No. 785,434. PATENTED MAR. 21, 1905.

V. J. POUTET.

NAVAL GUN SIGHT.

APPLICATION FILED DEC. 11, 1903

2 SHEETS—SHEET 1.

Fig. 1.

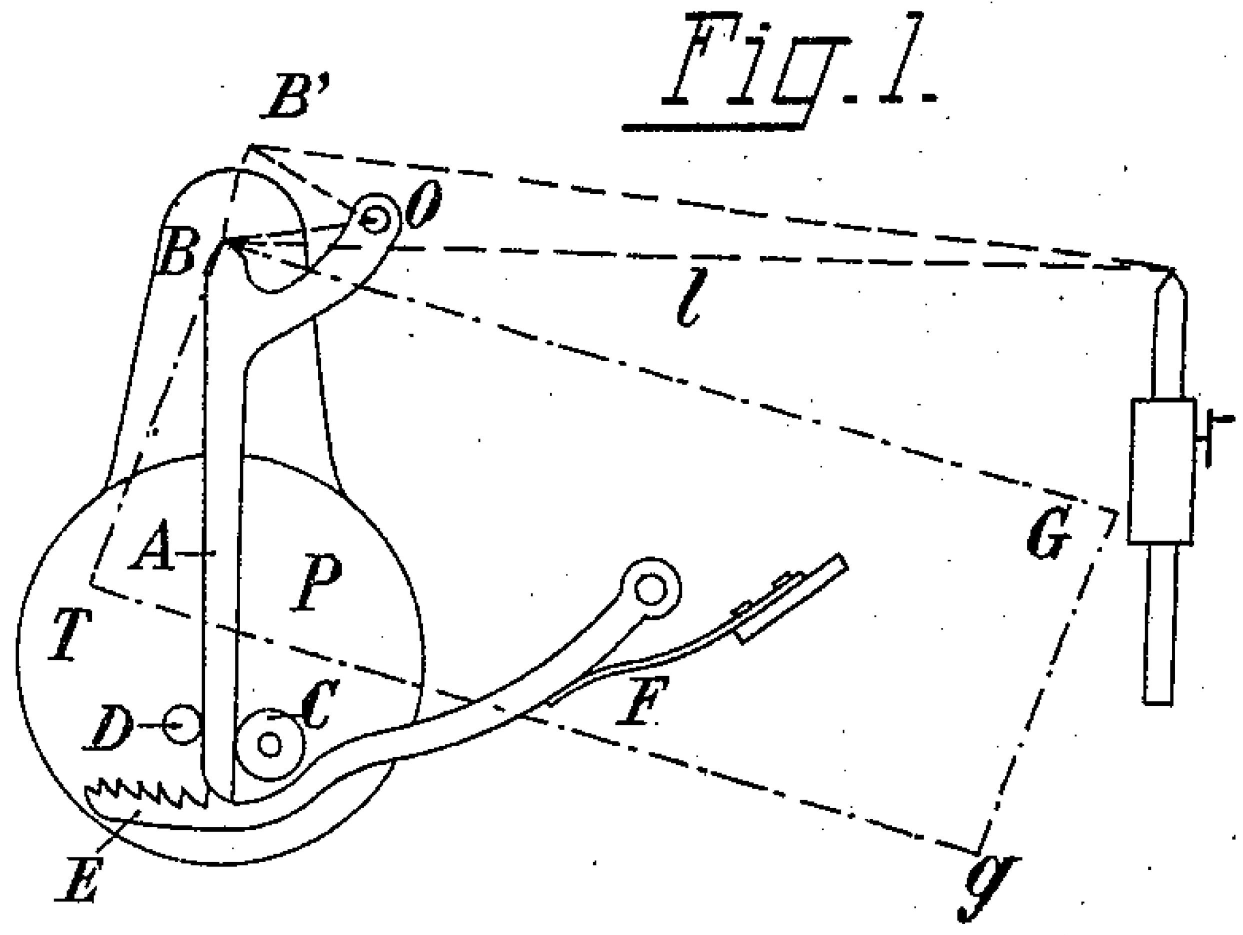


Fig. 5.

