

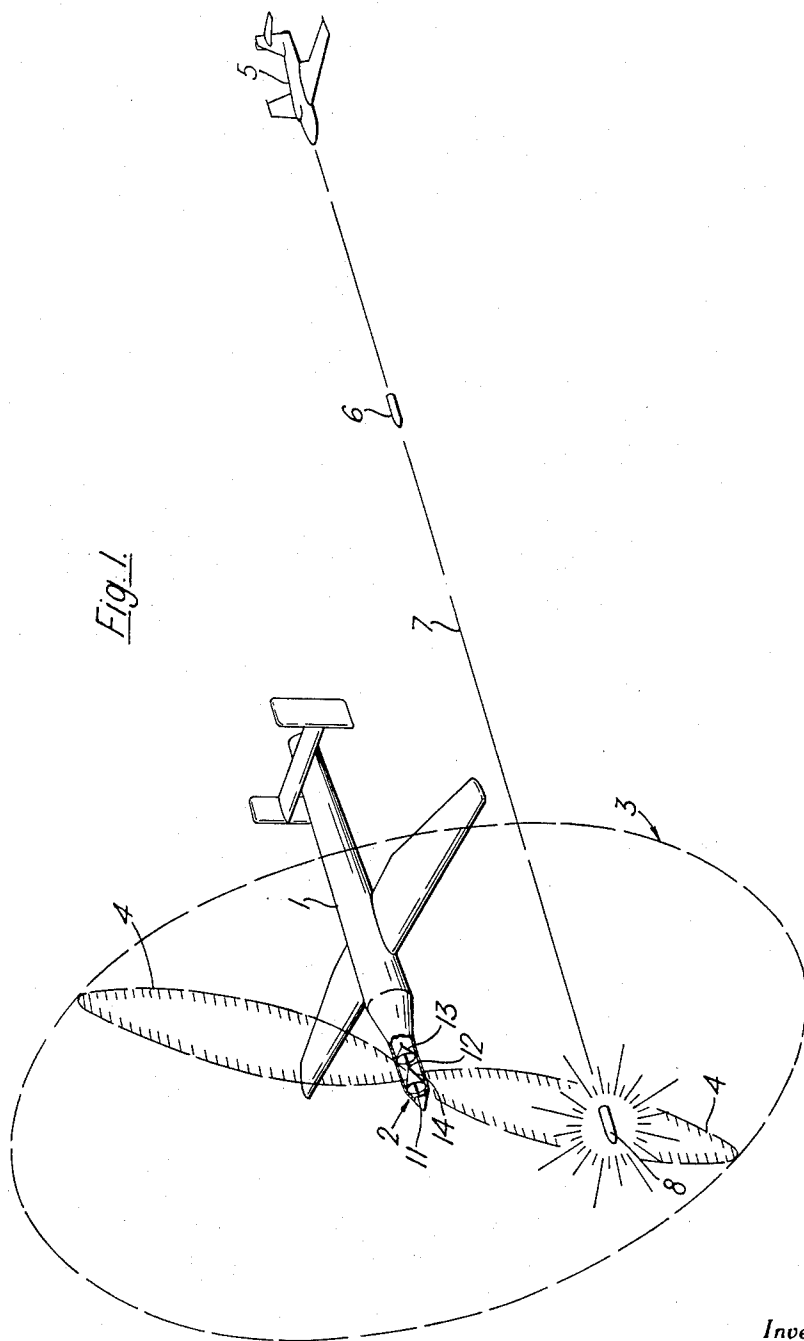
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TARGET PRACTICE SYSTEMS

