Oct. 26, 1954 P. E. PLUESS 2,692,534

GUNFIRE CUTOFF DEVICE

Filed March 6, 1952

Fig. 1.

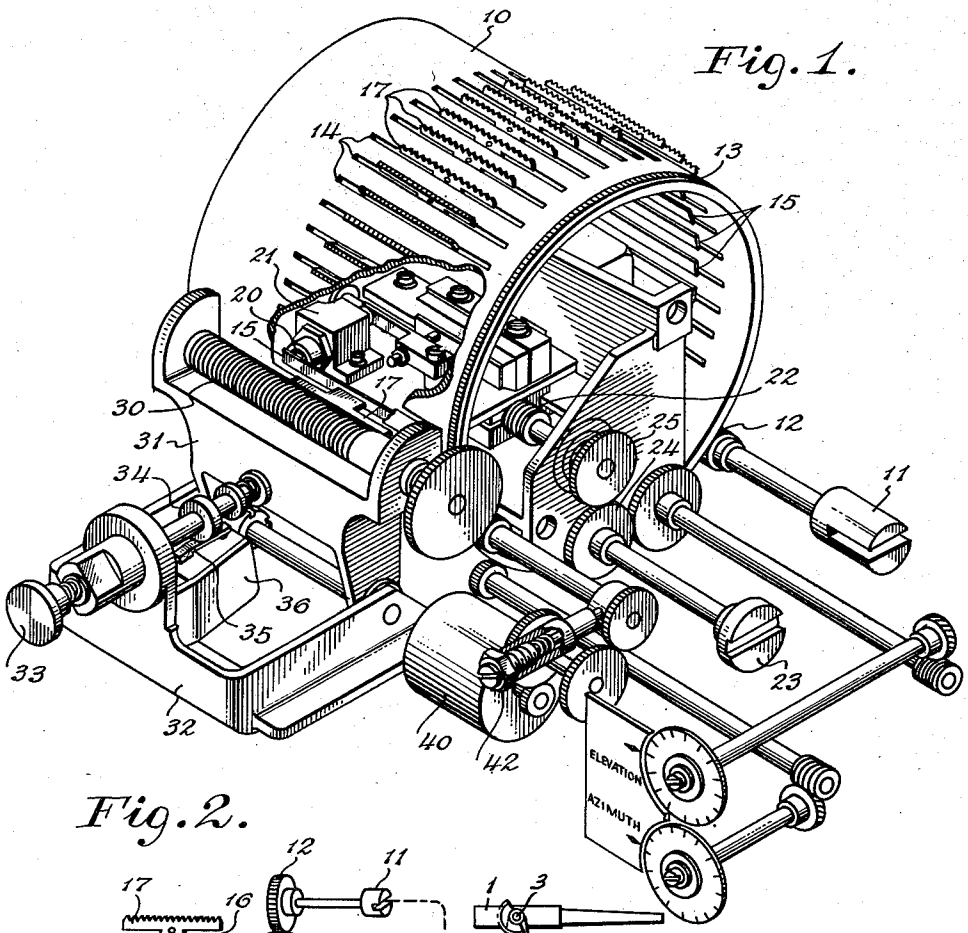


Fig. 2.

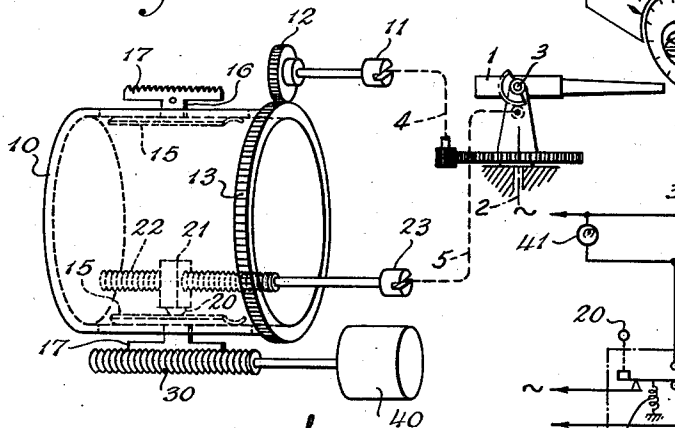


Fig. 3.