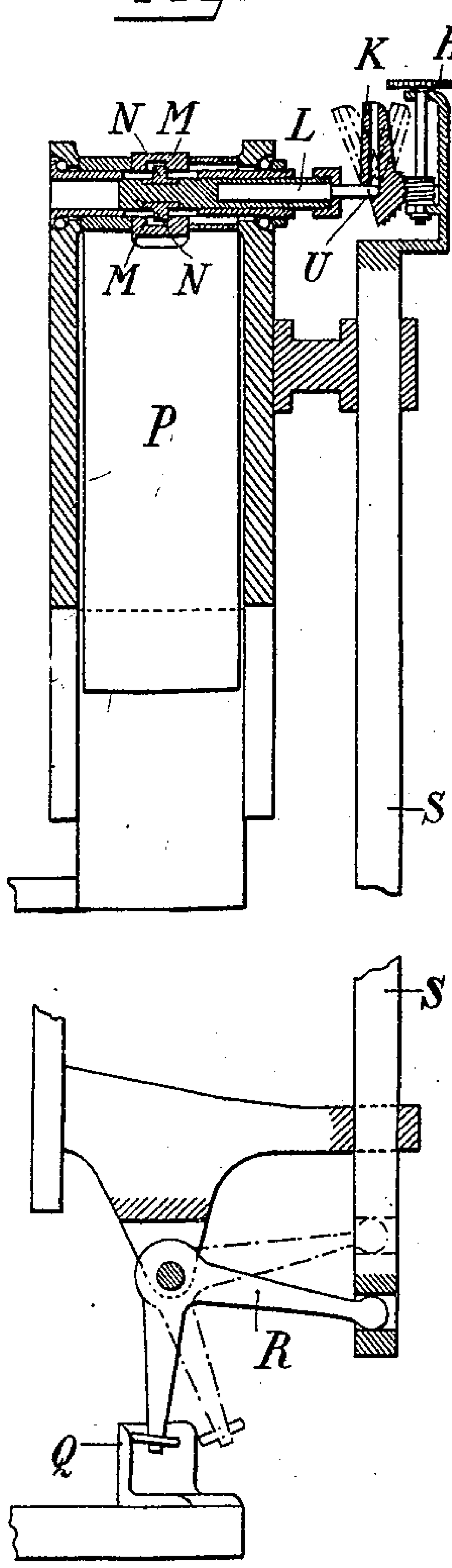
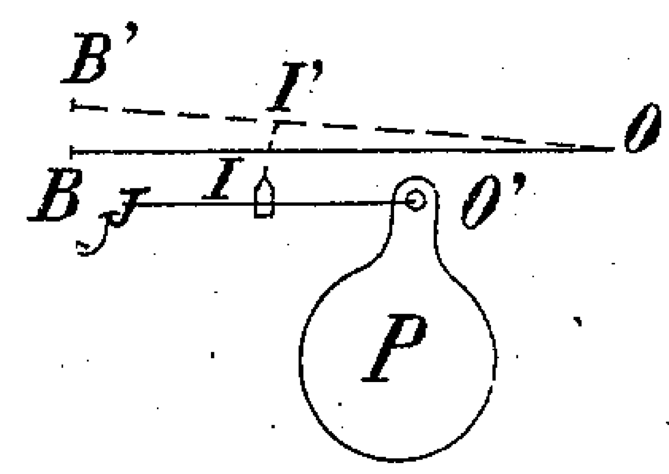


Fig. 2.



WITNESSES:

W. M. Avery

A. H. Davis

INVENTOR

Victor Jean Poutet

BY Munn & Co

ATTORNEYS.

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2 SHEETS—SHEET 2.

Fig. 3.

