No. 658,287. Patented Sept. 18, 1900.

L. K. SCOTT.

SIGHT FOR ORDNANCE.

(Application filed Dec. 29, 1897.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 2.

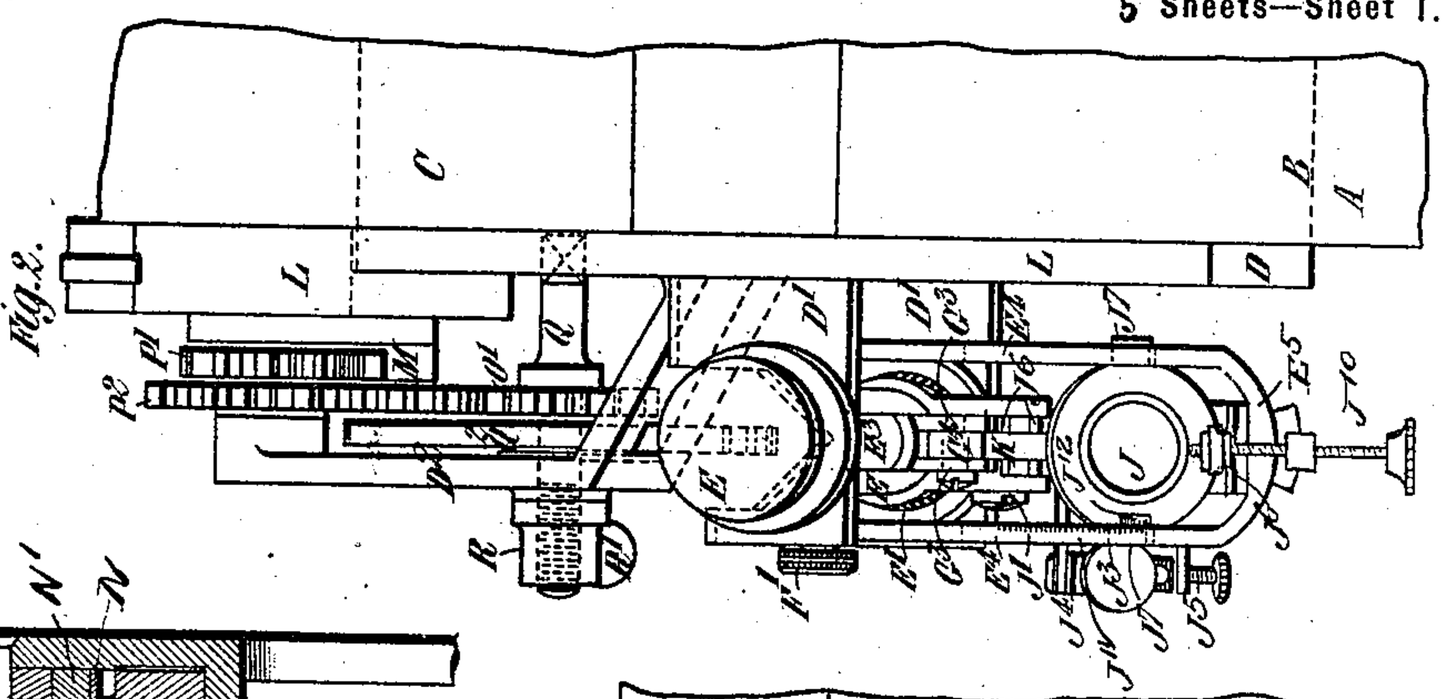

Fig. 2a.

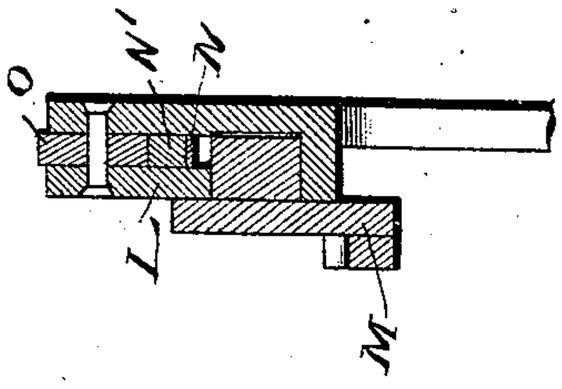

Fig. 1.

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(No Model.) 5 Sheets—Sheet 2.

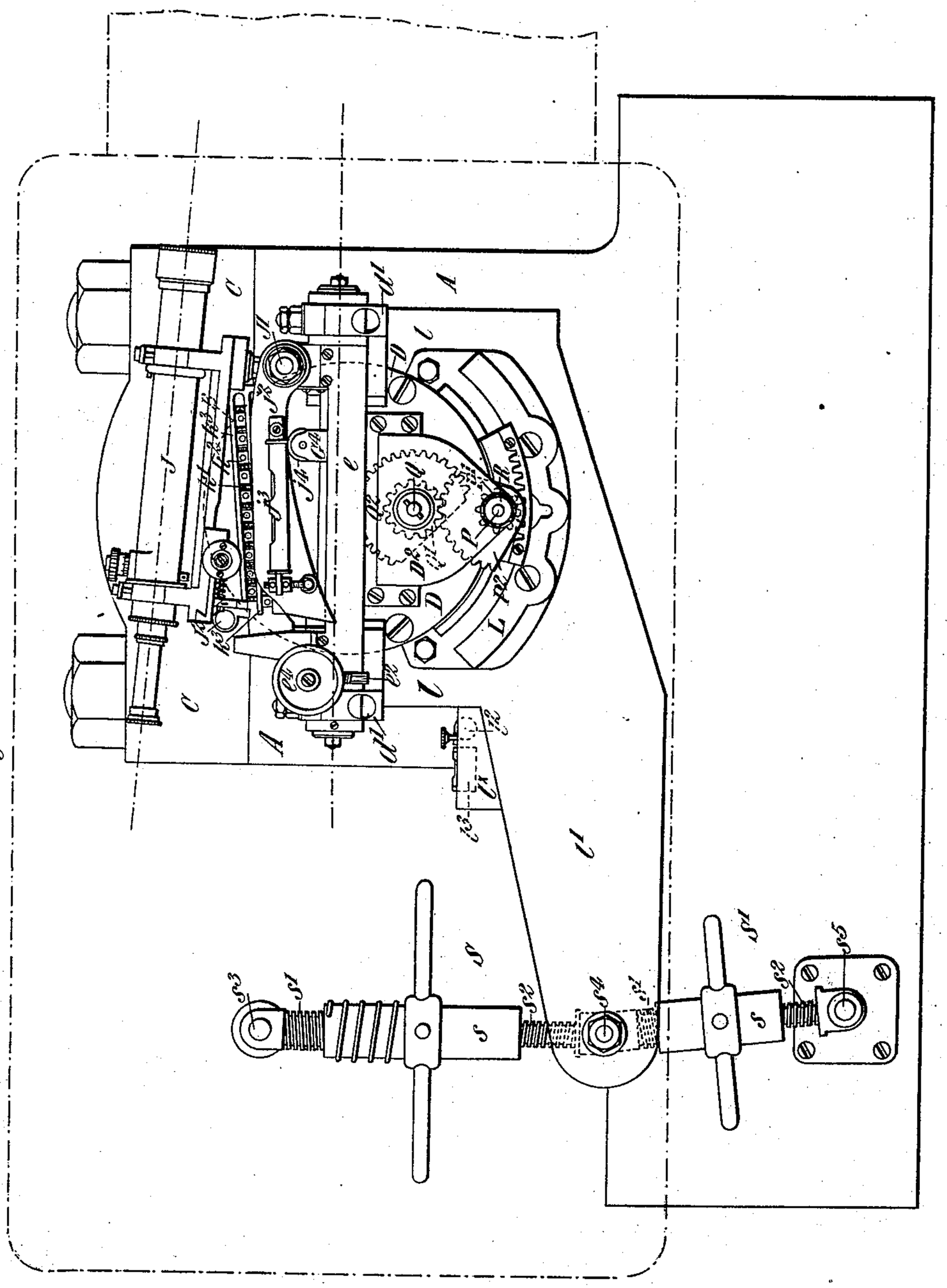

Fig. 3.

