Sept. 4, 1928. 1,683,073

J. B. HENDERSON

SIGHTING DEVICE

Filed July 26, 1919 3 Sheets-Sheet 1

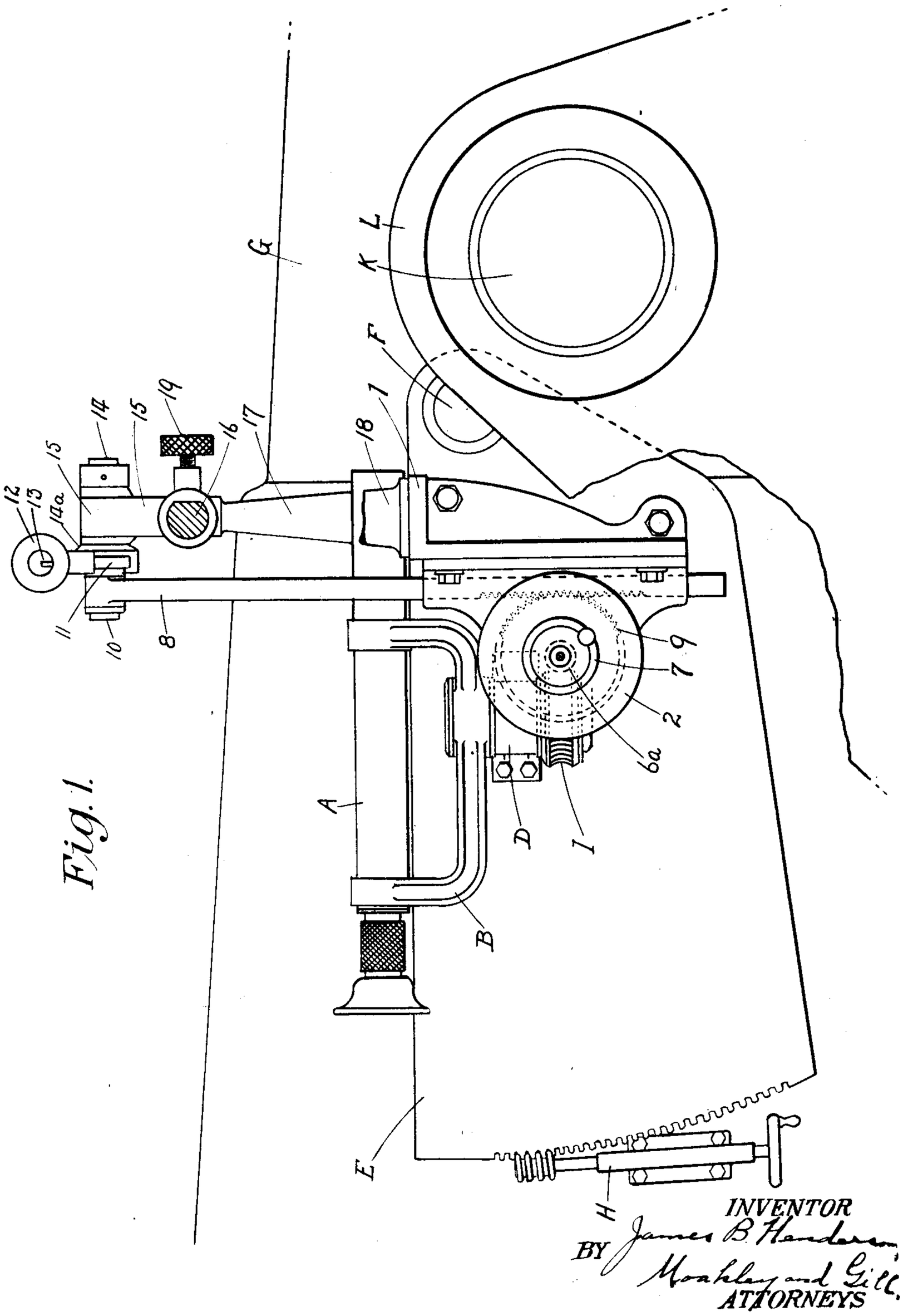


Fig. 1.

INVENTOR
James B Henderson
BY Moakley and Gilc.
ATTORNEYS

Sept. 4, 1928. 1,683,073

J. B. HENDERSON

SIGHTING DEVICE

Filed July 26, 1919 3 Sheets-Sheet 2

Fig. 2.