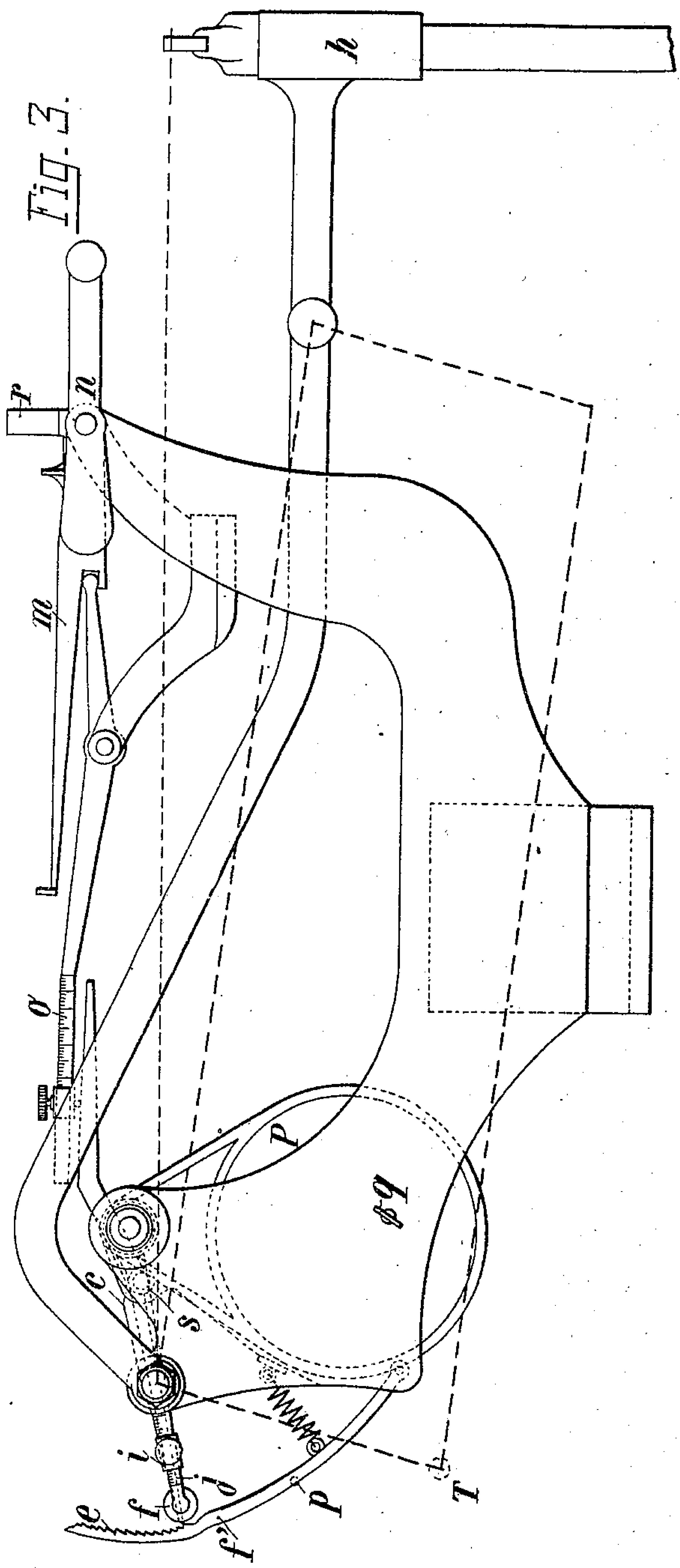
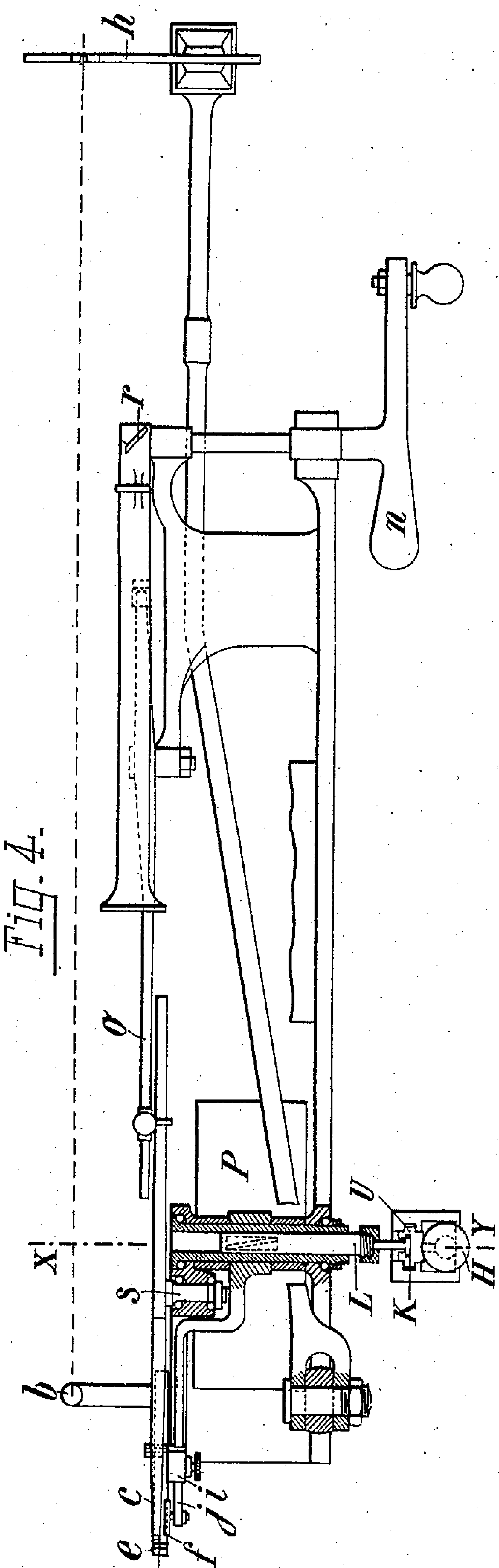


Fig. 4.



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UNITED STATES PATENT OFFICE.

