TARGET HIT INDICATOR

Fig. 1

INVENTOR

JOSEPH G. EDRICH

INVENTOR

JOSEPH G. EDRICH

BY

ATTORNEYS
This invention relates, in general, to an indicating device and more specifically to a device that automatically indicates, in a visual manner, the actual area of impact of a projectile upon a replica of a target that is located at a convenient, remote location.

At the present time, the usual method of determining the area of impact of a bullet upon a target consists of observing the target through a telescope after each round and noting the location of the hit.

The main disadvantage with this method is that it is time consuming; requires two men, one to fire the gun and one to observe the target; and the actual area of impact of the bullet is difficult to detect on a target that has been used previously. Another method of locating the area of impact is to position the target upon a vertical track adjacent to a well-protected area, such as a trench observation post. After each round is fired, the observer lowers the target, marks the location of the hit, and then raises the target to its ready position. This method also requires the use of two men, is time consuming, and exposes the observer in the trench to possible injury that can result from ricochet bullets or from misinterpretation of signals.

To correct these serious defects, targets have been developed that convert the location of the area of penetration of a projectile upon said target into discrete information. The generated information appears in the form of voltages that represent either the polar coordinates or the rectangular coordinates, or both, of the actual area of impact.

This invention cooperates with a target that indicates the location of the area of impact of a projectile upon said target by generating a plurality of voltages. The generated voltages are fed into this device to indicate accurately and automatically the location of the actual hit. This invention consists of an indicator over which is placed a replica of the actual target. Each time that a hit is made upon the target, a small dark circular spot appears in the same relative position on the indicator. The appearance of the dark spot creates the impression that holes are actually being shot into the target indicator. The generator of a dark spot in contrast to a light background results in a visual presentation that is readable over a very wide range of light conditions and at varying distances from the indicator. The indicator is portable and can be adjusted to indicate normal or rapid fire. Under conditions of normal fire, a hit indication persists until a subsequent hit is sustained, at which time the original hit indication automatically disappears and the new hit location is presented. Under the condition of rapid fire, all hit indications persist so that the target indicator presents a multiplicity of hit locations. The hit indications can be erased manually at any time by the observer.

The primary object of this invention is to reproduce accurately at some convenient remote location, intelligence as to the area of impact of a projectile upon a target.

An additional object is to provide a target indicator that is readable over a wide range of light conditions and at varying distances from the indicator.

A further object is to provide a device that indicates a single hit, or multiple hits, at any particular instant. Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is an isometric view of a target indicator showing the face plate, the overlay card that contains a facsimile of the target configuration, and the actual target that is located at some remote location;

Figure 2 is an enlarged detail view showing a cross section of the indicator through one of the plunger solenoids but omitting the larger slide bar solenoids;

Figure 3 is a perspective view showing the interconnection between the slide bar solenoids, the slide bars, and the plunger solenoid;

Figure 4 is a section taken on the line 4—4 of Figure 1; and Figure 5 is a section taken on the line 5—5 of Figure 1. Similar numerals refer to similar parts throughout the several views.

The target hit indicator 2 is electrically connected to a target 4 through the cable 5. The target 4 is of the voltage generating type wherein a discrete voltage is generated in accordance with the location of the area of penetration. This type of target is described and disclosed in complete detail in the patent application of Thomas Mongello, filed on January 26, 1934, Serial No. 406,371 entitled "Automatic indicating Target."

The target hit indicator 2 is housed in an open face box 6. A transparent sheet 8 bearing target circles and a translucent sheet or material 9 containing a plurality of holes or transparent areas 10 are placed over the open face or front of said box 6. The head 16 of a plunger 12 is located directly behind the transparent area 10. The remainder 14 of the sheet or face plate 8 is opaque by having the painting, etc., and appears as a light gray. The upper surface of the head 16 of the plunger 12 is also finished in a light gray. Thus, when the plunger 12 is in its deactivated position, as shown in broken lines in Figure 2, the head 16 is normally pressed and held against the rear surface of face plate 8 to give the appearance, from the front, of a solid or continuous sheet having a uniform shade. At the instant that the plunger head 16 is withdrawn from the face plate or sheet 8 to the activated position shown in solid lines in Figure 2, the clear portion or hole 10 changes its appearance from light gray to essentially black. Therefore, each time that a plunger is retracted, the effect is that of a hole being "shot" in the inductor. Said hole is at the same relative location on the inductor, as the area of impact of the bullet upon the actual target.