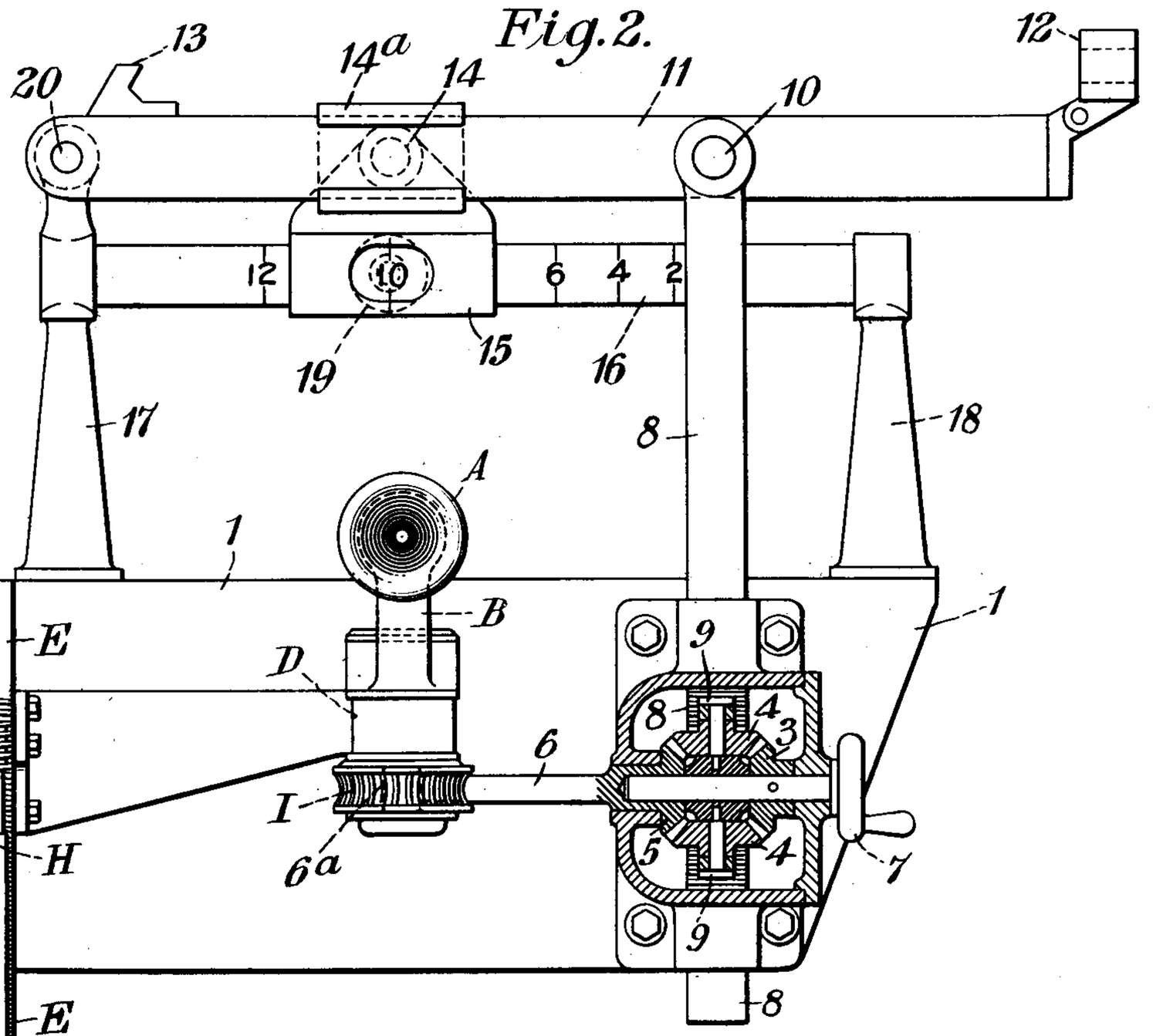
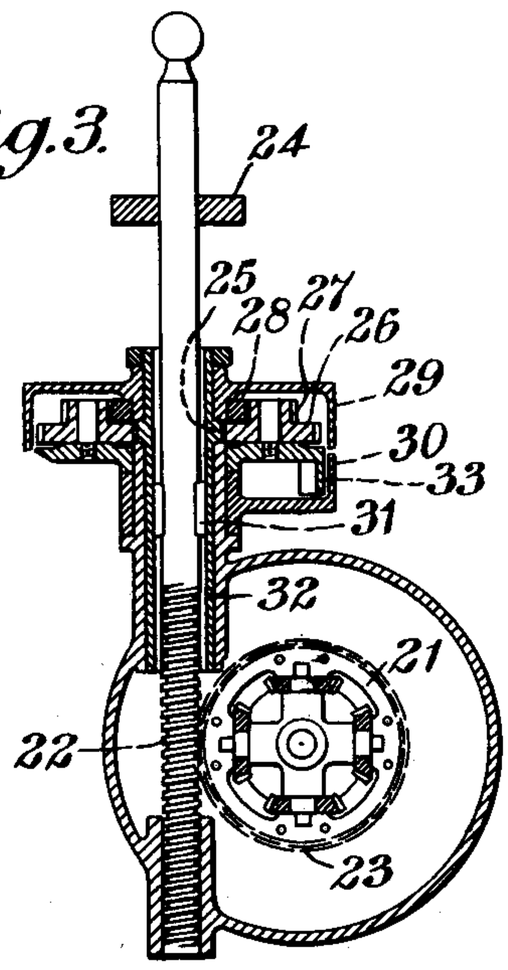


Fig. 3.



INVENTOR.
James B. Henderson,
BY Mosher and Gill
ATTORNEYS.

Sept. 4, 1928.