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(No Model.) 5 Sheets—Sheet 3.

Fig. 4.

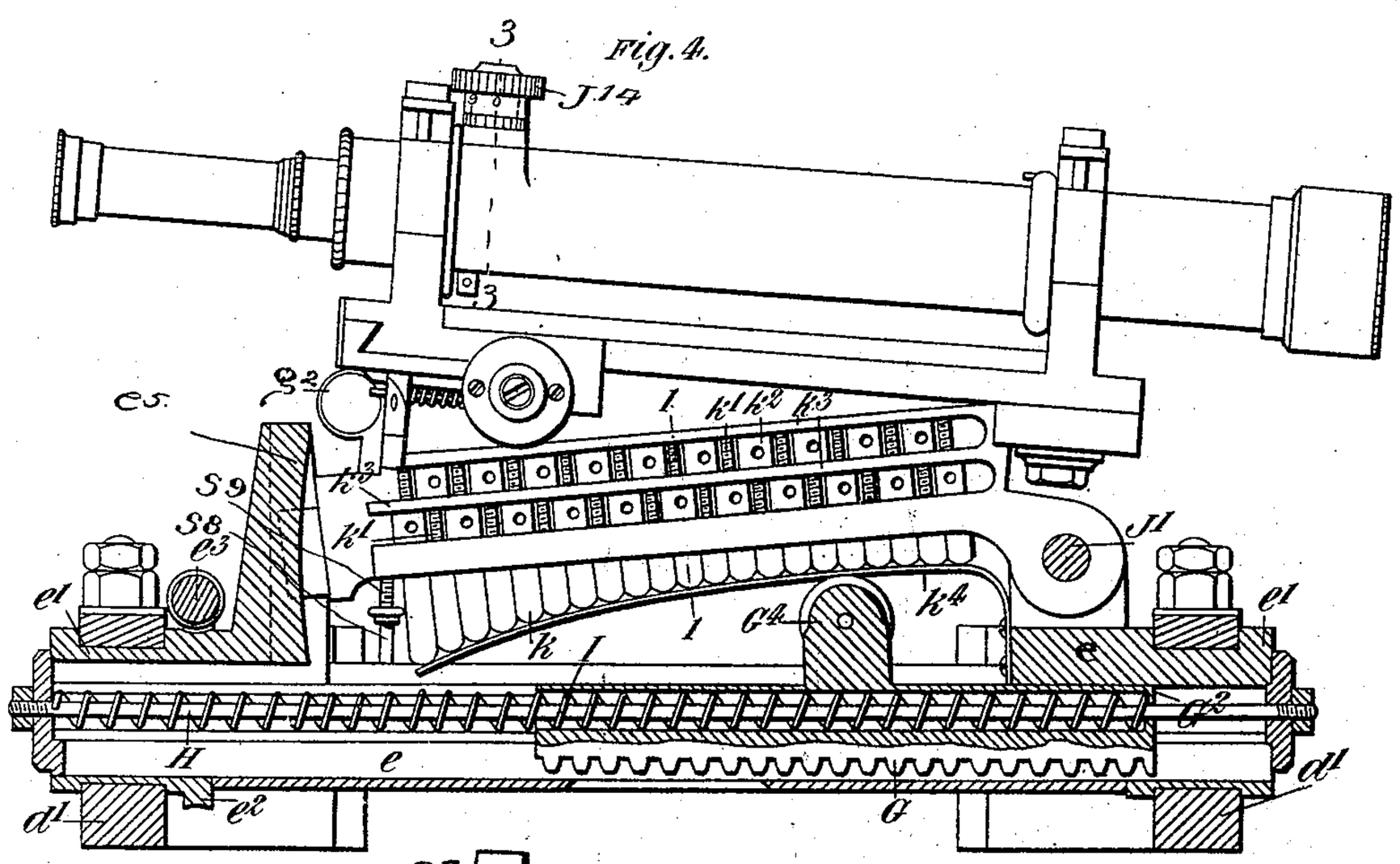


Fig. 4b.

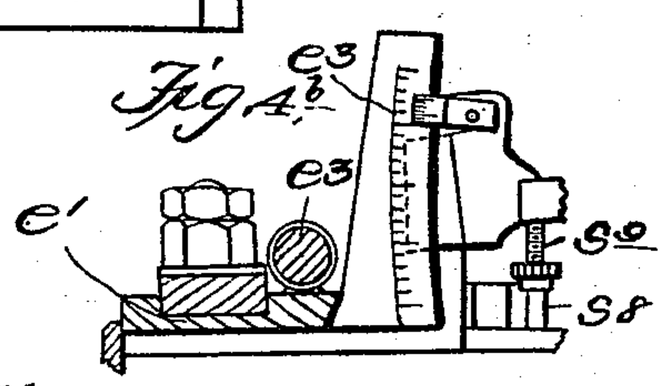


Fig. 5.

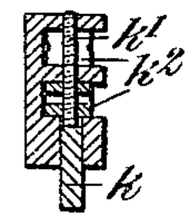


Fig. 7.

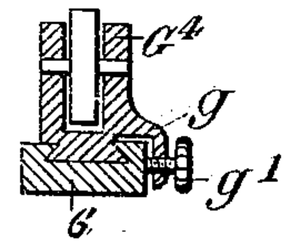
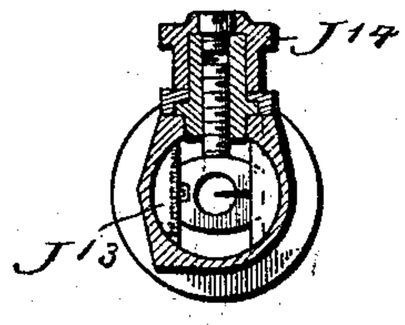


Fig. 4a.