3,138,101

Filed May 22, 1961

2 Sheets-Sheet 1



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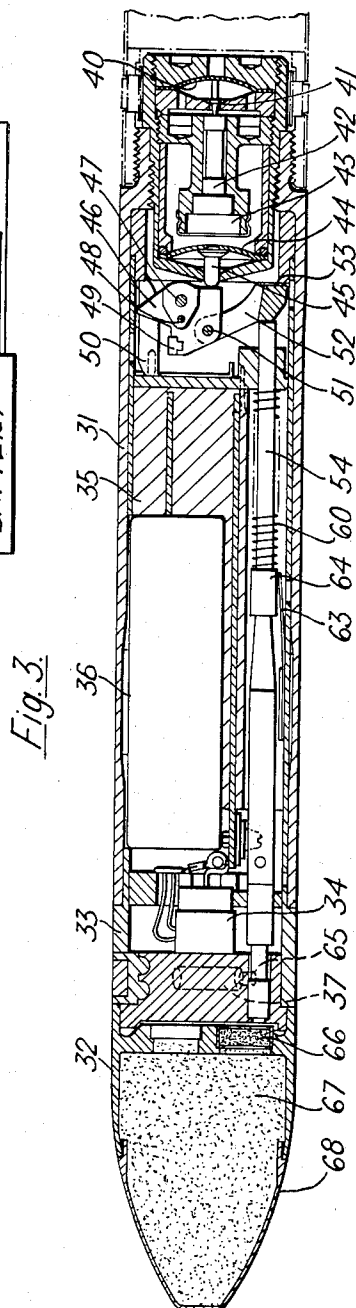
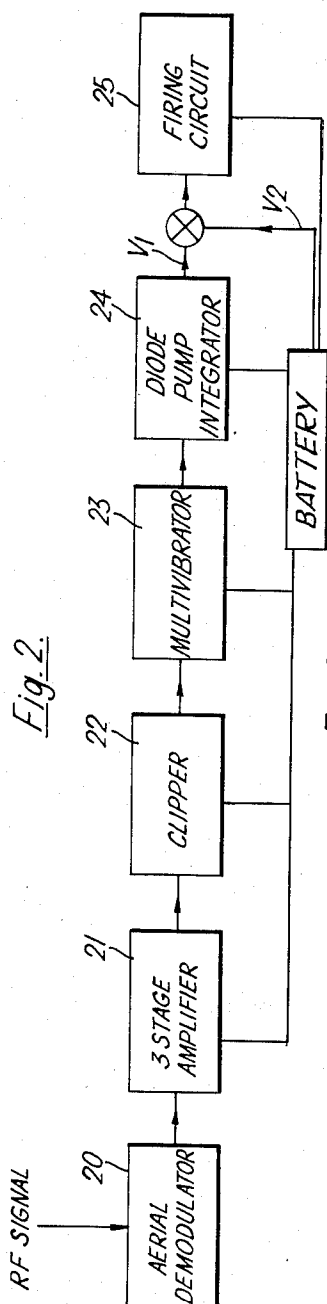
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TARGET PRACTICE SYSTEMS

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2 Claims. (Cl. 102—70.2)

In aircraft air-to-air target practice exercises when live ammunition is used, there are various aids employed to enable a gunner in an attacking aircraft to ascertain the effectiveness of his shooting. The commonest of these aids is the tracer shell which is inserted periodically in a belt of explosive ammunition and which emits either a trail of light or smoke when fired. These shells have the same ballistic characteristics as normal explosive shells and give the gunner a visual indication of the path of his shells.

According to the present invention a target practice system comprises an aerial in the target designed to radiate radio signals from a transmitter in a relatively flat beam encircling the target in a vertical plane transverse to its direction of motion and a missile fitted with a radio receiver responsive to the signals from the transmitter to operate a visual indication device. Consequently, the missile which may, for example, be a rocket or shell, passes through the beam of radiation encircling the target, and the visual indication device is operated to produce, for example, a flash of light or a puff of smoke. This may either be observed by the gunner in the attacking aircraft or may be photographed for record purposes. This provides a good indication of the accuracy of shooting since unless the missile passes relatively close to the target, no indication is obtained at all. It is found in practice that a localised indication in the vicinity of the target is much preferable to the indication provided by a tracer shell which is visible for the whole of the path of the shell.