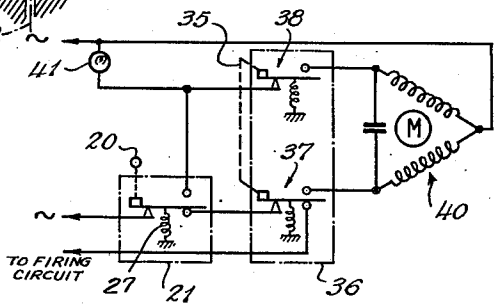
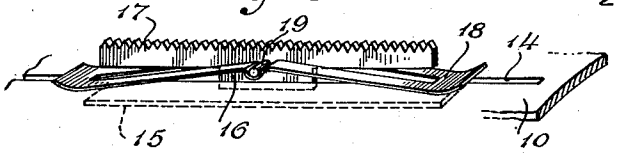


Fig. 4.



INVENTOR
PAUL E. PLUESS
BY
Thomas J. Scheerer
ATTORNEY

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GUNFIRE CUTOFF DEVICE

Paul E. Pluess, Roslyn, N. Y., assignor to The Sperry Corporation, a corporation of Delaware

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9 Claims. (Cl. 89—41)

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This invention relates to circuit making and breaking systems and particularly to such systems when applied as gunfire cutoff or "dead area" control devices for ordnance equipment.

In the field of gunnery, it is common practice in designing certain types of guns to provide a fire cutoff device whereby the firing circuit of the gun is broken during such time that the gun is aimed in a direction in which it is not desired to fire. Such devices are usually employed on rapid firing guns of the type that are traversed during firing. These installations are common on board ship and on aircraft where the field of fire of a gun includes structure on the ship or aircraft. The usual procedure in such cases is to provide a fixed cam, properly oriented with respect to the structure to be protected, that is effective to control an electrical circuit or a mechanical linkage to prevent the operation of the firing circuit during the portion of the travel of the gun in which it bears on the friendly structure. Similar devices are also used on permanent anti-aircraft installations where it is essential to protect adjacent buildings.

Ordinarily, there is no need to provide a cutoff device for conventional field artillery because it is usually aimed in the direction of unfriendly territory and, as a rule, has a limited field of fire. However, in recent years improvements in mobile ordnance equipment have created a different situation. The increased use of heavy probing attacks and large flanking movements require that the attacking force be almost completely dependent on its own artillery. Since the forces are subject to severe interdiction attacks by enemy aircraft, it is essential that they have artillery that can be used with equal facility for anti-aircraft activity as well as for the support of ground troops.

For such situations, special purpose guns have been developed. These guns must be of heavy caliber to be effective against modern aircraft, and must have a field of fire that includes a complete circle in azimuth and from the zenith to below the horizon in elevation. However, because of the large caliber and long range of these guns, every effort must be made to prevent inadvertent fire from being directed at supporting troops, supply lines, and friendly rear areas. When engaging enemy aircraft, it is impossible for a battery commander properly to direct his fire and, at the same time, keep in mind the location of friendly deployments. Therefore, it is essential that such guns be provided with fire cutoff devices that can readily be made operable

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automatically to prevent firing in any "dead area," i. e., one occupied by friendly troops or installations.

Although the firing cutoff devices presently in use are suitable for applications in which the dead areas remain fixed relative to the gun, they are not suitable for the situations described above. Under these conditions it is essential that the cutoff device be such that it can be rendered effective to safeguard surrounding dead areas immediately after the gun is brought to a new firing location. In addition, it must be sufficiently flexible that the effective field of fire can be changed at will and on extremely short notice in order that the gun be adaptable to rapidly changing tactical conditions.

As a solution to this problem, the present invention provides a system whereby at any given gun location the surrounding dead area may quickly be represented as a two-dimensional pattern and the firing of the gun may automatically be controlled from this pattern in accordance with its azimuth and elevation position. To establish this pattern, it is proposed that the azimuth circle of fire be divided into a convenient number of sectors and, in each sector, the minimum effective elevation of the gun be determined.

