATION FOR SIMULATED SHOOTING


(71) We, LASPO AKTIENGESELLSCHAFT, a body corporate organised according to the laws of Switzerland, of Schlattingerbuch, CH-8253 Diessenhofen, Switzerland, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


The invention relates to an installation for simulated shooting having a pulse emitter connected to a shooting device, which emitter is arranged to emit pulses of radiation, and having a target mechanism with a score indicator.

Installations of the type described above are known, but they have considerable disadvantages which mean that they are unsuitable for true simulation of shooting, especially of shooting as a sport. Firstly, the pulse of radiation emitted from the shooting device is divergent so that in the plane of the target it does not correspond to the calibre of the shooting device but has a larger diameter. Secondly, the intensity of the radiation is too low which means that it is only possible to shoot at a relatively short distance. Finally, for the target mechanism, a plate fitted with photosensitive elements is used which can be of only limited size since photosensitive elements suitable for use are only produced in a very limited size. Photosensitive elements with a larger face tend to have flaws which produce weak signals or none at all, which means that a pulse of radiation incident at one of these points would release an insufficient indication or no indication at all. The known installation is therefore at best suitable for simulating shooting at a short distance.

It is an object of the invention so to design an installation for simulated shooting of the type described above that shooting of a conventional type can be simulated exactly.

The invention provides an installation for simulated shooting comprising a weapon which has a pulse emitter and a target mechanism having a target image and a score indicator, wherein the weapon has an optical adjusting device for adjusting to the calibre of the weapon the diameter in the plane of the target image of pulses of radiation emitted by the pulse emitter, and wherein the pulse emitter is connected to an electrical supply mechanism and has an adjustable electrical timing member.

The invention also provides a weapon suitable for use as the weapon in an installation according to the invention.

As a result of the fact that the pulse emitter has a calibrated adjusting device for the pulses of radiation in order to adjust to the calibre of the shooting device their diameter of incidence in the plane of the target of the target mechanism, it is possible for the pulse of radiation to be so adjusted for each distance of the target mechanism, that in the plane of the target the diameter of incidence of the pulse of radiation corresponds exactly to the calibre of the shooting device. As a result, the divergence of the path of rays peculiar to each pulse of radiation is removed, even if the rays *per se* are oriented in a parallel manner, and in addition the pulse of radiation is concentrated at the point of incidence in the plane of the target of the target mechanism.

The pulse emitter may have, for example, a light-emitting diode, preferably, a laser diode or infra-red diode which is especially suitable for shorter distances. A pulse emitter with a light-emitting diode in particular also may be designed as an insertable component with which a conventional shooting device can be equipped without any alternations being made. For simulated shooting at a greater distance a laser tube is particularly suitable. This may be arranged on or in the shooting device. It is also possible to arrange it outside the shooting device, in which case it is connected to the shooting device by means of a light conductor.

The adjusting device of the pulse emitter preferably has an optical portion which can be adjusted in calibrated manner and is advantageously a lens. The term "optical device" used here and in the following is to be understood in its most general sense, and is to include not only light-optical devices

but also electron-optical devices.

The pulse emitter advantageously contains an optical device for propagating and focussing a pulse of radiation. A device of this type is suitable in particular for producers of radiation which emit practically parallel rays such as, for example, a laser tube. As a result, the parallel rays can be propagated and focussed to form a converging pulse of radiation which can then be so adjusted that it corresponds to the calibre of the shooting device in the plane of the target.

The pulse emitter can have also an optical device with a condenser and an objective lens, in the common focal point of which an aperture is arranged. A device of this type is suitable in particular for producers of radiation which do not have a circular source of rays and, optionally, emit no parallel rays. As a result of the condenser, the rays are concentrated on a focal point in which the aperture forming the beam is located. The beam, which is focussed through the aperture, is then projected into the plane of the target through the next lens, and by adjustment of the lens, the diameter of the beam in the plane of the target can be adjusted to the calibre of the shooting device.

In pulse emitters with an unbroken beam, such as is the case, for example, in a continuous laser, for example, a laser tube, it is an advantage to produce pulses of radiation by arranging in the path of rays a shutter which is coupled with the trigger of the shooting device. For this, the shutter is preferably positioned between the source of rays and the adjusting device for the pulses of radiation.