In order to obtain the necessary flat beam of radiation the aerial preferably includes an antenna extending axially through a pair of substantially conical reflectors facing in the same direction with the tip of one cone spaced slightly from the open end of the other. In addition to the radiation thus produced in the transverse vertical plane a proportion is also radiated in forward lobes but since it is normally arranged that the firing occurs from the rear of the target, these lobes are situated on the opposite side of the main beam of radiation in the direction from which the missiles are to be fired and thus do not affect the system as a whole. If the target is in the form of an aircraft, the aerial just described is preferably situated in the nose so as to avoid rearward reflection of the lobes just mentioned. If, however, a towed target is used, the aerial may be mounted at the rear since there is not sufficient reflective surface ahead of the aerial to produce objectionable reflections.

In order to avoid any small risk of the radio receiver in the missile picking up stray radiation and inadvertently operating the visual indication device, the transmitted radiation is preferably in the form of intermittent pulses and the radio receiver operates to sum these pulses and to operate the visual indication device only after the receipt of a predetermined number of pulses. Consequently, the receipt of a single pulse of stray radiation will not affect the missile.

As a further precaution an inertia-controlled mechanism may be included which completes the circuit to the radio receiver and also prepares a fuse for the operation of the visual indication device only after the missile has been fired. This provides a double safeguard for preventing the visual indication device being operated either just prior to firing or, for example, while the missile is in store.

A system in accordance with the invention will now

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be described in more detail by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view showing diagrammatically the system as a whole;

FIGURE 2 is a schematic circuit diagram of a radio receiver included in a missile used in conjunction with the system of FIGURE 1; and

FIGURE 3 is a sectional view of the head of the missile.

Referring first to FIGURE 1 the system is illustrated as applied to a radio-controlled target aircraft shown as 1. This includes a radio transmitter supplying an aerial system in the nose of the aircraft indicated generally as 2. This aerial system is such as to radiate a signal lying mainly in a relatively flat beam encircling the aircraft in a vertical plane and indicated by the dotted circle 3. The lobe-shaped outlines 4 are intended to indicate the general cross-sectional configuration of this beam which as will be seen is substantially flat. In addition, some of the radiation is included in forwardly extending lobes which are not effective in the operation of the system.

The attacking aircraft is shown as 5 and it is shown as firing a missile 6 which may be, for example, either a rocket or a shell. The line of flight of this missile is indicated as 7 and it will be seen that it passes through the flat beam of radiation from the target 1. As it passes through the beam, the radio receiver in the missile responds to the signal from the radiation of the beam and operates a visual indication device to give a flash of light as shown at 8. This is observed directly from the attacking aircraft 5 and provides an indication of the proximity of the missile to the target 1. The flash may also be photographed for record purposes.

The aerial system 2 is supplied by a co-axial feed cable 11 and includes an antenna 12 extending axially through a pair of conical reflectors 13 and 14. As will be seen the tip of the cone 14 lies slightly forward of the open end of the cone 13 and it is found that this arrangement gives rise to radiation in a radial direction to constitute the flat beam 3. The transmission from the aerial system is in the form of intermittent pulses constituted by a modulated radio frequency wave and in a particular example consists of an ultra-high frequency signal having a frequency of 1250 megacycles per second modulated at a frequency of 8 kilocycles per second to give a succession of 2-microsecond pulses. The radio receiver in the missile 6 is designed to accept this radiation in order to operate the visual indication device only on receipt of a signal of this nature. The circuit of the receiver is shown in FIGURE 2.