Essentially the invention comprises a mechanical representation of this dead area pattern that is oriented with respect to the gun and is turned in azimuth therewith, a firing circuit switch that cooperates with the pattern and is moved in elevation in accordance with the movement of the gun, and a pattern setting device that is employed to establish the dead area pattern corresponding to the friendly area surrounding the gun site.

The principal object of the invention is to improve fire cutoff or "dead area" control devices for ordnance equipment. Further objects of the invention are to render gunfire cutoff devices more flexible in operation, more quickly adaptable to a given location, and more readily adjustable to conform to changing tactical conditions.

A preferred form of the invention is shown in the accompanying drawings, in which:

Fig. 1 is an isometric view of a gunfire cutoff device equipped with the invention;

Fig. 2 is a schematic view of the basic elements of the structure of Fig. 1;

Fig. 3 is a wiring diagram of the fire cutoff portion of a firing circuit and the pattern setting circuit; and

Fig. 4 is an isometric view of a portion of the fire cutoff mechanism.

In the form shown in the drawings, the invention is adapted for use on a gun having a barrel 1 (see Fig. 2) that is mounted for complete freedom of rotation in azimuth about an axis 2, and may be raised in elevation about an axis 3 substantially to the zenith for anti-aircraft activity and depressed at least one hundred mils below the horizontal for use against ground targets. Such a gun is equipped with suitable azimuth and elevation drive mechanisms, and is provided with a solenoid actuated firing circuit. For the purposes of this description, these devices are considered conventional and are not described since it will be apparent that the system may readily be adapted for any dead area control application without departing from the scope of the invention.

In order to provide a framework for the mechanical representation of the dead area pattern, the invention includes a hollow cylinder 10 (Figs. 1 and 2) that is mounted for rotation in suitable bearings (not shown) that are fixed to the gun mount. This cylinder is rotated from the azimuth drive of the gun through a flexible shaft 4 and a drive connection 11 having a gear 12 fixed thereon that meshes with a ring gear 13 fixed on the cylinder. A suitable gear ratio is provided so that the cylinder makes one complete revolution for each complete revolution or 6400 mil travel in azimuth of the gun. In the present arrangement cylinder 10 is provided with sixty-four parallel slots 14 equally spaced about its periphery at 100 mil intervals. Each slot serves as a guideway for an associated slide member 15 (see also Fig. 4) which is curved to fit the inner surface of the cylinder and is provided with an extension 16 that projects through the slot and terminates in a rack portion 17. Each slide member 15 extends transversely of its slot through an arc that subtends an angle of approximately fifty mils on either side, so that adjacent slides serve to form a substantially continuous surface.

Each slide is provided with a slotted leaf spring 18 that bears against the outer surface of the cylinder, and has a midportion formed as a seat for a short pin 19 that extends through a hole in extension 16. By this arrangement, each slide member 15 is held snugly against the inner face of the cylinder and may be moved longitudinally in its slot, by means described below, whereby a pattern of the dead area surrounding the gun may be formed.

Cooperating with slide members 15 is an actuating element or plunger 20 for a microswitch 21 that is mounted for movement longitudinally of the slide members on a lead screw 22 that is mounted for rotation on a suitable bracket fixed to the gun mount. Lead screw 22 is rotated from the elevation drive of the gun through a flexible shaft 5, drive connection 23 and gears 24 and 25, whereby these elements constitute a means to move the switch 21 and actuating element or plunger 20 in accordance with the movement of the gun in elevation. In a typical application, the amount of longitudinal movement that may be imparted to switch 21 is proportional to a movement of the gun from approximately minus 100 mils elevation to substantially its zenith. Plunger 20 of microswitch 21 (see also Fig. 3) is resiliently urged by a spring 27 to its outward position against cylinder 10 in which it is effective to close the firing circuit of the gun. When plunger 20 engages or rides on a slide 15, it opens the firing circuit and closes a circuit to a warning lamp 41 that serves as a signal to the gun crew that the gun is aimed at a dead area position.

