No. 887,023. PATENTED MAY 5, 1908.

K. VÖLLER.

SIGHTING APPARATUS FOR ORDNANCE.

APPLICATION FILED JAN. 30, 1905.

7 SHEETS—SHEET 1.

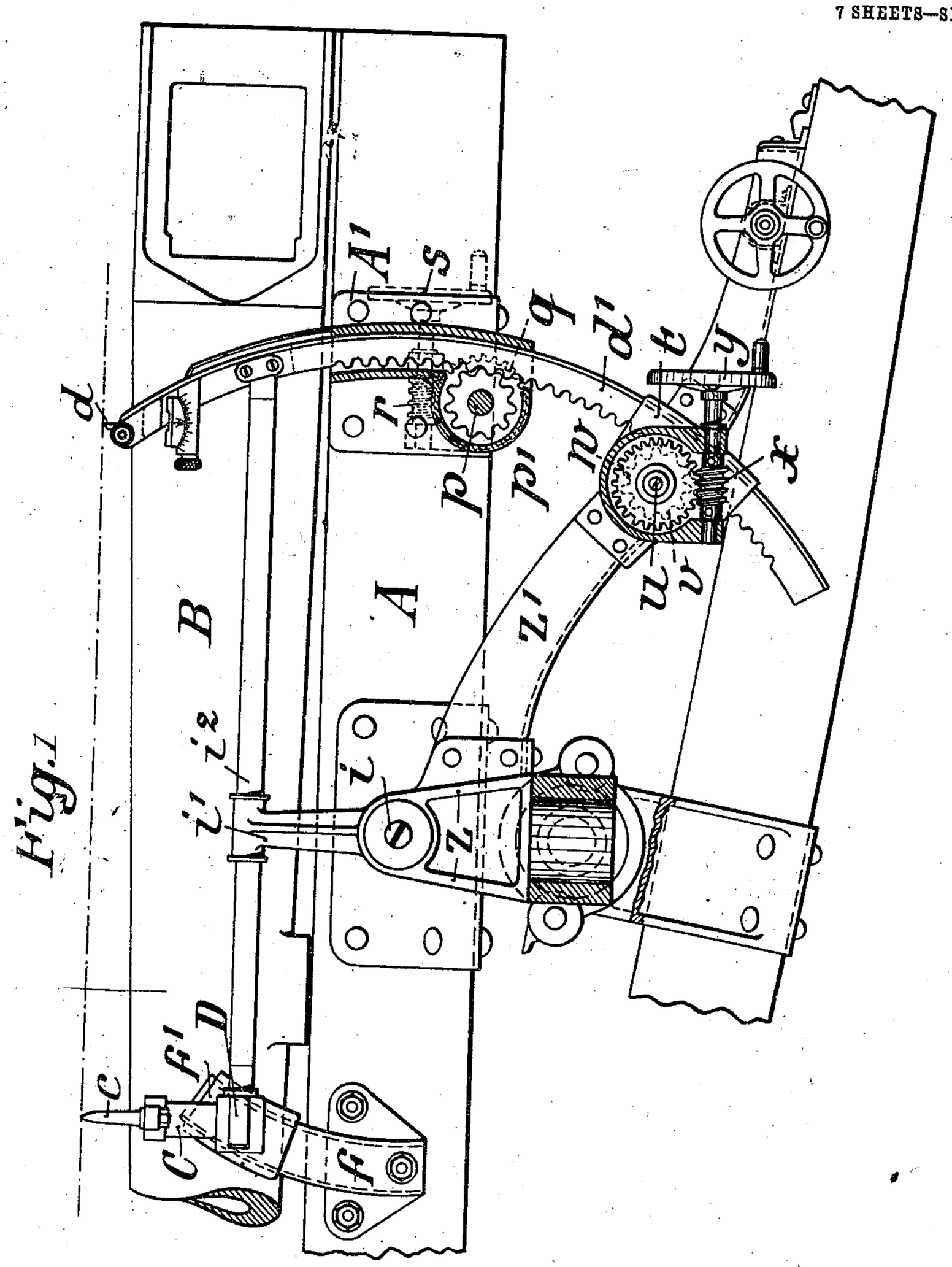

Fig. 1.

WITNESSES

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M. F. Anderson

INVENTOR

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by Georgii & Massie

his ATTORNEYS.

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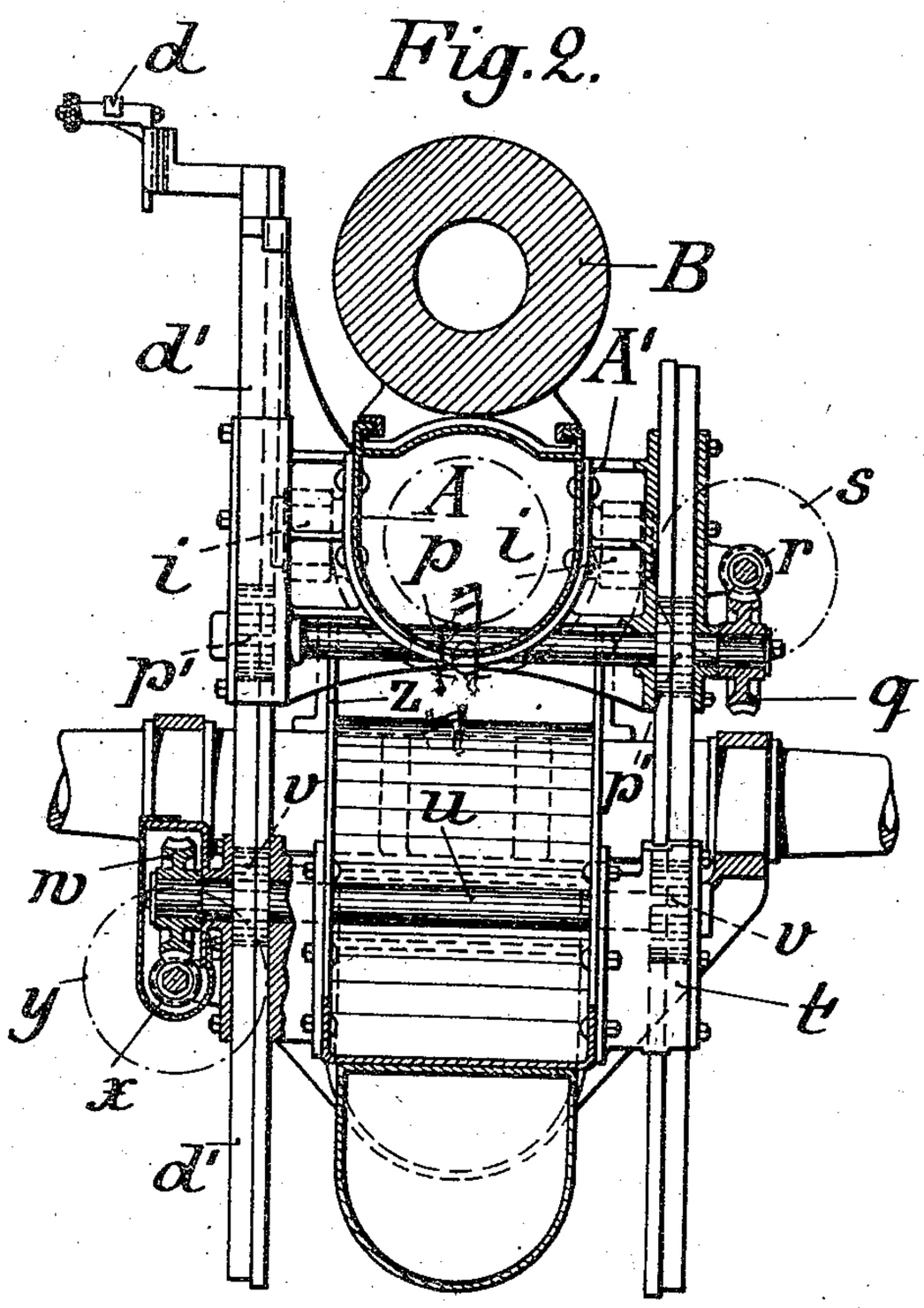
7 SHEETS—SHEET 2.

