April 21, 1959 R. D. BOGNER ET AL 2,883,194

AUTOMATIC TARGET RANGE

Original Filed April 27, 1955 6 Sheets-Sheet 1

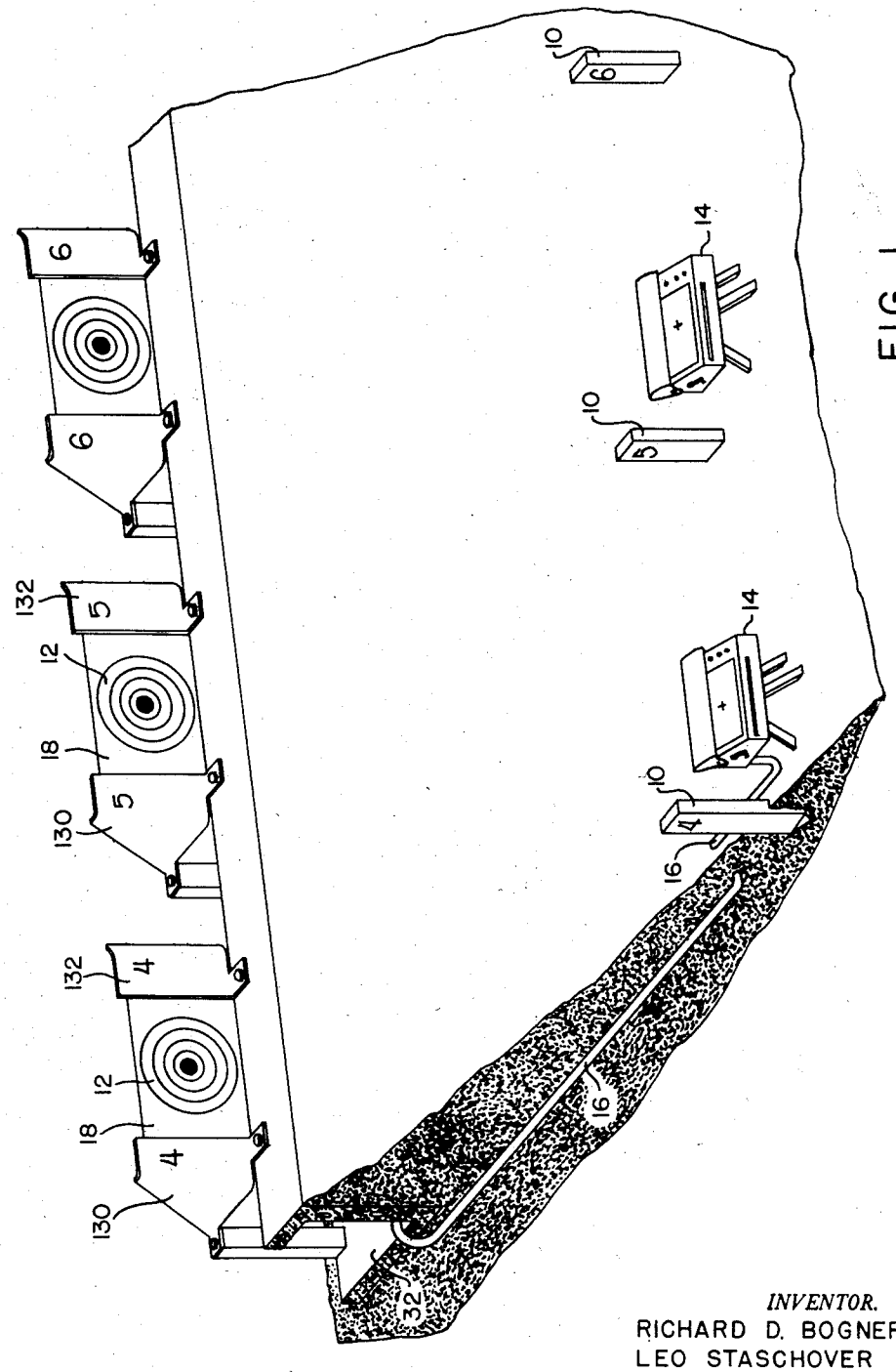

FIG. 1

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AUTOMATIC TARGET RANGE

Original Filed April 27, 1955 6 Sheets-Sheet 2

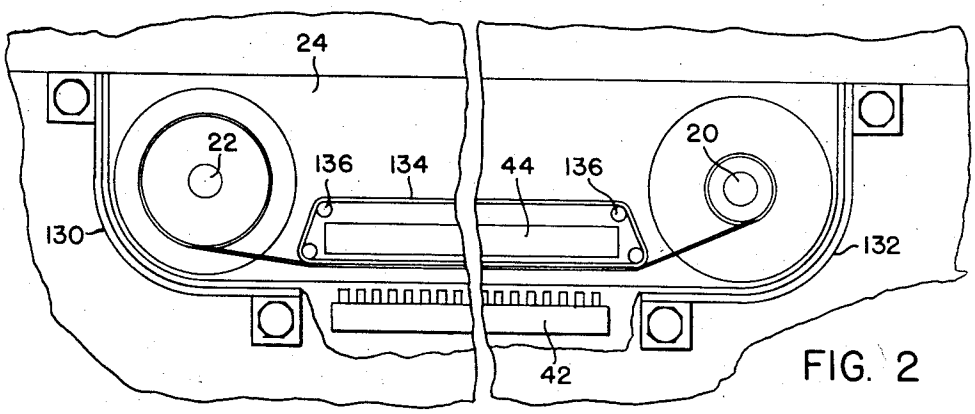

FIG. 2

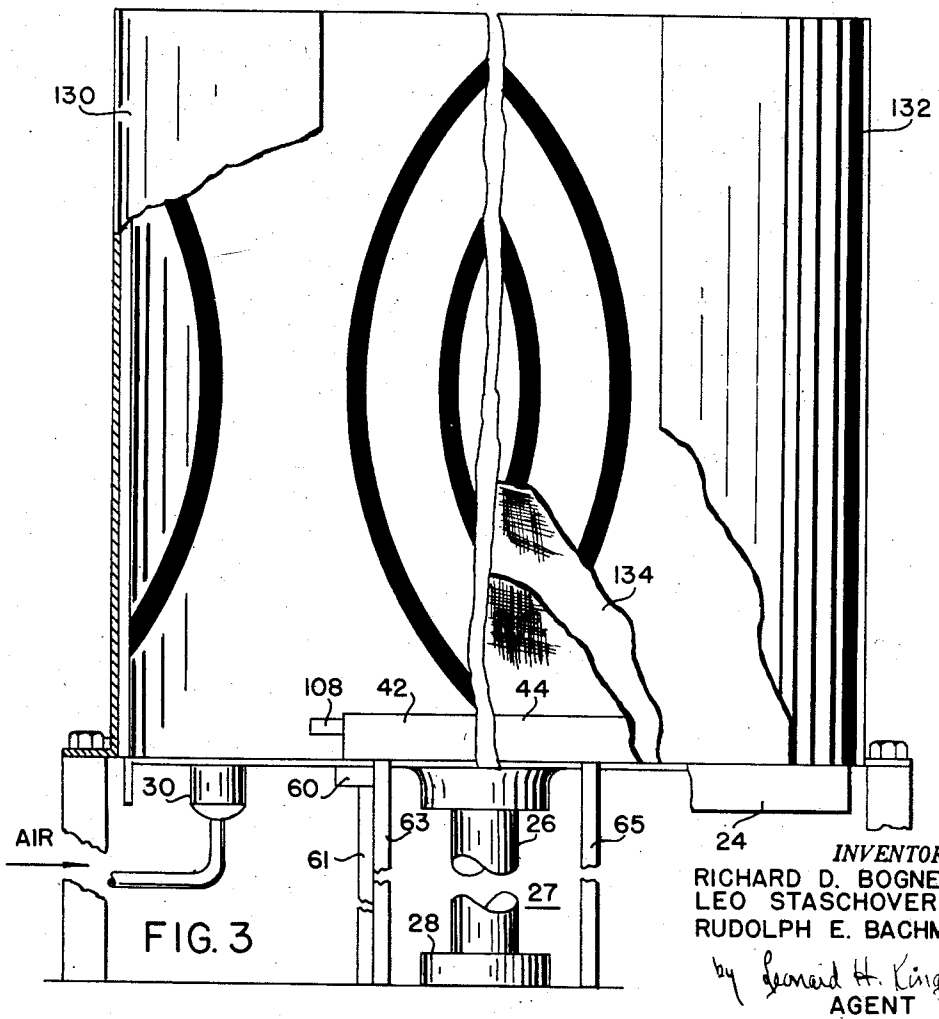

FIG. 3

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AUTOMATIC TARGET RANGE

Original Filed April 27, 1955 6 Sheets-Sheet 3

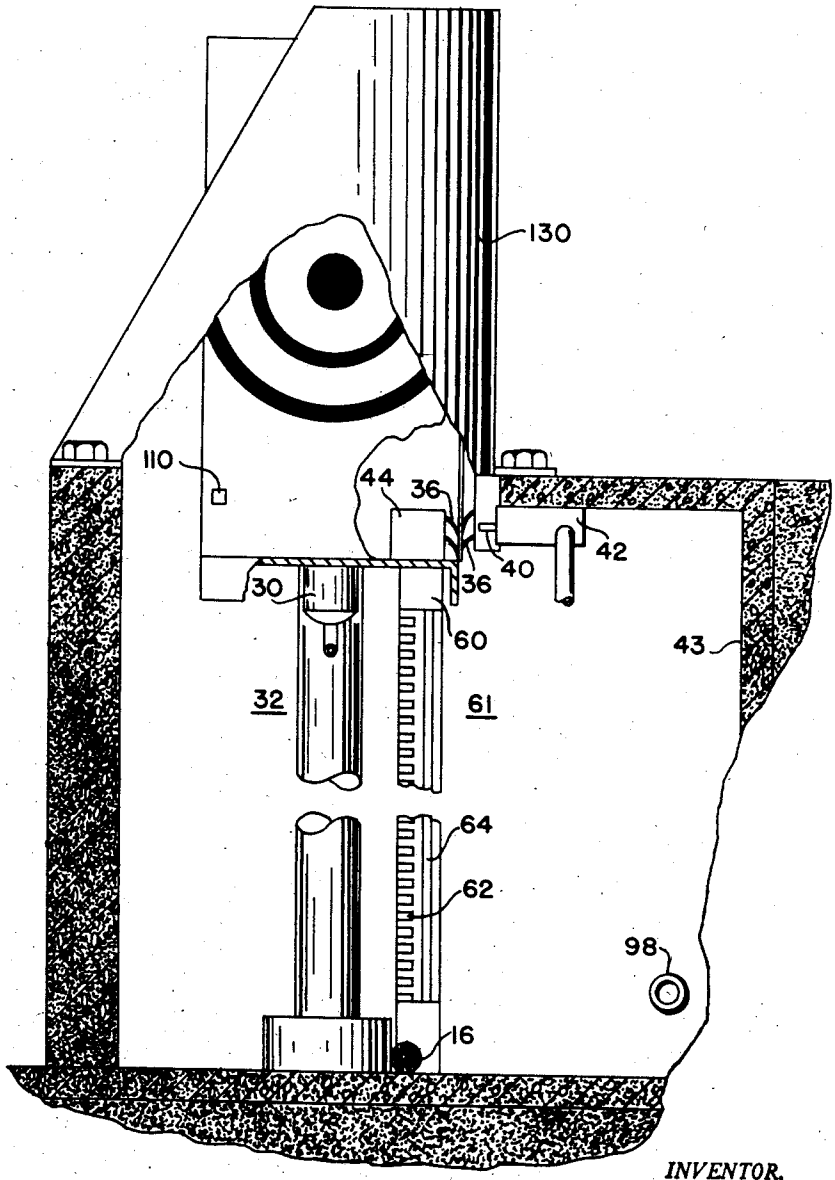

FIG. 4

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AUTOMATIC TARGET RANGE

Original Filed April 27, 1955 6 Sheets-Sheet 4

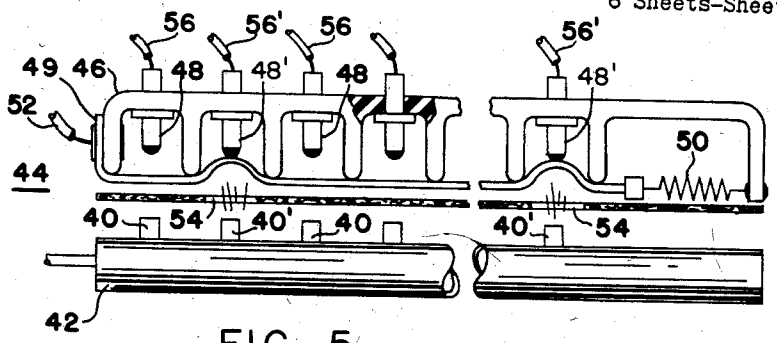

FIG. 5

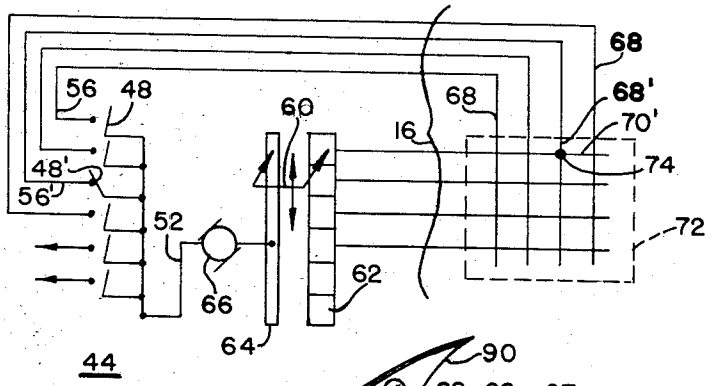

FIG. 6

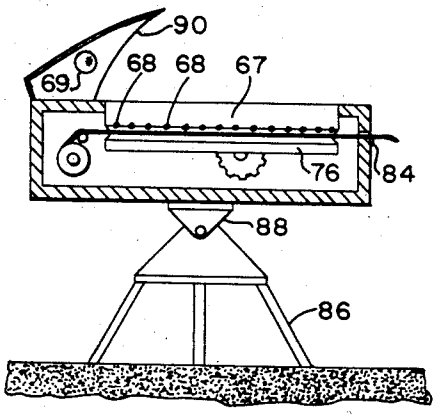

FIG. 8

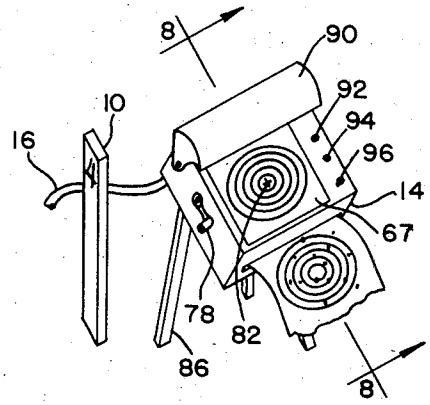

FIG. 7

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AUTOMATIC TARGET RANGE

Original Filed April 27, 1955 6 Sheets-Sheet 5

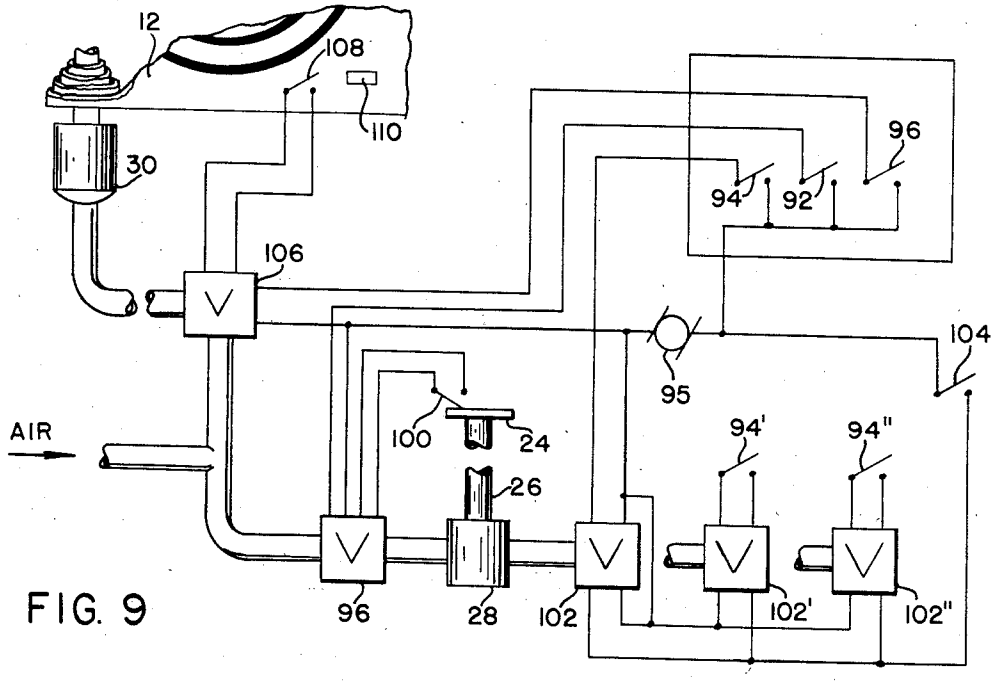

FIG. 9

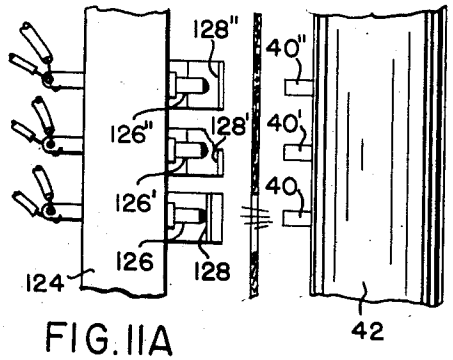

FIG. IIA

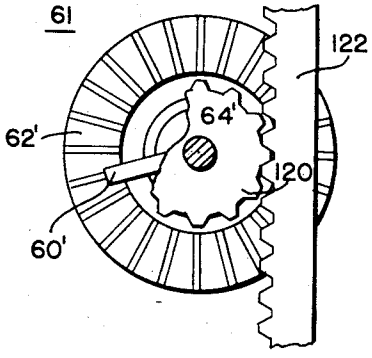

FIG. 10

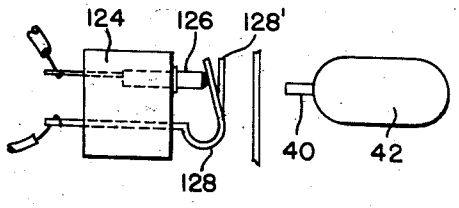

FIG. 11

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AUTOMATIC TARGET RANGE

Original Filed April 27, 1955 6 Sheets-Sheet 6