By the foregoing arrangement, when slides 15 are set in a pattern representing the dead area surrounding the gun, rotation of the gun in azimuth causes cylinder 10 to rotate and thereby bring each slide 15 successively in alignment with plunger 20 of switch 21; whereas, movement of the gun in elevation causes plunger 20 to move longitudinally to slides 15. Thus, in any given position of the gun in azimuth and elevation in which plunger 20 contacts a slide 15, the firing circuit is opened and the gun is prevented from firing, whereas, when the plunger is not in contact with a slide the firing circuit is closed and the gun may be fired.

In order to position slides 15 in a pattern representing the surrounding dead area, the invention provides a slide setting mechanism that is operated by the gunner as soon as the gun is in position. For this purpose, a lead screw 30, having a pitch corresponding to that of the teeth in racks 17, is rotatably mounted in a bracket 31 that is pivoted on a frame 32 fixed to the gun mount. Bracket 31 is spring urged (counterclockwise in Fig. 1) to hold lead screw 30 out of engagement with any of the racks 17. When it is desired to position a slide 15, a setting plunger 33 is depressed which, through bracket 31, moves lead screw 30 into engagement with a rack 17.

Also mounted on setting plunger 33 is a collar 34 that cooperates with a switch actuating member 35 that is connected to the armatures of a microswitch assembly 36. Switch assembly 36 comprises two single pole, double throw microswitches 37 and 38 which comprise a starting circuit for a two-phase capacitor motor 40 which, through suitable gearing, is effective to rotate lead screw 30. Depressing setting plunger 33 actuates switches 37 and 38 to divert line voltage from the firing solenoid circuit to one side of motor 40.

If, because of the position of the gun at the time of setting, plunger 20 is actuated by a slide 15, line voltage is diverted from the firing solenoid circuit to the other side of the motor capacitor. Since line voltage is directly connected between the windings, the induction motor will rotate in the direction which moves the slide away from plunger 20, opening microswitch 21. As soon as the microswitch opens, the motor reverses, and the slide is moved towards plunger 20. As long as setting plunger 33 is held in, the motor alternately reverses direction under control of actuating element or plunger 20, thereby causing the slide to oscillate relative to the plunger. The continual reversing of the motor, which alternately opens and closes microswitch 21 through the oscillating slide, causes lamp 41 to flash on and off, indicating to the operator that the slide is in proper adjustment. A suitable friction brake 42 is employed to limit the amplitude of oscillation of the slides 15 while they are being positioned.

In practice, as soon as a gun equipped with the invention is unlimbered and levelled in a given position, the dead areas within range of the gun are determined in terms of gun azimuth and elevation. The gun is then manually set to the nearest 100 mil graduation, as read on the azimuth dial, whereby cylinder 10 is rotated through the azimuth drive to bring the rack 17 on the selected slide 15 in register with lead screw 30. If no fire cutoff is required in that sector, the gun

is then depressed in elevation to its lower limit. If fire cutoff is required, the gun is elevated to, or slightly above, the elevation angle beneath which gunfire is not wanted.

In either case, switch 20 is positioned accordingly, with reference to the selected slide 15, by the elevation drive. Plunger 33 is then depressed to engage lead screw 30 with the associated rack 17 and to energize motor 40 to drive slide 15 in the required direction. The plunger is held depressed until lamp 41 flashes, indicating that the fire cutoff control for that sector is properly positioned. This procedure is then repeated for each of the remaining azimuth sectors, in sequence, to complete the firing cutoff control for that gun location.

It may be noted that the use of 100 mil azimuth sectors, in the present instance, is purely a matter of choice since it is apparent that the invention may readily be adapted for use with any size sector. The ultimate choice is primarily a matter of tactical consideration that is determined as a function of the relative importance of accuracy of control and the time required to set the control.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In combination with a circuit making and breaking switch, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members to engage the actuating element, said members being effective when engaged with the actuating element to move it to its other position, means to move the plurality of members transversely to the actuating element, means to move the actuating element longitudinally to the plurality of members, and means to vary the setting of each member of the plurality of members.