1,683,073

J. B. HENDERSON

SIGHTING DEVICE

Filed July 26, 1919

3 Sheets-Sheet 3

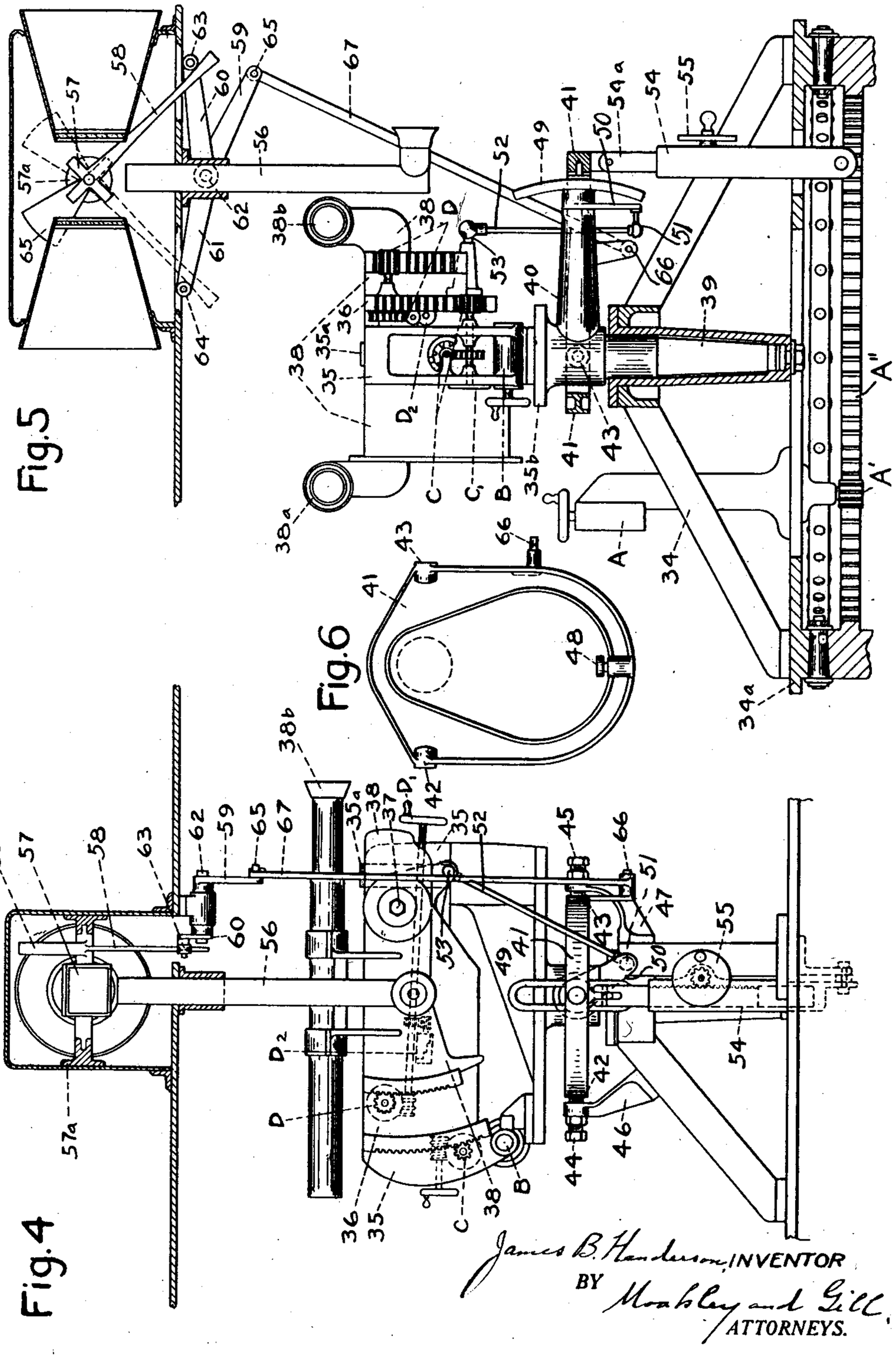


Fig.5

Fig.6

Fig.4

James B. Henderson, INVENTOR

BY Mosbley and Gill,

ATTORNEYS.

Patented Sept. 4, 1928. 1,683,073

UNITED STATES PATENT OFFICE.

JAMES BLACKLOCK HENDERSON, OF LEE, ENGLAND.

SIGHTING DEVICE.

Application filed July 26, 1919, Serial No. 313,538, and in Great Britain June 29, 1917.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

The object of my invention is to correct the error in the trajectory of naval guns, or of those mounted on any moving platform, due to any angular motion of the ship or platform round the line of sight to the target. Since the gun is elevated relatively to this line of sight, any angular motion of the gun trunnion round that line causes the plane of the trajectory to deviate in azimuth from the vertical plane through the line of sight, as the trunnions become inclined to the horizontal.

To carry out my invention, I apply to the ordinary deflection corrector of the gun-sight, an adjustment which angles the sight in a plane containing the line of sight and parallel to the gun trunnions, i. e., in azimuth if the deck is horizontal, by an amount which is given by the equation tan a=sin b tan c, in which a is the applied deflection, b is the inclination of the gun trunnions to the horizontal or the angle of roll, and c is the quadrant elevation of the gun, or the tangent elevation if the line of sight is horizontal.

As a datum for the measurement of the angle of roll I employ at right angles to the gun-sight, an auxiliary open sight or telescope, which can be kept laid on the horizon. Alternatively I may employ one of the forms of optical level, which I have described in my copending application Serial No. 313,541, filed July 26, 1919, embodying a bi-prism or I may employ a gyroscopic pendulum to determine the vertical, and use the pendulum as datum instead of the horizon.

Figure 1 is an elevation, partly in section, of an embodiment of my invention, shown as applied to a gun sight.

Figure 2 is a side elevation, part sectioned, of Figure 1.

Figure 3 is a view principally in section of an alternative arrangement particularly adapted for a director sight in which the deflection is applied to the training gear of the sight.