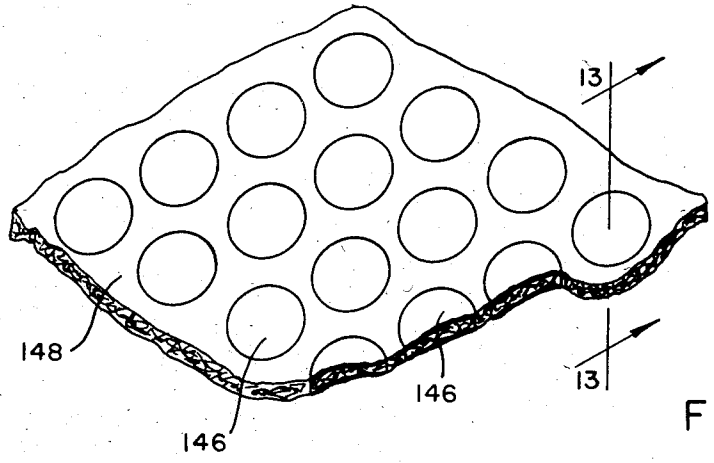


FIG. 12

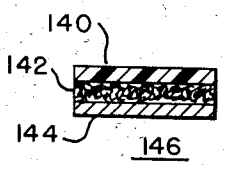


FIG. 13

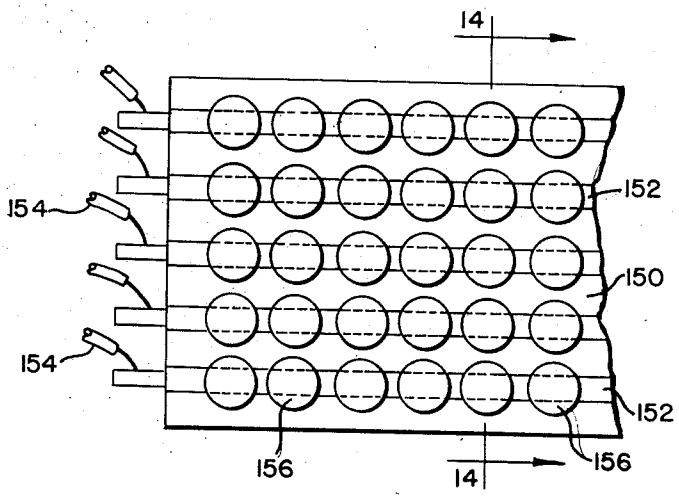
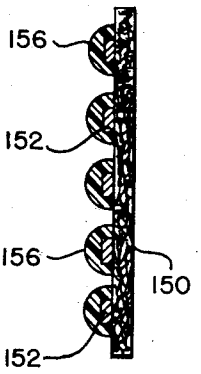


FIG. 15

FIG. 14



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United States Patent Office 2,883,194 Patented Apr. 21, 1959

2,883,194

AUTOMATIC TARGET RANGE

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Substituted for abandoned application Serial No. 504,223, April 27, 1955. This application October 25, 1957, Serial No. 692,966

10 Claims. (Cl. 273—105.6)

This application is a substitute for Serial Number 504,223, filed April 27, 1955, which is now abandoned.

This invention relates to a remote scoring apparatus for rifle ranges and the like.

In the operation of rifle ranges, as by the military for example, a target is located at a distance from the rifleman. Beneath the target in a pit there is stationed an operator whose sole function is servicing the target which includes the changing of the paper targets and scoring of the hits. This system has several basic objections. The employment of personnel to perform a task that can be performed by a machine is wasteful of manpower. Men positioned in the pit are in danger of ricocheting bullets. The present manual system also lacks versatility in that it is inconvenient and time