No. 729,491. PATENTED MAY 26, 1903.

C. J. A. DICK.

INSTRUMENT FOR INDICATING AND RECORDING THE AIMING OF NAVAL GUNS.

APPLICATION FILED JUNE 6, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

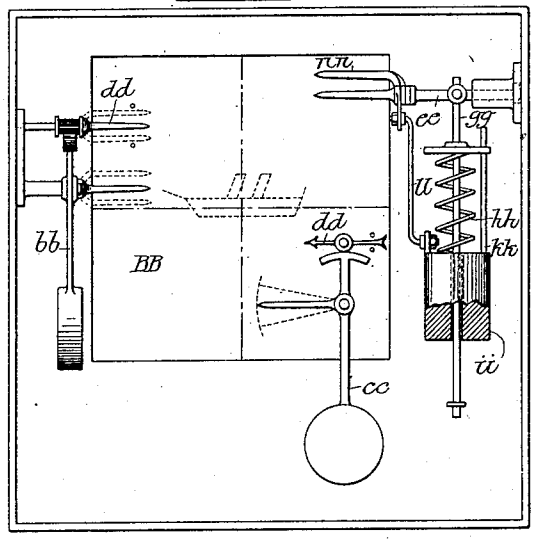


Fig. 2.

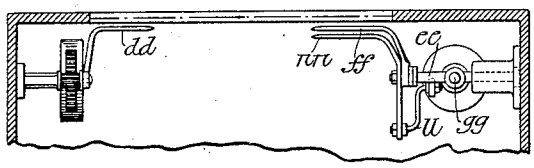


Fig. 4.

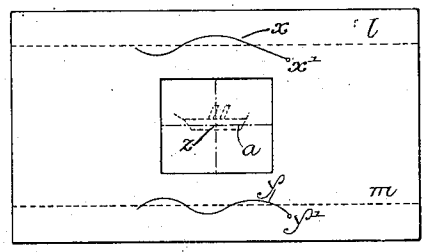


Fig. 3.

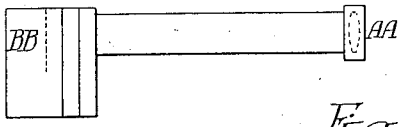
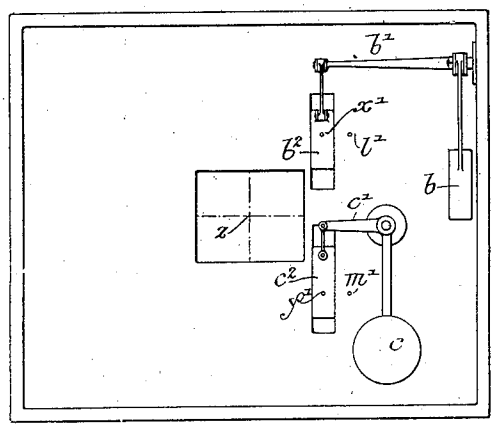


Fig. 5.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 6a

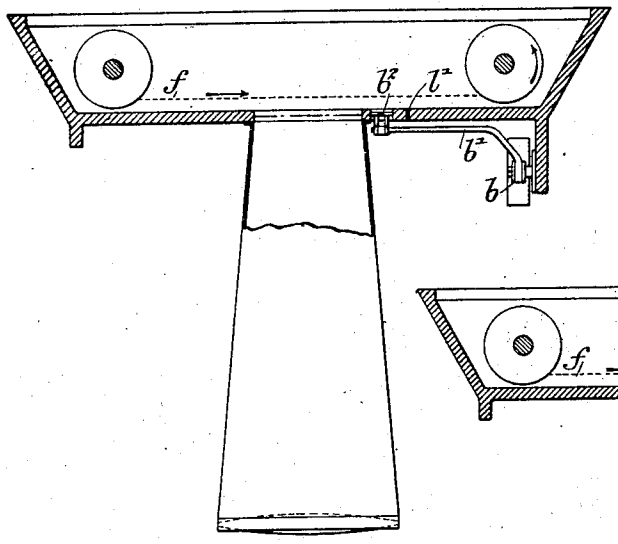


Fig. 6b

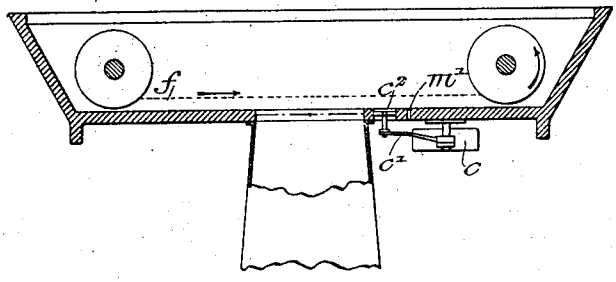


Fig. 7.

