

Feb. 23, 1960

J. G. EDRICH
TARGET DEVICE

2,926,015

Filed June 30, 1954

2 Sheets-Sheet 1

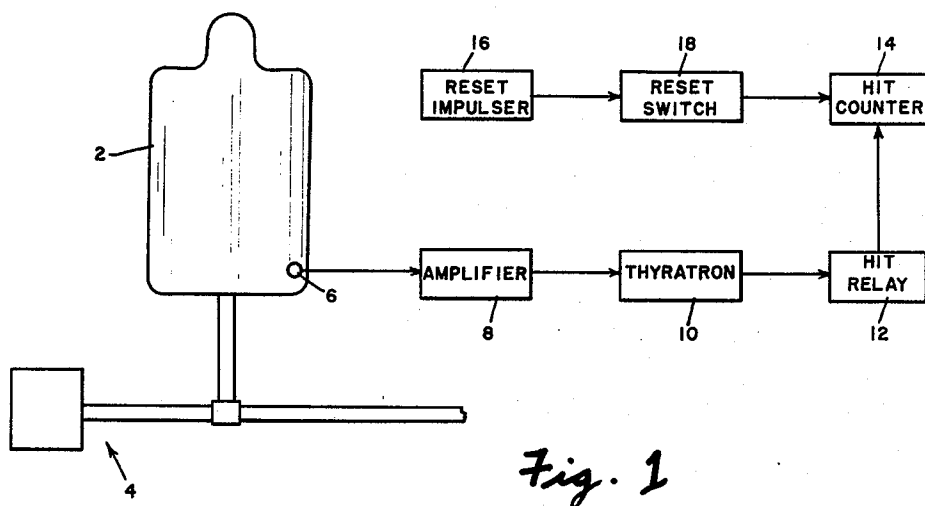


Fig. 1

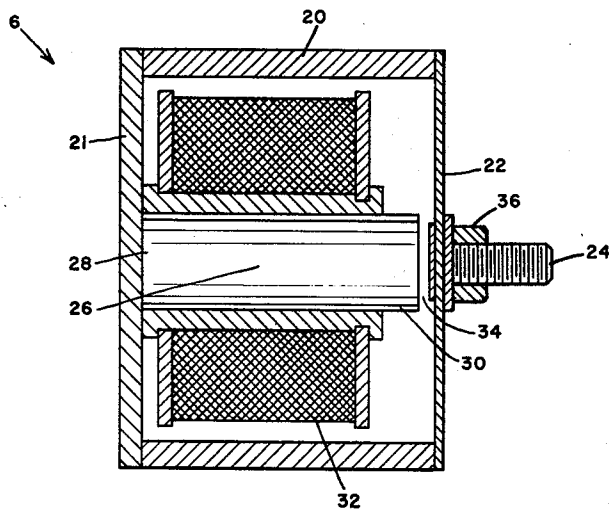


Fig. 2

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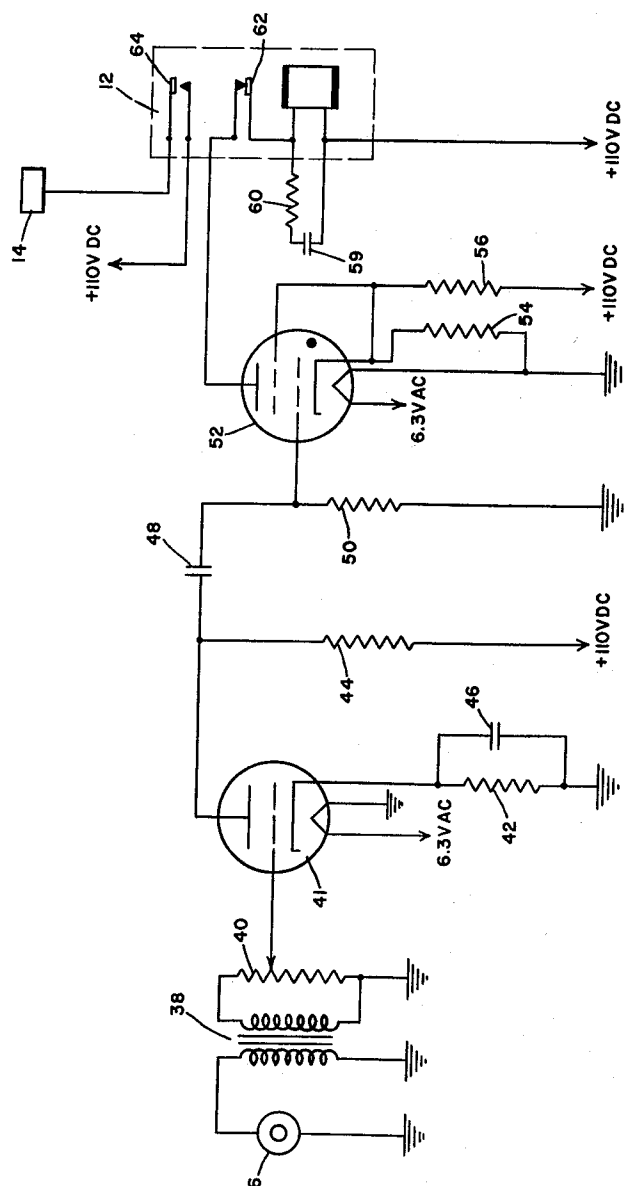


Fig. 3

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1

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TARGET DEVICE

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3 Claims. (Cl. 273—102.2)

This invention relates in general to indication devices and more particularly to a device that automatically indicates and records the hits of projectiles upon a specific target area.

To become proficient in the use of small arms such as pistols, rifles and the like, it is essential that the trainee practice by actually using the gun. The most common method of determining the accuracy with which a gun is fired is to shoot at a target that is located at some specific distance from the gunner.

After each round is fired an observer sights the target area by means of a telescope and notes the hit location, or actually inspects the target at close range and marks the area of penetration. The first method is time consuming and inaccurate. The second method is dangerous in that the person inspecting the target is exposed to possible injury from inaccurately fired bullets that are directed at adjacent targets or by the misinterpretation of signals. To improve the marksmanship of the person using small arms, it was found necessary to more accurately reproduce the actual conditions under which a gun is fired. This was accomplished by placing the target upon a linkage system to give movement to the target. By means of the linkage system, it is possible to orient the target along a predetermined path at a preselected speed. Thus the target can be controlled to appear and then disappear into the ground, in a vertical manner, after a specific length of time. The target may be controlled to move along a horizontal path or along some path that combines both horizontal and vertical motion.