The received signal first passes to a demodulator 20 which includes a crystal diode. The resultant direct current pulses are passed to a three-stage amplifier 21, the output of which is supplied to a clipper 22 which removes the noise in the signal. The output pulses from the clipper 22 pass to a monostable multi-vibrator 23 which is triggered so as to produce a succession of pulses of constant amplitude and width. These are fed to a diode pump integrator 24 which sums these pulses so as to give a steady state output voltage indicated as V1 which is approximately proportional to the frequency of the input pulses. This voltage V1 is connected in opposition to a backing-off voltage V2 and when the resultant (V1—V2) reaches a sufficient value, a firing circuit 25 is energised to operate the visual indication device.

The construction of the head of the missile is shown in FIGURE 3. This has a casing formed in two parts 31 and 32 made of conductive material and insulated from one another by a spacer 33 of insulating material to form an aerial for the radio receiver. The signals picked up by this aerial are demodulated as already described by the demodulator which is mounted as a separate component 34. The remainder of the receiver circuit is cast within a

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body of resin 35, being supplied by a battery 36, and the firing circuit is connected to an explosive fuse 37.

The missile includes inertia-operated mechanism which prevents the operation of the visual indication device until after the missile has been fired. For this purpose a diaphragm 40 is acted on by gas pressure from the burning propulsion charge of the missile and carries a firing pin 41 which initiates a gasless delay train 42. After a short delay which is sufficient to ensure that the missile is clear of the attacking aircraft, the delay train ignites a small charge of powder contained within a casing 43 which acts on a further diaphragm 44 to press a plunger 45 against a lever 46 pivoted at 47. This breaks a plastic shear pin 48 and completes a circuit from the battery 36 to the radio receiver. For this purpose the lever 46 carries a small conducting part 49 which is moved upwardly to bridge the gap between two contacts 50. The lever 46 also has pivoted to it at 51 an arm 52 which is lifted by the rocking of the lever so that a thickened foot portion 53 is lifted away from the end of an inertia rod 54.

The rod 54 is surrounded by a light coiled spring 60 which normally presses it to the left but which is overcome by the inertia forces when the arm 52 is lifted. The rod 54 thus moves to the right as seen in FIGURE 3 where it is latched in position by means of a leaf spring 63 which engages to the left-hand side of an enlargement 64 on the rod 54. Movement of the rod 54 to the right exposes the end of a small port 65 leading from the fuse 37 so that access is provided between the fuse 37 and an explosive charge 66 for firing a quantity of flash powder 67 which constitutes the visual indication device. This flash powder is mounted in the nose of the missile and is enclosed by a light plastic cover 68.

The rod 54 can only move to the right after the missile has been fired and when it is travelling at sufficient velocity to produce the necessary inertia forces. Once the rod 54 has moved as described so that the fuse has access to the charge 66, the flash powder 67 can be fired as soon as the receiver picks up the signal from the target aircraft so as to produce a voltage sufficient to energise the firing circuit in the manner already described.

As illustrated, the target is in the form of a radio-controlled aircraft and the aerial system is mounted in the nose so as to prevent the forward lobes of the radiation being reflected backwardly by the body of the aircraft. The transmitter and aerial system, may, however, also be mounted in a towed target in which case there is no ap-

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preciable chance of reflection and the aerial is accordingly mounted at the rear of the target.

I claim:

1. An aircraft target practice system comprising in combination;

a target;

a radio-transmitting apparatus carried by said target and including antenna means for radiating signals from said target in only a substantially flat beam encircling said target in a plane which is transverse to the major axis of said target, said antenna means including a pair of substantially conical reflectors facing in the same direction with the tip of one cone spaced slightly from the open end of the other cone and a member extending axially through said pair of conical reflectors;

a missile;

radio receiving means carried by said missile;

and visual signalling means carried by said missile, said signalling means being operative in response to the receipt of signals by said receiving means from said radio-transmitting apparatus.

2. A target practice system as defined by claim 1 in which said radio-transmitting apparatus comprises a pulse type transmitter for intermittently transmitting pulses and in which the radio receiver in the missile includes means operative to activate the visual indication device only after receipt of a predetermined number of pulses by said radio-transmitting apparatus.

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