

June 7, 1949.

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2,472,136

AIMING AND FIRE CONTROL SYSTEM

Filed Jan. 3, 1945

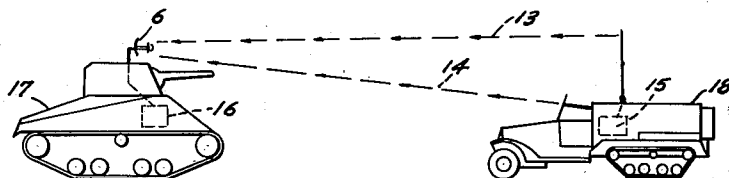


Fig. 2

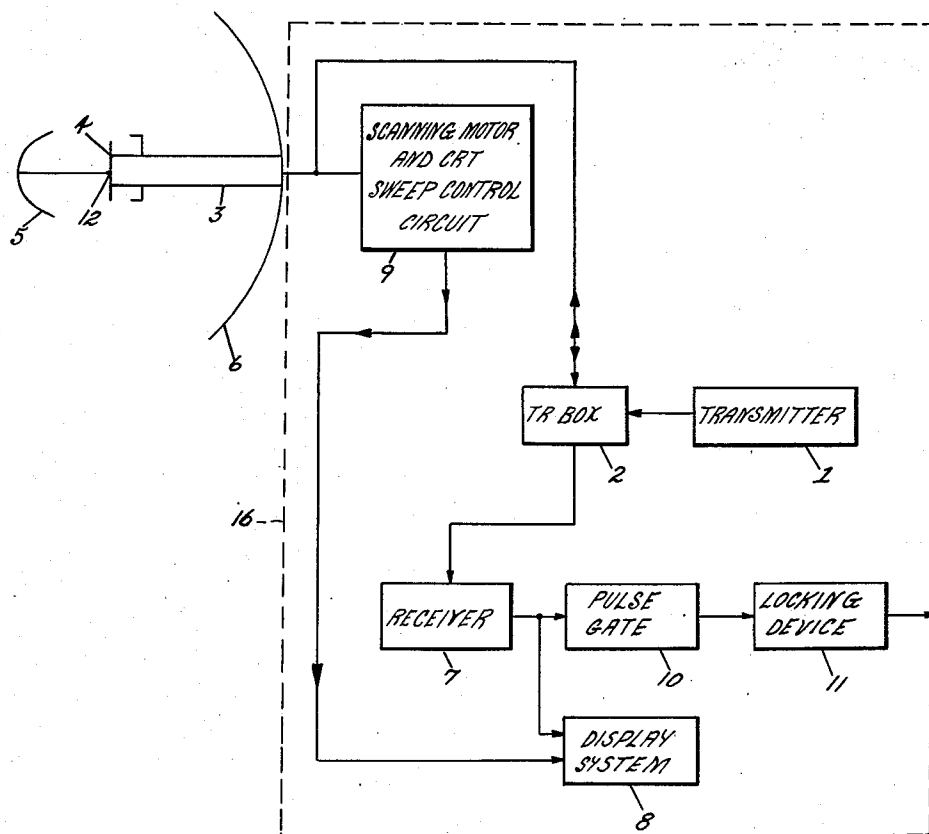


Fig. 1

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AIMING AND FIRE CONTROL SYSTEM

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Application January 3, 1945, Serial No. 571,189

1 Claim. (Cl. 89—28)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to radio systems and more particularly to an aiming and fire control system by radio impulse.

The objects of the present invention comprise a simplified microwave equipment for short wave applications in aiming and protective fire control; a means for presenting on a concentrically calibrated display screen a contour image of a potential target that is obscured from sight by cover of darkness, fogs, clouds, smoke screen, or other view obscuring media; a short range system of very high frequency that minimizes interfering with other electronic equipment in the immediate vicinity and hence minimizes detection of the system by an enemy; a short range system to be used at point blank range, under which circumstance correction for windage, gravity, and the like, are not required; and a fire control system associated with a weapon to be aimed and controlled and the system employing quasi-optical radiation that upon encountering a friendly target equipped with a protective transponder operating on the same frequency as the fire control system, causes the firing mechanism of the fire control system to be locked to prevent its associated weapon from being fired on the friendly equipment.