VICTOR JEAN POUTET, OF MARSEILLES, FRANCE.

NAVAL-GUN SIGHT.

SPECIFICATION forming part of Letters Patent No. 785,434, dated March 21, 1905.

Application filed December 11, 1903. Serial No. 184,758.

To all whom it may concern:

Be it known that I, VICTOR JEAN POUTET, lieutenant-colonel, of 18 Rue du Chapitre, in the city of Marseilles, Bouches du Rhône, Republic of France, have invented a Naval-Gun Sight, of which the following is a full, clear, and exact description.

This invention relates to a new system of sighting apparatus for naval ordnance by means of which when firing at sea certain errors in aiming due to the rolling of the ship may be corrected.

In firing in a seaway, as is well known, the gun should be fired at the end of the first half-period of upward roll at the moment when the ship passes the upright position. Now whatever the skill of the gunner a certain time must always elapse between the moment when (on the line of sight being laid on the object) the gunner commences to operate the firing mechanism and the moment when the projectile leaves the gun. This difference is due in the first place to the fact that the gunner's thought is not instantaneously converted into action upon the firing device, while, further, (and more especially when slow-burning powder is used,) a certain interval must always elapse between the moment at which the gunner operates the firing device and that at which the projectile leaves the bore. To illustrate the importance of this delay, it can be shown that for an interval of 0.3 second at a distance of three thousand meters the projectile may pass seventy-five meters above the point aimed at. Thus let ω be the angular velocity of the vessel in passing to an upright position, which may be regarded as the maximum speed of rolling; x, the amplitude of rolling to one side; $2x$, from side to side; t, the period of oscillation from $+x$ to $-x$, t being a constant for the same ship whatever may be x. It is known, according to the laws of pendular movement, that whatever may be the values of x and t, $\omega = \pi \frac{x}{t}$. t being thus constant, ω is proportionate to x. Supposing an average roll of ten degrees and a period of oscillation of six seconds, $\omega = \pi \frac{10}{6} = 5^\circ$, about, it thus follows that for a space of time equal to 0.3 second the corresponding angular deviation will be $5 \times 0.3 = 1^\circ 30'$. At three thousand meters the projectile would pass at a height above the object approximately equal to $3{,}000 \times \sin. 1^\circ 30'$, or $3{,}000 \times 0.025 = 75$ meters. In addition to this, even should this deviation of one degree thirty minutes be known, it is not possible for the gunner to previously correct the aim, as this deviation, which is one degree thirty minutes, on the beam diminishes with the "bearing"—that is to say, with azimuth of the gun relatively to the axis of the vessel—and, moreover, each different amplitude of roll would need a different adjustment. Now it is impossible to suppose that the gunner could at the moment of firing estimate both the azimuth of the gun and the amplitude of roll and rectify the aim accordingly.

The present invention has for its object to provide an instrument with the aid of which the line of sight may be previously so raised in accordance with the amplitude of the rolling motion as to correct the retarding effects above mentioned. This retardation and the period of oscillation having been previously carefully determined once for all, the gunner need simply to separate the firing mechanism at the exact moment when the line of sight covers the object. Firing on a rolling ship can thus be carried on as if upon a platform on land, a greatly-improved result being consequently obtained.

The principle of the apparatus is as follows: The fore sight or hind sight of the gun is adapted for being acted on by a device movable about an axis parallel to that of the sighting apparatus and capable of retaining during the necessary interval of time a fixed direction in space. This device may either consist of a pendulum constantly tending to remain vertical or it may be a telescope pointed toward the horizon. In consequence of the rolling motion this instrument, whereby a fixed direction in space is maintained, receives a relative angular displacement, which is communicated to the fore sight or hind sight throughout the whole duration of the second half-period of downward roll. At the end of this period—that is to say, when the vessel is at its lowest point—the fore sight is by a suitable contrivance made fast with the aiming apparatus until such time as the ship arrives at firing position. From this moment the fore sight again becomes free and may be again acted on by the instrument for maintaining a fixed direction throughout the whole duration of the following descending period, and so on. It results from the arrangement that when the ship at the end of the first half-period of upward roll reaches an upright position the fore sight will have retained the angular displacement imparted to it by the oscillating device during the downward roll. This angular displacement is utilized to produce a difference in elevation of the fore sight—that is to say, an advance on the position which it would have occupied without such displacement. The raising of the line of sight as a result of the vertical movement of the fore sight may be considered (without too great an error) as proportionate to this vertical displacement, which is itself proportionate to the amplitude x of the rolling. Thus let X be the rise in the case of firing on the beam—that is to say, where the firing plane is at ninety degrees to the axis of the vessel—and T the time corresponding to such elevation, which is equal (in the example above cited) to 0.3 second. It is thus evident that $X = \omega T$, whence $X = \pi \frac{T}{t} x$. Now as T and t are constant, therefore $X = k\,x$, k being a constant. It is sufficient to give to the line of sight an angular rise, which, relatively to the amplitude of rolling, is in the ratio k. In cases where the firing plane makes an angle α with the normal to the axis of the vessel the error in aiming is multiplied by cos. α. In this case the rise relatively to the amplitude of the rolling would be in the ratio k cos. α. It is evident that the rise in the line of sight would follow the same progression.