The switch for release of the pulse of radiation is preferably designed as a switch in the form of a cartridge that is inserted in the barrel of the shooting device and is actuatable by means of a firing pin of the shooting device. For this, the firing pin may bring into engagement two contacts, arranged in an insertable switch, or preferably may bridge directly two contacts of this type if the firing pin is in the firing position. The insertable switch consists preferably of a sleeve of electrically insulating material and has a contact ring positioned in the region of the firing pin, which ring cooperates with a contact lug of a supply mechanism for the pulse emitter. The insertable switch is advantageously electrically connected to the pulse emitter by means of a plug connection. This is of particular advantage if the pulse emitter in the form of an insertable component is inserted from the front into the barrel of a shooting device, in particular, a pistol.

The length of the pulse of radiation is preferably so adjusted that it corresponds to the time between the pulling of the trigger of a shooting device and the actual discharge of a shot from the shooting device. This enables each movement of the shooting device to be registered during the pulling of the trigger to be registered; preferably, however, only that part of the pulse of radiation is registered on the target mechanism which would correspond to the discharge of the shot out of the barrel, that is, only the end of the pulse of radiation is evaluated. Thus, an accurate simulation of a shooting device is produced as in shooting with ammunition.

It is possible for a supply mechanism for the pulse emitter to be arranged outside the shooting device. However, it is preferably arranged on the shooting device, in which case it is particularly advantageously designed as an insertable magazine for the cartridge magazine of the shooting device. A supply mechanism of this type, designed as an insertable magazine, can be fitted with a contact lug which is connected to the switching device for release of the pulse of radiation.

A particularly advantageous design of the switching device has a piezoelectric device which responds to the impact of the firing pin, which device is arranged to cause the emission of the pulse of radiation. A design of this type is of particular advantage if an ordinary shooting device is to be re-equipped for use in the simulated shooting without any alternations being made.

The target mechanism advantageously has a target image divided into target areas, in which, in a detector, a sensor is assigned to each target area, which sensor responds to an incident pulse of radiation. In this arrangement it is of extreme advantage if the sensor is smaller than the assigned target area of the target image, there being provided between the plane of the target image and the detector formed by the sensors, an optical device for deflecting and proportionally diminishing a pulse of radiation onto the sensors, which pulse is incident on the plane of the target image. As a result, it is possible to equip the detector with very small, effective sensors and still to have a target image of any size. This also has the advantage that the pulse of radiation incident in the plane of the target is concentrated as a result of reflection and of proportional diminishing and thus can be evaluated with greater energy at the sensor. With a target mechanism of this type, it is possible to simulate accurately target practice using conventional distances and also conventional target disc images.

In the plane of the target image, advantageously a collecting lens is arranged which, for example, may be a Fresnel lens, an aspherical lens or a chamfered lens. In the latter case, for example, it is unnecessary to use a sensor, the face of which is proportional to the face of one chamfer, but it is

possible to use a point sensor which is arranged in the focal point of the chamfer. In order to exclude the effects of other light it is an advantage to arrange an interference filter on the target mechanism between the sensors and the plane of the target image. This may, for example, be in the form of an interference filter film which has minimal effect on the path of rays. It is of particular advantage for this that the interference filter film be arranged on reverse side of the collecting lens.

The target mechanism contains a device for fading-in a target image. For this purpose, a semi-reflecting mirror is suitable and an advantage, with which mirror it is possible for the target image to be faded-in into the path of rays. The target image may be of any type, and advantageously is a target disc. There also exists the possibility that the background of the target mechanism, which is situated behind a collecting lens, be designed in the form of a target image.

The sensors are advantageously photosensitive elements, preferably phototransistors on a silicon base. If, for example, a target disc is to be used as a target image, it is preferably divided into sections, the detector having sensors corresponding to the ring sections. When phototransistors are used, it is possible for the rings to be designed as collectors and the sections as emitters. A collector of this type is advantageously connected to an evaluating device which contains a first coder connected to the rings and a second coder connected to the sections, which in each case transmit the coded ring and section signals to a shift register, the signals corresponding to a ring section which has been hit, and the register being connected to a shift register of the score indicator. The first coder is preferably so designed that in the case where a shot hits two rings it transmits the higher ring value to the shift register. It is then possible for the rings and sections that have been hit to be indicated in the score indicator. For this, it is an advantage if the score indicator is in turn provided with a shift register and decoders. Indication on the score indicator can be made in analogous manner, or digitally. Advantageously, the ring value is indicated digitally. The section is preferably indicated in analogous manner by lights associated with the sections.