With the above and other objects in view which will be apparent to those who are informed in the subject of radio operated fire control systems, a symbolic and block diagram of a preferred system and circuit for operation of the present device is shown in Fig. 1. Fig. 2 is a pictorial representation of vehicles utilizing a fire-control system in accordance with this invention.

The system that is contemplated hereby comprises a sighting and fire control interlock system that is carried upon an attacking vehicle and inclusive of protective transponder equipment that is carried by friendly objects that otherwise might be mistaken for legitimate targets.

The present system, in its association with the normally operated weapon to be aimed and controlled, employs quasi-optical, pulse-modulated, electromagnetic radiation and preferably is mounted directly upon the weapon carriage. The system comprises, as a part thereof, a cathode

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ray tube display system that is shown in the accompanying drawing. In the system there shown a transmitter 1 provides a short burst of high frequency energy that is projected through a transmit-receive switch, or TR box 2, and a wave guide 3 to a dipole antenna 4.

The energy originating in the transmitter 1 and so projected to the dipole antenna 4 is radiated from the dipole antenna 4 through the action of an associated parabolic reflector 5 and is projected from the surface of a spherical reflector 6 as a highly directional beam.

The paraboloid 5 is pivoted at 12 to be rocked in such a manner as to result in a combined horizontal and vertical scan. The dimensions of the spherical reflector 6 compared with the wavelength of the radiation are such that, with the rocking point 12 of the paraboloid 5 located at the center of the sphere of rotation, the element of spherical surface intercepted by the beam of radiation is effectively plane. The radiation from the parabolic reflector 6 will, therefore, be again reflected at this surface and will be projected into the region that centers along the axis of the radiating system and is bounded by the solid rocking angle.

The energy pulse that is radiated from the spherical reflector 6, upon its being reflected by an object in its path, will be returned to the antenna system which then acts as a receiving antenna.

The echo energy that is intercepted by the spherical reflector 6 is reflected thereby upon the parabolic reflector 5 whence it is focused on the dipole antenna 4 and passes through the TR box 2 and is applied to radio receiver 7. The output from radio receiver 7 is applied to a cathode ray tube, part of a display system 8, where such output intensity-modulates the electron beam within the cathode ray tube.

Scanning impulses that originate within the cathode ray tube sweep control part of the scanning motor and cathode ray tube sweep control circuit 9, are applied to the cathode ray tube deflecting plates and cause the cathode ray beam to be deflected in synchronism with the movement of the paraboloid 5. The luminous spot therefore moves over the face of the cathode ray tube screen in much the same manner as in a conventional television display system.

The cathode ray tube is blanked at all times

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except when energy is being received. Hence the presentation upon the concentrically calibrated screen of the cathode ray tube is a silhouette image of the energy intercepting object or target. Intersecting hair lines substantially at the center of the concentric circles upon the screen of the cathode ray tube within the display system 8 permit an operator of the system to present the impinging point of the projected axis of the antenna system upon a desired part of the target, since the antenna is directional, by bringing the intersection of the hair lines on the cathode ray tube to bear upon that part of the target image at which it is desired that a shell be placed. Since the proposed operating range of the weapon that is associated with the system is the effective point-blank range of the weapon and since the aiming part comprised of reflector 6 is firmly attached to the weapon in such a manner as to remain aligned with the flight axis of the projectile, the point at which the cross hairs bear on the cathode ray tube image will correspond to the point of impact of the projectile upon the target, except for a slight error due to parallax. The use of exceedingly short wave length radiation, as in radar and the like, provides good penetration of obscuring media and also provides sharp beaming.

In operation during conditions of darkness, heavy fog, smoke screens and the like, heavy caliber ordnance that is carried by aircraft, tanks, tank destroyers, P. T. boats, gun boats, and the like, and that is provided with the system that is disclosed herein, is equipped to close in upon an intended target to within point blank range and cause the transmitter 1, through the disclosed antenna, to maintain a practical image outline of the target upon the cathode ray screen part of the display system 8 and to place one or more shells precisely upon an intended part of the target. The equipment may then, under the cover of the obscuring agency be advanced to further objectives or be withdrawn to safety, as required by circumstances.