Fig. 2.



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7 SHEETS—SHEET 3.

Fig. 5.

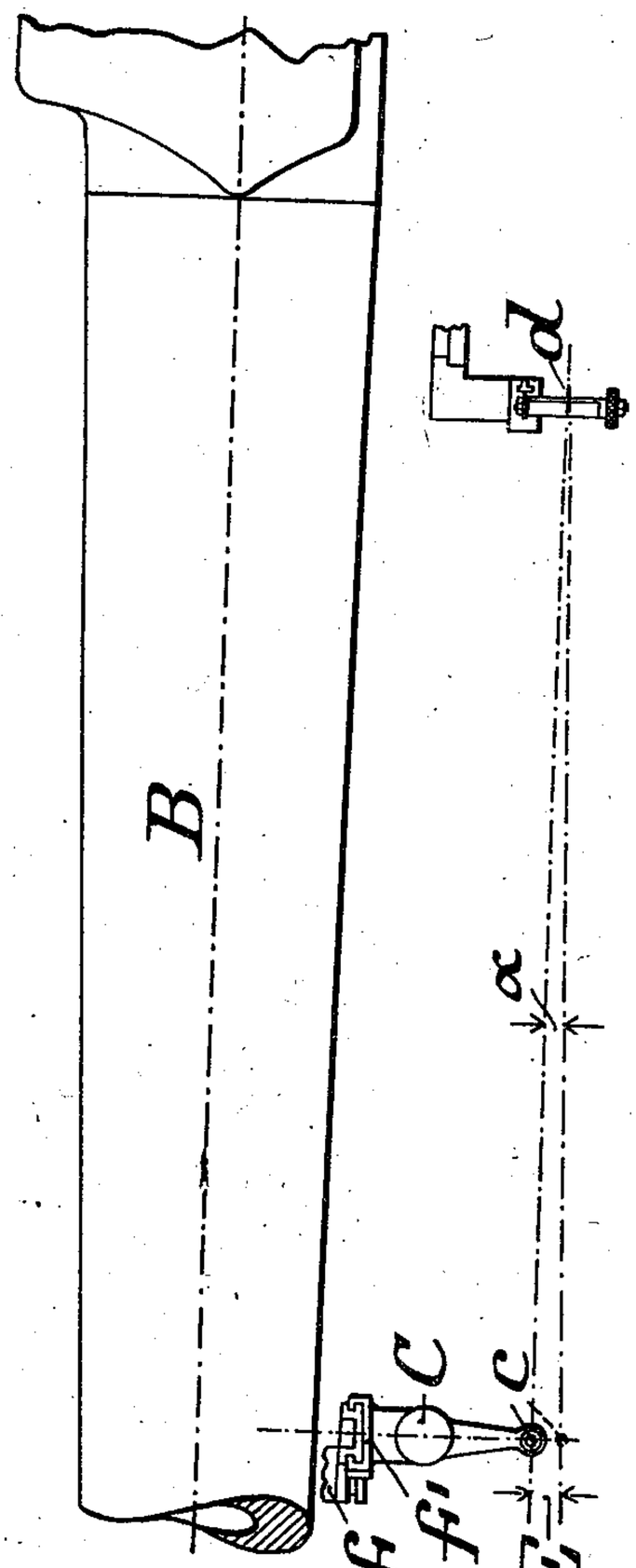


Fig. 3.

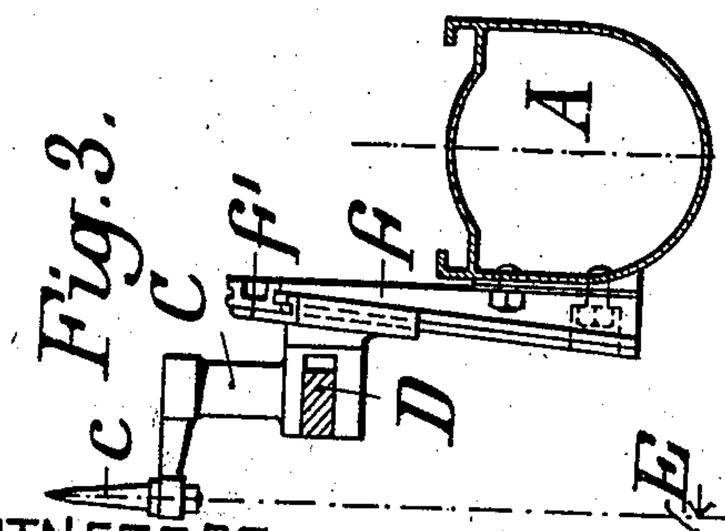
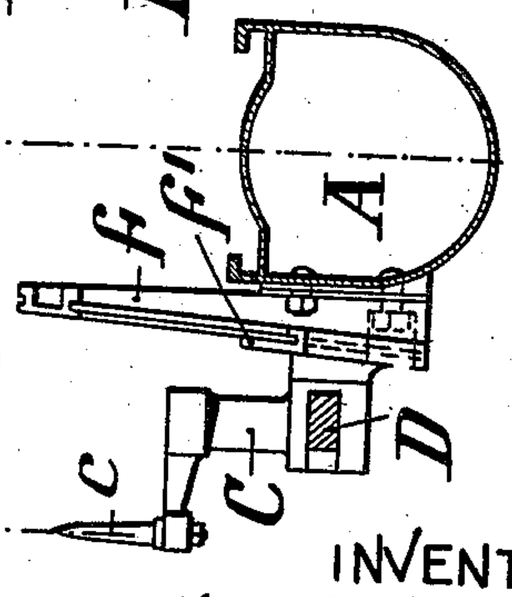


Fig. 4.



WITNESSES

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7 SHEETS—SHEET 4.

Fig. 6.

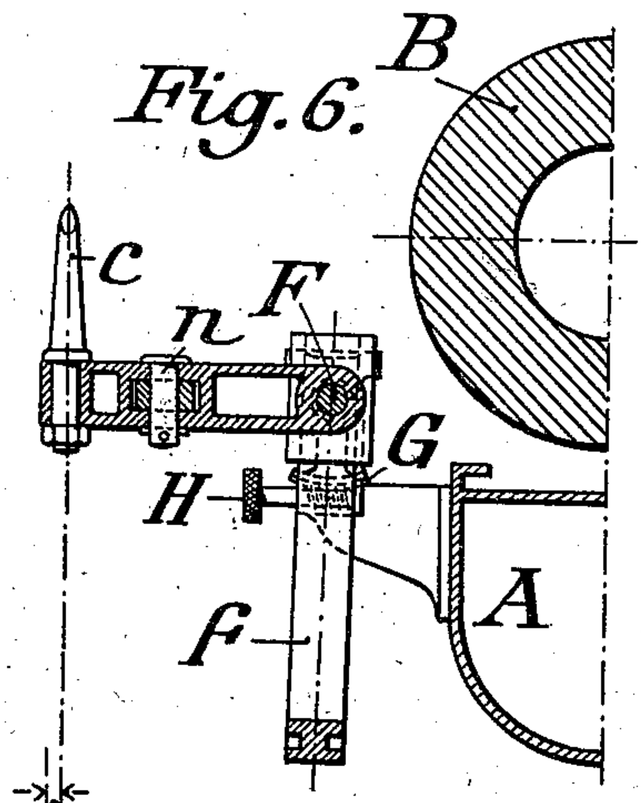


Fig. 8.

