J. B. HENDERSON.

METHOD OF CONTROLLING GUNS.

APPLICATION FILED SEPT. 20, 1919.

1,327,204. Patented Jan. 6, 1920.

Fig. 1.

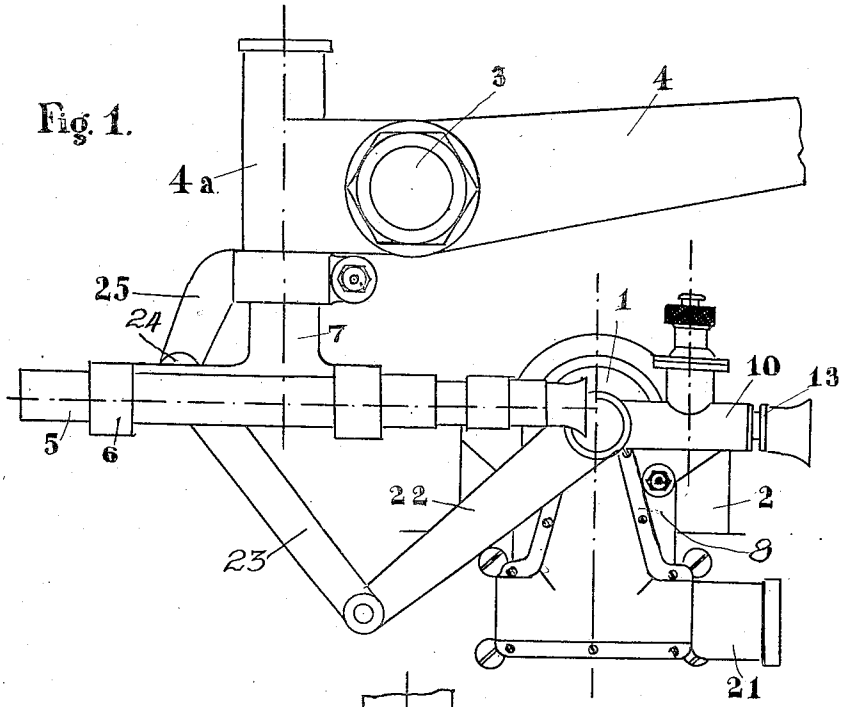


Fig. 2.

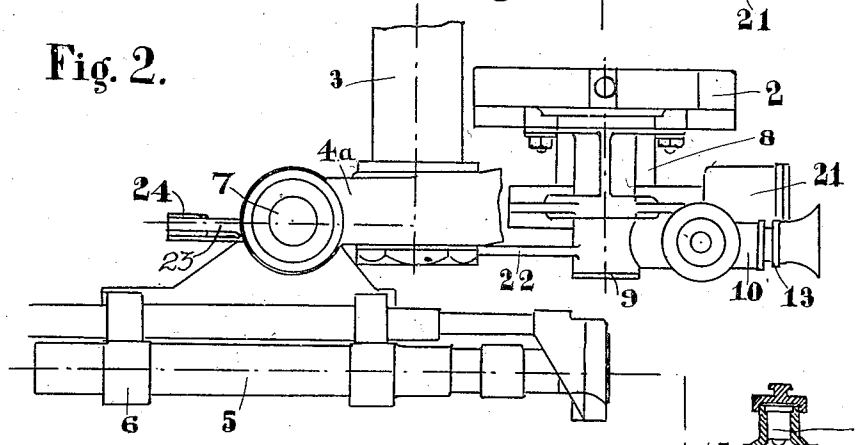
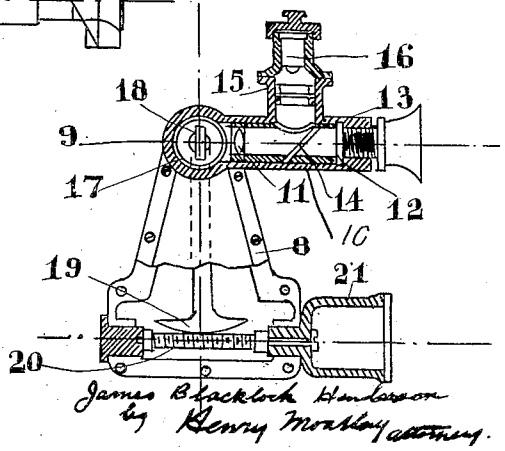


Fig. 3.



James Blacklock Henderson
by Henry Morsby attorney.

UNITED STATES PATENT OFFICE.

JAMES BLACKLOCK HENDERSON, OF LEE, ENGLAND.

METHOD OF CONTROLLING GUNS.

1,327,204. Specification of Letters Patent. Patented Jan. 6, 1920.

Application filed September 20, 1919. Serial No. 325,174.

To all whom it may concern:

Be it known that I, JAMES BLACKLOCK HENDERSON, subject of the King of Great Britain, residing at 2 Cambridge road, Lee, in the county of Kent, England, have invented certain new and useful Improvements in Methods of Controlling Guns, of which the following is a specification.