consuming to inform the rifleman of the precise location of each shot. In particular, a need exists for means to conveniently advise the rifleman of his results after each round so that he may appropriately change the adjustment of his rifle sights or correct his firing technique.

Accordingly, it is an object of this invention to provide a fully automatic, remotely-operated target and scoring system.

It is another object of this invention to provide a remotely controlled scoring system for fire arms.

It is still another object of this invention to provide a rapidly acting scoring system for rifle ranges.

A particular object of this invention is to provide a rifle range scoring system incorporating a permanent recording means.

A still different object of this invention is to provide a highly accurate hit location detection system for a rifle target.

It is still a different object of this invention to provide a rugged hit detection system for targets.

Another object of this invention is to provide an apparatus for repeatedly detecting hits in a given target after a selected number of rounds have been fired without introducing ambiguities.

A particular object is to provide a multiple target firing range having means for simultaneously operating all targets.

Another object of this invention is to provide an improved hit sensing means.

A further object of this invention is to provide an air actuated hit sensing means.

A different object is to provide an improved electrosensitive recording medium.

Still other objects and advantages will be pointed out with particularity and still others will become apparent from consideration of the following description studied in conjunction with the accompanying drawings in which:

Figure 1 is a pictorial view of the rifle range of this invention.

Figure 2 is a top view of the target supporting apparatus.

Figure 3 is a front elevational view of the apparatus of Figure 2.

Figure 4 is a side elevational view of the apparatus of Figure 3.

Figure 5 is an enlarged plan view of the sensing device of this invention.

Figure 6 is a schematic diagram of the indicating circuit of a device of this invention.

Figure 7 is a pictorial view of a recording apparatus of this invention.

Figure 8 is a cross-section of the apparatus of Figure 7, taken on line 8—8 of Figure 7.

Figure 9 is a diagram of a control circuit, partly in schematic and partly in perspective.

Figure 10 is an elevational view of a commutator in a device of this invention.

Figure 11 shows in elevation an air-pressure sensitive detection means employed in the apparatus of this invention.

Figure 11A is a plan view of a portion of a typical bank of the detection means shown in Figure 11.

Figure 12 discloses pictorially an improved electrosensitive recording medium for a device of this invention.

Figure 13 shows an electrosensitive element forming a portion of the medium of Figure 12.

Figure 14 shows, greatly enlarged, a side view of a portion of an alternative sensing medium.

Figure 15 shows in plan a view of the sensing medium of Figure 14.

In the various figures, like numbers refer to like parts.

In Figure 1 there is shown a typical rifle range employing the apparatus of this invention. A plurality of firing positions identified by numbered range stakes **10** are provided with a target **12** and a recorder **14** connected by cable **16** to sensing devices disclosed more fully hereinafter. The cable **16** may be run underground as a protection against bullets. A plurality of targets **12** are printed on a roll of paper **18**.

With reference to Figure 2, the roll **18** is placed on spindle **20** and connected to a take-up spool **22**. The spool arrangement is shown in Figures 2, 3 and 4 wherein supporting frame **24** supports spindle **20** and take-up spool **22**. Frame **24** is mounted on piston **26** which fits in cylinder **28** so as to provide a conventional pneumatic lift arrangement **27**. Pneumatically operated motor **30** operates take-up spool **22**.