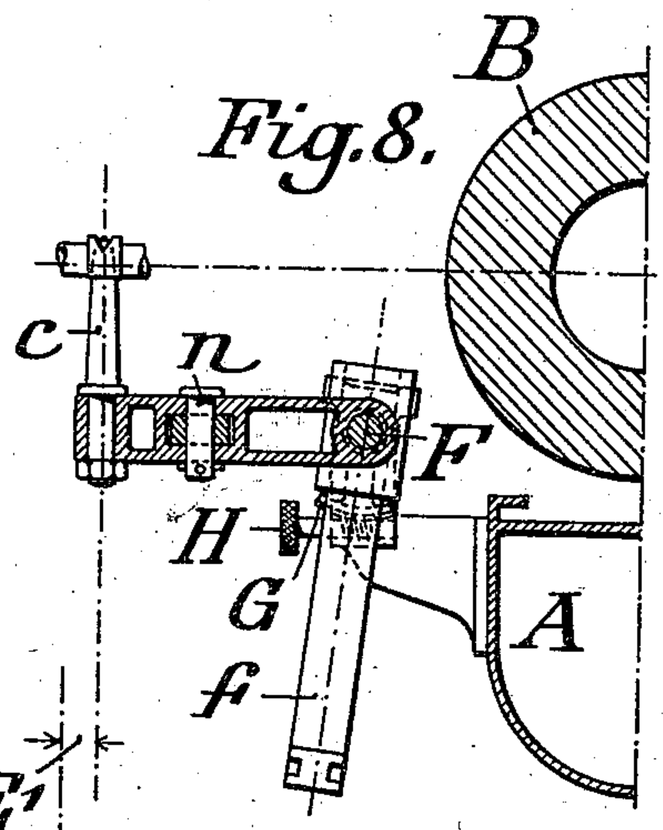


Fig. 7.

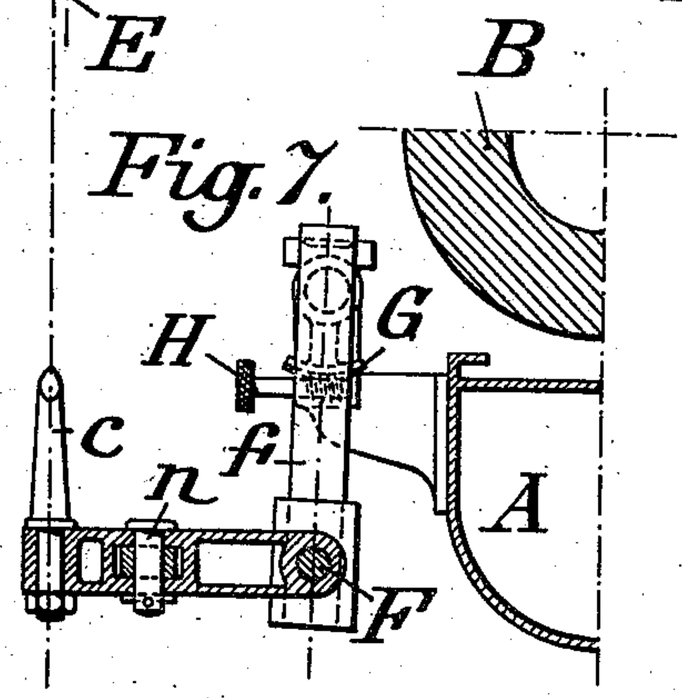


Fig. 9.

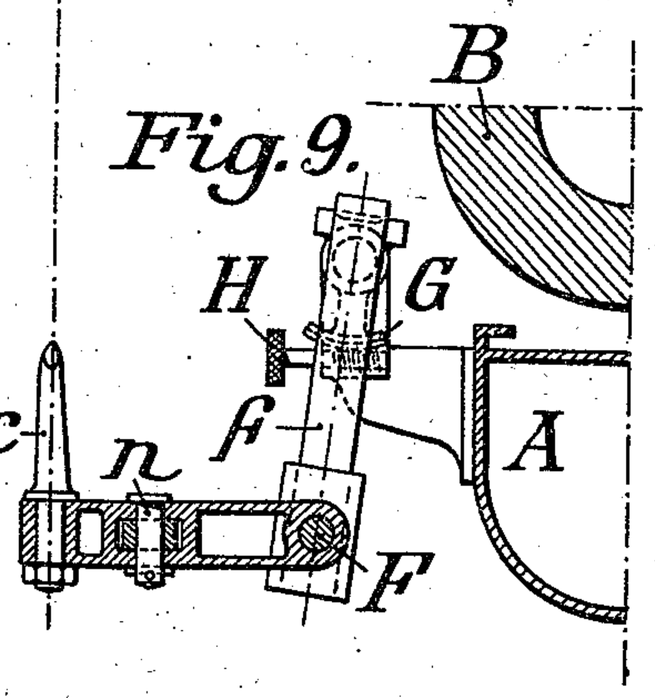
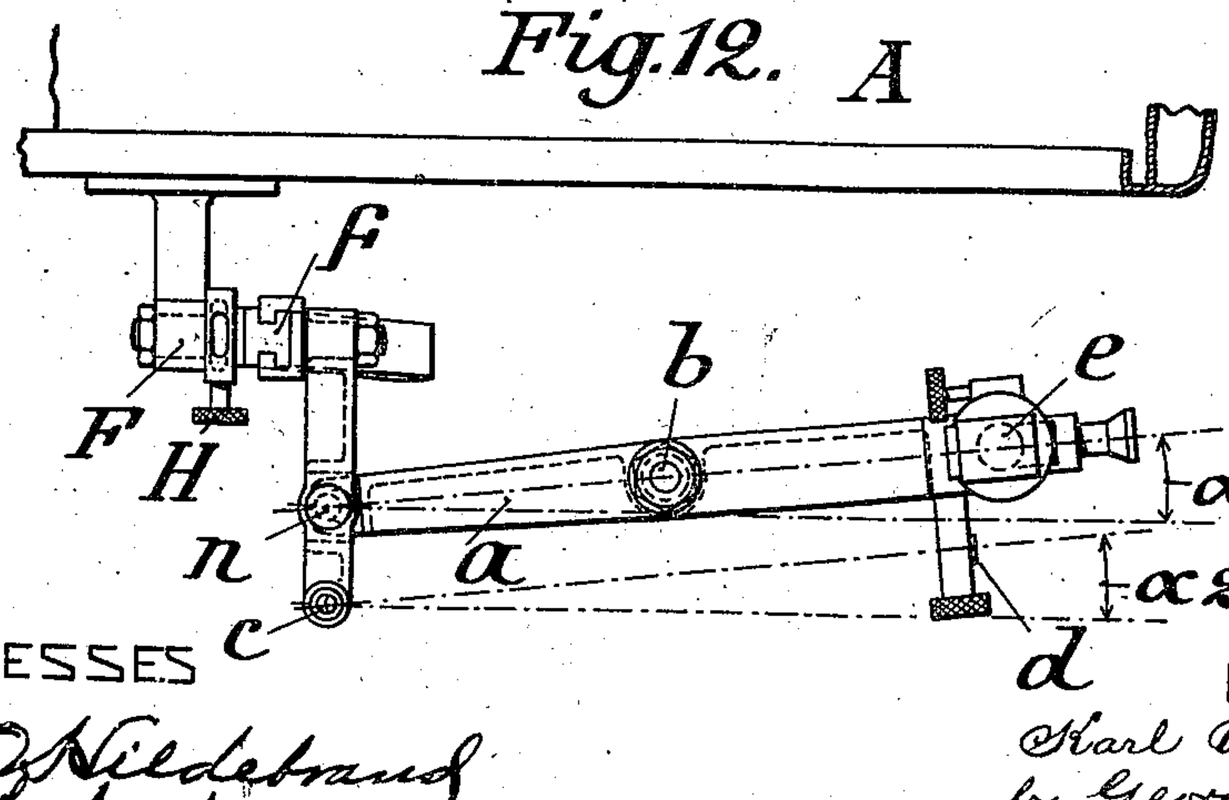


Fig. 12.