Figures 4 and 5 show two views at right angles to each other of the application of my invention to a sight in which an open sight is replaced by a periscopic one and also in which the range adjustment is brought about by the range setting of the sight, and

Figure 6 is a plan view of the frame of the device shown in Figures 4 and 5.

In Figures 1 and 2 the mechanism shown is suitable for fixing to any gun sight, the sight illustrated in Figure 1 being of conventional type and forming no part of the invention. The sighting telescope A is supported in a carrier B, which is pivoted in a bracket D bolted to the sight quadrant E. The quadrant is pivoted on a horizontal trunnion F on the gun G and is capable of being elevated or depressed round the trunnion axis F by the hand operated worm gear H fixed to the gun. Deflection is applied by rotating the telescope on its vertical bearing in D, as by a worm gearing with the worm-wheel I on the spindle of the sight carrier B. The gun and sight can be elevated or depressed by mechanism not shown, the gun being pivoted for this purpose on horizontal trunnions K in a cradle or gun-mounting L. The object of my invention is to eliminate the effects of tilting of the gun trunnions K due to rolling or pitching of the ship.

To apply my invention to such a sight I bolt a bracket 1 to the sight quadrant E at right angles thereto. This bracket carries the box 2 of a differential gear 3, 4, 5 through which the shaft 6 may be turned, this shaft carrying the worm 6^a which gears with the deflection worm-wheel I of the sight. The sight can therefore be deflected either by turning the pinion 3 by means of the handwheel 7 or by turning the epicyclic portion 4 by means of the rack 8 gearing with the spur pinion 9. I use the handwheel 7 to apply ordinary deflection and the rack and pinion 8, 9 to apply the correction for dealing with the angular motion of the ship round the line of sight, i. e., the gun-trunnion tilt-correction.

The rack 8 at its upper end is pivotally connected by the pin 10 to the bar 11 of an open sight provided with a sight hole in the eyepiece 12 and a foresight 13. This sight is pivotally mounted on a fulcrum 14 about which it can be turned by hand so as to be kept laid on the horizon at right angles to the line of sight to the target. The fulcrum pin 14 is mounted on a slide 15 which can be set at any point of the slide bar 16 which is fixed by the two pillars 17 and 18 to the bracket 1. The slider is fixed in position on the bar 16 by the thumbscrew 19 (Fig. 1) and the slide 16 is graduated in a scale of angles of elevation of the gun or preferably in a scale

of ranges. The bar 11 of the sight can slide relatively to the fulcrum pin 14 as shown in Fig. 2, the pin 14 being attached to the slide 14a. A locking pin can be inserted through the hole 20 in the end of the sight-bar 11 and engaging with a similar hole in the upper end of the pillar 17 locks the mechanism when not in use. The scale of ranges is so graduated that when the fulcrum pin 14 is set to the range-indication, and the sight 11 is kept laid on the horizon while the ship rolls around the line of sight to the target, the proper deflection is applied to keep the line of sight in the vertical plane through the axis of the gun. This correction is given by tan a=sin b tan c in which a is the deflection, b the elevation of gun and c the angle of roll.

In some types of sights the deflection is applied to the training gear of the sight or its support by means of a differential gear. The ordinary training is done by transmission through the differential gear from side to side the box which carries the epicyclic pinions being fixed, and the deflection is applied by turning this box. Figure 3 shows a section through this differential gear, the deflection being applied by turning the box 21. In applying my invention to this type of sight I turn this box by means of a rack 22 and pinion 23. The rack 22 is cylindrical with a square threaded screw cut on it, the screw threads acting as the teeth of the rack. To correct for the rolling about the line of sight the rack 22 is moved up and down by means of an open sight in a manner similar to that described in Figure 1, and in order to be able still to apply ordinary deflection, I rotate the rack about its axis thereby turning the box 21.

To facilitate the rotation of the rack I fit a knurled hand wheel 24 to it and in order to reduce the angular rotation to a suitable scale of deflection I introduce a reduction gear of the double reduction type. The pinion 25 is turned by the rack on account of the feathers 31 engaging in slots in the cylindrical part of the slide 32. Pinion 25 gears with pinion 26 which is compound with pinion 27 which gears with pinion 28 coaxial with 25. Pinion 28 carries the scale of deflection 29. The pointer 30 is not fixed but can be turned round the axis of the rack to a setting for drift on a drift scale 33. Instead of the pivot pin 10 in Figure 1 a socket would be provided to take the spherical end of the rack 22 in Figure 3.

Figures 4 and 5 illustrate another embodiment of my invention applied to a director sight in which I introduce the adjustment of the sight to compensate for rolling of the ship by deflecting the sight as a whole by means of mechanism independent of the training and deflection gears. As shown the sight is carried on a tripod mounting 34 which is bolted to a turntable 34a and the sight is trained in azimuth by training the tripod and turntable by means of the training gear mounted on the turntable, the gear driving a pinion A′ which meshes with a circular rack A″ rigidly attached to the ship, as shown in Fig. 5. The sight comprises a central frame 35 supported on a vertical pivot 35a by a base 35b which usually is rigidly attached to the tripod mounting, the frame 35 being keyed to the base 35b by the deflection gear B. The central frame 35 supports on a horizontal pivot 37 an intermediate member 36 on which the U-shaped sight bracket 38 is pivoted about the same axis 37, the central frame 35 and intermediate member 36 being situated between the legs of the U of the sight bracket 38. The two telescopes 38a and 38b are rigidly attached to the sight bracket, one to each leg of the U, so that both elevate and depress together. The sight bracket 38 is keyed to the intermediate member 36 by the elevating gear D operated by the handwheel D_1 which also operates a transmitting D_2 electrically connected to receiver motors operating the elevating gears of the guns. To transmit elevation to the guns the intermediate member 36 is depressed by the range-setting gear C to a depression angle equal to the range elevation which it is desired to convey to the guns, the gear C also rotating the range dial C_1 from which the range or depression angle can be read. Simultaneously with the depression of the member 36 the gun-layer operates his elevating handwheel D_1 so as to keep his telescope on the target, the resulting elevation of the sight bracket 38 relatively to the intermediate member 36, i. e., the desired angle of gun elevation, being automatically communicated to the guns by the transmitter D_2.