2. In combination with a circuit making and breaking switch, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members to engage the actuating element, said members being effective when engaged with the actuating element to move it to its other position, means to cause movement of the actuating element relative to the plurality of members, means to cause movement of the plurality of members relative to the actuating element, means to vary the setting of each member of the plurality of members, and means controlled by the actuating element to determine the direction and extent of operation of the last recited means.

3. In combination with a circuit making and breaking switch, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members to engage the actuating element, said members being effective when engaged with the actuating element to move it to its other position, means to cause movement of the actuating element relative to the plurality of members, means to cause movement of the plurality of members relative to the actuating element, driving means to vary the setting of the plurality of members, means selectively to engage the driving means with each member of the plurality of members, and means controlled by the actuating element to determine the direction and extent of operation of the driving means.

4. A dead area control system for a gun comprising a switch to open and close the firing circuit of the gun, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members arranged for movement to engage the actuating element, said members being effective when thus engaged to move the actuating element to its other position, means to move the plurality of members relative to the actuating element proportionally to the azimuth movement of the gun, means to move the actuating element relative to the plurality of members proportionally to the elevation movement of the gun, means to vary the setting of each member of the plurality of members, and means controlled by the actuating element to determine the direction and extent of operation of the last recited means.

5. A dead area control system for a gun comprising a switch to open and close the firing circuit of the gun, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members arranged for movement to engage the actuating element, said members being effective when thus engaged to move the actuating element to its other position, means to move the plurality of members relative to the actuating element proportionally to the azimuth movement of the gun, means to move the actuating element relative to the plurality of members proportionally to the elevation movement of the gun, driving means to vary the setting of the plurality of members, means selectively to engage the driving means with each member of the plurality of members, and means controlled by the actuating element to determine the direction and extent of operation of the driving means.

6. A dead area control system for a gun comprising a switch to open and close the firing circuit of the gun, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members arranged for movement to engage the actuating element, said members being effective when thus engaged to move the actuating element to its other position, means to move the plurality of members transversely to the actuating element proportionally to the azimuth movement of the gun, means to move the actuating element longitudinally to the plurality of members proportionally to the elevation movement of the gun, means to vary the setting of each member of the plurality of members, and means controlled by the actuating element to determine the direction and extent of operation of the last recited means.

7. A dead area control system for a gun comprising a switch to open and close the firing circuit of the gun, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means

to urge the actuating element to one of said positions, a plurality of individually settable members arranged for movement to engage the actuating element, said members being effective when thus engaged to move the actuating element to its other position, means to move the plurality of members transversely to the actuating element proportionally to the azimuth movement of the gun, means to move the actuating element longitudinally to the plurality of members proportionally to the elevation movement of the gun, driving means to vary the setting of the plurality of members, means selectively to engage the driving means with each member of the plurality of members, and means controlled by the actuating element to determine the direction and extent of operation of the driving means.

8. A dead area control system for a gun comprising a switch to open and close the firing circuit of the gun, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members arranged for movement to engage the actuating element, said members being effective when thus engaged to move the actuating element to its other position, means to move the plurality of members transversely to the actuating element proportionally to the azimuth movement of the gun, means to move the actuating element longitudinally to the plurality of members proportionally to the elevation movement of the gun, means to vary the setting of each member of the plurality of members, means controlled by the actuating element to determine the direction and extent of operation of the last recited means, and signalling means operable upon the engagement of the actuating element with any of the plurality of members.

9. A dead area control system for a gun comprising a switch to open and close the firing circuit of the gun, a switch actuating element movable to one position to open the switch and to another position to close the switch, resilient means to urge the actuating element to one of said positions, a plurality of individually settable members arranged for movement to engage the actuating element, said members being effective when thus engaged to move the actuating element to its other position, means to move the plurality of members transversely to the actuating element proportionally to the azimuth movement of the gun, means to move the actuating element longitudinally to the plurality of members proportionally to the elevation movement of the gun, driving means to vary the setting of the plurality of members, means selectively to engage the driving means with each member of the plurality of members, means controlled by the actuating element to determine the direction and extent of operation of the driving means, and signalling means operable upon the engagement of the actuating element with any of the plurality of members.

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