My invention relates to the control of guns and more particularly to the system of control of naval guns known as director control in which all the guns or a group of guns on a ship are fired simultaneously by an observer in an elevated position known as the director tower. The object of my invention is to simplify the system of director control more especially when applied to ships having mixed armament, that is to say two different types or sizes of guns which may have to be fired simultaneously at the same target, in which case they must be elevated at different angles relatively to the line of sight to the target. My invention however is not confined to the case of ships having mixed armament; it also provides a simplified director system for use in any ship.

My invention consists in laying the guns relatively to the deck of the ship by arranging at each gun an artificial target on which the gun-layer lays the gun and in elevating and depressing this target relatively to the deck in phase with the elevation and depression of the director layer's telescope.

The artificial target is preferably made the cross wires of a collimator which may be rigidly attached to the gun-sighting telescope and say at right angles to it or it may be attached to some part of the mounting which does not elevate with the gun, and I arrange a reflector outside the gun-sighting telescope so that the beam emerging from the collimator is reflected into the gun-sighting telescope thus forming an image of the artificial target in the focal plane of the telescope, and I elevate and depress this reflector by means of an electro-magnetic receiver motor worked electrically by a transmitter on the elevating gear of the director layer's telescope. I attach the receiver mechanism which carries the mirror to a part of the mounting which does not elevate with the gun so that any change of range setting on the sight displaces the artificial target from the cross wires and causes the gun layer to elevate or depress the gun to suit the change of range. If the collimator is mounted on the telescope the mirror is elevated through the same angle as the director telescope but if the collimator be attached to the pedestal say, the mirror is elevated through half that angle. The reflector thus introduces not only the change of elevation relatively to the deck due to the motion of the director telescope, but also the elevation due to change of range. The range is transmitted from the control tower and is set on the sight just as in ordinary individual firing of the guns.

I may arrange the gun sighting telescope so that it serves both as collimator and telescope or I may employ an auxiliary telescope for the same purpose the most suitable arrangement depending very much upon the mechanical linkage between the gun sight telescope and the gun. For example, I may attach the case of the receiver motor rigidly to the plumber block supporting the gun trunnion and arrange around this case a cylindrical sleeve turning on the receiver case coaxial with the mirror spindle, the sleeve carrying an auxiliary telescope and being linked to the gun sight so that the sleeve elevates and depresses with the gun sighting telescope. The auxiliary telescope serves both for laying the gun and as collimator. The cross wires are illuminated by a night-sight lamp and the beam emerging from them through the objective is reflected from the receiver mirror back into the telescope again and forms an image in the focal plane. The gun layer keeps this image of the cross wires coincident with the cross wires themselves.

The most convenient manner of applying my invention to any particular type of gun will obviously depend to a certain extent on the design of the gun mounting. It will suffice therefore if I illustrate the application of my invention to one type of gun mounting and gun sight.

Figures 1 and 2 are respectively elevation and plan of apparatus constructed in accordance with my invention and Fig. 3 is a sectional elevation of the collimating telescope and parts connected therewith.

The gun and cradle are not shown. The cradle is mounted on trunnions 1 on the plumber block 2 which is carried by the gun pedestal or by the gun turret. The cradle also carries the sight horizontal pivot 3 upon which the sight is elevated and depressed by the lever 4, the end of this lever being

elevated and depressed by a cam attached to the range dial, both cam and dial being mounted on the gun cradle. The cam and range dial (not shown) are of the usual construction, and other mechanism for moving the sight in accordance with the range may be utilized.

The telescope 5 and its carrier 6 are carried upon a vertical shaft 7 which can turn in bearings in the extension 4^a of the lever 4.

In one method of applying my invention to such a gun mounting I attach to the plumber block 2 a casting 8. This casting is provided with a cylindrical projection 9 upon which is pivoted the case of a collimating telescope 10 containing an objective 11, a graticule 12, an eyepiece 13, a plane glass reflector 14 at 45° to the axis of collimation and another graticule 15 which is illuminated by a lamp 16. The graticule 15 carries the cross wires or other mark which forms the artificial target upon which the gun is laid.

The mirror 17 is pivoted upon an axis 18 which is preferably coaxial with the gun trunnion and this mirror is turned upon its axis 18 by means of a worm sector 19 and a worm 20 which is turned by an electro-magnetic receiver mechanism contained in the box 21 which forms part of the casting 8. This receiver mechanism would be of the usual construction, consisting preferably of an electro-magnetic step-by-step motor which is electrically connected to a transmitter actuated by the director gear to transmit to the worm 20 an angular movement which is proportional to the angle which the director layer's telescope makes with the horizontal.

The collimating telescope 10 is elevated and depressed about the trunnion 9 by means of a crank 22 which is rigidly attached to the telescope and which is connected by a connecting rod 23 to a pin 24 on a bracket 25 which is rigidly attached to the pivot 7. The length of the connecting rod 23 is equal and parallel to the distance between the axes 1 and 3 so that the telescope 10 is elevated and depressed by the same amount as the lever 4.