Figure 2 illustrates one application of the invention. The boxed-in elements of Figure 1 are indicated by reference numeral 16 and shown installed on vehicle 17.

The prevention of the destruction of friendly objects by misdirected fire resulting from errors in target identification is effectually minimized by having mounted thereupon a transponder that operates upon the same frequency as the aiming and fire control system that is contemplated hereby. It will be apparent to those skilled in the radio art that the responder contains apparatus capable of receiving a signal within its range on its frequency and then retransmitting it in some modified form. The transponder 15 installed on friendly vehicle 18 is designed to receive a pulse signal of high frequency electromagnetic energy and to transmit a corresponding energy pulse 13 which differs from the received pulse in pulse width. The circuits of the transponder 15 are continuously tuned over a predetermined band of frequencies at a rate sufficiently rapid to avoid the overlooking of targets. The width of the transmitted reply pulse is accurately predetermined to match the setting of the pulse gate 10.

The transponder is triggered by a pulse that arrives at the potential target from the antenna of the system that is disclosed herein. The transponder bearing device returns two pulses, an echo pulse 14 and a modified pulse 13 that are transmitted by the transponder. These two pulses

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are returned to the primary radiator or antenna 6 of the contemplated system. The echo pulse and the modified pulse are both of the same carrier frequency as the interrogating or emitted pulse but their duration will be modified.

Pulses that are properly modified and that arrive at the radiating receiving antenna of the present system pass through radio receiver 7 and pulse gate 10 and are applied to and activate a locking device 11. The locking device 11 energizes any usual form of mechanism operating devices, such as relays, not shown, or the like, that lock the firing mechanism of the piece of ordnance upon which the equipment that is contemplated hereby is mounted and prevents it from firing upon the vehicle that carries the transponder. As in the previously described system, an image of the transponder conveying device is continuously available on the cathode ray tube screen of the display system 8.

The transmitter 1, the transmit-receive device 2, the receiver 7, the display system 8, the scanning motor and cathode ray tube sweep control circuit 9, the locking device 11 as well as the transponder are components well known in the art and no claim is made to any of these units per se. A description of these components may be found in "Principles of Radar" published by the Massachusetts Institute of Technology. The pulse gate 10 may be of the type described in my abandoned copending application S. N. 557,537, on "Pulse width discriminator" filed October 6, 1944.

The use of wave lengths that are one centimeter or less in length are large in comparison with the dimensions of the water particles that make up fogs and clouds, solid particles that may be suspended in air to form smoke or dust storms, and the like, and hence the use of wave lengths of the intended lengths provide advantageous penetration of these types of obscuring media. The use of short wave lengths of radio energy also permits proper pulse formation and the use of small light weight equipment. These same characteristics make the present equipment readily transportable and its simplicity makes it highly dependable in operation.

It is to be understood that reasonable modifications and substitutions may be made in the circuit and parts thereof that are disclosed herein without departing from the present invention as defined by the appended claim.

What I claim is:

An aiming and fire control system for manually operated weapons comprising a first device mounted on a weapon to be fired; and a second device mounted on a friendly object; said first device comprising in combination a short range pulse modulated radio transmitter, a directional antenna system for directing the output of said transmitter toward said object and for receiving echoes and radiations therefrom, said directional antenna mounted so that its radiation axis is parallel to the bore axis of said weapon to be aimed; a radio receiver for receiving signals intercepted by said antenna; a display means including a cathode ray tube responsive to the output of said receiver for presenting a contour image of said object; electro-mechanical means responsive to a selected output of said receiver for preventing the firing of said weapon; said second device comprising electronic means for receiving said pulse modulated signals from said directional antenna and retransmitting said signals in a modified form; whereby said retransmitted signals are received by said first device and

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prevent the operation of said weapon when radiation from said antenna strikes said friendly object.

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