An advantageous design of the target mechanism includes as a detector a television camera with a collecting lens connected upstream in the plane of the target image. It is a particular advantage to use semiconductor television cameras which contain the semi-conductor elements assigned to the image areas. It is possible to use as score indicator a monitor on which a target image is faded-in. As a result, it is possible to produce an accurate illustration of the shot in the target image. It is an advantage if a score indicator of this type is equipped also with a microprocessor which determines the ring value that has been scored and indicates it in a digital display.

The present installation makes it possible to simulate conventional shooting situations accurately. The installation is particularly suitable for simulating competitive shooting or target practices in shooting ranges, both with pistols and with guns. Consistently good results are obtained, whether shooting is simulated with a gun towards a 100 cm disc at 300 m or shooting with an air pistol towards a 10 cm disc at 10 m. Simulation of field firing is also possible, in which case any target image desired can be faded-in in the target mechanism. The sensors of the detector can be coordinated with target areas of the target image. A target mechanism of this type can be set up anywhere. The installation is also suitable for enclosed areas where target practice can be simulated without any danger.

Various forms of installations according to the invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows an installation for simulated shooting in schematic form;

Figure 2 shows the arrangement of a pulse emitter, of a calibrated adjusting device, and of the plane of a target image in schematic form;

Figure 3 shows a conventional pistol reequipped for simulated shooting in schematic form and partially cut-away;

Figure 4 shows a target mechanism with faded-in target image in longitudinal section and in schematic form;

Figure 5 shows a block circuit diagram of a target mechanism and of a score indicator in schematic form;

Figure 6 shows a target mechanism with an aspherical lens, in longitudinal section and in schematic form;

Figure 7 shows a further target mechanism with a Fresnel lens, in schematic form and in longitudinal section;

Figure 8 shows a further target mechanism with a television camera and a score indicator in the form of a monitor, in schematic form; and

Figure 9 shows the chamfer of a chamfered lens in schematic form.

Figure 1 shows an installation for simulated shooting with a shooting device 2 in the form of a rifle, which has a pulse emitter 4 for emitting a pulse of radiation 6 on to a target mechanism 8. The pulse emitter 4 contains a calibrated adjusting device 12 for the pulses of radiation in order to adjust to the calibre of the shooting device their diameter of incidence in the plane of the

target image of the target mechanism 8. The target mechanism 8 is further equipped with a score indicator 14 which, in the present example, indicates, in each case digitally, the rings which have been hit and also the target section. The pulse emitter 4 is fed by a supply mechanism 16 arranged in the shooting device, the mechanism being connected to a source of current by means of a lead 18. In contrast to the example shown, it would also be possible to arrange the supply mechanism 16 and, optionally, the source of rays 10 outside the shooting device 2. In the case of a source of rays 10 arranged outside the shooting device, the source is to be connected to the adjusting device 12 by means of a light conductor.

Figure 2 shows a pulse emitter which is particularly suitable for simulating a shooting operation at a considerable distance. This pulse emitter contains a laser tube 20 as the source of rays 10, which tube operates, for example, on a helium-neon basis and projects an uninterrupted beam 22 on to the adjusting device 12. This device contains firstly two diverging lenses 24 for propagating the practically parallel beam 22. The propagated bundle of rays is collected again and focussed in a lens 26 with converging lenses 28. During this time, the lens 26 in the housing 30 of the adjusting device 12 is displaceable by means of a control 32. The path of displacement is so calibrated that the emitted beam can be so adjusted according to the distance of the plane Z of the target image, that the diameter of incidence D corresponds to the calibre of the shooting device. In order to emit an individual pulse of radiation, a shutter 34 is arranged in the path of rays between the laser tube 20 and the adjusting device 12, which shutter in the rest position is always closed and interrupts the path of rays. The shutter 34 is actuated by means of an electromagnet 36 which can be connected to an electric current in order to open the shutter by means of the trigger 38 of the shooting device. The length of a pulse of radiation is determined by a timing member 40, for example, an RC-network, which can be adjusted. As a result, the length of the pulse can be adjusted to a value corresponding to the period of time between the pulling of the trigger of an ordinary shooting device and the discharge of the shot from the barrel.