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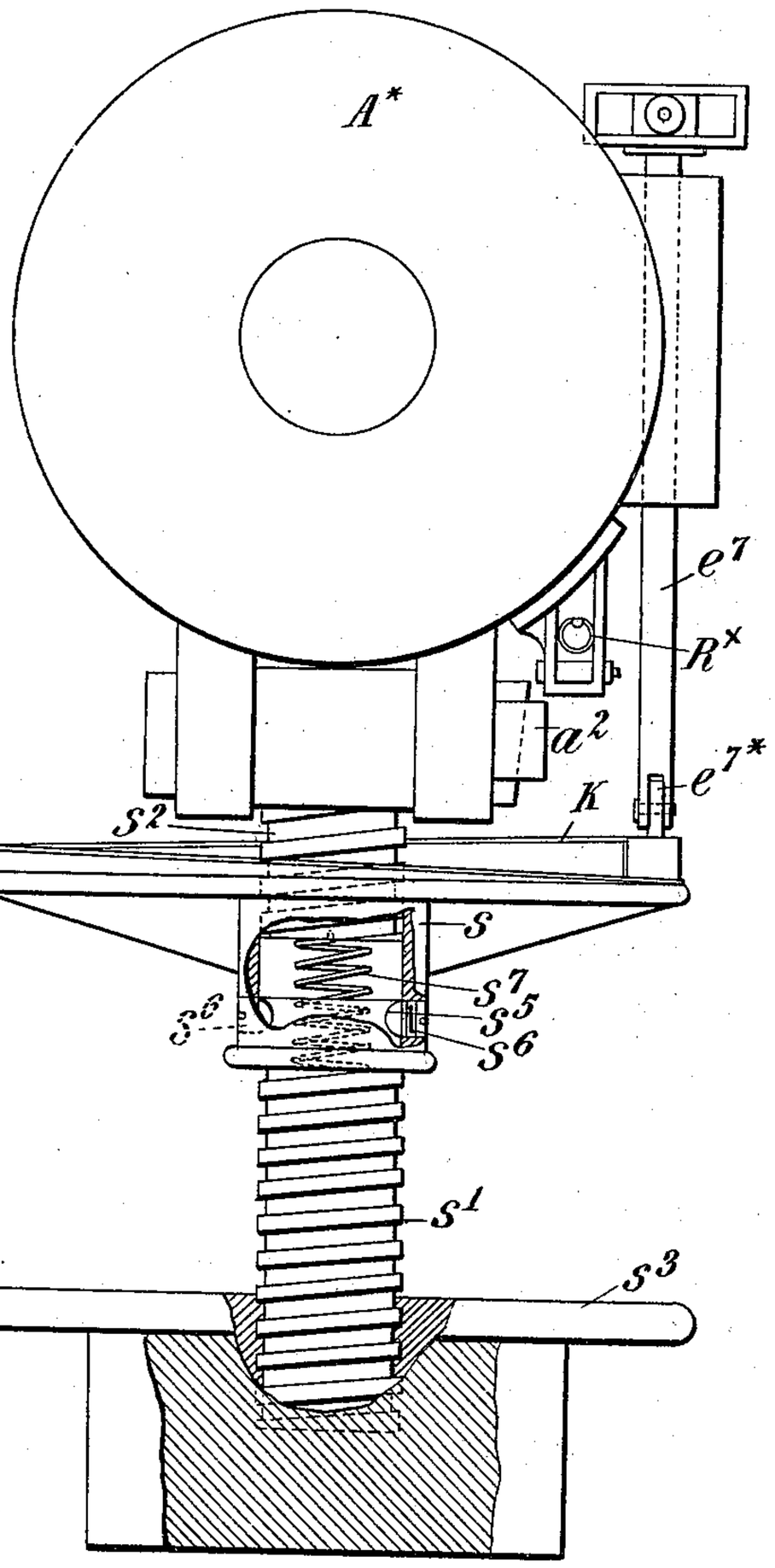
SIGHT FOR ORDNANCE.

(Application filed Dec. 29, 1897.)

(No Model.)

5 Sheets—Sheet 4.

Fig. 6.



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No. 658,287. Patented Sept. 18, 1900.

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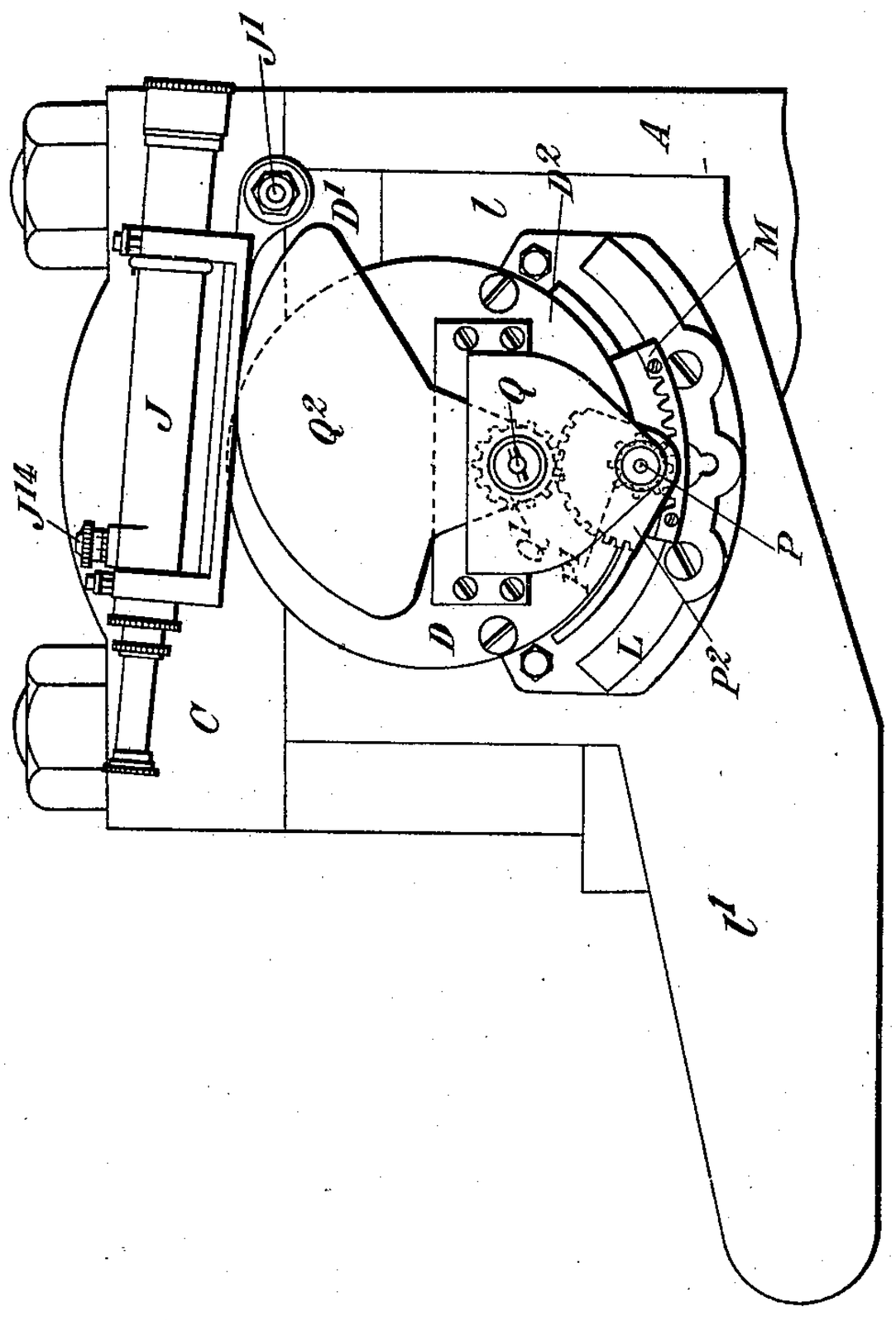
SIGHT FOR ORDNANCE.