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7 SHEETS—SHEET 5.

Fig. 10.

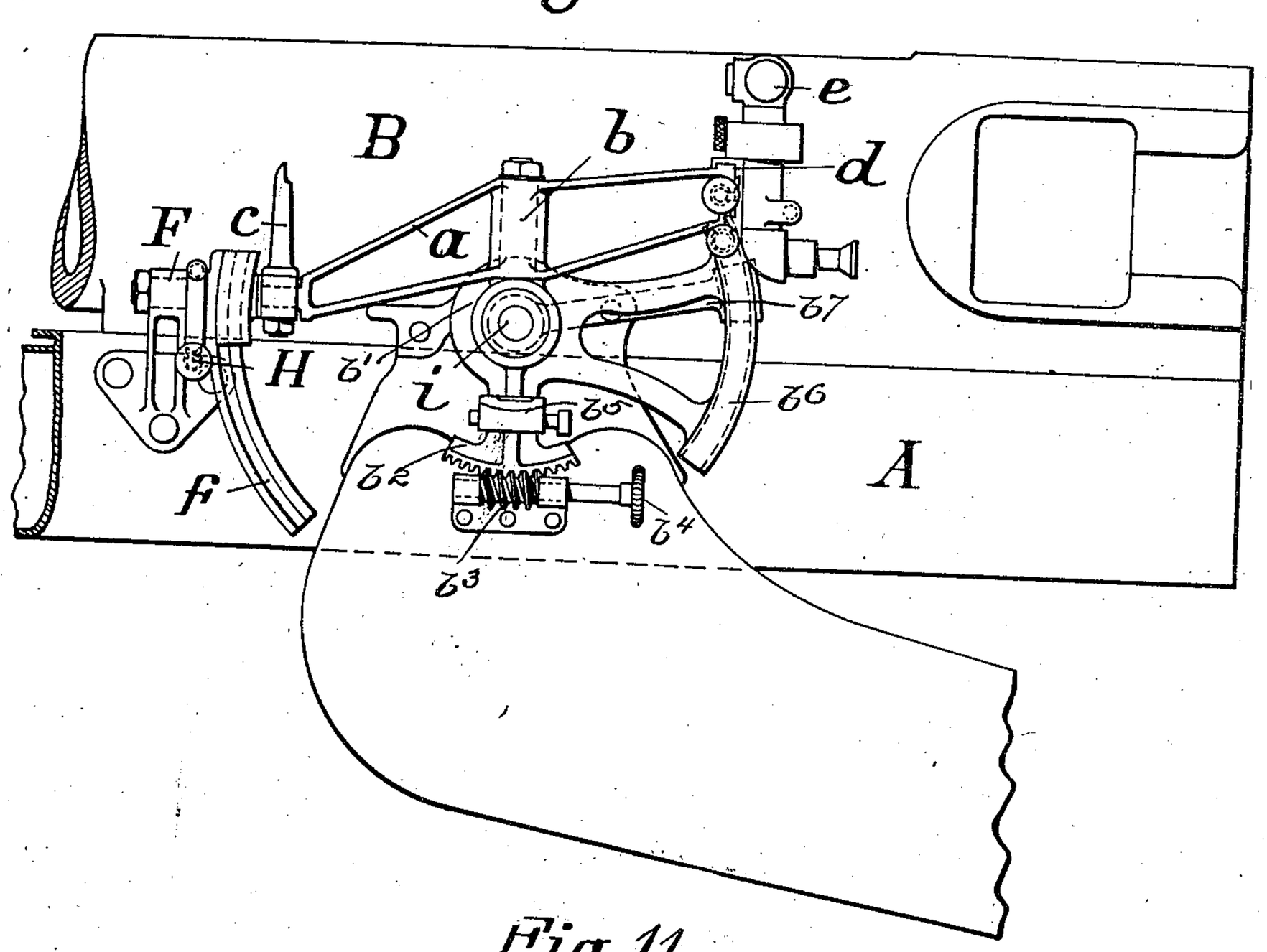
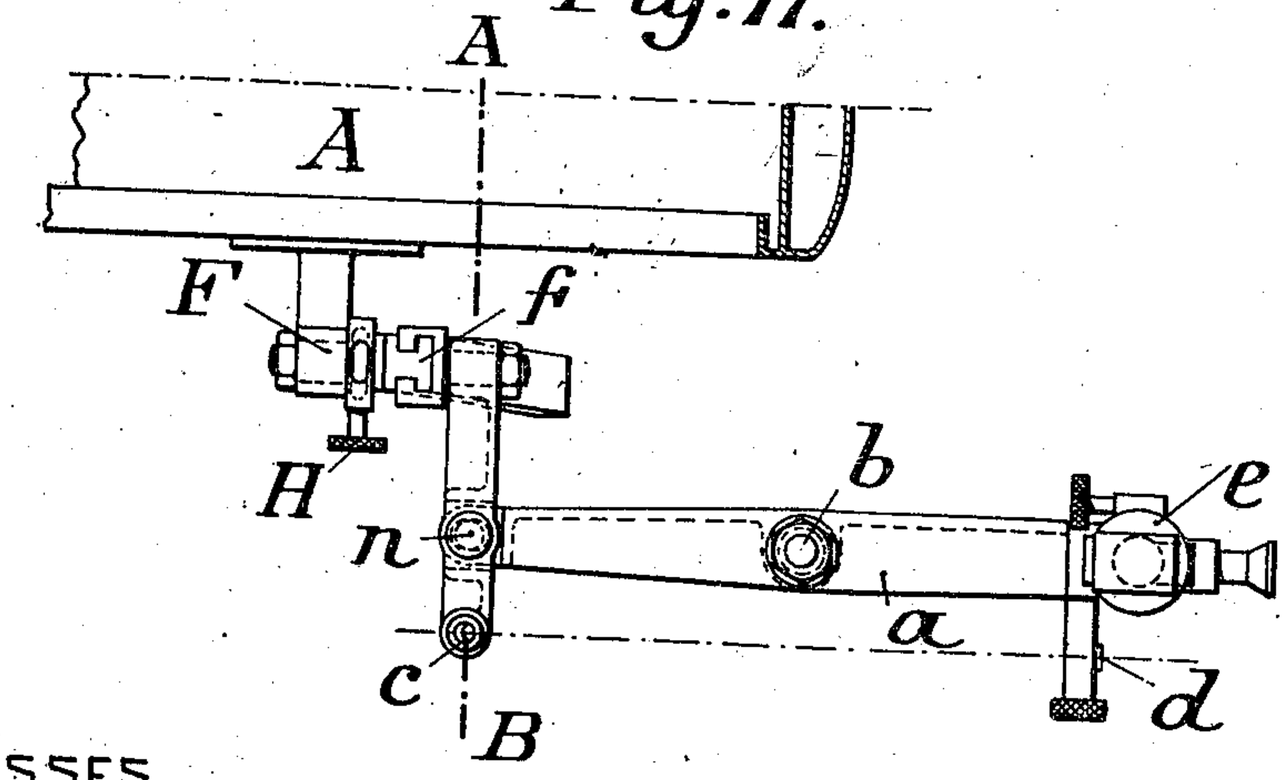


Fig. 11.