Figure 3 shows a conventional pistol as the shooting device 2, which has been re-equipped for use in simulated shooting. For this, the pistol contains a pulse emitter 42 which is designed as an attachment insertable into the barrel 44 of the pistol. The attachment is connected by means of a plug connection 46 to a switch which is designed as an insertable switch 48 in the form of a cartridge, which is placed in the barrel 44 of the shooting device in place of a conventional cartridge. In the cartridge magazine 50 a supply mechanism 52 is arranged, which is in the form of an insertable magazine, which mechanism is in contact with the insertable switch 48 by means of a contact lug 54. By removing the pulse emitter 42, the switch 48 and the supply mechanism 52 in the form of an insertable magazine, the shooting device can be re-used immediately as an ordinary gun.

The pulse emitter 42 of the shooting device in the form of a pistol has a light-emitting diode 56 as a source of rays which is, for example, a laser diode or an infra-red diode. The light-emitting diode is arranged directly in the tubular casing 58 of the adjusting device 60. The latter device has a condenser 62, downstream of which is connected an objective lens 64 for collecting and focussing the rays. In the common focal point of the condenser 62 and of the lens 64, an aperture 66 is arranged in order to give the concentrated beam a circular cross-section. The lens 64 is arranged in an annular mount 68 which is adjustable in an axial direction on the tubular housing 58, for example, by means of a thread in order so to adjust the emitted pulse of radiation 70 in the plane of a target image which is not shown, that its diameter of incidence corresponds to the calibre of the shooting device. The path of adjustment of the lens is calibrated so that the lens has to be adjusted simply to the distance of the target mechanism.

The switch 48 is in the form of a shell and is made of electrically insulating material. It contains on the side facing the firing pin a contact ring 72 which is in connection with the contact lug 54 of the supply mechanism 52. The contact ring 72 is connected to a first contact 74, which contact is positoned opposite a second contact 76 connected to the plug connection 46. When the trigger of the shooting device is pulled, and in the firing position, the firing pin 78 bridges the contacts 74 and 76 so that current can flow from the supply mechanism 52 to the pulse emitter 42. In contrast to the example shown, the insertable switch could be so designed that the firing pin brings two switching contacts into direct contact.

In contrast to the embodiments shown, it is possible so to design the switching device for release of the pulse of radiation that it has a piezoelectric device for release of the pulse of radiation, which device responds to the impact of the firing pin. A piezoelectric device of this type could be arranged, for example, in a supply mechanism arranged on the shooting device and thus be subjected to the impact of the firing pin.

In Figure 4, a target mechanism 80 is shown, which contains in the plane Z of the

target image a collecting lens 82, which transmits a pulse of radiation 6 to a detector 84. Upstream of the detector there is arranged firstly an interference filter 86 for excluding the effect of other light, and in front of this a diffusing lens 88 is arranged. The optical device of the target mechanism 80 works according to the priciple of the Galilean telescope. Upstream of the collecting lens 82 a semi-reflecting mirror 90 is arranged in an inclined manner, at an angle of 45° to the path of rays, in order to fade-in a target image from an original 92. The pulse of radiation 6 incident on the target mechanism 80 is deflected and concentrated through the collecting lens on to the detector 84. The detector 84 accordingly has a substantially smaller face than the target image in the plane Z of the target image.