Thus the problems encountered and the difficulties presented make it almost impossible to determine the presence of a hit upon a moving target by the actual visual inspection of the target area. The present invention eliminates the need of actually inspecting the target, moving or stationary, to determine the existence of a hit by a projectile upon the target.

This device includes a shock sensitive microphone mounted on the target near to the target area. At the instant that a bullet strikes the target, a shock wave is transmitted to and received by the microphone. The microphone converts the shock wave into an electrical pulse that is amplified and then utilized to operate a counting device. Thus, with this device it is possible to determine immediately, at some remote location, the accuracy of a fired projectile. The results are accurate and are obtained instantaneously, consecutively and continuously. This device will allow a gunman to practice rapid repetitive or single shot fire on stationary or moving targets without the necessity of exposing himself to undue danger or requiring the direct visual observation of the target area to determine if there has been a hit. In the case of a moving target, this device eliminates the necessity of stopping and positioning the target after each round to evaluate the accuracy of the gunman's fire.

It is an object of this invention to provide a device that will automatically indicate at a remote location the impact of a bullet upon a target.

It is another object to provide a device that will indicate and count the number of times that the target is hit by a projectile.

2

It is an additional object to provide a device that will detect hits on a moving target or on a stationary target. 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:

Fig. 1 is a block diagram of this device illustrating a target, a pickup device, a counter and the equipment that is necessary to operate the counter,

Fig. 2 is a cross section view of the pickup device that is attached to the target to convert a shock wave into an electrical signal, and

Fig. 3 is a schematic wiring diagram of the amplifier and the thyatron circuits.