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7 SHEETS—SHEET 6.

Fig. 13.

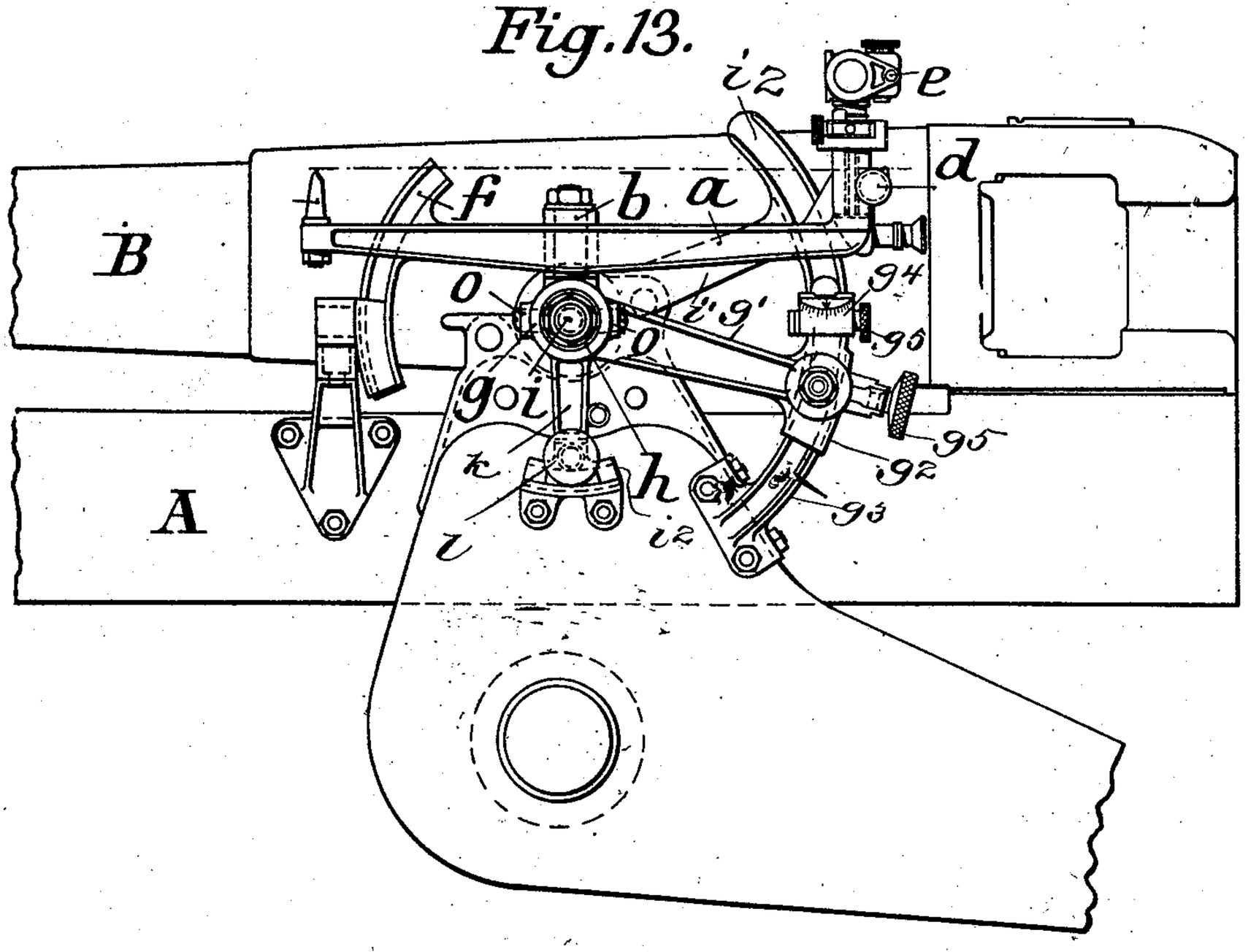

Fig. 14.