Figure 5 shows a block circuit diagram for evaluating the score of the pulses of radiation incident on the detector 84. The detector 84 is divided into rings $R_1$ to $R_{10}$ in accordance with the target disc, and, in addition, is divided into eight sections $S_1$ to $S_8$. Each ring section 94 and also the centre 96 are constructed as sensors for detecting an incident pulse of radiation. The sensors are preferably phototransistors on a silicon base. For this, the portions of the detector corresponding to the rings are designed as collectors and the portions corresponding to the sectors as emitters. In order to evaluate the score, the individual collectors of the ring are connected to a first coder 98 and the emitters corresponding to the sections are connected to a second coder 100. The coders are so designed that they determine in each case only the end of a pulse of the incident pulses of radiation. Furthermore, the first coder is so designed that in the case of a shot which hits two rings, it evaluates each time only the ring of higher value. In the coders, the signals received are coded after evaluation and transmitted to a shift register 102. The register is connected to a further shift register 104 of a score indicator 106. A clock generator 108, common to both, serves to trigger the shift registers 102 and 104. Downstream of the shift register 104 of the score indicator 106 are connected a first decoder 110 and a second decoder 112 which decode the coded signals and transmit them to an indicating device 114 and 116. In the indicating device 114 the ring value scored is indicated digitally, while the indicating device 116 consists of eight indicating lamps 118 which are arranged according to the sectional arrangement of the target disc, and each one lights up if the shot is in its associated sector.

According to the same principle, other target images or disc divisions can also be evaluated.

Figures 6 and 7 show further target mechanisms which have an aspherical lens 120 or a Fresnel lens 122 respectively, as collecting lenses.

In Figure 8 a further target mechanism 124 is shown with a score indicator 126. The target mechanism 124 contains a television camera 128 having a collecting lens 130 connected upstream in the plane Z of the target image. The television camera is preferably a semi-conductor camera which is fitted with a number of semi-conductors corresponding to the number of image points, so that certain image areas are assigned certain semi-conductors. The score indicator 126 is in the form of a monitor, in which it is possible to fade-in a target image 132 in a precisely adjusted manner, by means of an appropriate device. As a result, the shot can be indicated accurately at every point of the target image, which means that it is unnecessary for the target image to be divided into sections. Advantageously, the score indicator is additionally fitted with a microprocessor and a digital indicator which, for example, determines the ring value of the ring on a target disc which has been hit and indicates it digitally.

Figure 9 shows in schematic form a chamfer 134 of a collecting lens in the form of a chamfered lens. A chamfer 134 of this type makes it possible for the chamfered area to be evaluated with a sensor 136 which is almost a point sensor.

WHAT WE CLAIM IS:—

1. An installation for simulated shooting comprising a weapon which has a pulse emitter and a target mechanism having a target image and a score indicator, wherein the weapon has an optical adjusting device for adjusting to the calibre of the weapon the diameter in the plane of the target image of pulses of radiation emitted by the pulse emitter, and wherein the pulse emitter is connected to an electrical supply mechanism and has an adjustable electrical timing member.

2. An installation as claimed in claim 1, wherein in use the timing member is so adjusted that the length of the pulse of radiation corresponds to the length of time from pulling the trigger of the weapon to the discharge of a projectile from the barrel from an equivalent conventional weapon.

3. An installation as claimed in claim 1 or claim 2, wherein a cartridge-like switch-insert is inserted into the barrel of the weapon and has two contacts which are bridged by means of the firing pin of the weapon when the weapon is fired.

4. An installation as claimed in claim 3, wherein the switch insert has a casing of electrically insulating material having a contact ring, the ring cooperating with a contact lug of the supply mechanism for the pulse emitter.

5. An installation as claimed in claim 3, wherein the switch insert is electrically connected to the pulse emitter by means of a plug connection.

6. An installation as claimed in any one of claims 1 to 5, wherein the pulse emitter is a laser pulse emitter.

7. An installation as claimed in claim 6, wherein the pulse emitter has a laser tube.

8. An installation as claimed in claim 7, wherein the laser tube is connected to the weapon by means of a light conductor.

9. An installation as claimed in any one of claims 6 to 8, wherein the laser is a helium neon laser.

10. An installation as claimed in any one of claims 1 to 9, wherein the optical adjusting device has lenses associated with the pulse emitter arranged to cause the pulse of radiation to diverge and further lenses downstream thereof for focussing the emitted pulse of radiation.

11. An installation as claimed in claim 10, wherein the lenses for focussing the emitted pulse of radiation can be moved parallel to the optical axis to adjust the pulse.