When the mirror 18 is perpendicular to the axis of collimation of the telescope 10 a real image of the artificial target engraved upon the graticule 15 is superposed on the graticule 12 due to reflections in 14 and 17, and if the mirror 17 be elevated or depressed by the receiver mechanism, the image of the target is elevated or depressed on the cross wires but by elevating the gun the image of the target may be maintained centrally upon the cross wires. Thus, the gun can be kept in step with the elevation or depression of the director sight.

Again when a change of range is set upon the gun sight the lever 4 is elevated or depressed and carries the telescope 10 with it but does not affect the mirror 17. A displacement of the image of the artificial target therefore takes place relatively to the cross wires and an elevation of the gun is required to replace it. Thus every change of range is converted into its corresponding elevation of the gun.

The arrangements for controlling training do not differ from those for controlling elevation more than elevation controls will differ among themselves. I may employ in training control a vertical collimator fixed to the deck above the gun with its axis of collimation along the axis of the vertical pivot of the gun. A reflector placed at 45° to the vertical reflects the beam into a telescope fixed to the trainer's telescope bracket and a receiver mechanism turns the mirror around the vertical axis of the collimator. Many other arrangements are possible however.

It is evident that instead of shifting the image of an artificial target, as described in the specific embodiment of the invention disclosed, the artificial target itself may be displaced, and it is intended that the term "artificial target," as used in the claims, will cover both the displacement of an artificial target itself and the image of an artificial target by means of an optical system.

It is also to be understood that the term "director angle," as used in the claims, is the angle which the director layer's telescope makes with the horizontal, or in other words, the angle which the deck of a vessel will make with the horizontal at the instant of firing the gun, as is the usual meaning of this term.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a director firing system, a gun, a sight mounted to move with the gun, an artificial target adapted to be located through said sight, means operable from a director's station at which the actual target is sighted for causing a relative displacement of said target and sight in accordance with a function of the position of the actual target whereby said gun may be pointed by moving said gun until the target may be again located through the sight.

2. In a director firing system, a gun, a sight mounted to move with the gun, an artificial target adapted to be located through said sight, means for causing relative displacement of said sight and target in accordance with the range of the actual target, means operable from a director's station at which the actual target is sighted for causing a further relative displacement of said target and sight in accordance with a director angle whereby said gun may be

pointed by moving said gun until said target may again be located through said sight.

3. In a director firing system, a gun, a sight mounted to move with said gun, an artificial target adapted to be located through said sight, means operable from a director's station at which the actual target is sighted for causing relative displacement of said target and sight in accordance with the director angle whereby the position of the gun may be corrected for said director angle by moving said gun until said target may again be located through said sight.

4. In a director firing system, a gun, an artificial target, an optical system having parts at least mounted to move with said gun for locating an image of said artificial target in a definite normal position, and means operable from a director's station at which the actual target is sighted for shifting the image of said artificial target in said optical system, the said means being operable in accordance with a function of a position of an actual target whereby the gun may be pointed by moving said gun until the image of the artificial target is again located in its normal position in the optical system.

5. In a director firing system, a gun, an optical system having parts thereof mounted on said gun to move therewith and other parts movable independently of said gun, means operable from a director's station at which the actual target is sighted for shifting the relative position of the parts of said optical system in accordance with the range of an actual target, and also in accordance with the director angle, an artificial target having its image located in a definite normal position in said optical system which is shifted upon the shifting of said parts of said optical system whereby said gun may be pointed by moving the gun and the parts of the optical system thereon until said image again resumes its normal position in said optical system.

6. In a director firing system, a gun, a collimating telescope mounted for movement with said gun, said collimating telescope comprising an artificial target and a mirror for reflecting an image of said artificial target into said telescope, and means operable from a director's station at which the actual target is sighted for shifting the position of said mirror to vary the position of the image of said artificial target in said telescope, whereby the gun may be pointed by moving said gun until the image again assumes its normal position in said telescope.

7. In a director firing system, a collimating telescope mounted for movement with said gun, said telescope having a pivotal axis coincident with the trunnion axis of the gun, said collimating telescope comprising an artificial target and a mirror for reflecting an image of said target into the telescope, said mirror having its pivotal axis also coincident with the trunnion axis of the gun, means for shifting said telescope in accordance with the range and means for shifting the said mirror in accordance with the director angle.

8. In a director firing system, a gun, a collimating telescope having its pivotal axis coincident with the trunnion axis of the gun, said collimating telescope comprising an artificial target, and a pair of mirrors, one of said mirrors being fixed in said telescope and the other of said mirrors being pivoted for movement relative to said telescope whereby the artificial image is adapted by double reflection to be thrown in the field of said telescope, and means for shifting the relative position of said mirrors in accordance with the function of the position of an actual target whereby said gun may be pointed by shifting said gun until said mirrors occupy their normal relative position which may be determined by locating the image of said artificial target in the field of said telescope.

Dated this 2nd day of Sept., 1919.

JAMES BLACKLOCK HENDERSON.