(Application filed Dec. 29, 1897.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 8.



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UNITED STATES PATENT OFFICE.

LOTHIAN KERR SCOTT, OF FARNBOROUGH, ENGLAND.

SIGHT FOR ORDNANCE.

SPECIFICATION forming part of Letters Patent No. 658,287, dated September 18, 1900.

Application filed December 29, 1897. Serial No. 664,263. (No model.)

To all whom it may concern:

Be it known that I, LOTHIAN KERR SCOTT, lieutenant-colonel, late Royal Engineers, a subject of the Queen of Great Britain, residing at Forest Lodge, Farnborough, in the county of Hants, England, have invented certain new and useful Improvements in and Relating to the Sighting of Ordnance, (for which I have obtained a patent in Great Britain, No. 159, dated January 3, 1894,) of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to improvements in sights for ordnance.

The object of my said invention is to construct a sight which is of such a nature and is so combined with the gun that all that need be done when laying the gun is to bring the line of sight upon the object aimed at, no matter at what range the object may be, which sight when turned with the gun effects automatically the adjustment required for range, provided that an initial adjustment, according to the position of the gun, is properly made. The said sight serves also as a range-indicator. It is a very important feature of the sight that by its special construction it can be employed to correct mechanically any errors in laying which may arise by reason of irregularities in the level of the racer of the platform or by reason of alterations in the vertical height of the gun above the sea-level and to variations in the tide. My improved sight is particularly useful for guns situated at an elevation above the sea and for guns, inland, on commanding positions above level ground or above ground which undulates more or less uniformly over the field of fire. The employment of such a sight would render night firing at moving objects illuminated by the electric light not only easy but effective, for in its use there is no time lost in range-finding and in adjusting the sight for elevation by hand, for no such operation is needed, and, moreover, it would tend to result in the quickening of accurate fire from a group of guns and when necessary would supply each gun with the means of its own independent self-defense.

In order that my invention may be clearly understood, I will now proceed to describe the same, with reference, by way of example, to the accompanying drawings, wherein—

Figure 1 is a side elevation, partly in section, of one form of sighting apparatus constructed according to my invention and of as much of a gun-mounting as is necessary for the purposes of explanation; and Fig. 2 is an elevation of the same at right angles to Fig. 1. Fig. 2^a is a section through the telescope, taken on the line 1 1, Fig. 1. Fig. 2^b is a section on line 2 2, Fig. 1, omitting the wheels P′ Q′, the segments P^2 Q^2, and the plate D^2. Fig. 3 is a side elevation of a modified construction of the sighting apparatus. Fig. 4 is a detail sectional view showing more clearly the "range-curve" employed in this modification. Fig. 4^a is a section taken on the line 3 3, Fig. 4. Fig. 4^b is a detail side elevation of the scale shown in Fig. 4. Fig. 5 is a transverse section on the line 1 1 of Fig. 4. Fig. 6 is a part-sectional view showing a modification of the sighting apparatus. Fig. 7 is a detail sectional view showing the traveler made adjustable and hereinafter explained. Fig. 8 is a side elevation of a modified construction of the automatic sight-elevating gear shown in Fig. 3.

Like letters of reference indicate similar parts throughout the drawings.

Referring more particularly to Figs. 1 and 2, A is part of the carriage.

B is one trunnion of the gun, resting in a bearing on the carriage.

C is the cap of the bearing.

D is a frame secured to the trunnion.

D′ D′ are brackets which extend from the frame D.

E is a tube graduated externally, closed at the end by suitable caps and held in jaws formed in the brackets D′ in a position parallel to the axis of the gun. The said tube can be turned in the brackets about its own axis.

E′ is a worm-wheel fixed upon the tube E. and F is a worm journaled in one of the brackets D′ and geared with the worm-wheel E′.

F′ is a milled head whereby the worm F can be rotated to turn the tube E in the jaws of the brackets.

G is a hollow sliding rack provided with teeth G′, which pass through a slot E^2 in the

tube E. It is closed at one end by the plug G^2 and is movable endwise in the tube and provided with projections G^3, which extend through a slot E^3 side by side and have a roller G^4, hereinafter termed a "traveler," journaled between them for a purpose hereinafter specified. The roller may, if desired, be dispensed with and a projection from the hollow rack employed instead.

H is a rod fixed centrally in the hollow rack G.

I is a spring placed between the plug at the front end of the rack and the rear end of the tube E to take up backlash in the gearing hereinafter specified and to keep the tube E pressed to the rear. A slight amount of clearance is left between the rear face of the forward bracket D' and the adjacent collar on the tube to permit the tube to have a slight endwise movement in the bracket during recoil, so that the spring may lessen the effect of the shock upon the sighting apparatus. The spring I encircles the rod H, which serves to prevent it from buckling excessively. Moreover, a spring I' is placed around the rear end of the tube between the rear cap thereof and the rear bracket to assist in neutralizing the shock of recoil.

E^4 E^4 are slotted cheeks which extend down from the tube E and are connected by a cross-piece E^5 for a purpose hereinafter specified.

J is a telescope having an internal pointer and an internal adjustable scale for lateral deflection, as is well understood. It is hinged at J' to the tube E and is fitted with a cross-level J^2 and a longitudinal adjustable level J^3, which can be operated in a vertical plane by the interaction of the spring J^4 and adjusting-screw J^5.

K is a cam-plate, hereinafter referred to as a "range-curve." It is firmly held in lugs J^6 on the telescope J by the screws J^9, so that it can be replaced by other range-curves of different curvature, as may be desired.

A pin J^7 projects from each side of the object-glass end of the telescope and is guided in the slots of the cheeks E^4. The telescope can be adjusted non-automatically between the cheeks E^4 about its hinge J', if desired, by means of the adjusting-screw J^{10}, the object-glass end of the telescope being thus raised or lowered and the angle through which it passes being read by means of a scale J^{11} on one of the cheeks E^4 and a vernier J^{12} on the telescope. The screw J^{10} is removed when the sight is used automatically, or in the apparatus shown in Fig. 4 the guide E^5 may be graduated and a vernier on the frame k^3 raised or lowered on the scale thus formed by means of a screw socket or nut s^8 and a screw s^9, fixed to the frame k^3 and engaging with said socket or nut to effect the same purpose. In this manner the telescope can be used as an ordinary sighting-telescope, as is well understood by artillerists.