The mechanism just described forms no part of my invention but is thus briefly described as it is necessary for comprehension of this embodiment of my invention to note that the intermediate member 36 is depressed relatively to the line of sight of the sighting telescopes through an angle equal to the angle of elevation of the guns.

In adapting this type of sight to my invention I mount the sight-base 35b on a vertical pivot 39 in the tripod instead of the usual rigid connection and I apply the correction for rolling of the ship about the line of sight by deflecting the whole sight about this pivot 39 by mechanism independent of the deflection and training gears. To produce this deflection I fit a projection arm 40 to the central pivot and I key this arm to the tripod by means of a frame 41 shown in plan in Figure 6 which is pivotally mounted on the tripod on the two centres 42 and 43 engaging with the centre pins 44 and 45 which are screwed into the brackets 46 and 47 fixed to the tripod 34. This frame also carries a

roller 48 which engages in a slot in the sector 49 which is pivotally mounted on the projecting arm 40. This sector can be turned about the axis of the arm 40 so that the slot becomes inclined to the vertical, by means of a crank 50 the crank pin 51 being connected by a link 52 with a pin 53 on the intermediate member 36. The distance of the pin 53 from the centre 37 is equal to the length of the crank 50. Thus when the intermediate member is depressed through an angle equal to the angle of elevation of the guns the slotted sector 49 becomes inclined to the vertical at the same angle. The outer end of the frame 41 is linked to the base of the tripod by the telescopic link 54 which has pin joints at both ends and the length of this link can be altered at will by turning the hand wheel 55 which works a rack and pinion mechanism causing the part 54[a] to slide in and out of the tube 54.

A periscope 56 is fixed to the roof of the canopy or tower and a view of the horizon in a direction at right angles to the axis of the sighting telescope is obtained in the periscope 56 by means of a mirror 57. This mirror is pivoted on centres 57[a] and has the lever 58 attached to it. This lever is controlled so that when the ship rolls about the line of sight to the target if the hand wheel 55 is operated so as to keep the frame 41 horizontal, the mirror 57 tilts about its trunnions through half the angular motion of the frame 41, and the image of the horizon thus remains on the cross-wires of the periscope 56. To bring about this result I pivot a treble crank 59, 60, 61 on an axis 62 the three cranks being rigidly attached to each other. The crank 59 is connected by the connecting rod 67 and the crank pin 65 with a crank pin 66 on the frame 41, so that the three cranks elevate and move in phase with this frame. Cranks 60 and 61 carry the rollers 63 and 64 and the lever 58 attached to the mirror is kept in contact either with the roller 63 or the roller 64 by means of a spring or by means of a counter weight 65. The alternative position of the lever and mirror is shown dotted. The length of the crank 59 is equal and parallel to the distance of the pin 66 from the pivotal centres 43 of the frame 41, and the length of the cranks 60 and 61 is equal to the distance of the crank centre 62 from the mirror pivots 57[a].

The intermediate arm 36 having been depressed through an angle equal to the angle of elevation of the guns, the curved-slotted-link 49 is inclined to the vertical at the same angle. The observer who works this correcting device keeps his eye to the periscope 56 and his hand on the hand wheel 55 and turns the latter so as always to keep the image of the horizon on the cross wires. In doing so he raises and lowers the end of the frame 41 carrying the roller 48 and since this roller acts as the key between the sight and the pedestal by engaging with the slotted sector 49, deflection is automatically applied to the sight by the observer of an amount just sufficient to keep the line of collimation of the sighting telescope parallel to the vertical plane through the axis of the gun.

It will be understood that in the embodiments illustrated and described above the cross levelling gear, that is the means to establish a datum by reference to the horizontal together with the member settable in accordance with the elevation of the guns and the appropriate linkage, does not directly apply the correction to the guns but serves primarily to measure the correction and to displace accordingly the main sight. Also this displacement of the main sight does not correct the guns but serves only to indicate visually the amount and direction of the required correction. The actual correction of the guns is applied or transmitted by independent mechanism adapted simultaneously to restore the main sight to the line of sight to the target.

It is evident that there are many equivalent methods of putting the invention into effect. The essential factors of the invention are, first, means to determine the deflection of the axis of the gun from the vertical plane of the line of sight, measured parallel to the deck, by continuous reference to a datum direction inclined substantially to the line of sight, such as the horizon in line with the gun trunnions, combined with a member settable to the gun elevation; second, an indicator (which may be a telescope) displaceable from a zero position by the first mentioned determining means, so as to indicate the amount and direction of the required correction; and, third, other mechanism for applying (as in Figs. 1, 2 and 3) or for transmitting (as in Figs. 4 and 5) to the guns a compensating movement the amount and direction of which is measured and checked by the simultaneous restoration of the indicator to its zero, so that it may be known when the correction has been applied or transmitted to the guns.