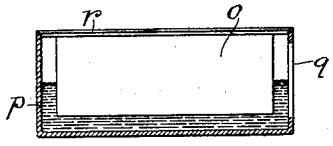


Fig. 7a

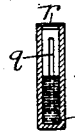


Fig. 7b

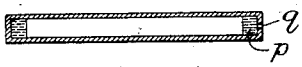


Fig. 7c

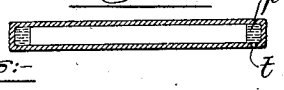
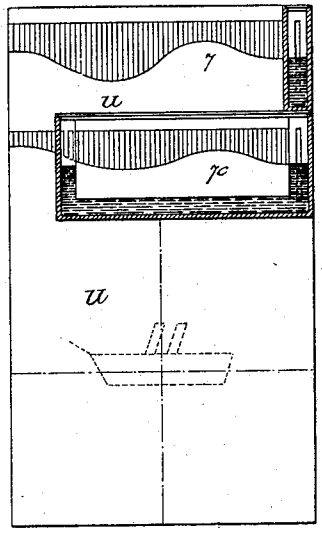


Fig. 8.



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Inventor:
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by his Attorneys:
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No. 729,491. Patented May 26, 1903.

UNITED STATES PATENT OFFICE.

CHARLES J. A. DICK, OF LYSAKER, NEAR CHRISTIANIA, NORWAY.

INSTRUMENT FOR INDICATING AND RECORDING THE AIMING OF NAVAL GUNS.

SPECIFICATION forming part of Letters Patent No. 729,491, dated May 26, 1903.

Original application filed September 23, 1901, Serial No. 76,217. Divided and this application filed June 6, 1902. Serial No. 110,496. (No model.)

To all whom it may concern:

Be it known that I, CHARLES JAMES ADOLPH DICK, a subject of the King of England, and a resident of Lysaker, near Christiania, in the Kingdom of Norway, have invented a new or improved instrument for indicating and recording the aiming of naval guns and the motion of such guns produced, for instance, by the rolling or pitching of the ship at the moment of firing, (the same being a division of application Serial No. 76,217, filed September 23, 1901,) of which the following is a specification.

The rolling and pitching motions experienced by a ship at sea make it exceedingly difficult for naval gunners to take correct aim at a target or hostile vessel.

The subject of this invention is an instrument intended to be used mainly for training the gunners to overcome the above-mentioned difficulties without necessitating the actual firing of the gun. For this purpose the direction and movement of the gun at the moment of firing with regard to the horizontal plane and the object aimed at are accurately recorded. One can thus after the gun has been fired or is supposed to have been fired determine definitely the direction in which the gun was pointing and moving at the given moment. There can therefore be no difference of opinion as to whether the gunner aimed correctly and whether the mark would presumably have been hit if the gun had actually been fired at that moment.

The invention consists of certain arrangements whereby the recording is effected by photographic means.

Figure 1 is an interior elevation showing the detail arrangement of a portion of my invention. Fig. 2 is a sectional plan view of a portion of Fig 1. Fig. 3 is a side elevation showing the relative positions of the lens and sensitized film of the camera employed with my invention. Fig. 4 is a view illustrating one of the records made by my improved device. Figs. 5 and 6 are views showing a possible arrangement of the various structures constituting my invention whereby it may be successfully carried out. Figs. 6^a and 6^b are plan views showing the detail arrangement of certain portions of my device; and Figs. 7 to 8, inclusive, illustrate special forms of the invention.