J^8 is a spring attached to the telescope and arranged to bear upon the cross-piece E^5 to press the telescope upward to keep the edge of the range-curve K between the projections G^3 and in close contact with the traveler G^4, or such contact can be insured by "over balancing" the telescope when using the construction shown in Figs. 3 and 4. The angle contained between the axis of the telescope J and that of the tube E corresponds with what is technically called in gunnery "the sight angle of elevation"—that is to say, the angle made by the line of sight with the axis of the gun—and its amount is governed by the movement of the roller along the range-curve, which curve is calculated for the height of the horizontal axis of the gun above sea-level and is preferably fixed, as aforesaid, to the upper side of the telescope. The roller or traveler G^4 is moved along the tube E when the elevating-gear of the gun is operated by gear hereinafter described, which is operated by the movement of the gun-trunnion relatively to the gun-carriage and which is adapted to multiply that movement in order to render the adjustment and indications of the device less minute than would otherwise be the case.

The arrangement of the gearing whereby the sights are laid automatically in the movement of the gun will now be described.

L is a slotted arc fixed to the gun-mounting.

M is a segmental rack adjustable in the slotted arc L.

N' is a block which is normally kept, by means of a spring N, in contact with a cam O, pivoted in the arc and adapted to bear on the block N' to depress the latter and cause the spring N to bear with sufficient pressure on the rack M to clamp it in any position to which adjusted in the arc. Any suitable clamping device may be used in lieu of the cam O. The lever-arm of the cam is elastic, so as to spring into place behind a stud L' at one extreme of its movement.

Where the gun-platform is permanently level, the rack M need not be made adjustable, but can be permanently fixed to the carriage.

P and Q are non-rotatable spindles supported in the upper part of the frame D and in the front plate D^2, forming part thereof. Upon the spindle P are journaled the wheel P' and segment P^2, which are in one piece or are otherwise firmly secured together. Upon the spindle Q are journaled the wheel Q' and the segment Q^2, which also are fixed together. The wheel P' gears into the rack M, the segment P^2 gears into the wheel Q', and the segment Q^2 gears into the rack G.

R is a nut screwed onto the spindle Q and provided with a handle R', whereby it can be operated to move the spindle endwise to jam the wheel Q' and segment Q^2 against the inner face of the plate D^2 to prevent them from rotating when it is desired to lock the train of gearing.

On moving the gun by means of the elevating-screw the movement of the train of gear-

ing P′ P² Q′ Q² with the trunnion will cause the wheel P′ to be rotated by reason of its movement over the stationary rack M, whereon movement will be communicated from the wheel P′, through the multiplying-gear P² Q′ Q², to the sliding rack G′, which will move the traveler G⁴ along the range-curve K to permit the telescope J to be adjusted by the spring J⁸ at such angles to the tube E that the line of sight at any instant is directed upon the point at which the fire of the gun in its corresponding position happens to be directed. In other words, the traveler and the range-curve coact to determine the sight-angle for each range, so that when the telescope is directed upon a target in the manner hereinbefore specified the requisite elevation will be given to the gun to enable it to hit that target. A convenient indication of the range is afforded at any moment by the position of the traveling with regard to the graduated tube E and the graduated range-curve. Thus under the conditions specified the apparatus is a range-finder, as well as a sight.

With apparatus constructed and arranged in the manner hereinbefore specified irregularities in the level of the racers of the platform can be readily corrected in a manner which will now be explained. Transverse inequalities are corrected by means of the cross-level J² on the telescope, which is leveled by rotating the tube E, and thereby insuring the verticality of the sight. Longitudinal inequalities are corrected as follows: The gun is first traversed to a position where the "racers" have been ascertained to be level transversely and longitudinally. This is recorded by attaching a level permanently to the gun-carriage in such a manner that its bubble will be central so long as the racers remain level at that place. The range-curve is calculated or is shaped by actual practice in accordance with the datum height of the gun. Consequently the axis of the gun will have when the carriage is properly adjusted the correct elevation to hit any one of the targets on which the telescope can be laid by the elevating-screw of the gun for all positions of the traveler G⁴ on the range-curve K. Next, both the cross-level J² and the longitudinal level J³ are to be leveled, the former by turning the bar E and the latter by its own leveling-screw J⁵. Then the train of gearing P′ P² Q′ Q² must be locked to the plate D² by turning the handle R′ and the segmental toothed rack M must be unclamped by suitably operating the lever-arm of the cam O, whereupon the gun should be pointed in the direction and in advance of the target, assuming the latter to be moving across the line of fire. When the gun is thus pointed, level both the levels if they have been put out of level by the unevenness of the racers. The cross-level must be leveled by turning the tube E, as before, but the longitudinal level must be leveled by elevating or depressing the gun by the elevating-gear. By this means any quadrantal elevation lost or gained by the axis of the gun in its transit along the racers, as shown by the disturbance of the bubble of the longitudinal level, will have been compensated for. After these adjustments to cause the sight to act automatically reclamp the segmental toothed rack of the gun and unclamp the train P′ P² Q′ Q². Then the cross-wires of the telescope are brought onto the target by the elevating-gear of the gun, whereby the proper elevation will have been given to the axis of the gun to enable it to hit the mark in spite of any previous loss or gain of quadrantal elevation which may have resulted from irregularities of the racers, as aforesaid.

If the gun is employed against a floating target, the telescope should be laid on the water-line of the target by the elevating-gear of the gun, or if the tide be below the datum-level to which the range-curve is calculated the line of sight should be laid on a point above the water-line. Now level the cross-level J² by turning the tube E and level the longitudinal level by its own screw. The leveling of the longitudinal level at this stage supplies the datum level or level of reference for checking and correcting, if necessary, the quadrant angle of the gun for the succeeding shot, for the same or any other position of the gun-carriage on the racers, and it obviates the necessity for retraversing to the original datum position on the racers on each occasion. I can compensate for the rise and fall of tide in one of three ways—that is to say, by mechanically increasing the sight angle of elevation given automatically to the telescope by the movement of the roller along the range-curve, raising or lowering for this purpose the cross-wires of the telescope up or down a vertical scale therein, or by supplying different range-curves made interchangeable upon the telescope, for instance, in a series on a rotatable collar, or by using only one range-curve, which has been calculated for high-water level, and by directing the telescope above instead of on the water-line of the target for a lower tide to such an extent as is taught by the experience of practice.

My improved sight can either be used to act automatically, as described above, or by turning the elevating-screw of the gun and so moving the roller to zero on the range-curve, then clamping the train of gearing in the position it then assumes and unclamping the segmental toothed rack from the carriage it can be used in conjunction with a graduated arc or spiral, like the ordinary and well-known "Scott telescopic sight," and can be given by hand the requisite sight or clinometer elevation for ranges communicated from a range-finder to the gun.

Instead of the stationary rack and the gear hereinbefore referred to I may employ a pendulum or other suitable appliance preferably carried by the tube E and becoming op-

erative to move the traveler at a suitable rate along the range-curve as the gun is elevated or depressed.