12. An installation as claimed in any one of claims 1 to 9, wherein the adjusting device has a lens system having a condenser and an objective, in the common focal point of which an aperture stop is arranged.

13. An installation as claimed in any one of claims 1 to 12, wherein the optical adjusting device is in the form of an attachment that can be inserted into the barrel of the weapon.

14. An installation as claimed in any one of claims 1 to 13, wherein the pulse emitter for emitting a pulse of radiation has a shutter, which is arranged in the path of the radiation and is connected with the trigger of the weapon.

15. An installation as claimed in any one of claims 1 to 14, wherein the target mechanism has a target image divided into target areas and a detector in which there is assigned to every target area a sensor responsive to an incident pulse of radiation.

16. An installation as claimed in any one of claims 1 to 15, wherein the face of the or a target mechanism detector is smaller than its assigned target area of the target image, there being provided between the target image plane and the detector an optical device for deflecting a pulse of radiation incident in the plane of the target image onto the sensor and reducing the diameter of the pulse.

17. An installation as claimed in claim 16, wherein a collecting lens is arranged in the target image plane.

18. An installation as claimed in claim 17, wherein the collecting lens is a Fresnel lens.

19. An installation as claimed in claim 17, wherein the collecting lens is an aspherical lens.

20. An installation as claimed in claim 17, wherein the collecting lens is a chamfered lens, there being arranged a sensor in the focal point of each chamfer.

21. An installation as claimed in any one of claims 1 to 20, wherein a diffusing lens is arranged upstream of the detector.

22. An installation as claimed in any one of claims 1 to 21, wherein there is arranged upstream of the or a target mechanism detector a device for excluding the effect of light other than light from the pulse emitter.

23. An installation as claimed in claim 22, wherein the device for excluding the effect of other light is an interference filter.

24. An installation as claimed in claim 23, wherein the interference filter is an interference filter film.

25. An installation as claimed in claim 24 when dependent upon any one of claims 17 to 20, wherein the interference filter film is arranged on the reverse side of the collecting lens.

26. An installation as claimed in any one of claims 1 to 25, wherein the target mechanism has a device for fading in a target image.

27. An installation as claimed in claim 26, wherein the device for fading-in a target image is a semi-reflecting mirror.

28. An installation as claimed in claim 15, wherein the sensors are photosensitive elements.

29. An installation as claimed in claim 28, wherein the sensors are phototransistors.

30. An installation as claimed in any one of claims 1 to 29, wherein when a target disc is used as a target image, the image is divided into rings and sectors, the detector having sensors corresponding to the ring sectors.

31. An installation as claimed in claim 30, wherein the detector has phototransistors as sensors, the collectors being designed as rings and the emitters as sectors.

32. An installation as claimed in claim 30 or claim 31, wherein the target mechanism has an evaluating device which contains a first coder connected to the rings and a second coder connected to the sectors which transmit coded ring and section signals, corresponding to a ring section which has been hit, to a shift register, which is connected to a second shift register which is connected to decoders for the score indicator.

33. An installation as claimed in claim 32, wherein the first coder is so designed that in the case of a shot which hits two rings, it transmits only the higher ring value to the shift register.

34. An installation as claimed in any one of claims 30 to 33, wherein the score indicator is designed to display the rings and sectors which have been hit.

35. An installation as claimed in claim 34, wherein the score indicator indicates digitally the ring values scored.

36. An installation as claimed in any one of claims 30 to 35, wherein the score indicator displays in an analogue manner the sectors which have been hit.

37. An installation as claimed in any one of claims 1 to 27, wherein the or a target mechanism detector is a television camera.

38. An installation as claimed in claim 37, wherein the camera is a semi-conductor television camera.

39. An installation as claimed in claim 37 or claim 38, wherein the score indicator is a monitor with a faded-in target image.

40. An installation as claimed in claim 39, wherein the score indicator has a microprocessor for determining and displaying digitally the ring value scored.

41. An installation as claimed in any one of claims 1 to 40, wherein the target mechanism has an evaluating device for the detected pulses of radiation, which device contains a mechanism for evaluating in each case only the end of a pulse of radiation.

42. An installation as claimed in claim 1 and substantially as hereinbefore described with reference to, and as illustrated in, Fig. 1 of the accompanying drawings.