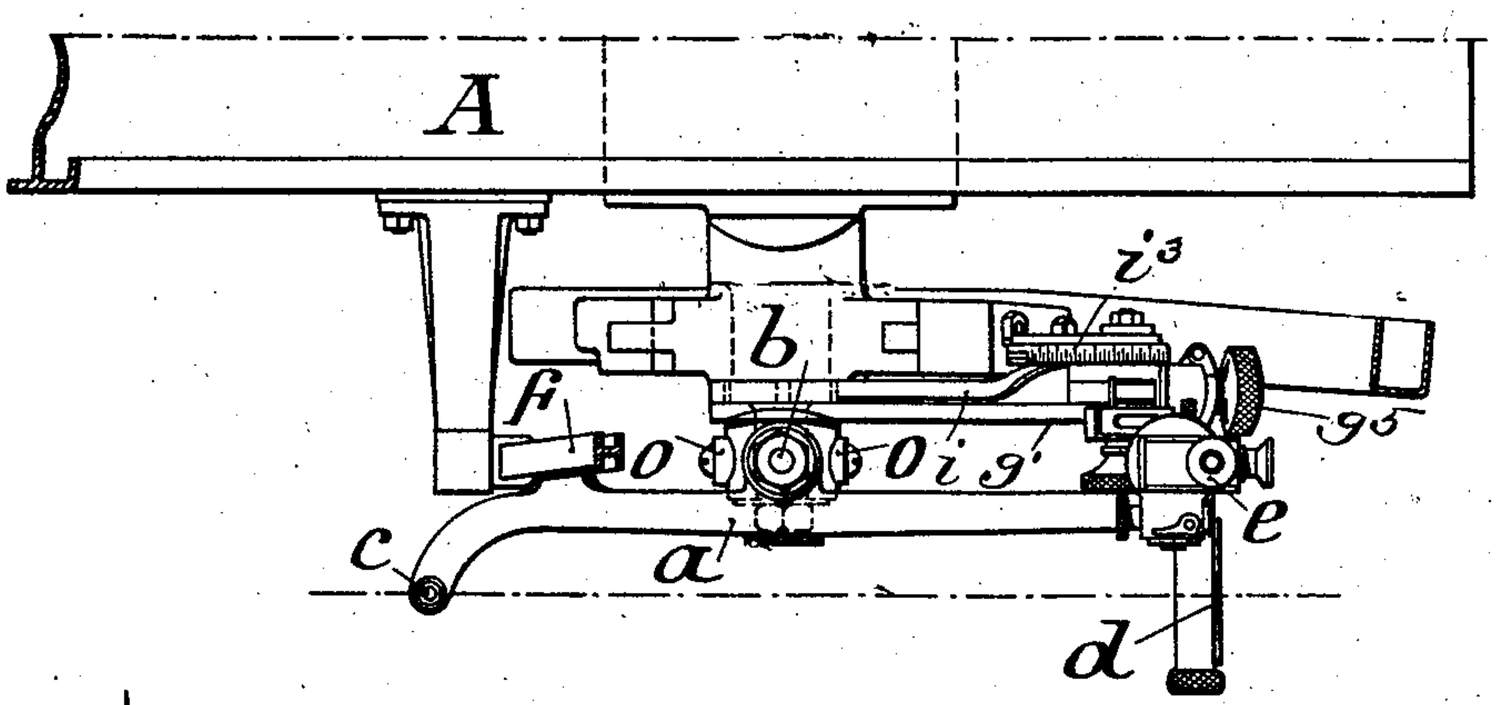

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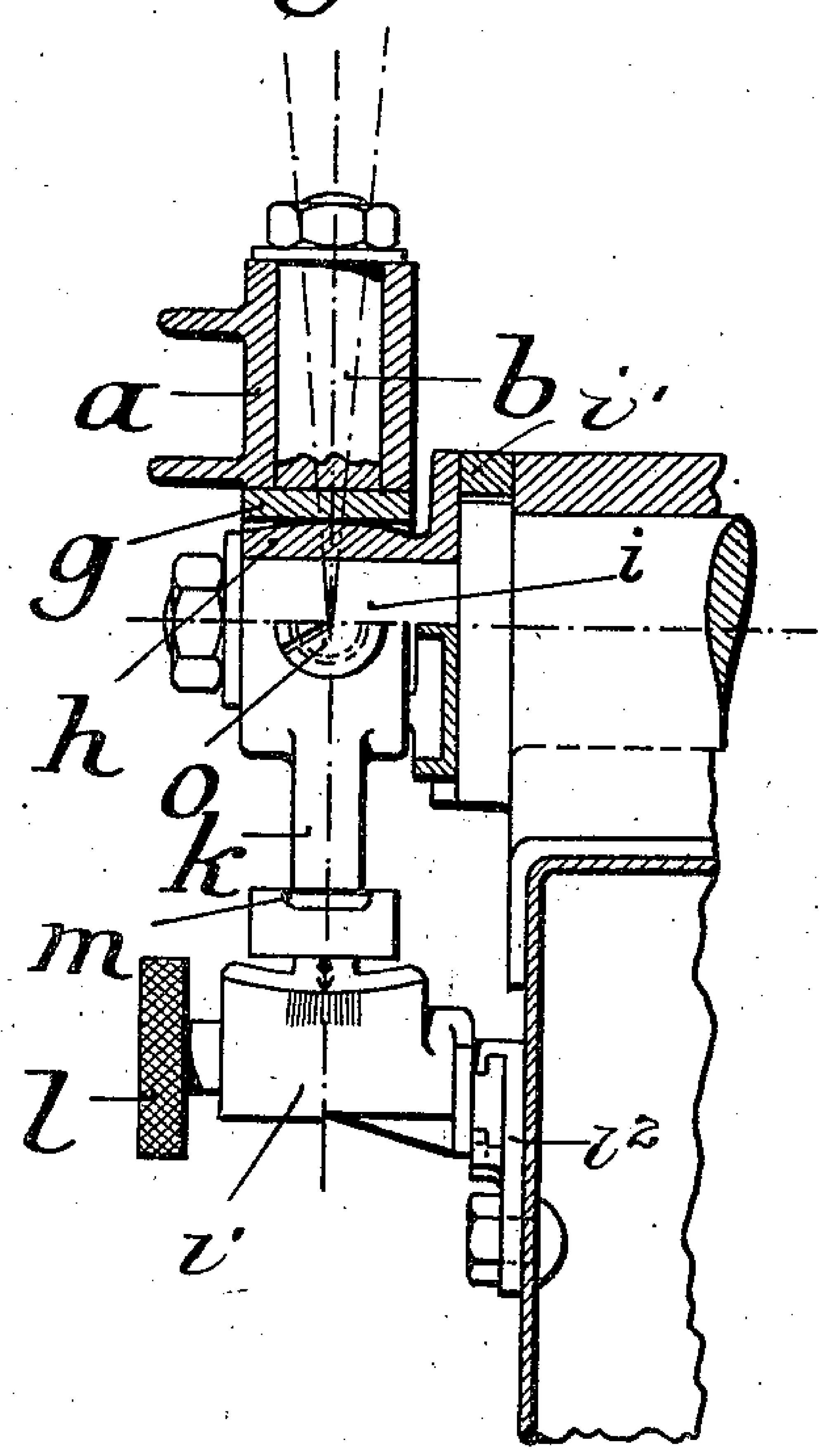
Fig. 15.



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UNITED STATES PATENT OFFICE.

KARL VÖLLER, OF DUSSELDORF, GERMANY, ASSIGNOR TO RHEINISCHE METALLWAREN- UND MASCHINENFABRIK, OF DUSSELDORF-DERENDORF, GERMANY.

SIGHTING APPARATUS FOR ORDNANCE.

No. 887,023. Specification of Letters Patent. Patented May 5, 1908.

Application filed January 30, 1905. Serial No. 243,381.

To all whom it may concern:

Be it known that I, KARL VÖLLER, engineer, a subject of the German Emperor, residing at Düsseldorf, 47 Jülicherstrasse, Germany, have invented certain new and useful Improvements in Sighting Apparatus for Ordnance; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

On firing with rifled guns as is known a lateral deviation of the trajectory takes place, which is caused by the action of the rifling pitch upon the trajectory of the projectile. If the axis of the gun is directed accurately upon a vertical line as the mark, then the striking point will not be situated in this line, but with a certain range it will be situated a distance laterally from such line proportionate to the range. The line of sight of the gun must therefore form a certain angle with the axis of the gun, and this angle must be varied according to the variation of the range. This was heretofore provided for in guns with sighting device attached directly to the gun (or, in the case of guns recoiling on the carriage, connected to the cradle or upper carriage) by imparting to the rod of one sight mount connected to the gun, a position inclined to the vertical plane passing through the gun's axis. If the elevation of the gun was altered for an increased range the said rod had to be moved upwards by hand along its guiding support, in consequence of which the distance of the back sight from the vertical plane passing through the axis of the gun was altered. The angle which the line of sight forms with the said vertical plane is consequently altered by the shifting of the said rod. With sighting devices in which the line of sight is independent of the gun, *i. e.*, in which the line of sight retains its position when the elevation of the gun is altered according to the range, the said deviation fault cannot be corrected in so simple a manner.

The present invention relates, on the one hand, to a sighting apparatus for those guns in which the line of sight is independent of the elevating motion of the gun, and on the other hand, to those guns in which the line of sight is determined by means of a fore-sight and a back-sight, in order by a certain construction of the fore sight to afford the possibility of effecting the necessary correction of the deviation, also in the case of guns with independent line of sight, this being effected automatically for all ranges.

I will now specifically describe some preferred embodiments of my invention, in connection with the accompanying drawings, in which

Figure 1 shows a part side elevation of a gun with an embodiment of the improved sighting apparatus combined therewith, Fig. 2 shows a rear end view thereof partly in section. Figs. 3 and 4 show by cross-sections through the cradle two different positions of the fore-sight. Fig. 5 shows diagrammatically the shifting of the line of sight. Figs. 6–12 show a modification of the present invention. Fig. 6 is a cross-section showing the position of the parts in the horizontal position of the gun, and with a level position of the wheel-base, and Fig. 7 shows the position with the greatest elevation of the gun, and a level position of the wheel-base. Fig. 8 shows the position of the parts with a horizontal position of the gun and an inclined position of the wheel-base, while Fig. 9 shows the position of the parts with the greatest elevation of the gun and an inclined wheel-base. Fig. 10 shows a side view of a part of the gun and upper carriage with the sighting apparatus. Figs. 11 and 12 show top-plan views of the same with the sighting apparatus in different positions. Fig. 13 is a part side view of another modification, Fig. 14 shows a plan view thereof and Fig. 15 is a detail transverse section partly in elevation, through the axis *b*.