I will now refer to Figs. 3 to 5, wherein I have shown the apparatus somewhat modified. In this case the telescope J is arranged above the rack G and is pivoted at its forward end to the frame *e*, which is equivalent to the hollow tube E referred to in Figs. 1 and 2, and contains the sliding rack G. The range-curve is situated below the telescope J and is constructed in a different manner to the range-curve K, as will be hereinafter described. The slotted arc L instead of being arranged above the trunnion is situated below it, and instead of being attached to the mounting is attached to a collar *l*, embracing the trunnion B, such collar being provided with an arm *l'*, the end of which projects between two elevating-screws S S' for the purpose hereinafter stated. The telescope J is provided with a vertical scale J^{13}, up and down which the pointers or cross-wires can be moved by turning the milled head J^{14} for the purpose of compensating for the rise or fall of tide, as previously referred to. Before proceeding to describe in detail this modified construction of sighting apparatus I would here state that there are certain general principles required to be observed for the correct automatic sighting of guns, without the fulfilment of which the system of sighting with my improved apparatus (where the projectiles fired from the guns have to strike their targets, such as ships, as entire shells) is absolutely useless, although it might prove of value for field-guns, the projectiles of which have to strike their targets at short ranges and burst before striking such targets. These principles have already been contemplated in the foregoing description, although they have not been specially mentioned, and may be stated as follows: First, the platform on which the gun rests must be absolutely level; second, the height of the axis of the trunnion of the gun above the horizontal plane must be constant, and, third, the explosive employed with the gun must be of uniform and constant strength.

As a matter of fact the platforms for heavy guns as a rule are not absolutely level, and if made so at the time of their construction they rapidly get out of level from continued firing, and where the guns are for coast defense the rise and fall of tide will prevent the height of the axis of the gun above the horizontal plane remaining constant, and the explosives employed usually deteriorate by keeping. Therefore an automatic sight to be of any value for sighting a gun which has not a level platform must embody in itself mechanical principles which can eliminate automatically as far as possible the errors in shooting caused by the inaccuracy in laying due to want of level in the platform, and such automatic sight must also have the mechanical power of connecting automatically the variation in the shooting, due to variations in the height of the axis of the gun's trunnions above the level of the sea, owing to the rise and fall of the tide, and also have mechanical means for correcting the varying strength of the explosive.

To make an automatic sight (with or without telescope) for a gun on a perfectly-level platform is a far easier matter than to make one for a gun on an unlevel platform. The fact of the gun-platform being absolutely level would remove a considerable complication in the construction of an automatic sight; but there still remains the difficulty of providing the mechanical means for correcting the sighting for rise and fall of the tide and other errors which must be common to all such sights when used for firing to sea from land positions.

In my present construction of sight I have preferred to provide mechanical means for correcting all errors in shooting due to unlevel platforms and to varying heights of the axis of the trunnions above the sea-level, owing to rise and fall of the tide, which gives the sight a complicated appearance; but if the causes of error in the shooting do not exist it stands to reason that the mechanical complications for their removal will be also correspondingly reduced and that the required sight will assume a more simple form. In order to explain the value and the working of my invention, I will enumerate the errors in shooting caused by irregularity in the level of the platform and by a varying height of the axis of the trunnions above the sea in the case of coast-batteries and how to remedy them, special reference being had to Figs. 3 to 5 of the drawings.

Errors due to irregularities in the level of the platform.—The platform may be transversely or longitudinally inclined, or both. Where the platform is inclined to the right, the sights will be inclined to the right, and the gun when laid by the sight will carry to the right and short of the target. There is therefore an error in the direction and in the range. To remedy these defects, the sight must be made capable of angular movement about an axis parallel to the axis of the gun, so as to assume a truly-vertical position. This is accomplished in Fig. 3 by constructing the tube *e*, to which the telescope is pivoted at J', with end trunnions *e'*, working in bearings *d'*, one of said trunnions being furnished with a toothed arc e^2, with which a worm e^3 engages, the said worm having a milled head e^4 for enabling it to be operated. By turning the said milled head the sight can be brought into the desired vertical position, which will be indicated by the cross-level J^2.

When the platform is inclined longitudinally—*i. e.*, dips to the front or rear—the gun when traversed will assume different quadrantal elevations automatically and quite independently of the elevating-screw of the gun, which at the same time works the sight-

ing apparatus. This automatic alteration in elevation or depression of the gun due to the irregularity of the platform must be corrected before the automatic laying of the gun by means of the range-curve can be begun. This is effected by providing the supplementary elevating-screw S′ beneath the ordinary elevating-screw S of the gun, which enables the automatic sighting apparatus and the gun to be elevated or depressed together without in any way altering the angle between the sighting apparatus and the axis of the gun, or, in other words, without setting in motion the traveler G^4, on which the range-curve rests. This is arrived at by fixing the segmental rack M to the collar *l*, which is arranged around the trunnion B of the gun, fitting it well, but loosely. This collar has an arm *l′*, which extends as far as the ordinary elevating-screw S of the gun and below it. This arm *l′*, with the elevating-screw, rests upon and is supported by the supplementary elevating-screw S′, which when turned raises or lowers the arm *l′* and the gun together, thereby correcting any + alterations in the quadrantal elevation of the gun due to dip in the platform without disturbing the automatic sighting apparatus. This arrangement of the segmental rack M and the collar *l*, with its arm *l′* located below the ordinary elevating-gear, is very advantageous, because in the event of the trunnions jumping on shock of discharge the rack M and the gear-wheels connected therewith jump together, and consequently are not likely to get out of gear with each other. The said elevating devices S S′ are each composed of a nut *s*, receiving screwed spindles s' s^2, which are oppositely threaded, the screw s' of the upper elevating device being hinged at s^3 to the gun and the screw s^2 thereof being hinged to the arm *l′* at s^1. The screw s' of the lower elevating device is also hinged to the arm at s^4, and the screw s^2 thereof is hinged to the carriage at s^5.

The aforesaid so-called "automatic" alterations which should not take place in the quadrantal elevation of the gun by traversing a pivoted gun across an unlevel platform are automatically indicated either by a telltale level j^3, attached to the sight itself, or by a cross-level l^2 and longitudinal level l^3, set at right angles to each other in a hinged frame, suitable means being provided for adjusting the said levels. The levels are attached to the arm *l′* of the collar to which the rack M is fixed, the longitudinal level being parallel to the axis of the gun. When the maximum depression has been given to the gun, from which the rest of the range-curve for that position has to be calculated, as it were, from zero, these telltale levels are fixed in position with their bubbles in the center of the tubes, the one for the sight itself being preferably located on a curve-plate j^2, pivoted at J′ to the same center as that of the range-curve, and the other being preferably adjustably attached to the movable arm *l′*, as already stated. The curve-plate j^2 of the telltale level j^3 is actuated by a roller j^4, working on the same spindle as that of the traveler G^4 and parallel to it. Such curve should be of a form that the bubble will remain in the center of the level during the movement of the gun from its maximum depression to its highest angle of elevation, and the level must be parallel to the axis of the gun.

If the bubbles of the longitudinal levels do not remain in their center during the traverse of the gun, it shows that the gun has been elevated or depressed by an irregularity in the level of the platform, and therefore this longitudinal level must be brought back to its original level by the supplementary elevating-screw of the gun before laying the gun onto the target by the upper elevating-screw.