In the accompanying drawings, Figure 1 represents, by way of example, a diagrammatic view of the apparatus, from which the working will be readily understood. Fig. 2 is a diagrammatic view of a regulating device. Fig. 3 is a side elevation; and Fig. 4 a plan of the apparatus, Fig. 5 being a vertical section on line $x\,y$, Fig. 4.

The same letters of reference denote like parts in the several figures.

It will be seen from the foregoing description that when the gun is fired on the vessel reaching the upright position during its upward roll the error in the aim is corrected by the raising of the line of sight, which may be effected either by the raising of the fore sight or the lowering of the hind sight. In the following example the raising of the fore sight will be described. Supposing a heavy pendulum, Fig. 1, having but a short period of oscillation (0.5 second, for example) relatively to that of the ship and mounted to swing about an axis parallel to the axis of rotation of the sighting apparatus, it is known that this kind of pendulum is best adapted to maintain its verticality on a rolling-ship, and even should the pendulum (owing to the centrifugal component) not be exactly vertical at the mid-point of its period of oscillation it may be assumed that such pendulums approach the vertical with sufficient accuracy at the end of these periods at the moment when the speed of oscillation and the centrifugal force are neutralized. In firing on the beam the pendulum will thus indicate approximately the amplitude of the rolling, and consequently the maximum speed of oscillation, (the ship being in an upright position,) which is proportionate thereto. This being so and firing on the beam being alone in question for the moment, let us suppose that upon a gun-cradle is mounted a fore sight B, movable about an axis O connected to the framing and normal to the plane of fire and a hind sight movable with the aid of a jointed parallelogram B T g G about an axis passing through the fore sight when at rest and parallel to the first-mentioned axis. Suppose also a pendulum P of the kind before referred to capable of swinging independently about the same axis B. The fore-sight B is mounted on a rod A. When at rest, said rod bears against a roller C, attached to the pendulum, which may, together with rod A, be retained by a stop D. The line O B is inclined to the axis of the gun about six degrees in the forward direction, so that it may be assumed that by an angular movement of twelve degrees in an upward direction the foresight will be sensibly shifted in a direction perpendicular to the line of sight, supposed horizontal, the ship being in the upright or firing position. Let $OB = d$ and let l be the length of the line of sight Bh. When the pendulum is held out of action, the sighting apparatus may be used in the usual manner. On withdrawing the stop D the pendulum will oscillate, thrusting before it the rod A as far as the limit of inclination of the rolling movement, and as B C is relatively great in proportion to O B it will rotate the fore sight B about O as a center to an angle which is sensibly equal to the limit of inclination of the rolling movement. At this moment a ratchet-toothed rack E under the thrust of a weak spring F holds fast the rod A and fore sight B while the pendulum swings backward. Thus when firing takes place at the end of the first half-period of upward roll the fore sight will be raised from B to B′, and the angle of correction in elevation will be expressed by $\frac{BB'}{l}$. Suppose, for example, the ship rolls ten degrees and $\sin. 10^\circ = \frac{1}{6}$. It has been shown above that for a rolling motion of ten degrees the angle of fire at the moment the projectile leaves the bore of the gun is increased one degree thirty minutes. The elevation from B to B′ should therefore reduce it to an equal extent, so that