A camera is fitted with an instantaneous shutter and with a wire cross or other similar device that shows the center of the camera on the sensitive plate or film, while one or more pointers, which are placed in front of the sensitive surface, are by means of pendulums or other similar devices continually kept in a horizontal position. The pendulums also act on a second pointer by changing their positions as to the body of the camera. These latter pointers allow one to see in which direction, either upward or downward, the camera and the gun were being moved by the rolling and pitching of the ship at the moment of firing. A pointer which is likewise placed in front of the sensitive surface and which is influenced by a spring and weight or other similar device is used for indicating and recording the direction of the vertical motion of the ship—*i. e.*, the rising and falling—the rolling and pitching motions being indicated and recorded by the pendulums, as aforesaid. All these pointers, or all those that may be required, are pictured on the sensitive plate. One of these pendulums is fixed so as to swing approximately parallel to the longitudinal axis of the gun to which the camera is fixed, while the other can be fixed so as to swing at approximately right angles to the former one. Consequently the motion of the ship caused by the rolling, as well as that caused by the pitching, is recorded.

The camera is placed with its longitudinal axis parallel to the sighting-line of the gun, with such corrections for the speed of the ship and the wind as may from time to time be necessary—that is to say, the camera may be placed on the sighting apparatus of the gun. The instataneous shutter of the camera is released at the moment of actual or supposed firing of the gun.

The photographic picture produced hereby (see Fig. 1) shows, first, the target *a a*, which, if the gun was correctly sighted, should be exactly at the point of intersection of the two wires of the wire cross—*i. e.*, in the center of the camera. The photograph likewise shows the position of the gun with respect to

the horizontal plane indicated by the relative positions of the horizontal wire of the cross and the pointer, which is fastened to the pendulum *b b*, swinging parallel to the longitudinal axis of the gun. This pointer is placed at right angles to the swinging plane of the pendulum and shows when fixed to a broadside gun the influence of the rolling of the ship. Thirdly, the position of the gun toward the horizontal is shown by a pointer which is fixed to a similar pendulum *c c*, that swings at right angles to the former pendulum. As this pointer is placed in the same plane as that in which the pendulum swings, it shows with a broadside gun the influence of the pitching of the ship.

The upward or downward motions of the ship at the moment of firing are shown by pointers or arrows *d d*, which turn on fixed axles and which are moved by segmental bows connected with the pendulums and by small friction-rollers or other similar devices firmly fastened to the axles of the arrows. These friction-rollers turn the arrows instantly against a stopping-pin and keep them in that position until the changed swinging of the pendulum reverses their direction. The arrow drops into a horizontal position when the ship is at rest. This may be effected by slightly hollowing out the middle of the segmental bow. These arrows will thus show the direction of the upward or downward motion produced by the rolling and the pitching of the ship at the moment of firing. Another pointer shows the direction of the vertical motion of the ship apart from the rolling and pitching motions by the relative positions of a fixed and a movable pointer. The latter arrangement, as here described, consists of a bar *e e*, secured to the camera and having at its end a fixed pointer *f f*, which, being cranked, is brought close to the sensitive film. The bar *e e* carries likewise the vertical spindle *g g* to the plate, at the upper end of which is secured the coiled spring *h h*, which serves to suspend the weight *i i*, through the center of which the spindle passes, acting as a guiding-rod. Other guiding-rods *k k* may be attached to the weight, passing through suitable apertures in the suspending-plate. A bar *l l*, fastened to the weight, is attached to one end of the lever *m m*, which is loosely hinged on the bar *e e*. The other end of the lever is bent at right angles and parallel and close to the pointer *f f*, thus constituting the loose pointer *n n*. Under the influence of the up-and-down movements of the ship the distance between the suspension-plate, to which the upper end of the spring *h h* is secured, and the weight *i i*, fastened to the lower end of the spring *h h*, varies—*i. e.*, it will be greater during the upward and less during the downward motion of the ship, these variations being made apparent by the relative positions of the fixed pointer *f f* and the loose pointer *n n*, as will be easily understood from the drawings. All these pendulums, arrows, and pointers are inclosed in a frame which is placed between the lens A A and the film B B. (See Fig. 3.) The instantaneous shutter may be placed in front of this frame. Other horizontal lines are marked on the film parallel to the horizontal wire of the cross in order to facilitate the reading of the angles and distances.