43. An installation as claimed in claim 1 which includes parts substantially as hereinbefore described with reference to, and as illustrated in, any one of Figs. 2 to 9 of the accompanying drawings.

44. A weapon suitable for use as the said weapon in an installation as claimed in any one of claims 1 to 14.

ABEL & IMRAY,
Chartered Patent Agents,
Northumberland House,
303-306 High Holborn,
London, WC1V 7LH.

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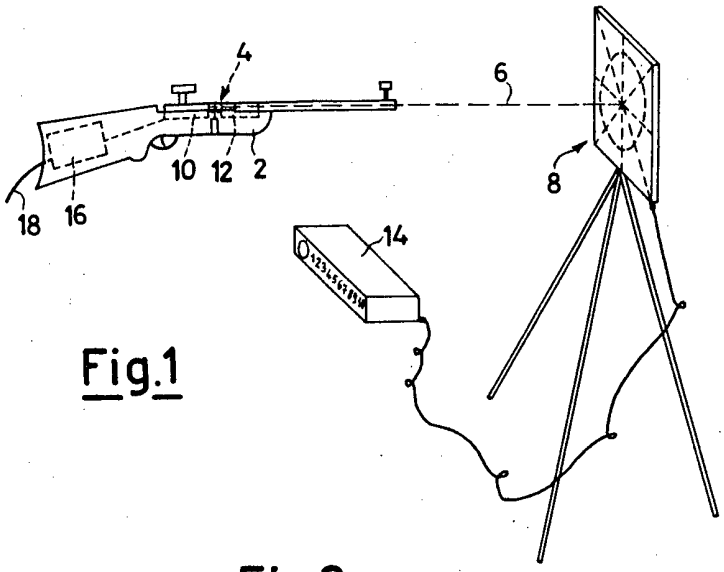
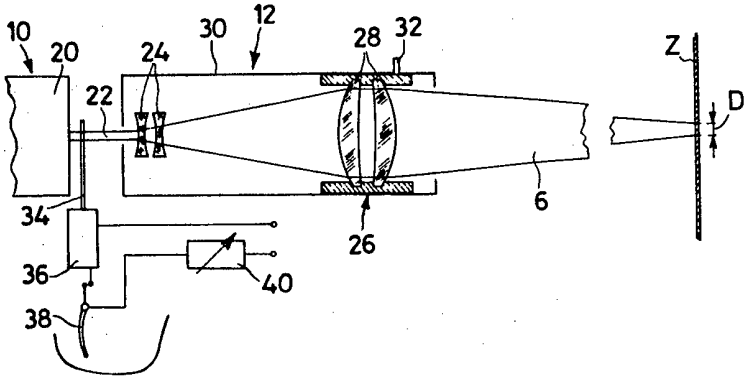