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. Apparatus for compensating for the difference between the angle of train of a gun carried by a rolling platform at any point in the roll of the platform and the angle of train measured in a horizontal plane, comprising a support having a fixed relation to the platform linkage mechanism associated with the support and having a part adapted to be set at an angle with respect to the support corresponding to the angle of gun elevation as measured from a horizontal plane and a part adapted to be maintained in a horizontal plane, a sighting device for

viewing the horizon connected to said last named part, a sliding connection between said parts, a sighting device for the gun movably mounted with respect to the support and means associated with the sliding connection and attached to the second device whereby upon a roll of the platform the linkage mechanism will move the device to compensate for the difference in the angle of train at any point in the roll of the platform.

2. In a director sight for use on a rolling platform, a support having a fixed relation to the platform, a sighting device movably mounted with respect to the support for viewing the target to determine the angle of train of a gun carried by the rolling platform, a linkage mechanism associated with the support and connected to said sighting device and having an angularly movable part adapted to be set with respect to the support to the angle of gun elevation as measured from a horizontal plane, a second part having a sliding and adjustable connection with said first part, a sighting device for viewing the horizon connected to said second named part for maintaining it fixed with respect to the horizontal, said first named part being adapted to roll with the platform whereby upon a roll of the platform said linkage mechanism will compensate for the difference in the angle of train at any point of the roll of the platform.

3. In a director sight for use on rolling platforms, a support having a fixed relation to the platform, a member movably mounted on the support adapted to bear a predetermined relation to the line of sight to a distant object, linkage mechanism connected to the support and associated with said member and having a part adapted to be set with respect to the support to an angle of gun elevation measured from a horizontal plane and a second part having a connection with said first named part, said first named part being fixed to roll with the platform and means for maintaining the said second named part fixed with respect to the horizontal comprising a sighting device for viewing the horizon.

4. The method of correcting for the effect of angular displacement of a gun mounted on an angularly movable platform which consists in establishing a line of sight to an objective, establishing another line of sight at a substantial angle to the first mentioned line of sight, continuously and effectively maintaining the second mentioned line of sight laid on a distant point while the first mentioned line of sight is displaced angularly about the axis of the gun, and utilizing the angular displacement between the platform and the second mentioned line of sight to correctively position the first mentioned line of sight for the effects of such displacement.

5. The method of correcting for the effect of the angular movement of a platform upon a gun mounted thereon which consists in establishing a line of sight to an objective, establishing another line of sight to a distant fixed point at a substantial angle to the first mentioned line of sight, continuously and effectively maintaining the second mentioned line of sight unresponsive to angular movement of the platform that would deflect it above or below the distant point upon which it bears, and shifting the first mentioned line of sight with respect to the gun proportionately to the movement of the platform relatively to the unresponsive position of the second mentioned line of sight to correct the direction of the first mentioned line of sight for its displacement by movement of the platform.

6. Apparatus for sighting a projectile discharging device mounted on an angularly moving platform, comprising a member adapted to bear a predetermined relation to the line of sight to a target, a member adjustable in accordance with the range adjustment of the device, an element connected to both of said members, an optional instrument associated with the element whereby the element may be maintained in a predetermined plane by continuously laying the instrument upon a distant object lying at an angle to the line of sight, to move the first named member proportionately to a correction needed to compensate for the effect of the movement of the platform upon the trajectory of the projectile.

7. Apparatus for sighting a projectile discharging device mounted on an angularly moving platform, comprising a sighting instrument adapted to establish a line of sight to a target, a member adjustable in accordance with the range adjustments of the device, an element connected to the member, an optical instrument associated with the element whereby the element may be maintained in a predetermined plane by continuously laying the second-named instrument upon a distant object lying at an angle to the line of sight, and a connection between the sighting instrument and the element whereby the first instrument may be continuously moved proportionately to a correction needed to compensate for the effect of the movement of the platform upon the trajectory of the projectile as the member moves by motion of the platform.

8. In a sighting apparatus for a projectile discharging device mounted upon an angularly moving platform, a sighting instrument adapted to establish a line of sight to a target, an element adjustable in accordance with the range adjustments of the device, an optical instrument adapted to be continuously maintained upon a distant object lying at an angle to the line of sight, a member associated with the optical instrument and adapted to be continuously maintained in a predetermined di-

rection, a connection between the element and the member and means actuated by the member for moving the sighting instrument to compensate for the effect of the movement of the platform upon the trajectory of the projectile.

9. In a sighting apparatus for a projectile discharging device mounted upon an angularly moving platform, a member adapted to bear a predetermined relation to the line of sight to a target, an element adjustable in accordance with the range adjustments of the device, an optical instrument adapted to be continuously maintained upon a distant object at an angle to the line of sight, a member connected to the optical instrument and adapted to be continuously maintained in a predetermined relation to the optical instrument, and means actuated by the second named member for moving the first named member to compensate for the effect of the movement of the platform upon the trajectory of the projectile.

10. Apparatus for correcting for the effect of the angular movement of a platform upon a projectile discharging device mounted thereon, comprising an optical instrument for continuously viewing a target, a second optical instrument for viewing a distant point lying at an angle to the line of sight to the target, a member adapted to be continuously maintained in a predetermined relation to the second optical instrument, a member connected to the first named member and adjustable in accordance with the range adjustment of the device, and actuating means connecting the first named optical instrument and member for shifting the line of collimation of the first named instrument in accordance with functions of the range adjustment of the device, and the angular movement of the platform by movement of the first named member.