Another method of carrying out the invention is moving the recording-surface, which consists, for instance, of a strip of sensitive film or paper, at a suitable speed from a few moments before or from the instant of firing or supposed firing until a few moments after the firing or supposed firing. In the case of photographic recording the movable pointer is represented by a point of light, (pinhole,) which in consequence of the motion of the sensitive surface traces a curve on the same. In the case of mechanical recording the point of a pencil, for instance, is used instead of the point of light for marking the curves on a strip of paper. If the recording-surface has already been set in motion before the firing takes place, then at the moment of firing this point of light or pencil-point is made to show a wider mark, or it makes a sideway movement, so that its position on the curve at that moment is indicated. If, however, the recording-surface is only set in motion at the moment of firing or supposed firing, then the point where the curve commences is equivalent to this mark on the curve. The direction and form of the curve allows of determining accurately in which phase of motion the gun (the ship) was at the moment of firing or supposed firing. A fixed pointer, consisting likewise of a point of light or pencil-point, demonstrates the position of the ship when at rest (in smooth water) drawing a straight line on the recording-surface.

The inclosed drawing Fig. 4 shows the picture produced by photographic recording. The target *a* must appear at the point of intersection *z* of the horizontal and vertical wires. *x* is the curve traced by the movable point of light *x'* under the influence, for instance, of the rolling motion. *y* is the curve of the point of light *y'* under the influence, for instance, of the pitching motion. The straight lines *l* and *m* indicate the position of the ship when at rest and form consequently the axes of the abscissæ of the curves *x* and *y*. The curves coincide with these axes when the ship is horizontal in smooth water and the registering-points are at rest. The deviation of the position of these axes from that of the middle or average intersecting line of the curves may serve to show a possible list of the ship.

Figs. 5 and 6 suggest an arrangement which can be used for carrying out the invention. Two pendulums *b* and *c* are suspended at right angles or approximately at right angles to one another. These pendulums are connected with arms *b' c'*, to which are fastened, in the case of photographic recording, light-

tight slides b^2 c^2, which move in the front of the camera close to the sensitive surface. In these slides there are small openings (pinholes) forming the points of light x' y'. The lines l and m are traced by openings l' and m' in the front of the camera. The sensitive surface f consists, as usual, of a film which is moved along the front of the camera in the direction indicated by the arrow by means of clockwork or other similar device. This clockwork is started before or at the moment of firing, and it continues to run after the shot has been fired or is supposed to have been fired sufficiently long to show at least part of the next branch of the curves x and y.

To determine the position of the point x' on the curve x and y' on y at the moment of firing, one can, for instance, make wider apertures on both sides of the openings x' and y', which are opened at the same time as the instantaneous shutter of the camera which takes the picture of the target and the horizontal line. Thus a line will be traced the point of intersection of which with the curves x or y will show the positions of the points x' y' at the moment of exposing the film. If the clockwork is set in motion only at the moment of firing the gun, the point where the curves commence shows the position of the points x' y', and in photographic recording the light-points x' and y' may be opened simultaneously with the instantaneous shutter of the camera and closed again after tracing the curve or curves. The taking of the picture of the target is almost instantaneous, while the tracing of the curves requires longer time, so that the closing of the light-points x' y' does not coincide with the closing of the instantaneous shutter of the camera. The surface of a liquid may also be used instead of the pendulums b and c for tracing and recording the curves resulting from the oscillating motion of the ship—*i. e.*, gun.

In the case of photographic recording a vessel containing an opaque liquid, such as mercury, or a liquid colored in such a way as to intercept the chemical light-rays, is placed close to the sensitive surface and is fitted on the side nearest thereto with a transparent vertical slit, which is opened to the light simultaneously with the starting of the clockwork at the moment of firing or supposed firing. The light falling through this slit shows on the moving sensitive surface in the form of a strip, the upper edge of which being a straight line parallel to the horizon (when the ship is at rest) and corresponding to the lines traced by the action of the light-points l' m', while the lower edge of the strip corresponds with the curved lines traced by the movable light-points x' y', the liquid surface remaining horizontal and the vertical transparent slit moving up and down with the oscillating motions of the ship, a greater or lesser height of the sensitive registering-surface is exposed to the action of the light falling through the slit as the surface moves along, the curve thus being traced. The vessel containing the liquid should be of sufficient length to clearly mark variations in the ship's position, and it is desirable to use two such vessels, the one set with its longitudinal axis parallel to that of the gun, its transparent vertical slit lying in its longitudinal axis, and the other having its longitudinal axis approximately at right angles thereto, and its vertical transparent slit placed sidewise and turned in such a way that it marks the action of the light on the sensitive surface at the end of the vessel in the direction of its cross-axis. In this way both the rolling and pitching motions can be traced on the same sensitive film simultaneously.