Fig.1

Fig.2



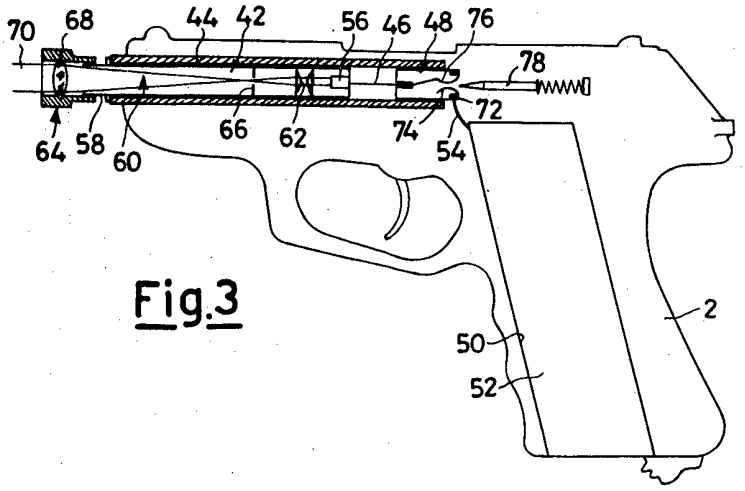



Fig.3

Fig.6

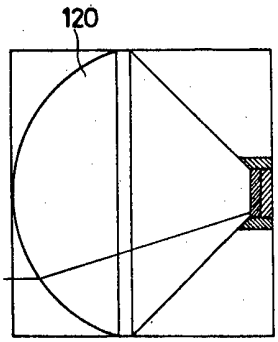



Fig.7

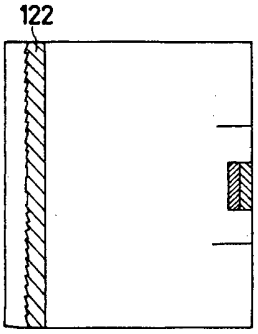


Fig.4

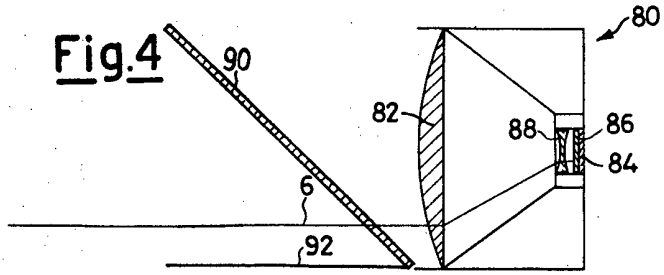

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Fig.5

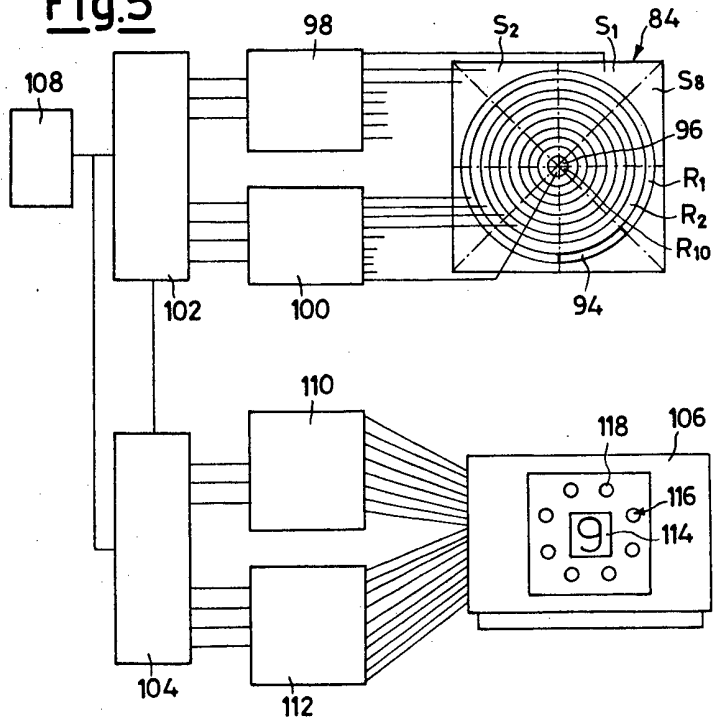
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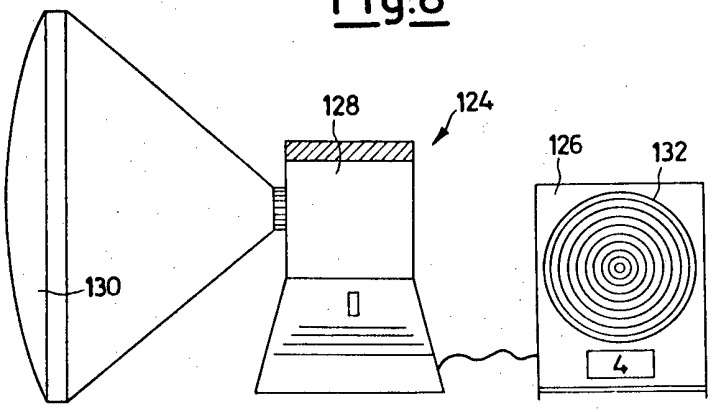
Fig.8



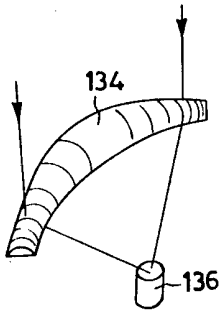




Fig.9