11. In apparatus for correcting for the effect of the angular movement of a platform upon a gun mounted thereon, comprising a sighting instrument, a member associated with the instrument and adapted to bear a predetermined relation to the gun, an optical instrument for continuously viewing a distant point lying at an angle to the line of sight, and means associated with the optical instrument whereby the relation between the sighting instrument and the member may be continuously changed to compensate for the effect of the movement of the platform upon the trajectory of the projectile.

12. Apparatus for sighting a gun mounted on an angularly moving platform, comprising a telescope, means for moving the telescope relatively to the platform to compensate for the angular motion of the gun around the line of sight, a second telescope having its line of collimation at an angle to that of the first named telescope and adapted to be continuously maintained in a predetermined plane, and means associated with the second named telescope for continuously moving the first named telescope in accordance with a function of the angular movement of the platform.

13. Apparatus for sighting a gun mounted on an anguarly moving platform, comprising a sighting instrument, a member movable in accordance with the elevation of the gun measured from a predetermined plane, a member adapted to be maintained in a fixed direction during the angular movement of the platform, an optical instrument associated with the member for viewing a distant point at an angle with the line of sight of the sighting instrument whereby the member may be continuously maintained in such fixed direction, and means connecting the member and sighting instrument whereby the sighting instrument may be displaced in accordance with a function of the angular movement of the platform.

14. A sighting device for use with a gun mounted on a rolling platform comprising a sighting telescope, a telescope adapted to be maintained upon a point lying at a substantial angle to said sighting telescope and means continuously actuated by the second named telescope for actuating the sighting telescope whereby errors resulting from displacements of the gun axis due to the movement of the platform may be corrected.

15. Apparatus for sighting a gun mounted on an angularly moving platform, comprising an optical instrument adapted to be pointed at a target, a second optical instrument lying at an angle to the first named instrument adapted to be continuously maintained on a distant object lying at a substantial angle to the line to the target, mechanism for moving the first instrument relatively to the platform to compensate for the angular motion of the gun around the line of sight and means for continuously actuating the mechanism by the second instrument.

16. Apparatus for sighting a gun mounted on an angularly moving platform, comprising an optical instrument adapted to be pointed at a target, a second optical instrument lying at an angle to the first instrument, and means including differential mechanism under the control of the second optical instrument for moving the first instrument relatively to the platform in azimuth to compensate for the corresponding component of the angular motion of the gun around the line of sight.

17. Apparatus for sighting a gun mounted on an angularly moving platform, comprising a sighting device, a telescope, means associated with the telescope for continuously viewing distant points lying at an angle to the line of sight, and on one side or the other of said line, and means under the control of said telescope for continuously moving the line of collimation of the sighting device rel-

atively to the platform to compensate for the angular motion of the gun around the line of sight.

18. Apparatus for correcting for the effect of the angular movement of a platform upon a gun mounted thereon, comprising a member adapted to bear a predetermined relation to the line of sight to a target, a member adapted to be set in accordance with the angle of gun elevation, means for changing the predetermined relation of the first named member in accordance with a function of the angular movement of the platform, comprising linkage mechanism having a part connected to the second named member, a part to the first named member, and a part adapted to be continuously maintained in a given direction irrespective of the angular movement of the platform, and means associated with the last named part for continuously viewing a distant point at an angle to the line of sight whereby the member may be maintained in a predetermined direction.

19. In apparatus for sighting a gun mounted on an angularly moving platform, a sighting telescope, an auxiliary telescope arranged at an angle to the sighting telescope and adapted to be continuously maintained on a distant object and continuously operable linkage mechanism connected between the telescopes for displacing the sighting telescope relative to the platform in order to keep its line of collimation parallel to the vertical plane through the gun axis, said linkage mechanism including a member adjustable in accordance with the angle of gun elevation.

20. In a sighting device for use on a rolling platform, a sight and means for moving the sight to compensate for the effect of the movement of the platform upon a gun mounted thereon, comprising linkage mechanism having a part adapted to be set at an angle corresponding to the angle of gun elevation measured from a horizontal plane and a part associated therewith adapted to be continuously maintained in a given direction, and a continuously effective auxiliary sighting device associated with the last named part for maintaining it in said predetermined direction.

21. In a sighting device for use on a rolling platform, a sight and means for moving the sight to compensate for the effect of the movement of the platform upon a gun mounted thereon, comprising linkage mechanism having a part adapted to be set at an angle corresponding to the angle of gun elevation as measured from a horizontal plane, a part adapted to be maintained in a predetermined plane, and a sliding connection between said parts whereby upon a roll of said platform said linkage mechanism will move the sight in accordance with a function of the angle of roll, and an auxiliary sighting device connected to said second mentioned part adapted to be maintained in a predetermined plane for viewing a distant point at an angle to the line if sight to maintain said second mentioned part in its predetermined plane.

22. In a director sight for use on a rolling platform, a sighting device for viewing a target, a linkage mechanism connected to the sighting device and having a movable part adapted to be set to the angle of gun elevation as measured from a horizontal plane, a second part having a sliding connection with the first part, and means for maintaining said second part fixed with respect to the horizontal, said first named part being adapted to roll with the platform whereby said mechanism will move the sighting device to compensate for the effect of the angular movement of the platform upon the guns controlled by the director sight, and a second sighting device connected to the means for maintaining the second part fixed with respect to a horizontal plane, and adapted to be pointed toward a distant object lying at an angle to the line of sight.