As to Figs. 1–5 the line of sight is determined by the edge of the back sight *d* which is carried by the curved elevating bar d^1 of the gun, and the point of the fore sight *c* carried by the support C. Fig. 1 of the drawings shows the line of sight in the horizontal position, the axis of the gun being also in the horizontal position. Fig. 3 shows the position of the fore sight, viewed from the rear, for the horizontal position of the line of sight and the gun axis. Rigidly fixed to the gun cradle is a curved guide bracket *f* of a dove-tailed cross section, the curvature of the bracket being formed as an arc struck from the center of the pivots or trunnions of the gun B. On this curved guide bracket is mounted the curved slide f^1 which carries the fore sight *c* by means of the support C.

The surfaces in contact of the bracket f and slide f^1 are situated in a plane inclined to the vertical. If, therefore, the slide f^1 be moved upward or downward, the distance of the fore sight c from the vertical plane through the gun axis will be correspondingly varied. The fore-sight support C has a horizontal slot in which is engaged to slide one end D, of the two-armed lever i^2, the other end of which is rigidly fixed to the curved elevating bar d^1. This lever i^2 is supported by the bracket i^1 pivoted to the bracket Z carrying the gun cradle A.

Rigidly fixed to the gun cradle is a frame piece A^1 in which the elevating bar d^1 is guided and in which a shaft p is rotatable. The elevating bar d^1 is provided with teeth with which engages a pinion p^1 fixed on the shaft p. At the other end of this shaft is fixed a worm-wheel q engaging with a worm r fixed on the shaft of a hand wheel s. As will be seen, by turning the hand wheel s motion is given to the worm wheel q, and the pinion p^1, whereby the gun B and the cradle A are swung round the pin i, the frame piece A^1 sliding along the elevating bar d^1. The elevating bar and the line of sight remain stationary. At its lower end the elevating bar d^1 passes through a frame piece t rigidly connected with the arm z^1 of the cradle support z. In the frame piece t a shaft u is supported in suitable bearings. On the shaft u is fixed a pinion v engaging with the teeth of the elevating bar. A worm wheel w fixed on the shaft u engages with a worm x provided with a hand wheel y. If the latter is rotated in one or the other direction the elevating bar d^1 is moved up or down together with the gun and the cradle. By rotating the hand wheel y therefore the gun and the line of sight are moved together. This movement is especially for adjusting the gun in accordance with the angle of the ground. When however the rear end of the gun is moved downward along the elevating bar d^1 by means of the upper toothed gear shown, by rotating the hand wheel s, the two armed lever i^2 as also the end D thereof remain in their original position, and by this means the fore sight c will be held by the slide f^1, also in its original position. The curved guide bracket f however will move upwards relatively to the slide f^1 and in consequence the fore sight c and its support C will be shifted laterally to the left, *i. e.*, will be moved a greater distance from the axis of the gun.

Fig. 4 shows the position of these parts when the gun has received its highest elevation. The distance of the foresight from the axial plane of the gun will thereby have been increased by the amount E. As shown at Fig. 5, the line of sight will by this motion have been shifted horizontally through the angle α.

The apparatus, described with relation to Figs. 1–5 only takes into account the lateral deviation of the projectile due to the pitch of the gun's rifling, which deviation varies according to the distance of the mark and consequently with the elevation of the gun. There occurs, however, frequently another source of error which can cause a further lateral deviation of the projectile. If, namely, a gun stands upon inclined ground in such manner that the one wheel is situated lower than the other wheel on the same axis, it is evident that in imparting the requisite elevation to the gun, the latter will not move upwards in a vertical plane, but will also simultaneously have a lateral motion imparted to it. If, on the other hand, the gun were to be turned down out of the elevated position then, if in this position the projection passing through the gun's axis is parallel to the line of sight, on the gun assuming the horizontal position the line of sight and the gun's axis would form an angle with each other. These disadvantages resulting from an inclined position of the wheel-base may be obviated by so arranging the before-mentioned arc-shaped piece or bracket (which, in elevating the gun, slides up and down relatively to a slide carrying the foresight and thereby effects the automatic lateral shifting of the foresight), that it is pivotally arranged upon an axis parallel to the gun's axis, in order to enable the angle which it forms with the vertical plane through the gun's axis to be varied correspondingly to the angle formed between the trunnion axis of the gun-carriage and a horizontal plane. Such an arrangement is shown in Figs. 6–12 of the drawings. In the said figures, to the upper carriage A or to the gun B is attached the arc-shaped piece or bracket f upon which can slide the foresight c, when on elevating the gun, the bracket f moves upwards. In this motion, as shown in Figs. 6 and 7, the foresight c is shifted laterally to the extent E in consequence of the inclination of the bracket f.

Now in the present modification the bracket f is pivotally mounted at F and can, for example, be adjusted on this pivot by providing on the bracket a toothed quadrant G, with which is engaged a worm H that can be turned by a button. With the adjustable bracket f is advantageously combined a spirit-level which assumes the middle position when the gun and line of sight are in the horizontal position. If the gun is to be fired when the wheel-base is standing on an incline, the bracket f is turned upon its pivot F by means of the worm and toothed quadrant until the spirit level is again in the middle position, the elevating of the gun is then directly effected in exactly the same manner as when the trunnion axis of the carriage is horizontal, the gun then being trained as may be required to bring the sight on the tar-

get, whereupon the gun will be properly pointed. In Fig. 8 is shown such an adjustment of the bracket *f*. Fig. 9 shows the lateral shifting of the foresight caused by the increased inclination of the bracket *f*. When the gun is elevated to a greater angle, this lateral shift E^1 is considerably greater than the shift E shown at Figs. 6 and 7 when the trunnion axis of the carriage is horizontal, such shift E serving in this case solely to correct the lateral deviation due to the rifling pitch.

Figs. 10 to 12 of the drawings show an arrangement whereby the described lateral shift is imparted, not only to the foresight, but also to the backsight, and whereby also the invention is applied to the case wherein the sighting and elevating of the gun is effected by the aid of a sighting telescope. To the foresight *c* is connected the one end of a two-armed lever *a*, pivotally mounted upon a vertical axis *b*, and carrying at its other end (which is free) a panorama telescope *e* as also, in the example shown, the backsight *d* mounted on a lateral arm thereof. The optical axis of the panorama telescope coincides in the horizontal projection with the extended connecting line of the axes of the rotatable pivots *n* and *b* which line is parallel to the line of sight determined by the foresight *c* and backsight *d*. If the foresight is shifted laterally on the bracket *f* the two-armed lever *a* and consequently also the optical axis of the panorama telescope *e* and the backsight *d* are shifted, the motion being such that the backsight is shifted towards the gun when the foresight is shifted away from it. In the example illustrated in the drawing, the vertical axis *b* of the two-armed lever is shown as carried by a sleeve b^1, loose upon the trunnion *i* and provided with a downward extending sector b^2 which is provided with teeth on its lower surface in engagement with a worm b^3 capable of being turned by a milled head b^4. The said sector b^2 carries a level b^5. To the sleeve b^1 is also attached a rearward extending sector b^6 which may be provided with the usual gradations, not shown, to indicate the angle of elevation of the gun-barrel, said graduations being read by the aid of an index consisting of an arm b^7 fixed to the gun-trunnion. Upon planting the gun, the milled head b^4 is turned to rotate the worm and bring the sector b^2 to such a position that the level b^5 will be in the zero position, thus bringing the axis *b* to a position in the vertical plane which passes through the axis of the trunnion. The gun may then be elevated or depressed as required.