By means of pneumatic lift **27** target **12** may be lowered into pit **32** and therefore out of the line of fire. As will be explained hereinafter a master control is provided which enables the firing range officer to simultaneously drop all targets. In the performance of the rapid firing test, for example, participants are required to fire a given number of rounds in a prescribed period of time. In the prior type of range, riflemen could fire after the signal to stop firing was given and have the shot recorded. In the range of this invention the targets can be dropped at the signal so that only shots fired before the "stopping" signal is given can effectively hit the targets.

As shown in Figure 4, target **12** is lowered into the pit by action of pneumatic lift **27**. Fingers **36** located on both sides of paper sheet **18** maintain the paper in a rigid condition in a restricted region opposite orifices **40** in air manifold **42**. Manifold **42** may be attached to the concrete wall **43**. Opposite each of the orifices **40** there is provided a sensing device **44**. Such a sensing device is shown in the plan view of Figure 5. An insulating plastic base **46** supports a number of horizontally aligned contacts **48**. A flexible metal band **49** is held in tension opposite contacts **48** by means of spring **50**. Bullet holes **54** through the target permit air from orifices **40'** to deform band **49** so as to touch the corresponding contact, to thus complete the circuit from lead **52** to lead **56'**.

Thus sensing element 44 serves to detect bullet holes in a series of vertical lines. There are 250 individual contacts provided for a 6' target providing a resolution of approximately 0.3". This resolution is adequate for the purpose as a .30 caliber bullet will produce a 0.3" hole at a range of 300 yards.

As shown in Figure 4, as the target is lowered brush member 60 of vertical commutator 61 traverses commutator segments 62 and take-off 64 to provide information as to the horizontal line being sensed. The commutator 61 is provided with 250 segments to provide vertical resolution comparable to the horizontal resolution. A source of power 66 energizes the circuit. The commutator 61 may be attached to post 63 which in combination with post 65 supports sensing device 44.

Referring to Figure 6, it will be seen that an energized circuit now exists from power supply 66 through lead 52 through switch 48' and leads 56 through cable 16 to electrically conductive grid member 68', referred to hereinafter as a vertical grid member because it is connected to means for sensing vertically along the target. Likewise horizontal grid member 70' is connected to the power supply 66 through cable 16, commutator 62, brush 60, and take-off 64 to provide horizontal sensing.

It will be appreciated that a potential difference exists between vertical grid member 68' and horizontal grid member 70'.

An electro-sensitive recording paper 72 is positioned between the vertical grids 68 and horizontal grids 70. In the region common to a particular pair of energized grids, the potential difference will cause a mark to be formed on the paper in a region corresponding to that of the bullet hole in the target.

Physically, the said vertical and horizontal grids are located in recorder 14. As shown in Figure 8, transparent glass or plastic cover 67 supports vertical grids 68. Platen 76 carries horizontal grids 70. Platen 76 is spring loaded so as to provide a pressure contact between grids 68 and 70 and paper 72.

If the recorder is positioned with the recording medium in a horizontal plane, then both grids would be in a horizontal position also, with the recording medium therebetween.

Crank 78 serves to transport paper 72 so as to expose fresh portions as required. Such mechanisms which will release the platen and transport the paper are well known to the art and accordingly are not described herein in detail. A target 80 may be imprinted on the paper. This target 80 may be aligned by the use of cross-hairs 82 on cover 67.

There is also provided a serrated edge 84 for tearing off recorded sheets. Tripod 86 and pivot head 88 support the recorder 14. Hood 90 is intended as a sunshade and as a mount for a source of illumination such as an electric bulb 69.

A number of controls are provided for remote operation of the target. Switch 92 raises the target; switch 94 lowers the target; switch 96 moves the used target so as to expose a fresh target. As this is done, a fresh section of recording paper 72 is inserted in the recorder.

Referring to Figure 9, it will be appreciated that closing of switch 92 completes a circuit from power source 95 to latching type solenoid controlled valve 96. Valve 96 admits compressed air from a main 98 visible in Figure 4, into cylinder 23 (Figure 9) so as to raise lift piston 26 until frame member 24 closes limit switch 100. Closing of switch 100 in turn results in closing of valve 96. Thus once the operator closes the switch 92 the target is thereafter automatically positioned at the proper height.

Switch 94 actuates solenoid valve 102 which bleeds air from cylinder 98 so as to lower the target. Likewise, switches 94' and 94" actuate solenoid valves 102' and 102" which provide similar functions, as does valve 102, as part of adjacent range firing positions.

Switch 104 is a master control switch for actuating solenoid valves 102, 102' and 102" etc., so as to simultaneously lower all the targets on the firing range. A master switch not shown may also be provided for the purpose of simultaneously raising all targets.

Motor 30 is used to wind up paper 18 on take-up spool 22 and thus bring fresh targets 12 into position. Switch 96 actuates latching type solenoid valve 106 which admits air to motor 30 until the solenoid is de-energized by closing of switch 108 by action of hole 110 in the paper 18. Holes 110 are appropriately spaced in relation to imprinted targets 12 so that they serve to accurately position the targets 12 in the proper relation to the firing position.

In place of the commutator 61 shown in Figure 4, a rotary type 61' as shown in Figure 10 may be employed. This type employs radially deployed commutator segments 62', take-off track 64' and a brush 60'. In this embodiment brush 60' is carried by gear 120 which is rotated by rack 122 which is mounted so as to move up together with frame 24. The advantage of this embodiment lies in its adaptability to enclosure against dust and other environmental conditions.