23. In a director sight for use on rolling platforms, a sighting device for viewing the target, linkage mechanism connected to said sighting device whereby it may be shifted angularly to compensate for the effect of the roll of the platform upon the guns controlled by the director sight, and a continuously effective auxiliary sighting device associated with the linkage mechanism for continuously maintaining a part thereof in a predetermined plane, said auxiliary sighting device lying at an angle to the first named sighting device.

24. In a gun controlling director sight for use on an angularly moving platform, a pair of sighting devices jointly movable in elevation and train, an auxiliary sighting device lying at an angle to said sighting devices, mechanism having a part connected to the auxiliary sighting device and adapted to be maintained thereby in a predetermined direction during the roll of the platform and connections between the mechanism and the pair of sighting devices for shifting them angularly whereby compensation may be made for the effect of the roll of the platform upon the guns controlled by the sight.

25. In a gun controlling director sight for use on a rolling platform, a pair of sighting devices jointly movable in elevation and train, an auxiliary sighting device lying at an angle to said sighting devices, mechanism operatively related to said auxiliary sighting device whereby it may be maintained in a horizontal direction during roll of the platform and connections between the mechanism and the pair of sighting devices for shifting them angularly to compensate for the effect of the roll of the platform upon the guns controlled by the sight.

26. In an apparatus of the character de-

scribed, in combination, a pointer's telescope, a trainer's telescope and a cross-leveler's telescope and means associated with said telescopes whereby they mutually cooperate for correcting the error in the sighting of one or more guns.

27. In an apparatus of the character described, in combination, a pointer's telescope, a trainer's telescope and a cross-leveler's telescope, means associated with said telescopes whereby they mutually cooperate for correcting the error in the sighting of one or more guns due to inclination of roller path.

28. In an apparatus of the character described, in combination, a pointer's telescope, a trainer's telescope and a cross-leveler's telescope, means associated with said telescopes whereby they mutually cooperate for correct the error in the sighting of one or more guns due to the roll or pitch of the ship.

29. In an apparatus of the character described, in combination, a pointer's telescope, a trainer's telescope, and a cross-leveler's telescope, means associated with said telescopes whereby they mutually cooperate for correcting the error in the sighting of one or more guns due to the inclination of the trunnions of the guns or roll or pitch of the ship.

30. In an apparatus of the character described, in combination, a pointer's sighting means, a trainer's sighting means and a cross-leveler's sighting means, means for actuating said several sighting means for keeping the same on the target and horizon respectively and means for rotating all of said sighting means about a vertical axis.

31. In an apparatus of the character described, in combination, pointer's sighting means, trainer's sighting means and cross-leveler's sighting means and means actuated by said cross leveler's means for overcoming the error introduced in the training of the guns due to inclination of the gun trunnions.

32. In a sighting apparatus of the character described, in combination, a pointer's sighting means, trainer's sighting means and cross-leveling means, all of said means being rotatable about a common vertical axis and means for adjusting the pointer's sighting means for desired gun elevation.

33. In a sighting apparatus of the character described, in combination, pointer's sighting means, trainer's sighting means, a cross leveling means, and transmitters associated with said pointer's and trainer's sighting means and connected therewith through said cross-leveling means whereby the line of sight of the pointer's sight remains in the same vertical plane as the axis of the bore of the gun or in a plane parallel thereto.

34. In an apparatus of the character described, in combination, pointer's sighting means, trainer's sighting means and cross leveller's sighting means and means actuated by said cross leveller's means for displacing the pointer's and trainer's sighting means to overcome the error introduced in the training of the guns due to inclination of the gun trunnions.

35. In apparatus for correcting for the effect upon a gun of angular movement of a platform upon which the gun is mounted, the combination of means for establishing a stable plane of reference including a sighting device adapted to be continuously laid upon a target and a second sighting device adapted to be continuously laid upon a distant object at a substantial angle to the line to the target, a member displaceable from the plane of reference in accordance with the angle of elevation of the gun, a second member displaceable in accordance with the relative angular movement between the platform and the plane of reference and mechanism actuated by said members for moving the first sighting device in a direction to compensate for the deviation of the gun from its true position due to the angular movement of the platform.

36. In a gun controlling director sight for use on an angularly moving platform, a pair of sighting devices movable in elevation and jointly movable in train, an auxiliary sighting device lying at an angle to said sighting devices, mechanism having a part connected to the auxiliary sighting device and adapted to be maintained thereby in a predetermined direction during roll of the platform and connections between the mechanism and the pair of sighting devices for shifting them angularly whereby compensation may be made for the effect of the roll of the platform upon the guns controlled by the sight.

37. In a gun controlling director sight for use on an angularly moving platform, a pair of sighting devices movable in elevation and jointly movable in train, an auxiliary sighting device lying at an angle to said sighting devices, mechanism having a part connected to the auxiliary sighting device and adapted to be maintained thereby in a predetermined direction during roll of the platform and connections between the mechanism and the pair of sighting devices for shifting them in train whereby compensation may be made for the effect of the roll of the platform upon the guns controlled by the sight.

Dated this 25th day of January, 1918.

JAMES BLACKLOCK HENDERSON.