Fig. 7 shows the vessel o partly filled with the recording liquid p, having at its end the vertical transparent slit q, closed by glass or other transparent substance. r is a transparent cover, and s an opaque slide which can be opened to admit light.

Fig. 7^a is a vertical section of the above.

Fig. 7^b is a horizontal section of the same vessel.

Fig. 7^c shows the same arrangement of vessel, but with the vertical slit t set sidewise.

Fig. 8 shows the registering-surface u and the position of the vessels described by Figs. 7, 7^a, 7^b, and 7^c with regard to such registering-surface, Fig. 7 tracing curves showing the motion of the gun in the vertical plane of its longitudinal axis and Fig. 7^c its action at right angles thereto.

The action as to the moving of the sensitive registering-surface can be varied by the two vessels described by Figs. 7 and 7^c being mounted on a slide moving along a stationary registering-surface.

If the apparatus should stand in a dark place, it may be necessary to use artificial light—for instance, electric lamps—in order to obtain sufficiently active points of light, or mechanical recording must be resorted to, as stated above.

I claim—

1. In a device of the character described, the combination of an indicator supported by and free to move with the gun, with a device having a suitable surface and means for recording upon the same the position of said indicator and the position of the object aimed at, substantially as described.

2. In a device of the character described, the combination of a reference-indicator constructed to remain in a substantially constant position, an indicator supported by the gun and movable with the same, with a device having a suitable surface and means for recording upon the same the position of said two indicators and the position of the object aimed at, substantially as described.

3. In a device of the character described, the combination of a photographic apparatus having means for recording upon a suitable sensitized surface, the position of the object aimed at, said apparatus being attached to

the gun and having an indicator free to move and constructed to remain in a constant position relatively to a horizontal plane, said indicator being placed so that its position may be recorded by the sensitized surface, substantially as described.

4. The combination in a device of the character described, of an indicator having means free to retain a constant position relatively to a horizontal plane, a second indicator operative in a plane at right angles to the plane of the first indicator, and a photographic device for simultaneously recording the position of an object aimed at and the positions of said two indicators, substantially as described.

5. The combination in a device of the character described, of an indicator having means free to retain a constant position relatively to a horizontal plane, a second indicator operative in a plane at right angles to the plane of the first indicator, and a photographic device for simultaneously recording the position of an object aimed at and the position of said two indicators, with means for indicating whether the device is moving up or down, substantially as described.

6. The combination of a photographic device attached to the gun for indicating the relative position of an object aimed at, a device acted upon by gravity and having means whereby it is caused to record upon the film of said photographic device variations in the level of the same, with a second device also acted upon by gravity placed in the plane at right angles to the plane of the first-mentioned device, substantially as described.

7. In a device of the character described, the combination of a photographic device, means for indicating changes in the level of said photographic device and an indicator having means constructed to be operated by changes of position, said photographic device being constructed to simultaneously record the position of an object aimed at and the various positions of said indicating device, substantially as described.

8. The combination with a camera attached to the gun, of a movable structure having a pivoted weight operative upon it, a second structure having a pivoted weight free to swing in a plane at right angles to that of the first weight, said structures being placed between the lens and the sensitized surface of the camera so that their relative positions may be recorded thereupon, said camera being constructed to simultaneously record the position of an object aimed at and the positions of the indicating structures, substantially as described.

9. The combination with a camera attached to the gun, of a movable structure having a pivoted weight operative upon it, a second structure having a pivoted weight free to swing in a plane at right angles to that of the first weight, said structures being placed between the lens and the sensitized surface of the camera, so that their relative positions may be recorded thereupon, said camera being constructed to simultaneously record the position of an object aimed at and the positions of the indicating structures, and being provided with means for indicating when said object is in the line of the longitudinal axis of the gun, substantially as described.

10. The combination with a photographic device attached to the gun, of an indicator for showing the position of said gun in two planes relatively to a horizontal plane, with means for indicating the direction of motion of the gun in a vertical plane, and other means for indicating the direction of motion of said gun in a plane at right angles to said first plane, substantially as described.

11. The combination in a device of the character described, of means for indicating the direction of motion of the gun in a vertical plane at right angles to its longitudinal axis and means for indicating the direction of motion in a vertical plane parallel to said axis, means for indicating the amount of motion in both of said planes, and a photographic device for simultaneously recording the position of said indicators and the position of the object aimed at, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

C. J. A. DICK.

Witnesses:
A. RAMSTAD,
O. RAMSTAD.