Referring to Fig. 1, therein is disclosed a device comprising a target 2 that is composed of material having good shock wave transmitting characteristics. A few materials found to be acceptable and that performed in a satisfactory manner were sheet steel, brass, and iron. The target 2 is cut to any desired size or shape to represent any specified configuration. The target 2 that is illustrated represents the outline of the upper portion of a man. Said target 2 is controlled by a convenient means represented by 4 that moves the target 2 along a predetermined path. The control means 4 is not shown nor described in detail as such means is well known to those experienced in the art. Conveniently attached to the target 2 is a microphone or pickup device 6. The electrical output of said microphone is fed into an amplifier 8, where it is amplified and then utilized to actuate a thyatron circuit 10 that controls a hit relay 12. A hit counter 14 is controlled by the hit relay 12 and each time said hit relay is actuated, the hit counter 14 advances one number. The reset impulser 16 and the reset switch 18 cooperate with each other to reset the hit counter 14 to indicate zero at any desired time.

Referring to Fig. 2, therein is shown the cross-sectional view of the microphone or pickup device 6. Said microphone consists of a cylindrical case 20 that is composed of a material that readily conducts magnetic flux lines without appreciable loss. It has been found that a steel case performed in a satisfactory manner. One end of the cylindrical case 20 consists of a thin diaphragm 22 to which a mounting bolt 24 is securely attached. A permanent magnet 26 is positioned within said cylindrical case 20 and one end 28 of said magnet is securely mounted to the rigid end 21 of the case 20. The other end 30 of said magnet 26 comes within close proximity but does not make actual physical contact with the diaphragm or flexible plate member 22. A coil of wire 32 is positioned around the magnet core 26. The permanent magnet 26 has magnetic lines of flux from one end 28 to its other end 30. The path the lines of flux take is from the end 28 then through the steel magnetic conducting casing 21, and through casing 20, then through diaphragm 22, and through the air gap 34 to the other end 30 of the permanent magnet. A vibration that is imparted to the diaphragm 22 of said microphone 6 will cause the air gap 34 that is between said diaphragm 22 and the end 30 of said magnet 26 to vary. The variation of the size of the air gap 34 will accordingly alter the strength of the magnetic field by varying the reluctance of the magnetic circuit. Thus a voltage is induced or generated within the coil 32. The microphone 6 is securely attached to the target by means of the mounting bolt 24 and a nut 36 so that the target is sandwiched between said diaphragm 22 and said nut 36.

Referring to Fig. 3, therein is shown a schematic diagram of the amplifier 8 and the thyatron circuit 10. The voltage signal that is generated by the microphone

6 is fed into the primary of a transformer 38. A primary to secondary impedance ratio of said transformer which has proven to give satisfactory results is fifty to fifty thousand ohms. A potentiometer 40 of fifty thousand ohms is connected across the secondary of said transformer. The output of said potentiometer is fed to the grid of a 6C4 type vacuum tube 41. The design of said amplifier is common to those experienced in the art. The coupling components present high attenuation to frequencies below five hundred cycles. The component values are thirty-three hundred ohms and one hundred thousand ohms for the cathode resistor 42 and plate resistor 44 respectively, and one quarter of a microfarad and five thousand micromicrofarads for the cathode by pass condenser 46 and the blocking condenser 48 respectively. The output of said amplifier is fed into the control grid of a thyratron type 2D21 tube 52. The grid leak resistor 50 is approximately one hundred thousand ohms. A fixed bias of approximately plus five volts is applied to the cathode of said tube 52 by means of the voltage divider network consisting of the resistors 54 and 56 that are twelve hundred ohms and twenty two thousand ohms respectively. When the control grid of the tube 52 receives a voltage that is approximately one and one-half volts more than the bias, said thyratron 52 fires, energizing the coil of the relay 12. The energy storage capacitor 59 has a value of one microfarad and is connected in series with a twelve hundred ohm resistor 60. Said resistor, capacitor combination is connected across the coil of said relay 12 and operates to hold the normally open contacts 64 of said relay closed for about thirty five milliseconds. The resistor-condenser combination operates to make said relay of the slow-break type. Thus said relay remains operative for a specific minimum predetermined time duration. When the tube 52 starts to conduct current, the relay 12 becomes energized and operates. The normally closed contacts 62 open thus breaking the plate circuit of the thyratron, deionizing said thyratron, and the normally open contacts 64 close. The counter 14 receives a voltage pulse through the closed contacts 64 and said counter advances one step. The time delay or slow break characteristics that are built into said relay 12 is of sufficient duration to allow said counter 14 to operate. The time sequence of the relay 12 is as follows: when the tube 52 is non-conducting, the relay 12 is not operative and the contacts 64 and 62 are open and closed respectively. When said tube 52 begins to conduct current, the relay is energized through the normally closed contacts 62 and operates. The normally closed contacts 62 open, breaking the plate circuit of the thyratron. The normally open contacts 64 close allowing a voltage pulse to be transmitted to and operate the counter 14 one step. After a predetermined time interval, as determined by the time delay combination 59 and 60, the relay contacts assume their normal position and the system is now in condition to again record.