Figure 5 shows a perspective view of the operating mechanism. The device consists of a plurality of parallel solenoids 18 that cooperate with a plurality of substantially horizontal slide bars 20. A second plurality of parallel solenoids 22 cooperate with a plurality of substantially upright or vertical slide bars 24. There is a separate solenoid and slide bar 18 and 20 respectively for each horizontal row of transparent portions or holes 10 and a separate solenoid and slide bar 22 and 24 respectively for each vertical row of holes 10. Located within close proximity to the intersection of each of the vertical and horizontal bars, is a smaller solenoid 26. Said solenoid 26 is positioned so that its longitudinal axis passes through the center of the clear area 10. The electrical contacts of said solenoid 26 are each connected to a corresponding one of the contact springs 28 and
30. The horizontal slide bar 20 contains a clearance cutout 32 and the vertical slide bar 24 contains a clearance cutout 34. The slide bars 20 and 24 and the contact springs 28 and 30 are made of material that has good dielectric and magnetic characteristics. The slide bars 20 and 24 are electrically insulated from each other. This can be done simply by spacing them apart. The two bars 20 and 24 are connected across the opposite terminals of a battery 36. The plunger 12 cooperates with the solenoid 56 and said plunger 12 is retained in an extended position by periods of deactivation of said solenoid 26, by means of a non-magnetic helical spring 38. The plunger 12 is drawn into the solenoid 26, against the force of the spring 38, at the instant that the solenoid 26 is energized. To energize said solenoid 26, solenoids 18 and 22 are activated, thus displacing longitudinally the slide bars 20 and 24. This displacement causes misalignment of the clearance cutouts relative to the springs 28 and 30, thus resulting in an electrical contact between the bars 20 and 24 and said contact springs 30 and 28 respectively. The flow of current is, therefore, from the terminal of the battery 36, to the horizontal slide 26, to the contact spring 30, through the solenoid 26 to the contact spring 28, to the vertical slide 24, and back to the other terminal of the battery 36. Thus, as shown in Figures 1, 4 and 5, when a "hit" is made at position 37 on target 4, the solenoid plunger 12 for hole 10a is energized. Figure 2 shows a detail view wherein the plate 8, which contains a plurality of clear areas or holes 10, is positioned above or in front of the operating mechanism. Located immediately below said plate 8 is a front magnetic plate 40 that is made of iron or soft steel. Aligned with each hole or clear portion 10 of sheet 8, there is a clearance hole 42 within said plate 40 for the plunger 12. Immediately beneath said plate 8 is a top insulation plate 44 that is composed of material having good electrical insulation properties such as plastic or other like materials. Below said plate 44, is a second insulation plate 46. A third or bottom insulation plate 48 is located below said plate 34. Said plates 46 and 48 are made of material that possesses good electrical insulation properties and, for convenience, can be made of the same material as plate 44. Each of the insulation plates 44, 46 and 48 contains a clearance hole 50, 52 and 54 respectively that is aligned relative to each other and to the hole 42. A plurality of slots are located between said first and second plates 44 and 46 to accommodate one set of slide bars as illustrated in Figure 3 by slide bar 20. A second plurality of slots are located between said second and third plates 46 and 48 and at right angles to said last mentioned plurality of slots, to accommodate the other set of slide bars as illustrated in Figure 3 by slide bar 24. A second plurality of holes are located within said plates 44, 46 and 48 and are aligned to accommodate the contact springs 28 and 30. The plunger solenoid 26 is located to operate said plunger 12 and is positioned between the third insulation plate 48 and a magnetic plate 58 that is composed of iron or soft steel or any material that will readily conduct magnetic flux lines. The magnetic plates 40 and 58 are essentially square in shape. An electric holding magnet 60 is located at each corner of and between the two magnetic plates 40 and 58. Said magnet 60 is secured rigidly to the plates 20 and 58 by any convenient means. Thus, said plates 40 and 58 are maintained at a constant distance from each other and function as a single rigid unit.