Errors due to varying height of gun above the sea owing to the rise and fall of tide.—A different range-curve is necessary for every alteration in height of the gun above the sea. For instance, the curve constructed for a gun two hundred feet above the sea at high tide will not be accurate for two hundred and ten feet above the sea at mean tide, because when the gun receives elevation by the elevating-screw the telescope is automatically directed by the traveler on the point which should be struck by the shot at any given elevation of the gun. When the target is seen by the telescope at high tide and the range-curve of the telescope is made for high tide, it will be struck by the shot; but if the target be seen at mean tide ten feet lower with the same elevation given to the gun the target will not be struck, because the target in order to be seen by the telescope must be farther off. The true way to correct this error with accuracy and automatically is to change or alter the curve to suit the rise and fall of tide. To admit of this, I make the range curve adjustable to suit any height above the horizontal plane. For this purpose I construct the range-curve of a series of movable parallel blocks or teeth *k*, each furnished with a screw-stem *k′* at one end to enable them to be adjusted by screw-nuts k^2, working in the frame k^3 above the curve. By these means I can set the said teeth into any desired position to form a curve at their free ends suitable to the altering height above the horizontal plane at any time of tide. The free ends of these teeth are bridged over by a flat spring k^4 or other suitable means, such spring being sufficiently thick to prevent any indentation between the teeth from the weight of the telescope and curve above—that is to say, it is sufficiently strong to act as a counterpoise and reduce, as required, the pressure on the traveler underneath, so as to enable the spring I, which acts on the traveler G^4, to have sufficient power to keep the teeth of the rack (on its return journey) against the teeth of the pinion Q^2 of the multiplying-gear, and thus keep the two in continual contact and avoid

loss of time. The aforesaid teeth are adjusted in the example illustrated by revolving the nuts k^2 by a suitable tool. I may, however, employ any other suitable means for adjusting the said teeth.

Instead of constructing the curve of a series of teeth alterable at will, as above stated, several interchangeable ready-made curves of different curvature could be employed for attachment to the curve-frame.

When the platform is transversely inclined and the sight correspondingly inclined, the traveler, actuated by the elevating-screw, will arrive at the range on the curve of the telescope before the gun has actually received the elevation to hit it; but if the sight be turned into a vertical position to correct there will still remain a slight error in range, which can be rectified by correcting the angle between the axis of the telescope and that of the gun by turning the milled head J^{14} of the telescope, and thus altering the position of the pointers on the vertical scale in the telescope. (See Fig. 4ª.)

Owing to having to adapt this automatic system of sighting to different gun-mountings and for other reasons it might be necessary to modify the general mechanical arrangement of its different parts and at the same time to maintain in their entirety or otherwise, according to the platform, the theoretical principles considered necessary for the correct working of an automatic sight for coast-batteries and for quick-firing guns. Such being the case, I will describe the modifications that might become necessary or be of advantage to adopt.

It might be necessary to have a longer range-curve. The possible length of the range-curve is regulated by the maximum movement of the traveler G^4. At the trunnion of the gun the vertical movement of the axis of the gun in elevation is the least and at the breech of the gun it is the greatest. It is evident, therefore, that if I apply to the multiplying-gear in its present position a movement corresponding to a ten-degree arc at the breech instead of a ten-degree arc close to the axis of the trunnion of the gun I shall get a correspondingly-increased movement of the traveler, and consequently a very much longer curve would become available and would of course give much larger graduations for each hundred yards range all along the curve.

First modification. Dispensing with the range-curve and traveler and using a cam to raise the sight-bar or telescope instead.—If the sight is attached to the trunnion of the gun, as shown in the drawings, the curve and traveler can be dispensed with, if a cam with adjustable teeth forming the suitable range-curve be attached to the axle Q of the train of wheels and brought into contact with the under part of the sight-bar or telescope to raise it, as the former revolves exactly as it is raised by the traveler acting on the curve. An arrangement of this kind is shown in Fig. 8, in which the sight is attached to the trunnion of the gun and operated in a similar manner to the arrangement shown in Fig. 3. In this figure, however, the segment, range-curve, and traveler are replaced by the cam Q^2, which constitutes the range-curve and upon which the telescope-bracket rests. The telescope is hinged at J′, as previously described, and when the automatic sight-elevating screw is operated the cam is caused to move about the pivot Q, as the gun is elevated or depressed, and so give the necessary adjustment for range.

Second modification. If the platform is perfectly level, there is no need of a leveling-screw for the sight nor of a supplementary elevating-screw, range-curve, traveler, multiplying-gear, and for short ranges a telescopic will not be required.—In this modification a tangent-sight or back-sight is only necessary to be raised and lowered, so that the line of sight will point on the target as soon as the gun has got the elevation required to hit it.

Referring to Fig. 6, the adjustment for range is given by the direct action of an automatic sighting gear-wheel upon the ordinary tangent-sight of the gun through the intermediary of an inclined plane or screw constituting the range-curve. A* is the breech end of the gun. The elevating-screw is divided into two parts—viz., a lower part s', forming the ordinary elevating-screw and operated by the ordinary elevating gear-wheel s^3, and an upper part s^2, by means of which the gun can be elevated or depressed and at the same time the necessary adjustment of the sight for range be given. This screw s^2 is pivoted to the gun at a^2 and is operated by the screw-sleeve and hand-wheel s. The upper end of the screw s' is provided with an annular groove s^5, and a smooth part at the lower end of the sleeve s fits over the upper end of the screw s' and is retained, so as to be capable of rotating thereon, by means of screws s^6, which pass through the said sleeve and project into the groove s^5. K is an inclined plane or screw fixed to the upper surface of the hand-wheel carried by the sleeve s and constituting the range-curve. e^7 is a tangent-sight of ordinary construction carried in a sleeve fixed to the gun and capable of moving vertically through said sleeve, and e^{7*} is a roller pivoted to the end of said tangent-sight and normally kept in contact with the range-curve K by gravity. s^7 is a spring situated between the screws s' and s^2 to take up any possible backlash. $R^\times$ is a graduated clinometer-level of ordinary construction suitably attached to the gun. Upon turning the elevating screw-wheel s^3 the gun will be elevated or depressed without giving any adjustment to the tangent-sight for range; but upon turning the elevating gear-wheel carried by the sleeve s the gun will be elevated or depressed and at the same time the neces-

sary adjustment for range given (through the medium of the range-curve K) to the tangent-sight.

In order to provide means for altering at will the angle between the axis of gun and the axis of telescope independently of those provided by the elevating-screw of the gun, the traveler may have a sliding movement given to it in the direction of the curve to the right and left of the zero, as shown in Fig. 7, where G^4 is the traveler, provided with dovetail edges working in corresponding grooves formed in the bracket or bar G. The said traveler is furnished with means, such as the arm g and the pinch-screw g', whereby it can be readily adjusted in the required position and locked.

Instead of constructing the traveler so that it will be capable of independent adjustment, as above stated, I may arrange the curve so as to be capable of longitudinal adjustment in the cam-frame.