In Figures 11 and 11A there is shown, in elevation and in plan respectively, an alternate type of air-pressure sensitive detection means. In this embodiment an insulating plastic base 124 supports contacts 126 and flexible metal reeds 128. Air from orifice 40 passing through bullet hole 130 is shown deflecting reed 128. Reeds 128' and 128" are shown in their undeflected position.

In order to protect the roll of target paper 18, spindle 20 and take-up spool 22 steel shields 130 and 132 are provided, as shown in Figure 1. The shields are supported from concrete pit walls 43.

As shown in Figure 2, in order to permit the use of thin economical paper 18, there is provided supporting canvas belt 134 which is arranged to move about rollers 136 as the paper is advanced so as to present a fresh surface and thus extend the belt life. The canvas belt serves as a windbreak and stiffener.

There are a number of commercially available electro-sensitive papers such as, for example, semi-conducting papers, which consist of a cuprous thio-cyanate coating 140 applied in combination with a lacquer binder to the paper stock 142. Certain of these papers employ a metallized backing 144. In utilizing such backed papers it is preferable to punch out segments 146 and insert them in a paper matrix 148 so as to electrically isolate them as shown in Figures 12 and 13.

In another embodiment, Figure 15, paper stock 150 is coated with electrically conductive metal or graphite strips 152. These strips 152 thus provide one set of conductive grids to which contact is made by means of spring or roller type brushes 154. The electro-sensitive recording medium 156 is printed as isolated clumps onto the strips 152. This embodiment permits the use of but one set of recording grids.

In place of the preferred pneumatically operated devices disclosed, it is contemplated that for selected installations, hydraulic, electrical or mechanical actuation means may be employed. Combinations of such means may be used. For example, the lift may be actuated by a rack gear or a hydraulic cylinder while the take-up spool motor may be an electrically energized type.

Other switching means may be substituted for switch 44 as, for example, a photoelectric cell actuated by a light source in place of air source 42.

While we have disclosed the best mode of carrying out the invention presently contemplated, we wish it understood that many changes may be made in the various constructional details and that accordingly we desire to be limited only by the scope of the appended claims.

What we claim as new is:

1. A rifle range comprising a target station and a marking station for permanently recording the position of bullet perforations on a target, the said target station

comprising a perforable target adapted to be raised and lowered, vertical scanning means for said target adapted to produce a first electrical potential, horizontal scanning means for said target adapted to produce a second electrical potential differing in value from said first potential, the said vertical and the said horizontal scanning means being disposed below the line of fire and adapted to scan said target with reference to bullet perforations as said target is lowered and brought into juxtaposition with said scanning means, conductor means adapted to carry said first and said second electrical potentials to said marking station, the said marking station comprising means to remotely control the raising and lowering of said target, means to remotely control the replacement of said target with a fresh target, and circuit connecting means for said first and said second potentials, said circuit connecting means including a first set of electrodes energizable by said first electrical potential, a second set of electrodes energizable by said second electrical potential, and a sheet of electro-sensitive recording medium interposed between said first and said second set of electrodes to complete an electrical circuit, whereby said medium is permanently marked by current flow upon energization of said electrodes, to indicate the perforated aspect of said target.

2. A device as in claim 1 wherein said vertical scanning means comprise a plurality of vertically disposed conductive segments traversed and contacted individually in sequence by a wiper adapted to move downwardly as said target is lowered, in synchronism with said target, said conductive segments being electrically connected to said first set of electrodes disposed at said marking station, corresponding in number to said vertically disposed segments, and a source of potential whereby said electrodes of said first set are energized individually in sequence corresponding to the electrical energization of the said vertical segments; and said horizontal scanning means comprise a plurality of horizontally aligned sensing elements adapted to be actuated whenever a perforation in said target appears in proximity with one of said sensing elements as said target is lowered, said sensing elements being electrically connected to a second set of a plurality of aligned electrodes disposed at said marking station, corresponding in number to said horizontally aligned sensing elements and a source of potential whereby said electrodes of said second set are energized individually in sequence corresponding to the electrical energization of the said horizontally aligned sensing elements.

3. A device as in claim 1 wherein said horizontal scanning means comprise a horizontally disposed air manifold having a plurality of air vents adapted to direct individual air streams upon said target when said target is moved downwardly past said air manifold, the said air streams then passing through the bullet perforations in said target, and sensing means adapted to be actuated by pressure of said air stream passing through said bullet perforations.

4. A device as in claim 1 wherein said horizontal scanning means comprise a horizontally disposed air manifold having a plurality of air vents adapted to direct individual air streams upon said target when said target is moved downwardly past said air manifold, the said air streams then passing through the bullet perforations in said target, a horizontal flexible electrically conductive band moved laterally by pressure of said air vents passing through said bullet perforations, a plurality of individual electrical contacts disposed in horizontal confronting relation to said conductive band whereby electrical connection is made by air pressure thrust between said band and said individual contact only at the point where a bullet perforation exists in said target, said individual electrical contacts being electrically connected to a said second set of a plurality of electrodes disposed at said marking station corresponding in number to said target station electrical contacts, whereby said electrodes

of said second set are individually energized by the presence of a bullet perforation in said target, so as to provide a difference in potential between a selected electrode of said second set and a selected electrode in said first set and thereby mark the said medium.