As indicated in Figures 4 and 5 the plate 40 is maintained in position by a plurality of non-conductive fiber angle supports. Said angle supports are attached securely to the plate 40 and to the interior of said box 6. Fiber angles are used to confine the magnetic lines of force to specified prearranged paths.

The holding magnets 60 are utilized to maintain the hit indication for any desired duration of time. The coils of the holding magnets 60 are energized by means of a battery (not shown) that supplies a source of current to said coils and a switch (not shown) that is connected in series with said battery to stop the flow of current through said coils. When the coils of said holding magnets 60 are energized the magnetic plate 40 and 58 become the opposite poles of a magnet. The strength of the magnetic holding system is too small to activate any of the solenoid plungers 12. However, when the solenoid 26 is energized, the plunger 12 is drawn down so that the bottom of the plunger 12 contacts the lower magnetic plate 58. The concentration of magnetic flux from plates 40 to 58 through the plunger 12, causes said plunger to remain in its withdrawn position. The plunger will remain in its withdrawn position after the solenoid coil 26 is deactivated, so long as the holding circuit coils 60 are energized.

The plungers can be released at any desired instant by reversing the flow of current through the holding magnet coils. At the instant that the magnetic field strength of the holding circuit passes through zero, on its way to reversal, the springs 38 return the plungers 12 to their deactivated extended position.

By utilizing said holding magnets, the time duration of display of each hit can be accurately controlled. An overlay card 1 of transparent material and containing an exact replica of the actual target design is placed over the sheet 8 to indicate the area of impact of the bullet relative to the actual target.

In operation, this device is connected to the actual target but is located in close proximity to the firing line. At the instant that a bullet strikes the target, a discrete electrical impulse is transmitted to the indicator. Said impulse actuates a specific vertical slide bar and a specific horizontal slide bar. The vertical slide bar connects one terminal of all the small plungers actuating solenoid coils along its coordinate path to a source of power. The horizontal slide bar functions in a similar manner. One side of all the plunger solenoid coils along its path are connected to the same source of power but to the opposite polarity terminal. Therefore, the coil at the intersection of the two slide bars is the only coil that has both of its terminals connected to the source of power. This one solenoid is energized and actuates its associated plunger to indicate a dark spot at the appropriate area. After a fraction of a second, the information that initiated the indication disappears, the slide bar solenoids are de-energized, and the slide bars are returned to their deactivated positions. The small hit solenoid is also de-energized, and the holding circuit is utilized to maintain the hit indication. By the selective use of well known circuits, this device will maintain each hit indication until "erased" by manual means; or indicate one hit at a time wherein each successive hit "erases" the preceding "hit" indication.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A target hit indicator comprising a face plate containing a plurality of translucent sections, discs located behind each hole or clear part of said face plate to cooperate with said translucent sections to give the surface of the face plate a continuous unbroken appearance, solenoid means connected to said discs to remove said discs from adjacency to said translucent sections whereby the location of the area of impact of a bullet upon a target that is connected to said indicator is indicated in terms of a geometric coordinate system of reference, and holding means coupled to said solenoid means to magnetically retain said discs in displaced position after deenergization of said solenoid means.

2. A target hit indicator comprising a face plate con-
taining a translucent opening, a plunger located behind said face plate to cooperate with said translucent opening to give one surface of the face plate the appearance of a continuous surface, a solenoid coil cooperating with said plunger to move said plunger away from said face plate, flexibly contacting said plunger to the ends of the solenoid coil, electrical conducting slide bars positioned to cooperate with said flexible contacts, and other solenoids connected to actuate said slide bars.

3. A target hit indicator comprising a face plate, a plunger that cooperates with said face plate, a magnetic plate located below said face plate, a second magnetic plate located parallel to said first magnetic plate, said plunger lying between said plates and extending beyond one plate, an electromagnet located between said magnetic plates to produce a magnetic flux within said plates, to releasably retain said plunger between said plates, a plurality of electrically conducting slide bars mounted between said magnetic plates, a plurality of solenoids connected to actuate said slide bars, contact springs connected to cooperate with said slide bars and another solenoid connected to said contact springs and operable upon engagement of said bars with said springs to actuate said plunger.