$$\frac{BB'}{l} = \text{arc } 1^\circ\, 30' = 0.02625.$$

Now

$$BB' = \frac{OB}{6},$$

so that

$$OB = 6 \times l \times 0.02625 = 0.1575\, l,$$

since

$$l = 1^{m}.00 \quad OB = 0^{m}.1575.$$

It is, however, necessary that rod A in order that it may give the amplitude of the next succeeding roll should not remain constantly held by the rack. For this purpose the pendulum roller C is caused at the commencement of the second half-period of upward roll to bear upon the rack, so as to hold it disengaged from the rod C during this half-period and the following period of downward roll, after which the rack is again permitted to bear upon rod A, which slips lightly over the inclined teeth of the rack and reëngages therewith at the end of the half-period of downward roll, and so on. In this way whether in firing on the beam or at any other angle the proposed system corrects the errors of elevation in aiming when the gun is fired with the ship upright. It may be shown that the same is the case with other azimuths. Thus let α be the angle between the plane of fire and the normal to the ship's axis. α is also the angle made with this normal by the plane of oscillation of the pendulum, which moves with the gun and the entire carriage in the lateral direction. In this instance during the rolling at the end of the descending period the pendulum no longer gives the true angle of rolling β, but sensibly $\beta \cos\, \alpha$. When the gun is laid exactly at 0°, the preceding error in aiming is also multiplied by cos. α, the gun being always fired with the line of sight horizontal. Thus in this case also the pendulum gives the true correction. Lastly, when the gun is neither fired on the beam nor horizontal, the ship being upright, the error in aiming varies with the angle of fire, while the correction remains constant; but should the angle of fire not exceed fifteen degrees the difference between the error and the correction amounts at most to one-fifteenth, the maximum deviation occurring when firing in the direction of the axis. For an angle of fire of five degrees the difference would be less than one one-hundredth. It may thus be admitted that in all cases in firing with the line of sight horizontal and the ship in an upright position the proposed system corrects to a quite sufficient extent the error in aiming due to the rolling.

First—Preliminary adjustment.—It has been seen that for the angle of correction E we have

$$E = \frac{BB'}{l} = \pi \frac{T}{t} x,$$

in which l represents the length of the line of sight; T, the retardation of the firing; t, the period of an oscillation; x, the roll to one side. For the same gun l is a constant on which depend the firing-tables. t is variable with the ship on which the gun is placed. T is dependent on the gunner. E should thus vary with $\frac{T}{t}$. It would, however, remain invariable for the same ship and the same gunner. To a given installation will thus correspond a preliminary adjustment dependent upon $\frac{T}{t}$, and as l must remain constant it is to B B′ that the adjustment must be applied. To this end the fore sight and pendulum are made movable about two parallel different axes O O′, while the pendulum carries a graduated rod O′ J, (see Fig. 2,) upon which is mounted a movable slider I, forming a rest for the rod O B of the fore sight. It is found that

$$BB' = II'.\frac{OB}{OI} = O'I \times x \times \frac{OB}{OI} = OB \times x \frac{O'I}{OI} = OB\, x \frac{O'I}{OO' + O'I}.$$

O B and O O′ being fixed, B B′ is a simple function of O′ I. It thus suffices to graduate the rod O′ J for the corresponding values of B B′. Under these conditions the preliminary adjustment for a particular gunner and ship is readily obtained by adjusting the slider I without in any way altering the other conditions.

Second—Oscillation about an oblique position.—We have in the foregoing description supposed the ship to roll about its upright position, as will usually be the case. In the case, however, of gyration, or of a strong cross-current of wind, or of uneven trim, or of damage in action, this condition may not always hold good. There remain, therefore, two causes of deviation to be considered. In the first place the amplitude of oscillation of the pendulum no longer gives the mean roll upon which the maximum speed of oscillation of the ship and the principle of the sight in question depend. Consequently if the line of sight is always maintained sensibly parallel to the deck the firing can no longer take place at the moment of maximum speed of oscillation. As the speed of oscillation of the ship varies but slightly from the maximum, it will suffice, as regards the second cause of deviation, to so alter the aim of the gun that the line of sight may be approximately in a plane parallel to the ship's axis and normal to the oblique position about which the ship rolls. In other words, this secondary correction consists in an arrangement by which in sea-firing the line of sight will be horizontal when the vessel passes by its mean oblique position.

In Figs. 3 and 4 of the drawings, *h* represents a hind sight, and *b* a fore sight, the latter being mounted on a lever *c*, movable about an axis *s* and provided with a pawl *a*. The movement of the pendulum P may be transmitted to the fore sight by means of a slider *i*, mounted on an arm *j*, adapted to be engaged and held rigid with the pendulum, the slider *i* being intended for effecting the preliminary adjustment, as before stated. A rack *e* serves to retain the pawl *a* at the end of its course, the disengagement being effected by the roller *f* bearing against the bend *f'* of the rack-bar.

Fig. 5 shows an arrangement for throwing out of action the slider-carrying arm *j*, this disengagement varying according to the bearing of the object and when firing on the beam proportionately to the angle between the mean oblique position and the upright position of the ship. In firing in the direction of the axis it would always be *nil*. The maximum angle of release is determined by means of the milled head H. When the release movement is *nil*, the slide K is perpendicular to the firing-platform. The angular position of this slide may be varied by rotating the milled head, the slide K carrying with it the rod L, which through the medium of cams M and tenons N effects the disengagement of the slider-carrying arm *j* from the pendulum. The slide K is also movable in the vertical direction when the gun is laid, the movement, which is produced by a cam Q, fixed to the sole-plate, being transmitted by the bell-crank lever R and vertical rod S. When the gun is laid parallel to the ship's axis, the head U of rod L is at the bottom of the slide K and coincident with its axis of rotation, in which case there is never any disengagement, however much the milled head H may be rotated.