What I claim is—

1. A sighting apparatus for ordnance comprising a tube attached to the gun parallel to the longitudinal axis thereof, a telescope and "range-curve" hinged to one end of said tube, bearings projecting from the opposite end of said tube, pins projecting from the object-glass end of the telescope and sliding in said bearings, a traveler carried by said tube and bearing on the "range-curve," a spring for maintaining said "range-curve" in contact with said traveler, and means for operating said traveler when the gun is elevated or depressed so as to automatically effect the proper adjustment of the angle between the telescope and tube in accordance with the range at which the target is situated, substantially as described and for the purpose specified.

2. In sighting apparatus for ordnance the combination with a tube carried in bearings upon the gun and parallel to the longitudinal axis thereof, of a telescope hinged to said tube, a level hinged to said telescope and adjustable in a plane parallel to the longitudinal axis thereof, an adjustable segmental rack carried by the gun-mounting and gearing between said rack and said telescope, whereby the position of the latter is varied with the adjustment of the gun in elevation, substantially as described and for the purpose specified.

3. In sighting apparatus for ordnance the combination with a tube parallel to the longitudinal axis of the gun and rotatable about its longitudinal axis in bearings upon the gun, of a telescope hinged to said tube, a level hinged to said telescope and adjustable in a plane parallel to the longitudinal axis thereof, an adjustable segmental rack carried by the gun-mounting, gearing between said rack and said telescope, whereby the position of the latter is varied with the adjustment of the gun in elevation, a cross-level, and mechanism for moving the tube angularly about its longitudinal axis substantially as described and for the purpose specified.

4. In a sighting apparatus for ordnance the combination with a tube attached to the gun parallel to the longitudinal axis thereof, of a telescope and "range-curve" hinged to said tube, a toothed rack movable in said tube, a traveler carried by said rack, an adjustable toothed rack carried by the gun-mounting, mechanism gearing the rack in the said tube with the rack on the gun-mounting, means for clamping said mechanism, and means for taking up "backlash" in the gearing, substantially as described and for the purpose specified.

5. In a sighting apparatus for ordnance the combination with a tube attached to the gun parallel to the longitudinal axis thereof, of a telescope and "range-curve" hinged to said tube, a toothed rack movable in said tube, a traveler carried by said rack, an adjustable toothed rack carried by the gun-mounting, mechanism gearing the rack in the said tube with the rack on the gun-mounting, means for clamping said mechanism, means for taking up "backlash" in the gearing, and means for minimizing the effect of recoil on the apparatus when the gun is fired, substantially as described and for the purpose specified.

6. In a sighting apparatus for ordnance the combination with a tube carried in bearings upon the gun and parallel to the longitudinal axis thereof, of a telescope and "range-curve" hinged to said tube, a toothed rack movable in said tube, a traveler attached to said rack for operating said range-curve and telescope, an adjustable toothed rack carried by the gun-mounting, mechanism gearing the rack carried by the tube with the rack carried by the gun-mounting, and a spring one end of which bears against the rack carried by the tube and the other end of which bears against one of the closed ends of the said tube so as to take up "backlash" in the said gearing, substantially as described for the purpose specified.

7. In a sighting apparatus for ordnance the combination with a tube carried in bearings upon the gun and parallel to the longitudinal axis thereof, of a telescope and "range-curve" hinged to said tube, mechanism gearing said "range-curve" and telescope to the gun-mounting, and means applied to said tube for lessening the shock of recoil when the gun is fired, substantially as described.

8. In a sighting apparatus for ordnance the combination with a tube carried in bearings upon the gun and parallel to the longitudinal axis thereof, of a telescope and "range-curve" hinged to said tube, a toothed rack movable in said tube, a traveler attached to said rack for operating said "range-curve" and telescope, an adjustable toothed rack carried by the gun-mounting, mechanism gearing the rack carried by the tube with the rack carried by the gun mounting, and a spring interposed between a collar at one extremity

of said tube and its bearing at that end to minimize the shock of recoil when the gun is fired, substantially as described.

9. In sighting apparatus for ordnance the combination with a telescope and "range-curve" hinged to the gun, of mechanism gearing said telescope and "range-curve" to the gun-carriage, so that by means of a single operation of the elevating device the adjustment for range is given and the gun is elevated or depressed, and means whereby the telescope may be used as an ordinary sighting-telescope without the adjustment for range being effected by the elevating-gear of the gun, substantially as described.

10. In sighting apparatus for ordnance the combination with means whereby the angle between the line of sight and the longitudinal axis of the gun is automatically altered so as to give the necessary adjustment for range when the gun is elevated or depressed, of means whereby the gun and telescope can be together elevated or depressed without altering the said angle, substantially as described and for the purpose specified.

11. In a sighting apparatus for ordnance the combination with the tube attached to the gun and parallel to the longitudinal axis thereof, of a telescope and "range-curve" hinged to said tube, a traveler for operating said "range-curve" and telescope, means for operating said traveler when the gun is elevated or depressed so as to automatically effect the adjustment of the angle between the telescope and tube in accordance with the range at which the target is situated, and means whereby the telescope and tube can be moved together with said gun (when the latter is elevated or depressed) without altering the angle between them substantially as described and for the purpose specified.

12. In a sighting apparatus the combination of a collar embracing one of the gun-trunnions and provided with a segmental rack M, of an arm carried by such collar and of two independent elevating-screws one of which is connected to the said arm and the gun, and the other of which is connected to the said arm and a fixed point below it, for the purpose specified.

13. In sighting apparatus the combination with the arm of the collar embracing one of the gun-trunnions, of two spirit-levels located thereon and set at right angles to each other, of a frame for receiving said levels and of means whereby said frame and its levels can be adjusted either vertically or horizontally for the purpose specified.

14. In sighting apparatus the combination with the pivot to which the telescope is connected, of a curved plate adapted to be acted upon by the roller j^4 and of a longitudinally-arranged adjustable level carried by such plate substantially as described and for the purpose specified.

15. In sighting apparatus a range-curve comprising a series of parallelly-disposed movable blocks or teeth mounted in a frame and capable of independent adjustment for the purpose specified.

16. In sighting apparatus, a range-curve comprising a series of parallelly-disposed movable blocks or teeth mounted in a frame forming part of the telescope-support, of screw-stems on each of the said movable blocks or teeth, and of nuts carried by said stems and adapted to be revolved substantially as described.

17. In sighting apparatus the combination with the series of parallelly-disposed movable blocks or teeth of a resilient strip adapted to cover the free ends of the said blocks or teeth and fixed at one of its ends substantially as described and for the purpose specified.

18. In sighting apparatus for ordnance the combination with a tube attached to the gun parallel to the longitudinal axis thereof, a telescope and "range-curve" hinged to said tube, a rack movable in said tube, a traveler attached to said rack, and means for shifting the position of the said traveler on the movable rack, substantially as described and for the purpose specified.

19. In sighting apparatus for ordnance the combination with a tube attached to the gun parallel to the longitudinal axis thereof, a telescope and "range-curve" hinged to said tube a rack having a dovetail groove therein and movable in said tube, a traveler having a dovetail capable of sliding in said groove in the movable rack, and a lug and clamping-screw on said traveler, substantially as described and for the purpose specified.

In testimony whereof I have hereunto set my hand this 13th day of December, 1897.

LOTHIAN KERR SCOTT.

Witnesses:
H. B. GREEN,
FRED C. HARRIS.