By the described arrangement of the two-armed lever and the consequent shifting of the backsight in the contrary direction of the foresight the extent of the latter's motion will be reduced in proportion to the ratio between the lengths of the two arms of the lever *a*.

Fig. 12 shows that in the lateral motion caused by the bracket *f* the optical axis of the panorama telescope always remains parallel to the line of sight determined by the foresight and backsight, angle α^1 being equal to α^2. It is not necessary for the shifting of the telescope that the lever *a* should be a two-armed one, as the required alteration of the position of the optical axis can also be obtained by a one-armed lever.

In the arrangement above described it is necessary when the wheel base of the gun is on an incline in a transverse direction, to effect a correction in view of the fact that the axis on which the lever turns laterally does not remain in the vertical plane passing through the sighting line, but retains its position relatively to the wheel axis, so as to be on a slant. The sighting line, in consequence of the slanted position of the said lever axis, is thereby so shifted that it is, for example, lowered in front and raised behind. Thus, on sighting a false sighting line would be obtained unless a range were assumed which did not correspond to the actual range, or, unless a correction were made by the aid of calculated tables.

In Figs. 13–15 I have shown an arrangement of the sighting apparatus whereby the necessary correction can be effected without varying the range or without the use of correcting tables. This is effected by arranging the said axis of the lever so as to be adjustable upon another axis in such manner that when the wheel base is on an incline the lever axis can be brought back into the vertical plane passing through the sighting line, or into a vertical plane parallel thereto. *a* is the lever pivotally mounted on the axis *b* and carrying the foresight *c* and the backsight *d* as also the sighting telescope *e*, which lever on varying the elevation of the gun and upper carriage is caused by the curved guide piece *f* fixed to the upper gun carriage to turn upon the axis *b* for varying the angle between the sighting line and the axis of the gun. When the gun stands on inclined ground, so that the wheel axis and the trunnions assume an inclined position, the sighting line is required to vary its position only in a horizontal plane, if the mark and the gun are on the same level, and only to turn upon an axis which lies in the vertical plane passing through the sighting line or a vertical plane parallel thereto. For this purpose according to the arrangement shown by way of example, the pivotal axis *b* of the lever *a* is carried at its lower end by a sleeve *g* which is mounted upon a second sleeve *h* fitted loose upon the extension *i* of the gun trunnion, the sleeve *g* being carried upon sleeve *h* by means of pivots *o* screwed into *g* and serving as an axis upon which sleeve *g* and pivot *b* can

turn in a direction at right angles to the gun's axis as shown by the dotted lines in Fig. 15. The sleeve *g* has a downward extension *k* terminating in a toothed segment which is engaged with a worm that can be turned by the button *l*, so as to cause the sleeve *g* and pivot *b* to turn upon the axis *o*, the extension *k* being provided with a spirit level *m*. Thus, when the trunnion axis and wheel base are inclined, thereby also inclining the axis of pivot *b* out of the vertical plane through the sighting line, such axis can be brought back into the said vertical plane by turning the button *l* and thereby shifting the extension *k* until the spirit level is brought into the horizontal position again, and thus the lever *a* is brought back into the correct sighting position independently of the inclined position of the trunnions and wheel base. In the arrangement shown the outer surface of the sleeve *h* is formed spherical, so as in all positions to serve in addition to the axis *o*, as a support to the sleeve *g*, pivot *b* and lever *a*.

The sleeve *g* is provided with an arm *g'* which carries a segmental plate g^2 which moves over a curved standard g^3 bolted to the carriage as shown in Fig. 13. The segmental plate g^2 carries a level g^4, Fig. 13, and may be clamped to the standard g^3, at any position to which it is adjusted, by means of a screw g^5. To the trunnion of the gun is fixed an arm *i'* which carries a segment i^2 graduated on its edge, as indicated at i^3, Fig. 14, so that the angle of elevation of the gun may be read from said graduations.

The bearing *l''* for the button *l*, Fig. 15, is mounted so as to slide in an arc-shaped track shown in end elevation at l^2, Figs. 13 and 15, said track being bolted to the carriage. When the gun is planted in position the button *l* is turned to bring the level *m* to its zero position, and then the arm *g'* is swung to bring its level g^5 into its zero position, whereupon the axis *b* is truly vertical. The gun may now be elevated or depressed until the desired angle of elevation is laid off on the graduated segment i^2 and the sights will then be in proper adjustment for the final pointing of the gun.

Having thus fully described my invention, what I claim is:

1. The combination, with a gun, a sight, and means for adjusting the sight in elevation, of means for elevating the gun independently of the elevation of the sight, and means actuated by the elevation of the gun independent of the sight and arranged to adjust the sight in azimuth to compensate for drift.

2. The combination, with a gun, a sight, means for adjusting and fixing the sight in elevation, and means for adjusting the gun in elevation while the elevation of the sight is fixed, of means actuated by the movement of the gun in elevation independent of the sight and arranged to adjust the sight in azimuth to compensate for drift.

3. The combination, with a gun, and a sighting device comprising a foresight, of means for fixing said sighting device at any desired elevation, means for moving the gun in elevation independently of the sight, and means operated by the elevation of the gun independent of the sight and arranged to shift the foresight laterally.

4. The combination, with a gun, of a sight, means for moving the sight in elevation, means for moving the gun in elevation independently of the elevation of the sight, and a cam device fixed relative to the gun and arranged to shift the sight laterally when the gun is elevated independently of the sight.

5. The combination, with a gun and a sight, of a curved guide bracket movable with the gun and having an operative face inclined to the vertical, a member carrying the foresight and engaging with the operative face of the curved guide, means for holding said member against movement in a vertical plane, and means for elevating the gun and curved guide bracket whereby the sight is adjusted laterally to compensate for drift.

6. In ordnance in which the position of the gun can be varied independently of the line of sight the combination with the gun of a foresight, a slide carrying the foresight, a curved guide bracket movable with the gun and pivotally mounted on an axis parallel to the gun's axis and means for adjusting the said bracket in such a manner that the angle which it forms with the vertical plane passing through the gun's axis can be varied in accordance with the variation of the angle formed between the trunnion-axis of the gun carriage and the horizontal plane, substantially as described and for the purpose set forth.

7. In ordnance in which the position of the gun can be varied independently of the line of sight the combination with the gun of a foresight, a backsight a lever connecting the foresight with the backsight, a slide carrying the foresight a curved guide bracket movable with the gun and pivotally mounted on an axis parallel to the gun's axis and means for adjusting the said bracket in such a manner that the angle which it forms with a vertical plane passing through the gun's axis can be varied in accordance with the variations of the angle formed between the trunnion-axis of the gun carriage and the horizontal plane, substantially as described and for the purpose set forth.

8. In ordnance in which the position of the gun can be varied independently of the line of sight, the combination, with the gun, of a guide device having a lateral inclined face, a lever carrying a telescope and a slide fixed to the said lever and engaging with the lateral inclined face of the guide device, substan-

tially as described and for the purpose set forth.

9. In ordnance in which the position of the gun can be varied independently of the line of sight the combination with the gun of a curved guide bracket, a lever carrying the sighting device and a slide fixed to the said lever and engaging with the curved guide bracket, the pivot of the lever being rotatable upon an axis in such a manner as to enable the middle line of the lever to be brought into the vertical plane passing through the sighting line or a vertical plane parallel thereto notwithstanding any inclined position that the trunnions and wheel-base of the gun may assume, substantially as described and for the purpose set forth.

In testimony whereof I have affixed my signature to this specification, in the presence of two witnesses.

KARL VÖLLER.

Witnesses:
PETER LIEBER,
E. HERBER.