When the gun is laid on the beam, the slide K is lowered, and if the slide be then oblique it will be understood that there will result a release of the lever *j* variable every instant, this being a function both of the bearing and of the angle to which the milled head has been turned and which solely depends upon the obliquity of the median line of flotation.

It is to be understood that the rotation of the milled head H, as well as the position of the line of sight in the turret or other firing-chamber, would, if required, be indicated at each instant by the section commander in accordance with the estimated angle made by the oblique position (about which the rolling motion takes place) with the upright position of the ship.

It has before been stated that the amplitude of the rolling motion might also be ascertained with all desirable accuracy by the substitution for the pendulum of a telescope or like device capable of turning about the axis of oscillation of said pendulum (or upon an axis parallel thereto) and pointing constantly toward the horizon. In Figs. 3 and 4 is shown at *m* a bar which is capable of receiving oscillating motion through a hand-wheel or crank-handle *n*. When the ship, having passed beyond its mean position, continues to incline downward, the telescope is raised so as to constantly point toward the horizon, this movement being transmitted as a rising movement to the fore sight through the medium of a lever *o* in the same manner as when a pendulum was employed for the purpose. On arriving at the end of its course the fore sight is clamped by friction applied at any suitable point in the mechanism—as, for example, at the bearings of the crank-shaft. The correction in the aim thus made continues at least until the ship passes the upright position corresponding to the moment of firing, immediately after which the bar is returned to position in readiness for the next correction to be made at the next downward roll. The rack is in this case held fixed by means of a pin inserted in a hole *p*, the pendulum being held stationary by a pin *q*. In case the man told off to operate the bar is unable for want of space to stand behind it a mirror *r*, inclined at forty-five degrees to the line of sight, or any other suitable reflecting device may be employed for enabling him to adjust the bar from the side. The mirror *r* would be so placed as not to divert the whole of the rays, but to allow some of them to pass in order that the man standing directly behind the bar may, if necessary, himself lay the gun. This arrangement certainly affords greater precision than the preceding one; but as it cannot be conveniently applied when the horizon is foggy or at night or in smoke it is preferable to provide a combination of the two arrangements.

We have supposed (as stated at the commencement of this description) that the gun is fired at the termination of the first half-period of upward roll, when the ship arrives in an upright position. In this connection the correction consists in raising the line of sight, which is effected in the example given by the elevation of the fore sight, the return of the fore sight to its original position being brought about with the aid of gravity by mounting the stem which carries the sight slightly eccentrically upon its axis of rotation. In cases where it is desired to fire the gun every time the ship reaches the upright position, whether during the upward or downward roll, this can be easily effected with the aid of the bar by simply making the fore sight participate in all the movements of said bar in either direction.

The above-described arrangements serve equally well for the pitching as for the rolling motion of a ship, and the same apparatus may be employed in both cases of deviation. It will also be obvious that an apparatus based on the above principle may comprise but one only of the two arrangements described. There is no difficulty in applying this principle in cases where the axis of oscillation of the hind sight would not pass through the summit of the fore sight.

I claim—

1. In a system of sighting for naval guns, for the correction of the error in elevation of the muzzle of the gun due to the rolling and pitching of the ship in firing at sea, a device adapted to preserve a fixed direction in space, the said device being movable about an axis constantly normal to the plane of fire and adapted to automatically vary the line of sight, an amount proportionate to the angular velocity of the ship in rolling through a given position, substantially as hereinbefore described and illustrated in the drawings.

2. In combination with the sights of naval guns to be mounted upon vessels, a device coacting with the sights for correcting the error in the elevation of the muzzle of the gun due to the rolling and pitching of the vessel in firing at sea, which device has an actuating member arranged to preserve a predetermined fixed direction in space, the sight being held to move about an axis constantly normal to the plane of firing, and means connecting the sight with the actuating member, said actuating member coacting with said means to vary the line of sight an amount in proportion to the angular velocity of the ship in rolling through a given position.

3. The combination with the fore sight or hind sight of a gun, of a rectifying device adapted for action relative to one or the other of said sights, which device has a sight-carrying member movable about an axis normal to the plane of fire, and a member coacting therewith and held by gravity to preserve a fixed direction in space to automatically regulate the position of said sight-carrying member when the gun is tilted, and means for locking said device during a predetermined portion of the tilting movement of the gun.