4. A target hit indicator comprising a first slidably mounted electrically conducting bar, a first solenoid connected to move said bar, a first electrical conducting spring connected to contact said bar when said first solenoid is actuated, a second slidably mounted electrically conducting bar, a second solenoid connected to move said second bar, a second electrical conducting spring connected to contact said second bar when said second solenoid is actuated, a third solenoid having its coil electrically connected to said first and second conducting springs, a plunger that cooperates with said third solenoid, a non-magnetic spring cooperating with said plunger to move it to an extended position, a face plate containing translucent sections cooperating with said plunger to maintain said plunger in its retracted position after said third mentioned coil is de-energized.

5. A target hit indicator comprising a face plate having a translucent area, a plunger adjacent said face plate and masking said area, a solenoid coil coupled to be energized to move said plunger from said masking position, and solenoid-coil energizing means associated with said solenoid coil and including a plurality of slide bars which cooperate to energize said solenoid coil.

6. A target hit indicator comprising, in combination, an opaque face plate having a translucent area, an opaque plate normally masking said translucent area, a solenoid, a plunger coupled to said opaque plate and actuated by said solenoid to urge the opaque plate away from the translucent area when the solenoid is energized, solenoid energizing means associated with said solenoid and including a plurality of slide bars which cooperatively energize said solenoid, and holding means operatively associated with said plunger to magnetically retain said opaque plate distant from said translucent area after said solenoid is de-energized.

7. A target hit indicator comprising, in combination: an opaque face plate having a plurality of translucent areas; a plurality of opaque plates, each normally adjacent to and masking a different translucent area; a plurality of slide bars, each attached to a different one of said opaque plates; a plurality of solenoids, each arranged to actuate a different one of said plungers to move its opaque plate away from its associated translucent area when solenoid energized; solenoid-energizing means including a plurality of slide bars arranged to form horizontal rows and vertical columns with a different solenoid associated with each junction between a row and a column, the slide bars forming each junction cooperating to energize the solenoid associated with that junction.

8. The combination of claim 7 including: holding means operatively associated with said plungers to magnetically retain them in actuated position after said solenoids are deenergized.

9. A target hit indicator comprising, in combination: a face plate containing a plurality of translucent areas; first means located behind said translucent areas to make said areas appear opaque; and second means connected to be energized to actuate said first means to indicate in terms of a geometric coordinate system of reference the location of the area of impact of a bullet upon the target, said second means including a plurality of slide bars which cooperatively actuate said first means; and holding means coupled to said first means to magnetically retain said first means in actuated position after said first means is deenergized.

10. A target hit indicator comprising, in combination: a face plate containing a plurality of translucent areas; first means located behind said translucent areas to make said areas appear opaque; second means connected to be energized to actuate said first means to indicate in terms of a geometric coordinate system of reference the location of the area of impact of a bullet upon the target, said second means including a plurality of slide bars which cooperatively actuate said first means; and holding means coupled to said first means to magnetically retain said first means in actuated position after said first means is deenergized.

11. A target hit indicator comprising, in combination: a face plate containing a plurality of spaced translucent areas; a plurality of opaque elements movable relative to said face plate and located adjacent said translucent areas to form an apparently continuous opaque surface on said face plate; and means connected to be energized to actuate said elements to indicate in terms of a geometric coordinate system of reference the location of the area of impact of a bullet upon the target; said means including a plurality of slide bars, at least two of which cooperate in the actuation of any given opaque element.

12. A target hit indicator comprising, in combination: a face plate containing a plurality of spaced translucent areas; a plurality of opaque elements movable relative to said face plate and located adjacent said translucent areas to form an apparently continuous opaque surface on said face plate; first means connected to be energized to actuate said elements to indicate in terms of a geometric coordinate system of reference the location of the area of impact of a bullet upon the target; said first means including a plurality of slide bars, at least two of which cooperate in the actuation of any given opaque element; and second means operatively associated with said opaque elements to hold them in actuated position after said first means is deenergized.

13. A target hit indicator comprising, in combination: a face plate having a plurality of translucent areas; a plurality of plungers adjacent to and opaquing said translucent areas; a plurality of solenoids adapted to be energized to move said plungers from their positions adjacent said translucent areas; and a plurality of solenoid energizing means associated with said solenoids and including a plurality of slide bars arranged to form horizontal rows and vertical columns, at least one row and one column cooperating to energize a solenoid.

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