5. A device as in claim 1, wherein said marking means at said marking station comprise a support member, a platen mounted on said support member, a first set of parallel electrodes disposed in said platen, a flat transparent member disposed in abutting relation against said platen, a second set of parallel electrodes disposed in said transparent member, said second set being at right angles to said first set to form an electrode grid in conjunction with said first set, one of said electrode sets being in electrical contact with the said horizontal scanning means of said target station, the other of said electrode sets being in electrical contact with the said vertical scanning means of said target station, said electro-sensitive recording medium being interposed and securely retained between said platen and said transparent member, whereby the intersection of an individually energized electrode of said first set with an individually energized electrode of said second set will cause a current flow through said medium to permanently mark said medium at the said point of intersection in closely accurate correspondence to the point of said bullet perforation in said target.

6. A device as in claim 1 wherein said vertical scanning means comprise a vertically disposed rack adapted to be lowered in correspondence to the lowering of said target, a rotary brush geared to said rack and rotated thereby, a plurality of radially deployed commutator segments adapted to be wiped individually in sequence by said rotary brush, said commutator segments being electrically connected to a first set of a plurality of electrodes disposed at said marking station, corresponding in number to said radially deployed commutator segments, and a source of potential, whereby said electrodes are energized individually in sequence corresponding to the electrical energization of the said commutator segments.

7. A device as in claim 1 wherein said horizontal scanning means comprise a horizontally disposed air pipe having a plurality of air vents adapted to direct individual air streams upon said target when said target is moved downwardly past said air pipe, the said air streams then passing through the bullet perforations in said target, a plurality of flexible electrically conductive reeds, adapted to be moved laterally by pressure of said air streams passing through said bullet perforations, a plurality of individual electrical contacts disposed in horizontal confronting relation to said reeds whereby electrical connection is made by air pressure thrust between said reeds and the said individual contact corresponding to a bullet perforation in said target, each of said individual electrical contacts being electrically connected to a corresponding one of a plurality of electrodes of said second set of electrodes, disposed at said marking station, corresponding in number to said target station electrical contacts, and a source of electrical potential different in value than said first electrical potential, whereby selected ones of said second set of electrodes are individually energized by the presence of a bullet perforation in said target.

8. A target station and a marking station, an air operated pneumatic lift, positioned at said target station, valve means controlling air to said lift, means disposed at said marking station to remotely open said valve so as to raise said lift, means for automatically closing said valve means when said lift reaches a predetermined level, a roll of flexible sheeting bearing target markings, means for supporting said roll on said lift, means to maintain said flexible sheeting rigid, an air-driven motor and means associated therewith supported by said lift and adapted to transport said target-marked sheeting, means disposed at said marking station for remotely operating and control-

ling said motor, a plurality of air actuatable switch means arranged horizontally below the level of firing, a source of air positioned opposite each of said switch means, the said switches being actuated by air passing through bullet perforations in the target, said switches and air source being fixedly positioned so as to horizontally scan said target when said lift is lowered, a commutator provided with a plurality of conductive segments, a movable contact-making means arranged to be positioned in contact with one of said conductive segments in accordance with the position of said lift to vertically scan said target, a recording apparatus disposed in said marking station including a first set of electrodes electrically connected to said vertical scanning means, a second set of electrodes electrically connected to said horizontal scanning means, means to support an electro-sensitive recording medium between said first and said second sets of electrodes and in contact therewith, and means to electrically energize said vertical scanning means and said connected first set of electrodes with a first electrical potential, means to electrically energize said horizontal scanning means and said connected second set of electrodes with a second electrical potential differing in magnitude from said first electrical potential, whereby said electro-sensitive recording medium is permanently marked by a flow of current resulting from said potential difference to indicate the perforated aspect of said target.

9. A rifle range comprising in combination: an air-operated pneumatic lift; valve means controlling air to said lift; means to remotely open said valve means so as to raise said lift; means for automatically closing said valve means when said lift reaches a predetermined level; a roll of flexible sheeting bearing target markings; means for supporting said roll on said lift; an air driven motor

and means associated therewith supported by said lift and adapted to transport said target-marked sheeting; remotely operated means for controlling said motor; means to maintain said flexible sheeting rigid; a plurality of air actuatable switch means arranged in a horizontal row and a source of air positioned opposite each of said switch means, the said switches being actuated by air passing through bullet perforations in the target, said switches and air source being fixedly positioned so as to horizontally scan said target when said lift is lowered; a commutator provided with a plurality of conductive segments; a movable contact-making means arranged to be positioned in contact with one of said conductive segments in accordance with the position of said lift, to vertically scan said target; a recording apparatus including a first set of electrodes connected to said vertical scanning means; a second set of electrodes connected to said horizontal scanning means; means to support an electro-sensitive recording medium between said first and second sets of electrodes and in contact therewith; and means to electrically energize said electrodes, whereby the passage of electric current through said electro-sensitive recording medium indicates the perforated aspect of said target.

10. The apparatus of claim 9 wherein said means for supporting said flexible sheeting consists of a flexible belt supported by said lift.

References Cited in the file of this patent

UNITED STATES PATENTS

966,361	Rose	Aug. 2, 1910
1,185,720	Rose	June 6, 1916
2,104,171	Schwerin	Jan. 4, 1938
2,767,987	Klose	Oct. 23, 1956