4. In naval-gun sights, the combination with a pendulum of a fore or hind sight pivotally mounted and which has a pendent arm, said pendulum having a short period of oscillation relative to that of the ship and mounted to swing about an axis parallel to the axis of rotation of the sighting apparatus with which it is used, a roller-contact between the pendulum and the arm of the coacting sight and a locking and releasing device for said arm, substantially as set forth.

5. In naval-gun sights, the combination with a pendulum of a fore or hind sight pivotally mounted and which has a pendent arm, of a pendulum element having a short period of oscillation relative to that of the ship and mounted to swing about an axis normal to the plane of fire, a roller-contact between the pendulum and the arm of the coacting sight, a locking and releasing device for said arm, and a stop for holding said pendulum and arm against operation.

6. In naval-gun sights, the combination with a pendulum of a fore or hind sight pivotally mounted and which has a pendent arm, of a pendulum element having a short period of oscillation relative to that of the ship and mounted to swing about an axis parallel to the axis of rotation of the sighting apparatus in connection with which it is used, a roller-contact between the pendulum and the arm of the coacting sight, and locking and releasing mechanism for the free end of the sight-arm, all operated in the manner specified.

7. In a device of the character described, a sight-point movably mounted, and means for automatically varying the line of sight an amount proportionate to the angular velocity of the ship in rolling through a given position.

8. In a device of the character described, a sight-point movably mounted, means for automatically varying the line of sight an amount proportionate to the angular velocity of the ship in rolling through a given position, whereby to compensate for the length of time required for the gun to discharge a projectile after the firing mechanism has been operated upon, and regulating means for modifying said automatic variation of the line of sight an amount proportionate to the time required for a given gunner to operate the firing mechanism.

9. In a device of the character described, a sight-point movably mounted, and means for automatically raising the line of sight an amount proportionate to the maximum angular velocity of the ship in rolling through its vertical position whereby the elevation of the line of sight compensates for the retarding in firing.

10. In a device of the character described, a sight-point movably mounted, and a pendulum coöperating therewith and adapted to automatically vary the line of sight an amount proportionate to the angular velocity of the ship, in rolling through a given position.

11. In a device of the character described a sight-point movably mounted, a pendulum coöperating therewith and adapted to automatically vary the line of sight an amount proportionate to the amplitude of the ship's roll and the consequent angular velocity of the ship in passing through a given point as it rolls, and means for automatically locking the sight-point when it has been moved by the pendulum a distance proportionate to the roll of the ship in a given direction.

12. In a device of the character described, a sight-point movably mounted, a pendulum coöperating therewith and adapted to automatically vary the line of sight an amount proportionate to the amplitude of the ship's roll and the consequent angular velocity of the

ship in passing through a given point as it rolls, means for automatically locking the sight-point when it has been moved by the pendulum a distance proportionate to the roll of the ship in a given direction, and means for automatically unlocking the sight-point when the pendulum has reached a predetermined position in its return movement.

13. In a device of the character described, a sight-point, a movable member upon which said sight-point is supported, a pendulum adapted to turn on its pivot an amount proportionate to the amplitude of the roll of the vessel, and an adjustable connection between said pendulum and said movable sight-supporting member, whereby to adapt the pendulum to move said sight-point a distance proportionate to the position of the adjustable connection between the pendulum and the movable member.

14. In a device of the character described, a sight-point mounted on the cannon to oscillate thereon, and a member adapted to automatically raise said sight-point a distance proportionate to the angular velocity of the vessel in rolling around its vertical position, whereby to compensate for the delay of firing.

15. In a device of the character described, the combination with a sight-point, of a pivoted arm carrying said point to movably support the same, a pendulum adapted to automatically move a distance proportionate to the amplitude of the rolling of the ship, a roller carried by said pendulum and adapted to engage said sight-carrying arm and move the same with the pendulum on the downward roll of the ship to elevate the sight-point a distance proportionate to the movement of the pendulum, and a spring-controlled ratchet-lever for engaging said sight-supporting arm at the downward limit of the roll of the ship, said ratchet-lever having a swell thereon located in the path of the return movement of said roller on the pendulum and adapted to be engaged by said roller at the beginning of the second half-period of upward roll of the ship, whereby to disengage the sight-carrying arm from said ratchet-lever to leave the same free to be operated upon by the next succeeding downward roll of the ship.

The foregoing specification of my naval-gun sights signed by me this 23d day of October, 1903.

VICTOR JEAN POUTET.

Witnesses:
ALLAN MACFARLANE,
VARDINE.