At any desired instant, the operator can reset the hit counter 14 by pressing the reset switch 18. Said reset switch 18 allows a series of voltage pulses to be transmitted to the hit counter 14 from the reset impulser 16. Said reset impulser 16 continues to step the hit indicator 14 until said indicator shows all zeros. The design and construction of the hit counter 14, reset switch 18 and reset impulser 16 and the connections between said units are well known to those experienced with the art. Thus said items were not described nor shown in detail.

This device operates to indicate a target hit in the following manner. A shock wave is transmitted through the target each instant the target is struck with a bullet. The permanent magnet 26 of the microphone 6 produces a magnetic field that passes through the center of the coil 32 and around the diaphragm 22 and steel case 20. The shock wave that is generated within the target causes the diaphragm of the microphone to vibrate rela-

tive to the case thus changing the air gap 34 between the diaphragm and the magnet. This produces a variation of the reluctance of the magnetic circuit. Said reluctance change results in the generation of a voltage pulse in the coil 32. The case of the microphone 6 remains essentially stationary relative to said diaphragm because of its high inertia. The generated voltage pulse is amplified and then utilized to fire a thyratron tube. A relay that is connected to the output of said thyratron activates a counter one step each time the thyratron fires. At any desired instant the counter can be reset to all zeros by pressing the reset switch 18.

Thus this device automatically indicates and records at a remote location hits upon a moving or stationary target.

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. An impact actuator hit scoring device comprising a hollow magnetic flux conducting casing, having one side which comprises a flexible plate member, fixedly and flatly mounted against a source of shock, said source of shock being a target for projectiles, means for mounting said target on said flexible plate member whereby said target develops a shock vibration upon impact with a projectile, a magnet positioned normal to said flexible plate in said casing and slightly spaced therefrom, a coil of wire coaxially mounted on said magnet, and a magnetic flux conducting medium comprising said hollow magnetic flux conducting casing, said flexible plate and the air gap spacing between said magnet and said flexible plate, said flexible plate vibrating relative to said magnetic flux conducting medium and coil assembly when said plate member experiences the shock impulses from the target, whereby said shock impulses from the target cause said flexible plate to vibrate, thereby changing the width of said air gap spacing and thereby vibrating said magnetic lines of flux within said air gap spacing, said vibrating magnetic flux lines causing a voltage to be induced into said coil of wire.

2. The combination of claim 1 wherein said hollow magnetic flux conducting casing is in the shape of a cylinder and has one rigid end and one flexible end, said flexible end constituting said flexible plate member, said magnet being mounted within said casing and being secured at one of its ends to the rigid end of said casing and coupled magnetically at its other end to the flexible end of said casing.

3. The combination of claim 2 wherein a flexible ferromagnetic diaphragm constitutes said flexible end of said casing, said diaphragm having a mass that is small relative to the mass of the hollow magnetic flux conducting casing whereby shock impulses from said target are coupled to said diaphragm causing it to vibrate and induce a potential pulse in said magnetic coil because of the vibration of said air gap spacing, thereby changing the reluctance of the flux conducting medium.

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